

Nonlin. Processes Geophys. Discuss., referee comment RC2  
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## Comment on npg-2021-15

Anonymous Referee #2

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Referee comment on "Reduced non-Gaussianity by 30s 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-RC2>, 2021

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Review of "Reduced non-Gaussianity by 30-second rapid update in convective-scale numerical weather prediction " by J. Ruiz et al..

General comments:

This paper has investigated how the DA frequencies affect non-Gaussianity using a high resolution NWP model with LETKF method for data assimilation. DA experiments with different frequencies are conducted using real observations. They have some findings about the non-Gaussianity in data assimilation, which are quite new and interesting. They have used a high resolution DA system with very high DA frequencies to support their conclusions. And they have analyzed the results comprehensively. The manuscript is overall well-written. I am in support of publishing this manuscript after minor revision.

Specific comments:

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This work measures the non-Gaussianity (by KLD) of the analysis fields. They found that increasing the assimilation frequency up to 30 seconds and assimilating more observations can reduce KLD. This conclusion can be expected easily. As acknowledged, EnKF and LETKF are sub-optimal when the forecast error are non-Gaussian, and the non-Gaussianity of the forecast error grows during model integration. If the DA frequency is higher, the non-Gaussianity of the forecast will be smaller due to shorter

integration period, therefore the EnKF will be more effective.

However, they didn't show the KLD of the prior error distribution. If they can compare the posterior KLD with prior KLD with different DA frequencies, they can better illustrate the "reduced non-Gaussianity by 30-second rapid update" in the title.

■

Page 5, lines 110-125 and figure 2. Compared with the rest of this article, the readability of this paragraph is poor. They have shown too much information in figure 2, such that they need to use parentheses constantly to indicate the subplots and features (shades or contours) in figure 2. And there are also some problems with the order of expression in this paragraph, therefore the readers have to look at the subplots back and forth. I suggest splitting the paragraph from line 116 or 117.

■

Figure 2e-h, they use shades to show KLD for W, while use blue contours for KLD for T and red contours for ensemble spread. This is very odd. In my opinion, use contours of different colors to show KLD for different variables seems more reasonable.

■

Figure 2a-h, the location of the maximum KLD for vertical velocity is shown by blue circles. I think the circle is too large and its color is inappropriate. I cannot clearly see whether the ensemble spread maxima are slightly out of phase with respect to the KLD maxima. What about a black x or plus sign?

■

Line 114 and line 117. The authors have shown that "KLD is reduced more from 5MIN to 2MIN than from 1MIN to 30SEC" and "The ensemble spread for W is reduced significantly from 5MIN to 2MIN". I think this is also associated with the nonlinearity of this model. Could it possible that the non-Gaussianity of prior distribution grows fastest during the freerun between 2min to 5min?

■

Since increasing the analysis update frequency from 5 minutes to 2 minutes has most significant impact upon non-Gaussianity. So can we say it is a optimal strategy considering the trade-off between cost and efficiency?