BONUS SHEBA – a project devoted to sustainable shipping and environment of the Baltic Sea

Markus Quante[1] and Jana Moldanova[2]

[1] *Helmholtz-Zentrum Geesthacht, Insititute of Coastal Research, Geesthacht, Germany (markus.quante@hzg.de)*

[2] *Swedish Environmental Research Institute (IVL), Gothenburg, Sweden*

Introduction

The Baltic Sea has been an important route for maritime trade since historic times. Today it is one of the most intensive trafficked sea areas in the world (about 15% of the global seaborne trade). The number and size of ships, especially oil tankers, have been growing during the last years. This trend is expected to continue over the upcoming decades. In addition cruise shipping is a growing sector.

Shipping may affect the environment in several ways. Among them are emissions of air pollutants, illegal and accidental discharge of oil, release of hazardous substances and waste to the water and introduction of alien species via ballast water and hulls. Underwater noise is an additional topic, which gathered more attention in recent years.

The BONUS SHEBA project brings together experts from the fields of ship emissions, atmospheric, acoustic and oceanic modelling, atmospheric and marine chemistry, marine ecology, environmental economics, and social sciences 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 project started in April 2015 and runs to the end of March 2018. SHEBA is a Baltic Earth affiliated project. Here we would like to give a short introduction to the project.

Baltic shorelines and shipping. Photos: M. Quante, V. Matthias (ferry)

Objectives and structure

The aim of BONUS SHEBA is 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.

More specific 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.
6. Assess changes in ecosystem services in different shipping scenarios compared to a Baseline.
7. 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).
8. 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.

BONUS SHEBA has analysed the drivers for the shipping sector and summarising the relevant key international and national policies affecting shipping for the countries. The project produced datasets with gridded present traffic volumes, estimated the future traffic volumes projecting the current trends to year 2030 and 2040 and developed a set of alternative scenarios. These traffic volumes , known emission factors and assumptions about employment of different abatement strategies in the shipping sector have been used for calculations of current and scenario emissions to water, to air, and of underwater noise building on AIS ship movement data combined with an advanced emission model STEAM . Atmospheric, oceanic and noise propagation models in combination with ecotoxicology studies are currently used to assess spatio-temporal distributions, fates and effects of these stressors in the Baltic Sea region.

Further, the project will finally 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.

