

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-209

Anonymous Referee #1

Referee comment on "The second Met Office Unified Model–JULES Regional Atmosphere and Land configuration, RAL2" by Mike Bush et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-209-RC1>, 2022

General comments

This paper describes the changes to the regional atmosphere land (RAL) configuration of the Met Office Unified Model and demonstrates the impact of the changes for various variables, regions of the world, seasons, and case studies. Effective use is made of scorecards to highlight the nature of the changes from RAL1 to RAL2. Overall RAL2 provided more improvements than detriments.

These results demonstrate the large effort required by the Met Office and its partners to continuously improve the simulation of the atmosphere-land system. The fact that the differences between RAL1 and RAL2 were not very large (even if they were statistically significant) highlights just how far the community has come in recent decades in producing excellent numerical weather forecasts. This paper makes a useful contribution to documenting progress in NWP development.

When writing about a complex NWP model it's difficult to be brief and still convey complete information (or at least cite where the reader can find out more). Most of my specific comments relate to incomplete information that needs to be better described or defined.

The English was of good quality, and the graphics were well presented.

Specific comments

- p.4, lines 20-27 – The overlap between liquid water and ice phases is “limited” but you don’t describe how. Is there a cap on the percent overlap? Is this documented elsewhere and could be referenced?
- p.5, lines 12-14 – since you show results for addition of the Leonard terms in Figs. 5 and 6, it would be good to give more explanation here of what the Leonard terms actually refer to.
- Table 2 – what are b_{LEM} and c_{LEM} ?
- p.6, line 12 – seems odd to have “(no reference)” – consider omitting
- p.6, eq.(1) – what is Γ ?
- p.6, lines 24-25 – why does fixing the multilayer snow scheme allow reintroduction of graupel? Does it form on the snow surface?
- p.7, bottom – the scorecards in the figures use 10.5 km scale (7 grid-lengths). It would be good to explain why this particular scale was chosen for evaluation.
- p.7, line 18 – define GPM
- p.10, line 1 – this should be “the improvement in performance in Winter is much better than the improvement in performance in Summer”.
- p.10, lines 13-14 and Fig. 12 – do the model results in Fig. 12 correspond to the large rectangular domain over Darwin or for the circular domain of the radar? Please clarify, including in the caption for Fig. 2. If the model results are for the larger domain, how much difference from the radar could be explained by sampling different areas?
- p.11, lines 4, 9, 10, 14 – define GWP, LMI, ENLS, QCF
- p.11, lines 17-18 – readers may not know where these regions are – it would be better to say what part of India (northern, etc.)
- p.12, lines 6-10 – do you think the implementation of RAL2 in operations with only 70 levels rather than 90 levels (as shown in the results in this paper) has much effect on the improvements over RAL1? If this has been tested it would be good to say a bit more about it.
- p.A table of acronyms is provided in Appendix 2 but never referred to in the text.

Technical corrections

- p.1, line 18 and elsewhere – There are too many parentheses in the in-line citations. This should be (e.g. Baldauf et al., 2011; Brousseau et al., 2016; Bengtsson et al., 2017; Klasa et al., 2018).
- p.2, line 6 – Fix spelling of ‘the’
- p.2, line 16 – RAL has not yet been defined in the body of the paper
- p.2, lines 30, 32 and elsewhere – Instead of “Sect” write “Section”
- p.4, line 10 – fix “but extensively modified is used”
- p.4, line 20 – do you mean “a change in RAL2-M”?
- p.5, line 21 – change “RAL2 to use” to “RAL2 uses”
- Tables – remove “%” from captions
- p.9, line 6 and 8, and elsewhere in case studies – remove the “0” from “04th December 2019”
- Results sections – no need to capitalise Winter and Summer
- p.9, line 23 – should be “Figure 11 shows RAL2 outperforms RAL1...”
- p.10, line 20 – rather than “in the longer time” give the hours for which RAL2-T performance is better than RAL1-T