

## ***Interactive comment on “Recommendations for processing atmospheric attenuated backscatter profiles from Vaisala CL31 Ceilometers” by Simone Kotthaus et al.***

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Received and published: 16 June 2016

Response to Anonymous Referee #3

We would like to thank the referee for their positive feedback and the valuable suggestions to improve the manuscript. Please see comments below.

Please note that an additional dataset is included in the revised version as these observations provide additional insights on sensor-specific characteristics (e.g. the instrument-related background signal). Further, the near-range correction (Sect. 3.4) is updated in the revised version to make it more generally applicable, i.e. the new version can also handle more complex conditions. Conclusions and recommendations

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are updated to reflect results presented in the revised version.

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This manuscript presents a set of corrections to be applied to CL31 ceilometer data. It is worthy to highlight how the corrections are presented according to different firmware versions and sensors. The excellent scientific significance is evidenced by its contribution to the climatological studies which have to rely on old databases and, as it was already commented by the Anonymous Referee 2, by its contribution to the industrial developments. Despite I recommend its publication, the authors should consider the following comments:

I agree with the previous Referees regarding the introduction and conclusion. Maybe the summary can be split into Summary with a 'list of corrections' and finally the Conclusions.

→ We have split the Summary into sections: 'Instrument-specific characteristics and issues', 'Proposed corrections', and 'Concluding recommendations'.

Following the previous comment, the Summary surprisingly provides more information about the ringing effect than its proper section. For example, the ringing period is not provided during the discussion but it is included in the summary: Page 17 Line 9- 11: 'ringing effect at short time scales of hours to weeks'. I suggest a careful revision. → The Summary section as been revised. Comments regarding the 'ringing' effect have been adapted.

The lack of references to other papers of other type of ceilometer have been evidenced by Anonymous Referee 2. The introduction may show other corrections as the overlap correction method proposed Hervo et al., 2016 (10.5194/amt-2016-30).

→ The Introduction has been extended and restructured, now also including the Hervo et al. reference. (page 3, line 32). It is further mentioned in the section on overlap corrections (page 14, line 21).

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The Section 3 and Section 4 are named 'Profile corrections' and 'low-level corrections', respectively. This is confusing since the low-level correction are also profiles corrections. I suggest to change name of Sections 3 and 4 by 'Far-field corrections' and 'Near-field corrections', respectively, or similar. Additionally, the phrase 'low-level correction' is confusing (is it about near range or 'not important' corrections?). Near- and far-field corrections or near- and far-range correction may help to avoid misunderstandings.

→ We agree that the divide was unnecessary. Now all corrections are outlined in Section 3 'Corrections'. The correction of hardware-related perturbation and obstruction correction affecting the first range gates < 100 m is now labelled 'near-range correction' as suggested.

Page 8 Line 11: state -> states.

→ Corrected

Page 8 Lines 18-22: In this section it is commented that the background noise cannot be analyzed below 2400 meters because of the aerosol and humidity and because of the termination hood is unusable. Then, the background is extrapolated from the upper region. Thus, this assumption is performed in the most important region (below 2400 m) where the aerosol used to be present. Authors should include a discussion about the uncertainty due to this assumption and/or how these uncertainties may be estimated. For example, measurements performed at high stations (at mountains) may avoid the aerosol and humidity and thus, the methodology might be applied without assumptions.

→ Given the impact of background correction is significantly reduced below 2400 m after the range correction, the assumption of a constant background correction can be justified. Now the background profiles are also displayed as range-corrected signal (Figure 3e) and zoomed into the lowest 3000 m (Figure 3e) and further discussion regarding the use of termination hood profiles is included. As uncertainties with respect

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to the background correction below 2400 m remain, a comment is included stating your suggestion that the background signal may be evaluated below 2400 m at sites where ABL aerosol and humidity is low (page 11, line 15).

Obstruction correction: as far as I understood, this section presents a method to correct the first 10 bins of the profile. This method uses a linear fit for the last 5 bins (5th-10th) whereas the 1st, 2nd and 4th are normalized to the 3rd one. The normalization of the first four bins is based on the following argument: 'Generally, the first four gates have height-invariant factors'. I think that this phrase means that the backscatter signal is usually height-independent in this region. Despite I agree with the sentence, 'generally' doesn't mean 'always'. I would like to warn that the continuous and widespread application of this correction may mask real signal changes in the first meters of the atmosphere as the first convection cells (after sunrise) or different hygroscopic growth at different altitudes during fog formation. Further studies in this way should be performed to assure that no real changes are being masked.

→ This correction is termed 'near-range correction' in the revised version (Sect. 3.4). It was updated to account for situations when actual gradients appear in the attenuated backscatter signal, such as during hygroscopic growth periods as mentioned. The correction is now simplified, i.e. no linear-relations are applied. Instead, the revised correction now only addresses those profiles with a pronounced, artificial peak value at any given range below 100 m.

As it said before, I strongly recommend publishing the manuscript after minor revisions.

Please also note the supplement to this comment:

<http://www.atmos-meas-tech-discuss.net/amt-2016-87/amt-2016-87-AC3-supplement.pdf>

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-87, 2016.

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