

NEWS FROM BOOS

NEW

FOCUS ON FERRYBOXES

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UPCOMING EVENTS

19-21 November, 2012

MyOcean Science Days
Geesthaht, Germany

21-23 November, 2012

EuroGOOS Annual Meeting
Hamburg, Germany

24-25 April 2013

5th Ferrybox Workshop
Helsinki, Finland

26-30 August 2013

9th Baltic Sea Science Congress
Klaipeda, Lithuania

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.

EDITORIAL

Dear reader,

This is the second issue of the new BOOS publication. The first number of the newsletter was received well both in and outside of the BOOS community. Getting encouraged by that the BOOS Annual Meeting decided to continue with publishing the newsletter twice a year.

The second newsletter continues to introduce the member institutes that were not reflected in the first one. At the same time the number has another thematic focus – Ferryboxes. From this issue you will find an overview of existing and planned Ferrybox lines, facts about the Alg@line co-operation and invitation to the 5th Ferrybox Workshop to be held in Helsinki on 24-25 April 2013. We also highlight some developments of GMES Marine Services at European scale, such as FP7 project MyOcean.

Hopefully the publication serves its purpose well as a promoter of the BOOS activities and you will find it interesting. Naturally the electronic version of the publication is available on the BOOS website.

Enjoy!

Urmas Lips
BOOS chair



Baltic Operational
Oceanographic System

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

NEWS

BOOS Annual Meeting welcomed two new members to BOOS community – Estonian Marine Institute, University of Tartu and St. Petersburg Branch of State Oceanographic Institute.

EuroGOOS Annual Meeting in Rome in 2011 decided that EuroGOOS should become a legal entity and will therefore look to become a Belgian international non-profit association. A decision was also made to move the EuroGOOS Secretariat to Brussels during autumn 2012.

EuroGOOS and the Oceanography Center of the University of Cyprus organized a meeting of operational oceanographic institutes on October 10, 2012 in Nicosia under the auspices of the Cyprus EU presidency. The aim of the meeting was to elaborate a strategic partnership agreement between European Centre for Ocean Monitoring and Forecasting (ECOMF) and national oceanographic centres to advance and implement a marine monitoring and forecasting system using a European Centre(s) approach. The drafted document named as “The Nicosia Declaration” was agreed upon by the participants and will be further discussed at the EuroGOOS Annual Meeting in Hamburg on 21-23 November 2012.

FERRYBOX SYSTEMS IN THE BALTIC SEA AREA

Bengt Karlson

To monitor the state of the seas and to understand the ongoing processes a number of different observation systems are used to cover diverse parameters and needs regarding temporal and spatial resolution. This article is about Ferrybox systems, i.e. systems for automated measurements and water sampling using ships of opportunity, e.g. merchant vessels and passenger ferries. The term “underway data” is often used for data from this type of measurements. Underway measurements of oceanographic parameters on research vessels have a long history. The use of Ferryboxes on ships of opportunity started out in Estonia and Finland around 1990 and has subsequently spread to many sea areas in Europe and also elsewhere (see www.ferrybox.eu). A basic system consists of a water inlet at 3-4 m depth, a pump and sensors for temperature, salinity and chlorophyll fluorescence (a proxy for phytoplankton biomass), a GPS unit and a computer or other data logging device. Many systems also have water sampling devices and additional sensors for e.g. phycocyanin fluorescence (a proxy for cyanobacteria biomass), turbidity, oxygen, pH, carbon dioxide and in air sensors for irradiance, air pressure, air temperature and wind. New developments include the possibility to measure

the concentration of Coloured Dissolved Organic Matter, CDOM. Regular maintenance is important for acquiring high quality data using Ferrybox systems. Although automated washing procedures have been developed visits to the ship at least every other week is standard procedure at present.

A number of ferries and other merchant ships in the Baltic Sea – Kattegat – Skagerrak area have instrumentation for automated oceanographic measurements and water sampling (Fig 2 and Table 1).



Fig. 1.

