A Status Update for FLASHFlux and SOFA working groups including Data Usage Highlights from new POWER portal

Paul Stackhouse and David P. Kratz (NASA LaRC)

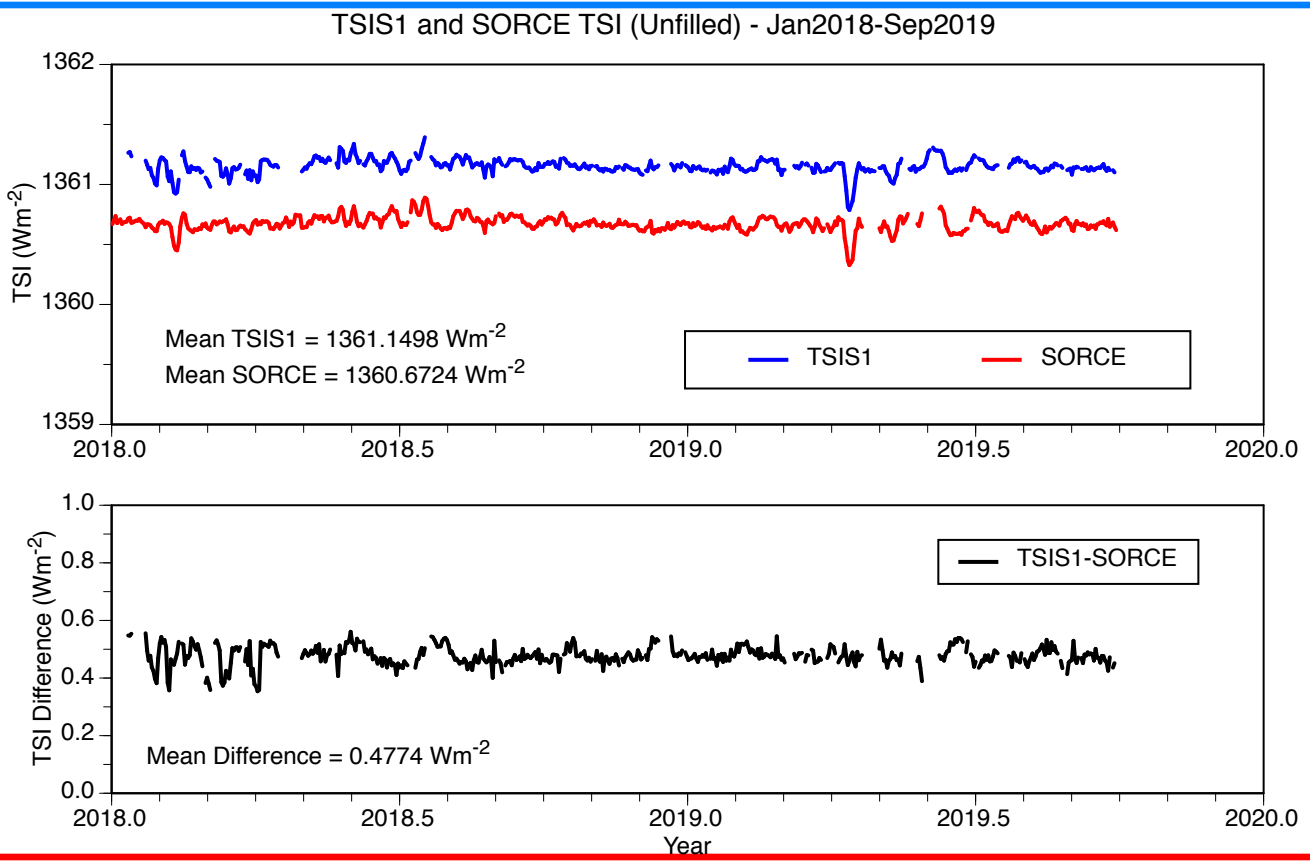
PC Sawaengphokhai, Shashi Gupta and Anne Wilber (SSAI)

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

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

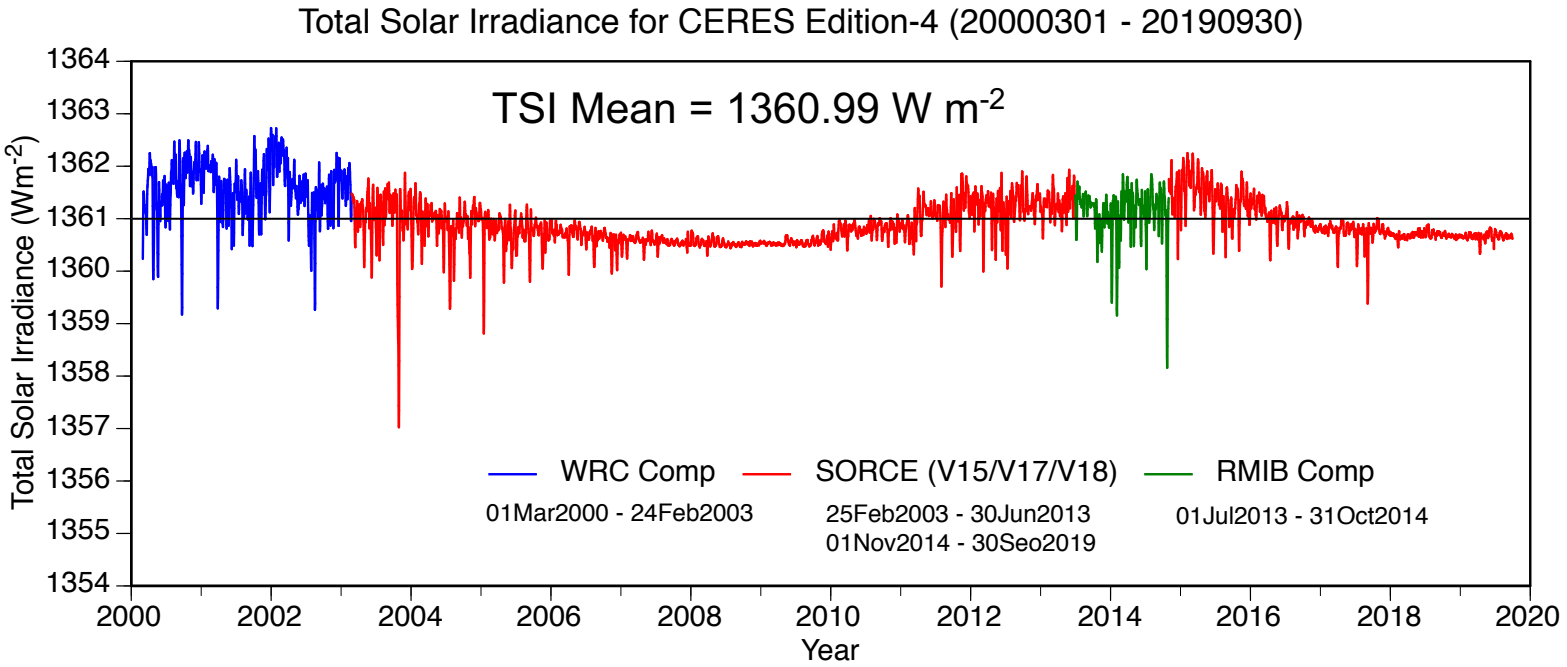
TSI Updates For CERES Processing: Introducing TSIS

- TSIS now providing TSI measurements since Jan11, 2018,
- Gives about +0.5 W m^{-2} more irradiance than SORCE v15
- Space Station orbit causes 2-5 day gaps in TSIS measure-ments
- SORCE gaps are fewer and shorter, but are mostly supplemental



TSI Updates For CERES Processing

- CERES TSI still primarily coming from SORCE (v15) with scaled TSIS for gap filling
- SORCE ceases Jan 16, 2020
- TSIS requires gap filling once SORCE ceases; procedures are TBD



CERES FLASHFlux Overview

- ***FLASHFlux Overview***
  - Uses CERES based production system through inversion
  - Most recent calibration projected forward; running 3-day TISA
  - LPSA/LPLA SOFA algorithms for surface fluxes
- ***FLASHFlux Objectives***
  - SSF products within 4 days
  - Global 1x1 daily averages from a FF TISA (uses a running 3-day average); goal: 6-7 days latency
- ***FLASHFlux Usages***
  - Primarily used for applied science and education
  - Supports also QC for selected missions
  - TOA gridded fluxes; normalized to TOA EBAF for annual “State of the Climate” assessments (most recent report published August 2019).

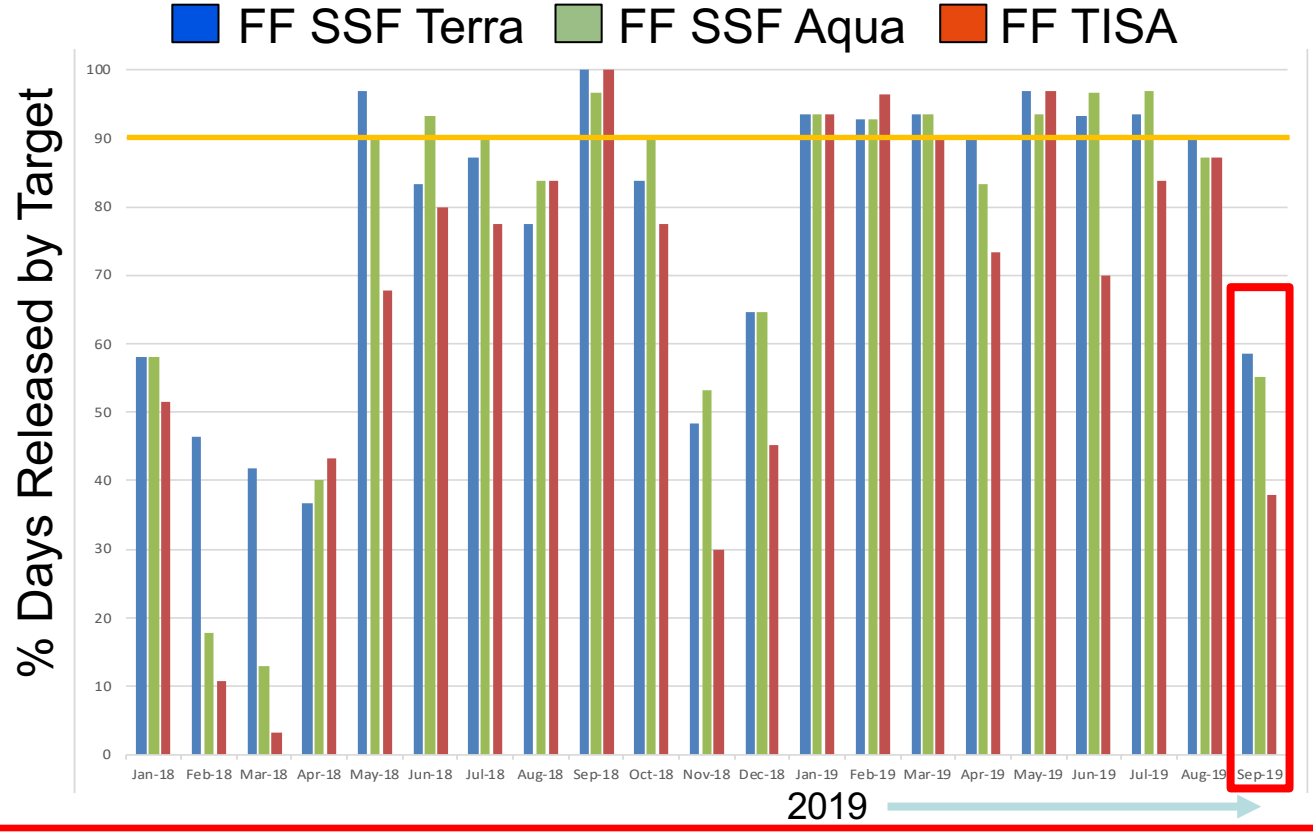
FLASHFlux v3C Status

- ***Production with v3C (MODIS C5/C6/C6.1) (since Jan 1, 2017)***
  - Now uses FP-IT (GEOS 5.12.4) and MODIS Collection 6.1 (after March 1, 2018)
  - FLASHFlux TISA available via CERES subsetter, ASDC and specialized formats through POWER web portal (power.larc.nasa.gov) 5-6 days latency
  - Plan to continue production for 2019 through Dec 31, 2019 while production adapted to FF v4A; plan to reprocess at least from Dec 1, 2019 once FF v4A ready
- ***Current Activities***
  - Recovering from production issues due to system configuration changes
  - Evaluating FLASHFlux SSF V4A through (uses MC6.1); applying new calibration
  - V3C vs 4A SSF; code modifications for newer x86 processor complete
  - Finalizing V4A TISA modifications (consistent with CERES Ed 4); issues with surface LW
- ***FLASHFlux Data Provision Through POWER:***
  - POWER web portal usage growing (https://power.larc.nasa.gov)
  - Usage examples in energy and agriculture growing
  - User metrics through September

