



EarthCARE 2026 Science and Validation workshop

8–12 June 2026 | Rhodes House | Oxford, UK

EarthCARE BBR Operations and L1/L2 Performances

Nicolas Clerbaux, Almudena Velazquez, Edward Baudrez – Royal Meteorological Institute of Belgium / EarthCARE DISC

EarthCARE BBR Instrument and Products



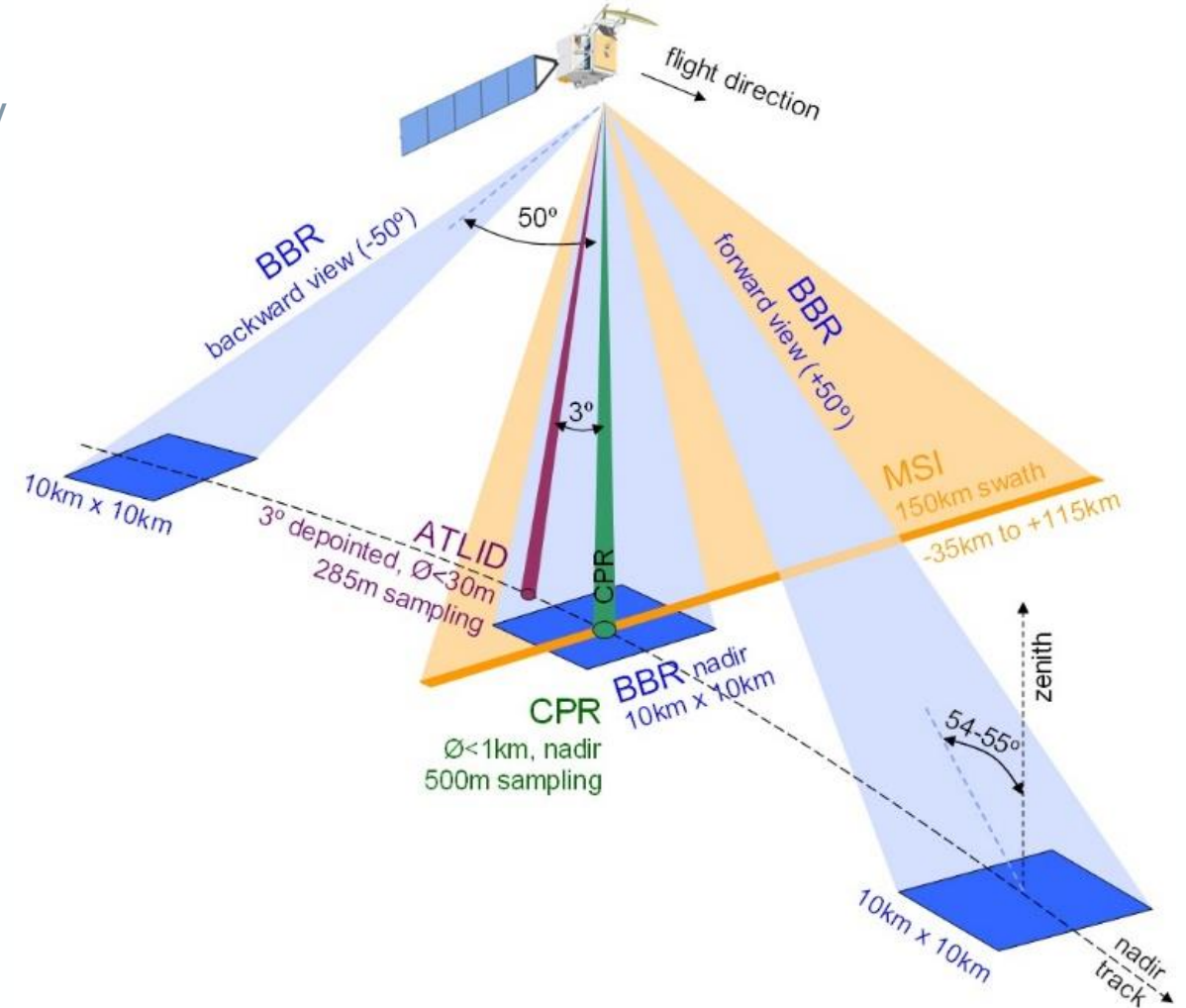
Objective : observe TOA solar and thermal fluxes with instantaneous accuracy $< 10\text{W/m}^2$ for domains of typically $10\text{km} \times 10\text{km}$.

→ broadband detectors (micro bolometers) and quartz filter to separate SW

→ 3 views: nadir, fore and aft

→ Fine spatial resolution for a precise colocation of the 3 views (Earth rotation between the fore-nadir-aft obs.!))

→ Arrays of 30 detectors across track with ground sampling distance of 600m (nadir) / 1000m(fore/aft).
Sampling distance alongtrack of $\sim 1100\text{m}$.



EarthCARE BBR Instrument and Products



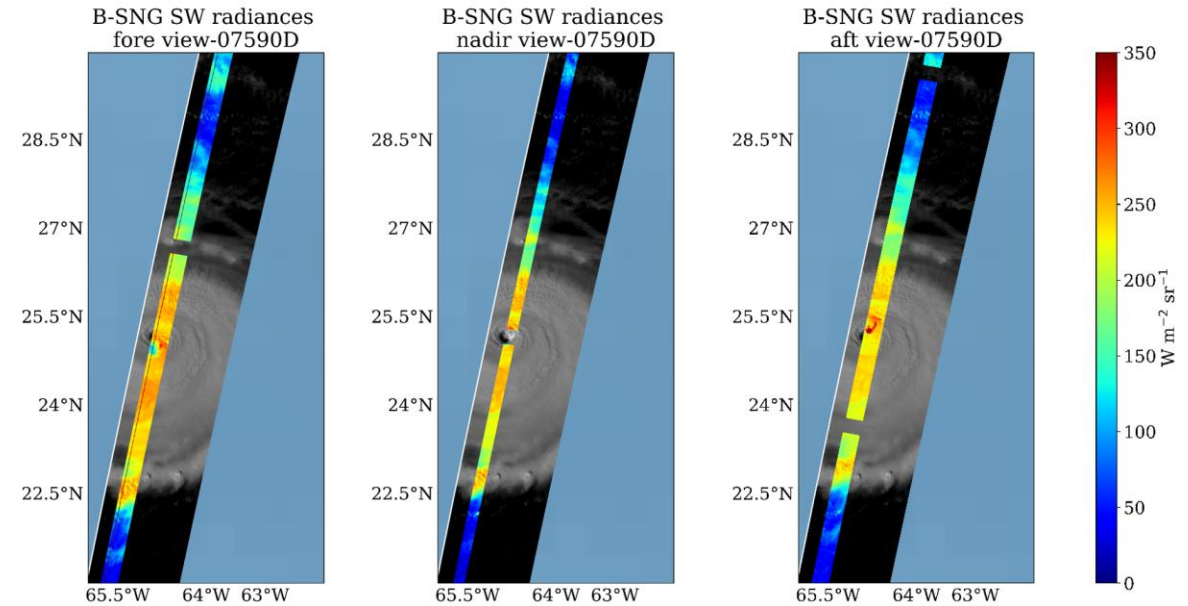
Objective : observe TOA solar and thermal fluxes with instantaneous accuracy $< 10\text{W/m}^2$ for domains of typically $10\text{km} \times 10\text{km}$.

