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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Inertia-Gravity Wave Breaking: Primary and Secondary Instabilities

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The three-dimensionalization of turbulence in the breaking of nearly vertically propagating inertia-gravity waves is investigated using singular vector analysis applied to the Boussinesq equations linearized about two-dimensional time-dependent basic states obtained from nonlinear simulations of breaking waves. The singular vectors are compared to integrations of the linear model using random initial conditions, and the leading few singular vectors are found to be representative of the structures that emerge in the randomly initialized integrations. A main result is that the length scales of the leading secondary instabilities are an order of magnitude smaller than the wavelengths of both the initial wave and the primary perturbation, suggesting that the essential dynamics of the breaking might be captured by tractable nonlinear three-dimensional simulations in a relatively small triply-periodic domain. The implicit Large Eddy Simulation (LES) scheme ALDM is tested against Direct Numerical Simulation (DNS) as to whether it is able to parameterize the turbulence in such cases, with encouraging results. Both two- and three-dimensional nonlinear simulations are discussed.