Impact of Solar wind parameters on Geomagnetic Parameter at 1 AU

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NASA/SDO/AIA Image

The disturbance in earth magnetic field is known as space weather.

The disturbances in the geomagnetic field are caused by fluctuation in the solar wind impinging on the earth.

Data Source:) ***www.omniweb.gsfc.nasa.gov***

Space Weather : Dst < -50nT

Table 4.3: A list of Geomagnetic Storms Dst ≤ -50 nT at instant of Dst minimum, G2

S. N.	Date	Dst (nT)	Bt	By	Bz	Temperature	Density	Speed	Pressure	E-field	Plasma beta	A_E
1	13/01/1996	-90	--	--	--	--	--	--	--	--	--	544
2	23/10/1996	-105	8.2	-1.3	-0.8	347438	5.8	634	4.66	0.19	1.71	760
3	10/01/1997	-78	14.9	-5.5	-12.9	20328	4.7	445	1.64	5.65	0.13	663
4	10/02/1997	-68	9	1.3	-7.6	19976	0.4	479	0.17	3.33	0.03	977
5	11/04/1997	-82	7.9	-3.1	-5.8	108076	15.6	437	5.49	2.84	2.46	808
6	21/04/1997	-107	12.7	-7.8	0	40111	8.4	389	2.34	1.56	0.37	731
7	15/05/1997	-115	24.4	11.2	-21.3	16239	4.8	447	2.12	9.16	0.05	813
8	27/05/1997	-73	9.7	-4.9	-8.2	12876	11.4	328	2.1	2.95	0.71	921
9	09/06/1997	-84	11.1	-5.5	-8.7	18965	13	374	3.16	2.73	1.46	616
10	03/09/1997	-98	14	-6.8	-0.6	250517	9.3	487	4.8	3.52	0.65	765
11	01/10/1997	-98	11	6.5	-7.4	104910	6.7	466	2.59	-0.39	0.75	672
12	11/10/1997	-130	12.9	0.2	-9.1	15396	8.7	422	2.88	4.43	0.54	1258
13	07/11/1997	-110	13.9	13.2	0.8	220545	17.1	456	6.58	1.41	1.28	632
14	10/11/1997	-54	9.6	-2.2	-4.7	61698	13	382	3.6	1.6	1.12	414
15	22/11/1997	-75	25.8	17.3	9.4	267338	10.8	481	5	-2.21	0.21	662
16	23/11/1997	-108	13.2	-5.8	-8.6	11756	8.3	500	4.15	3.2	0.28	406
17	07/01/1998	-77	16	15.8	-1.3	27101	8.5	414	2.76	-0.41	0.21	746
18	18/02/1998	-100	16.2	-8	-12.8	90091	18.1	409	5.64	6.18	0.63	942
19	10/02/1998	-116	11.7	-6.8	-2.8	--	--	529	--	3.12	--	831
20	21/03/1998	-85	11.8	2.8	-7.4	198795	11.1	429	4.08	2.57	1.08	1182
21	26/04/1998	-63	8.3	-7	-0.6	194558	5.1	473	2.19	1.47	0.99	1103
22	02/05/1998	-85	12.9	3.5	-8.2	11828	5.3	596	4.67	3.87	0.19	973
23	03/05/1998	-69	9	-3.1	-3	9321	17.2	486	8.96	1.75	1.22	619
24	04/05/1998	-205	32.2	-24.1	-10.4	577140	17.2	803	22.18	13.17	0.49	1587
25	26/06/1998	-101	13.2	9.4	-7.2	45811	7	465	2.7	3.44	0.29	741
26	06/08/1998	-138	15.6	4.7	-14.2	51015	37.6	398	10.7	5.89	1.15	639
27	27/08/1998	-155	15.2	9.7	-9.7	46721	2.7	635	2.18	8.45	0.09	808

