Investigating Gravity Wave Characteristics and Mesospheric Temperature Variability over Antarctica

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Atmospheric gravity waves (GWs) and tides are known to play key roles in a broad range of dynamical processes extending from Earth's surface well into the Mesosphere and Lower Thermosphere (MLT) region (~80-100 km) and potentially to higher altitudes. GW are excited primarily in the lower atmosphere by strong convection, topography, and wind shears and can attain large amplitudes as they propagate upwards transporting copious amounts of energy and momentum. Remote sensing optical measurements of the naturally occurring airglow emissions, particularly the bright near infrared OH layer (peak altitude ~87 km) provide a very effective method for studying the characteristics of these wave using their induced intensity and rotational temperature signatures.

This study focuses on high-latitude airglow measurements, mainly from Antarctica, where observations of gravity waves and tides and their effects on the MLT field have been limited to date. Results from all-sky OH measurements of short- and medium-scale GW over Halley (78°S) and Rothera (67°S) stations (2000-to date) obtained during the winter months, are contrasted with their summertime-wave characteristics over Antarctica, as recently determined using Polar Mesospheric Cloud (PMC) data from the Aeronomy of Ice in the Mesosphere (AIM) satellite. In addition, new wintertime measurements from South Pole station, (altitude 2900 m), which lies deep within the polar vortex), have been made (2010-to date) using a recently developed Advanced Mesospheric Temperature Mapper (AMTM), which measures the IR (1.5µm) OH (3,1) rotational temperature and band intensity with high precision (1K in less than 1 min). These data have revealed a remarkably rich and dynamic mesospheric environment containing a broad spectrum of waves, ranging from short-period (several minutes) GW to tidal oscillations and planetary wave signatures. These emerging results have led to the development of a new international program: ANGWIN (Antarctic Gravity Wave Imaging Network) involving coordinated measurements of the MLT region using available instrumentation at several key sites around the continent, including South Pole, to investigate the larger-field effects of GW on the Antarctic MLT environment.