Project Details

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Topic: Causes and Consequences of Hemispherical Asymmetries in the M-I-T System

Project Title:
Impact of Thermospheric Asymmetry On Geospace Coupling

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Summary:
Ionospheric outflow consists of ions that have escaped the upper atmosphere and flow into the magnetosphere where they impact the global magnetosphere dynamics that feedback into the upper atmosphere. The amount of ion outflow is determined by the energization sources from the magnetosphere above and the underlying thermospheric state, but the northern and southern thermospheric states have drastically different seasonal dependencies that will influence the resulting ion outflow characteristics. A comprehensive understanding of the ion outflow response to the asymmetries in the thermosphere continues to prove challenging because it requires characterization of the thermosphere and outflow for each hemisphere simultaneously (of the whole geospace coupled system). Sources of asymmetry can come from any of the geospace components and characterizing their importance and influence requires a complex coupled geospace model. Previously modeling efforts have only electrodynamically coupling the thermosphere to the magnetosphere, limiting the types of asymmetries that can propagate. Recent development of a coupled geospace model provides additional pathways for asymmetry to propagate. Specifically, this project aims to address the following scientific issues through numerical modeling and model-data comparison:

1) Characterization of the degree in which ion outflow is hemispherically asymmetric under different seasonal and solar activity.
2) Role and relative contribution of various asymmetric drivers to asymmetric outflow.
3) Impact of asymmetric outflow on geospace coupling and feedback loops.
4) Determine the relative contribution of each asymmetric driver on the whole coupled geospace model.

We will employ a coupled geospace model that includes the Lyon-Fedder-Mobarry global MHD magnetosphere model, the Ionosphere-Polar Wind Model of the polar wind and ion outflow, and the Thermosphere-Ionosphere-Electrodynamic General Circulation Model of the global thermosphere and ionosphere in combination with observations (particularly NASA FAST, NASA THEMIS, AMPERE, and DMSP) to carry out numerical experiments to simulate asymmetry within the whole geospace system and to address these scientific issues.

The proposed work is directly relevant to the goals of the NASA LWS Focus Science Topic #4: Causes and Consequences of Hemispherical Asymmetries in the Magnetosphere   Ionosphere   Thermosphere System, as the proposed work carries out numerical simulation using a coupled geospace model that captures the asymmetries from both external and internal asymmetric drivers for all three systems and is capable of propagating their asymmetries to the other systems.

Publication References:

no references