Volume 7

Spring 2016

NEWS FROM BOOS

NEW

FOCUS ON
NEW DEVELOPMENTS IN THE BALTIC SEA OPERATIONAL OCEANOGRAPHY

IN THIS ISSUE

UPCOMING EVENTS

17-19 May 2016
BOOS Annual Meeting and Scientific Workshop
Sopot, Poland

18-19 May 2016
European Maritime Day
Turku, Finland

23-27 May 2016
Liège Colloquium: Submesoscale processes - mechanisms, implications and new frontiers
Liège, Belgium

24-25 May 2016
EuroGOOS Executive Board Meeting
Brussels, Belgium

25-27 May 2016
EuroGOOS General Assembly 2016
Brussels, Belgium

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,

A year has passed since the publication of the last BOOS newsletter. During that time, many significant changes have taken place for the BOOS community. The new BOOS strategy 2016 – 2020 was drafted, the Modelling Programme Agreement was adopted, and hopefully the Observation Programme Agreement will be adopted at this year's Annual Meeting.

The new BOOS web page is under construction. The old web page served its purpose well, but it was definitely time to make changes. The new web is similar to EuroGOOS', has a modern design, is easier to administrate and is responsive – i.e. it looks good on all devices.

From this issue you will find interesting articles about wave forecasts for the Baltic Sea, a satellite-based operational system for monitoring the Baltic Sea, marine services at IMWM NRI, marine robotics, experiences with gliders and cabled profiling station. This time, the newsletter is a bit more Polish-centered as this year's Annual Meeting takes place in Sopot.

During the past five years, it has been an honor to chair the BOOS community, but it is the time that the next person took over this responsibility. So this is the last issue of News from BOOS that is edited by the MSI team. Thank you to everyone who have contributed.

Urmas Lips
BOOS chair

Baltic Operational Oceanographic System

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

New BOOS strategy 2016 - 2020

Main themes (from the BOOS Steering Group)

The present Baltic Operational Oceanographic System (BOOS) includes two main programmes: BOOS Modelling Programme and BOOS Observation Programme, both dating back to mid-1990s. The main aim of the BOOS is to coordinate, harmonize and develop operational oceanographic observation, information and forecasting systems for the Baltic Sea. It comprises operational agencies and research institutes from all countries bordering the Baltic Sea.

The new BOOS Strategy 2016-2020 focuses on five main areas of co-operation:

1) Service Development;
2) Observations;
3) Forecasting systems;
4) Communication and promotion;
5) Research and Development.

The BOOS Vision 2020 in service development segment foresees that the BOOS and its members are the main providers of operational oceanographic services for the local, national, regional and European users in the Baltic Sea area.

The main goal in the field of in-situ observations is to develop further the multi-platform interdisciplinary network of real-time observations to meet the requirements of Copernicus marine service, marine environment monitoring, climate change studies, maritime affairs and marine research and innovation. It includes the development of the network of Baltic Sea Argo floats, establishment of the Baltic Sea glider port and initiation of the programme of long-term glider sections in the Baltic Sea.

BOOS mission will also be to promote the development of operational applications and use of satellite remote sensing data to increase the quality and capacity the Baltic observational systems, especially in synergy with developed models and collected in situ observations.

Since 2015, an EC funded Copernicus Marine Environmental Monitoring Service (CMEMS), which includes the forecasting system for the Baltic Sea, is in operation. The special conditions of the Baltic Sea, being located at high latitudes, having strong stratification, deep basins and complex coastline require close co-operation of institutes towards high model resolution, two-way nesting and/or application of unstructured grids and flexible mesh, coupled modelling approach (ocean circulation, sea ice, waves, sediment transports, ecosystem, etc.), and extensive usage of operational data-assimilation techniques.

The aim of the communication and promotion strategy is to raise awareness of BOOS both for internal and external users, including governmental, local and regional agencies, industry, marine conventions, and policy makers via the web page (www.boos.org), newsletter and focused seminars/workshops.

The BOOS Research and Development has to envisage the newly emerging fields of operational oceanography, as well as evaluate the latest technologies and methods in oceanography with a potential to fill gaps in the operational system. The most striking new fields in operational oceanography, which need research and development in the coming years, are the dynamics of coastal waters and operational ecology.

A SATELLITE-BASED OPERATIONAL SYSTEM FOR MONITORING OF THE BALTIC SEA ENVIRONMENT - SATBALTYK

Miroslaw Darecki, Mirosława Ostrowska

Satellite remote sensing gives us a powerful tool for monitoring of the marine environment. Although it does not provide us with all demanded parameters, it is the only tool that allows us to specify the selected parameters for the entire body in nearly one moment of time. The importance of such data in modern oceanography and especially in tracking changes of the marine environment, resulting either from progressive eutrophication or as the effects of climate change, could not be underestimated. The only limitation, when data from visible and infrared domain are collected is the cloud cover over the investigated area. Unfortunately in case of the Baltic Sea such situation is very common and therefore often prevents the acquisition of such data.

To overcome this limitation, a synergy with other sources of data is necessary. Only satellite remote sensing, supported by continuous stream of in situ data and data from dedicated hydro physical models, preferably extended to bio-optical parameters, can be an effective tool for regular monitoring of environmental processes in the Baltic Sea. Such synergetic tools can fully satisfy present-day requirements for the continuous monitoring of the marine environment.

