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Characterization of Ionospheric Scintillation at High Latitude

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The chaotic behavior of the space plasma in the polar region is analyzed and characterized. The study was carried out using the amplitude and phase components of the GPS (Global Positioning System) L1 signal time series sampled at 50 Hz. A stationary signal is obtained after removing the trend due to the background electron density variability and the Doppler shift due to the satellite motion. The filtering is performed using the wavelet transform. The cutoff frequency is optimized by investigating the behavior of the Tsallis entropy of the system for different scales.

The construction of the probability density functions of the phase and amplitude fluctuations and the estimation of the corresponding higher order moments are used to quantify the phase and amplitude fluctuations of the signal. The results reveal a general non-trivial parabolic relationship between the normalized fourth and third moments for the amplitude of the signal. A multi-fractal analysis of the power fluctuations of the L1 GPS signal is also presented. We consider the differential signal for different time lags. Probability density functions are computed and fitted with the Castaing distribution. Higher order moments of the distributions are used to investigate the intermittent nature of the signal. The present work reveals the direct evidence that the intermittent aspect of the investigated events is more pronounced at small temporal scales than at long ones.

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