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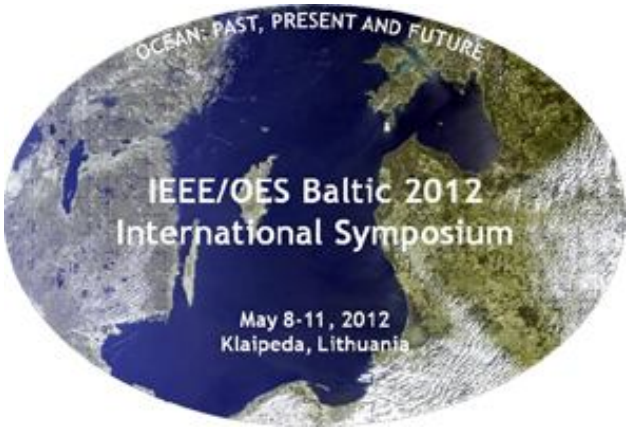

Presentation abstracts

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Implementation of the European Marine Strategy Framework Directive: where we are now? The Lithuanian case study

Sergej Olenin

Klaipeda University Coastal Research and Planning Institute
H.Manto 84, LT-92294, Klaipeda, Lithuania
E-mail: sergej@corpi.ku.lt

The European Marine Strategy Framework Directive (MSFD) aims to achieve Good Environmental Status (GES) in Europe's Seas by 2020. The GES is defined as "the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive". To help Member States interpret what GES means in practice, the Directive sets out eleven qualitative descriptors, which define what the environment will look like when GES has been achieved. The Directive implies an ecosystem-based approach to the management of all human activities that have an impact on the marine environment. The requirement for regional sea conventions and national authorities to identify and prioritise issues for management has meant that standardized methods to assess the current level of departure from GES are needed.

In 2009, the European Commission committed the EC Joint Research Centre (Ispra, Italy) and the International Council for the Exploration of the Sea (Copenhagen, Denmark) to provide scientific support in meeting this obligation. A Task Group was established for each of the Descriptors (except Descriptor 7, Hydrographic conditions) of Annex I of the MSFD with the aim of developing criteria and methodological standards for each Descriptor. For each Task Group, independent experts were selected, drawing from experience related to the four marine regions (the Baltic Sea, the Northeast Atlantic, the Mediterranean Sea and the Black Sea) and a variety of relevant scientific expertise. This helped to ensure a wide thematic and European wide regional representation.

According to the MSFD, the Member States have to provide an initial assessment of the state of the environment, identifying the main pressures on marine regions, and defining targets and monitoring indicators by 2012. The integration of the existing knowledge into a comprehensive environmental status assessment posed a serious challenge to the marine science. The relationships between human activities and environmental conditions are context-dependent; temporal and spatial scales of impacts vary with different pressures and with system vulnerability, which, in turn, are dependent of the regional conditions. Even within a comparatively small marine area, such as the Lithuanian Baltic Sea, the conditions vary in great extent, from hydrodynamically active coastal areas influenced by the outflow of the Curonian Lagoon to the stagnant sub-halocline zone subject to constant hypoxia and formation of hydrogen sulphide. In addition, different Descriptors are expressed on inherently different scales. For example Descriptors "Commercial fisheries" and "Food webs" should be considered on moderately large scales, "Seafloor integrity" generally on local scales, and different attributes of the Descriptors "Biodiversity", "Non-indigenous species", "Eutrophication", "Litter" express themselves at a variety of scales from local to regional.

This study presents the results of the initial assessment of the environmental status of the Lithuanian Baltic Sea performed by the consortium of marine scientists of Klaipėda University, Nature Research Center (Vilnius) and other Lithuanian research institutions.

An Articulated Stable Ocean Platform

Victor Grinius

Offshore Model Basin
3567 Ocean Front Walk, San Diego, CA 92109
Mail: victorgrinius@yahoo.com

The Articulated Stable Ocean Platform (ASOP) is a floating structure where buoyancy is provided by members/floats which are free to move with the waves. The buoyancy devices can be attached to the main structure in various ways, which allows motions in six degrees of freedom. In conventional floating structures, the buoyancy is provided by the structure itself, thereby translating the wave energy into motions of the structure. A conventional platform is subjected to bending moments and stresses produced by the wave loads, necessitating enough structure to provide integrity. When the buoyancy members are free to move with the waves, only vertical and horizontal load components are introduced to the structure. The vertical load component provides the necessary force to keep the structure afloat (Archimedes Principle) while the horizontal load component must be reacted by mooring or dynamic positioning. Additionally the buoyancy providers do not introduce bending moments to the structure. The buoyancy devices can be attached to the structure in a variety of ways. The simplest would be a universal joint allowing for pitch and roll motions. Advanced technology methods were considered for the attachments, such as a constant tension winch, or an energy absorbing devise (shock absorber) allowing for all six degrees of motions: heave, pitch, roll, sway, surge and yaw. Theoretically this would allow for a motionless platform, or at least a platform with better motion characteristics than existing platforms. The ASOP can have multiple applications, such as scientific, defense, commercial and energy.

Chemical Munitions Search and Assessment (CHEMSEA)

Galina Garnaga, Jacek Bełdowski

Environmental Protection Agency, Marine Research Department
Taikos av. 26, LT-91222, Klaipeda, Lithuania
Mail: galinagarnaga@yahoo.com

Chemical Warfare Agents (CWA) from World War II were never used in battle. Over 50000 tonnes were sunk in the Baltic, with official dumpsites in the Bornholm Deep, Gotland Deep, Little Belt and Skagerrak. Basing on literature sources and occasional shoring /by catches of CWA, the munitions seems to be spread in many other places on the seafloor. In 1995 final report of HELCOM stated that sunk chemical munitions represent minor threat to the environment when undisturbed. However, several other reports published later showed that ecological threat for the Baltic Sea is real, in situation when the munitions are hit by sea-bottom installation and activities such as trawler fishing or cable works. Baltic Sea bottom activities are increasing due to technology progress and growing pressure on marine resources. In some cases, large scale hydrotechnical activities are situated close to contaminated sediments. So it is necessary to increase safety of underwater activities, by defining special areas, where submarine activities should be restricted, or carried out with special care. The CHEMSEA project aims to provide maps of sea bottom areas contaminated with CWA or CWA degradation products, and tools to assess environmental risk associated with eventual leakage of sunk chemical munitions, as well as guidelines and procedures developed for such sites. The synthesis of acoustic data together with database management and GIS-based maps will make new as well as already existing information on CWA distribution and fluxes easily available in a condensed form. Another aim of the project is translate obtained data into real environmental risk assessment on a case by case basis – by the use of biomarkers as an integrated response of marine biota to chemical warfare agents. Nowadays, both procedures for dealing with polluted sediments and safety recommendations regarding accidentally or deliberately fished CWA munitions are regulated by a number of national legislations, as well as HELCOM recommendations and guidelines. CHEMSEA will propose updated unified guidelines regulating both of these matters, including recommendations for CWA hot-spots where special procedures should be applied for marine resources exploitation. A memorandum to Baltic States will be formulated, concerning adoption of updated environmental guidelines developed in the project, supported by maritime administrations which are partners or associated partners to the project. So, the main product of the project will be enhanced knowledge about a chemical weapons hidden in the seabed, its distribution and properties.

Study of the Słupsk Furrow overflow: last advances and hopes for future

Vadim Paka

Atlantic Branch of Shirshov Institute of Oceanology
Prospect Mira 1, 236022 Kaliningrad, Russia
Mail: vpaka@mail.ru

In 2007 a proposal „Transformation of inflowing saline waters in the Słupsk Channel and its impact on the ventilation of the central Baltic (TRANSFLOWS)" was worked out and submitted to BONUS by an international team from IOW (Germany), IOPAN (Poland), Göteborg University (Sweden), and Shirshov Institute of Oceanology (Russia) with Volker Mohrholz, IOW, as the Project Coordinator. The proposal was aimed: • To clarify the processes causing intermittency of the overflow of saline waters from the Bornholm Basin at the Słupsk Sill • To improve our understanding of mixing and watermass transformation processes in the Słupsk Channel, after saline water masses have passed the Słupsk Sill • To investigate mechanisms and processes at the outlet of the Słupsk Channel that control the further pathway of the saline waters either into the Gdansk Basin or directly into the Eastern Gotland Basin • To develop an entrainment law for gravity currents, which enables the parameterization of the entrainment in hydrodynamic models • And finally, to analyse different scenarios of future development of Baltic Sea ecosystem. Unfortunately the proposal was not supported. Despite of failure with the proposal, an international team of volunteers from Russia, Poland and Estonia has pursued its study of the Słupsk Channel overflow. Results on the structure of unsteady overflow in the Słupsk Furrow obtained in 2009-2011 are summarized as follows: • A data set of closely spaced CTD profiling performed aboard Russian and Polish research vessels from 1993-2009, and numerical modeling are applied to study the variability in the asymmetric transverse structure of salinity/density in the Słupsk Furrow (SF) overflow of the Baltic Sea. • The numerical simulations show that, on the one hand, the overflow may be treated dynamically within the SF as a subcritical, eddy-producing gravity current in a wide channel, and on the other hand, displays some features at the sill peculiar to frictionally controlled rotating flows. • Comparison between the field measurements and the simulation results indicates that the variability of the cross-channel density structure is caused mainly by meandering of the gravity current and mesoscale eddies – mostly above-halocline cyclones and intra-halocline anticyclones. The meanders and eddies are found to be affected strongly by the bottom topography and wind forcing. • It is of practical interest that the geostrophic estimate of the SF overflow volume rate, , based on data of a single CTD cross section of the SF, was shown to differ greatly from the real value of , so that only the average over an ensemble of the CTD cross sections is valuable. • Closely spaced CTD transects across the Słupsk Furrow displayed a 'downward-bending' of salinity contours below the salinity interface on the southern flank due to a transverse circulation in the saline water overflow. Numerical simulation of a gravity current in an idealized channel with geometry, dimensions and initial density stratification all much the same as in the Słupsk Furrow was applied to verify whether the downward-bending could be transformed into an inverted density stratification. Some arguments in favor of the possibility of convective overturning due to the differential transverse advection beneath the gravity current, brought on by the numerical simulations, are discussed. Next steps towards understanding of SF salt water overflow need continuation of field study.

Global climate change: Did we pass a tipping point?

Adolf Stips[1], M. Lilover[2]

[1]*Joint Research Centre, Water Resources*
Via E. Fermi 2742, TP272, 21027, Italy
Mail: adolf.stips@jrc.ec.europa.eu

[2]*Marine Systems Institute*
Akadeemia tee 15a
12618 Tallinn, Estonia

Systems that have an internal feedback mechanism can principally behave non-linear. The climate on earth is such a complex system with internal feedback and a non-linear characteristic should therefore be expected. Nevertheless it is common practice to publish linear trends from many global data sets without considering their relevance. The classical example is the often cited (IPCC) global warming trend of 0.05°C/decade for air temperature during the last 150 years. The inadequacy of this linear trend model over such a long period is obvious when looking at the difference of the observed 2009 mean temperature to that estimated from the calculated linear trend. The trend calculation gives an underestimation of about 48% (~0.36°C to low, compared to a total change of 0.75°C). A similar inspection of several global atmospheric and oceanographic data time series provides reasonable doubt concerning the validity of the linear model for century long time series. Using a test for breakpoints we can show that most of the analyzed global climate time series contain statistical significant structural changes (breaks in the mean or in the slope of a linear regression). We will reveal the existence of breakpoints for most investigated parameters at the end of the 70ties of the last century. Breakpoints detected at a comparable time in many different regional and global climate variables are a strong indication for a corresponding regime shift in the state of the global climate. The enormous difference between trends calculated with and without consideration of breakpoints invalidates predictions based only on linear trends. Despite these statistical indications for the existence of a tipping point we cannot infer the underlying process dynamics from the statistics alone. The final confirmation has to come from an accurate and complete geophysical description of the climate system, a difficult and complex task still to be done.

Decadal and long-term variations in the wave climate at the Latvian coast of the Baltic Proper

Katri Pindsoo, T. Soomere, M. Zujev

Wave Engineering Laboratory
Institute of Cybernetics at Tallinn University of Technology
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: katri.pindsoo@gmail.com

Recent analysis of long-term visual wave observations and numerical hindcasts for the Baltic Sea has revealed an interesting spatial pattern of long-term trends and decadal variations in several wave properties. While the overall wave intensity in the entire Baltic apparently has experienced no significant changes since the 1950s, a number of reported variations in the intensity of coastal processes suggest that the local wave climate may have undergone significant changes. One of areas potentially hosting marked changes in the wave properties over the last decades is the nearshore of the Kurzeme Peninsula. We present an analysis of recently digitized data of historical visual wave observations from Ventspils, Latvia (57°24'N, 21°32'E), where regular wave observations have been performed since 1946 and wave heights are available since 1954. The basic features of the local wave climate (such as the average wave properties and frequency of occurrence of waves of different heights and periods, and joint distribution of wave heights and periods) match the existing knowledge about the basic wave properties in this area. It hosts an overall mild wave climate that contains shorter periods with strong storms. The long-term average wave height is well below 1 m and typical wave periods are 3-5 s. The strongest signal in the data is the pronounced seasonal course in wave heights. Relatively strong decadal changes and especially interannual variability in the average wave height largely mask long-term trends that apparently are statistically insignificant. Long-term and decadal variations in the mean significant wave height are compared with similar data from other sites of long-term wave observations in the north-eastern and south-eastern parts of the Baltic Sea (Vilsandi and Pakri in Estonia, Nida in Lithuania).

Nemunas delta distributaries water discharge and riverbeds permeability changes in the context of climate change

E.Glazaciovaite[1], I. Osadcij, I. Dailidiene[2], V. Jurkin[3]

[1]Vilnius university, Faculty of Natural Sciences,Department of Hydrology and Climatology
[2]Klaipeda University, H.Manto str. 84, LT-92294, Klaipeda, Lithuania
[3]Coastal research and planning institute, H.Manto str. 84, Klaipeda Lithuania
Mail: glazaciovaite@gmail.com

Climate change is a key factor for many geophysical nature sciences. Evaluation of these changes in time and space give us certain solutions. Rivers discharges redistribution during the year has changed already. In Baltic Sea region countries general stream flow changes show the distribution changes of annual runoff. Significant changes are determined for winter discharge increase and a tendency to decreasing spring floods. More significant river runoff changes have been forecasted in future because different emissions scenarios project a further increase of global temperature of 1-6 °C (Meehl et al., 2007). Nemunas delta branches exploration is important for touristic and shipping industry development. Climatic factor and discontinued dredging works (dredging- cleaning works had been done in the fairway of Nemunas, in Skirvytė and in Atmata origins during the period of 1957 – 1990) play a major role in riverbeds permeability changes in Nemunas delta. Discharge distribution analysis started by Rumland and Lipke in 1908, continued by Kolupaila, Macevičius. Since 1986 Šilutė hydrometeorology station systematically is monitorring water discharges. Recent authors and the period of 1986 – 2011 discharge distribution difference is equal to 19,5% (Skirvytė annual discharges decreased, Atmata- the same proportion increased). The difference shows the tendency of water discharge redistribution between Skirvytė, Pakalnė and Atmata. Historical sources show Ragininkai island impact for discharge and bottom relief changes. In the middle of the last century the shipping way was by the right bank of the island, but after few decades the fairway moved to the left bank of the island Growing islands by the left bank of Rusnė (Kaliningrad oblast jurisdiction zone) and Ragininkai island impacts strongly infuence the discharge distribution and bottom relief transformations. Bathymetric changes were set of the 1930‘s depths map by Rusnė and 2009‘s depths data.

Features of climate changes based on the chemical elements and palinological remnants distribution in the sediments and Late Pleistocene and Holocene deposits of the SE Baltic area

Prof. Olegas Pustelnikovas[1,2]

[1]*Klaipeda University, H.Manto str. 84, LT-92294, Klaipeda, Lithuania*
[2] *Pomeranian Academy, Poland*
Mail: olegas.pustelnikovas@gmail.com

Analysis of climate changes is very urgent in connection with unvalidity of hypothesis of the glacier melting and rise of World Ocean water level under the human impact. The history of Baltic Sea reaches only some thousands years. During its development were extreme periods, connected with manyscales rise of sea level (*Baltic Glacial lake, Ioldia, Littorina* phases) or its sinking (*Ancylus* phase), with increase of salinity or evidently water fresching without human impact. Even during the last some hundreds years is observed recurrance of processes, where evidently change sediments grain-size and chemical composition also quantities of botanic remnants. Climate change influenced sedimentation conditions, its rate and accumulation character. Here can to be also influence of neotectonical movements, with different direction in north and south parts of the sea. The data of this article are generalized the distribution of meteorological indexes, sedimentation rates, chemical elements (including their state forms) and palinological remnants in the manyaged sediments and deposits thickness of SE Baltic region areas (Pustelnikovas, 2012 a, b, Pustelnikovas et al., 1996, 2012 et al.).

The Regime Shift in the Baltic Sea area – caused by the change of the NAO sign?

Adolf Stips[1], M. Lilover[2]

[1]*Joint Research Centre, Water Resources*
Via E. Fermi 2742, TP272, 21027, Italy
Mail: adolf.stips@jrc.ec.europa.eu

2Tallinn University of Technology, Marine Systems Institute
Akadeemia tee 15a
12618 Tallinn, Estonia

In the Baltic Sea area during the late 1980s air and sea surface temperature increased. A longer growing season and increases in phytoplankton biomass as well as changes in the zooplankton and fish communities accompanied this. These changes are supposed to represent a regime shift in the ecology of the central Baltic Sea, which could be caused by a related sign change in the North Atlantic Oscillation (NAO). But the NAO has changed sign more frequently and most of the time no corresponding regime shift did occur therefore we must check this hypothesis more thorough. We investigated a broad range of variables including air temperature, wind speed, sea surface temperature, sea level, ice cover, cloud cover, solar radiation, precipitation, oxygen and phytoplankton biomass. Additional comparisons to climate indices (NAO, WIBIX, NEMO) of general relevance had been conducted. The time series data are analyzed with respect to autocorrelation, linear trends and the occurrence of breakpoints whereby always tests for statistical significance are conducted. Tests for structural breakpoints in these time series reveal for many investigated variables the existence of such breakpoints in the 70-80ties of the last century. But surprisingly in several physical variables and in the most common climate indices no clear breakpoints can be identified. Specifically the change of the NAO sign around 1987, which is proposed to be the reason for the ecological regime shift in the Baltic Sea is not statistically significant. The coincidence of the sign change and the ecological regime shift could just be pure random. In summary we strongly advocate to apply sound statistical procedures for detecting regime shifts instead of eye fitting and qualitative descriptions. A strong hypothesis like the postulation of a regime shift 1987 caused by the change in the NAO sign does require strong evidence, but it seems we might not have that.

River landslides in Nizhny Novgorod region and a possibility of local tsunami generation

I. Nikolkina[1], I. Didenkulova[1,2]

[1]*Institute of Cybernetics, Tallinn University of Technology*
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: irina.nikolkina@gmail.com

[2]*Nizhny Novgorod State Technical University*
Minin str. 24, 603950 Nizhny Novgorod, Russia

Landslides occurred in steep river banks and entering water are able to generate local tsunamis in the river, which can result in the strong impact on coasts and coastal structures. The first described event of this type occurred in Nizhny Novgorod in 1597, when the whole Pechersky monastery slid down into the river and induced a local tsunami which penetrated at least 50 m inland. Here we study the current situation of landslide occurrence along large rivers of Nizhny Novgorod region: Volga and Oka and discuss the possibility of tsunami generation. It is shown that in 2001 – 2011, 16 landslides along river banks were documented and one of them, which occurred in Gorbatov in 2001, slid into the water and induced tsunami.

