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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "A Statistical Mechanical Approach for the Parametrization of the Coupling in a Fast-Slow System" *by* Gabriele Vissio and Valerio Lucarini

Anonymous Referee #1

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The authors are concerned with a system where an L84 system is weakly coupled with a L63 system, applying the recently introduced Wouters-Lucarini (WL) linear response approach to devise a reduced model for the L84-variables.

The authors show numerically that the reduced system is able to reproduce the mean and covariance of the resolved L84 variables of the full system. Furthermore they use the Wasserstein distance to assess the relative merit of a first order and a second order WL parametrization. They show that the WL parametrization provides a reliable parametrization in the case when the driving L63 is a fast driver and when it is slow driver. In particular the latter case is not amenable to classical homogenization theory.

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Discussion paper

I recommend publication subject to some minor issues:

1.) page 2: The Mori-Zwanzig formalism does not coarse grain by “adding to the equations of motion . . .a deterministic, a stochastic and a non-markovian term”. It is a mere reformulation of the dynamics which consists of (not adds) those three terms.

2.) page 3: between lines 5 and 10; the Wasserstein distance (or any distance measuring how different the two pdfs are is not a measure “how different the attractors are”. One can construct the same pdf with very different chaotic systems. The authors could maybe replace “attractor” by “statistical behaviour” (although it does not tell you anything about temporal behaviour such as correlation functions).

3.) page 6: R in (20) is not defined/used anywhere.

4) page 7: above (25); \mu and \nu are measures nots sets.

5.) A reader would profit, I believe, from more detailed figure captions. Which system is used (L63 is fast or slow)? What are the parameters?

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