Combined meso/microscale modeling of the wind climate for wind power estimation

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The method of combining the Karlsruhe Atmospheric Mesoscale Model KAMM (Adrian and Fiedler, 1991; Adrian, 1994) and the Wind Atlas Analysis and Application Program WAsP (Troen and Petersen, 1989; Mortensen et al., 1993) to make local predictions of the wind climate for wind energy purposes is explained and some results are shown.

The wind is a very local quantity being influenced already by small hills, or roughness differences as e.g. between sand and bushes (see e.g., Mortensen and Petersen, 1997). WAsP is a model which "cleans" measurements from these local influences to obtain values that are more representative for the wind climate. The cleaned measurements form a "wind atlas" for the area around the site. The wind atlas is used to predict the actual wind at other sites with similar overall wind climate. However, to get a wind resource map of a larger region (e.g. 300×300 km^2) many measurement stations are needed. They are costly, and it takes a long time to obtain climatological estimates.

Mesoscale models are good tools to determine the wind climate for such regions. In addition, they can take advantage of the global data bases of the large-scale climate which are available, e.g. from the re-analyses projects at NCEP/NCAR (Kalnay et al., 1996), or ECMWF (Gibson et al., 1997). Mesoscale models are not well suited to predict the local wind climate.

The combination of KAMM and WAsP is illustrated in Figure 1. The way of preparing the input fields for WAsP from the results of the simulations with KAMM will be described in detail. The method has already been applied to Ireland (Frank and Landberg, 1997a,b). Results will be shown for other regions of Europe.

References

G. Adrian. Zur Dynamik des Windfeldes über orographisch gegliedertem Gelände. *Ber. Deutscher Wetterdienst*, 188:142 pp, 1994.

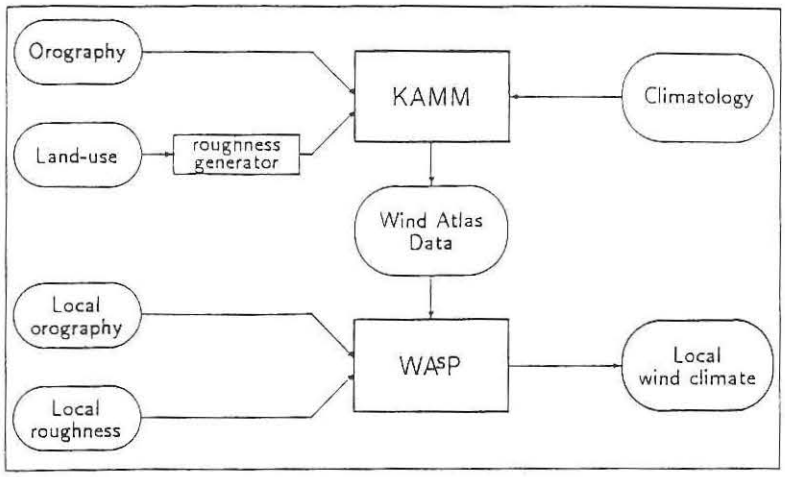

Figure 1: Schema of the combination of KAMM and WAsP to calculate the local wind climate.

G. Adrian and F. Fiedler. Simulation of unstationary wind and temperature fields over complex terrain and comparison with observations. *Beitr. Phys. Atmosph.*, 64:27–48, 1991.

H. P. Frank and L. Landberg. Modelling the wind climate of Ireland. *Boundary-Layer Meteorol.*, 85:359–378, 1997a.

H. P. Frank and L. Landberg. Numerical simulation of the Irish wind climate and comparison with wind atlas data. In *Proc. EWEC'97, Dublin*, 1997b.

R. Gibson, P. Kållberg, and S. Uppala. The ECMWF re-analysis (ERA) project. *ECSN Newsletter*, 5:11–21, 1997.

E. Kalnay, M. Kanamitsu, R. Kistler, W. Collins, D. Deaven, L. Gandin, M. Iredell, S. Saha, G. White, J. Woollen, Y. Zhu, A. Leetmaa, R. Reynolds, M. Chelliah, W. Ebisuzaki, W. Higgins, J. Janowiak, K. C. Mo, C. Ropelewski, J. Wang, R. Jenne, and D. Joseph. The NCEP/NCAR 40-year reanalysis project. *Bull. Amer. Meteor. Soc.*, 77:437–471, 1996.

N. G. Mortensen, L. Landberg, I. Troen, and E. L. Petersen. *Wind Atlas Analysis and Application Program (WAsP) Vol. 2: User's Guide.* Risø National Laboratory. Roskilde, 1993.

N. G. Mortensen and E. L. Petersen. Influence of topographical input data on the accuracy of wind flow modelling in complex terrain. In *Proc. EWEC'97, Dublin*, 1997.

I. Troen and E. L. Petersen. *European Wind Atlas.* Risø National Laboratory for the Commission of the European Communities, Roskilde, Denmark, 1989. ISBN 87-550-1482-8.