Understanding catchment classification and similarity through correlation in streamflow time series

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Catchment classification is an important component of hydrologic analyses, particularly for linking changes in ecological integrity to streamflow alteration, transferring time series or model parameters from gauged to ungauged locations, and as a way to understand the similarity in the response of catchments to change. Metrics of similarity used in catchment classification have ranged from aggregate catchment properties such as geologic or climate characteristics to variables derived from the daily streamflow hydrograph; however, no one set of classification variables can fully describe similarity between catchments as the variables used for such assessments often depend on the question being asked. We propose an alternative method based on similarity for hydrologic classification: correlation between the daily streamflow time series. If one assumes that the streamflow signal is the integrated response of a catchment to both climate and geology, then the strength of correlation in streamflow between two catchments is a measure of the strength of similarity in hydrologic response between those two catchments. Using the nonparametric Spearman rho correlation coefficient between streamflow time series at 54 unregulated and unaltered streamgauges in the mid-Atlantic United States, we show that correlation is a parsimonious classification metric that results in physically interpretable classes. Using the correlation between the deseasonalized streamflow time series and reclassifying the streamgauges, we also find that seasonality plays an important role in understanding catchment flow dynamics, especially those that can be linked to ecological response and similarity although not to a large extent in this study area.