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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hydrological trade-offs due to different land covers and land uses in the Brazilian Cerrado" *by* Jamil A. A. Anache et al.

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We would like to thank the anonymous **referee 3** for the kind words in support of our manuscript and for the time spent reviewing our text. Here, we replied the referee's comments, which were highly insightful and enabled us to improve the quality of our manuscript. Note that the original referee's comments are identified as R3Cxx and written in **bold**, and the authors' responses are labeled as AR-R3Cxx. In addition, all comments are numbered (xx).

R3C1: This paper describes an experimental approach at the hillslope scale concerning the possible water partitioning trade-offs due to the LCLUC dynamics. I think this paper is relevant since it studies water flux in the Cerrado

biome. The manuscript is interesting and well written. The results are original and represent an important contribution to the understanding of hydrological processes in the Cerrado. However, my main concern is that the problem statement is not clearly defined and that the field experimental description is not sufficient as it is. I think the paper is well written and the relevant literature cited, however it requires major revisions.

AR-R3C1: We appreciate the reviewer feedback about our manuscript and the time spent during the reading and further revision. Here, we express our accordance with the relevant given suggestions. We also added the information that will be included in a revised version of the manuscript. We will deeply revise the problem statement, which is mainly based on the lack of field studies in the tropics considering different land uses and an undisturbed condition (Cerrado). We recognize that it could contain more arguments involving the need of field observed data for both modeling and discovery sciences.

Suggested corrections:

R3C2: All acronyms of the equations that are in the text should be in italic and the equation with the unit (equation 8).

AR-R3C2: Thank you for the correction. We will change this along the text according to the instructions.

R3C3: Page 3: The figure 1, is it to highlight Brazil? the most important is the monitoring, the details in the photos are too small. Please improve visibility.

AR-R3C3: Thank you for your suggestion. We wanted to highlight the study area context by printing the country larger than the other information. However, we

recognized that it is more important to show the reader more information about the study site itself. Thus, we made a new Fig.1 (see below) considering this important suggestion.

R3C4: Page 3: In sub-Section 2.2 Experimental setting and instrumentation-better describe the part of the monitoring. What was the measuring range for each equipment? What are the distances between the equipments? What is the size of the plot? What are the characteristics of the forest? (DBH, Height, Density)

AR-R3C4: Thank you for these important questions. Concerning the measuring range of each equipment, we will add this information on Table 1 (see the supplement to this comment). The distance between sites 1 and 2 are 1.7 km. Site 1 has 9 plots placed side by side (approximately 2.5 meters of distance between each plot) (see Figure 1). Also in site 1, there is a meteorological station that concentrates almost all sensors placed at that site, except for the soil moisture probes (we have one placed inside the first sugarcane plot, and 20 m to the left, we have another one placed inside the first pasture plot). Site 2 has 3 plots inside a tropical woodland (wooded Cerrado) and due to the tree density and topography, the plots are approximately 5 to 10 meters distant from each other. Approximately 50 m to the north from the plots, we have a meteorological tower (11 m height) containing all the sensors placed at site 2. Concerning the forest characteristics, the wooded Cerrado area used in this study has 15522 individuals per hectare, the height of most of the trees is about 8 m, and the diameters (DBH) are predominantly between 3 and 7 cm (Reys et al., 2013). We will add an extra paragraph in section 2.2 in order to better describe the instruments' positions and the forest characteristics.

R3C5: In table 1: Were used different equipment for monitoring the same variable in different plots (i.e. soil moisture)? What is the error of each piece of

equipment? some tests were carried out to know the difference between devices?

AR-R3C5: Thank you for this important remark. We used the same model of soil moisture probes in the different probes (see the supplement to this comment). We added the maximum error of each piece of equipment in Table 1 (see the supplement to this comment). The soil moisture probes had their first use in our study sites and they were all previously calibrated with soil samples from our study sites.

R3C6: In figure 2, Why did not your measure soil moisture in the Bare soil? Please explain.

AR-R3C6: Thank you for the question. We had not enough ports in the datalogger to connect another soil moisture probe to monitor the bare soil plot. In addition, we did not have a piece of equipment available to perform such monitoring.

