SHEBA NEWS

// Dear Reader ...

… welcome to this SHEBA newsletter, which is the first of a series of 6 newsletters along the runtime of the project aiming to inform project collaborators, stakeholders affected by Baltic shipping and the interested scientific community on the content and development of SHEBA.
As this newsletter also the upcoming ones will have categories like "On SHEBA" reporting general project news and selected information from the working packages, "Featured topic" addressing one relevant topic in more depth, "Inside SHEBA" introducing the partners and personnel, "Meetings and Dissemination" summarizing meetings, listing upcoming meetings and providing hints to products.

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

Jana Moldanova (IVL) and Markus Quante (HZG)

// "On SHEBA"

Sustainable sHipping and Environment of the BAltic Sea region (SHEBA)

By Jana Moldanová ,IVL, (Coordinator of SHEBA) and Markus Quante, HZG, (SHEBA dissemination)

The BONUS project SHEBA brings together lead experts from the fields of ship emissions, atmospheric, acoustic and oceanic modelling, atmospheric and marine chemistry, marine ecology, environmental economics, social sciences, logistics and environmental law in order to provide an integrated and in-depth analysis of the ecological, economic and social impacts of shipping in the Baltic Sea and to support development of the related policies on EU, regional, national and local levels.

The objectives of SHEBA are:

1. Update shipping activity data using Automatic Identification System (AIS) data from HELCOM and data on activity data for leisure boats.
2. Determine today's scenario of shipping emissions, different categories of water pollutants, noise and production of liquid and solid waste as a function of vessel activity.
3. Assess the current situation of air and water pollution from shipping and the effects of scenario emission changes in the Baltic Sea region and in selected harbours by means of modelling systems.
4. Conduct an impact assessment of ship generated underwater noise in the Baltic Sea area using a proxy for the shipping induced noise.
5. Develop an analytical framework for the integrated assessment of effects of shipping and harbours in the Baltic Sea region.
7. Assess changes in ecosystem services in different shipping scenarios compared to a Baseline.
8. Evaluate various technology and policy options to reduce pressures and impacts from shipping and harbours in the Baltic Sea and identify and analyse trade-offs between these options as well as marginal changes in costs and benefits (Cost-Benefit Analyses).
9. Make inverted model scenarios in order to propose required levels of actions which would ensure that the impact from shipping will not escalate due to forecasted growth.

SHEBA will analyse the drivers for shipping, obtain the present and future traffic volumes and calculate a set of scenarios which will then feed into calculations of emissions to water, to air, and of underwater noise using and extending the currently most advanced emission model based on AIS ship movement data. Atmospheric, oceanic and noise propagation models in combination with ecotoxicology studies will then be used to assess spatio-temporal distributions, fates and effects of these stressors in the Baltic Sea region.

The project will assess the impact of different pollutants to the water quality indicators of the Marine Strategy Framework Directive and Water Framework Directive and to air quality indicators. Further, the project will provide an integrated assessment of policy options to mitigate pressures linked to shipping, quantifying as far as possible anticipated changes in ecosystem services compared to an established baseline. This will include an analysis of trade-offs between options as well as synergies, and the marginal changes in costs and benefits of options to reduce environmental pressures from shipping and

support the achievement of Good Environmental Status as prescribed by the Marine Strategy Framework Directive.

SHEBA is supported by a wide group of stakeholders, including harbours, shipping industry and authorities, who will be consulted about the input of data, feedback and results of the project. A stakeholder workshop and a conference on the impact of shipping on environment in the Baltic Sea region will be organised by the project as well as a number of activities and products aiming to rise the public awareness in this issue.

SHEBA´s research and coordination is structured into 7 working packages (WPs), of which WP6 and WP7 are overarching activities interconnecting all other WPs (see figure 1). In working package 1 the overall scene concerning maritime policy is set and shipping related scenarios are developed, its outcome feeds into the topical working packages “Air Pollution” (WP2), “Water pollution” (WP3), and “Noise” (WP4). Results from all working packages will be the bases of an “Integrated Assessment” which is central in WP5.

