



BOOS Strategy Plan

2004 – 2010



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1. Extended summary

The Baltic Operational Oceanographic System - BOOS - was formed by the signature of the BOOS Memorandum of Understanding in 2001 and the developments within BOOS since then has followed the strategies outlined in the “BOOS Plan 1999-2003” and most of the planned work has been initiated and implemented. It is therefore time to set out new priorities and strategies for the years to come. A strategy for the BOOS work in the period 2004 – 2010 is outlined in the present document, while the more detailed planning and the formulation of an implementation plan will be carried out as an integral part of the EU-funded project PAPA, which was launched on November 1, 2002 and will be terminated on October 31, 2005.

The key word in BOOS Strategy 2004 – 2010 is further integration of the operational oceanography activities in the Baltic Sea, so that BOOS by the end of the period can provide an integrated service to marine users and policy makers in support of safe and efficient off-shore activities, environmental management, security, and sustainable use of marine resources. The strategy involves all elements of an operational oceanographic system:

- Observations including real-time data exchange, quality control and analysis
- Forecast modelling ranging from Baltic scale to local scale with high resolution. The modelling activities will further include assimilation of observations, coupling of models, a multi-model based prediction system for ensemble forecasting.
- Dissemination of products, services and informations, primarily via the BOOS homepage, which in the future shall be a central portal for marine informations on the Baltic Sea.

Implementation of the BOOS strategy will require substantial research and development efforts and its success will heavily rely on cooperation with the marine research community in the Baltic region as well as the ability to attract the necessary funding.

2. Introduction

Marine meteorology has a long record of providing information to all activities at sea dependent on weather and sea states. The infrastructure and service are well established and accepted as important duties, providing benefits to the society. Also in the higher educational system professions on marine meteorology is provided. However, oceanography is so far recognised as a research activity at societal and university level altogether in many countries. Only recently was operational oceanography regarded as an activity needed by the society, while the market sector is far from mature. Most activities are carried out by governmental institutions at national and regional level. The competition from private companies is small, mainly due to a narrow market sector and in most cases an expensive production line. The oceanography infrastructure, needed for the production line, is in most cases carried out by different institutions with low level co-operation in each country and between countries. It is in this important sector the BOOS organisation is providing a strong contribution to the co-operation between institutes within countries as well as between countries in the Baltic Sea area.

The Global Ocean Observing System (GOOS) and EuroGOOS have supported the development of operational oceanographic systems in regional seas such as the Baltic Sea. When EuroGOOS was formed in 1994 it established five regional Task Teams of which one was for the Baltic Sea. The

planning work done within this Baltic Task Team did in 2001 lead to the formation of the Baltic Operational Oceanographic System – BOOS, which is a formal association of institutes from Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany and Denmark taking national responsibility for operational oceanographic services, which shall support the protection of lives and properties and the promotion of the development of society.

The Plans for BOOS for the 2000 – 2003 period was presented in the BOOS Plan (2000). Most of the activities outlined in the BOOS Plan have been initiated, and it is therefore time to lay down the strategy for the years to come.

The work within BOOS will closely follow and address priorities set by the international GOOS and EuroGOOS, but also initiatives taken by the European Union. GMES (Global Monitoring for Environment and Security) is a joint initiative of the European Commission and the European Space Agency, designed to establish a European capacity for the provision and use of operational information for Global Monitoring of Environment and Security.

In 2008 the foundations and the structuring elements of the European Capacity for Global Monitoring of Environment and Security should be in place and operating. This Capacity is seen to be composed of three modules, which together constitute the functional GMES "system":

- the production and dissemination of information in support of EU policies for Environment and Security;
- the mechanisms needed to ensure a permanent dialogue between all stakeholders and in particular between providers and users
- the legal, financial, organisational and institutional frame to ensure the functioning of the system and its evolution.

The ocean component addressing the goals and objectives of GMES is the MERSEA project, funded by EU. MERSEA is developing a framework for ocean monitoring and forecasting on the global scale, with plans for a European Centre for Global Ocean Monitoring and Forecasting by 2008.

BOOS will contribute to the goals of GMES and MERSEA and will form regional centres connected to the planned European Centre.

3. The BOOS Vision

The vision of BOOS is to provide an integrated service to marine users and policy makers in support of safe and efficient off-shore activities, environmental management, security, and sustainable use of marine resources.

