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Discussions

Interactive comment on "Influence of rain pulse characteristics over intrastorm throughfall hot moments" *by* J. T. Van Stan and T. E. Gay

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Many thanks to referee #2 for their insightful review! As they've already provided their comments in numeric order, please find our responses beneath excerpts from their review below.

Comment: 1) Terminology and classification of "hot moments". I am not sure if the term "hot moment" is really appropriate for describing temporal concentrations of throughfall. Even so the concept of "hot" and "cold moments" might be established it is rather confusing in the context of this paper. Why not working with terms that really describe what the authors try to investigate (such as "concentration in relative throughfall")? Moreover, the decision to classify relative throughfall > 80% as a "hot moment" is (as

the authors admit, P11343 L. 4 – 8) arbitrary and it is not clear how this decision influenced the results.

Response: As referee #2 is in agreement with referee #1 that the terminology "hot moment" is not clear, we will use referee #2's suggested term "temporal concentration in relative throughfall". For consistency we will remove text regarding "hot moments" and, instead, review the extant literature regarding thresholds in the canopy water balance with regards to throughfall.

In regards to the 80% threshold for temporal concentration in relative throughfall: perhaps since anything over the median (73%) is technically enhanced, a more objective approach would be to use > 73% as the threshold? We re-ran the multiple correspondence analyses using this threshold (bottom panels of Fig4-rev1.png and Fig5-rev1.png) and the original 80% threshold (top panels of Fig4-rev1.png and Fig5-rev1.png) to examine how our original threshold choice affected the results. These analyses also rely on median absolute deviation (MAD) rather than coefficient of variation (a correction made in response to comment #3). Results were very similar regardless of the 73% or 80% threshold, likely since the 80% threshold was the ∼60th percentile. We suggest using the more data-related 73% threshold (based on the median) for Figures 4 and 5.

Comment: 2) Data. There are two problems with the data used in this paper. First, the distance between the rainfall and the throughfall measuring site is large (distance of 1 km, P. 11341, L. 5 – 6). As a result, throughfall data do not necessarily reflect rainfall volumes. This issue is critical because the analysis is based on relative throughfall data (relative throughfall = throughfall / rainfall). Second, it is not clear why the authors restrict their analysis to 56 rain events only. Given that the work is based on tipping bucket data it should be possible to use more data. A larger dataset may outweigh potential errors caused by the large distance of the rain and throughfall monitoring sites.

Response: Referee #2 is correct that distances equaling and exceeding 1 km between rain and throughfall monitoring can prevent the matching of their volumes - but this issue is typically related to complex terrain. St Catherine's Island has extremely flat terrain with relatively even vegetation. Under such conditions, significant rainfall variability over 1 km is unlikely. Furthermore, Figures 2 and 3 demonstrate how well the data temporally correspond.

No entire rain events were excluded. There were only 56 storms that occurred without clogs or gauge malfunctions for the entire year. Storms that were clogged were, unfortunately, not recorded. But, a brief review of the meteorological station data showed 5 storms without throughfall data (we assume, then, that only these few storms were missed). Of the 56 measured storms, 70% of the total rainfall was included in our analysis due to difficulties separating pulses that occurred too close together to isolate without making assumptions about their temporal dynamics (which we believed would impact our analyses). Text clarifying these details will be added to the manuscript.

Comment: 3) Statistics. Throughout the paper the authors use both parametric and robust statis-tics for the same variable. This inconsistency should be avoided. For instance, it does not seem sensible to me to compare the coefficient of variation (CV) with the median of the same variable (e.g. P. 11346, L. 8 – 9). The CV is a parametric measure of variation (CV = standard deviation / mean), whereas the median is a robust measure of central tendency. To ensure consistency, the authors should either use parametric (CV, mean etc.) or robust statistics (interquartile range, median etc.) but not a mix of both approaches. In other parts of the manuscript, the authors provide the median of a variable and its standard error (P. 11346, L. 16; P. 11362, Table 1; P. 11363, Table 2). This is not inconsistent, this is clearly wrong. The median of a variable and the standard error of this variable cannot be reported together. The standard error is a quality measure of the mean (it equals the square root of the sampling variance). Consequently, it makes only sense to report the mean and its standard error. If the authors wish to use robust statistics they may provide the median and the median absolute

deviation (MAD).

Response: Referee #2 is correct that the inconsistency in statistical measures must be addressed. We have revised Tables 1 and 2 (Tables-rev1.png), as well as our Multiple Correspondence Analysis plots relying on this data (Figures 4 and 5) to consistently use robust statistical measure (median and median absolute deviation). These revised tables and figures are attached to this response. As expected, the points shifted in the MCA plots (Fig4-rev1.png and Fig5-rev1.png). However, the relationships between the points (which ones clustered in the positive and negative domain of each dimension) remained the same as in the original figures. We believe this supports our argument in response to referee #1: that the data naturally correspond as described and discussed in the manuscript.

Comment: P. 11337, L. 10: The range of relative throughfall is larger than 70 – 90 %; values between 60 % (e.g. Krämer and Hölscher, 2009) and 95 % (e.g. Zimmermann et al., 2013) are not unusual.

Response: Referee #2 is correct. We will revise this text accordingly.

Comment: P. 11343, L. 6: At individual locations throughfall can be Âż 100 %. For clarity, please make sure that you refer to average throughfall.

Response: Referee #2 is correct in this point as well. We will revise this text accordingly.

Comment: P. 11343, L. 14: Please provide a more in-depth explanation for "clusters fell prey to chaining".

