Project Details

ROSES ID: NRA-01-OSS-01
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Project Title:
Understanding the global structure and evolution of coronal mass ejections in the solar wind

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Summary:
We propose to use a new combined, global MHD model of the solar corona and inner heliosphere to interpret ACE and Ulysses plasma, magnetic field, and composition measurements of coronal mass ejections (CMEs) in the solar wind during various phases of the solar cycle: SAIC's coronal model will be used to initiate the disturbance and model its evolution to 20Rs and NOAA/SEC's heliospheric model will follow the evolution from 20Rs to 5 AU. The model results will be used to provide a global context with which to interpret in situ observations, and allow us to address fundamental issues concerning the origin, topology, and evolution of CMEs. In particular, we will address the following questions: - What are the fundamental evolutionary distinctions between CMEs and magnetic clouds? How do they relate to the concepts of "simple" and "complex" ejecta? - Under what conditions is the force-free approximation valid for CMEs? When, where, and why does it break down? - What is the relationship between the 3-part structure of CMEs seen in coronagraph observations and their interplanetary counterparts? - Do high-latitude CMEs (as observed by Ulysses) represent a distinct class of events? - What processes control the solar connectivity of field lines embedded within CMEs? - How do the properties of the ambient solar wind modify the evolution of ejecta? In particular, how does CME evolution differ at solar maximum from solar minimum? - What are the global morphologies of the so-called "double" flux ropes and "cannibal" CMEs? By exploring how different types of transient phenomena are initiated and evolve, and comparing with observations, we may also be able to resolve a long-standing controversy on whether there are two (or more) intrinsic classes of CMEs. Our team includes key personnel from the magnetometer, plasma, and composition instruments on board both ACE and Ulysses. The solar and heliospheric physics groups at SAIC and NOAA/SEC have maintained a successful history of developing sophisticated MHD codes and applying them to fundamental problems concerning CME initiation and evolution. As part of this investigation, we will make the results of our simulations available to the scientific community via the web.

Publication References:

Summary: no summary

Reference:
Riley, Pete; Linker, J. A.; Lionello, R.; Miki?, Z.; Odstrcil, D.; Hidalgo, M. A.; Cid, C.; Hu, Q.; Lepping, R. P.; Lynch, B. J.; Rees, A.; (2004), Fitting flux ropes to a global MHD solution: a comparison of techniques, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 66, Issue 15-16, p. 1321-1331. doi: 10.1016/j.jastp.2004.03.019