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Co-adsorption of nitrous acid and acetic acid on ice.

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The photolysis of nitrate, dissolved in the snowpack, is thought to be a source of nitrous acid (HONO). The release of HONO into the atmosphere and its photodissociation account for the high concentrations of hydroxyl radical measured over the snowpack. Nonetheless, the mechanism of production of HONO and its release is not yet fully understood. Its co-adsorption with other compounds onto snow crystals could influence its partitioning between the gaseous and the solid phase leading to an increase or a decrease of its gas phase concentration. In this study, we investigate the effect of acetic acid on the partitioning of HONO. The measurements were done using radioactively labelled HO^{13}NO molecules. The short lived ^{13}N isotopes ($t_{1/2}$ = 10 min) were obtained using the PROTRAC facility at the Paul Scherrer Institute, Switzerland. Radioactive and non-radioactive HONO were injected continuously into a packed ice bed column. The distribution of HO^{13}NO along the column with and without the presence of acetic acid was monitored during the experiment. Measurements of the uptake of HONO without acetic acid allowed the determination of the enthalpy of adsorption of HONO on pure ice, which was found to be ΔH_{ads} = -30($\pm$2) kJ mol^{-1}. This value is consistent with values reported in the literature and validates our experimental set up. When acetic acid was mixed with HONO in the gas phase before entering the column, our experiments show a decrease of the HONO uptake. The free energy of the uptake process was found to be higher in presence of acetic acid. Our measurements show that the release of HONO into the atmosphere is favoured in presence of acetic acid. This implies that the chemical composition of the snow influences not only the formation of HONO but also its emission. Moreover, it reveals that when studying the partitioning of trace gases, co-adsorption of different species should be considered.