

## ***Interactive comment on “Relationship between level of neutral buoyancy and dual-Doppler observed mass detrainment levels in deep convection” by G. L. Mullendore et al.***

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Reviewer's comments on “Relationship between level of neutral buoyancy and dual-Doppler observed mass detrainment levels in deep convection” by Mullendore et al. (2012) submitted to ACP for publications

General comments:

This is a nice study that followed up the author's 2009 publication (which analyzed a single case from TRMM-LBA). Now, they've extended the analysis to 9 cases and evaluated the time evolution of the detrainment and level of neutral buoyancy (LNB). Deep convective outflow and detrainment play an important role in regulating upper-

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tropospheric heat and trace gas budgets. Yet, a detailed understanding is still lacking concerning the characteristics of the detrainment and factors that control it. LNB as determined from the ambient sounding is usually taken as a first guess of the detrainment level. This study (as well as Mullendore et al. 2009) used dual-Doppler radar to conduct an in-depth analysis of the deep convective detrainment and a number of interesting results have been found. I believe this study will contribute to the literature in terms of providing important observations of the deep convection detrainment. On balance, the manuscript is publishable after some minor revisions. Some specific comments:

1. A recent study by Takahashi and Luo (2012, GRL) approached a similar line from satellite perspective. They analyzed thousands of convective objects observed by CloudSat cloud-profiling radar (CPR) over a period of 2.5 years. Some of their conclusions are similar to this ground-based study. However, satellite observations allow for a global analysis, adding new insights into the problem. For example, Takahashi and Luo (2012) showed that the detrainment or outflow characteristics are different between tropical land and ocean, with land convection having stronger core pushing the outflow level closer to the LNB. The authors should cite that paper. It is downloadable from [http://www.sci.ccny.cuny.edu/~luo/publications/Takahashi\\_Luo\\_2012GL052638.pdf](http://www.sci.ccny.cuny.edu/~luo/publications/Takahashi_Luo_2012GL052638.pdf).
2. (p21269, Lines 1-2) PBL air parcel can't make it to the upper troposphere “within minutes”. If we assume the updraft speed is 10 m/s, it will take the air parcel 30 min to get to the 15 km altitude. Unless it rises at a constant speed of  $\sim 100$  m/s, it's hard to finish the journey within minutes.
3. (p21271, Lines 25-26) Aren't these resolutions a little bit too coarse for ground-based radar? Even space-borne radar can achieve such spatial resolutions.
4. (Table 1) It will be nice to show a few cases in details including radar scan and satellite images (satellite images can be easily downloaded from <http://dcdb.ssec.wisc.edu/inventory/> for any historic dates). This will give the read-

ers some synoptic view of the systems being analyzed. Fig. 1 alone is not enough.

5. (p21274, Lines 2-4) So, is it assumed that water droplets are turned into ice crystals above the 0 °C level or -38 °C level?

6. (p21275, Lines 6-8) Why is it regarded as “the most representative LNB”?

7. (p21277, Line 1) It would be nice to give an estimate of the areal coverage of the positive vertical velocity in relation to the whole storm. The Arakawa-Schubert (1974) parameterization assumed that the areal coverage of the updrafts is negligible (compared to the GCM grid size). Is this true from observations?

8. (p21277, line 6): Is LMD 12.1 km or 12.3 km? Fig.2 mentioned the LMD is approximately 12.3 km.

9. (Fig. 3) These three levels are related, respectively, to the LNB\_CTH, LNB\_maxMass, and LNB\_CBH as defined in Takahashi and Luo (2012). They give the range of deep convective detrainment. The results should be compared to Takahashi and Luo (2012).

Signed by Johnny Luo, CUNY

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