Response to Referee #1

Title: The Probability Distribution of Daily Precipitation at the Point and Catchment Scales in the United States

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Dear Editor and Referees:

Thank you for your comments and suggestions for our paper. We have revised the manuscript based on the comments and our detailed responses are listed below.

Comment 1: Abstract: Personally, I would avoid a direct comparison of two- (G2) and three-parameter distributions (P3). Especially, since P3 is a generalization of G2 with an additional location parameter then "by definition" always will perform better. So maybe the authors wish to reform these statements.

Response:

We have reformed the statement by deleting the direct comparison of G2 and P3 in Abstract, i.e., the sentence has been revised as:

"Importantly, both Pearson Type-III (P3) and Kappa (KAP) distributions perform very well particularly for point rainfall."

Comment 2: Heading: In some heading authors are using ":" in the end that is not necessary.

Response:

Corrected.

Comment 3: Section 1.1: The GG was also used in stochastic modelling of precipitation, see Fig.5 for hourly and Fig.6 for daily in Papalexiou (2018). Actually any distribution that describes well wet-day precipitation (or at any other scale) can be used as this stochastic modelling scheme makes feasible to

use any probability distribution and any correlation structure. Additionally, the GG was also used to generate gridded daily precipitation that is consistent with monthly observations (see Fig. 11 in Papalexiou et al., 2018).

Response:

Thanks for your explanation about GG distribution. We have explained the GG distribution and the paper Papalexiou et al. (2018) has been cited in our paper.

Comment 4: L147: Here is mentioned that there is a consensus in using GEV, G, or GPA, for annual maxima. I would agree for G and GEV but the GPA is mainly used for peak above threshold values. Most of annual maxima samples have a bell-shaped density while the GPA is always J-shaped and of course its origin is from the Pickands–Balkema–de Haan theorem which refers to POT values.

Response:

Thank you. The sentence has been revised as:

"There seems to be a consensus that annual maxima appear to be well approximated by either a GEV or Gumbel probability density function (pdf); while peaks above threshold values are well approximated by a GPA distribution, and the series of wet-day precipitation is well approximated by a G2, GG, W2 or in some cases a mixed exponential distribution."

Comment 5: L160. Please delete the "generalized" before the "Burr type XII". Also just to explain the point made by the authors in the following lines regarding L-skew/L-kurt diagrams for the GG and BrXII(of course they do not have to add this in the manuscript). The truth is that they exist and I had formed the theoretical spaces similar to L-CV/L-skew but the problem was that the space was not "one-to-one", I mean that for different shape-parameters points the same point in the L-skew/L-kurt emerged. So, it was not possible to depict the theoretical space without avoiding overlapping.

Response:

We have deleted the “generalized” before the “Burr type XII” and thanks for your kind explanation regarding GG and BrXII.

Comment 6: L217: Since the authors are not including zeros in the analysis (and that is correct) there is no point to mention zeros a possible explanation of the skewness. So, the distribution of daily totals (of wet days of course) is highly skewed due to small nonzero values and high variance, i.e., since its bounded at zero and there is a high frequency of close-to-zero values and the variance is high then inevitable this creates the positive skewness.

Response:

We have rewritten the sentence as:

“The distribution of wet-day series of precipitation is highly skewed due to the large proportion of small non-zero values and high variance.”

Comment 7: L265: use italics for p, n and i, to display the equation properly.

Response:

Corrected.

Comment 8: Section 4.1.2: I think the explanation why points shift towards the G2 or P3 curve is due to the areal averaging process which lowers the variance and the kurtosis. I am a bit surprised though that I do not see lower values of skewness.

Response:

We agree with your opinion that areal averaging process lowers the variance and the kurtosis.

Comment 9: L321: At least in the title (4.2) I would suggest not using the abbreviation PPCC

Response:

The abbreviation “PPCC” in title has been spelled out.

Comment 10: L388: I am sure that the statement "the KAP is required to capture the tail behavior…" is a bit risky. I stress again that the Kappa distribution is a four parameter distribution and therefore has a huge flexibility and can fit to anything. Yet this does not imply that it can capture the behavior of the tail; the extrapolations could be very risky especially if estimation is based on small samples.

Response:

The sentence has been revised as:

"From the L-moment diagrams and PPCC comparisons we concluded that KAP can better capture the tail behavior of point wet-day series, though both P3 and G2 can provide reasonable approximations in many situations."

Comment 11: Table 2: An optional suggestion: there is a huge mess in the literature regarding the parameter symbols used in distribution which creates confusion. For example, here η, ω, ξ, μ, σ ,p, d, λ, β, b, φ, κ etc are used. There are only 3 type of parameters, location, scale and shape. I personally follow a clear and simple convention, i.e., α for location, β for scale, and γ for shape; if more than one parameter of the same type exist I use indices (γ_1, γ_2). This allows the reader to know the function of the parameters. Of course there are classical cases like the normal distribution where is standard to μ and σ due to the link with mean an sd. Please check the equations: the P3 authors show is something between Weibull and Gamma. To simplify reading authors can use exp instead of e. Check how equation are depicted, probably authors introduced eqs as pictures that creates distortion and unequal font size. Authors are not showing the Kappa distribution as it forms a space, but for completeness I would suggest to provide its formula.

Response:

Thanks. The equations have been revised.

Comment 12: Table 3: The Generalized Pareto is not the GP2, either correct the name or the equation. Please, correct the formula of the Weibull distribution, you are using exp and then superscript; no need for {} or [].

Response:

The Generalized Pareto in the paper is the two-parameter Generalized Pareto distribution. We have revised the equations of GP2 and Weibull.

Comment 13: Figure 2: X-axis maybe days? The same holds for Fig.3

Response:

The labels for X-axis in Figure 2 and Figure 3 have been changed to "Number of days".

Comment 14: Fig 5. I mentioned that before. The theoretical lines of G2 = P3, GP2 = GPA, LN2 = LN3 for Lskew-Lkurt diagrams. Authors can mention that if they wish.

Response:

We have added an explanation in the revised paper.

"It should be noted that the P3 distribution is the two-parameter G2 with an additional location parameter which does not affect the shape characteristics and thus the theoretical curve of P3 shown in Figure 5 is the same as the G2. The same holds for GPA and GP2 and for LN2 and LN3."