Using CERES GEOscan mode measurements to place instruments on same radiometric scale

Dave Doelling, Norman Loeb, **Kyle Itterly**, Janet Daniels, Conor Haney, Susan Thomas, Denise Cooper, Bijoy Thampi, Arun Gopalan

14 May 2026, 10:00 EDT

44th CERES Science Team Meeting

Background

- The CERES instruments onboard the Terra, Aqua, SNPP and NOAA-20 satellites need to be inter-calibrated to provide a seamless and consistent TOA flux product using multiple overlapping CERES records
- This was achieved by using simultaneous nadir overpasses (SNO) between Aqua-CERES with Terra-CERES, SNPP-CERES, and NOAA20 CERES
- The Terra and Aqua orbits have started to drift towards the terminator, and both will be deorbited in 2027
- Aqua-CERES SNOs can no longer be used to tie multiple CERES instruments to the same radiometric scale
- The SNPP-CERES, NOAA-20-CERES, and the future NOAA-22-Libera sensors will be in the same 16-day repeat cycle orbit, but spaced 4 days apart; thus, preventing any coincident collocations or SNOs
- Inter-calibrate NOAA-20 and NPP using geostationary imagers as transfer radiometers as proxy for CERES and Libera broadband sensors

GEOscan methodology

- Inter-calibrate the N20 and NPP CERES instrument SW and LW radiances with angle and time matched GEO derived broadband radiances
  - Assume that the GEO calibration does not change in 4 days
  - Any residual angle matching, NB to BB biases will be similar for NPP and N20 dataset since the satellites are in the same orbit but spaced 4 days apart
- Perform narrowband to broadband (NB to BB) on GEO NB radiances using multilinear regression trained on NOAA20-CERES (in GEO scan mode to match the angles of the GEO)
  - Aggregated regression using all pairs
- Apply the N20 NB to BB coefficients to the GEO 4 days later to compare with NPP-CERES
- A daytime bright cloud Indonesian (Papua-Day), daytime clear-sky Libyan desert (Sahara-Day), and nighttime East Pacific (Peru-Night) stratus cloud sites have been selected
  - The sites have unique spectral signatures and provide temporally consistent scenes
- Analyzed May 2025 - January 2026 N20 vs. NPP GEOscans using the CERES-like footprint machine learning radiance (MLR) product
  - The official N20 SSF L2 Ed1C dataset has typical 1.5-month latency
  - The NPP SSF L2 Ed2 dataset in production is not in forward processing mode
  - Compared N20 SSF with MLR radiances and they are very close

Inter-calibration approach

- Inter-calibrate the CERES SW channel instrument pairs during the day
  - Daytime Saharan Desert
- Inter-calibrate the CERES TOTAL channel instrument pairs at night
  - Nighttime Peruvian Stratus
- Adjust the NPP spectral response functions gains with above factors and rerun machine learning radiances for closure of LW-Day (TOTAL-SW)
  - Compare over both Sahara Desert and Papua
  - Iterate NPP SRF gain adjustment as needed

2025 GEOscan schedule

	NOAA20			NPP		
1						
2	Date	DoY	Event	Date	DoY	Event
3				*4/21/25*	*111*	*Sahara test*
4	*5/5/25*	*125*	*Papua*	*5/9/25*	*129*	*Papua*
5	5/21/25	141	Papua	5/25/25	145	Papua
6	6/4/25	155	Sahara	6/8/25	159	Sahara
7	6/6/25	157	Papua	6/10/25	161	Papua
8	6/20/25	171	Sahara	6/24/25	175	Sahara
9	6/22/25	173	Papua	6/26/25	177	Papua
10	6/26/25	177	Night	6/30/25	181	Night
11	7/6/25	187	Sahara	7/10/25	191	Sahara
12	7/8/25	189	Papua	7/12/25	193	Papua
13	7/12/25	193	Night	7/16/25	197	Night
14	7/22/25	203	Sahara	7/26/25	207	Sahara
15	7/24/25	205	Papua	7/28/25	209	Papua
16	7/28/25	209	Night	8/1/25	213	Night
17	8/7/25	219	Sahara	8/11/25	223	Sahara
18	8/9/25	221	Papua	8/13/25	225	Papua
19	8/13/25	225	Night	8/17/25	229	Night
20	8/23/25	235	Sahara	8/27/25	239	Sahara
21	8/25/25	237	Papua	8/29/25	241	Papua
22	8/29/25	241	Night	9/2/25	245	Night

Notes

HIM9 started having problems on Oct 11, HIM8 thru Nov 17

HIM8 on Oct 12 at 04:00 GMT has bad scans for bands 8-16 onward

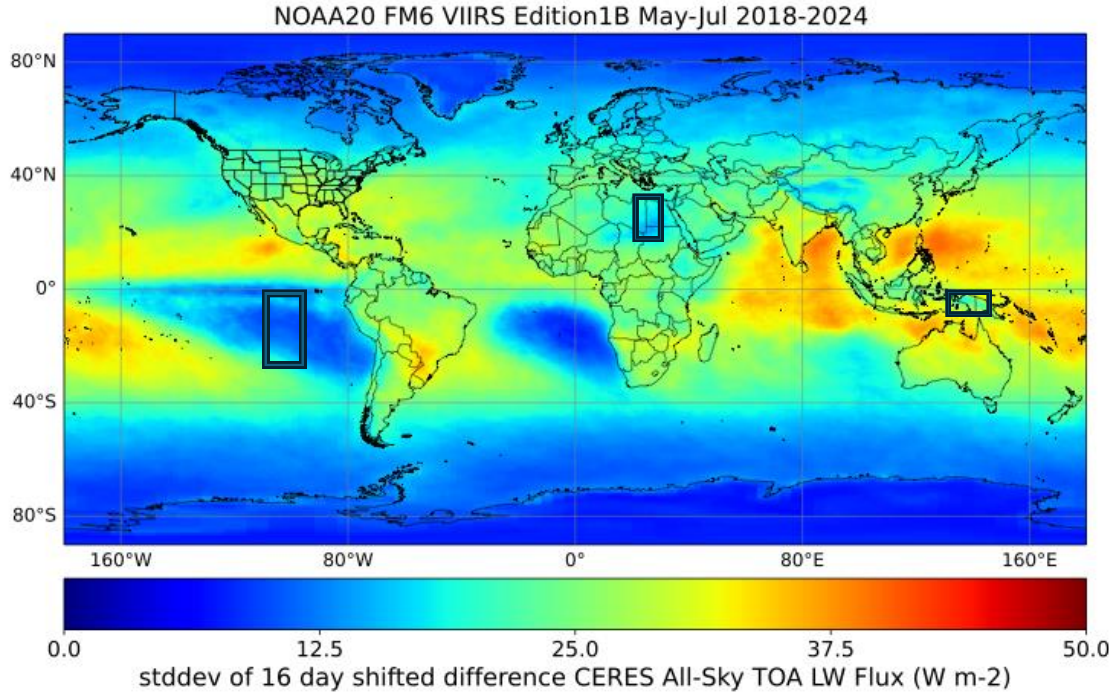
MET12 ~24-hour data gap starting late Sep 23

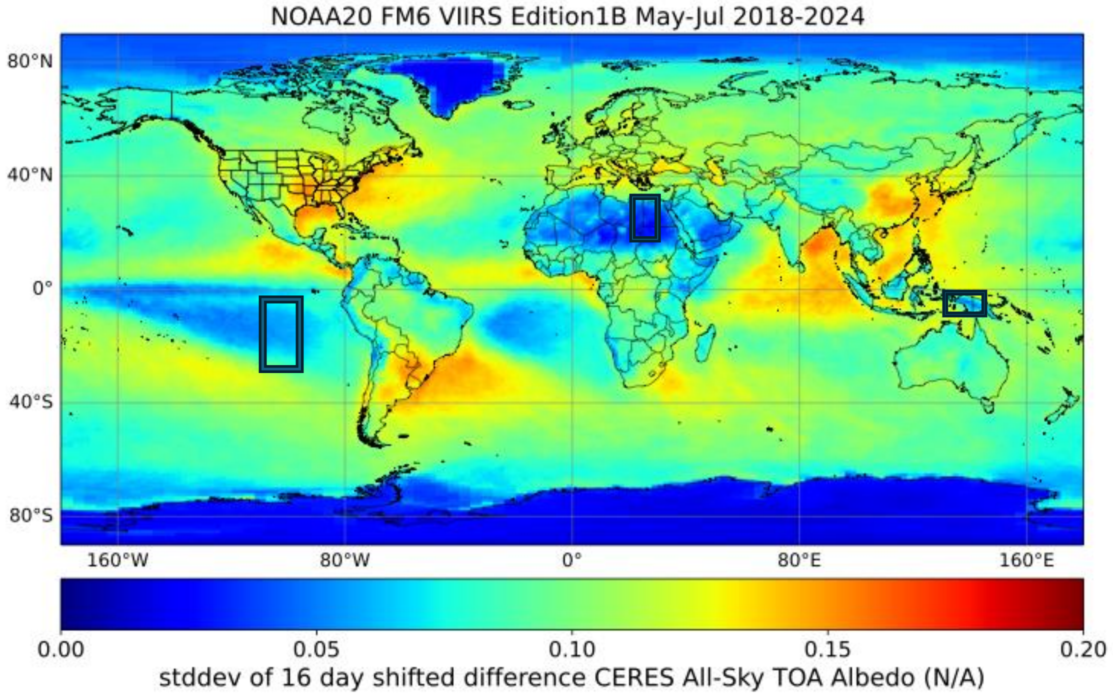
MET12 data gap on Oct 14

MET12 data gap on Jan 18

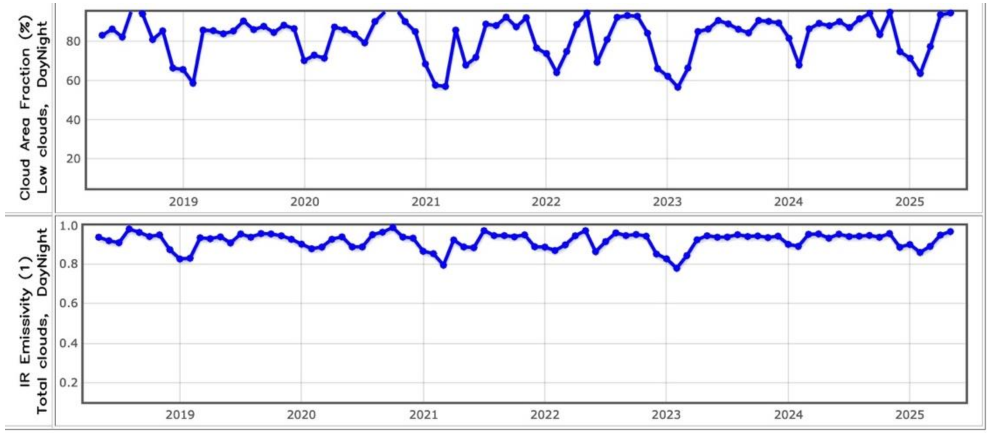
	NOAA20				NPP		
1							
2	Date	DoY	Event		Date	DoY	Event
3	9/8/25	251	Sahara		9/12/25	255	Sahara
4	9/10/25	253	Papua		9/14/25	257	Papua
5	9/14/25	257	Night		9/18/25	261	Night
~~6~~	~~9/24/25~~	~~267~~	~~Sahara~~		~~9/28/25~~	~~271~~	~~Sahara~~
7	9/26/25	269	Papua		9/30/25	273	Papua
8	9/30/25	273	Night		10/4/25	277	Night
~~9~~	~~10/10/25~~	~~283~~	~~Sahara~~		~~10/14/25~~	~~287~~	~~Sahara~~
~~10~~	~~10/12/25~~	~~285~~	~~Papua~~	HIM-8	~~10/16/25~~	~~289~~	~~Papua~~
11	10/16/25	289	Night		10/20/25	293	Night
12	10/26/25	299	Sahara		10/30/25	303	Sahara
~~13~~	~~10/28/25~~	~~301~~	~~Papua~~	HIM-8	~~11/1/25~~	~~305~~	~~Papua~~
14	11/1/25	305	Night		11/5/25	309	Night
15	11/11/25	315	Sahara		11/15/25	319	Sahara
~~16~~	~~11/13/25~~	~~317~~	~~Papua~~	HIM-8	~~11/17/25~~	~~321~~	~~Papua~~
17	11/17/25	321	Night		11/21/25	325	Night
18	11/27/25	331	Sahara		12/1/25	335	Sahara
19	11/29/25	333	Papua		12/3/25	337	Papua
20	12/3/25	337	Night		12/7/25	341	Night
21	12/13/25	347	Sahara		12/17/25	351	Sahara
22	12/15/25	349	Papua		12/19/25	353	Papua
23	12/19/25	353	Night		12/23/25	357	Night
24	12/29/25	363	Sahara		1/2/26	367	Sahara
25	12/31/25	365	Papua		1/4/26	369	Papua
46	1/4/26	369	Night		1/8/26	373	Night
~~47~~	~~1/14/26~~	~~379~~	~~Sahara~~		~~1/18/26~~	~~383~~	~~Sahara~~
48	1/16/26	381	Papua		1/20/26	385	Papua
49	1/20/26	385	Night		1/24/26	389	Night
50	1/30/26	395	Sahara		2/3/26	399	Sahara

