Atmospheric
Measurement
Techniques

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Discussions

Interactive comment on "Evaluation of Turbulence Measurement Techniques from a Single Doppler Lidar" *by* Timothy A. Bonin et al.

Anonymous Referee #2

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The authors compare different methods for calculation of turbulence parameters from measurements with a single Doppler lidar. The topic is up-to-date and is very important for the further development of different scientific disciplines and the further technical development, e.g., of wind power plants. The authors have put considerable work into the paper and AMT is the right journal to publish this study. I recommend publication if the following major issues are addressed:

Major issues:

1.) At many points in the document, quite subjective descriptions of a correlation or a match are given. Please look into this issue. You could, e.g., quantify what you mean with "good", "bad", "show skill" or "accurate" once within the document and connect it with proper numbers. It will really upvalue the paper, if you make it more quantitative.

It will help to transport the message.

2.) p12 l10: -> This discussion must be mentioned earlier in the document. Is there really no way to estimate the uncertainties of these methods? I would doubt that. Understandably, analytic error calculation is extremely difficult for this kind of evaluations. However, numerical methods exist that can yield an error estimation for certain kinds of noise. You could, e.g, use Monte Carlo simulations, imposing small variations on the input data and then analyze in what range the results change. With such an approach it would be possible to discriminate between measurement errors and methodical uncertainties (e.g., incomplete overlap between the tower measurements and the lidar observations). That would greatly help the interpretation especially of Figs. 4/5 and 8/9.

This topic is also connected with P.13 Line 8: "Approximately half of these outliers are negative TKE values, which were removed as discussed earlier..." -> Are those really outliers or just noisy values that happen to be close to zero. An uncertainty estimation or a more thorrough description of the 6-beam technique would help here.

3.) p9 l18: "These erroneous echoes were removed using a discontinuity-based algorithm described by Bonin and Brewer (2016)" -> Maybe it is not so easy. Such a correction is never perfect and some artifacts always remain. The kind of signal folding you experience imposes spatially confined biases on the measured signal (spanning some range gates). Some techniques may be more susceptible to this influence than others, introducing an unknown bias into the intercomparison. E.g., the six beam technique will be affected differently by spatially confined shifts in a single beam than the RHI scans. Signal folding is also no necessity for Doppler lidar measurements. They can be avoided by reducing the pulse repetition rate, which should be mentioned. Several other questions arise and have to be discussed: (a) How is it possible to identify the folding effect unambiguously in the data? (b) What percentage of data is affected? (c) What is the remaining bias after correction?

Minor issues:

p2 l7: "good": -> As described above, please quantify...

p2 10 "the long time series of staring": -> Again, please quantify. It is actually a very good question what "long" means here. You correctly cite Lenschow et al. (1994) here, but leave the calculations to the reader. Please give a rough estimation of what "long" means in this context.

p1 l4: "trusted in situ instrumentation": -> I think I know what you mean, but please give a reference of what "trusted" means in this context. Do you mean something like "officially approved by a standardization institution"?

p1 l12: "None of the methods evaluated were able to consistently accurately measure the shear velocity" -> Please discuss what accuracy is necessary to measure shear velocity "accurately". Which maximum error is allowed for which purpose?

p6 l7: Since data were collected at 2 Hz, two samples were collected 0.5 s apart -> Please decide between mentioning "2Hz" or "0.5s".

p8 l4: SNR<-27 dB -> which definition of SNR is applied here?

p16 l1: "show skill" -> Please define "skill" together with the other descriptions.

Typos:

p1 l11: Typo: "to biased" -> "to be biased"

Table2: typo at "0.547nb"