



State of CERES



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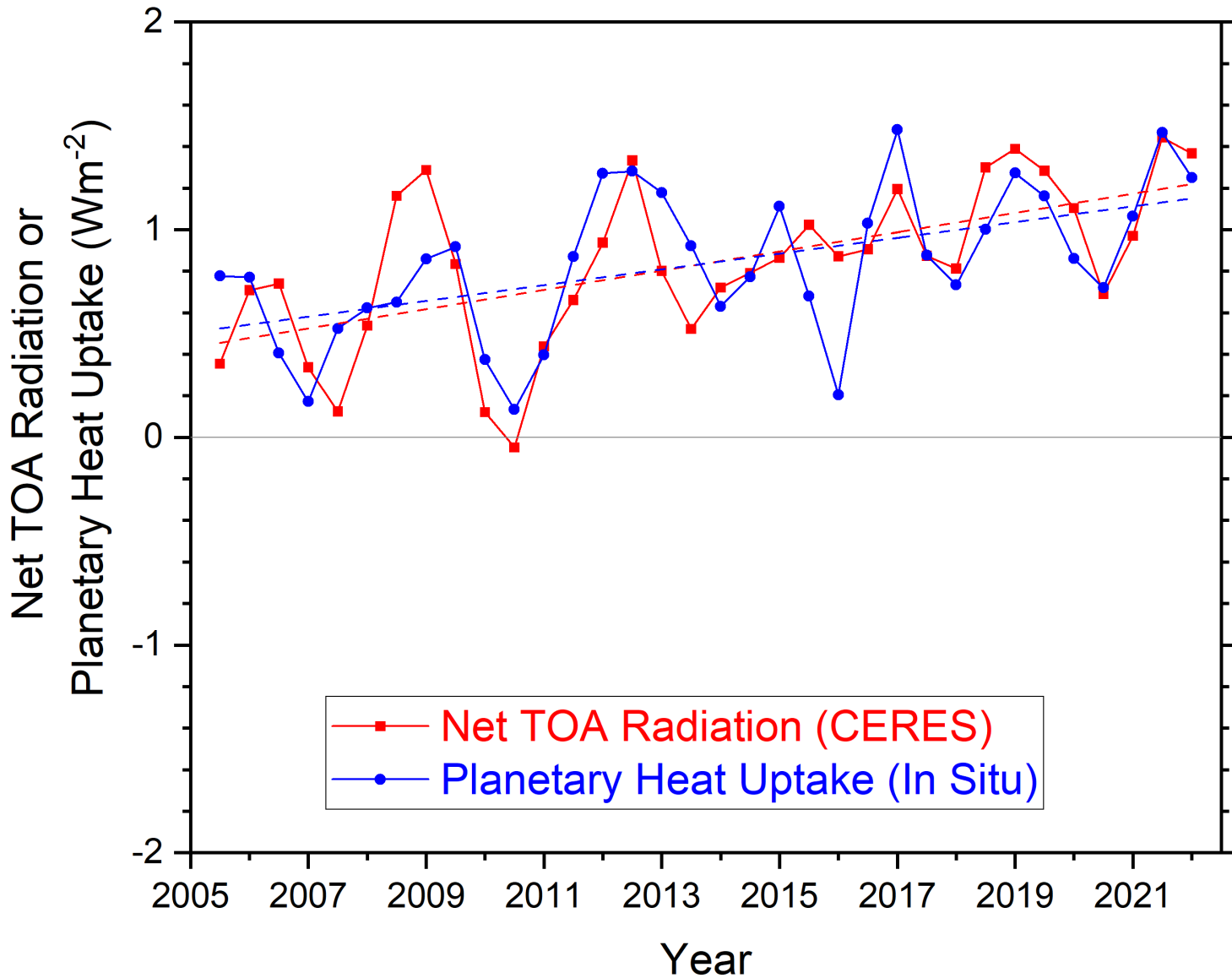
CERES Science Team Meeting, May 9-11, 2023
NASA Langley Research Center, Hampton, VA

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 Update
- FLASHFlux Update
- Data Management Team Update