Site Selection Process

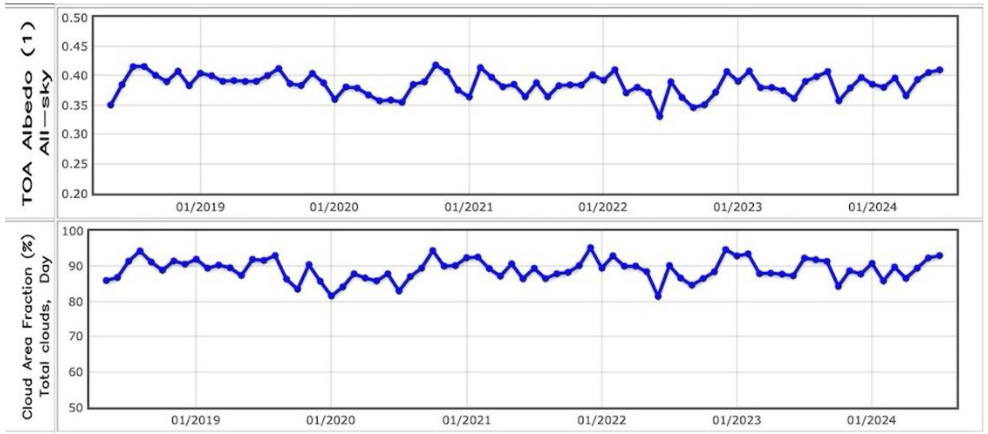




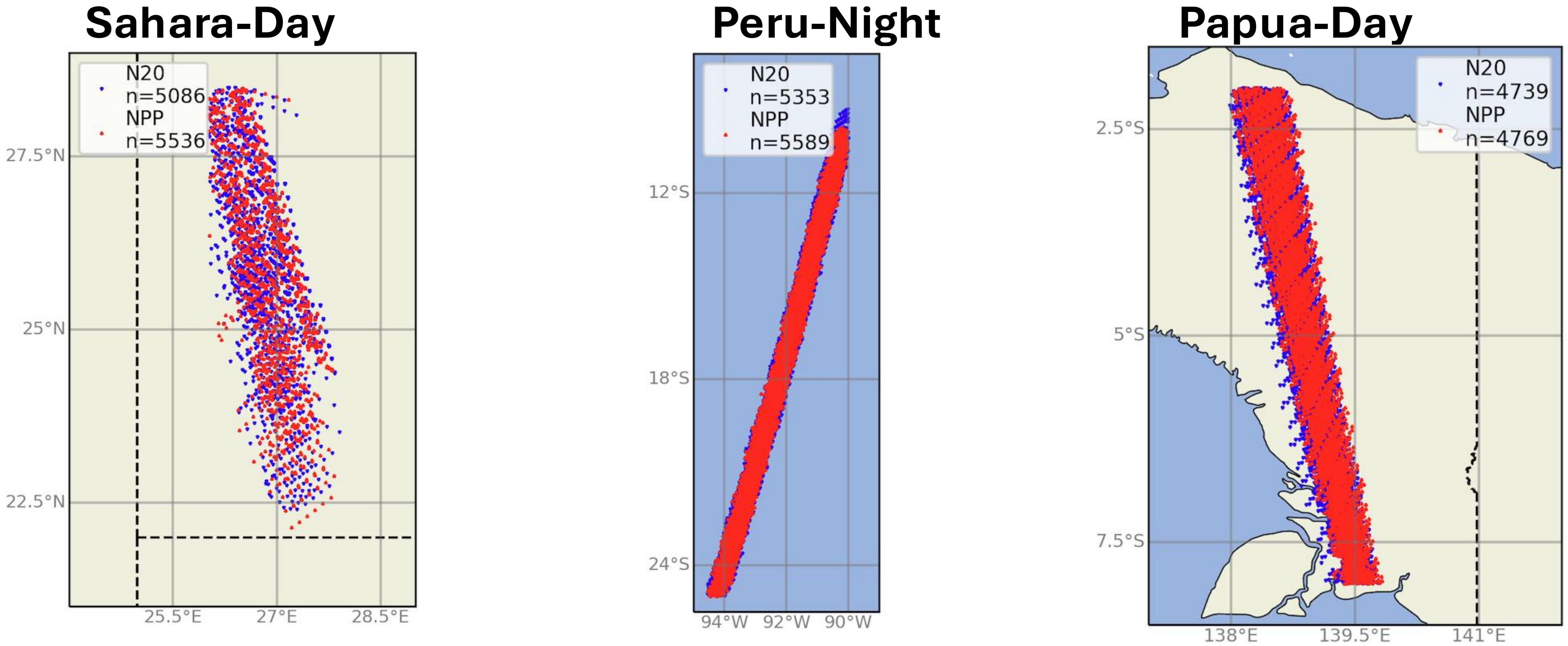
Peruvian Stratus, 15.5°S; 92.5°W



Papua-Day, 4.5°S; 139.5°W



Footprint Distribution of 2025 GEOscans



MET12 ch. > 5 (< 5) µm for LW (SW) NB to BB
KDTree with 0.5° radial search and >= 10 neighbors
Matched within 2.0° VZA and (5.0° scattering angle)
cos(sza) adjustment for SW

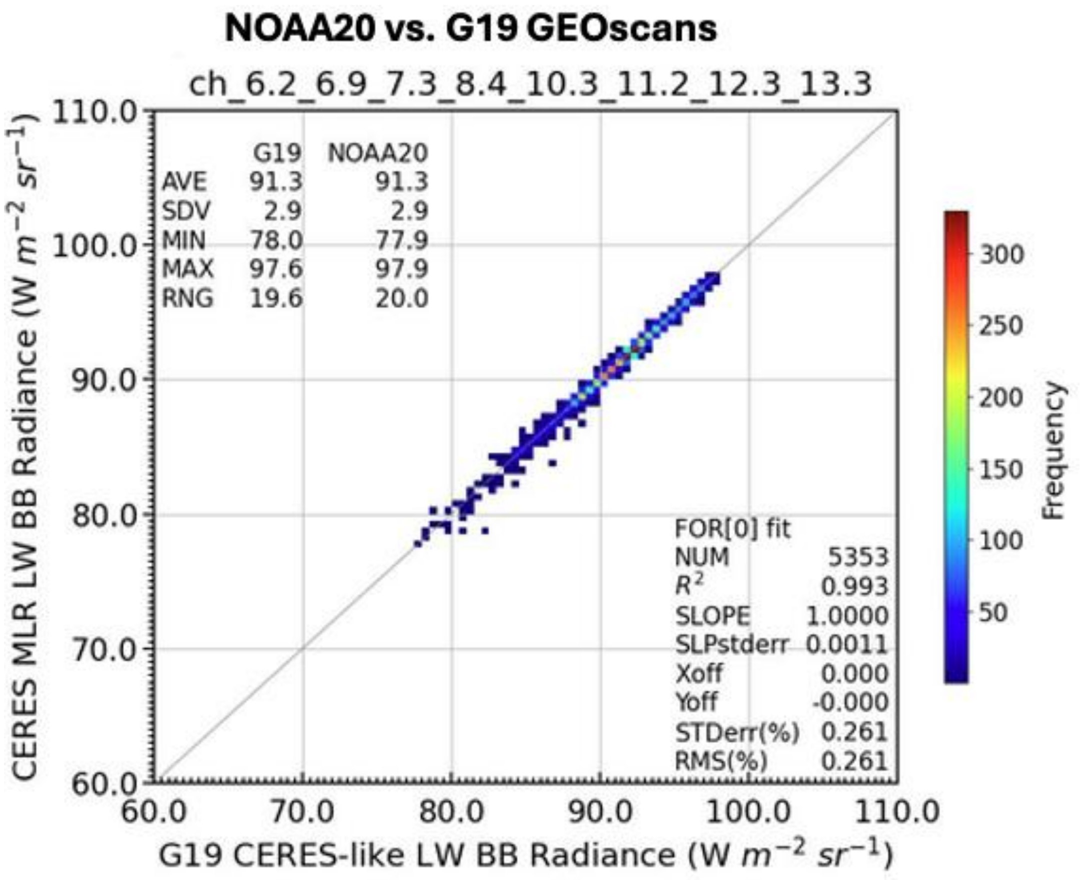
G19 ch. > 5 µm for LW NB to BB
KDTree with 0.25° radial search and >= 10 neighbors. Matched within 2.0° VZA
Cirrus filtering (10.4 - 12.3 BTD < 3 K)

As Sahara but using HIM-9

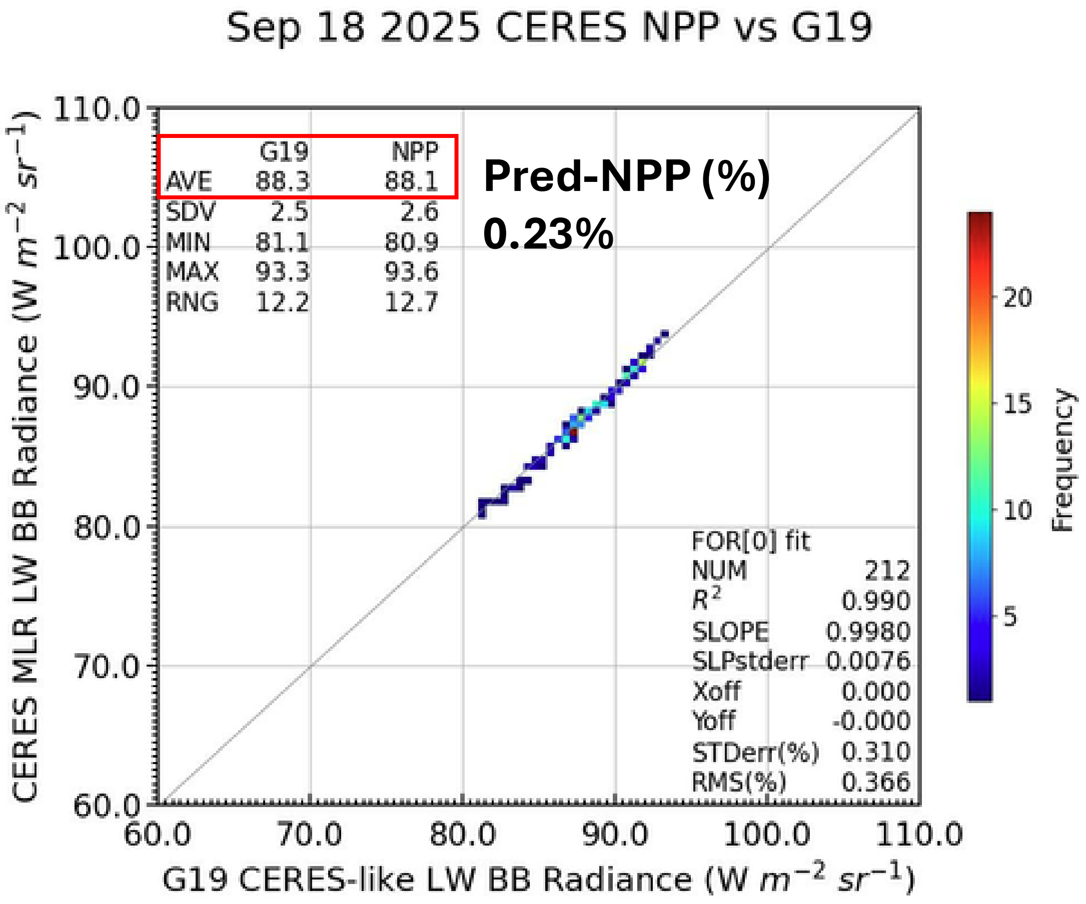
CERES NOAA-20 and NPP footprints angle-matched with GEO during GEOscan operations between 5 May 2025 – 24 January 2026

