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New particle formation in air mass transported between two measurement sites in Northern Finland

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Abstract. This study covers four years of aerosol number size distribution data from Pallas and Värriö sites 250 km apart from each other in Northern Finland and compares new particle formation events between these sites. In air masses of eastern origin almost all events were observed to start earlier at the eastern station Värriö, whereas in air masses of western origin most of the events were observed to start earlier at the western station Pallas. This demonstrates that particle formation in a certain air mass type depends not only on the diurnal variation of the parameters causing the phenomenon (such as photochemistry) but also on some properties carried by the air mass itself. The correlation in growth rates between the two sites was relatively good, which suggests that the amount of condensable vapour causing the growth must have been at about the same level in both sites. The condensation sink was frequently much higher at the downwind station. It seems that secondary particle formation related to biogenic sources dominate in many cases over the particle sinks during the air mass transport between the sites. Two cases of transport from Pallas to Värriö were further analysed with an aerosol dynamics model. The model was able to reproduce the observed nucleation events 250 km down-wind at Värriö but revealed some differences between the two cases. The simulated nucleation rates were in both cases similar but the organic concentration profiles that best reproduced the observations were different in the two cases indicating that divergent formation reactions may dominate under different conditions. The simulations also suggested that organic compounds were the main contributor to new particle growth, which offers a tentative hypothesis to the distinct features of new particles at the two sites: Air masses arriving from the Atlantic Ocean typically spent approximately only ten hours over land before arriving at Pallas, and thus the time for the organic vapours to accumulate in the air and to interact with the particles is relatively short. This can lead to low nucleation mode growth rates and even to suppression of detectable particle formation event due to efficient scavenging of newly formed clusters, as was observed in the case studies.

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