



State of CERES



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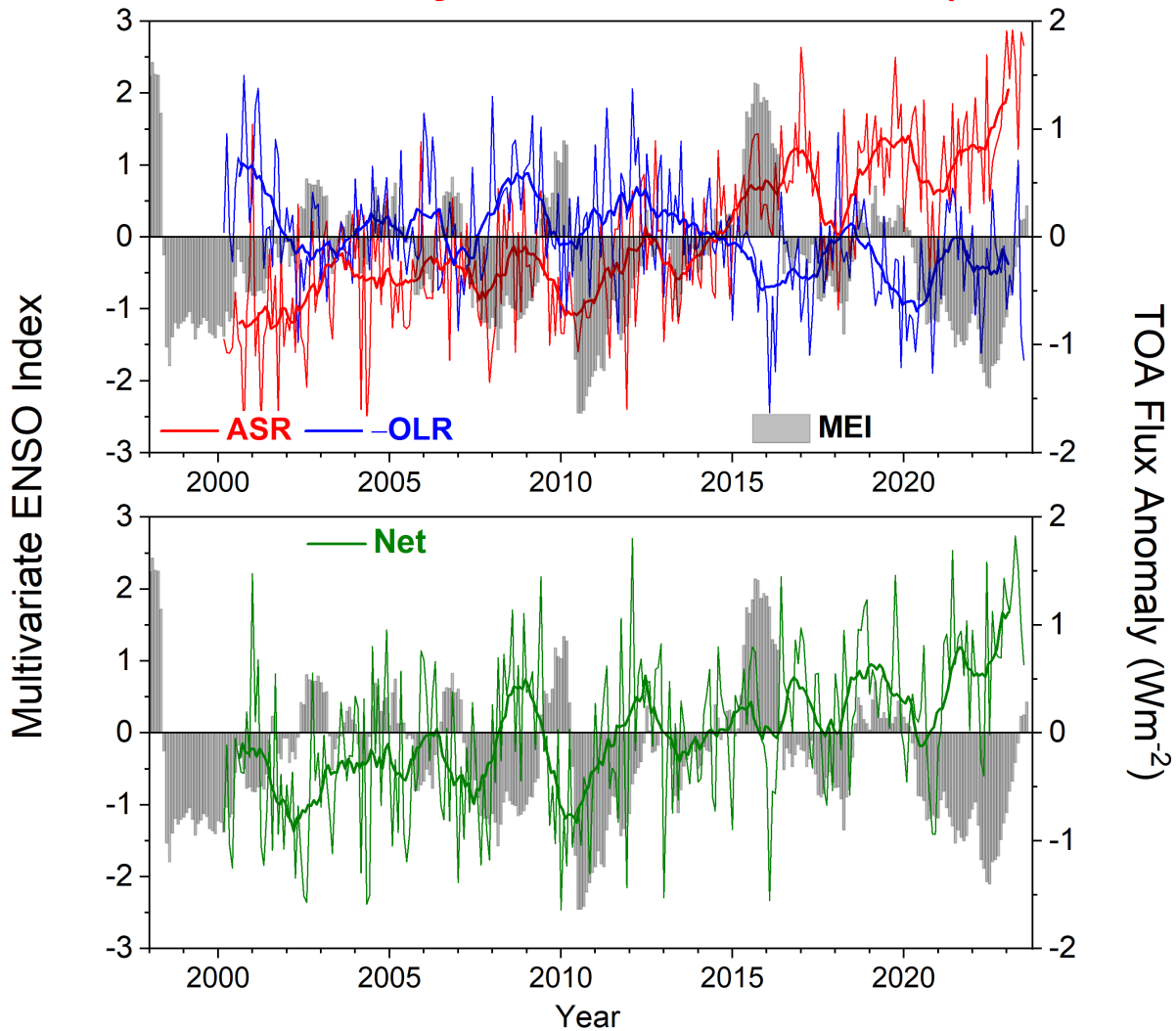
CERES Science Team Meeting, October 17-19, 2023
NASA Goddard Institute for Space Studies, New York, NY

CERES Technical Meeting

Review Status of CERES Instruments and Data Products:

- State of CERES
- CERES Terra, Aqua, S-NPP, NOAA-20 Instrument Calibration Update
- MODIS & VIIRS Cloud Algorithm & Validation Status
- ADM, SARB and TISA Working Group Reports
- EBAF-SFC Update
- FLASHFlux Update
- Data Management Team Update

Global Mean All-Sky TOA Flux Anomalies (CERES EBAF Ed4.2; 03/2000–07/2023)



Trends (Wm^{-2} per decade; 2.5-97.5% CI)

ASR: 0.77 ± 0.20

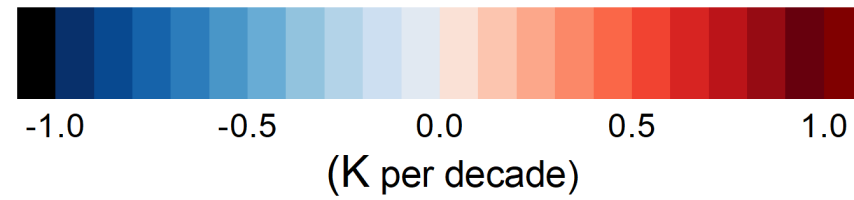
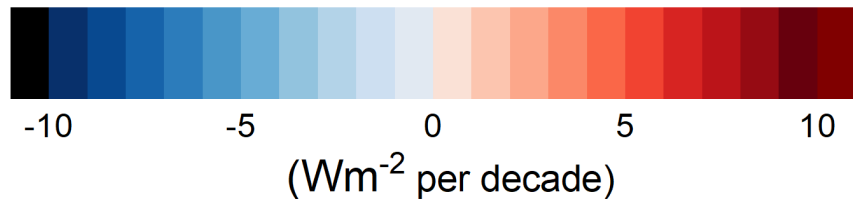
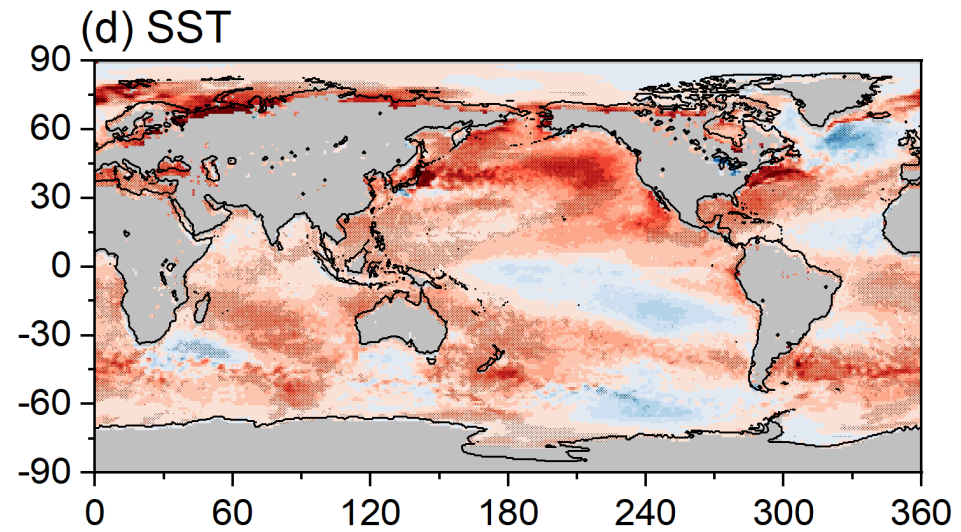
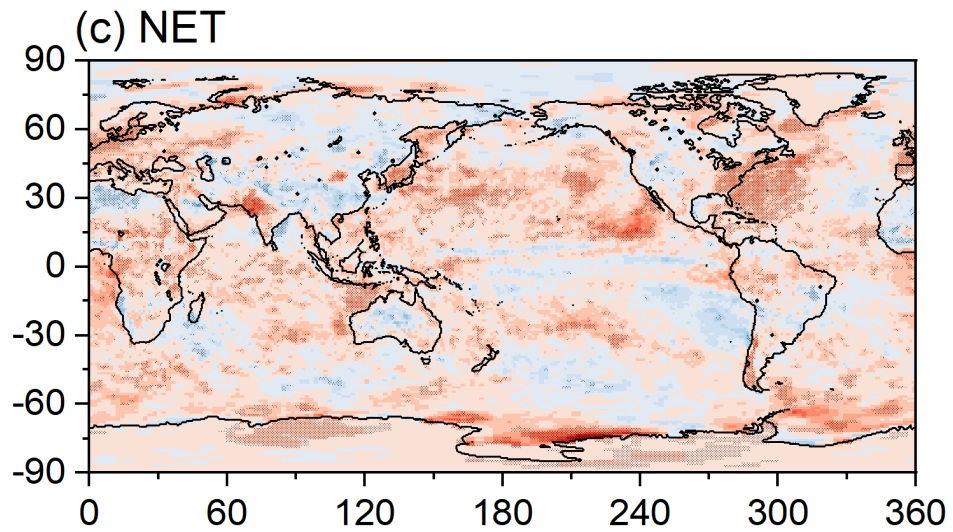
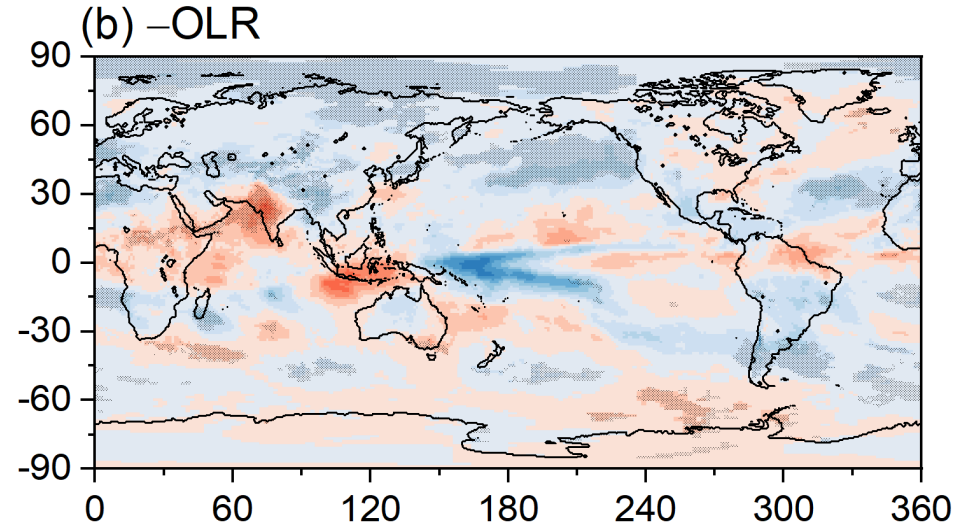
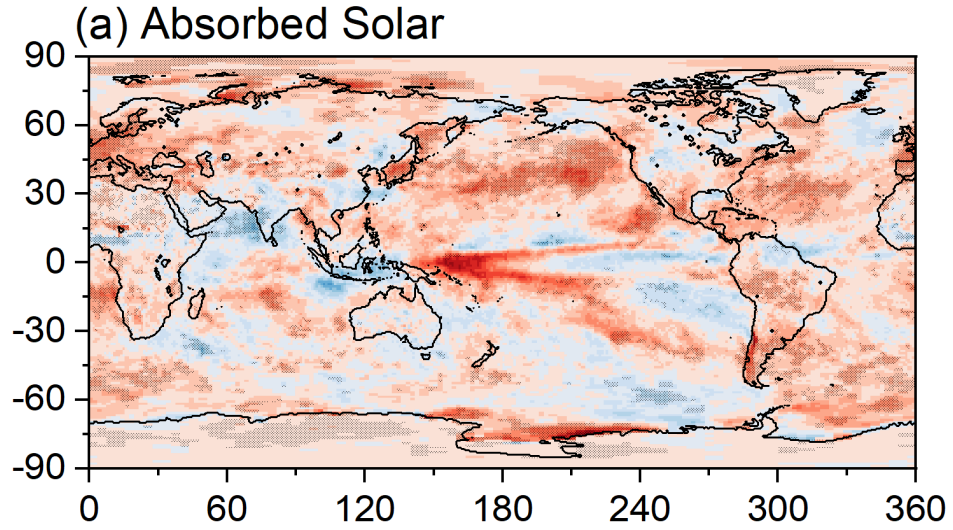
-OLR: -0.27 ± 0.18

