

Interactive comment on “Riparian forest and permanent groundwater: a key coupling for balancing the hillslope water budget in Sudanian West Africa” by A. Richard et al.

A. Richard et al.

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Received and published: 26 July 2013

We carefully evaluated these comments and suggestions and implemented them in the text wherever possible. Please, see the corrected version of our HESSD paper.

General comments: The title is acceptable but I feel it could be better as it is a bit clumsy. A possible suggestion: Quantifying the importance of riparian forest transpiration and permanent groundwater in the hillslope hydrology of Sudanian West Africa.

Thank you. We suggested a new title: "Interplay of riparian forest and groundwater in the hillslope hydrology of Sudanian West Africa (Northern Benin)".

C3499

The subject of riparian area water-use is critical and very relevant and I believe this paper could make a useful contribution to our broader thinking if the English were improved and the critical contribution of the paper be made more apparent.

I like the strategy of using the different modelling scenarios to quantify the role of the riparian forest transpiration with root access to the permanent groundwater. However, many papers have already shown the importance of the riparian area to streamflow. This paper quantifies the riparian forest transpiration in terms of the water balance at this site and reiterates its importance concluding that we need to model the riparian forests and the permanent groundwater in mesoscale hydrological models better.

Some of the resulting suggestions are however stretching the limits of your results. For example I don't think the suggestion that an entire slope of forest, when felled would not change the flow regime. These trees on the slope could have roots down to the water table and what about canopy and litter interception? Without having actually modelled this, it is not a good idea to guess.

We suggested removing this part: "But what would happen for a hillslope covered by forest? Having shown that crop and trees have a similar transpiration rate during the rainy season leads to assume that on a forested hillslope, the transpiration is equal or only slightly higher than on a cultivated one. Thus, to a first approximation if a slope forest were cut, at the exclusion of the riparian forest, there would be little change in the water flow regime. On the opposite, if the riparian forest were cut as well, this could increase the river flow. The riparian area thus appears as a key factor for river flow supply. This conclusion may serve as a guide for land management in a context of rapid and drastic evolution of the vegetation cover. Forests are currently covering 50 % of the upper Oueme basin and the region is witnessing a strong increase of population through inner growth and settlement from outer areas, involving land clearing; whether this clearing occurs with or without cutting the downslope riparian forest, might consequently have a strong impact on the local water cycle, and, regionally, to the monsoon dynamics."

C3500

I found the introduction confusing and I would like to see this restructured so that it is clearer. I found the remaining sections reasonably clear in terms of thought process but a simpler structure would be beneficial. The standard: Intro., methodology, discussion, results would work well for this paper I think.

OK, we accepted this suggestion.

I am not convinced that narrow strips of riparian forest influence the monsoon dynamics. Supply references showing this or prove it!

We accepted this remark and removed the corresponding elements.

I would like some references to other studies that investigate riparian water use and impact on hillslope hydrology and some indication of how your results fit with the results from other studies. This may help you identify what is unique about your particular study.

References were added.

Unfortunately the English grammar is poor and really detracts from the quality of the paper which is at times difficult to understand because of sentence structure. A thorough revision is required before this paper could be considered for publication. Some notes on the grammar: The tense is incorrect just about throughout the paper. Most of it should be in past tense as you are describing work which has been done. Where 'is' or 'are' exist, they should in most cases be 'was' or 'were' respectively. You would also say that the data 'showed' and not 'show'.

OK, we now paid particular attention to the grammar and tenses so that we hope it is acceptable for the editor to give a final improvement to it.

Some phrases are repeatedly incorrect: Use 'in contrast' instead of 'in the opposite'

OK.

Numbers below 10 should be written out in full. Three and not 3.

C3501

OK, we accounted this comment.

