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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Data assimilation as a deep learning tool to infer ODE representations of dynamical models" *by* Marc Bocquet et al.

Anonymous Referee #2

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This paper proposes to use data assimilation techniques to infer surrogate dynamical model from partial observations of reference model. Applications to several well-known toy model examples of geophysical flows are presented, where quality of the surrogate model is assessed by performing forecasts and comparing with those of the reference model. Obtained results demonstrate viability of the proposed methodology.

Overall, this is a solid paper that brings novel ideas from data-assimilation perspective to the burgeoning field of machine learning and data-driven modeling. Still some aspects would benefit from additional clarification, as suggested below.

1. p.6, lines 15-18. The locality assumption is obviously helpful since it reduces number of regressors, but I wouldn't go as far as claiming that long-range dependencies are precluded in geophysical applications. For example long-range teleconnections in

coupled ocean-atmosphere system are well established.

2. Section 2.2.2. The homogeneity assumption is also useful since it simplifies even more estimation of the surrogate model and obviously helps with robustness. On the other hand, the toy-model examples largely favor this assumption in a sense that the statistical properties of state variables are basically the same, namely x variables in L96, L05III and KS. However in real-world applications this is hardly the case, for example ENSO dynamics of sea surface temperatures in tropical Pacific which is very inhomogeneous. It would be helpful to have authors elaborate more on this point, i.e. in lines 23-25, p6.

3. Section 3.1. Having monomials in the surrogate model can bring numerical instabilities, so it is nice to see that authors have plans to deal with this issue – (Eq.43) and lines 10-14 on p.14. However it is not clear if this remedy has been applied for the examples presented.

4. The term "resolvent" was used multiple times, the meaning of it was not clear to me.

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