StanBC : Standardisation of Black Carbon aerosol metrics for air quality and climate modelling

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The need :

1. **Black carbon (BC)** contributes to global warning
2. In 2019, about **300 000 premature deaths** in the EU were attributed to fine particulate matter in ambient air. BC-containing particles from combustion sources are deemed as carcinogenic.
3. The **lack of standard** methodology for BC mass concentration have not allowed incorporating it into the **Air Quality legislation**

Question:

How to establish new standards for the determination of aerosol light absorption and Black Carbon mass concentration (BC) ?

$$BC\ (g/m^3) = \frac{b\ (m^{-1})}{MAC\ (m^2/g)}$$

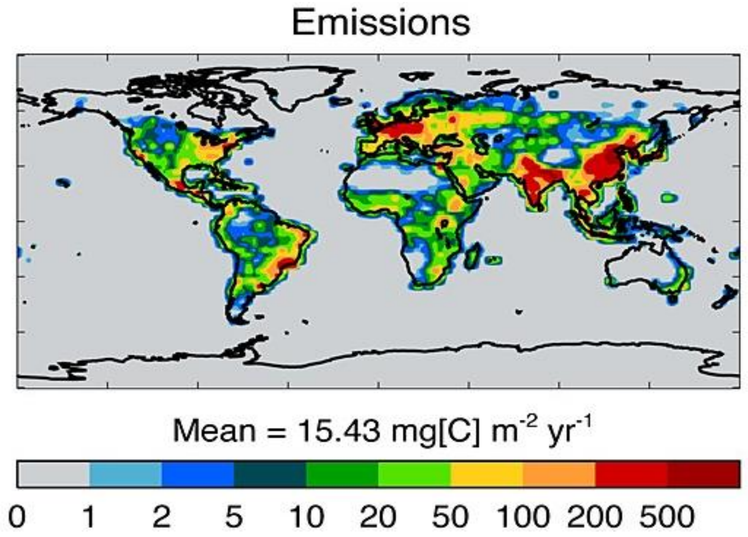
Aerosol light absorption coefficient (b)

Mass absorption cross section (MAC)

Scientific objectives to address this question:

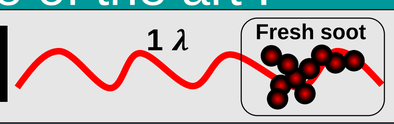
1. **WP1 :** To standardise and calibrate in situ reference methods for aerosol light absorption coefficient
2. **WP2 :** To standardise methods for the measurement of mass absorption cross-section (MAC)
3. **WP3 :** To standardise methods for calibrating filter-based photometers against the reference methods
4. **WP4 :** To develop a new CEN standard which describes traceable methods for BC-related metrics
5. **WP5 :** To facilitate the uptake of the technology and measurement methodologies developed in the project

Bond, T. C., et al. (2013), Bounding the role of black carbon in the climate system: A scientific assessment, *J. Geophys. Res. Atmos.*, 118, 5380– 5552, doi:10.1002/jgrd.50171.

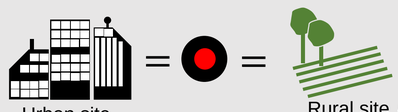


State of the art :

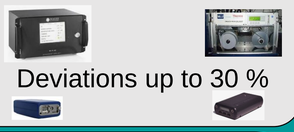
Traceable measurement of **absorption b**



MAC value is fixed and constant



Filter-based techniques



Deviations up to 30 %

Secondary standard

PAX

In-Situ Primary Standard

CAPS PMEx + NEPH3563

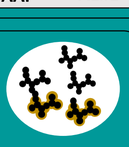
PTAAM-2λ

Deviations up to a **factor of 2**

Filter-based instruments

AE33 MAAP AE51 MA200

The EN 16909:2017 is the only existing relevant standard on the measurement of EC mass collected on filters



Partners

Institut "Jožef Stefan" Ljubljana, Slovenija

ILMATIETEEN LAITOS METEOROLOGISKA INSTITUTET FINNISH METEOROLOGICAL INSTITUTE

University of Applied Sciences and Arts Northwestern Switzerland

DEMOKRITOS

TROPOS Leibniz Institute for Tropospheric Research

Stakeholders

AMAP Arctic Monitoring and Assessment Programme

Department for Environment Food & Rural Affairs

Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA Federal Office of Meteorology and Climatology MeteoSwiss

Umwelt Bundesamt

Joint Research Centre JRC

Sunset Laboratory In

Atmo France

Empa Materials Science and Technology

Swiss TPH Swiss Tropical and Public Health Institute

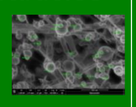
Aerosol

Environment Agency

WP1 (Objective 1)

Aerosolised nigrosin spherical particles

Refractive index + Mie theory



NO_2 Gas

Primary standards CALIBRATION

Extinction Minus Scattering (EMS) Photo thermal Interferometry (PTI)

Secondary standards EQUIVALENCE TESTING

Photoacoustic (PAX)

Traceable light absorption coefficient

$b\ (Mm^{-1})$

Target uncertainty $<$ 10% (95% confidence level)

WP2 (Objective 2)

Primary standards CALIBRATED Instruments

Reference aerosols

$SSA < 0,7$ & $SSA < 0,3$

Fresh soot

Aged soot

Extinction Minus Scattering (EMS) Photo thermal Interferometry (PTI)

$b\ (Mm^{-1})$

Mass absorption cross-section

$$MAC(m^2/g) = \frac{b}{EC_{mass}}$$

Standardised Method

EC mass determination (EN 16909:2017)

EC_{mass} (g/m^3)

WP3 (Objective 3)

Vehicle engines

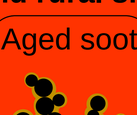
Fresh soot

Industrial and harbours site

Fresh soot + Ammonium sulphate (internally mix)

Suburban and rural site

Aged soot



Ambient-like aerosol in urban sites

Aged soot + Ammonium sulphate and mineral dust

$0,1 < SSA < 1$

WP1 ***Traceable light absorption coefficient*** b

WP2 **Mass absorption cross-section** MAC

Target candidate method Uncertainty $<$ 15% (95% confidence level)

eBC mass concentration

$$eBC(g/m^3) = \frac{b}{MAC}$$

Candidate Method

- Photo-acoustic instruments
- Filter-based photometers
- Wearable filter-based photometers

WP4 (Objective 4)

New working group within CEN/TC 264

Traceable reference methods for determining aerosol light absorption coefficients at multiple wavelengths

Materials, methods and correction factors for calibrating filter-based photometers against the reference method(s)

WP5 (Objective 5)

Stakeholder Committee

- Legislators and regulatory bodies
- Instrument manufacturers
- Academia
- Air quality and metrological networks.

Knowledge transfer

- National and international presentations
- Peer-reviewed publications
- Open access website
- Special conference session + Symposium
- 2 Workshops + Training sessions
- New CEN standard.

Exploitation

- New instrument SOPs
- New calibration and consultation services.

Impacts

Scientific:

- Improved Climate and Air Quality Models,
- Better understanding of the inter-connection between Black Carbon climate and Air Quality impact in short and long-term time resolution and local to global coverage,
- More reliable international data to help authorities and regulators improve their climate change and urban pollution mitigation strategies.

Socio-economic :

- Better protection of public health,
- Market share growth for EU instrument manufacturers,
- Input for revision of air quality legislation based on Black Carbon.

The EPM initiative is co-funded by the European Union's Horizon Europe research and innovation programme and the EPM Participating States

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