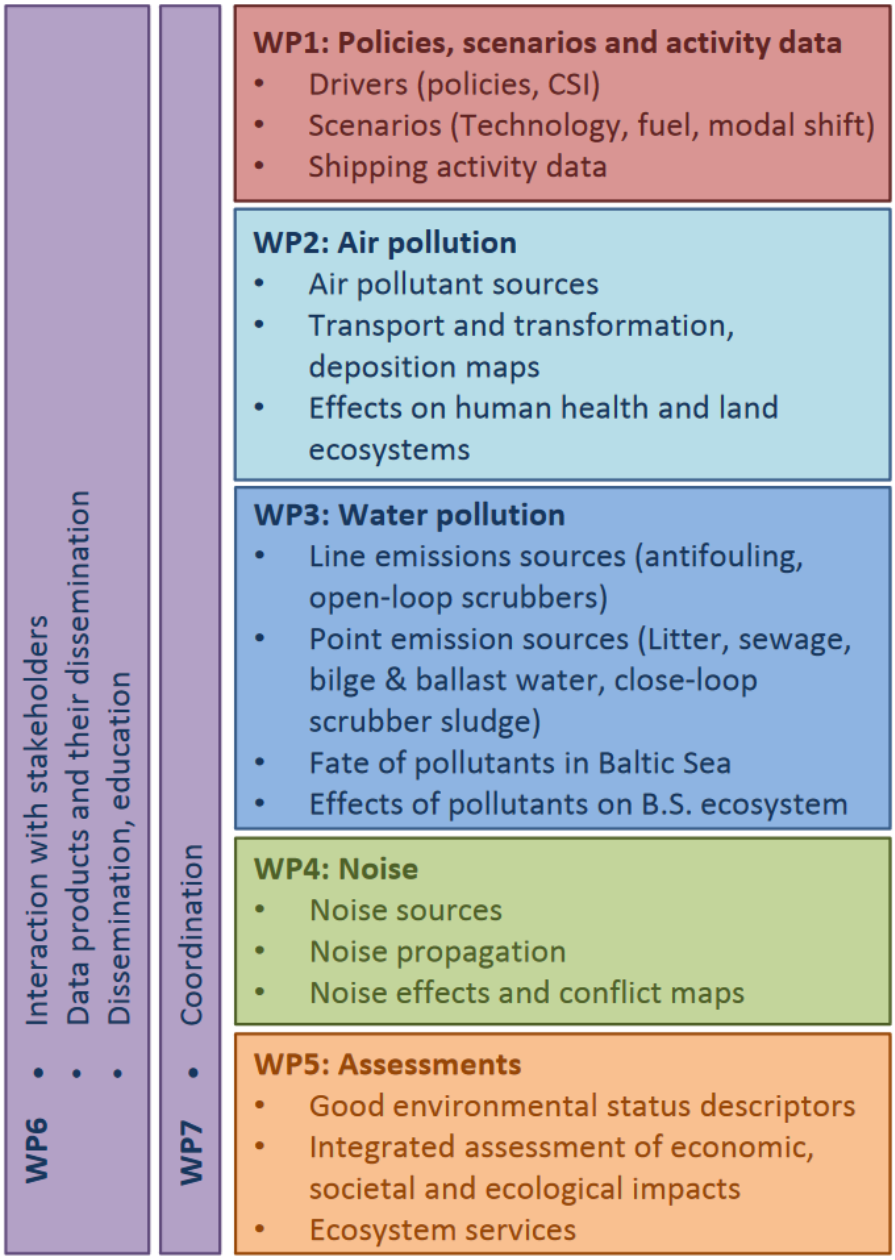


Figure 1: SHEBA´s research and coordination is structured into dedicated working packages (WPs)

SHEBA is supported by a wide group of stakeholders, including harbours, shipping industry and authorities. Experts from this group have been consulted using a dedicated quantitative elicitation meeting during the development of future scenarios. A conference on the impact of shipping on environment is organized by the project as well as a number of activities and products aiming to rise the public awareness in this issue. The shipping conference is jointly prepared with International Surface Ocean - Lower Atmosphere Study (SOLAS) and will take place on 24 and 25 of October 2017 in Gothenburg, Sweden (see separate announcement at the end of this text).

The eleven SHEBA partner institutions come from 6 Baltic countries and France. More on partners and events can be found on the SHEBA homepage: http://www.sheba-project.eu/.

Some selected examples of SHEBA topics

The different activities onboard of ships give rise to pollutants, acidifying- and eutrophying substances that enter the marine environment (figure 2). The ballast water and hull fouling also contain biological pollution as non-indigenous species may pose a risk to receiving ports' native flora and fauna. Ships, on average, are generally considered as the most energy efficient mode of transport with low ton-per-kilometer emissions of Greenhouse Gases (i.e CO_2), but comparably high emissions of pollutants like nitrogen oxides (NO_x), sulphur oxides (SO_x) and particulate matter (PM) occur. Ship activity data based on the Automatic Identification System (AIS) data is the backbone of the emission calculations (water, air and underwater noise) of SHEBA. Further on these emissions are driving a marine ecosystem model, several chemistry transport models with different grid resolutions and a noise propagation model. Figure 3 shows as an example results of a chemistry transport model, here the percent-changes due to shipping are display for NO_2 concentrations and nitrogen deposition in the southern Baltic region for one month in 2012. Scenario based assessments concentrate on the year 2030 and 2040. The investigation of emission contributions from leisure boats is also a sub-topic of SHEBA, as are pollution studies for selected harbor cities (Gothenburg, Rostock, Riga and Tallinn).

