Towards standardisation of black carbon monitoring instruments: recent progress and remaining challenges

D.M. Kalbermatter, G. Močnik, L. Drinovec, B. Visser, J. Röhrbein, M. Oscity, E. Weingartner, A. Hyvärinen and K. Vasilatou
grisa.mocnik@haze-instruments.com

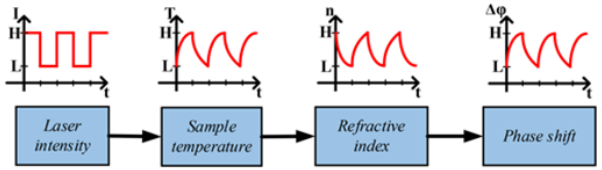
Photothermal interferometer

Absorption of light by particles and gas
→ increase of **particle temperature**

Heat transfer to surrounding gas
→ increase of **gas temperature**
→ reduction of **gas refractive index**
→ change of **optical path** length, 50 fm

Measurement of **optical path** with an **interferometer**
→ **measure** change in **phase shift**

Interferometer signal is proportional to the (aerosol) sample light absorption coefficient!



The new **dual wavelength photo-thermal interferometer PTAAM-2λ:**

- **532 nm** - **calibrated** with **NO_2**
- **1064 nm** - **calibrated** with **aerosolized nigrosin, Mie model absorption coefficient ratios**.
- **simultaneous absorption coefficient measurements @ 532,1064 nm** on the **same sample**.
- **artefact-free** absorption coefficient in **laboratory** and **ambient** measurements.
- Commercially available.

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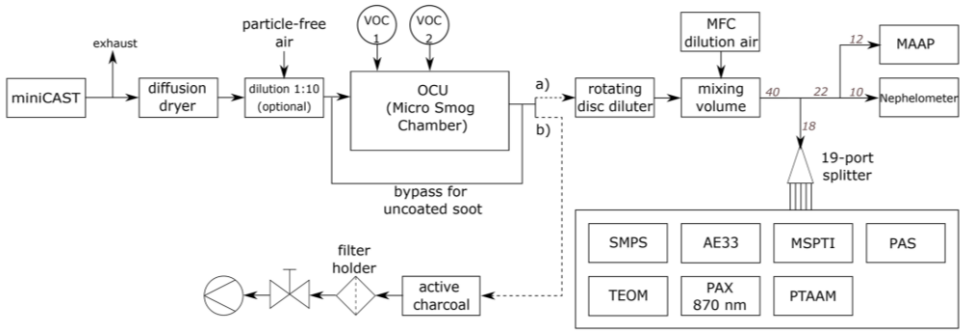
Calibration

- **532 nm** – traceable Permeation NO_2 generator
- **1064 nm – transfer of calibration** with **nigrosin** dye, **spherical** particles, size distribution + **Mie model**
- calibration validation: Mie model vs. calibrated measurement 532 nm, difference smaller than 6%
- **traceable calibration at 2 wavelengths**

Instrumental **uncertainties**:

absorption coefficient, 532 nm	**4%**
absorption coefficient, 1064 nm	**6%**
Absorption Angstrom Exponent	**9%**

Experimental setup

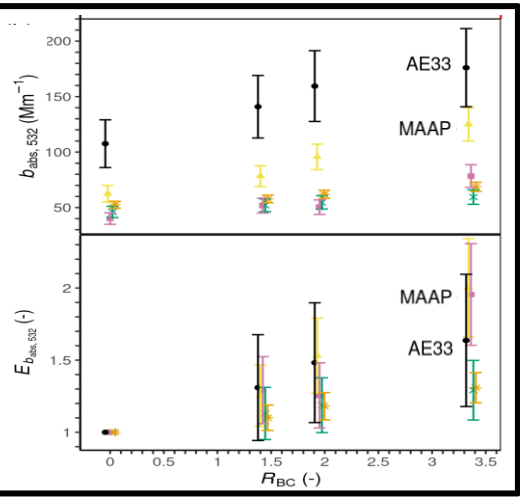


Results

instrumental comparison:
aerosol absorption coefficient b_{abs} 532 nm

AE33 520 nm
MAAP 637 nm
PAX 870 nm
PTAAM 532 nm
MSPTI 532 nm

absorption enhancement E_{abs} BC coated with α-pinene secondary organic material, depends on $R_{BC} = (M_{total} - M_{BC})/M_{BC}$



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Remaining questions, way forward

- **standardization**
- **reproducible procedure** for the inter-comparisons
- **characterization** of filter-based and direct BC-measuring **instruments** with **realistic samples**
- campaigns with **ambient aerosols** (with ACTRIS)
- supporting **addition of BC measurement in AQ guidelines** by EC
- optical properties of internal and external aerosol mixtures – **cal/val datasets** for **climate models**.