SHEBA NEWS

// Dear Reader ...

Welcome to the 4th BONUS SHEBA newsletter, which aims to inform project collaborators, stakeholders affected by Baltic shipping and interested scientists on the development of the project.
BONUS SHEBA is running now for about two years. There is one more year to consolidate the achieved results from measurement campaigns and ongoing numerical modelling. During a project meeting in October in Tallinn, Estonia, the consortium members exchanged information and conducted an expert elicitation to support final scenario building (see "Inside SHEBA"). A SHEBA sailing boat measurement campaign took place last summer in the central and southern Baltic Sea; this activity is in-troduced following these opening lines. The featured topic of this newsletter is Baltic Sea ecological modelling, an integrating activity considering marine emissions and atmospheric deposition.

We hope you enjoy reading this issue, and welcome any feedback via the contact information given on the last page,

Jana Moldanova (IVL) and Markus Quante (HZG)

// "On BONUS SHEBA"

The BONUS SHEBA sampling campaign - Measuring air and water contamination in the Baltic Sea

By Martin Eriksson (Chalmers)

The BONUS SHEBA project aims to assess impacts from shipping on the Baltic Sea through modelling approaches, but also through measurements. Therefore, a sampling campaign was performed in the Kattegat and the Baltic proper to measure concentrations of air pollutants and water contaminants. In addition, levels of acidification and various oceanographic parameters were monitored.

A 67 foot Challenge yacht, s/y Hrimfare af Ranrike (Fig. 1), was used and sailed from Gothenburg to Visby between the 27th of June and 2nd of July 2016. The approach to use a sailing vessel minimizes the problem of affecting the measurements by self-contamination from the engine. The focus of our efforts was to describe ship emissions to air and water along shipping lanes. The sampled shipping lanes were chosen based on their high shipping activity as indicated by the AIS data, which are also used in the project to calculate the shipping emissions.

The sampling was performed in transects perpendicular to the shipping lanes, with the intension to describe a potential gradient of contamination from shipping across the lanes. Three shipping lanes, one northeast of Anholt in the Kattegat, one northwest of Bornholm in the Baltic proper and one south of Öland were selected (see Fig. 3).

Continuous measurements of CO2, NOx, SO2, size-resolved particulate matter (PM) and soot in air were performed in the shipping lanes as well as during other parts of the cruise. First analyses of the data show that signatures of exhaust plumes from individual ships could be identified for the measured gases and particles. For example, when passing a scrubber-equipped ship, clear signals for NOx, CO2 and PM could be detected. The air pollution from nearby land regions, such as the Malmö-Copenhagen area, could also be detected.

Continuous water measurements of salinity, temperature, pH, oxygen concentration and partial pressure of CO2 (pCO2) were made using sensors mounted underwater. These continuous water measurements were made from Ystad to Visby (Fig. 2), and hence included the shipping lanes northwest of Bornholm and south of Öland. First results indicated higher temperature, lower salinity, lower pH and higher oxygen concentration inside shipping lanes compared to outside shipping lanes. Furthermore, to

Figure 1: The crew on board s/y Hrimfare af Ranrike. Photo: SHEBA

detect potential acidification from ship discharges, continuous measurements of pH and alkalinity were made in collaboration with the BONUS project PINBAL

Figure 2: Members of the Himfare crew taking measurements at different water depths. Photo: Jana Moldanova

In these measurements, a trend towards lower alkalinity and lower pH inside compared to outside shipping lanes was detected.

A small cast away instrument was in addition used to measure the salinity and temperature at different depths (Fig. 2). This enabled the compilation of a depth profile of these parameters and hence determines the depths of the different water layers (i.e. the stratification) in the studied waters. In this way it was ensured that the same water body was sampled at all sites within a shipping lane. It further enabled the detection that ship movements actually seem to affect the stratification of the water body in the shipping lane south of Öland. Ship movements seem to deepen the mixed layer from 10 to 20 meters in this shipping lane. In the Kattegat shipping lane this patterns was, however, not seen, and in the shipping lane northwest of Bornholm the ship-induced water mixing was probably also affected by the complex seascape and upwelling events in this region.