The chemical elements and sedimentation types of deposits in the dug holes Dubičiai 1, 2 and Mūšos Tyrelis as indicators of Late Pleistocene and Holocene climate changes

O. Pustelnikovas[1,2], M. Melešytė[3], E. Rudnickaitė[3], D. Kaminskas[3]

[1]*Klaipeda University, Lithuania*
[2]*Pomeranian Academy, Poland*
[3]*Vilnius University, Lithuania*
Mail: olegas.pustelnikovas@gmail.com

The distribution of chemical elements in the sedimentary stratum reflects the features of terrigenous, biogenous or chemical processes during sedimentation in a climate change time span. Environmental changes form different amounts of organic substance (OM as Corg) in multi-age deposits. The changes during sedimentation and inflow of sedimentary material into the basin obviously impact the accumulation levels of carbonates and microelements in these deposits. The aim of this paper is to describe the distribution of Ti, Zr, Mn, Cr, Ni, Co, V, Cu, and Pb in multigenetic Late Pleistocene and Holocene deposits in the light of the climate change.

Comprehensive recognition of the long- and short-term factors for the socio-economic efficiency estimation of dredging projects

George Gogoberidze[1], Maria Mamaeva[1], Julia Lednova[2]

[1]*Russian State Hydrometeorological University (RSHU)*
98 Malookhtinsky pr.
195196, St. Petersburg, Russian Federation
Mail: ggg_iczm@rshu.ru

[2]*St.Petersburg State Polytechnical University*
29 Polytechnicheskaya str.
195251, St. Petersburg, Russian Federation

The question of socio-economic efficiency of the dredging projects and the dredging works from the point of view of comprehensive long-term and short-term factors during and after project completion is observed. It's marked the lack of methods to assess the socio-economic efficiency taking into account long-term factors and the proposed method is an indicator method for such assessments.
In general, it's possible to recommend:

- the need to correct some items in the existing method of calculating damages from dredging projects, i.e. clarify the calculation of short-term effects;
- regulate and formulate correctly a list of qualitative assessments of the long-term effects of dredging projects, with inclusion one to the project documentation;
- develop a methodology for comprehensive socio-economic assessment of the long-term effects of the dredging projects, in particular the possible to use of the indicator method for assessing of the marine economy potential.

Aesthetic value characterization of landscapes in coastal zones

Daniel Depellegrin[1], Nerijus Blažauskas[1], Lukas Egarter Vigl[2]

[1]*Coastal Research and Planning Institute (CORPI)*
Klaipėda University, H.Manto 84, Klaipėda, 92294, Lithuania
Mail: danny_green@hotmail.com, nb@corpi.ku.lt

[2]*Institute for Alpine Environment*
European Academy Research (EURAC)
Drusus Alley 1, 39100 Bolzano, Italy
Mail: lukas.egarter@eurac.edu

Landscapes are essential for society, tourism industries and local communities. The development of tools capable to assess their environmental and socioeconomic importance are fundamental to preserve their aesthetic integrity, especially in coastal areas facing strong anthropogenic pressure. Online photo databases enable users to localize their images via GPS coordinates and share their photo albums with other users, constituting a powerful tool for (1) spatiotemporal investigation of visitor loads in recreational areas, (2) visitor flow definition and (3) aesthetic value characterization of natural and artificial landscape attributes undergone by visitors through shared images in the database. The research presents a framework for aesthetic value characterization in coastal zones using geotags from a webbased photosharing service named Panoramio as data source. A GIS tool for visitor hot spot detection in Lithuanian coastal areas was developed. At selected visitor hot spots, an expert based image content analysis was applied and indicators for the aesthetic value characterization were developed. In total over 63 visitor hot spots were detected along Lithuania's mainland coast and the northern tip of the Curonian Spit. Around 73% of all hot spots cover landscapes in proximity of water bodies. Aesthetic values assessment in hot spots are determined by the variety of anthropogenic and natural landscape attributes in the coastal zone. We conclude that the application of webbased photosharing services and the modeling for aesthetic value characterization can serve for tourism activity planning such as scenic pathways identification, landscape attribute based trip advisory, assessment tool for landscapes changes due to intensive tourism activity and invasive construction projects.

Ecological assessment of dredging in the Eastern Gulf of Finland

Alexander Chusov, Julia Lednova, Mikhail Shilin

St. Petersburg State Polytechnical University
29 Polytechnicheskaya str.
195251, St. Petersburg, Russian Federation
Mail: lednovajulia@mail.ru

In recent times the tendency of increasing a number of dredging projects in the world associated with new hydraulic engineering projects construction, maintenance and reclamation are observed. Nowadays in the Eastern Gulf of Finland there are some major engineering projects of new marine terminals, laying and reclamation of approach canals, creation of new areas for ensuing industrial and civil construction. According with "The General development program of Saint-Petersburg government" dredging works in the Eastern Gulf of Finland and Neva Bay, focused on development of navigation activity of St. Petersburg coastal zone, are made. Field studies in the form of Ecological Monitoring of Dredging and Reclamation (EMDR) program in the Eastern Gulf of Finland were carried out since 1999 by expert team specialists. Principal questions and goals of the EMDR are: (1) revealing of the short- and long-term environmental effects from dredging and reclamation, and establishing the difference between the natural and anthropogenic trends of the coastal ecosystems near the dredged material deposit sites; (2) estimation of reversibility / irreversibility of trends / changes in coastal ecosystems due to influence of dredging and reclamation; (3) finding the ways of minimizing and compensation of negative effects on the coastal environment. In general, the list of proposals to reduce and prevent the negative impact of dumping in the underwater deposit sites on the marine environment were formulated.

Environmental policy and legislation on dredged material in the Baltic Sea Region

Grazyna Sapota[1], G. Dembska[1], M. Bogdaniuk[1], G. Holm[2]

[1]*Maritime Institute in Gdansk*
Dlugi Targ 41/42
80-830 Gdansk, Poland
Mail: gsapota@im.gda.pl

[2]*Swedish Geotechnical Institute*
Olaus Magnus väg 35
581 93 Linköping, Sweden

The environment is not an external object that we should take care in order to fulfil regulations or follow guidelines or codes of conduct. The need of intensifying the protection of the marine environment of the Baltic Sea and the sustainable use of these resources is a widely accepted. However Baltic Sea countries are still failing to deliver upon their commitments and take the actions needed to protect and restore the Baltic Sea. Each of the nine coastal Baltic Sea countries is obligated to performance in implementing of the important international, regional and European agreements and conventions designed to manage and protect the Baltic Sea. The key indicators of five focal areas of crucial importance to the Baltic Sea and its health are: eutrophication, hazardous substances, the protection of biodiversity, maritime activities and integrated sea use management – the last being a more integrated approach to planning and managing the use of the sea and its resources. The true problem is also legislation regarding management of dredged material. Some part of dredged material is contaminated by human activity to an extent that major environmental constraints need to be applied when depositing these sediments. Some of these sediments are contaminated that heavily that this material has to be treated before the products can safely be brought back into the environment. Current policy and regulations as well as research efforts try to take problem of sediment contamination into account, however these regulations and efforts lack coherence and do not contribute to efficient management. In order to reduce the environmental impact of contaminated sediments, various countries or cross-country areas have inaugurated laws or developed guidance on how to deal with a problem, however all-embracing strategic documents on European level were not elaborated so far. There are a number of international and national documents, dealing with contamination of sediments and in particular with management of dredged materials. Many countries have adopted EU guidelines and conventions for the management of dredged material. However, there is no uniformity in these regulations. The project SMOCS (Sustainable Management of Contaminated Sediments under BSR Programme 2007-2013) deals with among others the problem of unification of BSR law relating to dredged material by proposing changes to the HELCOM.

Concept of State Cadastre of the marine coastal zone of the Russian Federation

George Gogoberidze[1], Daria Ryabchuk[2], Vladimir Zhamoida[2], Mikhail Spiridonov[2], Boris Arseniev[2]

[1]*Russian State Hydrometeorological University (RSHU)*
98 Malookhtinsky pr.
195196, St. Petersburg, Russian Federation
Mail: ggg_iczm@rshu.ru

[2]*A.P. Karpinsky Russian Geological Research Institute (VSEGEI)*
74 Sredny pr.,
199106, St. Petersburg, Russian Federation

State Cadastre of the marine coastal zone of the Russian Federation (RF SCMCZ) is created to ordering of information about resources and capabilities of the coastal zone as a set of data, including qualitative and quantitative inventory of the objects or phenomena and their economic evaluation. The main legal acts necessary for the preparation of methodological and legal foundations of the RF SCMCZ and its filling are the Constitution of the Russian Federation, Land, Water and Forestry Codes and Cadastres, and other laws of the Russian Federation.
RF SCMCZ is complex structure document that includes a multi-stage information on administrative, economic, legal, environmental and socio-economic characteristics of a single (coherent) area above and below the modern sea level. RF SCMCZ should be regarded as specially organized set of software and hardware tools to enter, store, save, visualize, analyze, synthesize and present in an easy to use spatially widespread (geographically referenced) information of the marine coastal zones of the Russian Federation.

A future technology of environmental management of semi-enclosed seas

Tarmo Soomere[1], O. Andrejev[2], K. Myrberg[2]

[1]*Institute of Cybernetics at Tallinn University of Technology*
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: soomere@cs.ioc.ee

[2]*Finnish Environment Institute, Marine Research Centre*
P.O. Box 140, FI-00251 Helsinki, Finland

The ever increasing impact of the marine industry on vulnerable sea areas such as the Baltic Sea, especially the increase in risks associated with potential oil pollution, calls for novel methods for the quantification and mitigating the impact of such risks. A feasible way forward is a cost-effective technology for preventive reduction of offshore environmental risks recently developed by the BONUS BalticWay international team. This technique offers a way to decrease the risks through minimizing the consequences of potential accidents and impacts. The approach is based on a smart use of the existence of semi-persistent current patterns, which considerably affect the properties of pollution propagation. The key idea is to systematically characterize the damaging potential of offshore domains to serve as a source of danger to the coastal environment through current-driven transport. The resulting maps characterize the spatial distribution of the related environmental risks and make it possible to place maritime activities (e.g. the major fairways) in the safest areas. The benefit is an increase in the time during which an adverse impact (for example, an oil spill) reaches a vulnerable area after an accident has happened or work has been undertaken. The technology has been tested in the context of managing coastal pollution in several sub-basins of the Baltic Sea such as the Gulf of Finland, northern Baltic Proper and south-western Baltic Sea. The optimum fairways are only weakly sensitive with respect to the particular choice of the criterion of environmental risk provided the underlying circulation model adequately represents the pattern of meso-scale motions in the study areas. Long-term variations in the optimum solutions show drastically different pattern in different water bodies. The key trigger for such variations in the Gulf of Finland is the seasonal course in driving factors. Analogous variations in the southwestern (SW) Baltic Sea have much longer time scales, are much more irregular and predominantly governed by atmospheric conditions favorable for water inflow or outflow through the Danish Straits. Moreover, inflow conditions in the SW Baltic Sea correspond to much lower probabilities for coastal pollution than outflow situations.

Development of wind parks in the Gulf of Riga – current status and perspectives

Inga Jansone, Ain Kull, Anda Ikauniece

Latvian Institute of Aquatic Ecology
Daugavgrivas 8, LV1002, Latvia
Mail: inga.jansone@lhei.lv

In the frame of the Estonia – Latvia programme's project GORWIND we have looked at the general policy descriptions, the laws and regulations on choosing the development areas at the coastal zone and in marine locations and the consideration of the wind energy question in the territorial plans of the local governments around the Gulf of Riga. The differences between two countries are mostly in the details of procedures. Still, the problems and inconsistencies are quite in common – a missing stability in legislation and coordinated development of infrastructure. The territorial plans of Latvian local governments in the Gulf of Riga area mostly have not regarded the existence of the wind park as a serious option. Already existing wind parks and turbines are located outside the Gulf area and therefore the development in this sense is somewhat delayed in Latvia. The situation in Estonia differs substantially as all coastal local governments have considered the possibility of having wind turbines in their territorial plans. In addition to the planned developments by the local governments we performed a direct survey of local inhabitants in the coastal areas to map their attitude towards the wind energy issues. The main objective of used questionnaire was to investigate whether the local inhabitants would agree of having the wind turbines in their neighbourhood. In the „interactive" part of the questionnaire the respondents were asked to depict graphically on the map the suitable and non-suitable areas for the wind parks. At the Latvian coast of the Gulf of Riga the local inhabitants show somewhat more positive attitude with the respect of wind park development. In the Estonian part the position of inhabitants is more cautious.

Harmonisation of developments and environment at the sea

Nerijus Blažauskas, Rosita Mileriene

Coastal research and planning institute
H.Manto str. 84, Lt-92294, Klaipeda, Lithuania
Mail: nb@corpi.ku.lt

Coastal and maritime activities are becoming more intensive and variable. Traditionally sea area was used for fisheries, shipping, coastal recreation. Nowadays there is rapidly growing interest for offshore oil extraction, alternative energy production, electricity connection lines, gas pipelines, LPG terminals and lots of other new economic activities development in the marine space. Offshore wind energy development is becoming a challenge of the first importance. However, traditional activities such as navigation or port developments are still keeping their place and even expanding. Furthermore, pressure at the coast for tourism and recreation space is growing, along with the demand for both residential property and holiday homes. Also natural values, ecological state of the seas are of the great concern. All these different interests meet in the same maritime space. Therefore, seeking not to provoke more harm and unsustainable pressures on fragile marine and coastal environment all economic activities have to be planned following principles of Integrated Maritime Spatial Planning (MPS).
The number of international EU co-financed projects – SEANERGY 2020, Baltic Master, SMOCS, BaltSeaPlan, BRISK, DENOFLIT, POWER and others - are devoted to resolve national, regional and subregional cumulative impacts of coastal and marine activities. The project SEANERGY 2020 aims to formulate policy recommendations on how best to deal with MSP and remove policy obstacles to the deployment of offshore RES in the EU. BaltSeaPlan seeks to promote an integrated approach to MSP and reduce conflicts amongst sectoral interests in the maritime area. SMOCS and BRISK concerns pollution problems and innovative way of solving ecological and management problems. There why application of MSP principals for the Lithuanian Baltic area conflict analysis was selected to be a most suitable approach. By identification of marine space as areas of special concern; areas already reserved (occupied) by other users; priority areas and no go areas it is possible to set specific measures in order to prevent.

Coasts and Landscapes in Early Holocene. Lithuanian waters

Vladas Žulkus, Algirdas Girininkas

Klaipeda University, Institute of Baltic Sea Region History and Archaeology
H.Manto str. 84, LT-92294, Klaipeda, Lithuania
Mail: vladas.zulkus@ku.lt

Over last decade members of Underwater Research Centre (URC) from Institute of Baltic Sea Region History and Archaeology of Klaipėda University in several locations of the Lithuanian water area on the Baltic Seabed discovered relicts of prehistoric coastlines and traces of submerged forests. Particular attention of geologists and archaeologists is focused on findings of relict forests on the Seabed. Submerged stumps are traced in three sites; two of them are in the neighbourhood of Klaipėda and the third one is south of it. They are separated by 5 km and 22 km (from north to south). Most advance to the south is site RF-I (Relict forest-I), which is close to the Juodkrantė settlement, on the sandy bottom at a depth of 25-29 metres. By means of ^{14}C method two stumps were dated. Calibrated age of the stumps are from around 8500 cal BC. They belongs to the pine (*Pinus*). On a stony bottom of the other site (RF-II), in the depth of 14,5 m, a wooden stump was traced. This sample calibrated age cal 5831 BC. RF-III site appears on a sandy bottom, at a dept of 11 metres. A section of the stump calibrated age 7612 cal BC.
When analysing records of the sonar in RF-I site, in about 20-25 m from discovered stumps some small dim spots were traced on a sandy bottom. Development of methodology for search of relict stumps on a sandy bottom is one of research aims. The small size of many of the stumps which prevented their detection on sidescan-sonar records. In 2010 - 2011 Seabed images in the area of 30 sq.km. were also received by side scan sonar and multibeam. In RF-I site from 787 selected targets, 324 objects of them are identified as likely trees. Confirmation of the sonar results was obtained by scuba examination. Research aims: development of detailed picture of seabed relief; Tree-Ring dating for establishing the relative scale and growing period of this relict piny wood; evaluation of stratigraphy of Seabed sedimentation; pollen analysis; supplementary Radiocarbon dating; simulation palaeo-geographical environment; search of artefacts
Hopefully, interpretation of data will enable to restore palaeo-geographical environment of this site in 9^{th} – 8^{th} millennium BC and discover probable traces of human activity for the Mesolithic period.

Erosion, transport and redeposition of sediments in the bifurcation area of saline inflows in the southern Baltic Proper

Emelyan Emelyanov

Atlantic Branch of Shirshov Institute of Oceanology
Prospect Mira 1, 236022 Kaliningrad, Russia
Mail: abio@atlas.baltnet.ru

Processes of erosion, transport and redeposition of sediments in the southern Baltic Sea, as affected by near-bottom currents around the Słupsk Furrow (SF) outlet where the main part of the salt water overflow makes for the Gotland Deep while the smaller part finds its way to the Gdaņsk Deep, are discussed. In this area there is a spacious flattened bottom rising with depths ranging within 75-85 m (the Gdaņsk-Gotland Rising). The permanent halocline/pycnocline depth here is rather close to the bottom. Owing to increased activity of various internal waves near the pycnocline as well as perpetual salt water flow in the transition zone, bottom sediments here are under the continuous dynamical forcing. This is confirmed by a specific distribution of sediments with their grain size: on depths of 75-100 m they are represented by sands well washed out from pelitic particles while the deeper sediments are mostly mud. The aleuritic and fine-aleuritic mud stripes are extended along the slopes. According to field measurements and model calculations the SF outflow creates a gravity current which on the depth matching the water density turns into a horizontal contour current adjacent to the right-hand slope. At the left-hand periphery of this current, its velocity diminishes, and consequences for discharge of suspended particulated matter occurs; this leads to creation of muddy sediment bodies on depths of 110-140 m. Morphologically, within this zone one can allocate an “foredelta of the Słupsk underwater river” and an asymmetric contourite drift near the eastern slope of the Deep. Maximum mud thickness in the avandelta body exceeds 6 m. Mud of this sediment body is rich in methane, different elements (up to 3.58 % Corg, P up to 0.20 %), and some embedments are enriched in Mn (up to 0.90 %), Fe (up to 6.5%), and microelements (Cu, Zn, Cr, Ni, Co, As, etc.). Action of major inflows appears in the central part of the Eastern Gotland Deep. The major inflows bring the densest water flowing as the bottom current below the “old” dense water being capable to reach the maximum depth. On such background, the contour currents play the accessory role. Occasional but powerful near-bottom currents blocked the deposition of Litorina mud on 180-210 m depths where sharp slope bending is pointed out. As a result, the Ancylus lake clays are exposed here. Discharge of the gravity currents occur in the centre of the Eastern Gotland Deep at depths of 190-240 m where the Littorina mud thickness is 2-3 m. In the Gdaņsk Deep, manifestation of density currents as derived from sedimentation processes is less evident.

