Amplitude-phase differences of thermal characteristics of an atmosphere and ocean in a coastal zone of North-East Black Sea.

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The major feature of interaction between ocean and atmosphere in daily scales are amplitude-phase differences of thermal characteristics of an atmosphere and ocean. Daily changes are cyclic processes. For the analysis of phase shifts of cycle processes two-parametrical phase diagrams is used. The choice of each pair parameters is defined by physical features of researched processes. In coordinates of these parameters on a plane their dependences in time which for cyclic processes form the closed trajectories can be considered. Phase trajectories were considered for air temperatures and surface water temperature; saturation water pair pressure and partial water pair pressure near sea surface. Phase diagrams were built for observation data in a coastal zone of Black Sea summer 2004-2005. A direction of walk loops of a diurnal cycle is clockwise. Such direction reflects lagging a phase of ocean from an atmosphere in a diurnal cycle (on 2-3 h.). The nature of a phase leading in air temperature of water temperature will consist not only in the big water specific heat, but also in the increased ability of a moist atmosphere above ocean to absorb coming and reflected by ocean solar radiation.

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POSTER

Towards a Biogeochemical Classification of Alluvial Estuaries

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Alluvial estuaries are characterized by a strong coupling between tidal hydraulics, salinity intrusion, biological, chemical and morphological processes. These processes are driven by a wide array of forcing mechanisms and interact on very different temporal and spatial scales. As a result, the understanding of the physical, chemical and-biological interactions is still limited and a biogeochemical classication of alluvial estuaries is thus seriously compromised. However, the use of idealized, yet physically-resolved reactive-transport models can advance our understanding of the estuarine biogeochemical functioning under contrasting conditions of climate, system geometries and river inputs. This approach can ultimately provide a synthetic view of the role of the estuarine filter for the global coastal nutrient and carbon cycles.

In this study, the possibility to classify alluvial estuarine systems based on the mutual interdependence between geometry and hydrodynamics, on the one hand, and between hydrodynamics and biogeochemistry, on the other hand, is explored by means of a reactive-transport model. The proposed estuarine classification scheme is established on the premise that physical forcing mechanisms are the dominant controls on estuarine biogeochemistry at a series of hierarchically related system levels. Each level of the hierarchy describes a level of organization that dominates a specific spatiotemporal scale. A set of reactive-transport model simulations is then used to provide first insights into the variability in the estuarine functioning and response from the constraints set by the riverine inputs and the fundamental characteristics of estuarine systems. The simulation results are analyzed to determine the extent to which the system's biogeochemical functioning can be related to the hydrodynamic and geometric estuarine characteristics.

AlgaRisk: A pre-operational algal bloom monitoring and forecast tool.

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A partnership between the Met Office, Plymouth Marine Laboratory and the Environment Agency (EA) is currently developing a demonstration service for forecasting water quality and nuisance algal blooms based on the combination of Earth Observation data and operational physical-biogeochemical models.

The operational Medium Range Continental Shelf (MRCS) model, combined with the ERSEM biological model, is daily run at the UK Met Office. Its model output, mainly chlorophyll, SST, stratification, tidal range and nutrients, is combined with Numerical Weather Prediction model variables (wind speed and direction, cloud cover pressure, PAR), to produce a set of indicators on which to anticipate algal blooms.

Satellite data are processed at the Plymouth Marine Laboratory in near-real time to provide water quality indicators, which are available as maps a few hours after the satellite overpass and are instantly viewable through the AlgaRisk portal, developed as part of this project. The indicators include chlorophyll-a concentration, a spectral classifier to estimate the likelihood of certain HAB species and sea-surface temperature.

The AlgaRisk web portal is updated daily and allows users to view the most recent satellite and model indicator maps. The user can view historical conditions, current conditions and forecast data, up to five days ahead, allowing them to compare the range of different indicators and environmental parameters detailed above.

The service is being tested in anticipation of a European Union Bathing Waters Directive that will require the UK Environment Agency to provide water quality forecasting by 2015. The pilot service aims to assist present Environment Agency activities by providing sufficient forewarning to ensure that response teams can anticipate a bloom event and effectively mobilise targeted monitoring programmes. This presentation will describes the service operation in terms of Earth Observation (EO) and model data provision, products and service reliability since the beginning of the project in April 2008.

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The state of the art of the emergency plans and contingency for oil spills in Brazilian ports and maritime terminals.

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The Brazilian regulation establishes that potentially polluting activities, as is the case of ports and maritime terminals, must develop emergency plans for contaminant spilling in order to prevent impacts on the physical, biological, socio-cultural and work environment. The Brazilian Federal Law nº 9966, of April 2000, known as the "Law of the Oil" established the basic principles, to be followed by the companies that manipulate oil and other harmful or dangerous substances in ports, maritime terminals, platforms and ships. The Law defines that the emergency plans are a chain of procedures to be immediately set after an incident, determining responsibilities and defining human resources, materials and adequate equipments for the prevention, control and combat of the waters pollution. The Emergency Control Plan - PCE has the purpose of defining the operational structure to fight emergency situations that threaten man, the environment and the port patrimony. Among these emergency situations fire, explosion, spilling or dumping of dangerous products, pollution or other accidents with victims can be mentioned. Besides the PCE, the Mutual Assistance Plan `- PAM is an integrated emergency action that set multi-user structures for large-scale events. The emergency plans in the logistics of transportation of oil had gained notoriety, mainly from a number of large-scale accidents that due to its dimension get out of control because of the lack of structure (equipment and personnel). In Brazil, the three last accidents of large mediatic repercussion were: the great oil leaking of the Refinery Duque de Caxias, in Guanabara Bay (Rio de Janeiro) in the year 2000; the careening and, the posterior shipwrecking, of the petroleum platform P-36 in the Campos Basin in the year 2004 and the explosion of Vicunha ship, in a terminal of liquid granaries in Paranaguá Bay in the year 2005. This article aims to raising the current situation of the emergency plans of harbors and maritime terminals in the Brazilian coast. It can be observed that although many units within the port have their own PCEs as determined by the Portuary Authority, the integration of these units in a PAM is not set, so far. The definition of responsibilities and roles of each of the players in a PAM is not yet well established because it depends on the overall arrangements of the units in a port. However, it is necessary that the local authorities, including the environmental agency start to discuss a generic model that would warranty the safety of the large-scale operations in the port and prepare for amplified accidents. As a conclusion, some suggestions on the organization of this model are offered.

POSTER

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Action plan for integrated coastal management in the Saquarema Municipality (Rio de Janeiro, Brazil) aiming sustainable activities

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Coastal lagoons are known to have important ecological and economic roles in the coastal environment. Under the ecological point of view, these environments are used by a number of species as breeding area, and are also important sources of nutrients that support whole oceanic food chains. The coastal lagoons have supported marginal communities that carry out traditional fishing for the last four or five thousand years. However, in the last few decades, coastal lagoons were subject to a strong touristic development, that was responsible for predatory occupation and uncontrolled degradation of its surroundings. Besides the fact that this occupation constituted a serious treat to traditional fishing, in the long term it is expected to be unsustainable because of the destruction of the scenery. The conflict of uses can be attributed to the fact that no action plan has been set-up to guarantee the preservation of the environment and the control of processes like increasing sedimentation and eutrophication. The need for remediation solutions has drove the authorities to develop strategies that may, in some cases, improve environmental quality. This is the case in the lagoon of Saquarema, where the construction of an artificial canal, connecting the lagoon with the sea (Barra Franca Project), significantly reduced water residence time. Nonetheless, the increased touristic use of the region resulting from the improvement of the environmental quality may, in the short term, engender further degradation. In this work, the results of a socio-environmental survey are presented, and will provide information for an action plan aiming the integrated management of the Saquarema region. The survey was outlined to incorporate community participation that was achieved in seminars and discussion workshops. Well established indexes were assessed to better describe the social and economical features of the region. Semi-structured interviews were applied to local decision-makers to determine the main problems of the region. A strong unbalance of the activities could be detected, indicating that a major part of the GIP (gross internal product) is concentrated in housing construction and short term house rental, activities that were shown to cause serious damages to the environment in the region . The socio-economic and environmental indexes indicated low life quality, when compared to other Municipalities in the State of Rio de Janeiro. The main civil organisations identified were the Tourism Committee, Lagos/São João Consortium (of local Municipalities), "O Saquá" (local newspaper); local water and wastewater company, fishermen association; A.M.I.G.O.S (Inhabitants Association); Forum for the Integrated Local Development of Saquarema; neighbourhood associations and the Municipality. The interviews with decision makers and discussions with the community permitted to identify the main socio-environmental problems (in order): 1) uncontrolled human occupation; 2) dumping of domestic sewage and 3) over-exploitation of the aquifers. It was concluded that the uncontrolled development of summer housing facilities (as a distinguished activity from tourism) is the main environmental degradation factor and an action plan for the integrated management is proposed to mitigate the observed problems.

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Response of circulation and stratification within the Ria de Vigo to externally forced upwelling and downwelling.

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The Ria de Vigo, a wide, semi-enclosed embayment with limited seasonal freshwater inflow in NW Spain, is strongly driven by conditions on the Atlantic continental shelf. Two intensive studies were carried out under contrasting conditions of upwelling and downwelling in June 2007 and September 2006, respectively. In both, an array of ADCPs and temperature, salinity and fluorescence loggers monitored conditions throughout the ria during several weeks surrounding a 6 days of observations of towed and conventional CTD, ADCP and biogeochemical conditions from two vessels. During the first study, airplane over-flights recorded high spatial resolution surface fields of temperature and ocean colour. This overview of the experimental results documents the contrasting response of the ria in terms of stratification, residual circulation and turbulence regimes during upwelling and downwelling states. During the September downwelling, poleward nearshore flow along the continental shelf introduced dramatic warming and a harmful algal bloom into the outer ria. The June upwelling study revealed surface outflow and the penetration of a lower layer of cold, nutrient rich water into the ria. In both cases, strong fronts form in the inner ria through interaction of the externally forced circulation and the relatively weak estuarine outflow. The influence of upwelling events well inside the ria delivers nutrients and plankton to these sheltered waters. Consequently the ria forms part of the largest mussel production area in Europe. On the other hand, downwelling events and their associated harmful algal blooms can have deleterious economic impact by forcing closure of the mussel industry. The achievement of a rational balance between the demands of aquiculture, mercantile activity through the port of Vigo, tourism, and the burgeoning coastal population of the ria demands better understanding of the ria ecosystem as a whole.

Seasonal and interannual variability of physical oceanographic characteristics in a Marine Protected Area of Labrador

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Gilbert Bay is the first marine protected area in the Canadian subarctic coastal zone. It is situated on the southeast coast of Labrador Sea and is the habitat of a unique population of Atlantic cod [Wroblewski et al., 2007]. This talk will present results from an observational study of the physical oceanographic characteristics of Gilbert Bay. The observations suggest a recent warming trend in atmospheric and seawater temperatures. A physical oceanographic model is used to diagnose the detailed thermohaline variability of the water column and sea-ice during the past 50 years. The model solution for recent relatively warm years is analyzed and compared to model simulations prior the 1990s.

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A climate sensitivity study of a Marine Protected Area in Labrador: regional projection of IPCC climate scenarios

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Gilbert Bay is the first marine protected area in the Canadian subarctic coastal zone. It is situated on the southeast coast of Labrador Sea and is the habitat of a unique population of Atlantic cod [Wroblewski et al., 2007]. This talk will discuss the potential changes in vertical thermohaline structure and sea-ice which are expected to happen in this region. A one dimensional turbulence model (GOTM) is used to simulate the thermohaline variability of the water column. The surface forcing is from IPCC scenarios for future climate change in the region. Model results suggest that the future changes in the thermohaline stratification and sea-ice are strongest under the A2 scenario. If the atmospheric characteristics vary according to this scenario, sea-ice in Gilbert Bay will disappear before 2100. Stratification will become weaker with a warmer and saltier surface layer during the summer months. The talk will present detailed comparison of all IPCC climate scenarios and potential local environmental changes.

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Net ecosystem production and carbon dioxide fluxes in the Scheldt estuarine plume

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A time series of 4 consecutive years of measurements of the partial pressure of CO2 (pCO2) in the Scheldt estuarine plume is used here to estimate net ecosystem production (NEP). NEP in the Scheldt estuarine plume is estimated from the temporal changes of dissolved inorganic carbon (DIC). The strong seasonal variations of NEP are consistent with previous reports on organic carbon dynamics in the area. These variations are related to successive phytoplankton blooms that partly feed seasonally variable heterotrophy the rest of the year. On an annual time scale the Scheldt estuarine plume behaves as a net heterotrophic system sustained with organic carbon input from the Scheldt inner estuary and the Belgian coast. During one of the years of the time-series the estuarine plume behaved annually as a net autotrophic system. This anomalous ecosystem metabolic behaviour seemed to result from a combination of bottom-up factors affecting the spring phytoplankton bloom (increased nutrient delivery and more favourable incoming light conditions). This net autotrophy seemed to lead to a transient accumulation of organic carbon, most probably in the sediments, that fed a stronger heterotrophy the following year. The present work highlights the potential of using pCO2 data to derive detailed seasonal estimates of NEP in highly dynamic coastal environments. These can be used to determine potential inter-annual variability of NEP due to natural climatic oscillations or due to changes in anthropogenic impacts.

POSTER

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Estimating pCO2 from remote sensing in the Case-II waters of the Belgian Coastal Zone – First results from the BELCOLOUR-II project

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In coastal waters, a purely data based approach will be probably insufficient to better constrain the air-sea CO2 fluxes, to study their inter-annual variability and their long-term changes. One approach to achieve these goals is to use remote sensing fields of relevant biogeochemical independent variables to extrapolate available data, and produce maps of the partial pressure of CO2 (pCO2) and air-CO2 fluxes. In the open ocean this approach has to some extent been successfully used based on fields of chlorophyll-a (Chla), sea surface temperature (SST) and sea surface salinity (SSS). This approach remains challenging in coastal waters that have complex optical properties (Case-II waters) and that exhibit highly dynamic pCO2 temporal and spatial variations. During the first year of the Belgian funded BELCOLOUR-II project (Optical remote sensing of marine, coastal and inland waters; http://www.mumm.ac.be/BELCOLOUR/EN/index.php), three field cruises for optical measurements were carried in April, July and September 2007. Here, based on the preliminary BELCOLOUR-II data, we investigate the possibility of deriving algorithms to predict pCO2 from remote sensed variables.

POSTER

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Variability of the partial pressure of CO2 in the upper Scheldt estuary from 2003 to 2007

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The variability of the partial pressure of CO2 (pCO2) is investigated at several time scales (diurnal, seasonal and inter-annual) in the upper Scheldt estuary from a time-series from 2003 to 2007 at the Ste Anna fixed station located in Antwerp (51°14'N 4°23'E). The diurnal variations of pCO2 are dominated by the tidal signal. The seasonal variations of pCO2 are related to the combination of temperature change, emission of CO2 to the atmosphere and biological activity. From 2003 to 2006, the annual average of pCO2 is relatively stable. A very marked pCO2 decrease was observed from 2006 to 2007 that we attribute to the start of the Bruxelles-Nord sewage treatment plant that started early 2007.

POSTER

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Carbon dioxide dynamics and air-sea CO_2 fluxes in several Southern European Seas ecosystems: results from the EU IP SESAME

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Underway measurements of the surface partial pressure of CO2 (pCO2), surface oxygen saturation (%O2), sea surface temperature (SST) and sea surface salinity (SSS) were obtained with a 1 min frequency during the March-April and September-October 2008 cruises of the EU IP SESAME (Southern European Seas: Assessing and Modelling Ecosystem changes) on board the BILIM in the Cilician basin, Levantine basin, Eastern Aegean, Straits & Marmara Sea and Black Sea. Cross analysis of pCO2, %O2, SST and SSS allows to identify the major drivers of pCO2 dynamics in these areas (temperature change effect on the solubility coefficient, biological activity, river inputs, …). The relative horizontal variability and seasonal change is analysed across the 5 ecosystems. Air-sea CO2 fluxes were computed and atmospheric CO2 source-sink status of the 5 regions is evaluated, and compared to the other Southern European Seas ecosystems that are the focus of SESAME.

POSTER

Modelling the interactions of mussel farming with C, N and P biogeochemical cycles along the north western Adriatic coast

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We present the results of a modeling study aimed at assessing the interaction of long-line mussel farming (*Mytilus galloprovincialis*) with the carbon, nitrogen and phosphorus cycles at a regional scale. The integrated numerical model was applied to a coastal area located in the north western Adriatic Sea, (Italy), where mussel farming has been constantly increasing in the last 20 years. The integrated model includes three coupled modules: 1) a 2D pelagic biogeochemical reaction-transport model; 2) a farmed mussel population dynamic model, 3) a model for the simulation of early diagenesis processes in surface sediment. The first module simulates the evolution of the concentrations of ammonia, nitrate, reactive phosphorus, organic non-living seston and of the densities of two microplanktonic and one zooplanktonic pools. The second one, describes the growth of farmed mussel, in term of wet weight and length and allow one to compute the total fluxes of mussel biodepositions on the sea bed. These fluxes represent the input for the early diagenesis model, which enables one to estimate the steady-state vertical profile of ammonia, nitrate and reactive phosphorus in the pore water of the superficial sediment. The fluxes of the above compounds, from the sediment to the water column, are then computed on the basis of Fick's law. Model results indicate that the biomass yield depends on the location of a licensed area. Furthermore, even though the amount of organic biodeposition per unity surface is much lower than that produced by sea-cage fish farming, the overall impact of mussel farming on the C, N and P cycles may be more significant at a regional scale, because of the much larger extension of mussel farming licensed areas. These findings suggest that this integrated model can be used for assessing the changes in the functioning of the coastal system in response to intense levels of mussel farming, the so-defined "ecological carrying capacity issue" (McKindsey et al., 2006). Moreover, these model capabilities may represent important features, when applying it as a tool for managing mussel farming in a ICZM approach.

