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Determination of leading drivers of hydrological variability

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Due to environmental changes in global and local scales, the understanding of leading drivers for hydrological variability is acquiring more relevance in hydrological design, forecasting and water management. Traditionally, hydrological variability is studied by statistical methods describing the random component of hydrological signals with stationary probability density functions of Pearson family type, discarding any attempt of physical explanation of variability drivers. When using hydrological models to explain or predict the fate of a hydrological process, uncertainty analysis is used to describe its variability structure but the link between this pattern and physically drivers is not established. In the case of climate change process, inquiring about possible variability structure changes is mandatory for water management under heavy environmental changes in river basins. At this light, we present an approach to determine the forcing drivers of hydrological variability. The approach is based on the principles of the theory of stochastic processes and heavily uses the Fokker-Planck-Kolmogorov equation as the main operator to simulate the variability behaviour. Discussed method determines where the leading drivers are of meteorological, landscape or anthropic nature. The experience of using this approach at different time resolution is shown. The results for ultra long term forecasting of variability show a flexible methodology to simulate hydrological variability evolution in terms of variability of water discharges or describing the changes in the second order statistical moment for the variables of the water balance in a given river basin. For higher time resolution (monthly and daily scales) results show the importance of process inertia in order to understand when similar inputs and parameters of the hydrological system allow the emergence of different extreme values in the studied river basin. Finally, we discuss the informational and computational requirements of this approach for variability modeling and also present the emerge challenges of this method.