MESOSCALE MODELLING OF OFFSHORE BOUNDARY LAYER WINDS

Domingo Muñoz Esparza, Spain
Supervisor: Prof. J.P.A.J. van Beeck
Promoter: Prof. J.-M. Buchlin (ULB, Belgium)

Nowadays, Numerical Weather Prediction (NWP) models are being used by the wind energy industry for different purposes. They are mainly employed to prognosticate the wind power output of wind farms and to estimate the wind resource of a given area. One of the advantages of these NWP models is that they are capable to forecast a few days ahead events based on a reduced set of information provided on a very coarse spatial and time resolution, which normally is about 1 degree and 6 hours, respectively. On the other hand, the standard horizontal discretization of such models is in the order of 10 km, with the corresponding difficulties to handle small scale turbulent processes.

The effect of the vertical mixing due to turbulence in the Planetary Boundary Layer (PBL) is not explicitly resolved by mesoscale models. NWP models parameterize this effect assuming the so-called closure techniques based on gradients of resolved quantities. For some applications, such as wind energy, where the near-surface atmospheric processes are crucial, the choice of PBL modeling becomes an important issue.

In this study, it has been proven that such parameterization of the vertical turbulent flux plays a major role on its applicability for wind energy purposes. A considerable spreading was obtained when six different WRF-PBL schemes were considered for different stability scenarios. Particularly, some formulations present problems to reproduce stable stratified conditions due to the fact that they are too diffusive and partially suppress the surface shear. Under convective stability, the different formulations present a better agreement with the vertical structure of the wind profile compared to the offshore field measurements from the FINO1 research platform, located in the German part of the North Sea.

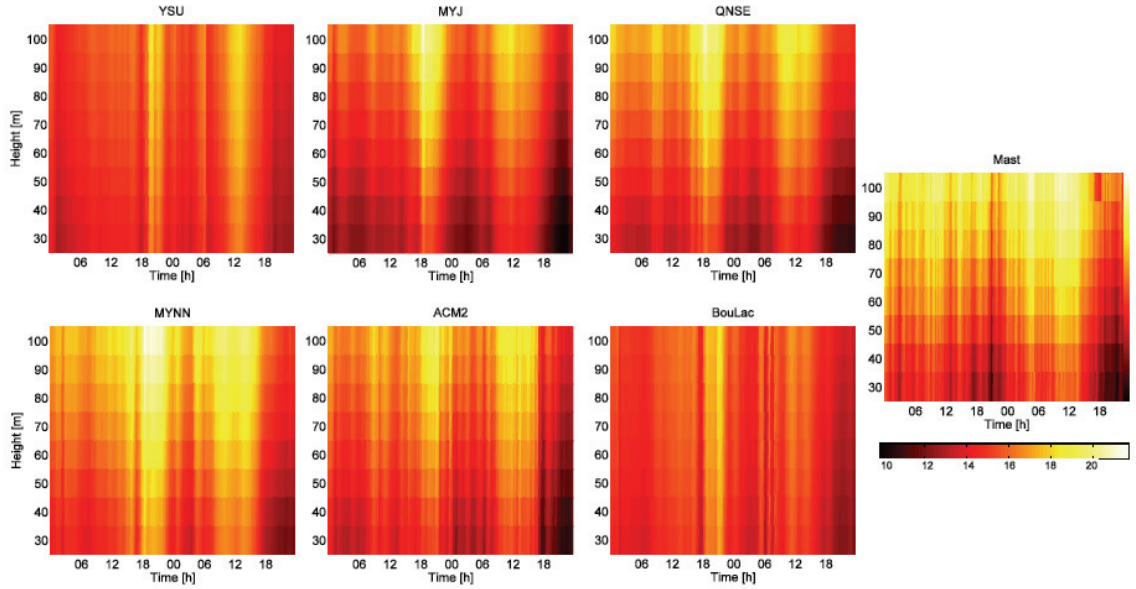

Figure 1: Time-altitude wind speed maps (ms^{-1}) for the six WRF-PBL schemes and FINO1 Mast measurements. Stable period (16-18/03/2005)