

Interactive comment on “The role of the retention coefficient for the scavenging and redistribution of highly soluble trace gases by deep convective cloud systems: model sensitivity studies” by M. Salzmänn et al.

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Received and published: 14 February 2007

We appreciate the review by this referee and agree that the comparison should focus more on ARM LSF and ARM A BUB. Although using bubbles can lead to very efficient transport of released tracers, it can not be ruled out that for STERAO the higher elevation above mean sea level also plays a role (see also reply to Referee #2). To this end the discussion in Section 5 has been extended to the ARM A BUB case (see also Figs. 10 and 12 of the revised manuscript), and Fig. 9b regarding the STERAO case has been replaced by the corresponding figure for the ARM A BUB case (Fig. 13b of the revised manuscript).

In the abstract, the sentence “This result indicates that previous cloud resolving model studies using bubbles to initiate deep convection may possibly have over-estimated the influence of the retention coefficient on the vertical transport of highly soluble tracers.” has been changed to

“A comparison of the two ARM runs indicates that using bubbles to initiate deep convection may result in an over-estimate of the influence of the retention coefficient on the vertical transport of highly soluble tracers.”

The corresponding sentence in the conclusions has also been changed accordingly.

Furthermore, the description of the ARM A BUB run (Sect. 3.2.1 of the revised manuscript) has been extended to include a better description and motivation of this run:

“... The relatively warm bubble in the ARM A bubble (“ARM A BUB”) run results in a rather short lived single cell storm (Fig. 3b) with a top below 12 km above mean sea level (MSL), while the cloud tops in the run with large scale forcings were higher (see Section 5). A few sensitivity runs starting from other initial profiles based on observations during the 4-day ARM A episode yielded even shorter lived storms (not shown). If, on the other hand, large scale forcings were applied in addition to the bubble in the relatively short “ARM A BUB” run, much higher cloud tops and longer lived systems developed (not shown), reflecting the importance of the large scale forcings in the ARM case. The ARM A BUB run was designed as a sensitivity experiment in order to estimate the effects bubbles can in principle have on the transport of soluble tracers.”

The discussion of Colorado thunderstorm in Sect. 6 has been extended including potential effects of the terrain height on the scavenging of soluble tracers in the STERAO case.

Note that efficient transport of non-retained tracers in bubble runs is also consistent with findings from some preliminary studies for idealized meteorological initial profiles

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which are not included in the manuscript. The difference in cloud water mixing ratio at low levels between the ARM A LSF and the ARM A BUB run is attributed to differences in the inflow regions. Much of the cloud water in the LSF runs co-exists with rain. Consequently, it is difficult to judge which simulation is more realistic based on observed radar reflectivities. We believe that the LSF runs are a fairly good presentation of reality for the ARM A and the TOGA COARE case. However, especially regarding the bubble runs we also recognize the need for further studies for different cases with a more realistic initiation of deep convection e.g. considering effects of orography in a nested model setup. The latter has been indicated in the abstract of the revised manuscript. Such nested runs are planned within the framework of a future study. However, the setup of these runs still requires a large amount of preparatory work. To our knowledge, neither nested nor LSF runs have been used in previous studies investigating the role of the retention coefficient.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 10773, 2006.

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