PACON 2004
(20th Anniversary)
New Technologies, New Opportunities

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PACON 2004 (20th Anniversary)
New Technologies, New Opportunities

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GLOBAL LEADERSHIP, GLOBAL OPPORTUNITIES

Richard W. Spinrad
Ocean Services and Coastal Zone Management, NOAA
Silver Spring, Maryland, USA

The U.S. National Oceanic and Atmospheric Administration (NOAA) is charged with understanding and predicting changes in the Earth’s environment and conserving and managing coastal and marine resources to meet the U.S.’s economic, social, and environmental needs. Increasing pressures on coastal and marine resources are, however, requiring even more diligent and innovative efforts to not only increase our understanding of and ability to predict environmental changes, but to strengthen our focus on properly managing resources to balance environmental conservation with the economic and other societal needs that all nations have in common.

In light of this need for balance, the four mission goals for NOAA are to: protect, restore, and manage fisheries and other living marine and ocean and coastal resources; understand climate variability and change; serve society’s needs for weather and hydrological information; and support commerce by providing oceanographic and meteorological services that promote safe, efficient and environmentally sound transportation. New technologies have provided rapid advancements in our capabilities to acquire, process and deliver data and services to meet each of these goals.

Fulfilling these responsibilities, however, also means recognizing the undeniable importance of our relationship with other nations in addressing ocean issues. Just as nations are connected through our shared marine environment, coastal and marine ecosystem stewardship must be globally integrated. NOAA has developed a vision for global leadership in this arena, leadership that relies on new opportunities to communicate and share both ideas and results with other nations that strive to attain similar goals. This vision can be achieved through coordination of international efforts, capacity building, technology transfer, and integrated management.

NOAA’s efforts, both through our diverse domestic programs and our commitment to international activities, provide a wealth of opportunities to further an integrated management approach that incorporates science and technology, views the needs of stakeholders as a primary consideration, and promotes the sharing of standards, practices, and capabilities to allow enhanced international partnering.
TECHNOLOGIES AND OPPORTUNITIES TO PROTECT CORAL REEF ECOSYSTEMS IN THE PACIFIC

Robert H. Richmond

Kewalo Marine Laboratory, Pacific Biomedical Research Center
University of Hawaii, Honolulu, Hawaii, USA
richmond@hawaii.edu

Tropical coral reef ecosystems possess a high degree of biodiversity that supports their ecological, cultural and economic value. Scleractinian corals are conspicuous and essential elements of these biological communities and their populations persist through the dual processes of reproduction and recruitment of individuals and colonies. Most reef-building corals reproduce during limited mass spawning events annually, during which time their gametes float to the ocean’s surface and intermingle. Pollutants carried in freshwater runoff from land-based sources can interfere with critical chemical cues affecting synchronization among reproductive coral colonies, egg-sperm interactions, larval development, larval recruitment and subsequent acquisition of symbiotic zooxanthellae. Re-suspension of accumulated sediments can also impact coral reef resilience in the absence of additional terrigenous sources. Interdisciplinary and multidisciplinary studies are crucial to answering key questions about coral reef structure, function and response as well as to supporting sound policy development for the implementation of scientifically based coral reef resource protection initiatives. Modern technologies in the physical, chemical and molecular sciences can provide answers, however social sciences and traditional cultural practices are essential elements in providing workable solutions. By integrating technological advances with traditional management schemes and societal structures that are well established within the Pacific Islands, great opportunities exist to manage human activities that are responsible for coral reef degradation. It is an important responsibility of scientists to meet the challenges of translating research into policy and action if we are to leave a decent environmental legacy to future generations.
PLANNING OF TAIWAN DISTRICT AS A SEA TRANSPORTATION HUB IN THE ASIA-PACIFIC REGION

Ho-Shong Hou
Office of the President
Taiwan

Taiwan, a stronghold island of a shipping line. She is also the perfect economic location for Pan Pacific shipping fleets that serve the region among Japan, Korea and North of America. From the perspective of U.S. or Japan, Taiwan or Hong Kong should be the most west point of Pacific shipping line. And Singapore should be the most east point of the main shipping line towards Europe via Suez Canal. Ports among Singapore, Taiwan or Hong Kong become feeder ports and transshipment ports.

Taiwan locates at the top of the Pan Pacific shipping line, which is the hub location of the maritime market main shipping line connecting short-term feeder shipping or global shipping line towards Europe via Suez Canal. As the cost consideration, Taiwan can also be the ideal transshipment port of Mainland China’s coastal harbors, such as Shanghai, Ninpo, and Fuchou. As the maritime market geographic location, Taiwan locates at the best location, which possesses an important position of global maritime market and that promote Taiwan's trading credit and the economy growth to be the best location for Asia-Pacific region.

In the future, mutual tractional economy power between Hong Kong, Taiwan and Shanghai will form a brand new economy region—Asian Golden Triangle. Core area of that region provides economic scale and assembly economy. Taiwan’s economic scale and assembly economy has reached the economy core area of high income, hi-tech, and diversification. Asian Golden Triangle’s future is restraining on Taiwan’s self-promotion, and if transportation system can provide low-cost and convenient joint system, then transportation will gather industries’ independent functions.
THE PROMISE OF MARINE BIOTECHNOLOGY, ILLUSTRATED
BY A MISSING LINK IN THE CARBON CYCLE EQUATION

Ronald Weiner

Department of Cell Biology and Molecular Genetics
College Park Maryland, USA
RW19@umail.umd.edu

The early promise of Marine Biotechnology is on the threshold of great fulfillment, offering new and improved products from the seas, including enzymes, pharmaceuticals and biomass with cognate degradative enzymes for energy production. It offers new and improved processes including bioremediation and aquaculture technologies. It is the beneficiary of the last frontier of exploration on earth (e.g. 99% of all marine prokaryotes remain undiscovered) as each new discovery spawns exciting biotechnological applications.

One important area, considering global warming concerns, is the marine carbon cycle. Yet, an important component of this carbon cycle, the microbial degradation of cellulose and hemicellulose, is not well characterized in the oceans which comprise most of the biosphere. In fact, surprisingly little is known about how the >25 billion tons of complex polysaccharides (CP), including those associated with biofilms, planktonic organisms, algal blooms, shells of benthic invertebrates and, especially, woody material are recycled to usable carbon. Very recently, several related bacterial genera that carry out these processes have been discovered, either by isolation or metagenomics. One species, *Microbulbifer degradans*, is the very first free-living, marine bacterium shown to be capable of degrading cellulositic algae, higher plant and woody material in monoculture.

The annotations of its genome sequence and subsequent proteomics have yielded many surprises. *M. degradans* is truly unique, so far, in the variety of carbohydrates it produces. Analysis of its recently sequenced genome predicts that there are >180 open reading frames encoding enzymes involved in the depolymerization of CP. Additionally, it is likely that at least another 200 genes are involved in signaling, regulation and further metabolism of CP. *M. degradans* is the first free-living marine bacterium shown to degrade all three of the major components of higher plant cell walls. To do this it synthesizes six major enzyme systems (cellulases, xylanases, arabinanases, laminarinases, pectinases, and mannanases), more than 60 enzymes in all.

The significant discovery of *M. degradans*, and related prokaryotes, as versatile saprophytes and significant participants in the marine carbon cycle, has suggested numerous biotechnological applications. They have multiple hydrolytic enzyme systems useful for bioremediation and they have significant potential in the exploitation of biomass by the energy industry.
We made a research of the technique development to evaluate water depth errors and to improve accuracy of survey, in order to measure the pondage of the dam with the high-precision with the multi-beam sonar system. The research to introduce here was carried out in the dam site, but it is expected that this technique will be effective in a place where the signal from the GPS doesn’t reach easily like a narrow cove and a fiord surrounded by mountains. As the specific research issue, we narrowed down to three problems. The first has expanded a useful area of KGPS by a method of two dimensional processing. Secondly, the motion difference of an underwater sonar head and a ship body was compared. At last, the comparative test of a magnetic compass (KVH Gyro-track) and a fiber-optic gyro (OCTANS) was carried out to investigate the necessity of the high-precision acoustic beam position measurement that used a fiber-optic gyro. As a result, detailed bathymetric information of the lake was gotten.
ATTRIBUTES OF MULTI-ANGLE SWATH BATHYMETRY SONARS

John S. Bird, Geoff K. Mullins and Paul Kraeutner

School of Engineering Science
Simon Fraser University
Burnaby, British Columbia, CANADA
jbird@sfu.ca

The term ‘multi-angle swath bathymetry’ (MASB) is used to describe angle-estimation bottom-mapping sonars that use filled arrays. This paper addresses the accuracy of these sonars and shows that in terms of angle estimation performance there is little difference between sonars using filled linear arrays of multiple elements and simple interferometric sonars using two-element arrays. However, other issues that make simple interferometric sonars impractical in many real mapping situations can be mitigated with filled arrays. The paper begins by comparing and contrasting the angle estimation performance of filled arrays and two-element arrays of the same physical extent. The issues of angle ambiguities, multiple angles of arrival, and array imperfections that plague two-element interferometric sonars are then addressed. It is shown that filled array sonars do not suffer from angle ambiguities and can effectively estimate the angle to the bottom even in the presence of a strong multipath signal. Moreover, the backscatter signals from the filled array can be processed in a manner that reduces the effect of crosstalk, and gain and phase imbalances in the array. Examples of beampatterns for real MASB arrays exhibiting various degrees of crosstalk, and bottom profiles obtained in multipath environments are presented.
REPEATED TRIALS OF SEAFLOOR GEODETIC OBSERVATION AROUND JAPAN

Masashi Mochizuki¹, Masayuki Fujita², Mariko Sato², Zengo Yoshida¹, Masato Katayama², Tetsuichiro Yabuki² and Akira Asada¹

¹Institute of Industrial Science
University of Tokyo
Meguro-ku, Tokyo, JAPAN
moma@iis.u-tokyo.ac.jp

²Hydrographic and Oceanographic Department
Japan Coast Guard
Chuo-ku, Tokyo, JAPAN

Institute of Industrial Science and Hydrographic and Oceanographic Department have been constructing the geodetic observation network on the seafloor around Japan. The observation network, which consists of sixteen seafloor geodetic reference stations, has been built along the ocean trench regions by the end of 2003. Several more stations are planned to be added to cover whole area of the Nanakai trough where the Philippine Sea plate is subducting beneath the Japan main land and huge interplate earthquakes are expected to occur in future. The observation system we have been developing equips a combination of long baseline kinematic GPS positioning and precise acoustic ranging techniques to achieve centimeter-level seafloor geodesy.

Observations to measure the positions of the seafloor stations have been conducted repeatedly. Though we obtained almost satisfactory results with the already existing system, we come up with possible improvements of the system as we accumulate the experience of the observations using the system. The robust system, that we are aiming at, for centimeter level seafloor geodesy cannot be achieved without solving small issues on the system.

Results from several observations we had show that how stable and robust it is to locate the positions of the seafloor geodetic reference stations depends on the spatial distribution of the acoustic ranging data and the sea surface current during the measurements. This means these two factors are major error sources on the locating procedures. We will discuss and present the dependency between positioning accuracy and two major error sources as well as the latest results from our observations in this talk.
ART NEURAL NETWORKS FOR SEAFLOOR CLASSIFICATION OF MULTIBEAM SONAR DATA

Xinghua Zhou¹,², Yongqi Chen¹, Nick Emerson¹ and Dewen Du²

¹The Department of Land Surveying and Geo-Informatics
   Hong Kong Polytechnic University
   Kowloon, Hong Kong, CHINA
   qdxhzhou@163.com

²The First Institute of Oceanography
   State Oceanic Administration
   Qingdao, CHINA

This paper presents a seafloor classification method of multibeam sonar data, based on the ART neural networks. In this study, we propose a general ART-based information extraction and classification framework for multibeam sonar data. An evolutionary strategy is used to generate new training samples near the clusters boundaries of the neural networks; therefore the weights can be revised and refined by supervised learning. The proposed method resolves the training problem for ART neural networks, which are applied to seafloor classification of sonar data when there are less than adequate ground-truth samples. The results are synthetically analyzed in comparison with conventional maximum likelihood classifier. The conclusion can be reached that ART neural networks can be alternative powerful tools for the classification of multibeam sonar data.
A SHORELINE EROSION PREDICTION MODEL OF LAKE ERIE

Ron Li, Xutong Niu and Alok Srivastava

Department of Civil and Environmental Engineering and Geodetic Science
The Ohio State University
Columbus, Ohio, USA
li.282@osu.edu

Some coastal areas along the southern Lake Erie shoreline are severely impacted by erosion (Li et. al., 2002). Influenced by either natural processes and/or human activities, coastlines have never been stable. Recently, however, in one area the shoreline has eroded at an alarming rate of one to two meters (3 to 7 feet) per year. This research presents a shoreline-erosion prediction model that can forecast shoreline change in annual or 10-year increments. It was developed using historical Lake Erie coastline data from 1973, 1979, 1990, and 2000 provided by NOAA and local government agencies. The relationship among these previous shorelines is thoroughly analyzed using a least-squares method. Erosion rates are then derived from shoreline changes. On the basis of previous shorelines, this model also considers other influential factors such as changes in terrain and water-level changes derived from a hydrodynamic model of Lake Erie.

To notify and educate shoreline landowners and governmental decision makers, a web-based GIS system has been created that displays prediction results from the model. With the help of this new technology, viewers will be able to observe projected shoreline changes for individual land parcels over specific durations of time, and plan for proactive approaches to protect their properties.
This study concerns on a problem of time space scaling of ocean front evolutions. A theoretical solution of the ocean front model has suggested that the front can be classified into three categories. The author considers the three categories of the ocean front help us to have a hydro-dynamical understanding about the ocean front evolutions found as thermal patterns in the series of the imageries which has been obtained by processing a directly received data set of the signals of the infrared band from the satellites. When the theoretical model is formulated by using non-dimensional parameters for describing the specific dynamical factors, the solution could be taken as a solution for a general process, and be applied for all of the related ocean front evolutions.
MOUNTING PARAMETERS CALIBRATION FOR UNDERWATER LASER SCANNING SYSTEM

Chau-Chang Wang, Hsin-Hung Chen and Ju-Min Lee

Institute of Undersea Technology
National Sun Yat-sen University
Kaohsiung, TAIWAN
chauwang@athena.iut.nsysu.edu.tw

The quality of underwater video photography is limited by the visibility of the water column. Generally speaking, it is difficult to tell the dimension of the target directly from the underwater images. To overcome this problem, we may cast a laser line stripe onto the target and observe the displacement of the laser line. The displacement reveals the profile of the object at that location. With a calibrated CCD camera, the displacement of the laser stripe in the image framed can be converted into the actual profile dimension of the target. The overall 3D surface of the target can be reconstructed by merging multiple profiles acquired at different location. We mount the CCD camera and laser beam unit on a linear track or a turntable to have consecutive image acquisition. The mounting configuration is designed such that the view of the camera covers the target area and also yields good resolution of the laser stripe in the image. For the simplicity of the profiles merging process, the laser beam source is adjusted to point downward with respect to the major axis of the motion. However, there are always some residual angles and misalignment of axes that results in system errors. These mounting parameters are small and cannot be measured directly. They can only be estimated with post-processing of the data. This idea is similar to the calibration of multibeam echo sounder mounting parameters. In this work, we let the system to scan an NC machined test piece with known features like steps, grooves and edges. With cross-reference between the surface constructed and the CAD model, we can infer the residual angles and misalignment. These parameters are then updated to generate the new calibrated surface for comparison. This procedure is repeated until the inconsistency between the measurement and the CAD model is minimized. This is process is implemented as a control feedback problem in C program. The preliminary experiments show that after calibration, our underwater laser scanning system can measure the seabed ripple with sub-millimeter accuracy from 80 centimeters away with off-the-shelf internet video conference camera and laser beam.
LAST GLACIAL-HOLOCENE PALEOENVIRONMENTAL HISTORY OF DERUGIN BASIN (OKHOTSK SEA)

Irina Burmistrova and Natalia Belyaeva

P.P.Shirshov Institute of Oceanology
Moscow, RUSSIA

Environmental conditions changes in the Derugin Basin (the Northwestern of Okhotsk Sea) were investigated based on analyses of benthic and planktonic foraminifera from sediment core 6676 (53 31.4 N., 145 56.0 E., from depth 1750 m, 298 cm length). The core obtained in area where methane expulsion is a recently active process. The Glacial – Earliest deglacial sediments (26 000 - 12 180 yr. BP) almost lack of benthic foraminifera. Only few basic layers contain reworked tests of *Uvigerina auberiana* and *U.peregrina*. The occurrence of chemoautotrophic worms tubes within sediments provide evidence for active fluid venting during that time. Planktonic foraminifera are presented by a few tests (less 10) two species – *Neogloboquadrina pachyderma* and *Globigerina bulloides*. We belive that in the study area a perennial ice cover persisted through Glacial period. The surface circulation and biological productivity were significantly reduced.

The foraminiferal assemblages between 12 180 and about 7 000 yr. BP contain abundant perfectly preserved tests of *Uvigerina peregrina*, *Valvulineria ochotica*, *Cassidulina laevigata*, and *Brizalina spissa*. Present-day these species dwell only within high productivity regions at the depths occupied by warm Pacific Intermediate Water. The appearance of this benthic foraminiferal assemblage and peculiarity of planktonic foraminifera distribution are evidence that the study area was in sea-free conditions in early Holocene. The surface circulation significantly increased and biological productivity was high. The warm oxygen-depleted NPIW spread above the bottom of Derugin Basin.

Later *U.peregrina*, *B.spissa* and *V.ochotica* dissappeared. The benthic foraminifera assemblages of Last Holocene are dominated by *Gyroidina orbicularis*, *U.auberiana*, and *Cassidulina teretis*. This compositional shift may be caused by cooling of bottom waters and decreasing of organic matter input.
ON THE ROLE OF SERPENTINITE LAYER IN FORMATION OF HYDROCARBONS

Anatoly Dmitrievsky and Inna Balanyuk

P.P. Shirshov Institute of Oceanology
Russian Academy of Sciences
Moscow, RUSSIA
balanyuk@sio.rssi.ru

One among the most perspective direction in studying the ocean floor is the research of hydrothermal fields within the most active zones — rift valleys, where the processes of spreading of the ocean floor, uplift of the deep matter to the surface of the ocean floor, and creation of the new oceanic crust occur. Volcanic activity in these zones is accompanied with the formation of the hydrothermal system executing separation, transfer, and precipitation of a series of chemical elements and formation of hydrocarbons.

The hypothesis of hydrocarbon deposits generation over the shallow slopes in rift oceanic zones as an outcome of the action of two factors: formation of faults and fractured-porous rocks and the reaction of serpentinization of the crust is suggested. The carbonic-acid gas dissolved in the seawater is involved into the process of hydrocarbons formation. The conditions of water convection in the porous media are favorable for the formation and accumulation of hydrocarbons in the near-surface layers of the oceanic crust near continental slopes and island arcs.

Hydrothermal fluids migrating in the faults filtrate through the sedimentary cover, and form hydrocarbon and gas hydrate deposits. Transform plate boundaries are just such structures in the ocean. They represent wide zones of deep-seated faults along which realizes the plate motion. Queen Charlotte fault extending along the Western Canada coast and the western part of Aleutian Trench from the Bering Island to Kamchatka, transform fault near Sakhalin Island are examples of such plate boundaries in the Pacific Ocean. Geological situation in the Gulf of California characterized by enormous sedimentation rates is unique.
OIL SPILL CONTINGENCY PLANS: 
DIFFERENCE BETWEEN KOREA AND JAPAN

Nobuhiro Sawano
Seiryo Women’s Junior College
Kanazawa, Ishikawa Prefecture, JAPAN
sawano@mailhost.seiryo.ac.jp

For oil spill history, most countries start to make their contingency plans just after their “Shoreline Shock”. Korea has started to prepare national contingency plan after Sea Price accident happened in 1995. While, Japan experienced Nakhodka heavy oil disaster in 1997, cabinet decided national contingency plan for oil spill ten months after the accident.

Two countries are geographically near but the contents of each plan are quite contrastive. Once a large-scale oil spill accident occurs, Korean plan prescribes all the rights of enforcement to the director of national marine police agency. On the other hands, Japanese plan has no decisive rules on “who manages the accident”.

