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Better Understanding of Open Ocean Deep Convection in the Greenland Sea using a Finite Element Ocean Model.

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Studies have shown that the small-scale features of open ocean deep convection (OODC) appear to matter for large-scale climate (e.g. Marotzke and Scott, 1999, Dickson et al., 1996). However, traditional parameterisations for OODC in general circulation models (GCMs) omit these details because of poor resolution. There is therefore a need for greater understanding of the OODC process and its implications for climate change.

This project aims to produce an idealised model of the Greenland Sea and an in-depth study of OODC - its formation, behaviour and sensitivity to e.g. bathymetry, meteorology and ice, with greater accuracy than heretofore possible, using the Imperial College Ocean Model (ICOM) (Ford et al. 2004). ICOM is a 3D finite element, non-hydrostatic model with an adaptive, unstructured mesh and non-uniform resolution, allowing modelling on the basin scale (e.g. gyre circulation) and resolution of small-scale features such as OODC simultaneously. The results of this study will be used to improve parameterisations of OODC in GCMs.

Initial model runs have produced realistic simulations of OODC using both high resolution fixed mesh and adaptive mesh approaches. Classical fluid dynamics problems such as the onset of convective instability in a layer of fluid heated from below (Chandrasekhar, 1961) have been simulated in order to quantitatively assess the performance of the model with success.

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