Coastal changes in western Estonia and on Russian coast of Gulf of Finland caused by extreme storm Berit in November 2011

Hannes Tõnisson[1], Ü. Suursaar[2], S. Suuroja[3], D. Ryabchuk[4], K. Orviku[1], A. Kont[1], Y. Sergeev[4], R. Rivis[1]

[1] *Institute of Ecology, Tallinn University*
Uus-Sadama 5, Tallinn 10120, Estonia
Mail: Hanne.tonisson@tlu.ee

[2] *Estonian Marine Institute, University of Tartu*
Mäealuse 14, Tallinn, 12618, Estonia

[3] *Geological Survey of Estonia*
Kadaka tee 82, Tallinn 12618, Estonia

[4] *A.P.Karpinsky Russian Research Geological Institute (VSEGEI)*
Sredny prospect 74, St. Peterburg 199106, Russia

The study is analyzing the climatic parameters, hydrodynamic conditions and coastal changes caused by an extreme storm called Berit, which travelled across the Baltic Sea from 27 to 29 November 2011. Maximum wind speed reached 19,7 m/s (gusts 29 m/s) in W Estonia and 15 m/s (gusts 20 m/s) in eastern Gulf of Finland in Russia. The sea level reached 108 cm in Pärnu and 190 cm near St Petersburg (outside from the Flood Protection Facility). Shorelines, scarp positions and beach profiles were measured at the end of summer in several sites along the Estonian and Russian coast. Two researchers recorded changes in shorelines, scarp positions and beach profiles on Harilaid Peninsula, Saaremaa Island during the storm event. The measurements in the Russian study site (Komarovo-Repino) were performed a few days after the storm. All the measurements were carried out using DGPS with the accuracy of 1 cm in vertical and horizontal scales. Wave run-up and sea-levels were also recorded. In order to assess variations in forcing conditions during the storm, a wave hindcast was performed using a SMB-type wave model. Calibrated against the field measurements, the model is forced by wind data, and it calculates significant wave parameters for a chosen location. Significant wave height 1.5 km off the west Estonian study site was 2.9 m and maximum waves reached 4.4 m. The first results show that a 1.5 m high sandy scarp in Cape Kiipsaare receded over 5 m. The loss of sand was ca. 8 m3 per 1 m of shoreline. The speed of scarp recession was ca. 0.6 m/h during the peak of the storm. A gravel-pebble spit at Kelba got longer and up to 2.8 m high gravel ridges were formed in the proximal part of the spit. In the Russian part of the eastern Gulf of Finland as a result of storm and flood an up to 2 m high scarp was formed along 15 km of dunes on the northern coast (Komarovo, Repino). It was the first strong erosion event observed after the extreme dune's damage during autumn 2006 and winter 2007.

The influence of meteorological data on calculation of longshore sediment transport

K. Marusin, Elena Fedorova

Institute for Water and Environmental Problems of Siberian Branch of the Russian Academy of Sciences
Molodezhnaya str. 1., 656038, Barnaul, Altai Krai, Russia
Mail: fedorova@iwep.asu.ru; kat@iwep.asu.ru

This paper presents results of longshore sediment transport calculation based on various meteorological data. It is shown that meteorological data from two different weather stations located almost equidistantly at the study site, could give of different direction and value of the longshore sediment transport.

Extreme erosion events in the coastal zone of the Russian Baltic as a result of rare severe winter storms

Daria Ryabchuk[1], Vadim Sivkov[2], Vladimir Zhamoida[1], Alexander Sergeev[1], Zhanna Stont[2]

[1]A.P.Karpinsky Russian Research Geological Institute
St.Petersburg, Sredny pr. 74, 199106, Russia
Mail: Daria_Ryabchuk@mail.ru

[2]Atlantic Branch of P.P.Shirshov Institute of Oceanology RAS, Laboratory of Environmental Geology
Prospekt Mira 1, Kaliningrad, Russia

In 2011-2012 VSEGEI together with ABIORAS continue study and monitoring of hazardous exogenous geological processes of the Russian Baltic and its coastal zone. As a result of extreme storms in autumn and beginning of winter 2011-2012 serious intensification of coastal processes was observed. In the Eastern Gulf of Finland 26-28 of November and 23-31 of December a storm surge (with wind speed up to 24-28 m/s and water level outside St. Petersburg Flood Protection Facility up to 235 cm above normal sea level) occurred. Wave impact on the coasts was more intense due to absence of ice cover as December 2012 was the warmest since beginning of weather observation. Severe storm caused extreme erosion events damaged the coastal dunes with forming of active escarpment, destruction of coast protection and recreation infrastructure, complete transformation of sand accretion spits. Effect of storm surge was much higher outside the Flood Protection Facility as a result of its impact on hydrodynamic regime. In the South-Eastern Baltic (Kaliningrad Region) winter 2011-2012 was characterized by very high cyclonic activity. 28 of November the speed of wind gusts reached 37 m/s. Storm duration was about 40 hours. In December there were several storms with wind speed of about 20 m/s with duration of two twenty-four-hours. The most severe damage of coast was caused by “Elfida” cyclone (13 of January, 2012). Northern wind speed reached 28 m/s, water level was 1.5 m higher than average. The probability of such wind occurrence for the Eastern Baltic is just 0.1%. Very unusual storm event cause catastrophic damage of sandy beaches of the Sambian Peninsula, as well as Vistula and Curonian spits. Effect of this storm has shown important role of the rare severe northern storms in prognosis of coastal zone development. Research was undertaken in the frame of State Monitoring of geological environment of Russian part of the Baltic Sea and its coastal zone and Federal Program “World Ocean”.

Relationship between coastline changes and dynamics of coastal ecosystems of Tahkuna Peninsula, Estonia

Agnes Anderson[1], Urve Ratas[2], Reimo Rivis[2], Valdeko Palginõmm[3]

[1] *Institute of Mathematics and Natural Sciences, Tallinn University*
Narva mnt 25, Tallinn 10120, Estonia
Mail: agnes94@tlu.ee

[2] *Institute of Ecology, Tallinn University*
Uus-Sadama 5, Tallinn 10120, Estonia

[3] *Environmental Management Department, Ministry of the Environment*
Narva mnt 7a, Tallinn 15172, Estonia

The coastal zone as a boundary between sea and mainland is characterized by different landscape types with high biodiversity. Global climate change is one of the most significant factors that is causing changes on coastal area. The climate warming during the last decades has been evident in the Baltic Sea region. The effects of climate change on seacoast can be seen in the changes of sea level, coastal hydrodynamics and ice conditions as well as in human actions. On regional and local level the change of coastal landscape generally depends on shoreline stability. Most vulnerable to erosion are densely populated coastal areas with cities. The coastal erosion is an increasing problem, it also reduces and causes damage to coastal communities including habitats of NATURA 2000. During the last decades, the coastline and morphology of sandy beaches have noticeably changed at Tahkuna Peninsula. Different methods have been used for landscape investigation. Landscape changes were studied by using maps of different periods. Method of landscape complex profile was used as a basis for research. The aim of study was to find relationships between coastline changes and dynamics of coastal ecosystems. Due to intensive erosion the study area with habitats of sandy beaches (1210, 1640), embryonic, white and grey dunes (2110, 2120, 2130) has decreased. Repeated surveys in the eastern part of peninsula (Tõrvanina) show the disappearance of a 45-m-wide strip of land during 1976–2009. The eroded deposits are partly transported to the south where the sandy spit is rapidly elongating, there takes place development of new plant communities. Changes along the coast are result of combination of natural processes and human influence (Lehtma harbour). The study area has a high nature conservation and recreational value. Therefore it is essential to continue monitoring and to improve the planning processes in these vulnerable areas.

Circulation of the surface and deep water masses in the Iceland basin at the end of the late Pleistocene

Nadezhda Lukashina, Leila Bashirova

P.P. Shirshov Institute of Oceanology of Russian Academy of Science, Atlantic Branch
Prospect Mira, 1, Kaliningrad,
Kaliningrad region, 236022, Russia
Mail: lukashinanp@mail.ru

At the present time, North-Atlantic Surface Water (NASW) with annual temperature ~10°C is widespread above the Iceland basin. Eastern North-Atlantic Deep Water (ENADW), as the main component of the deep circulation, is formed in the north part of the Iceland basin from water masses, overflowing from the Norwegian Sea. From this site the bottom sediments core AMK- 4442 with water depth 2787 m was taken. To obtain paleotemperature estimates both Modern Analogue Technique (MAT) and Revised Analog Method (RAM) were applied. 9 Marine Isotope Stages (MIS) spanning 300 ka were allocated. During MIS 9, 7 and 5 (about 300, 245-186, 128-71 ka) NASW was circulated over the Iceland basin. The maximum of the SSTs, reconstructed for the last interglacial period, were 18°C and 12°C for summer and winter, respectively, which is ~2°C higher than during the Holocene. Migration of the polar water front to the South occurred in MIS 8, 6 and 4-2 (303-245, 186-128 and 71-12 ka). In these periods average annual SSTs were 4,5 °C, 3°C and 2 °C, respectively. Investigations of benthic foraminiferal assemblages gave an information about difference between modern and paleocirculation of deep water in the Iceland basin. The Iceland basin was filled with warm, nutrient-rich and oxygen-pure water masses even during the interglacial periods including interglacial MIS 5. "Stagnant" situations have been temporarily interrupted during the transition from interglacial to glacial conditions, when cool and oxygen-rich water mass have been overflowing from the Norwegian Sea to the Iceland basin. However, the "modern" ENADW appeared in the Iceland basin only in the late MIS 3 (about 40 ka). Its constant formation began at the end of the last glaciation during the Bølling/Allerød (14 ka).

Shore changes during a period from August 2008 to August 2009 and their relationships to hydrodynamic conditions in Kelba Spit, Saaremaa Island, Estonia

Hannes Tõnisson[1], Ülo Suursaar[2], Kaarel Orviku[1], Are Kont[1], Reimo Rivis[1]

[1]*Institute of Ecology at Tallinn University*
Uus-Sadama 5 Mäealuse 14
Tallinn 10120
Mail: hannest@gmail.com

[2]*Estonian Marine Institute, University of Tartu*
ESTONIA Tallinn, 12618 Estonia

The study is focused on a gravel-pebble spit in Kelba. It is a dynamic region in the magnitude and velocity of hydrodynamic and shore processes, where historical changes in shoreline position reflect the changes in wind and wave climate. The region has probably the roughest wave climate along the Estonian coast. In order to assess the changes in shoreline and configuration of shore formations, the study sites in Saaremaa have been regularly examined since the 1960s. The study of coastal changes was based on orthophotos and GPS measurements. Sonar and leveling surveys were carried out in 2008 and 2009 to assess changes in the volume of deposits. Recording Doppler Current Profiler was deployed near Kelba Spit from December 2006 to May 2007 to measure hydrodynamic variables. In order to assess variations in forcing conditions during the study period (2008-2009) a wave hindcast was performed using a SMB-type wave model for Kelba. Calibrated against the field measurements, the model is forced by wind data from Vilsandi station, and it calculates significant wave parameters for a chosen location. The sea level data from Ristna mareograph was also used. Changes in the area of the study site reached 7800 m2 during that period. Erosion made up nearly 2/3 of the changes. Accumulation in volume reached 9200 m3 while loss of the sediments was only 6100 m3. 95% of accumulation took place in the distal part of the spit while 60% of erosion appeared in the proximal part. The year of 2008 started with stormy, ice-free conditions. Although there were no remarkable single storms or storm surges, the wave activity on average was among the strongest over the last two decades. The shore changes were faster than the annual average of the last decade showing that rapid shore changes may happen even without extreme storm events.

Monitoring sediment transport in the coastal zone of Tallinn Bay

Fred Buschmann[1], A. Erm[1], V. Alari[1], M. Listak[2], J. Rebane[2] and G. Toming[2]

[1]Tallinn University of Technology, Marine Systems Institute
Akadeemia tee 15a, 12618 Tallinn, Estonia
Mail: fred.buschmann@phys.sea.ee

[2] Tallinn University of Technology, Center for Biorobotics
Akadeemia tee 15a, 12618 Tallinn, Estonia

Continuous near bottom measurements of wave characteristics, bottom velocity and turbidity were performed using an acoustic Doppler velocimeter (Sontek ADV Ocean Hydra, USA) integrated with a turbidity meter (OBS-3+, YSI, USA) and a pressure wave gauge (PTR Group, Estonia). An experimental autonomous submersible camera system (framerate 25 fps) was constructed (Centre of Biorobotics, TTU, Estonia) and used to monitor the motion of particles in the bottom boundary layer (BBL). The ADV measured flows consisted of wind induced currents, wave induced orbital motions and turbulence. Maximum of wind induced currents reached up to 10 - 15 cm/s, while the maximum near bed orbital motions peaked over 40 cm/s. From the comparison of ADV, turbidity and wave characteristics it followed that turbidity was clearly depending on the wave energy. It means only long and quite high waves generating bottom orbital velocities (calculated from the wave gauge data and/or measured using ADV) over 20 cm/s were able to resuspend bottom sediment and induce some increase in turbidity values – 5-12 NTU in stormy days. Sediment fluxes were estimated using measuring data, sediment characteristics and BBL model. It followed from the modeling results that the height of all BBL varied from 1 cm to 10 cm, and the height of the bottom-most layer (skin friction layer) varied from 0.01 cm to 1 cm. Running the model has shown also that the currents have a significant impact to the sediment resuspension only if their speed reaches to 15 – 20 cm/s occurring very seldom in Estonian sea areas. Absolute majority of measurements showed an error below 5% using the wave skin friction shear velocity instead of the total skin friction velocity, i.e. excluding the existence of a skin friction sublayer. Captured video clips were split into frames and pairs of images were analyzed using particle image velocimetry software by MatPIV toolbox for MATLAB. The velocity and vorticity vector fields of bottom boundary layer were subsequently visualized.

Forecast of sediment flow along the Curonian Spit under different wave climate

Maija Viška, Tarmo Soomere

Institute of Cybernetics at Tallinn University of Technology, Wave Engineering Laboratory
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: maija@ioc.ee

The Curonian Spit is narrow sandy peninsula that is formed during intense wave-driven sand drift from the Sambian peninsula. Recent analysis of the basic properties of sediment transport along the Curonian Spit has shown that it is in dynamic equilibrium in the existing wind climate. Owing to its specific shape, changes to the wave height apparently will not lead to radical changes in the evolution of the entire spit but changes in the wind and/or wave approach direction may result in drastic changes in its further development. We analyse the stability of the evolution of the Curonian Spit in changing directional wave climate, with the basic goal to estimate the range of variations under which the entire spit remains stable. The longshore sediment transport along this section of the coast is calculated using the CERC formula with a resolution of about 3 nautical miles based upon numerically simulated long-term time series of wave properties along the beach. The CERC formula assumes that the longshore transport is proportional to the rate of beaching per unit of coastline of the alongshore component of wave energy flux. The time series of wave fields are modeled using a WAM wave model with an extended spectral range for short waves and with a temporal resolution of 1 hour. The model is forced by geostrophic winds from the Swedish Meteorological and Hydrological Institute. Changes to the wave propagation direction are simulated using two approaches. First, the contemporary wave approach direction is systematically changed to clockwise and counterclockwise. The other approach relies on the fact waves approach predominantly from the west or from NNW. We analyze the reaction of the coast on the change in the proportion of wave energy approaching from different directions. The results allow to determine what kind and/or magnitude of wind and wave climate changes could result in a serious impact on the further development of the spit.

Trends of simulated oxygen dynamics and hypoxia in the Baltic Sea

Svetla Miladinova, Adolf Stips

European Commission - Joint Research Centre
Via E. Fermi, 2749 (TP272)
I-21027 Ispra (VA), Italy
Mail: adolf.stips@jrc.ec.europa.eu

Over the last century hypoxia is increasing in large parts of the Baltic Sea. Inflowing salt water brings new supplies of oxygen to the bottom water however is at the same time enhancing stratification and thereby creating favourable conditions for hypoxia. Moreover, it is the increased flux of organic material to the bottom water and sediments due to nutrient enrichment, which has disrupted the balance between oxygen supply through physical processes and oxygen consumption from decomposition of organic material. The aim of the present work is to explore the oxygen availability in the Baltic Sea on the base of a 3D numerical model. The used 3D hydrodynamic model is the General Estuarine Transport Model code (http://getm.eu), which is implemented for the whole Baltic Sea including the Kattegat and is forced with real water level data. The simulated time period covers the 5 decades from 1960 until the end of 2010. Oxygen concentration in the surface layer is mainly controlled by the air-sea gas exchange depending on wind speed, temperature and salinity. Oxygen consumption in the bulk and oxygen demand at the bottom are both parameterised simple as exponentially increasing functions of temperature and salinity. Despite this simplistic model approach, modelled oxygen concentrations agree well with independent observational data. The statistical analysis of the data with regard to trends and structural breakpoints in oxygen concentration and anoxic bottom area reveal overall increasing trends. The detailed picture is however more complicated as shown by decreasing trends in the 60ties until the 70ties followed by a trend reversal and accelerated increasing trends after that time. The time series are characterised by a statistical significant breakpoint around the end of the 70ties.

Device for taking samples from the bottom boundary layer of a water body

Ants Erm[1], Martin Voll[1], Rainis Suits[2], Mati Kaeeli[2]

[1]*Marine Systems Institute at Tallinn University of Technology,*
12618 Akadeemia tee 15a, Tallinn, Estonia
Mail: ants@phys.sea.ee

[2]*Dimentio LLC, 12911 E.*
Vilde tee 107-22, Tallinn, Estonia

Long-term changes in the marine and lake environment are well described by their bottom sediments, particularly by the profiles of these sediments. Compact bottom sediments can be sampled by different sampling devices elaborated and manufactured in tens of variants, e.g. gravity corers, vibratory corers, grab samplers, sampling boxes connected to the supporting frame, etc. The components of floating and lighter contact layers will be pushed away using these samplers, and the sample obtained will have a highly mixed structure, which cannot be used to determine the distribution of vertical, i.e. temporal, distribution of the components. In 1975 Martin Voll started the study of pollution with aromatic hydrocarbons of the Baltic Sea and some Estonian lakes with a unique sampler allowing taking sectioned cores produced in the Special Construction Bureau of the Estonian Academy of Sciences. The device was continuously improved due to the experience obtained during the lakes' and Baltic Sea expeditions (1975–1990) and protected with the Soviet Union Inventor's Certificates, afterwards with the patents issued in the USA, Federal Republic of Germany, Finland and, finally, in Estonia (1998). In 1988-1990 Voll used his device during the Pacific Ocean expeditions arranged by the Academy of Sciences of the Soviet Union with an aim to bring clarity to the processes of formation of iron-manganese concretions in the abysses at a distance of thousands of kilometers from the nearest coast. The solution was found owing to the undisturbed samples got by means of Voll's device – water decaying bacteria were found at a depth of 6000 m at the bottom of the Pacific Ocean. The goal of this report is to lighten some results and advantages of the Voll's sampler, and introduce an evolved device (protected with a United States patent application) for taking undisturbed samples from the bottom boundary layer, being in the phase of construction and trying out today.

Ship waves in Tallinn Bay, Baltic sea: their parameters, group structure and runup

Artem Rodin[1,2], Ira Didenkulova[1,2]

[1]*Institute of Cybernetics, Tallinn University of Technology*
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: artem@cens.ioc.ee

[2]*Nizhny Novgorod State Technical University*
Minin str. 24, 603950 Nizhny Novgorod, Russia

High-amplitude water waves induced by high-speed ferries are regularly observed in Tallinn Bay, the Baltic Sea causing intense beach erosion and disturbing marine habitants in the coastal zone. Such a strong impact on coast can be a result of a group structure of the wake and it is studied experimentally at Pikakari beach, Tallinn Bay. The most energetic vessel waves at this location have amplitudes of about 1 m and periods of 8-10 sec with maximum run-up heights up to 1.4 m. These wakes represent a certain structure, where the largest and longest waves come first and waves of smaller amplitude and period after. Sometimes the groups of different heights and periods can be separated even within one wake. The wave heights within a wake are well-described by the Weibull distribution, which has different parameters for wakes from different ships. Wave runup heights can also be described by Weibull distribution and its parameters can be connected to the parameters of the distribution of wave heights. Finally, the runup of individual waves within a wake is studied. It is shown that the largest amplification occurs for waves of weak amplitude and is in a good agreement with an estimate for the nonbreaking runup of a sinusoidal wave. The largest waves are strongly affected by the wave breaking and their runup is modeled numerically in the framework of the nonlinear shallow-water theory.