The ship TransPaper operates the route Gothenburg-Kemi-Oulu-Lübeck-Gothenburg every week. This facilitates measurements and water sampling in a large part of the Baltic Sea and the Kattegat twice a week. Samples are collected and the system is serviced in Gothenburg

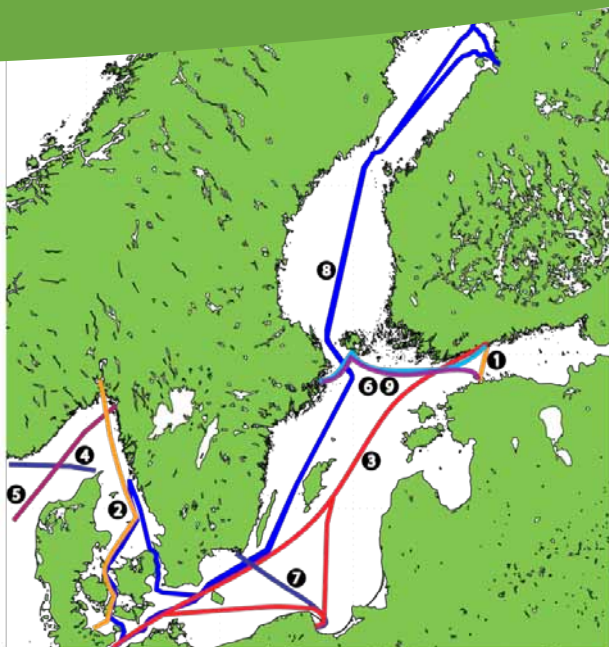


Fig. 2. The main Ferrybox systems in the Baltic Sea area

The Swedish Meteorological and Hydrological Institute (SMHI) operates a system on the ship TransPaper (Fig. 1) in cooperation with the Finnish Environment Institute (SYKE) and the shipping company TransAtlantic AB. The route is Gothenburg – Kemi – Oulu – Lübeck – Gothenburg every week. This means that the Gulf of Bothnia, a large part of the Baltic Proper and the Kattegat is covered twice a week with automated measurements approximately every 200 meters. The system has sensors for the basic parameters but also for oxygen, turbidity, phycocyanin fluorescence, CDOM, pH and pCO₂. Water sampling is carried out every two weeks at 12–24 locations for analysis of total alkalinity at the oceanographic laboratory in Gothenburg. The parameters related to the carbonate system are important for studies

of the acidification of the seas and new sensors are evaluated in a research project funded by the Swedish Agency for Water Management, SWAM and by the Swedish Environmental Protection Agency, SEPA. Also water samples for laboratory analyses of salinity, CDOM and chlorophyll and for microscopic analysis of phytoplankton are collected, the latter ones to study harmful algal blooms, the biodiversity of phytoplankton etc.

Today most ships have internet connections. This makes it possible to publish near real time data on the web. There are several web sites with presentations of near real time data available. In the on-going EU projects MyOcean2 and JERICO data handling and quality related issues are further discussed and developed. BOOS has a role in co-ordinating the data flow and quality control of data from Ferrybox systems in the Baltic Sea area. It builds on existing cooperation in the Alg@line consortium. The next step could be to coordinate the handling of data from water samples, e.g. nutrient data, chlorophyll data and data on phytoplankton. This would facilitate better long term monitoring and also a system for warnings of harmful algal blooms based on identifying harmful species using microscopy and in the near future automated imaging and molecular techniques. This would supplement research vessel based water sampling of phytoplankton and remote sensing observations of surface scums of cyanobacteria.

