Atmos. Chem. Phys. Discuss., 7, S7549–S7552, 2007
www.atmos-chem-phys-discuss.net/7/S7549/2007/

Atmospheric Chemistry and Physics Discussions

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

F. Fierli et al.

Received and published: 10 December 2007

General comment:

The paper has been substantially re-written following the reviewers comments. To the author8217;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 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 paramterizations, provide a good qualitative explanation of the observations.

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 - The ECMWF trajectories are no longer included and have been replaced by trajectories derived from the Bolam simualtions to take into account convective transport.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:

1./ MODIS data at 16h30 UTC have been added and discussed. "aerosol optical depth" has been corrected to "optical depth". The scale has also been changed according to the reviewer8217;s comments.

2./ To our opinion, the statistical differences between lidar layers shown in figure 3 is reinforced by the water vapour observations. Figure 4 provides the classification for the vertical profile showing that there are two cirrus typologies that are different on both statistical and physical bases. The box line size in figure 3 is reduced to ease readability of the figure.

3./ The water vapour data are now included. The correlation between lidar and SDLA brings new important elements for the interpretation. Shibata et al. work provides useful elements for this analysis. Fig. 9 and 10 are no longer included in the paper.

4./ The key parametrizations of the Schultz microphysical scheme that are used in the

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model are now described. It is important to note that BOLAM gives supersaturation in presence of cirrus clouds and that supersaturation is driven by convection. Kain Fritsch parametrization can lead to supersaturation in presence of intense uplift. RHI values are reduced below 100 % by parametrized ice fall and sublimation that requires several model timesteps to be effective. To complete the microphysical analysis, we have performed a sensistive study to three key parameters for ice formation: (a) ice formation supersaturation level increased to 120%, (b) halved ice cloud fall speed, (c) simulation without parametrized convection. Simulations were averaged inside the eastern yellow box shown in Fig. 6, left panel of the revised paper. Profiles are shown for the last model timestep (00 UTC Feb. 25). The results (attached figure) shows that the first two sensitivity runs (run (a) and (b)) have a small impact on the RHI and cloud ice (qi) vertical profile and uncertainty on their values do not change dramatically the overall outflow structure. Convection clearly plays the main role determining the modelled distribution of RHI and qi.

5./ The ice cloud simulated by BOLAM are now fully integrated in the paper and used to interpret the lidar data. Fig. 6 included both ice water field and vertical profiles, Fig. 7 reports ice clouds along the trajectories and Fig. 8 reports the location where ice is formed.

Figure caption: Left: Ice water (black) and cloud water (red) for reference simulation (solid lines), simulation (a) (dashed lines) (b) (dotted lines). Right: as Left but for RHI (black lines) and RH (red lines)

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 6737, 2007.

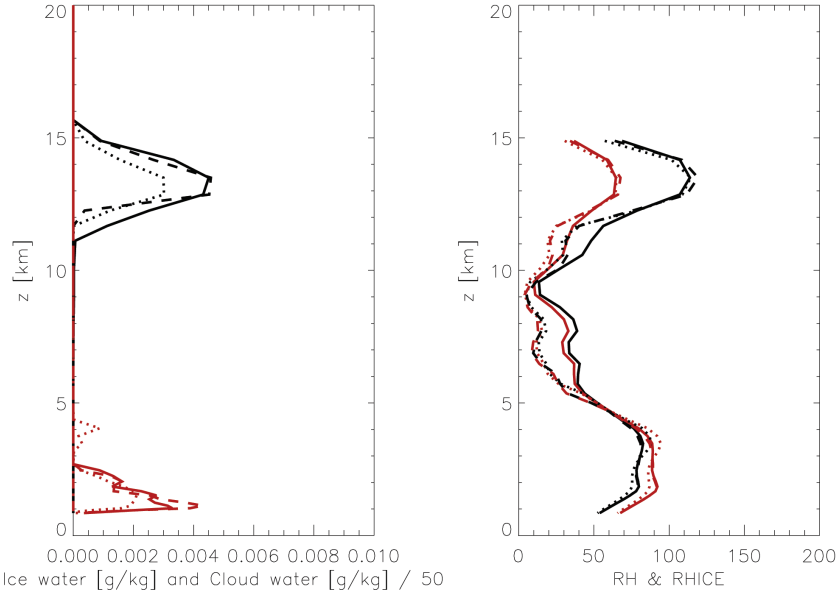

Figure 1:

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