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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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Specific comments

We agree that the gas uptake is clearly underestimated in our calculations in the part of the cloud where liquid droplets and droplets containing both ice and water are prevalent (mainly where temperature is above 235 K). We say clearly in our paper that our objective is to discuss the trace gas uptake by dry ice below 235 K where there is no or rarely liquid drolets. In a 3D model we will include the uptake of trace gases by liquid droplets and by mixed droplets (ice + water) as well as trace gas uptake by dry ice. From the definition of the ice categories in the BRAMS microphysics code, the graupel

category is allowed to carry some fraction of liquid. This is the reason why we do not consider strictly this category as dry ice. At temperatures below 235 K this fraction of liquid could be nevertheless very low and graupel could therefore be included in the definition of the dry ice. In the revised version of the paper we added a section (section 5) to discuss of the possible impact of graupel on the trace gas uptake at temperature below 235 K. It is found to be negligible.

Caption of Fig. 1 Correction done in the revised version.

P24364 Line 22. We agree that it is surprising that ozone is so 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. We added this remark in the revised version of the paper to say this.

P24368. Line 8 . In the 3D-model ice crystal shape/size for snow and pristine ice categories equilibrates with changes in T and RH. As explained page 24375 lines 14 to 19, we have only assumed one type (shape) of ice crystals along the trajectories for snow and one for pristine. This allows us to clearly interpret the results (that would be difficult if the type of crystals could change at each trajectory point). For both snow and pristine ice, the type chosen is the hexagonal column since the output of the 3D simulation clearly showed that the dominant type of ice crystals by far was the hexagonal columns. We have changed section 3.2 to make this clearer in the revised manuscript. In the 3D model ice crystals are advected along with the air parcels but also undergo sedimentation for snow and aggregates. In the trapping calculations discussed in section 4.3, the gas mixing ratio and the trapped trace gases into the bulk of the ice are computed assuming that the total mixing ratio (gas + ice) is conserved along the trajectories and that the evolution of the gas mixing ratio and of the bulk mixing ratio is possible only by trapping and by evaporation. This is not fully satisfying because we do not take into account sedimentation and turbulent mixing but this is convenient to assess the importance of the ice uptake process. In the trapping calculations the important parameters are the trapping rate and the evaporation rate which are quan-

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titative evaluations of the importance of trapping and sedimentation at each timestep of the simulations. We added some text in the introduction and at the beginning of sections 3.3 and 4.3 to insist on the fact that the objective of the paper is to assess the importance of gas uptake. The accurate calculation of the evolution of gas mixing ratio along the trajectories is out of the scope of this paper. In 3D BRAMS calculations that will be done in the future the sedimentation and the turbulence mixing will be taken into account.

Page 24373 Line 22. Correction done in the revised version.

Page 24374 Line 25. Correction done in the revised version.

Page 24379 Line 3. The sentence has been changed in the revised version.

Figures 4 and 5. In the revised version we have added a figure (new figure 7) showing the total surface area on each trajectories. In section 3.3 the HCl mixing ratio in the gas phase is now firstly compared with the total surface area.

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

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