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Modelling of the GIUH hydrologic response function using morphometric properties of channel network

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River networks serve as a paradigmatic example of all branching networks. A good knowledge of the detailed architecture of the river network is essential for the identification of the geomorphological instantaneous unit hydrograph (GIUH). The aim of this presentation is to explain the hydrologic properties of the GIUH (shape, peakflow, lag time) as a function of the catchment's internal structure i.e. the topological properties of the channel network and hillslopes, the hydraulic characteristics of flows, and the spatial distribution of soil and effective rainfall. Applications are conducted on twelve basins located in France with areas ranging from 40 to 2600 km^2. First, statistical relationships are established between the GIUH characteristics and the morphometric characteristics of the bifurcation nodes of the channel network. Then, a deterministic auto-similar geometric method to model the architecture of the channel network of natural rivers, as derived distributions of the statistical laws established above, is reported. It is first demonstrated that the procedure may be used to simulate natural width functions, preserving their most relevant features like their overall shape and their observed power spectra. It is then shown, via the twelve natural river networks studied, that the approach may also be used to closely approximate existing GIUHs. The sensitivity analysis shows that the GIUH is more sensitive to the channel topology and to the spatial distribution of rainfall when correlated with altitude, than to the hydraulic properties of flow on hillslopes and in the channel. Through numerical simulations, the travel time on hillslopes and through the channel network as a function of the parameters of the GIUH are compared and thus basin segmentation constraints are defined for spatially distributed hydrological models.