

ICES WGGIB REPORT 2008

ICES BALTIC COMMITTEE

CM2008/BCC:03

Report of the ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic (WGGIB)

26–28 February

Gothenburg, Sweden



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Recommended format for purposes of citation:

ICES. 2008. Report of the ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic (WGGIB), 26-28 February, Gothenburg, Sweden. CM2008/BCC:03. 15 pp.

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Executive summary

The ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic (WGGIB) met in Gothenburg, Sweden, 26-28 February 2008 to:

- a) review progress in implementation of the GEOHAB-BALTIC cooperative research plan;
- b) define processes and plan experiments that are needed for better parameterization of dynamical HAB models;
- c) review the progress of incorporating the Baltic HAB list into the IOC Taxonomic Reference List of Toxic Plankton Algae;
- d) discuss and report on the need of a Baltic HAB researcher network, in the light of the WGHABD comments on WGGIB performance.

GEOHAB Implementation in the Baltic

The “BALTIC GEOHAB – Cooperative Research Plan”, finalized by WGGIB in 2007, was briefly reviewed and discussed. It was considered a useful platform and framework of future HAB studies in the Baltic Sea. It was noted that a few HAB projects (such as BANSAL, MARCOAST and SEED, as well as certain locally funded activities) are presently going on. A few of them and their basic results were presented by the participants.

Development of HAB modelling in the Baltic

It was noted that the general goal of the HAB modeling should be, according to the GEOHAB-BALTIC, to develop species-of-interest and ecosystem models that allow reliable prediction of HAB development in their natural physico-chemical environment. This requires development of various types of models, with various scales. The Group also held that models that take into account the potential effects of climatic change on the functioning of the Baltic Sea will be very useful for the abatement of the eutrophication of the Baltic Sea.

Incorporating the Baltic HAB list into the IOC Taxonomic Reference List of Toxic Plankton Algae

No changes needed to be imposed on the list of “Potentially harmful phytoplankton species in the Baltic Sea”, annually updated by the group. It was held important that the Baltic HAB species, either toxic or potentially harmful - are considered in the global context. Also, since a web based list, such as the IOC Taxonomic reference List of Toxic Plankton Algae (<http://www.bi.ku.dk/ioc/>) exists, it was decided that the experts of the Group start incorporating the Baltic HAB list into the IOC taxonomic reference List of Toxic Plankton Algae.

Development of Baltic HAB researcher network, and the future of WGGIB activities

The Group thoroughly discussed the future need of a Baltic HAB researcher network and the necessity of continuing the WGGIB activities. It was noted that the implementing of the BALTIC-GEOHAB depends very much on external funding, and on the willingness of the various research groups to cooperate. Thus the role of WGGIB as a platform of cooperation diminishes as soon as the specific projects get funded.

Finally the Group decided to finish WGGIB as such, but to actively promote participation of Baltic HAB experts in WGHABD that reports to the Oceanography committee.

WGHABD is a good active group with international experts, and interaction between Baltic HAB scientists and WGHABD was found to be most useful. WGHABD can take the responsibility of implementing GEOHAB goals, also because it is a group focused on HAB dynamics.

It was however held imperative that the WGHABD will retain the Baltic issues, including cyanobacteria, on their future agendas and terms of References, and relevant recommendations were added into the WGGIB report.

1 Opening of the meeting

The ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic (WGGIB) met in Gothenburg, Sweden, 26-28 February 2008 in Gothenburg, Sweden. The meeting was hosted by the SMHI Oceanographic Unit.

Altogether 8 scientists from Finland, Sweden, Germany and Poland participated. The list of participants is presented in Annex 1 and the meeting agenda in Annex 2.

The meeting was opened by the Chair, and the participants introduced themselves.

2 Adoption of the agenda

The agenda was approved and the chairman agreed to keep track of the discussions and prepare the draft report for the group.

3 Terms of reference for 2008

At the 94th Statutory Meeting (2007), Helsinki, Finland, the council approved the proposed terms of reference.

The ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic [WGGIB] (Chair: M. Viitasalo, Finnish Institute of Marine Research, Finland) will meet in Gothenburg, Sweden, February 2008 to:

- a) review progress in implementation of the GEOHAB-BALTIC cooperative research plan, with:
 - reports from the projects in progress;
 - reports from projects at planning stage;
- b) define processes and plan experiments that are needed for better parameterisation of dynamical HAB models;
- c) review the progress of incorporating the Baltic HAB list into the IOC Taxonomic Reference List of Toxic Plankton Algae;
- d) discuss and report on the need of a Baltic HAB researcher network, in the light of the WGHABD comments on WGGIB performance.

4 Progress in implementation of the GEOHAB- BALTIC cooperative research plan

The “BALTIC GEOHAB – Cooperative Research Plan”, finalized by WGGIB in 2007, was briefly reviewed and discussed. It was held a useful platform and framework of future HAB studies in the Baltic Sea.

It was noted that a few HAB projects (such as BANSAL, MARCOAST and SEED, as well as certain locally funded activities) are presently going on. A few of them and their basic results were presented by the participants.

Ann-Turi Skjevik (SMHI) presented recent results of cyanobacteria monitoring activities around Sweden. The obvious differences between the developments of different HAB species in the different study areas highlighted the need of high frequency sampling, as well as the need of retaining monitoring methods and sampling prac-

tises that allow determination of phytoplankton species at the highest possible taxonomic resolution (species or species groups).

Martin Hansson (SMHI) presented recent satellite monitoring results. He reviewed the strengths and shortcomings of the satellite methods, and noted the very high interannual variability in the strengths of the blooms. He noted that, despite the opposite has been claimed, the available 2-3 decades of satellite monitoring does not prove an increasing trend in the cyanobacteria blooms in the Baltic Sea.

Günther Nausch (IOW) gave an update of certain German projects studying the phosphorus regulation of cyanobacteria. He highlighted the importance of methodologies and pointed out that not always can the reasons for inter-annual differences in bloom strength be explained by the observed nutrient dynamics.

Markku Viitasalo (FIMR) presented the EU-funded HAB research project, "SEED - Life cycle transformations among HAB species, and the environmental and physiological factors that regulate them". The objective is to understand the importance of the different life history parameters in the HAB bloom formation, and hence the relative importance of anthropogenic vs. natural causes. The major differences in the overwintering strategies have been documented between the dominant cyanobacteria species in the Baltic.

Also, projects at planning stage, such as the plans for a Polish national bloom monitoring programme using ferryboxes, a German project that will study the overwintering strategies of HAB species and cyanobacteria nutrient dynamics, and Swedish plans to use automated optical techniques were presented and discussed.

Finally it was noted that there is a huge potential for HAB studies in the institutes and universities around the Baltic, but that the actual implementing of the BALTIC GEOHAB, i.e., setting up GEOHAB-endorsed research projects within the Baltic region, depends very much on external funding, and on the willingness of the various research groups to cooperate. Various HAB research consortia had been formed and joint Letters of Intent had been recently submitted for the BONUS+ call, but knowledge of their success was not yet available.

5 Development of HAB modelling in the Baltic Sea

According to the GEOHAB-BALTIC plan the general goal of the HAB modeling should be to develop species-of-interest and ecosystem models that allow reliable prediction of HAB development in their natural physico-chemical environment.

Kari Eilola, SMHI, presented preliminary results from an ongoing research project at SMHI in collaboration with Gothenburg University and financed by the Swedish research council FORMAS. The project aims to develop an ecosystem model that predicts the impacts of anthropogenic increase of nutrients, and the environmental changes induced by the climatic change, in the development of the future phytoplankton biomass, especially cyanobacteria.

A high-resolution 3D coupled biogeochemical-physical ocean model is used to evaluate the impact on the probability for the occurrence of cyanobacteria, deep water oxygen concentrations, excess dissolved inorganic phosphorus (DIP), biomass production and length of productive season, nutrient budgets, sources and sinks, and the surface water visibility. Furthermore, the impact of future climate changes will be addressed using a dynamical downscaling approach with a regional coupled atmosphere-ocean climate model.

The presentation was held very interesting and it launched a vivid discussion. It was noted that ecosystem modeling always involves simplifications and approximations. The modeling community needs to develop methodologies for estimating errors associated with forcing and initialization data as well as due to approximations in physical/biological models.

