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Advanced inflow forecasting for a hydropower plant in an Alpine hydropower regulated catchment – coupling of operational and hydrological forecasts

Anna-Maria Tilg (1), Johannes Schöber (2), Matthias Huttenlau (1), Jakob Messner (3), and Stefan Achleitner (4)

(1) alpS – Centre for Climate Change Adaptation, Innsbruck, Austria (tilg@alps-gmbh.com), (2) Tiroler Wasserkraft AG, Innsbruck, Austria, (3) Department of Electrical Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark, (4) Unit of Hydraulic Engineering, University of Innsbruck, Innsbruck, Austria

Hydropower is a renewable energy source which can help to stabilize fluctuations in the volatile energy market. Especially pumped-storage infrastructures in the European Alps play an important role within the European energy grid system. Today, the runoff of rivers in the Alps is often influenced by cascades of hydropower infrastructures where the operational procedures are triggered by energy market demands, water deliveries and flood control aspects rather than by hydro-meteorological variables. An example for such a highly hydropower regulated river is the catchment of the river Inn in the Eastern European Alps, originating in the Engadin (Switzerland). A new hydropower plant is going to be built as transboundary project at the boarder of Switzerland and Austria using the water of the Inn River. For the operation, a runoff forecast to the plant is required. The challenge in this case is that a high proportion of runoff is turbine water from an upstream situated hydropower cascade. The newly developed physically based hydrological forecasting system is mainly capable to cover natural hydrological runoff processes caused by storms and snow melt but can model only a small degree of human impact. These discontinuous parts of the runoff downstream of the pumped storage are described by means of an additional statistical model which has been developed.

The main goal of the statistical model is to forecast the turbine water up to five days in advance. The lead time of the data driven model exceeds the lead time of the used energy production forecast. Additionally, the amount of turbine water is linked to the need of electricity production and the electricity price. It has been shown that especially the parameters day-ahead prognosis of the energy production and turbine inflow of the previous week are good predictors and are therefore used as input parameters for the model. As the data is restricted due to technical conditions, so-called Tobit models have been used to develop a linear regression for the runoff forecast.

Although the day-ahead prognosis cannot always be kept, the regression model delivers, especially during office hours, very reasonable results. In the remaining hours the error between measurement and the forecast increases. Overall, the inflow forecast can be substantially improved by the implementation of the developed regression in the hydrological modelling system.