High Resolution Numerical Simulations of Gravity Wave Encounters with the Tropopause

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Gravity waves are ubiquitous in the atmosphere. They play critical roles in the global circulation and the temperature and constituent structures in the middle atmosphere. Gravity waves also play significant roles in the dynamics and transport and mixing processes in the upper troposphere and lower stratosphere (UTLS). As gravity waves propagate upward (and laterally as well) in the atmosphere, they can experience significant changes in their properties due to the background stratification and winds and can also become unstable and lead to turbulence. The tropopause region (and more broadly the UTLS) has dramatic vertical variation of stratification and may also have significant wind shears. Previous observational studies have shown that there is often a discontinuity of gravity wave characteristics in the troposphere in comparison to that in the lower stratosphere. Many previous studies also often observe enhancements of turbulence energies near the tropopause due to breaking gravity waves. In light of these, it is important to study the propagation and interactions of gravity waves with the background atmosphere in the tropopause region using high resolution numerical simulations which can shed light on the dynamical coupling and transport and mixing processes in this region. In this presentation, we will show some initial results of high resolution numerical simulations of gravity waves encountering the tropopause. We will explore the effects of some representative tropopause stratification and wind profiles on gravity wave propagation, transmission, instability dynamics in this region, and the effects of those encounters on the tropopause.

Key words: gravity wave, tropopause, high-resolution numerical simulation, instability and turbulence