



State of CERES



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CERES Science Team Meeting, October 6-10, 2014
Toulouse, France

CERES Meeting & Workshop Objectives

1) CERES Meeting:

- Status of NASA & CERES Project
- CERES Terra, Aqua and SNPP SW/LW/TOTAL Channel Calibration Update
- CERES FM6 and RBI Update
- CERES SNPP SSF Edition-1: VIIRS Cloud Algorithm & Validation Status
- CERES GEO Cloud Algorithm Status
- CERES ADM, SOFA, SARB and TISA Working Group Reports
- Data Management Team & Atmospheric Sciences Data Center (ASDC) Updates

2) Workshop:

- Calibration intercomparison between CERES, ScaRaB and GERB.
- Evaluation of CERES time-space averaging using temporal information from ScaRaB and GERB.
- Towards synergistic scientific use of CERES/ScaRaB/GERB.

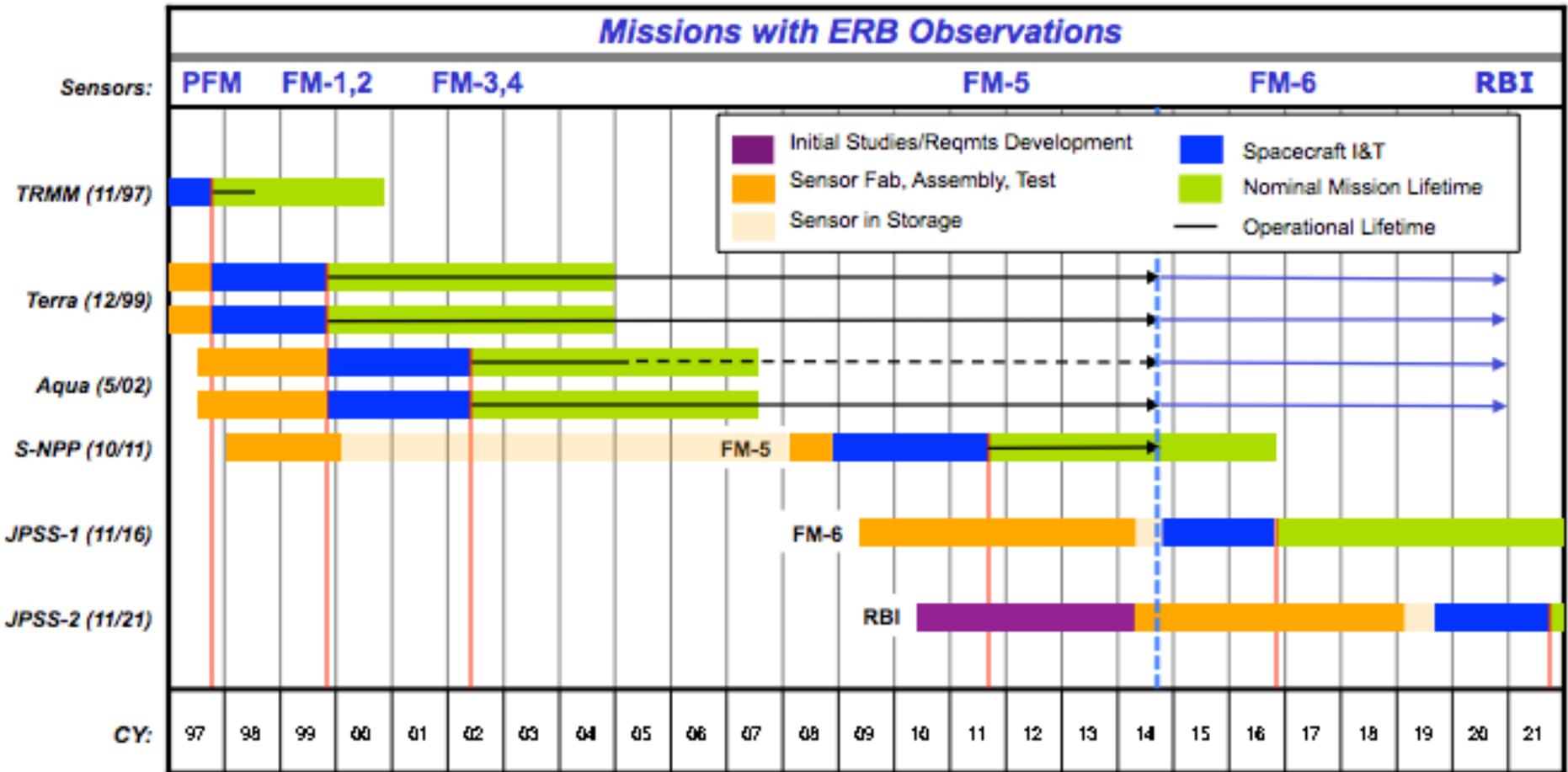
CERES Team Leads

- **Principal Investigator: Norman Loeb**
- **Project Scientist: Kory Priestley**

CERES Working Groups:

