GERB/CERES Comparisons Update

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Abstract

The paper provides quantitative results of comparison between the GERB and CERES instruments in January and February 2007. The comparisons have been done for the radiance and the flux and for the shortwave and longwave radiation. We have followed the same methodology as in a previous GERB/CERES comparison exercise [*Clerbaux et al.*, 2009]. Therefore we do not provide all the details here.

In the SW, GERB-1 is closer to CERES than GERB-2. The results are consistent with a decrease of 3-4% of the GERB SW level between GERB-2 and GERB-1. As it was already observed, the SW flux ratio is higher than the radiance ratio by about 1-2%. Finally for the SW, this work indicates a decrease of the GERB-2/CERES ratio by about 1.7% between 2004 and 2007. This decrease is under investigation.

Concerning the LW radiation, GERB-1 is slightly higher than GERB-2 ($\sim$ 0.4%) and closer to CERES. The radiance and the flux ratio are in good agreement. The GERB-2/CERES ratio are similar in 2007 and in 2004. We can conclude that GERB and CERES are both stable in the LW.

1 Introduction

Since February 2004 direct observation of the broadband radiant energy leaving the Top–Of–Atmosphere (TOA) is available from the Geostationary Earth Radiation Budget (GERB) [*Harries et al.*, 2005] instrument on the Meteosat Second Generation satellites. The GERB-2 instrument, on Meteosat-8, was in charge of the operational GERB observation up to May 2007. At that time, the GERB-1 instrument on board Meteosat-9 becomes the operational one while GERB-2 mostly remains in "SAFE mode". Simultaneous observations with both instruments are however regularly realized since 2006 (about twice per year).

In this study the GERB observations from both GERB-1 and from GERB-2 are compared to the observations realized by the Cloud and Earth Radiant Energy System (CERES) [*Wielicki et al.*, 1996] instruments. The methodology is the same as the one followed during a previous GERB/CERES comparison for observations in June and December 2004 [*Clerbaux et al.*, 2009].

2 Data

This study is based on GERB and CERES data acquired during 30 days, from 13 January 2007 to 11 February 2007.

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GERB-1 – Number of shortwave observation pairs												
INST	$\alpha < 2°$			$\alpha < 5°$			$\alpha < 8°$			Flux		
	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR
FM1	2243	2133	4108	10247	9764	25478	23773	22637	63758	1251216	1194980	5201454
FM2	9345	9102	34924	30054	28728	169788	51354	49025	315423	821492	787065	5701095
FM3	2010	1925	3789	9432	8877	23042	21865	20556	58481	1216330	1145348	5127519
FM4	0	0	0	0	0	0	0	0	0	0	0	0
GERB-1 – Number of Longwave observation pairs												
INST	$\alpha < 2°$			$\alpha < 5°$			$\alpha < 8°$			Flux		
	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR
FM1	5699	4142	8078	26262	19055	50501	61548	44421	127746	3490922	2506918	11317817
FM2	15218	11133	39023	52515	38093	195193	97827	70890	379452	2859613	2090607	11681555
FM3	5627	4198	8181	26475	19278	50039	62346	45032	127740	3548338	2544781	11526361
FM4	2701	1966	2439	12534	8853	14836	26812	20097	30842	1501948	1093331	2842228
GERB-2 – Number of shortwave observation pairs												
INST	$\alpha < 2°$			$\alpha < 5°$			$\alpha < 8°$			Flux		
	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR
FM1	1865	1911	3494	8765	8713	22085	20502	20199	55979	1155098	1133912	5135737
FM2	11306	11369	44258	29023	29025	173925	47443	47141	305775	775314	763257	5584073
FM3	1964	1851	3703	9056	8535	21553	21044	19838	56719	1144148	1105394	5127699
FM4	0	0	0	0	0	0	0	0	0	0	0	0
GERB-2 – Number of Longwave observation pairs												
INST	$\alpha < 2°$			$\alpha < 5°$			$\alpha < 8°$			Flux		
	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR	ARG	BARG	HR
FM1	4694	4126	7897	22856	18904	48783	52400	43876	123457	2978327	2425918	10878945
FM2	16948	13420	48378	49350	38678	201166	88172	69582	375563	2423000	2006418	11205937
FM3	5068	4157	8050	23303	19048	48902	54119	44366	126700	3000811	2433990	11090941
FM4	2308	1995	4087	10532	9183	25657	24407	21396	65059	1357294	1169468	5458066

Table 1: Numbers of coangular radiance pairs and colocated flux pairs for GERB-1 (top) and GERB-2 (bottom) used for the SW and LW comparisons.