→ broadband detectors (micro bolometers) and quartz filter to separate SW

→ 3 views: nadir, fore and aft

→ Fine spatial resolution for a precise collocation of the 3 views (Earth rotation between the fore-nadir-aft obs.!).

→ Arrays of 30 detectors across track with ground sampling distance of 600m (nadir) / 1000m (fore/aft).
Sampling distance alongtrack of $\sim 1100\text{m}$.



EarthCARE BBR Instrument and Products



Objective : observe TOA solar and thermal fluxes with instantaneous accuracy $< 10\text{W/m}^2$ for domains of typically $10\text{km} \times 10\text{km}$.

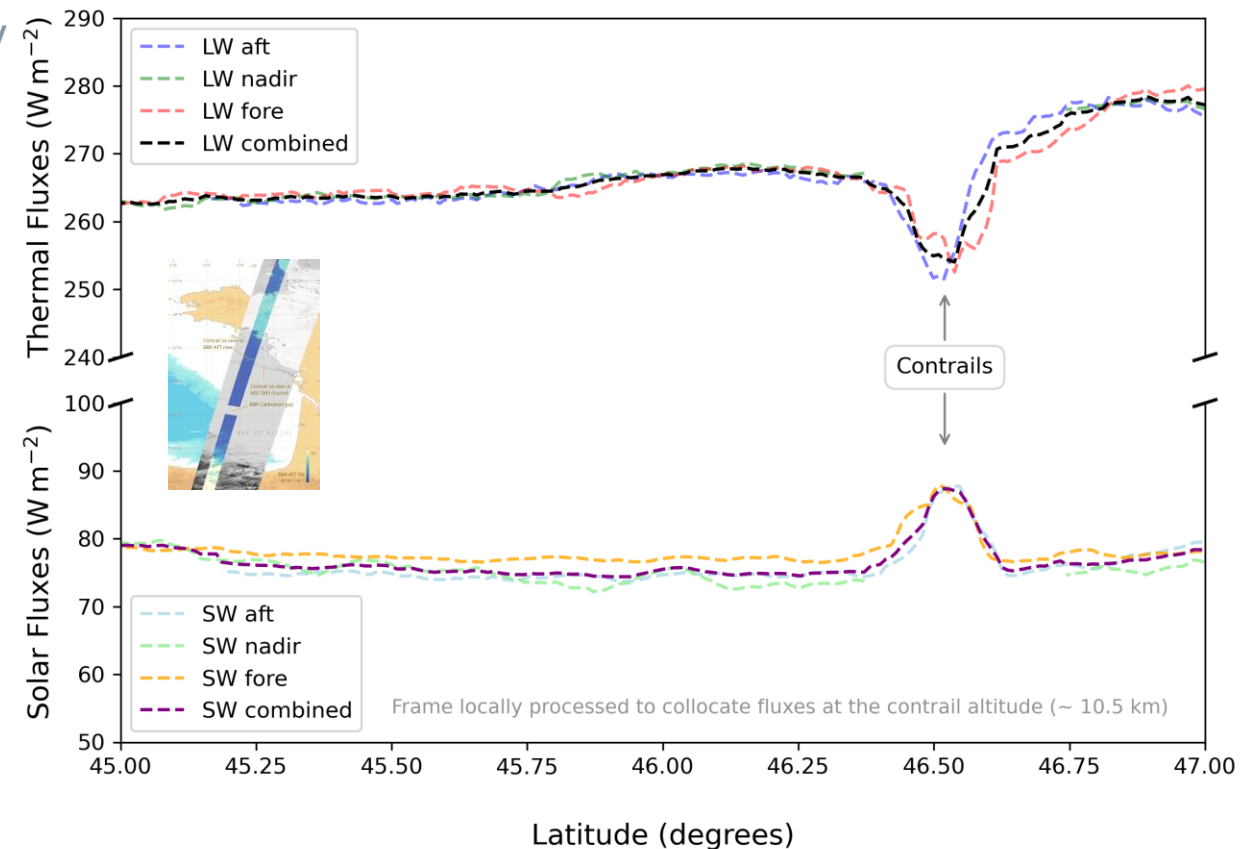
→ broadband detectors (micro bolometers) and quartz filter to separate SW

→ 3 views: nadir, fore and aft

→ Fine spatial resolution for a precise collocation of the 3 views (Earth rotation between the fore-nadir-aft obs.!))

→ Arrays of 30 detectors across track with ground sampling distance of 600m (nadir) / 1000m (fore/aft). Sampling distance alongtrack of $\sim 1100\text{m}$.

