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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Modelling the reversible uptake of chemical species in the gas phase by ice particles formed in a convective cloud" *by* V. Marécal et al.

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Subtancial criticisms

The parameterized coefficients given in Huffman and Snider (2004) could be useful for models and we will study the possibility to include them in a 3D model. Nevertheless, the objective of this paper is limited to assess the importance of trace gas uptake in the cold part of a convective cloud (temperature lower than 235 K). This is the reason why we do not use the coefficients proposed by Huffman and Snider (2004). We mention this work in the revised version and explain why we do not consider it in the model runs.

In this paper we emphasise the fact that this study is preliminary and aims at estimating the possible importance of the uptake process for different species in typical atmospheric convective conditions to prepare its introduction in the 3D model. In the case of the Langmuir approach, the mixing ratio in the gas for a constant total mixing ratio is an instantaneous parameter independent of the history along the trajectories. In the trapping theory, the trapping rate and the evaporation rate are also instantaneous parameters. From these parameters it is possible to assess the importance of the uptake process. The accurate evolution of the gas species along the trajectories is out of the scope of this paper. We added some text in the introduction and at the beginning of section 3.3 to insist on this point. We nevertheless compute the evolution of the gas mixing ratio on the trajectories to illustrate the results but we agree that the assumption of a constant total mixing ratio of each trace gas conserved along the trajectories is not fully satisfying. From the 3D meteorological model fields we cannot derive/estimate the total gas variations along the trajectories. Loss by hydrometeor sedimentation from the considered trajectory point is one of the processes which leads to the variation of the total mixing ratio (gas + ice) but the total mixing ratio will also be modified by the hydrometeor sedimentation from above the trajectory point and also by turbulent mixing. From the 3D meteorological model fields, it is not possible to predict the evolution of the gas removal/increase along the trajectories by these processes. A 3D simulation including tracer transport is required for this.

Other criticisms

p.24365: The sentence has been removed in the revised version of the paper

p 24365: We agree that bullet 2 must be removed but not bullet 4. Degassing is possible by sublimation also at low temperature. Bullet 2 is removed in the revised version of the paper

p 24364 and 24364, l24: We agree that it is surprising that ozone is large in the ice phase. It is what the author (Wang, 2005) claimed but he is aware that his results could be uncertain due to the very approximate gas uptake coefficients used (i.e. ignoring



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surface equilibrium by considering only accommodation). We added this remark in the revised version of the paper to say this.

Figures 1 and 2: Changes are done in the revised version of the paper

P 24367 and 24368: D and ïĄĞïĂăïĂžïĂăïĄŤheir definitions are now given here in the revised version of the paper. P 24366, l17: correction done in the revised version

P 24370: We had some text in the revised version to say that the term “dry ice” does not refer in this paper to the commonly used colloquialism for solid CO2. In the definition of the “graupel” ice category of the BRAMS microphysics code it is said (Walko and al., 1995) that it is allowed to carry a small fraction of liquid. It is the reason why we do not include this category in the “dry ice” category. We agree with you that this fraction is probably very low/negligible in the cold conditions we are analysing and that graupel could be added to the “dry ice”. We include a new section in the revised version (new section 5) of the paper to discuss this point. We conclude that there is a negligible impact of graupel in the langmuir and trapping uptake. This is because of their relatively high density and their small surface compared with other “dry ice” categories for the same mixing ratio.

P24371: correction done in the revised version

P24372: nG is used in equation (5) which is part of equation (4) so we think that it can be defined before equation (4). The typos in the parenthetical definition of nG and nS are corrected in the revised version

P24373: correction done in the revised version

Figure 6: Points have been removed and the curves are now extrapolated in the range 200-235 K. The temperature range for which laboratory data are available is given in Table 1. Text has been changed accordingly.

Equation 9: Yes, this has been done in the revised version



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P 24377: We agree. It has been corrected in figure 7 (figure 8 in the revised version) and in the figure caption.

P 24379 : correction done in the revised version

P 24380: corrections done everywhere in the revised version

P 24385: correction done in the revised version

P 24386 : correction done in the revised version

Throughout: "concentration" has been changed, where appropriate, to "mixing ratio"

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 24361, 2009.



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