Science, research and development

European Commission

EurOCEAN 2000

The European Conference on Marine Science and Ocean Technology

Hamburg, 29 August - 2 September 2000

Abstracts of oral presentations

ENERGY, ENVIRONMENT
AND SUSTAINABLE DEVELOPMENT

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COASTAL ZONE MANAGEMENT

WHAT HAS THE 4 th FRAMEWORK PROGRAMME DELIVERED ?

Tuesday, 29 August 2000

Abstract for EurOCEAN 2000

Converting coastal data and models to management tools in the COAST3D project

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The COAST3D project, a collaborative project co-funded by the European Commission's MAST-III programme and national sources, runs from October 1997 to March 2001. A consortium of 11 partners from five EU states (UK, Netherlands, France, Spain and Belgium) is undertaking the project, which has the following objectives:

- to improve understanding of the physics of coastal sand transport and morphodynamics
- to remedy the present lack of validation data of sand transport and morphology suitable for testing numerical models of coastal processes at two contrasting sites
- to test a representative sample of numerical models for predicting coastal sand transport and morphodynamics against this data
- to deliver validated modelling tools, and methodologies for their use, in a form suitable for coastal zone management

Four field experiments have been successfully performed, resulting in large amounts of high quality data on water-levels, currents, waves, sediment transport and bathymetric changes. The first two experiments took place at Egmond on a quasi-2D sandy stretch of the Dutch coast, with a pilot and main experiments in spring and autumn 1998 respectively. The second two experiments took place at Teignmouth on the south coast of England in spring and autumn 1999, where a rocky headland and a river mouth provide a strong three-dimensionality to the sand and shingle sediments. The data will provide new understanding of coastal physical processes, which are valuable for coastal management both directly, and through the improvement of hydrodynamic and morphodynamic numerical models.

The field measurements were purpose-designed for numerical model evaluation, with adequate boundary conditions and a dense horizontal array of measurement points. Numerical modellers are working interactively with the experimenters, at the planning, experiment, and evaluation phases. Very successful "Modellers' Weeks" were held at both sites during the experiments, when the project's modellers, supplemented by others from outside the project, ran their models together at the site they were modelling.

An important aspect of the consortium is that national regulatory authorities from UK (Environment Agency) and NL (RIKZ/Rijkswaterstaat) are represented as full partners, to ensure that the project is focused on practical tools for Coastal Zone Management (CZM). They have a number of important roles: as members of the Project Steering Committee, as providers of financial and logistical support for the field experiments, as leaders of the CZM Tools Group, and as leaders of the Exploitation Plan.

The means by which results from the project can be made use of in CZM applications was addressed from the outset of the project. It has been found to be by no means straightforward: there is a gap between the problem-driven requirements of CZ Managers and the science-driven goals of the researchers. All partners are keen to find methods of bridging this gap. To aid this, a questionnaire has been prepared by the CZM Tools Group and distributed to all the consortium partners, requesting them to answer a number of questions that relate to CZM in terms of the results that their data analysis and/or modelling will provide. Preliminary results from this will be available by the time of the EurOCEAN conference, and full results will be available by the end of the project.

A draft Exploitation Plan has been prepared, identifying the following products:

- **Data-sets:** (CR-ROM), from two different coastal environments
- **Reports and papers:** on coastal processes, morphological models, and innovative instrumentation
- **CZM tools and guidelines:** a report describing WHEN to use WHAT tools and HOW to use these tools, illustrated by case studies at Egmond and Teignmouth
- **Models:** improved, validated, morphodynamic numerical models
- **Instruments:** innovative instrumentation and systems.

Issues of ownership, exploitation and dissemination have been discussed in this, and will be finalised towards the end of the project, when a full Technology Implementation Plan will be prepared.

EurOCEAN-contribution to: **Coastal zone management: What has the 4th Framework Programme delivered?**

Can (operational) modelling improve coastal zone management? Suggestions from local applications.

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General improvements of forecast ability of operational systems are an important prerequisite for long-term predictive capability of coastal zone evolution with a view to sustainable protection and use of the coastal and shelf environments. Additionally, integrated coastal zone management requires appropriate, reliable and timely information in a form which is suitable for the task at hand. Results from the FP4 OPCOM project suggest that this objective could be reached somewhat more reliable by consulting information sources like those from local operational models. Besides ecological and management implications, such models possess considerable economic advantages which could enable also a cost-covering operation. From applications in four very different coastal locations the project partners have won many more experiences especially by facing real life issues of the user community by means of face to face interviews. This representation will dwell mainly on results concerning the sustainable management of oyster farming in the Bay of Marennes-Oléron and the impact of natural and anthropogeneous changes on environmental conditions in the Elbe estuary. Additionally a short generalisation is presented of a number of different objectives of **coastal zone management** where **local operational models** could be used to its advantage. These include

- Long-term routine monitoring and assessment activities in coastal waters to complement existing field measurements and observations. High-resolving (in time and space) model information can provide a far more consistent picture than single point time series or accidental observations. In this respect there is even a better prospect with the possible future development of combinations of operational models with sophisticated new technology of remote sensing. Updating of extension of tidal flats, in-situ measurement probes for nutrients and dissolved oxygen or the vast amount of data from ferry box operations are expected to be feasible in the short term.
- Future planning activities and necessary assistance in decision support by providing impact assessment information. Here even a limited set of stored model scenarios could prove to be very useful for interested parties to obtain a first guess in preliminary planning stages. Additionally the very existence of an operational system could help to avoid considerable efforts and costs for the set-up and qualification of another version of consulting tool (preventing the everlasting re-invention of the wheel).
- Needs of short-term information provision like nowadays weather forecasts. Such applications could include early warning systems (pollution control or hazardous surge predictions) and on-line nowcast information on current and wave conditions. However, especially the necessary on-line data flow from field stations and larger-scale hydrographic and meteorological models prove to be essential and (in most cases) very expensive.

Coastal Zone Management Issues in the Firth of Clyde, S.W. Scotland

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The Firth of Clyde is the broad semi-enclosed sea area into the head of which the Clyde Estuary discharges. The estuary became heavily industrialised during the late 19th century at a time when Glasgow became one of the largest industrial cities in the world, and a centre of commerce and ship-building. At the same time the Firth of Clyde became heavily exploited and coastal villages and towns developed as tributary commercial centres and residential towns. Nevertheless, as a result of its complex geomorphology incorporating numerous sea lochs and islands, combined with the influence of the North Atlantic drift which brings warm waters and a mild climate, the Firth probably supports a greater variety of inshore marine habitats and a richer marine fauna, than any comparable area of the UK. In recent decades the decline in heavy industry and ship-building has resulted in a decline in potential impacts from most forms of pollution. At the same time however threats to marine biodiversity have intensified. The increased efficiency with which renewable marine resources are exploited has resulted in overfishing and collapse of traditional fisheries (e.g. for herring and cod)m and in recent years new invertebrate fisheries for Norway Lobster (*Nephrops norvegicus*), crabs, scallops, winkles and most recently Razor clams (*Ensis* spp.) have been developed. These have involved increasingly intensive trawling and dredging which have not only caused a significant mortality of juvenile fish and their prey species, but has impacted and altered both physical and ecological structure of a range of benthic communities. Amongst the most impacted have been the species-rich maerl beds formed by coralline algae, the two main species of which are the only algae requiring management under the EU habitats Directive. On land economic restructuring and changing lifestyles have led to further new threats to the coastal environment including loss of raised beach flora-rich grassland, loss of intertidal habitat to marina and power station construction, increased intrusion into previously undisturbed areas e.g. by golfers and jetskiiers, sewage pollution due to overloading of coastal drainage systems, accumulation of marine and beach litter and some beach erosion associated with coastal activities perhaps combined with a greater severity of winter storms. A Firth of Clyde Forum has now been established as an interagency consultative body involving all interested stakeholders in the development of policies and plans directed at enhancing the quality of the marine and coastal landscape and sustaining marine resources and biodiversity and in the face of rapid economic and social change. Priority actions are likely to include developing effective management regimes for sensitive areas of seabed and coast, within which deleterious impacts can be controlled and natural communities protected.

Abstract for EurOcean2000

Intended Colloquium:
Research Policy, Coastal zone management: What has the 4th Framework Programme delivered?

Archipelago Sea Coastal Modelling System

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The Archipelago Sea is a sea area in the Baltic Sea between Åland and Finnish mainland strongly influenced by the Baltic Sea forcing. The Archipelago Sea waters are threatened from the southern and eastern sides by more nutrient rich waters from Gulf of Finland and Baltic Proper, and also by local nutrient loads from Finnish mainland, fish farming and other local loads inside the archipelago. The state of the Archipelago Sea is deteriorating and some areas of the sea suffer from excessive eutrophication and toxic algae blooms.

A modelling system was applied to the Archipelago Sea within the ongoing OPCOM EU-project, in order to investigate water exchange, nutrient transport and relative significance of different nutrient sources. The system consists of a 3d hydrodynamic model, a water quality model using hydrodynamic data, and a model management user interface. It is intended to be used by the local authorities as a management and planning tool enhancing the understanding of the current state of the sea, and enabling what-if scenario testing. A typical management problems to which the system can and has been applied for is an investigation of the local and larger scale water quality implication of nutrient load additions and reductions, such as a fish farm siting problem, or a reduction of loads from a wastewater treatment plant.

The end users see the system as potentially very useful tool, and generally do find the system easy to start with. However, there have been some clear usability problems that do reduce the motivation of some end users to apply the system to practical management problems. Therefore, to make the system more useful in the future even more emphasis should be placed on the usability of the computer software, user training and software documentation, in general getting the required end-results easily and efficiently without compromising reliability of the model computations.

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Topic: Coastal Zone Science and Engineering.
Session: Coastal Zone management: What has the 4th Programme delivered.

European Shore Platform Erosion Dynamics: Monitoring the downwearing of shore platforms in the context of the management and protection of rocky coasts.

D.A.Robinson, C.Andrade, Y.Foote, J.Fornos, A.Miossec, C.Moses, J.Swantesson and R.B.G.Williams.

Inter-tidal shore platforms are a common feature of many European rocky shores. They are especially well developed in areas of cliffed coastline. The platforms help to protect the cliffs and also sea walls and other engineering structures by absorbing and reducing wave energy. Paradoxically, despite their importance in coastal defence and coastal management, shore platforms remain poorly studied and little is known about the erosive processes that both shape and destroy them. It is generally assumed that wide platforms are much more protective than narrow platforms, but platform gradient is probably also important. Models exist regarding the evolution of platforms over time but there has been little empirical research to test the validity of the models. Much research to date has been concerned not with the platforms but with determining the rates of cliff retreat and on the design of engineering structures to protect the base of rapidly eroding cliffs along the increasingly urbanised shorelines of Europe. However, cliff erosion and the life span of engineering structures are closely controlled by the evolution of the shore platforms. Coastal protection agencies and engineering contractors have, historically often assumed that the platforms are relatively stable and unchanging, but this is frequently not the case.

The EU has funded research into European Shore Platform Erosion and Dynamics (ESPED) under MAST IV that is designed to increase our understanding of the processes and rates of change on shore platforms around the coasts of Europe. The platforms developed around the shores of Europe exist in very different climate, tide and wave environments. They have a varied history with respect to the rise and fall of land and sea levels both in the past and at the present day.

The erosion dynamics comprise three fairly distinct components, the physical loss of rock mass through wave action, the chemical losses due to solution processes and physico-chemical losses associated with the action of the biological organisms that live and graze on the platforms. Together they lower the platform surface and a major aim of the ESPED programme is to identify the relative importance of these different components and how their contributions to downwearing of the platform may vary under differing environmental conditions. Monitoring sites have been established at sites representative of the contrasting coastal environments of Europe. These are along (i) the high wave energy, meso-tidal Channel and Atlantic coasts of southern Britain, northern and western France and Portugal with their warm to cool seas of average salinity, (ii) the low energy, micro-tidal Baltic coast of Sweden with its cool to cold sea of low salinity and (iii) the low energy micro-tidal Mediterranean coast of mainland Spain and the Balearic Islands with their warm sea of above average salinity.

This paper will be concerned with the overall rates of downwearing of the platform surfaces. It will describe the methodology being used to measure the downwearing of the shore platforms and present some preliminary results from the first year of study. The research is making innovative use of a new laser based scanner which was originally developed at the University of Karlstad for field monitoring of the decay of rock art exposed to the weather. This equipment can make accurate micromaps of small areas of the platform surface and by overlying maps taken at regular intervals enable rates of change over time to be mapped. This is being combined with measurements taken along representative transects with mechanical micro-erosion meters and detailed topographic surveying to determine down-shore rates of change.

Problems of relating platform evolution to cliff recession will be outlined and the need for long term studies will be emphasised. The impact of seawalls on erosion rates and platform morphology will be discussed and examples will be shown of very rapid rates of erosion leading to the potential de-stabilisation of coastal defence structures.

Subject: EurOCEAN 2000, Hamburg, 29 August – 2 September 2000

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Titel: Submarine groundwater discharge in coastal zones and their impact on the environment (M. Schlüter and the Sub-GATE Partners).

The discharge of groundwater into the coastal zone has now been recognized as an important process in many areas. Groundwater discharge into coastal waters and the ocean is important for groundwater resource management and, due to the release of nutrients and trace gases (e.g., methane), for the marine environment.
Different techniques as geochemical tracers, direct measurements, video observation, and seismic studies are applied for the detection of submarine seepage of freshwater. For the Eckernförde Bay (W-Baltic Sea) results of geochemical studies are reported which allow a detailed characterisation of the spatial distribution of submarine groundwater discharge (SGD) and quantification of discharge rates. These results are compared to direct measurements and discharge rates derived by hydrological budgets established for the landside catchment area. The impact of SGD for the environment is assessed by consideration of the nutrient flux and the release of methane from the sediment. In addition to the scientific results technical concepts for rapid diagnostic and assessment tools to evaluate the local importance of SGD for the environment will be considered.

From river load reduction scenarios towards a concept of sustainable use for the North Sea

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Reduction scenarios of the river nutrient loads by 50 % were simulated with the ecosystem model ERSEM (European Regional Seas Ecosystem Model) for the North Sea. The biological complexity of ERSEM offers the possibility to demonstrate various effects of the river load reductions on the ecosystem as a whole. Second, the use of realistic forcing for the model allows the analysis of the effects of the reductions within the natural variability of the ecosystem.

The model results showed, that a reduction in the nutrient load by 50 % for N and P does not automatically lead to a similar reduction in primary production in comparison to the standard run with realistic river forcing. While the reduction scenario revealed decreased winter concentrations of nitrogen and phosphorus by 40 % in the costal regions of the North Sea, the decrease in net primary production was clearly lower. Reducing the anorganic and organic river loads by 50%, the model showed the largest effect with a reduction on the net primary production by about 20 % in the coastal zone.

The phytoplankton groups exhibited different reactions to changed nutrient availability. While the diatom concentration did not change much, differences did occur for the flagellates. However, these differences also indicated sporadically higher flagellate concentration in comparison to the standard run. Since the increase in algal biomass due to eutrophication was related mainly to an increase in flagellates, this effect cannot be easily reversed accordingly to this reduction scenario.

Regional differences can also be seen between primary production and nutrient uptake of algae. Greatest differences between the two simulations with regard to primary production are found downstream of the mouth of the the river Rhein and the Elbe river. Generally, there were significant changes in the strength and timing of the nutrient limitation in all phytoplankton groups in the model, indicating differences in the strength of the nutrient flows and the pathways through the ecosystem. One of such changes is the increased importance of the microbial loop for the material flows in the ecosystem. However, which of these changes can be interpreted as an improvement for the ecosystem as a whole is difficult to judge. A standard set of parameters, like the diaton/non-diatom ratio used in the ASMO Eutrophication workshop, is missing for the interpretation of the results, especially when the changes should be demonstrated for the whole ecosystem.

With the ongoing activites towards three-dimensional ecosystem models these difficulties need to be overcome in an additional conceptional effort, since these models face restrictions in computer time and storage potentials. Concepts for the sustainable use of the North Sea also need to derive key parameters which allow to judge the development of the state of the ecosystem. The aim is to optimize the effort needed for the three-dimensional ecosystem models towards their eventual use as a management tool.

SESSION B

THE CONTRIBUTION OF MARINE RESEARCH TO SUSTAINABLE DEVELOPMENT

EXAMPLES FROM ENCLOSED EUROPEAN SEA

Tuesday, 29 August 2000

Abstract

Key note speech

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Title: Are we achieving sustainability for European seas? resources, risks, regulations and research".

1. Sustainability issues; valuation of natural resources (very brief introduction)

2. What are the human impacts on European seas? Summary of issues, with simple comparisons for range of water bodies (eg Irish Sea, North Sea, Baltic, Mediterranean, Black Sea - and Caspian?) To cover the following environmental problems, mostly in diagrammatic form:

a) regional and local effects
- what goes in (nutrients, pollutants, changes in freshwater flows and sediment delivery; effects of land use in drainage basins)
- what comes out. Extraction of non-living (hydrocarbons etc) and living resources (fisheries...).

b) global effects climate change impacts on biology (productivity and biodiversity) and physical systems (sea level, storminess, coastal erosion/flooding). Potential for UV impacts.

3.. What is the existing policy framework for addressing these problems? how well are we meeting the goals of sustainable development? Evolution of regulatory framework, including information flow from researchers to (and from) policy makers, at national and international levels. Role of OSPAR, HELCOM, ICES etc.

4. What are scientific implications of (3)? Why and how should governments and the EU support marine environmental research? Do the main knowledge gaps relate to modelling, monitoring or human behaviour?

INTEGRATED APPROACHES TO THE SUSTAINABLE DEVELOPMENT OF ENCLOSED SEAS

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The present overview delineates not only unique dimensions of "enclosed" seas but attempts also to explicate policy options and alternative futures for European marine environments. The paper opens with a short presentation of environmental challenges at the beginning of the 21st century. In outlining the forces generating changes in oceans, seas, bays and the water's edge, the concepts of "complexification", uncertainty and vulnerability are used as the backdrop for a series of interlocking crises and inherent policy dilemmas. A second part, extends the argument to the challenge of addressing sustainability and marine development, especially in terms of the search for appropriate indicators in valuing marine resources. The discussion here uses the notion of runaway ecological load and of environmental unknowns as an organizing concept to address the problem of using the seas as a collective sink.

The third part of the paper concentrates on a comparative analysis of four "enclosed"/"semi-enclosed" European Seas, namely the Mediterranean, the Black and Azov Seas, the Caspian, and, the Baltic. Central here is the close interrelationship between land and marine environments and the consequences of anthropogenic activities. Consequences of natural and anthropogenic acticities are more severe in relatively "closed" marine environments (as e.g. hypoxia). Items of concern include the sources and magnitude of marine degradation, institutional mobilization and capacity building, and, the importance of transboundary interdependencies and resource regimes.

The final two parts summarize both a paradigm shift to more comprehensive models and the changes from crisis to risk management (proactive vs. reactive approaches). In addition to the building of epistemic communities for addressing interdisciplinary problems, the paper discusses requisite new conceptual models; new contexts, such as interdependence and rapid change; new methodologies, more sensitive to complexification and expanded spatial envelope; and, new transnational organizations for environmental governance, including the centrality of international stewardship, binding transboundary agreements and environmental diplomacy. The conclusions, attempt to round up a series of alternative marine futures as well as pragmatic approaches to complex environmental challenges.

Are we achieving sustainability for European seas? Resources, risks, regulations and research

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The sustainable use of marine resources requires that associated human impacts are within acceptable limits. Since there is shared access to most European seas (by both EU and non-EU states), and the total conservation of most marine resources is impracticable, setting the limits - and implementing them - are difficult political tasks. This process demands high quality scientific information and understanding. However, marine systems are highly dynamic, and many features that are most valuable for human exploitation are naturally variable, with a complex interplay of biological, chemical and physical factors over a wide range of temporal and spatial scales.