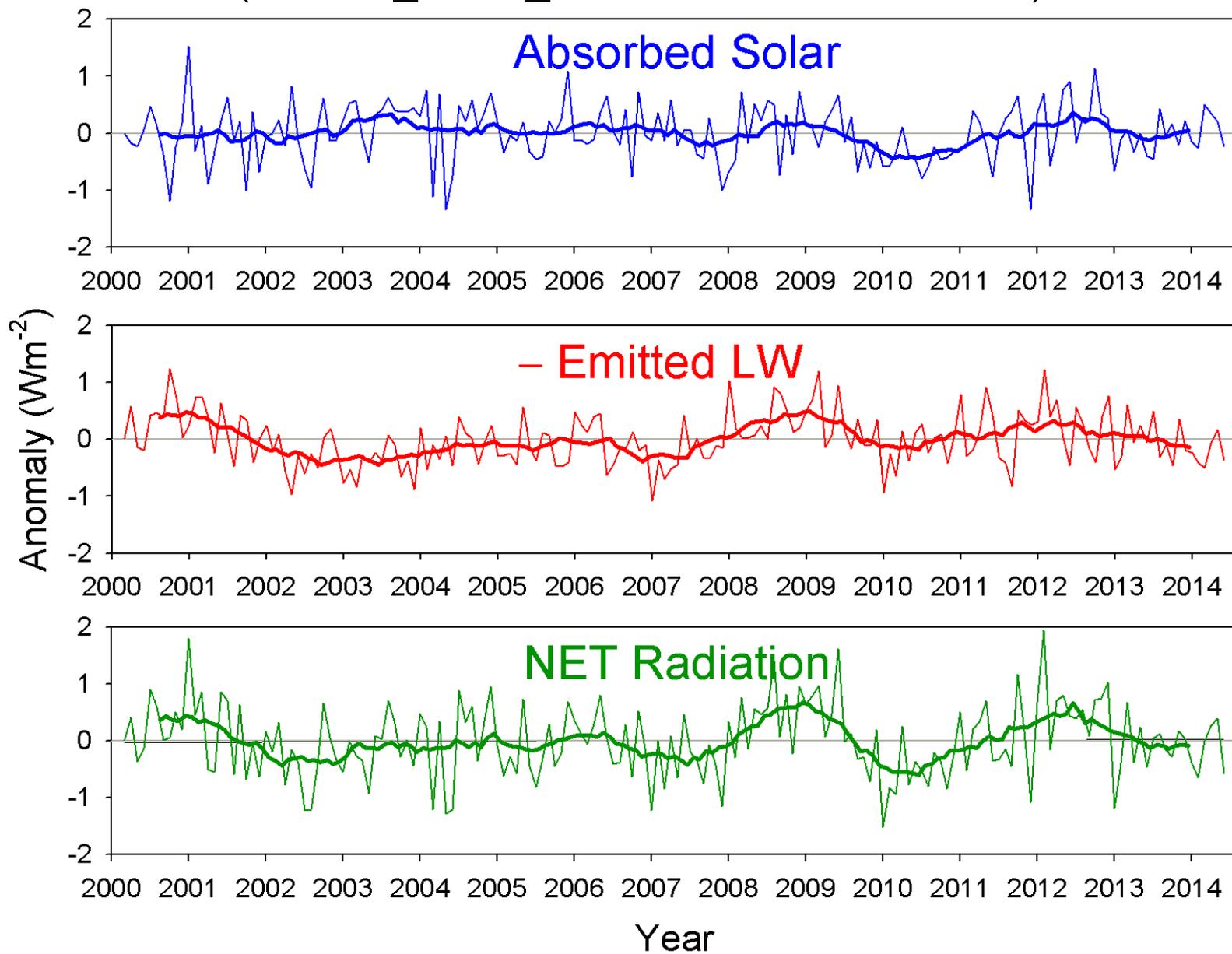
- **Instrument: Kory Priestley**
- **ERBElike: Takmeng Wong**
- **Clouds: Pat Minnis (Lead); Bill Smith Jr., (Deputy)**
- **Inversion: Wenying Su**
- **SOFA: David Kratz**
- **SARB: Seiji Kato**
- **TISA: David Doelling**
- **FLASHFlux: Paul Stackhouse & David Kratz**
- **Data Management: Jonathan Gleason**
- **ASDC: John Kusterer**

CERES Flight Schedule



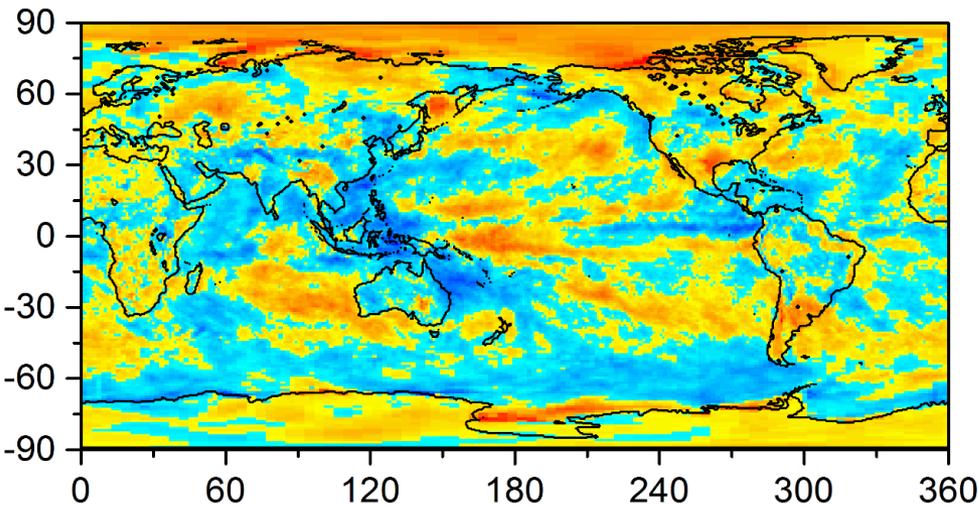
- Five CERES instruments on 3 satellites (Terra, Aqua, SNPP) are flying.
- FM6 will be fly on JPSS-1 in 2016 and the CERES Follow-on (RBI) will fly on JPSS-2 in 2021.

