Gurdak, J.J., 2006, Predicting Colorado Front Range stream discharge under natural climate variability: The Cache La Poudre River case study, Managing drought and water availability in vulnerable environments: Creating a roadmap for change in the United States, Geological Society of American, Longmont, Colorado, 9/18-20, 2006.

Predicting Colorado Front Range stream discharge under natural climate variability: The Cache La Poudre River case study

Jason Gurdak, USGS, Colorado Water Science Center

Natural climate variability on interannual to interdecadeal time scales can play a crucial role in successful conjunctive management of surface-water resources along the Front Range of Colorado. The response of stream discharge to complex climate variability has particular relevance for management decisions during drought and for water resources close to the limits of sustainability, because even marginal changes in supply and demand are of great importance. Consequently, it is necessary to understand past linkages between climate variability and the cycles of surface-water supply and demand that drive consumptive uses. Such understanding is the foundation for realistic predictions of stream-discharge response under future climate-variability scenarios and improved projections of the consequences of resource decisions on future water availability. Recent research has identified interactions between interannual and interdecadal climate cycles that produce a cumulative climate variability that directly affects the distribution of precipitation and, in turn, stream discharge. Stream discharge can respond dramatically when climate variability from different cycles lie coincident in a positive (wet) or negative (dry) phase of variability. Using a case study of the Cache La Poudre River, which contains one of the longest stream-discharge records (>100 years) in the U.S., a methodology is presented to quantify historical stream-discharge responds to climate variability and to calculate the probability of future climate-variability shifts and corresponding stream-discharge response. Preliminary results indicate variability in the stream-discharge record attributed to all important interannual to interdecadal climate cycles of the western US. These cycles include El Niño/southern Oscillation (ENSO) (2 to 6 years), North American Monsoon System (NAMS) (6 to 10 years), Pacific Decadal Oscillation (PDO) (10 to 25 years), and Atlantic Multidecadal Oscillation (AMO) (50 to 80 years). The majority of the variance in the stream-discharge record and strong correlations to the PDO and AMO indices indicate the importance of these decadal-to-multidecadal climate cycles on stream discharge along the Front Range. A probabilistic prediction model of the risk of future PDO and AMO regime shift is presented. Preliminary results indicate the PDO and AMO dry phases of variability, and corresponding drought conditions and lower stream discharge across the Front Range, are likely to persist on the order of years to decades. The probabilistic models presented here are likely valuable decision support tools useful to water managers along the Front Range whose principal concerns lies in accurately knowing how and when surface-water resources will respond to future climate-variability shifts.