Nonlinear Processes in Geophysics Discussions

Nonlin. Processes Geophys. Discuss., referee comment RC1
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Comment on npg-2021-25

Anonymous Referee #1

Referee comment on "Inferring the instability of a dynamical system from the skill of data assimilation exercises" by Yumeng Chen et al., Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2021-25-RC1, 2021

This paper explores an interesting area of using the DA method to infer some basic properties of the dynamic system. The hypothesis is investigated on the Vissio-Lucarini 2020 model. The method is sound. However, the authors should address the below comments.

- *Generally, the length of this manuscript is a bit too long. The authors need to revise and strengthen the direction of their work. Either has a clear aim and objectives or poses the main research question with sub-questions. At the moment your introduction has three parts: "Lyapunov vectors and related measures of chaos in a nutshell", "Data assimilation in chaotic systems: the signature and the use of chaos" and "This paper: data assimilation as a tool to interrogate the dynamics". Besides a literature review and introduction of these three topics, the authors should also explicitly state the correlations of these three topics and connect them smoothly. And finally, have aim and objectives (or research questions) drive an overall high-level methodology for the paper.*
- *In section 4.2, the authors considered relaxing the observational constraint and concluded the linear relation is very robust against the level of observational noise (within a certain range) while it turns quadratic once the interval between successive measurements gets too large. Could the authors also provide some insights into these results? Could you explain the potential reasons for the rather less effect of the observational noise and rather a large effect of the observation frequency?*