Invariable source contribution to wintertime rural aerosol in Warmia-Mazuria, Poland

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Introduction

Residential coal and wood combustion can create serious air pollution problems. In the north-eastern part of Poland, both wood combustion and coal combustion are usual ways of heating homes, and in this study, we attempt to apportion the carbonaceous matter (CM) to these two sources in the EMEP winter campaign, January-March, 2018.

Methods

Measurements took place at the rural EMEP station Diabła Góra in north-eastern Poland (Figure 1, 54.13 N, 22.04 E). Daily filters samples were collected with analysis of PM10, PM2.5, OC/EC, and levoglucosan, and CM was estimated from OC and EC data.

Figure 1. Location of Diabla Góra EMEP station.

This was complemented with minute resolved, filter based aethalometer (AE33) measurements as assistance to the source apportionment.

Conclusions

The daily PM2.5 concentrations varied between 3 and 45 µg m^{-3} during the two-month period (Figure 2). The remarkable finding in this study is that the relationship between different measured compounds is almost invariant, for example the Absorption Ångström Exponent (AAE), the levoglucosan to OC ratio, or OC to PM2.5 ratio. This also means that the different sources contribute in equal amounts all the time in this period irrespective of concentration values and where the winds have come from.

Hence, source receptor modelling will be very challenging. The variation between measured parameters may depend more on measurement uncertainties than variation between sources. However, we still pursue apportion of sources using two independent methods to apportion wood and coal combustion with AAE and levoglucosan data.

The average AAE value was 1.60 with 0.08 standard deviation. If we assume that the AAE for wood and coal chunk combustion equals 1.93 and 1.3 respectively (Sandradewi et al., 2008; Bond, 2001; Sun et al., 2017), then the contribution from wood and coal combustion to CM can be estimated with the Sandradewi et al. (2017) AAE method (Figure 2). This yielded a contribution of 45 and 55 % from wood and coal combustion respectively. We have disregarded traffic exhaust as important contribution.

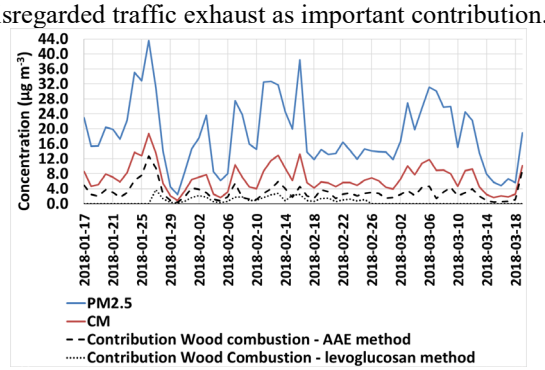

Figure 2. PM2.5, Carbonaceous matter (CM), and the contribution from Wood Combustion to CM from two independent methods.

Levoglucosan contributed to about 2 % of the CM. By comparing with Martinsson et al. (2017) who shows about 10 % contribution of levoglucosan in a wood combustion dominated environment, the wood combustion contribution in Diabła Góra should be about 20 %. Please see the contribution for individual days in Figure 2. This is significantly lower than the 45 % contribution obtained with the AAE method. We will investigate further the discrepancy of apportioned wood combustion between the AAE and levoglucosan methods.

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