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Phase transitions and hygroscopic growth of aerosol particles containing humic acid and mixtures of humic acid and ammonium sulphate

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Abstract. The phase transitions and hygroscopic growth of two humic acid aerosols (Aldrich sodium salt and Leonardite Standard (IHSS)) and their mixtures with ammonium sulphate have been investigated using a combination of two techniques, Fourier transform infra-red (FTIR) spectroscopy and tandem differential mobility analysis (TDMA). A growth factor of 1.16 at 85% relative humidity (*RH*) was found for the Aldrich humic acid which can be regarded as an upper limit for growth factors of humic-like substances (HULIS) found in atmospheric aerosol and is significantly smaller than that of typical atmospheric inorganics. We find that the humic acid aerosols exhibit water uptake over all relative humidities with no apparent phase changes, suggesting that these aerosols readily form supersaturated droplets. In the mixed particles, the humic acid component decreases the deliquescence relative humidity (DRH) and increases the efflorescence relative humidity (ERH) of the ammonium sulphate component, and there is some degree of water uptake prior to ammonium sulphate deliquescence. In addition, at low RH, the FTIR spectra show that the ammonium is present in a different chemical environment in the mixed aerosols than in crystalline ammonium sulphate, perhaps existing as a complex with the humic materials. The growth factors of the mixed aerosols are intermediate between those of the single-component aerosols and can be predicted assuming that the inorganic and organic fractions take up water independently.

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