



THE IMPORTANCE OF THERMAL EFFECTS ON THE WIND SHEAR AT OFFSHORE WIND FARM SITES

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The flow in the coastal marine atmospheric surface layer differs from onshore situations mainly in two ways: the surface roughness of the sea is not constant like for land surfaces and the influence of atmospheric stability on the offshore flow is more important than on land. Both affect the vertical wind speed profile and thus the wind shear, which is important for resource calculations as well as for turbine design considerations.

Data from the field measurement program Rødsand in the Danish Baltic Sea are used to investigate the importance of these effects for resource estimation and wind shear modelling. Sea surface roughness has been found to be of less importance for resource calculations and for wind shear modelling in moderate wind conditions. On the other hand, thermal effects have an important influence on the wind speed profile at stable and near neutral conditions. For such situations the wind speed increase with height is larger than predictions with Monin-Obukhov theory suggest. A simple correction method has been developed and tested to account for this effect.

Example calculations show that the prediction error in the extrapolation from 10 m to 50 m height can be reduced significantly with the proposed correction method. A strong dependency of the wind shear on atmospheric stability has been found, which is not usually accounted for in current turbine design guidelines. This leads to an underestimation of the wind shear in stable conditions in comparison with e.g. the power law profile used in the current IEC certification guidelines.