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Hydrology and Earth System Sciences Discussions

Interactive comment on "Skewness as measure of the invariance of instantaneous renormalized drop diameter distributions – Part 1: Convective vs. stratiform precipitation" *by* M. Ignaccolo and C. De Michele

Anonymous Referee #1

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General comments:

This is a paper about an interesting topic, the characterization of the invariance of DSDs and the existence (or not) of a so-called "universal distribution" for the normalized DSD whatever the rain types (convective / stratiform) and/or the climatic regime.

The normalization procedure is quite different from the normalizations proposed elsewhere in the literature (e.g. Sempere-Torres et al. 1994; Testud et al. 2001; Lee et al.

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2004): it uses the mean and the standard deviation of the DSD to define a reduced-centred diameter Dr. The probability density function of the reduced-centred diameter is expressed as the diameter standard deviation multiplied by the pdf of the diameter. One must remark that such relationship does not hold for the exponential and gamma pdfs that are largely used to model DSDs. The authors then propose to use the skewness parameter of the normalized distribution as a measure of the invariance of the DSD "shape". The reviewer is wondering about the physical significance of the skewness parameter. On another hand, the reviewer is also wondering why the authors do not use the kurtosis as another statistical parameter to be used for checking the similarity of the scaled DSDs. The authors do not display the normalized spectra which could probably be the best solution for convincing the reader of the invariance of the scaled spectra. Instead, they analyse the skewness parameter for the entire dataset, and for a convective/stratiform segregation. They also investigate the shape of the DSD for various skewness parameter classes, identifying "the most common distribution of renormalized drop diameters and two main variations. The comments of the results displayed in Fig. 3 about the similarity of the mean convective/stratiform scaled spectra should be mitigated by those of Fig. 1 about their respective occurrence. Again, the reviewer suggests giving an indication of the variability of the scaled spectra in Fig. 3. The authors finish the paper with a section about the sample variability of the skewness and a study about the relationships between the mean, the standard deviation and the skewness.

This paper is both original (actually the normalization is original but this aspect has been already published) and rather difficult to read. I am sorry to say the authors did not convince me of the relevance of their novel normalization technique compared to the other recent contributions mentioned in their bibliography. With the objective of studying the invariance of the DSD shape, the proposed scaling appears (reasonably) well suited but it may be of little help for other applications such as establishing relationships between bulk variables of interest in atmospheric sciences. To be provocative I am tempted by asking a major revision of the paper; I think the authors have to demonstrate the added value of their approach.

Specific comments:

P7 (the full number is 5607, omitted for conciseness), line 9: here and everywhere in the text, write “Hazenberg” and not “Hazenber”

P8, l5-23: this is a summary rather than an introductory paragraph, you should describe the structure of the paper; we don’t know well where we are heading.

P8, 14: “the distribution of skewness is strongly peaked”: this “peakedness” character could (should?) be quantified

P8, 23: “associated” and not “associates”

P9, 9: the instantaneous bulk variables “or power functions of those bulk variables”

P9, 15: if I understand well the index “G” stands for “ground”, is it really useful?

P9, 18: maybe add “total” drop count

P9, eq.(3): this equality holds e.g. for the Normal and the double exponential pdfs, but not for the exponential and gamma pdfs. . . any comment? Mention the units of the 2 pdfs: p(Dr) is unitless and p(D) is in [L-1]

P10, 14: “check of self-consistency” what do you mean?

P10, 15 – P12, 20: what are you doing?

P10, 23: pG(DR) is defined much later by equation (5)

P12, eq (6): the raindrop diameter range does not extend to infinity

P12, 5: the term “quantization error” between comas is a bit surprising (just like “check of consistency” before)

P13, eq (8): why don’t you consider also the kurtosis as a parameter of interest for checking the similarity of the scaled spectra?

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P13, 3: before "measuring" the invariance, it could be interesting to have a figure with all the scaled spectra displayed together, just to see. . .

P13, 19: "< ": what is meant?

P13, 3 – 14, 2: this "verbose" paragraph should be compressed / suppressed.

P14,16 and 22: January, February

P16, 1-12: I am not convinced this procedure allows you to "verify that the class gaps are due to sampling fluctuations and not to some real dynamical property of rainfall"; the choice of the 90% threshold has little justification. I don't understand also your justification for suppressing the drop counts following a gap! You have no good reason to consider those counts as "defective". A solution to minimize the class gaps problem is to increase the time interval I.

P16, 10-12: something is missing in this sentence

P16, 23: Better use "histogram" instead of "probability". These are the empirical distributions. Wouldn't it be interesting to model these histograms just to see the kind of distribution the skewness coefficient follows?

P16, 26: "With respect to the entire. . ."

P17, 1: "this figure indicates the existence of a substantial degree of invariance"; one could say "this figure indicates the existence of a substantial degree of variability" as well. I am sorry but the skewness of the distribution of the reduced diameter has little physical significance for the standard reader (!) and it is difficult to follow you. . . Again, why don't you show the normalized spectra?

P18, 16-20: what is the practical significance of this result?

P18, 22 –p19, 14: not clear to me after several readings. . .

P18, 26: standard distribution = Normal pdf with 0 mean and 1 standard deviation?

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