State of CERES

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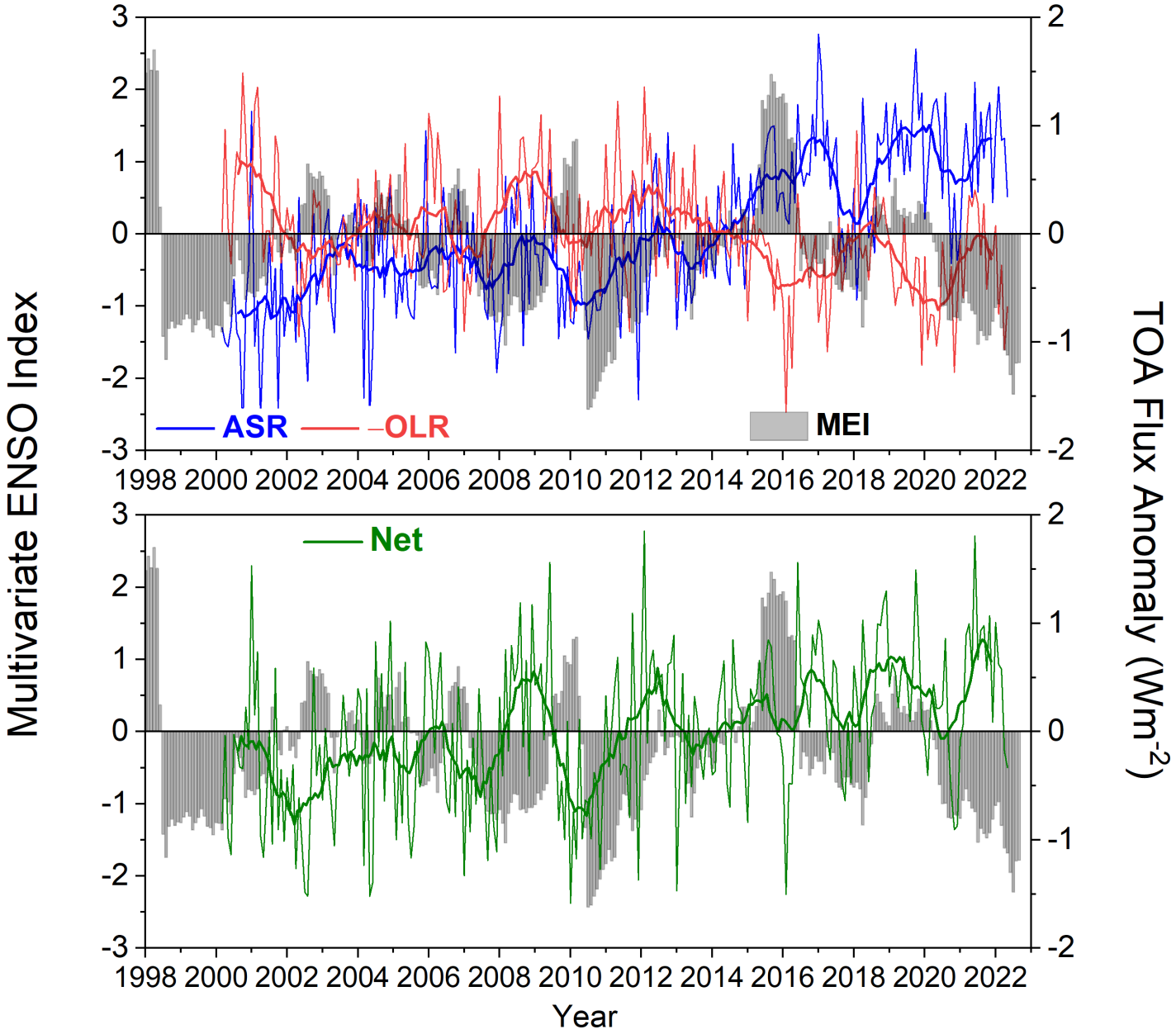
CERES Science Team Meeting, October 12-14, 2022
Max Planck Institute, Hamburg, Germany

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

Global Mean All-Sky TOA Flux Anomalies & Multivariate ENSO Index
(CERES EBAF Ed4.2; 03/2000–05/2022)



