Geophysical Research Abstracts
Vol. 21, EGU2019-5178, 2019
EGU General Assembly 2019

Aerosol remote sensing by means of ceilometer measurements: treatment of water vapor absorption

Matthias Wiegner (1), Ina Mattis (2), Margit Pattantyús-Ábrahám (3), Josef Gasteiger (4), Alexander Geiß (1), and Ulrich Görsdorf (5)

(1) Ludwig-Maximilians-Universität, Meteorological Institute, München, Germany (m.wiegner@lmu.de), (2) German Weather Service, Meteorological Observatory Hohenpeißenberg, Hohenpeißenberg, Germany, (3) Federal Office for Radiation Protection, Department of Environmental Radiation, Neuherberg, Germany, (4) Faculty of Physics, University of Vienna, Vienna, Austria, (5) German Weather Service, Meteorological Observatory Lindenberg, Lindenberg, Germany

In the last years a significant number of eye-safe single-wavelength backscatter lidars, often referred to as ceilometers, was installed for unattended operation. Though the primary reason for such ceilometer networks is the automation of synoptic observations, in particular the determination of the cloud base height, the potential of quantitative remote sensing of aerosols has been investigated for approximately 10 years. One of the main benefits is the very good spatial coverage that allows to track aerosol layers in real time. The optical characterization of aerosols is however limited to the particle backscatter coefficient β_p. In this context it was ignored for a long time that most of the ceilometers work in a spectral range where water vapor is absorbing, so that a correction is required if one aims at the quantitative retrieval of β_p.

As a consequence we have investigated the relevance of water vapor absorption for ceilometer signals and developed a numerical procedure to correct for it (Wiegner and Gasteiger, 2015). Recently the validation of this correction scheme was attempted (Wiegner et al., 2018), based on data from the CeiLinEx2015 campaign in Lindenberg, Germany, when several types of ceilometers and a reference lidar system were deployed. In this context it must be considered that a strict validation is hardly possible as the optical properties of particles (backscatter and extinction) at the wavelength of the reference system (without water vapor absorption, in our case at 1064 nm) and at the wavelength of the ceilometer (with absorption, around 910 nm) are different. They can only be estimated from sun photometer data and the inversion of the reference lidar signal. Moreover, the emitted wavelength of the ceilometers is typically not exactly known due to missing technical specifications and possible drifts with temperature. Taking these uncertainties into account it was demonstrated that the correction of CL51 (Vaisala) measurements is trustworthy.

We want to emphasize that water vapor absorption does not play a significant role for the assessment of the mixing layer height (mlh) and the detection of (elevated) aerosol layers. For these applications the low signal-to-noise ratio and (possible) signal artefacts, but also the ambiguity of most mlh-retrievals are more relevant. Nevertheless, we recommend monitoring the emitted wavelength of the instrument to obtain new options of aerosol remote sensing.

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

Wiegner, M. et al.: Aerosol backscatter profiles from ceilometers: validation of water vapor correction in the framework of CeiLinEx2015, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2018-307, in review, 2018.