Project Details

ROSES ID: NNH09ZDA001N
Selection Year: 2010
Program Element: Focused Science Topic

Topic: Predict the Onset and Space Weather Impacts of Fast CMEs/Eruptive Flares

Project Title:
Using a Sophisticated MHD Model to Improve Prediction of CME Initiation and Propagation

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Summary:
We propose to use a sophisticated magnetohydrodynamic (MHD) model to improve our understanding of CME initiation and propagation. Our proposed modeling will focus on performing detailed CME "event studies," in which we will use detailed observations as inputs to the model, including observed magnetic fields. From the model we will produce simulated outputs that can be directly compared with observations, including white-light images and EUV and X-ray emission, and the evolution of flare ribbons. The proposed work will improve our understanding of CME initiation, and the subsequent propagation of CMEs in the inner heliosphere, leading to improvements in space weather prediction.

At present, there are many theories of CME initiation. The proposed CME event studies are meant to identify which one (or more) of these theories captures the essential aspects of CME initiation, by using observations to discriminate between competing theories.

The following are selected guiding questions that will help us to improve CME prediction:

* Is there a relationship between the free energy in the magnetic field and the tendency of an active region to erupt?

* Can this relationship be exploited to predict when an eruption is imminent?

* Is there a characteristic signature in the magnetic field geometry/structure/topology that might be used to sense eruption?

* What are the fundamental ways in which active regions are energized?

* Can we quantify the trigger for eruption and use it as a predictor?

Our proposed project will utilize data from the upcoming SDO mission extensively, as well as data from Hinode, STEREO, and SOHO observations. The testing of models against these observations is a central task in our proposed effort. We will share our simulation results with the Focused Science Team members to maximize the progress of the team, and we will incorporate innovations from other team members into our model.

Publication References:

Summary: no summary

Reference: Miki?, Zoran; Török, Tibor; Titov, Viacheslav; Linker, Jon A.; Lionello, Roberto; Downs, Cooper; Riley, Pete; (2013), The challenge in making models of fast CMEs, SOLAR WIND 13: Proceedings of the Thirteenth International Solar Wind Conference. AIP Conference Proceedings, Volume 1539, pp. 42-45, doi: 10.1063/1.4810985

Summary: no summary

Reference: Lionello, Roberto; Velli, Marco; Downs, Cooper; Linker, Jon A.; Miki?, Zoran; (2014), Application of a Solar Wind Model Driven by Turbulence Dissipation to a 2D Magnetic Field Configuration, The Astrophysical Journal, Volume 796, Issue 2, article id. 111, 7 pp, doi: 10.1088/0004-637X/796/2/111