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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of a global-climate model simulation to a cloud-system resolving model simulation for long-term thin stratocumulus clouds" *by* S. S. Lee et al.

Anonymous Referee #2

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The manuscript presents numerical simulations of a marine atmospheric situation characterized by formation of stratus clouds that evolve further into cumulus. Numerical simulations are carried out with a relatively detailed cloud resolving model, that accounts in some way for aerosol, aerosol activation and cloud microphysics, and a global climate model in which aerosol and cloud processes are parameterized in a relatively simple way. The CRM reproduces the cloudy episode relatively consistent with measurements, whereas the GCM fails to represent the intricate boundary layer dynamics that lead to the formation of cumulus from the stratus.

The cloudy episode is presented in detail, with attention for heat and radiation fluxes, LWC and LWP, and aerosol concentrations. The dynamics and microphysics are described in a clear and convincing manner. The comparison with the GCM is also very clearly presented. Of course it is no surprise that the more detailed model performs better than a GCM, with relatively coarse resolution and highly parameterized microphysics, but it is highly illustrative to compare the performances of both models with detailed attention for all relevant parameters. The figures are clear and of good quality. The manuscript is certainly suitable for publication in ACPD and ACP. I have a few minor comments that need to be considered.

Specific comments

Section 2. CSRM contains a sophisticated aerosol activation scheme, but the representation of aerosol in the model is not clearly explained.

page 12307. The last sentence before 6.5: "condensation provides liquid water as a source ...." can be formulated more clearly.

Fig. 8a/b: How do you explain the large LWP variability in the GCM compared to MODIS and the CSRM? And how do the approximate accuracies/uncertainties associated with the retrieval of the MODIS LWP and droplet size compare with the model-observation discrepancies?

Section 3.I missed information on the vertical resolution of the GCM in the relevant atmospheric domain.

According to Fig. 18, the condensate in CSRM*2 is about 10% different from CSRM. On page 12308 it is mentioned that the average cloud drop sizes in both simulations are 10 and 16 micron, respectively. Are these numbers really correct? Firstly, for an average size of 16 micron, larger than the precipitation threshold of 14 micron, significant precipitation might be expected. Secondly, to achieve more or less the same liquid water content for these sizes, the amount of activated particles in CSRM*2 must be about fourfold the amount activated in CSRM. However, for a doubling of initial aerosol I ex-

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Interactive Comment

pect something in the order of 20-80% more (as is shown in Fig. 19a), dependent on the circumstances, but not fourfold. Precipitation formation can not explain this, since it is demonstrated that precipitation formation is rather unimportant throughout most of the CSRM simulation.

Summary and conclusions, p. 12315 “The role of autoconversion .... is negligible when spectral information ... is considered”. The study uses an idealized gamma-distribution, which may or may not be consistent with an actual droplet size distribution. What is the impact of this particular choice?

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 12283, 2009.