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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The influence of water table depth on evapotranspiration in the Amazon arc of deforestation" *by* John O'Connor et al.

Anonymous Referee #2

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General comments

In this paper, O'Connor et al tackle an interesting and very important question in the field of ecohydrology: how does groundwater affect plant functioning? As a community, it is important that we move from the broad, large-scale influences of climate towards focusing on the regional to local scales, where, as shown by several authors, groundwater might be one of the driving forces of ecosystems. This has important implications for our understanding of the response of natural and agricultural systems to climate change, and this study is a timely contribution to this field.

I believe, however, that there are some conceptual and methodological issues with this study that should be addressed before publication. Below I offer some comments on the content of the paper and also pose some questions that might help the authors in

further refining it.

Specific comments

1) The ultimate focus or "big question" of this study was somewhat unclear to me as I read the paper. In the introduction, a lot of importance is given to large scale problems such as the impact of land use changes on precipitation recycling and the subsequent negative effect on forest cover through a reduction in ET. However, in the conclusions section, the "key messages" are related to agricultural management and forest conservation. I believe the paper would greatly benefit from a clear, defined question that is posed in the beginning of the paper and that guides the discussion and conclusions. From the climate system point of view, the small differences in ET between shallow and deep WT observed in the study might not be significant, while from the perspective of sustainable agricultural management and general crop productivity these changes might suggest a more water efficient practice. Perhaps the authors could group their questions with their hypotheses, which currently are somewhat scattered throughout the introduction and methodology sections.

2) Although groundwater is the main environmental factor addressed in this study, very little is discussed about it throughout the paper. What is topography like in the region of study? How does the water table field look like in this area? How deep and how shallow can the water table be? What is the meaning of an "equilibrium water table depth"? What are the benefits and the drawbacks of using an equilibrium water table instead of a dynamic product? Is this an area where the water table responds directly to precipitation or is lateral convergence an important process? These are some key questions that directly impact the hypotheses and conclusion of this study, and therefore should be well addressed in the manuscript.

3) I don't understand the reasoning behind choosing the wet and dry season transitions as periods of stress for vegetation. The use of a climatic index neglects the important time lag displayed by groundwater (and soil moisture in general) that has been shown

to support considerable levels of ET well into the dry season for several places in the Amazon basin (Miguez-Macho and Fan, 2012). In fact, seasonal soil moisture storage maps from Miguez-Macho and Fan (2012) show that, in the top 2 m, October is a more critical month in this general area than the dry season transition (June/July) proposed here by the authors. Is there a specific reason for choosing these periods?

4) The authors should include early in the introduction that irrigation is still an uncommon practice in this general area, before proposing that a deep water table is detrimental for crop growth. This is a critical information for understanding why crops in this area would depend on natural soil moisture. As it is now, this is only clarified towards the end of the discussion (line 459).

5) Although a shallow water table can be beneficial for vegetation, as thoughtfully discussed in the manuscript, waterlogging also plays an important role in regulating vegetation function and distribution by causing anoxia in the rooting zone (e.g. Rossato et al (2012) for savannas, among several others). Was this considered when classifying the pixels into the two categories? Does this occur in the study area?

6) Why were savannas included in the analysis? Very little is discussed about their characteristics, functioning and why they were of interest to this study. In Figure 2 savannas are lumped with croplands as “other vegetation” (line 229) and hypothesized to have shallow roots, while in reality savanna species can grow roots as deep as or even deeper than forests (Canadell et al, 1996). Besides that, waterlogging is an important driver of distribution and function in Brazilian savannas and therefore special attention should be payed to pixels in the “Shallow WTD” category (as said before in item 5), as they might encompass this condition that is highly detrimental for vegetation.

References

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