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Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "Rain event properties and dimensionless rain event hyetographs at the source of the Blue Nile River" *by* A. T. Haile et al.

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This paper reports on the spatial and temporal properties of sub-daily rainfall events across a number of pluviograph stations in Ethiopia. I believe that the paper makes important contributions to the study of rain events, in ways that are useful and indeed necessary if we are to realise more fully how rainfall climate affects hydrologic and geomorphic processes. The paper is generally clearly structured and thorough in its processing of data.

That said, I felt that the paper somewhat unhelpfully attempted to present both empirical data and a 'model' of the rainfall climate. I could see less point to the latter exercise, and no real justification for it is included in the paper. At the end of section 1, the authors simply note that a beta distribution model is fitted to their data. They provide no rationale for spending time on this aspect of the work. My own feeling would be that all of this material could be omitted without significant loss of value, and indeed, might result in a paper with a clearer message in a more concise format.

The field data set analysed is quite short (Jema station, only the wet seasons from 2007 and 2008). The authors do not (but probably should) comment on why they believe that this small data set is sufficient for the exercise that they are undertaking.

Section 3.1: properties of rain events

Here I was unable to find a rationale for the adoption of a 30 minute MIT. The purpose of my 2008 paper (cited as Dunkerley 2008b) was to point out that the choice of MIT can greatly alter apparent rain event properties (rain rate, event duration, event waiting time, etc). The authors have selected an unusually short MIT (30 minutes), whereas in the literature, values of 6-8 hours are more common. I surmise that this might have allowed the identification of more events from the short records available, and so supported statistical analysis by yielding more events to process. But I think that the paper would have been stronger if the authors had analysed, and reported briefly, how their results would have changed had they adopted, for instance, a more common criterion such as MIT = 8 h.

The authors do not adequately describe their data processing. Bucket tip events in what were presumably (not stated, though later in section 4.1 the authors refer to bucket tip events) tipping bucket gauges occur at varying time intervals. Yet the authors in equation (1) sum one-minute rainfall depths. How were these derived? How does the error in estimating a 1 min rainfall rate vary with the rainfall rate? How might the data (and event properties) have been affected had they aggregated to 6 min data, for instance?

In the same way, I looked without success for any description of the field installation of the gauges (on the ground, mounted above the ground, location in the terrain, and



HESSD

7, C2867–C2871, 2010

Interactive Comment

influence of surrounding vegetation, etc). The authors do not even include the bucket capacity or sensitivity of the raingauges used (i.e., 0.2 mm per tip, 0.5 mm per tip, etc).

The symbols adopted in equations (1) and (2) are unhelpful, the subscript e in equation (1) standing for ‘event’ while in equation (2), E stands for event. Likewise, in (1), d stands for duration while in (2), d stands for depth. This needs to be rectified.

Likewise, terminology is used too loosely. What is referred to in equation (3) is a rainfall rate, not an intensity. The term ‘rainfall rate’ should be applied to any calculated or derived rate, such as the hourly equivalent of a near-instantaneous ‘intensity’. Any figure written in mm/h is more than likely to be a rainfall rate. True intensities are rarely measured or reported.

Section 4.1 rain event properties

Here a limitation is that only data from the Jema station are analysed, and only for two seasons of record. This is a very small set of data upon which to explore the rainfall climate of the area. The authors make no analysis of the extent to which these two years might, or might not, have been representative in terms of their synoptic climatology.

Section 4.3 points out that rainfall event properties change through the course of the wet season, including in the inter-event waiting time. These are useful results and field studies of hydrologic and erosional processes need more often to be informed by analyses such as this.

Section 4.4.5 presents further useful exploration of the variation of rain event properties and elevation. Again, it seemed to me that this kind of analysis is highly desirable and may provide critical insights for workers interested in understanding the landscape role of rainfall and the variation of runoff and erosion processes with location.

Section 4.5 (Dimensionless event hyetographs) seemed much less useful or informative to me. Given the very limited data set, performance of the empirical model in over-



HESSD

7, C2867–C2871, 2010

Interactive Comment

or -underestimating particular aspects of the rainfall record seems of no particular significance.

Likewise, for me Section 4.6 on conditional probability of rainfall occurrences across the network really adds nothing new to the literature, and could be dispensed with to reduce the length of the paper. The decline in cross-correlation with increasing inter-gauge distance is widely known.

Section 5 Discussion and Conclusions highlights well some of the significant findings of the paper. For instance, it reminds us that events at mid-season tend to be more closely spaced in time (smaller inter-event waiting time) than events at the start and end of the season. This kind of result could well prove helpful in understanding the time variation of runoff ratios, for example. Likewise, the authors remind us that event properties were found to vary with topography. This of course is well known from studies of orographic precipitation, which tends to be prolonged and to exhibit long events with higher rain rates (for their duration) than is seen in other topographic contexts. However, it is an aspect of rainfall climate that warrants far more attention.

But this highlights something that I would like the authors to discuss: the mechanisms that are involved in producing the local rainfall at each site. On p5826 they refer to 'convective events' but I felt that too little was said about the precipitation mechanisms and their local or synoptic context. This touches on one of the rainfall event descriptors that the authors no not address, namely, the intermittency of rain with events. The authors have reduced the chance of long rainless interludes by adopting a short MIT, but nonetheless the frequency with which rain briefly ceases and then resumes (allowing ephemeral surface ponding to partially dissipate, and so renewing surface depression stores) is arguably as significant as the statistical properties of the enclosing rainfall events.

The statement in the final paragraph about erosive power of rainfall is rather laconic and I felt that it was weaker than it might have been. There are many published studies of rainfall kinetic energy and erosivity that could have been referred to here, to strengthen what is an overly casual and unreferenced idea.

Overall I thought that this paper was a very worthwhile contribution, and I hope that it alerts other researchers to the potential for the behaviour of rainfall, considered at sub-daily time scales, to offer possible insights into the responses seen in landscapes and ecosystems. This is an area too long neglected, owing in part to the simplicity and accessibility of rainfall data aggregated to daily and longer timescales. The paper demonstrates ably that there is a tradeoff here - simplicity and convenience may be gained at the cost of a reduction in real process understanding and explanatory power.

Minor errors:

p5808 line 15: setup should read set up p5809 line 8: raifall should read rainfall p5813 line 10: insert 'alpha and beta' after 'Both..'. p5815 line 1: 236 rain events have should read 236 rain events has p5828 line 28 poor should read poorly

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 5805, 2010.