BOOS aims to develop a single system for operational monitoring and forecasting of the Baltic Sea and a co-ordinated network of coastal systems. The systems will merge and assimilate diverse data from space-borne sensors and in situ measurement networks in order to monitor the Baltic Sea physics, biogeochemistry and ecosystems and to provide forecasts on prediction time scales ranging from days to months.

BOOS will develop marine applications and services which address the needs of both intermediate and end-users, whether institutional or from the private sector.

The objectives are to:

- Improve the safety and efficiency of maritime transport and marine operations.
- Enable the sustainable exploitation and management of Baltic Sea resources (fisheries).
- Support safe and efficient offshore energy activities.
- More efficiently mitigate the effects of environmental hazards and pollution crisis (oil and chemical spills, harmful algal blooms).
- Contribute to ocean climate variability studies and seasonal climate prediction and their effects on coastal populations.
- Support improved national security and reduced public health risks.
- Advance the Baltic Sea marine research and enlarge the knowledge on the climate, the sea and its ecosystems.

The development of BOOS requires an unprecedented level of collaboration and coordination of multidisciplinary research, development and operational activities. BOOS will federate the resources and expertise of diverse institutes, agencies, and companies in the public and private sector, in the fields of satellite data processing, in situ observing systems, data management, ocean and ecosystem modelling, marine and weather forecasting, and fisheries.

4. Observational strategy

The basic element in an operational forecasting and warning system is the availability of high quality observations in real time for analysis, assimilation into models and model verification. It is therefore the strategy of BOOS to collect all relevant observations using:

- permanent stations
- ship based observations
 - ships of opportunity (SOOP)
 - research vessels
- remote sensing

Observations will primarily be performed by the BOOS members individually, but co-operative efforts in the future are foreseen in implementing new observation technologies or running common observation platforms in order to reach high data quality combined with reasonable production costs.

It is of special importance to improve the rate of supply and distribution of validated observations (in terms of parameters and delivery time) for development and application of nowcasting and forecasting systems, for environmental assessment purposes and for research.

The objectives are to:

- establish, improve and extend existing Real-Time (RT) observation exchange networks for fixed platforms,

- improve environmental monitoring data exchange by setting up Near Real-Time (NRT) networks to exchange temperature-, salinity-, nutrients- and oxygen-data,
- identify methods of harmonising existing national monitoring programmes and stimulate integrated monitoring activities for lacks identified in data supply,
- propose new international monitoring concepts for the Baltic Sea to minimise the individual national operating expense
- enhance the performance of marine observational data resources in the Baltic Sea by making observations and observation products ready for operational and environment assessment models and wider scope of end users
- exchange knowledge in instrumentation-techniques for using robust and stable, and cost-effective sensor types to reduce redundant research and development expenses
- start the planning of cost-effective fixed stations for different parameters reflecting the experience of all members

Marine information products can be provided by analysis of observed data as well as by dynamical modelling. Data analysis and model/data assimilation is essential for using data products in dynamical models. The data analysis procedure should include data quality control and quantitation as well as filling temporal and spatial gaps in observations.

BOOS will define a digital climatology maps of physical parameters for the Baltic area using a compilation of national historical data sets as a basis to evaluate operational data.

An operational observation analysis system for a wide range of parameters has to be established for BOOS to use marine observations efficiently in operational models.

The existing observations have rarely been used in marine nowcasts and forecasts in a basin wide range, not only due to the limited observation exchange, but also due to the lack of unified quality control and analysis systems. BOOS will therefore establish a number of distributed “Data and Analysis Centres” (DAC’s). Each centre will be responsible for the establishment of a shared observation database and for building up a quality control, analysis and archive system for all relevant parameters.

5. Modelling Strategy

The Baltic Sea is one of the most developed regions in operational oceanography in the world. The BOOS partners do operational forecast of ocean currents, temperature and salinity structure, waves, ice, water level and biochemical parameters. They all use state-of-the-art operational marine models. Operational met-ocean forecasts are becoming more and more widely used in marine economy and public service (e.g., storm warning, surge and high waves warning for ports, sailors, oil drift prediction for oil combating etc).