In the shipping lanes in the Kattegat and northwest of Bornholm concentrations of specific contaminants were measured, such as petroleum compounds, metals, nutrients and micro-particles, in surface water (5 meters) samples. These contaminants can originate from shipping, for example from bilge water and stern tubes, from antifouling paints and from black and grey water. If these contaminants increase in concentration inside compared to outside shipping lanes, it indicates contamination of the environment from shipping. No clear such increases could be detected. It should, however, be noted that the dilution inside a shipping lane is very large and hence large differences should not be expected. Still, in the Bornholm shipping lane, where petroleum compounds bound to particulate matter were also analysed, some particulate matter-bound petroleum compounds occurred in higher concentrations within the shipping lane compared to outside. In addition, an indication of more micro-particles, including putative antifouling paint particles, in shipping lanes was detected.

Scientists from the Swedish Environmental Research Institute and Chalmers University of Technology in Sweden, the Leibniz-Institute for Baltic Sea Research in Germany, the Finnish Environment Institute in Finland and sailors from Hrimfare Expeditions in Sweden participated in the sampling campaign. Data analysis from the campaign is ongoing and it is expect to find more interesting results and describe more patterns in relation to how shipping g affects the environment in the Baltic Sea.

// “Featured Topic”

Baltic Sea Ecological Modelling

By Mariliis Kõuts and Ilja Maljutenko (TUT)

General

The Baltic Sea has been under spotlight for decades as the growing economy and anthropogenic pressure have pushed the limits of the marine ecosystem. With improving marine observation techniques we have become aware of new environmental risks that affect the eco system and will have serious con-

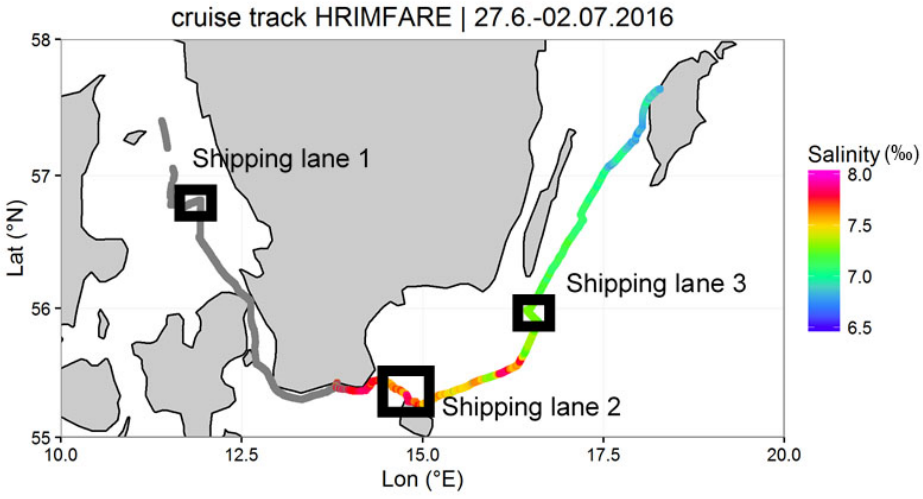


Figure 3: Cruise track of s/y Hrimfare and sampled areas in shipping lanes. Colored cruise track indicate the use of continuous measurement of salinity, temperature, pH, oxygen concentration and partial pressure of CO_2. Grey cruise track indicate absence of such measurements.

sequences for the economy of countries surrounding the Baltic Sea. Hence, the Baltic Sea states have decided on adopting the Marine Strategy Framework Directive (MSFD) to improve and sustain the marine ecosystem. The definition of a healthy environmental status as well as actions to reach this status are still under debate. It is, however, agreed upon, that eutrophication is one of the major environmental risks in the Baltic Sea that needs further attention. Eutrophication is a very complex process with various negative consequences for the ecosystem, most of which do not appear immediately. This makes studying and understanding eutrophication very difficult, but decisions to alleviate the problem need to be made, the sooner the better. Modelling is an advanced technique to get a better understanding of the various sub-processes of eutrophication and make forecasts of possible outcomes using different scenarios. Eutrophication can be modelled with biogeochemical models describing the cycle of nutrient uptake, primary production, decomposition/detritus and nutrient release.

