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Variation of high-energy particles during geospace storms: Geospace Environment Modeling for Integrated Studies (GEMSIS)

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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. GEMSIS (Geospace Environment Modeling System for Integrated Studies) of STEL, Nagoya University, is the observation-based modeling project for understanding energy and mass transportation from the Sun to the Earth in the geospace environment. 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). Geospace storms can considerably change magnetic configuration in the magnetosphere. When the magnetic storm occurs, the radiation belts, which consist of high-energy relativistic electrons, are strongly affected. The GEMSIS-RC model is a self-consistent numerical simulation code solving the five-dimensional Vlasov equation for the ring-current ions in the inner-magnetosphere coupled with Maxwell equations. Our approach is unique in that it includes MHD modes as well as deformation of magnetic field configuration due to the ring current self-consistently. To understand the dynamics of the radiation belt, we have developed the GEMSIS-RB model that calculates relativistic charged particle trajectories in the magnetosphere. 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. In this presentation, we report on some of recent studies from the GEMSIS-Magnetosphere project with an emphasis of the models of the ring current and radiation belt.

Keywords: magnetic storm, geospace, ring current, radiation belt, particle acceleration, drift kinetics