Abstract View

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Specification of Eddy Transfer Coefficients in Coarse-Resolution Ocean Circulation Models*

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ABSTRACT

Parametric representations of oceanic geostrophic eddy transfer of heat and salt are studied ranging fromhorizontal diffusion to the more physically based approaches of Green and Stone (GS) and Gent and McWilliams(GM). The authors argue for a representation that combines the best aspects of GS and GM: transfer coefficientsthat vary in space and time in a manner that depends on the large-scale density fields (GS) and adoption of atransformed Eulerian mean formalism (GM). Recommendations are based upon a two-dimensional (zonally orazimuthally averaged) model with parameterized horizontal and vertical fluxes that is compared to three-dimensional numerical calculations in which the eddy transfer is resolved. Three different scenarios are considered: 1) a convective “chimney” where the baroclinic zone is created by differential surface cooling; 2) spindownof a frontal zone due to baroclinic eddies; and 3) a wind-driven, baroclinically unstable channel. Guided bybaroclinic instability theory and calibrated against eddy-resolving calculations, the authors recommend a formfor the horizontal transfer coefficient given by [stDFORMULA ID=][sv31=s6]

$$k = \alpha \frac{f}{\sqrt{\mathrm{Ri}}} l^2 = \alpha \frac{M^2}{N} l^2,$$

where $\mathrm{Ri} = f^2N^2/M^4$ is the large-scale Richardson number and f is the Coriolis parameter; M^2 and N^2 are measuresof the horizontal and vertical stratification of the large-scale flow, l measures the width of the baroclinic zone,and α is a constant of proportionality. In the very different scenarios studied here the authors find α to be a“universal” constant equal to 0.015, not dissimilar to that found by Green for geostrophic eddies in the atmosphere. The magnitude of the

implied k, however, varies from 300 $m^2\ s^{-1}$ in the chimney to 2000 $m^2\ s^{-1}$ inthe wind-driven channel.

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