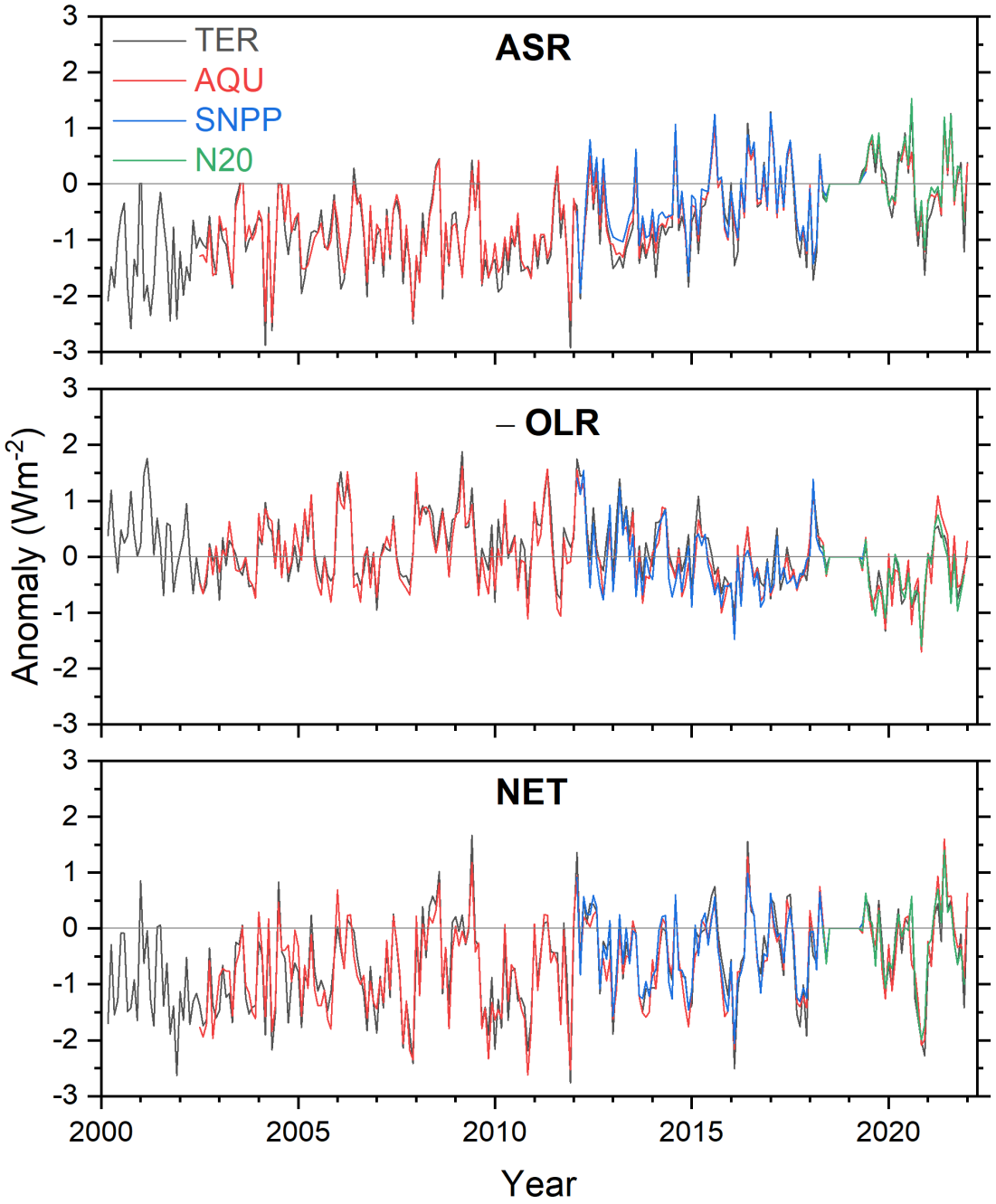
EBAF Trends (03/2000-05/2022)

ASR: 0.70 ± 0.20 Wm^{-2} per decade

LW: -0.28 ± 0.20 Wm^{-2} per decade

NET: 0.42 ± 0.19 Wm^{-2} per decade

Global Mean All-Sky TOA Flux Monthly Anomalies (03/2000-01/2022; Climatology: 05/2018—06/2019)



- Based upon CERES SSF1deg products (no GEO)
- NET monthly anomalies consistent to 0.3 Wm^{-2} (1σ)
- No evidence of CERES instrument drift

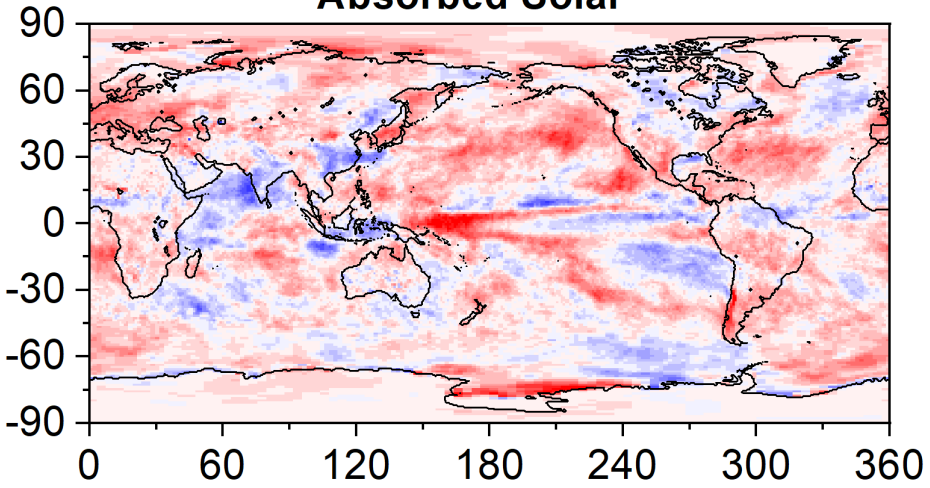
TOA Radiation Changes (03/2000 – 05/2022)

Hemis. Trends (Wm^{-2} dec^{-1})