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Simulation of sub-mesoscale eddies in the Ligurian Sea

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We study numerically the dynamics of intense anticyclonic eddies in the Ligurian Sea (NW Mediterranean Sea). To this end, we use the Regional Ocean Modeling System (ROMS) configured at a resolution of 3 Km for a domain covering the Ligurian Sea, with an embedded child grid covering the North-West part of Ligurian Sea at a resolution of 1 Km. The model is forced with daily mean boundary conditions at the open lateral boundaries. We compare two simulations. In the first run, the model is forced by climatological monthly mean wind stresses, while in the second run it is forced by daily mean wind stresses. The latter simulation shows the formation of intense anticyclonic eddy structures in the coastal area, generated by the variable winds and by the interaction with bottom and coastal topography (NW part of the Ligurian Sea). We discuss the effects that these vortices have on the distribution and dynamics of phyto- and zooplankton.

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First two years of results from a mooring over a Posidonia Oceanica seagrass meadow (Corsica, France)

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We report the first two year of results from a 10m deep mooring over a Posidonia Oceanica seagrass meadow (Corsica, France) where we deployed from August 2006 to August 2008 an array of 3 optodes, a fluorometer and a sensor for measurements of the partial pressure of CO2 (pCO2). The oxygen data are used to compute by mass balance ecosystem metabolic performance rates (gross primary production, community respiration, net community production). The comparison with rates derived from discrete benthic incubations (every 2 months) is very satisfactory. The pCO2 data are used to assess the sink or source of atmospheric CO2 of the Posidonia Oceanica seagrass meadow. An application of such a mooring is to detect changes in the productivity of the Posidonia meadow that can be used as indicators of overall ecosystem "health" or degradation by human activities. Such a mooring can be used as an affordable and simple tool for management and sustainable development of coastal areas in the Mediterranean.

COSYNA, an Integrated Coastal Observation System for Northern and Arctic Seas

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The development of an integrated coastal observing system for the German Bight (COSYNA) is one of the focal issues of German marine research in the next decade. A major challenge of COSYNA is to tightly fusion data from a dense observational network and modeling via data assimilation. The integrated system will focus on daily-to-weekly processes providing objective measures of uncertainty in the state estimates and forecasts. In the longer run it will also cover seasonal and inter-annual time scales and could contribute to identifying changes in the North Sea ecosystem, including climate-induced and anthropogenic cause-and-effect chains and for the development of future scenarios with increased confidence.

The German Helmholtz Research Centre GKSS will coordinate the implementation of COSYNA from 2007 to 2012 as a central part of its national mission in close cooperation with members of the German Marine Research Consortium (KDM). The system is closely connected to existing monitoring programs. Individual components will be deployed in coastal arctic waters as well.

The observational module of COSYNA is designed to change the present typical situation of under-sampling both in time and space towards a pre-operational, remotely controlled observation mode where ecosystem key variables and processes will be studied with high temporal and spatial resolution. This approach requires novel technological solutions. High-resolution time-series will be recorded by multi-sensor underwater systems mounted on research platforms and wind turbines in the German Bight. Cruising autonomous underwater vehicles and ships-of-opportunity will fill up the spatial gaps between these reference stations throughout the water body, while remote sensing techniques will provide synoptical views of water surface parameters on a large spatial scale.

COSYNA will link partially existing systems from Wadden Sea basins to the North Sea scale. Physical and biogeochemical key parameters including fluxes will be measured vertically from the sediment-water to the water-atmosphere interface. Transects from intertidal zones to offshore locations will allow the representation of horizontal, cross-coastal gradients, for example with respect to wave fields or water quality.

The presentation will outline the functional COSYNA elements and illustrate first results from a pilot phase. For example, we illustrate consistency and complementarities of different data sets from observations and modeling and exemplify the integration of data into a coupled physical-biological model resolving meso-scale structures in chlorophyll in the Wadden-Sea. Potential benefits for both marine science and coastal management will be discussed and specific benefits for stakeholders are indicated. Finally, the international dimension of this coastal observatory is put forward.

Development of environmental and climate indicators based on Marine Core Services in support to European Environment Agency and local authorities

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New services such as the routine production of environmental and climate indicators for specific users are nowadays possible thanks to the maturity of development of the Marine Core Service (MCS). Indicators are synthetic indices of environmental changes at various time scales. The indicators are used by international environmental agencies and national directorates like the European Environment Agency (EEA web page on indicators: http://themes.eea.europa.eu/indicators/) and by the regional Conventions (i.e. Helcom webpage on indicators: http://www.helcom.fi/environment2/ifs/en_GB/cover/). We are presenting the preliminary results of the process of improving existing indicator in use by EEA and on the development of new indicators based on MCS products. The list of indicators includes: Temperature anomalies and trends, Chlorophyll-a (from ocean colour) trends and water column stability indicators.

A Sea Surface Temperature (SST) indicator has been designed and it consists of: a) long (120 years) timeseries of SST anomalies that evaluate climate change signals in the European Seas; b) SST trends of the last 25 years in the European Seas to estimate spatial changes of SST; c) real time SST for the European Seas to detect temperature anomalies that may effect coastal ecosystems. The SST indicator is in the process of being accepted by EEA and has been included in the recent EEA report "Impacts of Europe's changing climate - 2008 indicator-based assessment"[19]. Moreover a webpage has been launched at EEA website to present these SST products: http://www.eea.europa.eu/themes/coast_sea/sea-surface-temperature

Chl-a trends, deduced from satellite Ocean Color MCS products, are presented and will contribute to the further development of the EEA Chl-a indicator that is based on chl-a in-situ measurements (CSI023[20]). To take into account the different morphological and hydrological structure of European regional areas and identify shelf, coastal water areas we have classified the European waters into 'Chl-a areas'. The Chl-a areas have been defined in the European Seas on the basis of River Basin Districts[21] (WFD-Water Framework Directive[22]) and ocean sub-basins, each chl-a area have been sub-divided in a coastal sub-area from 0 m to 30 m depth and in an off-shore sub area from 30m to 200m depth. *Chl-a* trends have been calculated for the Mediterranean Sea and Black Sea *Chl-a areas* using MCS products. The *Chl-a trends* show a spatial variability with maximum negative trends in areas close to Po Danube rivers' mouths and positive trends in proximity of other rivers such as the Ebro.

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[19] http://reports.eea.europa.eu/eea_report_2008_4/en

[20] http://themes.eea.europa.eu/IMS/ISpecs/ISpecification20041007132031/IAssessment1116504836843/view_content

[21] http://www.eea.europa.eu/themes/water/mapviewers/myRBD

[22] http://ec.europa.eu/environment/water/water-framework/index_en.html

For the above mentioned indicators production phase has been undertaken in 2008 within the European Topic Center for Water (ETC-W[23]) and BOSS4GMES[24] projects and will continue using MyOcean [25]MCS products. In addition to the products described above, we have also identified a Density indicator that appears relevant for the eutrophication problems and ecosystem health.

A Decision Support System is under development for the Regional Environmental Protection Agency of Emilia Romagna in Italy (ARPA-DAPHNE). The so called ADRI-DSS (ADRIatic sea Decision Support System) aims to contribute to the environmental monitoring system of ARPA-DAPHNE. ADRI-DSS will consist of a visualization system that integrates the following products: a) model simulations and forecasts from the Adriatic Sea forecasting System (AFS); b) real time satellite observation related to SST, Chl-a, and Sea Level; d) in situ observations; e) SST and Ocean color derived indicators. ADRI-DSS will also allow the extraction of timeseries and online post-processing.

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23 http://water.eionet.europa.eu/

24 http://www.mersea.eu.org/Indicators-with-B4G.html

25 http://myocean.oceanobs.com/

Assimilation of Sea Surface Temperature in the MARS3D modelling System using Ensemble Kalman Filter

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A study of sequential data assimilation of satellite derived sea surface temperature (SST) in the free surface primitive equation model MARS-3D [*Lazure and Dumas*, 2007] using Ensemble Kalman Filter [*Evensen*, 2003] is presented with application to the Bay of Biscay. Skill assessment of the data assimilation system is analysed over April-July 2006, a period for which independent temperature and salinity profiles are available over the Continental shelf.

The spatial and temporal structure of forecast errors is investigated using an ensemble modelling approach (Monte-Carlo). Multivariate ensemble forecast statistics associated by distinct model error sources (wind forcing, model parameters) are shown to be neither homogeneous over the Continental shelf nor stationary. In this large space dynamical system, localization and filtering of small-sized ensemble correlations is needed to provide a consistent result for EnKF analysis. The localization used is inversely proportional to the bottom depth. Statistical analysis of the ensemble forecast reliability also reveals that SST forecast errors over the Continental Shelf of the Bay of Biscay are season-dependant: in spring they are mainly governed by the fraction of light loss due to scattering and absorption (extinction coefficient) which occurs over the Loire and Gironde plumes although they are dominated by wind stress and ocean mixing errors in summer.

The potential of sequential data assimilation of SST to improve T-S model predictions over the shelf is investigated using independent in-situ temperature and salinity profiles over spring and summer test periods. The data assimilation system provides significant error reduction compared to the non assimilative one for temperature and salinity over the shelf but does not improve the quality of T-S prediction over the abyssal plain. Finally, the efficiency of combined parameter and state estimation to reduce the SST model forecast biases over the shelf is shown over April-May, a period for which the forecast error is mainly governed by the extinction coefficient.

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Toxicity of copper, nickel and zinc on picoplankton populations of natural water samples from the Strait of Gibraltar.

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Picophytoplankton of water samples collected from two sites of the Strait of Gibraltar, one on the Atlantic side (35º57´16”N, 5º49´41”W) and the other in the Mediterranean (36º00´48”N, 5º15´04”W), were exposed to 72h toxicity tests of copper, nickel and zinc. All samples were analysed by flow cytometry (conferring information of size, chlorophyll a and pigments) during an Oceanographic cruise in September 2008, distinguishing a group that can match with Synechococcus population of oceanic waters with a high phycoerythrin signal, in all surface and deep chlorophyll maximum samples (DCM).

Result data for all metals studied, showed differences in either growth or signals corresponding to chlorophyll a content, phycobilins and cellular volume between samples from the Atlantic and Mediterranean, while no significant differences were observed between populations from surface samples and maximum chlorophyll depth samples. Copper resulted, of the three metals studied, as the most toxic with EC50 growth inhibition values of 3 ppb for populations belonging to the Atlantic samples, and 11 ppb for those belonging to the Mediterranean. For the other two metals studied less than 50% growth inhibition was found in all cases for concentrations studied up to 600 ppb. For all metals there appeared to be an increase of size when exposed to metal concentrations, even in cases where growth inhibitions were less than 20% (Zn); on the other hand, in the case of chlorophyll a and phycoerythrin signals there seemed to be a decrease with metal concentration.

A multi-scale, finite-element model for the transport and fate of contaminants in the Scheldt tributaries, River, Estuary and ROFI

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Modelling the hydrodynamics of the Scheldt Estuary presents many challenges. The predominant dynamical actor, the tide, is propagated upstream more than hundred kilometres, through the Scheldt River and its tributaries, which impedes a simple boundary condition at the upstream end of the estuary. Formulating downstream boundary conditions at the mouth is not straightforward either, due to data scarcity. Therefore, enlarging the modelled domain both upstream (to include the tidally influenced riverine network) and downstream (to the Northwestern European Continental shelf break) is the most elegant solution to enable accurately imposed boundary conditions. In this multi-scale application the use of a single structured computational grid (with the same resolution in whole study domain) would either result in a uselessly coarse resolution in the estuary, or in unfeasible computation times. Instead, one should choose either nested structured grids or an unstructured mesh. The Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM: www.climate.be/SLIM) is a finite element hydrodynamical model and can therefore take advantage of the flexibility of an unstructured mesh, with large grid cells on the continental shelf and much smaller elements in the area of interest, the Scheldt Estuary. Besides the tidal dynamics, the regular drying and submerging of sand banks in the estuary is a typical feature of the study domain. The finite element model was adapted in order to enable an accurate representation of this process. The accuracy of the constructed model was validated against data of hydrodynamical variables.

Besides the hydrodynamics, the model is also coupled to a reactive tracer module to simulate the fate of environmental contaminants. This work falls within the framework of an interuniversity project (TIMOTHY), aiming at a better understanding of the natural and anthropogenic effects on the Scheldt basin and adjacent coastal zone. Fecal bacteria were chosen as a first contaminant case study in the Scheldt domain. They only enter the natural environment by external sources; in the case of the highly populated Scheldt basin these are mostly point sources like waste water treatment plants. After entering this hostile aqueous environment, the fecal bacteria are gradually removed from the water column, either by mortality or by sedimentation. These trends have been observed in previous studies carried out in areas different from the Scheldt. Indeed, the study of fecal bacteria in the Scheldt is hampered by acute data scarcity. Especially data covering relatively short time scales of a few hours are lacking, although the predominant dynamical features, bacterial decay and tidal excursion, belong to this regime. Therefore, this multidisciplinary research project has put some effort in developing a model-based strategy to plan future sampling campaigns such that the resulting data would contain a maximum amount of information. First tests indicated that application of this strategy can reduce the number of needed samples to attain a given level of information by a factor of ten.

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From monitoring to assessment: data management at BMDC

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The Belgian Marine Data Centre (BMDC) serves as the national repository and processing centre for marine and environmental data collected in the framework of national and international research and monitoring programmes. Its holdings cover most domains of oceanology: physico-chemical measurements, optical properties of seawater, biodiversity, hydrodynamics, sedimentology and geography. Most of the datasets relate to the Belgian Continental Shelf, the Scheldt estuary and the surrounding areas. Collecting data at sea is a very expensive business, which makes the database extremely valuable. As such, a good management system is of prime importance for current and future scientific research or for assessment of monitoring data.

The integrated database managed by the BMDC mainly contains the results of in situ measurements and observations and laboratory analyses of air, water, sediment and biota samples. Currently a lot of effort is put into facilitating the inflow of data by adapting and linking relevant existing data storage systems to this database. The quality of the data and their quantity will benefit greatly from the information registered at sampling time onboard the RV Belgica and from a direct link with the management system storing the analysis results at MUMM's chemical laboratory.

Further, the database has recently been extended to enable referencing and documenting of data stored in files such as discrete profiles, time series and trajectories containing data cycles with a high sampling rate.

Online data access to this highly diverse information will be demonstrated (www.mumm.ac.be/datacentre). Some of the data sets, particularly those collected in the framework of the Oslo and Paris convention, cover periods of time of 20 years and even longer. It will be shown how this information can be used to obtain a quality assessment of the marine environment in the Belgian coastal area.

The BMDC is also a partner of SeaDataNet (www.seadatanaet.org), the Pan-European infrastructure for marine and ocean data management. The standards and procedures which are currently being set up in order to ease data querying from more than 40 data centres all around Europe will also be described and demonstrated.

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First examples of operational support in oil spill emergency cases in the Mediterranean Sea

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Marine pollution accidents, oil storage facilities, illegal and continuous discharge of oil along transportation routes are possible sources of spills. At the time of previous accidents in the Mediterranean (Haven Tanker in the Ligurian Sea, 1991) and in the European Seas (Prestige, Galicia, Spain 2002) few operational oceanographic products for oil spill detection and forecasting were available. Now, on the basis of the MOON[33] (Mediterranean Operational Oceanography Network) and GMES[34] (Global Monitoring for Environment and Security) international and European effort the first operational support system in oil spill emergency cases in the Mediterranean Sea has been implemented, providing earlier detections of an oil slick and predictions of its transport, dispersion and drifting. The hydrodynamic model outputs from MFS has been coupled operationally with the 3D oil spill model MEDSLIK [Lardner, 2006]. This model is designed to predict the transport, fate and weathering of an oil spill.

MOON community has been able to provide, through the integrated satellite monitoring system and through the Mediterranean ocean Forecasting System current forecasts (MFS, [Pinardi, 2003]) coupled with MEDSLIK Oil spill model, timely information on the oil spill detection and evolution forecasting during several emergency cases.

In this work, the first examples of an oil spill monitoring and forecasting system in emergency cases will be shown, such as the Lebanon crisis (July 2006), the Gibraltar (September 2007) and Und Adryiatik (February 2008) accidents. During this oil pollution crisis MOON successfully assisted the decision makers in Europe and the Eastern Mediterranean. Moreover MOON has shown the capability of supporting end-users in cases of illegal oil spills detected from Satellite through services such as CLEANSEANET[35].

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Science Based Integrated Coastal Zone Management in the Balearic Islands

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The conservation and management of the coastal zone requires a comprehensive understanding of the multidisciplinary processes that that affect ecosystem health. This requires a strong backing from the natural and earth sciences. However, where understanding physical, biological, and chemical factors within coastal habitats represents a significant challenge to managing coastal environments, in reality, it is the social-economic-political system behind the impacts and the management of these areas that, more often than not, is the limiting factor to conservation and restoration. This calls for multi-disciplinary research, which is currently limited, to bridge the gap between the natural, physical and social realms. Humans appear to be far less predictable than ecosystems. They require, among others, incentives, legislation, enforcement, and awareness in order to change their behaviour. Understanding the processes that govern the actions and choices of humans and how those elements affect natural resources is essential to the conservation of coastal habitats. This reality is especially relevant in the Balearic Islands, one of the most significant tourism destinations in the Mediterranean region.

Since 2005, the Mediterranean Institute of Advanced Studies (IMEDEA) has been working with the Government of the Balearic Islands to implement science-based Integrated Coastal Zone Management (ICZM) in the Islands. The project (i+D+I GIZC) represents the first step towards ICZM in the Islands. The underlying principle of this initiative is the consideration that ICZM, if properly implemented, it is an effective tool for advancing towards sustainability in the coastal zone, ensuring equitable use of coastal resources (natural, socioeconomic, and cultural) and integration among the different administrative and societal sectors. The transfer of scientific information in meaningful formats to policy makers and finding a balance between the natural and social sciences represent significant challenges to this process. In this context, project activities fall under three major categories: (1) Targeted, disciplinary research aimed at addressing specific data needs and priorities to progress towards ICZM, (2) interdisciplinary research aimed at addressing cross-cutting issues, and (3) the generation of technological and conceptual tools and models that will assist decision-makers to effectively manage the coastal zone and address specific issues related to ICZM. Congruent with this are activities to promote the involvement and collaboration of stakeholders and the continuous transfer of information in useable, comprehendible format to decision-makers. Critical research gaps were identified and 35 projects initiated to address them with the involvement of over 50 scientists. Project results include, among others, a system of indicators of ICZM in the Balearic Islands, the development of a spatial boundary decision-making tool for ICZM, quantitative inventories of beaches and bays in Mallorca, and a study of beach user satisfaction. The objective of this presentation will be to share a selection of the current results and lessons learned from the project, thus advancing towards a better understanding of how science may be applied to informing ICZM decisions with the overall goal of achieving sustainability in coastal areas.