CERES FLASHFlux Latency Status

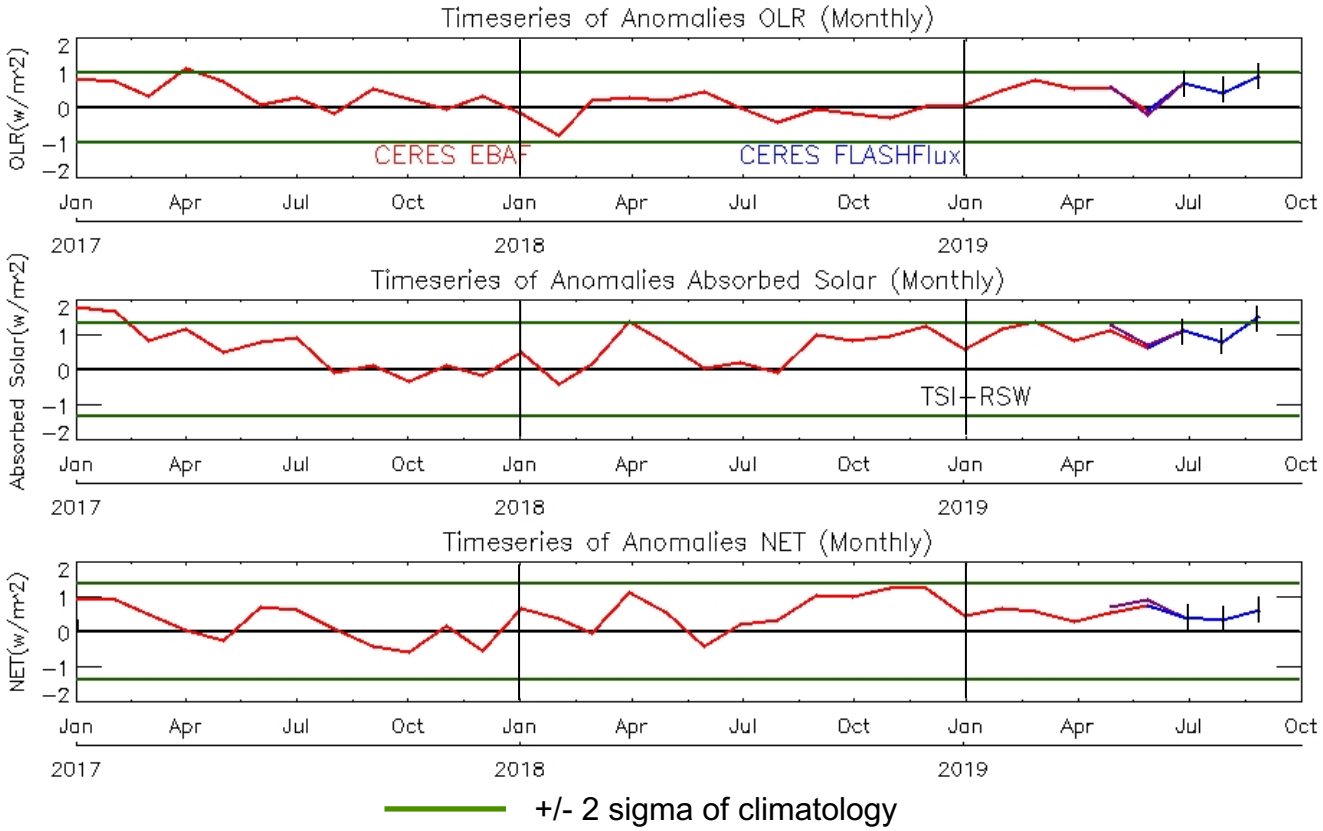
- FF SSF Success Target = data release within 4 days
- FF TISA Success Target = data released within 6 days
- Only 4 of last 9 months > 90% TISA success
- Sept. 2019 < 40%
- Working with ASDC to address issues

75% of daily solar irradiance users request low latency



Updated Global TOA Anomaly Time Series

- OLR anomalies jump back up > 0.4 W m^{-2}
- Net RSW (absorbed SW) anomalies remain +0.7 to 1.5 W m^{-2}
- Subtraction gives Total Net in +0.3 to 0.6 W m^{-2} range the last two months
- FF uncertainties +/- 0.2 W m^-2; Sept had missing data
- Continuing to monitor



POWER GIS-Enabled Portal Featuring FLASHFlux Fluxes (https://power.larc.nasa.gov)

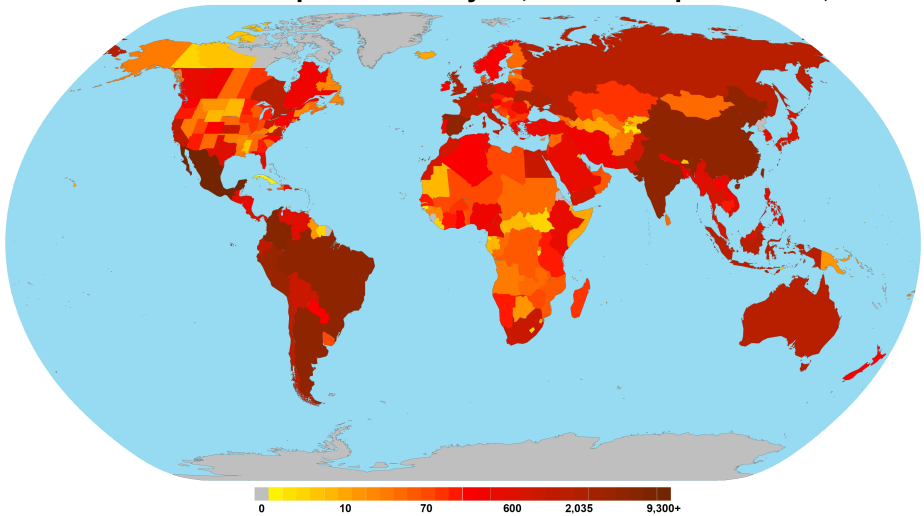
- **Using ArcGIS architecture** to geospatially enable entire POWER data archive for access to growing Applied Science users.
- **Increased spatial/temporal resolutions**:
  - Features CERES FLASHFLUX for Solar & GMAO MERRA-2/GEOS 5.12.4 for meteorological parameters
  - Mapped to ½ x ½ spatial resolution, Low latency Daily Time Series, 30 Year Climatological Averages
- ***Complete API service (data order using URL)***
  - allows for data to be repeatedly requested using a script or from within a user analysis program
- ***Interactive Data Access Viewer and ArcGIS Image Services***
  - User selection of location, parameters
  - Output formats ASCII, CSV, geoJSON, NetCDF4, ICASA, GeoTiff

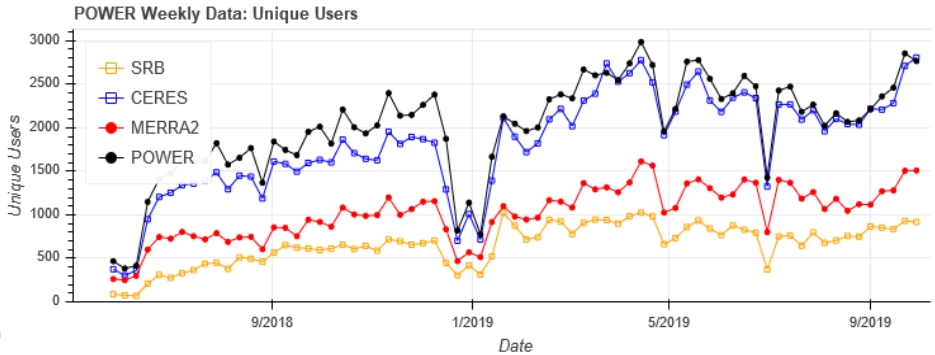
FLASHFlux to POWER Metrics

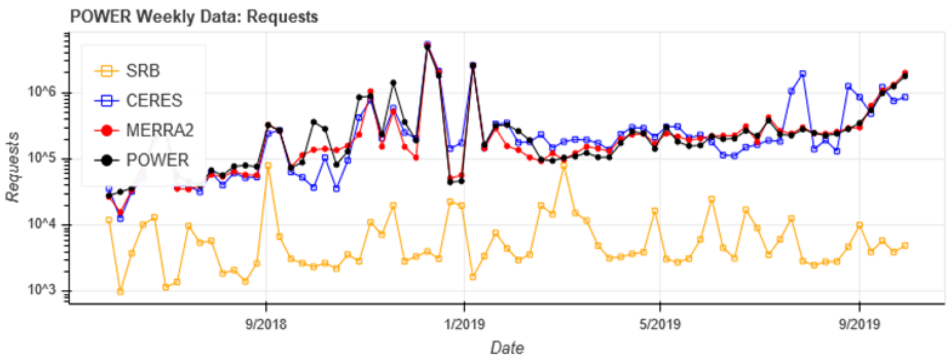
Metrics (2018/05/16 to 2019/09/30):

	Total	Monthly	CERES %
Requests	52,516,652	3,089,214	58.2%
Unique Users IPs	141,710	6,820	73.5%
Volume	30,005 GB	1,824 GB	28.6%
Latency < 2 Weeks %	74.9%	--	74.9%

POWER CERES Unique Users May 16, 2018 to September 30, 2019

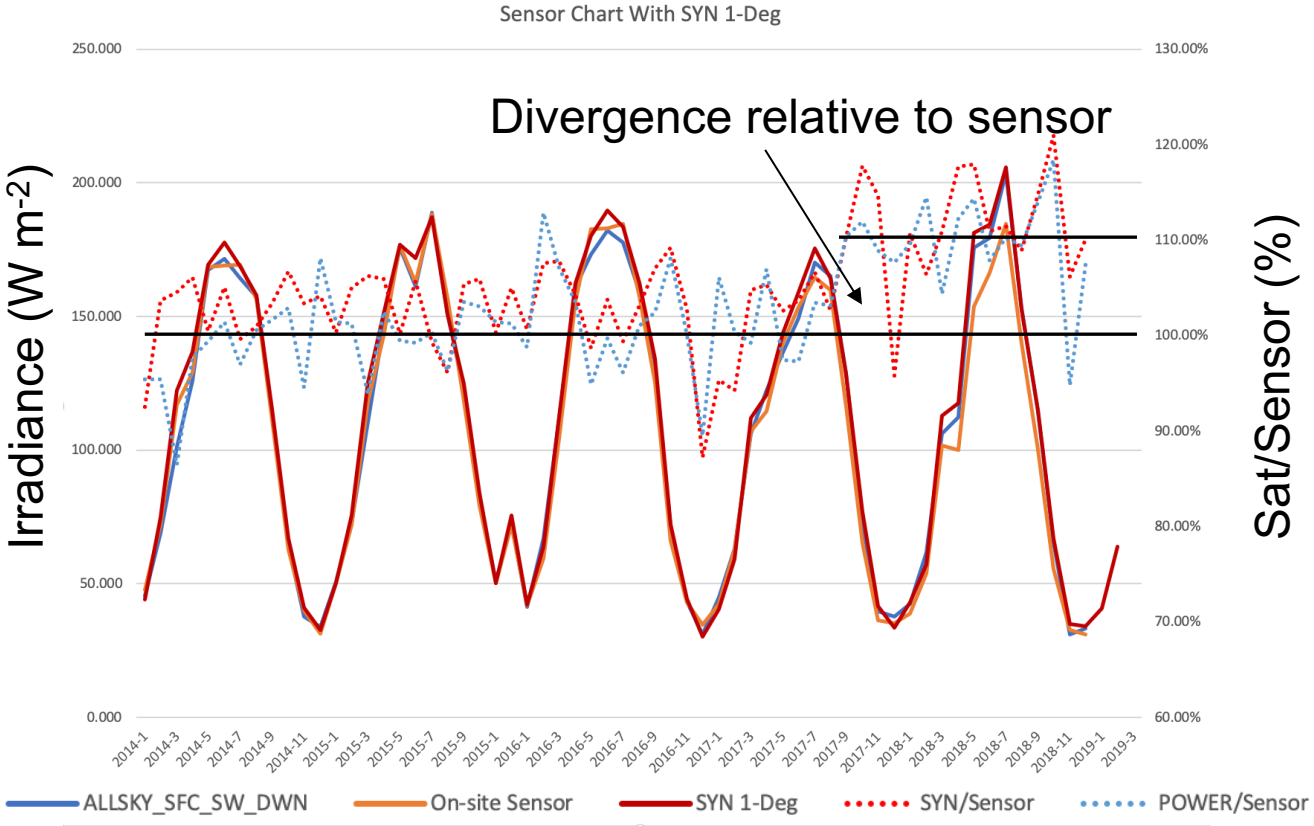




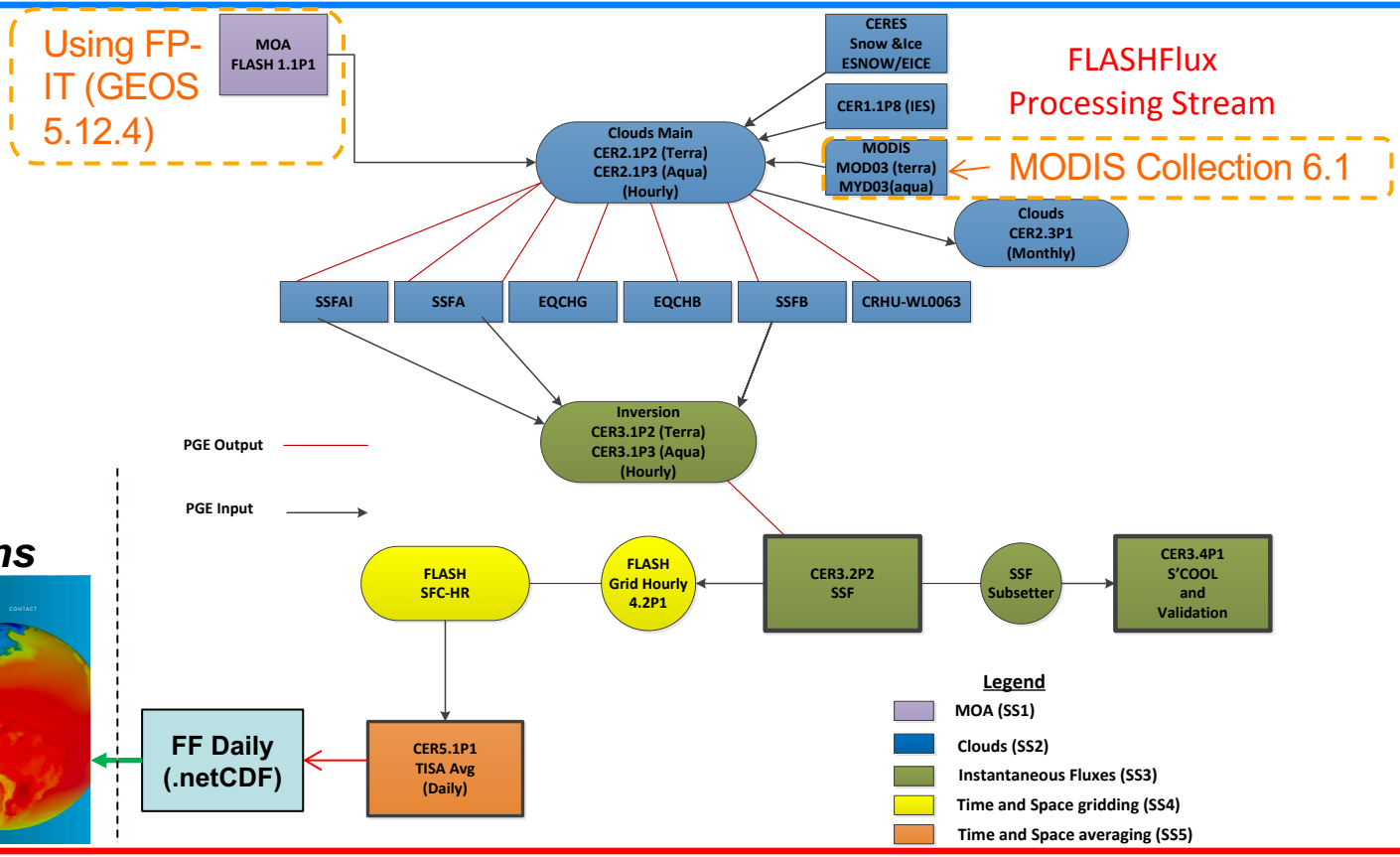


Example Usage: Solar Panel Installation Monitoring

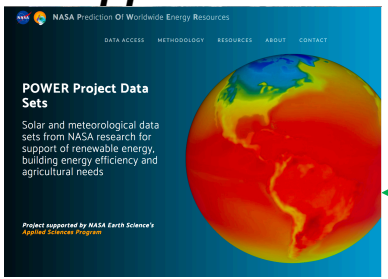
- User manages 50 solar panel sites producing 5.3 MW of power.
- Deploys FF (POWER) and sensors to help monitor performance
- Noted divergence > 5% with FF surface irradiance
- Used SYN1 and EBAF (not shown) to evaluate for trend; none found
- After several additional months divergence reached 50%
- User concluded sensor was bad