Chronicle of rogue waves for 2006 – 2011

Irina Nikolkina

Tallinn University of Technology, Laboratory of Wave Engineering
Akadeemia 21, 12618 Tallinn, Estonia
Mail: irina.nikolkina@gmail.com

The information about rogue waves occurred worldwide in 2006-2011 has been collected and analysed. Only events associated with damage and human loss are included. The events were classified by their validity as true and possible and by the location of their occurrence: we distinguish deep, shallow and coastal rogue waves, which occurred in deep/shallow waters or at the coast. The validity of the event has been estimated by the rogue wave height, which should be twice larger than the significant wave height, and/or by the associated hazard reported in mass media. The background significant wave height was estimated from the satellite wave data. It is shown that it is essential to consider the rogue wave hazard for shallow and coastal areas, where the major damage has been reported.

Optimizing breakwater configuration for vessel wakes and wind waves

Rain Männikus, T. Soomere, T. Torsvik

Wave Engineering Laboratory, Institute of Cybernetics at Tallinn University of Technology
Akadeemia tee 21
12 618 Tallinn, Estonia
Mail: rainmo86@gmail.com

The increasing use of strongly powered ships has introduced a new component of hydrodynamic activity in semi-sheltered seas such as the Baltic Sea, with properties (wave height, period and dominant direction) largely differing from the usual wind waves. This affects the coastal ecosystem as well as the safety of people and their property in locations near commercial harbors or shipping fairway. Constructing breakwaters that can effectively protect valuable property and ecosystem areas against both wave sources is a challenging coastal engineering problem. Noblessner Port is a small marina in Tallinn, located about 2 km west of Tallinn international ferry terminal. It is exposed to wind waves approaching from the north as well as ship wakes from the north and east. There are plans for reconstruction of the marina in order to accommodate more yachts. A study of the present day wave conditions and effects of possible future breakwater configurations is being carried out at the request of the port managers. Measurements of the present day conditions are recorded using a submerged wave recorder (LM2) within the port aquatorium and an ultrasonic echo-sounder device (LOG_aLevel) mounted on the open sea side of quay in front of the port. With this measurement set-up it is possible to correlate wave conditions inside and outside the breakwaters, thereby providing an assessment of the efficiency of the present day harbor protection for both ship wake and wind wave conditions. Simulations of wave conditions in the port area are performed using the numerical phase-resolving wave model COULWAVE. The model is based on weakly dispersive Boussinesq-type equations, and is primarily used to model the long period waves in the ship wake. By changing the topographic data in the model we analyze different breakwater configuration with the goal of establishing a cost-effective solution.

Statistics of shallow water rogue waves in Baltic Sea conditions: the case of Tallinn Bay

Artem Rodin[1,2], Ira Didenkulova[1,2]

[1]*Institute of Cybernetics, Tallinn University of Technology*
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: artem@cens.ioc.ee

[2]*Nizhny Novgorod State Technical University*
Minin str. 24, 603950 Nizhny Novgorod, Russia

The properties of rogue waves in shallow water are analyzed based on high-resolution records of sea surface elevation in Tallinn Bay, the Baltic Sea. Two datasets measured in Pikakari beach from 17 June till 1 July 2009 and in Aegna Island from 22 June 2008 till 21 July 2008 are analyzed and compared. Both datasets were measured at the distance 100 m from the coast at the water depth 2.7 m and contain freak waves, which occur in both calm and relatively rough weather conditions. Typical parameters of freak waves occurred in these two locations (freak wave height, steepness and amplification with respect to the significant wave height) are discussed and compared. The statistics of freak wave occurrence in these two sites reveals common features and some local peculiarities influenced by the location. The dependence of frequency of freak wave occurrence on the current significant wave height and characteristic wave steepness is a subject of special investigation.

Evaluation of ice compression hazard by means of fuzzy logic model

Tarmo Kõuts, Madis-Jaak Lilover

Tallinn University of Technology, Marine Systems Institute
Akadeemia str. 15a, 12618 Tallinn, Estonia
Mail: tarmo.kouts@sea.ee

Ice compression is the serious navigational hazard for all ships proceeding in the ice. In most compression cases no obvious special indications can be observed on the ice surface, the phenomenon activates and develops very fast being local in time and space. The classical methods of observation of the ice dynamics and of the modelling describing the compression with one physical parameter are not able to evaluate the degree of threat of ice compression in pre-determined sea area (in space or time or both). Therefore, alternatively it is probably meaningful to describe the compression with an integrated (composed) parameter (not directly measureable), which is divided into classes. We suggest to realize this approach using fuzzy logic model based on parameters obtained from numerical ice dynamic models and/or different other sources of information about the ice compression in the meso-scale (or even in the ship scale). First, we take into account parameters which make up the potential (or power) of compression. Among these parameters are the ice thickness, the ice compactness and ice categories. Second, we consider parameters which trigger the potential to the compression hazard. For the simplest model such triggering parameters could be the change of wind forcing or some other estimates obtained from the relevant model output and/or remote sensing product. A fuzzy logic model considers both the potential and triggering measures and provides a forecast of hazard of ice compression at a given grid point (or at a certain location). The model output is appropriately divided into classes like either missing, mild, moderate or severe compression. For the model calibration and validation the data from ocean circulation models which include the ice sub-model (e.g. HIROMB) or pure ice dynamics models (e.g. HELMI) could be used along with the relevant data from shipping (AIS), direct observations at ship bridges, classical ice maps, satellite images and ice drifter data.

Modeling of eutrophication in the Gulf of Finland during 1991-2010

Gennadi Lessin[1,2], Adolf Stips[2]

[1] *Marine Systems Institute at Tallinn University of Technology*
Akadeemia tee 15a, 12618 Tallinn, Estonia
Mail: gennadi.lessin@phys.sea.ee

[2] *European Commission – Joint Research Centre*
Via E. Fermi, 2749 (TP272), Italy

Modeling of eutrophication in the Gulf of Finland during 1991-2010 G. Lessin and A. Stips The hydrodynamic model GETM coupled with the ecosystem model ERGOM was applied for the Baltic Sea area for the period 1991-2010. The first decade of the modeled period is characterised by considerable socioeconomic changes in the area, which are often considered to be favorable for the status of the coastal marine ecosystem. Gulf of Finland, the most eutrophied sub-basin of the Baltic Sea, is chosen as a focus area for the current study. Model validation showed very good agreement between most modeled and measured parameters in the Gulf. Only in the surface layer nitrates were slightly underestimated, while phosphates were overestimated during the last decade. Near-bottom parameters were generally accurately reproduced. Model results show that in fact the eutrophication status of the Gulf of Finland has worsened during the last two decades, especially during the second part of the modeled period. This is reflected by an increased frequency of anoxic conditions combined with a consecutive steady increase of near-bottom phosphate and decreasing near-bottom nitrate concentrations. Time-series analysis shows that stronger stratification favors anoxic conditions in the near-bottom layer, while decreasing salinity induced by wind mixing allows oxygen to penetrate to deep areas and therefore improves the eutrophication status of the system. Model results showed that the near-bottom ecological situation in the Baltic Proper has very little influence on conditions in the Gulf of Finland, therefore not supporting the theory that major Baltic Sea inflows could lead to anoxic conditions and cyanobacteria blooms in the Gulf of Finland.

Simulating wave-surge interaction in a non-tidal bay during cyclone Gudrun in January 2005

Victor Alari, Tarmo Kõuts

Marine Systems Institute at Tallinn University of Technology
12618 Akadeemia Rd 15a Tallinn, Estonia
Mail: victor.alari@phys.sea.ee

Cyclone Gudrun (Erwin) crossed the Baltic Sea in 8-9 January 2005. The maximum sustained wind speed measured over the Baltic Proper reached 28 m/s (gusts 37.5 m/s) and prior the high surge (2.75 m in Pärnu city), wind blew mainly from the sector SWWSW. The hydrodynamic consequences, coastal damages and wave conditions in Baltic Proper and Gulf of Finland resulting from windstorm Gudrun have been analyzed previously. Lacking was the knowledge of wave-surge interaction and the role of wave induced setup. The aim of this paper is to study the effects of surge upon surface wave field dynamics and to reconstruct the possible wave induced set-up at a natural beach by means of numerical modeling. Modeling system consisting of a spectral wave model SWAN and non-hydrostatic depth-averaged free surface flow model SWASH was implemented. Spectral model was implemented to describe wave conditions in the Baltic Sea during the passage of cyclone and for providing boundary data to SWASH model, which in turn is used to calculate setup and inundation. Modeling relies profoundly on the quality of modeled wind fields - hence the accuracy of downscaled ERA40 wind fields during cyclone Gudrun is analyzed. We conclude an overall good level of agreement between modeled winds and observations and suggest using it in further modeling studies. Significant wave height in Pärnu bay increases up to 1 m by taking into account the additional deepening of water due to surge. The transformation of waves over the swash zone results in wave induced setup of 0.51 m and additional inundation of 130 m.

Consistency of residence time calculations based on Lagrangian trajectory analysis in ocean modeling

Tomas Torsvik

Wave Engineering Laboratory, Institute of Cybernetics at Tallinn University of Technology
Akadeemia tee 21
12618 Tallinn, Estonia
Mail: tomas.torsvik@ioc.ee

Lagrangian particle tracking has become an important tool for analysis of transport problems in numerical ocean models. Particle tracks are used to visualize flow patterns, and statistics based on resident time or age of particles within a model domain provide important information when applied to pollution control or primary production of biomass. Lagrangian particles are also useful when analyzing the probability of transport between two or more locations within a model domain, which is an important question for coastal management, if we wish to protect a specific site from pollution from a specific source, or for the fish farming industry who wish to avoid disease agents from spreading between farm locations. It is important that the statistics derived from Lagrangian particle tracking is consistent, i.e. that the results are not sensitive to the number of particles used or the time integration step when calculating particle motion. It is often the case that numerical results are presented based on a single simulation run without discussion about the number of particles used. It is also common practice to run particle models off-line, using pre-calculated velocity fields from a GCM, which restrict the particle tracking model to use much larger time integration steps that what is used in the corresponding GCM simulation. In order to examine these issues in a controlled environment, we make a series of simulation runs with a simple model configuration consisting of a channel containing a semi-circular bay structure at the half way point. The particle tracking model is run on-line with the GCM, which allows us to easily control the time integration step for the particle tracking model, including the case where the particle tracking model and the GCM are integrated with the same time step.

Transfer of heights to islands in West-Estonian Archipelago using hydrodynamic levelling

Aive Liibusk[1], Tarmo Kõuts[2], Artu Ellmann[3]

[1]*Department of Geomatics, Estonian University of Life Sciences, Tartu, Estonia*
Mail: aive.liibusk@emu.ee

[2] *Marine Systems Institute, Tallinn University of Technology, Tallinn, Estonia*
Mail: tarmo.kouts@msi.ttu.ee

[3] *Faculty of Civil Engineering, Tallinn University of Technology, Tallinn, Estonia*
Mail: artu.ellmann@ttu.ee

Implementation of a common national height system may require transferring of heights to adjacent islands. Therefore across-water height transfer needs to be solved also in West-Estonian Archipelago. In the past some oceanographic and hydrostatic methods have been developed, whereas data of float-in-a-well tide gauges (mareographs) and hydrostatic levelling have primarily been used. If within the area of interest no mareograph exists nor its establishment is viable then alternative methods must be considered. During the last decade water level measurements in terms of pressure sensors became popular, since they are compact, can withstand icy conditions, are easy to integrate with data loggers and communication systems. In particular, the piezoresisitive pressure sensors have showed good performance and short-term stability in low pressures. This study investigates the long term (up to 2 years) stability of the pressure sensors. In particular staff gauge readings are used as validation data for pressure based sea level measurements. Time-dependent sensor drift close to linear was found as most prominent feature in time series and eliminated in every station individually. Thereafter, the across-water hydrodynamic levelling was performed using two years long time series. Paper reviews the results of case study of precise hydrodynamic levelling in West-Estonian Archipelago using data from six sea level stations. Configuration of measurement stations form a closed 253 km long levelling loop, connecting two largest Estonian islands to national levelling network in mainland. Misclosure of the levelling loop as of 1.5cm was achieved. Results from hydrodynamic levelling were compared with other past (e.g. hydrostatic levelling) and up-to-date (such as GNSS-levelling) methods. A pilot study verifies that piezoresistive pressure sensors observations are feasible for hydrodynamic levelling transferring heights over short distance (under 50 km) waterways with a cm range accuracy.

Analysis of the Structure of Currents in the Gulf of Finland using the Okubo-Weiss parameter

Bert Viikmäe, T. Torsvik and T. Soomere

Institute of Cybernetics at Tallinn University of Technology
Akadeemia tee 21, 12618, Tallinn, Estonia
Mail: bert@ioc.ee

We analyze transport properties of surface water flow in the Gulf of Finland, the Baltic Sea, using spatial distributions of the Okubo-Weiss parameter, which reveals the spatial pattern of strain and relative vorticity at a specific time. The calculations are based on surface velocities calculated using the OAAS model with a spatial resolution of 1 nautical mile for 1987 in the framework of BONUS+ BalticWay cooperation. The currents are, on average, strain-dominated, with typical OW parameter values about 0.1. During short instances the OW parameter can abruptly increase by a factor 10. These events are not correlated with wind speed but occur slightly more frequently during the windy autumn season. Substantial areas of strong strain and relative vorticity regularly occur along the coast (due to topographic effects and coastal current fluctuations) and at two offshore areas; (i) in the eastern part near the mouth of the Neva river and (ii) in the north-western part of the gulf. The patterns of strong strain in the western part of the gulf originate from the northern nearshore but at times span down to the southern coast.

Gyration estimated from global surface drifter data in the Pacific Ocean

Aleksander Toompuu, Jaak Heinloo

Marine Systems Institute, Tallinn University of Technology
Akadeemia tee 15A, Tallinn 12618, Estonia
Mail: alex@phys.sea.ee

Two quantities measuring the average effect of the direction and intensity of eddy rotation (gyration effect) in the upper ocean are discussed. The quantities under consideration are the gyration vector introduced in the theory of rotationally anisotropic turbulence, and the spin following from the Lagrangian stochastic turbulence models and applied formerly to the estimates of oceanic eddy rotation. The following aspects of the two measures are compared: (i) the differences following from the definitions of the measures, (ii) the transparency of interpretation of the measures estimated from data and (iii) the differences resulting from the diverging physical context of the measures under consideration. While the gyration vector expresses the average kinematic effect of eddy rotation in a mechanically straightforward and transparent way, then the spin appears to be the sum of the gyration vector and of an additional term combining the gyration effect with some other effects masking its mechanical (physical) sense and complicating the interpretation of estimates of spin in terms of eddy rotation. The differences between the gyration vector and the spin are exemplified on the meridional distribution of zonally averaged gyration effect estimated from the global surface drifter data obtained in the Pacific Ocean of the depth exceeding 2 km between 120°E and 90°W. The estimates of the gyration vector from the global surface drifter data show the domination of anticyclonic eddy rotation at all latitudes of the area except in a narrow latitude band to the north of the equator. If compared with the formerly introduced spin the advantages of application of the gyration vector comprise its transparent mechanical sense, explicit dynamical context, and the simplicity of its application to the actual measured data.

Tidal currents as estimated from ADCP measurements in "practically non-tidal" Baltic Sea

Madis-Jaak Lilover

Marine Systems Institute, Tallinn University of Technology
Akadeemia str. 15a, 12618 Tallinn, Estonia
Mail: madis@phys.sea.ee

The Baltic Sea has been usually described as "practically non-tidal sea". The statement is motivated by the landlocked intracontinental location of the sea connected to the ocean (North Sea) via narrow and sallow Danish Straits (Belt Sea). For most of the non-south-western Baltic Sea the tidal amplitude of the sea level is less that 10 cm except in the eastern Gulf of Finland (GoF) where the amplitudes greater than 10 cm have been reported. The knowledge about the horizontal motion of water associated with the water level oscillations (tidal currents) is insufficient till now. We estimated tidal currents from direct current measurements performed at three locations along the southern coast of the GoF using a bottom-mounted ADCP. The rotary spectra of the current velocity revealed significant energetic peaks with the periods of the dominating seiches, tides and inertial oscillation (13.9 h). In the bottom layer the diurnal tides (O1 and K1) dominated over the semi-diurnal (M2 and S2) constituents with roughly twice larger current velocity amplitudes (about 9 and 5 cm/s respectively). In the upper layer the both, diurnal and semi-diurnal, tidal amplitudes were similar – about 6 cm/s. The autocorrelation function of diurnal current constituent (band-pass filtered) revealed 14 day period pointing to their "tropical" intensification. Some 3D simulations of the Baltic Sea salinity in the deep layer below the halocline by a model with the effect of tides included have shown the salinity values smaller than the outcome of the model with the tides excluded. The latter probably implies the importance of tidal currents to the vertical mixing of bottom layer salt and nutrients. Thus, in contrast to the intermittent wind and density-driven currents in the bottom layer the tidal currents are always present and can substantially contribute to the vertical mixing and in this way have an effect on the eutrophication - the most discussed ecological problem of the Baltic Sea.

Monitoring of ice dynamics using bottom-mounted ADCP in the central Gulf of Finland in 2010

Tarmo Kõuts, Juss Pavelson, Madis-Jaak Lilover

Marine Systems Institute at Tallinn University of Technology
Akadeemia 15A, EE12618 Tallinn, Estonia
Mail: tarmo.kouts@msi.ttu.ee

This study is aimed to describe the sea ice dynamics in relation to wind forcing using bottom-track facility of the ADCP (Acoustic Doppler Current Profiler) for detecting the presence and movement of the ice. The measurements were performed from 12 January to 27 April 2010 in the central part of the Gulf of Finland 8nm off Kunda (59.7017 N, 26.4033 E). A broadband ADCP (307.2 kHz, RDInstruments) was deployed on the bottom at 63m depth and was configured to measure bottom-track velocities (i.e. sea surface tracking) with the sampling interval of 10 min (average of 5 pings). The relevant wind data was mainly obtained from meteorological station on the island of Vaindloo about 8nm to the north from the location of ADCP. The gaps in the measured wind series were filled with the operational model HIRLAM wind data (interpolated to the location of the ADCP). The winter of 2009/2010 was a bit colder than average, the major parts of the Gulf of Finland were ice covered and especially in the second half of the winter the ice conditions were very dynamic as well. The detection of the ice cover and ice free periods based on the bottom-track velocity and the rms of error velocity values was successful. We found that the rms of bottom track error velocity for the ice cover periods were about five times smaller than those for the ice free periods. Altogether five periods with ice cover with the duration from 6 to 12 days were determined, which makes approximately 60% of the whole 'ice season'. The alternation of ice conditions was in a good accordance with variations of wind over the gulf and was also confirmed by the available cloud free MODIS (NASA) satellite images. The speed of the ice motion was well correlated with the measured nearby wind speed data. For all ice episodes taken together, the correlation coefficient was 0.84 (maximum 0.96 in a particular episode). In accordance with other ice studies the mean ice to wind speed ratio was 3% and the mean direction of ice motion was 15° to the right from the direction of wind.The study concludes that the bottom-track option of the ADCP applied for detecting the ice cover is a reliable tool for monitoring the ice conditions and therefore can be more widely used in the future researh.

