



A Status Update for the FLASHFlux/SOFA Working Group

Paul Stackhouse (NASA LaRC)

*PC Sawaengphokhai, Anne Wilber, Alice Fan,
Ryan Scott, Walt Miller and Victor Sothcott (SSAI)*

POWER Team: Bradley MacPherson (Booz-Allen-Hamilton)

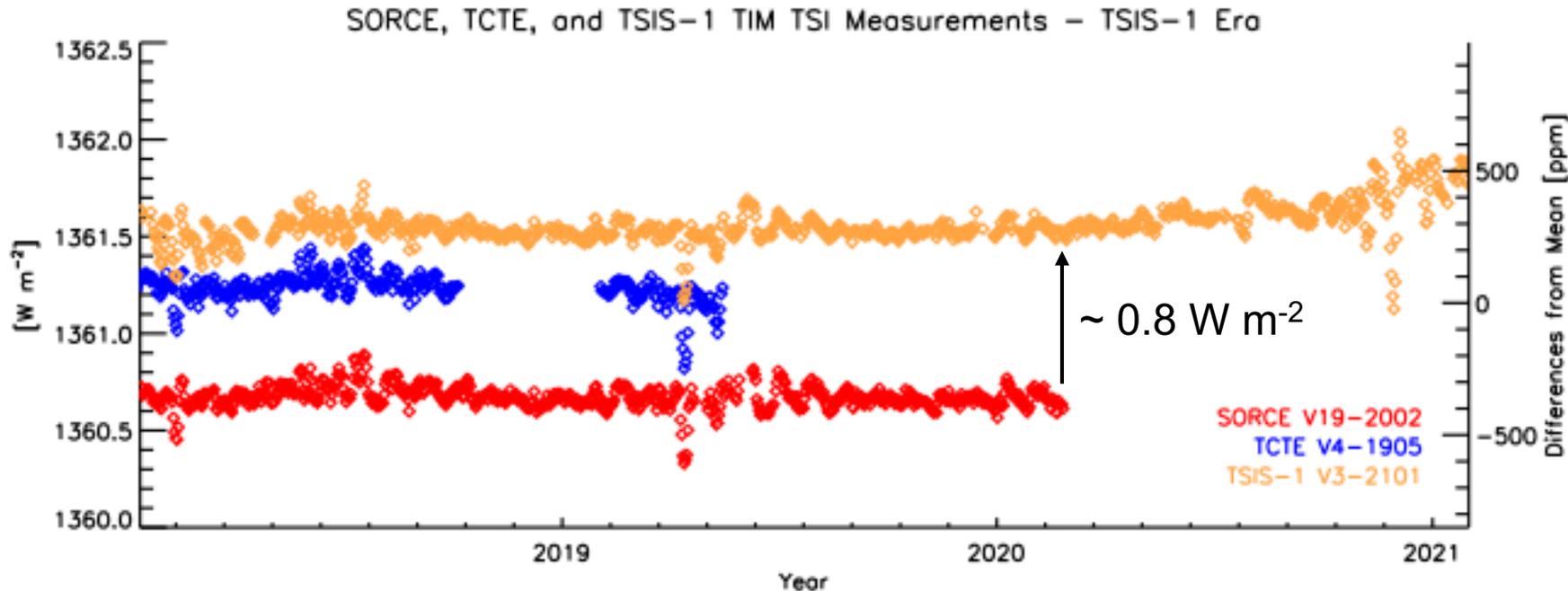
*Tonya Davenport and Fenny Wang and the
Atmospheric Science Data Center Team (SSAI)*

Acknowledging Recent Retirees: David Kratz, Shashi Gupta and now Anne Wilber



CERES TSI: From **SORCE** to **TSIS**

- CERES Normalizes to SORCE v15; TSIS-1 TIM v2 $\sim 0.4 \text{ W m}^{-2} >$ SORCE v15
- TSIS-1 team releases TIM v3 data set on May 26, 2020: v3 - v2 $\sim 0.4 \text{ W m}^{-2}$



