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Multicomponent New Particle Formation in an Urban Atmosphere: Results From the CLOUD Chamber

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Atmospheric aerosols play an important role on climate via aerosol-radiation interaction and aerosol-cloud interaction. The latter is strongly influenced by new particle formation (NPF). The physical and chemical mechanisms behind the NPF process are still under investigation.
Great advancements were made in resolving chemical and physical mechanisms of NPF with a series of experiments conducted at the CLOUD (Cosmics Leaving Outdoor Droplets) chamber facility at CERN (Geneva, Switzerland), including binary nucleation of sulfuric acid - water, ternary nucleation of sulfuric acid - water with ammonia or dimethylamine as well as oxidation products (highly oxygenated molecules, HOMs) from biogenic precursors with and without the presence of sulfuric acid.
Here, we investigate possible NPF mechanisms in urban atmospheres, where large populations are exposed to high aerosol concentrations; these mechanisms are still missing and are urgently needed. Urban atmospheres are highly polluted with high concentrations of SO_2, ammonia, NO_x and volatile organic vapors from anthropogenic activity as well as with high particle concentrations, which provide a high condensation sink for condensable gases. Aromatic hydrocarbons from industrial activities, traffic and residential combustion are present at high concentrations and contribute significantly to photochemical smog in the urban environment.
The experiments were conducted at the CLOUD chamber facility during the CLOUD11 campaign in fall 2016. Three aromatic hydrocarbons were selected: toluene, 1,2,4-trimethylbenzene (1,2,4-TMB) and naphthalene (NPT). Experiments were also conducted with mixtures of the three aromatic hydrocarbons to better represent the urban atmosphere. All the experiments were conducted in the presence of sulfuric acid concentrations with or without the addition of ammonia and NO_x. New particle formation rates and early growth rates derived for each precursor and their mixture, together with sulfuric acid and with or without the addition of ammonia and NO_x will be reported.