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Interactive comment on “Identifying global patterns of stochasticity and nonlinearity in the Earth System” by Fernando Arizmendi et al.

Anonymous Referee #3

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In the manuscript “Identifying global patterns of stochasticity and nonlinearity in the Earth System” by Arizmendi et al. the authors adopt two metrics from information theory to characterize the properties of surface air temperature (SAT) and the relationship between SAT and solar forcing. While I strongly support the use of methods from information theory and neural network to investigate climate patterns and relationships, I find the manuscript in its current form not suitable for publication in ESD. The interpretation of the results is very superficial or absent, and the authors do not provide any physical justification for their findings. The authors mention various climate processes that could help explain Figure 1 and 2, but no attempt is made to an attribution based on physical principles/mechanisms except for unsubstantiated speculations. It is not investigated in any detail why ERA and NCEP are so different in the warm pool (i.e. are the extreme values responsible for the differences reasonable or not and what is

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the mechanism by which those values appear?). It is not discussed what role does resolution play in the analysis presented and more generally how Shannon entropy depends on resolution. Figure 3 has orange squares underneath the black circles and its unclear how meaningful is overall. Finally, it is not obvious how the tail of the PDF in figure 4 and the Shannon entropy are linked (I find Fig 4 very confusing but instead it should explain the differences between the two reanalyses in Figure 2)

The lack of any in depth interpretation adds to confusing statements about stochasticity repeated throughout the manuscript. Shannon entropy does not quantify the degree of stochasticity, but inform on the degree of unpredictability of a signal. It is not obvious or proven that extreme values of Shannon entropy for SAT are stochastic or due to stochastic processes (chaos does not have to be stochastic).

There are few typos throughout the manuscript.

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