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Geoscientific Model Development Discussions

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

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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).

The comment is correct that the Straub and Kiladis (2003) paper does not explicitly mention the MJO, although, as stated above, the line between CCKWs and the MJO is indeed blurry. The text has been altered to only attribute the link between equatorward-propagating Rossby wave trains from the SH and CCKWs (not the MJO specifically)

with the Straub and Kiladis (2003) study.

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.

The reviewer is correct in suggesting that such sensitivities are missing from the discussion of slab ocean models. The part of section 1.2 discussing slab ocean models has been extended considerably in the manuscript. Further related modifications have been made to section 1.3.

These sections now outline the advantages of having a vertically resolved ocean over a slab on the representation of tropical variability (Woolnough et al. 2007, Klingaman et al. 2011, Tseng et al. 2014). Discussion has also been added, as suggested, about the sensitivity of simulated variability to the depth of the slab ocean. For example, the Maloney and Sobel (2004) and Watterson (2002) studies which systematically test the sensitivity of variability to different slab depths are discussed. The additional point is made about the inability, within a slab configuration, to store anomalies below the mixed-layer depth which can later re-emerge and affect the atmospheric circulation. Sensitivities to temperature correction techniques employed in a slab model are also mentioned.

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.

The authors accept this comment. In Figures 3a and 4a the shading has been changed to A-K31 minus ERA-Interim rather than the total field for A-K31. This makes identifying biases compared with ERA-Interim much clearer. Following a comment by a separate reviewer, stippling has also been added to Figures 3 and 4 to indicate where differences are significant at the 95% level.

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.

The text on Figure 6 has been enlarged. A grey box has been added to highlight the MJO spectral region to make these comparisons easier. The spectral box is added for the region of 30-80 days, wavenumbers 1-3.

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 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?

There are improvements in the representation of the MJO in the coupled MetUM-GOML configuration shown here compared with the MetUM atmosphere-only versions: slight improvement in spectral power associated with the MJO (Figure 6), improved intraseasonal variability in precipitation (Figure 7) and significant improvements in MJO propagation (Figure 8). However, there remain significant deficiencies in the representation of deep tropical convection in the MetUM which result in weaker-than-observed MJO activity in K-O. The amplitude of MJO power in Figure 6 (d) is still significantly less than in NOAA observations Figure 6 (a). Therefore, it may be that the improvements in MJO activity in K-O are not significant enough to influence the circulation response to the MJO in the extra-tropics which is why minimal changes are seen in the storm tracks by this measure (Figure 9). That said, all of the changes in 2-6 day variability in Figure 9 are significant at the 95% level and there are considerable changes to the representation of blocking frequency in the Euro-Atlantic region with the coupling (Figure 10). This suggests that there may be teleconnection patterns associated with the improvements in intraseasonal variability in the tropics. The tropical-extra-tropical

teleconnections within these runs warrants further investigation.

Horizontal resolution may also play a role here in the connection between tropical and extra-tropical variability. Increasing horizontal resolution has been found to improve storm-track variability and blocking (e.g., Matsueda et al. 2009). Therefore, the N96 horizontal resolution used in the experiments in this study may be too coarse to capture this extra-tropical variability, no matter how good the tropical variability is represented.

In response to this comment the text at the end of section 4.1 has been changed to reflect that, although improvements are made in the representation of the MJO in K-O, significant deficiencies still remain. The text now states that if the improvements in MJO activity are large enough and the MetUM is able to accurately simulate the circulation response to increased MJO activity associated changes may be seen in extra-tropical variability. Further clarification has been added to the text at the end of section 4.2.1.

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.

This note about the 31-day smoothed SSTs including the effect of increased, high frequency SST variability has been repeated at the end of the experimental setup section (section 2.3).

Possible typographical errors: P6175 L19: have -> has

This has been changed as suggested.

P6176 L13: influence -> influences

This has been changed as suggested.

P6195 L28: indicate -> indicates

This has been changed as suggested.

Interactive comment on Geosci. Model Dev. Discuss., 7, 6173, 2014.