NET: 0.50 ± 0.18

Units: Wm^{-2}	Solar Irradiance	ASR	-OLR	NET
03/2000-02/2010	340.14	240.7	-240.2	0.53
03/2013-02/2023	340.17	241.7	-240.6	1.08
Difference	0.03	1.0	-0.4	0.55

Doubling in EEI!

Regional Trends in TOA Radiation and SST (03/2000–07/2023)



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Environment ▶ **Climate crisis** Wildlife Energy Pollution Green light

Climate crisis

'Gobsmackingly bananas': scientists stunned by planet's record September heat

The carbon emissions driving the climate crisis and rapid arrival of an El Niño event are to blame, researchers say



A firefighter tries to control a wildfire in the hills at Cali, Colombia on 22 September. Photograph: Anadolu Agency/Getty Images

Damian Carrington
Environment editor

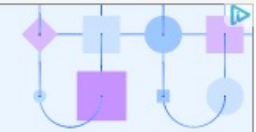
@dpcarrington

Wed 4 Oct 2023 22.00 EDT



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Mika Rantanen

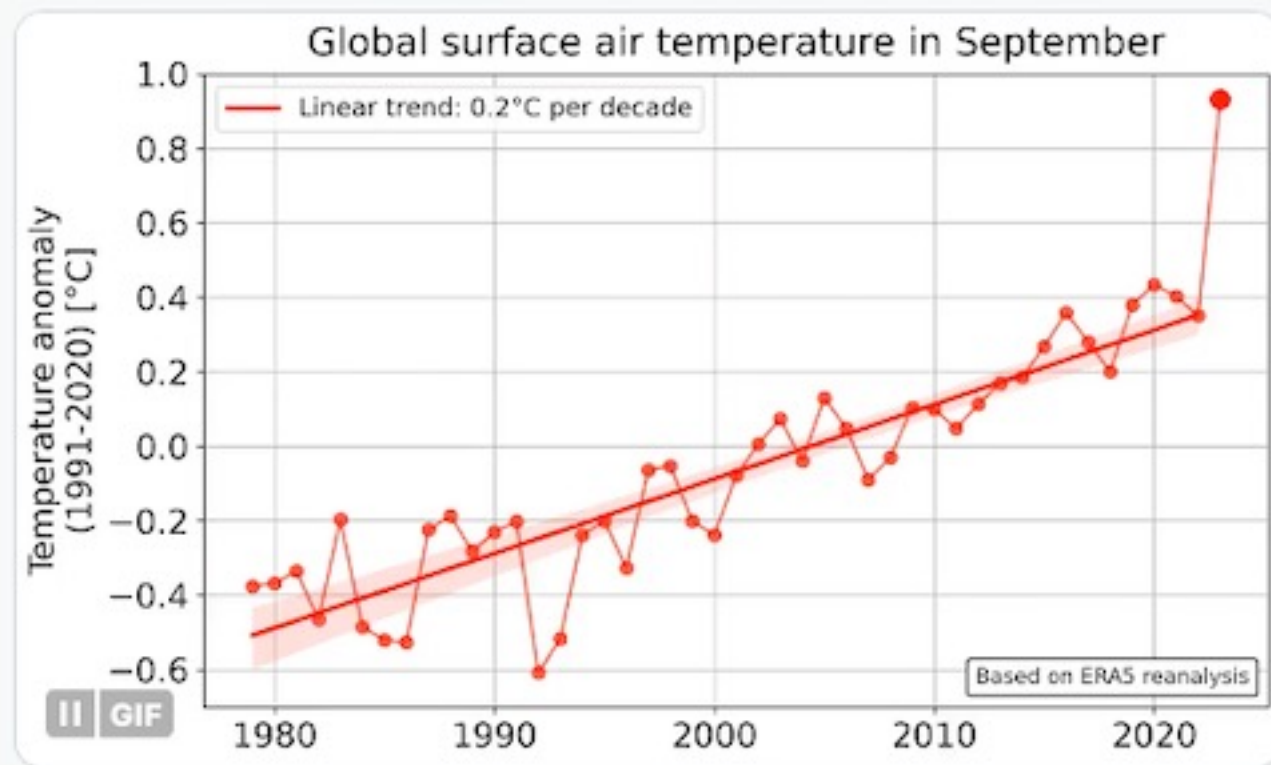
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ERA5 September 2023 monthly data are out.

