Anonymous Referee #3

The authors thank the reviewer for the comments which have undoubtedly improved the paper. The reviewer's comments are shown in red and the authors response shown in black.

One paper on solar calibration accuracy is referenced but references on calibration of the infrared radiances are necessary, particularly in light of the statement that the dataset is well suited to investigation of trends.

Added in reference for calibration of Infra red channels

D.L. Smith, J. Delderfield, D. Drummond, T. Edwards, C.T. Mutlow, P.D. Read, G.M. Toplis, Calibration of the AATSR instrument, Advances in Space Research, Volume 28, Issue 1, 2001, Pages 31-39, ISSN 0273-1177, https://doi.org/10.1016/S0273-1177(01)00273-3.

Specific comments: The sentence in lines 45-47 implies CloudSat detection of GHGforced trends in cloud height is limited by nadir-only sampling. The larger issue is separating forced cloud changes from natural variability. There has been considerable work which makes clear that long-term calibration stability is a major difficulty in characterizing forced trends from passive sensors observations. See, for example, Shea et al. (JGR, 2017, doi:10.1175/JCLI-D-16-0429.1). I'm not sure what the point of the last half of this paragraph is, which raises complex observational issues which are beyond the scope of this paper.

In response to the above comment I have removed this sentence and associated reference

'and they have operated for a relatively brief period. It has been estimated that CloudSat-like radar instruments would need to constantly observe the Earth until at least 2030 to detect a noticeable trend in cloud top height related to climate change~\citep{takahashi}.'

Line 72: This doesn't look like a complete sentence. Maybe something like "ATSR is designed to provide low noise radiance measurements . . ." - ?

This paragraph is rewritten to be more clear

ATSR channels are specifically is designed to have low noise. Furthermore AATSR measurements are carried out with a high level of accuracy as the instrument includes an on-board thermal black body and a visible calibration system designed for high uniformity and stability~\citep{smitha}.

Table 3: Define 'hit rate'. How is hit rate different from probability of detection? I'm not familiar with Kuiper Skill Score, please provide a reference.

Definition of the hitrate was added to the text

hit rate the percentage of pixels identified correctly as either cloudy or clear

A reference for the Kuiper Skill score was added

Hanssen, A.W.; Kuipers, W.J.A. On the relationship between frequency of rain and various meteorological parameters. Meded. Verh. 1965, 81, 2–15.

Line 221: As a general comment: peer reviewed publications should be cited rather than data quality summaries posted on-line, unless the information is only available from on-line summaries. Results reported in refereed papers are archival, have usually received more scrutiny, and tend to be better explained and documented.

Updated the reference for TOA CERES uncertainty to Loeb 2018 however a published reference for the uncertainty of BOA products could not be identified so the data quality statement (with link now referenced) has been included.

Text changed:

The CERES team have evaluated the accuracy of the products in [Loeb et al 2018] and states that their all-sky shortwave and longwave **monthly** uncertainty is 2.5(3) Wm-2 for Aqua and Terra (Terra only) period, while the clear-sky shortwave and longwave uncertainty is 5(6) and 4.5(5) Wm-2, respectively for the Aqua and Terra (Terra only) monthly products

Line 222: Are the CERES uncertainties which are mentioned the uncertainties in the monthly global means?

Answered in the paragraph added above, they are monthly uncertainties

Line 223 and 258-259: global means are within CERES uncertainties only for 60N60S. All-sky fluxes show differences which are much larger, and there are significant regional biases which seem to be associated with clouds.

The authors found a bug in the code that calculated the difference between V3 and the CERES data. As the global coverage varies with season (i.e no data in the polar winters) for the AATSR data, the data is now only compared with CERES when both instruments report data. The data has been reprocessed and the numbers in the table have been updated accordingly. The change to the numbers between -60 and 60 latitude was negligible however the change to the value encompassing -90 to 90 has changed considerably nearly all the comparisons with CERES data have improved . The text has been modified accordingly in the section ‘Comparison of radiative fluxes’. All except the LW BOA down (all sky and clearsky) agree within the CERES uncertainty estimates. The LW BOA estimates are of the order (2.8% allsky and 3.8% clearly) just outside the range of the CERES uncertainty. It is hypothesised that the assumed cloud base height is systematically biased in the AATSR data set. This will be re-evaluated in future versions.