Global TOA All-Sky Radiation Anomalies (CERES_EBAF_Ed2.8; 03/2000 – 06/2014)

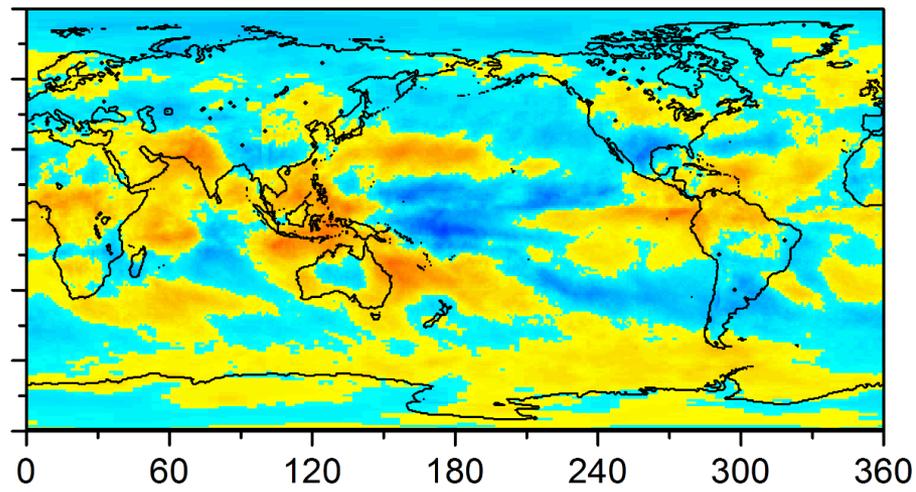


TOA Radiation Changes (March 2000 – June 2014)

