Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2020-17-RC1, 2020

Annales Geophysicae Discussions
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Interactive comment on "Magnetic field fluctuation properties of coronal mass ejection-driven sheath regions in the near-Earth solar wind" *by* Emilia K. J. Kilpua et al.

Anonymous Referee #1

Received and published: 20 May 2020

General comment

This manuscript concerns with the investigation of magnetic field fluctuations in three coronal mass ejection (CME)-driven sheath regions at 1 AU with their speeds ranging from slow to fast. The main findings are related to the intermittent and turbulent properties of sheath regions which are also compared and described by means of a common intermittent model as the $p-$model. The authors suggest that turbulent properties in sheaths resemble that of the slow solar wind, that they are partly similar to those found in terrestrial magnetosheath, and that they can vary considerably within the sheath.

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In my opinion the results look very interesting and support the view of the complex formation of sheaths and their role in generating fluctuations. The manuscript reads well, contains new results useful for a wide community, and its focus is within the scope of Annales Geophysicae. I have some concerns regarding the presentation of the results and their possible improvements.

Remarks

1. Fig. 2 and Fig. 4: why to show both figures instead of only considering Fig. 4? I think it contains much more information than Fig. 2 since it can be easily used to investigate a lot of turbulent properties (as usual) as the (non-)Gaussian behavior. Moreover, I would suggest to go further into the description of non-self-similar properties evident in Fig. 4 for the benefit of the reader.

2. Page 14, lines 19-20: the authors say that "the Kraichnan-Iroshinikov form fits yield consistently larger p-values than the Kolmogorov form fits, but both indicate high intermittency". I suggest the authors to carefully consider some implications of this statement. Both theories are based on similar assumptions although scaling-law behaviors are obtained from HD and MHD equations. So, how to reconcile both theories? I mean the sheaths should be described as a fluid or magnetofluid system? This could affect the larger $p-$values the authors obtained. Moreover, how to assess the suitability of the $p-$model for modeling scaling exponents? From Fig. 6 it seems that some cases are not exactly reproduced through a $p-$model (for example the event on 14 Dec 2006). I would suggest to add a more detailed discussion on these aspects, on possible improvements to simple multifractal models and their suitability in describing sheaths scalings. Furthermore, what about exploring the behavior of singularities and of singularity spectrum derived from scaling exponents? This could also give more informa-

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tion about symmetries and/or irregular/regular behavior of the fractal nature of sheaths. Finally, for the simple benefit of the reader I suggest to only show the best fits through $p-$models in Fig. 6 instead of several $p-$values.

Minor remarks

- I suggest to carefully check through the text some inconsistency between text and figures' captions in terms of the magnetic field component used in the analysis. If I correctly understood the authors show only results for B_z, while through the text and in figures' captions there are some discrepancies.
- Page 7, lines 20-23: is it possible to measure the degree of compressibility/Alfvénicity?
- Page 7, line 28: it seems to me that it is not a universal property but it depends on the scale. Could the authors comment on this?
- Page 8, line 11: to see how Gaussian are distributions I suggest to also normalize the pdfs with respect to the standard deviations.
- Page 9, line 20: why only three timescales to determine spectral indices?
- Table 2: I suggest to add errors on spectral indices.
- Page 11, Line 21: please check the consistency between components used for the analysis.
- Figure 3: please correct "intertial" with "inertial". Moreover, I suggest to enlarge the frequency range of dashed-line fits to cover more decades.

- Figure 6: please correct the form of the values of p and α parameters. The same number of decimal places should be used for the values and the standard deviations. Moreover, it could be useful for the reader to directly compare the different phases (pre-SW, near-shock, mid-sheath, and near-LE) in the same panel to highlight the different level of intermittency.

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2020-17, 2020.

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