FLASHFlux Working Group Status: Production Transition to CATALYST and Continuing Usage Through POWER

Paul Stackhouse (NASA LaRC)

PC Sawaengphokhai, Hunter Winecoff, Jay Garg (SSAI)
POWER Team: Bradley MacPherson and Christopher Higham (Booz-Allen-Hamilton)

CERES Team members: Katie Dejwakh, Dave Doelling (LaRC),
Walt Miller, Pam Mlynczak, Victor Sothcott, Cathy Nguyen, Nelson Hillyer (SSAI)

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

CERES FLASHFlux Overview

- ***FLASHFlux Overview***
  - Uses CERES based production system through inversion
  - Periodic calibration updates projected forward; running 3-day TISA
  - Upgrade from S4PM production system to CATALYST
  - New Data Product: NOAA-20 SSF
- ***FLASHFlux Latency Objectives***
  - SSF products within 3-4 days
  - Global 1x1 daily averages from FF TISA; goal: 5-7 days latency
- ***FLASHFlux Uses***
  - 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 .

FLASHFlux Operational Status

- ***FF Production status:***
  - Current Status: SSF Terra: 10/3/22; SSF Aqua: 10/3/22; TISA: 10/1/22
  - Updated calibration coefficients received; promoted as cc change effective 10/1/22

- ***FF Operational Issues:***
- Transitioned to DarkHorse Ingesting system on June 6
  - Metadata issues since then means that no data is available on EarthData search after that date; must obtain through CERES subsetter or DDD
- LAADS system maintenance on August 1st delayed several input data products; Additional system maintenance from August 23-25, 2022.
- Transition to CATALYST Completed on 9/30

FLASHFlux (v4A) SSF Latency Assessment

Success rate % of time < 3 (dark/thick bar) or 4 days (lighter/thinner bar) for S4PM

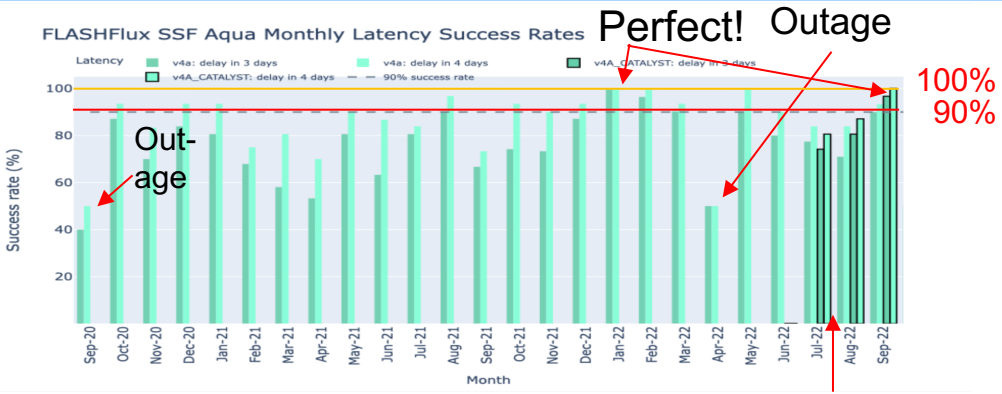
Last 3 months show latency from CATALYST production (outlined bars)

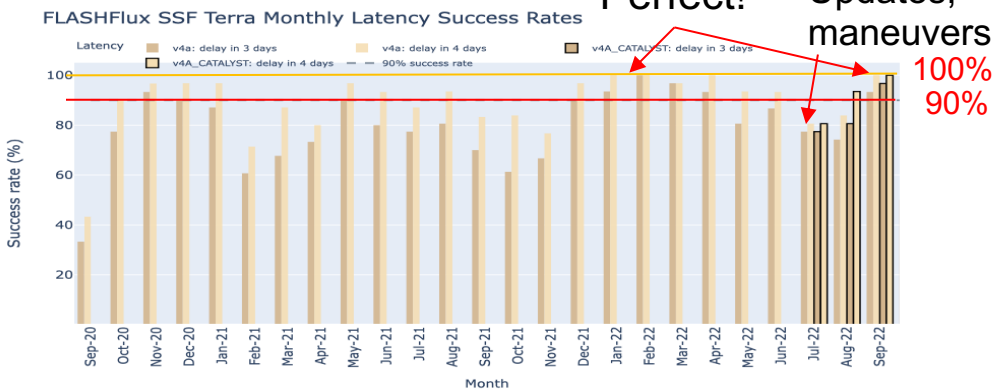
Since Oct 2021, both Terra & Aqua had 8 months at or exceeding 90% of days at 4 day latency

Only Jan and Feb 2022 had all SSF within 4 days using S4PM; CATALYST achieved this in Sep 2022 => perfect months!

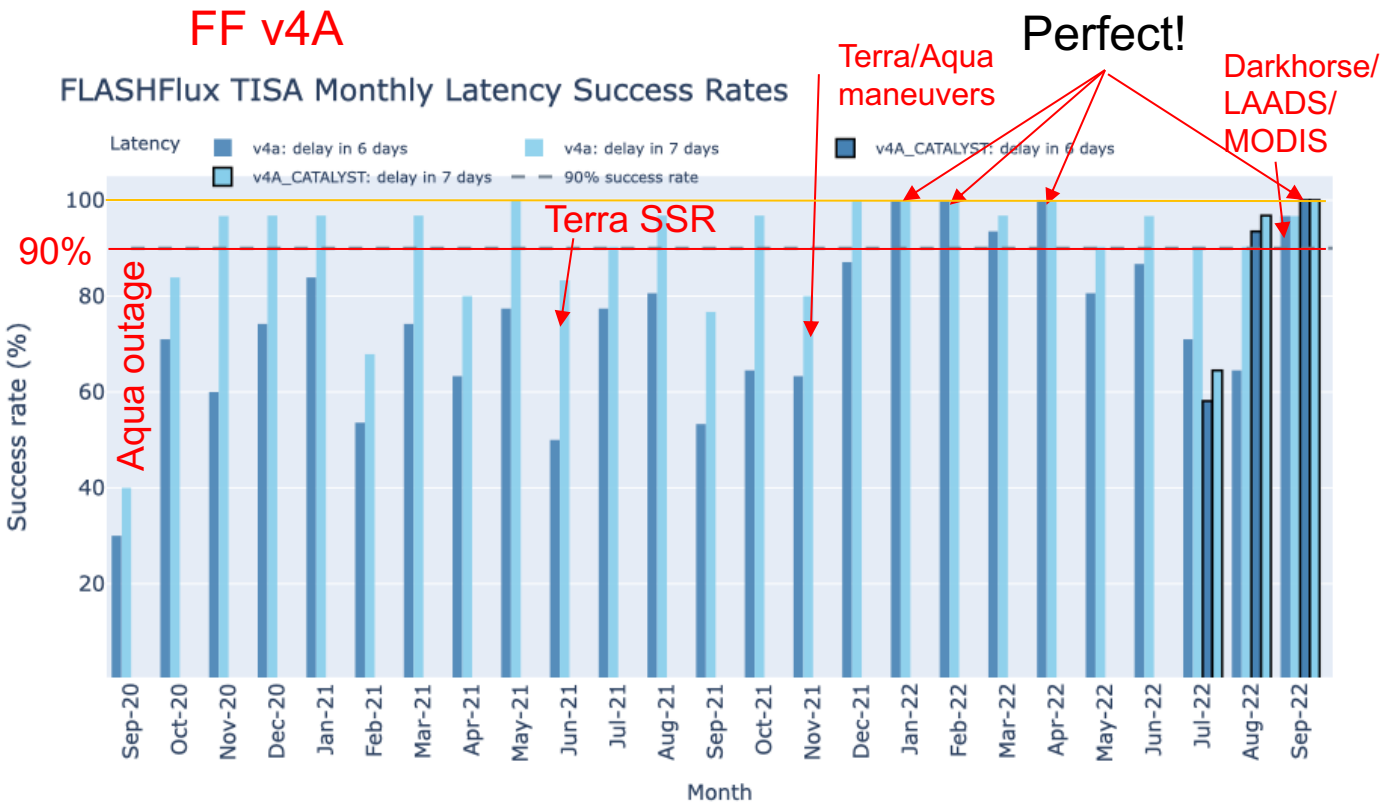
Lags due to: maneuvers/ satellite issues, ASDC updates/outages, ASDC Darkhorse, GSFC LAADS

