Investigation of the truncation correction of the polar nephelometer Ecotech Aurora4000

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In this work we present an investigation of the truncation of near-forward scattering of the polar nephelometer Aurora4000, Ecotech Pty Ltd.

Aerosol particles are known to contribute to climate change (Forster, 2007). The asymmetry parameter or phase function of aerosol particles plays a key role in a proper evaluation of its radiative forcing effect. The polar nephelometer measures the scattering coefficient of the aerosol for up to 18 angular sectors between 0 and 90 degrees. In this way, it's possible to evaluate a quasi-phase function of the aerosol.

Methods for reducing the uncertainties of angular non idealities of the nephelometer intensity function are widely discussed in literature (Anderson and Ogren, 1998; Massoli et al., 2009; Bond et al., 2009; Müller et al., 2011) and correction factors are based on Mie calculation or on parameterization of the Angström exponent. The truncation angle, generally accepted as 10 degrees for Aurora4000, is based on technical drawings and was never measured experimentally.

In order to investigate the truncation error, measurements of aerosol extinction and scattering coefficients were made. Polystyrene latex spheres (PSL) with diameter of 491 ± 4 nm were used, with concentration varying from 20 – 73 #/cm^3. As these particles are non-absorbing, the extinction is equal to the scattering coefficient. For extinction measurements we used a Cavity Attenuated Phase Shift Spectroscopy (CAPS), Aerodyne Ltd., at the wavelength 530 nm.

Preliminary results

Three methods for truncation correction were tested: a) Polar correction (Müller et al., 2012), using the information of the scattering coefficient sectors 10 and 20 degrees; b) Angström exponent measured by the nephelometer itself (Müller et al., 2011); c) calculations using Mie theory and the size distribution of the latex spheres. The Figure 1 shows the comparison of those methods and the error bars correspond to the standard deviation of 5 minutes average of extinction coefficient. The corrections are in good agreement in the region of 20 – 50 Mm^{-1}, probably because the concentration reached a more constant level.

Also the angular scattering was investigated and the measurements are in good agreement with the expected from Mie theory, as seen in Figure 2.

More experiments will be done furthermore with different particle sizes and ambient aerosol. The purpose is to test the instrument limits and improve accuracy.

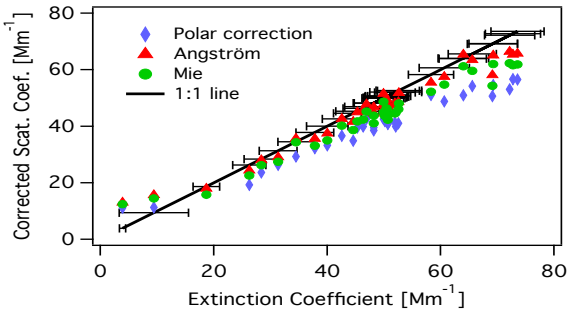

Figure 1. Correlation plot of the scattering coefficient measured by the polar nephelometer corrected using: a) polar correction; b) Angström exponent (Müller et al., 2011); c) Mie calculations using the nominal size distribution of latex spheres; and the extinction coefficient measured by CAPS. The error bars are the standard deviation of the extinction measurements.

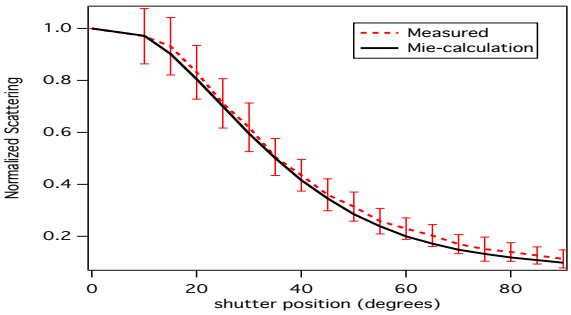

Figure 2. Scattering coefficient of angular sectors normalized by the total scattering measured by the polar nephelometer and calculated using Mie theory. The error bars are standard deviation of the average.

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