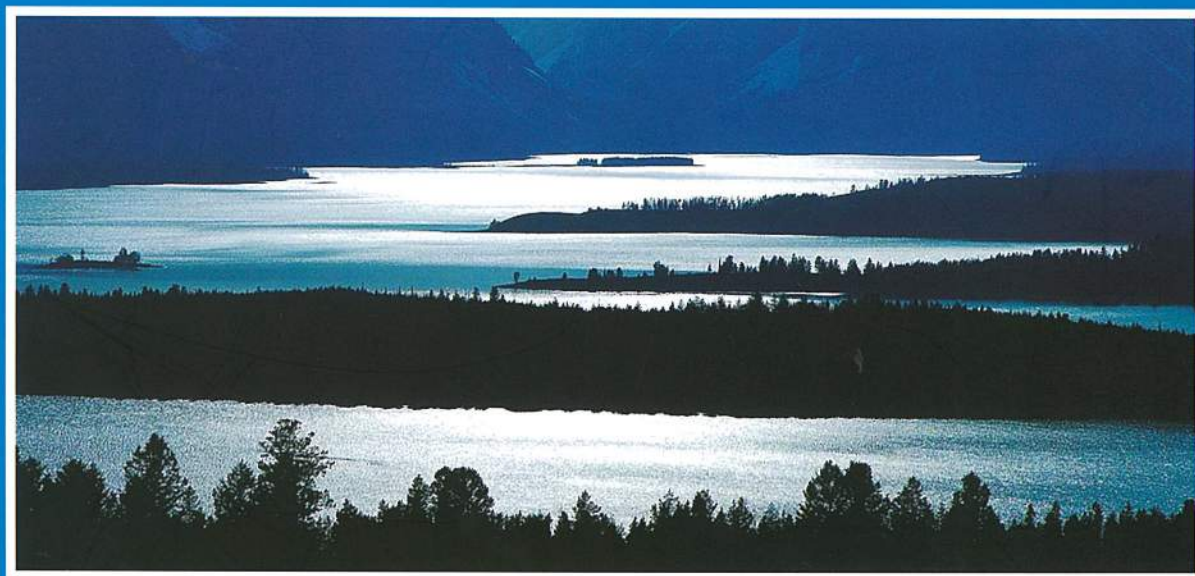


EMECS-8

HARMONIZING RIVER CATCHMENT AND ESTUARY

Shanghai October 26th-30th 2008



<http://www.emecs-8.ecnu.edu.cn>



**Global action on reversing degradation of river catchments
and adjacent large marine ecosystems through GEF and UNDP partnerships**

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Disruption of the global nitrogen cycle and excessive loading of nitrogen and phosphorus pollution from agriculture, human sewage, and industry have created more than one hundred "Dead Zones" of coastal water quality and environmental degradation across the planet. These "Dead Zones" seem to be expanding, projections of future degradation are alarming, and urgent action on pollution reduction is needed in river basins draining to these areas to restore and protect coastal areas and enclosed seas. This paper focuses on the issue of "Dead Zones" in the coastal oceans which can be divided into sub-units known as Large Marine Ecosystems (LMEs). The Global Environment Facility (GEF) and its partner agencies UNDP and the World Bank have collaborated for 15 years in efforts to assist the countries to address this adverse coastal impact from land-based activities. Over \$300 mil of GEF grants and \$1.3 Billion in co-financing have been mobilized in an initiative to help GEF recipient countries to address this growing problem. Specific examples from the Black Sea LME and connected Danube Basin as well as East Asian LMEs and connected land-based activities are presented. The paper describes the use of LMEs for this task, the processes used by GEF to foster country commitments to action, and the actual investments in the agriculture, municipal, and industrial sectors as well as in floodplain and wetland restoration for reducing nitrogen, phosphorus, and other pollutants.

Beginning in the 1970s and continuing through to the early 1990s, nutrient-enrichment of the Black Sea LME resulted in oxygen depletion, causing mass mortalities of animal life within huge areas of the NW Shelf. The GEF for the last 15 years has supported several regional projects in the Danube-Black Sea Region to reduce nitrogen and phosphorus pollution in the Danube Delta and downstream Black Sea. 16 countries have worked together with GEF, UNDP, and World Bank assistance and the European Union to address these land-based pollution sources creating dead zones in the Danube Delta and Black Sea. Pilot demonstrations for nutrient reduction in the agriculture, municipal sewage, and industrial sectors and to trap nutrients in restored floodplains are proving to be cost effective ways of reversing coastal dead zones with potential annual reductions of 15,645 tonnes of nitrogen and 5,050 tonnes of phosphorus. Nutrient emissions to the Danube have been substantially reduced over the last 15 years (nitrogen emissions have decreased by about 20% and phosphorus by almost 50%), and the North West Shelf of the Black Sea is showing quite remarkable signs of recovery. Measurable improvements have been observed in the Danube and Black Sea ecosystems over the last decade and a half. Nowhere has such nitrogen and phosphorus pollution reduction been achieved as to reverse the documented dead zone of oxygen depletion in the Black Sea's NW shelf. Ultimately, the GEF-funded actions in the Danube-Black Sea basin demonstrate how countries can work together to reduce land-based pollution and Dead Zones. Outcomes of these interventions are favorable in terms of on-site effectiveness and multi-country cooperation.

This initiative is now being replicated in East Asian LMEs with the GEF/UNDP PEMSEA program and World Bank investments. The East Asian Seas (EAS) region comprises six Large Marine Ecosystems (LMEs) - East China Sea, Yellow Sea, South China Sea, Sulu-Celebes Sea, Indonesian Sea and the Gulf of Thailand. In the last 30 years, 11 percent of the region's coral reefs collapsed while 48 percent are currently in a critical condition and over 80 percent are at risk. Mangroves have lost 70 percent of their cover in the last 70 years while seagrass beds' loss ranges from 20-60 percent. Unless properly managed, the current rate of loss will result in the removal of all mangroves by 2030, while reefs face collapse within 20 years. Investments in China, Vietnam, and Philippines, are described in this paper along with an agriculture pollution reduction project just outside of Shanghai that will (i) reduce land-based pollution from the rural/agricultural sectors of the coastal areas and the East China Sea; (ii) promote and replicate cost-effective and resource-efficient agricultural sector pollution control and waste management; (iii) promote and replicate methodologies appropriate for the cost-effective management of wastewater from diverse rural communities; (iv) protect water resources and enhance access to sanitation in rural areas; and (v) encourage and facilitate coastal conservation.

Special efforts in the Yellow Sea LME and the Hai River Basin draining to the YS LME are highlighted.

Of the 64 large marine ecosystems in the world's oceans, the Yellow Sea is one of the most significantly affected by human development. Bordering countries share common problems with pollution from municipal and industrial sites as well as agriculture. Degradation of the environment is shown by reduced fish catches; shifts in species biomass (partly caused by over-fishing); red tide outbreaks, degradation of coastal habitats (caused by extensive coastal development) and climate variability. The Yellow Sea LME is also an important global resource supporting substantial populations of fish, invertebrates, marine mammals, and seabirds, many of which are threatened by both land and sea-based sources of pollution as well as loss of biomass, biodiversity, and habitat resulting from extensive economic development in the coastal zone, and by the unsustainable exploitation of natural resources.

Surface and groundwater quality in the Hai river basin, has been seriously degraded due to lack of effective pollution control combined with increasing population, industrial output, and intensification of agriculture and livestock production. Over 80% of the river stretches in the Basin are classified as polluted. Groundwater contamination of drinking water aquifers is a widespread, yet poorly understood, problem in the Hai Basin. Degradation of urban water supply aquifers can have large-scale public health impacts and destroy a valuable resource. Contamination of shallow aquifers from agricultural runoff and use of polluted irrigation water threatens the water supply source for many rural communities. There is also extensive seawater intrusion on the littoral plain of Hebei, threatening irrigation, rural, and urban water supplies. Discharge of pollutants into the Bo Hai Sea, particularly around the mouth of the Hai River near Tianjin, have resulted in large and frequent "red tide" incidents which can contaminate shellfish and poison humans that consume them. Globally, the GEF 4 Strategy for International Waters contains a global initiative on further action in support of the Global Programme of Action. Opinions of conference participants will be sought as to whether such an initiative should be continued in future phases of the GEF.

Advancing the global oceans agenda to 2016

Cicin-Sain BILIANA

This presentation will review progress on the global World Summit on Sustainable Development (WSSD) and Millennium Development Goals, as they relate to the oceans and coasts, as well as highlight the importance of putting climate on the oceans agenda and vice versa and emphasize the need to move toward ecosystem-based management of marine areas beyond national jurisdiction, which represent 64% of the ocean. The results reported are drawn from the work of the Global Forum on Oceans, Coasts, and Islands in outlining the major ocean and coastal issues countries will need to face in the period to 2016 and the 4th Global Oceans Conference held in Hanoi, Vietnam, in April 2008.

The WSSD goals encourage the application of the ecosystem approach by 2010 and promote integrated coastal and ocean management (ICM). To date, over 100 countries have established ICM programs and between 20 to 30 countries are developing or are implementing integrated national ocean policies covering the Exclusive Economic Zone. Eighteen GEF-funded Large Marine Ecosystem (LME) projects in the world's large marine ecosystem areas are either approved or in the preparation stage. Small island developing States (SIDS) are making progress with a high level of ratification on international environmental agreements, including the Convention on Biological Diversity (100%) and the Law of the Sea (93%). However, many SIDS need to develop specific institutions or processes to implement cross-cutting approaches to planning and management of oceans and coasts, including addressing the impacts of climate change.

Fisheries face continued pressure: 76% of all global fish stocks are fished at or beyond their biological limits. There needs to be a continued focus on reform of Regional Fishery Management Organizations (RFMOs); illegal, unregulated, and unreported (IUU) fishing; fishing overcapacity; and development of guidelines and legal frameworks for aquaculture. The WSSD goals call for a significant reduction of the current rate of biodiversity loss by 2010 and the establishment of marine protected areas, including representative networks by 2012. The status of many marine species is not known, due to a lack of data; however, the Global Marine Species Assessment (GMSA), a joint effort of IUCN/SSC with Conservation International and other partners, seeks to ensure that the conservation status of every marine vertebrate species and of selected invertebrates and plants is reviewed, with a target of 20,000

species assessed by 2012. Based on data from the Convention on Biological Diversity (CBD) 3rd National Reports, 81.8% of reporting coastal countries have designated MPAs and 92.9% have plans to develop new MPAs.

There continues to be a disconnect between the freshwater and coastal/ocean communities. The WSSD goal to develop integrated water resource management (IWRM) plans by 2005 has seen progress. Comparing 53 countries participating in the 2005 Global Water Partnership Survey and the 2007 UN Water Survey, the percentage of countries having plans completed or under implementation rose from 21% to 38%. Over 60 countries are in the process of developing, or have finalized, their respective National Programmes of Action (NPA) to control land-based activities, although the extent of implementation is uncertain.

The oceans play a significant role in regulating the global climate and moderating weather systems around the world. Changes in climate can have a profound impact on the functioning of ocean, coastal and island ecosystems. The impact of climate change on developing nations, especially SIDS, is significant and the implications of these potential effects range from changes in ocean chemistry and forecasted sea level rise (9cm to 88cm) to impacts on ecosystems, human health, and the displacement of coastal peoples. The need to address these issues in the oceans community is a vital first step in combating the potentially devastating effects of climate change with specific attention to the developing world and SIDS.

The impacts of climate change and rapid economical development in China on the ecosystem in the Changjiang Estuary and in the East China

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The circulation and marine environment in the Bohai, Yellow and East China Seas are influenced by the discharges from major nine rivers (Changjiang, Minjiang, Ou, Qiantangjiang, Huanghe, Hai, Liao, Yalu, and Han), tides, meteorological conditions and the Kuroshio Current, but the Changjiang River is the major source of freshwater, sediments and nutrients that flow into the East China Sea. Economic development in the Changjiang catchment, including industrialization, agriculture and water-resource development, such as the construction of the Three Gorges Dam, may affect the water and elemental cycles in the catchment. Ultimately, the supply of freshwater, sediments and nutrients into the East China Sea will be altered and, therefore, the Changjiang river discharge gives the biggest influence on the ecosystem in the Changjiang estuary and the East China Sea as well as in the Yellow Sea.

Climate change in recent years caused the change in precipitation pattern which resulted in big floods during wet season (June–September) and drought during dry season (January–March). In 1998 the second biggest flood occurred in Changjiang catchment and the discharge of Changjiang river at Daton hydro-station recorded over 80 000 m³/s on August, 1998. Pollutant accumulated in the Changjiang catchment run-off during big flood and discharged to the East China Sea. Therefore the increase in flood event due to climate change will result in increase of pollutant load to the East China Sea, which will cause heavy eutrophication and red tide outbreaks.

In 2006 severe drought occurred in Changjiang catchment and the discharge at Daton hydro-station dropped significantly on March, 2006. Salinity intrusion into the Changjiang river will be caused by the decrease in the fresh water discharge from the Changjiang river due to drought and the increase in the fresh water intake for industries and municipalities along the Changjiang river. Salinity intrusion will damage the economy in Shanghai city in the area of drinking water, industrial water and agriculture.

This paper presents the environmental impacts on the ecosystem services in the Changjiang catchment, estuary and the East China Sea under the condition of climate change and rapid economical development in China by using the integrated model for management of environmental resources.

The followings will be presented.

1. Environmental pollution loads from the Changjiang catchment
2. Salinity intrusion in the Changjiang river during drought period
3. Trans-boundary flow in the East China Sea caused by the 1998 big flood in the Changjiang catchment
4. Heavy eutrophication and red-tide outbreaks in the East China Sea

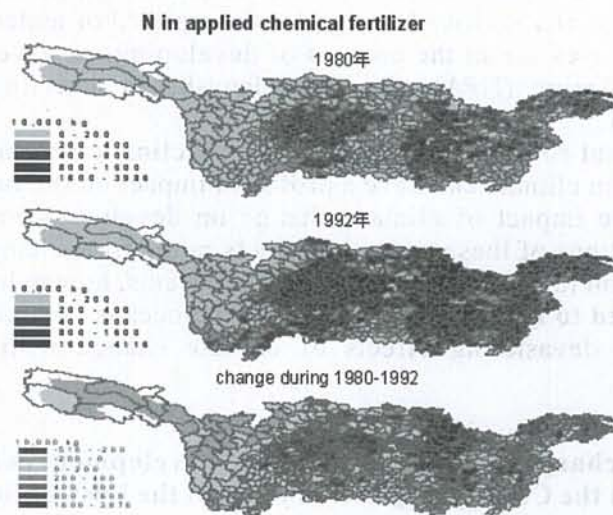


Fig. 1 Nitrogen load as chemical fertilizer in the Changjiang catchment



Fig. 2 Salinity intrusion in the Changjiang river

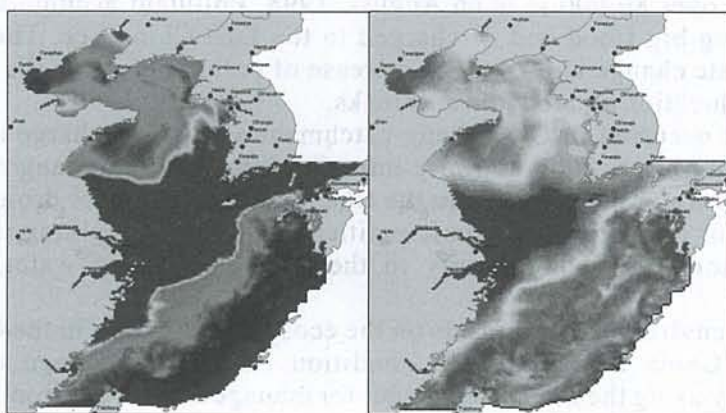


Fig. 3 Predicted chl-a distribution and TN distribution (Sep.15, 1998)

Biogeochemistry On The Continuum From Watersheds To The Continental Margin: Case Studies From China

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Coastal environment represents an over-stressed ecosystem under the influences from both land and open ocean but with different patterns in terms of time-scale and magnitude. Land-based human activities from watersheds, such as deforestation, agriculture, and hydrological engineering (i.e. dam construction), have altered the fluxes of natural weathering materials and pollutants to the West Pacific Ocean. On the other side, incursion of Kuroshio regulates the biogeochemical processes of adjacent coastal ocean. The changes occurring in the Pacific Ocean Proper, such as in the El Niño-Southern Oscillation, climate warming, and variability of ocean circulation (e.g. PDO), have altered the fluxes of material from the ocean to the coastal Pacific region as well.

In the presentation, the role of biogeochemistry in the land-sea interaction is evaluated using some case studies from China Seas as an example. Data of this study are from various sea-going cruises in and cover a region from upstream of drainage basin to the continental margin, which includes nutrients, trace species, biomarkers, stable and radio isotopes. Cases studies are given, such as damming and fresh water regulation in the watersheds and monsoon induced change in water exchange over the shelf. Biogeochemical dynamics in the coastal environment is examined in more detail.

Several scientific issues on the health of estuarine ecosystem

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Estuary is a semi-closed water body located in the boundary of the land and ocean, and always characterized by high biodiversity and high primary productivity. As an important habitat of the earth system, estuary provides with irreplaceable service functions and resources for human beings. From the perspective of its nature, a healthy estuarine ecosystem should be an integrated, stable, and sustainable zone with the strong resistance to unfavorable factors. And from the perspective of its social attributes, a healthy ecosystem should be able to offer comprehensive ecosystem functions for human beings, and meet entertainment needs for local residents. Studies on the health of estuarine ecosystem in the world started from its continuous damage due to human activities.

By taking a broad range of biological, physical, chemical, and socio-economic factors into whole consideration, this paper focused upon some key scientific issues on estuarine eco-health with reference to the "pressure-state-response" theory on the basis of cause and effect relation between factors of the ecosystem. These issues involve the watershed-scale based estuary ecosystem health, main principles to establish the **index** system of the estuarine eco-health, the ecological impacts caused by special pollutants, the habitat assessment and classification for the estuary and coast area, and the impact of sedimentation on the estuarine eco-health. Based on the discussions, some conclusions were drawn: (1) For the sustainable development of the earth system and human beings, the habitat and biodiversity in the estuary must be fully protected, and their basic natural functions should be maintained; (2) As the important interface of the land and ocean, estuary plays a significant role in the interaction between the land and sea through physical, chemical, and biological processes. However, our knowledge concerning such land-ocean interface is so little the further research should be strengthened; and (3) Due to the continuous pressure from the immoderate development of the landscape, significant changes occurred to the estuarine habitat conditions with apparent degradation of the ecosystem and its service functions. Therefore, more efforts, including the cause identification of the degradation and active control strategies, are imperative to protect and restore our estuarine ecosystem.

Watersheds and coral reefs: conservation science, policy and implementation

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Coral reefs throughout the world are being degraded by human-induced disturbances, resulting in ecological, economic and cultural losses. Runoff and sedimentation impacts are among the greatest threats to coastal reefs surrounding high islands and adjacent to continental landmasses. Data were collected from three watersheds and their adjacent coral reefs in Palau, Guam and Pohnpei. Runoff and associated sediments from these watersheds had significant impacts on the diversity, abundance, distribution and physiological functioning of corals, fish and a variety of invertebrate species. Additionally, pollutants were found to affect the life history and cellular biology of exposed corals at both lethal and sublethal levels over large distances from sources. These data demonstrate that marine protected areas (MPA's) alone are insufficient for coral reef protection and that integrated watershed management practices are also needed. Notable gaps in the effectiveness of environmental policy, legislation and regulatory enforcement have resulted in the continued degradation of these Pacific coral reefs. Data demonstrated that efforts for restoration of reefs must focus on restoring those conditions that allow natural recovery to occur. Participating communities involved in this program, with intact resource stewardship and traditional leadership systems, have been able to apply research findings, integrating traditional ecological knowledge and land use practices with coral reef management policies, relatively quickly. Three case histories in the Pacific Islands provide insight on how biophysical data was used to manage human activities and behaviors responsible for coral reef destruction, through the application of the social sciences.

Estuary response to environmental change: managing the future with reference to the past

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Present and future coastal populations rely on healthy estuarine and lagoonal ecosystems for the delivery of goods and services that support human well-being. Sustainable provision of these ecosystem goods and services is highly dependent on effective management at the land-ocean interface under increasing pressure from climate change, population growth and human impact. Examples are drawn from estuaries and back-barrier lagoons over a range of timescales (Holocene to the present) to illustrate their sedimentary and geomorphic evolution in response to changing sea-level, climate, fluvial sediment flux and coastal morphology (due to storms and/or sediment deposition/erosion). Particular attention is given to back-barrier wetlands under conditions of high relative sea-level rise (36 mm yr⁻¹) and reduced terrestrial sediment delivery during the mid-Holocene as a model for future estuary hinterlands where climate change is leading to accelerated sea-level rise and where river flow is becoming increasingly impounded and recycled.

The Delaware estuary: tracking changes to assess human impacts and the effects of climate change

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The Delaware River is a living, working river providing a corridor for commerce and vital living resources. The Partnership for the Delaware Estuary recently released the "State of the Estuary 2008" report which tracks the progress made in implementing the long-term "Delaware Estuary Comprehensive Conservation and Management Plan". The report provides environmental indicators with a status rating and a trend. Usually five years of data are evaluated to establish trends, and if longer term data are available, they are considered in 5-year increments. Recommendations are provided in the form of "Actions and Needs". Some of the indicators are: population, water use patterns, land use, water quality health, natural resources, tidal wetlands and salinity. There has been little recent trend in overall water quality, but there are improvements in oxygen and nutrients. One of the unique features of the Estuary is the freshwater tidal marshes. Although less than 5% of the freshwater tidal marshes remain, they are an ecologically significant feature of the urban corridor. Some living resources such as bald eagles and blue crabs have upward trends, while others are declining, such as Atlantic sturgeon. The possible effects of climate change are included. Accelerating sea level rise, combined with natural subsidence are already threatening the tidal marshes of the Estuary. The upward trend in extreme weather events could have significant impacts as well. Although some potential indicators of climate are expected to change gradually, some biological and ecological responses could be sudden if critical thresholds are passed. An ecosystem-based monitoring approach, predictive modeling and regional coordination are necessary for future sustainability of crucial ecosystem goods and services in the Delaware Estuary.

North-western European Seas: How to Restore Damaged Coastal Marine Habitats?

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With the launching of the new Directive on the Marine Strategy, the European Union has completed a whole set of legal tools for attaining a better ecological status of the marine environment. The strategy comes as a complement to existing directives such as the Water Framework Directive, the Habitats Directive or the Bird Directive. The objective of this paper is, firstly, to analyse the benefits brought by the older directives in the management of north-western European seas: the English Channel, the Celtic Sea, the North Sea and the Baltic Sea. All these enclosed or semi-enclosed waters sit on the European coastal shelf and are epi-continental ecosystems. They are subject to various pressures due to human activities and in addition, global warming is affecting coastal habitats. Secondly, the paper will show how these disturbances impinge on goods and services provided by these ecosystems. In particular, it will give examples of how certain estuarine habitats have been damaged by misuse and unwise management.

The main part of the article will be devoted to efforts for restoring water quality in some industrialised estuaries during the few past decades. It will then compare strategies for the recovery of damaged habitats and the restoration of lost ecological functionalities. Case studies will be taken from the Seine in France, the Mersey and the Humber in England, the Scheldt in Belgium and the Netherlands and the Elbe in Germany. The Kuronian lagoon (Lithuania) will be selected from the Baltic Sea.

Through comparing the various restoration schemes, policies will be assessed. The discussion will then put together the various approaches. Resting on a rigorous scientific approach, the discussion will propose a synthetic approach to restoration. It will consider:

1. Efficient procedures of socio-ecological evaluation
2. A methodology to assess the ecological quality of systems considered
3. Rigorous monitoring programs, resting on a relevant choice of indicators
4. Participation of local communities

in order to define strategies compatible with conservation and sustainable development at the regional and European level.

The conclusion will demonstrate that any intervention on an estuarine ecosystem should be incorporated into a global restoration plan, working on the long-term. An ecological vision on the long-term would mean analyzing the past to predict.

Coastal management in the Mediterranean

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In the early 1990's, integrated coastal management (ICM) in the Mediterranean basin found general acceptance as an important issue both at national and regional levels, and since then it has been steadily developing. Donor organizations, especially the European Union and the UNEP's Mediterranean Action Plan played important catalyst roles in this development by initiating and supporting pilot projects. In 1992, the European Union launched the Mediterranean programs in which the environment, and especially the coastal environment, was considered as a priority issue. In the following years, EU provided financial support to ICM related projects in the Mediterranean in the context of the Marine Science and Technology (MAST) and the Framework Programs, as well as the Euro-Mediterranean Partnership scheme (such as the SMAP III Programme). Parallel to this development, several NGO initiatives took place for public awareness on pressing coastal issues and in training and education. MEDCOAST, a network of Euro-Mediterranean academic institutions, has been providing scientific and professional support to the practice of ICM in the Mediterranean (and the Black Sea) countries and organizing forums for exchanging ICM experiences, disseminating information and training professionals at mid-managerial levels. Today, there exist significant levels of efforts in the form of policy and strategy development, ICM projects and programs, especially in the northern Mediterranean countries.

This paper presents the history of efforts for advancing coastal management in the Mediterranean countries, including the recent work for a Protocol on Integrated Coastal Zone Management within the framework of the Mediterranean Action Plan, the ICZM projects funded by the European Union through SMAP III Programme and the implications of the recent EU Integrated Maritime Policy.

Recent results of ocean remote sensing research for global climate change

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Recent ocean remote sensing missions and techniques of new generation of active and passive space borne remote sensing sensors have produced a remarkable data sets of high accuracy measurements of sea surface height, wind, roughness, temperature, clarity, phytoplankton pigment concentration, etc. One can now study, on a truly global basis, the fluid ocean and its variability due to global climate change at all periods between years and days, on all spatial scales from the global to about 20 meters. The accuracy and precision of the measurements are so good, that, with the help of the newly developed various remote sensing data processing techniques, a huge variety of phenomena can now be addressed. This talk will summarize new research results of the state of art remote sensing methods and applications for impacts of global climate changes on global and coastal oceans using altimeter, scatterometer, SAR, SST and Ocean Color data, and describe some of our recent cutting edge research and the recent attempts to combine satellite remote sensing with other in situ observations and techniques, to infer the three-dimensional time-varying ocean circulation, air-sea interactions, and global and regional oceanographic processes that relating to global climate change. As an example, I will present my recent research results about ocean's role in global water/energy cycles and meridional transport, which reported by the Science magazine recently.

**Ten Major River Basins in Monsoon Asia-Pacific:
The quadrangle of social, economic, environmental and governance challenges**

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Approximately one third of the mankind lives within the immediate influence of the large rivers of the Monsoon Asia-Pacific. These rivers include Indus, Ganges- Brahmaputra, Ayeryarwady (Irrawaddy), Salween, Chao Phraya, Mekong, Song Hong (Red River), Zhujiang (Pearl), Changjiang (Yangtze) and Huanghe (Yellow river). Whereas the concentration of people within the basins of these rivers is remarkable, even more striking is the agglomeration of poverty, malnutrition and uncontrolled urbanization; it is estimated that around the half of the world's total in these matters occurs within these basins. At the same time a remarkable and growing share of the world's economic growth takes place in the basins.

Most of these rivers and their basins have been massively modified over the years, centuries and millennia. It is important to recognize that the contemporary pace of change is extremely speedy, many-sided, and unforeseen in history, and it is expected to keep accelerating in few decades to come.

An assessment of major driving forces, pressures for change and vulnerability of the major river basins of the Monsoon Asia-Pacific was performed. The analysis was done using various geospatial databases of the river basins including data on nature and environment (such as climate, hydrology, land cover, land use etc.), demography, as well as social and macroeconomic development. A vulnerability profile of the basins was produced.

Session - 1

**Catchment-Coastal Environmental
Vulnerability under Global Warming Setting**

Policy modifications to combat with sea level rise and other coastal hazards in Sri Lanka

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As a coastal island, Sri Lanka's coastal environment is highly vulnerable to the potential impacts of sea level rise in the future. The social, economical and ecological systems in the coastal region are also at risk with the increased frequency of occurring coastal hazards as a result of global climate changes. The massive devastation of Indian Ocean Tsunami 2004 gave a wake up call to combat with all possible weapons to reduce the vulnerability of coastal environment to future natural disastrous event so as to protect not only lives, but also biodiversity, ecological integrity and coastal livelihoods. This paper highlights the policy options adopted by the Government of Sri Lanka as countermeasure to mitigate the potential impacts of future coastal hazards; they are:

- Assess the vulnerability of coastal areas for different coastal hazards and map the high risk area.
 - Development of new cities beyond the risk area and relocate existing urban centers in high risk area to more interior safer sites
 - Establish new infrastructure developments away from the coastal areas to avoid concentration of socio-economic activities in the coastal areas
 - Strict enforcement of coastal buffer zones and building codes to reduce the potential impacts of hazards
 - Restore, Rehabilitate or enhance coastal ecosystems as Bio-shields to mitigate the potential impacts of future disastrous events
- Integrated Coastal Management reduce the complexity in implementation of these policy modifications through providing a platform for more collaboration and coordination among different sectors and disciplinary.

A close introspection on the past 30 years of Catchments Estuarine Coastal system of tropical central Kerala, India

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A vivid and graphic description of the environmental settings of the tropical central Kerala is drawn up to illustrate the interlinkages between catchments, estuarine and coastal system. Christened as "Queen of Arabian Sea" in "God's Own Country", COCHIN and its neighborhoods of vast expanses of Vembanad Lake is blessed with perennial river flows from six rivers, originating in the Western Ghats. The Ghat sections are steep hills imbibed with tropical forests, followed by milder slopes westwards of country parts of green plantation eventually running down to coastal plains swathed in brackish to saline waters amidst islands, bars and wetlands. As a trade and commerce centre, Cochin, the main city has witnessed urbanization coupled with vast land use changes; water resources at times dwindle from plenty to scarce whereas the ecosystem has undergone vary many transformations. A multitudinal, complex (management) scenario prevails, challenging every other sphere of human activity. To illustrate, this sector of the state has witnessed inter basin transfer of water, construction of large water barrages, extensive reclamation, changes in catchments practices, segmented urban growth, old to new industrial establishments, prolonged but seasonally intensified river sand mining, small to large scale coastal erosion / deposition and more minor alterations. And currently this region is poised to house large containerships, master port facilities, new industrial complexes amid plans to improve transportation and living amenities. To specify, the catchments area dynamics now revolves around re-plantation and terracing; the hydro-environment reflects low storage, but abundant seasonal supply; the estuarine sector appears most stressed due to multi-developmental activities and the coastal zone is presently an arena of challenging tasks and issues on account of policy shifts to accommodate dictates of people's participatory programs. As to strike a balance between human aspirations and environmental upkeep, there lies a need to appreciate and evaluate the past 30 years or so of records for this tropical system and assess vulnerability in a changing scenario of environmental settings; case by case, the scenarios are evaluated for resilience, with regard to sustainability.

Impacts of climate change and land-use change on flood inundation: a coupled modelling approach

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Recent major floods around the world have raised concern that climate change is causing increases in the frequency and magnitude of high discharge events. Furthermore, the sensitivity of the system to climate change appears to have increased significantly as a result of anthropogenic land-use change. This study investigated the impacts of climate change and land-use change upon flood inundation using a coupled modelling approach in an upland catchment with downstream urbanized floodplains through continuous scenario-based simulations in the City of York, Yorkshire UK. It also investigated how the potential impacts of climate change and land-use change at the catchment scale could be alleviated to reduce flood risks. Flood alleviation measures were designed and fed into the coupled model to investigate their impacts on flood inundation. In particular, this focused on flood alleviation measures in relation to construction of flood defences, provision of washlands and increase of channel capacity due to sedimentation. This study also evaluated land management options in mitigating the flood risks in the future, including how they scale through to downstream effects, e.g. sediment delivery and floodplain inundation. Coupled continuous simulations of catchment-scale rainfall-runoff and reach-scale flood inundation for the next 100 years was carried out to derive flood inundation extents under different climate change, land-use change and flood alleviation scenarios. This allows integrated analysis of flood risks at both catchment and reach scales. This study addressed a much understudied aspect in flood risk management which is the impact of catchment-scale rainfall-runoff on flood risk in terms of flood inundation extent. This represents a more holistic approach that involves whole catchment and risk-driven adaptation to climate change.

Water abstraction from the Changjiang River downstream Datong and its impacts on water discharge into the estuary under the extreme drought of drainage basin

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Datong is a hydrometric station in lower reach of the Changjiang River, which is closest to the estuary. But the distance between Datong and the estuary is still about 500 km. The water level of the Changjiang River downstream Datong is affected by ebb and flow of tides, which produces the opportunities for areas along the Changjiang River to abstract water from it. And these are the most developed areas in the drainage basin. With the development of economy, the requirements for water resource of these areas increase quickly. And the water-abstracting projects increase continuously, including sluices and pump stations built at the estuary of branches, culverts along the bank, and other pump stations along the bank for life and corporations. At present, the total water-abstracting capacity reaches about 20000 m³/s. Because the salt water intrusion in estuary became stronger and stronger in recent years, the problem about effects of water abstraction downstream Datong on water discharge into the estuary and salt water intrusion was paid attention to. In 2006, the extreme drought occurred in the upper and middle drainage basin of the Changjiang River. And the Three Gorge Dam stored water just in that period. As a result, the water discharge from the upper and middle basin decreased greatly. And the salt water intrusion in estuary was very strong, the occurring time was ahead of the usual about 2 months. But when salt water intrusion occurred first time in September the corresponding water discharge in Datong was still more than 17000 m³/s. In this paper, the practical situation of water abstraction between September 2006 and April 2007 is estimated and analyzed, based on many observed day-by-day data and investigated data. And the effect of water abstraction on water discharge into the estuary is calculated and analyzed. The results show that, on the whole the rainfall was ordinary in areas downstream Datong and no severe drought occurred. The sluices and partial pump stations (especially the water-diversion projects between drainage basins) are the main water-abstracting projects, which greatly impacts the quantity of

water abstraction from the Changjiang River. And the water discharge of several branches is the important factor that impact the quantity of water drainage into the Changjiang River, such as Huaihe River, Guxi River, and Qingyijiang River. Water abstraction of sluices is regularly, which corresponds to the magnitude of tides. And the water discharge into the Changjiang River of some branches is also impacted by tides. In September and October 2006, the quantity of water abstraction is much more than water drainage. The net decreased water discharge reached more than 1400 m³/s, which will affect the water discharge into estuary of the Changjiang River, especially when the water discharge from the upper and middle basin is low.

Krka river estuary (Eastern Adriatic Coast) evaluation of natural and anthropogenic influences by multielemental analysis

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The Krka river estuary is located on the Eastern Adriatic coast and is a typical highly stratified karstic estuary with fresh/brackish surface water layer flowing seawards and bottom upstream counter-current seawater flow. The estuary has a total length of 22 km, its depth gradually increasing from 2-42 m. Input of terrestrial material into the Krka river estuary is relatively small and prevented by the number of calc tufa barriers at the river/estuary confluence. Due to the uniqueness of these tufa barriers and waterfalls, this area now is a National Park.

The town of Šibenik (40000 inhabitants) is located in the central part of the estuary. The main sources of anthropogenic pollution in this part of the estuary are phosphate-ore handling in the Šibenik port, the input of untreated wastewaters from the city of Šibenik and the now defunct factory of ferromanganese alloys. All these sources of pollution are now either inoperational or being remediated. Previous work established localized pollution with some elements (Hg, Mn, U, ref. 1, 2, 3), but assessment of the contamination of the entire area of the Krka river estuary with a variety of eco-toxic elements was never performed.

The aim of the work was to establish the degree of anthropogenic influences in the estuary by

multielemental analysis of sediment and water. Surface sediments and sediment cores as well as surface water were analyzed for trace element composition by means of the HR ICP-MS (High Resolution Inductively Coupled Plasma Mass Spectrometry).

Obtained results indicate a clear anthropogenic point-source influence on several locations within the Krka river estuary. The most severe impact was established for the Šibenik port - for elements Hg, Cd, Zn, Pb, As and Cu and must be understood in terms of a combined effect of contamination related to phosphate-ore unloading over many years and input of untreated municipal wastewaters.

Further contamination of the estuarine sediment column was established in front of the closed ferromanganese-alloy factory, where high concentrations of Mn, Pb and Ba were measured. However, in the largest part of the Krka river estuary the concentrations of measured elements were low and within expected ranges of natural (lithogenic and marine) variations. This indicates that the major part of the Krka river estuary is still unpolluted.

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Increase in moon Jellyfish populations in Seto Inland Sea, Japan: possible effect on predator-prey interactions under summer hypoxia

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The moon jellyfish *Aurelia aurita* has increased in abundance in coastal waters around Japan during recent decades. Since the moon jellyfish is highly tolerant of low dissolved oxygen concentrations, predation impacts by moon jellyfish on zooplankton can increase during summer hypoxia in coastal waters, which is often caused by anthropogenic effects such as an increase in nutritional loading from the land and global warming. Field sampling during summer 2006 and 2007 revealed that moon jellyfish was abundant in the upper Hiroshima Bay, Seto Inland Sea, southwestern Japan, where summer hypoxia commonly occurs. Laboratory experiments were conducted in order to test the hypothesis that summer hypoxia leads to qualitative changes in predator-prey interactions between moon jellyfish and larval fish. Larvae of a common coastal fish, red sea bream *Pagrus major* (2.9, 4.1, 6.2 and 8.6 mm in standard length), were used for the experiments. Predation rates (% of larvae preyed on by a moon jellyfish per 10 min.) were examined at four oxygen concentrations (1, 2, 4 and 5.8 mg/L) in 10 L tanks (4 replicates). Size-selective predation was observed at the two highest oxygen concentrations (4 and 5.8 mg/L): about half of the 6.2 and 8.6 mm larvae survived the 10 min. trials while more than 85% of the 2.9 and 4.1 mm larvae were captured. Larval body size did not affect the predation rates at the two lowest oxygen concentrations (1 mg/L and 2 mg/L): more than 90% of larvae in all size classes were caught. These results indicate that trophic flow from ichthyoplankton to moon jellyfish increases during summer hypoxia in coastal waters and a qualitative change in predator-prey interaction, i.e., shift from size-selective to non-size-selective predation occurs at oxygen concentrations < 2 mg/L.

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200-year development of Tokyo, Ise-Nagoya, and Osaka Bays: on-line learning tools on environmental management of enclosed coastal seas

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Three major urban areas in Japan, Tokyo, Nagoya, and Osaka, are located at the mouth of major rivers in Bays that open to the sea and have functioned as the major commercial centers and transportation nodes. This paper looks at landform changes of the three major bay areas and environmental risks that accompany rapidly changing land use patterns. The analysis is based on graphical information from Tadataka Inoh's maps some 200 years ago, modern maps since the Meiji era starting 150 years ago, and IKONOS satellite images for the recent years. Statistical data on the landform changes are then examined from three aspects: pressures including population and economic activities from 1880 on; state of environment as indicated by reclamation of the bay area; and responses to environmental risks such as water pollution, loss of biodiversity, and vulnerability of sub-zero meter zones against rising sea levels and frequent typhoons induced by global warming. Geographically, Osaka Bay is located at the end of the Seto Inland Sea that provides tranquil sea lane. The City of Osaka developed on the delta of Yodo River. The City of Nagoya opens to the Ise Bay located at the central part of Japan. Several major rivers flow from the central mountain ranges into the Bay, including Kiso, Nagara, Ibi, and others origins of which are traced to the central mountain range beyond the Nobi Plain. Tokyo was formerly called Edo during the Tokugawa Period covering 300 years preceding the Meiji Restoration, and Tokyo housed the largest number of population among world largest cities already during the Edo period. Tadataka Inoh (1745–1818), a geographer who lived close to the end of the Tokugawa period, successfully measured the entire Japan through a series of expeditions during 1800 to 1816, including the three major bay areas that are examined here. He left several versions of detailed Japanese maps from about 200 years ago*. Detailed maps are 1/36,000; mid-scale

Three major urban areas in Japan, Tokyo, Nagoya, and Osaka, are located at the mouth of major rivers in Bays that open to the sea and have functioned as the major commercial centers and transportation nodes. This paper looks at landform changes of the three major bay areas and environmental risks that accompany rapidly changing land use patterns. The analysis is based on graphical information from Tadataka Inoh's maps some 200 years ago, modern maps since the Meiji era starting 150 years ago, and IKONOS satellite images for the recent years. Statistical data on the landform changes are then examined from three aspects: pressures including population and economic activities from 1880 on; state of environment as indicated by reclamation of the bay area; and responses to environmental risks such as water pollution, loss of biodiversity, and vulnerability of sub-zero meter zones against rising sea levels and frequent typhoons induced by global warming. Geographically, Osaka Bay is located at the end of the Seto Inland Sea that provides tranquil sea lane. The City of Osaka developed on the delta of Yodo River. The City of Nagoya opens to the Ise Bay located at the central part of Japan. Several major rivers flow from the central mountain ranges into the Bay, including Kiso, Nagara, Ibi, and others origins of which are traced to the central mountain range beyond the Nobi Plain. Tokyo was formerly called Edo during the Tokugawa Period covering 300 years preceding the Meiji Restoration, and Tokyo housed the largest number of population among world largest cities already during the Edo period. Tadataka Inoh (1745–1818), a geographer who lived close to the end of the Tokugawa period, successfully measured the entire Japan through a series of expeditions during 1800 to 1816, including the three major bay areas that are examined here. He left several versions of detailed Japanese maps from about 200 years ago*. Detailed maps are 1/36,000; mid-scale maps are 1/216,000; and summary maps are 1/432,000. Inoh's work, completed before the Japan's industrialization drive some 150 years ago starting with the opening of the country at the start of the Meiji Period, provides an ideal starting point in an attempt to trace the impact of human habitat to the enclosed coastal seas. For more recent period, official maps and IKONOS satellite images are used. Increase in land reclamation is most visible during 1960 to 1985. According to statistics and maps, the peak period seems to have been during 1970 to 1980 when the increase in land area averaged 9.1 square kilometers per year in Tokyo Metropolis and 5.0

Natural hazard assessment over Iranian coastlines

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1. Introduction

Coastal areas are usually subjected to disasters due to natural hazards. Detecting probable hazards in coastal areas, preparing suitable policy and basic planning are essential to reduce disasters due to a certain hazard. Making proper management decisions will result in preventing from inappropriate development as well as reducing disasters and irreparable damages in the area. Coastal hazards are comprised of geological (earthquake, land-slide, settlement, liquefaction), climatology and hydrological (drought, heavy storms, heavy freezing, flooding and heavy rain) and marine hazards (storm surge, storm waves, water level variations and tsunami). Considering other experiences in the world, an appropriate method is applied for overall hazard assessment in coastal areas. In the mentioned method, each hazard is considered in the study area based on conducted analysis and the hazards are graded based on the intensity to four categories from 1 to 4, where 4 is the more intense one. Finally, effects of all the hazards are considered together in order to obtain an overall hazard assessment. The overall assessment is graded through 7 levels from 1 to 7 (very low to very high level of hazard).

2. Hazard assessment and classification

Gradation of hazard intensity in an area requires scientific judgment, understanding the history of hazards and getting acquainted with contributing parameters in hazards. A powerful statistical system is also required for predicting time and location of hazards. The system must be updated regularly. In this study, seven types which are more effective in the coastlines are investigated and graded in four categories from mild (i.e. 1) to sever (i.e. 4) and are presented in Table 1, separately for the seven hazards.

3. Overall hazard assessment

In addition to separate assessment of each hazard, an Overall Hazard Assessment, OHA, is to be performed for general assessment of a certain area.

Therefore, available hazards are classified to dynamic and non-dynamic categories. Dynamic Hazards occur in a very short period and result in sever disasters, which are earthquake, land-slide, liquefaction, storm waves, heavy storms and Tsunami. On the other hand, some hazards such as shoreline change occurs during long periods and result in minor disasters and are known as non-dynamic hazard. In order to simulate OHA parameter grade of each hazard, both dynamic and non-dynamic ones, are squared and a double value is assigned to dynamic items to magnify dynamic hazards and finally, averaging the obtained quantities, the OHA value is achieved.

4. Conclusion

A comprehensive method is introduced here for assessing environmental hazards in coastal areas, through which interactive effects of the hazards are predicted in OHA parameter in addition to separate effects of each parameter. Coastal areas are graded in different categories, from low level to high level of hazard intensity. The described method is employed for the Iranian coastlines in the north and south of the country and the results are presented as hazard assessment maps; where an example is presented in Fig.1.

Kind of hazard	Scale	Range
Geology hazard	seismic	ground acceleration
		Low
		Moderately Low
	Land slide	Moderately High
		High
		0-5
		5-10
		10-15
	liquefaction	>15
		no history of Liquefactvity
Climate hazards	Extreme storms	Number of Land slide
		Number of stormy days
		qualitative data
		High Liquefactvity
		Low Liquefactvity
		Moderate Liquefactvity
		High Liquefactvity
		High Liquefactvity
		High Liquefactvity
		High Liquefactvity

Kind of hazard	Scale	Range
Marine phenomena hazards	Hazard waves	Wave height meter
		Tsunami wave height meter
		Caspian sea
		Oman sea, Persian gulf and Strait of Hormoz
		<3
		3-5
		5-6
		6-7
	Tsunami	Tsunami wave height meter
		0-0.5
		0.5-1
Geomorphology hazards	Change of shoreline	qualitative
		Low erosion rate
		moderate erosion rate
		high erosion rate
		Very high erosion rate

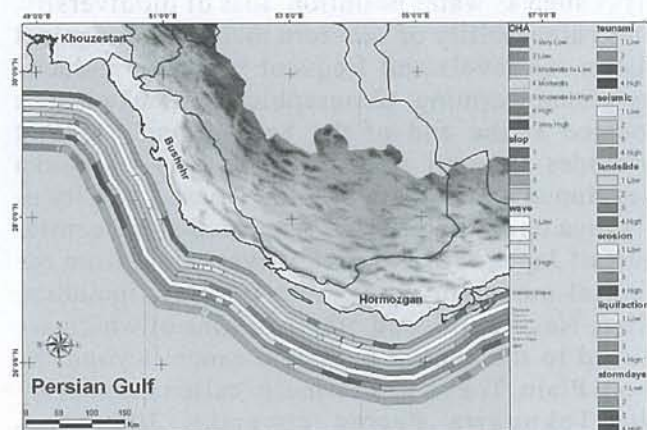


Fig.1 Sample of hazard assessment map for Iranian coastlines over the Persia Gulf

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Possible biotic changes in the Yangtze delta-estuary as a result from the Three Gorges Dam construction and global warming

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It's obvious that the Three Gorges Dam construction as well as global warming can lead through a cascade of top down causality (main reasons of changes in some part of river-estuarine system are situated upper) to salinization, eutrophication and another changes of Yangtze delta estuarine and coastal waters and as a result to destabilization of ecosystems. We discuss this top down cascade. We take into account that the structure of cause-effect relation chain is different on different temporal and spatial scales. Destabilization of ecosystem leads to decreasing of ecosystem immunity against alien species and increasing of number of alien species forming stable populations^(1,2). Can we evaluate ecosystem immunity? Can we predict what species have more chance to be new inhabitants in these waters? What possible ecosystem transformation will be resulted from it? What biotopes will be colonized at first? Using available our and published data for the Azov, Black, Caspian, Baltic seas and Great Lakes^(3,4) we try to give some answers on these questions. Giving answers we take into account data on long-term biotic changes in saline lakes driving by changes of salinity in them⁽⁵⁾. Sediment load reduction of the Changjiang after the Three Gorges Dam construction (from 480 Mt yr⁻¹ to 150-200 Mt yr⁻¹)⁽⁶⁾ leads to decreasing of sediment accumulation rate in delta and sea and as result after some time to increasing of coastal erosion. We know a lot of such cases. Coastal erosion effects on eutrophication rate and turbidity, they both lead to decreasing of biodiversity⁽⁷⁾. Different impacts of climate changes and the Dam on biota can drive its changes in different directions. Trying to predict all changes we need remember about limits for such predictions⁽⁸⁾.

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Vulnerability to climatic changes on Mediterranean beaches: a modelling approach

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Climate change induced vulnerability is defined by the Intergovernmental Panel on Climate Change (IPCC) as the combination of sensitivity to climatic variations, probability of adverse climate change, and adaptive capacity. As stated

by the IPCC (Watson et al., 1997), the “*coastal systems should be considered vulnerable to changes in climate*”. In these areas, amongst the most serious impacts of sea-level rise (Nicholls, 1996) are erosion and marine inundation. Thus, the coast of metropolitan France, being composed of 30% sandy coasts, is potentially vulnerable. Within this context, the present paper will give the methodology for the modeling approach to analyze the vulnerability of several beaches on the French coast. Here we will have more particularly a study on a Mediterranean beach. All these studies are involved in the VULSACO project.

The coastal morphology evolution can not be represented with average climatic conditions but need to simulate the extreme events as the storms and therefore, in a long term approach, the morphological evolution is the result of the combination of storm events and calm periods.

The morphological evolution in the near shore region, including its large-scale features, was first investigated using a combination of a commercial 2DH model and a MultiDH model (Camenen and Larroude, 2003, 2003b). Simulation of the wave-driven currents was carried out with Telemac, a finite-volume elements model, and the Sisyphé sand transport module served to compute sediment transport rates and bed evolution. Since the sediment transport in the surf zone is mainly controlled by undertow, an undertow model (based on Svendsen, 1984) was added to account for that process.

These models were used in the framework of a simulated meteorological cycle describing the seasonal evolution of hydrodynamic factors. Results from monthly 2DH evolution simulations show a perfect fit with field data obtained on the beaches in Sete (Certain, 2002). Morpho-hydrodynamic feedback of a bar having undergone reinforcing is also examined. All these assumptions should, of course, be systematically checked, the purpose of the exercise being to assess, through mid-term bathymetric evolution simulation. Then, vulnerability can be studied: the vulnerability of coast/beach will be defined and studied based on in-situ observations and model results will be taken into account as a modulator of the physical vulnerability.

Sea surface temperature and Mekong River discharge estimated by multi-element analysis of coral skeletons from the south of Vietnam

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Tropical climate is one of the most important factors connected with the global climate system. In addition, recent human activity has serious influences on the climate system, as most remarkably manifested as the global warming. On the other hand, we do not have enough accumulation of meteorological/environmental data for understanding the tropical-global connection and anthropogenic influences on global climate. The South China Sea (SCS), especially its southern part, is likely to be one of the most important regions in connection with the global climate system, because it is close to the Western Pacific Warm Pool that generates the world's most active convection, and is also dominated by Southeast Asian monsoon. The meteorological data in the southern SCS are very limited, mostly spanning the past few decades after the late 1970s or early 1980s. To extend the limited meteorological data, a Vietnamese coral sample (*Porites* sp.) with annual bands of AD 1948-2000 was used as archives of the past climate and environment. The annual bands in the coral sample were visualized by X radiography and UV-luminescence photography and confirmed by ¹⁴C measurements detecting a signal of atmospheric nuclear tests in the late 1950s and early 1960s.

The Sr/Ca, Mg/Ca and Ba/Ca ratios in the annual bands were determined at a temporal resolution of about one month, using a high-precision CCD simultaneous ICP-OES. The Sr/Ca time series shows clear annual cyclicity and is mainly controlled by sea-surface temperature (SST). In the coral sampling site, instrumental SST observation has been made since 1980. The instrumental SST data was compared with the Sr/Ca data to establish a Sr/Ca thermometer as follows: $\text{Sr/Ca (mmol/mol)} = 9.905 - 0.03897 \times \text{SST (}^{\circ}\text{C)}$. Application of the thermometer to the whole Sr/Ca time series provides a SST reconstruction from 1948 to 2000. The

reconstructed SST variation shows general correlation with El Niño-Southern Oscillation (ENSO) and a sea-surface warming of $\sim 0.7^\circ\text{C}$ in the latter half of the 20th century. The Mg/Ca time series exhibits indistinct annual cyclicality, indicating that the previously-reported strong correlation between coral Mg/Ca ratio and SST is disturbed by some factors. The Ba/Ca time series shows annual spikes coincident with annual bright UV-luminescence lines. The Ba/Ca spike and the bright UV-luminescence line occur in September to November (the wet season) when seawater salinity decreases to a minimum value. Since the coral sampling site is only 90 km distant from the mouth of the Mekong River, the Ba/Ca spikes and bright UV-luminescence lines may be related with the discharge from the Mekong River. This study is the first attempt in the southern SCS to reconstruct past ocean environment by multi-element analysis of coral skeletons and has demonstrated its usefulness for understanding the environmental changes in Southeast Asia.

Mangrove reforestation as one of the activities to curtail global warming

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The climate change that leads to global warming is becoming one of the important world issues. Continuing increase in atmospheric temperature has led nations, corporations, and individuals to implement actions to try to curtail global warming. One of important innovations has been the development of green house gas emissions trading through which companies, in conjunction

with government, agree to cap their emission or to purchase credits from those below their allowances. Reforestation is one of the activities that can be used for this kind of carbon trading. A case study of mangrove reforestation in Thailand can be used as a successful example of carbon credit.

Mangrove forest areas increased in Thailand during 1997–2004 after a long decline for at least the past 40 years. This mangrove recovery was amounting to the increase of 85,384 ha of forest area. The rate of mangrove forest increase during 1997–2004 was greater than the greatest recorded loss rates during 1980–1986. Mangrove recovery was a result of several efforts for instance the keen public awareness of mangrove forest values, wide spread use of intensive shrimp farming culture technology that no longer benefits from use of mangrove areas, termination of mangrove forest concession by the government, and mangrove reforestation programs supported by both public and private sectors. The Royal Family also strongly supported mangrove preservation and reforestation. Mangrove forest areas in Thailand are expected to continue increasing on the strength of the momentum created by these efforts. In calculating the mangrove recovery back to carbon deposition, this amount of carbon can be used for trading. This activity complies with the concept of clean development mechanisms (CDM) set by the Kyoto Protocol.

Yangtze river 2006: low water discharge and salt water intrusion of extreme drought event

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The year 2006 is currently considered to be the fifth warmest year on record and it's been marked by warmest Autumn in Europe, severe drought in Australia, extreme drought and heavy Exceptional low water discharge had happened over Yangtze River in 2006. Based on meteorological data, historical current & sediment data and the data collected in October 2006 in Yangtze River basin and in estuary, the analyses of exceptional low water discharge characteristics, effect on suspended sediment and the cause of strong salt water intrusion were carried out. The results showed that: 1) 2006 discharge is characterized by exceptional low

during flood time. The maximum reduction of runoff and water level of hydrological stations occur during August and September. Maximum runoff reduction is all beyond 50% and the water level has significant drop at the same time; 2) compared with that in the same time of history, the water-income from Dongting Lake and Hanjiang River is significantly less while the water from Poyang Lake is plentiful which to some extent lighten the severe low discharge in the main stream; 3) the sediment discharge decreased remarkably in the year of low water discharge, and the sediment discharge of flood season at Datong Hydrographic Station is only 19.8% of the mean value from 1985 to 2000. The mean suspended sediment concentration in October 2006 was 0.057 kg/m³ in the middle and lower Yangtze River, being only 20.6% of the mean value in October from 2003 to 2005; 4) the mean suspended sediment median diameter in October 2006 was 4.8 μm , being only 26.3% of the mean value of historic records and 41.8% of the annual mean value recently; 5) the contribution of suspended sediment concentration from Dongting and Poyang Lake to the main stream was greater than that of any other lakes and tributaries, and the contribution of Poyang Lake was greater than that of Dongting Lake. The influence of the suspended sediment diameter from Hanjiang River and Chaohu Lake to the main stream was greater than that of any other lakes and tributaries, while influence of Dongting and Poyang Lake was relatively smaller; 6) the extreme low precipitation and high temperature over upper reaches (especially the area between Pingshan and Yichang) is the main cause of the exceptional low discharge. There is a good relationship between variation of weather and runoff; 7) water storage of Three Gorges Project decreases the October discharge of Yichang hydrological station by 50% and the influential index to the discharge decrease of Datong hydrological station from October to November is 18.7%. 8) mitigate seawater intrusion and safeguard mega-city water supply become a major challenge to Shanghai.

In-situ observation of aggregate sediments and the analysis of the effect factors in the Changjiang Estuary

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The in-situ observation of fine grain sediment size, aggregate particle size, organic matters, metal cations and the related dynamic factors in the Changjiang Estuary were studied in February, 2006 and August, 2006, respectively. The results are shown that 1) the grain size of fine sediments is about 4.2~7.0 μm , while the aggregate size is about 63.2 μm . 2) the biggest aggregate size is about 107 μm occurred when the current velocity is within the range of 0.4~0.7 m/s. 3) the concentration of dissolve organic carbon (DOC) decreases from Xuliujing area to the sea. And there is not obvious phenomenon in vertical distribution. The concentration of particle organic carbon (POC) increases from Xuliujing to the sea. And there is an increased trend of the concentration from the bottom to the surface. 4) the concentration of metal cations was effected by the tidal flow and surface runoff in the Changjiang Estuary. In the Turbidity Maximum, the concentration of metal cations ranged from 40mmol/L to 110mmol/L in the flood season, while from 150 mmol/L to 260 mmol/L in the dry season. 5) the flocculation of fine grain sediments occurred in the combining effects of the sediment size, current velocity, the concentration of the organic matters and the metal cations.

Bengal megadelta environmental parameters in the context of climate change

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Bengal delta with large river basins facing the Bay of Bengal is the largest in the world. It has complex landuse with rivers, canals wetlands, fertile agriculture land, mangrove forests, cities, villages, small islands, ports, fishing harbours etc. A major portion of delta is in Bangladesh and the paper discusses the problems of aqueous delta in east India part. During the last few years the environment has deteriorated due to upstream pollution and sedimentation, disposal of waste change in tidal character, manmade activities, changing agriculture and fishery practice and an unsustainable pattern of development. Due to sealevel rise some small islands have disappeared and there is intrusion of salt water. There is chemical contamination of water also. Unesco

declared a biosphere zone because of rich flora and fauna and suggested some measures like creation of buffer zone, transition area and core area.

A regional environmental study is required with different parameters as the problems can be classified as anthropogenic, natural and biophysical. An at first an inventory of landuse is required and identified vulnerable spots, both tangible and intangible. Different metrix can be evaluated and arranged on the impact of upstream activities, downstream disaster mitigation and adaption to climate change in the context of conservation, environment and development. Various governments have issued landuse and building regulations, identified safety zones and outlined mitigation measures but efforts are haphazard. Restoration of coastal ecosystem is essential. Sediment control reduction of soil erosion, rainwater harvesting and recharging ground water, use of new type of building design to withstand disaster, control of sustainable pattern of agriculture and fishery, development of salt resistant species etc and conservation of forest, coral reefs and mangroves to absorb carbon.

As Kolkata, one of the large megacities is located nearby (as Dhaka is Bangladesh), use of clean and renewable energy, is required with concept of reduce, reuse and recycle, and nowturing of high land low level environment flow. A structure of governance with participatory processes also required together with a holistic environmental plan for the megadelta. Unesco's IPCC report has already assessed impact of climate change and it is estimated that large coastal in areas Bangladesh, India, China will be inundated. Action is required now for integrated coastal zone management with restoration of ecology. The paper identifies parameters to mitigate changes.

CO₂ dynamics in a coastal sea: Seto inland Sea, Japan

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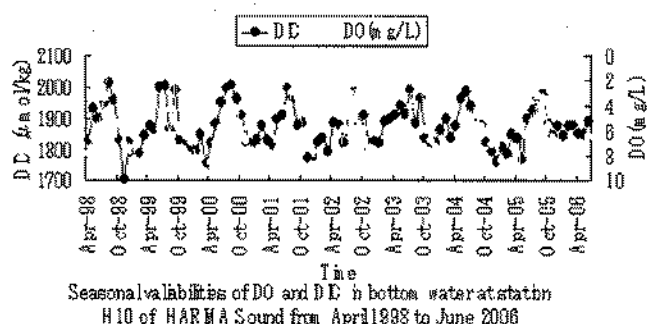
It is well known that the ocean is the biggest reservoir of CO₂ in the global carbon dioxide dynamics. Various CO₂ related data are world

widely collected in CDIAC (Carbon Dioxide Information Analysis Center) and delivered on HP. These data in coastal seas are, however, quite scarce. Relatively wide shelf seas spread in East and Southeast Asia, substantially no CO₂ related data are available in these seas.

In coastal seas, anthropogenic nutrients and CO₂ are converted to organic matter by primary production. This organic matter sinks to the lower layer and decomposes into nutrients and CO₂ at this layer. Dissolved oxygen is also consumed at this time. Therefore, the lower layer water becomes a pool of CO₂ and hypoxic water during stratified season in eutrophic coastal seas. While this process is common to the process that occurs in open ocean in the depth range 0 ~ 500 m. Our observation indicates that the process occurs in ~ 50 m depth range in coastal seas.

To reveal CO₂ dynamics in shallow coastal seas, we have been conducting field observations in the Seto Inland Sea and developing method to measure CO₂ related properties. Levels of dissolved oxygen in bottom waters of HARIMA Sound decreases during the summer every year. Seasonal changes of DIC (Dissolved Inorganic Carbon), DO (Dissolved Oxygen), AOU (Apparent Oxygen Demand), Alkalinity and pH were investigated. DIC concentration in bottom water increases during summer due to the decomposition of organic matter mainly originated from phytoplankton (Bottom figure). DIC concentration decreases during winter due to the vertical mixing and CO₂ is released into the air. Development of hypoxic water is intimately related to CO₂ storage in lower layer and to eutrophication.

In this presentation, we represent necessity of CO₂ dynamics study in coastal seas, especially in Asian coastal seas, where eutrophication is now proceeding.



Influence of urbanization and economic development on Yangtze River intertidal zone sediment

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Concentrations of selected heavy metals in surface sediments from 26 sites within the Yangtze River estuary intertidal zone were studied to understand the environmental impact due to urbanization and economic development in Shanghai, China. The sediment samples were collected between 2004 and 2005 during several sampling events. We found that heavy metal concentrations in surface sediments (0-5 cm) ranged from Al: 40803-97213 mg kg⁻¹; Fe: 20538-49627 mg kg⁻¹; Cd: 0.12-0.75 mg kg⁻¹; Cr: 36.9-173 mg kg⁻¹; Cu: 6.87-49.7 mg kg⁻¹; Mn: 413-1112 mg kg⁻¹; Ni: 17.6-48.0 mg kg⁻¹; Pb: 18.3-44.1 mg kg⁻¹ and Zn: 47.6-154 mg kg⁻¹, respectively. Metal enrichment factors (EF) suggest that individual metal contamination (e.g., Cd, Cu) exists in some localized areas that could be caused by the local point sources. However, the study shows that heavy metals in the intertidal zone are mainly from natural weathering processes in general.

The sediments characteristics of the tidal zone in Tianjin

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36 surface sediments in the tidal zone had been positioned and sampled, and the grain size had been analyzed by the integrated methods. The results showed that the surface sediments in the tidal zone consisted of silty fine sand, fine sand-silt-clay, silt-clay-fine sand, fine sandy silt, fine sand-silt, silt and fine sand. They gradually became coarse grain from the shore to the subtidal zone. Horizontally, the surface sediment grains changed from coarse to fine between Lujia River and Duliujian River. The reason was the outline of the shore changes the water current by building the shore bathing place. Vertically, the sediments were coarse at the bottom and fine at the upper

part, because the coastal freeway had been built and the coastal line was retreated to the sea. These characters were closely related to the mankind activity and the water current changing.

Pollution induced water shortage in the Yangtze River Delta: chances and challenges for wetlands as treatment system

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• Introduction

The Yangtze River Delta is one of the world largest river deltas in the world. It includes the whole Shanghai metropolitan region, southern Jiangsu province and northern Zhejiang Province, with an area of 99,600km²(about 1% of China), and a population of 74 million (about 6% of China). It is one of the most rapidly developing zones in China, even in the world. In 2007, the GDP of this area reached 4667.2 billion Yuan, which accounts for 18.9% of the whole country, with an increase speed of 15%.

The annual average precipitation in this delta is about 1100mm. Yangtze River brings nearly 1000 billion m³ water discharge every year. Therefore, it is "rich" in water theoretically. But, with the quick economic development, pollution induced water shortage has become the "bottle neck" for further economic development in this region.

• Pollution induced water shortage in the Yangtze River Delta

High economic growth rate has attracted large amount of labour flow from outside of the region. Therefore, the real population size is far higher than the registered number. Most of the labours are hired by small enterprises all over the area, such as spinning and dyeing companies, chemical plants, paint factories, and feedingstuff factories, etc. Due to lack of efficient waste treatment facilities and scattered distribution pattern of these small enterprises, water pollution has become a serious problem. The occasional pollution water discharge from upper streams further deteriorates the situation.

Most of the lakes in this delta experience eutrophication problems nearly every year during warm and hot seasons. In 2007, the average total nitrogen and phosphorous in Tai Lake reached 4.0 and 0.13 mg/L, respectively (Hu, 2007), which resulted in the devastating algae blooming in May. Most of the lake water belong to class level IV, V,

or even worse, according to the National Water Quality Standard (GB3838-2002). Although strict environment protection strategies have been implemented by the central and local governments, the level of N and P remains high due to lack of removal techniques in the water treatment plants, as well as long term accumulation in the sediments. Rivers and canals are even worse, especially in the urban sections. Water body is black and smells bad, and therefore belong to level V or worse. In the Northern Zhejiang Province, 84% of the river water is not suitable for drinking. In the catchment of Tai Lake, 80% of the rivers are polluted, with 60% of the water undrinkable. The major pollutant species are BOD₅, COD-Mn and volatile phenol (Chen 2001, Wang 2002). Inland water pollution has resulted in the "red tide" and low oxygen area in the coastal area of East China Sea. Habitat for some rare fish species has been destroyed or fragmented at the estuary of the Yangtze River. Pollution induced water shortage will not only smother the life in water, but also smother the economic growth in the Yantze river delta, if measures are not taken in time.

• Chances for wetlands as treatment system

The southern part of the Yantze River Delta is famous for its low land with plenty of water and has gained the name of "Shui Xiang", which means "land of water" in Chinese. It has numerous lakes and ponds with criss-crossing rivers and canals connecting them. The main functions of the lakes/rivers in the Yantze River Delta are for water regulation against flooding and drought, water supply for agriculture, industry and drinking, or aquaculture. Many water plants, such as water bamboo (*Zizania latifolia*), lotus (*Nelumbo nucifera*), water shield (*Brasenia schreberi*), and chufa (*Eleocharis tuberosa*) etc., are harvested as vegetables for the local people. Paddy field is another type of artificial wetland that has existed here for thousands of years. There is a great potential for using wetlands as "treatment system" for cleaning up the water in this region. Several demonstration projects on wetland treatment systems have been launched and showed the possibility of water purification with wetlands. A total area of 200 km² wetland parks have been built in the delta in the last 3 years, for the protection and demonstration of importance of wetland functions. The local people are willing to clean up the lakes and rivers after so many years of tolerance of spoiled water. But, establishing new wetlands specially dedicated for water

purification is difficult because the land is very intensively used in this region.

• Challenges for wetland treatment system development

Although the wetlands in the Yantze River Delta occupying almost 80% of the area, and being used for thousands of years, the idea of using wetlands as treatment system for polluted water has rarely been taken into account, especially in those wetlands used for aqua-/agricultural products. How to make full use of the wetlands in this region and convince the local people to accept the idea of using their paddy fields and lakes/canals for water purification remains a challenge. The main problems concerning the use of wetlands as treatment system include: Will it increase the cost, or lower down the benefit from wetland outputs? How to deal with the biomass if strong nutrient absorption species are introduced while they have lower economic value? What if secondary pollution happens caused by concentration of heavy metals by wetland species? How to deal with the increasing waste water from economic development in the future? Or, all in one question: Is it possible to use the existing wetlands as treatment system to solve the "Pollution induced water shortage" problem in the Yangtze River Delta? And How?

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The Changjiang sediment flux/load into the seas: measurability and predictability

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This paper challenges the credibility and predictability of sediment flux/load of the Changjiang River entering the seas in the past decades. The assumption of the study is that missing suspended sediment concentration (SSC) during peaking flood period is much likely, while considering the historical observational method (30-50 times a year) applied to Datong

hydrological gauging station. This insufficient method that obviously did not cover the peaking SSC during peaking floods, would result in an inaccuracy in estimating the Yangtze sediment flux/load into the seas, ranging from 4.7×10^8 t/a in 1950s to $< 1.0 \times 10^8$ t/a, presently. Also, sediment depletion that often takes place in the upstream Changjiang basin has, to some extent, degraded the credibility of sediment rating curve that has been widely used for sediment budget estimation. Herein, a newly established sediment rating curve is proposed to simulate the sediment flux/load into the seas by using those SSC only under 60,000 m³s⁻¹, the discharge threshold that is significantly correlated to SSC. Since discharge of 60,000-80,000 m³s⁻¹ often links to extreme floods and to sediment depletion in the basin, un-incorporating SSC under 60,000-80,000 m³s⁻¹ into the sediment rating curve will increase the credibility for estimating sediment flux/load. Using sediment rating curve of the present study indicates the sediment load of 3.3 - 6.6×10^8 t/a to the seas in the past decades. Also, our analytical result shows a lower sediment flux pattern in 1950s, but higher pattern in 1960s-80s, which was closely associated with the changes in land-use in the upstream Changjiang basin, including devastated deforestation during the middle 20 century.

Population structure of *Pinus thunbergii* coastal protection forest and its spatial variation at different distances to coast in Yantai Region

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In order to characterize the age structure and spatial variation of the *Pinus thunbergii* coastal protection forest, 42 plots (10 m × 10 m) were investigated in Yantai Region. All the trees were identified, measured and tagged by sampling method. With the method of spatial sere substituting for time sere, by trunk size structure in place of age structure, the structure of *Pinus thunbergii* population was studied. According to different distances to the coast, the spatial variation of *Pinus thunbergii* population was analyzed. The *Pinus thunbergii* population has reverse-J shaped DBH class. It seems that the population is a stably developmental one with sufficient recruitment. Outstanding correlation

relationships between the growth status of *Pinus thunbergii* and its population density are found. There are negative exponential relations between population density and diameter, individual biomass, respectively. And tree height significantly correlates to population density negatively. The density effects of *Pinus thunbergii* population can be explained by the regeneration difference among different stands. From 50 to 500 m distance to coast, the population density of *Pinus thunbergii* increases and its mean diameter, tree crown degrade with distance to the coast. The spatial distribution of *Pinus thunbergii* population is mainly attributed to the environmental heterogeneity caused by sea-land interactions.

Seasonal variability of saltwater intrusion in the Pearl River Estuary

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The seasonal variability of estuarine circulation, salinity stratification and saltwater intrusion in the Pearl River Estuary (PRE) were investigated in the study by a three-dimensional numerical model. The model was calibrated against with observed data during December, 2007 including salinity, current velocity and surface elevation. Some model experiences representing seasonal varying river discharge in different seasons were conducted. The model results shown that the PRE was dominated by a two-layer circulation with seaward current at surface and landward current at bottom. The saltwater intrusions in the PRE became worse during winter (dry season) and slight during summer (wet season). The differences of saltwater intrusion between spring and neap tide periods in winter and summer were studies as well. In winter, saltwater intrusion during neap tide was stronger than that during spring tide in Modaomen Inlet, however, saltwater intrusion was weaker during former period than that during latter period in Humen Inlet. The circulation and salinity stratifications in Modaomen Inlet shown that the gravitational circulation was strengthened due to the stronger stratification during neap tide that brought more saltwater landward in winter. But the circulation in the Humen Inlet was dominated by tide-induced current in this dry season indicated that saltwater intruded landward more easily during

spring tide period than that during neap tide. On the contrary, saltwater intrusions were weaker and stronger during neap tide period than spring tide period in the Modaomen and Huemln inlets in summer, respectively. The model results indicated that the current was controlled by seaward current driven by river discharge in Modaomen Inlet rather than the gravitational circulation and tide-induced current due to this large river flow during neap and spring tides period in summer. However, the gravitational circulation in Humen Inlet was strengthened due to the strongest stratification during neap tide in the wet season.

Vegetation and the sedimentary patterns in various environments along the drainage area of the Red River, Vietnam

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The evolutions of delta and estuarine are firmly correlated to the water and sediment discharge of rivers, on which vegetation, climate, and human activities impact along the drainage area. The Red River, one of the large rivers in the Asian monsoon region, is necessary to know the sediment patterns relating to the various environments along the river. Data from 76 sampling stations in the field investigation, including vegetation, sedimentary environment, soil, physiognomy, and data of palynological, magnetic parameter and grain size analyses on samples in laboratory were compiled and analyzed to know the potential effects of vegetation, climate and human activities by the cooperated group of China, Japan and Vietnam. This paper specially summarized the results of the parameters of vegetation compositions, topography, magnetic susceptibility and grain size to show how the vegetation impacts on the sediment in various environment conditions.

The vegetation and sedimentary patterns clearly distinguished three basic subsystems along the drainage of the Red River, including the mountainous areas, the channel-floodplain-bank

of river and the delta plain-flat. In the subsystems of mountainous areas, the primeval vegetation distributes in vertical zones although it was intervened. There were tropic rain forest, monsoon rain forest, upland rain forest, subtropical evergreen broad-leaf forest, mountainous mossy forest, temperate broad-leaf forest, coniferous and broad-leaf forest, mountainous shrubbery and grassland from the bottom to the top of mountains. Pollen assemblages are well corresponding to the main components of forest in vertical zones. Both of total organic content and magnetic susceptibility in the surface sediments are highest in this subsystem. In the subsystem of channel-floodplain-bank of river, vegetation is characterized by hydrophytes and swamp plantgrass and shrub with scatters of tropical forest. The pollen assemblages in the different reaches reflected that river plays a more important role than wind in pollen dispersal from the upper reaches to the estuarine. In the subsystem of delta plainflats, vegetation includes the swamp forest and mangrove. Pollen assemblages of the surface sediments from this subsystem and the submarine delta can indicate that the hydrodynamic conditions highly co-effects on the pollen distribution with both local and regional vegetations.

In addition, great mounts of bamboo, pine forest and grassland contribute to the major secondary vegetations of those burned forests under which the soil shows the highest magnetic susceptibility. That means the large difference of magnetic susceptibility in the mountainous areas is not only related the vegetation effects but also the human activities with fires. Coherent to the more terrestrial sources, magnetic susceptibility in the channel-floodplain subsystem is also obviously higher than that in the flats and the predelta-shelf subsystem.

New foundations for restoration and adaptive management in the Chesapeake Bay watershed

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The thirty-year effort to restore Chesapeake Bay has generated numerous scientific advances and new models for regional management of coastal resources. However, increased pressure on the watershed from a population that now exceeds 16

million residents continues to impair ecosystem health and slow the progress of restoration efforts. Growing frustration on the part of the general public and policymakers has sparked calls for a greater focus on accountability and performance-based adaptive management to justify the large public investment. The scientific and management communities recognize the need for new approaches to address these challenges. Experience suggests that efforts must be better targeted, supported with an appropriate level of funding and administrative infrastructure and linked in an interdisciplinary manner. Among several examples of integrated approaches to management in the Chesapeake watershed, we focus on three specific efforts each is an attempt to build a new foundation for adaptive problem solving in an ecosystem context.

Understanding thresholds. Most scientists acknowledge that the Bay is unlikely to respond to restoration efforts in a simple, predictable manner. Instead, the Bay will cross certain ecological thresholds that may cause quick changes, either for worse or for better. One example of a threshold response is the catalytic growth of underwater grasses in response to improved water clarity. A new initiative has started to bring scientists and managers together to examine such nonlinear or threshold events and to help develop new predictive tools to monitor recovery, manage public expectations, and maintain a clear and confident approach to restoration.

Managing fisheries. Management of economically and ecologically important Bay fisheries has become increasingly more complex. The completion of a fisheries ecosystem plan for Chesapeake Bay has catalyzed an effort to implement regional ecosystem-based fisheries management. Success will depend on strong scientific analyses from a diverse array of participants and stakeholders to provide decision support tools for fisheries managers, tools that integrate factors extending across biological, geographic and socioeconomic boundaries. Success will depend on an inclusive structure that yields credible policy recommendations that managers can translate into tangible actions.

Building local capacity. The success of watershed restoration depends on decision making at the local level. On-the-ground solutions that result in measurable improvements in water quality and wildlife habitat on a small watershed scale will ultimately build the foundation of Baywide restoration. A new initiative is underway to develop a sustained interface between

communities and relevant knowledge and technical service providers in the public, non-profit and academic sectors. The goal of this undertaking is to build needed capacity for land use planning, implementation of best management practices and watershed restoration where it can be most effective.

From the pursuit of a new scientific understanding related to ecological thresholds to a new structure to facilitate ecosystem-based scientific input to fisheries management to capacity building for watershed restoration at the community level, these three efforts are collectively building a new generation of interdisciplinary, adaptive management approaches for the Chesapeake watershed.

Phytoplankton species succession in Tokyo Inner Bay under global warming using experimental microcosm system

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Global Warming is one of the most important environmental problems because of its serious effect on the ecosystem structure including the energy flow, the material circulation and the biological interaction. IPCC reported in 2007 that 40% of all wildlife species on the earth will exterminate with 4°C increasing in atmospheric temperature. However, the basic information for the relationship between Global Warming and biological species succession in aquifer has not been enough to establish the countermeasure in both academic and administrative. For this reason, the experimental data is much important to be obtained sooner and numerously.

