

## ***Interactive comment on “What is the benefit of ceilometers for aerosol remote sensing? An answer from EARLINET” by M. Wiegner et al.***

**Anonymous Referee #4**

Received and published: 15 April 2014

General comment:

The article "What is the benefit of ceilometers for aerosol remote sensing? An answer from EARLINET" by M. Wiegner et al. deals with one of the most pressing open question within the ground-based remote sensing scientific community, i.e. the definition and understanding of the usefulness of single-wavelength elastic LIDAR (ceilometer). The authors provide a thorough analysis of what is quantitatively achievable and what remains a qualitative assessment. The paper is well written and responds to the main questions that in the last 15 years scientists keep debating about: calibration procedure, uncertainty ranges, standard retrieval methods, comparison with established references. Although few aspects, mostly related to the water vapor absorption in the 905-910 nm spectral range and the possibility to calculate the LIDAR constant using

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a forward approach remain partially unsettled, the gross picture is fully resolved and one have the feeling of having gone one step further in the understanding of the real benefit of using a ceilometer after reading this paper. A part from technical remarks that I summarize in the section below, I strongly support the publication of this article in AMT. To be accepted with minor revisions.

Specific Comments:

There are only few points that remains partially unanswered in the text or that may lead to confusion, I list them hereafter:

Pg 2499, In 4-5: “in the near infrared...”, as it is, this statement is not fully correct. The transmission term is close to unity in the free troposphere not necessarily in the lower troposphere (boundary layer). Little-absorbing particles are slowly attenuating the LIDAR signal, but as soon as the absorption coefficient grows (soot, BC,...etc) the extinction is not negligible anymore.

Pg 2499, In 5-6: I am not sure that can be generally true. In fact, when comparing backscatter coefficient and att. backscatter in the boundary layer the two hardly give a match. Imagine having a height-dependent LIDAR ratio and a highly changing  $\alpha$ -to- $\beta$  relation, then the relation between att. Backscatter and backscatter is far from being obvious.

Pg 2503, In 2-3: you should add here also the estimate of the error when the full overlap is at 1.5 km, which is typical for the CHM15K

Pg 2510, In 25-26. The hydrophobic assumption for aerosols, depending on the site, can be a very wrong assumption.

Pg 2511, In 20-22: One might argue this statement. By looking at Fig. 4, (which is excellent and very much informative!) it is clear that at higher ranges, and in any case where the water vapor concentration is negligible, the difference between the dry-atmosphere curve and the other curves is constant. That suggests that when retrieving

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the LIDAR constant C one could just rescale the LIDAR signal to the molecular profile. That would result in smaller C values in case of water vapor absorption. One should always consider this when physically interpreting C, but it would not prevent to calculate C.

Technical corrections:

Generally through all text, the term LIDAR should be in capital as it is an acronym.

Pg 2492, In 16: should be “with a relative error”.

Pg 2492, In 23: replace “changing” with “modification of”.

Pg 2492, In 24: please add the correct reference to the indirect effect based on IPCC R5. It should be added in brackets “(ERFaci, Cloud lifetime effect and glaciation indirect effect, IPCC AR5, 2013)”.

Pg 2493, In 15: should be “as they can provide”, drop “only”.

Pg 2494, In 2: define here the meaning of subscript “p”.

Pg 2494, In 7-8: replace by “Based on this set of parameters, and under favorable conditions, it is possible....”.

Pg 2494, In 17: should be “increase in”.

Pg 2494, In 21: should be “the poor spatial resolution remains an issue”.

Pg 2495, In 1: “investigate to which extent”.

Pg 2503, In 6-7: The statement “we conclude that the accuracy....” is too qualitative. The authors should consider replacing the statement with a maximum range of error to be taken into account when applying Eq.12 to higher overlaps, e.g. 1.5 km.

Pg 2508, In 10: replace straight forward with “straightforwardly”.

Pg 2508, In 14: Should be “solid lines”.

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Pg 2510, In 13: should be “spatio-temporal”.

Pg 2510, In 20: not “evaluation”, replace with “evaluating”.

Pg 2510, In 25: “are used”.

Pg 2511, In 6: Please add, “A water vapor distribution between 0 and 2 km”.

Figure 5: Authors should add a legend to the figure describing the different colors.

Figure 13: the caption of Fig. 13 is misleading. I think it should be like that: percentage of elevated layers detected by the CHM15Kx in daytime and nighttime conditions. The EARLINET-LIDAR MUSA is used as reference for the total number of aerosol layers.

Pg 2521, In 7: There is no need of the first paragraph, conclusions should start from here.

Pg 2521, In 19: should be “particularly during night”.

Pg 2522, In 8: not “underway”, replace by “on the way”.

Please also note the supplement to this comment:

<http://www.atmos-meas-tech-discuss.net/7/C545/2014/amtd-7-C545-2014-supplement.pdf>

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Interactive comment on *Atmos. Meas. Tech. Discuss.*, 7, 2491, 2014.

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