Recently executed project SatBałtyk in Poland has developed such a system for the Baltic Sea. The project was carried out during 2010-2015 by the Consortium, which associates four scientific institutions: the Institute of Oceanology PAN in Sopot –the Project coordinator, the University of Gdańsk (Institute of Oceanography), the Pomeranian Academy in Słupsk (Institute of Physics) and the University of Szczecin (Institute of Marine Sciences). Their objective was to develop scientific principles and methods for utilising remote sensing technology to monitor the Baltic Sea, and potentially other enclosed or semi-enclosed seas with a high level of biological productivity. The project is aiming to prepare a technical infrastructure and set in motion operational procedures for the satellite monitoring of the Baltic ecosystem.

As a result, the system was launched which continually monitors, at the moment, some of 70 different structural and functional properties of the Baltic ecosystem. Among them: the solar radiation influx to the sea's waters in various spectral intervals, short- and long-wave radiation budget at the sea surface and in the upper layers of the atmosphere, sea surface temperature distribution, dynamic states of the water surface, concentrations of chlorophyll a and other phytoplankton pigments in the Baltic water, distributions of algal blooms, the occurrence of upwelling events, and the characteristics of primary organic matter production and photosynthetically released oxygen in the water and many others. The parameters currently available in the system have been divided into eight groups: 1. Atmosphere, meteorology, 2. Hydrology, 3. Ocean optics, 4. Radiation budget, 5. Sea water components, 6. Phytoplankton, photosynthesis, 7. Coastal zone, 8. Hazards. The spatial distributions of these parameters are available in near real time to users on the website http://satbaltyk.iopan.gda.pl/ (see Figure 1) or through the SatBaltyk Portal http://www.satbaltyk.pl/. Also historical data are available at the system together with a short forecast of some modelled parameters.

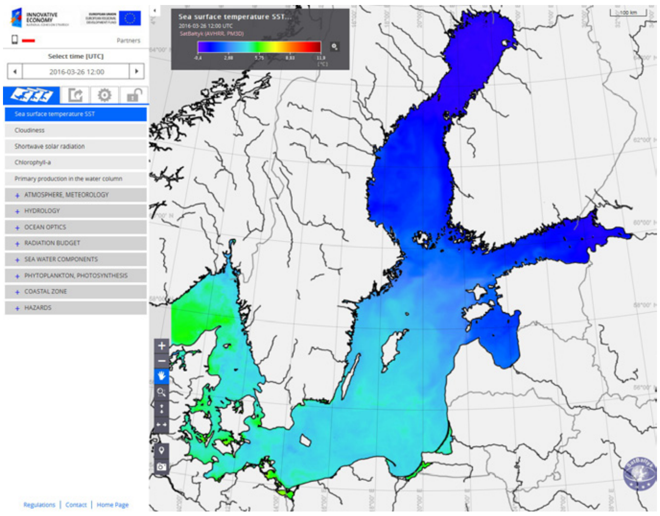

Figure 1. Starting page of the SatBaltic System (http://satbaltyk.iopan.gda.pl/)

The SatBałtyk system utilises data from a number of satellites systematically monitoring the Baltic as well as data from two mathematical models: the diagnostic ones named the DESAMBEM , consists of several bio-optical algorithms, and the prognostic ones referred to as BALTFOS. The environmental parameters determined with the aid of these two systems complement one another: BALTFOS assimilates empirical data obtained from satellite information using the DESAMBEM algorithms, while at the same time filling in gaps in the DESAMBEM data when the satellite retrieval could not be made because the relevant areas were covered by clouds.

The SatBałtyk System is continually being calibrated and corrected on the basis of various in situ measurements acquired during regular cruises on the Baltic of the research vessels r/v Oceania, k/h Oceanograf 2 and the motor boat Sonda 2, as well as from autonomous measurements at the buoys, the instruments installed at the Baltic Beta oil platform, located 75 km north of Polish coast, and in some shore stations situated along the southern coast of the Baltic. This system was established as a result of earlier optical, bio-optical and other studies, which enabled the scientific foundations for the remote-sensing of the complex Baltic Sea environment to be laid. Those studies were performed over many years by cooperating teams of scientists from SatBałtyk scientific consortium.

The launching of the system was only the end of one stage of this cooperation, which will be continued and expanded to new institutions, not only from Poland. Based on that the system will be further developed and improved in subsequent years. With ongoing scientific research continuing to expand knowledge of the Baltic environment, it will become possible to derive ever more accurate mathematical descriptions of the relationships among the various processes taking place in the sea and the atmosphere. Consequently, the set of parameters available in the SatBałtyk system describing the Baltic ecosystem will be extended and matched to the needs of its users.