Habitat classification and determination of biotic integrity of few tidal channels in north of the Persian Gulf using benthic indices and scoring

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Classification of temperate sea shores and sub tidal soft bottom habitats was started in early 20th century. But in tropical regions such classifications are rare. So description of biotopes and habitats using modern methods of classification is necessary for such regions. The study area Khowr-e Musa tidal channel in the northern Persian Gulf has undergone rapid development in past two decades. Sediment samples were collected seasonally from 18 points with three replicates by van Veen grab for analysis of grain size and organic matter contents. Environmental factors including temperature, salinity, dissolved oxygen, pH, current speed and electro conductivity were measured at sub surface level and one meter above bottom. Shear stress, skewness and kurtosis also were calculated. Benthic index of biotic integrity (B-IBI) was calibrated using exploration of reference data of the area and application of the data to determine ecological health of benthic condition. Analysis of environmental factors showed well mixing in water column due to high altitude tidal regime of the area. Three stations had dissolved oxygen less than 4 mg/l above bottom. Totally 44 macro invertebrate species were identified. Most abundant group was polychaetes (15 species) followed by amphipods (10 species). Density and diversity of macrofauna especially polychaete taxa showed reduction with increasing organic matter. A decrease in size of *Paphia gallus* was observed as compared to the measurement of empty shells collected from the area. Based on B-IBI scores it could be said 72.22% of sites had degraded/ severely degraded conditions and 11.11% of sites had natural condition. By using PCA the area was divided in to three biotopes. The first biotope included sites that had more than 75% percent sand and shell fragments and less than 15% organic matter. The second biotope had less than 15% sand and shell particles and more than 20 percent organic matter and the third biotope had sites with intermediate conditions. Fine fractions (< 0.063 mm) of sediments and their relative factors were found to have a strong correlation with the first component of PCA. The B-IBI scores, biomass and density had maximum correlation with the second component.

POSTER

Improved Jason-2 altimetry products for coastal ocean: PISTACH

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As part of Jason-2 project, CNES is conducting a study to improve altimeter products in coastal areas and inland waters. This 18-months-project named PISTACH for « Prototype Innovant de Système de Traitement pour les Applications Côtières et l'Hydrologie » is structured in three phases.

In the first months of the project, a study of the user needs and the definition of the products were conducted. The second phase dealt with analysis, selection and development of new fields to be taken into account (retracking of the waveforms, radiometer and model wet troposphere correction, local model for correction of tides and atmospheric forcing, sea state bias, data editing). The third phase consists in prototype implementation, validation and operations during Jason-2 CalVal phases.

Since October 2008, the PISTACH prototype is generating coastal dedicated Level 2 (I)GDR altimeter products. These products are delivered to expert users trough an anonymous FTP website. The evaluation of the actual improvements and data quality reached near the coasts is now under investigation.

The main results of the project (user needs, new algorithms and prototype) as well as the PISTACH products will be presented at the meeting.

Benthic fluxes in the northeastern shelf of the Gulf of Cádiz (SW Iberian Peninsula).

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Benthic fluxes of dissolved inorganic carbon, total alkalinity, oxygen, nutrients, dissolved nitrous oxide and methane were determined by benthic chamber deployments at nine stations on the northeastern near-shore continental shelf of the Gulf of Cádiz, during three cruise periods (June 2006, November 2006 and February 2007). Sediment oxygen uptakes and inorganic carbon fluxes, which ranged respectively from 9 to 27 mmol O2 m-2d-1 and from 18 to 58 mmol C m-2d-1, showed a good linear correlation with the organic carbon content of surface sediments (range: 1 – 4 %). Average carbon oxidation rates for each station ranged from 16 to 40 mmol C m-2d-1. Benthic fluxes of methane, which varied between 0.9 and 24 μmol CH4 m-2d-1, represented only about 0.02 % of the mineralized carbon. Two regions were differentiated by sediment properties and location, one off the Guadalquivir River mouth, which showed higher carbon remineralization, and another in the Bay of Cádiz and neighboring shelf. The mean carbon oxidation rate estimated for the entire study site was 27 ± 8 mmol C m-2d-1. About 20 % of inorganic carbon fluxes were attributed to the dissolution of CaCO3. The average ratio of carbon oxidation to oxygen uptake was 1.5 ± 0.2, indicating the importance of anaerobic mineralization processes and the storage of reduced metabolites. An attempt was made to estimate the relative importance of aerobic and anaerobic respiration, resulting in about 35-40 % of the carbon being oxidized via oxygen reduction and the rest via anaerobic respiration. Benthic fluxes of inorganic nitrogen and phosphorus were in all cases lower than expected from Redfield stoichiometry, which suggest nitrogen removal via denitrification and strong phosphorus retention in the sediments. Denitrification was estimated to account for about 12 % of organic matter remineralization and for a loss of about 66 % of potentially recyclable nitrogen. Benthic fluxes of N2O, ranging from -1.2 to 10.4 μmol N-N2O m-2d-1, accounted on average for less than 1 % of total inorganic nitrogen fluxes. Overall, benthic remineralization was estimated to account for about 45 % of overlying primary production, supplying about 15 and 12 % of the phytoplankton N and P requirements, respectively.

POSTER

Air-ice CO_2 fluxes in the Arctic coastal area (Amundsen Gulf).

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Sea ice covers about 7% of the Earth surface at its maximum seasonal extent. For decades sea ice was assumed to be an impermeable and inert barrier for air – sea exchange of CO_2 so that global climate models do not include CO_2 exchange between the oceans and the atmosphere in the polar regions. However, uptake of atmospheric CO_2 by sea ice cover was recently reported raising the need to further investigate pCO_2 dynamics in the marine cryosphere realm and related air-ice CO_2 fluxes. In addition, budget of CO_2 fluxes are poorly constrained in high latitudes continental shelves [*Borges et al.*, 2006]. We report measurements of air-ice CO_2 fluxes above the Canadian continental shelf and compare them to previous measurements carried out in Antarctica.

We carried out measurements of pCO_2 within brines and bulk ice, and related air-ice CO_2 fluxes (chamber method) in Antarctic first year pack ice ("Sea Ice Mass Balance in Antarctica –SIMBA" drifting station experiment September – October 2007) and in Arctic first year land fast ice ("Circumpolar Flaw Lead" – CFL, April – June 2008). These 2 experiments were carried out in contrasted sites. SIMBA was carried out on sea ice in early spring while CFL was carried out in from the middle of the winter to the late spring while sea ice was melting.

Both in Arctic and Antarctic, no air-ice CO_2 fluxes were detected when sea ice interface was below -10°C. Slightly above -10°C, fluxes toward the atmosphere were observed. In contrast, at -7°C fluxes from the atmosphere to the ice were significant. The pCO_2 of the brine exhibits a same trend in both hemispheres with a strong decrease of the pCO_2 anti-correlated with the increase of sea ice temperature. The pCO_2 shifted from a large over-saturation at low temperature to a marked under-saturation at high temperature. These air-ice CO_2 fluxes are partly controlled by the permeability of the air-ice interface, which depends of the temperature of this one. Moreover, air-ice CO_2 fluxes are driven by the air-ice pCO_2 gradient. Hence, while the temperature is a leading factor in controlling magnitude of air-ice CO_2 fluxes, pCO_2 of the ice controls both magnitude and direction of fluxes.

For a same temperature, pCO_2 in Arctic is significantly higher than in Antarctica. This potentially decreases air-ice CO_2 fluxes in Arctic compare to Antarctica. Unfortunately this difference is still an open question. However, the impact of the coastal processes should not be excluded. Air-ice CO_2 should be taken into account budgets of CO_2 fluxes in the coastal zone of the Arctic Ocean.

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POSTER

Morphology and dynamics of the Danube delta littoral between the Sulina and Sfantu Gheorghe river mouths (Romania)

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The delta littoral is situated between the river mouths of Sulina and Sfantu Gheorghe, with a length of 33km and it represents the central alignment of the delta sector. The dynamic complexity increases to the south and to the north of the two river mouths, due to several alluviation and erosion factors. Littoral morphology and dynamics is getting complicated also due to the hydro technical works built up by the European Danube Commission, and continued by other companies, at the Sulina mouth. When the navigation passage insurance dams had reduced length and advanced several hundreds meters into the sea, the littoral dynamics occurred in accordance with the natural laws. At the end of 2008, the length of the jetties (advancement dams) in Sulina exceeded 9 km and the advancement in the aquatic littoral zone radically changes the direction of the currents and waves. In the area of the central delta littoral, for about 9 months a north-south current occurs, and for about 3 months (during summer) a south-north one. The two flows annihilate each other next to Sfantu Gheorghe mouth. The meeting of the two water fluxes with different directions, generates a special dynamics in the sector situated south to the Sulina mouth: in the immediate neighbourhood, an intense alluviation process occurs (alluvia trap), while in the central sector, a significant erosion process is present (between Sondei channel and Împutita brook) (*Romanescu*, 1996). The littoral erosion next to the Sondei channel could reach, in certain periods, up to 10-12 m/year and 20 m/year (maximum) (*Romanescu*, 1996,2005; *Stanica et al.*, 2007) . A proof of this complicated dynamics is represented by the rapid shore line change rate, but also by the particle size value of the material involved. On the whole, the sector between the two river mouths is dominated by erosion, while progradation is less represented. This phenomenon is due to the fact that the alluvia transported next to the shore are reducing continuously, because their discharge occurs at large distances offshore, and they do not enter the circulation system very next to the beach.

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Operational forecast of circulation and water quality assessment in harbour domains.

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Nowadays it is required to have the maximum concern about environmental protection issues in order to manage and develop sustainable harbour activities. In this framework**,** an exhaustive and continuous assessment of harbour water quality arises as a necessity to protect marine life and to minimize the impact of industrial and harbour activities on the surrounding ecosystem. The implementation and the use of operational systems able to characterize and forecast harbour circulation in real-time is not so widespread and common. The 3D harbour water circulation configures the resulting residence time pattern and determines the harbour water renovation. Considering that together with the significant influence that circulation patterns have in the dispersion of pollutant and oil spills**,** it is evident that the lack of this kind of operational circulation systems arises as a significant limitation in terms of assessing the risks associated to water quality degradation or pollutant spillages. A dynamic downscaling approach consists of a set of increasing resolution nesting model applications capable of solving processes from basin scales to harbour local scales has been used to simulate local harbour circulation. Once, the velocity field is obtained, the harbour water renovation is parametrised in order to obtain spatial distribution of residence times. Finally, a risk water quality assessment is carried out applying a methodology taking into account the physical behaviour and the antropogenic uses of the harbour. The final product is focussed to provide a tool for the environmental management in harbour. The methodolgy is applied in the Barcelona Harbour (NW Mediterranean).

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Modelling the effect of carbon and nutrient river loads variability on air-sea CO_2 fluxes in the coastal Southern North Sea at different time and spatial scales

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The past and present-day variability of air-sea CO2 fluxes in the Eastern Channel and Southern Bight of the North Sea that receives important nutrient and carbon river loads is investigated making use of the biogeochemichal MIRO-CO2 model implemented in two different physical frames. The multi-box 0-D MIRO-CO2 investigates the average last 50 years (1951-1998) trends while the 3-D implementation describes the contemporary spatial variability of air-sea CO2 fluxes. The implementation domain of the multi-box MIRO-CO2 covers the Eastern English Channel and Belgian Coastal Zone (BCZ) and receiving loads from the rivers Seine and Scheldt. Model simulations are performed from 1951 to 1998 using real daily SST, wind speed and atmospheric CO2 and RIVERSTRAHLER simulations for river carbon and nutrient loads. Model results suggest that the BCZ shifted from a CO2 source before 1970 (low eutrophication) towards a CO2 sink during the 1970-1990 (increased anthropogenic N and P loads). After 1990, the progressive decrease of P loads lowers the CO2 sink and the BCZ acts again as a CO2 source in the late 1990's. Scenarios testing the relative impact of the different forcings on the simulated air-sea CO2 fluxes suggest a major role of nutrient loads as drivers of 1951-1998 trends in air-sea CO2 fluxes in the BCZ. Spatial variability of the present-day (1993-2004) air-sea CO2 flux is then approach by a 3D implementation of MIRO-CO2 model in the English Channel and the Southern North Sea. Runs are performed from 1993 to 2004 using actual sea water temperature, light, wind speed and river forcings. Model results show large spatial and seasonal variations of surface pCO2 (range 100 - 600 ppm). Significant under- (and over-) saturation are simulated in spring (and summer) due to the dominance of auto- (and heterotrophic) activities. The highest pCO2 values are simulated in the vicinity of river mouths. Similarly, the computed annual air-sea CO2 fluxes varies spatially, predicting sources of CO2 to the atmosphere near estuaries but moderate sinks (or neutral) in offshore waters. Sensitivity studies are further performed to estimate the contribution of organic and inorganic carbon and nutrient river loads on the air-sea CO2 flux simulated in the area.

Topographic influence on mixing and stratification in a tropical tidal embayment

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The Bay of Banten is a tropical ROFI (Region Of Freshwater Influence), subject to a mixed, mainly diurnal tidal regime and a monsoonal wind climate. A partially inactivated delta shapes the east coast of the bay and constitutes the main source of freshwater. The spatial and temporal variation of haline stratification was analysed based on measurements made with an ADCP, a CTD and a conventional current meter. Tidal straining and mixing control the intratidal variations of stratification, which was demonstrated from bulk estimates of the Richardson number and properties of tidal ellipses. The fortnightly variation of stratification is much related to differential advection of salinity by the subtidal flow, rather than variation in tidal mixing energy. The strength of the tides, and therefore levels of stratification, feature a marked spatial variation. The propensity for mixing is largest at the subaqueous plain in front of the former delta, where flow contracts around the protruding delta, which hydrodynamically acts as a headland. The most active mixing occurs when both the tidal and the subtidal currents in the bay are directed towards the sources of buoyancy along the eastern coastline. The vertical circulation in the bay is composed of baroclinic and Ekman components.

During the wet season, the secondary flow driven by the eastward monsoon-induced flow along the bay's isobaths reinforces an estuarine type of circulation, stretching the ROFI in offshore direction.

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The Irish Sea Coastal Observatory

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A Coastal Observatory has been operating since August 2002 in Liverpool Bay, Irish Sea. Its rationale is to develop the science underpinning the ecosystem based approach to marine management, for instance in relation to the UK Marine Bill and the EU Marine Strategy Directive, including distinguishing between natural and man-made impacts, and to investigate how the environment of a typical continental shelf sea responds to change. Liverpool Bay has strong tidal mixing, receives fresh water principally from the Dee, Mersey and Ribble estuaries and has at times elevated levels of nutrients. Blooms occur periodically throughout the summer as nutrients are delivered via the estuaries. There is dynamic exchange of sediment between the Bay, coasts and estuaries. The water column stratifies intermittently on tidal, spring / neap and monthly timescales, although persistent stratification rarely lasts longer than a few days. Horizontal and vertical density gradients are variable both in space and time. Because of the variability and because the region is turbulent, turbid, has enhanced nutrients and is productive, the area is an excellent test of the physical and biological understanding of continental shelf seas and a stringent test of real-time model predictions. The Observatory has three components – measurements, some in near real-time, numerical modelling and a data management and web-based data delivery system, see http://coastobs.pol.ac.uk. The four measurement main strands, each on different space or time scales are fixed point time series (both in situ and shore-based), regular spatial water column surveys, HF radar for surface currents and waves and an instrumented ferry. These are supplemented by weekly composite satellite images and river flow data. The emphasis is on physical and chemical / biological variables which are modelled with coupled 3-D hydrodynamic, wave and ecological models forced by forecast meteorology and whose predictions tested against the observations. A major objective is to obtain multi-year records to quantify processes and events. In the next few years the Observatory will expand in spatial coverage and in capability, for instance through the deployment of gliders, forming a focus for Irish and Celtic Sea studies. The Observatory is being used in investigations of whether enhanced nutrient levels lead to undesirable disturbances, provide information for shoreline management and study potential impacts of climate change. Results from 6 years of operation will be presented and the Observatory's value reviewed.

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Coastal (Sub) Mesoscale Eddies in the Gulf of Lion

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The LAgrangian Transport EXperiment (LATEX) project (2008-2011) has been initiated in order to study the role of (sub)mesoscale structures on shelf-offshore exchanges in the Gulf of Lion. The strategy will combine use of data from an inert tracer release (SF6), Lagrangian drifters, satellites and Eulerian moorings with numerical modeling.

In this work, we present a shelf-scale model of high resolution (1-km) nested in a regional-scale model (3-km). We use an upwind-type advection-diffusion scheme, in which the numerical diffusion term is adjusted by an attenuation coefficient. Sensitivity tests have been carried out, varying the model spatial resolution and the attenuation coefficient to reproduce the (sub)mesoscale structures. A wavelet technique is applied on model outputs to identify eddies and to define their area, position and tracking duration.

Comparisons between the modeled eddies and those observed by satellite have allowed us to choose the best model configuration. With this setup, single and combined effects of wind forcing, bathymetry and mesoscale circulation are investigated to propose a generation process of these simulated eddies. Then, simulations are run for long period to obtain annual variability and statistics of the coastal eddies. These coastal (sub)mesoscale eddies potentially interact with the distal plume of the Rhône river and the Northern Current.

Numerical modeling sets the foundation to understand the eddies' dynamics and helps us set up the sampling strategy of the cruises. The in situ measurements combined with the modeling results will allow us to evaluate the eddies' potential impact on the coastal-offshore transfer of matter and energy.

