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Size-segregated aerosol chemical composition at a boreal site in southern Finland, during the QUEST project

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Abstract. Size-segregated aerosol samples were collected during the QUEST field campaign at Hyytiälä, a boreal forest site in Southern Finland, during spring 2003. Aerosol samples were selectively collected during both particle formation events and periods in which no particle formation occurred.

A comprehensive characterisation of the aerosol chemical properties (water-soluble inorganic and organic fraction) and an analysis of the relevant meteorological parameters revealed how aerosol chemistry and meteorology combine to determine a favorable "environment" for new particle formation. The results indicated that all *events*, typically favored during northerly air mass advection, were background aerosols (total mass concentrations range between 1.97 and 4.31 μg m^{-3}), with an increasingly pronounced marine character as the northerly air flow arrived progressively from the west and, in contrast, with a moderate SO_2-pollution influence as the air arrived from more easterly directions. Conversely, the *non-event* aerosol, transported from the south, exhibited the chemical features of European continental sites, with a marked increase in the concentrations of all major anthropogenic aerosol constituents. The higher *non-event* mass concentration (total mass concentrations range between 6.88 and 16.30 μg m^{-3}) and, thus, a larger surface area, tended to suppress new particle formation, more efficiently depleting potential gaseous precursors for nucleation. The analysis of water-soluble organic compounds showed that clean nucleation episodes were dominated by aliphatic biogenic species, while *non-events* were characterised by a large abundance of anthropogenic oxygenated species. Interestingly, a significant content of α-pinene photo-oxidation products was observed in the *events* aerosol, accounting for, on average, 72% of their WSOC; while only moderate amounts of these species were found in the *non-event* aerosol. If the organic vapors condensing onto accumulation mode particles are responsible also for the growth of newly formed thermodynamically stable clusters, our finding allows one to postulate that, at the site, α-pinene photo-oxidation products (and probably also photo-oxidation products from other terpenes) are the most likely species to contribute to the growth of nanometer-sized particles.

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