New figure below

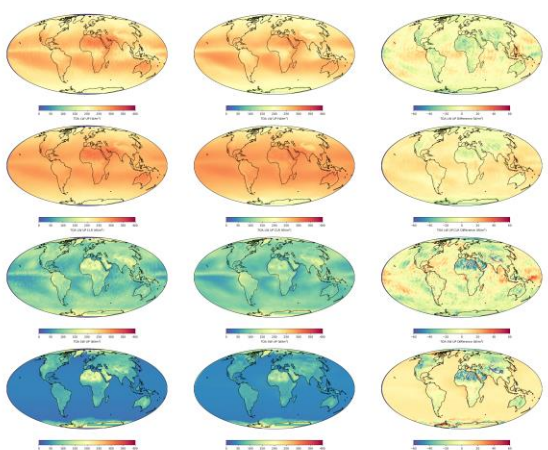

Figure 4. Examples of Level-3C (yearly average for 2008) Cloud_cci AATSR V3 (left column), CERES (middle column) and difference CERES-AATSR (right column) global maps of fluxes from top to bottom LWF^{up}_{TOA}, LWF^{up}_{TOA}clear, SWF^{up}_{TOA} and SWF^{up}_{TOA}clear

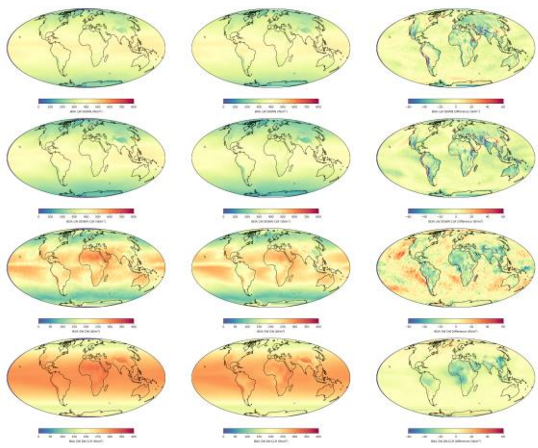

Figure 5. Examples of Level-3C (yearly average for 2008) Cloud_cci AATSR V3 (left column) and CERES (middle column) and difference CERES-AATSR in the right column global maps of forcing from the top to the bottom, LWF^{down}_{BOA}, LWF^{down}_{BOA}clear, SWF^{down}_{BOA}, SWF^{down}_{BOA}clear

Old figures below

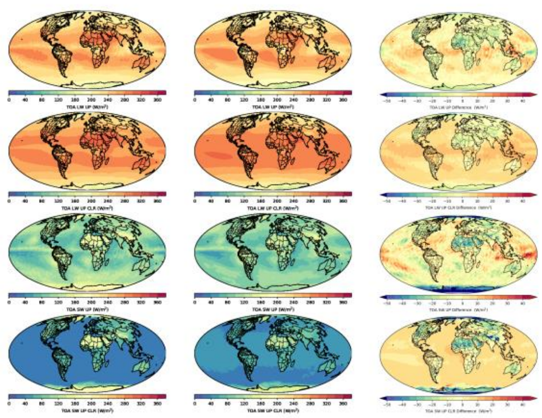

Figure 4. Examples of Level-3C (yearly average for 2008) Cloud_cci AATSR V3 (left column), CERES (middle column) and difference CERES-AATSR (right column) global maps of forcings from top to bottom LWF^{up}_{TOA}, LWF^{up}_{TOA}clear, SWF^{up}_{TOA} and SWF^{up}_{TOA}clear

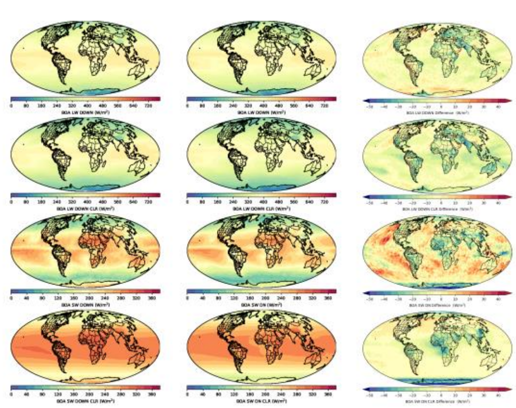

Figure 5. Examples of Level-3C (yearly average for 2008) Cloud_cci AATSR V3 (left column) and CERES (middle column) and difference CERES-AATSR in the right column global maps of forcing from the top to the bottom, LWF^{down}_{BOA}, LWF^{down}_{BOA}clear, SWF^{down}_{BOA}, SWF^{down}_{BOA}clear

New tables shown here

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Table 6. Multi-annual (2003-2012), zonal averaged broadband shortwave and longwave fluxes (SWF, LWF) at the top-of-atmosphere (TOA) inferred from the Cloud_cci AATSR V3 dataset. Two latitude ranges, -60° to 60° (top) and -90° to 90° (bottom), are presented. The values are compared with the equivalent values from the Clouds and Earth Radiation Energy System (CERES) Energy Balanced and Filled (EBAF) fluxes. All values are given in Wm^{-2}. The differences and relative differences are also reported.