This study was conducted to investigate the effect of temperature on microbial community structure, especially phytoplankton flora which plays important roles on aquatic ecosystem as primary producer, using the experimental flask-size microcosm system. The experimental microcosm system is filled with sea water and sediment that sampled in spring season from Funabashi port in Tokyo Inner Bay, Japan. The glass culture vessel is 480 ml volume, and was pored 100 g(w/w) of sediment and 380 ml of sea water. that contains nutrient salts and zoo and phytoplankton. The microcosm culturing was conducted under 20,000 lux(L/D=12/12 hr.), without stirring, and the

incubate temperature was set up to 10°C (lower), 20°C (usual) and 30°C (higher). Quantity and quality analysis of phytoplankton was conducted with microscopic observation for 60 days culturing period.

The results obtained can be concluded as follows;

1) The dominant species was different in each temperature condition within the same sea water, and water bloom (red tide) was observed under high temperature conditions.

2) *Heterocapsa rotundata*, *Thalassiosira* spp. and *Skeletonema costatum*, some of which produce toxic matter, were dominant under high temperature conditions, and the possibility of occurrences of some trouble was suggested in water use for human society.

3) The common species of phytoplankton such as *Skeletonema costatum* in each microcosm indicated high specific growth rate in high temperature conditions.

4) Bio-diversity was lower in both high and low temperature conditions from the viewpoint of the Shannon Index (H') analysis.

5) Temperature increasing influences to ecosystem structure as same as temperature decreasing from the viewpoint of the Nomura-Simpson's coefficient (NSC) analysis.

Effects of climate change on long-term and seasonal variations of the water temperature in Seto Inland Sea

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The Seto Inland Sea (SIS) located in the western part of Japan is connected to the western Pacific Ocean through two channels: Bungo Channel in the west and Kii Channel in the east. The meteorological and oceanographic data with high temporal (~monthly) and spatial (~km) resolutions have been collected over the past few decades around the SIS. To assess the impacts of climate change on the coastal sea, the spatial and temporal variations of air and water temperatures around SIS were examined by historical data and numerical model. The air temperature has increased about 1-2°C due to the global warming and progress of urbanization irrespective of the season. On the other hand, the long-term variation of water temperature in SIS has the seasonal

dependence over the past 29 years (1972-2000). The water temperature has positive trends (1~3°C) during autumn-winter and negative trends (-1~-3°C) in spring-summer at the surface and the bottom, although the water temperature in the offshore (the southern part of two channels) has positive trend (1~2°C) at the surface and has negative trend (-2~-4°C) at the bottom over the past 30 years, irrespective of the season, associate with changing patterns of the Kuroshio current affected by offshore climate changes. The opposite trends in winter and in summer mean the decrease in seasonal amplitude of water temperature caused at the shallower region in SIS. These primary factors were investigated by using numerical model, the Princeton Ocean Model, in a rectangular basin with a constant bottom slope and an open boundary. The effects of global warming on the seasonality of water temperature were estimated by the difference between two results calculated from past (-1°C) and present (+1°C) seasonal variabilities of the air temperature. Moreover, the effects of decreasing of offshore bottom water temperature on the seasonality of water temperature were also estimated by the difference between two results calculated from past (+1°C) and present (-1°C) offshore bottom water temperature. The vertical averaged water temperature indicated positive trend by vertical diffusion and indicated negative trend by advection over the course of the year. The negative trend in summer was strongly dependent on the advection due to the weakening of the warm water intrusion especially during spring. The positive trend in winter was strongly dependent on the diffusion due to the strengthening of the heat flux especially during autumn. The negative trend in the offshore bottom temperature caused negative trend of water temperature in SIS due to bottom intrusion of cool water from spring to autumn. These results suggest that the global warming causes decrease in seasonal amplitude of water temperature in SIS. In addition, the negative trend of offshore bottom temperature causes decrease in the water temperature and in its seasonal amplitude in SIS.

Is *Nodularia* a possible new toxic cyanobacteria in Yangtze delta-estuarine system as a result from the Three Gorges Dam construction and global warming?

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It is obvious that the Three Gorges Dam as well as global warming can lead to salinization of Yangtze delta – estuarine waters and as a result to changes of species composition in these waters. One of the problems following from it is a new for China species of toxic microalgae and cyanobacteria forming blooms. We don't analyze this problem as a whole, we only explain why we think that *Nodularia* is one of the main candidates to be new toxic blooming cyanobacteria in Yangtze delta – estuarine waters. *Nodularia* is filamentous, dinitrogen (N₂)-fixing cyanobacteria that forms massive blooms in some marine coastal waters, lagoons, estuaries and saline lakes worldwide [1,2,4,6], but not in China [R.Li, pers. com.]. It is a halotolerant – from fresh to hypersaline waters [1,2], we found it under salinity to 190 psu.

Nodularia cells produce hepatotoxin nodularin [1,3,4]. Its blooms have caused numerous cases of animal poisoning with damage for human health, fishery, aquaculture, agricultural animals in different countries [5]. Using our own experimental and field as well as published data we base our conclusion. *Nodularia* can be transported in Chinese waters with atmospheric mass (aeroplankton) and with ballast waters.

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Estuary runoff changes under global change: a case study of Five-Dragon River Basin in Shandong Peninsula

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Long-term estuary runoff change is a typical indicator for impacts of global changes on coastal areas. It's well-known that climate changes and human activities are the most dominant factors or elements of the global changes. And lots of case studies have revealed that the precipitation changes, as well as the Land Use and Land Cover Changes (LUCC) have been played the leading roles for the long-term variations of estuary runoff. However, impacts of global changes have remarkable spatial variations, and there are various differences between mid-small scale coastal river basins and macro-scale river basins, such as the hydrological rhythms, the aquatic environment, the aquatic ecosystem, as well as their threshold characters and temporal-spatial variations. Therefore, more and more studies have put emphasis on mid-small scale coastal river basins in recent years. In Shandong Peninsula, most of the rivers flowing into bays or gulfs are mid-small scale coastal rivers, which have no more than 200 kilometers of channel length and no more than 5000 square kilometers of river basin area. In this paper, Five-Dragon River Basin, which is a typical coastal river basin in Shandong Peninsula (Fig.1), was selected as the case study area. First, multi-resource dataset including remote sensing image, land use map, climate data, soil map, in-situ hydrological measurements data, and so on, were integrated by the Geographic Information System (GIS) techniques. Next, in order to reveal the trend of estuary runoff variations under climate change and LUCC in the past decades, the annual estuary runoff were simulated mainly based on GIS techniques and the SCS curve number method. The results showed that, 1) the annual precipitation and the estuary runoff in the study area has shown a remarkable downtrend respectively in the past 50 years. And

it has been the dominant characters of land use changes that forest, grassland and un-used land has greatly decreased while urban built-up area has acutely increased. 2) The annual precipitation decrease and the land use changes have made and will go on making great impacts on runoff depth of coastal river basins as well as their estuary runoff. 3) In the past decades, the precipitation change has been the leading factor influencing runoff depth all over the river basin as well as the estuary runoff. 4) Land use change has been a significant disturbing factor for the estuary runoff because it has caused the spatial and temporal variations of runoff depth all over the whole river basin. Further, impacts of land use changes on estuary runoff have been gradually enhanced in the past decades.



Fig.1 Locations of the Five-Dragon River Basin

Driving force of wetland change under rapid urbanization and environmental changes: a case study of Tianjin, China

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The driving force of wetland change is an important issue in wetland science. This paper analyzed the driving force of wetland change resulted from natural factors and human factors in Tianjin. Firstly, land use/cover change and landscape parameter in 1977, 1993, 1998, 2006 was conducted by remote sensing and Geographical

Information System techniques. Secondly, in order to explore the human influence on wetland, soil, water and atmosphere quality in different human-pressure zones was analyzed. Thirdly, based on climate change analysis and local social statistics, the driving-force of wetland change was probed under background of rapid urbanization and population growth. Results show that land reclamation started in the 1970s is the main driving-force of wetland change at large scale, which resulted in the increase of agricultural land and the decline of wetland. Landscape structure and biogeochemical characteristics of wetland has experienced enormous change with different disturbance induced by human activities. Natural factors are immanent cause of wetland change while man-induced factors have accelerated the change. Human factor has overlapped the natural factor and generated amplified action. Although the study area show obvious and long-range climate warming and natural factor can influence wetland change in long period, the extent affecting change is limited. Comparing with natural factor, Human activities served as the intensity of driving force is evident excess of natural factor. In order to keep the harmonious status between human and nature, feasible countermeasures on how to keep ecological balance so that good conservation benefits of the nature reserve and economical development can be achieved. This research is a part of Projects 40671001 & 40830746 supported by National Natural Science Foundation of China. The authors acknowledge the support.

Environmental vulnerability to sea level rise

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A key consequence of global warming is sea level rise (SLR). This could endanger the world's most populated and highly urbanized coastal areas. High use of fossil fuels and gases in such regions can alter existing climate and create corresponding new microclimates. This study proposes an approach that highlights natural and anthropogenic parameters that influence SLR, and also characterize environment of the area of study. Vulnerability of coastal areas to SLR and its potential increase is assessed for any coastal areas as regards the worst world situation

considered as the reference or the comprehensive global value. To demonstrate the feasibility of this approach, coastal regions from varied locations of the world have been considered. The results lead to a prioritized list emphasizing areas having maximal environmental coastal vulnerability to SLR vis-à-vis the general world data. The results lead also to ancillary conclusions as regards measures to be taken for development of the requisite monitoring, analysis, and decision-making towards mitigating adverse SLR impact upon specific coastal locations throughout the world.

Morphological and hydrodynamic changes of the Oum Er Bia Estuary, Morocco

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The Oum Er Bia, is a small estuary system located in the north portion of the El Jadida Bay, NW Morocco, is under the influence of important anthropogenic activities. It is about 7 km along the estuarine axis with the average width about 1 km; with the average depth is about 3 m. Since 1980, a small dam located in the upper part of the catchments area (Sidi Daoui) started to store water from the river. Furthermore, recent climatic changes, characterised by severe drought during 1996 and 1997, have decreased river discharges, enhancing the influence of tides on the water estuarine flow. All these climatic events and human manipulations lead to a change of sedimentation rate in the estuarine area. Thus, a refined method must be applied in order to describe the sediment accumulation in this estuarine system and to show anthropic impacts. Since 2003, significant volumes of sediment were being dredged in the estuary. Dredging changes the morphological and hydrodynamic regime and the system tends to search for a new equilibrium; this results in erosion in some locations and siltation in others. This paper describes an analysis of historical bathymetric survey data and the use of hydrodynamic modelling, to evaluate whether dredging has influenced the large-scale estuary morphology or impacted on the ecological habitat or hydrodynamic regime.

Bathymetric data collected, with echosounder, between 2003 and 2007 (every 6 months), were analyzed to identify regional patterns of accretion and erosion, and to quantify changes in channel geometry and sediment volume. The paper survey records were digitised, geo-referenced and standardised to the modern datum and units. Both sets of data were re-contoured and analysed using a GIS package. Comparisons between 2003 and 2007 hydraulics were made using a 2D hydrodynamic and sediment transport model set up for the bathymetry at those times but 'driven' using a single, common, year-long data set for tides and river flows.

Results showed that the surface area of intertidal mud in the estuary appears to have increased by only 5-6 % and the positions of the drying lines (0 m contour) have not changed significantly over the century. The volume of water below low water has increased over the same period through channel deepening and this was broadly consistent with a first order budget of sediment inputs and spoil removal. The changes in channel cross-section were generally small and there was no significant difference in the overall modelled hydrodynamic regime of the Oum Er Bia between 2003 and the present. These results suggest that although the navigational channel is, on average, 4 m deeper in 2007 than it was in 2003, this has had an effect on the large-scale hydrodynamics of the estuary and minimal impact on the area of intertidal habitat.

Geomorphological response of the Noirmoutier Island to sea-level rise and anthropic impact

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Natural and anthropogenic factors such as sea level rise, storm events, dune occupation or coastal engineering actions, often produce changes in tidal inlet conditions. Background knowledge of tidal behaviour and evolution is therefore needed to understand and predict the consequences of engineering actions or extreme

natural events. The long-term behaviour of islands depends on the rate of the sea-level rise, on the sediment supply and on the hydrodynamic forces related to wave climate and tidal dynamics. Anthropogenic influences, e.g. coastal protection measures, may also interfere with the islands evolution. The aim of this paper focused on the study of coastal morphology and evolution with particular interest in the factors controlling changes of sea level and climatic signals recorded in coastal deposits in Noirmoutier Island.

The Noirmoutier Island is located in the western portion of the French coast. The climate is dry in summer and rainy in winter. The average annual rainfall is 611 mm. The island is always windy but the wind force is stronger in winter. The coast of the Noirmoutier inland can be described as semidiurnal macrotidal with mean tidal ranges of 3.4 m. The storm surge deposits recorded in the Noirmoutier island marsh and surrounding area would appear to represent surge magnitudes similar to modern day surges, although for reasons of preservation potential, it is unclear whether the frequency of surges has changed during the late-Holocene. Holocene relative sea-level change along the Brittany coast is characterised by an almost continuous rise from - 110 m NGF to its present position, with three short periods of negative tendency at around 10,000 BP, 4000 BP and 3000 BP. The historical morphological development of the region has been influenced by a sea-level rise of ca. 0.5 m per century.

The analysis of coastal evolution over a period of 172 years (Historical shoreline evolution), was carried out using map (Cadastre Napoléonien 1832) and ten, well temporally spaced, photogrammetric flights. Most of the Noirmoutier littoral, over historical shoreline evolution, recorded erosion, while accretion has been recorded over recent years in the southern part (Barbatre commune). Coastal erosion was related to the impact of several storms and dune accretion was linked to the action of eastern winds.

Beach profiling was a very useful method for obtaining short-temporal changing trends. The methodology adopted allowed measurement of dry beach width variations by always using a constant, average value of the mean sea level position derived from the numerous surveys carried out. Results showed erosion in most of the Noirmoutier littoral especially in the northern part (-63000 m³ Epine coast) and accretion in the southern part of the studied littoral, was related to the periodical transfer of sediments. The beaches examined in this study react to meteorological conditions in many different ways.

Session - 2

**Policies to address ecological and social risks
in an Integrated Coastal Management framework**

Heavy metals distribution on the Nile Delta Coast: a review emphasizing the eco-environmental challenge after Aswan Damming, Egypt

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The Nile Delta coast along the southeastern part of the Mediterranean Sea is featured by 4 lakes, from east to west, are: Manzalah, Burullus, Edku, and Mariut. The levels of pollution in these lakes are Lake Mariut > Lake Manzalah > Lake Edku > Lake Burullus.

For the purpose of coastal conservation and environmental development of the Nile Delta region, multipurpose projects are being carried out as to face the eco-environmental challenge particularly after Aswan Damming. Government strategy is directed towards promoting environmental collaborative projects (e.g., climate change, geomorphology, hydrogeology, hydrogeochemistry, soil geochemistry) such as the Seventh European Framework Programme (FP7) and the current Egypt-China project.

Erection of the Aswan High Dam (AHD) in 1964 was accompanied by a considerable increase in population and consequently in man's activities, mainly in agriculture and industrialization, constituting the main causes of pollution in the Delta wetlands. Major power-based industries were developed after the completion of the AHD power station in 1970. These industries have discharged untreated metal-bearing wastes into the Nile Delta drainage network.

The most important heavy metals from the point of view of water pollution in the Nile Delta lakes are Zn, Fe, Cu, Mn, Cd, Pb, Hg, Ni and Cr. Values of contamination factors showed that Cd is the major pollutant to cause relatively high pollution load in all Nile delta lakes, while Fe and Mn are the least metals to influence the pollution load. Moreover, computing ratios of some heavy metals to Fe revealed a Cu enrichment in lake Manzalah and a Zn enrichment in Lake Mariut.

The mean post-1960 sedimentation rates (0.2 and 0.21 cm yr⁻¹ for Manzala and Burullus, respectively) calculated from records of fallout

Pb, Cs and radionuclides, including macrofossil and pollen are significantly lower than the pre-1960 values (0.51 and 0.39 cm yr⁻¹ for Manzala and Burullus, respectively). These results suggest a significant reduction in sedimentation rates after ca. 1960 which is probably attributed to reduced sediment inputs as a consequence of the end of Nile floods following construction of the Aswan High Dam.

The coastal aquatic environment and its water quality is becoming the main concern for social development in a close association to health security through food chain, nowadays. Heavy metals are signatures of diseases in the northern Nile Delta region (e.g., renal failure, cancer, liver diseases). Pancreatic cancer patients in East Nile Delta, for example, revealed significantly higher serum cadmium levels than control subjects. In order to increase the opportunities of socio-economic development the environmental-protection policies such as legislation, standards, criteria, waste minimization, effluent treatment, monitoring, education and public awareness should be enforced.

Artificial reefs as the tool of handle of processes in coastal ecosystems

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Now artificial reefs are considered as the effective tool of handle of ecological processes in coastal ecosystems of the sea [1-5,]. In lab of an Ecological metabolism of Institute of Biology of Southern Seas (Sevastopol, Ukraine) is accumulated wide experience in constructioning and in multipurpose usage of artificial reefs [3-17]. In the report the theoretical and practical aspects of constructioning and usage of reef constructions of different reserving are considered.

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NetArea common platform for integrated Catchment-Coastal management

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Intensification of integration processes in the catchment and coastal areas results in the fact that effective cooperation of all industrial and agricultural enterprises and municipal organizations, engaged in coastal and catchment ecosystems resources management in the respective catchment-coastal area, becomes and important advantage in the competition. Economic activities in coastal and watershed areas become ever more intensive. At the same time, information structure of integrated catchment-coastal management becomes more and more expanded. But the expansion alone does not mean development. Informational dissociation of systems, used by individual enterprises operating in the contact zone, and the absence of coordination thereof hamper timely implementation of up-to-date technologies. In this respect, NetArea platform is developed to create unique common media for integrating all resources in the system of integrated catchment-coastal management. This can be achieved due to the flexibility of the system and possibility of introducing necessary changes therein, which also allows us to use the available resources effectively and decrease their cost.

The proposed NetArea information platform is a system of a new generation, making use of the advantage of up-to-date service-oriented architecture. The system is not just a set of individual instruments intended for communication; it is a common information platform. The possibility of integrating any applications on the basis of the available open

standards and numerous specially developed adapters for integrating applications, that cannot support open standards, makes the proposed platform a unique means of effective informational support of any engineering solutions or managerial decisions.

The implementation of NetArea platform provides:

- a new level of communication and interrelationship between people, information flows, and economic processes, increasing the efficiency of business, which can now be organized in the common information field;
- new possibilities for effective cooperation with business partners due to optimization of economic processes - both within and outside the catchment-coastal zone under consideration;
- possibility of developing new multifunctional processes on the basis of the existing diverse schemes;
- quick implementation of innovative solutions, permanent improvement of the process, which becomes possible due to simplicity and safety of introducing any changes in the system;
- new functional options provided by simple implementation of new strategies and use of outsourcing;
- a higher level of capital investments profitability ensured effective investments in the IT sphere, its achievement being important for the management process.

NetArea information platform was tested for individual sections of the Russian catchment-coastal area, where oil is intensely produced. The trial NetArea operation allowed for the increase in the competitiveness of economic objects operating in the zone in question.

✓ Estuarine and coastal zone ecohydrology

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The successful management of estuaries and coastal waters requires an ecohydrology-based, basin-wide approach. This necessitates getting away from present practices by official institutions based on municipalities or counties as an administrative unit, or the narrowly-focused approaches of managers of specific activities (e.g. farming and fisheries, water resources, urbanisation, shipping, wetlands management and recreation). Without this change in thinking and management concept, estuaries and coastal waters

will continue to degrade, whatever integrated coastal management plans are implemented. This is demonstrated in my 2006 Springer book "The environment in Asia Pacific harbours" for twelve mega-cities and harbours in the Asia Pacific region, including Shanghai and Hong Kong. Ecohydrology is neglected and the best of engineering practices have failed to provide a healthy environment to 100 million people.

To help foster this change, UNESCO-ROSTE and a number of agencies supported

(1) the implementation of ecohydrology in the planning of human activities in watersheds draining estuaries,

(2) the development of an estuarine and coastal waters ecohydrology model.

The aims were to

-base the model on the dominant estuarine ecohydrological processes,

-Keep the model simple but realistic,

-to use the model to study scenarios of impacts in the estuary of developments in the watershed on the estuary, its fringing wetlands, and its coastal waters

-enable an interaction between scientists, economists, and the public and decision makers to enable decisions based on ecohydrology principles. Examples extracted from my 2007 Elsevier book 'Estuarine Ecohydrology' will be shown for - Darwin Harbour, Australia

- estuaries in Palau and Pohnpei (Micronesia)

- the Great Barrier Reef of Australia

- the Guadiana Estuary, Portugal

as well as a new study of remediation for coral reefs in Hawaii.

Limitation of nutrient loading to the Baltic Sea

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Marine eutrophication is now becoming a world-wide problem. Eutrophication is the most environmental problem in the Baltic Sea to be solved by the HELCOM Baltic Sea Action Plan. Effects of eutrophication such as cyanobacterial summer blooms and extensive bottom water hypoxia are now more pronounced than ever before. Nutrient pollution does not recognize state borders and nutrient inputs from one country eventually affect the marine environment of all other countries. The purpose of research consist in a substantiation of quotas on anthropogenic nutrient loading the unfiltered phosphorus to sub-

regions of the Baltic Sea from catchment areas of the countries of the Baltic Sea. Research has consisted of four stages. At the first stage annual average loading of unfiltered phosphorus to various sub-regions for the period since 1997 to 2003 have been calculated (Table 1). At the second investigation phase according to our hypothesis the following exponential equation has been found:

$$Q = \exp(6.94 + 8.07 \cdot \beta) \quad (1)$$

Where β is part of the area of the given drainage area from the area of all catchment areas of the Baltic Sea.

At the third investigation phase under the formula (1) values of the unfiltered phosphorus input to the Gulf of Finland from the catchment areas of different countries have been calculated (Table 2).

At the fourth investigation phase the following principle of limitation for nutrient reduction to the Baltic Sea has been formulated: quota (Δ) of nutrient reduction of the given country should be in direct proportion to the part of the catchment area of considered country (β) from the common area of all countries of considered water area (D): $\Delta = \beta D$ (2)

According to the HELCOM Baltic Sea Action Plan to reach good environmental status of the Gulf of Finland it is needed phosphorus reduction on 2,000 tonnes, and nitrogen reduction on 6,000 tonnes (Table 3).

Table 1 Average loading (L) of unfiltered phosphorus to various sub-regions of the Baltic Sea

Sub-region	Q, tonnes	F, km ²	L, gP/m ² a	Sub-region	Q, tonnes	F, km ²	L, gP/m ² a
Gulf of Finland	6,860	29,498	0.233	Danish straits	1,410	20,121	0.070
Gulf of Riga	2,180	17,913	0.122	Kattegat	1,570	22,287	0.070
Baltic Proper	19,250	209,930	0.092	Bothnian Bay	2,460	79,257	0.031
Bothnian Bay	2,580	36,260	0.071	Q input, F water area			

Table 2 Input unfiltered phosphorus to the Baltic Sea from catchment areas of different countries

Country	β	Q, tonnes	Country	β	Q, tonnes
Russia	0,160	3,761	Estonia	0,015	1,168
Finland	0,062	1,706	Latvia	0,002	1,051

Table 3 Distribution of quotas (Δ) for nutrients reduction in the Gulf of Finland

Country	Catchment area, D, km ²	β	Δ (unfiltered phosphorus), tonnes	Δ (nitrogen), tonnes
Russia	276,100	0,669	1,338	4,014
Finland	107,000	0,259	518	1,554
Estonia	26,400	0,064	128	384
Latvia	3,400	0,008	16	48

Greener hydropower by paying for ecosystem services

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Coastal environment is influenced by both oceanic and terrestrial processes, it has been commonly agreed to integrate watershed activities so as to improve coastal management. River is one of the most important physical

links between upstream watershed and downstream coast; therefore, water resources exploitation will have great influence on coastal environment. Hydropower exploitation, as a popular development approach, used to be regarded as clean energy, actually has many negative impacts on watershed ecosystem including its damage on water quality, estuary sedimentation, life habitat, landscape, and biodiversity etc. These changes in watershed ecosystem may decrease its benefits for human beings; however, hydropower developers did not consider this kind of environmental costs in the past. In our study supported by National Science Foundation of China, we firstly made a literature review on the application of various theories and methods especially of

watershed ecosystem services valuation in this field. In the second part, we will present our preliminary results of the watershed ecosystem services valuation. All watershed ecosystem services affected by hydropower development will be identified and classified, available methods of ecosystem services valuation will be discussed and applied in the targeted watershed, Jiulongjiang Watershed in the Southeast of Fujian Province. The rate of hydropower developers' payment for the watershed ecosystem services will be quantified based on the previous methods; and the results will be analyzed by comparing with other exploiting costs. In the third part, we will also discuss some preliminary study results on the related mechanism to charge hydropower developers and its use methods. The mechanism to charge hydropower developers for the impacts on watershed ecosystem services will make hydropower "greener" since it integrates environmental costs into consideration, and at the same time, compensation will inspire those vulnerable groups to participate the protection activities. All of these also provide an alternative for integrated coastal management.

Freshwater supply for the Changjiang Delta in suspense with the integrated water resources management within the drainage basin

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As the freshwater resources for the city in the estuary are inevitably controlled by the mixing of fresh and salt water, interaction between the river runoff and the sea, forming the estuarine circulation, is of great importance. Because the impact of seasonal changes in the runoff and the variations in strength and the range of the tides there are considerable salinity variations in the estuary and the estuarine freshwater supply is influenced by salt water intrusion resulting in an intermittent lack of fresh water supply. This occurs each year mainly during a salt intrusion at spring tide in the dry season from December to March, when the river discharge is low. Distortion of the flow in each individual channel dominated by ebb or flood tide and phase differences produce a transverse circulation between two bifurcating

channels. Thus a salt water and sediment intrusion during flood tide from the North Branch coming into the South Branch during the ebb flows out into the sea through the South Branch. This transverse salt intrusion is the main source of salt water that is regularly present around the intake of the Chenhang reservoir, which presents a problem for a safe fresh water supply to Shanghai. Supply for freshwater supply has greatly increased with the increase of the population in the developing city, especially since the early 1990s when the exploitation of Pudong started. The freshwater supply from our suggested combined reservoirs will be sufficient through the storage of fresh water during the periods of flood or drought, when no intake of fresh water is possible. Nevertheless there are some uncertainties because of the present global climate change and the huge impact of the human driving force in the drainage basin on the land-sea interaction in the estuary because of a decrease in river discharge to the estuary. These uncertainties are increase in the frequency of extreme climatic conditions because of global change, arbitrary water allocation and storage in the upper section of the river, salinity criteria of the discharge at Datong during the dry season, irregular freshwater supply in the lower section of the river and sea level rise and land subsidence in the Changjiang delta area. Their impact will reduce the intensity of mixing of fresh and salt water and inevitably will increase the salt water intrusion, thus threatening a secure fresh water supply. Thus the reasonable suggestions are given for a harmonious and consistent joint development of nature and humans in drainage basin and estuary.

Challenges in the integrated coastal zone management and in the implementation policies and regulations in India

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The 7000 Km long coastal zones of India face challenges from natural as well as human induced environmental changes. Millions of population in these zones directly depends on natural resource bases of coastal ecosystems. Estuaries and deltas in this zone are rich in biodiversity and play a crucial role in fishery production besides protecting the coastal zones from erosion by wave action. But, entire coast of India is under threat from degradation and possible global warming.

India has been identified as one among the most vulnerable countries to the impacts of global warming related accelerated sea level rise. This is mainly due to the extensive low-lying coastal area, high and increasing population density, frequent occurrence of cyclonic storms, high rate of coastal environmental degradation due to pollution and non-sustainable development. Possible global warming and change in regional climate may be reflected in sea surface temperature, frequency, intensity and tracks of storms, and sea level. Rise in sea level could result in the loss of rich cultivable land due to inundation, saltwater intrusion into coastal ecosystems and into groundwater systems and damage to coastal biodiversity. Though the 11 major and 130 minor ports and numerous fishing harbours located in the coastal zones are economically very important, they add a lot to the degradation of coastal environment through ballasting and introduction of invasive species and releasing of grease, oil and solid wastes. Increasing number of factories pollute the coastal freshwater resources. Coastal aquaculture invites saltwater intrusion far inland. Overdraft of groundwater in coastal zones has permanently degraded the groundwater in some of the States. Sand quarrying, construction of buildings and unscientific coastal protection walls have impact on both land and water resources. Rivers joining the coastal seas and backwaters carry tremendous loads of domestic wastes and industrial pollutants. Agricultural development release pesticides and fertilizers into the water far above permissible limits. East and west coasts are vulnerable to severe tropical storms. Storms of various intensities hit the coasts almost every year, causing casualties and widespread damage. Rules and regulations at the national and state levels to protect the coastal zones and the coastal resources become farce because of various political, financial and social reasons. Government machinery is often slow and without coordination among different departments involved. Coastal zones are becoming more and more environmentally significant, as life and economy of the country are largely dependent on it and increasing population, urbanization, industrialization and agricultural expansion are posing threat to it, making sustainable management a challenging issue. This paper is an assessment of the environmental significance of the coastal zones of India in the changing scenarios of population, environment, economy and politics. A review of existing coastal zone regulation act, constitutional provisions,

efficiency of the institutional mechanism in the implementation of regulations and various social issues in the coastal zones in view of the new trends associated with globalisation have been made. Suggestions for effective implementation of the coastal protection strategies and adaptation measures have been provided.

Ecohydrology - The interplay between biota and hydrology for the sustainable ecologic functioning of estuarine and marine areas in south-eastern Portugal

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The Ecohydrology approach applied to estuaries and coastal areas is based on the interplay between hydrology and biota, which can be tuned for restoring, improving and sustaining water quality and ecosystem functions. This approach considers the entire river basin and its ecologic and hydrologic processes as a template for the implementation of integrated solutions. The Guadiana estuary and adjacent coast, in the south east of Portugal, have been used for developing and testing ecohydrologic solutions and approaches. This area has been affected by the construction of the largest dam in Europe, the Alqueva dam, completed in 2002. Changes in ecosystems functions and associated uses by human populations were observed, particularly in terms of estuarine nursery functions and coastal fisheries. We propose several solutions based on the dual regulation hydrology-biota to improve water quality and to allow long term sustainable uses of estuarine and coastal resources.

Lessons learned in the development of coastal management strategy for Trat Province, Thailand

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Trat Province is located in the east of Thailand and has borders with Cambodia to the east, and the Gulf of Thailand to the south. The second biggest island of Thailand is Koh Chang, belonging to this province, together with more than 50 surrounding smaller islands, forms the popular tourist destination of Thailand. The Thai Government declared Mu Koh Chang as a special administrative zone for sustainable tourism development in 2002. An estimated 30% of the coral reef areas are within the jurisdiction of Mu Koh Chang National Park which was established in 1982. Mu Koh Chang was also selected as one of the demonstration sites for coral reef subcomponent under the UNEP/GEF Project on Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand. Pollution Control Department and relevant government agencies in consultation with local administration offices and local communities develop a management strategy for natural resource conservation, pollution control, reversing environmental degradation and best land uses in the coastal area of Trat Province. Based on the root cause analysis, the main environmental problems are solid waste, wastewater, coastal erosion, sediment load from coastal development, inappropriate land use in coastal area, unsustainable fisheries, inappropriate tourism activities and oil spill. The natural resources degradation includes coral reefs, seagrass beds, mangroves, terrestrial forest, sandy beaches, endangered species and fishery resources. Five management policies are proposed, i.e., solid waste management, wastewater management, land use management, coastal and marine resources management and sustainable tourism practices. Each management policy consists of five measures. i.e., scientific research support, promoting knowledge to support effective management of natural resources and environment, coordination and participation of relevant agencies, raising public awareness, improvement of laws and regulations for effective management, financial support for management and monitoring and evaluation. Under each proposed measure, there are projects/activities, priority, key agencies, supporting agencies, budget, key performance indicator (KPI) and status. There is a total of 245 proposed projects and needs about seventy million USD for implementation. Long-term financial support and better coordination among government agencies and stakeholders are important factors for sustainable use of coastal resources in the area.

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Social responsibility, awareness and participation of local communities are key to effective CZM: a case study in Orissa, East Coast of India

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Fishers, fishing households and fishing communities worldwide are not homogeneous. Each location has its unique social and ecological context that needs to be considered for implementation of coastal zone management (CZM) and awareness programmes and their impact assessment. Coastal communities in many locations around the world face a growing degree of insecurity as a result of poverty and high dependence upon natural resources. This vulnerability is often compounded by declining resources, high population growth, limited alternative livelihoods, limited access to land, economic and political marginalization, unsustainable land use practices and development, competition and conflicts over resources, health burdens, and civil strife. In Orissa, a state along east coast of India, some villages along the shore are situated a few meters (< 2 m) above mean sea level (MSL) in the Kendrapara district and are frequently prone to the fury of tidal waves causing erosion and sea water intrusion. As a result, most of the agricultural fields are lost due to sand filling and saline intrusion. In two villages, Satabhaya and Pentha, people mostly depend on marine fishery and agriculture. However, due to severe coastal erosion and seawater intrusion, the life and property of these coastal people and the communities are at stake. The major problems faced by these people are; i) Constant shifting of households, ii) shifting of livelihoods, iii) loss of

agricultural lands and ownership of land holdings, iv) loss of mangrove forest due to its indiscriminate use as fuel wood, v) lack of alternative livelihoods, vi) rising discontentment among people resulting in refusal of government rehabilitation programmes etc. As a result people very often engage in social conflicts. Therefore, the social responsibility on the part of the government, non government organisations (NGO) and community level should be extended to give them their basic human rights. Awareness of the local people about the use and conservation of the natural environment and resources, and their participation in checking the coastal erosion is essential to make the CZM programmes successful and effective and to enable the coast to be used sustainably and ensure its long-term protection. The effectiveness of the current CZM programmes were assessed through a survey within randomly selected households in communities living in the two villages. The fragmentation of management, lack of communication and collaboration between stakeholders, inadequate government funding and poor community support are the main obstacles to effective CZM. Therefore, there is need to integrate the local communities resident within the areas or dependent on the resources for their livelihoods.

Natural hazard assessment over Iranian coastlines

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INTRODUCTION

Coastal areas are usually subjected to disasters due to natural hazards. Detecting probable hazards in coastal areas, preparing suitable policy and basic planning are essential to reduce disasters due to a certain hazard. Making proper management decisions will result in preventing

from inappropriate development as well as reducing disasters and irreparable damages in the area. Coastal hazards are comprised of geological (earthquake, land-slide, settlement, liquefaction), climatology and hydrological (drought, heavy storms, heavy freezing, flooding and heavy rain) and marine hazards (storm surge, storm waves, water level variations and tsunami). Considering other experiences in the world, an appropriate method is applied for overall hazard assessment in coastal areas. In the mentioned method, each hazard is considered in the study area based on conducted analysis and the hazards are graded based on the intensity to four categories from 1 to 4, where 4 is the more intense one. Finally, effects of all the hazards are considered together in order to obtain an overall hazard assessment. The overall assessment is graded through 7 levels from 1 to 7 (very low to very high level of hazard).

HAZARD ASSESSMENT AND CLASSIFICATION

Gradation of hazard intensity in an area requires scientific judgment, understanding the history of hazards and getting acquainted with contributing parameters in hazards. A powerful statistical system is also required for predicting time and location of hazards. The system must be updated regularly. In this study, seven types which are more effective in the coastlines are investigated and graded in four categories from mild (i.e. 1) to sever (i.e. 4) and are presented in Table 1, separately for the seven hazards.

OVERALL HAZARD ASSESSMENT

In addition to separate assessment of each hazard, an Overall Hazard Assessment, OHA, is to be performed for general assessment of a certain area. Therefore, available hazards are classified to dynamic and non-dynamic categories. Dynamic Hazards occur in a very short period and result in sever disasters, which are earthquake, land-slide, liquefaction, storm waves, heavy storms and Tsunami. On the other hand, some hazards such as shoreline change occurs during long periods and result in minor disasters and are known as non-dynamic hazard. In order to simulate OHA parameter grade of each hazard, both dynamic and non-dynamic ones, are squared and a double value is assigned to dynamic items to magnify dynamic hazards and finally, averaging the obtained quantities, the OHA value is achieved.

CONCLUSION

A comprehensive method is introduced here for assessing environmental hazards in coastal areas,

through which interactive effects of the hazards are predicted in OHA parameter in addition to separate effects of each parameter. Coastal areas are graded in different categories, from low level to high level of hazard intensity. The described method is employed for the Iranian coastlines in the north and south of the country and the results are presented as hazard assessment maps; where an example is presented in Figure 1.

Table 1 Coastal area hazard and relevant intensity

Kind of hazard		Scale	Range	
Geology hazard	seismic	ground acceleration		Low
				Moderately Low
				Moderately High
				High
	Land slide	Number of Land slide		0-5
				5-10
				10-15
				>15
	liquefaction	qualitative data		no history of Liquefaction
				Low Liquefaction
				Moderate Liquefaction
				High Liquefaction
Climate hazards	Extreme storms	Number of stormy days	Caspian sea	8-13
				13-16
				16-18
			Oman sea, Persian gulf and Strait of Hormoz	18-21
				35-67
				67-98
				98-119
				119-130

Kind of hazard		Scale	Range	
Marine phenomena hazards	Hazard waves	Wave height meter Tsunami wave height meter	Caspian sea	<3
				3-5
				5-6
			Oman sea, Persian gulf and Strait of Hormoz	6-7
				<2
				2-3
	Tsunami	Tsunami wave height meter		3-4
				>4
Geomorphology h hazards	Change of shoreline	qualitative		0-0.5
				0.5-1
				1-2
				2-2.7
				Low erosion rate
				moderate erosion rate
				high erosion rate
				Very high erosion rate

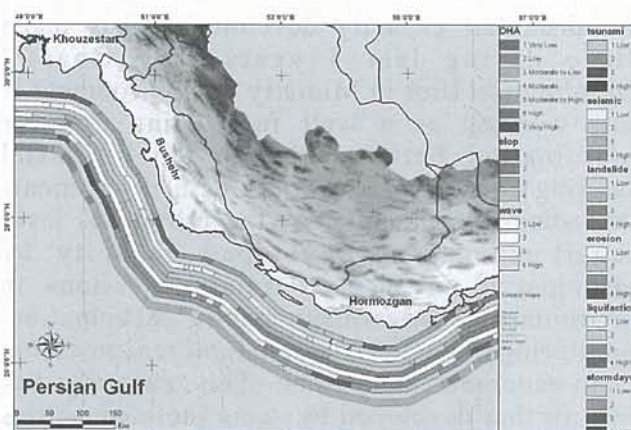


Figure. 1 Sample of hazard assessment map for Iranian coastlines over the Persia Gulf

Integrated coastal zone management in Cambodia: the case encompasses institutional and human resources development at national, provincial and community levels

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The natural resources and environment in Cambodia's coastal zone experience increased pressure from an expanding population and economic activities. Issues of concern include degradation of habitats, including coral reefs, sea grasses and mangroves from unsustainable exploitation and management practices, extended poverty, conflicts in land and resources usage, insufficient legal and enforcement framework, cases of conflicting mandates and management functions and lack of information to support management decisions. The country is severely constrained in terms of institutional capacity and limited human resources.

Since 1997, the Government of Cambodia with support from Danida has been engaged in building up a system for integrated coastal zone management. The approach taken has been to establish inter-ministerial and inter-departmental coordinating platforms and involve these in identifying and addressing coastal development issues in a partnership with other stakeholders including NGOs and local communities. Various management tools have been introduced and training provided in their use. The comprehensive training has been given in learning by doing approach resulting in a number of outputs within important management dimensions.

A substantial capacity development has taken place during last 5 years. The Coastal Coordination Unit in Ministry of Environment is now working as a well functioning unit for coordination between the National Coastal Steering Committee to the provincial departments and commune councils. At the provincial level departments have developed capacity by participating in focused training sessions in environmental assessment, public participation, monitoring of environment, natural resources and socio-economic indicators. This capacity has been further developed by using these capacities in actual work in the coastal area. Additionally, this substantial capacity development has also taken place in the coastal communes and communities where more than 800 villagers have been trained in integrated farming systems, veterinarian assistants, community based natural resources management, and different vocational training such as engine and electronic repair. All the capacity development at the commune and community level where further supported by tangible input such as livestock, fruit trees, and provision of tool boxes. On the other hand, a comprehensive program was also targeting environmental awareness in 20 schools in the coastal area and providing small demonstration projects to the schools.

An important lesson learned regarding capacity development project is to maintain focus throughout the whole capacity development effort, establish local ownership and that it is a long-term effort. As the capacity at the national, provincial and commune level is very weak the support should not be too complex not to lose local understanding/ownership and it can be difficult to counterpart staff to adapt to donor induced changes without a loss in motivation or understanding. As capacity development is a long-term effort it is important that the counterpart staff involved have the basic education level relevant for their positions and have an age so that when the capacity development effort are finalized they will still be working within the fields strengthened through the capacity development effort, and that the involved institutions agree to a career opportunity plan for the involved staff.

Changing River Basins in monsoon Asia-Pacific: implications to social, economic and environmental vulnerability of the major deltas

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Approximately one third of the mankind lives within the sphere of influence of the large rivers of the Monsoon Asia-Pacific. These rivers include Indus, Ganges, Brahmaputra, Meghna, Ayeryarwady (Irrawaddy), Salween, Mekong, Song Hong (Red River), Pearl River, Changjiang (Yangtze) and Huanghe (Yellow river). Whereas the concentration of people within the basins of these rivers is remarkable, even more striking is the agglomeration of poverty, malnutrition and urbanization; it is estimated that around the half of the world's total in these matters occurs within these basins. At the same time a remarkable and growing share of the world's economic growth takes place in the basins.

Most of these rivers and their basins have been massively modified over the years, centuries and millennia. It is important to recognize that the contemporary pace of change is extremely speedy, many-sided, and unforeseen in history, and it is expected to keep accelerating in few decades to come.

The deltas of these rivers are of particular interest in this study. An assessment of major driving forces, pressures for change and vulnerability of the deltas of the large rivers of the Monsoon Asia-Pacific was performed. The analysis was done using various geospatial databases of the river basins including data on nature and environment (such as climate, hydrology, land cover, land use etc.), demography, as well as social and macroeconomic development. A vulnerability profile of the deltas was produced.

Conversion of finfish and shellfish wastes into pharmaceutical products an alternative employment for fisherfolk of Tamilnadu

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The Tamilnadu coast (S. India) is known for its diversified fisheries resources viz., finfish and shellfish such as shrimps, crabs, lobsters and cuttle fish. The annual catch amounts to 0.4 million tonnes. While the high value finfish are processed and exported, low value fishes such as sardines, lesser sardines, silverbellies and white baits are mainly used as an ingredient in live stock and poultry feeds. The meal of these fishes is rich

in high quality protein (6-28%), vitamins such as A, B12, C, D, E thiamin riboflavin, nicotinic acid, pantothenic acid, pyridoxine, biotin and folic acid and minerals (0.4-1.5%) such as potassium, calcium, phosphorus, sulphur, sodium, magnesium, chloride, iron, manganese, Zinc, fluoride, arsenic, copper and iodine. The essential amino acids determined in certain low value fishes are Leucine, phenylalanine, valine, methionine, tryptophan, threonine, arginine, lysine and histidine.

The above low value fishes could therefore be converted into health powder for addition in cereals and other food stuff especially for the nutritionally deficient children of developed and underdeveloped countries. The shell wastes of shrimps and crabs which are hitherto wasted in processing industries could be converted into chitin and chitosan. As a polymer chitosan reduces in cholesterol level and weight loss; decreases urea and creatine level; increases haemoglobin level; improves appetite and sleep; protects liver; prevents tumour and ulcer formation; regulates blood pressure and promotes immune response and growth of bacteria in intestine to improve digestion, cleanse colon and prevent diarrhoea and constipation. It is estimated that about 40,000 tonnes of chitosan could be obtained from the above crustacean shell wastes. The inner shell (bone) of cuttle fish is rich in calcium carbonate (80-85%) and is a good source of dietary calcium. It is also known to be a traditional medicine for tropical sprue and dysentery. The black coloured ink of cuttle fish is nowadays traditionally included by the people of southeast Asian countries in rice and pasta. Intensive research is needed to identify its pharmaceutical properties. The above calls for creating awareness among seafood processors and pharmaceutical industries to put up new industries in tamilnadu coast so as to generate alternative employment avenues for fishermen. Details relating to number of such industries, finance requirements and training programmes to be offered for fishermen have been worked out and discussed.

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Management of endangered mangrove coasts and human health: a proposed comparison of cholera dynamics in the Sundarban and Amazonian regions

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In many developing countries, particularly in their coastal region, cholera is still an important cause of mortality and morbidity. In 1991 a cholera epidemic started in Peru and spread throughout South America reaching the Amazonian coast. Despite modern advancements, cholera was reported from over 90 countries during 1994, the largest scale ever recorded in human history (WHO, 1998). As early as 1884, Robert Koch suggested that the Sundarban mangrove forest was the main source of cholera. He stated that the combination of a brackish wetland environment, rich in organic matter and with a high density of human population depending on wetland resources, represented the ideal conditions for the proliferation of *Vibrio cholerae*, the etiological agent of cholera. Although the high demographic density surely plays a role, probably amplifying the transmission mechanisms of cholera, it is not necessarily its primary cause. *V. cholerae* is part of the autochthonous flora of brackish and estuarine environments, and cholera epidemics can be linked to plankton blooms, rise in temperature, El Niño Southern Oscillation, and persistence of brackish to saline water conditions (Colwell, 1996). Cholera generally breaks out more devastatingly after floods by cyclones or other natural disasters.

In Bangladesh, from the southern Bay of Bengal, increased frequency and intensity of storms produces salinization of inland water bodies, facilitating the spreading of the salt-loving *Vibrio* organisms and affecting drink water availability. From the land side, transboundary dam construction has severely reduced riverine discharge into Bangladesh, what has further

facilitated salt intrusion into its estuaries. The vulnerability of this setting has recently increased due to the massive damage inflicted to the Sunderbans by the cyclone Sidr in 2007, which affected about 30% of its extension and killed ~10,000 people. Particularly affected was the marine front of the mangrove and the villages therein, which respectively most mitigated and suffered the strongest cyclone impact (Ocha, 2007). This situation has led to a controversy regarding the strategy to reduce the vulnerability of the Sundarban socio-ecological system (SES). While sectors of the Forestry Department originally planned a rapid reforestation of the affected sectors, environmentalists proposed to leave the system regenerate by itself. Although both had reasons supporting their positions, some intermediate solutions were not considered, such as the selection of pilot areas for comparative studies on the adequacy of each approach for increasing the robustness of the coastal belt in a time scale compatible with the increased cyclone frequency. This could have included the monitoring of vegetation development, participatory management for fallen wood use and tree replanting, and the study of *V. cholerae* dynamics in natural and replanted wetlands, water bodies and human population. Particularly interesting tools for such purpose would have been the approaches of the "Social Forestry" and "Coastal Greenbelt" Projects, initiated in Bangladesh in 1980's and '90s and the UNESCO Ecohydrology Program, which deals with new ways of increasing the bio-physical stability of coastal zones, using the system's own properties for the creation or restoration of wetlands (Zalewski, 2000).

In Brazil, the mangroves in the Amazonian coastal region show presently significant changes, being the loss of vegetation coverage the dominating process along the coastline in the last 25 years. At the same time mangrove has actively invaded herbaceous mud flats in the topographically higher locations. The topography-dependent dynamics of this process strongly suggest an increase in inundation frequency and changes in soil salinity, and the current dynamics of vegetation change matches predicted rates of sea-level rise (Cohen and Lara, 2003). Other parallel studies show an increase of the socio-economical vulnerability of the coastal region (Szlafsztein and Lara, 2003). Although this region has been affected by cholera in the past, the disease never established as around the Bay of Bengal. The first city in Brazil struck by Asian

cholera in 1855 was Belém, in the Amazonian coastal zone. From there it followed the Amazon river upstream into the interior of Pará and westward into the province of Amazonas. In 1991, the epidemic initiated in Perú expanded roughly eastward and soon hit the Amazonian coast, but there it extinguished after seven months.

At a global level, a comparison between the two largest brackish wetlands worldwide as *Vibrio* habitats, the Sunderbans and the Amazonian mangroves, could provide a deeper insight into the mutual interactions between the impact of cholera on human coastal population, wetland dynamics and *Vibrio* diversity. The environmental setting of both regions is similar: large mangrove extensions, high riverine input and sediment load. Despite several epidemics in Amazonia and throughout South America, cholera did not develop regular annual outbreaks with a seasonal pattern as in South Asia. Thus, a major question regarding the dynamics of the SES in each region is: Why is cholera endemic in Bangladesh/India and not in tropical South America? Is this mainly a biodiversity, biogeochemical or social/demographic issue? Although human population density in Amazonia is much lower compared to South Asia, the seasonality of cholera epidemics in the latter is strongly related to natural aquatic cycles. Thus, the reasons for endemicity, whose consequences permeate the whole SES are not obvious and deserve an integrated, comparative research approach in order to further improve mangrove management criteria and disaster mitigation policies.

Coral reef degradation and management implications at Samui Island, Surat Thani Province, Thailand

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Main causes of coral reef degradation around Samui Island, the Gulf of Thailand are high sedimentation exposure during low tides and mass coral bleaching. The process of degradation involves a failure to recover from disturbances. The present study concentrates on settlement and recruitment of corals which is critical to the recovery of coral reefs after disturbance and hence an important aspect of reef resilience. The settlement, plate experiments showed that coral

larval supply at Samui Island was relatively high. However the density of juvenile colonies observed on reef substrates was very low. There were available substrates for coral settlement mainly dead corals, but they were covered quickly by algal turfs and sediment. Coral reef recovery at Samui Island may be delayed because of abundant algal turfs and coral stress by high sedimentation. Appropriate management strategies to prevent high sediment inputs from developed catchments and coastal areas are proposed.

ICZM in the era of the basic act on Japanese Ocean policy: the role of local governments - case of Tottori Prefecture

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The year 2007 was a turning point in Ocean management by Japan. In April, the Basic Act on Ocean Policy was enacted and Japan stood at the starting line of cross-sectoral comprehensive ocean management. Article 25 stipulates the integrated coastal zone management (ICZM), the first time this stipulation has appeared in Japanese statute act. In November, the Third National Strategy for the Conservation and Sustainable Use of Biological Diversity was announced. It is the first to include content related to the problem of biological diversity conservation in coastal zones.

What kinds of initiatives should local governments take concerning coastal Management in response to this trend? This paper reports on a study of the role of local governments in coastal zones management in the present age of the Basic Act on Ocean Policy. The study focused on a case in Tottori Prefecture: a prefecture facing the Japan Sea, home to the smallest prefectural population in Japan, a place endowed with a beautiful coastal zone including the well-known Tottori Sand Dunes, and the site of Japan's first advanced initiative under the Integrated Soil and Sand Management Plan.

Investigation on fish market wastewater characteristics in Lempasing, Bandar Lampung, Indonesia

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The Lempasing fish market is the fish auction center, located near the coastal area of Bandar Lampung City, Lampung Province, Indonesia. Due to the inefficiency of wastewater treatment facilities, the water quality of the coastal nearby becomes deteriorated. In this research, we investigate the fish market activities condition in related to the wastewater generated. We took samples of wastewater from the fish vendors when they finished washing the fishes. Water samples were also taken from three points of the coastal area. The results show that BOD concentration of wastewater reached 160 mg/l, COD concentration reached 528 mg/l, TSS concentration up to 150 mg/l, and E. coli number was more than 1420 cell/100ml. Those values were over the standard limit. From the seawater samples analysis, the results show that dilution and distribution effect of the sea dispersed the contaminants offshore. However, the number of *E. coli* was still high (>2800 cell/100ml) and it appeared that the coastal sediment contained high septic decomposed organic matter. The dissolved oxygen was as low as 4.5 mg/l. It is recommended that wastewater treatment facility includes units of filter, sedimentation, and filter press for sludge handling.

Concept of integration in shoreline management

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The significance of integration in coastal zone management has been the topic of various issues and comments and the investigation in this variety expresses each commentator's span of vision. Governments, private organizations, national institutions, scientists and researchers, experts and professionals have explained "integration" from their own point of view and each explanation can be an exact description in the related specific situation. For instance, although in some Pacific or Asian countries this word has been utilized in a vast extent as an indicator to a suitable policy from cultural and executive point of view, the authorities in Australia do not agree with the utilization of this word as they believe it might

not be in coordination with the fragmented Australian official and governmental system. Perhaps this disagreement is due to the difference between "integration" and "coordination".

An integrated system is a complete and comprehensive system, although it may have subordinate components. But a coordinated system owns independent and usually equivalent components working for a common purpose. On the other hand, a kind of spatial point of view governs the meaning of integration in integrated

coastal zone management. Spaces considered in the integrated coastal zone management are as follows:

Coastal zones, near shore waters, offshore waters and open seas Although the natural phenomena in these four zones are similar, the integration of management systems in these zones faces different obstacles due to the various differences in the nature of possessions, governmental revenues and organizations ruling them.

(Table No. 1)

Table 1 Different possessions, governmental revenues and organizations in land and sea spaces

Zone	Land	Coastal Zones	Nearshore Seas	Offshore Seas	Open Seas
Possession	Private	Private or Public	Usually Public		
Governmental Venue	Local or Provincial	Local and Provincial	Local and Provincial	Usually Nationally	Usually Internationally
Ruling Organizations	Multipurpose Governmental Organizations		Monopurpose Provincial or National Organizations		

Integration can be considered in diverse levels referring to different aspects as follows: Intergovernmental integration in different levels, land and sea integration with a powerful relation between activities performed in these two circumstances intersect oral integration between governmental and private organizations, spatial integration between land based and sea based activities and integration between science and technology. The mentioned items are introduced by other integration aspects in coastal zones like institutional, temporal, management and international integrations. There is every reason to say that the integration in coastal zones shall be diametrical in most occasions. The diametrical integration explains that the various levels of organizations shall be participated according to the discussed integration topic.

The authentic management of coastal zones requires consideration of different effective factors. The word "integration" is selected because it may be the only word to imply this meaning. Nevertheless, the concept of integration differs from its current concept. It should be mentioned that the purpose of integration is not combination of factors in a country or a region and it emphasizes on further coordination. Finally, the different integration levels are necessary to be assessed and evaluated in coastal zone management. In this way proper criteria shall be designed. In other word, confidence of integration existence is more important than integration word existence.

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Measurement of groundwater salt concentration in mangrove swamp using the chlorine electrode system

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1. Introduction

Mangroves forests grow in tidal saline wetlands along tropical and subtropical coasts. It is known that mangrove has the role of preservation of biodiversity in coastal ecosystems, and averting from tsunami damage. Mangrove plants live in the area where sea levels are from the mean level to the highest level. Groundwater salt concentration in mangrove swamp is one of the major factors determining the growth of mangrove species. There is a growing concern that sea levels rise due to global warming may cause destruction of important ecosystems such as wetlands and mangroves. Especially, it is important to monitor groundwater behavior and salt concentrations in mangrove forests, because the growths of mangrove forests have close interactions with sea levels and salt concentrations. The purpose of this study is to develop the cheap and easy monitoring system which measure groundwater behaviors and salt concentrations in mangrove sediments using a chloride electrode. 2. Materials and methods

2.1 Monitoring system

The system was mainly made from the chloride electrode (ϕ 4mm; DKK-TOA), the reference electrode (Leak Free type ϕ 2mm; Warner Instruments Inc) and voltage data logger (VR-71; T&D). The electrodes were set in the stainless-steel bar (ϕ 2cm). The tip of bar was cuspidate for sticking in the sediment easily. The waterproof box for storage the data logger was set on the top of bar. 2.2 Measurement

The analytical curve was made using sodium chloride solutions. The sampling points were the mangrove forests in Ooura river where the north of main land in Okinawa, Japan. The measurement point was under 30 cm from the surface of sediment in mangrove forests. Water level on the point was measured with water level indicator (Water level Logger Titanium; HOBO Onset Co.). Grain size distribution at the

measurement point of sediment was analyzed.

3. Results and Discussion

Analytical curves were two lines, for the low salt concentrations (<30 g NaCl/L) and the high salt concentrations. However, the range of high salt concentrations (>30 g NaCl/L) was not enough to distinguish the values. It is considered for improving the problems that to be higher the detection range of data logger, and to set the chloride electrodes for low salt concentrations and high salt concentrations. When the salt concentrations were measured on the point under 30 cm from sediment surface, the salt concentrations reach the highest concentrations (27g NaCl/L) after 70 minutes later when the water level reached the highest. In addition, the rate of increasing salt concentrations in groundwater was almost same as the rate of sea level rising. These results showed that groundwater salt concentration behaves in relation to the change of tidal shift.

4. Conclusion

Groundwater salt concentration in mangrove swamp was measured continuously using the monitoring system with a chloride electrode. This system is useful for measuring the salt concentrations under mangrove sediments, and investigation the permeation flow by set many points of mangrove forest.

Modeling solid waste dispersal from milkfish farm

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Assessing environmental impacts of aquaculture through numerical modeling have been demonstrated for sea bass, sea bream and salmon but none for milkfish culture. This study investigated solid waste dispersion in milkfish farm and assessed if existing guidelines are appropriate through numerical hydrodynamic and particle dispersal models. Unlike other studies which used single sinking velocity of a particle, this model took into account variable sinking velocities of solid waste such as excess feed. The spatial extent and degree of sedimentation were used as bases for determining threshold distances for fish cage spacing.

Design and completion of database and geographical information system of Iranian ports and coasts

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Introduction

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Design of a suitable data model

Because of the variability of coastal geographical data and problems, there is a need to design special models. Some of the existing models and solutions include the ArcMarine, IHO and NTDB which provide useful guides for modeling of the marine, hydrographical and topographical data. However by considering the spatial characteristics of the ports and coasts and various responsibilities of the ICZM project, neither of the existing models is adequate for this purpose and design of a suitable model is an important task. Therefore by considering the different requirements of the ICZM project a suitable structure and data model for organization and management of the geographical and attribute data was defined. In this model, all data are classified in three groups as below:

- 1- Base and Technical data
- 2- Related activity data
- 3- ICZM programs and plans.

Each of the three groups is subdivided in minor classes as outlined in figures 1 to 3.

Data collection and database development

After the conceptual, logical and physical design of the data model, different map layers and attribute data were collected and imported to the data base. The collected data include about 250 map layers and 20 main attribute tables. And provide a unique GIS-based database for many applications by different users.

Conclusions

Availability of this database, and connection of many map layers with the relevant attribute data, provides many possibilities and opportunities for planning, management and monitoring of different activities in coastal areas. These may include simple to complex applications such as Querying, buffering, Overlay, data fusion, modeling and decision support. Completion of the developed database and increase of its efficiency is a continuous effort in the future.

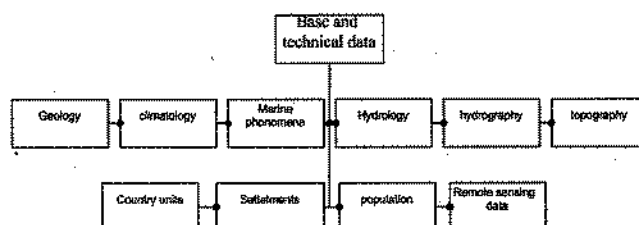


Figure. 1 classes of the Base and technical data group

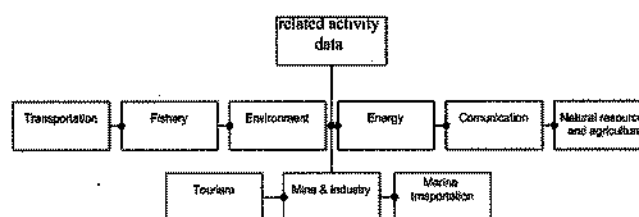


Figure. 2 classes of the related activity data

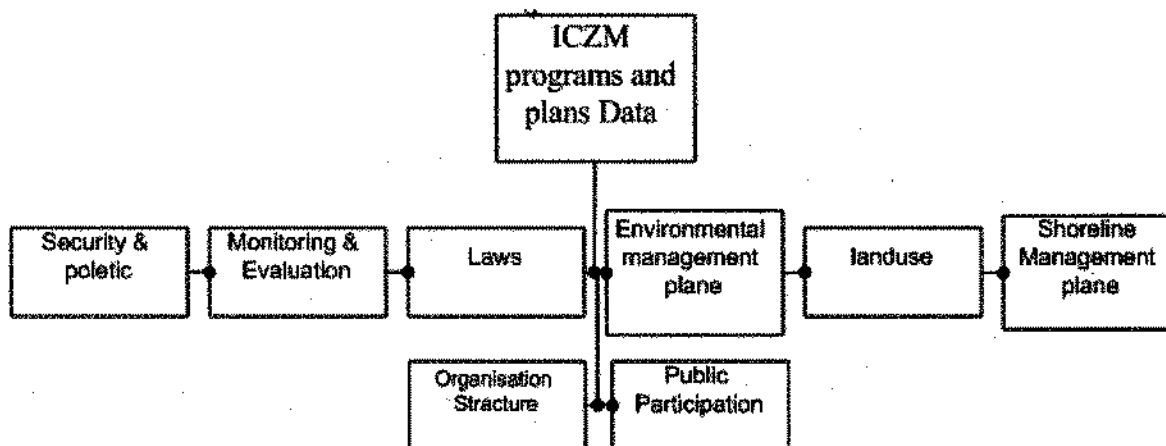


Figure. 3 classes of the related activity

Study on food composition of the Persian Sturgeon (*Acipenser Persicus*) in coastal zone of Caspian Sea

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Introduction

The Caspian Sea with a catchments area of 3.5 million square kilometers (km²) is famous for its population of Sturgeon and, at its peak in the mid-1980s harbored some 85% of the world sturgeon population (Ivanov et al., 1999). The present study was conducted to study the feeding habits in Sturgeon caught up to depths lesser than 10 m in southern part of the Caspian Sea (Guilan Province) for to determine the different types of main and secondary prey consumed and also to determine the feeding index in sturgeon to understand the food availability of these species.

Material and methods

This paper is based on the data obtained during 2000-2003 when cooperative societies and trawl surveys were carried out in the Caspian Sea at different depths to collect premature Sturgeon specimens. Away from each other throughout the year using a 6-m trawl net with a mesh size of 8 mm. Trawling wires were pulled for 20 minutes at different depths of 2-4 m, 5-7 m and 8-10 m. Organisms consumed were benthic invertebrates belonging to class Bivalvia, Polychaeta, Crustacea and Bony fishes.

Results

Frequency of food items in Sturgeon in showed that Maximum and minimum total lengths recorded were 34 and 10 cm, respectively. it is evident that for fishes in the length range 10-25 cm the main prey was comprised of animals belonging to the class Polychaeta. However gradually from length class 25-35 cm feeding intensity of premature *A. persicus* changed to crustaceans (Pseudocumidae) and fishes belonging to other families were given lesser preference.

Discussion

Seasonal changes in diet are characteristic of this species: in spring, the main food items were Gammaridae and fish; in summer - Gammaridae and Cumacea. Indices of stomach fullness in juveniles were higher in spring (57.5 0/000, 32.0% of sampled fish with empty stomachs), than in summer (10.0 0/000 and 50.0%, respectively) (Zolotarev et al., 1996) also Food composition in *A. persicus* studied in 1997-1998 indicates that these fish show a preference to bony fishes belonging to the families Gobiidae along with benthic invertebrates when they reach a length of above 25 cm (Mai Seiv & Philatova, 1985). Recent findings indicate that food spectrum in premature *A. persicus* (young of year, one year old and two year olds) was composed of 8 genera of benthic organisms whereas that in adult *A. persicus* was composed of fishes belonging to the families Gobiidae, Atherinidae and Clupidae.

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Responsibility and policy relevant aspects of ecological interests in the activities of different social actors: sociological point of view

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Water problem issues is too important for Ukraine that caused not only by the state of water supply resources, technologic regimes of water treatment, the number of emergency and regular pollution source but the attitude of population towards this problem, the dominance of economical and ecological priorities in mass consciousness, the users' mood of the citizens. Sociological researches show the stereotypes of ecological consciousness of population can be determined as principle factors of human behavior regarding different spheres of the environment including the hydrosphere. They are also important for finding out the causes which have to be taken into the consideration by other social actors during decision making. At that time the change of stereotypes of ecological consciousness is considered as the level of real change of situation within political and social negotiation process. In this context policy relevant aspects of ecological interests of the social actors (political parties, NGO, business) are investigated.

On basis of empirical research the estimation of ecological perception and behavior of different

social groups, willingness to cooperate is conducted. The results of issues demonstrate that the division of population only partially depends on occupation and residence of population. The main factors are the formed stereotypes among which the most spread aspects are the following: 1) the necessity of environment renewal; 2) the determination of the role of social actors participated in this renewal; 3) the readiness of the citizens to the individual participation in corresponding ecological activity. The sociological indicators were used: the public trust to the ecological information received from the bodies of various levels executive power; individual people participation in environmental activity; the role of different social subjects in solving of ecological problems and individual readiness of citizens for cooperation with them. These data opposes to the indices of satisfaction/dissatisfaction of Ukrainian population by the ecological situation residentially, the disquietude of water supply, soils, air and other components of environment; evaluations of its influence on the health and migration behaviour of anthropogenic factors. The determined stereotypes of ecological consciousness limits largely the successful achievements of political decisions and support of effective social dialogue between various part of society engaged into the solving of water issues. To solve this problem it is necessary to change, firstly, the opinion of population about the factors of rehabilitation and environment protection, increasing of individual interesting of the citizens in development of successful strategies regarding the environment.

Influence of phytoplankton bloom and heterotrophic bacteria on dissolved organic matter in coastal water

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Dissolved organic matter (DOM) in the sea, one of the largest reservoirs of organic matter on the earth's surface (Ogawa and Tanoue, 2003), plays an important role in the global biogeochemical

cycles and microbial loop (Pomeroy, 1974 and Azam and Hadson, 1977 in Hedges, 2002). Although phytoplankton has been identified as one of the autochthonous DOM sources (Nagata, 2000) but the lacks of significant correlation between phytoplankton abundance and DOM were reported. In addition, DOM supply would activate microbial food webs by means of heterotrophic bacteria (Azam et al., 1983). This study was conducted in Yashima Bay, Seto Inland Sea to clarify role of phytoplankton on DOM formation. Monthly samplings or more were conducted and determined the concentration of chlorophyll *a*, phytoplankton and bacteria density and DOM included dissolved inorganic nutrients and fluorescence excitation emission matrix (EEMs) during February 2005 to August 2006. The correlations between phytoplankton abundance, DOM concentration and characteristic and also bacteria density during blooming and non-blooming periods were evaluated.

Good relationship between chlorophyll *a*, bacteria density with DOM concentration and characteristic was observed. During the both summers, DON, DOP, CDOM fluorescence, UV₃₅₀ formation and EEMs corresponded with the onset, development and decay of phytoplankton bloom. High DON, DOP, CDOM fluorescence (Ex/Em 350/400-600 nm) and UV₃₅₀ were observed only summer during blooming periods. Moreover, high peaks of DOM were observed after the peaks of chlorophyll *a*. Significant positive correlation between DON ($r = 0.66, p < 0.01$), CDOM fluorescence ($r = 0.67, p < 0.01$) with chlorophyll *a* were observed. DOM characteristic also corresponded with the development of phytoplankton bloom during the both years sampling. When phytoplankton biomass was low, the aquatic DOM pool was dominated by humic-like substances presumably by-product of bacterial degradation. In contrast, dominant DOM pool was tyrosine-like substances, exuded by phytoplankton in exponential phase, during phytoplankton bloom periods. Closely or similar to Redfield ratio of DON/DOP molar ratios during phytoplankton bloom confirmed our conclusion on phytoplankton is one of the autochthonous DOM sources in Yashima Bay. However, there was no correlation between DOP and UV₃₅₀ with chlorophyll *a*. During the sampling period, bacteria density in the surface water corresponded with DOM formation. Significant positive correlation between DON ($r = 0.51, p < 0.01$), DOP ($r = 0.32, p < 0.05$), CDOM fluorescence (r

$= 0.63, p < 0.01$), UV₃₅₀ ($r = 0.54, p < 0.01$) with bacteria density were observed. Thus, supply of high DOM concentration, released from phytoplankton, affected on the increasing of bacteria as a food source. Namely, the increase of bacteria density during blooming period corresponded with DOM may show another role of bacteria on new organic matter producer in the aquatic system.

Concept of integration in shoreline management

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Design and completion of database and geographical information system of Iranian ports and coasts

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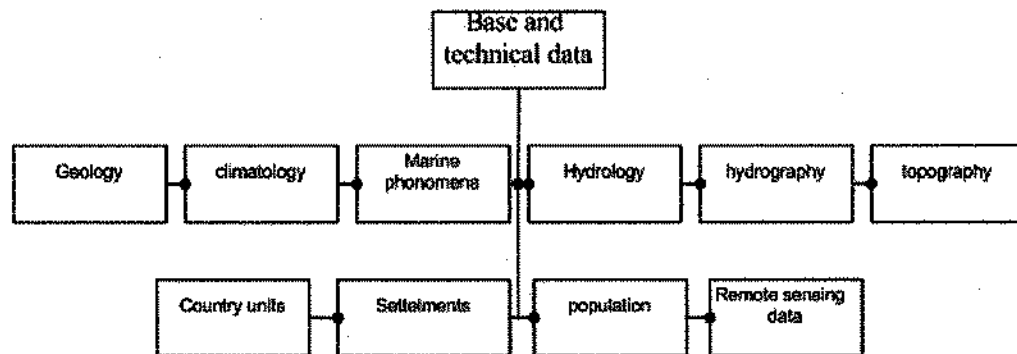


Fig.1 classes of the Base and technical data group

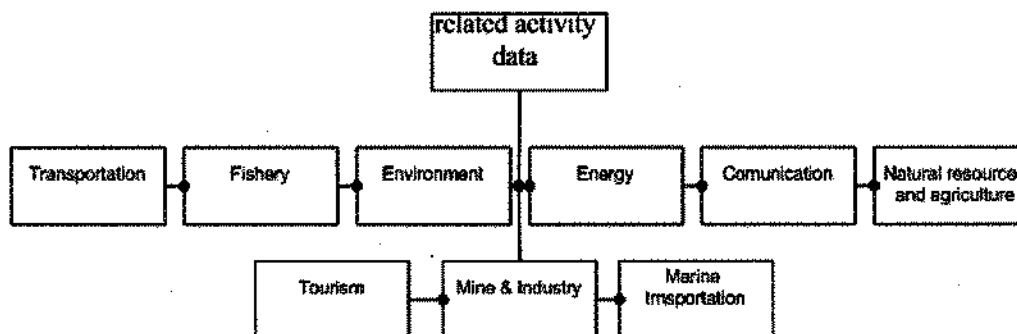


Fig.2 classes of the related activity data

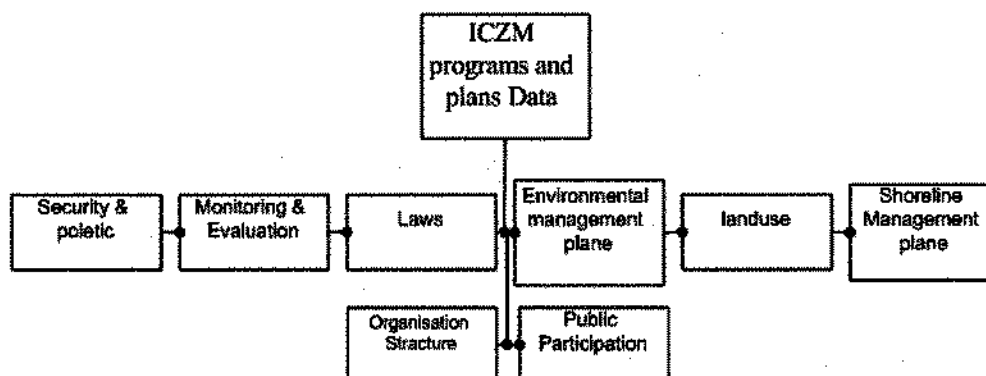


Fig.3 classes of the related activity data

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Determination of Iranian coastal zone boundaries

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1. Introduction

Integrated Coastal Zone Management (ICZM) is a dynamic and continuous process which aims stable development in coastal management. The main objective of ICZM is to obtain a stable situation in social and economical activities as well as environmental aspects in Iranian coastal areas. Development and coastal protection are included in ICZM; however, ICZM is not a policy based on coastal protection. It is a plan for improving economical and social conditions in coastal areas. In order to obtain this objective through integrated coastal management project, it is necessary to define the effective domain on the shorelines. Defining the domain and boundaries of coastal zone based on coastal and port engineering criteria as well as socio-economical and environmental aspects along the northern and southern coastlines, considering the relations between different organization and authorities, is the main objective of shoreline classification studies

2. Determination of Iranian coastlines Boundaries

Considering similar experiences in other countries regarding shore classification, management boundaries are ideally include all the economical, social environmental and ecological interactions. This results in a very extensive domain which is extended from special economical areas (usually 200 miles from the reference line) in the sea side to the end of hydrological basin of coastal rivers in the land

side. In the mentioned vast region, integrated coastal management includes two major items:

1) Direct management which includes shoreline area and its margins are Hazard line in land side and boundary of active sediment transport area in the sea side. Managing should be together with control and enforcement.

2) Supervisory management of ICZM, where the margins are boundary of hydrological basin in the land side and exclusive economic zone (EEZ) in the sea side. In such an area managerial affairs are performed through enacting regulations and controlling application of land (for industrial, agricultural and accommodation purposes), hydrological basin management, recreational and tourism activities and employing resources.

The managing domain in land which is related to optimum application of land is designed in three phases. Phase one, villages boundaries; Phase two, towns boundaries and finally basin boundaries in phase three. In the sea side, the area between active sediment area and EEZ may be investigated in two phases. In the first phase, the managing domain is limited to the territorial sea limit (12 miles) and in the 2nd phase will be extended to EEZ. Figure 1 schematically shows proposed boundaries for Iranian coastlines.

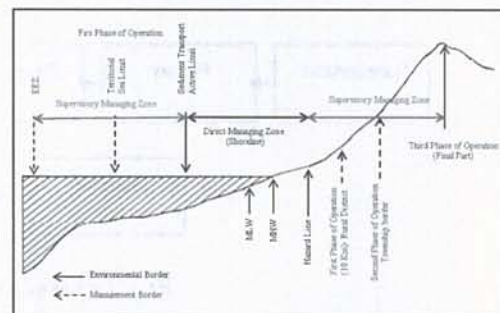


Fig.1 Proposed boundary for Iranian coastal areas

3. Conclusion

Selecting the boundary of hydrological basin of rivers as the management boundary in land results a very vast domain which makes the managing plan time consuming and many arrangements are required; especially in the south of country whose basins are very broad. Therefore, this project is divided to three phases. In phase one, the program is conducted up to the villages boundaries and after 5 years it will be extended to the towns in phase two and finally it will be extended to the border of basin boundaries in phase three during 10 years. In the first phase of ICZM studies, the area up to the distance of 10 km from shoreline or village boundary is employed as the domain of

studies for appropriate application of land. The boundary was specified on the basic maps based on some criteria such as village boundary, main roads, boundaries of strategic and protected areas, uniformity and simplicity of employing data during process procedures. In the sea side, selecting EEZ as the managing margin leads to an extensive area in the sea that should be divided to some phases, same as land side, to ease the required procedures for completing the project. In the southern coastlines, the first phase considers the area between active sediment transport zone and the territorial sea limit and the study area of phase two starts from the territorial sea limit and ends at in the boundary of EEZ or agreed boundary of countries. In the northern coastlines, the sea side will be investigated in two phases. The boundaries will be defined after defining the legal regime of the Caspian Sea.

A pilot survey of managing coastal resources by choice experiments

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In many coastal regions, oil spills can be considered one of the most important and certainly the most noticeable forms of marine pollution. Efficient contingency management responding to oil spills on waters aiming at minimizing pollution effects on coastal resources turns out to be critically important. Such decision making highly depends on the importance attributed to different coastal economic and ecological resources. While economic uses can, in principal, be addressed by standard measures such as value added. Due to a missing of market in the real world for natural goods, they cannot be directly measured in money terms what increases the risk of being neglected in decision making. This paper evaluates these natural goods in a hypothetical market by using stated choice experiments. Oil spill management practice in German North Sea is used as an example. Results from a pilot survey show that during a combat process, beaches and eider ducks are of key concerns for households. An environmental friendly combat option has to come to a minor

cost for households. Moreover, households with less children, higher monthly income and a membership of environmental organization are more likely to state they are willing to pay for combat option. Despite that choice experiments require knowledge of designing questionnaire, statistical skills to deal with discrete choices and cost time for conducting a survey, such a method can offer useful information for decision makers to find cost effective combat strategy, also has wide application potential in the field of Integrated Coastal Zone Management.