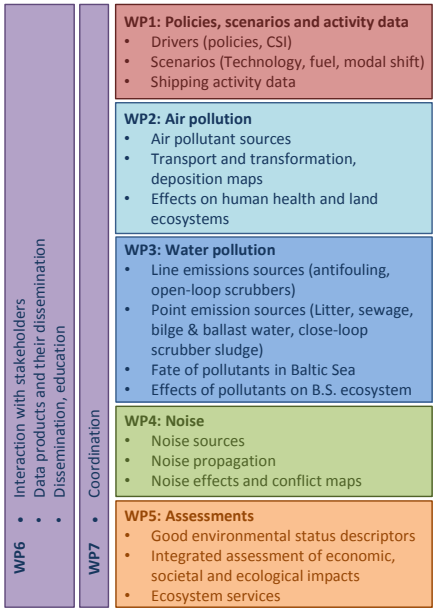


Figure 1: Sketch of the Working Package (WP) structure of SHEBA.

Eleven partners from 7 countries are linked-up in SHEBA, their geographical location is displayed in figure 2. The list of the project partners along with the acronyms used is given below. SHEBA is running from April 1st 2015 to March 31st 2018. A total funding of 2.9 M€ has been assigned through BONUS, half of the funds originates from the European Union the other half is provided by national sources. Key theme of the BONUS call addressed by SHEBA is: “Assessing the effects of air and water pollution and introduction of energy (including noise) by shipping activities on the marine environment and integrated water management in harbours”. As supplementary themes “Governance structures, policy performance and policy instruments”, and “Maritime spatial planning from local to Baltic Sea region scale” were chosen. Along its running time SHEBA will receive advise from an external, international Advisory Board consisting of the following experts: David Turner, *Gothenburg University*, Sweden; Carl Carlsson, *Swedish Shipowner´s Association*; Anita Mäkinen, *Finnish Transport Safety Agency*, Helsinki, Finland; Stefan Schmolke, *Federal Maritime and Hydrographic Agency*, Hamburg, Germany; and Magdalena Wesolowska, *Maritime Office in Szczecin*, Poland.

Project Partners

Sweden

IVL, Swedish Environmental Research Institute (IVL), Gothenburg

Chalmers University of Technology (Chalmers), Gothenburg

Swedish Defence Research Agency, FOI (FOI), Stockholm

Figure 2: The SHEBA partner institutions are located around the Baltic Sea, except CNRS/CINAM. Acronyms are assigned in the partner list beside and below.

Germany

Helmholtz Zentrum Geesthacht, Centre for Materials and Coastal Research (HZG), Geesthacht

Ecologic Institute (EI), Berlin

Finland

Finnish Meteorological Institute (FMI), Helsinki

SYKE, Finnish Environment Institute (SYKE), Helsinki

Estonia

Marine Systems Institute, Tallinn University of Technology (TUT), Tallinn

Poland

Maritime Institute in Gdansk (MIG), Gdansk

Denmark

University of Southern Denmark, Department of Environmental and Business Economics, (SDU), Esbjerg

France

Centre National de la Recherche Scientifique, Marseille Interdisciplinary Centre for Nanoscience, joint research unit UMR 7325 (CNRS/CINAM), Marseille

// "Featured Topic"

Air Quality and Shipping -a Modelling Perspective

By Jukka-Pekka Jalkanen (FMI) and Volker Matthias (HZG)

Shipping is the backbone of the global trade. According to the International Maritime Organisation (IMO) more than 90% of the global trade is carried by sea and no other means of transport can replace shipping as intercontinental carrier of cargo. Ships, on average, are generally considered as the most energy efficient mode of transport with low unit emissions of Greenhouse Gases (GHGs), but comparably high emissions of pollutants like nitrogen oxides (NO_x), sulphur oxides (SO_x) and particulate matter (PM).

