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Evaluation of Offshore Wind Farm Wakes

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Offshore wind farms contribute a considerable part of today's production of renewable electric energy.
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.
This arrangement affects one another through increased wake losses. 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 in the German Bight.

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. We will give an brief overview of the WIPAFF project which ended in April 2019. Further we will show that the measured airborne data suggest that the recovery of the wake can be described by a simple analytical model with an exponential function. Factors which influence the wake recovery rate such as thermal stratification and wind farm architecture are presented and discussed.