

Interactive comment on “Assessment of climate change impact on hydrological extremes in two source regions of the Nile River Basin” by M. T. Taye et al.

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We wish to thank the reviewer for the valuable suggestions made for improving the quality of the paper. We agree that the paper in its current form would have been incomplete. Our responses to these comments follow hereafter.

Comment 1: The paper needs editing for English language

o Response – We will polish the English language in the revised paper.

Comment 2: Many papers are missing

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o Response – We appreciate the reviewers suggested citations. We will mention the citations in the updated manuscript.

Comment 3: Two different models are proposed in the study, which could be interesting, but a lumped versus spatially distributed would have been much more interesting. Also, the difference of the model is just reported, but is not further integrated with the other climate results.

o Response – We agree that a lumped versus a spatially distributed model would be more interesting. However, given the large set of simulations, a distributed model would have been computationally challenging. Also, the current lack of data in the study regions presents another challenge for the use of distributed models. Nevertheless, the study of two lumped models is still interesting considering that the modelling philosophies vary even at the lumped state. This was not adequately expressed within the results section. However, the results showed that the two lumped models result in a similar range of projections for the annual flows. This could perhaps be explained by the large temporal scale analysed and differences could be more noticeable when low temporal scales are considered as revealed in the daily peak flow extremes in fig. 3. The paper did not include details on the influence of the model structure has on the climate change projections. This was a shortcoming which will be addressed. Indeed, this is one of the comments raised consistently by the reviewers.

Comment 4: How could ET values been computed by point measurements? Next sentence states they are computed using temperature values... Please clarify

o Response – The computation of ET using the minimum requirement of maximum and minimum temperature is also repeatedly raised by the reviewers. We have responded to a similar comment (see reply to Axel Thomas). We agree that the sentence needs further clarification. It does not mean that the other variables were not considered when using the FAO Penman Monteith method. Rather the parameters were estimated based on the minimum and maximum temperatures. We will add extra details to clarify

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this.

Comment 5: A very ad-hoc procedure is used for the climate change downscaling. On what basis, wet and dry days have been added? Why randomly? Does that respect the wet after-day and wet-after-wet statistics? Why not using the many reported techniques that have been described in literature (e.g. statistical downscaling, regional climate models)?

o Response – The reviewer notes the use of an ad-hoc downscaling procedure. We realize this comment was raised due to the missing details on the downscaling procedure. We had originally preferred to split the paper into two parts to avoid a very long paper. The first paper would deal with the quality of the GCMs and the downscaling approach. The second paper would cover the impact results. However, it is now clear that a better paper requires merging the two studies. Concerning the comment, we should point out that we did not invent the method. The method is not an ad-hoc method but a combination of already existing downscaling approaches. The day to day variability is addressed through the use of adjustment of the length of wet and dry spells. In addition, because different changes are possible for the time series, we perform a random approach that keeps altering the wet and dry spells until they match the required change in mean spells. This change in mean spells is determined from a given climate model projection. Next to this, we use a quantile perturbation approach which has been recommended for a more realistic projection of future changes in extremes (Olsson et al., 2009; Chiew, 2006). The method essentially ensures that each quantile is changed with a factor that depends on the return period. This overcomes the limitation of using mean changes on all the quantiles (e.g. monthly changes) which may underestimate changes in extremes.

Comment 6: P6 line 30: please describe the method instead of referring to the paper

o Response – It is not clear what the reviewer means. “P6 line 30” is hard to track. We presume that the reviewer means the assumption on page 5446 by Andersson et

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al. (2006) which states that models which simulate present day climate well are more likely to represent the future changes better than less performing models. However, Anderson et al. (2006) do not verify this assumption. Perhaps a better reference is required. Nevertheless, we prefer not to verify this assumption as it is clearly out of the scope of this study.

Comment 7: $1/Q$ transformations could be dangerous for the very low flows that go close to 0. 50% decrease on nearly nothing is nearly nothing.

o Response – We used the $1/q$ transformation for the extraction of “nearly independent” low flow extremes from the full time series, using the same method as was applied for the high flow extremes: the Peaks Over Threshold (POT) method. After selection, we transform the low flows back to the original flows to determine the percentage changes. We will make this clearer in the updated manuscript.

Comment 8: The conclusion section looks like it has been copied directly from a thesis and are not all supported by the text and figures.

o Response – The conclusion section will be updated with more discussions on the findings stated in the text and figures.

References

Olsson, J., Berggren, K., Olofsson, M., Viklander, M.: Applying climate model precipitation scenarios for urban hydrological assessment: A case study in Kalmar City, Sweden. *Atmospheric Research* 92 (3), 364-375, 2009.

Chiew, F.H.S.: An Overview of Methods for Estimating Climate Change Impact on Runoff. In: 30th Hydrology and Water Resources Symposium, Launceston, Australia, pp. CDROM (ISBN 0-8582579-0-4), 2006.

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