Changes in coastal ecosystem of the eastern Baltic Sea under eutrophication and climate variability

Nadezhda Berezina, Yulia Gubelit

Zoological Institute RAS
1 Universitetskaya embankment
St. Petersburg, 199034 Russia
Mail: na-berezina@rambler.ru

Due to osmotic stress for both marine and freshwater origin species the brackish inland Baltic Sea is characterized by low species diversity and is easily colonized by allochtonous species. Climatic changes and destruction of habitats that accompanies globalization are among the most important factors, facilitating losses in native biodiversity and success of invasive species. This paper focuses on dynamics and changes in coastal ecosystems of the Baltic sea that are main habitats for representatives of Malacostraca and the most sensitive ecotone subjected to consequences of eutrophication and climate changes. It analyses history and current distribution of malacostracan crustaceans in the north-eastern and south-eastern parts of the Baltic Sea (primarily Gulf of Finland, Curonian and Vistula lagoons). Warming has facilitated the rapid dispersal of everythermic crustaceans from Ponto-Caspian and Mediterranean basins to the Baltic Sea and further their high ecological significance. Climatic changes influence primarily on water temperature, hydrology and nutrient balance that can be environmental limits leading to deceleration of species number and abundance and change in trophic links within community. Community responses to climate influence differ strongly between years. In cold years the primary productivity and nutrient release from catchment area as a rule decrease and only stenothermic species are extremely stressed and can decrease their significance. In warm years, higher temperatures are likely to lead to higher primary productivity with more intense algal blooms; and invertebrate communities are especially vulnerable to eutrophication (oxygen depletion, hydroxide sulphide production). Increased water temperature leads to a change in food webs with higher winter survival of animals, and to dominance of fast-growing algae. Filamentous algae proliferation will cause stress for invertebrates with high oxygen needs and shift community composition and abundance.

Current variability and spreading of suspended matter in the deep layers of the Gulf of Finland

Irina Suhhova

Marine Systems Institute at Tallinn University of Technology
Akadeemia 15A, EE12618 Tallinn, Estonia
Mail: irina.suhhova@phys.sea.ee

Variability of currents in the Gulf of Finland was studied using bottom-mounted ADCP, which was deployed at four sites along the Estonian EEZ border. The SBE 16plus V2 CTD probe was connected to the ADCP to measure temperature, salinity, oxygen content and turbidity in the near-bottom layer. In the present paper, the observational results obtained during the construction of the Nord Stream pipeline in the Gulf of Finland from September 2010 until August 2011 are analyzed. In the near-bottom layer (at 4-6 m and 6-8 m from the bottom) the ADCP recorded occasionally strong currents with a speed exceeding 30 cm s-1. Maximum current velocities in the near bottom layer were measured on 9-10 November 2010, when velocity rose temporarily up to 43 cm s-1. Concurrently high water turbidity was recorded. The measurements have revealed two other occasions with a relatively high turbidity in the deep layers of the Gulf of Finland, although those events were not related to the high near-bottom current velocity. Possible causes and responsible processes/mechanisms of these events, associated with the redoxcline, are discussed. Since we have observed the near bottom current velocities exceeding 40 cm s-1 in certain conditions, we argue that the suspended matter released from the bottom sediments could be transported over much greater distances than estimated earlier for the deep layers of the Gulf of Finland. We believe that the data collected (and knowledge gained) in the frames of the environmental monitoring of the Nord Stream construction could build a better basis for the future assessments of environmental impacts of large off-shore installations in the Baltic Sea.

On the compressibility of surface currents in the Gulf of Finland, the Baltic Sea

A. Giudici[1], J. Kalda[1], T. Soomere[1,2]

[1]*Institute of Cybernetics at Tallinn University of Technology*
Akadeemia tee 21, 12618 Tallinn, Estonia
Mail: andrea@cens.ioc.ee

[2]*Estonian Academy of Sciences*
Kohtu 6, 10130 Tallinn, Estonia

A fascinating property of different substances in the marine environment is their ability to form areas with high concentrations (patches) in the surface layer. We make an attempt to link the potential of formation of such patches with the so-called property of compressibility of sea surface (understood as the relative weight of the potential component of a velocity field). We introduce a modified measure of compressibility that is directly related to the ability of clustering of passive tracers in some regions of the sea surface and that can be calculated in a straightforward way from surface velocities. We call this measure Finite Time Compressibility (FTC). This measure is calculated based on 3D velocity fields obtained using the Rossby Centre Ocean Model (Swedish Meteorological and Hydrological Institute) for 1991 and the TRACMASS code for tracking Lagrangian trajectories. We introduce for the first time systematically calculated maps of compressibility for the area of the Gulf of Finland, the Baltic Sea. We highlight some interesting features of these maps. We set up a scenario to test the validity of FTC against the classical definition of compressibility. In order to do that, we aim at calculating compressibility according to the classical definition and compare it to FTC with respect to a known relationship with Lyapunov exponents, within the area of our interest.

The recovery of twaite shad (Alosa fallax) population in Lithuania

Rimantas Repečka

Institute of Ecology, Nature Research Centre
Akademijos str. 2, LT-08412, Vilnius, Lithuania
Mail: repecka@ekoi.lt

The abundance and biological characteristics of twaite shad (Alosa fallax), and the the reasons of its population recovery in Lithuania is presented in this study. Migratory fish are extremely susceptible to changes in environmental conditions. For a long time twaite shad have been enjoying the status of important object of commercial fishing in Lithuania waters: in the Curonian Lagoon and the lower reaches of the Nemunas River. The commercial catches of this fish species reached several hundred tons in the first half of XX century. However, 50-60 years ago the abundance of twaite shad started noticeably decrease due to increased pollution and marked deterioration of reproduction in rivers and Lagoon (dams, reclamation). For a long time twaite shad almost disappeared. It was included to Red Data Book of Lithuania since 1992. Lately twaite shad have noticeably increased in abundance as a result of rivers and Curonian Lagoon pollution abatement (several wastewater treatment plants were built, the amount of industrial and agricultural pollutants decreased) and deepening of the narrow Klaipėda Strait. Now, nitrogen and phosphorus levels are 2–3 times lower in rivers and Curonian Lagoon in comparison with the period 20–25 years ago. Twaite shad appeared in experimental and commercial catches in the Curonian Lagoon after a long period only in 1994. The abundance of twaite shad begin to grow and it was excluded from Red Data Book of Lithuania since 2005. Commercial catches of twaite shad in Baltic coastal zone and Lagoon have considerably grown up and reach more than 100 tons in recent years. On further replenishment of stocks, twaite shad is expected to grow in commercial importance. The abundance, migration routes, spawning grounds and biological characteristics of twaite shad have been investigated in the recent years.

Factors, influencing on macroalgal communities in the Neva estuary (eastern Baltic Sea)

Yulia Gubelit

Zoological institute of the Russian Academy of Sciences
199034 Universitetskaya emb.1,
St. Petersburg, Russia.
Mail: gubelit@list.ru

The eastern Gulf of Finland is a shallow water body, characterized by low salinity (0-3.5‰) and high level of eutrophication. Sampling was conducted along the coast in 2002–2011 by scuba-diving method. Every summer we observed mass development of fast-growing filamentous macroalgae (up to 450 gDWm-2) and the formation of decaying mats. During study period dredging works and land reclamation led to significant decline of total macroalgal biomass in 2008, but in next three years the biomass reached previous meanings. Natural factors, as a weather conditions and salinity also influenced on coastal communities. Changes of salinity determined distribution of marine species in the eastern Gulf of Finland. At the same time weather conditions influenced on seasonal dynamic of macroalgae. Correlation analysis showed significant link between average seasonal biomass (depth 0.5 m) of macroalgae and average wind speed during sampling season ($R=-0.94$, $p<0.05$). At the same time the link between midsummer biomass and temperature was founded. Our study showed, that species composition and biomass of macroalgal communities reflected complex of antropogenic and natural factors, which influenced on the Neva estuary.

A polarimetric model to observe targets at sea by PingPong mode COSMO-SkyMed SAR data

Maurizio Migliaccio, Ferdinando Nunziata

Università degli Studi di Napoli "Parthenope"
Dipartimento per le Tecnologie
Centro Direzionale, isola C4, 80143 Napoli, Italy
Mail: maurizio.migliaccio@uniparthenope.it

Ship and oil platform observation over the sea are topics of remarkable interest in several applications concerning environmental monitoring and maritime surveillance. Ship observation is of paramount importance for fishery applications, to prevent oil pollution and to ensure an effective traffic and immigration control. Oil platforms pose an important environmental risk in case of accidents, e.g. the recent Deepwater Horizon oil spillage. Moreover, other natural events, such as hurricanes, can sometimes totally wreck oil platforms generating oil pollution at sea. To be operationally effective, both ship and oil platform observation should be accomplished on a synoptic basis and both day- and night-time. Synthetic Aperture Radar (SAR), due to its fine spatial resolution, together with its all-weather day and night capabilities, is the most important remote sensing tool for a synoptic observation of both ships and oil platforms, hereinafter metallic targets. In this study, a dual-polarimetric approach is first developed to exploit X-band COSMO-SkyMed (CSK) dual-polarimetric PingPong mode SAR data for observing metallic targets at sea. This is of paramount importance from both a theoretical and an operational viewpoint. On a theoretical side, CSK polarimetric mode, based on alternating polarizations between bursts, does not preserve coherence between polarimetric channels, hence, an ad hoc modeling of polarimetric sea surface scattering with and without metallic targets is requested. In this study, the correlation between the co-polarized channels is first related to the time offset between bursts relevant to the HH and VV polarimetric channels, in case of sea surface with and without metallic target. On an operational side, CSK is very attractive since, being a constellation of four satellites each equipped with a dual-polarimetric SAR, it is able to guarantee a high spatial/temporal coverage. First experiments, undertaken over a data set of COSMO-SkyMed Single Look

Introduction of the Compact HF Radar "WERA-S"

Thomas Helzel, Birgit Hansen, Matthias Kniephoff, Leif Petersen, Markus Valentin

Helzel Messtechnik GmbH
Carl-Benz-Str. 9, 24568 Kaltenkirchen, Germany
Mail: helzel@helzel.com

The new ocean radar system "WERA-S" is the more compact successor of the well known WERA system. The new system provides several new features to provide more flexibility for site geometry to make the site selection easier. In particular the wire-less connection between the transmit and receive unit allows to install the WERA-S even at populated coasts where suited sites are rare. Furthermore the power consumption is minimised to enable the operation at remote locations. The total power consumption of less than 300 Watts can be provided by means of solar power generators. The high quality standard and reliability of the WERA concept is kept to guarantee highest data availability for operational application. For the scientific community the open interface structure is kept as well to allow scientist to use this instrument for research projects. Results for first tests at the German coast are presented and demonstrate the high signal quality of the new WERA-S system. A configuration of this new WERA for three regions at the Baltic coast and its estimated performance is introduced.

Tracking and Monitoring Oil Slicks Using Remote Sensing

Victor Klemas

College of Earth, Ocean and Environment
University of Delaware,
Newark, DE 19716
Mail: klemas@udel.edu

Oil spills can harm marine life in the ocean, estuaries and wetlands. To limit the damage by a spill and facilitate cleanup efforts, emergency managers and modelers need information on spill location, size and extent, direction and speed of oil movement, wind, current, and wave information for predicting oil drift and dispersion. The main operational data requirements are fast turn-around time and frequent imaging to monitor the dynamics of the spill. Remote sensors can provide key inputs to drift prediction models and facilitate targeting of skimming and booming efforts. Radar and multispectral imagers on satellites can be used for general assessment of oil slick location, size and drift. For a more detailed spill assessment and tracking, aircraft are used, since satellites do not provide the required temporal and spatial resolution. Laser fluorosensing and microwave radiometry from aircraft can help identify oil type and estimate slick thickness. Submerged oil plumes have been tracked with AUVs and ocean gliders equipped with acoustic and visible sensors. Ocean Acoustic Waveguide Remote Sensing can track submerged oil plumes and fish schools over long distances.The Sea Princess tanker grounding off the coast of Wales and the explosion on the Deepwater Horizon rig in the Gulf of Mexico provide two representative, yet different, scenarios for evaluating the effectiveness of remote sensors during oil spill emergencies.

X-band azimuth cut-off for wind speed retrieval by means of COSMO-SkyMed SAR data

Maurizio Migliaccio, A.Montuori, F.Nunziata

Università degli Studi di Napoli "Parthenope"
Dipartimento per le Tecnologie
Centro Direzionale, isola C4, 80143 Napoli, Italy
Mail: maurizio.migliaccio@uniparthenope.it

High-resolution sea wind vector measurements are of paramount importance for several maritime applications, such as weather forecasting, clean energy development, marine disaster monitoring and ocean-air interactions. Microwave remote sensing has shown the capability of providing wind field data with mesoscale resolution and with short revisiting time. Satellite-based scatterometers can provide wind vector measurements with a spatial resolution ranging between 12.5 and 2.5 km. Unfortunately, such resolutions may be not adequate for some applications, especially in coastal and near shore regions, where scatterometer-based wind field products suffer from uncertainty and large errors. Sea wind vector retrieval from Synthetic Aperture Radar (SAR) images, with high-resolution and in areas where the scatterometer measurements fail, is very interesting from an operational viewpoint. The relationship between the SAR normalized radar cross section (NRCS) and the sea wind vector is typically described by tailored Geophysical Model Functions (GMF), which account for both sensor and geophysical parameters. They strongly need both well-calibrated NRCS and the a priori wind direction information to estimate the wind speed at sea. Recently, a SAR wind speed algorithm based on the azimuth cut-off procedure has been developed for C-band SAR data, which is able to provide accurate wind speed estimations without requiring any a priori wind direction information and calibration accuracy. In this paper a new SAR wind speed algorithm based on the azimuth cut-off procedure is first proposed for X-band COSMO-SkyMed SAR data. The data set consists of about 100 X-band COSMO-SkyMed SAR data, gathered both in different acquisition modes (i.e. StripMap, Spotlight and ScanSAR) and over different geographic areas. The validation step is accomplished by using the ground truth provided by timely and spatially co-located ASCAT scatterometer winds, ECMWF model data and in situ observations.

Using MERIS/Envisat data to assess the Secchi depth – A case study from Lithuanian Baltic Sea waters

Diana Vaičiute

Klaipėda University Coastal Research and Planning Institute
Klaipėda University Geophysical department
Herkaus Manto 84, Klaipėda, Lithuania
Mail: diana@corpi.ku.lt

The south-eastern part of the Baltic Sea in front of the Lithuanian coast is a highly variable dynamical system due to small-scale water exchange between the Baltic Seas and Curonian Lagoon mainly driven by local wind and water level. According to typology in the frame of WFD (2000/60/EC) this are was assessed as transitional waters (Daunys & Olenin, 2007). The outflow of mainly fresh hypereutrophic waters of the Lagoon may strongly affect the ecological status of Baltic Sea waters, drastically change the composition of plankton communities and level of water quality, and reduce sun light penetration into deeper water layers necessary for benthic macroalgae. On the other hand nutrient rich waters may force the development of marine phytoplankton and play like an additional food source for fish. At this moment most of these hypotheses are poorly tested. I. Olenina (1997) defined the extension of lagoon waters in the Baltic Sea according to phytoplankton composition: 35 km to north, 30 km to north-west, 14-15 km to west and south-west. In Technical Note B "Typology for surface waters" (2004) it was determined as water with a 10% deviation from the coastal waters background salinity and roughly corresponds 5-6 psu. However, plume area is extremely unstable in space and time and spatial resolution of monitoring stations and/or frequency of observations are relatively low for the assessment of the extension of outflow of the Lagoon waters (Daunys & Olenin, 2007). During the typology and classification of ecological status of Lithuanian coastal and transitional waters the modeling approach using salinity parameter was suggested as applicable tool (more in details in Daunys & Olenin, 2007). However, ecological effects are still poorly known. Recently satellite-based remote sensing has become useful tool for the analysis and monitoring of the environment processes in the frame of climate change. Therefore the aim of this study is to demonstrate the applicability of remote sensing combined with in situ bio-optical measurements for the: i) determination of spatial and temporal extension of the plume; ii) assessment of inside structure heterogeneity of the plume.

Ground-penetrating radar study of coastal landscape on Hiiumaa Island, Estonia

Kadri Vilumaa, A. Kont, U. Ratas, H. Tõnisson

Institute of Ecology at Tallinn University
Uus-Sadama 5, Tallinn
10120, Estonia
Mail: kadri.vilumaa@tlu.ee

This case study presents the results of a ground-penetrating radar (GPR) profiling in Hiiumaa, west Estonian archipelago. Most of the coast of Hiiumaa has emerged from the Baltic Sea during Limnea Sea stage. The study sites are located on Tahkuna Peninsula, North Hiiumaa where the coastal plain is characterized by a series of beach ridges. The beach ridges are separated by narrow wet depressions where non-calcareous sandy deposits are covered with peat. Due to tectonic land uplift, the landforms are located at different distance from the nowadays shore and at different altitudes. The morphology of landforms and the character of deposits influence the soil formation and the development of peat layer. The layer of varved clays under the sand prevents infiltration and stabilizes the water regime. The water movement also depends on the orientation, height and width of the beach ridges. The achieved results are based on cartographic analysis, fieldwork data including topographic survey and geological radar survey along transects by using SIR-3000. In order to verify the radar image interpretation, 33 boreholes were drilled on the profiles.The main objective of the study was to determine the thickness of peat and to characterize the topography of sub-peat mineral soil by GPR. Two ~1 km long GPR profiles perpendicular to the ridges were examined. A 100 MHz frequency was used, which reflected to approximately 10 m depth. It appears that the Tahkuna study site has developed in nutrient poor environment – the peat layer is thin (up to 1 m) and transitional bog peat makes up a small part of the whole peat layer. The thickness of subjacent sand is 2-4 m. In the course of time the depressions are filled with mire deposits and the peat layer will cover the beach ridges entirely, which leads to surface leveling and reduction in plant species as well as diversity of landscape in general.

Usage of videomosaic for computed aided analysis of North Sea hard bottom underwater video for baseline study of offshore windmill park

Aleksej Šaškov[1], Thomas Dahlgren[2], Marie-Lise Schläppy[3], Yuri Rzhanov[4]

[1] *Coastal Research and Planning Institute, Klaipėda University, Lithuania*
[2] *UNI Research, Norway*
[3] *École Polytechnique Fédérale de Lausanne, Switzerland*
[4] *Center for Coastal and Ocean Mapping/Joint Hydrographic Center, University of New Hampshire, USA*
** Corresponding author e-mail: aleks@corpi.ku.lt*

Windmill park on the open North Sea coast at Hävsul area in Norway is one of the first in the world to be build on such extreme high-energy coast. To determine possible environmental impact of this project, baseline study was performed in 2010-2011. Two areas, impacted (area where windmill park is planned to be build) and reference were chosen. For hard bottoms work class ROV was used to take underwater video, as no traditional sampling methods are suitable for such environment and depths. The system was equipped with powerful (400 Watt) xenon lights, USBL navigation and HDTV color camera. For video analysis videomosaicing approach was used. Combining overlapping frames into a single picture allows include in the analysis all visual information, and avoid over counting due to the possible presence of the same feature in the number of differnt frames.

Bottom fauna and flora in the area include highly heterogenic small patches of various red algae, encrusting algae and encrusting animals. For lesser depths kelp “forests” are common, some megabenthos species are also present. Due to extreme patchiness of the bottom views, it is difficult to process them manually. To overcome this problem computer aided analysis method was developed.

Computer aided videomosaics analysis method used for this study is based on color differences of different bottom features. After manually creating training color pallets for different features, it is possible to process large amount of visual data obtaining repeatable and reliable quantitative estimations on the coverage. Additional benefits of videomosaickning are extended abilities to manipulate visual data, what allows more accurate manual estimation of certain features, such as counts of mega benthos species individuals.

Although initial study was successful and color based features extraction approach proved to be robust and accurate, it can’t reliably separate certain features (for example, different red algae species). Additional researches on implementing textures and shapes based analysis are needed.

