Volume 5 Spring 2014

NEWS FROM BOOS

NEW

IN THIS ISSUE

UPCOMING EVENTS

7-9 May 2014
BOOS and HIROMB Annual Meetings
Riga, Latvia

21-23 May 2014
EuroGOOS AISBL annual General Meeting 2014, Brussels, Belgium

27-29 May 2014
IEEE/OES Baltic Symposium „Measuring and Modelling of Multi-Scale Interactions in the Marine Environment“, Tallinn, Estonia

8-9 September 2014
6th Ferrybox Workshop
Tallinn, Estonia

28-30 October 2014
EuroGOOS Conference “Operational Oceanography for Sustainable Blue Growth”, Lisbon, Portugal

NEWS FROM BOOS

is a publication of the Baltic Operational Oceanographic System. It is used to foster the co-operation between the BOOS members and to make the services and the information of operational oceanography in the Baltic visible for the public.

FOCUS ON PROJECTS RELATED TO OPERATIONAL OCEANOGRAPHY

EDITORIAL

Dear reader,

The summer is rapidly approaching, where new research ideas can be tested at sea that have been planned in project applications. This time the News from BOOS focuses on the various projects carried out or just started in the area.

In addition to articles introducing the EMODnet Physics, BalticWay project results, there is a lot more interesting to read: about MarineExplore, the company developing planetary data software, the vertical sea level reference system, the new 6-year research project in MSI and more.

Please also pay attention to information about the upcoming events – conferences including operational oceanography topics and courses for graduate and PhD students.

Urmas Lips
BOOS chair

Baltic Operational Oceanographic System

BOOS

Baltic Operational Oceanographic System

describes the actual, anticipates the future, and classifies the state of the Baltic Sea!

6TH FERRYBOX WORKSHOP

8-9 September 2014, Marine Systems Institute at Tallinn University of Technology

Ferrybox systems are constantly developed and more instruments are integrated to the flow-through system which are installed to more ships with new transects hence covering more sea-areas with more precise data. Integrating even more with remote sensing and modeling products, these in-situ measurements will be a substantial part of an operational oceanographic network. To discuss gathered experience (knowledge), new ideas and directions considering flow-through systems, 6th FerryBox Workshop is held on 8-9 September 2014, Tallinn, Estonia in the premises of Marine Systems Institute at TUT.

Themes

- Regional systems – latest developments (new systems and lines, integration with other systems, development of indicators for WFD and MSFD).
- New sensors and applications (algal productivity, carbonate system, detection of species/groups, micro plastics and harmful substances).
- Operational oceanography applications (ground truth for remote sensing, assimilation into operational models).
- Latest scientific findings and results (with contribution from ferrybox systems).

Dates and deadlines

Abstract submission: 15 June
Abstract acceptance: 30 June
Preliminary program: 15 August
Workshop: 8-9 September

Registration and abstract submission

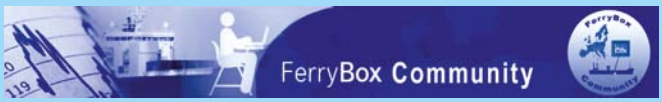
Participation at this meeting is free of charge, but limited to 50 people. For registration please send an email (villu.kikas@msi.ttu.ee) containing following information:
name, institute, title of presentation/poster, other.

Location and contact information

Marine Systems Institute at TUT,
Akadeemia tee 15A, Tallinn, Estonia
villu.kikas@msi.ttu.ee

More info about program and accommodation will be coming shortly.

TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY



NEWS

A new BOOS Memorandum of Understanding (MoU), new version of HIROMB agreement and draft agreement on Operational Ocean Observations Programme (OBS) will be discussed at the Annual Meeting.

The BOOS Steering Group (BOOS STG) in cooperation with the legal advisor of the SMHI have drafted a reviewed version of the BOOS MoU. It has been changed in many aspects to better reflect the planned new structure of co-operation on operational oceanography in the Baltic Sea area. BOOS will incorporate two major Programmes – HIROMB Programme for the development and handling of operational oceanographic forecasting system and OBS Programme. The latter Programme has the main aim to develop and secure the operational observations (in-situ and remote) and real-time data exchange.

A joint project of Estonian, Russian and Finnish marine scientists and environmental specialists – the Gulf of Finland Year 2014 has been launched.

This provides an opportunity to analyse in detail the ecological status of the gulf. Throughout the year research is organised around key research themes: fish & fisheries, ecosystem health, geological and biological diversity, marine traffic safety, and maritime spatial planning. The research themes have been chosen to support the implementation of (inter) national legislation and conservation commitments. In the end of the theme year the three project countries will sign the Gulf of Finland Declaration which will present the most essential measures to be conducted to improve the ecological state of the gulf. Throughout the year a variety of events will be held for researchers, educators, decision makers, and the general public. Keep yourself posted with the latest news and events at Gulf of Finland Year 2014 web site

http://www.gof2014.fi/en/.

Two practical multidisciplinary ship-based training courses for European Graduated and Postgraduated Students of Marine Related Sciences will be arranged in summer 2014 – on 4th - 9th July in Messina, Italy, and on 17th - 22nd August in Tallinn, Estonia. The latter course is designed to enable PhD Students to acquire advanced practical skills for using new technologies for multidisciplinary oceanographic research (including gliders, autonomous profilers, ferryboxes, and towed instruments). More information can be found at the Eurofleets web site: http://www.eurofleets.eu/np4/74.

