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CONTROL ID: 1482376

TITLE: Gravity waves from 30 to 160 km observed by an Fe lidar at McMurdo, Antarctica

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ABSTRACT BODY: Observations of gravity waves in the neutral atmosphere were usually limited to ~105 km where lidars can have appreciable signals. The first discovery of neutral Fe layers with gravity wave signatures in the thermosphere up to 160 km by an Fe Boltzmann lidar campaign at McMurdo, Antarctica has significantly pushed the limit to ~160 km. Two channels of Fe signals allow us to derive the Fe density from ~75 to 160 km and Fe temperature from ~80 to 150 km using the Fe Boltzmann technique. Furthermore, operating at UV 372 and 374 nm, this Alexandrite-laser-based Fe Boltzmann lidar produces strong Rayleigh scattering signals from air molecules. High-resolution measurements of temperatures are thus achieved from 30 to ~70 km utilizing the Rayleigh integration technique. As a consequence, the McMurdo Fe lidar data provide the first opportunity to trace gravity waves from ~30 km all the way up to ~160 km with a single ground-based instrument, which is the main focus of the current study.

McMurdo (77.83S, 166.66E) is in the gap region between the South Pole and the Antarctic Circle. Located on the Ross Island, McMurdo is next to the most southerly active volcano Mt. Erebus, also to the east of the

Trans-Antarctic Mountains, and by the poleward edge of the aurora oval as its geomagnetic latitude is near 80 deg. McMurdo turns out to be a 'hot spot' for waves, and large amplitude waves are frequently observed from the stratosphere to the thermosphere. All these factors may have contributed to, or influence, the very rich wave activities, the formation of converged Fe layers in the thermosphere, and the elevated thermospheric temperatures revealed by the lidar data of temperature and Fe density. Starting from late December 2010, the University of Colorado lidar group has collected over 1900 hours of data in the first 19 months at McMurdo, establishing a database for gravity wave studies.

In this paper we will characterize gravity wave parameters from ~30 km up to 160 km for the first time at McMurdo. Gravity waves with periods of 1.5–2 h have been observed by the lidar in May 2011 from ~30 km to ~160 km. The shapes of these waves observed in the thermospheric Fe density are strikingly similar to the traveling ionospheric disturbances (TIDs). Meanwhile, inertia-gravity waves (IGWs) with periods of ~5–8 h (near the inertial period of 12.24 h) are also visible in temperatures from ~30 to 110 km. A case in 2012 further reveals the possible situation of both a wave with 2.5-h period and an IGW with period of 6–8 h reaching the thermosphere and contributing to the formation of converged Fe layers superimposed on a diffuse background exceeding 140 km. We will focus on several cases in 2011 and 2012, and make comparison with the Whole Atmosphere Model (WAM) to examine the possible wave sources along with the contributions of background atmospheric conditions to the formation of Fe layer, elevated temperature and wave dissipation.
http://cires.colorado.edu/science/groups/chu/projects/mcmurdo.html

INDEX TERMS: [3369] ATMOSPHERIC PROCESSES / Thermospheric dynamics, [3334] ATMOSPHERIC PROCESSES / Middle atmosphere dynamics, [0355] ATMOSPHERIC COMPOSITION AND STRUCTURE / Thermosphere: composition and chemistry, [7959] SPACE WEATHER / Models.

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Additional Details

Previously Presented Material: Part of the lidar observations were presented at 39th COSPAR Scientific Assembly in Mysore, India in July 2012. But the AGU paper will provide entirely new analysis of these wave events.

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