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Time span and spatial scale of regional new particle formation events over Finland and Southern Sweden

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Abstract. We investigated the time span and spatial scale of regional new particle formation (NPF) events in Finland and Southern Sweden using measured particle number size distributions at five background stations. We define the time span of a NPF event as the time period from the first moment when the newly formed mode of aerosol particles is observable below 25 nm until the newly formed mode is not any more distinguishable from other background modes of aerosol particles after growing to bigger sizes. We identify the spatial scale of regional NPF events based on two independent approaches. The first approach is based on the observation within a network of stationary measurement stations and the second approach is based on the time span and the history of air masses back-trajectories. According to the second approach, about 60% and 28% of the events can be traced to distances longer than 220 km upwind from where the events were observed in Southern Finland (Hyttiälä) and Northern Finland (Värriö), respectively. The analysis also showed that the observed regional NPF events started over the continents but not over the Atlantic Ocean. The first approach showed that although large spatial scale NPF events are frequently observed at several locations simultaneously, they are rarely identical (similar characteristics and temporal variations) due to differences in the initial meteorological and geographical conditions between the stations. The growth of the newly formed particles during large spatial scale events can be followed for more than 30 h where the newly formed aerosol particles end up in the Aitken mode (diameter 25–100 nm) and accumulation mode size ranges (diameter 0.1–1 µm). This study showed clear evidence that regional NPF events can pose a significant source for accumulation mode particles over the Scandinavian continent provided that these findings can be generalized to many of the air masses traveling over the European continent.

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