EMS Annual Meeting Abstracts
Vol. 14, EMS2017-673, 2017

Probabilistic forecasts of ice formation on wind turbines with a limited-area ensemble prediction system

Lukas Strauss, Stefano Serafin, and Manfred Dorninger
University of Vienna, Department of Meteorology and Geophysics, Vienna, Austria (lukas.strauss@univie.ac.at)

Icing of wind turbine blades is a major limiting factor for the operation of wind farms during winter time, altering the aerodynamic behaviour of the blades, reducing the energy yield, and causing dangerous ice shedding. Icing also leads to unplanned downtimes, resulting in increased balancing costs and significant economic losses to power companies. The recently launched project ICE CONTROL, an Austrian research initiative, addresses this problem with the measurement, probabilistic forecasting and forecast verification of wind turbine icing.

Our limited-area ensemble is based on the non-hydrostatic Weather Research and Forecasting (WRF) model. The domain covers North-Western Europe. Short forecast ranges of 48 hours are considered. Initial and boundary conditions are drawn from selected members of a global ensemble prediction system (currently the ECMWF EPS). The essential elements of the ensemble design include the selection of representative members from the global ensemble, the use of a multi-physics approach to represent model uncertainty, the possible use of stochastic perturbation schemes, and the verification and calibration of forecasts. Preliminary results from an implementation with 12.5-km grid spacing are presented, while a 2.5-km implementation is foreseen in the near future.

Emphasis is placed on how different state-of-the-art boundary-layer and microphysical parameterization schemes impact the accuracy of the ensemble forecasts. Critical weather parameters include temperature, wind speed, and liquid water content. Ensemble weather forecasts are coupled to icing models in order to obtain probabilistic forecasts of ice load on the turbine blades. Great sensitivity of the predicted ice loads on the liquid water content as well as the cloud droplet number concentration is found, pointing to the need for microphysics schemes with a two-moment description of the liquid hydrometeor species for accurate icing forecasts.