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Geoscientific Model Development Discussions

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Interactive Comment

Interactive comment on "GEWEX Cloud System Study (GCSS) cirrus cloud working group: modelling case development based on 9 March 2000 ARM SGP observations" *by* H. Yang et al.

Anonymous Referee #1

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General comments:

The main subject of this manuscript is the development of a case study of a mid-latitude cirrus cloud which is intended to become a reference case for the evaluation of existing and future cirrus models. The comprehensive dataset of the 9 March 2000 ARM IOP includes remote sensing, radiosonde, and aircraft measurements and is supplemented by an extensive effort to derive the most appropriate large scale forcing. The availability of retrieved ice water path in conjunction with ice number concentration, and fall velocity, offers valuable constraints to evaluate model performance. The authors make the effort to determine the ambient conditions during cloud formation, i.e. vertical velocity and water vapour distribution, predominantely controlling the cirrus microphysical properties, to their best knowledge. To complete the manuscript initial numerical simulations with the UK Met Office LEM model (1D - 3D) for the cirrus case are presented. It is shown that the model is able to reproduce the retrieved ice water path, allowing for a natural evolution of the cloud under the deduced forcings.

I think this work is worth publication in ACP as a very valuable basis for model evaluation and a reference case for future model development. However, as the exact meteorological conditions and ice-precursor (aerosol) composition are almost impossible to derive from data sets, a discussion of uncertainties and missing information in the case setup would be very useful. This may help as a basis to discuss deviations between models runs of different cirrus models.

Specific comments/revisions/questions:

(1) Given the radar retrievals as one major tool to evaluate the model results, could you please discuss how accurate the retrieved values of ice water path, number concentration, and fall speeds are? As you mention particle size distribution is used as input in the retrievals. Are the assumed distributions compared to the psds obtained during the flight legs of the aircraft measurements? Further shape assumptions have to be made. Is there any information on the error bars belonging to the according values of iwc and so forth?

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(2) Which water vapour profiles from the radiosonde sounding are used? According to Miloshevich et al. (2001), there exists a correction to the radiosonde data leading to higher relative humidities than assumed in your simulations. This may allow for the homogeneous nucleation pathway.

(3) Could you please introduce a paragraph of available (or non-available) information on the aerosol properties for that day. Different nucleation formulations in the models may leed to differing results. Could you constrain the IN availability? Further, could you add the nucleation parametisation used in your model?

(4) In the power spectrum in Figure 5: Is there an indication of the gravity wave signal which may confirm your assumption that gravity wave forcing is the dominant contribution to cloud evolution? As the cirrus layer intensifies at later times, I assume a large scale updraft should be present or at least evolve at later times.

(5) In Figure 13: The retrieved ice water mixing ratio shows a bimodal structure. This may be linked to a dryer layer in the moisture profile, which is evident in radiosonde data. Why is your ice water mixing ratio profile so smooth?

(6) When comparing your model results to the measured values you may use pressure as vertical coordinate. Then you do not have to account for the vertical displacement of your semi-lagrangian domain.

(7) Why don't you use the calculated generalised effecive size for the optical properties in your radiation module? Are the results sensitive to this assumption?

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Minor remarks:

In Figure 4: Could you please highlight the cloud structures you are referring to in the plots?

p. 2756 line 10: using
p 2770 line 13: involve
p 2770 line 19: The intention of

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