R3C7: Page 4: The paragraphs in lines 5 to 13, should be inserted in the sub-section 2.2.

AR-R3C7: We agree that this information suits on section 2.2. However, we added these paragraphs in section 2.3 (water balance components) because each of them is describing how we obtained each of the water balance components: Page 4, lines 5-6 describe how we monitor the rainfall; Page 4, lines 7-9 describe how we obtained the overland flow and how we calculated the runoff coefficient; Page 4, lines 10-12 describe how we estimated the reference evapotranspiration. Thus, we argue that removing these paragraphs from section 2.3, we may lose the sequence of the text. You can see that just after line 13 (page 4), we present Equation 2, which is also referred in line 13. Additionally, these paragraphs define how we obtained the input variables used in Equation. 1.

R3C8: Page 5: How and when do you obtain soil field capacity and saturated hydraulic conductivity?

AR-R3C8: We obtained the soil field capacity and saturated hydraulic conductivity using Büchner funnels and Richards extraction chambers. These tests were performed in the beginning of the experiment (2012) (Oliveira, 2014). We collected the samples with undisturbed structure in volumetric rings at depths of 20, 50 and 100 cm.

R3C9: Page 5, Table 3: remove this table, you can describe it in a paragraph.

AR-R3C9: Thank you for the suggestion. We will remove Table 3 and a new paragraph will be added after line 22 (page 5): "The Priestley and Taylor coefficients (α) calculated for a wooded Cerrado area close to the study site (Cabral et al., 2015) differed according to the season: 1.09 for Summer (December – March); 1.00 for Fall (March – June); 0.77 for Winter (June – September); and 0.98 for Spring (September – December).".

R3C10: Page 6: In sub-section 2.4 and 2.5 describe more about these topics.

AR-R3C10: Thank you for the suggestion. We completed these 2 paraghaphs with additional information. We will modify the paragraphs as reported below:

Section 2.4: Groundwater table fluctuation "The water table was registered twice a day (at 6 am and 6 pm) using pressure transducers (Diver, Schlumberger) placed inside two monitoring wells (well 1 located in the pasture area; and well 2 located inside the wooded Cerrado area). In the study site, both wells presented similar hydraulic conductivity according to the slug test (Bouwer and Rice, 1976) previously performed. We evaluated the aquifer hydraulic conductivity from both wells in order to

validate the water table comparison among each other, as whether the aquifer condition in the wells were different, the such comparison would not be fair. Both wells reach the water table at approximately 40 m depth in an unconfined sandstone formation (Botucatu formation), which belongs to São Bento Group of Mesozoic age. In addition, the soils above the aquifer that appears thought the unsaturated zone are Cenozoic sediments weathered from the sandstone (Wendland et al., 2007)."

Section 2.5: Data analysis "The normality assumption was tested using the Shapiro-Wilk test using a 95% confidence interval for rainfall, evapotranspiration, surface runoff and soil water storage datasets. The one-way analysis of variance (ANOVA) was applied to test the null and alternative hypothesis, that is, equality of surface runoff, evapotranspiration and soil water storage distribution functions between the four treatments (LCLU) versus the difference in distribution functions between at least two treatments. Additionally, the multiple comparisons between treatments were performed using the Tukey test (Montgomery, 2008). The rainfall, evapotranspiration, surface runoff, water balance residual and soil moisture graphs were plotted using a daily basis timescale. The groundwater table fluctuation was plotted using a monthly timescale due to the noise typically found in this kind of measurement. In order to present the order of magnitude along the years, the data was also resumed annually in tables and figures."

R3C11: Page 8, Results and discussion: I think you need to further describe the results and compare with other papers. The study would have been of more interest to readers if various published water flux models had been tested using the data.

AR-R3C11: Thank you for your suggestion. As asked by other reviewers too, we will improve the results' discussion by contrasting our outcomes with other studies in the revised manuscript to be submitted. Concerning the testing of water flux models, it

was not part of our scope to test models using our data. We consider that water flux model testing with the data presented along this study should be part of a new study. Thus, we may add it as a recommendation along the discussion and also in the concluding remarks. We believe that the main contribution of our study is the long-term monitoring at the hillslope scale under subtropical conditions. Such kind of data is a resource for both discovery and modeling sciences . Additionally, we could draw significant conclusions by the comparisons of the contrasting land uses considered in this study.