Problems of modeling of the processes controlling water-sediment interactions in the coastal zone: consequences to man and environment

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To correctly understand and describe the processes controlling the fate of contaminants in sediment in the coastal zone, as well as removing contaminants from sediments, are important in the development of management practices for marine environment under evaluation of consequences to man and biota after environmentally hazardous accidents.

Descriptions of water-sediment interactions come up against the problem of complexity. It should take into account the fact that contaminants are partitioned between the water phase and suspended sediment material in the coastal environment. Processes of particle sedimentation, mixing due to molecular diffusivity, due to pore-water exchange, sediment reworking and burial of contaminants in deep sediment are very important for understanding the exchange of contaminants between water and sediment phases. The problem of complexity in describing processes of water-sediment interactions by large sets of parameters will lead to a situation where different sets of parameters can provide similar and a satisfactory description of experimental data. Such possibilities were clearly demonstrated in [Mitchell et al., 1999] and have to be taken into special account.

The sediment phase in the coastal zone can be very sensitive to some pollution scenarios and local conditions. For example, calculations using different approaches for describing the sediment distribution coefficient indicate that concentration of radionuclide ^{137}Cs in the Ob Bay (Russia) can be changed up to three order of magnitude while concentration in the water phase was changed no more than forty percent. Another example corresponds to the potential accidental release scenario of radioactive waste into Norwegian coastal waters [Iosjpe et al., in press]. Model calculations indicate that for the same release scenario consequences to marine organisms in the water column can be less than the screening dose (the non-harmful dose), while the dose to biota in the sediment phase can be significantly higher than the screening dose for many generations.

A sensitivity analysis of main parameters describing the water-sediment interaction, provided in the present work, demonstrates that relationships between parameters and consequences of pollution can be complex: consequences can decrease as well as increase with the same change of the investigated parameter, depending on time and distance from the source of pollution. It is also shown that the accuracy of the model predictions for consequences to the coastal environment, biota and populations can be significantly increased with improvement of water-sediment interaction description, especially for hazardous situations, which may lead to economical and social consequences even in the event when health consequences might be of minor concern.

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Evolution of coastal line of the strip dunes of the lagoon of Nador and the vulnerability of its ecosystems

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The North East coastal zone of Morocco contains one of the largest lagoons of the south Mediterranean part. It is a wetland of international importance classified as Ramsar Site having great ecological and landscape values. The area is dominated by portions of barrier beach of gentle slope backed by a wetland and marshes. Besides its importance for migratory birds it contains also a variety of natural habitats characterized by a land-water continuum with the presence many endemic and rare species. However, the ecosystem integrity is threatened by coastal erosion, which can lead to the disappearance of some habitats and species or the malfunctioning of natural processes leading to ecosystems disturbances.

The evolution of coastal morphology is due to the effects of the wind, the waves, the currents, the level of water, the type of sediments and the human action. These effects, combined, can strongly lead to coastal erosion which can be accentuated by a sea level rise particularly for dunes and sand beaches. The lagoon of Nador, located in the East part of the Mediterranean coast of Morocco, having a twenty five kilometer length sand strip with variable heights and widths, is very sensitive to coastal erosion.

The purpose of this study, carried out within the framework of the project ACCMA (www.accma-maroc.com), is to analyze the coastal dynamics and the quantification of losses and gains of surfaces along the beach surrounding the lagoon and to evaluate the degree of vulnerability of these ecosystems, mainly the vegetation groupings, to dynamic of coastal line. The approach adopted took into account as a reference line the shoreline.

The methodology used for the estimation of the evolution of the morphological dynamics of the coastal line consists on the digitalization of shorelines on georeferenced aerial photos (missions 1986,2003 and 2006), the use of a geographical information system with the extension `DIGITAL Shoreline Analysis System' (DSAS), filed prospecting and the application of beach vulnerability indices. The estimate of the average rate of change of the feature of coastline was carried out using the statistical methods EPR (End Point Rate) and LRR (Linear Regression Rate). The historical evolution was used to prospect the tendency of future shoreline mobility.

Two indices were calculated, the BTL (Beach Time Loss) and the BVI (Beach Vulnerability Index). The study of the BTL shows that the beach of the sand dunes in the west part of the lagoon is the most vulnerable part in terms of erosion.

Thus, diachronic analysis of the state of the coastal zone showed a regressive evolution of shoreline averaging - 0.43 m/an, and disappearance of 38.83 ha (1.94 ha/year) of beach and sand dunes between the years 1986 and 2006. The vegetation grouping that was affected is the grouping of Sarcocornia fruticosa and Limonium gummiferum, which will lead to the disappearance of some species of patrimonial interest such as Limonium gummiferum and lycium intricatum.

Seasonal variability of carbon dioxide and methane in the rivers and lagoons of Ivory Coast (West Africa)

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We report partial pressure of CO_2 (pCO_2) and ancillary data in three rivers (Bia, Tanoé and Comoé) and five lagoons (Tendo, Aby, Ebrié, Potou and Grand-Lahou) in Ivory Coast (West Africa), during four cruises covering the main climatic seasons (high dry season, high rainy season, low dry season and low rainy season). The three rivers were oversaturated in CO_2 with respect to atmospheric equilibrium, and the seasonal variability of pCO_2 was due to dilution during the flooding period. Surface waters of the Potou, Ebrié and Grand-Lahou lagoons were oversaturated in CO_2 during all seasons. These lagoons behaved similarly to the oligohaline regions of macrotidal estuaries that are CO_2 sources to the atmosphere due to heterotrophic activity and inputs of riverine CO_2 rich waters. The Aby and Tendo lagoons were undersaturated in CO_2 with respect to the atmosphere because of their permanent haline stratification (unlike the other lagoons) that seemed to lead to higher phytoplankton production and export of organic carbon below the pycnocline. The surface waters of the three rivers were oversaturated in CH_4 with respect to atmospheric equilibrium, and the seasonal variability of CH_4 seemed to be largely controlled by dilution during the flooding period. The surface waters of the five lagoons were also oversaturated in CH_4 with respect to atmospheric equilibrium. The largest CH_4 over-saturations and diffusive air-water CH_4 fluxes were observed in the Tendo and Aby lagoons that are permanently stratified systems (unlike the other 3 lagoons), leading to anoxic bottom waters favorable to a large CH_4 production. The permanent stratification also leads to higher primary production rates and an efficient transfer of organic matter across the pynocline, hence the Tendo and Aby lagoons were respectively, a low source of CO_2 to the atmosphere and a sink of atmospheric CO_2 while the other 3 lagoons were strong sources of CO_2 to the atmosphere but lower diffusive sources of CH_4 to the atmosphere.

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Hydrochemical regime in the coastal waters northeastern Black Sea as an example of Gelendzhik and Golubaya bays

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The goal of this work was to study the hydrochemical regime in the coastal waters of the northeastern Black Sea. The observations were performed in influenced by significant anthropogenic stress Gelendzhik bay and at the open coast region (Golubaya bay). A sampling program has been initiated by the Southern Branch of Shirshov Institute of Oceanology, RAS, (SB SIO RAS) on a weekly basis at the shore line area of «Chernomorets» beach (Gelendzhik bay) and from the head of pier in the Golubaya bay. Studies were carried out during a period from January 2001 to December 2008. List of measured parameters includes following: temperature, salinity, dissolved oxygen, biological oxygen demand (BOD), pH, alkalinity, phosphate, organic phosphorus, silicates, nitrates, nitrites, ammonia, urea, organic nitrogen, oil products.

The Gelendzhik bay in its different parts is characterized with strong variability of concentrations of hydrochemical parameters. Above all, it relates to complex structure caused by wind impact. Parts of the bay filled with nearshore and sea waters are legibly differ from each other. The bay itself is rather isolated from the open sea, and its liability to man's impact leads to forming of next features of its seasonal variability of physical-chemical state:

- On the base of Si/P and Si/N ratios analysis it was shown that the Gelendzhik bay waters are significantly enriched with nitrogen and phosphorus compounds.
- Unlike the Golubaya bay, phosphates are always present in the water of the Gelendzhik bay and development of photosynthesis is not limited with nutrients. It may lead to processes of intensive eutrophication.
- As it seems, features of seasonal variability of nutrients in the Gelendzhik bay (increased concentrations, pronounced summer-autumn maximum) are caused by man's impact – outflow of nutrients with shore input and recreational burden during the summer holiday season.

The conclusions obtained during our studies testify that the pollution from local spots of the coasts of the Black Sea, connected first of all with eutrophication, can play a large role in the nutrient balance of the Sea and affect its ecological state.

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Grain size distribution of suspended particulate matter in the marginal filters of the Northern Dvina River (the White Sea basin) and the Ob River (the Kara Sea basin).

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Marginal filters are formed within the river and seawater mixing zones in river mouths [Lisitzin, 1995]. In the near mouth regions of rivers (in the areas of marginal filters), the initial riverine water is subjected to a combined effect of various sorbents, organisms, biofiltration, and a series of other processes characteristic of only this area. The processes of grain size transformation in the marginal filter areas are discussed. Grain size distribution of suspended particulate matter (SPM) is one of the main characteristics responsible for the dynamics of geochemical processes in the river and seawater mixing zone. The regularities of quantitative distribution of volume concentration and surface area of the SPM, which influence physicochemical activity of its particles, are investigated. It is stated that the suspended particulate matter is removed from the water at the earliest stages at salinities from 0 to 5 psu. Consequently, the coarsest terrigenous SPM is mostly deposited near the river mouth at the river–sea barrier. This is gravitational stage of the marginal filter. The sorption system of a marginal filter is the second qualitatively and quantitatively new stage of the distribution of SPM and its grain size. Its domain is conventionally limited by the isohalines of 2 and 15 psu. At this stage, the greatest surface area of the suspended particulate matter, corresponded to its lowest median diameter (Md = 11.8 μm) and the maximal value of the total amount of microorganisms (520 th. cells/ml). The suspended particulate matter featured a well-developed surface and seemed to be characterized by high physicochemical activity. At the third (the so-called "biological") stage of the marginal filter the surface area of the suspended particulate matter significantly drops as compared to the preceding stage. After the two-staged avalanche-like precipitation of suspended particulate matter, the water becomes more transparent, which gives a start to the phytoplankton development. Here is prevail the coarse (silt) particles (mainly diatoms and its colonies).
The study of SPM as a dispersion system requires the complex approach, i.e., consideration of biological, optical, and geochemical parameters of marine environments. The study of grain size composition is needed for solving sedimentological and ecological problems. The grain size of SPM governs the distribution of material in the marine dynamic system. In addition, it represents the main depositional characteristic of pollutant distribution in sea environments.

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POSTER

Recent coastal processes of the Taman shore of the Black Sea

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Taman peninsula is situated in the western part of the Krasnodar Region. From the north it is washed by the Sea of Azov, from the south – by the Black Sea. A region of investigations is in the southern-western part of the Taman peninsula; from the south and south-west it is bordered with the Black Sea, and from the north with Taman bay.

During the last thousand years coasts of the Taman peninsula is developed in conditions of continuous relative sea level lifting which includes a slow tectonic immersion of the shore and more rapid rise of the World ocean level. [*Geology of the Large Caucasus*, 1976]. Two types of coast prevail: accumulative, formed of sandy-clay deposits and abrasion ones.

In an average the height of abrasion benches varies from 15 to 35 m. They are bordered by narrow beaches composed of sandy-clay deposits impure by shells, pebble, gravel chippings. A mean rate of the retreat of the coastal bench edge is 1 m/yr [Aibulatov*, Shcherbakov, 2001*]. Wave impact on the coastal bench together with the rock properties became the reason of the processes on the coastal bench, the main of which are landslides. At some sections landslide and slough processes reach to 30%. Mainly loess loams of the upper bench slough along the shear cracks. Sometimes landslides and sloughs of the bench material completely overlap a beach.

Tuzla spit is a large accumulative body, it is composed of quarts sand, shell and pebble. At the present stage of the coast development the spit is a degradating form. Taking into account a critical state of Tuzla spit, in the end of 2003 a backfilling of existed breakthrough was done, as a dam of rock material with stabilization of flanks by rock-fill of slope type. A total volume of material in the dam body was 580 thousand cubic meters. Reconstruction of the roof part of Tuzla spit has decreased rate of abrasion of the northern shore of Taman bay. At present restored part of Tuzla spit is resistant even to the influence of strong storms.

Wave influence on easily eroding rocks of coastal bench presented by loams and clays with interlayers of sand, mudstone, and ferric sandstone is the basic factor that determines a formation of coastal belt and proceeding of coastal processes on the Taman peninsula at present.

As a result of fulfilled research on the Taman peninsula coast, which is one of the poorly studied area in the Black Sea, a detailed characteristics of modern coastal processes and factors determining them was done.

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Does reducing river nutrient loads impact on eutrophication and transboundary nutrient fluxes in the Belgian waters? A modeling study.

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Nitrogen (N) and phosphorus (P) inputs from rivers cause high biomass blooms of colonial *Phaeocystis* in Belgian waters. This area is hence classified as a eutrophication problem area in the context of the Oslo and Paris Commission for the Prevention of Marine Pollution (OSPAR) and action must be taken to reduce nutrient inputs. Eutrophication in the North Sea may arise as result of excessive inputs of anthropogenic nutrient loads (river discharges, atmospheric deposition, point sources like Waste Water Treatment Plant and diffuse sources). An additional contribution of nutrients to national maritime regions results from the transboundary transport of nutrient. These latter inputs can be potentially important for downstream areas with coastal currents. There is a growing recognition that eutrophication problems from one maritime area may result from nutrients originating in a different maritime area and transported by currents. Quantification and determination of the origin of these transboundary inputs is critical in order to be able to identify and take cost-effective measures to combat eutrophication in the OSPAR maritime area. Since transboundary nutrient fluxes are not easily and routinely directly measured, ecosystem models are considered as a tool that may provide some information on the direction and magnitude of transboundary nutrient fluxes as well as their origin. Nutrient reduction scenarios are performed here using a 3D ecosystem model (MIRO&CO-3D) to determine the impact of various reductions (50%, 70%, 90%) of N and P, both singly and combined, and hence orient decision making appropriately. The MIRO&CO model has been implemented for the region between 48.5°N-4°W and 52.5°N-5°E by using actual river loads, SST and meteorological forcing (1993-2006). Results will be analysed in term of (i) eutrophication status of Belgian waters and (ii) fate of nutrients by computation of transboundary nutrients fluxes across Belgian borderlines.

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Dynamics of surface currents and effects on the Hydrology and Plankton Community in Syro-Lebanese coastal waters (East Mediterranean)

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The Eastern Mediterranean, including the Syro-Lebanese seawaters is a strongly oligotrophic water body, the primary productivity rate being the lowest in the entire Mediterranean. The salinity and temperature are the highest in the entire Levantine Basin. Water movement along the two adjacent coastal areas is mostly influenced by the wind blowing most of the year from the west and south west direction towards the north, whereas the temperature and salinity have the biggest influence on the hydrology of the area.

The surface current of S-N keep in parallel to the coast line at few miles offshore, showing a high speed in winter (December-March) reaching 15-30 m/sec and reduced to 2-5 m/sec at 100 m depth and a low speed in spring and summer not exceeding 0.15 m/sec. From the main current which follows the configuration of the coast, detach anti-cyclonic eddies, creating seawater movement in coastal area.

During the fall (September-December) the direction of the surface current inverses from the north-west to south-east showing moderate speed. During winter the hydrological conditions are characterized with homo-thermal conditions in the whole water column, accompanied with water mixing and low temperature and salinity (T~16-17° C; S~38.75-39.15‰), while in summer the increasing offshore surface T/S may reach maximum values (T~29-30°C; S~ 39.455-39.75‰), the highest in the entire Mediterranean and create a strong sharp thermocline in the layer 30-75 m. The stopping of the Nile flood, after the construction of Aswan High Dam in 1964, has had a big change on the hydrology of the entire Levantine Basin, including the Syro-Lebanese sector. The increment of the T and S in addition to the shortage of nutrients, raise the oligotrophy of the seawater and thus reduce the primary productivity rate and fisheries.

As consequences to these hydrological changes, despite the high diversity, the plankton community shows a low phytoplankton standing crop and weak zooplankton biomass. Certain “tropicalization” of the area due to the global warming and to the climate change, is manifested with increasing biological invasion of marine tropical forms through the Suez Canal pathway, creating thus some change in the biodiversity of the Levantine flora and fauna.

Key-words: Levantine Basin, Hydrology, Oligotrophy, Plankton, Tropical invasion.

Operational identification of water masses in the Southern North Sea.

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MUMM's team for OPerational TOols and Services (OPTOS) develops and manages a series of mathematical models for providing assistance to human activities at sea. Twice a day, these models issue five days ahead forecasts of sea surface elevation, three dimensional currents, waves, temperature and salinity. Such information is useful for, e.g., navigation in coastal waters, diving activities and flooding risk assessment. In case of pollution, combatting teams also receive information on drift, spreading and fate of the pollutant. Besides these traditional applications, OPTOS is enlarging its products catalog in order to improve its support to environmental researchers concerned by the Southern Bight of the North Sea.

Following the recent recommendations of the ICES Working Group for Operational Oceanographic products for Fisheries and Environment (WGOOFE), we are currently developing an operational identification procedure for water masses, fronts and river plumes. That new product uses passive tracers to characterize the signature of the different water masses in terms of the Atlantic salty waters and fourteen different riverine freshwaters (Thames, Rhine, Meuse, Scheldt, Seine, Wash, Humber, Tees, Tyne, Forth, Ems, Weser, Elbe and Ijssel).

Results obtained with the 3D hydrodynamical model OPTOS_NOS (a particular implementation of COHERENS) indicate that the water masses of the Belgian Continental Plate are mainly dominated by the inflow of the Channel water mass which mixes with freshwater originating from the Rhine/Meuse and a smaller contribution from the Scheldt.

If that new operational product is already a useful meta-data for guiding *in situ* sampling analysis, its reliability will be greatly improved as soon as the operational oceanography community will access to rivers runoff in real-time.

Scientific integrated coastal system assessment: a paradox?

