Sources of dicarboxylic acids at several continental sites in Central Europe

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Dicarboxylic acids (DCAs) are among the most abundant organic compounds observed in atmospheric aerosol particles and have been extensively studied at many places around the world. The importance of the various primary sources and secondary formation pathways discussed in the literature is often difficult to assess from field studies, though. In this study, a large dataset of size-resolved DCA concentrations from several inland sites in Germany is combined with results from statistical back-trajectory analysis and additional data to elucidate the main sources of DCAs at continental sites in Central Europe.

Size-resolved particle sampling using 5-stage Berner impactors was performed within several field campaigns at different locations in Germany between 1997 and 2005. They include the rural sites Melpitz (close to Leipzig), Falkenberg (close to Berlin), and Goldlauter (near Mt. Schmücke, Thuringian forest), an urban background site in Leipzig and a traffic-impacted site in the city of Dresden. The samples were analyzed for inorganic ions (ion chromatography), OC/EC (thermographic method) and short-chain dicarboxylic acids (capillary electrophoresis). Statistical back trajectory analysis was performed following the approach of van Pinxteren et al. (2010) to obtain residence time indices for several land cover classes.

Principal component analysis was then used to reveal the most important factors governing the abundance of DCAs in different particle size ranges. Identified sources are depicted in Fig. 1.

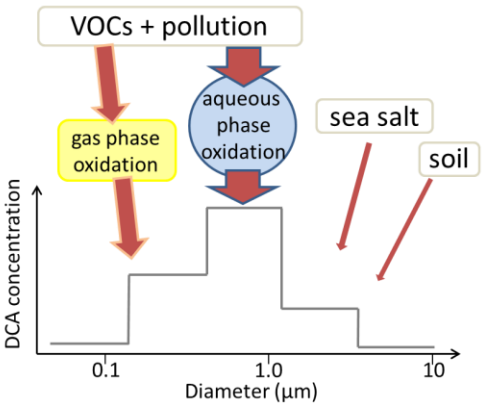

Figure 1: Schematic depiction of identified DCA sources in different particle size ranges.

The two most important sources revealed are i) photochemical formation in polluted air masses, likely occurring in the gas phase on short timescales (gasSOA), and ii) secondary reactions in anthropogenically influenced air masses, likely occurring in the aqueous phase on longer timescales (aqSOA). While the first source strongly impacts DCA concentrations mainly in small and large particles, the second one enhances accumulation mode DCAs and is responsible for the bulk of the observed concentrations. Primary sources were found to be minor (sea salt, soil resuspension) or non-existent (biomass burning, traffic). The results can be regarded representative for typical central-European continental conditions.

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References

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