EMS Annual Meeting Abstracts
Vol. 15, EMS2018-81, 2018

Optimizing scanning lidars for turbulence measurements

Alfredo Peña and Andreas Bechmann
Wind Energy Department, Technical University of Denmark, Roskilde, Denmark (aldi@dtu.dk)

The measurement of the three velocity components of the atmospheric flow can be performed using a scanning lidar by measuring at least at three spatial positions. However, we need to assume that at the different measurement positions, the flow has the same characteristics, which is not the case in many complex sites with high wind potential. One solution to avoid any assumptions is to use three scanning lidars measuring at the same positions.

WindScanners are scanning lidars that can be synchronized in time and space. The idea of our study is to optimize a WindScanner scanning strategy for turbulence measurements. The measurement of turbulence by a lidar is slightly complex as they do not measure exactly along or perpendicular to the wind vector but at some other direction, the line-of-sight direction. This means that the lidar turbulence measurements are 'contaminated′ by the velocity variances and covariances. Further, lidars do not measure at a point but have a non-significant probe volume that decreases or 'filters′ the variances in the line-of-sight direction.

For the measurement of turbulence, we therefore need, in principle, at least six WindScanners and we need to know the amount of filtering. Here we show a simple method to optimize scanning strategies using WindScanners for turbulence measurements with the objective of wind turbine siting. We also show a bootstrapping-based method to estimate the relative error of turbulence measurements for the optimized scanning strategy. We demonstrate that using non-optimized scanning strategies can lead to very high relative errors of turbulence measurements.