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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Fractional relaxation noises, motions and the fractional energy balance equation" *by* Shaun Lovejoy

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This article deals with the resolution and the mathematical properties of the solutions of a stochastic fractional relaxation equation.

The main motivation is supplied by the fact that, to model the earth's energy balance, this equation presents several advantages over previously considered equations.

Physics requirements have implications which are used in the derivation of this equation, and lead to its particular form:

- integer order derivatives in the equation lead to unrealistic Green functions so that fractional derivatives are required

- Solutions must be stationary

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Discussion paper

This paper certainly is an important contribution to the existing literature on fractional processes. In particular, many divergence issues are discussed and handled convincingly. A natural question which is not addressed (though it is an important issue in real-life applications) is the discussions of Gaussian vs. nonGaussian modelling of the noise part in the equations. Many references in this paper are (rightly) to Benoit Mandelbrot, who was extremely careful to discuss this matter with great care, and I would have expected this issue to be discussed (even briefly) in such a review paper (the mathematical study of the processes solutions of equations with nonGaussian noise, though it started much later than in the Gaussian case, now starts to be substantial). The nature of this paper may seem surprising: This volume will contain review papers on geophysics issues. The present paper is mainly constituted of lengthy explicit computations, which are often hard to follow, partly because the paper is not self-contained: at many key-points in the proofs, the reader is just referred to another paper.

Additionally, very little physical intuition is given to back these formal computations. When this happens (see e.g. lines 445-454), the explanations are sketched and can give light only to readers that already are well acquainted with these questions. However, here, the review part, and in particular the geophysical motivations, are barely sketched and the reader is mostly advised to consult references. A very positive point is that simulations are welcome and convincing: they clearly show that different qualitative behaviors can occur. Here too, I think that the geophysical implications of these differences would deserve to be discussed in more details. The issue of prediction only is discussed for its physics implications.

As it is, this paper is more an exploratory paper in applied mathematics (as can be found in applied math journal, such as e.g. SIAM review). In my opinion, substantial rewriting would be needed to make it a review paper in geophysics.

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