Calcium ion thin layer observed with a resonance scattering lidar at Syowa, Antarctic

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Layers of metal ions in the mesosphere and lower-thermosphere (MLT) are produced by meteoric ablation. The meteoric metal ions have relatively long chemical lifetime in the MLT region and behave as plasma affected by neutral atmosphere dynamics. In the mid-latitude, the meteoric metal ions in the MLT region are generally accepted as key species for generation of sporadic E (E_s) layer in the wind shear theory. The close link between the E_s layer and calcium ion (Ca^+), one of meteoric metal ions, layer has been also clearly shown by radar and lidar observations [Raizada et al., 2012; Ejiri et al., 2019]. On the other hand, ion convergence at high latitude by the wind shear theory is expected less efficient than mid latitude because of large inclination angle of magnetic field line [e.g., Shinagawa et al., 2017]. A resonance scattering lidar developed by the National Institute of Polar Research (NIPR) was installed at Syowa (69S, 40E), Antarctic in 2017 and obtained Ca^+ density profiles 6 nights in total in Spring in 2017 and 2018. Ca^+ thin layers with high densities were observed on October 6 - 7 in 2018. That night was quiet of the geomagnetic activity (Kp = 0), therefore, effects of electric field to generation of the Ca^+ thin and dense layer were probably negligible. Vertical Ca^+ velocity induced by the neutral wind can be calculated using background wind measured by MF radar at Syowa. A comparison in temporal variation between Ca^+ density and gradient of vertical Ca^+ velocity profiles shows that the Ca^+ thin and dense layer was located at the altitude that the gradient was 0 $ms^{-1}km^{-1}$. We will discuss a possible generation process of the observed Ca^+ thin and dense layer.

Keywords: mesospheric Ca+ layer, Lidar observation, Antarctic, thin layer