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Raman analysis of ice-gas co-deposits generated from mass spectrometry calibrated vapor mixtures

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With the discovery of the Antarctic ozone hole, the interest for atmospheric processes has increased substantially. Physical and chemical interactions between trace gases and atmospheric components like ice particles are studied to investigate the impact produced by their increasing concentrations on atmospheric chemistry.

Light volatile organic compounds (e.g. methanol, ethanol, formaldehyde) are intermediate products in the oxidation of atmospheric hydrocarbons. They are closely linked to the production of HO_x, the main atmospheric oxidant. These trace gases interact with water and may affect the chemistry in the troposphere. Recent studies in Polar Regions showed that the concentration of several VOCs (formaldehyde, acetaldehyde etc) in the lower troposphere is higher than expected from model calculations. It is suggested that the source of these highly concentrated species is related to snowpack chemistry (Dominé & Shepson, 2002). A characterization of the condensed phase of the ice-gas system is therefore necessary, more particularly of the equilibrium solubilities of gaseous species in ice.

We are mainly interested in the production of laboratory samples by condensation at low temperature from the gas phase (Chazallon et al., 2006). A stable gaseous composition water/gas mixture can be easily obtained by collecting vapors at equilibrium above aqueous solutions of the different compounds.

An experimental protocol using mass spectrometry is developed to analyze the composition of the collected vapor (water + trace gases) above aqueous solutions. This

is achieved by calibrating mixtures of known composition ($P_{H2O}/P_{tracegas}$ ratio (methanol-water, formaldehyde-water)). Then, the water-trace gases mixtures are deposited at low temperature and characterized using Raman spectroscopy. The composition of the condensed phases is estimated with a kinetic model. First experimental results using our new set-up (low temperature stage / MS vacuum line) will be presented and discussed within the context of the tropospheric gas-ice interactions (e.g. methanol, formaldehyde).

References

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