[1] *project funded by the European Union through European Regional Development Fund, (contract No. POIG.01.01.02-22-011/09 entitled 'The Satellite Monitoring of the Baltic Sea Environment')*

[2] *The DESAMBEM algorithm (DEvelopment of a SAtellite Method for Baltic Ecosystem Monitoring) came into being in 2001–2005 as a result of the implementation of the project The study and development of a satellite system for monitoring the Baltic Sea ecosystem (project No. PBZ-KBN 056/P04/2001) by the Institute of Oceanology (Polish Academy of Sciences, Sopot) in cooperation with the Institute of Oceanography (University of Gdańsk), the Institute of Physics (Pomeranian Academy, Słupsk), and the Sea Fisheries Institute (Gdynia).*

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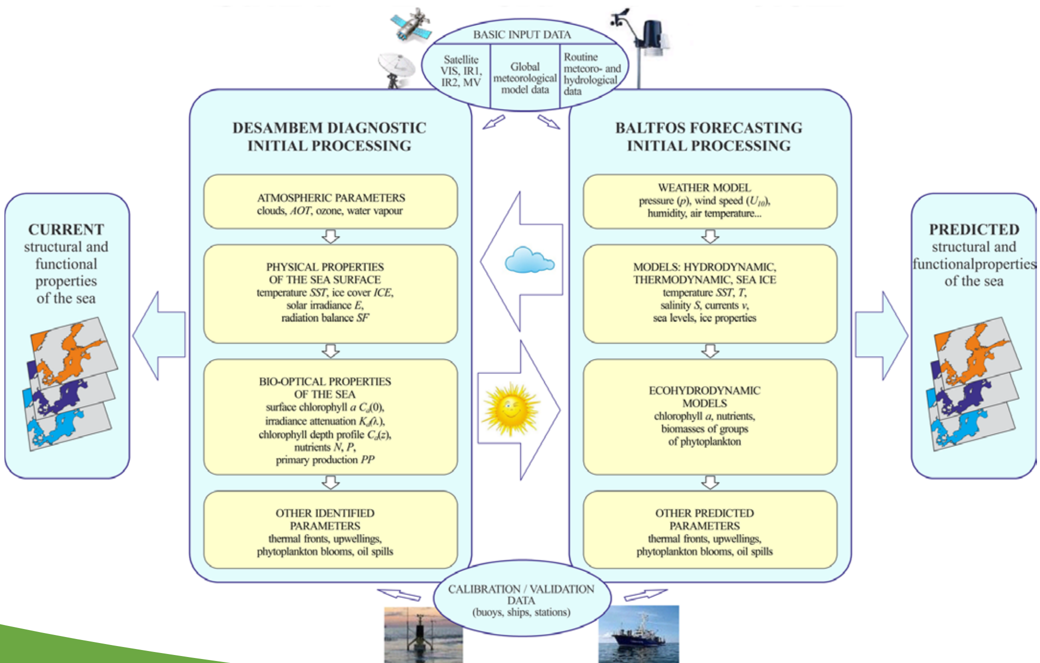


Figure 2. Simplified general block of the SatBałtyk System

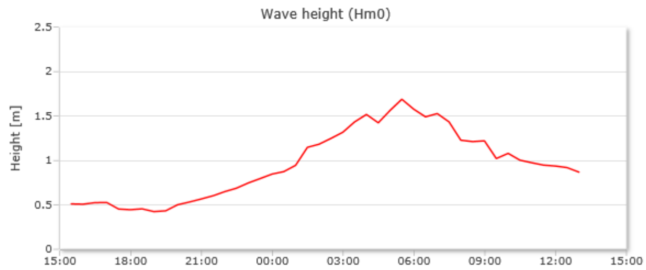
RECENT DEVELOPMENT OF MARINE SERVICES AT THE INSTITUTE OF METEOROLOGY AND WATER MANAGEMENT NRI MARITIME BRANCH IN GDYNIA

Włodzimierz Krzymiński

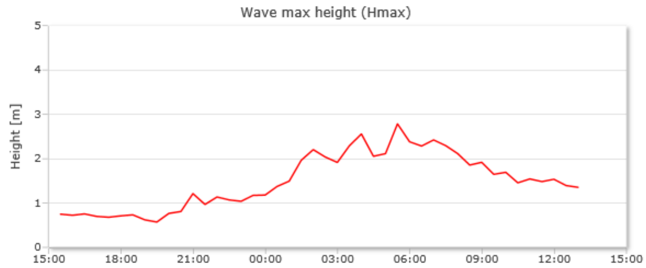
The year of 2015 was a period of extensive actions resulted with new marine operational services of IMWM NRI in the Baltic Sea. The first was the installation of a device (AWAC of NORTEK) for on-line wave measurement, while the second was deployment of the three meteorological buoys. AWAC purchase and installation has been financed from the resources of internal research programme. The financing of the buoys came from the project METEORISK (http://meteorisk.imgw.pl/) in the frames of European Programme "Infrastructure and Environment".

Wave and currents measurements

For the measurements of wave parameters as well as the vertical profile of the currents the Nortek AWAC with operation frequency 600 kHz was deployed and bottom mounted near the oil rig of PETROBALTIC S.A. at the depth ca. 80 meters in June 2015. It is a current profiler and a wave directional measuring system in one unit. It measures the current speed and direction in 5-meters thick layers from the bottom up to the near surface layer. The waves of all varieties are measureable including long waves, storm waves and short wind waves. The AWAC uses Acoustic Surface Tracking (AST) - echo-ranging to the surface with the vertically oriented transducer what improves short waves detection. Thanks to the AST the wave parameters can be derived based on times series analyses with the help of software provided. This means that the AWAC can directly measure wave parameters such as Hmax, H1/10, Tmean etc. The system is cable connected with oil rig, what allows for near real time data transmission to the server at IMWM NRI in Gdynia. Next, data are visualized at the web page http://www.baltyk.pogodynka.pl//ftp/kwd.