EMODNET PHYSICS AND BOOS

A. Novellino, P. Gorringe

The advent of the INSPIRE Directive and **Marine Strategy Framework Directive** made compulsory a comprehensive monitoring of the marine environment beyond the geographical limits by means of better discovery of data, **free access** to data and few restrictions on use and **re-use of data**. As a result, in its Blue Book for Maritime Policy the European Commission undertook steps towards a **European Marine Observation and Data Network (EMODnet)** in order to standardize methods for observing and assessing the grade of the Member States seas and improve access to high quality data. Since 2008-2009, European Commission, represented by the **Directorate-General for Maritime Affairs and Fisheries (DG MARE)**, is running several service contracts for creating pilot thematic components of the ur-EMODNET: Biology, Bathymetry, Chemistry, Geology, Habitats, and Physics.

The existing EMODnet-Physics portal (www.emodnet-physics.eu) is based on a strong collaboration between EuroGOOS member institutes and its regional operational oceanographic systems (ROOSs), and the National Oceanographic Data Centres (NODCs), and it is a marine observation information system that makes (in situ) physical data and metadata available (www.emodnet-physics.eu/map) for use (discover, view, plot and download) and contributes towards the definition of an operational European Marine Observation and Data Network (EMODnet).

With a long term-vision for a sustained pan European Ocean Observation System EMODnet Physics is supporting the coordination of the EuroGOOS ROOSs and the empowerment and improvement of their observing and data management infrastructure. In turn EMODnet Physics has implemented high level interoperability layers (WMS, Web catalogue, web services, etc.) to facilitate connection and interoperability towards global observing systems for itself, the ROOSs and the Institutes within the ROOSs.

BOOS infrastructure (managed by SMHI) is already well organized and fully connected to EMODnet Physics (about 120 fixed stations and 5 Ferryboxes) and for implementing a further engagement and empowerment of the infrastructure and community EMODnet Physics is supporting BOOS to attract and connect new data providers and new platforms for mutual benefit.

Patrick Gorringe is Senior Operations Officer at EuroGOOS AISBL. He is responsible for the coordination of the five EuroGOOS Regional Operational Oceanographic Systems (ROOSs) and involved in a number of projects and initiatives related to marine data management and dissemination of data. Patrick has a unique competence of operational oceanography and its applications, its users and ocean policy issues within Europe and at global level.
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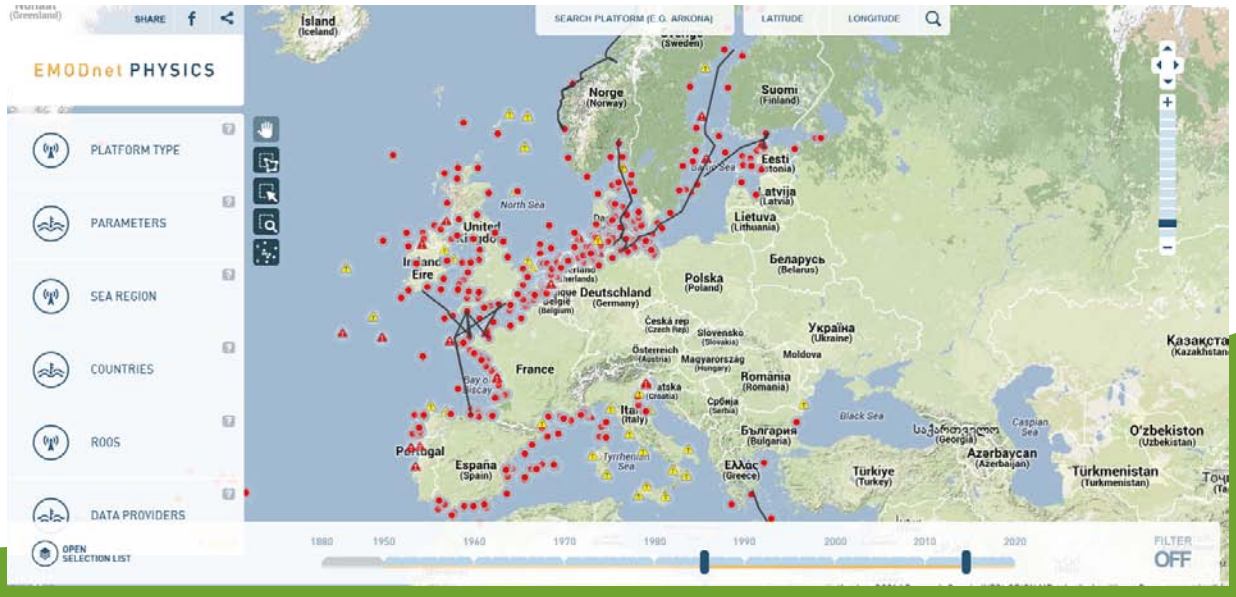


OPTIMIZED FAIRWAYS MAY REDUCE POLLUTION RISKS IN THE BALTIC

Jens Murawski & Palle Bo Nielsen

Two ships collide in the middle of the Gulf of Finland. Immediately, oil from the ships leaks into the sea, and wind and currents transport the oil towards the coast, which is polluted shortly after. This is hypothetical but realistic example of an accident with severe consequences for the marine environment.