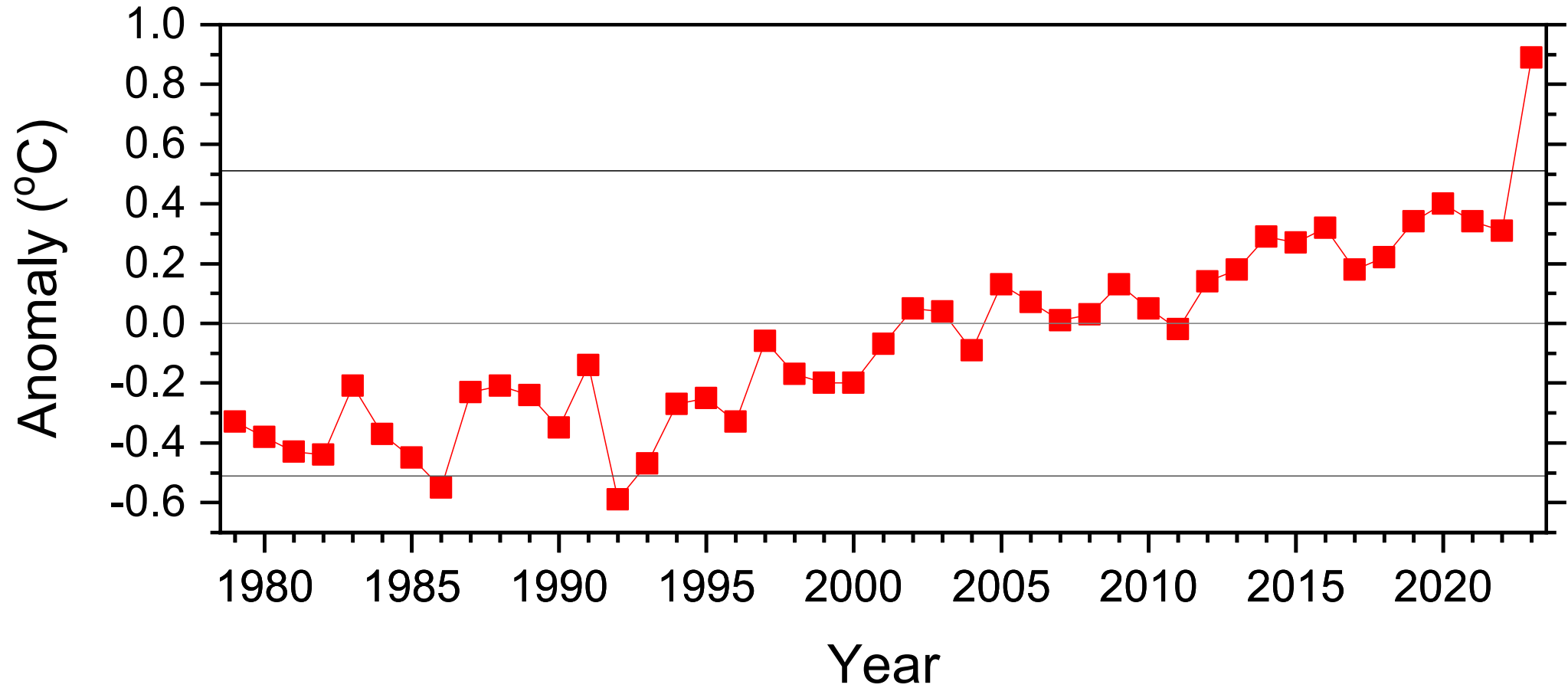
I'm still struggling to comprehend how a single year can jump so much compared to previous years.

Just by adding the latest data point, the linear warming trend since 1979 increased by 10%.

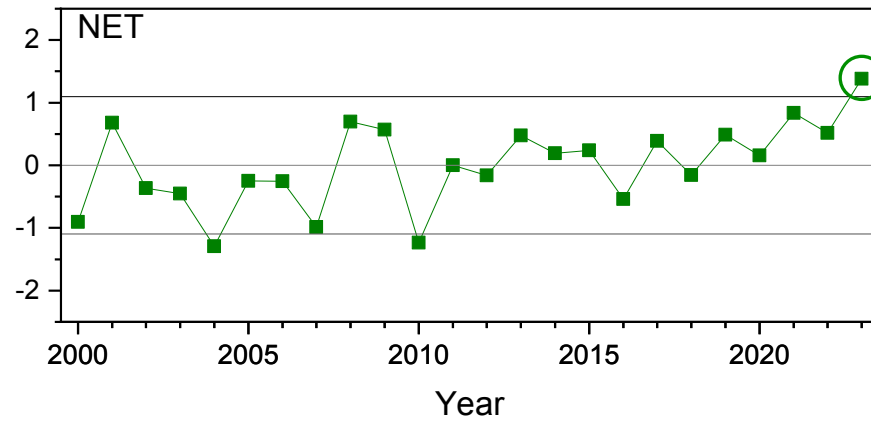
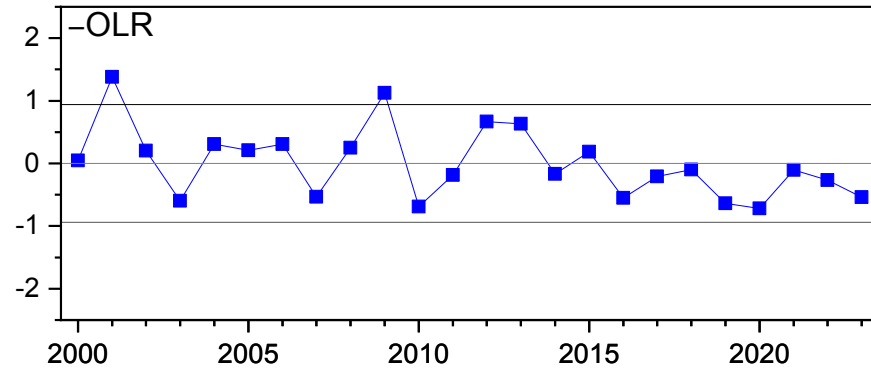
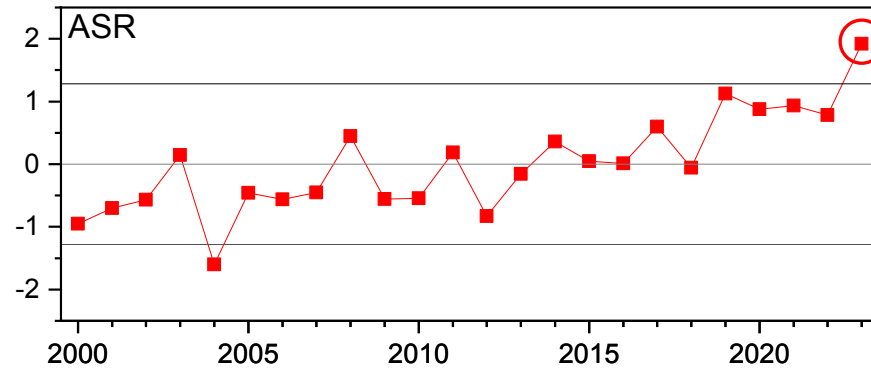


September Global Mean Surface Temperature Anomaly

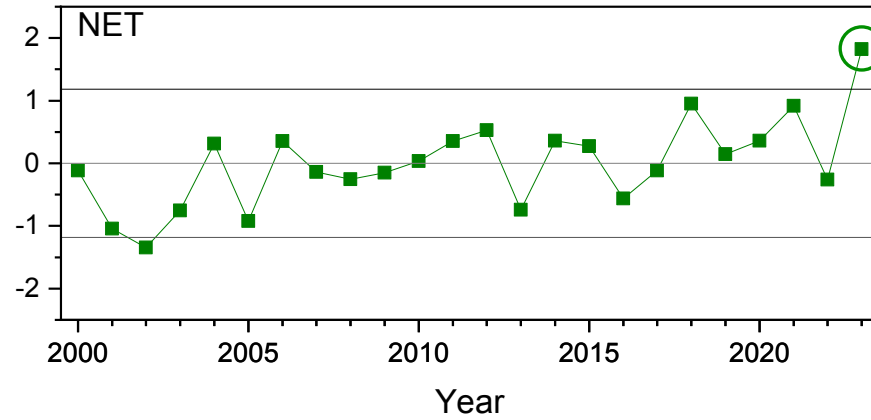
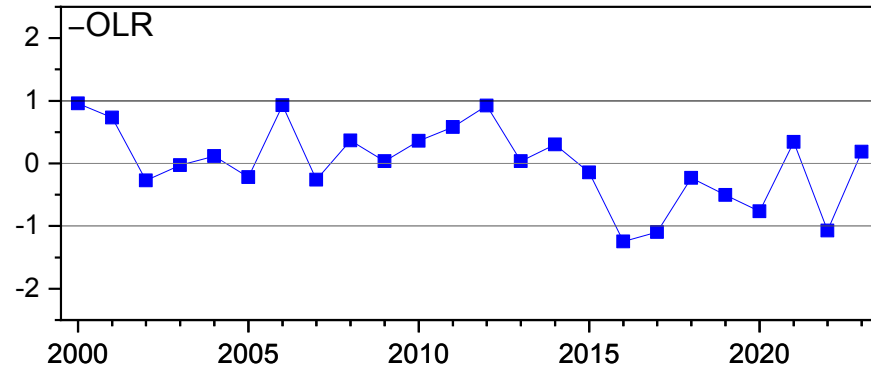
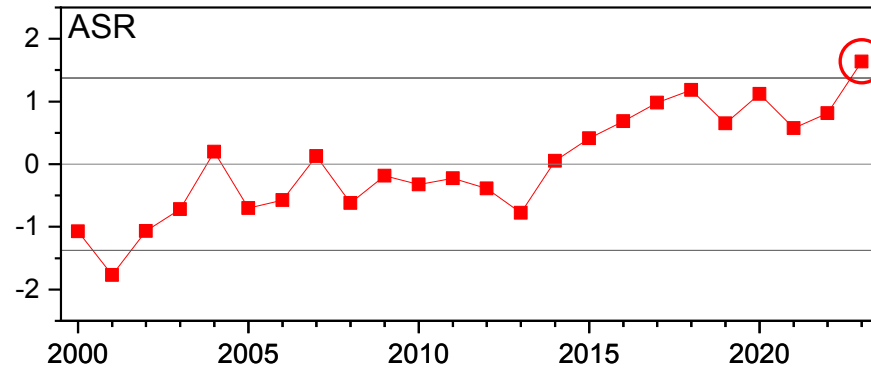
(Climatology: 1991-2020; Source: GISTEMP v4)