When actual oil spill has occurs, international corporation have to be indispensable. To facilitate such corporations, some rules have to be standardized between each county. In this presentation, “minimum similarity” required in each contingency plan will be reviewed.
Microbulbifer degradans 2-40 (2-40) is emerging as a vanguard of a recently discovered group of marine bacteria that recycle complex polysaccharides (CP). It was isolated from decaying marine grass, Spartina, and can decompose the plant in monoculture, unusual in that it normally requires a consortium of species to carry out the process. 2-40 synthesizes an extraordinary array of proteases, lipases, lignases and, most importantly, 10 different complete enzyme systems that attack CP. 2-40 acquires some of its unique number of diverse carbohydrate systems by horizontal transmission through unusually high frequency recombination, using a dynamic integrase mechanism shared with other bacteria including vibrios. The enzymes are best induced by the homologous substrate and their synthesis is repressed by glucose. 2-40 is ecologically significant. In terrestrial habitats microorganisms that degrade a significant portion of the >52 billion tons of annual cellulose production have been well characterized. However in the oceans much less is known about how the >25 billion tons of CP is recycled and 2-40 appears to be a missing link.

Cell biology is important in the degradation of CP by 2-40. It forms surface protuberances (termed hydrolysomes), when growing on complex carbohydrates but not when growing on simple sugars. The hydrolysomes house some of the carbohydrases, which are displayed on the surface.

We are working with DOE to sequence and annotate the genome of 2-40, now in Stage IV finishing. 2-40 is unique in its variety of depolymerases and unusual in its number (>150) of open reading frames coding for CP depolymerases. For example, the chitinase system of 2-40 includes secreted chitin depolymerases, a secreted chitin binding protein and periplasmic chitooligosaccharide modifying enzymes. The agarase system was also examined. Five agarase depolymerases are identified. All share at least 40% similarity to known agarases and their coding regions are dispersed within the 2-40 genome.

M. degradans 2-40 is the first marine bacterium shown to have enzymatic systems that degrade all three of the major components of plant cell walls. Of these, 17 have been firmly identified as likely cellulases, cellobiases, or cellodextrinases and 15 identified as xylanases. Additionally, there are 13 pectin lyases, 8 laminarinases and 7 arabinases. Zymograms reveal eight bands active against CMC in cells grown on Avicel and five xylanolytic bands in xylan-grown cultures.

2-40 appears to be a versatile saprophyte and a significant participant in the marine carbon cycle. Additionally, a number of its enzymes and other proteins have medical, food, energy and bioremediation applications.
THE PRODUCTION OF ALKENONES AND ITS PHYSIOLOGICAL ROLE IN A COCCOLITHOPHORID, *EMILIANIA HUXLEYI*

Yoshihiro Shiraiwa1*, Ken Sawada2 and Masako Kubota1

1Institute of Biological Sciences
University of Tsukuba
Tsukuba, Ibaraki, JAPAN
*emilhux@biol.tsukuba.ac.jp

2Division of Earth and Planetary Sciences
Graduate School of Science
Hokkaido University
Kita-ku, Sapporo, JAPAN
sawadak@ep.sci.hokudai.ac.jp

Long-chain alkenones \( nC_{37}-C_{39} \) are known as specific lipid biomarkers of the family Gephyrocapsaceae (Noelaerhabdaceae) and Isochrysidaceae in Haptophycean algae. These molecules have frequently been used as a tool for the determining the paleotemperature in geochemical and geophysical sciences, since the number of the double bonds in the molecules is produced in response to the prevailing temperature during their growth. The double-bond configuration of alkenones is *trans*, while that of fatty acid esters in membrane-bound lipids is generally *cis*. This fact has indicated that the physiological and biochemical roles of alkenones and alkenoates are very different from those of fatty acid esters involved in membrane lipids. In order to understand the physiological role of these lipids in this organism, we isolated the membrane fractions and cellular organelles by a liquid two-phase fractionation method and analyzed the distribution of lipid biomarker molecules in each fraction. We then determined the lipid class composition and examined the distribution of alkenones and alkenoates and their unsaturation ratio of \( C_{37} \) alkenones, calculated as the ratio of \( [C_{37:2}]/[C_{37:2} + C_{37:3}] \), in the individual membrane and organelle fractions of *Emiliania huxleyi* cells. The alkenones were mainly located in coccolith-producing compartment (CPC). In contrast, the alkenoic acids seemed to be mainly located in the chloroplast (thylakoid)-rich fractions. The alkenone unsaturation ratio and the ratio of alkenoate to alkenones were similar in all fractions, while the unsaturation ratio of alkenoic acids in the thylakoid-rich and plasma membrane/Golgi body-rich fractions was overwhelmingly higher than that in the endoplasmic reticulum/CPC-rich fractions. We therefore presumed that the alkenones and alkenoates are membrane-unbound lipids that might be associated with the function of CPC. In addition, data on factors regulating the biosynthesis of alkenones will also be presented and physiological role of alkenones will be discussed.
SUPEROXIDE DISMUTASE IN MARINE ALGA, *DUNALIELLA*

Man Jang, Seunghye Park, Taek Kyun Lee and EonSeon Jin

Korea Ocean Research Development Institute
Harmful Algal Research Unit
Jangmok-myon, Geoje-shi, KOREA
mchang @kordi.re.kr

The marine alga *Dunaliella* is commercially important organism producing β-carotene and xanthophylls which are known to be quenching reactive oxygen species. In this work, we studied the relation between antioxidant and antioxidant enzymes; chloroplastic iron superoxide dismutase (Fe-SOD) from *Dunaliella salina* under different physiological conditions. The enzyme superoxide dismutase (SOD) represents a first step in such ROS scavenging systems, catalyzes the dismutation of $O_2^-$ to $H_2O_2$ and oxygen. Therefore this enzyme is critical to control the levels of reactive oxygen species in cell compartments.

A cDNA-encoding Fe-SOD was isolated from *Dunaliella salina*. This Fe-SOD is nuclear-encoded; its deduced amino acid sequence is 67-75% identical to Fe-SOD isoforms from plants and cyanobacteria, respectively, and residues responsible for iron binding are fully conserved. We showed that the mRNA for Fe-SOD was induced in response to UV-B illumination and to growth under increasing light fluencies. Light-induced up-regulation of Fe-SOD expression and increment of antioxidant such as β-carotene and xanthophylls in *D. salina* are discussed in terms of algal mass culture.
DEVELOPMENT OF CaCO₃ POROUS MATERIAL FOR IMPROVEMENT OF MARINE ENVIRONMENT

Minoru Yamanaka¹, Kaori Yasuoka¹, Masaru Terabayashi¹, Tetsuya Matsuyama², Takashi Hoshino¹, Yoshihiro Suenaga¹ and Rie Nakahara³

¹Faculty of Engineering
Kagawa University
Takamatsu, Kagawa Pref., JAPAN
yamanaka@eng.kagawa-u.ac.jp

²Nihon-Kogyo Co, LTD, JAPAN

³Kagawa Prefectural Industrial Technology Center, JAPAN

In present state, the environmental improvement in inland water like Seto Inland Sea in Japan sufficiently does not advance. The development of technology of the organism habitat environment for maintenance, improvement and creation becomes the urgency.

The purpose of this study is to develop the new CaCO₃ porous material that the bioaffinity is high and that it is available as a member of the aquatic resource multiplication structure. In this study, some material tests were carried out in order to require optimum formulation of porous material suitable for the carbonation, and void quantity and strength of porous material were examined. Iron and steel slag (air-cooled blast furnace slag) and construction by-product (concrete mass) were used as an aggregate of the porous material.

The porous material made in optimum formulation was carbonated using the special carbonation equipment. The carbonation of the porous material surface was observed by the scanning electron microscope. As a result of the observation, it was possible to confirm increase of C (carbon) and decrease in Ca (calcium) in the porous material surface. The degree of the carbonation increased with the increase in the carbonation hour.

At present, the actual artificial reef using this developed CaCO₃ porous material is produced. In the future, it is installed as an artificial reef in the real sea area, and the effect of bait organism curing and organism aggregation will be verified by the field observation.
SPACEBORNE LASER ALTIMETRY

Bob E. Schutz

University of Texas at Austin
Austin, Texas, USA
schutz@csr.utexas.edu

The NASA Ice, Cloud and land Elevation Sat (ICESat) was launched into a 600 km altitude, near polar orbit in January 2003. The primary instrument carried by ICESat is the NASA Goddard Geoscience Laser Altimeter System (GLAS). The first of three lasers was activated on February 20, 2003 and elevation profiles of the Greenland and Antarctic ices sheets, as well as land and ocean profiles, have been produced using the 1064 nm wavelength of the laser. The laser divergence and altitude produce illuminate a 60 m diameter spot on the Earth’s surface. The pulse repetition rate and the orbital motion result in 170 m spot separation on the surface. Because of the narrow laser beam, the laser direction must be determined in addition to the scalar altitude measurement. This altitude vector is determined with an innovative system of CCD cameras plus calibration/validation methodologies. The current system performance is approaching the specification for pointing accuracy knowledge that translates into 4.5 m horizontal spot location. On smooth surfaces, the single shot altitude precision is 2 cm. Combining the altitude vector with position information from orbit determination, the surface profile is generated. The GLAS lasers are being operated for periods of about 30 days and current operations are using laser 2. The operational status and example surface profiles will be presented.
THE OCEAN OBSERVER STUDY
OPTION 5 MISSION DESIGN

James P. McGuire\textsuperscript{1}, John D. Cunningham\textsuperscript{2}, Andrew J. Gerber\textsuperscript{3} and William G. Pichel\textsuperscript{4}

\textsuperscript{1}IPO/NASA
Silver Spring, Maryland, USA
James.McGuire@noaa.gov

\textsuperscript{2}IPO/NOAA
Silver Spring, Maryland, USA

\textsuperscript{3}NASA/JPL
Pasadena, California, USA

\textsuperscript{4}NOAA/NESDIS
Camp Springs, Maryland, USA

The Integrated Program Office is a Government Office whose function is to fulfill the future Operational Satellite requirements handed down to it by DoD and NOAA. In reviewing its requirements, the Office felt that the Ocean Aspects was not being adequately addressed. Because of that, the Office initiated a study to determine what additional appropriate requirements were needed. It squired over 200 scientists in academia and Government, came up with requirements, then did a mission study to determine how to fulfill those requirements. This presentation will review the results of that study.
Since 1996, global near real-time maps of mesoscale anomalies derived from tandem sampling provided by satellite altimeters aboard the TOPEX/POSEIDEN and ERS-2 satellites have been posted on web pages hosted at the Colorado Center for Astrodynamics Research. As additional altimeter satellites have become operational, such as Jason-1, Geosat Follow-On (GFO) and Envisat, we have added those data streams. The current system processes and hosts daily data products from all operational satellites, which can be accessed through interactive data forms allowing online users to selectively subset and visualize the data. The primary operational products produced are daily global mesoscale sea surface height anomaly maps for monitoring mesoscale variations in sea level associated with the movement of eddies and fronts in the ocean. In addition to the daily nowcast maps, historical data archives are maintained to host daily products based on retrospective analyses for the time period from 1993 through the present. Mesoscale circulation impacts a number of offshore operational activities including offshore oil and gas exploration/production, marine cable laying, ship routing, marine habitat identification/monitoring, and recreational activities such as sport sailing and fishing. In this paper, we give examples of the data products hosted to highlight applications developed by end-users of the data system to encourage further use of this resource in the Pacific maritime nations.
DYNAMICALLY BALANCED DECADE-MEAN SEA LEVEL DERIVED FROM DRIFTER AND SATELLITE DATA

Nikolai A. Maximenko¹, Pearn P. Niiler², James C. McWilliams³ and Chester J. Koblinsky⁴

¹International Pacific Research Center
School of Ocean and Earth Science and Technology
University of Hawaii, Honolulu, Hawaii, USA
nikolai@soest.hawaii.edu

²Scripps Institution of Oceanography
University of California
San Diego, La Jolla, California, USA

³University of California
Los Angeles, California, USA

⁴NOAA Climate Office
USA

The global decade-mean absolute sea level at mesoscale resolution is obtained by integrating the horizontal momentum equation suggesting the balance in the upper ocean between the acceleration term, Coriolis force, pressure gradient and Ekman force. The terms are estimated using drifter data, satellite altimetry and NCAR/NCEP reanalysis and QuikSCAT winds. Ralph and Niiler (1999) parameterization of the Ekman term is improved using the Gravity Recovery and Climate Experiment (GRACE) data. The sea level is compared with historical hydrographic data and deep float trajectories. Effects of higher order terms, data errors and complex Ekman dynamics are discussed.
Sequential infrared images from the Advanced Very High Resolution Radiometer (AVHRR) and the MODe rate resolution Imaging Spectrometer (MODIS) are used with coincident ocean color images from MODIS with the Maximum Cross Correlation (MCC) method to make high-resolution (1 km) map of coastal surface currents. These MCC currents are composited over intervals of a few days and mapped using optimum interpolation. The currents are then fit to a stream function and the resulting current vectors are merged with geostrophic currents computed from all available satellite altimeters. The results are MCC and merged MCC + altimetry surface current composites for 3-day periods. The spatial mapping errors for these spatial surface current maps are also computed for each 3-day period showing where the merged current field is the most reliable.

In addition to the real-time system historical archives of AVHRR and MODIS data are being used to compute long-term climatologies of the surface currents in the areas of interest. Long-term mean and seasonal statistics will be computed from these surface current climatologies to describe the character of the mesoscale surface currents in the area of interest. These statistics can be compared with similar statistics computed from the real-time maps to help understand and predict the behavior of the surface currents in the region of interest.
The consortium for Estimating the Circulation and Climate of the Ocean (ECCO) has demonstrated the feasibility and utility of providing global, sustained, dynamically sensible estimates of the full three-dimensional, time-varying oceanic state and of associated surface forcing fields required to bring the model into consistency with ocean observations. Remotely sensed (sea level, winds, temperature, gravity) and in-situ (temperature, salinity, velocity) observations are assimilated with a state-of-the-art numerical ocean model using advanced estimation methods (adjoint, Kalman filter, and Rauch-Tung-Striebel smoother). The estimates are available in near real-time and are being used for a wide variety of scientific applications.

The ECCO assimilation system is presently being ported to a near global, eddy-permitting model to better resolve meso-scale variabilities and their effects on the large-scale circulation. This new analysis has an isotropic grid with a nominal 1/4-deg resolution that extends from 80S to 80N. This effort is a first attempt to assimilate observations to achieve a physically consistent estimate of the ocean's temporal evolution at global eddy-permitting resolution. This presentation will review existing ECCO operational products and applications and summarize the motivation, objectives, and status of the ECCO high-resolution initiative.
DETERMINATION OF THERMAL STRUCTURES USING SATELLITES: COMPARISON WITH ARABIAN SEA BUOY OBSERVATIONS

Rashmi Sharma, Neeraj Agarwal, Sujit Basu and Vijay K Agrawal

Oceanic Sciences Division
Meteorology and Oceanography Group
Space Applications Centre
Ahmedabad, Gujarat, INDIA
rashmisharma_01@rediffmail.com

The present work examines the possibility of deriving subsurface thermal profiles using satellite observations. These profiles are required as inputs for ocean general circulation models and in the studies of ocean processes. Empirical Orthogonal Function (EOFs) analysis of temperature profiles measured under World Ocean Circulation Experiment program is carried out. Data for the period 1990-1999 are used. Analysis is done separately for different months. The EOFs are obtained from a set of nearly 1000 (for each month) temperature profiles. The first three EOFs explain about 75% - 90% of the total variance for different months. The corresponding principal components for each month are regressed against the sea surface temperature anomaly and dynamic height anomaly obtained from the same set of profiles using a second order polynomial. These regressions and the EOF expansion are used to establish a retrieval algorithm for each month. Monthly relationships between dynamic height anomaly obtained from in situ profiles and sea surface height anomaly obtained from TOPEX/POSEIDON altimeter are also obtained. This is needed so as to facilitate the use of satellite observations in the final retrieval algorithm. Monthly fields of temperature profiles in each 1° by 1° degree of latitude and longitude grid for the year 1994-1995 are generated using satellite derived sea surface temperature and dynamic height anomalies. These profiles are compared with buoy observations (1994-1995) in the Central Arabian Sea. Root mean square error of retrieval for different depth ranges from 0.5° C to 2° C, and is better than the standard deviation barring few levels. Thus the results seem to be promising enough for application in various oceanographic studies.
EVALUATION OF OCEAN SURFACE VECTOR WINDS OBSERVED BY SEAWINDS ON ADEOS-II

Naoto Ebuchi¹, Hans C. Graber², Michael Caruso³ and Mark A. Donelan²

¹Institute of Low Temperature Science, Hokkaido University
Sapporo, JAPAN
ebuchi@lowtem.hokudai.ac.jp

²RSMAS, University of Miami
Miami, Florida, U.S.A.

³Woods Hole Oceanographic Institution
Woods Hole, Massachusetts, U.S.A.

The ADvanced Earth Observing Satellite-II (ADEOS-II) was launched by the National Space Development Agency of Japan (NASDA) on 14 December 2002, into a 802.9-km, near-polar, Sun-synchronous orbit at an inclination angle of 98.7 deg. The mission carries five sensors including SeaWinds, which is a microwave scatterometer that measure near-surface wind speed and directions under all weather and cloud conditions over the global oceans. It uses a rotating dish antenna with two pencil beams that sweep in a circular pattern at incidence angles of 46 deg.(HH-pol) and 52 deg.(VV-pol). The antenna radiates microwave pulses at a frequency of 13.4 GHz across broad regions on Earth's surface. The instrument can measure vector winds over a swath of 1800 km with a nominal spatial resolution of 25 km. In the present paper, wind vectors observed by ADEOS-II/SeaWinds are evaluated by comparing with wind and wave data from the NDBC, TAO/TRITON and PIRATA buoys in the Atlantic and Pacific Oceans and Gulf of Mexico. The comparisons show that the wind speeds and directions observed by ADEOS-II/SeaWinds agree well with the buoy data. The root-mean-squared differences of the wind speed and direction are 0.95 m/s and 22.1 deg, respectively, while no significant dependences on the wind speed are discernible. The collocated data set is also used to explore differences of wind speed and direction against oceanic and atmospheric parameters as geographic locations and footprint positions.
ATMOSPHERIC RESPONSE TO MESOSCALE OCEAN FEATURES

Richard J. Small, Shang-Ping Xie, Jan Hafner, Yuqing Wang and Haiming Xu

International Pacific Research Center
University of Hawaii
Honolulu, Hawaii, USA
small@hawaii.edu

New microwave satellite observations have allowed the classification of atmospheric boundary layer response to mesoscale ocean features such as fronts and eddies. The Tropical Rainfall Measuring Mission Microwave Imager has provided sea surface temperature (SST) of the tropical belt since 1997, and the Aqua Advanced Microwave Scanning Radiometer has covered most of the globe since 2002. Both instruments have the significant advantage of being able to see through the cloudiness often associated with the atmospheric response to ocean SST gradients. When combined with scatterometer measurements of surface wind speed from QuikSCAT, these datasets provide high resolution, daily maps of atmosphere-ocean interaction.

It is found that in most cases around the globe, surface wind speed varies in phase with the SST over mesoscale features. Examples are shown from the Pacific Ocean, including the Kuroshio current regime and waves on the equatorial SST front. The possible physical mechanisms for the response are reviewed in the context of new high resolution Regional Climate Models. The possible influence on the deeper atmospheric structure and systems is discussed.
DEVELOPMENT OF THE SYSTEM FOR CREATING FISHERY GROUNDS BY USING REMOTE-SENSING

Atsuko Nonomura¹, Takashi Hoshino¹, Yoshihiro Suenaga¹, Tatsuya Hirosako¹ and Koichi Masuda²

¹Faculty of Engineering
Kagawa University
Takamatsu, Kagawa Pref., JAPAN
nonomura@eng.kagawa-u.ac.jp

²College of Science and Technology
Nihon University
JAPAN

In Japan, there are many spawning and nursery grounds of valuable marine resources. On the other hand, variable marine environmental problems have been caused by red tide and severe gather up sand resources. Therefore, the pollution from land area can affect the environment of spawning and nursery grounds in and around the marine area. After the field experiments, it was found the tidal current, distribution of water density, bottom topography, Chlorophyll-a concentration, biological condition and DO consumption rate by sediment are important factors to evaluate the characteristics of fishery grounds.

The authors proposed a more appropriate system for creation fishery grounds by combining three kinds of technology, remote sensing, 3-dimensional numerical model, and GIS system, namely fusion system. Remote sensing provides the distribution of Chlorophyll-a from near the coastal area to the off-shore, and GIS is powerful tool in extracting interactive relationships among many kinds of data related to creating fishery grounds, for example distribution of Chlorophyll-a, water density, bottom topography and phytoplankton production in the marine area into consideration. Moreover, 3-dimensional numerical model perform prediction about the effect of this project and assessment the impact of this project against the environment before construction.

