[EE] Evening Poster | P (Space and Planetary Sciences) | P-EM Solar-Terrestrial Sciences, Space Electromagnetism & Space Environment

[P-EM15]Dynamics in magnetosphere and ionosphere

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Mon. May 21, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

This session provides an opportunity to present recent results from satellite and ground-based observations and theoretical and simulation studies on the magnetosphere, ionosphere, and their coupling system. We invite contributions dealing with various phenomena related to the magnetosphere-ionosphere system: solar wind-magnetosphere interaction, magnetosphere-ionosphere convection, field-aligned current, magnetic storms/substorms, neutral-plasma interaction, ionospheric ion inflow and outflow, aurora phenomena, and so forth. Discussions on planetary and satellite ionosphere and magnetospheres, future missions and instrument developments are also welcome.

[PEM15-P14]N2+ resonant scattering light in the topside ionosphere observed with the auroral spectrograph

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We focus on the molecular ion upflow in the topside ionosphere based on a ground-based optical data. Ion upflow is important since it is considered to be a source of ion outflow which contributed planetary atmospheric escape and controls magnetospheric dynamics. The heavier ions including molecular ions (N2+, NO+, O2+) have been observed in the magnetosphere [Klecker et al., 1986] in spite of their existence in the lower ionosphere (E-region) originally. The mechanism of ion upflow in the ionosphere for molecular ions is uncertain because it is rather difficult for heavy ions to move upward overcoming the gravitational force. Furthermore, N2+ ion production mechanism in the topside ionosphere in relevance to N2+ ion upflow is not understood well. Thus, we examined the unresolved mechanisms for N2+ ion production and N2+ ion upflow using ground-optical instruments data.

We investigated the data obtained with the Auroral Spectrograph (ASG) located at Longyearbyen (78.15N, 16.04E) during the period of 2004 - 2016 to measure the N2+ resonant scattering light at 427.8 nm in the sunlit region of topside ionosphere associated with N2+ ion upflow and/or caused by locally generated N2+ ion. The field of view for ASG is 180 deg. for the geomagnetic meridian, and the spectral range is 420 – 730 nm. We found totally 13 events of N2+ resonant scattering light in the sunlit topside ionosphere out of 75 analysis days selected from the data obtained at one month before and after the winter solstice. The MLT range of the events was 9 - 18 MLT in the dayside sector. In this study, we selected for a single auroral arc case by using the data taken by ASG and All-sky Color Digital Camera (CDC). In this case, we assumed that the observed emissions of N2+ 427.8 nm, O 557.7 nm and 630.0 nm are along a single geomagnetic field line, and calculated the auroral emission heights converting elevation angle to altitude.

During the period of 7:00 - 8:34 UT, a stable aurora was observed in the southward of the field of view for ASG with relatively bright 630.0 nm aurora (~ 10 kR). The maximum intensity of 427.8 nm emission was recorded at 8:34 UT, and was ~ 650 R at an altitude of 350 km. The intensity above ~ 600 km kept brighter than 100 R extending up to 1,000 km, and the inclination above the peak of 427.8 nm emission

was relatively steeper than that of 557.7 nm and 630.0 nm emission above ~ 450 km. In addition, we investigated the time variation of the N2+ resonant scattering light in the F-region and in the topside ionosphere during the period of 7:00 - 8:20 UT when there were no clouds in the southward of the field of view for ASG. The time variation of N2+ emission in the F-region (400 km) was different from that in the topside ionosphere (800 km). The intensity at 400 km randomly varied in the range of 150 - 500 R, while at an altitude of 800 km, gradually increased throughout this period (~ 100 R to ~ 300 R). Next, we evaluated the N2+ emission with the GLOW model and compared with the ASG data at 7:36 UT when the DMSP satellite passed over the aurora. The auroral electron flux measured by DMSP was used in the GLOW model. When we increased the atmospheric scale height in the altitude range above 200 km, the calculated 630.0 nm emission peak is consistent with observed emission and the height profile of calculated 557.7 nm emission above 200 km was similar to the observed emission. For 427.8 nm emission, both of the emission peaks at 300 km and the height profile below 450 km were similar.

From the results obtained in this study, we suggest that N2+ ion upflow starts from F-region or above the F-region, not the E-region, and N2+ ion in the topside polar ionosphere in the dayside sector is dominantly produced by the charge exchange reaction between N2 and O+. Our results also demonstrate that the existence of soft electrons precipitation is correlated well with N2+ ion upflow probably due to strong ambipolar electric field and N2+ ion production in the topside ionosphere which implies that the enhancement of O+ generated by precipitating soft electrons in the F-region. The relationship between N2+ ion upflow and outlflow, and its effect on the magnetospheric dynamics will be examined by the Arase (ERG) satellite or future missions. Furthermore, the understanding of N2+ ion escape would contribute to evaluating the long-term planetary atmospheric evolution.