



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

The paper shows an interesting simulation on the role of groundwater sustaining riparian forest transpiration in a tropical country (Benin, Africa). The modeling is made using Hydrus 2-D.

However, the results could be discussed in a more appropriate and balance way.

OK, we tried to do it.

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There are many references available on the subject of riparian forests and stream-flow/groundwater interactions. The authors should include them because they will strength the paper and they will also insert the paper in a broader context since riparian forests was also a matter studied in many other countries.

OK.

The scientific results and conclusion could be presented clearer way.

We tried to do it.

The paper needs to be better organized using a classical original research format (see comment below).

OK, we agreed.

With regard to the English, it also needs a substantial rewriting. This has to be done by a native speaker. For these reasons, the paper needs substantial changes before it is considered for publication. There is a lot of interest in the paper main topic. I really would like to reread this paper after changes are incorporated.

We made effort about the English.

Central questions that might help the authors: What's the paper novelty? Are your results in line with the current knowledge? Regardless the answer, you should discuss why? Is there somewhere where similar results were found? I recommend the classical original research article format: Introduction → Methods → Results → Discussion → Conclusion. Other possibility is to gather Results and Discussion.

OK, we agreed.

Title: What do you mean with “a key couple for balancing the hillslope water budget in Sudanian West Africa”?

We would mean that these two elements (riparian forest and deep grounwater) together

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can explain some observed hydrological processes in this area, and are crucial to correctly balance the water budget. We suggest a new title.

Abstract An English review is needed for this part.

OK.

P5644 L5: "This is especially true" → in the introduction you said that it is assumed.

OK, we modified this part.

P5644 L5-6: The riparian forest and groundwater coupling is not the only way forests transpire throughout the dry season(see Nepstad et al., 1994; Markewitz et al., 2010).

OK.

Moreover, I suggest to the term groundwater/permanent water table instead of permanent aquifer.

We maintained the term "aquifer" in section 2.1: "The aquifer containing the permanent and unconfined water table is mainly made up of silty and clayey 5–25 m thick saprolites, overlying the metamorphic (gneiss and micaschist) fractured basement (Affaton, 1987; Descloitres et al., 2011)."

After the incorporation of the changes specified below, please, rewrite the Abstract.

Done.

Introduction section Keep in mind the objective of the paper.

OK.

The first paragraph (P5645 L4-20) is the clearest one in this section. The second one (P5645 L21-27 and P5646 L1-12) and the others seem to digress. Thus, this section needs to be reorganized substantially. Try to connect the ideas in the paragraphs leading the reader to finally understand the real purpose of the paper. Maybe a better organization of the paragraphs is enough but the way it is, it is confusing and hard to

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follow. I have made some comments on that, but, as I said, it requires a substantial effort to make it clearer.

OK, we rewrote the introduction.

Is there any concrete information on the possible role of riparian forests contributing to the monsoon in the region? A study using tracers? If not, excluding this part is recommended.

We rewrote this section.

You should highlight the novel that this paper brings about to the current knowledge. See the references.

Thank you for these references. We included few of them and others.

P5666 L17-26: There are many studies in the literature that analysed the riparian forest evapotranspiration. You should look for them and include it.

OK.

Specific comments: P5645 L1-2: “The West African climate is characterised by strong interactions between the atmosphere, the ocean and the land surfaces”: Please include a reference where the reader can find more information on this statement.

Done.

P5645 L2-5: “During the wet season, the ocean brings moisture to the continent through a typical atmospheric monsoon circulation driven by meridional energy and moisture gradients.” Again, please include at least one reference where the reader can find more information on this statement.

Sentence deleted.

P5645 L11-12: “It is suspected that this reservoir of water plays a major role for the WAM onset into the Sahel”: Which reservoir? Please be specific to avoid different

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interpretation.

