Signatures of Storm Sudden Commencements(SSC) in geomagnetic H field at Indian stations and associated changes in interplanetary magnetic field orientation

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Abstract

Storm sudden commencement (SSC) or sudden impulse (SI) is one of the important aspects of solar terrestrial relationships involving solar wind, IMF, magnetosphere, ionosphere and EEJ. The understanding of the SCs in general involves the complex current systems that develop in the magnetosphere-ionosphere domain as a result of sudden magnetospheric compression. In recent years, the statistical studies showed the local time (LT) pattern of occurrence of preliminary impulse at middle and low latitudes and associated mechanisms of field aligned currents and ionospheric currents. The objective of this work focuses is on the SSCs chacteristics of severe magnetic storms which occurred during solar cycle 23 and associated IMF parameters and solar wind dynamic pressure will be investigated using digital geomagnetic data from Indian sector and also satellite data. This study will also aim to understand the aspects of preliminary impulse and main impulse characteristics at low latitudes from Indian sector and the associated ionospheric current systems which will be the tool to investigate the coupling between magnetosphere and Ionosphere.

1.Introduction

The SSCs observed globally everywhere at ground, the amplitude of each SSC and waveform will different and depends on the latitude and also the local time. The statistical study for large number of SSCs observed at equatorial and low latitudes are investigated and their dependency on southward IMF (Bz) orientation and local time by Araki 1977; Rastogi., 2001; Araki et al, 2006. Also the relationship between the amplitude of SCs and the dynamic pressure jump of the interplanetary shock or discontinuity has been studied by Russell et al (1992, 1994). The earlier studies reveal the relationship between the amplitude of SC/SI, the dynamic pressure jump of the interplanetary shock and the direction of IMF. The understanding of the SCs in general involves the complex current systems that develop in the magnetosphere-ionosphere domain as s result of sudden magnetospheric compression. In recent years, the statistical studies available and showed the local time(LT) pattern of occurrence of preliminary impulse at middle and low latitudes and associated mechanisms of field aligned currents and ionospheric currents.

SC wave form in the H component typically consists of two successive pulses of opposite polarity termed as preliminary impulse(Pi) and main impulse(Mi), which result from three effects associated with sudden magnetospheric compression caused by the increase in solar wind dynamic pressure. The first effect is due to a dusk –to-dawn electric field imposed on the polar ionosphere and penetrates to magnetic equator as a electromagnetic wave between the conducting Earth and Ionosphere. The second is the fundamental effects of the compressional hydromagnetic (HM) wave that induces a step like increase in the H component of magnetic field which dominates at low latitudes. The third effect prevails ram pressure, after the tailward passage of the compressional wave, is kept behind the interplanetary shock that caused the sudden compression leading to enhanced magneospheric convection and the associated dawn-to-dusk electric field (Kikuch et al., 1978, Kikuchi and Araki, 1979). The present project focuses on severe magnetic storms which occurred during solar cycle 23 and the their SSC characteristics during night and day time and associated IMF parameters and solar wind dynamic pressure using digital geomagnetic data and also the satellite data. The study will also focuses on the finest aspects of preliminary impulse and main impulse characteristics at low latitudes from Indian sector and the associated ionospheric current systems which will be the tool to investigate the coupling between magnetosphere and Ionosphere.

2. Summary

In this paper, we examine the solar wind interaction, the response of the low latitude ground stations from India sector, to sudden pressure changes in the solar wind associated with the passage of interplanetary shocks using the ground geomagnetic H component data and ACE satellite data for Interplanetary parameters. All SSC events occurred during solar

cycle 23 which are reported by Indian Alibag observatory (Geo.Lat.18.63 N) are considered for the present analysis. The SSC events are separated on the basis of the interplanetary magnetic field direction during the passage of interplanetary shocks and also further separated the events for local day and night. The solar wind dynamic pressure is calculated for pre and post interplanetary shock for all SSC events. The low latitude ground level response for the interplanetary shocks contains both magnetospheric and ionospheric contributions. By comparing these observations, the latitudinal variation of SSC amplitudes can be known.