What do you mean when you say, 'By construction'? (Page 5661, line 14)

To make this point clear, our formulations were modified as follows: Current: By construction, the potential evaporation, which is time-dependent, is the same for all the simulations. Proposal: As explained in section 3.2, the choice was made to keep the potential evaporation time-series the same for the four virtual experiment simulations. Consequently, differences between simulations would not result from differences in potential evaporation. Section 3.2 was also modified for clarity purpose: Current P5656 L3-19 : The goal of simulation 1 is to test the impact of the presence/absence of the riparian forest on the water budget of the elementary hydrological unit. To this end, the tree root system is replaced by the crop root system (20–50 cm depth). However, the LAI time-series used in this configuration is the same as in the base case simulation, meaning that the impact on the evapotranspiration due to the modifications of the LAI when removing the riparian forest is not addressed here. This also means that the partitioning of the potential evapotranspiration between the potential evaporation and the potential transpiration, as defined by Eq. (3) is neither modified. Proposal P5656 L3-19: The goal of simulation 1 was to test the impact of the riparian forest on the hillslope water cycle: the tree root system was replaced with the crop root system (0.2-0.5 m depth) in the riparian area. However, the LAI time-serie was not modified, and thus neither was the partitioning of the potential evaporation and the potential transpiration, as defined by Eq. (3). This issue is discussed in Sect. 5. The actual transpiration was simply reduced proportionally to the change in the root system distribution.

You abbreviate simulated evapotranspiration to ET, but then fail to use the abbreviation most of the time.

OK, we now used this abbreviation.

There is inconsistency: In figures especially you sometimes have ET0 and other times ET0. P age 5658 lines 7-8. Second section and then sect. 3 and then Section 4.

C3502

Current P5652 L16: The potential evapotranspiration E_{Tp} is partitioned into the potential evaporation (E_p) and the potential transpiration (T_p) depending on the LAI (Ritchie,1972): ... Proposal P5652 L16: According to Ritchie (1972), the reference evapotranspiration ET_0 was partitioned into potential evaporation E_p and the potential transpiration T_p , depending on the LAI (Eq. (3)). Modification of the Eq. (3): ETP is replaced with ET_0 .

An example of grammatical corrections can be found in the abstract of the supplement OK, thank you.

Hydrological data: I don't see how the LAS data contributes to the study. In Fig. 2 all you show is a single location for a LAS. Is this the transmitter or receiver? What vegetation does it cover? Is it a valid comparison in Fig. 6?

LAS is one of the two measurements of the actual evapotranspiration in this study. In Fig. 2, the schematic representation of the LAS is the receiver of the instrument. The transmitter is located at the same position on the symmetrical hillslope with respect to the river drain. Compared to the studied hillslope, the symmetrical one is longer, has more vegetation fallow and less crops. LAS measurements provide a more spatially integrated value of the evapotranspiration (including riparian forest and crops).

There is not enough detail about the type of sensors you use and the measurement interval. I would like to get the impression when reading the paper that the authors know what the field measurements were about!

OK, we added a table with these details and a sentence.

References: Well done. All references in the text were listed but further references of other similar studies should be added.

OK, references were added.

In Table 3 I would prefer that you show percentages to be 0% rather than a - which

C3503

indicated not applicable to me.

OK, done.

Fig. 5. Move the box showing which line is measured/observed to near the top of the figure.

OK, done.

Fig. 7. State somewhere that this is simulated.

OK. Current: Fig. 7. Water velocity within the hillslope. The black solid line corresponds to the deep groundwater table. Day of year: 210 (29 July 2006). Vertical exaggeration: 10. Proposal: Fig. 7. Simulated water velocity within the hillslope. The black solid line corresponds to the simulated deep groundwater table. Day of year: 210 (29 July 2006). Vertical stretching: 10.

Fig. 11. What is the vertical exaggeration?

Current: vertical exaggeration. Proposal: vertical stretching. We also modified legends of Fig. 2, 4 and 7 adding: "Vertical stretching: 10".

I would say just saprolite and not saprolitic soil. It is implied.

OK.

Please also note the supplement to this comment: <http://www.hydrol-earth-syst-sci-discuss.net/10/C2240/2013/hessd-10-C2240-2013-supplement.pdf>

OK.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 5643, 2013.

C3504