Current: It is suspected that this reservoir of water plays a major role for the WAM onset into the Sahel ... Proposal: It is suspected that the reservoir of continental groundwater plays a major role for the WAM onset into the Sahel ...

P5645 L16: Please include the word “of” after the word “understanding”

Sentence rewritten.

P5645 L16-19: Very long and possibly confusing sentence. Please break it into smaller ones and rephrase it.

Rewritten.

P5645 L20: Please delete “to” after the verb “benefit”

Rewritten.

P5645 L21: Is it possible to provide the full name before the first appearance of the acronym?

Done.

P5645 L19-20: What is a “better closing of the water balance”? I don’t feel that this is a good justification for the study.

Rewritten.

P5645 L23: What do you mean with “nested catchments”?

Removed

P5646 L3: What do you mean with “subsurface fluxes”? Baseflow? Please be specific. Subsurface processes are interflow in these cases.

P5646 L28-29: “Along these lines”. Please rephrase it.

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Proposal: suppression of "Along these lines".

P5647 L17: "guessed to be so important". Please rephrase it. In addition, please include a reference(s) with regard to riparian forests and their role in evapotranspiration.

Please, see the answer to comment P5644 L5.

P5647 L18: Please include a "," after the word "rainfall".

Rewritten part.

P5647 L22-24: Please rephrase it.

Current: Guyot et al. (2012) showed that during the dry season, the measured turbulent fluxes are the signature of persisting vegetation. Proposal: During the wet season, taking into account only the water stored in the first meter of soil is not sufficient to explain the measured actual evapotranspiration (Guyot et al., 2009); during the dry season, the measured turbulent fluxes are the signature of persisting vegetation (Guyot et al., 2012; Mamadou et al., subm.).

P5647 L24-27: Very long and possibly confusing sentence. Please rephrase it.

Current: Therefore, representing the functioning of such a hydrological system requires to use a model able to simulate both the vertical and lateral redistribution of water susceptible of replenishing the permanent deep water storage and the pumping up of this deep water by the vegetation. Proposal: The physically-based Hydrus model (Simunek et al., 2006) was used as a coherent framework to represent and quantify the soil water transfers in both lateral (water distribution at the hillslope scale) and vertical (transpiration) directions.

P5647 L27-29: Please rephrase it.

Please, see previous answer.

P5648 L4-10: There is no need for this explanation about the structure of the paper.

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The final paragraph of the “Introduction” section is generally used to define the objective of the paper in the light of the context presented along the section. So, please, be concise and direct to expose your objective very clearly.

We removed the plan of the article.

Comment on Figure 2. What’s the riparian buffer width? Could you mention in the text?

The riparian buffer width is partially known. Its aerial part is known and given beyond in the text in the following section (Study site). Its underground part (roots) is not known and calibrated for the simulation. In order to keep the Fig. 2 as clear as possible, we decided to not illustrate aerial elements for the hillslope (riparian forest, crops) and illustrate instruments in a simple way with schematic elements.

Methods section Please avoid using terms (i.e. “base case”) that might be confusing for the reader.

The calibrated simulation of the year 2006 is called the 2006 simulation in the calibration, evaluation and virtual experiment sections. We removed the term "base case" as it is suggested.

P5648 L17-18: “cultivated area associating crop and fallows”. Please rephrase it.

Current: ... cultivated area associating crop and fallows ... Proposal: ... cultivated area with mixed crops and fallows ...

P5648 L19: “free water areas”. Please define it or rephrase it.

We suggested water body areas.

P5648 L20-22: Could you provide the width of riparian forests?

Current: The hillslope studied here is entirely cultivated with crop rotation and fallows and its lower part is bordered by a riparian forest covering 5 % of our elementary hydrological unit. Proposal: The studied hillslope here is entirely cultivated, with alternating

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crop rotation (yams, maize, cassava, sorghum) and fallows. Its lower part is bordered by a 20 m wide riparian forest which represents about 5 % of the hillslope length.

