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Remedying excessive numerical diapycnal mixing in a global 0.25° NEMO configuration

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If numerical ocean models are to simulate faithfully the upwelling branches of the global overturning circulation, they need to have a good representation of the diapycnal mixing processes which contribute to conversion of the bottom and deep waters produced in high latitudes into less dense watermasses. It is known that the default class of depth-coordinate ocean models such as NEMO and MOM5, as used in many state-of-the art coupled climate models and Earth System Models, have excessive numerical diapycnal mixing, resulting from irreversible advection across coordinate surfaces.

The GO5.0 configuration of the NEMO ocean model, on an "eddy-permitting" 0.25° global grid, is used in the current UK GC1 and GC2 coupled models. Megann and Nurser (2016) have shown, using the isopycnal watermass analysis of Lee et al (2002), that spurious numerical mixing is substantially larger than the explicit mixing prescribed by the mixing scheme used by the model. It will be shown that increasing the biharmonic viscosity by a factor of three tends to suppress small-scale noise in the vertical velocity in the model. This significantly reduces the numerical mixing in GO5.0, and we shall show that it also leads to large-scale improvements in model biases.