Ferrybox systems also have a role in the implementation of the EU Marine Strategy Framework Directive and in the Water Framework Directive as well as in HELCOM and OSPAR related

No. on map	Ship	Route	Institute
1	Baltic Princess	Tallinn-Helsinki	MSI
2	Color Fantasy	Oslo-Kiel	NIVA
3	Finnmaid	Helsinki-Lübeck-Gdynia-Helsinki	SYKE
4	MS Bergensfjord	Bergen-Hirtshals	NIVA
5	Lysbris	Hamburg-Immingham-Halden	NIVA and HZG
6	Silja Serenade	Helsinki-Mariehamn-Stockholm	SYKE
7	Stena Spirit	Gdynia-Karlskrona	IMGW-PIB
8	TransPaper	Gothenburg-Oulu-Kemi-Lübeck-Gothenburg	SMHI
9	Victoria	Tallinn-Mariehamn-Stockholm	EMI
10	Brahe	Along the coast of Finland	SYKE, KAS ELY, Helsinki City

Table 1. The main Ferrybox systems in the Baltic Sea area

monitoring. The high frequency measurements and water sampling makes it possible to monitor some aspects of eutrophication, part of plankton food webs, invasive species and the biodiversity of phytoplankton and microzooplankton and also harmful algal blooms. Costs for operating Ferrybox systems are very low compared to costs for operating research vessels. However, since Ferrybox systems only monitor near surface water parameters they will never replace sampling from research vessels. Algal blooms often start as sub surface blooms before they are observed near the surface and low oxygen conditions is mainly a deep water phenomenon. To follow inflows of oxygen- rich water into the deep parts of the Baltic

Sea Ferrybox systems are essentially useless. Another problem is that ships operated by shipping companies sometimes change their route on short notice due to commercial reasons. Still the future of Ferrybox systems seems bright.

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ALG@LINE – FERRYBOX MONITORING SYSTEM

Seppo Kaitala

The Ship of opportunity (SOOP) monitoring system onboard Finnlines ferries operating across the Baltic Proper from Helsinki to Travemünde has formed the backbone for the Alg@line monitoring. The Alga@line observations started on that line first on board Finnjet in 1992 and continued on Finnlines ferries since 1998. The ferry sails twice a week. Chlorophyll-a fluorescence, temperature and salinity are recorded in a flow-through water system with a spatial resolution of about 200 m. The data recording has the geo-reference logging from GPS.

Nowadays, Alg@line is a co-operation between several research institutes and shipping companies and is co-ordinated by the Marine Research Centre at the Finnish Environment Institute (SYKE). Alg@line monitors the fluctuations in the Baltic Sea ecosystem in near real time using high frequency automated sampling on board merchant ships (ship of opportunity, SOOP).

The ferry Finnmaid is maintained by SYKE and it is travelling twice a week across the Baltic Proper from Helsinki to Travemünde. The ferry Silja Serenade is cruising nightly between Helsinki and Stockholm and is managed by Uusimaa ELY Centre with

SYKE. In addition to the Göteborg-Kemi ferry line (see previous article by Bengt Karlson), the M/S Brahe is cruising only during the summer months along the Finnish coast of the Gulf of Finland. This ferry is maintained by KAS ELY, Helsinki City Environment Centre

and SYKE. The ferry Baltic Princess is cruising daily between Tallinn and Helsinki and maintained by Marine Systems Institute (MSI), Tallinn University of Technology. The ferry Victoria is cruising from Tallinn to Stockholm and maintained by Estonian Marine Institute (EMI), University of Tartu. The near real time observations of the ferries Finnmaid and Transpaper are displayed in the Baltic Sea Portal (http://www.itameriportaali.fi/en/tietoa/algaline_seuranta/en_GB/algaline_seuranta) and data is transferred also to MyOcean In Situ Thematic Centre database (<http://www.myocean.eu.org>). A Ferrybox monitoring system was installed on the Finnish oil combating vessel Louhi in cooperation of SYKE and Finnish Meteorological Institute in 2011. Also a new Ferrybox monitoring line from St Petersburg–Helsinki–Antwerp–Bilbao is currently in planning.