Current v3C Production System

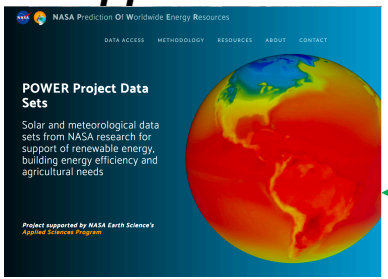


POWER Applications

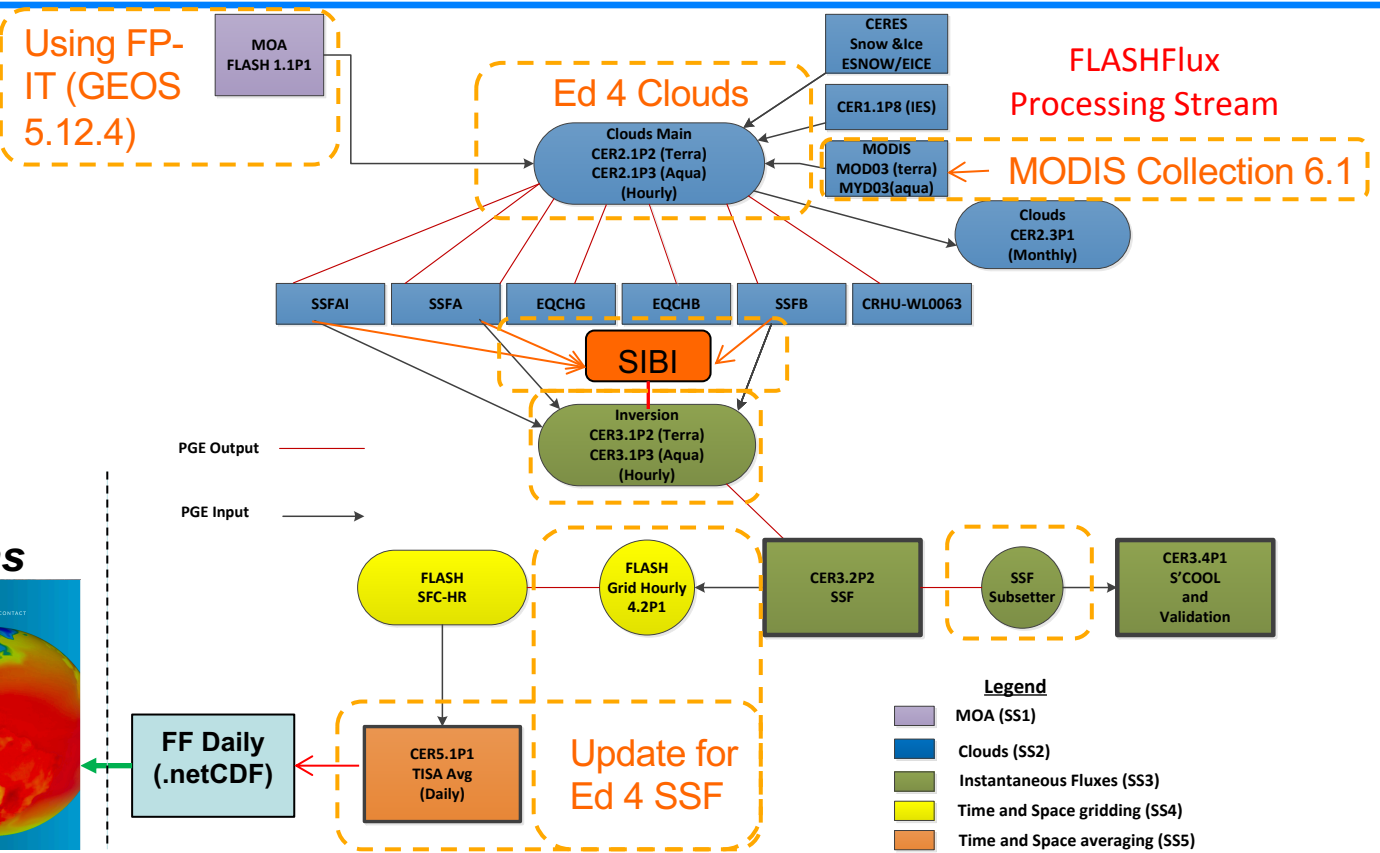


Future v4A Production System

Initial data date Jan 1, 2020



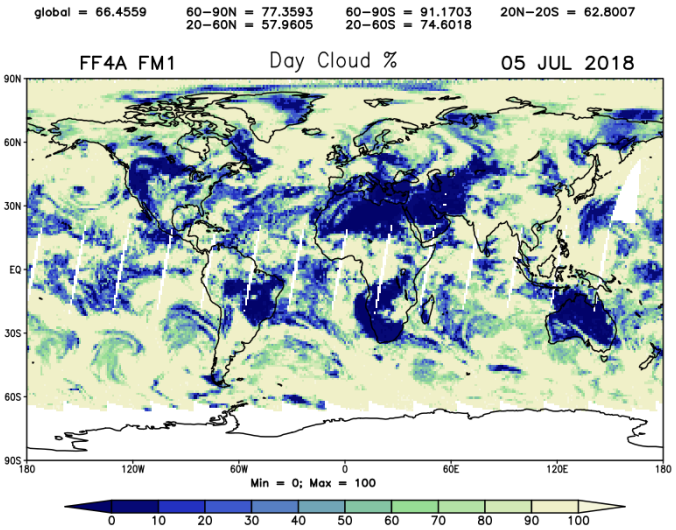
POWER Applications



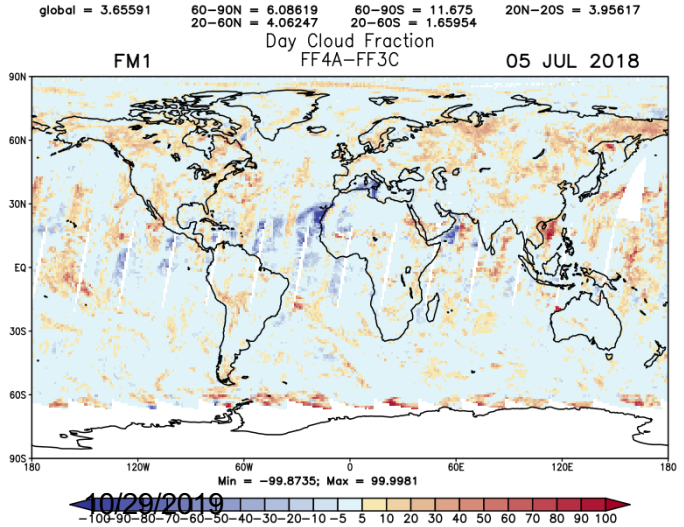
FLASHFlux V4A: SSF Results

- Samples from 4 test months are now being analyzed: July 2018, October 2018, January 2019 and April 2019
- Show examples of FF SSF differences between FF V3C (current), FF V4A and the CERES SOFA Ed4 from Terra and CERES FM1 fluxes
- Show and discuss daily composites from SSF July 5, 2018

