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Initial steps of aerosol growth

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Abstract. The formation and growth of atmospheric aerosols depend on several steps, namely nucleation, initial steps of growth and subsequent – mainly condensational – growth. This work focuses on the initial steps of growth, meaning the growth right after nucleation, where the interplay of curvature effects and thermodynamics has a significant role on the growth kinetics. More specifically, we investigate how ion clusters and aerosol particles grow from 1.5 nm to 20 nm (diameter) in atmospheric conditions using experimental data obtained by air ion and aerosol spectrometers. The measurements have been performed at a boreal forest site in Finland. The observed trend that the growth rate seems to increase as a function of size can be used to investigate possible growth mechanisms. Such a growth rate is consistent with a recently suggested nano-Köhler mechanism, in which growth is activated at a certain size with respect to condensation of organic vapors. The results also imply that charge-enhanced growth associated with ion-mediated nucleation plays only a minor role in the initial steps of growth, since it would imply a clear decrease of the growth rate with size. Finally, further evidence was obtained on the earlier suggestion that atmospheric nucleation and the subsequent growth of fresh nuclei are likely to be uncoupled phenomena via different participating vapors.

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