Seasonal and solar flux dependence of the growth and decay of intermediate scale ESF irregularities from VHF scintillation measurements

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Abstract

The ambient conditions required for the onset of equatorial spread F (ESF) irregularities have been the focus of numerous studies. However, for prediction of the strength and duration of scintillations on VHF and higher frequency radio signals, it is necessary to know how ambient conditions influence the growth and decay of intermediate scale (~ 100 m - 1 km) irregularities in the post-sunset equatorial ionosphere. For this purpose, the coherence scale length of the ground scintillation pattern of intensity is computed from spaced receiver measurements of intensity scintillations on a VHF signal transmitted from a geo-stationary satellite and recorded at an equatorial station. For weak scintillations ($S_4 \leq 0.5$), the coherence scale length is determined by the Fresnel scale length and the irregularity spectrum. The observed scintillations are an integrated effect of all the irregularities in the path of the signal, with maximum contribution coming from the region of the F layer peak. Hence for weak scintillations, the coherence scale length depends on the height of the equatorial F layer peak, which changes with time. For saturated scintillations ($S_4 \geq 1$), the coherence scale length becomes independent of the height of the scintillation-producing irregularities, and is determined by the strength of the irregularities and the spectral slope of a power-law irregularity spectrum. Dependence of the computed coherence scale length for weak as well as saturated scintillations, on season and solar flux, is interpreted in the context of theoretical results derived from modeling of scintillations. It is found that for days with 10.7 cm solar flux greater than 150, the shallowest irregularity spectrum near the equatorial F layer peak is likely to be found after midnight, whereas for days with lower solar flux, the irregularity spectrum becomes shallowest before midnight.

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