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The hydrogen bonding structure of adsorbed water on feldspar substrates monitored by in-situ spectroscopy

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The hydrogen bonding structure of adsorbed water on a solid substrate may control deposition nucleation, which is a pathway of heterogeneous ice nucleation, but may also reflect the interface between the solid and liquid water relevant for immersion freezing. The hydrogen bonding structure may be affected by short and long-range interactions between the substrate and the adsorbed water molecules. Electron yield near edge X-ray absorption fine structure (NEXAFS) spectroscopy at the oxygen K-edge is used to experimentally explore the difference between the hydrogen bonding structure of H_2O molecules under different conditions of temperature and water vapor pressure. Experiments reported in this work were performed at the in-situ electron spectroscopy endstation at the NANOXAS beamline at the Swiss Light Source (PSI, SLS). We report electron yield oxygen K-edge NEXAFS spectra and X-ray photoelectron spectraof adsorbed water on milled feldspar samples under subsaturated conditions with respect to ice. As substrates, we have chosen two feldspar samples: Potassium containing feldspars (Microcline), which has been considered as an important mineral dust for ice nucleation in mixed phase clouds. On the other hand, sodium-rich feldspar is believed to have contrasting ice nucleation ability. Hence, for the adsorbed interfacial water layer on the surface, we expect a different hydrogen bonding structure under subsaturated condition respect to ice due to potentially different interactions between water molecules and the surface structure of the two different feldspars. Under isobaric conditions and by varying the temperature of the sample, we can change the relative humidity with respect to ice, which leads to varying amounts of reversibly adsorbed water in equilibrium between the substrate and water vapor. Preliminary results show that, under different relative humidity, the weakly and strongly coordinated OH bonds of adsorbed water on feldspars show different contributions to the Auger electron yield NEXAFS spectra, that is, the resonant transitions near the oxygen K-edge vary with relative humidity and temperature.