The GERB-2 data are the Edition-1 for the ARG format and the Version 3 for the BARG and HR formats. These data have been generated in near real time by the RMIB GERB Processing (RGP) system. Note that the Version 3 processing is similar to the Edition-1.

The GERB-1 data are Version 6 which is the latest processing version that is expected to become the Edition-1 in a close future. With respect to the near real time Version 5, the new version provides improved A values for the detectors and also fixes a bug that affected the cloud retrieval (use of a wrong LUT in Version 5).

For CERES, the SSF Edition2F (FM1 and FM2) or Edition 2C (FM3 and FM4) have been used with application of the Revision-1, using the scaling factors provided by the CERES team. Note that the SW detector of the FM4 instrument is broken since 30 March 2005. This instrument is therefore not useful for the comparisons in 2007, except for the nighttime longwave comparison, as in this case the LW is equal to the TOT measurement.

Table 1 gives the numbers of coangular radiance observations (for different maximum angles α between the GERB and CERES directions of observation) and the number of collocated flux between the 2 GERB instruments and the 4 CERES instruments. The higher number of matches for the FM2 is provided by operating this instrument in a scanning mode that optimizes the number of coangular observations with GERB. Compared to the previous comparison of 2004, the number of matches is smaller due to the use of less days for the comparison. As already said, the FM4 does not provide neither SW observation nor LW observations during day time.

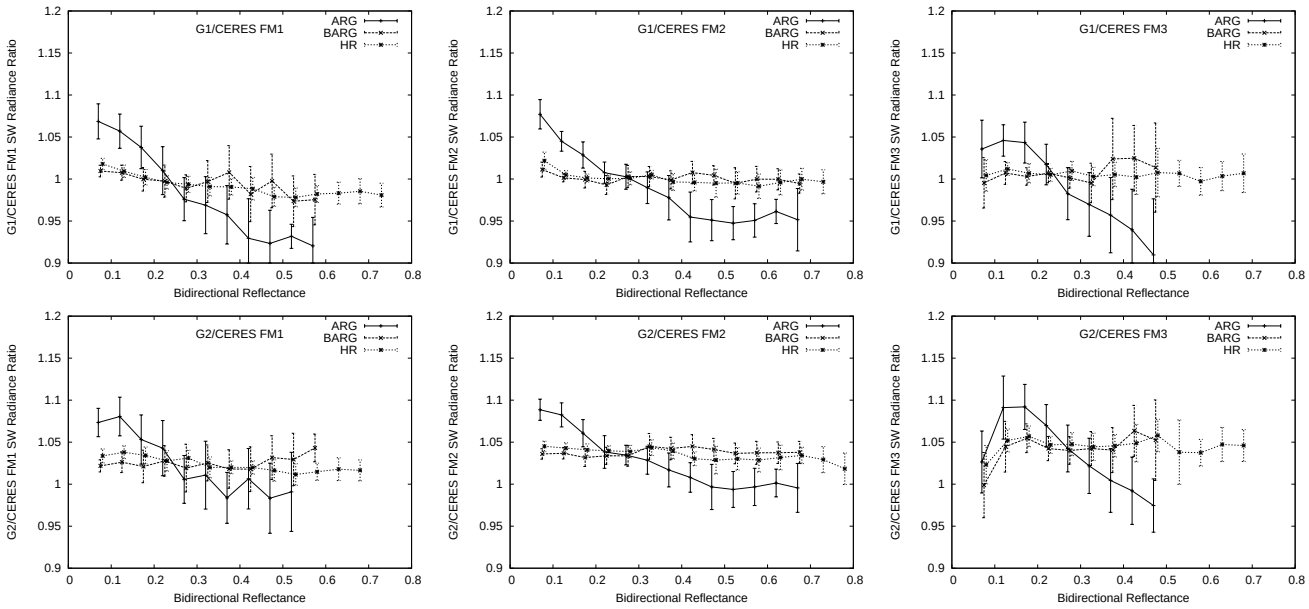

Figure 1: GERB/CERES SW radiance ratio and uncertainty in reflectance bins for $\alpha < 5°$.