Then, it is necessary to take this fusion system to choose the most suitable area for creating fishery ground in the offshore area.
CHLOROPHYLL-A MAPPING USING 500M RESOLUTION MODIS IN HIROSHIMA BAY

Yuji Sakuno and Daisuke Yamaguchi

Department of Social and Environmental Engineering
Hiroshima University
Hiroshima, JAPAN
sakuno@hiroshima-u.ac.jp

The purpose of this study is to estimate chlorophyll-a concentration (Chl-a) distribution from the 500m resolution satellite ocean color sensor “MODIS” data in order to grasp the amount of phytoplankton which is not only food of marine resources and but serves as an index of red tide in Hiroshima Bay (an eutrophic inner bay), Japan. Though “the ratio of a Band 9 (443nm) and Band 12 (550nm)” of 1000m resolution MODIS is general algorithm for the Chl-a estimation in the open ocean, "the ratio of Band 3 (469nm) and Band 4 (469nm)" of 500m resolution MODIS was proposed to use instead in this study. The result is that, there is a high correlation between “the ratio of Band 3 and Band 4” and the in-site Chl-a (R=-0.85, RMSE=0.13). Moreover, it turned out that most of the atmospheric influence by the simple atmospheric correction, which subtracts the minimum value of each band was removed.

MODIS data was converted Chl-a into by the estimative expression obtained from the regression analysis using the band ratio of the 500m resolution MODIS and the in-situ Chl-a in the bay. As a result, Chl-a in the area along the shore showed high concentration, and the low Chl-a distribution had spread in the middle and the mouth of the bay with deep depth of water. From these results, it was suggested that the data of 500m resolution MODIS is a useful Chl-a mapping tool in the bay.
Acoustic communications provides a viable means for underwater networking. However, the extreme propagation delays and limited bandwidth significantly impact the throughput capability of the network. This situation is further exacerbated by the use of half duplex communications between network neighbors. While collision avoidance techniques are used to limit the number of retransmissions due to reception collisions, the net effect is to implement a “stop and wait” flow control protocol, which severely limits achievable throughput. For links with high propagation delays a sliding window flow control protocol is much more efficient. This situation is not unlike that of satellite communications. As a sliding window implementation requires full duplex communications, and full duplex communications requires either an increase in the available bandwidth or proportionate decrease in individual channel capacity there is a system cost for implementing the sliding window protocol.

Some military satellite systems have employed a demand assigned multiple access technique to allow a limited number of channels to support many more users, where the typical user data arrives in bursts. This “statistical-like” multiplexing of the user data, coupled with a sliding window flow control protocol, greatly improves the effective throughput of the system. The authors hold that such an improvement in acoustic communications throughput is also possible by adapting these techniques to the acoustic communications channels. This paper provides an analysis, based on a first order simulation, of the relationship between the number of users, the number of channels available, and frame size with respect to demand channel assignment.
A DEVELOPMENT OF AN AIRCUSHION TYPE VLFS AND HYDRODYNAMIC CHARACTERISTICS

Tomoki Ikoma¹, Koichi Masuda¹, Chang-Kyu Rheem² and Hisaaki Maeda¹

¹Department of Oceanic Architecture and Engineering
CST, Nihon University
Funabashi-shi, Chiba, JAPAN
ikoma@ocean.cst.nihon-u.ac.jp

²Institute of Industrial Science
The University of Tokyo
Tokyo, JAPAN

If a horizontal scale of a floating structure is small, an aircushion type may not be a feasible type for a floating structure because of a problem of a hydrostatic stability. However, the problem of the stability can be avoided if some conditions are cleared in case that the horizontal scale of the structure is enlarged.

When the aircushion is several times as large horizontally as the wavelength, pressure in the aircushion becomes smaller so that the wave exciting force on the structure should decreases. In addition, an incident wave can propagate easily under the structure to backward because there is free water surface in the aircushion. This thing contributes directly to preventing increase of the wave drifting force. A basic concept of a development of the aircushion type VLFS is: a VLFS can be installed to sea area being severer sea conditions by reducing the hydroelastic defection and preventing increase of the wave drifting force due to Hydroelastic response reduction.

In this presentation, at first concepts of the aircushion type VLFS is explained. In addition, theories and problems regarding analysis of the aircushion type VLFS is expressed, and approach of a new theoretical calculation method and some results are shown. Then the presence of influence of the draft of the structure is examined by using the three-dimensional and the zero-draft theories. The linear potential theory is applied, and influence of the free water surface in the aircushion is directly considered in the calculation. In the new calculation method, a method for reducing a computational work is applied. At last, variation of hydroelastic behavior due to the arrangement of aircushion division is investigated and it is concluded that distribution of horizontally random scale aircushion division are more effective than that of same scale one to reduce the elastic behavior.
MOTION OF FLOATING BODY IN FULLY NONLINEAR WAVES

Akio Kobayashi¹, Koichi Masuda¹, Tomoki Ikoma¹,
Yuki Yamaguchi² and Naoki Hanazawa²

¹Department of Oceanic Architecture and Engineering
College of Science and Technology
Nihon University
Funabashi, Chiba, JAPAN
kobayashi@ocean.cst.nihon-u.ac.jp

²College of Science and Technology
Nihon University

Because the most of floating structures are exposed to high waves in the stormy condition, interaction between nonlinear waves and floating structure is considered one of the important design items for both the functionality and safety of the structure. Authors developed a numerical code to simulate the coupling of fluid flow and solid body motion by using the volume of fluid method. This study shows the result of the verification of the code.

The verification was carried out by solving the following four problems. The first problem was an accurate calculation of a fully nonlinear wave force. The wave force induced by the overtopping waves on the floating body was calculated, and the result was compared with a model experiment. The second problem was about the numerical technique for solving the moving boundaries as the moving body in each calculating time. A free-fall problem of a solid body in water was simulated to verify the technique, and the result was compared with a mathematical solution. The third problem was a process of the coupling computation of fluid flow and body motion. The simulated result was compared with the linear solution. The last problem was the coupling computation of a fully nonlinear wave and solid body. A simulation of the motion of a moored floating body was carried out and the result was compared with a model experiment. According to the results of above tests, this code, which uses the volume of fluid method, is able to simulate the motion of the floating structure in an actual nonlinear sea state.
VIBRATION MITIGATION ON THE TENSION LEG PLATFORM SYSTEM

Hsien Hua Lee and P. Y. Chang

Department of Marine Environment and Engineering
National Sun Yat-sen University
Kaohsiung, TAIWAN
hhlee@mail.nsysu.edu.tw

In this study, the response of tension leg platform (TLP) subjected to wave force is studied by means of both of analytical stochastic technique and experimental testing in the laboratory. The effectiveness of tuned liquid column damper (TLCD) and the effectiveness of various parameters to the TLP are discussed. The experimental study is used to verify the analytical results and also check for the feasibility of the this new application.

It is realized from the analytical solution that all the parameters including the mass of the platform, the diameter and the draft of the floating barrel for the platform system and the dimension of the platform will affect the TLP’s resonant frequency and amplitude. When the TLCD is applied to the platform system and compared with the platform of the same mass, the peak value is reduced for both the surge and heave response spectrum generally while reduction on the peak value of the pitch response spectrum is not so obvious even though the pitch response is in a small scale compared to the others.

The experimental testing was also performed in the hydraulic laboratory, where a water-tank equipped with wave maker was utilized. Comparing with the analytical solution the experimental results show reasonable consistence in trend of the dynamic behavior in between before and after the application of the mitigation application. It is also realized from the experimental study that the application of this particular type of mitigation devices on the tension leg platform system is effective and convenient in terms of the mechanical behavior of the platform systems.
 Coastal and ocean structures are subjected to the very high pressures generated by the impact of breaking waves. It is important to predict flow-induced vibration and deformation of a bluff body elastically supported in the free-surface flow. Therefore, in this study, we are dealing with a very complex fluid-structure interaction in the free surface flow including wave breaking. A new numerical method is developed to solve the problem of an elastically supported circular cylinder in the free surface flow as an example of a combined fluid-structure interactions involving vibration or large deformation of a coastal and ocean structures.

The computational procedure based on FDM method consists of two stages. Firstly, the iteration stage is input by time steps. The free surface flow including wave breaking is solved using CIP method. Next, the resulting pressure obtained by the fluid dynamics analysis becomes the loading conditions for solving the equation of motions for the elastic body, and the displacement, velocity and acceleration of each cell are computed by using the Newmark method.

The present numerical model has been developed to study of hydro-elastic force and violent fluid-structure interactions around the elastic circular cylinder.
A RESEARCH ON NUMERICAL ANALYSIS FOR RESPONSES OF A FLOATING BODIES DUE TO TSUNAMI USING FAULT MODEL

Maki Uchida¹, Koichi Masuda², Tomoki Ikoma² and Akira Takeda¹

¹Graduate School of Science and Technology
   Nihon University
   Funabashi-shi, Chiba, JAPAN

²Department of Oceanic Architecture and Engineering
   CST, Nihon University
   JAPAN
   masuda@ocean.cst.nihon-u.ac.jp

The objective of present paper are to establish the practical numerical system for analysis of responses of motions and the mooring forces on floating bodies induced by Tsunami and to indicate the characteristics of responses of motions and mooring forces on floating bodies in tsunami. In the present analysis system, the initial tsunami profile is evaluated by Manshiha-Smylie’s Method and propagating tsunami profiles are calculated by linear long wave theory and also the interaction of tsunami and floating body is computed by numerical wave tank based on VOF method and then the motions and mooring tether forces due to Tsunami on floating bodies are predicted by the convolution integral method. The usefulness of present system is confirmed by comparing with the experimental results on Tsunami forces and motions on floating bodies. The responses of floating body due to tsunami using fault model of Tokai earthquake are computed by using the present simulation system so that the characteristics of responses on floating bodies are examined and are clarified.
INTER-TIDAL FLAT AREAS HAVE BEEN REDUCING FOR REASONS OF COASTAL RECLAMATIONS IN JAPAN. LAW CONCERNING CONSERVATION AND RESTORATION OF REDUCING NATURAL ENVIRONMENT, SUCH AS TIDELANDS, TOOK EFFECT IN 2003. CONSEQUENTLY, A LOT OF RESTORATION PROJECTS HAVE BEEN PROMOTED IN INTER-TIDAL FLAT AREAS.

WE ATTACH GREAT IMPORTANCE TO ADEQUATE PRIOR RESEARCH AND MONITORING RESEARCH, WHICH WILL MAKE KNOWN BIOMASS AND DISTRIBUTION OF MACROBENTHIC ANIMALS AND RAISE EFFECTS OF THESE PROJECTS. HOWEVER WE HAD SHOWN THER WERE STRANGE RESULTS IN SOME CASES WITH CONVENTIONAL METHODS, BECAUSE DISTRIBUTION OF THEM CANNOT BE FORECASTED. WE PROPOSE THAT RESEARCH IN INTER-TIDAL FLAT AREA BE CARRIED OUT WITH PENETRATION RESISTANCE, WHICH IS EASY TO MEASURE AND DOES NOT NEED CHEMICAL ANALYSIS. WE HAD SHOWN PENETRATION RESISTANCE HAD RELATION WITH SOME PHYSICAL AND CHEMICAL FACTORS IN MUD AND DISTRIBUTION OF MACROBENTHIC ANIMALS IN A TIDAL FLAT AREA.

IT IS NECESSARY FOR THAT ABOVE RELATIONS TO BE COMMON IN DIFFERENT AREAS FOR A NEW METHOD IN INTER-TIDAL FLAT AREA. IN THIS STUDY, WE INDICATED PENETRATION RESISTANCE HAD A SIGNIFICANT CORRELATION WITH SOME PHYSICAL AND CHEMICAL FACTORS, SUCH AS TIDAL LEVEL, MOISTURE CONTENT, SILT-CRAY CONTENT, IGNITION LOSS IN FIVE INTER-TIDAL FLAT AREAS, AND THAT IT WAS EXPLAINED BY TIDAL LEVEL AND SILT-CRAY CONTENT, ACCORDING TO MULTIPLE REGRESSION ANALYSIS. IN ADDITION, DISTRIBUTION OF MACROBENTHIC ANIMALS IN TWO AREAS WAS RELATED TO PENETRATION RESISTANCE. AS A RESULT, IT WILL BE RECOGNIZED THAT METHOD WITH PENETRATION RESISTANCE MAKES KNOWN SUITABLE BIOMASS AND DISTRIBUTION OF MACROBENTHIC ANIMALS.
EFFECT OF ENGINE GOVERNOR CHARACTERISTICS ON SHIP’S CRASH-STOP MANEUVERS

Fang Wei and Lambros Bakountouzis

Department of Mechanical Engineering
The University of Hong Kong
Hong Kong, CHINA
weifang@hkusua.hku.hk

Over the years, considerable efforts have been devoted to studying the control systems of ship’s prime movers with the view to reduce sea calamities, particularly with regards to operation in restricted waters, such as ports, channels, etc. In order to assess engine performance when the ship encounters an emergency, the transient performance of the whole ship-engine system needs to be taken into account. The engine governor constitutes a major part of the overall control system and its mathematical representation (through its transfer function) can be readily used in model simulation to study its effect on the overall, transient performance of the ship during emergency stopping maneuvers.

In this paper, a mathematical simulation model is developed to study the effect of varying the transfer function of the governor on the transient performance of the whole ship system. The model used in this study closely resembles an actual high-speed, passenger ferry fitted with two pairs of high-speed diesel engines, each pair connected to a single propeller. Calm water, straight-line acceleration/deceleration without propeller cavitations are assumed throughout.

The mathematical tool used in the simulation is Matlab and its toolbox Simulink. Results presented in the paper emphasize the effect of varying the structure of the transfer function of engine governor on the transient performance of the ship as a whole. It is concluded that the transfer function of the governor plays a significant role in the overall ship propulsion system performance and maneuverability under emergency conditions.
A GRAPHICAL INFORMATION DISPLAY FOR ROV NAVIGATION

Hsin-Hung Chen, Chau-Chang Wang, Yu-Hung Hsiao and Tsung-Han Young

Institute of Undersea Technology
National Sun Yat-sen University
Kaohsiung, TAIWAN
hhchen@mail.nsysu.edu.tw

In general, a pilot looks at video images and other sensor readings, such as depth and heading sensors, to perform the navigation of a remotely operated vehicle (ROV). Even though the video images are easy for ROV pilot to interpret, however, it is limited to water turbidity and the lack of 3-D information. Therefore, an experienced ROV pilot must be familiar with vehicle’s dynamic characteristics and has well-built ability of sensory data integration. And this is the main obstacle to beginner pilots. That is, a pilot to be adept in maneuvering a ROV has to have lots of practice. If there is an interface integrating needed sensor data, the ROV navigation can become easier. Moreover, if a virtual environment can graphically and dynamically real-time displays the 3-D models of both surface ship and ROV then the ROV navigation would be safer and more efficient. This paper presents a user-friendly graphical interface for ROV navigation. The graphical interface is constructed by using C++ language and OpenGL libraries under Windows operating system. This system integrates all sensory data in nearly real-time to yield a 2-D navigation map and a 3-D virtual environment having the advantage in hand-eye coordination for ROV pilots. These sensory data include the ROV depth, ROV heading, ship heading, ship DGPS data, and USBL tracking system. The perspective of the virtual environment can switch at different views to help the pilot to have a better sense of the whereabouts of the vehicle. The system also storages and graphical replays raw navigation data and allows pilots to review the route and the whole operation process from different views.
HUMAN IMPACTS ON THE GLOBAL ENVIRONMENT – IS HUMAN EXTINCTION A POSSIBILITY?

P. I. Dixon, R. M. Golding and D. Hopley

The University of New South Wales
Sydney, New South Wales, AUSTRALIA

In this presentation, we shall outline the dramatic human impact on the globe and in particular on our marine environment. The impact has escalated over the last 20 years. We shall highlight the changes to the environment such as the human population growth, the exploitation of resources and modification of the climate. Secondary or reinforcement impacts will be discussed such as soil degradation, water resources, local scale climate effects, impacts of higher temperatures and UV radiation on marine organisms, sea level rise and extinctions.

These issues will be addressed with an emphasis on the restoration of the environment that will require at least significant higher quality than has been the case over the last 20 years.

Furthermore, we shall outline the development of a scientific model that may be used to explore, for example, animal populations associated with food. Changes in the rate of production of food will be examined amplifying the complexity of our natural systems. Impacts of limited food and introduction of diseases will be assessed. Extension of the model will predict dramatic non-steady state conditions. We shall show how a marked time dependence may arise yielding severe oscillations for instance that will result in dramatic complex time dependent patterns of animal populations that may lead to extinctions. These outcomes may be correlated to the current observations.
MARKET ORIENTED APPROACHES TO CLIMATE MITIGATION AND ADAPTATION: A NEW CENTER AT THE UNIVERSITY OF HAWAII

Lorenz Magaard

School of Ocean and Earth Science and Technology
University of Hawaii
Honolulu, Hawaii, USA
lorenz@hawaii.edu

Previous writers on adaptation to and mitigation of climate change mostly assume that free markets are a cause, and regulation is the most feasible solution. This approach, however, is associated with considerable costs and impediment of innovation including those that could allow vastly superior solutions. Analysts at the newly established International Center for Climate and Society (ICCS) at the University of Hawaii have embarked on a program to enlist the power of markets as an ally rather than an opponent. At this center, socio-economic innovation as realized through dynamic markets becomes a major driver of adaptation and mitigation. In other words, center participants are developing a market oriented rather than a regulatory approach which will considerably widen skills in mitigation and adaptation, decrease costs, and extend the option space.

This paper presents a description of the new center and describes current activities and plans for the future.
MARKET ORIENTED APPROACHES TO CLIMATE MITIGATION
AND ADAPTATION –
MODELING INNOVATION DRIVEN MITIGATION

Wolf D. Grossmann

UFZ Center for Environmental Research
Leipzig/GERMANY
wolf@grossman.de

In the US about 70% of the present economy was created since 1980 through investments, which are now at about $ 2.7 trillion per year. Most of this investment is done to use innovation. The resulting large-scale economic transformation would provide a unique opportunity for climate mitigation. The challenge is to learn how to do this. Consultants have developed methods to influence innovation and make it more successful. However, these methods are not simple, as they deal with the close interactions in that system behind innovation: people who are at the core of producing and managing innovation, the new knowledge sector and the innovating economy. There are issues of winners and losers, of vested interests, of old vs. new and so on. One policy alone cannot address all of these issues. Rather, packages of policies are necessary to succeed with influencing innovation. We will outline a regionalized, multilevel dynamic systems model that analyzes the economic transformation with respect to decreasing greenhouse gases. This model will allow analysis and development of packages of novel policies to support economic development with the desirable side effect of, simultaneously, decreasing emissions of GHGs. The model fosters a market-oriented approach to mitigation and adaptation that is innovation-based. As this economic change is happening anyway it is highly promising to learn to use it for environmental objectives.

The research is done in cooperation between ICCS and IPRC, University of Hawaii, GKSS Research Center/Geesthacht and UFZ Center for Environmental Research.
MARKET ORIENTED APPROACHES TO CLIMATE MITIGATION AND ADAPTATION: MARKETS AND REGULATION

James Barney Marsh

International Business Economics
University of Hawaii at Manoa
Honolulu, Hawaii USA
barney@hawaii.edu

Economists have produced thousands of articles and books on the concepts of markets & regulation, almost all of which occupy a spot in a rather narrow spectrum between “too much” regulation and “too little.” Regulation, in this context, is limited to government activities in markets designed to modify the economic behavior of participants through altered relative prices, wages, stock evaluations, or other economic variables. The modifications often target certain non-economic goals, such as environmental improvement, but aim to do so by framing the improvement as a positive externality. Unregulated market supply and demand, however, are always deeply involved in these processes. Resulting impressive environmental improvements, accumulations of consumer and producer knowledge, technology and quality upgrades, rapid growth in incomes, opportunities and product varieties indicate that competition already heavily regulates economic activities and all of their positive and negative externalities. The question to be addressed is one of the trade-offs between the benefits & costs of greater regulation or less.

In our context, we view mitigation & adaptation as externalities that are highly interactive with the large, creative socio-economic-technological evolutionary field that will be shaping our civilization for the predictable future. We appreciate that formerly highly concentrated accumulations of economic assets and economic power, as well as geographic agglomerations and long established path dependencies, melt under the influence of computer networks and information technologies. Lifestyles change rapidly. GDPs become significantly less heavy industry- and more information-intensive.

