



## Validation of Boundary Layer Winds from WRF Mesoscale Forecasts over Denmark

Hahmann, Andrea N.; Pena Diaz, Alfredo

*Published in:*  
EWEC 2010 Proceedings online

*Publication date:*  
2010

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Hahmann, A. N., & Pena Diaz, A. (2010). Validation of Boundary Layer Winds from WRF Mesoscale Forecasts over Denmark. In *EWEC 2010 Proceedings online* European Wind Energy Association (EWEA).

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

# Validation of Boundary Layer Winds from WRF Mesoscale Forecasts over Denmark

Andrea N. Hahmann and Alfredo Peña

Wind Energy Division,  
Risø National Laboratory for Sustainable Energy,  
Technical University of Denmark, Roskilde, Denmark

August 28, 2009

## 1 Introduction

Since May 2009, the Wind Energy Division at Risø-DTU has maintained a real-time weather forecast modelling system (Wang et al. 2009) to forecast boundary-layer atmospheric conditions over Denmark. Wind speed and direction forecasted by the model are verified against hourly winds from 10-meter conventional METeorological Aerodrome Report (METAR) measurements and wind measurements at several masts across Denmark.

The National Center for Atmospheric Research (NCAR) Advanced Research WRF (Weather Research and Forecast) model is used in the simulations. The WRF model is a numerical weather prediction and atmospheric simulation system designed for both research and operational applications.

The goal of the real-time WRF system at Risø-DTU is to provide guidance to understand the WRF behavior and to aid in selecting the best parameterizations and parameters for wind power meteorology applications.

## 2 Description of the model setup

Figure 1 displays the grid configuration used for the runs. The mother domain (D1) has a horizontal grid spacing of 18 km, the first nested domain (D2) 6 km and the second and innermost nest (D3) 2 km. The model forecasts use 37 vertical levels from the surface to the top of the model located at 100 hPa; 12 of these levels are placed within 1000 m from the surface. The

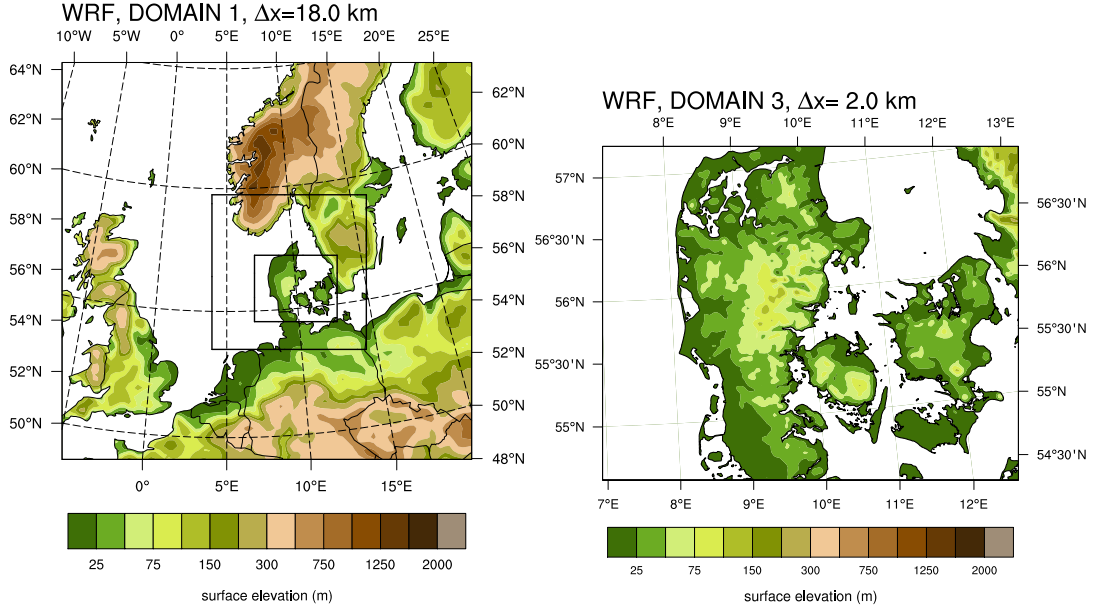


Figure 1: Left: Domain configuration and terrain elevation of the Risø’s WRF model setup. The black squares indicate the boundaries of three domains and  $\Delta x$  the horizontal grid resolution. Right: The innermost domain,  $\Delta x = 2$  km, covering Denmark.

model setup uses standard parameterizations including the Yonsei University (YSU) PBL scheme (Hong et al. 2006).

The location of the METAR stations used in this study is presented in Fig. 2. The data from these stations is mainly hourly and include wind speed and direction, air temperature, dew-point temperature, and sometimes sea-level pressure. These stations are complemented by measurements at towers maintained by Risø-DTU. Output from the model forecasts of these same fields is hourly for the integration time of 48 hours. Forecasts are started twice daily at 0000 and 1200 UTC driven by the USA NOAA Global Forecast System analysis and forecasts. For simplicity, we verify only the 1200 UTC runs here; similar results are found for the 0000 UTC runs.

### 3 Methodology and first results

A variety of verification statistics are calculated, including biases, mean absolute error (mae), and root mean square error and analyzed according to forecast time, time of the day, level from surface, and in their distribution in space.



evaluate different parameterizations schemes, in order to understand their influence on the forecasts and to improve the model, if possible.

## References

- Gryning, S.-E., E. Batchvarova, B. Brümmner, H. Jørgensen, and S. Larsen, 2007: On the extension of the wind profile over homogeneous terrain beyond the surface layer. *Bound.-Layer Meteorol.*, **124**, 251–268.
- Hong, S.-Y., Y. Noh, and J. Dudhia, 2006: A new vertical diffusion package with an explicit treatment of entrainment processes. *Mon. Wea. Rev.*, **134**, 2318–2341.
- Peña, A., 2009: Sensing the wind profile. Tech. Rep. Risø-PhD-45(EN), Risø DTU, Roskilde, Denmark, 80 pp.
- Peña, A., S.-E. Gryning, and C. B. Hasager, 2009a: Comparing mixing-length models of the diabatic wind profile over homogeneous terrain. *Theor. Appl. Climatol.*, DOI 10.1007/s00704-009-0196-8.
- Peña, A., S.-E. Gryning, J. Mann, and C. B. Hasager, 2009b: Length scales of the neutral wind profile over homogeneous terrain. *J. Appl. Meteorol. Climatol.*, under review.
- Wang, W., et al., 2009: *WRF-ARW Version 3 Modeling System User's Guide*. Mesoscale & Microscale Meteorology Division, National Center for Atmospheric Research, Boulder, USA.