BALTIC MYOCEAN GROUP AT WORK

Vibeke Huess & Palle Bo Nielsen

The Baltic model group will in the follow up project MyOcean 2 continue the work done in the EU financed project MyOcean. MyOcean succeeded in establishing one entry data portal for users of oceanographic data with easy and free access to many ocean products – both observations and model forecasts – on scales from regional (as the Baltic Sea) to the global ocean. Focus in MyOcean 2 is to improve the service to the users as well as improving the oceanographic products.

The MyOcean Baltic modelling group – the Baltic Model Forecasting Center (BAL MFC) consisting of the partners BSH, DMI, FMI, MSI and SMHI – has in MyOcean 2 been strengthened with inclusion of HZG, Germany. HZG will secure transfer of model research and development knowledge between the seven different regions in the project (the Baltic Sea, North West Shelf, Arctic, Iberian Sea, Mediterranean Sea, Black Sea and the global ocean).

The Baltic MyOcean Products

At the MyOcean web portal www.myocean.eu, we provide real time forecasts for the physical and bio-geo-chemical conditions in the Baltic Sea for the coming two days. The model runs are computed twice per day at DMI acting as the nominal BAL MFC production unit. To secure a robust system, a back-up production is computed independently at BSH - also twice per day.

Furthermore the BAL MFC has computed two different reanalysis products for the physical condition in the Baltic Sea, produced at SMHI and DMI with different data assimilation schemes applied. The monthly means are available on the MyOcean portal for the 20 years period 1990 to 2009 for both reanalysis products.

Free access to all MyOcean products is available on the web portal via the three access concepts:

- Discover which products that are available for a specific area, parameter etc.
- View the data
- Download the data to your own computer (can be done interactively or via an automatic script job)

A user registration is mandatory for download of data. This is because the MyOcean system wishes to have a close contact with the users of the products, both for the purpose of user feedback to improve the system and for providing service messages to the users when incidents occur.

Future plans

For the next two years, we will in the BAL MFC group work on further improving the physical ocean model code – the HIROMB-BOOS-Model (HBM). Three model upgrades are scheduled. DMI and BSH are the main partners in the model code development. The high technical standard of the model codes will continue to be a high priority.

The quality of the model is always verified both before and after a system upgrade by a verification frame work designed by MSI and BSH. This work will continue with special focus on benefits from using a multi model ensemble approach.

Furthermore usage of data assimilation in the Baltic Sea will be investigated in depth by comparing and improving existing schemes. FMI will lead this work. SMHI will focus on reanalysis simulations including a new 20 years product for the bio-geo-chemical conditions in the Baltic Sea.

Vibeke Huess is a physical oceanographer and manages the Baltic model group in the MyOcean project.

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MARINE RESEARCH IN FINNISH ENVIRONMENT INSTITUTE (SYKE)

Seppo Kaitala

SYKE is the research and development institute of the environmental administration of Finland. Its tasks include monitoring and assessment of the state of the environment, pollution loading, land use changes, and water resources. SYKE operates a routine EO-based program for water quality management. The institute further develops, assesses and applies environmental technology and instruments to guide the use and protection of natural resources, and models and methodologies to support the use and management of water resources and marine environment. There is a strong emphasis on SYKE to provide scientific support to the decision making processes concerning large scale environmental problems such as loss of biodiversity, air pollution, climate change, eutrophication of the Baltic Sea and the effects of agriculture on aquatic and terrestrial ecosystems in Finland. SYKE employs around 600 people, 400 of which are scientists.

The SYKE Marine Research Centre (MRC) conducts wide-ranging research on the ecosystems, marine life and state of the open Baltic Sea and the coastal waters around Finland, also assessing the factors that affect the marine environment. A key focus area is to measure and examine the impacts of substances entering the Baltic Sea. SYKE operates two research vessels: R/V Aranda mainly in the open sea area and R/V Muikku in the coastal areas.

The SYKE Data and Information Centre (TK) compiles and manages data systems including GIS and EO information infrastructure and reports to the Finnish environmental administration as well as internationally. Research is conducted in order to provide relevant remote sensing services for operational snow, land cover and water quality monitoring in Geoinformatics and Land Use Division (TK/GEO) of the centre.