However, the Group was unanimous that these kinds of models that also take into account the potential effects of climatic change on the functioning of the Baltic Sea will be very useful for the abatement of the eutrophication of the Baltic Sea.

6 Incorporating the Baltic HAB list into the IOC Taxonomic Reference List of Toxic Plankton Algae

It was noted that no new changes need to be imposed on the list of “Potentially harmful phytoplankton species in the Baltic Sea”, annually updated by the group.

The possibility of incorporating the list into the IOC Taxonomic reference List of Toxic Plankton Algae (<http://www.bi.ku.dk/ioc/>) was discussed. It was noted that the present IOC list does not include cyanobacteria at all, and that this list emphasizes the word “toxic”, while the Baltic Sea list also includes “potentially harmful species”. Obviously, these issues should be cleared before the Baltic species list can be incorporated into the IOC list.

It was however held important that the Baltic HAB species, either toxic or potentially harmful - are considered in the global context. Also, since a web based list was held more easily accessible than a separate list updated by WGGIB, it was decided that the experts in the Finnish Institute of Marine Research and SMHI will contact the IOC Taks Team of Algal Taxonomy, in order to start incorporating the Baltic HAB list into the IOC taxonomic reference List of Toxic Plankton Algae.

7 Development of Baltic HAB researcher network, and the future of WGGIB activities

Originally the SGGIB (later WGGIB) was formed to prepare a GEOHAB endorsed cooperative research plan. This task was fulfilled in WGGIB 2007 in Helsinki, when the BALTIC-GEOHAB plan was finalised.

In Helsinki it was however decided that the Group will meet at least once, to review the progress of ongoing HAB projects, and due to the need of developing a functional network between the different projects and between Baltic HAB scientists. The necessity of any further meetings was left to be decided in this meeting.

In Gothenburg it was noted that there have been differing opinions on what grounds the WGGIB should meet: whether it is useful to meet to share new findings and build contacts, or should the only focus be in the implementation of the GEOHAB-BALTIC. The group has emphasized the need of communication of results, whereas the implementation has been emphasized by the GEOHAB Scientific Steering Committee. It was agreed that the group indeed should meet primarily to plan and implement projects and activities approved by GEOHAB.

Finally, it was noted that presently a formal Baltic HAB researcher network may not be necessary, if other means of communication and cooperation are established.

As for the future of the WGGIB, the following alternatives were discussed:

- 1) Retain WGGIB. Continue keeping up exchanging information and planning further cooperation on Baltic HAB research. Promote the implementation of various parts of the BALTIC GEOHAB plan.
- 2) Finish the Group and form an informal "Baltic HAB workshop/mini-symposium", which takes place e.g. biannually.
- 3) Finish the Group and suggest another type of Baltic HAB group to the ICES, such as "WG on Dynamics, Toxins and Ecosystem Effects of HABs in the Baltic Sea".
- 4) Finish the group and promote participation of Baltic HAB experts in WGHABD.

Pros and cons of the different alternatives were thoroughly discussed. Finally the alternative 4 was chosen, e.g., because of the following reasons:

- The cooperative plan is done. It can be used as a starting point for the implementation of GEOHAB goals in the Baltic.
- The BALTIC GEOHAB is a large consortium of different projects and activities. It cannot be realized without further funding. Also, the implementation depends very much on the willingness of the various research groups to work together. Thus WGGIB cannot take a coordinating role in GEOHAB implementation unless several institutes, countries and funding agencies support BALTIC GEOHAB.
- Presently there is some overlap, as well as common interests, between the activities of WGGIB and WGHABD (the Working Group of Harmful Algae Bloom Dynamics, that reports to the Oceanography Committee).
- WGHABD is a good active group with international experts. Interaction between Baltic HAB scientists and WGHABD is most recommendable.
- Incorporating WGGIB activities into a thematic group such as WGHABD promotes a more problem oriented and less local approach.
- WGHABD could take the responsibility of implementing GEOHAB goals, since it is a group focused on HAB dynamics.
- Many of the WGGIB members are also active in WGHABD. It is more practical to travel to just one WG meeting instead of two.