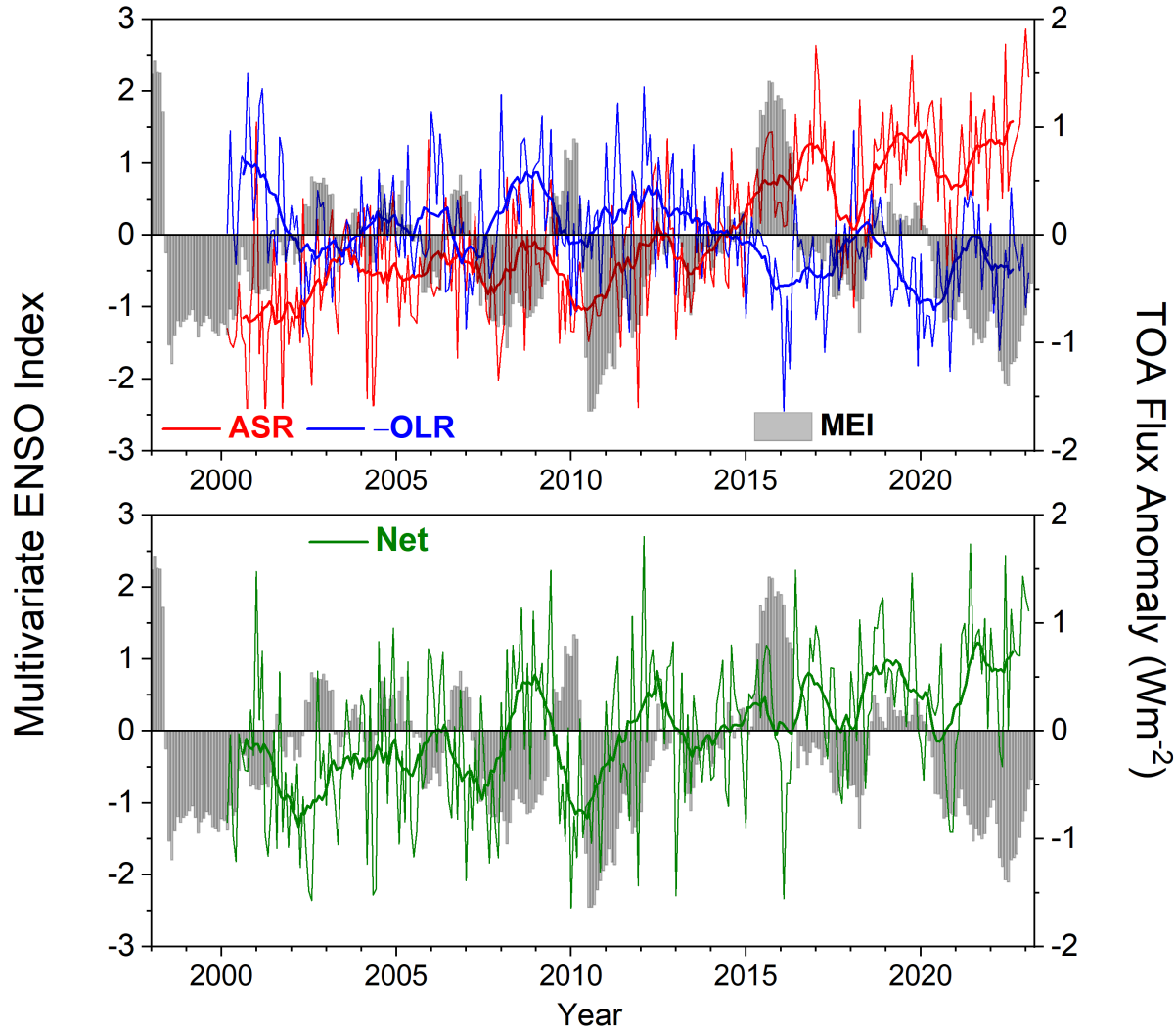
Annual Mean Net TOA Radiation & In-Situ Planetary Heat Uptake (07/2005-06/2022)



	Trend ($\text{Wm}^{-2} \text{ dec}^{-1}$)
CERES EBAF Ed4.2	0.46 ± 0.33
In-Situ	0.38 ± 0.31
Difference	0.084 ± 0.24
R ²	0.54

(update to Loeb et al., 2021)

Global Mean All-Sky TOA Flux Anomalies (CERES EBAF Ed4.2; 03/2000–02/2023)



Trends (Wm⁻² per decade; 2.5-97.5% CI)

