Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrologic response of a semi-arid watershed to spatial and temporal characteristics of convective rain cells" *by* H. Yakir and E. Morin

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Response to Reviewer #2

Reviewer: This manuscript describes i) a procedure for the estimation of rain fields over a given area by using a cell-based rainfall model, and ii) the analysis of runoff response to rain cell characteristics. Runoff response is examined by means of a semi-distributed hydrologic model. In the cell-based model, the rainfall field is produced by the superposition of a sample of rain cells, each characterised by geometrical and kinematic parameters.

I found this paper very interesting and potentially very useful for evaluating the detail of rainfall spatial variability required for runoff modelling, especially in semi-arid areas where convective precipitation is the dominant process for heavy precipitation events. This approach is of interest, because it allows one to isolate hydrologically-relevant cell properties, such as direction, location, and velocity, and to investigate the hydrologic response of watersheds to changes in these properties. The paper is well organized, concise, and scientifically sound. However, I think that with some modifications it could make a stronger point. My recommendation is that the paper is accepted for publication after a minor revision. My comments are listed below.

Response: We thank the reviewer for the encouraging review and we will follow the recommendations to improve the manuscript. Below is our response to the reviewer comments.

Reviewer Comment 1: P7726, L23-25. Here the authors review previous work on runoff sensitivity analysis to rainfall characteristics. Actually, there is a large body of work on stochastic models of storm rainfall based on the theory of point processes (LeCam, 1961; Gupta and Wymire, 1979; Northrop, 1998; among others). Usually the building blocks for the spatial component of these storm rainfall model are the marked point processes, while the modeling of the cell characteristics is very similar, in many respects, to the one advanced in this work. In my opinion, this body of work is relevant for the development of the rain cell model advanced in this work. The authors should describe how their work is linked and in which respect it differs with reference to the above mentioned body of research.

Response to Comment 1: We agree with the reviewer that storm models based on point processes (and marked point processes) are good examples of the second approach presented in lines L20-26 (P7726), i.e., generating synthetic rainstorm data . . . We will add a paragraph in the revised manuscript describing some of these works and the similarity and the difference between them and the current study.

Reviewer Comment 2: P7728, L8-9. The clarity of this sentence should be improved.

Response to Comment 2: The sentence will be rephrased.

Reviewer Comment 3: P7728, L16-17: "The location of the storm over the main channel is also of great importance (Morin et al., 2006)." This is a very important point, which should be emphasized. Runoff routing through branched channel networks imposes an effective averaging of spatial rainfall excess at equal travel time, in spite of the inherent rainfall spatial variability. Previous work on this subject has been done by Sangati et al., (2010), Viglione et al. (2010) and Zoccatelli et al. (2010).

Response to Comment 3: We adopt this suggestion and we will add a discussion of the relationships between rainstorm and channel network routing in the revised manuscript.

Reviewer Comment 4: P7733, L6-8. "The cell's parameters are assumed to remain constant in time. From the tracked cell data we computed for each parameter the median value and used it for the parameter value throughout the cell's life span." Please explain the implication of this assumption, which has important consequences on the physical realism of the rain model. Also, accordingly with Reviewer 1, please describe in more detail the tracking algorithm.

Response to Comment 4: After examining different time evolution models, it was decided to keep the parameters constant because no specific and consistent pattern was found. As in the case of tracking algorithm selection, the main difficulty is the very short cell life span (2-3 radar images). This implies that the presented analysis does not consider changes occurring during cell life cycle such as strengthen and weakening of the cell. It has to be emphasized that for the analyzed case study no indications of such changes were found. We will elaborate more to better explain this point in the revised manuscript. In addition, we will describe in more details the tracking algorithm which was manual in the current work.

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