Spurious Diapycnal Mixing in z-coordinate Ocean Circulation Models on Unstructured Meshes

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Spurious diapycnal mixing arising from advection schemes is common in models using z or sigma vertical coordinate. Here we look into the performance of several advection schemes on triangular unstructured meshes in Finite-Element Ocean circulation Model. The spurious mixing is diagnosed on meshes using tetrahedral and prismatic elements, and for regular and fully unstructured surface mesh. The cases of velocity field represented with linear continuous and linear nonconforming basis functions are considered. The diagnostics are performed for a baroclinically unstable turbulent flow in a zonally reentrant channel in eddy permitting and eddy resolving regimes.

The motivation behind the study is that mesh irregularity generally leads to larger residual terms in representing advection operators than one finds on regular meshes. This may result in a stronger diapycnal mixing. We discuss the effect of mesh inhomogeneity on the coefficient of effective diapycnal diffusivity and show that it strongly exceeds the level of 0.1 cm2/s in most circumstances. However, typical magnitudes found by us have the same order of magnitude as those reported earlier for regular meshes.