SYKE Alg@line provides to BOOS FTP distribution data monitored onboard Finnlines ferry sailing

between Helsinki and Travemünde, occasionally via Gdansk. Data file is updated twice a week. The reported parameters are: date, time, location, water temperature and chlorophyll-a fluorescence. Also 13 coastal stations are reported through BOOS FTP distribution including observations such as station name and time and location, water temperature, oxygen, phosphate, total phosphorus, nitrate, total nitrogen, chlorophyll-a, silicate and turbidity. The more extensive Alg@line information is available through BOOS web page <http://www.boos.org/> under Products/Observations/Algae.

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FINNISH METEOROLOGICAL INSTITUTE IN BRIEF

Pekka Alenius

The Finnish Meteorological Institute (FMI; <http://en.ilmatieteenlaitos.fi>) is a research and service agency under the Ministry of Transport and Communications. FMI is 150 years old and has today over 600 employees. The institute has three major divisions, Weather and Safety, Research and Development and Administration. FMI is operative 24/7.

Weather and Safety division is responsible for the public and commercial weather services, develops and maintains the institute's production system, information management and observations. It has five operative units, Weather and safety centre, Customer services, Development services, Information management services and Observation services. Most relevant parts of Weather and Safety division for BOOS are marine techniques group in Observation services and Oceanographic services group in Weather and Safety centre.

The marine techniques group maintains the sea level stations, installs instruments into the sea and serve

scientists in doing observations onboard research ships. Oceanographic services in the Weather and Safety centre take care of ice service and operational warnings related to marine incidents. They give ice and sea level forecasts and answer to the public questions concerning the present physical state of the sea. They make use of different model results from BOOS members as background information in serving the society.

Research and Development division has eight units, Climate change, Air quality, Meteorology, Marine research, Earth observation, Arctic research, Kuopio unit (a local regional unit) and Consulting services. It can be said that the topics of the division reach from the inner Earth to the planets. FMI has built instruments for space missions for example to Jupiter moon Titan and to Mars. For BOOS the most relevant unit is the Marine research that has three groups, Waves and sea level, Ice research and Marine dynamics and modelling.

Waves and sea level group conducts research on surface waves and sea level and gives consulting services on these topics. They develop wave models, too. One specific topic of the group is studies on CO₂ transfer between the atmosphere and the sea. The group has constructed advanced installation to research ship Aranda for studying the air-sea interaction.

Ice research group develops thermodynamic models for sea ice growth and especially methods for interpreting sea ice properties in the Baltic and Arctic seas from satellite images and radar images.

Marine dynamics and modelling group conducts research on hydrographic conditions of the Baltic Sea and the Arctic Ocean. The group develops and runs several 3D numerical models for the Baltic Sea and conducts field studies on sea currents and surface drift.

All the Marine Research groups are very relevant for BOOS, because they develop the forecasting models that are used to produce the Finnish products in BOOS.

For ship borne observations FMI has an agreement with Finnish Environment Institute (SYKE) on the

use of research ship Aranda that is presently owned by SYKE. Many of the workers of FMI have been developing scientific systems for Aranda and have decades of experience on research cruises.

Recent BOOS-related work in FMI has been the implementation of HBM and Nemo models. HBM has been put to operational work and Nemo has been used for a 47 years long simulation of the Baltic Sea. FMI is now strengthening its cooperation with SeaTrackWeb-consortium.

Some recent developments in observations are the test of an Argo float in the Southern Bothnian Sea and surface drift experiments in the Gulf of Finland. The Argo float has already worked for several months and has collected some 140 profiles during its semi-free floating in that sea area. The Argo float test has already proved to be very successful.

FMI has done several cruises in recent years where surface drift has been measured with freely floating buoys. In 2012's cruise in mid-September FMI used freely drifting wave measuring WaveRiders, AIS-buoys and Iridium buoys. FMI has also some data on the very thin surface drift made with simple floats.

