Observation of Ion Refilling Rates using Cross-phase Analysis

Yuki Obana[1]; Frederick W. Menk[2]; Ichiro Yoshikawa[3]

[1] Earth and Planetary Sci., Univ. of Tokyo; [2] University of Newcastle; [3] Univ. of Tokyo

Measurements of the eigenfrequency of geomagnetic field lines can provide information on the plasma mass density near the equatorial plane of the magnetosphere. Data from an extended meridional array of ground magnetometers therefore allows the radial density distribution, and its temporal variation, to be remotely monitored. Using cross-phase analysis of ground magnetometer array data, we determined the equatorial mass density during three moderate geomagnetic storms in March 2004, June 2001, and April 2001. After the commencement of the storms, the field line eigenfrequency over L = 2.3 - 3.8 was unusually high. This corresponds to very low mass densities, indicating that the plasmapause moved Earthward and these flux tubes were depleted. Over 2-4 days the eigenfrequency at these L values progressively decreased, indicating refilling of the flux tube to pre-storm levels, superimposed upon diurnal variations. By comparing density measurements we have determined the ion refilling rates and fluxes at the 1000 km level for several flux tubes in L=2.3 - 3.8 range. The upward ion fluxes were in the order of 10^8 amu/cm^2/sec in all of the events and slightly decreased with increasing L-value in the event in March 2004. These values are in excellent agreement with daytime upward electron fluxes calculated by previous authors. About half of the L-value dependence of the ion flux can be explained by solar zenith angle control of ion production rates, but this still underestimates the observed flux.