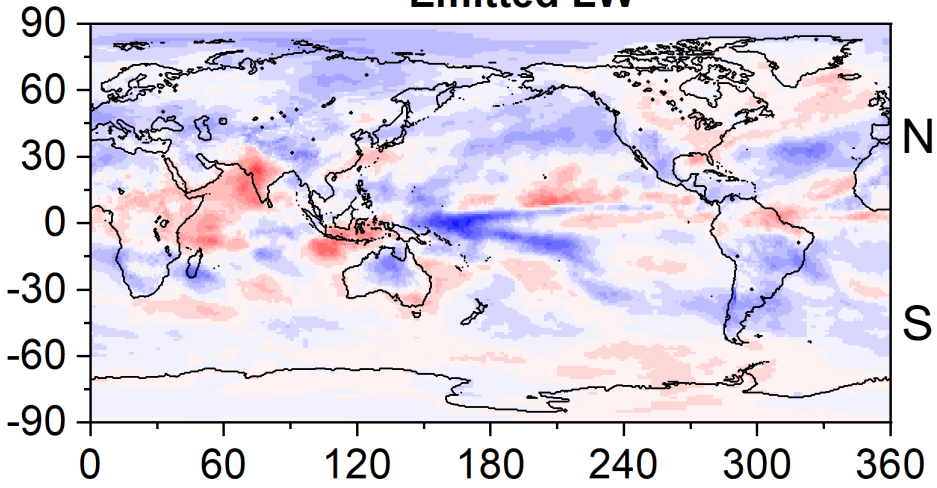
NH: 0.78±0.24

SH: 0.62±0.24

Absorbed Solar



– Emitted LW



Hemis. Trends (Wm^{-2} dec^{-1})