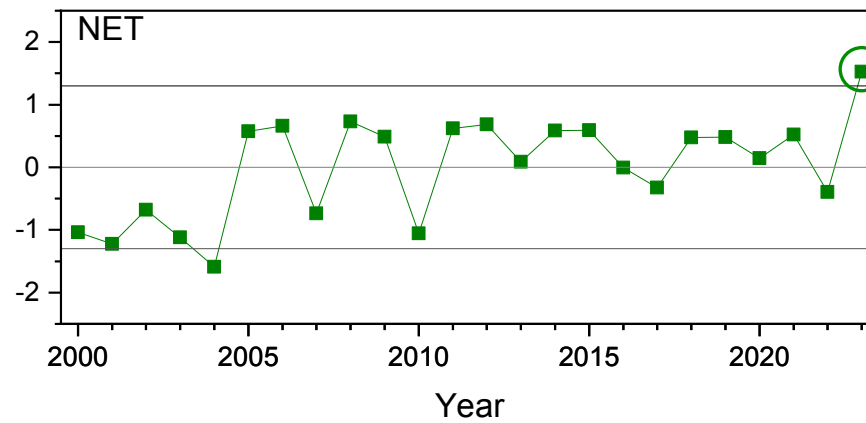
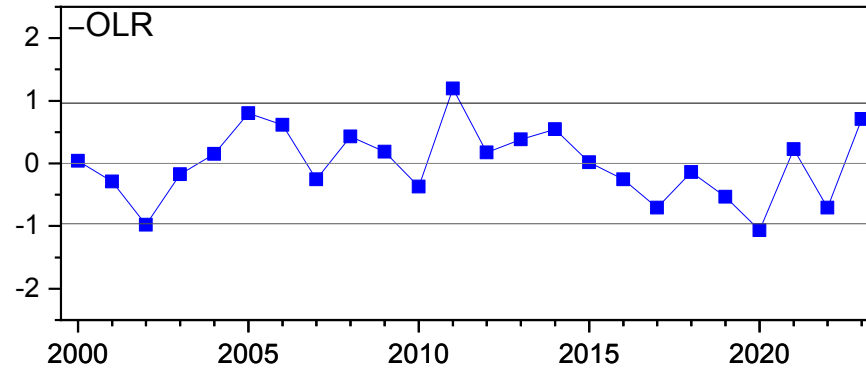
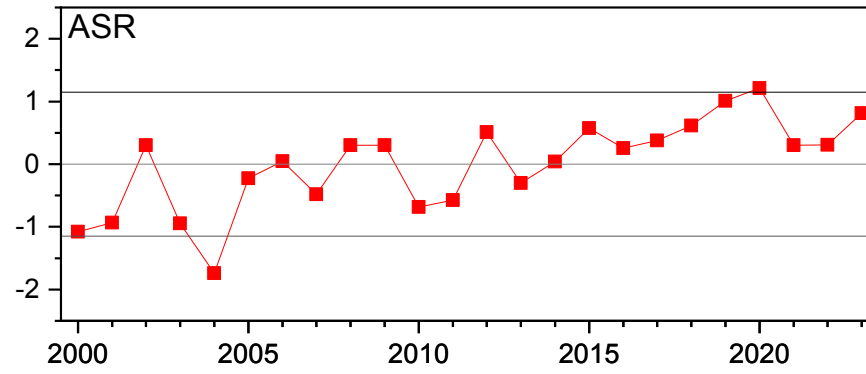
TOA Radiation Anomalies (March)



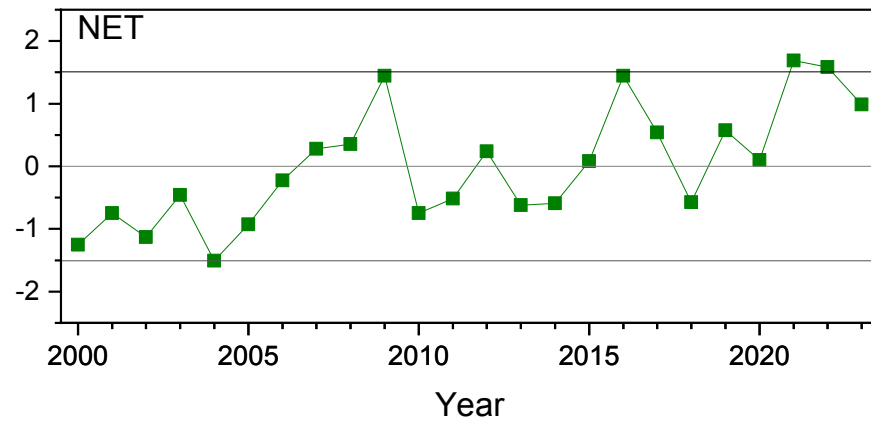
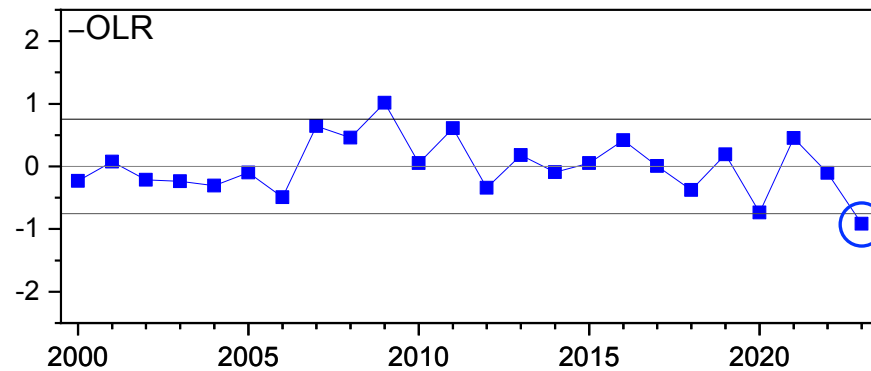
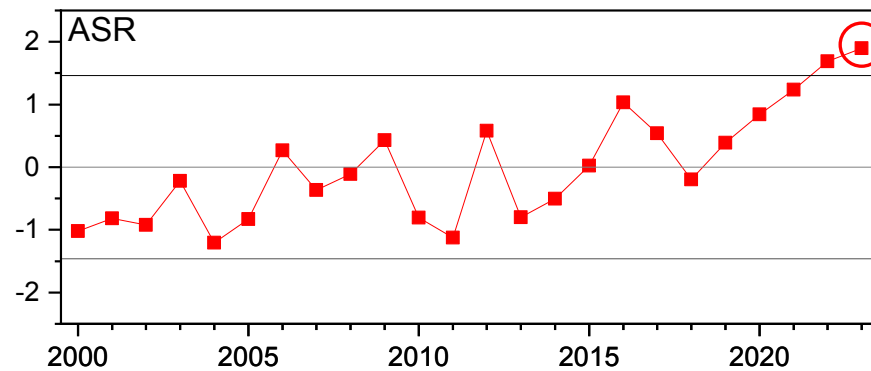
TOA Radiation Anomalies (April)



