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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Selection of multi-model ensemble of GCMs for the simulation of precipitation based on spatial assessment metrics" *by* K. Ahmed et al.

Anonymous Referee #3

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In this manuscript, authors evaluated precipitation data from 20 CMIP5 GCMs and selected four better-performing CMIP5 GCMs based on their spatial performance against observed precipitation (GPCC) during the historical period (1961-2005). To evaluate the skill of model precipitation (CMIP5 GCMs) against observed precipitation (GPCC), they used six spatial metrics (SPAEF, Goodman-Kruskal's lambda, Fractions Skill Score, Cramer's V, Mapcurves, and Kling-Gupta efficiency). Finally, they generated multi-model ensemble mean (MME) of precipitation of four selected GCMs using Random forest regression and simple mean method. The manuscript is written fairly well, and the idea of spatial assessment of CMIP5 GCMs for multi-model ensemble mean is appreciated. However, the execution of manuscript seems sloppy and hasty.

There are numerous methodological, data, explanation, reporting, and citation issues in the manuscript. Thus I recommend major revisions be required before publication.

Major issues:

1. Error and unexplained parameters in the formula of matrices: I have many doubts about spatial assessment methods. Authors need to explain all six methods clearly and correctly. a) In Goodman-Kruskal's lambda, how many classes you have taken in the contingency matrix? Please mention the number of classes and explain- Are these classes sufficient to explain spatial variability of rainfall or measure the matrix accurately? Did you consider only one annual map to estimate the lambda value for each model? If yes, then there may be many years those have low or high bias but not captured in the annual mean map. You need to estimate lambda value for each year or seasonal map. What is the maxj (or maxj)? What is the value of m and n? b) In the fraction skill score, there should Nx*Ny in the palace of N. Roberts and Lean, (2008) used Nx*Ny. It will affect the final results. Please explain it. c) In Cramer's V, you have taken the wrong formula. There should be N*(min(m-1,n-1)), but you have taken N*(min(m,n)-1. It will also affect your final selection. d) In Mapcurves method, did you classify your map in the different range of rain? If yes, how many classes you have taken? Did you calculate Y value for each month/ season/year? It should be calculated for each year (1961-2005) between model and GPCC data in the case of annual values. e) In Kling-Gupta efficiency, please check Demirel et al., 2018 paper. They have taken different formulas for beta and gamma. f) Why did you choose these six methods? What are the limitations of each method? Please explain.

2. Error in rating metrics formula: (P10, L10) In this formula, rank varies from 1 to 6 (n=6) but it should be 1 to 20 (model=20) for each matrix. Please explain this.

3. Pre-monsoon and Post-monsoon seasons: Why did you not consider the pre and post monsoon season for the analysis and during the overall rank. These seasons will affect significantly in the overall ranking. I recommend to estimate rank month-wise.

That will improve the results significantly and should not provide the same weight to each month. Here, you provided the same weight to annual, monsoon, and winter rank (during overall rank). Why?

4. Inconsistency in spatial resolution: You should consider the same spatial resolution to compare the maps or data sample. In the manuscript, observation data (GPCC) are available at 0.5° resolution and model data are prepared at 2° resolution. Model data should be regridded at 2°.

5. Random Forest Method: Please explain the method and weight value.

6. Increase the number of CMIP5 models in the study: Authors used only 20 models for the current study and said all four RCP data available for 20 models. However, there is no use of RCP data in the analysis. Hence, they can get historical data for more than 35 CMIP5 GCMs. That will increase the scope and use of this study. I recommend they should use the maximum number of models.

7. Selection of better performing models should be based on at least precipitation and temperature: In the manuscript, authors used only precipitation variable to select better performing models, but there are many models under CMIP5 those have low projection skill in temperature data and high skill in precipitation. Hence, there is a possibility of the poor skill of temperature projection in the selected GCMs. Moreover, most of the studies in the hydrology and earth science commonly use precipitation and temperature variables. Therefore, they should include the temperature variable in the analysis and select the models based on the high skill in both (Precipitation and temperature) variables.

Other issues: (P- no of page; L- no of line) 1. P2, L1 – please provide citation after several studies (related to the heatwaves, cold snaps etc.). Duffy et al. (2015) is about drought and wet spells. 2. P2, L7: please provide the correct citation. Hegerl et al., 2018 is not about the affecting hydrological cycle (that include ET, runoff, soil moisture, and precip) 3. P2, L9: should be Akhter et al., 2017\ 4. P2, L10: Wright et al., 2015 is

about RCMs. Please provide a correct reference. 5. P2, L13: cite CMIP5 GCMs 6. P2, L14: Cited paper is not about the cmip5 and cmip3 comparison. 7. P2, L14: more than 50 GCMS are available. Please check other papers. 8. P2, L16: Ekstrom et al., 2016 is not about size and restriction on the size of the subset of GCMs. 9. P2, L16: Salam et al., 2018a and 2018b is same 10. P2, L17: should be 2018 11. P2, L16: cite some paper about the uncertainties in GCMs and why do we need to do ensemble mean. Please add some line about this. 12. P2, L19: “prediction” (“projection”) 13. P2, L22: Wang et al., 2017 14. P2, L24: Wang et al., 2017 15. P2, L25: Fu et al., 2018 and Dong et al., 2018 are not about the comparison between MEE and individual. They are based on temperature projection. 16. P2, L31: 2018 17. P3, L15: Gleckler et al., 2008a and 2018b are same. 18. P4, L1: provide citation after several studies. 19. P4, L7: you used six methods. Please correct this number throughout the paper. 20. P4, L11: please mention the calendar months. 21. Figure 1: should include a climate zone map also. 22. P4, L25-29: this data conflict with the fig 3a. 23. P5, L7: please provide the website link (GPCC data). 24. P5, L11: high correlation? Please provide the number. 25. P5, L14-20: Please mention the ensemble member that you have used in the CMIP5 GCMs. 26. P5, L15: provide a website link. 27. P6, L24: Please check the citation. In the introduction, you mentioned Demirel et al., (2018). 28. P7, L11: Lambda (heading) 29. P11, L12- 25: You did not mention about the time series. Is it annual rainfall or seasonal or monthly time series? Did you check NRMSE and md between the annual time series? 30. No need for figure 2. You can remove the figure 2 and include the rank in table 3 in brackets.

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