Comments on: Observing Phase Transitions in Extreme Rainfall Events: Insights from Sub-Minute Observations and Universal Multifractal Analysis

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Overall Comments:

This paper uses the UM framework that was developed in the 1980's and 1990's and has since been applied across a diverse range of precipitation (and other) data sets. While the paper is basically sound, it is critically missing a comparison with the numerous other UM studies of precipitation: how does this paper improve / advance our understanding?

Detailed comments:

Line 27: It is has not yet been specified that these are rather abstract, *multifractal* phase transitions. Readers may easily have the impression that the authors are discussing ice to water phase transitions.... Similarly, I think the word "multifractal" should be used in the title in order to avoid this obvious source of confusion.

Line 63: Refer the reader to table 1 for the the total duration of the records in hours.

Line 66: a minimum threshold of 6 mm/hr is in fact a very high threshold, quite a bit above the typical mean – at least over periods of time where there may be zeroes. This begs the question about zero values. What fraction were below the threshold and thus treated as zero? Could this account for the bias reported in fig. 2? You could cite other authors who tried to address this issue, notably Verrier et al.

Line 67: You mention that the reference is the accumulation based Accu NRT gauge. There is a very big theoretical difference between the statistics of constant *temporal* resolution rain rates series and series with constant *depth* resolutions (whose temporal resolution depends on the rain rate and is therefore highly variable). The statistics of the two types of series will be different and this includes the extremes. How do you achieve a constant temporal resolution rain rate series?

Fig. 3: these spectra appear to be in base *e* which is a very inconvenient choice for readers. Could it be redone in $\log_{10}$? (Even using a basis of 2 - as used for the selection of the series length - would be easier to interpret!). This same comment holds for the other plots: when analyzing empirical data, the standard convention across the sciences is to use $\log_{10}$, (sometimes $\log_2$), but not $\log_e$.

Also, k is usually a wavenumber, not frequency so the notation will be confusing.

Also there are no units on the x axis. Overall the figure is very difficult to interpret.

Averaging over frequency bins would be important to better assess the quality of the scaling.

Table 2: The table gives q_s^{Theo} as estimated in eq. 7. What were the values of N_s, l, D_s? From the description, I expect 1, 2^{16}, 0?

Fig. 5: TH is never defined. It is confusing since the caption suggests (without saying so) that the "horizontal axis represents the normalized absolute value of fluctuations of the rainfall time series". In this case I would expect TH to be nondimensional whereas the axis says the units are mm/hr. What is it?

Conclusions:

In table 5.1b of Lovejoy and Schertzer 2013, there is a list of 13 different papers citing q_D values for precipitation, and this includes three papers studying "high resolution gauges" one of which goes back to 1995 and two of which had 15 second resolutions (nearly the same as those used here). Please cite and discuss these other studies. How does this study fit into this wider body of work? Without this context, one gets the impression that the field has not much advanced.