The question is how to influence these driving economic forces so that they contribute even more positively to mitigation and adaptation.
GLOBAL-SCALE CO₂ MITIGATION AND RENEWABLE ENERGY FROM PHOTOSYNTHETIC MICROBES: A NEW APPRAISAL

Mark E. Huntley¹ and Donald G. Redalje²

¹International Center for Climate and Society
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa
Honolulu, Hawaii, USA
mhuntley@hawaii.edu

²Department of Marine Science
University of Southern Mississippi
Stennis Space Center, Mississippi, USA

The only major strategy now being seriously considered for biological mitigation of atmospheric CO₂ relies entirely on terrestrial plants. Photosynthetic microbes were the focus of similar consideration in the 1990s. However, two major government-sponsored research programs in Japan and the USA concluded that the requisite technology was not feasible, and those programs were terminated after investing $US80 million and US$25 million, respectively. We report here on the results of a privately funded US$20 million program that has engineered, built and successfully operated an industrial-scale, modular (1-ha), production system for photosynthetic microbes. The production system couples photobioreactors with open ponds in a two-stage process - a combination that has been suggested, but never attempted - and has operated continuously for several years. The annually-averaged rate of achieved microbial oil production is equivalent to >420 GJ ha⁻¹ yr⁻¹, which exceeds the most optimistic estimates of biofuel production from plantations of terrestrial “energy crops.” The maximum production rate achieved to date is equivalent to 980 GJ ha⁻¹ yr⁻¹. We present evidence to demonstrate that a rate of 3,200 GJ ha⁻¹ yr⁻¹ is feasible using species with known performance characteristics under conditions that prevail in the existing production system. At this rate, it is possible to replace reliance on current fossil fuel usage equivalent to ~300 EJ yr⁻¹ - and eliminate fossil fuel emissions of CO₂ of ~6.5 GtC yr⁻¹ - using only 7.3% of the surplus arable land projected to be available by 2050. By comparison, most projections of biofuels production from terrestrial energy crops would require in excess of 80% of surplus arable land. We suggest a decade-scale research and development strategy that has the potential to double the rate of bioenergy production from photosynthetic microbes while simultaneously rendering the process cost-competitive with fossil fuels. Genetic and molecular engineering, in particular, offer specific prospects for doubling productivity and halving costs. Civil, chemical, and computer engineering will also play significant roles in optimal design and cost reduction. We recommend a decade-scale global initiative of collaboration between government, industry, and academia be established at a cost of ~US$100 million per year to achieve these objectives.
SURFACE WATER $\text{TCO}_2$ VARIATION ANALYSIS USING $\text{CO}_2$ FEEDBACK MODEL

Rieko Inoue, Masatoshi Akiyama and Kana Nakamoto

School of Marine Science and Technology
Tokai University
Shizuoka, JAPAN
2aoim003@scc.u-tokai.ac.jp

Global warming has imposed an important impact on people activities at the present time. Carbon dioxide ($\text{CO}_2$), one of the most important green house gases, is associated with air-sea gas exchange and global carbon circulation. The estimation of air-sea $\text{CO}_2$ flux is very important in global carbon circulation and climate research. The flux of $\text{CO}_2$ between the atmosphere and the ocean is estimated by the partial pressure of $\text{CO}_2$ ($p\text{CO}_2$) difference multiplied by $\text{CO}_2$ gas exchange coefficient which is one of the very important parameters in estimating air-sea $\text{CO}_2$ flux.

Several gas transfer models which calculates gas exchange coefficient have been proposed, but it is not easy to evaluate $\text{CO}_2$ gas transfer models at the present time due to the difficulties of gas exchange coefficient measurement.

In this study, we developed “Air-sea carbon dioxide exchange feedback model” to describe gas exchange processes caused at the air-sea interface, which can estimate the temporal variation of $p\text{CO}_2$ in the seawater. As a result, typical $\text{CO}_2$ exchange coefficients had accuracy of 1% within wind speed about 7-15m/s.

Next, we analyzing the variation of the time series of the surface total $\text{CO}_2$ ($\text{TCO}_2$) about the $\text{CO}_2$ taken into an oceanic surface, we have made another one model of the “$\text{TCO}_2$ variation analysis”. According to this model, surface $\text{TCO}_2$ change could be divided into the influence from $\text{CO}_2$ flux from atmosphere and other influences.
IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES IN CHINA

Shourong Wang, Qing Zhu, Shuangzhi Xu, Ying Liu and Hongxiang Ren

Zhejing Provincial Meteorological Bureau (ZPMB)
Hangzhou, CHINA
wangsr@cma.gov.cn

Affected by both natural variability and anthropogenic activities, climatic conditions in China have obviously changed for last 50 years. Temperature in northern part rose about 1.0-2.5°C, while in southern and southwestern parts decreased somewhat in 1960s and 1970s. Precipitation was relatively abundant in 1950s, but reduced afterwards until 1990s. Climate change has undeniable impacts on water resources in China. In last 50 years, besides Pearl River and Songhua River, stream flow in most main basins such as Yangtze River, Huai River, Yellow River, Hai River and Liao River abated in different rates. The decreasing rate in Hai River is as high as 22.5-23.4 percent. According to the simulated results of hydrology modeling nested with climate models, by the year 2030, temperature in China will increase 1.4-3.1°C in various regions, and precipitation change from minus 7.1% to positive 12.9 percent. Precipitation in the regions south to Yellow River seems to augment in certain degrees, but in some northern parts increase just slightly, while in the Northwest decrease about 7.1 percent. At that time, runoff in main river basins will increase except Yellow River and continental rivers in the Northwest. Runoff in the two regions will decrease 12.6-20.9 and 22.0-48.3%, respectively. For the whole country, water demand will exceed $1 \times 10^{12} \text{m}^3$, which is $0.3259 \times 10^{12} \text{m}^3$ more than in 1990s and near the most available amount $1.2 \times 10^{12} \text{m}^3$. Climate change will cause water shortage for some basins such as Hai River and Yellow River. The shortage amount for the two basins is as high as $25.2 \times 10^8$ and $13.5 \times 10^8 \text{m}^3$, respectively, which will obstruct sustainable development in the regions. In order to adapt and mitigate impacts of climate change on water resources in China, some specific strategies such as water saving, industry structure change, rational water allocation and water contamination disposal have been adopted, and the programs of water transfer from the south to the north have been implementing.
SENSITIVITY OF EARTHQUAKE-GENERATED DISTANT TSUNAMIS TO THE SOURCE PARAMETERS

Edison Gica\(^1\), Michelle H. Teng\(^1\), Philip L.-F. Liu\(^2\) and Vasily Titov\(^3\)

\(^1\)Department of Civil and Environmental Engineering
University of Hawaii at Manoa
Honolulu, Hawaii, USA
gica@wiliki.eng.hawaii.edu
teng@wiliki.eng.hawaii.edu

\(^2\)School of Civil and Environmental Engineering
Cornell University
Ithaca, New York, USA
pll3@cornell.edu

\(^3\)NOAA/PMEL/OERD
Seattle, Washington, USA
vasily.titov@noaa.gov

When we apply the commonly used dislocation theory (Mansinha and Smylie 1971) to predict earthquake-generated tsunamis, we need to input a set of source parameters including fault slip, epicenter, fault area, focal depth, strike-, dip-, and rake-angles. However, in most cases, not all these parameters are known. This is especially true for historical earthquakes that occurred more than decades ago. Titov et al. (1999) investigated the sensitivity of several source parameters to earthquake-generated tsunamis by varying these parameters and examining their effects on the predicted wave height. They found that for distant tsunamis, the earthquake acts more or less as a point source and some parameters are not critical to the final prediction. Their study was based on one earthquake-tsunami event, namely, the 1996 Andreanov Island tsunami in the Aleutian region. The present paper is an extension of Titov et al.’s (1999) study. We examine another past tsunami, i.e., the 1960 tsunami generated by the great Chile earthquake, by using the Cornell COMCOT tsunami simulation model. Two source parameters—strike angle and focal depth—that have not been studied before will be investigated in the present study.

We first validate the COMCOT model by simulating two past tsunamis, namely, the 1946 and 1960 tsunamis generated by the Aleutian and Chilean earthquakes. The predicted and observed results on wave elevation and run-up are compared at selected sites on O‘ahu Island in Hawai‘i, and they showed good agreement. The model is then applied to test the sensitivity of the tsunami wave height to variations in the earthquake source parameters while maintaining the same earthquake magnitude. Our preliminary results show that the distant tsunami wave height is very sensitive to the fault slip, length, epicenter and strike angle while it is less sensitive to dip-, rake-angles and focal depth. For example, for wave heights offshore Hawai‘i due to the 1960 Chile earthquake, a 10° variation in strike angle would induce a 70% change in wave height, and if we double the fault slip, the resulting wave height will also be doubled even when the earthquake magnitude is maintained the same. However, when we double the dip- or rake-angles, the variation in wave height varies from only 11 to 32 percent. Similarly, when we vary the focal depth from 10 km to 93 km, the variation in the resulting wave height both near the source in Chile and offshore Hawaii is within 20 percent.
Korean coastal area has been frequently suffered from natural hazards due to severe waves caused by typhoons. Typhoon No. 0314 “Maemi” with the minimum atmospheric pressure of 910 hPa passed through the Korean peninsula for the duration of 6 hrs (18:00~24:00hr) on September 12 in 2003. The typhoon central pressure was ~950 hPa with the maximum wind of 60m/s (in Jeju) even after it landed on the southern coast. The typhoon Maemi induced an extreme wave particularly, in the southern coast.

During the passage of typhoon “MAEMI”, the maximum heights of significant waves were observed as 8.1m at Ieodo Offshore Tower Station located in the East China Sea, and 8.0m at Busan Station and 9.5m at Ulsan Station which are located in the southern coast. In order to predict wave climate for typhoon “MAEMI”, the numerical wave simulations using WAM and SWAN models were carried out. The predicted results were compared with the observed waves at the three different stations.
SIGNAL LENGTH FOR THE TEST OF BREAKWATER STABILITY IN IRREGULAR WAVE CONDITION

Akira Kimura¹, Yoshiharu Matsumi¹ and Ken-ichi Ohno²

¹Department of Social Systems Engineering
Faculty of Engineering
Tottori University
Tottori, JAPAN
matsumi@sse.tottori-u.ac.jp

²Information Processing Center
Tottori University
Tottori, JAPAN

Though several empirical formulae based on experiments have been proposed to give the stability weight of armor blocks. However, it has been obvious that any formula cannot be applied to the test data of other researchers. One and the largest reason may be that they pay small or no attention for the reproduction of the critical situation (critical wave) in the experiments with irregular waves. The occurrence probability of high wave exceeding the critical wave height, which is related to the damage of armour units, varies according to the number of waves in the irregular wave train adopted in the laboratory tests. Consequently, the dispersion of the damage criterion takes place.

In this study, to gain an assessment referring to a number of waves in irregular wave experiments, the influence of wave signal length to generate irregular waves in a laboratory test on the damage level of armour layer is investigated. Furthermore, the statistical properties of high waves and wave grouping relating to the damage of armour blocks are investigated changing the wave signal length.

The appearance probability of high wave exceeding the critical wave height within the limited number of waves is analyzed theoretically. It is found that 600 waves at least are necessary to give the tentative critical wave automatically in the laboratory irregular wave tests. Furthermore, it is also shown that to see a better insight into the criteria for the number of waves, statistical evaluations of the run length of the high wave exceeding the critical wave height is necessary.
The expedition in Theodosia Bay in the northeastern part of the Black Sea was carried out in August-September 2002. The measurements were made with a complex of hydro-, aero- and radio-physical equipment in the sea and seashore. The mechanisms and conditions for the formation of slick anomalies at the sea surface were studied. Similar anomalies regularly appear at the same points of the bay. On the basis of CTD-data and chemical analyses of bottom water samples the conclusion about the existence of submarine discharges of underground water at the bottom of the bay was made. This conclusion agrees with the Borisenko’s hydro-geological model (“Hydro-geological conditions of submarine discharges of the Crimea underground water”, 2001).

The researches of topographically guided flow influence on the inhomogeneities at the sea surface wave structure and on the variations of boundary atmosphere layers were carried out. It was shown, that the currents flowing around a bottom elevation induce transformations at the water surface, which manifest themselves in the spectrum of gravity-capillary waves and formation of slick anomalies. In their turn, the appearance of slick anomalies produces the variation in small-scale structure of aero-physical parameters in the near sea surface of atmosphere. Thus, the experiment in Theodosia Bay allowed us to study the phenomenon of the sequence development of different processes during the interaction with the environment. Such process is known as a cascade phenomenon. Experimentally the vertical scale of such phenomenon was estimated as several tens of meters of water column and in the boundary layer of the atmosphere.
The material of the lithosphere is periodically subjected to forces caused by such astronomical effects as the tidal perturbation, precession, and Chandler pole motion. The stress tensor in the Earth’s crust was reconstructed and the total free-energy balance was estimated on the theoretic level (Levin, Pavlov, 2001).

The goal of our study is a search of the latent regularities for the Pacific tsunami occurrence. We used the Expert Tsunami Database for the Pacific. By choosing 139 events with magnitude M>6.0 out of the Pacific zone tsunami list for the last fifty years, we subdivided these events into two groups: the northern part and the southern one. The analysis showed that there is temporal regularity in the tsunami occurrence: the event series occurred in turn for the Northern Hemisphere and then for the Southern one and so on. The typical periods of change over from one to another hemisphere were 6 and 18 years approximately and these periods are comparable with the well-known periods of the Chandler pole motion.

The annual distributions (for 12 months) were also examined for some regions of the Pacific (South America, Japan, Kuril Isl., Kamchatka and so on). It was detected that significant part of tsunamis in some regions for specific magnitude levels occurred in one or two month of the year (for example December and May for South America). The irregularity of the annual event distribution for some regions has statistical validity. Such annual irregularity may be caused by a peculiarity in the Sun-Earth system interaction.
MULTIPARAMETRICAL REGRESSION METHOD
FOR THE TSUNAMI SOURCE DEFINITION

Andrei Marchuk¹ and Konstantin Simonov²

¹Institute of Computational Mathematics and Mathematical Geophysics
   Siberian Division of the Russian Academy of Sciences
   Novosibirsk, RUSSIA
   mag@omzg.sscc.ru

²Institute of Computational Modeling
   Siberian Division of the Russian Academy of Sciences
   Krasnoyarsk, RUSSIA

Recently it became possible to install the deep-water wave detectors, which can transmit in real
time the ocean surface elevation. This gives the possibility for determination of the tsunami
source (its location and form).

During the last two years the team of scientists from Russia (Siberian Branch of the Russian
Academy of Sciences) and the United States (PMEL, Seattle) worked out the algorithm that
constructs the initial tsunami source as the linear combination of several unit sources. This
approach works correctly in that case, when the form and location of the real source is similar to
the unit one.

Method for the more precise tsunami source determination consists of the preliminary
computations of the wave propagation, generated by several tsunami sources that are located on
the boundaries of the source area. Then the comparison of the real and synthetic wave series
(marigrams) makes it possible to find the real source location and its size. This procedure can be
made in the neural-network algorithms. In this case the deep-water stations data is changed by
approximation generated by neural network.

The proposed method was tested on the model bathymetry, which includes the finite bottom
slope. The method enables to determine tsunami source using wave records even from 1-2 deep-
water stations. Neural-network approach was tested on the real case of Pacific tsunami.
MOVING BOUNDARY TREATMENT OF HYDRODYNAMIC NUMERICAL MODELS

Byung-Cheol Oh¹, In Ki Min¹, In Sik Chun² and Yong Shik Chu¹

¹Korea Ocean Research and Development Institute
Seoul, KOREA
bcoh@kordi.re.kr

²Department of Civil Engineering
Konkuk University
Seoul, KOREA

The fixed boundary is often used for hydrodynamic numerical simulation in a small bay with small tidal flat areas. However, it is not valid in the areas with large tidal flat which may induce large errors, because the exposure areas should be large during the ebb. Thus, the moving boundary condition should be used in this case.

The slot method deals with the moving boundary, which brings the water in front of the shoal into the shoal; therefore, the dry area is also included in the simulation and it looked like a fixed boundary area. The advantage is that we can transform the moving boundary into fixed boundary simulations which is unnecessary to judge every time step and every node.

In this paper, the slot method is used to simulate hydrodynamic numerical model with moving boundaries. And then this model is applied in Gwangyang Bay dominated by tides. The computational results are in good agreement with the observed data.
The problem of local tsunami warning remains an unsolved problem. Local tsunamis are generated within waterside no far than 100 km from coastal line and their propagation time from a source to coast is less than one hour. It makes these tsunamis extremely dangerous. A possible way to solve this problem is to pick up the acoustic signals what appear in water at the critical stage of the submarine earthquake preparation. An earthquake preparation zone is characterized by increasing of the micro-crack density. This process generates acoustic signals (AS) with frequency 10-100Hz. The AS decay fast in the solid layers but in water medium these signals propagate far because of a weak attenuation of the signal in the incompressible water.

A joint analysis of the local Kamchatka earthquake catalogue data and hydroacoustic observation data from high-quality hydroacoustic receiving array located in the ocean was carried out. Two types of signals were detected from the zones of a submarine earthquake preparation: the micro-earthquakes (MEQ) whose focuses were located in the same area as the seismic focus of main earthquake and the seismic noise, which appears just before the main shock. The MEQ duration was about 3-4 seconds, frequency - 40-75 Hz. It was shown that the MEQ focuses were located not far from the ocean floor while the earthquake focus may locate a lot deeper. The presented results show that the monitoring of the hydroacoustic signals can be used for local tsunami warning system improvement.
This paper presents a two-dimensional finite volume model for long-wave run-up calculations. The model is based on the nonlinear long-wave equations with source terms. A Godunov-type scheme using the exact Riemann solver provides accurate descriptions of bores and depth discontinuity. The Riemann solver also includes a moving-boundary formulation for run-up calculations. The surface gradient method accurately reconstructs the data at the cell interface for a well-balanced formulation of the flux gradient and source terms. Comparisons of the results for one and two-dimensional solitary-wave run-up problems with analytic solutions and laboratory data show good agreement.
EXTREME SEA LEVEL EVENTS AT HONOLULU, HAWAII

Y. L. Firing and M. A. Merrifield

Department of Oceanography
University of Hawaii
Honolulu, Hawaii, USA
firing@hawaii.edu

For about a week in September 2003, the tide gauge at Honolulu measured the highest daily means on record. The high sea level was accompanied by reports of increased erosion and salt-water flooding in some areas of Oahu. This event is placed in the context of historic high sea level events at Honolulu. It is found that deviations of more than 200mm from the mean and long-term trend occur on the order of every 20 years, and last on the order of a week. Historically most of the high events occur in September, at the maximum of the seasonal cycle. The anatomy of this event is examined using other tide gauge records, satellite sea surface height, sea surface temperature, winds, and temperature and salinity profiles. The event is found to be caused by a warm-core eddy that originated several thousand kilometers to the east. Additional height comes from what appears to be the beginning of an interannual or decadal upswing similar to those observed throughout the record, and the co-occurrence of the seasonal maximum in sea level.
THE PREDICTION OF STORM SURGE CAUSED BY TYPHOON “MAEMI” IN MASAN BAY, KOREA

S.W. Kang, K.C. Jun, S.I. Kim and K.S. Park

Coastal and Harbor Engineering Research Laboratory
KORDI
Seoul, KOREA
swkang@kordi.re.kr

Korean coastal area has been frequently suffered from natural hazards due to abnormal water-level elevation due to storm surge and wave caused by typhoon. Typhoon No. 0314 "Maemi" with the minimum atmospheric pressure of 910 hPa passed through the Korean peninsula for the duration of six hours (18:00~24:00hr) on September 12, 2003. The typhoon central pressure was ~950 hPa with the maximum wind of 60m/s (in Jeju) even after it landed on the southern coast. The typhoon Maemi induced an extreme storm surge and wave particularly, in Masan Bay causing the enormous coastal flood disasters in the coastal area of Masan City.

The storm surge in Masan Bay during the passage of typhoon "MAEMI” was simulated using a fine-scaled surge model, which was connected to three different large-scaled models using a nested grid system. The predicted results show that the spatial distribution of the maximum surge heights in Masan Bay was in the range of 130cm~140cm, with increasing the surge height toward the bay inside where Masan City is located. The predicted surge heights were in a good agreement with the water-level elevations observed in Masan City.
OSCILLATION OF MOORED FLOATING BODY DUE TO THE LOW FREQUENCY WAVES

Akira Kimura and Hidekazu Fujii
Dept. of Social Systems Engineering
Faculty of Engineering
Tottori University
Tottori, JAPAN
kimura@sse.tottori-u.ac.jp

A proto-type of a floating runaway (1000m x120m x 3m) has been constructed in Tokyo bay, Japan, and its function has been investigated in many ways. Its dynamic behavior due to wind waves has been investigated experimentally. Although surging motion by a wind wave with a period of order 10s is negligibly small, considerable slow drift oscillations with a period of order 100s were observed in in situ measurements. This is induced by the non-linear (mainly 2nd order) low frequency waves (Newman 1974; Pinkstar 1976).