SSF utilized by GLOBE Clouds; occasional satellite algorithm comparisons (i.e., NOAA GOES ABI, CloudSat Production)





FLASHFlux TISA Latency Assessment



Success rate is % of time data released with latency of 6 (light blue) or 7 days (dark blue)

With S4PM, Jan, Feb, April reached 100% at 6 day latency; 10 of 12 months had 7 day latency > 90%

CATALYST achieved data 100% release within 6 days in Sept 22

Lags due to: maneuvers, ASDC&GSFC updates/ outages

TISA delivered to POWER Web Services Suite

FLASHFlux Data Delivery via POWER Web Services Portal (2021/09/01 to 2022/08/31)

CERES Data Orders Delivered via POWER <3 weeks latency (FLASHFlux Data)

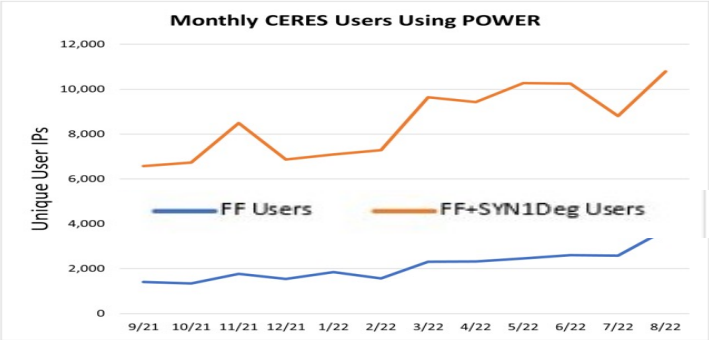
	Total	Monthly	Avg. Last 3 Months
Unique Users IPs	~21.2 K (13%)	~2.1 K (13%)	~3.0 K (16%)
Requests	~19.1 M (46%)	~1.6 M (46%)	~1.84 M (44%)

CERES Data Orders Delivered via POWER including SYN1Deg and FLASHFlux data

	Total	Monthly	Avg. Last 3 Months
Unique Users IPs	~88.6 K (54%)	~8.5 K (53%)	~10 K (55%)
Requests	~ 30.7 M (73%)	~2.56 M (73%)	~2.95 M (70%)

(includes SYN1Deg from Sep 2001 through latest month released)

Dot density map showing locations of users (red) and data request locations (white). Brighter colors show larger frequency at that location.



Total FF+ SYN1Deg > 10,000/month

FF nearly 4K/ month

SSF User Story: GLOBE Clouds

GLOBE Clouds Match to a Million Celebration Event

Since 2017:

- **Over 1,027,000** Satellite Matches
- **Over 1,190,00** GLOBE Observations
- **Over 1,855,00** Images Submitted

Celebration recording

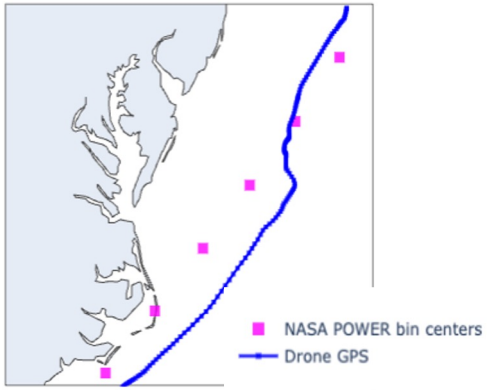
- Use FLASHFlux SSF data for Satellite matches
- Use by Citizen scientists from grade school to retiree

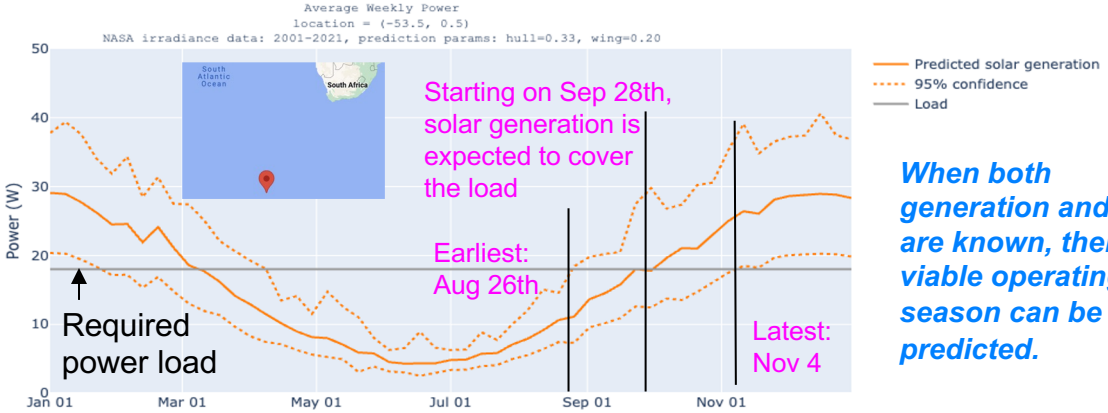
FF TISA User Story (Through POWER): Saildrone

Saildrone is a platform for ocean data collection. Typically, the data is used for:

- *ocean-science*
- *bathymetry*
- *maritime security*

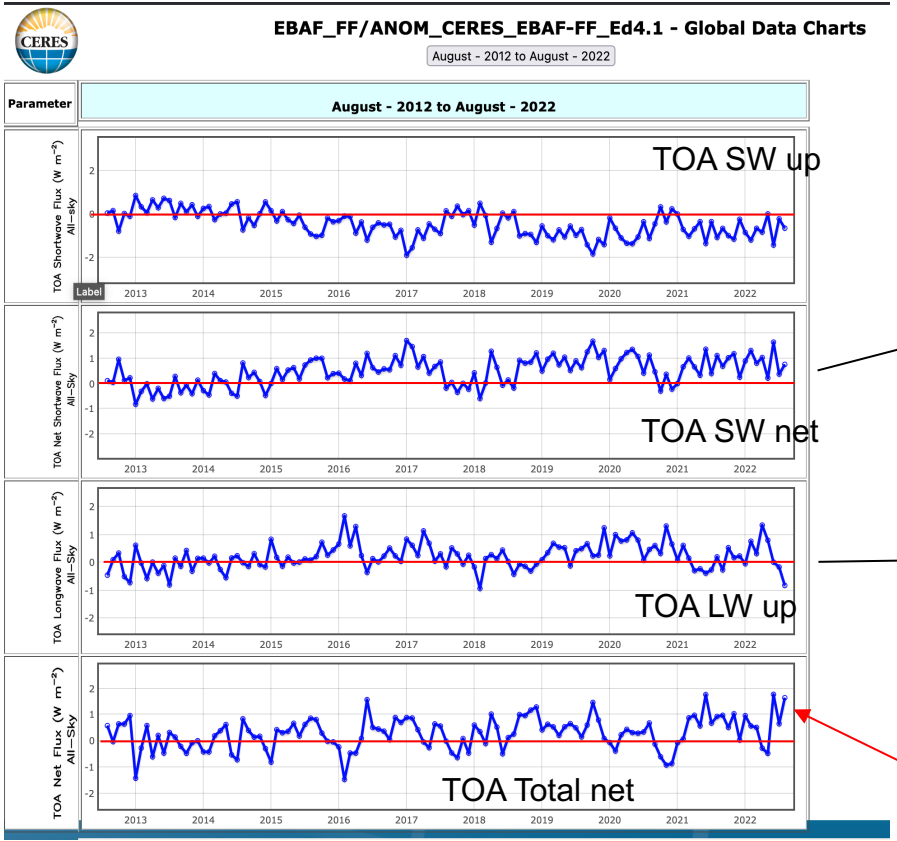
- **Saildrones are mobile**
- **CERES data is delivered through POWER's API service**
  - *Use a time history of locations (blue GPS track)*
  - *Pull data from 1x1 grid box centers*
- ***Seasonal archive used for solar resource projections***

