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Interactive comment on "Impacts of future deforestation and climate change on the hydrology of the Amazon basin: a multi-model analysis with a new set of land-cover change scenarios" *by* Matthieu Guimberteau et al.

Anonymous Referee #2

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Scientific significance:

This manuscript uses 3 Global Climate Models (GCMs), 3 Land Surface Models (LSMs), and 3 Land Cover Change (LCC) scenarios to investigate the impacts of future deforestation and climate change on the hydrology of the Amazon Basin. The scientific questions posed, i.e. What is the direction of projected change; how is hydrologic change apportioned between climate change and land cover change forcings; and what are the relative uncertainlties introduced by different GCMs, LSMs and LCC scenarios are of interest to the international hydrologic sciences community and within

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Discussion paper

the scope of HESS.

The techniques and tools utilized in the study are standard: Use of publically available (and slighlty outdated) CMIP3 models, use of existing LSM models, and development of a suite of Land Cover Scenarios using a combination of a participatory approach with existing land use models. No new data is collected and, as discussed below, no calibration or validation of the LSM models against existing hydrologic data is presented. As such the paper presents no new methodological contributions; its contribution is primarily in the integration of existing tools and synthesis of resulting predictions to answer important questions.

One of the major scientific limitations of the study, the omission of any feedbacks between land cover change and climate change, is acknowledged in the first sentence of the abstract and the last paragraph of the conclusions. While rectifying this omission is likely beyond the scope of this study or this team of researchers, it does call into question whether the study's conclusions will hold up under the likely scenario that changes in evapotranspiration as a result of amazon deforestation change the regional climate. Nevertheless, with a more rigorous validation of LSM predictions of historical hydrology, a more quantitative partitioning of sources of prediction uncertainty among GCMs, LSMs, and LCC scenarios , and a stronger synthesis of results into new insights or actionable information I believe this paper would be of interest to the HESS readership. Detailed suggestions are given below.

Scientific quality:

While the scientific approach seems valid, insufficient details are given on the modeling methodology, for example the following details are not clear:

1) More details on the GCM bias correction and statistical downscaling methods should be provided. Since the authors are evidently using others' results the methodology descriptions do not need to be exhaustive but the methods used in the referenced papers should be identified so readers do not have to look up the previous work.

2)The LSMs are not adequately or consistently described in the manuscript or supplemental material. It is not clear how the important hydrologic processes are represented, or how they are parameterized, in the three LSMs. Details regarding the spatial and temporal resolutions of the models should be presented in Table 2, along with much more detail regarding how particular hydrologic processes (evaporation, transpiration, unsaturated flow, groundwater flow, overland flow, river routing) are simulated in the models. The description of the models in the supplementary material is qualitative rather than quantitative and focuses most strongly on vegetative processes.

3)No evidence is given that the LSMs are able to adequately simulate historic ET and river fluxes in the study region. The supplemental materials broadly states that two of the three models (LPJmL-DGVM and ORICHIDEE) have been widely tested, but a comparative summary of the three models predictions during the historic period should be presented. Historical rivers flows are included in Figure 14 but no attempt is made to attribute errors in predictions or discuss the relative magnitude of errors among LSMs. Section 3.3.3 discusses differences in LSM predictions in a qualitative way but without knowing specifics of how the processes are simulated in the different models it is difficult to generalize the results beyond this modeling exercise. Since the goal of this manuscript is to understand hydrologic change it is important to show that the hydrologic models make credible predictions of ET, soil moisture, groundwater levels, river flow during the historical time period, and to understand how specific differences in hydrologic representation among the models lead to differences in predictions.

4)The description of the development of the deforestation scenarios is somewhat confusing. I am not a land use change modeler but it is not clear to me how the results from the participatory process in certain parts of the study region were extrapolated and incorporated into the LuccME and CLUE models, or why two different land use change models were required. The manuscript states (e.g. line 21 p 5 and line 34 p 5) that maps were used to “calibrate and validate the deforestation model”, and scenarios were “translated into model parameters” but no details are given on the methods,

parameter values or prediction accuracies. I am left wondering how good the land use change models are, and how much the precise spatial distribution of deforestation shown in figure 7 matters, versus a more generic uniform decrease in forest area across the domain. If the actual locations of increased deforestation make a difference to predictions of future hydrologic change this would be interesting.

The authors present a wide range of results showing how future projections differ based on GCM, LSM and LCC scenario. However it is unclear at the end of my reading of the manuscript what are the dominant drivers of these differences, or what new insights or actionable information has been generated from this study. It would be useful if the authors could synthesize their results to quantitatively apportion uncertainty for various hydrologic predictions among the three sources (GCM, LSM, LCC). It might also be interesting to weight the ensemble of future projections based on historical reliability of the GCMs and LSMs and possibly the convergence of their future predictions (see e.g. reliability ensemble averaging (e.g. Giorgi and Mearns, Geophysical Research Letters, 2003; Asefa and Adams, Regional Climate Change 2013).

Presentation quality:

The manuscript is generally well-written, concise and well-structured. The figures are generally of good quality, however many of the labels and legends are difficult to read (e.g. Fig 1a, Fig 4 , Fig 8, Fig 13). In addition the figures are quite numerous. It would be helpful if the figures could be reduced and their content synthesized to more succinctly present the study's major findings and conclusions.

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