ASR: 0.73 ± 0.19

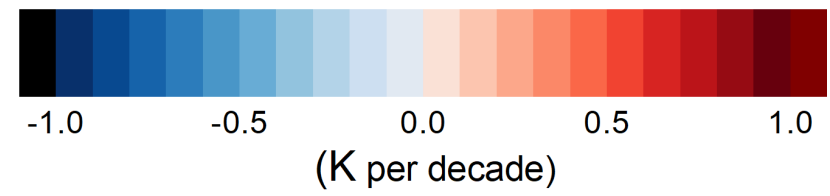
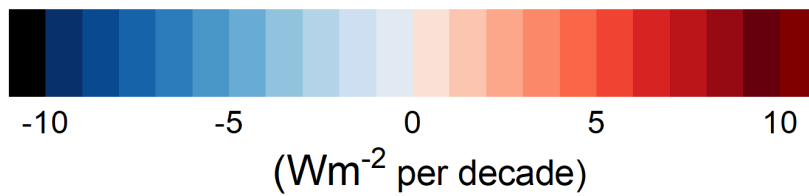
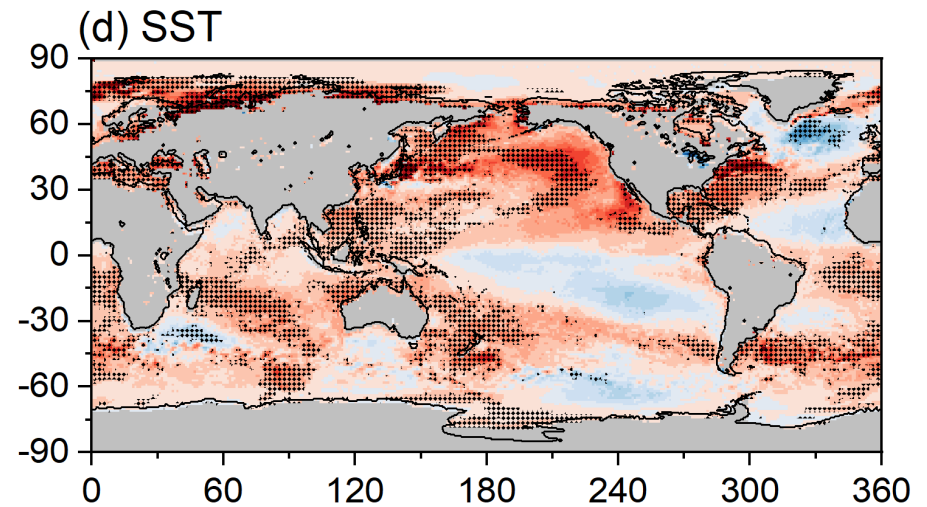
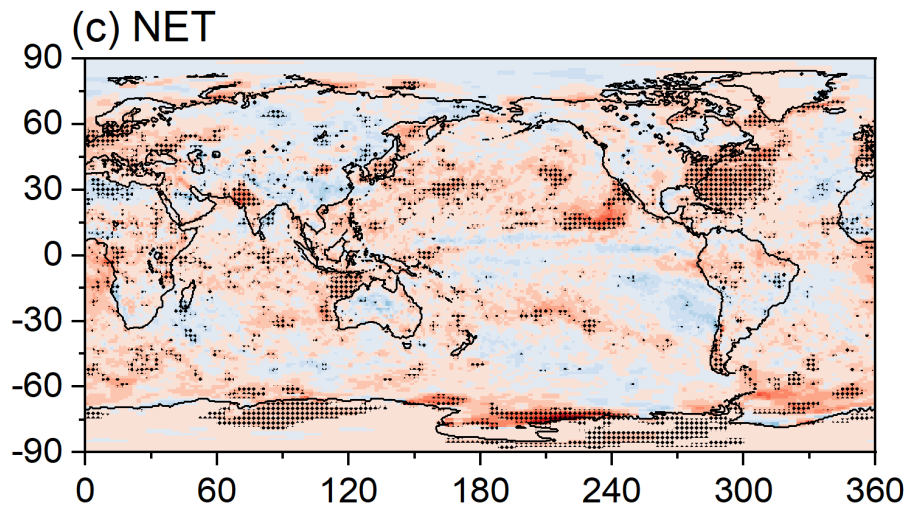
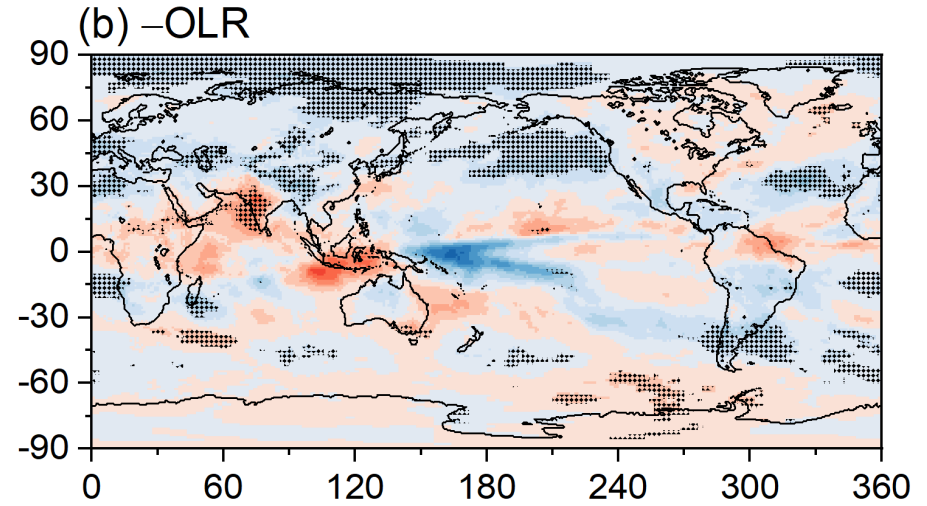
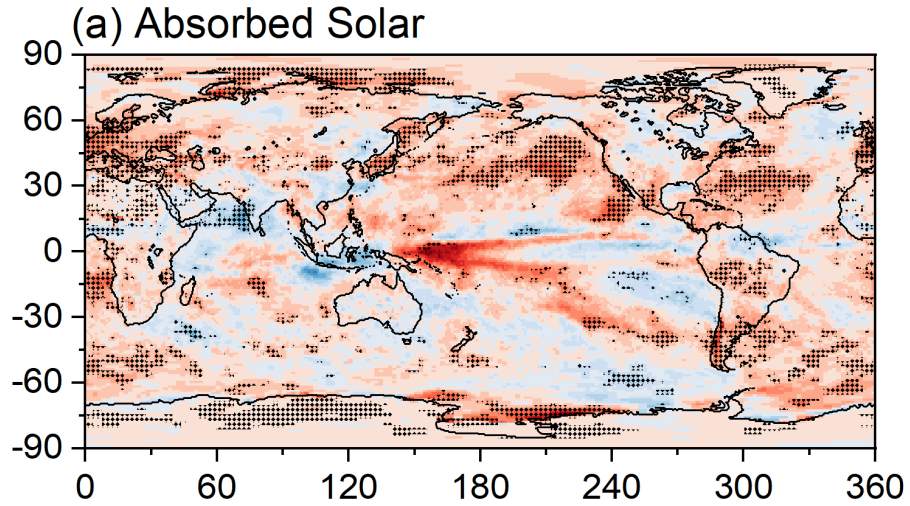
-OLR: -0.27 ± 0.19