However, several major issues remain to be improved:

- real-time forecasts lack on-line quality evaluation, which is frequently asked by users, esp. when they have access to forecasts from several models;
- in extreme conditions, it is not uncommon to see significant divergence in the forecasts made by different ocean-weather models. This is usually explained by their high sensitivity with respect to initial conditions and parameterisation errors. One way to improve the forecasting accuracy

would be the use of a multi model prediction system. Ocean models and wave models are less sensitive to the initial conditions than the atmospheric models. On the other hand they are more dependent on the boundary conditions such as the bathymetry as well as the forcing from the atmosphere. The multi model prediction system serves therefore similar purpose for ocean and wave models as the ensemble prediction system for atmospheric models (as performed by ECMWF for their 10-day global weather-wave forecast).

- for risk management, a probability forecast could be very useful. However this service is not available now in regional met-ocean forecasting because existing forecasts are made deterministically.
- encourage the development of a basin wide ecosystem model realistic enough to predict the effects of physical and chemical changes in the Baltic Sea on biological processes.

BOOS aims to improve the above issues by establishing a new marine forecast capability through the development and implementation of a Multi-model based ensemble prediction system (MPS) based on integrating forecasts made in all the BOOS members.

To achieve this objective, the following tasks will be implemented:

1. an on-line forecast validation system for model forecasts.
2. Multi-model based Prediction System (MPS).

This will provide an on-line quality index for all exchanged forecasts as well as confidence criteria and probability forecasts for selected parameters.

The MPS will be developed in 3 stages, i.e. development of methods, calibration and demonstration and operational run and evaluation. In the first two stages, a historical data set is used and in the third stage, the forecasts and observations which are being exchanged on-line are used.

The use of community models and workshops to exchange information is essential part of the modelling strategy of BOOS. The diversity needed to support the MPS approach will be obtained by the local implementations. Locally important features eg. in the boundary conditions are best accounted for when each member institute of BOOS will take special care of the features of their own area.

The use of community models will allow the developments of new physics modules that are portable. This means that the adaptation to local features will not be limited to the implementation only.

6. Information and marketing strategy

Informed decisions and policy making can only be based on sound scientific understanding and indisputable evidence. But policy makers need **simplified information summaries** in the form of **indicators and indices**. These are not presently readily available; and those that are available are

not always appropriate to monitoring and understanding Baltic Sea environment. BOOS will seek to develop appropriate indicators on the ocean environment in support of HELCOM as well as EU policy, and will address the objectives and vision of several initiatives such as GMES.

The BOOS partners already produce a variety of operational oceanographic services on a national scale of which storm surge warnings, wave forecasts, drift forecasts, and forecast of sea ice distribution and concentration are the most advanced. These services are distributed to the users via established communication lines (phone, fax), Internet, public media (papers, radio, TV). It is obvious that no operational cross boundary system in any domain can be successful without efficient and robust information exchange and dissemination systems. It is even more obvious that systems relying on data collected in different parts of the Baltic Sea by different parties of co-operation cannot become really operational without such an information system.

BOOS therefore aims at further developing its web based information system (www.boos.org) to be the central information source for Baltic Sea marine informations. The BOOS information system shall therefore contain:

- Presentation of real-time observations
- Products from the BOOS analysis centres
- Forecasts and warnings
- Products from the BOOS MPS
- Links to national Marine Informations Centres which typically will present more local observations and forecasts
- “Indicator or indices” information for policy makers
- Timeseries of selected parameters
- Case scenarios
- On-line decision support tools (like oil-spill models)

Parallel to the improvement and developments of operational oceanographic activities in the Baltic Sea, it is important to promote the products and services generated by the BOOS partners through an marketing campaign addressing a full hierarchy of stakeholders. The marine industries and services sector, governmental agencies and authorities, counties and municipalities, policy-makers, and the marine scientific community will be the main target. The scope is to build momentum towards societal support and seek commitments from governments for operational ocean monitoring and forecasting.

Intermediate users from the public and private sectors will be involved in BOOS marketing campaign to establish a feedback loop delivering continuous assessments of BOOS products in terms of accuracy, reliability, and adequacy to their needs. The design of the BOOS information system will be formulated taking account of their specifications, which will allow for specific delivery of information (*push*) to targeted users, and will plan for easy access by a wider class of customers (*pull*) such as the scientific community and the general public.