Modelling

Modelling of eutrophication usually requires including a full nutrient cycle of nitrogen since it is the main limiting factor of phytoplankton growth in the sea. Simplest nutrient cycle models can be described by 4 different state variables: nutrients, phytoplankton, zooplankton and detritus (NPZD). More advanced models reach over 30 components (BALTSEM - Baltic sea Long-Term large Scale Eutrophication Model, ERSEM – European Regional Seas Ecosystem Model) including higher trophic levels (zooplankton, benthos). Their task however remains the same - to express the most important species of living organisms as well as biological and chemical processes in the water column and sediments.

So how should one model the ecosystem of the Baltic Sea? What kind of simplifications can one allow in its study and what should definitely not be left out? There are different levels of (complexity and simplicity) on how to model such a complex system as the ecological environment. However the basis for the whole ecological modelling is a physical model that could describe the environment in which biology exists. Hence, a realistic marine circulation model is needed to describe key physical parameters of the marine environment such as: transport by currents, turbulence, salinity and temperature. Biological and chemical processes are then coupled to this physical base model. Still, how can one manage to squeeze biology into a simplified system? For example, there are more than 1700 different phytoplankton species in the Baltic Sea. Can each species be represented in the model? No need for that because in general the phytoplankton species can be distributed into functional groups according to size end behaviour: large cell phytoplankton, small cell phytoplankton and cyanobacteria. The same holds for zooplankton and benthic organisms, as well as bacteria. The model then represents the known interactions between these groups and chemical and biological processes related to them. Some processes are general and work in every kind of waterbody. There are, however, also some specific features that make the Baltic Sea special, which have to be taken into consideration. One of those features are cyanobacteria blooms, which are frequent in summer when nitrogen is depleted and phosphate remains in excess. This happens due to intense spring blooms, which deplete nitrate but do not manage to use all of the phosphate, which is brought up in large amounts from the sediment, another characteristic feature of the Baltic Sea. Cyanobacteria can fix their own nitrogen and are considered as nitrogen input vector, that in turn enhances eutrophication. Another characteristic feature of the Baltic Sea is hypoxia, which is related to periodical inflow events from the North Sea, water salinity and intense eutrophication.

In BONUS SHEBA we implement a 3D circulation model GETM to simulate governing physical processes in the Baltic Sea (Fig. 4). The physical

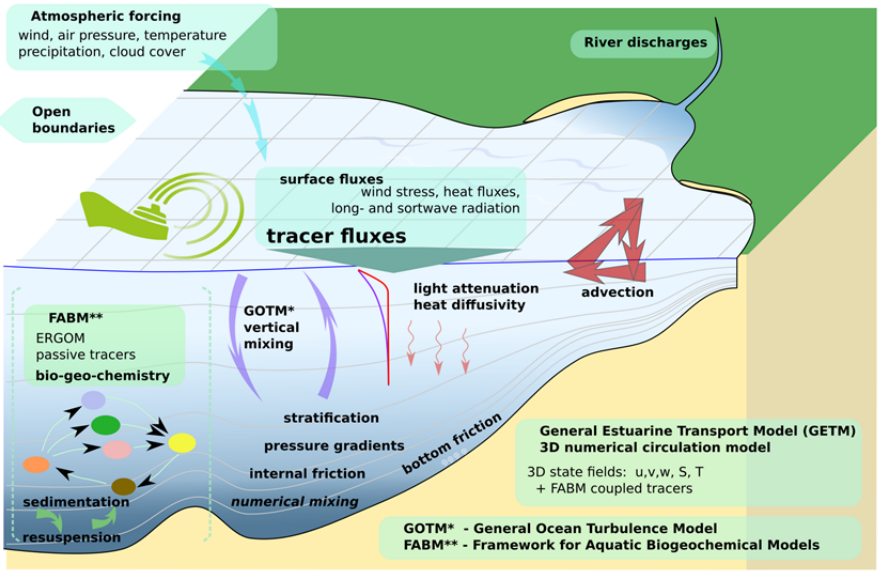


Figure 4: Schematic view of GETM and selected relevant processes.

