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Hydrology and Earth System Sciences Discussions

Interactive comment on "A modeling approach to determine the impacts of land use and climate change scenarios on the water flux of the upper Mara River" *by* L. M. Mango et al.

Anonymous Referee #1

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General comment: The paper describes a study on the effects of land use and climate change on the water resources of the Mara. Such types of studies are very useful for sub-Saharan regions that are subject to global changes potentially effecting their hydrology and are therefore relevant for a HESS journal. The paper is fairly written but needs some clarifications at several places. More importantly, the conclusions are driven to easily, as I see a couple of limitations in the study. I do not see how state-of-the-art research is used for this study (literature review is lacking) or any novelty in the methodology. In addition, the used methodology is not well validated (poor model validation, no attention to spatial representation of processes and/or parameters in the

hydrological model).

Main comments: (1) The paper lacks a proper literature review on model application in the Mara and the use of hydrological models to study land use and climate change (many exist). (2) The hydrological model SWAT is proposed to compute the effects on the hydrological cycle. While SWAT is indeed described as a model that can be used for ungauged basins, one should be carefull with this statement in applications outside of the US. The most important hydrological parameter, the Curve Number, has been assessed for soil and land uses in the US based on large datasets. However, for Africa these default curve numbers do not exist. An appropriate calibration is an alternative but at the same time it remains difficult to identify the distributed parameters that should represent the spatial variability in the land use. (3) The methodology for land use change analysis can be questioned. A distributed hydrological model is used that should allow for land use change assessments. Nevertheless, the model has been calibrated by using a single dataset at the outlet of the sub-basin. On top, the results, especially for the validation period are poor. It can be questioned whether the individual land uses are properly identified. I would rather speak of a land use sensitivity study. More important, the study does not report on more important changes in land use: moving from rain-fed agriculture towards irrigated agriculture. Effects are mainly expected of those changes, especially when associated with dam constructions. It is also not clear how the land use changes were implemented. Were new land use maps created or were the changes done directly in the model (changing the fractions)? (4) For climate change, the authors use the so-called 'delta-t' method to compute future climate change series while many more advanced techniques have been reported in literatures, such as regional climate models or statistical downscaling methods. In addition, all days in the year undergo the same changes while climate models provide monthly changes. So, this can hardy be called a climate change study, rather a climate sensitivity study. Since there is a strong seasonality in the region, it is important to account for the seasonalities in the projected climate change (dry season may become dryer even when the average rainfall increases). Recommendations: (1) Include

a good literature review, including hydrological studies in the Mara, climate and land use studies in the region etc. (2) Better describe the hydrology of the SWAT model, the curve numbers etc. Merge section 2.4 and 2.2 (3) Better describe the sensitivity and calibration methods. Which parameters have been changed and how? There are many parameters, and they are distributed. (4) Include scenarios with irrigation developments (5) Improve the calibration/validation results, or alternatively, evaluate the individual land use hydrology by experts (hydrologists) by comparing the hydrological components, the ET values, biomasses etc. Are these results logic? (6) Use better climate downscaling techniques, or, as a minimum, implement climate change scenarios on a monthly basis so that also minimum flows can be evaluated. (7) Show the hydrographs (observed versus simulated) (8) Account for the comments below. Specific comments: - Improve the description of the case, more emphasis on the 2 tributaries that have been studied. Locate the gauging station on figure 1. - Improve the description of the land cover classification so that non-specialists can understand it. Eg. “Spectral values’ in line 3 and ‘reflectance data’ in line 4 refer to the same data? How were the classes (line 7) defined? I guess by experts as described later but in that case, describe the actions in the right sequence. - The paper describes the river Mara, but eventually looks at the rivers Amala and Nyangores only. - Page 5859, line 21 mentions years calibration + 2 years validation for the RFE model, while in page 5860, 2 years are mentioned. - Use more logic titles for the scenarios: partial deforestation converts to agriculture while complete deforestation converts to grassland, so I would call them (1) partial deforestation, conversion to agriculture PDA (3) complete deforestation, conversion to agriculture CDA (2) complete deforestation, conversion to grassland CDG - How were the land use classes in the SWAT model parameterized? The SWAT crop data base only contains US data. - Use less significant numbers for the K statistics. What does it means? % that was classified correctly in validation? - Line 3 of page 5864: what is meant with parameter ‘adjustment’ ? - What was the model bias? Technical comments - Please refer to the figures (figure 1-6 are not referred to!), also line 5865 does not mention which graph? - Some splitting is very unfortunate eg

5855 line 3, 5853 line 8

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 5851, 2010.