ASOCIATION BEETWEEN GEOMAGNETIC STORM AND SOLAR WIND

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ABSTRACT-

In the present study we have investigated the variation of the interplanetary parameters such as solar wind speed, IMF, SSN with Dst (≤ -50 nT) during the time interval 2008-2016. In our study Disturbance storm time (Dst) index is taken as a measure of Geomagnetic Storm (GS).

The interaction of solar wind generates a ring current which is made up of opposite charges that of earth's magnetosphere. This weakened the earth's magnetic field and a large disturbance is marked for these years. In the initial stage of solar cycle i.e. for 2010 large amount of charge particles emerges from sun which causes a strong disturbance in earth's magnetosphere while for 2011 it is very weak (Shown in DST/SW correlation graph). These results show that the geomagnetic variations at different latitudes of the terrestrial system are very well correlated, in particular during fast solar wind speed. This may suggest that the geomagnetic activity observed during the faster solar wind conditions can be more directly related to plasma processes inside the magnetosphere than to the interplanetary parameters. These results suggest that the processes responsible for the energy transfer between the interplanetary medium and the magnetosphere saturate and the influence of internal magnetospheric plasma physics on the geomagnetic activity may be larger for highly correlated years. The space weather is greatly affected by solar winds and IMF features.

Dst index and solar wind are in same phase for year 2010 and 2012. Dst index and SSN are in same phase for year 2010. Dst index and IMF features are in same phase for year 2011, 2012, 2013, 2014 and 2016.

Keywords: GS - Geomagnetic storm, Dst - Disturbance storm-time, CME - Coronal mass ejection, ICME - Interplanetary coronal mass ejection.

INTRODUCTION-

The Dst index is a measure in the context of space weather. It gives information about strength of ring current around earth caused by solar protons and electrons. The ring current around earth produces magnetic field that is directly opposite Earth's magnetic field i.e. if the difference between solar electron and protons gets higher then Earth's magnetic field becomes weaker. During a geomagnetic storm, the number of particles in the ring current increases which causes a decrease in geomagnetic field. The solar wind is highly correlated to Dst in mid of solar cycle-23 which represents the maximum solar activity years (Mathpal et al., 2016). The GS changes dynamic pressure of the solar wind and the orientation of the IMF is responsible to change the dynamic structure of earth's magnetosphere. Fast CMEs are known to produce preceding shocks and compressed solar wind and IMF, and these elements are generally associated with the onset of geomagnetic storms (Tsurutani et al., 1990a; Gonzalez et al., 1994).The Association of Halo Coronal Mass Ejections and Geomagnetic Storms during 2000-2005 studied (Prasad et al., 2013a).

The relation varies during solar cycle where the GS occurs within 5 days after the onset of coronal mass ejection and variation in geomagnetic disturbance generally follows the phase of the solar cycle (Prasad et al., 2013b). The Interplanetary magnetic field Bz component is generated as a result of solar wind turbulence and wave generation (Velli and Birn 1999).

Inter planetary Coronal Mass Ejection (ICME) when arrive near the earth it contains solar wind plasma ahead of high speed solar wind, this compressed solar wind plasma exerts a dynamic pressure on Earth's magnetosphere (Prasad et al.2013). The strong coupling of solar wind and earth's magnetosphere causes various changes in magnetosphere during GSs. The time of higher solar activity there is an increase in Ultra violet radiation and auroral energy input, as a result to heat up earth's atmosphere causing it to expand magnetosphere. The GS changes dynamic pressure of the solar wind and the orientation of the IMF is responsible to change the dynamic structure of earth's magnetosphere. The Association of Halo Coronal Mass Ejections and Geomagnetic Storms during 2000-2005 studied (Prasad et al., 2013a).

