

Nonlin. Processes Geophys. Discuss., referee comment RC1
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Comment on npg-2022-12

Anonymous Referee #1

Referee comment on "Control simulation experiments of extreme events with the Lorenz-96 model" by Qiwen Sun et al., Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2022-12-RC1>, 2022

The manuscript is nicely exploring the possibility to perturb a simulation (that would represent a real system) to reduce the risk of extreme events. This is explored in the context of the Lorenz-96 model, with perturbations built on the difference between members of an ensemble forecast. The authors have carefully design experiments in doing so and they show that a considerable reduction of the occurrence of extremes is notable by using such an approach. They further explore the impact of different parameters like the lead time of the forecast and the amplitude of the perturbations, as well as the possibility to perturb locally the system and the number of observations. This is a well written and very clear thought experiment that is worth publishing in Nonlinear Processes in Geophysics. Here a few points that are worth addressing at the time of revision.

One key aspect of control is the energy to be introduced in the system. The authors have here computed such an energy in the context of the Lorenz system, but it would be important to give a first clue to what quantity of energy would be necessary in a more realistic setting. As the Lorenz-96 model provides a toy model of the large scale variables at a specific latitude, it would be very interesting to convert the energy needed in an energy that the meteorological community could apprehend (power, work...) and discuss that in the conclusions.

When perturbing a system (as done for instance with the increase of CO₂), there are extremes that become less frequent like for instance a reduction of cold waves in certain regions with the increase of the global temperature. But this has other effects with an increase of heat waves. If one transposes this to the current setting, some extremes are suppressed, but some others might be arising. Did you see such type of situations in the context of the Lorenz model? In any case it is necessary to elaborate on this somewhere in the manuscript.

In Figure 9, the authors show a saturation of the number of actions as a function of the

localization scale. I am wondering whether it is related to the spatial correlation of the perturbations needed. Furthermore I am wondering what is the nature of the global perturbations. Do they look like bred modes? It would be really interesting to elaborate on that aspect.

Minor aspect

- The last paragraph of the introduction should be placed in the conclusions
- Line 126. There is no Appendix in the document