The present study investigated theoretically the behavior of a large floating body due to the 2nd order low frequency waves that are induced by the non-linear interactions between (the 1st order) component waves in a spectrum. In the theoretical investigations, new free low frequency waves were detected. Considerable surging motion was induced by the new low frequency waves. Motion of the floating body due to these low frequency waves is given in very simple equations. The present model is also available to the surging motion of vessels directly.
ON THE SCOURING OF WESTERN BREAKWATER
AT MAILIAO HARBOR, TAIWAN

Ho-Shong Hou¹, Tai-Wen Hsu², Yuan-Jyh Lan² and Chin-Yen Tsai²

¹Office of the President
TAIWAN
hou@infg.com

²Department of Hydraulics and Ocean Engineering
National Cheng-Kung University
Tainan, TAIWAN

This paper aims at the numerical simulation of scouring at the head of western breakwater at Mailiao Harbor, Taiwan, using wave, tidal current and coastal morphodynamic models. The western breakwater of Mailiao Harbor is located in a deep water of 25m. The mechanism of hydrodynamic and coastal morphology around the harbor is a combined effect by both waves and currents, and it is quite different from that in the nearshore zone. Thus, the existing hydrodynamic and coastal morphodynamic models are improved to simulate and analyze scouring at the head of the western breakwater. The numerical results including the currents and bathymetric changes closely match the field survey data. Furthermore, the computed concentration of sediment and sediment transport rate around the western breakwater during the monsoon season and typhoon events are analyzed. The results suggest that the scour at the head of the western breakwater is formed due to the sediment enhanced by wave-induced circulations and carried seaward by tidal currents.
SIMULATION OF WAVES PASSING OVER POROUS MEDIA USING EMSE WAVE MODEL

Tai-Wen Hsu, Yuan-Jyh Lan and Chin-Yen Tsai

Department of Hydraulic and Ocean Engineering
National Cheng-Kung University
Tainan, TAIWAN
twhsu@mail.ncku.edu.tw

An extension of elliptic mild slope equation (EMSE) by Rojanakamthorn et al. (1989) including energy dissipation term is derived on the basis of the equation for waves passing over porous media. A finite-element model based on mild slope equation is also developed. The second-order radiation boundary condition is applied for wave propagation with large angle incidence. Triangular elements with quadratic shape function are employed in the model. The validity of resulting model is checked through comparisons with experiments for a trapezoidal submerged breakwater on a sloping beach and a rectangular submerged breakwater on a flat bottom. Numerical computations are found to be in agreement with observed data, indicating that the present model has made a good improvement for simulating waves transformation over a submerged breakwater. Furthermore, the model is applied to a real-world case in Tainan, Taiwan.
MODELING OF WAVE SPLASH ON BLOCK MOUND SEAWALL FOR COASTAL HIGHWAY

Katsutoshi Kimura¹, Masashi Hamaguchi¹ and Toshiaki Shimizu²

¹Department of Civil Engineering
Muroran Institute of Technology
Muroran, JAPAN
kimura@mmm.muroran-it.ac.jp

²Research and Development Section
Nippon Data Service, Inc. Co., Ltd.

This study focused on traffic hindrances caused by high waves on a coastal highway. In the design of seawalls, the tolerance limit of the wave-overtopping rate should be decided according to the utilization of the hinterland. When designing a seawall for a coastal highway, the wave-overtopping rate of $10^{-4}$ (m³/m/s) is regarded as the limit to ensure safe traffic. In such a condition, wave splash causes direct and indirect influences to running vehicles. However, the mechanism of wave splash generation is not clear.

The target structure of this study is block mound seawall, which is generally used for coastal highways in Japan. Hydraulic model tests were carried out in two dimensional wave channels with irregular waves. The characteristics of wave splash on block mound seawalls were examined for several structural conditions.

In the model test, two types of wave splash were observed. The first one is made when the wave hits the block mound surface (Phase I), and the second one is made when the wave hits the back wall (Phase II). Based on the test results, the initial speed and the projecting angle of wave splash were formulated for Phases I and II. The applicability of the formula was also confirmed by the field observation.
Accompanying with developments of solution techniques, research publications on waves propagating over poro-elastic seabed have increased in volumes in recent years. Solution procedures presented by Hsu, Jeng and Tsai (1993) made it possible that the problem can be solved analytically. By applying the same approach several different related problems were also been solved. However, theoretical solutions were limited to an approximation that wave actions were directly added on the surface boundary of the seabed. Therefore, that is only one-way action of incident waves on poro-elastic seabed. And effects of the poro-elastic seabed on incident waves were assumed to be small and can be neglected. Lee and Lan (2002) proposed a theoretical solution that included interactions between waves and poro-elastic seabed, in which kinematic and dynamic matching conditions on the interface were included in the solution. But in the solution coupling effects between waves and poro-elastic seabed were coexisting, effects of the poro-elastic seabed on incident waves could not be discussed.

In this paper, Lee and Lan’s solution is improved to solve the problem again. And interactions between incident waves and the poro-elastic seabed can be solved completely. The present theoretical solution is verified by comparisons to experimental results by Yamamoto et al. (1978). Using the present theoretical solution, wave reflection, transmission, and energy dissipation inside the porous medium for incident waves propagating over poro-elastic seabed were discussed. The distribution of dynamic pressure and stress conditions inside the poro-elastic seabed due to incident waves were also investigated.
NUMERICAL ANALYSIS ON THE WAVE PRESSURE ACTING ON RUBBLE MOUND BREAKWATERS

S. Seong, I. Chun and C. Kim

Department of Civil Engineering
Konkuk University
Seoul, KOREA
ss914@nate.com

The analysis of the stability of rubber-mound breakwaters needs the information of dynamic pressures occurring at the frontal slope exposed to wave incidence. In the present study, a numerical wave flume based on Navier-Stokes equation and VOF (volume of fluid) method was applied to reproduce the nonlinear wave field occurring on the slope. The purpose of the study is to provide a basis for an empirical formula of the wave pressure acting on the frontal slope of rubber-mound breakwaters.

The amplitudes of the dynamic pressure on the slope were calculated and compared with the existing results of hydraulic experiment. It was appeared that they agreed quite well. It was found that there is a kind of linear relationship between the maximal wave pressures also and surf similarity parameter. Through a number of experiments, an empirical formula was proposed. The maximal pressures along the slope were finally compared with the values of Goda's simple formula. The latter showed considerably larger values than the present results.
THE EXPERIMENTAL STUDY OF HEXAGON MULTI-APERTURED PILLARS SCRAP TIRES OF SUBMERGED BREAKWATER

Jian-Chung Shern¹ and Ho-Shong Hou²

¹National Kaohsiung Marine University
Kaohsiung, TAIWAN
jcshern@mail.nkimt.edu.tw

²National Policy, Office of the President
National Sun-Yat-Sen University
Kaohsiung, TAIWAN

The test that proposed the submerged breakwaters of hexagon multi-apertured pillars scrap tires resulted to protect coast. Armored blocks are shape of hexagon multi-apertured pillars and have wedges that hanged easily to combine to submerged breakwaters. The internal part of Armored blocks that was formed with chains of scrap tires to be multi-apertured structure and caused the wave of incidence interfering, reflecting, breaking energy of wave and being artificial reefs. In the nearshore submerged breakwaters stacked the form of line or row that could break waves, dissipate energy, decrease sediment suspensions and protect the coast. Submerged breakwaters were stacked in coastal line that could protect the coast. The Model Experiment was 1/50 scale and tested in National Kaohsiung Marine University wave maker tank. On condition that scaled the model Experiment was under control and could deeply research in different model, relative depth, period and reducing energy of wave relatively. The result revealed that reduced energy of wave was 35%~52%, could project the effect of submerged breakwaters in coast. Therefore proof of the new type of submerged breakwaters. Armored blocks could reduce wave energy and be protective the coast excellently.
A STUDY FOR SUBMERGED HORIZONTAL PLATES 
BY EXPERIMENTS 

W. K. Weng and C. R. Chou

Department of Harbor and River 
National Taiwan Ocean University 
Keelung, TAIWAN

In recent years the characters of submerged plate have attracted much attention, many papers concern to submerged plate had been presented, including numerical and experimental study. However, most of papers gave their focus on the wave’s transformation on submerged plate and the characters of wave dispersing due to a submerged horizontal or inclined plate.

In this paper, the influences of multi-horizontal submerged plates for wave dispersing are our interesting, therefore, a series of experiments about multi-horizontal submerged plates are proceeding in wave tank. The discussions includes the differences for wave dispersing between multi-layer horizontal plates and one layer plate, wave dispersing and it’s transformation on plate are also discussed only when a submerged horizontal plate is set up but with different thickness. All test wave conditions are under the limit of wave unbroken on submerged plate.

An array wave gauges are arranged that have a ten centimeters distance between each other for convince to understand wave transformation on submerged plate. Pressure gauges are set up on and down the surface of plate and also have a ten centimeters distance between each gauge for surveying wave dynamic pressure. The results of preliminary analysis are that the set up of one or two layers submerged plate make no difference to the characters of wave dispersing, but thickness of submerged plate will cause the differences for wave transforming on the plate.
STUDY OF THE PREVENTION OF SALTY WIND DAMAGE

Yoshifusa Yamada¹, Saichi Tamai² and Mitsuo Takezawa³

¹Japan Technology Co., Ltd.
   Tokyo, JAPAN
   yd@japatech.co.jp

²Kochi University
   Kochi, JAPAN

³Nihon University
   Department of Civil Engineering
   Tokyo, JAPAN

The height and distance of splash being generated by sea waves were simulated in the wave tank with a wind tunnel, and the prevention of salty wind damage is considered in the present study. The experiment was carried out using a two-dimension wave tank with a wind tunnel. A 1/20 model of the seawall was set up on the fixed bed with a 1/15 slope at the end of the wave tank.

Models of the concrete armor unit were heaped up in front of the seawall in four rows and two steps. The windbreak net models were made of a 2 mm x 2 mm mesh. The heights of the windbreak nets were 15 cm and 20 cm. The windbreak net was built up at positions of 10 cm, 20 cm, 30 cm, 40 cm and 50 cm behind the seawall.

The height and distance of splash were observed using a camera and the human eye. The distribution of wave topping was obtained from the weight of the blotting papers installed at 10 cm intervals behind the seawall. The model wave period was 0.89 sec – 1.34 sec, the model wave height was 3.0 cm – 5.6 cm, the model wave steepness was 0.013 – 0.046, and the model wind speed was 0 – 4.90 cm/sec.

The main conclusions are the following:

1) The splash behind the seawall was prevented by the windbreak set.
2) The splash height was influenced by the concrete armor unit in front of the seawall.
WAVE CONDITIONS INSIDE THE HUALIEN PORT, TAIWAN

Y. F. Chiu1, J. G. Lin2 and H. S. Hou3

1Center of Harbour and Marine Technology
   Institute of Transportation
   TAIWAN

2Department of Harbor and River Engineering
   National Taiwan Ocean University

3Office of The President
   TAIWAN

Due to the special topography and bathymetry, Hualien Port in Taiwan contains long period oscillations inside the harbor, and has caused many problems for the ship maneuvering and anchoring. From the past researches by numerical simulations and hydraulic model tests, the tranquility of Hualien Port might be excited by the wave period longer than 100 sec, which is, consist with the field measurement results. In this study, field wave data around Hualien Port during May 2002 and September 2002 was used to investigate its long period oscillations. The component waves with period grater than 30 sec were first subtracted via moving average or band-pass filter, and analyzed. The results will also compared to the hydraulic model results.
This study is to submit port development project to help Kaohsiung Port as a hub port by means of comprehending its functions and special features. For the improvement of operation and administration efficiency and competition power, the authorities are suggested to engage in: solving stevedores problem, carrying out policy of privatization, liberalization and computerization, setting up port operation and management systems, developing high value added industries and distribution centers within or nearby the port area, and setting integrated transportation and telecommunication port into action. Port of Kaohsiung with a total length of 23 KM has 106 berths, 77% with 16.5 M water depth capable of accommodating 120,000-ton-vessel and 23% for military and service crafts. Its sound port facilities, excellent geographic condition and large cargo throughput amount make the future expansion feasible and construction cost low. However, there are still problems. Port development, including the planning, expansion, finance, has to be examined and verified by various organizations since ministry of transportation and communication is in charge of port management system. Meanwhile, the service quality of Harbor Bureau is affected because of lacking flexibility. It is responsible for stevedore management rather than hiring them. The operation efficiency of Kaohsiung Port is influenced as well by factors, like lease mode of container terminals, and quality and management of dock labor. Besides, Port of Kaohsiung has difficulty to provide the environment for operation of value-added industries because there is no planning for logistics or distribution center within port area. This study tries to plan the whole picture of Port of Kaohsiung, such as making the administration and operation powers of port affairs separately and independently, creating a competitive environment for shifts and shipping companies choosing stevedores, regulating reasonable rental charge mode and flexible rates when using equipments of different quality levels, etc. After the completion of construction of Container Terminal No. 5 in Tajen commercial port area, there will be 8 more container berths to cope with the demand of container operation. According to the policy of pushing Taiwan to be the Asia-Pacific Operations Center, Port of Kaohsiung will add its competition power by being chosen to be the marine transshipment center.
SEDIMENT DISPERSION OF SAND EXPELLED FROM DISCHARGE PIPE

Tadayuki Yamamoto, Mitsuo Takezawa and Yoshihiko Maeno

Department of Civil Engineering
College of Science & Technology
Nihon University
Tokyo, JAPAN
takezawa@civil.cst.nihon-u.ac.jp

Sea reclamation works such as offshore airports, marine parks, have been constructed in deep water. Construction requires the deposit of reclaimed sand away from the work site. One dropping method involves dumping reclaimed sand into the sea from hopper barges directly. Another dropping method continuously expelling a slurry of reclaimed sands drawn into hopper barges by drag-suction dredgers from drag-heads lowered into the sea.

Sediment dispersion of the sand expelled from the discharge pipe of the drag suction dredger is described in the present paper. The scatter and spread of sands in the underwater settling process were studied theoretically and experimentally, and a field study was proposed. Model tests were conducted in a water tank (length 2 m, width 1.3 m and depth 1.8 m), using three sand discharge pipes, four sand grain sizes, and four varying water depths.

Conclusions reached in the present study are as follows:

1. The relationship among the sand concentration, the width of sand diffusion and the settling distance of sand in still water was verified using a turbulent diffusion equation.
2. The relationship between the settling velocity and the apparent measurement concentration of sand in groups was given by an equation of motion in fluid.
3. Model tests demonstrated that the settling velocity of sand in groups was decided by sand grain size and apparent measurement concentrations.
4. Field data confirmed the modeling results for the sediment dispersion of sand expelled from the drag suction dredger’s sand discharge pipe.
CONCEPTUAL MODELING OF A PORT IN THE EASTERN MEDITERRANEAN: AN OPERATIONAL AND A MANAGERIAL APPROACH

Funda Yercan

Institute of Marine Sciences and Technology
Dokuz Eylul University
Izmir, TURKEY
funda.yercan@deu.edu.tr

Seaports have been one of the oldest forms of transportation infrastructures and have played vital roles in the social, economic, and technological growth of regions since many centuries. Rapid developments and changes in the maritime industry and increasing integration of waterborne, land and air transportation systems have affected the design, operation, and management of ports. Therefore, impacts of higher quality services provided at ports have been considered in order to increase the effectiveness of ports in contribution to the regional economy.

A conceptual system model is developed to give a basic descriptive explanation for a qualitative approach towards the initial analysis of the port industry and to form the basis for understanding the port operations and management system and related policy developments. The model is operationalized through a series of conceptual contexts, which are associated with the broad port industry. Thus, developments and issues related to this subject are examined through these contexts. The conceptual contexts used to provide a framework for the conceptual system model of the port industry and for the Port of Izmir, in Turkey in the Eastern Mediterranean area, in particular, are examined within spatial, economic, technological, organizational, logistical, managerial, operational, marketing, legal, and environmental impacts.

Consequently, this paper is focused on the conceptual modeling of the port industry with more attention to the Port of Izmir in Turkey in the Eastern Mediterranean. The integration of the conceptual concepts is analyzed to achieve more efficient logistics solutions in the port industry.
The Kwangyang Bay, located in the southern sea of Korea, has undergone severe environmental changes due to the construction of Kwanangyang Harbor since 1982. A three-dimensional layer-level hybrid model developed by the author was applied to the Kwangyang Bay to estimate the impact of the development of the bay. The simulations for circulation and sediment transport were performed to quantify the changes of tidal current, the spreading pattern of the runoff from the Sumjin River and the morphology. In addition, intensive field measurements on the hydrodynamic and sediment conditions have been carried out around the Kwangyang Bay from November 1986 to August 2002. The model predicted tide, tidal currents and sediment transport rate agreed reasonably well with the measurements.

The spreading pattern of the river plume after the construction of Kwanangyang Harbor is toward the eastern part (Noryang Channel) of the bay whereas the spreading pattern before the construction is mainly southward (Yeosu Channel). Averaged over a month the sediment transport in the channel is seaward and on the tidal flat land-ward. Water and sediment from the upstream river are transported downstream. So, the residual sediment transport in the channel is in the ebb-direction. The erosion occurs in the entrance areas in which the current velocities are very strong. This model can be used as an important tool to study the impact over local fishery and ecological system which require further detailed investigation.
FORMATION OF NAKDONG RIVER DELTA

Hyoseob Kim and Youyeal Lee

Department of Civil and Environmental Engineering
Kookmin University
Seoul, KOREA
hkim@kookmin.ac.kr

A series of deltas were formed at the mouth of Nakdong River. Like other deltas the deltas were under delicate balance influenced by the waves, the tidal or wave-induced currents, and the river floods. The Nakdong tidal barrage was built upstream of the deltas in 1990, and the bathymetry around the barrage is still adjusting itself towards a new equilibrium. The effect of tidal current on the growth or decay of the deltas has been studied by Kim et al. (2003).

The effect of the river flood flows is examined on the delta formation here. A representative river flood was chosen for the description of the formation of the delta group, and the same flood was applied to the new bathymetry with the barrage.

The model results imply that the river floods will act a role of decreasing the size of each delta. So far the equilibrium state of the deltas can be understood with the change of the critical shear stress for the erosion of the bed material caused by the change of the tidal system and the river flood flows. The effect of the wave and the wave-induced current on the delta reformation will be discussed later.
BATHYMETRIC CHANGE MODELING PLAN
OF SAEMANGEUM AREA

Hyoseob Kim and Sunjung Park

Department of Civil and Environmental Engineering
Kookmin University
Seoul, KOREA
hkim@kookmin.ac.kr

Saemangeum Barrage has been constructed since 1989, and will be completed in about a few more years. Both waves and tides are significant at the area. The area is famous for wide tidal flat. The bed material at the site is composed of grains of a wide spectrum of sizes, gravel, sand, silt, and clay depending on the position.

A few beaches are situated near the barrage. Questions arise on the future changes of the beaches either qualitative or quantitative due to the construction of the new barrage. A comprehensive study on the bathymetric change was recently planned by Kookmin University and Korea Ocean Research and Development Institute.

Making use of existing data sets, numerical modeling was included in the whole study. A numerical model system, KU-BATH was chosen for the simulation of the bathymetric change. The present paper describes the modeling plan of the bathymetric change at the area.
Many pocket beaches are found on the east coast of Korea. Between two promontories sand or slit moves free depending on the wave or current conditions. It should be noted that most beaches has symmetric shapes with regard to the central profile of the beach.

Assuming that the bed material budget in a pocket beach is limited, the equilibrium shape of a beach may be decided from several parameters, e.g. beach length, beach slope, bed material, wave height, wave period, and wave direction. Two representative waves could describe the equilibrium status of the shoreline.

A few beaches on the east coast of Korea were chosen for the analysis of the symmetry of the shoreline shape. Numerical modeling was undertaken to describe the symmetry of the shoreline. The computation results show that the absolute value of the sediment transport rate along the shoreline shows a distribution of quite symmetric shape along the shoreline.
FUNDAMENTAL REASONS OF OCCURRENCE OF BEACH EROSION DUE TO EXTENSION OF BREAKWATER

Yukiyoshi Hoshigami\textsuperscript{1}, Akio Kobayashi\textsuperscript{1} and Takaaki Uda\textsuperscript{2}

\textsuperscript{1}Department of Oceanic Architecture & Engineering
College of Science and Technology
Nihon University
Narashino, Chiba, JAPAN
yukiyoshi_hoshigami@kkc.co.jp

\textsuperscript{2}Public Works Research Center
Taito, Tokyo, JAPAN

Fundamental mechanism of accretion in the wave shadow zone and erosion in the surrounding area, triggered by the extension of port breakwaters, has been widely understood, and various predictive models are applicable to coasts. However, this type of beach erosion and accretion has been repeated at many coasts in Japan. This study aims at investigating the fundamental reasons of the repetition of this failure of beach erosion, with deep concern with the Japanese system of the environmental assessment.

