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Reduced Equations for Rapidly Rotating Convection on the Tilted f-plane KEITH JULIEN, Applied Mathematics, University of Colorado at Boulder, EDGAR KNOBLOCH, Dept. of Physics, University of California, Berkeley, MICHAEL SPRAGUE, School of Natural Sciences, University of California, Merced, JOSEPH WERNE, Northwest Reseach Associates, Inc., CoRA Division
— Non-Hydrostatic Quasi-Geostrophic Equations (NHQGE) are derived asymptotically in the limit of rapid rotation from the Navier-Stokes equations under the Boussinesq approximation. We consider the case where gravity and planetary rotation vectors are not aligned which requires a multiple-scales representation in a non-orthogonal coordinate system. We numerically investigate the solution to a reduced system of nonlinear PDEs for rapidly rotating convection: non-hydrostatic quasi-geostrophic equations (NHQGE). The resulting equations filter fast inertial waves and relax the need to resolve Ekman boundary layers. NHQGE are applicable to thermally forced flows characterized by thermal and vortical coherent structures that span the layer depth. We examine variation of heat transport as a function of scaled Rayleigh number. We also investigate the dynamics of the vortical structures and their effect on lateral mixing.

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