An example of the significant wave height records.



An example of the maximum wave height records.
The first data obtained from the system exhibits interesting and valuable information on the currents in the near bottom layers. Some inertial phenomena will be studied further.

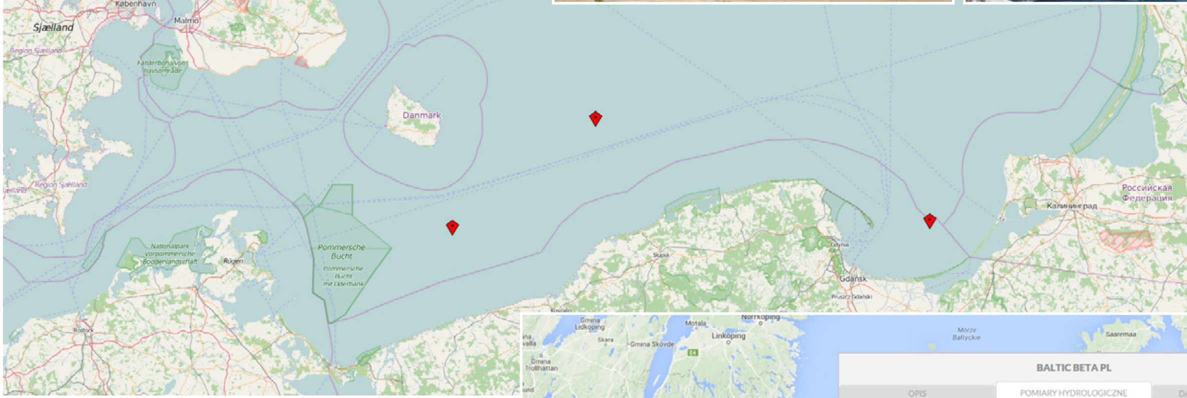
The first data obtained from the system exhibits interesting and valuable information on the currents in the near bottom layers. Some inertial phenomena will be studied further.

Marine meteorological measurements

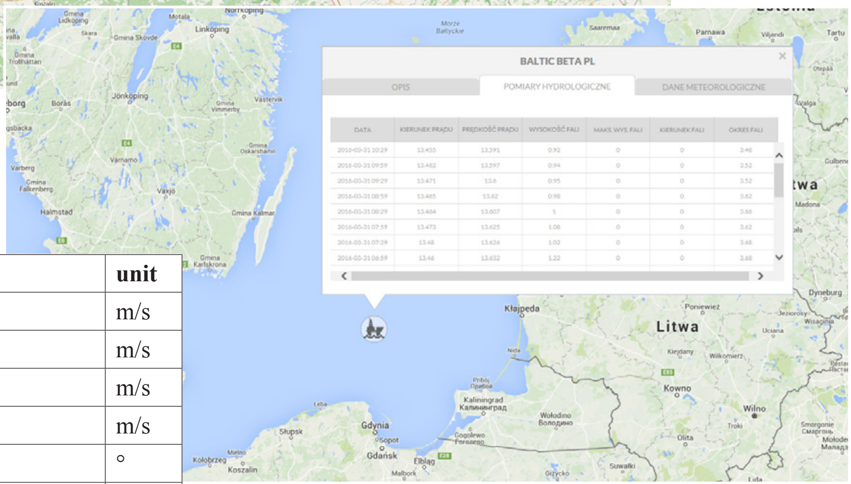
In the frames of the METEORISK project, module 1.6 the "Marine measuring and forecasting system supporting forecasting for marine offshore and onshore areas" was completed in 2015. The main task was the construction and deployment of buoys equipped with sensors for daily measurement of selected meteorological parameters and transmission of the data to the forecast office as well as to be assimilated in meteorological model COSMO. The main objective of the tasks was the improvement of the COSMO model thorough availability of the data for assimilation.

The four buoy systems were assembled and deployed at selected locations. One of the buoys serves for replacement in the case of malfunctioning of the others.

It is required that the system will provide uninterrupted data transmission in 90% of the time per year.



Location of the meteorological buoys within the Polish EEZ.



Location of AWAC in the Polish zone of the Baltic Sea.

Parameters	Description	unit
WSA_2	Wind speed, 2 min. average	m/s
WSA_10	Wind speed, 10 min. average	m/s
WSM	Minimum wind speed	m/s
WSX	Maximum wind speed	m/s
WD_2	Wind direction, 2 min. average	°
WD_10	Wind direction, 10 min. average	°
WD_SD	Wind direction, standard deviation	°
CO	Compass	°
T	Air temperature	°C
PR	Atmospheric pressure	hPa
PT	3 hours atmospheric pressure trend	hPa
PR2	Atmospheric pressure z WS300	hPa
RH_2	Relative humidity, 2 min. average	%
RH_10	Relative humidity, 10 min. average	%

Parameters as measured at the buoys

Date: 31.03.2016 time: 08:00 UTC

time	Buoy			WSM	WSX			WD_SD	CO	T	PR	PT	PR2	RH_2	
2016-03-31 08:11:00	western	5.9	6	4.1	8.3	277.8	281.2	3.2	240	5.1		1.7		94.5	94.5
2016-03-31 08:11:00	middle	6.2	6.2	4.5	8.1	253.9	252.7	2.6	40	4.7	1010	1.9		97.6	97.8
2016-03-31 08:11:00	eastern	5.4	5.4	3	7.1	233.4	227.4	5.9	172	5		.9		89.6	90.5