Specific objectives of the BOOS Information and Marketing Strategy are to:

1. further enhance a range of operational ocean prediction products;

2. development and demonstration of these products to industrial, governmental and other potential users;
3. demonstrate through a cost-benefit analysis the advantages of having operational ocean forecast products available for a range of services and thereby develop a market for such products;
4. coordinate marketing policies for BOOS.
5. enhance public awareness of BOOS marine products;
6. network operational product producers, value-added marine service providers and end-users, make interactive dialogues between them, performed through a combination of forum and workshops;
7. identify existing and possible expansion of marine market (user requirements and economic significance)
8. disseminate BOOS products (products based on exchanged forecasts, MPS products, exchanged observations and higher level observation products etc. to meet identified end-user needs.

7. Research and development strategy

In the BOOS Memorandum of Understanding it is agreed that the development of BOOS shall be undertaken through projects, which shall be performed by the BOOS partners that have the interest and capacity to do so.. In order to fulfil the strategies outlined in the previous chapters it is therefore of the outmost importance that research and development projects will be run in a more strict and focussed manner. This require:

- Stronger integration with the marine research community in the Baltic region
- Stronger interaction with the instrument manufactures and data communication experts
- Stronger commitment from the participating BOOS partners
- Dedicated funding from internal as well as external funds

The research and development strategy of BOOS shall therefore be based on the following elements:

- BOOS shall be the regional key platform on initiating and co-ordinating marine R&D projects and promoting oceanographic infrastructure in member institutions (measurements, models and products)
- BOOS should have strong links to NOOS and other similar organisations to make advantage of ongoing developments and to avoid double work.
- Support the EuroGOOS R&D Group
- BOOS will be pro-active towards EC on R&D projects, for example in launching new framework programs i.e. the upcoming FP7 and in the Coastal GOOS.

Specifically BOOS should focus the R&D work on the following activities:

- Improve quality assurance (QA) in measurements, data, data exchange and products

- Develop the risk assessment concept on extreme waves and sea levels, currents for ship traffic, oil spills and alga blooms:
 - Identify other potentially hazardous situations,
 - Apply appropriate methods to estimate the likelihood that a hazard occurs, and the uncertainty in that estimate,
 - Provide alternative solution to reduce the risk,
 - Estimate the effectiveness of the solutions,
 - Provide information to base a risk management decision and
 - Estimate the uncertainty associated with the analysis.

- Develop the concept on Indicator Fact Sheets for HELCOM assessments.
- Develop a BOOS Nowcasting system
- Develop data assimilation in oceanographic forecasting models.
- Initiate a summer school on Operational Oceanography.

These key research elements are the necessary steps to obtain a reliable, basic operational system for oceanographic services in the Baltic Sea area.

8. Capacity Building

Education

Operational oceanography is a rather new field of marine knowledge-based activities. Most of the persons active in this field have been educated as research oceanographers, engineers etc. in times when present concepts of operational oceanography were not developed yet. Expertize in different operational oceanography sub-fields is not equally distributed among the BOOS members. Therefore specialized education and training activities are necessary, both for the junior and senior staff.

BOOS members will be active to organize and contribute in the advanced study courses. Partners for such courses will be sought from the universities and funding agencies. BOOS members will contribute also in appropriate lecture topics at university level, including supporting and/or supervising the study themes for Master and PhD students. Hosting the fellowships (including Post-Docs) and on-site training of fellows will be an essential part of the activities at BOOS member institutions.

Science

BOOS aims to be based on the latest results of science. At the same time, several topics for scientific research arise from the needs of BOOS, especially those integrating oceanography and environmental studies with information technology and engineering.

BOOS would be active to take benefits from the developing European Research Area and linking of national research programmes within ERA-NET facilities. More specifically, EU project BONUS

(Bonus for Baltic Sea Science – Network of Funding Agencies) is providing a background for the Baltic Sea marine science development. BOOS members will propagate inclusion of operational topics into the national marine science programmes.

Infrastructure

Largest differences among BOOS partners are evident in the available infrastructure of operational oceanography. Upgrading of observational capability is especially important in the new EU member states and Russia.

Awareness

Success of the activities described above depends on how public opinion and public authorities rank the operational oceanography among other knowledge-based fields of public interest. Within the specific awareness activities BOOS will also cooperate to arise awareness in the Baltic Sea issues in general.

9. Related relevant EU strategies and projects (list)

Implementation of the outlined BOOS strategy will support a number of EU strategies and benefit from the outcome of several EU-funded projects:

EU strategies

- EU Marine Policy and Marine Strategy
- Global Monitoring for Environment and Security

Relevant EU funded projects

- PAPA
- MERSEA Strand 1
- MERSEA IP
- ODON
- FERRYBOX