The sediment characteristics of the tidal flats in the northern of the estuary of Beilunhe, Guangxi, China

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Beilun River estuary, an internal boundary water between China and Vietnam, is located the northwest of the Beibu Gulf, which plays an important role in the internal and external traffic and the economic development. The broad tidal flat of the estuary provides survival for a human, as a potential large-scale land resource. However, suffered from the storms and strong tidal-wave actions as well as the irregular exploitation, the beach area decreases and coastline landward retreats recently. To stimulate the sustainable development of the beach of the estuary, we need to better understand the sediment characteristics on the beach and the controlling factors.

The geomorphology of the estuary is characterized by sand island, coastal dam, tidal flat, tidal ridge and tidal grooves, in which the tidal flat is the emphasis for the research. Compiling the data from previous researches and the field investigation on sediment types, water table, vegetation, hydrodynamics, geomorphologic features, we summarized the two main types of sandy coast and muddy coast with two transects for each besides mangrove coast elsewhere. The sediments of the high intertidal zones along the transects F10 and F03 mainly compose of yellow middle-fine sand above 4 cm, and grey fine sand below in F10, dark grey in F03, which indicates the higher organic or humic content in sediments of the later. The material obviously accumulates where mangrove plants scatter. Mosaic tidal ridges and creeks distribute

in the middle intertidal zones and tidal flow cracks are marked in the low intertidal zones. Different from F10 and F03, the transects of F06 and F04 are characterized by the exposed base rock, detritus and shells in the high intertidal zones, fine sand, silt and silty clay in the low intertidal zones.

The most distinguished phenomenon is human impacts on the tidal flats in common. For example, the sediment patterns are strongly destroyed and recreated by people scraping clams and dredging, shown by the obvious signs on the tidal ridges and grooves. The new hydrodynamic system of the recreated micro-geomorphology would intensify the erosion together with the native tidal actions. In the middle intertidal zone of the transect F03, the large-scale purse seine intensifies the sediment deposition inside and the erosion outside. The deforestation has also accelerated the flat erosion without the mangrove protection. In all, the tidal flats in Beilun Estuary are dominated by sand sediments with mangrove scatters in the high zones, fine sand or silt with high organic or humic material content in the middle zones and silty clay in the low zones. Human activities strongly affect the sediment depositions and intensify the coastal erosions by destroying the vegetation proof and micro-geomorphology systems. We should full consider the features of the tidal flats and formulate the valid protection measures such as curing mangrove diseases, replanting to restore mangrove, prohibiting the arbitrary excavation to prevent the flat erosion for the sustainable development.

Lessons learned in the development of coastal management strategy for Trat Province, Thailand

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Trat Province is located in the east of Thailand and has borders with Cambodia to the east, and the Gulf of Thailand to the south. The second biggest island of Thailand is Koh Chang, belonging to this province, together with more

than 50 surrounding smaller islands, forms the popular tourist destination of Thailand. The Thai Government declared Mu Koh Chang as a special administrative zone for sustainable tourism development in 2002. An estimated 30% of the coral reef areas are within the jurisdiction of Mu Koh Chang National Park which was established in 1982. Mu Koh Chang was also selected as one of the demonstration sites for coral reef subcomponent under the UNEP/GEF Project on Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand. Pollution Control Department and relevant government agencies in consultation with local administration offices and local communities develop a management strategy for natural resource conservation, pollution control, reversing environmental degradation and best land uses in the coastal area of Trat Province. Based on the root cause analysis, the main environmental problems are solid waste, wastewater, coastal erosion, sediment load from coastal development, inappropriate land use in coastal area, unsustainable fisheries, inappropriate tourism activities and oil spill. The natural resources degradation includes coral reefs, seagrass beds, mangroves, terrestrial forest, sandy beaches, endangered species and fishery resources. Five management policies are proposed, i.e., solid waste management, wastewater management, land use management, coastal and marine resources management and sustainable tourism practices. Each management policy consists of five measures, i.e., scientific research support, promoting knowledge to support effective management of natural resources and environment, coordination and participation of relevant agencies, raising public awareness, improvement of laws and regulations for effective management, financial support for management and monitoring and evaluation. Under each proposed measure, there are projects/activities, priority, key agencies, supporting agencies, budget, key performance indicator (KPI) and status. There is a total of 245 proposed projects and needs about seventy million USD for implementation. Long-term financial support and better coordination among government agencies and stakeholders are important factors for sustainable use of coastal resources in the area.

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Iranian Oceanographic Buoy network

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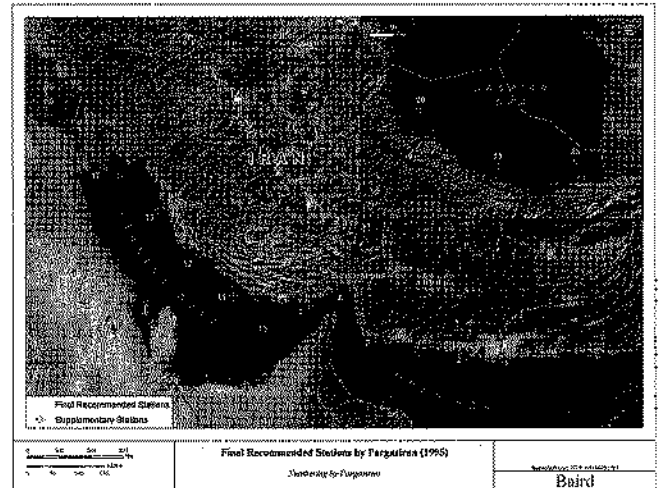
INTRODUCTION

Lack of sufficient marine information for engineers and others related, caused that Ports and Maritime Organization PMO as one of the major authorities in maritime and coastal engineering affairs in Iran to proceed solving this problem to perform its governing responsibilities. One of the measures taken into account was the related studies for measurement network of marine parameters, completion of this network and installment of necessary equipment in this respect. The observed coastal and offshore networks like meteorology stations and buoys provide the necessary data for meteorology and oceanography alarm systems as well as weather forecast of seas. Such networks are usually designed with multi functional purposes like gathering of general information for a better comprehension of coasts' nature and provision of immediate data for fishers, sailors and etc. This information as well as being used in optimum and secure designation of coastal and marine structures, can be applied in calibration and verification of meteorological and oceanographic hindcast systems and getting a better understanding over them while being utilized in calibration of wave models used for hindcast and forecast.

The previous Studies

The PMO gave the preliminary studies of the network in the early 1990's. At first, twenty six

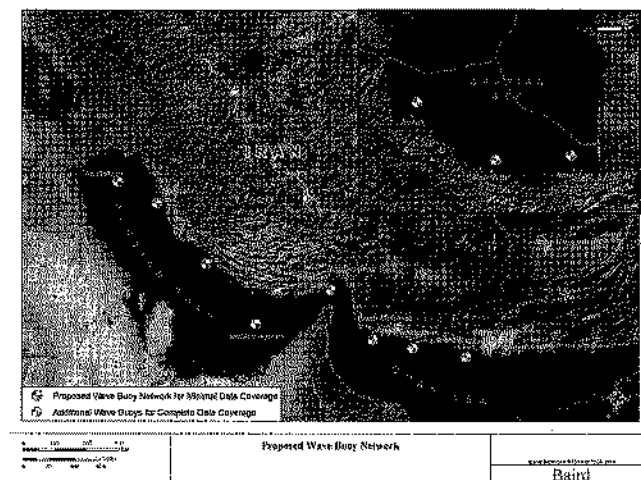
regions were chosen to be studied due to the significance of substructures. 13 of these regions suggested in Caspian Sea, Persian Gulf, Hormuz Strait and Oman Sea as the national buoy network. (Fig1)



Considering the experiences gained over the utilization of measurement equipment of marine parameters, development of coastal engineering, availability of modern equipment and with regards to accomplishment of Iranian Sea Waves Modeling Project (ISWM) which was defined by PMO, the preparation of optimum measurement network of marine parameters was scheduled for the consultants of Monitoring and Modeling studies of Sistan-Balouchestan coasts.

Those studies revealed that two principal factors affect the maritime measurements; Meteorological measurements and wave measurements. Meteorological studies, especially wind observations, provide the import data for numerical modeling of wave distribution which are used in forecasting and hindcasting of waves. Most errors in wave estimation related to the wind field. The proposed optimum network, using above information and gained experiences, provides a complete cover on Iranian coast lines and procures sufficient sources of data for model calibrations. In waters like Persian Gulf and Caspian Sea which are surrounded by mountains and high lands in some places, considerable effects of Orography are observed and winds calculated in coast lines may differ in value with those measured in offshore. On the other hand, the offshore winds have got extra importance in wave production. In this regard, a network consisting of 11 wavebuoys is suggested. The wavebuoys shall be capable of recording the meteorological

parameters as well. The proposed network is so designed that it can provide a full series of information. However the cost incurred by their preparation is not regarded as an effective factor. It should be mentioned that in the preparation of the above project, items like satellite tracks for recording marine parameters is taken into consideration. The buoys' layouts are recommended to be performed far from the coasts. Fig2



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Land use planning in Iran ICZM plan

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Abstract

Undoubtedly, the most principal objective of Integrated Coastal Zone Management (ICZM) is achieving sustainable development in coastal zones. Thereupon, Land-use planning of the Iranian coastal areas is formulated with a view to provide a proper ground for the execution of Integrated Coastal Zone Management as well as zoning of the activities commensurate with the

ecosystem of Iranian coastal areas. Dealing with the issues such as: coastal environment, infrastructure, population, fisheries and etc, land-use planning is aimed at orchestrating existing and future programs, protection of natural habitats and striking a balance between benefits derived from development and safeguarding the coastal areas. This paper intends to state necessities, objectives and methodology of the studies conducted regarding the land-use planning studies in Integrated Coastal Zone Management (ICZM) project and provide the findings of the said studies.

Keywords: ICZM, coastal areas, land-use, sustainable development, Methodology

The Aggregate Sediments Particle Size in the Changjiang Estuary

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The in-situ observation of fine grain size, aggregate particle size, organic matters, metal cations in sediment and the related dynamic factors of the Changjiang Estuary were analyzed in February, 2006 and August, 2006, respectively. The results were shown that 1) The grain size of fine sediments was about 4.2~7.0 μ m, while the aggregate size was about 63.2 μ m. 2) The biggest aggregate size was about 107 μ m occurred with 0.4~0.7 m/s of current velocity. 3) The concentration of dissolve organic carbon (DOC) was decreased from Xuliujing river section to the downstream area, and there was not obvious phenomenon occurred in the vertical distribution of DOC. However, the concentration of particle organic carbon (POC) was increased from Xuliujing river section to the downstream area, and there was an increased trend for the concentration of POC from the river bottom to the water surface. 4) The concentration of metal cations was affected by the tidal flow and surfacial runoff in the Changjiang Estuary. In the Turbidity Maximum, the concentration of metal cations was ranged from 40mmol/L to 110mmol/L in the flood season and from 150mmol/L to 260mmol/L in the dry season, respectively. 5) The flocculation of fine grain sediments were occurred in the combined effects of the sediment

size, current velocity, the concentration of the organic matters and the metal cations.

Reclaimed water for irrigation and other applications

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Wastewater reuse has drawn increasing attention worldwide as an integral part of water resource management due to increasing scarcity of freshwater resources and growing environmental awareness. Significant development of irrigation practices with recycled water has occurred over the last 20 years. Reclaimed water has been used for landscape and agricultural irrigation all over the world, and these practices have been documented as an effective method to use water resources wisely and efficiently.

Several technologies, ranging from conventional secondary treatment and natural treatment systems to advanced tertiary treatment and disinfection, are employed in this process. New policies and regulations also facilitate and stimulate the water reuse system. In spite of numerous environmental benefits, there are still some health issues in terms of reusing wastewater. As such, the choice of appropriate wastewater treatment and implementation of sound irrigation practices is very important, and the local government or environmental authorities should develop further relevant guidelines that give quality criteria and advice on how effluent should be treated and reused for different purposes.

Under the stewardship of sustainable development, growing environmental awareness and the increasing scarcity of freshwater resources, wastewater reuse will be accepted and practiced by more and more regions. Chongming Island lies in the estuary of the Yangtze River and western coast of the Pacific Ocean, and has been positioned as an 'eco-island' which is targeted by the government for sustainable development. It is therefore of great importance to implement water reclamation and reuse as a part of integrated watershed management strategies. The practice of reclaimed domestic water for agriculture and

landscape irrigation in Qianwei Village of Chongming Island is a good system for demonstrating how to use water resources efficiently, and how to conserve water resources as part of a community-based project.

Observations of sediment and morphodynamic processes on the subaqueous bedforms during the 1997 dry season at the upper South Channel of the Changjiang River estuary, China

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Field observational studies were carried out in order to improve our understandings of the fundamental sediment and morphodynamic processes on the subaqueous bedforms during the 1997 dry season at the upper South Channel of the Changjiang River estuary, China. Water surface elevation, near surface tidal current speed and direction were measured by a 174 SSM current meter at the 3 minute interval for 14 hours at the site NG. Near bottom tidal current speed and direction at the site NG were measured by using a SL9 electronic-magnetic current meter at the 30 minute interval for 10 hours. Vertical profiles of suspended sediment concentration were measured by using an Acoustic Suspended Sediment Monitor there. A total of 48 water samples were collected at 0.6H, 0.8H, and 1.0H (H: the total water depth), respectively. Suspended sediment concentration was analyzed for those samples with the standard filters in the laboratory. The transverse profiles over the subaqueous bedforms were recorded by a Thermal Depth Recorder of Inner Space 449M and their plane forms by a Sonar Sidescan 3050L, Geoacoustics, UK. A total of 6 bed sediment samples were grabbed and analyzed for their particle sizes with the standard sieves and siphons in the laboratory. Analyses of those results show that: (1) tidal asymmetries are shown by longer ebb tidal duration and stronger ebb tidal current speed; (2) suspended sediment concentration at the flood tide is higher than at the ebb tide; (3) three different periods (4.2 hours, 35 minutes and 2 minutes) of the bottom suspended sediment concentration events might correspond to several different types of hydrodynamic forces driving the bed sediment resuspension; (4) three different types of the subaqueous bedform states

are classified as ripple, small scale dune, and medium scale dune, respectively; (5) sediment processes on the subaqueous bedforms are dominated by burst-like turbulence causing resuspension of bed sediments with a period of 2 minutes; and (6) three different types of transverse dunes (medium grain size: 0.088 mm) are classified as small straight-crested (27%), medium parabolic-crested (50%), and large crescent (23%). These findings suggest a potential conceptual model for the formation of subaqueous bedforms in coarse silt and very fine sand with more than 20% of fine sands (mean grain size coarser than 0.125 mm) in a semi-diurnal tidal estuary.

Keywords: sediment; morphodynamic; process; subaqueous bedforms; the Changjiang River estuary

Session - 3

**Large River Dialogs - Water Quality,
Total Load Controls and Management**

Watershed influences on fluvial and internal loadings of Methylmercury in Near-Shore marine systems

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Coastal embayments and associated watersheds are contaminated with mercury (Hg) from modern discharges and the pollution legacy of the Industrial Revolution, and there is concern related to the transport, transformation, and fate of toxic methylmercury (MeHg) in these systems. Here, we present a well-constrained assessment of the behavior and fate of Hg and MeHg in the watersheds, coastal waters, and sediments of New York Harbor (NYH) and Long Island Sound (LIS) in the northeastern United States. Both of these "urban estuaries" support active commercial and recreational fisheries, and are impacted significantly by heavy metals, organic carbon, and nutrient loadings from their watersheds. Rivers are the primary source of Hg to both systems (60-70% of total inputs), with lesser inputs from water pollution control facilities and direct atmospheric deposition. Most (60-70%) of the fluvial Hg input to the Sound can be attributed to atmospheric deposition and subsequent leaching from the watershed, whereas runoff of atmospheric Hg to the Harbor is less certain (22-69% of fluvial flux). MeHg in coastal marine systems is derived from production in the watershed and *in situ*. Fluvial loadings of MeHg to NYH ($18 \pm 3 \text{ mol y}^{-1}$) are similar to those in LIS (15 ± 5) and not unexpected given the comparable sizes of their watersheds (~42000 km²) and similar land use. Rates of *in situ* sedimentary production and mobilization of MeHg also are comparable between NYH ($16 \pm 8 \text{ nmol m}^{-2} \text{ y}^{-1}$) and LIS (17 ± 6). This result is surprising because loadings of inorganic Hg (Hg(II)) substrate to sediments of NYH ($1640 \text{ nmol m}^{-2} \text{ y}^{-1}$) are about 8× greater than those in LIS (210). This indicates that Hg methylation and/or MeHg mobilization is inhibited in sediments of the Harbor relative to the Sound. Organic matter largely controls the sedimentwater partitioning and bioavailability of Hg(II) to methylating bacteria in both systems; partitioning coefficients (K_d) for MeHg and Hg(II) are related positively to the organic content of sediments with less than 10 μM dissolved sulfide.

Potential gross rates of Hg methylation, assayed by experimental addition of an isotopic tracer (²⁰³Hg) to intact sediment cores, are related inversely with K_d of Hg(II) in both LIS and NYH. However, K_d values for MeHg and Hg(II) in sediments of NYH are about 10× greater than those in deposits of LIS and the adjacent continental shelf, suggesting differences in the affinity of Hg for allochthonous (Harbor) and planktonic organic material (LIS and shelf). Dissolved sulfide affects the speciation and inhibits methylation of Hg(II) in both systems. Hence, it appears that loadings of allochthonous organic matter (terrestrial and/or sewage) to the Harbor, as well as associated production of sulfide by benthic respiration of this material, reduces the bioavailability of Hg and attenuates MeHg production in the Harbor relative to LIS. Watershed inputs of labile organic matter and nutrients also affect distributions of dissolved oxygen in coastal marine systems and thereby influence the mobilization of MeHg from sediments. Flux chamber investigations show that sedimentwater exchange of MeHg is largely diffusional when dissolved oxygen is less than about 80% saturation and enhanced at greater levels, which may be linked to increased abundance and/or activity of infauna that irrigate sediment. Thus, management programs intended to minimize allochthonous organic matter and nutrient loadings to coastal systems, in an attempt to curb eutrophication and hypoxia/anoxia in the water column, may inadvertently enhance the production and mobilization of MeHg from underlying deposits by both reducing the reservoir of organic material and sulfide and increasing the abundance and activity of infauna.

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Some issues on water resources system of the Changjiang River Delta in China

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Water resources system is a complicated large system, which contains certain regional background, as well as specific framework, function and dynamic balance. The Changjiang River Delta is a very important area in China. As the local water resources are concerned, the Delta is an area lack of water as a matter of fact. The water resources system of the Delta experiences a long, intricate and degenerate period. The lacking of water due to resources shortage in 1950's changes into that due to water quality from 1980's. Furthermore the status of water shortage sharpens gradually. The representations are summarized as follows: firstly, the discharge amount of wastewater and polluted water is large all along. Secondly, the pollution status of rivers, which involve the Changjiang River, the Grand Canal, the rivers in city and the rivers in small towns and villages, is noticeable. Thirdly, water quality of Taihu Lake is worth of more attention. Therefore, the countermeasures on the reconditioning and regulating of water resources system in the Delta demands the following new strategies, such as to

treat the rivers, the lakes and the seas as an overall system, to improve, harmonize and counterpoise water resources system carrying capacity, to implement the integrated management of water resources, which means the integrated management of drainage area along with the regional area, especially the integrated management of city water, and to carry on water saving and scientific using to increase the efficiency of water use, and so on. Consequently, human can coexist with water harmoniously in the Delta. And the objective to ensure the sustainable social and economic development with the sustainable usage of water resources can be implemented.

Simulation of coastal currents and river discharges in the South-eastern Black Sea

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In this study, development and evaluation of buoyant river plumes under the influence of the coastal currents and the guidance of topography in the south eastern Black Sea coast (Solaklı and SÜrmene) rivers were analyzed. For simulation, the rivers are inputted as source of zero salinity in computer based simulation model CARDINAL, which uses depth averaged shallow water equation for two-dimensional conditions and the equations of non-steady boundary layer for three-dimensional conditions. The river plumes are examined with realistic topography and idealized wind conditions. In order to check accuracy of the simulation, temperature, salinity, current speed and directions were measured in 22 stations and then density was calculated by using UNESCO formulae. Comparison of the measurements and modeling of currents showed good agreement. When both buoyancy and wind are employed as external forcing, the circulation is influenced by the opposing tendencies for stratification. The present findings suggest that transport of low salinity waters depends on buoyancy in the vicinity of rivers and wind components away from river mouths.

Remotely-sensed suspended sediment dynamics in the Yangtze River Estuary

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The Yangtze River estuary is a typical example of extremely turbid water-suspended sediment dominated case II water. Suspended sediment concentration (SSC) presents remarkable variability of temporal-spatial distribution with the alternations of semi-monthly spring/neap tidal cycle and irregular semi-diurnal flood/ebb tide in the estuary. Moreover, the concentration distribution is greatly influenced by fluvial sediment discharges with dry/wet season variation. The range of SSC is generally about from 100mg/l to even 2500mg/l more or less. However, costly conventional investigations can not be conducted frequently so that it is hard to better understand sediment dynamics in temporal-spatial distribution. Remote sensing approach, offering unique advantages of synoptic, regular and repetitive views of study areas, has demonstrated great capabilities and potentials in SSC retrievals. ENVISAT/MERIS sensor from European Space Agency is currently more suitable for coastal water application than others due to its high spatial resolution and numbers of visible wavebands. However, MERIS-derived SSC magnitude with standard algorithm is greatly underestimated in the estuarine water through the comparison to field-truth data. Two main reasons could involve atmosphere "over-correction" and the SSC retrieval algorithm of MERIS that is applicable for lower turbid water (e.g. European coastal water) and does not work well in extremely-turbid sediment dominated water (e.g. the Yangtze River estuarine water). In this work, an effort to re-process MERIS Top-Of-Atmosphere (TOA) radiance, by employing radiative transfer model of atmospheric correction (e.g. MODTRAN) so as to subtract atmosphere contribution and work out water-leaving reflectance, and quantitatively retrieve SSC from MERIS data with the regional algorithm based on field measurements in situ and tank experiments is made. By comparison, it is found that the relative errors between MERIS-retrieved SSC and simultaneously in situ measured SSC are less than 0.5-0.8. Furthermore, a series of MERIS images captured during spring/neap tidal cycle, flood/ebb tide in wet/dry season from 2003 to 2007 are processed and

retrieved into a series of SSC thematic mappings. Synoptic overviews from those mappings will be helpful to the sediment dynamics in the Yangtze River estuary.

Tide, tidal current and sediment transport in the Mahakam Estuary, east Kalimantan, Indonesia

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The Mahakam Delta, located on the east coast of Kalimantan, Indonesia, is an active delta system which has formed in humid tropical environment under condition of relatively large tidal amplitude, low wave-energy, and large fluvial input. The Mahakam estuary is influenced by tide and tidal current from the Makassar Strait. In this study, we developed a numerical model to study the dynamics of tide, tidal current and cohesive sediment transport in this region.

A fully three-dimensional finite difference baroclinic model system for hydrodynamics and cohesive sediment transport is described. The hydrodynamic model is based on the hydrostatic and Boussinesq approximations. The simulation of cohesive sediment transport processes is performed solving the 3D-conservative advection-diffusion equation. The model was run for 15 days (27 June 12 July 2000) driven by tidal forcing at the open boundary and river discharge at the upstream. The observed temperature, salinity, and suspended sediment data were available for the start of the simulation. Good agreement was found between model results and observed temporal and spatial variations in water elevation, currents, and suspended sediment concentration (SSC) in the Mahakam Estuary.

The calculated elevation and current velocity agree well with the observed elevation (maximum amplitude of about 0.6 m) and currents velocity (maximum amplitude of about 0.15 ms⁻¹) in the Mahakam Estuary. The root mean squared error in the model elevation and current velocity are 0.15 m and 0.05 ms⁻¹, respectively. Wave form is changed from the mouth of the estuary to upstream. The natural oscillation period of the Mahakam Delta T_c is 19 hrs. T_c is near the period

of diurnal tide and far from that of semi-diurnal tide. The decrease of semi-diurnal M_2 and S_2 amplitudes in the estuary is larger than that of diurnal (K_1 , O_1) ones. The M_2 tidal current amplitude follows the M_2 tidal amplitude distribution, peaking at mid estuary, whereas M_2 tidal elevation amplitude is greatest farther to upstream. In the Mahakam estuary, tidal elevation amplitude distortion (M_2/M_1) is less than 0.3. For current amplitude, M_2/M_1 reaches a maximum of 1.85 about 40 km from the head of the estuary. During the flood tidal condition, the tidal current advected the higher salinity water into the estuary, resulting in a relatively large salinity gradient inside the estuary. During the ebb tidal condition, the combined gravitational and tidal flows moved the low salinity water seaward from the upstream, leading to a rapid decrease of salinity and near the mouth of the estuary.

The simulation results of suspended sediment transport in the Mahakam Estuary nearly followed the salinity transport. The suspended sediments were mainly transported from Mahakam river towards Muara Pegah and Muara Jawa than Muara Berau and Muara Bayur. The SSC at Muara Jawa, Muara Pegah, and Muara Kaeli was mainly influenced by river discharge, meanwhile at Muara Bayur it was dominated by tidal current

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Water quality in the upper Mississippi River: Historic trends, present status, and emerging concerns

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The upper Mississippi River receives contaminants from agricultural, industrial, and municipal sources, including metals, pesticides, synthetic industrial compounds, and many other chemicals. Concentrations of contaminants from industrial sources and sewage treatments plants

are generally greatest in reaches within and downstream of metropolitan urban areas. Lake Pepin, a natural lake extending 75-110 km downstream from the Twin Cities metropolitan area (Minneapolis and St. Paul, Minnesota), traps particles and associated contaminants, decreasing the transport of potentially harmful pollutants from the metropolitan area, the Minnesota River basin, and other upstream sources into the reach of river downstream from the lake.

Contamination of the river with mercury and lead rapidly followed settlement of the basin by European immigrants in the mid 1800s. Moreover, in the 1900s, the river was also contaminated with synthetic organochlorines. Certain contaminants including methylmercury, PCBs, DDT and its degradation products readily bioaccumulate and can biomagnify to harmful concentrations in organisms in upper trophic levels of aquatic food webs. Contamination of the aquatic food web with PCBs was the probable cause of a sudden decline in populations of mink (*Mustela vison*) on the Upper Mississippi River National Wildlife and Fish Refuge during 1959-1965. Institutional responses to bioaccumulative contaminants have included reduction of point source discharges and issuance of fish consumption advice. The US Federal Clean Water Act, passed in 1972, has effectively reduced discharges of certain industrial pollutants from point sources to the river, thereby decreasing the exposure of fish and wildlife to compounds, such as PCBs, lead and methylmercury. The decline in PCB contamination of riverine fish after the ban on their production and related efforts to reduce the release of PCBs into the environment was followed by the gradual recovery of mink populations in the Refuge. Similarly, the abundance of fish-eating birds, such as bald eagles (*Haliaeetus leucocephalus*) and double-crested cormorants (*Phalacrocorax auritus*), along the river corridor has increased since the banning of DDT and other eggshell-thinning insecticides, paralleling national (US) population trends for these species.

Some sources of contaminants, particularly nonpoint sources, are not subject to the regulatory provisions of the Clean Water Act. Much of the basin is intensively cultivated for corn and soybean production, and tributary streams receive agricultural chemicals and their degradation products via surface runoff and groundwater flow, acting as point sources of agricultural chemicals to the main stem river. The upper Mississippi River basin upstream of its confluence with the

Missouri River contributes much or most of the load of many pesticides present in the Mississippi River, even though the flow of the upper Mississippi at that location is only about one-fifth of that from the entire Mississippi River basin. High nutrient loadings have caused a number of adverse effects, including blooms of noxious algae. The export of nutrients (particularly nitrogen) from the upper Mississippi River basin has contributed to hypoxia and associated mortalities of biota in the Gulf of Mexico. Ammonia has been implicated in die-offs of fingernail clams (*Musculium transversum*), an important component of the benthic food web, in extensive reaches of the upper Mississippi River. The modern river also receives inputs of hundreds of recently synthesized chemicals from multiple sources, and the behavior and potential ecotoxicological significance of many of these compounds are largely unknown. Emerging contaminants (e.g., perfluorochemicals, pharmaceuticals, personal care products) and recently discovered mechanisms of adverse biological effects (e.g., endocrine disruption) pose substantial continuing challenges for scientists and environmental managers concerned with the ecological health of this complex ecosystem.

The fish mercury project: monitoring to support adaptive water quality management and risk communication in the San Francisco Bay and Sacramento-San Joaquin delta region (USA)

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The San Francisco Bay-Sacramento/San Joaquin Delta (Bay-Delta) watershed in California includes thousands of miles of rivers and streams and thousands of lakes and reservoirs. This vast region supports a large and growing human population (currently over 9 million). Many of these people catch and eat fish from the watershed. Unfortunately, fish contamination in the watershed is a serious environmental and public health concern. Intensive gold and mercury

mining across the watershed has left a legacy of mercury contamination, and many fish populations are tainted with mercury. In the Bay-Delta and surrounding areas, the contamination is among the most extensive in all of California. An additional cause for concern relates to the ambitious habitat restoration programs underway in the Bay-Delta ecosystem. Both California and U.S. agencies are investing considerable resources in restoring wetlands and other aquatic habitats, a process expected to provide substantial benefits for fish and wildlife populations. However, exacerbation of the existing mercury problem is a potential side effect of restoration activities because wetlands and newly flooded habitats could accelerate mercury uptake into the food chain.

A Mercury Strategy for the watershed has been developed to integrate mercury investigations, ecological restoration, management, and risk assessment. Monitoring of mercury in fish is a key element of the Strategy, providing an essential foundation for evaluating the effect of management actions and for reducing exposure in the near-term through providing guidance to the public on safe fish consumption. The Fish Mercury Project (www.sfei.org/cmr/fishmercury) is a three-year effort begun in 2005 to implement elements of the Mercury Strategy related to monitoring mercury in fish. The FMP is conducting the most extensive monitoring to date of mercury in sport fish in the Delta region. In 2005, the FMP and other smaller programs collected over 2000 fish from 22 species and 69 popular fishing locations. Mercury concentrations in fish varied significantly among species, locations, and with fish size. Overall, largemouth bass was the most contaminated of the target species, and bluegill and redear sunfish were the least. The least contaminated locations sampled in 2005 were mainly in the central and southern Delta. The most contaminated locations were along the mainstem and tributaries of the Sacramento and San Joaquin Rivers, as well as the Cosumnes River. For many species (including largemouth bass, Sacramento sucker, and Sacramento pikeminnow), larger and older fish had higher concentrations of mercury.

The FMP is also performing the most extensive monitoring ever conducted of small fish in the watershed. These "biosentinels" are effective indicators of fine-scale spatial and temporal variation in mercury uptake into the food web. Biosentinel fish were collected from 50 sites throughout the watershed, especially near large

wetland restoration projects. Encouraging results were obtained from the Napa Marsh area, the site of some of the most extensive wetland restoration activities in the watershed, including projects initiated in 1995, 2002, and 2006. Biosentinel fish collected in 2006 from a Napa Marsh salt pond that was opened to tidal action earlier that year had the lowest mercury observed for the indicator species across the entire watershed. Fish from other locations in this area also had low concentrations in both 2005 and 2006. These findings indicate that some restoration projects may be associated with reduced, rather than increased, mercury accumulation in the food chain. Other significant findings from the biosentinel work to date include the observation that seasonal variation in mercury uptake seems associated with episodic flooding of normally dry soils, documentation of significant year-to-year variation, and an improved general understanding of the spatial pattern of accumulation across the watershed.

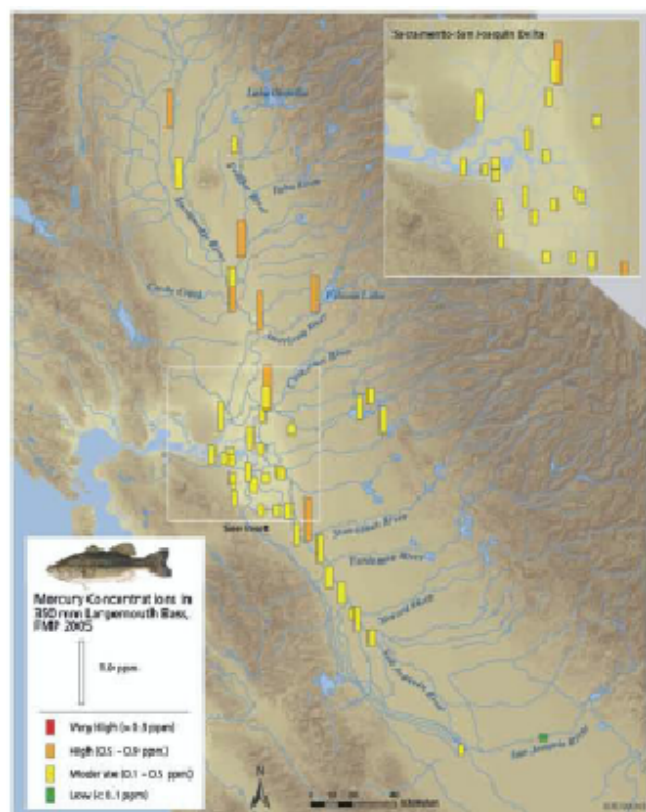


Fig. 1 Mercury concentrations in largemouth bass in the study area in 2005

Increased eutrophication in the northern coastal waters of the South China Sea revealed by sedimentary records

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The sedimentary organic matter in coastal areas mainly originates from primary and secondary production within the ecosystem, terrestrial inputs and bacterial production in the water and sediments. The relative significance of these sources is determined by local environmental factors, such as climate, hydrodynamic conditions and nutrient supply. Changes in any of these factors will result in the change of sedimentary organic matter. Algal blooms or/and red tides caused by eutrophication occurred at some given environmental condition and may imprint markers in the sedimentary records.

The total organic carbon (TOC), total nitrogen (TN) and stable isotope values ($\delta^{13}\text{C}_{\text{org}}$ and $\delta^{15}\text{N}$) from the dating sediment cores were analyzed. The profiles of TOC, TN, C/N, $\delta^{13}\text{C}_{\text{org}}$ and $\delta^{15}\text{N}$ indicate that terrestrial organic matter downs from 50% to 20% of TOC in the Pearl River estuary while Dapeng Bay has no obvious terrestrial organic matter input. The highest TOC occurred in middle part of the estuary because of high precipitation of terrestrial organic matter. Algal-derived organic carbon content increases with the time in Dapeng Bay. This kind of increase is caused by enhancement of primary marine productivity due to more nutrient input.

The sediment core taken from Dapeng Bay reveals that diatom and dinoflagellate productivity which is reflected in the biogenic silica (BSi) and dinosterol concentrations respectively, increased gradually starting in 1940 and accelerated after 1965, especially between 1980 and 2000, indicating that algal blooms and/or red tides caused by eutrophication increased during this time. The abundance of coprostanol, which reflects domestic sewage discharge, and the terrestrial biomarkers (long-chain fatty acids and fatty alcohols and sitosterol) exhibit similar temporal changes with the primary production, showing that the enhanced eutrophication resulted from increased anthropogenic activities in the northern coastal waters of the South China Sea (SCS) in recent decades.

Studying on formation dynamic mechanism of the freshwater zone near the MeiMaoSha in the Changjiang Estuary

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The observation data confirms the existence of a longshore freshwater zone in Meimaosha area in the Changjiang Estuary during dry season. Used the three-dimensional numerical model ECOM and considered the multiple dynamic factors, this paper focuses on the formation dynamic mechanism of the freshwater ribbon zone. The calculated current velocity, direction, and salinity well match the observed data, and the phenomena of intermissive appearance of the freshwater zone at upper Meimaosha during ebb current in spring tide is produced. Validation results qualify the model of correctly simulating the hydrodynamic process in the Changjiang Estuary. As shown in the residual current field, the residual current in Meimaosha area in the south passage is mostly come into being the river discharge. Upriver freshwater passing here is the main cause of the formation of the Meimaosha freshwater zone. Under the interaction of river discharge and tidal current, the freshwater zone is temporal and spatial variation. As heavy saltwater intrusion from out sea during flood current, the freshwater zone disappeared. While the upper low salinity water is advected to the area during ebb current, the salinity reduces. The oscillation of tidal current during spring tide is much greater than the one during neap tide, it can easily bring freshwater from farther upper reaches into the area and the time interval freshwater appears. Although the saltwater intrusion from out sea is strengthened in spring tide and the salinity is serious increases during flood current, the minimum salinity during ebb current in spring tide is still lower than the one during ebb current in neap tide. The freshwater zone forms when the river discharge becomes larger, and disappears when the river discharge becomes smaller. The interaction of river discharge and tidal pump is the primary formation dynamic mechanism of the MeiMaoSha freshwater zone in the South Passage.

Reservoir de-siltation and rapid mud deposition in river and estuary - risks to ecosystem health and human uses

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The water in the estuarine portion of major river Periyar of Cochin backwater system experienced rapid changes to red in 2007. The discoloration, taste and smell changes along with high turbidity were resulted from the unprecedented action of emptying a major reservoir and the running down of the decomposed bio-waste and sediments collected in the reservoir for 18 years. Pumping and distribution of the muddy water employing the traditional treatment methods using chlorine and alum seemed to be insufficient for human consumption. Though the present crisis occurred only on account of the negligence on the part of the officials to clean the reservoir once in two years- but cleaning was never done in the last 18 years; similar openings of dam shutters can occur due to the heavy precipitations associated with climate changes. It is worthy to examine the water quality changes in the river and estuary and the manner in which the 40 lakh people depending on this river for potable water reacted to the alarming situations of the spreading of waterborne diseases and also to look into the urgent precautionary measures taken by the authorities. The turbidity level in the river had varied between 58 and 68 ntu and after treatment with alum and lime, the water quality level returned to the acceptable limits (4 - 7) ntu. The local NGOs after waiting in vain for some help to come by from the authorities concerned had to approach the judiciary for the release of water from another dam to remove the muddy water and for a direction to the government to constitute a high-power monitoring committee to take appropriate action and for the release sufficient funds to meet the situation. Growing public discontent forced the Government to release water from two other dams to check the turbidity. To pre-empt eutrophication, the authorities were forced by NGOs to step up inflow to stabilize the pH factor and oxygen content in the estuary and authorities had diverted water from another reservoir. It is high time for authorities to device mitigation plans for dam shutter openings anticipated with heavier monsoons linked with global warming.

Origin of particulate organic matter in the Yura River, Japan

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Riverine particulate organic matter (POM) discharges into estuaries. Some of riverine POM is utilized by estuarine organisms such as bivalves and amphipods, and the other is decomposed by heterotrophic microorganisms with oxygen consumption in estuaries. As the fate of riverine POM depends on its origin, understanding of the sources of riverine POM is important for environmental conservation in estuaries. In this study, therefore, we focused on the elucidation of origins of POM in river waters. Our observations were conducted along the Yura River, which discharges into the Sea of Japan and is typical of rivers in southwest Japan. The Yura River has a total length of 146 km and a total drainage area of 1882 km². Forest covers much of the watershed areas from upstream to midstream, while from midstream to downstream land usage is agricultural and urban. Riverine POM samples were collected from 11 sites along the main stream of the Yura River in May and November 2006, and were analyzed for carbon and nitrogen stable isotopic compositions. Isotopic compositions and C/N ratios of POM suggested that riverine POM originated mainly from attached algae, phytoplankton and anthropogenic materials. Assuming that each POM source mixed conservatively, the fraction of each POM source can be estimated using a three source mixing model. POM was mainly dominated by attached algae in the upstream area, and phytoplankton and anthropogenic materials increased in the midstream area (including dam) and in the downstream area, respectively, during both months (see figure). The calculated carbon and nitrogen concentrations of anthropogenic POM in river waters were positively correlated ($r^2 > 0.7$) with the population density. This indicates that the increase of those concentrations were due to the increase of population density. In May, phytoplanktonic matter showed high concentrations at sites in the midstream and downstream areas. This may be caused by phytoplankton input from rice paddy fields. Our study indicates that human activities in the river watershed account for about 50% of the total POM input into the estuarine ecosystem.

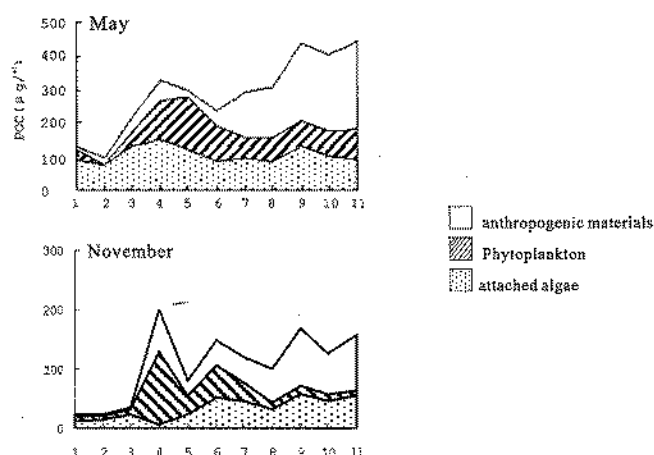


Figure Seasonal variation in the fraction of each POM source estimated from isotopic compositions. Stn. 1 is the most upstream and Stn. 11 is the most downstream. Stn. 4 is the dam

Riverine and wetland influences on methylmercury contamination of the aquatic food web in nearshore environments of Chequamegon Bay (Lake Superior, Wisconsin, USA)

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Mercury is a potent neurotoxin that is known to have developmental effects on humans and wildlife. The most toxic chemical form, methylmercury, is synthesized by naturally-occurring bacteria in aquatic ecosystems. Such bacteria thrive in oxic/anoxic interfaces that have abundant organic carbon supply and sulfate conditions typically found in wetland environments. Thus, tributaries and coastal regions with a significant wetland component in their watershed are particularly prone to elevated methylmercury concentrations in water, sediment, and the entire aquatic food web.

Lake Superior is the largest fresh water lake in the world by area, and is the deepest and coldest of the Laurentian Great Lakes of North America. The lake and its surrounding region are not heavily industrialized or populated, and are largely devoid of major atmospheric or aqueous point sources of mercury. Despite these characteristics, Lake Superior has regions with fish consumption advisories for certain long-lived fish species along its more populated and warmer southern margin. Our study objective was to determine the

relative role of contrasting coastal environments on supplying methylmercury to the lower aquatic food web. We examined the cycling and sources of mercury to a southern semi-enclosed embayment of Lake Superior (Chequamegon Bay), where the water is relatively shallow and warm compared to the majority of the lake.

We sampled the Bay at several contrasting locations to evaluate the relative contributions of wetland- versus non-wetland dominated coastal zones to water, sediments, and the lower portion of the aquatic food web. The principal sites included 1) two small wetland-dominated tributaries, 2) a wetland coastal margin (no tributary), and 3) two reference locations. Water, sediment, zooplankton, benthic macroinvertebrates, and small prey fish were collected over a 3-year period from five locations, and analyzed for total mercury, methylmercury, and stable isotopes of carbon and nitrogen.

Our results indicate that the lower food web of the wetland-influenced tributaries were highest in total and methylmercury content, followed by the marginal wetland, and the reference sites. Methylmercury concentrations observed in filtered water (site mean 0.05-0.2 ng/L), sediment (0.03-0.43 ng/g dry weight), zooplankton (22-66 ng/g), benthic invertebrates (15-55 ng/g), and age-1 yellow perch (61-153 ng/g) indicate bioaccumulation through the lower food web. Analyses of stable carbon isotopes in benthic invertebrates indicated that the highest methylmercury concentrations correlated with terrestrial (watershed) carbon sources rather than from in-lake cycling. Observed levels of methylmercury contamination in the Bay are greater than the bulk of Lake Superior, but lower relative to small lakes typical of central North America up to six times lower in the small prey fish.

Our findings suggest that tributaries draining extensive wetland-dominated watersheds may lead to significant exposure of biota to methylmercury in localized estuarine mixing environments, which are typically regions of high productivity, trophic transfer, and fish harvest. Even Lake Superior, with its low temperature and mercury content, appears to favor elevated fish mercury in its largest and oldest fish due to these localized wetland-tributary influences.

San Francisco Bay mercury loads: scientific information development and management response

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The State of California lists San Francisco Bay as mercury-impaired and a fish consumption advisory was issued in 1994. In the 1990s, management solutions were hampered by poorly defined loads. In response, the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) methodically completed research to determine the magnitude of loads from key pathways. Now, after eight years, RMP program scientists and collaborators have provided quantitative load estimates of atmospheric mercury deposition to the Bay (27 kg/y) (Tsai and Hoenicke 2001), of the large rivers (261 kg) (David et al. 2008), of the mining impacted Guadalupe River (140 kg) (McKee et al. 2005), and of an industrial urban tributary for a dry year (results not yet available). In parallel, the Regional Water Quality Control Board (RWQCB) developed a series of draft Total Maximum Daily Load Reports (2000, 2003, and 2004) that collated knowledge about mercury in the Bay and incorporated RMP research information year-by-year. The RWQCB prepared a Basin Plan Amendment that prescribed waste load allocations designed to remove impairment within 20 years (25% reduction from the large rivers; 50% reduction from urban runoff; 98% reduction from Guadalupe River; 33% reduction from municipal and industrial wastewater) (Looker 2006). Then a first-of-its-kind mercury budget for urban stormwater was developed that indicated historic and ongoing atmospheric deposition was the largest source to urban stormwater (45%), that erosion of natural soil mercury accounted for 27%, and that mercury spilled or volatilized as it is moved into the wastewater (transport to and processing in landfills and recycling facilities) accounted for 22% (McKee et al. 2006). Given little opportunity for improving waste management or recycling, it was concluded that mercury capture across large areas of the urban landscape would be most effective (street sweeping, drainage maintenance, and industrial area retrofit treatment). However, to achieve the prescribed waste load allocations in

20 years, perhaps wholesale stormwater treatment will be necessary in the absence of controlling atmospheric sources (Mangarella et al. 2006). Research is now beginning to focus on speciation (methyl and reactive mercury). This paper demonstrates the association between scientific information development and harmonizing a closely connected, highly urbanized, catchment-estuary system.

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Estimation of biomass resource from *Mytilus galloprovincialis* attached the vertical seawall at Osaka Bay in Japan

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The invasive mussel *Mytilus galloprovincialis* dominates at the vertical structure composing the coast in Japan. This species plays a role of water purification from taking the terrestrial polluting load. However, a lot of oxygen was consumed after dropping the feces of this species and mussel themselves to the bottom during the summer. This causes to the dissolved oxygen deficiency at the bottom.

In this study, we suggested that the harvesting of this species cut the load of mussel residue and improved the bottom condition. We estimated the standing stock of this species and examined the difference of attached biomass in relation to the environmental condition at Amagasaki Harbor, Osaka Bay, Japan. Amagasaki Harbor is a closed shape by the vertical seawall. Our previous results suggested that the dissolved oxygen deficiency occurred in the bottom of this Harbor during 7 months through the year. The seawall of Nishinomiya is a straight line form with 4 km long. The average depth is about 12 m. A large amount of mussels attaches on the surface of seawall. We investigated the standing stock of this mussel from 14 sites at Amagasaki Harbor and on Nishinomiya seawall on August 2007 and January 2008.

The Blue mussel *Mytilus galloprovincialis* and the Pygmy mussel *Xenostrobus securus* coexisted at Amagasaki Harbor in summer and no *M. galloprovincialis* was observed in winter. Therefore, it is considered that the mussels dropped out and died. The other side, three species: *M. galloprovincialis*, *X. securus* and the Green mussel *Perna viridis*, were found at the seawall of Nishinomiya even in winter.

We compared the difference in size of this mussel between at Amagasaki Harbor and Nishinomiya seawall. The mussel size at Amagasaki Harbor was larger than that in Nishinomiya seawall.

From this result, the larva of this mussel move into Amagasaki Harbor earlier than Nishinomiya seawall. The mussel size in Nishinomiya seawall grew by 30 mm from July to January.

When the annual harvesting time is made summer, the amount of biomass resource from Amagasaki Harbor and Nishinomiya seawall was Total Organic Carbon (TOC) 4.7 t and Total Nitrogen (TN) 830 kg, and this time is assumed winter, the quantity was TOC 87.6 kg and TN 13.8 kg.

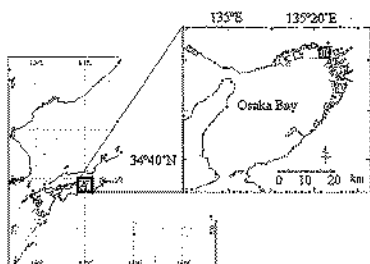


Figure1 Amagasaki Harbor and Nishinomiya seawall at Osaka bay in Japan

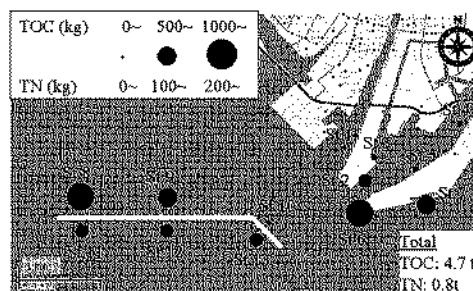


Figure2 The Amount of TOC and TN per the length seawall 1m at each sites in summer

Impact of damming and eutrophication on DSi: DIN ratio in river water, a case study of Yahagi River, Japan

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Dissolved silicate (DSi) is one of the key nutrients to determine structure of phytoplankton communities. In recent years, significant reductions in the transport of DSi from river have been reported after construction of dams, with severe consequences for food web structure in the coastal areas as diatoms are replaced by non-siliceous (potentially toxic) species. These issues are not a regional problem, but likely to occur in many freshwater and marine systems throughout the world.

To assess current status and possibility of Si depletion in Japanese river, variations of DSi and ratio to dissolved inorganic nitrogen (DSi:DIN ratio) were investigated in the Yahagi River, Japan over three years (from June 2000 to June 2003). DSi concentration and DSi:DIN ratio in the Yahagi River ranged from 75 to 254 M (average: 162 M) and from 0.74 to 4.3 (average: 2.3), respectively. Referring to the DSi:DIN ratio, there is a possibility of Si depletion in the Yahagi River and Mikawa Bay during the low flow period.

DSi:DIN ratio in the river were reduced by high DIN loading from the lower tributaries, and its effect was stronger during the low river discharge period. From November to May, the low water exchange rate of the dam water leads to diatom blooms and results in the reduction in DSi:DIN ratio in the river water.

It is suggested that the increased nitrogen loading from agricultural and urbanized catchments and lower river flow induced by the water utilization, brought about not only a decrease in the DSi supply to the coastal sea but also a reduction in the DSi:DIN ratio.

Suspended sediment dynamics at the Mekong Floodplains: data analysis

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Sediments are an essential part of the floodplain ecosystems providing nutrients for the primary and secondary production. The sediments are also an important part of the ecosystem processes in the Lower Mekong floodplains in Cambodia, including the Tonle Sap system and other floodplains downstream from Kratie. However, the present sediment dynamics there is still rather poorly understood, especially outside the Tonle Sap.

The Mekong region is developing with increasing

pace and especially hydropower construction is starting to boom in upstream countries, especially in Lao PDR and China. The impacts on the downstream sediment balance, by trapping the sediments in reservoirs, might be severe. Thus, it is highly important and timely to enhance the understanding of the present sediment dynamics in order to be able to predict the possible future impacts.

This paper aims to analyse the suspended sediment dynamics at the Lower Mekong floodplains in Cambodia downstream from Kratie based on the data from extensive field work during the last years, Mekong River Commission database and other relevant sources. Moreover, the upstream development impacts on the sediment balances are discussed and briefly analysed.

Assessment of shellfish farming ecosystem contamination due to watershed disturbances: the cases of Le Croisic and the Auray River (France)

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The European Union legal framework for shellfish water quality refers to the Directive 2006/115/CE. This Directive is based on the Water Framework Directive which specifies the use of an integrated approach for watershed management in order to reach a good chemical and ecological status of groundwater, surface and estuarine waters by 2015. The impacts of watershed disturbances are more and more blamed to contaminate shellfish farming ecosystem. These contaminations could be due to non-point source pollution including animal manure spreading or just flawed treatments of sewage. Therefore, it seems to be critical to use an integrated approach to study these processes. The aim of this study is to assess an integrated approach using the agro-hydrological model SWAT (Soil and Water Assessment Tool) in order to make a spatial analysis of pollutant transfers from the watersheds to the coastal waters. This method has been experimented on two shellfish farming areas on the west coast of France which are confronted to recurring problems of

deterioration of their coastal water quality.

The physically based model SWAT, developed by the Agricultural Research Service of the United State Department of Agriculture to predict the impacts of land management practices in large heterogeneous watersheds (Neitsch et al., 2002; Di Luzio et al., 2002), has been implemented on the different sub-watersheds of both areas to simulate the pollutant flows (mainly nitrogen, phosphorus, pesticides and bacteria). To calibrate and validate the different simulations, the simulated outputs have been compared to the water samplings from the monitoring gages. According to the Nash and Sutcliffe efficiency criterion (Nash and Sutcliffe, 1970), the simulated pollutant concentrations and flows are close to the measurements. Indeed, depending on which simulation, but the efficiency criteria range from 0.67 to 0.98. The simulations enabled to determine the sub-watersheds which contributed the most to the coastal water eutrophication and to the bacteriological pollution of these shellfish farming areas. Therefore, it is now possible to suggest priority areas of intervention for the actions of restoration of the coastal water quality. In a near future, this modelling tool is expected to be coupled with a hydrodynamic model in order to predict the dispersion of the pollutants in the coastal waters and to realise prediction scenarios with practice modifications on watersheds.

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Role of discharge regulation and over population on hydrochemistry and total loading of the Nile River and its estuary to Mediterranean Sea

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The Nile River is one of the North African rivers; opens on the SE Mediterranean Sea. The Nile River part in Egypt is the water course starting from a huge reservoir called Nasser and Nubian Lake in front of a man-made dam at Aswan at extreme south of Egypt, called the Aswan High Dam (AHD) and down to a distance of about 1000 km before reaching Cairo, the capital of Egypt. Then from there the river course bifurcates through the Nile Delta into two branches called Rosetta and Damietta Branches before reaching the sea. Currently, no discharge to the sea is occurring from the last branch due to blocking of its seaside end with a permanent earthen dam. The AHD regularly discharges the water that traveled downstream at a rate reaching 0.2 km/d. The direct discharge to the sea from Rosetta branch is occurring through a barrage called Edfina barrage. The population in Egypt now reaches 76 million inhabitants increasing in 2025 to about 95 million inhabitants. The current amount of freshwater supplies available to Egypt is from: 1- Nile river allocation at AHD 55.5 km³/y, according to 1959 agreement with Sudan. 2- ground water 2.9 km³/y. and 3- drainage water reuses 7.3 km³/y. So the total is 65.7 km³/y, meaning Egypt is now poor in water (as each inhabitant share is less than 1000 m³/y). Water use estimates for the Nile River in Egypt in agriculture is 45 km³/y, which is the main water user in Egypt. In the Upper Egypt an estimation of about 3.75 and 0.312 km³/y of agricultural drainage water and industrial liquid outlets respectively are discharged into the Nile River through 67 discharges. With such large upstream pollution loads, one might expect the Nile at Cairo to be very highly polluted, but this is alleviated by the huge water flow of the river which takes the pollutants away quite effectively. In the Nile Delta region, there are several hot spots of pollution discharging their waste effluents directly into the river.

The present work is an assessment of the environmental state of the Nile River (at Aswan, north Cairo besides its lower reach Rosetta Branch) and Rosetta Estuary and total loading to the Mediterranean Sea.

Using hyperspectral data to estimate suspended sediments concentration in the Pearl River Estuary

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The Pearl River is one of the largest rivers of China. The Pearl River delta has been experiencing a rapid development of industry, aquaculture, transportation et al., and the water quality of estuarine waters is changing greatly. Suspended sediments (SS) not only influence water quality, but also play an important role in coastline evolution. To develop advanced remote sensing approaches to monitor SS, several cruises were conducted at the Pearl River estuary (PRE), water samples were collected for measuring the SS concentration (SSC) and remote sensing reflectance data were simultaneously collected. Based on the first-order derivative value at about 605 nm, a derivative algorithm was developed to estimate SSC and applied with the Hyperion/EO-1 images, and a good capability of estimation was demonstrated in the PRE waters.

A comparison of macroinvertebrate production between main-channel border and backwater habitats in the upper Mississippi River

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Large rivers, such as the Upper Mississippi River (UMR), are among the most productive freshwater ecosystems. Macroinvertebrate production is a primary energy pathway to riverine fish. Much of our existing understanding of macroinvertebrate standing crops in the UMR has been derived from sampling soft sediments, however, many macroinvertebrates are unable to colonize these highly disturbed habitats in the main channel of the UMR. Current channel alignment structures and other natural hard substrates (e.g., tree roots, logs and branches) may provide stable, alternative habitats that support greater levels of macroinvertebrate production. The primary objective of this study was to investigate the colonization and secondary

production rates for macroinvertebrates on stable substrates in the UMR. In addition, we sampled macroinvertebrates from 4 adjacent backwater lakes (Lawrence Lake, Round Lake, Target Lake, and an impounded, open-water habitat near Stoddard, WI) to compare the level of secondary productivity between the high-flow main-channel habitats and low-flow contiguous backwater habitats. The backwater habitats varied in their connectivity to the main channel of the UMR. In the spring and summer 2006, Hester-Dendy artificial substrates (HDAS), consisting of 14 Masonite® discs with a total area of 0.16 m², were placed at three locations (UMR River Mile 691.6, 693.3, and 699.8) along alignment structures. We also sampled backwater invertebrates from a standard area of 0.06 m² using a Gillespie-Brown (G-B) sampler. Three HDAS and 2 (G-B) samples were collected from each location approximately once every 4 weeks. Using image analysis software, video microscopy and empirical area-to-weight relationships, over 17,000 individual macroinvertebrates were identified and measured for size. Water temperature, an important factor affecting macroinvertebrate growth and production, varied during the study period and between habitat types, but not among sites within habitats. Filter-feeding caddisflies *Hydropsyche orris* and *Cheumatopsyche campyla* (Hydropsychidae: Trichoptera) dominated the macroinvertebrate colonists on the HDAS in both number and biomass. Standing crop increased rapidly between June and July across all sites and peaked in August then declined in September. Colonization rates were greatest, averaging 200.0 to 325.0 individuals m⁻² d⁻¹, in June and then monotonically declined to 37.5 to 56.3 individuals m⁻² d⁻¹ by September. Annual production rates for *H. orris* from UMR River Mile sites 691.6, 693.3, and 699.8 were 379.2, 350.9 and 246.6 g DW m⁻²/yr, respectively. The amphipod *Hyaella azteca* (Amphipoda: Talitridae) dominated the macroinvertebrate community in the backwater habitats in both number and biomass. Standing crops peaked in July across all backwater sites. Annual production rates for *H. azteca* increased with habitat connectivity and ranged between 21.1 and 45.8 g DW m⁻²/yr. These initial findings suggest that colonization and production rates for filter-feeding caddisflies on channel alignment structures and, potentially, natural, snag habitats, represent a much larger source of secondary production for main channel areas in the UMR than originally thought. Rates of production for *H.*

azteca were greater in well-connected backwater habitats. Both habitats are likely sources of food for main-channel fish, however, the mode and rates of delivery are likely to differ substantially.

The role of crabs (*Macrophthalmus Japonicus*) burrows on organic matter decomposition in estuarine tidal flat, Japan

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The objectives of this study are to elucidate the burrow structure and to clarify the role of burrows in material cycle in the tidal flat. In our work, we focus on the dominant species in muddy tidal flat, crab *Macrophthalmus japonicus*.

Burrow structure of *M. japonicus* was investigated on a Katsuura river tidal flat in Tokushima prefecture, Japan, using *in situ* resin casting. The study location covered area of approximately 5000 m². Sampling was conducted in August 2006, and a total of 48 burrow casts were obtained.

Burrows consisted mainly of J-shaped structures (98%) while the rest belonged to U-shaped structures (2%). The maximum measured burrow volume was 120 cm³; wall surface area was 224 cm², while maximum burrow length and depth was 23.2 cm and 16.5 cm, respectively. Burrow volume and surface area were strongly correlated with carapace width of *M. japonicus*. Investigation of the individual number of *M. japonicus* in 13 quadrats (50×50×20 cm) was conducted using 2mm sieve. The number of *M. japonicus* was 36 ind./m² in August 2006. Using cohort analysis we estimated that surface area of burrows was 0.2m²/m².

Oxygen consumption was measured during the period from August 2006 to July 2007 at the top 5 mm of surface sediment as well as on burrow walls at 5, 10 and 15cm intervals. Results varied 117.16 ± 17.40 to 452.77 ± 43.15 mgO₂/m²/h, but no significant difference between oxygen

consumption and in respect to that organic matter decomposition of the surface sediment and burrow walls were observed. However, if we took into account the burrow existence (e.g. their calculated surface), the estimated organic matter decomposition was $146.12 \text{ gC/m}^2/\text{month}$ comparing to $116.5 \text{ gC/m}^2/\text{month}$ without burrows. This leads conclusion that organic matter decomposition increased 1.25 times, because of the expansion of the tidal flat surface area by burrowing activity. The rate of organic matter decomposition in burrow walls therefore contribution with 20.3% to organic matter decomposition in the tidal flat. These result indicated that in situ activities of *M.japonicus* significantly influences the material cycle and it is important to consider the existence of burrow in order to understand the fluxes of materials and to evaluate the purification function of the tidal flat.

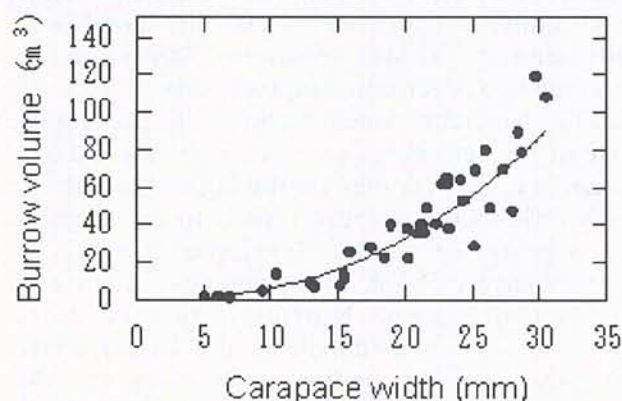


Fig.1. Relationship of carapace width with burrow volume

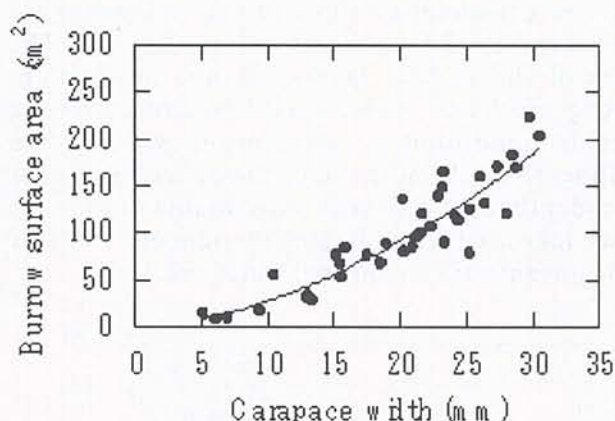


Fig.2. Relationship of carapace width with burrow surface area

Seasonal variations of fresh water residence time and their impact on the water quality at Hurun Bay, South Sumatera, Indonesia

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Hurun Bay is a semi enclosed water ecosystem that is situated at the western coastal area of Lampung Bay, southern coastal area of Sumatera and faces to the Sunda Strait (Fig.1). The environment within this area seems to be strongly influenced by monsoonal wind system that affects on the variability of the meteorological and oceanographic conditions of Lampung Bay. To understand the characteristics and control mechanism of water quality at Hurun Bay, a seasonal variations in freshwater residence time was investigated based on a series of physical (temperature, salinity), chemical (DIN; Dissolved Inorganic Nitrogen, TOM; Total Organic Matter, DIP; Dissolved Inorganic Phosphorus) and biochemical (DO; Dissolved Oxygen and phytoplankton) data observed during 2003-2004. The residence time of freshwater as indicator of the water exchange played an important role in the control of the water quality at Hurun Bay. Long freshwater residence time in both transition periods of Wet-Dry and Dry-Wet seasons has increased the DIN and TOM accumulation in the water column, and it stimulated phytoplankton bloom at Hurun Bay. This situation has caused the DO concentration decrease due to high decomposition of the organic matter. The results recommend that in both transition periods, the aquaculture activity should be limited at minimum level to reduce the risk of fish mass mortality caused by the DO depletion, diseases appearance, and particularly harmful algae bloom such as *Noctiluca sp* that appeared during these periods. DIN was a main factor of the environmental pollution at Hurun Bay due to the intervention of the anthropogenic activity through aquaculture. The DIN/DIP ratio within this area was less than 16.

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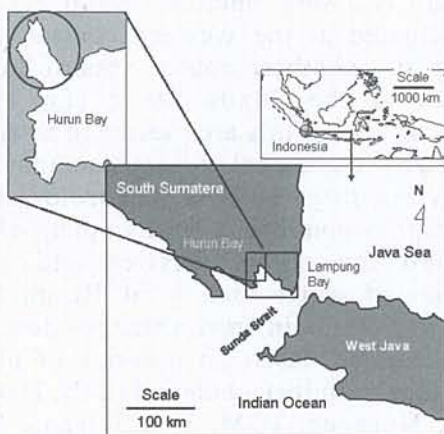


Fig. 1 The situation of Hurun Bay in the southern coastal area of Sumatra

Influence of water pollution control measures on sediment quality in Japanese Lakes

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Lake sediment qualities in three lakes (Lake A, B and C), which differ in the levels of water pollution control and therefore pollutant load, were measured and compared.

Lake conditions: Lake A had suffered from heavy blue-green algae blooming caused by pollutant load from houses and livestock since 1970's, however, because of the progress of sewerage system installation and dredging of lake sediment in heavily polluted area, blue-green algae blooming has stopped for recent five years. On the

contrary, Lake B, where sewerage installation is at low level and livestock load is large, has been experiencing algae blooming recently. Lake C, which is a small brackish lake and receives large pollutant load from cities and agriculture, has a water pollution problem for over several decades. Sewerage installation levels expressed as a population ratio served by sewerage system are 55%, 8% and 50% for Lake basins of A, B and C, respectively. And the levels of domestic pollution load to the lakes expressed as the ratios of population without sewerage system to the lake surface area are 2,600, 1,800 and 73,000 capita/km² for Lake A, B and C, respectively.

Methods: Lake sediments were collected in the center of the lakes using core samplers, and the concentration profiles of nitrogen, phosphorus and organic carbon in solid phase and liquid phase along the depth were measured. Also, release rates of nitrogen, phosphorus and organic carbon from the sediment core samples were measured at 20°C under aerobic and anaerobic condition. Additionally, some sediment layers were subjected to oxygen consumption tests.

Results: Nutrient concentrations in the liquid phase of the sediments were the smallest in Lake A, then in Lake B, and by far the highest in Lake C, which reflects the pollution loads to the lakes as the consequence of the development stage of countermeasures such as sewerage system and sediment dredging. Nutrients release rates showed the same tendency as the liquid phase concentration of the sediments (Fig. 1), and the comparison between the release rates in Lake A and Lake B indicates the effectiveness of taking polluted sediments out of the lake even though the phosphorus concentration of surface water does not show much difference.

Oxygen consumption rates of the sediments are shown in Fig. 2 for several sediment layers. The rates of the surface layers are not so different among the lakes, which might be caused by the aerobic conditions of the bottom water when sediment samples were taken, however, the rate of 2cm-depth layer of Lake C was double of those of other lakes, which indicates the tendency of low DO concentration in bottom water in Lake C.

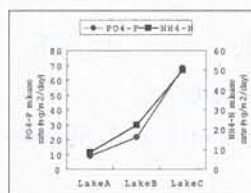


Fig.1 Nutrients release rate from sediment under anaerobic condition

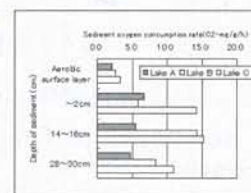


Fig.2 Comparison of sediment oxygen consumption rate for several

The impact of high densities of mussel (*Mytilus galloprovincialis*) on the cycling of metals in an artificial environment of Osaka Bay, Japan

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The impact of biodeposition by dense bivalve population (*Mytilus galloprovincialis*) on the cycling of heavy metals in the vicinity of artificial vertical structures in Osaka Bay was studied. Such studies are important because, as a consequence of land reclamation, artificial structures nowadays occupy more than 30% of the coastline in Japan, and over 90% in Osaka Bay, which is, as an enclosed coastal sea, especially sensitive on development pressures and coastal pollution. Most of these structures are vertical seawalls (breakwaters and quays) surrounding harbors and ports, forming low energy environments with slow turnover rates, thus resulting in enhanced sedimentation and high anthropogenic impact.

As a model for investigation, Amagasaki port was chosen, as one with the worst environmental conditions in Osaka Bay. At the time of the experiment (late July) biomass was maximal and activity of the mussels was high due to increased concentration of phytoplankton in summer. Sediments and biodeposits were collected in 15 sediment traps (90 cylinders) placed on five sampling stations at depths corresponding to average depth in the port. Two stations were at distance of 1m from the quaywall with attached colonies of mussel *Mytilus*. Traps from these points collected particles from natural sedimentation together with faeces and pseudofaeces (biodeposits). Other traps were set on three sampling stations at 50 m distance from the wall. One group comprised of empty cylinders, while in the other group we placed living mussels (with known mass amount). The third group was control, containing dead mussels. Naturally sedimenting material was collected in all cylinders, and in those containing live mussels, the faeces and pseudofaeces was also collected.

All pretreatments and analytical procedures were performed in the laboratory. After the digestion

the sediment trap material was analyzed using flame and graphite furnace AAS for determination of following metals: Fe, Mn, Zn, Cu, Pb, Cd and Cr. Analytical assurance was performed by measurements of three certified reference materials for trace metals in marine sediments.

The summed deposition due to sedimentation and biodeposition was compared with deposition in mussel-free traps. Biodeposition was calculated as the amount of material collected in each mussel cylinder minus the average sedimentation obtained in the control traps.

Bivalves and their support structures doubled the rate at which suspended matter was being added to the sediment (41.96 gm d⁻¹ vs 20.15 gm d⁻¹ for natural sedimentation). This consequently leads to an increase in the metal deposition rates of 42% for Cd to 144 % for Zn. These results support the hypothesis that the presence of dense mussel population leads to increased flux of metals from the water column to the harbor bottom altering their movement around vertical structures. On the basis of obtained results we tried to establish whether the impact of biodeposition on the metal concentration and distribution around vertical structures is significant or trivial in the period of experiments.

The variability of Amur River water quality: linkage with the biogeochemical processes and fluxes of chemical substances in Amur River Estuary

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Amur River is the biggest river of the Russian Far East with mean water discharge about 11,000 m³/s but with average solids load as low as 72 g/m³. The minimum water discharge (about 2,000 m³/s) is observed during late autumn winter under ice low water. The spring snow melting high water (May-July) and summer rain floods (August-September) have water discharge 15,000-28,000 m³/s (maximum 40,000). The low water period is accompanied by the increased mineralization (TDS) up to 130 mg/l with the diminishing down to 60 mg/l and less at the high water period due to dilution by the precipitations (rains and snow)

with low TDS. The same seasonal patterns are observed for the macro-ions and some nutrients (NH_4^+), though for some other substances (Si, COD) there is positive relationship with water discharge. The beginning of snow melting flood is often outstanding in terms of elevated concentration of many chemical substances accumulated in the snow during the winter.

The Amur water runoff has increased by 10%-12% in a hundred-year period of observation due to increase of atmospheric precipitation, but in the same time there is obvious trend of water runoff decrease during last 25 years. This trend is accompanied by the clear rising of the mean annual mineralization from 46-64 mg/l to the 93-110 mg/l.

The Amur River Estuary is localized in the vast (about 5,000 km²) shallow (average depth 2.5 m) straight between Sakhalin Is. and mainland. During the summer the prevailing direction of the river flux is northward and the plume of brackish water can occupy east part of Sakhalin Bay.

The distribution of some dissolved chemical substances along the salinity gradient have been studied during the summer high and low water. The non-conservative decrease of Fe at the salinity less than 10‰, and conservative decrease of Cu and Ni were observed. Dissolved Mn always shows the increase at the intermediate salinity. Cd is the only metal studied showing different distribution at the different hydrological conditions. The more pronounced stratification in the north part of estuary and disposition of water with salinity 10‰–20‰ in the southeast part of Sakhalin Bay during high water allow to distinguish the desorption from riverine suspended matter as a key reason for the dissolved Mn distribution. Flux from bottom sediments is a master variable for the dissolved Cd distribution in the estuary with very low initial concentration of metal in Amur river water and suspended solids. The change of the chemical composition of suspended matter in estuary is controlled firstly by the ratio of terrigenous aluminosilicate material enriched by Al and Fe, and marine biogenic particles enriched by Cu, Mn, Cd, and in some cases by Ni. There is relationship between accumulation of metals in the biogenic suspended solids and ability of the phytoplankton. The high plankton biomass is accompanied by the decrease of Zn, Pb and Ni concentrations in the suspended solids, but Cu shows inverted relationship.

The chemical composition of Amur river water determines the character of the processes occurring in the estuary but existing data allow to

suppose the some independence of the variation of river flux at least during the warm period.

Assessment and control of anthropogenic impacts of the Dniestr River upon the estuarine zone of the Black Sea coast of Ukraine

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Discussed at the paper are results of assessment of anthropological impacts of economic developments at the Dniestr River basin, including impacts caused by hydroengineering construction upon the estuarine areas of the Black Sea coast. Assessment was carried out under the framework of a number of international and local projects, funded by the World Bank, UNDP and UNEP. Shown and discussed are results of reckless development policy at this river basin in the former USSR, lack or poor enforcement of environmental regulations relating to this river and the estuarine zone. Shown also are benefits and obstacles to efficient coordination and cooperation in management of this trans-boundary river basin which passes through Ukraine, Moldova and again through Ukrainian part (Odessa region). Considered are various types of man-made impacts on water quality, both at the river and estuary, pollutants transfer and pollution load delivered by the river to the estuary as well as impacts on wildlife, biodiversity and touristic potential of the area.

Reviewed also are political and economic tools for possible minimization of the pollution load. Underlined and demonstrated are possible environmental policy upgrading and improvement approaches, the need for better enforcement and the need for reform of some river basin and coastal zone management regulations, both on national and international level. Touched upon are also issues of general public and private sector involvement into monitoring, enforcement and financial support for coastal zone management. Issue relating to NGOs role in public education and public awareness raising on issues of estuaries and river basin cleanliness maintenance are also discussed.

Catchments' value-pressure assessment and its management strategies in Shanghai, China

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Water is the most active element in the world. Therefore, catchments are the basic space unit which consist the comprehensive earth surface system. The health of catchments is the base of earth surface health. Simultaneously, catchments health is the precondition of river health, without healthy catchments, without easy-maintained healthy rivers. Especially in river-network area, due to the commonly connecting and crossing of rivers and lakes, it is difficult to ensure an effective management if only focus on single river or lake.

Catchments health assessment is not only a theory question in catchments studies, but also the presupposition for the whole catchments management. Physical, social and economic features of catchments should be included in designing assessment indicators and methods. Shanghai is located at the coastal area near Yangtze estuary. River-network is the base element that formed the most typical characteristics of water environment and catchments growth. For the sake of effective flood control and water resources management, the whole Shanghai city was divided as 14 catchments called water Conservation Zones since 1970s. In this paper, we try to make integrated value-pressure assessment, and to develop a practical method for catchments health assessment in river-network areas.

Four dimensions have been designed as the first level for catchments value assessment, each dimension include 2 or 3 indicators. They are (1) rivers, which include three indicators as river environmental stability, diversity of hydrological elements and the goodness of water quality; (2) river net-work, which include two indicators as water area and stream structure; (3) catchments, which include three indicators as land use type expressed by penetrative area, flood control capacity expressed by water storage and regulative capacity per unit area and threatened eco-system; (4) characteristic dimension used to describe the special value of catchments and special features need to be protected. For assessing the pressure that catchments might face, indicators such as the increasing of no penetrative area, the increasing of non-point contamination discharge, possible change of river environment, possible change of stream structure and possible change of hydrological regime were listed for selective use. The data system (2,4,6,8,10) were

taken to measure the value and pressure of catchments in which "2" meant low value and pressure, "10" meant high value and pressure. Catchments would be classified as six types. Type A catchments were in top-priority protection with high-value and high pressure; type B catchments were in top-priority with limited future development, which usually located in upper river area with high value; type C catchments were in middle-priority with middle value and high development level; type D catchments were in middle-low priority with low value and high pressure; type E catchments were in low priority with low value and low pressure; type F catchments were also in low priority, which were protection zone with high value and low pressure. Assessment result showed that Shanghai has not F-type catchments with high value and low pressure. Most of areas in Shanghai city are in face of high pressure due to rapid economic development. A-type catchments include Pudong and East Punan, which is the highlight of advanced- manufactory development area and hi-tech zone. Pressures to health catchment mainly come from rapid land use change. B-type catchments locate at the city water resources protection zone, which are limited development area since 1980s, the main landscape is countryside, farmland and water area. However, based on the water quality data in 2005, this area is now suffered from serious pollution compared with its function standard of water quality. North Jiabao is only C-type catchment in Shanghai, which is the industry base since 1950s, and city regeneration was ongoing since 1990s. D and E-type catchments belongs to the high developed area of Shanghai, human activities strongly affected river net work, but great change will not happened in near future.

