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Validating Global Magnetosphere Simulations with Multipoint Measurements

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The Space Weather Modeling Framework (SWMF) aims at providing a flexible framework for physics based space weather simulations. The SWMF combines numerical models of the Solar Corona, which includes the Eruptive Event Generator, the Inner Heliosphere, Solar Energetic Particles, Global Magnetosphere, Inner Magnetosphere, Radiation Belt, Ionosphere Electrodynamics and Upper Atmosphere into a parallel, high performance model. All the components can be replaced with alternatives, and one has the option to use only a subset of the components. The SWMF enables us to do simulations that were not possible with the individual components. We highlight some numerical simulations obtained with the SWMF. During the Halloween storms the Sun exhibited some of the most violent outbursts in recent history. Some of the huge coronal mass ejections associated with the Halloween storms hit the magnetosphere and generated very large magnetic storms. We present a simulation that was driven by solar wind conditions observed upstream of the Earth by the ACE and Geotail spacecraft. This simulation tested the coupled global magnetosphere, inner magnetosphere, ionospheric electrodynamics and upper atmosphere models. The simulation results were compared with observation in the dayside magnetosphere, cusp region, geosynchronous region, and the distant magnetotail by Cluster, Polar, GOES-10, GOES-12 and Wind. In addition we compared the simulated Dst with the observed values and the simulated cross polar cap potential to those obtained by the AMIE technique. The agreement with all these observations is quite good, demonstrating that the SWMF can accurately handle extreme magnetospheric storms.