EMS Annual Meeting Abstracts
Vol. 10, EMS2013-329, 2013
13th EMS / 11th ECAM

Influence of the atmospheric boundary layer on wind turbine wakes within the offshore wind farm EnBW Baltic 1

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Europe's wind capacity is expected to grow up to a total of 400 GW out of which more than one third (150 GW) is projected to be offshore. Germany's first commercial offshore wind farm "EnBW Baltic 1" is located about 16 km North of the peninsula Darß-Zingst within the Baltic Sea. The wind farm consists of 21 - 2.3 MW wind turbines each with a hub height of 67 m and a rotor diameter of 93 m. The turbines are arranged in an irregular shaped triangle with edge lengths of 3 km, 4.5 km and 6.5 km. Due to the shape of the wind farm, several wake situations (single up to sixfold wakes) can be studied for the same wind direction.

The atmospheric conditions in the Baltic Sea are very complex. Because of the comparatively short distance of the wind farm to the coastline, a mixture of onshore and offshore conditions is prevailing. Pure offshore conditions can only be expected for very narrow westerly wind sectors. In addition and in contrast to the North Sea, the atmospheric boundary layer above the Baltic Sea is predominantly stably stratified.

The operation of the wind farm started in May 2011, thus a two year SCADA - data set is now available. During the first years the operation of the wind farm is accompanied by a research project. One focus of the project is to investigate different wake situations for varying atmospheric conditions. Therefore, the operational data of the wind farm as well as LiDAR and data of a meteorological measurement campaign within the wind farm are studied.

The results from the measurement campaign are utilized as input and validation data for simulations with the LES model PALM, which is used to get a better understanding of the wind farm flow. Results from simulations of wake effects within the wind farm will be presented. These simulations do account for the inhomogeneity in the regions as well as for the impact of atmospheric stability on the flow conditions.