Supplement for "Wavelength- and NO_x-dependent complex refractive index of SOA generated from photooxidation of toluene” by T. Nakayama et al.

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S1. Calibration procedure for the PASS-3

Detailed descriptions of the performance of the 3λ-photoacoustic spectrometer (Droplet Measurement Technologies, PASS-3) are in preparation in a separate paper (Nakayama et al. manuscript in preparation). Here, only a brief description of the calibration procedures used for the present study is given.

The $b_{sca}(\lambda)$ obtained using the PASS-3 was calibrated with monodisperse polystyrene latex (PSL) particles. PSL particles with diameters of 203, 299, or 400 nm (Duke Scientific), generated by an atomizer, were dried using a diffusion dryer with silica gel and then passed through a differential mobility analyzer (DMA) (TSI, model 3081) and an aerosol particle mass analyzer (APM) (Kanomax, model 3601). The generated aerosols were supplied to the PASS-3 instrument and a condensation particle counter (CPC) (TSI, model 3772). The calibration factors for $b_{sca}(\lambda)$ were estimated by comparing the $b_{sca}(\lambda)$ data obtained using the PASS-3 with those calculated based on Mie theory by using the particle diameter, particle number density, and literature refractive index (Nikolov and Ivanov 2000). As a result, a strong particle size dependence of the calibration factor for b_{sca}(532 nm) was found, while no significant size dependence was observed for b_{sca}(405 nm) and b_{sca}(781 nm). The results may be explained by the difference in the truncation errors, because the polarization plane of the 532 nm laser beam is perpendicular to the view plane, while those of the 405 and 781 nm laser beams are parallel. Therefore, the b_{sca}(532 nm) data obtained using the PASS-3 were not used in this work.

The b_{abs}(405 and 781 nm) obtained using the PASS-3 were calibrated with polydisperse propane soot particles. Calibration factors for the $b_{abs}(\lambda)$ were estimated by comparing the $b_{sca}(\lambda)$ obtained using the PASS-3 with those obtained from subtraction of the corrected $b_{sca}(\lambda)$ from the $b_{ext}(\lambda)$ determined by changing the laser power passing through the cell in the presence and absence of the soot particles. The b_{abs}(532 nm) obtained using the PASS-3 was calibrated with monodisperse nigrosin particles. Similar to the experiments for the PSL described above, nigrosin particles (Wako Chemicals) generated by an atomizer, were passed through a diffusion dryer, DMA, and APM to obtain monodisperse particles. Monodisperse nigrosin particles with diameters of 200, 250, or 300 nm were then supplied to the PASS-3 and the CPC. The b_{abs}(532 nm) obtained using the PASS-3 was compared with those calculated based on Mie theory using the particle diameter, particle number density, and literature refractive index (Dinar et al. 2008, Garvey and Pinnick 1983, Lack et al. 2006). The b_{abs}(532 nm) was also calibrated using gaseous light absorption by NO_2. Gaseous mixtures of NO_2/air (1-6 ppmv) were prepared by diluting 10 ppmv NO_2 (Japan Fine Products) in air with synthetic air and then supplied to the PASS-3. The b_{abs}(532 nm) obtained using the PASS-3 was compared with those determined by changing the laser power passing through the cell in the presence and absence of NO_2. The uncertainties associated with the calibration were then estimated from a combinations of the statistical and estimated systematic uncertainties (including the uncertainties in the particle size and refractive index of the PSL particles) to be 8, 10, 8, 10, and 10% for b_{abs}(405 nm), b_{abs}(532 nm), b_{abs}(781 nm), b_{sca}(405 nm), and b_{sca}(781 nm), respectively.

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