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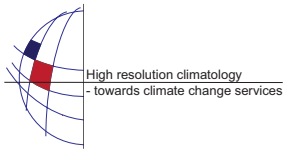

Wind turbines in icing conditions: performance and prediction

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Wind farms in cold climate regions have an estimated installed capacity of 3 GW which constantly increases, e.g., in Scandinavia, the Alpine region, and North America. One significant problem in cold climate regions is icing. Icing on wind turbines causes a variety of problems: reduction of power production, overloading due to delayed stall, increased fatigue of components and risk of ice throw. Thus, power forecasts considering icing are important to optimize performance and to minimize risks.

The present study aims at investigating how well the effect of icing can be included in power predictions. Studies concentrate on in-cloud icing - the most frequent reason for atmospheric icing on structures in most countries. Wind power production is predicted using the weather forecast model WRF coupled with a Kalman filter and an icing algorithm. The icing algorithm calculates ice load based on temperature, wind, cloud and rain water content from the WRF results. In previous studies, the model system demonstrated the ability to predict icing events.

Forecasts will be simulated for a test site in complex terrain in Switzerland. It consists of two wind turbines equipped with wind, temperature, humidity and longwave radiation sensors. Additional equipment with regard to icing are two webcams monitoring icing on blades and anemometers and an icing sensor. LIDAR measurements were carried out in January 2010 to measure an undisturbed vertical wind profile. During winter 2009/2010 longer icing periods of a total length of 9 days and several shorter icing periods were observed. These icing events are used to evaluate the wind power forecasts under icing conditions.