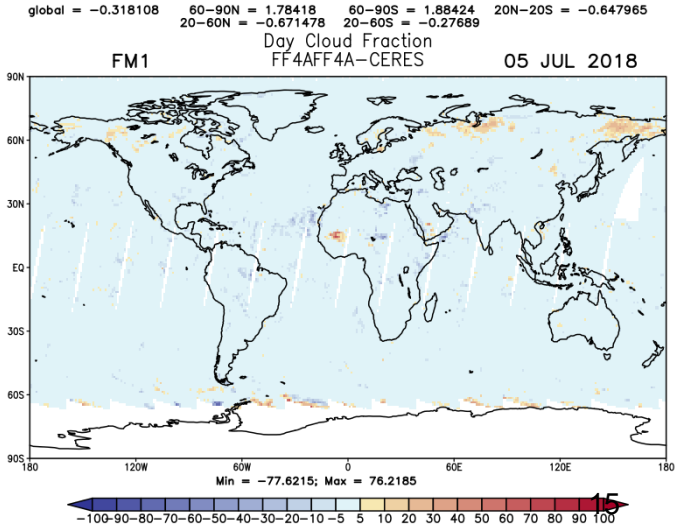
Cloud Daytime



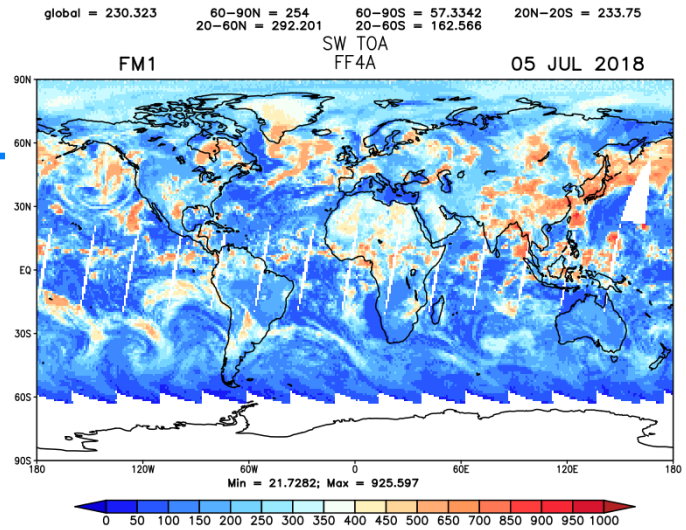
FF V4A – FF V3C



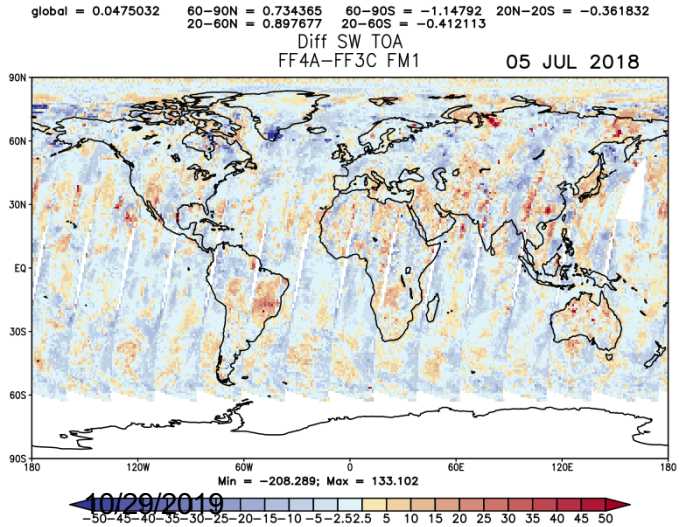
FF V4A – CERES Ed4



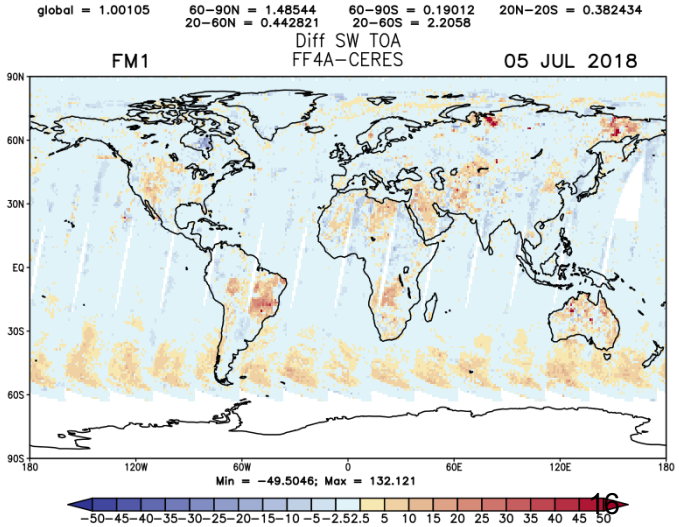
SW TOA



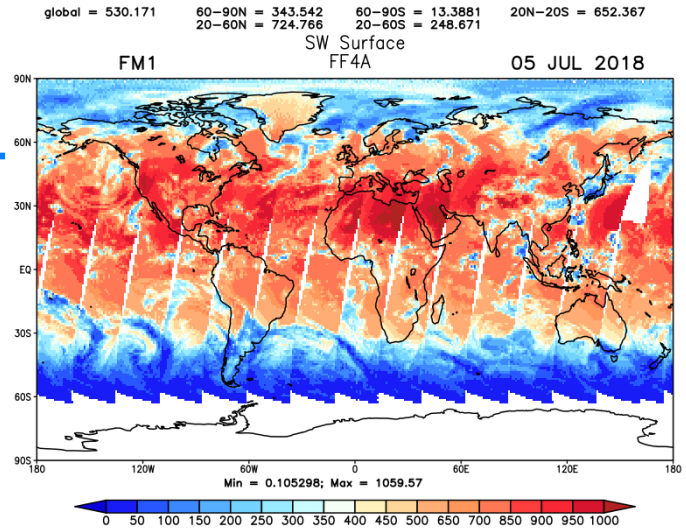
FF V4A – FF V3C



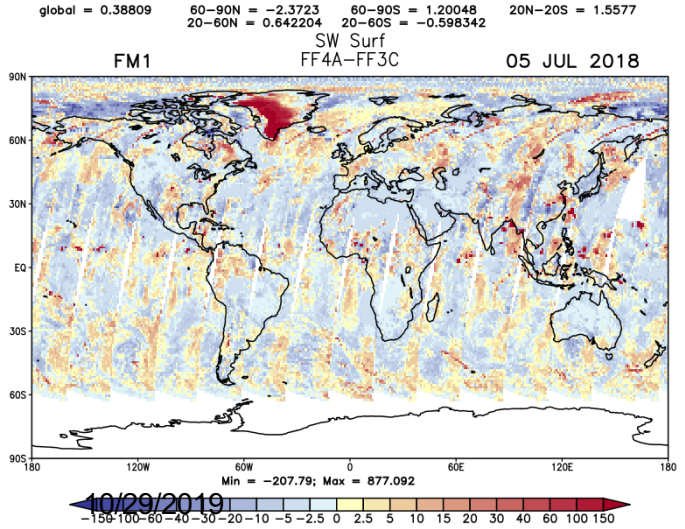
FF V4A – CERES Ed4



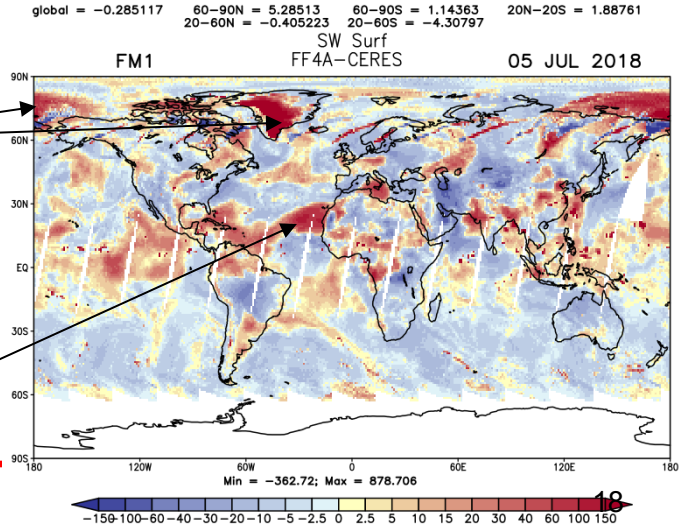
SW Surface



FF V4A – FF V3C



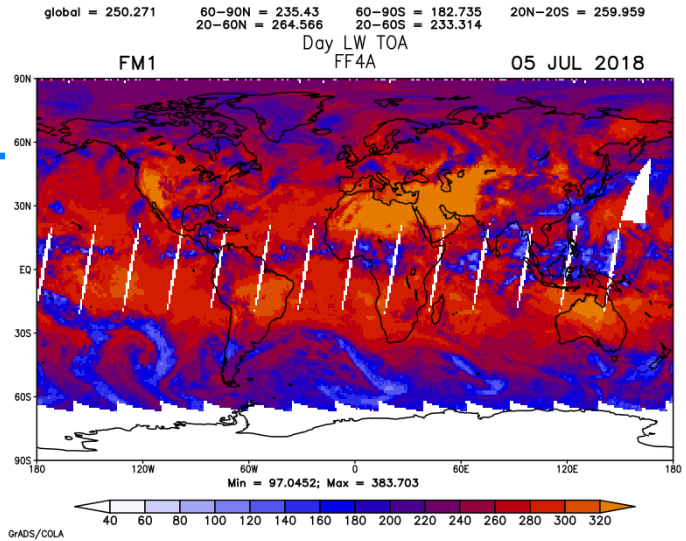
FF V4A – CERES Ed4



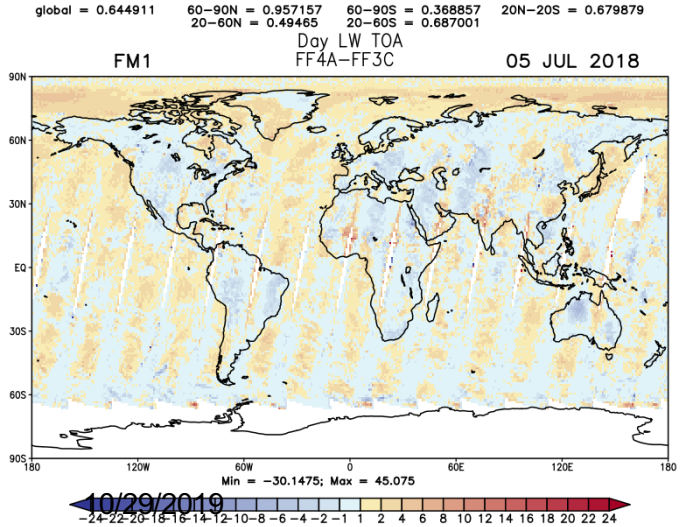
Revised secondary algorithm

Aerosol differences

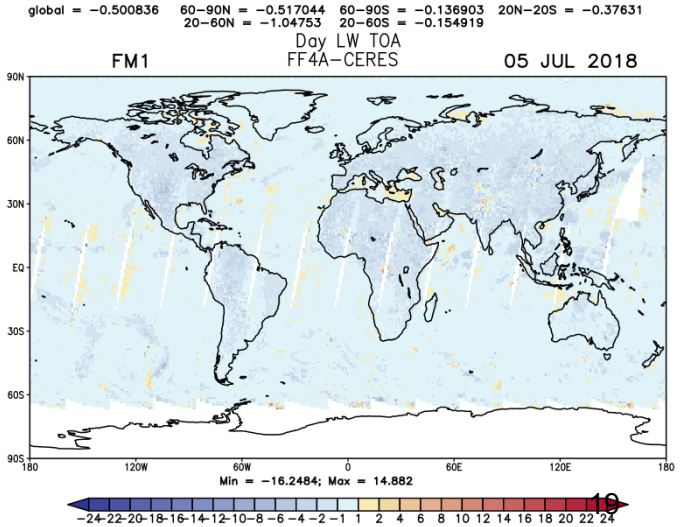
LW TOA Daytime



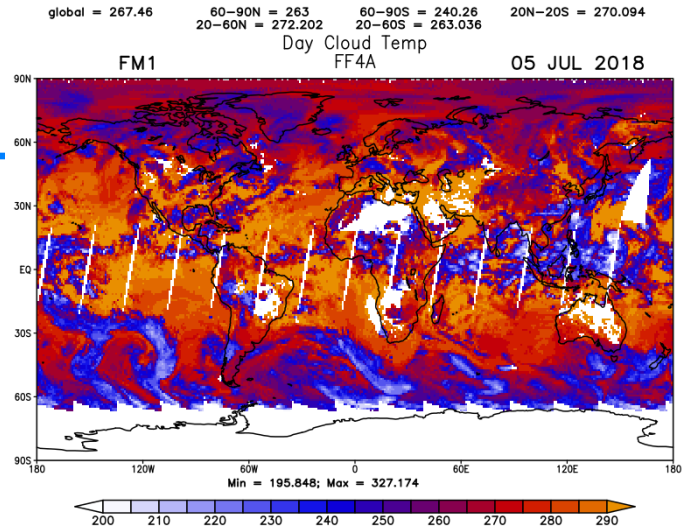
FF V4A – FF V3C



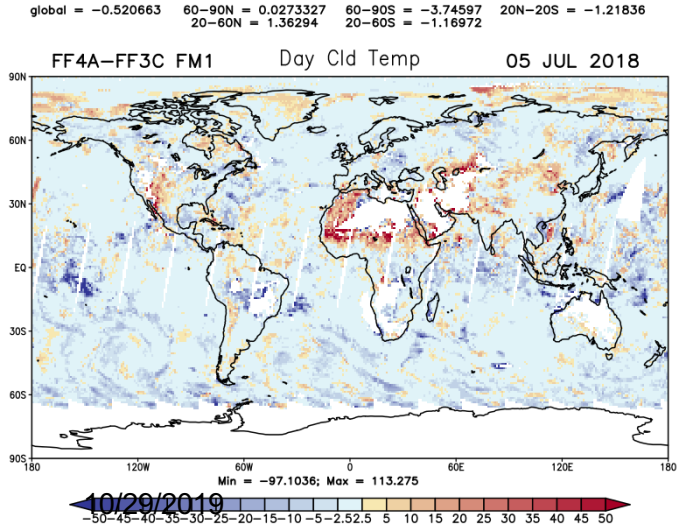
FF V4A – CERES Ed4



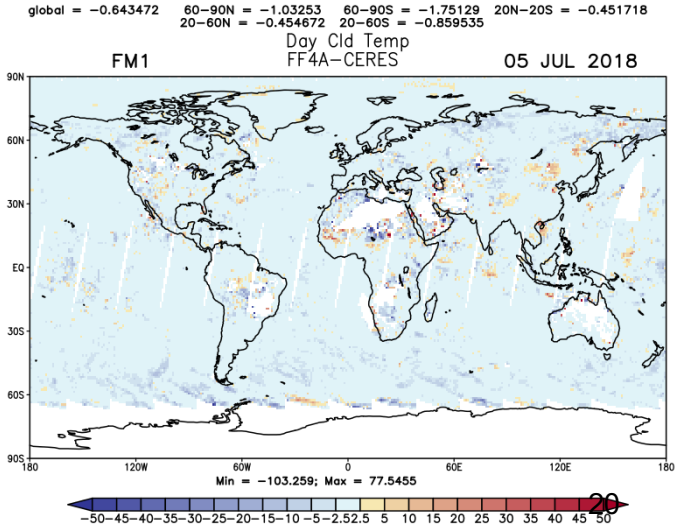
Cloud Base Temperature Daytime



FF V4A – FF V3C



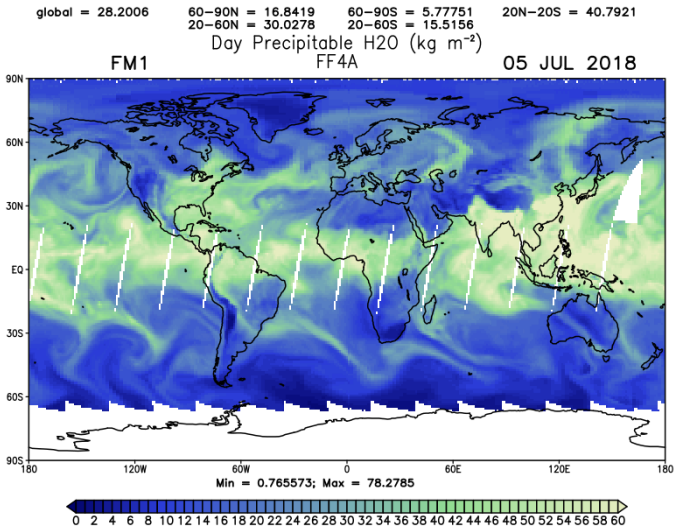
FF V4A – CERES Ed4



CERES uses atmospheric temperature profiles from GEOS 5.4 and FLASH uses GEOS5.12

Precipitable H2O Daytime

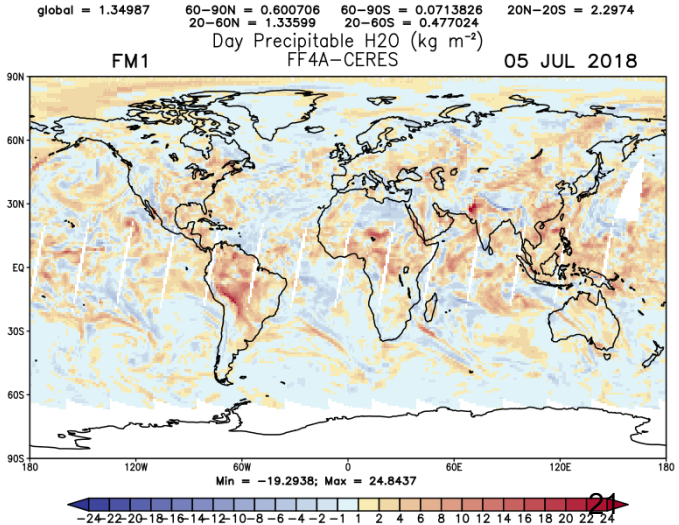
FF V4A – FF V3C



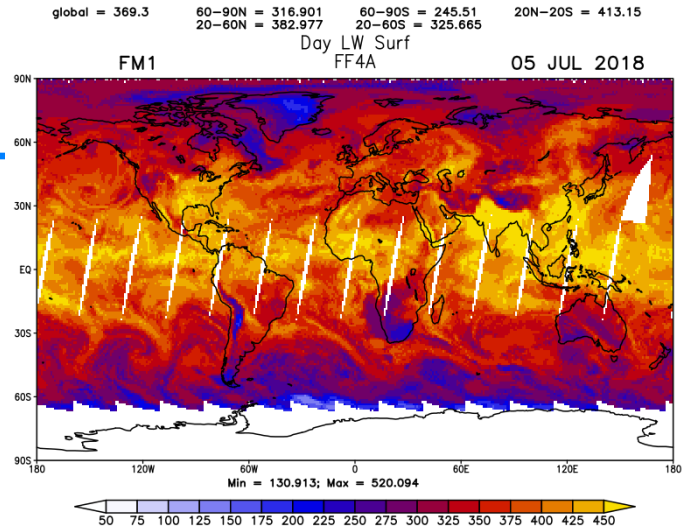
CERES uses column water vapor from GEOS 5.4 and FLASH uses GEOS5.12

