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Quasi steady relative humidities and relaxation times in natural cirrus and AIDA ice clouds

Martina Krämer(1), Stefanie Schlicht(1), Alexander Mangold(1), Iulia Gensch(1), Cornelius Schiller(1), Nikolai Sitnikov(2), Volker Ebert(3), Harald Saathoff(4), Ottmar Möhler(4)

(1) FZ Jülich, Institute for Chemistry and Dynamics of the Geosphere I: Stratosphere, Jülich, Germany; (2) Central Aerological Observatory, Moscow Region, Dolgoprudny, Russia; (3) University of Heidelberg, Institute of Physical Chemistry, Germany; (4) FZ Karlsruhe, Institute for Meteorology and Climate Research, Karlsruhe, Germany
(Contact m.kraemer@fz-juelich.de)

The relative humidity with respect to ice (RH_{ice}) inside cirrus is high at ice formation and then starts to decrease by water transport to the growing ice crystals. Measurements show that in many cases RH_{ice} remains in the range of 100%-180% inside the cirrus with a tendency to higher values in colder clouds. Recently it is discussed if these high RH_{ice} inside cold cirrus are in thermodynamic equilibrium. Here, we investigate, based on the theoretical framework provided by Korolev and Mazin (2003, JAS 60, 2957-2974), quasi steady relative humidities in ice clouds (RH_{qsi}, equilibrium relative humidity at $\frac{dRH_{ice}}{dt} = 0$, traditionally called quasi steady relative humidity) and the respective relaxation times τ_p in the temperature range 180-230K for natural cirrus and for ice clouds formed in the aerosol chamber AIDA (Forschungszentrum Karlsruhe, Germany).

We present preliminary results, showing that the quasi steady relative humidities (RH_{qsi}) can increase with decreasing temperature to values clearly above saturation for both natural cirrus and AIDA ice clouds. The supersaturation raises with decreasing integral ice particle size ($N_i\overline{R_i}$) and increasing updraft velocity (u_z). The relaxation times (τ_p) are very fast (in the range of seconds) for higher temperature, updraft velocity and for a large number of small particles but increases to the range of hours with decreasing temperature. Comparison with field data show good agreement between measured and calculated RH_{ice}.