Example of data presentation

Włodzimierz Krzymiński is a physical oceanographer by education and profession and Head of the Department of Oceanography and Monitoring of Hydrosphere and Atmosphere in IMGW – PIB Maritime Branch in Gdynia. His professional interests include the dynamics of the sea, observations and modelling.
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MARINE ROBOTICS ADVANCES IN FMI

Pekka Alenius

Finnish Meteorological Institute (FMI) tested a Slocum glider in the Bothnian Sea and in the Archipelago Sea in two short experiments in September 2013. The experiments were done together with Plataforma Oceanica de Canarias , PLOCAN (http://www.plocan.eu/index.php/en/), Gran Canary, Spain using their ocean going glider. The experiments were done within an European glider infrastructure project "Gliders for research, ocean observation and management" (GROOM). FMI purchased a Slocum G2 shallow water glider in Autumn 2015. We will begin missions with the new glider in early May in Tvärminne, Gulf of Finland. In the summer we will do a lake experiment in southern Finland and in the autumn the glider will be used in the southern Bothnian Sea. In this context FMI and Balearic Islands Coastal Observing and Forecasting System, SOCIB (www.socib.eu), from Mallorca, Spain plan close co-operation. SOCIB has long experience on using gliders for monitoring and research in western Mediterranean Sea.

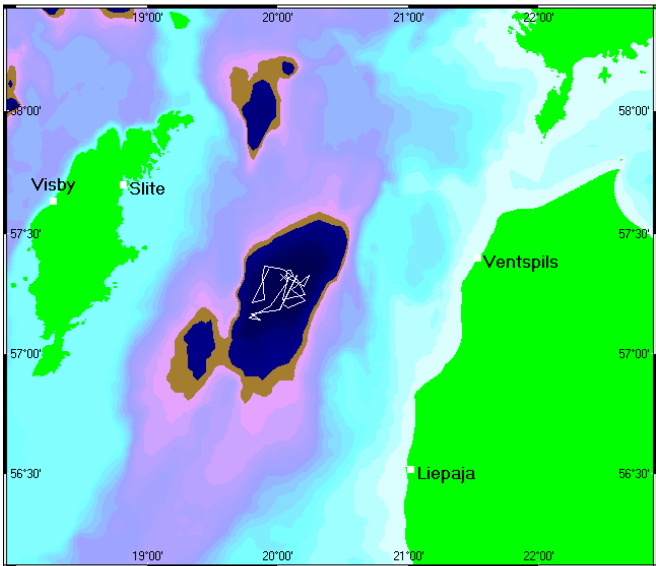
Figure 1. PLOCANs Slocum glider visits the surface at the Bothnian Sea in 16 September 2013.

We hope for a close co-operation in glider usage also with Marine Systems Institute, MSI, Estonia in the spirit of a northern glider port of the Baltic Sea. MSI and FMI have similar gliders, which makes the co-operation even more feasible. The European glider community, which was strengthened within GROOM, has close mutual contacts and we can benefit from the long experience of glider usage in the co-operating institutions around Europe. Already three persons from FMI have participated the glider school that PLOCAN organises annually in Gran Canary (http://gliderschool.eu/). The glider school gives a broad perspective to main glider models and offers direct contacts between glider users and manufacturers including laboratory workshops and short field mission within a work-full week (five and a half days).

Figure 2. Deploying a Slocum glider in the field experiment of the PLOCAN glider school in 23. October 2015.

FMI operates Argo floats in the Bothnian Sea and in the Baltic Sea proper since already a couple of years. We began testing for the Baltic Sea modified Argo floats in 2010. The first over six months long true mission was done in the second half of 2012 in the Bothnian Sea. In the Baltic Sea proper our bio-Argos have been in use since . As a representing entity from Finland in Euro-Argo RI, FMI is continuing this work as part of the routine monitoring of the Baltic Sea. Though our first glider missions will mostly be scientifically oriented projects, we expect that the glider data and results will benefit operational oceanography, too.

Figure 3. FMIs Argo floats route in the Baltic Sea Proper from 5 August 2015 to 11 February 2016.



