

# ***Interactive comment on “Developing a monthly albedo change radiative forcing kernel from satellite climatologies of Earth’s shortwave radiation budget: CACK v1.0” by Ryan M. Bright and Thomas L. O’Halloran***

## **Anonymous Referee #1**

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This study by Bright and O’Halloran developed shortwave radiative kernels based on the CERES EBAF products, which would be an alternative to GCM-based kernels. The performance of the observation-based kernels is also evaluated based on the multi-GCM mean. This is an interesting study, and the developed shortwave radiative kernels have the potential of being used for land use-climate studies. However, I think the manuscript needs some improvement and further development in the analysis before it can be published.

My major concerns include:

1. The evaluation of CERES kernels uses four GCM kernels as benchmarks. I am wondering the uncertainties among the different GCMs. First, why are these four models chosen? But why CAM3 and GFDL are not mentioned in the results? Second, for Figure 1, if plotting the radiative kernel for individual GCMs, is there a large spread like the CERES-based estimates? Third, are the author's conclusions model-dependent? Because the BO18 kernel is trained using the multi-GCM mean as the reference, it is not surprising that it has better performance than other CERES kernels. However, if using a single GCM (or including other GCMs, like HadGEM2 radiative kernels, Smith 2018) as the benchmarks, will QH06 or ANISO still be better than other kernel models? The authors may need more analysis and discussion about the model dependency.

2. One of the motivations of this study is “atmospheric state variables used as model input are limited to single years, thus being sensitive to anomalous weather conditions that may have occurred in those years”. Can you explain more about this? As the authors mentioned in L278, they are comparing the multi-year CERES kernel to a single-year GCM kernel. I assume the GCM simulations are only one-year long? The authors may need to provide more description and discussion about these GCM simulations. If the simulates are for a specific year (which year?), or a climatological run, are they comparable to the CERES-based kernel models which are for the period 2001-2016. Additionally, I am curious about the inter-annual variability of the multi-year CERES kernels.

3. This study is started with the “need within LULCC science community for simple and transparent tools for predicting radiative forcings from surface albedo changes”. Is it possible to provide a simple example of how to apply CACK v1.0 to the LULCC studies?

Specific comments:

1. The organization of section 2 and section 3 is a little confusing. The title of section 2 is “Review of existing approaches”, but most of the kernels described in section 3 are

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also “existing approaches”, aren’t they? 2. L40, What do you mean by “offline”? Run land surface model offline? I also can’t find the paper (Randerson et al. 2006) in the reference. 3. L151, Eq. (3) and Eq. (4), are  $\Delta\alpha_s$  and  $\Delta\alpha$  the same thing? If yes, it would be better to keep the consistency. 4. L247, Which part (or period) of data is used for model training, and which part is used for prediction? 5. L263, It should be “e. Initial screening of candidate models for a CERES-based kernel” 6. L409, They are mean absolute bias, not RMSD. 7. L441-444, Can the authors explain more about how the land-based solar radiation management is an example of the CACK’s flexibility?

Reference:

Smith, Christopher J. (2018) HadGEM2 radiative kernels. University of Leeds. [Dataset] <https://doi.org/10.5518/406>

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2019-15>, 2019.

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