Atmos. Meas. Tech. Discuss., 6, C483–C486, 2013
www.atmos-meas-tech-discuss.net/6/C483/2013/

Atmospheric Measurement Techniques Discussions

AMTD

6, C483–C486, 2013

Interactive Comment

Interactive comment on "Retrieving wind statistics from average spectrum of continuous-wave lidar" *by* E. Branlard et al.

Anonymous Referee #3

Received and published: 4 April 2013

In this manuscript, the authors present a way to estimate the second order statistics of turbulence using the probability density function of line-of-sight wind speeds obtained through the Doppler spectra. The technique described avoids the spatial averaging typically encountered when using a Doppler lidar, which often underestimates the second order statistics. A theoretical presentation of some sources of spectral broadening in the Doppler spectra is included, which is very informative and useful, given the interest in conically scanning lidar. In addition, the manuscript describes different techniques for estimating wind speeds from Doppler spectra, which serves as an excellent reference for the wind lidar community. The authors describe the benefit of using the estimated pdf of wind speeds to determine second order turbulence statistics, but I think the method is also well suited in determining even higher order statistics, for example to test whether turbulence is approximately Gaussian. Finally, the authors might

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

want to discuss how the line-of-sight pdfs can be used to estimate the vertical and horizontal wind speed pdfs in a conically scanning scenario. The manuscript is very informative and relevant. I recommend that the manuscript be accepted after some minor revisions.

Specific Comments:

In equation 1, the lower limit of the integral should be the distance where the lidar is located, not -\Inf. Perhaps this could be stated in the text.

Equation 12, first line: The integral expression does not depend on the frequency "f". Is there part of the expression missing?

pg. 1950, ln. 18: The time scales for a particle moving through the beam corresponding to w_0 = 57 um and using the wind speeds analyzed in Fig. 11 are of the same order as the window time T. For v_part = 10 m/s, the time scale is actually greater than the window time T. Therefore, it is not valid to treat the spectral shape as Gaussian, which requires T » tau. Could the authors justify why a Gaussian spectral shape is still used even at low wind speeds?

pg. 1951, ln. 4: If there is a reference available indicating how many particles typically travel through the focus point of a lidar during a sample interval, it would be interesting to include here.

pg. 1951, section 3.1: It is stated that the median of the spectrum is used to determine the velocity in the study. In section 2.1, it is stated that the velocity determined by the lidar is formed by the weighted average of velocities along the los (equation 1). I believe that equation 1 describes the radial velocity determined by the lidar when the mean of the spectrum is used. This equation is not exactly correct when the median method is used. There should be some justification, or perhaps a reference, indicating why the velocity determined using the median method can be approximated by equation 1.

pg. 1952, ln. 15: If available, a reference explaining why a threshold of the mean

AMTD

6, C483–C486, 2013

Interactive Comment

background plus three standard deviations is used would be useful here.

pg. 1953, ln. 15: Why does a correlation method need to be used to determine the direction of the lidar's los? Wouldn't the direction be known since the turbine's yaw angle is fixed?

pg. 1954, ln. 21: Why were wind speeds of 45 m/s and 55 m/s chosen instead of lower wind speeds closer to the ones observed in the field experiment?

pg. 1957, ln. 2: It would be interesting to state the Rˆ2 value for the average spectra method, if the value is known.

pg. 1957, ln. 27: The authors discuss the lower correlation of 98.4% for the lidar wind speed time series. It would be informative to provide the pdf of the lidar wind speed time series in Fig. 3 for comparison.

Section 6.2: The correlation between pdfs is used for comparison here. Why is the correlation between pdfs chosen as the method of comparison, instead of other techniques available for comparing probability distributions? Other methods for comparing the similarity between pdfs include the Kolmogorov-Smirnov distance and quantile-quantile plots. These methods might reveal more of a difference between the average spectrum method and the lidar time series pdf. The lidar wind speed time series correlation coefficient of 98.4% is still very high compared to 99.5% for the average spectra method. These results do not seem to illustrate the point that the average spectra pdfs are much closer to the true pdfs than the lidar time series pdfs (only slightly closer).

Section 6.3: The results in Fig. 5 support the hypothesis that the lidar time series method underestimates the standard deviation of the turbulence. As is stated in the text, the average spectra method provides standard deviation estimates which are much closer to the true standard deviations. However, there is still an underestimation bias. Can the authors explain possible causes of the underestimation with the average spectra method?

AMTD

6, C483–C486, 2013

Interactive Comment

Section 6.4: Are there any possible explanations for why there is a shift in the mean value of the hotwire pdf compared to the lidar pdfs for figures 7 and 9 (runs 2 and 7), but not for figures 6 and 8 (runs 1 and 3)?

Technical Corrections:

pg. 1948, ln. 15: consider changing "does" to "do".

pg. 1957, ln. 15: Should instationary be non-stationary?

pg. 1960, ln. 6: consider changing "pre-set speed wind speed" to "pre-set wind speed"

Table 1: The labels should be consistent with the labels in figures 6-9. For example, in table 1, Lidar avg. and Lidar hist. are used, but in the figures, lidar mean spectrum and lidar pdf are used.

Fig. 11: The results in this figure are very impressive. However, the labels are confusing. Consider changing "theory" to something like "theoretical: moving particle" and "convolution" to "theoretical: moving particle and finite sample time" or other choices which are more clear.

pg. 1962, ln. 3: consider changing "but the waist radius of approximately 2 mm" to "but the waist radius will be approximately 2 mm"

In some of the figures, spectrum is misspelled as spetrum. In the text, the term lidar average "spectra" is used. It would be good to be consistent between the text and figures.

This may be my personal preference, but often phrases such as "really good" or "really well" are used to describe correlations or agreements between pdfs, etc. I would prefer more technical descriptions such as "high degree of correlation." It is up to the authors.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 1943, 2013.

AMTD

6, C483–C486, 2013

Interactive Comment