Geophysical Research Abstracts
Vol. 18, EGU2016-6235, 2016
EGU General Assembly 2016

Superposed epoch analysis of vertical plasma flow and its relationship with FACs as observed by DMSP and CHAMP: IMF By and Bx dependence

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This study presents results of a superposed epoch analysis (SEA) method applied to vertical plasma flow and large-scale field aligned currents (FACs) in the Northern Hemisphere cusp region. Our study is based on DMSP (F13 and F15) and CHAMP satellite observations during the years 2001-2005. Interplanetary magnetic field (IMF) data were taken from the NASA/GSFC's OMNI online database. The dependence on IMF By and Bx component orientation is investigated, while the absolute amplitude of IMF Bz is selected to be less than 2 nT. Seasonal variations are also investigated with seasons defined as follows: local winter (1 January $\pm$ 65 days), combined equinoxes (1 April and 1 October $\pm$ 32 days), and local summer (1 July $\pm$ 65 days). The reference time and location for the SEA method are taken from the vertical ion velocity peaks (> 100 m/s for upflow and <-100 m/s for downflow) detected by DMSP in the northern cusp region. Our analyses were performed in the magnetic latitude (MLat) and local time (MLT) coordinate system.

In general the vertical plasma downflow is weaker than the upflow. This product, ion density times velocity, shows no dependence on the IMF By orientation, while its value increases towards local summer. The ion density is low in winter and increases towards local summer, while the vertical velocity is much higher in local winter than during equinoxes or local summer. The event number distribution (in MLat-MLT frame) of vertical ion velocity peaks shows no significant dependence on the given conditions.

In case of large-scale FACs a clear dependence on IMF By orientation and local season emerges from SEA analysis. Similarly to the vertical plasma upflow, the amplitude of large-scale FACs is also increasing towards local summer. Large-scale FACs show an IMF By dependent regular pattern for upflow cases and no regular pattern for downflow cases in all considered cases.