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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Numerical rainfall simulation with different spatial and temporal evenness by using WRF multi-physics ensembles" *by* Jiyang Tian et al.

Jiyang Tian et al.

hettyliu@126.com

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Point 1: please explain why a 6 hour spin-up period is used (e.g., why not 12 hours or other times).

Reply: The spin-up period is necessary for WRF model and the widely used lengths are 6 hours (Givati et al, 2012), 12 hours (Hu et al, 2010) and 24 hours (Wang et al, 2012). Before we decide to use the 6h spin-up period, longer spin-up times were also tried for the six storm events. Results did not show obvious differences regarding the simulated rainfall. In order to improve the calculation efficiency for further hydrological use (flood warning), we chose to spend 6 hours to spin-up the model.

Givati A, Lynn B, Liu Y, Rimmer A. Using the WRF Model in an Operational Streamflow Forecast System for the Jordan River. Journal of Applied Meteorology and Climatology, 2012, 51(2):285-299.

Hu X M, Nielsengammon J W, Zhang F. Evaluation of Three Planetary Boundary Layer Schemes in the WRF Model. Journal of Applied Meteorology and Climatology, 2010, 49(9):1831-1844.

Wang S, Yu E, Wang H. A Simulation Study of a Heavy Rainfall Process the Yangtze River Valley Using the Two-Way Nesting Approach. Advances in Atmospheric Sciences, 2012, 29(4):731-743.

Point 2: The critical value of Cv is 0.4 and 1.0 for evaluating the rainfall evenness. Please explain how they are derived.

Reply: In order to learn the spatial and temporal evenness of the rainfall in the two study catchment, both spatial and temporal Cv of the storm events from 1985 to 2015 are all calculated. In reality, rainfall in Northern China is much more uneven than the south and it is impossible to find absolute even rainfall in both space and time. So we chose a threshold of 5%, which is also considered in other statistical analyses in the same area, as the critical value to separate even and uneven rainfall events. With the threshold, we found the two critical values of 0.4 for the spatial Cv and 0.6 for the temporal Cv. That is to say, the storm events with the spatial Cv below 0.4 or with the temporal Cv below 1.0 account for 5% of the total storm events from 1985 to 2015 in the study area. Explanations will be added in the manuscript to clarify this issue.

Point 3: At fine spatial simulation resolutions (as pointed out by Referee #1), WRF is effectively running at CPM mode (Convection-permitting model) in which the dynamics of atmospheric convection is treated with sufficient accuracy in order to make it viable to switch off convection parametrization. It would be interesting to run your WRF model again without Cumulus parameterization and compare the results with the Cumulus parameterizations.

Reply: Agreed and we would like to carry out additional runs by masking the cumulus parameterizations. In the case, four members will be added in the physical ensemble in Table 1.

Point 4: It would be helpful to know if any of the six rainfall events have caused any floods in the two study sites. Please explain which WRF simulations are useful to the flood warning purposes, and which are not (ultimately, this is the main goal of WRF applications). Do different parameterizations make any differences for warning purposes?

Reply: Thanks for the referee's suggestion. We would like to provide detailed information of the hydrological responses caused by the six storm events in this study. For example, Event V which occurred on 21 July 2012 has caused the greatest flood during the past 10 year in Jing-Jin-Ji (Beijing-Tianjin-Hebei) area and received widespread attention in China. The 24 h rainfall accumulation was 155.43 mm in Zijingguan catchment and the peak flow reached 2580 m3/s at the catchment outlet. In such cases, accurate rainfall simulations and predictions can do great help to flood warning. However, to analyze the usefulness of the WRF simulations to flood warning, the rainfall-runoff transformation processes should be further considered. This will involve many uncertainties, such as the choice of the rainfall-runoff model, the data used for model calibration, and the involvement of a real-time updating scheme, etc., which also have considerable impact on the accuracy of the flood forecasting results. In this study, the physical ensembles work as a whole to reduce the uncertainty in rainfall simulation caused by a determined set of parameterisations. The exploration of different parameterisations from the flood warning purposes is an important and interesting issue, and worthy to be discussed in our further study.

Point 5: Language issues: The paper has several typos/grammatical errors. Please go through the whole paper carefully to remove them. For example, " the precipitation easily cause flood...(causes)", " which is trick for forecasting accurately (tricky)", " found by a lot of simulation. . .(simulations) ", etc.

Reply: We will go through the whole paper carefully and make efforts to improve the readability of the paper. Grammar and spelling errors will be corrected in the revision.

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Table 1. The constitution of the WRF physical ensemble

Member ID	Microphysics	PBL	Cumulus parameterisation
1	Lin	YSU	KF
2	WSM6	YSU	KF
3	Lin	MYJ	KF
4	WSM6	MYJ	KF
5	Lin	YSU	GD
6	WSM6	YSU	GD
7	Lin	MYJ	GD
8	WSM6	MYJ	GD
9	Lin	YSU	BMJ
10	WSM6	YSU	BMJ
11	Lin	MYJ	BMJ
12	WSM6	MYJ	BMJ
13	***Lin***	***YSU***	*/*
14	***WSM6***	***YSU***	*/*
15	***Lin***	***MYJ***	*/*
16	***WSM6***	***MYJ***	*/*

Fig. 1.