R005-57
Zoom meeting C ：11/3 AM2 （10:45-12:30）
11:30-11:45

Statistical properties of ion upflows in the low-altitude ionosphere observed by the EISCAT radar

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Molecular ions (O_2^+/NO^+/N_2^+) in the ring current of the terrestrial magnetosphere have been observed during the magnetic storms [e.g., Klecker et al., 1986; Seki et al., 2019]. Since the molecular ions usually exist in the low-altitude (< 300 km) ionosphere, an efficient upward ion transport (upflow) overcoming the loss by dissociative recombination is needed to supply them to the magnetosphere. However, the mechanisms that cause such an ion upflow at low-altitude are not clearly understood. As candidate mechanisms, some heating and acceleration processes such as ion frictional heating and small scale instabilities by soft particle precipitations have been investigated. Previous study showed that none of them was efficient enough [Peterson et al., 1994]. The purpose of this study is to understand properties of the ion upflows in the low-altitude ionosphere and their generation mechanisms based on long-term observational results of the EISCAT radars.

We used data from the EISCAT Svalbard radar at Longyearbyen from January 1, 2006 to January 1, 2016 and surveyed statistical properties of ion upflows in the low-altitude ionosphere. We selected data obtained at altitudes between 200 and 400 km, when the radar was looking along the local magnetic field line. Then, an ion upflow event was defined based on the following criteria: (1) Above the lowest altitude where the upward velocity becomes > 50 m/s, the flow velocity continues to be upward (> 0 m/s) up to 400 km altitude. (2) The average velocity between the lowest to 400 km altitudes is > 50 m/s. (3) An ion upflow event must continue for 2 minutes or more. The ion upflow events were identified in ~5 % of the selected field-aligned data in the 200-400 km altitude. The statistical results show that the ion upflows were observed during periods of relatively high AE index (> 200 nT), which means that geomagnetic activities affected the occurrence rate of ion upflows in the low-altitude ionosphere. On the other hand, the ion upflows were observed in the positive and negative SYM_H conditions. The result indicates that ion upflows were occurred both during the magnetic storms and non-storm periods. The most of the ion upflow events were observed when the average electron temperature exceeds 2000 K in the 200-400 km altitude. The detection probability of the ion upflow events become high when the average ion temperature was enhanced to more than 1500K in the 200-400 km altitude. It suggests that the electron temperature enhancement is a necessary condition for the ion upflow from the low-altitude ionosphere, while the ion temperature increase is also important to cause the upflows in many cases. In the presentation, we will also report on dependence of the ion upflows on the solar activities.

References:

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[2] K. Seki et al., Statistical Properties of Molecular Ions in the Ring Current Observed by the Arase (ERG) Satellite, Geophys. Res. Lett., 46, 8643?8651, 2019
[3] W. K. Peterson et al., On the sources of energization of molecular ions at ionospheric altitudes, J. Geophys. Res., 99(A12), 23,257-23,274, 1994