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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Fractional relaxation noises, motions and the fractional energy balance equation" *by* Shaun Lovejoy

Anonymous Referee #4

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The author proposes here new models, built using fractional derivatives in a stochastic framework, to model geoscience dynamics in a way compatible with scaling properties and long-range correlations.

Since there are many equations I regret that the author is not using LateX, which would be useful for a correct display of all the complex notations (see e.g. line 307, 320, 322, 333 etc. where alignment is not correct).

There are many mathematical expressions and the narrative is not clear. I suggest to explicitly indicate what is the process studied here, and what are its properties. A section on this seems really necessary: either in the beginning or at the end, as a kind of summary. Also, what is precisely the novelty, why is it necessary to have an infinite memory, what is new with respect to fBm. Also is the modeled process multifractal or

monofractal ?

Figures 5 and 6 display some simulation realizations for various parameter values. What are precisely the equations used for these simulations? It would be useful to provide the code to the community.

Line 110: the author cites Lovejoy et al 2019 as the original introduction of the idea presented here. However this paper is indicated in the references as "in preparation". Hence I suggest to remove it from the reference list, since it cannot be consulted and is not yet published.

The same applies to Hebert et al 219, which is under revision.

This is a long paper with relatively few references. I recommend to add more references. For example equation (4) for the Âń canonical Âż Weyl relaxation equation: if this equation is classical, a reference is here welcome. Another example: equation (16) seems to be a mathematical result and hence reference to relevant mathematical literature is needed.

There is a rather vast literature on fractional dynamics, or continuous time fractional random walks, which is only superficially discussed. I recommend to provide a link with this literature, at least in the introduction and discussion. For example the following might be relevant to discuss (this list is not exhaustive):

M. M. Meerschaert, A. Sikorskii, Stochastic Models for Fractional Calculus, De Gruyter Studies in Mathematics 43, 2012 R. Hilfer (Ed.), Applications of Fractional Calculus in Physics, World Scientific, 2000. J. Klafter, S. Lim, R. Metzler (Eds.), Fractional Dynamics: Recent Advances, World Scientific, 2011. D. Baleanu, K. Diethelm, E. Scalas, J. Trujillo, Fractional Calculus, Models and Numerical Methods, 2nd Edition, 2016

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