GPS triple-frequency statistical study of ionospheric amplitude scintillation at low latitude

A. O. Moraes[1], B. Vani[2], E. Costa[3], E. de Paula[4], J. G. Monico[5]

(1)Instituto de Aeronáutica e Espaço-IAE, São José dos Campos, SP, Brazil
(2)Instituto Federal de Educação, Ciência e Tecnologia de São Paulo - Presidente Epitácio - IFSP-PEP, Presidente Epitácio, SP, Brazil
(3)Centro de Estudos em Telemcounicações, Pontifícia Universidade Católica do Rio de Janeiro -CETUC/PUC, Rio de Janeiro, RJ, Brazil
(4)Instituto Nacional de Pesquisas Espaciais – INPE, São José dos Campos, SP, Brazil
(5)Universidade Estadual Paulista Júlio de Mesquita Filho - UNESP, Presidente Prudente, SP, Brazil

The ionosphere around Brazilian territory, more specifically over the peak of the equatorial ionization anomaly, represents a treat for navigation systems based on GNSS. Ionospheric scintillation creates a great vulnerability for GPS receiver tracking performance. It is responsible for significant degradation in the accuracy of navigation and positioning. Amplitude fades accompanied by significant phase shifts degrades the signal-to-noise ratio of the received signal to levels below the operational minimal signal strength. Strong scintillations make the GNSS receiver tracking loops difficult to recover the phase and code replicas which may affect availability and positioning. Recently the use of α-μ distribution was proposed and validated for statistical characterization of ionospheric amplitude scintillation, because of its flexibility provided by the two degrees of freedom of this model. In this work this distribution is used in low-latitude amplitude scintillation signals to evaluate the statistics of the received signals at the three available GPS frequencies, L1, L2C and L5. This work analyzes GPS scintillation data recorded during thirty days of the current solar maximum at São José dos Campos, Brazil, located near the southern crest of the equatorial ionization anomaly. The analysis has been performed focused on the α-μ coefficients of the three frequencies comparing the how those signals behave statistically in comparison each other. Aspects like fading characteristics, decorrelation time and probability of loss of lock will be discussed showing how the new frequencies are more susceptible to interferences in comparison to the widely used and studied L1 frequency. The results of this study will show the typical fading coefficients across the frequencies as function of scintillation severity, which GNSS users may be susceptible under similar geophysical circumstances, showing how vulnerable to availability problems it can be due to the ionospheric plasma bubbles.