Field test of five different continuous ambient soot monitors

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Introduction

Ambient soot monitoring in the Netherlands takes place mainly with the use of Thermo Scientific™ 5012 Multiangle Absorption Photometer (MAAP). In 2018 Thermo stopped the production of MAAP. In search of a suitable replacement for automated soot measurements, six public authorities from Belgium and the Netherlands worked together in a field test. Five automated continuous soot monitors have been compared over 10 months period at the measurement station of Wilrijk in Antwerp, Belgium. Main focus has been given to the comparability of the results to the MAAP and to the offline elemental carbon [EC] analyses according to NPR-CEN/TR 16909:2017. Additionally, the soot concentrations related to biomass burning (BB) have been investigated.

Methods

Preliminary results during the first 4 months of the campaign including the average soot concentrations and the correlations to the MAAP and to the offline EC concentrations are summarized in table 1.

Table 1. Preliminary results during the first 4 months of the campaign.

Monitor	Soot ($\mu g/m^3$)	Correlation to MAAP (R^2)	Correlation to EC[2] (R^2)
MAAP	1,00	1,00	0,77
AE33[1]	1,05	0,93	0,55
Met-one 1054[1]	0,82	0,93	0,68
Aethlabs 350[1,3]	0,89/0,93	0,91/0,92	0,54/0,58
Sunset Model 4 Field	0,82	0,91	0,66
Sunset BCTC Field	0,83	0,90	0,61

1: at 880nm 2: EUSAAR2 protocol 3: two devices available

Some of the tested monitors provide measurement results for up to ten different wavelengths. According to the formula given in Sandradewi *et al* (2008) the soot concentration related to biomass burning ("BB") can be calculated using the concentrations measured at the wavelengths 470 nm and 950 nm. Recent studies (van Poppel, 2016) have shown a high correlation (R^2=0,89) between the measured biomass burning concentration and the levoglucosan concentration, a tracer for biomass burning (Bhattarai *et al 2019)*.
Levoglucosan analysis for a selection of 90 days of the campaign is pending. The results will be used for evaluation of the BB reported by the online monitors.

Additional investigations on the effect of different inlets (TSP, PM10 or PM2.5), different analytical wavelengths and the time when the filter tape progresses have been performed.

Conclusions

Preliminary results from an extensive field test showed that several automated soot monitors correlated well with the MAAP. However, all tested soot monitors showed less strong correlations to EC. Two monitors offer the option to estimate the soot concentration related to biomass burning. Since biomass burning is a growing issue, specially in larger cities, the option of online monitoring becomes a necessity and is welcome for air quality monitoring networks.

NPR-CEN/TR 16909 (2017) *Ambient air - Measurement of elemental carbon (EC) and organic carbon (OC) collected on filters*

J. Sandradewi et al. (2008) *Using aerosol light absorption measurements for the quantitative determination of wood burning and traffic emission contributions to particulate matter* Environ. Sci. Technol., 42, pp. 3316-3323

M. Van Poppel et al. (2016) *Inschatting van de bijdrage van houtverbranding door burgers aan luchtverontreiniging in Vlaanderen VMM report MRG/R/0825*

H. Bhattarai *et al Levoglucosan as a tracer of biomass burning: Recent progress and perspectives Atmospheric Research Volume 220, 15 May 2019, Pages 20-3*