Abstract View

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Nonlinear Evolution of Linearly Unstable Barotropic Boundar

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ABSTRACT

The nonlinear evolution of linearly unstable barotropic boundary currents, consisting of three piecewise uniform vorticity regions, was investigated using the contour dynamics method. A physical interpretation of the nonlinear behavior of the unstable currents is also presented. The contour dynamics experiments reveal that the nonlinear behavior can be classified into three regimes dependent on the vorticity distribution of the basic flow and the wavelength of the unstable wave. In the first *breaking wave* regime a regular wave train appears with crests breaking on their upstream side. In the second *vortex pair* regime the unstable wave evolves into a mushroomlike shape consisting of two vortices having opposite signs, which, due to self-induced flow, advect coastal water far away from the boundary. In the third *boundary trapped vortex* regime the vortices generated in both the offshore and coastal shear regions remain trapped near the coastal boundary. Differences among the three regimes are mainly governed by the temporal change of the phase relationship between the vorticity centers in the piecewise uniform vorticity regions. The important point to note is that the nonlinear evolution exhibits qualitatively different behavior at different wavelengths, even if the basic currents have the same ve the real ocean, due to coastal topography or external disturbance, the scale of the disturbance is not determined by the fastest growing mode. Therefore, the nonlinear behavior of an unstable current, mixing and transport processes, should be studied with attention focused on various wavelengths o