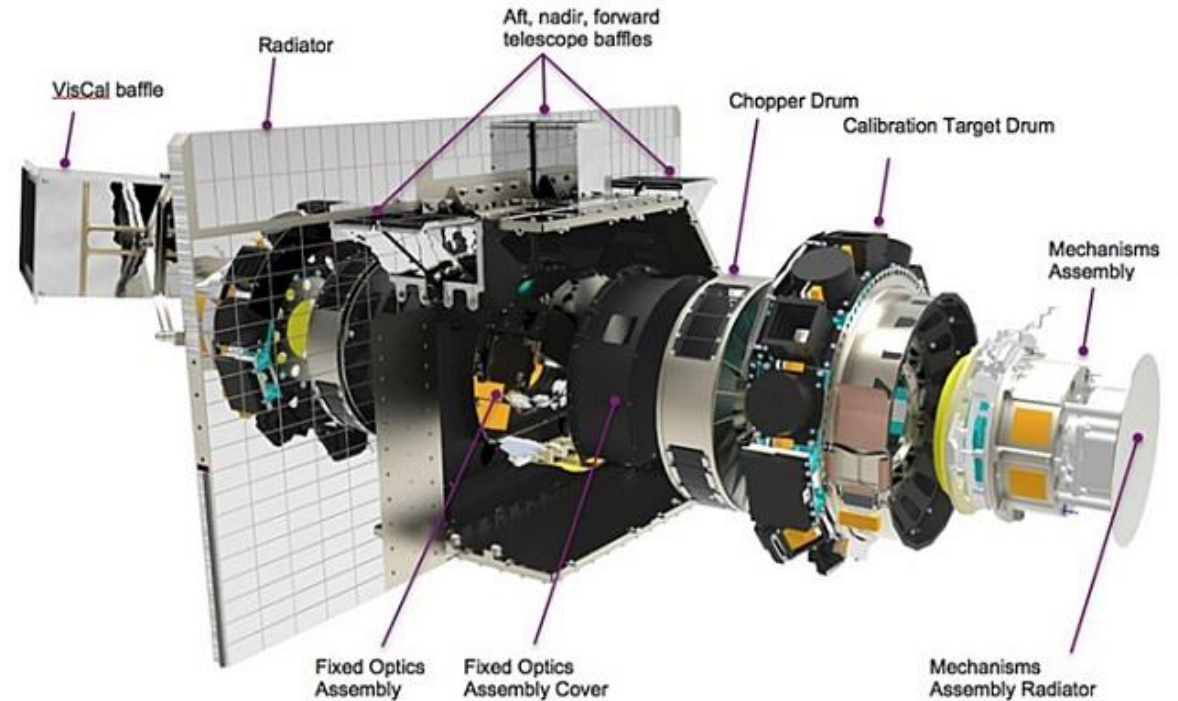
BMA-FLX Top Of the Atmosphere Fluxes



Intermittent operations



- Chopper Drum Mechanism qualified for (only) 219,362,425 revolutions
- Since beginning of mission the CDM speed was lowered to 196 rpm (75% of nominal)
- With continuous operation the End Of Life would have been in Aug. 2026 (!)
- Since 20 Nov 2025, intermittent operations with 5 days NOM and 15 days STDBY (+possibility to operate “on demand” for e.g. campaign) → EOL extended to Oct. 2028.
- Current investigations to further extend the STDBY period to reach EOL in ~2030 or ~2031.
- Any comments / request for BBR operation welcome.
- Decision to be taken by the QWG

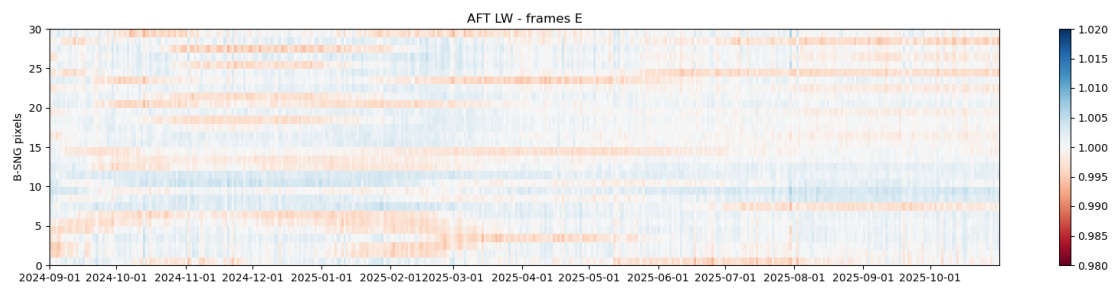
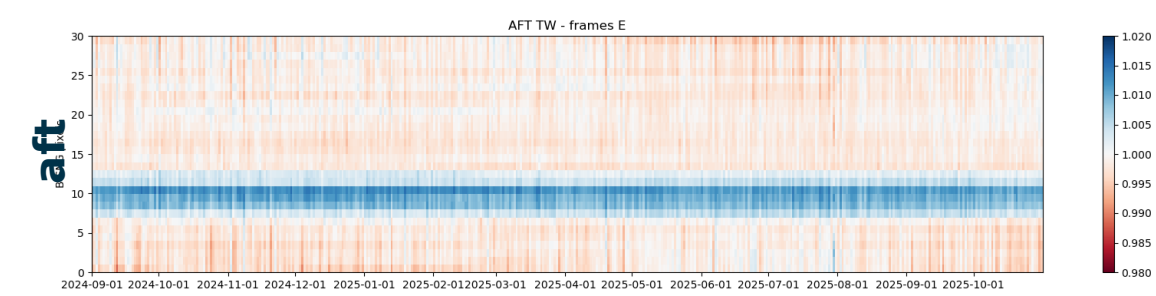
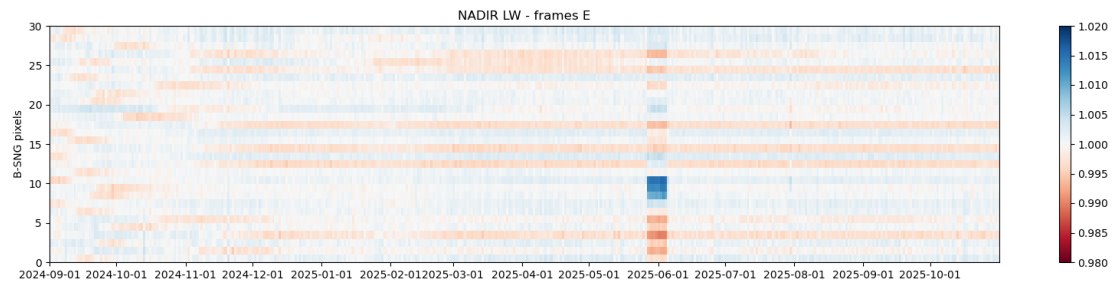
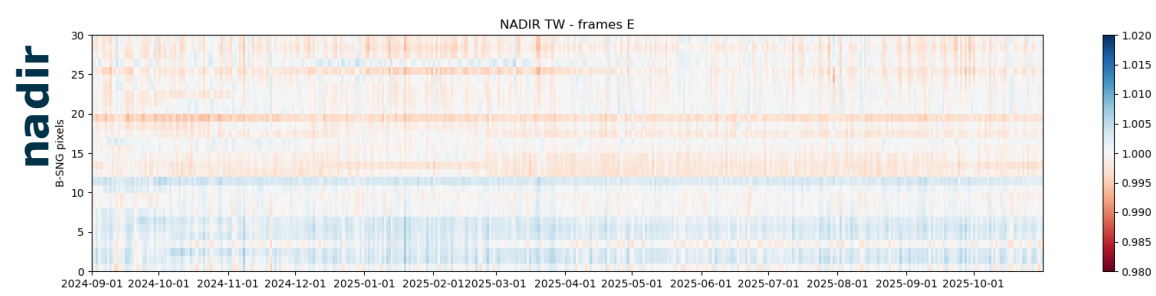
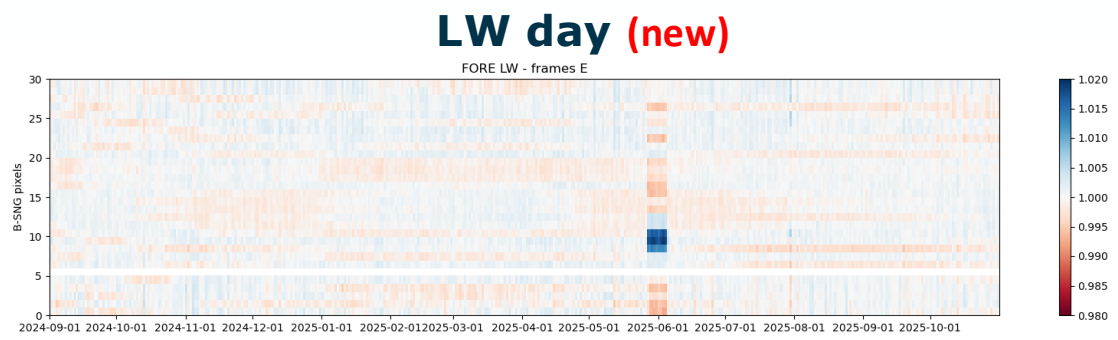
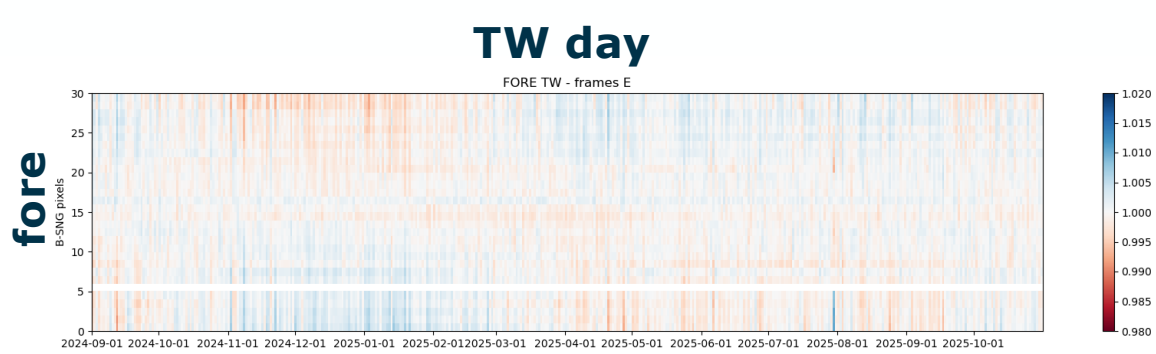


