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Strong wintertime influences of residential wood burning aerosols in urban environments: Grenoble and Paris, France

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Carbonaceous aerosols originating from biomass burning are known to contain high amounts of carcinogenetic polycyclic aromatic hydrocarbons as well as light-absorbing species (black and brown carbon) which significantly influence the aerosol radiative forcing and atmospheric photochemistry. It is thus of prime importance to evaluate their contribution to particulate matter in the ambient air. However, residential wood burning emissions have been generally disregarded until recently, and data related to their influence on the air quality of large European urban centres are still very scarce.

We investigate here the impact of residential wood burning aerosols on the air pollution of two French cities: Grenoble, located in an Alpine valley, and Greater Paris, one of the few European megacities. These studies were notably conducted using aerosol filter-based measurements, a c-ToF Aerosol Mass Spectrometer, and a multi-wavelength Aethalometer.

In particular, the latter instrument was used to investigate the spectral dependence of the aerosol light absorption, and subsequently to track the presence of brown carbon of biomass burning origin in the atmosphere of both cities. Relatively high Angstrom absorption exponents were observed during the winter season (Figure 1), suggesting a significant influence of residential wood burning aerosols in these urban environments. This hypothesis was confirmed by high amounts of (water-soluble) organic carbon, of humic-like substances, and of levoglucosan.

Various source apportionment exercises, including Positive Matrix Factorization (Lanz et al., 2007) and an Aethalometer model (Sandradewi et al., 2008), were then achieved to evaluate the contribution of wood burning aerosols to total particulate matter (Figure 2). Results notably indicate that residential wood burning emissions accounted on average for more than 50% and 25% of fine carbonaceous aerosols at wintertime in Grenoble and Paris respectively. Such results underline the significant impact potentially played by residential wood burning emissions on particulate air pollution in large European urban centres.

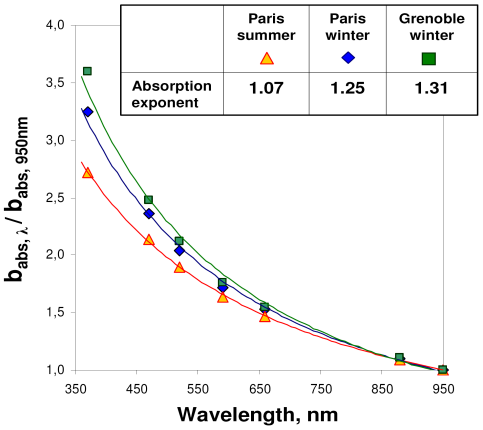

Figure 1. Mean spectral shape of aerosol light absorption in Paris and Grenoble.

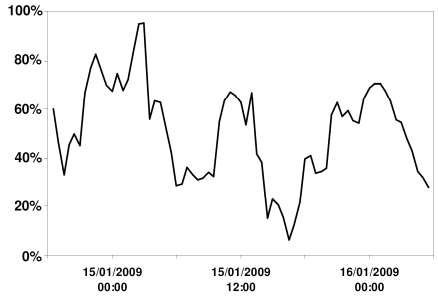

Figure 2. Contribution of wood burning emissions to carbonaceous aerosols during a winter pollution episode in Grenoble.

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Lanz et al. (2007). *Atmos. Chem. Phys.*, 7, 1503-1522.

Sandradewi et al. (2008). *Environ. Sci. Technol.*, 42, 3316-3323.