BBR Level-2 Validation Efforts within the BRAVO project

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What is the BRAVO project?

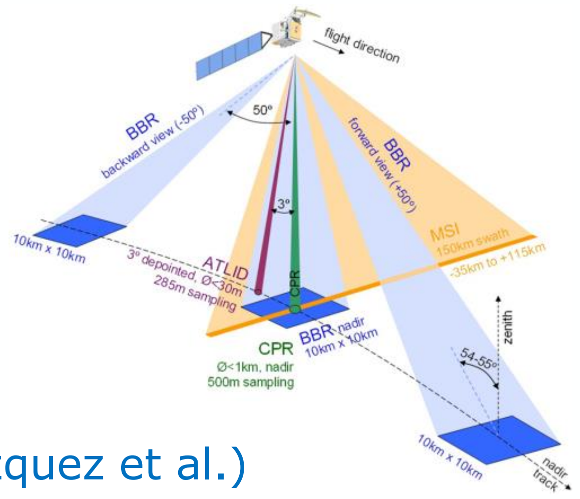
BRAVO: Broadband RAdiometer VerficatiOn project

- **Validation efforts of the BBR:**
  - L1 products: B-SNG and B-NOM
  - L2 products BM-RAD and BMA-FLX
  - ➢ Three telescopes (fore, nadir and aft)
  - ➢ Different resolutions (standard, small, full and assessment domain)

L1 PSF	Size (across x along track)	Reference grid	L1 filtered radiances	BM-RAD unfiltered radiances	BMA-FLX fluxes	BMA-FLX combined flux
Standard	10x10 km2	BBR	B-NOM	✓	✓	✓
Small	5x10 km2	BBR	B-NOM	✓	✓	✓
Full	17x10 km2 (nadir) 28x10 km2	BBR	B-NOM	✓	✓	
Assessment domain	5x21 JSG (configurable)	JSG	B-SNG	✓	✓	✓
JSG*	1x1 JSG (or 3x3 JSG)	JSG	B-SNG	✓		

Core analyses within the project:

- Intercomparisons between different baselines and telescopes.
- Comparisons with other sources: GERB, CERES, MTG, ...
- Stability checks/Checks for ageing of the instruments.
- Developing a narrowband-to-broadband product from MSI.



→ Poster P005: BM-RAD and BMA-FLX processor updates and validation (A. Velazquez et al.)

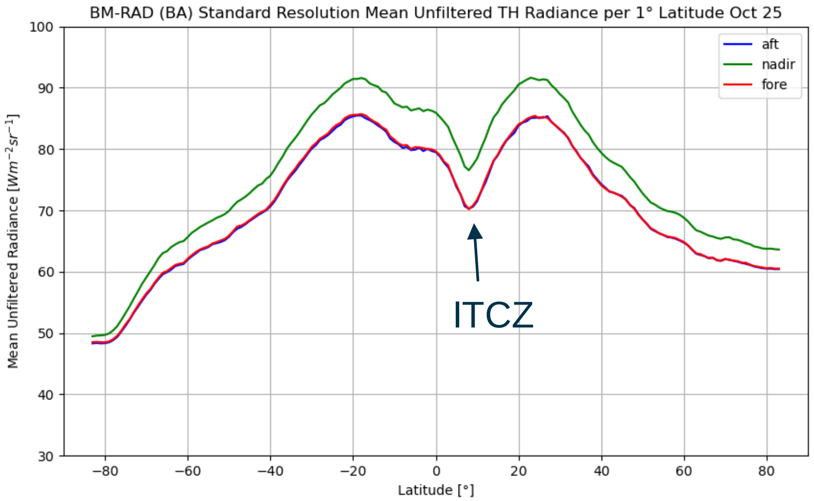
Outline

- Introduction of the **BRAVO** project
- **Stability checks** of the thermal and solar unfiltered radiances using the **BM-RAD** product
- **Stability checks** of the **BMA-FLX** product using deep convective clouds
- Comparison of the **BMA-FLX** and **CERES SSF** solar and thermal fluxes
- Preliminary results showing the **narrowband-to-broadband (NB2BB) product**
- Outlook producing a **Geo-Ring product**
- Summary

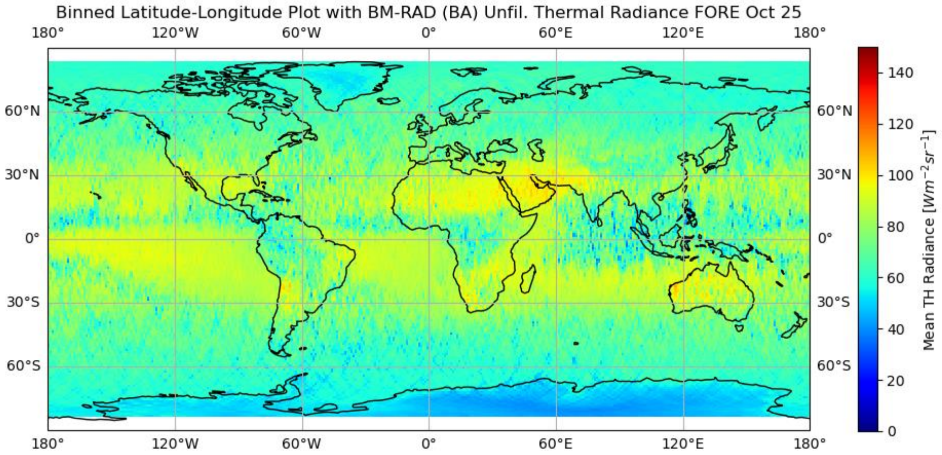
Stability Check: BM-RAD TH Unfiltered Radiance

