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Hydrology and Earth System Sciences
Discussions

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

Anonymous Referee #2

Received and published: 18 November 2018

I reviewed the manuscript "spatial relationship between precipitation and runoff in Africa", and I feel the manuscript has some major flaws. Besides the fact that the authors use a data set which has significant data gaps which are not discussed in the paper. This may have major implications for the validity of the results. Also the fact that the river basins change over time (eg anthropological changes) which are not taken into consideration. The approach taken to generate information in ungauged basins is not sufficiently validated with the observed data to be able to use them for the final analyses. Also the approach is not sufficiently described (eg what is the difference between the potential runoff coefficient and the final one), how are T and P used to generate the Rc? Below are additional general comments on the manuscript, also the paper does not use common hydrological terminology, which I have highlighted in the

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last section with detailed comments.

General comments:

Page 2, Line 10 “Although runoff studies have been conducted at global scale and in some local areas in Africa” Although there are few studies describing continental scale hydrology in Africa (but they do exist, see Schuol et al 2008), it is pertinent untrue to say there are only some studies on runoff in local areas in Africa. The authors are advised to perform a detailed literature review before writing the introduction and providing such an untrue statement.

Page 2, Line 24-26 “The Rc data were then interpolated to the ungauged areas using the key factors such as land-surface temperature (T), Precipitation (P) and potential runoff coefficient (Co) estimated from the land use and land cover, soil texture and slope information by using GIS spatial analysis techniques.” This is a typical approach to regionalise hydrological processes in ungauged basins. The authors should refer to earlier studies under the PUB initiative of the IAHS to explain how this approach is a well accepted approach. However, in this approach I don’t understand how the runoff coefficient (Rc) is dependent on the runoff coefficient (Co)? Are these not the same thing?

Page 5 figure 2, the conceptual framework calculates the runoff coefficient from the rainfall and runoff data bases, afterwards it recalculates the runoff by multiplying the rainfall with the runoff coefficient (top right box), how is this relevant?

Page 6, figure 3, colors indicated in the legend are not consistent with the map, unclear what the legend “mean number of streamflow recorded months per each month of the year during 1901-2017” means. Based on the text, this would mean 12 maps? Also I see some areas with yellow markers indicating less than 10 years of data, correct? And for the Congo river I only see a marker at the downstream end of the basin. How does this affect the analyses? Also using data from any period seriously affects the analyses, as many dams have been constructed in the later decades. Even for stations with data

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across the 117 years, this needs to be taken into consideration.

Page 6 equation 1 is an obvious equation and does not need to be presented.

Page 7 line 1-10: using two different datasets may bring in additional uncertainty, is it really worth including the additional 3 years of data?

Page 7 equation 2, does this mean you have for each station 12 Rc values for each month? The units for runoff and precipitation (line 14) should be mm/month. How do you convert this to an Rc on an annual basis? How do you take into account different availability of data for specific months?

Section 2.2.1: how many stations were used for the study with a typical availability of data?

Section 2.2.2: why is there a completely different approach for ungauged basins? How are the two studies linked?

Page 7 line 20: the authors are using IDW to interpolate runoff coefficients. However Rc is dependent on the upstream catchment area, two stations close to each other could have significant differences in upstream catchment area and dynamics, this is not an approach which has been tested in the hydrological field (neither are the authors providing evidence that this approach is appropriate).

page 11&12 figure 6: how was the most right map developed from the three other maps (not explained in text) What would be interesting is to assess how the approach in 2.2.2 is able to generate Rc for the gauged basins to validate the approach used.

Page 13 line 11 it is very confusing when the authors use ETc in a different way it is normally used (for crop evapotranspriration)

Page 13,14,15 section 3: there is absolutely no reflection on what figure 6&7 are showing, is this the result of the methodology described in section 2.2.1 or 2.2.2? How does the interpolation approach work compared to the one using observed data?

Page 17, section 3.1 to base any conclusion on the validity of the approach solely on continental scale data, is problematic. There is huge spatial and temporal variability across the continent, average monthly rainfall as presented in this section is irrelevant. Also observed runoff presented in figure 9 does not include the entire continent, how can this be compared to the interpolated one which covers the entire continent? The observed basins often collect data from large river basins, which have different dominating processes compared to smaller basins.

Page 19, section 3.3 To estimate runoff coefficients on country scale is irrelevant, as they do not constitute a drainage basin.

Schuol, J., Abbaspour, K.C., Yang, H., Srinivasan, R. and Zehnder, A.J., 2008. Modeling blue and green water availability in Africa. Water Resources Research, 44(7).

Detailed comments:

Use of definitions: Page 1 Line 28 “lacking precipitation”

Line 30 “precipitation scarcity”

Line 31 “eastern and western drylands of Africa”

Page 2 Line 4 “water runoffs”

Line 4 “hazards and disasters”

Line 5-6 “flood threats”

Line 12 “indicative runoff coefficient” what do you mean with indicative?

Line 16 “The runoff coefficient is the ratio of runoff depth to rainfall intensity” rainfall intensity is more often associated with events and not with long term runoff coefficient as you probably are referring to.

Line 17 “waterflow”

Line 19 “runoff coefficient is very useful for catchment scale land use and flood man-

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agement", I disagree with this statement, floods are often associated with short timespans

Line 30-31 "Evapotranspiration is generally less than precipitation in wet seasons, that is positive water balance due to groundwater accumulation, which results in an increased surface runoff." I do not understand this sentence

Line 32 "plants absorb underground water" why only the plants?

Line 33-34 "underground water can be ignored in the long-term annual mean water balance" Do you mean that "the change in storage" can be ignored?

Page 3 Line 8 unit for mean precipitation should be mm/year

Source of data for figure 1?

Page 4 Line 12-13 "Drainage patterns are controlled by the distribution of basins and swells, about 95% is drained through permanent or ephemeral rivers" what other types of rivers exist? And what is a swell? Aren't drainage patterns dependent on geographical location, topography, climatological factors etc?

Line 14 "sand sea"??

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