Optimal growth of mesoscale storms

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The motivation for this work is to understand the optimal growth evolution of mesoscale baroclinic cyclones. For this purpose Generalized Stability Theory (GST) analysis of baroclinic shear flow in the primitive equations is performed for high and intermediate Richardson number regime. For eddies with horizontal scale equal to, or larger than the Rossby radius, the primary energy growth mechanism is the conventional baroclinic conversion of mean available potential energy to perturbation energy mediated by the eddy meridional heat flux. However, for eddies smaller than the Rossby radius, enhanced optimal growth rates are dominated by conversion of mean kinetic energy to perturbation kinetic energy mediated by the vertical component of zonal eddy momentum flux. This growth mechanism is filtered in the quasi geostrophic frameworks. In the intermediate Richardson number regime mixed Rossby-gravity modes are nonorthogonal in energy and these participate in the process of energy transfer from the barotropic source in the mean shear to predominantly baroclinic waves during the transient growth process.