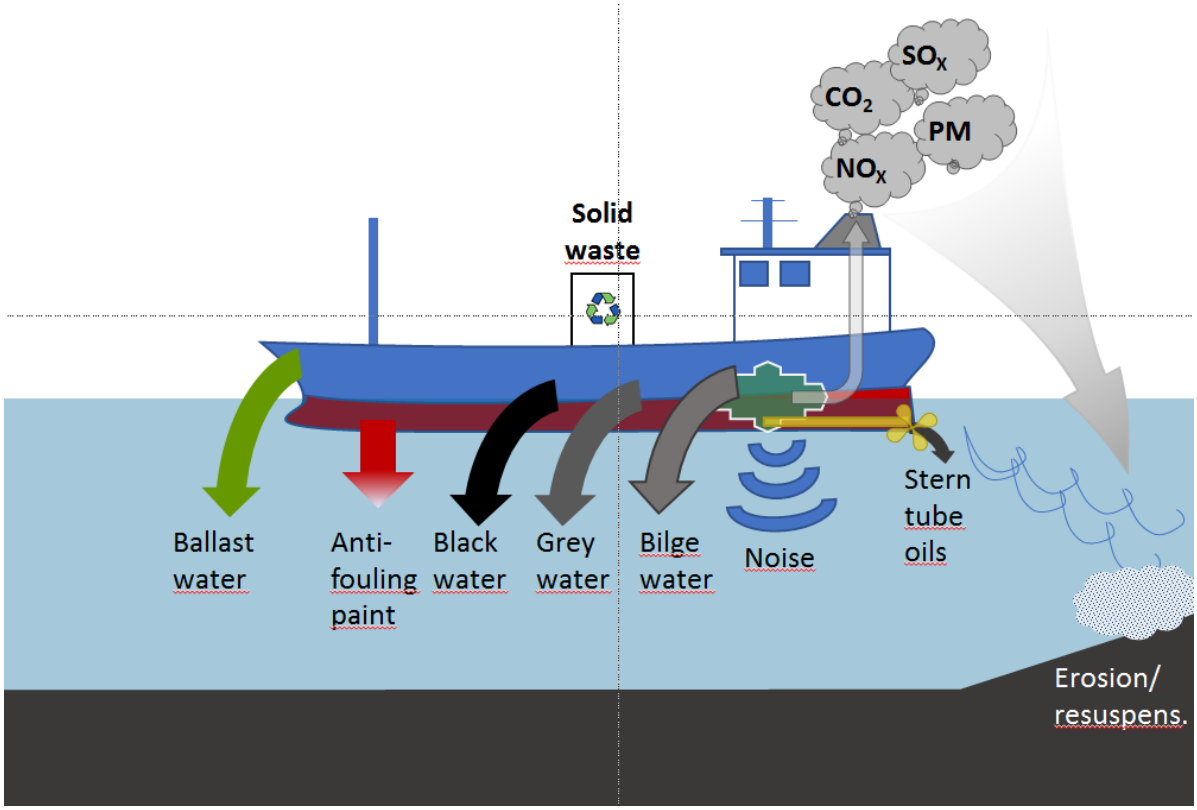
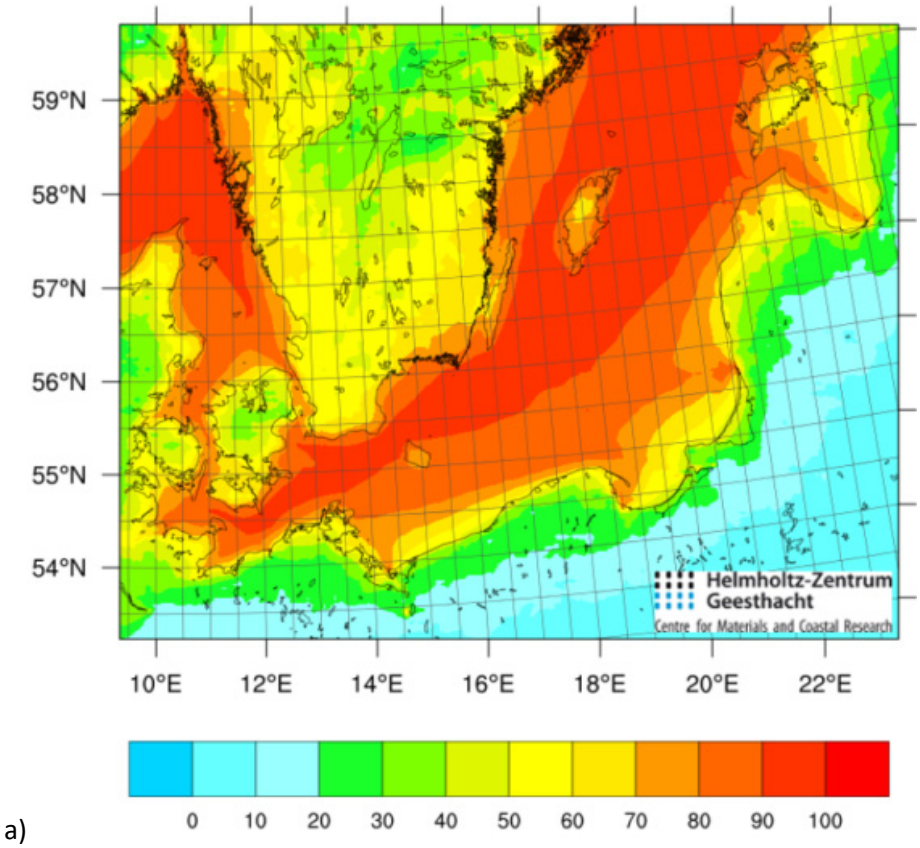