Validation of sea level in MyOcean Baltic modeling products

Priidik Lagemaa

Marine Systems Institute at Tallinn University of Technology
Akadeemia 15A, EE12618 Tallinn, Estonia
Mail: priidik26@gmail.com

The MyOcean Baltic Monitoring and Forecasting Centre (BalticMFC) is providing forecast and re-analysis products for the physical as well as biogeochemical parameters in the Baltic Sea. Results are based on the new community regional ocean model HBM which was built by combining the benefits of different modelling systems of the project partners. A thorough validation of the new model system was performed in order to ensure high product quality. A comprehensive validation system was built and applied to year 2007 hindcast runs. Hindcast runs were carried out in 4 production units (PU), SMHI, DMI, BSH and FMI, with different model forcing. A comprehensive sea level validation at coastal stations was carried out. From the dense tide gauge network in the Baltic Sea, 58 stations were chosen and compared to hourly model output. The results revealed correlations in between 63% – 98% and RMS differences (RMSD) of 15 – 32 cm, indicating substantial differences between the PUs. The skill of the models was evaluated separately for different sub-basins of the Baltic Sea. The bias of modeled sea level was higher in eastern Baltic Sea showing the values from 20 to 40 cm while in western Baltic Sea the bias is lower. After subtracting the bias, the accuracy of the models was found higher in Gulf of Finland and Riga and Bothnian Sea areas revealing the RMSD below 10 cm and correlation above 90%.

Biology, feeding habits and metazoan parasites of the round goby, *Neogobius melanostomus* (Pallas, 1811), in the Lithuanian coast and Curonian Lagoon

Egidijus Bacevičius[1,2]

[1]*Lithuanian Ministry of Agriculture, Department of Fishery Research and Science*
Smiltynės str. 1, P/B 108, Klaipėda, LT- 91001
E-mail: ebacevicius@mail.lt

[2] *Coastal Research and Planning Institute, Klaipėda University, H. Manto 84, Klaipėda, Lithuania*

The round goby, *Neogobius melanostomus* (Pallas, 1811), a recent invader of Ponto-Caspian origin, firstly was caught in the Baltic during 1990 in the Gdansk Bay. In Lithuanian coast the first specimen (21 cm, 2 years old male) was caught in August 2002. Development of the round goby population in demersal fish community was observed from the beginning of the invasion until 2012. During this time the species spreads and became abundant both in the coastal zone of the Lithuania (brackish water) and in the northern part of the Curonian lagoon, reaching Nida-Ventės Cape border (fresh oligohaline water). Totally 550 specimens of round goby were biologically analysed. Two periods of the high occurrence have been observed: May- June and August-September. The fishes were most abundant in the Baltic Sea coastal zone (depth range between 1-12 m, salinity - 0.5 to 7.7 psu) and less abundant in Curonian lagoon ($G= 65.2$, $df– 2$, $P < 0.05$). Temperature was detected as the main factor influencing behaviour and feeding capabilities of round goby (MANOVA, $P < 0.01$). They preferred water with temperature < 10-17^{O} C. During seasonal thermocline period gobies moved in deeper i. e. fresher water. From October- to beginning of May round goby absent in the caches in shallow areas. It is presumed, that during this time they are in the hibernation state in < 20 m deepth. According to G- test, adult fish have no preferences for sand or hard bottom habitat ($G= 21.9$, $df– 2$, $P < 0.05$). Body length ranged from 6 cm to 25 cm. Mean body length of the females and males were 15. $\pm$ 5 (Std. Err.) and 18 $\pm$ 2 cm. respectively. The fish weight differed additionally ($G= 42.1$, $df– 2$, $P < 0.05$). The fish age determined from otholits, and varied from 1+ to 5. Most abundant were 2-3 year old fishes females ($G= 4,742$, $df– 2$, $P < 0.09$). Male - female mean ratio was 2: 1.2 ($G= 4,742$, $df– 2$, $P < 0.09$). It is presumed that round goby spawning area is in the costal zone, first and successful spawning period detected in July, whereas second – in August. After beginning of the invasion of alien species, two generations have been passed. Species now is counted as stabilised population.

Marine deposits in Vistula and Curonian Spits

Ekaterina Badyukova, L.A. Zhindarev, S.A. Lukyanova, G.D. Solovieva

M.V. Lomonosov Moscow state university, Geographical department
Leninsky goru MSU, 119991 moscow, Russia
Mail: badyukova@yandex.ru

The geomorphologic structure of the accumulative barrier forms bordering significant parts of sea coasts does not leave doubts in close connection of the reasons and stages of their formation with changes of a sea level. Such dependence is traced in the structure of sandy barriers of southeast Baltic - Curonian and Vistula spits. Analyzing relief of these spits it is necessary to note, that now the most part of their surface consists of the eolian sand, marine genesis has a modern sea beach, and marine-lagoon genesis have a beach and low terraces (1.5 м) in the Curonian and Vistula gulfs. On sea coast of the spits there are the layers of pebbles in the bottoms of some blow-outs. These layers can serve as age analogue of lagoon terrace. The blow-outs strip is situated in the zone of the most active deflation of the coastal sand and located directly behind the avandune or foredune. The pebble layers fix, apparently, position of an ancient coastal bar, which was primary burred by sand, and then excavated by the modern processes of a deflation. The present pebble layers position exceeds a modern sea level on 1.5 - 2 m near settlements Khvoinoe and Morskoe. The most obvious proof of presence along Vistula Spit the ancient coastline connected to a sea-level rise is the coastal bar traced in the cliff foot in area of settlement Kosa. The bar consists of light grey coarse-grained layered sand with pebbles, mollusk shells and gastropods. Inside part of a bar is buried under eolian deposits and another one is opened in cliff extended in this part of the spit on some kilometers. Similar marine sand is found out and on other sites of Vistula Spit sea coast. On the basis of the mollusk shells dating 14 C from the marine sediments composing the bottom part of a cliff their absolute age 1270+60 cal BP (LU-6129) has been received. Sea level was on 0.5 m higher than contemporary one. Ancient coastline is corresponding to one of the last peaks of Limnea transgression.

Long term shoreline changes of the Lithuanian Baltic Sea continental coast

Ingrida Bagdanavičiutė[1], Loreta Kelpšaitė[1,2], Darius Daunys[3]

[1]*Klaipeda University Coastal Research and Planning Institute*
[2]*Klaipeda University Geophysical department*
[3]*Department of Ecology*
Herkaus Manto 84, Klaipeda, Lithuania
Mail: ingrida@corpi.ku.lt

Shoreline position measurements for various time periods can be used to derive quantitative estimates of the rate of shoreline change (erosion or accretion). These rates can be used to further our understanding of the magnitude and timing of shoreline changes in a geologic or socio-economical context. In this study evaluation of long-term coastal changes, at continental part of Lithuanian Baltic sea coast, was performed using aerial photographs and topographic maps (1947 -2010). Statistical approach for classification of the coast into dynamic sectors was integrated.

Comparison of long-term water level fluctuations between the South and South-East Baltic Lagoons

Nailia Bairamova, Inga Dailidienė, Henning Baudler

Klaipeda University
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: bnailia@yahoo.com

The global and regional water level rising is one of the most worrying aspects of the climate change. Recently, the scientific society discusses more about the sea level change in the future development and its consequences. The water level varies unequal in different places of the world. The sea level change is becoming an issue of increasing importance, especially in the context of anthropogenic global climate change. The water level rise can cause coastal erosion, determine beneficial conditions for the waves to act larger continent areas, affect the floods, a salt water intrusion, and the result of it may be affected aquatic ecosystems. The water level fluctuations problems are becoming more relevant in the Baltic Sea, which is a part of the World Ocean, therefore the global water level rise has a significant impact on the south-eastern Baltic Sea region development. The paper analyzes and compares the long-term water level fluctuations between the southern and the south-eastern Baltic lagoons. Based on the the Curonian Lagoon and the Darss-Zingst Bodden Chain (DZBC) lagoon water level data, the paper studies the peculiarities of the water level variations in these closed and shallow basins. The results showed that the water level rises from the 20th century sixth decade in the south-eastern and southern parts of the Baltic Sea. The water level rise in the Curonian Lagoon and Darss-Zingst Bodden Chain lagoon associated with the climate change.

Marine litter in the different functional zones of the Lithuanian coast line

Arūnas Balčiūnas

Klaipeda University Coastal Research and Planning Institute
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: Arunas.balciunas@corpi.ku.lt

Marine litter is any persistent, manufactured or processed solid material discarded, disposed or abandoned in the marine and coastal environment. With ever increasing anthropogenic activities in the Baltic Sea the direct and indirect effects of the marine litter is imminent. Determining the qualitative and quantitative characteristics of the marine litter in the different functional zones of the Lithuanian coast lines is essential for actual and potential assessment of socio-economics and ecological impacts of litter. The implementation of the Marine Strategy Framework Directive (MSFD) in Lithuania demand investigation of the pressures and impacts to the environment caused by the marine debris in order to maintain or achieve a good status in marine environment. The lack of knowledge of the amount, type and properties of litter accumulated in the Lithuanian coastal zone determines an urgent need for special investigations. In order to assess the pollution level, different functional zones of Lithuanian coast were investigated. The distribution and characteristics of the marine litter, comparison of the sea- based and land-based source of waste in six sections is presented.

Coastal zone contamination mitigation means

Olga Belous, Arunas Balciunas

Klaipeda University
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: Olga@corpi.ku.lt

Coastal zone industrial activity as well as settlements development and attractiveness for tourism generate persistent coast contamination by waste. Right industrial and domestic waste management and utilization are essential for ensuring reduction of coastal zone environmental pollution. Furthermore, effectively managed near source waste materials can be used as a valuable resource for reuse, recycling or recovery of different kind of energy. In this paper a review on waste as potential energy resource with the contribution to the reduction of carbon dioxide emission by creating a balance between energy consumption and sustainable use of resources in the Baltic Sea region is presented. Western Lithuania wastes compositions and properties, its moisture, nutrients, heavy metals concentrations, heat of combustion, total and organic carbon rate and main chemical elements content for comprehensive further operation and environmental impact assessment are investigated. The results of evaluation of current and prospective waste utilization technologies, determined during REMOWE project included in the EU funded Baltic Sea Region Program, are shown.

Development of regional bio-optical algorithms of satellite data for the South-eastern Baltic

Tatiana Bukanova[1], S.V. Vazyulya[2], O.V. Kopelevich[2], V.I. Burenkov[2], S.V. Sheberstov[2], S.V. Aleksandrov[3]

[1]*Atlantic Branch of P.P. Shirshov Institute of Oceanology, RAS*
Pr. Mira, 1, Kaliningrad, Russia, 236000
Email: felice04@rambler.ru

[2]*P.P. Shirshov Institute of Oceanology, RAS, Moscow, Russia*

[3]*Atlantic Research Institute of Marine Fisheries and Oceanography, Kaliningrad, Russia*

The Baltic Sea represents optically complex Case 2 waters with high concentration of colored dissolved organic matter. The standard algorithms for satellite data from ocean color scanners SeaWiFS and MODIS cannot provide accurate estimation of Chl in the Baltic Sea according to the results of in situ measurements carried by Polish specialists. The main objective of our research is to develop regional algorithms for estimation of Chl and TSM from satellite ocean color data in the Russian sector of the South-Eastern Baltic. The studies were conducted in two directions: validation of the standard algorithms by in situ data on Chl and TSM measured in the South-Eastern Baltic in 2003-2009; carrying out the extended in situ radiometric measurements jointly with satellite observations and in situ data on Chl and TSM, and a further thorough analysis of the whole set of the obtained data. The extended studies were carried out in four marine expeditions of April, June, July and October, 2010 that included the direct estimation of Chl and TSM, spectral radiometric measurements performed with a floating spectroradiometer and the concurrent satellite data derived from ocean color scanners SeaWiFS, MODIS-Terra, MODIS-Aqua, MERIS. The results have shown that the standard bio-optical algorithms aren't able to provide the Chl and TSM values from data of spectral radiometric measurements with a reasonable accuracy in the region. We have derived the corrected bio-optical algorithms for data of satellite scanners MODIS and MERIS. Comparison between satellite and in situ measured data on the water-leaving radiance from the expeditions of 2010 has demonstrated that the standard atmospheric correction of satellite data has resulted in great errors, and development of the advanced algorithm of atmospheric correction in that region is a problem of primary importance.

Results of satellite monitoring of oil spills pollution of the South-Eastern Baltic Sea in 2006-2011

Elena Bulycheva

Atlantic Branch of P.P. Shirshov Institute of Oceanology, RAS
Pr. Mira, 1, Kaliningrad, Russia, 236000
Email: e-lena.b@mail.ru

In frames of environmental monitoring of Kravtsovskoe (D-6) oilfield satellite monitoring of oil pollution is carried out. The area of monitoring includes Russian sector of Baltic Sea and adjacent areas of Polish and Lithuanian waters. For the purposes of satellite monitoring the data from three satellites is used: ENVISAT (ESA), RADARSAT-1 (CSA) и RADARSAT-2 (MDA). Since 2006 decoded radar images are received from Kongsberg Satellite Services (KSAT, Norway). During 2006-2011 there are 1184 image were received where 739 oil spills were detected including 369 oil spills in the area of interest. As an indicator of interannual and seasonal variability the area of detected oil spills and oil spill number were selected. There is a noticeable decrease in the number of oil spills and the total area of oil pollution in the Southeast part of the Baltic Sea is observed from year to year which is consistent with the data of the HELCOM for the whole Baltic Sea. Marked decrease in the number of detected oil spills in the cold and stormy period of the year obviously due to limitations of radar method of wind speed and with a more powerful roughness that disrupts oil films on the sea surface. Shape analysis of detected spills, their location along the main shipping routs and comparison with data from an automatic identification system AIS for location of ships in the Baltic Sea clearly indicates that the main sources of pollution of the sea surface are ships.

Klaipeda Seaport Key Sustainability Points

Vilma Burškytė, Olga Belous

Klaipeda university
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: vilmaburskyte@yahoo.com

The growing road transport costs and its environmental impact stimulate loads transportation and operation by marine facilities. A global comprehensive approach for port development is needed. The establishment of a balance between economical and ecological interests will be the most important issue for marine harbours. Therefore, the purpose of this work - to show the main points of a Sea Port development fitted within the framework of the sustainable development paradigm. The bases of the concept of sustainability for port development are presented, and the relationship within economic, environmental and social issues is analysed. Special attention is dedicated to application of different policy and management instruments that can be used to limit the negative impacts. This work provides a conceptual basis for incorporating environmental and social aspects into port activity, a general overview of “green” technologies promoted in the area of sensitive environment. Keywords: Port Activity, Sustainability, Innovative Technology.

Biological resources of subantarctic and antarctic pelagic zone of the World Ocean: knowledge, current state and exploitation prospects

Pavel Chernyshkov

Baltic Federal University, Geography of Ocean Department
Universinenskfya str. 2, Kaliningrad, 236040, Russia
Mail: pchernyshkov@kantiana.ru

At present the main part of biological resources in the World Ocean is exploited at the level of the Maximum Allowable Catch (FAO Fisheries and Aquaculture Department, "World fisheries and aquaculture production and utilization", Rome 2010). Underfished resources exist only in the sub-Antarctic and Antarctic zones of the World Ocean: 5.6 mln.t. of Antarctic krill in the Antarctic part of the Atlantic Ocean (according to the estimate by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and about 1.5 mln.t. of jack mackerel in the latitude zone 25-45°S in the Pacific Ocean (the South Pacific Regional Fisheries Management Organization – SPRFMO). These areas are open and have been investigated by scientists from the former USSR. In 1970s-1980s about 150 research expeditions were carried out in Antarctic and about 200 expeditions in the Southern Pacific Ocean. The level of knowledge of fishery hydrobiont populations functioning in relation to oceanological environment conditions in sub-Antarctic and Antarctic zones of the World Ocean was assessed on the basis of the published research results. The parameters of the current state and trends of inter-annual fluctuations of fishery bioresources biomass in conditions of observed climatic changes were estimated.

Origin, geological evolution and biology of Glacigenic reefs in the south-eastern Baltic sea

Aldona Damušytė[1], Jonas Šečkus[2], Jurgita Paškauskaitė[2], Albertas Bitinas[3], Darius Daunys[3]

[1]*Lithuanian Geological Survey, S. Konarskio str. 35, LT-03123, Vilnius, Lithuania*
[2]*Nature Research Centre, Institute of Geology and geography, T. Ševčenkos str. 13, LT-03223, Vilnius, Lithuania*
[3]*Coastal Research and Planning Institute, Klaipeda University, H. Manto str. 84, LT-92294, Klaipėda, Lithuania*

This study was aimed to investigate underwater moraine ridges known as one type of underwater reefs in the Lithuanian coastal waters of the Baltic Sea. Our research was focused on biology, geomorphology and geological properties of moraine ridges, which would enable description of origin and geological succession of these underwater structures. According to the results of acoustic seabed mapping, two distinct types of moraine ridges were distinguished: 1. up to 1.5 km long and 50-100 m width elongated ridges (elevation of 5-10 m) covered by large boulders and distributed parallel to the coastline (S-N direction) (further referred as Type I ridges); 2. up to 4.5 m high, 8-150 m long and 1-20 m wide elongated (length –width ratio of 3:1) hard till ridges (further referred as Type II ridges. Modelling results of paleorelief development showed that the study area was overflowed in Late Glacial during the Baltic Ice Lake stage. Later, during the Yoldia Sea regression it was a part of the coastal zone and later dry land. In the late Ancylus Lake-begining of Litorina Sea stages (8600-8000 BP) the area was overflowing again and became completly submerged 7300 BP. Various analysis demonstrated, the Type I moraine ridges most likely have been formed during the Middle Pleistocene (Medininkai (Saalian) Glaciation) and/or the Upper Pleistcene (Middle Nemunas Glaciation). Morphologicaly these ridges are very similar to De Geer moraines, which typically are formed at the glacial margins. This theory was supported by analysis of geomorphological features and measurements of the long axis orientation of pebbles and cobbles sampled from the ridge. The origin of type II moraine ridges is highly uncertain, however geomorphology and orientation support hypothesis on the dominant role of erosion in their evolution. It is likely, that the till loam of Medininkai Glaciation contained lenses and intersections of sandy type, which are less stable in respect to erosion effects in comparison to the base material (till loam). Effects of underwater currents and nearshore waves could be the major factors for erosion of unstable sandy intersections and leaving more stable till loam material in a form of 3-5 m high ridges. Both types of ridges were characterized by dominance of Baltic *Mytilus trossulus* community. Analysis of benthic community structure demonstrated relatively high differences between both types of ridges and surrounding level bottoms. On the other hand, type and position of the ridges in the study area had little effect on species composition and community structure. There was weak but consistently negative relationship between depth and overall macrofauna diversity, indicating average loss of 1 species/taxa per 4 m elevation. On the other hand, macrofauna diversity was obviously increasing with increased density of mussels up to values of 15 thous. ind m^{-2}. Different benthic species reacted individually to the degree of shelter and depth provided by 6-7 m high ridges, while the total biomass of benthic macrofauna was 2-3 times higher on top of the ridges in comparison to both slopes. This was largely determined by 2-4 times higher mean individual biomass of mussels on top of ridge (400±36 mg/mussel) in comparison to slopes (91 and 94 mg/mussel).

Preliminary results of the analysis of Dumping Sites in SE Baltic Region on example of Gdynia Dumping Site

G. Dembska[1], G. Sapota[1], M. Bogdaniuk[1], N. Blazauskas[3], S. Suzdalev[3], Ł. Zegarowski[1], B Hac[2], B. Aftanas[1]

[1]Maritime Institute in Gdansk, Department Environmental Protection
Dlugi Targ 41/42, 80-830 Gdańsk, Poland
Mail: grazyna.dembska@im.gda.pl

[2]Maritime Institute in Gdansk, Department of Oceanology
Dlugi Targ 41/42, 80-830 Gdańsk, Poland

[3] Klaipeda University Coastal Research & Planning Institute
H. Manto 84, Klaipeda LT 92294, Lithuania

Currently, there are more than 20 offshore dumping sites in South-Eastern Baltic Sea, which are used for depositing of dredged material from port areas and navigation channels. Development and maintenance of new ports will imply dredging of several million m3 of sediments in coming years, thus the need for new dumping sites should be also considered. Offshore dumping in the Baltic Sea is regulated by «Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Substances» (London Convention on dumping-LKD, 1972, amended in 1996) and the requirements of the Convention for the Protection of the Marine Environment of the Baltic Sea (HELCOM, 1992). However this Regulation lacks of detailed principles of dumping sites location and further management. In the framework of South Baltic Cross-border, Co-operation Program is realized project „Application of ecosystem principles for the location and management of offshore dumping sites in SE Baltic region" (ECODUMP), conducting by Klaipeda University Coastal Research and Planning Institute (Lithuania), Maritime Institute in Gdansk (Poland) and other associated organizations form ports and government administrations from Poland, Lithuanian and Russia. The project is planned to carry out geophysical surveys of sediments in areas of existing dumping sites. Made on the basis of their investigations sonar maps of dumping sites will identify the actual deposit of excavated material. The study of physic-chemical and ecotoxicological parameters of dumping sites will be conducted on a large scale. The processes occurring during depositing and storage of dredged material will be identify. Recognition of these processes will be used to try to create a model of spreading of contaminants from the sediment into the water column. Monitoring programme of existing dumping sites and based principles for the location of new dumping sites will be developed based on these studies and the dispersion model. Preliminary results of the analysis of Gdynia Dumping Site are presented in this paper.