P5648 L23: What are the cultivated crops? Wheat? Corn? Sugarcane? Could you include this information?

Please, see above.

P5648 L26 P56491: Please rephrase it. Avoid using the term “falling”.

We replaced "falling" with "occurring".

P5648 L2-5: If the flow is intermittent it is not permanent. Please rephrase it.

Done.

P5648 L5-6: “High waters” Please define it or rephrase it.

Current: High waters occur from mid-August to the end of September ... Proposal: Discharge peaks occur from mid-August to the end of September.

P5649 L13-14: Can you provide a more precise soil classification using for example the US Soil Taxonomy or other taxonomic system? In addition, “weathered gneiss and micaschist, fractured bedrock substratum” are not soils.

OK, done.

P5649 L15-19: OK. I see some soil classification. I guess it is the FAO system. Please include the system of soil classification.

OK. Rewritten part including the system of soil classification.

P5649 L18: What is “bas fonds”? Please explain it to the reader.

We added a definition of "bas fonds" and references.

P5649 L19: What is a “horizon base”?

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Current: Typical depths of the horizon base are 15 to 40 cm for the A horizon, 70 to 160 cm for the B horizon, and lower for the C horizon (Faure, 1977). Proposal: The typical soil horizons depths range from 0.15 to 0.4 m and 0.7 to 1.6 m, for horizons A and B, respectively; the C horizon lies deeper than 1.6 m (Faure, 1977).

P5649 L20-21: "The horizon is sandy, mainly sandy loam" Please rephrase it.

Done.

P5649 L24-25: "The aquifer is mainly made up of silty and clayey saprolites". You are referring to the grain size distribution of the saprolite not the aquifer. Please rephrase it.

We maintained the term "aquifer": "The aquifer containing the permanent and unconfined water table is mainly made up of silty and clayey 5–25 m thick saprolites, overlying the metamorphic (gneiss and micaschist) fractured basement (Affaton, 1987; Descloitres et al., 2011)."

P5650 L3-4: There is no need to define upper and lower limits of the hillslope. Catchment boundary → water/topographic divide in parenthesis.

Current: The studied hydrological system is a hillslope, limited upslope by the catchment boundary and downslope by the river. Proposal: The studied hillslope is limited upslope by the topographic divide and downslope by the river.

P5650 L4: What kind of sensors did you used? Please tell the reader in detail. The same thing for the rain gauge.

Please, see below.

P5650 L5: "hydrological terms". Please rephrase it.

Done.

P5650 L5-19: Since the hydrological data is the basis for a modeling, you should pro-

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vide more details on the instruments used. You should not tell the reader to look for more details in other references.

We added a table with these datails and a sentence in the text.

P5650 L6: What's a soil moisture station? Can you describe the soil moisture sensors used? How often do they record soil moisture?

We rewrote this part.

P5650 L7-9: Please try to be concise and avoid repetition.

OK, see above.

P5650 L20: "Soil physics properties" → Soil physical properties. Which soil physical properties? Please cite them explicitly.

Current: Soil physics properties are derived from various field measurements. Proposal: The soil physical properties (retention curve and saturated hydraulic conductivity) were derived from field measurements.

P5651 L6-7: If you have some rainfall data to define a "dry" or "normal" year. Please include a mean and standard deviation and then you can describe rainfall levels in 2006 and 2007. In this sense, the reader is able to identify if they were dry, normal or wet years.

We added details about the rainfall regime.

P5651 L9: What is a "significant rainfall"? Please rephrase it.

See below.

P5651 L8-11: Given that you're reporting annual levels from 2006 and 2007, you report it using the verbs in the past and not in the present. Please rephrase it.

Done. See below.

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P5651 L4-18: This part needs a substantial rewriting. Please try to be concise and provide detailed information on LAI only if it adds to the paper. Otherwise, I suggest to simplify this part by removing excess information.

