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Atmospheric Measurement Techniques Discussions

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

Anonymous Referee #1

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General comments This paper presents a fairly detailed analysis on the merits of ceilometers with respect to the characterization of aerosol properties. The paper is well written (some sentences may however be rephrased for clarification and acronyms should be all detailed), and valuable information is given. Comparisons between observations performed by various systems and how they can complement each-other, is of particular interest. The structure of the paper is fine, although at the end (section 7) some inversion could be done so not to disrupt the progression in the topics being discussed (see detailed comments).

Significant information is given on the limitations of ceilometers and a thorough review of the possible calibration procedures is presented, as well as usable analysis methods given. The paper is worth publication in AMT, but I recommend before it can be done

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that the authors to go through the recommendations and questions identified in this review.

The analysis focuses on the main ceilometers that can be used for such a purpose. Uncertainties, biases and ranges are given in the text (sensitivities may be also given), but as a lot of information is given, it is not quickly and precisely available to the reader. I would thus recommend that the authors add a few tables to synthetize their findings and summarize the main characteristics of the ceilometers, their advantages/drawbacks, give calibration and inversion uncertainties, biases, and ranges/sensitivities estimates in the specific conditions tested.

Detailed comments P2492, l11 : define EARLINET P2492, l12 : “for calibration” P2492, l15 : add information on the Day/Night range and sensitivities obtained by the analyzed ceilometers in terms of particulate backscatter coefficients (see the comment related to section 7.1 P2492, l18 : remove last sentence ”as a consequence . . .”, its place is more in the conclusion.

P2493 , l17 : add references on representative lidar systems for the characterization of optical and microphysical aerosol properties. May be remove or displace this sentence, as this is discussed after in page 2494.

P2494, l3 : “shape” may be beyond the capabilities, more likely “non-sphericity” P2494, l17 : I do not understand why the authors refer here to the EARLINET measurement procedure, which is not defined from aerosols characteristics but from operational constraints. EARLINET stations are not operating continuously, which is one advantage of ceilometers, but they could be operated differently, provided the observations are made on a regular basis.

P 2495, l3 : we see further in the paper that ceilometers can give access to backscattering coefficient and their data be used as inputs to models. The authors should come back on the complementarity between ceilometers and lidar networks in section 7.2 and/or 8. P2495, l16 : the definition of ceilometers by wavelength appears to

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me very specific to the authors. It should be explained first that the ceilometers are designed and built to operationally detect clouds (as mentioned later in p2498, move p2498, l24-26 at the beginning of this section to address this point). This has led to the development and commercialization of a few systems. I do not see why low power micropulse lidar systems operating at other wavelengths could not also be identified as ceilometers. But once again, this is more driven by required performance (allowing low sensitivity), technology and costs.

P2496, l11 and following : a list of various ceilometers is presented. The characteristics of the main systems often referred to in the study would be worth being reported in a table.

P2500, l9 : “technique”

P2503, l26 : measurements are not available at the ceilometer wavelengths identified by the authors, so the presentation of this analysis should be modified to identify what to do in this case.

P2504, l10 : define LMU. P2504, l15 : quantify the error that can be avoided.

P2507 : at the end of section 4, refer to a table summarizing errors on calibration.

P2508, l9 : typo F:=” P2509, l7 : be more explicit on Raman wavelengths that could be used, and mention that extinction is determined from the transmission obtained at this wavelength and at the emission wavelength, so that in fact an extrapolation is already needed to determine Sp using Raman scattering. It can be thus further used for ceilometer data correction. P2509, l23, explain why the emission wavelength may vary by as much as 3 nm.

P2510, l7 : give a reference for DIAL measurements and constraints.

P2512, l19-20 : precise/give the domain of variation of the wavelength lambda-i. P2512, l26 : at the end of section 5, summarize in a table the possible water vapor interference range.

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P2513, l15 : is there any saturation effect in the measured signal to account for ?

P2514, l20 : in turbulent conditions, the mixed layer is usually developed, and it is also possible to use vertical profiles. However, both in the vertical and horizontal, the profile in the surface and mixed layers may have a gradient and be spatially inhomogeneous. May be discuss more this point, as no optimal solution exist, but operation may be easier in a case than in the other.

P2515, l21 : “not on”

P2516, l17 and after : mention that profiles are taken during nighttime.

P2517, l11 : discuss more quantitatively the “slightly better performance” in terms of signal-to-noise-ratio (SNR).

P2518, l8 : acronym STRAT not defined. P2518, l20-29 : it would be preferable for the continuity of the text and discussions to move this part into the previous section 6 dedicated to the measurement range. A new subsection 6.3 may then be created for this purpose. Also, give the sensitivities in terms of backscattering coefficients corresponding to MUSA measurements, for the CHM15k at the identified maximal ranges (3 and 5 km).

P2520, l20 : optical depth or mass concentration cannot be determined but they can be estimated using a priori parameters and relationships or using AERONET data. Mention it and give a reference. P2520, l21 : “operationally provided” P2520, section 7.2 : add one or two sentences on the combination of lidar and ceilometer networks as inputs for the validation and exploitation of CTMs.

P2522, l10 : examples are given but other actions exist, verb is missing. Possibly start the sentence as ”One can mention EUMETNET’s . . . “.

P2532, Fig. 3 : plot results with respect to relative difference or ratio as in Fig. 6.

P2534, Fig5 : in legend “. . .different water vapor . . .”

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P2535, Fig6 : in legend “. . . retrieved and true . . . different water vapor. . . ”

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