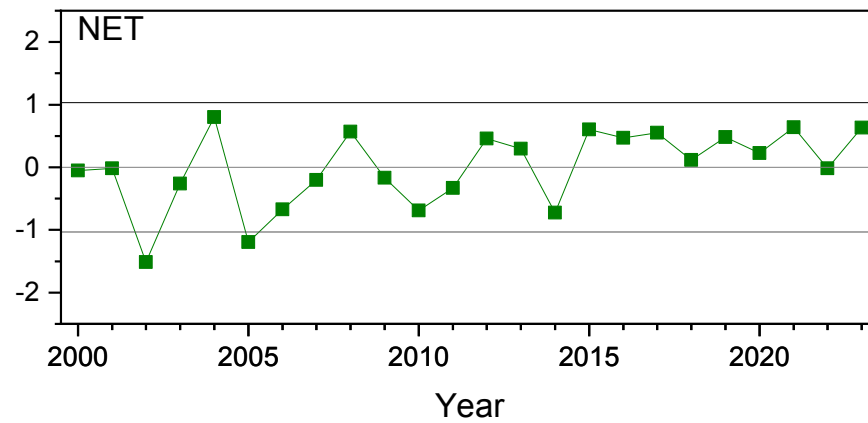
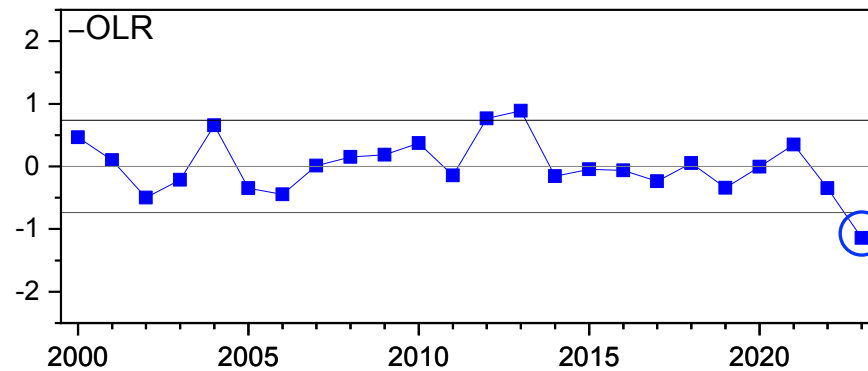
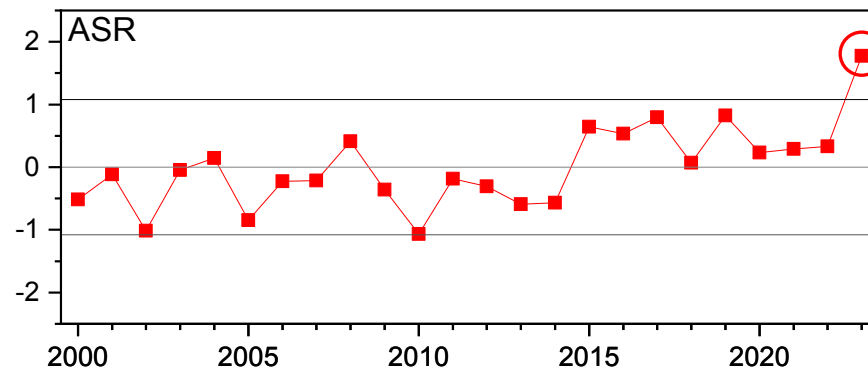
TOA Radiation Anomalies (May)



TOA Radiation Anomalies (June)

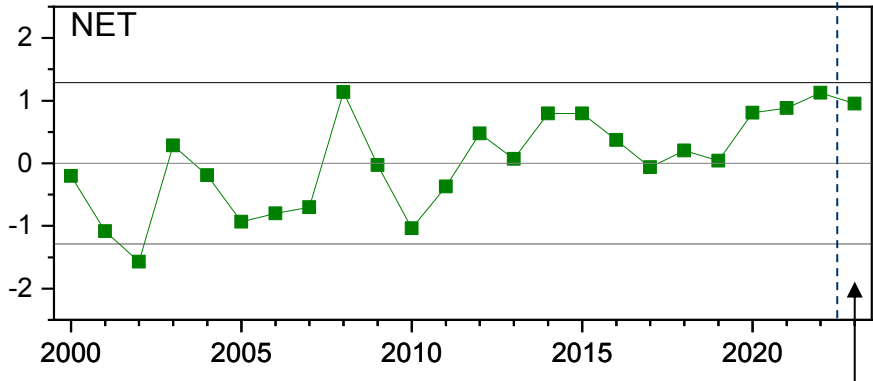
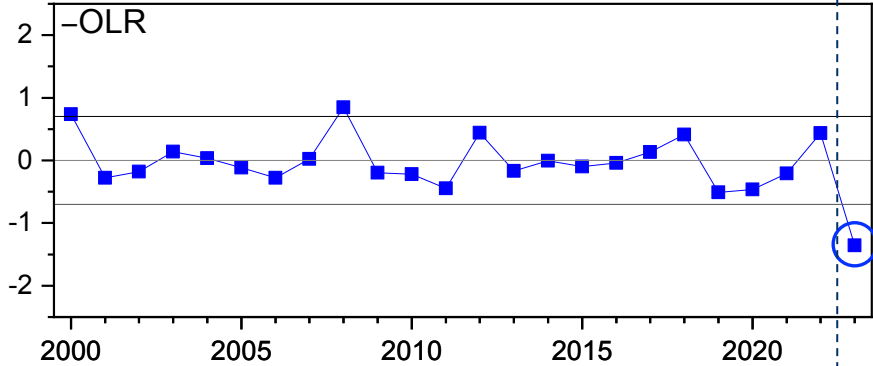
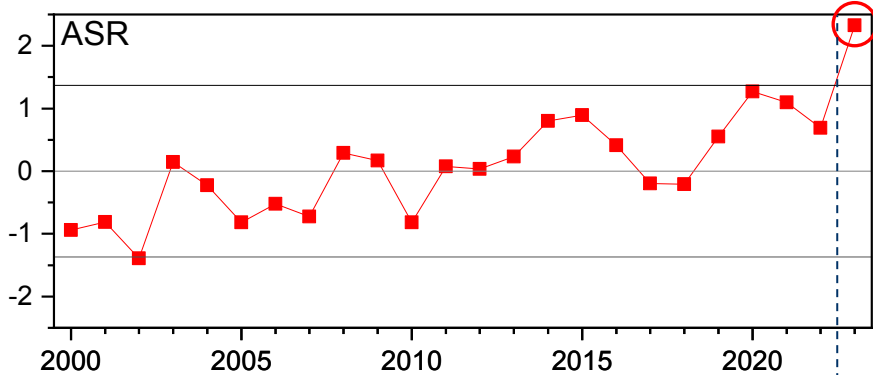


TOA Radiation Anomalies (July)



Year

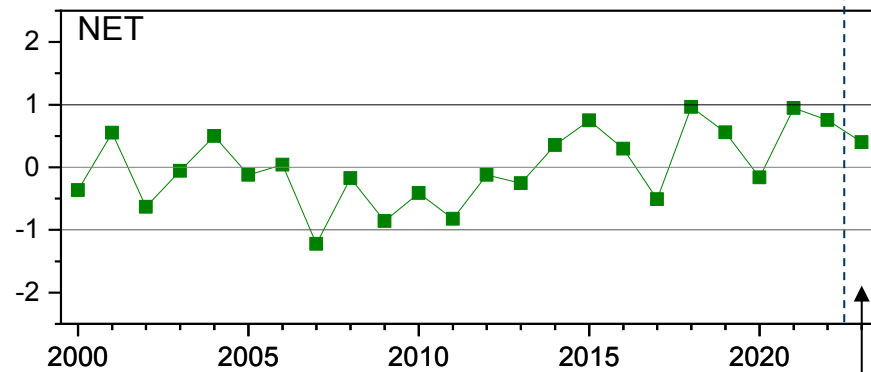
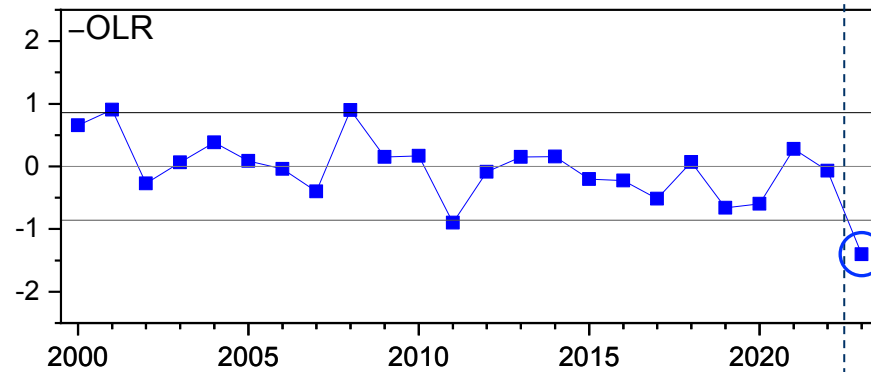
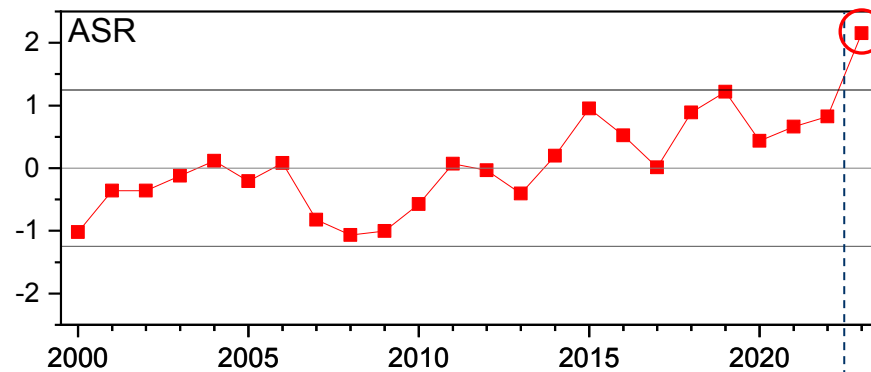
TOA Radiation Anomalies (August)



