We thank the reviewer for his constructive and insightful comments. We have considered his comments carefully and provided a response and revised manuscript.

Title: The genesis of Typhoon Nuri as observed during the Tropical Cyclone Structure 2008 (TCS08) field experiment. Part 2: Observations of the convective environment
Author(s): M. T. Montgomery and R. K. Smith (hereafter MK)
MS No.: acp-2011-674
Comment by reviewer Ed Zipser, University of Utah, USA

This is a worthwhile contribution to the important problem of tropical cyclogenesis, using analysis of the well-observed case of Nuri 2008 in the west Pacific as a case in point. The authors' main finding is that their analysis shows little change in mean virtual temperature in the low troposphere during genesis, and they use that finding to counter some of the recent thermodynamic control ideasof Raymond and collaborators. This manuscript should be published with minor revisions, after the authors address some of my concerns about their analysis and the generality of their conclusions.

As this comment was being prepared, Raymond submitted his own comment. His major caveat, with which I agree, is that the difference between concluding that the low troposphere is about 1°K cooler near the center, and MK's conclusion of little change, can easily be explained by the different choices of specific analysis domains. Raymond is the right person to continue the discussion with MK about the validity of the Raymond and Sessions (2007) thermodynamic hypothesis, and I will not comment further on that.

My principal concern is with the reliance upon large-area averaging of data with respect to the system-relative center, or pouch. I have no problem whatever with the pouch concept. My problem is that all dropsondes should not necessarily be weighted equally. In Nuri 1, large areas are devoid of significant precipitation, and there are about 9 dropsondes in such areas (Fig. 2a), while in Nuri 2 all dropsondes seem to be in locations with significant precipitation (Fig. 2b). It is not fair to make detailed comparisons without considering the potential differences.

Reply: We believe the reviewer has misinterpreted our objective in this paper. We are not making detailed comparisons of cloudy and non-cloudy regions per se. Rather, we are examining whether there are any systematic changes in the thermodynamic structure of the troposphere on meso-alpha (i.e. pouch) scale. In this more general multi-scale viewpoint articulated first by Dunkerton et al. 2009, we are not focusing here on particular cloudy or clear regions as these are part of the meso-beta and meso-gamma scales, which need to be considered in more detail in future work.

In Raymond and Lopez-Carillo (2010) their analyses were constrained in part by the availability of Doppler radar data from the NRL P-3, less available away from precipitation. So it is hardly surprising, as Raymond's comment states, that small differences in choice of analysis regions can lead to somewhat different results.

Reply: In the last sentence we are not sure what is meant by "somewhat different results". We accept the spatial limitations of the Doppler radar data, which confined the analysis to regions of precipitation. If "somewhat different results" is referring to the day-to-day difference in mean temperature, we agree that a different analysis region may lead to different conclusions on the

meso-beta scale of precipitation systems. As discussed above, however, our analysis is not focused on this scale.

At the risk of belaboring this difference of analysis scales, we recall our exact words in our submitted manuscript (section 2):

"In this study we are adopting the perspective of the marsupial paradigm and, unlike Raymond and Lopez (2010) and Raymond et al. (2011), we do not limit our analysis around a particular middle-level circulation centre within the disturbance and its partial overlap with a surface circulation. While we agree with Raymond and Lopez (op. cit.) that the vertical alignment of the pouch was an important element in Nuri's genesis (see also Montgomery et al. 2010), our perspective here is a broader one that is focused on the entire pouch region (that includes not only the region bounded by the closed streamlines passing through the nearest stagnation point in the co-moving frame, but also the nearby recirculating flow as defined above). With this perspective in mind, the distribution of dropsondes during Nuri1 and Nuri2 is shown in Figure 2a and Figure 2b, respectively."

My principal disappointment with this paper is that it introduces some of the main issues in cyclogenesis but studiously avoids addressing them directly. Near the end of the introduction, they hypothesize that a key "*ingredient for genesis is the recirculating flow as it will tend to protect the convectively-generated vorticity seedlings within the critical layer and harbour a favourable environment for vorticity aggregation and moisturization by deep cumulus convection*". Yes! How indeed does deep cumulus convection moisturize the pouch? Despite one of the best airborne Doppler radar in existence, none of the papers on Nuri have addressed this issue.