In conclusion, the Group decided to finish WGGIB as such, and to move its activities, including the GEOHAB implementation, into WGHABD. The Group decided to actively promote participation of Baltic HAB experts in WGHABD.

8 Other Business

The Chair thanked the hosts – SMHI and Bengt Karlson – for excellent arrangements for the meeting in Gothenburg and the WGGIB group for support during the past years.

Annex 1: List of participants

| NAME | ADDRESS | PHONE/FAX | EMAIL |
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Annex 2: Agenda

ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic [WGGIB]

26-28 February 2008, SMHI, Oceanographic Unit, Gothenburg, Sweden

Chair: Markku Viitasalo, Finnish Inst. of Marine Research

Email: markku.viitasalo@fimr.fi

Mobile: +358-40-5034848

Tuesday, February 26, 2008

12:30 Lunch

13:30 Welcome & Introduction of participants; adoption of the agenda (M. Viitasalo, FIMR)

14:00 **ToR a) Review progress in implementation of the GEOHAB-BALTIC co-operative research plan** (M. Viitasalo)

14:30 **ToR a-1) Reports from the HAB research projects in progress**

- Ann-Turi Skjevik & Bengt Karlson (SMHI): Long term trends of cyanobacteria blooms in the Baltic – results from cell counts.
- Martin Hansson (SMHI): Satellite monitoring of HAB cyanobacterial blooms in the Baltic Sea 1997-2007

15:30 Break

15:45

- Günther Nausch, Monica Nausch & Hans Ullrich Lass (IOW): Phosphorus regulation of cyanobacteria development in the Baltic Sea - what do we really know?
- Discussion on Cyanobacteria nutrient dynamics.

~16:45 Adjourn for the day

Wednesday, February 27, 2008

09:00 **ToR a-1) Reports from the HAB research projects in progress**

- Markku Viitasalo (FIMR): SEED - Life cycle transformations among HAB species, and the environmental and physiological factors that regulate them

09:30 **ToR b): Define processes and plan experiments that are needed for better parameterisation of dynamical HAB models**

- Kari Eilola (SMHI): Modelling harmful algal blooms in a future climate of the Baltic Sea
- Discussion on modeling

10:30 Break

10:50 **ToR a-2): Reports from projects at planning stage**, including existing BONUS+ plans.

- Hanna Mazur-Marzec (Univ. Gdansk): Plans for Polish national bloom monitoring programme using ferrybox technique.
- Bengt Karlson (SMHI): MARINESENS
- Discussion on cooperation in using FerryBoxes and buoys

12:30 Lunch

13:15 Tour of the lab**13:30 ToR b): Define processes and plan experiments that are needed for better parameterisation of dynamical HAB models**

- Discussion on modeling

~13:50 ToR a-2): Reports from projects at planning stage, including existing BONUS+ plans.

- Markku Viitasalo (FIMR): BONUS+ initiative "SeaHealth"
- Günther Nausch (IOW): BONUS+ initiative PRECYP
- Günther Nausch (IOW): BONUS+ initiative RECRUIT

14:30 Break

14:45 Bengt Karlson: Present status of B-NEAT, Baltic and North East Atlantic Taxa (www.test.b-neat.org/home/)

15:00 ToR c): Review the progress of incorporating the Baltic HAB list into the IOC Taxonomic Reference List of Toxic Plankton Algae

- Bengt Karlson: Presentation of the status of the incorporation.

16:00 ToR a) ...continued

- Emil Vahtera & Markku Viitasalo (FIMR): Baltic HAB dynamics research – gaps in knowledge.
- Discussion on gaps in knowledge, and possibilities for uniting existing and planned activities (incl. BONUS+ work)

~17:00 Adjourn for the day

Thursday, February 28, 2008

09:00 ToR d): Discuss and report on the need of a Baltic HAB researcher network, in the light of the WGHABD comments on WGGIB performance.
Discuss the need of a Baltic HAB researchers' meeting in 2009 (possibly in the context of BONUS+).

11:00 Other business

Terms of reference for 2009; meeting place for 2009.
Deciding on WGGIB future & chairing in 2009-
Meeting adjournment.

