Project Details

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Project Title:
Initial development of an analysis model of the Inner Magnetosphere

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Summary:
We propose to develop an analysis model of magnetospheric space weather based on statistical information from previous missions, optimal interpolation techniques, and basic physics. The model will be designed as a tool to make optimal use of data from the Living with a Star Geospace Mission. Analysis models are used extensively in the meteorological community to produce weather charts and frontal maps. Similarly, a principal goal of our proposed analysis model will be production of magnetospheric weather charts for use during the Living with a Star Geospace Mission, making optimal use of available data to specify the state of the magnetosphere. Initially, we plan to focus on three important aspects of space weather: the magnetic field, fluxes of radiation-belt particles, and fluxes of kilovolt electrons. Our analysis model will include four elements: a background empirical model, available observational data, a model error covariance matrix, and a physics checker/corrector. The methodology is based on a variant of least-square estimation theory. We will produce a set of background model outputs for different model inputs. From these results we will develop an error covariance matrix for the outputs of interest. Using the error covariance matrix, we will construct a space weather chart by adjusting the background model to optimize agreement with global observations, consistent with the inherent correlations of the empirical model. In order to ensure a physically meaningful solution, we will pass the results of the maximum-likelihood estimate through a physics checker/corrector. This routine will force the resulting space weather map to agree with well known and well understood physical laws (like div B =0 or nion ? nelectron). Our initial tests will be Observation System Simulation Experiments (OSSE), which use artificial data made up of select points from the input model and noise. By evaluating the value added to the space weather map by including data from an array of hypothetical orbits, the analysis model will be able to provide assistance in orbit determination for future missions. After our initial OSSE, we will test and tune the analysis model with historical data from CRRES and other missions. In this way, the model will be ready for use as soon as the Living with a Star Geospace Mission and other new data sources become available.

Publication References:

no references