A New Model of the Earth’s Ionosphere and Plasmasphere

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Abstract

A new high-resolution ionosphere-plasmasphere model has been developed in a collaboration between HAO and UCL. In the new model, the magnetic field is taken directly from the full International Geomagnetic Reference Field (IGRF) using the Apex coordinate system. The plasmaspheric component of the model along closed field lines follows the approach used by the SUPIM and CTIP models. The new model is modular in design to facilitate coupling to existing general circulation models.

Motivation

A vital requirement for space weather modeling is the accurate representation of the global ionosphere and plasmasphere. Previous ionospheric models, while providing powerful frameworks for research, have been limited in a number of ways. One such limitation has been the requirement of using a Dipolar representation for the Earth’s magnetic field. At certain locations on the planet (most notably the US sector), the field differs considerably from a Dipole, leading to modeled ionospheric features which are in the wrong place.

To address this deficiency, a new high-resolution ionosphere-plasmasphere model has been developed in a collaboration between HAO and the Atmospheric Physics Lab at UCL. In the new model, the magnetic field is taken directly from the full International Geomagnetic Reference Field (IGRF) and the ionospheric equations are solved within an ‘Apex’ magnetic field coordinate system (Richmond, 1995).

Results

The new model yields much improved, global high-resolution ionospheric parameters, such as the peak ionospheric electron density (NMF2) and the total electron content (TEC) shown opposite in the upper and lower panels respectively.

Model development is proceeding along a ‘modular’ route such that the new ionosphere-plasmasphere model can be easily coupled into existing atmospheric models, such as the NCAR Thermosphere Ionosphere Electrodynamics General Circulation Model (TIEGCM) and other components of the CISM system.