

Interactive comment on “Cirrus clouds in convective outflow during the HIBISCUS campaign” by F. Fierli et al.

F. Fierli et al.

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General comment:

The paper has been substantially re-written following the reviewers comments. To the author's point of view this should lead to a more readable paper and to clearer conclusions. The comparison between the Lidar observations and the water vapour data provides significant elements for the analysis; this shows the presence of ice supersaturations up to 140% in absence of ice clouds and lower values inside the clouds. Observed RHI helps to further interpret the lidar data and to formulate an hypothesis on the estimated age of the cloud based on the water cloud content and the backscatter ratio. The analysis shows that mesoscale models, despite the use of parameterizations, provide a good qualitative explanation of the observations.

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The major revisions of the paper are:

- MODIS observations were added in Fig. 2 and erroneous definition of aerosol optical thickness has been amended - The water vapour observations from SDLA are thoroughly discussed and compared to the lidar data in Figure 4. – The ECMWF trajectories are no longer included and have been replaced by trajectories derived from the Bolam simulations to take into account convective transport. – Model microphysics is now discussed in model description section. – Bolam model is compared directly to BRAMS (Marecal et al, ACP, same issue) and to SDLA water vapour in Figure 6 where the BOLAM ice water field is also shown. – We have skipped the tracer transport analysis in the revised version since the main conclusions are now inferred from the trajectory analysis: this is done to simplify the argumentation flow and to clarify the result interpretation. – The discussion and conclusion on the results are completely rewritten.

With respect to the specific points raised by the reviewer:

The ECMWF trajectories are no longer included in the paper. We now use the BOLAM trajectories that take into account the convective uplift. They are useful to identify the different ice water behavior for adjacent air masses and convective history. This also helps to simplify the discussion in which the eulerian tracer analysis is no longer needed.

The microphysical parameterization and results are now discussed in the paper. The Schultz scheme which is used in the Bolam model was designed to take into account the cloud processes. It is dependent on parameters that can be adjusted to fit with the upper tropospheric ice clouds dynamics and microphysics. Moreover, we performed a sensitivity analysis to show that the main factor controlling ice water in the model for this event is convective uplift in the convection parametrization. The details and the results are given in the answer to referee # 4. We decided to exclude this discussion from the paper since the main focus is given on the role of transport and convection in

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the formation of different typologies of cirrus.

Specific Comments:

- 1./ The threshold D value for aspherical particles is 10%
- 2./ RHI data are now included. In order to harmonize the publications within the HI-BISCUS special issue we decided to leave a detailed discussion of the Micro-SDLA measurements in the revised version of the paper Durry et al.
- 3./ The ECMWF trajectories (and Omega equation discussion) are no longer included in the revised version.
- 4./ The BOLAM RHI is now compared with the microSDLA data and with the BRAMS model results. See also general comments.
- 5./ The WMO reference saturation pressure is given by Goff and Gratch (1946) while saturation pressure over ice is calculated with Marti and Mauersberger formula. This is now detailed in the text.
- 6./ Different formulations of Hybrid coordinates are widely used in both limited-area and global models to treat the flow on the orography. We consider that the description of the vertical coordinates used (and described in the references) would lengthen the section without providing an information useful for the discussion.
- 7./ RTTOV (Radiative Transfer for TOVS) is a widely used fast radiative forward model that simulates the signal measured by meteorological satellites from thermodynamic and cloud parameters. The reference provided in the paper is the one prescribed by the developers. Further information can be found in http://www.metoffice.gov.uk/research/interproj/nwpsaf/rtm/rtm_rttov8.html. We have added "radiative" in the text to the definition of the RTTOV8.5 model. We believe that a longer description of RTTOV is not useful for the paper's aims.

The technical corrections have been included in the paper.

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