

Ionospheric Poynting Flux Binned in Auroral Boundary Coordinates

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Abstract

Energy deposition in the ionosphere is driven in part by magnetic reconnection in the interactions between solar wind and Earth's magnetic field. These magnetic perturbations drive a Poynting flux in Earth's high latitude regions, the magnitude and spatial distribution of which has not yet been statistically studied. To first calculate the Poynting flux, data from the Defense Meteorological Satellite Program (DMSP)'s F15 and F16 spacecraft were cleaned for the purposes of the calculation. The potential difference between geocentric and geodetic latitude was considered and explored through the application of coordinate system transformations in an attempt to further reduce the error inherent in the calculations. The ion flow measurements of the instruments included the co-rotation of the field line-tied plasma in the ionosphere that rotates with the Earth. By removing this co-rotation plasma velocity, the relative velocity could be determined and used in conjunction with magnetometer readings to calculate the electric field. The calculated electric field and the measured changes in the magnetic field were then incorporated to determine the Poynting flux. Uncertainties for the Poynting flux were then calculated for the first time for the DMSP data set to provide a more complete picture of the findings. Previous work that established a dynamic auroral boundary coordinate system was applied to the amassed Poynting Flux and uncertainty values to create a database comprised of flux statistics from each identified satellite track in the distinctive high-altitude regions. Mapping of these database values over the month of April 2006 resulted in observable trends behavior of Poynting flux magnitude and position with respect to the auroral boundaries. In particular, Poynting flux seems to maximize in the polar cap, just dawn-ward of noon. The collection of this study's processed and binned data provides a useful scientific tool for further statistical analysis of energy deposition in the ionosphere and provides a future path for large-scale data processing.