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Thermal wind and convection simulated in the generalized quasilinear approximation CURTIS SAXTON, STEVEN TOBIAS, Univ of Leeds, BRAD MARSTON, Brown University, JEFF OISHI, Bates College — We probe the connections between shear flows, vortices and convective turbulence, in 3D simulations of a rotating flow with a thermal wind basic state plus Boussinesq perturbations. The model occupies a horizontally periodic Cartesian slab, with fixed temperatures above and below, generalizing the Rayleigh-Benard system. We vary the basic states meridional temperature gradient (T_y which also controls the strength of the thermal wind), strength of convection (via Rayleigh number Ra), and rotation (via Taylor number Ta). Nonlinear (NL) runs provide benchmarks for assessing the effectiveness of the generalized quasilinear (GQL) approximation. GQL decomposes each variable (say u) in horizontal Fourier space, with a 'low' part (u_L) at $|k_x|, |k_y| \leq \Lambda$, and a 'high' ($u_H$) remainder. Varying the GQL cutoff ($\Lambda = \infty, 10, 5, 1, 0$) alters the kinetic energy and other statistics in the final quasi-steady state. As a controlled barrier to inter-modal exchanges, Λ impairs specific k-dependent processes, apparent in mean spectra and transfer functions. Morphologically, high-Λ simulations resemble the NL benchmark (with blurring), but low-Λ can artificially sustain features such as giant vortices that would otherwise dissolve.

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