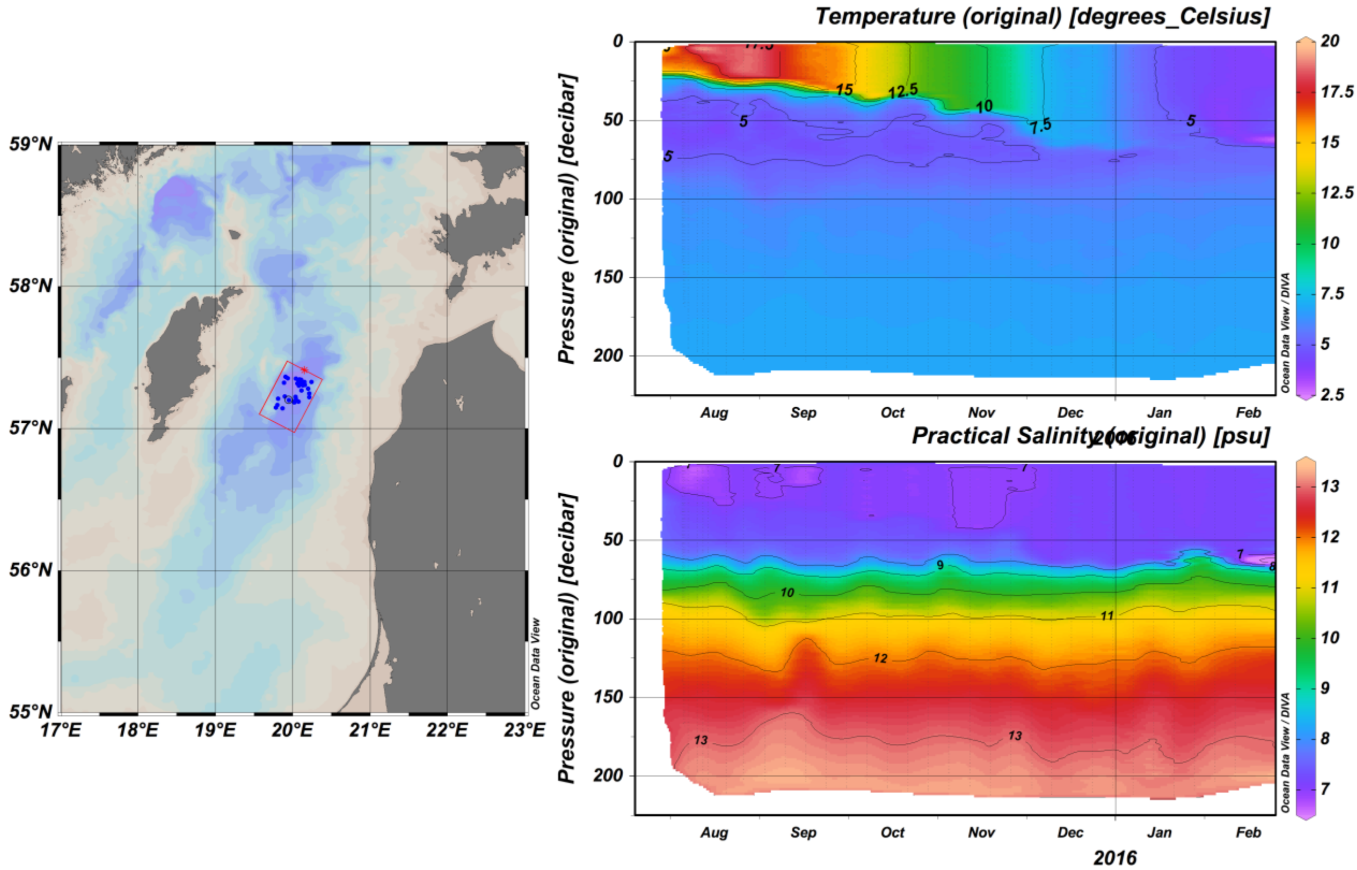


Figure 4. Temperature and salinity time series from the Argo float 5 August 2015 to 11 February 2016 in the Gotland Deep.

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WAVE FORECASTS FOR THE BALTIC SEA AS PART OF COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE

Laura Tuomi

The Baltic Monitoring and Forecasting Centre (BAL MFC) is building a high resolution wave forecasting system for the Baltic Sea as part of Copernicus Marine Service. The forecasts will be operational by the end of 2017 and will be available through Copernicus CMEMS catalogue (marine.copernicus.eu).

The forecasting system is based on Finnish Meteorological Institute's (FMI) operational wave model WAM. The model will have a horizontal resolution of ca. 1 nmi (1.852 km) for the whole Baltic Sea with open boundary at Skagerak. Forcing wind fields will be provided by FMI's weather prediction system HARMONIE with 2.5 km horizontal resolution.

The wave forecasting system will be able to take into account the seasonal ice cover. At first stage, the ice charts provided by Finnish Ice Service will be used to compile ice concentration data for the wave model. Later on, the ice conditions will be provided by a 3D ice-ocean model with the possibility to update the changes in the ice conditions within the forecast runs. Methods to account for attenuation of wave energy in partly ice-covered areas will be implemented in the wave model to increase accuracy of the wave forecasts.

The different characteristics of the Baltic Sea shorelines will be taken into account when compiling the 1 nmi grid for the wave model. For example, to obtain sufficiently accurate wave forecasts in coastal archipelagos a method developed at FMI will be used to find an optimal land-sea distribution for the model grid and to account for unresolved islands at given resolution.