The pollution of the coast depends on the position where the ships collide. To reduce the probability of severe oil pollution on the coast, fairways with more favorable currents and waves should be identified and used.

Safer fairways in busy waters

One of the purposes of the BalticWay project was to develop prototype technologies to identify safer fairways with respect to pollution of the marine environment. The Gulf of Finland was chosen as a first demonstration example of new computational techniques, which could be applied for other busy waters in the Baltic Sea and elsewhere. Oceanographers at the Centre of Ocean and Ice, DMI, have contributed to this work.

Economic benefits were also addressed in the project so the suggested fairways would be "fast" and low in fuel consumption too.

The gained knowledge in the BalticWay project is of vital importance for institutions responsible for environmental protection (ministries of environment, national and regional environmental agencies) and maritime spatial planning (see BOX).

Where the oil goes

Complex factors have to be taken into account when computing consequences of pollution after the release of oil:

- the movement of oil due to winds, currents and waves
- the mixing of oil in the water column by waves and currents
- the weathering and sinking of oil.

All the factors acting together determine where the oil goes and how its composition and concentration change in space and time.

When the oil is released into the sea, it moves with the wind and currents away from the release point. At the same time the oil is mixed vertically and becomes distributed in the water column. The oil also changes its composition by evaporation and other processes.

Dependent on the present wind and current conditions, the released oil pollutes areas offshore and hits the coast within hours or days.

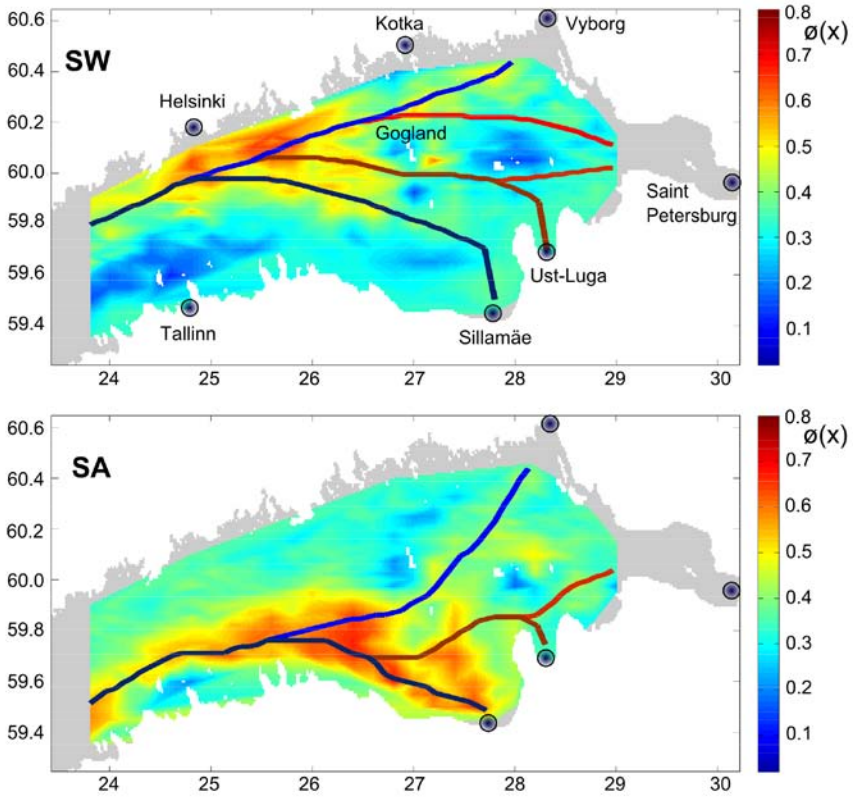
Although the sea seems alike everywhere, the new paradigm fostered in the BalticWay project is that environmental consequences of an oil release can be reduced by using some concealed features of the sea. These consequences -often delayed or remote- greatly depend on the release position. Areas far from the coast and with currents typically parallel to the coast are relatively safe. It is because the released oil is diluted in the sea water and partly evaporated before it hits the coast. Also the longer time at sea provides more time to combat the oil.

An operational oil spill model computes

To compute safe fairways with respect to oil pollution, the Centre of Ocean and Ice, DMI, has used their operational oil spill model in which all the above-listed factors are included. Earlier such computations simulated the oil as passive, floating particles, but now available super computer power and parallel processing allow for much more demanding computations.

A huge number of simulations are computed to cover all possible release positions and times combined with wind and current conditions that vary in time and space. From the results, maps like the two shown in the figure can be derived. It shows the optimum fairways to four ports in the Gulf of Finland.

As both the residence time of the oil at sea and the probability of coastal hit are important, both factors were included, although most weight were put on residence time to favor the combat of oil. Surprisingly, the optimum fairways for different seasons differ radically, mirroring the seasonal



Optimum sailing lines summer and winter (SW) and in spring-autumn (SA) seasons to four ports constructed based on the aggregate cost function in which the residence time of oil at sea and the probability of coastal hit have weights 2/3 and 1/3, respectively. From the article: Tarmo Soomere et al. "The Potential of Current- and Wind-driven Transport for Environmental Management of the Baltic Sea" AMBIO 2014, 43. 94–104.

