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Rainfall spatial variability and geomorphic hydrologic response

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This paper focuses on the spatial detail required for a proper description of rainfall patterns in hydrological models. In particular, we explore the impact of the resolution used to describe spatial rainfall on the hydrologic response of several basins. In fact, spatially distributed hydrological models can account for the spatial variability of rainfall and it is important to determine the resolution necessary to properly describe its effects on the hydrologic response. Rainfall patterns are described from raingauge observations via spatial interpolation. In order to obtain a reliable estimate of the spatial distribution of precipitation a relatively dense raingauge network is used (0.01 stations/km^2). The effects of rainfall fields with different spatial resolutions are evaluated through the application of robust geomorphic hydrological models to different watersheds with well-known characteristics. Rainfall fields with decreasing spatial resolution, ranging from 0.1 Km to 50 Km are considered in a coarse-graining experiment. The experiments are performed on several sub-catchments of the basins considered, in order to address the effects of basin shape, size and soil type on the relationship between rainfall field resolution and hydrologic response. The effects related to the variation of the overall precipitation volume falling on the catchments are removed in order to isolate the effects of rainfall spatial variability alone. Experimental analyses are also carried out in order to assess the role of the shape of the basins in increasing the effects of spatial heterogeneities. We find a range of catchment areas for which rainfall may be assumed to be spatially homogeneous, provided that the total rainfall volume is suitably represented. Our results indicate that for basins larger than about 3500 km^2, the homogeneous rainfall assumption no longer allows the accurate description of the hydrologic response. The results obtained emphasize the importance of a detailed rainfall observation network in order to accurately evaluate the rainfall

volume, rather than to describe the specific detailed spatial distribution of rainfall and highlight the singularity represented by elongated catchments in accounting for rainfall spatial variability.