Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PEM021-P08 Room: Convention Hall Time: May 24 17:15-18:45

GEMSIS-Ionosphere: Toward the understanding of global distribution of the ionospheric potential during disturbed time

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In phase 1 of the GEMSIS (Geospace Environment Modeling System for Integrated Studies)-Ionosphere project, the primary goal was set to reconstruct the global distribution of the ionospheric electric potential for the purpose of understanding the Sun-Earth system. Because of irregularly distributed observatories and insufficient number of them, it has been a challenging work to reconstruct the electric potential distribution. We initiated two different challenges. One is an inductive scheme using data from the SuperDARN radars and ground magnetic fields. By applying a new base model, a global-scale distribution of the electric potential will be obtained for the storm-time in which the convection cell is largely expanded to lower latitudes. The other challenge is a deductive scheme by applying Ohm's law for given electric currents flowing along a field line (field-aligned current) and the ionospheric conductance. One of the advantages of our deductive scheme is to solve the potential in the whole sphere under the realistic geomagnetic field. We developed a realistic model of the large-scale field-aligned current on the basis of 190,00 0 data sets of field-aligned current observations obtained by the DMSP and DE2 satellites. The data were sorted by the solar wind condition and tilt angle, providing realistic field-aligned currents having sharp boundaries. Data analysis efforts have also been made in terms of quantitative evaluation of transmission of electromagnetic energy, auroral breakup and magnetotail reconnection during substorms, inner magnetosphere-ionosphere coupling, and magnetosphere-ionosphere coupling system.

Keywords: Ionospheric electric potential, Magnetic storms, Substorms, Field-aligned current, Modeling