Typhoon rainstorm simulations with radar data assimilation in southeast coast of China

Reply to Referee #2

Comments:

Point 1: The computation of CSI and m-RMSE in terms of spatial and temporal distribution is still confusing for the reader. As I mentioned in the first review round, it seems that spatial m-RMSE refers to the evaluation of the modeled 24-h rainfall considering all 8 stations, while temporal m-RMSE refers the evaluation of the basin-averaged (areal) rainfall using 24 model-observations averaged over all 8 stations. Is that correct? If yes, the both metrics consider the spatial dimension. Thus, the spatial-temporal discretization has no point. Similar conclusions can be drawn for CSI.

Furthermore, the term "areal" is still unclear. Do you refer to the average of the modeled rainfall over the 8 rain gauges or to the basin-averaged modelled rainfall? In Figures 7-9, the rainfall observations at each hour are averaged over the 8 stations? To the end, do you compare the average of the modeled and observed rainfall over the 8 rain gauges or the basin-averaged modelled and observed rainfall? In the latter case, how do you compute the basin-averaged observed rainfall since you have point observations?

I suggest finding a more clear and robust way to describe the different metrics and its applications.

Reply: In this study, the observation of areal rainfall in Meixi catchment is averaged by the 8 stations with Thiessen polygon method, while the simulation of areal rainfall is averaged from all grids of the WRF model inside the Meixi catchment.

As mentioned in the manuscript, P'_j and P_j refer to the simulation and observation of 24-h accumulated rainfall at rain gauge j for spatial m-RMSE. That is to say, the spatial dimension evaluation is not affected by time dimension. For temporal dimension evaluation, P'_j and P_j are the simulation and observation of areal rainfall at each time j, respectively. That is to say, the temporal dimension evaluation is not affected by the spatial differences of rainfall.

For CSI, NA_i, NB_i, NC_i at each time step i (i=1 h) are calculated by comparing the rainfall observation with simulation extracted at 8 rain gauge locations in spatial dimension, and then the values of NA_i, NB_i, NC_i at all time steps are averaged to produce the final verification results. Therefore, N refers to the total time steps, which is 24. For temporal dimension evaluation, NA_i, NB_i, NC_i are first calculated using the time series data of simulations and observations at each rain gauge i (i= 1), then the averaged index values of all rain gauges are regarded as the final verification results. Thus instead of the simulation time steps, N represents the total number of the rainfall gauges, which is 8 for temporal

dimension evaluation. That is to say, the temporal CSI is the average index values of all rain gauges. The calculation method can also be found in the following reference:

Liu J., Bray M., Han D. Sensitivity of the Weather Research and Forecasting (WRF) model to downscaling ratios and storm types in rainfall simulation, Hydrol. Process., 26, 3012-3031, doi: 10.1002/hyp.8247, 2012.

Therefore, the rainfall observations at each hour are averaged over the 8 stations by the Thiessen polygon method in Figures 7-9. We compare the average of the modeled and observed rainfall over the simulated rainfall averaged from all grids of the WRF model inside the Meixi catchment and the observed rainfall averaged by the 8 stations with Thiessen polygon method.

In order to make the "areal" clear, the following sentences are added in Line 27-29, Page 6:

"In this study, the observation of areal rainfall in Meixi catchment is averaged by the 8 stations with Thiessen polygon method (Sivapalan and Blöschl, 1998), while the simulation of areal rainfall is averaged from all grids of the WRF model inside the Meixi catchment."

The sentences in Line 2, Page 7 are revised as:

"where P' is the simulation of 24-h accumulated areal rainfall, and P is the observation of 24-h accumulated areal rainfall."

The description of metrics in Line 9-15, Page 7 are revised as:

"NA_i, NB_i, NC_i at each time step i (i=1 h) are calculated by comparing the rainfall observation with simulation extracted at 8 rain gauge locations, and then the values of NA_i, NB_i, NC_i at all time steps are averaged to produce the final verification results. Therefore, N refers to the total time steps (N=24). For temporal dimension evaluation, NA_i, NB_i, NC_i are first calculated using the time series data of simulations and observations at each rain gauge i (i= 1), then the averaged index values of all rain gauges are regarded as the final verification results. Thus instead of the simulation time steps, N represents the total number of the rainfall gauges (N=8) for temporal dimension evaluation."

The sentences in Line 19, Page 7 are revised as:

"P'_j and P_j are the simulation and observation of areal rainfall at each time j, respectively."

Point 2: I still do not understand the phrase "Considering the application effect in southeast coast of China". I suggest keeping the justification of the physics options selection based on previous studies.

Reply: Thanks for the reviewer's suggestion. The sentence has been revised as:

"According to the previous studies on physics options selection."

Point 3: English grammar and style still need further improvements (e.g., use of past tense in the

description of the studied events in Section 2).

Reply: The gramma mistakes are checked carefully and English style is unified in the revised manuscript.