Management strategies for A-type catchments, the top target is to protect the high value of rivers, river network, catchments and special features. Therefore, we should maintain a good stream structure and a suitable width of riverside; keep a connected riparian and eco-environment diversity. Local characteristics also should be carefully protected. For B-type catchments, the main point is to control the process and rate of land use change, to set up the up-limitation of non-penetrated area. For C-type catchments, we should evaluate the health situation of catchments continuously so as to regulate the development speed timely. For D and E-type catchments, we should make efforts to restore river environment and public accessibility, to make river and riparian area a comfortable place for local

residents.

Investigating the effects of river flow on Apalachicola Bay by frequency analysis and hydrodynamic modeling

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Evaluating the effects of changing river flow on the ecology in downstream estuaries is an important issue. In this paper, a case study in Florida of USA is presented. Apalachicola Bay is located in the panhandle of Florida, which receives freshwater from Apalachicola River in the south end of the Apalachicola-Chactahoochee-Flint (ACF) basin. The bay is a highly productive barrier-island estuary, which in general produces 90 percent of the state's commercial oyster harvest, and the third largest shrimp catch. Preservation of the ecology in Apalachicola Bay has been recognized as of state, federal, and international importance. The bay has been designated as a National Estuarine Research Reserve, Outstanding Florida Water, State Aquatic Preserve, and International Biosphere Reserve. During the past several decades, the freshwater resources in the ACF basin have been developed to meet various demands for municipal and industrial water supply, flood control, hydropower, navigation, agriculture water supply, and fish and wild life conservation. There are hundreds of reservoirs in the basin, which can be used to regulate freshwater to meet certain water demands, which would modify the natural freshwater flow in Apalachicola Bay. If upstream water demands increase, freshwater inflow to Apalachicola Bay would alter and reduced. Since 1950, considerable growth has occurred in the Atlanta-metropolitan area. The population in this area increases from less 0.5 million in 1950 to almost 3 million in 1993. This has resulted in a considerable increase of demand for freshwater resources. Changing reservoir operation and water demand has resulted in the changes of freshwater inputs to the bay. As a result, it will affect predator-induced oyster mortality and growth. In the case study, a 3D hydrodynamic model was applied to examine the responses of estuarine salinity to the freshwater inflow. Frequency analysis has been conducted to identify the most frequently occurred river flow, and the frequency density of salinity in the oyster

beds. The integration of hydrodynamic modeling and frequency analysis will support decision making in estuarine and water resources managements.

Composition and sources of non-aromatic hydrocarbons in surface sediments of Daya Bay, China

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Reports related to lipid in Daya Bay, northern South China Sea, are very scarce. The present work represents the first study on the composition, origin and distribution of non-aromatic hydrocarbons (NAH) in solvent extractable organic matter (EOM) from Daya Bay surface sediments, and provides a background estimation of the contamination of Daya Bay surface sediments with petroleum related hydrocarbons. TOC and EOM contents show distinct spatial differences. TOC accounts for 0.861.60% of the dry sediment. EOM varies in a large range of 881637 $\mu\text{g g}^{-1}$ dry sediment and accounts for 0.8311.53% of the TOC contents. The contents of non-aromatic hydrocarbons vary from 32276 $\mu\text{g g}^{-1}$ dry sediment and account for 5.864.1% of the EOM. *n*-Alkanes with carbon number ranging from 1535 are identified to be derived from both biogenic and petrogenic sources in different proportions. The contribution of marine autogenic input to the sedimentary *n*-alkanes is lower than the allochthonous input based on the average $n\text{-C}_{15}/n\text{-C}_{16}$ alkane ratio. 25.646.5% of the *n*-alkanes, with a mean of 35.6%, are contributed by vascular plant wax. Results of unresolved complex mixture, isoprenoid hydrocarbons, hopanes and steranes also suggest possible petroleum contamination. There is strong evidence of a common petroleum contamination source in the Daya Bay.

Is the Three Gorges Dam changing the biogeochemistry of Yangtze River?

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For a long period, the dispute about the effects of the Three Gorges Dam (TGD) on the Yangtze River and East China Sea never stops. The results of recent studies emphasized the variation of nutrients and further effect on the coastal ecosystem based on limited observations, which may mislead our understanding of real situation in some extent. In our case, we use continuous observation data from anchor station located at the lower reach to obtain temporal variation, at the same time, we also collected the sample from the whole drainage basin to present spatial distribution of various parameters, such as nutrients, POC, DOC, stable isotopes and biomarkers etc. The obtained knowledge will be helpful to elucidate the effect of TGD on the biogeochemistry of Yangtze River and adjacent East China Sea.

The comparison of monthly water discharge at Datong in 2001-2005 does not show significant change before and after impoundment of TGD. The concentration of dissolved nutrients showed a slight increase except Si from 1997 to 2005. The N/P ratio also has similar tendency but not so significant change. DOC concentrations averaged 105 M C in 1997 and 108 M C in 2003 in the main stream. POC% ranged from 0.5% to 2.5%. The dominant vegetation in the tributaries are C3 plants. The predominant source of organic matter in the river is from the soil. The increase of DOC flux is observed from $2 \cdot 10^{-3} \cdot 10^6$ t/yr in 1960-80 to $10 \cdot 10^{-12} \cdot 10^6$ t/yr around 2000. POC fluxes decreased from $> 5 \cdot 10^6$ t/yr in 1960-80 to about $2 \cdot 10^6$ t/yr in 2000. Such fluctuation could be explained by the decrease of sediment load in the Yangtze, which is partly trapped by TGD.

In extreme drought year of 2006, The POC content in suspended particles (POC%) are particularly high in the middle and lower reaches of the Changjiang drain basin, which may be derived from the primary production of the phytoplankton in river. A dramatic drop of the POC fluxes as well as a sharp increase in the ratios of DOC fluxes to POC fluxes was showed during the observed period after the completing of Three-Gorges Dam, which could have significant effects on the trapping and degradation of POC. Elevated OC%, decreased lignin yields and higher degradation state were found in the SPM of 2006. The differences could be explained by the

changes of grain sizes of SPM and particle compositions with different size-fraction, which was caused by less water discharge and sediment load in 2006. So the hydrodynamic sorting was a major factor controlling the transport of TOC in Changjiang. Climate change such as precipitation and dam building maybe were primary drivers behind. Under such extraordinary drought in 2006, the particulate lignin flux entering ECS decreased 1.5 times than that in 2003. The great reduction of TOC would great influence the carbon cycle in Yangtze-ECS region.

Application of linear programming method based on response field in the total load allocation

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Total load control is an important strategy of water pollution control in china. Most of the problems of total load allocation can be regarded as optimization of the allocation target under some constraints, so they are the optimization problems with constraints. When the linear programming method based on response filed is adopted to solve the total load allocation problems, the concept is clear, the computation is rapid, and the optimum value is sure to be found. It is much superior to the optimization method based on nonlinear methodology. The linear programming method based on response filed was adopted to calculate the total load allocation in the Yangtze estuary and ambient marine area, it shows that the linear programming method is probably the sole method to seek the optimum value because the time to complete single hydrological and water quality calculation reaches to the temporal level of hours.

A numerical modeling study of nutrient budget in a shallow water system Lynnhaven River

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By quantifying nutrient inputs and transformations in estuaries, a nutrient budget is an important scientific and economic implement to assess potential effects of estuarine systems responses in terms of all sources and sinks. There

are many nutrient budget studies in deep estuaries regarding the fate of total nitrogen and total phosphorus inputs. For example, Nixon et al. (1996) found that the net transport of nutrients through estuaries to the continental shelf is inversely correlated with residence time of water in the relatively deep water systems. Whereas shallow water regions, with depths less than 2-3 meters, differ markedly from deep estuarine systems. In a shallow system, the light can penetrate through the water column and reach the bottom, which affects both the pelagic and benthic ecology. Activities of benthic microalgae influence sediment biogeochemistry processes, through uptake and release of nutrients in different seasons. This study aims at describing the unique aspects of nutrient budget in a typical shallow water region, Lynnhaven River, Virginia. In order to examine the role played by the benthic microalgae when nutrients pass through the Lynnhaven River, two numerical models, UnTRIM (hydrodynamic model) and CE-QUAL-ICM (eutrophication model), were utilized. The nutrient budgets were analyzed from the well-calibrated models results, which include the newly constructed sediment flux sub-model with benthic microalgae effect. Based on the results of annual nutrient budgets, it was shown that the major external source for nitrogen and phosphorus was from nonpoint source loadings (91% of the total nitrogen and 95% of the total phosphorus). There were three comparable sinks: (1) export to the Bay (32% for nitrogen and 26% for phosphorus), (2) burial in the deep sediment (31% for nitrogen and 74% for phosphorus), and (3) denitrification in the case of nitrogen (37%). One of the major pathways for nitrogen and phosphorus was the internal recycling. The regenerated dissolved nutrients that were recycled in the water column were more than two times larger than the current total nutrient external loadings. Sensitivity tests showed that, due to their retention capacity, benthic microalgae's presence in the Lynnhaven could decrease the overall export to the Bay, enhance the internal recycling, and increase the denitrification rate in the sediment.

Growth potential and productivity of phytoplankton community inhabiting in estuarine ecosystem, Western Japan

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Annual growth potential and productivity of estuarine phytoplankton community was investigated in Shinkawa-Kasugagawa estuary, western Japan, from January 2005 to December 2006. Annual variation of physico-chemical parameters was also monitored in the study site. Growth rate of natural phytoplankton community was estimated from increase of Chl *a* concentration during incubation of natural seawater for ca. 6 hours.

Water temperature, salinity and nutrient concentration at high tide varied as follows; 5.4-34.4°C, 7.2-29.4 psu, 7.52-144 µM (DIN), 1.04-6.24 µM (PO₄) and 10.1-123 µM (Si(OH)₄), respectively. Growth activity of the phytoplankton community was low under high light intensity and low temperature condition in spring, indicating photoinhibition. Afterwards, the growth rate was increased (1-4 div./day) with rising of water temperature, and extremely high growth rate, close to 7 div./day, were observed at 30°C in summer. Unialgal culture strain of *Cryptosporidium* sp., dominated in summer at the study site, showed extremely high growth rate (over 10 div./day) under 700 µmol m⁻² s⁻¹ (14:10 LD) at 30°C.

These results suggest that the primary productivity of natural phytoplankton community in the estuary was low in spring, but had extremely high productivity in summer. Primary production rate was calculated using the increase of Chl *a* concentration and C/Chl *a* weight ratio (33.7 for the benthic diatom) to 0.32 gC m⁻² day⁻¹.

Modelling diffuse nitrogen and phosphorus pollution in a medium-sized watershed: a comparison between a grid-based GIS method and the physically-based AnnAGNPS model

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The aim of this study was to compare and assess two models to calculate diffuse nitrogen and phosphorus emissions on a selected watershed. The empirical grid-based GIS method and the physically-based AnnAGNPS model were evaluated for comparative purpose. The methodologies were applied for the Jiulong River

watershed, covering 14700 km², located in southeast China, with intensive agricultural activities. The calculated river loads by AnnAGNPS model was checked by the measured values at the watershed outlet, whereas the calculated nitrogen and phosphorus emission by grid-based GIS method just spatially provided the potential values in terms of sub-watersheds, districts/counties, and land use type. Both models gave similar levels of diffuse total nitrogen emissions, which also fit well with previous estimates made in the Jiulong river watershed. Comparatively, the grid-based GIS method gave sound results of source apportionment of NPS from the available input data and critical source areas identification of diffuse nitrogen and nitrogen pollution. AnnAGNPS model predicted reasonable nitrogen loadings at the watershed outlet and simulated well for NPS management alternatives under changing land use conditions. The study indicated that the grid-based GIS method has its advantage in extensive studies as a decisions support tool for preliminary design since it is easily applied to large watersheds with less data requirements, while AnnAGNPS has its advantage in detailed emission assessment and scenario development.

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The environmental remediation effects of artificial tidal flat in inner part of Osaka Bay, Japan

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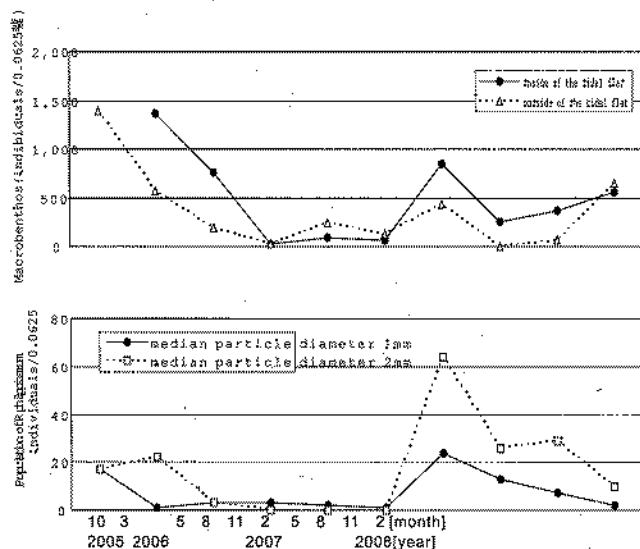
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The aim of this study was to contemplate the guidelines for environmental remediation based on creating artificial tidal flat in the inner part of Osaka Bay (enclosed coastal sea). Due to hypoxia in summer, macrobenthos cannot inhabit these waters. Therefore, to improve that condition, it is important to enlarge shallow area of the tidal flat, and thereby to expand habitat for macrobenthos. For that purpose artificial tidal flat in Omaehama was designed and constructed in November 2005. We investigated artificial tidal flat, over a period of two years.

Creating tidal flat did not change physical characteristics of sediment particle size and difference in elevation remain the same as for natural tidal flat which served as a control area. Four months after creating artificial tidal flat, shift in abundance of macrobenthic communities was observed. We focus our investigation on *Ruditapes philippinarum* as valuable fishery resources. It was observed that population of *R. philippinarum* (2859 ind./m²) in artificial tidal flat on May 2007, was 3.8 times bigger than in control area. In addition, comparing two types of sediment investigated in the artificial tidal flat, population of *R. philippinarum* was higher in 2mm of median particle diameter sediment (274 ind./m²) than in 1mm fraction (117 ind./m²). Therefore, effect of environmental remediation by creating artificial tidal flat was recognized. Physical characteristics of sediments were more stable and macrobenthic communities were larger in artificial tidal flat than in control area, though there is still significant decrease in individuals of macrobenthos in summer due to impact of seasonal water hypoxia.



Measurement of turbidity distribution in the interior parts of the Ariake Sea by satellite remote sensing

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The purpose of this study is to establish a method for monitoring the distribution of turbidity in the interior parts of the Ariake Sea, which is located in Kyushu, Japan and is a very shallow and a strong closed bay with an area of 1,700km², using a satellite remote sensing data. The relationships between the spectrum of the sea surface and turbidity which have great influences on the outbreak of red tide, the removal of phosphorous in the sea-water, and the estuarine ecosystem etc., the properties of path radiance included in the satellite remote sensing data, and the methods of atmospheric correction for the removal of path radiance and measurement of turbidity distribution were discussed on the basis of *in situ* measurements and satellite remote sensing data.

The spectral radiance just above sea-surface in the wavelength range from 0.4 µm to 0.9 µm was closely related to the turbidity, but beyond the wavelength of 0.9 µm it was almost zero, and the path radiance, which occupied as much as 70% to 90% of the radiance over the sea area in the wavelength range from 0.4 µm to 0.9 µm, was dependent on the law of about -3th power of wavelength. This fact indicated that the path radiance was due to the Mie scattering of light by haze and aerosol in the atmosphere. A reasonable

and simple method of atmospheric correction for satellite remote sensing data by using the radiance in the wavelength beyond that of 0.9 µm which seemed to be equivalent to the path radiance over the sea area and the dependence of path radiance on the wavelength was also presented. Moreover, the turbidity distributions in the study site were exactly measured by the regression equation between the turbidity and the ratio of radiance of Terra Aster Band-1 and Band-2 which were corrected for the atmospheric effects. Owing to the re-suspension of bottom mud by fast current velocity in this sea area, the measured turbidity was very high value of several hundreds mg/l near the river mouths and coastal areas where the large muddy tidal flats were formed.

Integrated management of estuary for diffused pollution of sediment in Dapeng Bay and Neighboring Rivers (Taiwan)

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This work investigated sediment samples collected from Dapeng Bay and three neighboring rivers (the Kaoping River, Tungkang River and Lingbeng River) in southwestern Taiwan. Multivariate statistical techniques such as cluster analysis (CA), factor analysis (FA), and canonical discriminant analysis (CDA) were used for evaluation of spatial variations, interpretation of pollution types and identification the sources of pollution from neighboring rivers. The result shows that the most important latent factors in Dapeng Bay are the soil texture causes factor, heavy metal influence factor, organic matter factor, and nutrient causes factor. From contour maps of factor scores it shows heavy metal accumulated in the lakesides especially southeastward. Cluster analysis was performed with factor scores computed from those latent factors. Then we classified these research areas into five distinct classes using sampling stations, it showed that in the three river classes the sediment properties were influenced by industrial wastewater, domestic wastewater, agricultural activities including farm activities and livestock breeding activities, respectively. Nevertheless in Dapeng Bay classes were more influenced by complicated biogeochemical processes and these could be identified as a pollution type. And

canonical discriminant analysis illustrated that two constructed discriminant functions showed a marked contribution to most of the discriminant variables, and the significantly parameters porosity, Cd, Cr, Al, and Pb were combined as the 'heavy metal effect factor'. The recognition capacities of the two discriminant functions were 82.6 and 17.4%, respectively. Perhaps the annual mean of water exchange time is insufficient about seven days to eliminate pollutants and has influenced significantly the carbon and nutrient biogeochemical processes and budgets in the semi-enclosed ecosystem. So it does not show obvious similarities the sediment properties among lagoon and neighboring rivers. These approaches and results yield useful information concerning habitat recovery and water resources management.

Interactions between atmosphere, ecosystem and marine environment in Nigeria

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Over the past decades we have witnessed extraordinary natural and anthropogenically-driven changes in Ocean Biogeochemical composition. Most of atmospheric and oceanic climatic variability have been related to interaction between Ecosystem, Atmosphere and Marine environment.

Between 2004-2006 we studied the Interconnection and Teleconnection between ecosystem, atmosphere and marine environment. We noted that critical input of nutrients by Riverine and increase in Green house gases caused significant changes in Biogeochemical properties of ocean around Lagos area of Nigeria. In turn, the feedback to local communities has resulted in changes in their economies and diets. More practical issues will be presented.

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Regional Seas - Total Loads Control

Research on the water quality characteristics in controlling sections in Yangtse Rive and its effects to Yangtse Rive estuary

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In this present study, three sections including Cuntan (upstream), Yichang (middlestream) and Jiangning (downstream) in Yangtse River were selected, and the diversities of water quality were analyzed on the basis of the data of water quality and hydrography monitoring in 2004-2005. The average of pH was 8.07 (from 7.95 to 8.15) in Yichang section, and 7.83 (from 7.6 to 8.0) in Datong section throughout the river, indicating that the middle and downstream water quality in Yangtse Rive was acid characteristic, and the pH value was less than 7.0 according to the runoff gross.

The suspended particle results showed that it was 311.8, 100.7 and 102.1 mg/L in Cuntan section, Yichang section and Datong section, respectively, indicating that the Three Gorges Reservoir has significant retention effects on suspended particles and the ratio of retention was about 67.7 %.

The index of COD_{Mn} showed that it was 3.37, 2.44 and 2.17 mg/L in Cuntan section, Yichang section and Datong section, respectively, indicating that the Three Gorges Reservoir from Cuntan to Yichang retained and eliminated those organic compounds and caused 27.6 % contamination decreasing. Although the middle- and downstream of Yangtze River accepted large amounts of organic pollutants, the organic pollutants discharged along sections were decomposed and the COD_{Mn} contents also reduced 11.1 % from Yichang section to Datong section. All of these suggest that Yangtse Rive can eliminate the COD_{Mn} to some extent.

The NH₃-N results showed that it was 0.15, 0.12 and 0.32 mg/L in Cuntan section, Yichang section and Datong section, respectively, indicating that the Three Gorges Reservoir from Cuntan to Yichang has self-purified capacity and caused 20% NH₃-N reduction. The concentrations of NH₃-N, however, increased 166.7 % from Yichang Section to Datong Section, indicating that the NH₃-N loading from middle- and downstream in Yangtse Rive exceeded the self-purification capacity of the mainstream in Yangtse Rive and the water quality declined significantly.

To similar the NH₃-N, total phosphorus (TP) results showed that 0.16, 0.10 and 0.12 mg/L in

Cuntan section, Yichang section and Datong section, respectively, indicating that the Three Gorges Reservoir from Cuntan to Yichang has self-purified capacity and caused 37.5% TP reduction, while 20.0% TP increased from Yichang section to Datong section.

NO₃-N results showed that it is 1.24, 1.40 and 1.52 mg/L in Cuntan section, Yichang section and Datong section, respectively, indicating that there was an increasing trend from Cuntan section to Datong section. The NO₃-N discharged mainly from municipal, industrial effluents and agricultural runoff, which accounted for about 50 %, respectively.

In view of the contamination control, the water quality of main channel in Yangtse River can not be affected, and there was no obvious effect on Yangtse River estuary environment with the presupposition that the COD_{Mn} discharge must meet the criterion in effluents discharging areas under present conditions. And it is necessary to improve the treatment efficiency of municipal and industrial effluents, to control the agricultural pollution loading, and to reduce the NH₃-N and TP discharges for ensuring the water quality in Yangtse River. At present, the main pollution factors are inorganic nitrogen and phosphorus in Yangtse Rive estuary, and so it is significant to control the TP and NO₃-N discharges for improving Yangtse River estuary environment and adjacent marine environment. Thus, in view of the gross controlling, it is not enough to control the water quality in Yangtse Rive area with COD controlling only, and it is necessary to control the contamination gross with different orientations and criterions.

Restoration of nutrient laden shrimp culture systems through improved feed technology an aspect of coastal zone management

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The effluents from shrimp farms are known to develop eutrophication in discharged sits viz., adjacent coastal waters due to excess nutrients like phosphorus (P). In order to restore normalcy in such sites, a case study was undertaken at Tharuvaikulam shrimp farm area (south India) during March to July 2006. The effluents

discharged from entrepreneurs' shrimp farms were found to be rich in total phosphorus (3.45-3.50 mg L⁻¹). In these farms, it was found that only 13% phosphorus introduced through feed is incorporated into shrimp flesh. Since the effluents discharged showed alarming values of P, there is urgent need to modify the existing feed technology in these farms. In this regard, laboratory experiments were conducted for a period of 90 days with juveniles of *Penaeus monodon* (4.35 to 4.74 g). The newly introduced feed technology involved the inclusion of phytase in feeds. The phytase (Natuphos) was added in the shrimp feed at 0, 200, 400, 2000 and 20,000 FTU/kg feed. Among these feeds, addition of 400 FTU/kg feed significantly improved phosphorus retention in shrimp ($P < 0.001$). The retention of P was 72 % while the discharge was 28 %. Experiments without the addition of phytase enzyme in feeds, showed an increase of P discharge at 57 %. That is the phosphorus level of the water in shrimp tank fed the phytase treated feed showed reduced level of 0.5-0.6 mg L⁻¹ while it was 3.36-3.47 mg L⁻¹ in phytase untreated feed shrimp tank water. This novel and improvised feed technology needs to be popularized among the shrimp farmers so as to keep the near-shore areas receiving shrimp farm effluents free from pollution due to eutrophication.

Sedimentary records of organochlorine pesticides in coastal and near sea of Eastern China Sea and northern South China Sea: regional cycling and time trends

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Organochlorine pesticides (OCPs), such as DDT and HCH, were of the most widely used pesticidal persistent organic pollutants (POPs) in the world. While the bans of agricultural usage of technical DDTs and HCHs in different countries in East/South Asia were commenced in between 1970-1990s, other usages of these pesticides, e. g. Malaria control, antifouling paint for fishing ships, or in different formula (Lindane), still

remain. High concentrations of DDTs were still found in high concentrations in fishes and human breast milk in the coastal zones of China, posing potential negative impact on marine ecosystem and human health.

Laminated, undisturbed sediment cores are thought to be natural historic archives for POPs in aquatic environment, owing to the hydrophobicity of these chemicals which favors their association with suspended particulates and sediments. Many studies have been reported on using sediment cores to reveal the time trend of POPs. However, as a result of the intensive human activities, in particular large scale land transform, in the fast developing coastal zones, a sediment pool may also receive recycled POPs from/via soil runoff and relocation of previously deposited sediments in the watershed. Therefore, it is assumed that the information a sediment core in estuarine and coastal environment may be a cocktail of the real time trend of regional usage and regional geochemical recycling of the studied POPs.

In this talk we will report the vertical profiles of OCPs in 15 coastal and near sea sediment cores, among which 5 were from Eastern China Sea, 10 from the northern South China Sea. The results were evident to support our hypothesis, that in the cores from coastal zones a significant accumulation of OCPs in the upper layer sediment recording the regional cycling of these chemicals can be observed, while in the sediment cores in the near sea gave expected time trend of their regional application history, concentrations peaking at the layers corresponding to the highest application in 1970-1980s.

The findings of the study highlight the importance/scale of human activity on the ultimate fate of POPs in coastal zones, which will result a 'relaxation' of these chemicals, between their application in terrestrial environment and their being exported to the coastal water environment.

Estimation of nitrogen and phosphorus inputs from the Changjiang river watershed into the East China Sea

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The watershed of the Changjiang river covers twenty percent of China's land area and about four hundred million people live in this watershed. This area produces about forty percent of agriculture and industrial products in China. To support this dynamical human activity, land uses are being changed dramatically in the watershed. For example, agricultural land is being converted to use for human settlements and industry, and forests are being cut and converted to agricultural land. These changes result in more nitrogen and phosphorus loads from factories and towns flowing into the Changjiang river, as well as greater amounts of soil, fertilizer and agricultural chemicals from farms. Based on field observations and flow rate data in 1998 and 1999, flux of nitrogen and phosphorus inputs from the Changjiang river was estimated and it was found that nutrients discharge from large cities, like Shanghai, contribute in large percentage to the total flux and the flux to the East China Sea was large during flood period. Relationship of nitrogen and phosphorus loads with the discharge, such as $L=aQ^b$, has been established for TP and TN at Cuntan and Datong stations (Fig.1) and it suggested that the prediction of nitrogen and phosphorus loads from the Changjiang river flowing into the East China Sea becomes possible. The estimation method of nitrogen and phosphorus input has been developed by using unit nutrient loads for 35 classified sectors based on input-output table in province level for year of 2000 in China. The basic inventory structure of unit nutrient loads for point source and non-point source is determined from the statistical data for each sector.

The comparison between estimated and observed data at Cuntan and Datong stations showed excellent agreements (Fig.2). The percentage of livestock and crop farming industry is about 60% of total nitrogen (Table.1) and non-point source is dominant in Changjiang river watershed.

This study suggests that the estimation method based on input output table is useful to understand the major sectors of point and nonpoint source responsible for improvement in water quality management in China.

Hydrological factors for exuberance of *Ulva* sp. in enclosed tideland lake; Yatsu tidal flat in Japan

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Tidal flat generally endows with a function of superior water quality purification. Especially, it is well known that algae as a prey have a great influence on water quality purification in the same as sandy shoreline.

The ranging area occupied by *Ulva* sp. classified in large chlorophyceae has been annually observed in Yatsu Tidal Flat since 1985. Total area of Yatsu Tidal Flat that is registered under Ramsar Convention in 1993 is 40.1 ha, and its tidal flat is connected to the seawater in Tokyo Bay by two narrow channels. The distribution of *Ulva* sp. in the tidal flat was continuously extended year by year, 6.8 ha in 1995, 13 ha in 1999, and more than 20 ha in 2000. Finally, a space for *Ulva* sp. to occupy was increased and attained on about 70 percent of the surface area in Yatsu Tidal Flat. In recent years, the surface of sediment/muddy layer in the tidal flat area is, therefore slid into anaerobic condition by the bodies of *Ulva* sp. covering on the tidal flat. Because of holding the anaerobic condition, the combination of various factors in its tidal flat ecosystem was collapsed as disappearance of a biotope of benthos. The decreasing of share on replay and rest place is eventually drawn very big problems for migratory birds.

Various environmental problems in Yatsu Tidal Flat caused by hydrological functions are, therefore investigated in this paper, for restoration of ecosystem with photographical monitoring data, topographical surveying data and meteorological data, which were stored for eleven years from 1996 to 2007.

Firstly as results, it is clarified that topography in the tidal flat is formed with a muddy flat plateau and several guts. A set of both banks of which height is slightly higher than the plateau level, exists in mouth and down stream region along the guts. Flow pattern of the seawater is therefore

slightly different between flood tide/inflow and ebb tide/outflow in the tidal flat, because of bars as banks. It will consider that *Ulva* sp. in the tidal flat is accumulated by the difference of the path of water flow as inflow and outflow on it; i.e. the inflow line is shorter than outflow line. Conversely speaking, contact period between atmosphere and the surface of muddy sediment layer has a tendency of decreasing.

Secondly, the distribution area of *Uva* sp. in the tidal flat is increased in proportion to seawater temperature in the region of more than 15 degree centigrade. Finally, it is analyzed that the accumulation of *Ulva* sp. in Yatsu Tidal Flat for the wind direction and velocity are classified in four patterns; combination pattern of sear breeze and flood tide/inflow, multiplication pattern, combination pattern of land breeze and ebb tide/outflow and run-up pattern due to typhoon.

Effects of phytoplankton vertical migration on the formation of oxygen depleted water in a shallow coastal sea

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It is widely recognized that oxygen depletion in the lower layer of water column during summer stratified season is mainly caused by higher decomposition rate of organic matter and lower oxygen supply from the upper layer. However, vertical migration of phytoplankton has not been adequately considered on the formation of oxygen depleted water in the lower layer. In this paper, we will show the effect of vertical migration of dinoflagellate on the oxygen budget at 10 m depth in semi-enclosed bay, Ago Bay, Japan. Benthic oxygen consumption rates were measured directly with in situ transparent chamber at 3 hours intervals from 13 July to 16 August, 2004. Hourly observations of water column temperature, salinity, and oxygen, combined with wind data, allowed calculations of oxygen flux from the air to seawater and diffusive oxygen flux through the pycnocline. The effect of horizontal advection and diffusion were neglected, because horizontal variations of oxygen and salinity were small during calculation period. During 30 July -2 August, stratification was temporarily destroyed

due to strong wind-induced mixing caused by typhoon. Before the mixing, phytoplankton species, the diatom *Skeletonema costatum* dominated in the lower layer below pycnocline. Oxygen supply rate to the lower layer by in situ planktonic net oxygen production and by physical processes from the upper layer was 2.1 g O₂ m⁻² day⁻¹ and 0.54 g O₂ m⁻² day⁻¹, respectively. The total supply rate was almost equal to the sediment oxygen consumption rate of 3.4 g O₂ m⁻² day⁻¹. As a result, oxygen decreased gradually at 0.3 g O₂ m⁻² day⁻¹ but was still remaining in the lower layer during the period of the diatom dominancy. In contrast, after the mixing, the dominant species was shifted to the dinoflagellates *Heterocapsa circularisquama*. Average net oxygen production in the upper layer increased to 3.4 g O₂ m⁻² day⁻¹, which was larger than that of 0.64 g O₂ m⁻² day⁻¹ during diatom dominant period. In the lower layer, however, despite the sediment consumption rate decreased compared to that in the diatom dominant period, oxygen decreased with 4 times higher rate (-3.2 g O₂ m⁻² day⁻¹). This could be attributed to a decrease in planktonic net oxygen production (-1.3 g O₂ m⁻² day⁻¹) (negative value signifies oxygen consumption) due to daytime upward migration of the dominant dinoflagellate *H. circularisquama*. The results of the present study indicate that phytoplankton migration behavior can affect on the formation of oxygen depleted water in the lower layer of eutrophic shallow coastal seas.

Contaminant loads and their variability in the Yangtze River estuary and its mouth

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Mass fluxes of the water quality constituents to the Yangtze River estuary, including chemical oxygen demand (COD_{Mn}), 5-day biochemical oxygen demand (BOD₅), nitrate nitrogen, ammonia nitrogen, and suspended sediments, are calculated using the water quality data of three stations in the lower reach of the Yangtze River from 1995 to 2002. The temporal trends of concentrations of water quality variables and their fluxes are analyzed and discussed. The results indicate that on an year-to year basis, the concentrations and annual fluxes of organic pollutants and suspended sediments show a declining trend over the past 11 years while those of nitrates nitrogen, and phosphates maintain a steady level. On a seasonal basis, however,

the monthly fluxes of most of the water quality variables exhibit significant mass during wet seasons and lower fluxes during dry seasons, except the ammonia flux, which exhibits an opposite trend. Further analyses demonstrate that the monthly mass fluxes are mainly controlled by the runoff; while the annual fluxes are mainly affected by the concentrations.

Rehabilitation and eco-environmental protection of the Yangtze Estuary

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The Yangtze is the largest river in China, the world's famous "Treasure House of biota", and the "Golden Waterway" connecting the east, middle and west part of the nation. Located at the joint of the Yangtze Economic Zone and the Coastal Economic Zone, the Yangtze estuary occupies an essential position in China. Along with the fast economic growth in the past decades, the pollution discharge in the basin has been increasing rapidly leading the deterioration of water quality in the estuary region. As a result, the Yangtze estuary and its adjacent sea area has become one of the most serious places of "Red tide" occurring in west Pacific Ocean. After completion of the Three Gorges Project and the Water Transfer from South to North Project as well as a number of hydropower projects in the upper reaches, the temporal and spatial distribution of water resources in the basin will be alternated, which will exert significant impacts on the ecosystem and environment in the estuary region. In order to preserve the ecosystem and environment, the Rehabilitation Planning of the Yangtze Estuary has been compiled to protect the important wetland and bio-diversity in the region, control the water pollution and the salt-water intrusion to ensure the safety of water supply in the mean time of maintaining the deep channels for navigation.

Investigation of microbial diversity and its degradation potential to PAHs in the sediment in Bohai Bay, China, by PCR-DGGE

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In order to investigate the biodegradation potential of the indigenous microorganisms in the sediment in Bohai Bay, China, an improved understanding of the diversity and structure of the microbial communities in the sediment is required. Seventeen sediment samples were collected in Bohai Bay (117° 41' -117° 60' E, 38° 33' -39° 00' N). DGGE analysis of PCR-amplified 16S rDNA gene fragments confirmed that there was a remarkable different in the composition of

the bacterial community in some different station. The content of polycyclic aromatic hydrocarbons (PAHs) in the sediment was also investigated. The presence of common bands for microbial species in the native sediment DNA indicated that some strains could be potential in situ PAH-degraders.

Ecological characteristics of the macrobenthic community in the Changjiang Estuary and its adjacent waters

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Spatial distribution and evolution of macrobenthos in the Changjiang estuary and its adjacent waters were presented in this study. Samples were collected from 86 stations in four investigations during 2005~2006. Among all the samples, a total of 330 macrobenthic species were identified including in the number of species: 122 Mollusca, 83 Polychaeta, 67 Crustacea, 23 Echinodermata, 28 Pisces and 7 other species. Total average abundance of macrobenthos in the study area was 146.4 ± 22.3 ind/m², the mean biomass (AFDW) was 2.31 ± 0.41 g·m⁻², and the mean secondary production was 2.48 ± 0.38 g (AFDW) m⁻² a⁻¹. The average values of Shannon-Wiener's, Margalef's and Pielou's indices were 1.72 ± 0.16 , 1.37 ± 0.19 , 0.64 ± 0.04 respectively.

The results showed that the macrobenthos of the study area could be divided into 3 levels from west to east, or from nearshore to offshore. In the most westward area named the Hekou subarea and the Hangzhou Bay subarea, the species composition of macrobenthos was very simple, and the indices of biodiversity were very low, indicating that the community structure was very susceptible. In the Kowai subarea and the Zhoushan subarea close to the central part of the research region, the species composition of macrobenthos was more complex than that in the most westward area, and the indices of biodiversity were higher, indicating that the community structure was relatively steady. In the most outside area named the Jinhai subarea, the species composition was most complex in the whole research region, and the indices of biodiversity were highest, indicating that the community structure was most steady.

Comparisons of the present results with those of other sea areas in China make it clear that the macrobenthos usually has low production in estuary area where the environments are usually hard physically and chemically to the

macrobenthos; the secondary production decreases with the depth in the expansive ocean areas where the environments are usually steady; the mean P/B ratio of the macrobenthos in the study area was $1.48 \pm 0.06 \text{ a}^{-1}$, indicating that most species here were usually with small individuals and high renewal.

During the recent 50 years, the total biomass of macrobenthos in the Changjiang estuary and its adjacent waters showed little variation with its value being around 20 g/m^2 or so. However, the dominant species in the research region changed distinctly from then on. In the diluted waters of the Changjiang estuary, the echinodermata that always having big individuals and long life cycles dominated significantly fifty years ago, now the polychaeta that always having small individuals and short life cycles became the most important species instead.

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Study of the establishment of countermeasures for marine litter in the Seto Inland Sea

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Introduction

Marine litter produces a variety of environmental problems in terms of marine pollution, waste treatment, marine ecosystems, scenic beauty and fishing industry operations. Measures must be established to deal with this type of litter. Moreover, to implement these measures, the current situation must be determined based on scientific knowledge. However, there are few case studies in which marine litter has been investigated and studied from a comprehensive perspective. Accordingly, this study was conducted, focusing on the Seto Inland Sea, the largest enclosed coastal sea in Japan and one in which the problem of marine litter has become obvious.

The Study

The field study determined the quantity and type of litter in 261 coastal locations of the Seto Inland Sea (representing approximately 1.25% of the entire length of the Seto Inland Sea coastline) from May through November 2006, in order to study the spatial distribution of litter washed up on the coast (beached litter). Moreover, in order to determine the spatial and temporal distribution, a monitoring survey has been conducted once per month at four locations (since July 2006) using an indicator method¹, with four types of beached litter as indicators: disposable cigarette lighters, plastic bottle and other types of cap, oyster cultivation pipes and golf balls.

Other efforts were also conducted, including studies in which geological data were used to estimate the distribution and total quantity of litter, simulations to determine the source of the litter, questionnaires aimed at understanding the problems and challenges of marine litter.

Results

The distribution of beached litter tended to be highest in the western part of the Seto Inland Sea (at Aki-nada and locations further west) and in the eastern part at Osaka Bay and Harima-nada. Very few of the special pipes used for oyster cultivation in certain areas of the western part of the Seto Inland Sea were found in the eastern part.

Temporal changes in the quantity of beached litter were greatest on the western-facing coasts in the wintertime (west coast of Awaji Island). On the other coasts, the quantity of litter tended to be greatest from summer through autumn.

Discussion

Marine litter does not drift in a uniform manner in the Seto Inland Sea. The drifting pattern can be divided into two types: one for the western part and one for the eastern part.

In the Seto Inland Sea region, it is common for seasonal winds to blow from the west during the winter. Seasonal fluctuations in beached litter, in accordance with the direction that the coast faces, are thought to result from the litter having been blown by the wind.

Conclusions

The results of the study indicate that the manner in which marine litter washes ashore is not uniform in either spatial or temporal terms. For this reason, any measures taken should treat the Seto Inland Sea as a whole rather than targeting individual prefectures or other administrative units.

Studies should be continued in order to propose

measures to deal with marine litter and to inform and educate the general public.

Nursery grounds of Green Tiger Prawn (*Penaeus semisulcatus*, De Haan) in the husherr coastal waters, Persian Gulf

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The survey plan for *Penaeus semisulcatus* nursery grounds was designed to encompass the main coastal prawn catching in Bushehr waters, Persian Gulf, from July 2003 to March 2005.

Sampling stations were selected in the shallow waters < 10 m deep and collections of juveniles were made from a small vessel powered by a 150 hp outboard engine that was equipped with a small beam trawl net with 10 mm stretch mesh. Prawns less than 15 mm carapace length were classified as juvenile.

The catches of *P. semisulcatus* juvenile were abundant at only a few sites in the shallow waters around southern (Motaf) and middle (Helaileh) regions of the study area. The maximum number of juveniles occurred in June and November 2003 and April and June 2004. Juvenile abundance was higher in vegetated sites as compared to non-vegetated sites during this study.

Finding from the present study support the facts that the extensive shallow reef of flat and open coastline sea grass and algae communities are therefore likely to be critically important for the fishery and should therefore be afforded protection from pollution, fishing gear damage and industrial development.

Modeling of phytoplankton production in Ise Bay, Japan: application of nitrogen isotopes to identification of DIN Sources

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An important aspect of the nitrogen cycle in coastal environments concerns the source of the nitrogen used in primary production. The continual input of external nitrogen can determine the total capacity of a bay to produce a sustainable fish harvest within the system. Our target area is Ise Bay, which is one of the most eutrophic coastal areas in Japan. Phytoplankton production in Ise Bay is supported by external nitrogen derived from rivers and ocean, and nitrogen regenerated within the bay. The objectives of this study are to clarify the characteristics of DIN in each source including riverine, oceanic and regenerated nitrogen, and to evaluate the contribution of each DIN source to primary production in time and space. In this study, therefore, the three-dimensional ecosystem model including nitrogen isotopes was developed based on the precise observations as follows. First, seasonal observations for identifying endmember values of riverine DIN were conducted in the lower part of the Kiso Rivers, which empty into the head of the bay. Second, the oceanic DIN endmembers were determined by the seasonal observations at the bay mouth. Third, the magnitudes of isotope effects by nitrification and denitrification on ¹⁵N dynamics were estimated at the central part of Ise Bay to clarify the seasonal changes in regenerated DIN inside the bay. Finally, nitrogen dynamics in Ise Bay were elucidated by the ecosystem model, which could reproduce the DIN concentrations and their isotope signatures obtained by the observations. The model results indicated that phytoplankton production is mainly supported by the internal DIN cycle rather than the external DIN supply. This would be the main reason for sluggish recovery of water quality in the system.

Field observation of water environment characteristics for restoration of the Amagasaki Canal, Japan

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The Amagasaki Canal (see Fig.1) is an enclosed waters approximately 11km in total length and 4m average depth, located in innermost recesses of Osaka Bay. In this area, we confirmed that the canal have been polluted because the canal is a sheltered waters with artificial vertical structures and is affected by waste water from factories. Therefore, it is not effectively used as an amenity space for local citizen. Then, we started the project named "The Sea Blue Project in Amagasaki" to improve water quality. It is necessary to understand the water quality characteristics for proposal an environmental restoration plan. Consequently, the objectives of this study are to clarify the water environmental characteristics of the canal, and to suggest restoration concepts in respect to material cycle. Field survey was carried out to clarify the seasonal change of water quality in every month in 2007. We measured a vertical profile of water temperature, salinity, dissolved oxygen, Chl.a, light and turbidity, respectively, using multi water quality meter (ALEC AAQ1186, Hydrolab DS-5). In addition, we measured water quality at one hour intervals to elucidate daily change in August, 2007. Sampling was also conducted for nutrients in surface and bottom water.

The seasonal investigation indicated that the stable stratification was formed through a year and it prevented a vertical mixing. The stratification was developed between 1m to 2m in depth. We confirmed seasonal variation of salinity correspond to the records of open and close the floodgates. It is interesting that variation of salinity was caused by the artificial manipulation of floodgates. Dissolved oxygen in bottom was about 1mg/L in summer and 3mg/L in winter. Diurnal change of Chl.a and dissolved oxygen was greatly changeable shallower than 2m in depth. The fluctuation range of Chl.a is 50µg/L, and the maximum of concentration was 70µg/L in a day. At the time, observed NH₄-N and PO₄-P concentration in factories effluent were higher 16.6 and 13.9 times than water in canal, respectively, it thought that factories effluent supplied nutrients to the canal mainly. It is found that this area has high primary production in clear

day, red tide occurred and disappeared daily in short time scale. We confirmed that extraordinary supersaturation of dissolved oxygen in surface, while anoxic water in bottom. These results lead that it is necessary for comprehensive action to restore the water quality to take into account reduce factories effluents, active primary production, oxygen deficiency near the bottom and eutrophication.

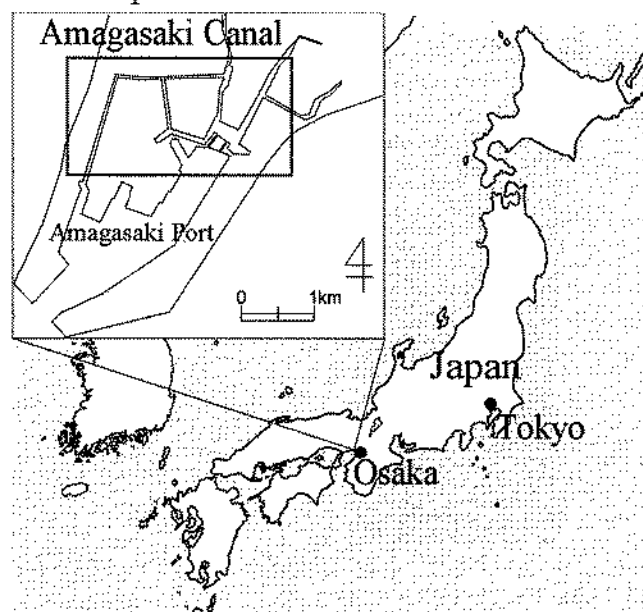


Fig.1 Location of the Amagasaki Canal

Domestication, isolation and identification of hydrocarbon biodegradation Marine Bacteria

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Using diesel oil as the only carbon source, domesticated gradually with two diesel oil concentration grad, 1% (V/V) and 2% (V/V) in succession, a bacterial consortium with high hydrocarbon degrading ability were isolated from oil-polluted sediments (oil content 0.2g/g) taken from intertidal zone of Tianjin seashore, through viable plate culturing. Two of the isolated bacteria strains, strain T1 and T2 with majority biomass, were identified by physiological and biochemical properties and 16s rDNA sequence analysis, showing that Strain T1 belongs to *Rhodovibrio* sp., and strain T2 belongs to *Pseudomonas* sp.

Table.1 Different Colony Numbers and the Degrading Rate along the Domestication

Times of domestication	Different Colony Numbers	Degrading Rate of the Main 14 Kinds of Alkane (%)	Degrading Rate of Aromatic Hydrocarbons (%)
1a	48±6.3	80.8±1.3	17.8±1.6
2 a	42±5.6	90.2±0.9	25.2±0.7
3 a	32±1.3	99.6±2.8	36.7±2.4
4b	12±0	76.3±0.7	25.5±3.4
5 b	8±0	89.5±1.8	27.6±0.6
6 b	4±0	97.6±3.4	33.8±2.1

a: the diesel oil concentration is 1%,

b: the diesel oil concentration is 2%.

A B C



1500 bp

(Lane A: 10 kb DNA Marker; Lane B: 16s rDNA of strain T1; Lane C: 16s rDNA of strain T2)

Fig. 1 Agarose gel electrophoresis analysis of 16s rDNA of strain T1 and T2

Japanese situation of comprehensive management of enclosed coastal sea~from the case of action plan for restoration of Inner Bays~

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February 2006, Ministry of Land and Transport started to manage "the Promotion Committee for Restoration of Ise Bay" and April 2007, it formulated "Action Plan for Restoration of Ise Bay". The members of this promotion committee are Ministry of Land and Transport, Cabinet, Ministry of Agriculture, Forestry and Fisheries, Ministry of Economy and Industry, Ministry of Environment, Gifu Pref., Aichi Pref., Mie Pref., Nagoya City, Nagoya Port Authority, Yokkaichi Port Authority. Promotion Committee was held totally three times managed by Ministry of Land and Transport (Chubu Branch). The actual work had been charged by liaison conference consisting of officials who was in charge directly

in each administrative organization and several theme committees. One of the theme committees, "Committee on Marine Area", only includes various sector members, for example NPO members and researchers, but actual plan had been mainly drawn by the administrative side.

By the way, the necessity for comprehensive management of enclosed coastal sea has been recognized in worldwide and such kind of system has been gradually adopted in many countries, but we don't have yet in the proper meaning in Japan, I think. I want to clarify the current situation of "Comprehensive Management of Enclosed Coastal Sea" of Japan, reviewing the action plans for restoration of inner bays like Ise Bay's case and to find the challenge which we should address in order to realize it.

In 2000, the National Land Agency drew up the guideline for comprehensive management of coastal area. It is well-written guideline based on international standard. Moreover, it is written as the complementing document to the "National Comprehensive Development Plan" which was endorsed by the Cabinet in 1998 so it was anticipated of its effectiveness or any compelling force. But no plan which meets this guideline has been realized in Japan until now. It is difficult to answer why. But if I show one reason, the National Land Agency changed its position by the Central Government Reform in next year (2001). Its affiliation changed from Cabinet to Ministry of Land and Transport. The power of coordination was bumped down a notch. I got this hypothesis when I heard from a unit in the Ministry of Land and Transport which hold jurisdiction over that guideline now. In 2001, "The Urban Restoration Project" sponsored by Cabinet indicated that "to improve urban bay area water quality, please make action plan by various administrative bodies' collaboration." Next year "the Promotion Committee for Restoration of Tokyo Bay" started to discuss and accomplished its "Action Plan" one year after. These kinds of action plans have followed by Osaka Bay, Ise Bay

and Hiroshima Bay, in nearly the same style from 2003 to 2007. I want to discuss about the characteristics of these action plans and evaluate to what extent they have comprehensive feature from the viewpoint of "the guideline for comprehensive management of coastal area". And I want to analyze why they don't reach to the guideline level.

Research initiative on northwest pacific sea marine environment protection

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Background and Policy

Along the coast of the seas surrounding Japan, fishery troubles have been caused by drifted refuge, as well as breakout of red tide and Echizen Kurage (jellyfishes) and as the countermeasures against these troubles a great deal of attention is turned on making a maritime basic plan in accordance with the Basic Act on Ocean Policy. To maintain a suitable level of water quality in public, the comprehensive countermeasure for reducing environmental loads is needed in accordance with the program for reducing environmental loads discharged from the land-based areas.

In this research, we grasp current status of water pollution in waters surrounding Japan and the loads discharged from the areas and a simulation model of water pollution is developed to assess the land-based countermeasures of the countries concerned. We further discuss the land-based countermeasures necessary to recover the desired maritime environment in waters surrounding Japan.

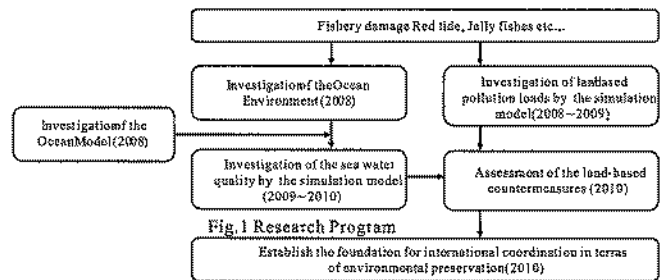
Objectives

- (1) In time of an advance in eutrophication and red tide drifting in waters surrounding Japan, current status of water pollution and pollution loads discharged by land-based areas are investigated.
- (2) Using the simulation model of water pollution, the land-based countermeasures of the countries concerned are assessed.

Results of the Research

The outcome of this research is expected to establish the foundation for international coordination in terms of environmental

preservation, including the reduction in pollution loads mainly based on the land-based countermeasures such as sewerage construction necessary for recovering the desired maritime environment in waters surrounding Japan.



The introduction support for Total Pollutant Load Control System (TPLCS) in the countries of the East Asia

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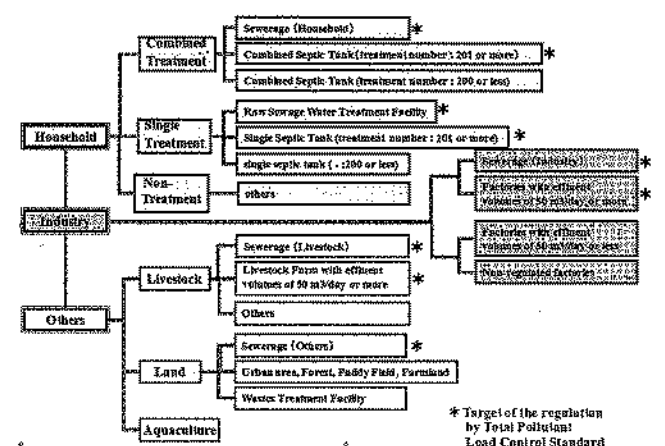
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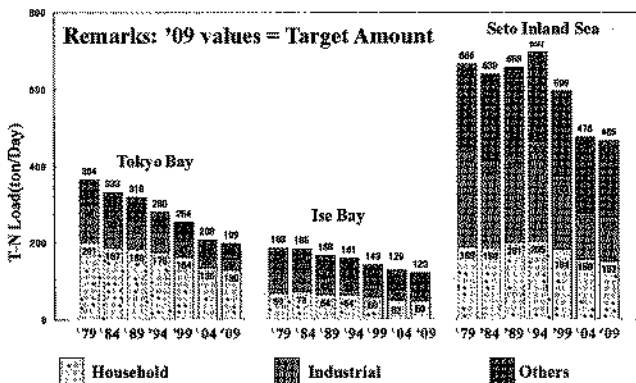
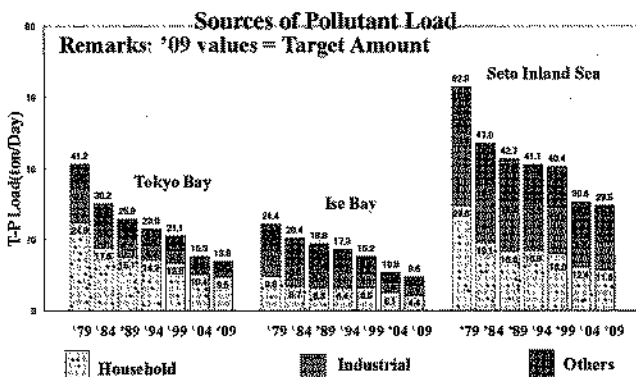
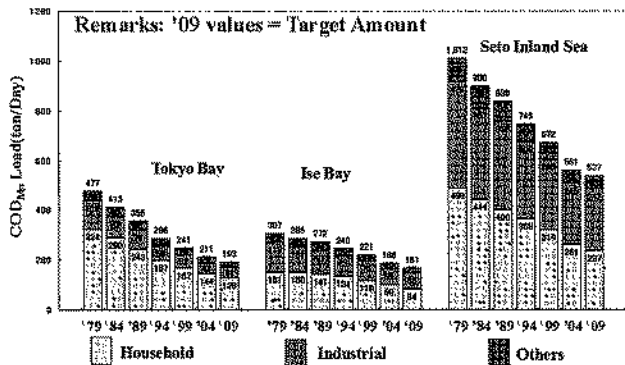
1. The Preservation from the Enclosed Coastal Seas in Japan

In Japan, TPLCS of COD, T-N and T-P is applied to the large enclosed coastal seas, where the effluent regulations by concentration are insufficient for achieving environmental quality standards.

TPLCS was established in 1979 to achieve environmental quality standards by reducing total land-based load from household, industry and other sectors such as livestock, land and aquaculture, respectively with estimation.

As a result, level of water quality in target seas of Japan has been improved steadily.





2. TPLCS as a Countermeasure against the Eutrophication in the East Asia

The eutrophication in the sea areas of the East Asia is now worsening by a large quantity of land-based load in rapid economic development. The introduction of TPLCS should be considered as one of effective countermeasures against the eutrophication.

So MOE started the project that will support the countries of the East Asia to build the framework for estimating total land-based load. The project is expected to establish the introduction guidance that provides the knowledge about the TPLCS that Japan stored in the past for the officials in the countries of East Asia.

The biodiversity of macrobenthos from the Jiaozhou Bay, Shandong Peninsula

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The situation of biodiversity of macrobenthos in the Jiaozhou Bay (South coast of Shandong Peninsula, Yellow Sea) is reported based on the data from the investigations carried out from 1998 to 2007. A total of 322 macrobenthic species were found, of which, 133 species belong to Polychaeta, while 92 to Crustacea. The biodiversities were very different among the sampling stations in the bay. The mean secondary production in the bay in AFDW was 18.65 g/m²/a from 1998-1999 and 13.41g/m²/a from 2000-2004; the mean P/B ratio was the same at 1.05/a for both periods of 1998-1999 and 2000-2004. The distributions of secondary production increased gradually from outside the bay (open sea), to the bay mouth, and to the northern bay (deepest part of the bay). The mean secondary production during 2000-2004 was lower than that during 1998-1999; a high value center during 1998-1999 was in central northern part of the bay near Hongdao, and the center during 2000-2004 was in the northwestern part of the bay near Dagu River estuary and Hongshiya. Highway construction and engineering around the bay and busy activities in the wharf in Cangkou area, resulting in disappearing of large area of ecotope in mud flat at Licun River mouth in northeastern part of the bay, which should be the main reason causing the high distribution center of the secondary production shifted from central northern bay to the northwestern bay. Human activity-related pollutions from household and industries around the bay, marine culture, and the dry-out of incoming rivers to the bay should be responsible for the decline of the secondary production during 1998 to 2004. Comparing with the results from the Bohai Gulf, southern Yellow Sea and the East China Sea, the present result confirmed the hypothesis that the secondary production is affected by water depth, and decreased exponentially as water depth increases. The P/B ratio result confirmed that the P/B ratio increased exponentially with water temperature. The P/B ratio at 1.05/a shows that the mean life history of macrobenthos in the Jiaozhou Bay is about one generation in one year. The macrobenthos from the intertidal zones were also studied, the species

compositions, dominant species and the three diversity indices among the nine intertidal sampling stations were obviously different.

The results of the above studied on the macrobenthos from the Jiaozhou Bay revealed that the number of species and abundance affected greatly on biodiversity, and some environmental factors such as temperature, salinity and primary productivity were closely interrelated with the biodiversity. Pollution and over-exploitation caused by human activities were very important factors affecting on the macrobenthic biodiversity. In order to find out the best way to enhance and protect marine living resources, the relationships of human activities and biodiversity of macrobenthos in the Jiaozhou Bay should be studied further.

Implications of excess ^{210}Pb and ^{137}Cs in sediment cores from Mikawa Bay, Japan

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Four sediments core were collected from Mikawa Bay, Japan, and excess ^{210}Pb and ^{137}Cs were measured by gamma spectrometry. Sedimentation rates for the four cores were determined by the ^{210}Pb method. The range of sedimentation rates is 0.10-0.70 g cm⁻² y⁻¹. The bio-mixing depth for each core, which is less than 7.0 cm, was determined by the excess ^{210}Pb profiles as well. Bioturbation is therefore considered as slight. The ^{210}Pb -derived dates coincide with the results from ^{137}Cs geochronology. Acceleration in sedimentation rate due to environmental alteration has been found in cores A2.5 and 05AS8, representing two depocenters due to the topography. Evidence of the Tokai Flood in 2000 was found in core 05AS8 according to the profiles of both radioisotopes and trace metals.

Seasonal variation in seawater intrusion and primary production in the Yura Estuary, Japan

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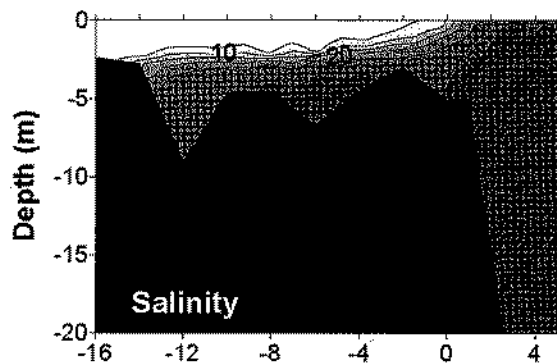
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Estuaries are the most productive areas in the world. Phytoplankton produced by abundant nutrients from rivers sustains prosperous ecosystems in coastal waters. It is well known that physical and chemical conditions vary considerably in time and space in the estuaries, where fresh and seawater are mixed. Primary production should be influenced by these environmental changes. However, because of the complexity, the mechanism of primary production has not been fully elucidated yet. To reveal the mechanism of primary production, we have conducted continuous observations in the Yura Estuary, which is located on the Japan Sea side of the central Japan. Tide is small in the Yura Estuary, and snow-melt runoff increases the river discharge in winter and spring.

The hydrographic condition showed large seasonal variations; seawater intruded into the lower layer of the estuary up to 17 km upstream from the river mouth during summer and autumn, when the river discharge was small (Figure). The strong halocline clearly separated fresh and warm upper layer and saline and cold lower layer. On the contrary, the estuary was occupied by fresh water in winter and spring because of the large precipitation and consequent river discharge. The strength of seawater intrusion into the Yura River was well-correlated with the river discharge and the sea level ($r^2=0.80$).

Phytoplankton bloomed in summer, up to 54 g/l in September 2006. The chlorophyll maximum was observed just below the halocline (Figure), indicating that phytoplankton transported by the seawater intrusion may uptake riverine nutrients. In contrast, chlorophyll concentration was always lower in the sea than that inside of the river mouth. These results suggest that the stratification in the river would play an important role for primary production in the Yura Estuary. A linear mixing showed that phytoplankton produced in the estuary is not simply transported to the sea, but exposed complicated biochemical processes.



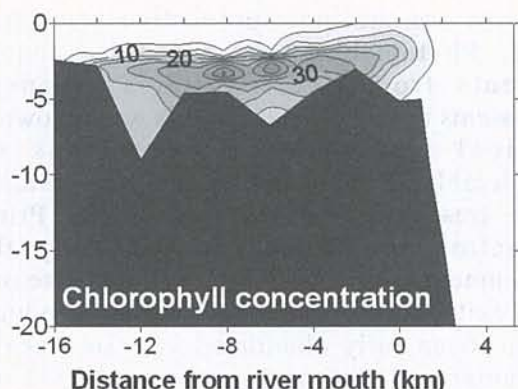


Fig. Longitudinal distributions of salinity and chlorophyll concentration ($\mu\text{g/l}$) in the Yura Estuary on 22 September 2006.

Monitoring of POPs with bivalves as a bioindicator in the Pearl River Delta

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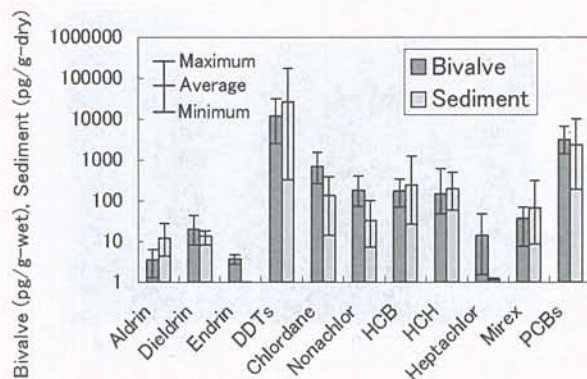
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In recent years, influence of POPs to humans and the ecosystem has been concerned and international monitoring and control has been more needed than ever. Because POPs concentration is commonly very low in the environment, it is difficult to measure the concentration directly. In contrast, biomonitoring is efficient because the concentration can be increased due to bioaccumulation.



In this study, distribution of POPs concentration was monitored with bivalves as a bioindicator in the Pearl River Delta. Accumulation characteristics of POPs and the availability of the POPs monitoring in the Pearl River Delta were discussed. Field surveys were conducted, and bivalves, water, and sediment samples were collected from 11 points in the Pearl River Delta. 10 kinds of chemical group and their isomers recognized POPs were targeted, and their concentrations in the bivalves, water samples (both dissolved condition and contained condition in the suspended solids in the water), and sediment samples were determined using high-resolution GC-MS. As a result, range of POPs concentration in each media was 1~10 (pg/g-wet), 1~10 (pg/g-dry), 1~10 (pg/L) and 1~10 (pg/L) respectively. DDTs concentration was the highest among POPs in bivalves, sediment and SS, whereas HCHs concentration was the highest in DM. In regard to DDTs, an indicator (DDE+DDD)/DDT that shows a possibility of new DDT discharge was below 10 in all samples¹⁾. And also the indicator exhibited below 1.0 in 7 of 38 samples, therefore the possibility of new DDT discharge was suggested. Concerning homologue of PCBs, total ratio of PCBs from M1CB to T4CB was 70% in water, however, that of PCBs from P5CB to D10CB was 60% in bivalves. Therefore it was found that high chlorinated PCBs can be more accumulated than low chlorinated PCBs from water to bivalves. In respect to accumulation characteristic of POPs, it was shown that there is a strong correlations ($R^2=0.86$) among the BCF of POPs, octanol-water partition coefficient (K_{ow}), and fat content (%) in bivalves. Using the monitoring result, primary risk assessment due to shell consumption was

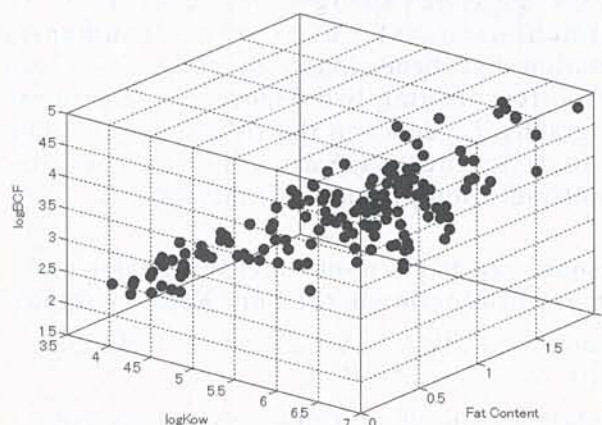


Fig.2 Multiple correlation among logBCF, logKow, and fat content

conducted, and potential cancer risk by PCBs and DDT was suggested. Based on the results, it was verified that POPs monitoring method with bivalves as a bioindicator is efficient and monitoring of PCBs and DDTs is significant in the Pearl River Delta.

Reference

Guo Jianyang, Eddy Y. Zeng¹, Wu Fengchang, et al (2007). Organochlorine Pesticides In Seafood Products From Southern China And Health Risk Assessment. *Env.Tox.Chemi.*, 26: 1109-1115

Effect of the condensed tannin from the dead leaves of deciduous trees on the photosynthesis reaction inhibition to *Microcystis aeruginosa*

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Hepatotoxin like microcystin from *Microcystis aeruginosa* (*M.a.*) is extremely toxic to human and is an important water issue in terms of water resources and water quality preservations. The countermeasures to the water-bloom occurrence due to the excessive growth of toxic cyanobacteria are not necessarily available at present. The authors have revealed that the condensed tannin (CT) in the water-soluble extract from the dead leaves of deciduous trees is very effective to the growth control of *M.a.* Furthermore, the growth control was clearly affected by the condensed tannin loading intensity (CTLI). The mechanism of the *M.a.* growth control is unknown yet. Photosynthesis light reaction has been divided into NADP reduction reaction (PS I) and oxygen generation reaction (PS II). The addition of the extract results in the growth control and in fact decreases in the oxygen generation simultaneously, which imply the extract from the dead leaves functions like PS II inhibition. Accordingly, the effect of the photosynthesis reaction inhibition was examined on the basis of the direct measurement of the DO concentration trend in the *M.a.* culture solution to evaluate the oxygen generation rate (OGR). Data were plotted in Fig. 1 to show the photosynthesis inhibition effect on *M.a.* obtained from National Institute for Environmental Studies, Japan, (NIES) as NIES 102 when the CT was

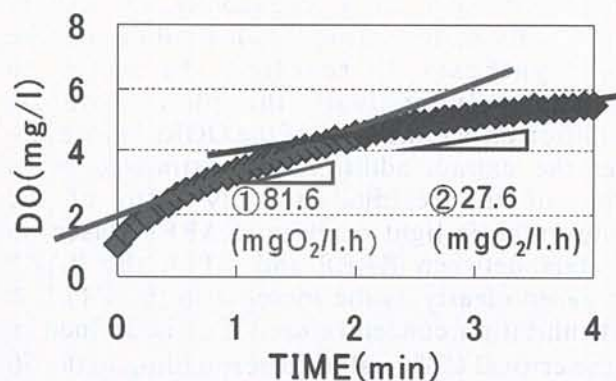


Fig. 1 OGRs before(①) and after the extract addition(②)

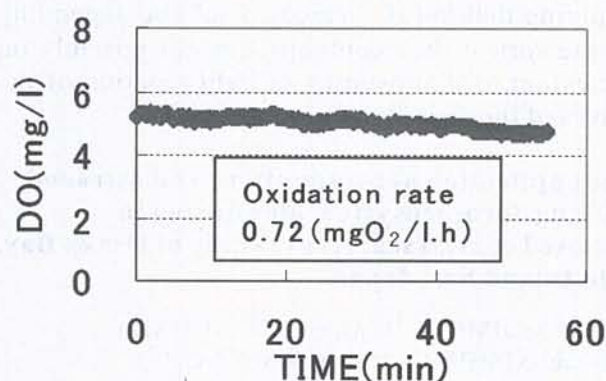


Fig. 2 DO consumption by condensed tannin

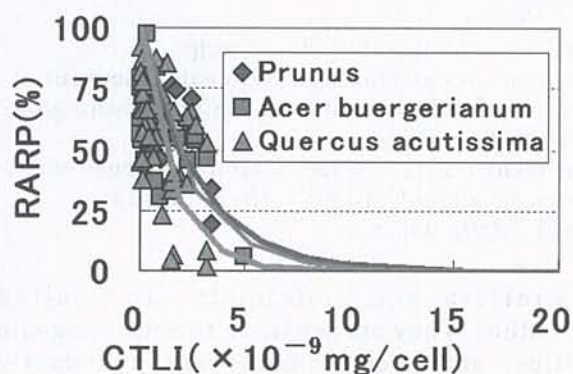


Fig. 3 Effects of condensed tannin on RARP

added into the *M.a.* culture solution at about 2 mg/L CT concentration and at about 1.47×10^{-9} mg/cell CTLI. The *M.a.* culture solution containing about 0.9 million cells per ml was lighted so that the initial OGR for control was about 81.6 mg-O₂/L·h. The OGR in 2 minutes after the addition of the extract decreased immediately down to 27.6 mg-O₂/L·h. The extract itself was consuming the DO at about 0.72 mg-O₂/L·h, being very small and neglected when compared with the

actual OGR (Fig. 2). Consequently, the extract would be the major reason for the inhibition of the photosynthesis II reaction. In order to quantitatively evaluate the photosynthesis inhibition effect, the ratio of the OGRs before and after the extract addition was estimated as in terms of the residual activity ratio of the photosynthesis light reaction (RARP). Based on the data between RARP and CTLI, the RARP decreased clearly as the increase in the CTLI. A half-inhibition concentration (IC_{50}) is defined to be the critical CTLI value corresponding to the 50 % value of the RARP. Some IC_{50} values are given for *Prunus* as 1.9×10^{-5} mg/cell, for *Acer buergerianum* as 1.4×10^{-5} mg/cell, and for *Quercus acutissima* as 0.8×10^{-5} mg/cell in order, implying that the IC_{50} values would be depending on the sort of the deciduous trees or possibly on the extent of photosynthesis light reaction of the leaves of the trees.

The application of foraminifera and ostracod for long-term ecosystem monitoring in enclosed coastal sea: A case study of Osaka Bay, Seto Inland Sea, Japan

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Foraminifera and Ostracoda are shelled meiobenthos. They are sensitive to anthropogenic activities, and their remains are abundantly preserved as 'fossil' in bay sediments after their death. Thus, they can be used to trace environmental/ecosystem changes over periods of decades and centuries using sediment cores. In this study, we investigated spatial and temporal distributions of foraminiferal and ostracod assemblages in Osaka Bay, one of the most polluted marine areas in the world.

Benthic foraminiferal and ostracod assemblages from surface sediment in Osaka Bay, collected in 2004, were analyzed to characterize the distribution of the modern foraminiferal and ostracod assemblages. The results suggested that

low diversity community, typically characterized by exclusive dominance of three eutrophication-tolerant foraminiferal species (*Ammonia beccarii*, *Eggerella advena*, and *Trochammina hadai*), is found in the inner part of the bay, where eutrophication is serious.

Four sediment cores, which obtained along a transect from mouth of the Yodo River (a source of nutrient input) to middle part of Osaka Bay, were examined to trace the development process of modern low diversity community. The records of foraminiferal and ostracod assemblages in the cores clearly documented the development of low diversity community after the urbanization in the early part of the 20th century. Many foraminiferal and ostracod species that are unable to tolerate low-oxygen conditions decreased and three eutrophication-tolerant foraminiferal species increased after the early part of the 20th century, when Japan's industrial revolution started. As a consequence, low diversity community developed rapidly in the inner part of the bay since that time. Low diversity community most progressed as a result of severe hypoxia and food increase by eutrophication during the high economic growth period (~1970's). A sewage treatment program for the Seto Inland Sea was enacted in 1970's in order to reduce the organic pollutant loads. Coincident with the commencing period of the program, the density of eutrophication-tolerant foraminiferal species decreased, but no major changes in the foraminiferal and ostracod assemblages occurred. This study provides new information regarding the use of foraminifera and ostracod as paleoecological indicators of anthropogenic environmental/ecosystem changes.

Annual variations of Oxygen Deficient Water Mass (ODW) in Jinhae Bay

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As a basic study to improve oxygen deficient water mass (ODW), this study analyzed the spatial and temporal variation of the water quality and investigated the characteristics of ODW in Jinhae bay, from 1989 to 2006. By observing the annual variation of water qualities, the severe polluted area was found, and the effects of a special management sea area in Masan bay and the construction of Pusan Newport on the water

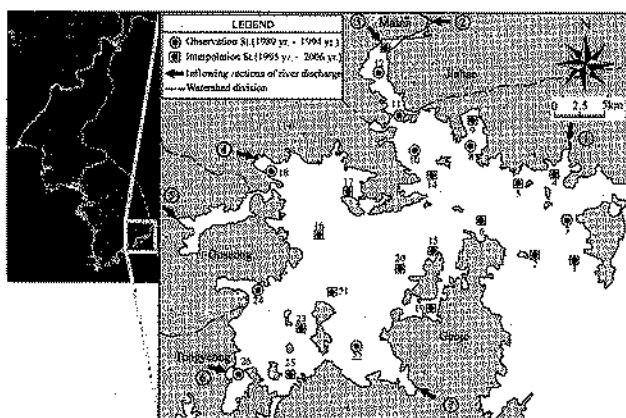


Fig.1 The map shows inflowing point of river discharges and divided area for calculated of pollutant load and observation stations of water quality in this study

qualities was investigated. Jinhae bay is a representative semi-enclosed bay which is located on the south-eastern coastal sea of Korea, and be surrounded by Masan, Jinhae, Changwon, Geoje, Tongyeong, and Goseong. The latitudinal and longitudinal length is about 25 km and 35 km, respectively. The average water depth in Jinhae bay is about 10 m and freshwaters from seven rivers inflowing into the sea area (The Korea ministry of Environment 1991). In this study, the analysis of annual variation for oxygen deficient water mass (ODW) in Jinhae bay was carried out. For the purpose, first, 26 stations where the construction of Pusan Newport is being processed were selected to investigate the characteristics of water quality in Jinhae bay. Second, the cluster analysis was conducted using the water quality data of the 26 Stations from 1989 to 2006, which were collected from the National Fisheries Research and Development Institute, KOREA (NFRDI). Third, Jinhae bay was divided into regions having similar water quality based on the collected data. Forth, by observing the annual variation of water qualities, the severe polluted area was found, and the effects of a special management sea area in Masan bay and the construction of Pusan Newport on the water qualities was investigated. Finally, we estimated oxygen deficient water mass (ODW) area, ratio and volume in Jinhae bay. **Fig. 1** The map shows inflowing point of river discharges and divided area for calculated of pollutant load and observation stations of water quality in this study. Finally, we estimated ODW_{area}, ODW_{ratio} and ODW_{volume} in Jinhae bay. From the study, it is shown that overall water quality at 2000s has been improved by investigating the variations of dissolved

oxygen, chemical oxygen demand, etc. From cluster analysis, Jinhae bay was classified into four regions. The four regions were defined as Southern (I), Central (II), Northern (III), and Eastern (IV). ODW was occurred in all areas of Region I in 1993 and 2002~2004. The value of 1.92 km³ is the highest value of Region I in 1993 and 2002~2004. ODW were not occurred in Region IV because seawater was well exchanged in the eastern part of Jinhae bay. On the other hand, ODW was generated every year in Region I, this means the southern part is the most polluted area in Jinhae bay. ODW was decreased in Region III; hence, it is shown that water quality of Region III has been improved since operating wastewater treatment plant in 1994.

Continuous surface sea water surveillance on Poly Aromatic Hydrocarbons (PAHs) from the Tokyo Bay, through the East China Sea, then to the South China Sea

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Purpose: Although the toxicity of most PAHs is much weaker than that of dioxins, the total toxicity of PAHs on earth is bigger, because a much larger amount of PAHs is produced than dioxins, and their harmful influence could be more serious. Many reports on the distribution of PAHs in large cities and in coastal sea areas are available; however, only a few exist on the high seas. The aim of this study is to elucidate the situation of pollution by PAHs in the East China and South China Seas.