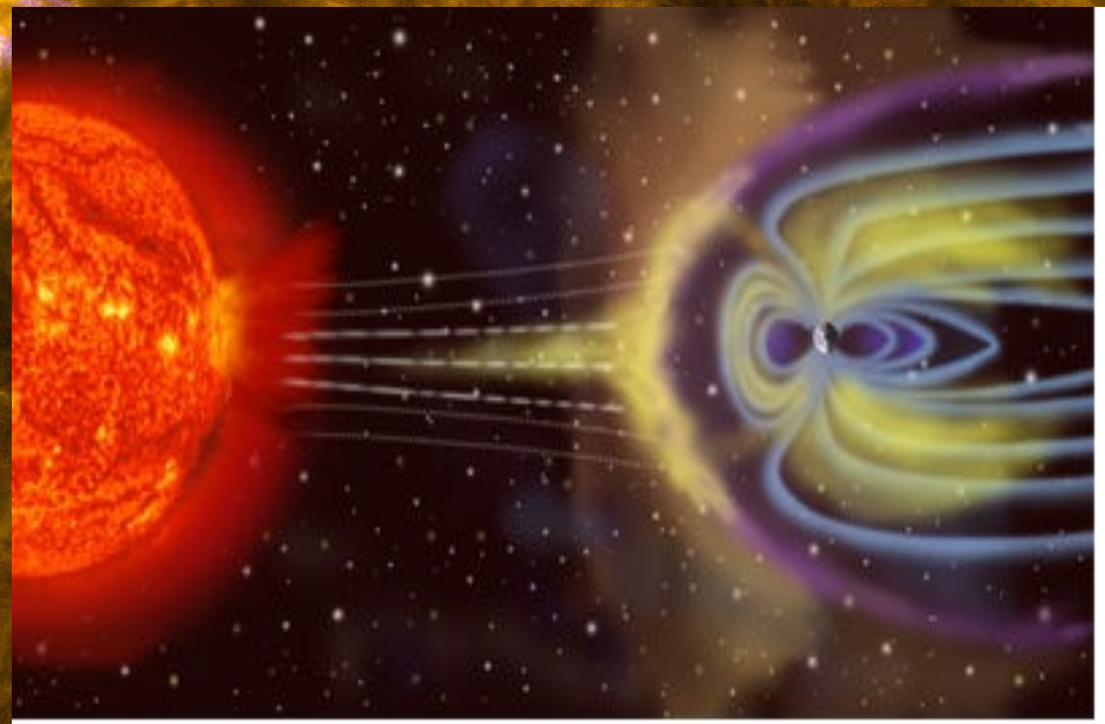


Figure – 3.1 : Solar particles interact with earth's magnetosphere.

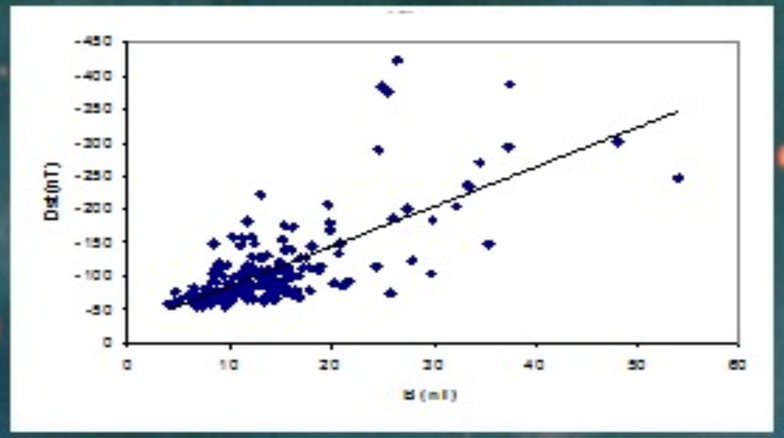
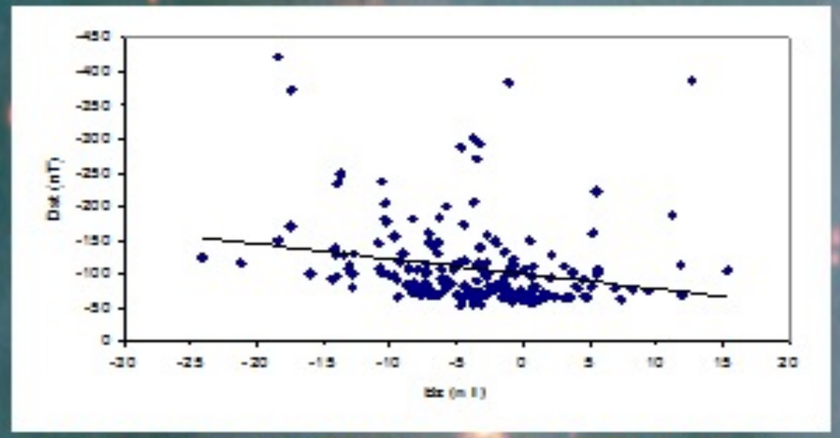


