Estimation of the benefits of remote-sensing profilers for sustainable energy applications

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Abstract

Over the last years, climate monitoring and operational weather forecasts have become an important topic for renewable energy management. One of the ways for a substantial improvement of numerical weather prediction (NWP) is the assimilation of new observational data. Data assimilation (DA) combines observations with short-term weather forecasts to achieve an optimal estimate of the atmospheric state required for NWP. One of the sources of information potentially valuable for DA are ground-based remote-sensing instruments. Our study focuses on the potential impact of ground-based remote sensors for energy applications. The potential impact is analyzed using ensemble sensitivity analysis which allows us to investigate how the assimilation of hypothetical ground-based profilers can reduce the forecast variance. We analyze relative changes in the variance associated with the assimilation of synthetic observations from a wind Doppler lidar. The variance reduction is investigated for domain-averaged sensitivities of 80 m wind (typical hub-height of wind turbines). For our analysis, we apply the first convective-scale 1000-member ensemble simulation over Germany. The simulation uses a full-physics non-hydrostatic regional model, consists of 16 ensemble forecasts and covers a high impact weather period in May/June 2016. Our study focuses on the urban and highly populated Rhein-Ruhr area and surrounding regions that feature wind parks.

Keywords: ensemble sensitivity approach, remote sensing for the boundary layer, wind Doppler lidar, low level wind forecast, renewable energy

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