Materials and methods: Surface water, from 200 km south of the Shikoku Island to the Straits of Malacca (8 samples, 765—1079 L/day), was collected continuously on a long voyage (Nov. 21—29, 2005) of the *Umitaka-maru*, a research and training ship of the university. PAHs were adsorbed by Blue Rayon, eluted with methanol, and then analyzed by HPLC (Wakosil-PAHs). Sample #2 and part of #3 were collected along a line parallel to the southeastern edge of the East China Sea, and samples #4-8 were collected along a diagonal line in the South China Sea in the direction of northeast to southwest. Water depth

and tidal stream (direction and speed at the depth of 30 m) was monitored by an Acoustic Doppler Current Profiler (ADCP) at all times during the voyage, and the number of ships at the periphery of the sailing route was recorded by using an Automatic Identification System (AIS).

Results: The total amount of PAHs was measured in each sample and found to range between 30.4–120.2 ng/L. The highest concentration was observed in sample #3, which was collected along the eastern shore of Taiwan. Ten different PAHs were detected in total, and acenaphthylene was observed in all samples. The three highest PAHs (26.1–67.2 ng) concentrations of acenaphthylene were observed in sample #4–6. In sample #1–3 and 8, naphthalene (23.0–52.0 ng) was the highest compound. Benz(a)anthracene (3.3–27.8 ng) was found in sample #1, 3, and 5–7, and was the highest PAHs in sample #7. The chemical composition of PAHs varied considerably after passing the center of the South China Sea, and benzo(a)pyrene, the most toxic compound in 16 PAHs, listed by USEPA, was detected in sample #7–8 (2.3–2.4 ng).

Discussion: Sample #3 collected along the eastern shore of Taiwan showed the highest total PAHs concentration and the nearby sample of sample #4 exhibited the lowest. The difference in the total amount of PAHs in these two samples was about four times. According to the ADCP, the current from Taiwan to the sea lane apparently changed to the opposite direction, namely from the Pacific Ocean to mainland China, at the border of sampling areas sample #3 and sample #4. Such a significant distinction in local ocean drift caused this big difference in the total amount of PAHs in the two adjacent samples. As a result, the degree of contamination in the enclosed sea coastal area is likely to be influenced by the presence of a pollutant source such as a big city or an upstream industrial belt, rather than by the depth of the sea. The high density of ships observed by AIS along the sea lane suggested that exhaust smoke from those ships was also responsible for the pollution.

The contribution of atmospheric deposition of nutrients to the Yellow Sea

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Atmospheric deposition is one of vital paths for chemical substance into the ocean, and an important source of nutrients, such as nitrogen, phosphorus and iron. Using the data of the total suspended particles (TSP) and size-segregated particles, Air Pollution Index (API), the deposition fluxes of aerosols and nitrogen over the Yellow Sea and Qingdao coastal seas were estimated, and the impacts of the dust weather on the seasonal varieties and spatial distributions of the aerosols and nitrogen were also discussed.

In 2002-2007, the dry deposition fluxes of aerosols and total nitrogen (TN) over the Yellow sea attenuated with longitude from west to east, and were about 544.2-1400.1 mg/m²/month and 9.17-23.6 mg N/m²/month respectively. The wet deposition fluxes of TN varied between 16.5-436.1 mg N/m²/month. The ratio of dry deposition to total deposition for TN was about 33%. The wet deposition fluxes of total inorganic nitrogen (TIN) was 15.0-393.9 mg N/m²/month, contributed more than 66% of TN. The ratio of dry deposition to total deposition for TIN varied between 1.5-63%. The wet deposition of nitrate and ammonium were about 1.6-9.5 and 3.0-17.3 mg N/m²/month, respectively. The average ratios of dry deposition of nitrate and ammonium to total deposition were 28% and 18% respectively.

The levels of dry deposition fluxes of aerosols and nitrogen over the Yellow Sea were about 1482.9-2641.0 mg/m²/month and 9.19-16.6 mg N/m²/month during dust period, respectively. They were about 2558.5 mg/m²/month and 16.1 mg N/m²/month over Qingdao coastal seas. The impact of the dust weather on the dry deposition of aerosols mainly focused on the coarse particles with the diameters above 3.3µm. The effect of dust weather on ammonium was larger than on nitrate.

River and atmosphere are both important sources for nutrients in the Yellow Sea. Compared with riverine input, the contribution of atmospheric deposition to total inputs of NO₃⁻+NH₄⁺ from the two sources was about 31.1%-35.5%.

Evaluation of water quality change and inflowing pollutant loads in the Gwangyang Bay of southern coast, Korea

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The Gwangyang Bay, located in the south sea of Korea, is a semi-enclosed bay with dimensions, 17 km from east to west and 9 km from south to north. The total area is about 230 km² and depth is between 20 and 30 m. Geographically, the Gwangyang Bay has two main water discharges (2.3 billion tons per year) from Seomjin river and Sueo river. Near the bay there are nationally recognized industrial complexes such as POSCO Gwangyang steelworks, Yeosu petrochemical industry stations, Yulchon industrial station, Yeosu thermal power plant, Hadong thermal power plant and Gwangyang Port.

Because of the geographical stand out and the industrial uses, environmental impact assessments have been continuously carried out to predict marine environmental variations of eutrophication, red tide outbreak, appearance of oxygen-deficient water masses, fish population, and so on. However, the assessments have been based on the data observed in the limited areas near the industrial complexes (for the most part, near POSCO Gwangyang steelworks and Yeosu petrochemical industry stations). Therefore, the quantitative analysis such as QWASI (Quantitative Water-Air-Sediment Interaction fugacity model) on inflowing pollutants loads into the Gwangyang Bay has been hardly carried out. Moreover, the calibration-verification process of the water quality modeling has been restrictedly conducted because the observed data of inflowing pollutants loads were not sufficient.

In this study, in order to setup a reliable management system of water quality, the inflowing pollutant loads and water discharges

from the five rivers (Seomjin river, Sueo river, Gwangyang-west river, Sangam river and Daepo sea wall) into the Gwangyang Bay were measured and estimated. The fresh water discharge from the five rivers into the Gwangyang Bay in dry season were estimated $20,864.7 \times 10^6$ m³/day, 222.9×10^6 m³/day, 217.2×10^6 m³/day, 126.5×10^6 m³/day, and 96.1×10^6 m³/day, respectively. In addition, the inflowing pollutants loads are defined by river discharge multiplied by water concentration, and six types of pollutant loads were estimated, COD (Chemical Oxygen Demand), SS (Suspended Solids), TN (Total Nitrogen), TP (Total Phosphorus), DIN (Dissolved Inorganic Nitrogen), and DIP (Dissolved Inorganic Phosphorus). As a result, the inflowing pollutant loads of COD, SS, TN, TP, DIN and DIP into the Gwangyang Bay in dry season were estimated 26,926 kg/day, 80,418 kg/day, 24,227 kg/day, 555 kg/day, 8,203 kg/day, and 212 kg/day, respectively. Those estimated pollutant loads are compared with the previous results, which were obtained from the limited observations; hence, a wider spatial variation of each pollutant load is obtained.

Design and application of artificial neural network predicting model of assessment index in coastal marine ecosystem

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Due to the overexploitation of marine ecological resources and the worsening of environmental pollution, our typical marine ecosystem has been seriously damaged, with local (regional) water ecosystems imbalance and biodiversity sharp decline. So the development of marine ecosystem assessment will provide an important basis for decision-making for the effective protection of marine ecological environment and sustainable exploitation and utilization of marine ecological resources. Ecosystem health assessment is not only a focus but also a difficult point in ecology studied at present; with promising development and application, it has a great deal of questions existing at the same time (for instance, the concept and definition of health, evaluation criterion, etc). According to the assessment index system that has already been set up, by using MATLAB7.0 neural network toolbox, set up artificial neural network (ANN) with mapping predicting model to various kinds of physical and

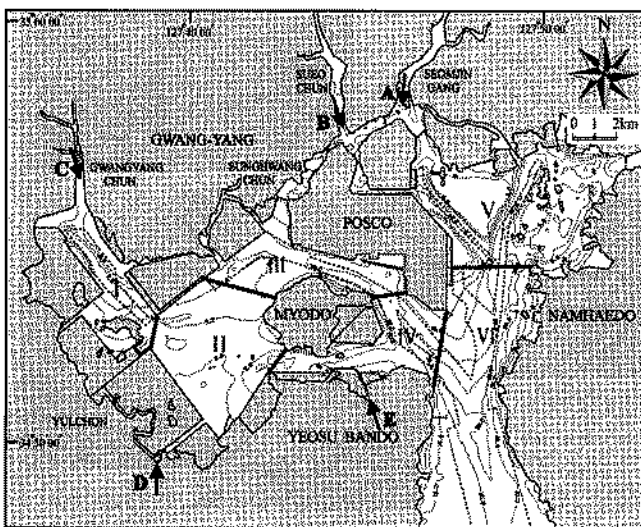


Fig.1 The map shows bathymetry, inflowing point of river discharges and divided area in the Gwangyang Bay

chemical, ecological factor and chlorophyll a density of coastal sea water. At the same time, the statistical software SPSS was used to make further optimization analysis to the correlation of marine ecosystem structure, function and environmental indicators. On this basis, perfect the method of ecosystem assessment, guarantee the accuracy and scientificity of assessment method, which promote the comprehensive understanding of ecosystem healthy.

Distribution of Polycyclic Aromatic Hydrocarbons (PAHs) concentrations in different size fractions sediments from the intertidal zone of Bohai Bay in China

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Distributions of 15 polycyclic aromatic hydrocarbons (PAHs) were analyzed in different particle size fractions (<0.031 , $0.031-0.063$, >0.063 mm) for three sediments from Intertidal Zone of Bohai Bay. The results indicated that the total PAH concentrations ranged from 58.60 to 1289.75 ng/g dry weight and varied remarkably among the different size fractions in these sediments. In all three sediments, the highest of PAH concentrations is in the sand fraction (>0.063 mm), the lower in the medium silt-clay fraction (<0.031 mm) relatively, and the lowest in the coarse silt fraction ($0.031-0.063$ mm). However, the relative contribution of PAH to environment in the medium silt-clay fractions for Qikou estuary sediments is absolutely main fraction, but in the sand fractions for Dagu estuary and Lujia river sediments because of the different percent ratio of three size fractions in the sediments.

Topographical change of the sandbar and estimation of suspended solid flux in the Nakdong River Estuary, Korea

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The ecological environmental zones in coastal area, like tidal flat, salt marsh and sandbars, were gradually decreased and changed due to large scale of coastal development projects, land reclamation, dike construction, and large amounts of soil dredging and so on. In this study, to establish a countermeasure from marine casualties as a basic study for long-term prediction of topographical change around Jinudo in the Nakdong river estuary, spatio-temporal topographical change monitoring was carried out. Also, In order to estimate the deposition changes concerning SS (Suspended Solid) flux at St.S1, SS concentration and current velocity were measured using the Van Dorn water sampler and RCM-9 during spring and neap tides.

From the monitored results of topographical change, it was found that the annual mean ground level and deposition rate were 158.8 mm and 0.43 mm/day and all parts except the northern part of Jinudo had the active topographical changes and a tendency to annually deposit. From vertical distribution of SS net fluxes, The depth averaged values of latitudinal and longitudinal SS net fluxes(SS_{xx} and SS_{yy}) during spring tide were estimated about 28.0 kg/m²/hr (eastward) and 11.1 kg/m²/hr (northward), respectively. It was found that SS_{xx} was 2.5 times higher than SS_{yy} . The maximum SS net flux was estimated to be about 39.7 (eastward) and 9.1 kg/m²/hr (northward) at the 3 m depths. Those during neap tide were estimated about 4.8 kg/m²/hr (eastward)

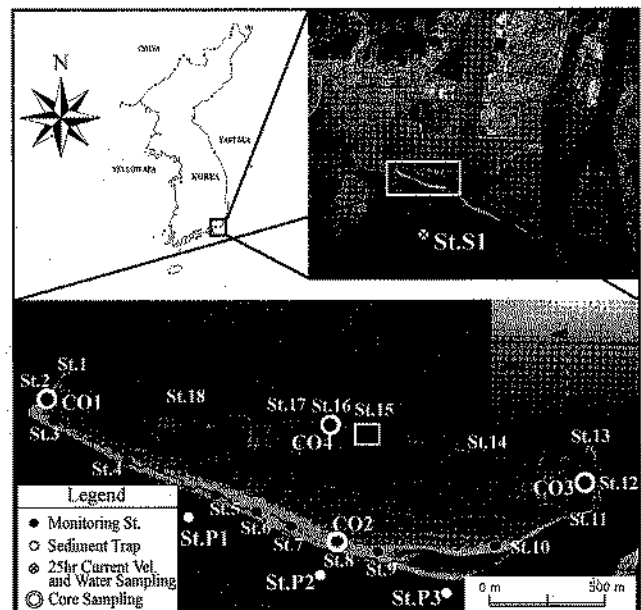


Fig.1 The geographical location and field survey Stations of Jinudo in the Nakdong river estuary, Korea

and $1.5 \text{ kg/m}^3/\text{hr}$ (northward), respectively. It was found that SS_{net} was 3.2 times higher than SS_{lv} . The maximum SS net flux was estimated to be about 9.8 (eastward) and $1.1 \text{ kg/m}^3/\text{hr}$ (northward) at bottom layer (6 m). As result of, the depth averaged values of SS_{net} and SS_{lv} during spring tide were approximately 6 times higher than those during neap tide. In order to estimate SS net flux of two tidal periods, and topographical changes in the southern part of Jinudo from the monitoring, both SS_{net} and SS_{lv} overall presented the maximum at bottom layer. Therefore, we considered that topographical changes were arisen by resuspension due to the bottom friction sediment by strong flow in the flood tide. The SS net fluxes in the Nakdong River estuary transport to the NE during spring and neap tides, this is well corresponding to the direction of residual currents. Future studies will identify changes of seasonal deposition and estimate quantitative behaviors of resuspended sediment. Besides, this field survey will be conducted at the other stations in summer.

Long term variation and major impact factors of nitrogen and phosphorus transportation by the Yellow River, China

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Monitored data of nitrogen and phosphorus of latest 40 years (for nitrogen) or 20 years (for phosphorus) in the lower reaches of the Yellow River were collected. Meanwhile, corresponding population, nitrogen and phosphorus fertilizer application data, and industrial wastewater data of the Yellow River basin were also collected. Statistical analysis was used to exam the relationship of these social economic development data and the water quality, in order to explore links between the population growth, fertilizer application, wastewater discharge and the variation of nitrogen and phosphorus transportation. The results indicated that nitrogen transportation in the Yellow River had an increasing trend during the last 40 years, however, it declined considerably in the later 1990s due to the desiccation of the Yellow River. In regard to the estuary, the nitrogen contribution from Huayuankou to Lijin was minus due to the huge amount of water diversion from the Yellow River for irrigation. The phosphorus contents fluctuated

in a certain range without tendency and also decreased in the later 1990s due to the desiccation. Further analyses indicated that the nitrogen transportation in the Yellow River was mostly impacted by the population and nitrogen fertilizer application, but showed no statistically significant relationship with wastewater loads. In contrast, the total phosphorus contents in the Yellow River showed no relationship with population, phosphorus fertilizer use and wastewater loads in the basin, but presented statistically significant relationship with suspended solid concentrations of the Yellow River. Calculation by regression equation indicated that the phosphorus content in suspended solids of the Yellow River was 0.54 g/kg , which was quite close to the P background value in the soil from the Loess Plateau, the intensive soil erosion area in China, through which the Yellow River flows. Therefore, it was concluded that phosphorus transportation in the Yellow River was dominantly controlled by the soil erosion from the Loess Plateau. This study can supply basis for the total nutrient load control and load allocation in the watershed and marine areas.

Grain size effect on PBDEs concentrations in sediments from the intertidal zone of Bohai Bay, China

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This research provides particle-scale understanding of PBDE distribution in sediments obtained from three intertidal flats of Bohai Bay, China. The sediments were classified into three groups: sand (particles $>63 \mu\text{m}$), coarse silt (particles $31-63 \mu\text{m}$) and medium silt-clay (particles $<31 \mu\text{m}$). In all three sediments, the total organic carbon was not associated with grain size, also the PBDE concentration as the same. But the silt-clay fraction contributed 82%, 56% and 85% of the total mass and 97%, 53% and 100% of PBDEs in Qikou estuary, Lujun river and Dagou estuary, respectively. The coarse silt fraction had the lowest percentage of the total organic carbon in all three sediments, although it had the highest percentage of the total mass in Dagou estuary sediment. The results indicated that the BDE209 was the dominate congener, and its distribution was not associated with grain size. Results of this

study illustrate the importance of understanding particle-scale association of hydrophobic organic contaminants for explaining bioavailability difference among sediments; however the further study is needed. In this work, we also found that the PBDE concentrations in sediments from Luju river and Dagu estuary were five times higher than Qikou estuary sediment, it may be that they were located in Tianjin Lingang Industrial Area where human activities are increasing rapidly in these areas.

Nutrient pollution in Tianjin Bohai Bay, China

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The paper studied the contaminative levels of biogenic elements, the historical evolvement trend and the eutropication of Tianjin Bohai Bay through the investigation of biogenic elements of surface seawater in Bohai bay as well as the collection and analysis of historical data concerned. The result indicated that the surface seawaters were under the bad nitrogen contaminative conditions. Beitang and Dagu estuary appeared to be the two main contaminative sources of inorganic nitrogen and phosphorus pollution. Historical evolvement trends of DIN and DIP closely related to the annual runoff into the ocean, especially the notable relation in the coastal areas of Dagu estuary where the contents of DIN and DIP were proportional to the annual runoff into the sea, indicating of the land sources of inorganic nitrogen and phosphorus around Bohai bay. Influenced by the increasing contents of inorganic nitrogen in the offshore area of Bohai bay in Tianjin, the nutrient structure of the offshore area of Bohai bay in Tianjin had been remarkably changed from 1985 to 2003. It had been changed from nitrogen limitation in 1985 to phosphorus limitation, thus greatly affecting the phytoplankton community structure in waters.

A simulation of the accumulation process of suspended particles derived from rivers flowing into Ariake Bay, Japan

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Ariake Bay is the one of the best-known semi-closed sea located in southwest Japan. In this bay, the decrease of fish hauls and bivalve larvae, the increase of red tides and incidences of oxygen deficiency and a change for the worse of the bottom sediment were all observed recently. Now, numerous scholars, government offices and others are performing research for the clarification of these environmental change factors. In the future, greater efforts for the restoration and preservation of the environment will be needed.

In order to evaluate the transport and accumulation of the suspended particles from the rivers flowing into Ariake Bay, the authors simulated the movement of the particles discharged from the main rivers and Isahaya Reservoir by using a computer simulation. The

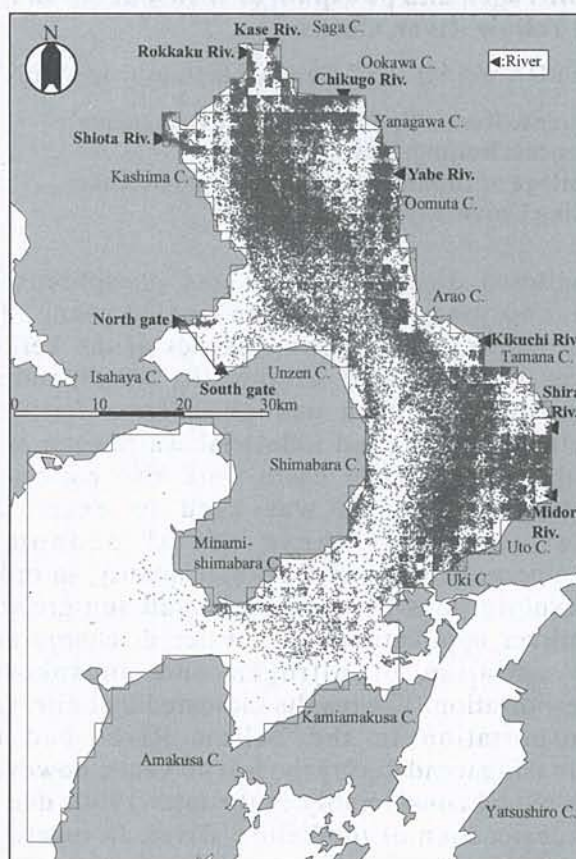


Fig. Distribution of accumulated particles in Ariake Bay sediment which derived from the rivers.

numerical model was created by combining both a hydrodynamic model and a particle tracking model. The particle tracking model used the Euler-lagrange method (Yanagi et al, 1989) combining the settling and resuspension process of the particles. The size of particles from rivers were divided into 12 categories. The settling rate of the particles was set up by Stokes equation. The resuspension process assumed that particles less than silt size (0.074 mm) which had accumulated on the bottom sediment were resuspended when the bottom friction force of the seawater flow was more than the critical shear stress.

As a result, the particles discharged from the rivers located at the head of Ariake Bay were moved in water columns and accumulated on the bottom sediment along the seawater flow towards the mouth of the Bay. Most of the particles which accumulated on the bottom sediment were supplied from the Kikuchi River, Sira River and Midori River which were all located in Kumamoto Prefecture. This model was able to quantitatively estimate the spatio-temporal behavior of particles during the process of accumulation on the sea bottom and subsequent resuspension in water columns. Hereafter, we will attempt to validate this model with a collection of real data from each of the locations that was simulated, while also estimating the contribution of particles from each source into the bay. Once validated, this simulation model could be useful for tracking the movement of plankton during red tides, as well as the journey of pelagic bivalve larvae.

Study on natural environmental characteristics of the Sone tidal flat in the Suo sea, Japan

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1. Introduction: The Sone tidal flat in Kitakyushu city has a dry flat of about 517ha during ebb tides, as shown in Fig. 1. It is one of the largest flat in the city and the nicest spots for the wild bird observation throughout four seasons. It is also famous as the breeding ground of Horseshoe crab (*Tachypleus tridentatus*). A construction of an artificial island for a new airport about 3 km offshore started in 1994, which was completed in

2006. A fishing port is under construction in the center of the tidal flat. There is therefore possibility that natural environments of the tidal flat may change. Although several large-scale landfills have been recently constructed surrounding the Sone tidal flat, number of Horseshoe crab breeding pairs laying eggs have been increasing. The aim of this study is to understand characteristics of the natural environments of the Sone tidal flat and to identify changes in wave environments due to the large-scale landfills through a numerical wave model.

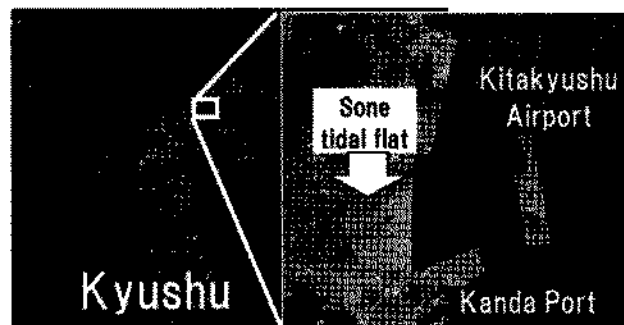


Fig.1 Location of the study site

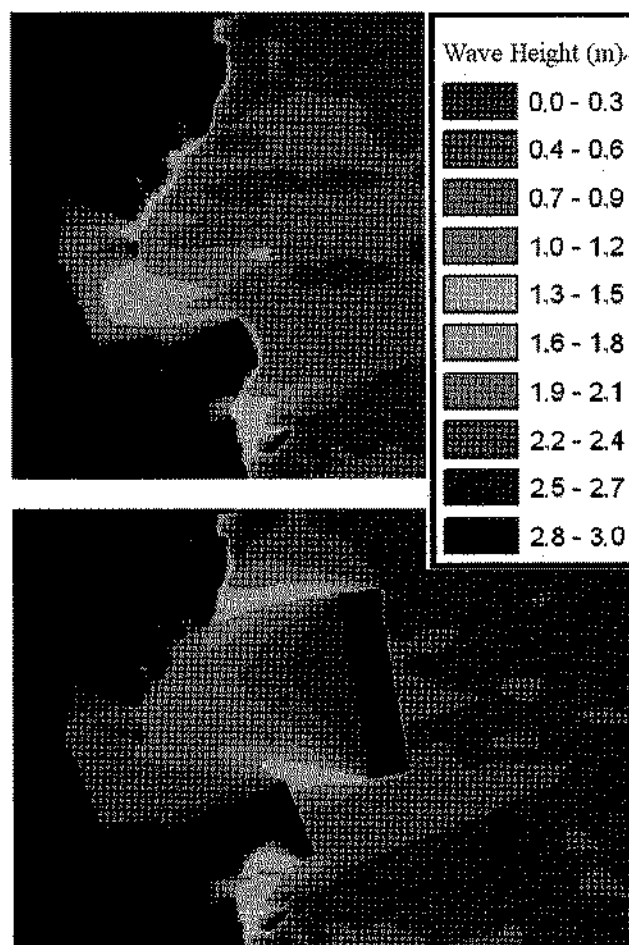


Fig.2 Computed wave height

2. Techniques used: An extensive field study has been carried out to collect pertinent data to ground elevation, water quality, bottom sediment quality and benthos in the recent three years starting 2005. Also, to understand basic physical environmental characteristics of Horseshoe crab larva's habitat, individual larvae have been observed on the flat. These investigation results are compared with the past findings. A numerical computation of wave height distribution and bottom Shields numbers through the energy balance equation method has been conducted to study any changes in wave environments due to the landfill constructions.

3. Results and conclusions: A drastic decrease in the wave intensity due to the large-scale landfills is confirmed, as indicated in Fig. 2 and may be one of the reasons for increase in number of the breeding pairs. The results of the field study indicate, however, that natural environments of the flat and its neighboring sea such as water and sediment qualities have not significantly changed at the present time. Also, basic physical characteristics of Horseshoe crab larva's habitat environments are identified and discussed, as shown in Fig. 3, where individual larvae are plotted with bars over the topographic map (left figure) and the horizontal distribution of ignition loss of the bottom sediment (right figure).

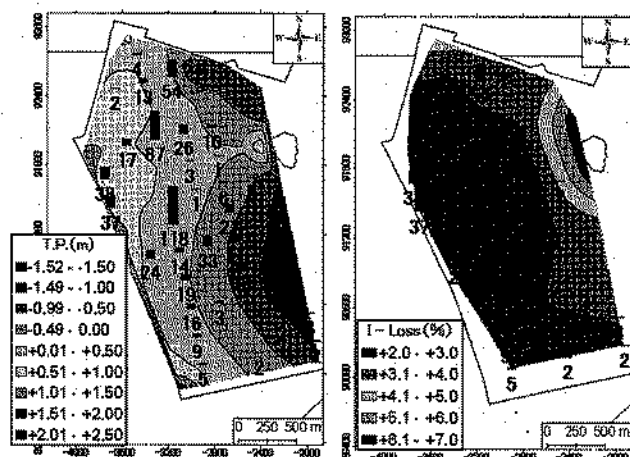


Fig.3 Individual larvae observed on the flat

Design and application of artificial neural network predicting model of assessment index in coastal marine ecosystem

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Due to the overexploitation of marine ecological resources and the worsening of environmental pollution, our typical marine ecosystem has been seriously damaged, with local (regional) water ecosystems imbalance and biodiversity sharp decline. So the development of marine ecosystem assessment will provide an important basis for decision-making for the effective protection of marine ecological environment and sustainable exploitation and utilization of marine ecological resources. Ecosystem health assessment is not only a focus but also a difficult point in ecology studied at present; with promising development and application, it has a great deal of questions existing at the same time (for instance, the concept and definition of health, evaluation criterion, etc). According to the assessment index system that has already been set up, by using MATLAB7.0 neural network toolbox, set up artificial neural network (ANN) with mapping predicting model to various kinds of physical and chemical, ecological factor and chlorophyll a density of coastal sea water. At the same time, the statistical software SPSS was used to make further optimization analysis to the correlation of marine ecosystem structure, function and environmental indicators. On this basis, perfect the method of ecosystem assessment, guarantee the accuracy and scientificity of assessment method, which promote the comprehensive understanding of ecosystem healthy.

Occurrence levels and distribution of organochlorine pesticides (OCPs) in surface sediments of the Bohai Sea, China

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The Bohai Sea located in North China is a shallow marginal sea enclosed by Liaodong and Shandong Peninsulas. Several large rivers, including Huanghe (Yellow River - the second largest sediment-load river in the world) drain into the Bohai Sea. The surrounding area of the Bohai Sea is a highly urbanized and industrialized region. The rapid industrialization and urbanization around the coastal regions has resulted in a severe environmental stress.

Organochlorine pesticides (OCPs), as one of the

groups of the persistent organic pollutants (POPs), have been caused extensive concern due to their high toxicity, persistence, bioaccumulation and biomagnification in the environment. OCPs have been widely used throughout the world since the 1950s (especially in China), thus they are ubiquitous in the environmental matrixes and the sediments usually regard as a final sink for the organic pollutants.

In this work, fifty-five surface sediment samples covering virtually the entire Bohai Sea were measured for OCPs to provide a better understanding of the occurrence levels, geographical distribution, possible sources and potential biological risk of these compounds in this area. The results indicate that the Bohai Bay and the area neighboring big harbors in the Bohai Sea had higher levels of DDTs, suggesting that the shipping and port facilities for transportation and fishery could be a local point source for DDTs in the coastal regions. Another possible cause is that the surrounding area of the Bohai Bay was ever an important production base for OCPs (especially HCHs and DDTs) in China. The (DDE+DDD)/DDT ratios indicate that degradation of the parent DDT occurred significantly in the study areas. The historical usage and production, suspended sediments, complicated hydrodynamic conditions and dilution effect could be responsible for the distribution patterns of OCPs. PCA results indicate that the distance to the pollution sources could be more important for the OCPs occurrence. Comparing the current data with sediment qualities guidelines, most of the OCPs in surface sediments from the Bohai Sea were relatively low from an adverse biological aspect, however, DDTs and chlordanes at various coastal sites had some biological risk due to their higher level in the area.

This work was supported by the Natural Science Foundation of China (NSFC) (No: 40776062) and National Basic Research Program of China (973) (Nos. 2002CB422304 and 2005CB422304).

Composition change of organic matter in bottom sediment of the Osaka Bay

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We studied the composition change of the persistent organic matter, which consist of humin, humic acid, and fulvic acid, in Osaka bay, the Seto Inland Sea, Japan. The bottom sediment was taken in 1985 and 2004, respectively. Humic substances which extracted by sodium-hydrate and sodium pyrophoric acid is named alkali extracted humic substances. The persistent organic matter that is not extracted by the reagent is humin, which is the most persistent in organic matter in bottom sediment. Then, humic acid was precipitated and separated by sulfuric acid. Amount of alkali extracted humic substances and humic acid were shown as total organic carbon (TOC) by TOC analyzer. Amount of hydrogen and oxygen in humic acid extracted were measured by CHNO analyzer after freeze dehydration. The qualitative alteration of humic acid was evaluated by using the relationship between H/C atomic ratio and O/C atomic ratio in humic acid. In addition, nitrogen and oxygen stable isotope ratio, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$, were analyzed for several samples. These parameters used to presume the origin of persistent organic matter.

The concentrations of TOC in surface bottom sediment significant decreased in 1985 than those in 2004. This demonstrated that total amount control of COD conducted since 1970's have been succeeded and the bottom sediment environment of Osaka bay has been improved. The ratio of alkali extracted substances to TOC decreased. This means that the amount of humin, which is the most persistent in organic matter in bottom sediment, raised relatively in 2004. The ratios of humic acid to alkali extracted humic substances in 2004 were greater than those in 1985, too. These results showed that amount of humin and humic acid, which are more persistent in organic matter, relatively increased in bottom sediment of Osaka bay.

The relationship between H/C atomic ratio and O/C atomic ratio in humic acid showed that the H/C atomic ratio enlarged in 2005. It was suggested that the decreasing of amount of humic acid flowing from land or the increasing of

younger humic acid in bottom sediment. The $\delta^{13}\text{C}$ was -22 ‰ at the station located in the inner area, and the value of $\delta^{15}\text{N}$ was higher than the value of phytoplankton. These results seemed that organic matter in bottom sediment related to organic matter of land origin but not phytoplankton. As the percentages of domestic wastewater treatment in the Osaka bay watershed, which include a regional sewerage system, a joint wastewater treatment, and a sewerage system for rural communities, raised from 30 % in 1970 to 90 % in 2004. A lot of easily decomposable organic matter was treated due to sewerage system process. Therefore, the percentages of persistent organic matter in effluent which flows into Osaka bay would relatively increase. It is not clear about the process of change from water to sediment on humic substances. These results suggest that the change of degradation property of organic matter in water might effect for bottom sediment.

Environmental implications of excess ^{210}Pb and ^{137}Cs in sediment cores from Mikawa Bay, Japan

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Abstract

Four sediments core were collected from Mikawa Bay, Japan, and excess ^{210}Pb and ^{137}Cs were measured by gamma spectrometry. Sedimentation rates for the four cores were determined by the ^{210}Pb method. The range of sedimentation rates is 0.10-0.70 g cm⁻² y⁻¹. The bio-mixing depth for each core, which is less than 7.0 cm, was determined by the excess ^{210}Pb profiles as well. Bioturbation is therefore considered as slight. The ^{210}Pb -derived dates coincide with the results from ^{137}Cs geochronology. Acceleration in sedimentation rate due to environmental alteration has been found in cores A2.5 and 05AS8, representing two depocenters due to the their topography. Evidence of the Tokai Flood in 2000 was found in core

05AS8 according to the profiles of both radioisotopes and trace metals.

Keywords: ^{210}Pb ; ^{137}Cs ; sedimentation rate; Mikawa Bay

A Study on Environment and Economic Development in Liaodong Bay, China

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Abstract: By referring to historical experience of the exploitation and development of the river Bay at home and abroad, considering the sustainable development of costal economical zone and the harmonious development between economy and environment, the emphasis of this paper is to explore the establishment of the forewarning index system of the harmonious development between economy and environment in Liaodong Bay and provide support for government decision-making. Liaodong Bay as its unique location and resource advantage is far more than today's situation in terms of both economy development quantity and quality and has a tremendous development potential. And we should ensure the environmental development keeping paced with costal economic zone exploration, protect the wetland and study on the migration characteristic of the pollutants and input flux, as well as monitor, evaluate and forewarning the environmental quality by the monitor station and chose some pollutant factors with certain working foundation such as heavy metal, polycyclic aromatic hydrocarbons (PAH) to have a long-term tract monitoring from the river transport to estuary diffusion and transformation in wetland sedimentation, then improve the monitoring ability and realize the monitor early-warning for the harmonious development between economy and environment in Liaodong Bay, thus avoid the environmental disaster resulted from the economical development and repeat the failures of inland sea.

Key Words: Liaodong Bay, Environmental quantity, pollution resource, Environmental and economical bearing capacity

Distribution patterns of foraminifers as an indicator of paleoclimatology

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A total of 86 surface sediments are studied to investigate the foraminiferal distribution patterns in the Yellow Sea. Number of benthic foraminifers ranges from 0 to 59,000 specimens/10 grams of dried sediment. Planktonic foraminifers occur 0-6,500 specimens/ 10 grams of dried sediment. Number of total (planktonic + benthic) foraminifers occur 0-65,000 specimens/10 grams of dried sediment. Greater abundance of planktonic and benthic foraminifers occurs in the western part of Jeju Island. In the Yellow Sea, the abundance of planktonic and benthic foraminifers is strongly influenced by the Yellow Sea Warm Current.

Influence of urbanization in the Yellow Sea Ecosystems

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Sediment samples from five stations at the Shihwa Lake sewage outfall, west coast of Korea (Yellow Sea), were collected to evaluate the effect of the outfall on benthic foraminifers. Heavy metal (Cr, Ni, Cu, Zn, Cd, and Pb), S, and P polluted eastern part of the Shihwa Lake, adjacent to the Shihwa-Banwol Industrial Complexes, shows barren or nearly barren of benthic foraminifers both at the core top and downcore. Pyritized foraminifers abundantly occur both at the surface and downcore sediments in the western part of the Shihwa Lake, suggesting that foraminiferal disease by anoxic bacteria. Intrusion of pollutants from the Shihwa-Banwol Industrial Complexes and adjacent six major streams severely polluted the Shihwa Lake as shown by the low abundance (number/10 g) of

benthic foraminifers, low number of *A. beccarii*, low species diversity, and absence of both *Elphidium* spp. and ostracodes at the surface sediments compared to the downcore.

Operation of three sites of Asian dust study adjacent to the Korean Peninsula

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ABSTRACT

The three islands adjacent to the Korean Peninsula are selected for the position of three fixed marine stations for collecting the falling Asian Dust (Yellow Sand) since the year of 2002 (Fig. 1). These three fixed marine stations are located on Baekryong Island in the West Sea of Korea, Jeju Island in the South Sea of Korea and Ulleung Island in the East Sea of Korea (Fig. 1).

Among the three fixed marine stations for collecting Asian Dust (Yellow Sand), two are located in the meteorological observatories under KMA (Korea Meteorological Administration). They are the Baekryong Meteorological Observatory of KMA in the west corner of Baekryong Island in the West Sea of Korea and the Gosan Meteorological Observatory of KMA in the northwest edge of Jeju Island of South Sea of Korea. Two high-volume samplers were installed on the roof of Baekryong Meteorological Observatory of KMA. These two locations are supported by the meteorological scientists who stay in the two locations for 24 hours of the whole year. Therefore, daily changing the filter papers can be possible by them even though the locations are remotely away from the Korean Peninsula. Another benefit is the comparison of meteorological data with the Asian Dust data which are collected in the same sites. Also, the machine of high-volume samplers are mechanically in trouble, the resident in the meteorological observatory can give information for quick repairing process. The Gosan Meteorological Observatory of KMA is located in the northwest corner of Jeju Island. This observatory is very important for understanding the route of typhoons and other severe weather conditions. Two high-volume samplers are installed on the roof of container at the westernmost of Gosan Meteorological Observatory of KMA. In the case of East Sea of Korea, the best site is the west corner of Ulleung Island. Actually, there was the history of trial and error. The first installation of sampler was in the Ulleung Meteorological Observatory of KMA. But, it was found that the

incinerating place was located near by the Ulleung Meteorological Observatory of KMA. The clean place was searched within the Ulleung Island and eventually the best location was reselected as the Taeha Lighthouse which is operated by the Ulleung Island Marine Fairway Mark Office of MLTM (Ministry of Land, Transportation and Maritime Affairs). Ulleung Island is located about 137 km east from the east coast of Korean Peninsula. Also, two high-volume samplers are installed on the roof of marine fairway mark office of MLTM.

Tide and meteorological effect on dispersion processes of high-turbidity river water and resuspension of sediment in the Bohai Sea

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In recent years, extraordinary economic development is happening in the coastal area of China, such as around the Bohai Sea and the mouth of the Yangtze River. According to the policy of putting the economy before the environment, the problem of water pollution has become more widespread and severe in Chinese estuarine and coastal areas. The Bohai Sea has experienced the highest increase of pollution levels caused by rapid economic development and discharge of land waste in particular. It is necessary to understand the polluted process of the sea for recovering the ocean environment in the Bohai Sea. The present study focuses on tide and wind effect on the dispersion processes of the river water of the Yellow River into the Bohai Sea including the land waste and the transport process of sediment. The current system, the density field, dispersion process of suspended solids and the resuspension of sediment by tidal current and sea wave were analyzed using a three-dimensional baroclinic flow model and a wave model. A long-term hindcast simulation for 2003 was carried out. The present model can predict well the distribution of high turbidity water mass which can be seen in the southwestern sea area in the Laizhou Bay at Landsat satellite images. According to the numerical results, most influent suspended solids settled to the sea bottom of the Laizhou Bay at least and the current and wind friction velocity are in the same range in the Laizhou Bay.

"Influence of the condensed tannin extracted from the dead leaves of deciduous trees on the growth control of toxic cyanobacteria like *Microcystis aeruginosa*"

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Because of the toxin like microcystin from *Microcystis* in eutrophicated lakes and reservoirs, the effective counter measures against its excessive growth have been widely called for. As for the growth control of *Microcystis*, Gibson *et al.* (1990) and Ridge *et al.* (1999) examined the effect of straws, and Nakai *et al.* (2000) reported the influence of the emergent plant. Relative to the possible growth control factor, Toda *et al.* (1991) examined the antibacterial action of catechin to *E. coli* forms, and Augustin (1991) reported the bactericidal action of the condensed tannin (CT) or of the polymerized catechin, from which catechin, being a kind of polyphenol, was considered to be a sort of the growth control factor.

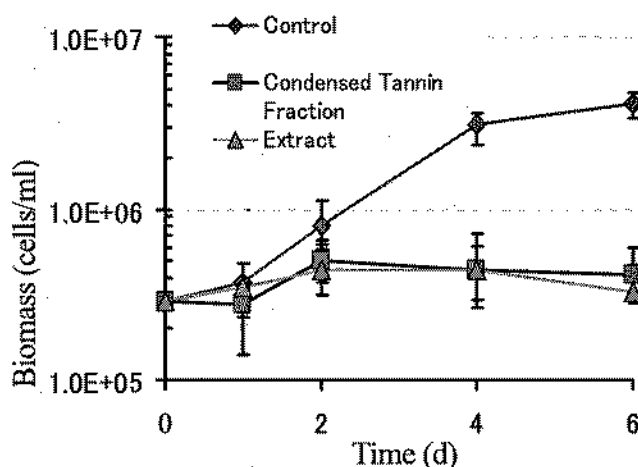


Fig-1 influences of extract and Condensed Tannin Fraction on Biomass Trend

The authors have disclosed that the water-soluble extract (WSE) from the dead leaves of deciduous trees shows the clear effect on the growth control of *Microcystis aeruginosa* (*M.a.*). The WSE was added into *M.a.* culture solution to let the condensed tannin loading intensity (CTLI in catechin concentration base) range at 9×10^{-9} to 28.2×10^{-9} mg/cell, and then, the daily change of the cell concentration was observed. The polyphenol concentration in the WSE was about 0.6 mg from 1 g of the dry dead leaves, of which the CT concentration was about 0.14 mg. Thus, the CT extraction rate was around 20 to 25 % of the polyphenol extracted. Accordingly, the addition of the WSE resulted in controlling the cell concentration and its influence was clearly affected by the amount of the CTLI. Consequently the CT in the WSE was further separated to produce a CT fraction by use of acetone/diethyl-ether according to Richard *et al.* (1978), and thus the CT fraction was examined about the extent of the growth control possibility. CT fractioning operation increased in the concentration of the CT from the WSE. On the basis of the CT concentration in the CT fraction, the CTLI was set at same as in the case of using the WSE, and was given to *M.a.* in the range of 14×10^{-9} mg/cell to examine the growth control like as the previous tests. The results are as in Fig-1, from which the effect of the CT was confirmed to be the same growth control as in both cases of the WSE and the CT fraction. Therefore, the results imply that the CT extracted from the dead leaves would become the major growth control factor of *M. a.*, and thus the dead leaves of deciduous trees would function as the effective growth control agent. .

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**Institutional models for Regional Collaboration
in coastal Science and Management
(LOICZ related)**

Two-dimensional finite volume modeling of Damietta Port, Egypt

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1. Introduction

The determination of the flushing characteristics of harbor basins with small tidal range and the associated water quality implications are particularly important when conducting environmental impact assessments of a harbor basin. When constructing new basins or quaywalls in a port, harbor or marina, one of the most important considerations is to study that there is adequate flushing in order to prevent gross deterioration of the water quality.

Damietta Port which is one of largest container ports on the Mediterranean handling over 450 000 TEU per year, is located 8.5 km west of Damietta branch of River Nile on the Mediterranean Sea. Damietta harbor was planned and constructed in the early 1980's as semi closed water body (finger type port) with water depth of 15.0 m. Under the expansion plan of the port, a new basin (1500 m × 280 m × 17.0 m) is planned to be constructed to accommodate giant container vessels.

It must be assured that the proposed extension of the harbour will not lead to the development of stagnant water areas, there by ensuring water movement and exchange throughout the entire harbour area. In order to assess these problems, a two-dimensional finite volume (hydrodynamics HD and advection-dispersion AD) model was set up for the harbor basin for the existing configuration and after constructing the new basin.

2. Models Development

The Finite Volume Model is a comprehensive two-dimensional model for the simulation of flows, distribution of pollutant concentration, and flushing time in coastal areas, harbors, marinas, and lagoons. The HD module is based on the depth-averaged shallow water equations where the effects of Coriolis, surface wind stress, and waves were included (1, 2). The AD module solves the equation of conservation of mass for dissolved or suspended substance to simulate the spread of such substances in an aquatic environment under the influence of the fluid transport. Currents and water depths are provided

by the hydrodynamic model as input data. Data on substance concentrations within the domain and at the boundary have to be specified to the model (3).

3. Model Application

The HD and AD models are first set up for the existing configuration of the Port. To assess the time scale associated with dilution of pollutants, an initial tracer concentration of 100% was introduced in the port basin with clean water outside the port boundary. The effects of tides and surface wind on the flow pattern is utilized to estimate the required flushing time. The HD simulation results showed that stagnation areas could only be formed near the closed end of the existing port basin and the flushing time needed for the existing port configuration is calculated as a reference flushing time.

Both HD and AD models are then set up with the proposed new basin. The AD model is set up for three different scenarios: (1) Pollution exists in the whole port basin and clean water enters from the port entrance; (2) Pollution exists only at the new planned basin; and (3) Pollution exists in the the whole port basin except the new basin.

Simulation results using the 2D finite volume model showed that constructing the new basin will increase the flushing time of the existing terminal basin. Results of the other scenarios will also be presented and compared with the reference flushing time needed to flush the port prior to the construction of the new basin. The model results for the different scenarios had shown to be a useful tool to understand the impacts of constructing a new port extension on the existing water quality and assess the impacts. Results are discussed in more details in the paper.

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Integrated Coastal Zone Management (ICZM) plan of Iran

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Iranian coastlines extend along more than 6000 kilometers in northern and southern regions. Despite the rugged and pristine beauty of coast, our coastal and marine ecosystems are suffering from ever-increasing human impacts including: population growth, dangerous coastal hazard areas, habitat damage, non-native species, and pollution. In the longer term, global warming, and the accompanying shifts in ocean currents, marine productivity, storm frequency and coastal erosion will have a significant impact on coastal and marine environments.

In order to achieve an ecologically sustainable development, the Ports and Maritime Organization of Iran is undertaking a number of studies leading to the development of a Coastal Zone Management Plan (CZMP). The general goal of the studies is to develop an integrated planning and management program that will address not only the current environmental and developmental pressures along Iranian coastlines, but also the long term restoration, protection, maintenance and sustainability of the natural, cultural and economic coastal resources.

The coastal zone can be loosely defined as the interface between the land and the sea (water and submerged land) in which the terrestrial ecology and use directly affects marine ecology and vice versa. Consequently, the landward and ocean geographical boundaries of the coastal zone will vary alongshore depending on the local physical, biological and human characteristics, interactions and inter-dependencies present at any specific location. The definition of a coastal zone is an ambiguous one. Coastal zone management is therefore synonymous with the concept of integrated coastal resource management. There are two aspects of coastal zone management:

1. Technical aspects related to beach protection, creation, stabilization and enhancement; water

quality monitoring, assessment and control; marine habitat monitoring and impact assessment; environmental ecosystem assessment; land use development review and approval process assessment; tourism and recreational activities; and 2. Resource extraction;

To direct and organize coastal zone management directives, recommendations, activities and actions requires the formulation of an Integrated Coastal Zone Management (ICZM) Plan. This plan will provide guidance and direction not only to the Government but also to the people as well as other stakeholders, be they private interests, NGO's, or other regional agencies. The coastal zone management plan will be used to establish priorities, recommend courses of action and procedures, and identify the relationships between these actions/procedures and the ultimate vision of coastal zone management.

This includes development of the matrix management model (impact components vs. geographical delineation) as a GIS database, which is necessary to advance this initiative. Tools to assist this program such as: institutional strengthening, environmental assessments, geographical information systems and impact component planning alternatives will also be developed to provide PMO with conceptual mechanisms by which it can implement the initiative.

The impact of oil exploration in coral reefs and the mitigation pre-cushions to prevent it: a case study from Red Sea, Sudan

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Humans are actively destroying the coral reef ecosystems on our earth, Oil exploration activity and the seepage from oil export terminal is the key threats to our coral reefs environment. The small amount of oil can do more damage in some areas than others. Coral reefs and mangroves are more sensitive to oil than sandy beaches or seagrass beds, intertidal zones are the most sensitive.

Authors have made a case study by analyzing role of Petroleum exploration activity, oil seepage and other chemicals dumped near Sudan red sea coastal waters, and how to prevent the ecosystems from the coming threat, which is eventually will find their way to the reefs and poison coral polyps and other marine life.

Human impact on the sediment transfer over the past 30 years, Pearl River Estuary, China

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The river discharge and sediment flux to the Pearl River Estuary has been changed significantly due to human activities in the upstream rivers, where bloom economic developments have been experienced in the Pearl River Delta over the past 30 years. Among others the sand mining has mainly droved to change the more flow from West River to North River and has resulted in an increase of total water discharge since 1990s. Land reclamation and dredging in the river mouths also caused the geo-morphologic and hydrological environment change which in turn affect the grain size distribution pattern according to the data analysis for 1975 and 2003-2005. The impact on basic pattern of the surface sediment is minor which may be caused by either stream sediment load increase or the increase of hydrodynamic influence or both over the last 30 years. The fact that the hydrological and sedimentary situation changes are resulted from human activities should be much more concerned in the future riverine and estuarine management.

The current status and long-term changes in the phytoplankton community in Lake Illawarra: a case study of a eutrophicated coastal area in NSW, Australia

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Lake Illawarra has been an important asset in the Illawarra region, NSW, Australia. However, human activities have significantly impacted the lake and its surrounding catchment, particularly since the arrival of Europeans some 200 years ago. From December 2004 to October 2006 three locations within the lake (one close to a

freshwater inlet, one in the middle and one near the seawater entrance) were sampled bimonthly. The spatial and temporal dynamics of salinity, water temperature, nutrients, chlorophylla, phytoplankton cell abundance and species composition were observed and analysed to establish the phytoplankton ecological status of Lake Illawarra. In addition, the diatom flora in two sediment cores from Lake Illawarra were analysed in order to trace the response of diatoms to environmental change over the past 100 years. Phytoplankton cell abundance and chl a in Lake Illawarra showed an obvious spring maximum as is found in many temperate waters. Low N:P ratio suggested that DIN was the limited factor for the phytoplankton growth in Lake Illawarra. An uneven horizontal distribution of phytoplankton indicated the impact of freshwater input, seawater exchange and seagrass competition on the phytoplankton assemblage in Lake Illawarra. In addition, jellyfish blooms from May to June are regarded as an important contributor to the low biomass and dinoflagellate dominance in winter in Lake Illawarra. The long-term climate change, eutrophication history and their link to the diatom diversity and abundance in sediments will be discussed along the history of European settlement.

Sea level rise in Bangladesh and its impacts on the coastal communities

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Bangladesh is an active delta that receives 1-2 billion tons of sediment every year from GBM basin discharge. Sediments received by the delta area are loose and compacts with the passing of time. Sedimentation causes higher river/ coastal bed but compaction lowers it. Thus compaction and sedimentation balances each other. However, it is expected that the country will gain a net SLR. Tidal level in Hiron Point, Char Changa and Cox's Bazar rose by 4.0 mm/year, 6.0 mm/year and 7.8 mm/year respectively, during the period of 1977-1998. If the GMB basin receives abnormal volume of rain water, it causes flood in the lower basin that contribute to local level sea level change. The flood of 1998 contributed to the SLR along Bangladesh coast. It is expected that there will be 60-90 cm SLR in the coastal zone of Bangladesh by 2100 AD.

A one meter SLR will affect the vast coastal area and flood plain zone of Bangladesh. The soils of Jessore, Magura, Narail, Faridpur, Gopalganj and Jhalokati were newly salinized in 24 years of time expansion due to sea level rise, causing decreased agricultural production. A 0.3 metre SLR will cause a net reduction of 0.5 million metric tons of rice production and a reduction of wheat production equivalent to US\$ 586.75 million. A one metre SLR will destroy coastal aquaculture and salt production. It will inundate 17.5% of country's landmass affecting 14.8 million coastal communities. It will affect national and food security of the country. The Sundarbans, the biggest single chunk of mangrove forest of the world, and the most important ecosystem of the country will be totally lost with one metre rise in sea level. Mitigation and adaptation are two options to minimize the impacts. A combined effort of Bangladesh Government, Bangladesh's people and International communities is emerge need for the survival of the coastal communities of the country.

History of the heavy metal pollution recorded in core sediment of the Yodo River Estuary in Osaka Bay, Japan

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1 Introduction

The catchment area of the Yodo River Bay has thriven as an economy center of Japan since Medieval Ages. The anthropogenic pollutants mainly flow into the inner area of Osaka Bay through the Yodo River. The heavy metals discharged from the catchment area become a main pollution source in Osaka Bay. Therefore, the quality of the aquatic environment in the Yodo River estuary has been profoundly influenced by the economical activities^{1,2,3}. In this study, the vertical distribution of heavy metals in the core sediment collected from the Yodo River estuary was analyzed to clarify the historical trends of pollution from the catchment area, in order to assess the relationship between human activity and anthropogenic pollution.

2 Sample Collection and Analytical Methods

Sediment core (86 cm length) was collected by scuba divers in the Yodo River estuary. Sediment is composed of homogeneous mud. Although no laminations were visible, the ²¹⁰Pb profile suggested minimal bioturbation. The core was sliced at 2 cm intervals. The ²¹⁰Pb geochronology was applied to the determination of sedimentation age. It also employed a chronology based upon the fallout of ¹³⁷Cs from atmosphere where it was introduced by nuclear testing. The activities of ²¹⁰Pb and ¹³⁷Cs were determined by gamma counting using an HPGe detector. The heavy metal concentrations in sediment were determined by an XRF analysis. A calibration standard was prepared from NIST SRM1646 (Estuarine Sediment). The mercury concentration was determined by a heating-vaporization atomic absorption spectrophotometry.

3 Results and Discussion

Although the sedimentation rate changed with the depth of the core, the sedimentation age at the 85 cm depth was estimated with 1830. Therefore, this core will be recorded the history of anthropogenic impact of pollutants from the catchment area of the Yodo River after the Meiji restoration 1868.

As a typical example, the vertical distribution of lead in the core is shown in Figure. In previous layer 1850's, the lead is ca.40 ppm, and this is almost equal to soil without the contamination. The concentration increased from bottom to surface, and the maximum of 110 ppm is shown in 1960's. Then the lead concentration decreased, it became 60 ppm at the present. The historical trend of the lead flux in the water-sediment interface is shown in Fig.1

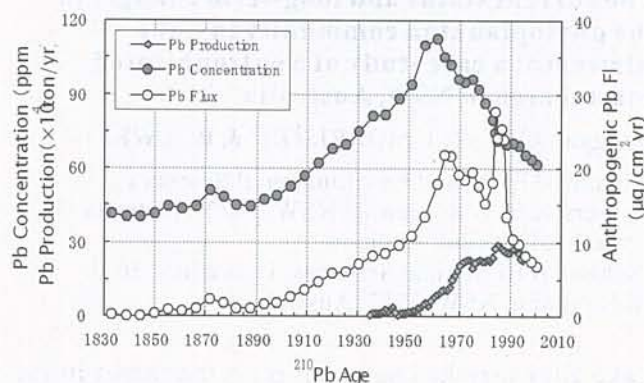


Fig. 1 Historical trend of lead pollution in the Yodo

Annual lead production in Japan is also shown. River estuary sediment

The time trend of lead pollution agreed with the history of the economic growth of Japan after the Meiji restoration, and the lead contamination of Osaka Bay rapidly increased from the Russo-Japanese War (1904–1905) by the high economic growth period after the World War II clarified. The lead pollution tended to decrease recently, because it was well controlled by legal restrictions and improvement on the processing technology of industrial waste including the pollutants. The flux anomaly in 1980's coincided with the period while the Kansai Airport was constructed.

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Variation of SST in the eastern coastal sea induced by strong marine wind under the development of coastal low pressure

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The variation of sea surface temperature along the eastern coast of Korea under the influence of strong marine wind was investigated from March 28 through 30, 2004, using SST satellite pictures and a three-dimensional numerical model, MM5, version 3.7. By the meteorological model meteorological elements-wind and air temperature with a 3 km, 9 km and 27 km horizontal resolutions were reproduced in the mountain, coastal and open seas. As supplementary materials, QuickSCAT wind data was also used for analyzing marine wind in the East Sea. The comparison of evaluated meteorological elements by the numerical model with observed ones was carried out at Gangwon Regional Meteorological Administration. NOAA MCSST satellite pictures were used for the analysis of daily mean SST variation affected by coastal wind. Winds evaluated at every 9 km horizontal interval using MM5 meteorological model and winds at a relatively wide horizontal interval from QuickSCAT was very similar each other. On March 28, as westerly wind under high

pressure system prevailed in the Gangneung coast and the open sea and wind driven current could be southward and resulted in cold water intrusion of the North Korea Cold Current toward the southward. Under this situation, the cool water was intruded from the north toward south along the coastal sea and sea surface temperatures (SST) along the coastal sea under the influence of the North Korea Cold Current was 11°C. On March 29, westerly wind by low pressure system produced the southwesterly marine surface wind, which could induce a strong southeastward wind driven current and results in the intrusion of cold water from north toward south along the coast. On March 30, low pressure system was developed with the decrease of 5 hPa from 1013 hPa to 1008 hPa, and the pressure pattern induced northerly wind along the coast and westerly wind in the offshore, resulting in cold water intrusion from the northern coast into southeastern sea. On this day, sea surface temperature near Gangneung coastal sea was 9°C. Northerly and westerly wind made further extension of cool water area toward the eastern open sea. This work was funded by the Korea Meteorological Administration Research and Development Program under Grant CATER 2006-2308 "Generation mechanism and prediction of windstorm in the mountainous coast" for 2006~2008.

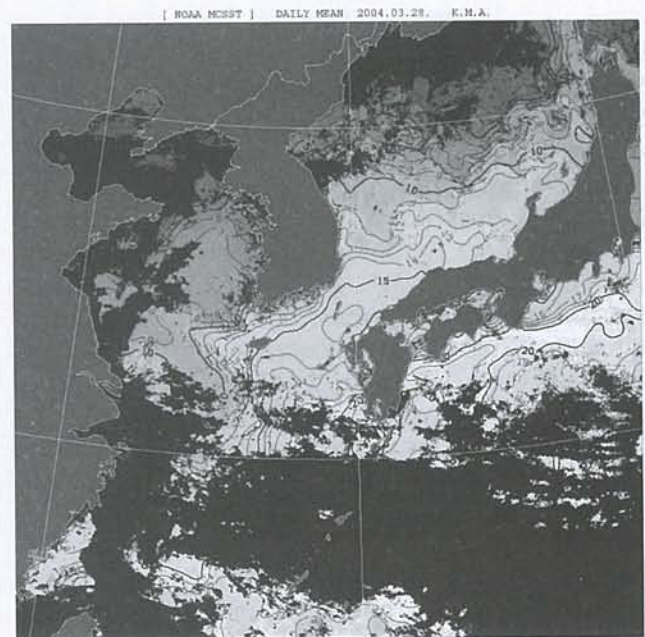


Fig.1 SST on March 28, 2004

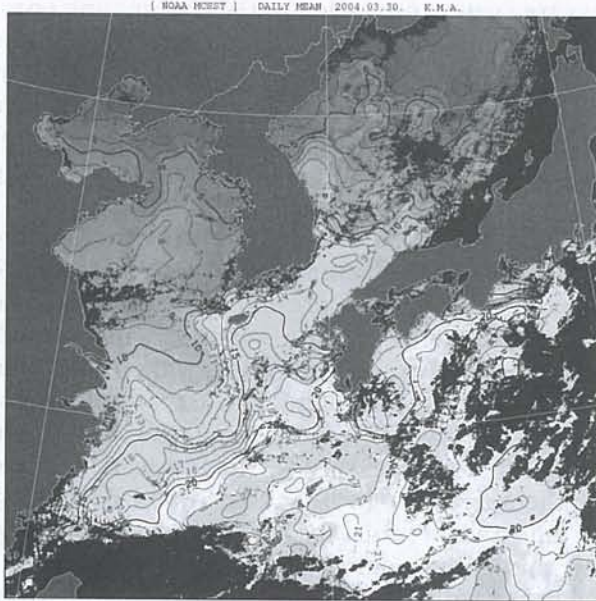


Fig.2 SST on March 30, 2004

Mediterranean protocol on integrated coastal zone management: innovative tool for regional governance

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The Ministerial meeting of the Contracting Parties to the Barcelona Convention adopted in 2003 a recommendation to draft the text of the regional protocol on Integrated Coastal Zone Management. Protocols are legal instruments for the implementation of the Barcelona Convention and they deal with specific thematic issues. Currently, there are six protocols in force (specially protected areas; land based sources of pollution; hazardous substances; oil pollution from ships; etc.). The Protocol has been signed in Madrid, Spain on 21 January 2008 by 14 Contracting Parties to the Barcelona Convention. It is expected that, within a year, the Protocol will be signed by the remaining 8 parties as well as enter into force.

Currently, similar institutional and legal arrangement could not be found in any of the world regions. European Union has adopted the ICZM Recommendation in 2001, being short, thus, of adopting a directive, which is a standard EU legal arrangement. This is proof that regulating ICZM at a regional level is an extremely difficult task, and requires parties to be highly committed to implement it. Mediterranean countries have

shown such courage. Many believe that this is the most important ICZM legal event since the adoption of the US CZMA Act in 1972.

The main objective of the protocol is to enhance legal capacity of the Mediterranean countries to regulate coastal development on a sustainable basis, and to assist countries in reducing development pressures in coastal areas of the region (tourism, urbanization, industry, transport, fish farming, etc.). The Protocol is very innovative in its endeavors; it is comprehensive, since it covers all important coastal issues, notably the impacts of climate change and other natural risks in coastal areas of the region; it is proactive; and integrated, since it is bringing together all pending coastal issues.

In the presentation, major activities will be outlined. First, the Feasibility Study was prepared. It proposed a legal document that is stricter than EU ICZM Recommendation, but not strict enough to hamper its adoption and implementation. The first draft of the text was prepared by a working group of legal and technical experts. It was discussed at several forums by a large number of regional stakeholders. In 2005, Contracting Parties decided to establish a Working Group of Experts to finalize the text. It met 5 times. The group worked gradually towards a commonly acceptable text. In the presentation, the difficulties encountered in the negotiation process will be exposed, as well as ways and means how these disagreements were sorted out. It will end with the presentation of the benefits which this innovative regional legal instrument will bring to the Mediterranean coastal areas and their population in the future. The text of the protocol will be presented as well as the guidelines for its implementation.

Land-ocean interactions in the coastal zone (LOICZ) a joint core project of IGBP and IHDP

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LOICZ is an international research project involving scientists from across the globe who have been investigating changes in the biology, chemistry and physics of the coastal zone since 1993. Since 2003, LOICZ has expanded its areas of research to include social, political and economic sciences in order to address the human dimensions of the coastal zone. The research

results are used to explore the role humans play in the coastal zone, their vulnerability to changing environments, and the options to protect coasts for future generations. The main goal of LOICZ is to provide the knowledge, understanding and prediction needed to allow coastal communities to assess, anticipate and respond to the interaction of global change and local pressures which determine coastal change.

Lessons and experiences of PEMSEA as a regional partnership mechanism in integrated coastal management program development and implementation

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The objective of this paper is to: 1) introduce the Regional Partnership Mechanism of PEMSEA, its key components, functions, roles and significance in achieving the sustainable development of the Seas of East Asia; and 2) review the lessons and experiences of PEMSEA in Integrated Coastal Management (ICM) program development and implementation, especially on how science can be effectively incorporated into the common framework for sustainable development of coastal areas thru ICM implementation.

PEMSEA is a regional programme that spans across the 7 million km² sea area that makes up the Seas of East Asia. From a project-based arrangement, PEMSEA entered into a new phase and transformed into a Regional Partnership Mechanism with a mandate to implement the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA). Currently the PEMSEA partnership consists of 11 State Partners, 16 Non-State Partners and other collaborators. The Partnership of PEMSEA is not the convention mechanism, but a regional partnership. The presentation will expand on the benefits and challenges of a partnership approach and why countries have agreed to such an arrangement.

Some useful experiences and lessons regarding the role of science in management and decision-making processes for coastal and ocean governance have been learned in the region (from Chua Thia-Eng. 2006. □The Dynamics of Integrated Coastal Management.□ PEMSEA.). The presentation will review some of these points, based on PEMSEA's experience in ICM program development and implementation, including, for example:

1. ICM promotes and facilitates the gathering of reliable scientific information, which has specific applications at various stages of the ICM cycle for policy and management decisions.

It is imperative that scientific advice be integrated as an essential part of the ICM program. The best way to obtain the needed scientific support and information is to involve research institution and universities in the activities of the ICM program. It also pays to develop scientific capability in local institutions, so as to sustain the provision of scientific technical information.

2. The long process of baseline research is not conducive to effective management of marine and coastal areas

In many ICM or coastal resource management programs in the past, the data-gathering stages tended to last for years. Although such an approach is helpful in formulating detailed plans of action, the downside is that the long process of information gathering and analysis often consumes a large portion of the project timeframe, and of the human and financial resources. As a consequence, the scientific reports and management plans become the final products of the project, and new projects are needed for their implementation. The reason for this situation often lies in the project design. The best approach is to include both coastal managers and scientific experts in the project design team, so that scientific concerns related to management issues are adequately considered.

Regional collaboration on coastal environmental monitoring and assessment in the Northwest Pacific Action Plan (NOWPAP)

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The Northwest Pacific Action Plan (NOWPAP) was adopted in 1994 as a part of the Regional Seas Programme of UNEP (United Nations Environment Programme). The People's Republic of China, Japan, the Republic of Korea and the Russian Federation are currently members of NOWPAP. Each member hosts one of the four Regional Activity Centres (RACs), which were responsible for individual NOWPAP activities in coordination with the Regional Coordination Unit (RCU). As one of the RACs, CEARAC (Special Monitoring & Coastal Environmental Assessment Regional Activity Centre) which was established in 2002 is located in Toyama, Japan is responsible

for special monitoring in particular of remote sensing by satellite and coastal environmental assessment.

In CEARAC activities, Working Group 3 (WG3) which is mainly responsible for harmful algal bloom (HAB) related issue and Working Group 4 (WG4) which is in charge of remote sensing are jointly operated. The author, as a Japanese expert of WG3, will introduce some cases of regional collaboration on coastal environmental monitoring and assessment among the NOWPAP member countries in this paper. WG3 and WG4 of CEARAC have already published the Integrated Reports both on harmful algal blooms and on ocean remote sensing for the NOWPAP region in order to understand the current status of the region and to build consensus on the future steps. The booklet of countermeasures against harmful algal blooms in the NOWPAP region and the eutrophication monitoring guidelines by remote sensing for the NOWPAP region were also published for more practical purpose. Unique pamphlet on *Cochlodinium*, which is one of the most harmful red tide causative unicellular marine plankton belong to dinoflagellate, was printed in the four languages of the NOWPAP member states, namely Chinese, Japanese, Korean and Russian. These pamphlets are expected to be utilized by fishermen, student and general public.

As a recent collaborative activities of CEARAC, the First Coastal Environmental Assessment Workshop was held on March 7, 2008 in Toyama, Japan in which three sessions and one panel discussion were held with participation of specialists from NOWPAP member states. After the report on CEARAC activities in Session 1, presentations on "Current situation on coastal monitoring in the NOWPAP member states" were made in Session 2 by the specialists from four countries. In Session 3, presentations on "Coastal environmental assessment in the NOWPAP member states" were made similarly. In the panel discussion, "Development of a procedure for assessment of eutrophication status in the NOWPAP region" was discussed from different viewpoints by the representatives of member states and also by keynote and special speaker of the workshop.

Procedure of coastal environmental assessment in particular of the experimental procedure as a result of case study conducted in Toyama Bay is now being developed under the cooperation of WG3 and WG4. This procedure will be reviewed by the member states and then applied to NOWPAP region in future. In this procedure,

assessment based on not only water quality data obtained by sea observation but assessment based on satellite data especially chlorophyll data are highly incorporated since chlorophyll is one of the important parameters indicate the status of eutrophication. Other related activities on regional collaboration in the NOWPAP region will be also presented and discussed.

Approaching a science based decision-support system to manage regional seas

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A decision-support system has been developed for the Baltic Sea in The Baltic Nest Institute (BNI). BNI is an international institute starting 20070901 with a department in Sweden and one in Denmark. The Institute shall further develop the decision support system Baltic Nest and apply ecological and economic models, scenarios and prognoses for the entire Baltic Sea Ecoregion. It shall provide managers and politicians with answers to the question: If you want a better environmental quality, the Baltic Nest model can tell what "buttons" to turn and what are the ecological and economic consequences. This is the first time in the world that inputs from land, rivers and lakes, the atmosphere and from the sea are integrated over such large geographic scales and combined with economy to provide a suite of models and scenarios. The rationale behind the system is a need to improve the environmental conditions in the Baltic Sea Ecoregion. The BNI system is composed of a number of ecological and economic modules available to end-users via the internet. The background for BNI is that The Baltic Sea is suffering from excessive inputs of nutrients, delivered from land and atmosphere, leading to eutrophication manifested by extensive areas of hypoxia, algae blooms, deterioration of benthic animals, loss of benthic vegetation, reduced recruitment of valuable fish species, etc. Eutrophication was clearly recognised as the most serious environmental challenge in the Baltic Sea at the HELCOM (Helsinki Commission) ministerial meeting in November 2007 (www.helcom.fi). The solution for restoring the Baltic Sea ecosystem to a healthy state is clearly that nutrient inputs must be reduced. This could either be a collaborative task where all countries discharging to the Baltic Sea contributes by an agreed percentage reduction of nutrient emissions,

or by a cost-efficient distribution of reductions, i.e. socially efficient targets are fulfilled to the lowest costs. In order to achieve good environmental status by 2021 present assessments indicate provisional targets for nutrient loads: For nitrogen the loads should not exceed 600 000 tonnes and 21 000 tonnes for phosphorus, corresponding to a reduction of 135 000 tonnes of nitrogen (18%) and 15 000 tonnes of phosphorus (42%). A first step towards operational management of nutrient inputs to the Baltic Sea was taken at the HELCOM ministerial meeting where countries approved a set of provisional nutrient reduction targets distributed between countries, and countries should take action not later than 2016 to implement measures (HELCOM Baltic Sea Action Plan). These provisional reduction targets should be periodically reviewed and revised using a harmonised approach for estimating nutrient inputs. The Baltic Sea Action Plan is the only realistic political instrument to achieve nutrient reductions and consequently improved ecosystem status. The provisional reduction targets were based on calculations carried out with the NEST model system developed within the Swedish MARE program. The NEST models are based on state-of-the-art knowledge of the Baltic Sea ecosystem and the models integrate ecological and economic properties. An entrance to the The Baltic Nest Institute, its activities and models are located here (<http://www.balticnest.com/>). The content, structure and philosophy of the decision-support system are presented and its future role as a management toolbox to be applied into other regional seas is discussed.

A practical program of environmental education, aiming at the environmental regeneration of the Seto Inland Sea, and calling the actual sea area into play

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1. The incidence of environmental pollution in Mizushima Region and the establishment of our Foundation.

Since 1961, the construction of a gigantic industrial complex gained impetus in Mizushima, the southern part of Kurashiki city in Okayama prefecture, facing the Seto Inland Sea. During the

latter half of the 1960's, the environments of above-mentioned areas were seriously polluted and many people were taken ill. In 1983, the people who suffered from serious health concerns caused by the pollution took the main polluters eight big companies in the Mizushima industrial complex to court. In 1996, this case was settled out of court.

After the settlement of this case the Mizushima Foundation was established in 2000, using a part of the settlement money. We, the members of this foundation, have worked for the environmental rehabilitation of Mizushima area. Our activities include a variety of endeavors, such as research and practical work to revive the water environment and make the experiences of the victims of the pollution known to the people of developing countries.

2. The practical activity of environmental education that uses the sea area.

Since the period of rapid economic growth, a broad stretch of land was recovered from shallow sea area containing tidal flat and eelgrass vegetation. Moreover, the sea area's environment has deteriorated because a large amount of waste has been scattered and deposited over the seabed. Therefore, the place where and the chance when people, especially children can soak themselves in an excellent waterside environment have remarkably decreased.

Then, our Foundation is making the overall environmental study programs, for people to regain the concern for the sea. There are two programs. One is experience study program that uses eelgrass vegetation as a field of natural environmental education. Another one is a program by which people learns the relations of the environment and industries through the fishery experience. Because the study on the problem of Seabed litter is included in this program, people can learn the problem of the sea more widely. Our activities have been supported by the Japan Fund for the Global Environment of Environmental Restoration and Conservation Agency.

3. The practical activity of environmental study program.

When we examined the environmental study programs, we set up the study committee that consists of persons in educational field, the specialists in the related fields, and the persons in charge of the municipality. Up to now, the study committee has been held five times, meanwhile the experimental practice of the study program has been executed.

We will complete the program in fiscal year 2008, resting on the results of an experimental experience study association held several times, and on the discussion at the study committee. At the same time, it is scheduled to publish "Guidance book" and "Picture book of Living thing" to enlighten the public.

A couple ocean-atmosphere model for ocean currents energy estimation

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Nature endowed Indonesia with all forms of renewable energy resources, such as ocean current and wind. Intensive research, exploration and exploitation of the resources are necessary to contribute in a sustainable manner to meet increasing energy demand that has been experienced in Indonesia. In this study, a couple ocean-atmosphere model was utilized and we estimated the potential energy of ocean currents in Indonesian Waters. Ten years satellite wind data provided by NCEP was also used for validating the model. Further, we also evaluated ocean currents, as components of tidal and wind induced currents, obtained from the 3D validated hydrodynamic-atmospheric model to estimate marine current potential energy in Indonesian Waters. From the study that we have carried out, it shows that Indonesia has a great energy resources of wind and ocean currents. The result of wind data processing shows that in southern part Indonesian area such as southern Java, Bali, Lombok, NTB, NTT, and Arafura Sea have larger energy potential which reach maximum peak during west monsoon (from Desember to February). We estimates the available wind power density in those potential area reach 1.325 - 3.66 kW/m². From the analysis that we have done, it indicates that Makasar, Lombok, Bali and Selayar Straits have strong current velocity therefore they have far larger energy than other Indonesian waters which contains power density 1.038 - 2.685 kW/m²

Sediment characteristics of the different intertidal flats along the Yellow River Delta

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The sediment distribution of intertidal flats is controlled by sediment supply and marine dynamics. The research on the distribution of sediment grain size helps to reveal the trend of sediment transportation and coastal morphodynamics. In this study, 167 intertidal surficial sediment samples were collected at cross-shore sections along the intertidal flats of the Yellow River Delta in 2004. Based upon statistics of sediment parameters and sediment moving modes from probability cumulative distribution curves, and combined with topography and hydrodynamics, the intertidal flats along the Yellow River Delta was discussed in present study. The objective is to obtain the characteristics and spatial distribution of intertidal flat sediments, and to better understand the sedimentary environment and the hydrodynamic factors. The results are shown as follows:

(1) The intertidal flats along the Yellow River Delta could be broadly divided into three geomorphic zones: abandoned area at the north of the delta (AAN), current river mouth (RMA) and Laizhou Bay (LZB). The surficial sediments of the different intertidal flats showed various characteristics, which was in accord with their hydrodynamic conditions.

(2) For AAN, in general, it showed complicated sediment types and poorly-sorted trend. The flats suffered from serious erosion, resulting in the developing of some shell ridges and eroded ridges. Cumulative grain-size distribution curves indicated that most of the sediment samples of AAN had a large bed load which was directly related to the strong wave activity.

(3) For RMA, the intertidal flats were relatively smooth and the tidal currents played more important role. In addition, groins cross the shoreline had great effects on the distribution of surficial sediments of the intertidal flats by changing partial tidal currents field along nearshore zone.

(4) For LZB, intertidal flats were very broad and had no obvious changes of sediment types. Sediment grain became coarser and better sorted from high intertidal flats to low intertidal flats.

Correspondingly, the saltation load on cumulative grain-size distribution curves became much larger, which indicated stronger hydrodynamic conditions towards low intertidal flats.