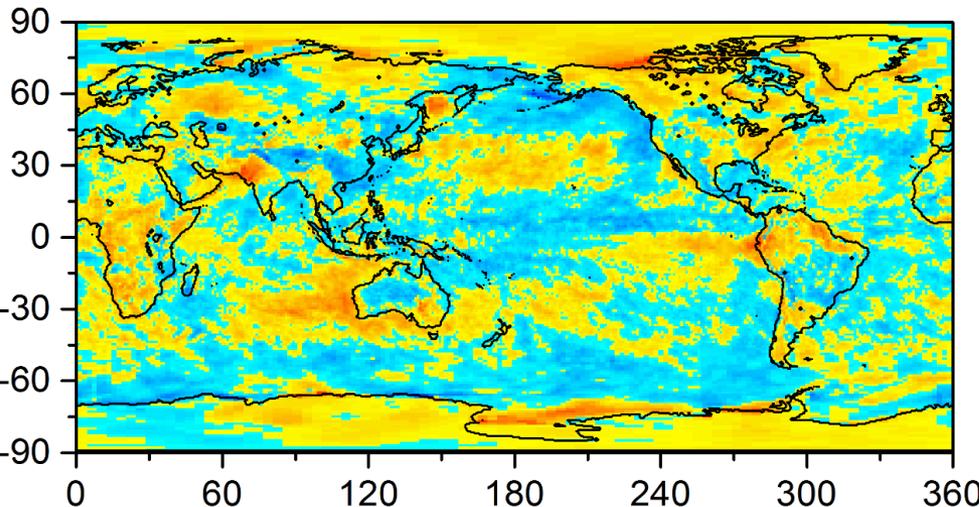
Absorbed Solar



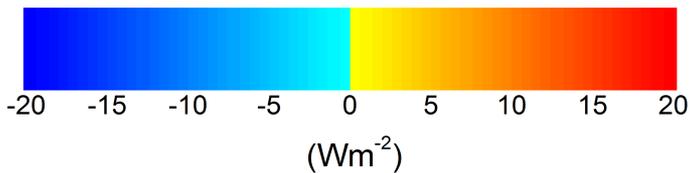
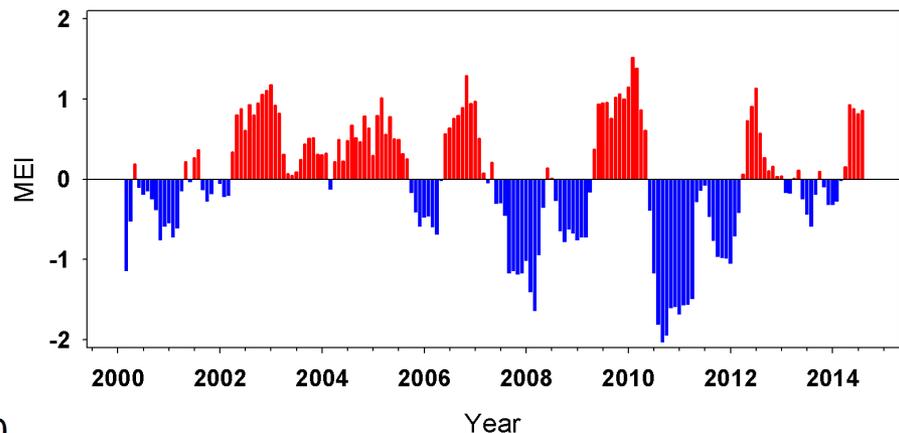
-Emitted LW