Reply: We thought that it was well known how deep cumulus convection moisturizes its environment (see e.g. Houze, 1992, Cloud dynamics, Chapter 7). In a related paper that the reviewer himself reviewed we (Smith and Montgomery 2012, section 5) stated that:

"Mixing and detrainment from a spectrum of convective cells with air in the cloud environment leads to a moistening of the environment in middle and upper levels."

The attached image overleaf shows remnant precipitation from a convective cloud that has largely evaporated, thereby moistening the atmosphere.

Finally, it is unclear to us how the issue of moistening can be addressed using airborne Doppler radar because this instrument does not measure in situ moisture!

They are silent on the specific nature of the deep convection and its mesoscale organization, in spite of teasing us in the first paragraph of section 2 that the NRL P3 is capable of documenting this.

Reply: The topic of mesoscale organization is a very important one for tropical cyclogenesis, but it is a topic that we are working on at present and beyond the scope of the current manuscript. As a first step, Raymond and Lopez have presented a mesoscale vorticity budget of the developing

typhoon. The issue of ‘convective organization’ is not a trivial problem in itself and remains a topic for future research.

Illustration of cloud moistening. The cloud has largely evaporated leaving the rain shaft. The photograph was taken near East Point in Darwin, Australia.

Instead, they report on area-average properties of the environment, as if “all convection is alike”. One obvious change between Nuri 1 and 2 could at least be mentioned; the greater percent coverage of precipitation in all quadrants with respect to the pouch center.

Reply: We have added a remark mentioning the greater percent coverage of precipitation in all quadrants between Nuri 1 and Nuri 2.

Some more minor comments follow.

It is impossible to see sufficient detail in Fig 3 to distinguish variability of thermodynamic parameters between Nuri 1 and 2. In Fig. 4, the larger variability in RH in Nuri 1 vs. Nuri 2 is apparent, but one may speculate that the 9 soundings taken outside precipitation in the former may account for much of that difference. The same comment applies to the higher RH and theta-e in Nuri 2 in mid-troposphere shown in Fig. 5.

Reply: To adhere to our stated objective we have purposefully not cherry-picked the dropsondes to isolate particular precipitation regions. Such a procedure would undermine the philosophy behind our study.

In my opinion, Nuri 3 and 4 comparisons with Nuri 1 and 2 are irrelevant to the purpose of this paper, and inappropriate because they are an obvious and inevitable aspect of the difference between a depression and a strong TC or typhoon. Let me put this strong statement in context. The best track data on Nuri (which would be a useful addition to this paper) show slow strengthening between Nuri 1 and Nuri 2. However, marked intensification is already underway during Nuri 3 that meets several of the criteria for rapid intensification starting between Nuri 3 and Nuri 4. How could there NOT be greater variability among a group of soundings at a range of distances from the cyclone center that has a marked warm core?

Reply: The best track data is shown in our Nuri Part 1 paper (Figure 5 of Montgomery et al. 2010) and also in Raymond and Lopez-Carillo (their Figure 2). In the revised manuscript, we have added a sentence to point this out.

Nuri3 and Nuri4 are included to provide context for the overall study. We do not understand why you think the Nuri 3 and Nuri 4 comparisons "are an obvious and inevitable aspect of the difference between a depression and a strong TC or typhoon." We have now added a remark to clarify that part of this variability may be associated with the increasing range of near-surface wind speeds on days 3 and 4.

The streamline analyses shown in Fig. 2a-c are not very useful because they show only relative wind direction and not speed. So they cannot be compared with similar analyses in papers such as Raymond and Lopez-Carillo (2010).

Reply: We are not comparing streamline analyses with Raymond and Lopez-Carillo. For one thing, the analyses presented are on a much different horizontal scale. For another, the streamlines are used only to identify the sounding locations in relationship to the recirculating pouch and nearby flow region. Finally, the wind speed information has been provided by our Nuri Part I paper (Figures 12 and 14 of Montgomery et al. 2010). A brief comment referring to the wind speed has been added in the revised manuscript.

The footnote on 31119 pours salt into the wound of one of my pet peeves by equating organized convection with thunderstorm activity. Not so! The existence and variability of electrification within tropical cyclones is a worthy topic of research, and we should not perpetuate common misconceptions like that one.

Reply: While we sympathize with your peeve, we have quoted the HRD website definition verbatim. It would be dishonest to tweak the quote!

EJZ, 1/1/12