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TITLE: Advances of Lidar Investigation of Middle and Upper Atmosphere from McMurdo, Antarctica

PRESENTATION TYPE: Assigned by Committee (Oral or Poster) [Invited]

CURRENT SECTION/FOCUS GROUP: SPA-Aeronomy (SA)

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ABSTRACT BODY: Despite the success of lidar observations at the South Pole and near the Antarctic Circle at Rothera, Davis and Syowa stations, a critical data gap existed in latitude between 90°S and 69°S. To help fill this gap, during the austral summer of 2010-2011, we deployed an Fe Boltzmann temperature lidar to McMurdo Station (77.83°S, 166.66°E), half way between the South Pole and Antarctic Circle. This lidar was originally developed at the University of Illinois by Chu, Gardner and co-workers and deployed to the South Pole (1999-2001) and Rothera (2002-2005). Recently it was refurbished and upgraded at the University of Colorado. With the support and collaboration of the United States Antarctic Program (USAP) and the Antarctic New Zealand (AntNZ), the University of Colorado lidar group installed the Fe lidar into the AntNZ facility at Arrival Heights, McMurdo in late 2010. This lidar has full diurnal coverage and is capable of detecting polar mesospheric clouds (PMCs), meteoric Fe layers, and temperatures under full sunlight. Following installation, it was operated around the clock, weather permitting.

In this paper we report the first lidar observations of polar middle and upper atmosphere at McMurdo, Antarctica, and present the newest science discoveries. These include the first-ever observations of neutral Fe layers with gravity wave signatures in the thermosphere from 110-155 km. Frequent occurrence of sporadic Fe layers and extremely active variations of main Fe layers are also unique among other lidar observations of metal species. These results of neutral Fe atoms challenge our understanding of the upper atmosphere composition, chemistry, dynamics and thermal structure. Furthermore, PMC data in the first summer season of 2010-2011 confirm previous reports of the inter-hemispheric difference in PMC mean centroid altitude. By combining the McMurdo observations with those obtained at the South Pole and Rothera, we find that the latitudinal dependence of mean PMC altitude is statistically significant with a slope of 40 ± 3 m/deg. Lidar observations provide direct evidence that the cold phase of wave-induced temperature oscillations facilitates PMC formation and Fe depletion.

http://cires.colorado.edu/science/groups/chu/projects/mcmurdo.html

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INDEX TERMS: [0340] ATMOSPHERIC COMPOSITION AND STRUCTURE / Middle atmosphere: composition and chemistry, [0355] ATMOSPHERIC COMPOSITION AND STRUCTURE / Thermosphere: composition and chemistry, [3311] ATMOSPHERIC PROCESSES / Clouds and aerosols, [3334] ATMOSPHERIC PROCESSES / Middle atmosphere dynamics.