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# Analytical characterization of the spatial correlation of streamflows

Andrea Betterle (1,2,3), Mario Schirmer (1,2), and Gianluca Botter (3)

(1) EAWAG Swiss Federal Institute of Aquatic Science and Technology, Department of Water Resources and Drinking Water, Duebendorf, Switzerland, (2) University of Neuchâtel, The Centre of Hydrogeology and Geothermics (CHYN), Neuchâtel, Switzerland, (3) University of Padova, Department ICEA and International Center for Hydrology "Dino Tonini", Padua, Italy

In this study, we establish an analytical approach to estimate the spatial correlation of daily streamflows in two arbitrary locations within a given hydrologic district or river basin at seasonal and annual time scales. The method is based on a stochastic description of the coupled streamflow dynamics at the outlet of two catchments. The framework aims to express the correlation of daily streamflows at two locations along a river network as a function of a limited number of parameters characterizing the main underlying hydrological drivers, that include climate conditions, precipitation regime and catchment drainage rates. The proposed method portrays how heterogeneity of climate and landscape features affect the spatial variability of flow regimes along river systems. In particular, we show that frequency and intensity of synchronous effective rainfall events in the relevant contributing catchments are the main driver of the spatial correlation of daily discharge, whereas only pronounced differences in the drainage rate of the two basins bear a significant effect on the streamflow correlation. The topological arrangement of the two outlets also influences the underlying streamflow correlation, as we show that nested catchments tend to maximize the spatial correlation of flow regimes. The application of the method to a set of catchments in the South-Eastern US suggests the potential of the proposed tool for the characterization of spatial connections of flow regimes in the absence of discharge measurements.