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Microphysical properties of cirrus clouds between 75°N and 25°S derived from extensive airborne in-situ observations

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Numerous airborne field campaigns were performed in the last decades to record cirrus clouds microphysical properties. Beside the understanding of the processes of cirrus formation and evolution, an additional motivation for those studies is to provide a database to evaluate the representation of cirrus clouds in global climate models. This is of importance for an improved certainty of climate predictions, which are affected by the poor understanding of the microphysical processes of ice clouds (IPCC, 2013).

To this end, the observations should ideally cover the complete respective parameter range and not be influenced by instrumental artifacts. However, due to the difficulties in measuring cirrus properties on fast-flying, high-altitude aircraft, some issues with respect to the measurements have arisen. In particular, concerns about the relative humidity in and around cirrus clouds and the ice crystal number concentrations were under discussion. Too high ice supersaturations as well as ice number concentrations were often reported. These issues have made more challenging the goal of compiling a large database using data from a suite of different instruments that were used on different campaigns.

In this study, we have have addressed these challenges and compiled a large data set of cirrus clouds, sampled during eighteen field campaigns between 75°N and 25°S, representing measurements fulfilling the above mentioned requirements. The most recent campaigns were performed in 2014; namely, the ATTREX campaign with the research aircraft Global Hawk and the ML-CIRRUS and ACRIDICON campaigns with HALO. The observations include ice water content (IWC: 130 hours of observations), ice crystal numbers (N_{ice}: 83 hours), ice crystal mean mass size (: 83 hours) and relative humidity (RH_{ice}) in- and outside of cirrus clouds (78 and 140 hours). We will present the parameters as PDFs versus temperature and derive medians and core ranges (including the most frequent observations) for each parameter. The new large data sets confirm the earlier results presented by Schiller et al. (JGR, 2008), Krämer et al. (ACP, 2009) and Luebke et al. (ACP, 2013), which are all based on much smaller datasets. Further, we will show the geographical and altitude distribution of IWC, N_{ice}, R_{ice} and RH_{ice}.