model setup covers the whole Baltic Sea with horizontal resolution of 1 nautical mile which is approximately 2 km. This is of course far from representing each ship or harbour in detail, but can still be considered sufficient to represent all main shipping lanes across the Baltic Sea. 40 adaptive layers are defined on the vertical scale, allowing the development of seasonal stratification and nutriclines. A small temporal integration time step and frequent input of shipping information will enable us to resolve diurnal shipping activity (i.e. important for passenger ships). Shipping is introduced as two-dimensional forcing of different deposition fields on the sea surface coupled with different aquatic submodels to study direct and indirect influences of shipping on the biological and chemical environment of the sea (Fig. 4). The strength of GETM lies in its flexible coupling with a library of different aquatic models via the FABM environment. This allows us to run GETM simultaneously with different ecological submodels inside a single model run. The impact of shipping on marine eutrophication will be assessed using the biogeochemical model ERGOM (Ecological Regional Ocean Model) (Fig. 5). As the ERGOM is based on nitrogen-cycle the main forcing vector for the model will be additional input of nitrate and ammonia from hourly atmospheric depositions, obtained from an atmospheric chemical transport model, and direct discharges from the ships. Additional nutrients will be diluted in the sea and fed to phytoplankton under favorable conditions for primary production. According to the model the pool of dissolved nutrients will have an impact on the dynamics of phytoplankton, zooplankton and detritus. Large quantities of nutrients will cause an increase in oxygen demand, which in turn enhances eutrophication. As a positive side effect, additional nitrogen from shipping would reduce the amount of excess phosphorus after the spring bloom by balancing the Redfield Ratio and thus decreasing the occurrence of cyanobacterial blooms in summer.

Shipborne contaminants are not included in the ERGOM model. Contaminants are modelled separately as passive tracers and their impact and concentrations assessed separately.

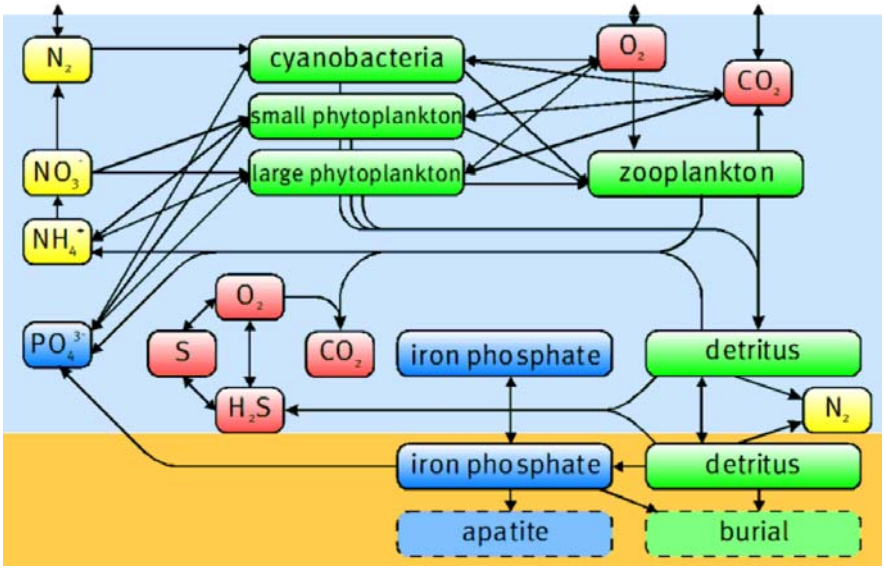


Figure 5: Schematic view of ERGOM state variables and processes (source: ergom.net http://ergom.net/tl_files/xMicrosite/images/ergom_schema.gif)

// "Inside SHEBA"

Intro: The Tallinn University of Technology (TTU)

The Tallinn University of Technology (TTU), the only technological university in Estonia, is the flagship of Estonian engineering and technology education, where synergy between different fields (technological, natural, exact, economic and health sciences) is created and new ideas are born. TTU, by relying on academic competencies and professional management, responds actively to the needs of the rapidly developing society and is involved in tackling the challenges of the digital era.

The Department of Marine Systems (MSI) carries out basic marine research and applied tasks related to the marine environment, harbours and maritime navigation. The main focus of the Department of Marine Systems includes:

- system study and modelling of physical and biogeochemical processes in the sea and waterbodies,
- investigation of functioning and stability of aquatic ecosystems, modelling and forecasting of their state,
- quantification and modelling of coastal and terrestrial interactions,
- development and application of oceanographic and aquatic operational nowcast and forecast methods and appropriate information systems,
- developing remote sensing methods for marine environment monitoring (physical processes and water quality parameters)

The department employs 56 persons, among them 25 with PhD or equivalent degree, and is a leading national research body to study the

physical forcing of the Baltic Sea ecosystem.

