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Simulations of the Denmark Strait Overflow in Eddy-Permitting and Eddy-Resolving Setups

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The Denmark Strait Overflow (DSO) represents the most important transport branch for dense and cold water formed north of the Greenland-Scotland ridge to the North Atlantic. As such DSO waters and the entrainment of ambient waters associated with the DSO represent a crucial role of maintaining the lower limb of the Atlantic meridional overturning circulation. Yet, due to the small Rossby radius in the region and the fact that the flow is bottom intensified (cascading down the bathymetry), shows a high degree of both eddy mixing and diapycnal mixing associated with entrainment makes it difficult to represent the DSO in an ocean model with a coarse resolution that is typical of climate models.

In this study, the effects of model resolution on the evolution of DSO water along its path downstream of the sill are explored in 1 year simulations with a regional setup using the MIT General Circulation Model. Three different horizontal resolutions ranging from $\sim$1km (eddy resolving) to $\sim$4km (eddy permitting) are used, whereas the vertical resolution is kept unchanged. All simulations show similar transport values for DSO water over the sill. However, our results show that the horizontal resolution affects the vertical structure of the overflow which in return changes the warming and entrainment rates of the plume as it descends downstream of the sill. In addition to the modification of the water mass properties downstream, effects of the horizontal resolution on the simulated ocean's energy budget are investigated. Conversions to eddy kinetic energy from eddy available potential energy and mean kinetic energy are compared between resolutions, along with energy transfers across scales. The resolution does not appear to substantially change the energy budget and conversion.