Project Details

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Project Title:
Development and Validation of a Comprehensive Magnetosphere Ionosphere Model

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Summary:
We propose a 5 year effort to combine a number of existing models of Earth's magnetosphere, ionosphere, and thermosphere into a comprehensive geospace model (CGM). Specifically, the CGM will be comprised of the OpenGGCM magnetosphere model, the CTIPe thermosphere-ionosphere-plasmasphere model, the CRCM and the RCM ring current models, and the Fok RBM radiation belt model. A substantial part of this effort is devoted to verification and validation of the CGM. We will use a number of ground and space based data sets to establish metrics and skill scores. The CGM will be able to perform in real time and will be run for at least one month in real time mode for verification. At the end of this effort we will deliver the CGM to the Community Coordinated Modeling Center, which may then further test it and prepare for transition into operations. The model will have the capability to follow the geospace response to time-dependent variations in the forcing from the solar wind and interplanetary magnetic field. The model will predict the following space weather effects: magnetospheric convection and auroral precipitation responsible for electrojet currents, radiation belt electron and ion fluxes, sub-auroral polarization streams and their impact on plasma density at mid-latitude, mid and low latitude plasma restructuring by the interaction between the penetration and dynamo electric fields, the background neutral, plasma, and electrodynamic context for forecasting irregularities, and thermospheric neutral density responsible for satellite drag, and O/N2 ratio, which is important for ionospheric production and loss rates. CGM will contribute many important new and unique aspects to the modeling and characterization of the Geospace domain. In particular, the development of a unified potential solver coupling the electrodynamics components will accommodate both symmetric and asymmetric elements of the inter-hemispheric interactions. CGM will also have a realistic topside ionosphere and plasmasphere, which is essential for the correct treatment of plasma redistribution at mid and low latitudes, and the emptying and refilling of the plasmasphere. It will have the potential to respond to realistic dynamical forcing from the lower atmosphere, which is responsible for much of the eomagnetically quiet day-to-day variability. The radiation belt module will also have the capability to respond to time-dependent magnetic and electric fields and covers both ions and electrons over the entire relevant energy range. CGM will address all the expected features of the development of the comprehensive magnetospheric-ionospheric- thermospheric model. In addition, the model will assimilate data for ionospheric and magnetospheric convection, include multiple species in the plasmasphere and the magnetosphere, and will accomodate multiple solar wind and interplanetary magnetic field monitors.

Publication References:

no references