

The effect of local wood combustion on fine particles in suburban small house areas in Helsinki Metropolitan Area, Finland

A. Kousa¹, J. Niemi¹, A. Svens¹, K. Teinilä², R. Hillamo² and T. Koskentalo¹

¹Helsinki Region Environmental Services Authority, P.O. Box 100, FI-00066 HSY, Helsinki, Finland

²Air Quality Research, Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland

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Presenting author email: anu.kousa@hsy.fi

Residential wood burning has a remarkable effect on fine particles concentrations during cold season even on urban areas where heating of buildings is mainly based on centralized district heating system. Large amounts of PM are still emitted e.g. in heat storing fireplaces and sauna stoves in suburban small house areas. In the recent study it was estimated that during the average cold season the contribution of wood combustion emissions to fine particles ranged from 18 % to 29 % at the urban sites and from 31 % to 66 % at the suburban areas in Helsinki Metropolitan area, Finland (Saarnio et al 2012). In addition it was estimated that occasionally the local wood combustion emissions caused an addition of even 10-15 $\mu\text{g}/\text{m}^3$ to the daily mean concentration of $\text{PM}_{2.5}$ while the average addition to the daily concentrations of $\text{PM}_{2.5}$ was about 1-3 $\mu\text{g}/\text{m}^3$.

Wood combustion in suburban small house areas

The measured concentrations of benzo(a)pyrene have been at the same level in an urban background site at least since year 2007 (Table 1). It seems that local traffic does not have an effect on the concentrations of benzo(a)pyrene because the concentration levels are equal with the urban background and street canyon sites. The highest benzo(a)pyrene concentrations are measured in the suburban small house areas where local wood burning exists. It seems that there is quite large spatial variation between different suburban small house areas. The EU's target value for benzo(a)pyrene (1 ng/m^3) is exceeded in some suburban small house areas clearly when in some other areas the concentrations are well below the target value.

Table 1. The concentrations of benzo(a)pyrene in an urban background, different street canyons and suburban small house areas.

Year	Concentration of Benzo(a)pyrene (ng/m^3)		
	Urban background	Street canyons	Small house areas
2007	0.3	0.3	
2008	0.2		1.1
2009	0.3		0.5
2010	0.3	0.3	0.5
2011	0.3		1.2

Black carbon (BC) concentrations in year 2009 were measured in the suburban small house area (the

annual BC concentration was 0.8 $\mu\text{g}/\text{m}^3$) and in year 2010 in one of the most polluted street canyon (the annual BC concentration 2,6 $\mu\text{g}/\text{m}^3$) in the Helsinki Metropolitan Area. The strong effect of local sources can be clearly seen in variation of BC concentrations between day of week and time of day (Figure 2). In the busy street canyon the concentrations were the highest during morning rush hours in weekdays while in the suburban small house areas the BC concentrations were highest on Saturday evenings. Also on Wednesday evenings the BC concentrations were elevated in the small house areas. This can be explained by the fact that Wednesday and Saturday are the days when sauna stoves are traditionally heated in Finland.

The annual $\text{PM}_{2.5}$ concentration was 8.1 $\mu\text{g}/\text{m}^3$ so it can be estimated that 11 % of total $\text{PM}_{2.5}$ concentration was caused by BC in the suburban small house area.

Correlations between the concentrations of levoglucosan and benzo(a)pyrene in an urban background site and suburban small house areas are also studied.

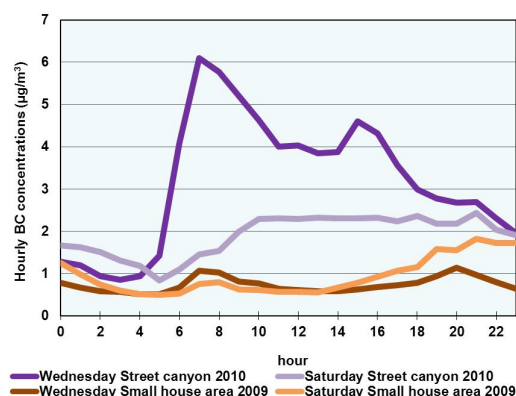


Figure 2. Daily variation of BC concentration in the street canyon and suburban small house area.

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