Geophysical Research Abstracts, Vol. 7, 02904, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02904

Evidence for significantly enhanced uptake of gas-phase HNO_3 by growing ice surfaces

M. Ullerstam and J. P. D. Abbatt

Department of Chemistry, University of Toronto, 80 St. George St., Toronto, ON., M5S 3H6, Canada

(mullerst@chem.utoronto.ca / Fax: (416)-946 7359 / Phone: (416-946 7359)

It is widely known that ice surfaces can scavenge different trace gases, such as nitric acid, as well as take part in heterogeneous reactions in the atmosphere. Previous laboratory studies of gas-to-ice uptake have been performed on "static" ice which is at equilibrium with the immediate environment, i.e. no net deposition or evaporation is occurring. However, ice surfaces frequently undergo cycles of both net growth and evaporation. For the first time, uptake measurements of HNO_3 to ice surfaces undergoing growth by vapour deposition at atmospherically significant rates have been performed.

In particular, the uptake was studied using a coated-wall flow tube coupled to a chemical ionization mass spectrometer, at nitric acid partial pressures between 10^{-7} and 10^{-6} hPa, and at 230 K. Ice surfaces were prepared as smooth ice films from ultrapure water. During the experiments an excess flow of water vapour was added to the carrier gas flow and the existing ice surfaces grew by depositing water vapour. Growth rates from $0.5 - 5$ μm min^{-1} have been employed which represents a common growth rate for an ice particle in a cloud.

With growing ice the long term uptake of nitric acid is significantly enhanced compared to an experiment performed at 100% RH_i. The fraction of HNO_3 that is deposited onto the growing ice surface is independent of the growth rate and appears to be driven by the solubility of the nitric acid in the ice rather than kinetics.