Fig.1. Dst peaks are often positively correlated with simultaneous solar wind plasma velocity (V_{sw}, kms) (Table 2). The figure 1 suggests that the correlation between Bt total and Dst is strong as -0.73, implying that the strength of the geomagnetic storm is strongly dependent on the total magnetic field of IMF.



to Fig.2. Shows correlation between Dst and southward component of IMF Bz. According previous studies the strength of the geomagnetic storm is strongly dependent on the southward component Bz. But in present study the correlation coefficient has been found to be low (0.24). This result may be obvious Solar wind Southward magnetic field component Bz has significant growth mainly during (or before) the initial phase of geomagnetic storm (not during the main phase, tested here). Thus, in this study period had something special which need to be understood, Bz is not essentially peak at the time of Dst peak value. This shows time delay between Bz and Dst peak.

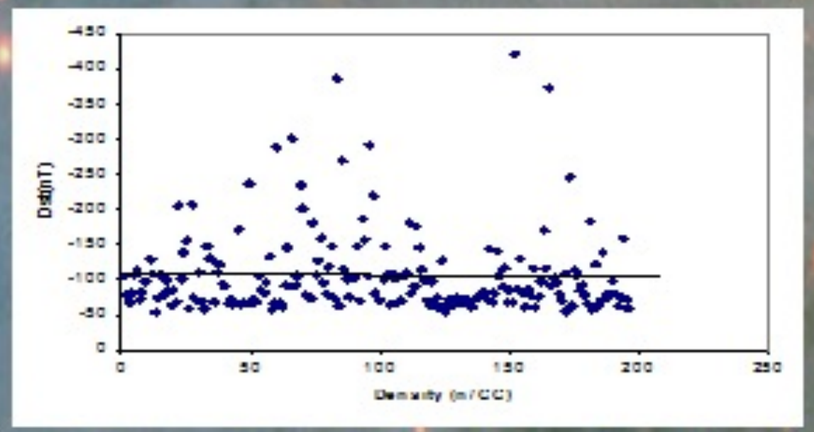


Fig.3. Correlation coefficients (r) between Dst peaks and simultaneous Density of Solar wind are shown at figure. Investigation shows that strong geomagnetic storms are not necessarily associated with high values of solar wind density. This means that there is a high probability that the intensity of a geomagnetic storm is not determined by the variation of plasma density. So, the weak correlation (-0.24) between Dst and Density is explained.

