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TITLE: Lidar Observations of Polar Mesospheric Clouds, Fe Layers, and Their Interactions at McMurdo, Antarctica (77.8°S, 166.7°E)

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ABSTRACT BODY: McMurdo (77.8°S) is located in a critical gap region between the South Pole and the Antarctic Circle since pioneering lidar observations of mesospheric clouds (PMCs) and Fe layers have been made at the Pole and Rothera (67.5°S). Because of McMurdo's high latitude, PMC occurs frequently in summer, allowing the study of PMC morphology with good statistics, its diurnal variations, and its interaction with mesospheric Fe layer. In the meantime, McMurdo is far enough from the Pole to be covered by AIM satellite, allowing comparison between ground-based and satellite-based PMC observations. Taking this advantage, we are conducting a lidar campaign year around at McMurdo with an iron (Fe) Boltzmann temperature lidar since Dec 2010. Over 1900 hours of data have been collected in the first 19 months, covering two austral summers and every month of a year. The new datasets provide a unique opportunity to characterize the PMC and Fe layer at this important high latitude and study their interactions in summer.

In the first summer, 85 hours of PMCs were observed between 21 Dec 2010 and 15 Feb 2011, giving an occurrence frequency of 29.9%. The mean PMC altitude confirms hemispheric difference and latitudinal dependence as predicted. More extensive data were collected in the second summer with some cases exhibiting nearly continuous presence of PMCs over 24 hours, e.g., on 24-25 Dec 2011. The observed summer-time Fe layer is distinctively different from autumn, winter and spring, with very low density, much higher altitude, and much narrower layer. Spectacular sporadic Fe layers were observed with peak density as high as strong meteor trails but in a much wider altitude range and lasting for hours, which challenges the current understanding of sporadic metal layers. Interestingly the Fe layer observed in Nov and Dec 2011 splits into two with a density trough near the normal layer peak altitude. All these phenomena are most likely linked to visible and sub-visible PMC ice particles. In this paper, we will fully characterize the PMC including its diurnal variations and the mesospheric Fe layer at McMurdo, and explore their interactions in summer.

The study will provide better understanding of how nanoparticles affect the composition and chemistry in the mesosphere and lower thermosphere.

INDEX TERMS: [0340] ATMOSPHERIC COMPOSITION AND STRUCTURE / Middle atmosphere: composition and chemistry, [3360] ATMOSPHERIC PROCESSES / Remote sensing, [3311] ATMOSPHERIC PROCESSES / Clouds and aerosols, [3349] ATMOSPHERIC PROCESSES / Polar meteorology.

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