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The first circular

5th FerryBox Workshop - Celebrating 20 Years of Alg@line

April 24-25, 2013, Finnish Environment Institute (SYKE), Helsinki, Finland

Background

Ferrybox instrument packages are used for automatic sample collection and registering measurements on commercial ships. After completion of the EU-funded project 'FerryBox' in 2005, the FerryBox community wanted to improve the combined knowledge and share experience in the use of different underway systems. That was the origin of the FerryBox workshops (<http://www.ferrybox.org/>). The 5th workshop will take place in Helsinki, Finland April 24-25, 2013 at Finnish Environment Institute.

Themes

1. FerryBox as a tool for monitoring; Regional cases.
2. Algae monitoring with Ferryboxes, including ecosystem modeling and EO observations.
3. Greenhouse gas measurements in Ferryboxes.
4. New commercial instruments and applications for Ferrybox monitoring.

Registration and Abstract Submission

Registration will open October 1, 2012. Maximum number of participants will be limited to 80 persons. Priority will be given to those active in FerryBox community. There is no registration fee for participants. A modest financial support expected from companies having presentation or stand (please, contact organizers).

Abstracts (Word file, max 250 words) for oral presentations and posters can be sent from October 1, 2012, to January 31, 2013. Selection of papers will be invited to be published in conference proceedings. Papers will be peer reviewed and published in a scientific journal, celebrating 20 years of Alg@line project.

Send your registration with abstract to the e-mail address algaline@environment.fi, and write "Ferrybox registration" in the subject field. Notification of abstract acceptance will be given latest on February 28, 2013.

Dates and Deadlines

October 1, 2012	Registration and abstract submission opens
January 31, 2013	Deadline for registration and abstract submission
February 28, 2013	Notification of abstract acceptance, preliminary program will be send
May 31, 2013	Deadline for submission of the invited manuscripts

For more information, contact algaline@environment.fi



DEFENCE CENTRE FOR OPERATIONAL OCEANOGRAPHY

Charlotte Wiin Havsteen

On October 3, 2011, The Danish Maritime Safety Administration (DaMSA) was closed as an independent governmental agency under the Danish Ministry of Defence. The tasks and responsibilities of the DaMSA were distributed among four different governmental agencies: the Danish Meteorological Institute (DMI), the Danish Maritime Authority (DMA), the National Survey and Cadastre (KMS) and the Danish Defence. All responsibilities, rights, assets, agreements and personnel have accordingly been transferred to these agencies.

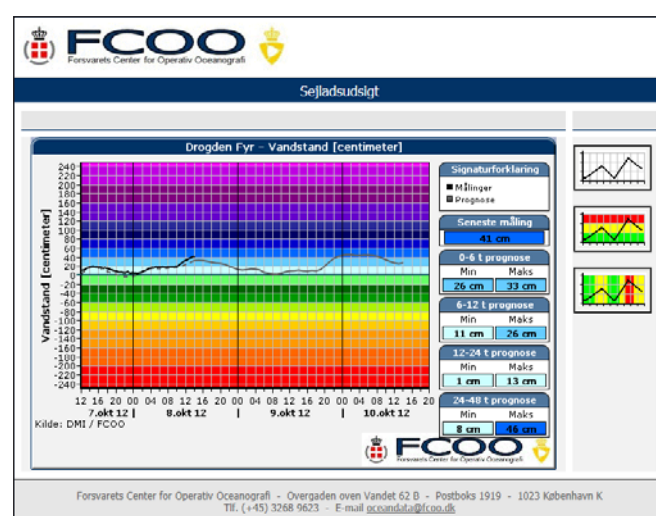
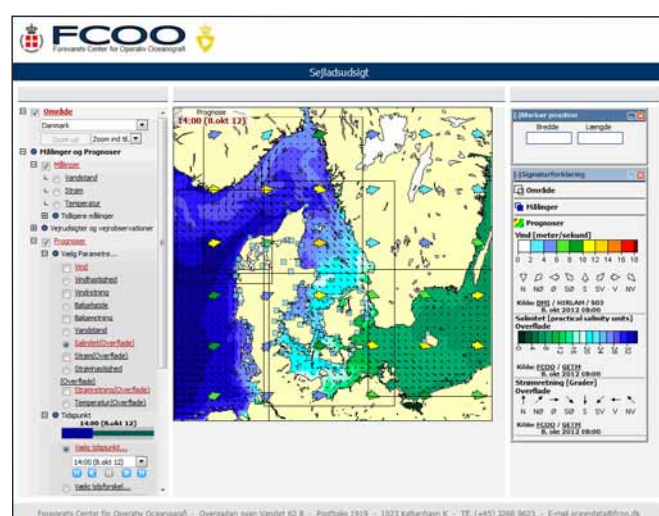
The responsibility for operational oceanographic and hydrographic support to the Danish Defence both at home and abroad, has been transferred along with the Defence Centre for Operational Oceanography (DCOO), to the Danish Defence. DCOO is now part of the Defence Acquisition and Logistics Organization (DALO) and is organized as an independent business area under the Technical Director, Maritime Systems in DALO.