BalticWay

"The ever increasing impact of the maritime industry on vulnerable sea areas such as the Baltic Sea calls for novel methods for handling the related risks. BalticWay develops methods for characterizing the damaging potential of the offshore areas in terms of the potential transport to vulnerable regions if faced by an oil spill or other pollution. These methods are used for preventive reduction of current-transported environmental risk. This way, by placing maritime activities in the safest offshore areas, the consequences of potential accidents can be minimized before they occur."

(From BONUS Briefing, Number 7, October 2011).

variations in the meteorological and oceanographic conditions. Upper panel is for summer and winter, and the lower panel for spring and autumn.

The computations behind the figure assume that all stretches of the coast are equally vulnerable.

Jens Murawski is a physical oceanographer who works with modeling of waves, ice and oil drift. E-mail: jmu@dmi.dk
Palle Bo Nielsen is a physical oceanographer who works with sea level, tides and communication. E-mail: pbn@dmi.dk
Both are working in the Centre for Ocean and Ice at the Danish Meteorological Institute.

MARINEOS PLATFORM FOR STREAMLINING OCEAN AND EARTH DATA

In March 2014 Marinexplore launched a leading software platform for organizing and interpreting global ocean, air and climate data.

In April 2014 the European Parliament endorsed a Directive for Maritime Spatial Planning for Member States to better coordinate the various activities that take place at sea. MarineOS, the cloud-based data platform, developed in partnership with organizations like Cornell University, Baltic Operational Oceanographic System and the World Ocean Council, is addressing the aims of the Directive to a great extent.

Sensors and models produce huge amounts of information at resolutions and rates that were not feasible just a few years ago. Despite these technological advances and an accelerating trend in data volume, vast repositories of oceanographic data are not readily accessible. Effective coordination of cross-boundary coastal and maritime data flows is required.

MarineOS Capabilities

The high-level architecture of an operational MarineOS deployment, currently streaming data from 32 organizations around the globe (including Baltic Operational Oceanographic System), is illustrated in the figure above. The design of the platform enables connections of data streams from compute centers, satellites, high frequency radars, ship sensors, mobile devices and animals. Unlike generic on-site storage and data management solutions, MarineOS is designed to work on active data projects in near real-time, supporting major ocean and air data types within a single system. Both private and public data-streams are integrated within the platform, allowing for secure and highly efficient data exchange. An integrated data platform encourages investments through availability of high quality environmental insight on demand.

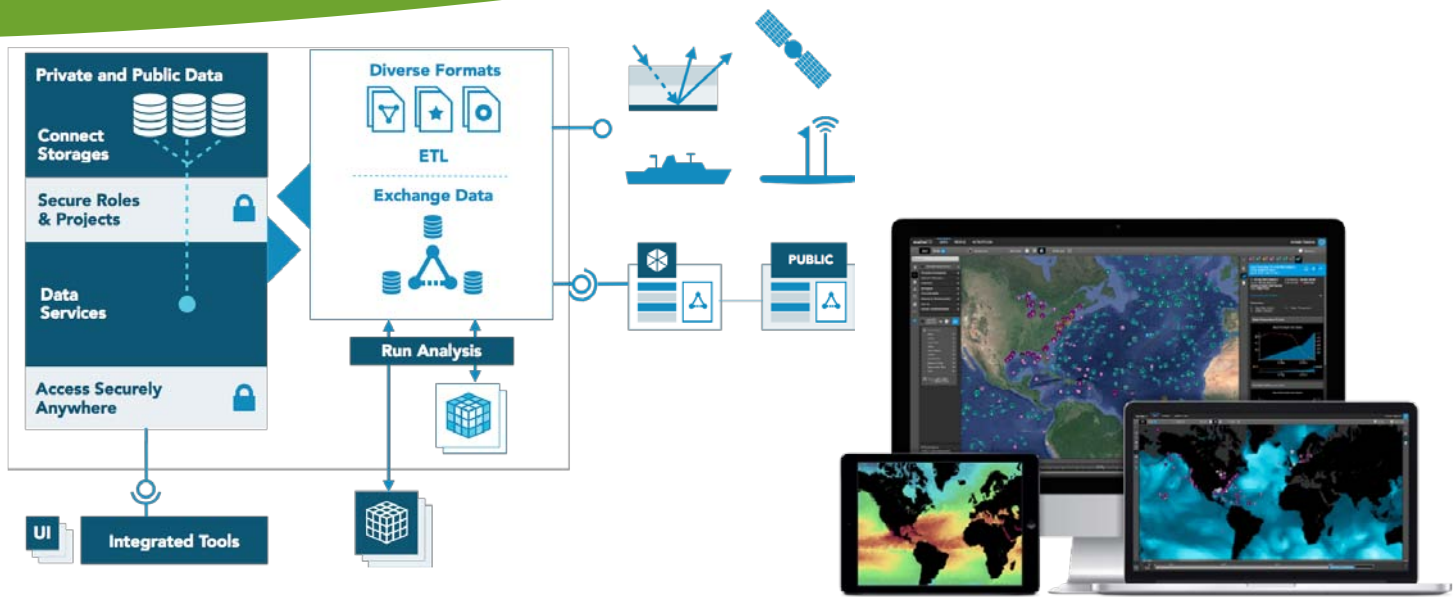
The platform consists of three core components: Data Manager for organizing data; Data Studio for visualizing, exploring and accessing data; and a Data Browser, a well-organized directory of data streams available in the Baltic Sea and across the globe.

