METOCEAN DATABASE OF NORTHERN EUROPEAN SEAS

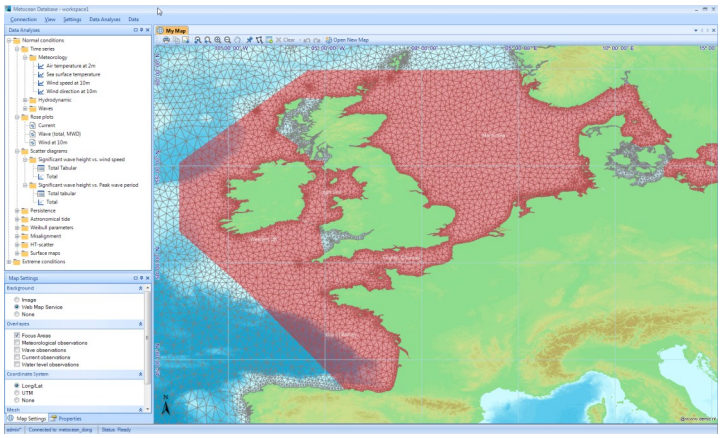
Fast assessment of MetOcean conditions for offshore wind farms

DONG Energy is doing its part to help the European Union meet its renewable energy goals. To aid in the anticipated increase in offshore wind farm developments in the region, we developed a 35-year database that includes meteorological, oceanographic, and wave data. DONG Energy is now using this database to decrease the amount of time needed to establish MetOcean criteria for offshore infrastructure.

SUPPORTING THE OFFSHORE RENEWABLE ENERGY INDUSTRY

Over the next 5-10 years, a substantial development in offshore wind power is expected in Northern Europe in order to fulfill the European Union's renewable energy target. In order to reduce costs and increase competitiveness, DONG Energy's ultimate goal was to establish local certified MetOcean criteria in less than four months. To do this, they needed to establish MetOcean conditions for the structural design and operation of offshore wind turbines, substations, and related infrastructure.

For the past several decades, we have continuously developed reliable and accurate data sets for the marine and energy industries – in particular in the seas of Northern Europe. In close collaboration with DONG Energy, we used the expertise gained from developing these data sets to create an extensive, validated, and documented database. The database includes meteorological, oceanographic, and wave data for a 35-year period with hourly values covering Northern European seas.



Database user interface with quick access and export functionality of MetOcean time series and analyses. This image shows a coarse representation of the computational mesh with more than 200,000 elements resolving nearshore areas with 1-3 km elements. ©DHI

CLIENT

DONG Energy

CHALLENGE

Need to speed up the establishment of certified MetOcean criteria for structural design and operation of offshore wind turbines, substations, and related infrastructure in Northern Europe

SOLUTION

Using customisable components to develop a validated, long-term 35-year database of meteorology, hydrodynamics, and waves covering Northern European seas, supplemented by pre-conducted statistical analyses

VALUE

- Statistical analyses relevant for the planning, operation, and design of offshore wind farms
- Quick access to long-term validated and documented MetOcean data and analyses
- Faster certification of local MetOcean design basis
- Consistent MetOcean data background and methods across sites in Northern Europe
- Easy access to data and customisable analyses via an all-in-one in-house database

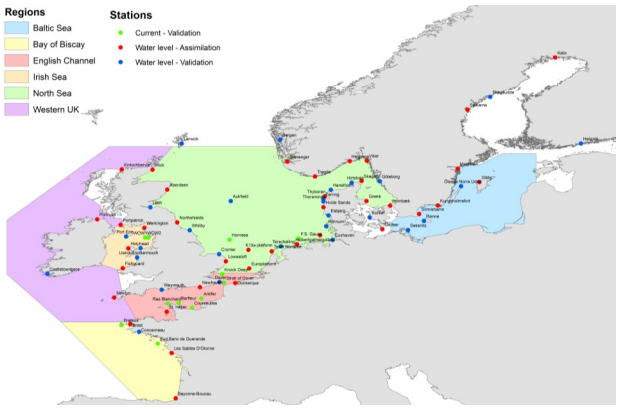
LOCATION / COUNTRY

Northern European seas

SOFTWARE USED

MIKE 21

The easily accessible, in-house, all-in-one database is supplemented with pre-conducted analyses relevant for planning, operating, and designing offshore wind farms.