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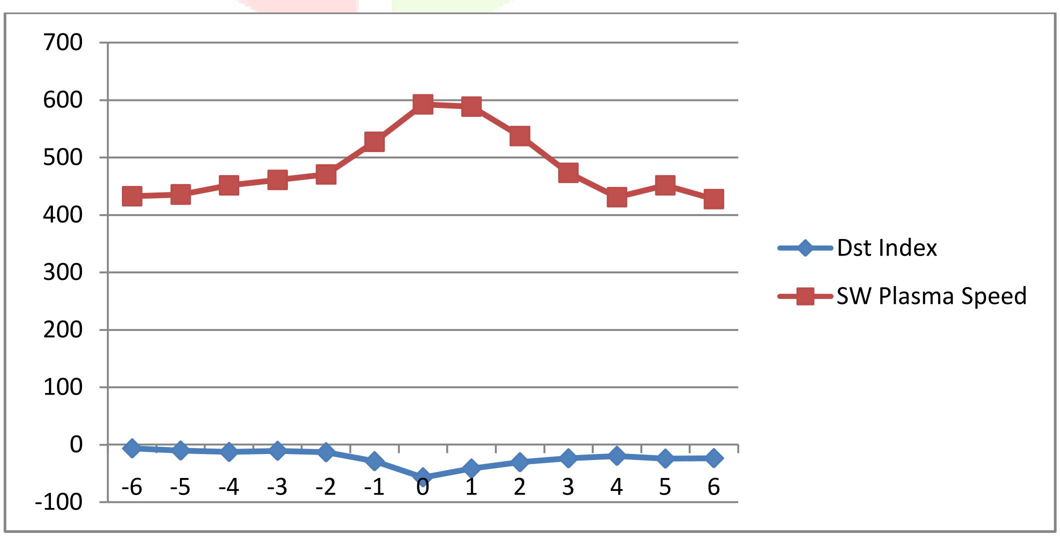
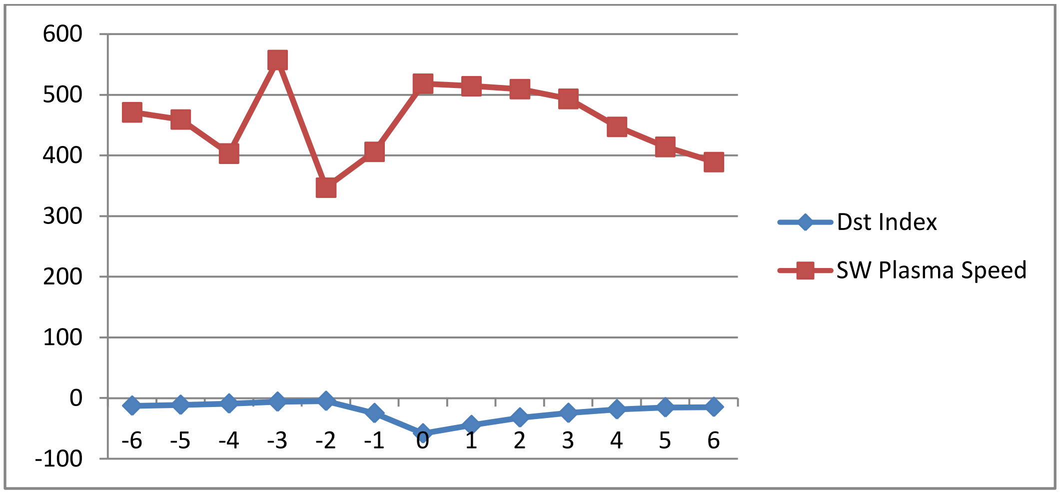
Inter planetary Coronal Mass Ejection (ICME) when arrive near the earth it contains solar wind plasma ahead of high speed solar wind, this compressed solar wind plasma exerts a dynamic pressure on Earth's magnetosphere (Prasad et al.2013). Many investigators have studied the association of geomagnetic activity to magnetic clouds and other IMF features (Farrugia, Burlaga, and Lepping, 1997; Tsurutani and Gonzalez, 1997).

DATA COLLECTION AND ANALYSIS-

The present study investigates by means of superposed epoch analysis the Dst index of GS and solar wind speed on a time scale of 13 days (days: 6 days before and 6 days after the occurrence of GSs) -



YEAR: 2010



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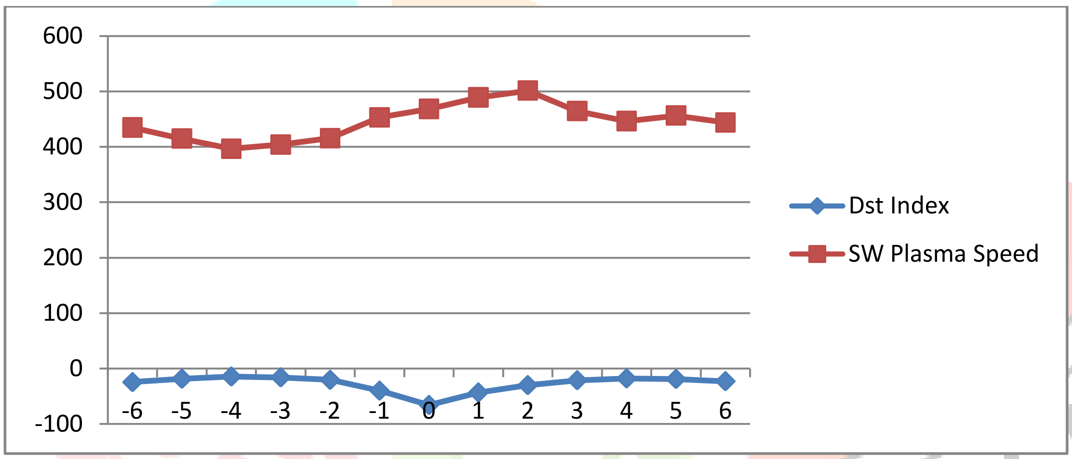

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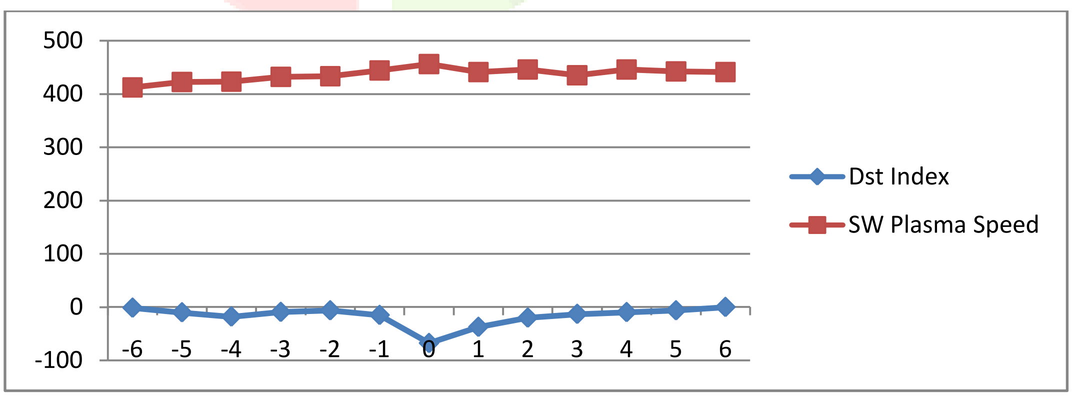

