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Full-scale wind lidar measurements of the shelter behind a fence

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The shelter behind obstacles is one of the most complex flows to measure and to model and so it seems natural to study them for applications such as wind energy. However, during the period of exponential growth of the wind industry in the late 90s and during the 00s, the shelter behind obstacles did not significantly represent an issue for the estimation of turbines' energy yields because the machines were sited in free-shelter areas and the rotors were placed at heights way beyond the influence of obstacles. In the recent years, wind energy has moved offshore and due to the less available best wind energy sites on land, many of the installations are close to obstacles. Also there has been a growth of the small wind energy industry and in countries like Denmark, due to planning regulations, small wind turbines need to be placed very close to houses, which represent an increase of the sheltering effects.

Here we present a unique dataset of full-scale measurements of the shelter behind a 3-m tall and 30-m wide solid fence, which were performed at DTU Risø campus in Roskilde, Denmark. The measurements were carried out by the short-range WindScanner system (http://www.windscanner.dk), where three synchronized wind lidars measured the 3D wind velocity vector on a vertical plane grid extending 2.7 m from the fence up to $\sim$30 m and from the ground up to $\sim$7.5 m. The measurements represent a wide variety of wind speed, turbulence and atmospheric conditions, and different cases are analyzed as function of the relative direction of the fence with the wind. The cases here presented represent a unique opportunity to evaluate engineering-like shelter models, which are generally thought to be rather conservative, and CFD-like models; both have mostly been otherwise evaluated using measurements from wind tunnels.