The scientific challenge is therefore to gain sufficient knowledge of the natural interactions to assess the impact of human interferences - and their future trajectories, on the basis of likely exploitation scenarios. Since research advances, policy-making, and changes in societal behaviour all can take several years to achieve, many decisions must be taken on the basis of imperfect evidence; otherwise (by waiting for certainty or near-certainty) irreversible damage may occur.

These general principles are illustrated by examples of marine research relevant to resource management for the North Sea, the Baltic Sea and the Barents Sea, and for other semi-enclosed European seas along their margin with the open ocean. The main environmental issues affecting the sustainability of these seas are over-fishing, mariculture impacts, and pollution (hazardous substances, nutrients and oil-related problems), as recently reviewed by the OSPAR Quality Status Report 2000. Such effects must be considered in the context of the likelihood of major ecosystem shifts, resulting from the regional impacts of global climate change.

ENVIRONMENTAL AND ECONOMIC LOSSES FROM THE ANTICIPATED GLOBAL SEA-LEVEL RISE AND SUSTAINABLE DEVELOPMENT STRATEGIES FOR SEA COASTS: EXAMPLE FROM THE SEA OF AZOV

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Major premises for the dramatic impact of possible sea-level rise on the coasts of the Sea of Azov in the coming century include: (1) prevalence of land subsidence and, therefore, higher regional estimates of the relative sea-level rise in comparison to the globally averaged values (by 2-3 times); (2) intensive retreat of the prevailing loess coastal scarps, substantially aggravated by landsliding processes, and degradation of depositional coastal bodies composed presumably of detrital sands; (3) high economic development of coastal zones with intensive crop- and fruit-growing on rich black earth soils, as well as cultivation of white beet, corn, and sunflower, and food industry, including fish processing, and light industry as a principal economic strategies; and (4) relatively high sensitivity of natural steppe and meadow ecosystems and even higher sensitivity of anthropogenic ecosystems to soil moisture content and, therefore, to the possible underground flooding. Sand extraction from beaches and other depositional coastal bodies contribute much to the increase of coastal vulnerability.

Risk assessment for the coasts of the Sea of Azov have been implemented for the scenarios of the rise in the global mean sea level by 0.5 and 1.0 m until 2100. The methodology is based upon the concept of various types of resources (natural, economic, cultural) and probabilistic prediction of shoreline retreat values for different morphological types of sea coasts. Graded scale is constructed to evaluate each type of resources and natural vulnerability in the comparable manner. The results allowed us to quantitatively estimate possible losses under sea-level rise.

The example case study for the Gulf of Taganrog, the Sea of Azov, will be presented at the conference. Due to shoireline retreat during the next 100 years, 50 to 200 inhabitants should be resettled from each kilometer of the shoreline length in the countryside and over 1000 - in towns and large villages, such as Eisk and Azov. At least threefold numbers characterize those of inhabitants whose quality of life would be decreased by the secondary impacts of sea-level rise (underground flooding, higher sick and unemployment rates, etc.). Nearly 15 large industrial objects should be moved. Direct loss of economic production is estimated at US$ 180,000 per sq. km on a yearly basis, whereas total losses that include industrial funds, private property, and compensation costs are over US$ 10,000,000 per sq. km in several segments of the coastal zone. Many unique ecosystems will be lost. Advance measures can diminish this these values by 3-4 times.

Recommendations for choose between retreat, accommodation and protection response strategies and several sub-strategies at the specific coastal segments were presented to regional authorities and resulted in the approval of the law on coastal management under changing environment in Kranodar Region, Russia. Similar law is under preparation in Mariupol Region, Ukraine. On the basis of these recommendations, sand extraction from beaches has been minimized, "soft" coastal defence structures are under construction or modification. Construction of several inductrial structures in the coastal area ceased.

The Influence of UVR and Climate Conditions on Fish Stocks: A Case Study of the Northeast Arctic Cod (UVAC)

Hansen, G., A. Borja, C. Alonso, K. Edvardsen, H.C. Eilertsen, R. Meerkötter, F. Saborido-Rey, S. Skreslet, J. Verdebout and T. Wyatt

It is well known that fish stocks, especially in regions with harsh natural conditions, e.g., the polar oceans, experience large natural variations depending on natural environmental parameters, such as feeding conditions, sea temperature, ice coverage and radiation conditions. A more comprehensive understanding of the causal chains of natural impact parameters is essential for a more sustainable exploitation of wild fish stocks in the future. This will be even more relevant, if global change (enhanced greenhouse effect, ozone depletion) and its impact on marine ecosystems will come true as expected by the vast majority of the scientific community.
The main objective of the project UVAC is to investigate the impact of solar ultra-violet radiation (UVR) on the Northeast Arctic cod stock. This relation is investigated as part of a more comprehensive impact system, including both other geophysical factors (climate) and biological species which are important for the cod stock (zooplankton, phytoplankton). The UVR impact is investigated both statistically using long-term biological and geophysical data records, and in-depth in dedicated field and laboratory experiments. A second major objective of the project is to develop modelling tools, which will be used to estimate cod stock size based on geophysical information available from remote-sensing and ground-based monitoring, thus providing a more reliable basis for a sustainable management of marine resources.

The project is performed using three sets of biological and geophysical data, covering different time scales and having different levels of information. Data over a 100-year period, consisting of annual cod landing records and *Calanus finmarchicus* annual biomass estimates on the biological side, and records of local climate conditions, regional climate indices and total ozone/UVR records on the geophysical side, are used to determine long-term correlations, and, if possible, to separate the impact of climate from that of UVR.

Data with a significantly enhanced degree of detail over a 15-year period (1985-2000) will then be used to investigate the impact of UVR on the species involved in more detail. To this purpose, high-resolution maps of relevant UVR parameters, based on remote-sensing data of total ozone and cloud coverage and calculated with state-of-the art radiative transfer models, will be constructed for the cod spawning area. These investigations will be supported by field and laboratory experiments/studies, which will cover the whole scope of biological and geophysical parameters assumed to play a role in the UVR – cod interaction.

The project started in March 2000 with a series of field surveys in the Lofoten/Vestfjord area. We shall present first results from these combined investigations of the development of the relevant biological species (cod eggs and larvae, *C. finmarchicus*, phytoplankton) and the geophysical parameters during the spring period (late March to early June). We will also demonstrate the capabilities of monitoring UVR over large areas by means of remote sensing combined with modelling, applied on the same area and time period.

Numerical models serving environmental policy: Scenario calculations for the North Sea

by Juergen Suendermann, Institut fuer Meereskunde, Universitaet Hamburg, Troplowitzstr. 7, D-22529 Hamburg

The North Sea is part of our marine environment, is a vital living and economic area. Its health and sustainable development possess a high societal rating. There are threats due to global change with an anthropogeneous and a natural component. Policy, economy and society need to know what are the future options for the North Sea and what effects protection measures will have. Answers can be obtained from model simulations representing possible scenarii.
Examples are given for
- the spreading and deposition of dissolved and suspended matter from land
- the effect of reduced nutrient release
- the development of storm surges under persistent green house conditions.
The results support the precautionary principle.

State-of-the-art in ecosystem modelling for shelf and coastal seas

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Improved assessments and predictions of the environment are not possible without an improved understanding of the web of physical-biological-chemical processes that characterise the dynamic shelf/coastal region. This review on shelf ecosystem models concentrates on plankton models, but also on benthic models which are necessary to be included in models for the whole ecosystem in shallow waters. This includes the physical-biological coupling in space and time with chemical induced matter fluxes (C, N, P, Si, O). The working hypothesis is that the spatial and temporal distributions of the key functional groups are determined largely by meso-scale physical and chemical phenomena. Thus, the primary focus of this assessment is on physical-biological models that have been developed for coastal marine systems. Littoral models are not included. The objective is to illustrate the modelling approaches and directions that have been used for marine ecosystems and to provide a framework for the development of subsequent marine ecosystem models. The final interest is to answer the question which of these models should be used for decadic simulations to reproduce annual cycles and the observed interannual variability. The aim is to give an overview on shelf ecosystem models using the same categories and objective criteria, especially for the North Sea or the north-west European continental shelf. Selected models developed for other shelf seas or larger-scale oceanic systems have been included, because these shelf seas or larger scale models have revealed many general issues that need addressing in order to improve the ecosystem modelling. And furthermore, the larger-scale models will need to include models of coastal and continental shelf processes. Twenty five years after the introduction of the first coupled physical-biological models and ten years after a North Sea review (Fransz et al. 1991, NJSR) it is appropriate to assess the current status of modelling marine ecosystems and look to the future in this area.

Contribution of research to sustainable development of the Baltic Sea

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ABSTRACT

Various research activities have been carried out within the international organizations and conventions (the EU, IOC, HELCOM) and programs (EMEP, ELOISE, LOICZ, BOOS) with the aim to develop strategies for the sustainable development of the Baltic Sea. Some of these strategies were then implemented as a result of international agreements on the reduction of chemical input to the Sea and the financial mechanisms were developed to help this implementation (e.g. bank loans, international debt to environment swap). In parallel, a number of assessment tools and monitoring networks have been establish to review the effectiveness of the implementation of these strategies. The paper reviews the strategies, their implementation, and assessment tools for the effectiveness of this implementation. The review is based mostly on the outcome of author's work for the Baltic Sea Environmental Programme, the EU ELOISE program, and the IOC Global Ocean Observing System (GOOS).

The Baltic Environmental Information Dissemination System as a Tool for Sustainable Development in the Baltic Sea Region

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Scientific Colloqium: The contribution of marine research to sustainable development: examples from enclosed European Seas

Abstract

The on-going economic development of EU-countries as well of the countries in the C&E European region has been leading to a significant use of a great deal of natural resources as well as to noticeable environmental problems. The lack of a wide-spread environmental awareness from the side of those acting in various sectors (industry, public administration, users) sometimes inhibit the implementation of legislation already available as well as the introduction of new technologies deriving, from example, from marine research. An example of this state of affairs is seen in respect of the implementation of the recommendations deriving from **Baltic 21** and **VASAB 2010,** which illustrate the advantages from a **cross-sectorial**, open mechanism for the dissemination of environmental information in the region.

There are various organisations today which act as suppliers of environmental information in the Baltic Sea Region. However, few, if any, are providers concerned with the various ways in which information on matters related to sustainable development is being used by various groups and audiences. This state of affairs makes it necessary to enhance the current mechanisms and approaches in place, so as to enable the wide-range of environmental information available today froma reas such as marine research, to be more widely used. It is equally important that the didactic or educational potential of such information be exploited, so as to not only inform, but also to educate various groups and the general public on matters concerned with the environment in European closed seas and give information to planners and politicians to prepare decisions.

In order to address such needs, the project "Baltic Environmental Information Dissemination System (BEIDS)" was set in motion. BEIDS has been taking advantage of the most modern information technologies and has been acting as a focal point for the circulation of intelligent information on aspects of the marine environment, but also emphasising related areas such as transport and sustainable development issues, among a sample of six BSR countries: Denmark, Finland, Germany, Sweden (EU) and Lithuania and Poland (non-EU), contributing to networking and know-how exchange, complementing efforts towards transregional cooperation in sustainable spatial planning on the basis of Baltic 21.

The results reached to date include: increased awareness of matters related to sustainable development in the six participant countries; enhanced communication exchange and

networking among the samples nations; improved information flow and increased participation in events, activities and programmes across the Baltic Sea Region. BEIDS is a prime example of the feasibility of using marine research as a tool for sustainable development.

Title: Contribution of the Mediterranean Targeted Projects (1993-1999) to the sustainable development of one of Europeãs most important enclosed seas.

The MTP project which was initially implemented through a series of 10 individual projects running from 1993 to 1996 gave way to one large project (MTPII, MATER) which ran from 1996 to 1999.
The major achievement of both projects was the creation of a well identified scientific community dealing with the dynamics and evolution of the Mediterranean Sea ecosystem. It was not until the implementation of the MTP projects that marine scientists from around the EU (and not only) got together in order to expose, identify and understand the effects of anthropogenic pressure on a very sensitive marine ecosystem. Numerous young scientists and students matured within the framework provided by the MTP projects by grasping the oppurtunity to put forward important issues and questions, and most importantly to seek answers in a coherent way throughout the Mediterranean Basin.
Major findings and results such as temperature increase of deep waters in the western Mediterranean, deep water formation events in the eastern Mediterranean, accumulation of nutrients and pollutants in coastal and deep waters, reduction in lead concentrations following the application of European regulations, formulation of advanced and reliable circulation and ecological models from the coastal zone to the open sea, loss or changes in biodiversity, impact of aeolian transfers on the productivity of the ecosystem, operational forecasting etc. all contributed to a better understanding of the underlying dynamics governing the functioning of the system.
Furthermore, countries such as Greece (with a short case history in marine research) found the oppurtunity to invest in new facilities and marine infrastructures and to mobilise their human capital towards marine oriented research.
In conclusion, no matter which point of view one adopts the socio-economic and scientific gains outweigh the costs.

Elpizo to abstract auto na einai sufficient.
Pes mou an xreiazetai na kano tipota allo.
Ta leme stin Copenhagi.

Tassos

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SESSION C

MARINE BIOTECHNOLOGY

Tuesday, 29 August 2000

Marine Biotechnology

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Biotechnology now forms a major industry, which uses biological processes and products to make a range of products. Marine biotechnology is the application of biotechnology using marine organisms. This field is multidisciplinary and ranges from old technologies as aquaculture to newly created ones as genomics of the rich bio diversity of marine life.

A number of recent events have highlighted marine biotechnology. These include the emergence in 1989 of the IMBC Conferences and subsequent creation of regional organisations, the emergence of Marine Biotechnology Centres, and a number of R & D initiatives in various countries. These initiatives involve inter-government co-operative agreements, private ones (World Bank, International Monetary Fun industry), and the role of Academic / Research Institutions.

Marine biotechnology provides a number of scientific opportunities for Europe. The oceans present an evolutionary environment with unique genomes yielding new chemical structures. Key European marine ecosystems are involved. Genetics exchange mechanisms are being discovered in marine organisms. Finally in recent years we have the emergence of European biotechnology.

Now is the time to develop a European Strategy for marine biotechnology. Europe has a rich history of marine laboratories in research, teaching, and public awareness and in commercial experience in aquaculture. Biotechnology opportunities are available in a number of areas (bioprospecting / bioscreening, chemical communications, marine genomics to name but a few). This strategy should include social issues such as biosaftey, public awareness, and the role of the public in policy decisions.

SESSION D

TECHNOLOGY AND MANAGEMENT

APPROCHES FOR EUROPEAN SEAS

Tuesday, 29 August 2000

ABSTRACT

EurOCEAN 2000
Hamburg, Germany, 29 August - 2 September

Session: **Shipbuilding and marine transport in the Arctic**

Analysis of Ship Passage in Ice Covered Waters

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The ice cover influences ship navigation in basically two ways. The ice loads created in breaking the ice during the passage may hazard the ship structures and cause damage and ultimately also ship loss. The ice cover also induces additional resistance which may exceed the ship propulsion and thus ship may be stopped and if the ship cannot move forward or back, the ship gets stuck in ice and requires icebreaker assistance. The design of ice going ships or marine transportation systems in the Arctic require that the ship safety i.e. ice loads and the ship trafficability i.e. transit times and need for icebreaker assistance must be related to ice conditions on the planned operational area. The present paper tackles the question of describing the ice cover in a way suitable for ship studies. More specifically, the parameterisation of ice cover suitable to determine the ice loads on ship hull and the resulting damage probabilities are investigated as well as the ice cover parameterisation suitable for ship transit studies. The approach in new as only a few studies have concentrated on the practicality of making the parameterisation together with analysing the application aspect.

The ice cover parameterisation must cover the whole area under investigation, it must be comprehensive in that it describes all relevant aspects and it must be practical to observe these parameters by remote sensing methods. This possible definition of parametres was investigated in the EU funded ICE STATE project. Here the main conclusions of the parameterisation are described. Especially the analysis of satellite SAR and other images is described as a new method to obtain the ridging parametres from the images is emerging. The parameterisation is then applied to determine the ice loading i.e. the maximum loads given the time period and the sea area. The routine to determine the loads and assess the probability of damage is described. This routine is based in modelling the ice loading in statistical terms. The method is semi-empirical because it was developed based on merchant vessels navigating in the Baltic. The parameterisation as well as the damage probability determination is then applied to segments of the Northern Sea Route (NSR). The availability of data is analysed first. Damage probabilities for different route segments and months are then determined. The analysis is done for a SA 15 type multi purpose vessel from which there exists damage data.

The second part of the paper analyses the ship transit through ice fields. The approach is to create by Monte Carlo method the ice field ship sails through and then simulate the ship passage by a routine developed for this purpose. The final aim here is to relate the statistical parameters describing the ice conditions with the statistics of transit time and also in more detail with the prabability to get stuck, number of rams needed for the passage etc. Again here the ice conditions along the NSR form the basic example of the routine.

ABSTRACT for EurOcean 2000:

Subsea Holography and its Application in Marine Science

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Holography is a well-known optical technique which can provide valuable information on the location and distribution of small particles in three-dimensional space. For the past three years a European consortium has been developing a holographic camera as part of a European Commission funded programme (MAST III - *HoloMar*) for recording of marine organisms *in situ* in their natural environment. The project also includes the development of an associated hologram replay and data extraction/analysis facility which enables reconstruction of the hologram images and the computer controlled extraction of co-ordinate information. By micro-positioner translation of a video-camera through the replayed image volume and performing "optical sectioning" on the image, individual organisms can be isolated and their size, shape and relative location precisely determined. Coupled with this is the development of image identification and feature extraction algorithms which allow optimisation of the holographic image together with automated identification of individual species and enumeration of concentrations. From this information, the local interactions between meso-zooplankton and micro-zooplankton, phyto-plankton and seston can be observed, recorded and quantitatively determined.

In this paper, the concepts of holography are described as far as they relate to the recording of marine organisms *in situ* from 5 μm up to several millimetres dimension in aquatic volumes up to 10^5 cm^3. The unique benefits of holography for marine biology are discussed and we see how holography can allow the extraction of relative location of particles as well as species identification and concentration. Two basic holographic geometries are generally useful for the recording of small organisms, viz. in-line (object in transmission) and off-axis (object in reflection) such that a wide range of species, sizes and concentrations can be recorded. In-line holography is capable of producing images of organisms in the size range 5 to 250 μm (at concentrations up to a few thousand per cubic centimetre at the smallest sizes). Off-axis holography is more suited to the recording of larger organisms from about 100 μm upwards at much higher concentration levels. Our camera utilises both systems simultaneously. A major benefit of holographic imaging over other visual and non-visual measurement techniques is that it allows non-intrusive and non-destructive visual recording of living organisms and inanimate particles in their natural environment. The use of a pulsed laser coupled with the inherent high resolution and three-dimensionality of holography effectively "freezes" the scene at a given instant. Although the recording of the holograms takes place in water, replay of the image is carried out in the laboratory in air, using the projected (real) image mode of reconstruction.

Results will be presented of the laboratory testing and evaluation of the camera currently being undertaken and, if available, results obtained in series of (soon to be conducted) dockside trials will also be presented. Although the design of the holographic camera and its application to the recording of marine organisms will be discussed in some detail, the paper will also outline how holography may be further developed for wider use in other areas of marine and river science such as in sedimentology.

