Atmospheric
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Techniques

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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 #2

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Title: Measurements of wind turbulence parameters by a conically scanning coherent Doppler lidar in the atmospheric boundary layer

Authors: Igor N. Smalikho, Viktor A. Banakh

General comments ——————-

This manuscript presents a methodology for deriving turbulent parameters from scanning Doppler lidar observations in the lower atmosphere. The methodology is sound

and the results show that the parameters derived from Doppler lidar measurements usually agree well with reference parameters obtained from a sonic anemometer.

The methodology uses a particular turbulence model which dictates how certain properties of the observed turbulence are expected to behave and so enable them to be derived. A clear statement describing atmospheric situations when this model is applicable, and situations when it is not likely to be applicable, should be included in the conclusion. Are there methods for checking whether the turbulence model is applicable in a particular situation? For example, can you use the Doppler lidar observations to check for stationarity? In addition, what are the likely biases if the model is not strictly applicable, but provides reasonable results? An example here is the slight underestimates in turbulent energy dissipation rate provided by the Doppler lidar at low values. Is this expected because of unrealistic integral scales used, or is it an issue in accounting for radial velocity measurement uncertainty correctly?

The manuscript contains all of the information necessary for publication, but in its current state is difficult to read. There are a huge number of variables and subscripts introduced, which although necessary for completeness, make it difficult to follow. It would be easier to comprehend if large parts of the derivation were placed in an appendix, with terms directly related to the parameters that will be derived from observations included in the text. In addition, the instrument should be introduced first in Section 3, so that it is easy to refer to the instrument specifications when introducing the measurement strategy. Add a table presenting the relevant instrument specifications, e.g. pulse-repetition-frequency, receiver bandwidth/Nyquist velocity, range gate length, azimuthal scanning speed, lidar wavelength, telescope type, rather than referring the reader to another paper. As an aid to the reader, this table could also include the associated variable in the equations.

After some minor modifications, I feel this manuscript will be suitable for publication.

Specific comments ——————

Page 1, line 19: The data provided by these instruments is not really 'raw' data, but radial velocities.

Page 2, line 13: Suggest replacing 'were proposed' by 'have been proposed'.

Page 2, line 24: Need to state that this is '100 to 500 m in altitude', as it could be assumed that the distances refer to range.

Page 2, line 27: Suggest starting the paragraph with 'First, we describe the equations that will be used to develop the measurement strategy and method for deriving the wind turbulence parameters:'

Page 2, line 28: The measured 'raw' radial velocities are not strictly instantaneous, as they are obtained by averaging a large number of samples internally.

Page 4, line 4: Suggest replacing 'some or other' with 'an appropriate'.

Page 4, lines 8-9: It would be clearer for the reader if these expressions were placed on separate lines.

Page 3, line 15; page4, lines 20-24; and Figure 1: It should be made clear, especially in the Figure caption, that the azimuth angle refers to the azimuthal resolution (if continuous scan) or separation between 2 adjacent rays in a scan (step-stare scan).

Page 5, line 1: Suggest replacing 'the both' with 'both'.

Page 5, line 5: What is the rationale behind choosing delta theta = 3 degrees? And what does L correspond to?

Page 5, Measurement strategy: Do you mean that you perform one conical scan with +ve azimuth rotation, then one scan with -ave azimuth rotation?

Page 5, line 24: As defined previously, R_0 should be (delta R / 2) if the first range gate is k=0, unless you define k=0 as the first usable range gate. Then 'minimal distance' should be defined precisely, e.g. define 'R_0 is the distance to the first usable range

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gate' before the equation on line 23, and explain why the first gate should satisfy the condition stated on line 25.

Page 5, line 26: The maximum range is effectively determined by the instrument pulse repetition frequency; the maximum usable range depends on the signal-to-noise ratio (SNR) and hence the atmosphere. Suggest rewriting this sentence, stating instead that the 'uncertainty in the radial velocity measurement depends on the SNR'.

Page 6, line 9: Use correct reference (Pearson)

Page 6, line 11: Do you mean azimuthal dimension rather than longitudinal dimension here?

Page 6, line 14: How do you know if Lv only occasionally exceeds the sensing volume?

Page 6, lines 15-17: Other authors have shown that it is usually safer to always take account of the uncertainty in the radial velocity estimates.

Page 6, lines 18-24: This sequence of equations requires much more explanation than is given here.

?? Page 8, lines 12-15: Not sure that this can be justified without evidence..

Page 9, line 16, and page 11, line 15: The focus of the lidar beam was set to XX m.

Page 11, line 9: Suggest 'To test the method for determining the kinetic energy,..'

Page 11, line 12-15: Suggest 'The presence of forest fires in the Tomsk region provided lidar measurements with high signal-to-noise ratios ...'

Page 11, line 15: Suggest replacing 'permanently' with 'continuously'.

Page 11, line 20: The 'minimum useful range'.

Page 12, line 3: I assume you mean 'horizontal wind speed'.

Page 14, line 21: This assumes that the turbulent parameters don't change over the

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time required to obtain 30 scans.

Figure 3: Suggest replacing 'Time profiles of the turbulence' with 'Time series of the turbulent'.

Figure 4: Suggest replacing 'Time profiles' with 'Time series'.

Figure 6: Panel (a) should state 'Wind speed' rather than 'Wind velocity' for the colorbar title.

Figure 7: Suggest replacing 'Temporal profiles' with 'Time series',

Figure 7,8 Suggest replacing 'instrumental error of estimation of the radial velocity' with 'uncertainty in radial velocity estimate'.

Figure 9: Suggest replacing 'Spatiotemporal distributions' with 'Time-height plots', and 'relative error of estimation of the dissipation rate' with 'relative error in dissipation rate'.