MSI people involved in BONUS SHEBA are:

Ilja Maljutenko, PhD student, Marine modelling, WP 1&3

Mariliis Kõuts, PhD student, Marine ecology modelling, WP 3

Prof. Urmas Raudsepp, head of the Modelling and Remote Sensing workgroup, WP 3

Intro: Ecologic Institute

Ecologic Institute is a private not-for-profit think tank for applied environmental research, policy analysis and consultancy with offices in Berlin, Brussels, and Washington DC. Founded in 1995, Ecologic Institute dedicates itself to working on the social-political aspects of sustainability research and bringing new knowledge into the field of environmental policy. Innovative research approaches, practical relevance, and a transdisciplinary working style ensure the excellent scientific quality and societal relevance of Ecologic Institute's work.

This work encompasses the entire spectrum of environmental topics, including the integration of environmental issues in other political fields. Ecologic Institute has a multidisciplinary staff of approximately 100 people. Ecologic Institute has a strong understanding of coastal and marine issues throughout the European Union, including the North Sea, Baltic Sea, Mediterranean Sea, and Black Sea regions. As social scientists, researchers at Ecologic Institute hold a diverse range of skills and expertise relating to the uses of and pressures on coastal and marine ecosystems and draw on methods such as stakeholder engagement, legal analyses, socioeconomic assessments, comparative case studies, and expert interviews. The work done at Ecologic Institute covers the spectrum of environmental topics, including inter alia marine biodiversity, blue economy, shipping and marine ecosystem services.

In this manner, Ecologic Institute provides expertise to the European Parliament, the European Environment Agency (EEA) and the European Commission, particularly with the Directorate-General for Research & Innovation. In Germany a multitude of ministries on a national and local level, downstream authorities, such as the Federal Environment Agency (UBA) and the German Parliament benefit from Ecologic Institute's research work. Over its history, Ecologic Institute has contributed to the decision-making processes of a variety of international institutions, committees and authorities on the European, national, regional and municipal levels.

Within BONUS SHEBA Ecologic Institute leads research to develop and implement an integrated socio-economic assessment for shipping in the Baltic Sea, using an ecosystem services approach to evaluate the effectiveness and benefits of proposed policy options for the shipping sector. The assessment will also include an analysis of the economic and societal effects of identified alternatives for shipping to comply with environmental regulations. Further, Ecologic Institute leads work on the main economic, social and policy drivers affecting the shipping sector in the Baltic Sea region.

Ecologic Institute's colleagues involved in the BONUS SHEBA project are:

Benjamin Boteler, Senior Fellow, Marine socioeconomics and policies

Dr. Manuel Lago, Senior Fellow, Environmental and natural resource economics

Jenny Tröltzsch, Fellow, Socio-economic valuation of policy instruments

Marius Hasenheit, Junior Researcher, Circular Economy, Transformation studies

Expert elicitation in support of BONUS SHEBA scenario building

By Markus Quante (HZG) and Lena Granhag (Chalmers)

To understand how shipping could potentially impact environment and society in the Baltic Sea region in the future SHEBA uses scenario development and assessment as central tools in its research agenda (see the contribution by Erik Fridell and Benjamin Boteler to SHEBA newsletter 3). The use of scenarios provides an opportunity to explore a range of long term alternatives actors (e.g. politicians, authorities, ship owners) could choose from to minimize the environmental impact of the shipping sector.

Building those scenarios is not a straightforward task, especially in case the time period of interest is well ahead in the future. Many uncertainties exist regarding the drivers of change and how they influence the development of future shipping. Besides economical and technical issues human behaviour and choices strongly influence the development, and it is impossible to know how actors will behave in future and what consequences this might have. In short, in the shipping sector uncertainties about future developments exist, when questions are studied to understand the possible impact of shipping on the Baltic Sea environment. Extensive knowledge that provides the basis for informed predictive decision making or scenario building is not available. In such situations informed judgement and prediction can be supported by a quantitative expert elicitation (Morgan 2014). Expert elicitation of scientific and technical issues involves the process of seeking carefully reasoned judgements from experts about an uncertain quantity or process in their domain of expertise, often in the form of subjective probability distributions based on Bayesian statistical methods (O´Hagan et al. 2006).