ABSTRACT

Holographing of Microparticles in a Liquid

A hologram of scattering volume allows the optical wave field to be reproduced to obtain information on the parameters of microparticles: size, shape, and spatial position. However, such investigations mostly deal with holographing of aerosols while not so many publications can be found in literature that concern holographic studies of microparticles in liquids. It is these media that are very often studied in marine (or lake) research, biology, medicine, and environmental control.
Holographic investigations of such particles are mainly considered in this paper.

A lot of particles are transparent or semitransparent and holographic image of such particle differs from the opaque particle image. Peculiarities of holographic images of these particles are discussed in
the paper. As a result, we proposed several methods for evaluation of the particle optical features (refractive index and absorption factor), in addition to its geometrical parameters. The additional information can provide more precise identification of particle type. Methods are
based on analysis of intensity distributions in various cross-sections of holographic image.

Very often liquid disperse medium under study is inside a vessel. In this case one should take into account an additional optical system: liquid - wall of the cell (usually glass) - medium where hologram is
recorded (usually air). The method of taking into account this additional optical system is proposed. This same method is acceptable for underwater holo-camera.

The above techniques have been applied to experimental measurements of the refractive index of water drops in the air, latex spheres in various liquids, air bubbles in water. The accuracy of measurements was about 10% for the particles of 100 micrometers in diameter.]

Results of holographing of biological microparticles and living organisms are presented as well.

Collection of Ocean Optics Data from an NDBC Weather Platform - Technology and Design

by
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Ocean optics sensors and other supporting oceanographic instrumentation will be deployed on the Molassas Reef light tower in the Florida Keys, U.S. The tower is part of the National Data Buoy Center's Coastal Marine Automated Network for collection of marine weather data in coastal waters of the United States. The objectives of this endeavor are to: 1) develop an operational capability to collect continuous, *in situ* oceanographic data synoptically with marine weather data, 2) develop technologies for coastal environmental monitoring, and 3) collect *in situ* optics data in support of interpreting and understanding satellite derived ocean color data for coastal oceans. Data will be collected and processed through a special interface controller and transmitted through GOES hourly. The Molassas Reef tower is part of a larger study being conducted in the Florida Keys monitoring physical oceanography, benthic communities, water quality, and ocean optics. Simultaneous sampling of meteorological data and oceanographic data will provide an important component to understanding biological processes in the context of the chemistry and physics of the surrounding waters.

"An Integrated Approach Would Drive Environmental Management Quality Of The Albanian Coastal Zone".

- A Case Study from the Coastal Zone of ALBANIA, **by Fatos HOXHAJ**

Abstract

As the ***introduction***, actually, the albanian sea-marine area is very important one. This is connected with the dynamics of the sea water mass formation and circulation. It results that the Albanian rivers discharge in the Adriatic Sea a considerable pollution which is not treated. At the same time Levantine water masses, which penetrate into Adriatic through the Eastern part of Otranto Srait, transport much pollution in the direction of North. The main problem of the coastal area lies in the complex hydrogeomorphology and habitats including consequences by development degradation. It is without doubt that the Albanian coastal zone is especially vulnerable area of Albania.

Looking back on the ***major findings***, I see that since 1990, after the end of the communist regime, the Albanian Coastal Zone has faced complex challenges represented by high population, soaring land prices, and a changing economic structure. Advancing urbanization deteriorated coastal water quality and the land ecology. Problems about have been studied with the help of an integration of GIS and numerical simulations models. In this models the basic concept is one of state, expressed in terms of numbers, mass, or energy, of interaction and dynamics where the basic elements may be water, air, sediment, biological or chemical ones. A rule-based approach is substituted timely for an used numerical model because of the processes have been not only in the physical and chemical, but in the biological and socio-economic domain. Two issues have been identified that need to be addressed to determine the current & future state of the Albanian coastal management. One of the issues, the near - term one, that needs to be considered is the importance of coastal (in sea & in land) water-land protection. Growing populations, increased demand for agricultural production and new environmental demands on coast are placing an increased stress on existing coast state. The second issue, the long - term one, that needs to be considered is regulatory compliance.

It is pertinent to the ***findings discussion*** to notice that measures to overcome these challenges include participating in a possible plan installing an automatic coastal water state monitoring & measuring system and solving hydrodynamic problems together with eutrophication ones in the lakes caused by increases in nitrogen levels. Integrated environmental coastal management information and decision support systems, will be built around one rule-driven coupled numerical model which will allow us to know & forecast in-depth the coast dynamics and understand the challenges coast problems face in providing high-quality management.

In conclusion, while coastal management appears to be both a science and an art, in the new millennium, Albanians need to make sure that their researchers about continue to challenge themselves and their future on how best to provide a sustainable management to coast.

EUROCEAN '2000

Abstract

The Outflow of the River Llobregat Imaged Using Various Spaceborne Multisensor Data

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We have studied the ability of different spaceborne sensors of monitoring the outflow of the river Llobregat into the north-western Mediterranean Sea. The river Llobregat is 170 km long and rises in the south-eastern Pyrenees. The river mouth is located south-west of Barcelona, where the original marshy terrain of the Llobregat delta has meanwhile been transformed to urbanised and industrial zones. Especially the high industrialisation in that particular area causes a high load of pollution within the river outflow, thus causing a plume in the Mediterranean, which is well visible by eye.

We have analysed various remote sensing data from the north-western Mediterranean covering the river mouth and therefore allowing for studying the ability of different remote sensing sensors (working at different electro-magnetic frequencies) for monitoring the river outflow. The sensors comprise the synthetic aperture radar (SAR) and the Along-Track Scanning Radiometer (ATSR) aboard the Second European Remote Sensing Satellite (ERS-2), the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) on the OrbView-2 satellite, and the Advanced Very High Resolution Radiometer (AVHRR) aboard the NOAA satellites. By using this large data set we are able to show the influence of the river plume on the local ecosystem, namely the enhancement of surface-active material (visible in the SAR imagery), the variation of the local sea-surface temperature (SST, visible in the ATSR and AVHRR imagery), and the enhancement of chlorophyll-A (visible in the SeaWiFS imagery). For one particular day (5 July, 1998) data from all sensors are available, thus allowing for a direct intercomparison of the signatures and, therefore, for a better interpretation of the obtained results.

Prediction of geotechnical properties of marine sediments from their seismo-acoustic response

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For many years, it has been known that the seismo-acoustic properties of a marine sediment and its geotechnical/physical parameters, which are of direct interest to geotechnical engineers, are inter-dependent. It has been postulated that this should allow the extraction of geotechnical information from seismic data, eliminating the need to interpolate between sample points and thus reducing the risk of misinterpretation.

Though in the literature many correlations between acoustic and geotechnical properties of marine sediments have been published for the near-surface area, there is a lack of information for greater sediment depths. Depth dependent compaction and consolidation are known to modify the acoustic and physical properties of sediments. Hence the objective of this study is to fill this knowledge gap by investigating marine sediment samples for their acoustic (velocity, impedance) and physical properties (porosity, density, mean grain size) under increasing load, simulating greater burial depth conditions (up to ca. 100 m).

To demonstrate the possibilities and show up the limitations of predicting a marine sediment's geotechnical properties from acoustic impedance, a desktop study on a synthetic seafloor model has been performed. The model is based on two existing boreholes in Liverpool Bay and simulates gradually varying acoustic sediment properties between them, such as might be expected for the gradual transition from one sediment type into another. An algorithm applying previously published prediction equations is used to predict porosity, bulk density and mean grain size. In the near-surface layers, the prediction algorithms produce meaningful results. At greater sediment depths though, some of the predictions become spurious, notably those of mean grain size. This is caused by the denser packing of the sediment in comparison to the near-surface layers and illustrates the need for further studies.

Acoustic and geotechnical properties were measured and compared for a number of sediment cores. In addition, in order to simulate greater sediment depth conditions, subsamples from the cores were subjected to increasing loads in acoustically equipped consolidation cells (oedometers). Monitoring of the compaction process allowed determination of the physical properties of the sample (porosity, density) along with seismic velocities throughout the test, providing the means to study acoustic-geotechnical property interactions under increasing effective pressures.

From the core measurements and the oedometer results at low pressures (representing small burial depths), the general applicability of established relationships has been confirmed. Porosity and bulk density can generally be predicted from acoustic velocity and impedance with a high degree of confidence. The prediction of mean grain size is also possible, but with less accuracy.

As effective pressure increases though, the observed relationships deviate more and more from the established ones for the near-surface area. The presence of small amounts of gas further distorts the relationship to the effect that measured velocities even show a decrease with increasing effective pressure. The results indicate that a depth correction should be introduced into the published prediction equations in order to obtain reliable estimates of physical sediment properties in greater sediment depths. This depth correction depends on the amount of free gas contained in the sediment.

Given seismo-acoustic data (e.g. a Boomer section) inverted for seismic velocity or impedance, the modified inter-relationships could be used directly to predict geotechnical properties of marine sediments. They therefore great potential to the offshore engineering industry which is always seeking more rapid, cost-effective site investigation methods.

Fast Micromethod: A new method for routine assessment of DNA single-strand breaks in test organisms exposed to polluted waters

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A microplate assay (Fast Micromethod) was developed for the fast and sensitive assessment of DNA damage in cell and tissue samples. This assay detects the presence of DNA single-strand breaks and alkali-labile sites by monitoring the rate of DNA unwinding under alkaline conditions using a fluorescent dye, which preferentially binds to double-stranded DNA at high pH (>12.0). The new method offers major advantages, in comparison with other tests for detecting DNA single-strand breaks (Comet assay, FADU- and AFE technique); it requires only minimal amounts of material (30 ng of DNA per well, corresponding to ~3 x 10^3 cells or ~25 μg of tissue) and can be performed within 3 h or less. This assay can also be applied for frozen samples by introducing a homogenization step in liquid nitrogen in a suitable buffer together with an anti-freeze (dimethylsulfoxide).

To demonstrate the applicability and sensitivity of Fast Micromethod, the method was used for the assessment of DNA damage in marine sponges following exposure to different stressors. Polychlorinated biphenyls (PCBs) are ubiquitous industrial compounds found in almost every component of the marine ecosystem. Analysis of DNA using Fast Micromethod revealed an increased frequency of DNA strand breaks, following exposure of the marine sponge *Suberites domuncula* to the mono- and di-*ortho* nonplanar congeners PCB118 and PCB153. The DNA damage induced by PCB153 was 2-fold higher than that found with PCB118. Marine sponges are able to accumulate high amounts of cadmium. Exposure of *S. domuncula* to cadmium chloride resulted in a strong increase in the frequency of DNA single strand breaks, as assessed by Fast Micromethod. The maximum increase in DNA damage was observed after an incubation period of 12 h in the presence of 1 mg/L of cadmium chloride; thereafter, the extent of DNA damage decreased, most likely due to DNA repair. The sponge *S. domuncula* can also be used as a bioindicator for biomonitoring of cadmium load in the field. Five stations were selected in the Northern Adriatic Sea, which are characterized by a distinct gradient of pollution. The frequency of DNA strand breaks, determined by Fast Micromethod, roughly paralled the gradient of pollution (cadmium levels) at these sites. This work was supported by grants from the Commission of the European Communities (MAS3-CT97-0118 and EVK3-CT-1999-00005).

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Improved Treatment of Waste Brines

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Sea-salt production in all South-European countries is based on sea-water evaporation, which results in concentration of a significant number of components. When the solution density reaches 1.22 - 1.24 g/cm^3, crystallization of pure NaCl occurs. After the removal of NaCl, the highly concentrated waste brines, which can be used as a source for magnesium, sodium and potassium salts production, are deposited back into the sea. These processes cause an osmotic shock of the living organisms (ecosystems) in the sea.

The innovative wasteless technology developed under the EC Project INCO COPERNICUS IC15-CT96-0747 for improved treatment of waste brines from the sea-salt production has 2 aspects: i) a method allowing practically complete utilization of the major components (Na^+, Mg^{2+}, K^+, Cl^- and SO_4^{2-}) presents in the waste brine after sea-salt production through production of some inorganic salts as commercial products; and ii) a way of protecting the living organisms from the harmful effect of the deposited waste brines.

The main advantage of this method is the cycle of the processes that allows utilization of the waste brines for production of 6 useful products using only two cheap chemicals ($Ca(OH)_2$ and Na_2CO_3).

This method includes 4 stages: (i) elimination of SO_4^{2-} ions by precipitation as $CaSO_4.2H_2O$ (gypsum); (ii) precipitation of $Mg(OH)_2$ and formation of MgO; (iii) crystallization of NaCl and KCl from the remaining brines after stage ii; (iv) conversion of gypsum into fine $CaCO_3$.

A technological scheme for industrial production has been designed and a pilot-plant installation was constructed by the team. The industrial application of the technology developed was proved on this installation.

Management of dredged harbour sediments- Producing bricks made of harbour sediments in an industrial scale instead of constructing landfills

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Harbour authorities have to dredge harbour basins and fairways in order to maintain shipping. The ports of Bremen consist of two harbour groups. Both are dredging contaminated sediments. The authorities of both harbour groups had a different concept in managing the dredged material. For the case of Bremen-City the sediments are de-watered in drainage polders and then disposed in a separate landfill for contaminated harbour sediments. In contrast dredged material of the port of Bremerhaven was disposed into the North Sea. However, the material is contaminated with chemicals like tributhyltin in a range, that the authorities of Bremen and Lower Saxony decided to avoid marine disposal. At present a new concept to manage the disposal of dredged sediments is evolving. Both harbour groups attempt to integrate various sediment treatment techniques in order to ensure the effectiveness of a long term solution.

Consequently, a project was initiated, to produce bricks made of Bremen harbour sediments at an industrial scale in a brickwork. It was an important aim of the project, to investigate paths of contaminants into the environment during the process of the production as well as during different stages of use of the bricks.

The fact that, in contrast to natural clays, harbour sediments contain contaminants led to different adaptions in procedures and operational practise compared to traditional brick production. This technical adaptions were developed by Hanseatenstein Ziegelei GmbH (HZG) Brickworks in Hamburg.

In this project, results of the waste water and exhaust gas phase measured during the production process and the results of the brick´s constructional characterics as well their leaching behaviour are reported. According to the applied german standards the bricks can be classified as mansonary bricks.

The investigations focused on the possible release of contaminants from the product. The leaching program varied the pH-value of the solution between pH 4 up to 11 and the size of the leached bricks varied between crushed sandy fractions and cm-cubes. The pH was varied in order to investigate the chemical situation for different stages of usage during the life-cycle of bricks. In case of acid rain the pH can have initial values down to pH 4 which would be buffered by the brick and the connecting mortar, when running off a masonry. After the life-time of a building one has to consider the pH of seepage waters of a rubble dump, which can reach pH 11.

The grain size is important, because bricks will become part of recycling after the life time of a building mostly as crushed bricks with a high reactive surface for leaching. It can be assumed that after demolation from buildings an increasing immission has to be expected because of higher surfaces. The results of the leaching program showed that metals and metalloides are mobilized dependent on the investigated grain size and the pH-value. However, according to german standards for immission and according to constructional standards applied in Germany and compared with other product and soils it can be stated that producing bricks is an alternative concept for beneficial use of contaminated harbour sediments instead of landfills or marine disposal.

SESSION A

COSTAL ZONE MANAGEMENT

HOW CAN THE SCIENCE BECOME MORE 'VISIBLE' ?

Wednesday, 30 August 2000

EUROCEAN 2000 - THE EUROPEAN CONFERENCE ON MARINE SCIENCE AND OCEAN TECHNOLOGY

Session A: Wednesday 30th August

Role of Socio-Economics in Bridging the Gap Between Managers and Natural Scientists

Prof. R Kerry Turner, CSERGE

Coastal systems have been experiencing intense and sustained environmental pressure and stresses from a range of direct and indirect socio-economic driving forces. Given this context, integrated coastal management (ICM) has to be interpreted as efforts to manage the rate of environmental change, with the general aim of trying to achieve only relative stability over prescribed periods of time. In the light of the generic goal of sustainable development, management agencies should seek to maintain the resilience of systems, in terms of their ability to cope with stress and shock, and thereby enhance capacities that allow adaptation to both physical and social vulnerability. System resilience maintenance and/or enhancement is linked to the ecological concept of functional diversity and the social science analogue, functional value diversity. The latter concept combines ecosystem processes, composition and functions with outputs of goods and services, which can then be assigned monetary economic and/or other values.

A management strategy based on the sustainable utilisation of coastal resources should have at its core the objective of ecosystem integrity maintenance i.e. the maintenance of systems components, interactions among them ("functioning") and the resultant behaviour or dynamic of the system. The strategy must therefore adopt a relatively wide (spatially and temporally) perspective and examine and seek to manage larger-scale (landscape level) ecological processes, together with the relevant environmental (including climate change) and socio-economic driving forces. The juxtaposition of different spatial, functional and temporal scales that is inherent in the catchment-coastal ecosystems-seas/oceans continuum poses particularly difficult challenges for both science and resource management/governance.

Four overlapping procedural stages are outlined in order to provide an interdisciplinary decision support system for coastal resource assessment and management. The following steps in the appraisal process can be identified:

- Scoping and problem auditing
- Identification and selection of appropriate decision-making calculi-research methods, including modelling
- Data collection and monitoring via indicators
- Evaluation of project, policy or programme options.

Progress through the ICM cycle will also be conditioned by the degree to which "accountability" and "trust" issues are successfully tackled. No process of ICM can produce legitimate answers and effective solutions to the challenges posed with meaningful public (i.e. a full range of interest holders) inclusion in the procedures. The public need to be incorporated in a proactive, inclusionary and conflict minimising fashion. Different types of inclusionary management processes based around social discourse are currently under discussion or test in different countries.

SESSION B

GLOBEC
RELATED STUDIES IN THE NORTHA ATLANTIC

A PERSPECTIVE FOR EUROPEAN / NORTH AMERICAN RESEARCH COOPERATION

Wednesday, 30 August 2000

Keynote:

Basin-wide studies of zooplankton through observation and modeling: Synthesis of North Atlantic GLOBEC data sets.

Peter H. Wiebe
Woods Hole Oceanographic Institution

A number of Global Ocean Ecosystem Dynamics Programs (GLOBEC) have been underway in the North Atlantic for the past five years with a primary goal to understand the dynamics of key zooplankton species in terms of their coupling to the physical and biological environment and their response to climate change. These include the U.S. GLOBEC Georges Bank Study, the TransAtlantic Study of Calanus (TASC), Mare Cognitum, and Canadian GLOBEC. These programs have completed major field work, data have been collected at the various study sites, and comprehensive databases are being assembled. These programs are now entering synthesis phases and the issue is how to proceed. A four-step program is proposed to work towards a new level of understanding of the dynamics of plankton, the impacts of environmental perturbations, and their linkages to fish stocks. The steps are: 1) compile information on features of the key species' biology, behavior, and physiology across their range; 2) apply new technologies to document the spatial and temporal patterns of the key species throughout their entire range; 3) develop basin-scale conceptual and analytical models to understand and predict spatial/temporal structuring of populations; and 4) develop indices of their stock structure to convey their status. This effort can best be accomplished through the development of collaborative programs involving physicists, biologists, and modelers from across the North Atlantic. The programs would assemble the data and build and test coupled physical/biological models that can effectively characterize the spatial and temporal variation of broadly-distributed and dominant members of the North Atlantic zooplankton community. The initial focus would be on Calanus finmarchicus, which would pave the way for the development of models for other species and for the ecosystem as a whole.

Provocateur:

A perspective on international cooperation in science: is the system broken?

Mark Ohman

Scripps Institution of Oceanography, La Jolla, USA

Speaker No 1

The legacy from TASC: Future scientific avenues and implications

Kurt Tande

University of Tromsø.