1° binned data Oct 2025

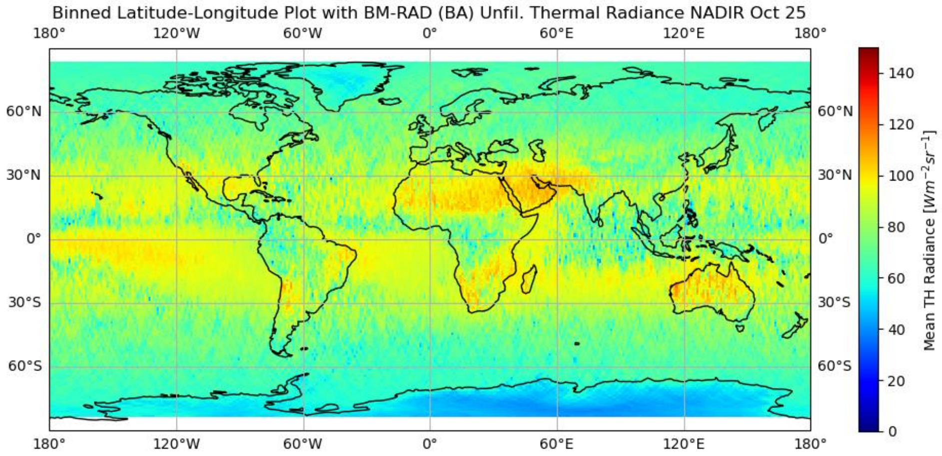
Baseline BA



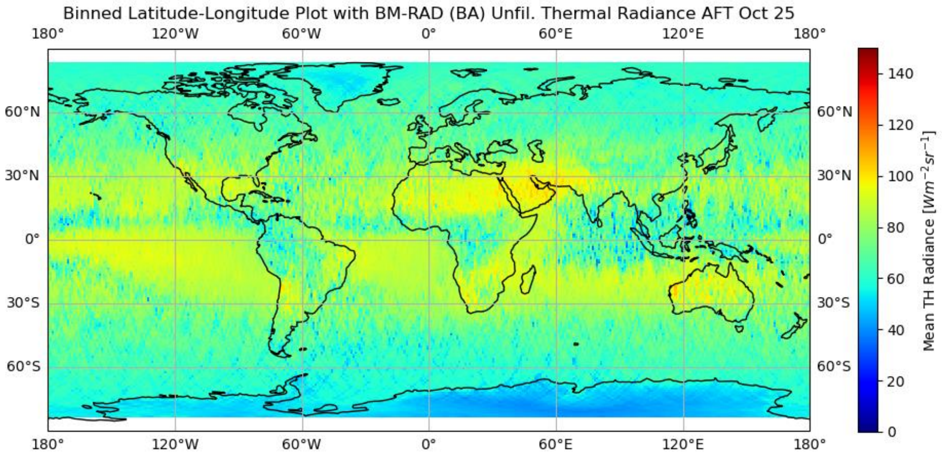
Fore



Nadir



Aft

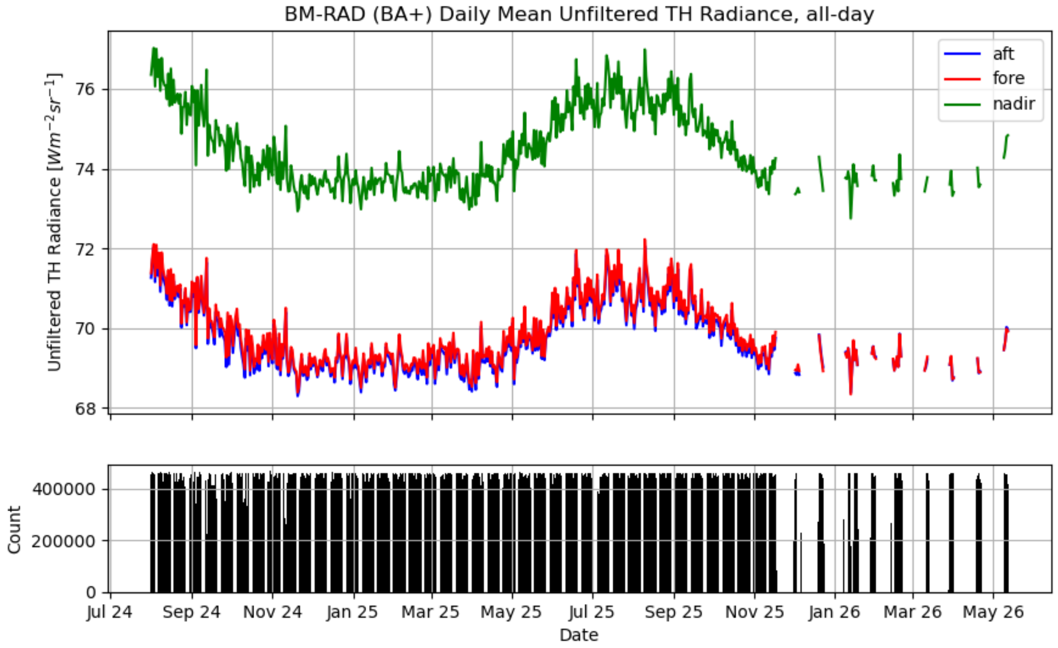


- **Limb darkening**: TH radiance values of the nadir view are higher than the off-nadir views.

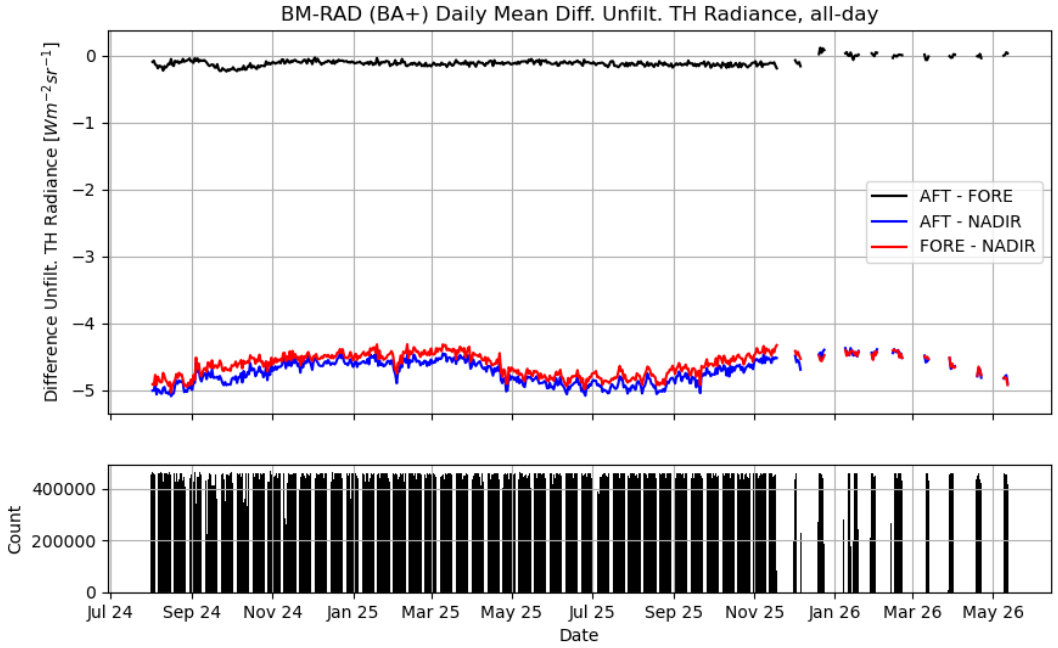
Stability Check: BM-RAD TH Unfiltered Radiance

