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The changes in the Baltic Sea ice cover by 2050

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Global warming affects nature and society in many ways. The winter ice cover of the Baltic Sea, for example, will face changes that can affect the shipping in the Baltic Sea. In this study we assess the future changes in the Baltic Sea ice cover by 2050. We focus mainly on the maximum ice cover extent and the average maximum fast ice thickness. The study area lies within 53 to 67 ˚N and 14 to 31 ˚E.

The results are based on observations and the results of 19 global climate models. A regression model was fitted between the observed maximum ice cover extent and coastal winter temperature. Using this result together with future coastal winter temperature based on climate model results, the distributions for maximum sea-ice cover extent for four future decades 2011-2020, 2021-2030, 2031-2040, and 2041-2050, were estimated. The average maximum fast ice thickness for each decade was calculated using Stefan's law and the winter-frost sum, which was based on climate model results.

According to these results, both the maximum ice cover extent and the probability of severe ice winters will decrease. Some changes will be already seen during next few decades. After 2030 severe ice winters (ice cover extent more than 279 000 km^2) will become rare, and after 2040, severe ice winters will rarely occur anymore. Correspondingly, mild (ice cover extent less than 139 000 km^2) and extremely mild ice winters (ice cover extent 52000-81000 km^2) will increase during the study period.

The average maximum fast ice thickness was assessed only in coastal sea areas. We find that the average maximum fast ice thickness during 2011-2020 will be about 10-15 cm thinner than the average maximum fast ice thickness for 1971-2000. After 2030 the difference to 1971-2000 will be about 20-25 cm and after 2040 about 25-35 cm. The southern and south-western parts of the Baltic Sea will stay ice-free during the average winter in future. However, the method used in assessing the ice thickness does not take into account the snow layer on top of the ice cover. Snow acts as an insulator and slows down the growth of ice thickness. The calculated ice thicknesses are thus about 10-20 cm too large.