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Unstructured finite element analysis, and parameterisation of open ocean deep convection in marginal seas.

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Open ocean convection, or overturning, is an important mixing process in marginal seas. Deep convection is a highly localised event in both time and space, but has far reaching effects on large-scale circulation and global climate. Most global ocean models are hydrostatic, and employ a convection parameterisation. These parameterisations usually consist of applying columnar adjustment algorithms which allow convective overturning to be represented, but not resolved.

The use of unstructured meshes and anisotropic adaptivity in three dimensions offers many advantages for the modelling of locally complex structures, such as convective chimneys. The ability to have variable resolution in time and space, enables more efficient modelling while capturing all the important features of the flow. The unstructured, adapting mesh presents additional challenges in the development of overturning parameterisations which are not present in conventional structured grid models.

Using the Imperial College Ocean Model (ICOM) we compare the performance of convective parameterisations on an unstructured, adapting mesh with the results of high resolution regular mesh simulations. The parameterisations developed in these tests are applied to the problem of convection in marginal basins, such as the Labrador Sea, previously studied by Spall (2003), and Straneo (2005). Applying an unstructured, adapting model to this system allows us to resolve the non-hydrostatic dynamics near the boundary more efficiently. A convective parameterisation is also applied to this problem, and compared with the unparameterised simulation.