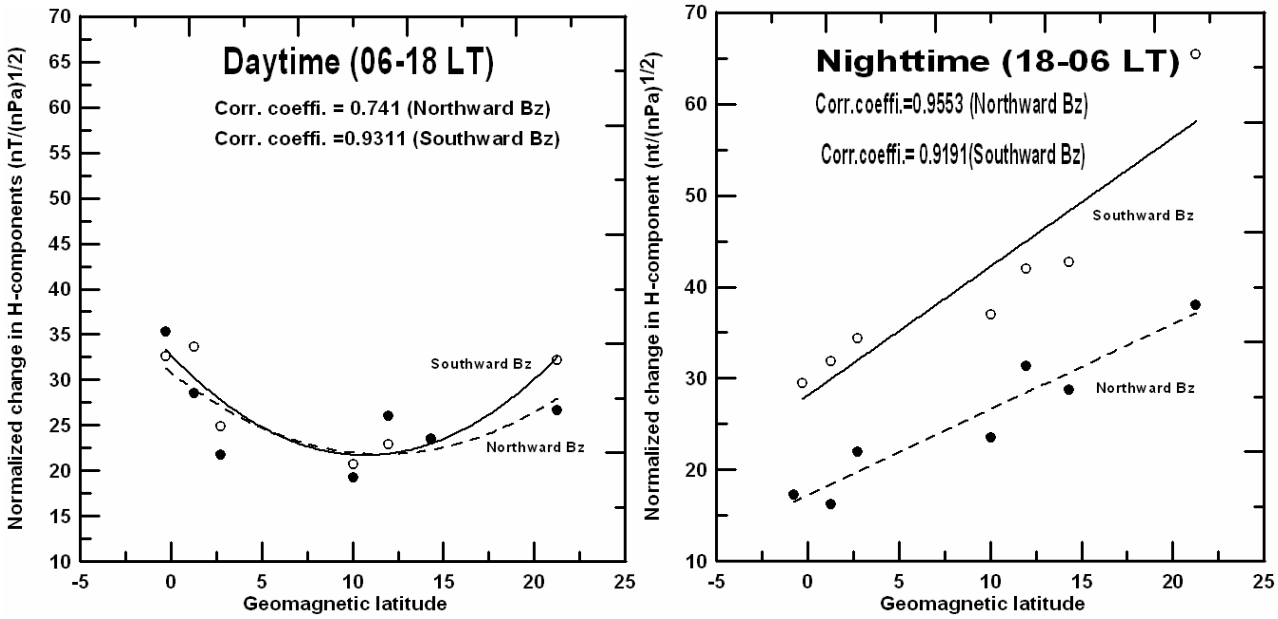

Fig1a **Fig1b.**

Figure 1a and 1b. The normalized change in the average H component of the surface magnetic field for an increase in the square root of dynamic pressure verses geomagnetic latitude for north and south ward Interplanetary conditions are plotted separately for local day and night times.

Figure 1 a and 1b show magnetic field changes for sudden impulse amplitude events normalized by the change in the square root of the solar wind dynamic pressure for the northward and southward interplanetary conditions for the local times periods 0600 to 1800 hours and 1800 to 0600 hours. Figure 1a shows the equatorial enhancement of SSC amplitude during local day time, due to increase of ionospheric currents, the equatorial electrojet at equator which decreases as move away from equator and minimum occurred at 10^0 geomagnetic latitude. Large correlation coefficient is evident for southward Bz (Corre.Coeff. 0.9311) events than northward events (Corre.Coeff. 0.741) during day time cases. At local night time, this equatorial enhancement disappears but showed the consistent increase with the geomagnetic latitude for both interplanetary conditions. The correlation coefficient is better for both northward (Corre.Coeff.0.9553) and southward (Corre.Coeff.0.9191) Bz conditions. All Indian stations data of H component changes for SSC events are compared with Alibag and found good correlation between the stations away from the equator. The further analysis of H component changes with solar wind dynamic pressure and local time will be examined in extended work.

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