Vertical Coupling of Eastward Travelling Planetary Waves from the Stratosphere to the Lower Thermosphere in Antarctica using lidar, satellite, and modeling

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Following the work by *Lu et al.* [2013] which has shown that the stratospheric temperature variations are determined by a group of eastward propagating planetary waves (PWs) with periods of 1–5 days, the impacts of the same group of PWs are identified in the mesosphere and lower thermosphere (MLT) region, using temperature measurements by the Fe lidar at McMurdo, Antarctica (77.8°S, 166.7°E). The superposition of these dominant PWs can account for the significant temperature fluctuations with a magnitude of ±30 K in the MLT. Combining the Fe lidar and MLS temperatures onboard the Aura satellite, the dominant peaks are found to be 4–5, 2–3, and 1.7 days, eastward propagating with wavenumbers of 1, 1, and 2, respectively. The vertical phase profiles in a larger vertical extent (30–110 km) are also provided for the first time at McMurdo and the corresponding vertical wavelengths of the PWs are ~50–70 km. A numerical model is developed to simulate the generation of these waves and the instability of the polar vortex is the wave source in the stratosphere. Although there exists a critical level near the mesopause, the modeling results show that the PWs can survive it and penetrate to the MLT region. The simulated vertical profiles of PWs are similar to lidar observations. The possible effects of strong gravity wave on this group of planetary waves are also examined.

Key words: vertical wave coupling, eastward traveling planetary waves, Antarctica, observation and modeling

References (if needed)

Lu, X., et al., 2013:Eastward propagating planetary waves with periods of 1–5 days in the winter Antarctic stratosphere as revealed by MERRA and lidar, J. Geophys. Res. Atmos., 118, 9565–9578, doi:10.1002/jgrd.50717.