Peru-Night

GOES-19 NB to BB regression with N20 CERES MLR

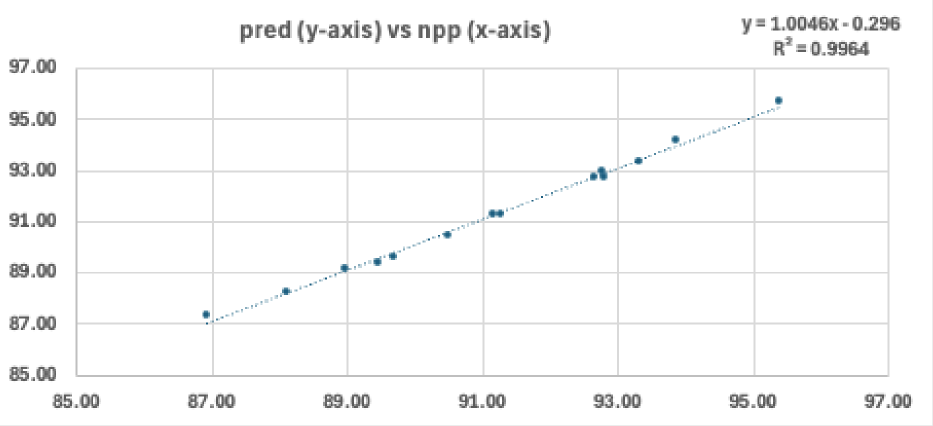


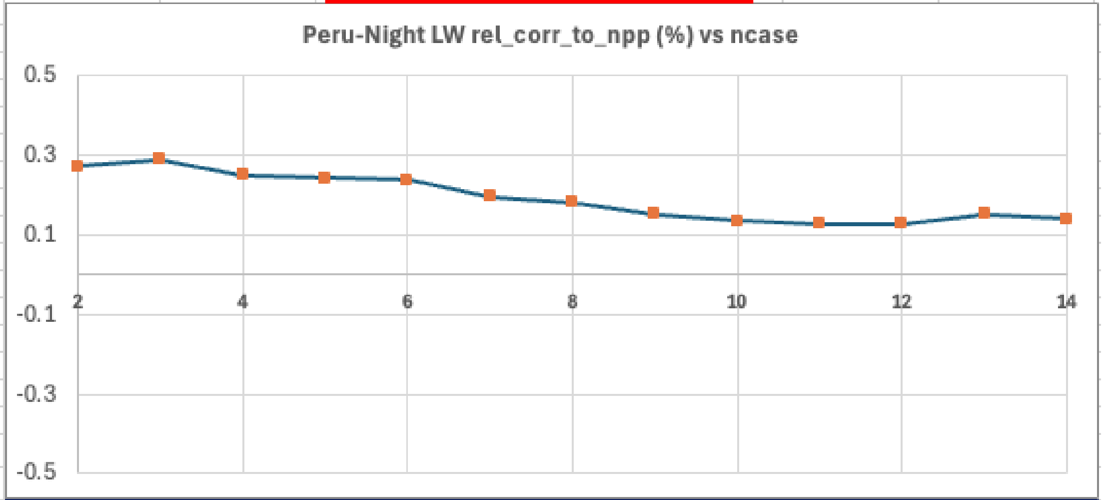
GOES-19 BB radiances using **N20** regression and compare with NPP CERES MLR



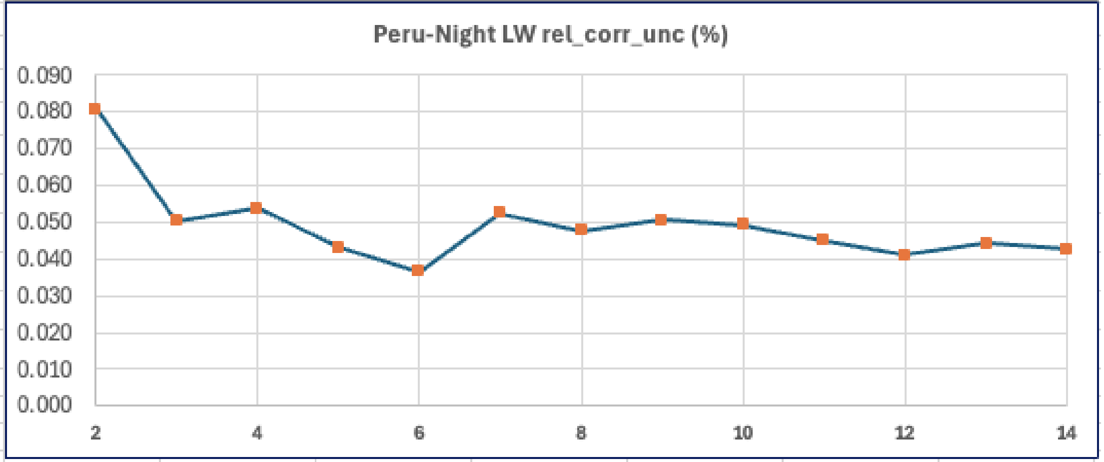
Use 8 GOES-19 IR channels to derive record multilinear regression coefficients with angle-matched NOAA-20 radiances for Nb2Bb, then apply to GOES-19 to predict NPP

N20 date (NPP +4 days)		npp (Wm-2sr-1)	pred (Wm-2sr-1)	pred-npp (Wm-2sr-1)	ncase	avg(npp) (Wm-2sr-1)	avg(pred) (Wm-2sr-1)	avg(pred-npp) (Wm-2sr-1)	sterr(pred-npp) (Wm-2sr-1)	rel_corr_to_npp (%)	rel_corr_unc (%)	npp corr fact	npp corr fact min	npp corr fact max
20250626	peruv	95.38	95.71	0.33										
20250712	peruv	92.78	92.96	0.18	2	94.08	94.33	0.26	0.08	0.271	0.081	1.0027	1.0019	1.0035
20250728	peruv	93.87	94.18	0.31	3	94.01	94.28	0.27	0.05	0.290	0.050	1.0029	1.0024	1.0034
20250813	peruv	92.65	92.78	0.12	4	93.67	93.90	0.24	0.05	0.251	0.054	1.0025	1.0020	1.0031
20250829	peruv	88.98	89.17	0.19	5	92.73	92.96	0.23	0.04	0.244	0.043	1.0024	1.0020	1.0029
20250914	peruv	88.10	88.27	0.18	6	91.96	92.18	0.22	0.03	0.237	0.037	1.0024	1.0020	1.0027
20250930	peruv	89.47	89.41	-0.05	7	91.60	91.78	0.18	0.05	0.196	0.052	1.0020	1.0014	1.0025
20251016	peruv	93.30	93.37	0.07	8	91.82	91.98	0.17	0.04	0.180	0.048	1.0018	1.0013	1.0023
20251101	peruv	90.49	90.43	-0.06	9	91.67	91.81	0.14	0.05	0.153	0.051	1.0015	1.0010	1.0020
20251117	peruv	89.70	89.66	-0.04	10	91.47	91.59	0.12	0.05	0.134	0.049	1.0013	1.0008	1.0018
20251203	peruv	91.27	91.33	0.06	11	91.45	91.57	0.12	0.04	0.128	0.045	1.0013	1.0008	1.0017
20251219	peruv	91.16	91.28	0.13	12	91.43	91.55	0.12	0.04	0.129	0.041	1.0013	1.0009	1.0017
20260104	peruv	86.94	87.32	0.39	13	91.08	91.22	0.14	0.04	0.152	0.044	1.0015	1.0011	1.0020
20260120	peruv	92.80	92.78	-0.02	14	91.21	91.33	0.13	0.04	0.139	0.043	1.0014	1.0010	1.0018





Notes:
Used all channels for NB2BB and cirrus filtering (< 3 K 10.4 - 12.3 BTD)
Aggregated N20 regression applied thru first 10 pairs
Used KDTree with 0.25-deg radial search and >= 10 neighbors to spatially filter footprints
No homogeneity factor
<= 2.0 deg dVZA



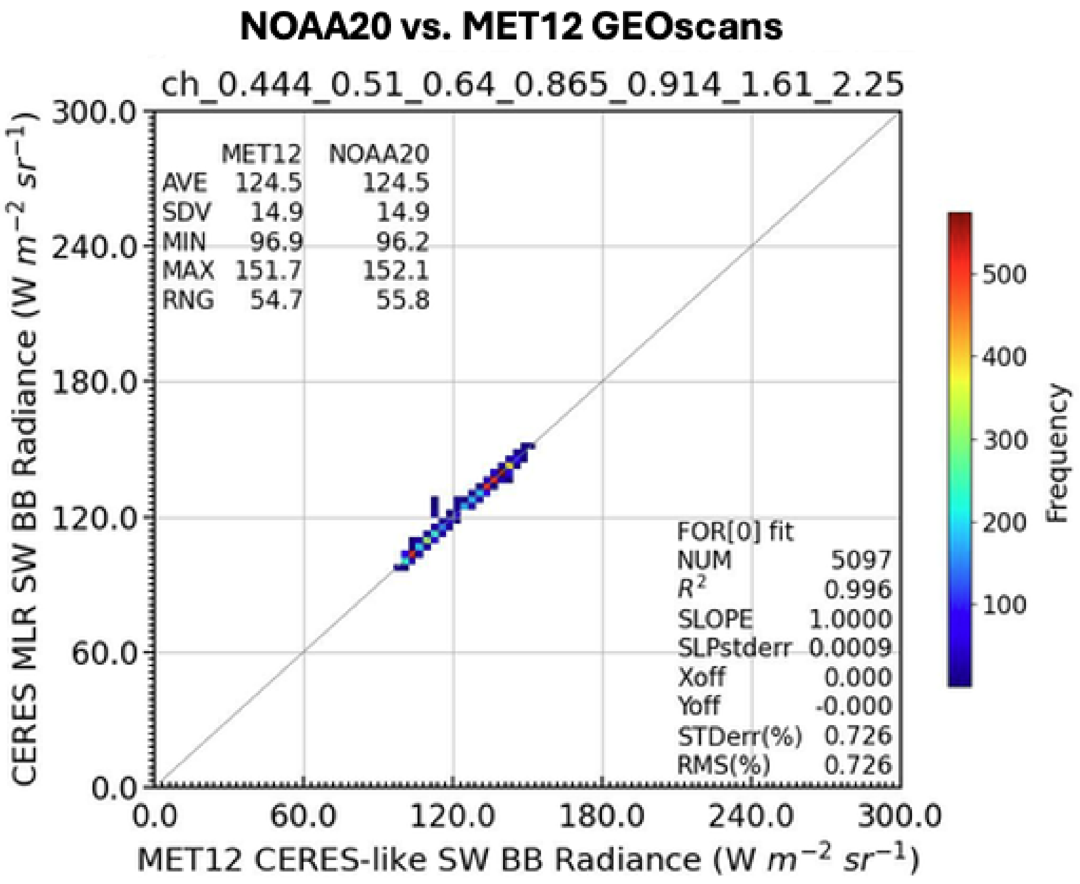
Linear Stats

slope	1.0046	-0.2960	**yint**
se_slope	0.0175	1.5987	**se_b**
rsq	0.9964	0.1514	**se_y**
F stat	3286.8778	12.0000	**dof**
sum of square	75.3428	0.2751	**residual sum of squares**

