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Estimating the numerical diapycnal mixing in the GO5.0 ocean model

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Constant-depth (or "z-coordinate") ocean models such as MOM and NEMO have become the de facto workhorse in climate applications, and have attained a mature stage in their development and are well understood. A generic shortcoming of this model type, however, is a tendency for the advection scheme to produce unphysical numerical diapycnal mixing, which in some cases may exceed the explicitly parameterised mixing based on observed physical processes (e.g. Hofmann and Maqueda, 2006), and this is likely to have effects on the long-timescale evolution of the simulated climate system. Despite this, few quantitative estimations have been made of the typical magnitude of the effective diapycnal diffusivity due to numerical mixing in these models.

GO5.0 is the latest ocean model configuration developed jointly by the UK Met Office and the National Oceanography Centre (Megann et al, 2013). It uses version 3.4 of the NEMO model, on the ORCA025 global tripolar grid. Two approaches to quantifying the numerical diapycnal mixing in this model are described: the first is based on the isopycnal watermass analysis of Lee et al (2002), while the second uses a passive tracer to diagnose mixing across density surfaces. Results from these two methods will be compared and contrasted.

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