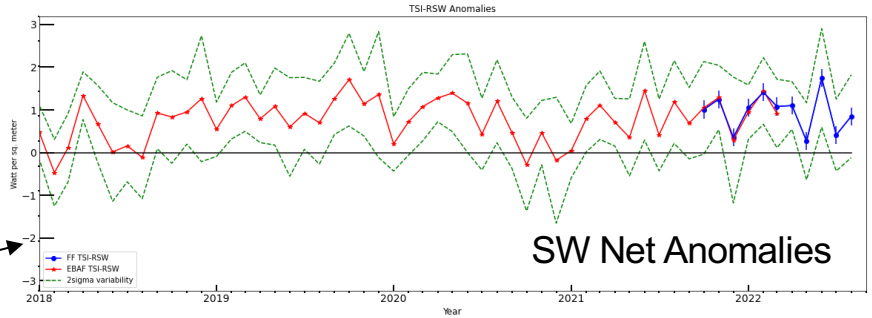


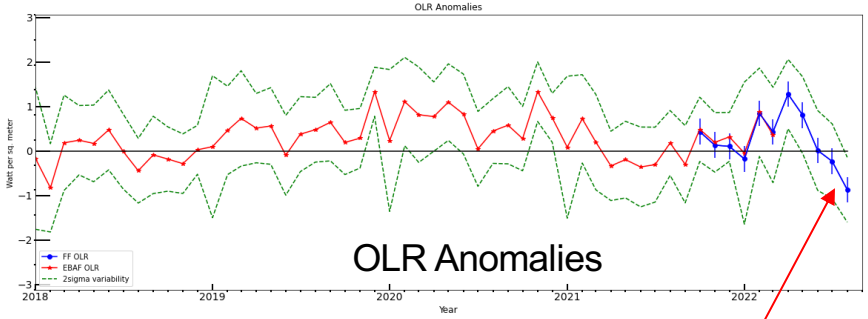


When both generation and load are known, then the viable operating season can be predicted.

Global Anomalies: EBAF + FF (Normalized)



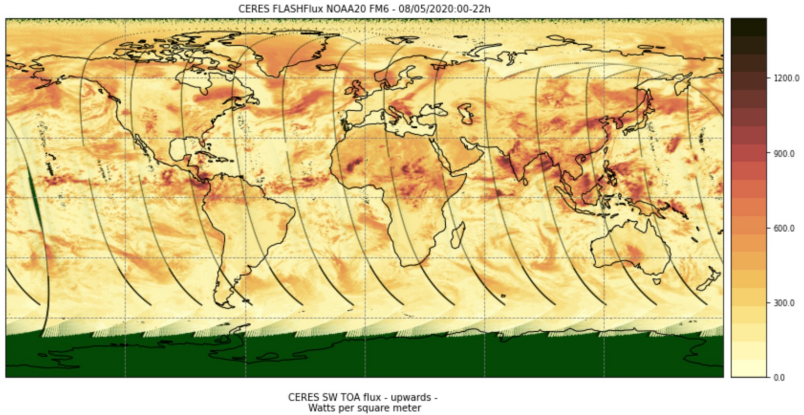


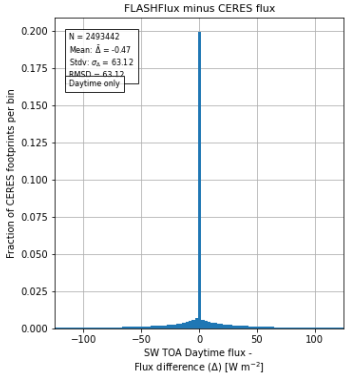


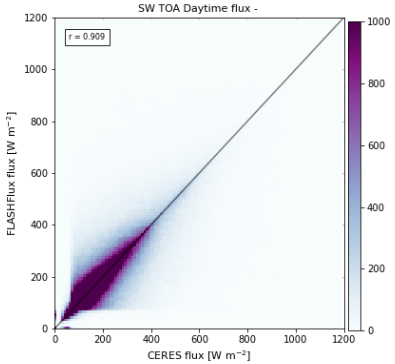
Notice positive net flux anomalies that are associated with negative OLR anomalies

NOAA-20 SSF – SW FLuxes($W\ m^{-2}$)

