Atmospheric
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Techniques

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Discussions

Interactive comment on "A robust automated technique for operational calibration of ceilometers using the integrated backscatter from totally attenuating liquid clouds" *by* Emma Hopkin et al.

Anonymous Referee #1

Received and published: 29 January 2019

Hopkin et al. present an automated technique to calibrate ceilometers using liquid clouds.

Ceilometer calibration is not a new topic and this paper is based on already existing methodology (mainly O'Connor et al. 2004). The novel aspect of this work is that the calibration is applied on a long period and for large network with different instrument types. This work is valuable to the scientific community as it can be applied to the new networks that are currently under development.

Therefore I recommend the publication of the manuscript after the following minor revisions.

1 Specific Comments

Abstract: the abstract is clearly summarizing the paper. However, I think than one important aspect of the paper is missing. This paper showed that the Lidar signal is affected when the external windows transmission is dropping below 90

Introduction: l 62-67. This paragraph is farfetched. A ceilometer is measuring attenuated backscatter that is not proportional to Ice Water Content. If there is a link between these quantities, please add an equation and the references to support your conclusion. If not, I would suggest I would suggest dropping this 10% requirement in the introduction and the section 5.2.

Section 3 line 204. This is a crucial part of your algorithm. To my understanding, it means that the calibration is valid only when the windows transmission and the energy are higher than 90%. Many instruments will be excluded by this criterion. Please perform a short sensitivity study on this criterion. Please also mention that your calibration is valid only in these conditions and that the authors recommend using the instruments only in this case.

Section 4.1 Wiegner et al (2019) suggested that "error sources beyond the water vapor absorption might be dominant" for CL31. What will be the impact if you drop the water vapor correction? Would you have a better agreement with the Lufft CHM15k?

Section 4.3. line 322. Could you give more details on these outliers? These outliers could be used to identify instrument malfunctions. Section 4.4. could you comment on the high calibration coefficient for Benson and Exeter?

Section 4.4 l355. Again, a quick sensitivity study might be useful to filter precisely the

outliers. Is your calibration still valid when the windows transmission is below 90%? Do you recommend not to use the data when the transmission is low has it affect the signal by 50%. This could be one major conclusion of the paper as it would affect the operational maintenance of ceilometer networks.

Section 5.1: Please add references to the saturation for photon-counting detectors. This is not a new challenge.

Line 381-382: There is a contradiction between this sentence and line 390. Either the negative backscatter can be used to remove the saturated profile, either not. Please replace the sentence "…to remove these profiles" by "…to remove most of these profiles".

Section 5.2 line 416: Do you filter the data at 1km, 2.2km (line 401) or at an height that is instrument specific (line 405)

Section 5.2: l426. Keep the 10% only if the demonstration in the introduction is more robust.

Section 6 line 436. Is the wavelength the only problem? What about the laser power and the instrument sensitivity?

Line 444: Please add a clear reference to support that drizzle scattering is almost wavelength independent

Conclusion: I recommend to add that the calibration is valid only when the windows transmission and the energy pulse are above 90% and that a maintenance should be performed if it is not the case.

2 Technical corrections

Introduction: l48. Please mention some operational weather models you are referring to.

Section 2.2 l110 and table 1: please check the maximum range for Vaisala CL31. According to the manual, the typical message contains 770 gates with a 10 meter resolution. Therefore the maximal range is 7.7km.

Section 4. l235. Please mention the Lufft CHM8k that is measuring at 905nm and specify that it the CHM15k that is measuring at 1064nm (l238)

Section 4.2 l279. Could you change the sentence "that confuse the non-expert" by that might confuse the non-expert". One could argue that the cosmetic feature is the confusing process.

L300: please check the reference formatting.

Section 5 line 364: Please mentioned CHM15k. This section is not valid for CHM8k measuring a 905nm.

Section 5.1 l 370 Please mention that the receiver type also has an influence on the saturation (photon-counting)