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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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Major comment

About your suggestion to publish the paper to Goescientific Model Development instead of ACP, we agree that it could be a possibility. But we prefer an ACP publication because it fits well into the ACP SCOUT-O3 Special Issue since it is the fruit of a collaborative effort between laboratory scientists and atmospheric chemistry modellers within SCOUT-O3 project.

Specific points and questions

1. Page 24368. Lines 8-10. As stated in the paper, the ice crystals shape is diagnosed in the 3D model at each grid point at each timestep as a function of temperature and relative humidity. We agree that in nature the ice crystal shape would depend on its history. But it would be very complex in the bulk microphysical scheme used which describes the hydrometeor size distribution with an analytical function to take into account the ice shape history. It would also be computing time and storage consuming. The revised manuscript addresses this point.

2. P24370. Lines 1-4. 2. P24370. Lines 1-4. In the present paper we do not feel that it is important to include a plot of the radiosounding used since the focus is on ice uptake within a typical tropical convection cloud and not on the study of a specific convective case. To create this typical convection cloud we use the radiosounding to set tropical atmospheric conditions in which we prescribe a moist/warm perturbation in order to develop a convective cloud with realistic extension and ice contents. The sounding used was chosen because it was not showing any particular important feature like a stratospheric intrusion (this information is given in the revised version). Any other typical tropical radiosoundings could be used instead without altering the interpretation of the uptake results.

3. Section 2.4. Your understanding is right. We have modified the revised version (section 2.4) to clearly indicate that the information from the 3D model (temperature, water vapour and ice mixing ratios, ice concentrations) is interpolated along the trajectories and is then used in a box model for the Langmuir and trapping calculations. We agree that an alternative method would be to calculate the microphysical fields in a cloud parcel model from winds, temperature and humidity. Since the future objective of this work is to introduce trapping in the BRAMS cloud model, it is better to use directly the microphysical fields from BRAMS to ensure a full consistency with the BRAMS microphysics.

4. P24378. Indeed this is due to the partition coefficients, which describe the propensity of the trace gases to stick to ice and are controlled (in part) by the strength of

hydrogen bonds between polar substituents of the trace gas and the ice surface.

5. P24379. Line 11. No, we did not state that the uptake coefficient is well correlated with the ice mixing ratio. We state that the uptake efficiency of HCl is in correlation with the ice mixing ratio. The correlation coefficient is now given in the text. As for liquid droplet, the surface area to volume ratio of the small crystal of pristine ice is larger than the surface area to volume ratio of the larger crystal of snow. But, contrarily to the liquid droplet, the surface area to volume ratio of pristine ice is lower than that of the large aggregates crystals. This is shown in Figure 7 (the presentation of this figure has been changed to be more understandable). As explained in the text (end of the part 3.2) this is because the surface of an aggregate particle is higher than the surface of a pristine ice with the same volume.

6. As stated in point 3, we cannot take into account in the calculation done in the paper the history of cloud physics processes (e.g. effect of aggregation) along a trajectory. The box model calculation along the trajectories we did only allowed us to evaluate the order of magnitude of the ice uptake for different species in order to prepare its introduction the 3D BRAMS model. Once uptake will be included in the BRAMS model it will be possible to make a detailed study of the impact of microphysical processes.

Technical details

1. The coefficients A and B used for the gas adsorption partition coefficient have been changed to AP and BP. Changes have been also made in table 1.

2. to 9. All other suggested technical corrections are taken into account in the revised version.

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