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An investigation of processes controlling the evolution of the boundary layer aerosol size distribution properties at the Swedish background station Aspvreten

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Abstract. Aerosol size distributions have been measured at the Swedish background station Aspvreten (58.8° N, 17.4° E). Different states of the aerosol were determined using a novel application of cluster analysis. The analysis resulted in eight different clusters capturing different stages of the aerosol lifecycle. The atmospheric aerosol size distributions were interpreted as belonging to fresh, intermediate and aged types of size distribution. With aid of back trajectory analysis we present statistics concerning the relation of source area and different meteorological parameters using a non-Lagrangian approach. Source area is argued to be important although not sufficient to describe the observed aerosol properties. Especially processing by clouds and precipitation is shown to be crucial for the evolution of the aerosol size distribution. As much as 60% of the observed size distributions present features that are likely to be related to cloud processes or wet deposition. The lifetime properties of different sized aerosols are discussed by means of measured variability of the aerosol size distribution. Processing by clouds and precipitation is shown to be especially crucial in the size range 100 nm and larger. This indicates an approximate limit for activation in clouds to 100 nm in this type of environment. The aerosol lifecycle is discussed. Size distributions indicating signs of recent new particle formation (~30% of the observed size distributions) represent the first stage in the lifecycle. Aging of the aerosol size distribution may follow two branches: either growth by condensation and coagulation or processing by non-precipitating clouds. In both cases mass is accumulated. Wet removal is the main process capable of removing aerosol mass. Wet deposition is argued to be an important mechanism in reaching a state where nucleation may occur (i.e. sufficiently low aerosol surface area) in environments similar to the one studied.

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