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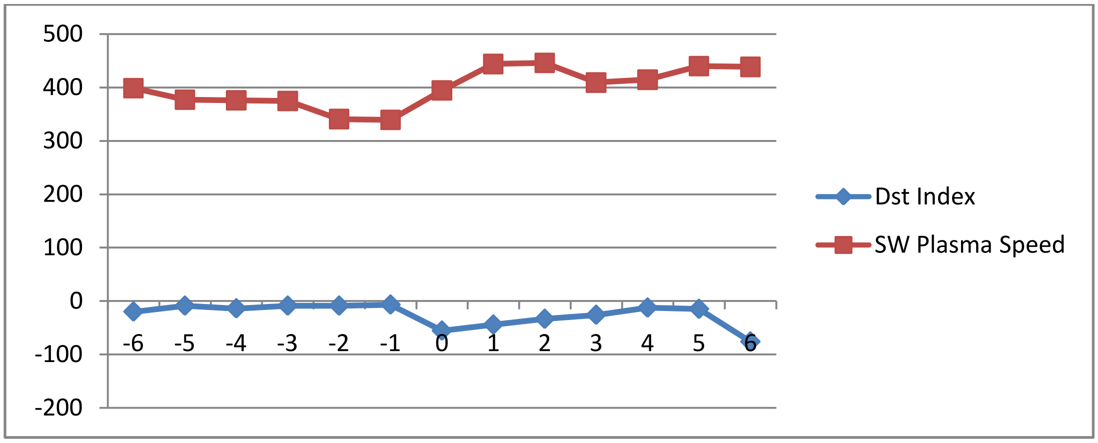

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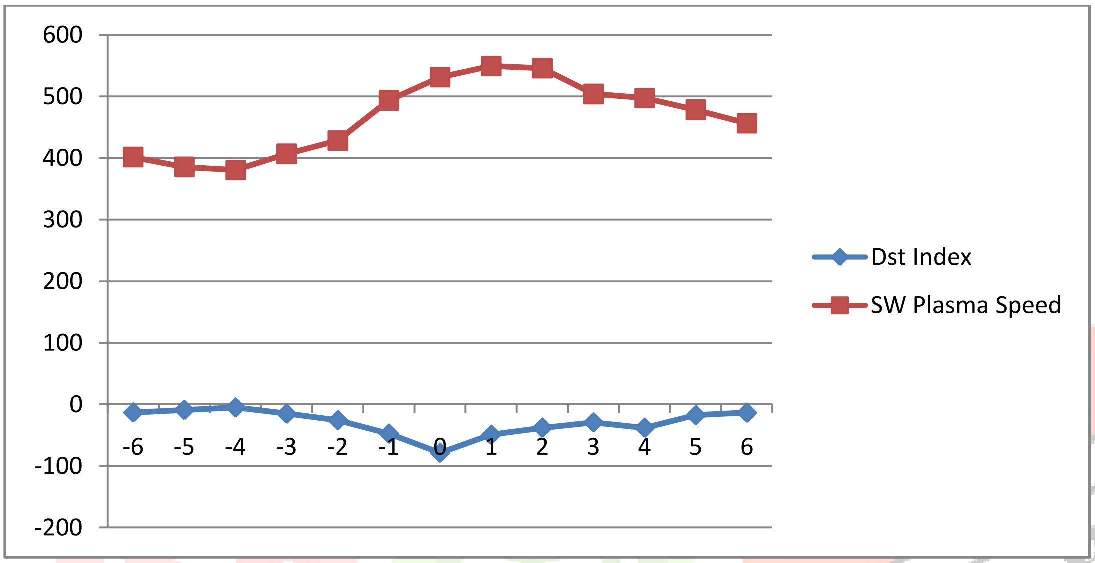

