



Dependence of nucleation rates on sulfuric acid vapor concentration in PoValley, Italy

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A field campaign was conducted at the polluted rural site, San Pietro Capofiume (SPC) in PoValley, Italy, from June 26th to July 12th 2009 in the framework of the EUCAARI (European integrated project on aerosol, cloud, climate, and air interactions) project. The gas-phase sulfuric acid concentrations were measured for the first time at SPC station during this campaign. Here we examine the dependence of nucleation rate on sulfuric acid vapor concentrations in SPC. The apparent nucleation rate – i.e. formation rate of 3 nm particles – was directly determined from differential mobility particle sizer data. The nucleation rate at 1 nm (J_1) was then calculated by accounting for the coagulation of the sub-3 nm clusters with large particles during their growth from 1 to 3 nm. The dependence of J_1 on $[H_2SO_4]$ was studied for each nucleation day individually and for all nucleation days as a whole. It is usually assumed that the dependence of nucleation rate on sulfuric acid concentration follows a simple power law model $J_1 = P [H_2SO_4]^n$; where P is the prefactor containing chemical and physical information of the nucleation process, and n is the nucleation exponent. With the so called activation and kinetic nucleation mechanisms, n takes the values 1 and 2, respectively, and most field studies show n to fall between these two values. For the SPC data, the nucleation exponent was higher than 2 for both individual days and for all nucleation days as a whole. In the light of the obtained results we will discuss the nucleation mechanism, composition of the nucleation mode particles, and the role of other gases (such as ammonia and water vapor) in the formation of new particles in SPC in more detail.