

Interactive comment on “Atmosphere-only GCM simulations with prescribed land surface temperatures” by D. Ackerley and D. Dommenges

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Reviewer general comments: This paper describes a method for prescribing land surface temperatures in an atmospheric model and then applies the method in a series of sensitivity tests. It is suitable for publication with minor revisions, although a restructure of the paper might make it an easier read (see specific comments).

Authors' response: The authors would like to thank the reviewer (Dr. R. Law) for her insightful, constructive and supportive review of our work. We have endeavoured to respond in detail to the comments raised and hope that we have answered those issues sufficiently. Please find them attached to this review as a supplement.

Specific comments Sec 2.2.2 and Figure 1: There appears to be a discontinuity at 0Z in the 1-2 January timeseries plots in the middle column of the figure. While other step

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changes appear commonly every 3 hours, presumably related to the radiation time-step, the 0Z step appears more consistent/worse, at least for Australia and N Asia. For N Asia this becomes the dominant feature in the figure rather than any diurnal cycle (and so appears to contradict the statement that 'a clear diurnal cycle can be seen at each of those grid points' (p6, line 9)). While I don't expect this issue to have any implications for the work presented here, a comment/explanation in the text would be useful to satisfy a curious reader.

Response: The authors agree that this is a strange discontinuity and that it appears to be systematic in all 50 years of the simulation (grey lines in Fig. 2) for the Australian and North Asian points. We assume that it must be due to the radiation time step too. We also agree that the statement about a 'clear diurnal cycle' is misleading in this case and we have changed the text to be, "...however, diurnal variability in the surface temperature can be seen at..." in order to avoid saying 'diurnal cycle' specifically in reference to Fig. 2. We have also included the statement at the end of that paragraph to account for the discontinuity, which states that, "There are also some discontinuities in the original time step data, which are likely to be associated with the radiative calculations within ACCESS (occur every three hours)."

Sec 2.2.3: Are there any implications for the surface energy balance in prescribing the surface temperature, or is any implied imbalance absorbed in the radiation terms? Did you do any checks to confirm this?

Response: The responses of the surface fluxes are plotted in the attached FIG. 1 below. The differences in each of the fluxes are small (generally within $\pm 2.5 \text{ W m}^{-2}$) despite there being some statistical significance, which is not surprising given that over 50 years of simulation even small systematic differences are likely to be significant (although physically irrelevant in terms of the resultant climatological state e.g. global circulation). Given these small changes, the inclusion of these results in the main text will not change the conclusions or provide any more insight. Furthermore, as this figure will be published (and freely available) with the review responses, readers will be able

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to view these figures (below).

Section 3: Please check references to east and west as they sometimes seem to be mixed up (see technical comments for examples).

Response: We thank the reviewer for noticing this and apologise for the systematic, unintentional misuse. We have corrected the text where necessary.

Restructure of paper: There are two aspects to the paper. The first is checking whether the prescribed land surface temperature reproduces the original simulation and the second is the set of example sensitivity experiments. I think the paper would be easier to follow if the two aspects were dealt with separately in the results/discussion section, i.e. present all the 'CON1-FREE' and 'CON2-CON1' results first and discuss these before moving onto the presentation of the sensitivity experiments. These also might be best presented as groups of experiments with the results and discussion presented together for each group. It may just be personal preference, but I would find it easier to be able to look at the temperature, precipitation and pressure differences together for one experiment (or set of related experiments) before going on to consider the next experiment. If a restructure is undertaken, I would move the comment about Antarctic temperatures (p6, line 17 and line 22-23) into the results/discussion of 'CON1-FREE', e.g. 'Initial tests showed ...', 'This was resolved by ...' giving 'CON1-FREE' results as shown in Figure ...

Response: The authors agree with the reviewer that the paper could be structured in another way; however, having the temperature, mean sea level pressure and precipitation plots all in the same place allows easy comparison between the control runs and each of the perturbed runs within the same panel. Furthermore, the current structure provides an overview of all the main features of each simulation and then, based on those interesting features, goes on to explain them. A reader can then either quickly browse through the overall results from the experiments (i.e. see how the control and perturbed simulations compare against each other) or look in more depth at the more

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speculative scientific interpretation as to why we see the results presented in section 3. Therefore we would like to keep the current format as it is.