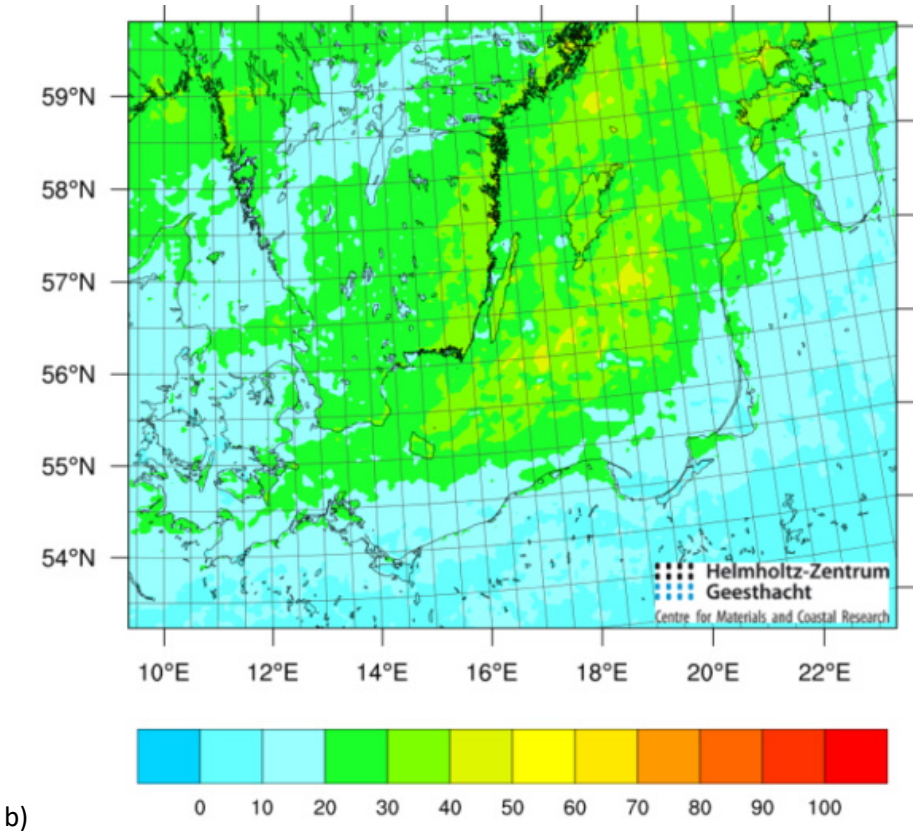


