Towards a classification of catchment structure and hydrological response

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Linking simple quantitative descriptors of hydrological behaviour to a geomorphic catchment classification is regarded a promising way to transfer process knowledge from gauged towards ungauged basins.

In this paper, we present results for geomorphic and hydrological classification based on the hillslope Péclet number. This dimensionless number, describing the ratio between diffusion-like and advection-like modes of subsurface stormflow, is a function of hillslope geometry only, and can be used to analytically predict the nondimensional moments of the characteristic hillslope drainage response. A catchment Péclet number can be formed by taking the weighted average of the Péclet numbers of the individual hillslopes that form the catchment. We show results of such a Péclet based analysis for a number of catchments in various environmental settings.

The analysis can be expanded by relating catchment Péclet numbers to a low-dimensional descriptor of overall catchment morphology. The rationale being that catchment morphodynamics is governed by a relatively small number of processes, of which diffusion-like hillslope sediment transport, and advection-like fluvial sediment transport are the most characteristic. This calls for a dimensionless 'geomorphic Péclet number', similar to the hillslope or catchment Péclet number. We present some results relating the geomorphic and hydrological Péclet numbers.