Abstract Submitted
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The Easily Excitable Baroclinic Critical Layers in Rotating, Horizontally Shearing, Vertically Stratified Flows and Their Roll-up into Vortices PHILIP MARCUS, SUYANG PEI, CHUNG-HSIANG JIANG, PEDRAM HASSANZADEH, UC Berkeley — Baroclinic critical layers can occur in rotating, vertically-stratified, uni-directional shear flows. They are special cases of neutrally stable eigenmodes. Baroclinic critical layers have logarithmic singularities in density and vertical velocity. They differ from barotropic critical layers associated with Kelvin's cats-eyes in constant-density, uni-directional shear flows, which form at locations where the shear flow velocity matches the eigenmode's phase speed and have singularities only in stream-wise velocities. Baroclinic critical layers are excited with no special tuning of parameters by perturbations from vortices or waves. Unlike barotropic critical layers the amplitudes of baroclinic layers become large by drawing energy from the background shear. The large vertical velocities in the critical layers, coupled with the Coriolis parameter create large-amplitude vortex layers. These layers often roll-up into large coherent vortices. The baroclinic critical layers' growth and roll-up are robust: they form in cylindrical and Cartesian geometries, in Boussinesq fluids and ideal gases, and in flows with uniform and non-uniform shear and vertical stratification. However, they do not form in numerical calculations with insufficient spatial resolution or large grid dissipation.

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