Review on AMT-2020-516 by Zhou et al.

Summary

The authors compare wind measurements obtained by 12 lidars (in two batches) to wind cup and wind vane measurements on tall meteorological towers and an L-band radar used as reference. The data used is obtained at two locations (Shenzhen National Climate Observatory, Zhangjiakou Meteorological Bureau) for a duration of 15 days for each lidar. The L-band radar comparison uses a subset of the lidars and covers 16 days.

Comment

A comprehensive long-term evaluation of different wind lidars in comparison to meteorological tower measurements or other remote sensing instruments is desirable and interesting. Unfortunately, this study does not present such an evaluation for a variety of reasons listed below. The lack in quality appears too substantial to be addressed in a revision, but should be treated through a re-submission of an improved version of the study. Therefore, I have no choice but to recommend a rejection of the current submission.

Structure of the manuscript

The manuscript lacks clarity and crucial information, making it hard to comprehend the study. Both the wording and grammar are not adequate for a scientific study. As an example, I give specific comments for the abstract at the end. Due to the severe scientific shortcomings listed in the following, individual remarks for the full manuscript are not given.

Study design

- The presented data used for comparison and lidar evaluation is limited to a few days, which is too little for meaningful results and does not present state-of-the-art data analysis conducted in other studies. Generally, I would recommend to use at least 3 months of data (e.g. one season), or better a full year.
- The lidar wind measurement accuracy depends on atmospheric conditions, therefore a variety of situations have to be sampled to allow for a meaningful comparison. For an example using one system, see Päschke et al. (2015) [and references therein].
- No information on the used systems and retrieval strategies is given (see below).

Lidar data

- There is no information on the used lidars in the manuscript. The motivation behind the selection of lidars, e.g. what's new about these 12 lidars, why they were selected, what their system characteristics are, is not clear. Information on the system characteristics should include the system name, the used

wavelength, pulse power, pulse repetition frequency, pulse width, range, resolution and more.
- Further, to obtain the horizontal wind, scanning followed by a retrieval needs to be performed (see e.g. Wang, 2015, and Newsom, 2017). Therefore, the specification of the scanning setup as well as the retrieval strategy and the quality filtering applied on the measurements and during the retrieval needs to be given.
- No statistics on the available data from each of the lidar instruments is provided.

Without this information a comparison study cannot be conducted.

Comparison data

For the main comparison, the wind cup/vane measurements from a meteorological tower are used, which is valid if conducted for a reasonably large data set. However, the used data set is not comprehensive enough and a systematic comparison is not performed, further crucial information on the used data is missing.

- The shown comparison uses only data from very few instruments at few heights and times (besides the generally too short measurement period discussed above), without providing the reasons for doing so. A systematic analysis of the results (e.g. error by height, error in relation to turbulent conditions in the boundary layer) is not conducted.
- An introduction of the tower measurements used for comparison is not provided (e.g. available measurement heights, wind cup type used).
- Quality filtering of the tower data (e.g. due to blocking of the flow by the tower, overspeeding of the wind cup measurements) is discussed, but no details on how it is conducted are provided (statistics of filtering, filtering criteria).
- The display switches between 1 min and 10 min aggregated data, without providing the reasons for doing so.
- Instead of providing the above crucial information, too much space is used for introducing the metrics used for comparison. The applied metrics used for comparison are satisfactory, but the bias is missing (giving only the y-intercept is not sufficient). The metrics can be introduced in an appendix as they are common. Further, they should be referred to in a standard way (e.g. ‘system deviation’ is non-standard, thereby it is unclear what is meant).
- In a future version of the study, I would advise on using faster measurement devices such as ultra-sonic anemometers beside the wind cup measurements. Further, other tower information (e.g. potential temperature for stability analysis, turbulence properties) should be included to allow for an analysis of lidar measurement accuracy under varying atmospheric conditions.

Graphical presentation

- The content of the figures are not discussed or described in the text adequately.
- Further, x-axis labels contain acronyms which are not explained (I guess they refer to individual lidars). Despite the fact that 12 lidars are used for comparison, only a few instrument comparisons are shown in the figures (based on the

incomprehensible x-axis labels). If 12 lidars are compared, I would expect to see 12 panels showing the data for each.
- The figure style is not consistent. In some figures, data density is color-coded, while in others it is not, without giving a reason for doing so.
- Peculiar measurement data is displayed in the figures, which are not discussed in the text. Examples include Fig. 4, 5 and 6, where spurious data points or missing sectors are detectable but not discussed. This casts an overall very problematic light on the conducted analysis and I would recommend on checking the data quality and display in-depth once a larger dataset is available.

Overall, due to the lacking information and presentation, the comparison metrics given in the tables cannot be evaluated by the reader.

Specific comments on the abstract to highlight deficiencies present throughout the manuscript:

P1 L9 'and' - This implies wind measurements and boundary layer meteorology are two different things, which they are not
P1 L9 'vertical wind field measurement' – Unclear what is meant by this. Measurement of the vertical wind or vertical profiles of the horizontal wind?
P1 L10 ~~the~~ Doppler
P1 L10 'the major domestic' – what does domestic refer to here? Also: The manufacturers and system details of the individual lidar systems are not specified anywhere in the manuscript
P1 L11 'organized to compare' – do you mean co-located and run simultaneously?
P1 L12 ~~which~~ – those
P1 L12 'meteorological gradient tower' – to my knowledge a gradient tower is not a term used in scientific literature
P1 L13 'comparison with the wind cup' – measurements?
P1 L16 'except the inflection point' – syntax error
P1 L17 incomplete sentence & 'which joint the comparison' is unnecessary
P1 L18 'system difference' – what is meant by this?
P1 L19 'it was founded' – it is found – which comparison does this statement refer to, radar or wind cup?
P1 L22 'That mean the results were more stable and reliable.' – Unnecessary sentence/means
P1 L23 'technical indicators' – what is meant by this?
P1 L24 'windcube indicators' – what is meant by this?
P1 L25 'Coherent Doppler lidar indicator' – what is meant by this?
P1 L25 'near-term weather forecasts' – not sure what is meant by this
P1 L26 'the lidars' – what does this refer to?

Literature

Newsom, R. K., Brewer, W. A., Wilczak, J. M., Wolfe, D. E., Oncley, S. P., & Lundquist, J. K. (2017). Validating precision estimates in horizontal wind measurements from a Doppler lidar. *Atmospheric Measurement Techniques*, *10*(3), 1229-1240.

Päschke, E., Leinweber, R., & Lehmann, V. (2015). An assessment of the performance of a 1.5 µm Doppler lidar for operational vertical wind profiling based on a 1-year trial. *Atmospheric Measurement Techniques*, *8*(6), 2251-2266.

Wang, H., Barthelmie, R. J., Clifton, A., & Pryor, S. C. (2015). Wind measurements from arc scans with Doppler wind lidar. *Journal of Atmospheric and Oceanic Technology, 32*(11), 2024-2040.