Longtime variability of hydrometeorological fields in the eastern part of Gdansk basin

Vladimir Dubravin, Zh.I. Stont, E.V. Dorokhova

Atlantic Branch of P.P.Shirshov Institute of oceanology Russian Academy of sciences
Pr. Mira 1, 236000 Kaliningrad, Russia
Mail: v_dubravin@mail.ru

On the base of data of seasonal surveys (May 2003 – November 2011) carried out during complex ecological monitoring of offshore oilfield Kravtsovskoye (D6) and data of automatic hydrometeorological station MiniKrams-4 (January 2004 – December 2011) seated on the offshore ice-resistant fixed platform Lukoil-Kaliningradmorneft the seasonal and interannual variability of follow parameters on the east of Gdansk Basin were investigated: water salinity S and temperature Tw, air temperature Ta, dew-point temperature Td, atmospheric pressure on sea level Po and wind speed W. It was shown that seasonal trend of Tw, Ta, Td and W is characterized by annual harmonic, in seasonal trend of S half year harmonic becomes pronounced, and for Po half year harmonic becomes prevalent. Interannual variability of hydrometeoelements of the region has cyclical character. Quasi two years, 3- and 5-years periodicities were marked off, and it is proposed of 7-8-, 10-12-, 19-, 22-24-years and century cycles.

Pecularities of sedimentary thickness of the northern part of Lithuanian coastal zone- confirmed

Dmitrij Gerok, A. Bitinas, D. Michelevicius

Klaipeda University Coastal research and planning institute
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: dgerok@gmail.com

In 1997 an integrated geological mapping at a scale of 1:50 000 was carried out in the northern part of Lithuanian coastal zone. As a result, a number of deep paleo-incissions filled by sandy sediments were discovered in the Quaternary deposits and the upper part of Pre-Quaternary sedimentary thickness. The deepest paleo-incisions (until 140 meters below sea level) were discovered in the coastal zone between Palanga and Šventoji – they are cutting the sedimentary thickness up to the Upper Permian rocks. According to their morphological shape the paleo-incisions have some similarities to the river valleys, but alluvial sediments are absent in these valleys. The origin of these buried structures is still under discussions. There are a few opinions concerning the genesis of paleo-incisions, but two of them are prevailing during scientific discussions. A significant part of investigators maintains that these buried forms are the valleys of paleo-rivers; another group of researchers explains the origin of paleoincisions by meltwarter erosion during a catastrophic discharge of big mass of water with high hydrostatic pressure beneath the continental ice sheets during the glaciations.

In order to establish the genesis of paleo-incisions, first of all it is necessary to collect more reliable knowledge (information, facts) about the morphology and geological structure of these valleys. The present-day information about geological structure of paleo-incisions is generally based on the data of single boreholes and their interpolation. In the published maps of Pre-Quaternary relief the network of paleo-incisions very often are shown as a system (network) of paleo-rivers.

The question of geological structure and genesis of paleo-incisions is important not only from the scientific point of view, but also has a particular practical significance in the Lithuanian coastal area, especially in the zone between Palanga and Šventoji. The reliable data about geological structure are very important for long-term coastal management, drinking water supply in the health resort areas, for technical decisions in making reconstruction of the Šventoji harbor or analyzing the possibilities of construction a new deep-water harbor, and others.

Investigations of the coastal area based on a complex of geophysical methods, such as shallow seismic and electrical tomography, could be one of the ways to solve the above mentioned problem. These investigations will be carried out in the Šventoji-Palanga coastal region together with re-interpretation of old factual geological and geophysical data.

Daily surface activity of the sandhopper Talitrus saltator (Amphipoda: Talitridae) on a eastern Baltic Sea beach

Rita Jankauskiene, Z. Baranauskyte, K. Plauska

Klaipeda University
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: rita.jankauskiene@ku.lt

The aim of the present study was to estimate surface activity of Talitrus saltator (Montagu, 1808) on the Smiltyne Beach (eastern Baltic) and consider the factors determining their movements. In August and September 2010 the daily patterns of amphipod activity were analysed. Each month the captures were made at 90 min intervals for 24h. The microclimatic conditions (atmosphere air and ground temperatures, wind speed) were recorded during the experimental period. Differences between juveniles and adults (males, females) appeared for density and biomass were determined. However, both adults and juveniles were active predominantly during the night (02:00 – 05:00hrs) and immediately after sunset (about 21:00 – 23:00hrs). Both juvenile and adult individuals had two peaks in the density and biomass during the night time. These population parameters are rapidly decreasing after sunrise. In August first peak of density juvenile individuals was observed at the shore line in 21:30hrs, second peak – occurs in 03:30hrs. The first peak of adults individuals was observed later – in 23:00hrs, but second peak coincided with juvenile individuals. In September density both juvenile and adult individuals appears depressed. This activity rhythms were correlated with wind speed and drifting sand. However, the activity rhythms were not correlated with the atmosphere air and ground temperatures.

Upwelling by the Lithuanian coast: numerical prediction using GIS methods

Viaceslav Jurkin[1], Loreta Kelpšaitė[2]

[1]*Klaipeda University Coastal Research and Planning Institute*
[2]*Klaipeda University Geophysical department*
Herkaus Manto 84, Klaipeda, Lithuania
Mail: viaceslav@corpi.ku.lt

Upwelling is vertical motion of water, which involves deep cold nutrient-rich water rising to the surface. It affects changes in atmospheric phenomena (cause fog, low stratus clouds, little rain) and involves eutrophication (when high nutrient concentrations stimulate blooms of algae). Usually for upwelling predictions are used numerical modeling, satellite data, mixture of neural networks and etc. Main purpose of this study was to create upwelling prediction model, integrate it into Geographical Information System (GIS), and adapt it for prediction of upwellings at Lithuanian coast in Baltic Sea. Analyzing historical data of the strongest upwelling at the Lithuanian coast durng 1993-2010 years were noticed that north and north-easterly winds occurred most of upwelling, and at Klaipeda south-east winds can generate upwellings too. The biggest upwellings at the Lithuanian coast were caused by long prevailing northern, north-eastern, eastern and south-eastern winds. Due to limitations of existing hydrological data created GIS model can only predict upwelling's appearance but can't the values of temperature change and upwelling horizontal scales offshore. Increasing number of monitoring stations and buoys installation in the Lithuanian territorial waters would give important hydrological information, which could significantly improve the predictive GIS model.

The Effect of Persistent Pollutants on Aquatic Ecosystem: A Complex Study

N. Kazlauskienė, G. Svecevičius, D. Marčiulionienė, D. Montvydienė, V. Kesminas, R. Staponkus, E. Taujanskis, A. Slučkaitė

Nature Research Centre,
Akademijos 2
LT- 08412 Vilnius, Lithuania
Mail: kazlauskiene.nijole@gmail.com

Wastewaters entering receiving water bodies become one of the main factors of pollution of natural waters; since they change the water and bottom sediment chemical composition, destroy the biological balance of the self-cleaning processes and finally can cause unpredictable changes in the ecosystem. Wastewater persistent pollutants (heavy metals) are the most dangerous as they migrate and accumulate in organisms in ecosystems. Heavily, and permanently polluted aquatic ecosystems are still found in Lithuania, which is the target of a complex ecotoxicological (experimental-field and hydrochemical) investigation. Water pollution assessment by use only physico-chemical methods do not provide integrated information on the effects of pollutants on aquatic life because toxicity is a biological characteristic. Investigations should be carried out under controlled laboratory conditions on testobjects of different trophic level, phylogenesis and ontogenesis (higher plants, leeches, daphnids, and fish), taking into account the test-set of functions. The peculiarities of test-objects and their test-functions to the effect of wastewater, natural water and bottom sediment persistent pollutants as well as their distribution in natural waters and bottom sediments should be investigated. The sensitivity and specificity analysis of the test-objects and their test-functions should be performed revealing functional alteration mechanisms and organism adaptation capabilities, which ensure the survival of individuals and populations. Complex experimentalfield and hydrochemical studies will enable to extrapolate obtained experimental results to natural environment and predict possible consequences of the pollutant effect on organism-population community set. Bioindication studies of ichthyofauna populations and communities should be performed as well as permanent pollutant (heavy metals, priority) bioaccumulation in fish as the highest of organisms of the trophic chain should be established. The use of European and Lithuanian fish index (LFI) will enable to assess the ecological status of the water body studied. Complex evaluation of biotesting, bioindication and hydrochemical study results of the permanently polluted water ecosystem could allow the extrapolation of experimental data into natural environments and to predict persistent pollutant potential impact of on the individuals, their populations and communities.

Calculation of equilibrium beach profile

Anton Khomchanovsky, Elena Fedorova, K. Marusin, A. Khabidov

Institute for water and environmental problems of Siberian Branch of RAS
Molodezhnaya St. 1, 656038, Barnaul, Russia
Mail: fedorova@iwep.asu.ru

The paper presents results of evaluation of several methods commonly used in coastal engineering practice for equilibrium beach profile calculation. Three approaches were used to calculate the shape of equilibrium beach profile: Bruun-Dean formula, the method prescribed by Coastal Structure Construction Code, numerical modeling by SBEACH. The calculation results were compared with the natural profile in equilibrium. It is shown that Bruun-Dean formula gives the best agreement with the data.

High resolution satellite SAR winds of the SE Baltic Sea

Igor Kozlov[1, 2], Inga Dailidienė[2]

[1]*Satellite Oceanography Laboratory, Russian State Hydrometeorological University*
195196, Russia, Saint-Petersburg, Malookhtinsky pr., 98
Mail: igor.eko@gmail.com

[2]*Klaipėda University,*
LT-92291, Lithuania, Klaipėda, H. Manto g. 84

In this work we analyse the applicability of satellite SAR data for high-resolution 10-m level wind field mapping in the SE Baltic Sea. The satellite-based SAR wind speed estimates are compared with wind records from buoy near the Lithuanian Baltic Sea coast. The study utilizes Envisat ASAR wind maps calculated with CMOD-IFR2 algorithm with ~1 km resolution for the period May-November 2010.
It is shown that high resolution wind fields based on SAR data are in good agreement with buoy measurements. Moreover, SAR data uniquely describe specific regional features of mesoscale wind fields in the coastal zone which is impossible neither with in-situ/ buoy measurements, nor with commonly used NWP models (such as NCEP, ECMWF, etc.). Obtained results can further be used for planning offshore wind farming in the study area.

The method of coastal recreational potential estimation (for the eastern part of the Gulf of Finland)

M.S. Lazareva

Russian State Hydrometeorological University
195196 Malookhtinsky prospect 98
Saint-Petersburg, Russia
E-mail: lazareva@rshu.ru

The most important quality criterion of beaches estimation is presence of the Blue Flag (BF). There are 60 countries including Russia, which participate in program BF. There are quite a number of methods estimate the parameters of the beach, one of which is a program of BF. However, it's difficult to apply the program on the Russian beaches because of incompatibility of systems caused by the lack of Russian legislative base and others reasons. As a result the technique of the estimation and development of recreational potential of the coastal zone based on following independent parameters has been applied in the work: geological and climatic processes, socially-demographic position in region (public opinion on the basis of questioning); a policy of development of region are named 'correcting factors' (CF). Maximum load-carrying capacity of the beach which defines effective utilization of recreational potential has been calculated with the use of knowledge of the beach's parameters and CF.

Marine climate transformation to the continental climate in the region of Lithuanian Baltic sea coastal

Giedrė Miltinytė, Inga Dailidienė

Klaipeda University
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: gmiltinyte@yahoo.co.uk

Nowadays new meteorological information is extremely important during the process of global climate changes. The more information we have about the climate, the more effective and accurate various economic development problem solving will be. The research object is about 100 km wide zone, stretching from the Baltic Sea coast to the continental climate. Two aspects are studied: the impact of marine climate to the continent and transformation to the continental climate. Transfer of western air mass, which dominates in the region of marine climate, formates more frequent rainfall and fluctuation of daily temperature. Moving from the West to the East, the features of marine climate weaken, therefore temperature amplitude is lower in the marine coast (Klaipėda 11.7° C) than in Zemaiciu highland (Telšiai 12.8° C). Natural seasons are different from the astronomical calendar, since they are determined by the average of daily air temperature during the bridging clause 0° C and 15° C for dates. At sea coast air temperature from negative to positive moves earlier than Zemaiciu highland, which is dominated by the longer and warmer spring, longer summer, when average daily air temperature rises higher than15 ° C. However, air temperatures over 0° C moving to the lower earlier at Telsiu and Laukuva meteorologic stations and longer dominated winter there, than at the sea coast. Differences in landform, slope exposition influences spring and autumn frosts, and cold along the length of the period. Baltic Sea coastal subareas tempered winter Cold and summer heat. Also delay coming of spring,but increases the autumn season. Of course the Baltic Sea coast impact is felt at sea coast subareas, but due to advection it is felt at Zemaiciu highland areas. It should be noted that the relief forms variety, paklotinio surface different of unequal conditions for warm-up area during the warm season and the cooling of the cold. Different surface temperatures and the development of convection.

Mapping SST changes in SE Baltic Sea with MODIS data

Toma Mingėlaitė, I. Dailidiene, I. Kozlov

Klaipeda University
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: toma.mingelaite@gmail.com

The surface temperature of the south-eastern Baltic Sea and Curonian Lagoon is examined for the period 2000-2010 using near 1 km resolution Aqua/Terra MODIS night-time (4 μ) imagery. The study shows the utility of satellite IR data for the analysis of spatial, diurnal, seasonal and interannual variations of sea surface temperature (SST) in the SE Baltic Sea and Curonian Lagoon. The satellite-borne SST maps are compared with in situ data from the Lithuanian monitoring coastal stations and general climatic tendencies are assessed and discussed.

Impact of winds on the wintertime shipping in the Gulf of Finland

Ove Pärn

Tallinn University of Technology, Marine Systems Institute
Akadeemia tee 15a, 12618 Tallinn, Estonia
E-mail: ove.parn@msi.ttu.ee

In the year 2003 there were 50 ice-related ship hull damages. In the winter 2009/2010 there were about 250 occasions the ship was stuck in ice. The total standstill time of all ships stuck was 67 days. But in many cases according to the model results the ice internal stress isn`t very high. The paper aim is to study what proportion of the total impact is the effect of wind on the ship stuck in ice. More, how wind influences the ship. The ship has an impact on the ice and the ice in turn affects the ship. There are two case study analyzes in this work.

Distribution of trace elements and radionuclides in the Curonian Lagoon and the Baltic Sea

N. Remeikaitė-Nikienė[1,2*], G. Lujanienė [1], G. Garnaga [2], K. Jokšas[3,5], A. Garbaras[1], R. Skipitytė[1], R. Barisevičiūtė[1], B. Šilobritienė[4], A. Stankevičius[2]

[1] *SRI Center for Physical Sciences and Technology, Vilnius, Lithuania*
[2] *EPA, Marine Research Department, Klaipėda, Lithuania*
[3] *SRI Nature Research Centre, Vilnius, Lithuania*
[4] *EPA, Environment Research Department, Vilnius, Lithuania*
[5] *Vilnius University, Vilnius, Lithuania*
Mail: n.remeikaite@aaa.am.lt

This study presents the distribution of trace elements (Hg, Cd, Pb, Cr, As, Cu, Ni, Zn, Co, V, Al, Li), organic carbon, $\delta^{13}C_{org}$ and radionuclides (^{90}Sr, ^{137}Cs, $^{239,240}Pu$, ^{241}Am) in the Lithuanian part of the Baltic Sea and the Curonian Lagoon. Particulate matter (PM) and bottom sediment samples were collected during the sampling campaigns in the frame of the State monitoring and during several other investigations over the period of 1997-2011.
The study area is characterized by variable loading with particulate matter. Averaged concentrations of the particulate matter in the water of the Curonian Lagoon area tended to be approximately 3 times higher in comparison with those measured in the Baltic Sea. Results showed a strong relation between metals and organic carbon in particulate matter ($r=0.69-0.98$, $p<0.05$). The correlation between metals and organic carbon in sediments was not so strong and varied in the range of 0.45-0.84. It was found out that the highest concentrations of trace elements in the Baltic Sea accumulated in the deepest stations of R7, 12A, 46 with the fine-grained, organic-rich sediments. Pollution was strongly pronounced in the Curonian Lagoon (including Klaipeda Strait area), elevated concentrations of metals were also measured in sediments of the plume of the Lagoon water into the Baltic Sea area and in the aleurite sediments in the Baltic Sea. Higher level of elements accumulated in the surface sediments (0-3 cm), the difference between core layers was more evident at the deepest stations. According to the results, higher concentrations of radionuclides accumulate in PM and sediments as compared to marine water. The correlation of ^{137}Cs, $^{239,240}Pu$ and ^{241}Am with total organic carbon in bottom sediments was found to be 0.75-0.98. $\delta^{13}C_{org}$ in suspended particles, surface bottom sediments and humic substances of the Curonian Lagoon and the Baltic Sea ranged from -22.3 ‰ to -31.8 ‰. $\delta^{13}C_{org}$ values in the bottom sediment samples well correlated with $\delta^{13}C_{org}$ values in PM and humic acid samples.
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Application of bivalve mollusk physiological response in bioindication of water quality

Andrey Sharov, Sergey Kholodkevich, Anton Kurakin

Saint-Petersburg Scientific Research Center for Ecological Safety Russian Academy of Sciences
Korpusnaya 18, 197110, St. Petersburg, Russia
Mail: sharov_an@mail.ru

The physiological status of aquatic animals is an important tool for assessment of water quality and ecosystem health. Original fiber-optic noninvasive method for registration and analysis of cardiac activity in macroinvertebrates with shells was elaborated in 1990s (Kholodkevich et al., 1999). This method is based on infrared light remote registration of the heart muscle volume change. Aim of this study is developing of this methodological approach for bivalve mollusks. We estimate heart rate in the some species of bivalves (*Macoма balthica, Unio tumidus, U. pictorum, Anodonta anatina, Dreissena polymorpha*) collected from the eastern part of Gulf of Finland and Gulf of Riga Baltic Sea. For the first time, we found that recovery time of the heart rate in mollusks after functional loading (increase of water salinity) to the reference heart rate is new biomarker of their physiological status. We found significant difference in the heart rate of mollusks contaminated and reference sites. The recovery time of mollusks was 20-30 min in reference sites and reached 90 min in contaminated sites. We conclude that the cardiac activity in mollusks is good physiological biomarker for assessment of health, management and conservation of water ecosystems in the Baltic Sea region.

