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Space weather has been modeled at Finnish Meteorological Institute (FMI) for over 40 years, starting with geomagnetically induced currents since 1980s, global magnetohydrodynamic (GMHD) modeling of Earth since 1990s and global hybrid particle-in-cell (GHPIC) modeling of several solar system planets, moons and smaller bodies since early 2000s. We describe the current status and future outlook of space plasma modeling at FMI, concentrating on global space weather models of Earth, Mercury and other celestial bodies.

The GMHD model GUMICS developed at FMI has been utilized for nearly 30 years, and was recently parallelized and used to simulate over 20 years of the interaction of solar wind measured by ACE with Earth's magnetosphere and ionosphere. We present an update to this work which includes few years of results with higher magnetospheric resolution than used originally. The GHPIC model HYB developed at FMI has been used for over 20 years, with its parallel version RHybrid developed during the past decade. Solar system bodies modeled with GHPIC at FMI include, for example, Mercury, Venus, Mars, Moon and comets. We show examples of latest analysis concentrating on induced magnetospheric processes, solar wind driven atmospheric erosion and physics of comparative planetary space weather.

Global space plasma models of FMI are based on modular libraries and modern C++ using an object-oriented template architecture. A parallel grid and other libraries shared between models provide synergy in developing and coupling different plasma descriptions. We demonstrate a staggered magnetic field solver under development for improved robustness and parallel efficiency of GUMICS magnetospheric solution. To our knowledge this is the first time that such a solver includes support for cell-based run-time adaptive mesh refinement and temporal substepping. We also discuss current development effort which includes adding support for both parallel run-time adaptive mesh refinement and electron physics with full kinetic plasma description to GHPIC.

Poster category:

Poster category
Geospace/Magnetosphere Research and Applications
Poster session day
Thursday, April 18, 2024
Poster location
10
Meeting homepage
Space Weather Workshop 2024
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