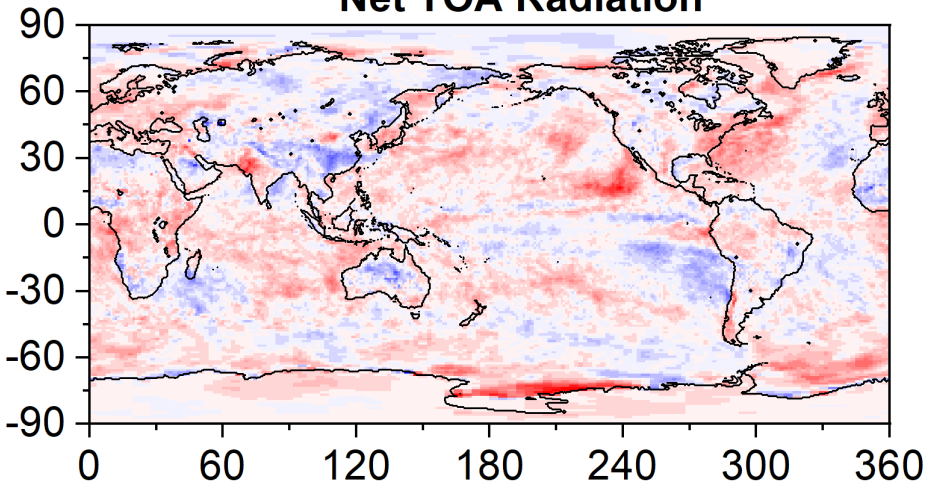
NH: –0.32±0.22

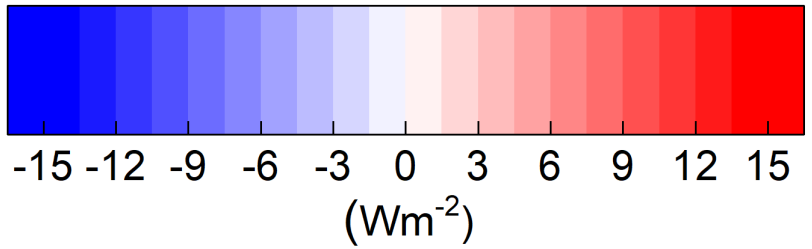
SH: –0.24±0.23

Net TOA Radiation

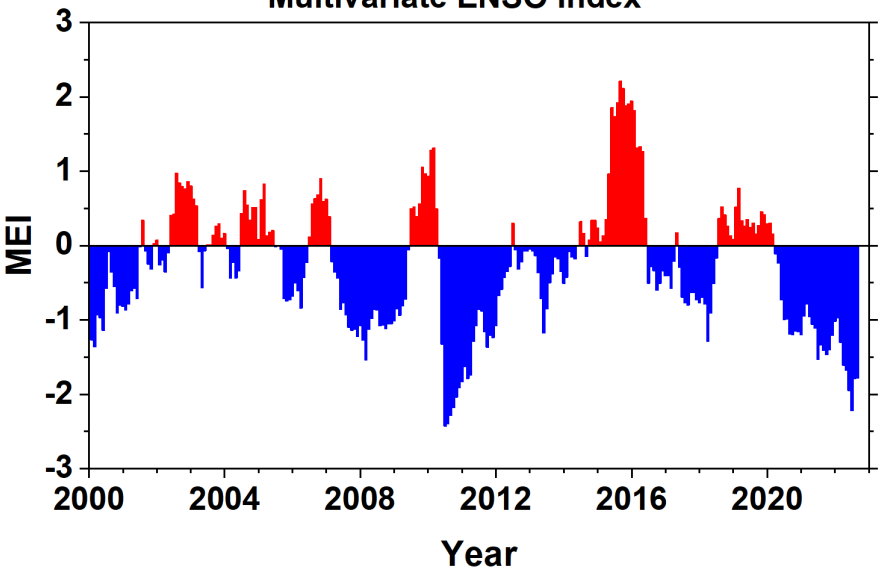
NH: 0.46±0.22

SH: 0.39±0.27

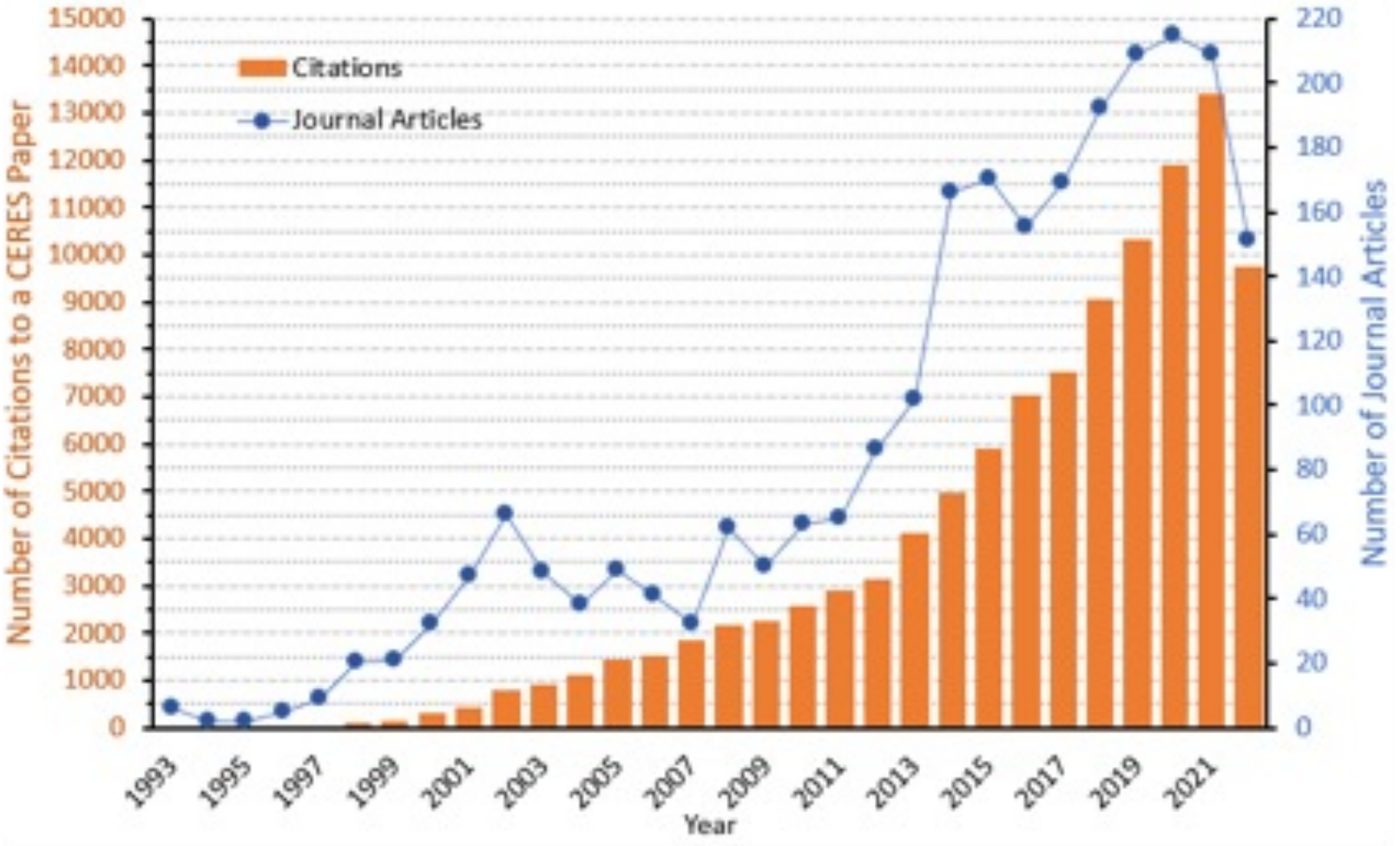




Multivariate ENSO Index



CERES Journal Publications and Citation Counts
(For Papers Between 1993-2022; Updated October 5, 2022)



- Total number of peer-reviewed journal articles: 2,482
- Total number of citations to CERES papers: 105,650

(Compiled by Dennis Keyes)

