# Biomass burning aerosol from residential heating: emission characteristics and environmental impact

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Household, institutional and industrial fuel combustion is the major sector contributing to anthropogenic primary $PM_{2.5}$ emissions in Europe (EEA, 2014). Contrary to the development in other sectors, these emissions have even been increasing in recent years. Residential combustion of biomass has been on the rise, both due to environmental ("green energy") and economical reasons (EEA, 2014). Therefore, domestic biomass burning is one of the key parameters influencing overall $PM_{2.5}$ burden, and closer investigations of its emission patterns and impact are an important field of research (Fuller *et al*, 2013).

Here, we present results from laboratory and ambient measurements of biomass burning emissions, both from household stoves and from larger (up to ~2 MW) institutional combustion facilities. On-line measurements of gas-phase species (CO, $CO_2$, $NO_x$, $SO_2$, $O_3$) and of aerosol particles (number and mass concentrations, size distributions, mass spectrometric measurement of $PM_1$ chemical composition) were performed using the Mobile Laboratory MoLa (Drewnick *et al*, 2012), which is suitable for both stationary and mobile measurements.

A detailed study of the influence of burning conditions and fuel types on the emissions of a regular household stove was performed in the laboratory. These experiments with a broad suite of instruments provide in-depth information about the emission characteristics with high temporal resolution. This allows for calculation of emission factors for the individual burning phases, as exemplarily shown in Fig. 1 for emission factors of $PM_1$ and CO obtained for different burning conditions and fuel types. The results from the laboratory experiments furthermore serve as a basis to determine markers suitable for the detection of emissions from biomass burning in the ambient atmosphere.

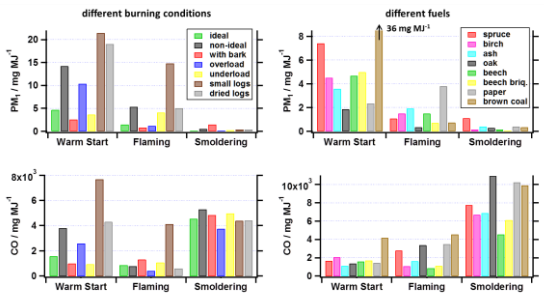


Figure 1. Emission factors of $PM_1$ (upper panels) and CO (lower panels) for different burning conditions (left) and fuels (right).

Ambient (stationary and mobile) measurements were performed in the Black Forest (Germany) and the Alsace (France). In both regions, measurements both in the vicinity of a larger biomass burning facility and in nearby villages (influenced by individual domestic heating) were performed. Figure 2 shows the distribution map of a biomass burning proxy (ratio of levoglucosan-marker to organic aerosol) calculated from mobile measurements around the facility and within the town of St. Peter (Black Forest). While no clear enhancement of the biomass burning proxy around and downwind the institutional combustion facility was observed, a clear enhancement of this proxy within the old town is visible, where household stoves are frequently operated. This example demonstrates the influence of flue gas cleaning technology and more efficient combustion within a larger combustion facility, which makes it preferable over individual household combustion for residential heating.

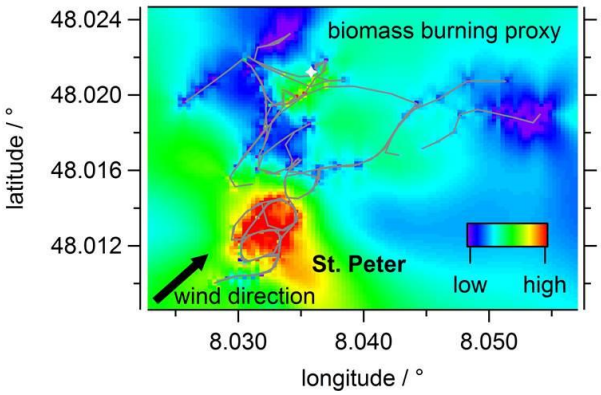


Figure 2. Pollutant distribution map of a biomass burning proxy in St. Peter and the surrounding of the community biomass burning facility (white star).

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