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Atmospheric
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Discussions

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. Salzmann et al.

Anonymous Referee #1

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1 General comments

This paper is devoted to the impact of deep convective clouds on the scavenging and redistribution of highly soluble tracers. The originality of the paper is to confront various simulations at high resolution. Each simulation is representative of various dynamical environments (continental vs. oceanic) and forcings (large scale forcing vs. warm bubbles). As in Salzmann et al. (ACP, 2004), the authors emphasize the sensitivity

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of simulated convection to the large-scale forcings. In this paper in particular, they qualify the sensitivity of the redistribution of soluble tracers to the dynamical forcings and to the retention coefficient of tracers in freezing hydrometeors. The authors find that the dynamics and thermodynamics properties of the convection in case of large-scale forcings are less favorable to the increase of high soluble tracers in the upper troposphere than warm bubbles simulations, independently of the retention coefficient. The only exception is for tracers having non-zero mixing ratios above the cloud water and rain levels. The paper is well written and the scientific methods and assumptions are valid and clearly outlined. This paper deserves publication to ACP after some minor corrections detailed below.

2 Detailed comments

Abstract
If I understand well, as mentioned in section 5, one main process which drives the differences between the simulations in term of scavenging efficiency is the dynamics of the inflow regions. This should be stated in the abstract.

2. Model description
The authors may want to shorten this section. In particular, the equations (3) to (7) can be find easily in the literature.

3. Model setup and meteorological overview
l16: I suggest to move the paragraph "The Henry's law coefficients (...) all sensitivity runs" to the section where the scavenging processes are described (Model description).
3.2 The ARM runs:

l24: too -> to

Figure 3: the modelled boundary layer is dryer and colder than the observations. Could it be that the prognostic turbulence scheme is less efficient in the ARM case ? This could lead to an underestimation of the inflow fluxes for the ARM cases. More generally, is it possible to get an estimation of the boundary layer height from the simulations ? It could be an important parameter to understand the differences between the simulations for the boundary layer tracer.

4. Transport of highly soluble tracers

Figure 4 is the key figure of the paper. I would have expected a decrease of boundary layer mixing ratios for the insoluble tracer as it is transported upward (mass conservation). It is effectively the case for the T1 tracer (except for ARM BB: why ?) but not for the T2 tracer. Is it a consequence of the averaging method over cloudy and non-cloudy air parcels ? How can T1 tracer escape the scavenging by raindrops (for the STERAO case for example which shows an increase of T1 in the upper troposphere)?

6. Additional sensitivity runs and discussion

In the paper Mari et al. (2000), the authors emphasise the potential role of entrainment of environmental air at different levels in the cloud (not only entrainment below the cloud base). Do you see such effect in the simulations at high resolution?

l25 tropsphere -> troposphere

The following references could be added:

* Stuart AL and Jacobson MZ, A numerical model of the partitioning of trace chemical solutes during drop freezing, JOURNAL OF ATMOSPHERIC CHEMISTRY 53 (1): 13-42 JAN 2006

* Stuart AL, Jacobson MZ A timescale investigation of volatile chemical retention during hydrometeor freezing: Nonrime freezing and dry growth riming without spreading JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES 108 (D6): Art. No.

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* Voisin D., D.C. Montague, and G. Vali, Hydrogen peroxide retention in rime ice, J. GEOPHYS. RES., 105, 6817-6836, 2000.

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

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