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Arctic climate change in the global coupled model EC-Earth: The role of the ocean heat transport

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This study analyses the role of the ocean heat transport for the Arctic climate change in an ensemble of IPCC AR5 future scenario simulations with EC-Earth. In the 21st century, all simulations show a strong amplified Arctic warming. The warming is particularly pronounced in the Barents Sea region with an annual mean temperature change of about 10 K in the RCP2.6 scenario and up to 18 K in RCP8.5 until the end of the 21st century. This is about twice of the mean Arctic warming and is mainly due to a strong reduction of sea ice in the Barents Sea and related increase of ocean heat release to the atmosphere.

The ocean heat transport into the Barents Sea is enhanced in the 21st century simulations and strongly contributes to the sea ice reduction in the Barents Sea region by enhancing the ocean to ice heat flux. This triggers the ice-albedo feedback in this region and leads together with increased ocean to atmosphere heat fluxes to the amplified temperature increase. The stable stratification of the atmosphere disappears in the future with large consequences for clouds and radiation in this region.
Low clouds are strongly reduced while middle and high level clouds are increased which impacts the radiation balance.
Both warming of surface near layers of the transported water masses and enhanced volume transport due to strengthened surface winds in the Nordic Seas are contributing to the increased ocean heat flux into the Barents Sea in the 21st century. However, north of Barents and Kara Seas, the inflowing warm water masses are mixed to larger depth and do not strongly contribute to sea ice melt in the Central Arctic Ocean. Also the changes in the ocean heat transports through Fram Strait and through Bering Strait are comparably small in our future simulations.