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Effect of Interplanetary Magnetic Field and Disturb Storm Time on H Component

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Abstract. A fluxgate digital magnetometer is used to study the variation of magnitude of H component during geomagnetic storm events of April, July and November 2004 at southern subauroral localized region at “MAITRI” (geom. lat. 62°S, long. 52.8°E). We also study the effect of vertical component of interplanetary magnetic field (IMF) on the variation of the magnitude of H component during storm time of April, July and November 2004. Results show that before sudden storm commencement (SSC) time magnitude of H component and IMF show smooth variation but after SSC of first storm of 22 July 2004, the magnitude of the H component shows fluctuations and at 09:00 UT it increases, but during second storm of 24 July 2004, the magnitude of H component indicates large fluctuations and it increases rapidly at 04:00 UT.

Key words. Sudden Storm Commencement (SSC)—magnitude of the H component deviation—Interplanetary Magnetic Field (IMF).

1. Introduction

The magnetosphere responds to the solar wind driving function in a variety of complex ways. Various types of disturbances are produced which can be monitored on the Earth to estimate the level of magnetospheric activity (geomagnetic storm and substorm). The association of SSC amplitudes in H with the equatorial electrojet currents has been earlier reported in the literature (Rastogi *et al.* 1964; Rastogi 1978). The geospheric environment is highly affected by the Sun and its features such as, X-ray-solar flares, active prominences and disappearing filaments (APDFs), coronal holes, Coronal Mass Ejection (CME), etc., which are responsible for some large/small geomagnetic storms (Gonzalez *et al.* 1994). This paper discusses three successive geomagnetic storm variations of the horizontal (H) component deviation of the geomagnetic field at subauroral zone with the time of the day, season and sudden storm commencement (SSC). The daily variation of H showed a large peak observed around night time at “Maitri”, Antarctica.

2. Data selection and methodology

A ground based digital fluxgate magnetometer is used to measure the earth's magnetic field at southern subauroral localized region "MAITRI" (geom. lat. 62°S, long. 52.8°E). Global geomagnetic Dst index is taken from the World Data Centre Service. Vertical Component of Interplanetary Magnetic Field values are taken from the Advance Composition Explorer (ACE) Satellite Data Service of World Data Centre. Days that are used for this work are successive storm days along with the preceding and succeeding days of equinox month of April 2004, summer month of July 2004, and winter month of November, 2004 and these storms occur after every alternate day. To study the H component deviation during storm time we have first calculated the average of quiet days as a reference of the storm month. With respect to that we have taken the deviation of H component of storm time and studied the effect of vertical component of the Interplanetary Magnetic Field (IMF) on it.

3. Result

08–13 April 2004. There are three panels (I–II–III) in Fig. 1. First panel shows the Dst of successive magnetic storm while second and third panels show the variation in H component deviation and Interplanetary Magnetic Field respectively. Graphs show the results of three magnetic storms dated 9 April, 10 April and 12 April, 2004. The upper panel of Fig. 1 shows the Dst variation for three magnetic storm. First storm began at 02:33 UT (08:20 LT) on 9 April 2004. The second storm began at 20:10 UT (25:40 LT) on 10 April, 2004 and third at 18:17 UT (23:47 LT) on 12 April 2004. Before SSC magnitude of H component deviation and IMF show smooth variation but after sudden commencement of first storm on 9 April 2004, the magnitude of H deviation shows fluctuations and at 01:00 UT it increases small and at 05:00 UT it sharply increased to 800 nT whereas IMF moves towards south and shows the value of 10 nT.

21–27 July 2004. Figure 2 has three panels (I–II–III). The first panel shows the Dst of magnetic storm while second and third panels, show the variation in H component deviation and IMF (Bz) respectively. Graphs show the result of three successive magnetic storms dated 22 July, 24 July and 26 July, 2004. The upper panel of Fig. 2 shows the Dst variation for three magnetic storms. First storm began at 10:36 UT (16:06 LT) on 22 July 2004, the second storm at 06:15 UT (11:45 LT) on 24 July 2004 and the third storm at 2:49 UT (29:29 LT) on 26 July 2004. Before SSC magnitude of H component deviation and IMF show smooth variation, but after sudden commencement time of first storm of on 22 July 2004, the magnitude of H deviation shows fluctuation and at 09:00 UT it increases little, but for the second storm of 24 July 2004, the magnitude of H deviation indicates fluctuation and at 04:00 UT it increases greatly. The magnitude of H component shows fluctuation and at 13:00 UT it sharply increased upto 1600 nT on the night of 27 July. The 27 July 2004 was a severe magnetic storm. Accompanying this the deviation in magnetic field depends on IMF and magnetic storm.