In the last few years, several initiatives have been introduced to improve the environmental performance of shipping. The energy efficiency of the global fleet will slowly improve with the requirements of the Energy Efficiency Design Index (EEDI) of the IMO, which requires new ships to use less fuel than before. In addition to overall energy efficiency improvements, IMO Marpol Annex VI targets NO_x, SO_x and PM reduction in specific Emission Control Areas (ECAs). The Baltic Sea, North Sea and North America have been declared as ECAs for SO_x where the sulphur contents in shipping fuels is restricted to 0.1% since 1 January 2015. In addition, regional restrictions apply for example in the European Union, which extend the use of low sulphur marine fuels to European harbours. A NO_x ECA which will considerably reduce NO_x emissions from new built ships exists in North American waters, only. There is still a debate in Northern European countries about the introduction of a NO_x ECA for the North and Baltic Seas.

Attempts to curb SO_x and PM emissions from ships in ECAs have reduced the harmful impacts of ship exhaust to humans, but the emissions of those PM components, which do not contain sulphur may not be reduced. Discussions to regulate the black carbon (BC) emissions from ships have already started in the IMO. Currently, there is no agreement whether the best way to limit the BC emissions from ships would necessitate the use of low sulphur fuel. BC emissions vary significantly as a function of engine working conditions. At low engine loads BC emissions can be considerable. This can often be observed during manoeuvering operations in harbours. Engine load may also be lowered when a vessel is navigating on ice covered seas, where the resulting BC emissions and their deposition may decrease the albedo of ice with a subsequent influence on the climate in the region. SHEBA partners from the Finnish Meteorological Institute (FMI) and the Helmholtz-Zentrum Geesthacht (HZG) work since several years on models to most accurately calculate shipping emissions in the North and Baltic Seas. These models are based on real ship movements that have been tracked via AIS (Automatic Identification System) signals from ships and information about the ship's technical specifications. Together with engine load dependent emission factors, bottom up emission inventories were constructed. They serve as input for chemistry transport models (CTMs), which calculate atmospheric transport, chemical transformation and deposition of atmospheric pollutants. CTMs consider the important interactions of atmospheric pollutants from different sources. They can give information about the spread of shipping emissions and their impact on secondary pollutants like ozone and small particles (PM2.5, particles smaller than 2.5µm in diameter). Figure 1a shows the modeled annual average PM2.5 concentration resulting from shipping activities in the North and Baltic Seas, it is around 1 µg/m³. In Figure 1b the contribution of shipping to the total PM2.5 concentration is given, it can be up to 15% in some regions in North Denmark. CTM model results reveal that in the entire Baltic Sea, shipping contributes about 40 – 80 mg/m² additional nitrogen deposition in the area of the North and Baltic

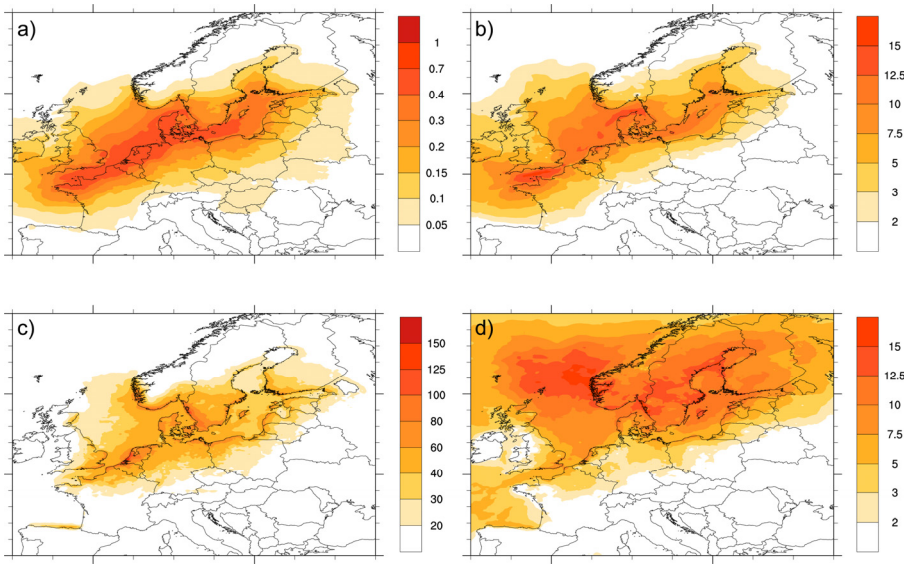


Figure 1 Shipping contribution to PM air concentration and NOx deposition in the North Sea and Baltic Sea areas: a) PM2.5 in µm m^{-3}, b) PM2.5 in %, c) total deposition of N in mg m^{-2} , d) total deposition of N in % (Image adapted from Jonson et al. 2015).

