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Interactive comment on "A sensitivity study of radiative fluxes at the top of atmosphere to cloud-microphysics and aerosol parameters in the Community Atmosphere Model CAM5" *by* C. Zhao et al.

Anonymous Referee #2

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Review of "A sensitivity study of radiative fluxes at the top of atmosphere to cloud-microphysics and aerosol parameters in the Community Atmosphere Model CAM5" by Zhao et al.

This manuscript uses an objective method to analyze a suite of common adjustable parameters in a community General Circulation Model. The analysis provides some useful information on what parameters define sensitivity of the top of the atmosphere radiation. The method is interesting, though could be a bit better explained, and the

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study and conclusions should be publishable in Atmospheric Chemistry and Physics with some important clarifications and corrections.

I have some concerns over the method. The analysis focuses on what increases variance the most, or what parameters explain variance spread, but only for the parameters you have chosen. If something else is more important, you would miss that, correct?

Also, I worry about short runs: there is not going to be statistical significance in the Arctic with 4 year runs: the variance of TOA radiative fluxes with variable SSTs is pretty high. I assume your significance tests account for the variance in the fields? This was not clear to me, and not clear if the 4 years are sufficient to tell much.

Also: the co-authors who are native English speakers should re-read this for grammar. There are some consistent mistakes in the text. I have noted some of the problems with plural nouns, but there are others.

Specific Comments

Page 12136, Line 24: You should make more use of the LW v. SW results, since they help tell about what kind of clouds and sensitivity of them.

Page 12137, Line 15: Clouds and aerosols: should be plural

Page 12138, Line 1: Limitations: plural

Page 12140, Line 7: treats: plural

Page 12140, Line 10: Awkward: do not mention 'diagnosed' in the sentence. I would not say diagnosed for convection in cam5: number concentrations are prescribed based on an assumed size

Page 12140, Line 27: Probably better to cite Neale et al 2010, NCAR technical note.

R. B. Neale et al. Description of the NCAR Community Atmosphere Model (CAM5.0). Technical Report NCAR/TN-486+STR, National Center for Atmospheric Research,

Boulder, CO, USA, 2010.

Page 12141, Line 8: 4 years with varying SST is going to be a bit hard to get statistical significance for FNET. do you analyze what sigma is? If not, you need to.

Page 12141, Line 14: Refer to personal communication below.

Page 12144, Line 7: are zero (plural)

Page 12144, Line 22: Sorry to be slow, but the method is a bit obtuse, and could use some more description. You are building a regression model or series of models to reconstruct FNET? Where does the 'variance' part come in? Please explain in words. Also, what do you use to determine significance? If FNET with a perturbation is significantly different than FNET in the base case? How does variance in the base case factor in? At all? Or are you just looking at contributions to spread in your ensemble? What about parameters that are out of sample?

Page 12145, Line 21: It would also be interesting to look at LW and SW components of each FNET, FNETC AND CF

Page 12145, Line 25: Unclear: "relatively insignificant....perturbation."

Page 12145, Line 29: Plural: parameter effects and interactions.

Page 12146, Line 1: predicts well

Page 12146, Line 3: So this is variance within the parameter set? You are not trying to explain all the possible variance in FNET in CAM. Clarify,

Page 12146, Line 24: Good. Should mention this earlier: using SW and LW components, and regression v. LWP.

Page 12147, Line 10: Can you explain the "surface temperature feedback" statement?

Page 12147, Line 13: in CAM5 development

Page 112148, Line 7: Why do fall speed parameters for ice/ snow affect SWCF so

much? What does 'mixed phase processes' mean?

Page 12150, Line 12: Do you mean spread among the simulations, or variance of the 4 years? I worry that 4 years is not long enough to generate statistics.

Page 12152, Line 22: Continents (plural) in this paragraph.

Page 12153, Line 14: Maybe all emissions components could be added to one figure, and published in the main text as a new figure.

Page 12154, Line 17: But the effect is combined anyway: the FNET variance is because of the variables, so they better reproduce it.

Page 12154, Line 25: Summarize LW v. SW.

Page 12156, Line 28: Comment on LW and SW please. Which is more sensitive? Is it LW because of DCS?

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