Response to Reviewers' Feedback

Original comment in black, *response in blue and italics*

We thank the reviewers for their time and the thorough examination. Their feedback helped to improve the quality of the manuscript. The main changes that have been made to the manuscript include the following:

- *We enhanced the image quality and added auxiliary lines to better explain the results.*
- *We modified language and expression to make the statement clearer and more accurate.*
- *We included additional relevant literature to assist readers in better understanding the study.*

Please note that all information concerning pages and lines refers to the revised clean version. Below, we address each of the reviewer's comments in detail:

Reviewer #1: Summary. This study investigates the influence of different combinations of model parameterization, nudging, and initial conditions on typhoon simulations using the WRF model, focusing particularly on the PRD region. Four typhoon cases within the region were simulated, and recommendations regarding the WRF model configuration in the area are provided. In comparison to the heavily cited work of Sun et al. (2019) in this manuscript, the emphasis of this study lies more on the model configuration, with less emphasis on comparing the results to observations as extensively done by Sun et al. (2019). I think this aspect could be improved if similar observation is available to the authors. However, with the substantial number of simulations conducted in this study, the results in this work appear robust. I have only minor comments for the authors to consider. It is recommended to pursue publication if the comments below can be satisfactorily addressed.

Thank you very much for the generally positive statements about our study.

Minor comments:

L23: "Cu" should be "CU"

We agree with the reviewer about the inconsistency regarding abbreviations and have changed all expressions concerning these abbreviations.

L40-45: the authors might want to cite another recent study below highlighting a potential positive trend in major TC landfall.

Wang, S. and Toumi, R., 2022. More tropical cyclones are striking coasts with major intensities at landfall. Scientific reports, 12(1), p.5236.

Thanks for the recommendation. We included this publication and cited it in the introduction (Line 43, revised clean version).

L79: "Sun et a.," should be "Sun et al."

Thank you, we corrected this typo.

L164: It appears the scientific question of the study can be further polished and specified. The authors tried some CU and MP schemes, but not all. Four typhoons were simulated, but, again, not all the typhoons in the region. Therefore, it would be difficult to answer the question the authors put there for themselves, i.e., what is the best combination to simulate TCs in the PRD with WRF? Instead of finding the best combination, which is almost undoable with the current model setup, I wonder if it makes more sense to explore why one combination of schemes is better than the rest that was tested in the authors' simulations. Here I'm not suggesting more simulations, rather, I wonder if it would be helpful to rephrase certain sentences in the manuscript for better clarity.

We agree with the reviewer that the scientific question of the study can be further polished and specified and we have changed it. We followed the suggestion of the reviewer and tried to explore why one combination of schemes performs better than the rest for specific TCs in this region. We modified the expression (Line 167-171, revised clean version), as follows:" The main objective of this study is to analyse the uncertainties from different combinations of schemes in WRF to represent TC Neoguri

(2008), Hagupit (2008), Hato (2017), and Usagi (2013) affecting the PRD region with different intensities and genesis locations. More specifically, it is analysed (i) how sensitive the typhoons belonging to specific intensity categories or genesis locations are to two CU (KF and CuOFF) settings and two MP (WSM6 and Thompson) parameterization schemes, three initialization times (TD, TS, ST), and two spectral nudging variables (UV, PT+UV). (ii) It is explored why the chosen combination of schemes is better than the rest from a thermodynamic perspective."

L175: Again, I'm not asking the authors to conduct more simulations to increase the grid spacing, but it might be worth explaining why the resolution is only 5 km. Nowadays even higher grid spacing has been applied with some operational setup with ensemble simulations.
We agree with the reviewer that nowadays even higher grid spacing has been applied to some operational setups with ensemble simulations. In this study, however, a balance between computational efficiency and model accuracy is achieved by using a horizontal resolution of 5 km for typhoon simulations. This domain selection considered studies like Sun et al. (2013) and Gentry and Lackmann (2010), which indicate less impact on typhoon intensity within a certain resolution threshold. Furthermore, similar horizontal resolutions have been applied by Gutmann et al. (2018) and Delfino et al. (2022). The references are listed below.

Table 1. I'm not sure "convection-permitting (CP)" is the best way in defining the suite of simulations with no cumulus scheme. As the authors mentioned, 5 km "is within the gray zone" (L185), the 5-km grid spacing may not have convection permitted.
Thanks for the suggestions. We modified the name into CuOFF, meaning that in this experiment we switched off the cumulus scheme.

Figure 1. Please mark the PRD region directly with a box in the plot.
Thanks for the suggestion. The figure is updated accordingly in the revised version of the manuscript.

Figure 2. Please improve the resolution of the figure.
Thanks for the suggestion. We will enhance the resolution of the figure to ensure it is more visually clear. The figure with improved resolution will be included in the revised version of the manuscript.

L526: please define θe first.
Thanks for the suggestion, we define ϑ_e first (Line 244, revised clean version) which could be beneficial for the reader's understanding.

References

Delfino, R. J., Bagtasa, G., Hodges, K., and Vidale, P. L.: Sensitivity of simulating Typhoon Haiyan (2013) using WRF: the role of cumulus convection, surface flux parameterizations, spectral nudging, and initial and boundary conditions, Nat. Hazards Earth Syst. Sci., 22, 3285–3307, https://doi.org/10.5194/nhess-22-3285-2022, 2022.

Gentry, M. S. and Lackmann, G. M.: Sensitivity of Simulated Tropical Cyclone Structure and Intensity to Horizontal Resolution, Mon. Weather Rev., 138, 688–704, https://doi.org/10.1175/2009MWR2976.1, 2010.

Gutmann, E. D., Rasmussen, R. M., Liu, C., Ikeda, K., Bruyere, C. L., Done, J. M., Garrè, L., Friis-Hansen, P., and Veldore, V.: Changes in Hurricanes from a 13-Yr Convection-Permitting Pseudo–Global Warming Simulation, J. Clim., 31, 3643–3657, https://doi.org/10.1175/JCLI-D-17-0391.1, 2018.

Sun, Y., Yi, L., Zhong, Z., Hu, Y., and Ha, Y.: Dependence of model convergence on horizontal resolution and convective parameterization in simulations of a tropical cyclone at gray-zone resolutions: RESOLUTION AND CONVECTION IN TC SIMULATION, J. Geophys. Res. Atmospheres, 118, 7715–7732, https://doi.org/10.1002/jgrd.50606, 2013.