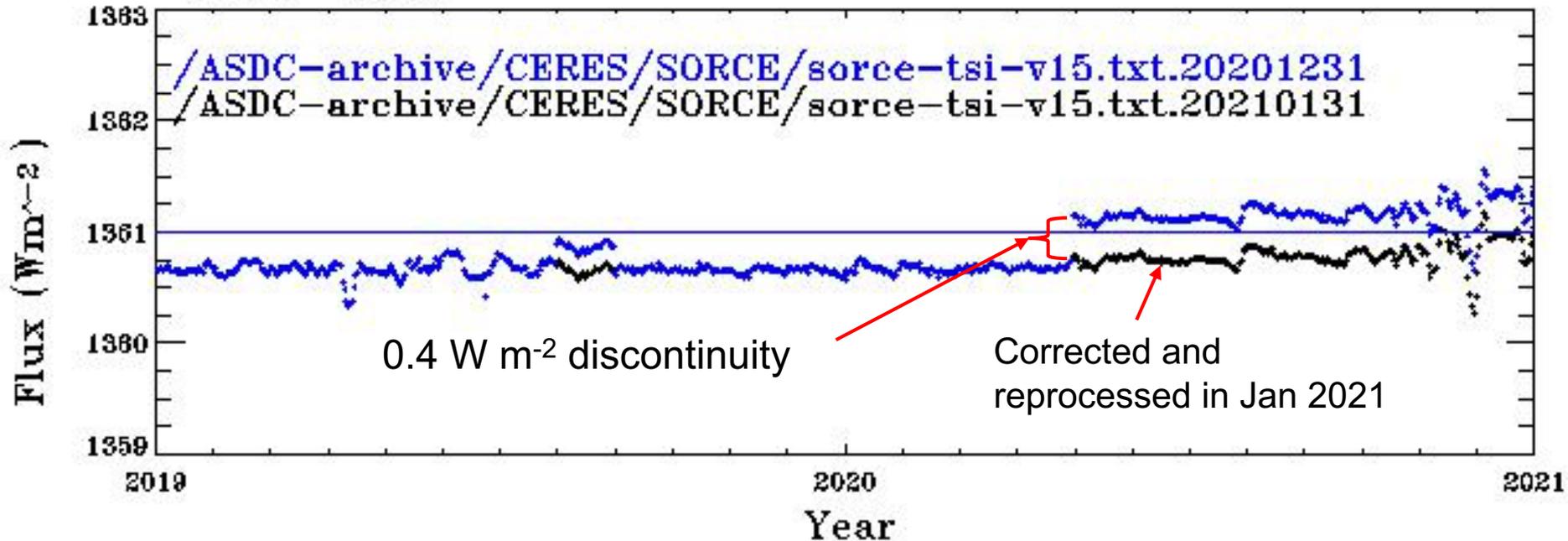
G. Kopp, 31 Jan. 2021



CERES TSI: From SORCE to TSIS

Unfortunately, CERES TSI production missed the TIM v3 delivery until January

2019-2020



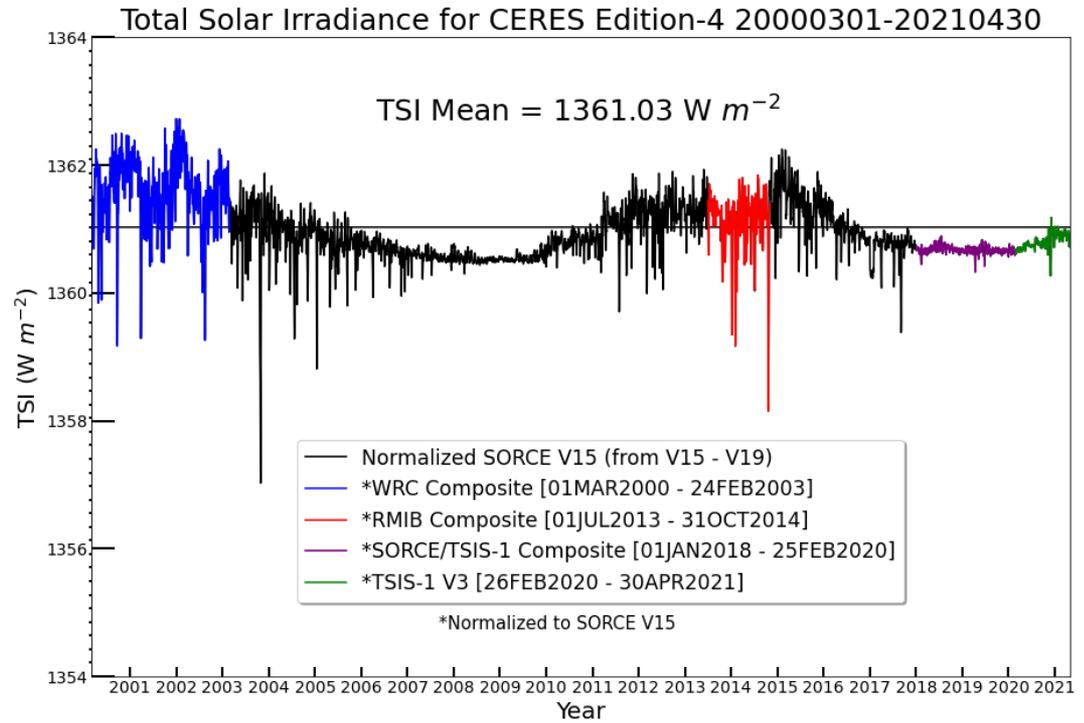


CERES TSI: From SORCE to TSIS

- Derived new normalization coefficients to SORCE v15
- Better QC instituted to prevent reoccurrence
- Details on CERES web site at:

<https://ceres.larc.nasa.gov/data/general-product-info/#total-solar-irradiance-tsi-information>

Remaining issue: TIM v3 – SORCE v19 difference is greater than the absolute uncertainty of SORCE; CERES Ed5?





CERES FLASHFlux Overview

- **FLASHFlux Overview**

- Uses CERES based production system through inversion
- Periodic calibration updates projected forward; running 3-day TISA
- LPSA/LPLA SOFA algorithms for surface fluxes

- **FLASHFlux Latency Objectives**

- SSF products within 4 days
- Global 1x1 daily averages from FF TISA (uses a running 3-day average); goal: 6-7 days latency

- **FLASHFlux Usages**

- Primarily used for applied science and education (i.e., POWER and Globe Clouds)
- Supports also QC for selected missions (e.g., NOAA NESDIS)
- TOA gridded fluxes; normalized to TOA EBAF for annual “State of the Climate” assessments (most recent report revised Mar. 2021).