EarthCARE BBR L1 / L2 Monitoring in DISC

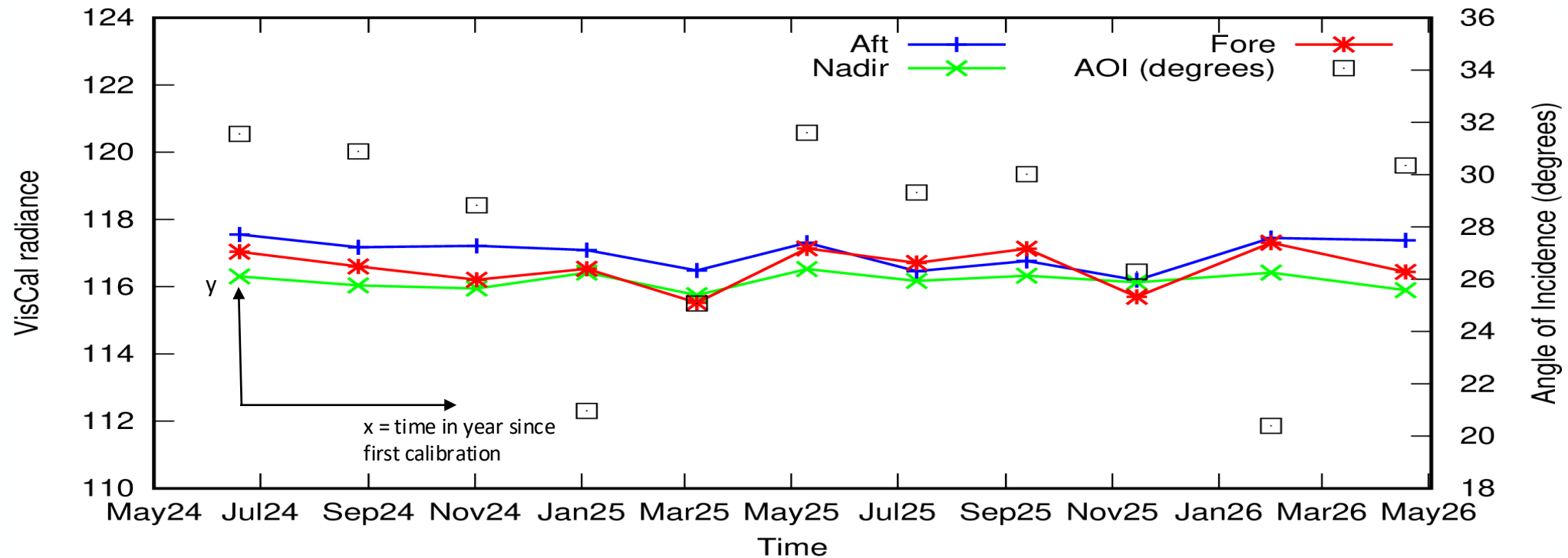


Item	DISC Partner	Description
BBR detector statistical consistency	QC (RMIB)	Allows to detect problems and degradation at detector level, before signal integration in the domains. Including change in the 'B' values that are used to compute the SW gain. Cover TW and SW, an also LW (new) .
BBR LW gain monitoring	QC	Allows to detect problems and degradation at detector level, before signal integration in the domains. Based on the blackbodies thus restricted to LW gain.
BBR VisCal observation (new, ongoing)	ICMF RMIB	Not yet operational. First results are encouraging for monitoring the degradation of the detector (B factors). Likely not useful for absolute calibration and for relative calibration of the 3 telescopes (they observe the same diffuser but with different optical paths).
B-SNG comparison with CERES FLASHFlux	RMIB	Near real time monitoring of the SW/LW calibration wrt NOAA-20 FM6 CERES instrument. Limited to the BBR nadir telescope.
B-SNG comparison with CERES SSF	RMIB	Comparison with Terra/FM1, Aqua/FM3, NOAA-20/FM6. Many matches with the nadir telescope. Few matches between FM3 (RAPS) and the fore detector (new) . No matching for the aft view.
B-SNG comparison with GERB	RMIB	Comparison with the GERB instruments on MSG satellites (0° and Indian Ocean). Only for the nadir view. Matches restricted to the MSG sub-satellite points (~ Equator).
BBR aft/fore views comparison	RMIB	Statistical comparison of the aft and view radiances. For the SW additional criteria on the Sun relative azimuth that should be the same for the aft and fore views (90° +/- margin).
BBR level 2 flux comparison	RMIB	Statistical comparison of the L2 fluxes from the 3 telescopes. This informs on the consistency of the 3 views but could be affected by ADM (radiance-to-flux conversion) error.

