

Interactive comment on “MetUM-GOML: a near-globally coupled atmosphere–ocean-mixed-layer model” by L. C. Hirons et al.

Anonymous Referee #1

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Summary: This manuscript introduces the Multi-Column K Profile Parameterization (MC-KPP), a sophisticated 1D mixed-layer ocean model framework designed to operate flexibly in a general circulation model. MC-KPP is integrated into the MetUM, and experiments investigating the impact of a highly vertically resolved upper ocean are conducted. Compared to atmosphere-only simulations forced by prescribed sea-surface temperatures, the MetUM-GOML (the coupled model) is shown to slightly reduce mean-state tropical precipitation biases and improve the representation of tropical intraseasonal convection and Euro-Atlantic springtime blocking patterns. The authors do not investigate physical mechanisms or connections that might explain why the coupled simulation is more realistic than the atmosphere-only simulations, but I feel such

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a digression is rightfully left to future studies.

Overall assessment: Accept with minor revision. The manuscript demonstrates logical organization and textual clarity and succinctness. The authors do well in maintaining the focus of the paper – introducing MC-KPP as a powerful tool that can be used in a host of diverse GCMs for a variety of weather and climate applications. I recommend that some of the figures be improved (either the plots were too small or difficult to read, the text was too small, etc. . . parts of Figs. 3, 4, 6, and 9). I am generally pleased with the scientific content and conclusions of the paper, and I feel that the manuscript will be a welcomed addition to the climate modeling community once the minor comments below are addressed.

Minor comments:

1. P6175 L19: Did Straub and Kiladis (2003) specifically mention the MJO in relation to tropical-extratropical interactions? From the second paragraph in their Section 5b, it seems that their focus is on convectively-coupled Kelvin waves (I admit the line between CCKWs and the MJO can at times be blurry).
2. P6179 L6-11: It may also be worth mentioning that sensitivities can also arise due to choices of mixed-layer depth and relaxation timescale.
3. P6186 L10-11, L23-25: It's quite difficult to assess 2K and 4K temperature differences based on the way that Fig. 3a is plotted (10K increments). Would it be worth using the shading for A-K31 minus ERA-Interim instead of shading total A-K31? I have a similar reaction to Fig. 4a.
4. Fig. 6: I recommend enlarging the text on the Figure 6 panels. Also, it is difficult to see and compare the MJO spectral region.
5. P6192-6193: I didn't feel that, given the commentary of previous studies presented in the last paragraph of Sec. 4.1, the authors brought enough closure to the discussion of extratropical storm tracks. Given the notable improvement to tropical intraseasonal

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variability (MJO), it was somewhat disappointing to see that the storm tracks did not change much for the better. I encourage the authors to add a brief comment about this result – does this indicate that the connection between tropical and extratropical variability in the MetUM-GOML is not as robust as it is in nature? Is this representative of an inherent weakness in the MetUM regardless of whether air-sea coupling is active?

6. P6195 L7-10: This note may be more important than the authors seem to suggest and should be moved (or, better yet, repeated) earlier when the experimental setup is described in Sec. 2.3. The temporal resolution of the SSTs (1- vs. 31-day averages) may well impact atmospheric circulations whether or not air-sea coupling is active.

Possible typographical errors:

P6175 L19: have -> has

P6176 L13: influence -> influences

P6195 L28: indicate -> indicates

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