Geophysical Research Abstracts
Vol. 16, EGU2014-11462, 2014
EGU General Assembly 2014

Short-term Reservoir Optimization by Stochastic Optimization for Mitigation Downstream Flood Risks

Dirk Schwanenberg (1,2), Alberto Assis Dos Reis (3), Julio Kuwajima (1), Rodolfo Alvarado Montero (1), and Fernando Mainardi Fan (4)

(1) University of Duisburg-Essen, Essen, Germany (dirk.schwanenberg@uni-due.de), (2) Deltares, Delft, The Netherlands (dirk.schwanenberg@deltares.nl), (3) Companhia Energética de Minas Gerais S.A. (CEMIG), Belo Horizonte, Brazil, (4) (fernando.fan@ufrgs.br)

An important objective of the operation of multi-purpose reservoirs is the mitigation of flood risks in downstream river reaches. Under the assumptions of reservoirs with finite storage capacities, a key factor for its effective use during flood events is the proper timing of detention measures under consideration of forecast uncertainty. Operational flow forecasting systems support this task by providing deterministic or probabilistic inflow forecasts and decision support components for assessing optimum release strategies.

We focus on the decision support component and propose a deterministic optimization and its extension to stochastic optimization procedures based on the non-adaptive Sample Average Approximation (SAA) approach and an adaptive multi-stage stochastic optimization with underlying scenario trees. These techniques are used to compute release trajectories of the reservoirs over a finite forecast horizon of up to 14 days by integrating a nonlinear gradient-based optimization algorithm and a model of the water system. The latter consists of simulation components for pool routing and kinematic or diffusive wave models for the downstream river reaches including a simulation mode and a reverse adjoint mode for the efficient computation of first-order derivatives.

The framework has been implemented for a reservoir system operated by the Brazilian Companhia Energética de Minas Gerais S.A. (CEMIG). We present results obtained for the operation of the Três Marias reservoir in the Brazilian state of Minas Gerais with a catchment area of near 55,000 km2, an installed capacity of 396 MW and operation restrictions due to downstream flood risk. The focus of our discussion is the impact of sparsely available ground data, forecast uncertainty and its consideration in the optimization procedure. We compare the performance of the above mentioned optimization techniques and conclude the superiority of the stochastic methods.