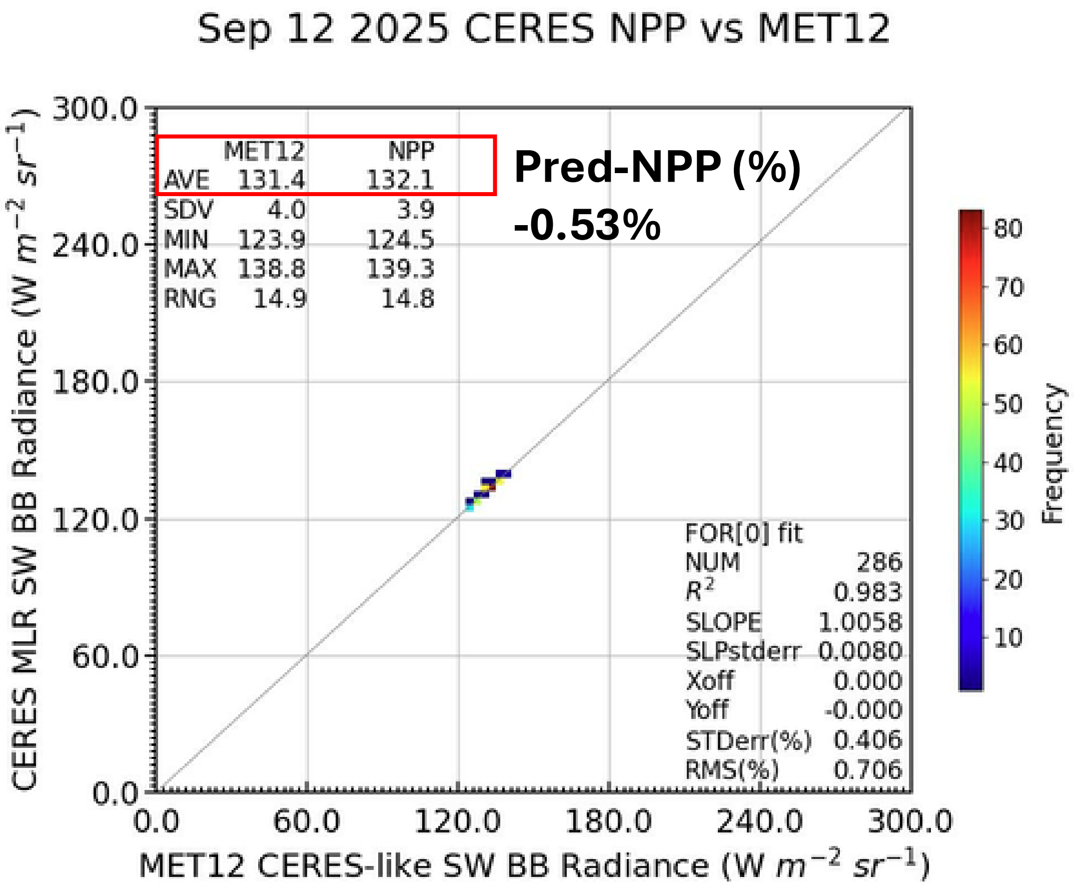
Peru-Night-Total

Sahara-Day

MET12 NB to BB regression with N20 CERES MLR

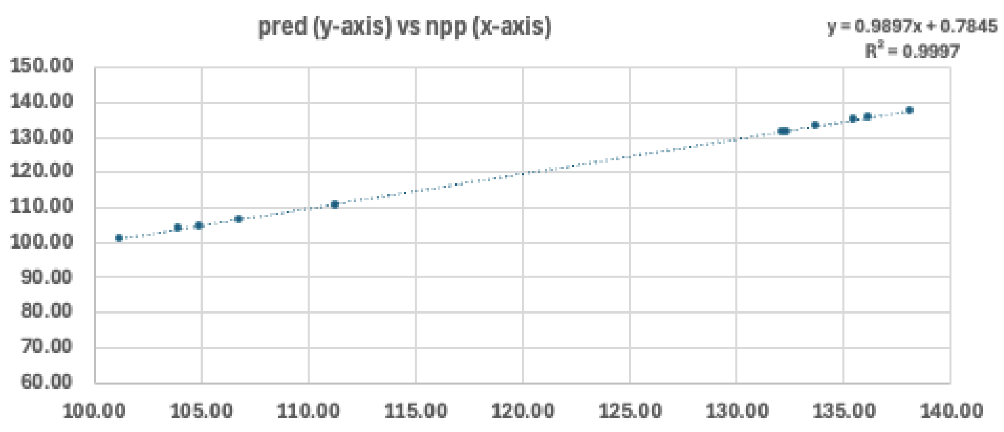


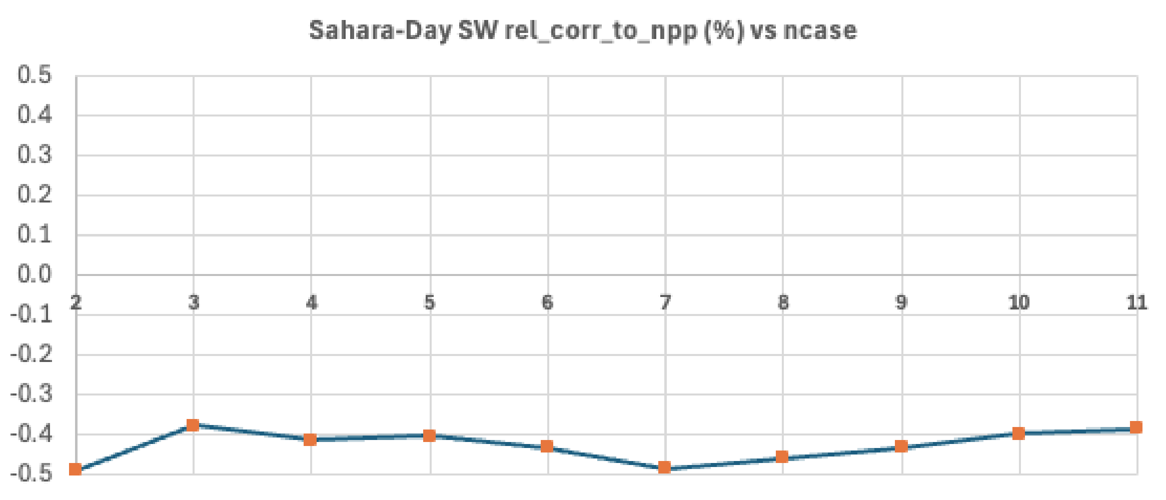
MET12 BB radiances using **N20** regression and compare with NPP CERES MLR

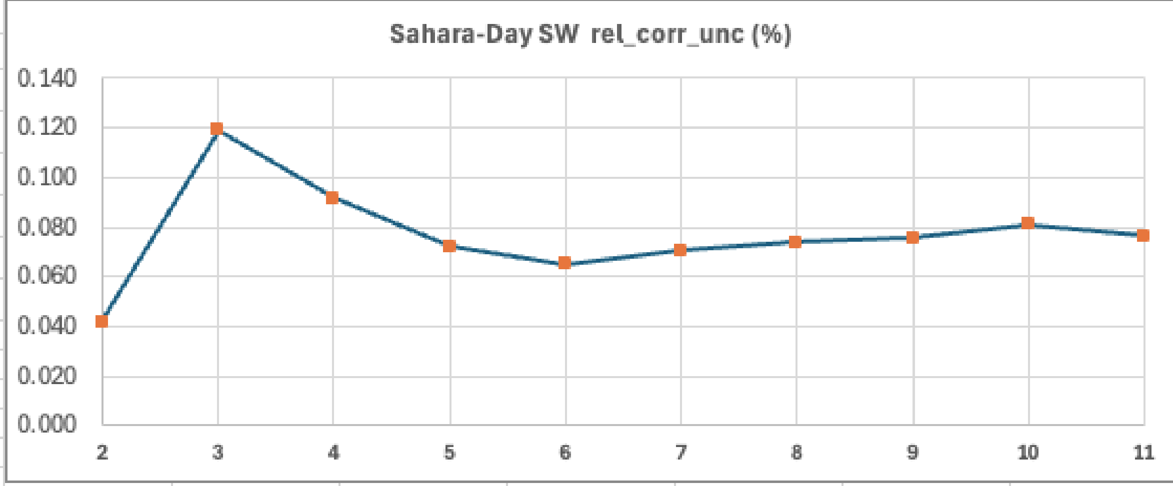


Use 7 MET12 VIS channels to derive record multilinear regression coefficients with angle-matched NOAA-20 radiances for Nb2Bb, then apply to MET12 to predict NPP

N20 date (NPP +4 days)		npp (Wm-2sr-1)	pred (Wm-2sr-1)	pred-npp (Wm-2sr-1)	ncase	avg(npp) (Wm-2sr-1)	avg(pred) (Wm-2sr-1)	avg(pred-npp) (Wm-2sr-1)	sterr(pred-npp) (Wm-2sr-1)	rel_corr_to_npp (%)	rel_corr_unc (%)	npp corr fact	npp corr fact min	npp corr fact max
20250604	sahara	138.09	137.48	-0.615750399	1									
20250620	sahara	136.15	135.42	-0.730211841	2	137.12	136.45	-0.67	0.06	-0.491	0.042	0.9951	0.9947	0.9955
20250722	sahara	135.42	135.22	-0.194418821	3	136.55	136.04	-0.51	0.16	-0.376	0.119	0.9962	0.9950	0.9974
20250807	sahara	132.28	131.57	-0.700434828	4	135.48	134.92	-0.56	0.12	-0.413	0.092	0.9959	0.9949	0.9968
20250823	sahara	133.67	133.19	-0.484346867	5	135.12	134.58	-0.55	0.10	-0.403	0.072	0.9960	0.9952	0.9967
20250908	sahara	132.13	131.37	-0.763590592	6	134.62	134.04	-0.58	0.09	-0.432	0.065	0.9957	0.9950	0.9963
20251026	sahara	111.33	110.36	-0.972298929	7	131.30	130.66	-0.64	0.09	-0.485	0.071	0.9951	0.9944	0.9959
20251111	sahara	106.82	106.58	-0.234226363	8	128.24	127.65	-0.59	0.09	-0.458	0.074	0.9954	0.9947	0.9962
20251127	sahara	103.98	103.79	-0.183732593	9	125.54	125.00	-0.54	0.09	-0.432	0.076	0.9957	0.9949	0.9964
20251213	sahara	101.24	101.23	-0.01600638	10	123.11	122.62	-0.49	0.10	-0.398	0.081	0.9960	0.9952	0.9968
20251229	sahara	104.97	104.72	-0.246506663	11	121.46	120.99	-0.47	0.09	-0.385	0.077	0.9962	0.9954	0.9969







Used all ch for NB2BB (no 1.38 for Sahara), Aggregated N20 regression applied to Pred
Used KDTree with 0.5-deg radial search and >= 10 neighbors to spatially filter footprints
No homogeneity factor
<= 2.0 deg dVZA, <=5.0 deg dscatAng, cos(SZA) adjustment

Sahara Day SW

	Linear Stats		
slope	0.9897	0.7845	yint
se_slope	0.0057	0.7000	se_b
rsq	0.9997	0.2786	se_y
F stat	29924.5078	9.0000	dof
sum of square	2322.0322	0.6984	residual sum of squares

NOAA-20 □ SNPP Difference Using GEO as Transfer Radiometer (Before Adjustment to SNPP; updated through Jan. 24, 2026)

Channel	Location & Scene Type	Number of GEOscan Pairs	Rel Diff (%)	Rel Std Error (%)	Total Error (%)
SW	Saharan Desert	11	-0.39	0.08	-0.39
TOT (Night)	Peruvian Stratus	14	0.14	0.04	0.14
LW (Day)	Indonesian Convection	14	1.46	0.17	1.46
LW (Day)	Saharan Desert	12	0.36	0.09	0.36

NOAA-20 □ SNPP Difference Using GEO as Transfer Radiometer (After Adjustment to SNPP; updated through Jan. 24, 2026)

Channel	Location & Scene Type	Number of GEOscan Pairs	Rel Diff (%)	Rel Std Error (%)	Total Error (%)
SW	Sahara-Day	11	0.0	0.07	0.0
TOT (Night)	Peru-Night	14	0.0	0.04	0.0
LW (Day)	**Papua-Day**	**14**	**0.49**	**0.16**	**0.49**
LW (Day)	**Sahara-Day**	**12**	**-0.45**	**0.07**	**-0.45**

Both Daytime LW regions are inter-calibrated within 0.5% after NPP SRF adjustment

