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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The importance of city trees for reducing net rainfall: comparing measurements and simulations" *by* Vincent Smets et al.

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Authors: We would like to thank reviewer 2 for his time to review our paper, we think his constructive comments have significantly improved the quality of our manuscript.

Reviewer main comment 1: The manuscript is, however, unusually long, and contains extended reviews of basic and standard canopy interception concepts that are not necessary and make the original contributions of the work difficult to extract. For example, Figures 1 and 5 are unnecessary: these have been standard for 50 years, and also the same analysis as Figure 5 was done for this research and presented as Figure 10. Sections 1.2, 1.3, and 2.6 could all be reduced substantially.

Authors response: We restructured the paper and shortened the manuscript. The main focus is now on the original contributions of the work: 1) The experimental setup and gathered dataset 2) Comparison of the performance of on one hand, the standard specialized forest interception models (Gash and Rutter) and on the other hand an adapted water balance model (WetSpa).

Change in manuscript: The regression analysis was removed because of its narrow application. The scenario analysis was also removed and instead a section (4.3) was added to discuss the relevance of our research to an urban context. Several paragraphs and subsections were removed or merged (e.g. section 3.3 'The sensitivity analysis' was substantially reduced and incorporated in sections 2.3 'The V-catchment Design' and 2.5 'The Meteorological Stations). Figures 1, 5, 6, 8, 9, 10, 11, 14 and 15 were removed.

Reviewer main comment 2: The choice of and behavior of WetSpa for interception modeling is difficult to evaluate. The WetSpa equations in Appendix A contain symbols that are not defined and the cited source for these is a white paper not contained in the References. As far as I can determine the simple assumptions it makes have never been tested in the refereed literature, despite the citations to support use of the WetSpa interception formulation (e.g., P5L15) that do establish that it has been used. There appears to be no scientific reason to include this model in a comparison, and it seems likely that it was chosen because of its familiarity to the authors.

Authors response: We want to test the performance of a water balance model to simulate interception storage of a solitary tree in order to be able to use the model in an urban context. WetSpa has been chosen due to the flexibility of the model which makes it easy to adapt it to our purposes (including LAI and setting up a V-catchment). The model flexibility and V-catchment set-up is well described in the PhD thesis of Elga Salvadore (Salvadore, 2015). The inclusion of LAI in the interception calculation is described in Wirion et al., 2016.

Change in manuscript: To better describe why we include WetSpa in the analysis we changed Paragraph 1.5 'Interception Models' and paragraph 1.6 'Research Questions'.

Reviewer main comment 3: The simplicity of the WetSpa formulation as an ultra-simple bucket model with, e.g., no provision for drip when storage is less than capacity or reduced evaporation rates from partially wetted canopy, is an interesting test against the more sophisticated Gash and Rutter models. That it appears to give empirically similar or superior results is a very useful finding for canopy interception science. However, the discussion makes essentially no attempt to explore the ramifications of this finding, either from a utilitarian (e.g., "should we be using simpler models") or physical (e.g., "what does it mean that only the coarsest components of the water budget need modeling?" Or "Is the superior performance of the super-simple model a fluke of this environment or should we be applying it more generally?") perspective. Re-stating and discussing the "WetSpa" formulation in terms of other, similar models in the older literature would help it to make the biggest contribution to the canopy interception literature.

Authors response: We agree that the good performance of WetSpa is surprising and important to notice. Further, we believe that different models serve different purposes. The disadvantage of Gash and Rutter in this case is that they were developed on forest stands and we believe this might affect their performance for bigger rainfall event as the evaporative potential differs in an urban context. We elaborate on this in the discussion of the results. We still promote the use of more specialized interception models for a more detailed understanding of interception on solitary trees. In the context of urban management, however, WetSpa seems a good alternative to quantify the interceptive potential of urban trees as a starting point to further analysis of other water balance components such as infiltration and runoff. When it comes to hydrological modelling the potential of interception storage is usually underestimated, simplified or even disregarded as its potential for flood mitigation is low. However, our study shows that most rainfall events in our climate are moderate and that 38% of the rainfall water during rain events is intercepted. It is thus important to consider interception in hydrological

simulations and therefore we propose a simpler approach such as the one WetSpa uses.