FF3C and FF4A use same MOA from GEOS 5.12

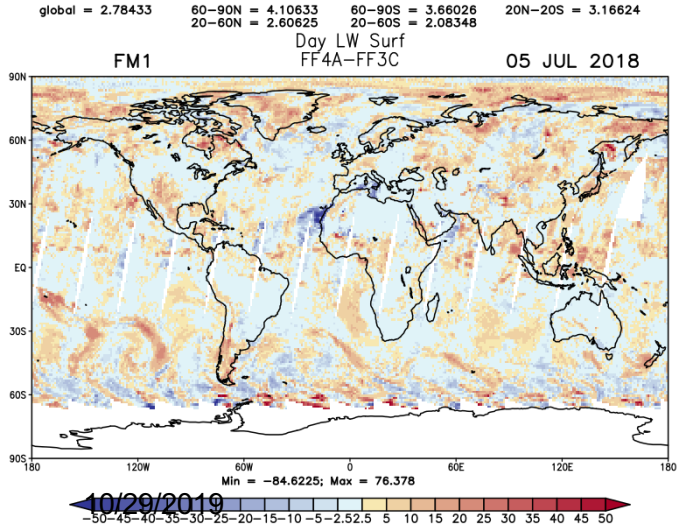
FF V4A – CERES Ed4



LW Surface Daytime



FF V4A – FF V3C



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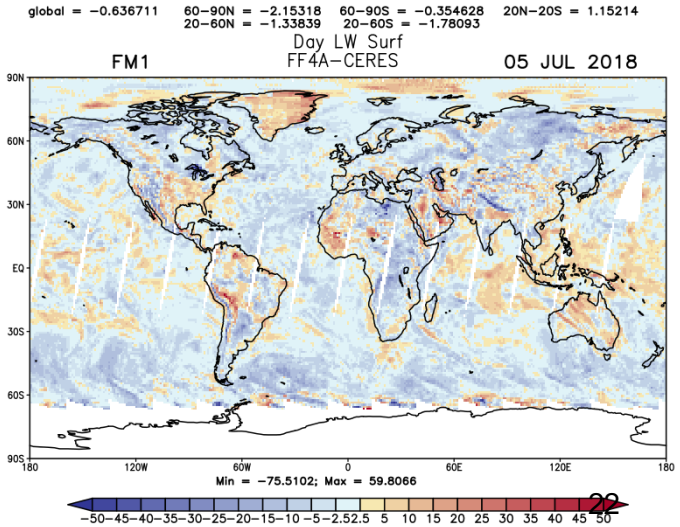
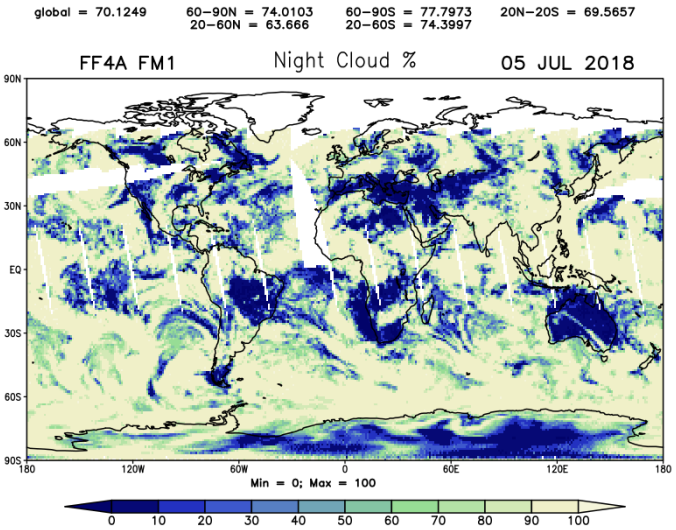
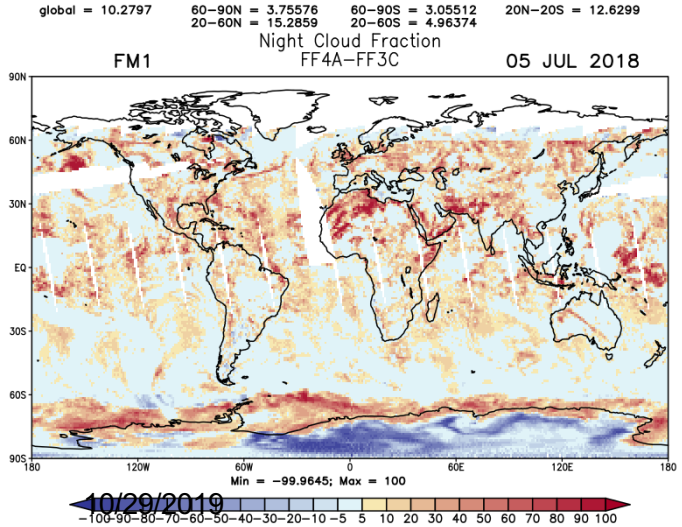


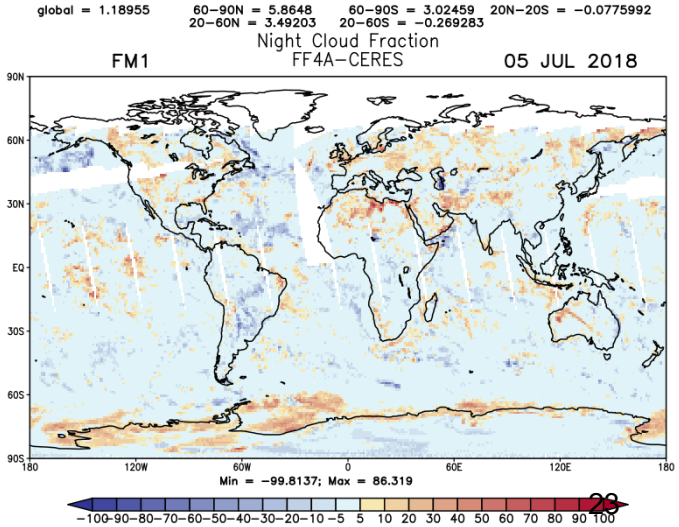
Cloud Nighttime



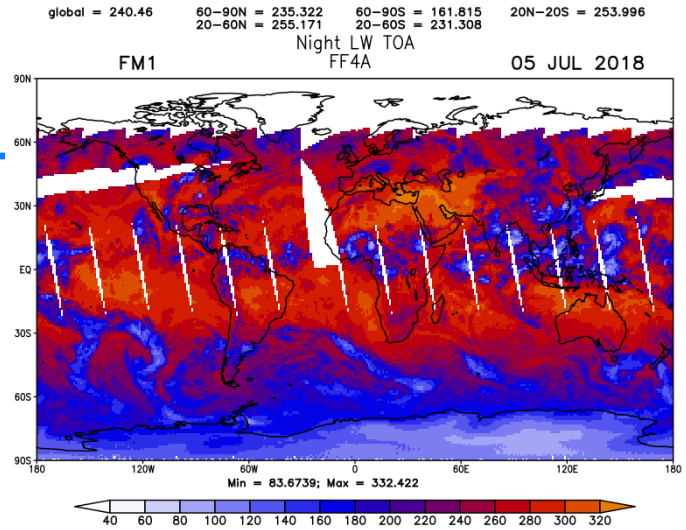
FF V4A – FF V3C



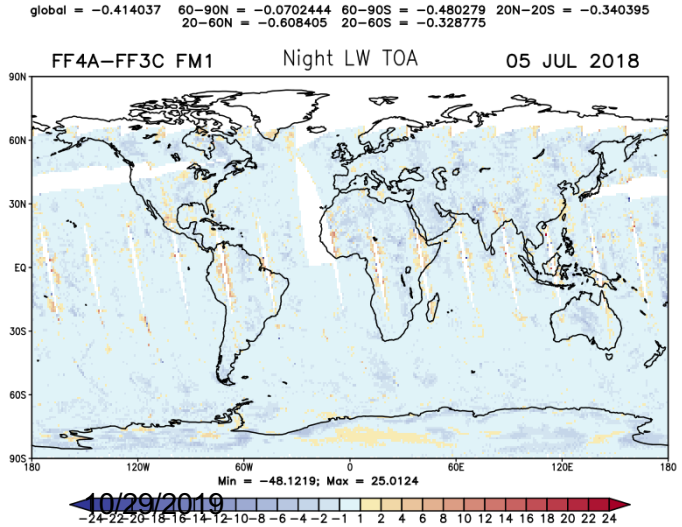
FF V4A – CERES Ed4



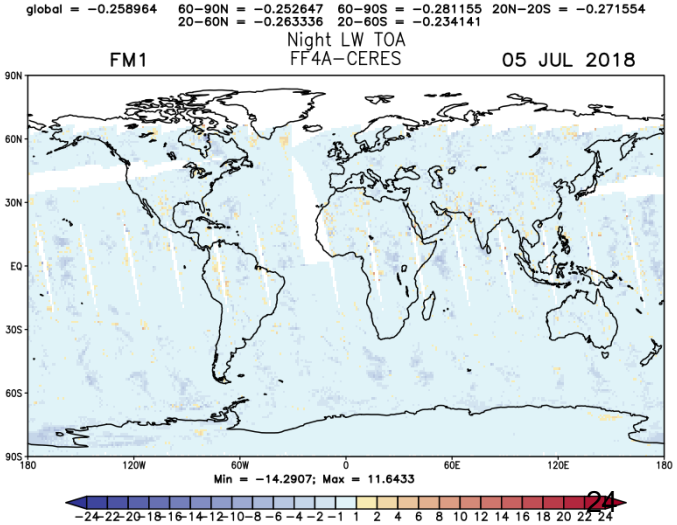
LW TOA Nighttime



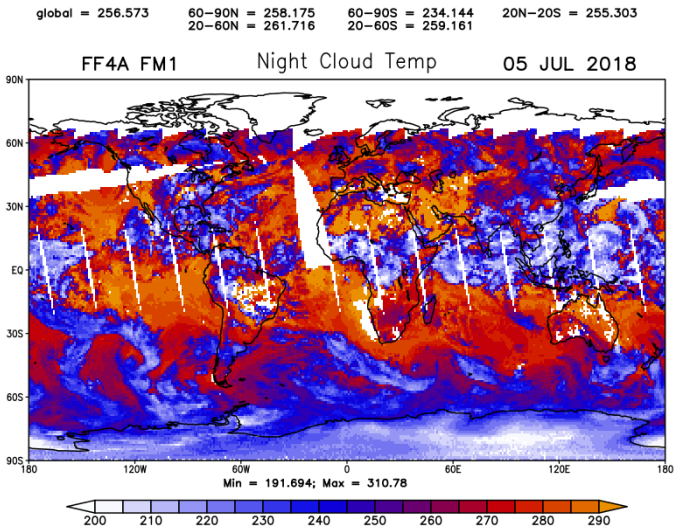
FF V4A – FF V3C



FF V4A – CERES Ed4

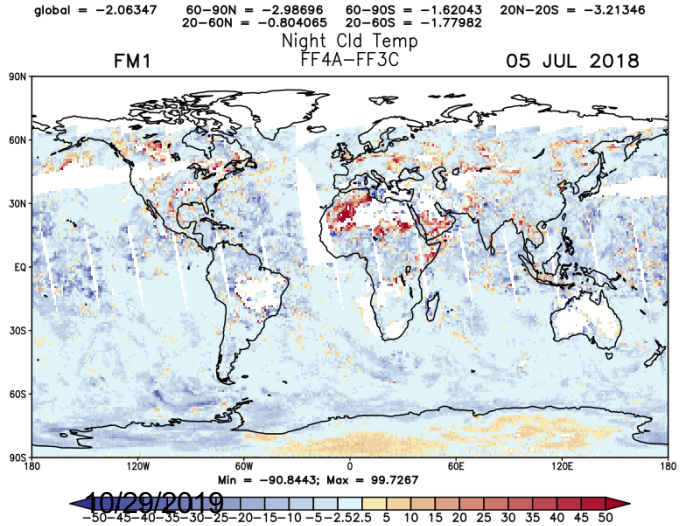


Cloud Base Temperature Nighttime

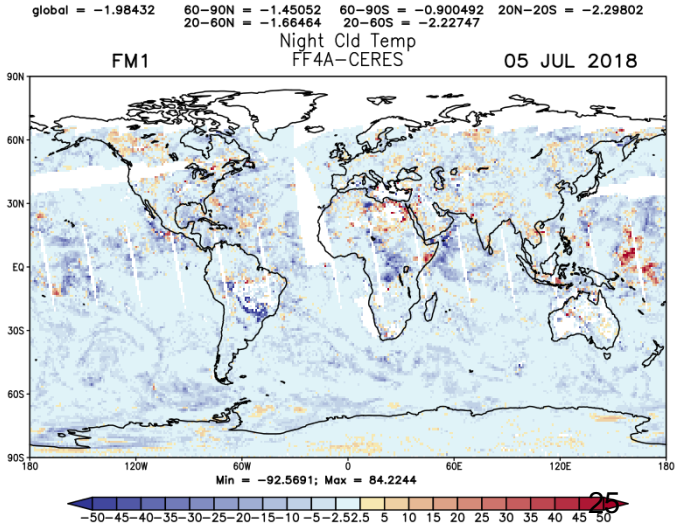


CERES uses atmospheric temperature
profiles from GEOS 5.4 and FLASH uses GEOS5.12

