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Hygroscopicity of HULIS in urban aerosol and its relationship with sources

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Atmospheric aerosol affects the Earth's radiation budget by directly scattering and absorbing solar radiation and indirectly acting as cloud condensation nuclei. Both of the effects are responsible for the uncertainties in the prediction of global climate change. A better understanding of the hygroscopicity of the organic aerosol is important because it is poorly characterized to date. In this study, the hygroscopicity of humic-like substances (HULIS), a ubiquitous mixture of water-soluble organic matter, isolated from aerosol samples collected in Beijing in different seasons, was measured using a hygroscopicity tandem differential mobility analyzer (HTDMA). The hygroscopicity parameter of the isolated HULIS fraction (κ_{HULIS}) was in the range of 0.03–0.13 (mean: 0.06). Considering the possible influence from small amounts of inorganic salts, the hygroscopicity parameter of pure organic HULIS (κ^{*}_{HULIS}) was found to be slightly lower (0–0.11, mean: 0.04). The κ_{HULIS} showed a seasonal variation; the values were highest in summer (0.08), followed by spring (0.06), autumn (0.06), and winter (0.04). The κ^{*}_{HULIS} showed a similar seasonal variation, with the highest and lowest values in summer (0.07) and autumn (0.01), respectively. Both κ_{HULIS} and κ^{*}_{HULIS} were correlated positively with the O/C ratio of the HULIS. Comparison of the hygroscopicity parameter values with factors from positive matrix factorization (PMF) analysis of the mass spectra of the HULIS fractions showed that κ_{HULIS} correlated positively with more-oxidized oxygenated organic aerosol (MO-OOA) and less-oxidized OOA (LO-OOA), and correlated negatively with cooking-like OA (COA) and biomass burning OA (BBOA). The relationship between the hygroscopicity parameter and sources was further explored based on a multi-liner regression analysis. The variation in the hygroscopicity of HULIS and its connection to sources provide an insight into the contribution of organics to aerosol hygroscopicity, toward a better understanding of its link to climate.