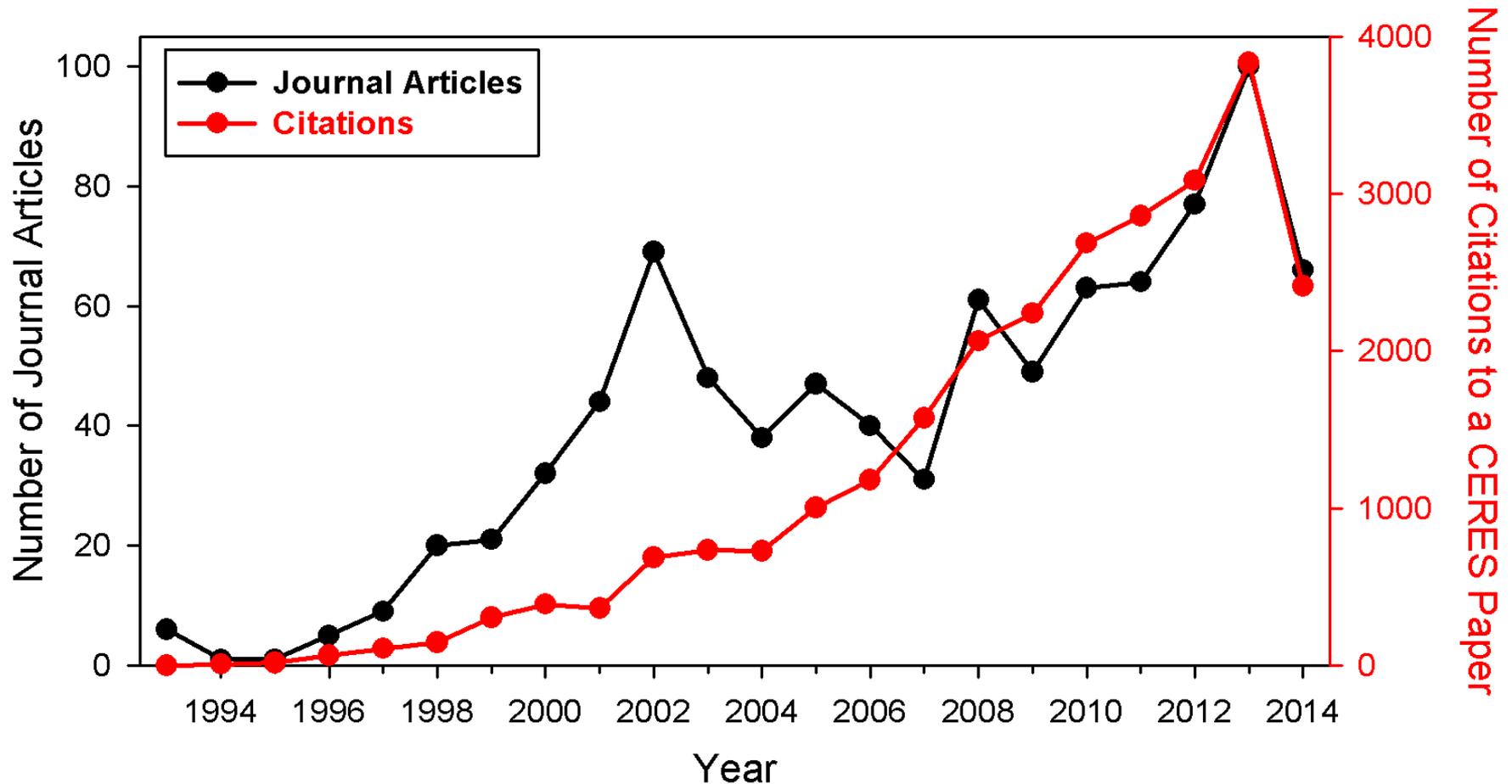
Net Radiation



Multivariate ENSO Index

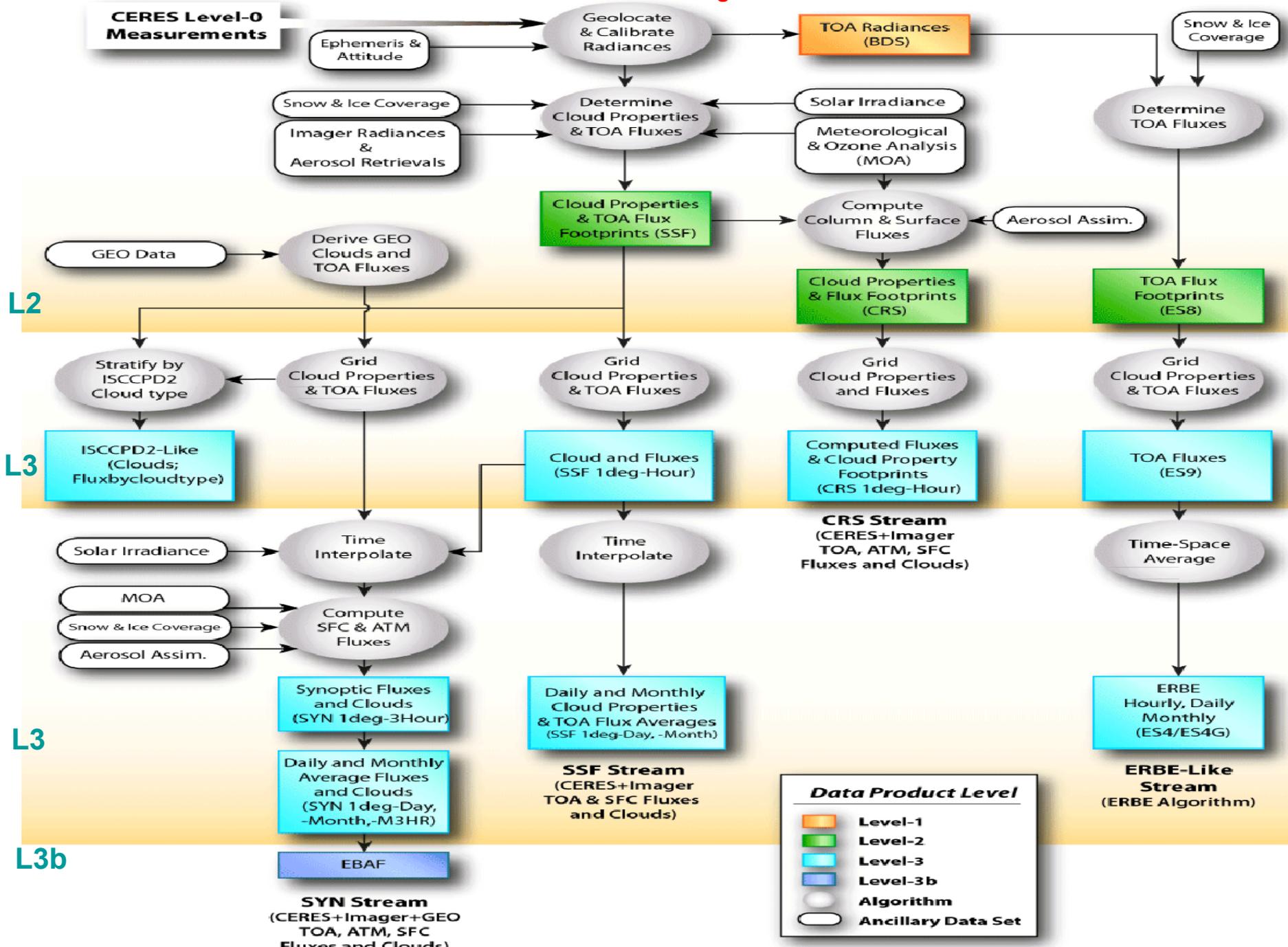


CERES Journal Publication and Citation Counts (For Papers Between 1993-2014; Updated September 1, 2014)



- Total number of peer-reviewed journal articles: 892
- Total number of citations to CERES papers : 26,467

CERES Data Processing Flow



CERES Level-0 Measurements

Ephemeris & Attitude

Geolocate & Calibrate Radiances

TOA Radiances (BDS)

Snow & Ice Coverage

Snow & Ice Coverage
Imager Radiances & Aerosol Retrievals

Determine Cloud Properties & TOA Fluxes

Solar Irradiance
Meteorological & Ozone Analysis (MOA)

Determine TOA Fluxes

Cloud Properties & TOA Flux Footprints (SSF)

Compute Column & Surface Fluxes

Aerosol Assim.

TOA Flux Footprints (ES8)

GEO Data

Derive GEO Clouds and TOA Fluxes

Cloud Properties & Flux Footprints (CRS)

L2

Stratify by ISCCPD2 Cloud type

Grid Cloud Properties & TOA Fluxes

Grid Cloud Properties & TOA Fluxes

Grid Cloud Properties and Fluxes

Grid Cloud Properties & TOA Fluxes

L3

ISCCPD2-Like (Clouds; Flux by cloud type)

Cloud and Fluxes (SSF 1deg-Hour)

Computed Fluxes & Cloud Property Footprints (CRS 1deg-Hour)

TOA Fluxes (ES9)

Solar Irradiance

Time Interpolate

Time Interpolate

CRS Stream
(CERES+Imager TOA, ATM, SFC Fluxes and Clouds)

Time-Space Average

MOA
Snow & Ice Coverage
Aerosol Assim.

