



## **An LES study of wind turbine wakes within the offshore wind farm 'EnBW Baltic 1'**

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The European Wind Energy Association (EWEA) expects Europe's offshore wind capacity to grow up to 133 GW in 2030. Most of the planned and already erected wind farms will be located in the North and Baltic Sea. The semi-enclosed Baltic Sea is of special meteorological interest as coastal distances are in general short and strongly varying with wind direction. In addition and in contrast to the North Sea, the stratification is dominated by stable stratification, which enhances wake effects due to lower mixing than in unstable situations.

Within the Western Baltic Sea, Germany's first commercial offshore wind farm 'EnBW Baltic 1' was connected to the grid in 2011. In a research project, accompanying the first years of the operation of the wind farm, power and meteorological data is available. Within this project, measurement data is analyzed to gain input and validation data for Large-Eddy simulations (LES) with the model PALM. Simulations for different wind speeds, wind directions and atmospheric stabilities allow for a detailed studying of the impact of the atmospheric conditions on the wind farm flow.

The results of the LES show that the distance to the coast is an important factor influencing the wind farm flow. This was accounted for by adjusting the surface properties (roughness lengths and temperatures) in the LES. The fetch length was afterwards considered by altering the simulation time after the coastal passage. In a third simulation step the wind farm was added.

An internal boundary layer develops as the flow moves offshore which is modified by the mixing induced by the wind turbines.