NET: 0.47 ± 0.18

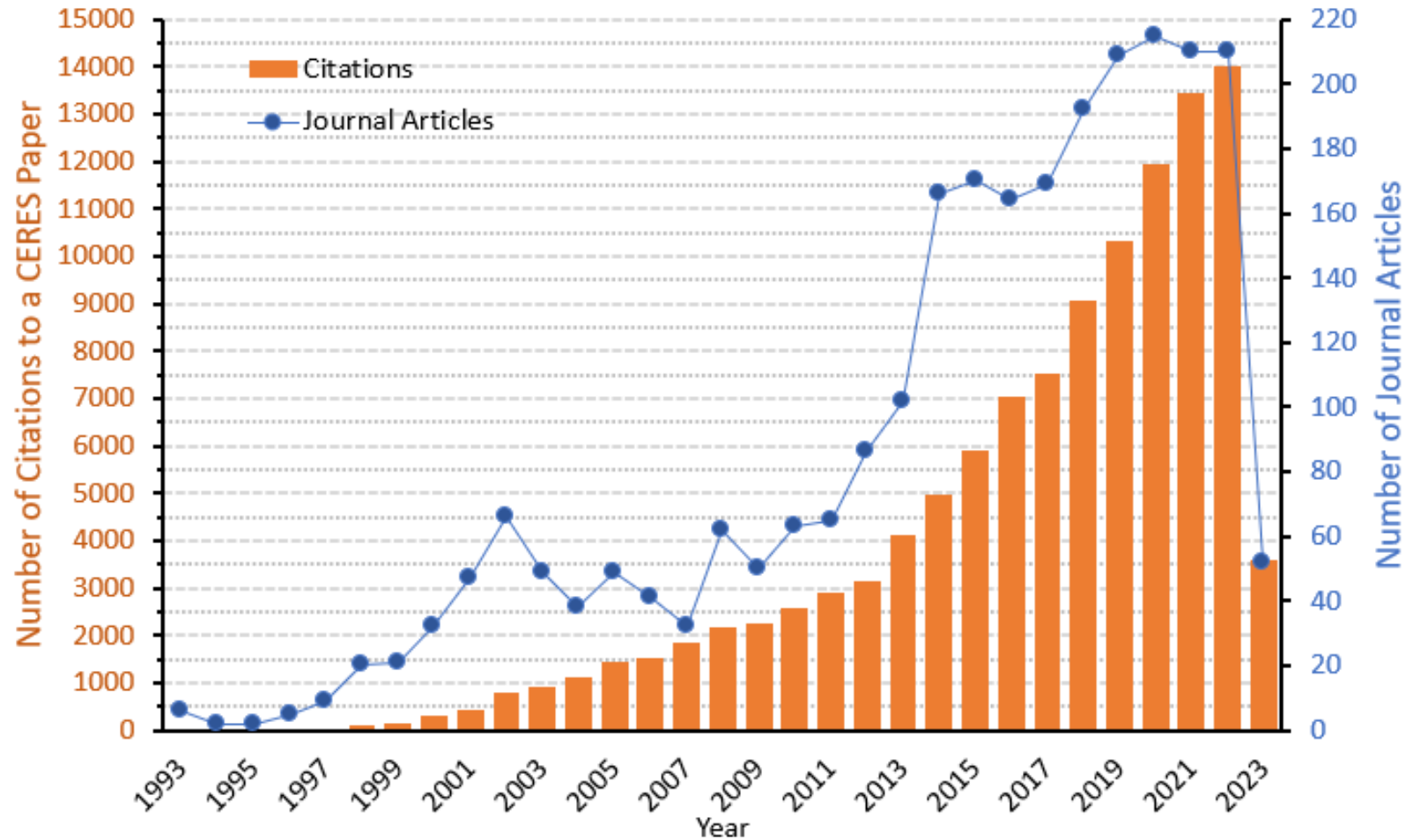
Units: Wm ⁻²	Solar Irradiance	ASR	-OLR	NET
03/2000-02/2010	340.14	240.7	-240.2	0.53
03/2013-02/2023	340.17	241.7	-240.6	1.08
Difference	0.03	1.0	-0.4	0.55

Doubling in EEI!