Compute SFC & ATM Fluxes

L3

Synoptic Fluxes and Clouds (SYN 1deg-3Hour)

Daily and Monthly Cloud Properties & TOA Flux Averages (SSF 1deg-Day, -Month)

ERBE Hourly, Daily Monthly (ES4/ES4G)

L3b

Daily and Monthly Average Fluxes and Clouds (SYN 1deg-Day, -Month, -M3HR)

SSF Stream
(CERES+Imager TOA & SFC Fluxes and Clouds)

ERBE-Like Stream
(ERBE Algorithm)

EBAF

SYN Stream
(CERES+Imager+GEO TOA, ATM, SFC Fluxes and Clouds)

Update on CERES Data Use – Number of Unique Users by Product

Products	2010	2011	2012	2013	2014
EBAF-TOA	72	146	234	381	407
EBAF-Surface			118	217	254
ESG		14	130	151	78
SYN1deg			61	315	285
SYN1deg-lite	41	126	133		
SSF1deg-lite	46	106	93	138	136
ISCCP-D2like	17	12	45	62	37
SSFlevel2	84	77	138	192	167
BDS	11	9	14	8	3
ES4	59	36	11	17	5
ES8	22	20	18	21	5
ES9	21	12	5	9	3
SFC	31	20	14	6	1
NEWS	31	32	33	19	6
MISR-MODIS	9	4	2	5	4
FLASH_SSF	25	8	15	12	5
FLASH_TISA	17	18	20	11	3