In BONUS SHEBA a number of scenarios are constructed in order to study several aspects of the future impact of shipping in the Baltic Sea region on air quality, water pollution, underwater noise emissions and on society. For some of these scenarios it was decided to consult experts for their judgement regarding specific future developments. The questions aimed at the use of Liquefied Natural Gas (LNG) as fuel, the employment of scrubbers for exhaust gas cleaning, and on the use of port reception facilities (PRF) for greywater. In detail, they were as follows:

a. In the year 2040: What do you think which fraction of the ships sailing in the Baltic Sea will use LNG as a ship fuel to reduce NOx emissions to air?
b. Given that open loop scrubbers will still be allowed in 2040: In your opinion, what fraction of the ships sailing in the Baltic Sea will use scrubbers to avoid sulphur emissions to air?
c. Under these conditions (b) in 2040: In your opinion, what fraction of the scrubbers in use will operate in closed loop mode?
d. In 2040 passenger ships would have to either treat the sewage effectively onboard or dispose it in the PRF. Assuming that the HELCOM process is successful and that all major ports in the Baltic Sea have adequate capacity to collect sewage from passenger ships smoothly, what would be the fraction of passenger ships that will bring the greywater to the PRF? (with sub-questions addressing ferries and international cruise ships).

The actual elicitation took place during the BONUS SHEBA stakeholder meeting on 12 and 13 October 2016 in Tallinn, Estonia. The method chosen to assess quantitative expert judgements was the Sheffield Elicitation Framework (SHELF). A preparatory SHELF training course for SHEBA consortium members was held in May 2016 in Gothenburg, Sweden (see contribution by Lena Granhag to SHEBA newsletter 3). During the two-day gathering Tony O´Hagan, a co-founder of SHELF, introduced key issues of this specific elicitation method and pointed also to certain pitfalls. During the Tallinn elicitation SHEBA consortium members conducted the elicitation by acting as hosts, facilitators, recorders, and method observers. The experts involved were invited members of the BONUS SHEBA advisory board and the extended SHEBA stakeholder group. They came from Denmark, Germany, Poland and Sweden and represented expertise in a variety of fields. For each of questions a) to c) 5 experts were available. For question d) (greywater) only 3 experts were present, and therefore it was decided not to apply the SHELF method in the latter case. The issue was assessed in an open discussion round. The SHELF training course as well as the Tallinn elicitation was financially support by the Swedish Institute.

In the following the procedure is

Figure 6: Daniel Yngsell, Chalmers, (left) and Tony O´Hagan, Sheffield University, taking the role as a recorder and facilitator, respectively, during a SHELF training session. *Photo: M. Quante*

briefly described and the main outcome of the elicitation is summarised. Prior to the specific elicitations all participants had access to an evidence dossier, which was especially prepared to summarise the state of knowledge in the field under consideration. At the beginning of a session the dossier was discussed with all experts and definitions together with the particular question were clearly stated. The questions were formulated in such a way that a numerical value valid for a target year (e.g. a percentage) was asked for. Then, each of the experts had to provide a plausible range (lower and upper bound), in which the answer might fall. Following this in two rounds the experts gave their estimates for the median, the lower and the upper quartile. Those numbers were used to fit individual distributions. As an example the distributions for the LNG question (a) are shown in figure 7. It can be seen that obviously the experts came to differing judgements concerning the position of the median and the width of the distribution.

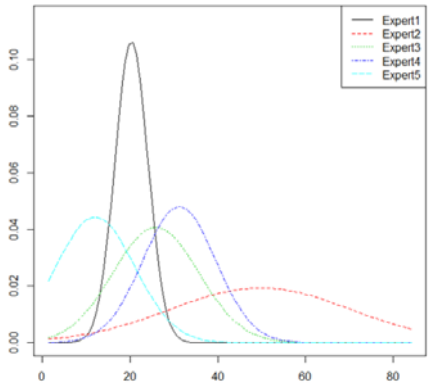


Figure 7: Individual normal distributions fitted to the expert's parameter estimates for question a) (LNG). The unit on the X axis is percent, the Y axis gives the normalised frequency.

In a next step the rational of the individual distributions were discussed among the experts with the aim to agree on a group judgement.