DCOO supports the Danish Defence daily with a wide range of data and products for operations and exercises in Danish and international waters. This includes in particular support to the Admiral Danish Fleet, for example, in connection with Search and Rescue operations and oilspill predictions. Most recently, DCOO supported a large exercise in Danish waters where navies from several nations participated. The support included specially tailored forecasts and tactical decision aids for use during the exercise.

In addition to supporting NATO and the Danish Defence with classified and unclassified data and products, DCOO also supports other governmental agencies and the maritime industry when possible.

To view DCOO civilian forecasts, please see www.dcoo.dk for further information.

*Charlotte Wiin Havsteen is head of the Danish Defence Centre for Operational Oceanography. She has a strong background in geophysics and has worked in the Danish Defence for many years, specializing in meteorological and oceanographic support to the Danish forces.
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ESTONIAN MARINE INSTITUTE AND OPERATIONAL OCEANOGRAPHY

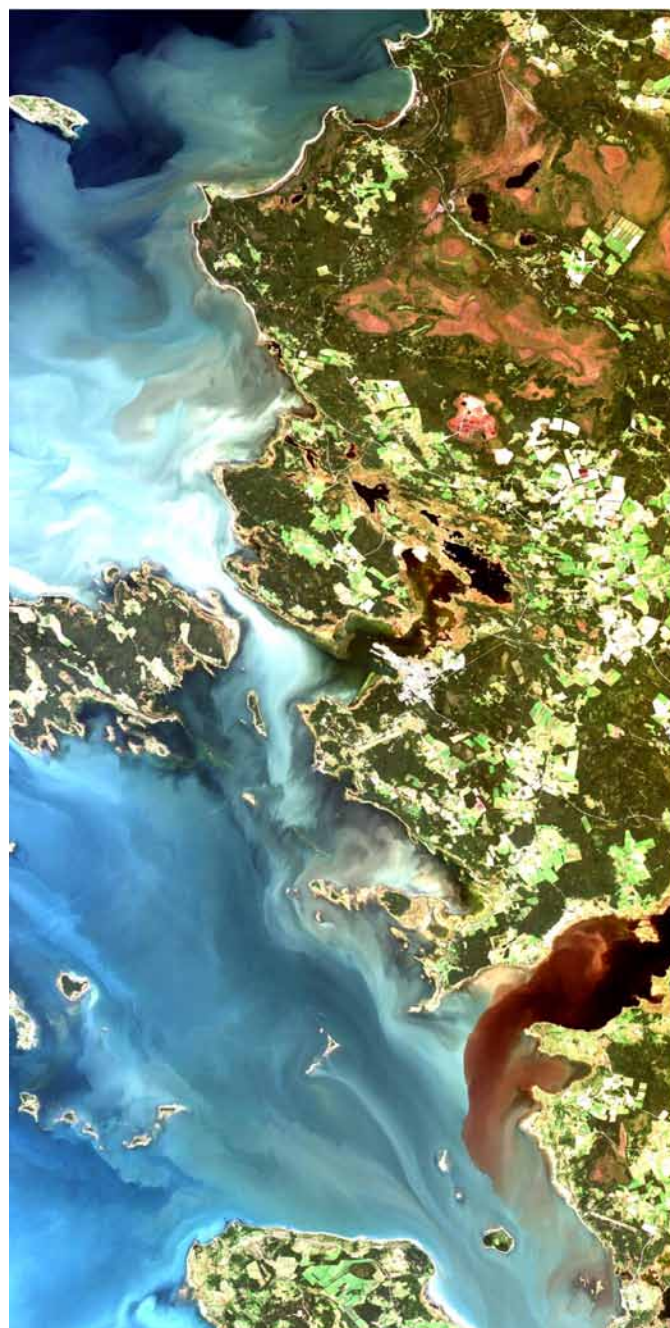
Tiit Kutser

The Estonian Marine Institute (EMI) is one of the biggest organizations in Estonia carrying out marine research in wide variety of fields. Our research ranges from water physics to biology, from microscopic scale to ecosystems and global scale studies having unique expert opinion and qualification in most research fields.

EMI is an educational basis for the marine biology-oriented postgraduate students and is actively improving the advanced and extensive higher marine education in Estonia. EMI (www.sea.ee) was established in 1992 and is currently affiliated to the University of Tartu (www.ut.ee). Scientists at EMI have over 50-years of experience in conducting marine science and providing management advice to stakeholders. Current staff of the institute is more than 130 people working in five departments: Marine Biology, Remote Sensing and Marine Optics, Fish Biology and Fisheries, Marine Systems, and Ecosystem Dynamics. The institute has several field stations (on Saaremaa and Kihnu Islands as well as in Kääsmu and Matsalu) and research vessels both at sea and Lake Peipsi.

Operational oceanography in EMI is carried out by two means of technology: ferrybox and remote sensing. EMI operates a ferrybox system on M/S Victoria I travelling between Tallinn and Stockholm. Data from the ferrybox system is available in the institute web page