FLASHFlux Version 4A

Attribute	FF v3C (MC6)	FF v4A
Baseline 1QC	Previous (Terra, Aqua)	New calibration delivered in May; moving to quarterly update cycle (Terra, Aqua)
GEOS FP-IT input	GEOS 5.12.4	GEOS 5.12.4 (soon to be GEOS-IT)
MOA	Ed 4 compatible	Ed 4 compatible
MODIS	Collection 6.1	Collection 6.1
Clouds	Ed 2b w/ updated MC	Ed 4 w/ MC 6.1 calibration
SIBi (Snow/ICE Brightness Index)	No	Yes
Inversion (improved ADMs)	Ed 2	Ed 4
Aerosols	MATCH climatology	MATCH climatology
Flux Algorithm	Unchanged	Modified LPSA (new snow/ice parameterization)
TISA	Ed 2	Compatible w/ Ed 4
Data Processed	SSF Terra 1/1/17 – 9/6/20; SSF Aqua & TISA (Terra+Aqua) 1/1/17 – 8/15/20	Operational; from Jan 1, 2019
Validation Results	1/1/17 – 12/31/19	1/1/19 – 12/31/2020



FLASHFlux Status

- ***Production with v4A Begun (since Aug 1, 2020)***
 - Operational FF v4A SSF and TISA v4A: SSF Terra/Aqua through 5/3; TISA through 4/30
 - Reprocessed with Version 4A from Jan 1, 2019 through July 2020 for validation
- ***Validation and Assessment***
 - DQS for SSF and TISA compare FF to CERES Ed4
 - SSF relative to CRS, CERES Ed4A SSF (SOFA) and FF and BSRN (Ryan's talk)
 - TISA Daily averages relative to BSRN for 2019 and 2020
- ***FLASHFlux Modernization and Updates***
 - Evaluating ML based algorithms for future FF SSF data products (Ryan's talk)
 - Migration to CERES CATALYST for future production managing
 - NOAA-20 path tested through inversion; upgrading TISA to accommodate
 - New GEOS-IT sample data coming (June ?)
- ***FLASHFlux Information & Data Provision Through ...***
 - Daily and monthly data available in internal subsetter; internal team web site
 - CERES web site and subsetter both SSF and TISA, ASDC (via EarthData) and POWER



FLASHFlux Data Delivery via POWER

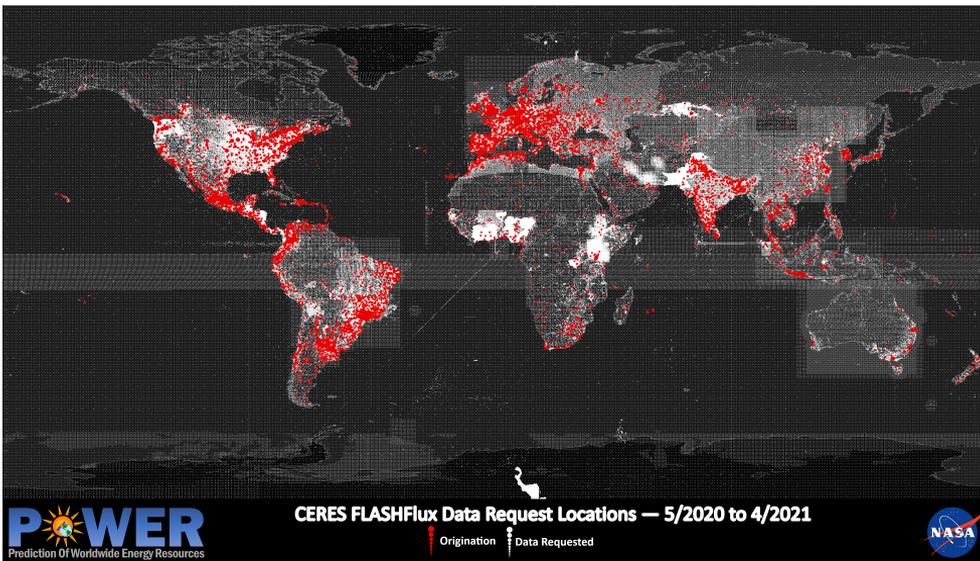
(2020/05/01 to 2021/04/30)

All FLASHFlux Orders Delivered via POWER

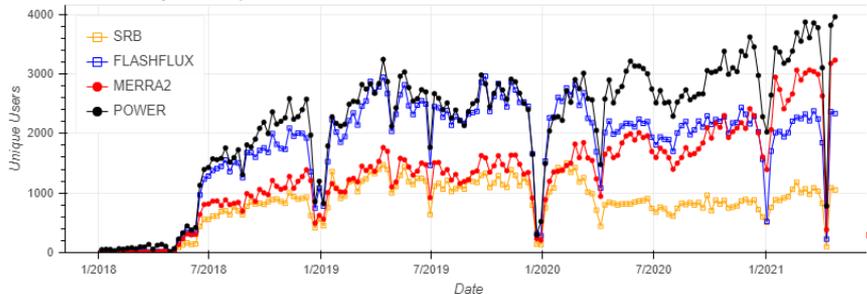
	Total	Monthly
Unique Users IPs	~116 K	~11,150
Requests	~ 55 M	~4.6 M