This process started again with individual estimates of several probabilities for overstepping and falling below certain values given by the facilitator. Accompanied by thorough discussions among the experts the given individual probabilities were merged to a common single set, which was used to fit a distribution as the final result of the group judgement. Again for the LNG question (a), the resulting single distribution is shown in figure 8.

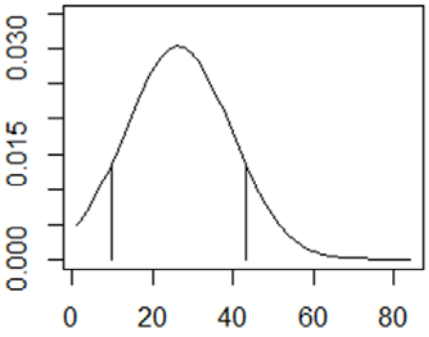


Figure 8: Normal distribution fitted to the expert group probability estimates for question a) (LNG). The unit on the X axis is percent, the Y axis gives the normalised frequency.

Here are the statistical parameters fromthe group judgements for the above stated questions of interest a) and b):

a. Median: 26.5%; Standard deviation: 13.1%; 10th percentile: 9.7%; 90th percentile: 43%

The expert group thinks that in 2040 about 27% of the ships sailing in the Baltic Sea will use LNG as fuel in order to reduce NOx emissions.

b. Median: 23.9%; Standard deviation: 13.4%; 10th percentile: 6.6%; 90th percentile: 41%

It is estimated by the expert group that in 2040 about 24 % of the ships sailing in the Baltic Sea will use scrubbers to reduce sulphur emissions to air.

For question c) (closed loop scrubber) only individual estimates were gathered, a group judgement was not performed since the individual judgements of probabilities were far apart and a lively discussion among the experts could not conclude to common values.

As stated above question d) (greywater) was not assessed by using the SHELF method. Instead a discussion round was moderated. At the end of the discussion none of the participants felt able to state, what the fraction of cruise ships will be that disposes greywater in the ports in 2040. The group pointed out the lack of data and an unsteady character of cruise tourism. Anyway, the extreme fractions like near 0% and near 100% were excluded by the participants.

Overall it can be stated that the chosen procedure was very useful in assessing the posed questions and lead partly to quantitative expert judgments. The accompanying discussions were particularly helpful.

All results of the elicitations are summarized in specific protocols, major aspects of the discussion are captured there as well. The outcome was passed to the SHEBA working group 1, which used the expert judgements and discussions during the development of related scenarios.

Acknowledgements

We would like to say thank you very much to the experts, who have spent their time and shared their knowledge to support SHEBA. Many thanks also to all the SHEBA consortium members involved. And we are especially grateful to Magda Wilewska-Bien and Daniel Yngsell from Chalmers for their invaluable support (i.e. on the technical side) during the elicitations. Supporting funding by the Swedish Institute is gratefully acknowledged.

Cited references:

O'Hagan A, C.E. Buck, A. Daneshkhah, J.R. Eiser, P.H. Garthwaite, D.J. Jenkinson, J.E. Oakley, T. Rakow, 2006: Uncertain Judgments: Eliciting Experts' Probabilities. Hoboken, NJ, John Wiley & Sons, 321 pp.

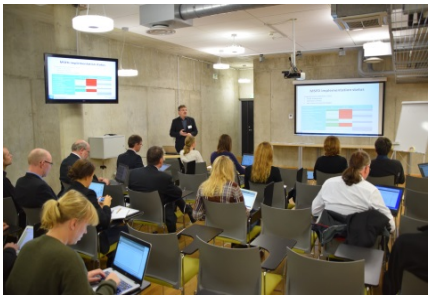
Morgan, M.G., 2014: The Use (and Abuse) of Expert Elicitation in Support of Decision Making for Public Policy, Proceedings of the National Academy of Sciences, 111(20), 7176-7184.