Regional Trends in TOA Radiation and SST (03/2000–02/2023)



CERES Journal Publications and Citation Counts (For Papers Between 1993-2023; Updated May 1, 2023)



- Total number of peer-reviewed journal articles: 2,604
- Total number of citations to CERES papers: 113,601

(Compiled by Dennis Keyes)

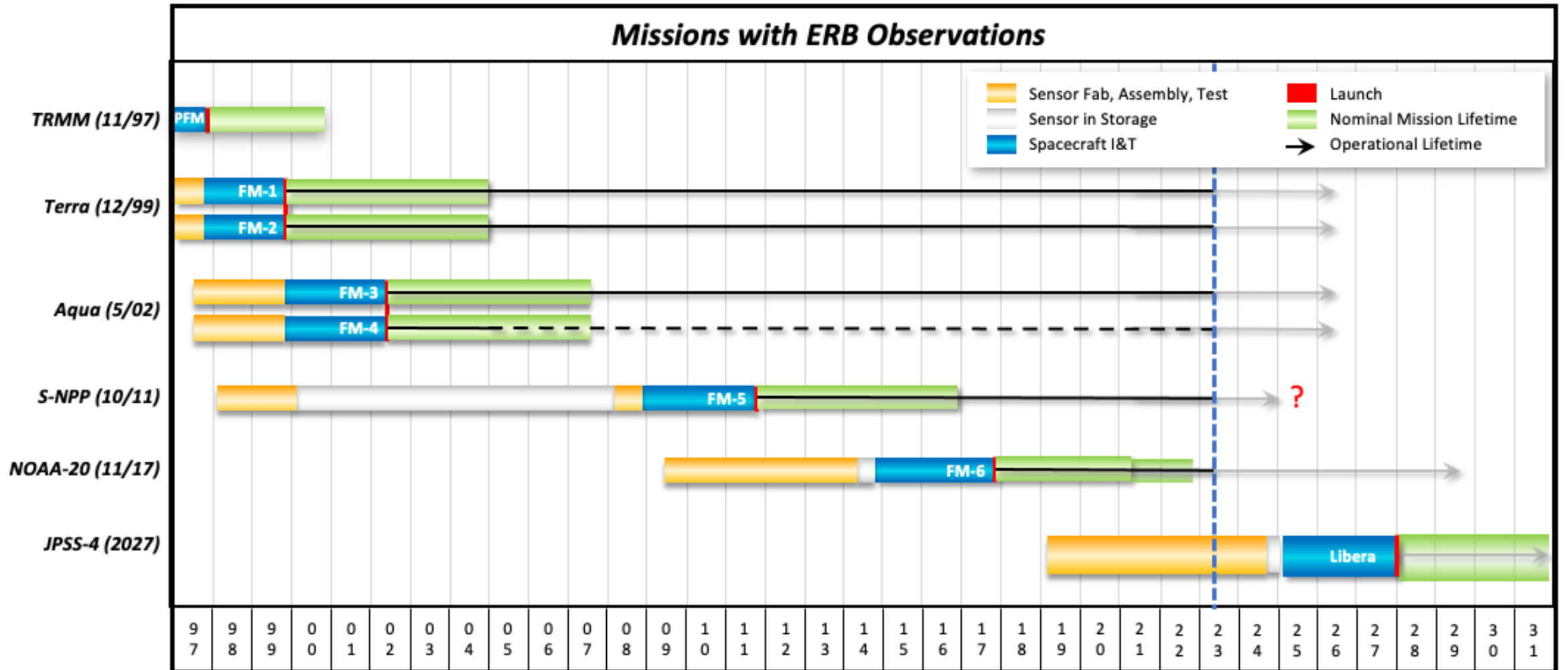
Number of Unique Users by CERES Data Product

(through April 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	5
2	SSF	247	253	278	327	235	251	245	266	272	100
	FLASH_SSF	30	61	41	68	101	92	103	111	123	28
	CCCM	28	55	54	49	49	36	45	58	64	27
	ES8	16	21	15	15	10	8	11	12	14	1
	SSF-MISR	4	2	1	3	1	1	4	3	0	0
3 & 3b	EBAF	731	787	783	935	928	995	1041	1055	1092	528
	SYN1deg	382	438	494	607	639	754	854	886	923	405
	SSF1deg	166	160	194	190	159	221	213	226	261	75
	CldTypHist	41	40	47	86	87	79	86	94	83	42
	FluxByCldTyp							50	69	67	34
	ES4	19	13	12	17	17	17	11	17	16	3
	ES9	9	5	5	8	6	6	8	5	9	1
	FLASH_TISA	15	15	36	52	65	81	131	110	117	30

