Project Details

ROSES ID: NNH19ZDA001N
Selection Year: 2019
Program Element: Focused Science Topic

Topic: Magnetospheric and Ionospheric Processes Responsible for Rapid Geomagnetic Changes

Project Title:
Physics-Based Modeling of Geomagnetically Induced Currents (GICs)

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Summary:
For the GIC problem, propagation of geoelectric fields from the ionosphere to ground is typically performed using Biot-Savart integrals. This approximation ignores the localized complexity of lithosphere electrical conductivity and the relative high conductivity of ocean water compared to lithosphere. Three-dimensional models of Earth conductivity with mesoscale spatial resolution are being developed, but a new approach is needed to incorporate this information into the space weather forecast modeling chain. In response to these short comings, we have developed a Finite Difference Time Domain (FDTD) electrodynamic model (called GeoRad) that solves Maxwell's equations on a vertically-stack 2D unstructured Voronoi tessellation. We propose to apply this new capability to provide more realistic simulations of the dB/dt generating at ground level during a variety of space weather disturbances including storms, substorms, and SMCs. We will utilize existing and new simulations of the geomagnetic disturbances computed with the SHIELDS framework (SWMF + RAM/SCB). It is expected that the results will substantially deviate from the currently used Biot-Savart methodology and we wil quantify these differences. The work is directly relevant to the Focused Science Topic #3 (Magnetospheric and Ionospheric Processes Responsible for Rapid Geomagnetic Changes) and has extensive important applications in space weather prediction and protection of ground-based long-conductor technological systems (e.g. Power distribution systems, etc.)

Publication References:

no references