The TASC project provided us with an enormous amount of new information about the population dynamics of *Calanus* and its relationship with its physical environment, prey and predators. The TASC project demonstrated that we are starting to understand how climate variability and changing ocean conditions affect plankton stocks, particularly *Calanus*. Some data showed that time series of stock variation have several more patterns across the full range of the North Atlantic, patterns for which we need causal understanding. The very high frequency simultaneous data on meteorology, ocean physics, primary production, and zooplankton populations obtained by TASC projects show the extraordinary power of continuous station occupation for revealing

oceanic ecology. At stations such as this, well out in major ocean gyres, population variability is dominated by biological processes, not transport of patches of plankton. The strength of TASC was that it enabled the scientists to address the interaction between physical and biological phenomena by an interactive use of several types of models covering a wide temporal and spatial range. Three examples are particularly elusive i) the variability in *Calanus* biomass over time and space, ii) the controlling role of predation in terms of *mortality risk* as opposed to *mortality rate*, and iii) population genetics, which is about to identify sub-population structures of *Calanus* over its distribution range.

TASC demonstrated that it is within the reach of our time to address successfully the ecology of the biggest ecosystem on the planet. A major challenge over the next few years is to bring this knowledge to bear on questions about marine ecosystem and fisheries assessment and management, a process, which already is well on its way. Equally important is to actively apply the experiences from TASC, when launching a North American-European project within the scope of GLOBEC International. The talk will try to identify some of the major scientific future avenues identified by TASC, and provide an outline of the methodology and technology needed if these are being set on the agenda.

Speaker No 2

A Canadian perspective

Ken Drinkwater

Ocean Sciences Division, Bedford Institute of Oceanography, Canada

SESSION C

SHIP BUILDING AND MARINE TRANSPORT IN THE ARCTIC

Wednesday, 30 August 2000

ABSTRACT

EurOCEAN 2000
Hamburg, Germany, 29 August - 2 September

Session: **Shipbuilding and marine transport in the Arctic**

Analysis of Ship Passage in Ice Covered Waters

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The ice cover influences ship navigation in basically two ways. The ice loads created in breaking the ice during the passage may hazard the ship structures and cause damage and ultimately also ship loss. The ice cover also induces additional resistance which may exceed the ship propulsion and thus ship may be stopped and if the ship cannot move forward or back, the ship gets stuck in ice and requires icebreaker assistance. The design of ice going ships or marine transportation systems in the Arctic require that the ship safety i.e. ice loads and the ship trafficability i.e. transit times and need for icebreaker assistance must be related to ice conditions on the planned operational area. The present paper tackles the question of describing the ice cover in a way suitable for ship studies. More specifically, the parameterisation of ice cover suitable to determine the ice loads on ship hull and the resulting damage probabilities are investigated as well as the ice cover parameterisation suitable for ship transit studies. The approach in new as only a few studies have concentrated on the practicality of making the parameterisation together with analysing the application aspect.

The ice cover parameterisation must cover the whole area under investigation, it must be comprehensive in that it describes all relevant aspects and it must be practical to observe these parameters by remote sensing methods. This possible definition of parametres was investigated in the EU funded ICE STATE project. Here the main conclusions of the parameterisation are described. Especially the analysis of satellite SAR and other images is described as a new method to obtain the ridging parametres from the images is emerging. The parameterisation is then applied to determine the ice loading i.e. the maximum loads given the time period and the sea area. The routine to determine the loads and assess the probability of damage is described. This routine is based in modelling the ice loading in statistical terms. The method is semi-empirical because it was developed based on merchant vessels navigating in the Baltic. The parameterisation as well as the damage probability determination is then applied to segments of the Northern Sea Route (NSR). The availability of data is analysed first. Damage probabilities for different route segments and months are then determined. The analysis is done for a SA 15 type multi purpose vessel from which there exists damage data.

The second part of the paper analyses the ship transit through ice fields. The approach is to create by Monte Carlo method the ice field ship sails through and then simulate the ship passage by a routine developed for this purpose. The final aim here is to relate the statistical parameters describing the ice conditions with the statistics of transit time and also in more detail with the prabability to get stuck, number of rams needed for the passage etc. Again here the ice conditions along the NSR form the basic example of the routine.

Year around traffic in freezing inland waters

Reko-Antti Suojanen, FIN

Abstract

Improving the effectiveness of inland waterways in freezing areas is a matter of finding suitable technical solutions to operate ships at wintertime. Paper describes a determined study to improve vessel and infrastructure concept to allow profitable operating year-around at Finnish inland waterways. The lake area of Saimaa will be closed during the wintertime as the channel leading the way to Baltic is closed. Narrow and rather shallow drafted channels create exceptionally thick icing during the winter when ships are breaking the channel from time to time.

Practise has shown the difficulty of traditional inland vessels to manage well in frozen channel. The new type Double Acting Ship concepts were tested along the traditional ones in Kvaerner Masa-Yards Arctic Technology Centre model basin. The new type DAS- vessels proved to manage well up to 2.5 metres brash ice. These vessels had remarkably better manoeuvring and speed capabilities than traditional ones allowing them to operate in narrow channels in heavy ice conditions.

Series of model tests and simulation studies of the whole European and overseas transport system were done in operating in two channel alternatives. These studies proved that water transport system would be more economical than on-land transport even at wintertime. The concept of new type DAS-vessels were designed and the required fleet and transportation chain was determined. Logistic study proved the practicability of such system to be remarkably economic than the current system where winter time transport is organised by trucks and train to ship transportation system.

Abstract: EurOCEAN 2000

SATELLITE ICE MONITORING FOR NAVIGATION OF AN ICE-GOING TANKER IN THE KARA SEA

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The study of sea ice by satellite radar images is part of the project Arctic Demonstration and Exploratory Voyage – ARCDEV (EU contract WA-97-SC.2192) which aimed to investigate the conditions for navigating a tanker vessel from Europe through the Kara Sea to the northwestern Siberian gas and oil fields during winter conditions in April-May 1998.

In order to perform such ship navigation operations, an escorting icebreaker support as well as detailed information on the ice conditions is required. It is demonstrated how satellite based microwave radar technology practically can support ice navigation operations to improve the safety and efficiency of the navigation. The ARCDEV convoy was supported by near real-time ice information derived from both ERS-2 and RADARSAT ScanSAR Synthetic Aperture Radar (SAR) information during the most difficult ice conditions for 30 years. Prior to and during the voyage a total of 28 satellite SAR images were acquired, analysed and transferred to the convoy prior to its arrival to the area covered in the image. Detailed analysis and ice type classification of the SAR images were performed. The results of the analysis were used both in the strategic and the tactical planning of the convoy navigation operations. In general, the convoy speed increased by a factor of at least two in the drift ice, and the use of SAR data was even more efficient for the preparation of a sailing channel through the fast ice in the Ob estuary.

Suggested sessions:

- Marine and coastal information from space
- Ship building and marine transport in the Arctic

p.m. SESSION A

POLLUTANTS, NUTRIENTS AND HARMFUL ALGAE IN THE SEA

ORIGIN ECONOMIC IMPLICATIONS AND EUROPEAN POLICY

Wednesday, 30 August 2000

Harmful Algal Blooms: causes, consequences for the economy, human health and the European Policy

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Abstract

Nuisance blooms of marine microalgae are recurring events in most marine open and coastal waters. These harmful algal blooms (HABs) are either toxic or have other deteriorating effects, such as causing oxygen deficiency in the bottom waters killing the bottom fauna. In either case, they may harm marine ecosystems and resources such as human health, tourism, fishery, and aquaculture some of the HABs events in Europe have amounted to losses of up to 10 million US dollars). The toxin produced by some of these algae, which even at low cell densities, can contaminate seafood, causes sickness and death in humans eating the seafood, or sickness and death in the shellfish and finfish.

HABs are an ancient phenomenon; there is a scientific record of such events from Venice in 1729, and several records from early European settlers in North America. In addition to the increased production of algae, an increasing number of exceptional phytoplankton blooms of dinoflagellates, flagellates and cyanobacteria (blue green algae), often toxic ones, have been reported during the last 15-20 years in many areas over the world. The causes seem to be several, but most of them seem to be connected to the human impact on the environment (eutrophication, overfishing, etc).

Thanks to the establishment of more effective monitoring programs the avoidance of human deaths and large-scale outbreaks of sickness was avoided in Europe for the last years. However, the threat remains, since toxic algal species found along most of European marine waters regularly cause acute sickness in humans and kill prime grade fish in aquaculture (such as salmon). There is a need to improve our research knowledge on the causes behind HABs in Europe if we are going to decrease and/or mitigate their effect on the marine ecosystems.

The effect of the establishment of a primary Wastewater treatment plant in the heavy metal distribution in the Saronikos Gulf, Greece

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Saronicos gulf, in the vicinity of Athens, is considered to be among the most polluted Greek gulfs. Its area is about 2600 km^2 and its maximum depth 450 m. About 40% of the country's industries are located at the coast of Attiki, along the northern part of the Gulf, and a large amount of industrial effluents are discharged into the sea. Navigation and shipping related activities is another source of pollution as Piraeus Harbor is one of the largest in Mediterranean. The adequate renewal of water masses, mainly in the eastern part of the gulf, due to winds, currents and the general water circulation, have prevented the appearance of significant ecological degradation. On the contrary, at the west part of the gulf (which is deeper and less affected by polluting activities) the renewal of water is very slow. Some of the main industries (oil refineries, shipyards, chemical plants, food, metal, cement industries etc.) are located within the Elefsis Bay, which lies between the coast of Attiki and Salamis Island, Intermittently anoxic conditions are developed every summer in this bay in depth >15m, due to the intense stratification of the water column.

Our laboratory works on the study of the behaviour and distribution of trace metals (Cu, Pb, Zn, Ni, and Mn) in Saronikos Gulf and the Elefsis Bay since 1986.

Until 1995 the urban effluents of Athens (more than 600,000 m^3/day) were discharged, untreated, in the shallow waters of Keratsini bay, through the Central Sewage Outfall. During 1995 has started the work of the Wastewater Treatment Plant of Athens in Psitalia island (Psitalia is an historical small island between Salamis and the coast of Attiki). The Plant was funded by the Coherence Fund of the E.U, as the European Environmental Policy suggests that all the urban effluents (and especially those of the big cities) must be treated and Athens was the only Capital City of E.U. without such a Plant.

The plant, till now, includes only primary treatment of the effluents in deposition tanks, for the removal of the suspended solids and part of the organic load. The treated effluents are discharged near bottom through two pipes in a distance of about 1,9 km from the coast and in a depth of 60m. Measurements of the quality of effluents of the plant have revealed that the system removes about 60% of the suspended solids and 34% of the organic matter. The average daily flow is $638*10^3$ m^3/d and the average hourly flow 29,800m^3/h. The maximum total polluting load (combination of flow and concentration) is on February and the minimum on August. A secondary treatment plant is now under construction, funded also by E.U. for the reduction of the quantity of nutrients and metals discharging to Saronikos gulf.

The change of the site of disposal and the reduction of the polluting load of urban effluents, in combination with various changes in the coastal human activities, have affected the concentrations, distributions and behaviour of metals in both seawater and sediments.

As it was expected, the concentrations of the dissolved and particulate metals were decreased near the exit of the old pipe while the maximum values were shifted towards the exit of the new pipe. The decrease of the metals concentration was lower than expected in the water column and sometimes the seasonal variations of the values exceeds the mean reduction due to the treatment of effluents. Especially for lead the results are ambiguous. Meanwhile, in West Saronicos, the dissolved oxygen diminishes in the near bottom layer and the metals concentrations increase, especially in the case of manganese, probably due to the accumulation of organic matter in areas with low renewal rate. This phenomenon was not predicted by the Environmental Impact Assessment of the Plant and it is dangerous for the ecosystems of the gulf.

The concentration of metals in the sediments of Keratsini bay remains high as the polluted sediments that were settled there are decomposed with a rather slow rate, without any management being a secondary pollution source for the Gulf.

The results of our research describe the present situation as it concerns the distributions of metals in the gulf and compare it with the relevant distributions for the period before 1995.We try to find out the positive and negative consequences of the establishment of the wastewater treatment plant to the marine environment and to propose some improvements in the management of both the effluents and the marine environment .

Conception of guaranteed risk: a tool for pollutant risk analysis in margin seas

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We discuss the problem as chose probabilistic criteria to find an optimal strategy for management and risk analysis of sea pollutants. The traditional in marine studies criteria are usually based on least squares estimations from the data being or collecting in situ within marine regions, results of numerical modeling and additional satellite observations. Our goal is to demonstrate as the best strategy can be selected through various least squares criteria (risk functions).
Our conception bases on so-called probabilistic first-passage boundary approach developed in Ivanov, Margolina et al. [1999] and takes account the possible stochastic deviations of least squares estimations from the mean (optimal) estimation. We will demonstrate that minimum of least squares estimation in comparing to other similar estimations is not sufficient condition to use its for the choice of the optimal strategy or the best numerical model to predict.
We illustrate the conception of guaranteed risk through three practical applications.
The first application is the identification of possible sources of radionuclide pollution of the Russian Western Arctic sector: the Barents, White and Kara Seas (Danilov, Ivanov et al. [1996, 2000]). This problem is unsuccessfully decided during long time. Applying of the conception allows synonymously separating contributions of different sources and pointing out to reasons of such pollution.
The choice of optimal ways to transport oil by tankers through European-Asia corridor of the Black Sea is the second application (Ivanov, Margolina et al. [1999]) . Satellite monitoring plays an important role to estimate pollution. However we have found that there are conditions when satellite information decrease pollution and distorts really observing picture.
The third application is estimating the Black Sea chlorophyll used often in ecological goals as an indicator of the global ecological well-being of this marine region (Ivanov, Kirwan, et al, 2000). Unfortunately our results demonstrate super unreliability of such an indicator by the reason of bad quality and limited quantitative of being chlorophyll observations. We have find that applying least square estimations does not allow to synonymously detect modern tendencies in the global pollution of the Black Sea.

Modeling the Response of a Semi Enclosed Marine Ecosystem (Pagasitikos Gulf) to Enrichment by Run off Fertilizers

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Pagasitikos Gulf is a semi-enclosed bay at the western part of Aegean Sea north of the island of Evia. The mean depth is 69m while the maximum depth is 108m at the east part of the bay characterizing a shallow water body. The total surface area is 520 km^2, and the total volume 36 km^3. At the south it is connected to the Aegean Sea through the narrow channel of Trikeri. The ecosystem of the gulf is significantly influenced by the industrial, urban and agricultural activities concentrated mainly at the North part where the city of Volos is situated. Although in the surrounding area there are no major rivers, significant quantities of polluted waters enter the system on a permanent or periodic basis. It has been mentioned that nutrients from the drainage of lake Karla and nearby farmland where significant quantities of fertilizers are used, enter the system at the North part of the gulf. In the recent past these nutrient inflows have caused extensive algal blooms and subsequent environmental problems in the fisheries, tourism and generally in the local economy.

The ecosystem of Pagasitikos has been extensively studied since 1975 yielding a valuable data set on a number of physicochemical (temperature, salinity, nutrients) and biological parameters (chlorophyll-a, phytoplankton, zooplankton). Recently field data from the Xirias outflow area has been collected in an attempt to study the inputs, distribution and to understand the effect of nutrients enrichment in the system dynamics.

A standard generic complex model has been developed to describe the ecosystem dynamics of Pagasitikos and has been validated with *in situ* data. The model uses a functional group approach to describe the ecosystem where by biota are grouped together according to their trophic level. The dynamics of the biological functional growth are described by both physiological and population processes. The biological variables in the model are phytoplankton, functional groups related to the microbial loop, zooplankton and benthic fauna. The dynamics of nutrients and oxygen are coupled to biologically driven carbon dynamics.

In this study the response of the gulf to enrichment caused by run off fertilizers and the development and evolution of harmful algal blooms are investigated through ecosystem modeling. In the standard model an additional module has been developed in order to assimilate external nutrient fluxes and to incorporate them into the ecosystem dynamics.

From the results of the standard model it is evident that the system is having two modes of operation. The winter one when the water column is homogenized and nutrients reach the photic zone, characterized by the growth of large phytoplankton and the development of a classical food web with a significant part of energy passing into big heterotrophs (mesozooplankton). The summer mode is characterized by low nutrient concentrations at the photic layer driving the system into a microbial food web with dominance of small phytoplankton and with a large amount of the energy recycling between phytoplankton and bacteria.

The nutrient forced model run for 10 years in order to reach quasi steady state, assimilates successfully the external river inputs producing nutrient and chlorophyll-a concentrations, which are in good agreement with the *in situ* data. The changes due to nutrient inputs in the ecosystem functioning with emphasis in the material cycling, the dominant limiting factors and modes of operation as well as its sensitivity to various parameters and to physical forcing are investigated and discussed. Considering the good behavior of the model, it can be usefully applied as a prediction tool to the particular area when forced with realistic atmospheric and nutrient inputs data sets, supporting essential management issues.

Eurocean 2000 - August/September 2000 Hamburg
Oral Presentation

A model study of the nutrient balance of the North West European shelf

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The water mass exchange between the Atlantic Ocean and the NW European continental shelf has important ramifications for all aspects of coast and coastal sea management. Accurate prediction of ocean/shelf exchange will lead to (among other things) improved shelf sea fisheries management and a better understanding of the flux between ocean and shelf of carbon and nutrients.

A 3D ocean / shelf ecosystem model covering the area 20W-13E, 40-65N has been developed to investigate the processes affecting primary production and nutrient cycling on the NW European shelf. The European Regional Seas Ecosystem Model (ERSEM) has been embedded within a 3-dimensional prognostic baroclinic hydrodynamical model with coupling at the hydrodynamic timestep (15 minutes). Realistic ocean boundary currents and hydrography is provided by the UK Met. Office Forecast Ocean Atmosphere Model (FOAM). Ocean nutrient fluxes are deduced from observations. The ocean extent of the model domain, coupled with the FOAM forcing provides a realistic cross-shelf flux of nutrients to the shelf seas.

The model is run for year-long simulations and validated against observations from the UK Land Ocean Interaction Study (LOIS). Additional scenario runs of the model examine the impact of reduced nutrient discharge from rivers and the climate of the late 21st century. These studies show how the balance of nutrient cycling in the shelf seas may be affected by likely future changes in legislation and climate.

For presentation in:
Pollutants, nutrients and harmful algae in the sea: origin, economic implications and European policy.

Abstract presented for ORAL presentation

FAECAL POLLUTION INDICATORS AS PREDICTORS OF PATHOGENS IN MARINE WATERS

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Health based monitoring of coastal marine waters, governed in the European Union by the 1976 Bathing Water Directive, has been based on arbitrary assumptions both as to the microorganisms selected to act as indicators and as to the maximum indicator concentrations that exclude the possibility of illness. The proposed new Bathing Water Directive (1994) introduces microbiological standards using the outcomes of microbiological studies. It is universally agreed that pathogenic microorganisms, entering the marine environment through municipal wastewater discharges, land wash-off and bird droppings, cause health complaints to the bathers. Yet very little, if any, attention has been given to the value of indicators as predictors of the presence of pathogens in recreational marine environments.

This study was aimed at investigating the indicator-pathogen relationship in marine coastal waters. This was achieved by determining the value of the three most commonly used indicator microorganisms - total coliforms, faecal coliforms and faecal streptococci - as predictors of the presence of three pathogens - Salmonella spp. Staphylococcus aureus and Candida albicans. Data were obtained from 303 sea water samples collected from stations of high and moderate pollution and from unpolluted sites. The detection of salmonellae was qualitative (per 1 lt), of the other microorganisms quantitative (per 100ml). Logistic regression analyses of the data demonstrated that total coliforms were the best predictors of the presence of salmonellae in areas of moderate pollution, faecal streptococci in areas of high pollution. In the regression analyses for Staph. aureus the most significant predictor in areas of moderate pollution was total coliforms. For C.albicans the best predictor in moderate pollution sites were faecal coliforms, in highly polluted sites faecal streptococci.

