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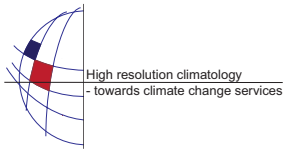

Impact of assimilating met-tower, turbine nacelle anemometer and other intensified wind farm observation systems on 0 – 12h wind energy prediction using the NCAR WRF-RTFDDA model

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In collaboration with Xcel Energy and Vasaila Inc., the National Center for Atmospheric Research (NCAR) conducts modeling study to evaluate the existing and the enhanced intensive observation systems for wind power nowcasting and short-range forecasting at a northern Colorado wind farm. The NCAR WRF (Weather Research and Forecasting model) based Real-Time Four-Dimensional Data Assimilation (RTFDDA) and forecasting system, which has been employed to support Xcel Energy operational wind forecast, was used in this study. The observational data include ten met-towers, a 915Hz wind profiler, a sodar and a Windcube Doppler lidar, besides the in-farm met-towers and wind speed and power reports from more than 300 of wind turbines. The WRF-RTFDDA 4-dimensioanl data assimilation algorithm allows to spread and propagate observation information in the WRF model space (x, y, z and time) with weighting functions built according to the observation location and time. The WRF-RTFDDA was set up to run with four nested domains with grid increments of 30, 10, 3.333 and 1.111km respectively. The standard and diverse non-conventional observations are assimilated on coarse grid domains along with the special wind farm observations. In this study, we investigate a) spread of surface observations in PBL according to PBL depth and regimes, b) optimization of horizontal influence radii and steep-terrain adjustment, and c) impact of different observation platforms and data types on 0 – 12 h wind prediction . It is found that PBL mixing and thermodynamic structures are greatly influenced by the PBL parameterization formulation. The range of the data assimilation effect on forecasts relies on weather and PBL regimes. In most cases, assimilation of in-farm and near-farm observations improves up to 12-hour wind power prediction and assimilation of in-farm data can significantly improves 0 – 6 hour forecasts.