R3C12: Page 12 Conclusions: The conclusion reads more like a summary of the paper.

AR-R3C12: We recognize this aspect. Along the revision, we will add substantial information in the results and discussion session. Thus, in the revised version, we will add other assumptions discussed thought the manuscript. The fact that we summarize the manuscript in the first paragraph of the conclusion is due to the need of remember the reader about the context of our study. In addition, some readers go straight to the conclusions in a first read of a paper and when we give at least a brief description of the study before giving the conclusions, we improve the comprehension of our scientific contributions.

Figure caption

Figure 1: Location of study sites, Cerrado biome borders, Guarani Aquifer System (GAS) outcrop zone distribution in Brazil, and experimental design, where site 1 contains the plots with agricultural land uses (pasture, sugarcane and bare soil) and site 2 contains the plots with wooded Cerrado.

References

Bouwer, H., and Rice, R. C.: A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resour Res, 12, 423-428, 10.1029/WR012i003p00423, 1976.

Cabral, O. M. R., da Rocha, H. R., Gash, J. H., Freitas, H. C., and Ligo, M. A. V.: Water and energy fluxes from a woodland savanna (cerrado) in southeast Brazil, J Hydrol: Regional Studies, 4, 22-40, 10.1016/j.ejrh.2015.04.010, 2015.

Montgomery, D. C.: Design and Analysis of Experiments, John Wiley Sons, 752 pp., 2008.

Oliveira, P. T. S.: Balanço hídrico e erosão do solo em mata nativa do bioma Cerrado, PhD, Departamento de Hidráulica e Saneamento - Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos, SP, 2014.

Reys, P., Camargo, M. G. G., Grombone-Guarantini, M. T., Teixeira, A. P., Assis, M. A., and Morellato, L. P. C.: Estrutura e composição florística de um Cerrado sensu stricto e sua importância para propostas de restauração ecológica, Hoehnea, 40, 449-464, 2013.

Wendland, E., Barreto, C., and Gomes, L. H.: Water balance in the Guarani Aquifer outcrop zone based on hydrogeologic monitoring, J Hydrol, 342, 261-269, 10.1016/j.jhydrol.2007.05.033, 2007.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-415/hess-2018-415-AC3-supplement.pdf

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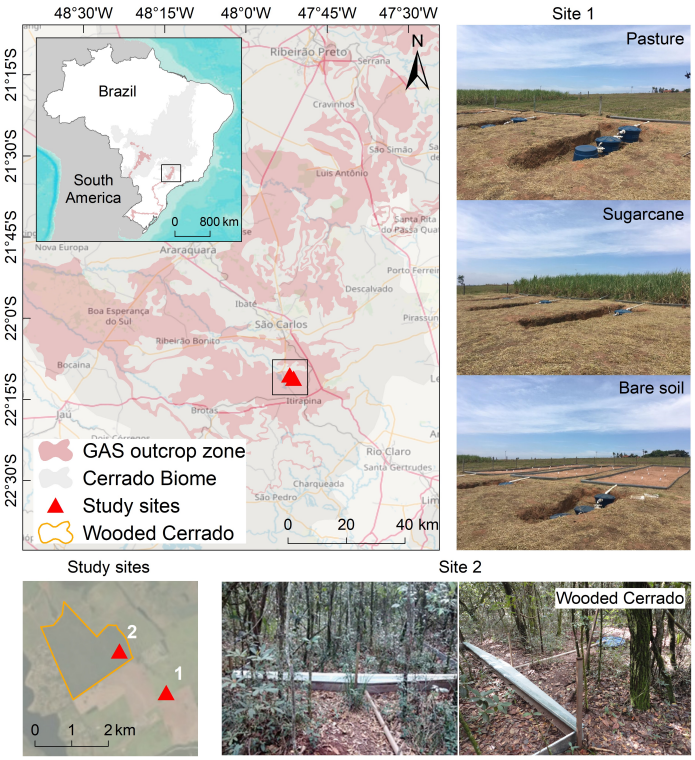

Fig. 1. Figure 1 (see caption above)