

Nonlin. Processes Geophys. Discuss., referee comment RC3  
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## Comment on npg-2021-15

Anonymous Referee #3

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Referee comment on "Reduced non-Gaussianity by 30% rapid update in convective-scale numerical weather prediction" by Juan Ruiz et al., Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2021-15-RC3>, 2021

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### General comments:

This study focuses on investigating the impacts of DA update frequency and observation number on the non-Gaussianity of model simulation error, in a case of strong convection. Results shown in the manuscript show that the non-Gaussianity of error can be reduced by increasing the DA frequency and number of observations, which could possibly improve the performance of EnKF. While the results are impressive, there are several problems the authors may need to address before the manuscript is published. I hereby recommend a major revision.

### Specific comments:

- Model configuration: The authors did not provide enough information about the model's configurations. In line 59, the model used in this study has a horizontal resolution of 1 km, 50 vertical sigma levels, and a size of 180 km by 180 km (Fig. 1a). I wonder what the range and resolution of the vertical sigma levels are defined. According to my knowledge, models with higher horizontal resolutions should also have higher vertical resolutions. The number of vertical levels of the model introduced in this study is probably too coarse for 1km-scale simulations. (also see specific comment 2)
- According to the paper, better results of radar data assimilation were obtained with vertical localization scale of 2 km and horizontal localization of 4 km (Line 70 – 73). In this sense, a 1:2 ratio of the horizontal to vertical resolutions of the model could give more reliable simulation results. i.e., If, in this study, the model's horizontal resolution is set as 1 km, then the vertical resolution could be set as around 500 m.
- The authors mentioned that the non-Gaussianity reduced by 40% when assimilation

window length shortened from 5 minutes to 30 seconds. What are the main benefits from the reduction? The authors claimed that this could improve the performance of the EnKF, without showing any evidence. It might be better by simply showing the error of precipitation output simulated in different experiments.

- 2e–h: The authors marked the location of the maximum KLD for vertical velocity at the lower troposphere in Fig. 2f, but middle troposphere in Figs. 2e, 2g and 2h even though a maximum KLD center is not obvious in Figs. 2g and 2h. If the authors intended to emphasize the improvement of KLD in the middle troposphere, they should consider the KLD in the middle troposphere in all cases.
- 5b and 5h: The main highlight of this figure (which is also that of the manuscript) is improvement in the KLD with higher DA frequency. However, Fig. 5 also shows obvious increase in the KLD of specific humidity in the 30SEC experiment, in both the raining and non-raining cases. And, it seems that the authors did not make any discussion on these results. While there are great improvements in KLD of most grid points, especially that of vertical velocity when the authors focus on convective-scale simulation, why is the same improvement not obtained for specific humidity? Are errors generated from the more frequent DA update?
- Line 67: "... Climate Forecast System Reanalysis Saha et al. (2010)" à "... Climate Forecast System Reanalysis (Saha et al., 2010)"
- Line 99 and Eq.(1): "where  $P(x)$  and  $Q(x)$  are two . . ." à should be "where  $p(x)$  and  $q(x)$  are two . . ."?
- Lines 140–141: Wrong use of "so that".
- Lines 144: "raining" and "non-raining" grid points sound better than "rain" and "non-rain" grid points to me.