Year

FLASHFlux

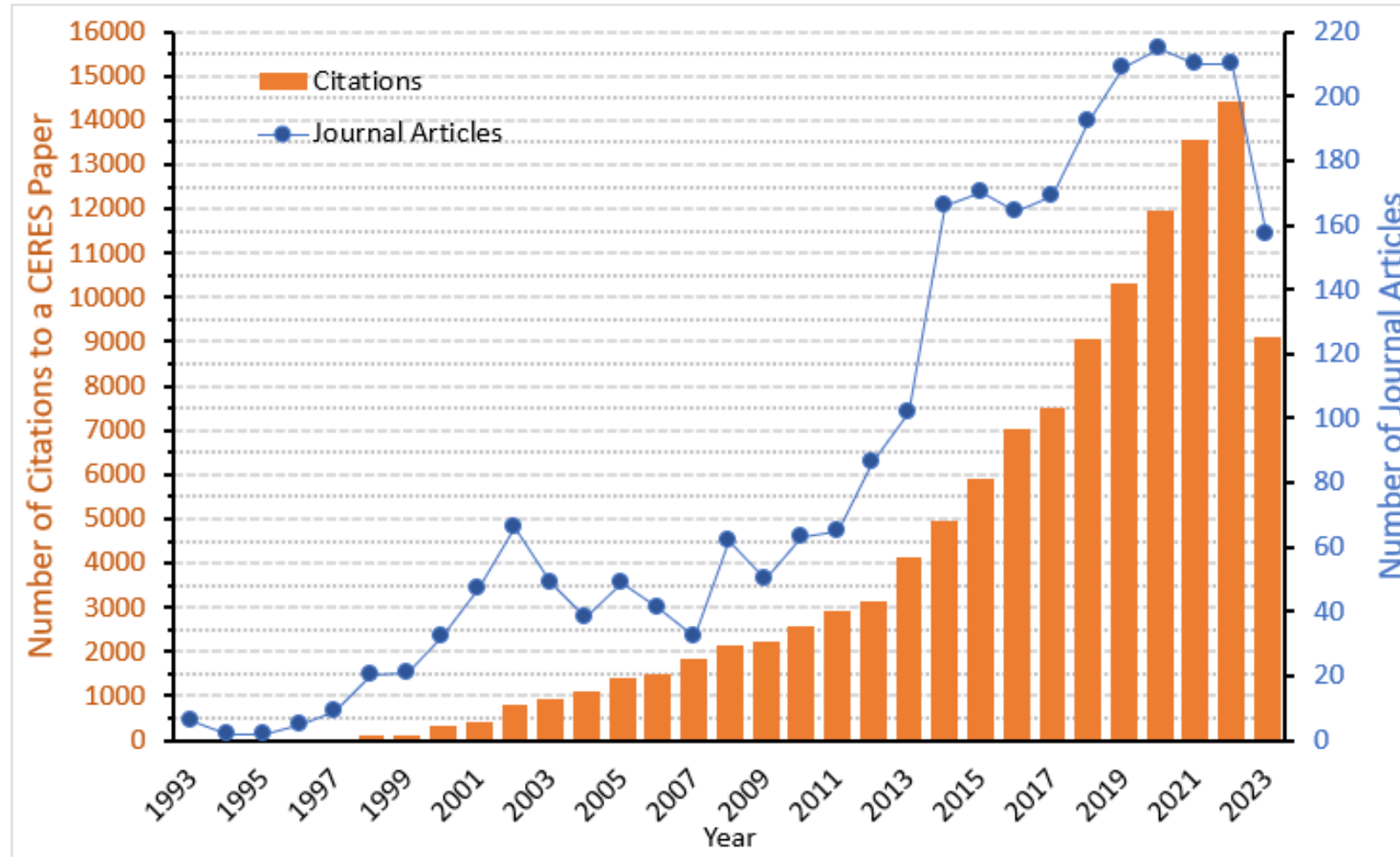
TOA Radiation Anomalies (September)



Year

FLASHFlux

CERES Journal Publications and Citation Counts (For Papers Between 1993-2023; Updated September 26, 2023)



- Total number of peer-reviewed journal articles: 2,709
- Total number of citations to CERES papers: 119,636

(Compiled by Dennis Keyes)

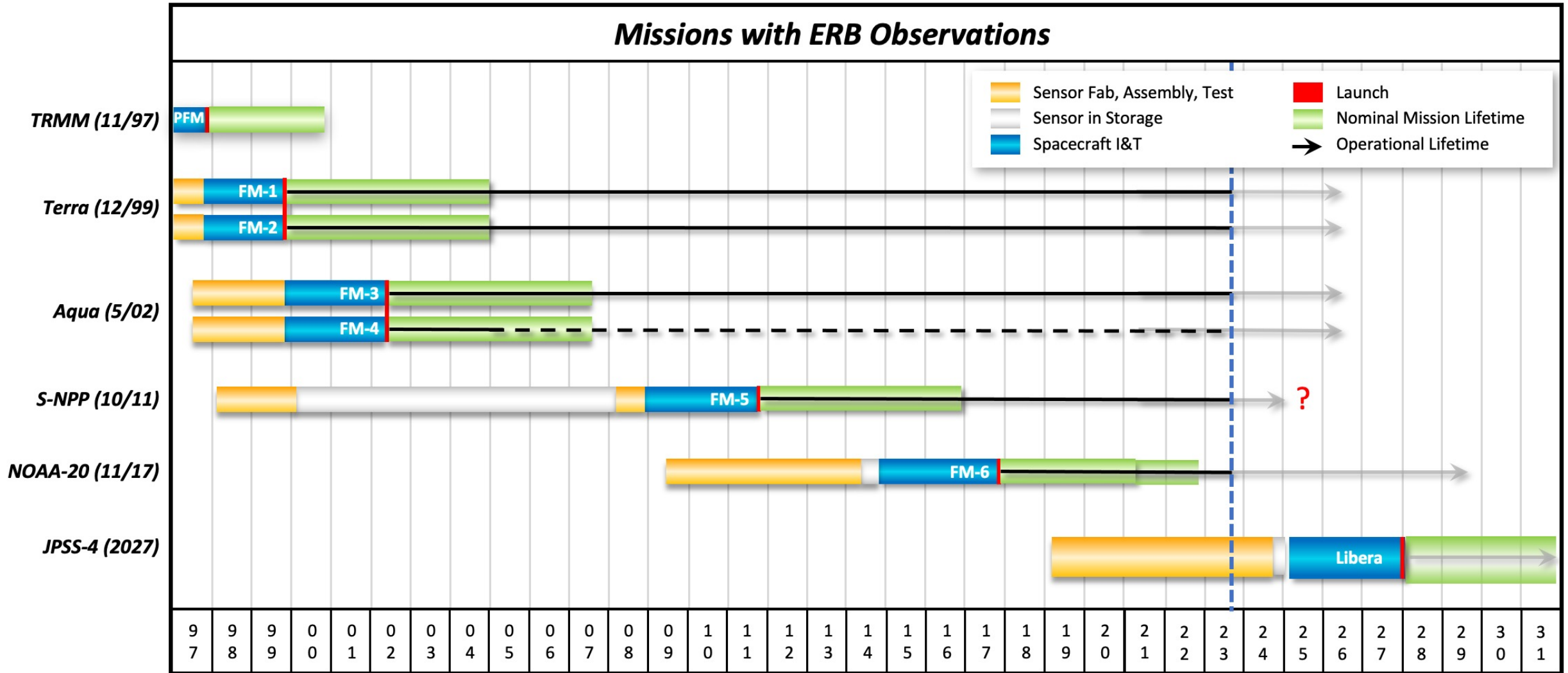
Number of Unique Users by CERES Data Product

(through September 30, 2023)

Level	Product	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1b	BDS	14	11	13	14	10	12	23	29	31	10
2	SSF	247	253	278	327	235	251	245	266	272	220
	FLASH_SSF	30	61	41	68	101	92	103	111	123	57
	CCCM	28	55	54	49	49	36	45	58	64	54
	ES8	16	21	15	15	10	8	11	12	14	8
	SSF-MISR	4	2	1	3	1	1	4	3	0	0
	CRS										15
3 & 3b	EBAF	731	787	783	935	928	995	1041	1055	1202	1203
	SYN1deg	382	438	494	607	639	754	854	886	923	770
	SSF1deg	166	160	194	190	159	221	213	226	261	144
	CldTypHist	41	40	47	86	87	79	86	94	83	92
	FluxByCldTyp							50	69	67	67
	ES4	19	13	12	17	17	17	11	17	16	11
	ES9	9	5	5	8	6	6	8	5	9	3
	FLASH_TISA	15	15	36	52	65	81	131	110	117	67