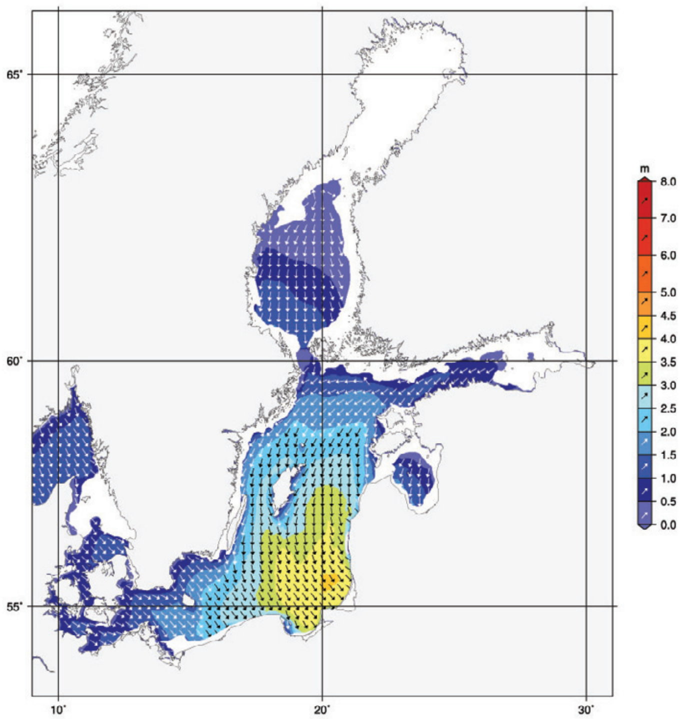

Figure 1. Modelled wave field for the Baltic Sea 20.1.2011 20 UTC. Significant wave height is shown with colour, wave direction with arrows and ice covered areas are marked with white colour. The wave model run is part of calibration period for the Copernicus wave forecast system and test the wave models capability to account for seasonal ice cover

The BAL MFC wave forecasting system will be run operationally at FMI with backup forecasting system at Marine Systems Institute, Estonia. The forecasts will be provided twice a day with two days forecast length.

Laura Tuomi is a physical oceanographer who works as a head of Operational oceanography group in the Marine Research Unit of Finnish Meteorological Institute. Her scientific interest include ocean surface waves, ocean surface layer dynamics and coastal oceanography.

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PROFILERS' NETWORK AND GLIDER SURVEYS BY MSI

Urmas Lips

Marine Systems Institute (MSI) at Tallinn University of Technology operates a network of vertical profilers in the Estonian marine area. The first moored buoy-based vertical profiler (Idronaut s.r.l., Italy) was deployed in the Gulf of Finland in 2009. It measures temperature, salinity and chlorophyll a in the water layer from the sea surface to 50 m depth. The second buoy profiler is in use since 2013. It is capable of profiling from the sea surface to the depth of 100 m, and the instrument package also includes dissolved oxygen, phycocyanin and turbidity sensors. Finally, the major development in the high-resolution vertical profiling was achieved in 2015 when a bottom-mounted profiling station was deployed near the Keri Island (at the depth of 110 m) in the Gulf of Finland. These two new profilers were designed and built by a small enterprise Flydog Solutions LCC (Estonia). The location of profiling stations (in 2015) is shown in Fig. 1.

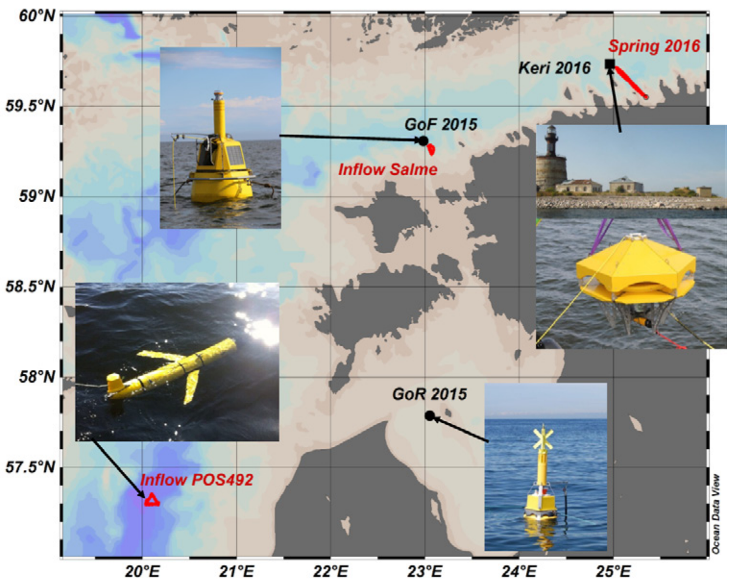

Figure 1. The location of profiling stations (black dots) and glider surveys (red tracks) in 2015-2016.

The main shortcoming in using buoy-based profilers is related to their vulnerability due to ice (and air temperatures below -5 °C), occasional rough wave conditions in the off-shore areas as well as ship traffic and fisheries activities. Nevertheless, the systems have the success rate of >80%. The bottom-mounted profiling station can be operated full year around. The operational use of the Keri station since 1 March 2016 has shown the success rate of 100%. An example of time-evolution of the vertical structure of the water column is presented in Fig. 2 where an arrival of more saline and oxygen-depleted water to the monitoring site in mid-March 2016 can be seen.

