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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.

J. K. Kiptala et al.

j.kiptala@unesco-ihe.org

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Authors' Response #1

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 #1 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 I have read the manuscript entitled “Modelling stream flow and quantifying blue water using modified STREAM model in the Upper Pangani River Basin, Eastern Africa” with great interest. This research article discusses an interesting approach towards modeling stream flow and quantifying blue water using modified STREAM model in the Upper Pangani River Basin in Eastern Africa. I think, the manuscript is valuable for the scientific community and recommend its publication. However, I will comment critically to further improve the paper and suggest the authors to revise the paper for its possible publication.

Specific comments are responded as shown below:

Referee comments 1-9 and general remarks.

1. The authors have used the double mass curve to derive the rainfall up to mountains peak using the rainfall data of the neighboring stations. Please explain in detail about double mass curve or at least provide suitable reference. Of course, this is well known method, but for readers it would be good to understand in detail.

Authors’ response

We agree and will add further explanation and references to explain the concept of the double mass curve.

2. P15778, L8

The authors discussed the short comings in the remotely sensed rainfall data. I agree with it, but the bias can be removed using limited ground data. For instance see Cheema and Bastiaanssen (2012), Local calibration of TRMM rainfall data. It will be nice to briefly discuss the short comings.

Authors’ response

We are in agreement that the bias of remote sensing data can be removed using limited

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ground data. But the argument was that the ground data on the mountainous areas are also missing and the RS data will also encounter similar shortcoming. We will elaborate the argument and add additional references.

3. P15778, L18

In model development section P15778 L 18; Is 8 day time step is a constraint? Can it be applied at daily time step? If you use the time step smaller than 8 days, how much your results would change. I am very much interested in checking the sensitivity of the developed model in the form of scenario analysis. Is there any sensitivity analysis performed? Would be nice to include it as well.

Authors' response

The actual ET (8-day) has limited the model timestep to 8-day, the model therefore cannot run at a daily time step. The 8-day time step provides sufficient detail for the purpose of the model (ie assessing blue water use), as the time scale for agri. water use is larger than 8 days. The interception that has lower time step was calculated as precessor at daily timestep and aggregated to 8-day. It is therefore expected that the results will not be much different if the model would have run on a daily time step. We will improve this explanation in the revised version of the manuscript. The suggestion of performing a sensitivity analysis for all model parameters is very much appreciated and will be included in the revised version.

4. In the paper, the ETb is calculated from the groundwater as capillary rise C(t). Which equations have been used to calculate the capillary up flow from groundwater? I would suggest the authors to read papers by Vervoort and Van der Zee, 2008, 2009 regarding calculating capillary up flow. They have developed analytical equations for capillary upflow and effect of capillary up flow on the soil moisture. Integrating these equations in your analysis would give another angle of checking your results.

Authors' response

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Our modified stream model does not include the capillary flow process. The water use by plants may include water from capillary rise and this is implicitly taken into account through our measured actual ET and minimum moisture depletion factor (f) which are an input in the stream model. The capillary flux is only derived through a simplified water balance to maintain the evaporative demand of the unsaturated zone. Using this procedure, the capillary rise becomes non influential parameter because it is dependent on ETa and f. However, the capillary rise estimates where comparable with the capillary fluxes calculated using the analytical modelling framework (Shah et al., 2011) in similar landscape and climate conditions. This will be added in the revised manuscript.

5. For simulating the model, how many years of rainfall data were used. For calculating long term average of discharge and other water balance components, you need to simulate the model for longer times. This may be another reason of underestimating/overestimating the discharge. I would suggest the authors to generate long term rainfall from the Poisson rainfall function and use this generated rainfall data for calculating the long term averages. For long term simulations, the moments become stabilize and output becomes more promising, if possible.

Authors' response

We appreciate the suggestion by the reviewer to extend the time series for the modelling in order to get better appreciation of long term water balance components. Unfortunately, rainfall is not the only input data required to run the model. ETa data is also required and we only had three years of data for this purpose, additional data would require substantial additional effort to generate. The modelling therefore does not provide long term average results, but the selected years do provide a range of wet (2008), average (2010) and dry (2009) years.

6. The regression line shows R2 more than 0.5, but the Qo and Qs don't lie on the 1:1 line especially for greater magnitude of discharge. Of course, you have explained that

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clouded satellite images create uncertainty and that's way both discharge differ a lot. Please write some words about possibilities of reducing this uncertainty in clouding. This is a great challenge to do further research. I also think that there are sources of errors in addition to clouding that generate theses uncertainties.

Authors' response

We appreciate the reviewer's sentiments that obtaining good quality ETa input data is crucial, but challenging because of the cloud cover. But indeed this is not the only potential source of error. Other sources of error include a) model conceptualization errors, b) errors in hydro-meteorological data - discharge data (poor maintenance, rating curves especially in high flows, and uncertainties in actual readings) and including rainfall. There is also the potential of improving uncertainty in clouding in future by using passive microwave imagery. We will include the discussion on other possible error sources in the revised manuscript

7. P15781, L15

In the equation 3, Is it total Ta?

Authors' response

Yes. Total Ta, includes soil evaporation. We will improve the explanation to make this clearer.

8. In the conclusion section it will be good to provide %age of various performance indicators used.

Authors' response

We will add the percentages of the performance indicators in the revised manuscript.

9. General remarks

1 P15587

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L2 Use “five” instead of 5.

Authors’ response

We will revise accordingly

L18 Eqs. (15) and (16), respectively.

Authors’ response

We will revise accordingly

L20 “squared” instead of square

Authors’ response

We will revise accordingly

2 P 15774, L10

Resulted instead of resultant

Authors’ response

We will revise accordingly

L25 Remotely instead of remote

Authors’ response

We will revise accordingly

3 P 15775, L14

Please use latest references. E.g. Cheema et al 2013 has used satellite derived rainfall to parameterize the SWAT model while Eta from ETLook was used to calibrate the model to determine contribution of groundwater use in total blue water use.

Authors’ response

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We have updated the literature with the latest publication - Cheema et al., 2014.

L20 I am not convinced with this statement. Such effects can be avoided using passive microwave imagery.

Authors' response

We agree. The lack of technical know-how is better term to describe the difficulties in extracting electromagnetic satellite information including the use of cloud-free sensors such as passive microwave imagery. Similar suggestion was made by the 2nd reviewer. We will revise this section accordingly

L23 Kindly rephrase the sentence "method of using of Eta".

Authors' response

We will revise accordingly

4 P 15777 L7 Remotely instead of remote

Authors' response

We will revise accordingly

5 P 15778 L2 "developed by" instead of "from recent research"

Authors' response

We will revise accordingly

6 P15779 L1

"was" instead of "is"

Authors' response

We will revise accordingly

L23 "calculated" instead of "calculate"

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Authors' response

P1580 - We will revise accordingly

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