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An idealised model of the restratification after open ocean deep convection using an unstructured mesh

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Open ocean deep convection occurs in various regions of the ocean, including the Labrador Sea. When convection ceases, the dense column left behind mixes with the stably stratified ocean, forming eddies due to baroclinic instability. Dense water formed during deep convection joins the meridional overturning circulation, so a good model of the restratification phase is important to our understanding of the ocean circulation.

Fluidity-ICOM is a non-hydrostatic, finite element ocean model with a mesh made up of unstructured tetrahedra. Our tests show that arbitrarily unstructured tetrahedra cannot be used for basin-scale simulations because the high aspect ratio of the elements creates errors in the horizontal, which then leak into the vertical. Instead, we use a mesh known as a two-plus-one mesh, created by extruding a two-dimensional triangular mesh in the vertical. This mesh is not necessarily layered, it can vary in resolution in both the vertical and the horizontal and may be adapted.

We will present some results illustrating the problem with the fully unstructured mesh and our solution. We will then show the results from an idealised model of the restratification after open ocean deep convection using a two-plus-one mesh. These results verify that our multi-scale finite element model performs well on basin-scale domains.