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Hydrology and Earth System Sciences Discussions

Interactive comment on "Multiplicative cascade models for fine spatial downscaling of rainfall: parameterization with rain gauge data" *by* D. E. Rupp et al.

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Reply to Referee #2 We would like to thank Referee #2 for his/her constructive comments. We have repeated the original comments, with our response immediately following each comment.

Anonymous Referee #2 Received and published: 19 September 2011 COMMENT: 1. This paper tries to suggest a simpler way to estimate the parameters of Multiplicative Cascade Model using conventional set of rain gauges rather than high resolution radar observation. The most advantage of MRC model is to reproduce the geometric spa-

tial rainfall distribution using statistical model by preserving statistical characteristics at each cascade level. In addition to that, if self-similarity or fractal feature of rainfield can be used, the downscaling process can be carried out more numerically efficient (parsimonious) fashion. The self-similarity parameter is usually derived from the high resolution radar observation and it has proven to be exponentially inverse proportional to the large-scale forcing, which consists of core algorithm of MRC model. The process mentioned above can be achieved partially by using the observation from gauge network, but it has to be very densely distributed which can be hardly found in actual rain fields. Recently hydrometeorologic radar observation is becoming widely established, so the needs and objectives for this kind of research should be justified with more convincing way.

REPLY: It is true that hydrometeorological radar observations are becoming widely established. However, the issue of estimating the true rainfall amount that reaches the ground surface from radar imagery is complex and a focus of ongoing research (Krajewski and Smith, 2002). Even where radar imagery is available, we believe there is value in estimating model parameters directly from rain gauge data, where the data has not been filtered by the process of converting radar imagery to rainfall estimates. We will state the above in the revised manuscript to strengthen the justification for our research. Additionally, a worthwhile follow-up to our study would be a comparison of methods using both raingauge data and radar data taken at the same time and place. Unfortunately, we have to date been unable (or not been permitted) to acquire Warsaw radar data from the Polish Weather Service. Thus, even when data exists, the obstacle remains (to many investigators in many countries, we assume) of data inaccessibility to the scientific community.

COMMENT: 2. In addition the most shortcoming of the MRC is its blocky-shaped artifacts shown in rain band images. The studies for MRC model should show the trials for improving this problem. One of good examples is the spatial reconstruction filter or digital Gaussian filter.

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REPLY: We concur that the blockiness of the simulated rainfall field is a shortcoming of the discrete MRC model and agree that methods of eliminating/reducing the blockiness should be explored as a follow up to the work presented here. Some methods include a filtering step with the cascade process and examples are discussed in Schertzer and Lovejoy (1987), Menabde et al. (1997), and Watson and Hodges (2005), which we will cite in the revised paper. However, these methods are an additional processing step and while they will affect the statistics of the simulated fields in interesting ways, they are not central to the methodology presented in our paper. It is our wish to keep the paper brief and succinct and focused on the basic method of estimating the parameters of the cascade generator from the rain gauge data. We would like to also refer to Referee #1, who suggested we also examine the universal multifractal (UM) model, which produces less blocky fields. We believe that it would be worth examining, in a subsequent study, the UM model in the context of using rain gauge data.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 7261, 2011.