Number of Unique Users by CERES Data Product

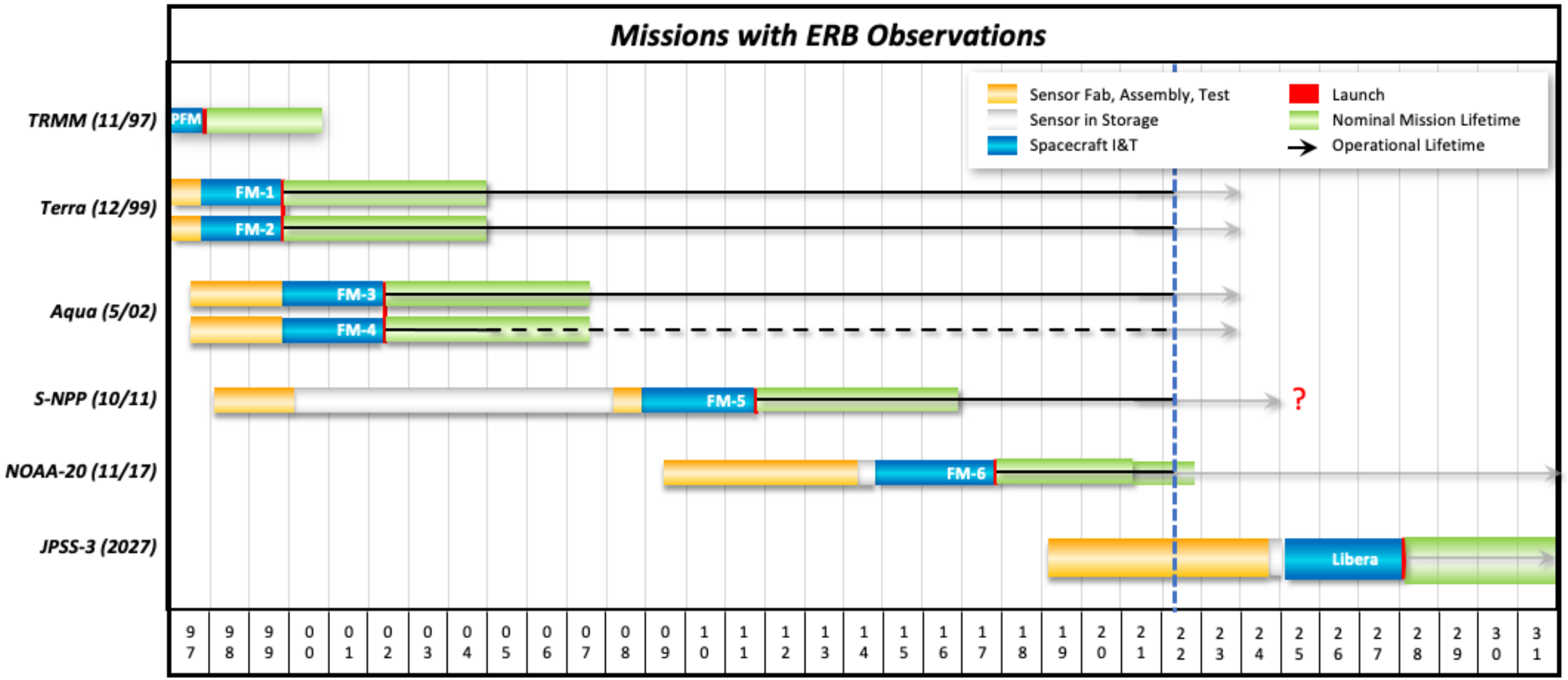
(through September 30, 2022)

Level	Product	2013	2014	2015	2016	2017	2018	2019	2020	2021*	2022*
1b	BDS	19	14	11	13	14	10	12	19	5	0
2	SSF	223	247	253	278	327	235	251	229	209	146
	FLASH_SSF	23	30	61	41	68	101	92	97	85	80
	CCCM	37	28	55	54	49	49	36	37	35	7
	ES8	31	16	21	15	15	10	8	8	0	0
	SSF-MISR	5	4	2	1	3	1	1	4	3	0
3 & 3b	EBAF	602	731	787	783	935	928	995	1010	921	742
	SYN1deg	353	382	438	494	607	639	754	827	765	645
	SSF1deg	157	166	160	194	190	159	221	199	185	136
	CldTypHist	57	41	40	47	86	87	79	84	74	49
	FluxByCldTyp								44	56	43
	ES4	27	19	13	12	17	17	17	10	5	0
	ES9	13	9	5	5	8	6	6	3	2	0
	FLASH_TISA	17	15	15	36	52	65	81	127	103	80

FLASHFlux via POWER since last year: **105,702**

* The numbers are lower because most orders through ASDC now come from Direct Data Download, which are not currently captured in the ESDIS Metrics System (EMS).

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-3

Future Operations of Terra, Aqua and Aura

- Current in-guide budget for Terra, Aqua and Aura ends science data collection in 2023, even though the missions can last at least through 2026 (Terra & Aqua), albeit with a drifting MLT.
- NASA has yet to decide whether to invite these missions to participate in the 2023 Senior Review, which recommends to NASA which missions should be extended for another 3 years.
- 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:

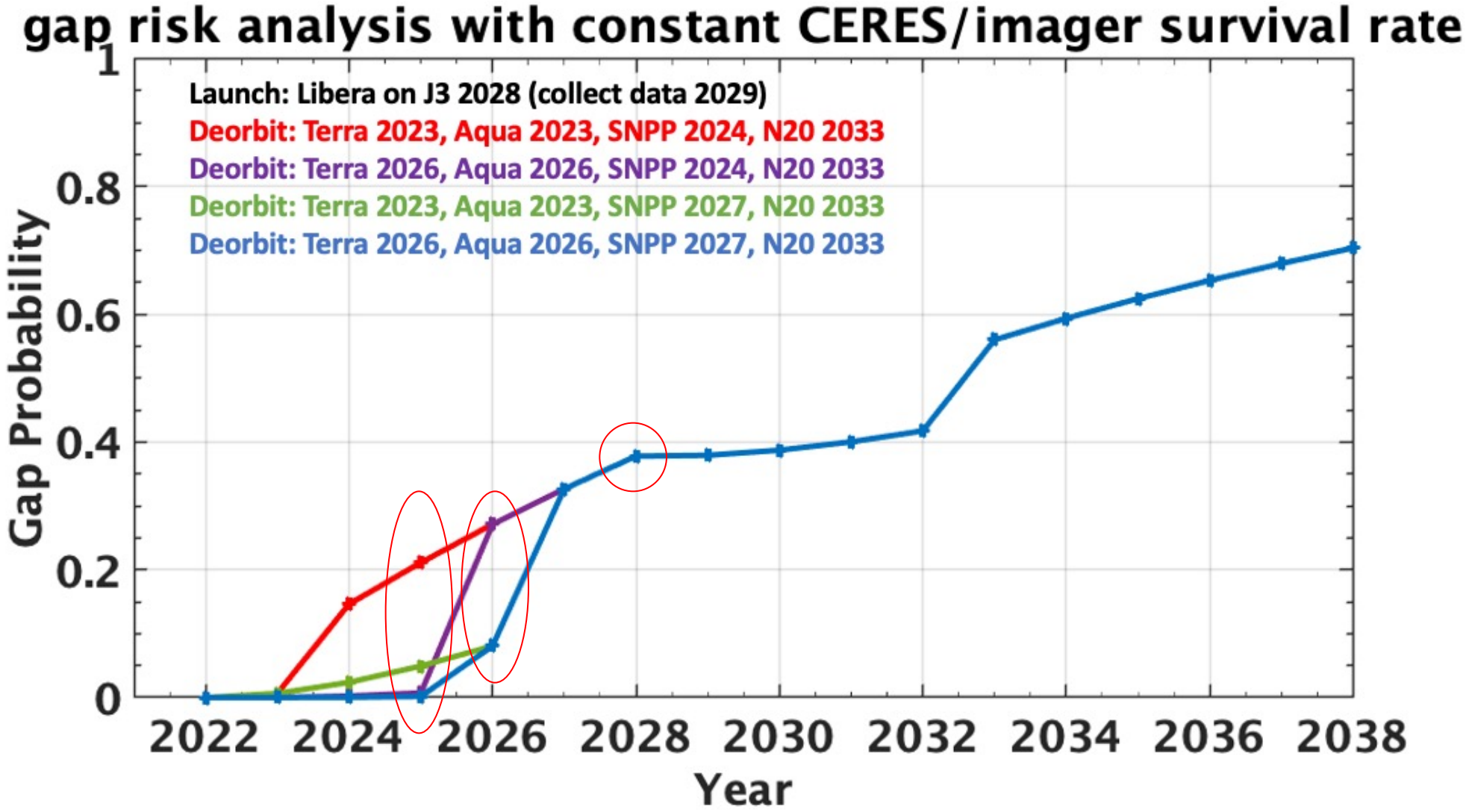
  Theme 1: Science objectives that can be achieved with Terra/Aqua/Aura data that are uniquely enabled by observations made during the period of orbital drift.

  Theme 2: Benefits to and impact on current societal applications during the period of orbital drift.

- A workshop discussing these themes will be held November 1-2. PLEASE REGISTER
- The projects will submit a workshop report to NASA HQ, who will announce their decision shortly after the workshop.

