Estimating near-shore wind resources

An evaluation and sensitivity study using the WRF mesoscale model to estimate the wind in a coastal area is performed using a unique data set consisting of scanning, profiling and floating lidars. The ability of the WRF model to represent the wind speed was evaluated by running the model for a four month period in twelve different set-ups. The atmospheric boundary layer was parametrized using the first-order YSU scheme and the 1.5-order MYJ scheme. Simulations with two sources of land use data, two sources of reanalysis data, two sources of sea-surface temperatures and three different horizontal grid spacings were performed for each of the two schemes. An evaluation of the wind profile using vertical profilers revealed small differences in modelled mean wind speed between the different set-ups, with the YSU scheme predicting slightly higher mean wind speeds. Larger differences between the different simulations were observed when comparing the root-mean-square error (RMSE) between modelled and measured wind, with the ERA interim-based simulations having the lowest errors. The simulations with finer horizontal grid spacing had a larger MSE. Horizontal transects of mean wind speed across the coastline measured with the scanning lidars were compared with the model simulations, showing that the shape of the horizontal gradient was well captured but the modelled mean wind speed was slightly overestimated. An evaluation of model performance with Taylor diagrams, showed that the sensitivity was largest to the PBL scheme and the reanalysis data. The simulations using the MYJ scheme had a lower RMSE and higher correlation coefficient than those using the YSU scheme, but also a lower variance compared to the observations. Using ERA interim instead of FNL as boundary conditions also led to a lower RMSE and correlation coefficient. Using a finer grid spacing of 1 and 0.5 km did not give better results and sensitivity to the input of different SST and land cover data in the RUNE area was small. The difference in mean wind speed between all simulations over a region 80 km around the RUNE area was less than 1 m s⁻¹, with the largest differences over land due to the roughness length deviations and over sea due to SST differences. Simulations using the YSU scheme were more sensitive to variations in land use near the coastline, SST and forcing than those using the MYJ scheme. The forcing data had an impact on the simulated mean wind speed offshore, but the impact was negligible in the immediate RUNE region. The variance varied little as a function of the model grid spacing. Finally a wind resource estimation was made using the WAsP model, the mesoscale model and scanning lidar measurements and the uncertainties in each of the estimations is discussed.