Impacts of disaggregation on modeled hydrologic responses

Andrew Augustine[a], Chris Olson[a], Jeff Niemann[a], and Jorge Gironás[b,c]
[a] Department of Civil and Environmental Engineering, Colorado State University
[b] Departamento de Ingeniería Hidráulica y Ambiental, Pontifica Universidad Católica de Chile
[c] Centro de Desarrollo Urbano Sustentable CONICYT/FONDAP/15110020, Santiago, Chile

Abstract. Detention ponds, low impact development, and best management practices are controls that are used in urban watersheds to reduce the negative hydrologic effects of urbanization. A common approach for incorporating a control into an urban rainfall-runoff model is to disaggregate the watershed into two subwatersheds, one upstream and one downstream of the control. Flow from the upstream subwatershed is then routed through the control and then the downstream channel before being added to the flow from the downstream subwatershed. However, such disaggregation changes how the flow accumulation process is modeled regardless of the presence of the control. Flows from the aggregated model are superpositioned at the outlet, which ignores flow interaction between the channel and downstream subwatershed. The objective of this study is to evaluate the impacts of this type of disaggregation on the modeled hydrologic response of urban watersheds. To accomplish this objective, a 10.9 km^2 urban watershed in southern France is disaggregated at various locations along its two main channels. The points of disaggregation represent locations where control devices could be installed. However, to isolate the effects of disaggregation, no control devices are represented at those locations. The Urban Morpho-climactic Instantaneous Unit Hydrograph (U-McIUH) model is then used to calculate the flow accumulation in each subwatershed. This model determines the outflow from the subwatershed by calculating the travel time of flow from each location in the subwatershed to its outlet. Those travel times are determined from the kinematic wave approximation. Routing from the upstream subwatershed to the downstream subwatershed is accomplished by kinematic-wave river routing. The hydrographs from the entire watershed that are derived from the disaggregated models are compared to the hydrograph derived from the U-McIUH without disaggregation. Results show the position of the disaggregation point determines the impact of disaggregation on the simulated hydrograph.