

## ***Interactive comment on “Quantifying interdecadal changes in large-scale patterns of surface air temperature variability” by Dario A. Zappalà et al.***

**Anonymous Referee #2**

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The authors address a novel problem relevant to the study of climate variability and change, that of changes in the short term variability in Surface Air Temperature (SAT) over the satellite era (1979-2016) from a global reanalysis. To this end they use an advanced signal processing method, Hilbert analysis.

I would like to praise the authors for having complemented the data analysis with appropriate, too often lacking, significance tests. Moreover, the authors went further than obtaining numerical results with a novel mathematical methods by giving coherent physical interpretations of the results and reaching novel conclusions regarding climate variability. They revealed the northward displacement of the intertropical convergence zone during the XXth century, which is an important result in itself and shows that the method has potential to gain novel insights on climate variability and change.

C1

I suggest the following as minor revisions:

- The Hilbert transform should be better motivated. What can be achieved? Why does it give an amplitude and a phase? What are its limitations? A brief overview of how the Hilbert transform works would also be helpful to potential readers not acquainted to this method. I understand that the authors may not want to lengthen the article, but the latter could be given as first section of the supplementary material. Something as short and clear as Pikowsky et al., 2002, Appendix A.2.1, would greatly benefit the reader.
- Regarding the interpretation of the blue and red spots in Fig. 2, please discuss the quality of the reanalysis in these regions. In particular, the blue spot in the Arctic is in a region for which there is little constraints from satellites on the reanalysis.

Technical comments:

- p.2, l.32: what is meant by "detrended"? The climatology is kept, while the long term trend is removed? How is this done?
- p.3, l.4: what is meant by "unwrapping the phase"
- p.3, l.6: how the 5% were chosen? Are the results robust to this choice?
- p.3, l.7: exactly reconstructs  $x_j$ , but for extreme realizations, right?
- p.3, l.30: That the results are robust to the threshold is convincing enough. However, why make the threshold based on the standard deviation and not perform a fully non-parametric test by choosing a significance tolerance, say  $\alpha = 0.05$  and consider as significant all values larger than  $(1 - \alpha/2) * 100\%$  of surrogate realizations?

C2

- p.4, l.11: Please, be more precise regarding what is meant by "fast oscillations".

Supporting Information:

- p.1, l.8: "In order" instead of "n order".
- Figure 2: the numbering of the panels is missing.

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