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Interactive Comment

# *Interactive comment on* "A numerical study of back-building process in a quasi-stationary rainband with extreme rainfall over northern Taiwan during 11–12 June 2012" *by* C.-C. Wang et al.

**Anonymous Referee #2**

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General Comment:

With a cloud-resolving model, this study investigates a quasi-stationary rainband that caused extreme rainfall over northern Taiwan, in an attempt to understand the processes responsible for the occurrence of severe flooding associated with this particular case. A primary conclusion drawn in this article is that the back-building (BB) processes were suggested to be crucial for contributing to the occurrence of the observed extreme rainfall. Some modeling aspects implicit in the BB processes are also presented and discussed. The central theme of the study is generally interesting. Unfortunately, the reliability of the conclusions learned from the study suffers from a number of fundamental problems, which can be clearly seen based on the current form of the manuscript. The reviewer believe that a significant re-work on writing and analysis will be required to accommodate these serious concerns and the resultant manuscript would be very different from this one.

Specific Comment:

1. Various observations and modeling results presented in the paper did support a close relevance of the frontal forcings to the development of heavy rainfall associated with the studied rainband. For example, the CWB surface analysis, the NCEP analysis, and the ASCAT winds shown in Figs. 1 and 2a,c,e all indicate that a slow-moving Mei-yu front was oriented NE-SW (roughly along 25 N) and located immediately north of Taiwan. The Mei-yu front coincided very well with the elongated studied rainband, and the orientation and spatial scale for the front and the rainband were consistent with each other, as illustrated by radar maps in Fig. 4. These observations strongly suggest that the convective system causing severe floods over northern Taiwan actually was a frontal rainband rather than a pre-frontal squall line as claimed by the authors. The convective forcings associated with the frontal zone are expected to be one of the primary contributors but were completely ignored in the current context of this study.

2. Further support of the reviewer's point mentioned in the comment#1 is provided by the CReSS model simulations presented in Fig. 7, which shows that the studied rainband formed over northern Taiwan was collocated with a narrow confluent zone in the vicinity of the Mei-yu front between northeasterlies and southwesterlies (cf. Fig. 7f). Note also that an additional wind shift zone was evident offshore over northwestern and northeastern Taiwan (Fig. 7), presumably due to the common occurrence of orographic blocking and/or the leeside effects of topography as prevailing southwesterly flow interacts with Taiwan island during the Mei-yu season (e.g., Sun et al. 1991, MWR;



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Chen and Li 1995, MWR; Li and Chen 1998, MWR; Yeh and Chen 2002, MWR). This topographically generated convergence may represent another critical mesoscale forcing, favoring the development and organization of deep moist convection associated with the studied rainband.

It is clear that both observations and modeling results provide consistent evidences that the organization and maintenance of the studied rainband are closely related to the frontal and topographic forcings. In fact, the authors have also admitted in the manuscript that the development of the studied precipitation system is closely tied to the low-level convergence associated with the frontal forcing (e.g., L26-29 in P32689). Given this fact, it is not wise to downplay the roles of the frontal forcing in contributing to the occurrence of the observed heavy rainfall.

3. The authors strongly argue that the BB processes are a key mechanism for the generation of the convective system that caused severe floods over northern Taiwan. However, this is obviously not the case, as indicated in the sequence of radar maps presented in Fig. 6. Based on these radar-observed precipitation signatures, severe floods over northern Taiwan could be mostly attributed to the presence of an approximately W-E elongated, quasi-stationary rainband. Several precipitation cells (Fig. 6) were formed near the western end of the studied rainband, as claimed by the authors, but they were quite transient and were generally located well offshore, far away from the target area of heaviest rainfall over northern Taiwan. In contrast, most of new precipitation cells conducive to the maintenance of the rainband's convection over land were evidently produced immediately ahead (south) of the entire length of the rainband (i.e., the inflow side), particularly for the inland region of northern Taiwan (cf. Figs. 6i-m). These cells were oriented (organized) roughly parallel to the preexisting rainband. In addition, the enhanced precipitation of the rainband tended to exhibit a quasi-steady signature (Fig. 6), which is in turn consistent with the influence of a persistent convective forcing associated with the slow-moving Mei-yu front as described in the comment#1 and #2. These observational evidences regarding the rainband's evo-



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lution did not support the likelihood that the BB processes are a reasonable scenario considering the extreme rainfall observed over northern Taiwan.

4. Suggestion: Because the scientific objective of the study is to understand the processes leading to the extreme rainfall for this particular event, the reviewer strongly feel that the authors should consider focusing on other observational aspects that are more relevant to the occurrence of heavy rainfall, instead of sticking to the unsupported mechanism (i.e., the BB process). For example, relative importance of frontal and topographic forcings and their roles in triggering and organizing the precipitation rainbands observed over northern Taiwan may be worth pursuing further to provide more solid and convincible descriptions.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 32679, 2015.



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