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Machine learning methods for predicting hourly to monthly energy demand/production based on hydro-meteorological measurements and forecasts

Konrad Bogner and Massimiliano Zappa
Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland (konrad.bogner@yahoo.de)

Reliable predictions of the future energy demand and production could be a gainful information for the management and integration of renewable energy sources . Especially in periods of water deficits or surplus this information could be beneficial for the planning of the hydro-power production for the upcoming days, weeks and months. Thus several different machine learning methodologies have been tested for predicting possible future demands and productions and for deriving predictive uncertainties based on the information of hydro-meteorological data. The methods analysed include the Multivariate Adaptive Regression Splines (MARS) approach, Support Vector Machines (SVM) and Quantile Regression Forests (QRF). Hourly measurements of temperature, precipitation, global-radiation, wind-speed, wind-direction, air-pressure, periodicity components (intra-daily fluctuations expressed as sinus and cosine functions), as well as information of weekdays and holidays are taken as input variables for calibrating the demand model. Additionally the information of the inflow to hydro-power plants is included for modelling the energy production. The same input information can be derived from hydro-meteorological forecasts and will be used to predict future energy demands and productions including uncertainties. Since the various models show differences in the performance of the forecast, the outcome can be further improved by averaging the different models applying combination methods like the Nonhomogeneous Gaussian Regression or the Bayesian Model Averaging approach. Different skill scores have been tested for verifying the predictions and first results will be shown for the southern Switzerland (Canton of Ticino).