Exploring Predictive Performance of Ground dB/dt Models: A Reanalysis of the Geospace Model Transition Challenge

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Geomagnetically Induced Currents (GICs) are electric currents driven by activity in near-Earth outer space as our magnetic field interacts with that of the Sun’s. These currents can flow through any conducting path, including pipelines and high voltage electric power lines. When GICs become strong enough, these technological systems can be interrupted or damaged, drastically affecting those who depend on them. Developing systems to accurately monitor and predict GIC events has therefore become a critical task for national security. An initial effort to assess the performance of five operationally-promising GIC models was presented by *Pulkkinen et al.* [2013]. The results of this validation effort showed that the models can provide predictive value, but shortcomings exist. While this work represents a landmark first-step towards numerical space weather forecasting, many questions remain concerning each of the models’ capabilities. How do the models perform for different levels of geomagnetic activity? What is the range of activity for which the models have been validated? Based on the assumptions and input data for each model, what is the maximum driving for which the results can be considered valid?
This study presents a reanalysis of the *Pulkkinen et al.* [2013] results to extend our understanding of the models’ capabilities and answer the questions posed above. Data-model errors between predicted and observed magnetometer dB/dt values are binned by activity (solar wind electric field or D_{ST}). The bins are arranged to yield error as a function of driving. Input data for empirical relationships, on which the models either rely or of which they comprise entirely, are binned by activity to determine the range of conditions over which each model is valid. A comparison of each model is presented to further illustrate previously published results. Additionally, because GICs are intimately linked to the electrojets which are in turn closely related to field-aligned currents, we also compare Birkeland currents from the different models to observations. For this we use radial current distributions from AMPERE based on the Iridium satellite constellation, providing assessments of the intensities and distributions of the global scale currents every ten minutes. From this new analysis, we place error bars on recent predictions of dB/dt made by the Space Weather Modeling Framework.

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