Response to Reviewer #1

The manuscript is well-written and the authors set out their objectives and results very clearly. It is suitable for publication in GMD if the following comments are addressed.

Thank you for reading through our manuscript and for providing valuable comments. Please find our point-by-point responses to your comments below. Reviewer comments are in bold and author responses are in plain text.

Specific comments:

Line 25: why are phase-averaged wave models quite expensive compared to the atmospheric and oceanic dynamic models? Do you have evidences for this? By the way, are you talking about "spectral wave models" or "phase-averaged" (which is more general,e.g. XBeach).

The expense of the wave model is due to the need to evolve the frequency/direction spectrum of the wave action in longitude/latitude space. This leads to a greater number of overall degrees of freedom compared to an ocean or atmospheric models. In the case of our study, the spectral mesh resolution means that there are 1800 unknowns per grid point (50 frequencies $\times$ 36 directions), as compared to a typical low-resolution E3SM configuration where the ocean and atmosphere models have less than 100 vertical layers at each grid point. The low-resolution E3SMv1 model ran at 10 simulated years per day (Golaz et al., 2019), which is roughly what we found the throughput of the unstructured mesh solution to be in this study. For additional evidence, we also point to the study done in Li et al. (2016) where WAVEWATCH III coupled to the CESM model. In order to reduce cost relative to the rest of the coupled model, the wave model resolution used in that paper was very coarse: 3.2×4 degree with a 25 frequency and 24 direction spectral grid.

Also, in the submitted manuscript we did use "spectral wave model" and "phase-averaged" wave mode interchangeably. Based on your comment, we now realize that it is more accurate to refer to spectral wave models as a specific class of phase-averaged model. We have done our best to clear this up in the text by referring to WAVEWATCH III as a "*spectral, phase-averaged wave model*"

Line 113: please add reference Dietrich et al. (2011) for completeness.

We have added this reference, as suggested.

Line 188: the first order PR1/CRD-N schemes have been employed. To what extent do they influence the outcomes (i.e. less accurate) in particular the 2-degree mesh case?

Thank you for raising this point. We have done our best to address this in Figure 1. This figure shows that the standard `PR3+UQ` schemes for structured meshes are more accurate than the first order `PR1` switch. However, the differences do not alter the conclusions of our study. We have added this figure as an Appendix in the manuscript.

Technical corrections :

Line 295: 36215 -> 46215

Thank you for carefully reading through the text to catch this mistake. We have corrected it.

References

Golaz, J.-C., Caldwell, P. M., Van Roekel, L. P., Petersen, M. R., Tang, Q., Wolfe, J. D., Abeshu, G., Anantharaj, V., Asay-Davis, X. S., Bader, D. C., et al.: The DOE E3SM coupled model version 1: Overview and evaluation at standard resolution, Journal of Advances in Modeling Earth Systems, 11, 2089–2129, 2019.

Li, Q., Webb, A., Fox-Kemper, B., Craig, A., Danabasoglu, G., Large, W. G., and Vertenstein, M.: Langmuir mixing effects on global climate: WAVEWATCH III in CESM, Ocean Modelling, 103, 145–160, 2016.

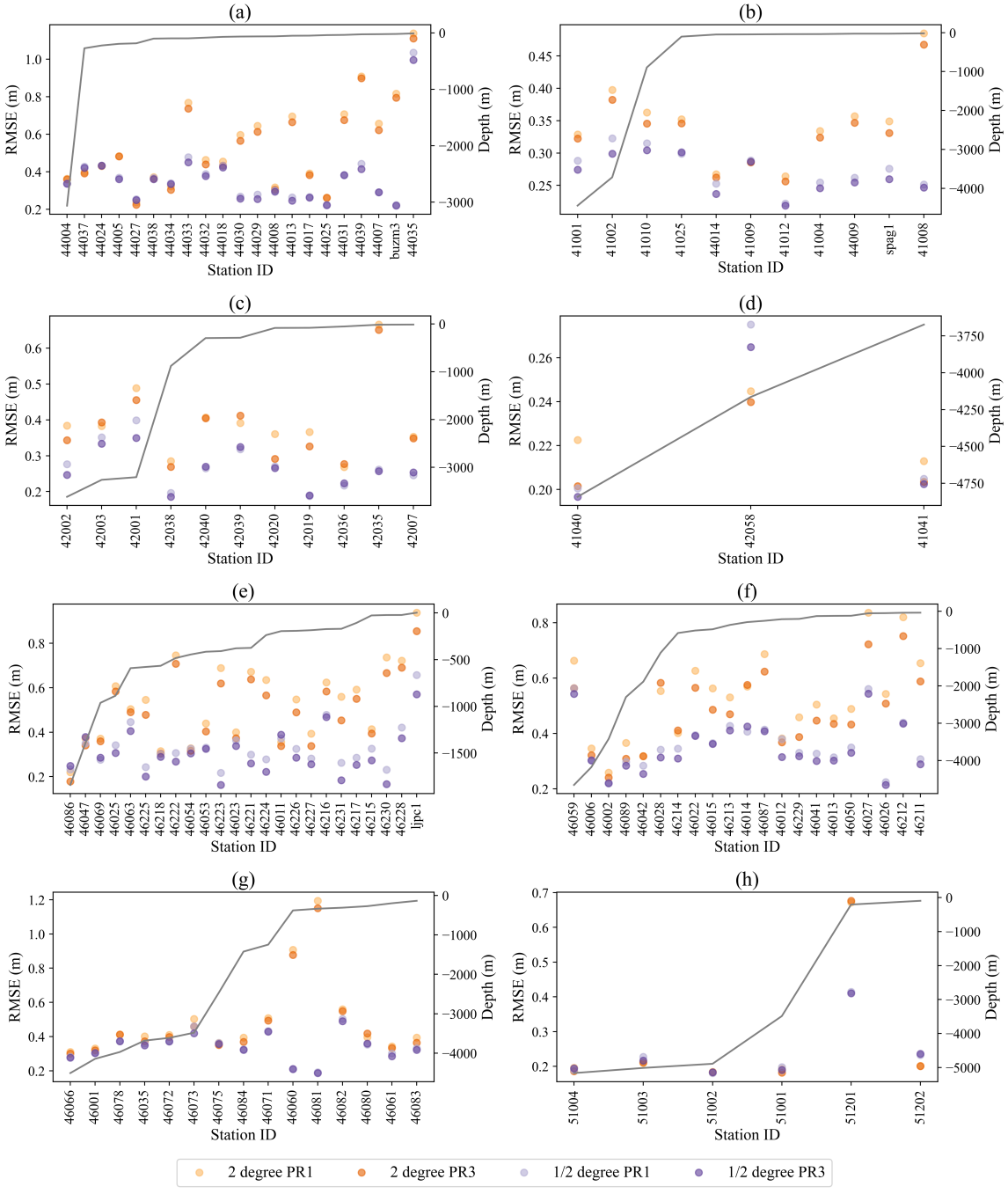

Figure 1. Root mean square errors comparing the accuracy differences between the `PR1` and `PR3+UQ` switches. The 2 degree structured mesh is represented by orange and the 1/2 structured mesh is shown in purple. Darker shades are associated with the `PR3` configuration while lighter correspond to the `PR1` switch. Subplots are presented in order of regions from the manuscript as follows: (a) Gulf of Main, (b) South to Mid-Atlantic East Coast, (c) Gulf of Mexico, (d) Caribbean Region, (e) Southern California Coast, (f) Northern California and Pacific Northwest Coast, (g) Alaskan Coast, (h) Hawaiian Coast.