Qualitative Assessment of Beach Vulnerability to Overcrowding

Oxana Sytnik

University of Cadiz, Facultad de Ciencias del Mary Ambientales
Campus Puerto Real, Cadiz, Spain
Mail: ox.sytnik@gmail.com

Climate-related hazards in coastal zones have always represented a challenge for coastal planners and managers. However, the assessments of other man-induced hazards, such as overcrowding, pose a significant increment in this challenge due to the scarcity of data available. This combined with a growing intensity of beach tourism -and its associated impacts- around the world, highlights the necessity of understanding exactly the environmental consequences of exceeding the beach carrying capacity. This research is part of a PhD thesis and has the aim to develop an adaptive tool to assess the sensitivity of a beach considering risks and vulnerability caused by the changes in beach users spatial and temporal distribution. The research is objected to develop an adaptive tool for risk and vulnerability assessment considering the sensitivity of beaches to the spatial and temporal distribution of its users. This tool is conceived to combine two techniques used independently in the field of impact assessment: interaction matrix and GIS map overlay. Both techniques are highly visual and easy to interpret, which will facilitate the decision making process for the planners. The interaction matrix investigates different indicators of physical-ecological and human-oriented factors that contribute to the degradation of the beach quality caused by overcrowding. This matrix identifies and quantifies the interactions between involved variables of the system and the interaction within the beach system as a whole. These quantifications then will be applied to spatial datasets within GIS. The main application of this tool is expected to be in preliminary risk assessments of such specific beach hazard as overcrowding along with development of coastal vulnerability indexes that would assist in defining vulnerable zones. Other potential applications could include the use of the tool in a predictive mode in order envisage “hot spots” and to perform ‘what-if’ scenarios.

How invasive aliens species are changing Ecological Quality Status of aquatic ecosystems?

Greta Srėbalienė, S. Olenin, D. Minchin, D. Daunys, A. Zaiko

Klaipėda University, Coastal Research and Planning Institute
H. Manto 84, LT 92294, Lithuania
Mail: greta.laureckaite@corpi.ku.lt

The main protection device of European water resources is Water Framework Directive. Analysis of the literature established observational and experimental proofs of 23 invasive species impacts on their environmental. However, invasive alien species (IAS) are not mentioned specifically in the WFD. Although, in the context of the directive's objectives IAS represent an important pressure since they can modify the native biological structure and ecological functioning of aquatic systems. In this paper we present simply scoring system that allows evaluate whether alien species have the capacity to modify WFD quality elements. We explore all indicators of the WFD ecological quality elements and the possible ways of how they can be modified by IAS in four surface water categories: rivers, lakes, transitional and coastal waters. The literature analysis shows that biological, physico-chemical, hydromorphological parameters may be, negative or positive, modified by invasive species.

Virtual atmospheric transfer Northern Atlantic Ocean and South-eastern Baltic Sea above by teisserene de bort terms

Zhanna Stont[1], R.Abramov[1], O. Goushchin[2]

[1]*Atlantic Branch of P.P.Shirshov Institute of oceanology, RAS*
Mail: stont@atlas.baltnet.ru

[2] *I. Kant Baltic Federal university*

Any flow induces/attends with vortices of opposite signs. North Atlantic items of Teisseren de Bort "centres d'action" (CDA) are Azore high (AzH) and Iceland low (IceL) of pressure P_H, P_L. CDA are real objects. Physical and statistic description of these objects include of the next symbols and simple operations.

I. P_H, P_L, φ_H, φ_L, λ_H, λ_L - pressure in the centre and its coordinates from Bracknell weather actual charts on 00 UTC every day (www.wetterzentrale.de). Monthly means are designated as line above: $\overline{P} = 1/n\Sigma P_i$ and so on. $\overline{\overline{\varphi}} = (\varphi_H + \varphi_L)/2$; $\overline{\overline{\lambda}} = (\lambda_H+\lambda_L)/2$. That's are parameters of position, "definitions".

II. $\Delta P = P_H - P_L$, $\Delta\varphi = \varphi_H - \varphi_L$; $\Delta\lambda_q = (\lambda_H - \lambda_L)\mathrm{Cos}\,\overline{\overline{\varphi}}$; $\Delta S = (\Delta\varphi^2 + \Delta\lambda_q^2)^{1/2}$ are the parameters of connection, "differences".

III. $K = \Delta P/\Delta S$ and $\beta^\circ = \mathrm{atg}\,\Delta\lambda_q / \Delta\varphi \pm 90^\circ$ ($\Delta\varphi \le 0$; $\Delta\varphi \ge 0$) are the parameters of interaction; "relations"

Formulae I-III are suitable as for CDA so for local defining centres of high and low pressure on interval 10^{-4} - 10^4 of days, as we have supposed.

With coordinates and pressure means and dispersions at last years 2007-2011 westerlies is confirmed and valued as steady. Pressure in the centre of the Iceland Low is variablest in opposite of Azore High. Transfere to Europa is resulted on direction 103 - 109°, and one over SE Baltic is on direction 75 - 42°.

The result is received, as authors have supposed, is interesting for discussion of circulation factors of climate.

Virus-Bacteria Interactions under warming and cooling impacts

Sulcius[1], S., Paskauskas, R.[1,2]

[1]*Coastal Research and Planning Institute, Klaipeda University, Klaipeda, Lithuania*
Mail: sigas@corpi.ku.lt

[2]*Institute of Botany, Nature Research Centre, Vilnius, Lithuania*

The mesocosm experiment on summer bacterioplankton was carried out in 2010 to evaluate the impact of temperature on virus-induced bacterial mortality. Triplicated indoor enclosures (1.4 m3) filled with seawater collected from Kiel (Germany) Fjord (Baltic Sea) were incubated at three temperature regimes (*in situ* and *in situ* ±4°C) followed natural conditions for 19 days. The dilution approach (Wilhelm et al., 2002) as modified for tangential flow filtration (Winget et al., 2005) together with epifluorescence microscopy (Noble and Fuhrman, 1998) has been applied for virus production measurements. The whole cell approach and electron microscopy was used to assess the frequency of visibly infected cells and burst size (BS) (Weinbauer and Peduzzi, 1994). Frequency of infected cells (FIC) and prokaryotes mortality was calculated using conversion factors (Weinbauer et al., 2002) and, in addition, data provided by both methods were compared. The total number of viruses and bacteria, virus to bacteria ratio, burst size, virus production, bacterial mortality rate, virus contact rate and success as well as virus turnover time was used in the model in order to observe simultaneous response of selected variables to different temperature regimes. Non-parametric, permutation test- based, multivariate analysis of variance (Anderson, 2001; 2005) was applied for the analysis and interpretation of the experimental data. The various patterns of different variables will be presented as a function of temperature mediated processes as well as threshold for ecologically significant virus production and bacterial mortality in terms of predator-prey interactions will be proposed.

Distribution patterns of organotin compounds contaminated bottom sediments in Klaipeda harbour area

Sergej Suzdalev, Saulius Gulbinskas

Klaipeda University Coastal Research and Planning Institute
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: suzdalev@corpi.ku.lt

In 2007 approved HELCOM Baltic Sea Action Plan contamination of Baltic sea with hazardous substances was mentioned among the most important ecological problems of the Baltic Sea Region. During the recent years in the South-eastern Baltic sea region problem of toxic tributyltin (TBT) contamination is standing high on the agenda. Although the use of antifouling paints containing TBT has been banned since 2003, the occurrence of tributyltin (TBT) is widespread in the Baltic marine environment. Highest values are observed in harbours and nearby shipyards sediments. Most of the investigations dealing with the analysis of TBT concentrations in Baltic sea region addressing biota, however detailed information on TBT compounds in separate water basins and their sediments is missing. Episodic investigations of TBT compounds in Lithuanian waters were carried during 2005-2008 in the open sea and Klaipeda harbour area. Regular monitoring of TBT in harbour area is carried in accordance to National monitoring programme, however the amount of data is not enough for the precise evaluation of contamination extent and tendencies. Current paper presents the results of newest investigations of TBT contaminated sediments in different parts of Klaipeda harbour area.

On the vertical distribution of the kinetic energy of the low-frequency currents in the Gulf of Finland

Lembit Talpsepp, M.-J.Lilover

Tallinn University of Technology, Institute of Marine Systems
Akadeemia Rd.15A, Tallinn, Estonia 12618
Mail: talpsepp@sea.ee

A bottom-mounted ADCP was deployed near the southern coast of the Gulf of Finland at the position 59N 27.400 24E 09.96 about 6 km offshore in the region of the coastal slope for the period from March 13 and 30 June 2009. For studying the vertical distribution of kinetic energy, the currents data at 20 different levels in the Gulf of Finland were analyzed. Between 13.March and 12.April the variability in the low-frequency range dominated, it was found that low-frequency oscillations were stronger below picnocline, having local maximum near the bottom. The energy spectra of the velocity components were computed using Welch overlapping method. The main peak in all spectra was at 5 – 5.5 days. The other peaks were 27 hours and the inertial period at 13 hours 50 minutes. The total kinetic energy of the low-frequency oscillations dominated in the layer below the picnocline but not clearly increased near bottom. The maximum energy was found at 23 m level. Kinetic energy in the surface layer was much lower - there was no remarkable peak in the spectrum in the low-frequency range. One possible mechanism for the generation of intensive low-frequency 5 to 5.5-day current oscillations may be topographic waves during that period. The model by Huthnance for stratified sea with variable depth was used to compare the vertical energy distributions of measured results and that by model. The model parameters were rather sensitive to the bottom slope and stratification, therefore, by choosing appropriate bottom topography parameters in the region with maximum slope we can achieve good coincidence with measured and modeled periods in the range of expected wavelenghts of 15-20 km. The variable wind up to 15 m/s mainly from west was expected to be the main source of forcing energy to these oscillations. The time-interval of oscillations was limited to 35 days after that variability ceased simultaneously with the weakening of the wind.

Mapping of sub-surface maxima of phytoplankton biomass by a towed undulating vehicle

Andres Trei, I. Lips, U. Lips

Tallinn University of Technology, Marine Systems Institution
Akadeemia tee 15a, 12618, Estonia
Mail: andres.trei@msi.ttu.ee

Sub-surface maxima of phytoplankton biomass are common in the stratified Gulf of Finland in summer. It has been shown that the most intense maxima occur in connection with the mesoscale features/ processes (eddies and fronts). Often the maxima coincide with sub-mesoscale intrusions in the areas of enhanced horizontal gradients of temperature and salinity. Until recent years, only data of a few special surveys focusing on sub-surface maxima were available. In 2010 we performed several surveys of temperature, salinity, chlorophyll a and phycocyanin fluorescence in the central part of the Gulf of Finland in various meteorological and oceanographic forcing conditions using a towed undulating vehicle. We present these observational data and analyze the links between mesoscale hydrophysical processes and the occurrence of sub-surface maxima of phytoplankton biomass (estimated on the basis of fluorescence data). Statistical characteristics of sub-surface maxima (intensities, vertical and horizontal dimensions of sub-surface maxima layers etc.) were revealed on the basis of more than 850 acquired vertical profiles.

Estimation of Harbour Reconstruction Influence to the Short-term Sea Level Fluctuation in Klaipėda Strait

Edvardas Valaitis[1], Saulius Gulbinskas[2], Inga Dailidienė[1]

[1]*Klaipeda University*
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: edvardasvalaitis@gmail.com

[2]*Coastal research and planning institute*
H.Manto 84, LT-92294, Klaipeda, Lithuania

The main objective of the study is the evaluation of Klaipeda port reconstruction impact on short-term water level fluctuations. Lithuania's main seaport is dislocated in Klaipeda straight, connecting Curonian Lagoon and the Baltic Sea. Klaipeda straight water area is the most technogenic affected throughout the Lithuania coast area. Economic activities change the hydrodynamics and flow structure in the port area. Harbour dredging, the reconstruction of jetties and security piers leads to straight capacity increase while construction of embankments – to decrease. While reconstructing the port, the entrance moles in the sea were prolonged and the barrier, which prevents the port from direct NW waves, was built. The most intensive water level fluctuations in Klaipeda port is caused by meteorological conditions: air pressure change, atmospheric dynamics, wind. Water level fluctuations are also affected by waves, which going through the sea port gates causes resonance waves and short-term water level fluctuations. The study aims short-term water level fluctuations that affect handling operations and difficult navigation conditions in the port. The weather conditions, which results in different short-term amplitude of water level changes were set out. Also the impact of reconstructed port entrance piers on short-term water level fluctuations was determined

Unexpected experiment of sediment transport on the Baltic Sea nearshore area of Lithuania

Erikas Visakavičius, Martynas Bučas, Aidas Figoras

Klaipeda University Coastal Research and planning institute
H.Manto 84, LT-92294, Klaipeda, Lithuania
Mail: erikas@corpi.ku.lt

Sea bottom along the continental part of Lithuania is covered with relict sediments of the last glacial, which consist of till (boulders with pebbles rinsed out of the till) and modern sand sediments. Because of the sediment deficiency near the biggest Lithuanian seaside resort Palanga, coastal abrasion has significantly increased, therefore the beach is being replenished with sand taken from the field located further in the sea. During the works of beach nourishment in spring of 2011 an accidental leak of sand occurred through the pipe of dredger causing formation of a sediment shoal up to 2 m deep within the depths of 9-10 m. Two weeks after the accident echosounding and SCUBA diving surveys were performed in order approximately assess how much material had been spilt and how big the impacted area by sand. It was estimated that the sediments covered till (boulders and pebbles) within 9.000 m2 area and the total volume of the sediments was 20.000 m3. One month later after the measurements the dredger spread the sand, however its impact was not assessed. One more acoustic survey of the sea bottom was performed by the end of January in 2012. The precise measurements showed that the sandy shoal flattened to 8 m plain, which covered 42.000 m2 area. Most of the sediments migrated 80 m towards North, 60 m towards East and 50 m towards South since the first assessment of sandy shoal. The western side of shoal had not significantly changed. The spilled sand covered the till bottom overgrown by the red alga (Furcellaria lumbricalis), which are important habitat forming species, natural spawning grounds for commercial fishes and feeding grounds for birds. The destroyed area of habitat was about 17% compared to the intact area of habitat, therefore the effect of spilled sand is relatively small. Sand was spilled on the till with 20-40% red alga cover, whereas the habitats with densest cover of species were located to the north and south of impacted area of habitat. The results of this study show the patterns of sediment transport in the deep coastal areas, where are very few observations, thus we recommend to continue monitoring of sediment spread, particularly assessing its impact on the valuable bottom communities and their recovery.

Using the Indicator Approach for the Sustainable Development of the National Park "Curonian Spit" on the Baltic Coast

M.V. Yamkovaya, N. L. Plink

Russian State Hydrometeorological University, Department of Integrated Coastal Zone Management
195196 Maloohtinskii prospect, 98
Saint Petersburg, Russia
Mail: mane4ka-86@mail.ru

The Curonian Spit National Park, located on the Baltic coast, is a unique natural and cultural-historical object, which is based on a sandy spit of the length 98 km and the width of 0.35 to 3.8 km, that separates the Baltic Sea from the Curonian Bay. The Curonian Spit is included into the Heritage List of UNESCO. The uniqueness of the natural landscape is attractive for recreation development and coastal tourism. As a result, natural systems are subject for the Curonian Spit, convergent to a high anthropogenic stress, and therefore requires an appropriate level of management and conservation of the national park.

In making recommendations for sustainable environmental development of the reserve was used indicator treatment. The indicator system has been adapted to local conditions of the national park. The obtained estimates allow us objectively assess in the situation in the environmental field, economic and commercial development of this coastal territory. The obtained indicator estimates to identify of the main challenges to sustainable development of the Curonian Spit, among which are:

- Eroding, bank erosion and the Curonian Spit, both from the Baltic Sea, and from the Curonian bay
- Low-quality tourism infrastructure, etc.

The Recommendations were developed on these based estimates for the municipal administration "Curonian Spit" to improve the integrated management for the conservation and sustainable development of its natural landscape and to prevent the contamination and the pollution of coastal waters the Baltic Sea and the Curonian Bay on the base of these evaluations.

Interannual, decadal and long-term variations in the wave fields

Inga Zaitseva-Pärnaste, Tarmo Soomere

Institute of Cybernetics at TUT, Laboratory of Wave Engineering
Mail: inga.zaitseva@gmail.com

The study focuses on spatio-temporal variations in wave parameters derived from historical visual wave observations performed since the mid-1900s at the eastern coast of the Baltic Sea, covering the coastal section from Lithuania up to the eastern part of the Gulf of Finland. We present for the first time the analysis of digitised data from Ventspils located at the north-western coast of Latvia (57°23'44" N, 21°32'04" E) for the years 1954–2010. The height of the observation site is 11 m from mean sea level and the site is widely open in the westerly direction, thus providing a good representation of the predominant wave fields. The results are compared against numerically reconstructed wave properties in the region for the years 1970–2007 based on adjusted geostrophic winds and the third generation wave model WAM Cycle 4 (Soomere and Räämet, 2011). The comparison confirms that changes in wave heights in different parts of the Baltic are not coherent. For example, a substantial increase in the wave heights in the northern Baltic Proper in the 1990s is accompanied with a decrease in the south-eastern Baltic. There is no statistically significant trend in the annual mean wave height at any of the observation sites. The formal linear trends are strongly masked by extensive interannual and decadal variability. Among the numerically simulated wave data, the strongest increasing trend in 1970–2007 is present in at Ventspils. This feature only partially matches the observed wave properties. The analysis suggests that wave properties have substantially at different subbasins of the Baltic Sea over the last decades but no well-defined trend exists for the entire Baltic Sea wave fields. T. Soomere, A. Räämet. Spatial patterns of the wave climate in the Baltic Proper and the Gulf of Finland, Oceanologia, vol 53, pp. 335-371, 2011.

Changes in Curonian lagoon water balance under climate change conditions

Jūratė Kriaučiūnienė, Darius Jakimavičius

Lithuanian Energy Institute, Laboratory of Hydrology
Breslaujos 3, LT-44403 Kaunas, Lithuania
Mail: hydro@mail.lei.lt

Changing hydrologic regime of Curonian Lagoon due to the natural and anthropogenic factors have a major impact on the lagoon ecosystem and state of the coasts as well as processes of bottom erosion and sediments accumulation in Klaipeda strait. Global changes in climatic processes have an impact on the hydrosphere, including the rivers, which inflows into the Curonian Lagoon and changes the hydrological regime of the whole water area. The aim of this work: to evaluate changes of Curonian lagoon water balance and determine its possible variations in XXI century using the database of hydrometeorological observations, climate change models and hydrologic modeling tools. The main elements of Curonian lagoon water balance are as follows:
- river inflow into the lagoon
- precipitation on the lagoon surface
- evaporation from the lagoon
- water inflow from the Baltic sea
- water outflow from the lagoon into the sea
- changes of Curonian lagoon capacity

Possible changes of mentioned water balance elements in XXI century were evaluated according to the A2, A1B and B1 greenhouse gases emission scenarios and data outputs from ECHAM5 and HadCM3 global climate change models. River inflow into the lagoon was calculated with the help of HBV hydrologic model. Comparing the foreseen changes in water balance for the 2011-2100 m. period and background values (1961-1990 year period) it was determined that river inflow to the lagoon will decrease up to 26,5 %; due to the increasing air temperature evaporation will increase up to 25,1 %; precipitation rate will slightly increase (up to 3,8 %), water outflow from the lagoon into the sea will decrease to 16,6%; water inflow from the Baltic sea will increase to 39,7 %.

Geochemical variations of Klaipeda FEZ environment

Ričardas Taraškevičius

Nature research centre
Mail: taraskevicius@geo.lt

The geochemical variations of Klaipeda free economic zone (FEZ) environment were determined on the basis of collected samples of bottom sediments and soil and their further analysis of chemical composition. Following potentially toxic elements were analysed in collected samples: As, Ba, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sn, V, Zn, oil products (fraction C10-C40) and the amount of makroelements. Evaluation of the results was completed in accordance with Lithuanian hygiene norm HN 60:2004 requirements by normalising with conservative makroelements. Chemical substances, which are dangerous to biota were grouped according to decreasing values of concentrations coefficient.