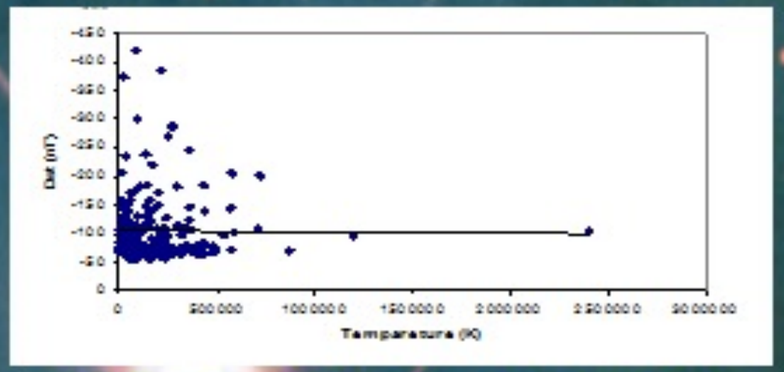


Fig. 4. shows the Temperature versus the maximum Dst at the time of Dst peak. For selected event the value of solar wind temperature has large range but most of event occurred when temperature values less than 200,000 K, which show in figure 5. But no correlation found between Plasma Temperature and Dst. It is clearly shows in scattered figure. Intense and Severe storms produced at the low Plasma Temperature.

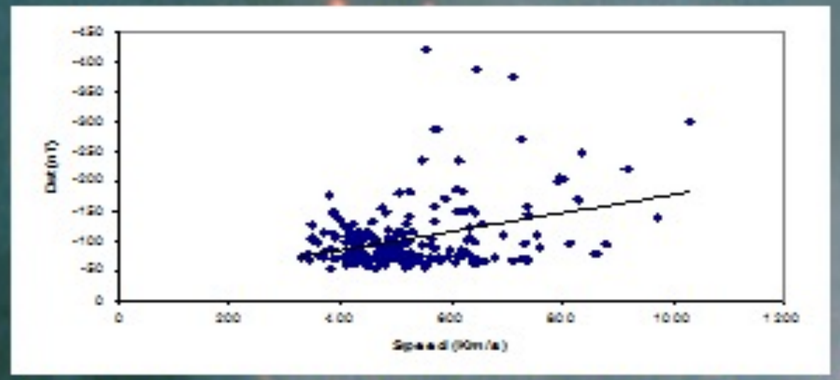


Fig.5. presents maximum values reached by the solar wind speed V versus negative Dst (max). The scatter is larger, with a wide range of velocities varying between 400 and 900 kms. The more intense geomagnetic storms (peak Dst < -250 nT) are not associated with greater values of solar wind velocities. The correlation coefficient between V and peak Dst has been found to be -0.39.

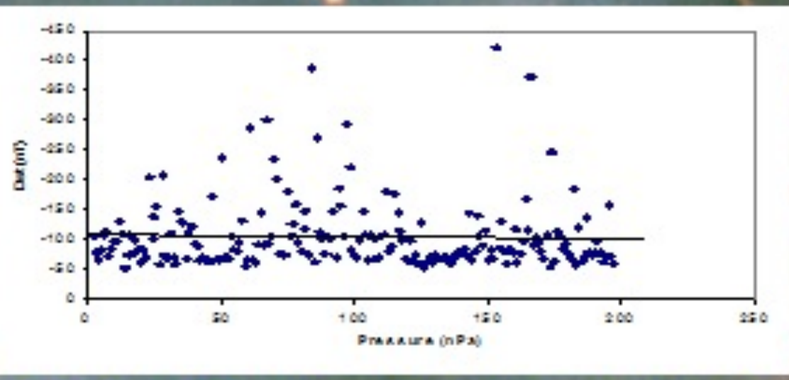


Fig.6. To ascertain the dependence of geomagnetic indices on the parameters of solar wind and interplanetary medium during solar cycle23 events several combination were tried. The most promising candidate is found in the form of solar wind pressure. Figure 6 shows this dependence on Dst. In figure 6 best fit line is shown which indicates that most of the observation of cycle23 indicates linear relationship of Dst and solar wind pressure (nPa).

Conclusion: **We observed that IMF B is highly geo-effective during the main phase of magnetic storms, while it more significant at the time of storm peak, which is further contributed by southward component of IMF Bz, substantiating earlier findings. The correlation between Dst and wind velocity is higher, as compared with IMF Bz.**