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# Influence of the presence of ethanol on the homogeneous freezing of ice particles

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Homogeneous ice nucleation plays an important role in the formation of cirrus clouds with subsequent effects on the global radiative budget. It has been recently demonstrated that water uptake of aerosols, heterogeneous chemical reactions in aerosol particles, as well as ice nucleation and ice crystal growth can be significantly impeded or even completely inhibited in organic-enriched aqueous solutions at upper tropospheric temperatures with implications for cirrus cloud formation and upper tropospheric relative humidity [1].

However, the presence of oxygenated volatile organic compounds such as alcohols, ketones and carboxylic acids in the upper troposphere is also well established [2]. These soluble species are likely scavenged by supercooled droplets contained in polluted air masses. When ice particles are then forming, soluble species contained in those particles that freeze may be retained in the bulk of these new ice crystals until they evaporate in the upper troposphere [3].

In this study, we perform laboratory work to examine and characterize the influence of the presence of a VOC, ethanol, on the homogeneous freezing of ice particles. Supercooled micro-droplets (in the micrometer size range) produced in emulsion are characterized by optical microscopy and micro-Raman analysis.

It is found that the first solid that nucleates during the cooling of micro-droplets of ethanol aqueous solutions of concentrations (0 to 2.62 mol %) is ice whereas it is an ethanol hydrate for concentrations in the range (5.30 to 20 mol %). These experimental results imply some deviation from the behaviour of homogeneous ice nucleation in aqueous solutions predicted by the water-activity-based nucleation theory.

[1] Zobrist et al. Atmos. Chem. Phys., 8, 5221 (2008)
[2] Singh et al. Nature, 410, 1078 (2001)
[3] Kerbrat et al. J. Phys. Chem., 111, 925 (2007)