Response: The "chaining effect" is a drawback of the simplistic "minimum distance" pairing done by single linkage clustering. It results in a long cluster consisting of a substantial portion of the dataset that can span an impractical breadth. In our case, it chained together just over 60% of our dataset to no meaning decipherable by us.

Comment: P. 11364, Figure 1: For clarity, please use a symbol for the monitoring site that has no background.

Response: A symbol for the monitoring site without a background will be provided in Figure 1.

Comment: P. 11368, description of Figure 5: There is no reference to sub-figure “c)”. Please correct.

Response: We will add a reference to subfigure “c)” in the Figure 5 caption.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 11335, 2014.

Table 1. Descriptive statistics for the rainfall pulse clusters identified by complete linkage cluster analysis.

			Median (MAD)				
Pulse Cluster	n	Sum rain (mm)	Rain (mm)	Intensity (mm 5 min^{-1})	Wind run (km)	VPD (Pa)	ADP (h)
1	11	41.7	1.5 (0.9)	0.33 (0.13)	4.0 (1.8)	349.6 (268.3)	86.7 (42.4)
2	12	108.3	2.9 (2.3)	0.50 (0.13)	18.5 (10.4)	169.8 (25.9)	4.4 (3.1)
3	29	293.2	5.1 (4.7)	0.25 (0.05)	76.5 (56.4)	26.9 (15.9)	1.4 (0.8)
4	17	109.6	2.5 (1.7)	0.27 (0.07)	16.7 (13.0)	110.5 (16.4)	9.6 (8.6)
All	69	552.8	2.7 (2.2)	0.30 (0.10)	21.0 (22.9)	94.2 (55.7)	4.0 (2.7)

Table 2. Throughfall pulse characteristics for each cluster identified by complete linkage cluster analysis. Superscripts indicate the order of medians (from high to low in alphabetical order) where similar superscripts indicate insignificantly different medians per Kruskal-Wallis ANOVA ($p > 0.05$).

			Median (MAD)	
Pulse Cluster	n	Sum (mm)	% Rain (%)	Intensity (mm 5 min^{-1})
1	11	21.6	37 (24) [b]	0.07 (0.03) [ab]
2	12	64.3	66 (9) [ab]	0.13 (0.06) [a]
3	29	241.2	88 (12) [a]	0.10 (0.08) [b]
4	17	78.2	75 (17) [a]	0.08 (0.04) [ab]
All	69	405.3	71 (17)	0.10 (0.06)

Fig. 1. Tables 1 and 2 (revised)

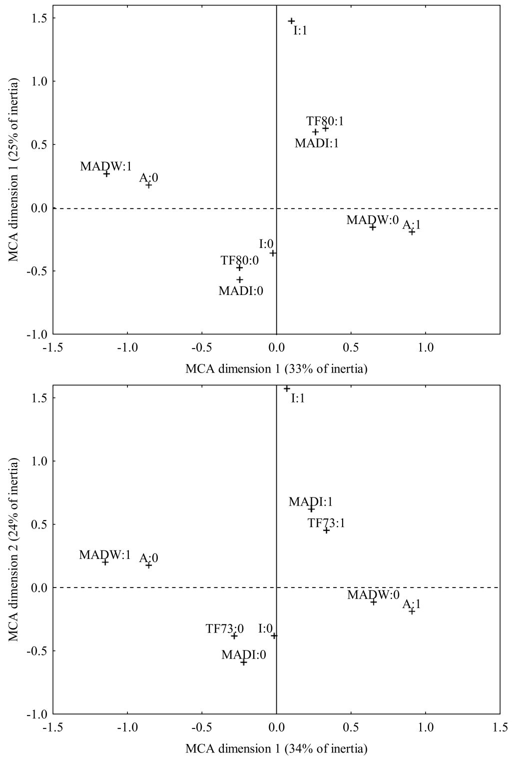

Fig. 2. Figure 4 (revised)

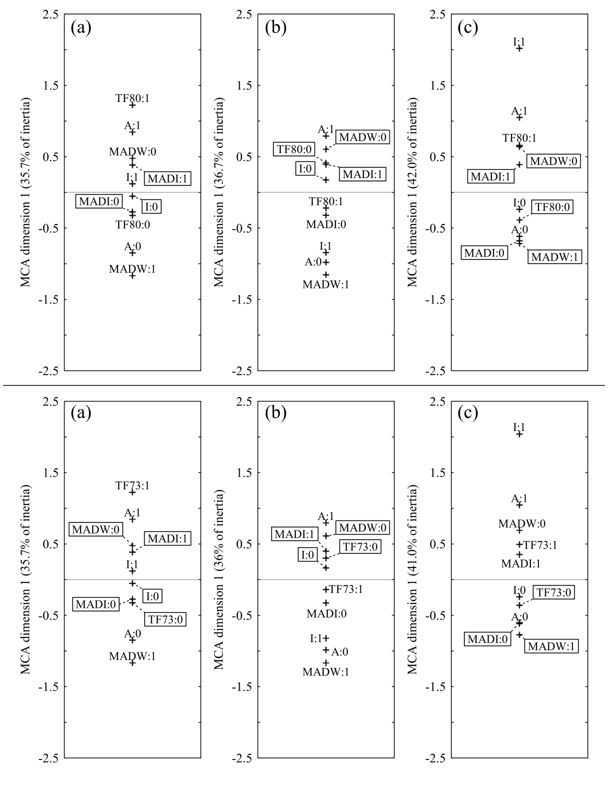

Fig. 3. Figure 5 (revised)