The Data Manager is designed for real-time control and organization of all ocean, air and climate data. It enables ingestion and curation of data flows and management of projects along with user rights. Access decisions to survey results, analysis and data across organization are put in the hands of project owners who administrate secure access and delivery of results to stakeholders.

A suite for exploring, visualizing and aggregating data is available requiring no additional purchase of expensive software licenses. Data Studio enables scientists and engineers to build custom datasets and access or download content from existing third party apps and languages. Existing tools and systems developed in Matlab, R and Python can be connected using a standard OpenDap API. The downloaded data is provided in a unified format either in CSV or well-defined NetCDF making it easy to connect diverse data types and data sets into a single analytical input. The visual exploration approach enables viewing and accessing public data along with your own.

The Data Studio provides responsive cross-filtering and dynamic time range selection for selecting the data of interest for interactive visualization. Viewing multiple data types at once and selecting relevant content via a simple polygon selection tool is provided. Team members can work across different locations and share the same workspace and data. The dataset and filter bookmarks are available for revisiting prior work and results.

The third component of MarineOS, the Data Browser is a well-organized directory containing rich information about data streams available across the globe and within your organization. The underlying metamodel of the directory relies on lessons learned by Marine Metadata Interoperability and the U.S. Ocean Observatories Initiative (OOI) Cyberinfrastructure. Support for metadata standards like ISO 19115 and netCDF's Climate and Forecast conventions are followed. Initiatives like SeaDataNet can be integrated with the global data platform to further increase the cross-organizational collaboration of European institutions focused on the environment.



Impacting The Industry and Environment

Land, sea and space sensor systems are now providing data at rates and dimensions beyond our inherent mental processing capabilities. For energy companies the data grows 500% annually. Worldwide, there are 7,000 offshore oil and gas installations and 60,000 cargo-carrying vessels that all depend on fast access to environmental data. Given the growing complexity and volume of these data, and increasingly sophisticated data-driven processes, it is obvious that traditional file storage systems can no longer meet the demands of data consumers. With open big data technologies and services brought together in MarineOS, a solution is attainable.

The MarineOS system contains open source components and is open ended so as to provide unparalleled opportunities for data analyses, visualization, interpretation and application.

For example, Marinexplore Global Public Data Initiative, Marinexplore.org for short, is a growing global partner network of 32 institutions offering fast access to a rich directory of well-organized environmental data from 40,000+ data streams. The goal of the service is to organize, interpret, and deliver public ocean data, and enable new analytical services to be developed. All of this has been and will continue to be served for free to the community. Over 7,000 ocean professionals have signed up to be a member of the service, having tested and verified the functionality of the underlying MarineOS.

Marinexplore.org demonstrates the capabilities of MarineOS to combine near real-time measurements from in-situ platforms with data products and simulation output produced by computing centers. The integration of high frequency radars in U.S. HF-Radar Network, satellite observations by sensors like ASCAT on the EUMETSAT's METOP platforms, Acoustic Doppler Current Profiler measurements by initiatives like Joint Archive for Shipboard ADCP (JASADCP), numerical simulations like OurOcean Group High-Resolution Sea Surface Temperature (GHRSST), and sensor data from devices like Argo floats, represent vast amounts of raw content collected and processed by individual institutions. The cost efficient infrastructure is made possible through the integration of high quality data products provided by partner organizations and data providers.

The MarineOS data platform is explicitly designed for streamlining private and public oceanographic and earth sciences data. The integrated powerful web based solution enables broad access to the data for different industries competing for the same space and resources: shipping routes, oil and gas installations, renewables like wind farms, fishing grounds and aquafarms, and infrastructures such as ports, cables and pipelines. The platform offers significant improvements for informed decisions in coastal and maritime regions, and ultimately leads to healthier seas and oceans.

Marinexplore: http://marinexplore.com

Founded in 2012, Marinexplore is the leading company developing planetary data software

A HARMONIZED VERTICAL REFERENCE SYSTEM FOR THE BALTIC SEA

Jyrki Mononen, Wilfried Ellmer, Thomas Hammarklint, Lars Jakobsson

Because there is no common vertical reference system for hydrographic or navigational tasks, Baltic Sea Hydrographic Commission (BSHC) has considered to be important to harmonize chart datums in the Baltic Sea. Countries have their own national systems differing from each other. Systems are based principally on mean sea level (MSL), but national realizations of MSL are different. This kind of situation is inconvenient for navigators, for data transfer between Hydrographic Offices and for other use of depth and water level data.

BSHC decided in 2005 to establish a Chart Datum Working Group (CDWG) to study and foster the harmonization of vertical reference systems. CDWG members include representatives from all Baltic Sea Hydrographic Offices, permanent representatives and observers from national geodetic and oceanographic organizations and BOOS.

The working group studied first the feasibility of the European Vertical Reference System (EVRS) as a principal alternative for a harmonized vertical reference system for Baltic Sea nautical charts. It also studied possible time schedules and necessary preconditions necessary for each Baltic Sea country to move to use harmonized datum on their nautical charts. The working group develops recommendations and guidelines on how the transfer period could be implemented.

The EVRS has been found to be feasible as a harmonized vertical reference system for the Baltic Sea. The change to the EVRS based reference system would have practically no effect in the southern parts of the Baltic Sea, but in the northern parts it would have around 15 – 20 cm effect on depths. There is good commitment among the Baltic Sea countries to take this harmonized datum in to use.