New monitoring item – B_SNG LW



New monitoring item – VisCal observations



Best fits ($y = \text{VisCalRad}$, $x = \text{time in year since "20240626"}):$

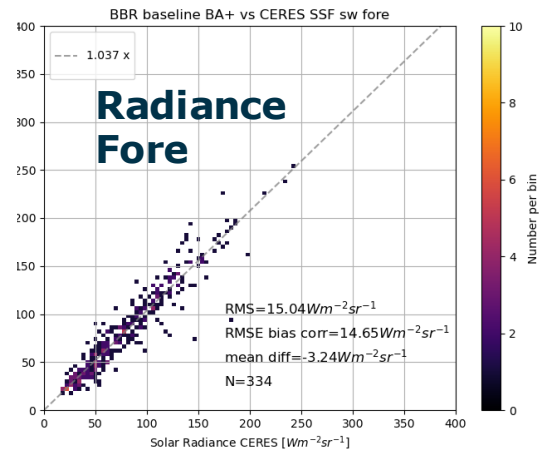
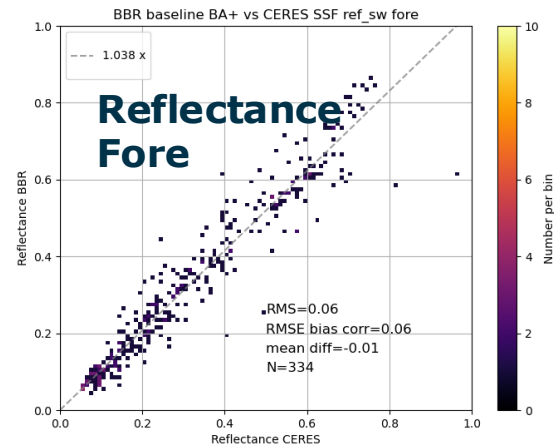
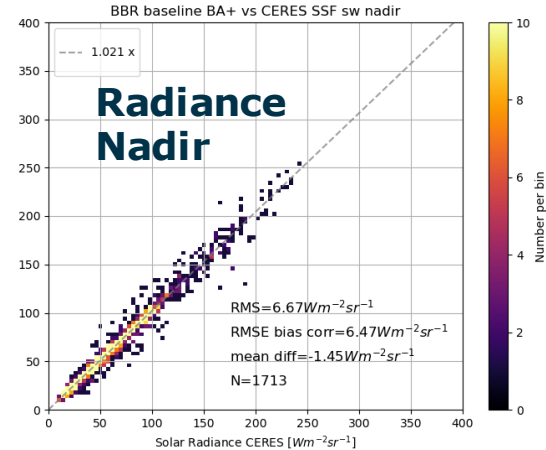
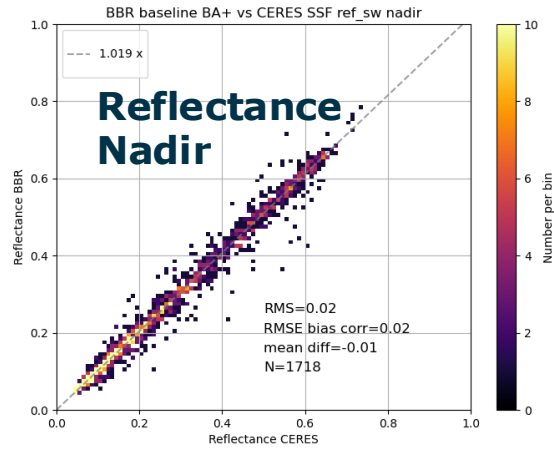
- Aft : $y = 117.15 (\pm 0.26) - 0.16 (\pm 0.25) * x$ (RMSE=0.43 W/m²/sr)
- Nadir : $y = 116.17 (\pm 0.15) + 0.01 (\pm 0.14) * x$ (RMSE=0.24 W/m²/sr)
- Fore : $y = 116.55 (\pm 0.34) + 0.03 (\pm 0.33) * x$ (RMSE=0.56 W/m²/sr)

(uncertainty at 1 σ , no autocorrelation)

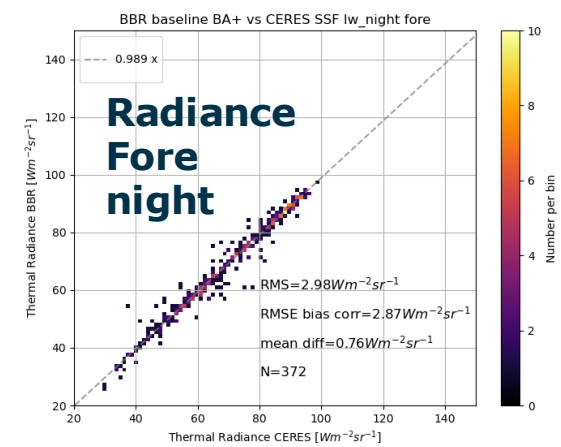
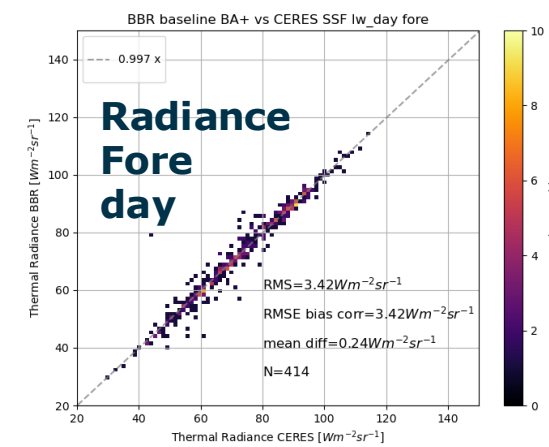
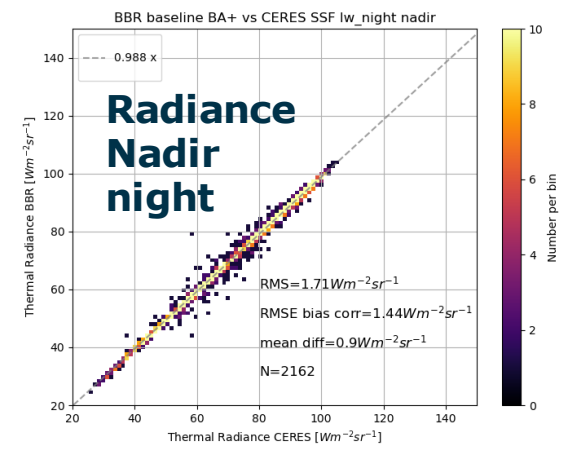
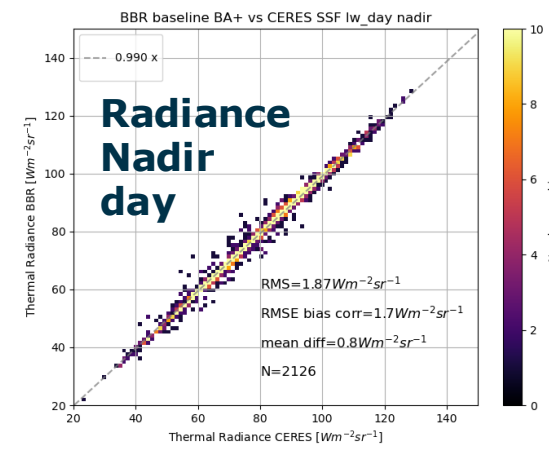
- No significant drift / jump in signal between the campaigns so far
- The BRDF seems to correctly account for the dependency in AOI

