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Development of magnetospheric current systems during storms: MHD and event-oriented magnetic field modeling approaches

N. Ganushkina (1), M. Liemohn (2), R. Ilie (2), M. V. Kubyshkina (3), A. Ridley (2)

(1) Finnish Meteorological Institute, Helsinki, Finland (Nataly.Ganushkina@fmi.fi/+358-9-1929-4603), (2) Dept. of Atmospheric, Oceanic, and Space Sciences, University of Michigan, MI, USA, (3) Institute of Physics, University of St.Petersburg, Russia

Geomagnetic storms cause significant changes in all magnetospheric current systems and therefore in magnetospheric magnetic field configuration. Two storms on September 22, 1999 and April 18, 2001 were modeled using two different approaches, namely, first-principles and event-oriented magnetic field modeling. As a first-principles approach, three components of the Space Weather Modeling Framework (SWMF) were used: the global magnetosphere (GM), inner magnetosphere (IM), and ionospheric electrodynamics (IE). The SWMF was driven by time-dependent solar wind and interplanetary magnetic fields. As event-oriented approach, the developed time-evolving model for the inner magnetosphere magnetic field which gives a global representation of the magnetic field evolution during specified time periods. The model is based on an empirical parametrization of magnetospheric current systems and use of in-situ magnetospheric measurements from GOES 8, GOES 10, Polar, Geotail and CLUSTER satellites and Dst measurements to define the intensity and location of these current systems for each time and location. Outputs from both approaches were then compared with in-situ measurements of magnetic field and Dst measurements. Although the SWMF is becoming capable of accurately conducting storm simulations, significant differences between the modeled and observed magnetic field and Dst index were found during those two storm events. We compare the global magnetic field topology determined by the event-oriented approach to the SWMF to attempt to elucidate a

physical understanding of the SWMF inaccuracies during these time periods.