Short-term streamflow forecasting with a hierarchal generalized regression neural network: Application in the Winooski River basin, Vermont

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Sustainable water resources management is critical to both developing and established communities; particularly with the challenge of surface and groundwater contamination and the potential precipitation shifts associated with climate change. To more efficiently manage water resources during times of shortage and provide improved flood mitigation strategies, we have developed a method for forecasting short-term (daily) stream flow using a data-driven generalized regression neural network (GRNN). Network inputs consist of elevation adjusted climatic variables (*e.g.* precipitation and temperature) lagged in time; network output is streamflow over space and time. To capture the spatial and temporal variability of this complex watershed river network, a hierarchy of GRNNs has been implemented to forecast streamflow; where output from upstream (or lower order stream) GRNNs are used as inputs (in addition to climatic variables) to downstream (higher order) GRNNs. In Vermont's Winooski River basin, six USGS stream gage stations and a weather record based on the Burlington National Weather service station and adjusted to individual subbasins using precipitation and temperature lapse rates, provide the training, cross-validation and prediction datasets for this application. GRNNs have advantages over other ANN forecasting methods, namely their speed of training and guarantee of convergence due to circumventing stochastic training, as well as their advantage over traditional multilinear regression in that the order of the polynomial to be fit does not have to be specified *a priori*.