Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2018-4-RC1, 2018

Earth System Dynamics
Discussions

Interactive comment on "How intermittency affects the rate at which rainfall extremes respond to changes in temperature" *by* Marc Schleiss

Anonymous Referee #1

Received and published: 21 February 2018

This manuscript revisits the question of how rainfall intensity changes with temperature, considering this across different time scales, quantiles, and climate regions. The manuscript introduces the idea of quantifying intermittency of rain during a given time interval, and then applies a model that separates intermittency from thermodynamic controls on rainfall rates. This consideration of intermittency offers a novel way to interpret these intensity vs. temperature relationships and helps show that once intermittency is accounted for Clausius-Clapeyron scaling is preserved in many cases. This manuscript is a useful addition to the ongoing investigation of simple temperature controls on rainfall intensity.

My one major comment relates to the explanatory power of quantifying intermittency. Page 8 Line 15 suggests that intermittency is a "much simpler" explanation of changes

in scaling versus trying to explain shifts in dominant rainfall type. However, intermittency is not in itself a fundamental explanation. Temperature scaling of intensity has a basic physical principle at its root (the Clausius-Claperyon relationship). Measuring intermittency is a convenient way to quantify shifts in some underlying relationship, but the relationship between temperature and intermittency is largely empirical and not something known a prior from basic principles. There is no fundamental physical principle that describes intermittency.

I'm not questioning the value in quantifying intermittency and using it to isolate the thermodynamic scaling. But, I think the language in the manuscript should possibly be changed in places to better acknowledge that intermittency is not really the fundamental explanation, but just a convenient way to generally quantify the different dynamic controls limit atmospheric moisture availability. For instance, Page 12 Line 5 says "Intermittency is a key feature controlling the variability of precipitation". I would suggest it might be more appropriate to say something "Quantifying intermittency aids in identifying controls on variability of precipitation". There are several other places in the manuscript were this slight shift in presentation of intermittency might be warranted.

Minor Comments 1. In the abstract, the term intermittency should be defined more explicitly. At least for readers with less of a meteorology background, intermittency may be more familiar at longer time scales (dry periods and wet periods over weeks or months). So, the idea of considering intermittency over shorter time scales (hourly to daily) should be made clear at the beginning.

2. Page 3 Line 17 & Line 22; Line 17 indicates data is from the US CRN but line 22 indicates stations include Canada and Siberia. There is an inconsistency here given that that the US CRN only includes stations in the US and Figure 1 only shows U.S. sites.

3. Page 3 Line 29 states that aggregation was performed with overlapping time windows (shifted by 5 minutes). If overlapping windows were used, this would suggest

that each aggregate data point was not actually statistically independent , especially at longer time scales. For instance, if one had a 24 hour time window shifted by only 5 minutes, over 99% of the data from one window to the next would be the same. If this is what was actually done, there probably needs to be some accounting for the lack of independence of each data point. If this isn't what was done, then the text should be clarified.

4. Page 3 Line 32: "one or several missing values"? Shouldn't this just say "one or more missing values"?

5. Page 5 Line 3: maybe define lacunarity as used here?

6. Figure 12 What is dashed line in bottom panel?

7. Page 8 Lines 21 and 29 refer to changes in rainfall intensity per degree temperature while discussing Figures 4 and 5. If this can't be taken from the figure (I don't believe it can be), it could be helpful to be more clear that it comes directly from Eqn. 14 (especially at Line 29).

8. Page 8 Lines 9 to 14 This section mentions some different possible explanations of changes in scaling with temperature. As another explanation to possibly offer, I believe in some cases at high temperatures, there is moisture limitation at the land surface. The atmosphere might have capacity to hold moisture, but the land surface in the region has no moisture to give. Temperature merely becomes a proxy for the dryness of a given season.

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