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On-line measurements of fine organic aerosols in the region of Paris (France): Evidence of a major source of domestic wood burning

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Factors controlling fast changes in levels and chemical/optical properties of carbonaceous aerosols were investigated in the region of Paris (France) during wintertime from a wide variety of on-line instruments. All the measurements were performed in the fine mode (A.D. < 2.5µm) for a period of 2 weeks (in February 2009) on the roof platform of LSCE, 30km south-west of Paris city.

Levels of water soluble organic carbon (WSOC) were investigated from 4-min time resolution on-line measurements obtained from a PILS-TOC system (Sullivan *et al.*, 2004). The PILS instrument used here was the one described by Sorooshian *et al.* (2006) and was equipped with a Total Organic Carbon (TOC) system Model 900 (Sievers Ltd).
Hourly concentrations of Elemental Carbon (EC) and Organic Carbon (OC) in the fine fraction were obtained from a semi-continuous ECOC field analyzer (Sunset Laboratory, Forest Grove, OR; Bae *et al.*, 2004).
Equivalent Black Carbon (EBC) measurements were obtained from 5-min integrated light absorption measurements performed by a seven-wavelength Aethalometer (Model AE-31, Magee Scientific).
These measurements were completed by fast (15-min time resolution) measurements of the major ions in aerosols using a PILS-IC instrument (Orsini *et al.*, 2003). Continuous (6-min time resolution) measurements of $PM_{2.5}$ (nonvolatile + semivolatile) were performed by a Tapered Element Oscillating Microbalance (TEOM) Model 1400 from Rupprecht & Pataschnik equipped with a Sample Equilibration System (SES) and a Filter Dynamic Measurement System (FDMS, 8500 model series) (Grover *et al.*, 2005).

RESULTS AND DISCUSSION: On-line measurements of WSOC, OC, and EC were first compared with similar measurements performed from VOC denuded filter sampling operating in parallel (R&P Partisol Model 2025, Thermo Scientific). Comparison between these two datasets (on-line vs integrated filter-based) has shown very good agreement, cross-validating the consistency of sampling & analytical techniques.

High Angstrom absorption exponents (derived from Aethalometer measurements) were observed at night pointing out a significant influence of residential wood burning aerosols. Maxima observed in the ($babs_{370nm}$/$babs_{880nm}$) ratio were also observed for potassium (known as a tracer of biomass burning), bringing further confidence on the role of domestic wood burning in the region of Paris.

A very good agreement (r^2=0.76; N=172); was found between ($babs_{370nm}$/$babs_{880nm}$) ratio and (WSOC/BC) ratios suggesting a significant source of WSOC (relatively to BC) for wood burning. By contrast, no correlation was found with WIOC/BC ratio, suggesting that domestic wood burning is a poor emitter of WIOC. These observations are consistent with commonly reported water soluble properties of organics emitted by biomass burning. Also, they clearly show that organic material absorbing in the UV and originating from wood burning is mainly water soluble.

Hourly WSOC/OC ratio was only 0.38±0.14 on average, suggesting a strong contribution of primary organics in the region of Paris for this period of the year. Although WSOC/OC ratio has shown relatively high values during wood burning periods, its variability seemed to be controlled by other mechanisms. The highest ratios were observed systematically at night (e.g. at low temperatures) and would suggest semi-volatile properties for WSOC as proposed recently by Hennigan *et al.* (2008).

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