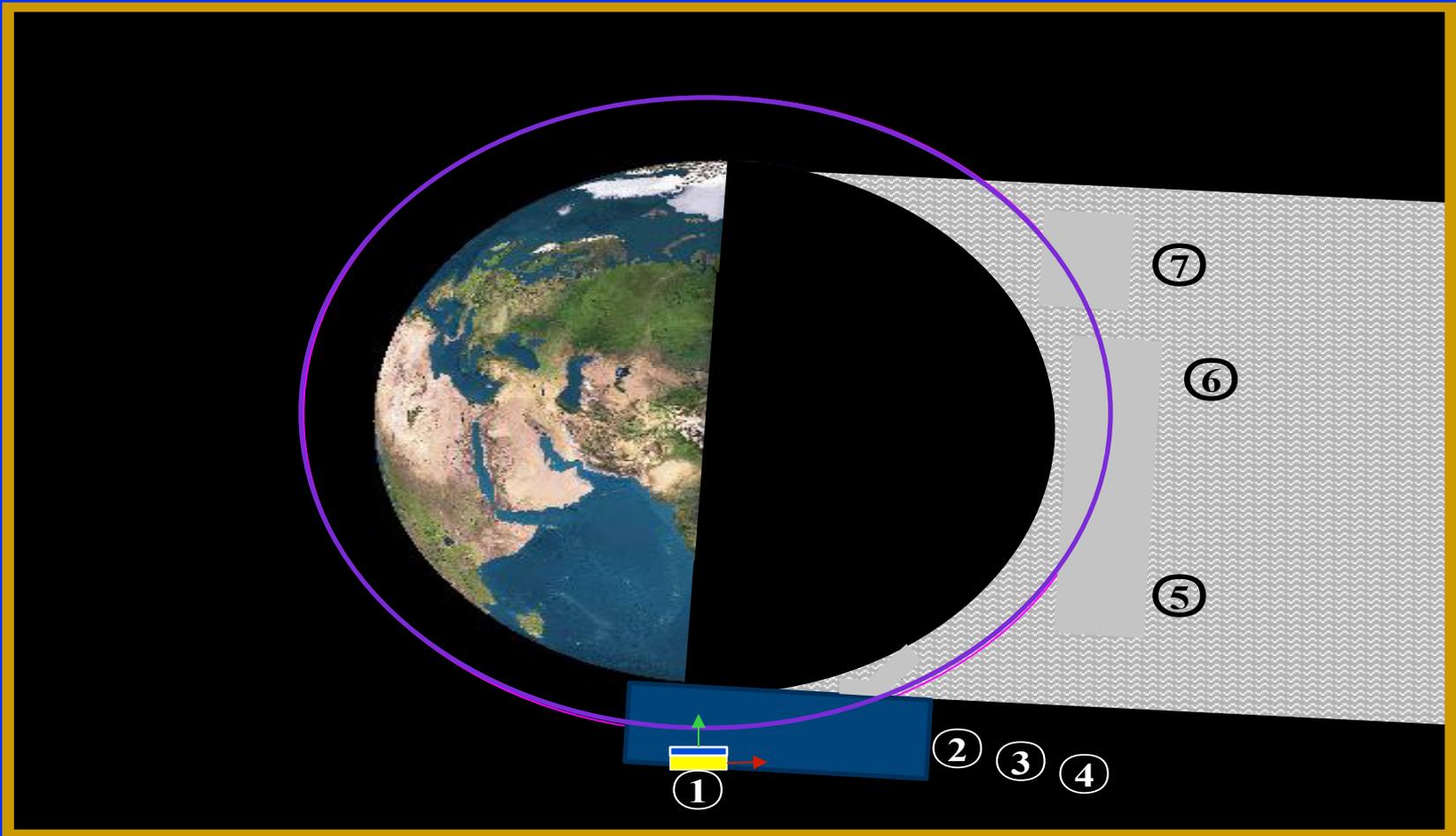
CERES Terra and Aqua Edition 4

- Instrument gains and SRFs: Delivered.
 - Improvement to Aqua SW part of TOT SRF.
- CERES Clouds code: Delivered. Several years of Terra and Aqua processed SSF Edition 4-beta2.
 - Increased cloud fraction (more consistent with CALIPSO).
 - Decreased cloud optical depth (more thin clouds).
 - Significant improvements to polar cloud mask.
- Inversion (ADMs and SOFA) code: Delivered.
 - 2nd generation CERES ADMs; Improved parameterized surface fluxes.
- SARB and TISA code deliveries within next few months.
 - Use of 5-channel 1-hourly GEO cloud retrievals.
 - Consistent reanalysis and MODIS calibration throughout.
 - SYN1deg to be released 1-hourly, 3-hourly, daily and monthly.
 - Consistent non-GEO and GEO TISA products (all GMT).
 - Improved to Fu-Liou RT code and ancillary inputs (e.g., Ed4 clouds+overlap, surface albedo, MATCH aerosols).

Terra Lunar Deep Space Calibration (LDSC) Maneuver

- In August 2013, the ASTER Team requested the Terra FOT to review the previous Deep Space Calibrations (DSC) in 2003 and determine steps for possible future DSC.
- ASTER Science team made an official request with the Terra Project Scientist for a LDSC maneuver.
- A DSC maneuver is an accelerated 240 degree pitch-over (360 relative to local horizon) during S/C night that provides observations of the cold background of deep space and an option for a lunar viewing.
- Two previous DSC maneuvers were executed in 2003:
 - March 26 maneuver was a deep space calibration (DSC)
 - April 14 maneuver was both deep space and a lunar calibration (LDSC).
- A LDSC provides the Terra instrument teams observations that can be compared against the LDSC in 2003.
 - Can be used to verify calibration changes from onboard calibration sources over the lifetime of the mission.

DSC Concept Diagram (Animation)



- Blue block on S/C is instrument deck

Terra Lunar Deep Space Calibration (LDSC) Maneuver: Timeline

- LDSC proposal will need to be presented to and approved by
 - Terra Project Scientist
 - Terra Science Teams
 - GSFC management
 - NASA HQ
 - Prior to approval an Updated Risk Analysis may be required
- FOT could support a LDSC near End of Mission if desired and approved
- The FOT has been able to identify potential opportunity dates based on desired phase angles 2017 - 2020
 - Preliminary opportunities are in line with Lunar Phasing (approximately one opportunity per month)
 - As desired dates get closer it will become easier to determine opportunities that meet all LDSC requirements
- At August 2014 interface meeting ASTER IOT has indicated to the FOT a LDSC on July 18, 2016 may be most desirable for science and budget considerations
 - FOT will follow up on investigating 2016 opportunity dates
 - Allows for less time to get required consensus and approvals prior to LDSC execution

CERES FM5 SNPP

- CERES FM5 time-varying gains and beginning of mission SRFs to be used in SSF Edition 1.
- Receiving Collection 1.1 calibrated VIIRS radiances from GSFC Land PEATE (Xiong).
- CERES Edition 1 Clouds: Delivered.
- SSF Edition1 will use Edition 4 Aqua ADMs. In production.
- Anticipate “MODIS-Like” VIIRS aerosols from Land PEATE (POCs: Rob Levy & Christina Hsu). Consider including in Edition 2.

Longer-Term Plans

- Work with GMAO on next generation meteorological assimilation used in CERES processing.
 - Kickoff meeting at GSFC November 19, 2014.
 - Hope to have GMAO representation at spring CERES meetings.
- Production code modernization effort.
 - Some subsystems rely on routines that go back 20 years or longer, with varying programming styles and standards.
 - Revision and modification of the CERES production code where necessary will ensure long-term maintainability and scalability of code, and ultimately improve efficiency (simplify code updates, smoother transition to next generation of programmers and scientists, etc.).
- Continued validation of Edition4 products. Identify improvements for Edition5.
- Work with Jack Xiong (GSFC) to place VIIRS radiances on same radiometric scale as MODIS Aqua.
- Work towards ensuring a seamless transition between ERB data products on different satellites (e.g., Aqua -> S-NPP -> JPSS-1 -> JPSS-2).
- Prepare production codes for CERES FM6 on JPSS-1.
- Evaluate impact of upcoming high spatial/temporal resolution operational geostationary imagers on CERES Level 3 products. (e.g., GOES-R ABI, HIMAWARI ABI, etc.).