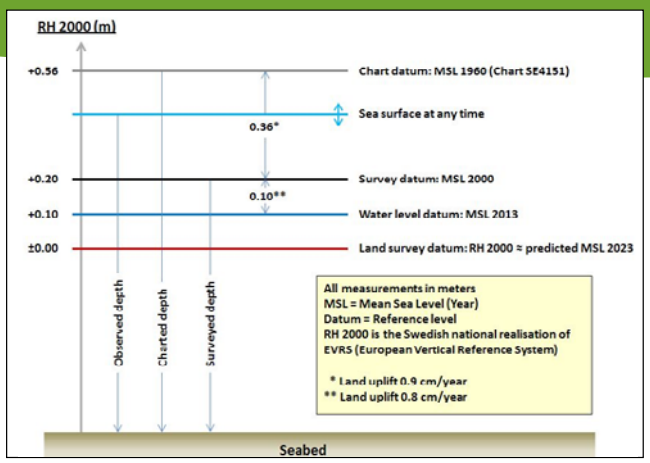
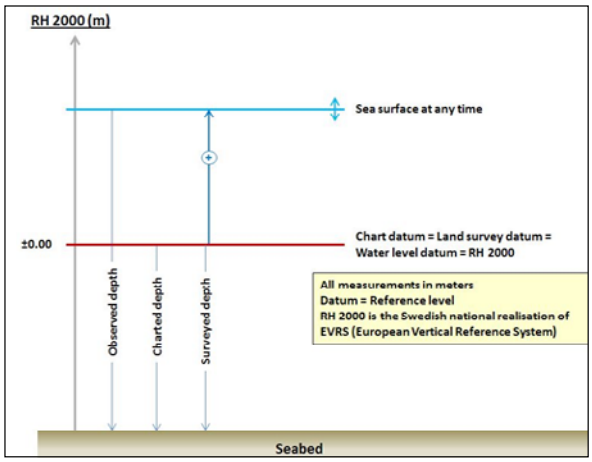


Fig. 1a. Present situation.



Images: Lars Jakobsson, Swedish Maritime Administration

Fig. 1b. Situation with harmonized chart datum.

There are a lot of benefits which can be achieved with a well-defined, international EVRS based harmonized vertical reference system when all the depth and water level information can be provided in the same datum within the whole Baltic Sea. E.g. elimination of confusion between different chart datums, and safer and easier data transfer between national Hydrographic Offices and other organisations. Further on a harmonized vertical reference system enhances wider and easier use of the data in accordance with the INSPIRE directive and enables the full utilization of future enhanced navigation systems based on International Hydrographic Organization (IHO) S-100 standards.

Other benefit for the EVRS is that it is a common European vertical reference system to which many national height systems are based on. Thus depths on sea and heights on land will be referenced to the same reference system. The common levelling network around the Baltic Sea, Baltic Levelling Ring (BLR), computed and adjusted in 2006 has given the possibility to tie all mareographs to this common datum.

Figure 1a illustrates the present complex situation with different MSL based chart datums. Figure 1b

illustrates the clear situation after the EVRS based harmonized vertical reference system has been taken into use.

It is vital for the mariner that charted depths and broadcasted water level information are in the same reference system. To provide all the information safely and reliably to the users during the transition period, it is essential to have a good cooperation and communication between different organisations like national hydrographic offices, geodetic and oceanographic organizations (e.g. BOOS) and mariners and other users of water level data both in national and international level.

CDWG will now concentrate on guiding the implementation process of the harmonized vertical reference system by preparing a road map and monitoring the status of the implementation process. CDWG supports efficient international communication and cooperation with relevant bodies. In addition CDWG will study other water level related issues, e.g. possibilities to develop common geoid model for the Baltic Sea and foster studies related to dynamic topography of sea surface in the Baltic Sea.

The implementation process will take several years: the transition is estimated to be completed by 2020. To make the transition process successful one of the key issues is to get all relevant national and international bodies to communicate and cooperate together. CDWG is one node point for this important international network.

Jyrki Mononen is working at the Finnish Transport Agency. Since 2013 he has been acting as the chairman of the BSHC CDWG.

Dr Wilfried Ellmer is working at the Federal Maritime and Hydrographic Agency in Rostock, Germany. He is the German representative in the BSHC CDWG.

Thomas Hammarklint is working at the Swedish Meteorological and Hydrological Institute (SMHI). Since 2003 he has been working with exchange of water level data in the Baltic Sea and is the BOOS representative in the BSHC CDWG.

Lars Jakobsson is working at the Swedish Maritime Administration. He is the Swedish representative in the BSHC CDWG.

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INSTITUTIONAL RESEARCH TOPIC AT THE MARINE SYSTEMS INSTITUTE FOR 2014 - 2019

Urmas Lips

Background

A six-year project aiming at enhancing predictability of the Baltic Sea system was initiated by the research team of the Marine Systems Institute at Tallinn University of Technology in 2014 (supported by the Estonian Ministry of Education and Research). The project is focused on multi-scale physical processes that significantly control the biogeochemical cycles of substances as well as mixing and dispersion of particles and pollutants, especially in the boundary layers (near-surface and near-bottom layer) and in the pycnoclines (seasonal thermocline and halocline) of the Baltic Sea. The in-situ observations using novel technologies combined with remote sensing and high-resolution numerical simulations are the main study method that allows tracking of physical and biogeochemical signal dynamics at a wide range of temporal and spatial scales. We aim to make a substantial step forward in the quantitative description of submesoscale processes and their impact on the biogeochemical cycles in the stratified Baltic Sea.

