Geophysical Research Abstracts,
Vol. 11, EGU2009-2132, 2009
EGU General Assembly 2009

The Effect of Strong Acids on the Ice – Air Interface Studied by X-Ray Photoelectron Spectroscopy

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Chemical processes on ice in snow and cirrus clouds are important for atmospheric chemistry, biogeochemical cycling of trace constituents and archiving of trace species in ice. It has been suspected since long that trace contaminants affect the thickness of the quasi-liquid layer at the ice - air interface, which is at the heart of the interactions between snowpacks or cirrus clouds and the surrounding air.

HNO_3 is highly soluble in water and has a strong affinity to ice. It has been suggested to be a source of NO and NO_2 through photolysis. HCl is a key species in stratospheric ozone depletion through its reaction with chlorine nitrate on ice or within liquid particles.

Using surface sensitive techniques, X-ray photoelectron spectroscopy (XPS) combined with near edge X-ray absorption spectroscopy (NEXAFS), performed at equilibrium pressures in the temperature range of 220 to 250 K, we investigate the effects of HNO_3 and HCl on the local hydrogen bonding environment at the ice surface. These gases were dosed at concentrations low enough to stay within the ice stability regime of the phase diagram.