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Hydrology and Earth System Sciences Discussions

Interactive comment on "The within-day behaviour of 6 minute rainfall intensity in Australia" *by* A. W. Western et al.

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We thank the referee for their thoughtful comments on our paper and respond to each in turn as follows.

***Referee 2**: 1. It is not clear to me why you cut-off the lower intensities before fitting the pdf. Couldn't you as well take all non-zero precip-data? I understand you focus on the higher precipitation events, but still (even after the cut-off that you applied) you focus on the right tail. To make the analyses more general, I suggest to include all data, or to better discuss why you didn't include it, and demonstrate the effect of putting a threshold on lower precip data on the fit (and the parameters of) the TDFs.*

The reason for censoring the low intensity data relate to the problem of measuring low intensities with the finite tip size inherent in tipping bucket technology. This introduces various artefacts. We have added the following two sentences at page 3194 line 5 to expand on the reasons for censoring the low intensities. “This error is related to the inherent quantisation involved in tipping bucket technology (the finite volume bucket must fill and empty for rain to be recorded). In addition low intensity periods have been handled differently over time by the Bureau of Meteorology, with earlier data having single tips spread across multiple 6 minute periods and later data having the tip assigned to a signle 6n minute period.”

Referee 2*: page 3194, line 28: you mention 2 mm* h^{-1}*: shouldn’t this be 0.2 mm* h^{-1}*?*

2mm h^{-1} is correct. This comes from 0.2mm tip size and 6 minute (0.1h) data interval. We have clarified this by adding “ i.e. 0.2mm tip and 6 minute intervals”.

Referee 2*: page 3196, line 3: “at least using traditional ways of thinking about rainfall”: what do you mean with this? What would the alternative way(s) be?*

We have reworded this sentence as follows so that it is clearer. “The validity of including these EVDs is open to question as the full range of observed intensity (ignoring the minor censoring at very low intensities) has been included, whereas EVDs describe distributions of extreme values (i.e. maximum or minimum) taken from of each of a set of realisations.”

Referee 2*: page 3197, equation 1: why use the RMSE? In statistics the “Wasserstein distance” (also called "Earth mover’s distance") is used more often! This measure has the advantage that it not only looks at the vertical differences between both functions (as the RMSE does) but also accounts for the horizontal differences. (this measure was lately used in HESS papers of Ehret and Zehe (HESS, 15, 877–896, 2011) and van den Berg et al. (HESS, 15, 1445–1457, 2011))*

We used the RMSE as it is a traditional measure of error used in hydrology and were

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unaware of the Wasserstein distance. We do not believe that this would significantly change the results of our analysis.

***Referee 2**: page 3198 lines 10 to 14: give more explanation on why the bins were set in this way. Is there any specific reason for using this formula?*

As stated in the paper, we followed the recommendations of the Engineering Statistics Handbook.

***Referee 2**: page 3198 lines 21-23: a lot of emphasis is given to the upper tail, while the objectives of the paper are focussing on the complete pdf. Some focus can be on the upper tail (but then this has to be specified in the objectives), but, given the current definition of the objectives, the whole pdf should be examined.*

***Referee 2**: page 3199, lines 9-11: it is not clear why the RMSE90 is used.*

We have added the following expanded explanation to this dot point. "The 90th percentile was chosen on the basis that it provides an indication of the minimum level of performance that can be expected from the majority of fits."

***Referee 2**: page 3208, line 20 to page 3200, line 5: basically, you end up with two groups: 1 and 2 (where 1 is better then 2, but 2 can be preferred above 1) and group 3 and 4 (where you state that the order between 3 and 4 is not important): I suggest that the authors do not rank them as they did, but rather that 2 groups are defined.*

We think this comment actually should refer to page 3207 line 20 to page 3208 line 5. Responding to this point and Willems comments, we have altered the text in line with the referees suggestion as follows. Page 3207 line 18 to 24 is replaced with: "Based on their performance as measured by the goodness-of-fit statistics mCOE and RMSE90, we suggest that the two best performing TDFs were GPT3 and GPT2, where GPT3 has a slightly better fit but GPT2 has the advantage of only two parameters. In selecting between two and three parameter distributions there is likely a trade-off between higher bias in the two parameter distribution (due to less flexibility) and higher uncertainty in

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parameter estimation in the three parameter distribution. The main advantage of GPT2 over GAMA and EXP is that it outperforms GAMA and EXP at the higher intensities."

***Referee 2**: page 3211, line 6 to 10: as this study is a precursor study, it would have been interesting to have had some insight in how the pdfs change with changing daily rainfall. The study conducted could have binned the daily totals and have looked at the statistics of the parameters of the distributions within each bin and see whether they change or not.*

We agree with the sentiment of this comment but think that we can infer relevant conclusions from Figures 9 and 10. We have added the following text following page 3211 line 4.

"It is clear from the relationships shown in Figures 9 and 10 that the parameter values for the intensity distributions will change with both latitude and the amount of rainfall on a given day. Both these factors could be incorporated into a predictive model for the parameters that is based on location and daily rainfall depth. However the results in Figures 9 also indicate that there is considerable variability between days with similar amounts of rain at a station, which suggests it may also be valuable to explore other predictors."

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 3189, 2011.