FLASHFlux Low Latency Orders Delivered via POWER

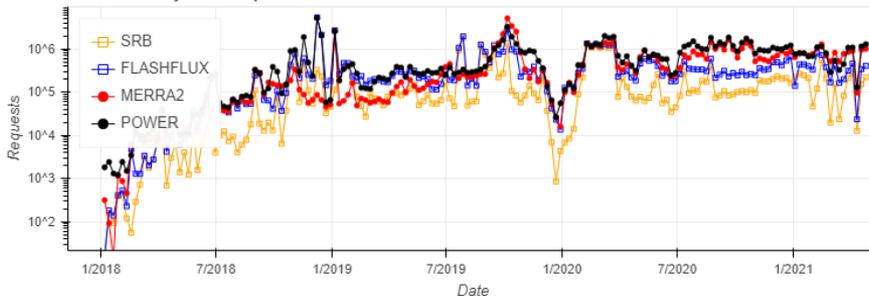
	Total	Monthly
Unique Users IPs	~33.4 K	~3,160
Requests	~36.5 M	~3.0 M
Latency < 2 Weeks %	66.4%	66.4%



POWER Weekly Data: Unique Users



POWER Weekly Data: Requests





Usage Highlight: Maritime Use of FF through POWER

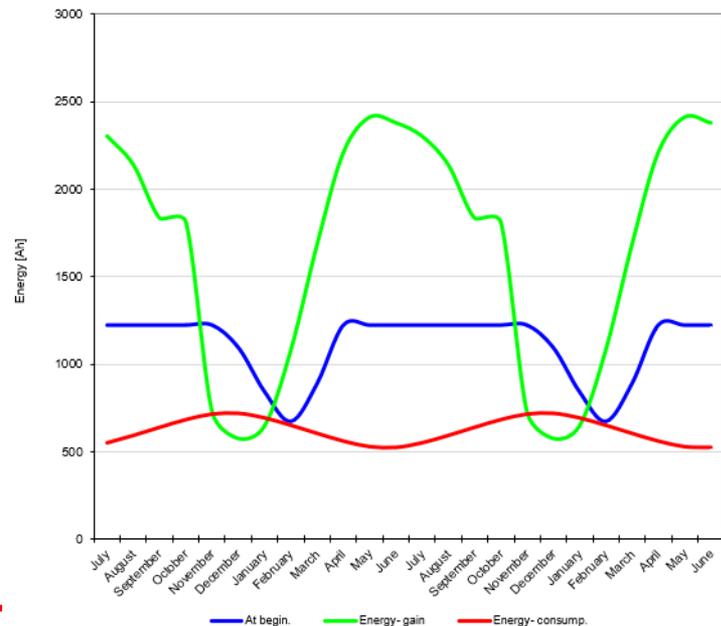
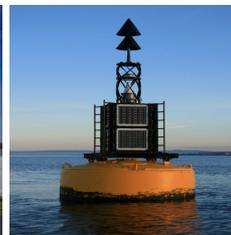
To support renewable energy for remote navigation aids, IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) publishes a solar and storage system design guide and sizing tool—which rely on NASA POWER and thus CERES FF as a core input.

Global data and specialized parameters integrate into IALA's tool in ways that other irradiance-only datasets cannot.

Sample critical Inputs:

- Daily global all-sky insolation
- Long-term statistics:
 - “black-sky days” parameter informs battery backup decisions using daily irradiance variability
 - tilted irradiance estimates including optimal tilt angle estimates

(Courtesy ICF POWER Use Case Report, 2021)