It is concluded that in areas of moderate sewage pollution, in seas of climatic and oceanographic conditions similar to those of Northeastern Mediterranean, enumeration of total coliforms only is sufficient for predicting the presence of both Salmonella and Staph.aureus. Faecal coliforms are the best predictors of the numbers of C.albicans.

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The Quality Status of the Northeastern Atlantic and Adjacent Seas
- OSPAR QSR 2000 -

(submission to SC 1 "Pollution and European Policy)

A first comprehensive assessment of the environmental status of the Northeastern and North Atlantic including their shelf seas has been produced within the framework of the OSPAR Convention. To achieve this twelve nations and the European Union (EU) have jointly co-operated in a six year activity. The report is now published as the OSPAR Quality Status Report 2000 (QSR 2000).

This QSR is undertaken to assess the marine environment with respect to human interferences, to evaluate the effectiveness of protective measures carried out in OSPAR's contracting parties or other EU member states, and to identify gaps in knowledge. The QSR presents detailed information as well as recommendations for future priority action.

The QSR focuses on information collected and assessed under the Joint Assessment and Monitoring Programme of OSPAR (JAMP). These information include results from internationally harmonised monitoring programmes, from other national sources and from international organisations such as the ICES..

Concern is in many regions of the OSPAR area about the environmental consequences of fisheries. Numerous fish stocks are outside safe biological limits; discard of by-catch modifies prey – predator relationships, natural benthic species composition and habitats are affected by bottom trawling. Existing regulatory measures of fisheries management installed to reveal a sustainable use of living resources have not been sufficient.

Contamination with hazardous chemicals is still a problem in parts of the OSPAR maritime area although improvements for classic contaminants such as heavy metals, some persistent organic pollutants (e.g. PCBs, several pesticides) and oil have been achieved. However, in some locations such as estuaries, and for some contaminants concentrations still exceed background concentrations and even ecotoxicological reference values. Problems exist with TBT-containing ships paints, substances acting as endocrine disrupters, and chemicals released from offshore activities.

Eutrophication caused by enhanced anthropogenic nutrient releases has generally decreased due to remarkable reductions in phosphate inputs by improvements in waste water treatment. However, there were no improvements in reducing nitrogen inputs because N-compounds originate largely from diffuse sources such as agriculture and fuel combustion. Therefore, N-type eutrophication is a persistent problem in many coastal areas.

Analysis of current and future policy instruments for dredged material on the national, European and international level

Abstract: The issue of dredged material disposal faces a number of challenges which can be devided in two categories. The first category is the prediction of the expected quality of the dredged material, which is influenced mainly by changing socio-economic activities in the Rhine catchment. The second category is the changing regulations for dredged material. In addition these regulations, although implemented at the local level, increasingly become dominated by regulations at the European and international level. The analyses of current national, European and international regulations, relevant for the disposal of dredged material, show that there exist no integrated assessment and the costs of disposal are being charged to the water or port authorities. This is in conflict with the "polluter pays" principle. Besides the national targets are unclear and international harmonisation is lacking. Furthermore a toxicity based evaluation as well as consideration of bioavailability and mixture effects are missing.
But some important changes for evaluation of the disposal of harbour dredgings have been announced and are expected to be implemented in 2002. The proposed framework will include an integrated evaluation based on chemical quality criteria, bioassays, and an assessment of several other environmental parameters. Prior to this feasibility studies are being executed for the design of this integrated assessment scheme.

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Identification of novel contaminants within the framework of marine environmental monitoring (target and non-target screening)

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http://www.chemie.uni-hamburg.de/oc/hfuss/

Abstract

For the assessment of the overall risk that aquatic organisms are exposed to by anthropogenic chemicals detailed information on the type and amount of substances present in the respective ecosystem is required. The wide range of industrially produced organic substances renders environmental monitoring for organic contaminants very difficult and expensive. Beyond the investigation of target substances listed by the OSPARCOM and HELCOM commissions (mainly organochlorine compounds like PCBs, HCH), the precautionary principle requires a comprehensive description of environmental pollution. This involves the identification of novel contaminants which have not been analyzed so far (non-target screening), in order to identify environmental hazards as early as possible. In optimizing and implementing such monitoring, not only analytical problems have to be solved but organizational and economic aspects must be considered as well. Results of different target and non-target screening approaches are presented and demonstrate the occurrence of a large number of xenobiotic compounds in the marine environment, among them industrial chemicals, pesticides, pharmaceuticals, tensides and musk fragrances.

p.m. SESSION B

THE IMPORTANCE OF THE INDUSTRY

MARINE RESEARCH LINK IN THE MARINE SECTOR

Wednesday, 30 August 2000

What is the industry role in marine research?

The European oceanographic and marine information industry currently comprises a large number of Small and Medium-sized Enterprises (SMEs) and a very limited number of larger organisations. It is estimated that the total number of European companies whose primary business is within this sector is between 500 and 600. Most of the SMEs work in one specialised aspect of the marine information business and many are very small organisations.

The worldwide commercial marine information business is estimated to have a current annual turnover estimated at €4 to €4.5 billion per annum. This is expected to approximately double in size in the next twenty years, with the largest growth sector expected to be monitoring, forecasting and information systems (ref: Report of the UK Foresight Task Force on Managing Marine Resources and the Marine Environment - 1999). However, this significant market is predominantly within the service sector and generated by a very small number of large survey companies. The global market for oceanographic instruments and sensors, however, is estimated at approximately €100 - 120 million, with the European market approximately €30 - 40 million. Furthermore, this market is very fragmented, made up of many much smaller markets for specific sensor or instrument types. But, the much larger survey market, and indeed the "marine research" market, is totally reliant on purchasing or renting relatively small numbers of these instruments. The importance of the manufacturing sector is therefore far greater than the market size suggests.

This Keynote Speech will draw on the input, conclusions and recommendations of the Electronic Conference: "How can marine research & industry work together in the future to realise sustainable development". The aim of this Paper is to initiate discussion, both within the meeting and into the future, by highlighting issues important to the marine industry in its relationship with the marine research sector. These will include:

1. Development and commercialisation of instrumentation, sensors and other products and services
    - should researchers do this in-house or leave it to the experts?

2. Technology transfer / Collaboration between industry and scientists
    - is the concept of risk understood by all participants?

3. Funding of SMEs
    - are existing mechanisms appropriate? Do our competitors do it better?

4. Intellectual Property Rights
    - who should own them? Is this actually the issue?

5. Competition between public and private sector for commercial contracts
    - is there a level playing field?

6. The Concept of the "End - User" in FP5

- what is an "end-user"? Is he/she like beauty, i.e. "in the eye of the beholder"?

Cliff Funnell

Advice for a Happy Marriage

from: Saskia E. Werners, adviser integrated coastal management
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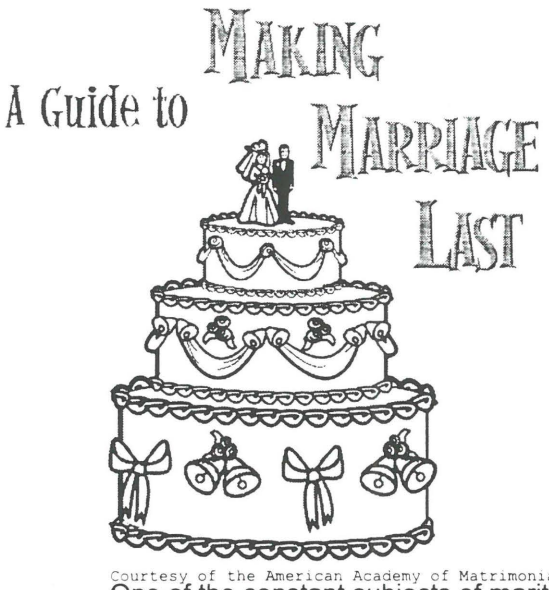
It cannot be emphasised enough: It takes time and energy to strengthen a marriage. But it can be done. If you come to our afternoon-session B on the 30th of August you've taken the first step toward making the marriage between marine science and industry work. It shows that you are willing to devote some time and energy to the identification of problems and opportunities in the relation between marine science and industry for the sustainable use of the marine environment.



Courtesy of the American Academy of Matrimonial

Why Marriages Fail

Not all marriages fail for the same reason. The most frequent causes are however:

- Poor communication
- Financial problems
- Lack of commitment & Infidelity
- Failed expectations or unmet needs

Communication

Poor communication often lies at the base of marital problems. Problems arise from the different ways partners communicate. For example, a scientist who complains about a terrible day at work probably wants encouragement, not a discussion about dropping the project altogether. Alternatively, an industrialist who asks where to go next probably wants an answer, not a vague response that "more research is needed."

Financial Problems

One of the constant subjects of marital disagreement is money. The key is to set short- and long-term goals together and to make sure both partners have some money to spend however they like.

Lack of Commitment, Infidelity & Failed Expectations

To keep your marriage healthy you have to commit time and energy to it. Infidelity may occur when the expectations and priorities of a partner are not met or shift. Needless to say that infidelity puts a marriage under enormous strain. Always discuss your needs and each other's welfare openly.

The Journey to Happiness: Improving Your Relationship

It has been said that most of life's happiness emanates from one's marriage. I hope that the advice provided here helps you improve the relationship between marine science and industry.

- Don't expect to get more from your partner than you give of yourself. Respect intellectual property rights and share information at an early stage to enhance the chances of collaboration.
- Learn to listen. Science and industry have to improve their communication.
- Learn to express you worries, but argue respectfully. Scientists have to take responsibility in signalling non-sustainable use even if this may seem to conflict with the interests of industry. Don't forget that both research & industry can be largely stimulated by public & political concern
- Don't try to change your partner; try to discover his or her strongest points and encourage these.
- Keep an open eye for your environment and the way it changes. Understanding of the marine system as a whole is essential to evaluate non-sustainable use and focus the contribution of science and industry to sustainable development.
- Set clear goals that can be evaluated. Meaningful indicators for sustainable development have to be target specific, predictable and reflect the characteristics of your environment.
- Keep your relation exciting. Give you & your partner the opportunity to explore new challenges.

Please treat this sheet as merely an introduction to the process of working on a marriage. In addition to the tips contained here, your library or local bookstore contains a wealth of information, as does the Internet. Couples should also not be afraid to seek professional help from a trained consultant.

Why science and technology and industry do not find together in the seas

RTD/D.1.3/KGB/iw D(2000) 441
Summary for the provocative statement at "EurOcean 2000"
29 August — 2 September 2000, Hamburg
Seesion B "The importance of the industry — research link in the marine sector
30 August, 14:30-18:30

Listening to the economical or political statements of the marine industry or reading about it, I get the picture of a struggling industry offering services and products nobody needs. By using some modern political keywords, asking for scientific and financial support the industry wants to rise awareness. But an industry is no industry, if it asks for public funds to grow since a long time, as the marine industry in Europe does. When services and products are not needed, than there is something wrong with the industry managers, at least with their sales managers.

On the other hand is it clear, that - compared to the knowledge we have about the land masses and their ecosystems - a lot is waiting to be done in the seas, which cover most of the planet. The problem is a political one: The ocean is seen as a distant planet not really belonging to the earth. The oceans are not in the public awareness like rain forests, rivers, lakes, woods, tundras, hills, mountains and alike. So turn the public with their face to the shore (leave out politicians, they look only after the big money and the next TV camera).

As a communication professional I see a communication problem on both sides: on the scientists side as well as on the industry managers side. I personally do not have problems to get the latest scientific findings even before they are published. I just pick up the phone or send some e-mails. Neither the marine science community nor the marine technology community is so big that it is not possible to go through to the important people within some hours calling and writing. It is a question of how communicative and creative in mind people are.

Scientists seem to get not tired in describing me complicated findings over and over until I understand. Managers of marine technology companies often do not even answer my e-mails or faxes, and always tell me, that they cannot tell me something, because it is highly secret. Some time later an American company sends me a press release about similar innovation and I do the story with them.

I also do not see the need for a special technology transfer organisation. We have a lot of them and if marine technology or science is done in their area, they are happy to transfer it - but no one calls!

When I look around in other science-based, innovative industries (chemistry, biotechnology, information technology), I see, that these industries have a lot of different "special interest publications", even on organisational web sites (often sponsored by one or more industrial opinion leaders). These are the market places, where scientists and engineers together exchange their latest innovations and results and discuss standards, find together for mergers or joint ventures and discuss strategies.

In the marine field there are on one side the science magazines, where the scientists publish their "Summary - Introduction - Method - Results - Discussion"-papers and on the other side the technical magazines, where the engineers demonstrate their mathematical skills and show a lot of fantasy to create new technical words. There seems to be no common platform for both of those who are active in the same wet medium. Especially none to talk about the business.

Neubert

SESSION A

FISHERIES AND AQUACULTURE RESEARCH :

THE CONTRIBUTION OF OCEAN SCIENCE AND MARINE TECHNOLOGY

Friday, 1 September 2000

Title

A New Muscle Biopsy Technique for Sex and Sexual Maturity Determination in Large Pelagic Fishes

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Presentation type preferred

Oral Presentation

Session

S.C. **Fisheries and Aquaculture Research**

Keywords

Large Pelagic Fish - Muscle Biopsy - Maturity Stage - Sex Determination - Steroid hormones, Vitellogenin, Fisheries Management

Abstract

In many fisheries fish are either landed already gutted or the value of the flesh prohibits ventral opening and the determination of sex and sexual maturation. The objective of the present studies was to provide new molecular techniques to make this possible and thus assist in stock assessment and management.

Through the use of new biotechnological techniques it is now possible to use molecular markers such as sex hormones and vitellogenin to determine sex and gonadal maturation in muscle samples from teleost fish. The present study concerns the development of a muscle biopsy punch together with the respective ELISA tests which can be used either in the field or at the market to obtain muscle biopsy samples from live or dead Bluefin Tuna or Swordfish. These samples can then be assayed using standard ELISA methods developed in our laboratory for sex hormones and vitellogenin. Experiments in the laboratory have to date shown that as little as 150 mg of tissue are required for these determinations and the self-activating punch system can be used as a "stand alone" hand-held device and is being considerer for sampling from live fish for aquaculture as well. In previous fishing seasons both plasma and muscle samples have been taken in Bluefin Tuna together with gonadal samples. Using this approach molecular techniques have been calibrated with histological data and are not set for market testing. Similar developments using field trials and sampling are also underway for Swordfish management.

Financial support provided by EU grant CFP - BFTMED - 97/0029 and SIDS QLK5-CT1999.01567

Abstract for EurOCEAN 2000 EU

Autonomous Underwater Vehicle MARIDAN-600 – Successful exploitation of European MAST project

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Maridan, Denmark has developed the MARIDAN-600 AUV (Autonomous Underwater Vehicle) as a multipurpose high performance sensor platform for high-quality cost-efficient oceanographic surveys. The ability of the AUV to accomplish pre-programmed missions with minimal user intervention are widely accepted for offshore applications where the AUV is required to follow its planned trajectory with high precision and to ensure efficient data collection over extended mission durations.

Based on its proven performance and robustness in meeting these critical demands for the commercial sector a number of scientific surveys are currently being planned in cooperation with oceanographic organizations in Europe.

The prototypes MARIUS (1991-1993) and MARTIN (1994-1997) have successfully completed a total of more than 1000 km sea trials. Based on the promising results Maridan was established in 1993 focusing on AUVs as its unique product.

The paper outlines the MARIDAN-600 design philosophy and the adaptation required in its core system architecture to meet the demands of scientific applications. Examples of sea trials and results of data gathering using camera, side scan sonar and subbottom profiler will be presented.

Bottom-up and top-down effects on biological productivity in the Black Sea

by Georgi M. Daskalov

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Abstract

More than 40 different hydroclimatic (SST, SLP, wind, run-off...), biological (plankton, benthos and fish abundance), and anthropogenic (nutrient input, hypoxia...) indices covering 20-30 years are analysed in order to describe and compare the main trends in the Black Sea ecosystem. Time-series analyses and multivariate techniques are used in exploring trends and quasi-periodic variations. Based on the existing knowledge, long-term patterns are examined on different temporal scales: secular trends, interdecadal, decadal and interannual variations. The results indicate deferent responses of the biological populations on different trophic levels to physical and anthropogenic forcing. Trends in pelagic predator abundance and meso-zooplankton are decreasing, while planktivorous populations and phytoplankton biomass tend to increase over time. Moreover the correlations between the couples of biological and physical variables tend to change their signs after 1970, when important changes as the collapse of the pelagic predators due to the fishery and increasing eutrophication, take place. The relative roles of the bottom-up and top-down controls for the observed changes are discussed. The rise in the phytoplankton production after 1970 can be explained by several factors acting simultaneously: hypothetical favorable climatic regime, increased eutrophication, and weakened herbivory due to decreasing zooplankton. A trophic cascade effect du to the predator's extinction propagating down the pelagic food web is hypothesized. The changes in a simplified theoretical food web are simulated using the Ecosim model.

CAPACITY FOR ADAPTATION AND GROWTH POTENTIAL OF LARVAL AND JUVENILE SOLE (*Solea solea* L.,) IN NET ENCLOSURES AND EARTHEN PONDS

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ABSTRACT

Rearing methods to produce larvae and juveniles of the common sole (*Solea solea*) were investigated based on the interest to introduce the species to marine fish aquaculture for species diversification.

Objectives A two-phase experiment was designed to access respectively: (i) the feasibility of producing semi-extensively 1g soles and (ii) the survival and growth potentials of these juveniles under extensive conditions.

Materials and Methods An approximately five-month experiment was conducted in earthen ponds of the French Atlantic coast, using small net enclosures and traditional pond management. Hatchery produced larvae (13 days post hatch) and one month old juveniles were released in two enclosures respectively: $1m^2$, small enclosure (SE) and $4m^2$, large enclosure (LE). In addition, temperature, salinity, oxygen, pH and chlorophyll-a were measured.

Results and conlcusions Growth was exponential until 1 month old juveniles reached a mean size of 24.2±3.31mm (an estimated mean weight of 106mg). Owing to density-dependent effects significant differences in the mean sizes of SE compared to LE occurred, thereby producing juveniles 46.1±3.02mm, 0.8g and 57.7±3.32mm, 1.6g respectively. Survival rates varied between 30% (SE) and 100% (LE). Subsequently the survivors of SE were released into the pond and were on-grown at a stocking density of 0.2 juveniles per square meter. Their growth rate in the pond increased from 0.78 mm/day in SE to 1.14 mm/day thus confirming density-dependent effects in SE. By the end of the experiment a mean size of 11±0.95cm (11.1±3.1g) was reached

with a survival rate of ~90%, indicating that pre-growing in enclosures favours both growth and survival of extensively cultivated juveniles.

DiCANN: a machine vision solution to biological specimen categorisation

By

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Abstract

Progress is reported on MAST project MAS3-ct99-0188: Dinoflagellate Categorisation by Artificial Neural Network (DiCANN). DiCANN is an advanced machine vision system that can be trained to categorise species of phytoplankton. It operates with images taken direct from laboratory microscopes and has been trained on field collected specimens, which normally require expert taxonomic judgement to identify.

Objectives

The objective of DiCANN is to obtain an accuracy similar to taxonomists when identifying specimens under the microscope. The task for both taxonomist and DiCANN gets complex due to the context of the analysis, where specimen morphology can vary under differing environmental conditions and the type of fixative used. Fragile specimens can also be damaged, cluttered by debris or overlapped by other specimens. One of the advantages of DiCANN is that it will not fatigue during the identification process.