3 Shortwave radiance comparison

Table 2 provides the shortwave radiance comparison results for the $\alpha < 5°$ criteria (similar results, not shown, are obtained with the $\alpha < 2°$ and $\alpha < 8°$ criteria). The results for the ARG format are not given here, as they are significantly affected by the non–correction of the GERB PSF in the matching with CERES [*Clerbaux et al.*, 2009].

In January 2007, the GERB-1 SW radiances are very close to the CERES ones. The GERB/CERES ratio are around 0.995, 1.002 and 1.007 for the FM1, FM2 and FM3 respectively. The uncertainty on the ratio is evaluated to about 0.005, thus half a percent. Compare to the same CERES instruments, the ratio for GERB-2 are about 3% – 4 % higher than for GERB-1. This result is consistent with the GERB-1/GERB-2 comparisons performed at Imperial College London and presented during the GIST meetings.

It is interesting to quantify the scene type dependency of the GERB/CERES ratio as it is an indirect validation of the instrument spectral response and unfiltering strategy. Figure 1 shows the variation of the ratio as a function of the scene reflectance (i.e. radiance normalized by the incoming solar irradiance). The ratio is very stable for the BARG and HR formats (the scene type dependency that seems to affect the ARG is due to the PSF).

4 SShortwave flux comparison

Table 3 summarizes the SW flux comparison in a similar form to that given in Table 2 for the SW radiance. All together, the flux ratio are about 1.5% higher than the ratio observed in radiance. This ratio increase is observed for GERB-1 and GERB-2, and was already observed for GERB-2 in the 2004 comparison.

