Study the Variation of Solar Wind Parameters during Highly Disturbed Month of Solar Cycle 23

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Abstract: **--**The Geomagnetic disturbances are a complex dynamics and this is happening by enhanced solar wind magnetospheric energy coupling process. This study analyzed the relative study between the peak intensity of the geomagnetic storm and the peak value of various plasma parameters Solar Wind Temperature, Solar Wind Speed and Proton Density. We have performed this study using daily values of the geomagnetic storm time (Dst) <-50nT for the period of Nov. 2001 (01-11- 2001 to 30-11-2001) because this is the most disturbed month of Solar cycle 23. It is reported that there exists a linear relationship between Dst with Solar plasma parameters like Solar Wind Temperature, Solar Wind Speed and Proton Density. The present result implies that neither density nor temperature is significantly related to the variation of geomagnetic disturbance; rather the effects of the pressure and speed. However, a low plasma condition during highly geo-effective event seems to be an important criterion.

Keywords: **--Plasma parameters, geomagnetic storms, interplanetary magnetic field.**

Introduction

Many Energized charged particles like electrons and protons flowing outward from the Sun, through the solar system at speed of about 400 km/s and at a temperature of 1 million degrees (Celsius), which is made of plasma, is called solar wind (E.N. Parker, 1958). Because of these solar wind interaction Some of this energy finds its way into our magnetosphere creating turmoil in geomagnetic activity resulting into geomagnetic storms, sub storms as well as aurora (K.A. Firoz, 2008). After entering inside the Earth's magnetosphere, when the magnetic field of solar wind interacts with Earth's magnetic field, the temporary disturbance emerge due to solar wind (J.W. Dungey 1961).

This increased energy in Earth`s magnetosphere ultimately increase the plasma level in magnetosphere and also increase the movement of electric current in magnetosphere and ionosphere (Dungey, 1961; Gonzalez et al., 1994). Geomagnetic activity also creates some directly and indirectly effect and among those some are health problems, satellite malfunction, weather changes etc. These all solar fluctuations are termed as solar variation and these collective effects of solar variations within Sun's gravitational field are termed as space weather. Negative Dst values indicate that a magnetic storm is in progress, and the more the negative Dst the more the intensity of the magnetic storm is. These negative deflections in the Dst are caused by the ring current intensification, which flows around the Earth from east to west in the equatorial plane.

Now these days the purpose of Space Weather research is to quantitatively predict the dynamics of the magnetosphere and ionosphere from measured solar wind interplanetary magnetic field conditions. In order to quantify the variability in Solar wind plasma parameters various research groups have reported such observations (Peng et.al., 1994; Ossadnik et.al., 1994; Taqqu et.al., 1995; Malamud and Turcotte et.al., 1999; Bunde et.al., 2000; Kantelhardt et.al., 2001; Hu et.al., 2001; Chen et.al., 2002; Gao et.al., 2007).

Data Set and Methodology

We collected our daily Dst indices data and Solar Wind Temperature, Solar Wind Speed and Proton Density to study the Variation of Solar Wind Parameters During Intense Geomagnetic Storms provided by the OMNI (Operating Mission as Nodes on the Internet web system) which is an International space related research centers and providing data through http://omniweb.gsfc.nasa.gov. The OMNI system has been conducting its research using many ground and space based GPS and satellite stations since long ago.

We had selected this time period i.e. Month Nov. 2001 (01-11- 2001 to 30-11-2001) for our study because this is the most disturbed Month for the complete 23 Solar cycle.

Results and Discussion

In the present work, Solar Wind Plasma Parameters has been analyzed. Analytical results of these parameters as follows:

- **Dst Index (nT)**

The geomagnetic conditions during the time period (Nov. 2001) are shown in Fig.1. As illustrated in figure, there was some presence of heavy geomagnetic activities during the most disturbed month of Solar cycle 23. On 06-11-2001 and 24-11-2001 the Dst observations reports heavy geomagnetic activities.

- **Solar Wind Temperature (˚K)**

Fig.2 demonstrates the Solar wind temperature profile for same highly disturbed month of Solar cycle 23. An elevated temperature value of Solar wind has been recorded on 24-11-2001 as shown in figure.

- **Proton Density (N/cm^3)**

Similar disturbances have also been observed in the proton density of Solar wind plasma during the Nov. 2001. As illustrated in Fig.3, 06-11-2001, 15-11-2001 and 24-11-2001 are the most disturbed days for proton density.

- **Solar Wind Speed (km/s)**

The Solar wind speed profile during the time period (Nov. 2001) is shown in Fig.4. As illustrated in figure, there were two peaks recorded on 06-11-2001 and 24-11-2001 during the most disturbed month of solar cycle 23.

