Daily streamflow forecasting with Artificial Neural Networks: Application in the Winooski River basin, Vermont

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Sustainable water resources management is critical in both developing and established communities; particularly with the challenges associated with surface and groundwater contamination and potential precipitation shifts resulting from climate change. We test and develop a method for forecasting short-term (daily) streamflow using data-driven Artificial Neural Networks (ANNs) to efficiently manage water resources during times of shortage and provide improved flood mitigation strategies. In this work, a generalized regression neural network is combined with a counterpropagation network (GRNN and CPN respectively). This hybrid network and its individual constituents are compared with traditional temporal forecasting methods (e.g. multiple linear regression and auto-regressive moving averaging or ARMA). Model inputs consist of antecedent precipitation, temperature and discharge, while the output is river discharge in space through time. A hierarchy of ANNs has been implemented to capture the spatial characteristics of this complex river network. In the network hierarchy, predicted discharge from upstream (or lower order stream) networks is used as inputs (in addition to climatic variables) to downstream (higher order) networks. A semi-variogram analysis is used to estimate the temporal lag between input and output variables. The methods are implemented on the 2,704 km^2 Winooski River basin in Vermont. Discharge records from six USGS stream gage stations and eight weather stations within the basin provide the training, cross-validation and prediction datasets for this application. Initial predictive results compare well with those published in the literature.