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Reply on RC1

Adnane Osmane et al.

Author comment on "Quantifying the non-linear dependence of energetic electron fluxes in the Earth's radiation belts with radial diffusion drivers" by Adnane Osmane et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-47-AC1>, 2021

We thank the reviewer for carefully reading the manuscript and providing us with a constructive feedback. Our answer to the specific comments (in bold and italic) can be found below.

Specific Comments:

1) Section 2 provides ~ 100 lines of generalities ("a brief but self-contained tutorial on the Shannon entropy and mutual information for a reader who is not familiar with information" 1.84-85). Yet, its value for the remainder of the manuscript is unclear. For instance, Fig. 1 provides the results of a numerical test that appears to be unrelated to the paper.

Figure 1 is provided to show the correspondence between the Pearson correlation and mutual information. We believe that everyone in our scientific community is familiar with the notion that a Pearson correlation greater than 0.8 is large. But the use of mutual information is fairly recent, and Figure 1 determines what values of mutual information are considered large, i.e., $MI > 0.5$. This clarification is added to the revised manuscript and discussion of Figures 4-11 will refer to Figure 1.

In addition, the formulas used to determine the quantities plotted Fig.4-Fig.11 are not explicitly provided. One way to address this comment could be to shorten the Section 2, retaining only the descriptions of the formulas that are used in the ULF/Eflux data analysis, and referring the interested reader to works already published on this topic (e.g. Wing et al., 2016 and references for information theory lectures). Another way could be to create an appendix for supplementary material.

We understand. We will shorten section 2, and be more explicit about the equations used to plot Figures 4-11.

2) The main results are presented as a list of 8 different figures (each composed of 4 different panels). Yet, there is little difference between the figures: They all appear to provide similar information (namely, that there exists a significant dependence between waves and particle fluxes). Fig.1 a)-b) is enough to

illustrate the approach and the point of the paper is conveyed in Table 1. In that context, everything else could be provided as supporting material. If all 32 panels are really necessary to convey the message of the work, this needs to be explained at the beginning of Section 4.

We agree with the reviewer that Table 1 contains all the essential results for the paper, and that a reader could simply go through Table 1 and skip the figures. However, Table 1 is extracted from the information found in Figures 4-11, and while the shape of the statistical dependencies are similar, differences between the two Events exist and are noteworthy, such as the larger error for mutual information in the 1993 Event than for the 1994 Event due to a difference in data points. Keeping the figures in the manuscript makes the paper self-contained and allows the reader to see the range of lags for which the mutual information is significantly different from zero. The revised manuscript contains this explanation at the beginning of Section 4 and inform the reader that the main results can immediately be found in Table 1.