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Ca+ density perturbations observed by a resonance scattering lidar during MSTIDs

EJIRI, Mitsumu K.[1*] ; TSUDA, Takuo[2] ; NISHIYAMA, Takanori[1] ; ABO, Makoto[3] ; NISHIOKA, Michi[4] ; MARUYAMA, Takashi[4] ; SAITO, Akinori[5] ; NAKAMURA, Takuji[1]

[1]National Institute of Polar Research, [2]The University of Electro-Communications, [3]Graduate School of System Design, Tokyo Metropolitan University, [4]National Institute of Information and Communications Technology, [5]Department of Geophysics, Graduate School of Science, Kyoto University

In the mesosphere and lower thermosphere region, there are permanent layers of metal atoms and ions, the source of which is vaporization of cosmic dust and meteoroids during their entry into the Earth's atmosphere. Some metal atom layers e.g. Na, K, Ca, and Fe layers, and only Ca^+ (Calcium ion) can be observed by ground-based resonance scattering lidars. The National Institute of Polar Research (NIPR) is developing a new resonance scattering lidar system with a frequency-tunable laser. The lidar transmitter is based on injection-seeded, pulsed alexandrite laser for 768-788 nm and a second-harmonic generation (SHG) unit for 384-394 nm. The new lidar is able to measure density variations of minor constituents including Ca^+ (393 nm). As a part of the development, observation tests are carried out at NIPR (35.7N, 139.4E) since 2013, and we got the first light from Ca^+ on 21 August, 2014. The Ca+ density profiles were obtained for $\sim$5 hours (23:13 LT-28:28 LT) with time and height resolutions of 1 min and 15 m, respectively. At the same night, sporadic E (E_s) layer was observed with an ionosonde at Kokubunji by National Institute of Information and Communications Technology (NICT) (35.7N, 139.5E), also medium scale traveling ionospheric disturbances (MSTIDs) were observed with the dense GPS receiver network (GEONET). In this presentation, we compare these data in detail and discuss relationships between observed Ca^+ density perturbations, E_s layer and MSTIDs.

Keywords: resonance scattering lidar, Ca+, medium scale traveling ionospheric disturbances, GPS-TEC, sporadic E layer