

# Offshore Wind Energy

Risø's Wind Energy Department has been active in offshore wind energy research for more than 15 years. Our current work is divided into:

- Offshore measurements
- Offshore resource modelling
- Offshore design and loads



In addition to measurement design and implementation, Risø supplies high-quality meteorological instrumentation and is equipped with remote sensing equipment and software such as sodar, lidar and satellite image processing.



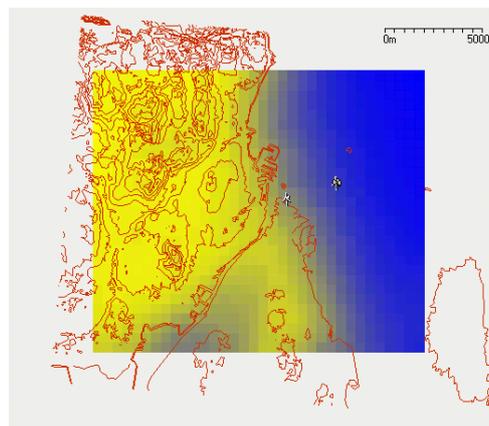
## Offshore measurements

Risø is active in technology development in support of meteorological and wind turbine measurements for offshore wind energy development for both research and commercial purposes. Risø currently uses both satellite and modem links to collect data from more remote sites. Real-time, on-line data are available at <http://www.risoe.dk/vea-data/maps/world.htm>



## Offshore resources

To characterise wind resources for offshore areas Risø uses its own WASP model, mesoscale models and statistical models with offshore and coastal data. Conditions in offshore areas are known to significantly deviate from near-neutral according to the location with respect to land, the prevailing wind climate and the temperature of land and sea. Quantifying this impact on vertical wind and turbulence profiles and hence on power output and wind shear is a major focus of current activity.



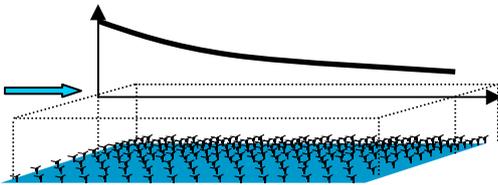
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## Wakes and offshore wind farms

Measurements are being conducted to examine wind speed recovery and turbulence generation in single and multiple wakes using traditional techniques and also with sodar and satellite images. A number of physical and empirical models are used for wake prediction in order to estimate power losses within offshore wind farms. Current work focuses more on wakes within and downwind of large wind farms (> 100 turbines). A combined measurement and model development approach is being utilized in order to evaluate current wake and boundary layer models and to estimate optimal spacing for clusters of wind farms placed in the offshore environment.



## Offshore design and loads

Risø is active in measurement and modelling of loads on offshore wind turbines and also in developing standards for offshore wind turbines.

Modelling of offshore wind turbines covers fatigue and extreme loads and encompasses determination of

- so-called external conditions
- safety levels to apply
- added loading due to wake effects from neighbouring wind turbine units
- combined effects of wind, wave and/or ice loads.

The research is applied in developing further on our aero-elastic wind turbine design code and – with Risø staff being members of several international standardization committees – the results are quickly propagated to practical use.



## Contacts

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