Reviewer#3

1. This study explores the mechanisms causing the record-breaking rainfall in southern Taiwan during the passage of Typhoon Morakot (2009). There are at least two published papers (Ge et al. in Atmospheric Science Letter and Hong et al. in Geophysical Research Letter both in 2010) addressing this extreme event. The findings of the present study are quite similar to what were presented in Hong et al., which explored the multiscale nature of Typhoon Morakot and pointed out the importance of the convergence of monsoon southwesterly and northwesterly of typhoon circulation over the Taiwan Strait west of Taiwan, and the topographic lifting effect. To appeal to the readers, the present study needs to bring in insight that is beyond what these two papers already provided.

R: We couldn't agree the reviewer's comments more, so we have finished a fine-scale numerical simulation in this revision. Allow me to stress that major focus of our paper are on the detail mesoscale processes. From the fine-scale numerical simulation, we have found that not only did the convergence itself provided the cause of the heavy rainfall when it interacted with the topography, but also there is an existence of the convective cells within the Typhoon's main rainband. The convective cells were in the form of small rainbands perpendicular to the main one, and propagated as vortex Rossby waves downwind. As the main rainband moved northward and reached the southern CMR, convective cells inside the narrow convergence zone to the south and those to the north as a part of the vortex Rossby waves, both rained heavily as they were lifted by the west-facing mountain slopes. Please check the model simulation and discussion in section 4. (Page 13-23)

2. The title of present study pinpoints what are missing in these two papers: mesoscale processes. However, the present study did not really explore the mesoscale processes that were embedded in Typhoon Morakot and led to the record-breaking rainfall. Instead, the approach is more like a synoptic-scale analysis. A mesoscale process study can be done by either a detailed radar data analysis or a high-resolution model simulation, or a combination of the two. Present study did not take any of the two approaches. Instead, it relied on the 0.5 by 0.5 degree data of the NCEP GFS and did a 10-km resolution simulation using WRF. It is then not surprising that the present study did not succeed in revealing the nature of mesoscale processes at convection scales. As noted in the manuscript, the continuously heavy rainfall on 8-9 August was the major reason for the disaster. The mesoscale processes leading to this continuous heavy rainfall should be the major focal point of present study according to the manuscript title.

R: As response in question #1, in this revision, we conducted a fine-scale

simulation and explore in detail why the mesoscale processes leading to this continuous heavy rainfall in section 4. (Page 13-23)

3. A help from professional English editor is desperately needed to improve the writing. Numerous typos and grammatical errors in the present manuscript make it difficult to read.

R: This manuscript has been proofreading by a native English speaker.

Specific Comments:

1. The introduction is too long. It contains too much non-essential information. For example, there is no need to show photos of Xiaolin village. On the contrary, the summary is too brief.

   R: Text has been amended and we dropped the photos of Xiaolin village.

2. The arrangement of figures should be arranged to match the discussion. Discussion often jumps from figure to figure. For example, Figure 1e was not discussed until Section 4. This practice makes it difficult to follow the authors' discussion.

   R: The order of the figure has been re-arranged.

3. What was done in the present study so that the model was able to simulate more realistic rainfall amount than Ge et al. did? Many similar modeling studies on Typhoon Morakot had been presented in recent conferences. They all reported similar rainfall distribution and amount as shown in Figure 1e.

   R: The goal of our paper is to understand why this typhoon can dump such a high rainfall amount over southern Taiwan. The purpose of other studies (e.g. Ge. et al. 2010) such as why delivered far less rain than observation is not the concern of this paper.

