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Interactive comment on "Surface and top-of-atmosphere radiative feedback kernels for CESM-CAM5" *by* Angeline G. Pendergrass et al.

Anonymous Referee #1

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The authors present a concise manuscript documenting and describing radiative feedback kernels for the top-of-atmosphere and surface produced with the CESM-CAM5. These kernels are likely to contribute to scientific advancement since they are one of few sets of documented kernels that also provide surface radiative responses and because they are produced from a different model and radiation code (although some clarification may be needed, as seen in detailed comments later). The authors also provide an assortment of example scripts that can be used for application of the kernels, which will be very helpful to the community. Nonetheless, I think the paper/data can be improved with regard to a few general things:

1) Some of the details in producing the kernels and applying them are lost due to the very concise nature of the text. While some of these details may be obvious to those

with experience in producing/using kernels, there is not quite enough basic information and detail for first-time kernel users. The authors provide several references pointing toward more information, but I don't think it would hurt or greatly increase the length of the text to give some of that information here. See specific comments below.

2) The provided data and scripts are a bit disorganized. If possible, I recommend putting all of the relevant data and example code in one place, rather than spanning two webpages. It may also help to organize the files into folders or categories based on their type (e.g., kernel files, forcing, relevant code, demos). On a more technical note, the readme file currently on the zenodo webpage should point to the actual filenames of all scripts that are described under "Additional scripts. . ."

Below are a series of specific comments, related to both scientific content and presentation.

Section 2, page 2, L6: It appears this radiation scheme is based on the CAM4, which is quite different and somewhat outdated compared to that in CAM5. Was the choice of this scheme because no other currently available kernels make use of it (e.g., I believe kernels based on ECHAM6 use a similar radiation scheme as CAM5), thereby increasing structural diversity among available kernels? It would be helpful to say a bit more here with regard to this.

Section 2, page 2, L8: Please explicitly state here what these "other necessary fields" are.

Section 2.1, first paragraph: State here that the simulations are only conducted for one year.

Section 2.1, L16: It is unclear where the number 63 comes from.

Section 2.1, L21-22: It should be mentioned that these perturbations are done at each grid cell.

Section 2.1, L22: Please clarify if these perturbations are computed with respect to

each corresponding control 3-hour timestep.

General computation comment: When going from the full kernel field (3-hourly, grid cell, level resolved) to the global averages presented here in tables, what is the procedure? For example, flux responses are first averaged in time (to monthly then annual) and space, and then vertically integrated with pressure weighting? I feel this should be mentioned.

Fig. 1 caption: This caption has some repetition and missing information. The Fig. 2 caption is fine and should be replicated for Fig. 1 but with obvious modifications.

Section 2, general: Can you expand a bit on how the patterns shown in the figures come about physically (e.g., the larger temperature kernel magnitudes in the tropics and the multi-peak structure in Fig. 1e), or at least provide references to previous work that has done so?

Fig. 3 caption: Should note that all panels are showing LW+SW, assuming that is actually the case.

Section 3, paragraph 2: It's a bit fuzzy what is done here. Are the kernels multiplied by the responses of the changing fields between the two years (with a procedure analogous to section 5)? Please expand. Also, explicitly state that these calculations are compared with the model-calculated flux responses between the same years.

Figures 4 and 5 captions: State that what is being shown is the global mean.

Section 3, paragraph 3 and related figures (4 and 5): Wouldn't the model-produced all-sky flux responses between 2006 and 2096 include cloud feedbacks as well? If so, what is the value of comparing those responses with corresponding all-sky kernel estimates that do not include the cloud changes (as stated on L11)?

Section 4, L22-23: change "based on changes in TOA..." to "based on model-computed changes in TOA..."

Section 4, L24: Insert "approximately" or symbols, e.g., "$\sim$", in front of these values.

Section 5, first paragraph: It would be useful to 1) give some brief qualitative discussion about how these calculations are conducted (e.g., that the kernels are first monthly averaged then multiplied by monthly-resolved climatological changes in the fields) and 2) Include here a reference to section 6 where one can find more information about relevant example code.

Section 5, L6: Could you clarify why one needs long-term mean water vapor mixing ratios?

Table 2 caption: Suggest changing the "Here" heading to "CAM5"

Section 5, L25: Unsure why long timescales are more similar to your calculations since your kernels are only computed for one year. Please explain.

Section 5, L30, with regard to "0.02," perhaps also specify which feedback this is and give this value as a percentage of the mean as well. I also recommend reiterating here that this estimate does not account for potential variability among kernels themselves if computed from different years/ensemble members.

Section 6, L4: Please again specify what the four radiative kernels are. Also note that they are provided as monthly averages in the files.

Typos/grammar:

Section 2, page 2, L25: change "has units" to "have units"

Section 3, page 4, L5: insert "of" between "decomposition" and "the"

Section 3, page 4, L6: Suggest changing "linear in..." to "linear with respect to..."

Section 5, page 5, L9-10: Should "the changes in top-of-atmosphere radiative feedbacks" just be "the top-of-atmosphere radiative feedbacks"?

Section 5, page 5, L16: "m(Pendergrass, 2017a)odel"

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