WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Decision Support System for River System management Under HydroclimaticVariability.

Focus Category: Water Supply (WS), Management and Planning (M& P), Surface Water (SW)

Keywords: Reservoir Management, Hydroclimatology, Stochastic Hydrology, Mathematical Models, Forecasting, Decision Models, Optimization, Arid Climates.

Duration: 8/98 9/00

Federal Funds Requested: $147,495.

Non-Federal Matching Funds Pledged: $303,145.

Principal Investigators: Juan B. Valdez, Kevin Lansey, Roy Koch, and Hugo Loaiciga

Congressional District: 5th Congressional District Arizona (K. Lansey & J.B. Valdes) 1st Congressional District Oregon (R. Koch) and 22nd Congressional District California (H A. Loaiciga)

Statement of critical regional or State water problems:

Management of large river/reservoir systems is typically very conservative as a result of the broad impact of decisions and failures. Loaiciga and Marino (1986) showed the risk-averse nature of reservoir operating policies in California's water systems. A significant cause of this risk aversion is the uncertainty of future inflows. Since major water management decisions may have a long period of influence, operations frequently base decisions on streamflows that are less than the average flow in order to provide a safety factor during operations (see Loaiciga and Marino, 1986). As a consequence, reservoir operating decisions may be far from optimal, (that could arise if perfect forecasts were available), and result in spillages that do not contribute to project objectives. This proposal focuses on developing a decision support system (DSS) to assist decision makers improve reservoir and river basin management by taking into account varying climate conditions.

The DDS will include components to produce forecasts and analyze the impact of an operation policy under different sets of forecasts either by simulation and/or by developing an optimal operation policy. The forecasting models will predict flows one year into the future from the time when decisions are made. A critical issue in water management in the western US is the influence of the El Nino-Southern Oscillation (ENSO). The interannual and intraannual hydroclimatic variability resulting from the ENSO have been documented to varying degrees in different western states (Redmond and Koch, 1987; Loaiciga et al., 1993). It has been shown to have a particularly profound impact on the northwestern United States. Preliminary analysis of data from Arizona and California also shows that significant variations occur during years when ENSO impacts the local climate (Loaiciga et al., 1993). Thus, the forecasting tools developed by this project ENSO's influence on complex water management decision and maintain predictive skill for one-year forecasts resolved on a monthly time step.

Statement of results and benefits:

This project has scientific and practical benefits. From a scientific perspective, new methodologies will be developed to make streamflow, precipitation, and snow water equivalent (SWE) forecasts on a monthly time step for at least a year into the future. Most previous work has relied on-seasonal forecasts and traditionally has not taken into account ENSO. Two hydroclimatic forecasting approaches will be developed and compared based on their forecasting sill. These methods will provide insight into the key factors that affect their accuracy. The hydroclimatic effect of ENSO in different regions in the western US and its effect on forecasts will also be identified.

The practical benefits are related to improving river basin management decisions. First, the DDS will allow reservoir-system operators to easily analyze the impact of decisions under a spectrum of forecasted streamflow scenarios. In addition, optimization tools will be included in the DSS to determine optimal release policies for a deterministic or stochastic forecast. Thus, reservoir-policies, as well as the risk of achieving that gain. Furthermore, benefits for that accrue from reduced forecasting uncertainty will be examined. An analysis will be carried out to quantify reservoir operation aided by forecasts and the gains in system benefits to determine the utility of better forecasts. The impact of improved forecasts may vary depending upon a number of factors that include geographic location, the complexity of reservoir systems (sizes and capacities), and the length of the planning horizon. The tradeoff analysis will be tested with reservoir systems in Arizona, California and Idaho. For each reservoir system, a series of comparisons will be made. These comparisons include: (i) determination of the impacts on considering ENSO forecasts on operating policies-and; (ii) consideration of snowpack conditions in streamflow forecasts. Those forecasts will be based on different methods to estimate monthly streamflow/precipitation, snow water equivalents SWE, and the timing the forecasts. Each of these comparisons will provide useful information regarding how policies should be altered to react to potential changes in climatic conditions. This research will benefit system managers in their planning processes. To insure that this information reaches this audience, the research team will work with system operators for the three cited reservoir systems to provide input and feedback to the research team during the project. Two reservoir managers have expressed their interest in the research results and potential applicability to their-systems.