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Soot aging time scales in polluted regions during day and night

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Abstract. The aging of soot is one of the key uncertainties in the estimation of both the direct and indirect climate effect. While freshly emitted soot is initially hydrophobic and externally mixed, it can be transferred into an internal mixture by coagulation, condensation or photochemical processes. These aging processes affect the hygroscopic qualities and hence the growth behaviour, the optical properties and eventually the lifetime of the soot particles. However, due to computational limits the aging of soot in global climate models is often only parameterised by an estimated turnover rate resulting in a lifetime of soot of several days. Hence, the aging process of soot is one of the key uncertainties governing the burden and effect of black carbon. In this study, we discuss the time scale on which diesel soot is transferred from an external to an internal mixture based on the results of our simulations with a comprehensive mesoscale model. For daytime conditions during summer condensation of sulphuric acid is dominant and the aging process occurs on a time scale of τ =8h close to the sources and τ =2h above the source region. During winter comparable time scales are found but ammonium nitrate becomes more important. During night time condensation is not effective. Then coagulation is the most important aging process and our results show time scales between 10h and 40h.

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