Figure 2: Sketch of discharges and emissions from ships into the marine environment. The terms black and grey water refer to sewage and wash water respectively. Bilge water originates from the engine room and is a mixture of condense water, oil, detergents and other cleaning agents (Figure prepared by Ida-Maja Hassellöv, Chalmers).



a)



b)

Figure 3: Change of NO_2 concentrations (a) and N-deposition (b) in percent due to shipping (with – without ship emissions) for May 2012 in the Southern Baltic Sea region. It can be seen, that shipping according to the model is responsible for about 20 to 60 % of the NO_2-concentartions and up to 20-30% of nitrogen deposition in coastal land areas.Courtesy of Matthias Karl, HZG.

Besides modelling, also observational activities are part of SHEBA in order to better understand some of the underlying processes. 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 sailing 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. Water measurements of salinity, temperature, pH, oxygen concentration and partial pressure of CO2 (pCO2) were made using sensors mounted underwater or taking water samples at different depths (Figure 4). The continuous water measurements were made from Ystad to Visby (Figure 5), and hence included the shipping lanes northwest of Bornholm and south of Öland. Data analysis from the campaign is ongoing and it is expect after first inspection to find interesting results and describe patterns in relation to how shipping g affects the environment in the Baltic Sea.

Figure 4: Members of the Himfare crew taking measurements at different water depths. Photo: Jana Moldanova, IVL

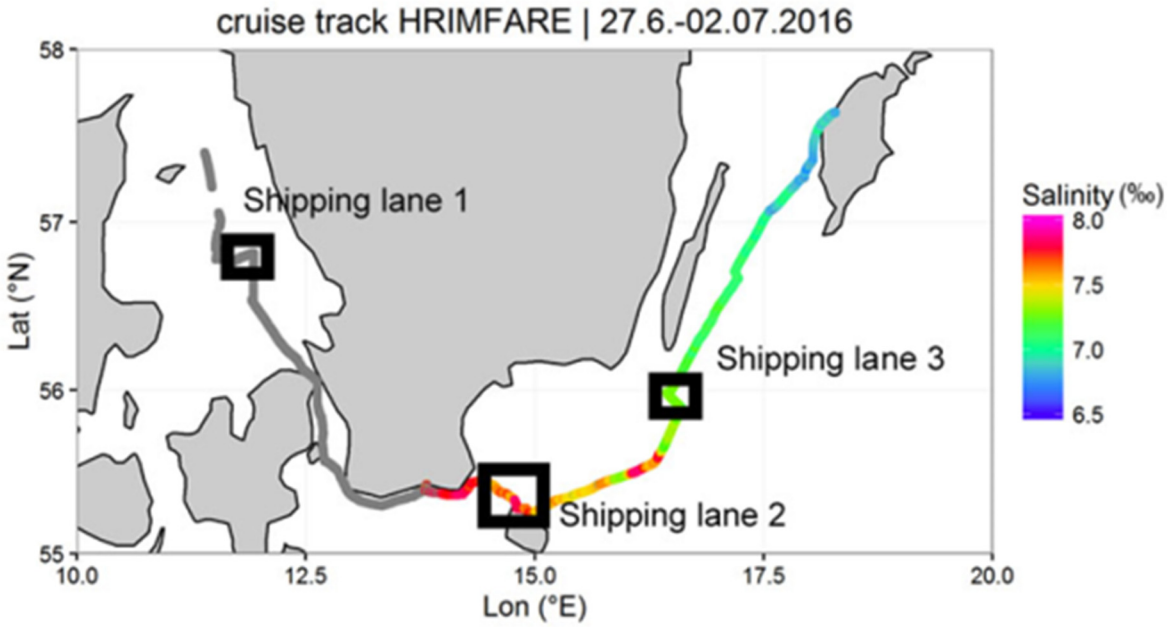


Figure 5: Cruise track of s/y Hrimfare and sampled areas in shipping lanes. Colored cruise track indicate the use of continuous measurement of salinity, temperature, pH, oxygen concentration and partial pressure of CO2. Grey cruise track indicate absence of such measurements. Courtesy of Martin Erikson, Chalmers.

On the observational side, also underwater noise measurements at specific locations are performed and field studies of fish behavior with respect to noise are conducted.

Currently the SHEBA partners work intensively on all listed topics and the integrated assessment. Results will be presented during the shipping conference in autumn 2017. A set of journal publications of SHEBA results is planned.

Shipping conference

BONUS SHEBA and by the International Surface Ocean - Lower Atmosphere Study (SOLAS) jointly organize an international conference on the environmental impact of shipping and its importance within policy, marine spatial planning and the maritime transport sectors, which is part of the BONUS Symposia series

SHIPPING AND THE ENVIRONMENT - From Regional to Global Perspectives

Gothenburg, 24-25 October, 2017

Topics addressed

- 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 impact on human well-being
- Environment and society-socio-economic valuation of the impacts of shipping, impact of shipping on ecosystem services, shipping and marine spatial planning

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