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Towards more accurate wind and solar power prediction by improving NWP model physics

Andrea Steiner, Carmen Köhler, Jonas von Schumann, and Bodo Ritter
Deutscher Wetterdienst, Germany (andrea.steiner@dwd.de)

The growing importance and successive expansion of renewable energies raise new challenges for decision makers, economists, transmission system operators, scientists and many more. In this interdisciplinary field, the role of Numerical Weather Prediction (NWP) is to reduce the errors and provide an a priori estimate of remaining uncertainties associated with the large share of weather-dependent power sources. For this purpose it is essential to optimize NWP model forecasts with respect to those prognostic variables which are relevant for wind and solar power plants. An improved weather forecast serves as the basis for a sophisticated power forecasts. Consequently, a well-timed energy trading on the stock market, and electrical grid stability can be maintained.
The German Weather Service (DWD) currently is involved with two projects concerning research in the field of renewable energy, namely ORKA*) and EWeLiNE**). Whereas the latter is in collaboration with the Fraunhofer Institute (IWES), the project ORKA is led by energy & meteo systems (emsys). Both cooperate with German transmission system operators. The goal of the projects is to improve wind and photovoltaic (PV) power forecasts by combining optimized NWP and enhanced power forecast models. In this context, the German Weather Service aims to improve its model system, including the ensemble forecasting system, by working on data assimilation, model physics and statistical post processing.
This presentation is focused on the identification of critical weather situations and the associated errors in the German regional NWP model COSMO-DE. First steps leading to improved physical parameterization schemes within the NWP-model are presented.
Wind mast measurements reaching up to 200 m height above ground are used for the estimation of the (NWP) wind forecast error at heights relevant for wind energy plants. One particular problem is the daily cycle in wind speed. The transition from stable stratification during nighttime to well mixed conditions during the day presents a big challenge to NWP models. Fast decrease and successive increase in hub-height wind speed after sunrise, and the formation of nocturnal low level jets will be discussed. For PV, the life cycle of low stratus clouds and fog is crucial. Capturing these processes correctly depends on the accurate simulation of diffusion or vertical momentum transport and the interaction with other atmospheric and soil processes within the numerical weather model. Results from Single Column Model simulations and 3d case studies will be presented. Emphasis is placed on wind forecasts; however, some references to highlights concerning the PV-developments will also be given.

*) ORKA: Optimierung von Ensembleprognosen regenerativer Einspeisung für den Kürzestfristbereich am Anwendungsbeispiel der Netzsicherheitsrechnungen
**) EWeLiNE: Erstellung innovativer Wetter- und Leistungsprognosemodelle für die Netzintegration wetterabhängiger Energieträger, www.projekt-eweline.de