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Interactive comment on "Connecting spatial and temporal scales of tropical precipitation in observations and the MetUM-GA6" *by* Gill M. Martin et al.

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Response to comments by Anonymous Referee 2.

General comments

This paper presents a useful study on the behavior of tropical precipitation in the MetUM-GA6 model and the sensitivity to grid spacing. The introduction does a nice job setting up motivation for the project and includes a concise synthesis of prior

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work related to precipitation modeling. The methods are outlined clearly; however, more justification for the years chosen for analysis could be included. In the results sections, the figures and accompanying text clearly communicate the results; claims are backed up with reasonable explanations and limitations/caveats are noted throughout. The presentation of different types of analyses helps bring together the results of the paper, the main take-away being that in this model, precipitation characteristics are largely unaffected by changing resolutions. Recommendation: Minor Revisions

Specific comments

- Discussion of Table 1 on P4 mentions several different geographical domains - a figure outlining all domains used throughout the study would be useful.

This was also suggested by Referee 1 and has been added as a new Figure 1.

- It is mentioned in the Methods discussion that there is little sensitivity in the year chosen for the time-step analysis (P4, L14-15), but is there any justification for why you chose the years you did? For instance, the simulation years for N512 noted in Table 1 are 1982-1990, but 2007 is used for the time-step analysis.

The years were chosen purely according to data availability. Since outputting and storing timestep data is computationally expensive, the diagnostic output is only switched on occasionally and the model year for which this is done is chosen at random. For the N512 simulation, the timestep output was switched on for 1985, but there was a technical problem with the output which meant the time-step diagnostics needed to be switched on again in a repeat of the run. This repeat simulation was started from 2007 due to the availability of a useable 1st June restart file for that year. Comparisons made between different years (on rare occasions when several years of timestep data have been available) have shown little sensitivity to the year chosen.

We have added this information to Section 2.1.

- The discussion of Fig. 1 talks about consistent intermittency between resolutions - this is qualitatively true, but difference PDFs, possibly between the highest and lowest resolutions, or some statistical significance testing could help show this more quantitatively.

We agree with the Reviewer that a more quantitative measure of the differences is necessary. Indeed, following reviews of the paper by Klingaman et al. which describes the ASoP1 methods, summary metrics were added to the methods. Therefore, in the revision of the present manuscript, these have also been used in a new section 3.6 and are shown in Table 3.

- The end of section 3.4 discusses how the explicit convection results compare best to CMORPH/TRMM - consider mentioning that possible explanations for this are discussed further in section 4.3.

Done.

- In the discussion of Fig. 7 in section 4.1, L26 (P9) refers to the consistency between resolutions as "remarkable". It is true that the overall patterns are quite similar, but there are some notable differences in N512, particularly between -15? S-0? off the east coast of Africa. Again, difference fields would be a concise way to highlight similarities and differences.

We did consider this but the problem is that in order to create a difference plot we would have to interpolate the results from the higher resolutions to the lower (or vice versa) and this process would throw away the information that we are trying to present, namely that the spectral shape for the timestep data is almost the same regardless of the resolution. The 1d histograms, which can be overplotted as in Figure 9, are the best way to illustrate this without having to perform any averaging or interpolation.

- From the discussion in section 4.3, it seems the explicit convection experiment is likely

getting the right answer for the wrong reasons. The inclusion of this experiment doesn't detract from the main messages of the paper, but I do wonder, what information is to be gained besides motivating future work for repeating this analysis with convective-permitting simulations? Also, consider Molinari and Dudek (1992) "Parameterization of Convective Precipitation in Mesoscale Numerical Models: A Critical Review".

Indeed, the reason for including this experiment, despite its unrealistic nature, was to demonstrate that the diagnostics were capable of identifying contrasting behaviour between parametrized and explicit convection, in order to motivate their usage for other convection-permitting simulations at more sensible resolutions. We have clarified this point in section 4.3.

Technical Comments

- P2, L13: Remove "both"

Corrected.

- P2, L14 (and throughout): comma after "e.g."

Corrected.

- P2, L16: Hyphenate "grid-scale" (issue also appears on P13, L14 and L15)

Corrected.

- P3, L10: "MetUM" was defined in the abstract, but has not yet been defined in the main body of text

Corrected.

- P4, L14: "data" should be added between "time-step" and "was"

Corrected.

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- P5, L3: Add "(not shown)" between "differences" and "confirming" as this comparison is not included in the paper

Corrected.

- P5, L19: Consider adding "(dashed line)" between "PDFs" and "among" for clarity and reminder for the reader

Corrected.

- P5, L21: Consider adding "strongly" between "not" and "affected" - there are some differences with resolution, albeit not drastic ones

Corrected.

- P6, L8: Consider changing "suggests" to "confirms" as we know N1024 is too coarse for explicit convection

Corrected.

- P6, L19: Is there an extra space before "Switching"?

Corrected.

- P6, L25: It's stated in section 3.1 that differences between resolutions were small, so consider changing the phrasing of this sentence. Maybe ". . .examine whether the character of grid-box/time-step precipitation discussed in section 3.1 persists. . ."

Corrected.

- P7, L8: Remove "perhaps" - it is clear that the model show this at a more limited extent than CMORPH

Corrected.

- P10, L29: Add reference to panels "a" and "c" of Fig. 9 to point readers quickly to correct panels

Corrected.

- P13, L24: Add period after "etc"

Corrected.

- Fig. 11, panel (c): should the legend reflect the "N1024e" experiment?

Corrected.

- Overall comment on figures with red and green colored lines: consider changing colors for readers who are red/green colorblind

We have now removed the red, pink and yellow colours and replaced with purple and dark brown.

Other changes

We have updated Figure 2 (new Figure 3) to remove the blank column labelled "XXX" following the reviews of the ASoP1 methods paper by Klingaman et al. (2016).

A tracked version of the revised manuscript is attached as a supplemental file.