06–12 November 2004. The event of 7 November storm was one of the severe magnetic storms of the year 2004. Figure 3 panel (I–II–III) shows the three successive magnetic storms of 6–12 November 2004. The first panel shows the Dst of magnetic storm while second and third panels show the variation in H component deviation and IMF respectively. First storm began at 02:56 UT (08:26 LT), then at 10:52 UT (16:32 LT) and finally at 18:28 UT (23:58 LT) on 7 November 2004. The second storm

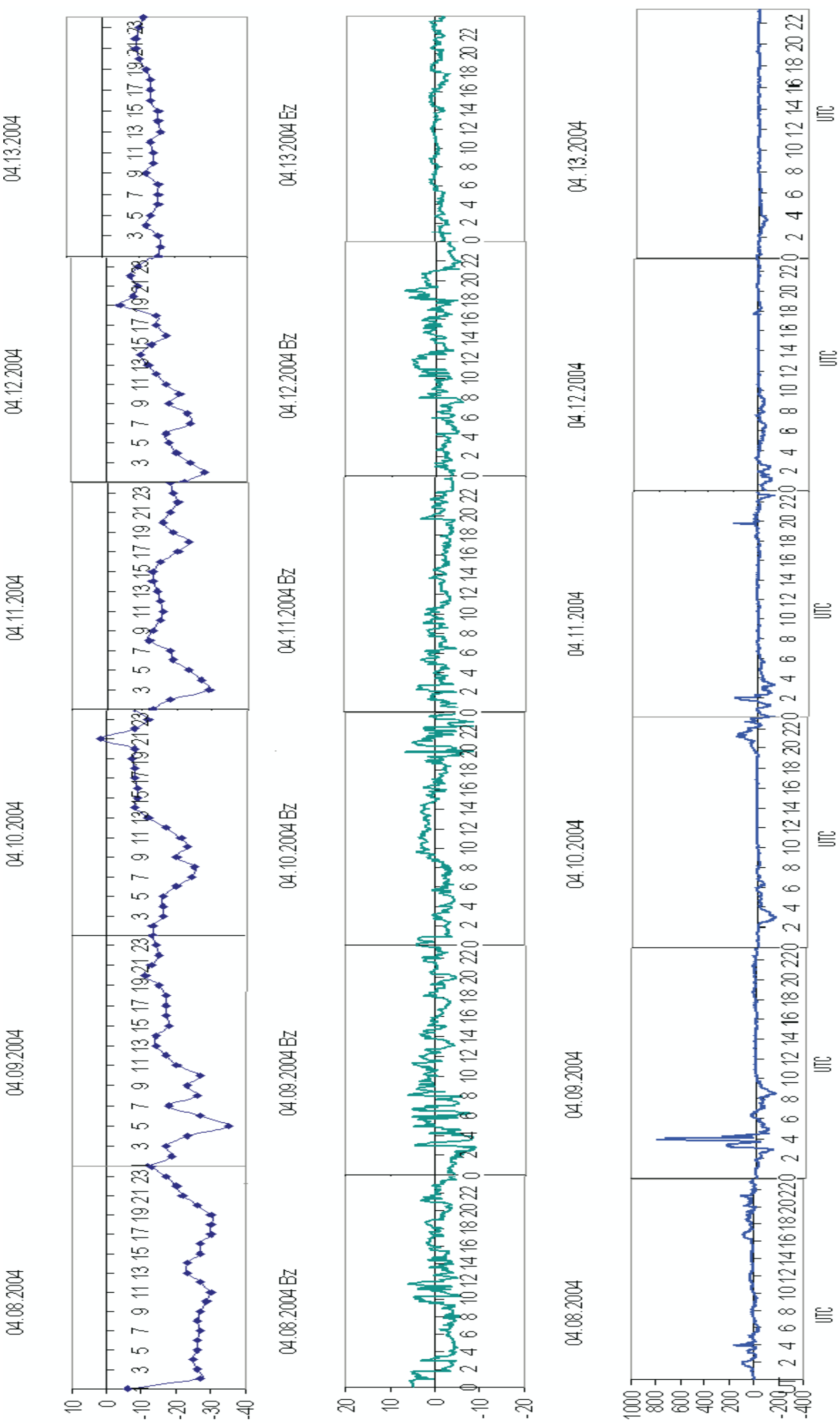

Figure 1. The three panels (from top to bottom) successively show the Dst index on y axis, IMF on y axis, deviation of H component on y axis and time on x axis in UTC which is common to all panels for the storm of 8–13 April 2003.