An environmental assessment has been conducted nationwide for the planning of port, and the result has been open to the public. In the Japanese environmental impact assessment law, terms of evaluation regarding the impact to the sea are specified, but indirect influences of the beach changes caused in the surrounding area of the planned site are expressed as consider, if necessary, that is, not mandatory. As long as the authority does not judge the necessity of the assessment, it has not been carried out. Thus, the impact to the coastal environment associated with the beach changes is not regarded as important, and issues become obvious after the resultant change in environment. Considering that the coastal environment inevitably changes with the beach changes, this is an absolute contradiction.

Consideration of impact to beach changes should be taken into account in the application of the Environmental Impact Assessment Law, despite the scale of the planned facility, as well as the education of city planners regarding the mechanism of beach changes.
BEACH CHANGE AND SORTING MODEL DUE TO LONGSHORE AND CROSS-SHORE SAND TRANSPORT

Takayuki Kumada¹, Akio Kobayashi¹, Takaaki Uda² and Masumi Serizawa³

¹Department of Oceanic Architecture and Engineering
College of Science & Technology
Nihon University
Funabashi, Chiba, JAPAN
0370291901@jcom.home.ne.jp

²Public Works Research Center
Taito, Tokyo, JAPAN

³Coastal Engineering Laboratory Co. Ltd.
Shinjuku, Tokyo, JAPAN

The necessity of a model applicable to the prediction of not only beach changes but also grain size changes is increasing as a tool for the prediction of the environmental impact associated with the various developments in coastal areas. Kumada et al. (2003) developed a predictive model of longshore grain size change, considering the sorting effect of grain size. However, their model could only predict the two-dimensional changes, and it was impossible to apply the full three-dimensional prediction of grain size distribution associated with the beach changes. In this study, a predictive model of shoreline and grain size changes developed by Kumada et al. (2003) was further expanded, and the contour line change model applicable to the prediction of three-dimensional distribution of grain size was developed, by taking into account of the concept of sorting of grain size due to cross-shore sand transport in the model.

Due to the result of model calculation, contour line and grain size changes depend on the power balance between longshore and cross-shore sand transports. Comparison with the results of a movable bed experiment shows that the contour line change and sorting of grain size are well reproduced. The model was further applied to the events on the Toban coast in Hyogo prefecture, Japan, and it was confirmed that it was applicable to the prediction of the three-dimensional changes of the contour line and grain size distribution.
The new port of Ishikari Bay is situated at the mouth of the Ishikari River, flowing into the Japan Sea, in Hokkaido, Japan. The coast area surrounding the new port of Ishikari Bay is comparatively stable. The main source of littoral drift along the Ishikari coast is the sediment from the Ishikari River, discharged at an annual average rate of 800,000 m$^3$. The littoral current along the Ishikari coast is unremarkable, and the predominant direction of littoral drift is from the mouth of the Ishikari River to the opposite side of the new port.

Coastal cross-section changes, before and after construction of the new port, are described in the present paper. Evaluation of the changes to the coastal cross-section was carried out using overlapping sounding charts from the previous 20 years. Wave observation data at Ishikari Bay were also analyzed.

The main conclusions are as follows:
1) Changes in the coastal cross-sections near breakwaters of the new port were evident, but coastal cross-sections at other sites were not influenced by the construction of the new port.
2) Erosion increased with wave steepness, but erosion decreased at a lower rate when wave steepness decreased.
3) The shoreline advanced toward the sea as the sand bar moved offshore, and the shoreline retreated toward the mainland as the sand bar moved onshore.
4) The existence of edged waves was estimated using the velocity of undertows.
GEOLOGICAL CHARACTERISTICS
OF COASTAL ZONES AROUND TAIWAN

Ho-Shing Yu

Institute of Oceanography
National Taiwan University
Taipei, TAIWAN

The length of coast around the island of Taiwan is about 1,250 km long. On the basis of
tectonomorphic characteristics the coastal zones of Taiwan can be divided into two major types:
 eastern collision coast about 300 km long and western trailing-edge coast about 430 km in
 length. The eastern collision coast is located along the active suture zone and stretches in a north-
south direction parallel to the Coastal Range. The eastern coastal zone is juxtaposed by very
 narrow shelf and its coastlines are relatively straight. Prominent sea cliffs and marine terraces
 occur at eastern coast mainly resulting from marine erosion and tectonic uplift of eastern Taiwan.

The trailing-edge coast in western Taiwan is situated on the stable foreland. Orogenic sediments
 are progressively transported westward and deposited to form convex coastline towards
 Mainland China. The western coast submerges into relatively wide Taiwan Strait shelf seaward
 and is neighbored by flat coastal plain landward. Much sediment derived from Central Range on
 the island is redistributed by longshore currents and deposited to form barrier-lagoon coast in
 western Taiwan. Large-scale geomorphology of Taiwan coastal zones is closely related to
tectonic settings. Plate tectonics play a major role in forming various coastal zones around
 Taiwan.

Cape-bay coast in northern Taiwan and coral reef coast in southern Taiwan are mainly resulted
 from combined marine, terrestrial and biological processes. The general trends of geological
 structures in northern Taiwan are normal to the shorelines. Alternating layers of sand and shale
 of these structures are undergone differential erosion, resulting in prominent coastal capes and
 bays. Coral reef coast in southern Taiwan is clearly formed by biological activities.
TEMPERATURE, SALINITY AND TURBIDITY CHANGES DUE TO GATE OPERATIONS

Hong-Yeon Cho, Shin-Taek Jeong and Won-Dae Baek

Coastal and Harbor Engineering Laboratory
KORDI
Ansan, Seoul, KOREA
hycho@kordi.re.kr

The principal objective of this paper is to analyze the dilution process due to gate operation. The gate operation has been carried out in order to improve the water quality (WQ) in the polluted waters impounded by the sea-dike, i.e., Lake Shi-hwa & Hwa-ong, located in the western part of Korean peninsula.

In general, the gate is opened to reduce the inundation damages of the watershed areas. The inland water is flowing into the coastal zone. In this case, however, the gate is opened to introduce the clean coastal water. This gate operation is intended to improve the inland WQ by the dilution effects. Then, the water temperature, salinity and turbidity are measured during the gate operation period using OBS-3A in the inside and outside points of the sea-dike. The quantitative dilution effects and the recovery time are analyzed in detail using the measured data set. There are many parameters involved in the WQ changes due to gate operation, i.e., the difference of the WQ concentration between inside and outside of the sea-dike, the interval and time of the gate operation, and the diffusion coefficients.
EFFECT OF ANTIFOULING BIOocide IRGAROL 1051 ON CALANOID COPEPOD, *Acartia omorii* (BRADFORD)

Md. Khaled Hossain¹, Takashi Ishimaru² and Seiichi Takeda³

¹Department of Marine Science and Technology
Tokyo University of Marine Science and Technology
Tokyo, JAPAN
Khaled125@hotmail.com

²Department of Marine Science and Technology
Tokyo University of Marine Science and Technology
Tokyo, JAPAN

³Department of Ocean Science
Tokyo University of Marine Science and Technology
Tokyo, JAPAN

The s-triazine herbicide Irgarol 1051 is the most commonly used alternative of tributyltin based antifouling biocide and remarkable concentrations were already reported in various coastal and marine environment. However, its impact on marine life especially on smaller zooplankton is very limited.

The present study was conducted to determine the effect of Irgarol 1051 on survival, egg production and egg hatch of calanoid copepod, *Acartia omorii* under bath administration. Each 10 individuals of adult female were incubated at different level of Irgarol 1051 (0.001, 0.01, 0.1, 1.0, 10.0 and 100.0 µg/L) with food (*Isochrysis* sp. + *Tetraselmis* sp., ratio 1:1). Survival was observed every 24h for 10 days. Egg production was observed through the incubation of single gravid female with above same conditions. Egg hatching success was determined for each 10 eggs at different concentration of Irgarol 1051, which were obtained from pre-exposed female at the same concentration.

Statistically no discrepancy was observed in control and solvent control (10 µl/L, dimethyl sulphoxide) treatment in all observations. LC₅₀ was obtained only 100.0 µg/L level of Irgarol 1051 after 192h of exposure. 10.0 µg/L and its below levels were appeared no effect on adult copepod. Significant (*P*<0.05) decreased in egg production was obtained in 100µg/L level. In hatching success, a little decrease was ascertained in 100.0 µg/L level but not significant. Result suggests that persistent level of 100.0 µg/L and above affect on reproduction success on the calanoid copepod, *A. omorii*. 
The seawater pumped storage pilot power plant was constructed in Okinawa Prefecture of Japan recently. The area of works locates at the northern Okinawa Island and remains many natures. Many precious organisms being on the verge of extinction inhabit in and around the area of works. This study is described about environmental conservation measures in case of constructing the power plant in the natural green space.

The scale of power plant is as follows: the maximum power discharge 26 m³/sec, the maximum output 30 MW, effective head 136 m, the circumferences of regulating pond-age 848 m, the reservoir capacity 590,000 m³, the length of penstock 314 m, the length of flood way 205 m, the size of power plant 40.4 m (length) x 16.4 m (width) x 32.8 m (height) and the total length of transmission line 18 km.

Points of environmental conservation measures in the construction of the power plant are the noise, the vibration, and the sanitary wastewater usually. However, very difficult measures of the construction of power plant in Okinawa of Japan were the sediment yield of red soil and the protection of precious animals.

As results, the sediment yield was measured by the catch drain, the weir and slope protection, and the natural conservation was protected by the construction of fences, the transplantation of vegetations and the preservation of wild animals.
DEVELOPMENT OF A NEW TYPE SEAWALL FOR IMPROVEMENT OF MATERIAL CYCLE

Junya Miyoshi¹, Yasunori Kozuki¹, Kengo Kurata², Shunpei Iwamura³
Hitoshi Murakami¹, Hiroyuki Mizuguchi⁴ and Masahiro Mizutani⁵

¹Department of Ecosystem Engineering
The University of Tokushima
Tokushima-city, Tokushima, JAPAN
miyoshi@eco.tokushima-u.ac.jp

²Research Center for Coastal Lagoon Environments
The University of Shimane
Matsue-city, Shimane, JAPAN

³Environments and Planning Department
ECOH Corporation
Taito-city, Tokyo, JAPAN

⁴Department of Civil Engineering
The University of Tokushima
Tokushima-city, Tokushima, JAPAN

⁵Port and Airport Technical Investigation Office
The Shikoku Regional Development Bureau
Ministry of Land, Infrastructure and Transport
Takamatsu-city, Kagawa, JAPAN

Harbors are usually surrounded with vertical structure, forming enclosed sea area. As a result, stagnating seawater delays to exchange. Nutrients from land area are easy to be saved in enclosed sea area, resulting in the primary factor of red tide. Suspension feeders that filter suspended organic matter and phytoplankton and excrete a lot of feces and pseudofaeces are overcrowded within an intertidal and subtidal zones because of vertical structures provide only small habitat. The rocky shore deposited seston is resuspended by turbulent flows due to wave and utilized by suspension feeders again, but deposited seston accumulates along vertical structure, resulting in hypoxia water. It is difficult for deposit feeders include Polychaeta to inhabit, after hypoxia forwards.

The test structure was placed at Okinosu port in Tokushima prefecture, western Japan in December 1999. And another structure on quaywall was placed at Amagasaki port in Hyougo prefecture, western Japan in March 2002. This objective was to place the horizontal shelf in rich dissolved oxygen layer that would facilitate suspended feeders to consume suspended organic matter such as feces and pseudofaeces deposited on it. This means that the shelf urges to improvement of material cycle. The authors reported on the effect of improvement through material cycle process from suspended solid to sediment.
STRATEGIC METAL VS BARRIER REEF: 
NICKEL IN NEW CALEDONIA

Lucile M. Roberts

Hawaii Institute of Marine Biology
Kaneohe, Hawaii, USA
lucile@hawaii.edu

New Caledonia holds more than a quarter of the world’s known nickel reserves. This special Pacific territorial entity of France also possesses a vast and complex barrier reef system, second only to Australia’s Great Barrier Reef. Strong demand for nickel, for both its strategic and industrial uses, is leading to an expansion of the exploitation of New Caledonia’s reserves into areas where this development may now seriously threaten the survival of the country’s reefs. A major international nickel company is investing an estimated US$1.8 billion in a mining and processing facility at Goro in the Southern Province of New Caledonia’s main island, with plans to begin operations in 2006.

Despite public assurances from the mining company that they are committed to protecting the environment of this small French Pacific island, disturbing signs that this may not be so continue to surface. This paper will examine portions of the mining and processing procedures, including high pressure acid leaching and submarine-tailing disposal. It will focus on the potential for serious damage to New Caledonia’s rich and diverse reef ecosystem, a candidate for UNESCO World Heritage Site protection.
Environmental problems caused in coastal waters by anthropogenic activities are analyzed. Complex technologies developed for analysis of remotely sensed satellite data combined with simultaneous oceanographic and meteorological are used to investigate the dispersion path of the wastewater plume discharged through a deep ocean outfall.

Treated effluent from the Sand Island Wastewater Treatment Plant is discharged through an outfall about two miles offshore at a depth of 70 meters into Mamala Bay. Wastewater is discharged through a diffuser to maximize initial dilution during its buoyancy phase. The measurements detected deep ocean processes and made it possible to track the wastewater plume within the study area.

Processing of high-resolution images from “Ikonos” satellite (∼ 1 m panchromatic and ∼ 4 m multispectral), revealed areas of anomalies at the ocean surface as well as in subsurface layer. These anomalies covered a relatively large area of the ocean in the study area (∼ 10 km).

Surface and subsurface anomalies detected result from interaction of existing surface features with physical mechanisms such as internal waves related to the wastewater discharge. The structure of surface signature produced by deep turbulent sources depends on outfall operating mode, ambient currents, density stratification, depth, wind conditions and the variation of light scattering in the subsurface layers.

Ocean properties are determined from physical and biological measurements at the time of satellite transit. Results obtained from the study can be used to develop programs to minimize the impact of wastewater discharge.
In this study we made clear the spatial composition of waterside settlement in Asia by a case study on Seraya, Indonesia. There are a lot of waterside settlements in the Flores Island, Indonesia. This study takes up Seraya settlement. The waterside settlement in Asia composes a suitable space for the fishery. Moreover, people who live their lives deeply connected with natural environment such as peculiar moistures and winds born of the waterside. This gives an important suggestion to the creation of the life environment of the coastal zone. We analyzed the settlement in terms of relationship between dwelling, settlement and coastal environment element. This paper based on field research carried out in October 2003. As a result, dwellings are composed to allow winds to reach every dwelling by operate dwelling arrangement and floor level. The spatial formation of settlement and dwellings are synchronized with the rhythms of coastal environment element.
THE APPROPRIATE SITES FOR DISPOSAL FACILITIES IN THE TOKYO BAY COASTAL ZONE

Yoko Nachi, Takamasa Miyazaki and Noboru Egashira

College of Industrial Technology
Nihon University
Narashino, Chiba, JAPAN
Miyazaki@arch.cit.nihon-u.ac.jp

There have been strong demands to reduce construction waste that amounts to approximately 20% of the sum of the waste of all industries in Japan. Additionally, in this decade, a considerable increase of construction waste is expected due to renewals of office buildings and houses that were constructed during the rapid growth periods in the 1960s. In order to solve the problem regarding the anticipated waste, there need to be appropriate plans in place to reduce waste at construction sites, to promote recycling, and to take hold of sufficient intermediary disposal facilities for recycling and disposal of waste. In this study we locate these intermediate disposal facilities in the Tokyo coastal areas, and examine the relationship between the amount of construction byproducts that are discharged from construction sites in Tokyo and the capacities of disposal in these intermediary disposal facilities. Additionally, we have the relationship between the current situation of the intermediate disposal facilities, which is analyzed by the aquatic system in the Tokyo Metropolitan area, and the distance from the waterline, under investigation.
THE SURROUNDINGS AREAS OF THE FISHING PORTS IN THE OSAKA BAY

Masayuki Suga¹, Takamasa Miyazaki² and Kiminori Nakazawa²

¹Nihon Bunri University
Oita, Oita, JAPAN
sugamy@nbu.ac.jp

²College of Industrial Technology
Nihon University
Narashino, Chiba, JAPAN
Miyazaki@arch.cit.nihon-u.ac.jp

This study investigates the characteristics and the changes of the land use in the surrounding areas of the fishing ports in Osaka Bay. We compared chronically the differences of the land use between the surrounding areas of the fishing ports in Osaka Bay and the entire Osaka Bay coastal zone by the types of fishing ports.

We have discovered that the land use in the surrounding areas of the fishing ports is unique in the sense that it is similar to that of the inland areas. For the results indicate that in most of the researched surrounding areas of the fishing ports, the occupancy rate of the designated industrial areas is low, and the occupancy rate of the designated residential areas is high. We suspect that this shows that the historical process of forming the town areas and the existence of the fishing ports and fishing villages play important roles in the urbanization of the Metropolitan coastal zone.
THE CHARACTERISTICS OF SPATIAL COMPOSITION IN (FISHING) VILLAGES OF THE REMOTE ISLANDS

Masaya Ohnuki, Takamasa Miyazaki and Kenji Yamamoto
College of Industrial Technology
Nihon University
Narashino, Chiba, JAPAN
miyazaki@arch.cit.nihon-u.ac.jp

The entire coastal line enclosing Japan (33,889 km) is approximately 85% of the circumference (40,000 km) of the earth. For that reason, the coastal areas of Japan contain many fishing villages that historically have been formed in close relation to the fishing industry, coastal management, and various utilizations of oceanic resources. In many such fishing villages, in the spatially limited areas behind the rock and the sand shore, there are residential spaces that are highly concentrated. In these fishing villages, the individual inhabitants maintain their cooperative lives with the neighboring societies, in addition to sustaining their private and family lives. Their lives also have been compatible with adequate environmental management and conservation of the resources of their nearby environments.

This study investigates the way of communal lives and environment formation of the highly concentrated residential spaces in such fishing villages, by examining the relationship between the spatial structures in which production, living, and communication repeat themselves within the communal space and the distance sense among individuals.
A STUDY REGARDING THE NATURAL ENVIRONMENT FORMATION OF METROPOLITAN COASTAL AREAS

Musaku Oi¹, Takamasa Miyazaki², Masayuki Suga¹ and Kiminori Nakazawa²

¹Nihon Bunri University
   Oita, Oita, JAPAN
   Oi7@msn.com

²College of Industrial Technology
   Nihon University
   Narashino, Chiba, JAPAN
   miyazaki@arch.cit.nihon-u.ac.jp

This study investigates the prospect of the natural environment formation in the metropolitan coastal areas including an examination of their historical progress to the present. In the process of urban development, a city acquires many functions. These functions gradually separate and spread, which creates regional specialization within the city. In a metropolis, as complex these functions become, the elements of urban structure tend to specialize furthermore. In order for the city to function soundly as a whole, each specialized region must correspond one to another. Since the Industrial Revolution, cities continue to enlarge themselves creating new functions. As an example of such a specialization, industrial sites have been designated in the outskirt of the city where the land is larger and cheaper than other parts of the city. Such placement of industrial sites is well represented in the Metropolitan coastal areas.

In Japan, the development of coastal areas historically has been closely connected to the expansion of land towards the ocean by reclaiming seaside areas, especially in the metropolitan coastal areas. For instance, the reclamation of the seaside areas of Tokyo Bay first was intended to satisfy the demand for the ever-growing industrial development of the rapid growth period of the 1960s. In the last couple of decades, however, seaside reclaimed areas have changed drastically in the perspectives of their usage. These seaside-reclaimed lands reserve sufficient room for large-scale development for their characteristics. They are fairly close to the centers of cities, are widely open to the ocean, and contain large land. The possibilities seem infinite. In this study, we try to present a general outlook of the future of the metropolitan coastal areas in terms of the natural environment formation.
THE RELATIONSHIP BETWEEN REGIONAL SCIENCE IN COASTAL ZONE AND IN WHOLE SPACE

Masaaki Sakuta
Nihon University
College of Engineering
Tokyo JAPAN
sakutama@gw3.u-netsurf.ne.jp

In the last time meeting (Kaohsiung, Taiwan), the influence of the coastal zone (ocean & land space), which was effecting in the land space, were discussed in the regional science in local area qualitatively. At that time, the pointed out as a problem was that there were the non-clarity and difference in the definition between in oceanography and in geography, in the coastal zone in the international as well. At the last time, the some parts of Wakasa-wan (bay) area were discussed as a practical example already with some contour line.