Current: Hillslope hydrodynamics is analysed at the annual time scale in order to interpret the annual water budget and intra-annual variability due to contrasted water content conditions: dry season, wet season and transient periods. The studied years, 2006 and 2007 have contrasted meteorological conditions. Annual rainfall was 851 mm in 2006 (dry year) and 1218 mm in 2007 (normal year). In 2006, apart from an isolated but significant rainfall (25 mm) observed mid-February, the rainy season extends from mid-April to mid-October. In 2007 the rainy season lasts 1.5 month longer (April to mid-November). The annual dynamics of the LAI is consequently different between the two years (Fig. 3). In 2006, the LAI increases early in February, in reaction to the early rain, then it decreases slightly until May when it starts growing again steadily to reach its maximum in August. In 2007, the increase starts in March only but it is steady and regular until it peaks in July, almost one month in advance as compared to 2006. The decreasing phase of the LAI is similar in 2006 and 2007 despite a 15 days delay in 2006. The annual cycle of the reference evapotranspiration is also given for both 2006 and 2007 in Fig. 3 (11 day moving averages), showing a similar dynamics for the 2 yr. Proposal: The study focused on two contrasted years: 2006 (851 mm of rainfall, “dry”) and 2007 (1218 mm, “normal”). In 2006, apart from an isolated rainfall (25 mm) observed mid-February, the rainy season extended from mid-April to mid-October. In 2007 the rainy season lasted one and a half month longer (April to mid-November). The annual dynamics of the LAI was consequently different between the two years (Fig.3), particularly during the transition period from the dry to the wet season. The annual dynamics of the reference evapotranspiration was similar for 2006 and 2007 (Fig. 3).

P5651 L20-21: Be concise. You could simplify the sentence saying that the topography and soil conditions along the hillslope are similar.

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Current: Given the symmetry of the topography and soil conditions transversally to the slope, the hillslope is studied as a 2-D system, as shown in Fig. 4. Proposal: Topography and soil conditions along the hillslope are similar, thus the hillslope is studied as a 2-D system, as shown in Fig. 4.

P5651 L21: The sentence “The finite. . . is used” is lost in the text. Please connect it to the other phrases.

Current: The finite element model Hydrus 2-D (Simunek et al., 2006) is used. Proposal: To simulate the hydrodynamic functioning of this hillslope, the finite element model Hydrus 2-D (Simunek et al., 2006) was used.

P5653 L10: “above 50 cm”. Above what? Please rephrase it. Besides, try to use meters instead of centimeters. And be consistent throughout the paper.

Current: The crop root system covers the entire hillslope and, according to observations, the bulk of the roots are located above 50 cm. Proposal: The crop root system covers the entire hillslope and, according to observations, the most of the roots were located above 0.5 m deep.

P5653 L11: “20 m large”? Do you mean height? “Root extent may be larger” Please rephrase it.

Current: The tree root system is concentrated downslope, in relation to the riparian forest. The riparian forest is 20 m large but the root extent may be larger. Proposal: The tree root system, corresponding to the riparian forest, was concentrated at the bottom of the slope. The width of the aerial part of the riparian forest was estimated (field surveys) at roughly 20 m, but the corresponding root part may be significantly larger.

P5653 L10-13: Please rephrase it. It's not clear.

See above.

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P5653 L17: horizon base? What do you mean?

Current: ... in agreement with the typical depths of the A and B horizon base in Benin ...  
Proposal: ... in agreement with the typical depths of the A and B horizon in Benin ...

P5653 L24: Please use meter instead of centimeter.

Done

P5654 L9: Please delete “Base case”

See the answer to the first comment of the methods section.

P5654 L11: Please rephrase “Soil parameters were locally measured”

OK, done.

P5654 L12-13: Please rephrase

Done.

P5654 L11-26: Please rephrase and pay attention to the verbs that should be in the past

Done.

P5655 L2: variable or parameter?

These are variables: water content, deep groundwater table ...