12:00 *Lunch*

Annex 3: WGGIB Terms of Reference for 2008

2007/2/BCC03 The ICES-IOC Working Group on GEOHAB Implementation in the Baltic [WGGIB] (Chair: M. Viitasalo, Finland) will meet in Gothenburg, Sweden, in 27–29 February 2008 to:

- a) review progress in implementation of the GEOHAB-BALTIC cooperative research plan, with:
 - i) reports from the projects in progress;
 - ii) reports from projects at planning stage;
- b) define processes and plan experiments that are needed for better parameterisation of dynamical HAB models;
- c) review the progress of incorporating the Baltic HAB list into the *IOC Taxonomic Reference List of Toxic Plankton Algae*;
- d) discuss and report on the need of a Baltic HAB researcher network, in the light of the WGHABD comments on WGGIB performance.

WGGIB will report by 30 April 2008 for the attention of the Baltic Committee.

Supporting Information

| | |
|--|---|
| PRIORITY: | The current activities of this Group will lead ICES into issues related to the effects of HABs on Baltic Ecosystem, as well as fisheries. Consequently these activities are considered to have a high priority. |
| SCIENTIFIC JUSTIFICATION AND RELATION TO ACTION PLAN: | <p>Action Plan No: 1.</p> <p>Term of Reference a)</p> <p>There is currently an intense research activity on HABs in the Baltic. It is in the interest of ICES, IOC and GEOHAB to foster international cooperative HAB research in the Baltic Sea. In 2007, the BALTIC GEOHAB – Cooperative Research Plan was prepared. This Cooperative Plan was intended to serve as a platform for more specific research projects to which funding will be applied during 2007 and 2008. For the implementation of the Cooperative Plan it is necessary to review the progress of the newly formed projects.</p> <p>Term of Reference b)</p> <p>The ultimate goal of the BALTIC GEOHAB is to develop means for better observation and prediction of HAB blooms in the Baltic Sea. To achieve this, ecosystem models are a primary tool. However, there are still gaps in knowledge in key parameters necessary for reliable modelling of HABs. These processes need to be identified and explicit experiments need to be designed to fulfil the existing gaps and to parametrise the models.</p> <p>Term of Reference c)</p> <p>A list of potentially toxic and bloom forming species has been prepared during the former SGGIB and WGGIB meetings. In 2007 it was decided that this information should be incorporated into the <i>IOC Taxonomic Reference List of Toxic Plankton Algae</i> .. Until this is completed the Baltic list will be updated if necessary.</p> <p>Term of Reference d)</p> <p>One of the GEOHAB objectives is to promote the cooperation and networking of HAB scientists. This Term of Reference intends to investigate if there is a need for a formal organisation of Baltic HAB scientists.</p> |
| RESOURCE REQUIREMENTS: | Part of the research that provides input to this group are already underway in the participating countries, and resources are already committed. Additional resources will be sought for from various sources to build up research projects to implement different subtasks of the Cooperative Plan. |

| | |
|--|---|
| PARTICIPANTS: | In 2007 the Group was attended by 19 participants |
| SECRETARIAT FACILITIES: | None. |
| FINANCIAL: | No financial implications. |
| LINKAGES TO ADVISORY COMMITTEES: | There are no obvious direct linkages with ACOM. |
| LINKAGES TO OTHER COMMITTEES OR GROUPS: | There is a close working relationship with several working groups in the Oceanography Committee (Harmful Algae Bloom dynamics, Working Group on Modelling of Physical/Biological Interactions). The scientific content of the planned projects will be reported through WGHABD. |
| LINKAGES TO OTHER ORGANISATIONS: | The Group is fulfilling the requirements of IOC and GEOHAB to foster international cooperative HAB research in the Baltic Sea. |

Annex 4: Recommendations

| RECOMMENDATION | ACTION |
|---|---|
| 1. As of 2009, the WGGIB activities will cease. WGGIB recommends the Baltic HAB researchers to actively bring their scientific issues to the attention of WGHAB members and, if possible, actively participate in the WGHABD. | To the attention of Baltic Committee and WGGIB members |
| 2. WGGIB recommends maintaining the Baltic HAB and cyanobacteria issues on the WGHABD agenda, perhaps in the form of specific terms of Reference. | To the attention of Oceanography Committee, Baltic Committee and WGHABD members |
| 3. WGGIB recommends that WGHABD and the former WGGIB members suggest a cyanobacteria oriented Special Session in the ICES ASC 2010. | To the attention of WGGIB and WGHABD members |

