**Atmospheric
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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 #5

Received and published: 21 November 2006

Review of "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., submitted to Atmos. Chem. Phys. Discuss.

This paper discusses sensitivity tests with a model to conclude that, by initiating a cloud by large scale forcing (LSF) rather than convective bubbles, scavenging by deep convection is reduced significantly, independent of the retention coefficient.

Although the paper has some interesting aspects to it, I do not believe it provides

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sufficient new science nor is it conclusive about a physical process.

The scientific conclusion is that the treatment of LSF versus bubbles to initiate convection results in a different level of scavenging. If true, this is a somewhat trivial scientific conclusion similar to a conclusion that treating a cloud more physically with liquid plus ice gives a result better than treating it with liquid only or solving chemistry with 10 equations rather than five gives a better result. Both LSF and bubbles are model parameterizations, with LSF arguably more physical, but still not physically correct itself. For example, just resolving the model over a much larger domain would eliminate the need to use LSF and provide a more physical result still and possibly a different result.

The result that the treatment of LSF to initiate convection prevents tracers from reaching the upper troposphere depends entirely on the specific model used and the conditions for the cases tested. The model used treats cloud microphysics and gas processes too simplistically for the conclusion to be believed with confidence. For example, it ignores both gas and aqueous chemistry and does not include size resolution of the hydrometeor categories. As such, it does not treat the microphysics or chemistry of the clouds physically. It is easily possible that, with more physical treatment of clouds and precipitation, the results would change.

Further, the results may depend on the types and/or location of storm. While some cases have been selected, there is not a distinction between, say supercell versus other less severe thunderstorms versus ordinary thunderstorms, where updrafts and downdrafts are not tilted), or squall line versus dryline, or results for different seasons and a sufficient number of different locations. It is also not clear what happens when pollution levels are high versus low. As mentioned though, because the result is model dependent, using the same model for these different cases would still result in the uncertainty as to whether more complete physics and chemistry would change the result.

Third, as mentioned, since large-scale forcing is really a parameterization, it is not clear

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how results would change if the large scale was resolved

Additional comments.

Except for the STERAO run, where it was held constant, was KH calculated or just KV? Was a minimum value set? If so, was this necessary to keep the model stable?

"Unfortunately, very large uncertainty still exists about the retention coefficient of H2O2. H2O2 also depends significantly on aqueous-phase oxidation in the liquid phase, which is not treated in the present study. Since the clouds examined undoubtedly contained supercooled liquid water, all results for H2O2 are moot. They would change by treating aqueous oxidation, which itself will depend on the gas concentrations, which would require gas chemistry to determine. The lack of gas and aqueous chemistry, again, is a serious shortcoming.

Equation 9. How is R(k,j) determined?

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

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