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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relationship between drizzle rate, liquid water path and dropletconcentration at the scale of a stratocumulus cloud system" *by* O. Geoffroy et al.

O. Geoffroy et al.

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We thank the reviewer for his/her constructive comments. Below follow our responses.

1) We don't think cloud fraction has a significant impact, because precipitation is produced at the scale of the convective cell. The suggested relationship reflects averaging precipitation rates over many cells at different stages of their life time. The relationship should therefore remain valid for the cloud fraction of a partially cloudy model grid. We agree that this should be checked with lower cloud fractions over a larger domain. Larger domain simulations are also needed for the case of large convective cells, of a size comparable to the resolution of the present simulation. As shown in Fig. 4, the precipitation rate with such large cells deviates from the proposed relationship and

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shows a cycle that reflects the life cycle of the cell. As mentioned at the end of Sec. 7.1, it is expected that a larger domain, with more cells, will show a similar relationship because the precipitation rate of the present simulation, when averaged over the life-time of the cell, remains close to the relationship. Larger domain simulations finally are needed to look at the transition from the stratocumulus to the cumulus case. Indeed the vertical profiles of the microphysics and the formation of precipitation are different in the two cases. It will therefore be interesting to examine if the relationship is specific to the stratocumulus case, or if it can be extended to more convective systems.

2) In the bulk parameterizations used in LES modeling, the threshold size for collection and coalescence can be expressed by a Heaviside function, for instance in Kessler type parameterizations. Such a threshold could be extrapolated to the scale of a cloud, as long as the size of the biggest droplets, probably close to cloud top, can be predicted for comparison with the critical size for collection. At the scale of a cloud system, with many cells, the size of the biggest droplets is more difficult to predict because it also involves the maximum cloud depth of each cell. In other words, the strong non-linearity of the collection process at the LES scale is progressively smoothed out by the cloud variability, when moving from the LES scale to the single cloud scale and up to the cloud system scale. From the numerical point of view, we don't think that using a threshold, and therefore a step function, is necessary because of the sharp decrease of the precipitation rate at low values of the LWP and at high values of CDNC (Fig. 3)

3) 4) 5) 6) We agree with these comments. We will do the modifications.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3921, 2008.

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Interactive Comment