Baselines BA - BC

Daily Mean Values



Difference

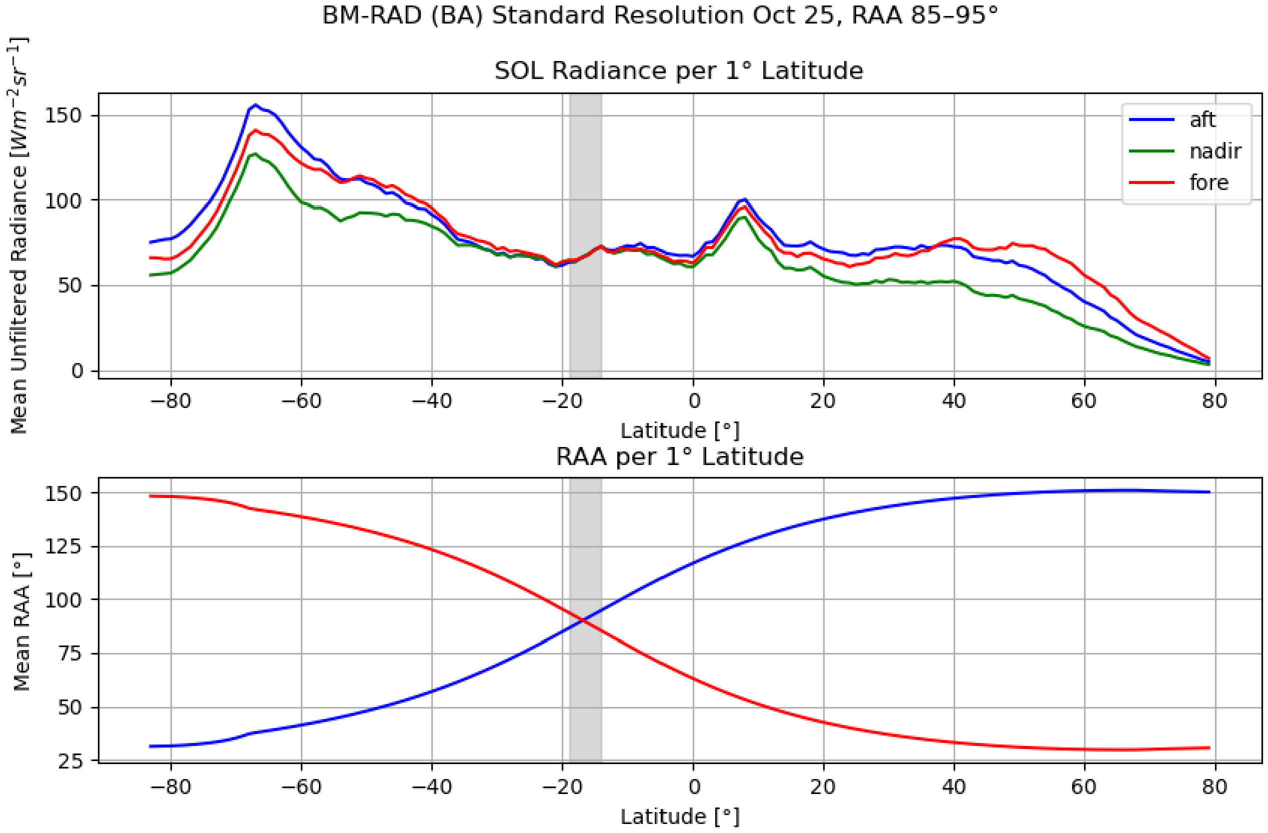


- Limb darkening: TH radiance values of the nadir view are always higher than the off-nadir views.
- Values of the fore view slightly higher than the aft view until November 2025. Thereafter, the differences seem to be smaller, coinciding with the regular switching on and off of the BBR.

Stability Check: BM-RAD SOL Unfiltered Radiance

Standard Resolution

Baseline BA

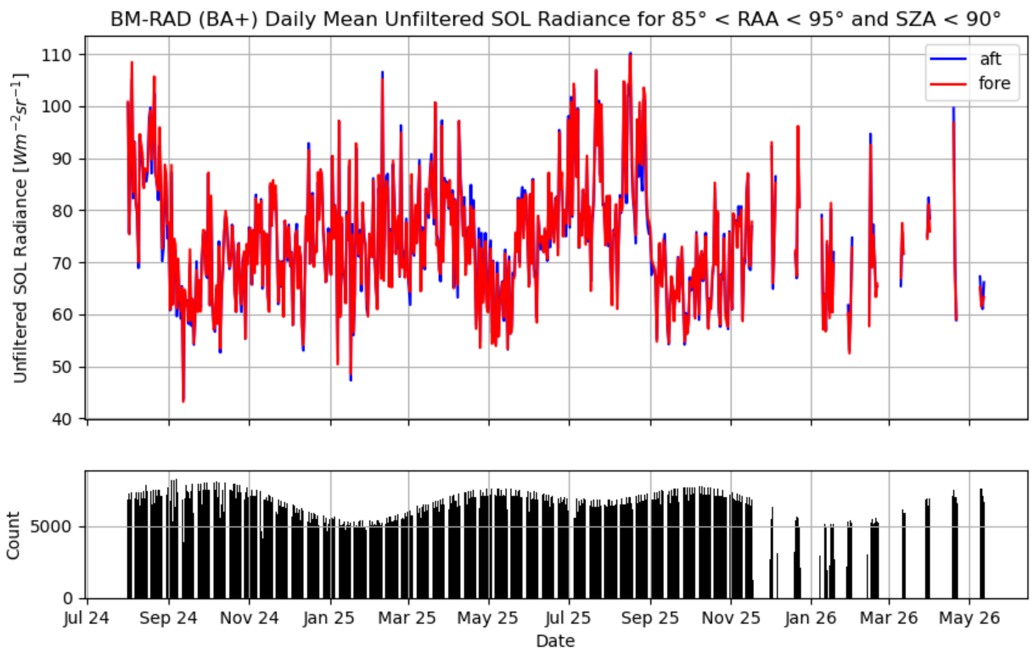


- If relative azimuth angle (RAA) is around 90°, then AFT and FORE view should match → RAA range of 85° - 95°.

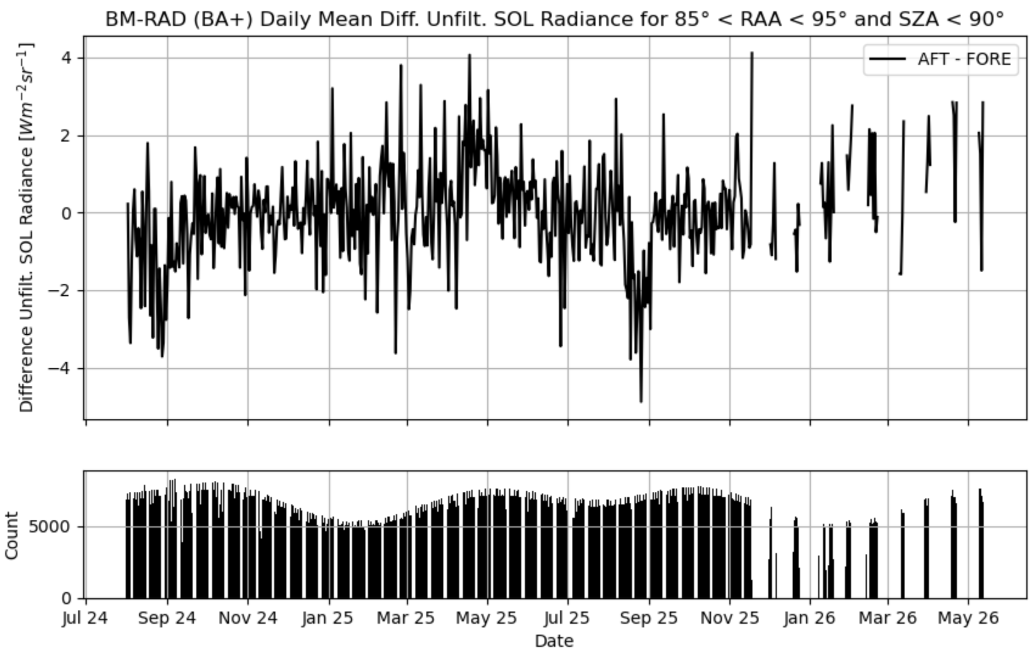
Stability Check: BM-RAD SOL Unfiltered Radiance

Baselines
BA - BC

Daily Mean Values



Difference



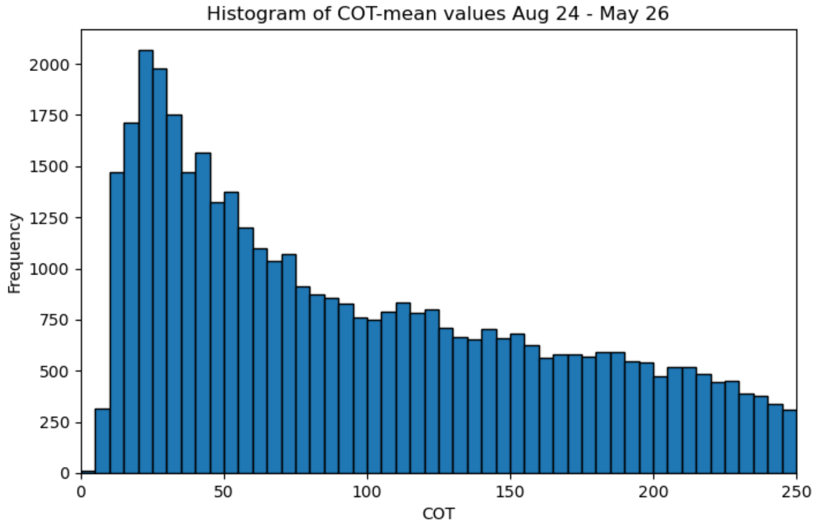
- Only data considered with relative azimuth angles (RAA) between 85° and 95°.
- More noisy than the thermal radiance and a slightly larger difference between the two views. Difficult to see a trend.