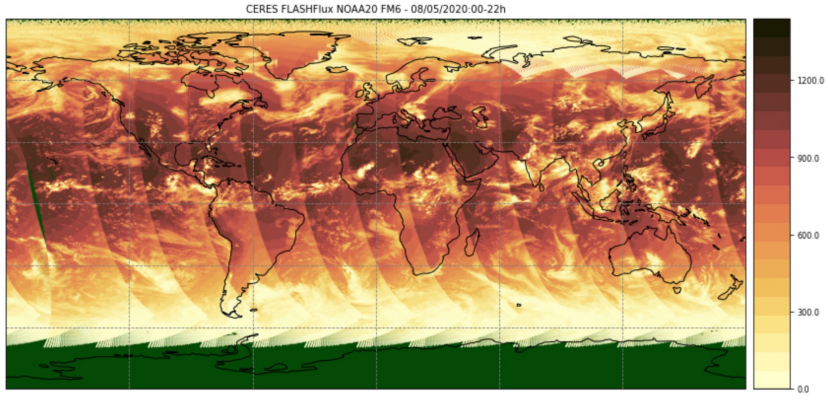
SW TOA Up

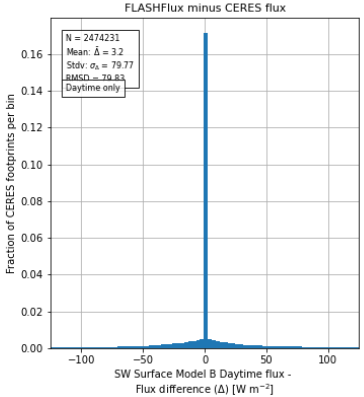


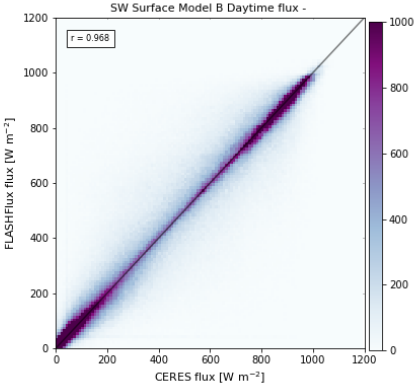




SW Surface Down

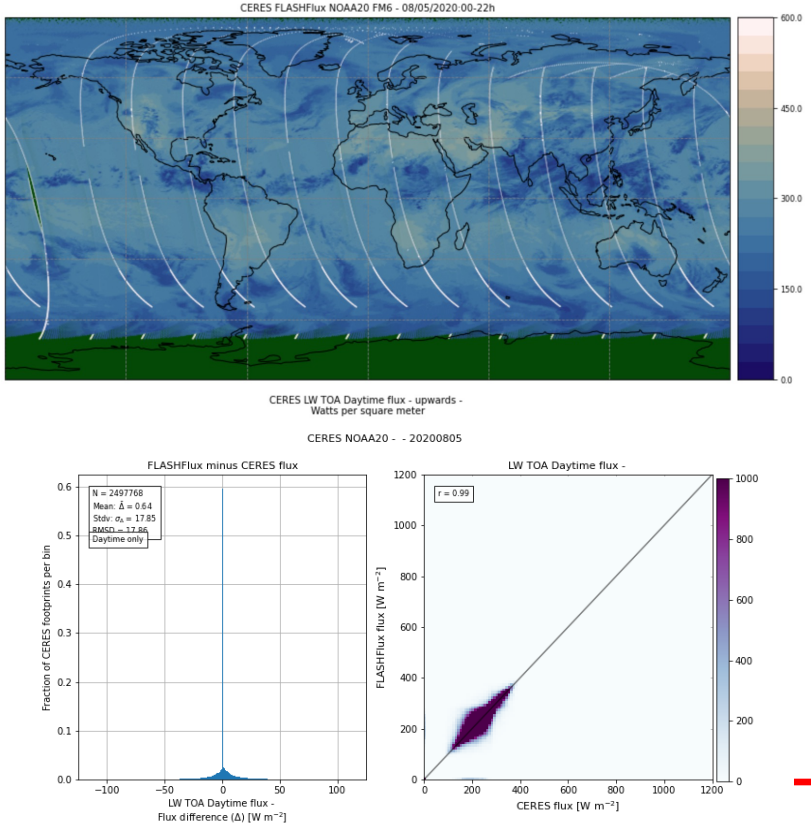




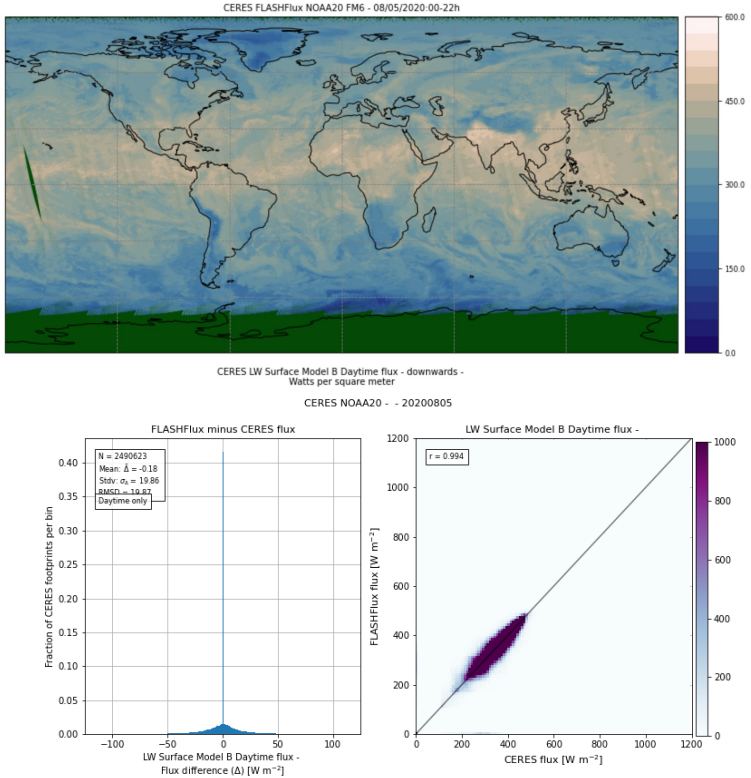


NOAA-20 SSF – LW FLuxes($W\ m^{-2}$)

LW TOA Day



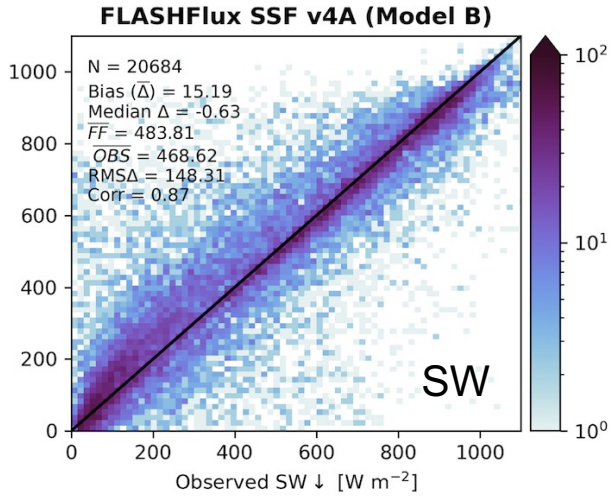
LW Surface Down - Day

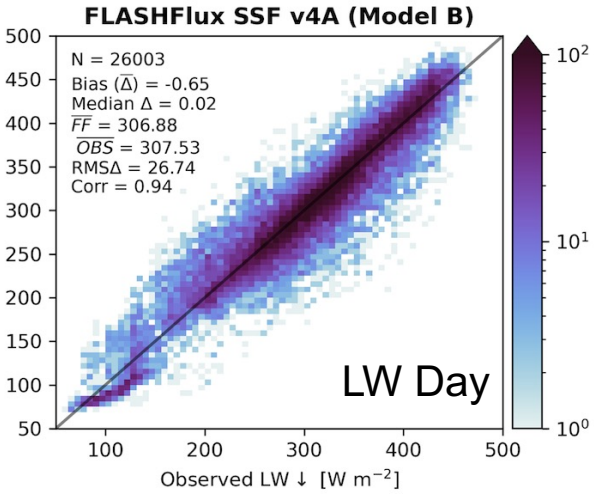


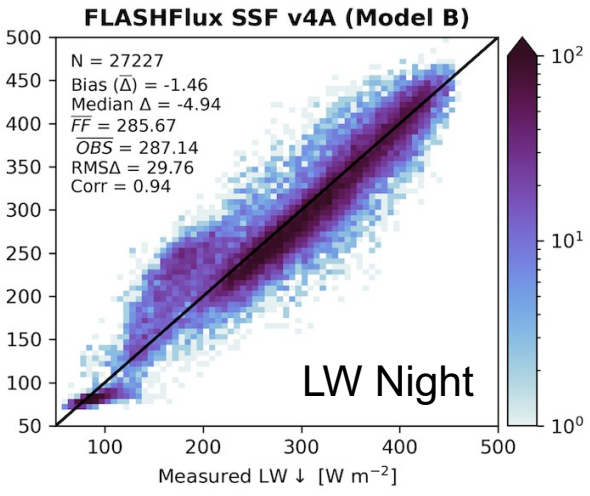
FF SSF Flux Validation: Terra 01/2019-04/2022

Overpass flux validation with BSRN measurements:

- large SW scatter; underpredicts > ~300 W m^{-2}; overestimates low
- LW night has larger scatter; instantaneous performing adequately







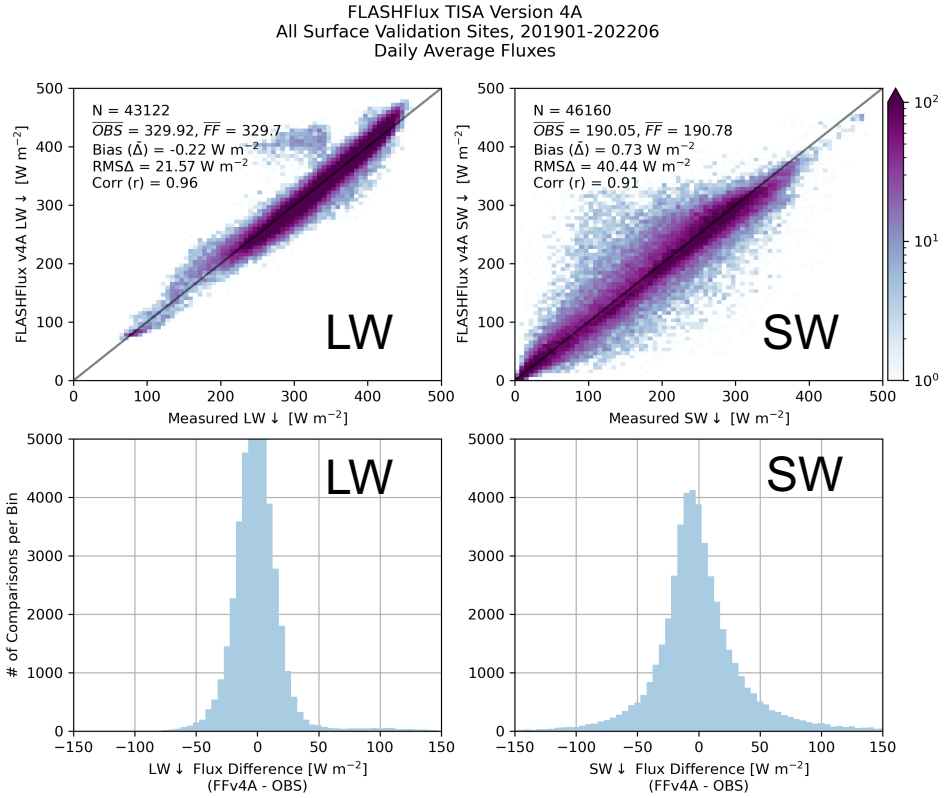
FLASHFlux TISA Validation: BSRN Fluxes

Ensemble FLASHFlux LW and SW Daily Average Comparisons to BSRN Measurements (01/2019-06/2022)