GERB-1 Binned Averaged Rectified Geolocated (BARG)						
Scene Type	FM1	FM2	FM3	$< \mathrm{FM} >$	$< L_g >$	ΔL
Allsky	0.996 ± 0.005 (0.995)	1.001 ± 0.003 (1.002)	1.008 ± 0.005 (1.007)	1.002	72.82	0.08
Overcast	0.992 ± 0.011 (0.987)	0.996 ± 0.014 (0.998)	1.005 ± 0.016 (1.007)	0.997	191.01	-0.54
Clearsky	1.017 ± 0.024 (1.013)	1.011 ± 0.008 (1.007)	1.011 ± 0.035 (1.018)	1.013	50.84	0.59
ocean	1.038 ± 0.026 (1.027)	1.018 ± 0.030 (1.032)	0.982 ± 0.053 (1.003)	1.013	26.55	0.22
dark veg.	0.997 ± 0.012 (0.998)	1.004 ± 0.007 (1.005)	1.023 ± 0.009 (1.019)	1.008	47.49	0.43
bright veg.	0.992 ± 0.010 (0.995)	1.000 ± 0.006 (0.999)	1.034 ± 0.020 (1.040)	1.008	56.02	0.47
dark desert	-	0.997 ± 0.015 (1.000)	1.022 ± 0.010 (1.018)	1.009	77.44	0.76
bright desert	-	1.011 ± 0.006 (1.009)	1.027 ± 0.027 (1.023)	1.019	101.45	1.84
GERB-1 High Resolution (HR)						
Scene Type	FM1	FM2	FM3	$< \mathrm{FM} >$	$< L_g >$	ΔL
Allsky	0.995 ± 0.004 (0.995)	1.002 ± 0.003 (1.004)	1.009 ± 0.004 (1.007)	1.002	74.26	0.12
Overcast	0.983 ± 0.009 (0.981)	0.994 ± 0.013 (0.994)	0.998 ± 0.013 (0.999)	0.992	186.35	-1.66
Clearsky	1.017 ± 0.014 (1.006)	1.010 ± 0.006 (1.008)	1.016 ± 0.013 (1.020)	1.014	48.59	0.61
ocean	1.032 ± 0.025 (1.016)	1.026 ± 0.019 (1.037)	1.001 ± 0.038 (1.017)	1.020	28.48	0.39
dark veg.	1.000 ± 0.008 (1.000)	1.006 ± 0.005 (1.007)	1.022 ± 0.011 (1.019)	1.010	48.05	0.47
bright veg.	0.989 ± 0.010 (0.991)	1.000 ± 0.006 (1.001)	1.025 ± 0.016 (1.034)	1.005	54.54	0.28
dark desert	-	1.007 ± 0.009 (1.006)	1.017 ± 0.007 (1.014)	1.012	76.40	0.93
bright desert	-	1.012 ± 0.005 (1.009)	1.028 ± 0.004 (1.029)	1.020	100.19	1.98
GERB-2 Binned Averaged Rectified Geolocated (BARG)						
Scene Type	FM1	FM2	FM3	$< \mathrm{FM} >$	$< L_g >$	ΔL
Allsky	1.026 ± 0.006 (1.025)	1.039 ± 0.004 (1.041)	1.048 ± 0.006 (1.047)	1.037	74.92	2.67
Overcast	1.038 ± 0.021 (1.032)	1.039 ± 0.006 (1.039)	1.047 ± 0.019 (1.050)	1.041	194.42	7.86
Clearsky	1.042 ± 0.027 (1.042)	1.051 ± 0.005 (1.051)	1.055 ± 0.051 (1.067)	1.050	52.10	2.64
ocean	1.046 ± 0.029 (1.039)	1.058 ± 0.022 (1.049)	0.970 ± 0.067 (0.952)	1.025	26.80	0.39
dark veg.	1.043 ± 0.015 (1.039)	1.056 ± 0.011 (1.053)	1.079 ± 0.012 (1.072)	1.059	49.94	2.84
bright veg.	1.066 ± 0.049 (1.067)	1.058 ± 0.031 (1.045)	1.094 ± 0.007 (1.093)	1.072	58.98	3.81
dark desert	-	1.032 ± 0.015 (1.041)	1.074 ± 0.016 (1.069)	1.053	79.93	4.10
bright desert	-	1.058 ± 0.008 (1.055)	1.079 ± 0.028 (1.085)	1.068	106.89	6.83
GERB-2 High Resolution (HR)						
Scene Type	FM1	FM2	FM3	$< \mathrm{FM} >$	$< L_g >$	ΔL
Allsky	1.025 ± 0.004 (1.025)	1.039 ± 0.005 (1.042)	1.045 ± 0.009 (1.048)	1.036	75.38	2.66
Overcast	1.013 ± 0.009 (1.015)	1.027 ± 0.012 (1.031)	1.046 ± 0.021 (1.037)	1.029	189.32	5.28
Clearsky	1.031 ± 0.015 (1.026)	1.049 ± 0.005 (1.052)	1.059 ± 0.026 (1.070)	1.046	50.34	2.46
ocean	1.024 ± 0.018 (1.020)	1.046 ± 0.016 (1.049)	0.997 ± 0.052 (1.009)	1.022	29.13	0.53
dark veg.	1.041 ± 0.010 (1.035)	1.055 ± 0.008 (1.055)	1.076 ± 0.011 (1.074)	1.057	51.30	2.85
bright veg.	1.044 ± 0.027 (1.045)	1.047 ± 0.009 (1.045)	1.082 ± 0.017 (1.091)	1.057	57.92	3.15
dark desert	-	1.045 ± 0.009 (1.048)	1.068 ± 0.012 (1.067)	1.056	77.78	4.18
bright desert	-	1.056 ± 0.005 (1.055)	1.079 ± 0.004 (1.079)	1.068	105.45	6.69

Table 2: GERB /CERES SW radiance ratio m and uncertainty for $\alpha < 5°$.

