



Research Paper

Ionospheric GPS-TEC responses from equatorial region to the EIA crest in the South American sector under intense space weather conditions

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ABSTRACT

We present and discuss the ionospheric F-region observations from equator to the equatorial ionization anomaly (EIA) regions over the South American sector during an intense space weather event occurred between 27 and May 29, 2017. During this geomagnetic storm, the symmetric-H (SYM-H) reached a minimum of -142 nT at ~ 0700 UT on May 28, 2017. For this investigation, we analyze the vertical total electron content (VTEC) observations from a chain of nearly 120 Global Positioning System (GPS) stations. Magnetometer measurements obtained at two stations in the low latitude regions are also presented. The observations do not indicate prompt penetration electric field (PPEF) effects in the VTEC variations. Magnetometer's observations over Cuiabá (CBA) and Cachoeira Paulista (CXP) in central west and south parts of Brazil, respectively, have shown a strong cross-correlation with SYM-H in the period between 3 and 48 h. The results also show positive ionospheric storm phase during the recovery phase on May 28, 2017. Positive effect during the recovery phase of the geomagnetic storm is possibly associated with effects of disturbance winds. During the recovery phase, a strong intensification of the EIA took place, possibly related to an additional ionization effect. The VTEC values show differences between the west and east sectors. This indicates that the EIA crest is stronger in the east sector than in the west sector, possibly due to the combination of disturbance wind effects and geomagnetic field geometry where in the east sector the field lines are more inclined.

1. Introduction

Interaction between the magnetosphere and ionosphere during geomagnetic storms continues as an important issue nowadays related to the space weather studies. Space weather can have significant and adverse impacts on increasingly sophisticated ground- and space-based technological systems and can endanger human life or health (e.g., degrades satellite instruments, dangerous particles to harm electronics and people, and disrupts Global Navigation Satellite System – GNSS) (Buonsanto, 1999; Schrijver et al., 2015). Geomagnetic storms have been studied for more than 60 years (Dungey, 1961; Willis, 1964; Gonzalez et al., 1990; Zhang et al., 2007; Echer et al., 2008; de Abreu

et al., 2010a, 2010b; Sahai et al., 2011; de Jesus et al., 2010, 2012, 2013; Astafyeva et al., 2015; Barbosa et al., 2018; Correia et al., 2017; Blagoveshchensky et al., 2018, and references therein).

Geomagnetic storms are due to solar wind energy entering into the magnetosphere through the reconnection processes (Rostoker and Falthammar, 1967; Akasofu, 1981; Tsurutani and Gonzalez, 1997, and references therein). The southward Bz component of the interplanetary magnetic field (IMF) interconnects with the northward Earth's geomagnetic field lines, allowing the solar wind energy and particles from the coronal mass ejections (CMEs) are transferred from the dayside towards the nightside magnetosphere tail. As a result, a new reconnection process occurs and the more solar wind energy and particles are

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