Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-140-RC1, 2017

Atmospheric Measurement Techniques Discussions

Interactive comment on "Measurements of wind turbulence parameters by a conically scanning coherent Doppler lidar in the atmospheric boundary layer" *by* Igor N. Smalikho and Viktor A. Banakh

Anonymous Referee #1

Received and published: 14 July 2017

In this manuscript, the authors describe how various turbulent parameters can be measured with a continuously conically scanning Doppler lidar. The techniques for measurement of the parameters are described in detail, and sample results of the measurements are shown. Doppler lidar measurements of the dissipation rate are compared with a sonic anemometer at 43 m, and are shown to generally agree well, except with some low biases under stable conditions when the lidar is unable to resolve the any portion of the inertial subrange. The turbulence kinetic energy from the Doppler lidar is shown to generally agree with measurements from a sonic anemometer at a lower

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Discussion paper

height. In all, the scientific quality of the manuscript appears to be solidly based in theory and good. The work builds on previous work, with new refinements made to the strategy. However, there are a few areas of the manuscript that could be clarified, as sections of the text are difficult to follow. As such, I recommend this manuscript be suitable for publication in AMT after minor revisions, in which the following comments, which are mostly of clarification, are addressed.

Specific Comments:

a) P. 1, line 19; p. 2, line 5 (and elsewhere): Change 'raw lidar data' to 'radial velocities'. By 'raw data', I interpret that to be the measured Doppler spectrum, which are not used directly in the referenced techniques to measure turbulence.

b) p. 2, line 9: By 'averaging over the sensing volume', clarify that you mean the spatial-temporal averaging of the pulse length over one beam accumulation and not the averaging over the entire conical area.

c) p. 2 line 12: What are dr and σr?

d) p. 2 line 20: Quantify 'high spatial resolution'.

e) p. 2 line 23: What disadvantages of the earlier methods, precisely? The averaging over the sensing volume?

f) p. 2 line 24: Change 'spatiotemporal' to 'time and height'. The term 'spatiotemporal' is too general, and generally means that information on the horizontal variability is measured/known.

g) p. 6 lines 22-24: This section is difficult to follow. Providing more text to describe the different terms and how they are related would be helpful.

h) p. 7-8: For this section in particular, it would be helpful to add a figure providing a few examples of the 2-dimensional spectrum and showing how the different parameters are calculated from it (particularly interested in σe, σt), including adding a paragraph

discussing the figures. This would be similar to showing how different parameters are calculated in Fig. 5.

i) p. 10 line 10: How much of the data was unusable exactly? The percentage of unusable data would be helpful.

j) p. 10 line 13: What was the averaging time that the results shown in Fig. 3 were computed over? Based on p. 9 lines 19/24, it seems that 4 PPIs were used (over 5 minutes) while the sonic anemometer used 20 min of data. How were these differences in averaging times rectified?

k) p. 12 line 5: Is it possible to discern that the increase in kinetic energy computed over more scans (over longer time periods) is truly a better measure, and not simply due to non-stationarity of the mean wind (as discussed for the stable case at line 15) increasing the variances across the entire conical scan? Based on Fig. 6, the mean wind changes (wind speed slowly decreases, direction shifts) over the 6 hour time window mentioned, thus this may be causing the increase in measured TKE.

l) p. 12 line 15: Other possible reasons include the inability of the lidar to resolve any portion of the inertial subrange (thus all derived parameters are not valid) and the low bias of dissipation (denominator for calculation of integral scale) when it is small.

m) p. 12 line 20-22: The meaning and significance of 'The value of ... over azimuth angles' is unclear; it should be rewritten.

n) p. 13 line 2: What is meant by 'close to each other'? A quantitative measure (standard deviation or range of values) is needed.

o) p. 15 line 125: Add the qualifier here that these high estimates were under stably stratified conditions.

p) End of manuscript: With the large number of variables and subscripts in this manuscript, adding a list of the symbols would be extremely helpful in reading this manuscript. I had to keep searching through the paper to find variables that were first

introduced many pages earlier in the paper.

Technical corrections:

a) p. 6 line 10 (and reference list): ‘Pearson’ not ‘Pierson’

b) p. 6 line 20: Should σe2 have an overbar as well?

c) P. 11 line 15: ‘continuously’ is a better word than ‘permanently’

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