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Atmospheric Measurement Techniques Discussions

Interactive comment on "Airborne validation of radiative transfer modelling of ice clouds at millimetre and sub-millimetre wavelengths" *by* Stuart Fox et al.

Anonymous Referee #2

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In this work, the authors perform a closure study trying to bring together observations in the submillimeter wavelength region taken by the ISMAR airborne demonstrator for ICI with radiative transfer simulations performed with the ARTS model and its accompanied single scattering database. The aim is to validate the radiative transfer setup, model, and the scattering database.

The manuscript nicely shows how difficult it is to perform such closure studies that try to match observations and models. This starts with the availability of appropriate instrumentation on suitable platforms and campaign setups that could provide all variables to constrain the atmosphere sufficiantly to accomplish the task. Evenmore, finding

suitable cases is not always possible.

Fox et al. present a work that faces some of these problems. By the instrument setup with having lidar for profile information only for low IWC and time shifted Nevzorov probe and insitu measurements on a limited number of levels, it is rather hard to constrain the atmospheric column. Especially for time shifts of up to one hour between remote sensing and insitu. As they mention themself, additional instrumentation like a radar and a second aircraft with the insitu probes flying more closely in time to the remote sensing suite, would have helped a lot.

Concerning the presented radiative transfer simulations with different particle types, I do not fully agree with the authors that the measured and simulated brightness temperatures are in the same range and represent the same variability. Strictly I would say, this is only the case for a few frequencies or parts of the flight legs. Although, they mention it is not within the scope of the study, one could consider varying the particle type along the legs or when flying in different altitudes as indicated by the paticle images. The extensive description of the particle habits in the database indicates the possibility of doing so. Here the shape information of the insitu probes could have been taken more into account.

In summary, the closure study did not succeed to find a match between observations and simulations over the whole measured spectrum and IWP range presented here.

I would recommend using the scan information provided by ISMAR if there are measurements under different angles during these flights. By this the study can be brought closer to ICI and could give information about orientation. It is too bad that interesting receiver channels did not work properly to perform a more in depth investigation of particle orientation.

448 +/- 1.4 Ghz is left out because the weighting function peaks very high in the atmosphere. Since the flights are very close to the clouds and high in the atmosphere, it might be worth taking them into account, eventhough the signal due to ice particles

scattering might be even smaller than in the other channels.

The influence of the surface in 243 GHz could be reduced by slanted simulations and observations. Over ocean it should be anyway possible to estimate the influence of the surface to a good degree. Especially in comparison between clear and cloudy sky, surface signal might not play a big role.

The derivation of the profiels of ice water content is not fully clear to me. I would appreciate of (average) profiles or time series of the IWC or IWP as utilized in the radiative transfer could be shown.

To my knowledge, there are coordinated flights of the BAe-146 with ISMAR on board with other aircraft like the HALO carrying water vapor lidar, radar and additional passive microwave instruments. Could these measurements help to constrain further the atmosphere and therefore the vertical distribution of ice water?

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