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On the performance of global magnetohydrodynamic models in the outer magnetoshpere

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The growing interest in space weather forecasting from both government and industry raises the bar for space weather model development. As the amount of infrastructure and people that can be affected by severe space weather events grows so does the need for reliable forecasting of those events and their effects both in space and on the ground. This in turn requires systematic testing, verification and validation of space weather models and the evaluation of their suitability for a particular purpose. Magnetospheric substorms, and hence the dynamics of the outer magnetosphere, can have a significant effect on technological systems even at ground level. For example the largest geomagnetically induced currents (GIC) occur with highest probability during the substorm expansion phase about five minutes after the expansion onset.

We present a systematic evaluation of the performance of four global magnetohydrodynamic models in the outer magnetosphere during an event with multiple substorms. The global MHD models BATS-R-US, GUMICS-4, LFM and OpenGGCM are given identical solar wind input and the results are systematically compared to the measurements of Cluster 1, Geotail, Wind and also SuperDARN. By using different metrics a quantifiable, unambiguous and objective estimate for model performance is obtained. All simulations are carried out through NASA's Community Coordinated Modelling Center (CCMC) website and the settings used for the models are as close to each other as reasonably possible.