

## HYDROLOGIC FORECASTING TECHNIQUES FOR ADAPTIVE RESERVOIR MANAGEMENT

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**ABSTRACT:** The goal of adaptive management is to make optimal decisions in the face of uncertain future conditions. For most decisions associated with reservoir operations and management, the largest source of uncertainty stems from future reservoir inflows. Ensemble hydrologic forecasts quantify this uncertainty and can assist reservoir managers in managing adaptively and understanding the risk associated with their decisions. For example, a municipal water supply reservoir may use hydrologic forecasts to estimate the probability of being able to reliably meet future demands and evaluate the need for conservation measures.

There are a number of hydrologic forecasting techniques available to reservoir managers, varying in predictive skill, complexity, and development cost. Currently the New York City Department of Environmental Protection (DEP) is exploring both statistical and hydrologic ensemble streamflow prediction models for adaptive reservoir management. This paper examines these forecast techniques and provides a brief example demonstrating how they may be used to develop dynamic reservoir operating rules.

The statistical hydrologic forecasts are generated using a stochastic model that makes predictions based on the observed serial correlation present in hydrologic data. This "memory" is commonly attributed to month-to-month persistence in baseflow and/or soil moisture. The initial algorithm was developed on a monthly time scale and is disaggregated into a daily time step for operational purposes. These forecasts typically have skill at a monthly time scale that diminishes as lag time increases, but lack short-term, day-to-day skill. However, short-term skill has been improved using an experimental, extended, daily algorithm. These statistical models are relatively simple and can be easily adapted to provide probabilistic forecasts for most reservoir systems.

The hydrologic prediction models are currently in development, and consist of ensemble meteorological forecasts issued by the National Weather Service (NWS) routed through NWS River Forecast Center rainfall-runoff models. Since this method is based on mathematical descriptions of physical processes, it is expected to have greater day-to-day skill than its statistical counterpart, however over longer forecast horizons the forecast skill is expected to be similar. This paper will discuss the development and application of these forecasting approaches and provide a framework for other systems to follow.

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