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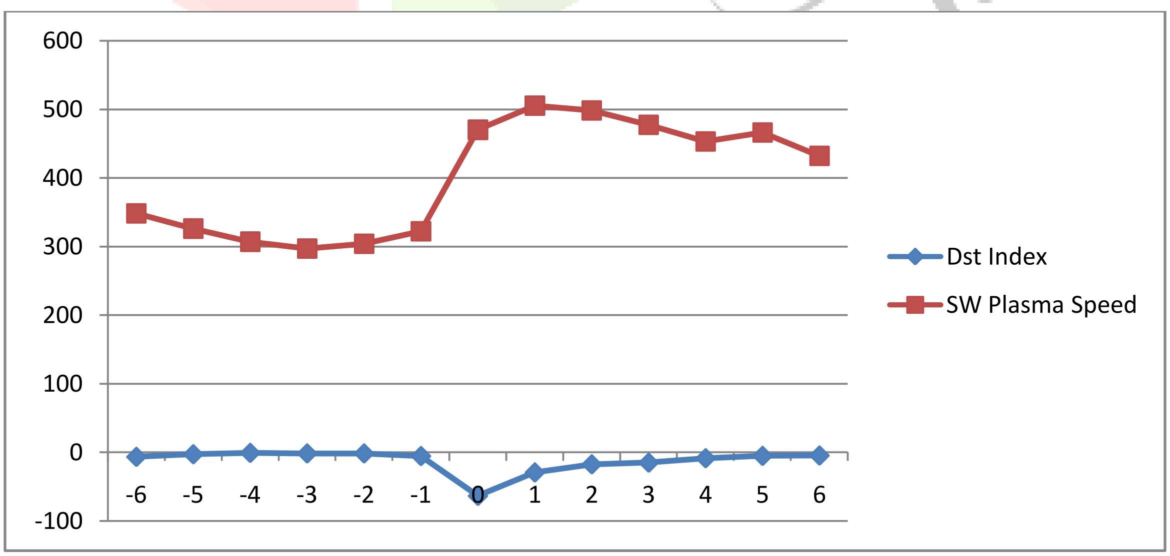
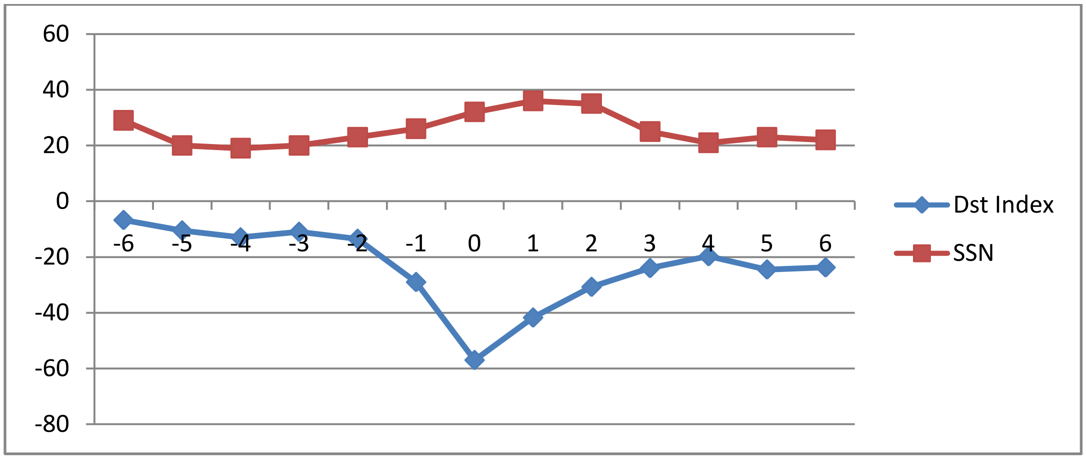
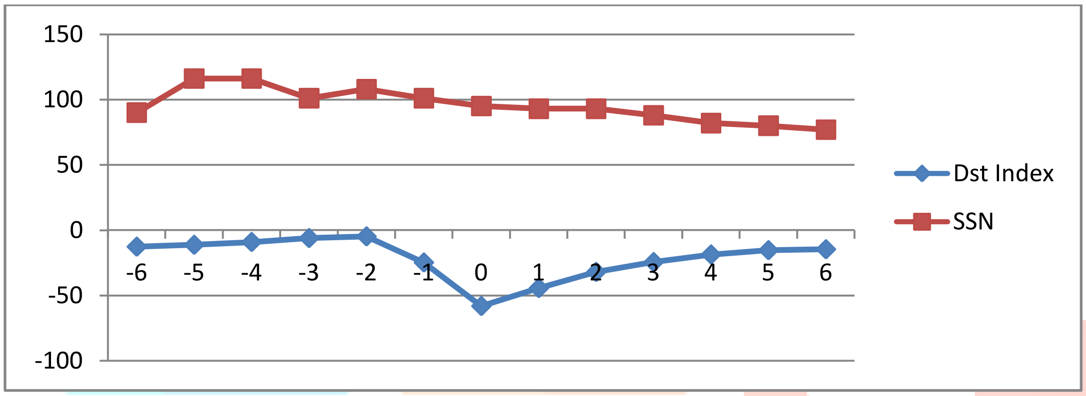


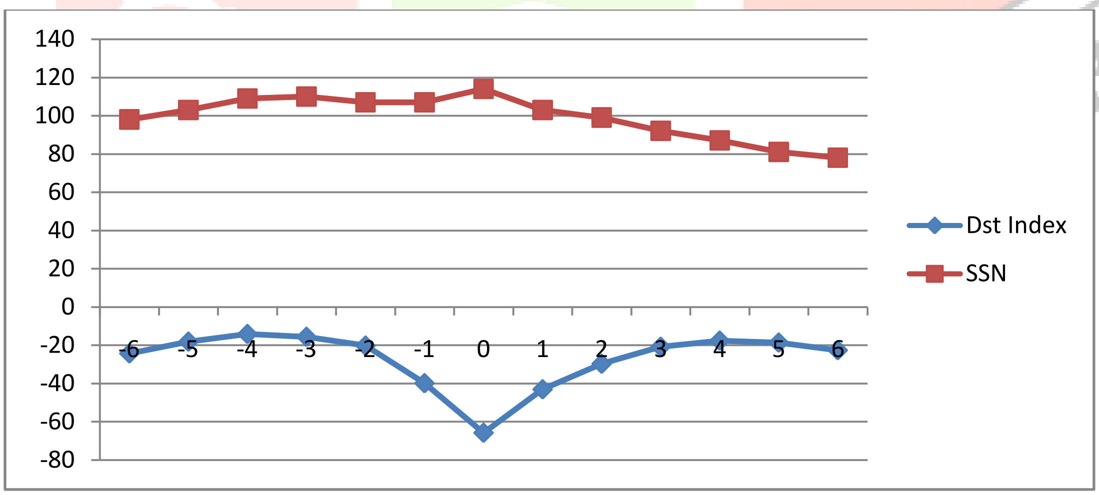
YEAR: 2016



YEAR: 2010



YEAR: 2011



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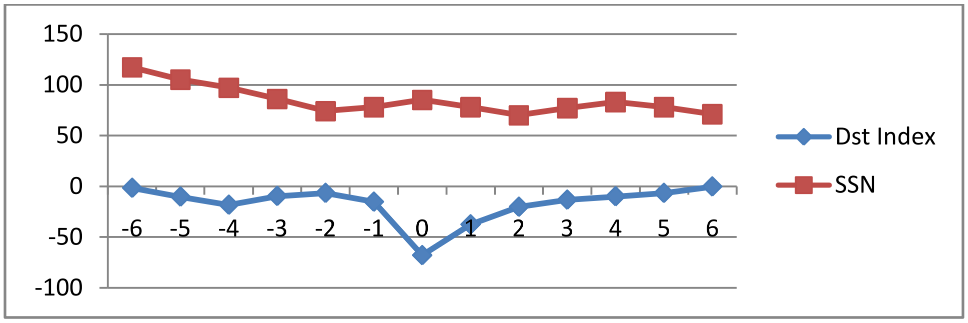

