

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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Thank you for taking the time to review this article and the many useful suggestions for improving clarity and content. In particular, thank you for highlighting Takahashi and Luo (2012), a very relevant article that we weren't aware of at the time of the original submission. Responses to specific suggestions are detailed below.

Please note that Dr. Sarah Tessendorf has been added as a co-author as she was mistakenly omitted from the original draft. Dr. Tessendorf conducted the dual-Doppler processing for several of the cases presented in the article.

1. *The authors should cite Takahashi and Luo (2012).*...

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Reference to Takahashi and Luo (2012, TL12) has been added to section 1, section 3, section 4 and section 5. Note that in this article we do not use reflectivity as a proxy for detrainment (as was done in Mullendore et al., 2009, and TL12), but the findings of TL12 are very intriguing, and the ability to expand the theory to a global data set is exciting.

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 ~100 m/s, it's hard to finish the journey within minutes.*

Yes, this statement was incorrect and has been corrected to say "tens of 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.*

Those are standard resolutions for ground radar grids (as referenced previously in this same section). A references note has been added to this sentence. Note that while some processing techniques provide better vertical resolution near the surface (e.g. 0.25 km; NMQ NEXRAD radar mosaics), even those have lower resolutions aloft (~2 km). Also, while space-borne radars achieve somewhat better higher vertical resolution, 0.5 km is better horizontal resolution.

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

The original Fig. 1 showing a horizontal cross-section of reflectivity of a single supercell case has been expanded to now show both a supercell and convective line case, with the addition of a vertical reflectivity view, and a visible satellite overview. Additional text has been added to sections 2.2, 2.3 and 2.4 in reference to this expanded figure.

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Although different synoptic conditions may lead to different storm types, the details of such synoptic differences do not directly impact the analysis of mass transport in the storms themselves, so we feel further details are not needed in this article. For further details on synoptic conditions, we refer the reader to previous analyses of these cases, as already referenced in section 2.4.

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?*

The calculation of parcel ascent including ice processes follows the work of Bryan and Fritsch (2004). Their methodology allows for mixed phase between 0 and -40 degrees C. The lack of reference to this work was a significant oversight, which has now been corrected, and additional text has been added to this paragraph.

6. (P21275, Line 6-8) *Why is it regarded as “the most representative LNB”?*

This was flagged by both reviewers and needed more explanation. Text has been added to this paragraph to better demonstrate how the most representative sounding was identified.

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?*

This is somewhat beyond the scope of the current study, as no special analysis was done to quantify the depth of particular updraft, e.g. the possible signal from elevated dissipating MCS updrafts (p21279, lines 11-15). However, this question of updraft size in relation to storm complex is being investigated currently in two different studies: 1) an observational study of radar-classification of deep convective transport using the cases presented here, and 2) a study of deep convective transport in high-resolution regional simulations.

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

There was an error in the figure caption for Figure 2. The LMD at 23:57 UTC is 12.1 km (dashed line), and the mean LMD is 12.3 km (solid line, and as stated in Table 2).

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).

Further reference to Takahashi and Luo (2012) has been added to section 5. Offsets between the three detrainment levels are compared between the two studies. As noted in the discussion, these three levels are based on velocity retrievals only, not on reflectivity. Further testing of the relationship between the velocity retrievals and various methodologies for retrieving the reflectivity anvil are currently being conducted (extension of the work in Mullendore et al. 2009).

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