www.sea.ee/keskkonna-info-2/ferrybox-4



Variations in optical water quality in Estonian west coast. Image collected with Advanced Land Imager (30 m spatial resolution) on EO-1 satellite.

The Baltic Sea is an optically complex water body. Therefore, the standard remote sensing algorithms, provided by different space agencies, do not provide reliable, stable and sufficiently accurate results here. This has directed work of the Remote Sensing and Marine Optics Department in EMI. Although we provided MERIS standard products to our colleagues and general public in our institute web page <http://www.sea.ee/keskkonna-info-2/kaugseire-rakendus-3> until the demise of the sensor in spring 2012 the main emphasis has been on development of remote sensing algorithms and methods for the Baltic Sea studies and monitoring. The specific applications range from recognition and quantitative mapping of potentially harmful phytoplankton blooms, operative monitoring of water turbidity during anthropogenic impact (dredging, port construction), mapping of

shallow water benthic habitat and water depth for environmental monitoring and spatial planning purposes, mapping water quality parameters (chlorophyll-a, suspended matter, dissolved organic carbon, water transparency, etc.), and testing possibilities of new water parameters to be mapped from space or airborne sensors. EMI Remote Sensing Department is one of the largest in the Baltic Sea region (7 scientists with PhD or higher degrees) and probably the best set of optical instrumentation in the region ranging from underwater instruments for measuring different inherent and apparent water properties and advanced laboratory equipment to an airborne hyperspectral imager.

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Mapping shallow water benthic habitat and coastal water quality (Ele Vahtmäe and Tiit Kutser).

SURVEY CRUISE SCHEDULES

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

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

MSI - <http://www.msi.ttu.ee/index.php?toc=48>



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VWFS Atair

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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Web page www.boos.org

Newsletter is available in pdf format on the web page



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