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Comment

Interactive comment on “Conjugate fluctuation analysis for a set of 41 magnetic clouds measured by the ACE spacecraft” by Ojeda González et al.

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We partially agree with the main points raised by the reviewer:

1. **Comments about the Title:** As was highlighted in the original title, the main objective of this analysis is to combine complementary methods to differentiate nonlinear regimes in patterns of temporal fluctuation. However, the word “Conjugate” was used because in Fig. 4 the graph allows a conjugate analysis of persistence, but the authors agree with the reviewer, this term could mislead the reader. Now, we propose the following title “Nonlinear fluctuation analysis for a set of 41 magnetic clouds measured by the ACE spacecraft”. We understand that “nonlinear fluctuation analysis” represents the best combined use of differ-

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- ent techniques for characterization of nonlinear processes observed through the temporal domain (e.g. ref. *Nonlinear time series analysis* by Holger Kantz and Thomas Schreiber).
- 2. Comments about the power spectral index β and its relationship with turbulence and persistence:** Persistence is a characteristic of the variability pattern of any fluctuation and therefore it has been used to identify different regimes in relation to its autocorrelation in time. While, more specifically, turbulence is a physical process which can be characterized using the value of the spectral index. When the power spectrum is calculated on the autocorrelation function, in a way, it is also brings information about persistence. Therefore, a more detailed study of this interesting relationship is, as pointed out by the reviewer, necessary. But we understand that this should be a subject for a more specific and technical work on the different nonlinear approaches used to analyse time series. In our approach, the power spectral index is used to study persistence, however the search of a physical singular value (e.g. $-5/3$) is not the main goal, but a range of values, for example to strong persistence which can be interpreted from the range: $1 \leq \beta \leq 3$. Finally, it is worthily to say that in the manuscript we addressed that β , using FFT, is not a suitable index to characterize autocorrelation persistence from the fluctuation analysed in this work.
 - 3. Comments about DFA limitations:** In the text was included a discussion of the limitations of DFA techniques, as suggested by the reviewer, “Bryce and Sprague (2012) reported that DFA asymptotically provides good results for stationary time series, which is a characteristic of several techniques of time series analysis, nonstationarity remains as the biggest problem in time series analysis. However, DFA is a commonly used technique, in the context of persistence analysis, to work with nonstationarity time series. Bryce and Sprague (2012) found little problem when applied DFA in time series with nonlinear trends. Also they reported other limitation in the partitioning scheme of the DFA for short data sets.

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- The weak point in the previous work was that they do not offer a clear solution to the reported limitations. So, we do not find a way to include those limitations in this manuscript.”
4. **Comments about the analysis of geomagnetic data using DFA:** In the manuscript, we briefly discuss about analysis persistence in Dst index, as was suggested by the revisor, now, the papers of [NPG, 18, 719, 2011] and Tsurutani et al (1990) are cited.
 5. **Comments about the relationship used by Rosa et al 1999 and 2008:** Fluctuations in time series can also be studied from techniques based on asymmetries that can be found in the gradient domain of the data. The gradient field compares amplitude values considering different scales of time fluctuation. The value of the gradient asymmetry coefficient can also present relations with the values obtained from DFA, Power Spectra and fractal measures. Therefore, as suggested by the reviewer, the use of gradient pattern analysis (GPA) must be explored in a complementary future work. This comment was added at the conclusion of this work.
 6. English has been improved as a whole.

Kind regards,

Ojeda, G. A.; Gonzalez, W. D.; Mendes, O.; Domingues, M. O.; Rosa, R. R.

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