Geographical coverage of the database as well as locations of water level and current measurements. ©DHI

LONG-TERM VALIDATED METOCEAN DATA

We established, validated, and documented a robust, accurate, consistent long-term data basis. This was achieved through a combination of:

- available meteorological data, in-situ measurements and satellite data
- extensive modelling of hydrodynamic and wave conditions using MIKE Powered by DHI's MIKE 21 hydrodynamic (HD) and spectral wave (SW) models

We adopted the meteorological data from the global Climate Forecast System Reanalysis (CFSR) and validated it for accuracy and consistency in Northern Europe.

Simulations of water level and current conditions were conducted using our MIKE 21 flow model with boundary conditions from our Global Tide model and meteorological forcing from CFSR. The flow model was further optimised using data assimilation – a methodology that applies measurements in order to improve the accuracy of the model.

The third generation wind-wave model (MIKE 21 SW) applied full spectral boundary conditions from our global spectral wave model and wind forcing from CFSR.

We conducted (and documented) comprehensive calibration and validation against data from more than 80 in-situ stations (including spectra comparisons) and satellite altimeter data. The accuracy and reliability of the data was assessed and visualised through numeric quality indicators covering the entire area.

A certifying company closely followed the process of establishing and validating the data basis and analyses methodologies.

ANALYSING NORMAL AND EXTREME CONDITIONS

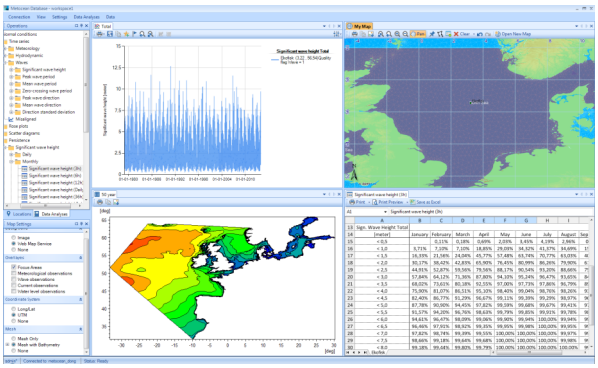
A significant number of analyses detailing the normal and extreme conditions relevant for offshore wind farms were made available at every mesh element (more than 200,000) in the database. This allowed DONG Energy to directly and easily access the analyses as well as extract data time series.

AREAS OF INTEREST

The project areas included the Bay of Biscay, Baltic Sea, English Channel, Irish Sea, North Sea, and off the coast of the Western United Kingdom.

ALL-IN-ONE DATABASE WITH USER INTERFACE

Utilising the data above, we developed the MetOcean database using our MIKE Powered by DHI customisable components – more than 10 TB of data was handled by our efficient Mesh Database technology. The database server software was PostgreSQL and data was stored on a network attached storage (NAS) drive. The database features are accessed through a GIS-based user interface. The user interface is flexible and allows direct access and customisation of analyses as well as time series export functionality.



Snapshot of the customisable database user interface with examples of time series and surface maps. ©DHI

Together with DONG Energy, we successfully applied the data for several local wind farm projects during the development of the MetOcean database. In addition, DONG Energy independently extracted data and information from the database for other projects.

CLIENT TESTIMONIAL

> *DHI demonstrated competences and eagerness to provide a high-quality product – from the core modelling work to the documentation of the work and the database, all of which were essential for speeding up the design process.*
>
> *Niels Jacob Tarp-Johansen—Lead Load Engineer—DONG Energy*

Contact: info@dhigroup.com
For more information, visit: www.dhigroup.com