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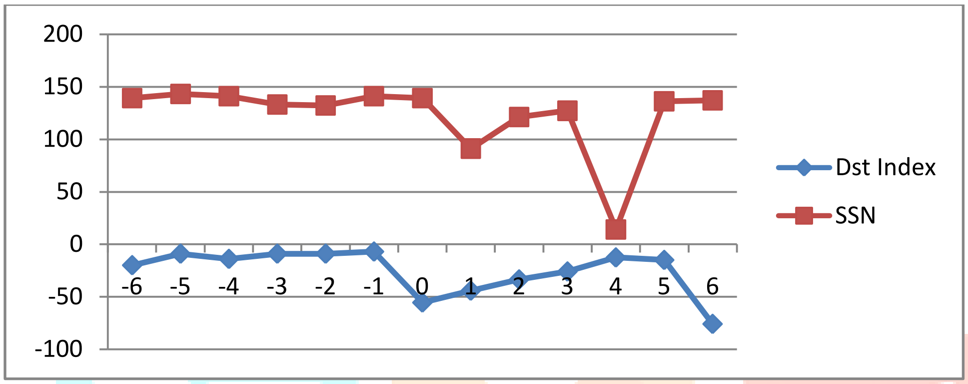

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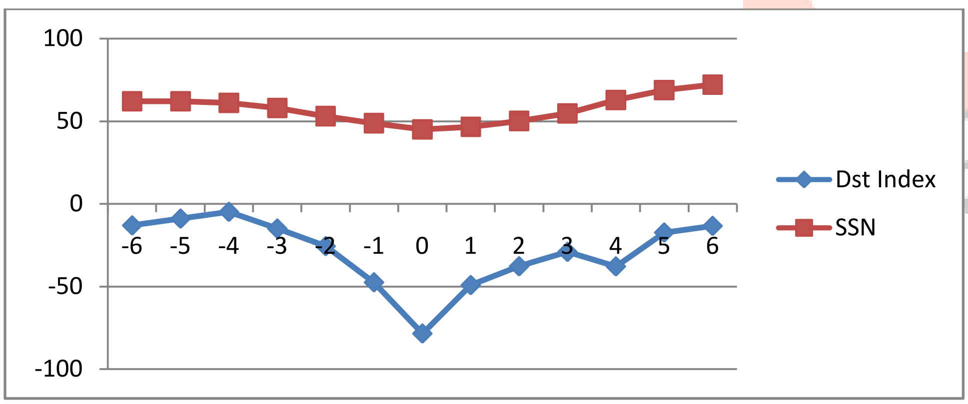

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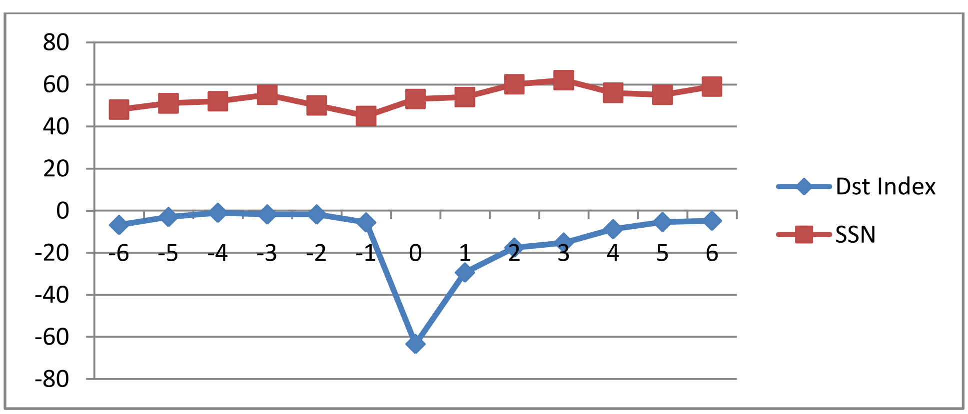

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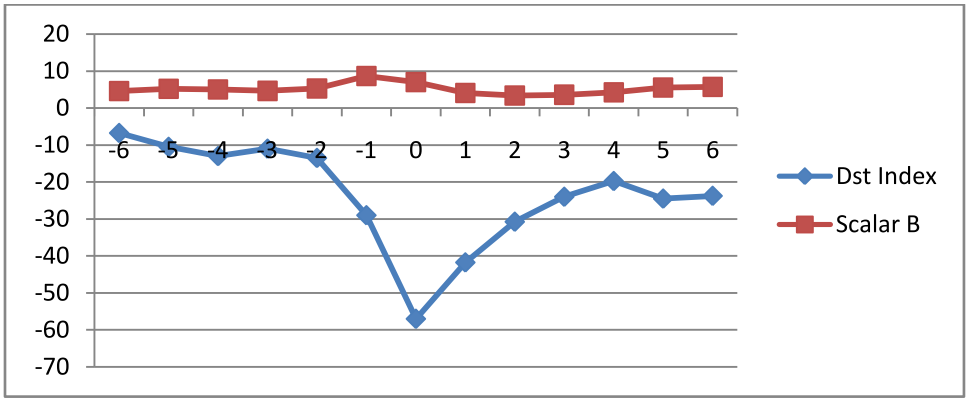

