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Discussions

Interactive comment on "Scenario-based impacts of land use and climate changes on the hydrology of a lowland rainforest catchment in Ghana, West Africa" *by* Michael S. Aduah et al.

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Responses to Referee# 2 Comment: This paper presents a well-documented and well-performed scenario study of climate and land-use changes in a Ghanaian rainforest catchment. As a case study, this is interesting for our audience, although one can doubt the innovation of the approach itself. Although it is essentially a scenario study to support management decisions, it may be considered under the category of 'cutting edge case studies', in a catchment where such studies have not been done before.

Regarding the impact of land use on runoff, it would have been good if the authors had specified how land-use is connected to the parametrization of the hydrological

model. It is not completely clear to me how land-use scenarios were coupled to model parameters and why certain values of these parameters were selected. As a result, it is very hard to judge how realistic the model results are in response to changing land use. I think that Section 2.2 and Section 2.3.1 should provide more detail on how land use is parameterized in the hydrological model, and how the model reflects the different land use scenarios.

Response for section 2.2 Section 2.2 has been improved with details of the land use parametrization used by the ACRU hydrological model.

The improvement (lines 91-109 in revised manuscript) reads as follows: "The physically-based conceptualisation of the land cover characteristics and its various interactions with the hydrological processes in the ACRU model, means that the structure of the model demonstrates a high sensitivity to changes in land cover, land use and land management (Schulze et al., 1995; Warburton et al., 2010). Therefore, the ACRU model is able to simulate the impacts of land cover and land use change on water flows. The land cover is conceptualized in ACRU by using vegetation and water use input parameters that describe the land use processes and how the hydrological processes are governed by the vegetation. The above-ground vegetation properties in the ACRU model are conceptualised through the consumptive water use of vegetation which is expressed as a monthly crop coefficient (ACRU variable name = CAY) and canopy interception loss as either a monthly canopy interception losses per rain-day (VEGINT) or calculated from the monthly Leaf Area Index (LAI). The rainfall abstracted by interception, surface detention storage and initial infiltration before stormflow commences is represented in the ACRU model through the coefficient of initial abstraction (COIAM). The soil water content of the A-horizon, infiltrability and initial abstractions influence the daily soil water budget (Schulze, 1995). The presence and amount of litter and/or mulch, which has the potential to reduce and/or prevent soil erosion and soil water evaporation losses (Schulze, 2007), is accounted for through the required input of the percentage surface cover (PCSUCO). The below ground processes are conceptualised through three root related parameters and a plant soil water stress indicator. The three root parameters required are the total depth of the root profile (EFRDEP), the percentage of active roots in the A-horizon (ROOTA) and lastly the degree of root colonisation in the soil horizons (COLON). To account for the onset of plant stress, the fraction of plant available water in the soil horizons at which total evaporation is assumed to drop below maximum evaporation due to drying of the soil needs to be input."

Response for section 2.3.1 Section 2.3.1 has also been improved with details of the land use information used in simulating impacts on streamflow changes in the Bonsa catchmemt.

The improvement (lines 138-147 in revised manuscript) reads as follows: The land use scenarios were obtained from (Aduah et al., under review). For each subcatchment the area of the land uses present in the baseline, current and future scenarios were determined, and used to create the HRU's. Thus, the areas of the various HRU's within the subcatchments varied between the different scenarios. For each land use type the parameters for the vegetation and water use variables described above were determined. The initial values of the ACRU model parameters were adopted from South African (Schulze, 1995;Warburton et al., 2012) and Ghanaian (Bekoe, 2005) case studies for a sensitivity and calibration study in the Bonsa catchment (Aduah et al., 2017), after which the final parameter values were selected. The original parameters of the ACRU model were derived by Schulze (1995) based on a working rule that linked the parameters to mean annual precipitation, monthly heat units, soil water status and crop physiology (Warburton et al., 2012). During the sensitivity analysis and calibration study the PCSUCO for all the land uses were estimated, based on field observations.

Minor comment #1: In line 77, please use the correct units [mm/y]. the mere mention of the word 'annual' in the text is no excuse for using the wrong unit. Precipitation is a flux and not a stock.

Response: Units (in line 80 of revised manuscript) have been changed to mm/year

Minor comment #2: In line 23-34: 'first ever and the most current information' is a bit overstated. I suggest to write 'necessary information' instead

Response: 'first ever and the most current information' (line 25-26 of revised manuscript) has been changed to 'necessary information'.

Minor comment #3: Figure 1 is hardly readable. Please use colours to distinguish the different boundaries and the river. Also the graphs would become clearer if clearer colours were used. For instance, Figure 11 is difficult to read.

Response: Figure 1 has been redrawn with colour and thickness of some of the lines have been increased to improve contrast and legibility.

Figure 11 as well as all the other figures have been improved with clearer colours and thicker lines.

Minor comment #4: In the caption of Table 3 write mean annual precipitation (MAP) in full. Response: In Table 3, MAP has been written in full as mean annual precipitation.

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