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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Rainfall interception and redistribution by a common North American understory and pasture forb, *Eupatorium capillifolium* (Lam. dogfennel)" *by* D. Alex R. Gordon et al.

Anonymous Referee #1

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Gordon et al. present observations of understory rainfall interception in the southeastern US. Dogfennel, the understory plant they study, is a tall and dense forb that the authors show can have a major effect on rainfall partitioning. The topic is of great interest to HESS readers, as rainfall interception is an important component of the water cycle that is nevertheless relatively poorly studied and represented in models. The authors make a compelling case that this is particularly so for low-stature and understory vegetation, such as the dogfennel communities they study. The manuscript, however, does not quite live up to the expectations raised in the powerfully argued introduction.

The analyses and interpretations contain considerable flaws and omissions: a flux that is essential to the authors' conclusions was interpolated rather than directly measured, which is only addressed in a cursory manner; the overall partitioning is never (or if so, inappropriately) estimated; and important details regarding the methods and observations are missing.

Event-level overstory throughfall

The overstory throughfall fluxes, which act as the normalization factor in the most important event-level rainfall partitioning estimates and are thus essential to the authors' conclusions, are interpolated rather than measured. The authors acknowledge this potentially major source of uncertainty only briefly when discussing the spatial variability (l280, Fig. 5). I feel that this issue needs to be addressed head on, as I have several concerns. First, it further introduces spatial variability. However, the spatial variability of understory throughfall (and overstory throughfall) is not analysed, despite the redundancy in the measurements. Second, there could well be an association between overstory throughfall and relevant dogfennel parameters such as their density. Such an association would need to be addressed if the authors want to draw robust ecosystem-level conclusions. Third, there may be a temporal bias here as well, but it is difficult to say because the study periods in which overstory and understory throughfall measurements were conducted are neither stated nor compared. Fourth, while the interpolation of spatially averaged overstory throughfall (supplement) provides a decent fit overall, the linear association is clearly insufficient for small rain events. For zero rainfall, it predicts negative throughfall. The authors, however, analyse small events in great detail. It is not clear to me how these issues impinge on their estimates of understory throughfall for small events. Similarly, the uncertainties that arise from the ad-hoc estimation of dewfall are not addressed or quantified. In summary, I thus have major concerns regarding the estimated event-level understory water balance, especially during small events.

Insufficient estimates of total rainfall partitioning

Apart from the issues raised above, the statistical analyses of rainfall partitioning are insufficient. The authors do not report the overall partitioning over the entire study period (e.g. stemflow vs total rainfall or overstory throughfall) and the associated uncertainties. The analyses at the event level that are shown are insufficient for three reasons. First, the overall partitioning is not reported. The individual ratios (e.g. stemflow divided by rainfall) in Tab. 1 cannot be averaged to obtain the overall ratio. The authors, however, do just that in the conclusions (they even report the median rather than the average) when they write: 'Eupatorium capillifolium (Lam., dogfennel) in the understory of an urban forest fragment intercepted 20.4% of verstory throughfall from Pinus palustris (Mill.).. I would expect both errors (aggregating ratios, median instead of mean) to overemphasize small events, and thus to overestimate throughfall/rainfall. The event-level fluxes need to be summed, see e.g. doi:10.1029/2000WR900074, doi:10.1016/S0022-1694(01)00393-6, doi:10.1088/1748-9326/ab1049, for how to estimate overall partitioning and its uncertainties (due to spatial variability, stems that were not instrumented, observation errors, etc.). Second, only summary statistics such as the median are shown (Tab. 1). A scatter plot would allow the reader to draw additional inferences, such as in what way stemflow increases disproportionately for larger events. Third, it is not clear how the data were spatially aggregated. Three clumps were instrumented, and I assume they were averaged over, but how?

Interception capacity

I could not follow the rationale behind the interception capacity measurements. How long were they dried in the oven? Did the leaf itself (not the intercepted water) lose weight during that period? Why not compare it to the weight before wetting? The other issue, which is that the submersion in the lab is very different from the wetting due to rainfall in the field, would remain. This needs to be spelled out clearly, cf. doi:10.1016/S0022-1694(01)00393-6.

Missing details

Several crucial aspects of the observations and analyses are not addressed in the methods:

The throughfall funnels are not described in detail, and there is not a single picture. In particular, I could not find relevant information on whether they were adequate for measuring below-dogfennel throughfall. The authors argue that they provide more robust estimates because they are larger than most rain gauges that are commonly used for such purposes, but at approximately 25x25 cm, this difference does not strike me as particularly noteworthy. Given the relatively large density of dogfennel plants, however, it is not clear to what extent the plants and hence the throughfall were disturbed by the installation of the funnels.

I would not be able to reproduce the scaling of the rainfall interception capacity measurements from the leaf to the plot scale. The authors mention in l176 that they use estimates of leaf area, but these estimates are never introduced. Equations would also help, as would a consistent terminology (surface area seemingly refers to very different things in the same paragraph).

It is not clear how dogfennel density (e.g. at what scale) was determined and whether the numbers given in Section 2.1 refer to the clumps the authors study or to other areas.

The three clumps the authors study are not described in detail. How do they differ? What do they look like? Does that have an impact on the rainfall partitioning?

The regression analysis shown in Fig. 5 (of doubtful value because it relies on the unrealistic assumption on overstory throughfall) is not described. According to the figures, it looks like the authors regressed the ranks rather than the actual observations, which would need justification. So would the fact that the authors apparently did not consider the joint influences of explanatory variables.

Minor points:

Figure 6 compares rainfall partitioning of herbaceous plants and trees, but I suppose the climatic conditions differ between the two and thus constitute a major confounding factor. These concerns are, however, not addressed.

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