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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluation of Doppler radar and GTS Data Assimilation for NWP Rainfall Prediction of an Extreme Summer Storm in Northern China: from the Hydrological Perspective" *by* Jia Liu et al.

Anonymous Referee #1

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This paper contains a comparison of eleven data assimilation modes, which are designed for assimilating different combinations of weather radar and GTS data in the two nested domains of the WRF model for rainfall prediction. It is always interested to see the efforts that try to integrate weather radar (providing local, short-term lead time but high spatiotemporal resolutions rainfall) with NWP model (regional, medium lead time but relatively poor-quality rainfall) as they are very complementary. Since the WRF model and the data assimilation methodology is increasingly applied in the hydrology and earth system areas, how to use the model and the data correctly and efficiently be-

comes an important issue that is worth discussing. The results of this paper are helpful for improving the rainfall prediction from the hydrological perspective and the content is of interest to the readers of the HESS journal. However, further improvements and clarifications are needed before the paper is acceptable. Detailed comments are listed below:

1) I agree with the authors that hydrologists are particularly concerned about the accuracy of the accumulative amount and the process of the predicted rainfall at the catchment scale. However, I did not observe any special configuration of WRF or data assimilation for this goal.

2) What factors drove your decision to have 40 vertical levels in WRF? Why not more?

3) The uncertainty of weather radar rainfall and GTS data, and their possible influences on the data assimilation process should be carefully specified.

4) The spin-up period may have influences on the rainfall simulation of the NWP. A 6 hour is used in this study, why not 12 h or other times? In fact, the authors should specify or at least discuss all the sense parameterizations, such as the domain design, downscaling ratios ect.

5) It is necessary to explain the causes of the heavy rainfall event in this study. The readers may be interested in the very convective system which affects the choices of the WRF parameterisation schemes.

6) The description of assimilation mechanism for the radar data is too simple. Please complement the model-derived observation operators that are adopted in the 3DVar method. This may explain why the assimilation of the radar reflectivity performs better than the radial velocity.

7) In general, this study describes the results of different data assimilation experiments and explains the reasons why the assimilation of the radar velocity always leads to worse results. It is wondered why the GTS data and the radar reflectivity can perform

better, and neither does the author give a plausible explanation why the assimilation of GTS data together with the radar data performs the best among the eleven assimilation modes. The revised manuscript needs to contain more deep analysis in the Discussion section.

8) The ultimate goal of the WRF applications in this study is for flood forecasts. It would be helpful to add references to explain how much the flood forecasts in general can be improved by the improvement of the rainfall accuracy. I also look forward to the follow-up study for the improvement of flood forecasts with data assimilation.

9) There are several typos and some cases where the grammar is off. For example, '4.1 Evaluation of the storm process improvements', '. . . and the forecasts had negative errors in the accumulated areal rainfall (negative bias)', etc. Please check the whole paper carefully and improve the English language.

10) The plot frame of the Figure 3(b) and Figure 3(c) is not clear.

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