Geophysical Research Abstracts
Vol. 18, EGU2016-5156, 2016
EGU General Assembly 2016

Performance assessment of deterministic and probabilistic weather predictions for the short-term optimization of a tropical hydropower reservoir

Fernando Mainardi Fan (1), Dirk Schwanenberg (2), Rodolfo Alvarado (3), Alberto Assis dos Reis (4), Steffi Naumann (5), and Walter Collischonn (1)

(1) Universidade Federal do Rio Grande do Sul, Instituto de Pesquisas Hidráulicas, Grupo de Pesquisa HGE, Porto Alegre - RS, Brazil (fernando.fan@ufrgs.br), (2) Deltares, (3) University of Duisburg-Essen, (4) CEMIG, (5) Fraunhofer Institute

Hydropower is the most important electricity source in Brazil. During recent years, it accounted for 60% to 70% of the total electric power supply. Marginal costs of hydropower are lower than for thermal power plants, therefore, there is a strong economic motivation to maximize its share. On the other hand, hydropower depends on the availability of water, which has a natural variability. Its extremes lead to the risks of power production deficits during droughts and safety issues in the reservoir and downstream river reaches during flood events. One building block of the proper management of hydropower assets is the short-term forecast of reservoir inflows as input for an online, event-based optimization of its release strategy. While deterministic forecasts and optimization schemes are the established techniques for the short-term reservoir management, the use of probabilistic ensemble forecasts and stochastic optimization techniques receives growing attention and a number of researches have shown its benefit.

The present work shows one of the first hindcasting and closed-loop control experiments for a multi-purpose hydropower reservoir in a tropical region in Brazil. The case study is the hydropower project (HPP) Três Marias, located in southeast Brazil. The HPP reservoir is operated with two main objectives: (i) hydroelectricity generation and (ii) flood control at Pirapora City located 120 km downstream of the dam. In the experiments, precipitation forecasts based on observed data, deterministic and probabilistic forecasts with 50 ensemble members of the ECMWF are used as forcing of the MGB-IPH hydrological model to generate streamflow forecasts over a period of 2 years. The online optimization depends on a deterministic and multi-stage stochastic version of a model predictive control scheme. Results for the perfect forecasts show the potential benefit of the online optimization and indicate a desired forecast lead time of 30 days. In comparison, the use of actual forecasts with shorter lead times of up to 15 days shows the practical benefit of actual operational data. It appears that the use of stochastic optimization combined with ensemble forecasts leads to a significant higher level of flood protection without compromising the HPP's energy production.