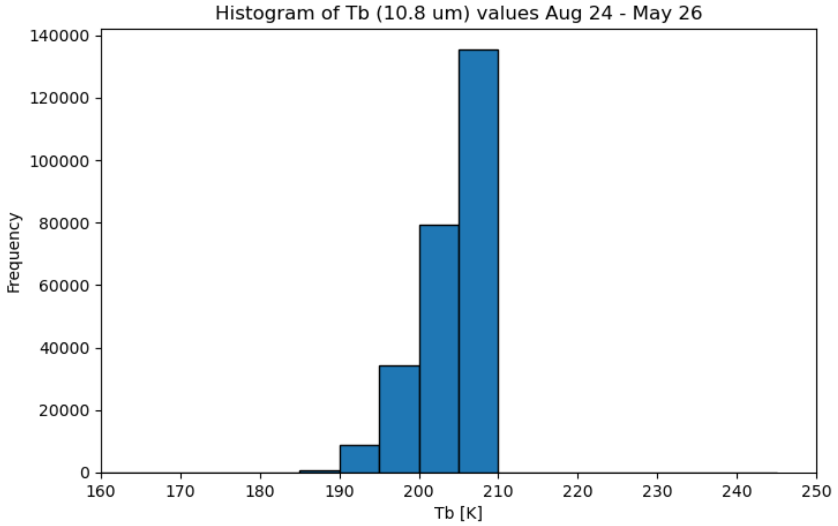
Deep convective clouds (DCC):

- Brightness temperature (10.8 µm) < 210 K
- Cloud cover > 99%
- Surface type ≠ permanent snow
- SZA < 40°

Analysis performed for DCC and data with baselines BA - BC: August 2024 – May 2026:

- Corrected for the Sun-Earth distance
- Reflectance instead of SOL Flux



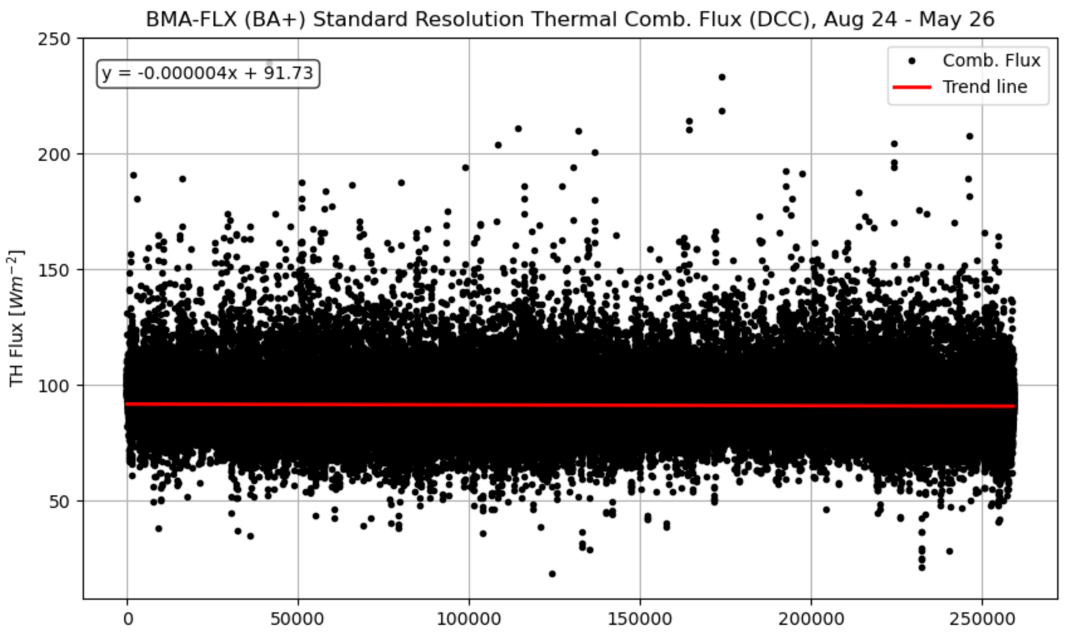


Stability Check Deep Convective Clouds (DCC)

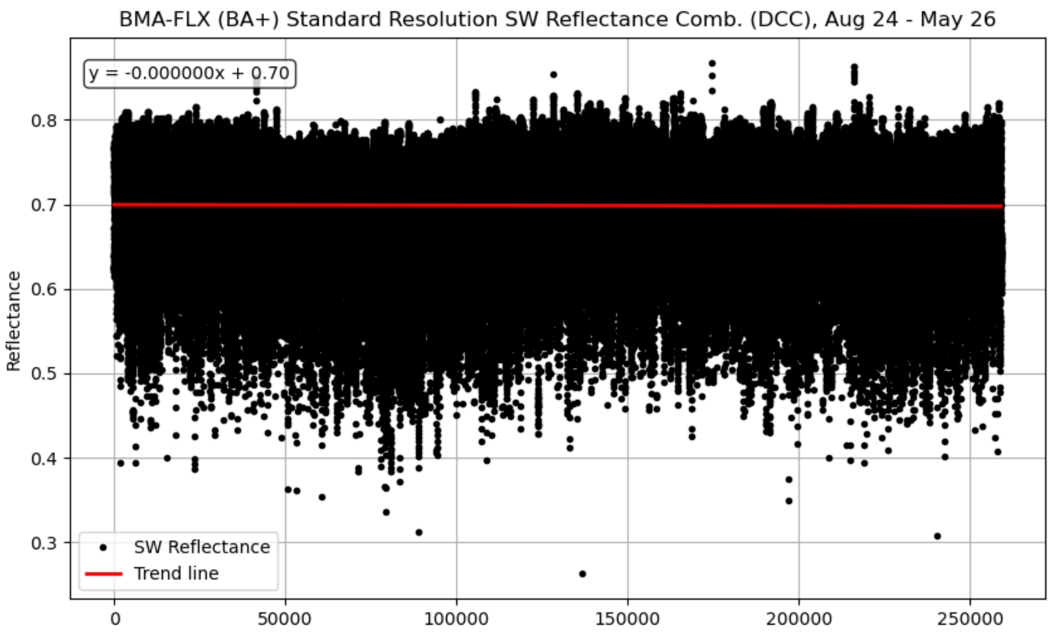
Baselines
BA - BC

BMA-FLX

Thermal Combined Flux



SW Reflectance Comb.



- Thermal combined flux and SW reflectance over deep convective clouds quite stable over almost 2 years of data.

