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Earth System Dynamics Discussions

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Interactive Comment

Interactive comment on "On the determination of the global cloud feedback from satellite measurements" *by* T. Masters

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As I have done more preparation for this response, I am becoming less and less inclined to recommend publication of M12 in anything close to its present form. The fundamental approach of M12 is to analyze several data sets and show that they don't agree — and therefore conclude that we don't know anything about what the actual value of the cloud feedback is and that Dessler 2010 is wrong. However, as I show below, a strong argument can be made that some of these data sets are less reliable than others — and that the more correct data agree with the results of Dessler 2010.

1. 2-m air temperature vs. skin temperature: This is a red herring. In climate models, the feedback obtained using the skin temperature and the 2-m temperature are nearly identical — as expected since these variables must track each other closely. In updat-

ing the Dessler 2010 calculation (covering 2/00-12/10), I find that the cloud feedback changes from +0.58 to +0.56 W/m2/K as one switches from skin temperature to 2-m temperature using MERRA and from +0.49 to +0.38 W/m2/K using ECMWF.

2. Clear-sky fluxes: I cannot reproduce the numbers in Table 1 of the author's response. I have therefore included an updated version of Table 1 from my original comment (as Fig. 1). It is clear that the calculations using Terra clear-sky fluxes lie at one end of the range, with EBAF and reanalysis agreeing closely at the other end, and with Aqua in between.

M12 is entirely predicated on the assumption that we know nothing about which of the clear-sky data sets is best. However, it is possible to delve into the data to determine that the Terra CERES clear-sky fluxes likely have problems. To begin, let's regress global average clear-sky longwave flux anomalies vs. 2-m surface temperature anomalies for each data set. During the Aqua period, this yields: Terra: 1.71, Aqua: 1.79, EBAF: 1.91, AIRS: 1.99, ECMWF: 1.96 (all W/m2/K).

This is an important result. In this type of analysis, the EBAF should inarguably be the best CERES clear-sky data set. EBAF has a more sophisticated clear-sky algorithm that is designed to capture information from partly cloud pixels, thus leading to a more accurate estimate. M12 argues that SSF1 has better long-term stability (which is true), but the results here and in Dessler 2010 come from a regression against surface temperature — and warm and cool months occur throughout the data set. Thus, the impact of spurious trends on the results is small, as discussed in Dessler 2010. The AIRS clear-sky fluxes provide an independent confirmation from an entirely different method. Results are similar over the Terra period, although there are only three data sets to compare.

These results suggest Terra CERES clear-sky fluxes should not be relied upon (and Aqua CERES may only be a little better). To investigate further, Fig. 2 shows the standard deviation of the clear-sky flux anomalies at each grid point over the entire time series for Terra, EBAF, and AIRS clear-sky fluxes. Both CERES data sets show large increases in variability just poleward of 60° in each hemisphere. This looks unphysical and there is no reason why clear-sky longwave flux variability should increase suddenly at this latitude, and indeed the AIRS data do not show it.

However, there is a good explanation: the CERES data require a determination of whether the footprint is clear or not, and doing this accurately requires sunlight. As a result, it is much more difficult at high solar zenith angles or at night, conditions that frequently occur poleward of 60°. That would lead to exactly the variability pattern shown here. The AIRS, on the other hand, uses a cloud-clearing algorithm that does not require a clear/cloudy determination and, as a result, it does not show the same pattern.

Between 60°N and 60°S, the EBAF agrees well with AIRS, while the Terra shows much higher variability. This is as expected. The reanalyses, not shown, agree closely with the AIRS and 60°N-60°S EBAF. This confirms that the Terra CERES regressions should be considered less reliable.

In his response to my review, the author writes: "The goal of M12 is to quantify uncertainty at a high level by noting the actual difference in estimates from the various sources of radiative flux data, as seen in the two tables of M12." However, by simply noting the differences in the results, the author has not done that. Rather, he needs to delve into the data to determine the relative quality of the data sets.

