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Interactive comment on "Diagnosis toward predicting mean annual runoff in ungauged basins" *by* Yuan Gao et al.

Yuan Gao et al.

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Reply to Referee #3: Wang and Gao et al conducted a study to develop a nonparametric mean annual water balance model for prediction in ungauged basins. They found that climate and topography play essential roles determining the storage capacity and its shape. I found this study is quite interesting and fits the scope of HESS. Relevant studies should be encouraged to understand and diagnose the impacts of different features on runoff generation in different time scales and their connections. Here I have several comments for the authors to consider for further improving the quality:

We thank the reviewer for this positive feedback. Our responses to your comments are listed below.

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(1) Why did the authors only use 35 catchments in this study? There are over 400 catchments in MOPEX data. Please clarify the reasons to exclude most catchments.

The 35 watersheds are selected considering the data availability including soil (hydrologic soil group), land cover and land use, DEM as well as the minimum snow effect and human activities. The data processing demand is also a consideration for selecting the limited number of watersheds. We think that the number of watersheds is sufficient for diagnosing the data requirement for estimating long-term runoff in ungagged basins, for example, the importance of bedrock data. The reasons will be clarified in the revised manuscript.

(2) Line 73-74. I cannot follow this sentence. Please rephrase it.

Thank you for pointing out the problem. This sentence would be revised as: It has also been suggested that the spatial variability of soil water storage capacity could suppress the actual evaporation because the maximum evaporation in areas with storage capacity less than Ep will smaller than Ep; therefore, the average evaporation over the entire catchment is smaller than Ep even though the average storage is greater than Ep, resulting in more runoff generation compared to the situation when the storage capacity is spatially uniform (Yao et al., 2020).

(3) Line 243. The Sb in Chattahoochee River watershed reaches to 1870mm. The value is to large, which let me doubt the physical meaning of the Sb parameter.

Sorry for the typo on the number of Sb in Chattahoochee River, and it should be 1559 mm. The physical meaning of Sb is the mean value of the soil water storage capacity over a catchment which is defined as the maximum storage from the land surface to the bedrock in this study rather than the storage capacity from shallow soils. Considering the maximum of soil water storage capacity could be 2000 mm from literature (Kollat et al., 2012), 1559 mm is considered to be reasonable in this study. To avoid this kind of the concern, the definition of the Sb will be clarified in the revised manuscript.

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Kollat, J., Reed, P. M., and Wagener, T.: When are multiobjective calibration tradeâĂŘoffs in hydrologic models meaningful?, Water Resour. Res., 48(3) https://doi.org/10.1029/2011WR011534.

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2020-353/hess-2020-353-AC3-supplement.pdf

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