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Raman scattering investigations of the interaction of a COV with pure and acid doped ice particles

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Ice present in polar stratosphere is as well a common component of the troposphere, particularly in cirrus clouds widespread in tropopause and upper troposphere region. With water droplets, ice constitutes the condensed matter that can interact with atmospheric trace gases via many different trapping processes (co-deposition i.e; incorporation during growing ice conditions, adsorption, freezing etc). The incorporation of trace gases in ice surface/volume can both affect the atmospheric chemistry and the ice structure and reactivity. This can therefore modify the nature and composition of the incorporated species in ice, or in the gas phase.

Recently, field measurements have demonstrated the presence of nitric acid in ice particles from cirrus clouds[1,2] (concentration between 0.63 wt% and 2.5 wt %). Moreover, laboratory experiments have shown that the uptake of atmospheric trace gases can be enhanced up to 1 or 2 orders of magnitude in these doped ice particles. Among trace gases capable to interact with atmospheric condensed matter figure volatile organic compounds such as aldehydes, ketones and alcohols (ex: ethanol and methanol). They play an important role in the upper troposphere [3,4] and snowpack chemistry [5] as they can be easily photolysed, producing free radicals and so influence the oxidizing capacity and the ozone-budget of the atmosphere [3,4]. The temperature range at which these physico-chemical processes occur extents between $\sim$ 190 K and 273K.

Interaction between ice and trace gases are therefore largely dependent on the ice surface properties as well as on the phase formation dynamic (crystalline or not).

This study aims to examine and characterize the incorporation of a COV (ex: ethanol), at the surface or in the volume of ice formed by different growth mechanisms (vapour deposition or droplets freezing). Vibrational spectra of water OH and ethanol CH-spectral regions are analysed using confocal micro-Raman spectroscopy at different temperatures (183 K to 273 K). Information at the molecular level on the surface structure can be derived from accompanying changes observed in band shapes and vibrational mode frequencies. The influence of the presence of nitric acid on the molecular interactions with the trapped organic species in ice particles can be also spectroscopically characterized.

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