New monitoring : BBR fore view wrt CERES

Shortwave reflectances / radiances



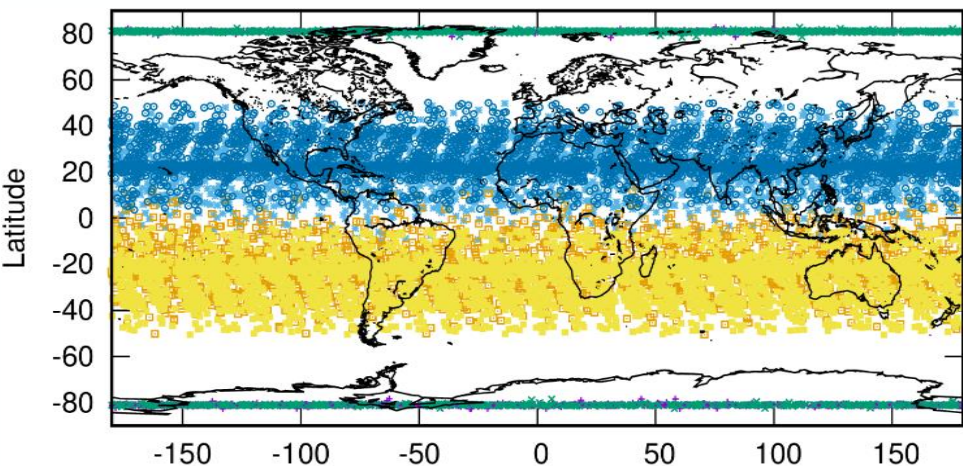
Longwave radiances(day / night)



Summary of the comparison with CERES - SW



Data : 10th Aug. 2024 to 30th Nov. 2025



CERES VZA < 50°

$\Delta\text{dist} < 3 \text{ km}$

$\Delta\text{time} < 5 \text{ min}$

Longitude

Terra FM1 - day
Terra FM1 - night
Aqua FM3 - day
Aqua FM3 - night
NOAA20 FM6 - day
NOAA20 FM6 - night

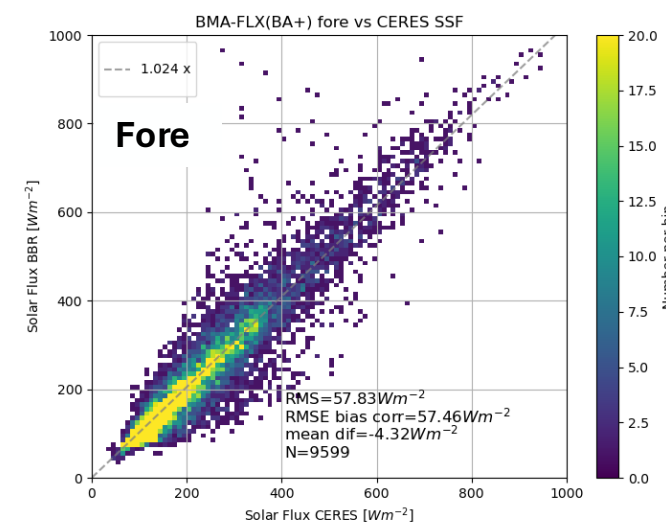
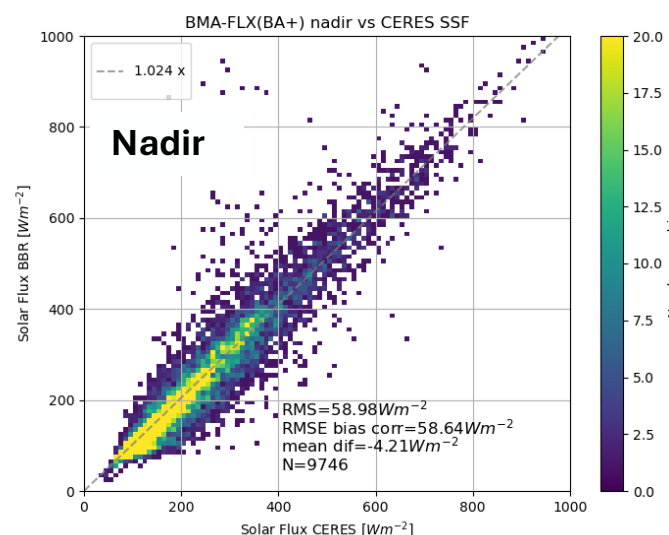
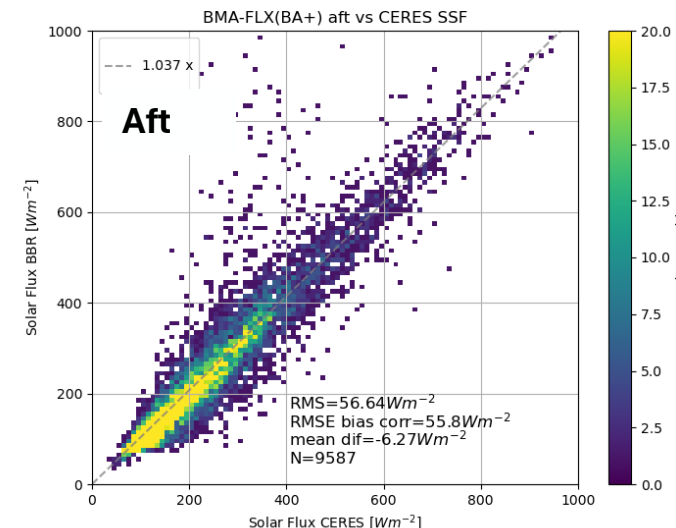
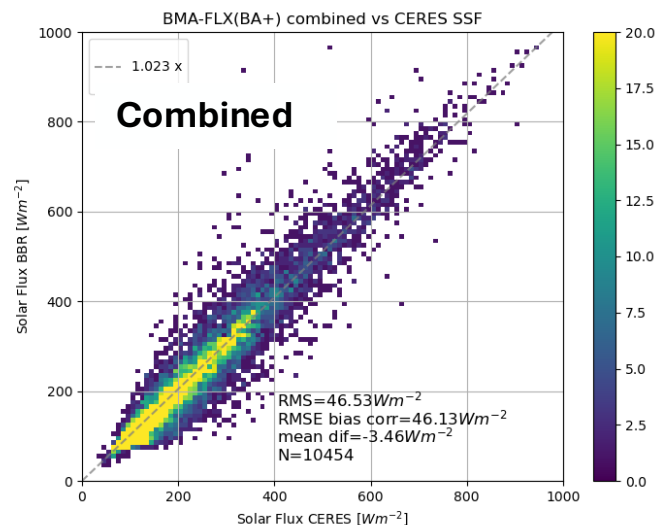
BMA_FLX SW flux vs CERES SSF:

Aft : $\text{BBR} = 1.037 * \text{CERES}$

Nadir: $\text{BBR} = 1.024 * \text{CERES}$

Fore : $\text{BBR} = 1.024 * \text{CERES}$

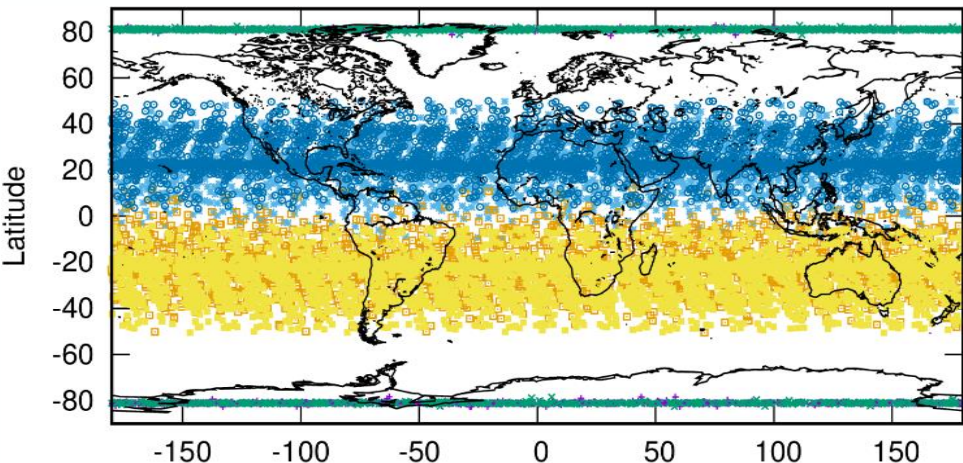
Combined: $\text{BBR} = 1.023 * \text{CERES}$



Summary of the comparison with CERES - LW



Data : 10th Aug. 2024 to 30th Nov. 2025



CERES VZA < 50°

$\Delta\text{dist} < 3 \text{ km}$

$\Delta\text{time} < 5 \text{ min}$

Longitude

Terra FM1 - day

Terra FM1 - night

Aqua FM3 - day

Aqua FM3 - night

NOAA20 FM6 - day

NOAA20 FM6 - night

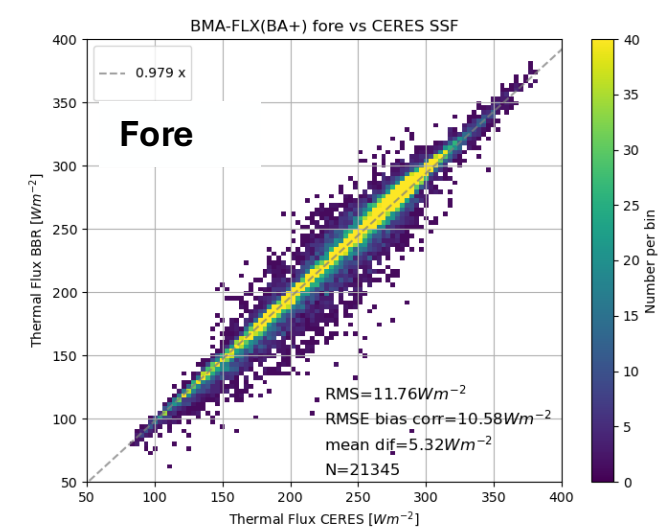
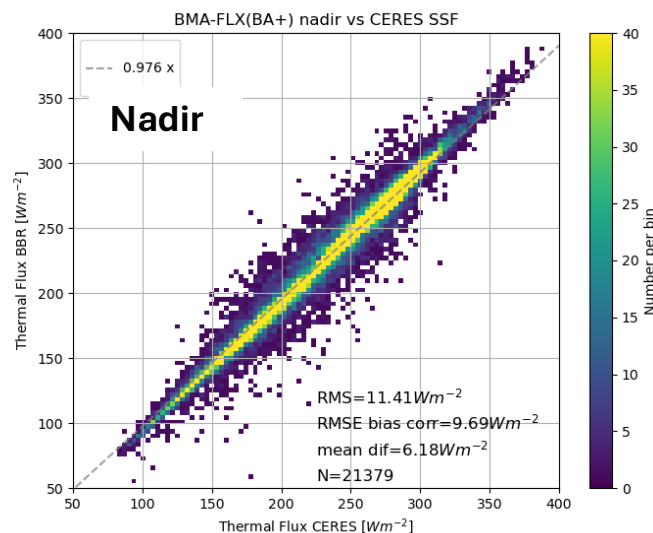
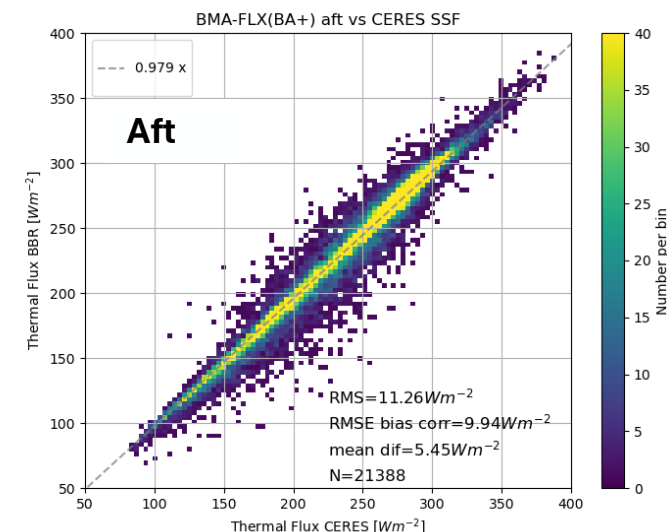
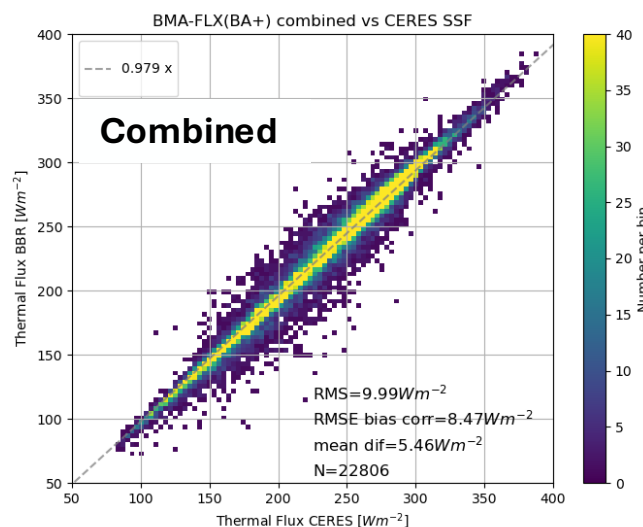
BMA_FLX SW flux vs CERES SSF:

Aft : $\text{BBR} = 0.979 * \text{CERES}$

Nadir: $\text{BBR} = 0.976 * \text{CERES}$

Fore : $\text{BBR} = 0.979 * \text{CERES}$

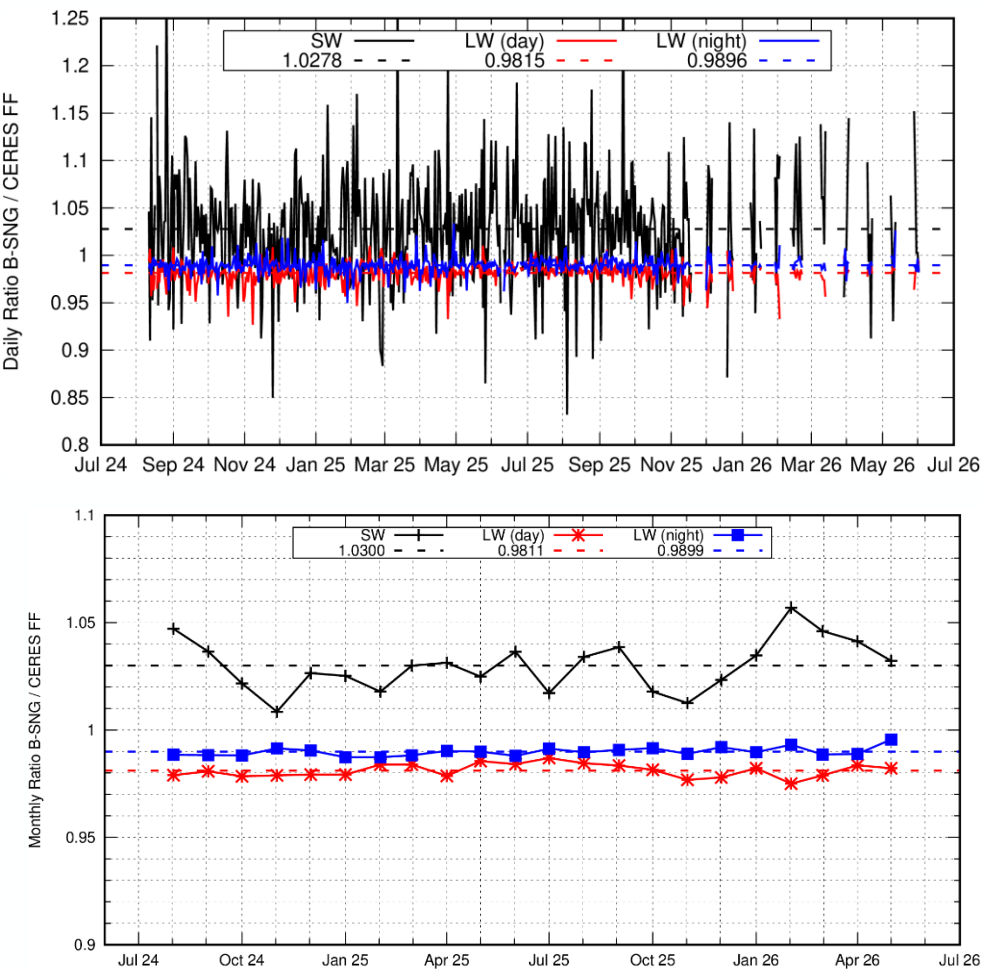
Combined: $\text{BBR} = 0.979 * \text{CERES}$



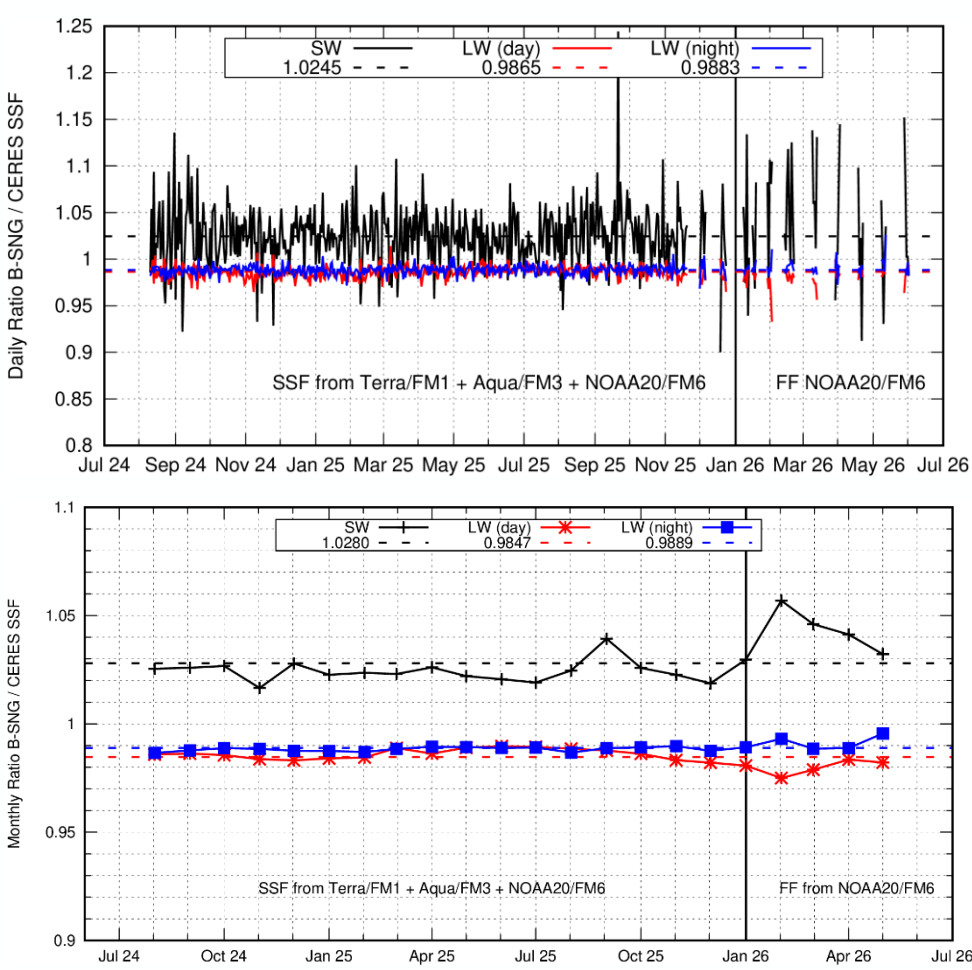
BBR stability wrt CERES FLASflux and SSF



FLASHflux (NOAA20/FM6)



SSF(Terra/FM1+Aqua/FM3+NOAA20/FM6)



Note: only 1 day in June

Summary of the performances and operations



- Overall the BBR instrument is performing well and is stable.
- Until Nov. 2025 excellent data availability, but now in intermittent operation mode (5 days NOM + 15 days STB)
- Since baseline BA, the level-1 products (B-SNG, B-NOM) are deemed to be useful for scientific uses.
- Radiometric levels wrt CERES SSF
 - SW higher by ~2% (radiance and flux)
 - LW lower by about 1% (radiance) -2% (flux).

Note : SW flux in CERES EBAF is ~2% higher than in CERES SSF → the BBR SW flux would agree with the EBAF radiometric level.

Other workshop contributions regarding BBR Performances:

- ESA L2 radiation and radiative closure product status, Jason Cole, today 11:22
- Towards Radiative Closure in EarthCARE: Evaluation of TOA Flux Retrievals, Carla Salas Molar, Wednesday 13:42
- BBR Level-2 Validation Efforts within the BRAVO Project, Christine Aebi, Wednesday 13:54
- BM-RAD and BMA-FLX processor updates and validation, Almudena Velazquez Blazquez, Poster P005