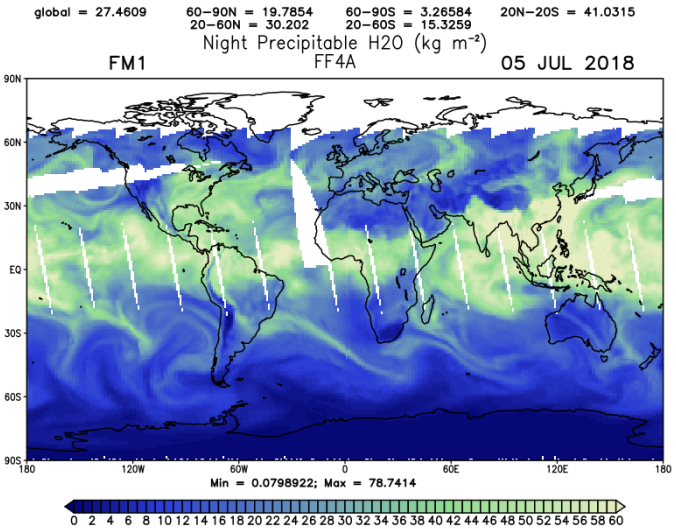
FF V4A – FF V3C



FF V4A – CERES Ed4



Precipitable H2O Nighttime



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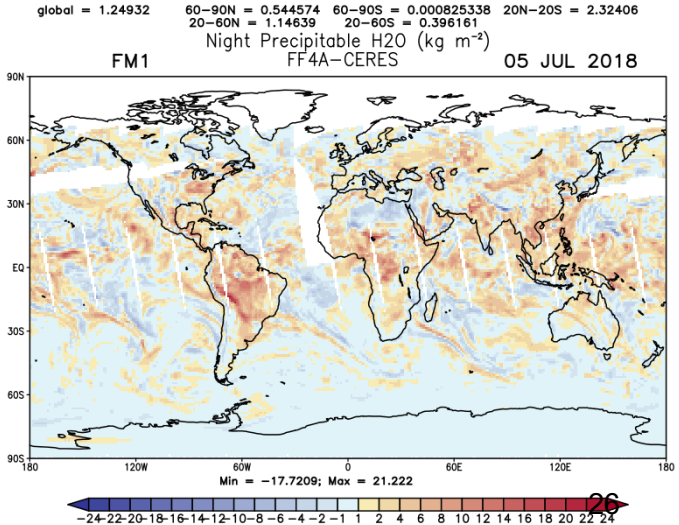
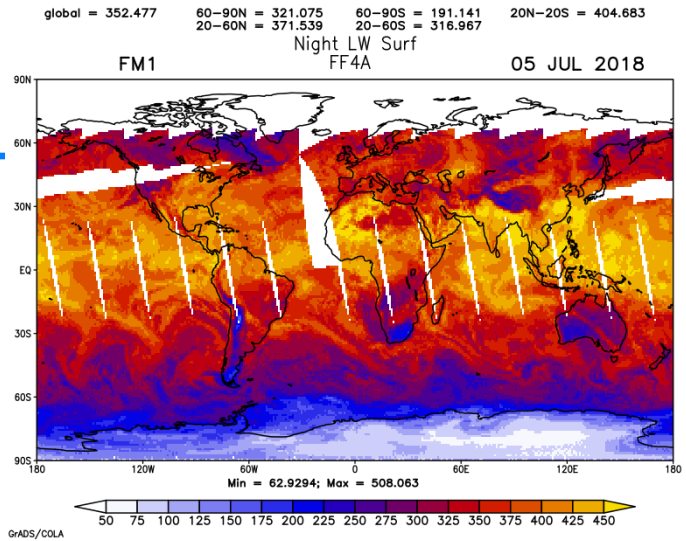
FF3C and FF4A use same MOA from GEOS 5.12

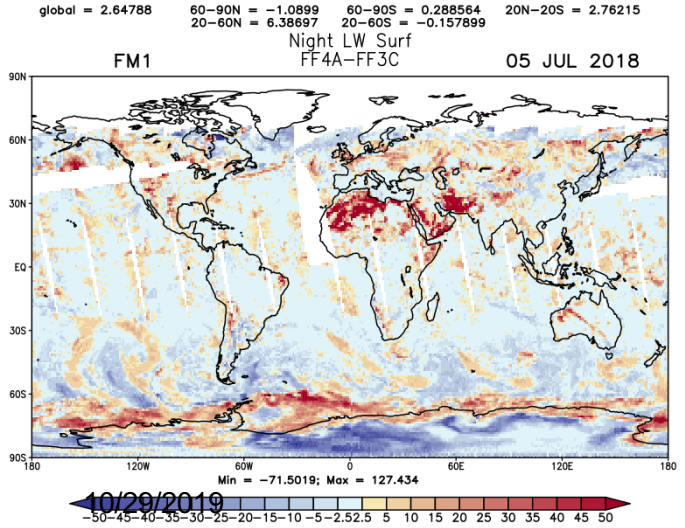
FF V4A – CERES Ed4



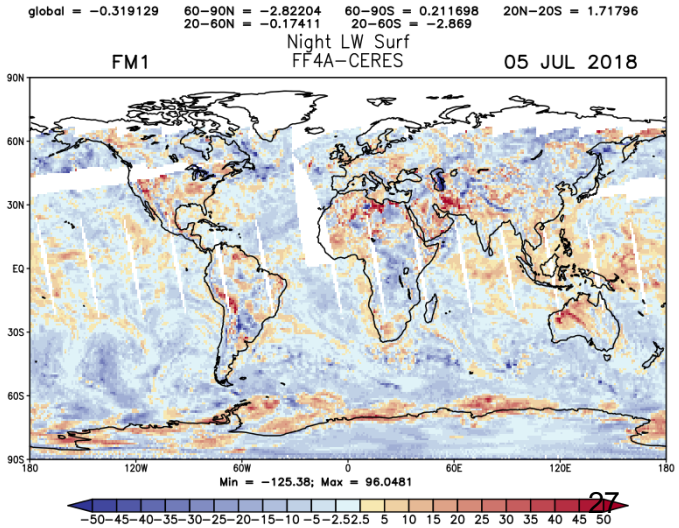
LW Surface Nighttime



FF V4A – FF V3C

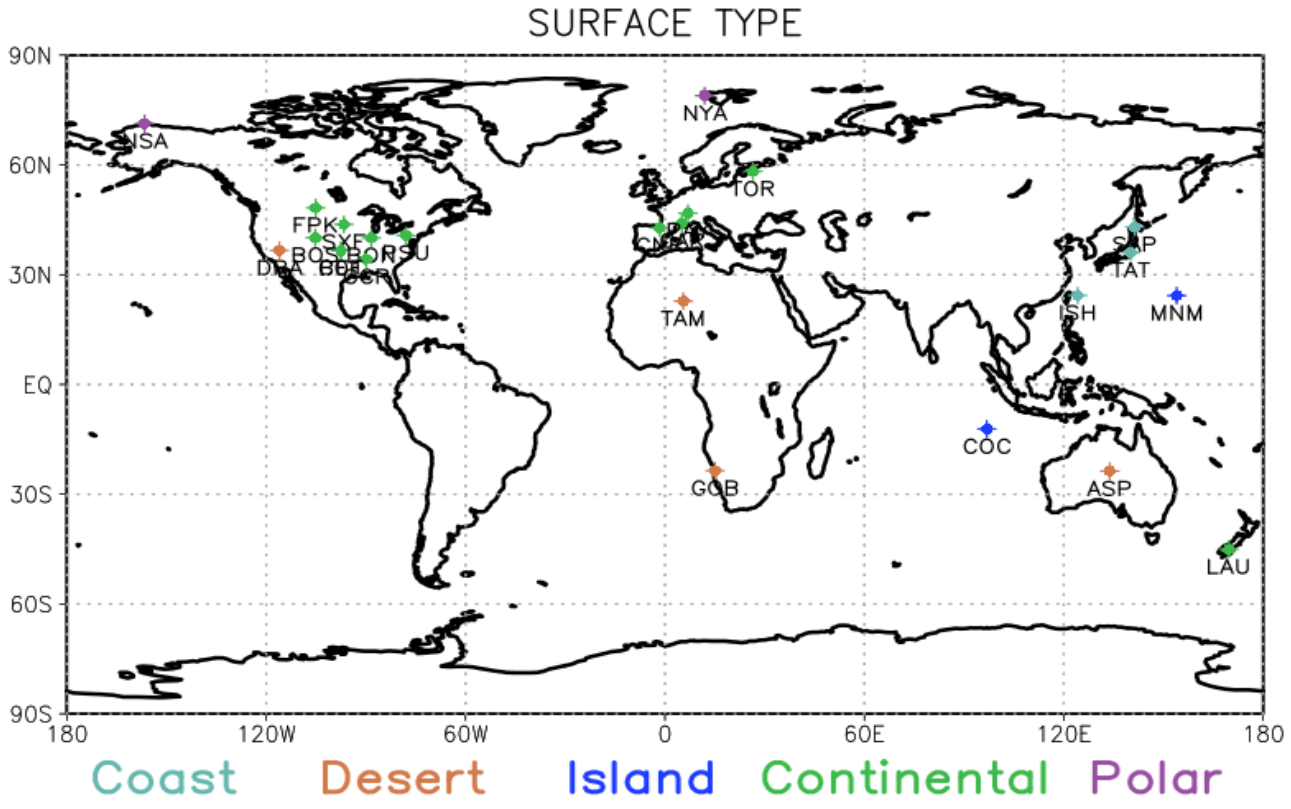


FF V4A – CERES Ed4



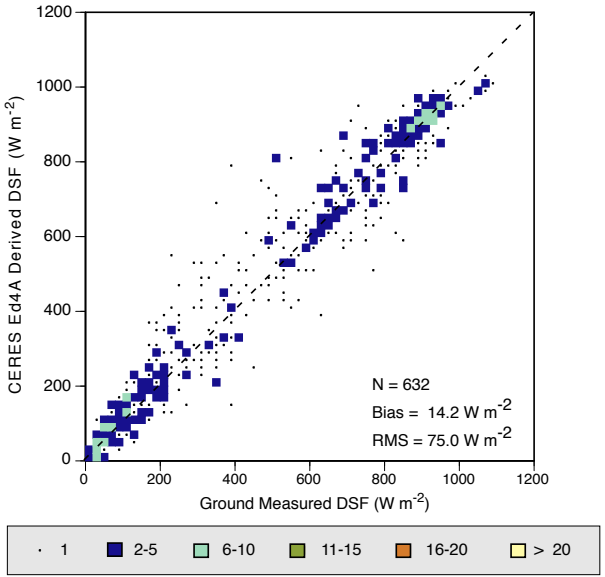
FF SSF Surface Flux Validation With BSRN

- FF SSF validation for Terra and Aqua
- SW and LW Day/Night separately
- Match overpass and BSRN observations

