EMS Annual Meeting Abstracts
Vol. 15, EMS2018-41, 2018

In-situ evidence of the far-field from offshore wind farms

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Offshore wind farms contribute a considerable part of today's production of renewable electric energy. More than 12 GW of offshore wind turbines are currently in operation in European waters.
In the last years a massive built-up in offshore wind energy farms has occurred with a concentration of the wind farms in groups and clusters, in order to optimise the use of the marine areas.
Understanding wakes of wind farms, which is the region of momentum and energy deficit downwind,
is therefore important for optimising the wind farm layouts and operation to minimize costs.

The German Government is presently funding a research project called WIPAFF (WInd PArk Far Field), which is dedicated to the the analysis of properties and impacts of offshore wind park far fields and wake losses by direct measurements, assessment of satellite images and numerical simulations.
The focus is on the quantification of wind farm wakes, their dependence on atmospheric stability and their regional climate impact.

The first direct in situ measurements of the existence and shape of large wind farm wakes by the especially equipped research aircraft Do-128 D-IBUF in 2016 and 2017 confirm wake lengths up to 70 km under stable atmospheric conditions, with maximum wind speed deficits of 40% in the initial part of the wake, and enhanced turbulence, which strengthens predictions by numerical simulations and indirect observations of the wind field by satellite images.

These measurements were the first step in a large research project to describe and understand the physics of large offshore wakes using direct measurements, together with the assessment of satellite imagery and models.