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Interactive comment on "On the numerical integration of the Lorenz-96 model, with scalar additive noise, for benchmark twin experiments" *by* Colin Grudzien et al.

Anonymous Referee #2

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This paper introduces the L96-s system as a stochastic differential equation with drift coefficient given by the Lorenz-96 equations and uncorrelated Brownian noise process multiplied a possibly time varying scalar diffusion coefficient. This is a timely contribution as many existing papers, especially in the data assimilation literature, have been making various ad hoc stochastic modification to the Lorenz-96 equations without introducing a rigorous SDE. The author's consider several consistent methods of numerically simulating the L96-s, including the easy to implement (but rarely used) Euler-Maruyama, and the even more rarely used Milstein scheme. They then consider the commonly used Runge-Kutta scheme, and illustrate how to correctly implement the stochastic forcing in order to have strong order-1.0 convergence (the various schemes

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Discussion paper

in the literature can be very different so this in itself is a valuable contribution). The authors also introduce a strong order 2.0 method based on a Taylor scheme. A thorough comparison is made between these methods, including how ensemble spread differs, which is a useful intuition for practitioners. One thing that would have been interesting to see (although perhaps difficult to produce) would be to compare trajectories generated with the various schemes but with the same noise realization (probably requiring Brownian bridges due to the different interior point samples).

The second part of the paper studies the effect of different numerical schemes on data assimilation. Using their Taylor 2.0 scheme with a fine discretization to generate the truth, they then attempt assimilation with various other schemes. The analysis is very thorough, and includes a range of diffusion levels and observation noise levels. It would be interesting to see if introducing inflation into the data assimilation scheme (artificially increasing the diffusion coefficient used by the filter to compensate for model error) could have compensated for the large errors introduced by the Euler-Maruyama scheme at the coarse time scale.

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