Project Details

ROSES ID: NRA-01-OSS-01
Selection Year: 2002
Program Element: Independent Investigation: Solar Helio LWS

Project Title:
Living with a Star: Development of an Observation-Based, Hybrid 3D-MHD Model for Predicting Solar Wind Conditions During all phases of the 11-Year Solar Activity Cycle

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Summary:
a. Objectives: We propose to develop a hybrid kinematic/3D-MHD solar wind model to simulate realistic solar wind conditions over a range of solar activity levels. Our goal is to improve the scientific understanding of the propagation and evolution of solar disturbances, in order to ultimately predict their eoeffectiveness and impacts on human technologies. In this project, we will focus on modeling solar wind conditions using solar data as inputs. b. Methods and Techniques: We will develop a new observation-based solar wind model by combining a modified kinematic model of the inner heliosphere with a full 3-D magneto-hydrodynamic solar wind model. This new hybrid model will be driven by observations of ambient solar conditions and transient events, and applied to a number of scenarios of solar disturbances throughout the 11-year solar activity cycle. The modeling system will be used to characterize and predict solar wind conditions, including corotating interaction regions, interplanetary shocks and the IMF lines connecting the traveling shock region to the Earth and L1, within a non-uniform ambient solar wind. We will apply our model to a list of candidate solar events having the potential for space weather impacts. We will study the evolution of the IMF at the interplanetary shock surface, with particular emphasis on the turning and recovery of Bz and its relationship to geomagnetic storms. Results will be interpreted by comparing modeled and observed solar wind speed, density, and IMF topology at the ACE and WIND spacecraft locations. c. Significance: This proposal is unique because we will combine, for the first time, our observation-based kinematic modeling system with a full 3D-MHD solar wind model. This will enable new comparisons of solar wind predictions with spacecraft observations. This in turn will allow NASA to quantify the relative importance of various solar disturbance sources to the transfer of energy from the Sun to the terrestrial system. This modeling effort is relevant to HEDS as a critical step in the subsequent development of observational solar energetic particle propagation models for predicting particle fluxes and fluences at Earth, Mars, and Earth-Mars transit orbits.

Publication References:

Summary: "

Reference: Living with a Star: Development of an Observation-Based, Hybrid 3D-MHD Model for Predicting Solar Wind Conditions During all phases of the 11-Year Solar Activity Cycle - Fry, Craig D. EXPI, Inc.