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Interactive comment on "On the importance of cumulus penetration on the microphysical and optical properties of stratocumulus clouds" *by* S. Ghosh et al.

S. Ghosh et al.

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Referee 2

Specific comments

1) Input aerosol spectra for the 4 sectional runs:

The referee wanted further details on the aerosol distribution for the four sectional runs. We have now added some more details in the revised text (see second column of p 6 of the revised paper). Each spectrum is an average over a 7 minute run which corresponds to about 42 kms in horizontal distance. The aerosol data for the four separate runs contained 30 bins each. This ranged from the smallest bin size of 0.055 μm to the largest bin with a size of $22.75 \mu m$. The accumulation mode aerosol size distributions were measured with a PCASP-100X probe and the coarse mode with FSSP. Although the peak number concentration were located at $0.137 \mu m$ radius, i.e. centred around the accumulation mode for all the 4 runs, the number concentrations showed a great deal of variability, particularly within the first 3 runs - the peak concentrations were 1574, 1188, 1265, and 1574 cm^{-3} respectively. Since the number concentrations in the coarse mode were small, the variability in the coarse mode concentrations were much less apparent - for example for a bin size of 1.75 μm the number concentrations were 0.3, 0.34, 0.285, and 0.33 cm^{-3} respectively.

In addition we have also clearly spelt out how the dynamics could have affected the differences in the resultant drop size distribution in addition to the differences in the dry aerosol input spectra in the four runs (see second column p 6 of the revised paper). The key dynamical factor that caused the variability can be attributed to the differences in the updraught speed. It is important to note that although the peak number concentration for Run 1 and Run 4 were the same, the average updraught speeds were quite different (0.66 and 0.58 ms^{-1}) respectively. The other two dynamical factors, i.e. the RH and the temperature at the cloud base were roughly the same for the 4 runs (99$\%$ and 12.5^{o}C). When entrainment effects are included, the variability in the updraught speeds causes a greater variability in the overall microphysical development because, in the simple model used, the mass dilution due to entrainment is directly proportional to the updraught speed (Mason and Jonas 1974). Based on all these above facts, it is abundantly clear that differences in the updraught speeds were the greatest contributing factors for the microphysical variability within the four sectional runs.

2) Entrainment effects :

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This issue has now been adequately dealt with -see our responses to referee 1 major comments 2-3 as well as specific referee 2 comment 1 above.

3) The referee has queried the relative importance of chemical versus dynamical effects (via cloud top entrainment).

We have now included further lines to briefly touch upon this point (see top of column 2 p 7 of the revised paper). We mention that tests with variable soluble mass fraction, can yield a quantitative estimate of the sensitivity of the microphysical development due to the presence of internally mixed aerosol particles. Only then can we quantitatively specify whether chemical effects are comparable in magnitude to the entrainment effects. However, it is reasonable to believe that the latter effect is likely to be dominant. Entrainment of dry air at the cloud top would have a great propensity to evaporate the smallest droplets at the cloud top. We shall examine these issues in a future study with a bin resolved large eddy model.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 4611, 2004.

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Interactive Comment