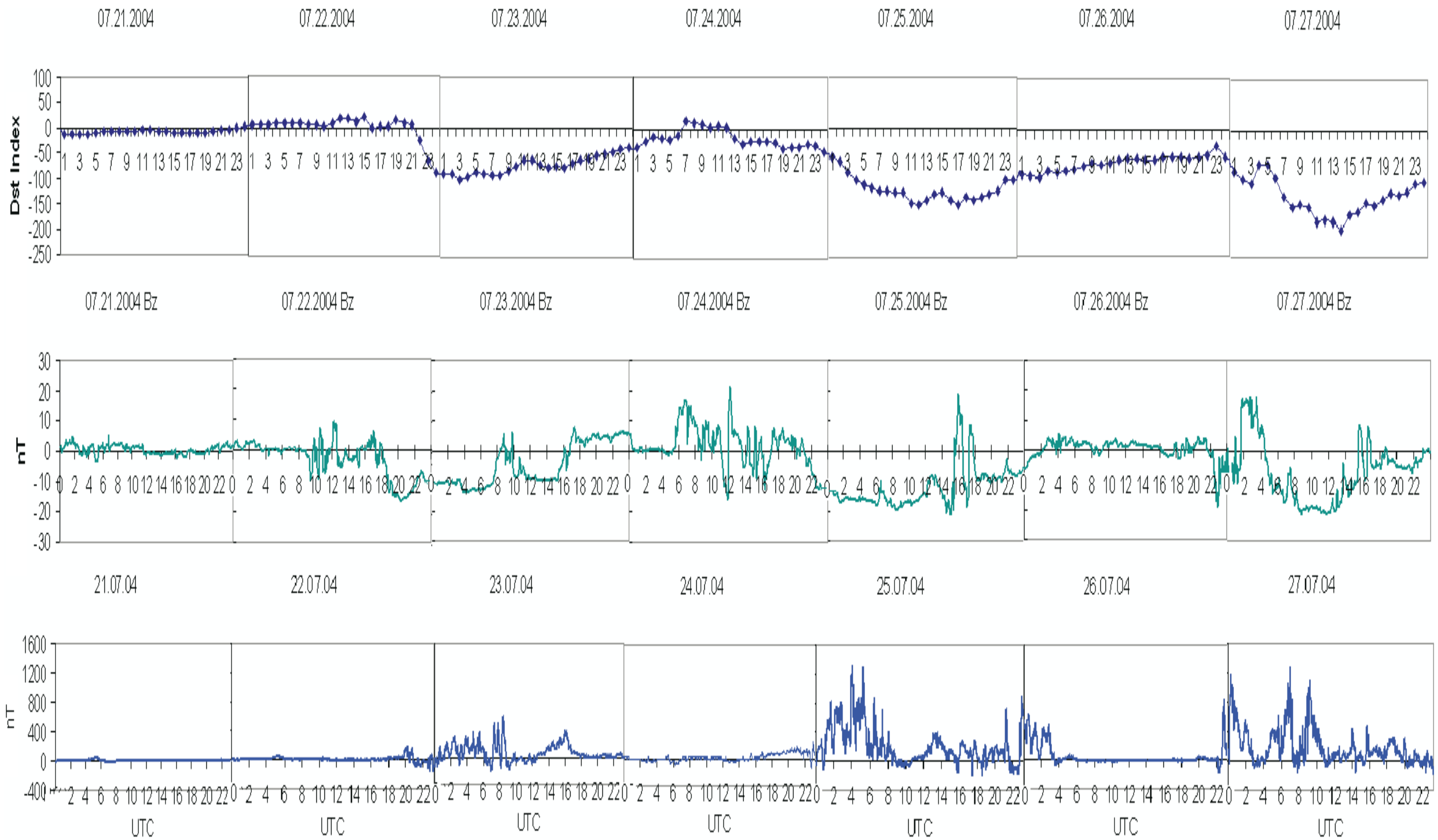

Figure 2. The three panels (from top to bottom) successively show the Dst index on y axis, IMF on y axis, deviation of H component on y axis and time on x axis in UTC which is common to all panels for the storm of 21–27 November 2003.

