Geophysical Research Abstracts
Vol. 17, EGU2015-7031, 2015
EGU General Assembly 2015

Water Accommodation on Bare and Coated Ice

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A good understanding of water accommodation on ice surfaces is essential for quantitatively predicting the evolution of clouds, and therefore influences the effectiveness of climate models. However, the accommodation coefficient is poorly constrained within the literature where reported values vary by up to three orders of magnitude. In addition, the complexity of the chemical composition of the atmosphere plays an important role in ice phase behavior and dynamics.

We employ an environmental molecular beam (EMB) technique to investigate molecular water interactions with bare and impurity coated ice at temperatures from 170 K to 200 K. In this work, we summarize results of water accommodation experiments on bare ice (Kong et al., 2014) and on ice coated by methanol (Thomson et al., 2013), butanol (Thomson et al., 2013) and acetic acid (Papagiannakopoulos et al., 2014), and compare those results with analogous experiments using hexanol and nitric acid coatings. Hexanol is chosen as a complementary chain alcohol to methanol and butanol, while nitric acid is a common inorganic compound in the atmosphere.

The results show a strong negative temperature dependence of water accommodation on bare ice, which can be quantitatively described by a precursor model. Acidic adlayers tend to enhance water uptake indicating that the system kinetics are thoroughly changed compared to bare ice. Adsorbed alcohols influence the temperature dependence of the accommodation coefficient and water molecules generally spend less time on the surfaces before desorbing, although the measured accommodation coefficients remain high and comparable to bare ice for the investigated systems. We conclude that impurities can either enhance or restrict water uptake in ways that are influenced by several factors including temperature and type of adsorbant, with potential implications for the description of ice particle growth in the atmosphere.

This work was supported by the Swedish Research Council and The Nordic Centre of Excellence CRAICC.

Reference:

X.R. Kong, P. Papagiannakopoulos, E.S. Thomson, J.B.C. Pettersson, Water Accommodation and Desorption Kinetics on Ice, J. Phys. Chem. A, 118 (2014) 3973-3979.

E.S. Thomson, X. Kong, N. Markovic, P. Papagiannakopoulos, J.B.C. Pettersson, Collision dynamics and uptake of water on alcohol-covered ice, Atmos. Chem. Phys. 13 (2013) 2223-2233.

P. Papagiannakopoulos, X.R. Kong, E.S. Thomson, J.B.C. Pettersson, Water Interactions with Acetic Acid Layers on Ice and Graphite, J. Phys. Chem. B, (2014) doi: 10.1021/jp503552w.