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Resolution dependent eddy transport parameterizations for eddy-permitting models

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Though ocean models are widely applied in eddy-permitting regimes, eddy transport parameterizations are required to model the missing antisymetric tracer stirring operator due to the unresolved part of ocean turbulence. Still, it is unclear to what extent such parameterization should depend on the model horizontal resolution η.

Our working hypothesis is that the local scale resolvability, ϵ, defined as the ratio of the model resolution to the first baroclinic Rossby radius λ , i.e. $\epsilon = \eta/\lambda$, is the relevant parameter for a given model. We present results on the design of eddy transport parameterizations which explicitly depend on ϵ.

First, a series of baroclinically unstable jet simulations is conducted with various ϵ. For each ϵ, Langrangian floats are used to estimate the equivalent stirring tensor. We then consider the projection of the stirring tensor onto the subspace of Gent-McWilliams (GM) type operators (Gent and McWilliams, 1990). By comparison with the limit "eddy-resolving" solution $\epsilon \rightarrow 0$, the missing GM tracer stirring tensor is obtained and, in turn, we estimate the required GM coefficient.

Second, according to the idealized experiments, we impose GM coefficient to depend explicitly on a local estimate of ϵ within a realistic $1/4^o$ Northern Atlantic simulations. The resulting circulation exhibits an enhanced restratification in the Labrador sea with no excessive diffusion of boundary currents. The combination of an ϵ dependence with a local parametric estimation of Gent-McWilliams coefficient is also discussed.