Takeaways

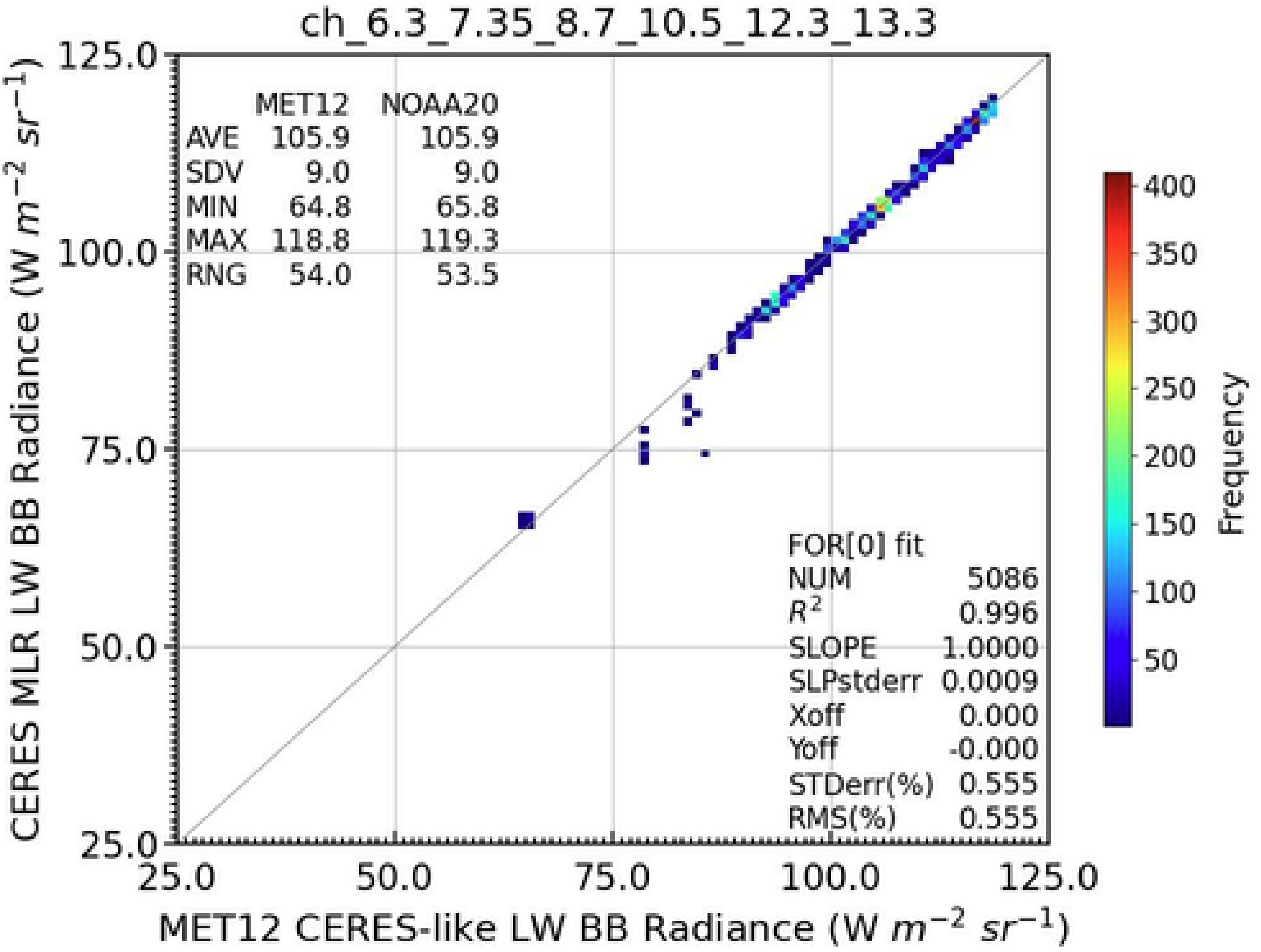
- The GEO scan methodology can inter-calibrate CERES pairs that are placed in the same orbit when no coincident observations are available
- The GEO scan analysis reveals a -0.39% NOAA20 minus NPP SW channel bias with an uncertainty of 0.08% (11 pairs)
- The GEO scan analysis reveals a 0.14% NOAA20 minus NPP total channel bias with an uncertainty of 0.04% (14 pairs)
- Adjusting the NPP SRF by the SW and TOTAL factors from above improves Daytime LW inter-calibration over an independent region
    - NPP and NOAA-20 daytime LW agree to within 0.5% after GEOscan-derived NPP SRF adjustment
    - Additional iterations of SRF adjustment within uncertainty ranges
    - Additional independent sites to test closure (clear-sky ocean)
- The future NOAA-22 Libera broadband instrument can be intercalibrated with the NOAA-20 CERES instrument using GEO scan
    - Methodology has potential for further optimization
        - e.g., better scene type filtering, rolling windows of aggregated NOAA-20 regressions

Backup Slides

Sahara-Day LW

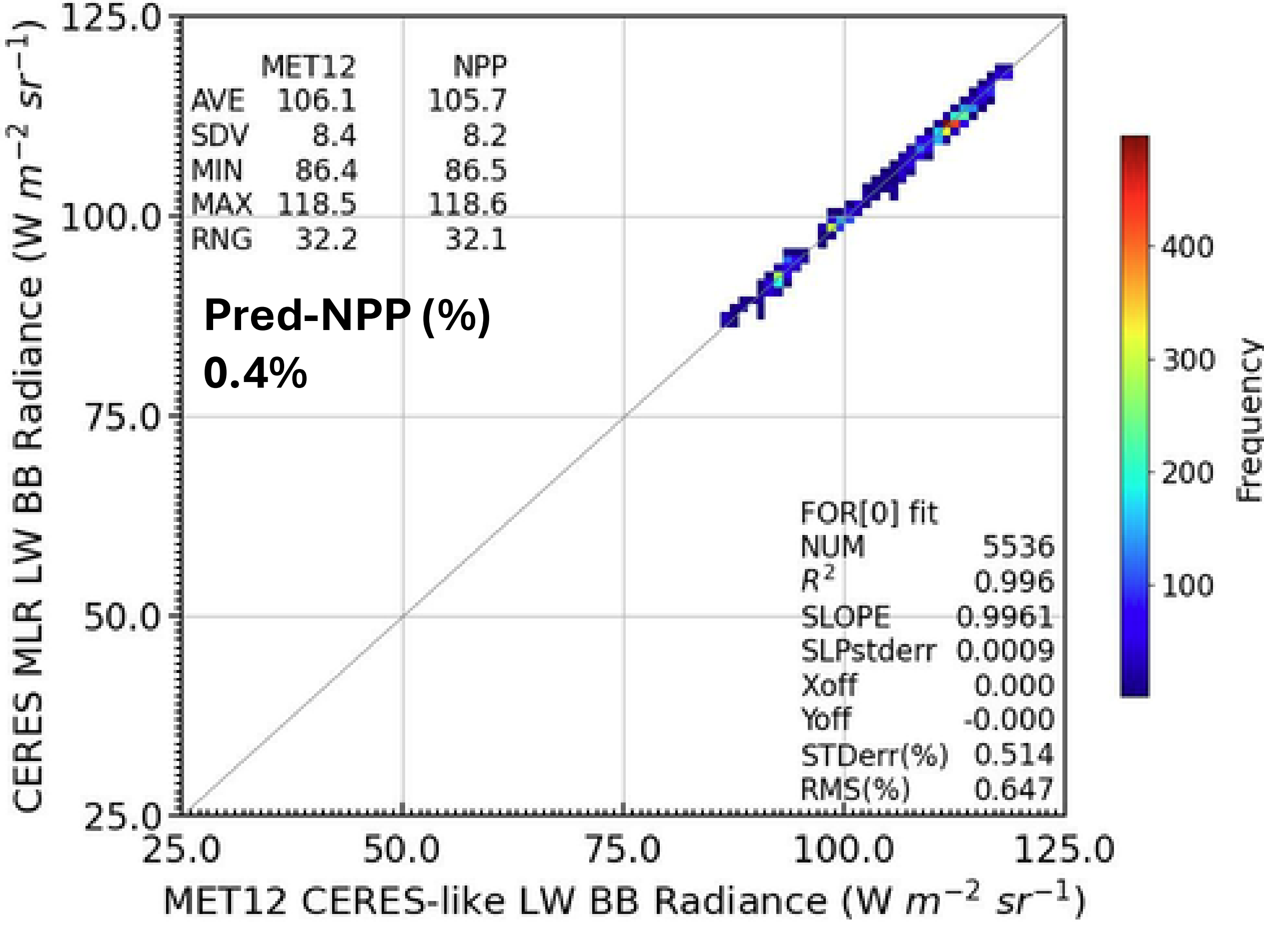
MET12 NB to BB regression with N20 CERES MLR

NOAA20 vs. MET12 GEOscans



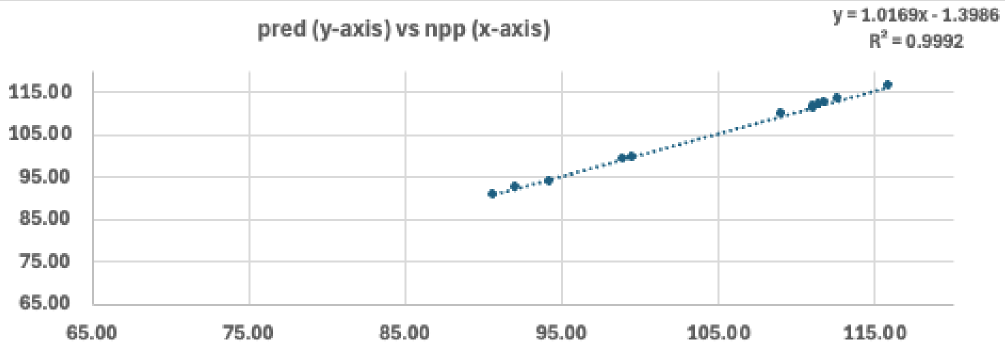
MET12 BB radiances using **N20** regression and compare with NPP CERES MLR