Context of the research

The packaged system will run on a personal computer and can be generally used by marine laboratory staff. Two marine laboratories are evaluating the package. Its efficacy and utility will be measured to ascertain its value within such monitoring laboratories prior to its potential application within the EU shellfish industry (with an output of over 1.5 million metric tonnes per annum). The system will not be a replacement for the existing technical staff of these laboratories. Rather it will act as an assistant to those staff to allow them to increase the frequency of water sampling, thereby increasing the throughput of the laboratory. Feedback from these laboratories, during the period of the programme, will enable the software to be further developed and targeted to the specific site problems. During this period work practices, and their accompanying quality assurance methods, will be developed.

DiCANN combines state of the art image pre-processing techniques (wavelet transforms, coarse channel analysis) with advanced pattern recognition systems (e.g. Radial Basis Function and Multi Layer Perceptron and Support Vector machines).

Results

Precursors of DiCANN have been shown, on a 23 species categorisation task, to get 83% accuracy of species label on a large data set of specimens that they had not previously seen. Human performance, by trained plankton taxonomists/ecologists, on the images drawn from the same image set attained a best accuracy of 86%. DiCANN is a laboratory prototype instrument and is being developed into a new class of computational device that will allow collection and analyses of biological data *in situ*. Trials of these new developments of DiCANN, operating in laboratory conditions, will be reported.

Conclusions

DiCANN is a trainable Natural Object Categorisation system and it is quite possible to apply it to other biological specimen categorisation tasks. With adaptation the software may be used to analyse the output of towed sensors or ferry box systems which will provide real-time specimen identification.

EUROCEAN, Hamburg 2000

Oral presentation
Abstract

MEASUREMENTS AND MODELLING OF OCEAN CLIMATE AND ZOOPLANKTON IN THE BARENTS SEA

Edvardsen, A., D. Slagstad[1], K.S. Tande and P. Jaccard[2]

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The coastal shelf of northern Norway and the Barents Sea is a productive area, with a food chain in which phytoplankton and zooplankton supports the recruitment of major fish stocks such as herring, capelin and cod. This area is a highly advective one, mainly perturbed by the North Atlantic Current and the Norwegian Coastal Current, which is an important factor for spatial and temporal distribution of zooplankton. This work was conducted along the western border of the Barents Sea repeatedly during 1998 and 1999. We implemented a new approach to study the interaction between zooplankton, vertical migration and advection using technology like Scanfish-OPC-ADCP-MOCNESS and hydrodynamical models. Zooplankton community structure was monitored by net tows and zooplankton abundance fields was mapped using an Optical Plankton Counter (OPC) counting copepodide life stages CIII-CV, which is the major contributors to the dietary input of planktivorous fish. Current fields were measured by a ship mounted ADCP and the residual current fields were calculated by subtracting the tidal component obtained from a hydrodynamical model. The flux of zooplankton during each cruise was calculated by combining the zooplankton- and residual current field.

Development of recirculating mariculture production system designed to minimize environmental impact.

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The research objective of this project is to develop an intensive recirculation system for use in mariculture. Ammonia, which is toxic to fish, is removed by a aerobic nitrifying bacteria in a trickle filter system. Then organic matter is reduced and excess nitrate and phosphate are removed by means of anaerobic denitrifying bacteria in a fluidised bed reactor (FBR). Laboratory experiments will be carried out to define and optimise the operational conditions for the FBR and other modules in the system, including the factors that might promote the (undesirable) production of hydrogen sulphide. Because hydrogen sulphide is very toxic to marine fish, it is planned to develop an iron oxide cartridge for the indication of its presence in the system and to degrade and remove it if accidentally produced. The data from a series of measurements and specific experiments will be used to describe mathematically the principal processes within the recirculating system in a computer simulation model of the entire system.

The system once developed can be used in a wide variety of contexts including intensive mariculture systems situated a distance from environmentally sensitive coastlines and even put in inner cities to cut transport costs and pollution.

The 1st pilot plant has been operating in Rehovot since April 1999. Routine measurements have been made to monitor its operation and the functioning of the individual modules. The understandings obtained have been used to develop and initialize the mathematical (computer) model. This model will need considerable modification as further data is obtained from the experimental systems, but it is already able to predict how the different components function and interact. The experience developed from this 1st pilot plant has been used in the construction and operation of the 2nd pilot plant recently commissioned in Eilat.

Laboratory experiments have been carried out to study the decomposition of organic matter. We conclude that complete degradation of the sludge occurs over a period of 250 days. Volatile fatty acid production and subsequent nitrate reduction took place at a rate that secures the complete reduction of nitrogen released by breakdown of organic matter to nitrogen gas. Addition of starch or cellulose enhanced nitrate removal during degradation of sludge.

Optimal operation of the FBR was established with a sand size of 4 mm diameter and a reactor retention time of 1.5 min. Preliminary results have shown that the average nitrate removal rate was 26 mg NO_3-N $liter^{-1}$ h^{-1}. The phosphate content of the bacterial biofilm adhering to the sand carrier was as high as 15% of the bacterial dry weight. Daily wasting of 5% of this bacterial biomass from the reactor did not influence the overall performance of the FBR.

After a period of method development, extensive data has now been obtained on the controls and rate of uptake of sulphide by ferrihydrite (generally considered to be the most reactive iron oxide) in seawater. A rate equation has been defined allowing for the prediction of sulphide removal by ferrihydrite at variable pH, total sulphide concentration and specific iron oxide surface area.

Studies for the improvement in the recovering of the *Gelidium sesquipedale* cast off algae using acoustic methodologies

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The objective of the paper is to improve the actual recovering of the cast off from *Gelidium sesquipedale* (Clem.) Born.et Thur.algae, by the use of acoustic technologies friendly to the environment. This algae specie has a high commercial interest, as it is used for the extraction of Agar, a polysaccharide utilised as food thickener and in biotechnological studies.

Gelidium sesquipedale is a Rhodophyte (up to 50 cm high) growing on limestone up to 20 m deep. During autumn and coinciding with the first storms, the *Gelidium* sp. population looses approximately the 70% of its biomass. The detached algae are known in Spain as "arribazones"(cast off). The remaining 30% will recover the same biomass along the following year. This naturally cut seaweed mass floats in the water column and can move offshore (if southern winds occur) or get stranded in the beach (with northern winds). In the first case, the resource often moves to a low dynamic area and gets lost (rotten) in eight days. That means that from a total of 100.000 t (wet) of floating algae, just a 15-20% is collected.

An average of 4000 t (dry weight) of the specie are collected in Spain each year, while in Portugal and France the values are of 2000 t and 1000 t per year, respectively. Although the price in raw form is about 1,5 million Euro approx. (0.25 Euro/Kg of fresh seaweed), it will get a very high added value when processed and transformed. At present, several harvesting methods are used, the most important ones are through diver hand plucking (6%) and by trawling, suction or netting the cast off (94%).

The paper addresses the need of a technology capable of detecting the algae floating masses, once separated from the stem and in a short time period.

Techniques based in underwater acoustics have been tried out, namely geocoded side scan sonar images obtained simultaneously in two frequencies (100 and 500 kHz), and echosounder data (200 kHz). The last one, a simple beam device, known as RoxAnn, has gained increased attention in the last years, as sit shows a capability to discriminate between different seabed materials (gravel, sand, clay, etc) in a reliable way. The RoxAnn system exploits the first and the second backscatter acoustic intensities by integrating over the tail of the first return and the whole of the second return. The echo integration provides information about the roughness and hardness of the surface, allowing a segmentation of the seabed biological characteristics

The reliability of these methodologies, applied to detection of Gelidium masses on sandy bottom have been tested using a groundtruthing based on diving observations and sampling.

The results obtained show the high acoustic selectivity of *Gelidium sesquipedale* in the sonographs corresponding to different frequencies. The big masses of floating algae are transparent in the sonar images taken at 100 kHz, but opaque at 500 kHz due to the acoustic target strength frequency dependence. Excellent results have been obtained applying mathematical operations (subtraction, ratios) on the real-time acquired images to locate such masses, of immediate application to the collectors community. These images have been afterwards processed in a laboratory to refine their characterization and quantification.

The data obtained with a RoxAnn echosounder show the strong influence that the seabed and its morphology has, even though the study has been carried out on a sandy bottom to override this type of problems. In homogeneous conditions the values show a trend to separate *Gelidium* masses in a specific classification box, which encourages the authors to do research in that direction. Best results have been obtained in the characterisation of the seaweed growing areas (characterisation of its roughness and acoustic impedance), quite difficult to observe in sonar images. Both study techniques show therefore a good complementation in the sense that RoxAnn can be used for the monitorization along the year of the Gelidium habitat, and sonar images may be applied for the location of the floating algae masses.

The tested methodologies are described, and the improvement in the catches are estimated.

SESSION C

THE AVAILABILITY OF DATA FOR MARINE RESEARCH :

DATA, DATA EVERYWHERE AND NOT A BYTE TO SPARE !

Friday, 1 September 2000

EUMARSIN : AN INTERNET DATA BASE OF SEA FLOOR SEDIMENT SAMPLES FROM THE EUROPEAN SEAS

By : Dr C.Perissoratis , Institute of Geology and Mineral Exploration of Greece, Marine Geology Department. Coordinator of EUMARSIN.

The European Seas although representing the most thoroughly explored sector of the world oceans are still virtually unexplored. With the acceptance of the International Law of the Sea and the 200 mile economic zone, the areal extent of the sea under EU jurisdiction is more than twice that of the land area and particular attention is given to environmental parameters in the marine sector. The original orientation of the marine projects was to meet the needs of domestic requirements. Today however the projects carried out by marine institutes are attaining a transnational character. This is because problems such as quality of coastal waters, impact of human activities, transport patterns of contaminants and circulation of water masses are now subjects of multinational cooperation.

In order to meet these modern challenges in 1996 all geological surveys of the EU and Norway formed a non-profit association called EUROGEOSURVEYS (EGS) and the 14 marine geology departments of EGS formed a relevant team. This team proposed the project EUMARSIN for funding to EC in the framework of the MAST III program to have all available sea sediment samples being incorporated to a metadata bank.

The project, in which participate all 14 EU geological surveys that have marine geology departments, covering all EU seas, started in November 1998 and will last for two years. The project uses already collected and analyzed public-domain marine sediment information required for first approach studies

Project Coordinator of the program is the Greek partner (IGME) and with a Steering Committee, consisted of the Norwegian (NGU), British (BGS) French (BRGM), the EUROGEOSURVEYS (EGS) Secretary General and MARIS, a Dutch company specialized on data management, are responsible for the management and the technical decision of the program. Each survey – member of the Steering Committee is also responsible for a regional European sea area and cooperates with the Surveys of the neighboring countries. Thus NGU is for Baltic, North and Norwegian Seas and cooperates with the surveys of Finland (GSF) Sweden (SGU) and Denmark (GEUS). BGS is responsible for the North Sea and the northeastern Atlantic and cooperates with the surveys of the Netherlands (NITG-TNO), Belgium (GSB), German (BGR) and Ireland (GSI). France is responsible for Eastern Atlantic and western Mediterranean, and cooperates with Spain (ITGE) and Portugal (IGM) and Greece (IGME) is for Eastern Mediterranean and cooperates with Italy (DSTN).

As of this time there are about 110000 sample stations from the geological surveys. In addition the partners have contacted in their countries other 373 European Research Institutes, that have sediment samples, and have indicated that they will incorporate an additional 13000 sample stations. As of now all survey data and most other institutes data have been imported in the metadata bank, according to the format developed.

Abstract submitted to "The availability of data for marine research: Data, data everywhere and not a byte to spare!" Scientific Colloquium at EurOCEAN 2000, Hamburg, Germany, 29 August - 2 September 2000

Meeting end-user needs - A model for accessing the European seafloor data archive based on the EUROCORE concerted action

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Hundreds of thousands of bottom samples, seafloor photographs and other seabed station data have been collected from European waters by national, international and EU-sponsored cruises. In addition, hundreds of thousands of kilometres of seismic lines and millions of square kilometres of side-scan sonar imagery and high-resolution swath bathymetry have been collected by European institutions. These data represent a vast resource of continuing scientific usefulness and importance, at present stored at a large number of locations dispersed throughout the countries of the European Union. Secondary use of these data is currently seriously impeded by lack of knowledge of what is available and where the data is stored. Successful collation and dissemination of metadata ('data on data') requires the formal establishment of an effective transnational data collecting infrastructure and universal rapid intuitive access and display. The EUROCORE Project was set up to make metadata relating to the European seabed sample archive accessible by establishing a central Internet database, thereby promoting secondary usage of this underexploited raw data resource. It forms part of the joint project EU-SEASED, together with the Concerted Action EUMARSIN (European MARine Sediment Information Network) and is supported by the MAST (Marine Science and Technology) programme of the DG XII Directorate of the European Commission. Although EUROCORE is restricted to establishing a meta-database of seafloor samples (cores, dredges and grabs), it has devised a proactive methodology for populating the database and a graphical interface covering the world ocean. It therefore provides a model which could be used to increase accessibility to other types of seafloor data, both station, profile and area-based. It has demonstrated the importance of the functional specification being end-user driven and the need for an intuitive graphical user-interface. Data acquisition needs a strongly proactive approach and the use of data scouts to actively solicit, and compile, third party metadata when necessary. For paper and photographic records, a specific effort is required to locate and digitise data (data archaeology) to allow preservation, recording and dissemination, and minimise future data loss. Considerable efforts have now been made through EU data management initiatives (e.g. EUROCORE, EU-SEASED, SEISCAN) to preserve and record non-digital marine data and make this more accessible to potential users. However, these efforts must continue, and expand to cover other types of marine data, if Europe is to capitalise on its considerable research investment and enable full exploitation of resources.

PANGAEA - Network for Geological and Environmental Data
- An Information System for Marine Data accessible through the Internet

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An introduction will be given to the information system PANGAEA, used to archive, publish and distribute data from marine research by projects. Data is stored with meta-information in a relational database which is accessible through the Internet. It is intended to operate the system within the World Data Center System of ICSU at MARUM.

PANGAEA is used to collect and share data, to make the data available to the community via the Internet and to store data in a long-term operated archive. The system is operated by the institutes AWI and MARUM, giving support for projects and users. Projects are responsible for collecting the data, quality control and import. PANGAEA is designed as a network which uses client/server technology through the Internet.

The challenge of managing the heterogenic and dynamic data of the different disciplines in marine research was met through a flexible data model which reflects a strictly generalized 'world' of scientific data. Within a PROJECT different CAMPAIGNs are carried out for investigations. At a number of SITEs samples may be taken or measurements are made (EVENT) resulting in analytical DATA. Each single value is quality flagged and georeferenced in space (latitude, longitude, elevation) and/or time (date/time or kyr BP); this allows the extraction of any subset of data from the inventory. Data series (one parameter/event) are stored with required meta-information (reference, PI, method, quality).

Access to data is realized in different ways which can be used depending on the requirements of the users or on the objectives of a project:
(1) The 4D-client is mostly used by a projects data manager for the import of data. To share unpublished data during a project, data can be password protected.
(2) The PANGAEA Advanced Retrieval Tool (ART) is a Java client with full access to the data model and can be used to retrieve and extract any required combination of metadata/data on the Internet.
(3) Due to the well defined links between the database and a web server, any individual view on information in PANGAEA can be realized easily with a Java applet. One example for this opportunity is PanCore which allows searches in the inventory of marine samples.
4) In case data sets need to be published with the related reference or in parameter specific lists, the Direct Download Interface (DDI) provides the easiest way of downloading data from PANGAEA to the users local PC just by a mouse click.
(5) PangaVista is a universal search engine on any data in PANGAEA. A given keyword will result in a list of related meta-information including the links to the data.
For the visualization of data in maps or property plots easy to use tools (freeware) are provided, which can be used either with a direct link to the clients or as standalone applications.

DATA MANAGEMENT FROM THE GEOSTAR MULTIDISCIPLINARY SUBMARINE OBSERVATORY

Authors: Paolo Favali, Giuseppe Smriglio

A data Management procedure developed for the geophysical and environmental data acquired by the GEOSTAR benthic observatory is presented.
GEOSTAR is a multidisciplinary, unmanned, modular observatory for the measurement of geophysical and environmental parameters, capable of long-term monitoring at abyssal depths (up to 4000 m.w.d.).
GEOSTAR has been successfully tested in 1998 in Adriatic Sea (MAS3-CT95-0007); a deep-sea mission in southern Tyrrhenian sea is scheduled in the period September 2000-Spring 2001 (MAS3-CT98-0183). The GEOSTAR concept is based on a Bottom Station hosting a wide range of sensors. Accurate and safe positioning at seafloor, re-entry and recovery capabilities of the Bottom Station, are ensured by a dedicated cable suspended thrustered module (Mobile Docker).
Presently, the Bottom Station hosts the following set of scientific sensors: 2 Three axis broad-band seismometer; Scalar (proton) magnetometer; Fluxgate (x-y-z) magnetometer; 300 kHz ADCP; CTD; Transmissometer; Gravity Meter; Single point current meter (3D); Chemical sensor (NH_3, pH); Water sampler.
Data communication capabilities are ensured by the following means:

- Data capsules (Messengers) released upon request or periodically by the Bottom Station and able to transmit data to a shore station over a satellite link;
- Near-real-time Communication System allowing bi-directional connection between a shore operator and the Bottom Station.
- Real-time communication is possible through the connection with a submarine cable.

A high precision clock ensures a long-term stable and accurate time reference for all sensors; therefore all data can be organised in a relational database. The scientific data acquired by the sensor packages are submitted to a first immediate, local, automatic control by an intelligent unit of the Bottom Station and then, after station recovery, to two levels of on-shore quality checks aimed at discriminating artificial from natural signals.
Documentation and format of the GEOSTAR data for public use follow the recommendations expressed by the Intergovernmental Oceanographic Commission of UNESCO (IOC) and decreed in the MAST code on data management.

Data dissemination is based on four ways:
- *Data banking*: data files with international exchange format available on CD-ROM upon request.
- *Internet*: the page www.ingrm.it/GEOSTAR includes general information on the GEOSTAR data, main graphics and results.
- *EDMED forms*: main data features are reported in EDMED forms according to the EDMED system rules.
- *Publications*: GEOSTAR data and main result published on international journals, proceedings of conferences, etc.

Present partnership of GEOSTAR project includes:

Istituto Nazionale di Geofisica - Roma (I) (Co-ordinator) Paolo Favali, Giuseppe Smriglio, Laura Beranzoli, Thomas Braun, Massimo Calcara, Giuseppe D'Anna, Angelo De Santis, Domenico Di Mauro, Giuseppe Etiope, Francesco Frugoni, Luigi Innocenzi, Caterina Montuori, Giovanni Romeo, Paolo Palangio.
Tecnomare S.p.A.- Venezia (I) Francesco Gasparoni, Daniele Calore, Renato Campaci.
Technical University of Berlin (D) Gunther Clauss, Sven Hoog.
Technische Fachhocshule - Berlin (D) Hans Gerber.
IFREMER - Brest (F) Jean Marvaldi, Jerome Blandin, Christian Podeur.
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Possible location of the abstract:
The availability of data for marine research: Data, data everywhere and not a byte to spare! (SC)

KEYWORDS: Real-time data transfer; data archiving; access to stored data; data standards, protocols and policies; test-bed data sets

- CoastBase -

From scattered data towards European level assessments regarding Marine and Coastal Environments

European research to improve the access, interpretation and aggregation of information.

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SUMMARY

Access to aggregated information at an European level concerning the marine and coastal environment is of increasing importance for different European institutes (such as EEA, EU, OSPAR and JRC). CoastBase, supported by the European Commission within the fifth Framework programme (DG IST), aims to improve the information flow for the assessments of the marine and coastal environments.