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Bringing the knowledge of different scientific disciplines together in a common modeling framework for integrated assessment is a key objective for several large research projects related to coastal management. The ongoing, EU-funded research program SPICOSA (Science Policy Integration for Coastal system Assessment) is an example of a project aimed to bring stakeholders, policymakers and scientists together. The core objective is to develop a methodological framework, Systems Approach Framework (SAF), in order to simulate how the social, economic, and natural systems interact within coastal zones and thereby simulate the effectiveness of potential management options. Importantly, the SAF is meant to be operational, not theoretical. To test and refine the SAF, it is being implemented and tested at 18 case study sites throughout the European Region. The implementation incorporates systems' thinking (streamlining the functionality of a system) into a standard approach for environmental problem solving: initial stakeholder consultation, conceptual and mathematical modeling, validation, and reporting to stakeholders and the public. A key objective of the project is the formation of a generic library consisting of model building blocks for integrated coastal-zone management, including the examples from the Project's Study Sites.

This paper makes a mid-term assessment of the approach from the standpoint of the model integrator, being the person charged with constructing the model library. Based on the results so far, the more important conclusions include the following:

Scientists from different disciplines have difficulty understanding each other's approaches. In general, natural scientists adhere to dynamic simulation modeling with relatively short time steps while social-economists commonly apply optimization theories and annual time steps. These differences and the lack of a generally accepted scientific theory for integrated modelling make it difficult to merge the domains of knowledge from different disciplines in a common framework for coastal management.

At the personal level, sometimes natural scientists make the mistake of presuming an unwarranted competence in the social sciences arguing life itself is a social school. On the other hand, social scientists sometimes oppose to the natural sciences paradigms based on the observations and mathematical equations, which predominate in non-behavioral systems.

Integration of disciplines requires simpler models, not more complex ones. Many scientists are reluctant to come up with simplified versions of their work, perhaps because they have been trained to do the opposite.

Building simple models of complex systems should not be done by novices in modeling but requires experienced researchers. The ability to simplify comes only after one thoroughly understands something, and in the case of multi-disciplinary systems most have not had the necessary training to make simplifications.

Above all, the model integration is a learning process, which often cannot be completed through a deadline-structured project. The question at hand is: are SPICOSA researchers and policy-makers involved learning enough such that the learning process can be continued and the approach survive.

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Finally, integrated assessment calls on the flexibility of all participants: the domain experts, stakeholders, model integrators, and project managers. Bringing the science of integration a step forward so that coastal managers can be supported more effectively is the challenge.

The coastDat data set and its potential for coastal and offshore applications.

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The coastDat data set is a compilation of coastal analyses and scenarios for the future from various sources. It contains no direct measurements but results from numerical models that have been driven either by observed data in order to achieve the best possible representation of observed past conditions or by climate change scenarios for the near future. Contrary to direct measurements which are often rare and incomplete, coastDat offers a unique combination of consistent atmospheric, oceanic, sea state and other parameters at high spatial and temporal detail, even for places and variables for which no measurements have been made. In addition, coastal scenarios for the near-future are available which complement the numerical analyses of past conditions.

The backbones of coastDat are regional wind, wave and storm surge hindcast and scenarios mainly for the North Sea and the Baltic Sea. Furthermore hindcast simulations are available for temperature, salinity, water level, u- and v-components for the North Sea. We will discuss the methodology to derive these data, their quality and limitations in comparison with observations. Long-term changes in the temperature, wind, wave and storm surge climate will be discussed and potential future changes will be assessed. We will conclude with a number of coastal and offshore applications of coastDat demonstrating some of the potentials of the data set in hazard assessment. Examples will comprise applications of coastDat in ship design, oil risk modelling and assessment, and the construction and operation of offshore wind farms.

Numerical study of coastal dispersion in the Tyrrhenian Sea

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An episode of prolonged dispersion of noxious substance along the coasts of the Central Tyrrhenian Sea has been simulated in this study. The event, reproducing the effects of a damaged submarine electric cable in the proximity of the Isle of Ischia, consisted in the weak, continuous emission of 5 tons of oil in a period of 6 months, from July to December, 2007 from a source located at 30 m depth. In order to study the dispersion and the possible impact on the coastal zones, the Princeton Ocean Model (POM2k) coupled with a Lagrangian dispersion model has been used on a regional scale. To determine the further effects on the local circulation and on the transport of pollutants due to the wind and the tidal currents superimposed to the regional scale currents along the Island of Ischia, the DELFT 3D model has been used in a 2D configuration. The POM Model has been applied in order to estimate the marine circulation on a regional scale in the summer- late autumn conditions in all the Tyrrhenian Sea; Regional scale transport has then been estimated by means of a Lagrangian particle dispersion model. POM results has been also applied as boundary conditions for the Delft 3d Model at small scale. Even in 2D, shallow water configuration, the Delft 3D Model was found useful to investigate the local effects on the circulation at small scale in order to estimate the transport to the coasts in different climatic conditions.

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An integrated observation system for tidal flat areas

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Since 2002, the GKSS Institute of Coastal Research is operating an integrated observation system in the H¨ornum tidal basin (German Wadden Sea). The major component of the system is an observation pole positioned in a tidal channel approximately in the centre of the basin and acquiring meteorological, oceanographical and biological parameters in the ice-free season between early March and November. During winter, the pole is substituted by a bottom-mounted self-contained device measuring basic underwater parameters. About 4 km seaward of the pole in the same channel are located another bottom-moored ADCP and a waverider buoy. The stationary measurements are supplemented by ship campaigns, the major purpose of which is to investigate the representativity of the point measurements.

Time series of the system have been analysed with respect to the budgets of heat and freshwater of basin. In both cases, a relationship is established between the velocity measured at the fixed stations and the volume flux obtained from ship surveys. The budgets of the upstream region are determined by integrating the fluxes of heat and freshwater, respectively, over one tide. For the years 2002 through 2004 and at the site of the bottom-mounted ADCP, the landward catchment area is diagnosed to export heat from March through August, while import is diagnosed for the same period of time at the pole. In autumn the situation is reversed. An analytical estimate suggests that the sign of the budget is controlled by the tidal prism and the length of the dry-falling period of the flats in the respective upstream region [Onken et al. 2007]. The freshwater budget for the catchment area of the pole exhibits a high-frequency variability with twice the tidal period, which is triggered by the sequence of day and night tides: over the bare tidal flats, enhanced freshwater loss by evaporation takes place predominantly during daylight hours. Averaging the tidal budges over one month reveals that the budget is dominated by the daylight losses, although the overall climate in this region is humid. Long-term averages indicate negative budgets for the years 2002 through 2005, while being positive only for 2006. The unexpected results suggest that the evaporation over the tidelands represents a significant process and should be taken into account by high-resolution local wheather forecasts for coastal areas [Onken and Riethm¨uller 2009].

Presently, the observation system is upgraded by self-contained devices acquiring the sediment temperature of the tidal flats. This data is mandatory to validate the results obtained so far by the indirect methods [Onken et al. 2009].

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3D numerical modelling of the oceanic circulation in the bay of Marseilles: towards the evaluation of anthropogenic supply to the marine environment.

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Understanding the fate of chemical contaminant inputs from major cities and its impact over the adjacent marine ecosystems is essential for the protection and management of coastal waters. In the framework of the IFREMER project METROC, a team aims to assess chemical contaminant raw inputs (from city to sea) and exports (from midsea to open sea) in the bay of Marseilles, a city whose geomorphology and density of contaminant-generating industries is highly representative of large modern Mediterranean cities. To evaluate the contaminant fluxes, a numerical tool is developed based on the coupling of a hydrodynamic model, a sediment model and a model of chemical contamination.

As a first step, this talk deals with the high-resolution hydrodynamical modelling of the bay of Marseilles (extended from the Rhone river to the Cap Sicie) using the numerical model MARS3D. The area of Marseilles is studied at a high horizontal resolution (200m). The simulations include the forcing by the general circulation thanks to a nesting strategy, the forcing by the high resolution meteorological model MM5 fields and the fresh water input from the Rhone river. In the area, the oceanic circulation is very sensitive to the wind [Pradal and Millet, 2006], with a rapid response to it, and to the occurrence of extreme meteorological events. For the years 2007 and 2008, the model results are validated by comparisons with in-situ observations of temperature, salinity and currents that were obtained during the ANR project MECHANGE, the Tethys cruises and the SCOPE07 and SCOPE08 campaigns at sea, and with satellite observations of sea surface temperature and ocean color. Preliminary results of the computation of residence times over the shelf and the consequences for the dissolved contaminant will eventually be shown.

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Dynamics of suspended particulate matter and particle fluxes in western bays of the Novaya Zemlya Archipelago, Vaigach Island and the adjacent Barents Sea at the end of summer

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The study of suspended particulate matter (SPM) in the ocean is necessary for understanding modern sedimentation processes and for assessing the ecological state of the environment. Currently, SPM in the Arctic is insufficiently studied. In this paper a comparative analysis of SPM and phytoplankton distribution and composition and vertical particle fluxes in Russkaya Gavan' Bay (Northern Island of the Novaya Zemlya), Bezymyannaya Bay (Southern Island of the Novaya Zemlya), Dolgaya Bay (northwestern part of the Vaigach Island) and adjacent part of the Barents and Pechora Seas is presented. Field studies were carried out during the 9th expedition of the RV "Professor Logachev" in September 1994, the 11th, 13th and 14th expeditions of the RV "Akademik Sergey Vavilov" in September–October 1997 and August–September 1998 and in 56th expedition of the RV "Professor Shtokman" (September 2003). For SPM studies the filtration of water samples was carried out through Nuclepore filters (pore size 0.45 μm) and Whatman GF/F filters. Spatial distribution of SPM in the surface waters of the Barents Sea was assessed using data of ocean color scanner SeaWiFS. The empirical relationship between SPM concentration and retrieved values of particle backscattering coefficient is obtained. For vertical particle fluxes studies we used cylindrical sediment traps (vinyl plastic cylinders, 118 mm in diameter, with a 490 mm high working part and baffles installed in the upper part).

On Novaya Zemlya and Vaigach, most SPM sediments in the bays (fjords) and only small part of it reaches the Barents Sea. This is due to the hydrodynamic conditions in the bays, the large size of the particles, and morphological barriers in the relief at the bay entrances. It is important for ecological purposes to map out migration pathways of the SPM with pollutants from bays to the open sea. Results of our investigation indicate that the western bays of the Novaya Zemlya act as traps for SPM derived from glaciers and coastal abrasion.

Laboratory investigations for process of the suspended solids sedimentation

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Introduction

In the article are presented laboratory investigations data for process of sedimentation of the suspended solids. Laboratory investigations data are gained by means of turbidimeters.

The obtained findings will allow inserting necessary corrections during carrying out of natural experiments and modelling of processes for weighing and transport of suspended sediments.

The optical turbidimeters, constructed in the southern branch of P. P. Shirshov Institute of oceanology, have been used for laboratory research.

Experiment setting

Investigations were carried out in a tank with 50 litres capacity. There were two turbidimeters simultaneously. Sand was on the bottom of a tank. Weighing of particles was carried out by the special device. Signals from turbidimeters were entered into the computer. Experiment management allowed changing concentration of the weighed particles. Simultaneously measuring of concentration by means of a pump was carried out in the course of investigating by turbidimeters. Sand with a known grain-size composition was used for experiment. In the course of experiment, calibration checking of measuring instruments is done. It is made so as to be assured of the gained effects.

For an estimate of allocation equability of suspended sediments in the explored volume, measurements were carrying out by two turbidimeters synchronously.

Graphical material of the spent investigations will be presented in the full article.

Results

Comparison of turbidimeters data and values of suspended sediment concentrations received by pump has shown a divergence no more than 2%.

The analysis of results for process of suspended solids sedimentation has allowed to define the maximum size of particles, which do not participate in processes of bottom forms deformation. These particles characterise only optical properties of water. Namely, a background transparency. Or, in other words, a ballast, which is necessary to take into consideration at the spectral analysis of dynamic processes of suspended sediments transportation.

One more result of the analysis allows saying a hypothesis about possibility of analysis of grain-size composition by laboratory method.

Materials of these researches will be presented in article in the developed kind.

POSTER

Modelling the characteristics and dynamics of surfzone transverse sand bars observed on natural beaches

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Patches of transverse sand bars have been observed in the surf zone of several beaches, spaced with a remarkable alongshore periodicity (from 20 to 200 m). A transverse bar is an elongated accumulation of sand attached to the low-tide shoreline that extends inside the surf zone with an oblique orientation up to 1 m depth. Many events of formation and evolution of bar patches were recently observed at Noordwijk beach, the Netherlands [Ribas and Kroon (2007)]. The bar crests deviated from the shore-normal against the longshore current _ow (up-current orientation).

A possible explanation for the formation of this type of bars is based on the concept of morphodynamic self-organization. Topographic perturbations superimposed on an alongshore uniform beach induce hydrodynamic perturbations, which can lead to convergence of sand transport over the bars, hence producing a positive feedback. Stability analysis is a convenient tool to investigate the possible feedbacks. It yields information about the shape, the growth rate and the migration speed of the initially emerging modes. A morphodynamic model has been developed and analysed to gain more fundamental physical knowledge about the characteristics and the dynamics of transverse bars. The model describes the feedback between waves, depth-averaged currents and bed evolution, so that self-organized processes can develop.

Realistic positive feedback leading to formation of up-current oriented bars like those observed only occurs if the stirring of sediment due to bore turbulence in the inner surf zone is included in the model. In that case, the depth-averaged sediment concentration decreases seaward across that zone. This, in combination with an offshore-directed _ow over the bars, leads to accumulation of sediment in the crest areas. Including the dynamics of the wave rollers is essential because they create the turbulent bores that lead to signi_cant sediment resuspension in the inner surf zone.

The model is applied to the speci_c wave and bathymetric conditions measured at Noordwijk. The modeled wavelength, crest orientation and growth rate are in good agreement with observations but the model overestimates the migration rates. Both in the model and in the observations, the most favorable conditions for bar formation are obliquely incident waves of intermediate heights.

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Negative impact of invasive species on the Biodiversity and fish stock, case study: Fistularia commersonii (Ruppel, 1838) in The Syrian Coast

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This work realized during the period, August 2004 and July 2005, exposes the impact of new migrant fish species, Bluespotted cornet fish (fistularia commersonii) from the Red Sea to Eastern Mediterranean on the Biodiversity and fish stock in new habitat off the Syrian coast.

The evolution of relative stock, feeding habit, and reproductive cycle of F. Commersonii was studied. The impact of introducing noindigenous species can be divided into two categories: ecologic and economic. Without any natural predators, invaders can threaten or even eliminate indigenous species.

Fistularia commersonii which recorded for first time in Syrian coastal water in 2000, was increased rapidly in the fish fauna on the eastern Mediterranean. It is carnivorous, and feed on many small fish species, such as Sardinella spp., Sprarus spratus, Alosa fallax, Boops bops .etc(12-30 individual preys has been found in the stomach of every Fistularia specimens). The hot fecundity, long period of reproduction, (May – August) and the rapidly expanding population preyed so heavily on fish that its biomass declined, causing local fisheries to suffer.

Key words: *Biodiversity, Fistularia commersonii, envasive species, Coastal environment, Syria.*

POSTER

The influence of Brantas River discharge on hydrodynamics and mixing in the Madura Strait coastal water

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The Brantas River is the main freshwater discharge source and the main nutrient source for the Madura Strait. The river has been undergoing long-term ecosystem modifications because of the anthropogenic activities, such as industrialisation, dam construction, chemical fertilizer use and land use modification. Clear understanding of the response of Brantas River estuaries and adjacent coastal waters of the Madura Strait in eastern Java, Indonesia to strong and episodic inflows of freshwater is required to manage the impacts of these events on the estuarine and coastal ecosystem. As preliminary approach, we use numerical modelling to investigate seasonal variation of hydrodynamics, temperature and salinity distribution in the coastal water of Madura Strait. In addition, we use particle tracer released from one river mouth to track the particle movement and its residence time. In the future, it is essential to couple the result of 3-D hydrodynamic model with sediment transport and biogeochemical model to resolve the effect of vertical dynamics of sediment re-suspension and mixing on phytoplankton dynamic.

Sediment dating in coastal waters: how far is ^{210}Pb reliable?

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Efficient management is required to control marine pollution, to preserve or ameliorate water and sediment quality, and *in fine* to maintain sustainable use of coastal areas. The distribution and fate of a substance in the coastal ecosystem depend on its input, its biogeochemical behavior, and physical processes. Control of coastal water quality requires appropriate tools. Sediments register environmental changes, and accurate sediment dating may provide a chronology of these changes. ^{210}Pb is widely applied as a tracer of recent sediment deposition history [Appleby and Oldfield, 1992]. This dating method is commonly used, and some articles report pollutant distributions with depth in sediment already converted in dates, without providing ^{210}Pb dataset and dating method.

The purpose of this abstract is to illustrate how a rash use of ^{210}Pb in coastal sediment could lead to erroneous interpretations on dating. The example is issued from an investigation of the sedimentation in the Thau Lagoon (French Mediterranean coast) in order to reconstruct pollution (program Chantier Lagunes Méditerranéennes). Three sites (C4, T11, T12) were sampled, at least two time, in the central part of this lagoon. ^{210}Pb profiles always exhibited a mixed layer followed by an exponential decrease with depth. The simple use of age models allowed establishing a suitable dating only for site T11. The comparison of cores at C4 revealed that one had lost the uppermost few cm, its dating need to consider this gap. The deep mixed layer of T12 was in contradiction with organic pollutant profiles and with the low bioturbation [Schmidt et al, 2007]. This apparent mixed layer was explained by a recent increase in sedimentation rates, which may affect dating.

^{210}Pb chronology needs then to be corroborated with an independent age control, like the appearance of ^{137}Cs or an identified event. Bioturbation and mixed layer depth can be check from ^{7}Be and ^{234}Th, which can be measured simultaneously to ^{210}Pb by gamma counting. The reliability of sedimentation rates could be improved by studying cores at the same site, if possible collected at different seasons.

