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Global patterns of streamflow signatures and their physiographic controls based on observations from some ten thousands of catchments

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Global characterization of streamflow patterns based on climatic and physiographic characteristics is important for advancing understanding of large-scale hydrology, assessment of macro-scale hydrological models, and detection of global hydrological changes, among other applications. Here, based on large and open global datasets of streamflow observations, topography, landscape information, and meteorological forcing, we investigate the main controls of streamflow characteristics at global scale using a combination of data analysis techniques (Kuentz et al, 2017). First, we use streamflow records at more than 10,000 gauges to compute 15 flow signatures describing magnitude, frequency and duration of flow events, and catchment responses. We also compute indices describing upstream catchment climatic forcing and a set of 44 descriptors of physiography. Then, we perform cluster analysis using both flow and catchment characteristics to identify hydrological similarity and train tree-based models to investigate the interplay among landscape attributes. Overall, we found 16 groups with similar hydrological response at global scale and that meteorological variables (temperature and precipitation) dominate among predictors discriminating main climatic regions. For example, in temperate to warm regions, 22 and 21 % of observations, respectively we found that hydrological responses are mostly controlled by moisture-limited conditions and atmospheric water inputs, respectively. Conversely, in cold regions temperature is the only control of hydrological responses. Further, we illustrate the advantages of combing large-sample dataset and statistical learning for diagnostic of hydrological models.

Reference
Kuentz, A., Arheimer, B., Hundecha, Y., and Wagener, T. 2017. Understanding hydrologic variability across Europe through catchment classification, Hydrol. Earth Syst. Sci., 21, 2863-2879, https://doi.org/10.5194/hess-21-2863-2017.