Print Close Window

Proof

Print

CONTROL ID: 1491588

TITLE: Solar Effects on the Mesospheric Iron Chemistry Observed by Lidar at McMurdo (77.8 deg S, 166.7 deg E), Antarctica

PRESENTATION TYPE: Assigned by Committee (Oral or Poster)

CURRENT SECTION/FOCUS GROUP: SPA-Aeronomy

CURRENT SESSION: SA005. Geospace Exploration From Antarctica

AUTHORS (FIRST NAME, LAST NAME): Zhibin Yu[1], Xinzhao Chu[1], Wentao Huang[1], Weichun Fong[1], Brendan R. Roberts[1], John Anthony Smith[1]

INSTITUTIONS (ALL): 1. Aerospace Engineering and Sci., Univ. of Colorado at Boulder, Boulder, CO, United States.

ABSTRACT BODY: Iron (Fe) and sodium (Na) are the two most abundant metal species in the mesosphere and lower thermosphere (MLT), providing excellent tracers for studying atmospheric thermal structure, dynamics, chemistry and the coupling between neutrals and ions. During the past three decades, extensive Na studies by lidar observations and numerical simulations have revealed diurnal variations in Na layers but the absence of significant extension of the Na layer bottom. Therefore, it was believed that there were no significant solar effects in metal layers. Part of the reasons was also because most of Fe observations were nighttime only. Consequently, the solar effects on metal layers and the related photochemistry in the MLT region have been ignored for a long time, and no photochemistry was included in the currently published Fe models.

The recent lidar observations from McMurdo, however, have completely changed our point of view on this matter. The Fe layer bottom is now found to descend from its nighttime altitude of 78–80 km to around 70–73 km under sunlight. This is the one of the first evidences to show the solar effects on Fe layers. Understanding and characterizing such solar effects are very important, because the layer bottom extension provides potentials to extend daytime lidar measurements of temperature and wind from ~80 to nearly 70 km. Such studies also advance our knowledge on the full Fe chemistry.

In this paper, we focus on the solar effects in the diurnal variations of Fe densities in the MLT region. The study is based on the ~1000 hours of lidar observations made by the University of Colorado lidar group at McMurdo, Antarctica, from December 2010 through 2011. Our observations show that the Fe layers undergo significant diurnal variations on the bottomside in autumn and spring with daytime downward extension during the local sunrise and nighttime upward contraction during sunset. The bottom growth/contraction of Fe layer is closely correlated with the solar elevation angle. The results indicate that neutral Fe and its reservoir species, FeOH chemistry with H, O and O3 and photolysis of Fe-containing species play an essential role in determining the Fe layer bottom. These are entirely new results that provide direct, real-time quantitative evidence for the influence of solar UV radiation on the chemistry and composition of mesopause region.

INDEX TERMS: [0317] ATMOSPHERIC COMPOSITION AND STRUCTURE / Chemical kinetic and photochemical properties, [0340] ATMOSPHERIC COMPOSITION AND STRUCTURE / Middle atmosphere: composition and chemistry.

(No Table Selected)

(No Image Selected)