Future Operations of S-NPP

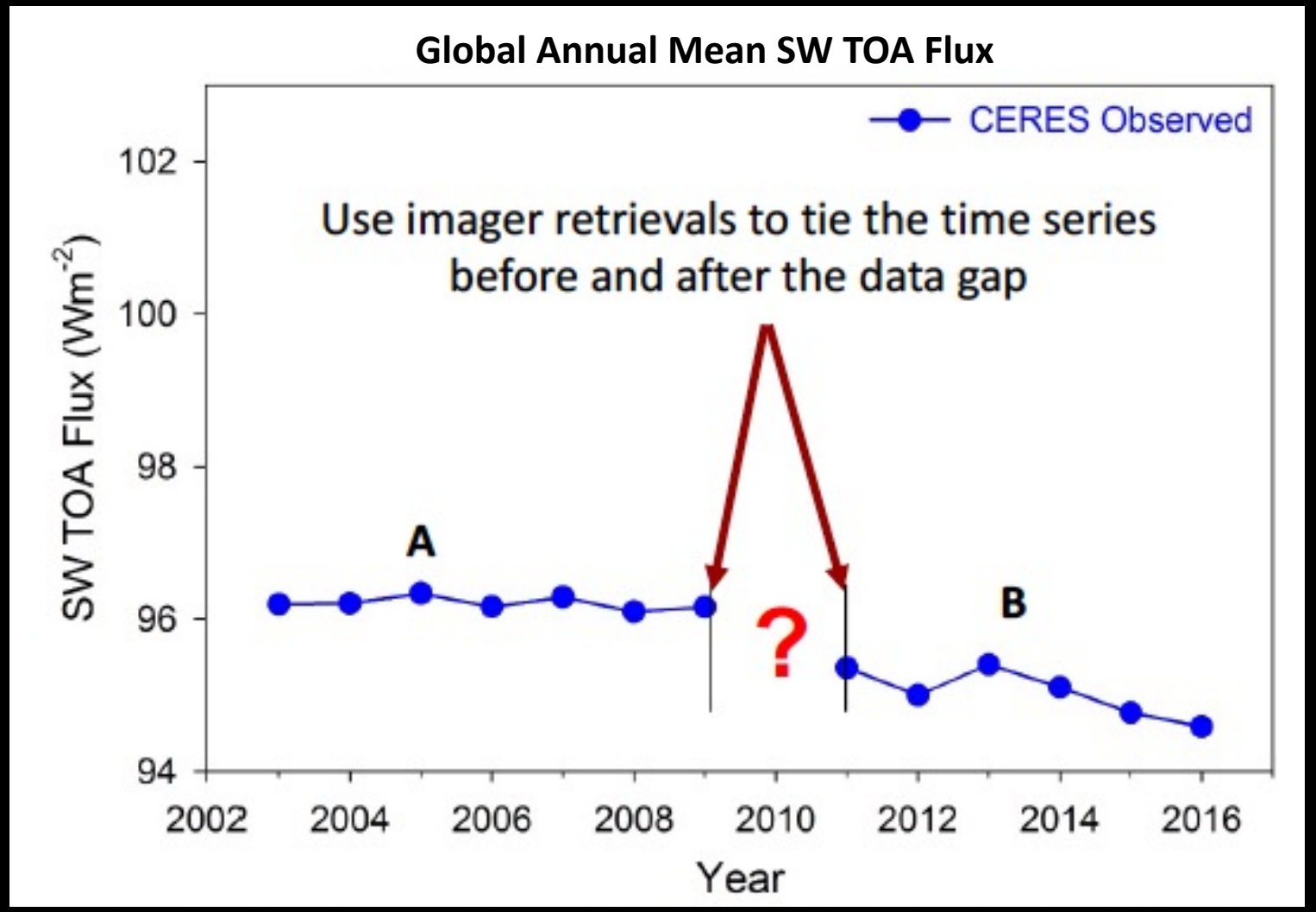
- S-NPP (launched in 2011), will continue to operate at least through spring 2024, 1.5 years after JPSS-2 launches in November 2022.
- S-NPP can last at least through 2027 based upon available consumables.
- If S-NPP ends science data collection in 2024, that will leave only CERES FM6 (NOAA-20, L2017), to provide overlap with Libera, scheduled for launch in 2028.



- Gap risk in 2025 exceeds 20% if SNPP ends in 2024 and TER & AQU end in 2023. Remains <5% if either SNPP ends in 2027 or TER & AQU end in 2026.
- Gap risk in 2026 reaches 27% if SNPP ends in 2024 but remains <10% if SNPP ends in 2027.
- Gap risk reaches 38% when Libera launches in 2028 for all scenarios.

Bridging a Data Gap in the ERB CDR

Goal: Examine the feasibility of using less-accurate imager retrievals to compute radiative fluxes and tie the time series before and after a data gap together.



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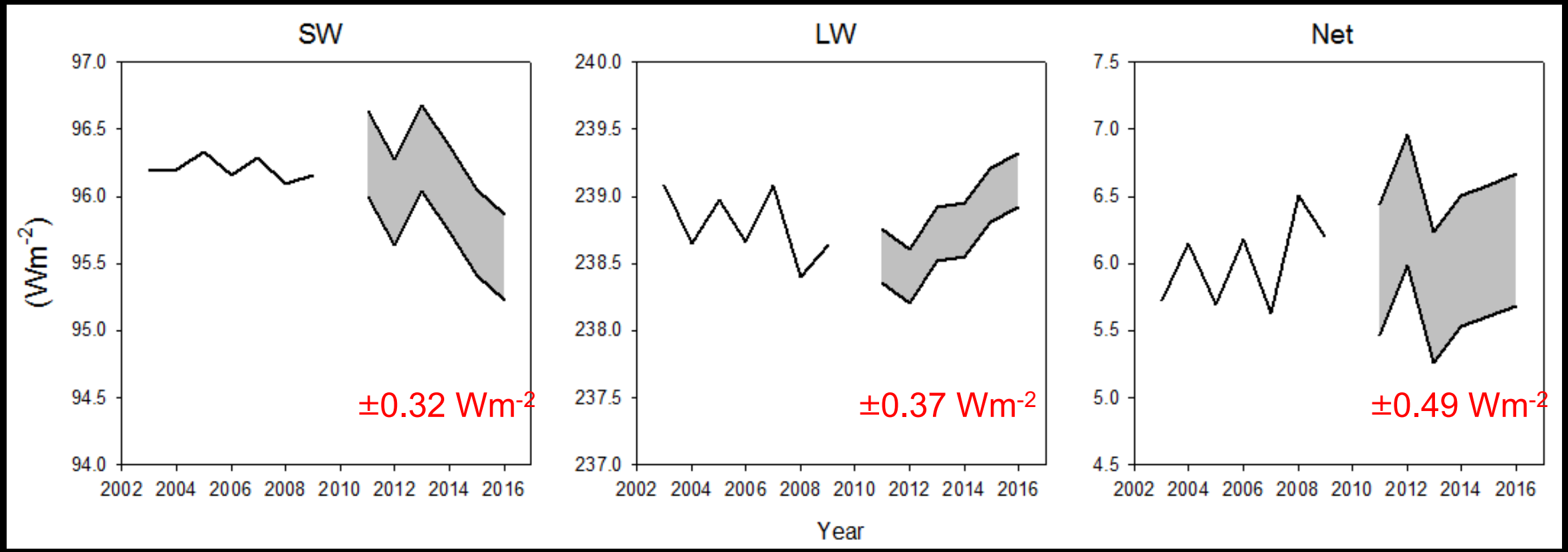


