# Analysis and modeling study of inter-farm and intra-farm wind variations with the NCAR high-resolution multi-scale WRF-RTFDDA system

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Significant variations of wind power capacity factors (cfs) were observed for turbines across individual wind farms, where the farms span a distance of 10 – 20 km. These variations have a vital impact on power integration and loading. To study these cfs variations, we investigate the inter-farm and intra-farm wind characteristics for farms in northeastern Colorado. This is accomplished by analyzing the wind-farm data, and performing a modeling study using the NCAR Real-Time Four-Dimensional Data Assimilation (RTFDDA) and forecasting system. The RTFDDA system, built around the US Weather Research and Forecasting (WRF) model, is capable of continuously collecting and ingesting diverse synoptic and asynoptic weather observations, including WMO standard upper-air and surface reports, wind-profiler data, satellite cloud-drift winds, commercial aircraft reports, all available mesonet/wind-farm weather data, radar observations, and any special instruments that report temperature, winds and moisture. The WRF RTFDDA provides continuous 4-D weather analyses, nowcasts and short-term forecasts.

In this study, the WRF-RTFDDA system is run with successive nested domains to simulate the multiscale weather and provide a detailed view of wind circulations at farms. The fine-mesh domains are run at a resolution of 1 - 3 km for spanning the overall environment of wind farms, and 0̃.1 – 0.35 km for the study of intra-farm weather features. Fine scale topography (100 m) and land use (30 seconds) data are used to specify the lower boundaries of the fine-mesh domains for simulation of the local underlying forcing. It is well known that the modeling of weather at these scales is a challenge. Thus, a set of sensitivity experiments is conducted to study the impact of available state-of-the-art modeling dynamics, physics and data assimilation schemes on the model performance. The findings will be reported at the meeting.