Estimation of Residential Wood Combustion in urban and rural background

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Atmospheric particles are responsible for the main part of the annual 2 million deaths worldwide, which according to WHO are attributed to air pollution. While the majority of ambient respirable particles in Denmark are long-range transported, emissions from traffic and woodstoves make up the main domestic sources of primary particles. Regulation of vehicular emissions for the past decades have reduced traffic emissions, whereas emissions from woodstoves are currently subject to only minor regulation, though they constitute the largest domestic source of ambient primary particles.

Wood combustion comprises both primary and secondary particles, and cannot be measured directly. Various attempts have been made to apportion the primary sources, e.g. using receptor models on ambient marker species. Since online analysis or analysis of specific organic markers from filter samples is both costly and time consuming, data is typically obtained during shorter campaigns and extrapolated to annual concentrations. At the same time, a substantial amount of data, some of which can be attributed to wood combustion sources is acquired during national monitoring programmes on a continuous basis.

In the WOODMAD project we evaluated Polycyclic Aromatic Hydrocarbons (PAH), Elemental Carbon (EC) and benzene as markers for residential wood combustion, the latter two in daily time resolution.

Table 1. RWC concentrations ($\mu g/m^3$) based on the markers EC and benzene during 2013-2014 (All), summer (June-July) and winter (January/February).

	RWC, EC rural backg.	RWC, benzene urban backg.	RWC, comb.
Annual	1.1	0.9	1.0
Summer	0.36	0.21	0.29
Winter	1.9	2.0	2.0

Summer concentrations of EC and benzene in urban and rural background, respectively, were assumed to origin from mainly traffic, industry and biomass combustion of which levoglucosan marker concentrations during summer were found to make up 10% of their winter concentrations. Following subtraction of the non-biomass combustion contributions to EC and benzene, the marker concentrations were converted to RWC ($\mu g/m^3$) using appropriate source profiles (McDonald et al, 2000; Tissari, 2007). The annual average of RWC in rural background was found to be 14% higher than urban background, mainly because of higher summer concentrations (Table 1). The standard deviations of RCW based on EC and benzene are illustrated during a two-year period in Figure 1. The two background stations are believed to span the background range in the greater Copenhagen area of which their average represents a conservative estimate of RWC. The results in Table 1 match recent source apportionment macro tracer approaches using receptor modelling in the same regions reporting 0.88 ($\mu g/m^3$) and 1.3 ($\mu g/m^3$) in urban (2011-2012) and rural background (2008-2009), respectively, including the fact that higher concentrations are found in rural background.

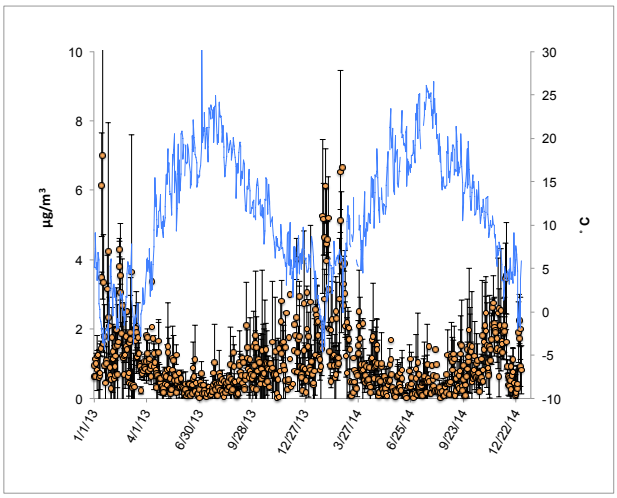

Figure 1. Ambient temperature and RWC concentrations ($\mu g/m^3$) based on the markers EC and benzene.

The background contribution from traffic and industry to the markers is established during summer, where RWC is lowest. Increases in the sources of non-wood combustion during winter could compromise the calculation of background concentrations and consequently overestimate RWC. However, the agreement with recent receptor modelling support this method of using single markers in these particular areas.

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