A Framework for Probabilistic Forecasting of Seasonal Water Quality Threshold Exceedance

Erin Towler[1]
Department of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder, Boulder, CO, USA; National Center for Atmospheric Research, Boulder, CO, USA

Balaji Rajagopalan
Department of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder, Boulder, CO, USA; Co-operative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO, USA

R. Scott Summers
Department of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder, Boulder, CO, USA

David Yates
National Center for Atmospheric Research, Boulder, CO, USA

Abstract. Though climate forecasts offer substantial promise for improving water resource oversight, additional tools are needed to translate these forecasts into secondary products that can be of use to water managers. To this end, we develop a generalized framework that uses seasonal forecasts to predict the likelihood of exceeding a prescribed water quality limit. Because many water quality standards are based on thresholds, this study utilizes a logistic regression technique, which employs nonparametric or "local" estimation that can capture nonlinear features in the data. The framework is applied to a drinking water source in the Pacific Northwest US that has experienced turbidity exceedances that are correlated with streamflow. The main steps of the framework are to: (1) obtain a seasonal probabilistic precipitation forecast, (2) generate streamflow scenarios conditional on the precipitation forecast, (3) use a local logistic regression to compute the turbidity threshold exceedance probabilities, and (4) quantify the likelihood of turbidity exceedance corresponding to the seasonal climate forecast. Results demonstrate that forecasts offer a slight improvement over climatology, but that representative forecasts are conservative and result in only a small shift in total exceedance likelihood. Synthetic forecasts are included to show the sensitivity of the total exceedance likelihood. The technique is general and could be applied to other water quality variables.

[1] Erin Towler, Ph.D. candidate, Department of Civil, Environmental, and Architectural Engineering, University of Colorado at Boulder, 428 UCB, Boulder, CO 80309-0428 USA, 303-735-4141, towlere@colorado.edu