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The influence of water vapor absorption on ceilometer measurements: Relevance for aerosol retrievals

Matthias Wiegner (1), Josef Gasteiger (1), Robert Begbie (2), Neda Boyouk (2), Mike Brettle (3), Jan Cermak (4), Marc-Antoine Drouin (5), Alexander Geiß (1), Ulrich Görsdorf (2), Alexander Haefele (6), Martial Haeffelin (5), Maxime Hervo (6), Katerina Kominkova (7), Ronny Leinweber (2), Ina Mattis (8), Gerhard Müller (8), Christoph Münkel (9), Margit Pattantyus-Abraham (8), Kornelia Pönitz (10), and Frank Wagner (8)

(1) Ludwig-Maximilians-Universität, Meteorological Institute, München, Germany (m.wiegner@lmu.de), (2) Deutscher Wetterdienst, Observatorium Lindenberg, Lindenberg, Germany, (3) Campbell Scientific Ltd., Shepshed, Loughborough, UK, (4) Department of Geography, Ruhr-Universität Bochum, Germany, (5) SIRTA, Palaiseau, France, (6) MeteoSwiss, Payerne, Switzerland, (7) Global Change Research Institute (CAS), Brno, Czech Republic, (8) Deutscher Wetterdienst, Observatorium Hohenpeißenberg, Hohenpeißenberg, Germany, (9) Vaisala GmbH, Hamburg, Germany, (10) Lufft Mess- und Regeltechnik GmbH, Fellbach, Germany

In the last years extended networks of single-wavelength backscatter lidars have been established by several national weather services. Due to improvements of the hardware and their 24/7 availability such ALCs (automated lidars and ceilometers) are increasingly used to monitor the aerosol distribution. Currently operational algorithms to quantitatively derive optical properties (backscatter coefficient) of particles are under development. Often mixing layer heights are provided as secondary products. These activities offer a wide range of applications including observations of the dispersion of volcanic ash plumes, input for air quality studies and validation of chemistry transport models.
For a better characterization of atmospheric parameters that can be derived from ALC measurements, and the assessment of uncertainties of the corresponding retrievals COST action ES1303 (TOPROF) was established. Major topics include e.g. the calibration of ALCs and the provision of overlap correction functions. Recently, it has been emphasized that ceilometers operating in the spectral range of 905 – 910 nm are influenced by water vapor absorption and that this effect must be taken into account if the particle backscatter coefficient shall be derived. Ignoring leads not only to quite large errors, moreover it is hardly possible to quantify this uncertainty. The water vapor correction scheme introduced by Wiegner and Gasteiger (2015) can reduce the uncertainty to less than 5 %, provided that the profile of the water vapor concentration (e.g., from radio sondes) and the spectrum of the emitted radiation are known. In the frame work of a field campaign in summer 2015 (CeiLinEx) co-located and coincident measurements of ALCs (at wavelengths with and without water vapor absorption) were performed. Thus the influence of water vapor absorption and the ability to correct for it when retrieving optical properties of particles can be demonstrated.

Wiegner, M. and Gasteiger, J.: Correction of water vapor absorption for aerosol remote sensing with ceilometers, Atmos. Meas. Tech., 8, 3971–3984, doi:10.5194/amt-8-3971-2015, 2015.