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The implications of frequent high-speed vessel traffic on a medium-energy coast: a case study in Tallinn Bay, the Baltic Sea

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Tallinn Bay is one of the few places in the world where high-speed ferries operate at or close to service speeds close to the shoreline, with up to 50 departures or arrivals per day. For most of the route, the vessels operate in the sub-critical regime, but the faster vessels enter the transcritical regime (depth Froude number ~0.9) in some places. The properties of wakes from high-speed ferries, their role in the wave energy budget and the impact on the coastal environment have been analysed in terms of wave energy and power, properties of the largest waves, and potential ship-wave-induced coastal erosion, since 2001. It is found that hydrodynamic loads caused by heavy high-speed traffic may play a decisive role in certain areas with high wind wave activity. Ship-generated waves form 5–8% from the total wave energy and 18–35% from the energy flux in the coastal areas of Tallinn Bay exposed to dominating winds.

The structure of the fleet has changed considerably in the last five years. There are two high-speed monohulls (operating speed ~65 km/h), and two medium-sized twin hull vessels (operating speeds ~60 km/h) which have been used on the route for several years. The biggest change is the introduction of several examples of a new class of large, mostly conventional ships operating at speeds ~50 km/h. A systematic study of properties of their wakes was undertaken in June–July 2008 at the entrance of Tallinn Bay. A record of high resolution (5 Hz, ±1 mm) water surface elevations were collected using an echosounder in 2.5–3 m water depth, ~100 m offshore, ~2700 m from the sailing line, at the closest point. Video and manual recordings of wave runup were made, and beach profiles were measured up to several times a day.

During calm conditions, vessel generated non-broken waves of up to 1.5 m, with periods of 10–13 seconds were measured, these being significantly higher than waves previously reported for Tallinn Bay. The typical daily highest ship wave is approximately 1.2–1.3 m. Such waves add significantly to the total wave energy experienced on this section of the shoreline, where >1 m wind waves occur with a probability of less than 2%. Most of the largest waves demonstrated significant asymmetry. The wake-waves generated, particularly by higher-speed vessels, contribute significantly to the energy budget of the shoreline (about 10% in terms of wave energy and >20% in terms of energy flux), even when they travel in the sub-critical regime.

Vessel generated waves have a significant effect on the morphology and sediment budget of the shoreline not only because of their large periods, but also because of their different direction of propagation compared with predominant wind waves. At the experiment site, there is no sediment transport from the East, due to the presence of an adjacent jetty, whereas significant sediment transport from the west is possible due to wind generated waves. Overnight, when vessel traffic is minimal and there are wind generated waves, the beach adjacent to the jetty builds up and a high-water berm is established from sediment transported from the west. The berm is removed by the first set of vessel wake waves each day, with sediment being transported offshore. During calm periods, when there is no wind-wave generated sediment transport, the beach is not replenished and significant loss of sediment across the beach profile is evident. The beach again builds when wind waves return. The beach, therefore, never reaches an equilibrium shape, as might normally be expected on the up-drift side of a groin.

Controls on nutrient, Chlorophyll and temperature variability in a mediterranean coastal Lagoon.

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The main external physical and biogeochemical forcing in San Quintin Bay (SQB) is from the neighbouring coastal ocean strongly influenced by upwelling. The frequency of the upwelling pulses likely controls the temporal variability of primary production and nutrients near the mouth within the bay. We suggest that the ability of this ecosystem to assimilate nitrate through primary production is result of the advection of newly upwelled waters from the adjacent coastal ocean which are brought into the lagoon through tidal pumping. This hypothesis is tested using a 1-D coupled physical-ecological model (ERSEM-GOTM) in which we allow horizontal advection forced from observed horizontal gradients. The model is compared with data (i.e. current velocity, temperature, chlorophyll and nitrate concentration) collected during May-July 2005. Then we used the model to assess the importance of the upwelling and the spring-neap tidal cycles on the biogeochemistry of San Quintin Bay.

Effects of Extreme Events in the Eastern Irish Sea.

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Future extreme coastal flooding and erosion events are expected to increase (in intensity and frequency) as a result of climate change. The Coastal Flooding by Extreme Events (CoFEE) and Morphological Impacts and COastal Risks induced by Extreme storm events projects are investigating the flood and erosion risks in the eastern Irish Sea/Liverpool Bay. This study area includes many of England's coastal types and the projects focuses on the management of the Sefton coast (between the Ribble and Mersey estuaries) with its mobile dunes. The present and future flood and erosion risk posed by extreme events are being investigated using coupled numerical models of hydrodynamics, waves, sediment transport and coastal morphology. A 10-year hindcast simulation (1996 - 2007) is being generated This will then be used to investigate the potential of coastal flooding and erosion using climate change scenarios based on IPCC guidelines and forced with Hadley Centre atmospheric forcing.

Quantification of surface and subterranean estuarine nutrient fluxes to the coastal zone

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Surface water discharge through estuaries has long been recognized as an important pathway for the delivery of nutrients (N, P, Si) to the coastal zone. The quantification of the biogeochemical and ecological controls on nutrient fluxes and their impact on coastal water quality has been the subject of extensive experimental research for years. More recently, an underground pathway of nutrient supply to the nearshore coastal zone through 'submarine groundwater discharge' (SGD), has also been identified. Although SGD rates are generally significantly lower than river runoff, the dissolved nutrient concentrations in groundwater tend to be higher than in surface waters, and may thus be an important pathway for nutrient delivery. Most studies to date have focused on the identification of hot spots for SGD and quantification of SGD of nutrients through the freshwater-seawater mixing zone in coastal aquifers, referred to as subterranean estuaries [*Moore, 1999*]. In addition to field studies, mechanistically-based models have also been recently applied on a local scale to advance our understanding of the nutrient filtering capacity in a restricted number of surface and subterranean estuaries [*e.g. Spiteri et al., 2008*] However, the global, quantitative significance of the estuarine pathway for the supply of nutrients to the coastal zone remains uncertain.

This contribution is divided in two parts. First, we perform a comparative analysis of the functioning of surface and subterranean estuaries, by focusing on the identification of external forcings and physical controls. We also show how modelling approaches that integrate the complex biogeochemical dynamics of estuarine systems provide better constrained estimates of N, P and Si fluxes to the coastal zone. Second, a review of available information on inputs, filtering capacities and nutrient fluxes through the surface and subterranean pathways is presented. Here, we attempt an assessment of the contribution of subterranean nutrient fluxes to the overall coastal nutrient inputs.

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COSYNA: A step towards model supported monitoring of the German Bight

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Extensive exploitation of presently available coastal data with high quality and capacity of contained information such as from HF-radars, ADCP, Ferrybox and fine resolution satellite images is needed to progress the understanding of the dynamics of coastal waters. The development of appropriate tools and methods is strongly related to the progress in data analysis, numerical simulations and data assimilation. The recent *Coastal Observation System for the German Bight* (COSYNA) provides an infrastructure and resources to advance model-supported monitoring in this region. We demonstrate in this paper an example for model validation and forecasting the German Bight and the Wadden Sea. Numerical simulations use nested 3-D numerical model coupled with a suspended matter transport model. It is demonstrated that combining theory and observations facilitates understanding of some basic processes, such as Stokes-drift induced vertical circulation, effects of breaking wind waves, and the interplay between turbulence and transport. The good agreement between observations and simulations provides convincing evidence that the model simulates basic hydrodynamics and sediment transport, and can be used as a building block for COSYNA. This system represents a unique monitoring device as it bundles sensors and models. It emerges as a spatially distributed observatory providing the necessary coverage to characterize highly dynamic, interconnected and heterogeneous environments. The pre-operational level is illustrated on the example of the physical variables. Later upgrades are planed for biogeochemistry and ecology of coastal seas. Data assimilation into models is described in this talk on the example of Ferrybox and sea level data. Specific focus is put on the assessment of the performance of observational networks.

Mekong Sediment Discharge and Delta Configuration: Holocene Evolution, Present Situation and Perspectives for the Future

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The coastal zone of South Vietnam is significantly impacted by major changes in the Mekong Delta over different time-scales which affect coastal hydro- and sediment dynamics, river discharge and sediment fluxes to the sea.

The first reorganisation of the SE Vietnamese coastal and shelf zone after the last glacial sea-level lowstand occurred by deglacial flooding of large formerly exposed shelf areas around 14300 calendar years BP (meltwater pulse 1A). The flooding of the incised Mekong valley on the shelf can be traced from 13300 cal yr BP until the maximum transgression around 8500 cal yr BP which reached the region of south-eastern Cambodia.

The second reorganisation started with the onset of the modern Mekong delta 8200 years ago during the final phase of the deglacial sea level rise when sea level stood a few metres below the modern one. At that time the Mekong Delta initiated near Phnom Penh/Cambodia at the landward apex of a big shallow-marine embayment. Rapid evolution of the Mekong Delta followed after the mid-Holocene sea-level highstand 6000 years ago. The delta prograded from southernmost Cambodia to the modern shoreline until 1000 yr BP in the eastern and central parts of the delta while Camau Peninsula in the southwest emerged during the last millennium. Wave influence increased together with slower delta-progradation during the last 3.0 ka after the infill of the former embayment and increasing exposure to the open sea.

The third reorganisation takes place today as response to global change/global warming and intensive human use. We observe a dramatic slowdown in delta progradation as indicated by strong coastal erosion at the shoreline east of Camau Peninsula. While the eastern Mekong distributaries do not contribute much to the monsoon-induced alongshore sediment transport, a major sediment plume is escaping from the Bassac river-mouth. This sediment plume is moving to the SW alongshore turning around Camau Peninsula to the north and extending now up to the coastal waters off Rach Gia forming delta-slope-clinoforms enveloping Camau Peninsula and the western border of the subaerial Mekong Delta. East of the Mekong Delta we find a sediment starved shelf where relict sands form current-induced subaqueous dunes which are generally moving south-westward.

From the interplay of monsoon-driven alongshore sediment transport and shoreward directed wave action a very pronounced delta-front configuration with steep slopes from seaward dipping clinoforms has evolved. Age control of sedimentary architecture, sediment accumulation rates of the subaqueous delta and prodelta areas as well as aquatic sediment transport in the Mekong plume are under investigation now. Remarkable is the shift of the prodelta depocenter away from the Bassac-River mouth in downdrift direction towards and around Camau-Peninsula as the result of wind-induced alongshore currents and wave action.

These special features point at reduced sediment fluxes from the river-mouth channels to the shore. First measurements of decreasing sediment accumulation-rates confirm this. Intense sand mining/dredging activities in the major deltaic channels as well as the construction of reservoirs in the upper reaches of the Mekong River could be envisaged as direct man-made contributions to delta-deterioration which may provoke together with the expected sea-level rise a substantial land loss of more than 30% in the densely populated delta plain during this century.

Benthic dissolved inorganic carbon dynamics in the Gulf of Biscay (June 2006-May 2007 and May 2008)

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The biogeochemical properties of an extensive bloom of the coccolithophore, Emiliania huxleyi, at the shelf break in the northern Gulf of Biscay was investigated in June 2006, May 2007 and May 2008. We report the results from the benthic measurements during the three cruises. Benthic respiration rates were quite low and varied between 2 and 9 mmol m^{-2} d^{-1}, in agreement with the fact that the study area consists of sandy sediments with low organic matter content. Benthic respiration was well correlated to the Chlorophyll-a (Chl-a) content of the top 1 cm of the sediment, and to the grain size fraction smaller than 63 µm, indicating the influence of turbidity to the deposition of fresh material. Chl-a values in May 2007 and 2008 were higher than in June 2006 in agreement with the fact that the 2007 and 2008 cruises were conducted after the first large peak of phytoplankton biomass associated to diatoms, visible on the Seawifs Chl-a values in the study area, and that the 2006 cruise took place after the second smaller peak associated to coccolithophores. $^{210}Pb_{xs}$ profiles (of the 2007 and 2008 stations) indicate that the sediments are well mixed and steadily accumulated below the mixed layer (up to 10 cm depth in the sediments). $^{234}Th_{xs}$ activities show a deposition of fresh material in the upper 2 cm of the sediments at almost all stations (2007 and 2008). A negative relation between $^{234}Th_{xs}$ and Chl-a remains to be investigated but could relate to rapid resuspension zones, a delay in bloom arrival of detritus to the surface sediments or increased remineralization through aerobic and anaerobic pathways based on high bioturbation rates. Based on the co-variance of water-sediment TA fluxes and O_2 consumption, evidence was found for dissolution of $CaCO_3$ due to acidification of superficial sediments in relation to the production of CO_2 by respiration, as shown by the positive correlation between the dissolved inorganic carbon (DIC) flux and respiration. There was an increase in nitrate in the overlying water of the sediment cores, ranging from 0.03 to 1.2 mmol m^{-2} d^{-1}over an average incubation period of 42 hours, however some stations give evidence of denitrification. There is an increase in silicate at all stations of 0.05 to 1.0 mmol m^{-2} d^{-1}.

Surface dissolved inorganic carbon dynamics in the Gulf of Biscay (June 2006 – May 2007 – May 2008)

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The biogeochemical properties of an extensive bloom of the coccolithophore, Emiliania huxleyi, at the shelf break in the northern Gulf of Biscay was investigated in June 2006, May 2007 and May 2008. We report the results from the surface measurements during both cruises. Seawifs Chlorophyll-a (Chl-a) values in the study area indicate that seasonal cycles of phytoplankton biomass were remarkably similar in 2006, 2007 and 2008 with a first peak in mid-April associated to diatoms and a second peak in late May associated to coccolithophorids. During both cruises, Total Alkalinity (TA) values showed strong non-conservative behaviour, indicative of the impact of calcification. TA anomalies were positively related to the degree of stratification, in agreement with the ecophysiology of coccolithophores, whereby these organisms flourish in nutrient depleted and high light availability conditions. The largest TA anomalies were observed in the high reflectance coccolith patch where we also observed an increase in the partial pressure of CO2 normalized at a constant temperature of 13°C (pCO2@13°C), in agreement with the transfer of CO2 from the bicarbonate pool during calcification. TA anomalies were of similar amplitude during both cruises, indicating that calcification affected markedly the dissolved inorganic carbon dynamics. During both cruises, pCO2 values ranged form 250 to 375 µatm and the area was found to act as a sink for atmospheric CO2. pCO2@13°C in the water column was negatively related to TA anomalies in agreement with an overall production of CO2 related to calcification. Hence, the calcifying phase of the E.huxleyi bloom decreased the sink of atmospheric pCO2, but did not reverse the direction of the flux. pCO2@13°C values in June 2006 lie below the values in May 2007, due to the cumulated impact of primary production on pCO2, since the 2006 cruise was carried out later in the year than the 2007 cruise.

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Effects of wave exposure on nearshore benthic habitat and circulation in a complex reef dominated coastal environment off South West Western Australia.

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Coastal waters off South West Western Australia are unusual, supporting high benthic biomass and a winter phytoplankton bloom, while the poleward flowing Leeuwin Current is nutrient poor. The region is micro-tidal, dominated by diurnal tides with a spring range of about 0.7m, exposed to long period southern ocean swell, and a strong sea breeze cycle during summer months. Shallow limestone reefs within a few kilometers of shore are common and exposure to waves is considered to have a significant affect on benthic communities. Wave breaking over these reefs force cross shore and alongshore mean flows in addition to the wind and tidally forced components of the circulation. In this paper we report results from a multidisciplinary study of the nearshore circulation, nutrient distribution and benthic habitat in this complex reef dominated coastal environment. Maps of nearshore wave exposure were derived with the wave model SWAN run at three daily intervals over twelve months using wave height, period and direction observed at an offshore wave buoy. The effect of wave exposure on benthic communities is examined using habitat maps and diver surveys of kelp density and species richness. Between July 2007 and May 2008 in situ measurements of waves, currents and water properties were made on and around a series of reefs off Perth, Western Australia, and reveal high temporal and spatial variability at scales of days to months, and 100m to 1000m, respectively. The measurements were made using an array of ten moorings and a variety of point current meters and profiling ADCPs, wave gauges and multi-sensors measuring temperature, salinity, oxygen, PAR and fluorescence. The array was deployed four times throughout the year, each deployment being 6-8 weeks duration. A CTD survey, including surface and bottom nutrient and chlorophyll measurements, on a grid of 30 stations was completed at approximately monthly intervals. Elevated nutrients, particularly nitrate, are observed over the reefs 3 to 4 km offshore, maximum in winter (NOX>1.5 μmol) and minimum in summer (NOX<0.2 μmol). Offshore wave height was also a maximum in winter, Hs > 3.5m, and minimum in summer, Hs <1m. The top of the reefs are typically 1-2m below the sea surface, and between the reefs and shore the average depth is about 10m. At most of the reef sites waves begin to break when the significant wave height exceeds about 1.5m resulting in spatially complex mean flows, with onshore flow over the reefs, offshore flow through some of the gaps between the reefs, and strong southward flow between the reef line and the shore. Strong winds often accompany the high wave events and separating wave and wind driven currents in the observations is often difficult. We have used the 3D Regional Ocean Modelling System (ROMS) to simulate wave and wind driven currents in a domain approximately 5km cross shore and 20km alongshore. The model is forced by tides at the open boundaries, wind stress, heat and fresh water fluxes at the sea surface, and wave breaking over the shallow reefs using a depth dependent formulation of the radiation stresses representing the excess momentum due to the presence of the waves. The model resolution is of order 100m in the horizontal with 8 vertical sigma levels. During periods of high waves the model captures at least some of the wave driven flow seen in the observations, and during periods of low waves diurnal variation of currents associated with the sea breeze cycle is reproduced.

Analysis of possible pollution scenarios of risk in Vado Ligure harbour

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The goal of the paper is to analyze the possible pollution scenarios of risk in Vado Ligure – Ligurian Sea using wave heights data obtained from a local buoy. The original data of buoy were provided by Savona's Harbor Authorities for this research.

The examined area present an extension of approximately 10 hectares, and the principal maritime structures are quays and piers. The realization of a new multipurpose platform with a surface over the sea of 250.000 m^2 implies that this is an area of interest for environmental analysis taking into account the increasing of trade of dangerous goods.

The area was defined in a detailed bathymetry with a grid of 5mx5m.

The wave heights were available only for a short period not significant to support a statistical approach but to describe a possible ordinary conditions of sea waves.

The analysis was curried out using the software of Danish Hydraulic Institute MIKE21 that allows to model starting from the boundary conditions over the examined area the hydro dynamic sea conditions and knowing the characteristic of polluted elements to evaluate the impact along the shore and in whole area.

