Project Details

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Project Title:
Dependence of Magnetic Storm Intensity on Interplanetary Electric Field Variability

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Summary:
Recent studies have shown that magnetic storms are relatively weak when the solar wind dawn-dusk electric field (Ey) is smooth and accordingly there is a lack of substorm expansion phases over long intervals (5 to 7 hours) during the ring current intensification. It is, therefore, speculated that the magnetic storm intensity is controlled not only by the intensity, but also by the variability of the interplanetary electric field. This proposed investigation addresses this issue by calculating the two types of current systems in disturbed polar regions (i.e., DP1 and DP2 current systems). Two scenarios of frequent or rare occurrence of substorm expansion phases are suggested to explain the model-predicted overestimation and underestimation of storm intensity. To test these scenarios we would study two categories of magnetic storms in the epoch from 1996 to 2003, specifically, those occurring during intervals of highly variable Ey and those induced by interplanetary magnetic clouds. We specifically choose this time interval to cover a solar minimum and a solar maximum. We would compare the two categories of storms on their intensities and the occurrence of substorm expansion phases (i.e., when the DP1 current system is dominant) and ionospheric/magnetospheric convections (i.e., when the DP2 current system is dominant). We would use Wind and ACE data for interplanetary events, Polar and IMAGE auroral images for the identification of substorm expansion phases, SuperDARN and DMSP IDM data for analyzing the polar cap potential drop and the magnetospheric/ionospheric convection, and the ground-based magnetograms for the calculation of DP1 and DP2 components. When necessary, other available data sets will be studied as well. The expected results of the proposed study include: 1) the answer of how the magnetic storm intensity would change when the dominant current system is different in terms of style (DP1 or DP2) and intensity; 2) the correlation between the solar wind controller and the DP1/DP2 current system, and therefore, the correlation between the storm intensity and solar wind conditions; 3) an elucidation the storm-substorm relationship from the point of view of the Ey controller; 4) suggestions on how to reduce the overestimation of the Dst index, and suggestions for how to increase the underestimation of the Dst index, respectively. This study will not only maximize the utilization of currently operating Sun-Earth Connection missions, but will also significantly improve our scientific understanding of the solar wind-magnetosphere-ionosphere interaction upon which space weather prediction tools and thermosphere-ionosphere models are developed. This effort, therefore, addresses important objectives of the NASA-LWS TR&T program and its mission exploration,i.e., "to address those aspects of the connected Sun-Earth system that affect life and society".

Publication References:

no references