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Large-Scale Lateral Entrainment and Detrainment at the Edge of a Geostrophic Shear Layer

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ABSTRACT

The evolution of large-amplitude disturbances at the outer edge of a quasi-geostrophic shear layer depends on the sign of the outward gradient of potential vorticity. Entrainment of ambient water can occur when the gradient of relative vorticity dominates in the potential vorticity, and detrainment from the current can occur when gradient of isopycnal thickness dominates. In the latter case long, thin filaments of finite area are “pinched off” into the surrounding water mass. This is verified using a quasi-geostrophic model having piecewise uniform potential vorticity. Contour dynamical calculations for many initial conditions allow us to define and tabulate an entrainment/detrainment velocity. This is used for an order of magnitude estimate of the flux of heat or salt on an isopycnal surface in a warm core ring.

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