This difference of the two definition between in oceanography and in geography, is concerned some obstacles in the case of international adjustment in the near future, based on a characteristic of the coastal zone. And some discussions are added the results measured precisely in the same area in this time, and are showed a solution in adjustment, in these problems mentioned above, in this presentation.

In this hypothesis, the surface area on seabed in coastal ocean space from MWL in shoreline has the boundary line, which is to equivalent surface area in the coastal land space above the sea level to 200 m height from MWL in shoreline. In this definition by the hypothesis, the coastal ocean space is that have two boundary lines with a shoreline and a surface line on seabed mentioned above. This presentation is the results that this definition is applied in the some part of the coastal zone (in land space and ocean space) in Wakasa-wan.
This paper takes a look at the history and roles of cartography in materializing both land and ocean space. Theories on territoriality tend to view state territory as container of people, resources, ideas, etc. Cartography has represented such contained spaces serving a crucial role both as a tool of the state in rationalizing space to secure resources and in shaping our very conceptualization of space. The focus on the nation-state undermines, if not consciously ignores, the complexity of diverse territorialities leading to their erasure on state maps. Concerning land space, we discuss how Indonesia rationalized its territory to create a new, homogenized and ordered spatiality to identify areas for natural resource exploitation. An important effect of this process was the dispossession of local communities who had their own ways of territorializing space. In the case of ocean space we discuss the history of ocean maps as reflecting and reinforcing our construction of ocean space as a medium for the free movement of goods and navies and as a container for resources. The projection of state power through the territorialization of ocean space with the introduction of the Exclusive Economic Zone served states interests in fishery resources without resolving the clash of views between coastal and maritime states as to the internal/external nature of that space. Finally, the paper problematizes how modern maps represent the interface between land and ocean space, which limit our ability to conceptualize and deal with the environmental connections between the land and sea.
The principle objective of this paper is to explore potential international legal solutions to protect marine life from LFAS, a powerful technology that has the capability of decimating animals through vast distances of sea. Scientific evidence demonstrates cetaceans are particularly vulnerable to LFAS. The navies of various nations have this technology to detect stealthy diesel submarines.

The majority of information about LFAS technology, strategic deployment, and potential impacts comes from the U.S. Navy. This is because the US Navy first developed LFAS to detect Russian nuclear submarines at long distances during the 1980s. Despite the end of the Cold War, the U.S. Navy continued developing the technology to replace its passive sonar system. United States environmental statutes have also mandated that the U.S. Navy release information about their LFAS system, and a U.S. court has applied those environmental laws to constrain the Navy’s planned deployment of LFAS. Other nations also currently possess LFAS, and may violate their international legal obligations by using the technology before adequately assessing its potentially devastating environmental impacts. As marine life is essential to the economic and cultural well-being of many nations in the Pacific Basin, these nations can attempt to use various international legal mechanisms to constrain the use of LFAS by nations other than the United States.
RECOMMENDATIONS OF THE PEW OCEANS COMMISSION
AND THE U.S. COMMISSION ON OCEAN POLICY

Linda M. B. Paul
The Ocean Law & Policy Institute of the Pacific Forum CSIS
Honolulu, Hawaii, USA
linpaul@aloha.net

In June 2003 the Pew Oceans Commission (POC) released its recommendations for a new national ocean policy for the 21st century. In April 2004 the U.S. Commission on Ocean Policy (USCOP) released its draft report, which set forth a series of recommended guidelines for a comprehensive national ocean policy. Prior to releasing these reports both commissions spent two to three years holding completely independent sets of public hearings across the United States. Although the scope of the USCOP inquiry was broader than the POC, both commissions came to surprisingly similar conclusions regarding the recommended courses of action that should be taken in those areas they had both investigated.

Both commissions noted the degradation of our coastal waters from a multitude of sources and emphasized the need to take a watershed approach in monitoring and management in order to deal with the problems of point and non point sources of pollution, sediment runoff and unplanned growth in the coastal zone. Both commissions noted the need for better coordinated and streamlined federal management and recommended the adoption of a national oceans policy act, the creation of a national oceans council within the executive office of the President and regional ecosystem councils, noting the need for representatives of all stakeholders to be part of the governance process. In terms of fisheries both commissions remarked on the continuing decline of our nations living resources and the need to manage on a multi-species, ecosystem basis and importance of adopting precautionary and adaptive management principles. Both commissions recommended more protection for coastal habitat, including the development of additional marine protected areas. Both commissions recommended the development of national aquaculture standards to deal with the real and potential environmental impacts of this industry. Both commissions recommended that the United States ratify the United Nations Convention on the Law of the Sea and both recommended greatly increasing the funding for basic ocean science research.
RESEARCH SCOPING PROCESSES FOR THE MANAGEMENT OF BOTANY BAY, AUSTRALIA

John Black

University of New South Wales
Botany Bay Studies Unit
Sydney, NSW, AUSTRALIA
j.black@unsw.edu.au

Botany Bay is an estuarine embayment with an entire hydrological catchment of 960 sq. km. that has about 40% of Sydney’s population that now approaches five million. It is one of the nation’s most important social environments (Aboriginal heritage of settlement and land management, European colonisation, industrial heritage and the growth of seaside suburbia) where there is a strong developmental pressure and impacts on the natural environments. Ecologically Sustainable Development (ESD), the significance of biodiversity resources and the need for a whole of catchment approach are underlying factors driving governments in developing appropriate management targets and prioritised actions through a suite of international, national and state policies and statutes.

Coastal zone management strategies are hampered by lack of knowledge of complex environments, and the need for independent science is clearly set out in Healthy Rivers Commission, recommendations, and a requirement, of the Cabinet-endorsed NSW Government Statement of Intent, and the draft Botany Bay Strategy submitted to the Government in early 2004. This paper describes the process of scoping the necessary research required for decision-makers and the different agents involved (including the Botany Bay Studies Unit) in the establishment of an independent research center. Research recommendations and priorities established at a stakeholder workshop in February 2004 are summarized with particular reference to the potential of such studies in helping shape management strategies for more sustainable economic, social and environmental outcomes.
THE HARIBON STRATEGIES IN COMMUNITY-BASED COASTAL RESOURCE MANAGEMENT IN THE PHILIPPINES

Belinda E. de la Paz
Haribon Foundation for the Conservation of Natural Resources
Quezon City, PHILIPPINES
advocacy@haribon.org.ph

The Philippines currently has a coastal population that is 70% of the total population or roughly 58 million. Scholars believe that there are around 1 to 3 million fishers in the country who engage in small-scale fishing as their sole source of livelihood. Haribon Foundation has been working with small fisher folks implementing the community-based coastal resource management (CBCRM) strategy for the past 16 years. Haribon, which is an NGO that focuses on biodiversity conservation, is one of the first environmental NGOs in the Philippines to recognize the key role of communities in marine conservation and fisheries management.

This paper will present 2 cases where Haribon implemented CBCRM. The case studies will show the unique facets of the CBCRM strategy employed that resulted in, among others, the creation of empowered peoples organizations (PO), a collection of more responsive and responsible local governments and the effective management of the coastal and marine environments. It will also show Haribon’s experience in coalition building and networking which is considered to be adjunct to the community-based approach and deemed as important. This latter approach allows the scaling-up of community-based efforts in terms of research, capability building and natural resource management. This approach has also been successful in lobbying for policy reforms allowing small fisher folks to effectively engage government in both local and national levels.
Designed networks of marine protected areas (MPA) are considered essential for coral reef conservation in many places, yet is often challenging for practitioners and scientists to establish networks of MPAs that adequately fulfill biodiversity conservation needs, as well as social needs at particular sites. The Locally Managed Marine Area (LMMA) Network is comprised of networks of LMMAs in seven countries in the Pacific, and is based on requirements of project commitment and participation (see www.LMMAnetwork.org). This is an example of a unique and practical approach that has emerged to address social and political obstacles to successful MPA network initiatives. This participatory approach facilitates the establishment of community based MPA networks that are monitoring and adaptively managing their respective projects. In contrast to many conventional networks of MPAs, some LMMAs are driven more by local community criteria and needs, rather than scientific and biodiversity criteria per se. The challenge in many areas is to integrate the two approaches; several case studies will outline how some LMMA projects are trying to achieve this convergence when progressing from sites to systems. As biologically driven approaches seek greater local stakeholder support for their networks, participatory LMMA approaches seek greater biological functionality through adaptive management and learning. The Community Conservation Network, a Hawaii based organization, is working to promote adoption of locally managed marine areas in regions of high biodiversity. CCN contends that this equally valid approach to conserving biodiversity because it is scalable, adaptable, and offers a high likelihood of community support and sustainability.
Coastal and ocean resource management programs within and outside the United States increasingly utilize a precautionary approach to scientific uncertainty. Under a precautionary approach resource managers are cautious when information is uncertain, unreliable, or inadequate, and the absence of complete scientific information is not used as a reason for postponing management measures.

The Hawaii Supreme Court endorsed a precautionary approach to watershed management in its 2000 decision concerning the Waiahole Ditch system on Oahu. The 2000 designation of the Northwest Hawaiian Islands Coral Reef Ecosystem Reserve involved a precautionary approach to resource management. Precautionary approaches have been used to manage protected marine species in United States waters under the federal marine sanctuaries, endangered species and marine mammal protection acts. The 1996 amendments to the federal Fisheries Conservation and Management Act implemented a precautionary approach to fisheries management. Several treaties to which the United States is a party or signatory utilize a precautionary approach to fisheries management, including the recently signed Pacific tuna treaty.

Many significant economic, scientific, social, and cultural activities depend upon the quality of the marine environment. Maintaining that environmental quality and using marine resources sustainably involve handling scientific uncertainty about coastal ecosystems and possible impacts of resource use and development. Revision of relevant laws, plans, and programs to include a precautionary approach to scientific uncertainty in marine resources management should aid in achieving those goals.
RAINE ISLAND, NORTHERN GREAT BARRIER REEF: GEOMORPHOLOGY, HYDROLOGY AND TURTLE NESTING HABITAT

David Neil
School of Geography, Planning and Architecture
The University of Queensland
Brisbane, Queensland, AUSTRALIA
d.neil@uq.edu.au

Raine Island is the nesting site of the world’s largest remaining population of the green turtle (*Chelonia mydas*). The island is a geologically recent, geomorphologically unstable, ephemeral and unique landform. Management of turtle populations and their habitat must address socio-economic issues (including exploitation for subsistence and profit and cultural significance), quality of feeding habitat (including food availability and anthropogenic disturbance and mortality (disease, boat strike, bycatch), viability of migration routes, and quality of nesting habitat, and the interactions between these. This paper examines: (i) variation in turtle nesting habitat quality (and associated variation in feeding habitat and migratory routes) in relation to eustatic sea level oscillations and reef island formation at Raine Island, (ii) implications of contemporary geomorphology and hydrology of Raine Island for turtle nesting habitat quality, and (iii) management implications.

Due to variations in sea level, reef growth and reef island development, Raine Island has, at various times in the recent past (10^4 years), been high quality, poor quality and non-existent as a turtle nesting site. In association with these changes, nesting habitat and migratory routes have also varied dramatically, in many cases ceasing to exist. Furthermore, contemporary geomorphology and hydrology of Raine Island is inimical to turtle nesting in several ways which result in turtle mortality, inhibition of nesting, and egg mortality. Analysis of landforms and hydrological modelling indicates the physical basis for these ecological outcomes. These relationships are discussed in the context of the present management regime, predicted environmental changes and the wider implications for management of coastal systems.
MARINE GIS OF THE CAMPECHE SOUND, GULF OF MEXICO

Vázquez G. F.¹, Herrera R. M.², Nitsch S. L.², Mendoza Q.-M. A.²,
Valencia R.¹ and Díaz de León H. L. M.¹

¹Instituto de Ciencias del Mar y Limnología
UNAM, D. F., MEXICO
felipe@mar.icmyl.unam.mx

²PEMEX-Exploración y Producción-Región Marina Noreste
Gerencia de Seguridad Industrial y Protección Ambiental
Campeche, MEXICO

In order that know the actual state of health of the Campeche Sound we are designed a Marine GIS. This area is important due the oil and fish industries are located in it. The date base use the results obtained during the expeditions SGM-3 (1997) to SGM-7 (2002) (SGM = South of the Gulf of Mexico). The expeditions include the follow studies: marine water quality (S, °C, pH, O₂, nutrients, chlorophyll, etc.), CO₂ System, suspended solids, metals (water, sediments and organisms), hydrocarbons (water, sediments and organisms), biomarkers, phytoplankton, zooplankton, fish, poliquetos, Meiofauna, currents, air pollution (since 2001), AVHRR and SeaWIFS images.

A preliminary analysis of data was used before the application of the GIS. The data of pH and total alkalinity show two big areas, the east area with high values and the west side with low values. Layers of nutrients and chlorophyll show the principal areas with high productivity. Surface dissolves metals, show four areas in the Campeche Sound, and show what the influence of the oil marine platforms is low. Input of the major rivers in the Campeche Sound is show with the lignina concentration in sediments. Distributions of biomarkers in the Campeche Sound show the early influence of the oil industry. The distribution of the main commercial species of fish shows a low biomass in the area.
STUDIES ON SEED PRODUCTION OF MUD CRAB FOR MANGROVE AND POND MARICULTURE

Romeo D. Fortes, Juliana C. Baylon, Evelyn T. Marasigan, Jerome G. Genodepa and Alan N. Failaman

Institute of Aquaculture
College of Fisheries and Ocean Sciences
University of the Philippines in the Visayas
Iloilo, PHILIPPINES
telyos@yahoo.co.uk

Improvement of techniques for the production of larvae and juveniles of the mud crab Scylla serrata Forskål for pond and mangrove mariculture was undertaken. Phase I carried out larval mass rearing to determine the effects on larval production of microencapsulated diet; treating rearing water with antibiotics; utilizing krill as supplemental feed; and use of F2 juveniles from hatchery-produced parents. Phase II tested various techniques of nursing zoea (Z) and megalopa (M) to crab stage (C) including feed and other factors. Phase III determined the effect of shelters in the grow-out phase to produce market-size mud crab in ponds and mangrove enclosures.

Phase I. Larvae fed microencapsulated diet did not improve growth and survival. Larvae collected 1 hr after hatching had higher survival (60 %) compared to those collected after three hours. Adding Artemia at either Z2 or Z3 stage did not improve production of M. Treating rearing water with 2 ppm Furan did not arrest mortality of Z1 but use of oxytetracyline resulted to better survival of larvae. Supplementing krill in feeds did not improve megalopa production. The second-generation larvae (F2) from hatchery-produced parents (F1) were observed to be equally robust as those caught from the wild.

Phase II. The 125 M/m² density had significantly higher (P<0.01) M survival than the 250 M/m² in 23 days but were not different (P<0.05) in terms of mean weight gain and SGR. Using lower densities of 25, 50, 75 and 100M/m², best survival was 32% at 25M/m². Survival of M to C after 10 days of rearing was highest at 1M/l and lowest at 8M/l. Molting to C was advanced by 1 day at densities 0.5M/l and 8M/l. Highest percentage of M molting to C was at 1M/l. The range of pH 5 to pH 9 had 100% survival; molting to C started at day 5 between pH 5 and pH 9 and highest at pH7. At pH 4, molting failed but those that molted had exhibited certain abnormalities. Desirable protein levels in feeds for mud crab is between 30 and 45 percent. These were significantly demonstrated in length increment and survival (P<0.05). Mussel meat appears to be the best natural food for mud crab.

Phase III. The use of coconut frond bases and bamboos shelters in mangrove and pond mariculture appeared to have no effect on mud crab survival. It is probable that more shelters and other materials are needed to significantly improve survival. Furthermore, the shelters at the densities and ratios used may not be sufficient that their use appeared to have not improved survival of the mud crab in the grow out phase.
This paper indicates the results of research and evaluation on construction technology of fishing ports which will help nurse and preserve fishery resources such as seaweed bed, fishes and shell fishes, cohabiting with natural environment. The technology is indispensable to enhance the roles and functions of the port in the consistent producing system of fresh and safe fishing products from the producing area to consuming area. In other words, through the application of the new technology the port can play an important role, in fisheries as a nursery to raise fish and also a base for preservation, of fish as well as unloading and distribution of fishery products.

Firstly, we studied the technical problems on construction and management after typing fishing ports according to their natural environment and uses. Secondly, we introduced to the field new construction methods and structures, such as creation of fishery habitat and improvement of seawater exchange between the sea and the port side, and conducted its longtime follow-up.

Lastly, as for the aforementioned technology we proved its effectiveness through comprehensive evaluation of effects on the production, conservation and nursery of fishery resources, influence on natural environment, construction cost reduction, efficiency of management and economic consequence assessment, comparing to the conventional fishing port which is used for fishing boats’ mooring and landing fish catch.
CHARACTERISTICS OF FISHERY PROCESSING DISCHARGE WATER AND TECHNOLOGY ON EFFICIENT PETRIFACTION SYSTEM

Shoji Kase, Hidehito Sumizawa, Tatsunori Funakoshi, Kenji Horie and Kunihiko Tahara

The Japanese Institute of Technology on Fishing Ports, Grounds and Communities
Tokyo, JAPAN
kase@jific.or.jp

In this paper, we clear up the characteristic of discharge water of the fishery processing by using result of investigation mentioned below. In addition, we report for displacing the fishery processing drain which needs efficient petrifaction system by using the appropriate sewage treatment method like wastewater treatment operations consist of screening filter, oil separation, biological treatment, gravity separation, sludge concentration, dewater.

Generally the discharge character of fishery processing has characteristics in BOD 100~30,000mg l⁻¹, COD 100~15,000mg l⁻¹, Nitrate N • Ammonia N 10~2,000mg l⁻¹, Phosphorus 10~600mg l⁻¹, plenty of fat and high density of organic matter and apt to rot. And it has the water volume and the characteristic of water quality according to the processed foods (caning, bottle, seaweed processing, fishery related, dried fish, frozen marine product food, etc), and fish species.

A great variety of Japanese marine processed foods has not only for storage and preservation technology of its use, but also for trying to improve and add value to the marine processed foods such as flavoring and add the different kind of chew taste, like no other country than Japan,

And most of Japanese fishery processing factory are located in fishing villages around Japan. We need sewage treatment plant because the by-product of discharge water during the progress of process which occurs raw material plant of each processing procedure, purification, extractor, percolation and other facilities is one factor in damaging the environment of the sea.
In this paper, we discuss the technological development on the material of the intake pipe such as high density polyethylene with steel wire/belt armor, concrete-weighted high density polyethylene pipe, etc, structure such as flexible bendable joint and construction methods, and its feasibilities in Japan, in order to realize various needs of utilization for the deep sea water (DSW) for recent several years.

The DSW below the depth of 200m that has some advantageous properties such as coldness, cleanness and nourishment, compared with that of seawater near surface, has been made progresses in practical use for the drink, the food processing, the cosmetics, the medical and fisheries for recovery of fishing grounds, aquaculture, fishery processing and the seaweed bed creation.

In order to realize those various needs, recent various technologies on DSW intake facilities have been developed as an infrastructure to supply DSW under the use requirement on the water quality and temperature for long period, safely and stably. Also, under the severe natural condition such as the current and the wave, and the bottom topography with complex shapes and steep slopes, around Japanese seacoast, the special materials, the structure and construction methods have been needed for construction works of the DSW intake facilities.
Aquatic resources as underwater forest in the world are decreasing year by year. Those reasons are over catching, change of habitable environments caused by pollution, global environmental change can be pointed out. As the result, especially, aquatic resources as underwater forest that supports marine ecosystems are decreasing in the ocean. Enhancement technology for aquatic resources as underwater forest is, therefore, the most important to improve the living environment of the seaweed communities and accelerate the growth.

Ferrous sulfate is a micronutrient elements considered essential to all algae. Ferrous sulfate that is used is an industrial waste, which comes from processing titanium, and it is very expensive to treat this waste.

Our object is to apply enhancement technology to aquatic resources in real ocean zone by use of ocean fertilizer, and to accelerate the growth of aquatic resources by ocean fertilizer. In this paper, we are going to check the reproductive behavior on the results by our experiments through a couple of years, and to discuss about the relation with the growth of aquatic resource and the quantities of ocean fertilizer.
TECHNIQUES FOR THE RESTORATION SYSTEM OF MARINE BIOLOGICAL ENVIRONMENT

Yoshihiro Suenaga\(^1\), Masashi Miyagawa\(^1\), Takashi Hoshino\(^1\), Kaori Yasuoka\(^1\), Koichi Masuda\(^2\) and Keiji Kimigawa\(^3\)

\(^1\)Faculty of Engineering
Kagawa University
Takamatsu, Kagawa Pref., JAPAN
suenaga@eng.kagawa-u.ac.jp

\(^2\)College of Science and Technology
Nihon University
JAPAN

\(^3\)Kuroshio Marine Technology Co, Ltd.
JAPAN

In Japanese political fisheries project, many types of artificial reefs have been developed and settled to create fishery ground for the production enhancement in shore and offshore marine areas.

