Field evaluation of miniature absorption photometers in an Eastern Mediterranean urban environment

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The recent development of small, portable, filter-based aerosol absorption photometers has provided unique possibilities for mobile measurements of equivalent black carbon (eBC). For example, vertical profiling using unmanned aerial systems (Pikridas *et al*, 2019) can provide insights into absorbing aerosol radiative forcing, while monitoring of personal exposure to BC enables the realistic assessment of its health effects. Therefore, it is necessary to evaluate the reliability of novel portable absorption photometers in order to assess their applicability in fulfilling the scientific goals mentioned above.

Several miniature absorption photometers were operated at the Thissio air monitoring station of the National Observatory of Athens during both the cold (10 Feb - 6 Mar) and warm (14 Jun - 6 Jul) periods in 2021. The array of instruments included the 5-wavelength Aethlabs MA200 and MA350 microaethalometers, the Brechtel Single Channel Tricolor Absorption Photometer (STAP) and the Haze Instruments 3-wavelength Continuous Light Absorption Photometer (CLAP). Attenuation and Absorption Coefficients (b_{ATN} and b_{abs}) as well as eBC estimates were compared to respective measurements from a 7-wavelength AE33 aethalometer (Magee Scientific) and a multi-angle absorption photometer (MAAP, Thermo Scientific). Concurrent measurements at Thissio included near-real time non-refractory submicrometer aerosol (NR-PM_1) chemical composition using an Aerodyne ACSM, as well as aerosol scattering and back-scattering recorded by a TSI 3563 integrating nephelometer.

As shown in Figure 1, depicting cold period measurements (at 625nm for MA200-MA350, 624nm for STAP, 653nm for CLAP and 660nm for AE33) , the miniature instruments captured the variability of b_{ATN} and b_{abs} being highly correlated (r^2: 0.89 – 0.98) to the AE33 measurements. Moreover, eBC concentrations from the MA200 and MA350 at 880 nm agreed excellently to the AE33 eBC at the same wavelength (0.85<slope<1.01, 0.94<r^2<0.97). High repeatability was also observed through inter-device MA200 comparisons, while different filter loading artefact compensation algorithms were evaluated for the STAP and CLAP.

Correction factors (C_{ref}) for the multiple scattering artefact were calculated for each instrument, utilizing the MAAP measurements. The aethalometer model (Sandradewi *et al*, 2008) was evaluated for the MA200 and the MA350 under intense biomass burning smog episodes in winter, while the impact of aerosol chemical composition to the performance of each instrument was also assessed.

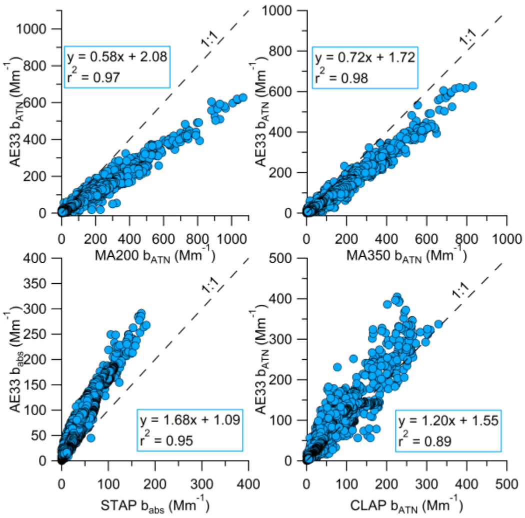

Figure 1. Scatter plots of b_{ATN} and b_{abs} from the AE33 versus the miniature absorption photometers.

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Pikridas *et al* (2019) *Atmos Meas Tech* **12**, 6425-6447.
Sandradewi et al. (2008) *Environ. Sci. Technol.* **42**, 3316–3323.