The sedimentation rate and grain size changes of the sediment core in the tidal flat at Yuantuojiao Point, Changjiang Estuary

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The Yuantuojiao Point located at the transition part of northern bank of the Changjiang River and the Yellow Sea. Tidal flat was well developed at Yuantuojiao Point. Tides, river discharge, sea waves and coastal reclamation were the main factors affecting the sedimentation on the tidal flat. The coast development has gone the accumulation trends and sensitivity to the coastal environmental changes. In this study a 192 cm core was collected and sampled at 2 cm intervals. The grain size was analyzed by Mastersizer2000. The vertical grain size changes were shown in the figure 1. There are three units in the core named A, B and C. In the unit A, there were frequently changes between silty sand and sandy silt. Unit B is the transition part of Unit A and C. From the bottom to the top the fine grains increased. This trend was coincided with the seaward migration of the coastline changes controlled by the human reclamation. The unit A and unit B are the natural sedimentary sequences of the tidal flat development at the northern bank of the Changjiang estuary. The boundary of unit A and unit B indicates the reclamation in the late time of 1950's. Because of the reclamation the coastline moved seawards and caused more fine sediments accumulating at the Yuantuojiao Point. The 137Cs vertical profile of the same core found the first peak of 137Cs fallout was at 52 cm, indicating the year of 1963. The another peak of 137Cs was at 18 cm, indicating the year of 1986 because of the Chernobyl event. The average sedimentation rate was 1.6 cm/a from 1986 to present, and from 1963 to 1986 the average sedimentation rate was 2.9 cm/a. The variation of the average sedimentation rates indicated that sedimentation rate has declined since 1960's corresponding with the sedimentation process of the tidal flat at Yuantuojiao Point because of the seaward reclamation. The average sedimentation rate at Yuantuojiao point was similar to the silt-muddy

tidal flat in southern Jiangsu coast, but lower than the sedimentation rate off the estuary of the Changjiang River. The seaward reclamation in the past decades at the Yuantuojiao Point caused the high sedimentation area moving to the eastern part and formed the spit and large muddy tidal flat at the northern part of the north branch of the Changjiang River. The main sediments source at Yuantuojiao Point was from the Jiangsu coastal tidal current from north to the south direction, which brought much fine sediments.

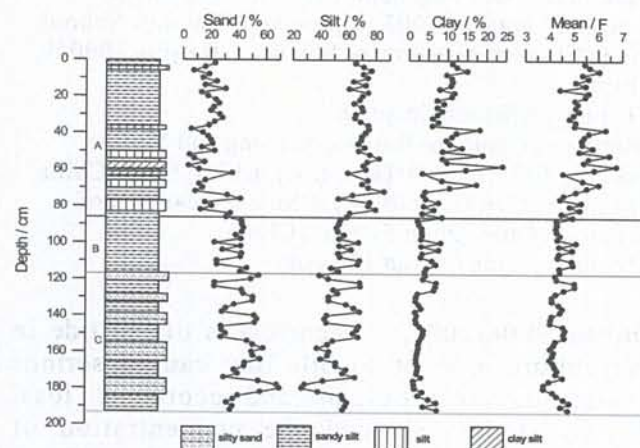


Fig.1 Grain size variations in the sediment core at Yuantuojiao Point, Changjiang Estuary

The tidal flat utilization and related ecological problems in China

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The amount of arable land has continually declined since 1990s due to soil erosion, desertification, salinization, seawater intrusion, and occupation of arable land for non-agriculture use, and the effect of natural calamity in the coastal zone. Especially, with the increase of population and economy development, the conflict between man-land becomes acute. As a potential land resource, the tidal flat utilization and development has received great concern from governments at all levels in the coastal zone. However, because eco-environment of the tidal flat is fragile and sensitive, some principles should be followed. Based on the analysis of the discussion of distribution, formation factors, classification, and the existing problems in the

exploitation and utilization of the tidal flat in china, models suitable to local conditions are proposed according to ecological function rationalization.

Discussion for Red Tide Prevention and Environment Sustainable Development in the Culture Area of Sishili Bay

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During 2004-2007, 7 occurrences of red tide in the culture area of Sishili Bay caused serious environmental problems and economic loss. Recent studies showed the concentration of inorganic nitrogen, phosphorus and the ratio of DIN/DIP in this area were relatively low, so the phytoplankton community may be relatively restricted by inorganic nitrogen. But under some special conditions, the relatively superfluous inorganic phosphorus met the demand of some red tide algae. Now, sewage discharge can not be completely controlled. Based on seasons and the extant concentration of nutrition in the water, we can selectively control the discharge of certain sewage with certain nutrition, and induce the well-balanced growth of phytoplankton community. The well-balanced phytoplankton community will benefit aquiculture, prevent red tide, and help to achieve the environment sustainable development in this area.

Estimating submarine inputs of groundwater to a coastal bay using radium isotopes

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This paper reports the initial results derived from radium isotopes of surface ocean waters in the Longjiao Bay, west shore of Taiwan Straits. The objective of this research is to assess the submarine groundwater discharge(SGD). *30

radium isotope samples of surface ocean waters (roughly 1m depth) for radium analyses was collected along two shore-perpendicular transects during two cruises(May 2007 and June 2007), each cruise had one transect with 15 samples. Samples were collected with 60L polypropylene bucket. The sampling was completed within 2h from the coastline(starting at low tide) to 10km offshore. In the laboratory, the water samples were immediately gravity-fed through a PVC column(4.5cm diameter, 50 cm length) filled with manganese oxide-impregnated acrylic fiber at a flow rate of ~300ml/min to retain radium(Moore,1976). The activities of ²²⁶Ra absorbed onto Mn-fiber were measured through emanation method. After that, the Mn-fiber was sealed for more than 7 days and the activities of ²²⁶Ra absorbed onto Mn-fiber measured through direct emanation method.

To assess the spatial distribution of ²²⁶Ra and ²²⁸Ra, two shore-perpendicular transects were sampled from the coastline to more than 10 km from offshore. Both of these tracers have high activities near the coast, activities decrease from nearshore to offshore. Offshore transects of the long-lived ²²⁶Ra indicate that eddy diffusion controls their distributions within 10 km of shore, ²²⁶Ra distribution yield a activity gradient of 0.79-10³ dpm km⁻¹. The short-lived ²²⁸Ra distribution in this region yield an eddy diffusion coefficient of 68.83 km² d⁻¹.

To estimate the seepage rate of groundwater into the study area, we used the approach developed by Moore(1996,2000). The short-lived radium isotopes, ²²⁸Ra, were used to establish eddy diffusion coefficient for the near-shore study area. The product of the eddy diffusion coefficient and the offshore ²²⁸Ra activity gradient established the ²²⁸Ra flux of 5.47-10³ dpm km⁻¹ d⁻¹. This flux must be balanced by Ra input from SGD. The flux of SGD within the shore based on the ²²⁸Ra budget was 2.61-10³ m³ km⁻¹ d⁻¹. This magnitude of SGD includes terrestrially-derived fresh SGD and recirculated seawater SGD (Burnett,2003), further research will be required for both of them.

Morphological Changes and Sedimentation Rate in the Tidal flat at Yuantuojiao Peak, Changjiang Estuary

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The Yuantuojiang Point located at the transition part of northern bank of the Changjiang River and the Yellow Sea. Tidal flat was well developed at Yuantuojiang Point. Tides, river discharge, sea waves and coastal reclamation were the main factors affecting the sedimentation on the tidal flat. The coast development has gone the accumulation trends and sensitivity to the coastal environmental changes. In this study a 192cm core was collected and sampled at 2cm intervals. The grain size was analyzed by Mastersizer2000. The vertical grain size changes were shown in the figure 1. There are three units in the core named A, B and C. In the unit A, there were frequently changes between silty sand and sandy silt. Unit B is the transition part of Unit A and C. From the bottom to the top the fine grains increased. This trend was coincided with the seaward migration of the coastline changes controlled by the human reclamation. The unit A and unit B are the natural sedimentary sequences of the tidal flat development at the northern bank of the Changjiang estuary. The boundary of unit A and unit B indicates the reclamation in the late time of 1950's. Because of the reclamation the coastline moved seawards and caused more fine sediments accumulating at the Yuantuojiang Point. The ^{137}Cs vertical profile of the same core found the first peak of ^{137}Cs fallout was at 52 cm, indicating the year of 1963. The another peak of ^{137}Cs was at 18 cm, indicating the year of 1986 because of the Chernobyl event. The average sedimentation rate was 1.6cm/a from 1986 to present, and from 1963 to 1986 the average sedimentation rate was 2.9cm/a. The variation of the average sedimentation rates indicated that sedimentation rate has declined since 1960's corresponding with the sedimentation process of the tidal flat at Yuantuojiang Point because of the seaward reclamation. The average sedimentation rate at Yuantuojiang point was similar to the silt-muddy tidal flat in southern Jiangsu coast, but lower than the sedimentation rate off the estuary of the Changjiang River. The seaward reclamation in the past decades at the Yuantuojiang Point caused the high sedimentation area moving to the eastern part and formed the spit and large muddy tidal flat at the northern part of the north branch of the Changjiang River. The main sediments source at Yuantuojiang Point was from the Jiangsu coastal tidal current from north to the south direction, which brought much fine sediments.

Key Words Tidal flat, sedimentation rate, grain size, reclamation, ^{137}Cs profile, north branch of

the Changjiang River

Acknowledgement: This work supported by the NSFC project (No.40676052) and Jiangsu Province NSF Project (No. Bk2007149).

Sediment Records of Paleoenvironment during MIS 3 in North Jiangsu Plain, East China

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Global sea level changed rapidly with the climate changes in past few million years, especially during the time of Quaternary. Sediment records in the coastal plain have the information of the sea level and coastline changes. In the past decade, the climate in the last few glacial-interglacial cycles was found that changed abruptly and the climate in the period of Marine Isotope Stage 3 (MIS 3) was warmer than the earlier estimation. In MIS 3 the sea level elevations were different in regions because of the tectonic up-down movements respectively. In China, the climate was more wetter at MIS 3 recorded by the deep channel deposits at the Three Gorges, the evidences of high lake levels in Tibetan Plateau. The early studies of the late Quaternary environment in the coastal regions of East China also indicated the high sea level appeared at the period of MIS 3 commonly named as "the second layer of marine deposits".

Northern Jiangsu Plain located at the northern part of the Yangtze River Delta, is one of the coastal plains which was well studied on the aspect of Holocene environment and sea level changes. Below the Holocene strata was the yellowish brown hard silt clay, which was regarded as the aeolian deposits corresponding with the low sea level during the last glacial period. Up to now few study was related to the paleoenvironment at MIS 3 in Northern Jiangsu Plain. In the year of 2004, the Department of Coastal Ocean Sciences of Nanjing University carried out a 146 meters long boring at Wangzhigang Town of Baoying County, 110 km from the present coastline, in which a well-defined marine unit has been recognized, on the basis of sedimentology, geochemistry and micropaleontology. Radiocarbon dating points to an age of ca. 30,000 a BP, which is the age of Marine Isotope Stage 3. The well developed

laminated tidal flat deposits indicated the shallow waters and the micropaleontology indicated the coastal lagoon or brackish water environment recorded in the BY1 Core. This is the farthest inland a late-Quaternary transgressive event has been observed in the North Jiangsu Coastal Plain.

The sedimentary characteristics at MIS 3 were composed of the dark grey olive grey sandy silt in the BY1 Core. The unit of MIS 3 was in the depth from 19 meters to 29 meters with the laminated layers, rich foraminifera fossils and the mollusk shells. The BY1 Core indicated the sea level in MIS 3 was about 20 meters below present sea level. This sea level elevation is much higher than the results in other Pacific coastal regions. Further study is needed about the MIS 3 transgression environment and its response to the global changes in North Jiangsu Plain, East China.

Acknowledgment: Financial supports from Natural Science Foundation of China Project (No. 40676052, No. 40271004) and Jiangsu Province NSF Project (Bk2007149).

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Marine sediment records and relative sea level change during late Pleistocene in the Changjiang delta area and adjacent continental shelf

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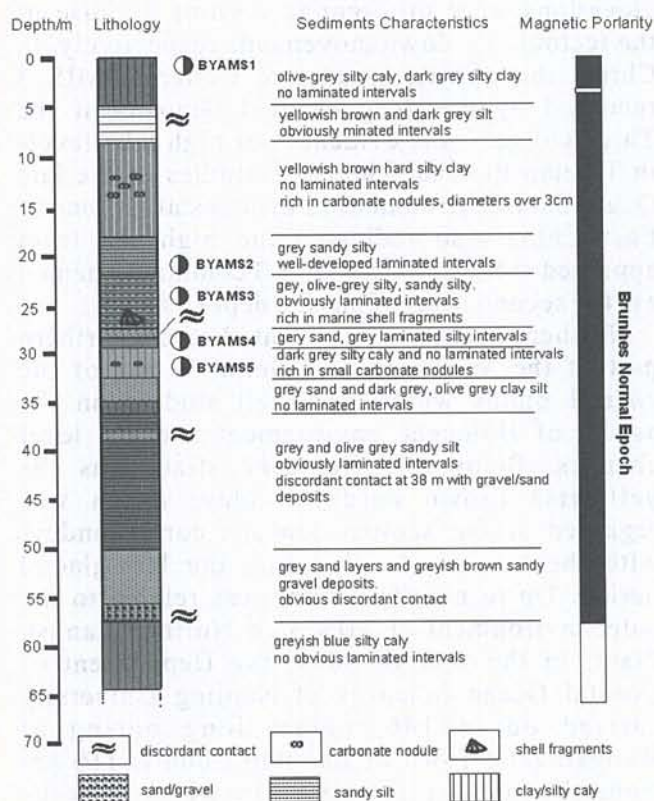
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Abstract

We conduct optically stimulated luminescence (OSL) dating and microfossil analysis on 2 late Quaternary boreholes in the Changjiang delta area, and describe 12 boreholes revealing lithology, stratigraphy and sedimentary facies from the Changjiang delta area and continental shelf of the East China Sea (ECS). These data are used to determine the chronology of two transgressions during marine isotope stage (MIS) 5 and MIS3, interpret the distinctive transgression pattern of MIS5 and MIS3, and reconstruct relative sea level of the study area during late MIS3. Results demonstrate that fluvial gravelly sediment deposition prevailed with limited marine influence during MIS5, while muddy and sandy deposition occurred along with widespread coastal facies during mid and late MIS3 in the Changjiang delta area. This suggests that the study area is dominated by high relief and local rivers occur with large freshwater and sediment discharge during MIS5. Therefore marine micro-faunas may not have survived due to freshwater process or strong erosion has scoured away the marine records of MIS5. Tectonic subsidence is suggested to happen at a rate of ~1 m/ka since MIS5 and lower the Changjiang coastal area to be invaded by seawater during MIS3. Abrupt sea level rise occurs and relative sea level is estimated as -5 m during late MIS3. Altitude of late MIS3 transgressive sediments decreases from the inner delta plain seaward gradually, reflecting differential tectonic subsidence of the study area.

Keywords:

OSL dating; MIS5, MIS3 transgressions; differential subsidence



(BYAMS1:1415±40; BYAMS2: 26470±60; BYAMS3:32910±170; BYAMS4:39385±170; BYAMS5:32530±180)

Fig. Sedimentary characteristics of the BY1 Core in North Jiangsu Plain, East China

Session - 6

**Megadeltas Landform Changes and Coastal
Hazards Assessment
(APN/IGCP475 Special session)**

Seabed signatures of gravity flows on subaqueous deltas: recent observations

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Rivers that create deltas typically transport large amounts of sediment and have significant vertical relief (e.g., delta-front and foreset regions). These two factors can lead to development of turbid flows with large concentrations of suspended sediment fluid-mud and hyperpycnal flows. Both are important because they transport large amounts of sediment. On broad continental shelves, the flows are responsible for developing morphologic features (e.g., subaqueous deltas, clinoforms), and on narrow shelves they can transport sediment beyond the shelf break. Because the flows have large amounts of sediment, they can dominate the flux of sediment across deltas. The flows also move under the force of gravity and follow different trajectories than sediment transported by physical motions of seawater (e.g., currents and waves). Recent research on deltas has provided knowledge about gravity flows and the resultant signatures recorded in the seabed (e.g., sedimentary structures, radioisotope profiles).

Studies associated with rivers discharging to broad shelves provide insights that are relevant to sediment dispersal associated with large Chinese fluvial systems (Changjiang, Huanghe). On the Amazon continental shelf, energetic tidal and wind-generated currents and waves put much sediment into suspension, and estuarine-like convergent transport creates localized concentrations of suspended sediment that flow from topset to foreset regions as fluid muds (>10 g/l) and cause aggradation and progradation of a clinoform structure. Studies in the Gulf of Papua document the occurrence of similar fluid-mud flows, and delineate the spatial variability of the flows across the clinoform in some cases due to the locations where physical processes focus suspended sediment on the topset, and in other cases where morphologic features (shelf valleys) focus flows on the foreset.

Studies associated with rivers discharging to narrow shelves provide insights that are relevant

to the mechanistic operation of gravity flows associated with large Chinese fluvial systems. Intense wave activity can create large concentrations of suspended sediment within a relatively thin boundary layer (cm to tens of cm thick). These turbid waters can then flow down bathymetric gradients, as long as the wave activity keeps the sediment suspended. Such mechanisms have been observed in association with the Eel and Po Rivers. In the former case, most of the sediment discharged is carried to the continental slope (including an adjacent submarine canyon), and in the latter case, much sediment moves to the foreset of the subaqueous delta. In some unusual cases (e.g., river floods), large concentrations of suspended sediment (>40 g/l) may enter the ocean directly (i.e., with freshwater) and flow under the control of gravity. These are more difficult to document, but some studies may be able to demonstrate their existence (associated with the Rhone, Sepik, and Eel Rivers).

Vulnerability assessment of deltas of the Asian monsoonal region

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Low-lying deltaic coasts are widely recognised to be experiencing coastal erosion and inundation along their ocean margins. The densely populated megadeltas of the Asian monsoonal region are also undergoing rapid changes as a result of human modification of land use both in the catchment and across the coastal plains, including water extraction and diversion. Global climate change presents an additional threat that will make the management of these dynamic systems increasingly difficult.

The potential impacts to which individual megadeltas are exposed are related to the climate drivers and the way in which they are changing, and the susceptibility of different sections of a delta is a function of the geomorphology of the shoreline and the delta distributaries. The adaptive capacity of the population in each delta is relatively low, rendering large numbers of people vulnerable, as tragically demonstrated during Cyclone Nargis. The threat is accentuated as a result of local factors including crustal

flexure, subsidence and compaction, as well as a reduction of resilience that often follows where the natural ecosystems have been transformed for agriculture, aquaculture or urban development. Subtle geomorphological variations between and within the extensive low-gradient delta plains reflect sedimentation patterns during aggradation and shoreline progradation over the past 6000 years. Substantial impacts result where rivers are dammed and sediment supply is decreased; in some cases, subsidence or compaction exceeds the rate of supply of new sediment, and the longer-term prospect of inundation is increased. The relationship between elevation of the plains surface and flood and storm surge levels is critical for sustainable management of these systems but sediment pathways and the interactions of river, wave and tide processes are rarely understood in sufficient detail.

There are relatively few approaches to assessing the vulnerability of coastlines that are appropriate for application to these multi-stressed sedimentary coasts. Vulnerability in Asian deltas is multi-faceted and assessment needs to address all its dimensions. This paper examines the factors that contribute to vulnerability and reviews the tools that are available to assist the assessment and management of vulnerability.

Cyclonic versus tidal mobilization and sedimentation in the submarine Ganges-Brahmaputra delta, Bangladesh

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The Swatch of No Ground is deeply cut into shelf at the northern Bay of Bengal. The canyon head ends in an amphitheatre-like depression intersecting the prograding foreset beds of the central submarine delta of the Ganges-Brahmaputra. Seismic profiles across the canyon and piston cores from the canyon floor were collected in 1994, 1997, and 2006 using the research vessel SONNE. The canyon floor is covered by several decimeter-thick, parallel-bedded sand-silt-clay sequences draping a slump-derived morphology. Sediments consist of graded,

partly laminated fine sand to clay deposited in a mostly anoxic environment. The deep shelf canyon (> 200 m water depth) is therefore a reliable recorder of sediment mobilization and transport at the adjacent shallow (< 20 m water depth) environments of the submarine delta. The high sedimentation rate of up to 50 cm per year allows a correlation of the graded layers with the historic records of tropical cyclones. The repetition of high-resolution seismic profiles and piston coring with a time difference of 12.5 years identifies an additional deposition of 1.75 m in the upper canyon. Detailed analyses of the grain size and the composition of diatom assemblages show that the tropical cyclones are the most effective agent to mobilize, transport, and widely distribute particles from the freshwater/brackish mangrove deposits and from the marine topset beds into the canyon.

In a more general scheme, the results indicate that extreme high-energy events like cyclones exert a much greater influence on the sediment distribution in submarine deltas than daily tidal currents under fair weather conditions.

Megarivers, megadeltas, and the future

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The ability of a river to create a large delta depends in part on the size of the river, particularly its sediment load. But the extent and growth of a delta also depend on the morphology of the river's watershed, the susceptibility of the river to periodic catastrophic events (such as storms or earthquakes), as well as the preference for floodplain vs. offshore storage, which in part is dictated by regional and local subsidence. Although Amazon River discharges approximately 400 times more sediment annually than the Chao Phraya (1200 vs. 30 (pre-dam) Mt/yr) their deltas are approximately the same size; similarly, the Mekong delta is an order of magnitude larger than the Amazon delta even though it discharges an order of magnitude less sediment.

Superimposed on the geologic and fluvial settings are the impacts of human modification and global climate change, sea-level rise being the most discussed in the popular press, although not necessarily the most critical. High-density urban population centers on the Ganges-Brahmaputra (Calcutta and Dhaka), Nile (Alexandria), Yangtze (Shanghai) and the Mississippi (New Orleans)

deltas, to mention only a few, will be under increased danger of short-term - and perhaps even permanent-coastal erosion and inundation in the foreseeable future due in part of river diversion and fluvial sediment reduction, as well as anthropogenically enhanced subsidence. To a large extent these conflicts in river utilization and delta survival may be intractable, as the growing need for water in industry and agriculture in many watersheds ultimately may supercede any ability to preserve the coastal environment. In some cases endangered delta urban centers already may be doomed (e.g. New Orleans); in others (e.g., Shanghai) the future is still unclear.

Flux and fate of Asian River-derived sediments in the Western Pacific marginal seas

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Rivers are the major carriers for delivering large amounts of land-derived freshwater, sediment, and natural elements to the global ocean. Collectively, the global rivers annually discharge about 35,000 km³ of fresh waters and 22-22 × 10¹⁰ tons of solid and dissolved sediment to the ocean. Among them, approximately 70% has been delivered from Asian large rivers (e.g. Yellow, Yangtze, Pearl, Red, Mekong, and Ganges-Brahmaputra, etc) and numerous small mountainous rivers (e.g. rivers in Taiwan, Indonesia, and Papua New Guinea, etc) into the Western Pacific marginal seas, e.g. Yellow Sea, East China Sea, and South China Sea. As a result, Asian rivers, especially those large rivers, play important roles in not only controlling the physical and biogeochemical features of the Asian estuaries and Western Pacific ocean margins, but also in impacting on the evolution and culture development of Asian society.

Field studies show nearly 50% of Asian large river-derived sediment has been deposited in the lower reach of the river mouth, forming many extensively distributed subaerial delta plain, and rest of them discharges into the adjacent ocean. Among those being discharging into the ocean, nearly half of them has been found to be longshore-transported several hundreds kilometers from the river mouth. There is very little or few percent of the total sediment discharge has been found to be across-shelf transported into the deep ocean.

In contrast, sediment from small rivers has a very

different fate. Some major small mountainous rivers in active margins (e.g. Kaoping, Choshui, Lanyang, etc), usually do not form deltas and are mainly controlled by episodic events, contribute more than 50% of global terrigenous sediments to the sea. However, more than 80% of their sediment discharges are transported directly to the shelves or deep canyons mainly via gravity/turbidity or hyperpycnal flows, which are distinctly different from the above large rivers that discharge to passive margins or shallow marginal seas.

Holocene evolution of Yangtze delta: Retrospective and Perspective

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The present study is to review the numerous previous efforts on the geomorphological and sedimentary environmental evolution of the Yangtze delta since LGM. Many studies were carried out in the 1980s, primarily focusing on the morphologic change by the means of traditional methods, including development of the modern delta, Holocene sea transgression and storm depositions on the delta coast. In 1990s, more intensive studies were given to sedimentary facies change and stratigraphy by using conventional radiocarbon measurement, which had helped examine in the paleo-incised valley of the Yangtze estuary. Progress has been made after later 1990s, since AMS ¹⁴C becomes available to help establish more detailed sediment stratigraphy and sedimentary facies distribution in time and space. This further support sea level establishment and morphological identification on the delta plain and in the river mouth. Also, numerous surveys using combined coring and seismic profiling in cooperation with AMS ¹⁴C have further promoted the study of the Holocene delta evolution, including high-resolution chrono-stratigraphic formation, sea-level rise model, coastline shift and delta plain morphological change, etc. Of note, geoarchaeological study of the Yangtze delta has highlighted the interaction between nature and the nearly Neolithic activities.

Presently, we are paying more attention to the future delta studies, primarily involving estuarine sedimentary processes in response to east Asia monsoon and human activities in geological and human dimensions.

Key words: geomorphology; sedimentary environment; sea level; east Asia monsoon

Modern mangrove pollen representation and a 9,000-year record ecological changes from the northwestern coast area of the South China Sea

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The relationships between vegetation and modern pollen are examined along a coast to inland gradient of plant communities in the Yingluo Bay area, Guangxi, in China. Communities of *Rhizophora stylosa*, *Kandelia candel*, *Bruguiera gymnorrhiza*, *Kandelia candel* and *Excoecaria agallocha* that develop on tidal flat were sampled for pollen analysis. The distribution of these communities can be related to both specific plant individual and environmental parameters such as plant cover, tree breast diameter and topography, water table depth, substrate type and salinity. High percentages of mangrove types can reflect the mangrove vegetation in general, although some terrestrial pollen occur. After drawing the scatter diagram and using correlation analysis, cluster analysis and detrended correspondence analysis, we summarized two groups impacting on pollen abundance. One includes the parameters of plant, in which plant cover is significant associated with pollen percentages for *Rhizophora stylosa* and *Kandelia candel*, plant percentage play an important role on pollen abundance for *Bruguiera gymnorrhiza* and *Excoecaria agallocha*, and tree breast diameter is for *Avicennia marina* by controlling plant percentage. The other group mainly focuses on the environment conditions, of which soil types and salinity factors are displayed by the first axis of DCA, altitude or water table depth shown by the second axis and tidal hydrodynamics

indicated by the third axis according to the separated samples associated with the communities in each sampling squares. Subsequently, fossil data from four cores in a mangrove system from the northwestern coast area of the South China Sea were compared to the modern data set in search of similarities between fossil and modern pollen spectra. Both of regression correlation and composite DCA revealed that the fossil pollen assemblages have modern counterparts, permitting to interpret the vegetation changes of various areas and the coastal line migration in greater details during the last 9000 years.

Neotectonics of the Jadukata fan, Bangladesh

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Jadukata fan is one of the fans developed at the base of the southern foothill region of the Shillong Plateau in Bangladesh. With the objectives of characterizing a tropical and humid alluvial fan and examining the influence of tectonics in the formation and development of a fan, geomorphology of the fan has been studied. This study has been carried out with help of different remote sensing data and subsequent field checking. Natural levee, bars and crevasse splay are the common geomorphic features on the fan. The area lies in a tectonically complex region of the world, evidenced by the high seismicity. Important neotectonic signatures identified on the fan are preferred flow direction of the streams, bends in several streams along a N-S directed line, sudden widening of consecutive small streams along a E-W directed line and multi-level of bars on the Jadukata River. Results of the study show that the alluvial fan building processes is controlled by the neotectonic activities. The whole area is affected by natural hazards like flood, river bank erosion and siltation. Data show that low magnitude earthquake occurred in the area during the last two decades. Occurrence of these and several large earthquake in the surrounding areas in the past indicate the possibility of future earthquake occurrence.

Evaluation of sedimentation in the navigational channel of Damietta port, Egypt

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The Port of Damietta is connected with deep water offshore by means of a dredged channel which creates greater than normal depths with the result that littoral materials accumulate there in. The main object of the present work is to evaluate the monthly sedimentation rates in the navigation channel of the Damietta harbor using Bailard's (1981) and Rijn's (1991) formulae. The data used in the present work were obtained during the bathymetric survey of the harbor by the Coastal Research Institute in August, 1998. The investigation revealed that the summer season is, generally, characterized by lower monthly sedimentation rates ($< 0.1 \times 10^{-3} \text{ m month}^{-1}$), with a minimum value of about $0.027 \times 10^{-3} \text{ m month}^{-1}$ occurred in September, 1998. Higher monthly sedimentation rates ($> 0.1 \times 10^{-3} \text{ m month}^{-1}$), generally, occurred in winter, where a maximum value of $0.345 \times 10^{-3} \text{ m month}^{-1}$ was estimated for January, 1999. These differences of sedimentation rates are mainly due to the relatively strong storms that are frequent to occur during the winter season (January–March). The annual sedimentation rate was estimated to be about $1.38 \times 10^{-3} \text{ m yr}^{-1}$, of this value the suspended-load transport contributed about 20%, which is in agreement with the other estimates that had been done in this area.

Holocene evolution of mangrove vegetation at Chandrapur, Chilka Lake, Orissa, India in relation to pollution and anthropogenic impact

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Chilka Lake lying along the eastern coast of Orissa State is one of the ecological and socio-economical important wetlands of India. This largest open lagoon of Asia covering an area of 1165 sq. km is showing alarming environmental degradation. The fine resolution

palynostratigraphy of a sediment profile collected from Chandrapur village, Chilka Lake, Orissa has exhibited the significance of mangroves in unfolding the fluctuations of sea level, transgressive and regressive facies and depositional environments.

In order to translate the significant bio-and-climatic events of last two millennia, six biostratigraphical units as pollen zones (CH-1 CH-6) has been identified from three metre deep sediment profile. Pollen zone CH-1 exhibited the marine environment whereas pollen zone CH-2 recorded the shift of vegetation from mangrove forest to midland forest. Pollen zone CH-3 signified the total absence of mangrove forest and is succeeded by the open land vegetation dominated by Chenopodiaceae and other non-arboreal. Pollen zone CH-4 exhibited the re-emergence of core mangrove forest vegetation and pollen zone CH-5 suggested the prevalence of deltaic environment wherein both mangroves and land plants co-existed in juxtaposition. The uppermost part of the Chandrapur profile encompassing a total period of 300 years has suggested that the mangrove forest, albeit in degraded form, existed till recently along with the land plants. The varying concentrations of metals such as Co, Cr, Cu, Ni, V, Zn, As, Pb, Cd were registered at different levels indicating the environmental stress of the ecosystem. It has been inferred that these chemicals are mainly incorporated by the use of fertilizers and pesticides in agriculture. However, siltation, eutrophication and industrial development are major threatening factors affecting the sensitivity of lake, its shrinkage and total disappearance of surrounding vegetation.

Quantifying the morphological changes of the Ganges in Bangladesh using geospatial data

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The objective of this paper was to quantify morphological changes of the Ganges basin in Bangladesh by using geospatial data. Two historical maps along with remotely sensed data between 1930 and 2007 were acquired and used to quantify the changes in river morphology. In addition, hydrological data during 1951–2007 were collected and incorporated in this study. First of all, topographic maps were scanned and rectified to the UTM system. Using the rectified

maps, georeferencing of remotely sensed data were performed until the root mean square error (RMSE) resulted in <1 pixel. Image enhancement using histogram equalization was conducted for satellite data in order to increase the interpretability of features. In addition, different band combinations were tested in relation to specific targets to be mapped. It was found that bands 4, 5, 2 for the TM and ETM+ and bands 4, 5, 7 for MSS were particularly useful to detect the changes in river morphology. For ASTER, we used only VNIR that includes bands 1, 2, 3. A detailed analysis of the spectral signatures of terrain features added some important elements both to geometric and textural characteristics of the landform units. The subsequent systematic interpretation was performed by visually interpreting features present across the river basin. Three types of information were identified based on features color, tone and texture as active course, sandbar and vegetation bar, and finally on-screen digitization was performed to generate vector-based datasets. These vector datasets were edited and leveled with ArcGIS (9.2), and afterwards converted to raster to evaluate river shifting, erosion and accretion patterns. Mean daily discharge data were processed to mean monthly values and correlated with the morphological information. The analysis showed that river shifting, channel widening in terms of lateral erosion and narrowing became the major geomorphic characteristics across the Ganges in recent years. In some places channel widening became acute resulting in the rapid loss of floodplains. The sinuosity index showed that the river became wandering in response to low flow during dry season. Accretion and erosion statistics indicated that during 1977-1989, 26,465 ha areas were eroded and 10,648 ha were accreted. In contrast, between 1989 and 2000, total eroded lands were 11,433 ha, meaning that the erosion was reduced during this period. Similarly, accretion was also reduced. Between 2000 and 2007, significant reduction in eroded lands was observed, only 5,619 ha. However, 30 years changes in erosion and accretion patterns showed that 33,209 ha of lands were lost due to erosion and 10,954 ha of lands were deposited, illustrating the loss of lands due to erosion was higher than that of accretion. Mean monthly discharge analysis showed that after the construction of Farakka barrage in India, the hydrological regime has been changed drastically leading to the considerable decrease in the dry seasonal flow. The result of the study should have substantial implications as the changes in river

morphology and sediment flux would influence the delta building process in the active part of the Ganges basin in Bangladesh.

The initiation, development and degradation of Indus delta through time

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The Indus River and Delta system was formed shortly after the collision between the Indian and Eurasian Plates prior to 45 million years ago. During, the Holocene, vast deltaic complex in southern Sindh experienced abandonment of several creeks due to frequent natural channel avulsions. Abandoned Indus delta channels have been reworked by tides all along the coast into dendritic tidal creeks. The tidal creek network appears to be most extensive and mature east of the present mouth of the Indus. The lobate delta of the Indus formed under arid climatic conditions under highly variable river discharge, a moderate tidal range, extremely high wave energy, and a strong monsoonal wind system. A stronger wave influence along this part of the coast compared to conditions further east is suggested by the frequent occurrence of drumstick-shaped barrier islands, characteristic of island systems significantly influenced by both waves and tides. Because of the high sea-level stand, the impact of fluvial sediment is not strong enough to maintain a supply of coarse sediment to the deep-sea. The delta extends to the east into the Great Rann of Kutch, a vast mudflat area that is invaded by storm surges during the summer monsoon. Seaward of its delta, the Indus is transformed into a complex and spectacular distributary system which has created the world's second largest submarine fan in the Arabian Sea. The recent multi beam and seismic data collected from offshore delta shows some exciting results about the lateral and vertical extend of the vast distributary system even in areas where they were least expected. It appears that the seismic events in addition to flesh floods are some how responsible for the architecture of the distributary system.

Use of high-resolution satellite images for studying alluvial valleys and deltas of large rivers

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Satellite imagery with resolutions less than 1 m is now available for studying alluvial landforms in detail. Various aspects of a large river, such as channel and floodplain morphology, source-to-sink sediment transfer and storage, and the changing pattern of deltaic distributaries across a range of resolutions can be studied in detail. Seasonal changes in river morphology due to monsoonal fluctuation of discharge and large-scale episodic changes due to tropical cyclones or tsunamis can be mapped across a hundreds of kilometres. This type of mapping over time and space was not possible earlier.

We illustrate a number of these possibilities by using mainly MODIS and IKONOS images of Southeast Asia. We demonstrate mapping of source-to-sink transfer and storage of sediment along the Mekong River, the seasonal flux of sediment along its delta face, and coastal changes following cyclone Nargis and the 26 December tsunami. Such findings need to be checked by ground-truthing, but it is now possible to map rapid changes across space and over time for a number of events. The technique is not difficult, requiring an understanding of regional geomorphology and some exposure to remote sensing. Previously, satellite mapping could be used for reconnaissance surveying but the current family of imagery allows observations at almost ground detail over hundreds of square kilometres simultaneously. It is likely that future investigation of alluvial landforms and related processes would use satellite imagery commonly as an investigating tool. Currently, however, the cost of high-resolution satellite imagery forces one to be selective in its application.

Holocene geology and hazards of lower Ganges-Brahmaputra Delta, Bangladesh

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The Ganges-Brahmaputra (GB) river system has formed an extensive deltaic plain in Bangladesh and adjoining states of West Bengal in India. Present study investigates Holocene geological characteristics and persisting coastal hazards in the lower subaerial deltaic part of the GB delta in Bangladesh.

The deltaic plain exhibits five different sedimentary environment of deposition. These are the deposits of levee or levee complex, abandoned meander belt, beels or depressions, interdistributary tidal plains and estuarine plain. The sedimentary sequences encountered in the boreholes of the interdistributary tidal plain and estuarine plain during the Holocene time show typical deltaic sequence stratigraphy where the sediments were deposited in the sub-aqueous conditions except the uppermost part. On the contrary, the sedimentary sequence in the upper reaches of the study area particularly in the levee complex and beels suggest that the sediments were deposited as floodplain deposits in the subaerial deltaic environment. The thickness of the Holocene sediments increases in the south-eastern direction towards the present delta lobe.

The coastal parts of Bangladesh regularly face natural hazards like tropical cyclones, tidal and cyclone surge inundations, bank erosion, sand encroachment, salinity intrusion, etc. Major part of the coast is threatened by serious land erosion due to sea level rise in recent years whereas the estuarine part of the Ganges-Brahmaputra delta is prograding considerably. Water logging has become a major threat in the last few decades and the condition has deteriorated. The waterlogging problem resulting from land subsidence and low sedimentation have become acute in recent years. Mangroves in the Sundarban forest are also under stress, as a result of several natural and man-made causes.

Impact of the Three Gorges Dam on the sediment reduction from the upper Changjiang (Yangtze River) and its downstream channel-delta erosion

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After the operation of the Three Gorges Dam (TGD) in 2003, the mean annual sediment load at

Yichang station at the end terminal of the upper reaches of the Changjiang (Yangtze River), 40 km downstream of the TGD, decreased drastically to 70 million tons (Mt) in 2003-2006, or 20% of that during the pre-TGD period (1956-2002). Based on the annual sediment data for the last 51 years recorded at the key hydrographic stations in the mainstream and the major tributaries of the upper Changjiang, our study shows the TGD annually trapped about 154 Mt/yr during the period of 2003-2006 that is higher than both the values published by the Changjiang Water Resources Commission and that estimated by other authors. These differences are mainly resulted from the underestimation or neglect of the siltation in the backwater region of TGD. The sediment budget shows that 89% of the sediment deposited within the TGD Region from Cuntan to Yichang stations, the remaining 11% deposited in the upstream reaches from Pingshan to Cuntan owing to the effect of the extended backwater area than the proposed. Moreover, the sediment retention caused by the TGD explained only a minor part (36% or 153 Mt/yr) of the total sediment reduction of 422 Mt/yr at Yichang in comparison with that during the pre-TGD period. In contrast, the major part (64% or 269 Mt/yr) was ascribed to the decline of sediment loads supplied from the upper reaches into the TGD owing to dams construction and soil conservation works in the upper Changjiang basin, especially in the Jialingjiang and Jinshajiang basin.

The variation of annual sediment accumulation rate in the mid-lower reaches of Changjiang from 1958 to 2006 shows that the accumulation process was the dominant regime before 2002, but the riverbed erosion has been dominant process since 2002 with an averaged sediment erosion rate of 63 Mt/yr in 2002-2006. A significant relationship exists between sediment accumulation rate and annual sediment load at Yichang since the mid-1980s, which suggests that sediment load at Yichang is a primary factor controlling the sediment transport and storage in the mid-lower reaches of Changjiang. The mid-lower reaches degrade when the sediment load at Yichang became lower than a threshold level of 326 Mt/yr. Given the absence of the TGD, we estimate the sediment load at Yichang would be 225 Mt/yr during the period of 2003-2006, much lower than the threshold value. Therefore, the TGD only accelerated the downstream riverbed degradation rather than the decisive causation.

The theoretical trapping efficiency of the proposed cascade reservoir in the lower

Jinshajiang River and the TGD has been calculated using the Brune's method. The result shows that the cascade reservoir and the TGD will collectively trap around 93% of the sediment loads from the upper Changjiang basin, therefore the annual sediment load at Yichang will decrease to ca. 16 Mt/yr, and then the sediment discharge from the Changjiang to the sea will decrease to about 95 Mt/yr in the coming decades. In the presence of low sediment discharge, profound impacts on the morphology of estuary, delta and coastal sea are expected.

Use of grain size distribution patterns and textural parameters to distinguish different sedimentary environments in a deltaic plain, India

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A deltaic plain represents a mosaic of different sedimentary facies like river, beach, coastal dune, and tidal flat. The objective of this research is to differentiate these different depositional sedimentary deposits by grain size distribution pattern and textural parameters. The idea behind is the different magnitudes of transporting power of the transport media in the same regime of deposition. The density of air being less than the river water, its transporting capacity is less than that of the river water. Similarly, the density of river water is less than that of seawater; accordingly its transporting capacity is less than the seawater. With this idea, sand samples from different sedimentary environments in the Sunderban deltaic plain of India, were collected from different sites.

Grain size analysis was carried out for a total of 310 sediment samples by sieving and pipetting methods. Grain size distribution patterns were compared with two-model distributions: log-normal and log-skew-Laplace. A total of 72 sand samples were collected from four beaches (Sagar island, Junput, Bakkhali and Fraserganj), 88 nos of samples from the corresponding coastal dunes bordering the beaches, 24 nos of samples from the corresponding tidal flats and finally a total of 126 sand samples from the different rivers, both tidal (Hooghly, Bhagirathi) and non-tidal (Ajoy, Damodar and Usri) of the same deltaic plain.

Grain size distribution patterns indicate that for beach sands, log-normal distribution model fits

better for 54.2% cases and log-skew-Laplace model for 45.8% cases. For dune sands, log-normal model fits better for 51.1% cases and log-skew-Laplace for 48.9% cases. For tidal flat sands, log-normal model fits better for 79.2% cases and log-skew-Laplace for only 20.8% cases. Difference between the two slopes ($\alpha \sim \beta$) in Laplace distribution for beach sands is 0.662, for dune sands 0.290, for tidal flat sands 2.408 and for river sands 0.299 indicating a wide variation of degree of sorting. Dune sands are better sorted (sorting, $\rho=0.302\phi$) than beach sands ($\rho=0.357\phi$), beach sands are better sorted than river sands ($\rho=0.553\phi$) which again is better sorted than tidal flat sands ($\rho=1.604\phi$). Beach sands are negatively skewed in 31% cases and positively skewed in 69% cases, dune sands are negatively skewed in 20% cases and positively skewed in 78.8% cases, zero for 1.2% cases. Tidal flat sands are negatively skewed in 33.3% cases and positively skewed in 66.7% cases.

The statistical analysis of the river sands indicates that the grain size distribution of the tidal stretch of the Hooghly-Bhagirathi river system has a tendency of attaining a log-skew-Laplace distribution model whereas for the other three non-tidal rivers the log-normal distribution pattern is suggestive of a best-fit statistical model. When all the rivers are considered, log-normal statistical model is the best-fit statistical model in 79.2% cases. Kurtosis is a measure of peakedness of the size distribution. From the analysis it appears that both beach and dune sands exhibit high kurtosis values (>3) with fine to medium grain size indicating high-energy-level of reworking. Beach, dune and tidal flat sands are apt to be more positively skewed than the river sands indicating preponderance of finer fractions. Skewness and kurtosis measure the discrepancies in properties of materials of various sizes being deposited in the same environment at the same time. As such high skewness and kurtosis values in beach, dune and tidal flat sands can be generally interpreted as indicating that a large amount of reworking has taken place. Tidal flat sands are generally finer and poorly sorted than the beach, dune and river sands.

Delta morphological processes in the Gulf of Carpentaria, Australia

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Deltas in large, shallow intracratonic basins affected by meso- to macro-tidal conditions and seasonal rainfall, such as the Gulf of Carpentaria, are characterised by a morphology that reflects significant reworking of the deltaic material by wave and tidal processes without losses of fluvial detritus to deeper water environments.

The mesotidal Gulf of Carpentaria in northeastern Australia receives sediment from numerous surrounding rivers during the annual December to March summer monsoon period but maintains a relatively straight coastline dominated by prograding beach ridges or cheniers. This is a result of relative importance of landward-directed wave and tidal sediment transport versus freshwater flooding.

During the three months of the monsoon period the gulf rivers discharge large quantities of sand and mud into the shallow offshore portion of the gulf. The muddy sediment forms a plume, extending at least 10 km offshore, that is redistributed by the clockwise tidal circulation pattern within the nearshore portion of the gulf. The sand is deposited as broad intertidal to subtidal deltas adjacent to the river mouths in water depths of less than 5 m. Being rapidly dumped, this detritus is very poorly sorted with large quantities of mud retained in the predominantly sandy nearshore subtidal deltas. As the monsoon-generated river discharge and the seasonal wind-driven sea-level set-up both decrease, wave and tidal processes start to dominate the delta areas.

Normal wave activity in the gulf is capable of moving sandy bottom sediment at least down to 5 m water depths. This wave activity produces a landward movement of fine and very fine sand that builds up as nearshore and intertidal shoals. These shoals are also subject to longshore movement from combined wave and longshore clockwise tidal current circulation. This supplies sand for the southward and westward elongation of beach ridges and cheniers around the eastern and southern shores of the Gulf of Carpentaria. Large waves are only present in the gulf during periods of cyclone activity but these are too infrequent in any one part of the gulf to act as the main transport mechanisms within the nearshore regions. However, they do cause local scouring and short-term transport especially in the formation of the higher marine portions of the beach ridges where the sea-level set-up and increased wave run-up interacts with the aeolian deposits in the upper parts of the beach ridges.

Wave action also resuspends the mud from the

offshore deltaic muddy sand deposits accounting for the high turbidity of the nearshore gulf waters throughout most of the year. This resuspended mud is transported landwards with each tidal cycle resulting in the deposition of a mud blanket over the margins of the tidal channels and the extensive intertidal to supratidal mudflats between the successive beach ridges or cheniers. The thickness of the mud blanket in the channel is greatest a few hundred metres from the mouth with a slow decrease in thickness upstream until the tidal limit is reached usually some 20 km or more inland. Mud deposition within an annual cycle is commonly 10 cm or more on point-bars where it forms an annual sand-mud couplet. Upstream from the tidal limit a very rapid reduction in mud is apparent and the channel bed remains predominantly sandy.

The resultant pattern of broad rounded to straight delta morphologies is characteristic of the Gulf of Carpentaria deltas exposed to wave modification, with the only exceptions occurring where the river mouths are protected by offshore islands, e.g. in the McArthur River delta.

Impacts of last glacial-interglacial cycle on sediment yield and delivery in Yangtze Drainage Basin to the East China Sea

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Sediment output from a drainage system is mainly controlled by tectonics, climate (glaciation and precipitation), and sea level change. There are quite ambiguous on the driven mechanisms of sediment yield and delivery processes in drainage basins. Some favor exhumation in mountainous regions being controlled by tectonic forces, while others presume that climate is the primary forcing of sediment erosion and dispersion, especially in monsoon systems. Furthermore, Mé tivier and Gaudemer (1999) argued that the average sediment input of the large rivers of Asia should have remained constant throughout the Quaternary in spite of strong tectonic activity and great fluctuations in climate and sea level. This paper focuses on the provenance change of the Yangtze drainage basin in the past ca. 20 ka through using U-Pb dating of zircon grains from the Yangtze delta, eliminating changes in tectonics as the potential forcing of sediment

production. Consequently, changes in the provenance of sediment delivering to the delta are used to discuss how climate change has influenced sediment production in the Yangtze drainage basin since the Last Glacial Maximum (LGM).

The two major U-Pb age populations were clustered at 50-350 Ma with a prominent peak around 200-250 Ma and 550-900 Ma with an obvious peak around 700-800 Ma. 200-250 Ma correlates to the age of collision between the South and the North China blocks, and 700-800 Ma is the age of amalgamation of the Cathaysia and the Yangtze block to form South China. Two minor age populations were located at 350-550 Ma with a minor peak at 450-500 Ma and at 1450-2000 Ma with a minor peak at 1700-1750 Ma. A 450-500 Ma population is likely derived from rocks of Andean-type arc preserved in the northern Qinling Shan. A 1.7-1.75 Ga population is usually considered to source from the North China block, which is almost located beyond the Yangtze drain basin. This age zircons are inferred to be recycled sediments from Songpan-Ganzi terrane, highly folded and uplifted Since Tertiary. Middle Holocene deposits have higher content of Early-Proterozoic grains and less abundance in Late-Proterozoic and Triassic grains than LGM sediments. It may be inferred that strong summer monsoon during Middle Holocene should have drain more sediments from the Upper Yangtze drainage basin (i.e. Songpan-Ganzi terrane). Weakened summer monsoon at present is, however, not observed to decrease the input from the Songpan-Ganzi terrane. It can be interpreted to suffer from human impact on sediment yield patterns over climatic cycle.

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Spatial distribution characteristic of sedimentation rates on the Tianjin supratidal zone

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In the last hundred years, especially the past tens of years, results of natural factors and human

activities exacerbate modern deposition on the intertidal flat of Tianjin, China, where Tianjin Binhai New Area is located. Consequently, the tidal flat changes rapidly, the mouths of rivers emptied into the Bohai Bay are strongly blocked up (Zhong et al., 2002; Wang et al., 2002; Li et al., 2007). Very soft and high water saturated fluid mud and/or hard pan of silt and very fine sand can be accumulated as thick as a few meters. Those have initiated many scientists' interests, and many works have been done on this. This paper, 12 Eijkelpamp cores was taken on the supratidal zone of Tianjin, and ^{210}Pb and ^{137}Cs activity was measured by Gamma detector to study the modern sedimentation rates quantitatively.

12 ^{210}Pb and ^{137}Cs cores taken from the supratidal zone of Tianjin showed that ^{137}Cs activity was detected except the site 9086, and the maximum depth can give sedimentation rates. ^{210}Pb curves showed "Episodic-event-influencing-type", except the curves of 9086 and 9089 showed "Wiggling with approximate equivalent amplitude", which mean that the sedimentation processes were not constant, and the sedimentation rates changed frequently during the last 100 years because of the influencing of the strong water events. Furthermore, only $^{210}\text{Pb}_5$ and $^{210}\text{Pb}_{10}$ were calculated by CIC model to gain the sedimentation rates. Cooperating with ^{137}Cs and ^{210}Pb , the spatial distribution characteristics of the sedimentation rates on the supratidal zone of Tianjin were still been gained: the sedimentation rates of the supratidal zone on the south Haihe River were higher than northern. The sedimentation rates on the supratidal zone from Mapengkou to Dagou Pollution River decreased, and the sedimentation rates were all higher than 1.19cm/a; the sedimentation rates of Beitang Channel was higher than 3.58cm/a, where is a sedimentation center; the sedimentation rates of supratidal zone from Chengtougou to Dashentang decreased, and the sedimentation rates were all less than 0.88cm/a. The sedimentation rates are higher in the southern Haihe River than the northern area.

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Channel planform morphology of macrotidal deltaic- estuarine systems in northern Australia and southern Asia

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Several of the Asian megadeltas are influenced by a large tidal range and the distributaries that dissect the largely abandoned sections of these delta plains show a number of distinct morphological features. Similar channel planform morphologies occur in the macrotidal deltaic-estuarine systems of Northern Australia, most of which are 'tide-dominated'. Channels within such systems typically exhibit a strongly 'funnel shaped' width profile, tapering landwards into a sinuous tidal channel. Geomorphological descriptions of the typical morphology of such channels have been presented in the literature (Chappell and Woodroffe, 1994), and in several cases the evolution of channel shape over major changes in boundary conditions can be inferred (Woodroffe, 2005). Theories regarding the process controls on channel width profiles have also been suggested (e.g. Wright et al., 1973; Chappell and Woodroffe, 1994). However, relatively little quantitative morphological data has been presented with which to test and extend these ideas. In the present contribution, the shape of a number of channels is extracted from satellite imagery. This database is used to explore quantitative trends in macrotidal channel planform morphology, both with respect to width profiles and meander form. The results highlight significant scale-shape relations in both aspects of channel form. These trends have theoretical implications for our understanding of tidal channel morphology, and its evolution.

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Anthropogenic activities and their impacts on natural resources and livelihoods of the coastal region of Bangladesh

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The coastal region of Bangladesh encompasses about one fifth of the country' landmass and supports livelihood of about 35 million people. This region is ecologically vulnerable because of its geographical settings, while the climate change is aggravating the incidence of natural disasters especially periodical cyclonic storms and tidal surges. Besides, the region is increasingly becoming vulnerable to various extreme climatic events due to different anthropogenic activities. The major anthropogenic activities identified are coastal embankment, brackish water shrimp farming, salt production, urbanization, transport and navigation, industries, ship breaking activities and indiscriminate use of agrochemicals in farming activities. Growing anthropogenic activities have been found to put multifarious adverse impacts on natural resources, environment and livelihood of the inhabitants. Embankments constructed to prevent salinity intrusion are now used a pool of saline water for brackish water shrimp farming. This is in turn causing long time water stagnation and thus converting crop lands to non-crop ones. Shrimp farming with more than 200 thousand hectare areas is already causing major adverse effects on agricultural production, forest, biodiversity, fodder, energy, environmental, as well as human and animal health. Gradual expansion of salt production has been causing increased salinization of soils as well as decreasing land area for agricultural crops and vegetation. High levels of organic, inorganic and radioactive pollutants in waste discharges from growing

number of fish processing plants, industries and ship breaking yards have been found to pollute the estuarine and marine ecosystems. Human settlements; road networks; road transport and marine transport; bilge water and crude oil leakage from mechanized boats, ships and fishing trawlers have also been found to cause damage to the mangrove ecosystems, destruction of aquatic lives and contamination of food chain through toxic buildup. The resultant effects all these events are causing severe degradation of ecosystems and livelihood opportunities of the poor coastal communities. The government of Bangladesh recognized all these events and efforts are underway towards formulating mitigation strategies at both national and international levels.

Changes in sream depth and width in Moribund Delta and effects on primary economy: a case study on greater Kushtia and Jessore of Bangladesh

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Ganges moribund delta includes small river, tributary and distributaries of greater Kushtia and Jessore district of Bangladesh and Murshidabad and Nadia of West Bengal of India. The area of moribund delta is about of 18,000 km². Geographically the moribund delta is a potential part of the Ganges delta. It is playing a vital role in protecting the regional ecology and primary economy. After 1947 the small flows have been being disturbed due to huge number of road, culvert and bridge construction. The flows of Bangladesh have been being disturbed due to embankment of upstream reportedly. The ultimate result is that many tiny flows (distributaries) have been turned into swamps and marshes (locally termed as baor). Not only that most of mighty streams (small rivers) in Kushtia and Jessore (Mathabhanga, Isamati, Kumar, Kapatakhmo, Vairab, Vadra, Horihor, Chitra and Nabaganga) have been turned into very tiny water bodies. They become almost dry in winter and summer. To detect the changes in river depth and width of

moribund delta of Greater Kushtia and Jessore of Bangladesh, empirical field visits have been introduced in selected locations. Several PRA sessions (group discussion) and key individuals interviews have also been done to collect necessary information on stream flow and related primary economy. Unpublished and published documents have also been considered to reach the goal. The investigation reveals that human activities cause significant shrinkage of stream channels, rapid decrease in depth, separation of small channels from mainstream and creation of lakes or 'Baors' and alarming extinction and decrease in endemic fish species. Due to above changes extraction of endemic fishes have been decreased about 85% in context of 1960s. The silted riverbeds are being used in agricultural purpose and farmers use chemical fertilizer and insecticide for luxuriant growth of crops in seasonally dried siltbeds which is also significantly responsible for extinction and decrease of endemic fish species. The research also reveals that previous primary economy (extraction of endemic fishes) is more profitable and eco-friendly than present modern cropping system.

History of Sefidrud River avulsion in South Caspian Coastal Plain (Guilan Province, Iran)

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River avulsion in the Caspian basin since its isolation from the world oceans in the Pliocene had great impact on the water balance, coastal morphology and biological diversity. Huge Caspian sea-level fluctuation in an amplitude of 150 m accelerated the avulsion process in the main rivers which could be traced in the Caspian bottom and coastal plain. The Sefidrud River as the greatest sediment supplier into the Caspian Sea drains 66000 square kilometers of the Alborz and Zagros mountain ranges entering (with high sinuosity) from the south coast into the Caspian Sea. It has developed a delta plain in a width of 60 kilometers and repeatedly changed its course in the plain. The last major Sefidrud avulsion has occurred around 1100 after the Caspian sea-level highstand in 1500 BC. The older avulsion was discovered in the west part of the present main channel. The Sefidrud valley in the Early Holocene,

with great Caspian sea-level lowstand, abandoned in depth of 20 meters in Sea bottom. Sedimentological, morphological and palynological data obtained from cores retrieved in coastal lagoons and avulsed valley outcrops demonstrate that Sefidrud avulsion was mainly controlled both by channel sinuosity and Caspian sea-level changes. The Holocene and historical Sefidrud avulsion are related to the Caspian sea-level fall, which changed the base level.

Combined impact of sea-level rise, high riverine sediment supply and strong longshore drift caused development of open and closed coastal lagoons. Data retrieved from infilled and present coastal lagoons revealed that the avulsions and corresponding deposits are inclined eastward, to the direction of prevailed longshore current. Result of changes in regional climate and water level are recorded in the lagoonal deposits showing periods of less and more humidity. Furthermore, the anthropogenic impact on the lagoons and surrounding forest ecosystems can be inferred from palynological data. The Late Holocene and historical pattern of Sefidrud avulsion show the influence of both the basinal (sea-level change and longshore drift) and riverine (sinuosity and superelevation).

Regional environment simulator in IDEC, HU

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Regional Environment Simulator (RES) developed in IDEC, Hiroshima University, Japan is a meso-scale coupled model cluster that can be utilized in the study of regional disasters and environmental problems mainly concerning with natural water circulation. RES consists of three parts (Fig.1); 1) atmosphere-surface waves-ocean circulation, 2) atmosphere-land surface process-hydrological circulation and 3) coastal and estuarine circulation. Each part is constructed with state-of-the-art public domain numerical models being synchronously combined with own-developed model coupler. Therefore, RES can give us detailed insights from various aspects by considering coupled processes between the component models about specific problems. For

instance, RES has been used for the study of storm surge by typhoons and hurricanes, wintertime abnormal high waves in Japan, dam-made lake circulation, local air-sea interaction under typhoon, summertime heavy rainfall and runoff in Japan, estuarine circulation at a river mouth in Indonesia and wave overtopping in coastal region. Most recently, a project on the impacts of reduced discharge of freshwater and sediment from Yangtze River basin on the adjacent East Asian Seas has been initiated using the RES as a significant tool for the environment assessment.

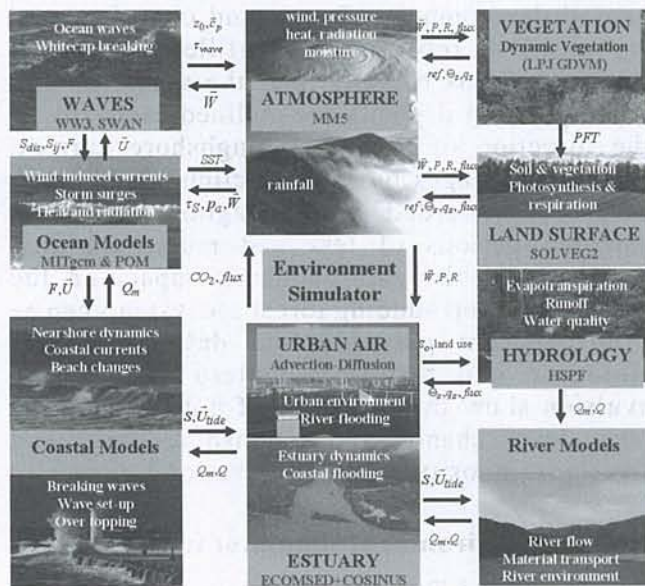


Fig.1 Framework of Regional Environment Simulator

Storm-induced landform changes along the delta front coasts examples from the east coast of India

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The Bay of Bengal is known for the origin of tropical cyclones, a majority of which crosses the east coast of India. About 113 major cyclonic storms had their landfall along the eastern seaboard of India during the last 300 years between 1681 and 2007. Almost 50% of them crossed the coast of Andhra Pradesh State in the central part of the coast of which as many as 22 storms had their landfall over the Krishna-Godavari twin delta region. Similarly, the Mahanadi delta in Orissa is also frequented by the cyclonic storms. These deltas show about 30-km-

wide seaward bulge characterized by vast stretches of gently sloping fluvio-marine plains that sustain large populations and intense economic activity. In view of the low-lying nature of these delta plains, the high-energy waves and tidal surges that accompany the cyclonic storms reach several kilometers inland causing serious destruction to life and property. Besides, the storm surges often lead to considerable coastal erosion thereby offsetting several years of prior depositional activity.

Apparently each time a severe storm hits these deltaic regions, some of the coastal depositional landforms are removed, either wholly or partially thereby significantly reversing the regular shoreline behavior. For instance, the 'killer' cyclone that lashed the Krishna delta region in 1977 accompanied by a 4.9 to 5.5 m tidal surge that reached almost 12 km inland lead to erosion of a prominent sand spit, besides causing heavy damage to life and property. Similarly the 1990 storm that was accompanied a 5-6 metre-high surge in the Godavari delta caused erosion of about 2-km-wide coastal land near Biyyaputippa village which was 2 km inland from the coast before the event. Nearly one-half of the built-up area of the village was vanished. Similarly, another devastating cyclone that crossed the Godavari delta coast in 1996 breached the Kakinada spit at its base over a 1.5 km stretch. Further, the 1999 'super cyclone' that hit Mahanadi delta coast was accompanied by a 8-9 metres surge had eroded the coastal spits besides extensively destroying mangrove vegetation as revealed by the satellite images. These examples suggest that the episodic events such as cyclones bring about changes in the coastal configuration and thereby the delta growth. Therefore, it is concluded that studies on the coastal morphodynamics along the delta regions should also consider the impact of episodic events like cyclonic storms as one of the important geomorphic processes.

The post-glacial sedimentary characters and environmental evolutions in the muddy area off the Yangtze River estuary

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A 35.6 m-long core (ECS-0702) was recovered at a water depth of 22 m in the muddy area off the Yangtze River estuary, and was analyzed to document the sedimentary characters, provenance and environmental evolutions during the post-glacial period in the study area. Based on lithology and AMS ^{14}C data, the core can be divided into four depositional units (DU₁ to DU₄, in descending order) with a general fining-upwards trend in grain size. DU₄ corresponds to tidal flat facies formed during about 13.0-11.6 cal kyr BP; DU₃, to subtidal nearshore facies during the Holocene sea-level rising from about 11.6 to 6.5 cal kyr BP; DU₂, to shallow-sea facies during the sea-level highstand from about 6.50 to 0.54 cal kyr BP; and DU₁, to shallow-sea facies from ~0.54 cal kyr BP to present. Analyses of clay minerals, detrital minerals, and element geochemistry for the uppermost 25.9 m core suggest that the sediments were derived jointly from the Yangtze River and Yellow River. In particular, the content of calcium carbonate and sedimentation rates are much higher above 9.70 m depth in the core than below, in accordance with the intrusion of Yellow River into the South Yellow Sea from 1128 to 1850 AD since the 9.70 m depth in the core corresponds to about 822 cal yr BP based on AMS ^{14}C data. The initial development of DU₁ roughly corresponds to the onset of the Little Ice Age (ca. 1400-1900 AD). The finer grain sizes of sediments in DU₁ than in DU₂ are interpreted to be due to combined impacts of human and climate (the Little Ice Age), which led to the decreased water discharge of the both major rivers and thus finer sediment input into the study area. Our research on the core highlights the contribution of Yellow River-derived sediments to the post-glacial strata development of the muddy area off the Yangtze River estuary and climatic and human impacts on coastal sedimentation.

Early diagenetic processes of Fe and Mn in Yangtze Estuary

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The vertical distributions of iron and manganese in pore water and solid sediments, collected from Yangtze Estuary, were determined. The results

showed that the iron and manganese oxides or hydroxides were reduced in early diagenetic processes. The manganese prior to iron participates in the organic matter degradation. Both Slomp's and Berger's models were used to fit the interstitial Mn and Fe profiles. The fitted curves of both models for interstitial Mn²⁺ are very well, whereas for interstitial Fe²⁺ are mediocre. Adsorption process has great effect on the distribution of interstitial Fe and Mn. The greater the adsorption coefficient is, the smaller the concentration of interstitial Mn and Fe in the upper sediments is. Compared to Mn²⁺, Fe²⁺ is more sensitive to the change of adsorption coefficient. Calculations with Fick's first law showed higher fluxes of manganese into the overlying water while the fluxes of iron were much lower.

Heavy mineral distribution and its provenance implication in late Cenozoic sediments in western and eastern area of the Yangtze delta

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Two Cenozoic boreholes Pd and Sk10 were recovered respectively from the estuary and inland plain area in the Yangtze delta. 118 and 310 sediment samples were taken from the boreholes Pd and Sk10 for heavy mineral analysis to discuss the provenance difference between the two regions. The results showed that five zones were identified from the borehole Pd and four zones from the borehole Sk10, and these zones upwards had a good relation with Pliocene, Early, Mid-, Late Pleistocene and Holocene.

During Pliocene both regions were characterized of Rutile, Zircon and Tourmaline derived from andesitic-granitic igneous rocks, accompanying with many oxidant autogenetic minerals such as Hematite, Limonite and Leucoxene. This heavy mineral assemblage implied local and/or near west highlands sediments provenance and a strong chemical weathering environment.

However there was a great difference in heavy mineral assemblage between the estuary and inland plain region during Quaternary, which implied the different provenances between the two regions. Inland plain area kept the same characteristic minerals as those during Pliocene. Rutile, Zircon and Tourmaline derived from andesitic-granitic origin still remained a certain

proportion but unstable and reductive autogenetic minerals increased obviously, such as Amphibole, Pyrite, Barite and Carbonate, and few Metamorphic minerals occurred. All of these suggested the same provenance from west highlands as that during Pliocene but different depositional environment. By contrast, in the estuary region the input of Strauroilite, Kyanite and Vesuvianite of metamorphic derivation, together with a few Tourmaline of andesitic-granitic origin in the sediments of Early Pleistocene represented the extension of sediment sources to the lower and middle Yangtze basin where was covered by old metamorphic and andesitic-granitic rocks as the study area subsided. Few heavy minerals remained in the sediments of Mid-Pleistocene, when mottled thicker stiff muds occurred as the lacustrine facies, suggesting a quasi-coastal floodplain with lower capability of sediment transport. Especially after Mid-Pleistocene diverse mineral types occurred continuously, such as Rutil and Sphene from andesitic-granitic origin, Hypersthene and Ilmenite from basaltic and Diopside, Kynite, Strauroilite and Vesuvianite from metamorphic, which showed the region received more sediments from the middle-lower and upper Yangtze gradually with further subsidence of the delta region.

Pollen stratigraphy, vegetation and environment of the last deglaciation a record from North Yellow Sea

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Three sediment cores from the North Yellow Sea were analyzed for pollen assemblage and concentration. The pollen record revealed a detailed history of vegetation succession and climate changes in the Huanghe delta for the last 12.8ka BP. Fossil floras were dominated by the xerophytic herb *Artemisia* and *Chenopodiaceae* from 12.8 to 12.3ka BP, reflecting a short-term climate deterioration, it was possibly Younger Dryas. The period between 12.3 and 10.1ka BP, *Pinus* and spore predominated, with a minor increase of deciduous broadleaved forest, marking a cold and humid climate. In early

Holocene (10.1-6.6ka BP), deciduous broadleaved forest and xerophytic herbs flourished, suggesting warm and arid conditions. The mid-Holocene climate optimum occurred between 6.6 and 5.0ka BP allowed evergreen and deciduous broadleaved forests thrived. During the period of 5.0-0.5ka BP, the deciduous broadleaved forests declined, implied the climate generally became cooler and more dried than the climate of preceding period. It was characterized by cold and humid from 5.0-4.0ka BP, but it was featured for a cold, dry episode during period of 4.0-0.5ka BP. Fluctuations of climate conditions in the Huanghe drainage area were not only related to changes in the seasonal distribution of solar insolation but also were closely linked to the intensity variation of the East Asian summer monsoon which was related to rain-front latitudinal migration.

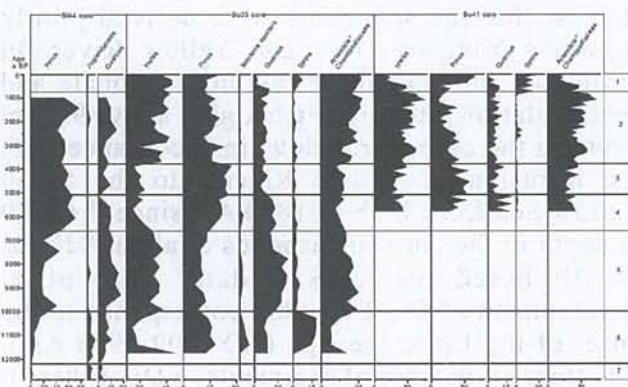


Fig.1 Pollen diagram of selected taxa for the B-L44, B-U35 and B-U41 core.

Wave climatology around the Huanghe Delta estimated from a numerical model

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Wave characteristics in the Bohai Sea over the last ten years (1998-2007) have been estimated by combining a third-generation numerical wave model with NCEP/NOAA reanalysis wind dataset. The estimation was made for a spatial resolution of 1/12 degrees and a temporal resolution of three hours. The objective of this study was to provide basic information on the effect of waves on coastal environments around the Huanghe Delta. It was found that waves around the delta region develop mainly from January to February and from October to November each year, in response to the East-Asian monsoon climate. In addition to

the seasonal change, interannual variability was also observed. For example, developed wind-waves were observed for more than one day at most areas in the Bohai and Laizhou bays at October 2003, whereas bays were calm during October and November 2004.

Seasonal and annual geomorphologic changes of mesotidal beach at Ba Dong, Mekong River delta, Vietnam

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The Mekong River delta, South Vietnam, is located in the tropical monsoon area with distinctive two seasons: wet season due to southwest monsoon from May to October; and dry season due to northeast monsoon from November to April. The modern coast of the Mekong River delta, facing the South China Sea, is a mesotidal beach. There are a few studies of seasonal and annual changes in such a mesotidal beach affected by monsoon. We thus carried out a repeat survey of the beach profile and sediment eight times between Nov 2005 and Feb 2008 at Ba Dong, located in the central part of the Mekong River delta coast. During the survey, we had the procedure as follows: (1) to set up six survey lines (A, C, BN, BT, D and E from the south to north) normal to the shoreline, (2) to measure beach profiles using auto-level, (3) to describe bedforms and surface sediment, (4) to sample surface sediments for grain-size analysis and percussive cores 1 m long, and (5) to monitor current directions and velocities using the flow velocimeter. Here, we focus on geomorphologic features, especially seasonal and annual change of beach topography and sedimentation on the beach.

The Beach sediment consists of fine to very fine sand and beach gradient is 1/301/100. The beach

is characterized by multiple bars which are asymmetrical and dip landward more steeper. Beach profiles of the southwestern part (lines A and C) and northeastern part (lines D and E) show erosional beach form (concave-upward), whereas the profiles of central part (lines BN, BT) show depositional beach form (convex-upward). The beach shows seasonal profile change which varies from place to place. Lines A and C showed erosional and depositional profile changes during wet and dry seasons, respectively. Sediment volume increased at lines BN and BT, and decreased at lines D and E consistently during the survey.

The spatial and seasonal variations of the beach profile suggest that beach sediment was mainly derived from Co Chien River, which discharges at the north of Ba Dong, due to strong northeast monsoon during the dry season. But there was negligible supply from this river. As a result, we could observe depositional tendency only in the central part and erosion tendency in the southern and the northern parts during the dry season. During the wet season, much sediment is considered to have been derived from the southern Hau Giang River, of which river mouth is located at the south of Ba Dong, due to southwest monsoon. Hence, we could observe depositional tendency in the southwestern part and the central part, but erosion tendency in the southern part. On the annual scale, the southern part showed a slight net erosional tendency, where the landward and seaward parts of the beach transect is erosional and depositional, respectively. The northeastern part also showed erosional tendency. But huge accumulation occurred about 1.5m (maximum) during last two years in the central part.

Distribution and assemblage of heavy minerals in the modern Yangtze River Delta and shelf of East China Sea

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Surface sediment samples were collected from the Yangtze River Delta (YRD) and shelf of the East China Sea (ECS). These samples were sieved, and sediments with mean grain size from 0.063 to 0.125mm were chosen for heavy mineral analysis.

In total, 145 samples from the YRD and 458 samples from shelf of the ECS were identified for their compositions and contents of heavy mineral, on which the distribution and assemblage of heavy minerals research were based.

Data of 5 representative minerals, hornblende, epidote, pyroxene (augite and hypersthene), schistose minerals and sum of extreme stable minerals (ZTR: zircon, tourmaline and rutile) were taken as variables for hierarchical cluster analysis, from which ten heavy mineral provinces were derived, three from the YRD and seven from the shelf of the ECS respectively.

Heavy mineral provinces I to III cover the modern YRD as a whole, while province IX to X are situated on the shelf of the ECS.

Province I is corresponded to delta front of the YRD roughly. Sediments in this province are generally fine sand and sandy silt. There were 53 sediment samples being analyzed in this province. The dominant minerals are hornblende and epidote. Contents of hornblende, epidote, ferric-oxide mineral (hematite and limonite), augite; ZTR are high in sediments from this province. These minerals are commonly bigger than other minerals, with subangular granular shape. Surface of them are red or brown which indicate they have been iron-stained. Heavy mineral assemblage is hornblende-epidote-ferric oxides, and diagnostic mineral is augite. Meanwhile, content of sericite is relatively higher in north of province I than in other area of this province.

Province II is corresponded to main part of prodelta of the YRD. Sediments in this province are clayey silt and sandy silt. Totally, 73 sediment samples were analyzed. Contents of sericite and muscovite are higher than other recognized heavy minerals. Grains of hornblende and epidote are corroded obviously. Authigenic pyrite is very rich in this area, which implies an oxidizing environment and a weak hydrodynamic circumstance. So the dominant minerals are hornblende and epidote. Diagnostic minerals are ferric oxide minerals and pyrite.

Province III covers southeast part of prodelta of the YRD. There were 19 sediment samples in this province being analyzed. Contents of sericite, muscovite and biotite are higher than other minerals. Heavy mineral assemblage is hornblende epidote muscovite, while diagnostic minerals are ferric oxide minerals and sericite. This province is under a relatively quiet hydrodynamic condition and strong oxidizing environment.

Province IV is located at north shelf of the ECS..

There were 130 sediment samples in this province being analyzed. Sediments in this area originated from the Yangtze River and Paleo-Yellow River Delta. Thus, mixing of different sediment source is very conspicuous deduced from the characteristics of heavy minerals. Contents of ilmenite, magnetite and ZTR are higher than other heavy minerals which indicate strong hydrodynamic current. Heavy mineral assemblage is hornblende epidote - metallic.

Province V is situated in the middle shelf of the ECS. There were 183 sediment samples being analyzed in this province. Sediments derived mainly from the runoff from the Yangtze River. Content of hornblende is about 50%. This shows that material of Yangtze River has been sorted when material entering into shelf. Some unstable mineral had disappeared that created dominant mineral such as hornblende content added. Mineral assemblage is hornblende-epidote.

Province VI covered south part of the SCS shelf. There were 176 sediment samples being analyzed in this province. Dominant minerals are hornblende and epidote. According to former research, sediment in this area belongs to the relic sand sheet, which was formed during Holocene transgression. Its mineral assemblage is hornblende and epidote that is very similar with that of province I.

Province VII stretched along coast of Zhejiang and Fujian provinces. There were 20 sediment samples being analyzed in this province. Dominant minerals are schistose minerals such as muscovite. Their contents are very high, with a mean content near 29% and highest content of 76%. Heavy mineral assemblage is schistose mineral- hornblende that similar with that of province III. Contents of hornblende and epidote have decreased. Sediment mainly derived from fine suspended particulate matter of the Yangtze River.

Provinces VIII, IX, and X were located at the northeast ECS shelf, Okinawa Trough and northeast to Taiwan island respectively. Few sediments in these areas come from runoff of the Yangtze River. Thus, heavy mineral assemblages in these areas are distinctively different from province I to VII. In province VIII, Heavy mineral assemblage is epidote - hornblende - metallic. While, it is assemblage of hypersthene ilmenite - epidote in province IX because detritus in this area was mainly derived from volcanic source. As for province X, metallic mineral reach the highest content among all these ten provinces. And augite is also relatively abundant. Mineral assemblage in

this area is metallic mineral- hornblende - epidote. From the characteristic of mineral assemblages, we can conclude that heavy mineral compositions of province I to VII were mainly dominated by sediments from the Yangtze River. However, it exerts less influence on the heavy mineral assemblages of province VIII to X. Instead, volcanic detritus play decisive important role on heavy mineral composition of province IX, while sediments eroded from Taiwan Island definitely controlled heavy mineral composition of province X.

Morphology and internal architecture of a banner bank off Chengshan headland, Shandong Peninsula

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The morphology and internal structure of a banner bank off Chengshan headland, Shandong Peninsula, are described on the basis of echo sounder bathymetry, side-scan sonar and high-resolution seismic data sets. The sandbank occurs off north coast of Chengshan headland, Shandong Peninsula. It is approximately 3 km wide and 13 km long in NWW direction, with maximum height 40 m in the east part. The sandbank is made of silt or clayed silt. The sand waves and megaripples are observed on the bank. The currents formed typhoons induced waves have eroded the subaqueous clinoform, transported the sediments and deposited them on the west of the Hail- Island when the current speed decreased, and then the sandbank was formed. The strong waves by north winds in winter result in the south-moved sand waves on north side of the bank, and strong tidal currents control the development of megaripples.

