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A synthetic and dynamic morphometric parameter based on cellular automata for the improvement of classical morphometric indices.

J. Douvinet (1), D. Delahaye (1), P. Langlois (2)

(1) GEOPHEN-UMR LETG 6554 CNRS, University of Caen, Caen, France, (2) MTG-UMR IDEES 2795 CNRS, University of Rouen, Rouen, France. (johnny.douvinet@unicaen.fr / Fax: +33231566386 / Phone: +33231566384)

Classical morphometric indices have been the first methods created by geomorphologists to quantitatively measure the theoretical influence of morphology on catchment hydrology. This work led to the development of many indices. However, dynamic effects of local topography on surface runoff response observed at the global catchment scale remain still poorly understood with these methods. Moreover, recent hydrological studies have demonstrated the dependence of these indices to the working scale. The objective of this work is to propose a new methodology based on cellular automata in order to analyse the dynamic effects induced at the same time by the catchment shape, slopes, and the drainage network. Simulations of surface runoff are assumed to depend on surface topography from digital elevation models. In addition we consider the surface and drainage network organizations within the catchment as a source of spatial variability in catchment response. Results focus on the progress made on i) the identification of specific catchment configurations and functional morphological areas, and ii) the creation of an aggregative index to locate points and threshold areas characterized by a maximum hydrological efficiency.

Examples of catchments of varying sizes are discussed. It is demonstrated that: i) In some catchments, drainage networks and the associated sub-catchments form functional entities at the global scale. ii) Some small-scale catchments or upstream sub-catchments have a strong hydrological efficiency which is not suggested by analysing the hydrological response at the global scale, particularly when the catchment is elongated.