Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-318-AC1, 2016

Hydrology and Earth System Sciences
Discussions
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Interactive comment on "Temporal and spatial changes of rainfall and streamflow in the Upper Tekeze–Atbara River Basin, Ethiopia" *by* Tesfay Gebretsadkan Gebremicael et al.

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Received and published: 8 November 2016

On behalf of myself and the co-authors, I take the opportunity to thank the anonymous reviewer for her/his constructive comments, questions, and editions. We have responded to all questions and comments, as discussed below. Making use of the given comments and suggestions we have updated the manuscript accordingly. We feel the quality and readability of the paper have been improved significantly.

Comment 1: The study is relevant to the broader community in terms of illustrating the need to consider global change (not only climate change), including land use and land management as well as changes thereof in water resources planning. The study should be able to provide needed information for the basin water managers as well.

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Although the methods used are not novel, a study of this nature in that area provides new results. The paper claims to assess the changes temporally and spatially. Although a spatial description is given, there is no map or link to figures displaying the results spatially thus it is not possible to determine spatial patterns in the changes and the text was difficult to follow. The only map of the catchment provided does not illustrate the catchments referred to in the text. The spatial aspect of the analysis needs to be strengthened. Linked to this are the weak conclusions drawn.

Response: We agree with the reviewer on the main comments: the flow of text, maps of spatial variability, and articulated conclusions. We have added two maps to show spatial variability in the basin; Fig. 3 for rainfall and Fig. 5 for streamflow. The reader can then easily spot trend at the stations. Accordingly, the discussion part on the spatial variability of rainfall and streamflow has been improved in the manuscript. We have also added sub-basins to the map of Fig. 1 to link location of stations to boundaries of a sub-basins. Following these improvements, the conclusion part has also been improved to be clearer.

Comment 2: The paper states the relation of the trends observed in streamflow to the hydropower dam and the land management changes. Spatially these relationships are not illustrated and there is no quantitative assessment undertaken. It would strengthen the paper to have a stronger relationship between the changes in streamflow and these changes demonstrated.

Response: Indeed it would have been more informative if relationships of land changes and stream flow are identified more accurately. However, this requires a lot of work on land use land cover change detection using satellite imageries for the last 4 decades. This is beyond the scope of the paper which attempts to quantify the long-term trends of rainfall and stream flow, and wheather they are associated together. In fact, the analysis of LULC change and its relation to stream flow is our next exercise. Yet, where possible, we tried to give a further interpretation of the results from literature – but qualitatively.

Comment 3: The reference to the monthly results in the paper when they are not actually included needs revision. If they are important/relevant enough to discussed in the paper, then they should be provided.

Response: We have added monthly and seasonal results of Mann-kendall and Pettitt tests as a supplementary file in Table S1 and Table S2, respectively. Results of monthly streamflow analyses from Pettitt test is included in Fig.S3 for further references. The discussion of this part has also been modified accordingly.

Comment 4: Beyond this, there were several grammatical and spellings errors in the manuscript. A thorough proof read is required. Other comments are included in the attached pdf.

Response: The language of the manuscript somewhat improved to allow smooth flow of information and according to the comments the following specific changes has also been made in the manuscript.

Page 3 Line 24: delete “the” from the sentences

Corrected

P3L26: Delete “from” from the sentences

Corrected

P3L28: unnecessary phrase “topography of the”

Repetition avoided

P3L31-32: repeated word “climate”, ”himud?” and change” ranging” to ranges.

Corrected

P4L15: Delete, “in the” from the sentences

Deleted and the sentences is rephrased

P5L14: Correct sentences to “rainfall stations with less than 10% missing data have been used”

Sentences improved accordingly

P5L20: Grammar, “were” changed to are.

Corrected

P6L8: Improve sentences to “performed the best and were recommended for the basin”

Improved according to the suggestion

P6L17: change “were” these to these were

Corrected

P6L25-27: Need to show on map to be able to place in context of the catchment

We have improved Fig 1 to include the sub-basins and rainfall and streamflow stations. We have also included two additional maps showing the distribution of trends across the sub-basins.

P6L28: remove “out” from sentences

Removed

P7L5: Change “where” to when

Sentences improved

P7L9: add “s” after tend and change “of” to in

Grammar corrected

P7L14: unnecessary word “approach”

Deleted

P8L14: change “seen” to found

Changed

P8L15: use streamflow is some instances and stream flow in others

Corrected to streamflow in the whole document

P9L17-19: Meaning unclear

Sentences rephrased to make it clearer

P9L19: change “that” to if or why

Replaced by why

P9LL27: In the text you described the spatial variation but not shown in figures. I think maps showing this would improve the paper.

Mean annual rainfall and streamflow (dry season) are presented on the map of Fig. 3 and 5. Results of the trend test given in the map of Fig. 3 for rainfall and Fig. 5 for streamflow. The discussion part has also been improved accordingly.

P10L3: Both of which have the highest percentage of missing data

Discussion added to the text, in that discrepancy from stations could be because of unreliable data.

P10L9: Either the result should be provided or this should be omitted

Summary results on monthly rainfall trends is added as supplement document (Table S1).

P10L13: again-not sure that this is necessary. Was the change point test simply not done? In the next sentences though you refer to a figures as an example of the annual and seasonal time steps.

We did not include all results because of space. However, based on reviewers recom-

mendation, now we added monthly results (Table S1) and seasonal results (Table S2) as supplementary data. Discussion for this part has also been improved accordingly.

P10L19-20: But no monthly results are shown so how is this possible to deduce?

Monthly rainfall result is now included as supplementary file (Table S1)

P11L5: correct spelling “gagging”

Corrected

P11L13: rephrase sentences to “did not significantly changed”

Rephrased

P11L15: change “decreasing of” to decrease in and “in” to at

Grammar mistakes corrected

P11L29: correct spelling “ungagged”

Corrected

P12L6 and L7: put “an” before abrupt, replace “of” by in and “in” to at

Corrected

P12L11-17. Why are the monthly results not included?

Monthly streamflow from Pettitt test included as a supplement document (Fig. S3). Spatial variability of monthly flow is discussed based on the graphs.

P12L31: replace “in” before four station and three stations by at

Replaced

P13L7: What is meant by this?

Modified to short period fluctuations of hydrology

P13L9: IHA parameters or variables?

Parameters included after IHA

P15L8: change “compare£ to compared

Corrected

P15L17: remove significant

Removed

P15L24: change “week” to weak

Corrected

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