Seas (Figure 1c). This is about 5 to 10% of the total nitrogen deposition on annual average (Figure 1d). However, there exists a strong seasonal variability in Baltic Sea shipping and both vessel activity and contribution to eutrophication peak during the summer months. In some parts of the Baltic Sea, about half of the airborne nitrogen may come from ship emissions. The situation is similar in the southern North Sea, where shipping contributes about 20% to NO_2 summer concentrations in coastal areas and has about the same share in atmospheric deposition of oxidized nitrogen.

The combination of shipping emission models together with atmospheric chemistry transport models allows for an investigation of future developments in shipping. Fleet developments, new regulations, technical improvements and their effect on emissions, concentrations and deposition can be considered. Subsequent chemistry transport calculations give information on pollution levels and the input of eutrophying substances into the Baltic Sea. These can be used further in ecosystem models for the Baltic Sea.

Figure 2 shows an example of an investigation of future scenarios with the CMAQ model for Northwest Europe. Three scenarios with different rules for NO_x emissions from shipping in emission control areas (ECAs), like the North and Baltic Sea, are shown. It can be seen that NO_2 concentrations will increase by 20-30 % in North Sea coastal areas if the allowed emissions per produced kWh will not be reduced (scenario No ECA). This is a consequence of increased ship traffic until 2030. On the other hand, if strict regulations apply to all ships, a significant reduction of the NO_2 concentration that stems from ships can be achieved (scenario ECA opt). More realistic is that stricter rules for NO_x emissions will only apply to new built ships from a certain year onwards. This is shown for 2021 as the year when the rules come into force. The consequence would be that the contribution of ships to NO_2 concentrations would slightly increase compared to the reference year 2011.

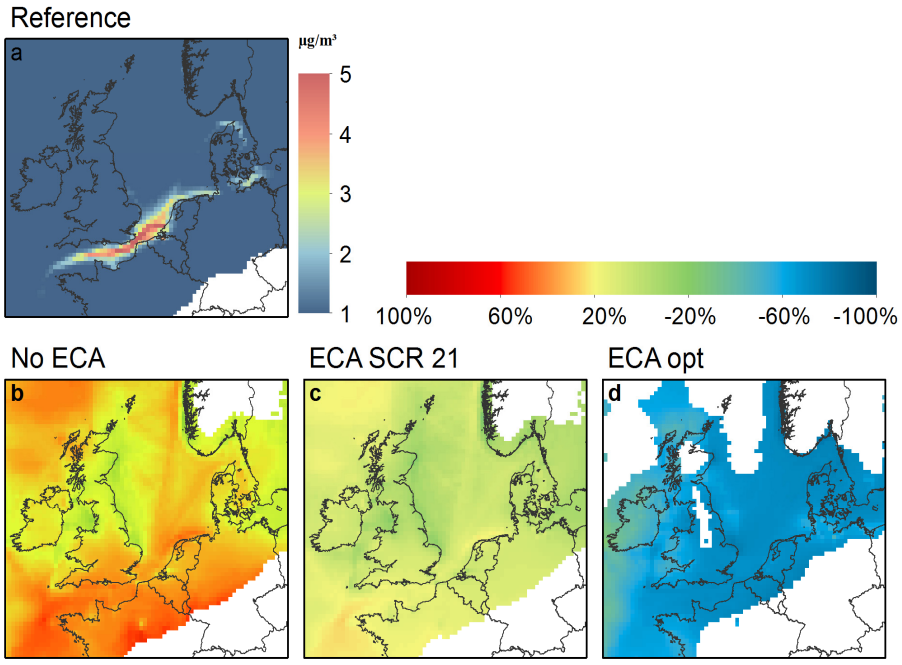


Figure 2: Scenarios of future changes in the contribution of shipping to NO_2 concentrations in Northwest Europe in the year 2030; changes are given in percent of the reference case for the year 2011 (Matthias et al., 2015).