CoastBase will be a step ahead in the provision of timely, targeted, relevant and reliable information on an European scale. This information is needed for a sound preparation of European policies. Access to aggregated information also contributes to the harmonisation (and standardisation) of the marine and coastal policy implementation at a national or sub-national level.

The CoastBase project focuses on the construction of a technical architecture and the related communication process among European authorities at different levels, which is essential to put techniques in to practice.

Coastal areas and their natural resources play a strategic role in meeting the needs and aspirations of the European population. The large variety of environmental conditions and gradients creates highly productive systems for all kind of sectors. Managing authorities consider these uses and interactions between actors from different sectors and policy levels for integrated coastal zone management.
The National Institute for Marine and Coastal Management of the Ministry of Transport, Public Works and Water Management, is a partner within the Topic Centre for Marine and Coastal Management, the consortium providing information to the European Environment Agency.
In this context and others (such as OSPAR and EuroGOOS) the access to information, both basic data and aggregated products is essential for a good fulfilling of these tasks.
The information gathering and manipulation process becomes more and more relevant for the policy support throughout the EU, which has to connect well to the lower level policy makers to assure adequate implementation of European regulations.
All aspects regarding the information flow in Europe between institutes working in the field of Marine and Coastal Environment and all relevant information delivering and requiring organisations (ranging from provincial, regional to an European scale), are therefore central in the CoastBase project.
The quality of the products which are used for policy making is highly determined by the data and information used. Efforts and time needed to obtain good information at an European level costs at this moment a significant amount of work and the results do not reflect the enormous amount of available knowledge and information.
The CoastBase consortium consists of governmental organizations, private organizations and NGO's. The cooperating partners are varying from researching, monitoring and policy preparing agencies at a national, intergovernmental and European level, to a NGO linking local Marine and Coastal Management institutes.

Sea-Search: Your on-line gateway to marine and oceanographic data , information and knowledge in Europe

Authors: Dick Schaap (1), Meirion Jones (2), Karien de Cauwer (3), Wolfram Schrimpf (4), Riitta Olsonen (5), Kimmo Tikka (5), Catherine Maillard (6), Eric Moussat (6), Friedrich Nast (7), Efstathios Balopoulos (8), Hedinn Valdimarsson (9), Bronwyn.Cahill (10), Orla Nicheileachair (10), Giuseppe Manzella (11), Nico Kaaijk (12), Taco de Bruin (12), Harald Loeng (13), Helge Sagen (13), Rogerio Chumbinho (14), Rui Battista (14), Demetrio de Armas (15), Jan Szaron (16)

National Oceanographic Data Centres play a key role in data management of oceanographic data & information. Nowadays these Data Centres are developing their services very much pro-active towards users. The Data Centres are making their data holdings accessable by Internet and as data management partner are supporting many national and European research projects in setting up good data management systems and dissemination activities.

A very important initiative in this respect is the EURONODIM project, better known as SEA-SEARCH, a Concerted Action within the framework of the EC-MAST III programme.

SEA-SEARCH is a European cooperative network of 16 national oceanographic data centres and marine information services from 14 European countries, including the EC-Joint Research Centre. Each SEA-SEARCH partner is specialised in managing and giving access to extensive resources of oceanographic and marine data & information and is providing data management services & support to a wide range of institutes and research projects, both nationally as internationally.

The primary goal of SEA-SEARCH is to provide users with a central overview and access to ocean and marine data & information in Europe. This is accomplished by operating a network of partner websites and a joint European website (www.sea-search.net)., that is being developed into the key resource or 'portal site' for oceanographic data & information in Europe.

The SEA-SEARCH website hosts an array of catalogues, overviews and links and acts as central gateway to ocean and marine information & data resources of SEA-SEARCH partners and other related organizations in Europe.

SEA-SEARCH provides:

- an Internet gateway for users, searching for ocean and marine data & information in Europe

- a support infrastructure for organizations and projects, dealing with ocean and marine data & information, for indexing, disseminating and promoting their data & information resources to a wide user community
- a valuable resource for data management expertise and support

Key Resources of SEA-SEARCH

Together the SEA-SEARCH partners maintain a number of major catalogues and overviews, that can be searched through the central SEA-SEARCH website:

*** EDMED - Marine Environmental Datasets**

The European Directory of Marine Environmental Datasets (EDMED) was initiated in 1991, recently upgraded, and has established itself as a de-facto European standard for indexing and searching datasets relating to the marine environment, covering a wide range of disciplines. It is a high level inventory, covering Datasets and Data holding centres. At present EDMED covers already more than 2300 Datasets from more than 500 Data holding centres. SEA-SEARCH partners are responsible for keeping their national contributions up-to-date.

*** ROSCOP - Research Cruises**

The Directory of Research Cruises is based upon ROSCOP, a global standard for indexing oceanographic cruises by research vessels. It gives insight in data collection activities and research institutes, involved in these cruises. The reports are prepared by chief scientists and the national collation is done by SEA-SEARCH partners. The SEA-SEARCH website gives access to the European Directory of Research Cruises, that are also transferred to ICES for global compilation. Next to Search options the SEA-SEARCH website will also provide entry facilities for chief scientists to submit ROSCOP forms online.

*** EDMERP - Marine Environmental Research Projects**

The European Directory of Marine Environmental Research Projects (EDMERP) gives information on ongoing research projects, data collection activities, involved organisations and scientists, and resulting products. Compared to EDMED and ROSCOP this directory is a relatively new item, that will expand in coverage and importance rapidly, undertaken by the SEA-SEARCH partners.

*** EC Marine Research Projects**

This is a special issue of the Marine Environmental Research Projects directory, covering already more than 300 marine research projects, that are funded through the EC MAST and ENVIRONMENT programmes. This directory will also keep track of new marine research projects, that are initiated within the EC 5th framework.

*** Marine Data Networks in Europe**

Influenced and supported by international initiatives like EC programmes, EuroGOOS and others a number of marine data networks have been and are being implemented, e.g. in the fields of operational oceanography, marine geology, ocean geology. The SEA-SEARCH website maintains an overview and relevant web links to these marine data networks in Europe.

*** Marine Data & Information Centres in Europe**

An up-to-date overview and web links to centres in Europe specialised and involved in management, processing, archival, dissemination and related support services for ocean and marine data & information.

Strategy of Sea-Search:

The Sea-Search network and its central website are seen as an umbrella and bundled marketing effort for creating awareness and giving overview and access to all ocean and marine data & information activities by organizations in Europe. So Sea-Search is not only covering traditional oceanographic research, but also aiming at giving shelter and indexes / links to data initiatives in 'operational oceanography' and 'remote sensing' communities. For a major part this is accomplished by having Sea-Search partners joining and supporting various data and network initiatives with their data management and dissemination activities.

Visit the website at : www.sea-search.net

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Data Standards Everywhere and not a One to Share!

by Dr Geoff Meaden, Fisheries GIS Unit, Canterbury Christ Church University College, Canterbury, UK.
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During the past decade various interested groups have made significant progress in agreeing international digital data standards across a range of subject areas. Most of this work has been carried out in the terrestrial sphere by subject specialists working under, or in co-operation with, the International Standards Organisation. Work on data standards for marine applications is far less organised. The objectives of this paper are to briefly describe the progress with regard to the setting of marine data standards, and to identify the practical difficulties that researchers in the "Fisheries GIS" subject area face through not having coherent standards. The focus therefore is from the user's perspective rather than the "producer's". Major reasons for the importance of this research are the dichotomous factors of the explosion in data quantity and the implosion of commercial fishery catches in many marine areas. Also, the expanding frontier of marine research has spawned the adoption of a plethora of mostly digitally-based data collection instrumentation, with an ensuing exponential growth in data quantity. This activity has been mostly promulgated from the private sector, with numerous individual and often fragmented projects having been embarked upon. Relatively little attention has been given to either adding value to the data via sharing or to the consideration of data standardisation. A recent estimate found that at least 30 marine data formats are currently used, and this number is growing.

The main contributor to the setting of standards in the field of digital geographic information is the International Standards Organisation (ISO) through their TC211 Committee, though they are only in the process of initiating digital terrestrial standards, and they have no special project covering marine data needs. From the marine perspective the concept of a standards "lead organisation" is more difficult to perceive, and it really depends whose publications are read. The main international standards organisations here, i.e.IMO, IOC, IHO, ICES (Marine Data Management Working Group), ISO, NATO (DIGEST), the OGC (Open GIS Consortium), the ICA (International Cartographic Association), and the GSDI (Global Spatial Data Infrastructure), each have unique yet overlapping areas of interest, but there are also individual groups (e.g. UKOOPA), national governmental organisations (e.g. the FGDS bathymetric sub-committee), and individual projects (e.g. WOCE), that have all set their own marine data standards. Although there is some synergy between various of these groups, and a limited recognition of present inadequacies, there is often a strong desire to protect their own vested interests. There is thus little movement towards any true internationalisation of marine data standards.

The author has made surveys to assess the consequences of this "fragmented data standards" scenario. Findings indicate that the main problems caused for work in the "Fisheries GIS" subject area (excluding universal problems associated with lack of standards) include:

- A lack of awareness that standards even exist.
- Data gathering instruments and methods may only be tied to local company or industry standards.
- The variability of data quality between data sets, and thus the levels of confidence in both input and output data.
- Establishing a unified dictionary of fisheries biological terms.
- Establishing true depths for measurements in the water column, e.g. was tidal correction allowed for, and what datum was used?
- The variety of ways in which bottom substrates were defined.
- A lack of temporal consistency for successive data sets.
- The possibility of standards being "dictated" by private groups, i.e. by requiring the use of their coding or software.
- No agreed resolutions for handling data, e.g. can data gathered from an infinitely small point be allocated to any sized 3D volumetric area?

Additional to these problems, there are no existing standards showing how data on the various facets of fishery activities should be digitally captured. It is likely that other marine subject areas will share many of these concerns and will have some of their own. It is concluded that the problems relating to the setting of universal marine data standards are political rather than technical. Unless and until the international marine bodies concerned get talking to each other, then the data standards situation may get rapidly worse.

Abstract for EurOcean 2000, Hamburg 29 August – 2 September 2000

Addressing the issue:
"The availability of data for marine research: Data, data everywhere and not a byte to spare!"

Online availability of wave data from the North Sea and the Norwegian Sea

Using operational data for research purposes.

By dr. Anne Karin Magnusson, Norwegian Meteorological Institute

Several contemporary oil platforms located in the North Sea and the Norwegian Sea deliver high density meteorological and wave data for their own purposes to monitor the environment, in particular during critical operations. Concerning wave data, these comprise both standard parameters such as significant wave heights and period, as well as off standard data such as 2D wave spectra and 2Hz time series of surface elevation.

As these data sources are transmitted to land in real time to the Norwegian Meteorological Institute, where they are merged with auxiliary data such as from numerical models, a 'laboratory of opportunity' is achieved, that can facilitate new advances in the understanding of wave physics.

This presentation will show examples of such data, their ways of transmission to land, their related data from other origins, and some preliminary results of studies where such combinations of data have resulted in new scientific findings regarding the nature of waves through storms, and of single and extreme ocean waves. These findings will not only enhance our understanding of wave physics, they may also have impact on design of ships and offshore constructions, and warning systems at sea.

European Conference on Marine Science and Ocean Technology, Hamburg, 29.8.-2.9.2000

Abstract submission for oral presentation in Session "The availability of data for marine research: Data, data everywhere and not a byte to spare! (SC)"

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Realtime data access to the deep-sea: applications for climate change research and ocean science (DOMEST)

During the last years many fields of marine science developed an increasing demand of high resolution scientific data both in time and space, in order to solve process-related key questions rather than conservative observations of environmental scenarios. Consequently, new technologies like space-based remote sensing or autonomous moving *in-situ* sensors became highly efficient tools for the measurement of key parameters, which now provide an amount of data never available to the researcher at anytime in the past. However, although complex marine processes i.e. in the upper ocean became more transparent through realtime AVHRR or SeaWIFS ocean color observations, the researchers ability to react to these observations - in terms of controlling sampling devices or sensors *in-situ* - is still restricted to coastal aeras, surface buoys or expensive and mostly non-frequent ship-excursions.

In many fields of marine science, especially climate related research, time series of water and particle samples or *in-situ* measurements of complex parameters are essential but strictly restricted to static sampling intervals over long periods of time, and data (and sensor status- "did it work?") become available only at the end of the deployment period - after months to years. In comparison to the availability of i.e the above mentioned data and their potential for process-related science like climate or socio-environmental research, this is certainly a disproportional situation that has to be changed in the near future.

Together with the forthcoming start of international ocean monitoring programs like i.e. GOOS and EUROGOOS, several approaches are undertaken to develop instant access of data from different ocean compartments, i.e. the development of profiling and free drifting floats (i.e. the Array for Real-time Geostrophic Oceanography, ARGO). In order to address the increasing technological demands to combine *long-term timeseries* in the deep-sea with realtime data acceess and dynamic sensor control, the german marine technology project DOMEST (Data Transmission in the Ocean and Sensor Technology in the Deep Sea) was started in May 1998 at the University of Bremen, in close cooperation with local industrial partners (OHB-System, Orbcomm Germany). Within DOMEST, a highly interactive system was developed which allows the user a nearly realtime data request and wireless remote control to sensors installed at great waterdepths, either from ship or via the internet. This approach enables instant data access and device control to long-term deployed sensors with considerably shorter reaction times than before, i.e. during short-term environmental events like dust storms, plankton blooms or anthropogenic pollution events.

To address a wide range of applications, a major aim of DOMEST was to develop an open network structure for deep-sea deployment based on proven standard communication protocols and hardware, which allows a reliable communication link at acceptable data rates with a number of different commercially available sensors.
The communication technology used within DOMEST is based on a combination of Low-Earth-Orbit (LEO) satellite-transmission (Orbcomm) with commercially available underwater acoustic telemetry (Orca). Essentially new developments are the soft- and hardware of the communication network nodes, the surface-underwater link, and highly integrated sensor packages like an autonomous Deep-Ocean-Profiler (DOP), a Multi-Sensor-Device (MSD) and a Deep-Ocean Bottom-Station (DOBS). The entire hardware is designed for long-term deployment of up to 1 year at waterdepths of max. 6000 m, with daily transmission of 3kB at rates of max. 2400 bits/sec. After funding of three years by the german ministry of science and research (BmBF), DOMEST is now fully functional and will be transferred into an operational status. Using infrastructural developments like DOMEST or ARGO, the missing link between space-, surface-based and deep-sea measurements may be closed, and important and climate-relevant questions regarding the coupling of the upper and deep ocean may be addressed with a methodology based on dynamic, in realtime observed processes rather than static, pre-programmed sampling intervals.

p.m. SESSION A

MARINE AND COASTAL INFORMATION FROM SPACE

Friday, 1 September 2000

Abstract: EurOCEAN 2000

Satellite studies of ocean fronts and eddies for deepwater development in the Norwegian Sea

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The background for this study is the requirements from the oil industry to obtain more knowledge about currents and eddies for the deepwater exploration west of Mid-Norway. In this study more than 70 Synthetic Aperture Radar (SAR) scenes from the ERS-2 satellite, each covering 100 by 100 km, were investigated for low wind conditions allowing observation of current patterns and fronts. Also altimeter data from ERS and TOPEX/Poseidon satellites were analyzed in order to estimate geostrophic currents in the study area. The study showed that SAR and altimeter data can illuminate mesoscale ocean currents in different ways, providing synoptic mapping which is an important supplement to time series of current measurements at single locations. The SAR has capability to map location, size and other geometrical properties of eddies and fronts, provided that the wind conditions are moderate. In at least 50 % of the SAR images which were investigated, the wind speed was dominating and masking out eddies and frontal features. The altimeter data from two satellites (ERS and Topex/Poseidon) can be used to calculate seasonal eddy kinetic energy and 10-day averaged geostrophic velocity anomalies. Sea surface temperature from AVHRR can be useful occasionally, but the frequent could cover in his region prohibits regular use of infrared remote sensing techniques. Preliminary comparisons between the SAR and altimeter results indicate that that there is qualitative agreement. The time and spatial scales of the two methods are different, however, which makes it difficult to perform accurate comparisons. The altimeter velocity fields should be compared with eddy-resolving models and both methods should be compared directly with in situ current meter data. The study suggests that both SAR and altimeter should be used in monitoring of mesoscale currents as a supplement to traditional current meter moorings.
The study has been supported by the EC OPERALT project (contract no. ENV4-CT98-0739) and Norske Shell a.s.)

HIGH-ACCURACY, NEAR-REAL-TIME SATELLITE ALTIMETRY : SCIENTIFIC AND COMMERCIAL USES

Philippe Gaspar, Pierre-Yves Le Traon, Eric Dombrowsky, and Nicolas Ducet
CLS, Satellite Oceanography Division (Toulouse, France)

Satellite altimeters provide unique observations of the sea surface topography and thereby of the ocean circulation. Two radar altimeters are now in operation on ERS-2 and TOPEX-POSEIDON. Another two altimeters will be launched in 2001 onboard ENVISAT and JASON-1. There is thus enormous potential for developing applications of altimetry on the long term. But high-accuracy altimeter data processing, such as needed to monitor the large-scale ocean circulation, is complex. Until recently, it was not performed in real-time. This restricted use of altimeter data to reanalyses of past oceanic situations.

In the context of the DUACS project (4th Framework Program), CLS started pre-operational production of high-accuracy global altimeter data in February 1998. The main product is a weekly global map of sea level anomalies based on TOPEX-POSEIDON and ERS-2 measurements. This product has now been extensively tested in DUACS to improve the ocean initial state in coupled ocean-atmosphere models used for seasonal climate forecasts. Results are very encouraging as altimeter data prove to have a beneficial impact on ocean analyses and seasonal climate forecast skill in all four tested models.

Similar near-real-time (NRT) altimeter products are currently used in operational or pre-operational ocean forecasting systems such as the French Navy SOAP system and the Mediterranean Forecasting System Pilot Project. (MFSPP).

On the commercial side, products directly derived from NRT altimeter information have been successfully tested by different fishing fleets to help locate favorable fishing grounds such as certain ocean fronts. These products are now commercially available. Similarly, altimeter-derived NRT products are tested to plan and monitor operations on offshore drilling sites.

In the presentation we will show examples of scientific, operational and commercial uses of NRT altimetric products. We will also show that using common processing facilities to jointly serve scientific, operational and commercial customers is not a simple task, but it has many advantages and benefits to all users.

to be presented at EuroOcean 2000
The European Conference on Marine Science and Ocean Technology
29. August to 2. September 2000, in Hamburg, Germany.

Wind and Wave Measurements from Spaceborne Synthetic Aperture Radars

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Abstract: The availability of cloud- and light-independent synthetic aperture radar (SAR) data on a global basis provides a perspective of the ocean surface that is unique in satellite remote sensing. The high spatial resolution and large coverage of satellite-based SAR systems offer the opportunity to derive mesoscale wind and ocean wave fields on an operational basis. The spatial resolution of SAR derived wind fields are nearly 2 orders of magnitude higher (500m) than conventional scatterometers (45 km). This enhanced resolution gives new opportunities for quantitative analysis of the marine atmospheric boundary layer and oceanographic processes especially in coastal areas.

