

## ***Interactive comment on “Spatial Relationship between Precipitation and Runoff in Africa” by Fidele Karamage et al.***

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SC1-Anonymous Referee #3 Anonymous Referee of the HESS Journal Dear reviewer M. Mutema,

Subject: Responses for your review comments posted on 18 October 2018 on our manuscript No.: hess-2018-424, entitled “Spatial Relationship between Precipitation and Runoff in Africa”

We would like to thank you for the time and effort used to review our manuscript. We have carefully reviewed the comments and have revised the manuscript accordingly. Our responses are given point by point below and the track-change and clean-revised manuscripts were also prepared. We thankfully acknowledge your comments, as they

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were valuable in improving the quality of our manuscript and are useful in our future work.

Yours sincerely,

Review comment 1

I will start by appreciating the amount of energy put in gathering, processing and analyzing the huge amount of hydrological data on Africa. However, in agreement with Referee #1, whose contributions are already posted, I noted a number of unfounded pronouncements. I will not repeat on issues already raised by Referee #1. My comments/remarks are summarized as follows: - It is common knowledge that there are many factors with significant control on the hydrology of catchments/basins; therefore, it is always important for authors to justify their choice of factors to include/exclude in their study. The authors listed their choices on page 2, lines 24-26, without any attempt to explain why they considered them to be the more important ones.

Response

Thank you for the remarks about the choice of runoff controlling factors. Based on your comments the interpolation method was revised and more details were provided. Actually, the methodology used to predict the runoff depths and coefficients in ungauged regions is the inter-gauged and ungauged basin parameter transfer method that can be considered as a hybrid interpolation method based on spatial hydrological similarities analyzed using the key runoff controlling factors. This is one of the recommended approaches for hydrological predictions in ungauged basins (PUB) (Bárdossy, 2007; Blöschl, 2006; Chiew et al., 2018). This method assumes that two separate catchments can have a similar hydrological process if they have similar climatic and physical conditions. In the revised manuscript, this study has 2 objectives: (1) the estimation of the relationship between precipitation and runoff using the runoff discharges down-scaled from basin to grid-scale which can be reasonably utilized on the non-catchment regional studies (i.e.: Country scale), (2) prediction of runoff depths and coefficients

over ungauged regions utilizing the inter-gauged and ungauged basin parameter transfer method based on spatial hydrologic similarities. This is one of the recommended approaches for hydrological predictions in ungauged basins (PUB) (Bárdossy, 2007; Blöschl, 2006; Chiew et al., 2018). This method assumes that two separate catchments can have a similar hydrological process if they have similar climatic and physical conditions. The hydrologic similarity was assessed based on the key runoff controlling factors selected based on their potential sensitivity in runoff generation process as revealed by different hydrologists. Detailed information about the choice of runoff controlling factors was provided in the revised manuscript. Regarding the validation of the approach used to predict the data for filling the gaps indicated that the estimated and observed runoff coefficients have the goodness of fit ( $R^2$ ) ranging from 0.56 to 0.67 for the long-term monthly  $R_c$  and 0.78 for the annual mean  $R_c$  (Figure 14). These results are within permissible validity limits since an  $R^2 > 0.5$  is considered acceptable for calibration and validation in hydrological modeling (Santhi et al., 2001; Van Liew et al., 2003).

## Review comment 2

The choice of a country as the finest spatial scale in the study also required a base. It is not clear how the authors can justify their choice and how they treated the fact that many African countries drain into more than one river basin. This is important because it might affect the results shown in Figure 11.

## Response

Thank you for raising the issue concerning the choice of a country as the finest spatial scale in the study. In the revised manuscript, the relevancy of runoff estimation on a non-catchment scale was highlighted. Actually, runoff-related studies are often conducted at a drainage basin scale, but, hydrological studies on the grid and country scales are also very useful at the national level since each government has own policies for water resource management. For instance, it has been noticed that

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runoff discharges are useful in water stress analysis on a country scale (Ruess, 2015; Smakhtin, 2004). Utilization of average basin estimates directly at a country level or any other non-catchment locality seems to be unrealistic. This is the reason why this study suggested the process of downscaling the basin' observed runoff discharges based on grids' direct runoff contributions to their corresponding basins which helps to incorporate the effect of major runoff controlling factors (i.e.: land cover types, soil characteristics, moisture conditions and precipitation intensities) within different grids sharing the same catchment according to the Natural Resources Conservation Service (NRCS) runoff curve number (CN) variables.

### Comment 3

The results of the current study seem to confirm what is already known about the hydrology of Africa, which leaves one wondering whether the authors were able to articulate the objectives of the study. The discussion part of the paper did not help to put the study into proper context either.

### Response

We apologize for the poor articulation of the objectives and discussion of the study. In the revised manuscript, the objectives and the contribution of the study were revised accordingly. "The study has 2 objectives: (1) the estimation of the relationship between precipitation and runoff using the runoff discharges downscaled from basin to grid-scale which can be reasonably utilized on the non-catchment regional studies (i.e.: Country scale), (2) prediction of runoff depths and coefficients over ungauged regions utilizing the inter-gauged and ungauged basin parameter transfer method based on spatial hydrologic similarities."

### Comment 3

The immediate above remark, perhaps, explains the weak discussion and, especially, the conclusion of the paper. For example, the study has no basis for concluding that

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items enumerated on page 24, lines 11-12, are the solutions to address water scarcity in Africa. My opinion is that, while a lot of effort was put in gathering, processing and analyzing the data, there was not much zeal in interpreting and interrogating the results leading to a weak discussion of the results and conclusions.

## Response

We are sorry for unwell-developed discussion and conclusion. In the revised manuscript discussion and conclusion sections were revised according to the objectives of the study.

Again, we are thankful and appreciate your valuable comments that very helpful in revising our manuscript.

Please also note the supplement to this comment:

<https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-424/hess-2018-424-AC2-supplement.zip>

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2018-424>, 2018.

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