

## ***Interactive comment on “Modeling impacts of climate and land use changes on catchment hydrology: Meki River, Ethiopia” by D. Legesse et al.***

**T. Beyene (Referee)**

tazebe@hydro.washington.edu

Received and published: 16 September 2010

Modeling impacts of climate and land use changes on catchment hydrology: Meki River, Ethiopia D. Legesse<sup>1</sup>, T. A. Abiye<sup>2</sup>, and C. Vallet-Coulomb<sup>3</sup>

Comments

General comment

I believe this paper fits to the general purpose of the special issue, but it needs to a lot of redo. If this paper was intended to add any new insight to what has been published

C2325

by the same authors in an adjacent catchment, there is nothing new and didn't meet the intended purpose. Many explanations can be given to the merits of its publication and I agree with the response given by the authors to the first RC, it is a different catchment with different hydrological and hydrologic process, but the paper failed to capture and express the state-of-the-art of modelling hydrologic process in a changing climate. The major weaknesses are:

• Poor literature review and connection with what was intended to be delivered i.e. “Assessing the impact of land use change and climate variability on the catchment's runoff under different land use/land cover and climate change scenarios” Second objective of the paper with its problems. None of which is adequately answered, no land use change scenario, no adequate land cover change scenario, except (converting areas between 2000 to 3000m a.s.l. to woodland) • The paper mainly discusses how PRMS can be applied to water shed scale to generate naturalized flows using basic hydrology/land surface hydrologic modeling and further the paper discusses lengthy calibration and validation processes, the later is very well dealt in early published paper by the same Authors. I would like to see more than 50% of the paper focused on the methodology of generating climate change scenarios, land use/land cover changes and interpretation of the sensitivity of the watershed/catchment to these changes • The paper is lengthy and need to go through serious editing. Try to make the paper as short as possible; what is intended in this paper is to show how the catchment is sensitive to changing climate and land use/land cover. Detailed PRMS hydrological model sensitivity, calibration and validation analysis are not important here; give very general description and the audience can be referred to the earlier paper published if they are interested in these results.

Let me give examples from my preliminary review of the paper

1) Title of the paper: As its current form the phrase “of climate and land use changes” is misleading and inaccurate. There is only one land cover change, not land use and there is only one set of (rain fall and temperature change). Climate change is any change in

C2326

global temperatures and precipitation over time and includes whole host of issues and projections in green house gas emissions. If you are going to use multiple projections of temperature and precipitation for specific water shed, we can appropriately use the climate change synonymous, but using perturbed observed climatology would lend itself to climate sensitivity analysis. I would suggest changing the Title to “Streamflow sensitivity to climate and land cover change: Meki River, Ethiopia ”

â€” Abstract – roughly 2/3 of it discusses more of the calibration and validation processes (Which I believe was very well documented in earlier published paper on adjacent watershed by the same authors), give more coverage to scenario result analysis and insight.

2) In the abstract the authors suggest that “Increase in temperature has also a significant impact both on the potential evapotranspiration and stream flow of the basin”. That is a little bit misleading and not supported by the quantitative analysis presented. As it is reported , the rainfall elasticity is 4:1 for 20% increase in Rainfall and 3:1 for 20% reduction in Rainfall and streamflow sensitivity to temperature is in the order of 8.67%/OC. So by these accounts, it seems to me that the watershed is more elastic to rainfall increase than temperature. Secondly I would not attribute the streamflow sensitivity to potential evapotranspiration increase as a result of altered mean temperature for the following reasons: -

â€” If you change your daily maximum temperature by keeping your daily minimum temperature (dew point temperature) unaltered, you end up varying the downward solar radiation and vapour pressure deficit that will affect your potential evapotranspiration. But my understanding is, in this study the changes are only applied to the daily mean temperature, meaning both Daily Min and Max are shifted by the same amount keeping the solar radiation constant and as a result it only affects the actual evap. â€” I have no idea how PRMS works , but if you can set your canopy resistance to zero, you can quantify potential evap sensitivity to temperature , keeping the evaporative demand constant ( rainfall is unaltered).As its current form, I would

C2327

avoid the discussion on Potential evap in any part of the document and I would focus on actual evapotranspiration ( see a paper by Sankarasubramanian et al., 2001 : <http://engineering.tufts.edu/cee/people/vogel/publications/climate-elasticity.pdf> )

3) Introduction: Needs major re-writing and references; One example is, paragraph 4 line 26 “Hydrological models have served as a valuable tool in water resources management for many years and are usually used to predict the impacts of proposed land use and climate change scenarios, no source/reference and the use of words like “predict, forecast” are inappropriate ....I would be reserved from using these words for the very reason that they are always associated with skill and time scale. For the purpose of this paper and the general audience of HESS, special issue, I would use words like Simulate, analyse process etc.....

4) Methods and Data, I would suggest some detailed review to avoid redundancy and serious grammar errors. Eg Sec 4.5.1 Climate Scenarios “For this study, incremental climatic scenarios were used. Incremental scenarios or synthetic scenarios describe techniques where particular climatic elements are changed incrementally by plausible though arbitrary amounts” ...could be shortened simply by saying “In this study we used a delta method to perturbed observed historical climatology ( reference ...)”.....in the same section from line 12 to 15 “ In this study a 20% change in precipitation and a 1.5 \_C increase in temperature were assumed and nine climatic scenarios were then developed in order to assess the response of the river runoff to climate variability” . What are the nine scenarios? What is climate variability? Use climate change than variability and avoid using variability in any part of the document. . . .

5) Results and Discussion is poorly represented and need to be re-written focusing on clarity and simplicity Eg. Paragraph line 16 to 19 “Rainfall change scenarios were introduced both on year round basis and on seasonal basis. This was to assess the sensitivity of the catchment runoff to both seasonal and general rainfall changes”. Question. ...1) what does year round basis means? What is general rainfall? Well to be clear if the daily climate variables of (temperature and rainfall) are changed by

C2328

X-rainfall scale and Y-temperature shift , then you don't need to worry about impacts of seasonal precipitation and temperature change ,but if you do both daily and seasonal , then discuss it in your methodology part. Honestly it is hard to follow the entire documents starting from the Data and methods to Discussion and conclusion part. NEED MAJOR WORK HERE!!!!

6) In general figure quality is poor. Captions and labels are hard to read and in some cases missing

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 4535, 2010.