Geophysical Research Abstracts,
Vol. 11, EGU2009-9898, 2009
EGU General Assembly 2009

Integrating short-term and long-term forecasting with reservoir optimisation; Mantaro Basin, Peru.

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Operational water management often requires a trade-off between short-term and long-term water demands, where short-term demands are driven for example by hydropower generation and flood protection requirements and the long-term demands by water and irrigation supply, sustainable reservoir management and the seasonal impacts of snow melt or climate. This paper presents an operational decision support system designed to forecast and optimise reservoir operations in both the short-term and long-term. The system has been established for the 20,000 km2 Mantaro river basin located in the high Andes with altitudes ranging from 3500 to nearly 6000 m.a.s.l.. The two main power stations at Tablachaca have a combined capacity of more than 1000 MW that supplies 30% of Peru's electrical energy. In addition, the basin's water resources supply extensive agricultural areas, an urban population and mining activities and sustain important ecological habitats.

In this paper, the methodologies used for the integrating short-term and long-term forecasting are presented together with their application to the optimal operation of reservoirs. A key element in the system is the MIKE BASIN modelling tool. The system uses several modelling capabilities of MIKE BASIN: rainfall-runoff, reservoir operation, hydropower production, and river flow routing. The system also takes advantage of long-term forecasts (based on statistical information) and short-term forecasts (based on telemetry data). The continually updated runoff and flow forecasts enter the optimization, which applies the Model Predictive Control principle for MIKE BASIN as the core simulation model. For each optimization, a non-linear program algorithm is used to find the best release strategy. On the basis of the forecasted inflows and the real time data the system suggests to the user from which reservoirs to release water for alleviation of possible forecasted deficits. In addition to the Tablachaca scheme the model accounts for operation of upstream private hydropower plants as well as water extractions for domestic supply and for extensive irrigation.