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A quantitative study of 3D anistropic dynamic adaptivity applied to open ocean deep convection

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We present a quantitative analysis of the performance of the unstructured nonhydrostatic finite element ocean model ICOM applied to the problem of open ocean deep convection in a box as described in (Jones and Marshall, 1993). This is a problem with many scales with geostrophic motion near the top of the convecting column and strong nonhydrostatic dynamics near the descending plumes. In this study we attempt to resolve the details of the convection, without using convection parameterisation schemes. A comparison is made with a resolved calculation on a regular mesh without adaptivity. We describe the error metrics used in the calculation to define the mesh resolution and compute errors in the temperature and velocity structure for varying weights, showing the error metrics obtained, as well as errors computed relative to the fixed mesh calculation. We compare the meshes obtained with anisotropic error metrics with those obtained with isotropic error metrics and provide estimates for the relative efficiency of fixed, isotropic and anisotropic meshes in the various phases of the formation of the convective cell.