Geophysical Research Abstracts
Vol. 12, EGU2010-12947, 2010
EGU General Assembly 2010

Statistical modelling of forecast errors for multiple lead-times and a system of reservoirs

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Water resources management, e.g. operation of reservoirs, is amongst others based on forecasts of inflow provided by a precipitation-runoff model. The forecasted inflow is normally given as one value, even though it is an uncertain value. There is a growing interest to account for uncertain information in decision support systems, e.g. how to operate a hydropower reservoir to maximize the gain. One challenge is to develop decision support systems that can use uncertain information. The contribution from the hydrological modeler is to derive a forecast distribution (from which uncertainty intervals can be computed) for the inflow predictions.

In this study we constructed a statistical model for the forecast errors for daily inflow into a system of four hydropower reservoirs in Ulla-Førre in Western Norway. A distributed hydrological model was applied to generate the inflow forecasts using weather forecasts provided by ECM for lead-times up to 10 days. The precipitation forecasts were corrected for systematic bias. A statistical model based on auto-regressive innovations for Box-Cox-transformed observations and forecasts was constructed for the forecast errors. The parameters of the statistical model were conditioned on climate and the internal snow state in the hydrological model. The model was evaluated according to the reliability of the forecast distribution, the width of the forecast distribution, and efficiency of the median forecast for the 10 lead times and the four catchments. The interpretation of the results had to be done carefully since the inflow data have a large uncertainty.