Project Title:
Magnetospheric Current System During Disturbed Times

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Project Information:
In this proposal we present a research program that will help provide a basis for the construction of a viable space weather model in the Living With the Star era. Such a model must provide both timely and reliable predictions of magnetospheric storms and substorms. The advance warning of solar disturbances given by solar wind monitors must be coupled to an accurate model of the magnetosphere, in particular the near-Earth region. Because the near-Earth region is the location of most spacecraft as well as vulnerable Earth based human technology, the prediction of conditions in this region is the primary goal of space weather research. The storm time injection of energetic particles into the ring current has a major impact on the near-Earth space. The physical models developed as part of the Living With a Star program must be capable of predicting the properties of the inner magnetospheric region with a high level of detail and specificity. Presently, global magnetohydrodynamic (MHD) are the most advanced models capable of simulating the entire magnetosphere and its interaction with the solar wind. Global MHD models have progressed in the last few years by using upstream solar wind observations to drive the simulations. These models however have limitations, particularly in their ability to model the inner magnetosphere. Our research program will significantly enhance the capabilities and physical realism of our global MHD simulation code and our model of the ring current through a systematic program that will result in a unified model. Time-dependent electric and magnetic fields obtained from a global MHD simulation will be used to carry out bounce-averaged particle drift calculations. A major element of our study is to use the parallel and perpendicular components of the particle pressure to feed back into the MHD momentum equation. We will validate our MHD and particle drift calculations by modeling both quiet and storm intervals. By iterating between measurements and theoretical calculations we will obtain a reliable set of MHD and particle drift models capable of accurately predicting the properties of the inner magnetosphere for a wide range of solar wind conditions. A global model that combines the magnetohydrodynamic approach with an inner magnetospheric model based on a bounce average drift model will be a major advance in the sophistication of the tools available to study the solar wind-magnetosphere-ionosphere system.

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