New Article Published: Advancements in Experimental Characterization of Complex Atmospheric Flows

A pioneering new study published in *Science Advances* unveils a groundbreaking method for experimentally analysing the interaction between the atmosphere and surface obstacles, which is crucial for meteorology, forestry, urban climate, wind engineering, and wind energy. The research paper titled "**Experimental Characterization of Complex Atmospheric Flows: A Wind Turbine Wake Case Study**" is written by Nikolas Angelou, Mikael Sjöholm and Torben Krogh Mikkelsen at the Technical University of Denmark (DTU). They demonstrate a method, based on three simultaneously scanning, laser-based wind measurement devices (lidars), to study the detailed dynamics of the turbulent wake flow produced by a utility-scale wind turbine in real atmospheric conditions.

The method, which captures the three-dimensional flow dynamics of the wind, is based on the DTU WindScanner infrastructure. In the case study presented in the research paper it is demonstrated that the WindScanner infrastructure is a useful tool for enhancing the understanding of intricate interactions between wind turbines and the surrounding atmosphere, which lead to wake generation.

Wakes are characterised by a reduced wind speed and an increased turbulence, and these features can negatively impact the performance of adjacent turbines, reducing the overall energy output and longevity of wind farms. Field observations of wake characteristics by the method presented can provide validation data for engineering models used for the study of wind turbine performance and wake management. Thus, facilitating the optimization of wind energy production of wind farms which is crucial for achieving global renewable energy goals.

Key Findings:

- The use of three synchronous scanning wind lidars can "see" the three-dimensional wind field under natural atmospheric conditions.
- The study presents detailed data on wind turbine wake flows, capturing both the wind deficit, the rotation, and the mixing of ambient air into the turbulent wake.

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Figure 1 – *The continuous-wave laser-based short-range WindScanners developed at DTU Wind.*

For more information, visit the article:
https://www.science.org/doi/10.1126/sciadv.adw8524 / https://zenodo.org/records/17805298

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