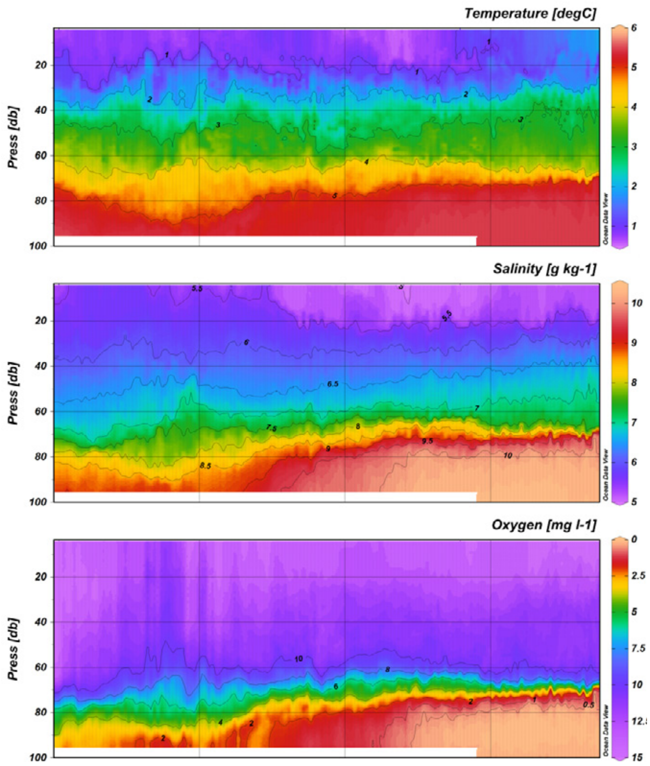

Figure 2. Temporal variability of vertical distributions of temperature, salinity and dissolved oxygen at station Keri in March-April 2016.

Since 2014, a shallow water (200 m) glider MIA (Teledyne Webb Research Slocum G2) is used for different research projects at the MSI – mainly to acquire high-resolution vertical sections of different parameters in connection to certain processes under investigation. For instance, in 2015, the surveys were related to the studies of Inflow 2014 water penetration to the Gotland Deep and further to the northern basins. The glider MIA records temperature, salinity, chlorophyll a fluorescence, dissolved oxygen, and turbidity. An example of vertical sections sampled in the Gulf of Finland mouth area in June-July 2015 is shown in Fig. 3.

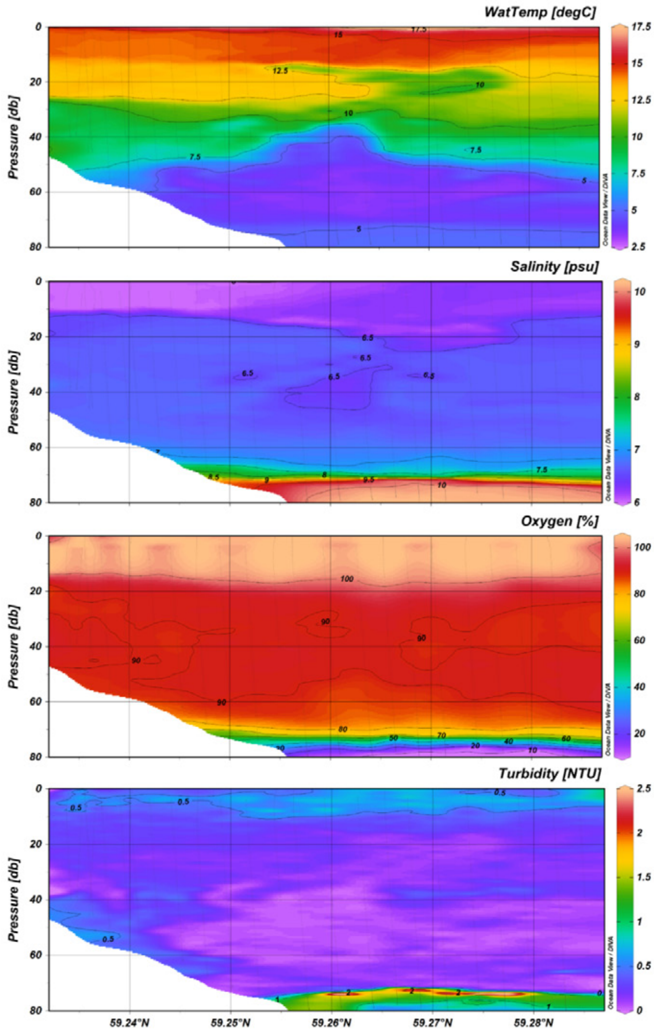

Figure 3. Vertical sections of temperature, salinity, dissolved oxygen and turbidity in the mouth area of the Gulf of Finland (southern slope) in early July 2015.

The glider survey data reveal a quite high spatial variability of measured parameters suggesting that sub-mesoscale processes have a much larger role in the vertical exchanges and re-stratification of the water column in the Baltic than assumed before. For instance, sub-mesoscale features are well seen in the thermocline layer in Fig. 3. Furthermore, using the glider surveys it is possible to map the lateral structure of the turbid layers associated with the Baltic Sea redoxcline (see Fig. 3, lower panel). MSI supports the establishment of a glider port in the northern Baltic Sea area as suggested by FMI.

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HELCOM ON-LINE SYSTEM OF RESEARCH VESSELS

HELCOM has developed and published an on-line information system of research vessels used for the Baltic Sea coordinated monitoring program. The website contains technical parameters of vessels, links to their web sites where survey plans and reports can be found, live map of current positions of research vessels, etc.

HELCOM has adopted a new recommendation on co-operation regarding research vessel based monitoring in the off-shore areas (Rec 37/1). Please, visit the web site and encourage the vessel operators to join the on-line information system, which is a valuable tool to plan and coordinate the operational oceanographic activities in the Baltic.

Helcom Research Vessel Database:
www.helcom.fi/action-areas/monitoring-and-assessment/research-vessels

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