Relationship between N2+ emission intensity and ion upflow in the polar topside ionosphere

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Ion upflow in the polar topside ionosphere plays an important role as a source of ion outflow since ion constituent would affect the magnetospheric conditions. In particular, the behavior of heavy ions, such as N2+ and NO, has been examined with immense interests since it is considered that heavy ions hardly escape from terrestrial gravity. Recently, optical measurement data taken by a satellite showed N2+ 1st negative band emissions in the sunlit region suggesting the existence of N2+ upflow. In this study, to clarify the ion upflow events, we have carried out the coordinated observations between the Reimei satellite and the EISCAT/ESR radar during the winter solstice periods in 2005, 2006 and 2007.

Since the successful launch in August 2005, the Reimei satellite has showed good performance of auroral image and particle observations at an altitude of 610-670km. The multi-spectral auroral camera (MAC) measures auroral images at emissions of N2+ 1st negative band (427.8 nm), OI green line (557.7 nm), and N2 1st positive band (670 nm). In addition to the auroral emission, only N2+ emission is also caused by the resonant scattering in the sunlit region. Thus, the field-of-view (FOV) of MAC is directed toward the earth's limb in order to observe the height profile of N2+ emission intensity produced by resonant scattering. In this observation mode, N2+ emission image is taken with every 1 second. It is supposed that N2+ upflow occurs when the N2+ emission is seen in the upper/topside ionosphere, since N2+ normally exists in the lower ionosphere. On the other hand, ion upflow speeds near the FOV of MAC are simultaneously observed by the EISCAT/ESR radar with the fast scan mode. In this mode, the azimuthal scan range is 120 degrees centering the geomagnetic north direction, and time resolution is about 3 min.

Here, we have examined statistical study the relationship among N2+ 1st negative and OI green line emissions, ion upflow and geomagnetic activity. From the data obtained in 2005 and 2006, it is found good correlation between N2+ emission intensities at 300 and 400km altitude and Kp index. At these altitudes, N2+ emission intensities were 100-600R greater than OI intensities when Kp was greater than 3+. This suggests that N2+ density increase, or ion upflow occurs in the topside/upper ionosphere when geomagnetic activity increased. In this talk, the statistical results including the data in 2007 and the relationship between N2+ intensity and ion upflow speed will be presented.