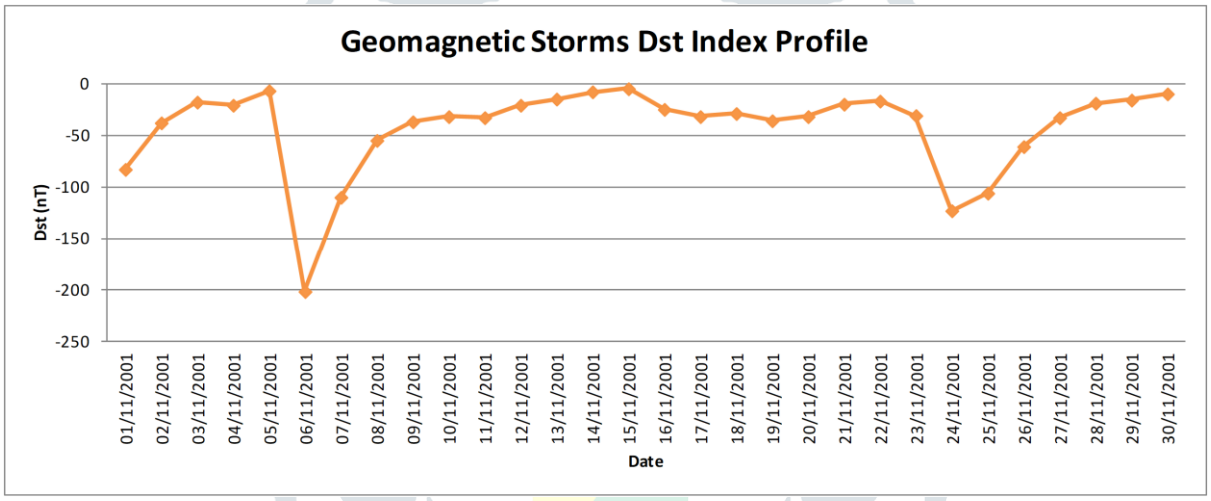

Fig. 1 – Dst Index Value Plot for Highly Disturbed Month of Solar cycle 23 (Nov. 2001).

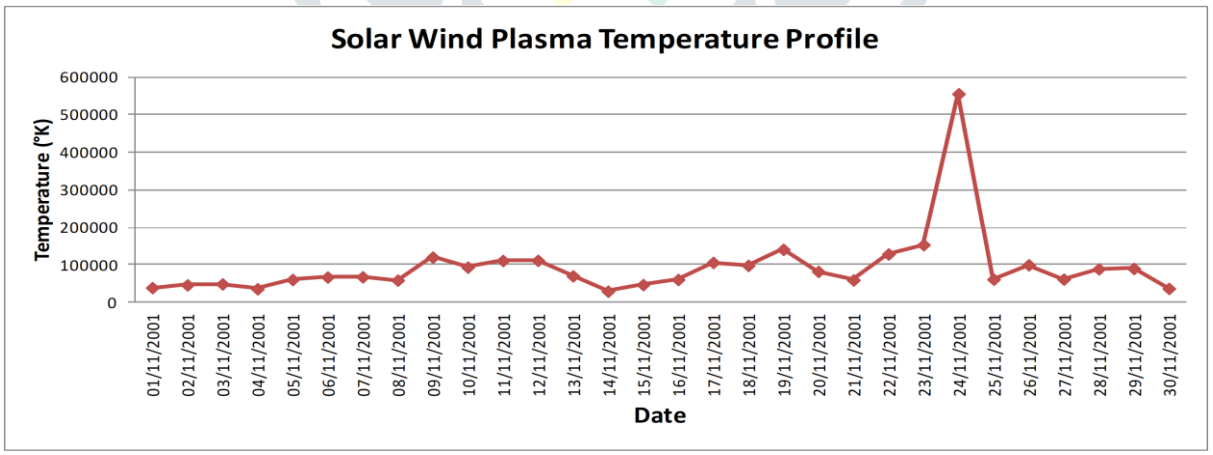

Fig. 2 – Solar Wind Temperature for Highly Disturbed Month of Solar cycle 23 (Nov. 2001).

