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Infiltration Experiments and a Digital Elevation Model to Upscale Soil Hydrological Processes

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In catchment hydrology, it has been shown that for runoff generation processes, the use of measured in-situ parameters cannot be expected to produce accurate predictions at any scale because of the non-linearity of the processes involved and the heterogeneity of the natural system. Although models (based on soil data, geology, topography and vegetation) for process identification producing maps of the dominant runoff show the potential of each area to contribute to runoff, they i) do not take into account the change in the process on temporal and spatial scales and ii) do not address the hydrological connectivity between the process areas. One way to overcome this drawback is to investigate the channels to which flow converges that are characterized by a structured correlation due to a smoothing effect, by using, for example, Terrain Analysis with Digital Elevation models (TauDEMs). In fact, the continuity of the digital elevation models (DEMs) is an important contributor to interpolated gradient values, potentially affecting energy estimates as well as flow directions (Tarboton, 1997). The principal aim of this study is to produce high resolution maps of flow process on a spatial scale, by combining maps of flow directions according to Tarboton (1997), maps of zones of predisposition, and in-situ sprinkling experiments. The in-situ calibration of the TauDEM via the in-situ sprinkling experiments considering two plot scales (16 m2 divided into 16 plots of 1m2 of various slopes) produced successful results in terms of cumulative runoff at the catchment scale. In this study, it was shown that increasing rainfall intensity from 24 mm/h to 36 mm/h increases the risk of predisposition from weak to medium. In addition, the results also show that it is not only the order in which the predisposition areas succeed in space that plays an important role but also the tortuosity and length of channels that enhance the cumulative water volume in the target outlets. Although the TauDEM is a useful tool for up-scaling shallow flow processes, additional consideration of the geology is needed to take into account deep flow percolation to improve runoff calculations at large scale.