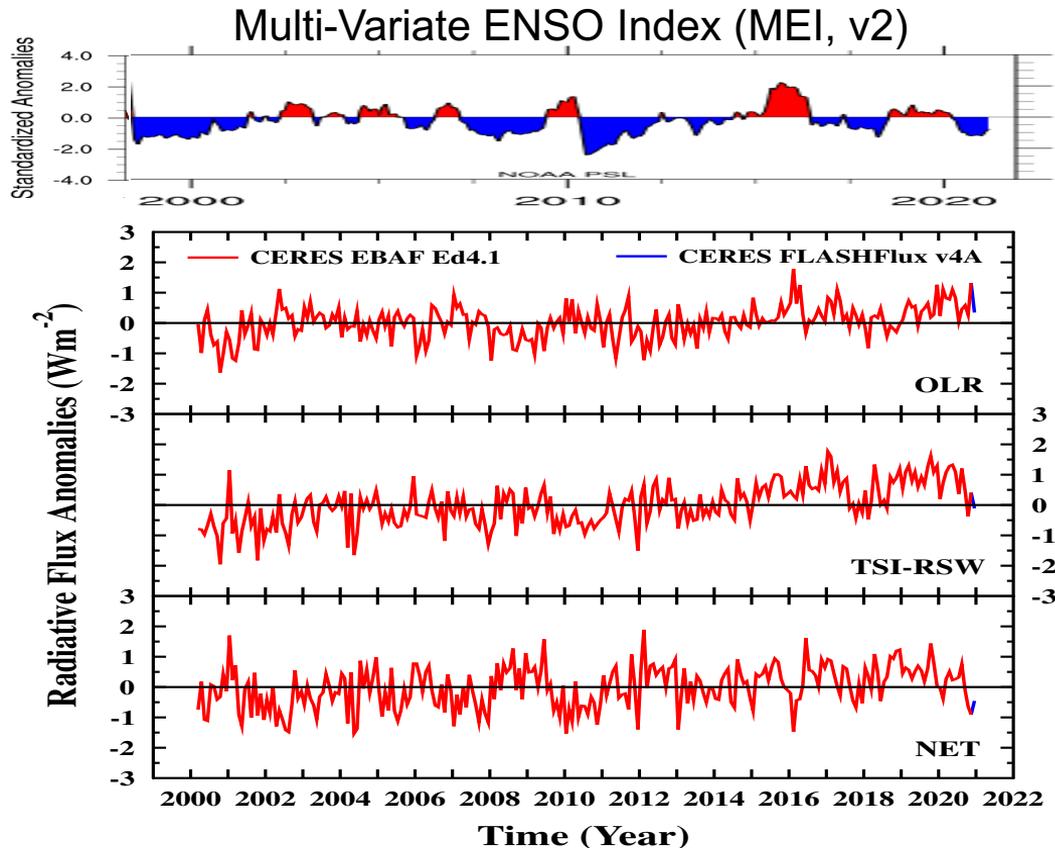


TOA Anomaly Time Series for State of the Climate

“State of Climate” 2020
submitted to BAMS in March

2020 highlights

- Only needed 1 month of FF since EBAF deliveries only 2-3 months lags
- Changes after July: seems to correspond to transition to La Nina
 - OLR anomalies rose to $\sim +1.0 \text{ W m}^{-2}$
 - dropped in July, but rose toward end of 2020
- Net RSW (absorbed SW) anomalies reduce to $\sim 0.0 \text{ W m}^{-2}$
- Total Net holds drops to near -1 W m^{-2} by by end of 2020.

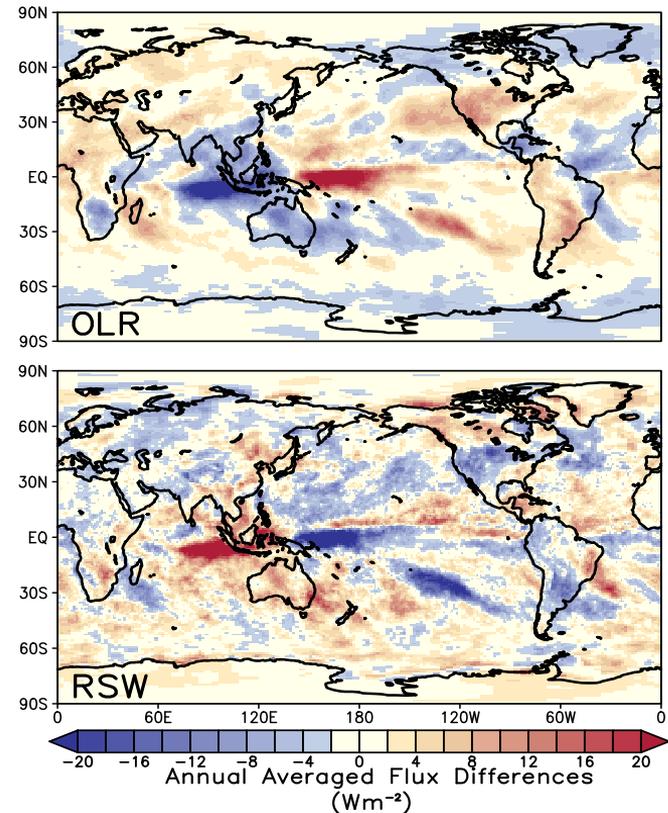




“State of the Climate”: Annual Average Flux Difference 2020 - 2019

Regional year to year differences show La Nina signature

	One Year Change (2020 minus 2019) (W m^{-2})	2020 Anomaly (Relative to Climatology) (W m^{-2})	Climatological Mean (2001 to 2019) (W m^{-2})	Interannual Variability (2001 to 2019) (W m^{-2})
OLR	0.20	+0.65	240.20	± 0.65
TSI	0.05	-0.05	340.00	± 0.15
RSW	0.40	-0.70	99.00	± 1.00
TSI-RSW	-0.40	+0.65	241.00	± 0.95
Net	-0.60	+0.00	0.80	± 0.80





