Geophysical Research Abstracts
Vol. 16, EGU2014-16634, 2014
EGU General Assembly 2014

Surface and bulk uptake of H_2O_2 to snow: Insights from laboratory studies

Thorsten Bartels-Rausch, Thomas Ulrich, and Markus Ammann
Paul Scherrer Institut (PSI), Villigen PSI, Switzerland

The trace gas hydrogen peroxide (H_2O_2) is chemical vey reactive in the atmosphere and in the cryosphere. Its gas-phase concentration may significantly determine OH and O_3 levels, and thus the oxidative capacity of the atmosphere. In snow, H_2O_2 can drive oxidation of impurities and also a vivid photochemistry is observed. It is further the only major atmospheric oxidant that is directly taken up by snow. Snow might thus be an important reservoir for atmospheric H_2O_2 and reconstructions of its atmospheric concentration from ice core records might deliver crucial information about past atmosphere.

Because H_2O_2 readily exchanges with between the ice and the gas phase, the transfer function of H_2O_2 between snow and the atmosphere is crucial to understand and predict the large-scale importance of its chemistry in snow, its exchange with the atmosphere, and its fate in ice-cores. Characterizing the physical exchange of H_2O_2 between the snow grains and the surrounding air has consequently received much attention in laboratory studies. In one type of studies that focused on short time scales, a detailed description of the adsorption equilibrium between the gas phase and ice was derived. These studies, done on very thin ice films, indicate that H_2O_2 exclusively adsorbs to the surface. Earlier studies with packed snow samples, published 30 years ago, have shown a different picture of the H_2O_2 interaction with snow, where surface adsorption and accommodation into the bulk ice governed the overall uptake in long-lasting experiments. The situation where uptake of a trace gas to snow can be driven by several processes with different time scales is typical for the interaction of a number of trace gases with snow. Describing both processes in detail is thus a key-issue in current research. Generally, the uptake occurring on short time scales in thought to be caused by surface adsorption; slow transfer behaviour is related to uptake to the bulk. As H_2O_2 is not soluble in solid ice crystals, the bulk uptake is thought to occur into grain boundaries. Characterizing the uptake of trace gases to ice on different time-scales and identifying the compartment to which trace gases are taken up in snow are essential, but open questions.

In this study the H_2O_2 uptake to thin ice films was investigated over long time-scales of hours, thus combining features of previous experiments. A long-lasting uptake of H_2O_2 to thin ice films is observed for the first time. The initial component of the overall uptake agrees perfectly with the parameterisation of surface adsorption derived in the previous study on thin ice films. The total uptake that was observed in this study agrees with the pioneering study on H_2O_2 uptake to backed snow samples. The total amount of H_2O_2 taken up by the ice film via this slow process might easily exceed the adsorbed H_2O_2 under environmental time scales.