Project Details

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

Topic: To determine the topology and evolution of the open magnetic field of the Sun connecting the photosphere through the corona to the heliosphere.

Project Title:
Understanding magnetic complexity in active regions from structure functions of observed magnetic fields

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Summary:
OBJECTIVE. Non-stationary explosive events in the solar atmosphere, such as solar flares and coronal mass ejections (CMEs), may cause significant changes in the earth magnetic and ionospheric environment and thus affect human life. The origin of those events is concealed in the variability of solar magnetic fields, in particular, magnetic fields of active regions. Understanding how magnetic fields evolve and produce these events is of great importance for both fundamental solar physics research and practical applications such as space weather forecasting. APPROACH. We propose to study physical properties of ever evolving solar magnetic fields by using a cross disciplinary approach. We will apply method of structure functions, that is widely used to study non-linear processes in the solar wind, to photospheric magnetograms. The research is based on our previous results obtained for a limited number of active regions. Earlier we found that high statistical moments of structure functions calculated from the photospheric magnetograms describe the complexity of the magnetic field and they are related to the level of flare productivity of a given active region. This novel method of structure functions allowed us to detect such variations in the complexity of photospheric magnetic fields that could not be sensed by traditional methods where only low order statistical moments are analyzed. PLAN and DELIVERABLES. (1) We will carry out a broad statistical study of different active regions observed with high time resolution near the center of the solar disk in order to: i) confirm the reliability of our previous conclusions on a larger data set; ii) create a more complete picture of how the derived parameters reflect both the state of evolution of the magnetic field and flare productivity of an active region. (2) We will analyze the basic properties of structure functions for many flare-productive active regions, determined prior the flare onset. Then we will conduct a correlative study of these properties with the parameters of the associated flares. We expect the following deliverables of the research: i) results of data analysis -- specifications of the solar magnetic fields which will be used as input/restrictions for modeling; ii) diagnosis and analysis tools for the future studies and iii) online spaceweather related data products. RELEVANCE. The main question we are going to address is how the parameters, describing the complexity of an active region magnetic field, are correlated to the state of evolution of an active region and to the level of flare productivity. Thus, this study will have a noticeable impact not only on the research on solar flares their precursors but also on the demands of space weather. The results of this study will provide an important knowledge and analysis tools for future missions within LWS program such as Solar Dynamic Observatory (SDO) and the development of online data bases.

Publication References:

no references