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GEMSIS-Magnetosphere: Observation-based modeling of high-energy particle variation in the inner magnetosphere

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GEMSIS (Geospace Environment Modeling System for Integrated Studies) of STEL, Nagoya University, is the modeling project for understanding energy and mass transportation from the Sun to the Earth in the geospace environment. In order to understand the geospace environments, we develop physics-based models as well as empirical models using in-situ satellite measurements and global ground-based measurements. Comparisons between models and observational results are essential to improve the models and to eventually understand the dynamics of the geospace. Geospace storms are the largest electromagnetic disturbance in near-Earth space and facilitate extensive particle acceleration in the inner magnetosphere, which causes development of the ring current and a drastic increase of relativistic electrons in the radiation belt. Aiming at understanding the dynamics of the inner magnetosphere during the geospace storms, the GEMSIS -Magnetosphere working team has addressed the development of new physics-based models for the global dynamics of the ring current (GEMSIS-RC model) and radiation belt (GEMSIS-RB model). We are also developing a high-resolution global MHD simulation code, which enables us to study MHD turbulence in the solar wind-magnetosphere interaction. Integrated data analysis studies on such as topics as supply mechanisms of ring current ions and relativistic electron accelerations are also conducted using various types of geospace observations from space and from the ground. Some results are applied to studying the forecasting of radiation belt variation. Other ongoing research includes concept design for an integrated data analysis tool and a related database for effective research with various types of data, including those obtained from satellite observations, ground-based observations, and numerical simulations/models.

Keywords: geospace, inner magnetosphere, magnetic storm, ring current, radiation belt, plasma