Evaluating winds and vertical wind shear from Weather Research and Forecasting model forecasts using seven planetary boundary layer schemes - DTU Orbit (31/12/2018)

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The existence of vertical wind shear in the atmosphere close to the ground requires that wind resource assessment and prediction with numerical weather prediction (NWP) models use wind forecasts at levels within the full rotor span of modern large wind turbines. The performance of NWP models regarding wind energy at these levels partly depends on the formulation and implementation of planetary boundary layer (PBL) parameterizations in these models. This study evaluates wind speeds and vertical wind shears simulated by the Weather Research and Forecasting model using seven sets of simulations with different PBL parameterizations at one coastal site over western Denmark. The evaluation focuses on determining which PBL parameterization performs best for wind energy forecasting, and presenting a validation methodology that takes into account wind speed at different heights. Winds speeds at heights ranging from 10 to 160 m, wind shears, temperatures and surface turbulent fluxes from seven sets of hindcasts are evaluated against observations at Høvsøre, Denmark. The ability of these hindcast sets to simulate mean wind speeds, wind shear, and their time variability strongly depends on atmospheric static stability. Wind speed hindcasts using the Yonsei University PBL scheme compared best with observations during unstable atmospheric conditions, whereas the Asymmetric Convective Model version 2 PBL scheme did so during near-stable and neutral conditions, and the Mellor–Yamada–Janjic PBL scheme prevailed during stable and very stable conditions. The evaluation of the simulated wind speed errors and how these vary with height clearly indicates that for wind power forecasting and wind resource assessment, validation against 10 m wind speeds alone is not sufficient. Copyright © 2012 John Wiley & Sons, Ltd.