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The Accommodation Coefficient of Water Molecules on Ice and its Role for Cirrus Clouds

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One of the parameters governing the growth of ice crystals in cirrus clouds is the accommodation coefficient of water molecules on ice. However, its magnitude is still unclear, since experimental results vary from below 0.01 up to unity depending on the design of the experiment and the examined ice growth process [1]. Values below 0.01 could be an explanation for the observation of unexpectedly high ice number concentrations and persisting supersaturations within cirrus clouds [2].

For the ice crystal growth in cirrus clouds, no previous experimental studies regarding the accommodation coefficient exist. Therefore, dedicated experiments were carried out at the cloud simulation chamber AIDA [3], examining the ice crystal growth for deposition nucleation in the temperature range from -75 ˚C to -40 ˚C. These experiments were evaluated with two different models, the Simple Ice Growth Model for determining Alpha (SIGMA) and the more advanced and extended Aerosol-Cloud-Precipitation Interaction Model (ACPIM) [4].

The outcome of these two models is compared to absolute in-situ humidity data measured within AIDA using extractive as well as open path diode laser hygrometers (TDLAS) [5]. For each experiment, best-fit values for the accommodation coefficient are obtained and the respective overall uncertainties are estimated by a Monte Carlo analysis.

First results indicate that the accommodation coefficient is larger than 0.1 in the examined temperature range. According to previous model studies [6], this suggests that the accommodation coefficient has no significant influence on ice crystal growth and ice number concentrations in cirrus clouds.

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