Melting Sea Ice in the Baltic Sea – Changes and Possible Effects

The Baltic Sea is one of the busiest water bodies for ship traffic in the world. Cargo, cruise and passenger vessels operate year-round, connecting ports of many Baltic Sea countries and beyond. However, in some northern and eastern regions, the sea ice coverage in winter and early spring restricts ship traffic to some extent and requires the assignment of ice breakers to keep shipping routes open for ship traffic (fig. 1). Given the discussion of global warming and the regional influences of climate change within the 21st century, changes in the occurrence and extent of sea ice coverage in the Baltic Sea are one of the open questions, especially on a regional scale. To judge the band width of possible future changes, scenario simulations are necessary and broadly used including different CO2-emission cases provided by the Intergovernmental Panel on Climate Change (IPCC). The Baltic Sea Research Institute (IOW) established simulations about the future of the Baltic Sea, based on the IPCC-scenarios A1B and B1, which show an air temperature increase of up to 3, respectively 2 Kelvin until the end of the century. According to the latest simulations, the Baltic Sea will get warmer, less saline and its sea-level will increase up to one meter. Connected to the warming, ice creation will decline, which means that the annual ice extent as well as the freezing period and ice thickness will drastically decrease (fig. 2). Previous studies showed, that a temperature increase of 1 Kelvin causes a shortening of the freezing period of one to two weeks. As a consequence, the ice thickness is reduced by 5 – 10 cm and the total ice-covered area in the Baltic Sea goes back up to 10,000 km^2.

The decline of ice creation will certainly have direct effects on the ecosystem (e.g. the ringed seal's breeding strongly depends on ice conditions) but also on ship traffic. For the Gulf of Bothnia the ice decline could most likely have a positive economic effect, as today the area cannot be used as shipping route for

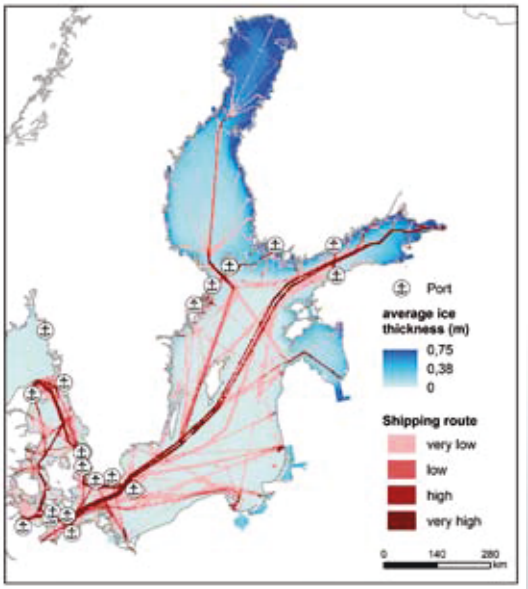

Figure 1: Average ice thickness 1970-2000

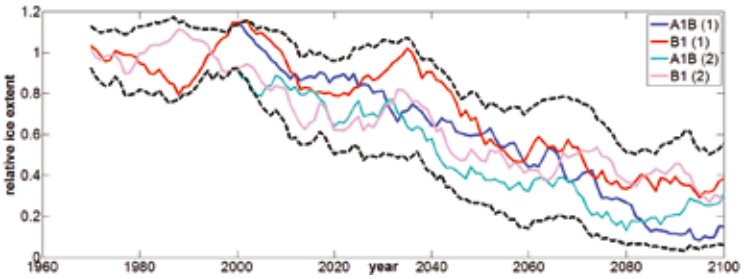

Figure 2: Decline of ice extent in different climate scenarios

one third of the year. Also other intensively cruised routes especially in the Gulf of Finland to St. Petersburg, Helsinki and Tallinn will in the future become utilisable without the usage of ice breakers (fig. 3), a fact that will increase the annual shipping period and make it more competitive. However, around the Gulf of Finland several marine protected areas (MPA) are located, which might be indirectly affected, as they are more endangered to be hit by pollutants from ship accidents in winter than in other seasons due to the surface currents, like recent simulations showed.

Model simulations can only show the band width of possible changes and may not be used as exact forecast. However, the results can provide valuable hints for the future adaptation of maritime regions and also for the management and protection of MPAs.

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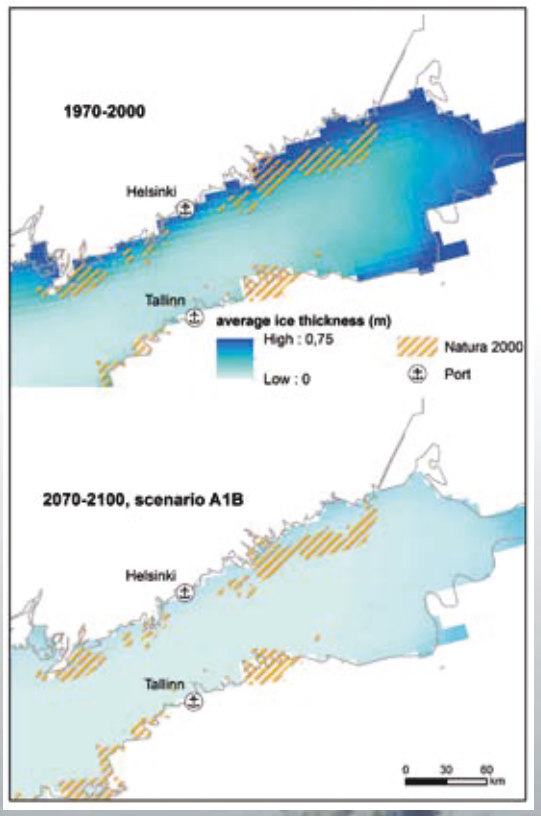

Figure 3: Average ice thickness in the Gulf of Riga, period 1970-2000 vs period 2070-2100 (A1B)

Ice breaker towing cargo ship, © Markus Wiesener