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Computational Analysis of Ionospheric Transition Region using Multifractal Approach

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Meneveau and Sreenivasan proposed p-model to characterize multifractality in the fully developed turbulence data by modeling energy-cascade in the inertial range by the special case of a weighted curdling scheme. Ionospheric irregularities are turbulent phenomena and have been investigated using Power Spectral Density methods. However, it is evident that ionospheric data exhibits nonlinear behavior and richness of scaling whose underlying process is very hard to characterize (Fornari et al., 2016). Beyond the traditional PSD analysis, the scaling information taking into account much more complex process such as nonhomogenous energy cascade can be examined using the multifractal computational analysis. In this work, we applied the multifractal detrended fluctuation analysis (MFDFA) algorithm in order to refine the interpretation of ionospheric data from E-F transition region obtained from a rocket experiment. Earlier results from this data using PSD method has shown the presence of a dual slope. Singularity plot obtained from MFDFA analysis can be fitted using the p-model input parameters. The preliminary results we have obtained are $1.66 < \text{beta} < 2.00$ and $0.505 < p < 0.7$. Then, these results suggest that the main underlying physical process is the nonhomogenous turbulence.

P-model. Ionospheric turbulence. MFDFA