



Which catchment characteristics control the temporal dependence structure of daily river flows?

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A hydrological classification system would provide information about the dominant processes in the catchment enabling information to be transferred between catchments. Currently there is no widely-agreed upon system for classifying river catchments. This paper developed a novel approach to assess the influence that catchment characteristics have on the precipitation-to-flow relationship, using a catchment classification based on the average temporal dependence structure in daily river flow data over the period 1980 to 2010. Temporal dependence in river flow data is driven by the flow pathways, connectivity and storage within the catchment. Temporal dependence was analysed by creating temporally averaged semi-variograms for a set of 116 near-natural catchments (in order to prevent direct anthropogenic disturbances influencing the results) distributed throughout the UK. Cluster analysis, using the variogram, classified the catchments into four well defined clusters driven by the interaction of catchment characteristics, predominantly characteristics which influence the precipitation-to-flow relationship. Geology, depth to gleyed layer in soils, slope of the catchment and the percentage of arable land were significantly different between the clusters. These characteristics drive the temporal dependence structure by influencing the rate at which water moves through the catchment and / or the storage in the catchment. Arable land is correlated with several other variables, hence is a proxy indicating the residence time of the water in the catchment. Finally, quadratic discriminant analysis was used to show that a model with five catchment characteristics is able to predict the temporal dependence structure for un-gauged catchments. This work demonstrates that a variogram-based approach is a powerful and flexible methodology for grouping catchments based on the precipitation-to-flow relationship which could be applied to any set of catchments with a relatively complete daily river flow record.