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Analysis of Low and High Molecular Weight Water-Soluble Organic Aerosol Components by LC-MS

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Water soluble organic compounds (WSOCs), including low (e.g. dicarboxylic acids, nitrophenols et al.) and high (e.g. proteins, DNA et al.) molecular weight compounds, play an important role in the ambient atmosphere. WSOCs not only directly affect the atmosphere's radiation balance by scattering and absorbing solar and infrared radiation, but also modify the radiative properties and lifetimes of clouds by enhancing aerosol mass concentrations and increasing cloud droplet formation.

In this study, liquid chromatography coupled to mass spectrometry (LC-MS) was used to characterize low and high molecular weight WSOCs.

The small molecular weight WSOCs in fine and coarse aerosol particles were collected on glass fibre filters with a high-volume dichotomous sampler. After water extraction, the WSOCs were analyzed by LC-MS with electrospray ionization. The detected and quantified compounds comprise nitrophenols, aliphatic and aromatic dicarboxylic acids, pinic, pinonic and a C_8-tricarboxylic acid (204 Da). The latter acid is found as a major component of pinene SOA in tropical rainforest aerosol from the Amazon basin and in summertime aerosol from Ghent, Belgium (Kubatova et al., 2000). Recently, Szmigielski et al. (Szmigielski et al., 2007) identified this tricarboxylic acid as 3-methyl-1,2,3-butanetricarboxylic acid and suggested an oxidation mechanism involving pinonic acid. However, our findings that C_8-tricarboxylic acid showed no correlation with pinonic acid in both coarse and fine particle samples, could not support the mechanism proposed by Szmigielski et al. (2007).

The high molecular weight WSOCs in aerosol particles include DNA and proteins. Several studies indicated that proteins could be nitrated by the gas phase reaction with NO_2 and O_3 in the atmosphere and that the nitration takes place at the tyrosine site (Franze et al., 2003; Franze et al., 2005). Some recent studies suggested that nitrated proteins might cause and enhance allergic diseases and asthma (Gruijthuijsen et al., 2006). Native protein bovine serum albumin (BSA) was nitrated by tetranitromethane (TNM) in the liquid phase and with NO_2 and O_3 in the gas phase. The characteristic of nitrated BSA was studied using LC-MS.

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