TOA flux comparison with CERES				
	LWF^{up}_{TOA}	SWF^{up}_{TOA}	Clear LWF^{up}_{TOA}	Clear SWF^{up}_{TOA}
Cloud_cci ATSR-2/AATSRv3	245.8	104.4	268.7	47.5
CERES EBAF Ed 4.1	244.1	98.70	273.9	48.8
Difference	-1.7	-5.7	5.2	1.3
Rel. difference	0.7%	5.7%	1.9%	2.7%
Cloud_cci ATSR-2/AATSRv3	235.7	113.7	235.7	61.7
CERES EBAF Ed 4.1	233.4	108.8	233.4	63.3
Difference	-2.3	-4.9	-2.3	1.6
Rel. difference	1.0%	4.5%	1%	2.5%

Table 7. As for Table. 6 but for the bottom-of-atmosphere (BOA).

BOA flux comparison with CERES				
	LWF^{down}_{BOA}	SWF^{down}_{BOA}	$clearLWF^{down}_{BOA}$	$clearSWF^{down}_{BOA}$
Cloud_cci ATSR-2/AATSRv3	364.5	191.8	335.7	255.5
CERES EBAF Ed 4.1	354.4	190.0	323.9	250.4
Difference	-10.1	1.8	-11.2	-5.1
Rel. Difference	2.9%	.9%	3.5%	2.0%
Cloud_cci ATSR-2/AATSRv3	335.7	180.2	303.2	240.7
CERES EBAF Ed 4.1	326.5	179.0	292.2	237.6
Difference	-9.2	-1.2	-11.0	-3.1
Rel. Difference	2.7%	.7%	3.8%	1.3%

Old tables for reference

Table 6. Multi-annual (2003-2012), zonal averaged broadband shortwave and longwave fluxes (SWF, LWF) at the top-of-atmosphere (TOA) inferred from the Cloud_cci AATSR V3 dataset. Two latitude ranges, -60° to 60° (top) and -90° to 90° (bottom), are presented. The values are compared with the equivalent values from the Clouds and Earth Radiation Energy System (CERES) Energy Balanced and Filled (EBAF) fluxes. All values are given in Wm^{-2}. The differences and relative differences are also reported.

TOA flux comparison with CERES				
	LWF^{up}_{TOA}	SWF^{up}_{TOA}	Clear LWF^{up}_{TOA}	Clear SWF^{up}_{TOA}
Cloud_cci ATSR-2/AATSRv3	246.3	104.4	268.7	61.9
CERES EBAF Ed 4.1	244.2	98.70	273.9	63.6
Difference	-1.9	-5.7	5.2	1.63
Rel. difference	0.8%	5.7%	1.9%	2.6%
Cloud_cci ATSR-2/AATSRv3	234.9	114.0	255.1	47.5
CERES EBAF Ed 4.1	225.1	104.2	248.9	48.7
Difference	-9.9	-9.8	-6.2	1.2
Rel. difference	4.4%	9.4%	2.4%	2.7%

Table 7. As for Table. 6 but for the bottom-of-atmosphere (BOA).

BOA flux comparison with CERES				
	LWF^{down}_{BOA}	SWF^{down}_{BOA}	$clearLWF^{down}_{BOA}$	$clearSWF^{down}_{BOA}$
Cloud_cci ATSR-2/AATSRv3	364.6	192.2	335.3	255.7
CERES EBAF Ed 4.1	354.4	190.4	323.9	250.3
Difference	-10.26	1.9	-11.4	-5.4
Rel. Difference	2.9%	.97%	3.5%	2.1%
Cloud_cci ATSR-2/AATSRv3	334.1	181.3	301.7	241.3
CERES EBAF Ed 4.1	306.8	176.0	272.7	232.6
Difference	-28.4	-5.3	-29.1	-8.7
Rel. Difference	9.2%	3.0%	10%	3.8%

Line 164: “version 4-20” should be “version 4.20”

Corrected in text

Line 228: incomplete sentence

Paragraph rephrased to the text below

The TOA shortwave flux in clear scenes is systematically lower than CERES indicating a potential underestimate of the surface reflectance in the AATSR product. The AATSR surface reflectance model uses a Cox and Munk~\cite{cox} formulation a key source of uncertainty could be the sensitivity to the diurnal correction applied to the AATSR data in order to make a like for like comparison with CERES. These differences his will be investigated for improvement in future versions.