P5655 L18: “Evaluated”. Do you mean validated?

We thought that the term validate is not appropriate because one year is not sufficient to validate a model.

P5655 L11: Is it really necessary to call 2006 as “base case”? I don’t think so.

See the answer to the first comment of the methods section.

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P5655 L20: What was the period of time that “virtual experiment” was performed? 2007? Be express it.

The virtual experiment is performed on 2006.

P5655 L22-24: The water budget is a calculation. You used it to evaluate other things like evapotranspiration. . . please rephrase this part and include these things that you really wanted to measure through the use of the water budget.

Current: The virtual experiment is intended at analysing the impacts of the riparian forest and of the permanent groundwater table elevation on the water budget. Proposal: A virtual experiment was performed on 2006 in order to understand the interactions of water uptake by the riparian forest, ground transfers, water table level fluctuations and downslope outflows to the river.

P5655 Table 2 is okay. But  $T_p(t) = T_{p,base}(t)$  and something alike is not clear for the reader. Is it really necessary to keep this part within the Table? If so, please specify like you did with PRSD and LBC

OK. Please, see the new version of this table.

P5656 L3-4: See the comment P5655 L22-24

OK.

P5656 4-5: include in the end of the phrase “in the riparian area” or something like this. Be specific.

Done.

P5656 L3-19: It’s very clear for the reader the “virtual experiment”. However, don’t forget to include verbs in the past form, okay?

Done.

P5656 L5-8: It’s okay to do this with LAI. However, don’t forget to adress this limitation

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on the discussion part of the paper.

OK, proposal in the text.

RESULTS You should include in the discussion section that the calibration was made for 2006 which was dry year. What are the implications for the model performance during a wet year like 2007? Please discuss it.

OK, we added a discussion section.

P5656 L24: “prescribed” please rephrase it.

Done.

P5656 L25: “Soil physics parameters” → see comment above.

OK.

P5656 L26: Please delete “as already mentioned earlier” or rephrase it.

OK.

P5656 L5: If you know the lateral extent of the root is around 20 m, why didn't you use it?

We thought this comment corresponds to the P5657 L5. We do not know the real spatial distribution of the tree root system. We only have information about the aerial part of the vegetation cover. Consequently, we have calibrated the tree root system.

P5657 L11-12: “The 2006 calibrated simulation reproduces correctly the internal dynamics of the vadose zone” I can not see this, especially with regard to Fig.5 c, d, d'

Current: The 2006 calibrated simulation reproduces correctly the internal dynamics of the vadose zone and of the permanent groundwater table, as can be seen from the graphs of Fig. 5 illustrating the annual evolution for the bottom and the middle of the hillslope. Proposal: The 2006 calibrated simulation reproduces the main characteristics

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of the internal dynamics of the vadose zone and that of the permanent groundwater table.

P5657 L12: Please delete “as can be seen from the graphs on Figure 5”.

OK.

P5657 L20: include it was not good for the rainy season Please delete “illustrating the annual evolution for the bottom and the middle of the hillslope.”

See above.

P5657 L14: Figure 5: I see the point to keep a and a' identical in the same figure.

OK.

P5657 L15-16: Please rephrase it.

Current: Water contents at 20 cm depth (Fig. 5b and b ) are well simulated all along the year for the two positions on the hillslope, albeit a systematic and weak underestimation (about 0.02 m m ) during the dry season. Proposal: The water content dynamics at 0.2 m depth (Fig. 5b and b') are well simulated all year long. These simulated variables are slightly underestimated (about 0.02 m<sup>3</sup> m<sup>-3</sup>) during the dry season.

P5657 L19-20: Please rephrase it.

Current: Simulated water contents at 100 cm depth (Fig. 5c and c ) are in a good agreement with the measurements during the dry season. Proposal: During the dry season, the model captures the main characteristics of the water contents at 1 m depth (Fig. 5c and c').

