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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Why do GCMs overestimate the aerosol cloud lifetime effect? A comparison of CAM5 and a CRM" *by* Cheng Zhou and Joyce E. Penner

Anonymous Referee #1

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This paper discusses the aerosol cloud life time effect for the diurnal cycle of Stratocumulus clouds over the ARM SGP site, and comparing the results by a cloud resolving model with those of a GCM. They find that entrainment related evaporation can dominate the autoconversion reduction with increasing aerosol concentration, a mechanism not typically observed in GCMs. In general, I find this paper well written, understandable and novel, so I recommend publication in ACP after some questions are addressed. Particularly, I am worried about the 50 to 100m horizontal resolution of the CRM, and the 30+ m in the vertical; in most LES intercomparisons of SCu, a much higher resolution is used, particularly to resolve the sharp interface of the SCu top entrainment. Do the authors have a good feel for how well their CRM is converged? The

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Discussion paper

other major question that I have is about the case that they chose. It is a complicated SCu case, with a strong diurnal cycle, and an a-typical qt profile. So why this case, and do you feel it is representative for cloud life time effects across the globe? Perhaps a slightly less generic title would help to lower the expectations here. Other points: 1) It is not very clear from your introduction that you are talking about Stratocumulus, and probably of the kind that barely precipitates. I would make that more clear in the introduction. 2) How does your work compare with the DYCOMS results, and the papers by Andy Ackerman et al? (e.g., Nature, 2005 and MWR, 2009) 3) P2, l 14: Make sure to name your models, and to expand properly 4) P3: I am missing a description of your boundary layer scheme here. This is likely a crucial part of information for the GRM entrainment (or lack thereof). 5) Since your resolution is on the lower side for the cloud top: What is your advection scheme in GCE? 6) Also, I have to ask: Is the fact that you are using a bulk micro physics scheme an issue here? 7) P5, l 10: The linear decrease in aerosol means that you have a decreased CCN concentration in the Boundary Layer of of about 5%, if my math is correct. Why make that change? 8) P7, l 1: Could you plot the cloud cover as well? The dynamics may very well change as a function of aerosol (or model), for instance moving between cumulus and stratocumulus here. 9) P7, l 18: To mitigate concerns about this particular case, it could be nice to quickly look at a second one as well. But at the very least, a bit more discussion about the dynamics of this case would be appreciated. (e.g., is it decoupled? What is the w2 profile? How much precipitation do you observe as a function of height) 10) Why do the observations in Figure 1 show no diurnal cycle? 11) P8, l 22: You state that some differences are likely because of details in the microphysical model. I understand that you cannot get those perfectly identical, but did you do a parameter study to get a feel of this sensitivity? 12) P9, l 21: "..50m to 100km. . ." Should be meter, (I hope)

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