FLASHFlux via POWER since last year: **114,013**

Flight Schedules

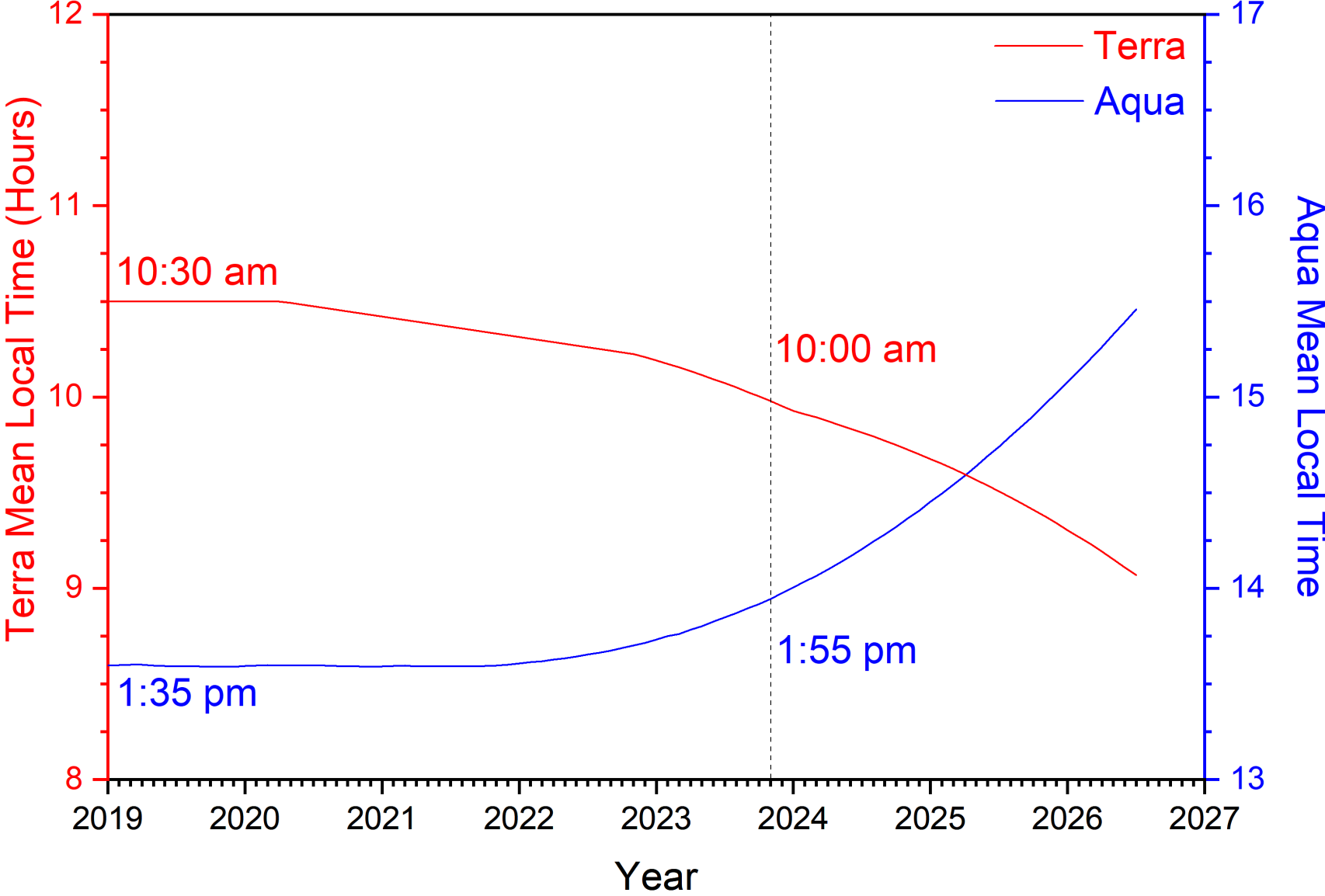


- Currently, 6 CERES instruments fly on 4 satellites: Terra (L1999), Aqua (L2002), SNPP(L2011), NOAA-20 (L2017)
- Libera scheduled for launch in 2027 on JPSS-4

Future Operations of Terra, Aqua and Aura

- NASA invited T/A/A to participate in the 2023 Senior Review, which recommends to NASA what missions should be extended for another 3 years.
- Final decision on the fate of these missions has not been released yet.
- However, the panel report has been released. The panel recommends that both Terra and Aqua be extended 3 years.

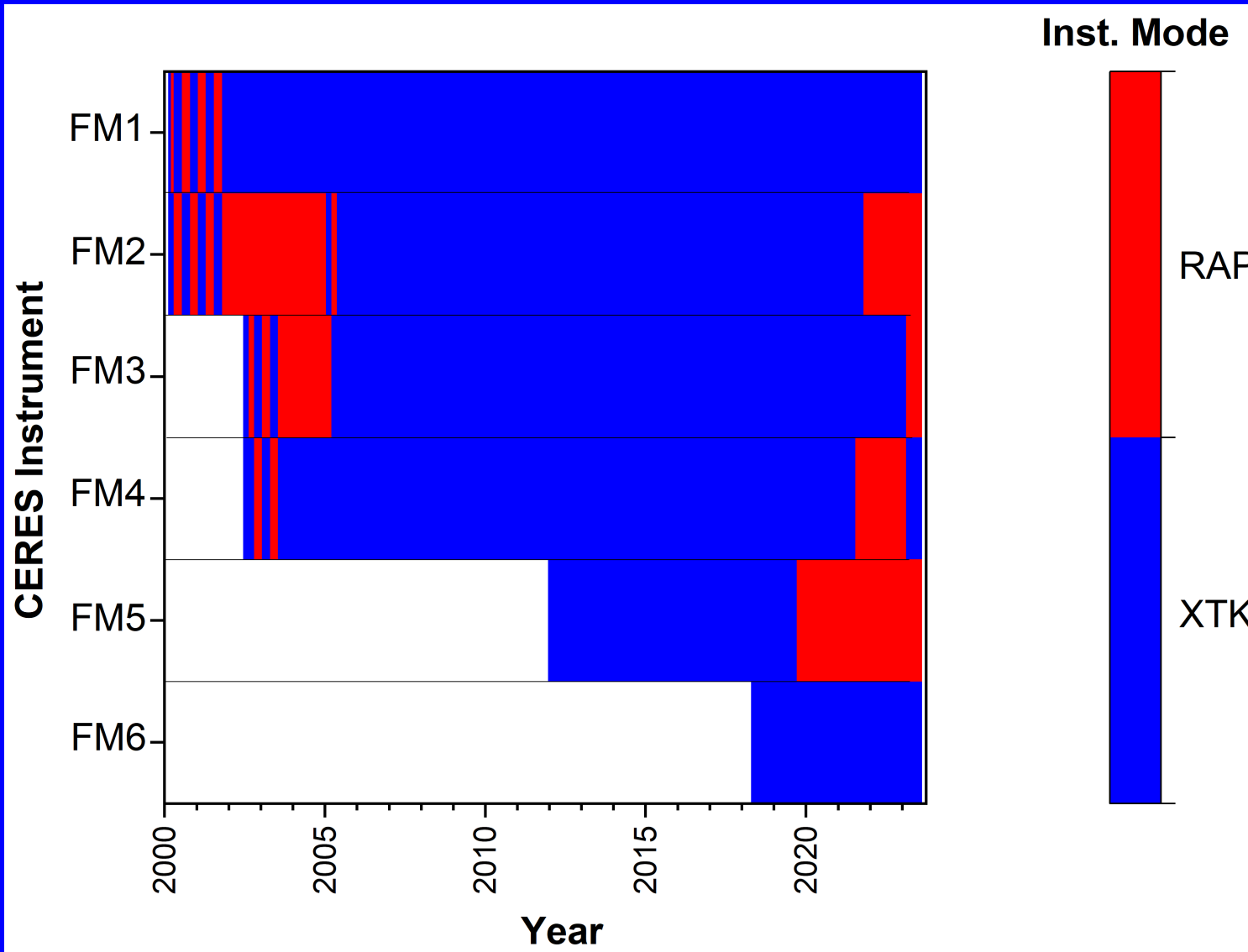
Terra and Aqua Mean Local Equatorial Crossing Times (MLTs)



• Daily MLT updates available at: <https://terra.nasa.gov>

CERES Instrument Modes of Operation

Modes of Operations
(03/2000-09/2023)



Modes of Operations
(10/2023-Onwards)

