A six-beam method to measure turbulence statistics using ground-based wind lidars

A so-called six-beam method is proposed to measure atmospheric turbulence using a ground-based wind lidar. This method requires measurement of the radial velocity variances at five equally spaced azimuth angles on the base of a scanning cone and one measurement at the centre of the scanning circle, i.e. using a vertical beam at the same height. The scanning configuration is optimized to minimize the sum of the random errors in the measurement of the second-order moments of the components (u;v;w) of the wind field. We present this method as an alternative to the so-called velocity azimuth display (VAD) method that is routinely used in commercial wind lidars, and which usually results in significant averaging effects of measured turbulence. In the VAD method, the high frequency radial velocity measurements are used instead of their variances. The measurements are performed using a pulsed lidar (WindScanner), and the derived turbulence statistics (using both methods) such as the u and v variances are compared with those obtained from a reference cup anemometer and a wind vane at 89 m height under different atmospheric stabilities. The measurements show that in comparison to the reference cup anemometer, depending on the atmospheric stability and the wind field component, the six-beam method measures between 85 and 101% of the reference turbulence, whereas the VAD method measures between 66 and 87% of the reference turbulence.

General information
Publication status: Published
Organisations: Department of Wind Energy, Test and Measurements, Meteorology
Contributors: Sathe, A., Mann, J., Vasiljevic, N., Lea, G.
Pages: 729-740
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Atmospheric Measurement Techniques
Volume: 8
ISSN (Print): 1867-1381
Ratings:
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.37 SJR 2.058 SNIP 1.427
Web of Science (2015): Impact factor 2.989
Web of Science (2015): Indexed yes
Original language: English
Electronic versions:
A_six_beam_method.pdf
DOIs:
10.5194/amt-8-729-2015

Bibliographical note
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This work is carried out as a part of a research project funded by the Danish Ministry of Science, Innovation and Higher Education – Technology and Production, grant no. 0602-02486B. The resources provided by the Center for Computational Wind Turbine Aerodynamics and Atmospheric Turbulence funded by the Danish Council for Strategic Research grant no. 09-067216 are also acknowledged.

Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research › peer-review