# Probabilistic Forecasts of Wind Power Generation

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The increasing production of renewable energy, and in particular wind energy, introduces highly volatile sources of energy in the total production. This implies that methods for reliable probabilistic forecasts of future production of energy are essential. Today there exist numerous methods and tools for providing point forecasts of wind power generation. However, for efficient and safe regulation, and for harvesting optimal trading strategies reliable information on the uncertainty is also needed. In this paper we focus on forecasts on the 1-48 hour horizon. It is well-known that the form of the conditional density for the wind power production is highly dependent on the level of predicted wind power in addition to the prediction horizon. The paper describes a new approach for wind power forecasting based on state-dependent stochastic differential equations (SDEs). Specifically we will use a logistic type stochastic differential equation formulation to account for the natural restrictions (wind power cannot exceed installed capacity and cannot be below zero). The SDE is driven by a well-known and widely used point predictor for wind power forecasting, and the SDE formulation allows us to calculate both state dependent conditional uncertainties as well as correlation structures. Evaluation and optimization of the model is obtained by specifying the likelihood of a 48-dimensional random vector when accounting for the correlation structure defined by the SDE-formulation. We describe the inter-dependence structure of the probabilistic forecasts for increasing horizons by a using a non-parametric (spline based) model for the parameters.

Key Words: Forecasting, state-dependent stochastic differential equation, integration of renewable energy, generalized prediction errors