

Short-term real time forecast model in the upper Colorado River tributary basins

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A high-precision short-term forecast and routing model was developed for the Green / Yampa River system. It is currently being used to support operations of Flaming Gorge reservoir during the spring runoff season. This model generates a 120-168 hour (5-7 day) hourly forecast for the outflow of the Yampa River, and for the flow in the Green River downstream of the Yampa River confluence based on a user-constructed hourly release schedule from Flaming Gorge dam. The model is driven by realtime streamflow and climate data as well as short-term point climate forecasts in the upper reaches of the basin. This modeling system provides reservoir operators a high-precision, yet easy to operate model that can be run daily in less than 20 minutes. It produces hourly forecasts that are on average within 5% of the actual flows for the next 5-7 days.

First in a GIS environment, the basin is decomposed into subbasins with breakpoints at the locations of realtime streamgages and at confluences of gaged tributaries. Subbasins are then delineated and physical characteristics of each subbasin are extracted and incorporated into the model. The forecasting process starts with the generation of a 96-hour forecast hydrograph at each of the headwater sub-basins in the Yampa Basin. The forecasts are generated by analyzing the SWE depth, temperature, and precipitation data with respect to resulting stream flows in each basin over the past few days. Then based on forecast temperatures, precipitation, and SWE conditions for the next 96 hours, it makes a streamflow forecast for each of upper-most sub-basins. These forecast hydrographs are then routed through the stream network via a high-precision routing algorithm developed specifically for the hourly flow data of this model. The routing through each subbasin is calibrated to the most recent streamflow data available from the realtime gages within the basin. Once the routing network is calibrated, the operator can enter prospective release schedules for Flaming Gorge, and immediately view the resulting forecast flows 100 miles downstream on the Green River below the Yampa River confluence over the next 5 to 7 days. Alternatively, when the operating criteria prescribe specific flow targets, the release schedule can be constructed in order to optimally meet these targets. In practice the model is being used to forecast the peak outflow from the Yampa basin in order to augment the natural peak from the Yampa River with peak power-plant release from Flaming Gorge to benefit the fisheries in Reach 2 of the Green River. Flow targets have been developed for this reach for three endangered fish species found there.

Since its development and first use in 2004, additional models have been constructed for the Gunnison / North Fork Gunnison, and the San Juan / Animas River systems. The three modeling systems were used to support operations on Flaming Gorge, the Aspinall Unit, and Navajo Reservoir during the spring of 2005.