P5657 L14: If they are identical, please, leave only one. There is no need for repetition.

See answer to comment P5657 L14.

P5658 L6: “amplitude”? Do you mean range? Amplitude of what? Water table depth? If so, please, be specific.

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Range is more appropriate.

P5658 L8-15: Visually, I really think the model simulated the evapotranspiration very well.

OK.

P5658 L20: all year long → please delete “the”

Done.

P5658 L22: Fig.8 → seepage can not be seen very clearly. Is it possible to make it clearer?

Seepage is very close to zero all year long, it is difficult to make it clearer. We suggest adding a detail in the legend. Current P5683: Fig. 8. Synthetic annual water balance of the hillslope: rainfall, transpiration, evaporation, seepage and water storage. All terms are simulated except the rainfall which is measured. Proposal P5683: Fig. 8. Synthetic annual water balance of the hillslope: rainfall, transpiration, evaporation, seepage and water storage. All terms are simulated except the rainfall which is measured. Seepage is close to zero all year long.

P5658 L24: “larger” → higher

Done.

P5658 L25-26: “installation of the rainy season” → please rephrase it.

Current: ... it then increases at a larger and steady rate from the beginning of May (likely as a reaction to the installation of the rainy season) to the end of November. Proposal: ... it then increases at a higher and steady rate from the beginning of May (likely as a reaction to the beginning of the rainy season) to the end of November.

P5658 L29: see the comment P5658 L20

Done.

P5659 L6: “pumping the missing water from the water table” → please rephrase it.

Done.

P5659 L12: evaluation or validation?

See answer to comment P5655 L18.

P5659 L13: “variable” or parameter? “Fitted”? Do you mean calibrated?

It is variable and not parameter. Current: The model, fitted to the 2006 observations is evaluated on year 2007. Proposal: The same variables as those used in Fig. 5 for 2006 are chosen to illustrate the simulation quality for 2007 (Fig. 9).

P5659 L18: what’s “resp. higher”? What’s “resp. middle”?

Current: The simulated water content was lower (resp. higher) than the observed one at the bottom (resp. middle) position. Proposal: The simulated water content at the bottom and the middle position was lower and higher than the observed one respectively.

P5659 L20: “the annual dynamics is quite well simulated” → I don’t agree (see Fig. 9c)

Current: Concerning water contents at 100 cm depth at the bottom position (Fig. 9c) and at mid-slope (Fig. 9c ), the annual dynamics is quite well simulated until a series of large rain events occurs at the beginning of September, the response of the model being much smoother than that of the observations. Proposal: Regarding water contents at 1 m depth at the bottom position (Fig. 9c) and at mid-slope (Fig. 9c’), the annual dynamics is globally reproduced by the model until a series of large rain events occurs at the beginning of September, the response of the model being much smoother than that of the observations.

P5659 L22: “as for the year 2006” → please rephrase it.

Current: However, as for year 2006, the model does not achieve to ... Proposal: How-

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ever, similarly to 2006, the model does not ...

P5659 L27: “the maximum is reached too late” → please rephrase it.

Current: This value close to the saturated water content is in accordance with measurements but high frequency fluctuations are missing and all in all, the maximum is reached too late. Proposal: This value close to the saturated water content is in accordance with measurements but high frequency fluctuations are missing. Moreover, the simulated maximum value is reached later than the observed one.

P5660 L10-13: Good! Whenever possible, try to make this link between years (simulation x validation).

OK.

P5660 L24: “unrealistic dream” → please rephrase it.

OK, this part of the sentence was removed.

P5660 L24: “dispose”? What do you mean?

We replaced "dispose" with "obtain".

P5660 L26: vegetation and aquifer do not control the water budget. They may affect the water dynamics (hydrological processes) which can be evaluated by calculating the water budget.

OK.

P5661 L3: “The virtual experiment bears on year 2006”. Please rephrase it.

