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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Modelling stream flow and quantifying blue water using modified STREAM model in the Upper Pangani River Basin, Eastern Africa" *by* J. K. Kiptala et al.

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Title: Modelling stream flow and quantifying blue water using modified STREAM model in the Upper Pangani River Basin, Eastern Africa.

We would like to thank anonymous referee #2 for his/her comments to improve the quality of the manuscript. We acknowledge the valuable time that was put in towards providing detailed and helpful suggestions. The suggestions are very valuable and we will incorporate them as indicated in the detailed response.

Here are point to point comments and issues addressed in the revised manuscript.

Overview

This paper highlights an approach of incorporating remotely sensed satellite data in distributed hydrological modeling. Such an approach is warmly welcome in the sub-Saharan Africa where most hydro-met stations are pitted against vandalism and lack of capital investment from relevant authorities. It is worth noting there a relatively few hydrologists who are conversant with the technical details of manipulating raw remotely sensed data into meaningful hydrological signatures as presented in this paper. The paper goes into deeper depths of detailing the model structure but with limited focus on results and discussion – especially on the capabilities of the modified STREAM model in capturing the various hydrological signatures over space and time. This is one of the major weaknesses of this paper on and above several typo errors.

Specific comments are responded as shown below:

1. Abstract L1. The sentence could have a better meaning if "water uses" could be replaced with "water resources management".

Authors' response

We will revise accordingly.

2. Abstract L11. The abbreviation "STREAM" needs to come after a description of the full name. This is applicable to all abbreviations in the document.

Authors' response

We will revise accordingly.

3. P 15773 L2 ,: : :impacts of different scenarios; The word "management" is missing here! Otherwise what scenarios are we talking about?

Authors' response

We will revise accordingly

4. P15774 L10 “resultant” should be replaced with “resulted”

Authors’ response

We will revise accordingly.

5. P 15775 L15. This paragraph highlights challenges of applying remotely sensed data in hydrology, notably in hydrological modeling. This paragraph could benefit more if the authors could read the following article [Schultz G.A. 1993. Hydrological modelling on remote sensing information. Advances in Space Research, 13 (5):149-166)]. Most hydrologists are only used to conventional hydro-met data sets and lack technical know-how of how to manipulate RS data in hydro-studies. This is a big challenge on wider adoption of RS data in hydrological studies.

Authors’ response

This is a valid limitation for wider adoption of RS data in HM. We will include a section on the lack of technical know-how to transform RS data (electromagnetic information) to hydro-meteorological data in the text and provide reference.

6. Model Development.

The use of an 8-day aggregate (8-day time step) need more clarification. The authors indicate that this time step correspond to time scale that characterizes agricultural water use. I am lost here: : :what agricultural water use are they talking about? Is it irrigation scheduling? I am not convinced by this statement and have the feeling that the authors chose this time step mainly for convenience given the fact that the MODIS products are available on 8-day aggregates. If this is the case, then, what uncertainty is introduced by this “convenience”?

Authors’ response

Indeed the time step of the modelling is predefined by the available data on actual evaporation. We argue that this does not affect the modelling results much because

of the mentioned timescale for agricultural water use. This agricultural water use incorporates both rainfed and irrigated agriculture, which use water from the unsaturated zone. The time scale of this water use is between 10 - 30 days (unsaturated zone storage over transpiration rate). The rainfall and interception that has lower time scales have also been calculated as precessor in the model using daily data and aggregated to 8-day time step. We will expand the section on the use of the 8-day time step in the revised manuscript.

7. Results and discussions.

The authors have not provided a rigorous analysis of results and discussions as what readers would have expected. The paper would have benefited more if the authors could have developed and analyzed at least a few water use management scenarios in the Pangani basin using their modified STREAM model and compare with baseline (the current situation). Otherwise the paper does not abide to the tone in their abstract and even introduction of the paper. Naturally, the use of a model in water resource management is in providing answers to the typical question “what if?”. This is what the authors need to highlight in this paper, and also water resources managers want to read and hear the same as well.

Authors’ response

We will introduce 3 scenarios for water saving and increased crop productivity. This is a very interesting suggestion, and we believe that incorporating these three scenarios will improve the outcome and the general outlook of the paper.

8. STREAM Model

The authors have noted that the motivation of modifying the STREAM model was due to failure of the earlier version to account for actual transpiration in a realistic way. They have also provided references to support their argument. However, as a reader, I am more interested to see a comparative analysis of the two versions of the model, with

focus on actual transpiration and possibly other parameters as well. Possibly, a Table or graphical representation would suffice.

Authors' response

STREAM model was initially developed purposely to simulate stream flow generation in mostly natural landscapes - forest, woody savannas and dambos (wetlands that store large quantities of water) in upper Zambezi (Gerrits, 2005; Winsemius et al. 2006). The STREAM model was therefore not meant for use in a highly utilized landscape like the Upper Pangani River Basin (also from personal communication with Prof. H. Savenije involved in model devt). The motivation for modifying STREAM model was therefore to improve the model capability to account for irrigation water usage especially in a river basin where informal irrigation systems are dominant. In our view, it makes little sense to model the Pangani with the original STREAM model developed for the Zambezi and thereafter compare the outcomes with the modified STREAM. The two other references where STREAM was used in its original form were cases also dominated by natural landscapes (Abwoga, 2012; Bashange, 2013). However, in few irrigated areas, Ta was underestimated, fundamentally because of the model incapability to account for blue water use.

9. Sensitivity Analysis

Lastly, the authors need to address sensitivity and uncertainty issues of their model. This is a typical issue in hydrological modeling and the authors cannot escape this.

Authors' response

This is helpful suggestion particularly for the modified model. We will present a sensitivity analysis for all model parameters.

10. Figures

Fig.5(a-d). It would be nice to have scatter diagrams as well.

Authors' response

This was also a good suggestion and will be included in the revised version of the manuscript.

11. Figures

all figures. The authors need to be consistent throughout the document. They have used both "Figure" and "Fig." in the text.

Authors' response

We will use "Fig." in all the text.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 15771, 2013.