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3D Empirical Tools for the Magnetotail

The roadmap of NASA SEC STP calls for launch of several multispacecraft missions, namely Magnetospheric Multiscale (MMS), Magnetospheric Constellation (MC), and Geospace Electrodynamics Connections (GEC). NASA SEC LWS program will also launch complementary multispacecraft missions, e.g., Ionospheric Mappers (IM). New technique will be required to assimilate and display these multi-point measurements in the ionosphere and magnetosphere into coherent and unified 3D global images of the magnetotail. We have previously developed a method for inferring plasma sheet ion density (n), temperature (T), and pressure (p) from ionospheric observations. This method relies heavily on the accuracy of the ionosphere-magnetosphere mapping, which shall be improved with a new technique. The new technique could be applied and tested on the existing NASA and non-NASA satellites. The resulting 2-D/3-D plasma sheet profiles not only help guide the upcoming multi-spacecraft missions, e.g. spacecraft orbits and spacing, but also contribute to the NASA LWS science objectives. Therefore, we propose to (1) radically improve the ionosphere-magnetosphere mapping using $\text{grad } p = \mathbf{j} \times \mathbf{B}$ relationship; (2) expand the method to incorporate mid-altitude and high-altitude measurements; (3) construct 2-D/3-D plasma sheet n , T , and p from DMSP observations for over one solar cycle binned by solar wind and IMF parameters as well as storm and substorm onset times; (4) link our model profiles to Fok ring current-radiation belt model [Fok et al., 2001]; and (5) develop a 3-D magnetotail viewer. Relevance to NASA LWS Program The proposed work can significantly aid the upcoming NASA SEC STP and LWS multi-spacecraft missions. In addition, it is relevant to the NASA LWS TR&T Objective 2, which calls for developing new empirical tools and numerical simulations that predict the occurrence and amplitudes of solar, interplanetary, and geospace disturbances, including software that identifies, retrieves, assimilates, and portrays data and model results from different sources for LWS forecasting and research objectives (http://research.hq.nasa.gov/code_s/nra/current/nra-03-oss-01/appendA3_7.html). The proposed work addresses 3 NASA OSS Science Objectives and Research Focus AREAS (RFAs): (1) Goal I, Sun-Earth Connection Theme, RFA 1(b); (2) Goal II, Sun-Earth Connection Theme, RFA 1(c); and Goal II, Sun-Earth Connection Theme, RFA 2(b).