GERB-1 - Binned Averaged Rectified Geolocated (BARG)						
Scene Type	FM1	FM2	FM3	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	1.011 ± 0.002	1.013 ± 0.003	1.026 ± 0.001	1.017	252.69	4.16
Overcast	1.007 ± 0.003	1.011 ± 0.003	1.023 ± 0.003	1.014	535.79	7.27
Clearsky	1.015 ± 0.002	1.012 ± 0.003	1.031 ± 0.003	1.019	236.45	4.42
ocean	1.022 ± 0.011	1.018 ± 0.016	1.030 ± 0.008	1.023	90.46	2.04
dark veg.	0.991 ± 0.004	0.991 ± 0.007	1.011 ± 0.006	0.998	164.34	-0.41
bright veg.	1.023 ± 0.005	1.016 ± 0.006	1.031 ± 0.005	1.023	221.06	5.00
dark desert	1.002 ± 0.004	0.998 ± 0.006	1.019 ± 0.005	1.007	218.05	1.38
bright desert	1.016 ± 0.002	1.016 ± 0.003	1.035 ± 0.004	1.023	318.46	7.01
GERB-1 - High Resolution (HR)						
Scene Type	FM1	FM2	FM3	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	1.010 ± 0.002	1.011 ± 0.003	1.028 ± 0.003	1.016	255.64	4.13
Overcast	1.000 ± 0.003	1.004 ± 0.004	1.020 ± 0.003	1.008	516.11	4.06
Clearsky	1.016 ± 0.003	1.014 ± 0.004	1.034 ± 0.004	1.021	222.24	4.61
ocean	1.028 ± 0.009	1.021 ± 0.014	1.027 ± 0.010	1.025	90.32	2.22
dark veg.	0.994 ± 0.008	0.993 ± 0.009	1.018 ± 0.007	1.001	164.53	0.20
bright veg.	1.019 ± 0.008	1.014 ± 0.010	1.031 ± 0.008	1.021	213.84	4.51
dark desert	1.012 ± 0.006	1.010 ± 0.009	1.026 ± 0.006	1.016	221.19	3.46
bright desert	1.017 ± 0.003	1.019 ± 0.003	1.038 ± 0.004	1.025	315.63	7.64
GERB-2 - Binned Averaged Rectified Geolocated (BARG)						
Scene Type	FM1	FM2	FM3	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	1.047 ± 0.002	1.049 ± 0.002	1.063 ± 0.002	1.053	260.58	13.09
Overcast	1.042 ± 0.003	1.047 ± 0.002	1.062 ± 0.003	1.050	544.21	26.13
Clearsky	1.066 ± 0.002	1.063 ± 0.003	1.076 ± 0.005	1.068	242.77	15.51
ocean	1.021 ± 0.011	1.019 ± 0.017	1.031 ± 0.011	1.024	90.59	2.11
dark veg.	1.053 ± 0.004	1.054 ± 0.007	1.060 ± 0.006	1.056	175.52	9.27
bright veg.	1.076 ± 0.006	1.068 ± 0.008	1.081 ± 0.005	1.075	229.67	16.07
dark desert	1.053 ± 0.004	1.050 ± 0.007	1.064 ± 0.006	1.055	227.86	11.95
bright desert	1.070 ± 0.003	1.071 ± 0.003	1.084 ± 0.004	1.075	333.84	23.30
GERB-2 - High Resolution (HR)						
Scene Type	FM1	FM2	FM3	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	1.047 ± 0.002	1.048 ± 0.003	1.064 ± 0.002	1.053	263.36	13.28
Overcast	1.037 ± 0.004	1.041 ± 0.004	1.060 ± 0.004	1.046	528.89	23.27
Clearsky	1.066 ± 0.003	1.064 ± 0.004	1.073 ± 0.009	1.068	227.29	14.55
ocean	1.027 ± 0.011	1.022 ± 0.014	1.031 ± 0.012	1.026	90.50	2.34
dark veg.	1.058 ± 0.007	1.057 ± 0.008	1.068 ± 0.010	1.061	176.29	10.07
bright veg.	1.072 ± 0.009	1.067 ± 0.010	1.082 ± 0.008	1.073	223.08	15.31
dark desert	1.065 ± 0.006	1.063 ± 0.009	1.068 ± 0.009	1.065	230.54	14.06
bright desert	1.071 ± 0.004	1.073 ± 0.004	1.086 ± 0.005	1.077	330.19	23.49

Table 3: GERB /CERES SW flux ratio and uncertainty.

