#55 Received 01/19/2015

Rino, Charles[1]; Charles Carrano[1]; Keith Groves[1]; Patrick Roddy[2]
1. Boston College
2. U.S. Air Force Research Laboratory

Reconciling Two-Component Power-Law Spectra

Abstract:
Inverse power-law spectra have been used to interpret scintillation data for decades. Two-component power-law spectra were invoked to explain the frequency dependence of equatorial scintillation from VHF to S-Band. More recent analyses of equatorial scintillation by Carrano have identified two-component structure with variable power-law indices. Carrano's results were facilitated by new phase-screen strong-scatter theoretical computations. This paper reconciles variable two-component equatorial power-law spectra with high-resolution in-situ measurements obtained from the Air Force C/NOFS satellite from 2011 through 2014. Several researchers have noted that intermediate scale spectral strength and power-law index parameters are inverse correlated. The largest intensity is associated with the shallowest index. We show evidence that this varying structure evolves from an initial two-component distribution in the region of largest background electron density with a significant input near one-kilometer. We hypothesize that the predominance of single power-law structures with an index near 2 reported in an earlier study is decaying structure initiated in more highly disturbed higher density regions. Path-integrated structure is necessarily dominated by the strong two-component structure. Hence, the predominance of that structure in fully developed equatorial scintillation. The C/NOFS satellite circular orbit progression provides opportunities to observe the evolution of nighttime structure over sequential passes. Whereas ionospheric structure has been characterized almost exclusively in the spectral domain, textural changes are evident in the in situ measurements. It is know that nonlinear cascades associated with a large variety of processes can be classified by power-law size distributions that can be measured directly. Wavelet decompositions can be interpreted as size distributions that align with spectral characterizations when statistical homogeneity supports a consistent average. Because of the very large dynamic scale range associated with equatorial plumes, they are difficult to characterize systematically. The results are preliminary, but they suggest that the structure evolution is manifest in size distribution.