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 helioseismology measurements to predict active region flaring probability

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Summary:
As our society becomes more technologically advanced, space weather is an increasing concern. Solar flares and CMEs affect satellite function, high frequency communication, power grids, as well as many applications related to GPS (deep-sea drilling and precision farming to name just two). Because of our increasing reliance on technology that is so susceptible to space weather effects, it is necessary to improve our ability to forecast when a solar event will occur and how large it will be.

One of the "holy grails" of space weather is the ability to forecast flares with useful accuracy and precision. Currently, the best methods are based on surface magnetic field measurements, and have a success rates ranging from 8-15% higher than always assuming no flare will occur (Barnes & Leka, 2008). We propose to use the properties of subsurface motions, detected through helioseismology methods, to understand and predict the onset of flares in active regions. Recent results indicate that helioseismology can be a useful tool to predict flare occurrence. Komm and Hill (2009) found that the combination of large flux and large vorticity in a given active region is highly correlated with the production of very large flares. Preliminary results from helicity measurements (Reinard et al., 2009) suggest that we can detect changes in helicity that predict the occurrence of a flare 1-3 days in advance. We will build on these results, improve our technique and quantify the predictive potential. We will then extend our analysis to a more detailed examination of how SVA measurements relate to other phenomena such as adjacent active regions (ARs) and Coronal Mass Ejections (CMEs). Once we have a firm understanding how SVA measurements relate to CME/flare onset we will conduct studies to gain a more complete understanding how subsurface motions lead to flare and/or CME production. Finally, we will test the method on new data and investigate the potential for a real-time warning system.

This proposal is highly relevant to NASA goals and to the scientific objectives of the focused topic (c): Predict the Onset and Space Weather Impacts of Fast CMEs/Eruptive Flares. The results from this study will increase our understanding of CME and flare initiation. The inclusion of the subsurface vorticity will result in improved flare forecasting, and this will increase the accuracy of space weather predictions with corresponding benefits to society in general. In addition, further study of the relationship between the subsurface vorticity, magnetic field evolution, and flare/CME activity will proved insight into the basic mechanisms of solar flares, sunspot structure, and astrophysical MHD.

Publication References:

no references