# Development of an offshore wind index for the German Bight from mesoscale simulation data of over a decade

M. Dörenkämper, L. Vollmer, B. Stoevesandt, D. Heinemann*

Fraunhofer IWES, Oldenburg, Germany, +49 441 798 5014,
martin.doerenkaemper@iwes.fraunhofer.de
*ForWind – Center for Wind Energy Research,
Carl von Ossietzky University Oldenburg, Oldenburg, Germany

## 1. Introduction

The number of offshore wind farms within the German Bight grew significantly over the last years. The power output of existing wind farms suffers from the wakes of nearby erected wind farms. Besides these wake effects there is also a natural inter-annual variation of the offshore wind conditions [1].
Consequently, in the offshore exploration phase it remains questionable for wind farm owners and operators how to rate the annual power output of their wind farm, as wake and inter-annual variability cannot be separated from measured production data.
FROENIX, the FRaunhofer IWES Offshore wind ENergy IndeX is a publically available online resource enabling an estimation of the natural inter-annual variability of the offshore wind energy within the German Bight.

## 2. Method

FROENIX is calculated from more than a decade of mesoscale model simulations of the wind conditions over the German Bight. Therefore, the mesoscale model WRF [2] was used, applying an offshore optimized set-up [3].
The simulation data provides a resolution of 2.1 km in space and 30 min in time. These data were interpolated to hub height fields and scaled with a power curve of a typical offshore wind turbine [4]. Afterwards, the annual energy production (AEP) of a year is compared to the AEP of the last five and ten years. As a result, the expected surplus or deficit of the natural inter-annual variability in terms of percent is given.

## 3. Results

The resulting wind index is visualized for the thirteen offshore wind farm clusters over the German Bight. The index is made freely available only on an interactive map.

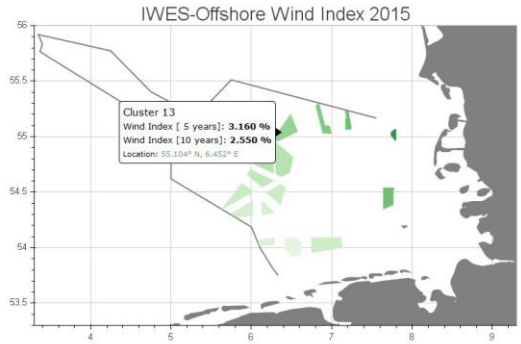


Fig. 1 Illustration of the interactive Offshore Wind Index from 2015 (snap shot), available online.

Figure 1 shows a snap shot of the FROENIX map.

As wind farm wakes are not regarded in the index, it allows wind farm owners and operators to estimate its impact on the annual wind resource by comparing the index to measured production data.
Additionally, a site-specific calibration of the wind index using a wake model and SCADA data can be applied to the wind index, leading to more accurate results for a single wind farm site

## 4. References

[1] The Crown Estate Commissioner (2017): Study on UK Offshore Wind Variability, Technical Report, DNV-GL, 67 pages.
[2] Skamarock et. al. (2008): A description of the advanced research WRF Ver. 30, Technical Report, NCAR, 113 pages.
[3] Dörenkämper, M., et. al. (2015): On the offshore advection of boundary-layer structures and the influence on offshore wind conditions, Boundary Layer Meteorol., 155(3), 459-482.
[4] Jonkman et. al. (2005): Definition of a 5-MW reference wind turbine for offshore system development, Technical Report, NREL, 75 pages.