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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Minimum forest cover for sustainable water flow regulation in a watershed under rapid expansion of oil palm and rubber plantations" *by* Suria Tarigan et al.

Anonymous Referee #1

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The manuscript deals with the effect of land cover and/or land use on a watershed response functioning. The authors investigated the influence of forest and monoculture plantations (oil palm and rubber plantations) on rainfall partitioning to direct runoff and subsurface flow for a humid tropical watershed in Indonesia. The results are based on streamflow as simulated by a calibrated SWAT model and observations across several watersheds and subsequently derived the direct runoff coefficient (C) and the baseflow index (BFI). The study exhibits a statistically significant correlation of percentage of forest covers in a watershed with C (negatively) and BFI (positively). On the other hand, the rubber and oil palm plantations showed flow regulation behaviour contrary to forest covers. Finally the study suggests the minimum forest cover requirement in

the study area (i.e. 30%) for sustainable ecosystem services. The topic is of current scientific interest and several studies have also investigated previously. However, the manuscript requires a substantial improvement of the methodology and, results and discussion to be publishable. Furthermore, the manuscript would benefit a lot with the inclusion of more discussions in the introduction section from previous similar studies in the tropical regions.

General comments 1. Given the previous several studies on the effect of land cover/use conversion on the hydrology of a watershed, the introductory section needs further literature review in this regard. It should also highlight the new contribution of this manuscript. 2. I think the organization of the methods section, in general, requires restructuring and further information. For example, there is no section that describes the general SWAT model and the SWAT model for the study area, which are important for general readers and non-SWAT users. 3. Section 3.2 and section 3.3 should be presented before section 3.1. Logically thinking, observation based model evaluations should be presented first and then results of analyses based on the model simulation. 4. No information is provided in the manuscript about the SWAT parameters, particularly the ones that control the surface runoff and the baseflow process. I think information about some of the sensitive parameters would give a good discussion points on the flow regulation behahavoir of different Landover/use in the study area. What was your observation on the calibrated SWAT parameters such as CN2, SOL_AWC, ALPHA_BF and CANMX among other? 5. The calibration and validation strategy are not clearly stated, albeit its importance in interpreting simulation outputs from SWAT. The calibration and validation period need to be explicitly stated. Which automatic calibration algorithm was used in SWAT-CUP? It is also essential use multiple evaluation criteria. 6. I encourage the authors to explicitly discuss the SWAT model simulation results are mainly arising due to changes in land cover not by wrong parameterization. SWAT is a highly parametrized model, therefore we might get the expected patterns for the wrong reason. This could be addressed by referring the calibrated SWAT parameters.

Specific comments Lines 1-2: I suggest to check the title. i) Since it is an application in tropical region in Indonesia, it needs to be specific. ii) It seems to me some action words are missing. You could simply add, for instance, “requirement” that reads as “Minimum forest cover requirement for sustainable water flow regulation: A case study in a watershed under rapid expansion of oil palm and rubber plantations in Indonesia” Lines 9-32: The abstract could be shortened to a certain extent by reducing the seemingly redundant sentences on flow regulation functioning and benefits, keep the most important points only. Lines 14-15: It is a bit confusing sentence, please improve the language. Line 40 “ Lele, 200” please add 0 Line 40 “Functional water flow regulation reduces flood peaks by moderating direct runoff.” It would be nice to add some references here. Line: 46:”base flow” remove space Line 46: “)]” remove the square bracket Lines: 69-71: Please improve the language Lines 72-73: Improve the language, for instance, “Distributed hydrologic models such as the Soil and Water Assessment Tool (SWAT) are useful to understand the effects of land use changes on watershed flow regulation. . .. . ..” Lines 80-81: “. . .. . . is the direct runoff ratio of to rainfall.” should be “is the ratio of direct runoff to rainfall” Line 88: Please add the size of the study area and perhaps the location coordinates. Lines 88-93: It would be informative to add information on the historical land cover change in the study area. Lines 94-98. I think the methodology description should not be included in study site description. I suggest to move this part to appropriate subsection in the methodology. Line 99: Replace “&” with and Line 101: “C & BFI” it should be “C and BFI” like in the abstract section and it should be consistent throughout the manuscript. Lines 102-104: Please improve the language. And it is somewhat similar with Lines 109-110 Lines 104-109: This is confusing! This describes the general SWAT model and I would rather expect a separate subsection for it. This should also tell how SWAT computes surface runoff, baseflow. . ...See the comments in the general comment. Line 114: I would prefer the areas in km2. Line 118-121: Describes the SWAT model setup for the study area. Therefore, I would expect to get this information before describing section 2.2 (Simulated C and BFI) values. Line 122: Add SWAT-CUP reference Lines 121-129: This

part tries to elaborate the model calibration and evaluation part. SWAT-CUP provides several options for model calibration, which one did you use in this study? Please be specific. When is your calibration and validation periods? I suggest separate subsection for model calibration and evaluation approach. Line 128: As demonstrated in several studies, NSE is sensitive to peak flows. You calibrated and evaluated your model using only NSE. How do you justify this? I think it would be good to add a few more performance indices in the evaluation so that the reader would have a better feel on the reliability of the model simulation outputs. Line 130: Again “&” remove throughout the manuscript. Line 158 “didn’t” should be “did not” Lines 162-163 repetition see line 121 Line 163-164: Add more statistics Lines 165-167: what did you obtain from the comparison? How much they agree? What statistical measures did you use? Lines 168-173: More suitable in the methodology section. Lines 180-184 Too long sentence, it is better to follow simple sentences. Improve the language as well. Line 182: Oil palm harvest and oil palm circle are equal (i.e. 3 cm h-1). Lines 185-188: I’m puzzled by this conclusion. Is the rainfall distribution similar throughout the basin? Because if there is a spatial variation in rainfall magnitude, the effects of forest conversion on the flow regulation would vary accordingly. In Figure 4a, I see a C value less than 0.35 for forest cover about 20%, what do you think about this? Line 207: please improve the language Lines 207-214. I think this need more discussion. SWAT has a known limitations in simulating the low flow regime and that would have an effect on the BFI, as also mentioned by the authors. See the recent study for further discussion: Pfannerstill, M., B. Guse, and N. Fohrer, 2014a. A Multi-Storage Groundwater Concept for the SWAT Model to Emphasize Non- linear Groundwater Dynamics in Lowland Catchments. Hydro- logical Processes 28:5599-5612, DOI: 10.1002/hyp.10062

Line 344: “. . .MT(b,. . .” Line 376: Table 3, In MT watershed sub.wat.nr 23 has a 100% forest cover but the BFI is low, meaning low baseflow contribution from the groundwater. Justify this in the discussion. Line 379 Table 4, Please recheck the numbers and the calculations.

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