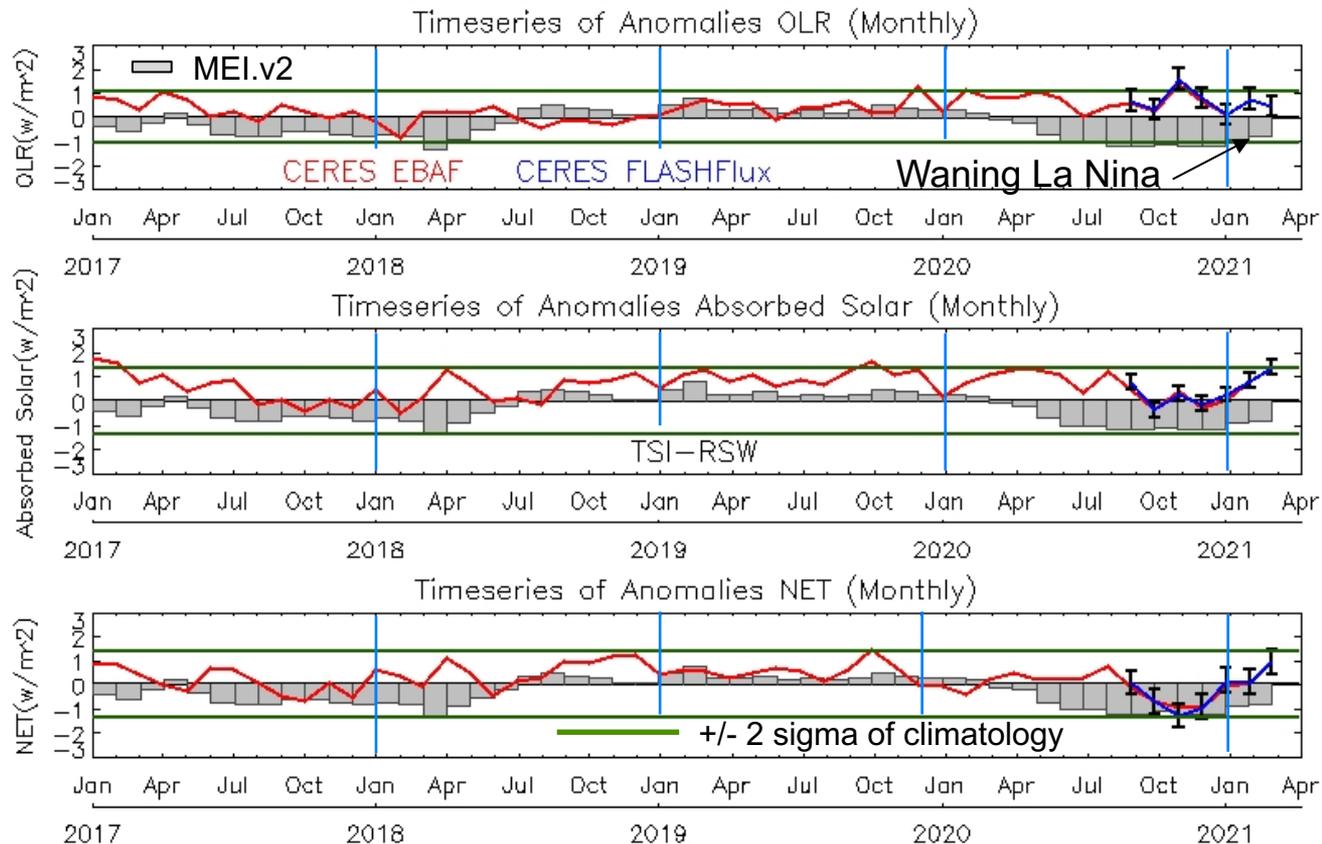
TOA Anomaly Time Series for State of the Climate

TOA FF Flux anomaly update through 3/21 (EBAF through 2/21):

Last few months

- OLR anomalies increase but $< +0.5 \text{ W m}^{-2}$
- Net RSW (absorbed SW) increasing since Dec $> 1.0 \text{ W m}^{-2}$ in March 2021
- Total Net drops to near $+1 \text{ W m}^{-2}$ in March 2021.

NOAA CPC ENSO April 8: “A transition from La Niña to ENSO-Neutral is likely in the next month or so, with an 80% chance of ENSO-neutral during May-July 2021.”





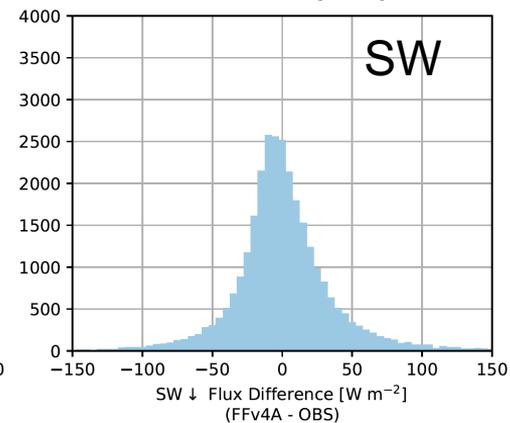
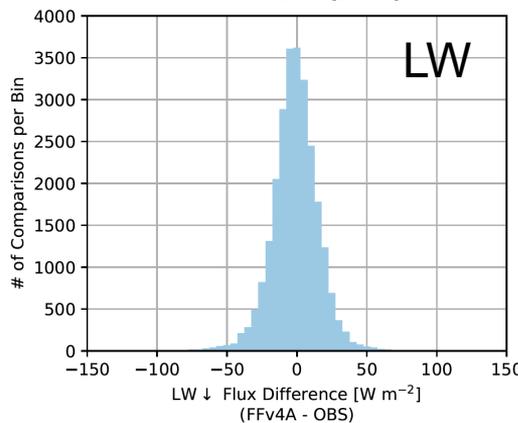
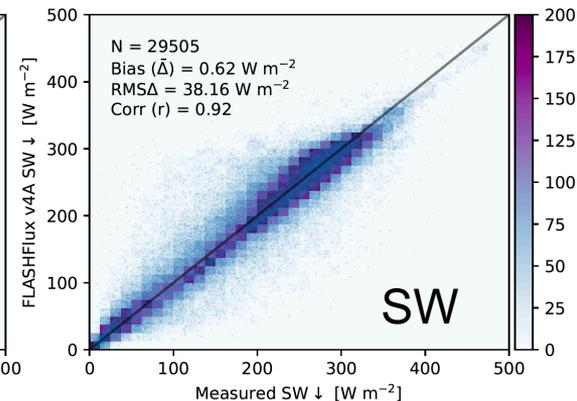
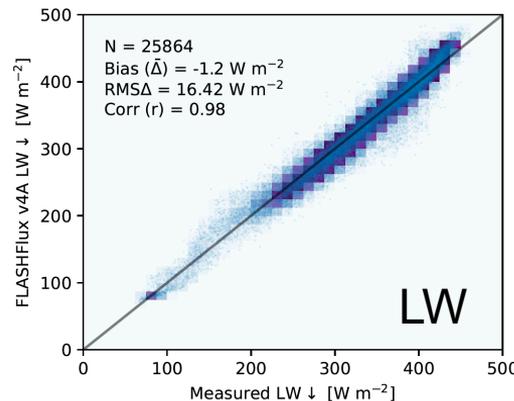
FLASHFlux TISA Validation: BSRN Fluxes

