USE OF SEASONAL FORECAST UNCERTAINTY FOR IMPROVED RESERVOIR RELEASE DECISIONS

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Abstract

We examine the conditions for which beneficial use of forecast uncertainty may be made for improved reservoir release decisions. The talk highlights the parametric dependencies of the effects of uncertainty in seasonal inflow volumes on the optimal release and objective function of a single reservoir operated to meet a single volume target at the end of the season under volume and release constraints. The duration of the "season" may be one or several months long. The analysis invokes the application of Kuhn-Tucker theory, and it shows that the presence of uncertainty introduces complex dependence of the optimal release and objective function on the reservoir parameters and uncertain inflow forcing. The seasonal inflow volume uncertainty is represented by a bounded symmetric Beta distribution with a given mean, that is considered unbiased, and a half-range, QR. We find that the use of predicted inflow uncertainty is particularly beneficial during operation with a volume target that is either near reservoir capacity or near zero reservoir volume, with the optimal release directly dependent on QR in these situations. This positive finding is moderated by the additional finding that errors in the estimation of predicted QR can result in significant operation losses (larger deviations from the target volume) that are due to suboptimal release decisions. Furthermore, the presence of binding release constraints leads to loss of optimal release and objective function benefits due to the seasonal inflow uncertainty predictions, suggesting less rigid release policies for improved operations under uncertain forecasts. It is also shown that the reservoir capacity values for which optimal reservoir operations are most sensitive to seasonal inflow uncertainty predictions are found to be at most five times the uncertainty range of the predicted seasonal inflow volume, and at least as large as the uncertainty range of predicted inflow volumes. Suggestions for continued research in this area will be discussed.