Geophysical Research Abstracts, Vol. 8, 02270, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02270

Laboratory studies about the interaction of ammonia with ice crystals

I. Hoog (1), K. Diehl (1), S.K. Mitra (1), and S. Borrmann (1, 2)

(1) Institute of Atmospheric Physics, University of Mainz, Germany; (2) Max Planck Institute for Chemistry, Mainz, Germany (hoog@mail.uni-mainz.de)

Ammonia as the only inorganic base is one of the most important trace gases in the atmosphere. It is characterized by good water solubility and, therefore, plays an essential role in the acid-base-interactions of cloud and rain water. In the present investigations the interactions of ammonia with ice were studied by means of single ice crystals to simulate atmospheric conditions for in-cloud and below-cloud scavenging. In a first series of experiments dendritic ice crystals were grown from water vapour in presence of ammonia gas in various concentrations (4 to 400 ppbv) at temperatures around -15°C and super-saturations of about 15 %. In a second series of experiments pure ice crystals grown from water vapour without ammonia were exposed to an ammonia-air mixture inside a small horizontal flow tube. The influence of temperature (-7°C and -20°C), ammonia gas concentration (0.6 and 1.5 ppmv) and exposure time on the ammonium production at the ice surface was examined. In both series of experiments, the ammonia uptake was quantified by determining the ammonium content in melt water of ice crystals by ion chromatography. The results showed that during the growth of ice crystals significant amounts of ammonia (around 200 μg/L) were taken up even at small gas concentrations. In opposition to that, even at higher gas concentrations the uptake of ammonia on non-growing ice crystals was approximately one order of magnitude lower than during the growth of ice crystals. Further experiments indicated that the surface properties of the ice crystals play a meaning role in the adsorption process. Surfaces with impurities such as sulphate show an enhanced ammonia uptake. Results showed a factor of 5 to 10 more ammonium in the melt water of those contaminated ice crystals. However, even the increased uptake of ammonia in ice is rather small compared with the uptake in water droplets.