Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM28-11 Room:413 Time:April 29 15:15-15:30

Solar zenith angle dependence of relationships between energy inputs to the ionosphere and O+ and H+ ion outflows

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Recent satellite observations and simulations have clarified that plasma outflows play an important role in abrupt changes in the ion composition in the plasmasheet and ring current during geomagnetic storms. Statistical studies by Strangeway et al. [2005] and Brambles et al. [2011] indicated that the flux of ion outflows is correlated well with soft electron precipitation (precipitating electron density and electron density in the loss cone), and DC and Alfvenic Poynting fluxes using the data obtained by the FAST satellite near the cusp region in the dayside during the 24-25 September 1998 geomagnetic storm. To distinguish between O^+ and H^+ ion outflows, we performed statistical studies using the ion composition data in addition to the ion and electron data obtained by the FAST satellite at 3000-4150 km altitude during January 1998 and January 1999. The long-term dataset enables us to identify empirical formulas between the outflowing O^+ and H^+ ion fluxes and the precipitating electron density, the electron density in the loss cone, the net electron number flux, and the DC and Alfvenic Poynting fluxes in a wide solar zenith angle (SZA) range (for dayside, 50-110 degree; and for nightside, 90-150 degree). In the SZA range of 90-110 degrees, the above formulas in the dayside are almost similar to those in the nightside. While SZA dependence of the relationshps between the outflowing O^+ and H^+ ion fluxes and the DC and Alfvenic Poynting fluxes are weak, the empirical formulas between the outflowing O^+ and H^+ ion fluxes and soft electron precipitation, especially the precipitating electron density and the electron density in the loss cone, depend on SZA. Although the precipitating electron density and the electron density in the loss cone that correspond to the outflowing O^+ ion flux of about 10^7 /cm^2/s increase with decreasing SZA, the outflowing O^+ and H^+ ion fluxes become more sensitive to an increase in soft electron precipitation with decreasing SZA.

Keywords: ion outflow, polar ionosphere