Methods of in-situ observations

While the study is based on the combined use of the data from in-situ and remote sensing observations and numerical simulations, here the approaches of in-situ observations focused on processes in the upper and subsurface (thermocline) layers are presented. The core of the measurement complex

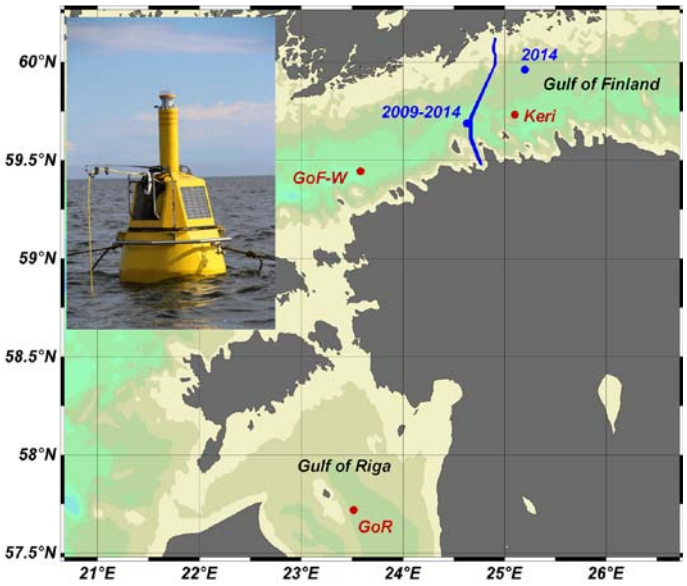

Fig. 1. Location of profilers (blue in 2014 and red from 2015) and ferrybox line Tallinn-Helsinki; upper left corner - buoy profiler designed by Flydog Solutions.

contains three autonomous profiling stations (buoy-based or bottom mounted) deployed in the Gulf of Finland and Gulf of Riga for the most of the study period (Fig. 1). Vertical profiles of temperature, salinity and chlorophyll a as well as dissolved oxygen, phycocyanin and turbidity at least at 2 stations are recorded with a time step of 3 to 6 hours. In addition, meteorological parameters and vertical profiles of currents are measured.

Ferrybox systems onboard a Tallinn-Helsinki ferry (see route in Fig. 1) and onboard the RV SALME measuring temperature, salinity, chlorophyll a and turbidity as well as dissolved oxygen, phycocyanin, and pCO2 (in newly installed system of RV SALME) in the upper layer with a spatial resolution of 150 m to a few hundreds of meters are applied. In order to reveal submesoscale variability in the subsurface layers the towed undulating vehicle and glider surveys near the autonomous stations are planned. Such surveys allow linking of high-resolution temporal variability with high-resolution 3D spatial variability under different forcing and large-scale background conditions. Ship-borne surveys (CTD and optical devices) and water sampling for nutrient and biological analyses will be carried out covering all seasons (mainly spring and summer). In addition to conventional methods fluorescence microscopy, flow-cytometry and methods of metagenomics will be applied for microbiological analyses.

Recent results

Measurements by an autonomous profiler in the Gulf of Finland have revealed the key role of vertical stratification, mesoscale processes and submesoscale intrusions for phytoplankton dynamics, including formation of thin layers of subsurface chlorophyll maxima in the deeper part of the seasonal thermocline. Quasi-stationary stratification patterns were identified and a conceptual model was developed to describe the dynamics of vertical stratification in the Gulf of Finland. It was shown that the main discrepancies between the model and observational data (collected by the autonomous profiler) exist in case of energetic mesoscale processes altering the thermocline location and strength. In addition, layered flow structure and submesoscale intrusions were characteristic features of vertical profiles in periods of stratification transformations. Such mesoscale processes and submesoscale features create patchiness of surface and subsurface distribution of phytoplankton as well as influence the mean time that photosynthetic organisms spend in the euphotic layer and thus can promote primary production. It is also suggested that mesoscale dynamics can act against dispersal of cells migrating between the surface layer and subsurface nitrate reserves and thus could create conditions for biomass growth in the surface layer which is depleted of inorganic nitrogen.

Thus, qualitatively it can be shown that the dynamics at the submesoscale is important in shaping the distributions patterns of tracers. As an example of the variety of submesoscale features associated with a subsurface mesoscale eddy is shown in Fig. 2 on the basis of measurements by a towed undulating vehicle in the Gulf of Finland. This intra-pycnocline eddy was formed in the process of relaxation of an upwelling event near the southern coast of the gulf. Clear submesoscale intrusions along (or slightly intersecting) the inclined isopycnal surfaces both near the upper and lower borders of the eddy are seen. This is a qualitative evidence of active layered dynamics leading to lateral mixing of water properties in case of rapid transformations of vertical stratification. In numerical models with a grid step of a few kilometers such features and mixing have to be taken into account in parameterization of subgrid processes.