All options available for ship emission reductions are investigated thoroughly in SHEBA and the consequences on ecosystems, economy and trade in the Baltic Sea region are taken into account.

Cited refrences:

Jonson, J.E., Jalkanen, J.-P., Johansson, L., Gauss, M. and Denier van der Gon, H. A. C.:, 2015: Model calculations of the effects of present and future emissions of air pollutants from shipping in the Baltic Sea and the North Sea, Atmos. Chem. Phys., 15, 783–798.

Matthias, V., Aulinger, A., Backes, A., Bieser, J., Geyer, B., Quante, M., and Zeretzke, M., 2015: The impact of shipping emissions on air pollution in the Greater North Sea region – Part 2: Scenarios for 2030, Atmos. Chem. Phys. Discuss., 15, 11325-11368.

Further reading:

Aulinger, A., Matthias, V., Zeretzke, M., Bieser, J., Quante, M., and Backes, A, 2015.: The impact of shipping emissions on air pollution in the Greater North Sea region – Part 1: Current emissions and concentrations, Atmos. Chem. Phys. Discuss., 15, 11277-11323, doi:10.5194/acpd-15-11277-2015.

Jalkanen, J.-P., Johansson, L., Kukkonen, J., Brink, A., Kalli, J., and Stipa, T., 2012: Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide, Atmos. Chem. Phys., 12, 2641–2659, doi:10.5194/acp-12-2641-2012.

Jalkanen, J.-P., Brink, A., Kalli, J., Pettersson, H., Kukkonen, J., and Stipa, T., 2009: A modelling system for the exhaust emissions of marine traffic and its application in the Baltic Sea area, Atmos. Chem. Phys., 9, 9209-9223, doi:10.5194/acp-9-9209-2009.

// “Inside SHEBA”

This rubric will briefly introduce over the set of newsletters the partners of SHEBA as well as key personnel. We start with IVL and our coordinatior Jana Moldanova.

IVL – coordinating SHEBA

Swedish Environmental Research Institute (IVL) undertakes applied research and contract assignments across the entire environment and sustainability field. IVL, Sweden's first and oldest research institute, was jointly founded in 1966 by government and the industry sector, primarily to deal with environmental issues encountered in industry. Today, IVL has evolved into Sweden´s leading institution for applied research on environment and sustainability. Next year the institute will celebrate its fifty years anniversary.

IVL is a limited, non-profit company owned by a foundation with representatives from both government and industry. The aim of the foundation is to promote the long-term conditions required for environmental research and, through ownership, guarantee IVL’s autonomous status.

IVL has approximately 230 employees at offices in Stockholm, Gothenburg, Malmö, Lysekil and Beijing. IVL employs engineers, economists, social scientists, chemists, geoscientists, biologists, agronomists, communicators, behavioural scientists, etc.

Over half of IVLs activities consist of contracted research assignments that are either jointly funded by state and industry, or supported by grants from government research agencies, research foundations and the EU. IVL is also a frequent consultant and contractor to municipalities, government agencies and industry.

The marine research at IVL can be divided into three categories:

- **Environmental status** – projects involving studies of occurrence, sources and impacts of organic contaminants, nutrients, plastics, microplastics as well as ecosystem status and functioning
- **Policies and instruments** – which includes development of economic instruments, policies as well as assessment and analysis of efficiency and implementation
- **Reducing pollution** – which includes development and assessment of methods for reducing pollution from shipping, air emissions, ballast water as well as for wind-powered oxygenation of bottom waters. IVL is also a main actor in development of innovative and resource efficient sewage treatment for recovery of water, nutrients and energy.

The marine research is performed in cooperation with a number of stakeholders from local and national authorities, industry and international organisations and conventions.

