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Interactive comment

Interactive comment on "Structural characterization of the equatorial F region plasma irregularities in the multifractal context" *by* Neelakshi Joshi et al.

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1. General comments

This paper carried out a multifractal study of ionospheric turbulence associated with the equatorial F-region density irregularities. The multifractal detrended fluctuation technique using the p-model fit was applied to analyze several time series of in situ plasma density fluctuations measured by the electric field double-probe onboard two sounding rocket experiments in Alcântara, Brazil. The results of this paper confirmed the nonho-

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Discussion paper

mogeneous nature of ionospheric density irregularities and characterized the underlying multiplicative turbulent cascade hypothesis. This paper makes an important contribution to improve our understanding of the multifractal scaling and complex behaviour of the nonlinear evolution of plasma bubbles driven by the generalized Rayleigh-Taylor instability in the equatorial ionosphere. It can be published as a regular article in AG after making the revisions recommended.

2. Specific comments A number of sounding rocket experiments have been launched in Brazil and other sites to study the equatorial plasma bubbles and polar ionosphere apart from the two sounding rocket experiments described by this paper which were not mentioned in this paper. Costa and Kelley (JGR 83(A9) 4359–4364 (1978)) showed that the Rayleigh-Taylor instability that initiates in the bottomside equatorial F-region can nonlinearly develop very sharp gradients leading to the formation of steepened structures responsible for the power-law spectra observed by a rocket experiment in Natal, Brazil. Shock waves were observed by numerical simulation performed by Zargham and Seyler (JGR 92(A9), 10073–10087 (1987)) of the generalized Rayleigh-Taylor instability at the bottomside and topside F-region equatorial ionosphere, which was confirmed by rocket and satellite in situ data reported by Kelley, Seyler and Zargham (JGR 92(A9), 10089–10094 (1987)). Hysell et al. (JGR 99(A5), 8827–8840 (1994a); JGR 99(A5), 8841–8850 (1994b)) proposed a model of plasma steepening, evolving from plasma advection that occurs on the vertical leading edges of plasma depletion wedges, to interpret shock waves detected in the equatorial ionosphere by rockets launched from Kwajalein Atoll. Jahn and Labelle (JGR 103(A10), 23427–23441 (1998)) measured shocklike structures characterized by the density waveforms at the bottomside and topside F-region of the equatorial ionosphere in a rocket experiment in Alcântara, Brazil. To help the readers to understand better the results of this paper, a detailed discussion of the aforementioned papers and the relation between the results of this paper and the previous rocket experiments should be inserted. In addition, a recent paper by Spicher et al. (JGR 120, 10,959-10,978 (2015)) reported a multifractal study of intermittent turbulence in the polar ionosphere

based on a sounding rocket experiment. Since the paper by Spicher et al. (2015) is very closely related to the approach and subject matter of this paper, it is important to insert a discussion to compare the two studies.

Please also note the supplement to this comment:
https://www.ann-geophys-discuss.net/angeo-2019-133/angeo-2019-133-RC1-supplement.pdf

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