To simulate the diffusion of the polluted elements we have proposed different approach used in literature assuming different conditions of wind and current to evaluate the extension of the possible pollution and the value of its concentration.

The different results obtained are then compared among them to define the worst condition of waves and winds in case of accident.

Tidal and subtidal flow patterns at the Berau Inner Shelf, Indonesia

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The present study sets out to describe the tidal and subtidal water motion at the Berau coastal shelf, which represents a tropical continental shelf of variable width hosting a complex of barrier reefs along its oceanic edge. Moored and shipboard measurements on currents and turbulence were made as part of the multidisciplinary East Kalimantan Research Program. These results, and collected data on sealevels, meteorology and bathymetry, were used so setup and calibrate a three-dimensional hydrodynamic model in the ECOMSED environment, which is derived from the

Princeton Ocean Model. Concurrent profile measurements of flow velocity and Reynolds stress with an acoustic Doppler current profiler allowed to infer values of the drag coefficient on locations on the shelf and within the barrier reef environment. The drag coefficients determined from shelf measurements differed less than 20 percent from optimal model settings. Diurnal and semidiurnal tides have the same character, propagating across the isobaths with amplitudes that increase towards the coast by shoaling. The tidal amplification is captured in a one dimensional model, revealing an analogy with the Amazon Shelf. Regarding the subtidal depth-mean flow, tidal Eulerian residual currents dominate over monsoon-driven currents, and occur to compensate for Stokes drift. The mean seasurface topography shows the largest tidal wave setup in a coastal region where the shelf width is smallest, driving an Eulerian mean current component towards the wider shelf section. At a regional scale, the reef complex is established to be semitransparent to tides, enhancing the tidal amplification by 8 percent. The barrier reef influences the tidal phases rather then the amplitudes, especially in the shelf region that is insulated by the reefs. This may explain why tidal phases predicted from hydrodynamic models of tropical continental shelves often feature substantial discrepancies from measurements made at coastal observatories.

POSTER

Impact assesment of nutrient reduction policies on coastal Phaeocystis blooms: an integrated modeling approach.

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High biomass blooms of Phaeocystis colonies occur each spring in the eastern Channel and Southern North Sea area as a result of nutrient loads discharged by the Seine, Somme and Scheldt rivers. These blooms affect significantly the structure and functioning of the coastal ecosystem and cause environmental damage visible as foam accumulation on beaches. In spite of intense research effort little is known on the present-day magnitude of the phenomenon and how it might change in the future in response to planned nutrient reduction policies. In this work we apply an integrated modelling approach that links the undesirable Phaeocystis phenomenon to changing human activity in the three watersheds. The mathematical tool results of the coupling between the SENEQUE-RIVERSTRAHLER model, an idealized biogeochemical model of the river system implemented in the Seine, Somme and Scheldt watersheds and the biogeochemical model MIRO describing diatom and Phaeocystis blooms in the marine coastal domain. Model simulations explore how realistic nutrient reduction options regarding diffuse and point sources would impact on the Phaeocystis colony spreading in the coastal area. The reference and prospective simulations are performed for the year 2000 and nutrient reduction scenarios include and compare upgrading of waste water treatments and changes in land use and agricultural practices. A cost-effectiveness analysis is performed for each nutrient reduction scenario. Finally the reduction obtained for Phaeocystis blooms is assessed by comparison with ecological references (bloom magnitude and duration) and the daily cost of reducing foam on the beaches is estimated

A Management Tool for Coastal Waters based on Data Assimilation Techniques

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Pagasitikos gulf is a semi-enclosed basin highly influenced both by anthropogenic activities (inflow of nutrients at the north and west parts) as well as by water exchange between the gulf and the Aegean Sea at its south part (Trikeri channel) resulting in the development of functional sub-areas within the gulf. Thus the inner part is characterized by eutrophic conditions with sporadic formation of harmful algal blooms while the central part acts as a buffer with mesotrophic characteristics influenced by the oligotrophic outer area. Within the framework of the European INSEA project, a management tool has been developed based on an advanced forecasting system for the Pagasitikos Gulf ecosystem.

The system is based on a multivariate sequential data assimilation that blends satellite sea colour (chlorophyll) data with the predictions of a three-dimensional ecosystem model of the Pagasitikos Gulf. The hydrodynamics are solved with a very high resolution (1/100o) implementation of the Princeton Ocean Model (POM) nested within a coarser resolution model of the Aegean Sea which is part of the Greek POSEIDON forecasting system. The forecast of the Aegean Sea model nested itself and initialized from a Mediterranean implementation of POM model is also used to periodically re-initialize the Pagasitikos hydrodynamics model using variational initialization techniques. The ecosystem dynamics of Pagasitikos are tackled with a stand-alone implementation of the European Seas Ecosystem Model (ERSEM). The assimilation scheme is based on the Singular Evolutive Extended Kalman (SEEK) filter, in which the error statistics were parameterized by means of a suitable set of Empirical Orthogonal Functions (EOFs).

Before the implementation of the data assimilation scheme, the biogeochemical model was tested against field data using a cost function. Simulation results are in good agreement with in-situ data illustrating the role of the physical processes in determining the evolution and variability of the ecosystem as well as pointing out the significance of inputs in the functioning of this sensitive ecosystem, highlighting thus the need of using data assimilation techniques. The assimilation experiments were performed for year 2003 and a 9-month period over 2006 during which the physical model was forced with the POSEIDON-ETA 6-hour atmospheric fields. The accuracy of the ecological state identification by the assimilation system is assessed by the relevance of the system in fitting the data, and through the impact of the assimilation on non-observed biochemical processes.

Several different physical/chemical/environmental parameters were used (such as light intensity, sea surface temperature, wind, mixed layer depth, salinity, nutrients, etc) to identify which variables control or significantly affect the surface Chl-a of Pagasitikos Gulf (Greece). The variables were acquired from a coupled hydrodynamic-biogeochemical model. The remotely sensed data were derived from the SeaWiFS sensor, for the period of 1997-2008. Generalised Additive Models (GAMs) and regression techniques were used to examine the relationships between chlorophyll-a and the biogeochemical regime. GAMs analysis showed that the combined effects of the variables used, explained >70% of the surface Chlorophyll variation; SST appeared to play the most important role on the intensity of these blooms, illustrating the highest Chl-a values during the lowest SSTs.

Assimilation of either GlobeMed (2003) or SeaWiFS (2006) data significantly improves the forecasting capability of the ecosystem model. Results, however, indicate the necessity of subsurface data to enhance the controllability of the ecosystem in the deep layers.

As the particular ecosystem is very complex and fragile, planning decisions require integrated management policies based on holistic approaches that include as many system components as possible. In order to support management decisions, the forecasting system was implemented,

simulating the ecosystem response due to fish farm activities, i.e. by incorporating in the biogeochemical model the fish farm effect in the form of weekly inputs of nutrients and organic matter. The impact on the Pagasitikos gulf ecosystem from two marine fish farms is explored and analyzed, while the sensitivity to different loadings is examined through different scenarios. The tool capabilities as illustrated by the simulation results nicely demonstrate its role in supporting management decisions.

Biomonitoring of pollutants in the marine environment using molecular markers

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In the present day, it is very important to monitor river and marine pollution, since metabolites of toxic compounds from waste water/effluent are hazardous and carcinogenic in nature. The toxic compounds are lipophilic in nature, easily accumulating in aquatic habitants and food organisms such as fish and prawn. Accumulation of pollutants in the food organisms causes toxic consequences to human through food chain. Recently, the food organisms such as crustaceans and mollusk are reported to accumulate higher level of pollutants and believed to transport toxic chemicals into their predators including human being. Since, the ability of detoxification of pollutants are poor in invertebrates (crustaceans and mollusk), much works are done in the aspect of metabolism of these contaminants. Quantification and detection of complex of pollutants (xenobiotics/chemicals) in water (river or marine) medium are very complicated, and expensive. On the other hand, estimation of biochemical changes in the aquatic organisms would gives us clear idea about the accumulation of toxic chemicals. Biomonitoring of pollutants, in aquatic medium and organisms, using biochemical changes are known as biomarker. Applications of biomarkers (enzymes which involves in the metabolism/elimination of toxic chemical in aquatic organisms) for the early detection of aquatic pollution have been useful in recent years.

Biomarkers

Cytochrome P450 is a heam protein and supergene family of monooxygenase enzymes. The pivotal role of P450s is metabolism and detoxification of endogenous and exogenous compounds such as pollutants and toxic chemicals. The cytochrome P-450 (CYP 450) serves as both the oxygen and substrate-binding locus for the monooxygenase reaction and undergoes cyclic oxidation / reduction of the heme iron during catalysis. It consists of single polypeptide chain with iron-protoporphyrin IX loosely bound by hydrophobic forces, electrostatic and covalent bonds. The cytochrome P450 monooxygenase function in association with several microsomal proteins, located in the endoplasmic reticulum together with the P450 isoenzymes that transfer electrons to reduce cytochrome P450 during its catalytic cycle. These components include NADPH-cytochrome c reductase, cytochrome b5, and NADH-cytochrome c reductase. Electrons from NADPH or NADH are transferred through these compounds and cytochrome P450 (CYP 450) insert one atom of oxygen into the substrate (drugs / xenobiotic compound) and reduces the second oxygen atom to form water. The oxidized toxic compounds are further removed my Glutathione s transferases (Phase II enzyme). **From the above said detoxification mechanism, we have selected (1) Cytochrome P450, (2) NAD(P)H cytochrome P450 reductase, (3) CYP450 monooxygenase Ethoxyresorufin-O-Deethylase (4)Glutathione s transferases as biomarkers for biomonitoring the marine pollutants using different marine organisms.** During CYP450 reaction free radicals are produced in marine organisms. Antioxidant enzymes such as superoxide dismutase, catalase and Glutathione peroxidase play a main role in the removal of free radicals such as anions and peroxides (anions and peroxides are toxic to biological organisms). **Hence, in the present work, antioxidant enzymes (1) SOD, (2) CAT and (3) GSH-Px enzymes are planned to utilize as biomarkers to detect marine pollutants using marine organisms.**

Effect of large angles of wave incidence on beach nourishments

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Beaches are of great interest from environmental, social and economic points of view.

Protecting and preserving them from erosion is a big challenge for coastal engineering especially in view of the climate change and the need for sustainable development. However, beaches are very dynamic systems on the solid earth as they are continuously shaped by waves and currents. Beach nourishment, i.e., dumping sand on a beach, is a soft intervention to prevent erosion. Nourishments are always a temporary solution as the sand eventually spreads out and is removed from the nourished beach. Nourishments started in the past without much knowledge of the complex interactions between waves, currents and morphological changes. However, recent advancements in understanding such processes may largely improve the efficiency of nourishments, i.e., their useful lifetime (Grunnet and Ruessink 2005). On the other hand, it has been discovered in recent years that the coupling between waves and morphology may render a rectilinear sandy coast unstable if the angle between wave fronts and shoreline is large enough (Ashton et al. 2001, Falqués and Calvete 2005). The instability causes the formation of alternating erosion and accretion spots with a spacing of a few km's and characteristic times of a few years. The aim of this study is to investigate the effect of such instability on beach nourishments. The main objective is finding out how the nourishment of a particular beach must be designed to i) optimize its useful lifetime and ii) avoid damage on surrounding beaches. It is found that, if wave climate is dominated by high wave incidence angles, beach nourishment may trigger the instability. In this case, sand initially accumulates at the place of the nourishment but severe erosion problems occur at several stretches of coast downdrift of the nourished beach. Besides, the erosion/accretion spots migrate downdrift and the nourished beach tends eventually to its initial state.

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Analysis of Water flow around patches of saltmarsh vegetation

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In the past decades the effects of saltmarsh vegetation on currents and waves have been studied in narrow laboratory flumes. In these channels, water is forced through the vegetation. In the field water may either flow through or around a patch. We tested the effect of patches of vegetation on hydrodynamics in a large-scale laboratory basin of 16m wide by 20 m long. Three different types of vegetation were used: Common Cordgrass (*Spartina anglica*) is one of the most common species on the Dutch saltmarshes. It is a fairly firm, tall grass that forms large, tussocks. A young, newly formed saltmarsh is characterised by many smaller, individual tussocks with large areas of bare sediment in between. Older marshes look more like large grass land areas, intersected by creeks and gullies. In comparison to *Spartina*, Common Saltmarsh Grass (*Puccinellia maritima*) is much more flexible and tends to grow in patches of much higher density. Marsh Samphire (*Salicornia europaea*) has relatively thick, rigid stems that tend to form complicated branched structures in older plants. In comparison to the other two species, *Salicornia* forms relatively open canopies.

Particularly with submerged vegetation, large differences exist between the surface flow and near-bed flow. We analysed the 2D horizontal patterns of surface currents with Particle Image Velocimetry (PIV). Velocities in lower layers were analysed using electromagnetic velocimeters (EMV) and an acoustic Doppler velocimeter (ADV). Additionally, the flow was modelled using Delft3D-FLOW. The PIV technique was valuable in highlighting the complex flow structures around emergent vegetation.

In very shallow water, the wake behind a patch of *Spartina anglica* is long. The limited water depth restricts the formation of Kelvin-Helmholz instabilities and thus restricts lateral momentum exchange that in deep water would speed up the wake. In relatively small patches (2 patches of 2x2 m, separated by a channel) the flow through the canopy and immediately downstream of the vegetation was nearly stagnant. In wider patches (e.g. a single patch of 4m wide and 2 m long) a larger portion of the fixed water flux was forced through the canopy. In both configurations the ratio between the total cross section in the flume taken up by vegetation and the total flume width was the same. This implies that due to the increased flux of water with suspended sediment, wider, continuous patches may retain relatively more sediment than smaller tussocks, interspersed with channels, even if the total vegetated surface area is the same.

Changes in the marine environment: the Belgian part of the North Sea revisited

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Sustainable development requires the quantification of human impacts, against the seafloor's ecological value. Recent impact studies have shown localised effects only, though indications of a longer-term and broader-scale degradation of the seafloor exist. This is due possibly to cumulative anthropogenically-induced effects, but the natural evolution and the response of the seafloor due to sea-level rise are poorly known. Such evolution needs to be disentangled against the impact of dredging, aggregate extraction, fisheries and beach replenishment.

Naturally-, as well as anthropogenically-induced sediment dynamics are studied in detail along the Belgian part of the North Sea [*Van Lancker et al.*, 2008]. State-of-the-art observations/sampling, advanced modelling, as well as analyses of long-term datasets on sediment nature and dynamics, geomorphology and macrobenthos are carried out. Additionally, integrated sand/mud models and dynamically coupled current/wave models are being developed, with boundary conditions generated from models focusing on the Scheldt estuary and on the coast. A historic reference framework has been set-up, based on a sediment and macrobenthos dataset of 100 yrs ago [Gilson dataset, *van Loen & Houziaux,* 2002]. In representative areas, erosion/sedimentation patterns and rates are quantified and balanced against the occurrence and intensity of human activities.

Results are integrated in the view of developing criteria, monitoring strategies and recommendations for a more sustainable exploitation/management of the EEZ. Particularly, the allocation of efficient dumping grounds, large-scale aggregate extraction and sustainable coastal protection schemes are being considered, also in the perspective of future sea-level rise scenarios.

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Estimating errors of a hydrodynamic model.

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The expected modelling error of hydrodynamic models can be obtained by means of ensembles, in which various parameters are perturbed by different means: the bathymetry, the initial conditions, atmospheric forcing fields (air temperature, cloud coverage, wind), and internal model parameters (diffusion coefficients).

These ensembles are then forwarded in time, and the evolution of the differences (i.e. the model error) between members is analyzed. In particular, one can examine the time evolution and stationarity of their spatial average, and the spatial distribution of the error at different instants, by means of its first to fourth order moments, and of empirical orthogonal functions. One can also verify whether the a posteriori error distribution is Gaussian.

We applied the described ideas to an ensemble of 250 members covering the whole Mediterranean Sea, with perturbed initial conditions, bathymetry, diffusion parameters, wind forcing field, air temperature forcing field, and cloud coverage forcing field.

Another ensemble covers the Black Sea, and apart from modifying initial conditions, boundary conditions and model parameters, we now also change the model code itself (i.e. we use different model codes).

From these ensemble simulations, we are able to assess what parameters and forcing fields are most critical for a correct forecast. Furthermore, we are able to quantify the expected error range on forecasts. Finally, we are able to construct (reduced rank versions of) realistic multi-model, multi-variate model error covariance matrixes, which are much needed for e.g. data assimilation or super-ensemble techniques, but are, in practice, often grossly approximated.

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The impact of maritime access works on coastal turbidity in the Belgian coastal zone (southern North Sea)

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Large scale infrastructure, dredging and sediment disposal works are executed in the area around Zeebrugge (Belgian coastal zone) to improve maritime access. From in-situ and remote sensing measurements it is known that a turbidity maximum is formed between Oostende and the mouth of the Westerschelde (with Zeebrugge in the centre). This local increase in suspended particle matter (SPM) concentration has been explained by the complex residual currents, the influence of the Schelde estuary and erosion of muddy sediments (Nihoul, 1975; Van Alphen, 1990; Fettweis and Van den Eynde, 2003). In this paper we want to add another perspective to the discussion by exploring the different sources of mud in the coastal waters, showing that in the area around Zeebrugge sources due to maritime access works are important. In conclusion of this paper we want to formulate the hypothesis that the present coastal turbidity maximum is significantly influenced by / for a large part caused by the maritime access works carried out in that area.

