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Stochastic flow regime classification and inverse precipitation estimation from discharge in the humid tropics

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Streamflow regimes and water availability are controlled by landscape and climate dynamics and their variability impacts ecological and societal needs. Streamflow erraticism and sensitivity to geomorphic and hydro-climatic forcing are governed by spatially heterogeneous, complex and dynamic processes. Detailed hydrological characterization of such complex systems depends on the availability of high-quality field measurements. When data is limited, a parsimonious theory in combination with a hydrology backward approach able to describe streamflow and precipitation regimes and deduce catchments characteristics could provide valuable information for water management in data-constrained regions such as the tropics.

In this study a stochastic analytical model was used to characterize the streamflow regimes (discerning between persistent and erratic) of 18 diverse catchment across a tropical climate gradient in Costa Rica, Central America. The original model proposed by Botter et al. (2013) has been modified to take into account the lack of rainfall data and the stochastic method proposed allowed a hydrology backward approach in order to deduce rainfall-runoff characteristics of every catchment. This work allowed us to evaluate the mean (effective and total) rainfall frequency and intensity across the study catchments as well as the relative seasonal characterization of the flow regimes. Results showed mostly persistent streamflow regimes across Costa Rica with few exceptions both on the Pacific slope and in the Caribbean.

Finally, in order to Rica to facilitate catchment classification at ungauged sites, the seasonal analysis of the streamflow and precipitation patterns were used to propose a novel and coherent classification of Costa Rica into four hydro-climatic zones: Persistent Caribbean, North-western Plains, Steady Pacific and Seasonal Pacific.