Apart from SHEBA, IVL is also coordinating two other BONUS projects at the moment: OPTITREAT and ZeB. OPTITREAT promotes development and optimizes the efficiency of small wastewater treatment systems techniques already available on the market in the Baltic Sea region. The ZeB project envisions zero emissions of oily water in the ecologically sensitive Baltic Sea, focusing on the separation of oily water and the development of existing technologies.

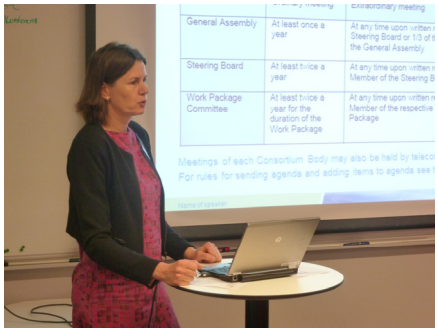
Jana Moldanova (IVL)
- coordinator of SHEBA

Jana Moldanová is a senior scientist at IVL in the field of atmospheric chemistry. She holds Ph.D. from Institute of Chemistry, University of Gothenburg and spent her post-doc at Max-Planck Institute for Chemistry in Mainz.

She has a long experience both with numerical modelling of atmospheric processes, air pollution and with experimental research on chemical and physical properties of particulate matter with focus on emissions from shipping.

Jana has been involved in a wide range of national and international research projects, many with focus on impacts of the transport sector on air pollution and climate (e.g. EU projects Quantify and Transphorm).

Jana during one of her scientific ship cruises.



Jana opening the SHEBA Kick-Off Meeting in May 2015.
Photo: V. Matthias.

Contacts:

Jana Moldanova (IVL)
for all SHEBA issues.
(jana.moldanova@ivl.se)

Markus Quante (HZG)
for dissemination issues
(markus.quante@hzg.de)

// "Meetings / Events"

SHEBA Kick-Off Meeting (12 & 13 May 2015)

By Sara Jutterström (IVL) and Markus Quante (HZG)

The Kick-Off Meeting for SHEBA was held in Gothenburg, Sweden, on the 12-13th of May. The event took place at Lindholmen Science Park and was hosted by Chalmers University of Technology.

For the 2 day event close to 40 scientists from the 11 participating institutes were present as well as Andris Andrusaitis from the BONUS secretariat and two members from the SHEBA Advisory Board: Professor David Turner from Gothenburg University and Carl Carlsson from the Swedish Shipowners Association. During the meeting Anders Carlberg from Region Västra Götaland gave a talk on the maritime cluster of West Sweden. Carl Carlsson presented the Zero Vision Tool, which is a collaboration method and project platform developed by the Swedish Shipowners' Association and SSPA for a safer, more environmentally and energy efficient transport by sea.

The busy 2 days included presentations of each of the partners together with the people that will be involved in the project, the project management structure and project office, the deliverables and objectives of SHEBA. Detailed planning of the upcoming steps of each of the projects' work packages was conducted in break-out sessions. The participants began the exciting and challenging scientific collaboration necessary to reach the goals set for SHEBA during the coming three years.

During a nice and interesting boat trip through the harbor and charming channels of Gothenburg the participants could also sense an active water cycle.

Overall the kick-off meeting was a full success on working level as well as on the social side, since many of SHEBA´s collaborators met for the first time in person.

1st SHEBA Stakeholder Meeting (29 & 30 Sept. 2015)

Interaction with stakeholders from the marine and maritime sector is of vital importance for reaching the goals of SHEBA especially to ensure that the project will provide useful support for decision making both for the shipping industry and for national, regional and local authorities and civil actors.

SHEBA plans two stakeholder meetings within the three years of its duration. The main focus of the first meeting will be on the evaluation of stakeholder needs in terms of knowledge and expectations the different stakeholders have on the project as well as to get input in terms of information and possibly supporting data.

The first SHEBA stakeholder meeting will take place in **Hamburg 29-30 September 2015**. We start with an Icebreaker gathering on the 28.09. at 6 pm. The meeting will have different formats between plenary sessions and round tables.

The meeting is open for all SHEBA collaborators and invited stakeholders.