Other major comments: I will resist the urge to do a point-by-point rebuttal of the author's response to my comment. However, here are a few general thoughts.

In my original comment, I pointed out that the M12's criticisms of the methodology (including "robustness") were essentially bald-faced speculations unsupported by any analysis. In response, the author simply restated his original speculations and shows no sign that he will fix this. Unless he can demonstrate real issues with the methodology, all of that should be removed from the paper. And I note that issues of short-term

ESDD
3, C61–C66, 2012

feedbacks versus long-term feedbacks are adequately discussed in Dessler 2010, so they need not be repeated here.

The author needs to review exactly what the rˆ2 statistic tells us. rˆ2 is proportional to slope: if the slope is zero, rˆ2 must be zero; as the slope increases, rˆ2 increases. Thus, the findings highlighted throughout M12 and the response that higher slopes have larger rˆ2 does not mean what the author seems to think it does. The higher rˆ2 does not mean the slopes are more reliable, nor does it mean that the CRF adjustment has injected information. The author needs to carefully scrub the paper to correct these misapprehensions.

The author's argument that one can take an anomaly of an anomaly (because they are calculated over different time periods) is simply incorrect. I defy the author to find an example anywhere in the peer-reviewed literature where anyone else has ever done this.

Interactive comment on Earth Syst. Dynam. Discuss., 3, 73, 2012.

		T_s = skin temperature		T_s = 2-m air temp.	
All-sky flux	Clear-sky flux	TERRA period 3/00-6/11	Aqua period 9/02-6/11	TERRA period 3/00-6/11	Aqua period 9/02-6/11
Terra CERES	Terra CERES	-0.57±0.79	-0.05±0.87	-0.89±0.76	-0.38±0.86
EBAF	EBAF	-0.08±0.69	0.23±0.79	-0.34±0.67	-0.03±0.78
Terra CERES	ERA interim	0.25±0.77	0.19±0.88	0.05±0.75	-0.05±0.88
EBAF	ERA interim	0.21±0.72	0.23±0.81	-0.01±0.71	0±0.81
Aqua CERES	Aqua CERES	N/A	0.10±0.82	N/A	-0.22±0.81
Aqua CERES	ERA interim	N/A	0.28±0.84	N/A	-0.04±0.84

Figure 1. Units are $W/m^2/K$, and the uncertainly is $\pm 2\sigma$. The surface temperature data are from ERA interim. The Terra CERES + ERA interim results are basically the same results as Dessler 2010. (I know this is a table and not a figure, but I couldn't figure out how to add a table to a comment)

Fig. 1. Table 1

ESDD

3, C61–C66, 2012

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ESDD
3, C61–C66, 2012

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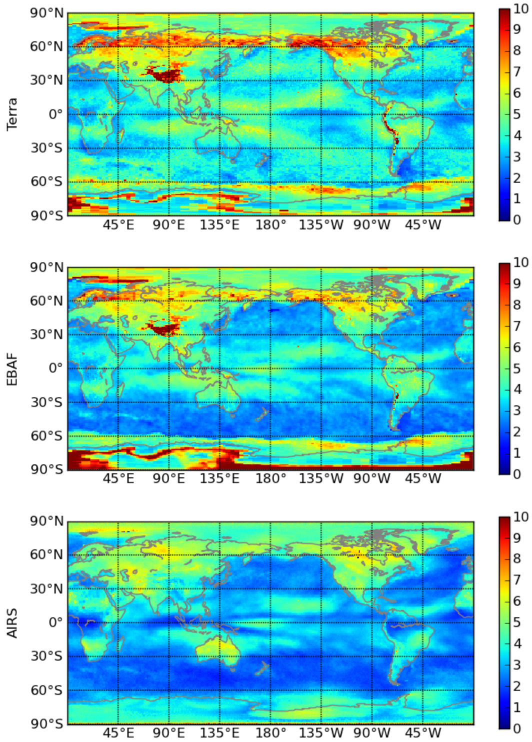

Fig. 2. Standard deviation of the anomaly time series at each grid point. In W/mˆ2.