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Abstract title:

What is required of global magnetosphere-ionosphere-thermosphere models to predict geomagnetically induced currents?

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Geomagnetically induced currents (GICs) are one of the most important manifestations of space weather, but they also represent the last link in the long chain of physical processes responsible for channeling the solar wind energy through the magnetosphere-ionosphere-thermosphere (MIT) system. Many of these interlinked processes are still poorly understood, particularly, during strong disturbances, i.e., geomagnetic storms. They include intense magnetic field dipolarizations in the magnetotail, the generation of the ring current, electron precipitation, which regulates ionospheric conductivity and current closure, and thermospheric heating and dynamo. To be able to predict GICs, global MIT models must faithfully represent these incredibly complex multiscale interactions in a self-consistent fashion. The challenges are not only physical but also numerical, as many of the processes involved operate at mesoscales while having global-scale consequences. This places stringent requirements on models to resolve a wide range of scales which, in turn, entails implementation of highly accurate and at the same time computationally efficient algorithms. In this presentation, we will review the current state of MIT modeling with respect to GIC prediction, describe some of the most pressing observational, theoretical, and modeling challenges, as well as give examples of model successes in reproducing ionospheric electrodynamics and corresponding GIC signatures.