Ensemble FLASHFlux LW and SW
Daily Average Comparisons to
BSRN+Ocean Buoy Measurements
(2019-2020)

LW: Bias -1.2 W m^{-2}
RMS 16.4 W m^{-2}

SW: Bias 0.6 W m^{-2}
RMS 38.2 W m^{-2}

Histograms show peaked, relatively
symmetric distributions, median
bias is negative bias for SW, LW





FLASHFlux TISA Validation: BSRN and Ocean Buoy Fluxes

FLASHFlux v4A TISA Daily Average Fluxes (2019 – 2020)

Region Type	LW Bias	LW RMS	# LW Pairs	SW Bias	SW RMS	# SW Pairs
Ensemble	-1.2	16.4	25,864	0.6	38.2	29,505
Coastal	0.3	15.3	5373	-1.8	35.0	5238
Desert	-7.0	18.8	1818	-12.2	28.7	1801
Island	6.4	14.7	1668	18.9	46.8	1640
Continental	-4.0	18.2	9127	-3.9	40.3	9083
Polar	0.2	18.4	2841	-6.8	47.7	1941
Ocean buoys	1.0	12.4	5036	6.8	35.6	9832



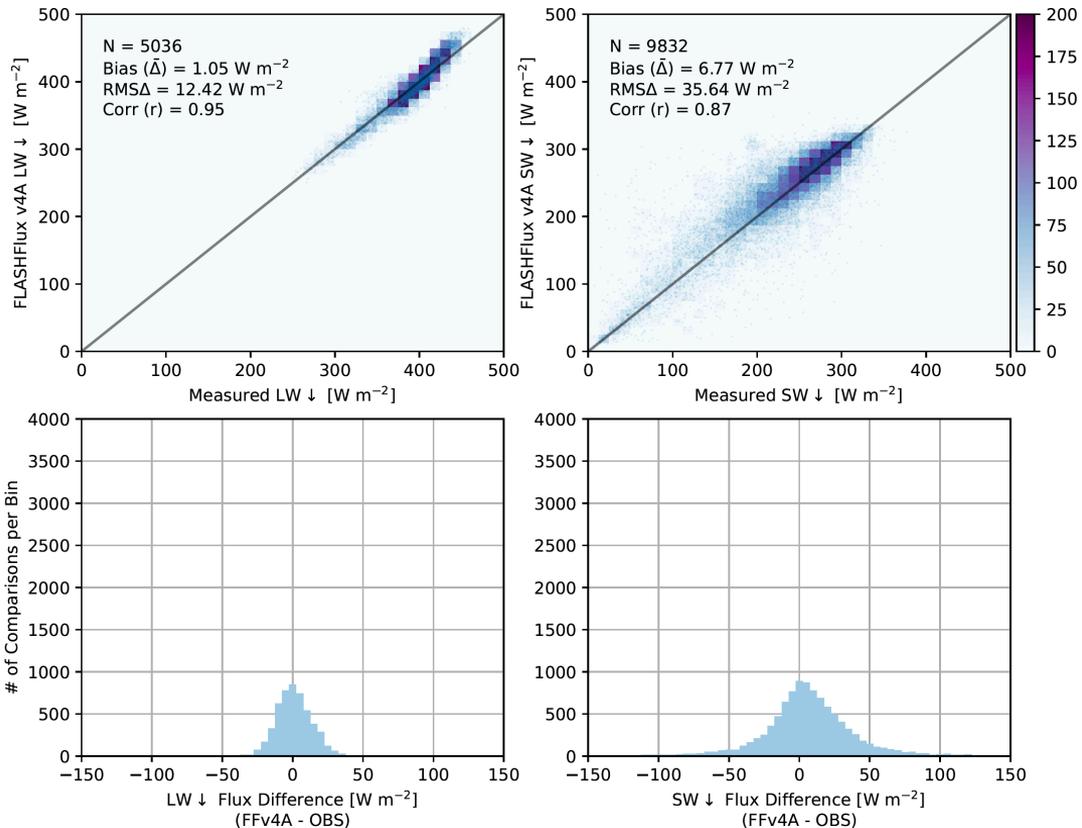
FLASHFlux Validation: Ocean Buoy Fluxes

Ensemble FLASHFlux LW and SW
Daily Average Comparisons to
Ocean Buoy Flux Measurements
(2019-2020)

