Nonlinear Processes
in Geophysics

Discussions

# *Interactive comment on* "Detecting Changes in Forced Climate Attractors with Wasserstein Distance" *by* Yoann Robin et al.

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Dear authors,

I have found the paper quite interesting and innovative and I support its publication in NPG once certain issues are analysed in greater detail. I would like to make some remarks that I hope the authors will take into consideration.

1- Page 1, Line 21

The authors should consider giving a look Lucarini et al. J Stat Phys 166 1036–1064 (2017) where an extensive statistical mechanical analysis of climate response to forcing is given.

2 - Page 2, Line 24. "Intuitive" is not really a good world. Our visual impression and

the way we interpret it is far from being in any sense objective. I understand what the authors say, but I kindly ask to re-formulate.

3 - Page 4, line 18. The construction of the pullback attractor requires the integrations started at a $t=t_0$, with $t_0$ going to minus $\infty$. Otherwise no well-posed definition is possible. This should be clearly explained. Is one year of integration enough, in this case?

4 - Page 5, line 11. In this part there is no mention of the way A is chosen. This seems quite important for the rest of the paper.

5 - Page 5, line 13. The authors might want to note explicitly that each of the realised estimate of the measure supported by the pullback attractor come from initial conditions at $t_0$ (see point 3) distributed uniformly according to Lebesgue of the union of the little cubes.

6 - Page 6, Section 3.3 Discussion on the value of A is missing.

7 - Page 7, line 3 - I disagree with the use of "visual impression".

8 - Page 8, lines 13-14 - The statement is indeed overblown if given in all generality as here.

9 - Page 9 - End of Section 4. There is a fundamental misunderstanding here, I believe. It is true that a much lower number of integrations is needed to say that two attractors are different. This is a very interesting result. But you are not able to quantify well what is (quantitatively) the difference between the expectation value of any given (possibly interesting) observable of relevance. So, you are left with a statement that is in fact qualitative rather than quantitative (the two attractors are different!). How can you relate the Wasserstein measure to any useful information?

This does NOT diminish the relevance of the performed analysis, to be clear.

10 - Page 11, line 7: not clear the relationship between $\rho$ and $\mu$.

Best Regards, Valerio Lucarini