LW: Bias -0.22 W m^{-2}
RMS 21.6 W m^{-2}

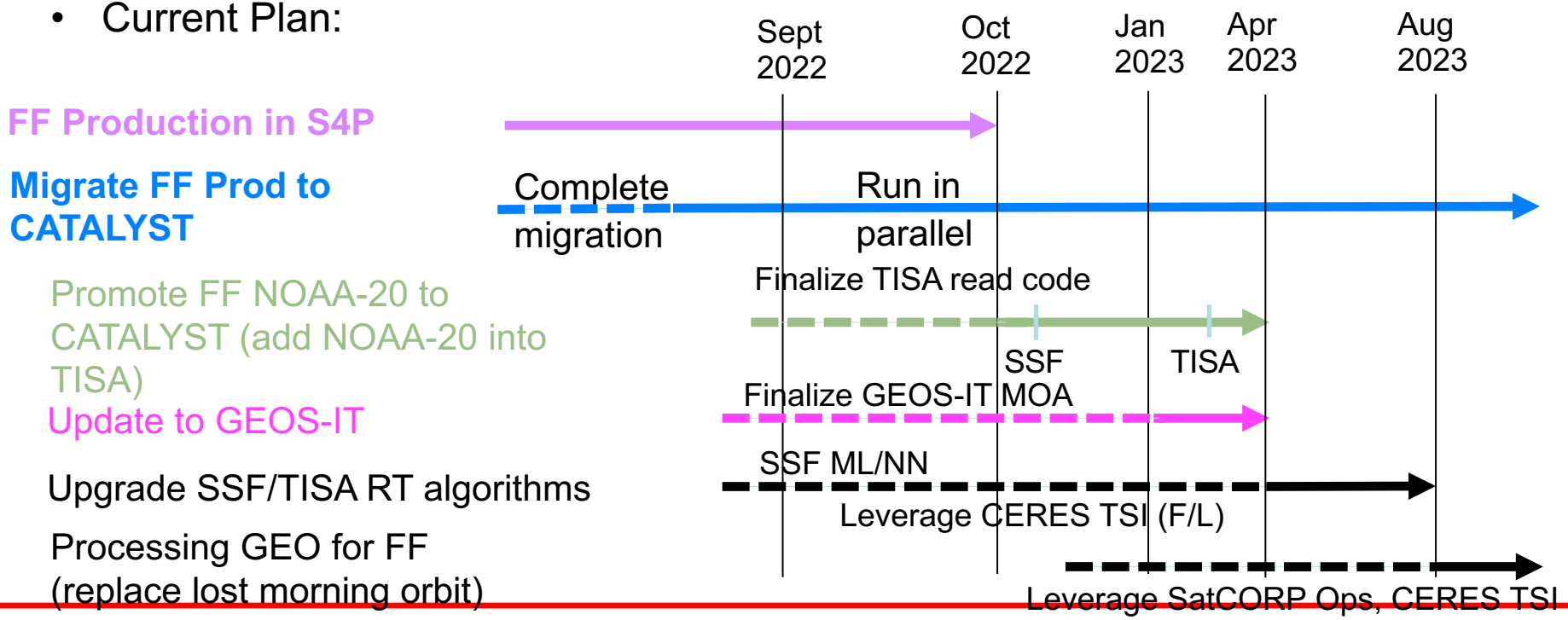
SW: Bias 0.7 W m^{-2}
RMS 40.4 W m^{-2}

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



FLASHFlux Future Production Strategy

- Both Terra and Aqua are scheduled to be turned off in 2023; production system must be modernized and adjusted to continue production
- Current Plan:



FLASHFlux Summary

- ***Production with v4A Begun (since Aug 1, 2020)***
  - Operational FF v4A SSF and TISA v4A (since Jan 1, 2019): SSF Terra/Aqua through 9/23; TISA through 9/21
  - New FF Gain+Spectral coefficients beginning Oct 1st, 2022.
  - Production with CATALYST from June 1st, 2022. Publicly available starting on September 1st, 2022.
- ***Validation and Assessment***
  - FLASHFlux SSF surface fluxes relative to BSRN for 01/2019 through 04/2022
  - TISA Daily averages relative to BSRN for Jan 2019 through June 2022 (42 months)
- ***FLASHFlux Modernization and Updates***
  - Migration to CERES CATALYST reached through FF SSF (also see Katie's talk); Completed
  - NOAA-20 SSF data product; Goal Nov 2022
  - Terra+NOAA-20 TISA data product; Goal Mar 2023
  - New GEOS-IT sample data; first cut comparisons to FP-IT (still assessing); Goal Apr 2023
  - ML non-linear Tree based algorithms for future FF SSF data products; Goal Aug 2023
  - Migrate configuration to NOAA-20 + GEO (leveraging Ed5 TSI); Goal Oct 2023
- ***FLASHFlux Information & Data Provision Through ...***
  - CERES web site and subsetter both SSF and TISA, ASDC (via EarthData) and POWER
    - FF POWER Distribution in last year: ~59,200 unique IPs; > 16M orders; orders >70% low latency
  - 2021 BAMS State of the Climate TOA Flux reports

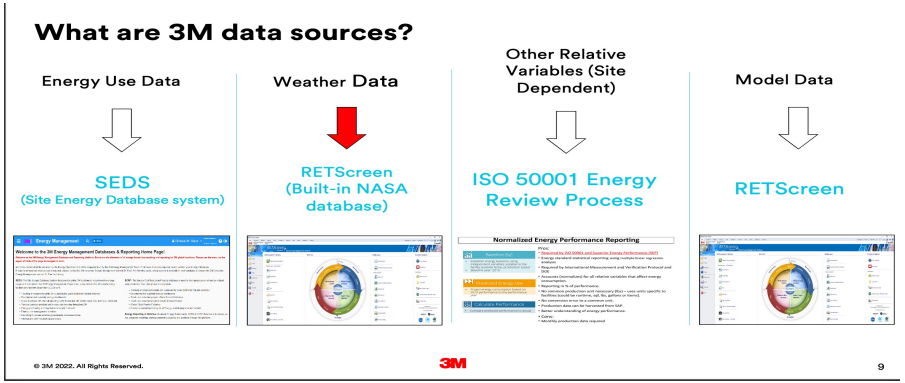
FLASHFlux Web Sites

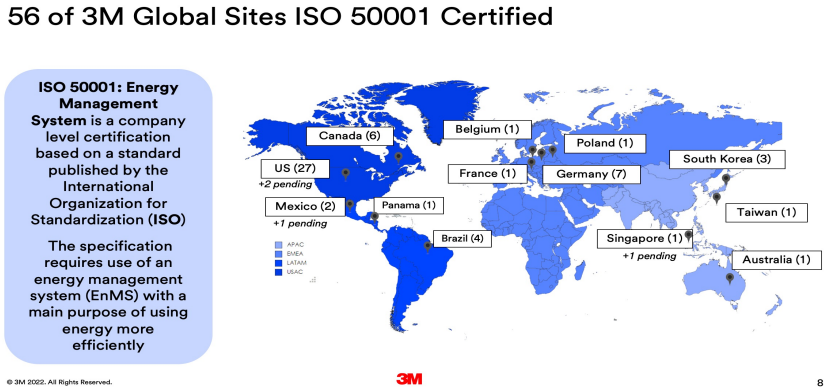
https://ceres.larc.nasa.gov/data/#fast-longwave-and-shortwave-flux-flashflux