LW: Bias 1.0 W m^{-2}
RMS 12.4 W m^{-2}

SW: Bias 6.8 W m^{-2}
RMS 35.6 W m^{-2}

Histograms show peaked, relatively
symmetric distributions, median
bias is centered on near zero





Summary and Conclusions

- **FLASHFlux 4A progress**
 - V4A continues in forward production mode; begin on Jan 1, 2019
 - SSF TOA comparisons show good agreement at TOA for SW and LW if calibration updated
 - SSF surface fluxes show biases over oceans, polar areas relative to CRS (Ryan's talk)
 - TISA LW and SW v4A validation reasonable bias/RMS; biases noted for some surface types
- **FLASHFlux Continuing Work**
 - Continue assessing LPSA, LPLA for improvements; ML for SSF?
 - Ready for first GOES-IT samples; MOA modifications and testing required
 - Production system improvements: hardening of current TISA code for more flexible configurations; migration to CATALYST (i.e., NOAA-20)
- **FLASHFlux Applications:**
 - Datasets continuing being distributed through POWER web services; Aqua gap at least temporarily to be filled with Terra-only; evaluate to add NOAA-20
 - CERES FF ordering past year ~116,000 unique ISP; nearly 55M orders; >66% low latency
- **FLASHFlux Publications:**
 - 2020 SotC report submitted; waiting for reviews



**FLASHFlux Web Sites
now moved to under CERES page**

<https://ceres.larc.nasa.gov/data/#fast-longwave-and-shortwave-flux-flashflux>

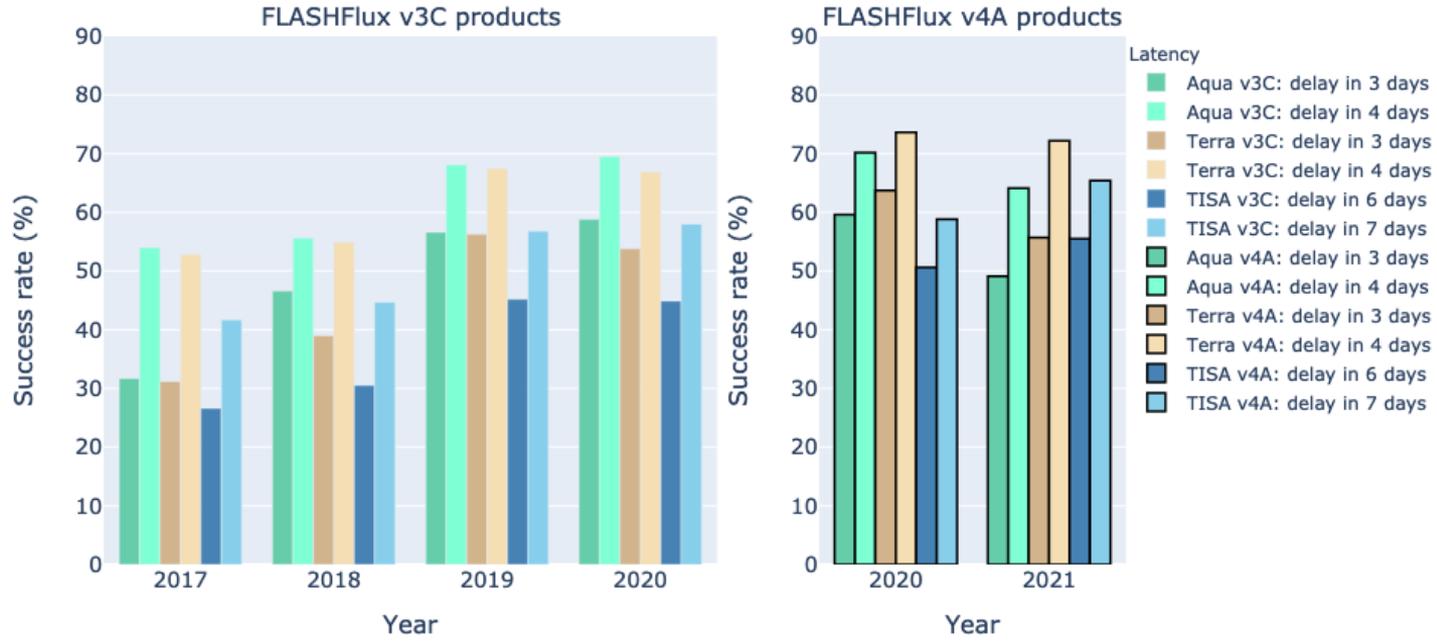
**Data also served through
<https://power.nasa.gov>**



Extras



FLASHFlux Annual Latency Success Rates





FLASHFlux Data Delivery via POWER

(2020/04/01 to 2021/03/31) – Is April 2021 possible?

All FLASHFlux Orders Delivered via POWER

	Total	Monthly
Unique Users IPs	82,100	7,768
Requests	25,953,830	2,162,819

FLASHFlux Low Latency Orders Delivered via POWER

	Total	Monthly
Unique Users IPs	26,503	2,493
Requests	15,629,427	1,302,452
Latency < 2 Weeks %	60.22%	67.82%