Technical comments p3, line 7: list Bi et al (2013) before Frauen et al. (2014) and perhaps note that the Bi et al. paper it is the ACCESS1.0 version that is most relevant. Response: Changed order and included "(primarily ACCESS1.0)" in the sentence.

p3, line 5: suggest adding 'configured similarly to' before 'Hadley Centre ...' Response: Changed as suggested.

p3, line 9: delete repeated 'the' Response: Corrected.

p3, line 19: 'constraint' mis-spelled Response: Corrected.

p5, line 8: delete 'the' before 'ATMOS_PHYSICS2' Response: Deleted.

p6, line 5: Might be worth noting that the grid-cell values shown are the mean across the tiles in the grid-cell, assuming that is the case. Response: At the end of the sentence referred to we have included, "... (values are the grid-box mean across all surface tiles)."

p7, line 4: 'The first three experiments ...' not four. Response: Corrected.

p7, line 9: insert 'is the' before 'same' Response: Included.

p8, line 29 and 30: western Pacific, western Indian Ocean? Response: Yes, corrected as suggested.

p9, line 6: south-east of the Amazon? Response: Yes, corrected as suggested.

p9, line 10: the remote responses in the AUS10K temperature show some similarity to the con2-con1 differences. Do you think this is just coincidence? Response: Given that the changes in CON2-CON1 are not statistically significant then it is likely to be coincidence.

p9, line 12: east of the continent? Response: Yes, corrected as suggested.

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p9, line 32: did you mean south-east, as this would be more consistent with the temperature anomaly? Response: Yes, corrected as suggested.

p10, line 6: 'increased precipitation coincides' Response: Corrected as suggested.

p10, line 15: add 'be' before 'representative' Response: We have changed the order of that sentence to read ('refs' refer to the existing references already there, which are unchanged): "Accepting that ACCESS (Ackerley et al. 2014; 2015) and other GCMs (Yang and Slingo, 2001; Dai and Trenberth, 2004; Dai, 2006; Dirnmeier et al., 2012) produce convective rainfall too early in the day relative to observations, the same. . ."

p10, line 17: 'assess' mis-spelled Response: Corrected.

p12, line 6: add 'Antarctic' after 'allowing the' Response: Changed as suggested.

p12, line 26: delete space between T and 1.5 Response: Corrected.

p12, line 27: delete 'the' at start of line Response: Deleted.

p16, line 10: 'an' not 'and' towards end of line Response: Corrected

p16, line 13: Should be figures 11(a) and 11(e) not (b) and (f) Response: Corrected.

p16, line 31: replace 'or' with 'of' Response: This part of section 4.2.4 has been changed considerably and this suggestion no longer applies.

p17, line 5: ')' after 'respectively' Response: This part of section 4.2.4 has been changed considerably and this suggestion no longer applies.

p18, line 1: 'the' before 'imposed' Response: Corrected.

p20, line 3: 'GCM' instead of 'GCMs' Response: Corrected.


p20, line 21: 'model' not 'mode' Response: Corrected.

p21, line 4: 'of' repeated Response: Corrected.

p22, line 13: 'Cook' needs capital Response: Corrected.

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Figure 1, middle column: the orange line is not defined in the figure caption (though the three-hourly input is mentioned for the right column but not shown?). Is the thickness of the black line significant or just for readability? Response: The authors have adjusted the figure in question so that the full caption can now be seen. The thickness of the black line is just for readability.

Figure 11: The colour bars in panels (a), (b), (e), (f) appear to be swapped. Response: The colour bars have been corrected. 

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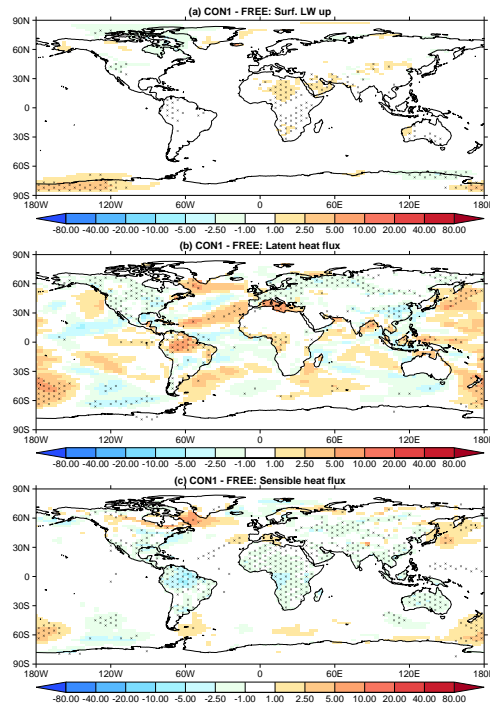


Fig. 1. The difference in (a) surface long-wave emission (upwards, W m^{-2}), (b) upwards latent heat flux and (c) upwards sensible heat flux between CON1 and FREE.