Data also served through
https://power.nasa.gov

Extras

User Story: 3M Energy Management System

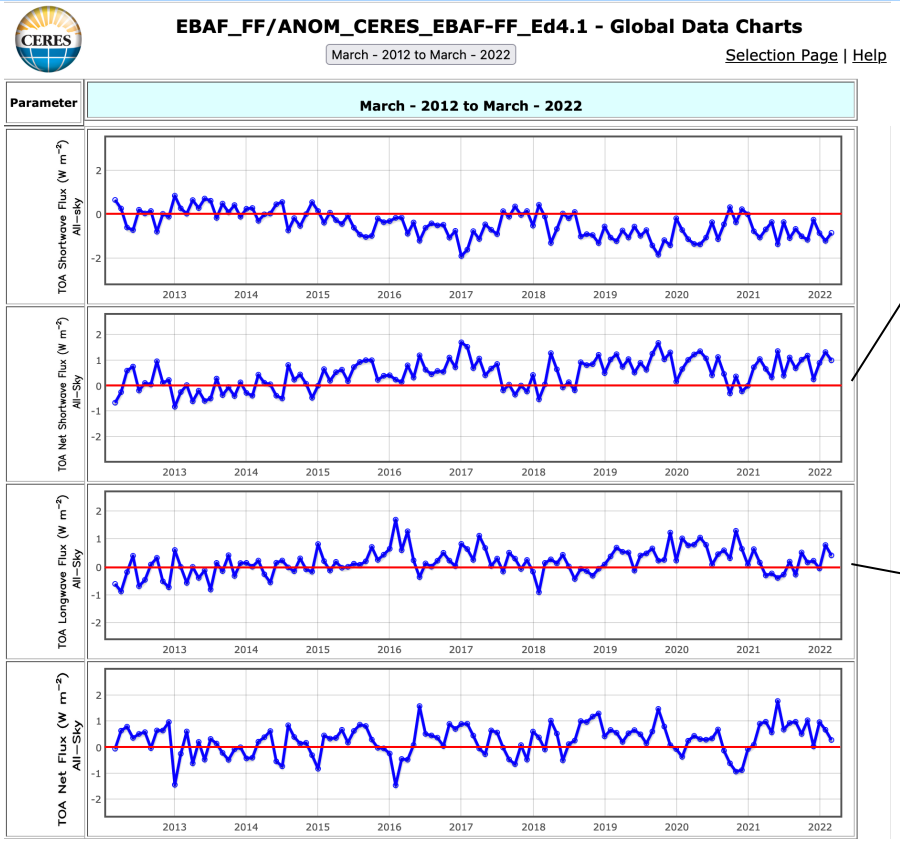


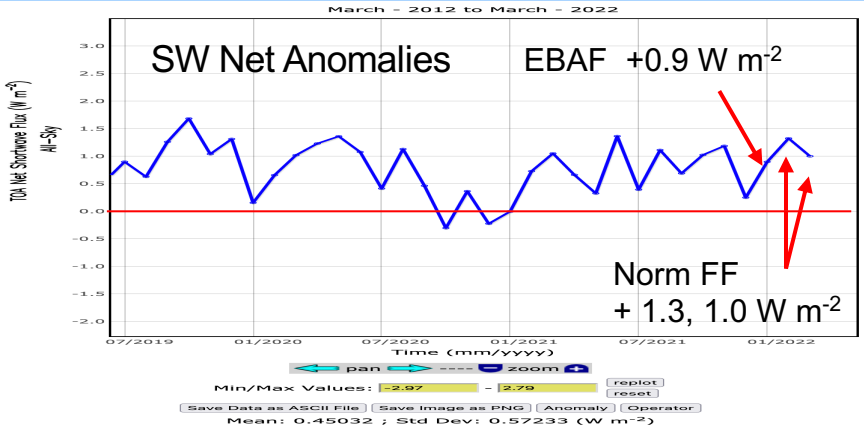


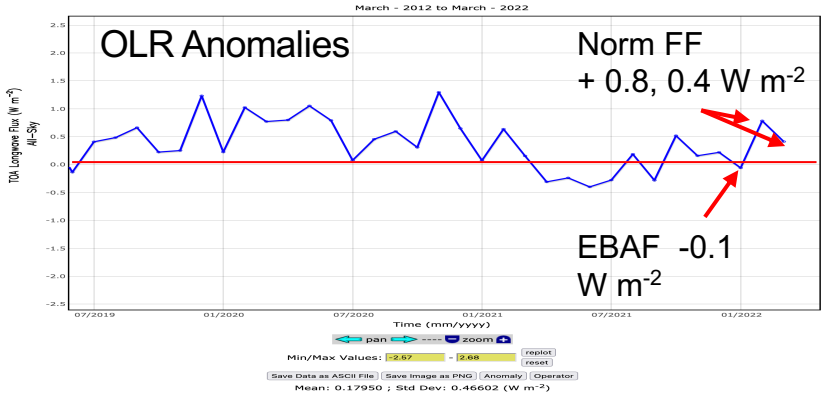
ISO 50001 provides a framework of requirements that help organizations to:

- develop a policy for more efficient use of energy
- fix targets and objectives to meet the policy
- use data to better understand and make decisions concerning energy use and consumption
- measure the results
- review the effectiveness of the policy and
- continually improve energy management.

Global Anomalies: EBAF + FF (Normalized)







Example SSF Validation: Terra and Aqua

Overpass flux validation with BSRN measurements (R. Scott):

- SW Model B implementation shows compensating clear/cloudy; errors to be assessed
- LW Model B seems to underestimate day-time clear-sky more than night

Sate-lite	Spectral Band	All-sky (W m^{-2})		Clear-sky (W m^{-2})		Cloudy Sky (W m^{-2})	
		Bias	RMS	Bias	RMS	Bias	RMS
Aqua	SW	+15.8 (3.4%)	153.3 (33.7%)	-12.8 (2.0%)	141.7 (22.3%)	36.6 (13.3%)	274.6 (64.0%)
	LW day	-2.1 (0.0%)	27.9 (9.1%)	-14.3 (5.3%)	33.0 (12.1%)	+1.2 (0.0%)	30.3 (9.5%)
	LW night	-1.1 (0.0%)	31.1 (11.1%)	-5.4 (2.2%)	29.6 (11.9%)	-1.7 (0.0%)	33.7 (11.1%)