// "Meetings/Events"

Consortium meeting in Tallinn 11-13 October 2016

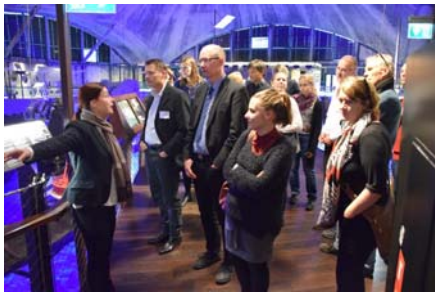
By Jana Moldanová

From 11th to 13th of September 2016 the Marine Systems Institute of Tallinn University of Technology hosted a combined Bonus SHEBA consortium and expert elicitation meeting. The first day was dedicated to internal project meetings and workshops where the work progress in SHEBA and coordination of the different project tasks has been discussed. The second day the highlights of the results achieved in the project were presented for the consortium, the expert group and invited guests including representatives of the Bonus secretariat and Helcom. The day was opened by an invited talk on regional co-operation in the Baltic Sea area and measures planned for an implementation of the MSFD in Estonia given by Prof. Urmas Lips from the hosting institute.



Prof. Urmas Lips presenting his keynote talk. Photo: Volker Matthias

The SHEBA presentations covered the development of future scenarios for shipping, the development of inventory of pleasure boats, noise modeling results, fish experiment at Tvärminne zoological station, air quality simulation results, measurement campaign on s/y Hrimfare, outreach activities in Sheba and the Sheba data portal. In the evening the meeting participants have visited the impressive Seaplane Harbour maritime museum before the day was wrapped up at restaurant Tuljak were discussions could be continued over a wonderful dinner.



Guided tour in the maritime museum. Photo: Volker Matthias

The third day of the meeting was started by a tutorial on the Sheffield expert elicitation method (SHELF) and the rest of the day was dedicated to the expert elicitation where the invited experts helped us to estimate a number of parameters needed in development of the scenario emission inventories. You can read more about the expert elicitation in a special report included in this newsletter.

Thank you to Ilja Maljutenko and Urmas Raudsepp for perfectly arranging the meeting in Tallinn.

Progress of SHEBA presented during EUSBSR-Steering Committee meeting

BONUS SHEBA is a flagship project of EUSBSR PA Ship (EU Strategy for the Baltic Sea Region – Policy Area on Clean Shipping). The 7th international Steering Committee meeting of EUSBSR PA Ship was conducted on 10 October 2016 in Stockholm.

SHEBA presentation during Swedish Toxicological Council meeting

On September 14, 2016, Erik Ytreberg (Chalmers) presented BONUS SHEBA during a seminar of the Swedish Toxicological Council in Stockholm, Sweden.

Upcoming:

Next BONUS SHEBA Consortium meeting

The next meeting of the entire SHEBA consortium will take place from 22nd to 24th of May 2017 in Gdansk, Poland. Our partners from the Maritime Institute in Gdansk will host the meeting. Besides discussions on working package level, plenary talks and discussions as well as a general SHEBA assembly gathering will be on the agenda.

Open Ship activity

As in 2016 the research vessel Prandtl of the Helmholtz-Zentrum Geesthacht will go on an Open Ship tour from 3rd to 6th July 2017 along the eastern German coast of the Baltic Sea. Among others BONUS SHEBA topics will be presented.

2nd Baltic Earth Conference

BONUS SHEBA is an affiliated project of the Baltic Earth initiative. The 2nd Baltic Earth Conference will take place from 11th to 15th of June 2018 in Helsingør, Denmark. SHEBA results could be presented under the conference topic "Multiple drivers for regional Earth system changes".

BONUS SHEBA/SOLAS

Shipping Conference

24 & 25 October 2017 in Gothenburg

An international conference on scientific findings on impacts of shipping on environment and their application in policy, marine spatial planning and the maritime transport sector is jointly organised by the Bonus project SHEBA and by the International Surface Ocean – Lower Atmosphere Study (SOLAS).

S&E
SHIPPING & THE ENVIRONMENT

Topics addressed by the conference:

- Impacts of shipping on air pollution and climate change including impacts on human health and land ecosystems
- Impacts of shipping on marine pollution and marine ecosystems
- Impact of shipping on noise pollution - underwater noise and its impacts on marine biota, above-water noise and its impacts on human well-being
- Environment and society - socio-economic valuation of the impacts of shipping, impacts of shipping on ecosystem services, shipping and marine spatial planning

A call for abstracts will be launched in the next weeks. The conference web address is:

http://shipping-and-the-environment-2017.ivl.se

Photo: Markus Quante

Photo: Volker Matthias

Photo: Markus Quante

BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

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