Response to comments by Referee#2 Dr. Rogier Westerhoff on "Aerial and Surface rivers: downwind impacts on water availability from land use changes in Amazonia"

We would like to thank referee #2 Dr. Westerhoff's (hereafter, the referee) suggestions that help us improve our manuscript.

This paper addresses the role of soil moisture recycling (aerial rivers) in the water balance, and how it affects downwind climates in scenarios of land-use, more specifically forest change in the Amazon. The paper reads well and touches on a topic that is not often discussed amongs hydrologist. The study also potentially has a large impact and therefore much relevance. I have to so that I am not an expert in soil moisture recycling and I could therefore not go into detail on validity of all the methods used. However, I do see that the paper could use some extra description and discussion on uncertainty.

We thank the referee for highlighting the potential application of our results to the community. We have included more discussion on uncertainty in the revised version as suggested to improve our narrative on the findings in Sect.4.5 limitation.

The only major comment I have is that the figures that you present incorporate some uncertainty or range, but without any explanation on how these were estimates. Also, other uncertainties are not addressed, e.g., the assumption of constant groundwater. Some uncertainties might be higher than your actual estimates. Or not, but without proper explanation we do not know. I think the paper also deserves a discussion that deals with uncertainty.

Since my comments are relatively easy to address (in my opinion) I therefore recommend this paper to be accepted with minor revisions.

Thank you to the referee for the positive feedback. We agree with the referee to improve the description and discussion on uncertainties in the revision to avoid potential confusion. We have added information to Table 2 where uncertainty ranges represent the standard errors of the measured data in Sakai et al., 2004. We also find it important to discuss uncertainties in the stable groundwater storage assumption and have added the discussion in Sect. 4.5. We have also added more information on the processes and methods (e.g. MIP boundaries) that we think needed more clarification.

These are my comments. Please treat the comments on uncertainty as less than minor.

- Page 2, line 7. Two sentences that almost say the same, try turning these into one.
- Page 2, line 19-21. The sentence is unclear, especially the part "some areas' water regime". Please rephrase.
- Page 2, line 26. Explain the abbreviation SDGs. Maybe a reference to some of these SDGs (e.g. water)
- Page 2, line 34. The first time you use the term aerial rivers, explain what they are. That is important, since the term is in the title. You can either probably solve that quite simple by saying:" 'aerial rivers', i.e., preferential pathway of moisture flow, termed in Arraut et al. (2012) as an analogy to surface rivers."
- Revised as suggested.

Page 3, line 6-10. Try to avoid method description in the introduction.

We have now simplified this part in order to give the readers a brief impression of the tool used in the study, directly right after our introduction to the tools used in the community.

Page 3. Define what the sinks and sources are in this study.

We did not state it clearly and clarified our definition on P3 L15.

Page 5, line 22. It is e.g., not eg.

Corrected as suggested.

Page 6, line 13. I think you should explain the assumption of Zemp et al. (2014) in somewhat more detail, instead of the quick reference. What is balance? Are they equal? Or are their ratios equal?

We agree with the referee that the assumption was not clear and have clarified it. We further shifted the reference of Zemp et al. to Sect 4.1 to avoid confusion. We referred here to their paper originally for their discussion on the MOD experiments' E and P balance (Sect 2.1.2; Zemp et al., 2014). However, they did not make the assumption of E and P balance which was made here in the present study. Thus we shifted the reference to where we discuss the bias induced by the imbalance between E and P in some geographic regions e.g. the Andes (Sect. 4.1) as was also pointed out by Zemp et al. (2014) in their discussion.

- Page 6, line 13. The steady groundwater storage assumption is of major importance in my opinion. This needs to be in the discussion. For example, removing trees generally elevates the water table. Although the water table is already very shallow in most of the Amazon, small differences of e.g. 5 cm might have mahor differences in the whole balance that you are calculating. Can you something on the uncertainty surrounding that?
- Page 9, I would like to see some more uncertainty discussed. E.g. the groundwater assumptions. Also, it is not entirely clear from the method how you got your result uncertainty ranges (e.g., the 10-26%m 5-12% etc).
- We agree that it is important to discuss uncertainty in the assumption of stable groundwater storage in our runoff estimation. We have added a discussion (in Sect. 4.5) on studies partitioning river water storage and groundwater storage's contribution to the variation in terrestrial water storage. However, the groundwater storage's importance still remains disputed among previous studies focusing on the Amazon basin. We have referred to previous findings in the revision for the reader's information. In addition, we have included more relevant processes in our discussion in Sect. 4.5.

  The ranges in Sect. 3 Results were to express the number span between different land use change scenarios and we have added clarification (according to scenarios) when this expression first appeared to avoid confusion in the revision.

Page 8, line 6-7. a quarter of what, and extra time of what?. This sentence should be much clearer.
Clarified as suggested.
As also mention above, we have added more discussion on the uncertainties and limitation.
Page 9-10: Discussion: Can the discussion mention what the relative contribution is compared to the moisture from the sea?
The oceanic source is out of the scope of our study focusing on the terrestrial moisture recycling. However, we have added in the revision a description specifying that the terrestrial recycling contribution to the sensitive areas is 74.7% in average for readers' comparison.
Page 13, line 31. It is 'bottom-up'
Revised as suggested.

References

Sakai, R. K., Fitzjarrald, D. R., Moraes, O. L. L., Staebler, R. M., Acevedo, O. C., Czikowsky, M. J., Silva, R. Da, Brait, E. and Miranda, V.: Land-use change effects on local energy, water, and carbon balances in an Amazonian agricultural field, Glob. Chang. Biol., 10(5), 895–907, doi:10.1111/j.1529-8817.2003.00773.x, 2004.

Zemp, D. C., Schleussner, C. F., Barbosa, H. M. J., Van Der Ent, R. J., Donges, J. F., Heinke, J., Sampaio, G. and Rammig, A.: On the importance of cascading moisture recycling in South America, Atmos. Chem. Phys., 14(23), 13337–13359, doi:10.5194/acp-14-13337-2014, 2014.