Project Details

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Project Title:
A comprehensive study of relationships between solar wind density and auroral electrojets

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Summary:
It is well known that sudden pressure enhancements associated with the solar wind density compress the magnetosphere, increasing large-scale currents in the magnetosphere-ionosphere system. Relationships between the solar wind density and auroral electrojets are qualitatively known to be different for different interplanetary magnetic field (IMF) orientations. The relationships for southward IMF are much stronger than those for northward IMF. However, their quantitative relationships and responses of the magnetosphere-ionosphere system to the solar wind density variability have been less fully investigated. In this proposed study, we will first search for events with a density variation but for which other solar wind parameters are relatively constant using solar wind data from the Wind spacecraft. We will also calculate the changing rates of auroral electrojets (characterized by the AU and AL indices) per unit of the solar wind density for these events. We will then construct a database, which contains the changing rates and various solar wind parameters, and pursue a parameterization study. With this database we can determine that, under which solar wind conditions, the density effect on the auroral electrojets will be most significant. A clear articulation of such a significant effect should motivate theoretical focus. We will also derive a representation of the changing rates in terms of the IMF By, Bz, and solar wind velocity. In addition to the parameterization work, we will perform case studies using multiple observations (Polar UltraViolet Imager, Defense Meteorological Satellite Program particle precipitation, plasma flow, and magnetometer data, and Super Dual Auroral Radar Network convection data) by choosing events which have a large density variation. These case studies allow us to scientifically understand how the density variations affect the electrodynamic properties of the magnetosphere-ionosphere system, including auroral electrojets, auroral brightness, ionospheric convection, particle precipitation, and field-aligned currents. These case studies also allow us to investigate the relative importance of the conductance and the electric fields to the auroral electrojets during the density variations.

Publication References:

Summary: no summary

Reference: Shue, J.-H.; Newell, P. T.; Liou, K.; Meng, C.-I.; (2002), Solar wind density and velocity control of auroral brightness under normal interplanetary magnetic field conditions, Journal of Geophysical Research (Space Physics), Volume 107, Issue A12, CiteID 1428, DOI 10.1029/2001JA009138, doi: 10.1029/2001JA009138

Summary: no summary

Reference: Kamide, Y.; Shue, J.-H.; Brittnacher, M.; (2003), Effects of Solar Wind Density on the Auroral Electrojets and Global Auroras During Geomagnetic Storms, Disturbances in Geospace: The Storm-substorm Relationship. Geophysical Monograph 142. Edited by A. Surjalal Sharma, Yohsuke Kamide and Gurbax S. Lakhina. ISBN 0-87590-407-6. Published by the American Geophysical Union, Washington, DC, USA, 2003, p.15, doi: 10.1029/142GM02

Summary: no summary

Reference: Shue, J.-H.; Kamide, Y.; Newell, P. T.; (2005), A systematic study of effects of solar wind density on auroral electrojets, Geophysical Research Letters, Volume 32, Issue 14, CiteID L14112, doi: 10.1029/2005GL023197