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Atmospheric Chemistry and Physics Discussions

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 #1

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The authors present a case study on a heavy precipitation event over northern Taiwan. The case is investigated in reanalysis data, observational data and data from numerical model simulations. The underlying processes of the storm evolution are evaluated, with a special emphasis on the dynamics of the storm. In particular, the developing pressure perturbation is investigated, and its thermodynamic and dynamic contribution are separated. The case is well studied and documented. It could benefit from placing the studied case into a larger context, e.g. by giving an indication, how often these events occur over this area, or by describing if this is a typical or untypical event.

General comments:

1. In the area where the back-building process occurs, the flow undergoes channelling between the Taiwanese island and the Chinese main land. As described in the study the atmosphere is very moist, especially in the lower layers, thus the channelling leads to strong moisture-flux convergence. In addition, the flow undergoes some lifting over the taiwanese mountain chain. The fact that LHR and buoyancy play the dominant role in the storm process hints at moisture-flux convergence as the driving mechanism. The process of moisture-flux convergence in a conditionally unstable environment, which naturally leads to the initiation of convection should be mentioned and discussed further.

2. The numerical model seems to capture the storm evolution well. However, it appears to me from looking at the figures, that it overestimates the amount of the flow that goes over the mountain chain but underestimates the portion that is directed around the ridge/island and undergoes channelling. As a result, the simulated precipitation tends to occur more on top of the mountains and is underestimated at the tip. Please include some analysis into the manuscript.

3. The formation mechanism for the layer with negative $\Delta p'$ and negative $\Delta p'_b$ around 5 km between 120.8 and 120.9° remains unclear to me. It coincides with a layer of negative buoyancy. There is no cloud visible, so evaporation of rain can be ruled out.

4. Page 32682, second paragraph: Even though the low levels of the atmosphere are very moist and little rainfall evaporates, downdrafts can still be driven by melting of cold hydrometeors, or simply by buoyancy loading. The buoyancy loading mechanism is studied later in the study. How strong/important is the melting? Melting and evaporation may moreover be quite sensitive to the parametrization of microphysical processes. The study uses a single-moment scheme, which

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may underestimate the evaporation process, as it cannot reproduce a variable droplet-size distribution (see e.g. Morrison, 2009).

5. Mention the term "case study“ somewhere.

6. Some of the figures are extremely small and hard to read, especially the labels and land-sea mask. This makes it very difficult to compare the different panels. Please make sure that they are printed larger.

Minor comments:

Page 32680, Line 9: mention already in the abstract which model you are employing.
Page 32681, Line 12: clarify what is meant by "slow-moving surface boundary". Is it a front, or a convergence line?
Page 32682, first paragraph: how important are elevated mixed layers remanent from the previous convective events?
Page 32686, line 13: illustrate the "relaxation method further". How is laplace p' inverted to retrieve p'? Which boundary conditions are used?
Page 32697: Which diabatic processes are active? Radiative cooling? Or something else?

Technical comments:

abstract, line 9, replace reproduced with reproduces.
Abstract, line 18: replace "gain" with "gained"
page 32680, line 24, remove "the" in front of "squall lines"
page 32681, line 6: replace "potential of" with "potential for".
Page 32683, line 3: include "whether" or "if" before "some other processes"
page 32684, line 7-8: Split the sentence up after "numerical simulation".

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page 3284, line 23: include "grid points" after 1000x800x50 and include "as" before "Already".
Page 32685, line 6: replace "on" by "of"
page 32685, equation (1) introduce F_z (presumably turbulent mixing)
page 32688, line 6: include "the level of" before "free convection".
Page 32692, line 22: replace "resulted" by "resulting" and remove "the" before "strongest".
Page 32692, line 27: remove "the" before "strongest"
page 32694, line 26-27: this sentence is confusing. Rewrite. The dominant contributor is p_b.

References:

H. Morrison, G. Thompson, and V. Tatarskii, 2009: Impact of Cloud Microphysics on the Development of Trailing Stratiform Precipitation in a Simulated Squall Line: Comparison of One- and Two-Moment Schemes. Mon. Wea. Rev., 137, 991-1007. doi: http://dx.doi.org/10.1175/2008MWR2556.1

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