Analysis of the long term correlation between the vertical drift inferred from Digisonde data and GNSS S4 index scintillation

Details

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Abstract

Digisonde data from São Luís (2.33 o S, 44 o W, dip latitude 1.3 o S) quasi-equatorial station and data from a network of GNSS receivers over the Brazilian territory were used to infer the correlation between the vertical plasma drift and the pre-midnight scintillation index S4. These data from 2001 to 2012 cover the periods of solar activity maximum of the cycle 23, the long lasting solar minimum and the ascending phase of the cycle 24. The digisonde vertical drifts were inferred from dhF/dt at five plasma frequencies adequately chosen to represent the F region true heights hF during the time interval of 17:30 to 19:00 LT and centered at the prereversal peak hours (19:00 to 21:00 LT). The S4 index, that represents the amplitude scintillation of the GNSS signal during ionospheric irregularities, was determined from a GNSS receiver located close to the magnetic equator (São Luís) and one receiver at the southern crest of the Equatorial Ionization Anomaly (EIA). Through the years of solar maximum, when equatorial vertical plasma drifts were high, scintillation occurrences were observed at both sites with a very high occurrence percentage. Some threshold values of the equatorial vertical plasma drift were proposed for the occurrence of scintillation. However, during the long lasting solar minimum of 2008-2009 weak scintillations were observed almost every night over São Luís, but not under the EIA crest. During this solar minimum, a threshold of vertical drift velocity of about 10 m/s could be correlated to scintillations at the equator with S4 > 0.1. As the solar flux increased along 2012, scintillations became stronger and were observed again at both the equator and low latitude sites. The observed correlation between the equatorial vertical plasma drift and the S4 index attests its importance in the prediction of scintillation occurrence. Other attributes that are being considered for this prediction include the F region base and peak altitudes,

the F10.7 cm flux, the S4 values at São Luís. The next step would be to test algorithms such as decision trees or neural networks in order to predict the S4 index at the EIA crest.

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