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

Flight Schedules

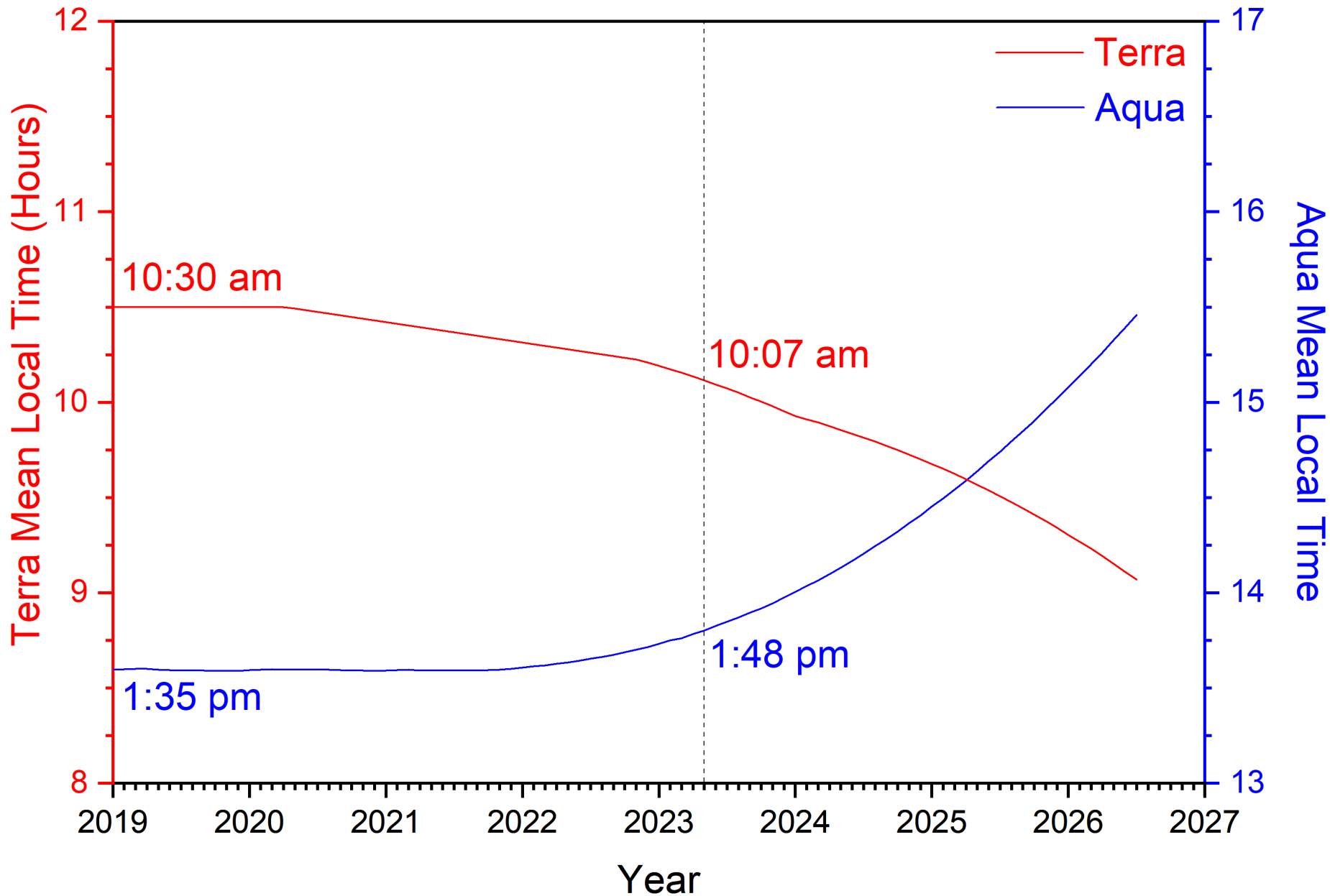


- Currently, 6 CERES instruments fly on 4 satellites: Terra (L1999), Aqua (L2002), SNPP(L2011), NOAA-20 (L2017)
- Libera scheduled for launch in 2027 on JPSS-4

Future Operations of Terra, Aqua and Aura

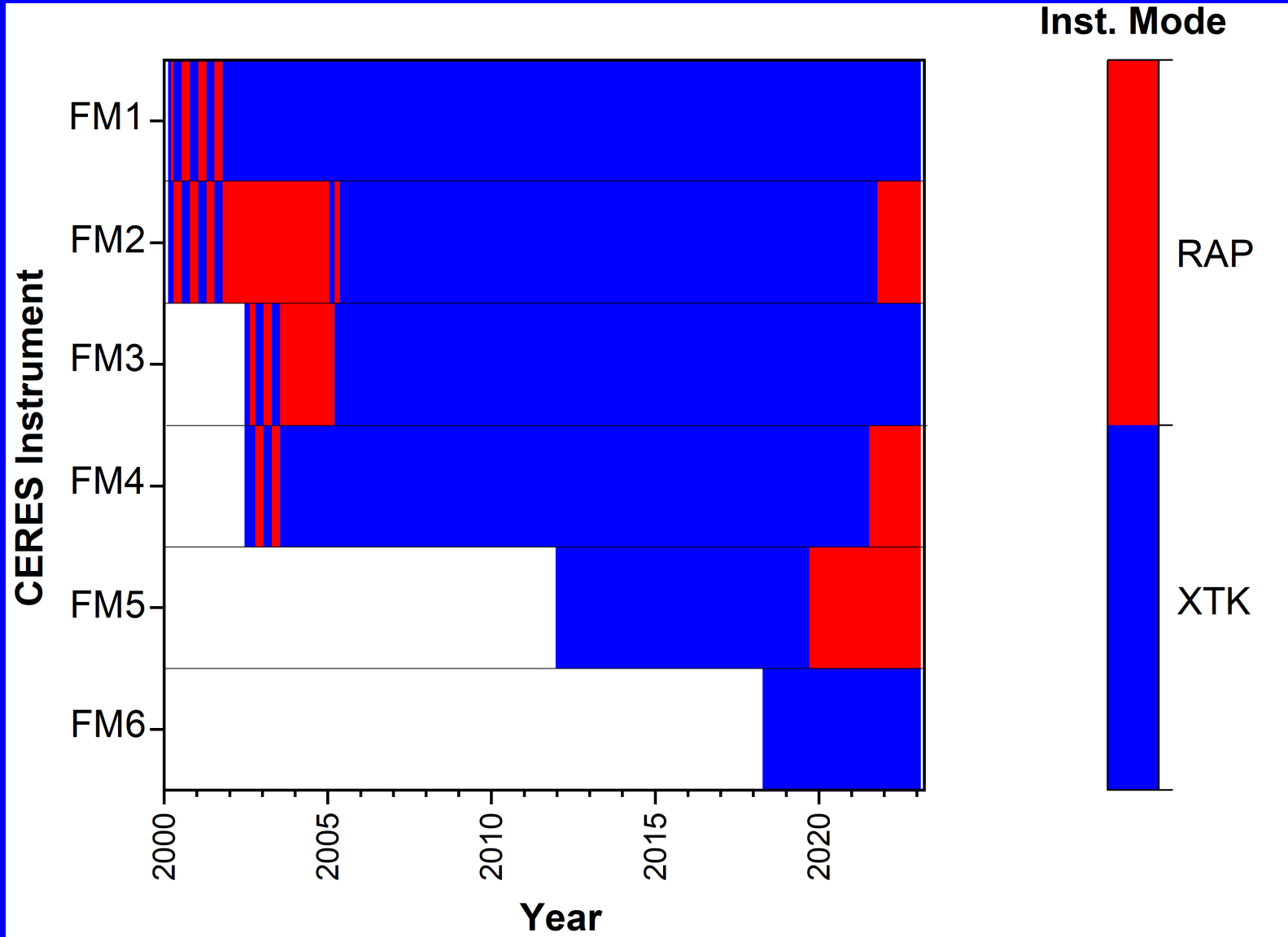
- Until recently, it was anticipated that Terra, Aqua and Aura would end science data collection in 2023, even though the missions can last at least through 2026 (Terra & Aqua), albeit with a drifting MLT.
- NASA asked members of the Terra, Aqua and Aura science communities to submit 3-page (max) responses to a request for information (RFI) on the following themes:
 - Theme 1:** Science objectives that can be achieved with Terra/Aqua/Aura data that are uniquely enabled by observations made during the period of orbital drift.
 - Theme 2:** Benefits to and impact on current societal applications during the period of orbital drift.
- A virtual workshop was held on November 1-2 to discuss these themes. There was overwhelming support by the community for these missions to continue.
- Workshop report available on NSPIRES (T/A/A Drifting Orbits page)
- NASA invited T/A/A to participate in the 2023 Senior Review, which recommends to NASA which missions should be extended for another 3 years.
- Final decision on the fate of these missions expected by late summer.