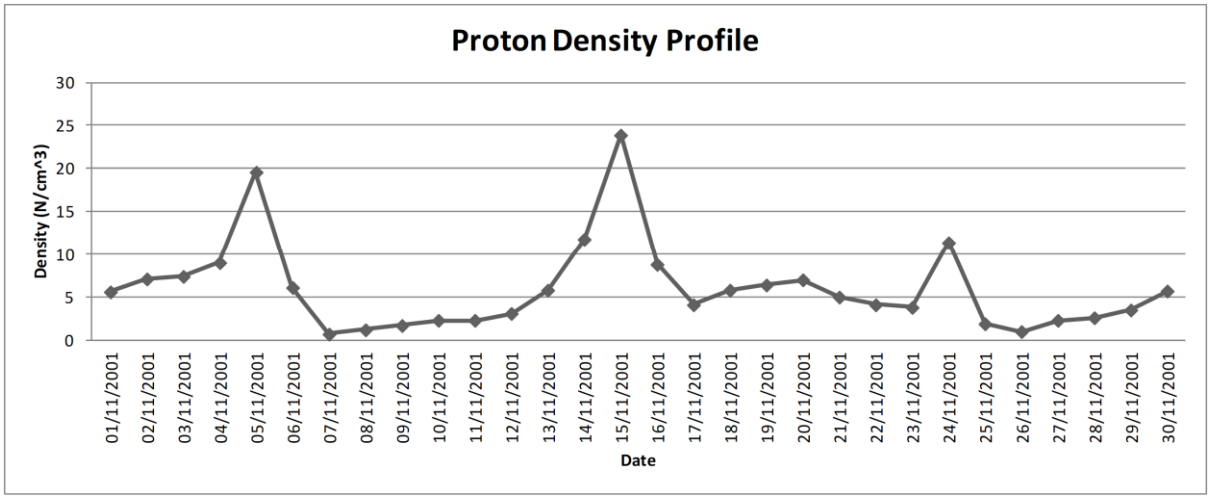

Fig. 3 – Proton Density Profile for Highly Disturbed Month of Solar cycle 23 (Nov. 2001).

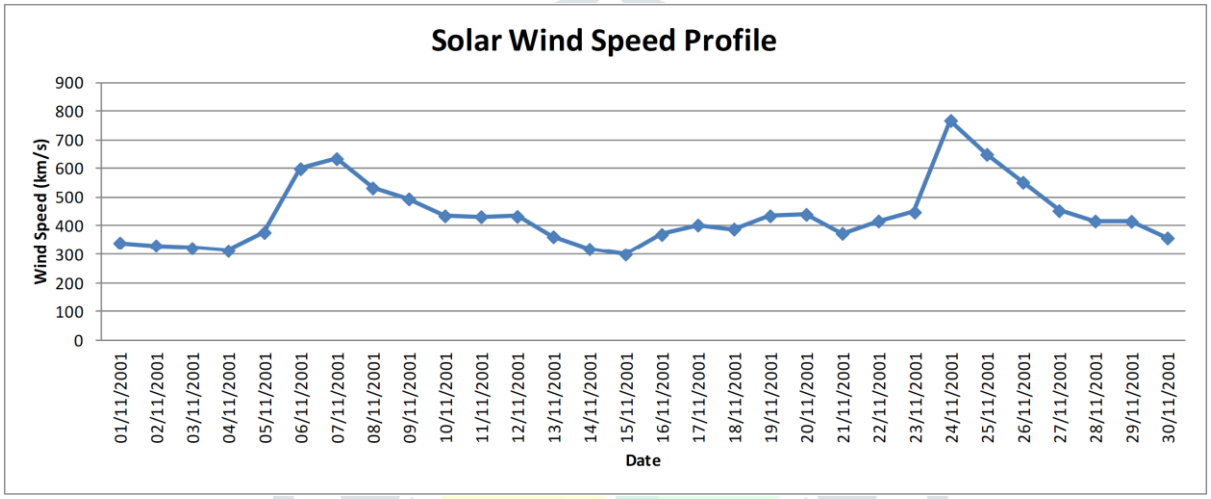

Fig. 4 – Solar Wind Speed for Highly Disturbed Month of Solar cycle 23 (Nov. 2001).

Conclusions

The study of geomagnetic storm is an important issue for the study of space weather. The Dst< -50nT component is an important parameter which indicates the presence of geomagnetic storm. In this research work the variation of different parameters during geomagnetic storms was studied. For this purpose, we select the three different parameters to study their variation due to geomagnetic storm and found that these parameters which show very intense effect and suggested that the interplanetary magnetic field has strong impact for the cause of geomagnetic disturbances and varies parameters. The wind speed is an important factor for the perturbations of geomagnetic storms. The effects of flow pressure and velocity are very effective in the large-scale diffusion of magnetic perturbations with Dst< -50nT. It is observed that the proton density and proton temperature is not a geo effective parameter but charged particles that enter the atmosphere of the Earth during a storm and produced substorms.

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