Annex 5: Abstracts of the presentations

Long term trends of cyanobacterial blooms in the Baltic – results from cell counts

Ann-Turi Skjævik & Bengt Karlson (SMHI, Sweden)

Diagrams from 5 different sampling stations in the Baltic Sea were analysed; BY2 (Arkona Basin), BY5 (Bornholm Basin), BY15 (Eastern Gotland Basin), BY31 (Landsort Deep) and B1 (Askö). BY31 and B1 are high frequent stations (sampling twice a month), BY2, BY5 and BY15 are sampled once a month. The sampling method has been by hose, 0–10 or 0–20 meters, and analysis has been done using the Utermöhl method.

Data is from the period June-September, when cyanobacteria blooms are most likely to appear. The time series differ between stations. BY2, BY5 and BY15 have been sampled for phytoplankton since 1999, B1 since 1992 and BY31 since 1990.

At BY2 and BY5, the total amount of cyanobacteria biovolumes and the genus *Aphanizomenon* has been decreasing during the period 1999-2000.

At BY31 and BY1 there has been a significant increase in biovolumes of *Nodularia spumigena* and *Anabaena* spp. However, when weighted summer mean values has been used, *N. spumigena* has had a nonsignificant increase at BY31.

The Baltic Algae Watch System – a Remote Sensing Application for Monitoring of Cyanobacterial Blooms in the Baltic Sea

Martin Hansson & Bertil Håkansson (SMHI, Sweden)

The summer bloom of nitrogen-fixing cyanobacteria in the Baltic Seaduring 2006 had the highest intensity recorded during the period 1997-2006. The extent of the bloom was the third largest observed and the duration was similar to the bloom 2005.

Cyanobacterial blooms in the Baltic Sea are regular and natural phenomena in the Baltic Seabut the past years strong and widespread blooms have caused major environmental concern both to the public and authorities due to its toxicity and the increased nitrogen input. The most abundant toxic species *Nodularia Spumigena*, can posses a threat to animals and children.

The Baltic Algae Watch System at SMHI has been operational since 2002 and provides near real time information both to the public and authorities. The main source of information is the satellite sensor AVHRR (Advanced Very High Resolution Radiometer), which measures radiation in five broad bands ranging from visual to thermal infra red. The highly reflective surface accumulation of algae can clearly be visible in the visual channel 1. The sampling frequency of AVHRR-images is high, 3-8 images per day can be used for detection during cloud free conditions.

To be able to compare blooms between different years definition of normalized extent, duration and intensity has been developed. Results suggest that the most widespread bloom occurred 1998 and blooms with the longest duration were found both 2005 and 2006.

SEED – Life cycle transformations among HAB species, and the environmental and physiological factors that regulate them

Hermann Kaartokallio, Sanna Suikkanen & Markku Viitasalo (Finnish Institute of Marine Research, Finland)

The EU-funded HAB research project, “SEED - Life cycle transformations among HAB species, and the environmental and physiological factors that regulate them”, is presented.

SEED aims to understand how and to what extent anthropogenic forces influence the non-vegetative stages of the life cycles of harmful algal species thereby contributing to the increase in harmful algal blooms in European marine, brackish and fresh waters. The overall objectives are to improve and extend our understanding of the transition between the different life history stages to identify the environmental and physiological factors that regulate those transitions, and hence the relative importance of anthropogenic vs. natural causes. This will allow improved prediction, mitigation and management strategies.

As for cyanobacteria, the first results of the project show that each of the three dominant HAB species in the Baltic Sea, *Aphanizomenon flos-aquae*, *Nodularia spumigena* and *Anabaena* sp., show different life cycle strategies (production of akinetes and/or vegetative cells) that allow them to overwinter and proliferate in the Baltic Sea.

