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Interactive comment on "Errors in radial velocity variance from Doppler wind lidar" *by* Hui Wang et al.

Anonymous Referee #2

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Summary

This manuscript discusses methods for quantifying random and systematic errors of variance from Doppler lidars. Factors such as sampling volume size, dwell time, and sampling period are taken into account and the effects of these factors on the auto-correlation and covariance of the radial wind speed are demonstrated using models. The random and systematic errors of variance between sonic anemometers and lidar measurements are compared using data from a field campaign.

Overall, the paper is well-written, although information in the paper should be expanded to make it more applicable to a general audience. A section on error quantification (e.g., difference between random and systematic errors, definition of expected values, etc.) should be added toward the beginning of the paper to assist readers who are

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unfamiliar with error quantification. In addition, the motivation and wider application of the error quantification presented in the paper should be discussed in greater detail. It is currently somewhat unclear how this error quantification method would be applied in the real world to select appropriate lidar scanning strategies and dwell times. A section after the discussion would be useful for describing general applications or perhaps a use case for the error quantification method.

Specific comments on different sections are listed below. Because of the work needed to improve the wider applicability of the paper, I recommend that the paper be accepted with major revisions.

Specific comments

p. 1 (Section 1: Motivation and approach) – Existing methods for quantifying lidar turbulence error should be discussed (e.g., Lenschow et al. 2000, Mann et al. 2010, Sathe et al. 2011)

p. 1, Line 15: Not all techniques for deriving second-order moments directly involve radial velocity variance. The u, v, and w components derived from the radial velocities can also be used to estimate variance. However, understanding error characteristics from the radial velocity is important, since all derived parameters will be dependent on the accuracy of the radial velocity estimates. Please rewrite this sentence for clarification.

p. 1, Line 21: Change “that” to “the technique” or “the theory”

Section 2 (Preliminaries): The discussion of the difference between vr and vR and the definition of the covariances in the x1 direction is a bit confusing. I would recommend including a schematic to show the coordinate system being used.

p. 4, Line 2: Define the difference between systematic and random errors

p. 4, Line 6: Define and give a reference for the VAD technique

p. 4, Lines 6-7: A VAD technique can also be applied to a lidar that samples at 4 or 5 locations – 6 locations is not the minimum

p. 6, Line 15: State which hours in the time series in Fig. 4 were affected by the turbine wake

pp. 7-8 (Sect. 4.3: Observed errors): The discussion of Figs. 6-8 here is a little thin. It would be useful to compare differences in error for the different measurement heights.

Technical corrections

p. 1, Line 10: Delete parentheses around 2013 in reference

p. 3, Line 4: Change “respectivley" to “respectively”

p. 3, Line 17: Change “lenght" to “length”

p. 4, Line 6: Delete parentheses around 2015 in reference

p. 6, Line 5: Change “repletion” to “repetition”

p. 6, Line 6: Change “wiht” to “with”

p. 8, Line 10: Change “th” to “the”

p. 9, Line 32: Change “icreases” to “increases”

p. 16, Figure 2 caption: Change “Rr and Rr” to “Rr and RR” and “r and r” to “r and R”

References

Lenschow, D. H.,Wulfmeyer, V., and Senff, C.: Measuring second-through fourth-order moments in noisy data, J. Atmos. Oceanic Technol., 17, 1330–1347, 2000.

Mann, J., Peña, A., Bingöl, F., Wagner, R., and Courtney, M. S.: Lidar scanning of momentum flux in and above the atmospheric surface layer, J. Atmos. Oceanic Technol., 27, 959–976, 2010.

Sathe, A., Mann, J., Gottschall, J., and Courtney, M. S.: Can wind lidars measure turbulence?, J. Atmos. Oceanic Technol., 28, 853–868, 2011.

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