EGU22-7146
https://doi.org/10.5194/egusphere-egu22-7146
EGU General Assembly 2022

Parametrization of In Situ Cloud Particle Size Distributions Including Small Particles

Irene Bartolome Garcia[1], Odran Sourdeval[2], Martina Krämer[1,3], and Reinhold Spang[1]
[1]Institute for Energy and Climate Research (IEK-7), Research Center Jülich, Jülich, Germany (i.bartolome@fz-juelich.de)
[2]University of Lille, CNRS, UMR 8518 - LOA - Laboratoire d'Optique Atmosphérique, Lille, France
[3]Institute for Physics of the Atmosphere (IPA), Johannes Gutenberg University, Mainz, Germany

The cloud particle size distribution (PSD) is a key parameter for the retrieval of microphysical and optical properties from remote sensing instruments, which in turn are necessary for determining the radiative effect of clouds. Current representations of PSDs for ice clouds rely on parameterizations that were largely based on in situ measurements where the distribution of small ice crystals (sizes smaller than 100 µm) were at best very uncertain. This makes current parameterisation inadequate to simulate remote sensing observations sensitive to small ice, such as from lidar or thermal infrared instruments.

In our study we fit the cloud particle size distributions (PSDs) of JULIA (JÜLich In situ Aircraft data set)*' **. This data set consists of 11 campaigns covering the tropics, mid-latitudes and the Arctic. For the fitting, we implement the method presented in the works of Field et al. (2005, 2007) and Delanoë et al. (2005, 2014) (referred as D05 and D14). The method consists on computing several moments of the measured in situ PSDs, use them to normalize the in situ PSDs and then fit the normalized PSDs to a certain function. Following D05 and D14, we use the normalization coefficients Dm (volume-weighted diameter) and N_0^* (intercept parameter) and a modified gamma function F(α, β, X). To find the right pair of α and β, first each in situ PSD is normalized using a random combination. Second, the observed ice water content (IWC) and number concentration (N) and the IWC and N obtained from the normalized PSDs are used to compute a cost function (J). The best α, β pair is the one that delivers the minimum value of J. The main advantage of this work is that it provides a fitting including small particles, since the used data set covers sizes from 3 – 1000 µm

From this method, we provide an improved representation of PSDs that will be useable in retrievals schemes to estimate with greater accuracy ice cloud properties sensitive to the concentration of small ice crystals, such as N.

* see presentation of Krämer, M., Spelten, N., Afchine A. and Spang R.: Occurrence patterns of cloud particles sizes in cirrus and mixed-phase clouds; EGU 2022.

** see presentation of Spang, R., Spelten, N. and Krämer, M.: A database of microphysical and optical properties of thin to thick cirrus clouds derived from bimodal particle size distributions;

EGU 2022.