COMPUTATIONAL STUDIES OF INERTIA-GRAVITY WAVES RADIATED FROM UPPER TROPOSPHERIC JETS

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ABSTRACT

The generation and physical characteristics of inertia-gravity waves radiated from an unstable forced jet at the tropopause are investigated through high-resolution numerical simulations of the three-dimensional rotating Navier-Stokes anelastic equations. Such waves are induced by Kelvin-Helmholtz instabilities on the flanks of the inhomogeneously stratified jet. From the evolution of the averaged momentum flux above the jet, it is found that gravity waves are continuously radiated after the shear-stratified flow reaches a quasi-equilibrium state. The time-vertical coordinate cross-sections of potential temperature show phase patterns indicating upward energy propagation. The sign of the momentum flux above and below the jet further confirms this, indicating that the group velocity of the generated waves is pointing away from the jet core region. Space-time spectral analysis at the upper flank level of the jet shows a broad spectral band, with different phase speeds.

The spectra obtained in the stratosphere above the jet show a shift toward lower frequencies and larger spatial scales compared to the spectra found in the jet region. The three-dimensional character of the generated waves is confirmed by analysis of the co-spectra of the spanwise and vertical velocities. Imposing the background rotation modifies the polarization relation between the horizontal wind components. This out-of-phase relation is evidenced by the hodograph of the horizontal wind vector, further confirming the upward energy propagation. The background rotation also causes the co-spectra of the waves high above the jet core to be asymmetric in the spanwisemodes, with contributions from modes with negative wavenumbers dominating the co-spectra.