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The Hohenpeissenberg aerosol formation experiment (HAFEX): a long-term study including size-resolved aerosol, H_2SO_4, OH, and monoterpenes measurements

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Abstract. Ambient aerosol size distributions (>3 nm) and OH, H_2SO_4, and terpene concentrations were measured from April 1998 to August 2000 at a rural continental site in southern Germany. New particle formation (NPF) events were detected on 18% of all days, typically during midday hours under sunny and dry conditions. The number of newly formed particles correlated significantly with solar irradiance and ambient levels of H_2SO_4. A pronounced anti-correlatation of NPF events with the pre-existing particle surface area was identified in the cold season, often associated with the advection of dry and relatively clean air masses from southerly directions (Alps). Estimates of the particle formation rate based on observations were around 1 cm^{-3} s^{-1}, being in agreement with the predictions of ternary homogeneous H_2SO_4-NH_3-H_2O nucleation within a few orders of magnitude. The experimentally determined nucleation mode particle growth rates were on average 2.6 nm h^{-1}, with a fraction of 0.7 nm h^{-1} being attributed to the co-condensation of H_2SO_4-H_2O-NH_3. The magnitude of nucleation mode particle growth was neither significantly correlated to H_2SO_4, nor to the observed particle formation rate. Turn-over rate calculations of measured monoterpenes and aromatic hydrocarbons suggest that especially the oxidation products of monoterpenes have the capacity to contribute to the growth of nucleation mode particles. Although a large number of precursor gases, aerosol and meteorological parameters were measured, the ultimate key factors controlling the occurence of NPF events could not be identified.

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