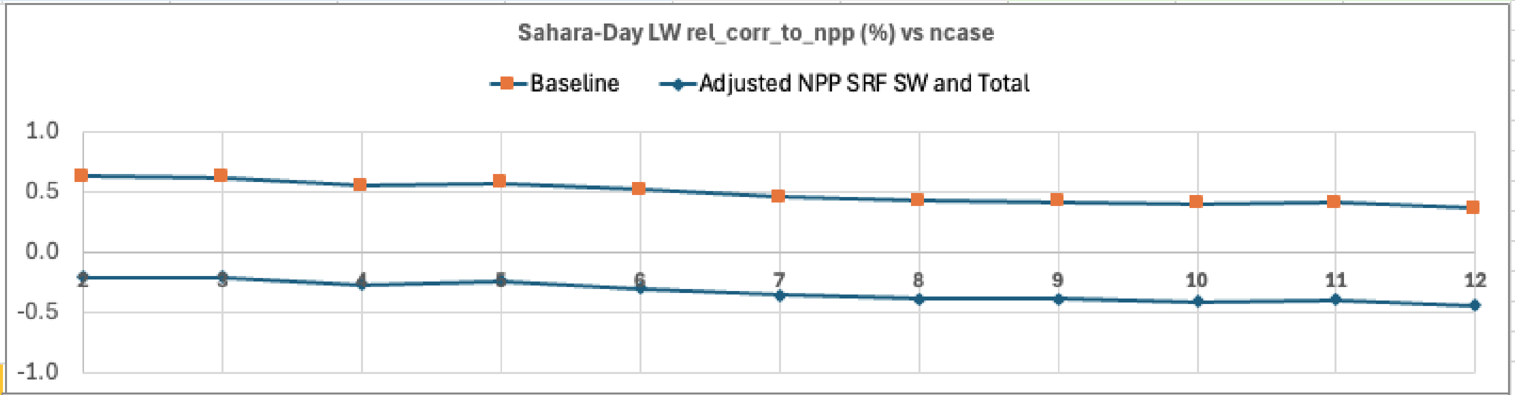
NPP vs. MET12 GEOscans

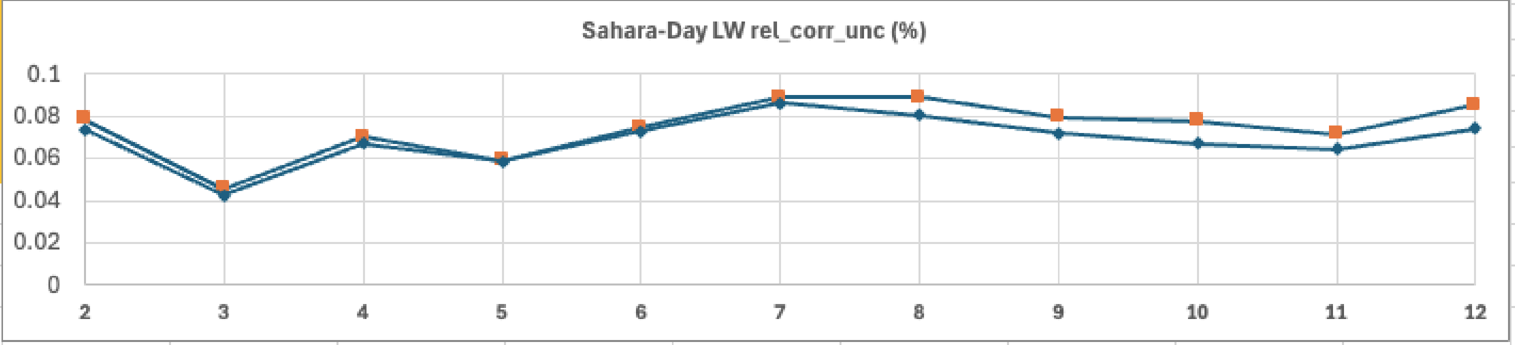


Sahara-Day LW

N20 Date (NPP +4 days)		npp (Wm-2sr-1)	pred (Wm-2sr-1)	pred-npp (Wm-2sr-1)	ncase	avg(npp) (Wm-2sr-1)	avg(pred) (Wm-2sr-1)	avg(pred-npp) (Wm-2sr-1)	sterr(pred-npp) (Wm-2sr-1)	rel_corr_to_npp (%)	rel_corr_unc (%)	npp corr fact	npp corr fact min	npp corr fact max
20250604	Sahara	111.48	112.27	0.78										
20250620	Sahara	111.81	112.42	0.61	2	111.65	112.34	0.70	0.09	0.623	0.079	1.00623	1.00545	1.00702
20250706	Sahara	112.73	113.40	0.68	3	112.01	112.70	0.69	0.05	0.616	0.046	1.00616	1.00570	1.00661
20250722	Sahara	115.94	116.35	0.41	4	112.99	113.61	0.62	0.08	0.548	0.070	1.00548	1.00478	1.00618
20250807	Sahara	109.07	109.81	0.74	5	112.21	112.85	0.64	0.07	0.574	0.059	1.00574	1.00515	1.00633
20250823	Sahara	111.14	111.40	0.26	6	112.03	112.61	0.58	0.08	0.517	0.075	1.00517	1.00443	1.00592
20250908	Sahara	111.13	111.22	0.09	7	111.90	112.41	0.51	0.10	0.456	0.089	1.00456	1.00367	1.00544
20251026	Sahara	99.52	99.66	0.14	8	110.35	110.82	0.46	0.10	0.420	0.089	1.00420	1.00331	1.00508
20251111	Sahara	98.94	99.34	0.40	9	109.08	109.54	0.46	0.09	0.418	0.079	1.00418	1.00339	1.00498
20251127	Sahara	90.73	90.88	0.15	10	107.25	107.67	0.43	0.08	0.397	0.078	1.00397	1.00319	1.00474
20251213	Sahara	92.09	92.59	0.50	11	105.87	106.30	0.43	0.08	0.408	0.072	1.00408	1.00337	1.00480
20251229	Sahara	94.24	93.99	-0.25	12	104.90	105.28	0.38	0.09	0.358	0.085	1.00358	1.00273	1.00443







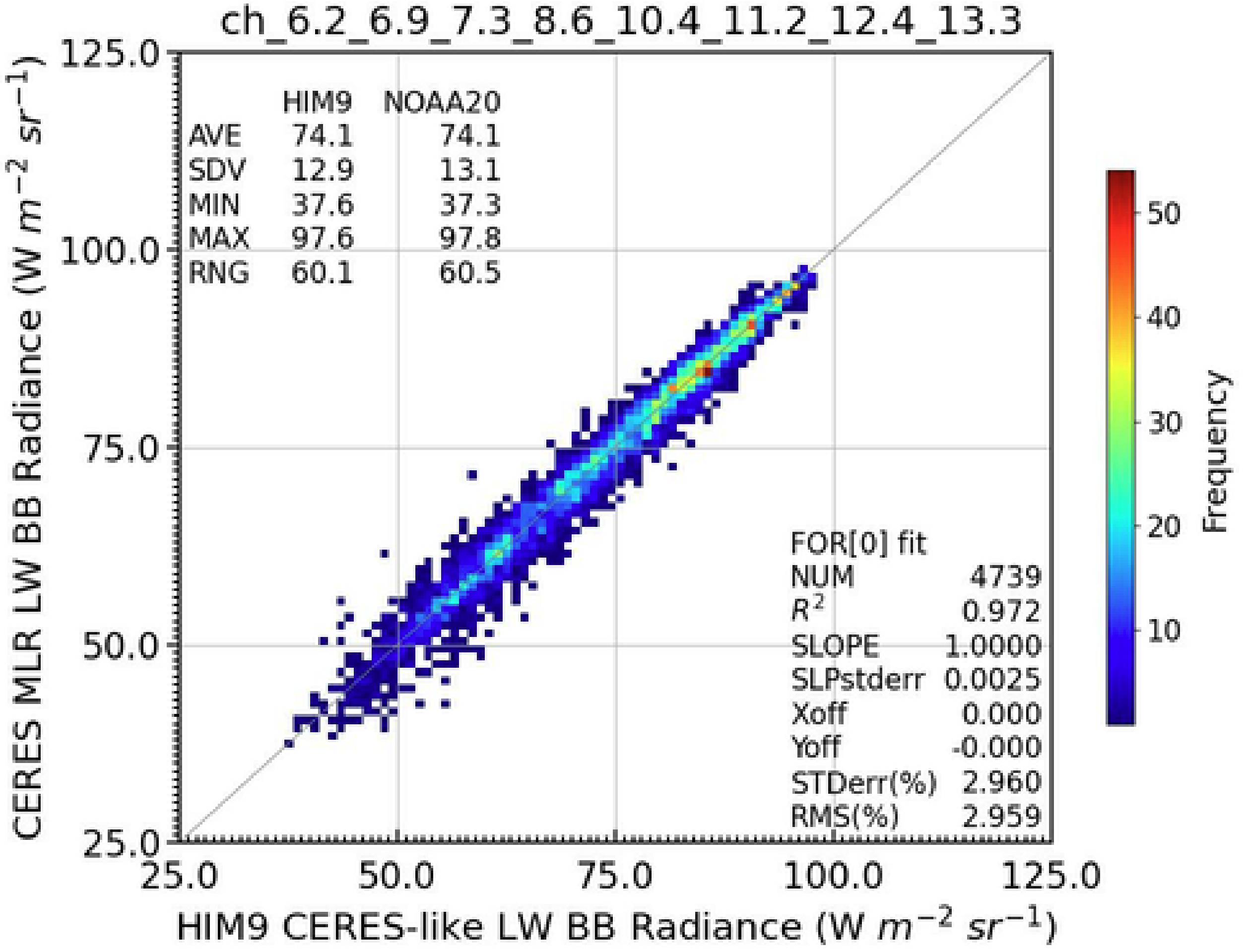
Notes:
Used all channels > 5 microns for NB2BB
Used KDTree with 0.5-deg radial search and >= 10 neighbors to spatially filter footprints
No homogeneity factor
<= 2.0 deg dVZA
Aggregated N20 regression applied

	Linear Stats		
slope	1.0169	-1.3986	yint
se_slope	0.0093	0.9830	se_b
rsq	0.9992	0.2821	se_y
F stat	11857.2818	10.0000	dof
sum of squar	943.4651	0.7957	residual sum of squares

Papua-Day LW

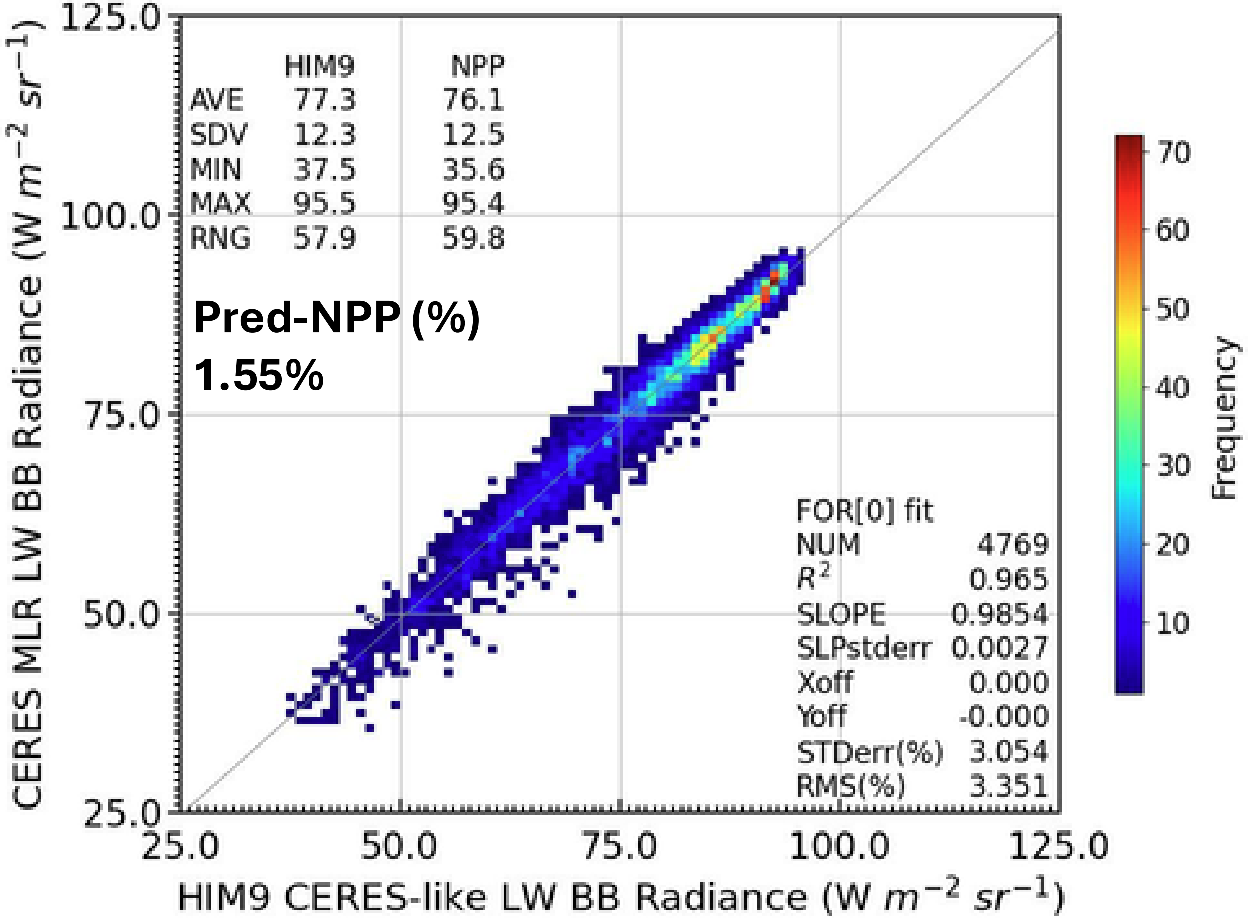
MET12 NB to BB regression with N20 CERES MLR

NOAA20 vs HIM9 GEOscans



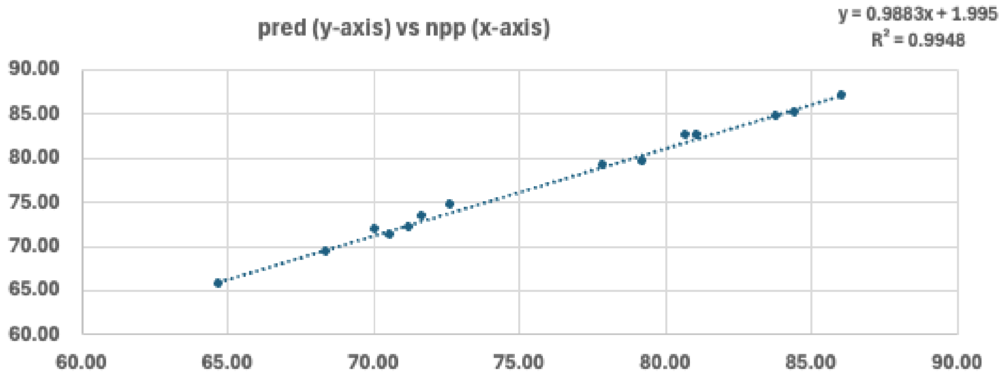
MET12 BB radiances using **N20** regression and compare with NPP CERES MLR

