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On selecting the resolution to represent eddy dynamics

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If meshes with variable resolution, in particular unstructured meshes, are refined to enable local eddy dynamics, a question
arises as how to vary their resolution and where precisely to deploy the refinement. We propose to use the observed sea surface height variability as a criterion. We explore the utility of such an approach (i) in a suite of simple experiments simulating a wind-driven double gyre flow in a stratified circular basin and (ii) in simulations of global ocean circulation performed with the Finite Element Sea Ice Ocean Model (FESOM). For the double gyre case we show that the variability simulated in the high-resolution reference run can be well captured on coarser meshes of variable resolution if they are refined in the domain where the variability is substantial in the reference run and additionally
include dynamically-important areas around the jet separation. In simulations related to the real global ocean the refinement based on the observed variability proves to be helpful too, yet the difference between the simulated and observed variability may remain higher. In this case it is more difficult to guess how well the areas upstream of sites with high variability have to be resolved whereas the practical limitation on the total number of mesh nodes also limits the size of refined areas if there are too many of them. The presence of coarse mesh in close proximity to the refined areas effectively damps the simulated variability in this case. A practical recommendation is to limit refinement to several regions, but make them sufficiently wide yet still following the observed variability pattern.