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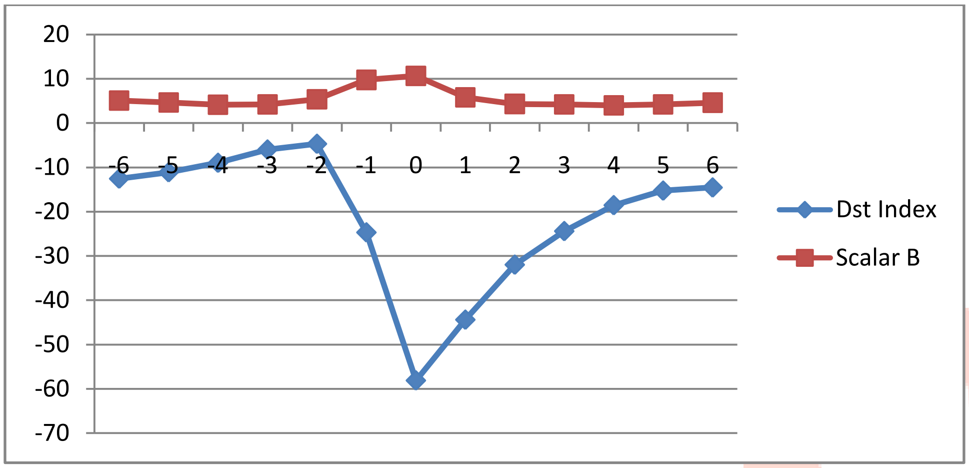
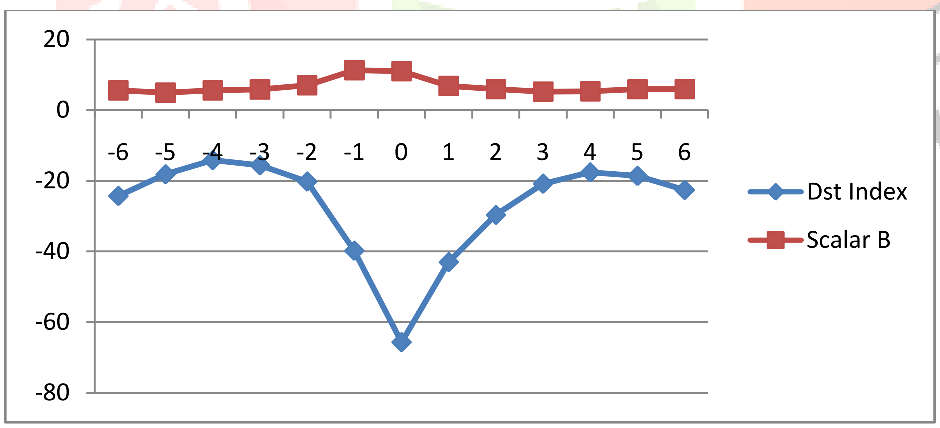
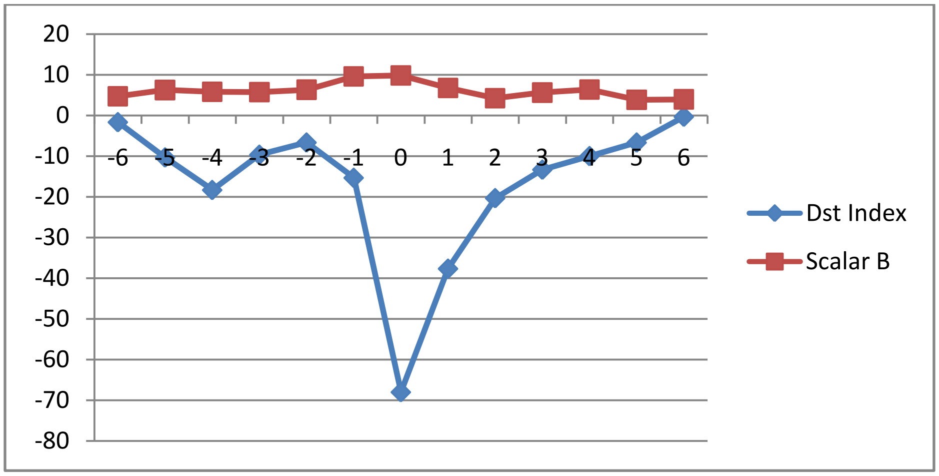