GERB-1 - Binned Averaged Rectified Geolocated (BARG)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.994 ± 0.001	0.998 ± 0.001	0.988 ± 0.001	0.987 ± 0.002	0.991	83.50	-0.71
Day	0.999 ± 0.002	1.000 ± 0.001	0.988 ± 0.002	-	0.996	86.00	-0.38
Night	0.987 ± 0.001	0.993 ± 0.001	0.987 ± 0.002	0.987 ± 0.002	0.989	82.05	-0.95
Clearsky	0.988 ± 0.002	1.000 ± 0.002	0.988 ± 0.002	0.987 ± 0.001	0.991	95.50	-0.87
Cloudy	0.997 ± 0.003	0.992 ± 0.004	0.990 ± 0.004	0.987 ± 0.004	0.992	65.09	-0.54
GERB-1 - High Resolution (HR)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.993 ± 0.001	0.998 ± 0.001	0.988 ± 0.001	0.987 ± 0.001	0.991	83.49	-0.72
Day	0.999 ± 0.002	0.999 ± 0.001	0.989 ± 0.002	-	0.996	85.45	-0.38
Night	0.987 ± 0.001	0.993 ± 0.001	0.986 ± 0.001	0.987 ± 0.001	0.988	82.69	-0.96
Clearsky	0.990 ± 0.002	1.001 ± 0.002	0.989 ± 0.002	0.988 ± 0.001	0.992	95.53	-0.80
Cloudy	0.995 ± 0.002	0.990 ± 0.003	0.985 ± 0.003	0.983 ± 0.003	0.988	66.84	-0.79
GERB-2 - Binned Averaged Rectified Geolocated (BARG)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.989 ± 0.001	0.993 ± 0.001	0.983 ± 0.001	0.982 ± 0.001	0.987	82.62	-1.11
Day	0.995 ± 0.001	0.994 ± 0.001	0.984 ± 0.001	-	0.991	85.11	-0.80
Night	0.983 ± 0.002	0.989 ± 0.002	0.982 ± 0.001	0.982 ± 0.001	0.984	81.49	-1.31
Clearsky	0.985 ± 0.002	0.996 ± 0.002	0.984 ± 0.002	0.983 ± 0.004	0.987	94.88	-1.27
Cloudy	0.989 ± 0.004	0.985 ± 0.004	0.980 ± 0.004	0.980 ± 0.005	0.984	64.33	-1.06
GERB-2 - High Resolution (HR)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.988 ± 0.001	0.993 ± 0.001	0.983 ± 0.001	0.982 ± 0.001	0.987	83.17	-1.12
Day	0.995 ± 0.001	0.994 ± 0.001	0.984 ± 0.002	-	0.991	84.64	-0.79
Night	0.982 ± 0.001	0.989 ± 0.002	0.982 ± 0.002	0.982 ± 0.001	0.984	82.41	-1.35
Clearsky	0.986 ± 0.002	0.997 ± 0.002	0.984 ± 0.002	0.984 ± 0.002	0.988	95.08	-1.17
Cloudy	0.988 ± 0.003	0.984 ± 0.003	0.978 ± 0.002	0.978 ± 0.004	0.982	66.84	-1.22

Table 4: GERB /CERES LW radiance ratio and uncertainty for $\alpha < 5°$.

5 Longwave radiance comparison

Table 4 displays the GERB/CERES LW radiance comparison results. The GERB LW radiances are lower than CERES by about 0.9% for GERB-1 and 1.3% for GERB-2. However, the longwave radiance ratio differs significantly between the 4 CERES instruments.

6 Longwave flux comparison

Table 5 reports the LW flux intercomparisons in a similar form to Tables 4. The BARG GERB-1/CERES flux ratio in all sky conditions lies between 0.988 (FM4 - nighttime only) and 0.995 (FM2). The average across the 4 CERES instruments is 0.991 (GERB-1) and 0.995 (GERB-2) which is in agreement with the radiance comparison. Slightly lower (about 0.2%) ratio are observed for the HR format than for the BARG format.

7 Conclusions

The SW comparisons are summarized in the following table of GERB/CERES ratio values:

