LiDAR for accurate wind resource assessment

**Background**

LiDAR is an acronym for light detection and ranging. LiDARs are used in the atmospheric analysis since 30 years and its recent application in wind energy is appreciated well by the industry and researchers. The principle of Doppler wind LiDAR is as shown in fig.1 [2]. The aim of the Lawine project is to test, develop and evaluate the LiDAR technology for power performance, load reduction, wind turbine control and operation. The study here presents the preliminary results of the comparison of the different sensors at the test site considered.

The wind speed comparisons between the cup anemometer and LiDAR are used to study the effects of tower shadow, wake effects, boom and mounting effects [4]. In fig. 5, the 5-40°, 200-300° and around 180° are under wake effects from neighbouring wind turbines. The reciprocating ups and downs could be due to turbulence eddies. Such values have to be filtered from the data analysis for further accurate analysis of the inflow conditions on the wind turbines [5].

**Objectives**

The Lidar Applications for Wind farm Efficiency (LAWINE) project initiated by Energieonderzoek Centrum Nederland, Energy research centre of the Netherlands (ECN) in cooperation with XDRC Darwind, Avent Lidar Technology and Technische Universiteit, University of Technology (TU) Delft under the framework of Top consortium Kennis en Innovatie Wind op Zee/Top consortium for Knowledge and Innovation Offshore Wind (TKI-WoZ) lays emphasis on the following objectives as shown in fig. 2 [1]. The study at TU Delft will mainly concentrate on the data analysis and wind flow modelling for optimising the wind farm control.

**Results**

The comparisons of windrose provides information on wake sectors, tower shadow, boom mounting effects and hence are important in the pre-study of any measurement campaign to modify necessary elements which might result in saving time and money [4]. In the fig. 4, the difference in wind direction detected by the WindCube LiDar and the wind vane is visible and the deviations from the tower, boom effects and the wake sectors from the wind turbines are the main causes. The WindCube LiDar however determines the wind direction with a high uncertainty in cases of wake regime.

**Conclusions and Further Work**

The results help to understand the complexities of a good wind resource assessment and allows us to filter out known complex phenomena resulting into inaccurate measurements. The wake of the nearby turbines or tower affect different sensors differently eventually affecting the uncertainty calculation of the site for annual energy prediction. A filter scheme based on the above results is being developed and would be further used for flow modelling of the LiDar measurements towards the wind turbine. The flow model developed would be used in the development of the transfer model for wind turbine control [6].

**References**