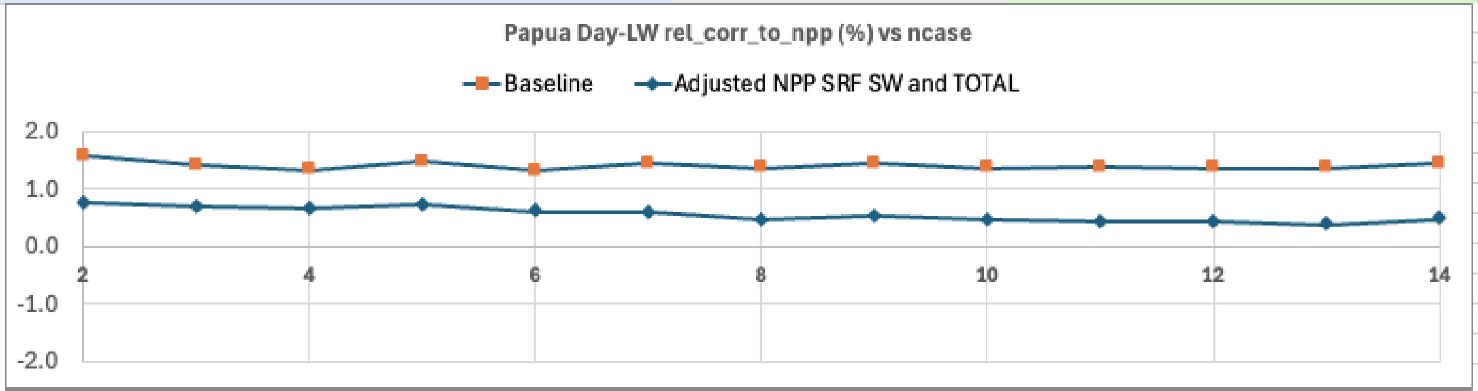
NPP vs. HIM9 GEOscans

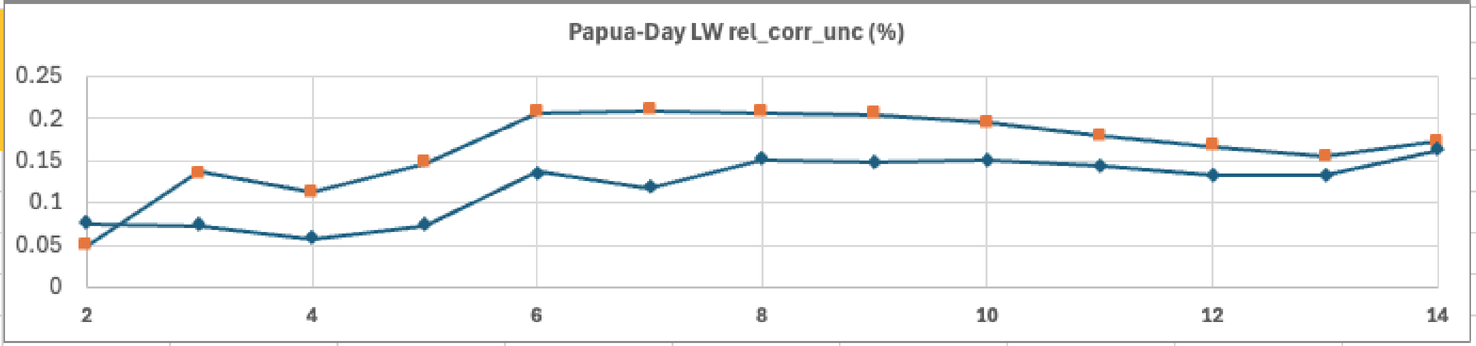


Papua-Day LW

N20 Date (NPP +4 days)		npp (Wm-2sr-1)	pred (Wm-2sr-1)	pred-npp (Wm-2sr-1)	ncase	avg(npp) (Wm-2sr-1)	avg(pred) (Wm-2sr-1)	avg(pred-npp) (Wm-2sr-1)	sterr(pred-npp) (Wm-2sr-1)	rel_corr_to_npp (%)	rel_corr_unc (%)	npp corr fact	npp corr fact min	npp corr fact max
20250505	Indonesia	81.12	82.40	1.28										
20250521	Indonesia	77.87	79.08	1.21	2	79.49	80.74	1.25	0.04	1.567	0.048	1.01567	1.01520	1.01615
20250606	Indonesia	83.81	84.74	0.92	3	80.93	82.07	1.14	0.11	1.406	0.136	1.01406	1.01270	1.01542
20250622	Indonesia	86.08	87.02	0.94	4	82.22	83.31	1.09	0.09	1.324	0.112	1.01324	1.01212	1.01436
20250708	Indonesia	71.72	73.28	1.56	5	80.12	81.30	1.18	0.12	1.476	0.147	1.01476	1.01329	1.01623
20250724	Indonesia	79.23	79.61	0.38	6	79.97	81.02	1.05	0.17	1.310	0.207	1.01310	1.01104	1.01517
20250809	Indonesia	70.08	71.73	1.65	7	78.56	79.69	1.13	0.16	1.443	0.209	1.01443	1.01235	1.01652
20250825	Indonesia	70.60	71.14	0.53	8	77.56	78.62	1.06	0.16	1.365	0.207	1.01365	1.01158	1.01572
20250910	Indonesia	80.75	82.46	1.70	9	77.92	79.05	1.13	0.16	1.451	0.204	1.01451	1.01247	1.01654
20250926	Indonesia	84.46	84.99	0.53	10	78.57	79.64	1.07	0.15	1.363	0.196	1.01363	1.01167	1.01559
20251129	Indonesia	64.70	65.69	0.99	11	77.31	78.37	1.06	0.14	1.375	0.180	1.01375	1.01195	1.01556
20251215	Indonesia	71.22	72.14	0.92	12	76.80	77.85	1.05	0.13	1.369	0.166	1.01369	1.01203	1.01535
20251231	Indonesia	68.38	69.21	0.82	13	76.16	77.19	1.03	0.12	1.357	0.156	1.01357	1.01201	1.01513
20260116	Indonesia	72.69	74.71	2.02	14	75.91	77.01	1.10	0.13	1.455	0.172	1.01455	1.01282	1.01627







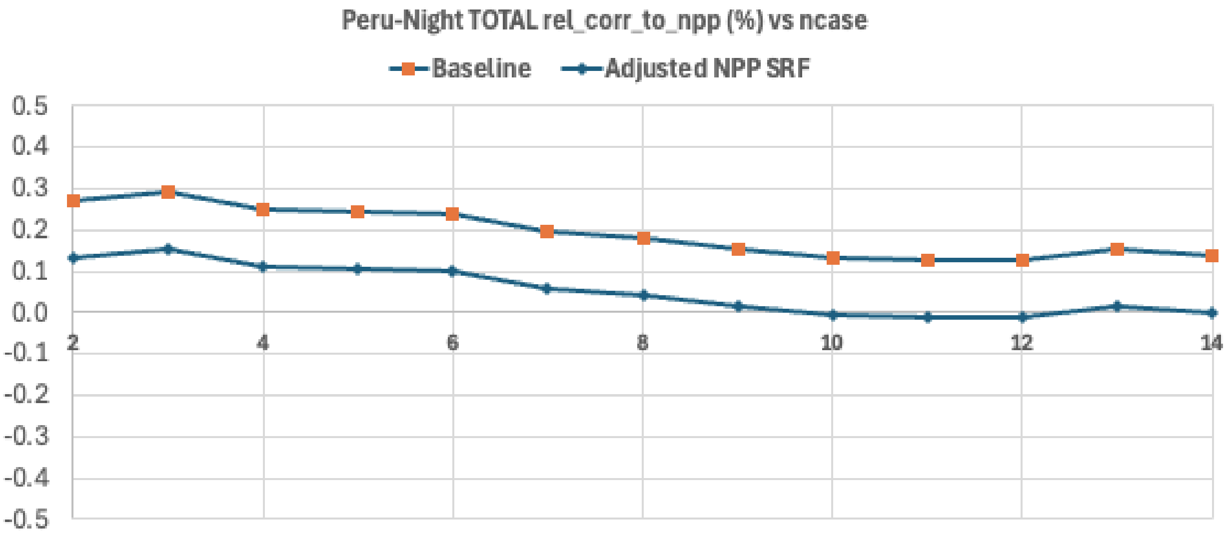
Notes:

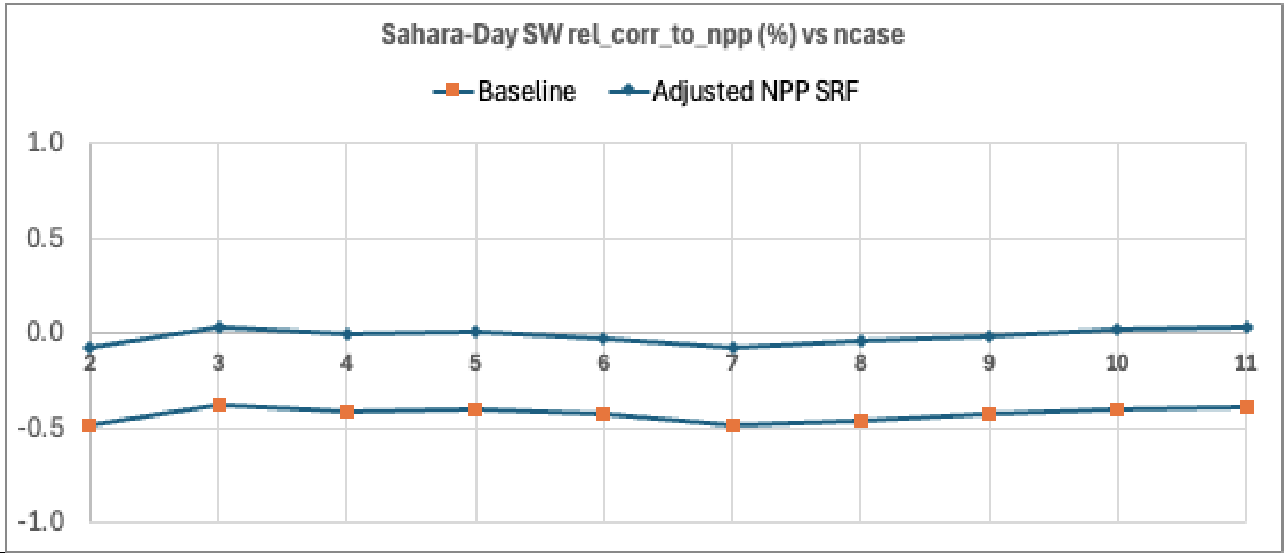
Used all channels > 5 microns for NB2BB (aggregated regression for both)

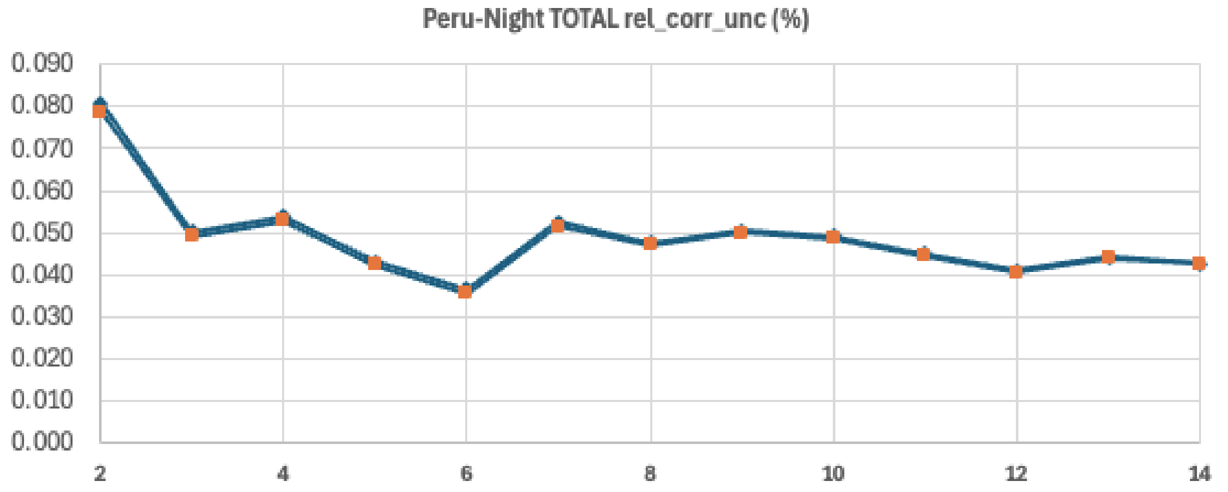
Used KDTree with 0.25-deg radial search and >= 10 neighbors to spatially filter footprints