The most important source of SPM in Belgian coastal waters is the material that is supplied by the residual coastal current from the Straight of Dover, along the French coast of Nord-Pas-de-Calais to the Belgian coastal zone. This source is relatively well quantified and amounts to about 17 MTDS (Million Ton Dry Solids), see Fettweis et al. (2007). Sources of SPM in eastern part of the Belgian coastal waters that can be related to maritime access works are: (1) the extension of the breakwaters of the port of Zeebrugge in the period 1979-1986 inducing a local scour hollow. As a consequence important amounts of mud were and still are released due to erosion of medium-consolidated Holocene mud layers; (2) the deepening of the navigation channels results in erosion of the neighbouring sea bottom because the channel slopes are gradually flattening towards an equilibrium profile. An average slope of 1/200 is measured for the navigation channels to Zeebrugge and Oostende. Again, the mud content of the eroded material is high (~former coastal plain); (3) due to maintenance dredging of the navigation channels and the coastal harbours (especially Zeebrugge) mud is almost continuously taken from the bottom and disposed at dedicated sites in the coastal waters. Yearly average amounts of maintenance dredging are about 10 MTDS. Although this maintenance dredging does not provide new mud to the system, it results in an increase of the SPM versus the deposited mud; (4) the maritime access works together with the associated erosion creates new sinks for temporary deposition of mud. This mud accumulation on the bottom can be eroded again during higher energy conditions by currents and waves, resulting in an increase of the SPM concentration.

Apart from the impact of maritime access works on coastal turbidity, research is also ongoing regarding the input of mud from inland waters. Monitoring at the landward side of the Schelde estuary, in several tributaries, has shown that the sediment flux towards the coast is in the order of 0.5 to 5 MTDS/year. These results show that the contribution of the Schelde estuary is probably much higher than previously assumed (Van Alphen, 1990).

This work is carried out in the framework of the Belgian Science Policy SSD project QUEST4D (Van Lancker et al., 2008).

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Inter-calibration/comparison of acoustic and optical turbidity sensors

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Robust turbidity and suspended sediment concentration measurements are a fundamental issue for the study of nearshore sedimentary processes and for oceanographic research in general. In the present contribution a set of acoustic and optical turbidity sensors is extensively tested and compared in laboratory conditions, under suspended sediment concentrations ranging between 0.1-10 gr/lt. Various well sorted, mixed, as well as natural sediments (including mud and sand) were used in various tests, in an effort to cover as many cases possible; material and instruments were placed in a cylindrical container with a stirrer used to achieve suspension. The optical sensors (Wetlabs BBSB, Troll 9000 and OBS-3) showed a stable linear response, while the acoustic measurements (Aquascat 1000, Nortek Vector ADV) were less linear and in many cases were better described by an exponential relation of the form $SSC=a\ signal^c$, where a, c are calibration constants. Acoustic instruments were also found to require longer stirring times to result in signal stabilization. The above behavior could be partially attributed to the longer wavelength of light (compared to sound) which allows for larger sampling volumes and makes optical sensors less sensitive to spatial concentration gradients. The Vector ADV, even though originally designed as a current meter, produced satisfying SSC measurements for concentrations >1 gr/lt above which the signal becomes less reliable due to saturation problems.

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Zinc effect on bacterial mineralization process of dissolved organic matter in coastal seawater.

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Numerous studies on coastal ecosystem have been carried out so far, because the environment is directly influenced by human activity. Since dissolved organic matter (DOM) strongly relates to energy flow and material cycle in seawater, estimation of the dynamics of DOM in coastal seawater has been required. The fate of marine DOM is significantly affected by the process of bacterial decomposition, which would be restricted by the activities of ectoenzyme and bacterial metabolism. Considering that the enzymatic activities depends on ambient zinc concentration probably due to the importance of zinc-binding to the active site of proteins, it is necessary to quantitatively evaluate the effect of zinc on DOM decomposition processes.

In the present study, we added concentrated high molecular weight dissolved organic matter (HMW-DOM) as organic substrate to natural bacterial community in order to set up decomposition experiment. The sample seawater was collected at a coast of Matsuyama in Japan in September 2008. The fraction of HMW-DOM (molecular size: from 3 kDa to 0.2 μm) was concentrated by ultrafiltration (3 kDa) after filtration using a large volume filterable cartridge filter (0.2 μm). Seawater containing natural bacterial community was made by filtration using GF/F filter to remove most of phytoplankton. A part of natural bacteria can be passed through GF/F. After combining the concentrated HMW-DOM solution with bacterial fraction, we added different concentration of zinc chloride (0-475 μg Zn/L) to the sample. The samples were stored under dark at 25ºC for two weeks, and subsamples were collected several times. The dissolved organic carbon (DOC) concentrations and bacterial cell numbers were measured by total carbon analyzer (Shimadzu TOC-V) and diamidino-phenylindole (DAPI) staining method, respectively.

The DOC concentrations in all sample bottles decreased with time, but the remaining proportions of DOC on the last day (day 14) against initial day ($\%DOC_{14d}$) were different among samples. The values of $\%DOC_{14d}$ in high concentration of zinc were higher ($\%DOC_{14d}$: 91-98%; Zn addition: 47, 136 and 475 μg Zn/L), compared with those with lower concentration cases ($\%DOC_{14d}$: 86-89%; Zn addition: 0, 1.4, 4.7 and 14 μg Zn/L). This shows that zinc addition induces inhibition of bacterial decomposition of DOM. The values of bacterial cell numbers on day 14 significantly decreased with the addition of zinc, implying that zinc input suppresses the bacterial activity. Since the zinc concentrations in coastal regions have wide variation from less than 1 μg Zn/L to more than 100μg Zn/L, the effects of zinc on DOM decomposition will be considerable to understand the material cycling in coastal ecosystems.

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Loading Capacity of a Brazilian Coastal Lagoon After the Construction of a Perennial Connection with the Sea.

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The Saquarema Lagoon is a choked coastal environment that in the last two decades has been subject to a rapid environmental degradation, leading to an advanced eutrophication state. This degradation threatened the sustainability of tourism activities and fishing making authorities to take the urgent decision of constructing a perennial connection between the lagoon and the sea. This connection was supposed to improve water exchange and reduce residence time, but chemical and biological processes like remineralization of nutrients and primary phytoplankton/algae production were overlooked. In a previous work [*Azevedo et al, 2009*] we presented the results of a one year monitoring program showing that during this whole period a consistent remineralization of nutrients from the sediments, particularly ammonium and phosphate did not allow the system to reach an equilibrium that would engender improvements of the water quality. In the present work a numeric model was developed in order to determine the loading capacity of the lagoon for the years 2010, 2020, 2030, 2040 and 2050. First, a mass budget of the nutrients was carried out using as input values the population growth projections until 2050 and the per capita nutrient production. The lagoon was segmented in sub-systems associated with the census sectors (the least element of the Brazilian Census that encompasses 300 homes). The population increment projection for each census sectors was carried out using the procedure developed by the Brazilian Geography and Statistics Institute. The amount of nutrient produced per capita, per day was obtained from the literature. The loading limits for nutrients were obtained from the water quality criteria from the Brazilian environmental regulatory agency (CONAMA). In a first simulation scenario, only the permanent population was considered (excluding tourists). During summer the resort tourists can double the permanent population and this constituted a second scenario. This second scenario is more appropriate to summer periods that, by the way, is the time when the water quality should be better for the sustainability of tourism. As far as fishing is considered, the first scenario gives a quite reliable figure. The projections show that in the worst scenario, the increase of the population will produce trespassing of the CANAMA limits by the middle of the 2010 decade. The opening of a connection between the lagoon and the sea alone will not be enough to solve the eutrophication problems. Further actions for the reduction of nutrients inputs like the installation of sewage treatment plants are required for the next few years.

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Understanding Ecosystem Processes in the Bering Sea

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The North Pacific Research Board (NPRB) and National Science Foundation (NSF) are studying the response of the eastern Bering Sea shelf ecosystem to climate change and sea ice loss. The program includes three field seasons (2008-2010) and two years of analysis and is based on NSF's 2005 Bering Ecosystem Study and NPRB's Bering Sea Integrated Ecosystem Research Program. Funds for the $52 million partnership include $16 million from NPRB, $21 million from NSF, and matching funds from NOAA, U.S. Fish and Wildlife Service, and U.S. Geological Survey. Over 90 federal, state, and university scientists are involved, many from Alaska, Washington, Oregon, and British Columbia. NSF researchers are studying atmosphere, ocean physics and lower trophic levels, including physical and biological sampling around sea ice and on the ocean floor; primary production near sea ice; nutrients and stratification; and energy transfer through zooplankton. NPRB funded research emphasizes forage fish, commercial fish species such as pollock, Pacific cod, and arrowtooth flounder; northern fur seals, walrus and whales; and thick-billed murres and black-legged kittiwakes. Foraging patterns of marine mammals and seabirds are being studied within large prey aggregations near the Pribilof, Bogoslof, and St. Lawrence Islands. Local and traditional knowledge research involves the coastal communities of Akutan, St. Paul, Togiak, Emmonak, Savoonga and Nelson Island. Federal matching funds from NOAA, USGS, and USFWS support trawl surveys; seabird telemetry; and studies of fur seal pups and persistence of foraging hotspots. An innovative vertically integrated ecosystem modeling activity ties the program components together.

Model insights to coastal monitoring system design in regions with high inter-annual variability.

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A sophisticated biogeochemical model has been implemented within a coupled 3D hydrodynamic and sediment model to simulate the cycling of carbon, nitrogen and phosphorus through dissolved and particulate organic and inorganic forms in the pelagic and surface sediments of the Huon Estuary and D'Entrecasteaux Channel in southeast Tasmania, Australia. The model was triple nested in a global model, forced with real meteorology, river flows, biogeochemical boundary conditions derived from a limited set of observations and real fish farm nutrient loads. The model has been validated against observations and captures the essential seasonal dynamics of nutrients and plankton in the D'Entrecasteaux Channel and side bays, and slightly less well in the Huon Estuary. A four year model simulation was used to investigate natural interannual variability and anthropogenic impacts. The simulated period included a wetter and a drier year, with elevated fish farm loads. Natural interannual variability was assessed from a repeat simulation without farm loads and demonstrated a considerable range in results between years. Results from all years were summarised to show regions where naturally high surface dissolved inorganic nitrogen, near surface chlorophyll and depleted bottom water oxygen had occurred. Further analysis showed the likelihood of detecting fish farm impacts in excess of natural system variability throughout much of the region by a monthly monitoring program was small. The probability of detecting farm impacts out-with natural variability did not appear to be closely correlated with interannual variation in farm loads suggesting that spatial and temporal variability in hydrodynamics, marine and river influx, dominated the regional biogeochemistry. This analysis suggests that it is necessary to collect data with high temporal resolution to characterise the impact of fish farm nutrients on the biogeochemistry of a region with high natural interannual variability.

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Modelling trace metals in the Scheldt estuary in the TIMOTHY project

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The aim of the TIMOTHY project is to develop, validate and apply tools to describe and evaluate the past (back to 1950), current and future (up to 2050) changes in quality of surface, ground and marine waters and to relate them to changing human activities on the watershed. With this general objective, a suite of models of varying complexity is developed to describe the transfer and retention of trace metals in the Scheldt estuary, with particular emphasis on cadmium and copper.

The hydrodynamic description is provided by 1D model of the tidal river part dynamically coupled with a 2D depth-integrated model of the lower estuary. The boundary inputs of the models are extracted from the available data bases and outputs of the RIVERSTRAHLER model covering the whole watershed. Since the Scheldt estuary is of well-mixed type, the 2D approach is appropriate to describe the export mass fluxes provided the horizontal diffusion coefficient is carefully validated against salinity longitudinal profiles.

In the first simulations, the dynamics of the trace metals is modeled using a salinity dependent partition coefficient Kd describing the distribution of metal between the dissolved and particulate phases. Salinity is however not the best predictor for the Kd ; on the basis of equilibrium chemistry and metal speciation equations, the parameterization can be refined by relating the partition coefficient to the total concentration of suspended matter, the particulate organic carbon and the dissolved organic carbon.

The model reproduces the general features of the observed spatial distribution of trace metals in the estuary provided that local point sources are taken into account.

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Three band model application in Remote Sensing of water quality monitoring on the coastal region of Hong Kong

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As one indicator of eutrophication and an important water quality information, Chlorophyll-a (Chl-a) directly affects on coastal and ocean ecosystem. Its concentration becomes a research focus on coastal water quality monitoring factor in ocean colour of remote sensing. Lots of research on Chl-a concentration emerged in the past few decades, including those traditionally studied and performed by taking ship-borne water samples and analysing the samples in the laboratory and/or by doing on-site measurements and few studies on remote sensing of specific algorithms from recently advanced satellite data (e.g., MODIS, MERIS) in the coastal region of Hong Kong and its vicinity. In this study, therefore, we first examine the pre-existing algorithms and test the optimal empirical algorithms and bands to retirve Chl-a concentration from satellite-based observations, and then apply the three band model in the coastal region of Hong Kong by using MODIS L1B and MERIS L2 data, respectively. Validation for the Chl-a concentration estimation model will be done by using in-situ data in 2006-2008 and the error analysis will also be discussed in the study.

“Sato - Umi” ; A new concept for coastal sea management

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A new concept for coastal sea management called “Sato-Umi”, defined as “High productivity and biodiversity in the coastal sea area with human interaction”, is proposed. To establish the Sato-Umi, it is necessary to realize comprehensive material cycling and appropriate fish resource management in coastal sea areas.

It is said that “Nature takes its best state without mankind”. Would it be true that no environmental problems would exist if mankind was not present on Earth? However, there would be no meaning to a discussion regarding environmental problems without the presence of mankind.

Nature does exist that takes its best state under mankind’s interaction. In Japan, it is called “Sato-Yama”. In Japanese, “Sato” means the area where people live and “Yama” means the forest. Sato-Yama is thus the forest near where people live. In 1987, the area of Sato-Yama in Japan was about 4,500,000 ha making up about 20% of Japan’s total area of forest of 25,000,000 ha.

In this paper we discuss a new concept for coastal sea management that is based on the ideas of Sato-Yama. Is it possible to create a “Sato-Umi” similar to Sato-Yama? In Japanese, “Umi” means the sea, so “Sato-Umi” is defined as “High productivity and biodiversity in the coastal sea area with human interaction” (Yanagi, 1998, 2007).

To establish the Sato-Umi, we first need to understand quantitatively material cycling in the coastal sea area. That is, we need to know the quantity of nutrients that are loaded from the coast, and what are the primary, secondary and tertiary productions in the area. We need to clarify what kinds of actions by mankind are permissible or prohibited in the coastal sea area from the viewpoint of increasing production and biodiversity. The important focus is to establish comprehensive material cycling in Sato-Umi.

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Water Volume and Heat Transport across the Strait of Otranto

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The water transport and advected heat through the Strait of Otranto are computed applying a new methodology to the historical data set. According to the previous oceanographic studies, the Adriatic Sea annually loses heat through the air-sea interface. This heat loss should be balanced by the heat advected across the Strait of Otranto. Direct current measurements for almost one year (December 94 – November 95), and four seasonal oceanographic campaigns are used in this study.

The current data are measured at 16 locations at different depths, near surface, intermediate depths and near bottom. The measured current data are detided and low pass filtered in order to remove tidal and inertial oscillations. The mean water flow across the strait consists of an inflow on the eastern side and an outflow on the western side, while there is a two layer structure in the central part. The latter has an inflow in the surface layer and an outflow in the bottom layer.

A variational inverse method based on a variational principle and a finite element solver is used to reconstruct the current field across the Strait section from sparse measurements.

The mean monthly, seasonally and yearly water transports and corresponding errors are determined. The mean annual inflow and outflow water volume rates are estimated as 0.90±0.04 Sv and -0.94±0.31 (error) Sv and the net is -0.04±0.32 (error) Sv. Thus, on a yearly time interval, the inflow and the outflow are practically compensated. These estimations of water transport are in agreement with previous studies.

The seasonal heat flux is estimated by using the data collected during the hydrographic surveys conducted in December 1994, February, May and August 1995. The results show a net heat advection into the Adriatic Sea on a yearly basis. The estimated value of advected heat, 21±5 (error) Wm^{-2}, is compared to the calculated heat loss of -36±152 (STD) Wm^{-2} over the Adriatic Sea.

POSTER

Statistical analysis of coastal monitoring time series in the English Channel

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Coastal waters can be considered as a complex system with many components interacting nonlinearily on many different scales. In order to install and develop integrated coastal zone managements, a better understanding of this complex system is needed.

Since the end of the 1990s, several monitoring programs have been developed in French littoral waters. We consider here data from two of these programs: SOMLIT monitoring program ("Service d'Observation en Milieu Littoral") from the INSU (Institut National des Sciences de l'Univers) and MAREL system ("Mesures Automatiques en Réseau pour l'Environnement Littoral") operated by IFREMER (French Research Institute for the Exploitation of the Sea). Both programs propose measurements of temperature, dissolved oxygen (DO), pH, nitrogen (NO_3+NO_2) chlorophyll a, particulate organic carbon (POC), salinity, particulate organic nitrogen (PON), phosphorus and silicates, recorded at fixed locations and regular intervals. For SOMLIT monitoring, the measurements are done once every two weeks and the water samples are transported to the laboratory and stored until manual analysis. The MAREL system is based on the deployment of automatic moored buoys equipped with physico-chemical measuring devices with time resolution of 20 minutes. We consider data from these two monitoring programs, in the coastal waters of the Eastern English Channel, close to Boulogne-sur-mer (France). A MAREL station is situated in the same area as the SOMLIT measurements site, 6 nautical miles further north along the coast. The data we consider are from 1997 to 2008 for SOMLIT program, and from 2004 to 2008 for the MAREL program.

We apply to these data several analyses techniques in order to characterize the dynamics of their fluctuations on a wide range of scales. We consider first the covariation between some parameters couples ((pH, DO), (DO, Chla), (Chla, N)) using some regression using a kernel estimator [*Wand and Jones, 1995*] in order to consider conditional averages. This method provides quantitative graphical interpretations and the regression function reveals concentrations values showing dependence levels and phytoplankton species succession. We also consider the probability density function of some ratios (N:P, Si:N, Si:P, COP:Chla, COP:NOP) that reveal in all cases a "wild" behaviour with many extremes the form $p(x) \approx x^{-\mu}$. We also use spectral analysis and estimate the Fourier spectral density of the MAREL time series, in order to reveal periodicities, scaling regimes, and turbulence influence.

With these results we wish to show some examples of applications of new methodologies, that can be applied on long-term monitoring and high resolution time series in order to provide quantitative and qualitative information on the state of coastal ecosystems.

REFERENCES

Wand, M. P. and Jones, M. C. *Kernel Smooting*, Chapman and Hall, 1995.