Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Focused Science Topic

Topic: To determine the solar origins of the plasma and magnetic flux observed in an Interplanetary Coronal Mass Ejection.

Project Title:
Relating Interplanetary Coronal Mass Ejections to their Source on the Sun

PI Name: Zoran Mikic
PI Email: mikicz@predsci.com
Affiliation: Science Applications International Corp
Project Member(s):
-

Summary:
In situ magnetic field measurements of propagated interplanetary coronal mass ejections (ICMEs) provide an important constraint in verifying CME initiation models. This understanding can improve our ability to predict geomagnetic storms, since CMEs are an important driver of space weather. We propose to use numerical simulations of CME initiation and propagation to explicitly elucidate the relationship between CMEs and ICMEs, and to thereby link in situ measurements with their solar sources. The novel aspect of our investigation is to increase the realism of the models, particularly to include the important effects of a realistic background solar wind on CME propagation and distortion, and to use measured photospheric magnetic fields on an active-region scale, including their interaction with the surrounding large-scale magnetic field. We will explore leading candidates for CME initiation, including the flux cancellation model and the breakout model. We propose to work with selected team members to maximize the scientific return from the novel ''Focused Science Topic'' approach of this LWS program. Our proposed program will help to develop the foundation for the prediction of the geoeffective properties of ICMEs at Earth from solar and heliospheric observations, by providing a deeper understanding of the initiation and propagation of CMEs. Eventually, the numerical tools that will be developed in this investigation could be used for the development of a predictive capability. The proposed simulation capability will allow us to explore the magnetic cloud-active region relationship in more detail than has heretofore been possible. We will address the expansion of magnetic clouds in interplanetary space from their origin in the low corona, including the topology of the magnetic field lines that connect the magnetic cloud with the Sun and the outer heliosphere. We will study how magnetic reconnection transfers magnetic field and electric current from an active region and the overlying large-scale coronal field into the magnetic cloud. We will also identify which characteristics of the magnetic field near the Sun determine the geoeffectiveness of ICMEs.

Publication References:

Summary: no summary

Reference:
Forbes, T. G.; Linker, J. A.; Chen, J.; Cid, C.; Kóta, J.; Lee, M. A.; Mann, G.; Miki?, Z.; Potgieter, M. S.; Schmidt, J. M.; Siscoe, G. L.; Vainio, R.; Antiochos, S. K.; Riley, P.; (2006), CME Theory and Models, Coronal Mass Ejections, Space Sciences Series of ISSI, Volume 21. ISBN 978-0-387-45086-5. Springer, 2006, p. 251, doi: 10.1007/978-0-387-45088-9_12

Summary: no summary

Reference: Forbes, T. G.; Linker, J. A.; Chen, J.; Cid, C.; Kóta, J.; Lee, M. A.; Mann, G.; Miki?, Z.; Potgieter, M. S.; Schmidt, J. M.; Siscoe, G. L.; Vainio, R.; Antiochos, S. K.; Riley, P.; (2006), CME Theory and Models, Space Science Reviews, Volume 123, Issue 1-3, pp. 251-302, doI: 10.1007/s11214-006-9019-8

Summary: no summary

Reference: Riley, Pete; Lionello, Roberto; Miki?, Zoran; Linker, Jon; (2008), Using Global Simulations to Relate the Three-Part Structure of Coronal Mass Ejections to In Situ Signatures, The Astrophysical Journal, Volume 672, Issue 2, article id. 1221-1227, pp, doi: 10.1086/523893