Conference programme

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Thursday, 19 November 2015
09:00 - 10:30 Advanced modeling of offshore and stratified flow

RESOURCE ASSESSMENT

Room: Montparnasse

In this session on advanced flow modelling focus will be on the following issues: modelling flow under stable atmospheric conditions, tools for offshore wind farm planning and the benefits of high-resolution modelling. The stable flows will be modelled with CFD codes in three different ways, applied to on-shore and coastal environments.

Learning objectives

Delegates will be able to explain:

why flow under stable conditions is different from neutral flow
the main additions to the CFD codes in order for the models to improve results under stable conditions
the main parts of a tool for offshore wind farm planning and how they work together
how increasing the resolution of models for resource assessment improves the value of the output

Lead Session Chair:

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Presenter's biography

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Dr. Charlotte Hasager is senior researcher at DTU Wind Energy. M.Sc. in 1992 and PhD. in 1996. She has worked in research on wind energy at DTU Wind Energy since 1993 with wind energy, boundary layer meterology and satellite remote sensing. Much focus on offshore wind energy, wind farms and wakes.

Abstract

Design tool for offshore wind farm cluster planning

Introduction

In the framework of the FP7 project EERA DTOC: Design Tool for Offshore wind farm Cluster, a new software supporting planning of offshore wind farms was developed based on state-of-the-art approaches from large scale wind potential to economic benchmarking. The model portfolio includes WAsP, Fuga, WRF, NetOp, LCoE model, CorWind, FarmFlow, Eefarm and grid code compliance calculations. The development is done by members from EERA (European Energy Research Alliance) and guided by several industrial partners. A commercial spinoff from the project is the tool 'Wind & Economy'.

Approach

The project aim of the EERA DTOC project was to develop 'A robust, efficient, easy to use and flexible tool created to facilitate the optimised design of individual and clusters of offshore wind farms'. This was successfully achieved during the 3.5 year long project coordinated by DTU Wind Energy and in collaboration with 21 partners.

Main body of abstract

The integrated software 'Wind & Economy' is based on software that has been compared and validated to wide extent. Within the EERA DTOC project one major task completed was comparison of around 10 wake models to SCADA data from Horns Rev 1 offshore wind farm in the North Sea, Lillgrund wind farm in the Baltic Sea and Rødsand-2 wind farm in the Baltic Sea. The Rødsand-2 is located nearby the Nysted-1 wind farm, thus the wake influence between dual operation twin farms was possible. Furthermore both micro- and mesoscale wake models have been compared to

satellite-based wind farm wake data in the North Sea. The WRF model is operated at three institutes (CENER, CIEMAT and DTU) and comparison of WRF model results to satellite winds has also been performed. WRF is generally used to provide the wind climate, with and without wind farm clusters, or alternatively if meteorological observations are available, these data may be used for wind climate. Another part of the work was on uncertainty analysis for estimation of annual energy yield. FINO-1 meteorological data were used as basis. Ship-based wind lidar data observed near FINO-1 and Alpha ventus wind farm in the North Sea and scanning lidar data were collected and compared to wake models. Also planning of the electrical grid both inter-array and long-distance cables were done by the software and several tests were made. The calculations include the smoothing effect on produced energy between wind farms located in different regional wind zones and the short time scales relevant for assessing balancing power. The grid code compliance was tested for several cases and the results are useful for wind farm planning of the grid and necessary components and controls.

Conclusion

The main project output, the 'Wind & Economy' software, provides a new frame for planning offshore wind farm clusters. By seamless integration of state-of-the-art models from the scientific development by the EERA members, which have been compared and validated by the research community and end-users, provides a significant potential for cost reductions. The rapid development of offshore wind farms in the Northern European Seas with major clusters planned in many countries makes the release of this novel tool available with due diligence.

Learning objectives

One learning objective is on integration of very diverse models. Another learning objective is on practical offshore wind farm planning needs and novel methodologies for developers.

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EWEA is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 600 members, which are active in over 50 countries, making EWEA the world's largest and most powerful wind energy network.

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