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Effects of SO_2 oxidation on ambient aerosol growth in water and ethanol vapours

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Abstract. Hygroscopicity (i.e. water vapour affinity) of atmospheric aerosol particles is one of the key factors in defining their impacts on climate. Condensation of sulphuric acid onto less hygroscopic particles is expected to increase their hygrocopicity and hence their cloud condensation nuclei formation potential. In this study, differences in the hygroscopic and ethanol uptake properties of ultrafine aerosol particles in the Arctic air masses with a different exposure to anthropogenic sulfur pollution were examined. The main discovery was that Aitken mode particles having been exposed to polluted air were more hygroscopic and less soluble to ethanol than after transport in clean air. This aging process was attributed to sulphur dioxide oxidation and subsequent condensation during the transport of these particle to our measurement site. The hygroscopicity of nucleation mode aerosol particles, on the other hand, was approximately the same in all the cases, being indicative of a relatively similar chemical composition despite the differences in air mass transport routes. These particles had also been produced closer to the observation site typically 3–8 h prior to sampling. Apparently, these particles did not have an opportunity to accumulate sulphuric acid on their way to the site, but instead their chemical composition (hygroscopicity and ethanol solubility) resembled that of particles produced in the local or semi-regional ambient conditions.

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