Multi-scale seismostratigraphic analysis of the Ganges-Brahmaputra submarine prodelta

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During present day eustatic conditions, coastal zone stability in a fluvio-deltaic environment is strongly related to the sediment input and the deposition in the offshore region. Building the greatest deltaic system, the Ganges-Brahmaputra Rivers deliver one billion tons per year to the Bengal shelf, whereby the intensively inhabited and cultivated coastal zone of Bangladesh is only a few metres above sea level. The monsoon circulation, related to the ITCZ migration around the equator, causes a westward transport of the delivered sediments on the continental shelf. Through time a wide submarine prodelta with an overall clinoform structure has been formed, where sediments actively accumulate in the prodelta front region. A dense net of WE and NS transect of multichannel seismic and Parasound echosounder profiles was collected during SO188 Expedition. Together with data collected during previous cruises, almost 40% of the region was covered. A first approximation of a multi-scale sediment budget calculation was used to test the general assumption that sediments are recently equally distributed in the subaerial delta, in the submarine prodelta and in the head of the canyon "Swatch of No Ground", deeply incised in the shelf, from where the sediments are transported to the Bengal Deep Sea Fan via turbidity currents activity. A high-resolution seismostratigraphic analysis was carried out in the prodelta front region using general principles of sequence stratigraphy. The modern depocenter seems to be depth related and is found between -30 and -60m; a decadal scale accumulation rate gradient was estimated by mapping thickness variations and compared with the previous measurements obtained from sediment cores dated using gamma spectrometry and the nuclides ¹³⁷Cs. The uppermost stratigraphic sequence of the clinoform structure is characterized by the presence of acoustic transparent units alternated with normally stratified layers. Such units can be identified and traced over the whole submarine prodelta front. Based on the known accumulation rate, a centennial scale sediment budget was calculated. The acoustically transparent units can be used as time markers because they seem to represent a specific type of sedimentary processes that occurs exclusively in the active prograding region of the prodelta. The late Quaternary mass balance at millennial scale of the source-to-sink

system Himalayas-Bengal Basin-Bengal Fan was estimated integrating the multichannel seismic data set with previous studies on the alluvial plain. The subsidence rate has to take into account for these calculations, but can be assumed as constant value for the studied time scales. If the sedimentary input is considered as constant for the last centuries, then the system is strongly sensible to monsoon circulation and intensified periods of cyclone activity during pre-monsoon. Therefore, the actual equilibrium could be easily destroyed by natural and human induced factors like a sea level rise or river damming.

Facies and origin of the northeastern part of offshore Nile delta Egypt

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The Nile Delta is considered one of the important Deltas in the world formed by the fluvial sediments of the River Nile. The present study focuses on the northeastern part of the offshore Nile Delta, based on ten drilled deep wells. The Nile Delta was formed during a long period of time from Late Oligocene to Recent. The Nile Delta comprises six rock units from base to top as follows. Tineh Formation (Oligo-Miocene), Qantara Formation (Early Miocene), Sidi Salem Formation (Middle Miocene), Wakar and Rosetta formations (Late Miocene), Kafr El Sheikh, Wastani, and Mit Ghamr formations (Pliocene-Recent). These rock units consist of fluvio-deltaic sediments that were formed during rapid rate of tectonics subsidence and accelerated sea-level changes. The sedimentation of Nile Delta was associated with three structural phases during sedimentation processes. The first phase (Late Eocene-Miocene) produced NNW faults that parallel to the Gulf of Suez rift, the second phase initiated during the Late Miocene-Pliocene giving NE-SW faults that alignment with the Gulf of Aqaba rift, the third phase dominated during Pleistocene-Recent producing faults trending N-S direction. These structural trends played an important role in the facies distribution of Nile Delta and were responsible for the subdivision of the Nile Delta into three sub-basins (western, middle and eastern) separated from each other by two paleohighs. These structures were probably rejuvenated and reactivated from the older Pre-

Tertiary tectonics. The thickness of the above rock units in the sub-basins increases towards the northwest during Oligo-Miocene and towards the northeast during the Late Miocene-Pleistocene. This indicates that the sedimentation process was affected by tectonics and followed the rapid tectonic subsidence. Sea-level changes make interruptions in sedimentation producing several depositional sequences bounded by unconformities.

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Numerical experiments of cohesive sediment transport in Yangtze Estuary

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The prediction of cohesive sediment concentration and its transport is vital to managers in coping with problems such as wetland protection and restoration, maintenance of navigation channels, residual onshore sediment transport, etc. Detailed mathematical models including three dimensional codes are necessary tools for the development and application of this knowledge. It is well known that the transport and the fate of fine-grained sediments in dynamic environments like estuaries and coastal waters are a function of sediments effective settling velocity. Settling velocity is affected by flocculation process.

In this study, a three-dimensional hydrodynamics and sediment transport model that is called ECOMSED is used as the major model framework. ECOMSED is a state-of-the-art hydrodynamics and sediment transport model that is capable of computing and predicting water circulation, temperature and salinity; mixing, transport, deposition, and resuspension of cohesive and non-cohesive sediments. A model for flocculation is introduced and implemented in ECOMSED together with mass conservation and momentum equations, turbulence closure model, and a number of algebraic relations to relate floc size, settling velocity, mass and volumetric concentration together. Properties of soil are taken into account by constitutive equations for effective stress and permeability.

This model is created to describe the evolution of flocs' settling velocity as a function of various parameters, i.e. the dissipation parameter and suspended sediment concentration. Furthermore, the process of consolidation of soft mud is modeled by using Gibson equation. Hence, in the next step, with using this model will enable us to study the influence of 3-Gorges Dam and natural phenomena, e.g. tidal straining, on parameters like sediment transport, erosion and deposition in a local system that is comprised of Yangtze River, the Yellow Sea, East China Sea, and even Sea of Japan (Figs.1-2)

Fig.1 Local system comprised of Yangtze River and 3 seas



Fig.2 Yangtze River mouse and delta

Plant remains in the deltaic deposits of Indian subcontinent as environment assessment indicators during Holocene

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The deltaic deposits of Indian subcontinent lying in the tropical latitude have records of rich mangrove plant assemblage in the Holocene. The assemblages are represented in a distinctly identifiable ecosuccession developed by the influence of degree of salinity in the estuaries. The Ganga - Brahmaputra (GB) deltaic basin has maximum diversity of mangrove plants with distinctive ecosuccession as Swampy Mangrove, Tidal Mangrove, True Mangrove decline, Colonisation of Nonlittoral species and non Mangrove fresh water species. This ecosuccession has been utilized for environment assessment of the deltaic deposits in the west and east coast of Indian subcontinent. The assessment of the ecosuccession has identified the major events of change of environment such as the Flandrian Transgression, the phase of higher rate of precipitation and the phase of drier condition in all the deltaic basins. Critical survey of present day ecosuccession of the different delta indicates the natural process of development of the individual delta.

Deltas on Indian east coast: monsoon impact and human influences

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The east coast of India in South Asia, shows major delta developments in a hot, humid, tropical climate with average annual rainfall 1500-2000mm. Climate-foreing influences monsoonal rainfall which is a prime factor in delta-building processes. Monsoonal circulation is complex in the Bay of Bengal. Dominant factor controlling this rainfall is the monsoon trough. In the Bay of Bengal the Low Pressure Systems which cause rainfall include depressions and cyclonic storms that relate to the activity of monsoon trough. Seasonal monsoonal rainfall depends upon the frequency of Low Pressure Systems over the Bay of Bengal during the southwest monsoonal months. On east coast of India, varying rainfall occurs depending upon the movement of the Low Pressure System. Southwest sector of monsoon depression gets more rainfall due to maximum low level convergence and vertical motion. Due to climatic/atmospheric changes, the number of days with more than 12mm rain across India had come down by 78% during the last 50 years, while days with less than 8mm rainfall increased by 45%. During past decades, there is reduced pressure formations, as well as their intensities. There has been overall a decrease in rainfall within 1980 and 1999 as per informations of the India Meteorology Department. The southwest monsoonal (Mid. June to Mid. October) voluminous water and sediment flux in the largest Ganga-Brahmaputra river system followed by the Mahanadi, Godavari, Krishan and Cauvery rivers from north to south on the east coast have built huge delta-complexes in conducive tectonic and sea-level settings.

The deltaic distributary mouth/estuary region ranges from microtidal in south through mesotidal upto macrotidal at the Ganga river mouth in the north where tidal range varies from 4.5 m-6 m. The coast is wave and mixed wave-tide dominated on the southern part and tide-dominated in the northern part. The prevailing hydrodynamic regime with the variations in nearshore wave and current system have formed long barrier bar, spit and island systems at the river mouths. There is strong littoral drift in the wave breaking nearshore region during southwest monsoon. The coastal geomorphological settings have large similarities in all these major deltas which have a larger delta plain area covering thousands of square kilometers having main river channel, flood-plain, abandoned channel, natural levees, distributary channels and small lakes that extend upto the coast where dunes, beach ridges, tidal channels/creeks, tidal marshes, inter tidal

bay and mangrove swamps are present. In the estuarine region active delta lobes are formed. Active delta lobe deposits are made up of channels with strong tidal influence near the mouth. Tidal ridges/bars alternating with channels extend to the innershelf at the Ganga river mouth. In the seaward direction of the deltas, the distributary mouth bars are succeeded by distal bar merging with deeper prodelta regime. Sediments of the deltaic/estuarine mouths to shelf environments are siliciclastic sand, silt, clay alongwith some peat layers. In an idealized progradational sequence the vertical facies architecture starts from subtidal deposit which upwardly passes into intertidal and then to supratidal-flat mangrove marsh in a short profile. In a longer vertical profile, sandy shelf deposits upwardly pass through pro-delta, distal bar, distributary mouth bar, tidal flat/channel with peat, mangrove marsh, beach/dune complex, river channel, natural levee and flood-plain facies sequences. Progradational succession may be capped by beach-dune deposits.

East coast deltas were initiated during the Holocene after the deceleration of sea-level rise and seaward shift of shoreline due to sea-level fall since 6-7000 yrs. ago. During the last 6000 years of sea-level stability prograding deltaic wedges formed due to heavy fluvial discharge carrying enormous sediment load to the distributary mouths of the rivers under a favourable paleomonsoonal setting. While the largest Ganga-Brahmaputra river system discharges annually, on the average 10^{11} liters of water and nearly two billion tons of sediments to the Bay of Bengal, the Godavari and Krishna respectively discharges 1.05×10^{11} and 6.0×10^{11} l of fluvial waters annually along with a respective amount of 4.3×10^{10} g and 2.5×10^{10} g of suspended sediments. Mahanadi discharges annually about 3.3×10^{11} l of water and a flux of 8.1×10^{10} g suspended sediments. Fluvial flux enters into the Bay of Bengal as a buoyant plume and /or friction-dominated plane jet. On the Ganga delta coast, the lack of significant seaward progradation in recent times suggests that a large part of fluvial sediments discharged to the Bengal Shelf is bypassing the shelf and is funnelled through a submarine canyon "Swatch of No Ground" to the deep sea Bengal Fan.

Human dimensions and related anthropogenic influences in the deltaic coastal tract have proved to be detrimental to the sustainability of the deltaic environments. Shoreline retreat/erosion 4.5m per annum on an average has been noted on

the Godavari delta front of ca. 160 km long and particularly river mouth areas are getting more eroded. Human activities may be responsible to a large degree for the shore erosion as there has been reduction of sediment supply to the shore-face due to construction of dams on Godavari River and its tributaries in the catchment area. Subsidence of land due to sediment compaction and land subsidence related to human activities like excessive pumping of ground water, digging aquaculture / shrimp culture ponds by large scale conversion of cropland, mud-flats and mangrove forests may promote land subsidence thereby facilitating landward marine ingress and shoreline retreat. Shore erosion on the Mahanadi river coast is very prominent partly due to natural processes and human activities. Construction of dam, barrages, weir on the rivers trap the sediments in the upstream side during the monsoonal river flow. Now, National Water Policy of Govt. of India to divert surplus water from one major river basin to other by interlinking river systems and construction of storage reservoirs will further trap sediments in the reservoirs thereby diminishing sediment supply to the shore-face affecting delta-building. Rampant deforestation in the catchment area also probably is affecting rainfall and consequent riverflow and sediment discharge. Mangroves are destroyed by human activities exposing the coast to storm/cyclone hazards.

Due to climate change/changes in monsoonal rainfall patterns, frequent natural hazards and human activities; it is apparent that east coast deltas are now in a crisis. If sufficient sediment does not reach the shore-face, the shore-line will retreat due to marine transgression. In the event of sea-level rise due to global warming, coastal erosion will be enhanced and will lead to staggering land-loss. Human population will face a crisis, as deltaic area has prosperous resources and products.

Architectural elements and facies analysis of Oligocene tidal sequence of Renji formation, Bengal Basin, Bangladesh

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A detailed study of architectural elements and facies of an exposed section (45×8.35 m) of the Oligocene Renji Formation of Barail Group in

Sylhet Trough, Bengal Basin has been done to interpret its paleoenvironments of deposition. All together three major architectural elements, like channel (CH), bar (LA, DA, LS) and tidal flat (TF) and thirteen sub-elements having first to fifth-order bounding surfaces have been recognized in the sequence. A broad spectrum of facies, like S_1 , S_2 , S_{2a} , S_{2b} , S_3 , S_4 , S_{4a} , S_{4b} , S_5 , S_6 , S_7 , S_8 , S_9 , S_{10} , S_{11} , S_{12} , S_{13} , F_1 and F_2 are present within these elements. These facies form multistoried fining upward sequences those belong to two distinctive genetic facies associations. The sandstone facies association (SFA) is related to stronger flow and tide in the channels and creeks whereas; heterolithic facies association (HFA) or tidalite is related to weaker flow and tide in channels, creeks, interdistributary bays and floodplain. Both the associations show bi-polar, bi-directional paleocurrent patterns with dominant direction towards SSW and NNW-SSE respectively.

Sedimentological aspects strongly suggests a deposition of the formation in subtidal, intertidal and even supra tidal sub-environments under tide dominated coastal paleogeographic setting along the northern margin of the Barail paleocoastal zone. Water depth during deposition of these associations SFA and HFA were 0.07-10 m and 0.01-0.164 m respectively with an overall decrease towards top of the sequence.

Facies depositional environment of Muglad Rift Basin with emphasis of geometry of sedimentary bodied determined from subsurface

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In the Muglad rift basin wells and seismic data recorded the domination of the elastic sedimentation. The fluvial and lacustrine environments are most commonly preserved. Seismic reflection character, tied to wells permits some prediction of lithology. In particular, shale prone lacustrine sediments are characterized by relatively slow seismic velocities and continuous high amplitude reflections. Fluvio-deltaic sediments tend to have relatively fast velocities and discontinuous, weak reflections. Within a rift basin, accommodation space may vary in different sub-basins depending upon the degree of subsidence and relative lake level.

Evidences like Ethiopian dome indicate tectonic uplifts occurring in the eastern margin, while

subsidence tacking place at the western margin. The facies types can be classified into two; the Cretaceous and post Cretaceous. The Cretaceous sediments characterized by source rock, reservoir and seal and the Tertiary. The Tertiary facies characterized strong faulted and recognized by clear maximum flooding surface in the lower portion of the facies.

Turbidites in the upper hhuhan member of the sitakund anticline, Chittagong, southeastern Bangladesh

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The Upper Bhuban Member in the Sitakund anticline, Chittagong, Southeastern Bangladesh is constituted by the light gray, light yellow and greenish gray sandstone and siltstone with dark gray, bluish black and black finely laminated silty shale to shale. The lithofacies of massive sandstone (Sm), turbidite sandstone (ST), flat bedded sandstone-siltstone (Sh), ripple cross laminated sandstone-siltstone (Sr), laminated sandstone-siltstone (Sl), lenticular laminated sandstone-siltstone-shale (Sll), wavy laminated silty shale to shale (Fw), laminated shale (Fl) with sub-facies black shale (F_{...}) and blue shale (F_{...}) and mudstone (Fm) have been delineated in this member. Based on genetic aspects the facies are grouped into (1) turbidity generated - and (2) deep marine basin plain facies association. The medium to fine grained facies Sm and ST with or without Sh, Sr, Sl, Sll, Fw and Fm facies constitutes the turbidity generated facies association. The deep marine basin plain facies association is characterized by the monotonous hemi-pelagic bluish black shale (subfacies Flb) and pelagic black shale (subfacies Flbk) with rare to scarce silty stringers of facies Sh, Sr, Sl, Sll and Fw. The facies Sm is turbidity channel in the inner part of medial fan and the complete ST sequence indicates channelized forms, while incomplete ones have been identified as channel or interchannel deposits in medial to distal fan. The facies F_{...} and F_{...} denote deep marine environments above and below the carbonate compensation depth, where the lithofacies facies Sh, Sr, Sl, Sll and Fw were deposited as distal turbidites. The facies sequence of medial to distal fan and deep marine basin plain were repeated and

randomly juxtaposed one upon other due to instability of basin probably by faulting along Dauki and adjoining area accompanied by sea level change. The paleoflow pattern indicates the dominant source of detritus was the Shillong plateau along with minor contribution from the Himalayas and Arakan Yoma Folded Belt.

The upper cretaceous, ghazal formation, reservoir characterization, unity field, Muglad Basin. (SW) Sudan

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The Campanian-Maastrichtian continental fluvial Ghazal Formation has been investigated based on data obtained from ten wells in the Unity field. Various methods have been used in the present study including different sedimentological, petrography and petrophysical techniques as well as conventional cores.

The lithofacies analysis allowed the sub-division into lower and upper parts. The lower Formation is composed of coarse lithofacies of sandstone that reveal fining upwards sequence of braided stream channels. The upper Formation is dominated by fine sandstone, siltstone and claystone that reveal coarsening upward sequence of meandering rivers.

The stratigraphic successions of lithological facies and depositional patterns reflect mainly allocyclic and autocyclic controls such as tectonic activity, climate, drainage system, and sediment load.

The clay mineral mainly consists of kaolinite, smectite, illite and chlorite. The kaolinite and smectite indicate a warm humid climate interrupted by dry season. The mixed layer of illite/smectite indicates the influence of the burial diagenesis with increasing depth and temperature. The clay mineral assemblages show relationship with lithofacies types and depositional system.

The diagenetic event has played considerable role in modifying the original framework components as well as the primary intergranular porosity of these sandstones. Therefore, the reservoir quality was mainly controlled by the original framework composition, cementation and compaction.

The porosity in these sandstones average is about 22–24, Permeability average is about 103–596 md.

The reservoir is relatively thicker in the units

Ghazal-D and Ghazal-H, and the shape of sand bodies are mainly sheet and massive in these layers, and have good lateral continuity.

Imprints of basement tectonics on the morphologies of the Krishna-Godavari Deltas, India

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The Krishna-Godavari twin delta region along the east coast of India is a pericratonic basin bound by two major faults: the basin margin fault along the landward (northwest) side, and the Matyapuri-Palakollu (MP) fault on its seaward (southeast) side. The initial rifting during the Late Jurassic created the basin with a landward tilt along the MP fault, while recurrence of tectonism during the Lower Cretaceous led to second-order *en echelon* faults thereby giving the basement a ridge-and-basin configuration with a number of parallel horst and graben structures (Manmohan et al., 2003, Venkata Raju et al., 2003). Although filled with sediment sequences over varying thicknesses ranging from 2 km to 6 km, the tectonic structure of the Archaean basement seems to have some bearing on the morphologies of the Krishna-Godavari deltas.

A comparison of the comprehensive basement tectonic map and the geomorphologic map of the Krishna-Godavari delta region revealed a remarkable correlation between the basement structures and the landform pattern. The Kolleru Lake in the inter-delta region is situated over the Gudivada Sub-basin, while the vast mudflat to the south of the Lake coincides with Bantumilli Sub-basin. The 8-km-wide beach ridge complex that separates the Kolleru and the southern mudflat largely coincides with the Kaja-Kaikaluru Ridge (horst) that lies in between the Gudivada-, and Bantumilli sub-basins of the basement. Swerving of the Krishna river course near Vijayawada at the delta apex seems to be controlled by the Krishna cross trend fault. The clock-wise bending of the Krishna Delta due to its rather skewed growth more into the Nizampatnam offshore sub-basin to its right also seems to be controlled by the basement structure here. The reversal of flow in landward direction of the Vasishta and Vainateyam distributaries of the Godavari with the undercut slopes eroding landward is anomalous in the estuarine zone of the delta. Apparently the paleo landward slope of the

hanging wall of the rift along the MP fault has some bearing on such an anomalous meandering of the river channels. Further southeastward, the Nilarevu distributary of the Godavari, which coincides with the MP fault has widened three times in four decades from 700 m in 1965 to 2400 m at present over a length of 12 km in its lower reaches up to its mouth. Similarly, the 70-km-long straight segment of the delta-front coast between Vasishta and Gautami mouths of the Godavari delta appears anomalous for a prograding delta. This coastal segment in the central part of the delta coincides with the landward boundary of the Ravva offshore sub-basin which probably limits the coastal advance here. The study suggests that the tectonic framework of the basement has an imprint on the morphologies of the Krishna-Godavari deltas due perhaps to neotectonic activity along the lines of weakness as reported elsewhere (Ramasamy, 2006) in the peninsular India.

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Suspended sediment dispersion off the Huanghe (Yellow River) Delta in the period of the river low water discharge

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Hydrographic survey along three sections in the southeast, middle and northeast off the recent Huanghe (Yellow River) delta lobe was conducted in August, 2003 during river low water discharge, 283 m/s at Lijin hydraulic station. The hydrographic data such as water temperature, salinity, sediment concentration, current and water depth were collected synchronically at 4-5

time-series boat-stations for 25 hours along each survey section and used to study the sediment dispersion off the Huanghe delta.

The results show that the river-laden sediment from the river mouth was dispersing within 5 m isobath and could only be delivered seaward no farther than 5 m isobath off the river mouth even in ebb tide due to the weak seaward flow during river low water discharge. The only moment for the turbid water from the river mouth broken through 5 m isobath was the transient period of two hours from ebb phase to flood phase due to the barrier effect of shear front. The turbid water with high concentration of sediment and less salinity behind the tidal shear front in water depth more than 5 m was transported by the ebb tide northward or southwestward by flood tide in paralleling to the coastline of the delta.

The southward transport of the turbid diluted waters driven by the flood tide current along the coastline was limited within 15 m and turned southwestward after the south end of the delta lobe, then entered the Laizhou Bay, forming a swirling in the southern area off the Huanghe Delta. Sediment flux at five stations in the Laizhou bay revealed that the landward transport of this turbid water body in Laizhou Bay during flood tide was limited to about 15 km from the shoreline by tide shear front and could not reach the shore. During ebb tide, the tide current with the turbid waters flowed southeastward at all the stations but except at the nearshore station B5, carrying out the turbid water seaward. Therefore, this turbid water body cannot reach the west seashore of the Laizhou Bay during the entire tide period. Thus, a narrow and relatively clear water band with low salinity and sediment concentration is formed between the turbid water body and the southwest coast of the Delta in paralleling to the shoreline. And this relatively clear water band is illustrated clearly on the satellite images. The shear front in flood tide and the seaward transport of the turbid water in ebb tide prevent the Delta southwest coast from sediment accumulation, resulting in formation of a weakly erosion zone in the Delta southwest coast.

The northward transport of the turbid diluted waters driven by the ebb tide current along the coastline was limited within 15 m as well. The sediment flux at four stations in the north section showed that there was a shear front between the nearshore station and the next deeper station, indicating that the turbid diluted water beyond 5m driven by the ebb tidal current northward could

not reach the shore, which consists with the accumulation-erosion pattern of subaqueous delta in this area, a transition zone between the seaward accumulation area and the erosion area near the coast.

Coastal landform change in relation to monsoonal activity in Mekong River Delta, Vietnam

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The Mekong River Delta (MRD) southern Vietnam, is a typical mixed-tide and wave energy delta with a huge delta plain formed for the last 6 ka. Holocene delta formation is controlled by the changes in sea-level, sediment supply and monsoonal climate. The delta plain has prograded more than 250 km from Cambodia border to the present coastline (Nguyen et al., 2000). This study emphasizes on coastal landform change in relation to monsoonal activity at the active delta in the eastern part and delta margin in the southern part prograded for the last 3 ka. Two depositional patterns and their distinct landforms could be recognized in the following:

(1) The active delta plain shows tide- and wave-dominated delta and characterized by sandy beach-ridge systems well distributed on the subaerial delta plain. Almost sand and sandy silt deposited at the active delta to form delta front and pro-delta facies and fine sediments transport southwest-wards owing to longshore currents generated by northeast monsoon (Ta et al., 2005).

(2) Tide-dominated delta progradation occurred in the Ca Mau deltaic margin. It is characterized by well-developed mangrove marsh on the subaerial delta plain. There is not any sandy beach-ridge to be found in the subaerial delta plain, and subaqueous delta shows pro-delta and shelf mud facies.

In millennial dimension, for the last 3ka delta-progradation rates are 10-20m/y (Ta et al., 2002) and 45-50m/y in the active delta and Ca Mau deltaic margin plains, respectively. In centennial and decadal scales, coastline has changed considerably by both erosion and accretion processes at the active delta plain and Ca Mau deltaic margin. In Ca Mau coastline, particularly,

erosion rate is about 30-50 m/y for the last 200 years. Beside that at Ca Mau cape, accretion rate is approximately of 50-80 m/y. Moreover, present tidal sand flat is found at the Ca Mau cape, meanwhile, there is not any evidence of sand flat and beach ridges in Ca Mau deltaic margin (Nguyen and Ta, 2008). Above-mentioned data indicate that the change in coastal landforms of MRD seems to be effected more strongly by monsoonal activity in the recent years.

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Concentrations and possible sources of PAHs in sediments from Bohai Bay and its adjacent area

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Introduction: As typical persistent organic pollutants and semivolatile organic contaminants, polycyclic aromatic hydrocarbons (PAHs) are widely distributed in various environmental media (Gschwend and Hites, 1981; Brown and Maher, 1992; Yu et al., 2008). Sixteen PAH compounds have been listed by the United States Environmental Protection Agency as priority

pollutants due to their carcinogenicity, mutagenicity, and toxicity (Wilson and Jones, 1993; Carmichael et al., 1997), hence their distribution in the environment and potential human health risks have become the focus of much attention (Witt, 2002).

In the last 30 years, the population, the economy growth and urbanization along the coastline of the Bohai Bay have increased drastically. A large number of industrial and domestic wastewater from cities such as Tianjin and Beijing flow into Bohai Bay directly, causing marine pollution. Recent studies indicated that detectable chlorinated and non-chlorinated hydrocarbons (such as PAHs) were present in water samples from various locations around the Bohai Bay and rivers directed into Bohai Bay (Wang et al., 2007) and in aerosols sampled in the cities of Beijing and Tianjin (Zeng et al., 2002; Wu et al., 2004; Yu et al., 2008). However little is known about the sources and concentrations of PAHs in sediments of Bohai Bay. The main objectives of the present work are to determine the distributions and concentrations of the 16 U.S. EPA priority PAHs (Wilson and Jones, 1993; Carmichael et al., 1997) in Bohai Bay. It is also hoped to identify the possible sources of these pollutants.

Materials and methods: A total of 26 Surface sediments were sampled with a stainless steel grab sampler in August, 2007. Sample extraction, cleanup and analysis of PAHs were conducted in the Suzhou Institute for Advanced Study, University of Science and Technology of China, following the methods described by Hu et al. (2008).

Result and discussion: Total concentration of 16 priority PAH were in the range of 140.6-300.7 ng/g (dry wt), with an average of 183.8 ng/g. The three predominant PAHs were Phenanthrene, Acenaphthene and Naphthalene. The PAH contaminants were concentrated on the mud patches in the Bohai Bay because of the inputs of industrial and domestic wastewater from rivers (Haihe River, Nanpawu River and Luanhe River), the hydrodynamic and sedimentation conditions. Based on the values of PAHs isomer, the potential sources of PAHs in sediments from each sampling station were identified. Results indicated that biomass burning might be the major origin of PAHs in the most sediment. While at other stations near the Luanhe River Estuary, the inputs of both petroleum combustion and biomass combustion were significant. One station located at the oil drilling platform appeared to be contaminated by petrogenic input and petroleum combustion.

Coastal erosion in the Chao Praya River Delta

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The Chao Praya river mouth is a tide-dominated, drown-river-valley-type estuary located in Central Thailand. The river empties to the inner Upper Gulf of Thailand. With large sediment supply from the river, vast shoal existed in front of the river mouth. But upstream damming and navigational channel dredging for the last 60 years have deprived the coast of needed sediment. Turning mangrove forest along the shoreline in to shrimp, cockle or fish ponds has made bottom sediment susceptible to erosion under strong wave action. On top of this, land subsidence and sea level rise also accelerate the coastal retreat.

The aim of this paper is to explain in more detail how the aforesaid factors have contributed to the coastal erosion along the Chao Praya River delta. Daming Pasak River which is the main tributary of the Chao Praya River has trapped the river sediment by as much as 20×10^6 ton annually. For the past 40 years, land around the Chao Praya River mouth has been subsided about 1 m due to continuing pumping up ground water for human consumption. Sea level also rises about 0.10 m over the last 100 years. Wave measurement yielded only small significant wave height of about 0.20 m with wave period over three seconds. Strong wave action occurred during stormy condition can cause severe coastal erosion.

Record of geomorphological changes in Bengal basin, India during holocene through correlation of biostratigraphic zones

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Evolution of Bengal delta during last 10,000 years is revealed through critical multi proxy data analysis of C¹⁴ dated peat, peaty clay, soft grey clay sediments exposed in the seven sections

of study area lying between 22° to 23° N 87° 30' to 88° 30' E. within 80 to 120 km. from present coastline in West Bengal, India. Multiple proxy data include macro, micro plant-animal-ichno remains of specific environment. Five biostratigraphic zones viz; BbBzH I-V above Barren zone have been identified. Correlation of Biostratigraphic zones together with the lithological and chronological data has identified distinct phases of geomorphological changes and evolution of deltaic Bengal Basin, India during Holocene. The study areas were arid upland before 7000 years; Flandrian transgression due to sea-level rise changed the geomorphology of the areas to estuarine and shallow marine condition during 7000 to 6500 cal years B.P. Deltaic estuarine geomorphology continued in the location during 6500 to 6175 cal years B.P. Seaward migration of the coastline with the mangrove ecosuccession started since 6175 cal years B.P. due to regression of the sea. The geomorphology of the areas gradually transformed to delta top to fresh water condition by ca 5000 cal years B.P. The coastline with the estuarine mangrove forest migrated 90 to 60 km south from the study areas by 4500 to 3000 cal years B.P. A shallow marine to delta front geomorphology existed 30 to 20 km inland from present coastline at this time. The Recent geomorphology of the southern Bengal delta developed during last 3000 years.

The discrepant signals of climate recorded by Holocene sediments of the North and East China monsoonal regions: a perspective from major elements characteristics

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Two sediment cores were retrieved respectively from enclosed Lake Daihai in the monsoon/arid transition zone of north china and Zhaoxiang (core ZX-1), Shanghai in monsoonal area of Yangtze River delta, Eastern China. Major element distributions and their ratios of the core sediments were employed to reveal the characteristic of Holocene climate in the two regions. It suggested that the distribution of major elements could serve as useful indicator

denoting the variations of monsoon effective precipitation for the enclosed lake. The highs of resistant elements such as Al_2O_3 , SiO_2 , TiO_2 , $(\text{FeO}+\text{Fe}_2\text{O}_3)$, MnO in the sediments corresponds to the depressed chemical weathering and weakened monsoon effective precipitation, while the highs of mobile and easy soluble elements such as MgO , CaO , Na_2O reflects the enhanced chemical weathering and increased monsoon effective precipitation in the lake basin. Whereas the behaviors of major elements in the sediment from the Yangtze River delta, Eastern China were largely controlled by both changes of sea level and the monsoon precipitation. The relatively highs of Al_2O_3 , TiO_2 , $(\text{FeO}+\text{Fe}_2\text{O}_3)$, K_2O in marine-influences sediments suggest relatively strong hydrodynamics status and chemical weathering, and vice versa. The lows of SiO_2 , Na_2O and CaO in sediments of terrestrial origin denote relatively strong hydrodynamics and chemical weathering due to the enhanced monsoon precipitation, and vice versa. Sedimentation environment should be taken into account when achieve a full understanding of their climate implications.

Nutrient transport from the Ganges (Hoogly) estuary

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Rivers play a major role in transport of terrigenous sediment and water to continental margins and thus exert an important component in coastal evolution. It has been estimated that the major rivers of India discharges about 2100 km³ of water and about a billion tons of sediment annually. However, little information is available on the fate of nutrients in the estuarine-ocean continuum. In this study, an attempt has been made to calculate the flux of DIC, DIN (NO_3^- , NO_2^- , and NH_4^+) from the Hoogly estuary and the first delatatic offshoot of the Ganges to the adjacent Bay of Bengal. This river flows through the western part of the Sunderbans mangroves. The study shows that the estuary is characterized by high suspended sediments due to high sediment input from the upstream Ganges and also due to continuous mixing. A positive correlation has been observed between pCO_2 and POC. The suspended sediments are rich in organic carbon and fuel heterotrophic processes resulting in higher pCO_2 concentrations. The first order fluxes

of N and C from the Hoogly estuary shows to be several factors higher than that of the contaminated rivers of the world.

Environmental hazard of alluvial gold mines in West-Kalimantan, Indonesia; its problem and an effort of reclamation

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An alluvial gold mine was introduced by Chinese people who came directly from China since 4 th centuries in West- Kalimantan. Since then this region become the most important gold alluvial produces in Indonesia. Digging out soil and sand from river bars and panning it in the stream are the initial problem resulted in environmental hazards of alluvial gold mines. Before 1965, they mined by digging out sand materials using plug and panned them. They produce only one cubic meter soil and sand per day. Besides, collecting gold by using mercury, in some places the local miner's are also picking diamond when sometime found amongst the grain.

Technology is quickly developed, and since 1970s many local people used sand pump for mining alluvial gold. A small pump machine of 2 HP was the first time used for alluvial gold mining as water gun for breaking soil or sand and put it into sluice box. Nowadays, 40 200 HP machines are used for this purpose.

Using this kind of equipment, one group of gold miners can remove 100 200 m³ sand or soil in a day. If one area of mine site at least there are 20 units of machine. It means 2000 m³ of sand or soil can be removed everyday from the ground to surface and dump them as tailing to somewhere else destroying many of vegetation and biological lives surrounding area. Thousand of hectares of fertile land surfaces; including rubber trees and paddy field, have been destroyed every months by these local miners. It can be imagined how many hectares of fertile soil will be destroyed every year, and who knows 10 years latter?

This paper will discuss what likely the geological information is required to manage and restrict the widespread destruction of the fertile land and its ground and surface water resources.

Depositional process and feature of the alluvial basin of the Echigo plain of Niigata, central Japan-analysis of the drilling core in the central part of the plain

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The Echigo Plain of Niigata is one of the biggest coastal plains along the Japan sea side situated in the central part of Japan. The plains were formed by vast pile of sediments that were transported into Late Pleistocene incised valley by the ancient Shinano, Agano and the other rivers. The uppermost Pleistocene and the Holocene under the plain is named the Shirone Formation. The depositional basin has continued subsidence by the diastrophic movement in the contrary the upheaval of surrounding mountain and hill areas after Pliocene. The diastrophic movement suggests maximum subsidence of 30m or more after the end of Pleistocene age.

Many of drilling cores were collected at the central part of the Echigo Plain. The sedimentological analyses carried out by using the borehole specimens to reconstruct the depositional environments and its vertical development processes of the Shirone Formation. Based on the facies analysis, 23 sedimentary facies were recognized in the formation and each facies formed under the four depositional systems of 1) river-floodplain, 2) tidal [salt marsh]-estuarine, 3) bay-head delta-shallow sea, and 4) strand systems.

The depositional process is roughly classified into three stages as follows: the first stage is the river-floodplain and tidal [salt marsh]-estuarine depositional systems aggraded after the late glacial stage of 15,000-8,000 years ago, and the second is bay-head delta-shallow sea and brackish lagoon systems prograded after maximum highstand stage of Jomon transgression in the Echigo Plain. The sediments accumulated with onlap form to inland side at the first stage. At the second stage, the sand-barrier island system associated with lagoon systems was established along the innermost zone of the Echigo Plain. The final stage is sea-level stagnation period, around 5,000 years ago. Afterwards the lagoon environments in inland were accumulated in the sediment supply of Shinanogawa and Aganogawa rivers. As a result, vast extent of the alluvial plain expanded quickly and the river-floodplain environments developed in inland area. On the other hand in the seashore area, abundant

sediments were supplied from large rivers, and the sands formed strand plain environments. The coastal sand dunes developed with the progradation form in this period.

Short-term sedimentation and preservation in the deltaic to estuarine intertidal-flat setting, Ganghwa Island, Korea

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The southern intertidal flat of Gwanghwa Island (6 km in length, 20 km in width and 90 km² in area), which corresponds to a type of deltaic to estuarine tidal flat, shows a different sediment logical patterns from those in the typical tidal flats developed either on tide- or wave-dominated settings. As three large rivers are merging at the river mouth locating in the north of Ganghwa Island, the tidal flat has been influenced by seasonal variation of river discharge. River discharge is here mostly concentrated during the summer season from June to August.

Three-type surface sedimentary facies such as mud, mixed and sand flats are well developed on this flat, similar to typical tidal flats. Compared to other tidal flats distributed in the western coasts of Korea, the seasonal change in surface sediment distribution is, however, not clear except for slight seasonal migration of the two boundaries among sand, mixed and mud flats. Both flat boundaries migrated landward from early winter to early summer, resulting in wide expansion of sand-flat area on the outer intertidal flat (Fig.1). Combined process of wave and tide is the main process in net deposition during this period. Mixed flat has prograded very rapidly during late summer, probably caused by tidal re-arrangement of riverine suspended sediment supplied in summer season. Retreat of mixed flat area starts from early fall and continues until middle summer when riverine suspended sediment is supplied again to the flat by tidal processes. On the other hand, mud flat is prograded until early winter and it is in turn retreated from middle winter when the finer-grained suspended sediment supplied from rivers and by wave reworking would be deficient. These seasonal changes of three-type flat facies suggest that riverine supply of suspended sediment would be the main controlling factor in facies distribution of the Ganghwa intertidal flat.

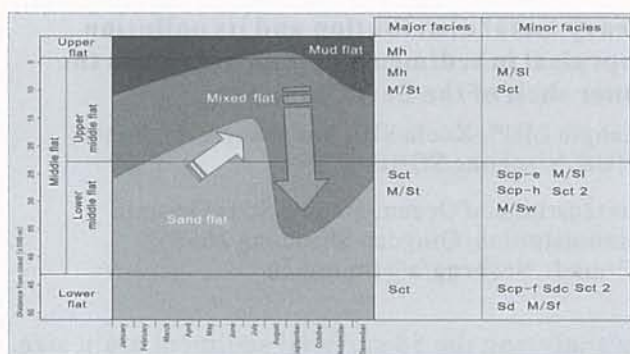


Fig.1 Seasonal changes of flat types and dominant sedimentary facies in each flat

Vertical sequences in the Ganghwa tidal flat show slightly coarsening-upward pattern with Holocene sea-level. Compared to open-coast tidal flats which occur dominantly in the southwestern coasts of Korea, storm-influenced units are very rare in the preserved deposits. Major depositional processes are weak wave-induced and strong tide-induced current, suggesting that tide-induced processes are more important than wave-induced ones in the preserved units.

Surface sedimentation is suggestive that this flat corresponds to deltaic to estuarine environment during summer but it does to normal tidal flat during other seasons at the point of preservation. However, it seems very difficult to differentiate deltaic summer layers from other tidal mud deposits in cores. A kind of seasonal bundle may be formed in deltaic to estuarine deposit, especially in monsoonal environments. Possible seasonal bundle could be a criterion to differentiate the coarsening- upward sequential pattern from open-coast and deltaic tidal flats. This warrants for the layer-by-layer works on mud laminations deposited in the upper tidal flats, if possible.

The settlement displacement and changes of agricultural cropping pattern: an overview on Char-Land of Padma River basin in the Ganges Delta

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Bangladesh is the great deltaic floodplain of the world. This deltaic floodplain is formed by the deposition of the Ganges, Brahmaputra, Meghna,

Jamuna and Tista River. The *Char-land* consists of riverine landscapes, features created by three mighty rivers Ganges Brahmaputra and Meghna (GBM) systems. The land which is newly emerged and deposit known as locally called *Char* or *Diara*. *Char-land* is the Bengali term for mid channel island that periodically emerges from the riverbed as the result of accretion. This new land is fertile and a valuable natural resource. The *Char-land* landscapes of Bangladesh are of great importance for its exceptional hydro-geographical setting. The physical characteristics of the land, geographic location, the multiplicity of rivers and the monsoon climate render the *Char-lands* highly vulnerable to natural disasters, such as floods and cyclones. There are over twelve million *Chaura* people are living in the *Char-lands* and struggling against monsoon floods and river bank erosion in Bangladesh. The *Char-lands* of Padma River are undergoing rapid hydro-morphological changes due to natural and anthropogenic causes. The Padma is a meandering river and has high rate of river bank erosion and accretion character in the channel. In the monsoon time (June-September) only Brahmaputra (Jamuna) transports water discharge 100,000 m³/sec which is 15 times more than Danube at its mouth. The excesses of water during the monsoon cause wide spread of flooding which damage *Char-land* settlements, agricultural crops, infrastructures, communication networks and lives. The Jamuna River carries 2.4 million tons sediments in every year and loads are settling down on the bed of the rivers and having negative impacts on the floodplain and *Char-lands*. The Purba Khas Bandarkhola Mouza of Char Janajat union of Madaripur district is part of the Ganges Active Delta and located in the main channel of the Ganges-Padma River. The Char Janajat inundate by the monsoon floods in every year, as impacts people have to displaced and the settlements are scattered from one place to another places (Fig.1). The elite class of *Char-land* lives in the main land and they control all most all the social and administrative functions of their self. The agricultural crops of the *Char* depend on the soil quality or fertility. The soil quality and fertility of *Char-land* is depending on floods and accretion. It has been asserted from the study that the agricultural cropping pattern in the *Char-land* is different from the other places of the country because of uncertainty of agricultural land. The study finding shows that the *Chaura* people have to displace because of the interval of massive floods and the trends of river bank erosion. The dwellers are displaced from the *Char*

and again come back to the native *Char* when the new land emerges in the river channel. The mobility distance of the *Char* settlements is 12 km range in an average distance (Fig.1). The study shows the interval of displacement is every five years at Purba Khas Bandarkhola Mauza in an average (Fig.1). The settlements displacement and population increases and decreases are deepened on floods and river bank erosion at the Bandarkhola Mouza (Fig.2). The study has done based on primary and secondary data sources. GIS Arc View 9.1 used for data visualization and Remote Sensing Imageries have been used to investigate the changing pattern of agricultural crops and settlement displacement trends. The research output will be a valuable contribution to make a national plan for *Char* development and protection of indigenous agricultural cropping systems in *Char-lands*. The objective of this study is to develop a comprehensive management and development plan for *Char* settlement and agricultural crops system in the Padma-Jamuna Riverine *Chars* in the Ganges Delta in Bangladesh.

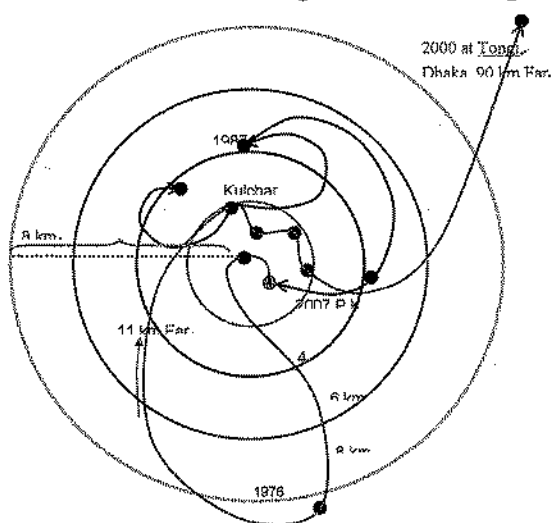


Fig.1 The Model of settlement displacement and char people mobility cycle

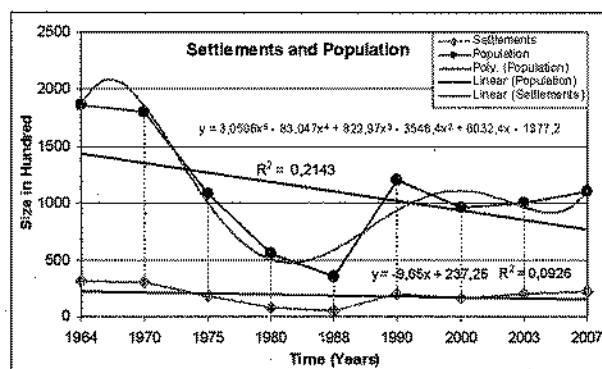


Fig.2 The Settlement and population displacement at Purba Khas Bandarkhola Mauza

Heavy metal distribution and its pollution appraisal in sediments of mud area from the Inner shelf of the East China Sea

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By analyzing the 58 surficial sediment grain size, the contents of organic materials, heavy metals of Cu, Pb, Cr, Zn etc. as well as Al_2O_3 in mud area of the East China Sea Inner Shelf, this paper discusses the spatial distribution characteristics and its influential factors of heavy metal elements in mud area of the East China Sea inner shelf. The correlation analysis results show heavy metal content is closely related to grain size, organic materials and terrigenous materials; the heavy metal content displays a strong grain size control effect and continental origin. The hydrodynamic force is another important controlling factor of heavy metal distribution, the coastal current in Fujian and Zhejiang Province as well as Taiwan warm current etc. results in heavy metal distribution isoclines being parallel with coastline. In the pollution accumulation appraisal of Cu, Pb, Cr, Zn, the sediments enrichment factor and the potential ecological hazards are applied, which shows that only the concentration coefficient of Pb in Minjiang River Estuary reaches moderate pollution degree, while other large area is commonly the zero-lightly polluted degree; the potential ecological hazards indicates a rather low bottom material pollution level in mud area of the East China Sea Inner Shelf, thus there is no ecological hazard temporarily.

Comparative analysis of palynassemblages of sediment profiles (CH-I & CH-51) from two different regimes of Chilika Lake, Orissa, India

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Chilika lake (19° 28' -19° 54' N; 85° 05' - 85° 38' E) along the eastern seaboard of India in Orissa State is one of the largest brackish water

bodies in Tropical Asia. This open lagoon is identified as one of the nationally important and internationally renowned ecosystem, which harbours a range of marine, brackish and fresh water biodiversity. Two sediment cores 360 cm (CHI-1) from north-eastern region dated back to $12,960 \pm 130$ yrs. B.P. and 530 cm (CHI-51) from eastern region dated back to $11,130 \pm 90$ yrs. B.P. of Chilika Lake have been studied through pollen analysis. The comparative analysis of palynodebris of two profiles from two different regimes of Chilika Lake showed difference in qualitative and quantitative abundance of palynodebris at different levels of sedimentation. Sedimentological and palynological investigations of CHI-1 revealed that mangroves flourished from 13,000 to 6,000 yrs. B.P. and then core mangroves started declining and almost disappeared at 3,000 yrs. B.P. The high freshwater input depressed salt intrusion in the upper reaches of Chilika and prevented the development of hypersalinity in the northern zone. Thus the deposition at the site has been influenced by fresh water environment which have been interrupted by a minor sea-level transgression. On the contrary, palynological investigations of CHI-51 exhibited absence of pollen at the base of the profile dated back to 11,000 yrs. B.P. Whereas, around 8000 yrs. B.P. extensive *Rhizophora*-dominated mangroves reached to their greatest extent and later on as sea-level rise slowed towards 6000 yrs. B.P. with a stillstand a brief return to terrestrial conditions at this site was registered. Gradually the mangroves were succeeded by freshwater swamp or swamp-forest. The difference in composition of palynodebris at two different regimes of Chilika Lake is mainly governed by the influx of fresh water discharge in Lake and intermittent sea level changes over the Late Quaternary.

Paleoflood investigations in the lower Changjiang valley using sedimentological and geochemical methods

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The continuous samples were collected from two short cores (LGZ-1 and LGZ-2) taken from the lower Changjiang valley in Jiangsu Province for the measurements of sediment grain size, organic elements and calcium carbonate. The main

research purpose is to investigate the natural-anthropogenic impacts on the sediment compositions over the last two hundred years, especially the occurrence of Paleoflood in floodplain. The sediment grain size show regular variations in the core with several peak values occurring in the middle and lower parts. The concentrations of total nitrogen (TN) and total organic carbon (TOC) also have small downcore variations except for the sharp increase at top. The contents of CaCO_3 and the TOC/TN ratios, however, exhibit larger variations in the core sediments (Fig.1). The peak values of median grain size are essentially coincident with those of the TOC/TN ratios, especially in the middle and lower parts of the core. The grain size compositions and TOC/TN ratios in sediments can be controlled by different factors such as sediment sources, hydrodynamic sorting during transport and deposition, and postdepositional alteration. In the present study, we propose that the median grain size and the TOC/TN ratios can be regarded as the proxy of paleoflood in flood plain. Based on the sediment accumulation rates, the peak values in the core represent several paleoflood events happened in 1954, 1936, 1931, 1921, 1896 and 1870. It is interesting to note that the median grain size does not show peak values during the flood periods in 1998 and 2001, which may be related to the disturbance of sediment compositions by extensive dam constructions in the upper-middle Changjiang valley since 1950s. The sharp increase of organic elements at top also suggests the increasing human influence on natural environment over the last decades.

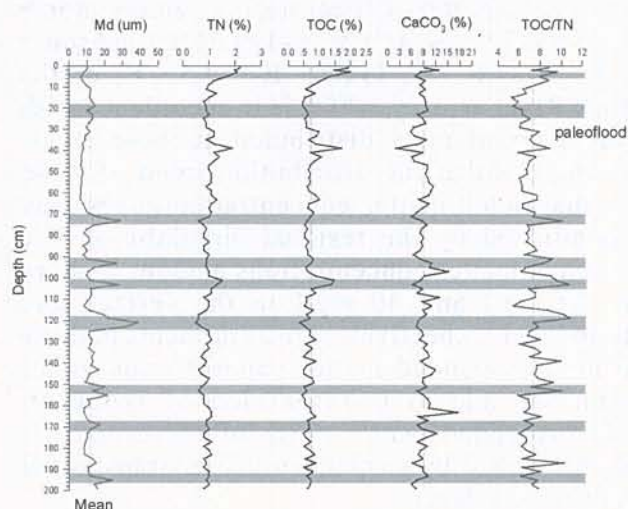


Fig.1 Depth profiles of sediment grain size, organic elements and CaCO_3 in the Core LGZ-2

Distribution and dispersion of suspended matter in the Yellow River estuary

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A large scale investigation of sediment and suspended matter in the Yellow River estuary and adjacent shallow sea was carried out during August-September, 2007. During the survey about 800 stations were covered and surface sediment samples were collected at each station, as well as 1200 water samples from about 400 sites at depth of 1 m (surface layer), 5 m (middle layer) and 1~2 m from the bottom (bottom layer) generally. The Sea-Bird SBE 25 and LISST-100 were used to get in situ temperature, salinity, turbidity and grain size of suspended matter at the water sampling stations. Grain-size composition of the surface sediment samples were analyzed by Malvern Mastersizer 2000.

The grain-size analysis data of surface sediments shows that the Yellow River estuary and adjacent shallow sea is mainly covered by silt and clayey silt, while sand and sandy silt occupy the eastern and southern side of Laizhou Bay. Surface and bottom suspended matter concentration have same horizontal distribution trend with averages of 15.6 mg/l and 29.1 mg/l respectively. Observed surface and bottom turbidity, as well as the suspended matter concentration displays two high suspended matter concentration zones north (37.7° N-37.9° N, 119.3° E-119.5° E) and south (37.4° N-37.6° N, 119.3° E-119.5° E) of the Yellow River estuary, which is in accordance with residual circulations distributed at these areas. This implies that the distribution trend of these high suspended matter concentration zones may be dominated by the residual circulations. The suspended matter concentrations amount to more than 20 mg/l and 40 mg/l in the surface and bottom layer respectively. Fine sediments in these two high suspended matter concentration zones are mainly due to re-suspension of sediment, while suspended matter north of the estuary is also influenced by suspended matter transported by the Yellow River.

The horizontal distributions of surface and bottom salinity are similar and illustrates a lower salinity zone extending from south of the Yellow River estuary to northeast. Distribution trend of

suspended matter concentration, turbidity and salinity indicates that part of sediment from the Yellow River goes south-east into the Laizhou Bay and then turns northeast at the center of the bay to the Bohai, but not transport along the Laizhou Bay coast east into the north Yellow Sea.

Mekong river delta in Vietnam: morpho-sedimentary characteristics and holocene evolution

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The Mekong River Delta (MRD) has prograded more than 200 km from the Cambodian border to the present coastline in southern Vietnam over the last 5-6 ka. The detailed topography of the subaerial delta plain shows an upper delta plain dominated by fluvial processes, lower delta plain characterized by well-developed beach-ridge systems and deltaic margin mainly influenced by marine processes (Nguyen et al., 2000). The upper delta plain mainly occupied by swamps and flood plain about 0.5 to 1.5 m high, and surrounded by the Late Pleistocene deposits of 3.0 to 5.0 m high to the north. In the lower delta plain, the rows of beach ridges trend northeast to southwest and are 3 to 10 m high; they are separated by inter-ridge swamps about 1.5 to 2.5 m high. The beach ridges often have a diverging, bifurcating pattern formed by southwest-ward progradation. The deltaic margin in Ca Mau located on the southwestern part of the MRD characterized by the lowest lands of mangrove swamps (Nguyen et al., 2000).

The Late Quaternary depositional sequences of the MRD developed during the last glacial episode and constitute incomplete sequences that are still evolving. The Pleistocene deposits are exposed to +5 m at the north part, and lowered to about -2 to -4 m in the upper delta plain, then commonly -10 to -35 m in the eastern part of the delta and -10 to -15 m in the Ca Mau peninsula excepting some incised valleys of Mekong river system reaching over -70 m. The Pleistocene deposits are dated 43.4 and 50.4 ka at some boring

sites around the recent coastline. Based on morpho-sedimentary characteristics and radiocarbon ages, Holocene evolution is considered as follows: 1) Pleistocene surface around the paleo-Mekong river valley submerged around 10 to 8 ka due to sea level rose rapidly. 2) Around 8 to 6 ka sea level continued rising, particularly a delta initiation is identified around 8-8, 2 ka and developed in aggradation phase. 3) After submergence of the Pleistocene surface, mangrove swamp started to develop around 7-6 ka in the main part of the upper delta plain. Maximum Holocene transgression occurred around 6 ka and its coastline located nearby border of Vietnam and Cambodia. 4) Tide dominated delta prograded from 6 to 3 ka in the upper delta plain. 5) Tide- wave dominated delta progradation from the last 3 ka characterised by beach ridges plain in the lower delta plain. 6) Tide dominated delta progradation characterised by widespread mangrove swamps in Ca Mau deltaic margin from the last 3 ka due to northeast monsoon activity (Ta et al., 2005).

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Water circulation simulation in Yangtze River-East China Sea system: effects of Three Gorges Dam

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1. Aims: Environment simulator which consists of Atmosphere, Ocean and Land Surface simulation has been developed in the Graduate School for International Development and Cooperation (IDEC), Hiroshima University. This simulator is applied to simulate the water circulation and material transport and transformation in the Yangtze River Basin, Estuary and East China Sea where both ocean and river water environment affected by dam discharge from the Three Gorges Dam are discussed.

2. Method:

(1) Atmospheric Simulation: Meso-scale meteorological simulation (rainfall distribution) with MM5,

(2) Land Surface Vegetation Model: interaction with vegetation and atmosphere with SOLVEG2,

(3) Hydrological Simulation: water quality and discharge simulation with HSPF (DEM: HydroSHEDS)

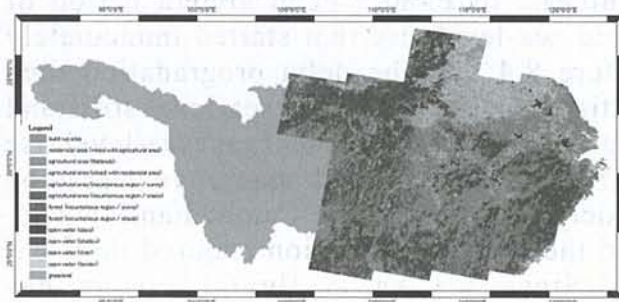
(4) Ocean Simulation: non-hydrostatic ocean current simulation with MITgcm (Mellor-Yamada TKM).

(5) Computational method: Dam discharge Q_d is assumed. Yangtze River Discharge Q_r .

Fig.1 Land-use data estimated by ALOS satellite PALSAR will be evaluated by hydrological simulation. Ocean and river water behavior is simulated by MITgcm by using river discharge Q_r . Initial and boundary condition of potential temperature, salinity, zonal and meridional velocities are imposed by JCOPE 1/12 deg ocean reanalysis data.

3. Expected Result

: Suitable dam discharge which can maintain the environment both in river and ocean waters will be discussed (minimum discharge and its time sequence).



Initiation of the Mekong River delta at 8 ka: evidence from the sedimentary succession in the Cambodian lowland

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Modern deltas are understood to have initiated around 7.59 ka in response to the deceleration of sea-level rise. This episode of delta initiation is closely related to the last deglacial meltwater events and eustatic sea-level rises. The initial stage of the Mekong River delta, one of the world's largest deltas, is well recorded in Cambodian lowland sediments. This paper integrates analyses of sedimentary facies, diatom assemblages, and radiocarbon dates for three drill cores from the lowland to demonstrate Holocene sedimentary evolution in relation to sea-level changes. The cores are characterized by a tripartite succession: (1) aggrading flood plain to natural levee and tidalfluvial channel during the postglacial sea-level rise (108.4 ka) (2) aggrading to prograding tidal flats and mangrove forests around and after the maximum flooding of the sea (8.46.3 ka); and (3) a prograding fluvial system on the delta plain (6.3 ka to the present). The maximum flooding of the sea occurred at 8.0 - 0.1 ka, when tidal flats penetrated up to 2050 km southeast of Phnom Penh after a period of rapid sea-level rise that started immediately before 8.4 ka. The delta progradation then initiated as a result of the sea-level stillstand at around 87.5 ka. Another rapid sea-level rise at 7.57 ka allowed thick mangrove peat to be widely deposited in the Cambodian lowland, and the peat accumulation endured until 6.3 ka. Since 6.3 ka, a fluvial system has characterized the delta plain, and the fluvial sediment discharge has contributed to rapid delta progradation. The uppermost part of the sedimentary succession, composed of flood-plain to natural-levee sediments, reveals a

sudden increase in sediment accumulation over the past 6001000 years. This increase might reflect an increase in the sediment yield due to human activities in the upper to middle reaches of the Mekong, as with other Asian rivers.

What environmental parameter has controlled early human settlement and salt production in the north-eastern Mekong Delta around 3 kyr BP?

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In the north-eastern Mekong Delta, an increasing number of archaeological sites are discovered recently that document a very early phase of human settlement around 3 cal kyr BP. Already during this time, the settlers seem to have produced or refined edible salt in large and professional scale, which represents as well the first sort of industrial activity in SE Asia at all. It is, however, not clear which environmental or economical parameter has led them chosen the particular and laterally well defined localities for their activity.

First geomorphological investigations show that the settlers have not chosen elevated areas such as old sand ridges or levees, and, thus, protection against seasonal flooding was not an aspect. Clay material as base for the massive production of oven ceramics is available all over the delta and the producers seem not to have paid attention to a specific sort of soil material. Therefore, the availability of salt is suggested of being the major controlling parameter. According to the geological situation, only sea salt is a possible candidate.

The archaeological sites are nowadays found 100 km or more apart from the modern coasts. Taking into account that the generally understood progradation of the Mekong Delta has led to a stepward extent of the delta seawards, the distance to the former coastline at times of settlement was surely shorter than today. However, existing reconstructions do not place this palaeo-coastline into a reasonable vicinity of the sites.

Here, we present preliminary results of a comprehensive geomorphological and geological study that interprets the innermost part of the Mekong Delta as a palaeo-coastal lowland environment rather than as a prograding sediment body. We propose that deep bays might have followed the morphostructure of river valleys at the particular time of early settlement and salt-water intrusion might even have amplified these marine influences deeply into the hinterland. However, main problem of this study is the very low preservation potential of thin-sheeted regressive deposits of the minor late Holocene sea-level lowering.

The architecture of the submarine Ganges-Brahmaputra delta results from high-resolution seismic and sediment echosounder surveys

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The submarine Ganges and Brahmaputra Delta plays an important role in the source to sink system Himalaya-Bengal Fan by connecting the Ganges and Brahmaputra rivers, which drain the Himalayas, with the largest submarine fan on Earth. Recently around one third of the delivered sediments are transported to the deep sea fan, whereas the other two third remains in the subaerial and the submarine delta. This huge amount of sediment is essential to stabilize the coast line, because the coastal zone is affected by a strong subsidence. It is obvious, that this sensitive balance between subsidence and sediment input is strongly influenced by climatic and sea level changes. To improve our understanding of this process, it is reasonable to study the development of the submarine delta under the influence of sea level changes in the past. The submarine Ganges Brahmaputra Delta was the target of three expeditions with the German Research Vessel "Sonne" in 1993 (SO93), 1997 (SO126) and 2006 (SO188), carried out in cooperation between the BGR (Hannover, Germany) and the University of Bremen (Germany). During all three cruises sediment echosounder Parasound data were collected, whereby several profiles from 1993 or 1997 were revisited in 2006 to image directly the modern

accumulation of sediments in the delta. As major part of the expedition in 2006, high-resolution multi channel seismic data were gathered on long overview lines and on detailed local surveys located on the eastern and western part of the delta. This multi-frequency seismo-acoustic data set allows now to study the delta in different vertical resolutions, i.e. on different time scales, from the head of the shelf canyon "Swath of No Ground" to the eastern part of the shelf. Over the whole study areas the submarine delta shows the typical clinoform structure, build on a distinct erosive surface probably representing the transgressive flooding. Below this surface the low stand Ganges Delta in the west and the Brahmaputra estuary system in the east could be identified. The clinoform structure itself could be separated into subunits, which maybe images changing of sea level rise. As important structural feature acoustically transparent units are found within the clinoform. These units are interpreted as homogeneous sediments, resulting from mass-wasting processes or in-situ homogenising processes. Both processes maybe triggered by earthquakes or strong storm surges. However, mapping shows that shelf wide events must have caused them and volume calculations reveals that major parts of the submarine delta deposits are affected by these processes.

Two changes of delta front; a case study of the Yahagi delta, central Japan

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Depositional history of delta was investigated by using radiocarbon-dated boring cores from the Yahagi delta (Nishimikawa plain), Central Japan. Especially, historical change of gradient, thickness, and grain-size distribution of the delta front and sediment discharge of the Yahagi River were discussed.

The latest Pleistocene to Holocene sequence in the Yahagi delta is interpreted as incised-valley fill system formed after Last Glacial and subdivided into five sedimentary facies, facies A (fluvial), facies B (estuary), facies C (prodelta), facies D (delta front), and facies E (tidal flat). In main axis of the incised valley, facies A, facies B, facies C, facies D, and facies A are deposited, in ascending order. In the western area of the valley,

facies E occurs adjoining to facies D. The delta front was formed by river floods without reworking by wave or tide. Based on the sedimentary structures of facies D, the Yahagi incised-valley system is interpreted to be calm and fluvial dominated system. The succession was interpreted as transgressive systems tract (the lower facies A and facies B) and highstand systems tract (facies C, facies D or facies E, and the upper facies A) formed under sea-level rise until ca. 7 cal kyBP and subsequent highstand. After the formation of the delta in ca. 7 cal kyBP, characteristic features of the delta front such as thickness, gradient, and grain-size distribution changed twice as delta prograded.

The first change occurred in 45 cal kyBP. In this change, the delta front became thicker and steeper. This change was induced by difference of water depth between middle incised-valley and outer incised-valley result from underlying clinoform architecture. This clinoform was formed in latest transgressive stage by difference of sedimentation rates between tide-influenced shallow area and deeper area when sea-level rising rate decreased to the same level as sedimentation rate in tide-influenced area.

The second change occurred in ca. 3 cal kyBP. In this change, grain-size distribution of the delta front became coarser and the sorting became poorer. Sediment discharge of the Yahagi River also increased abruptly. This change was induced by the increase of erosional capacity in the hinterland. Increasing human activities such as deforestation and poor soil conservation might induce this change.

These results imply that the delta system is strongly influenced not only by hydraulic- and geological-setting at the time but also by geologic history of the basin such as sea-level rising rate of former transgressive stage and topography of underlying estuary system or basement. In the piedmont and small incised-valley fill systems such as the Yahagi incised-valley fill system, these effects of underlying topography seem to be more important than other bigger systems.

Storm-influenced tiny delta

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To assess a long-term stability of the geological environments in a coastal zone, it is necessary to understand the depositional processes in the zone. At a river mouth during a high stand period, a delta is commonly developed. It is expected that the delta-forming processes are influenced by storm wave and flood during a storm event, however little is known about the characteristics of its facies. We investigated what kinds of facies are preserved in a storm-influenced tiny delta, in the case of the Lower Pleistocene Sarabetsu Formation in Horonobe area, northernmost Japan. An upward-shallowing succession (exposed thickness: 34.4 m) formed as a results of progradation of a tiny delta adjacent to a strand plain is recognized at the studied pit. The depositional environments and the water depths (Dw) estimated from the thickness of overlying marine sediments are as follows in ascending order: 1) Delta front slope, Dw > 20 m; 2) Delta front platform, Dw = 20-15 m; 3) Lower shoreface, Dw = 15-10 m; 4) Upper shoreface, Dw = 10-2 m; 5) Foreshore, Dw < 2 m; 6) Backshore.

Storm event deposits are recognized in the succession and consist of 4 facies as follows:

Facies A) Fine sand with hummocky cross-stratification (HCS). It is in the deposits of the upper part of delta front platform and lower shoreface (Dw = 16.5-11.5 m). It erodes the underlying deposits and is overlain by facies B) or C). Facies A is interpreted as a storm-wave deposit at the beginning of a storm event.

Facies B) Sand and gravel with wave-dune ripple (wavelength < 80 cm). It is in the deposits of delta front platform and the lower part of lower shoreface (Dw = 20-13.5 m). It erodes the deposits beneath. Facies B is interpreted as a storm wave deposit, thus the storm-wave base was estimated deeper than 20 m.

Facies C) Sand and gravel with combined flow dune ripple (wavelength < 160 cm). It is in the deposits of lower shoreface and the lower part of upper shoreface (Dw = 13.5-7 m). It erodes the deposits beneath. Facies C is interpreted as a deposit formed by combined flow of storm wave and flood, thus it is estimated that the flood current have reached at least 13.5 m in the water depth.

Facies D) Mud layer thinner than 9 cm. It is in the deposits of delta front platform, lower

shoreface, and the lower part of upper shoreface (Dw = 20-7.5 m). It covers facies A), B), and C). Facies D is interpreted as fine materials suspended by flood and storm wave, and deposited at the end of the storm event.

Four types of storm-event sequence are recognized in the deltaic succession; B-D (Dw = 20-13.5 m), A-B-D (Dw = 16.5-13.5 m), A-C-D (Dw = 13.5-11.5 m), and C-D (Dw = 13.5-7 m). The variation is inferred to have been caused by the scale of the storm events and water depths. These types could be applied to estimate the scale of flood and storm wave in the other ancient and modern deltas of the world.

Coastal accretion and erosion in Red River Delta and influence of monsoon

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During last thousand years, the mean rate of seaward expansion with the time has increased in the southwest part and has decreased in northeast part of Red River Delta (RRD). In the present time, RRD expands seaward at the mean rate of 25-30m/year, maximum 120m/year and prolongs southwest ward. This is a result of combination of Coriolis force and prevailing Northeast monsoon, and is reflected by morphology of streams and displacement of river mouths which are moved alternately northeast ward or southwest ward by periods of 30-50 years for large ones and 7-11 years for small ones.

There has been an irregularly accretion between high tidal flats and low tidal flats. High tidal flats have accreted faster 1.7 times than low tidal flats. In the same transversal section, the high tidal flats accrete rapidly, the low tidal flats accrete slowly, and contrarily, generally. The vertical rate of deposition has changed with elevation of tidal flats, from 1-4 cm/year when elevation below mean sea level (MSL); 5-20 cm/year from MSL to high neap tidal level; then smaller than 3 cm/year when elevation over the last level.

Based on the relationship between erosion - accretion, the coastal zone of RRD is divided into three parts. In Yen Lap - Do Son part (North) located in the Bach Dang estuary, erosion has a longtime tendency, but not large in rate. In Do Son - Ba Lat part (Middle), erosion was very strong, but has been weak recently. In Ba Lat - Lach Truong part (South), erosion has been very strong and

increased after time. Erosion and accretion relation can be divided into five main kinds: 1) Accretion has continued since the end of the last century; 2) Erosion is on-going from long time; 3) Accretion and erosion phases are alternately occurred; 4) Erosion was strong during longtime ago, but it has changed into accretion recently; and 5) Accretion was dominant, but it was suddenly changed into erosion recently. The mean rate of coastal accretion of RRD through periods 1930-1965, 1965-1990 and 1990-present was calculated as 28.7/year, 29.1 m/year and 44 m/year respectively. The sediment supply significantly depends on flood time falling in Southeast monsoon or dry time falling in Northeast monsoon, and the periods of great discharge from 8-13 years or the periods of small discharge from 10-28 years. Some extreme discharges of suspended sediments were recorded as 52.5 ton in 1963 (min.) and 202 mil. ton in 1971 (max.).

RRD has eroded in the total coastline length of 22.75 km with a mean rate of 11.5 m/year and maximum 20.5 m/year. Particularly, the Hai Hau (Van Ly) coast has eroded in the length of 17.2 km and at a mean rate of 14.5 m/year. The relationship between coastal direction and prevailing monsoon direction impacts greatly to coastal erosion. For almost eroded sites of RRD with NE-SW coastal direction of, the strongest erosion happens in the beginning of northeast monsoon (September-December). The southwestwards longshore drift by wave and seawards transversal drift created by great fluctuation of tidal range and combination of ebb tidal current and wind current in Northeast monsoon is cause of sedimentary lack in Hai Hau eroded coast. In RRD, the Cat Hai eroded site with latitudinal direction is a special case where the coastal erosion time is in the Southwest monsoon.

The effects of the use of DELTA zones for various industries and development projects in Sri Lanka

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The country Sri Lanka is a small Island and it is being considered as a developing country in the Asian region. The available resources in the Island and imported raw materials are used for

various development projects and industries within the land area and along the coastal zone. Due to the scarcity of the land area some industries and/or cultivations may be occurred within the Deltaic zones at the coasts. This paper describes the benefits and disadvantages or negative effects of those industries to the country and for the delta zones.

The total length of the coastline is 1639km. Two thirds of the Islands " coastline is considered as " "straight coast" and 20% belongs to bays, estuaries and lagoons. About 9% covered by sand spits and barrier beaches. Less than 1% of the coastal zone belongs to delta type geomorphological zones. Due to the short total length of the river courses the country has only small deltaic deposits at the coasts. About 45% of coastline is urbanized and 17% of country's agriculture produces from the rest area. 80% of the total fish production comes from this coastal zone. The country's principal coastal resources are; coastal habitats/ecosystems, the coastal fishery, mineral sands and limestone deposits, coastal land and water resources.

Due to rapid urbanization along the coastal zones people were used the delta areas for some industries and other economical and commercial activities. Fishing, tourism, industry and agriculture sustain the growing economy of the coastal region. Coconut is the major plantation and coconut based industries have been developed. Salt industries and prawn farming are the other industries within the lagoon areas and deltas. More bare lands have been converted to residential and industrial areas and commercial purposes as well as fishermen villages. These industries provide employment for many people and improve their living conditions. Development of infrastructure increased the facilities for residents.

The human activities due to the population increase create major environmental problems to the society. The most significant of these include sand mining from river beds and beaches, coral mining and destruction of reefs, removal of mangroves and other coastal vegetation as firewood for domestic, kilns and illicit distilleries and land clearing, improper locations for housing units, dumping of garbage and sewage disposal and various illegal activities are some of those. Therefore it is difficult to maintain the ecological balance.

There are many benefits to the people from some industries operating in the delta zones in Sri Lanka. It mainly reduces the employment

problem in the country. It is necessary to the highly populated small country. On the other hand illegal human activities always create many environmental problems to the society and to the country. To reduce such damages and maintain the balance of ecological environment the existing law should be enforced seriously.

Recent settlement and soil formation altering the late Holocene sedimentological and vegetation record in the northern Mekong Delta, Vietnam

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This article presents a sedimentological, geochemical and palynological study of a late Holocene sediment core taken in the northern Mekong Delta. Material at the base of the core is indicative of the mid-Holocene sea level highstand, revealing an intertidal flat with a nearby mixed mangrove forest (partly sandy but overall muddy sediment, predominantly mangrove pollen and the oyster *Placuna placenta*). Overlying muddy sediments record a decline in mangrove pollen and absence of *P. placenta*, which demonstrates the development of a coastal plain with initial marsh/swamp vegetation during the late Holocene sea level regression and delta progradation. The progressive development of the marsh/swamp vegetation recorded in the upper core is interrupted by an agricultural signal dated into the late 18th century where settlers were burning/clearing the area (predominantly mangrove pollen due to lack of grass pollen, high amounts of charcoal). The postdepositional acid sulphate soil formation influences the distribution of elements through the core and depending on the conditions in the soil (oxidic vs. reducing) specific elements are enriched or heavily leached. Thus the geochemical signal can only be used cautiously in the interpretation of the facies development.

Nature of organic matter on the Ayeyarwady continental shelf and gulf of Martaban

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The Ayeyarwady-Salween river system is the third largest in the world in terms of suspended sediment discharge (Bird et al., 2007; Robinson et al., 2007). The combined Ayeyarwady-Salween river system contributes annually more than 600 MT of sediment and 5.78.8 MtC/yr of organic carbon, suggesting that presently it may be the second largest point source of organic carbon to the global ocean after the Amazon. A major portion of the organic carbon of these rivers are carried out to sea and deposited on the Ayeyarwady continental shelf and Gulf of Martaban. Comparatively higher organic carbon (TOC) and nitrogen (TN) concentrations are found in fine-grained sediments on the inner shelf mud belt, and on the continental slope sediments and low TOC on outer shelf sediments relict sands. The $\delta^{13}\text{C}$ values of organic matter increase from 25‰ near the Ayeyarwady coast to about 22‰ in the slope regions reflecting decreased influence of terrestrial fluvial carbon. The $\delta^{15}\text{N}$ values of TN on the Ayeyarwady shelf are low (+3.3 to +4.8‰) compared to typical marine values probably because of higher fluvial nitrogen input and possible contribution from nitrogen fixing marine phytoplankton. A simple two end-member carbon mixing model applied to the Ayeyarwady shelf region indicates that terrigenous carbon constitutes about 80% of the organic carbon in the modern mud belt in the inner shelf and Gulf of Martaban reducing to less than 60% near the shelf edge.

A comparison study has been made of carbon preservation on the Ayeyarwady shelf with other major rivers like the Ganges-Brahmaputra, Amazon and Yangtze. A strong terrestrial organic carbon source is seen in the Ayeyarwady inner shelf and Gulf of Martaban sediments because of the rapid burial of the fluvial carbon due to high sedimentation rates. The burial efficiency of terrestrial carbon is enhanced by seasonal supply in sediment discharge and high turbidity in Gulf of Martaban which inhibits marine productivity. Fluvial terrestrial carbon in the suspended sediment of the Ayeyarwady Salween river systems is dominated by soil carbon (Bird et al., 2007) which is refractory in nature, less intensive processing and replacement in the flood plains and deltaic regions as well as rapid burial at sea leads to high preservation of terrestrial carbon on the Ayeyarwady continental shelf sediments.

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Numerical modelling of influence of monsoon on hydrodynamics and suspended sediment transport in Hai Phong Ha long coastal area

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The suspended sediment from Red River has a big impact on coastal zone of Tonkin Gulf, includes both positive and negative. Coastal zone Hai Phong-Ha Long is one of zone be influenced by that. This coastal zone has the most important port in the North Vietnam, Ha Long Bay- a UNESCO World Heritage, Cat Ba Archipelago- a UNESCO World Biosphere Reserves and Do Son beach- a famous tourist destination in the North of Vietnam. However, the suspended sediment from estuaries into this coastal zone annually is the causes of alluvial channels to Hai Phong Port, turbidity of water in Do Son Beach, water turbidity and contaminated to a part of Ha Long Bay, inhibit development of corals ecosystem in Cat Ba area.

Monsoon regime has influence on hydrodynamics and suspended sediment transport by mean of the seasonal variation of wind direction, river discharges and suspended sediment. This study is carried out in order to assess spatial distribution and temporal variations of suspended sediment from estuaries into coastal zone of Hai Phong-Ha Long. It also initial assess the role of each factors, including the influence of the monsoon. By means of model (modules Delft3D-Flow and Delft3D-Waq in the software package Delft3D) applications for each special scenario, this study has provided some useful results about the characteristics of hydrodynamics and suspended sediment transport in the study area.

