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Real-time measurements of levoglucosan in fine aerosols (PM2.5) in the region of Paris (France)

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Levoglucosan - one the major monosaccharide anhydride compounds produced by the combustion of cellulose and hemicellulose - is emitted in large amounts by wildfires or residential wood burning (during winter months). Over the past few years, this specific tracer has received more and more attention at it can be used in a quantitative way to derive atmospheric concentrations of biomass burning aerosols [Favez et al., 2010] which aerosol source has strong implications for climate and air quality studies.

A new technique has been developed and is presented here to investigate real-time concentrations of levoglucosan in fine aerosols (PM2.5). This technique is based on a Particle-into-liquid-sampler (PILS, Brechtel Manufacturing inc., model 4002) used "on-line" and coupled with an electrospray ionisation source – tandem mass spectrometry (ESI-MS/MS, AB SCIEX model 3200 QTRAP). Air was drawn in the PILS at 15LPM and removed from particles larger than 2.5μm aerodynamic diameter (AD) using a very sharp cyclone. Water-soluble aerosols were collected in the PILS and sent in the 10μl loop of the ESI-MS/MS at a flowrate of 50μl/min. Flow injection analysis (FIA) was then performed every 2.5min for the quantification of levoglucosan using a specific transition 161-113 m/z (negative mode), by Multiple Reaction Monitoring (MRM) mode. An internal levoglucosan standard was injected every 10 samples (i.e. every 25min) in order to check the stability of the mass spectrometry calibration. Field blanks were performed using a total filter upstream of the PILS instrument and did not show any detectable amount of levoglucosan. A limit of quantification (LOQ) better than 1 ng/m3 was calculated here for levoglucosan in FIA mode.

Based on these settings, unattended measurements of levoglucosan by PILS-ESI-MS/MS have been performed every 2.5 min in the region of Paris for a couple of weeks during the winter 2011 showing concentrations ranging from below 1ng/m3 to more than 500ng/m3. These measurements were compared to measurements of Black Carbon from wood burning obtained in parallel every 5 min using a 7 wavelength aethalometer (Magee Scientific, models AE31 and AE33,) and the use of the "aethalometer" model [Sandradewi et al., 2008; Sciare et al., 2001]. A very good agreement was observed between these 2 tracers of biomass burning aerosols, providing valuable information on the strong temporality of the domestic wood burning source.

This new tool, in conjunction with other real-time analyzers, may offer new opportunities to investigate the fast atmospheric processes of biomass burning aerosols which have been reported in smog chamber studies [Grieshop et al., 2009].

References

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