FF Future Production Strategy

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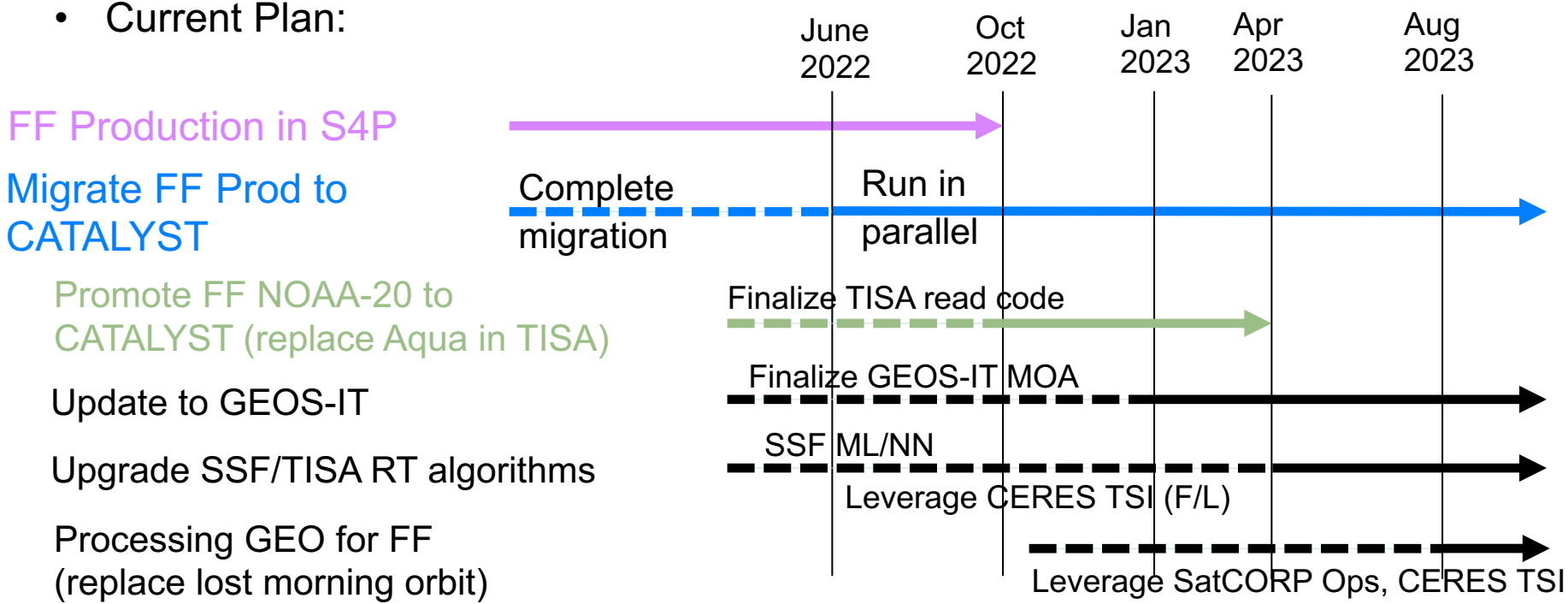
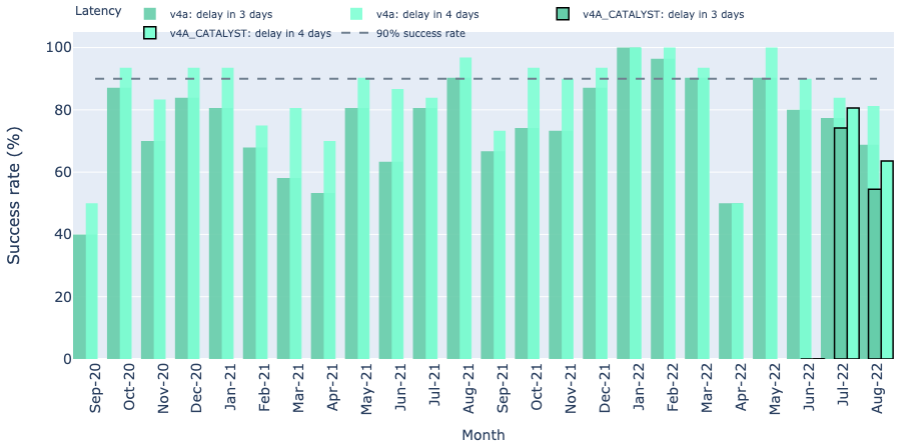
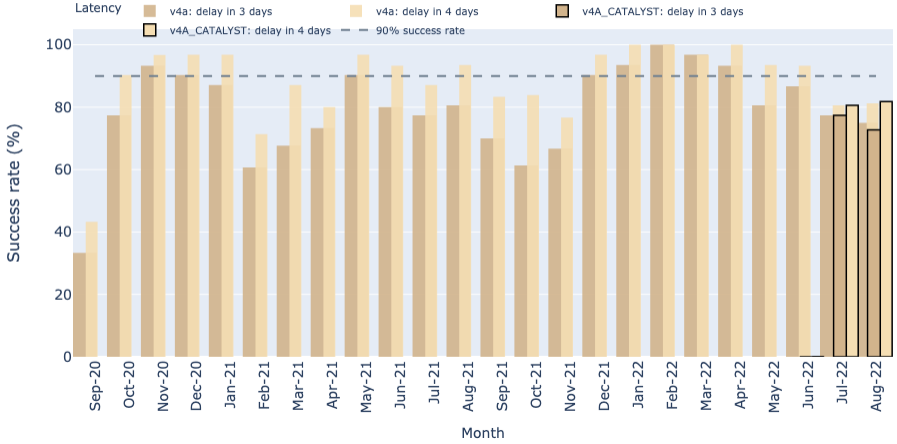


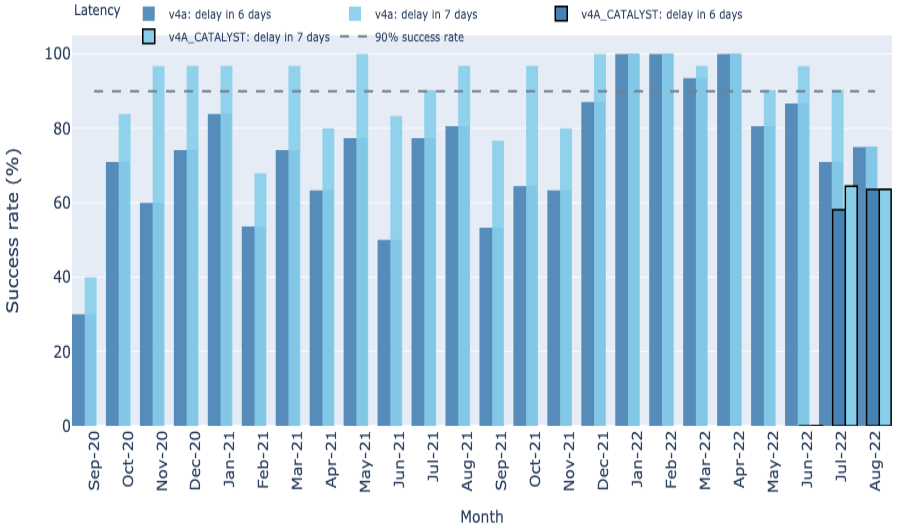
FLASHFlux SSF Aqua Monthly Latency Success Rates



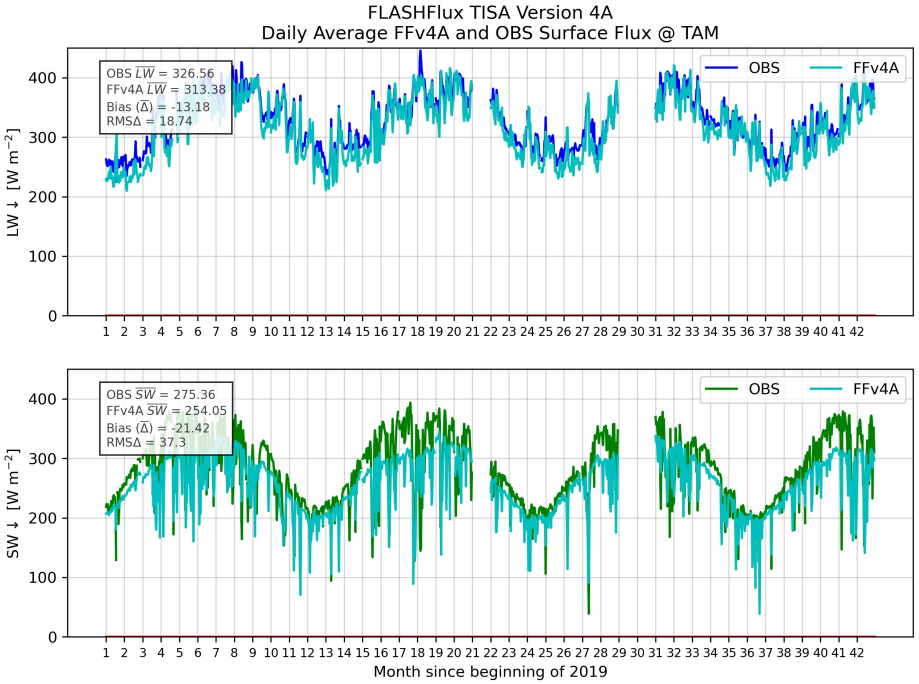
FLASHFlux SSF Terra Monthly Latency Success Rates