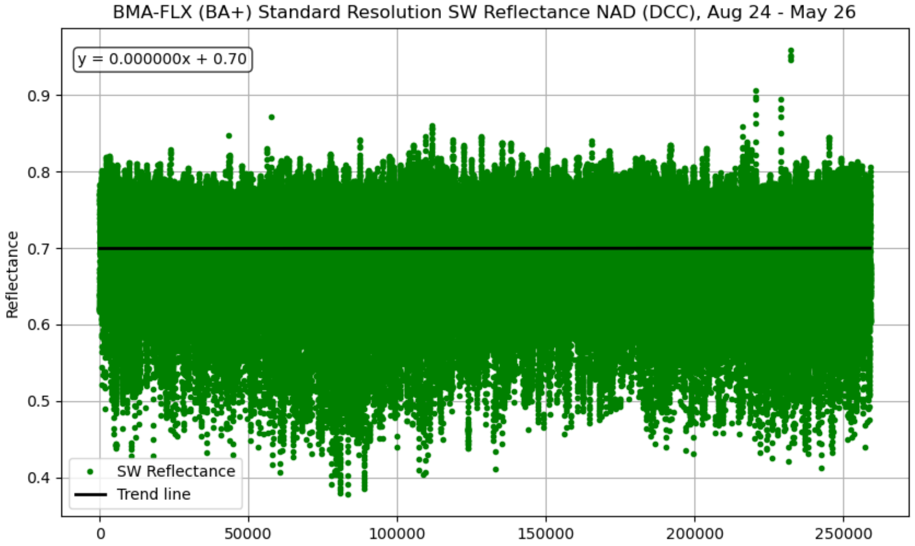
Stability Check Deep Convective Clouds (DCC)

JAXA esa EUROPEAN SPACE AGENCY

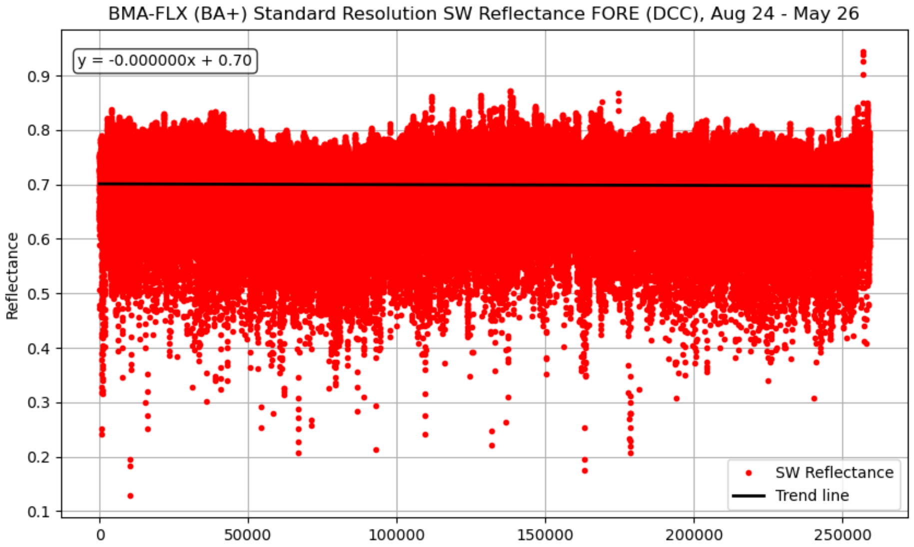
Baselines
BA - BC

SW Reflectances

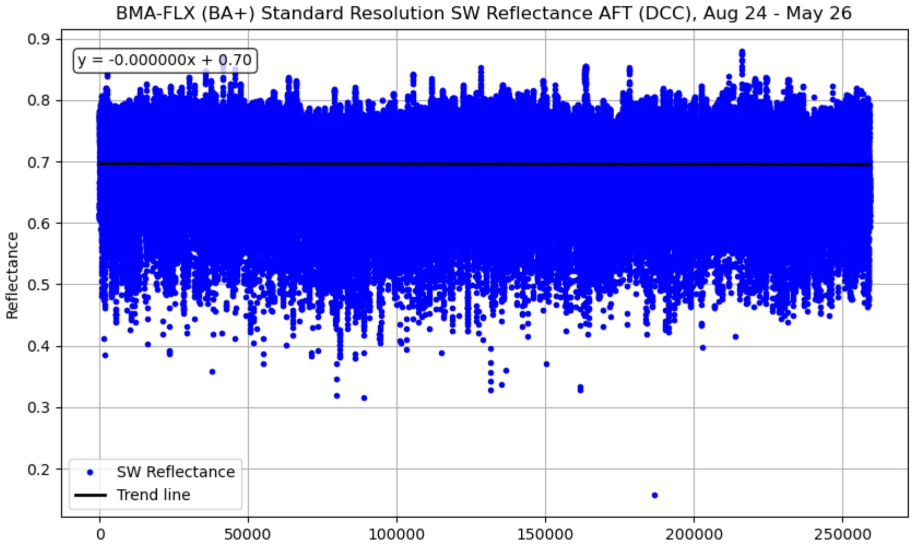
Nadir



Fore



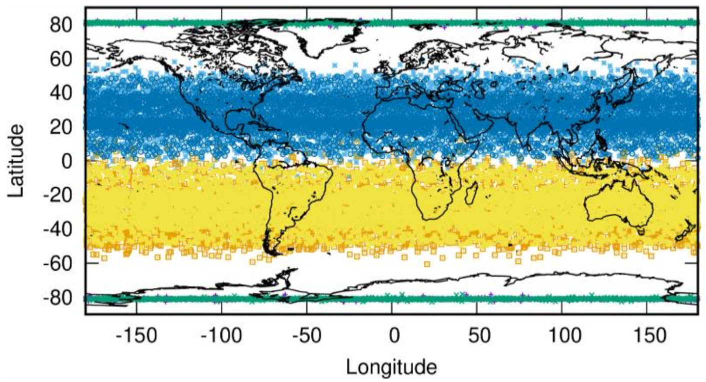
Aft



- SW reflectance for the three views separately over deep convective clouds are also stable over the full available time period.

BMA-FLX (BA+) vs CERES SSF: SW Flux

10 August 2024 to 31 January 2026



CERES VZA < 50°
Δdist < 3 km
Δtime < 5 min

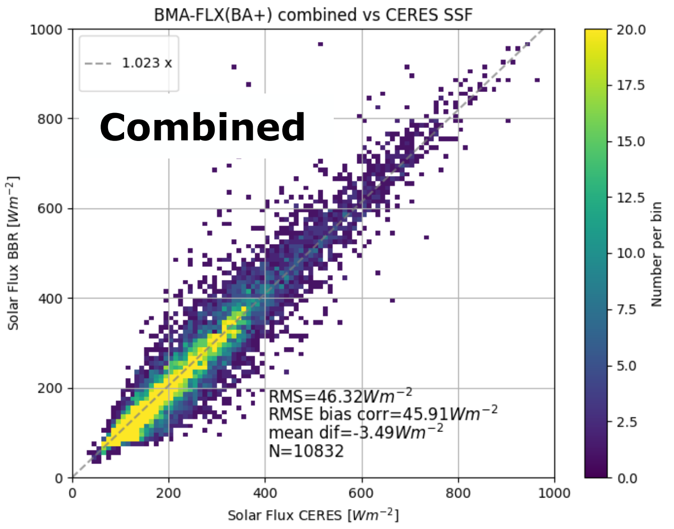
BMA_FLX SW flux vs CERES SSF:

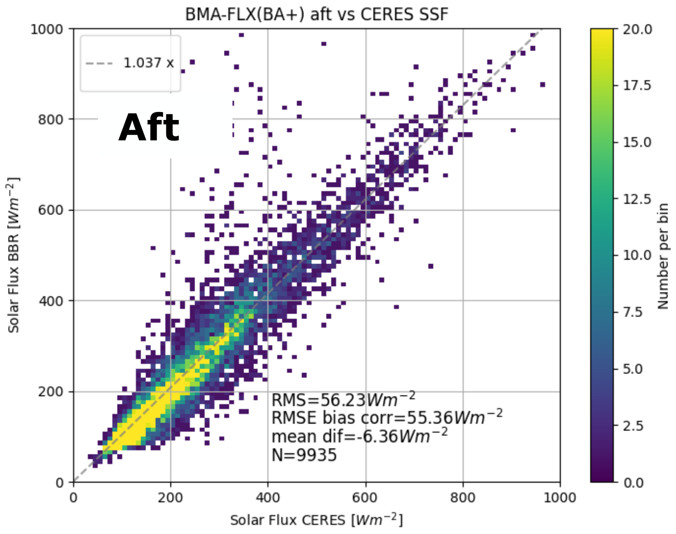
Aft : BBR = 1.037 * CERES

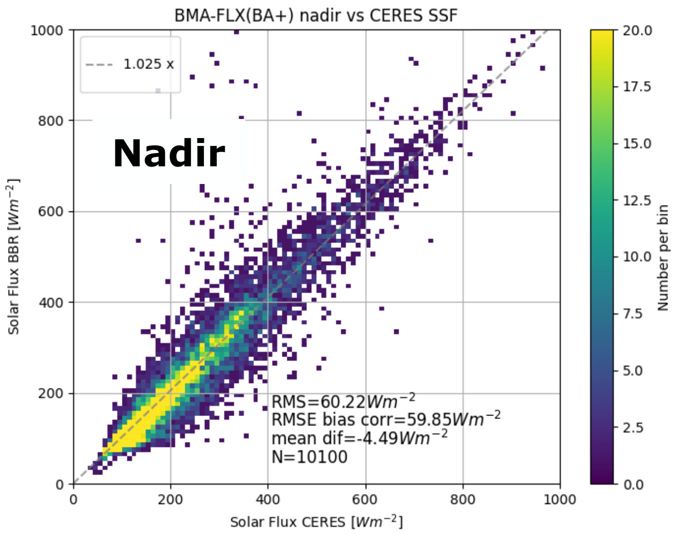
Nadir: BBR = 1.025 * CERES

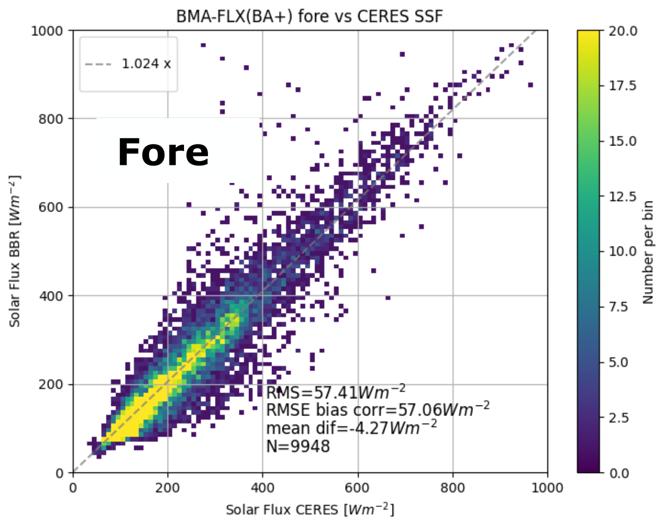
Fore : BBR = 1.024 * CERES

Combined: BBR = 1.023 * CERES



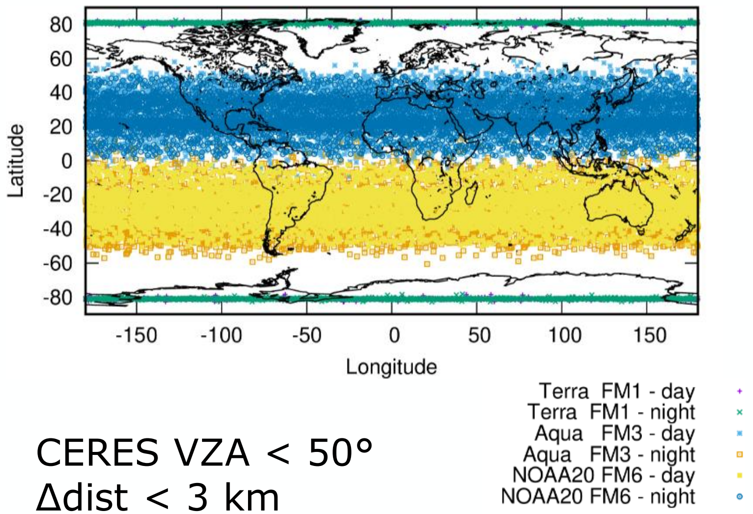






BMA-FLX (BA+) vs CERES SSF: LW Flux

10 August 2024 to 31 January 2026



CERES VZA < 50°
Δdist < 3 km
Δtime < 5 min

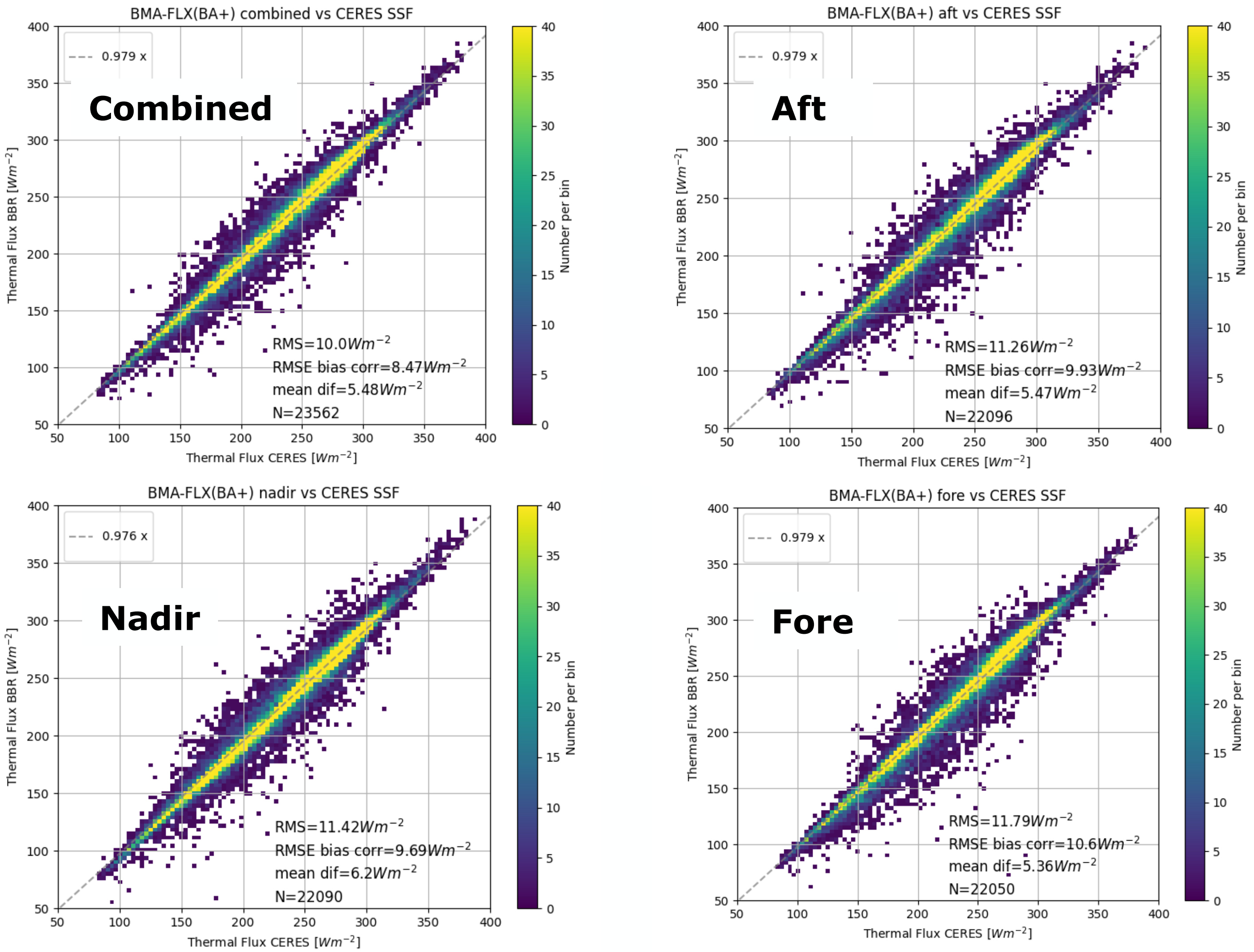
BMA_FLX SW flux vs CERES SSF:

Aft : BBR = 0.979 * CERES

Nadir: BBR = 0.976 * CERES

Fore : BBR = 0.979 * CERES

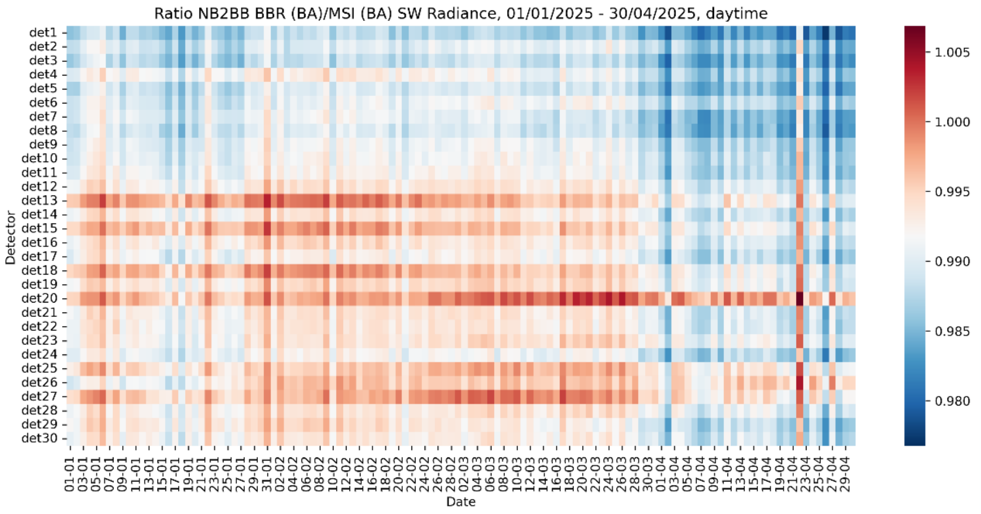
Combined: BBR = 0.979 * CERES



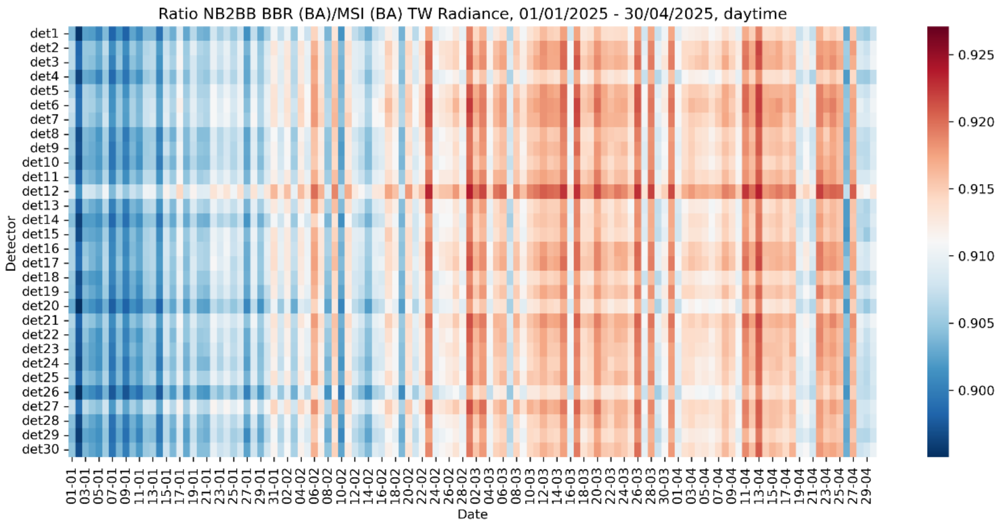
Outlook: NB2BB Product based on empirical regressions

Current status:

- NarrowBand-to-BroadBand (NB2BB) product that is calculated from MSI reflectances and radiances by using **theoretical regressions** derived from radiative transfer models.
- The derived NB2BB product is put into the BBR-grid.
- Ratios B-SNG/NB2BB calculated per detector (see graphs).



SW Daytime



TW Daytime

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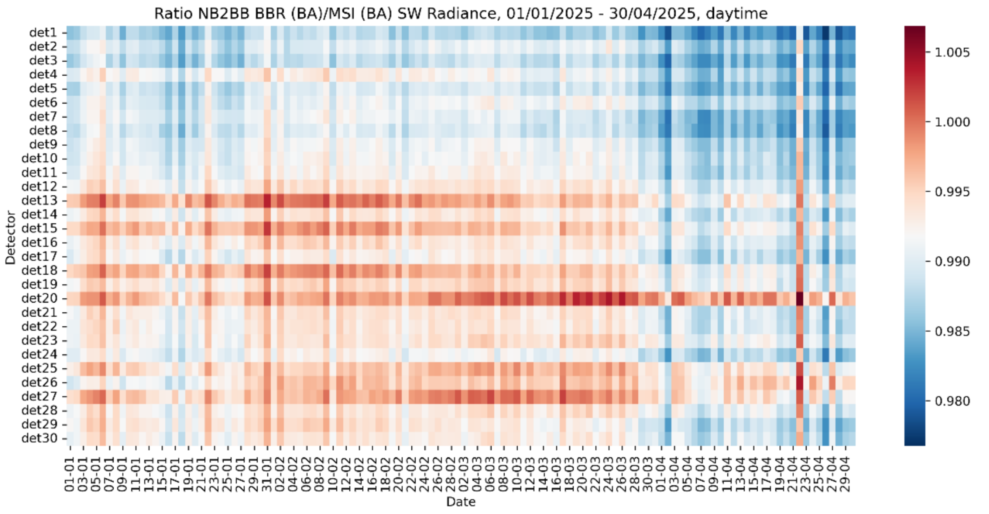
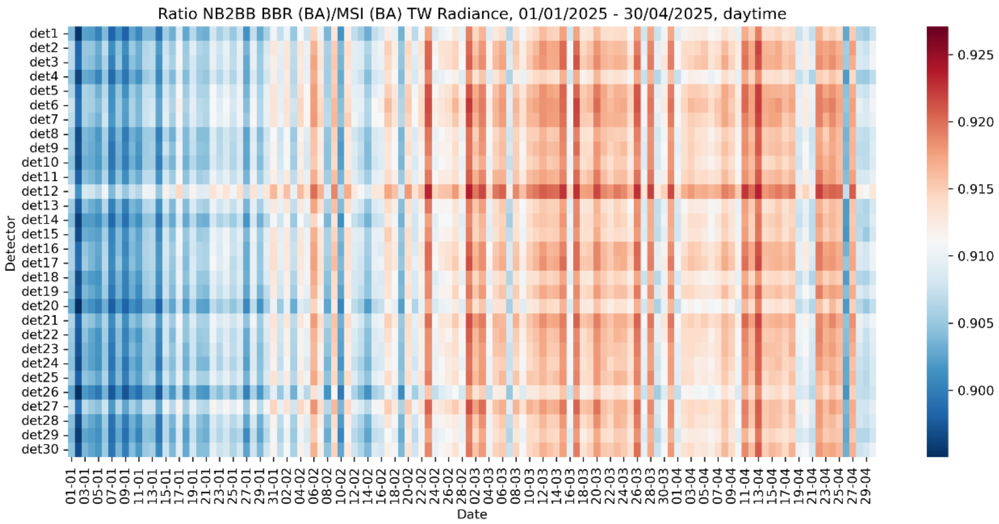
Outlook:

- Development of **empirical regressions**, since we have soon two years of data.
- Note: **All codes are available** to calculate a NB2BB product with empirical regressions thanks to the «exercise» with the theoretical regressions.



SW Daytime



TW Daytime

Outlook: Combination of BBR and Geo-Ring Data

- **Combination** of the **BBR** fluxes with the fluxes of five **geostationary satellites** (see below).
- **Objective:** Validation of the BBR and potential BBR-like flux calculation from GEO and MSI for gap filling purposes.

	Nominal Sat. Long.	Repeat cycle	Spat. Res.	n_sol	n_th	Remarks
MTG-I1/FCI	0°	10’	2/1km	8	8	Solar channels at 1km
MSG2/SEVIRI	45.5° E	**15’**	3km	3	8	High inclination orbit 15’ repeat cycle for MSG
Himawari-9	140.7°E	10’	2km	6	10	
GOES-18 (West)	137.2°W	10’	2km	6	10	
GOES-16/19 (East)	75.2°W	10’	2km	6	10	Switch G16->G19 on 07/04/25

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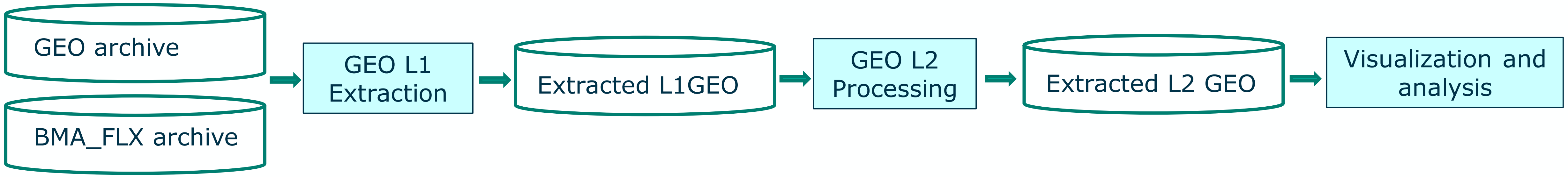
- **Method:**



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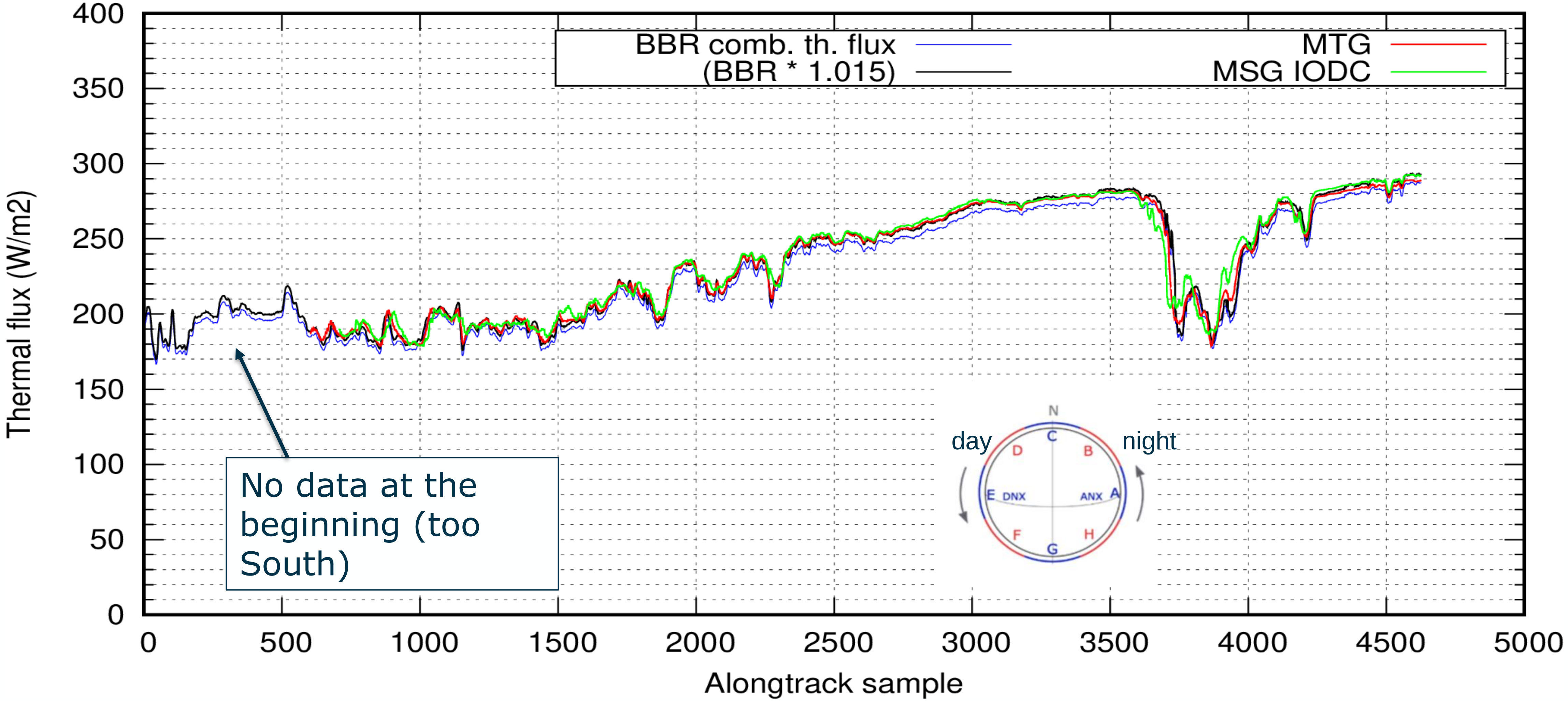
Outlook: Combining the BBR and Geo-Ring Data

Frame H, nighttime, 67.5° S – 22.5° S



Summary

- BBR instrument is stable and does not show (significant) ageing yet (after almost two years of measurements).
- The comparisons of the BBR Fluxes with CERES SSF products show a difference of roughly 2 - 3 % (BBR SW Flux 2% - 3% higher and BBR LW Flux 2% lower than CERES).
- Stable Earth targets like the deep convective clouds are a good tool to observe the stability of the instrument.
- Narrowband-to-broadband product is a helpful tool to check for ageing, and might also be useful to fill the data gaps (since end of November 2025) of the BBR.
- Geo-Ring analysis potentially helpful for gap-filling as well as validation purposes.

Thank you !