COMPARISON OF BIOMASS BURNING RELATED BLACK CARBON MEASURED WITH AE33 AND SP-AMS

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Keywords: black carbon, biomass combustion, AE33, aerosol mass spectrometer
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Introduction

Black carbon (BC) is a light-absorbing carbonaceous aerosol component that has positive radiative forcing on climate, and when deposited on snow, it may lead to the reduction of snow albedo. Moreover, BC has been associated with adverse effects on public health. BC sources are dominated by combustion processes. In urban areas, these are typically transportation, industry and residential combustion. Due to technology advancements and legislation, there is a declining trend in BC emissions from vehicular traffic but the emissions from residential combustion are not currently regulated in most European countries. Therefore, there is a growing interest to identify BC sources at different locations. In this study, we compared two methods to determine the contribution of biomass burning (BB) to the total measured BC concentrations (BB%) at two locations in Helsinki, Finland.

Methods

BC was measured by using a dual-spot Aethalometer (AE33) and Soot Particle Aerosol Mass Spectrometer (SP-AMS; Onasch et al., 2012). Measurements were conducted at a residential area with a lot of wood burning and at roadside characterized with heavy traffic. Measurements were performed at the residential site in winter (Jan–Feb 2019) and at the traffic site in spring (May 2018).

SP-AMS data was analyzed statistically by using Positive Matrix Factorization (PMF) including both organic and refractory BC (rBC) ions in the PMF input matrix. PMF resolved four factors for organics and rBC that were hydrocarbon like organic aerosol (HOA), low volatility oxygenated OA (LV-OOA), semi-volatile oxygenated OA (SV-OOA) and biomass burning OA (BBOA). Only rBC associated with BBOA factor was considered as BB-related BC. For AE33 data, the absorption Ångström exponent (α) of 1.6 was used for wood burning and 1.0 for fossil fuel (Helin et al., 2018).

Conclusions

At the residential site, average BB% was 50 and 37 % measured by AE33 and SP-AMS, respectively. It was found that when the total BC concentration was high (large marker size in Fig. 1), the SP-AMS gave larger BB% while at smaller BC concentrations the AE33 showed larger BB%. Although the time series of BB% from AE33 and SP-AMS followed each other rather well, BB% from AE33 and SP-AMS correlated rather poorly (R^2 = 0.23; 30-min time resolution) due to the large deviation at small BB%.

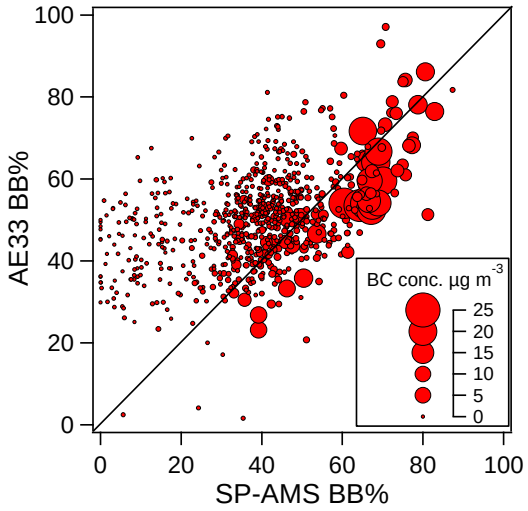

Figure 1. Biomass burning related BC (BB%) measured with the AE33 and SP-AMS (30-min time resolution). Marker size indicates BC concentration measured by the AE33.

This work was supported by Business Finland project # 4703/31/2018, Regional innovations and experimentations funds AIKO, governed by the Helsinki Regional Council (project HAQT, AIKO014), European Regional Development Fund Urban innovative actions initiative (HOPE (Healthy Outdoor Premises for Everyone) Project nro: UIA03-240) and COST Action (CA16109).

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