The flow in coastal zone of Hai Phong- Ha Long is characterized by combined effects of tidal current,

river-density current, wind-driven current; among these, tidal current governs the general flow pattern. Although, the magnitude of tidal current is very large, the tidal residual current velocity is very small, almost none of significance. The river-density current is an important component flow in the study area, it is the main factor creating the flow stratification in the estuary region and supplies the suspended sediment for the coastal zone. The wind-driven current in the study area is small in magnitudes. However, wind-induced currents are the main factor, which causes the uni-directional current directing north or south of the study area according to the wind direction. The magnitude of the wind-driven current in the rainy season is bigger than in the dry season.

The transport of suspended sediment in coastal zone of Hai Phong-Ha Long is closely related with river discharge, tidal oscillation and wind stress. The roles of factors depend on the season, and the locally of the study area. However, the temporal variation of suspended sediment concentration shows the influence of tidal oscillation; the zone with high-suspended sediment concentration in the rainy season is wider than in the dry season and it influenced on the west of Ha Long Bay. Tidal oscillation augments the transport of suspended sediment to the east of the study area, both in the rainy and dry season. Although the wind-induced current is not large as compared with the other current factors, it is important for the transport of suspended sediment. River discharge is the most important factor for the transport of suspended sediment in the coastal zone of Hai Phong-Ha Long. It varies with the season, and governs the spatial and temporal variations of the suspended sediment in the study area.

Weathering indicators of sediments of the Huanghe (Yellow river), Changjiang (Yangtze River) and Zhujiang (Pearl River) to the sea, their comparison and influential factors

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Semi-quantitative analysis of the quartz, feldspars contents of the 36 bulk sediment samples with 258 size-fractionated sediment samples from the Huanghe, Changjiang and Zhujiang to the sea were conducted by X-ray

diffraction. The feldspar/quartz ratio F/Q , K-feldspar/quartz ratio F_k/Q and P-feldspar/quartz ratio F_p/Q as weathering indicators were used together with the percentage contents of carbonate minerals to evaluate and compare the weathering intensities of the above three rivers. Their influential factors were discussed.

The results show that the ratios of the quartz percentage contents of the Changjiang, Huanghe and Zhujiang are 1/1.2/2.6/2, The ratios of feldspar contents from the Huanghe, Changjiang, Zhujiang bulk sediments are 1/0.7/0.3. This ratio revealed clearly that the weathering intensity of the three rivers is followed by a sequence of Zhujiang > Changjiang > Huanghe and this sequence of the F/Q ratio of the three rivers sediments is consistent with the sequence of their chemical weathering intensity level.

The difference of the F/Q ratios of the Huanghe, Changjiang and Zhujiang sediment vary significantly with the sediment grain size. It increases with the decreasing of the grain size in general. The F/Q ratio of the 2-4 μ m fraction of the Huanghe sediment is 3.4 times of that of the Changjiang. The F/Q ratios of the 2 μ m-4 μ m and 16 μ m-32 μ m fractions of the Huanghe sediment are 6.2 and 6.8 times of that of the Zhujiang, respectively. The F/Q ratios of the 16-32 μ m, 32 - 63 μ m fractions of the Changjiang sediment are 3.7 and 4 times of that of the Zhujiang. The F/Q ratios of above grain size fractions are the weathering sensitive grain fractions, which are much higher than that of bulk sediments from the rivers, and can be used to distinguish the weathering intensity of three rivers basins as proxy indicators.

The weathering indicators of sediments of the Huanghe, Changjiang and Zhujiang to the sea are closely related to the source rocks and the climate environment of the three river drainage basins reveal the causes of the difference in the sediment compositions of the three rivers. The weathering indicators of the three rivers can be used to identification of the sediment sources from the rivers on the shelves and evaluate the weathering history of the river basins in the past.

Sea surface temperature changes in the southern East Sea, Japan Sea and northern East China Sea during the last 15000 years

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Two piston cores (KCES1 and CSH1), which were collected from the southern East Sea/Japan Sea (ES/JS) and northern East China Sea (ECS) respectively, are examined to discuss the sea surface temperature (SST) and paleoceanographic environment changes in the both sides of Korea Strait/Tsushima Strait since 15 ka BP. Generally, high-resolution downcore variations of alkenone-based SST in KCES1 has the same trend with the other sediment core (TY99PC18) of the ES/JS during the last 15 ka BP. The U_{37}^{K} -SST data of CSH1 also displays increasing trend from 15 ka BP to the present whereas striking differences presented between the SST records of the CSH1 and the KCES1. During 15 to 14 ka BP, the SST decreased and 2.6-3.7°C cooler than today in the southern ES/JS but increased and 3-4°C cooler than today in the northern ECS. The Tsushima Warm Current (TWC), which had high temperature and salinity and regarded as a branch of Kuroshio Warm Current, was not formed because the main flow of Kuroshio shifted out of the Okinawa Trough during this period. The SST in the southern ES/JS was slightly increasing up to 14.5°C from 14 ka BP and then remained a relative stable SST condition during 14-12 ka BP at the same time the SST in the northern ECS still remain increasing trend and reach up to 23°C at 12ka BP. The Kuroshio current maybe began to influence the northern ECS but the TWC was not existed during this interval. Abrupt decrease in SST of the southern ES/JS from 12 to 11 ka BP indicates that the oceanographic environment of this area experienced drastic cooling course which coincided with the Younger Dryas cooling period probably. The fine laminated sediments began to appear at the end of this interval because the bottom water became ventilating. However, the oceanographic condition in the northern ECS was relatively stable as a result of stable Kuroshio influx at the same time no evidences could be found for the existence of TWC. During the early Holocene (11-7 ka BP), the SST in the southern ES/JS and the northern ECS increased rapidly and remained high values (about 17° in ES/JS and around 24° in ECS). A fully developed Kuroshio flowing into the Okinawa Trough and the TWC supplied high temperature and salinity water into the ES/JS after 11 ka BP. After 7 ka BP, the SST in the southern ES/JS became 1.5°C cooled again

and the SST was also fluctuating within 2°C extent in the northern ECS suggest that the Kuroshio flowing suppression as a results of Holocene cool event have great influence on both sides of the Korea Strait/Tsushima Strait. The SST variations of the study areas were close to the present value and small changes happened after 5 ka BP.

A preliminary study of sedimentation in the Mekong Subaqueous Delta, South Vietnam

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The Mekong River is Asia's third largest river systems in terms of sediment load. Detailed sedimentation studies have been conducted on the subareal part of Mekong River Delta (MRD). Based on borehole cores collected on delta plain, previous studies show that the subareal part of the MRD has continuously prograded more than 250 km from Cambodia toward the South China Sea since the Holocene sea-level highstand. A phase shift from tide-dominated to an intermediated type tide and wave-dominated delta since 3000 yrs BP is proposed. However, until now, no high-resolution seismic data have been obtained to document the nature of the sedimentation deposit in its coastal area.

Two cruises were conducted in April 2006 and March 2007. Approximately 1150 km long high resolution seismic profiles and more than 20 gravity cores were retrieved revealing the subaqueous part of the fast prograding MRD. Based on clinoform characters, the coastal area is dividend into 4 zones: Zone I. Mekong River mouth, Zone II. East side of Camau Peninsula, Zone III. Camau Cape, and Zone IV. West side of Camau Peninsula.

Seismic profiles are successively correlated to inland boreholes. 10 to 20 m thick deltaic sediments is found within 25 m water depth around the MRD, base on which the sediment budget of the Mekong River system in last 3000 yrs is updated. Approximately 80 - 18% of Mekong sediments has been trapped within the MRD and take part in its fast progradation. This is quite different from other large river systems in Asia, including the G-B, Yangtze, and Yellow.

Meanwhile, an intact incised valley fill is successively unveiled ~20 km outside the modern river mouth and a schematic model of its evolution since the LGM is proposed.

The study area is controlled by two different tidal systems from the South China Sea and the Gulf of Thailand. Most of the ^{210}Pb profiles in this study show highly fluctuating activities, indicating a complicated sedimentation process in near shore area. Calculated accumulation rate in the northwest and south tip of Camau Peninsula is between 0.23 and 0.44 cm/yr. This result is consistent with estimation based on the thickness of deltaic sediments. More hydrodynamic data is expected to further explain the MRD's unique sedimentation process.

Relationship between fluctuation of some Italian and Norwegian Alpine glaciers and evolution of the Nile Delta coast 20th century

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- More than 300 million people inhabit on world deltas, 10% of them live in the Nile Delta, but sea-level rise (SLR) estimates range from 0.5 to 1 meter by the end of 21st century, as a result of global warming due to increase of CO₂ ratio in the planet earth atmosphere, for that reason glaciers and ice sheets retreat and caused of rising the global sea level.

In addition to above reason there are some other factors causes of submersion of the Nile Delta coast:

1. Northeastern margin of the delta has subsided at rates of up to 0.5 cm/ year since about 7500 years ago.
2. Nile river flow and sediment discharge has oscillated due to climatic changes during last century.
3. The Nile delta promontories have eroded by effects of West/east direction marine currents.
4. Sediment deposition along the coast has been reduced because of the Aswan High Dam since 1964, as well as construction of Low Aswan dam during early years of 20th century. Its sediments were the main source of accretion on the Nile delta coast line and its two promontories of Rosetta and Damietta, but it has removed gradually from this date.
5. Some other manor human activities has assisted coastal erosion such as remove coastal

deposits and narrow river channels as a result of building houses or cultivating more lands.

This paper aims to define the relationship between Nile delta coastal erosion and Some Alpine glaciers. Comparing Multi dates remote sensing images for Nile delta coast dated 1984, 1990, 2000, 2001, 2004 and 2005 in addition to series of topographic maps dated 1909, 1922, 1949 and 1970 as well as field GPS measurements has been used to detect shoreline changes along the coast over the last century. Results of the study showed that the rate of 18 m/y as a minimum shift and 230 m/y as a maximum shoreline change at the delta promontories over the last century.

In other hand recent evolution of some hundreds of Italian and Norwegian Alpine glaciers has been analyzed of available fluctuation data collected on glaciers from 1908 to 2002. as well as field observation of Jostedal glacier in Norway as a case study. Results of the study shows that during the 20th century the chosen glaciers underwent a generalized retreat but in different rates. Comparing relationship between coastal erosion and glaciers retreat rates has analyzed to detect the main effective erosion factor of the Nile delta coast erosion during last century.

Anthropogenic activities and their impacts on natural resources and livelihoods of the coastal region of Bangladesh

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The coastal region of Bangladesh encompasses about one fifth of the country' landmass and supports livelihood of about 35 million people. This region is ecologically vulnerable because of its geographical settings, while the climate change is aggravating the incidence of natural disasters especially periodical cyclonic storms and tidal surges. Besides, the region is increasingly becoming vulnerable to various extreme climatic events due to different anthropogenic activities. The major anthropogenic activities identified are coastal embankment, brackish water shrimp farming, salt production, urbanization, transport and navigation, industries, ship breaking activities and indiscriminate use of agrochemicals in farming activities. Growing anthropogenic activities have been found to put multifarious

adverse impacts on natural resources, environment and livelihood of the inhabitants. Embankments constructed to prevent salinity intrusion are now used a pool of saline water for brackish water shrimp farming. This is in turn causing long time water stagnation and thus converting crop lands to non-crop ones. Shrimp farming with more than 200 thousand hectare areas is already causing major adverse effects on agricultural production, forest, biodiversity, fodder, energy, environmental, as well as human and animal health. Gradual expansion of salt production has been causing increased salinization of soils as well as decreasing land area for agricultural crops and vegetation. High levels of organic, inorganic and radioactive pollutants in waste discharges from growing number of fish processing plants, industries and ship breaking yards have been found to pollute the estuarine and marine ecosystems. Human settlements; road networks; road transport and marine transport; bilge water and crude oil leakage from mechanized boats, ships and fishing trawlers have also been found to cause damage to the mangrove ecosystems, destruction of aquatic lives and contamination of food chain through toxic buildup. The resultant effects all these events are causing severe degradation of ecosystems and livelihood opportunities of the poor coastal communities. The government of Bangladesh recognized all these events and efforts are underway towards formulating mitigation strategies at both national and international levels.

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Sato-Umi-New concept that increases biological productivity and biodiversity

Resolving oyster conflicts in the Chesapeake Bay: the concept of Sato-Umi

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Since the nineteenth century the oyster fishery in the Chesapeake Bay has seen intense periods of conflict. The fishery has evolved in three phases. The first phase witnessed almost unrestricted harvesting of the Bay's rich oyster reefs. The second phase pitted regulators and the oyster police against oyster fishermen unaccustomed to government control. A third phase established a complicated set of laws and restrictions meant to prevent overharvesting of an abused resource. During this phase the two Bay states of Maryland and Virginia took very different paths, the first favoring a common resource approach, the latter favoring the leasing of private oyster grounds. For much of the twentieth century the oyster fishery continued to operate under a range of restrictions, many of which prevented the use of modern harvesting equipment in an effort to control fishing pressure. Aquaculture, though advocated by some, failed to develop to any significant degree. Then as the 1950's ended, oyster disease struck. The oyster parasite *Haplosporidium nelsoni*, known at the time simply as "multi-nucleated sphere unknown," or MSX, devastated the Bay's oyster grounds, especially in Virginia's more saline waters. Much of the Virginia oyster industry soon collapsed. Annual Baywide harvests continued to hover around 3-4 million bushels (see Figure 1), until the mid 1980's. Then drought conditions drove a salt wedge up the Chesapeake estuary, allowing disease to spread well into Maryland. Since that time the Chesapeake oyster fishery has struggled, with harvests only a small fraction of even mid-twentieth century catches.

The Chesapeake Bay oyster fishery is now poised to enter a fourth phase that relies on aquaculture and careful management, but serious disagreements continue. Some are calling for a complete moratorium on oyster harvests to allow the overfished and disease-ridden native stocks to recover. Others, especially those in the seafood industry, are calling for the introduction of a non-native oyster, *Crassostrea ariakensis*, to supplement the failing native oyster. To date concerns over economically stressed fishing communities have prevented a harvest

moratorium, and worries over unexpected impacts from a nonindigenous introduction have prevented the planting of a new oyster in the Bay. Commissions and studies are now underway to attempt to address these issues.

Underlying conflicts over Bay oysters is a fundamental disagreement over the nature and purpose of oyster reefs. Traditional watermen see the reefs as their livelihood. Environmentalists see the reefs as natural habitat essential for restoring the ecological health of the Chesapeake Bay. The Chesapeake needs a new paradigm that will allow for the coexistence of protected oyster reefs, managed oyster fishing grounds, and intensive aquaculture areas. The concept of Sato-Umi provides such a paradigm. Intensive aquaculture areas would be like forest monocultures planted explicitly for wood production. Protected reefs would be analogous to protected forests in Japan, or Chinjyu-no-Mori, "where the gods live." Managed oyster grounds would be like managed forests, Sato-Yama, meant for human use but still valued for their ecosystem services (e.g., filtering function). This approach would go beyond "marine zoning," since it would offer a philosophical underpinning, with an emphasis on balanced use. Experiments would track to what degree protected areas or managed (worked) areas provide the greatest biodiversity. Research to date (e.g., Rodney and Paynter, 2006)

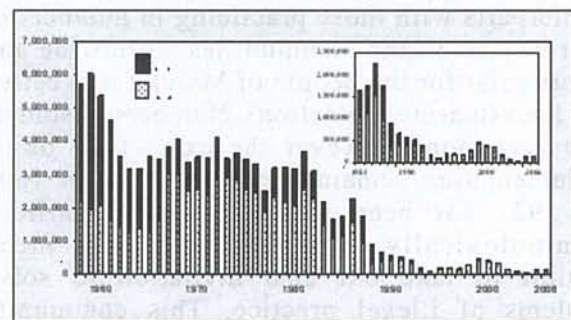


Fig.1 Oyster Harvests in Virginia (V) and Maryland (M) (in bushels). Source: NOAA Ches. Bay Office

suggests that protected reefs will result in greater biodiversity, since they provide valuable vertical structure in the water column.

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Sasi Laut: history and its role of marine coastal resource management in Maluku Archipelago

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Indonesia is an archipelagic state within which Maluku province is one of the seven archipelagic provinces and has been recognized for its abundant of marine resources covering fish, mollusks, crustaceans, seaweeds and many others. These great diversities are supported by the fact that Maluku province, situated in the Eastern part of Indonesia has such vast sea area of 527 191 km² (90%) compared to land area which is only 54 185 km² (10%) of the overall size of 581 376 km². Historically, the resources including various kinds reef fishes, small pelagic fishes, mollusks and seaweed have been long exploited for the need of people throughout villages around Maluku. Along with such activities there have been also a local knowledge practiced by the communities in terms of regulating harvesting the resources. In principal, this knowledge has its counterparts with those practicing in numbers of other coastal island communities worldwide and in particular for the people of Maluku it is called Sasi Laut (marine protection). Numbers of studies have been done however the exact time of its implementation remains unclear although 1600 and 1921 has been indicated as the earliest. Terminologically, Sasi does not just mean prohibit to take but also invitation to solve problems of illegal practice. This community based management of the local resources usage has been practice to close particular coastal areas inhabited by the resources as well as close season within the year. Coastal areas that are closed include estuarine, bays, lagoons and platform of coral reefs. Meanwhile the resources include various kinds of reef fishes like Lutjanids, Lethrinids and Seranids, small pelagic species involve *Trisina baelama*, mollusk like top shell (*Throchus niloticus*), green snail (*Turbo marmoratus*) and seaweed (*Eucheuma spinosum*). Interestingly, yet the practice is merely based upon the local community knowledge, closed season is also implemented correspond with the areas for as long as six to 12 months periods. In

numbers of coastal villages around Maluku archipelago, Sasi remains as part of their traditional way of managing their marine resources. Up to now this tradition has resulted not just social coherent among the villagers but also economic benefit and biologically support the sustainability of the resources. Despite its current practice, further study is critically required to assess the trend and possibility of its integration with modern science based knowledge on fisheries management. The reason is due to the fact that yet Sasi remains in place, biological characteristics of the resources begun to show significant changes. Up until 1980, production of top shell harvest in the island of Dawelor (South West Maluku) after Sasi was 7–8 ton per season. Currently however, the production has been dropped significantly to only 1 to 1.5 ton per season. It is argued that this approach should be adopted given the fact that local communities living closed by the resources. Thus by empowering our local communities, sustainability usage of coastal resources can be expected.

North-western European seas: how to restore damaged coastal marine habitats?

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With the launching of the new Directive on the Marine Strategy, the European Union has completed a whole set of legal tools for attaining a better ecological status of the marine environment. The strategy comes as a complement to existing directives such as the Water Framework Directive, the Habitats Directive or the Bird Directive. The objective of this paper is, firstly, to analyse the benefits brought by the older directives in the management of north-western European seas: the English Channel, the Celtic Sea, the North Sea and the Baltic Sea. All these enclosed or semi-enclosed waters sit on the European coastal shelf and are epi-continental ecosystems. They are subject to various pressures due to human activities and in addition, global warming is affecting coastal habitats. Secondly, the paper will show how these disturbances impinge on goods and services provided by these ecosystems. In particular, it will give examples of how certain estuarine habitats have been damaged by misuse and unwise management.

The main part of the article will be devoted to

efforts for restoring water quality in some industrialised estuaries during the few past decades. It will then compare strategies for the recovery of damaged habitats and the restoration of lost ecological functionalities. Case studies will be taken from the Seine in France, the Mersey and the Humber in England, the Scheldt in Belgium and the Netherlands and the Elbe in Germany. The Kuronian lagoon (Lithuania) will be selected from the Baltic Sea.

Through comparing the various restoration schemes, policies will be assessed. The discussion will then put together the various approaches. Resting on a rigorous scientific approach, the discussion will propose a synthetic approach to restoration. It will consider:

1. Efficient procedures of socio-ecological evaluation
2. A methodology to assess the ecological quality of systems considered
3. Rigorous monitoring programs, resting on a relevant choice of indicators
4. Participation of local communities in order to define strategies compatible with conservation and sustainable development at the regional and European level.

The conclusion will demonstrate that any intervention on an estuarine ecosystem should be incorporated into a global restoration plan, working on the long-term. An ecological vision on the long-term would mean analyzing the past to predict the future and promoting local activities in harmony with estuarine conditions

Development of integrated multi-trophic aquaculture in China

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With the rapid growth of population and development of urbanization in China, the Per capita agricultural land has steadily decreased from 0.19 hectares (ha) in 1949 to 0.076 (ha) in 2005. These considerations and the rapid changes in population structure, and rising living standards, have presented the Chinese with several challenges and opportunities to meet the rising demand for high quality seafood products. The challenge facing mariculture is to increase the production capacity of an existing site without exceeding ecosystem capacity. One method is to maximise resource utilization by adding

functionally different species to the cultivation system. One of the innovative solutions being proposed and accepted for environmental sustainability, economic diversification and social acceptability, is integrated multi-trophic aquaculture (IMTA).

After 30 years rapid development, the insbore areas have almost been full exploited for mariculture in China. In order to produce the higher quality seafood as much as demand by both international and domestic market, The IMTA has been implemented in China for years and is recommended and promoted as the new concept of mariculture by Chinese government. Two variations of the IMTA approach have been developed in China: suspended multi-species aquaculture in inshore and multi-species large scale sea ranching in offshore, deeper waters.

An example of suspended multi-species aquaculture is being developed in Sungo Bay, in the East of the Shandong Peninsula, China. Here, in an area of 13 300 ha the annual production is 2100 ton of scallop *Chlamys farreri* in fresh weight, 110 000 ton of oysters *Crassostrea gigas* in fresh weight, 80 000 ton of kelp *Laminaria japonica* in dry weight, and about 100 tonnes of finfish in 2005. The co-cultivation of abalone *Haliotis discus hannai* with *L. japonica* is also being developed, with abalones kept in lantern nets hanging vertically from the long lines and being manually fed with the kelp that is grown on ropes maintained horizontally between long. Once the kelp is harvested, the abalones are fed with dried kelp. With such kind of IMTA, the benefit is about ten times higher than that of monoculture of kelp. Now the experiment is carried out in the bay to develop a new IMTA by co-culturing sea cucumber with abalone together in lantern net. In this system, the kelp can control the eutrophication by absorb the nutrient and provide the food to abalone, sea cucumber can feed the faeces and detritus produced by abalone so as to reduce the influence of bio-deposit on environment. Furthermore, the economic benefit of such mariculture model will be significantly increased.

The most successful multi-species large scale sea ranching is taking place near Zhangzidao Island, 40 miles away from Dalian, in the northern Yellow Sea (water depth from 20 m to 40 m). Sea ranching is usually practiced for the enhancement of natural stocks such as Japanese scallop, sea cucumber, abalone, sea urchin and finfish. The Zhangzidao Fishery Group Co., Ltd., is authorized to farm up to approximately 40 000 ha,

and presently cultivates 26 500 ha of the scallop, *Patinopecten yessoensis*, 10 000 ha of the arkshell *Scapharea broughtonii*, 660 ha of the sea cucumber, *Apostichopus japonicus*, and 100 ha of the abalone *Haliotis discus hannai*. The company has been in existence for more than ten years. The total harvest in 2005 reached 28 000 tonnes, valued at more than US\$60 million (US\$18 million in net profit). To improve ecological conditions and the sustainability of the operation, the company is now thinking of developing seaweed cultivation and the construction of artificial reefs in more offshore environments. To date, about 13 300 ha have been optimized in this way.

Besides the development of demonstration activities and applied research to clearly show farmers and regulators the benefits of IMTA, basic research on IMTA has also been performed by some institutions of China, for example, the environmental requirements for the growth of seaweeds and shellfish to maximise the nutrient recycling efficiency to the culture conditions (depths, relative position with respect to the fish cages in relation to the prevailing currents, distance from the cages and culture density).

To avoid spatial competition and serious environmental impacts in inshore region, developing the IMTA in offshore areas, such as suspending culture of fish, shellfish and kelp, sea ranching of sea cucumber, sea urchin, abalone, seaweeds and scallop is a trend for mariculture industry in China.

Seasonal retention and release of phosphorus in Shinkawa-Kasugagawa Estuary, the western Japan

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Estimation of mass balance of biophilic elements, such as nitrogen or phosphorus, is very important to understand the dynamics of these materials in coastal ecosystems. Phosphorus plays as one of the most effective material for the growth of primary producer or the eutrophication including occurrence of noxious red tides in the coastal sea. Phosphorus, discharged from a river, is varied in quality and quantity in estuary ecosystem, and then flow out to the coastal sea. We carried out 10-

12 hours surveys during a high-low tidal cycle in May, August and November in 2006. Our objective is to estimate the phosphorus balance in Shinkawa-Kasugagawa estuary and to demonstrate the function of intertidal zone to coastal environment.

Hourly seawater samplings were conducted at boundary site between intertidal and subtidal area to estimate the abundance of phosphorus which flowed into or flowed out from intertidal zone. Collection of river water and measurement of flow rate of the river were also carried out to estimate the abundance of discharged phosphorus from the river. As a result, 40.9 kg of phosphorus (dissolved inorganic phosphorus+particle phosphorus) were discharged into intertidal zone from Shinkawa-Kasugagawa River, and 23.6 kg of phosphorus flowed out from intertidal zone to the sea in May. In August, 33.7 kg of phosphorus were discharged from the river and 12.4 kg of phosphorus flowed out to the sea. Therefore, 17.3 kg (42%) and 21.3 kg (63%) of discharged phosphorus from the river could be considered to trap in intertidal zone in May and August, respectively. On the contrary in November, only 2.6 kg of phosphorus were discharged from the river and 42.8 kg of phosphorus flowed out to the sea, showing 40.2 kg of phosphorus were released from intertidal zone.

Our results indicate that considerable phosphorus discharged from the river are trapped in intertidal zone during spring to summer, when various estuarine organisms are active, and are released drastically to the sea during autumn to winter.

Adaptive cooperative management of tidal flat by citizens - governments - researchers in the Yamaguchi Bay

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In the Yamaguchi Bay, which is located at the mouth of the Fushino River, fishery resources have been decreased quickly. The local government established a "committee of

developing a healthy river basin” in 2002, and selected the basin of the Fishino River as a model field. In 2003, the natural environmental restoration law has been established. Based on this law, a “council of the river mouse and tidal flat restoration in the Fishino River” has been launched in 2004. The members of the council were consisted of thirty individuals and citizen groups, eighteen local and national governmental organizations, and nine researchers. There are a lot of living organisms which should be conserved in the bay, which include short-necked clam, eel grass, houseshoe crab, waterfowls, etc. Among them, short-necked clam and eel grass were in the most serious situation. In the past, there were 700 ha eel grass hed in this area, which decreased down to 32 ha in 2002. The council members have planted young plant of eel grass, and the eel grass bed has increased to 153 ha in 2005. Our researches of finding the suitable habitat for eel grass would have helped the activity.

About short-necked clam, the situation was more complicated. Fishery catch of short-necked clam was 653 ton in 1975, which is sharply down to zero ton in 1991. Although there are a lot of possible reasons for this problem: 1. High mud

content on the bottom sediment, 2. Low nutrient in the water, 3. Toxic substances in the water, 4. Over fishing, 5. Predation, etc., we could not reach a concrete conclusion about the cause. The council needed to start from possible countermeasures together with monitoring and researches. Since the clearest change of the environment was rise of mud content, the local government conducted sand covering works at first. The council members also conducted tidal flat cultivation at the place where the sand became hard. Low nutrient, toxic substances and predation were left unknown. We

conducted researches to know the effects of these unchecked factors. Our research revealed that predation had a huge influence on short-necked clam biomass, and protecting by nets is essential in this bay. We also showed the appropriate location of spawning based on current simulations. Recently the council has set up protecting nets at some places in the bay based on our proposal. We will continue this cooperative activity until we

successfully restore this area in the near future.

Creation of SATO-UMI as a policy in Japan

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Circumstance of the Environmental Coastal Seas in Japan: In Japan, Effluent Standards of nitrogen and phosphorus are applied in the enclosed coastal seas. In particularly regional area (for example: Seto Inland Sea), Total Pollutant Load Control System of COD_{mn}, nitrogen and phosphorus is added. As a result, remarkable pollution was improved, but the functional depression of material circulation, deterioration of the ecosystem including marine resources and citizen's unconcern for water environment were advanced. Therefore the Government of Japan promotes the verification of technologies for improvement of the water environment in enclosed coastal seas, pushes forward establishment of action plan to achieve the water environment quality that should be target in future indicated by the DO in the bottom layer and transparency. And recently the restoration of enclosed coastal seas by the creation of SATO-UMI is added.

The Creation of SATO-UMI as a National Policy: The creation of SATO-UMI as a national policy had its inception when it was designated as the environmental policy which should be started during the next one or two years in BECOMING A LEADING ENVIRONMENTAL NATION STRATEGY IN THE 21st CENTURY (MOE, June 2007). This strategy plans the creation of seas which are full of the natural blessings that various fishery products inhabit by integrating promotion of conservation and restoration of shallow area, water pollution control, and sustainable resources management.

Therefore, MOE has started supporting the advanced activities for the environmental conservation and evaluating the effects of them since 2008, and the know-how of these activities are going to be edited as a manual which serves as a reference when a new activity is started.

View point at Creation of SATO-UMI: MOE tidied up the concept of SATO-UMI as follows in cooperation with some experts in 2007.

- SATO-UMI is the coastal sea where human coexist with nature tied to living and the



traditional culture of people deeply with appropriate function of material circulation, high productivity and biodiversity under integrated coastal management by mankind.

- The creation of SATO-UMI can be a tool of the participatory and cooperative model for the integrated coastal management, because SATO-UMI is the concept of not only space, but also including human activities and can be gain the continuity if tied to the human habit.

- By material circulation, ecosystem and water amenity (these 3 elements are conserved by SATO-UMI), spot and hody of activity, SATO-UMI is categorized into some patterns like Basin type, Fishing Village type and others.

Silvo-aquaculture: an ecosystem based management for sustainable coastal aquaculture in Thailand

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Mangrove forests in Southeast Asia have declined significantly over the past four decades due to many of human activities i.e. population pressure, wood extraction, conversion to agriculture and salt production, tin mining, coastal industrialization and urbanization including the conversion to coastal aquaculture. Silvo-aquaculture is an ecosystem based management for the sustainable use of coastal area for aquaculture that integrates mangrove and aquaculture for produce seafood in coastal areas especially shrimp farm. The large scale of silvo-aquaculture, an integrated 116 ha of shrimp farms with 160 ha mangrove, has been demonstrated at Kung Krabaen Bay, Chantaburi, Thailand. A number of 113 small scale farmers and community were educated in farm management practices based on ecosystem approach including with water irrigation, environmental protection, mangrove sea replantation, seaweeds conservation and fish stock enhancement in the bay. The annual shrimp production from this area was about 11.2 ton/ha/year while mangrove forest has been slowly increased at a rate 1.3 ha/year by natural reproduction and replantation. The study of water quality and nitrogen budget indicated that treatment system and the hay played it role on trapping and utilization of the nutrients from intensive shrimp farm.

The small scale silvo-aquaculture pond (5.2 ha) was demonstrated in the mangrove

(*Rhizophora apiculata*) replanted natural shrimp pond (density about 11 tree/ha or 2,614 kg/ha) located in Nakhonsrithammarat, Thailand. Mud crab (*Scylla serrata*) and black tiger shrimp (*Penaeus monodon*) were stocked to supplement the natural recruitment. Little amount of fresh fish was supplemented as feed to enhance growth of crab. The result suggested that the biomass of mangrove was increased about 10% or about 29-74.49 mgC/m²/d or 0.15-0.37 mgN/m²/d, while the rate of litter fall was about 6.7-32.3 mgC/m²/d or 0.06-0.29 mgN/m²/d. The contribution of the mangrove tree to the production of culture species is comparatively low comparing to the other processors. This is probably due to slow degradation of the litter fall from mangrove tree. In addition, the result from nitrogen budget suggests that mud crab and shrimp are suitable for the silvo-aquaculture pond because they are benthic detritus feeders. The addition management techniques are probably needed in order to utilize/transfer nutrients to the culture species.

Phytoremediation of organically enriched sediment evaluation by a numerical model

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Evaluation of results from field experiments was made by a numerical model. The field experiments were those to remediate shallow enriched sediment by replanting mass-cultured benthic microalgae, *Nitzschia* sp. The observation results have already reported elsewhere, in which organic content of the sediment was significantly decreased and inorganic nutrient concentration was increased. However, the processes which may have occurred in the surface sediment were not clear with only stock data. Then we tried to evaluate how much amount of biophilic elements were cycled in the surface sediments. The model constructed in the present study is consist of 9

compartments; dissolved inorganic phosphorus (DIP), dissolved organic phosphorus (DOP), particulate phosphorus (PP), adsorbed phosphorus (EP), benthic microalgal phosphorus (BMA), *Nitzschia* phosphorus (Nsp), detritus feeder phosphorus (DEB), filter feeder phosphorus (FIB), and dissolved oxygen (DO). A marked characteristic of the model is that the thickness of the oxic layer of the surface sediment was variable depending on DO concentration in the overlying water. The model outputs reproduced well the observed results with minimum tunings. In comparison of phosphorus flow in the experimental site and control site, most processes showed large values in the experimental site, indicating phosphorus cycle in the sediments was enhanced by replanting BMA. Particularly, decomposition of PP and release of DOP from the sediment to the overlying water were markedly enhanced. Although DO production was obviously increased by photosynthesis of the replanted BMA, DO flux to the overlying water did not increase due to consumption for decomposition of PP in the sediment. To evaluate the superior points of replantation method of mass-cultured BMA for remediation of organically enriched sediments, a several sensitivity analyses were carried out. In one of them, same amount of PP was inputted onto the sediment surface in the model, then compared the results to those of replanted experimental site. In the results from the replanted experimental site, replanted *Nitzschia* sp. was fed by benthic animals while such an enhancement of feeding activity was not found in the PP addition. From these numerical calculations, it was concluded that decrease of organic matter in the surface sediment by replantation of BMA was explained by substantial enhancement of material cycle through food web.

Definition of Sato-Umi

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A new concept for coastal sea management called "Sato-Umi", defined as "High productivity and biodiversity in the coastal sea area with human interaction", is proposed. To establish the Sato-Umi, it is necessary to realize comprehensive material cycling and appropriate fish resource management in coastal sea areas.

It is said that "Nature takes its best state without mankind". Would it be true that no environmental problems would exist if mankind was not present on Earth? However, there would be no meaning to a discussion regarding environmental problems without the presence of mankind.

Nature does exist that takes its best state under mankind's interaction. In Japan, it is called "Sato-Yama". In Japanese, "Sato" means the area where people live and "Yama" means the forest. Sato-Yama is thus the forest near where people live. In 1987, the area of Sato-Yama in Japan was about 4 500 000 ha making up about 20% of Japan's total area of forest of 25 000 000 ha.

In this paper we discuss a new concept for coastal sea management that is based on the ideas of Sato-Yama. Is it possible to create a "Sato-Umi" similar to Sato-Yama? In Japanese, "Umi" means the sea, so "Sato-Umi" is defined as "High productivity and biodiversity in the coastal sea area with human interaction" (Yanagi, 1998, 2007).

To establish the Sato-Umi, we first need to understand quantitatively material cycling in the coastal sea area. That is, we need to know the quantity of nutrients that are loaded from the coast, and what are the primary, secondary and tertiary productions in the area. We need to clarify what kinds of actions by mankind are permissible or prohibited in the coastal sea area from the viewpoint of increasing production and biodiversity. The important focus is to establish comprehensive material cycling in Sato-Umi.

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Rehabilitation of Ariake Bay by oyster cultivation

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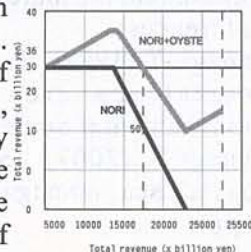
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One of the typical semi-enclosed bays in Japan, Ariake Bay, in Kyushu Island, western Japan is 20 km wide, 100 km long, 20 m deep as average and 1700 km² in area. Catches of finfish and shellfish have been decreasing since the late 1970's. The cultivation of sea weed, "Nori" had been

increasing but has now plateaued. Red tides in summer, however, cause anoxia and shortage of nutrients for "Nori" in winter. It has been assessed as receiving less, at least not more, nutrients and organic substances than in the past, no signs of rehabilitation have appeared in the bay. For recovering marine catches in the bay, there have been efforts to reduce pollutant load on the processes of generation, transport, and discharge of each pollutant, to control the catch by fishermen, to develop technologies, and to manage social systems on rehabilitation of the bay. In order to develop and apply new technologies and/or new systems for the rehabilitation, the most important item which has to be considered is the flow of nutrients, that is, food chain. As a technology to rehabilitate Ariake Bay, we propose the introduction of oyster cultivation including oyster bed to control the growth rate of phytoplankton. The procedure to develop the technology we have already taken is as follows:

1. To understand physiological characteristics of the oyster,
2. To understand relationship between the oyster and marine environment,
3. To establish a model to assess the growth of oyster which is competitive with "Nori" through phytoplanktons,
4. To secure a certain income for fishermen by cultivating oyster and "Nori" at the same time.

The conclusion obtained in our study is shown below. The cultivation of oyster could reduce the growth of phytoplanktons up to 8000 ton without any damage to the cultivation of "Nori." The income of fishermen increases at the amount. When the cultivation of oyster increases to 12500 ton, the increase of income by oyster balances the decrease of income in "Nori." The appropriate production of oyster is 8000 ton/year.



National initiative on environment management in coastal area of Korea

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The Korean coast, with fascinate landscapes and vibrant ecosystems, has been enduring intensive coastal developments since 1970's. More than 90% of national industrial complexes have been located in the coastal area. Population growth

rates of highly developed coasts are often three times higher than that of inland. Annual pollution load to the coastal area has increased 40 percent since 1990's; coastal wetlands were decreased 20% from 1987 to 2005; overall water quality conditions have been degraded by pollutants deposited by or discharged from inland as well; and massive harmful algal blooms (HABs) would lead to low oxygen levels in the water, fish kills, and economic losses. These coastal environmental issues resulted in raising public awareness on marine environmental protection.

To address coastal pollution issues, especially those of water quality, Korean governments initiated the National Clean Water Action Plan in 1995; with 4 billion USD investments, 205 wastewater treatment facilities were built in coastal area. And the National Plan for Marine Environmental Conservation was launched since 1996, providing national comprehensive framework for managing coastal environment systematically. Total pollution load management system (TPLMS), same as Total Maximum Daily Loads Program in USA, was introduced in the Masan Bay Special Management Area in 2008.

Recently Korean governments try to expand their management capacities to restore coastal ecosystems by enactment or amendment of relevant laws: Law on the Conservation and Management of Marine Ecosystem, Public Waters Reclamation Act, Coastal Management Act, and Marine Environment Management Act, etc.

Marine protected area network design ecological and socio-economic considerations and constraints in Thai Andaman coast

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Literature suggest that Marine Protected Area (MPA) Network or Network of Marine Reserves provide a framework that unifies the central aims of conservation and fishery management, while also meeting other human needs such as maintenance of coastal water quality, shoreline protection, education, research and recreational opportunities. In regard, some of the pioneer

researches on MPA Network design have focused on application of ecological criteria in designing an MPA Network, opportunity cost of developing such a Network as well as developing a general model for MPA Network design.

However, the examples are mostly from west (e.g., California Channel Islands, South Australia or Gulf of California), and there is not such study or research in Asian context. Therefore this study aims to examine an MPA Network design in Thai Andaman Coast, a tropical area with diversified ecosystems and habitats that belong to one of the world's highest biodiversity region. Among the existing studies, Gulf of California case resembles an area covering different habitats, which is more similar to the study area. But this case has not applied the ecological criteria to a greater extent. However this was another opportunity to examine the methodology context that they have used and modifying it with other case studies.

Although the other researches have used ecological criteria as a theoretical framework and describe the steps in designing an MPA Network, this study is keen in describing ecological considerations and identifying essential ecological criteria that mostly suite to the study area context. Within the existing ecological context it is necessary to identify the locally applicable and suited ecological criteria and selecting them to design an MPA Network in the study area i.e., Lower Thai Andaman Coast covering Krabi and Trang Province. Then the study aims in integrating socio-economic considerations which are necessary and are demonstrated in other research, e.g., fishing area, conflict use area.

The primary as well as secondary data collections have been done in relevant to the research objectives. Data on existing protected areas and available biodiversity, habitat types, human activities and uses, and major fishing grounds were collected. In order to collect primary data and interviews, field trips were conducted during Nov, 2005 and May July, 2006. The data were all processed into geo-spatial data or layers, which is in order to facilitate the Network design work in GIS environment.

Based on available data the study has demonstrated examples of an MPA Network in the study area considering existing ecological context and socio-economic activities. Further analysis on selecting applicable ecological criteria and socio-economic considerations are ongoing.

Effect of dredged sediments on ordinary concrete properties

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Artificial reefs with different geometric forms in general are used in aqua-cultural industry, because they provide different marine species with hard substrate for invertebrate organisms to settle in. Besides that provides protective shelters for fish and other marine organisms. Prospective assessment for making marine environmentally friendly materials such as marine blocks and reefs out of dredged sediments was evaluated.

Different proportions of dredged sediment treated with paper sludge ashes (1.5%) were added to the ordinary concrete in order to evaluate its effect on the compression strength, shrinkage and change in the mass for four weeks. Fine aggregate (sand) was partially or completely replaced by dredged sediments in the main concrete composites in order to compare between ordinary concrete and concrete with dredged sediments. Results indicated that, the three & seven days compressive strength was relatively higher for the samples treated with sediment when different W/C ratios were applied, however no change was observed at 28-days.

Moreover, no significant changes were noticed in the shrinkage and change in the mass for low W/C ratio (0.471), though these changes were relatively higher than ordinary concrete when W/C ratio was 0.686, and significant change at ratio of 1.145. To study the morphological aspects, SEM images were taken for different mixes at the age of seven days. SEM observations indicated that the micro-pores of the specimens contain sediment were filled with fine particles, therefore the total pore volume and maximum pore size were reduced significantly with increasing the sediment amount in the mixes.

Proper management of fishery resources using a bivalve growth model which included fishery catch and feeding damage

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Ariake Bay, which is one of the most prominent fishing grounds, is located in southwest Japan. The area is about 1700 km² with a tidal flat of about 190 km². Since the 1980's, fishery catch has decreased year by year. Among the suspected causes of the decrease, there are outbreaks of red tide, rise of water temperature, excessive fishery pressure and feeding damage by predators. Especially, as a cause of the feeding damage, it is reported that longheaded eagle rays (*Aetobatus flagellum*) have been seen in Ariake Bay since the 1990's, and prey on large amounts of bivalves. The eagle ray is more than 1 m in body width and 10 kg in weight. In Ariake Bay, a large number of rays appear in April and disappear in December. In this study, a simple numerical simulation model based on the bivalve growth considering fishery catch and feeding by the rays is developed and applied to assist with the proper management of fishery and extermination of predators.

The growth of bivalves is simulated as a function of water temperature. The quantity of natural resources of the bivalves is calculated by multiplying recent population density by habitation area. The fishery catch is estimated by summing up values of monthly catch from statistical reports. Monthly catch amount is more than 500,000 tons in the big catch years and equal to or less than 10,000 tons in the poor catch years. The biomass of the ray is estimated to be more than 3,000 tons based on the amount of capture for extermination. The daily amount of predation on bivalves by the rays is calculated to be 1% of the biomass during the appearance period.

As a result of this simulation, the bivalve resources varied according to the biomass of the rays. It was indicated that the predation pressure by the rays could be a serious factor affecting bivalve resources. With the big catch amount of

the past years, the bivalve biomass of recent years was entirely consumed causing the exhaustion of the bivalve. It clearly explains that the current bivalve resources cannot support the same amount of fishing as in the past. Under the conditions of both predations of the ray and past fishery catch, bivalve resources were diminished. To maintain the resources with this predation and catch, a biomass 4 times larger than recent bivalve populations is required. Our simulation model has revealed that it is important to decrease the feeding damage and to manage the fishery catch properly to maintain the bivalve resources.

Monitoring of macrobenthos and bivalve for biologically productive artificial tidal flats, Ago Bay, Japan

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Ago Bay in Japan is a typical enclosed coastal sea, which is connected to the Pacific Ocean through a very narrow and shallow entrance. The bay has been extremely contaminated by the practice of culturing pearls, which has been ongoing for the past 110 years. Because sediment eutrophication, oxygen deficient water and harmful algal blooms have occurred in recent years, the pearl culture industries were damaged. To address this problem, many attempts are being tried in order to improve the natural self-cleaning capability in the bay region by forming artificial tidal flat, shallow water area and sea algae and/or sea-grass bed inside the bay. To clean up the dredged sediments accumulated at the bottom of the sea, where the contamination is progressive, we are exploring the technologies to decompose the organic materials. This new technology-the Hi-Biah-System (HBS)-was developed in 2005. This system could dewater muddy dredged sediments and coagulate them to the solidified sea bottom

sediments for constructing an artificial tidal flat. The purpose of this study was to evaluate the environmental conditions of the constructed tidal flat over two years after it was built. We monitored the biological characteristics (restoration of macrobenthos and growth of bivalve) and physico-chemical parameters (oxidation-reduction potential, acid volatile sulphide, loss on ignition, water content, total organic carbon, total nitrogen, chlorophyll a, and particle size) for five types of constructed tidal flats and a natural tidal flat. At the same tidal situation, the physico-chemical parameters were almost similar among the five constructed and natural tidal flats. However, the biomass and macrobenthic population in the constructed flats was higher compared to the natural one. Moreover, it was observed that the results for the young short-necked clam indicated remarkably larger growth in the artificial tidal flat relative to that obtained in the natural one. From this result, it was supported that the muddy solidified sea bottom sediments were very effective for the excellent growth of the young clams. These observations may be considered to be attributable to the minerals which were supplied from the solidified sea bottom sediments. These solidified materials would give the good ecological conditions to benthic animals. The muddy dredged sediments generated by the HBS could provide useful materials for enhancing the productivity of the tidal coast in order to create new environment.

The present study is a part of the Ago Bay Environmental Restoration Project under the program of Japan Science and Technology Agency.

Isotopic evidence of seasonal variation in feeding niche of river and brackish gastropods

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Dynamics of organism's feeding niche in response to environmental changes is of fundamental importance for understanding determinants of community structures and diversity. Feeding niche can be examined by stable isotope analysis. At a downstream bank of Yura River, Kyoto, Japan, feeding habit of three common gastropods and their possible food were studied using ^{13}C and ^{15}N stable isotopes.

Anadromous gastropod *Clithon retropictus* depended mostly on benthic microalgae and marine POM as source of nutrition. It utilized about 65% benthic microalgae in spring and slightly decreased to 62% in summer while marine POM in its diet increased from 25% in spring to 30% in summer. Marine water enters Yura estuary and intrudes midstream from spring to summer, making oceanic phytoplankton available as part of the diet of *C. retropictus*. *Cipangopaludina japonica* and *Semisulcospira libertina* which are both freshwater gastropods change diet from spring to summer. In spring, *C. japonica* consumed about 67% from organic matter of the sediment but shifts its diet to river POM (68%) in summer. A wider food spectrum is consumed by *S. libertina* in spring; about 27% river POM, 25% sediment POM, 24% estuary POM and 16% microalgae. In summer, it shifts its diet to mostly river POM (71%).

To understand the dynamics of feeding niches of the three river gastropods, we measured and analyzed stable Carbon isotope trends of the five possible food items in the study site. Stable isotope ^{13}C of microalgae had enriched greatly from spring to summer, from -25‰ to -17‰ which indicated the presence of marine-origin epiphyton. The same trend was observed in sediment POM which increased from -26‰ to -22‰. River POM showed the opposite trend, ^{13}C decreased from -24‰ to -27‰ from spring to summer which indicated more influence of terrestrial-origin materials in the river freshwater during summer. Marine and estuarine POM showed relatively constant ^{13}C values in the two seasons (-22‰ and -24‰ respectively).

C. retropictus utilized marine POM aside from benthic microalgae. Although marine-origin materials are more available in summer due to marine water intrusion, *C. japonica* and *S. libertina* still selected terrestrial-origin materials either from river POM or sediment POM. Shift, expansion and overlapping of feeding niches were thought to be responses to food availability, competition and water dynamics in the estuary. River discharge and movement of marine water into the river may play an important role in the temporal change of feeding niches of the gastropod populations. This has implication on the diversity and management of river and estuary systems.

Evaluation of restoration effect in the coastal unused reclaimed area by promoting sea water exchange in Ago Bay, Mie Prefecture, Japan

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Ago Bay is located in Ise-Shima National Park, Mie prefecture, Central Japan. This bay is famous for cradle of the pearl culture and it has been continued for more than 100 years. However, harmful algal blooms and infectious diseases make the pearl oyster culture for whole year difficult. Furthermore, sediment eutrophication and frequent occurrence of oxygen-deficient water has caused the deterioration of benthic ecosystem and decrease of biological productivity in recent years. It is considered that one of the major causes of these phenomena is stagnation of the material circulation by reclamation of shallow coastal area including a tidal flat, sea glass and sea weed beds. The reclaimed coastal areas were made clear by the multi-spectrum aerial picture analysis. In detail, more than 50 years ago approximately 70% of tidal flats and shallow area were reclaimed for constructing rice fields in Ago Bay. But now these reclaimed areas are given up cultivation and changing the unused wetland. Therefore, for environmental restoration of Ago Bay, it is necessary to enhance the biological productivity and natural purification capacity which these areas provided, and to recover a smooth material circulation around the shallow area. Then in this study, attempts were made to enhance the biological productivity, by promoting water exchange between unused reclaimed area and outer sea using pumps, pipeline system was set up in an experimental reclaimed wetland. Improvements were evaluated by monitoring sediment quality, benthic abundance and species diversity every season.

1) Present state in unused reclaimed area

The total reclaimed areas are about 185 ha, however almost of these areas were given up cultivation and changed hypertrophic unused wetland in Ago Bay. Such areas add up to about 153 ha. The sediment of unused wetlands are too muddy and contain high organic matter, because the dykes which were constructing for reclamation, lead to accumulation of the nutrient and organic matter run off from the land. In these wetlands, the abundance and diversity of benthos

are quite poor.

2) Seasonal changes of the sediment quality, abundance and species diversity of benthos in experimental field by promoting the water exchange

The sediment samples from experimental field with promoting water exchange and natural tidal flat in front of the reclaimed areas were measured for COD, TOC, TN, IL, AVS, particle size, chl.a and benthic abundance and species were counted every season for 2 years. Now these monitoring are continuing. Before water exchange, sediment was hypertrophic and anaerobic state. *Capitella* sp. and *Chironomidae* were dominant species, because wetland was brackish. And more both wet weight and diversity were quite small. After water exchange, the macrobenthos were changed from brackish to sea water. The diversity and wet weight were gradually increased and after two years they became same level of the natural tidal flat in front of the reclaimed area. The COD and AVS in sediment were decreased too. These results indicate that the sediment statuses in wetland were gradually changed to the aerobic condition by promoting the decomposition of the hypertrophic sediment under the water exchange. Continuous water exchange would provide enhancement of the biological productivity. This method would lead to wise use of the coastal environment and enhance the biological productivity around the unused reclaimed areas.

Restoration of Elgrass (*Zostera marina* L.) bed by filling up a borrow pit with natural sediment

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The objective of this study is to evaluate restoration technology of eelgrass (*Zostera marina* L.) bed by filling up borrow pit by the coast of Iwakuni, the Seto Inland Sea, Japan. We constructed eelgrass habitat at the edge of a

previous borrow pit within eelgrass bed by filling up with natural sediment. We monitored sand movement, underwater irradiance and eelgrass shoot density at the constructed and natural habitats. Sand movement at the constructed habitat was from -8 cm to 9 cm showing little difference from that of natural habitats. The daily averaged underwater irradiance at the constructed habitat was more than 3 mol photons $m^{-2} \cdot day^{-1}$ necessary for eelgrass. Eelgrass disappeared after typhoon attacks in 2004-2006, whereas seedlings of eelgrass appeared both at the constructed and natural habitats every winter. These results suggest that restoration of eelgrass habitat by filling up borrow pit is a useful technique for eelgrass bed restoration

Possible bottom-up control of fisheries production in the Seto Inland Sea, Japan

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In recent decades, anthropogenic nutrient discharges into the Seto Inland Sea of Japan have reduced as a result of a set of measures for environmental conservation. On the other hand, several fish catches and/or stocks have collapsed in this area. Shifts in seawater quality and fisheries landings were accompanied by modifications in structure of marine communities. Alteration of resource availability represents a "bottom-up" effect on marine ecosystems, whereas removal of consumer biomass through fishing represents a "top-down" effect. Therefore, an understanding of how bottom-up and top-down processes influence the structure and dynamics of marine communities is necessary for effective management of fisheries production and marine ecosystems in the face of environmental variability and human impacts. In this study, we addressed the question of bottom-up versus top-down control of marine ecosystem trophic interactions by using long-term nutrients and phytoplankton biomass data and annual fish catch data (1973 - 2005) in Harima-Nada, located in the eastern part of the Seto Inland Sea of Japan.

Linear regression model showed a significant relationship between dissolved inorganic nitrogen concentration and phytoplankton biomass (chlorophyll a concentration) for the period 1991 to 2005. A positive relationship was also found between mean annual phytoplankton biomass and annual yield of pelagic plankton feeders for the same period. These results demonstrate close linkages between nutrients (especially dissolved inorganic nitrogen), phytoplankton, and pelagic plankton-feeding fishes, suggesting that bottom-up control regulates fisheries production in Harima-Nada during recent decades. Our findings have also an important bearing for ecosystem approaches to fisheries, particularly for the estimation of the carrying capacity with regard to sustainable exploitation.

Evaluation on Pb contamination in algae in Osaka Bay, Japan

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Heavy metal concentrations of the brown alga *Undaria pinnatifida* and the green alga *Ulva* sp. collected at 15 and 6 locations, respectively, from Osaka Bay are measured with inductively coupled plasma mass spectrometry (ICP-MS). The data are compared in order to evaluate the usefulness of a biomonitoring system for assessing the geographic distribution of heavy metals in coastal seawaters.

The ports of Osaka Bay are located on the N side coast (e.g., Kobe Port, Osaka Port) and the SE side coast (fishing ports). In contrast, Awaji Island, on the SW side of the bay has a natural coast. We believe the port areas receive contamination from anthropogenic sources such as shipping activities. *Undaria* from Kobe Port, a major industrial port, show extremely high Pb concentrations (3.5 ± 0.27 ppm, dry weight) and those from the SE area are relatively high (0.43—1.4 ppm, dry weight), while those from the SW area are low (0.14—0.36 ppm, dry weight).

Geographical variation in Pb concentrations of *Ulva* in the bay is different from that of *Undaria*. The Pb concentrations in *Ulva* from the SE area show a variance of between 0.29 and 1.71 ppm (dry weight). These concentrations are lower than those in the SW area (2.28-2.69 ppm, dry weight), although shipping activity in the latter is much less extensive. The sources of Pb contaminations in *Undaria* and *Ulva* are further investigated by Pb isotopic data and a factor analysis for heavy metal components (Cr, Mn, Cu, Zn, Cd, Pb) in *Undaria*.

Lead isotopic data for *Undaria* from two port localities, and two non-port localities and *Ulva* from one port locality and one non-port locality are acquired by thermal ionization mass spectrometry (TIMS). $^{208}\text{Pb}/^{206}\text{Pb}$ values in *Undaria* from non-port areas (Yura and Ikuho) are 1.1576 and 1.1638, respectively. These values are very similar to those in *Ulva* from port (Tarui) and non-port (Yura) areas: 1.1574 and 1.1649, respectively. However, *Undaria* from port areas (Kobe Port and Tarui) show $^{208}\text{Pb}/^{206}\text{Pb}$ ratios from 1.1372 to 1.1522, which are much lower ratios than those from non-port areas, suggesting that *Undaria* from port areas and non-port areas receive Pb from various sources and that *Ulva* and *Undaria* can maintain different Pb isotopic ratios in the same habitat. With the exception of one sample from Tarui, $^{208}\text{Pb}/^{206}\text{Pb}$ values in *Undaria* and *Ulva* (1.1486-1.1696) were similar to the ratios in the coastal seawater in Japan (Miyazaki and Reimer, 1993); however $^{208}\text{Pb}/^{206}\text{Pb}$ ratios in the latter are much lower (34.85-37.57) compared with the current report. Plots of $^{208}\text{Pb}/^{206}\text{Pb}$ versus $^{208}\text{Pb}/^{206}\text{Pb}$ ratios appeared to overlap with the field of airborne particulate in Osaka City (Osaka City, 2007) and those ratios in most specimens overlap with the field of road runoff in Osaka City (Osaka City, 2007).

Two significant factors accounting for about 77% of the variance were distinguished for the analyzed data. The first factor was characterized by high levels of Pb and Cu and the second factor was high level of Mn. Those scores of river water contaminated from road runoff (Osaka Pref, 2004) in the first and second factors differ greatly from those of *Undaria*. Those scores of *Undaria* from Amagasaki, where is near an abandoned industrial area and a sewage plant, corresponded closely to those from the SE area.

These observations suggest that $^{208}\text{Pb}/^{206}\text{Pb}$ and $^{207}\text{Pb}/^{206}\text{Pb}$ ratios in the algae from the areas affected by human activities in Osaka Bay are lower than those from the natural area and are

controlled by mixing processes involving various components including sewage water and seawater rather than one source such as road runoff.

Durability of sand capping effect in the inner area of Ariake Bay

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The sand capping method appears to be useful for improving the environment of bottom sediment in the inner area of the Ariake Sea. It is usually thought that its effect becomes dull in only a few years. The present study investigates the secular change of the bottom sediment environment in sand capped sections, which were constructed by Saga Prefecture from 2001 to 2003. The relation between the habitation of benthos and the grain size distribution was investigated.

Sediment sampling was conducted in nine sand capped sections for evaluating the profile of sediment environment in 2005 and 2006 and in three sections for investigating benthos in 2007. Sediment column was taken with an acrylic pipe. Three column samples were taken from each section, two samples were taken inside and one sample was taken outside a section. A sediment column was divided into pieces of 5 cm thick. The grain size distribution of each piece was examined with sieves. A surface sediment sample was taken using an Ekman-Birge type bottom sampler and put through a screen of 1mm meshes. The residue was fixed with 10 % formalin solution and benthic organisms were sorted, identified and weighed.

The ratio of fine sand (0.075-0.25 mm) of the surface sediment (0-0.05 m) increased from 2005 to 2006 at most of sections. The apparent change in grain size distribution might be occurred owing to huge disturbance of sea water caused by the typhoon (T0514) which crossed the Ariake Sea on September 6 in 2005. The effect of sand capping on grain size distribution was recognized except for section SW01, in which the ratio of sand ranged 0.075-2 mm was larger from the surface to deeper layer for capped and non-capped point, i.e. outside the section. Species, population and weight of benthos at sand capped point were obviously larger than non-capped point in NE02 and NE03.

Table 1 Grain size distribution of surface sediment (0-0.05 m, in 2006) and benthos (in 2007)

Section	Const- ruction	Grain size distribution (%)					Wet weight (g/m ²)				
		0.005mm	0.005- 0.075mm	0.075- 0.25mm	0.25- 0.85mm	0.85- 2mm	Mollusca		Anne- lida	Arthro- poda	other
							Bivalvia	Gastropoda			
NE01	2001	0.9	8.1	48.1	32.9	10.0					
NE02	2002	3.3	20.4	47.4	19.0	10.0	18862	147	93	4	267
NE03	2003	0.8	10.8	63.4	21.9	3.0	12142	178	0	0	360
SE01	2001	0.2	2.0	84.2	12.5	1.2					
SE02	2002	0.7	4.4	66.5	22.7	5.8	1787	218	0	22	111
SE03-1	2003	0.8	4.6	80.9	12.8	0.9					
SE03-2	2003	0.5	3.7	87.8	5.4	2.7					
NW01	2001	2.1	7.8	45.0	35.6	9.5					
Sw01	2001	0.6	3.6	39.4	40.2	16.2					

Studies on variability of phytoplankton concentrations in the Bay of Bengal and associated physical processes using remote sensing data

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The Bay of Bengal (BOB) surface water is considered as oligotrophic but bottom nutrient levels are higher relative to global ocean. Despite large influx of river water into the BOB, it is considered as moderately productive ecosystem (150–300 gC m²/yr) based on SeaWiFS global primary productivity estimates. The climatology of surface Chlorophyll-a (Chl-a) concentration as obtained from SeaWiFS show clear seasonal cycle with maximum concentration (>0.5 mg/m³) during post-monsoon season (September to November). Most fascinating features of BOB is the seasonal reversal of monsoon current and the summer upwelling across the east coast of Sri Lanka associated with the strong southwesterlies which pull up the thermocline.

Surface Chl-a concentration during summer (JJAS) and winter (NDJF) of 2000 and 2001 were derived from SeaWiFS data and were studied in relation to zonal Ekman transport based on estimate from QuickSCAT wind field, SST from NOAA-AVHRR and SeaWiFS derived photosynthetically available radiation (PAR). It is observed that coastal upwelling due to Ekman transport is not sufficient to overcome the stratification and to enhance the surface production. As most of the sky remains cloudy during summer monsoon season, it becomes an inhibiting parameter for the growth of primary production despite the fact that PAR is higher in summer compared to winter months. The

strengthening of seasonal thermocline in summer results in nutrient limitation of phytoplankton growth. Monthwise SST- Chl-a relationship for 2000 and 2001 show SST Chl-a anti-correlation and particularly during summer and winter months. Monthly sea surface height anomalies (derived from TOPEX/POSEIDON satellite altimeter data) overlaid on the monthly Chl-a (based on SeaWiFS) clearly show that a prolonged positive/negative sea level anomaly can lead to sparse/dense Chl-a levels. Monthwise composite of net surface flow with Chl-a concentration in the monsoon current province during 2000 show a strong linear relationship between the two. Chl-a concentration during some special weather events such as tropical cyclones which occurred during November and December 2000 were also examined as these short weather events significantly alter the biological state of the BOB surface water.

Thus, the above study clearly depicts the biological response of the BOB surface water to various physical forcing and their variability in time and space. Further, the study also points to the important use of multiple satellite data sets/observations, with or without model simulations, in understanding the complex biophysical environment in the Bay of Bengal, one of the largest fresh water and sediment input sites of the world ocean.

Approach to improve nutrient situation in the Seto Inland Sea, Japan

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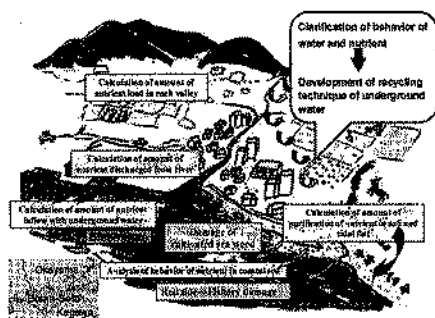
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The nutrient load from the land influences the nutrient concentration in enclosed coastal sea. On the other hand, even if the fishery damage that the nutrient state relates is caused, it is difficult to solve such problems, because extent where the nutrient load from the land influences the sea area water quality is not revealed yet. Then, in Bisan-Seto (central area of the Seto Inland Sea), a research project is started to clarify the behavior of the nutrient from the source (land) to coastal sea consistently. In this project, we are trying to specify the region where the possibility that the fishery damage occurs is high. And, by recycling underground water, we are aiming at technological development to decrease the nutrient concentration of the underground water at the farmland that is the nutrient source. This time, the outline of this project and the characteristics of Bisan-Seto are explained.

1. Outline of this research

This study project is composed of the item chiefly shown as follows, and shows the image in Figure1.

- 1) Calculation of behavior of nutrient that discharged from river and underground.
- 2) Calculation of amount of nutrient purified in soil and tidal flat.
- 3) Presumption of behavior of nutrient in



coastal sea.

- 4) Development of recycling technique of nutrient contained in underground water in farmland

2. Characteristic of Bisan-Seto

In order to clarify the characteristic of Bisan-Seto, we analyze the water quality data observed by Kagawa Prefecture and Okayama Prefecture. And using these data, numerical model experiments are carried out to calculate water flow field. As a result, the following fact was clarified.

- 1) The stratification doesn't develop enough even in summer, because tidal current is strong.
- 2) The nutrient concentration is usually low, except near the shore.
- 3) The nutrient concentration reaches the maximum value in autumn, though the cause cannot be clarified.
- 4) Because the stratification doesn't develop in summer, the seasonal variation of residual current is not found except around river mouth.

Nutrients, organic carbon and oxygen budget in semi-enclosed Ago Bay, Japan

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Ago Bay is a small semi-enclosed coastal water body of Japan and is well known as the birth place of the pearl culture. The culture began about a century ago and the production reached a peak point about 40 years ago. Since then, the production has declined and the present production had fallen down to the one fifth of its peak point. The deterioration of the marine environment has become serious in recent years, but it is unclear whether the long usage of the water body by the culture is the cause. The sediment quality in terms of COD at the bay head area has increased and had exceeded far the local regulation limit. The settlement of hypoxic water mass in the bay head area continues during warm season, every year.

Mie Prefecture, which is the local government, had conducted the corresponding research project called CREATE for five years. The outline of the project was presented on the EMECS 7 conference(1) to 4). This article reports a

conclusive result for the material budget around the bay. Nutrients, organic carbon and oxygen are the materials of subject, since the cause of the environmental deterioration was presumed to relate to the change of organic matter pathway in the bay.

The data for standing stock, flux and reaction rate of regarding materials were gathered by the extensive observations and the laboratory experiments performed during the project. Then, these data were utilized to set up numerical models, which played a role to produce data for material budget. The models consist of the catchments area model, the hydrodynamic model of seawater, the pelagic water quality model and the sedimentation model. Many features of the material flow in the bay were disclosed through the analysis. An important result is that the contribution of organic matter load to the seabed by the pearl cultivation was quantified. Fig.1 shows the Particulate Organic Carbon (POC) deposition flux from the pearl oyster is 50 ton yr⁻¹ which corresponds to only 3% of total POC deposition flux. This result, therefore, changes our view of the deterioration process of the sediment in the shell cultivating sea area. Fig.2 shows Organic Carbon (OC) budget in the sediment, which brought us the information about the degradation pathway for OC in the sediment at the different location in the bay. We will show comprehensive results for material budget of Ago Bay in the conference, including some results for evaluation of the future restoration activity.

References for EMECS 7; 1) S.Chiba, Session 1-7, 2) Anggara Kasih, Session 1-8, 3) T.Kato, Session 3-4, 4) S.Chiba, Session 3-5

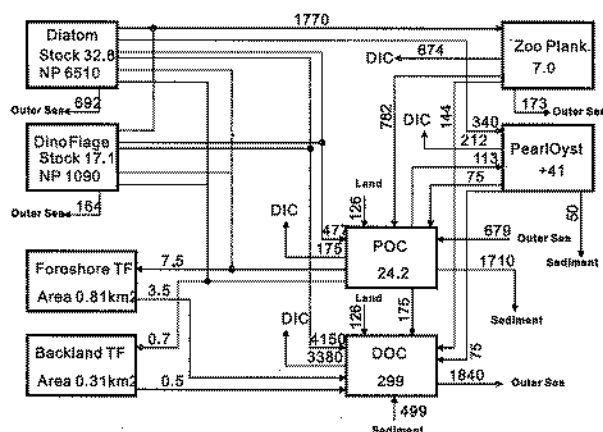


Fig.1 Yearly budget of organic carbon in the entire bay (ton year⁻¹); the data is the sum of the transport, production and consumption. TF means tidal flat

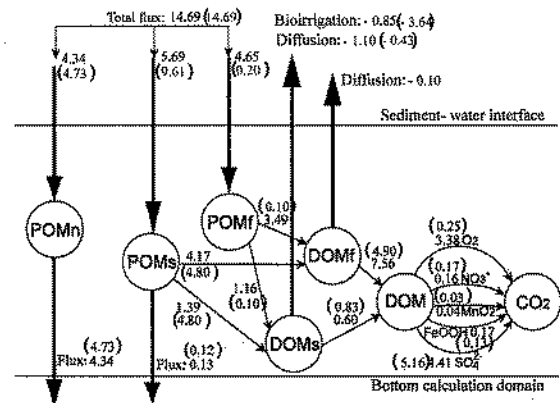


Fig.2 Yearly budget of organic carbon in the sediment (mmol m⁻² day⁻¹); the values with parenthesis are for the bay center area and those without parenthesis are for the bay head area, respectively

The improvement of the bay environment recorded in a sediment core at Asou Bay in the Tsushima Island, southwestern Japan

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The Tsushima Island is located between the Japanese Islands and the Korean Peninsula, eastern Asia. Asou Bay is present in the middle part of the Tsushima Island. The bay opens to the west and is connected to Miura Bay on the east through the Manzeki-seto Strait, which is an artificial strait and was constructed by the Imperial Japanese Navy in 1900. At that time, the strait was 40 m wide and 4.5 m deep. Afterward, it was extended and dredged in 1975 (width: 40m, depth: 4.5m). We collected a sediment core 18 cm thick in the inner part of Asou Bay (34° 18.069' N, 129° 20.869' E, 16 m in water depth). The core was sliced in 5 mm thick, and 36 samples were obtained. We conducted several analyses to reconstruct the temporal changes of depositional environments; gamma spectrometry (²¹⁰Pb and ¹³⁷Cs) analysis, CHN (total organic carbon (TOC) and total nitrogen (TN)) analysis, grain size analysis and meiobenthos (Crustacea: Ostracoda) analysis.

As a result, the sedimentation rate based on ²¹⁰Pb and ¹³⁷Cs dating was 0.11 cm/year. Therefore, the estimated age for 18 cm level is about 150 years. The C/N ratio is constant before the 1900s and

afterward it has decreased up to the recent. Before the 1980s, grain size was constant, but it became coarser gradually after 1980s.

The result from the ostracode analysis reveals that the construction and extension of the Manzeki-seto Strait have influenced the distribution and composition of ostracode assemblages around the inner part of Asou Bay. Before the 1900s, *Bicornucythere bisanensis*, which lives in oxygen-poor bottoms, was abundant. On the other hand *Nipponocythere bicarinata*, which cannot tolerate anoxic or oxygen-poor bottoms, was rare. Between the 1900s and 1970s, *B. bisanensis* decreased although *N. bicarinata* increased gradually. Since the 1970s, there are no significant changes of the species composition of ostracode assemblages, but the total number of individuals has increased up to the present.

Thus, seasonal hypoxia was developed in the study site before the 1900s. The construction and extension of the Manzeki-seto Strait, however, have promoted the inflow of oxygen-rich waters from open seas and have improved the environment in the inner part of Asou Bay.

Up-to-date technology for treatment watery sediments

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The Project of Environmental Restoration of Enclosed Coastal Seas in Agobay of Mie Prefecture in Japan was carried out by a group of collaborative researchers assigned by Japan Science and Technology Agency for five years since 2003. This project deals with efforts to clean up the deteriorated sediments that are accumulated at the bottom of the sea. Agobay is known as the starting bay on the culture of pearl oysters by Mr. Kokichi Mikimoto and has been contaminated in the continuation of pearl culture spanning 110 years. Attempts are in order to enhance the self-cleaning capability of the natural water in the bay by using the many kinds of artificial restoration technologies, that is, dredging engineering, re-forming artificial tidal lands and seaweed beds. As one of the innovated investigation results, new technologies for dewatering and solidification of the dredged

sediments were developed by the original coagulant, named 'AGOCLEAN-P', which was made of paper sludge ashes wastes and/or coal ashes as raw materials. The coagulating mechanism of AGOCLEAN-P is explained that ettringite crystallites are firstly formed in the watery sediments when the powdered coagulant and wet sediments are mixed. The mixture reacts with water to make soil particles by cross-linkages of silicate networks. Soil particles are agglomerated to become diameter several 10 μ m and does not disperse into water as silts. The separation between agglomerates and clear water is performed very well and sedimentation of agglomerates is happened very short time. After dewatering by press, treatment dredged mud can reuse for the raw materials of artificial tidal flats, granular micro-habitat beads for microorganism, seaweed beds, and marine blocks. This treatment will improve the turbidity of sea water in order to reach the sun light in the bottom of the sea. This technique will be applied to the environmental cleaning about river catchment and estuary areas in Asia. Wetland restoration actions, in general, for lagoons, lakes, rivers, and reefs grow yearly on a point of view for global environmental problems.

Nutrients transfer between the sea and artificially enclosed waters

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Agobay has several enclosed water bodies surrounded by concrete dykes which were artificially constructed for rice cultivation, and almost of the nutrients from the land flow down to the sea through these enclosed waters. In order to estimate the amount of nutrients discharged into the sea, evaluation of the waters enacting on the nutrients flow is regarded very important. Therefore, the nutrients flowing into the Ishibuchi-pond and Tateishi-pond have investigated in this study.

Area of Ishibuchi-pond is estimated to be ca. 15000 m², and the bottom sediments in this area are in extremely anaerobic condition. Tateishi-pond has no river flowing into them, and surrounded by natural forest. The total area of the

Tateishi-pond is estimated to be 850 m² at the low-tide (0 cm to 30 cm above sea level), and ca. 2000 m² at the high-tide (higher than 30 cm above sea level). Few benthos and shells inhabit the area.

In investigation of Ishibuchi-pond, survey was conducted at the water gate of the dyke and the mouth of the river flowing into the pond (two points). Tateishi-pond, survey was also conducted at the water gate. The measurements were carried out during spring-tide 2 or 3 days consecutively. Usually sea is alternating high-tide and low-tide twice in a day, however contrary to this, the water level in the pond was witnessed to have high-tide and low-tide only once a day. Furthermore, a time lag of ca. 3 h was recorded between the high tide in the pond and that observed in the outer sea. However, the time lag was only ca. 30 minutes in case of low tides in the pond and outer sea. It was considered that the water gate has a kind of structure of check valve, which is hindering the up-flow from the sea. The sea level fluctuates from spring tide to neap tide in two weeks. As may be expected, while moving from neap tide to the spring tide, usually sea water levels become higher at the high tide, and lower at the low-tide. Contrary to this, although water level in the pond on the same occasion becomes lower at the low-tide, it tends to remain/become lower at the high-tide as well. This phenomenon is regarded as an influence of the structure of the water gate which is hindering the water flow from the sea.

Regarding outflow and inflow of T-N and T-P between the outer sea and the waters, no significant difference was observed in Tateishi-pond, however, the outflow of T-N and T-P to the sea in case of Ishibuchi-pond was bigger than the inflow from the sea. So far, it has been presumed that the amount of nitrogen and phosphorus will be reduced by the processes like sedimentation and/or de-nitrification in the pond, however, results from the present study do not support this hypothesis. However, survey time in our investigation was rather limited, and therefore, much more accumulation of the data over a longer period is require.

China estuaries aquatic biodiversity and endanger aquatic wildlife conservation

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The coast line length of China is about 18000 kilometers; the Chinese insbore rivers are

numerous at the same time. There are 1500 or more with the river valley area is above 1000 square kilometers. The most of rivers flow to the ocean become various river estuary ecosystems.

The Chinese important river mouth includes the Liao River estuary, the Yellow River estuary, the Yangtze River estuary and the Pearl River estuary, these important river estuary be abundant on of the biology quantity, and with high biodiversities. All of them are important habitats for endanger wildlife species in China. "China national protection wildlife category" have 80 aquatic wildlife species, in addition to 20 fresh waters species, the big part of them distributes in estuary, first-class protecting aquatic wildlife include Chinese white dolphin (*Sousa chinensis*), Baiji dolphin (*Lipotes uexillifer*), Chinese sturgeon (*Acipenser sinensis*), Chinese paddlefish (*Psephurus gladius*) etc., second-class protecting animal include seal, cetaceans, Loggerhead Turtle (*Caretta caretta*), Green Sea Turtle (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Pacific Ridley Turtle (*Lepidochelys olivacea*) and Leatherback Turtle (*Dermochelys coriacea*), finless porpoise (*Neophocaena phocaenoides*), roughskin sculpin (*Trachidermus fasciatus*) etc. the estuary is important to the existence of these species. Most spot common seal (*Phoca utulina*) documented in the Liao River estuary for Breeding in China, the yellow river is an important waterfowl habitat, the Yangtze River is the important for Chinese sturgeon migration, also for finless porpoise and roughskin sculpin's habitats. The Pearl River is the important for Chinese white dolphin to distribute the ground, the many sea turtle was found in this area. Also Because of the influence of human activities, cause the river estuary ecosystem deteriorated seriously, express to descend for aquatic biodiversity. The main factor of affect include: (1) Pollution of the environment, enrich the nourishment; (2) The fishery activity cause of over-fishing; (3) The influence of the engineering construction; (4) the indiscipline variety of the sea fresh water quantity; (5) Transportation and ships.

Conservation recommendation: (1) Sound aim at the protective laws of the estuary ecosystem; (2) Raise the protective public awareness; (3) Strengthen the pollution exhausts the management, reducing discharge into the sea; (4) The control fisheries catch, manage the fishery on base of the ecosystem system; (5) enhance natural sanctuary construction and managements.