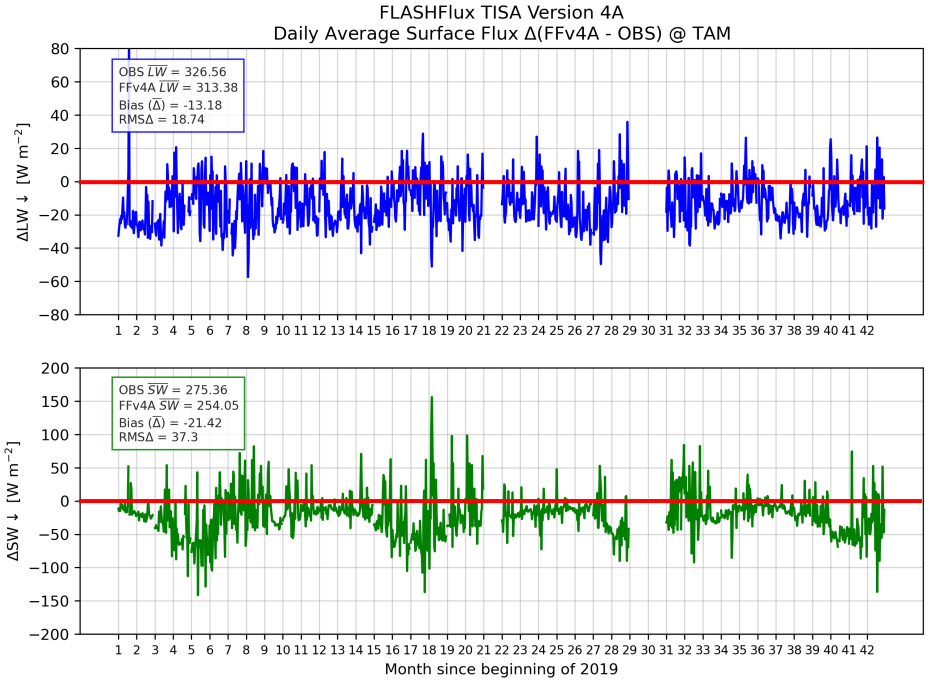


FLASHFlux TISA Monthly Latency Success Rates



FF Time Series (Tamanrasset, Algeria)



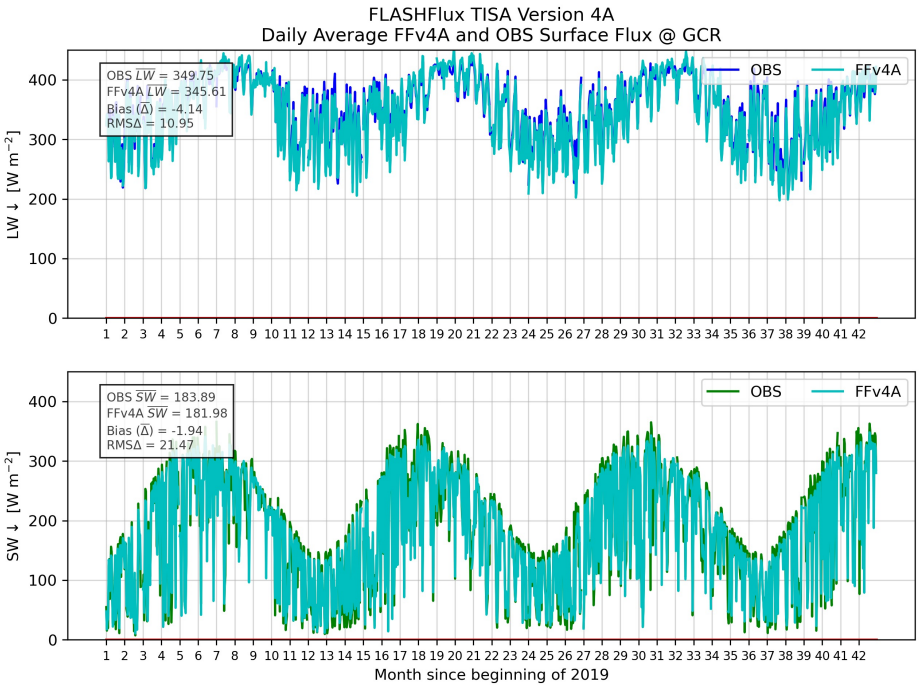


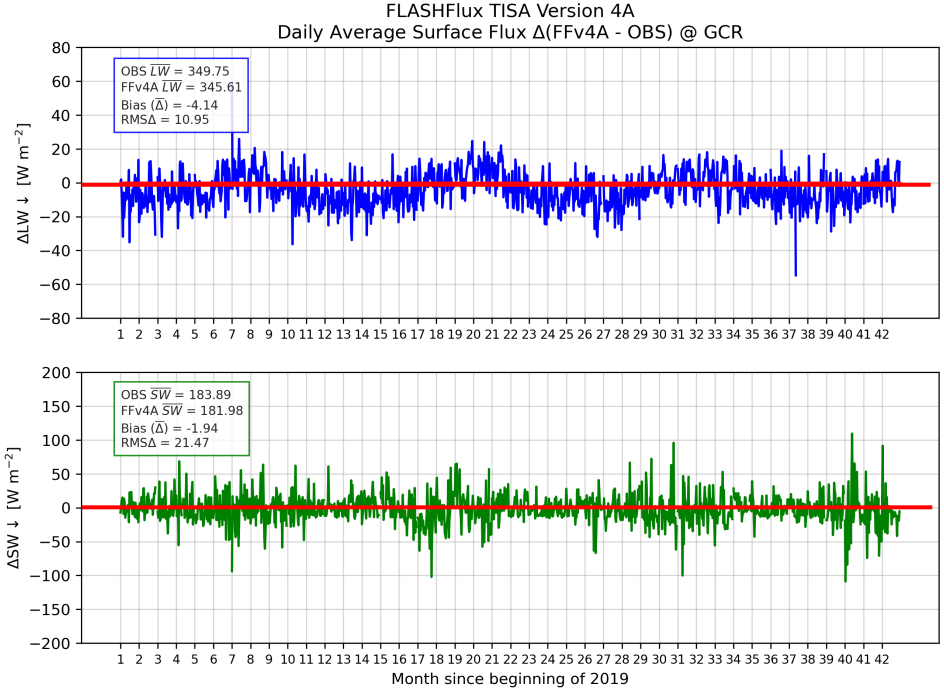
FLASHFlux TISA Validation: BSRN and Ocean Buoy Fluxes

FLASHFlux v4A TISA Daily Average Fluxes (1/2019 – 6/2022)

Region Type	LW Bias	LW RMS	# LW Pairs	SW Bias	SW RMS	# SW Pairs
All Ensemble	-0.2	21.6	43,122	0.7	40.4	46,160
Coastal	0.1	14.8	9460	-1.6	33.8	9159
Desert	-16.4	26.3	4187	-13.5	29.2	4157
Island	4.8	13.2	3877	19.2	47.9	3808
Continental	1.9	27.0	16473	-0.7	45.0	16417
Polar	0.8	20.1	4212	-7.8	49.9	2854
Ocean buoys	0.9	12.4	4913	6.7	35.6	9765

FF Time Series (Goodwin Creek, MS, USA)





FF Time Series
(Langley Research Center, VA, USA)