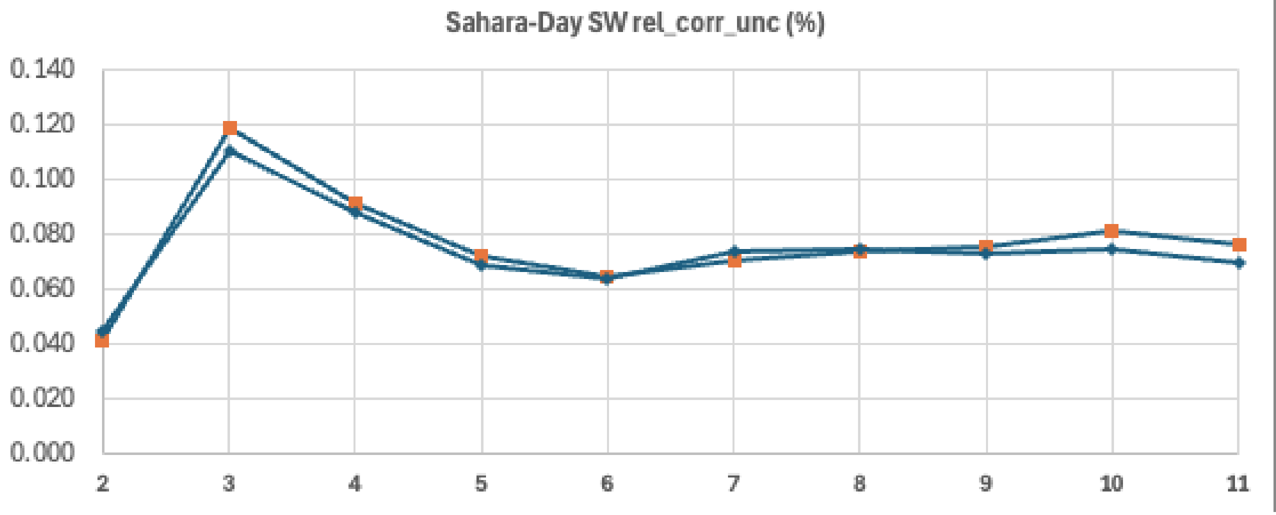
No homogeneity factor, <= 2.0 deg dVZA, Aggregated N20 regression applied

	Linear Stats		
slope	0.9883	1.9950	yint
se_slope	0.0205	1.5640	se_b
rsq	0.9948	0.5022	se_y
F stat	2317.7862	12.0000	dof
sum of squar	584.6641	3.0270	residual sum of squares





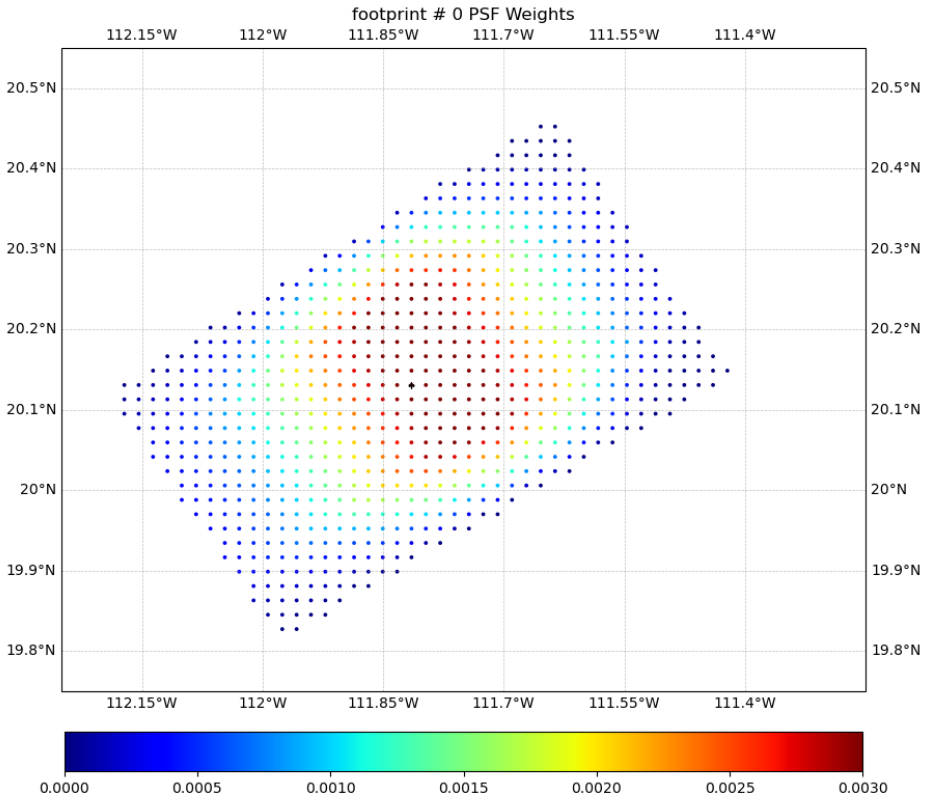




Adjusting the NPP SRF with the SW and TOTAL GEOscan-derived adjustment factors produces perfect agreement between NOAA-20 and NPP SW and night TOTAL

Convolution of GEO Narrowband Radiances to CERES Footprint

- Static 0.5-km NPP point spread function weights
  - project window of 2-deg. longitude by 1-deg. latitude at 2-km res. around footprint center
    - Compute along-track (∂) and cross-track (β) angles
    - restrict to 95% energy FOV
- 2-km weights and time/position written for each footprint (see plot)
- PSF weighting applied to GEO radiances
  - GEO convolved to CERES footprint
- Compared with 30 km^2 fixed aggregation
  - PSF weighting improved results



$$Rad_{footprint} = Sum[\ Rad_{pixel} * weight_{pixel}\ ] \ /\ sum\ (weight_{pixel})$$

where the weight w_{ij} is the integral of the PSF over an angular bin or

$$w_{ij} \equiv \int_{\delta = \delta_i}^{\delta = \delta_i + \Delta\delta} \int_{\beta = \beta_i}^{\beta = \beta_i + \Delta\beta} P(\delta, \beta) \cos\delta d\beta d\delta \qquad (7)$$

and x_{ij} is the arithmetic mean of all the $x(\delta_k, \beta_k)$ in the angular bin such that $\delta_i < \delta_k \le \delta_i + \Delta\delta$ and $\beta_i < \beta_k \le \beta_i + \Delta\beta$. The δ–β grid and values of w_{ij} are given in Figure 8-4 for half the FOV.

.

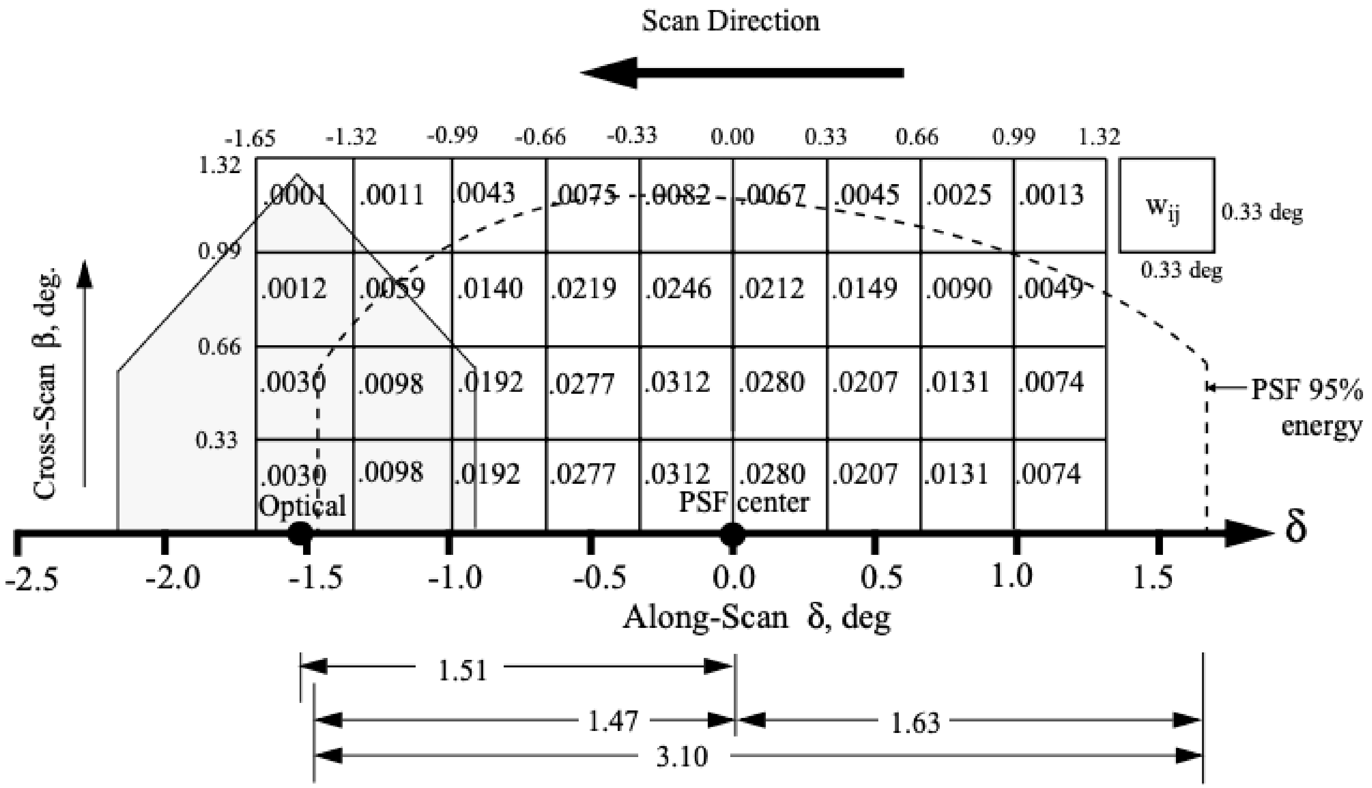


Figure 8-4. TRMM Angular Bin Weights

We have taken the FOV to be defined by $-1.65^o < \delta \le 1.32^o$ and $-1.32^o < \beta \le 1.32^o$ which approximates the 95% energy FOV in Figure 8-4. The integral over the FOV is given by $\sum_{ij} w_{ij} = 0.9483$ which is slightly less than 95% energy. So far we have made mention of only the centroid of the

NPP SRF adjustment notes

- Given NPP correction factors from GEOscan for SW and total channel and applied it to the gain
  - More accurate than linear adjustment of filtered radiances by factor
  - 1-to-1 for SW and total at night
  - Day LW = total – SW (not a 1-to-1, a little higher, ~1.25)
- NPP and N20 not expected to have the same radiometric scale, originally intercalibrated then let it run and adjusted independently using Aqua
- Remaining will be to look at longwave daytime

Region Selection Criteria

- Region has small SW and LW flux temporal variability
  - Temporally invariant and spatially homogeneous surfaces
  - Include regions with distinct TOA spectra
    - clear-sky deserts, land, and oceans
    - consistent land afternoon convection and maritime stratus
    - Avoid regions along coastlines or mixed surface types
  - Best if both SW and LW fluxes are temporally invariant
    - allow the total, SW, and LW channel to be intercalibrated in tandem between CERES and Libera
- Low GEO VZA - Regions near sub-satellite point
  - for VZA=60° the footprint size ~48km
- Find the repeat cycle day where the GEO and CERES footprint are within 2° VZA and 5° RAZ over the selected site