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Modeling the dynamic effects of catchment morphology on surface flow paths in small catchments of the Paris Basin, France.

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In this study we investigate the dynamic influence of morphology on surface flow paths in small catchments of the Paris Basin, France, using a methodology based on cellular automata models. Simulated surface runoff waters are based on a generalized cellular automaton which is a mixture of the traditional CA formalism and the multiple transformations required for the modeling of surface waters. Slope effects, precipitation amounts and rates, runoff-infiltration-imbibition coefficients or land use characteristics can progressively be implemented on each cell through the cellular routing scheme. The objective of this work is to i) evaluate the role of morphology through various combinations of conditions, and ii) focus our attention on the emergence of complex hydrological responses at a macroscale through the iterations of relatively simple interactive processes at a microscale.

Examples of catchments submitted to two different conditions are discussed: i) during winter and long-duration rainfall, land use covering seems to be the most relevant in relation with the catchment size which defined the runoff contributing area; ii) during spring or summer events, according to strongly storms providing more than 50mm in few hours, catchment morphology becomes the first-controlling factor on hydrological response. Land use can locally aggravate damage but is it not sufficient to explain location and gravity of observed floods impacts. Consequently, catchment morphology does not play the same role during these two systems.