GERB-1 – Binned Averaged Rectified Geolocated (BARG)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.992 ± 0.001	0.995 ± 0.001	0.991 ± 0.001	0.988 ± 0.001	0.991	253.31	-2.18
Day	0.997 ± 0.001	0.997 ± 0.001	0.993 ± 0.001	-	0.996	260.17	-1.09
Night	0.987 ± 0.001	0.993 ± 0.001	0.988 ± 0.001	0.988 ± 0.001	0.989	249.67	-2.79
Clearsky	0.985 ± 0.001	0.991 ± 0.001	0.984 ± 0.000	0.981 ± 0.001	0.985	282.05	-4.17
Cloudy	0.999 ± 0.002	0.996 ± 0.002	0.995 ± 0.002	0.996 ± 0.003	0.997	200.81	-0.70
GERB-1 – High Resolution (HR)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.989 ± 0.001	0.993 ± 0.001	0.988 ± 0.001	0.987 ± 0.001	0.989	251.30	-2.77
Day	0.994 ± 0.001	0.995 ± 0.001	0.990 ± 0.001	-	0.993	257.12	-1.91
Night	0.984 ± 0.001	0.990 ± 0.001	0.986 ± 0.001	0.987 ± 0.001	0.987	247.77	-3.33
Clearsky	0.983 ± 0.001	0.990 ± 0.001	0.982 ± 0.000	0.984 ± 0.002	0.985	281.28	-4.26
Cloudy	0.993 ± 0.001	0.989 ± 0.002	0.989 ± 0.002	0.991 ± 0.003	0.991	204.15	-1.96
GERB-2 - Binned Averaged Rectified Geolocated (BARG)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.988 ± 0.001	0.991 ± 0.001	0.987 ± 0.001	0.985 ± 0.001	0.988	251.74	-3.17
Day	0.993 ± 0.001	0.993 ± 0.001	0.989 ± 0.001	-	0.992	258.72	-2.13
Night	0.983 ± 0.001	0.989 ± 0.001	0.984 ± 0.001	0.985 ± 0.001	0.985	248.23	-3.70
Clearsky	0.982 ± 0.001	0.988 ± 0.001	0.982 ± 0.001	0.980 ± 0.001	0.983	281.10	-4.91
Cloudy	0.993 ± 0.002	0.990 ± 0.002	0.988 ± 0.002	0.988 ± 0.003	0.990	198.68	-2.02
GERB-2 - High Resolution (HR)							
Scene Type	FM1	FM2	FM3	FM4	$< \text{FM} >$	$< L_g >$	ΔL
Allsky	0.985 ± 0.001	0.988 ± 0.001	0.984 ± 0.001	0.983 ± 0.001	0.985	249.62	-3.79
Day	0.989 ± 0.001	0.990 ± 0.001	0.986 ± 0.001	-	0.988	255.62	-3.01
Night	0.981 ± 0.001	0.986 ± 0.001	0.982 ± 0.001	0.983 ± 0.001	0.983	246.11	-4.25
Clearsky	0.980 ± 0.001	0.987 ± 0.001	0.980 ± 0.001	0.983 ± 0.001	0.982	280.52	-5.03
Cloudy	0.987 ± 0.001	0.984 ± 0.001	0.983 ± 0.002	0.983 ± 0.002	0.984	202.52	-3.25

Table 5: GERB/CERES LW flux ratio m and uncertainty.

	FM1	FM2	FM3	FM4
GERB-1 SW rad 2007	0.996	1.001	1.008	-
GERB-2 SW rad 2007	1.026	1.039	1.048	-
GERB-2 SW rad 2004	1.045	1.054	1.071	1.067
GERB-1 SW flux 2007	1.011	1.013	1.026	-
GERB-2 SW flux 2007	1.047	1.049	1.063	-
GERB-2 SW flux 2004	1.066	1.066	1.080	1.086

We can conclude that:

- GERB-1 is lower than GERB-2 by about 3% – 4%.
- The GERB/CERES radiance ratio is lower than the flux ratio by about 1% – 2%.
- The GERB-2/CERES ratio has decreased by about 1.7% between 2004 and 2007. The magnitude of this decrease is similar for the different CERES instruments. An aging of GERB-2 could be an explanation of this. However, the SW calibration monitoring device (an integrating sphere) does not provide evidence of SW aging.

The LW comparisons are summarized in the following table of GERB/CERES ratio values:

	FM1	FM2	FM3	FM4
GERB-1 LW rad 2007	0.993	0.998	0.988	0.987
GERB-2 LW rad 2007	0.990	0.993	0.983	0.983
GERB-2 LW rad 2004	0.989	0.993	0.983	0.981
GERB-1 LW flux 2007	0.992	0.995	0.991	0.988
GERB-2 LW flux 2007	0.988	0.991	0.987	0.985
GERB-2 LW flux 2004	0.988	0.992	0.987	0.983

We can conclude that:

- GERB-1 is slightly higher than GERB-2, by about 0.4%.
- The radiance and the flux ratio are in good agreement.
- The GERB-2/CERES ratio are similar in 2007 and in 2004. We can conclude that GERB and CERES are both stable in the LW.

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