Some Studies From the ARGOS Mission

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LONG-TERM GOALS

The Advanced Research and Global Observation Satellite (ARGOS) mission, launched in February 1999, is carrying out several remote sensing experiments to measure and monitor neutral atmospheric and ionospheric species on a continual basis. Proper inversion techniques need to be developed to extract the altitudinal, latitudinal, and temporal variations of these species.

OBJECTIVES

The International Solar-Terrestrial Program's Solar and Heliospheric Observatory (SOHO), launched in December 1995, is providing continuous observation of the Sun. At the same time, NASA's Magnetopause-to-Aurora Global Exploration Satellite (IMAGE), launched in March 2000, is providing continuous monitoring of the magnetosphere and interplanetary magnetic field. Simultaneous studies from the results of SOHO, IMAGE, and ARGOS will help uncover some of the mechanisms by which transient effects on the Sun affect the Earth's atmosphere through complex interactions in the magnetosphere and the ionosphere.

APPROACH

The solar-terrestrial data for this study are obtained from the NASA-GSFC's Space and Astronomy Data Archive available on the Internet at: *fttp://nssdc.gsfc.nasa.gov*. Data from the ARGOS mission experiments will be used when available.

WORK COMPLETED

We have studied the generation of geomagnetic storms by solar wind disturbances. Geomagnetic storms are usually caused by two main sources in the solar wind: Coronal Mass Ejections (CMEs) and Corotating Interaction Regions (CIRs) [Tsurutani, et al., 1994; Gosling, 1997; McAlister and Crooker, 1997; Kamide et al., 1998]. There are various types of CMEs, some of which are associated with the transport of strong magnetic field from the solar corona and are called magnetic clouds [e.g., Farrugia, et al., 1997]. CMEs propagating with speed higher than that of the ambient solar wind compress the ambient plasma and Interplanetary Magnetic Field (IMF) ahead of their fronts. Increasing the magnetic field can be the cause for the generation of geomagnetic storms and geomagnetic storms often begin before the CMEs actually encounter the magnetosphere [Gosling, 1997].

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14. ABSTRACT

The Advanced Research and Global Observation Satellite (ARGOS) mission, launched in February 1999, is carrying out several remote sensing experiments to measure and monitor neutral atmospheric and ionospheric species on a continual basis. Proper inversion techniques need to be developed to extract the altitudinal, latitudinal, and temporal variations of these species.

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CIRs are formed by the interaction of long-living high-speed streams with lower-speed ambient solar wind [Tsurutani, et al., 1994; McAlister and Crooker, 1997]. Similar to CMEs, high-speed streams compress and heat the plasma in the interaction region between them and the ambient solar wind. CIRs are characterized by strong enhancements in plasma density, temperature and magnetic field.

Thus, high-speed streams related to CMEs and CIRs compress the ambient plasma and magnetic field ahead and in their leading portions. However, for geomagnetic storm generation, a strong southward component of the magnetic field in required [Gonzalez, et al., 1994; Kamide, et al., 1998]. Negative IMF B_z leads to a strong increase in the efficiency of the solar wind-magnetosphere interaction that results in increased probability for geomagnetic storm generation. Thus, only CMEs and CIRs associated with large negative B_z can lead to geomagnetic storm generation [Gosling, 1997; McAllister and Crooker, 1997; Crooker, et al., 2000].

RESULTS

We have used the superposed epoch method to reconstruct the typical behavior of solar wind parameters before and during strong isolated geomagnetic storms. Hourly solar wind data and geomagnetic activity Dst indices were obtained via the Internet: http://nssdc.gsfc.nasa.gov/pub/spacecraft_data/omni/. For this analysis, we have used 130 such geomagnetic storms during the period of 1966-2000. The results obtained show that a typical disturbance in the solar wind responsible for geomagnetic storm generation is associated with the propagation of high-speed plasma flow compressing ambient solar wind plasma and IMF ahead of the high-speed flow. This gives rise to enhanced magnetic field, plasma density, plasma turbulence, and temperature, which start to increase several hours before the onset of the geomagnetic storm. However, the IMF B_z (responsible for the geomagnetic storm onset) begins to increase significantly later (approximately 6-7 hours after the maximal variations in plasma density and IMF B_y). The time delay between the peaks in IMF B_z and (plasma density and IMF B_y) may be a result of the draping of high-speed plasma streams with ambient magnetic field in the z-y plane.

IMPACT/APPLICATIONS

This model will allow us to predict the generation of geomagnetic storms from observing the interplanetary magnetic field. The probability of the generation of geomagnetic storm is maximal when the high-speed plasma flow encounters the magnetosphere by its north-western edge for negative IMF B_y and south-western edge for positive IMF B_y.

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PUBLICATIONS

W. Lyatsky, G. V. Khazanov and A. Tan, Solar wind disturbances responsible for geomagnetic storms, submitted to *J. Geophys. Res.*, July 2001.