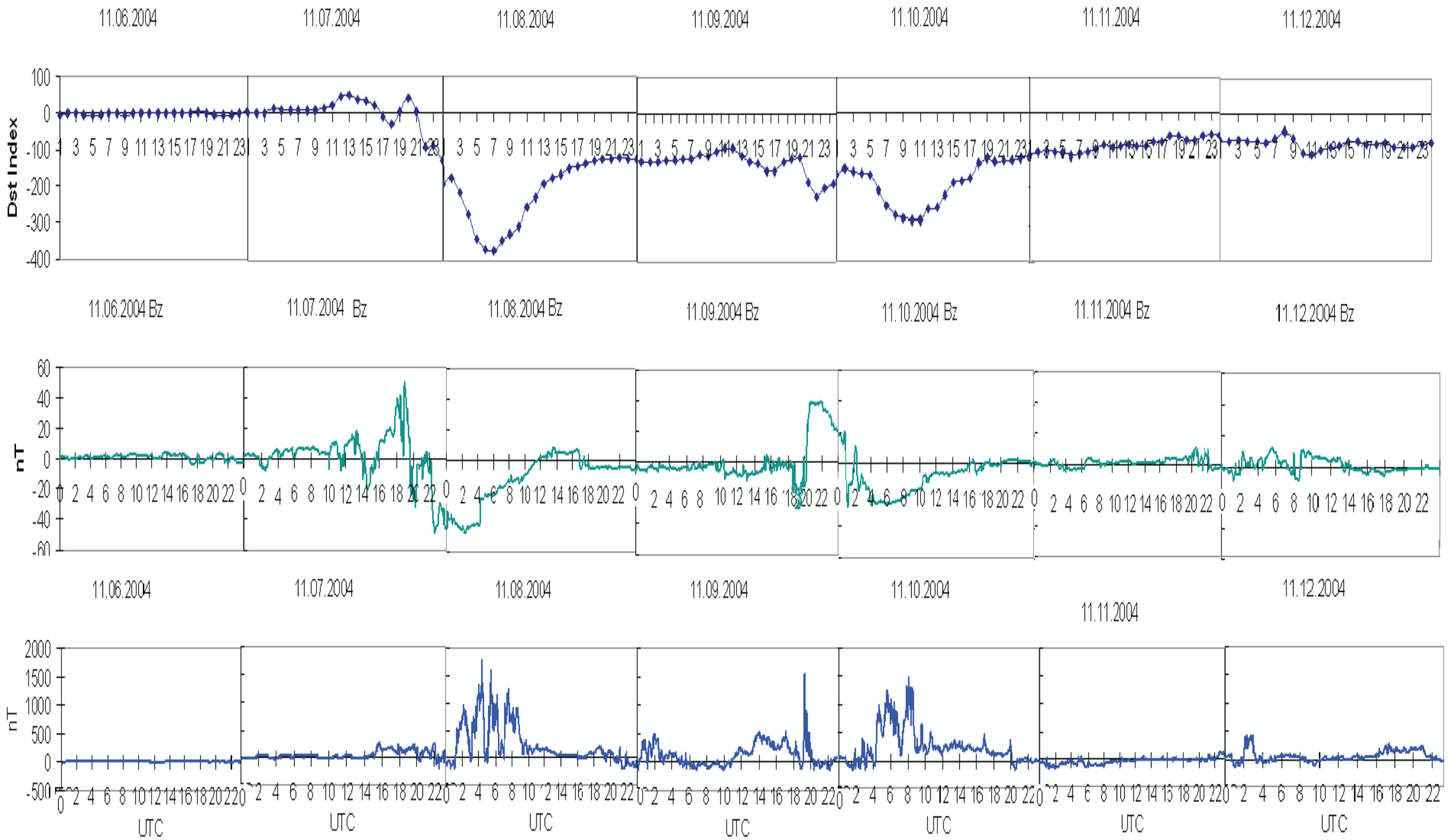

Figure 3. The three panels (from top to bottom) successively show the Dst index on *y* axis, IMF on *y* axis, deviation of H component on *y* axis and time on *x* axis in UTC which is common to all panels for the storm of 6–12 November 2003.

began at 09:31 UT (15:01 LT) on 9 November and the third storm began at 17:10 UT (22:40 LT) on 11 November 2004. Before SSC magnitude of H component deviation and IMF show smooth variation, but after sudden commencement time the magnitude of H deviation shows fluctuation and at 01:00 UT it sharply increased to 1878 nT on the night of 8 November 2004.

4. Conclusion

The study of southern hemispheric observations of the most energetic solar event of cycle 23 present a very peculiar situation in which there are very strong or the strongest X-ray-solar flares or CME. We observe that even when Bz was positive no significant geomagnetic activity is observed in Earth's magnitude of H component deviation. It is evident that most of the geomagnetic storm activities are associated with negative Bz at subauroral zone (Maitri, Antarctica). Thus either this study had some thing special which needs to be understood or Bz is an essential requirement for generation of strong geomagnetic successive storms and sub-storms at subauroral zone. More studies with other strong solar events are necessary to ascertain these findings. Results show that for the event of 8 November 2004 magnitude of H component shows maximum deviation when Dst shows maximum negative excursion of −373 nT with respect to IMF southward for a prolonged period of time. We observe that oscillations of H deviation in the earth's magnetic field at ground in different seasons is found to be different but the variations is observed alternate days of like waveform with the Sun's IMF after SSC time. The present result shows that the ionospheric conductivity over the magnetic equator and high latitude is directly proportional to the magnitude of H component deviation of the earth's magnetic field. For further studies we can examine the response to impulsive pressure variations in the solar wind.

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