R006-27
A 会場 ：9/26　AM2 （10:45-12:30）
12:00～12:15

磁気嵐時のカスプにおけるイオン流出のモデリング

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Modeling of acceleration of outflowing ions in the storm-time cusp

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In this presentation, we show the results of simulations of ion outflows associated with soft electron precipitation, frictional heating, and acceleration due to broad band ELF (BBELF) waves in an idealized cusp region during geomagnetic storms. The cusp region has been regarded as a major source of magnetospheric O^+ (and heavy ions) [e.g., Lockwood et al., JGR, 1985], which increases greatly during geomagnetic storms [e.g., Greenspan and Hamilton, JGR, 2002; Nose et al., JGR, 2005]. Under southward IMF conditions, the cusp becomes very thin in the latitudinal direction [e.g., Newell and Meng, JGR, 1987; Zhang et al., JGR, 2005]. Since a poleward flow is expected in the cusp under southward IMF conditions due to the dayside reconnection on magnetic field lines at the equatorward edge of the cusp, flux tubes cannot stay long time in the cusp. Thus, ion acceleration in the cusp seen from a convecting flux tube is not expected to last for a long time. Here we show the results of simulations of ion outflows with 2-min acceleration. Under the assumption of the latitudinal width of the cusp as 1 degree and the poleward convection velocity as 1 km/s, a convecting flux tube can stay in the cusp about 2 minutes. To investigate effects of soft electron precipitation, frictional ion heating, and ion acceleration due to broad band ELF (BBELF) waves on ion outflows, we used the kinetic polar wind outflow model (kinetic-PWOM) [Glocer et al., JGR, 2018], which uses the particle-in-cell approach with Monte Carlo collisions above 1000 km altitude. Although ion upflows (upward ion bulk flow much slower than the escaping velocity) around several hundreds of kilometers are driven by soft electron precipitation and frictional ion heating, the upward velocities are insufficient for most of O^+ to reach the altitude where acceleration due to waves become efficient within the time to pass through the cusp. O^+ density and flux at high altitudes near the cusp are controlled mostly by acceleration due to BBELF wave. Because it is impossible to travel long distance within a limited time interval (2-min here) of the acceleration, local acceleration rate and initial O^+ density at the altitudes where acceleration is effective are more important as compared with supply from the ionosphere as ion upflows. Based on this result, the solar zenith angle (sunlit or dark) at the ionospheric footprint and solar activity, which have a large impact on the temperature and scale height of O^+, can also be an important factor in determining O^+ outflow fluxes near the cusp during geomagnetic storms.