In this paper algorithms are developed and tested to retrieve mesoscale wind and ocean wave fields from spaceborne SAR data, acquired at C-band with either vertical or horizontal polarization in transmit and receive. These algorithms were developed as a preparation for the operational use of future ENVISAT ASAR data. Wind directions are extracted from wind induced streaks, e.g. from boundary layer rolls, Langmuir cells, or wind shadowing, by filtering of the image in the spectral and spatial domain. Wind speeds are derived from the normalized radar cross section (NRCS) and image geometry of the calibrated SAR images, together with the local wind direction by inversion of semi empirical C-band models, e.g. CMOD4 or CMOD_IFR2, which describe the dependency of the NRCS on wind. These models were developed for the scatterometer aboard the European remote sensing satellites ERS-1 and ERS-2, which operate at C-band with vertical polarization in transmit and receive. To apply these models to horizontal polarized SAR data, they have to be modified for horizontal polarization, which was performed considering several C-band polarization ratios including theoretical and empirical forms. Comparison of wind speeds retrieved from the Canadian RADARSAT-1 ScanSAR system to the Danish high resolution limited area model (HIRLAM) gives a correlation of 0.8 and a bias of 0.07 ms-1 showing the overall applicability of the algorithm. For ocean wave field extraction a SAR cross spectra ocean wave inversion scheme is developed and tested using complex SAR data from the European remote sensing satellite ERS-2, which is the only all weather system to provide directional ocean wave information on a global and continuous basis. Due to the nonlinear SAR imaging mechanism, the derivation of two dimensional wave spectra from SAR data requires some a priori knowledge. The inversion scheme presented in this paper takes the missing information from ocean wave models. The method is based on a maximum a posteriory approach. In contrast to the methods used so far a coupling of wave components is introduced yielding a more realistic and rigorous representation of the a priori knowledge. The scheme is tested using ERS-2 complex wave mode imagettes with collocated WAM model wave spectra, NOAA buoy measurements and ERS-2 scatterometer data. Special emphasize is put on a careful separation of a priori information and SAR observations. This study was carried out in close collaboration with our European partners in the framework of the European action, directional spectra of ocean waves (COST714).

EUROCEAN '2000

Abstract

Analysis of ERS SAR imagery and airborne oil surveillance data with respect to the detectability of marine oil pollution in European marginal waters

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We have analyzed more than 700 ERS SAR images of European marginal waters (acquired between December 1996 and November 1998 over the Baltic Sea, the North Sea, and the northwestern Mediterranean Sea) with respect to the detectability of marine oil pollution. Our statistical analyses provide information on the main locations of oil spills as well as on their temporal distribution. By taking into account mean surface winds we define the "normalized visibility" of marine oil pollution, i.e., the dependence of the oil spill detectability on wind speed. The normalized visibility, therefore, is a quantitative estimate of the usefulness of satellite-borne SAR techniques for oil spill monitoring with respect to the local environmental conditions, namely the local wind speed. Moreover, the normalized visibility enables us to show that the Baltic Proper, even though less pollution has been detected by the ERS SAR, is likely to be as polluted as the northwestern Mediterranean Sea. To demonstrate this, we provide maps for the three test sites showing the mean polluted surface area. Finally, we compare the results of the analysis of SAR images from the Baltic Sea with pollution data provided by local oil surveillance authorities. We use surveillance data from oil spills detected by both satellite-borne and airborne sensors to get more information on the life time of such oil spills. Again, this comparison helps to better describe the efficiency of the ERS SAR for oil spill monitoring.

Systems for operational use of remote sensing data in navigation in ice-infested areas

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Abstract

This paper describes technical solutions for facilitating operational use of remote sensing data when navigating in ice-infested areas. The system design principles have been validated onboard icebreakers, and on merchant ships that operate in the Baltic Sea.

Information about the prevailing ice situation is essential for ships in winter traffic in the Baltic Sea. Manually drawn ice charts can be delivered by fax and they provide a general overview, but satellite images provide a much more detailed and useful view of the situation – for example the use of SAR images onboard the Finnish icebreakers has significantly reduced the need for using helicopters for ice reconnaissance.

VTT Information Technology has developed a family of GIS (Geographic Information System) applications for operational use of remote sensing data. *ViewIce* is intended for merchant ships. It has satellite image viewing and route planning functions. *IBPlott* is part of the icebreaker system *IBNet*. IBPlott combines satellite images and route planning with presenting the traffic situation at sea, and thus provides the most important components as background for icebreaker assistance planning. The applications are implemented on a common software base using a *thick client* model because of the mobile environment and the rich set of functions.

The applications are designed for a production chain, where the remote sensing data is received on a ground station, prepared, processed and then compressed before distribution to the client applications onboard the ships. This architecture enables preparation and sending of different types of geographically located data, such as ice charts, weather forecasts and information about the traffic situation, using the same communication channel from shore to ship.

The systems have been in operational use on the icebreakers and on some merchant ships, and the feedback has been positive. However, the users desire a single tool which would, besides the satellite images, also present them with meteorological, hydrological and traffic situation observations and forecasts. Including forecasts in the system would introduce a new dimension - time - to the data flows with corresponding increases in the amount of transmitted data. The challenges then are how to cope with the narrow bandwidth of the communication channels in a cost-effective way and how to present the variety of different observation and forecast data types to the users in a consistent and understandable way. Some of these challenges

have been addressed in the EU-funded research project PRESTO, and other aspects are to be addressed in the research project IWICOS under the EU IST programme.

The paper focuses on analysing the technical alternatives of designing a near real-time system that provides remote sensing data for mobile clients, the functions of such a system and the end-user feedback regarding the usability of remote sensing data. A recommendation for further development topics is also given.

EurOCAN 2000
Hamburg, Aug 29 – Sept 2, 2000

USE OF SATELLITE DATA IN OPERATIONAL ICE SERVICE

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Among the basic obligations of an operational ice service is to provide ice information to navigation as timely and accurately as possible. Although the requirements of the different users may vary considerably, the common approach is to find/recommend an optimum route between the ice edge and a port or another point/area of interest within the ice cover. Powerful icebreakers may choose the shortest way. Less powerful and ice-strengthened vessels heading for friendly ice choose the best, i.e. easiest, fastest and least dangerous route. Economic and safe ice navigation means to avoid as much hostile (heavy) ice as possible - e.g. by using leads and circumnavigating large thick ice floes. In general it is better to approach the port of destination indirectly than to cruise straight ahead.

In order to be able to choose an optimum route through the ice, detailed information about the ice conditions is required. The view from the bridge or the crow's nest of a vessel offers only very limited tactical support, and the probability that a lead may prove to be a blind alley is rather high. As the availability of helicopter and/or aircraft ice reconnaissance is limited, satellite ice information is a basic tool for tactical and strategic support to ice navigation. Since the late sixties, ice information has been based mainly on visual/IR weather satellite images, and in the late seventies derived ice information from scanning microwave radiometers (SMMR & SSM/I) was additionally available. The launch of ERS-1 in July 1991 offered the opportunity of (near) real-time use of high resolution radar (SAR) ice information via different on-line data distribution links. Special routine applications in the 'home waters' and demonstration campaigns for research vessels in polar waters were performed. The presentation will deal with information on the activities and some relevant results. The primary objective is to demonstrate with various examples the potential use and the limitations of optical/infrared and microwave satellite sensors for ice identification and ice navigation in an operational environment. Technical constraints are highlighted. Perspectives are presented with special emphasis on the SAR data (ERS, RadarSat). To merge or assimilate their given formats and ice information potential, modified or new cartographic SAR (and other sensors) ice information products and routines must be developed for the routine users.

On the Application of Air- and Spaceborne Radar Imagery of Submarine Bottom Topography in the Coastal Zone

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Abstract

De Loor and coworkers in the Netherlands gave a first description of radar signatures of submarine sand waves in coastal waters already in 1981. They noticed such signatures in airborne radar imagery over the southern North Sea acquired in 1969, but little attention was paid to it. This changed drastically after 1978 as one of the instruments aboard the SEASAT satellite, the Synthetic Aperture Radar (SAR), produced unexpected views of the sea surface clearly showing the ocean floor.

First models described the radar imaging mechanism of submarine bedforms as a three-step process: (1) The interaction between the current and the sea bottom topography produces variations in the current velocity at the sea surface. (2) The variation in the surface current modulates the short-scale surface roughness which can be described by the weak hydrodynamic interaction theory in the relaxation time approximation. (3) The modulation of the wave spectrum gives rise to changes in radar backscatter.

During the next ten years the analysis of a variety of radar images has revealed patterns of reduced and enhanced sea surface roughness signatures corresponding to slope and crest regions of bedforms often previously mapped also by side scan sonar. The fact that submarine bottom topography in coastal waters becomes visible on air- and spaceborne radar images suggests that it may be possible to employ these remote sensing techniques for a cost-effective retrieval of depth charts. The development of quasi-operational tools for bathymetric radar image applications is of interest for a variety of end users. One aim is the application and validation of inverse modelling of the sea bottom topography to assess water depths from radar images. A research group in the Netherlands developed an operational system which has been implemented in a so-called Bathymetry Assessment System (BAS) which combines echosounding and SAR observations.

Nevertheless, acquisitions of experimental data are still needed in order to gain more insight into the wave-current interaction mechanism and to calibrate and validate the existing radar imaging models. Therefore, a field experiment in April 1996 within the Marine Science and Technology (MAST-III) programme of the European Commission (EC) was performed using a SAR and an Air-Sea Interaction Drift Buoy (ASIB) system. SAR images and in situ wave energy density measurements were acquired quasi simultaneously. This offered, for the first time, the possibility to compare P-band normalized radar cross section (NRCS) modulations and corresponding spectral wave energy density variations to prove the responsible first order Bragg scattering mechanism: both profiles compare fairly well, taking into account the lower spatial resolution of the wave energy density measurements. Although the narrow streaks of reduced sea surface roughness are undersampled, the profile of wave energy density shows the position of these streaks to coincide with the steep slope of the sand waves close to the crest. An independent georeference was not realized for the SAR image. But the superposition of the NRCS modulation with the wave energy density data showed that the SAR image can be positioned relative to the topography with some confidence. The conclusion is, that SAR imagery and the in situ measurements provided a qualitatively consistent view of sea suface manifestations of sea bottom topography. Quantitatively, the P-band NRCS and wave energy density modulation depths agreed within a factor of 2 which is acceptable but has to be further improved.

This contribution is submitted for the scientific colloquium of

- Marine and coastal information from space

Satellite remote sensing combined with numerical modelling an effective combination for river plume studies in coastal regions – example of the Oder River in the Southern Baltic Sea

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Submitted to the scientific colloquium "Marine and coastal information from space"

Abstract

Satellite data of different spectral ranges in combination with in situ measurements and numerical modeling were used to study the water exchange in the Pomeranian Bight characterized by the main freshwater input into the western Baltic Sea coming from the Oder river and Greifswald Bay. The distribution patterns of the discharge in the bight dominated by the local wind were investigated by sea surface temperature (SST) maps, derived from Advanced Very High Resolution Radiometer (AVHRR) data of the NOAA- satellites, verified by shipborne measurements. Distinct winds from the eight main directions induced typical distribution patterns. From an analysis of typical distribution patterns of the river discharge in relation to the main wind directions and in comparison to seasonal long term wind statistics, the two main transport directions were derived. The prevailing westerly winds produced an onshore transport and a downwind coastal jet which transports the river water along the Polish coast, in certain cases over a distance of 300 km to the Gdansk Bay. During a period of stable westerly winds, the calculated time scale for a water transport over 250 km corresponded to the observed time of 12 days indicating a mean current velocity of about 30 cm/s comparable to current measurements and simulations. In spring, the period of maximum river runoff, easterly winds dominate and transport occurs along the German coast into the Arkona Sea. The river water is guided by upwelling processes in front of the Polish coast. During occasional north-easterly winds stable plumes form in front of the Swine river mouth partly for several days.

These results allow to predict the main transport directions, affected coastal areas and accumulation basins for the Oder river load. The coupled numerical circulation and ecosystems model allowed to identify the processes forming the typical patterns. During the exceptional Oder flood event in summer 1997 this combination had a current application and delivered an important contribution to the monitoring of the river plume. Quasi-online satellite data were the basis of the daily in situ measurement planning. Additionally ocean colour data were used to follow the sediment transport an important tracer for inorganic and organic pollutants as trace metals, chlorinated carbons or bacteria and viruses to identify the extent and the affected areas.

The combination of satellite data and coupled ecological modelling will be actually used to optimise and improve coastal monitoring activities and support the interpretation of shipborne coastal pollution monitoring. Furthermore, from this combination can be expect an improvement of reliability and prediction of affected coastal zones during exceptional events.

ASSESSMENT OF PRIMARY PRODUCTIVITY AND WATER QUALITY IN COASTAL AREAS USING SATELLITE DATA

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Abstract

The coastal environment acting as an interface between the land and open ocean, is exposed to increasing environmental demands which can affect in a positive or negative way the ecological and economic stability of the coastal zone through eutrophication process and changes in the primary production.

At present, and in spite of a strong demand from major international bodies adequate information using conventional technique alone would not permit a well-defined, geographic estimate of the coastal productivity, and separation of the impacts due to human-induced land exploitation from those of natural climatic variation.

The objective of this presentation is to review the potential of imagery from Earth Observation satellites, particularly optical and thermal sensors, for operational use in monitoring the water quality in the coastal zone.

The combination of recently developed bio-optical models in turbid waters and advanced technical characteristics of recently-launched sensors is of importance to improve the efficiency and the operationality of these models in coastal waters, with the derivation of management products and bio-indicators of relevance to the ultimate users.

Phytoplankton biomass and primary production from satellite are themselves good indicators of the trophic conditions of marine waters. However, these variables do not make distinction between natural processes and the results of a massive flux of nutrient occuring on a land side as a result of man-induced activities. Powerful indices are optimized from the integration of satellite data and field observations with simple modelling activities.

Monitoring of the Straits of Messina by airborne and in-situ measurements

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In the Straits of Messina the strong tidal currents as well as the morphological features determine the upwelling of deep waters to the photic layer. Traditional oceanographic surveys, based on punctual sampling, are sometimes inadequate to investigate the areas subject to high variability modifying the distribution of abiotic and biotic parameters in space and in time.
The effect of tidal currents on the upwelling of the Straits of Messina has been measured by using the continuous survey of some tracer parameters in superficial waters (-1m) from sailing vessel and an airborne hyperspectral imaging during the syzygy lunar phase in September 1999.

On field validation survey was executed, in about three hours from vessel, around the peaks of maximum and minimum tidal level, in order to seize the quasi-stationary situations following the dynamic phases of high (southward current) and low (northward current) tides respectively. The parameters measured continuously (every 30 seconds) by the vessel were temperature, salinity and induced fluorescence.

The airborne hyperspectral remote sensing survey has been conducted to obtain a synoptic view of the sea surface temperature and chlorophyll concentration. The Straits of Messina has been surveyed on September 25th 1999, at 14:15 local time, by means of the 4 spectrometers of MIVIS (Multispectral Infrared Visible Imaging Spectrometer- Daedalus AA5000) instrument, recording 102 channels from Visible to Thermal Infrared along four southward oriented flight lines. The first flight line has been recorded from an altitude of 1500m a.s.l. (nadir pixel size of 3m) while the others have been acquired from an altitude of 4000m a.s.l. (nadir pixel size of 8m), both MIVIS scene has been recorded with a scanning speed of 25 Hz.
The collected hyperspectral data set, once calibrated to reflectance and geometrically corrected, has been used to develop preliminary local bio-optical algorithms derived from in situ (ground and sea) measurements and to obtain suitable mapping of the chlorophyll *a* distribution and of the SST (Sea Surface Temperature) of the investigated area.

The applications of the different monitoring methods show similar and corresponding results. The thermal variations, between 21.0 °C and 25.5 °C, showing that the upwelling is confined to the middle and southern zone of the Straits. The measurements of induced fluorescence show higher values in divergence zone (0.5 mV equal to 0.58 µg-Chl*a* l^{-1}).

THE USEFULNESS OF AERIAL AND SPACE IMAGERY IN THE GATHERING OF MARINE AND COASTAL INFORMATION*

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Abstract

An enormous amount of information, collected in different regions of the world over the years, is today available on marine and coastal environment. One of the major limitations is their complexity and then the number of different acquisition formats. Remote sensing techniques provide a useful means to face this problem, storing such information as imagery in a more effective way. The purpose of this paper will be to demonstrate the usefulness and effectiveness of data collected from air and space in the gathering of information on marine and coastal environment.

The Remote Sensing Group (RSG) at the Department of Industrial Engineering, University of Catania, Italy, has been carrying out an intense activity of remotely sensed data collection for many years, obtaining different data sets acquired from different monitoring platforms (satellite, aircraft, naval craft, fixed platforms). Information acquired consists of data from active and passive sensors for water quality assessment and oil pollution monitoring over marine and coastal areas, mainly in the Mediterranean region. The techniques used include, among many others, multi-spectral imagery, radar, laser-based techniques, passive microwave systems, as well as ship-based techniques for traditional collection of marine information. This methodology has been tested also in other geographic areas, such as the in the Caribbean where the use of satellite imagery may cause often problems related to the proximity to the equator. On the other hand, for specific purposes, the most part of such a plenty of images has been collected periodically, providing a powerful tool to monitor environmental changes on short time range in order to monitor human-induced variations in the marine environment.

RSG is now engaged in the organisation of the data acquired mainly as imagery, during the various investigations carried out, within a number of minor projects with local environmental agencies, in order to establish a Regional Information Network (RIN). This action is compliant with the EU policy of technology transfer to other countries and dissemination of results, even if they have been obtained through non-EU funded projects. This is the reason why RSG intends to submit project proposals to EU for funding the activity of data organisation described above within programs where this action would be eligible.

*To be submitted to EurOCEAN 2000 Conference for a Scientific Colloquium on «Marine and Coastal Information from Space», Hamburg, Germany, 29 August - 2 September 2000.

p.m. SESSION C

CONTINENTAL MARGIN RESEARCH :

SCIENTIFIC AND TECHNOLOGICAL ISSUES OF IMPORTANCE FOR EUROPE

Friday, 1 September 2000

The OMARC Cluster

Presented by André Freiwald

As commercial operations move into deeper waters, the challenge of sustainable use, previously focused on the coastal zone and the continental shelf, now extends over the shelf break onto the continental slope and the abyssal plains. To face this new challenge and in a true FP5 approach, a cluster of projects for multidisciplinary margin research is now formed to improve our understanding on gas-hydrates, submarine slope stability, Quaternary evolution of the European margin, cold-water coral reefs, and seafloor and sub-seafloor biosphere activity. This cluster runs under the acronym *OMARC* (Ocean Margin Research Consortium) and consists of the following FP5 projects:

COSTA (Continental Slope Stability), *STRATAGEM* (Stratigraphical Development of the Glaciated European Margin), Co-ordinator: Jürgen Mienert,
ECOMOUND (Environmental Controls on Mound Formation along the European Margin), Co-ordinator: Wolf-Christian Dullo,
GEOMOUND (The Mound Factory - Internal Controls), Co-ordinator: Jean-Pierre Henriet,
ACES (Atlantic Coral Ecosystem Study), Co-ordinator: André Freiwald,
DEEP-BUG (Development and assessment of new techniques and approaches for detecting deep sub-seafloor bacteria and their interaction with geosphere processes), Co-ordinator: John Parkes.

These projects are to complete the inventory of the deep-water mineral and biological resources of the European margins. They will contribute to the safe and environmentally friendly exploration and exploitation of European deep-water resources. In particular they will bring in new elements on environmental aspects of rich hydrocarbon-bearing provinces and highly exploited fishery zones in deep-sea. To ensure a timely and effective transfer of results to relevant end-users and stakeholders, the cluster will interact with Industry by establishing links with 4 ongoing Joint Industry Projects (JIPs) - SEABED project in Norway, GEML Network in the Faroes, WFA in the UK and PIP in Ireland - representing 27 European oil companies. Representatives from the whole hydrocarbon industy in Europe will also be invited to interact with the projects on a continuous basis. The cluster is also strongly

connected to the Ocean Drilling Programme, the international consortium conducting deep-sea seafloor sampling all around the world.