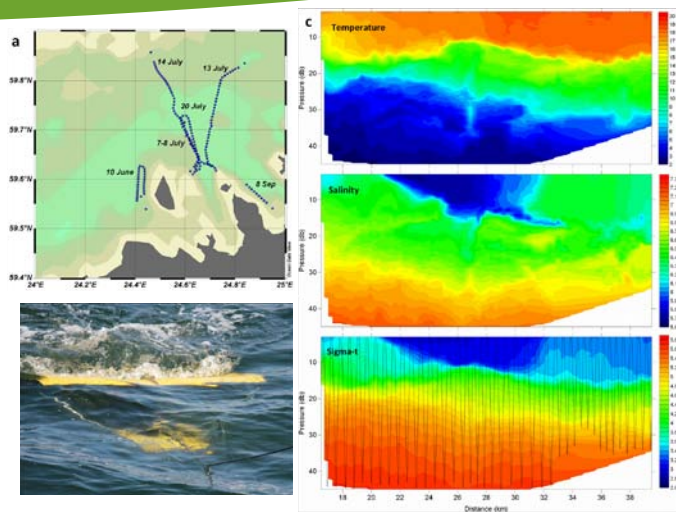

Fig.2. Vertical sections of temperature, salinity and density measured on 14 July 2011 in the Gulf of Finland; upper left panel - location of the transect, lower left panel - scanfish.

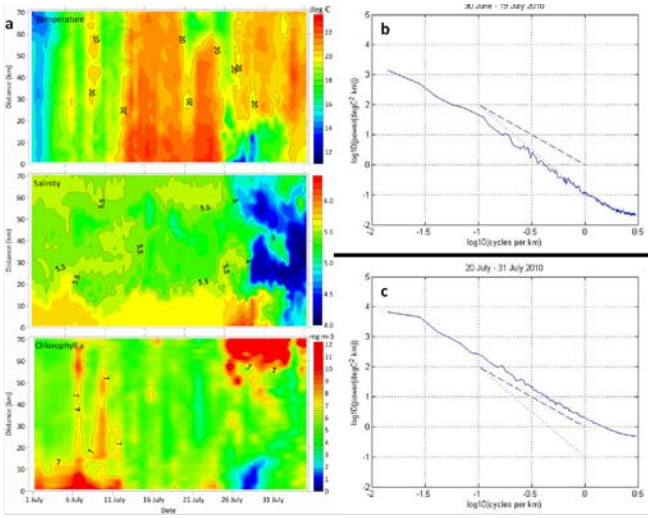

Fig. 3. Temporal variations of temperature, salinity and chlorophyll a in the surface layer along the Tallinn-Helsinki ferry line; left panels - average spatial spectra of temperature on 30 June - 19 July and 20-31 July 2010; straight lines indicate -2 (dashed) and -3 (dotted) slopes.

If assuming that the quasigeostrophic turbulence theory is applicable down to the rather small scales the kinetic energy of motions in the ocean falls rapidly (characteristic spectrum slope of -3 in logarithmic scale) from the mesoscale (50-100 km in the open ocean and 10 km in the Baltic Sea) towards smaller spatial scales. It is shown by numerical experiments that refinement of the lateral resolution will increase the proportion of kinetic energy at the submesoscale. Ferrybox data collected daily between Tallinn and Helsinki (spatial resolution of measurement is approximately 160 m) has been used to construct spatial spectra of temperature in the surface layer of the Gulf of Finland (Fig. 3). It is found that in case of high mesoscale (and submesoscale) activity caused by upwelling development and relaxation in the second half of July 2010 the spatial spectra of temperature revealed rather -2 than -3 slopes within the range of spatial scales from 10 to 1 km.

Schedule and data access

The project time frame is 6 years (2014-2019). The focus of the studies will vary between the years – in 2014 the main activities are planned for the Gulf of Finland (taking into account the international Gulf of Finland Year 2014) and in 2015 more intense studies will be carried out in the Gulf of Riga. A new autonomous profiler was deployed in April 2014 in the Gulf of Finland at 59°41,2' N, 24°37,7' E. The second profiler will be deployed in May 2014 (for spring-summer season) in the northern part of the gulf. The construction of the third (bottom mounted) profiling station will start near Keri Island in August 2014. Field campaigns including glider and scanfish surveys in the Gulf of Finland are scheduled for 2014. Adaptive sampling in connection to high-resolution profiling and 3D mapping is planned to study in more detail biodiversity of primary producers associated with different distribution patterns and mesoscale/ submesoscale dynamics.

The observational infrastructure used for the project is also part of the real time data collection network where data are made available for the Baltic Operational Oceanographic System (BOOS) community. As a result it supports the improvement of the every-day Baltic Sea operational forecasts. The near real-time data products will be presented in the internet (e.g. on-line.msi.ttu.ee), thus these in-situ observations could also raise public awareness on the Baltic Sea environment issues.

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SURVEY CRUISE SCHEDULES

BSH - www.bsh.de/en/Marine_uses/Science/Research_vessels/index.jsp

IMWM-NIR - www.mir.gdynia.pl/?page_id=12

MSI - www.ttu.ee/institutes/marine-systems-institute/research-vessel

SYKE - www.itameriportaali.fi/en/aranda/aranda_matkat/en_GB/2013

R/V Elisabeth Mann Borgese

Ideas/topics for the coming issues of the newsletter are welcome!

All contributions to the newsletter (news, links to research cruise schedules, articles, photos, new projects etc.) are welcome to Mairi Uiboaed, project manager at Marine Systems Institute (mairi.uiboaed@msi.ttu.ee).

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