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A method for detecting the presence of organic fraction in nucleation mode sized particles

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Abstract. New particle formation and growth has a very important role in many climate processes. However, the overall knowlegde of the chemical composition of atmospheric nucleation mode (particle diameter, d<20 nm) and the lower end of Aitken mode particles (d≤50 nm) is still insufficient. In this work, we have applied the UFO-TDMA (ultrafine organic tandem differential mobility analyzer) method to shed light on the presence of an organic fraction in the nucleation mode size class in different atmospheric environments. The basic principle of the organic fraction detection is based on our laboratory UFO-TDMA measurements with organic and inorganic compounds. Our laboratory measurements indicate that the usefulness of the UFO-TDMA in the field experiments would arise especially from the fact that atmospherically the most relevant inorganic compounds do not grow in subsaturated ethanol vapor, when particle size is 10 nm in diameter and saturation ratio is about 86% or below it. Furthermore, internally mixed particles composed of ammonium bisulfate and sulfuric acid with sulfuric acid mass fraction ≤33% show no growth at 85% saturation ratio. In contrast, 10 nm particles composed of various oxidized organic compounds of atmospheric relevance are able to grow in those conditions. These discoveries indicate that it is possible to detect the presence of organics in atmospheric nucleation mode sized particles using the UFO-TDMA method. In the future, the UFO-TDMA is expected to be an important aid to describe the composition of atmospheric newly-formed particles.

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