Self-elongation and nonlinear intensification of unstable baroclinic vortices

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Abstract

Physical mechanisms of nonlinear evolution of baroclinically unstable circular vortices are analyzed in the context of stratified rotating flows. Development of the most unstable elliptical mode is shown to result in self-elongation of the major vortex core and formation of co-rotating satellites with opposite sign due to splitting of the potential vorticity anomaly in initially quiescent layer into two parts. The role of angular momentum in determining of finite amplitude saturation under the tripolar form is demonstrated using a Hamiltonian model for elliptical vortex core and satellites. Such carousel tripolar flow pattern leads to self-intensification of fluid rotation around the vortex center that has important implications for understanding of the long life of real-ocean eddies.

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