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Mass transfer effects in hygroscopic measurements of aerosol particles

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Abstract. The tandem differential mobility analyzer (TDMA) has been widely utilized to measure the hygroscopicity of laboratory-generated and atmospheric submicrometer particles. An important concern in investigating the hygroscopicity of the particles is if the particles have attained equilibrium state in the measurements. We present a literature survey to investigate the mass transfer effects in hygroscopicity measurements. In most TDMA studies, a residence time in the order of seconds is used for humidification (or dehumidification). NaCl and $(NH_4)_2SO_4$ particles are usually used to verify the equilibrium measurements during this residence time, which is presumed to be sufficient for other particles. There have been observations that not all types of submicrometer particles, including atmospheric particles, attain their equilibrium sizes within this time scale. We recommend that experimentation with different residence times be conducted and that the residence time should be explicitly stated in future TDMA measurements. Mass transfer effects may also exist in the measurements of other properties related to the water uptake of atmospheric particles such as relative humidity dependent light scattering coefficients and cloud condensation nuclei activity.

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