**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "Parcel model simulations of aerosol – warm phase cloud microphysics interactions over the Amazon" *by* A. A. Costa and S. Sherwood

Anonymous Referee #2

Received and published: 31 January 2005

The paper discusses the development of warm clouds and warm rain in the Amazon region through the use of a simple parcel model. The authors carried out a number of sensitivity simulations to investigate the role of giant CCN (GCCN), Ultra giant CCN (UCCN), vertical updraft and the moisture below clouds on the potential development of rain. The potential was illustrated by the height at which drops reach a size of 24 microns. This was named the simulated warm rain height. The authors observed, as other have shown before, that the production of rain is reduced with increase in CCN concentrations. In addition, they demonstrated that the role of GCCN and UCCN is very important in the initiation of rainfall especially for clouds with high CCN concentrations.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU

Namely, polluted clouds are more sensitive to the incorporation of GCCN and UCCN. Furthermore, they show that for polluted clouds and not for clean clouds, the simulated warm rain height?varies with changes in moisture below cloud base and with updraft.

Comments: The use of a parcel model to simulate rain formation is not appropriate since the parcel model assumes that all particles and drops remain in the ascending volume. Therefore the use of a parcel model is only appropriate for the early development stage of the cloud when the particles are still very small. However, the parcel model is not good for cases in which the drops grow to large sizes because as their masses increase, their fall velocities exceed the updraft of the parcel, and thus they would leave the ascending parcel.

One major flaw in the paper is the use of a prescribed constant updraft. This means that the model only treats the microphysics of the growth and not the effect of the released latent heat. Namely, there is no feedback between the growth and the dynamics. I think that this does not truly describe the processes that take place in the clouds.

Although the criterion used in this paper refers to the height at which the drops reach 24 microns (the simulated warm rain height), the actual calculations used a very wide distribution (see figures 4 and 6). This would suggest that the results could only be used qualitatively to indicate the role of the various tested parameters. Because the real effect of the GCCN and the UCCN could be either larger or smaller than the present paper suggests.

The authors refer to a paper submitted to Earth Interactions. I do not have this paper and I would like to know what method they used to prove that the changes in cloud microphysics affected precipitation. Was radar used or rain gages on the ground? Often the connection between aerosols and rain on the ground is hypothesized or demonstrated with models. If such a prominent place is given to this reference, at least a short paragraph should be given describing the findings and the method used.

The model uses 167 bins for aerosols but there is no discussion about the method

used to nucleate the effective CCN once the critical supersaturation is reached. Are the newly nucleated drops put into the first bin? Are they placed into the bin that corresponds to the critical size in Kohler's equation? When GCCN and UCCN are used, what is the corresponding size of the nucleated drops? Yin et al 2000 used a method that takes into consideration the fact that the largest nucleated drops cannot initially grow fast (in radius). What was done here?

The authors mention that they use the breakup of drops based on Low and List 1962. Again, such large drops cannot remain in the parcel.

The authors use a polluted cloud with CCN concentrations of 60000 cm-3. Isn't it too high?

What are the relative concentrations of the GCCN and UCCN in each of the simulated cases?

Can one keep on adding GCCN and UCCN and keep on increasing the rain efficiency? Or does the effect of these particles reach saturation above a certain concentration?

In Figure 4 - It will be instructive to include the times at which the respective heights are reached.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 481, 2005.