Project: Possible incorporation of a weather generator in seasonal water supply forecasts

Last Update - February 2018

Goals:

1. To understand the potential benefits or limitations of using a weather generator to derive water supply forecasts

2. To investigate the feasibility of incorporating a weather generator into the operational development of water supply forecasts

3. If feasible, incorporate the use of a weather generator operationally

Status: The CBRFC investigated the use of two stochastic weather generators developed by the University of Colorado in developing seasonal water supply forecasts. The first weather generator considered[1] utilized a K-Nearest Neighbor technique to generate weather sequences by resampling historical weather sequences, which could be weighted by seasonal probabilities associated with climate forecasts; for instance, the probabilities associated with the occurrence of an ENSO event. While implementation of this weather generator was relatively easy, it was limited in that it could not generate reasonable weather sequences over the entire CBRFC area of responsibility in a way that captured the variable hydrologic characteristics over such a large area, and it was extremely expensive computationally.

The second weather generator considered[2] was much more robust and could develop weather sequences conditioned on interannual and multi-decadal trends. By taking into account trends, the weather generator was also able to develop sequences that were not present in the historical record, which was appealing. Computationally, this weather generator was also much less costly than the previous one. However, the weather generator was difficult to apply operationally to our data year-round, and applying it to the greater spatial scale that is the CBRFC's area of responsibility would have required more resources than were available at the CBRFC.

Method: The CBRFC investigated the use of two stochastic weather generators for developing seasonal water supply forecasts. Each of these weather generators were tested over the Gunnison River Basin in central Colorado and the Bear River Basin in northern Utah. While the use of a weather generator at the basin scale infrequently could be useful and interesting, the computational and resource cost of implementing a weather generator operationally over a large

[1] See Caraway et al., 2013, Multisite stochastic weather generation using cluster analysis and k-nearest neighbor time series resampling, Journal of Hydrology
[2] See Verdin et al., 2018, A conditional stochastic weather generator for seasonal to multi-decadal simulations, Journal of Hydrology

area such as the Colorado River Basin is challenging. The skill added to seasonal water supply forecasts using weather generators is uncertain.

Additionally, the National Weather Service is pursuing the use of a Hydrologic Ensemble Forecasting System (HEFS) that would utilize probabilistic forecasts of precipitation and temperature, which could force our hydrologic model in a way that is similar to that of a weather generator. The HEFS can be integrated more easily into operations and the CBRFC can better assess the associated skill working with HEFS over traditional weather generators.

Outcomes, Findings: While weather generators provided a worthwhile opportunity for the CBRFC to investigate their uses, operational implementation of them is currently too arduous. However, the CBRFC recognizes the value in developing forecasts that are not contingent on historical information; as such, the CBRFC is pursuing the use of the National Weather Service's HEFS, which would provide similar functionality to that of a weather generator.