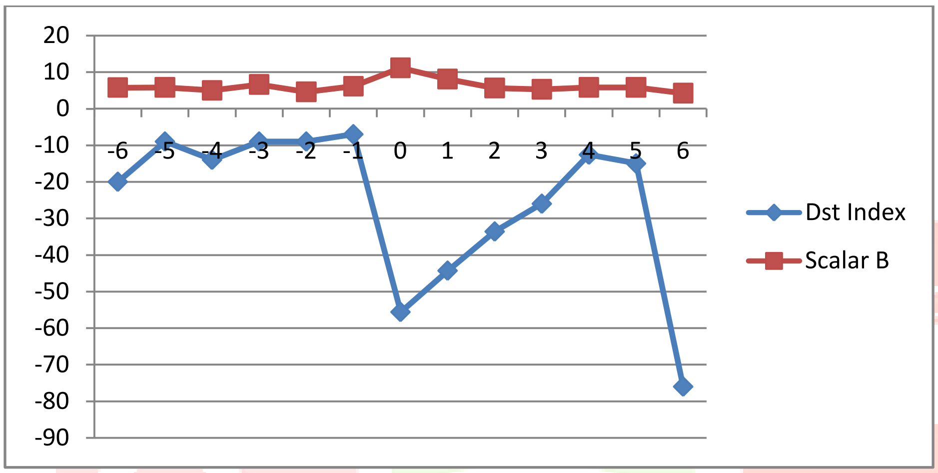
YEAR: 2011



YEAR: 2012



YEAR: 2013



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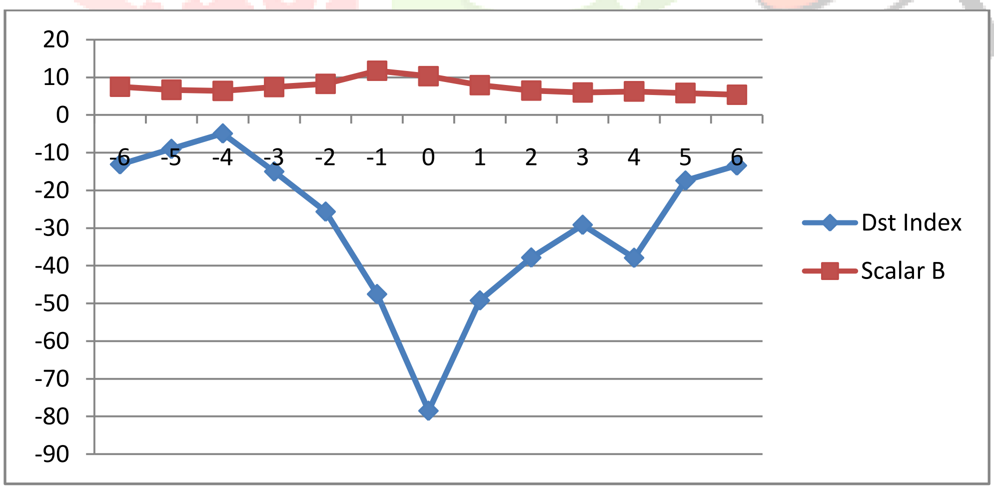