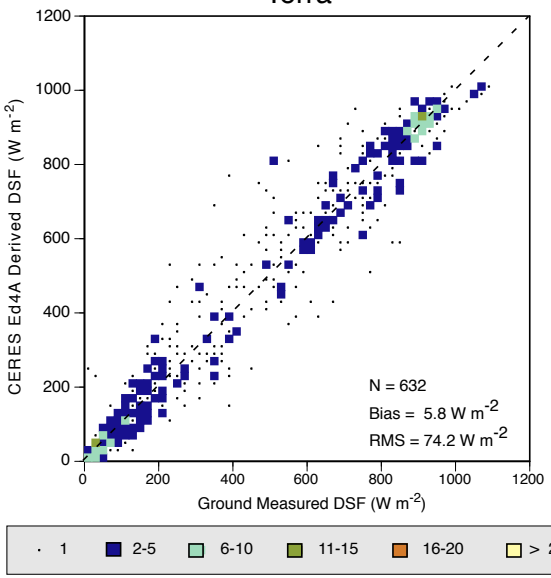


Terra FF SW SSF Surface Flux Validation

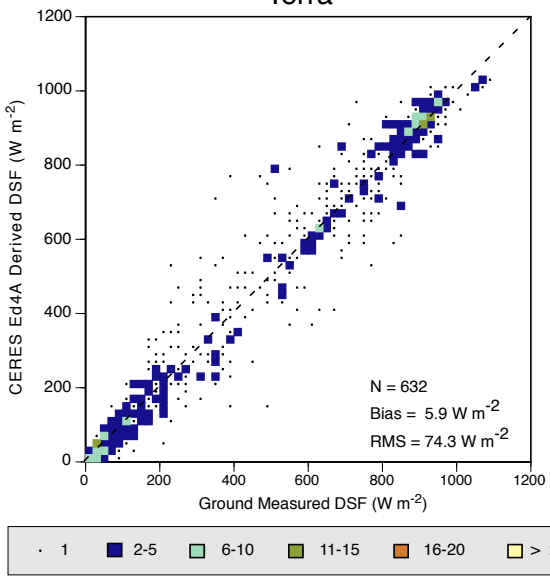
FLASHFlux V3C
201807
Terra



FLASHFlux V4A
201807
Terra

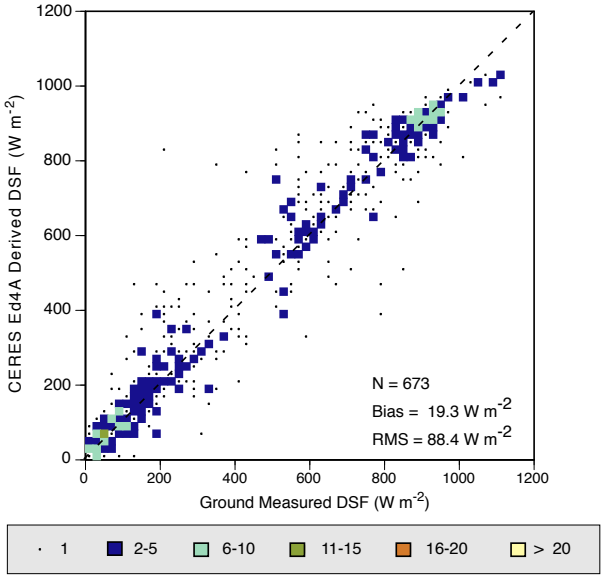


CERES Ed4A
201807
Terra

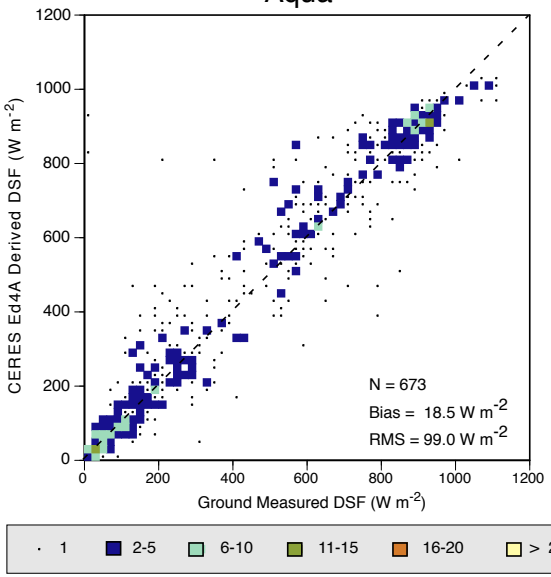


Aqua FF SW SSF Surface Flux Validation

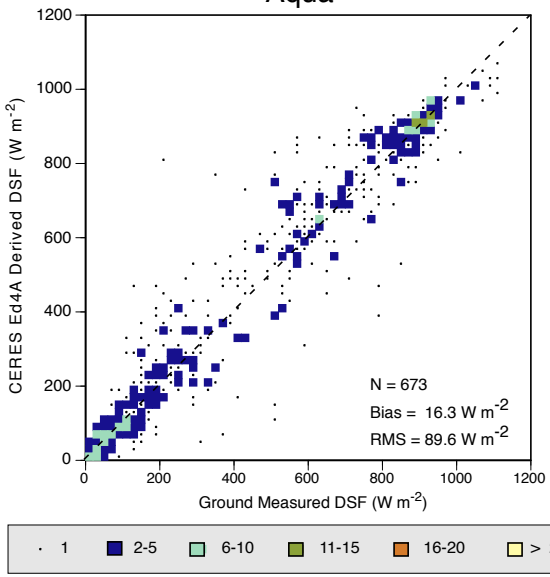
FLASHFlux V3C
201807
Aqua



FLASHFlux V4A
201807
Aqua



CERES Ed4A
201807
Aqua



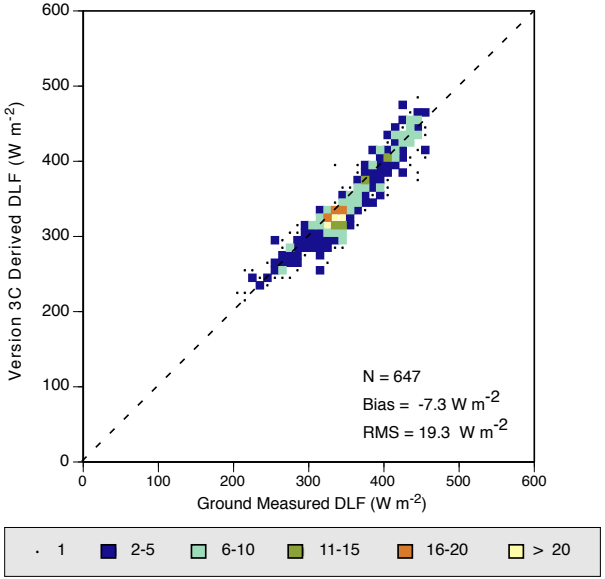
Surface SW FF Validation

For Test Months January 2019 and July 2018

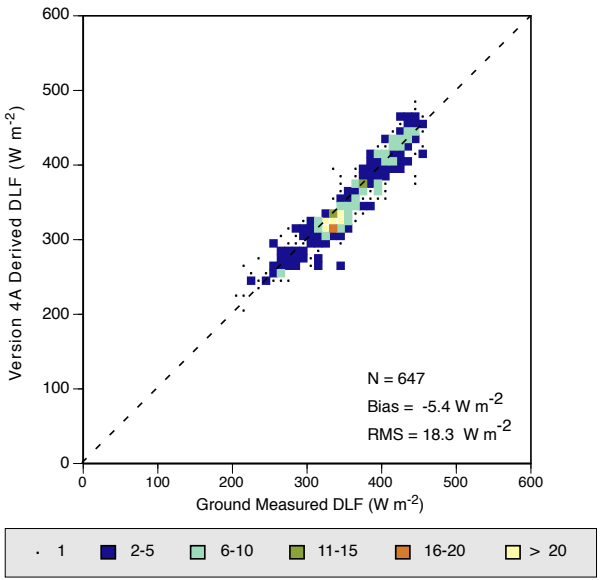
Sat	Month	FF V3C		FF V4A		CERES Ed4		Mean Obs	N Obs
		Bias (W m^{-2})	RMS (W m^{-2})	Bias (W m^{-2})	RMS (W m^{-2})	Bias (W m^{-2})	RMS (W m^{-2})	W m^{-2}	
Terra	Jan	9.2	77.4	4.0	78.3	7.2	78.6	356.8	339
	Jul	14.2	75.0	5.8	74.2	5.9	74.3	504.2	632
Aqua	Jan	17.2	79.9	14.9	80.1	17.6	80.0	390.0	316
	Jul	19.3	88.4	18.5	99.0	16.3	89.6	498.5	673

Terra FF Daytime LW SSF Surface Flux Validation

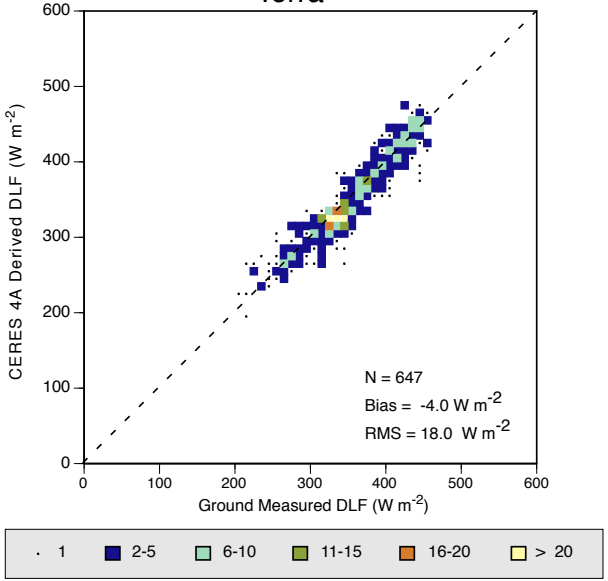
Daytime Ensemble
FLASHFlux V3C
201807
Terra



Daytime Ensemble
FLASHFlux V4A
201807
Terra

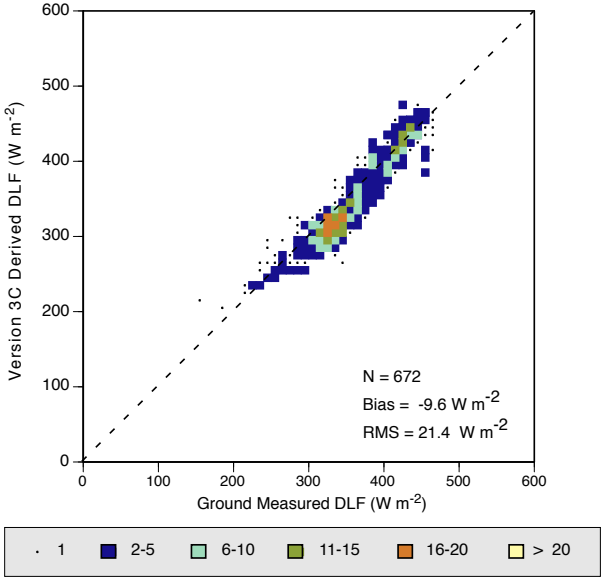


Daytime Ensemble
CERES Ed4A
201807
Terra

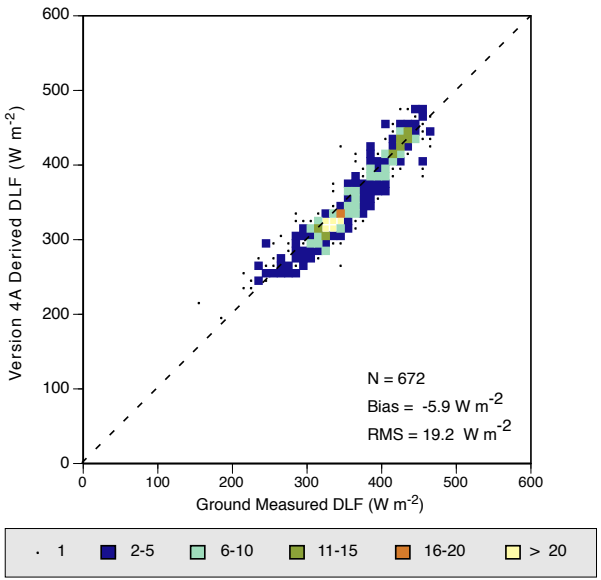


Aqua FF Daytime LW SSF Surface Flux Validation

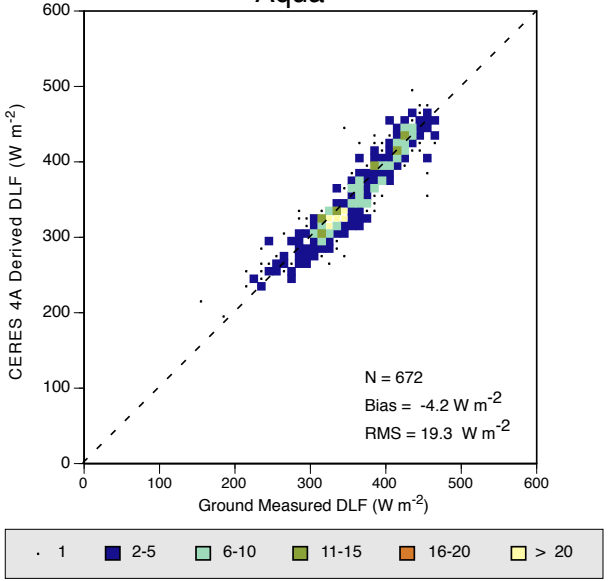
Daytime
Ensemble
FLASHFlux V3C
201807
Aqua



Daytime
Ensemble
FLASHFlux V4A
201807
Aqua



Daytime
Ensemble
CERES Ed4A
201807
Aqua

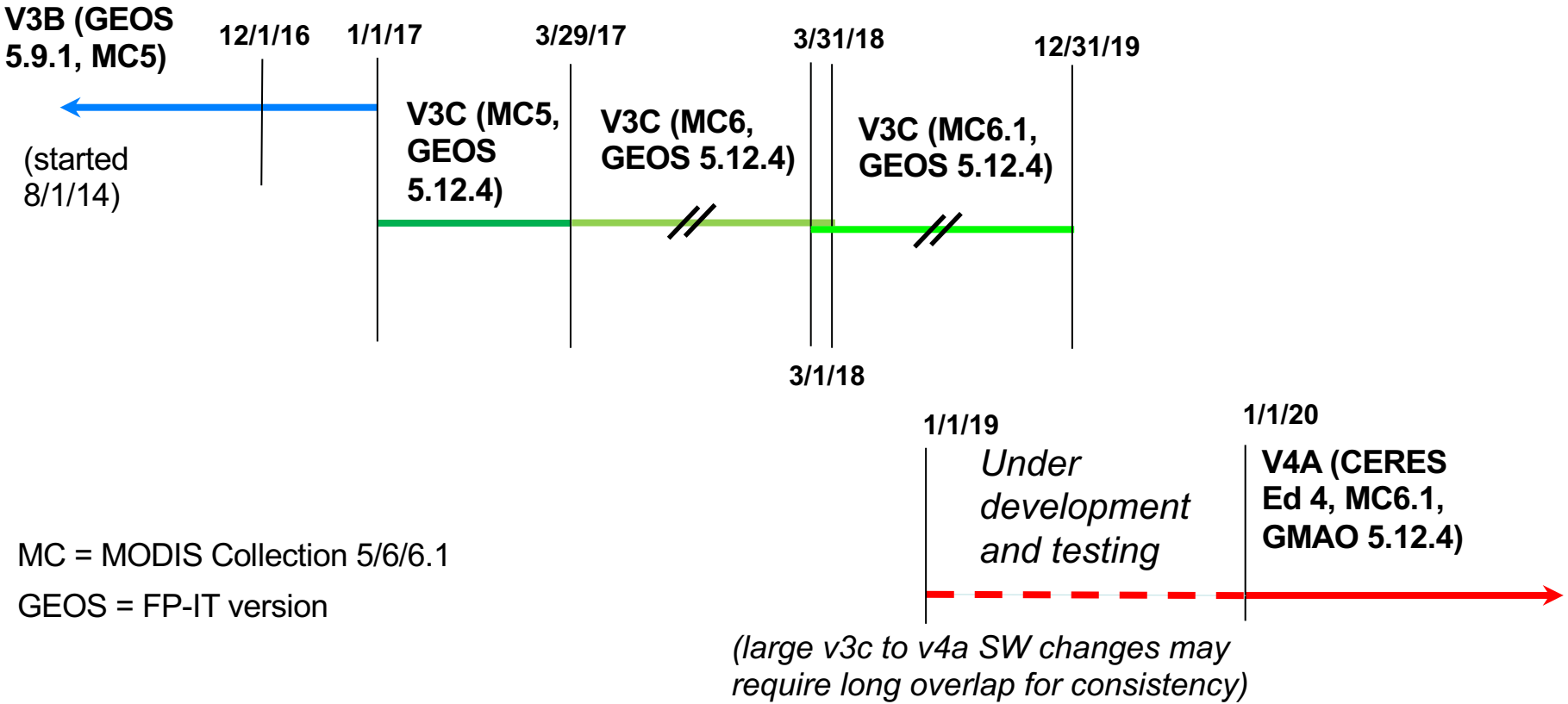


Surface LW FF Validation

For Test Months January 2019 and July 2018

	Sat	Month	FF V3C		FF V4A		CERES Ed4		Mean Obs	N Obs
Day/ Night			Bias (W m^{-2})	RMS (W m^{-2})	Bias (W m^{-2})	RMS (W m^{-2})	Bias (W m^{-2})	RMS (W m^{-2})	W m^{-2}	
Day	Terra	Jan	-2.5	19.5	1.8	18.7	4.6	19.7	284.7	342
		Jul	-7.3	19.3	-5.4	18.3	-4.0	18.0	356.1	647
	Aqua	Jan	-3.4	20.2	-.02	17.6	2.0	17.7	290.0	321
		Jul	-9.6	21.4	-5.9	19.2	-4.2	19.3	357.0	672
Night	Terra	Jan	-3.6	28.2	-1.3	33.1	-0.8	30.5	250.1	595
		Jul	-9.0	24.2	-2.1	25.2	-6.1	23.0	305.0	551
	Aqua	Jan	-8.9	32.8	-1.1	32.1	-2.2	30.7	247.3	583
		Jul	-10.3	23.9	-6.7	22.7	-6.9	23.6	303.6	573