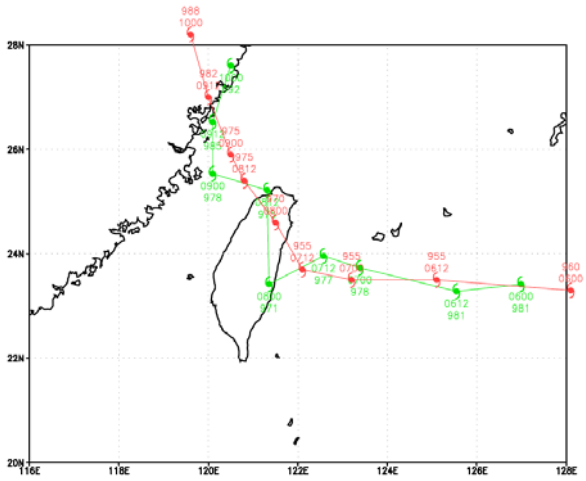
   Although, there are two papers have been published about this Typhoon. However, this is the first time to conduct such a large study domain (1081*691*45) with fine resolution (3km). More importantly, we do demonstrates the meso- and fine-scale mechanisms for the heavy rainfall limited to the 18-hour evolution of Typhoon Morakot as it invaded the island in this revision.

4. It is doubtful that a model simulation with 10-km resolution is able to simulate realistic mesoscale processes in convection scales. The model seems to be used like a downscaling tool in this study, not for dynamical processes. But the 10-km resolution is not high enough to provide the very detailed structure of the typhoon and rainfall distribution.

R: We agree reviewer's comment and already response in major revision question # 1 and #2.

5. Some details about the simulation should be discussed. For example, how was the case simulated? Was the model run starting from 0000UTC 06 for four days? How was the typhoon track simulated?

   R: We have 12 hours to spin up the simulation, i.e. we run starting from 1200 UTC 05 Aug (Page 6, L1-2). Here we further provided the typhoon track as below (Red: best track, Green: simulation). Our simulation results are quite agree to the best track.



6. It is better to scale typhoon strength according to the category scheme that is commonly used in the international meteorological community, although the CWB of Taiwan has its own unique scheme (i.e., strong, intermediate, and light).

   R: We have added the reference according to the category scheme that is commonly used in the international meteorological community in the article.

7. The 3-D figures presented in Figure 4 are difficult to comprehend. Why was the 550 contour chosen? It does not reveal 3-D structure clearly. A combination of few cross sections may be more informative than the present 3-D figures.

   R: We pick the moisture flux of 550 contour just for the purpose of qualitative description on the structure of the interaction between SW monsoon flow and typhoon circulation at 00Z 08 Aug. as shown in Radar reflectivity and Satellite images. In this revision we did the different cross-section to identify the major processes of the heavy rainfall dumped.

8. The topographic lifting effect was not really demonstrated in the manuscript.

   R: In this revision, we conducted different cross sections and demonstrated this effect in section 4. (Page 14-23)

Technical comments:

1. The manuscript contains too many typos and grammatical errors to be listed one by one in this review. Please seek for professional help in English writing.
   R: This manuscript has been proofreading by a native English speaker.
2. It should be A-Li Shan, not “A-Li Shan Mountain”. Shan is mountain in Mandarin.
   R: Text has been amended.
3. Line 16, page 1: It should be “ever recorded”, not “ever”.
   R: Text has been amended.
4. Line 15, page 6: The rainfall did not last for 4 days during 2-6 August. It occurred on and off
   R: Text has been amended.
5. Line 11, page 11: The blockage of the flow by the mountain cannot be seen clearly in figure 4e
   R: We further do the different cross-section in this revision and demonstrate this effect. (Page 20-21)
6. Figure 3b is redundant since it is not really discussed. Figure 3a alone is enough to reveal the loose structure of Typhoon Morakot and should be shown and discussed at the beginning.
   R: The satellite images (in this revision is Figure 2b) are the other way to show the variation of the typhoon structure to response the other reviewer’s concern.

7. Figure 1b can be removed. There is no need to show the auto rain gauge distribution. The box shown in figure 1b can be marked in Figure 1d. Simulated rainfall should not be shown in Figure 1e because it is not discussed until Section 4. Table 1 can be removed without harm since the comparison with previous typhoons is not an issue here.

   R: It is too busy to mark the rain gauge stations in the colored shaded in Figure 1d. To show the topographic in Taiwan is another purpose in Figure 1b. Table 1 roughly indicated the heavy rainfall occurrence for the first time combined with Typhoon circulation and southwesterly monsoon.