FM1	XTK+GEOSCAN
FM2	RAP
FM3	RAP+GEOSCAN
FM4	XTK
FM5	XTK*
FM6	XTK

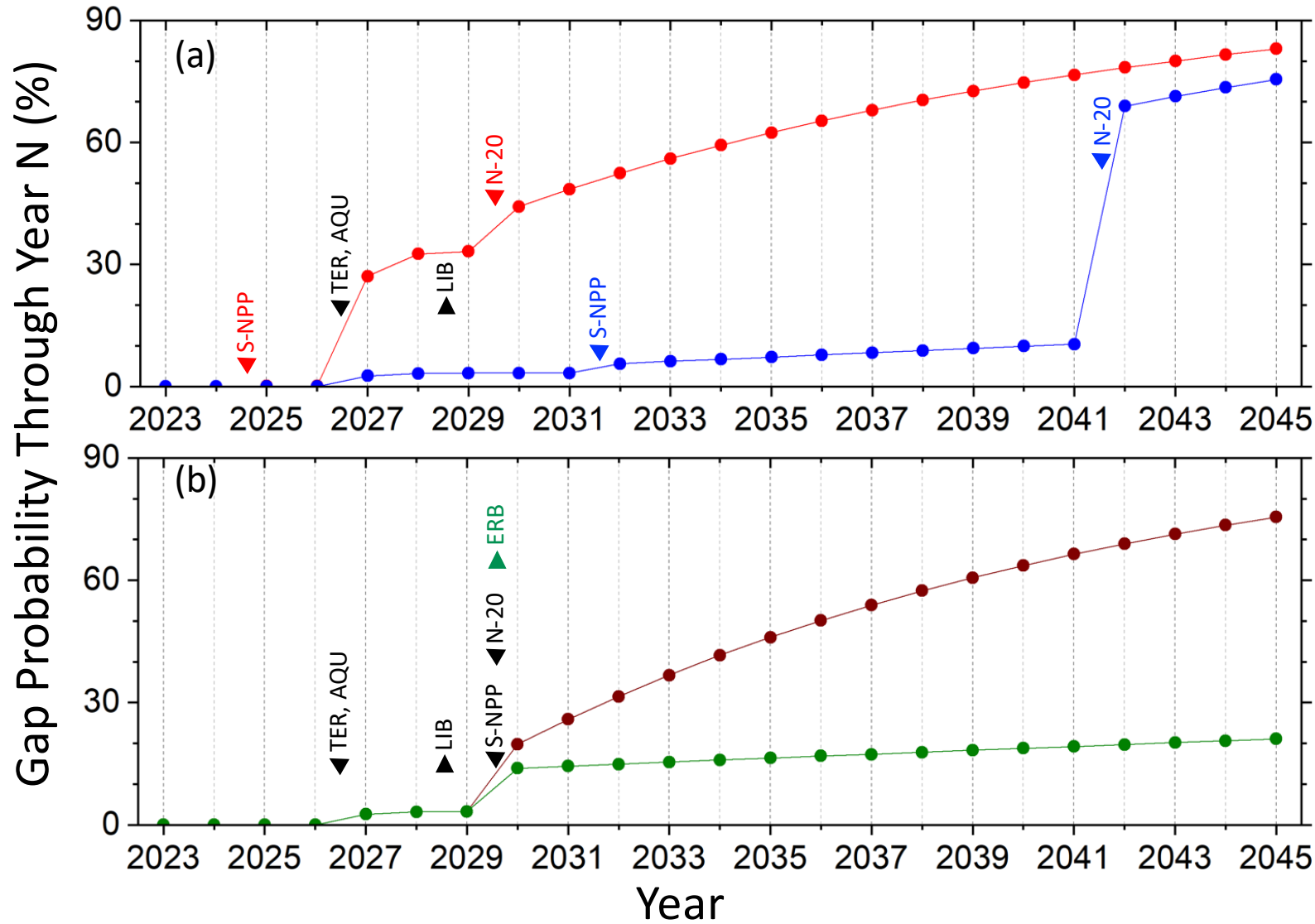
*After 48 months of RAP, FM5 returned to XTK mode in October 2023.

- Will schedule some Alongtrack in 2024.

Future Operations of S-NPP

- S-NPP (L2011) continues to operate with CERES FM5 onboard.
- As of March 10, 2023, there were 282 kg of fuel remaining on S-NPP and 345 kg of fuel on NOAA-20.
⇒ S-NPP could last until 2031, and NOAA-20 could last until 2041
- In practice, programmatic decisions can also limit how long these missions can continue, but that is highly uncertain at present.
- If either S-NPP or NOAA-20 are terminated prior to Libera, there is a 1 in 3 chance of a data gap in the ERB record.

Probability of a data gap through January 1 of year N



- If either S-NPP or NOAA-20 are terminated prior to Libera, there is a 1 in 3 chance of a data gap in the ERB record.
- Extending both through 2029 and launching a new ERB instrument the same year would ensure the data gap risk remains < 16% through 2035.

Planning for CERES Edition 5

- 1) GMAO improvements to atmospheric reanalysis system.
 - CERES and GMAO hold Teams meetings every 3 weeks to gauge progress and provide ongoing validation results for GEOS-IT.
 - GEOS-IT reprocessing is almost up to date. Should complete by **January 5, 2024**.
- 2) MODIS Collection 7. Release date for MODIS Level-1b is unknown. Awaiting final decision about Terra and Aqua Senior Review. Also requires approval by members of higher-level products.
- 3) CERES production code improvements.
- 4) CERES algorithm improvements (particularly those enabling a seamless transition across satellite platforms).

CERESMIP

- The Coupled Model Intercomparison Project (Phase 6) (CMIP6) protocol only uses observed forcings to 2014.
- However, climate variability since 2014 is quite pronounced and scientifically interesting (e.g., EEI and SST trends, PDO shifts, 2015/2016 El Nino, Marine Heat waves, etc.).
- In addition, many of the model inputs have been updated substantially since the CMIP6 inputs were defined.
- So why hasn't there been a coordinated effort to update climate model AMIP simulations?
- Gavin Schmidt (NASA GISS) is leading a new, relatively low cost, model intercomparison, CERESMIP, that will focus on the CERES period, with updated forcings to the end of 2021.
- The focus will be on atmosphere-only simulations, using updated SST, forcings and emissions from 1990-2021.
- The diagnostic focus will be on the EEI and atmospheric feedbacks, and so diagnostics should include output from the COSP simulator.
- A journal article describing CERESMIP has been published. <https://doi.org/10.3389/fclim.2023.1202161>
- New WCRP lighthouse activity on Explaining and Predicting Earth System Change (EPESC) with a focus on Earth's Energy Imbalance has been established.

CRAVE — CERES Radiation and Validation Experiment

<https://science.larc.nasa.gov/CRAVE/>



GRANITE ISLAND

- The solar tracker was fixed in May; Downwelling SW direct and diffuse are back online.
- Newly calibrated SW direct, diffuse and global installed.
- New Infrared Radiation Thermometer (lake temperature measurements) installed.
- AERONET, MET and PAR are functional.
- Next trip will be late October to winterize CRAVE-GI.
- Data availability: 2018 July – Present.

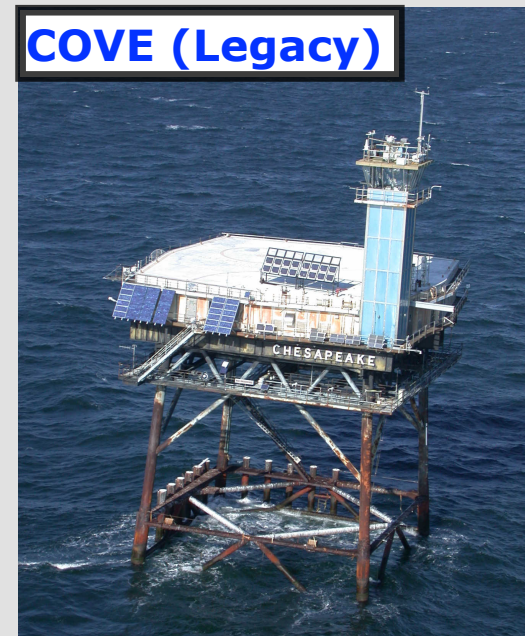


LaRC

- MPL is still down for calibration and maintenance. No ETA.
- BSRN, AERONET, MET and PAR are functional.
- In-person internship/mentorship with a Northern Michigan University student completed (June-August session).
- Round-robin SW calibration experiment is complete. Instrument calibration methodologies were compared at 3 different sites with contrasting climate environments.
- Data availability is 2014 December – Present.



COVE (Legacy)



Two NASA Langley owned reference absolute cavity pyrheliometers took part in the National Pyrheliometer Comparison, thus maintaining traceability of CRAVE surface validation measurements to the World Radiation Reference.

Data availability:
2000 May – 2016
November

Upcoming Conferences & Meetings of Interest

Fall AGU

- December 11-15, 2023, San Francisco, CA.

AMS Annual Meeting

- January 28-February 1, 2024, Baltimore, MD

Spring 2024 CERES Science Team Meeting

- May 14-16, 2024, NASA LaRC

International Radiation Symposium

- June, 2024, Hangzhou, China