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GEMSIS Phase 2 project: Investigation of particle acceleration and regional couplings during geospace storms

Kanako Seki[1*], Takashi Kikuchi[1], Kanya Kusano[1], Satoshi Masuda[1], Yusuke Ebihara[2], Takayuki Umeda[1], Kazuo Shiokawa[1], Satonori Nozawa[1], Tatsuki Ogino[1], Nozomu Nishitani[1], Yutaka Matsubara[1], Ryoichi Fujii[3], GEMSIS project team[1]

[1]STEL, Nagoya University, [2]IAR, NAgoya University, [3]Nagoya University

"Geospace" represents the near-Earth space where the influence of Earth is noticeable. Human activities in geospace have become important since the 20th century. The geospace storms, which often take place during the solar maximum, are drastic variation of the space environment caused by dynamic solar activities such as CMEs. During the geospace storms, enhanced regional couplings in the solar-terrestrial system and dynamic energy and mass transport, resulting in change of Earth's radiation belt and various space weather phenomena, are known to take place. Research into geospace storms, which can cause various natural and artificial phenomena, such as active auroras, satellite communication blackouts, and spacecraft malfunctions, are getting more international focus in preparation for the next solar maximum. International program CAWSES-II (climate and weather of Sun-Earth System, Part 2) and ISWI (International Space Weather Initiative) are now underway. RBSP (Radiation Belt Storm Probes) and Orbitals missions are being conducted in the US and Canada, respectively, with the ILWS (International Living With a Star) program aiming at the launch of geospace exploration satellites around 2013. Japan is also planning the ERG (Energization and Radiation in Geospace) project as a mission of the scientific community. One of characteristics of the ERG project is close collaboration between three task teams, namely, the satellite, ground-based observation, and theory/simulation/modeling teams.

Aiming at understanding of physical mechanisms of the particle acceleration and regional couplings in solar-terrestrial system during the geospace storms as well as providing efficient study environment for the trinity collaboration in the ERG project, GEMSIS (Geospace Environment Modeling System for Integrated Studies) Phase 2 project is planned to go from FY20 10 to FY2015 at STEL, Nagoya University. The project is based on studies conducted in the GEMSIS phase 1 project in FY2007-2009 that focuses on understanding the high-energy particle environment in geospace and developing basic technologies for geospace modeling. In the GEMSIS project, 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. In order to understand physical mechanisms of dynamic phenomena taking place in the complicated Sun-Earth system, the GEMSIS project is carried out by three working teams (WTs): The "GEMSIS-Sun" WT implements the modeling of high-energy particle dynamics and magnetic fields in the solar corona. The "GEMSIS-Magnetosphere" WT implements new models of global variation in the inner magnetosphere. The "GEMSIS-Ionosphere" WT implements models of global distribution of the ionospheric electric potential.
Another important task of the GEMSIS Phase 2 project is contribution to the ERG science center that facilitates the close collaboration between the satellite, ground-based observation, and theory/ simulation/modeling for geospace studies by providing integrated data analysis tools and combined database. In this paper, research highlights and strategy of the GEMSIS project will be

reported.

Keywords: geospace, magnetic storm, solar maximum, space environment, space weather, radiation belt