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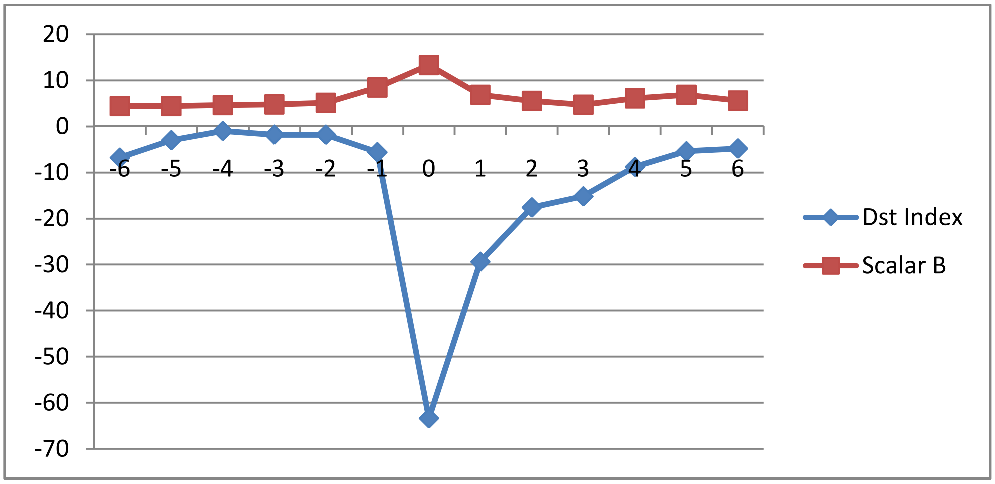
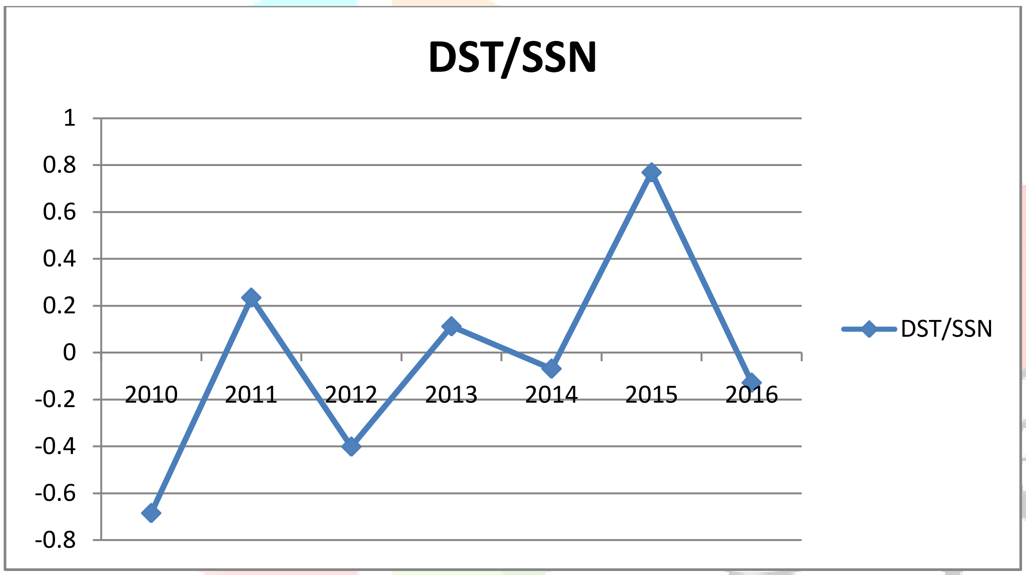
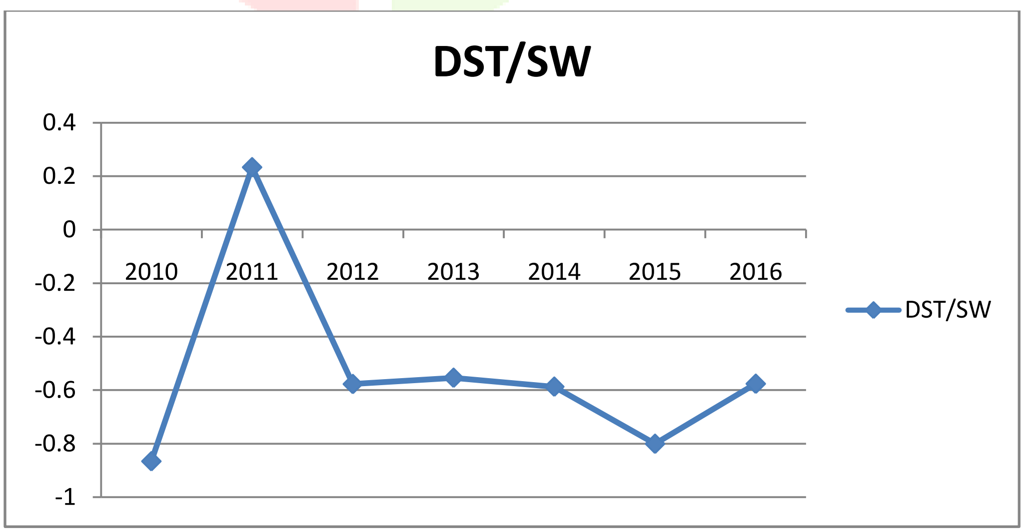
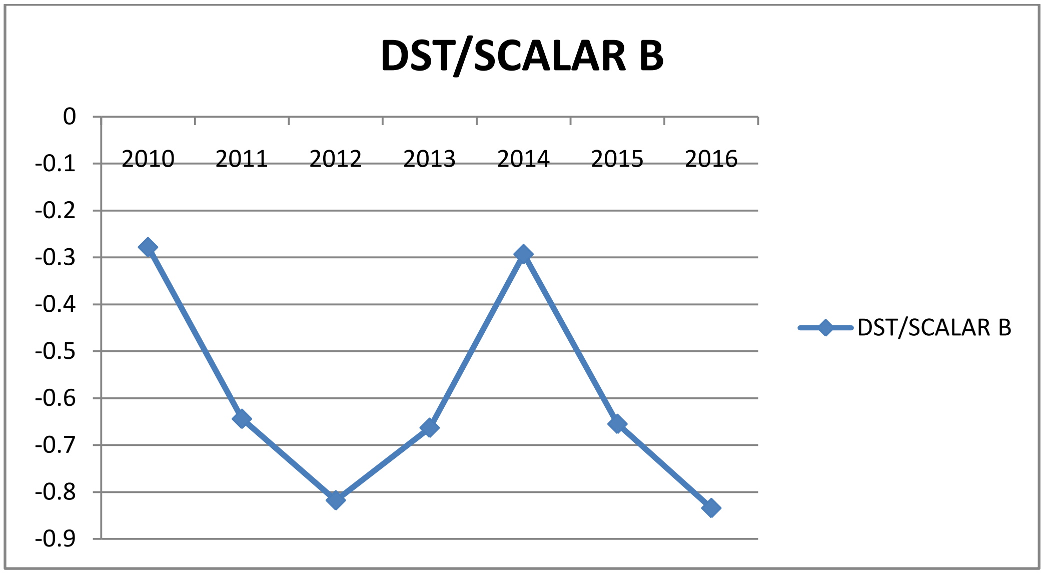


YEAR: 2016

CORRELATION GRAPHS –







S. No.	Parameters	Correlation coefficient
1	Dst index and SSN	-0.2461
2	Dst index and SW	-0.53228
3	Dst index and SCALAR B	-0.59812

RESULTS AND DISCUSSION-

Solar wind and IMF features are highly anti correlated with dst index for the solar cycle 24 which indicates highly solar active cycle. The anti correlation of dst and solar wind plasma indicates that the fast moving solar winds reaches Earth’s magnetosphere with high kinetic energy. The interaction of solar wind generates a ring current which is made up of opposite charges that of earth’s magnetosphere. This weakened the earth’s magnetic field and a large disturbance is marked for these years. In the initial stage of solar cycle i.e. for 2010 large amount of charge particles emerges from sun which causes a strong disturbance in earth’s magnetosphere while for 2011 it is very weak (Shown in DST/SW correlation graph). These results show that the geomagnetic variations at different latitudes of the terrestrial system are very well correlated, in particular during fast solar wind speed. This may suggest that the geomagnetic activity observed during the faster solar wind conditions can be more directly related to plasma processes inside the magnetosphere than to the interplanetary parameters. These results suggest that the processes responsible for the energy transfer between the interplanetary medium and the magnetosphere saturate and the influence of internal magnetospheric plasma physics on the geomagnetic activity may be larger for highly correlated years. The space weather is greatly affected by solar winds and IMF features. Dst index and solar wind are in same phase for year 2010 and 2012. Dst index and SSN are in same phase for year 2010. Dst index and IMF features are in same phase for year 2011, 2012, 2013, 2014 and 2016. The correlation coefficient between the Dst index and SSN is found to be very low. This shows that the SSN is not correlated to Dst index in solar cycle 24.Therefore we may conclude that the,variation in SSN during solar cycle 24 does not affect GS i.e. SSN is not an effective parameter to study GS. Thus space weather is not affected by SSN.

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