Geoscientific
Model Development
Discussions

Interactive comment on "Practice and philosophy of climate model tuning across six U.S. modeling centers" *by* Gavin A. Schmidt et al.

Anonymous Referee #2

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General Comments

This paper describes the approach to model tuning of six U.S. modeling groups. It describes itself as a follow on from a paper by Hourdin et al (2016) paper (The art and science of climate model tuning) which was an outcome of a meeting of International modeling groups starting to discuss tuning practices and the implications thereof. I think the paper is potentially publishable, although I have some reservations over the balance of the content, notably what is new. I think the authors need to address the following issues;

1. Section 2 covers very much the same ground as Hourdin et al (2016). Whilst it is well written, this is not the new part of the paper. I think this needs to be reviewed and shortened. There are useful additional contributions such as using examples from

the US models such as P4 second paragraph where parameter tuning vs structural uncertainty is discussed.

2. Section 3 describes the specific practices of each modeling centre and hence is the new contribution. However this section is very uneven and there is no common format by which the reader can compare the six modeling centre approaches. At the very least this needs to be organised so that all groups describe e.g. first their use of component models (AMIP, forced ocean etc), then coupled (AOIL, PI control and/or PD control) models then ES models (if appropriate). Then they should describe how they use historic simulations and idealised futures (e.g. 4K SST or 4CO2) to look at climate sensitivity. In many cases there is some similar structure to this but the vagueness or lack of common use of specific terminology for experiments or approaches makes it very hard to interpret.

3. Also in Section 3, the language describing the methodology to tuning by each centre is often vague and not well quantified. The groups use terms like 'the magnitude of the aerosol indirect effect …..was adjusted if deemed to be inconsistent with…' or 'Configurations for which the ratio… fell substantially below… were rejected' or 'A key tuning target is matching the ….'. How was the model adjusted? What represents substantial? How was the model 'matched' to observations? I think if we are to describe the detail of the tuning process at this level we need to be completely clear about what we mean. I recognise of course that this might mean we have to say 'A subjective decision on the relative quality of the various configurations based on a set of X metrics was taken' but at least the reader then knows how a decision was made.

4. In a few places there is a description of what I would call 'traditional model development' which is here described as tuning (e.g. p 10 3rd paragraph). I think we must be really careful to separate improvement to convection e.g. by inclusion of cold pools which leads to better MJO variability from tuning of parameters to ensure e.g. balance of large-scale measures. Indeed I think it would be helpful to recognise that modeling centres often 'monitor' some of these tuning targets as models are developed (e.g.

from bottom up) and this can avoid the need for a lot of final tuning in many cases.

Specific comments

P2, l10. I am not sure that model tuning has ever been transparent. It was simpler but still not documented in most cases.

P3, l26. Not only possible but likely, I would suggest

P5, l17. I suspect the changes made affected the NH more widely than just the UK.

P5,l24. I think the weak correlations between aerosol forcing and sensitivity do not provide strong evidence that there has been model tuning based on this trade-off but I don't think you can say that this means the CMIP3 models aerosols forcings were not tuned. I suspect it was done in some models but certainly not in all.

P7,l4 'Cess climate sensitivity is evaluated using idealised SST +4K simulations' How is this then used? Are models thrown away if this is outside of some range (e.g. CMIP5)?

P7, l16. '...to monitor the combined impact of anthropogenic forcings and climate sensitivity' Again, what does 'monitoring' mean? Is action taken if its deemed to be 'unacceptable'?

P8, l29. Why were new model versions constrained to have a ratio of RFP to Cess sensitivity the same as the old model? Presumably so that the evolution of historic temperature will not differ substantially from that achieved by the old model – although it sounds like it didn't work very well. The target for this tuning needs to be said more explicitly.

P10, l6. What happens if the coupled model drifts are not 'relatively small'? Do you go back to the start (i.e. component level tuning?)

P11, l2 'The tuning suite includes present day climate simulations, ...' Does this mean AMIP or coupled PD?

P11, l10 – same comment as above what do you mean by 'present day climate' here?

P11, l12 What does 'matching' mean. RMS?

P11, l26 What does 'bring together' mean?

P12, second paragraph. Are the higher resolution simulations tuned independently from the lower resolution ones, even for parameters with no obvious resolution dependence? How does this fit with a seamless idea or is this an explicit recognition of the specific requirements of the different uses/customers?

P13, l17. What is the basis for constraining the net aerosol forcing to be less than -1.5Wm-2?

P14, l13 Does 'transient mode' mean - historic simulation?

P14, l15 What tuning to the historic record does happen - no tuning or no fine-tuning?

P15, l4. Another example of model development. Increasing levels from 28 to 64 is not tuning.

P16, l1-4 You talk about the value of evaluating fast physics in short range forecasts. It wasn't clear that NASA GMAO used this capability for a seamless approach in their tuning approach?

P17, l14 I don't understand what 'using the decadal mean SST ... and constant yr 2000 forcings' means. What is the experimental design here?