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Mixed layers along the Atlantic water path in the Nordic seas in HighResMIP models

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Atlantic water flows over the Greenland-Iceland-Scotland Ridge into the Norwegian Sea. Along its path towards the Arctic, the Atlantic water is cooled by strong air-sea fluxes. Deep winter mixed layers modify the stratification and properties of the Atlantic water and precondition its flow into the Arctic, thus influencing Arctic sea ice and climate. Atlantic water also recirculates in the Greenland sea where deep water formation contributes to the dense limb of the Atlantic Meridional Overturning Circulation. It is thus of paramount importance to represent mixed layer deepening and lateral heat exchanges processes in the Nordic Seas in climate models.

Heat exchanges in the Nordic Seas are influenced by narrow current branches, instabilities and eddies, which are not accurately represented in low resolution climate model (with grid ~ 50-100km). Here we examine the mixed layer dynamics and heat exchanges using the latest generation of European high resolution global coupled models in the framework of HighResMip (5-15km grids in the Nordic Seas). We investigate in detail the effect of model resolution on the mixed layer depth and water mass formation in relation with the Atlantic water circulation and modification between the Norwegian and the Greenland Sea. First results show an increased northward ocean heat transport, a more realistic representation of the ocean current system in the Nordic Seas, and consequently an improved spatial distribution of the turbulent surface heat flux compared to standard resolution CMIP6 models. The mixed layer depth itself however varies strongly between different HighResMIP models. Summarizing, our assessment of the high resolution coupled simulations of the historical period demonstrates that future climate projections at high resolution have a huge potential, but also limitations.