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High Latitude Ionospheric Space Weather Derived from Global Maps of Field-aligned Currents

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Recent studies have related high-latitude electrical conductances and precipitating particle energy fluxes to field-aligned currents [1, 2]. This enables routine modeling of the spatial and temporal variation of electrodynamic properties and energy inputs from global maps of field-aligned currents from the Active Magnetosphere and Planetary Response Experiment (AMPERE). This model has been used to examine space weather phenomena in the high latitude ionosphere. A number of studies have been conducted to demonstrate and validate the model results. Simulated values for precipitating particle energy flux compare well with observations made by space-based far ultraviolet imagers. Simulated auroral electrojet currents are used to calculate magnetic perturbations that agree with observations made by ground-based magnetometers. Differences, when they occur, indicate the presence of large-scale, persistent neutral winds in the lower thermosphere. The modeled currents show the evolution of auroral electrojets associated with substorms. Global Joule heating rates correlate with the occurrence of ionospheric features such as Traveling Ionospheric Disturbances and semi-coherent ionospheric pulsing structures (SCIPS). The model produces maps of the high latitude electric potential updated every two minutes, which can be used to accurately track the transport and evolution of electron density structures. When combined with the precipitating particle energy flux, both the production and transport of F-region electron density can be simulated. Auroral electric fields, currents, and energy flux have been correlated with phase delays measured by GNSS receivers over Alaska. The model can also be used to reduce errors in the determination of electron density profiles at high latitudes from GPS occultation measurements. Although these capabilities require further testing and validation, they demonstrate the wealth of space weather information inherent in global maps of field-aligned currents.

References

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