



Multi-instrumental study of major geomagnetic event recorded on 15 December 2006 during unusual declining phase of solar cycle 23: complex interplanetary source event

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In this study, we present the behaviour of the solar and interplanetary parameters of a very complex anomalous geomagnetic storm that is recorded on 15 December 2006, during the declining phase of the solar cycle 23. This was the last major geomagnetic event that occurred during the declining phase of solar cycle 23. This declining phase was persist for few more years up to 2009, although this period was expected to be the starting minimum phase of solar cycle 24. The observed event shows a very prominent and abrupt increase in He/proton density, and plasma dynamic pressure with a depressed alpha/proton ratio and low plasma beta, more negative B_z , and the anomalous charge state of Iron at the stream interface of the event. Two days before of the event coronal hole associated high speed stream and 1 day before a halo earth-ward directed CME, with linear speed ~ 1774 km/s at 2:54:04 on 13/12/2006 were observed. This CME was evolved as ICME, which pushed the forward shock as sheath region and producing ring current in equatorial region of the earth's magnetic field. For the reported study which is under investigation, we use the hourly values of interplanetary plasma and magnetic field parameters as well as geomagnetic disturbance indices, for the period December 13-18, 2006. It is found that the major geomagnetic storm with a $Dst \sim -146$ nT, occurred on 15 December, 2006, and associated with Storm Sudden Commencement, (SSC), and had a more complex interplanetary structure with a X- class Solar flare and an ICME + Sheath. This geomagnetic event has peculiar characteristics with complexity in nature; particularly it is associated with CME and ICME, although it was expected to be associated with the CIR, because of its long recovery phase. The cause of the long recovery phase may be due to the another halo CME on 14 December 2006 with its linear speed ~ 1042 km/s [at 22:30:04 UT] from same active region, reported in SOHO LASCO CME list. The study of these anomalous characteristics of this particular major geomagnetic event through multi-instrument observations is the main aim of this paper. Our particular interest in this paper is to study the elemental and ionic composition in solar wind during event and compare with the event of 29-30 October 2003. In order to justify its anomalous elemental composition we also compare this event with the event of 29-30 October 2003.