ACPD-15-8479-2015
Responses to Reviewer 2 (anonymous)
Date: 9 July 2015

Title: A numerical study of convection in rainbands of Typhoon Morakot (2009) with extreme rainfall: roles of pressure perturbations with low-level wind maxima
Authors: C.-C. Wang, H.-C. Kuo, R. H. Johnson, C.-Y. Lee, S.-Y. Huang, and Y.-H. Chen

1. General comments:

This manuscript investigates the formation and evolution of deep convection inside Typhoon Morakot's rainband using CReSS model. The authors then discuss the back-building mechanisms and how the distributions of the dynamical pressure favored the new development of updraft on the west side (upstream) of a mature cell. The results appeared plausible and in general consistent with observations.

This paper should be accepted for publication after major revision. Specific comments are listed below.

Reply:

We appreciate the positive views and critical comments from all three reviewers, and have revised the paper accordingly. Among the changes, we have (1) added the diagnostic results at 0645 UTC (besides 0630 UTC) to show a dominant and persistent effect from the dynamical pressure perturbation in the mature cell, (2) employed 10-min radar CAPPI data at 3 km to show the back-building and merging behavior of convective cells, and (3) estimated the contribution from convection versus stratiform clouds over Taiwan plain area in the event. In addition, the figures are polished and font sizes enlarged, the method of diagnosis is validated, the scale of the low-level jet is clarified, the cold pool is examined, and the evolutions of model convective cells are discussed in more detail, as suggested.

The changes in the manuscript are marked in red, blue, and green for Reviewer 1, Reviewer 2, and Reviewer 3, respectively. The modifications made by ourselves during the revision are in orange (mostly to correct mistakes), and those made during the production stage of ACPD since our first submission (to meet the format requirements) are in pink. The point-by-point responses to each of the comments/suggestions from this reviewer are listed below.

2. Major comments:

1. The authors should be congratulated with this great simulation. What is the

potential for CReSS to perform real-time TC prediction?

Reply:

Thank you for the nice comment. In fact, the CReSS model has been used to perform real-time weather forecasts for several years and recent results of the first author (C.-C. Wang) demonstrate its superior capability particularly in quantitative precipitation forecasts (QPFs) for extreme rainfall events brought by the TCs. A few published works are also cited for reference (Wang et al., 2013b; Wang, 2014, 2015).

2. It is somewhat disappointing that the authors did not compare their results with ample radar observations on this particular rainband. Although radar observations were shown in Fig. 4, it would be helpful to show observed cells indeed went though this sequence. Some of the black arrows (indicating the sequence of back building) in Fig. 4 are not obvious. It is difficult to compare vertical velocity (Fig. 8) with reflectivity (Fig. 4). Perhaps the authors can pick one or two cells in the radar observations to demonstrate their life cycle.

Reply:

In the revision, series of CAPPI reflectivity observed by the Chigu radar (location marked in Fig. 3a) at 3 km every 10 min over two 30-min periods (0510-0540 and 0620-0650 UTC) on 8 August 2009 are used in Fig. 4 to replace the old figure, and these plots can better depict the back-building and merging behavior of the cells embedded inside the rainbands in the observation. Also, the faster moving speed of new cells (to the west) than the old cells (to the east) can be clearly seen prior to their merger. The description in text is also modified accordingly.

3. Please clarify the meaning of LLJ. Was this LLJ a synoptic scale feature that this rainband took advantages of growing on top of it or it was a mesoscale feature accompanied by this rainband. For example, did each rainband in the simulation accompanied by a distinct LLJ or the LLJ is a scale larger than the individual rainband. The formation and/or the source of the LLJ may be one of the key issues to characterize this type of rainband.

Reply:

In the revision, it is clarified that the LLJ was a part of the TC circulation but was also most likely enhanced by the southwesterly monsoon (cf. Fig. 3a), as suggested. Also, while the westerly LLJ forms in response to the convergence within the TC flow and with the monsoon (mainly the confluence in *v*-wind) in the background and thus is stronger toward the east (cf. Figs. 7 and 10a), the deep convection still exhibits significant modulation effects on the local wind field and give rise to the speed couplets (Figs. 9 and 10a). In the revision, the above phenomena and their relationships are described more clearly and explained in more details.

4. The figures are hard to interpret with distance represented in longitude. The authors should consider using km rather than lat and lon for the axes. Other than Fig. 9, there is no distance scale in other figures.

Reply:

The lengths of the vertical cross-sections in Fig. 10a and b and Fig. 14 (old Fig. 13) are given in the caption, and distance scales are also added in Figs. 12, 13, 15, and 16 (old Figs. 11, 12, 14, and 15) as well as the newly-added Fig. 17 in the revision, as suggested.

3. Minor comments:

1. Fig. 9 can include a vertical motion plot as panel (c) rather than having to refer back to Fig. 8a.

Reply:

We do appreciate the reviewer's suggestion to add a vertical motion plot in Fig. 9 as the third panel for easy reference. However, since the distribution of the simulated low-level *w* at 0630 UTC has already been provided in Fig. 8 (at 1058 m), Fig. 12 (at 547 m), and Fig. 13a-f (at both 550 and 1050 m) and is readily available for the readers to refer to, we feel that it is perhaps not necessary to add another similar plot in the manuscript.

2. Is there a reason Fig. 10 a and b showing two different cross-sections? It is confusing as the readers may compare the structures shown in 10 a and b then find out they are not suppose to do so.

Reply:

The E-W vertical cross-section in Fig. 10a is along 22.5°N and slices through (or near) three cells (C1, A1, and B1), while that in Fig. 10b is along 22.52°N and cuts through the center of A1 to provide a close-up view of this mature cell. These above reasons are stated in the text, and it is clarified that the cross-section in Fig. 10b is not the same as, and is slightly to the north (by about 2 km) of, that in Fig. 10a in the revision to avoid confusion.