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The decreases in the Baltic Sea ice cover by 2090

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Along with the global warming, the winter ice cover of the Baltic Sea will face changes that can affect the ecosystems and societies in the Baltic Sea region. In this study, we estimate the future decreases in the annual maximum ice extent (MIB) and the 30-year mean values of maximum fast ice thickness in the Baltic Sea by 2090.

The results are based on observations and the output of 28 global climate model simulations participating in Coupled Model Intercomparison Project Phase 5 (CMIP5). Two greenhouse gas scenarios are used: RCP4.5 and RCP8.5. The MIB was estimated using a statistical procedure, and the mean maximum fast ice thickness was calculated using Stefan's law. The results were calculated for the multi-model mean and separately for individual models.

The MIB is projected to decrease according to both scenarios. According to RCP8.5, only mild ice winters (ice extent < 115 000 km2) occur from the 2060s onwards. In RCP4.5 the decline of ice extent is slower: average ice winters (ice extent between 115 000 km2 and 230 000 km2) may still occur in the 2080s. The average maximum fast ice thickness was estimated only in coastal sea areas. In RCP4.5, the southern and southwestern parts of the Baltic Sea become ice-free in a typical winter by the end of the century. In 2081-2090, the largest thickness, locally more than 60 cm, is found in the Bay of Bothnia. In RCP8.5 in 2081-2090, ice occurs mainly in the Bay of Bothnia only. The uncertainties caused by differences in climate models, unknown future emissions and inaccuracies in the calculation methods are quite large. Despite these uncertainties, our robust finding is that the Baltic Sea is very unlikely to become totally ice-free during the 21st century.