# Calibration and Validation of Dynamic Wake Meandering model using lidar-based measurements

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## 1 Introduction

Wind turbines are typically installed in multiple rows inside wind farms. In these configurations, the upstream turbines create a wake flow characterized with reduced wind speed and increased turbulence, which reduces the energy production and induces more severe fatigue loads of downstream turbines.

Wake effects are recognized as one of the largest source of uncertainty in wind farm loads and power production predictions [1]. The accuracy of wake-induced effect predictions is relevant for several purposes such as estimation of turbine lifetime, structural reliability analysis and for optimizing the turbine operation.

The Dynamic Wake Meandering (DWM) model [2] is an engineering-like model, which is widely used and recommended by the IEC standard. The DWM predicts the wind speed deficit together with a meandering process to simulate the flow field in wakes [3]. Previous studies validated the performance of the DWM with high-fidelity CFD simulations and field data. However, they have not adequately characterized the statistical errors and uncertainties introduced by the model. Furthermore, novel approaches to retrieve wake parameters using nacelle-based lidars [4], enable opportunities to calibrate the DWM using full-scale wakes measurements obtained directly from wind turbines.

In the present work, we use full-scale lidar measurements obtained through the DTU SpinnerLidar (SP-lidar) at the SWiFT facility, Sandia National Laboratories [5]. The SP-lidar is a continuous-wave wind lidar that scans in a rosette pattern at multiple distances downstream the wake of an operating wind turbine. Based on lidar measurements, we derive profiles of the quasi-steady wake deficit, turbulence intensity as well as wake meandering dynamics. We compare measured wake characteristics with predictions from the DWM and quantify model uncertainties. Lidar-measurements of the wake serve also for the calibration of the DWM model. The objective of this study is to evaluate and potentially calibrate the DWM using wake measurements from nacelle-mounted lidars. A future study will focus on power and load validation procedure using calibrated DWM model against wind farm measurements.

## Bibliography

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