Moving to FLASHFlux Ed4A



Summary and Conclusions

- ***SOFA Group***
  - Evaluating TSI from TSIS and comparing to SORCE; must develop TSIS filling once SORCE ceases
  - SOFA Ed4 paper revisions submitted
- ***FLASHFlux 3C and 4A progress***
  - Developing v4A compatible with CERES Ed 4; will use to MODIS Collection 6.1
  - SSF comparisons show good agreement at TOA; calibration and angle differences at TOA
  - SSF surface fluxes show significant changes; especially over ice, still evaluating
  - TISA TOA agreement reasonable; surface differences noted; LW issue being evaluated
  - Goal: FF v4A operational in December 2019 for transition to new year; evaluating need for reprocessing
- ***FLASHFlux Applications:***
  - Datasets continuing being supplied and distributed through POWER web services; latency issue being addressed, but longer term strategy to change configuration may be required
  - Usage growth at 15-20% level; CERES FF is ~60% of all products; 75% of low latency include FF
- ***FLASHFlux Publications:***
  - 2018 SotC report published and Ed4 SOFA paper revisions submitted

FLASHFlux Web Sites:

https://flashflux.larc.nasa.gov

https://power.nasa.gov &
https://power.nasa.gov

Extras

Surface-Only Flux SSF Products

- CERES SSF includes several Surface–Only Flux Algorithms (SOFA) to compute SW and LW surface fluxes at footprint resolution

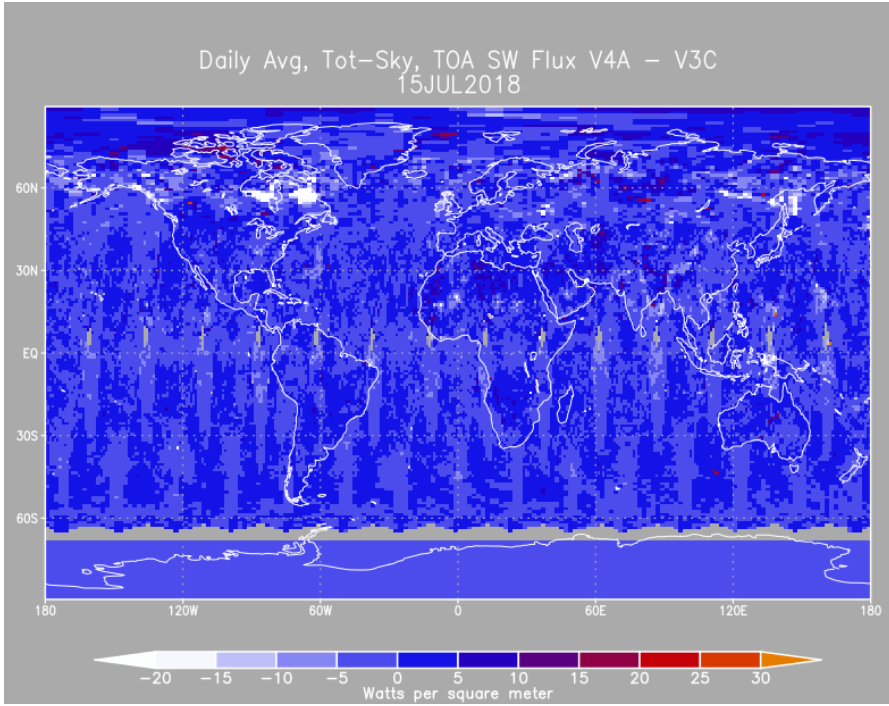
- The SOFA algorithms include (Kratz et al., 2010):

		Model A	Model B	Model C
SW	Clear	Li et al. (1993)	LPSA (Gupta et al. 2001)	--
	All-Sky	--	LPSA (Gupta et al. 2001)	--
LW	Clear	Inamdar and Ramanathan (1997)	LPLA (Gupta et al. 1992, 2010)	Zhou-Cess (Zhou et al., 2007)
	All-Sky	--	LPLA (Gupta et al. 1992, 2010)	Zhou-Cess (Zhou et al., 2007)

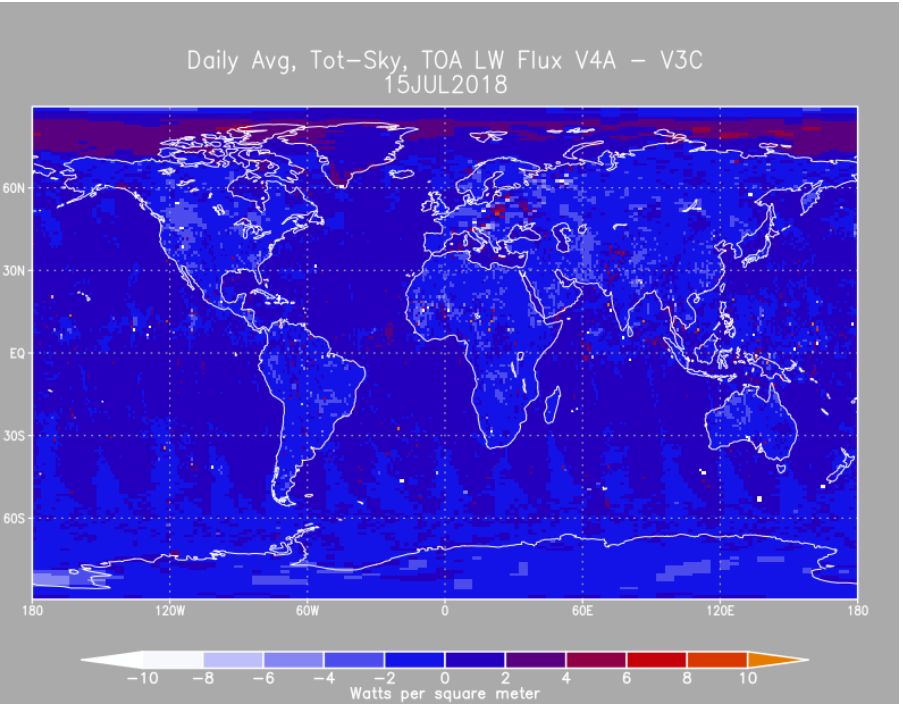
LPSA/LPLA = Langley Parameterized SW/LW Algorithm

- The SOFA group actively updates and validates these data products

FLASHFlux V4A: TOA TISA Differences

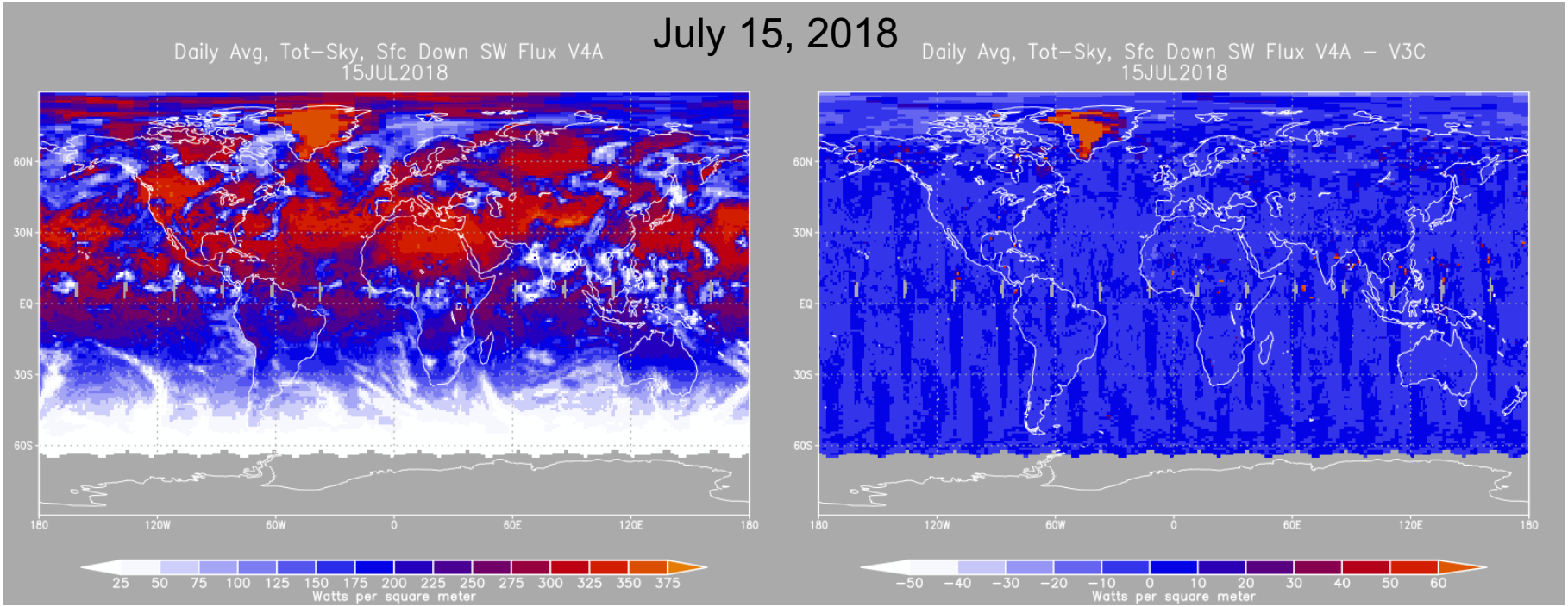


TOA SW V4A – V3C



TOA LW V4A – V3C

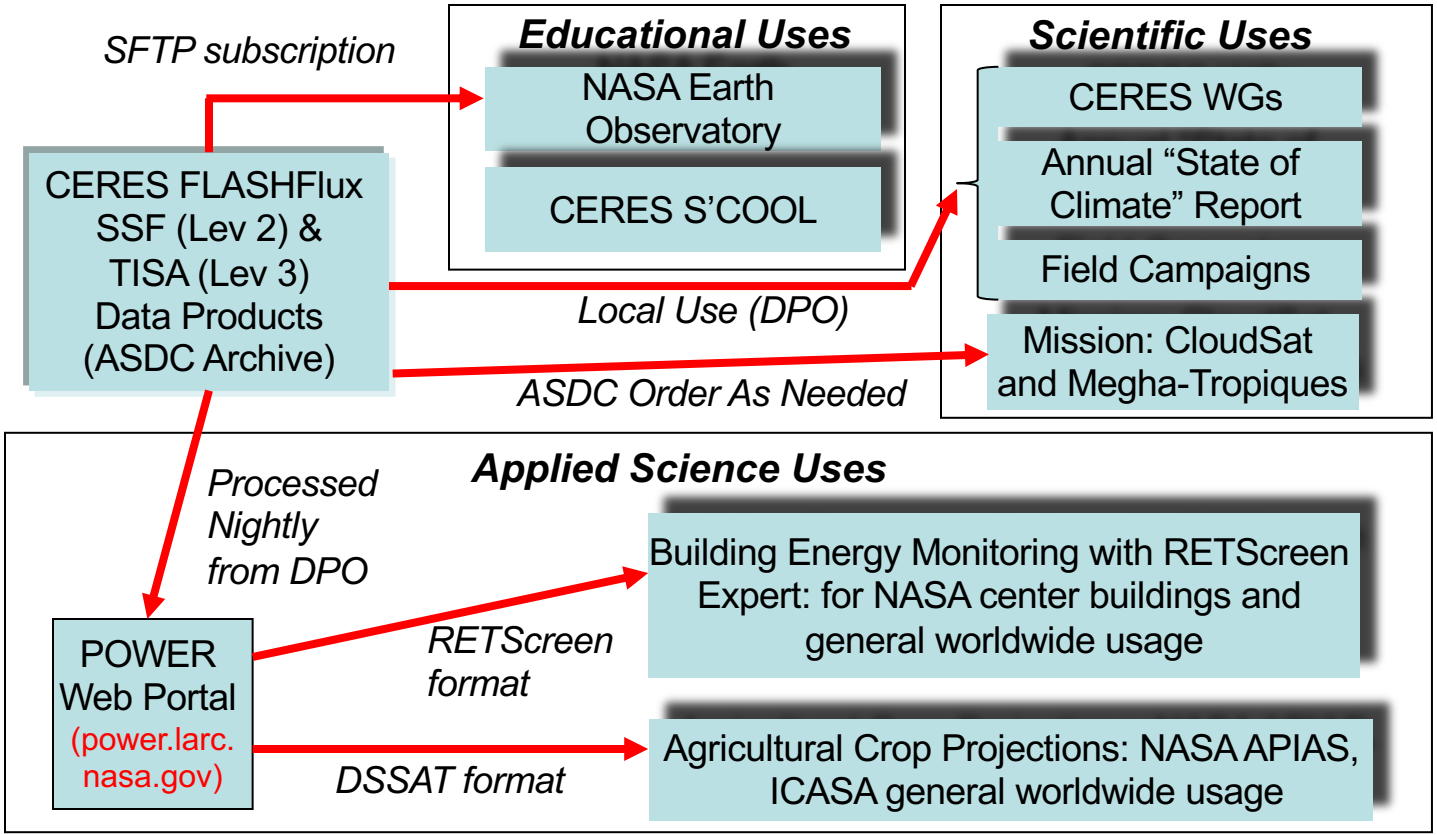
FLASHFlux V4A: SW Surface TISA Results



Surface SW V4A

Surface SW V4A – V3C

Near Future: Moving FLASHFlux Toward V4

Attribute	FF v3C (MC6)	FF v4A	FF v4B
Baseline 1QC	Previous	New calibration	New calibration
GEOS FP-IT input	GEOS 5.12.4	GEOS 5.12.4	GEOS new version
MOA	Ed 4 compatible	Ed 4 compatible	Ed 4 compatible
MODIS	Collection 6	Collection 6.1	Collection 6.1
Clouds	Ed 2	Ed 4 w/ MC 6.1 calibration (current work)	Ed 4
SIBi (Snow/ICE Brightness Index)	No	Yes	Yes
Inversion (improved ADMs)	Ed 2	Ed 4	Ed 4
Aerosols	MATCH climatology	MATCH climatology	GEOS 5.12.4(?)
Flux Algorithms	Unchanged	Modified SW surface algorithm (current work)	A0, Ap adjustments; new clear-sky TOA & surface albedos (current work)
TISA	Ed 2	Compatible w/ Ed 4 (current work)	Compatible w/ Ed 4 (custom CERES TSI?)
Data Processed	March 28 - present	Planned to begin 1/1/19	None
Validation Results	1/1/17 – 6/30/18	---	---

FLASHFLUX: Schematic of Current Uses