ACP-2022-377

Reply to Reviewer 1

Date: 7 Oct 2022

Title: A modelling study of an extreme rainfall event along the northern coast of Taiwan on 2 June 2017

Authors: Chung-Chieh Wang *et al.*

Reviewer's Comments:

Summary:

This study examines the mechanisms responsible for producing extreme rainfall during the 2 June 2017 Mei-Yu front case in Taiwan using a series of modeling experiments. The authors study the impacts of terrain in the 3-km simulations, which were found to have negligible effects on rainfall when the northern terrain was removed, but large impacts when the whole terrain of Taiwan was removed. For this reason, they postulate that the terrain in northern Taiwan was not the main factor responsible for producing heavy rainfall. Next the authors compared two 1-km simulations–one driven by a successful ensemble member from Wang et al. (2021) and the other using the control 3-km simulation as a driver. They found that the F1 simulation produced rainfall amounts closest to observations (and closer to those previously obtained in other studies) due to a persistent rainband that was produced by a frontal disturbance that was not seen in S1. Overall, this was an interesting and well structured paper that only needs minor revisions.

Reply: The positive view and constructive comments from this reviewer (Reviewer 1) are deeply appreciated. Following the instruction from the journal editor, herein we respond to all referee comments (RCs) and describe how the revision is to be performed. The actual revision will start immediately after we receive the go ahead from the editor. Below, the point-by-point responses to each of the comments from this reviewer are given, following the original comments.

General comments:

- How did you choose the microphysics scheme used in your study? Was it based on similar studies? And did you perform any sensitivity tests on how the microphysics scheme impacted your results?

Reply: The CReSS model is developed by a single research group, as described in our paper. So, for each of the physical options, it does not have many different choices, but only a few of them at different levels of complexity. This is in contrast to "community models" such as the WRF model, for which different groups can develop their own scheme and be included as an option. For cloud microphysics, the CReSS model (ver.3.4.2) has five options: no cloud microphysics, the warm-rain scheme (no ice phase), and single-moment cold-rain scheme (both liquid and ice phases), 1.5-moment cold-rain scheme (double-moment in ice, single in liquid), and double-moment cold-rain scheme (in both liquid and ice phases). For the study, we simply choose the most complicated option, as it is the closest one to the real process in the atmosphere (no test using the less complicated schemes). This was a natural choice, and was also used in our previous studies, including Wang et al. (2021: Atmos. Res.). These above points will be clarified in the revision to an adequate level.

Specific comments:

- Line 55: Can you specify have much economic loss? It would helpful to have a number here.

Reply: Yes, the amount in economic loss will be described in the revision as suggested.

- Lines 212-215: Did you specifically look at the relative height of cold hair behind the front to topography in your study? If not, please specify that this is a speculation and not actually examined.

Reply: No, we did not look at the depth of the cold air because of the limited impact when the topography in northern Taiwan is removed. Thus, we will specify that this is a speculation and not actually examined in the revision, as suggested.

- Lines 352–354: It is possible to compare the convergence values in observations to F1 to see if these values are similar? If so, that would be helpful to include.

Reply: Thank you for this suggestion. While directly comparing the near-surface convergence values in the observations (CWB local weather maps in Fig. 16) and the F1 experiment (at 1-km grid size) are not possible, we can at least compare the scale and magnitude of the low pressure disturbance along the front (the associated convergence would be similar if their size and strength are similar). So, we will include this comparison, along the lines as suggested.

- Figure 8: This is a nice figure but I suggest using a colormap that is more intuitive to distinguish early to late times. Something like using all shades of one color or cool to warms would work.

Reply: Thank you for this suggestion. In the revision, a different and more intuitive color scale will be used to replot Fig. 8 to better show the frontal movement, as suggested.

- Figure 13: This is an interesting figure but I had a hard time deciphering it. Why do you have two panels showing the same date for F1? How does the second plot below d) differ?

Reply: In this figure, two panels are plotted for some of the time periods, such as (b) and (d). The second one is intended to show newly-developed rainbands (dashed lines) at the same time as the old rainbands (solid lines). In the revision, their meaning will be clarified as suggested.

Technical comments:

- Lines 32–38: This is a long and confusing sentence. I recommend breaking this up into two separate sentences, such as "Under such conditions organized mesoscale convective (MCSs) systems such as squall lines can develop near the front and make landfall in Taiwan. The steep topography…"

Reply: Suggestion accepted.

- Line 53: Please remove "…the criterion to have one day off work and school" as it is not necessary information.

Reply: Suggestion accepted.

- Line 87: Please start a new paragraph at "A few questions remain…"

Reply: Suggestion accepted.

- Line 345: Please remove "As"

Reply: Suggestion accepted.