Gravity wave effects in the MLTI: Responses to planetary wave forcing, tidal filtering, and solar cycle variability

David C. Fritts

NWRA/Colorado Research Associates (CoRA) Division, 3380 Mitchell Lane, Boulder, CO 80301 (dave@cora.nwra.com / Fax: 303-415-9702 / Phone: 303-415-9701, ext. 205)

A series of ground-based and in situ observations during the July 2002 MaCWAVE/MIDAS rocket program in northern Norway yielded surprising departures from previous and subsequent years in both the dynamics and the microphysics of the MLT. GCM studies motivated by these observations provided strong evidence that these departures arose as a result of unusual southern hemisphere planetary wave activity and suggested a potential for inter-hemispheric coupling through modulation of the gravity wave spectrum and propagation that were not previously appreciated. Modulation of gravity waves and their momentum fluxes by tidal motions likewise contribute to variable mean and tidal structures in the MLT, and to variable gravity wave effects at higher altitudes, but are poorly represented or absent in large-scale models at present. Recent theoretical efforts have also addressed the penetration, behavior, and potential effects of gravity waves well into the thermosphere and suggest both neutral and plasma effects that have yet to be confirmed by observations or detailed modeling studies. These many influences on gravity wave momentum and energy transports, their forcing and imposed variability at higher altitudes, and the poor understanding and characterization of their many effects in GCMs and climate and forecast models provide the motivations for a satellite mission concept, WAVES, that would dramatically improve our knowledge of these dynamics on a global basis.