Terra and Aqua Mean Local Equatorial Crossing Times (MLTs)



CERES Instrument Modes of Operation

Modes of Operations
(03/2000-02/2023)



Modes of Operations
(03/2023-Onwards)

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

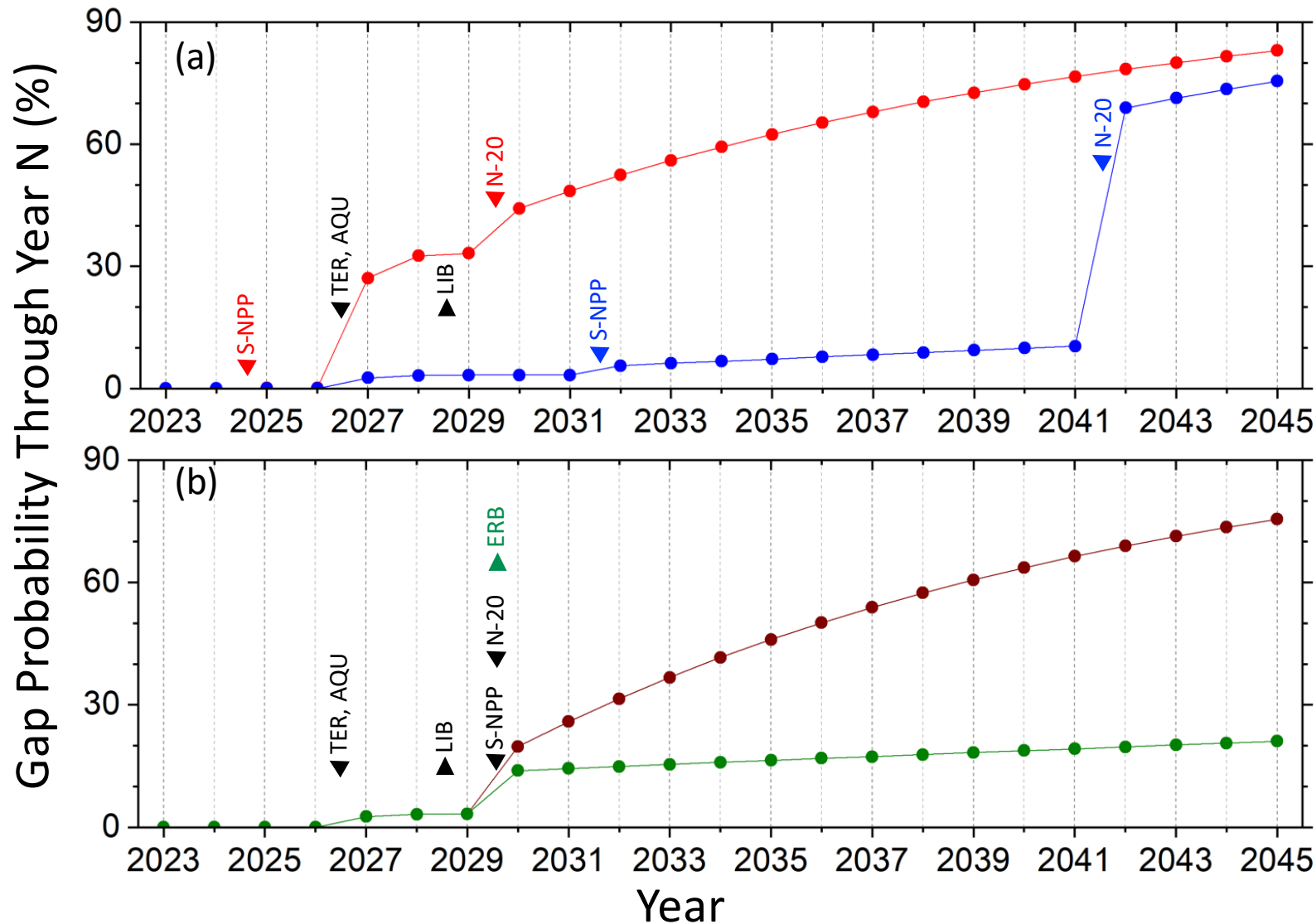
NASA Terra/Aqua/Aura Continuity Workshop (Virtual; May 23-25)

