The goal of this paper is to estimate the mass fractions of entrained and detrained air at a number of levels using data gathered by aircraft in 176 shallow, non-precipitating, warm cumulus clouds. The clouds were sampled by flying through as many as possible at different constant altitudes. The analysis uses moist static energy derived from the aircraft observations for each cloud penetration, which depends on the measurement of temperature in cloud. However, there is no mention of the instrument used and the problems documented in the literature associated with sensor wetting. The description of how detrained and entrained masses at specific levels are calculated is not clear.

Specific comments

1. p21787, l10: Murphy et al did not specifically mention vertical transport. Is Stainforth et al 2005 a better reference?

2. Line 17: It is not clear what process the authors believe detrainment can potentially dominate. The reference to Wang and Geerts seems inappropriate.

3. p21788, lines 9-10: The location of the studies, the environment, type and depth of clouds studied should be mentioned.

4. Line 19: It is not clear what is meant by "similar results for two clouds."

5. Lines 19-21: The statement does not summarize the main results of the study that are of most relevance to the current work.

6. Lines 26-29: It should be stated that the cloud system studied was capped by an inversion.

7. p21789, lines 4-9: The authors should make their arguments clearer. Raymond et al for example mention rapidly rising tops.

8. Lines 9-15: Since calculations were performed at each level using radar data it seems, presumably the statement here simply means on one side of the cloud.

9. p21790, line 1: The statement does not account for the presence of downdrafts.

10. p21791, lines 25-28: The sample rate of the chilled mirror dew point hydrometer should be given. What instrument was used to measure temperature? The problem of wetting should be discussed. There could be large errors in the quantities if there was a wetting problem. Furthermore, cloud regions may not be saturated as assumed. A criterion has been described in the literature using the cloud droplet probes. Also the instrument errors should be given along with an estimation of the errors in the analysis.

11. line 30 - p21792, line 1: The temperature of typical cloud bases and tops should be given. How were the altitudes of cloud top and base measured?

12. p21792, End of 2.1: Details should be given in Section 2.1 about the calculation of the environmental, in-cloud and cloud-base values of moist static energy and the assumptions and errors.

13. p21793, lines 1-6. I think it would be better to delete the paragraph and simply say that the clouds did not precipitate. The first part is obvious and the second is speculation that requires further analysis.

14. Lines 7-18: The paragraph should be shortened considerably.

15. p21794, lines 9-21: The text should say that MSE is only approximately conserved in a moist adiabatic process.

16. p21795, Assumptions 1 and 2: The assumptions perhaps paint a simplistic picture. The net effect of entrainment may be lateral in an Earth frame, but air is likely to have traveled vertically with respect to the ascending turret. It is well known that clouds have downdrafts at their edges.

17. p21795, lines 26-27: It is not clear what is meant by only applying to the cloud slice and not the entire cloud. The mass at a given level depends on entrainment and detrainment that occurred at all levels en-route to the level of interest. It is not clear how the method allows detrainment or entrainment at a particular level to be determined.

18. p21796, line 24: These points do not necessarily represent unmixed air that can be taken as the "cloud base" point. There have been several papers showing that the properties of updrafts below cloud base are different from those away from a cloud.

19. p21798, Figs 3-8. Are all the figures necessary? Perhaps it would be better to show only 2. The main results are shown in Figs 10 and 12.

20. p21799, line 21: The errors in the normalization should be given.

21. p21800, lines 14-15: Detrainment often gives rise to thin cloudy detrainment layers. Is it possible that pilots avoided these levels in order to get a better view of the clouds?

22. p21801. The discussion on this page should come after the assumptions have been tested and errors quantified. For example, it is discussed that the observed larger amount of entrainment in the upper portion of the cloud is consistent with the shedding thermal model, whereas it is assumed in the calculations that air is entrained laterally at each aircraft level.

23. Lines 3-9: The authors should clarify why a moister environment leads to a larger value of m_o.

24. Lines 11-13: Lu et al found that shallow clouds "exhibit quasi- adiabatic regions extending from cloud base up to 0.5 1 x cloud depth (H)." The idea of cores existing for a few diameters should be discussed.

25. Lines 20-24: Is the entrained air uniformly mixed with the adiabatic mixed-layer air?

26. p21802, lines 3-5: Also if the aircraft pass was across shear and perhaps only the growing part of the cloud was sampled.

27. p21803, lines 2-5: There are only a few points in the left-hand diagram of Fig 13 that are significantly different from zero. Is it meaningful to discuss means?

28. p21804, lines 15-16: The statement should be qualified: a limited number of levels were sampled and the clouds were from a particular environment.

29. Figs 15 and 16: It is interesting that the only negative buoyancy occurs in the upper levels. It is also surprising that the mean positive buoyancy is so large (Fig 15, z = 2100 m). It would be good to show a few time series with temperature, liquid water content and updraft speed. This is also relevant to the point raised about the wetting of the temperature probe.

30. p21805, lines 19-20: If air descended until it was neutrally buoyant and then detrained as suggested by Carpenter et al, why are the values of m_d not larger?