Modelling harmful algal blooms in a future climate of the Baltic Sea

Markus Meier, Kari Eilola & Elin Almroth (SMHI, Sweden)

We present some preliminary results from an ongoing research project at SMHI in collaboration with Gothenburg University and financed by the Swedish research council FORMAS. This project will study the response of the Baltic Sea ecosystem (with special focus on the occurrence of cyanobacteria) to changing climate and anthropogenic activities.

A high-resolution 3-D coupled biogeochemical-physical ocean model is used to evaluate the impact on the probability for the occurrence of cyanobacteria, deep water oxygen concentrations, excess dissolved inorganic phosphorus (DIP), biomass production and length of productive season, nutrient budgets, sources and sinks, and the surface water visibility. The role of dissolved organic nitrogen, as an additional nitrogen source besides nitrogen fixation will be evaluated. The model description of sediment re-suspension, cycling of organic matter and oxygen conditions of the inflowing water into the Baltic proper will be evaluated and improved.

To study past climate variability the nutrient loading from rivers and from the atmosphere for the period 1902-2006 will be reconstructed and the evolution of the marine ecosystem of the Baltic Sea will be simulated and validated against historical data. The impact of future climate changes will be addressed using a dynamical downscaling approach with a regional coupled atmosphere-ocean climate model and the uncertainties of the projections will be estimated using an ensemble approach with two global models and two emission scenarios. Also the impact of nutrient reductions will be investigated.

Plans for Polish national bloom monitoring programme using ferrybox technique

Hanna Mazur-Marzec & Justyna Kobos (University of Gdańsk, Poland)

In February 2007, a new bluebox was installed on board of Stena Line ferry that operates between Gdynia (Poland) and Karlskrona (Sweden). During the next 3 years, the equipment will be used for measurements and analyses conducted within the RTD project supported by the Ministry of Science and Higher Education in Poland. The project is coordinated by the Institute of Meteorology and Water Management in Gdynia (IMWM) in co-operations with two main partners: Institute of Oceanology, Polish Academy of Science in Sopot and the Institute of Oceanography, University of Gdańsk, in Gdynia

In situ measurements and sampling will be performed from March till November at six stations between Karlskrona and Gdynia. Additionally, during phytoplankton blooms samples and data will be collected from R/V Oceanograf 2, Oceania or Baltica. The idea of the project is to calibrate the satellite data with the results of *in situ* measurements and laboratory analyses of discrete samples. The attempts to determine phytoplankton groups and give accurate phytoplankton biomass values from satellite images will be made.

The project opens a possibility to extend the Baltic ecosystem observations to the part of the Sea that so far has not been included in any regular monitoring studies.

Baltic HAB dynamics research – gaps in knowledge

Emil Vahtera & Markku Viitasalo (Finnish Institute of Marine Research, Finland)

Ecosystem models are an important tool for reaching the GEOHAB goal, which is to develop better observation and prediction of HAB blooms in the Baltic Sea. However, there are still gaps in knowledge in key parameters necessary for reliable modelling of HABs. These processes need to be identified and explicit experiments need to be designed to fulfil the existing gaps and to parameterise the models. It will also be necessary to build species specific models at least for the dominant cyanobacteria and dinoflagellate species, as well as certain prymnesiophytes.

As for the cyanobacteria it will be necessary to build species-specific models. Some important gaps in knowledge remain. E.g., spatial and temporal variation in phosphorus sources and utilization in relation to cellular nutritive status and environmental conditions are less well known. Also, the role of akinetes in bloom formation is of importance in modeling initiation of blooms. Furthermore, little quantitative information is available on the loss terms, such as sinking, grazing and viral infection, of cyanobacteria.

As for dinoflagellates and prymnesiophytes, there are no specific models describing dinoflagellate occurrence. The biogeography and biodiversity is dynamic, which poses extra problems. Our knowledge is insufficient on cellular, community and ecosystem levels. A primary goal should be setting up a suitable observation system. Due to the large vertical span of many of the species, a high resolution surface sampling (SOOPs) will not be sufficient. High resolution vertical samples on a regular basis will also be needed.

Finally, the ultimate goal of the Baltic HAB dynamics research could be combining the species-specific models into large scale climatic biogeochemical models.