INTERPLANETARY ALFVÉN WAVES INDUCING IONOSPHERIC DISTURBANCES OBSERVED BY GPS DATA

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Interplanetary Alfvén waves appear in satellite data as high-amplitude, fast oscillations in the interplanetary magnetic field and solar wind velocity components. The waves are more often present in high speed solar wind streams emanating from coronal holes. For a long time, these Alfvén waves were not believed as able to produce geomagnetic responses due to the absence of a strong and sustained southward Bz (Bs) interplanetary magnetic field. But in 1987, Tsurutani and Gonzalez showed that these structures were responsible by intense and long-lasting auroral activity (observable through the AE index). However, these phenomena were not strong enough to produce significant ring current intensification (measured by the middle/low latitude Dst index). In this work we analyze three intervals of strong auroral activity related to interplanetary Alfvén waves outside main phases of geomagnetic storms. These events occurred in the years 2002, 2003, and 2005. The ionospheric effects were observed through the vertical Total Electron Content (TEC) data from GPS receivers. Data from three GPS stations were employed in this study: Porto Alegre (POAL, Brazil, Lat. 30.1° S, Long. 51.1° W, Dip Lat. 20.7° S, LT=UT-3 h), Bahia Blanca (VBCA, Argentina, Lat 38.7° S, Long. 62.3° W, Dip Lat. 22.4° S, LT=UT-4 h), and Rio Grande (RIOG, Argentina, Lat. 53.6° S, Long. 67.8° W, Dip Lat. 43.6° S, LT=UT-4 h). For each event three quiet days around the date were used to calculate the VTEC average and standard deviation. These values were assumed as reference for disturbed intervals comparisons. For the three selected intervals we observed VTEC increases in all the analyzed stations. The VTEC values may reach over 50% increases compared to quiet day values. Another remarkable observation is that the POAL station (the most equatorward station) always presents higher increases than the other stations. This effect is reduced as the latitude increases and becomes very small at RIOG (the highest latitude station). This behavior is unexpected, since these interplanetary structures were believed as affecting mainly the auroral region and then propagate to lower latitudes. However, the observations suggest the opposite way, with the ionospheric disturbances related to Alfvén waves appearing stronger in lower latitudes than in higher latitudes.

Alfvén waves, GPS, Total Electron Content

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