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Joint Baroclinic and Convective Instability[1] KEITH JULIEN, University of Colorado at Boulder, GEOFF VASIL, Candian Institute for Theoretical Astrophysics — The existence of balanced geostrophic dynamics for nonhydrostatic flows has been recently demonstrated.[2] The NonHydrostatic Balanced Geostrophic Equations that result are appropriate for columnar motions with significant unbalanced ageostrophic vertical motions. The NHBGE have successfully been applied to the case of rapidly rotating Rayleigh-Benard convection.[3] However, geophysical and astrophysical systems are fundamentally multiscale in nature, and when viewed on scales much greater than the convective eddies the forcing is fundamentally inhomegeneous in the lateral directions. Consequently, baroclinic instabililties may arise that both interact and compete with convectively driven motions. In this study, the NHBGE are extended to include large-scale inhomogeneous dynamics. The PDE's contains the classical problem of Eady (Tellus,1, 1949) for baroclinic instability. We show that Eady instability persists for an unstably-stratified fluid layer and competes with convective instability. We discuss criteria dominance of the baroclinic instability and present some results in the strongly nonlinear regime.

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[2]Julien, Knobloch, Milliff and Werne, J. Fluid Mech. 555 (2006)
[3]Sprague, Julien, Knobloch, and Werne, J. Fluid Mech. 551(2006)

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