Current: The virtual experiment bears on year 2006. Proposal: The virtual experiment is carried out on year 2006.

P5661 L3-5: This is very interesting!

OK.

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P5661 L5: delete “the” before the word “year”.

Please, see below.

P5661 L5-6: “the hillslope generated seepage all the year long”→ When? 2006? 2007? Please be specific.

Please, see below.

P5661 L3-13: please avoid repetition. These data is already presented in Table 3. So there is no need to mention what in there in the text. If you want you can leave the text and delete Table 3, but I wouldn't do so, since it synthesizes the results of your simulation. This is the central part of the paper. Be concise and discuss this table in Discussion. Then, you could include references that are or are not in line with your simulation.

OK, this part is now shorter.

P5661 L16-20: You should discuss the fact that LAI variation is not included in the simulation. What would be its impact in case it had been included? Why rooting depth has a weak impact on annual evaporation? Or evapotranspiration?

OK, we discussed it in the discussion section.

5 Synthesis and conclusions Where is the Discussion section? You should create it before the Conclusion section. This part is very long. I would create a discussion and then I would make a shorter conclusion with the core findings.

Done.

P5661 L22: “Position of the problem” → please rephrase it or delete it

Removed.

P5661 L24: Please replace “they” by “trees”

Removed.

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P5662 L1: You should include a reference that says what you said is assumed. Likewise, I don't think this approach strengthens the paper.

Removed.

P5662 L2: What's a "healthy monsoon"?

Removed.

P5662 L4: "pump" → please rephrase it.

Removed.

P5662 L6-7: nothing interacts through the water budget. The water budget is a calculation. Please see comment above.

Removed.

P5662 L8: Please delete "outmost"

Removed.

P5662 L10: "the table level" → please rephrase it.

Removed.

P5662 L12: which scale? Please be specific.

Removed.

P5662 L14: "fictive" → please rephrase it.

Removed.

P5662 L10-24: This part should be in the discussion.

OK.

P5662 L21-24: You have already said it earlier. So please delete it.

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Removed.

P5662 L26-27: this sentence has to be rephrased. Moreover, “80% and 90% of the annual water budget”. Do you mean 80% and 90% of the annual rainfall?

Removed.

P5663 L20: “potential transpiration” → please define it or reword it.

The potential transpiration is defined at P5652 L16-20.

P5664 L1-2: Be aware that riparian is a position in the landscape. So be specific when you say “riparian transpiration system”. In addition, define “couple transpiration system”.

OK. We replaced "couple transpiration system" with "interacting transpiration system".

I think there is a paradox between P5663 L25-27 and P5664 L8-10. Please reexamine it.

In these two sections, the water availability is different. P5663, there is no deep ground-water table whereas there is deep groundwater in P5664. In P5663, we want to specify that the spatial distribution of root system is less appropriate in simulation 2 than in simulation 3 due to the transpiration model of Hydrus. Due to the presence of the deep groundwater table in P5664, the riparian forest deep root system extract proportionnaly more water than crop roots. Perhaps, the term "efficient" is clumsy in P5663.

P5664 L14: What's “transpiration efficiency”? Reword it or define it.

Current: Thus, when not limited by soil water, crops and riparian forest have roughly the same transpiration efficiency. Proposal: Thus, when soil water was not the limiting factor, the extracted water per unit of root volume was roughly equal for crops and riparian forest.

P5664 L14: “On the opposite” → By contrast

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Current: On the opposite, during the dry season, the upper soil layers are dry and the forest transpiration reaches 57 % of the total hillslope transpiration, meaning that the riparian forest is almost 6.5 times more efficient than the other vegetation in pumping water back to the atmosphere. Proposal: By contrast, during the dry season, the upper soil layers were dry and the forest transpiration reached 57 % of the total transpiration, meaning that the riparian forest extracts more than six times more water than the other vegetation cover.

P5664 L16: Please do not use the term efficient cause it has other meaning in plant physiology.