- The loss of T/A/A data products will strongly impact ESD community.
- S-NPP/NOAA-20/NOAA-21/NOAA-2X provide significant level of T/A/A data continuity, but not completely.
- There is also concern about long-term continuity, particular for ERB observations.
- Workshop goal: determine the needs, evaluate the capabilities, identify gaps, and specify possible solutions for continuity beyond T/A/A.
- RFI was sent out by NASA. Received 184 responses. 14 (8%) are related to ERB.
- Workshop is open to everyone.
- Workshop report will include input from RFI responses and discussions during workshop.
- You are invited to participate in the virtual community workshop May 23-25 and provide feedback to NASA headquarters about your concerns.

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 2029, 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 2029, there is a 1 in 3 chance of a data gap in the ERB record.
- Extending both at least through 2029 and launching a new ERB instrument the same year would ensure the data gap risk remains < 16% through 2035.

Planning for Terra & Aqua Edition 5

- 1) GMAO improvements to atmospheric reanalysis system.
 - CERES and GMAO hold WebEx meetings every 3 weeks to gauge progress and provide ongoing validation results for GEOS-IT.
 - Expect GEOS-IT release for entire CERES period by fall of this year.
- 2) MODIS Collection 7. Expect release of MODIS Level-1b in spring 2024.
- 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 Niño, 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.
- See Gavin's invited presentation tomorrow. A journal article is in preparation.

CRAVE — CERES Radiation and Validation Experiments

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



GRANITE ISLAND

- Moved SW global from tracker to stand-alone, in case of solar tracker failure.
- Data availability: 2018 July – 2022 January and 2022 June– Present.
- The solar tracker did fail in January, but since global was moved to stand-alone and Downwelling LW does not need to be shaded, we still collected those measurements, along with AERONET, SP02, MET, PAR and Lake Temperature.
- But we lost downwelling diffuse and downwelling direct.
- Next trip to replace solar tracker and routine maintenance will be 2023 May.

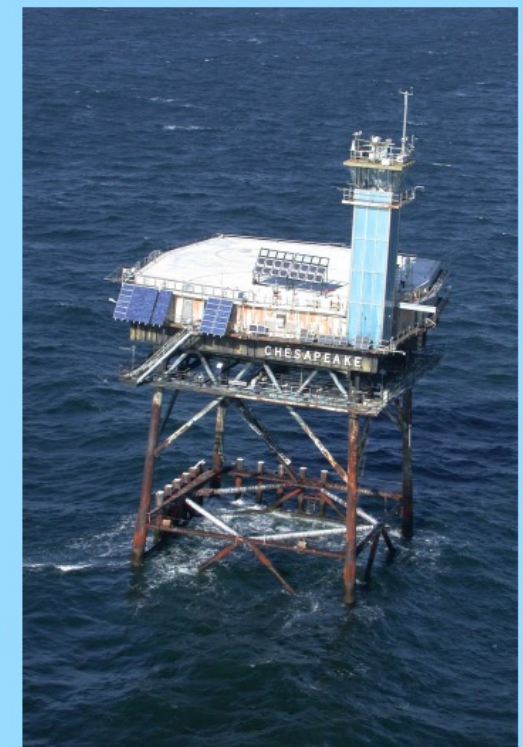


LaRC

- MPL is currently down for calibration and maintenance.
- BSRN, AERONET, MET and PAR are functional.
- A SW pyranometer instrument is participating in a round-robin calibration experiment to determine accuracies at 3 different sites in contrasting climate zones using different calibration methodologies.
- Data availability is 2014 December – Present

COVE (Legacy)

- Data availability from 2000 May – 2016 November.



Upcoming Conferences & Meetings of Interest

IUGG General Assembly

- July 11-20, Berlin, Germany

Gordon Research Conference (Radiation & Climate)

- July 23-28, Bates College, ME

Fall 2023 CERES Science Team Meeting

- TBD

Fall AGU

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

=> Session on CERESMIP organized by Gavin Schmidt.

AMS Annual Meeting

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