

**Interactive comment on “Drivers of spatial and temporal variability of streamflow in the Incomati River Basin” by A. M. L. Saraiva Okello et al.**

**Anonymous Referee #3**

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**Reaction to the interactive comment by Anonymous Referee #3**

We would like to thank this referee for the time spend in critically reading our manuscript and for his/her interesting comments and suggestions that contributed to improve our paper and to clarify specific points. Hereby we present the authors reply (AR) to the referee’s comments (RC).

RC: Saraiva Okello et al. report on the drivers of spatial and temporal variability of streamflow in the Incomati River Basin in Southern Africa using rainfall and streamflow observations over a relatively long time period. The topic is relevant to a wide range of readers and fits well within the scope of the Hydrology and Earth System Sciences journal. However, important links between the research objectives and analysis of outcomes in this MS are broken and need further attention before the paper is suitable for publication. Some of the overarching issues are summarized below. In addition, the MS would benefit from a thorough edit for English language usage.

AR: The authors thank the reviewer’s recommendations. The article was revised to strengthen the link between objectives and analysis, and then revised on English issues. Several comments made by the three reviewers helped in this regard.

RC: 1. Page 8880, line 4 (and throughout the MS): The authors discuss natural (environmental) flows and changes to the flow regime due to water management activities in response to different human-driven demands for water across the basin. The study, however, does not succeed in isolating the impacts of one or the other on streamflow. Taking this into consideration, the MS needs a thorough revision in order to make the research objectives more focused and feasible.

AR: In our opinion, comprehensive evidence is presented on isolating the impacts. For instance, the results are examined for sub-catchments and specific gauges and the observed changes were discussed specifically. For example, the impact of dams in Crocodile (gauge X2H013); irrigation; forestry (gauge X2H010); combined impacts (gauge X2H016). At higher spatial scales, the isolation of several human activities is not possible because of scale issues. On this issue, the discussion on re-enforcement or cancellation of impacts is given. Therefore, we consider that the manuscript does not need major revision on these points. However, the other reviewer’s comments contribute to clarify these points as well.

RC: 2. Page 8881, lines 20-27: The discussion of climate change impacts on hydrology are somewhat irrelevant, as the MS does not really provide a focused investigation of these. Investigating projected impacts such as decreased rainfall events would require analysis of sub-daily data, if the authors mean decreased rainfall duration. If number of rainy days is meant, however, this could be investigated from the relatively long time series of daily rainfall data that the authors have analyzed. However, this is not clearly addressed and instead the IHA methodology is followed without much justification on how it contributes to addressing the research questions of the study.

AR: We acknowledge that the analysis of sub-daily data on rainfall is important to further understand how rainfall intensity and other extremes have changed over time. This will be subject of further research. However, the manuscript's main focus was to understand the changes occurring on streamflow, therefore the analysis of rainfall data was conducted only at monthly and annual scales to assess if there were trends at this level corresponding to the streamflow trends. The explanation about the IHA methodology was improved in the manuscript, as well as the reason why specific methods were chosen.

RC: 3. Page 8882, lines 19-26: Generally, the research objectives then need to be followed by a focused methodology for answering these. This is not well achieved in the current MS version. What is needed is an explanation for the observed trends in streamflow, but not in rainfall. Land use changes appear to have contributed substantially to this but there is no mention of other variables such as temperature and humidity, for example, which could also have a pronounced effect on streamflow. Even the links with land use changes are not investigated in sufficient detail in order to draw the relevant conclusions and possibly this is one of the reasons for the authors struggling to interpret the outcomes from this study in the final sections.

AR: The authors have revised the manuscript, based on the suggestions of all referees to strengthen the link between research objectives, methodology, results and conclusions. The main focus of the paper is to look at drivers of streamflow trends observed. Climate can be one of the major drivers, particularly precipitation. The analysis of other climatic factors is also relevant, but was beyond the scope of the current analysis. The authors strived to establish links between trends identified and land use changes that occurred, however, some changes occurred well beyond the period of analysis (1970-2011). Therefore only secondary data about land use changes was available, but this already gives strong evidence of the importance of land use changes.

Some comments on figures and tables:

RC: - Table 3: The use of the @ symbol is inappropriate, the location could be given with either a comma or in parentheses.

AR: Revised.

RC: - Figure 2: The text is very unclear in this figure, consider revising the layout and presentation.

AR: Revised.

RC: - Figure 3: Is the N-S variability unimportant? Would it be better to present the error bars on a map?

AR: The N-S variability is also important. The graph will be changed accordingly.

RC: - Figure 9: The shaded box with trend parameters might not appear well in print, consider revising the figure.

AR: We believe the reviewer meant Figure 8, instead of Figure 9. The figure will be revised to increase the contrast between trend parameters and land-use map.

RC: - Figures 10&11: The text in the legends of these figures is too small to read, consider revising the layout and labeling of these plots.

AR: The layout and labels were revised; the font size was increased to make them more readable.