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Hygroscopic properties of water-soluble matter and humic-like organics in atmospheric fine aerosol

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Abstract. Ambient continental-rural fine aerosol (K-puszta, Hungary, $PM_{1.5}$) was sampled on quartz fibre filters in winter and summer 2001. Water-soluble matter (WSM) was extracted in MilliQ-water, and, in a second step, solid phase extraction was used to isolate the less hydrophilic fraction (ISOM) of the water-soluble organic matter (WSOM) from remaining inorganic salts and "most" hydrophilic organic matter (MHOM). This approach allowed ISOM, which constitutes the major fraction of WSOM, to be isolated from ambient aerosols and investigated in pure form. Hygroscopic properties of both WSM and ISOM extracts as well as of aquatic reference fulvic and humic acids were investigated using a Hygroscopicity Tandem Differential Mobility Analyser (H-TDMA). ISOM deliquesced between 30% and 60% relative humidity (RH), and hygroscopic growth factors at 90% RH ranged from 1.08 to 1.17. The hygroscopicity of ISOM is comparable to secondary organic aerosols obtained in smog chamber experiments, but lower than the hygroscopicity of highly soluble organic acids. The hygroscopic behaviour of investigated fulvic and humic acids had similarities to ISOM, but hygroscopic growth factors were slightly smaller and deliquescence was observed at higher RH (75-85% and 85-95% RH for fulvic acid and humic acid, respectively). These differences probably originate from larger average molecular mass and lower solubility of fulvic and humic acids.

Inorganic composition data, measured ISOM hygroscopicity, and a presumed value for the hygroscopicity of the small remaining MHOM fraction were used to predict hygroscopic growth of WSM extracts. Good agreement between model prediction and measured water uptake was observed with differences (by volume) ranging from +1% to -18%. While deliquescence properties of WSM extracts were mainly determined by the inorganic salts (42-53 wt % of WSM), the WSOM accounted for a significant fraction of particulate water. At 90% RH, according to model predictions and measurements, about 80-62% of particulate water in the samples are associated with inorganic salts and about 20-38% with WSOM. The relative contributions of both distinguished WSOM fractions, ISOM and MHOM, remains uncertain since MHOM was not available in isolated form, but the results suggest that the less abundant MHOM is also important due to its

presumably larger hygroscopicity.

Final Revised Paper (PDF, 756 KB) Discussion Paper (ACPD)

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