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Interactive comment on "Automatic tuning of the Community Atmospheric Model CAM5.3 by using short-term hindcasts with an improved downhill simplex optimization method" *by* Tao Zhang et al.

Anonymous Referee #2

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** Summary ** This is a nice study that investigates the possibility of automatic tuning, by using a much more efficient set of of successive short simulations with CAM. The outcome is that the model can be improved for an aggregate set of objective parameters through an objective minimum finding algorithm. There are however discussions that could be included to clarify the outcomes of the analysis and give greater isight into the performance of the algorithm, for all the individual variables.

-It's pretty clear to order 0 that LWCF is the only optimized variable by this process. Do the authors know why this is? -LWCF has always been a poorly performing variable in CAM and the main reason is that the clear-sky component of the LW is too strong,

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but their combination give about the right total LW at the top of atmosphere. This is the often the reason that LWCF is chose to be weaker than observed in order to get an accurate TOA flux. So does LWCF improve in CAM5 at the expense of the total LW? -Models are more often tuned (at least by humans!) from an energy budget balance and coupled system perspective. How does this technique inform this standard approach, and what would need to be added to make it appropriate? -Will coupled work as well as AMIP type? -It would be good to some of the initialized and maybe AMIP simulations with the individual optimized, to confirm the discussion of the reasons for field improvements. -Incompatible observations versus structural errors: Is it clear to what extend the role of each of these factors maybe. e.g., if you optimized to ERBE or TRMM instead what would be the outcome. -Ultimately, does it give greater insight into model tuning that we already have? i.e., if you made a list of parameter shifts required to optimize the model, would it be a surprise to someone who does traditional tuning, and could they give you a reason as to why they would not select these parameter values.

** Other Comments **

1. Introduction 2. Model and Experiments "The philosophy behind the hindcasts is to keep the model dynamics as close to observation as possible while test how the model simulates the physical variables" -I'm not sure what is meant by this? That you initialize both the dynamics and physics and yet the physics have longer timescales. Do you that this is indeed the case, by looking at RMSE/ACC for dynamical versus physical fields? So the only way you're 'keeping' the dynamics close is by initializing them close to obs. and doing the short runs right? -Could dynamical fields be a part of the optimization variable set (e.g., U850) to see if they are non-fast?

3-day biases versus -> climate model biases may be different. 3. Tuning metrics Equation 1 and 2 punishes bad performing variables disproportionately, such that improvements can dominate all other improvements/degradations. This is true for Taylor Diagram scores. Fig 3, would be great if you plotted the individual optimized fields to

see how they evolve and iterate to a minimum (probably SWCF is little change and LWCF dominates the optimization).

4.2 Figure 4/5: Although LWCF is improved the regional distributions are not that different in contrast to the control. It's therefore somewhat strange that this is not that different, even though LWCF was a target metric. But high-cloud is much improved even though it wasn't a target metric.

-In figure 7, it is a challenge to really say that the optimization seems not to be operating on anything but LWCF. What happens if you take LWCF out of the optimization fields? Does it look very similar to the control or does it find a more effective minimization for the remaining variables. -Also how significant are these control/exp changes in AMIP given the short nature of the runs. -If the models surface is warmer does this also imply a surface (and maybe TOA) positive energy imbalance -I am not sure the structural argument is a given. If it is then, it would imply that this process is not truly useful until we go away and fix these types of formulation problem. Incompatible observations may also be a contributing factor.

5. Conclusions -If model parameter sections were automated and not restricted to ranges, isn't there a danger that the resulting climate could be improved in certain ways, but at the large expense of non-optimized parameters. For example a climate that may have zero convective precip.

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