PO.128

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Reliable Offshore Wind Measurements Using Dual Scanning Lidars and AI-Based Wind Field Reconstruction.

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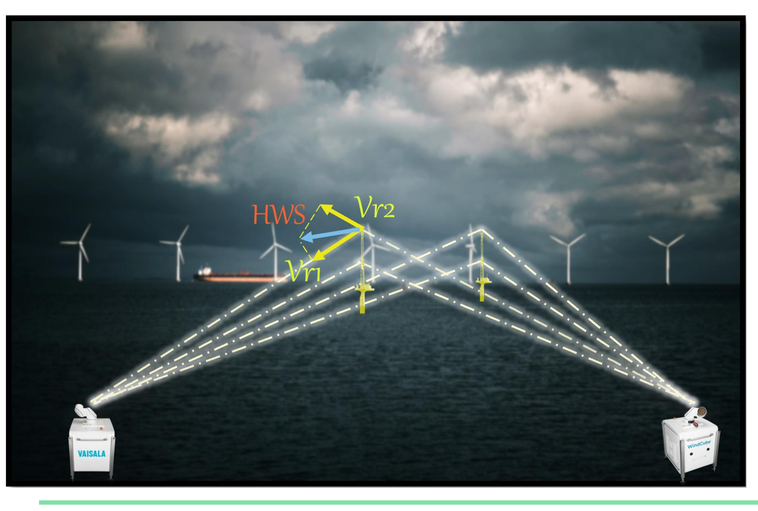
1. Vaisala France 2. Fraunhofer IWES 3. Oldbaum Services Limited

Neural networks can increase the measurement range of wind lidars while preserving the wind speed metrology.

Dual Scanning Lidar (DSL) is being increasingly used for Wind Resource Assessment (WRA) and turbine design. Combining the measurements of two scanning wind lidars, this solution allows the accurate measurement of wind speed, wind direction and turbulent intensity up to several kilometers from the devices. Dozens of DSL deployments have already occurred worldwide, especially in Japan for offshore WRA.

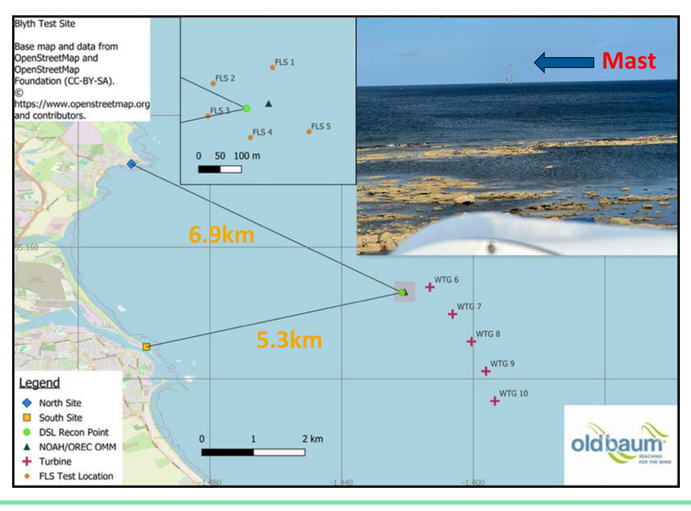
DSL makes it possible to capture both **spatial and temporal variations** across a large area.

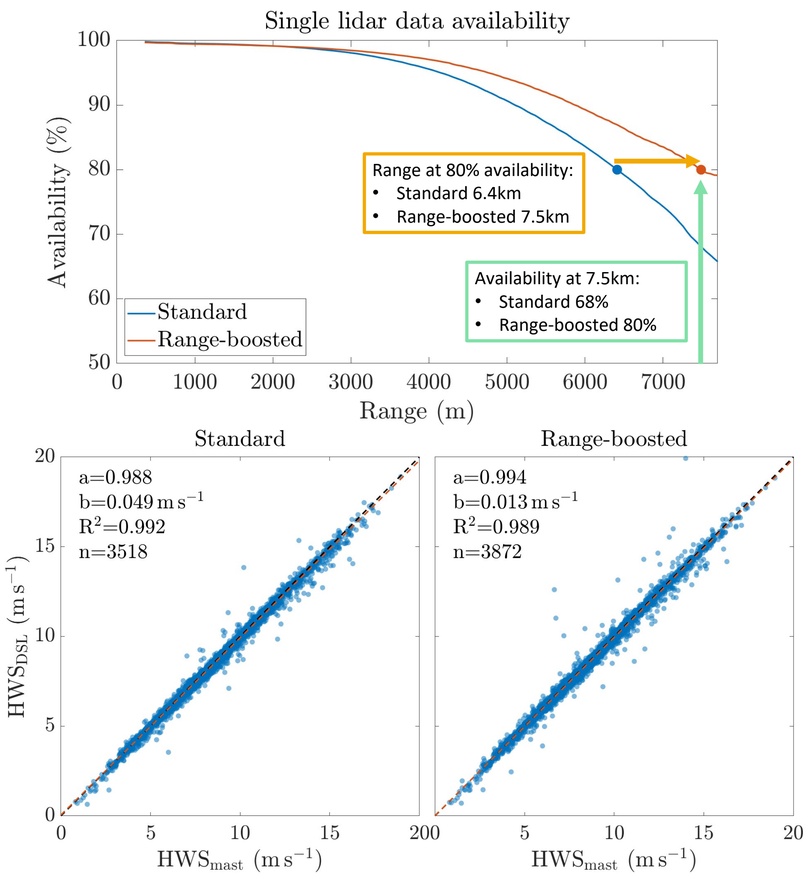
Meteorological conditions and measurement range can reduce the data availability. We explore a neural-network **range boosting** algorithm allowing **for increased range and availability**, while preserving the metrology.



We used measurement data from a campaign at Oldbaum **Center for the Testing of Environmental Science Technology** (C-TEST) site in Blyth, UK, organized by Fraunhofer IWES withing the ICON-NEMO R&D project. Two scanning wind lidars WindCube Scan are setup on the shore. They perform DSL measurement on the cup anemometer of the 100m-tall NOAH OREC meteorological mast offshore. The considered dataset covers a period of 55 days. The two lidars are located at **6.9km** and **5.3km** from the mast, respectively.

The wind speed is reconstructed using standard DSL practices. 10-min blocks with a data availability of less than 10% are discarded, no other filters are applied. Vaisala range boosting method is then used, and we compare the gain in **data availability** and the **metrology** of the enhanced data with the mast anemometer. The results are **independently assessed** in a **blind-test** by Oldbaum and Fraunhofer IWES.





We obtain a significant improvement in data availability, with one lidar going from **6.4km to 7.5km at 80% availability**. The DSL reconstruction has **10% extra** valid points. The metrology of the reconstructed wind speed stays **consistent** with the standard method. The slope and intercept of the linear regression show a slight improvement, while the R^2 decreases slightly.

The R&D project „NEMO - New methods for turbulence measurements and models in offshore wind“ (https://www.iwes.fraunhofer.de/en/research-projects/current-projects/nemo.html) is funded by the ICON programme of the Fraunhofer-Gesellschaft und led by Fraunhofer IWES. Access to NOAH (National Offshore Anemometry Hub) met mast data was provided by ORE Catapult through Oldabum Services.

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