- Assumes imager remains healthy and perfectly stable across the data gap. The longer the gap, the greater the risk.
- The resulting uncertainty is too large to enable decade-to-decade changes in EEI to be resolved.
- Time to detect a real trend above uncertainty would increase substantially.
- A gap would require considerable extra post-processing effort, thereby delaying release of the ERB data products.

Planning for Terra & Aqua Edition 5

Main Considerations:

1) GMAO improvements to their atmospheric reanalysis system.

- CERES and GMAO hold WebEx meetings every 3 weeks to gauge progress and provide ongoing validation results for the latest GEOS FP or FPIT version.

2) MODIS Collection 7 schedule.

4) CERES production code improvements.

5) CERES algorithm improvements (particularly those enabling a seamless transition across satellite platforms).

Note: EBAF Ed4.2 will be released this year in order transition from Terra+Aqua to NOAA-20 and to mitigate discontinuities in EBAF-SFC associated with input reanalysis data and GEO artifacts.

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 and Susanne Bauer (NASA GISS) are now 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.
- Susanne Bauer will give a Fall AGU talk on this. A journal article is in preparation.

CRAVE — CERES Radiation and Validation Experiments
https://science.larc.nasa.gov/CRAVE/

GRANITE ISLAND

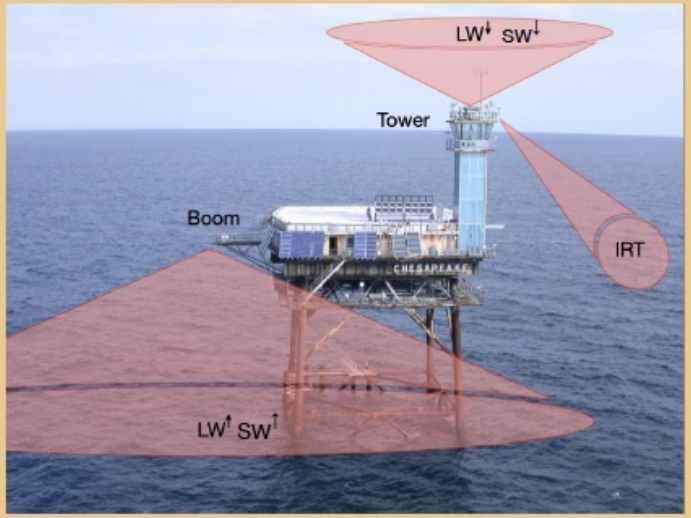
- Recall weeks of overcast sky conditions drained power system last winter. In early June: New batteries installed, replaced failed solar tracker and restarted all instruments (BSRN, AERONET, PAR, MET and lake skin temperature IRT).
- Plan is to move SW global from tracker to stand-alone, in case of solar tracker failure.
- Status and Operations poster virtually presented at the BSRN workshop in Ispra, Italy.
- Current data availability is 2018 July – 2022 January and 2022 June– Present.

National Pyrheliometer Comparison

- Two absolute cavity radiometers participated in late September.
- Located at the Solar Radiation Research Laboratory in Golden, CO.
- Event happens yearly to confirm direct traceability to the World Radiometric Reference.
- The cavity radiometers are used to calibrate SW instruments at both CRAVE-GI and CRAVE-LRC.

COVE (Legacy)

- Data availability from 2000 May – 2016 November



LaRC

- MPL is currently down since 2022 August 1 due to ransomware attack.
- BSRN, MET and PAR are okay. AERONET data should be okay.
- In-Person summer internship resumed after 2-year hiatus.
- Status and Operations poster virtually presented at the BSRN workshop in Ispra, Italy.
- Current data availability is 2014 December – Present.

Upcoming Conferences & Meetings of Interest

Fall AGU
- December 12-16, 2022, Chicago, IL

EGU General Assembly
- April 23-28, 2023, Vienna, Austria

Spring 2023 CERES Science Team Meeting
- TBD, NASA LaRC, Hampton, VA

IUGG General Assembly
- July 11-20, Berlin, Germany

Gordon Research Conference (Radiation & Climate)
- July 23-28, Bates College, ME

Richard Green (1940-2022)

Career at NASA: 1963-2001.

- Richard was part of the team that developed the orbit analysis methods that enabled the 1970s Viking mission for landing on Mars, the first successful landing on another planet.
- In the 1980s, Richard developed algorithms for ERBE TOA flux inversion (Wielicki and Green, Maximum likelihood estimation for scene identification) and WFOV TOA flux inversion.
- In the 1990s, he developed new methods for CERES vicarious calibration and ADM development.
- Mentor and friend to those of us who joined CERES in the late 1990s/early 2000s.