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Laboratory studies of ice chemistry: uptake of trace gases and onsets for deposition nucleation

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Two topics will be presented in this talk to illustrate ongoing laboratory studies related to ice chemistry. In the first half, recent studies on the uptake of trace gases by ice will be presented, with a focus on nitric acid and small VOCs. Interactions of this type may lead to removal of these trace gases in the atmosphere, or else to their redistribution. Studies at low partial pressures of nitric acid indicate smaller uptake-to-ice that at high partial pressures, more in line with aircraft observations in the field. However, the situation is complicated by two further observations. Experiments indicate that growing ice takes up considerably more nitric acid than does an ice surface that is not experiencing net growth. Presumably a metastable solution is forming. Also, the effects of the quasi-liquid layer on the enhanced uptake of VOCs appear to be substantial at high temperatures, close to freezing. In the second half, new results for the relative humidity onset of ice formation via deposition nucleation will be presented for a range of substrates, including mineral dust, solid ammonium sulfate, and model organics. We find that there is a strong dependence of the onsets on the total particulate surface area available, indicating that there is no single threshold value for ice formation for each material.