OK.

P5664 L19: Please rephrase “all along the year”.

Done.

P5664 L20-21: “It is the signature of deep rooted persistent vegetation”→ please rephrase it.

Removed.

P5664 L21: Delete “persistent”

Please, see above.

P5664 L21-22: superficial → surface

Current: Conversely, the superficial layer (0–0.5 m) shows a highly variable transpiration rate, depending on rainfall input, atmosphere demand and soil moisture availability and is consequently season dependent. Proposal: The surface layer (0-0.5 m) shows a highly variable transpiration rate, depending on rainfall input, atmosphere demand and soil moisture availability and is consequently season-dependent.

P5664 L24: “annual transpiration signal” → please rephrase it

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Current: The annual transpiration signal can be interpreted as the addition of a practically constant riparian forest transpiration which is around 0.4 mm d<sup>-1</sup> at hillslope scale and a time-dependent crop transpiration which is linked to rainfall inputs. Proposal: At the annual scale, transpiration can be interpreted as the addition of a practically constant riparian forest transpiration which is around 0.4 mm d<sup>-1</sup> at hillslope scale and a time-dependent crop transpiration which is linked to rainfall inputs.

P5664 L26: "transpiration is mainly supplied by the riparian forest" → please rephrase it

Removed.

P5665 L19-21: please rephrase it and explain better the results found by Séguis. 6 – 34 mm d<sup>-1</sup> is an enormous value!

OK.

P5665 L23: "emptying the downslope water table". Please rephrase it.

This part was rewritten.

In addition, include the daily riparian evapotranspiration that you estimated to compared to Séguis et al. 2011 estimates.

Done.

P5666 L12: Do you have any observation from the field to tell the reader it the absence of seepage is realistic? If so, please do it.

We added: "However field inspections in 2006 revealed no exfiltration ever visually observed at the bottom of this particular hillslope (but it could have happened between two visits), ..."

P5666 L14-16: I agree, otherwise there wouldn't be streamflow generation. But if first and second order streams are surrounded by riparian forests, where do you think

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streamflow is generated? As you said earlier, this modeling exercise was not aimed to be really accurate. Thus, the decoupling between groundwater and river might be a consequence of such “simplified hillslope representation” though some papers have shown the riparian forest water use on streamflow/groundwater (please see the references). You should discuss these uncertainties.

Thank you for the references. We discussed the issue of streamflow generation.

P5666 L17: Rephrase this first phrase.

OK.

P5666 L23: “slope forest” → please rephrase it.

Removed.

P5666 L17-26: There are many studies in the literature that analysed the riparian forest evapotranspiration. You should look for them and include it.

OK.

P5666 L27: What’s “rapid and drastic evolution of the vegetation cover”?

Removed.

P5667 L1: “inner growth” → please rephrase it.

Removed.

P5667 L4: In addition, the model assumes that all rainfall events infiltrate. This not a very realistic assumption since croplands usually show higher overland flow generation compared to native primary forests. Thus, land-use change is followed by changes in water flowpaths in most cases.

In a paper focused on hydrological processes along the West African rainfall gradient, Séguis et al. (2011) noted the weak contribution of Hortonian runoff to streamflow generation : "At the hillslope scale, previous studies showed that most infiltration excess

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water infiltrates before reaching an expanse of open water (van de Giesen et al., 2000; Masiyandima et al., 2003; Giertz et al., 2006). Consequently, Hortonian runoff should contribute little to total streamflow."

Figure 6. Please indicate the observed data in the graph. Do not use the method (i.e. flux tower).

We added details in the caption of the figure and we modified the legend.

Figure 9. Please rephrase the captions and avoid repetition of the same graph (a and a')

We modified the caption of Fig. 9 to be the same that the caption of the Fig. 5.

Figure 11. What's a saprolitic soil?

Current: Saprolitic soil. Proposal suggested by the Referee #2: Saprolite.

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

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