There are many issues to be clarified about the suitable installation of artificial reefs, such as the relation between flow conditions and the biological effect of artificial reefs. In this research, a set of technologies newly developed to restore marine biological environment is introduced. It consists of a numerical simulation method to select out the most appropriate area for marine habitat restoration and a new artificial reef that embodies multiple functions, such as flow control including the ratio of the location of the reattachment point to the height of the artificial reef’s model, increase in prey abundance, promotion of fish aggregation, thereby improving marine habitat.

The quantitative evaluation for the function of current control by new artificial reef was verified by water tank test. Also, in this study has revealed that distribution of zooplankton concentration, fish aggregation and prey abundance in biological environment in and around the disposed artificial reefs by field research including water tank experiment and using numerical simulation model.

The set of technologies was applied to two coastal areas of different characteristics and was verified to improve biological environment at both areas by continues field research in each season.
Coastal and marine environments are major tourist attractions in many parts of the Asia Pacific region. Much has been said about the need to ensure that tourism and recreation in these areas is sustainable, but little has been done in terms of systematic and effective longer term or strategic planning. Part of the reason for this lack of planning effectiveness has been a lack of comprehensive, reliable and relevant information on tourism and recreation in these areas and their impacts. Machlis (1996) has argued that there are four types of "usable knowledge", description of the existing situation, insights into the existing situation, predictions about the future and solutions to management problems. Each type builds upon the earlier ones. In other words, it is not possible to have sound predictions without both a complete description and some understanding of the current situation. This paper reviews regional tourism planning models and the protected area management literature to derive a general research agenda to support the management of ecologically sustainable recreation and tourism in marine areas. The paper will then demonstrate the value of this research agenda by describing the results of a major research program into tourism and recreation in the Great Barrier Reef World Heritage Area and the subsequent management implications.
THE NEEDS ASSESSMENT OF TRAVELERS OF RECREATIONAL BOATS IN KAOHSIUNG

Chang-Ching Tsai
National Kaohsiung University of Applied Sciences
Department of Tourism Management
Kaohsiung, TAIWAN
Cctsai44@hotmail.com

The purpose of this study is to investigate the profiles, behavior, past experiences and needs assessment of the travelers who took the trip by recreational boats in Kaohsiung city, Taiwan. In addition, this study examined if there exists differences among opinions by different personal social economic background. It's a new policy for the government to encourage marine tourism and recreation in Taiwan. One of the key areas for the government to promote is to take a trip by recreational boats. However, it’s very difficult for the practitioners to run their business if they have no any idea about the needs of the customers.

There are few researches about marine tourism and recreation in Taiwan, especially about the needs of customers of recreational boats. Therefore, this study is an exploratory research. The data was collected by a questionnaire. The subjects were the travelers who took the recreational boats in Fengbeetou Harbor, Kaohsiung. The data will be analyzed by frequency, mean, standard deviation, Chi square analysis, and one-way ANOVA. All the calculations will be done by SPSS. The results will be helpful for government to improve and adjust the policy as well as for practitioners to enhance their service quality and managerial performance.
UNDERSTANDING ENVIRONMENTAL OPTIMISTS AND PESSIMISTS AND AUSTRALIA’S GREAT BARRIER REEF

Philip L. Pearce

James Cook University
Tourism Program
Townsville, Queensland, AUSTRALIA
Philip.Pearce@jcu.edu.au

Individuals typically hold one of two kinds of environmental attitudes; there are those who see the future of settings as being maintained as well as or better than at present and those who view the state of the environment as likely to decline. This study reports a major survey of both the residents of Australia’s east coast cities as well as those living close to Australia’s Great Barrier Reef and explores resident responses to the threats and management priorities of the reef environment. The study uses the optimists-pessimists distinction as way of exploring the differences in public perception.

The paper aims to contribute to an understanding of marine environment futures in two ways. First the detailed results of the 1,183-person survey help define the current state of public awareness of reef issues and management priorities. Second in utilising the optimists-pessimists distinction the study provides an organising framework for understanding public perception which can be contrasted with residential or frequency of site use approaches. It will be argued that the optimists-pessimists distinction may be a useful organiser in other environmental settings as it can be linked to larger attitude and value frameworks embedded in the social psychological framework of social representations or everyday theories of how to see the world.
RESEARCH ON THE EVALUATION OF EMOTIONAL ASPECT
IN THE COASTAL ZONE

Megumi Yamazaki¹, Kenji Hotta², Jong-in Choi², Ken Yamazaki³ and Yoshio Okamoto⁴

¹Department of Oceanic Architecture and Engineering
CST, Nihon University
Chiba, JAPAN
m043030@edu.cst.nihon-u.ac.jp

²Department of Oceanic architecture and Engineering, Nihon University
³Department of Electrical and Electronic Engineering, CIT, Nihon University
⁴DAIKIN Industries, LTD

The interest to the spend way in the leisure heightens by the change of the life-style today and marine-tourism is being noticed as leisure activity which touch the emotional aspect of coastal zone.

In such inside, we have shown the relevance to the activation of the electroencephalogram of the human (wave) and the ultrasonic wave, included in the sound of the wave, and the ultrasonic wave has been noticed as one of the environmental factor, which raises emotional aspect of coastal zone.

In this study, for the purpose of more objectively evaluating the sound of the wave, the effect of ultrasonic wave, included in the sound, on the human was compared and was examined using the electroencephalogram.

It extracted the time series of α wave by the record in the experiment of the electroencephalogram in presenting totals of 4 kinds of the sound. These are the sound of the fountain, insect cry, road sound as a comparison object of the sound of the wave to the examinee.

As the result, the activation of wave by the ultrasonic wave, included in the sound of the wave, was confirmed. The wave also similarly showed the activation on the sound of the fountain, and it was quantitatively inferior to hoop and sound of the wave. In insect cry and sound of the road, the wave showed small activation or decline.

It became the clearness to be an environmental factor of which the sound of the wave is more excellent in emotional aspect than them. It is desired that various activity in coastal zone becomes more active through this paper.
HOW MULTIAGENCY PARTNERSHIPS CAN ADDRESS LARGE-SCALE POLLUTION PROBLEMS: A HAWAII CASE STUDY

Mary J. Donohue

University of Hawaii Sea Grant College Program
Honolulu, Hawaii, USA
donohuem@hawaii.edu

As a result of oceanic circulation patterns, the Hawaiian Archipelago is the repository for significant amounts of exogenous marine pollution, including derelict fishing gear from North Pacific Ocean fisheries. Derelict fishing gear is threatening Hawaiian coral reef ecosystems by abrading and scouring living coral polyps and altering reef structure through large-scale destruction of the reefs’ coral skeleton foundation. Derelict fishing gear also entangles marine mammals, turtles, sharks, other fishes, lobsters, and crabs. Entanglement in derelict fishing gear is hampering the United States federal government’s efforts to recover the critically endangered Hawaiian monk seal. Management responsibility for these islands, and associated natural resources, consists of a complex amalgam of government authorities. Non-government organizations (NGOs) and private industry also have regional interests. The Hawaiian Archipelago’s marine debris problem’s magnitude prevented effective mitigation by any single organization or agency. In addition, the scope of debris impacts overlapped management boundaries. In response to these circumstances, a multiagency marine debris-working group was established in 1997 that partnered stakeholders to improve Hawaiian Islands’ marine debris mitigation. To date, 16 federal, state, local, industry, and NGO partners have removed 330 metric tons of derelict fishing gear and other debris from the Northwestern Hawaiian Islands. This review details the evolution of this partnership, notes the challenges and rewards of such arrangements, and advocates for the use of this paradigm for more effective resource management.
DERELICT FISHING GEAR ACCUMULATIONS
IN THE NORTHWESTERN HAWAIIAN ISLANDS FROM 2001 TO 2003

Jacob M. Asher¹, Amy Hall¹ and Michael Noah²

¹Joint Institute of Marine and Atmospheric Research
Research Corporation of the University of Hawaii
Honolulu, Hawaii, USA
Jacob.Asher@noaa.gov

²NOAA Fisheries and Ecosystems
Pacific Islands Fisheries Science Center
Coral Reef Ecosystem Division, Marine Debris Program
Honolulu Hawaii, USA

A multi-agency program led by National Oceanic and Atmospheric Administration (NOAA) scientific and working divers to remove marine debris from the Northwestern Hawaiian Islands (NWHI) has met with great success since the program’s inception in the late 1990s (Donohue, et. al., 2001). Large-scale recovery efforts were conducted from 2001 to 2003, with almost 270 metric tons (t) of derelict fishing gear removed from Kure, Midway, Pearl and Hermes, Laysan, Lisianski, and French Frigate Shoals. The accumulation of marine debris in areas that had been previously surveyed and cleared was of particular interest. Manta tow protocol was used to conduct annual surveys of high entanglement risk zones (HERZ) around Pearl and Hermes, Kure, and Lisianski to monitor derelict fishing gear accumulation and to mitigate entanglement threats to Hawaiian monk seals (*monachus schauinslandi*). In addition, derelict fishing gear was collected from many landfall areas around the NWHI in order to gauge terrestrial debris accumulation. In all cases (Pearl and Hermes, Kure, Lisianski), the HERZs continued to accumulate derelict fishing gear annually. Terrestrial debris accumulation in the NWHI continues to be of concern. In 2003 alone, over 9.7 t of marine debris were removed from land areas that were surveyed in previous years. New marine debris inputs continue to impact the coral reef environs of the NWHI, as well as threatened and endangered species in the region. Future marine debris expeditions to the NWHI will continue to study historical accumulation sites, as well as highlight new target areas for study and monitoring.
The Northwestern Hawaiian Islands (NWHI) are a 2,200-km chain of atolls and islands, which lie within the subtropical convergence zone and act as a repository for derelict fishing gear. This region comprises 69% of all US coral reefs and provides habitat for over 7,000 species of marine mammals, fishes, sea turtles, and invertebrates. Pearl and Hermes Atoll, which lies in the northwestern end of the chain, has a high occurrence of derelict fishing gear found within the 0-to-10-meter isobaths of the back reefs, sand margins, and inner reticulated reefs. Survey efforts since 1999 have removed 223 metric tons of derelict fishing gear, representing 5,254 net sites, from the ecosystem. Manta tow and free-swim protocols were used to conduct the surveys, and data were collected on the debris in situ, including overall size class, before its removal. Each net was classified according to planar size, with size class 1 = 0.1-5m² (n=4711), size class 2 = 6-10m² (n= 441), size class 3 = 11-25m² (n=79), and size class 4 > 26m² (n = 23). Twelve of the size class 4 nets have exact length and width measurements. Using these size classifications, a minimum of 4.8 km² to a maximum of 30.8 km² of shallow water benthic habitat has been impacted by derelict fishing gear at Pearl and Hermes Atoll. This figure applies only to the area covered by the net in situ and does not address impacts the nets may have had en route to the removal sites.
A COST COMPARISON OF VARIOUS METHODS OF RETRIEVING DERELICT FISHING GEAR

Howard C. Wiig

Department of Business, Economic Development and Tourism
Strategic Industries Division
Honolulu, Hawaii, USA
hwiig@dbedt.hawaii.gov

This paper compares the costs of various methods of retrieving and disposing of derelict fishing gear. At the Asia Pacific Economic Cooperation (APEC) Seminar held in Honolulu in January 2004, participants agreed that derelict fishing gear is causing Asia-Pacific nations substantial financial losses. In addition, derelict gear is a marine industry hazard, causes significant marine life mortality to common and endangered species and degrades reefs.

Seminar presenters described vastly different methods of collecting and disposing of derelict fishing gear, ranging from providing incentives for fishermen to retrieve and bring the gear to port, to undertaking risky diving operations to remove tangled gear from reefs. The per-ton costs of the various retrieval methods were discussed in a very preliminary fashion.

This paper compares the estimated per-ton costs of retrieval programs of APEC participants including the Republic of Korea, Chinese Taipei, Japan, Hawaii and the Pacific Northwest and the Puget Sound regions of the U.S. The cost and tonnage data collected may provide stakeholders with a financial basis for beginning or revising their own programs to reduce derelict fishing gear.
Study of Sierra-Leone rift valley in 2002-2003 included, along with geological and hydrochemical observations, CTD measurements, which are used to reconstruct a specific thermohaline structure of near-bottom water masses in three deep enclosed depressions. Due to topographic features, the near-bottom water masses at depths from 3400-3600 m to 5000 m are insulated both from each other and from the ocean.

All cast profiles reveal existence of quasi-homogeneous bottom layer 300 to 1000-1200 m thick with near-adiabatic temperature distribution and neglected density gradients. The upper boundary of the bottom layer is clearly marked by a sharp change of the thermohaline structure and a correspondent transient layer 200-250 m thick where the bottom water mixes with deep-water masses of NADW. Over one of the deep depressions, this mixing layer is especially strongly developed. It is similar to a benthic pycnocline and has a prominent thermohaline structure and potential temperature gradients up to 0.1 deg C/m. Noticeable structural non-uniformity includes inversions and step-like structures several meters to several tens of meters thick on profiles of both potential temperature and salinity. The mean estimate of density ratio $R \sim 2$ that does not exclude conditions of instability to double diffusion.

Specific vertical stratification and significant horizontal changes in temperature of the mixing layer along with higher mean temperature and salinity of the entire uniform bottom layer of this depression, as compared with the two others, are associated also with some geological and hydrochemical evidence of active ore formation here and provide indications of hydrothermal activity on the bottom.
DEEP OCEAN WATER APPLICATION FACILITY PROPOSED FOR THE ISLAND OF OAHU BY THE HONOLULU BOARD OF WATER SUPPLY

George Kuo
Honolulu Board of Water Supply
Water Resources Unit
Honolulu, Hawaii, USA
gkuo@hbws.org

The objective of this project is to evaluate feasibility of the Deep Ocean Water Application (DOWA) facility as a viable mean for production of potable water while generating power, chilled water for air conditioning, and a host of other by-products such as root zone cooling for increased crop yields, liquid hydrogen for fuel cells, and aquaculture.

The project approach is highlighted by conducting a site selection study to identify and assess up to at least three locations along the southern coastal plains of Oahu suitable for the DOWA facility. The study will evaluate and compare candidate sites based on a list of criteria such as accessibility to deep cold ocean water, proximity to power grid, proximity to population centers with large air-conditioning demand, and a host of environmental, planning, social, economic and other factors.

Concurrently, a separate study will be conducted to highlight state of the art of various technologies underlying a DOWA facility. Based on the results of the site selection study and technology review assessment, elements of a multi-product DOWA facility with major emphasis on production of potable water will be identified. A system engineering approach will then be utilized to optimize the components of the multi-product system where components and the technology are synergistically molded to produce the best possible efficiencies. The mix of product of the system will include potable water, electrical power, chilled water for air conditioning systems, aquaculture farming, hydrogen production and other products.
Deep-ocean water (DOW) at a depth of 300 m or lower is cold, nutrient-rich, and free of pathogenic bacteria. This water is considered an important natural resource. One of the fully developed technologies of DOW application is ocean thermal energy conversion (OTEC), which makes use of DOW for energy production. In recent years, the potential of DOW to enrich the open oceans and thus to increase fish yield has attracted the attention of researchers. Before this potential can be realized, however, major scientific and technological developments concerning artificial upwelling, plume mixing, and DOW stimulated bio-productivity must be achieved. This study, which is a continuation of earlier research on artificial upwelling at the University of Hawaii, investigates the effects of discharging artificially upwelled DOW into the open ocean where it is subsequently mixed with surface water. The study involves both hydraulic modeling and numerical simulation, and its objective is to control the near-field mixing of DOW effluent such that the dilution is small and the settling depth does not go below the euphotic zone. Special attention is given to wave effects on the near-field mixing processes. Research results indicate that, with proper effluent control, desirable nutrient-rich DOW plumes can be established and maintained in the open ocean.
PARTICIPATORY MARINE SANCTUARY MONITORING: BUILDING LOCAL RESEARCH PARTNERS IN THE PHILIPPINES

Margarita N. Lavides, Jose Ma. Antonio Bringas, Don Geoff Tabaranza and Chona May Cunanan

Haribon Foundation for the Conservation of Natural Resources
Quezon City, PHILIPPINES
lavides@yahoo.com

Haribon (2000) studies show that there are 558 marine protected areas (MPAs) in the Philippines, with only 16% of them functional. Many of these functional MPAs have neither the technical capacity nor the resources to monitor the effectiveness of their MPAs. There are a number of institutions equipped with the technical capacity to monitor MPAs. However, often, these institutions have their own priority research agenda to address to leaving the many MPAs unmonitored.

Haribon Foundation, in its efforts to assist and work with PAMANA Ka Sa Pilipinas, a national alliance of community-based MPA managers, is employing participatory marine sanctuary monitoring (PMSM). A national consultation workshop on PMSM was held where practitioners shared experiences and lessons learned. The results of the workshop and the training needs analysis fed into a training and monitoring program and lead to the development of a training manual in the vernacular and a field guide specific for PMSM.

About 60 members of the communities, representing fifteen marine sanctuaries, had been trained in PMSM, ten of which were trained in SCUBA diving while the rest were using mask and snorkel techniques. A bay wide monitoring team has been set up and is currently being tested. The community monitoring team is composed of members and leaders of fisher folk organizations and local government units with the assistance of Haribon research team. The initially trained members of the community monitoring teams of PMSM together with their peer PMSM practitioners hope to catalyze in building a critical mass of local research partners in the Philippines.
THE RISE AND FALL OF MARITIME ARCHAEOLOGY AND HISTORY EDUCATION AT THE UNIVERSITY OF HAWAI`I

Sherwood Maynard

University of Hawaii Marine Option Program
Honolulu, Hawaii, USA
mop@hawaii.edu

Maritime archaeology and history (MAH) topics have been scattered throughout the curricula of the ten-campus University of Hawaii System (UH) since tertiary education began in this island state. In 1987 the UH Marine Option Program (MOP) initiated planning of a formal MAH program ultimately modeled after the pioneering program at East Carolina University (ECU) under the direction of William Still. This timing more or less coincided with enactment of the U.S. Federal Abandoned Shipwreck Act and subsequent interest internationally from UNESCO. The UH program developed through an annual symposium, introductions of new courses, field schools and field research projects, numerous committee meetings and related activities. The efforts culminated in a Graduate Maritime Archaeology and History Certificate Program administered by MOP with major participation from the Departments of History, Anthropology and American Studies at the main campus and a variety of faculty participating from the other nine campuses, as well as government agencies. ECU alumnus Hans Van Tilburg played a key role in leading the program. From 1998—2002, 23 students were admitted to the program and fourteen of these earned certificates. The certificate was open both to classified graduate students pursuing advanced degrees and to qualified community members with baccalaureates who just wanted to earn the certificate. The certificate required a minimum of 20 credits of coursework, including a capstone paper which provided a framework for student research. Projects ranged throughout the Pacific, including archival and field studies, spanning topics from Polynesian voyaging to European exploration to whaling to interisland commerce and World War II submerged cultural resources. Limited extramural funding was secured from Hawaii Sea Grant, the National Park Service, and the Naval Historical Center. Political, organizational and economic factors led to the program’s termination in 2003, but the symposium and a summer field school survive.
BELLARMINE PREPARATORARY SCHOOL MARINE CHEMISTRY ENVIRONMENTAL RESEARCH PROGRAM

Ronald Nilsen and Richard Barnhart

Bellarmine Preparatory School
Tacoma, Washington, USA
nilsenr@bellarmineprep.org

Bellarmine Preparatory’s Marine Chemistry Environmental Research Program is a four-year co-curricular scientific research program for highly capable and motivated students. Since 1987 the program has provided students the opportunity to do exiting original scientific research outside the mainstream curricular setting with scientific mentors in the community.

Through a series of summer and night school classes, students develop the skills necessary to undertake original scientific research, which culminates in the production and publication of a high-level research paper in the senior year. During the freshman year students learn chemical oceanography and analyze monthly water samples taken from nearby Puget Sound. Sophomore students receive extensive training in computer technology and research writing techniques. Throughout the junior year, students work with their community mentor doing original environmental research. In the fall of the senior year students produce and publish their research papers in scientific writing contests including Siemens Westinghouse Talent Search, Intel Science and Engineering Fair, and Washington Junior Science and Humanities Symposium.

Bellarmine’s proximity to the shores of Puget Sound not only provides opportunities for environmental research, but also provides the setting for the outdoor enrichment activities such as camping and scuba diving that have become such an integral part of the program’s holistic educational experience.

Graduates of the program are frequently admitted to the country’s most selective universities, receive thousands of dollars in scholarships, and often choose environmental research as their field of study.
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