Change in manuscript: Paragraph 4.2: Discussion on the model comparison.

Reviewer main comment 4: I think the urban hydrology modeling is a separate topic that is best left for another paper. Removing it would help shorten the paper to a more manageable size and also allow the strengths of the interception data to be better emphasized. Perhaps it is only a matter of taste, but I think the style in which the urban hydrological modeling text is written suggests bias on the part of the authors about the importance of urban trees, when a dispassionate evaluation would be more effective

Authors response: We agree with the reviewer's comments and removed the scenario analysis from the manuscript to focus more on the gathered dataset and the model comparisons.

Change in manuscript: Removal of the scenario analysis and addition of section 4.3 'The Potential Benefit Of Trees In An Urban Context' in the discussion, where the relevance of our findings in an urban context are discussed.

Reviewer main comment 5: The canopy interception conclusions mostly consist either of simple data or bland inferences based more on previous understanding of urban hydrology than on the results of this work. Adding theoretical discussion and making theoretical inferences from the data would help readers understand the scope of the work beyond the immediate context of this experiment.

Authors response: We have rewritten the conclusions with the aim to better emphasize our contributions to the urban hydrology literature. Furthermore, we elaborated on the model comparisons in the discussion section.

Change in manuscript: Our main conclusions are: 1) Both trees intercepted around 38% of gross precipitation, emphasizing the importance of (1) interception storage for reducing net rainfall and (2) accounting for interception storage in an urban water bal-

ance model. 2) The water balance model (WetSpa) and the specialized interception models of Gash and Rutter showed a similar performance when compared to the measurements. The three models underestimate interception storage for bigger rainfall events which we relate to a poor understanding of the evaporative behavior of intercepted rainwater during rain events in an urban environment. However, the relatively good performance of WetSpa for bigger rainfall events, its simplicity and its water balance framework promote it as a tool for assessing the interceptive potential of urban trees.

Line comments Reviewer comment: P12L15 Salvadore et al. 2015 published a general review of models of urban hydrology, and it is not clear how that review supports this work.

Authors response: We agree, her PhD is a better reference on why we use the WetSpa model.

Change in manuscript: The sentence has been deleted as the information is redundant (cf: introduction).

Reviewer comment: Figure 2 is not needed; its function is duplicated by Figure 3.

Authors response: We decided to keep Figure 2 as it gives a good overview of the environment and near surroundings of the trees. Figure 3-4 are presenting a clear image of the schematic- and actual experimental construction.

Change in manuscript: None

Reviewer comment: Section 3.1 should be Methods Authors response: We agree and moved this section to Methods. It is incorporated in section 2.2 and 2.4.

Change in manuscript: See section 2.2 and 2.4

Reviewer comment: Sections 2.5.2 and 3.3 the sensitivity analysis is difficult to understand. It seems like the data in the two panels of Figure 9 probably came from the

same assumptions, but I cannot follow the text P9L34-37

Authors response: We removed Figure 9 because it took up too much space and wrote the sensivity analysis more concisely. This part was added to section 2.3 and 2.5..

Change in manuscript: See section 2.3 and 2.5.

Reviewer comment: Figure 10 the inflection point is plotted at $\sim$2.5 but listed as 4.72.

Authors response: Because we decided to remove the Leyton analysis to estimate interception storage capacity from the manuscript, Figure 10 was also removed. A modified version of this figure, used to determine the free throughfall coefficient, can be consulted in Appendix A.

Change in manuscript: See manuscript

Reviewer comment: Figure 13e is unnecessary. The same information is in a-d. The equations for the regressions should be presented

Authors response: We added the regression equations and R^2 on the plot area and removed Figure 13d (the regression) and Figure 13e from the manuscript.

Change in manuscript: See figure 13 in the manuscript

Reviewer comment: Table 2 I disagree that regression does not account for evaporation during the event. It simply does so implicitly.

Authors response: We agree with this comment but decided to remove the regression from the manuscript because of its limited applicability.

Change in manuscript: See manuscript

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