Arctic Radiation–IceBridge Sea-Ice Experiment (ARISE)

- Field experiment over Arctic Ocean to study Arctic sea-ice, clouds and radiation during late summer to early autumn 2014.
- Consists of airborne polar geophysical project called Operation IceBridge.
 - Goal of IceBridge is to characterize annual changes in thickness of sea ice, glaciers, and ice sheets. Uses LVIS laser altimeter (1064 nm backscatter).
 - Bridges gap between ICESat satellite missions.
- Radiation science goals: Evaluate CERES clouds and radiation products for coincident Terra, Aqua and Suomi NPP satellite overpasses.
- Base of operation: ~~August 27–Sept 2: Thule Air Base, Greenland.~~
Sept 4–Oct 2: Fairbanks, AK.
- Aircraft: Wallop’s C-130
- Instruments: BBR (Bucholtz), SSFR (Schmidt), 4STAR (Redemann), ~~NAST-I (Noe)~~, LVIS + Digital Camera (Blair), in-situ Probes (Anderson)

Personnel:

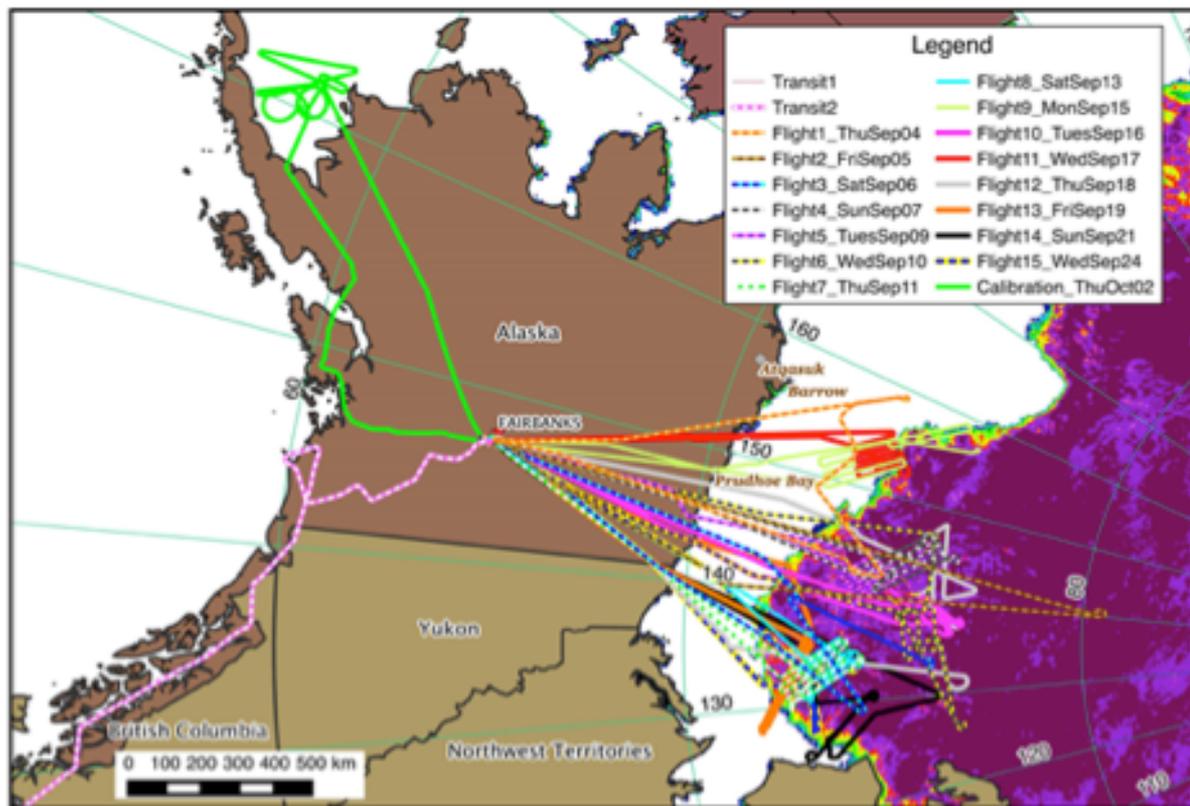
- a. Hal Maring – HQ Program Manager, Radiation Sciences
- b. Tom Wagner – HQ Program Manager, Cryospheric Sciences
- c. Bruce Tagg – HQ Program Manager, Airborne Sciences
- d. Christy Hansen – NASA Goddard, IceBridge Project Manager, and Radiative Balance Project Manager
- e. Bill Smith – NASA Langley, Science Team Lead



ARISE MISSION STATUS – 10/3/14

WEEK 5

Flight Map Summary: shows 17 ARISE science flights completed



Map created by LVE/Mart Bechly

ARISE Science Reports:

<https://espo.nasa.gov/missions/arise/mission-flight-docs>

“Days” Breakdown

- ✓ 33 days in field
- ✓ 2 transit flts complete
- ✓ 17 sci flts complete
- ✓ 1 planned maint.
- ✓ 6 reqd hard down days
- ✓ 1.5 wx. days
- ✓ 7 unplanned maint. no-fly days

Flight Hours

- ✓ 149 used
- ✓ 80 hours left

Asset Coordination

- ✓ TERRA
- ✓ AQUA
- ✓ CALIPSO
- ✓ CLOUDSAT
- ✓ METOP-A,B
- ✓ SUOMI NPP
- ✓ NOAA 15,18,19
- ✓ CryoSat-ESA
- ✓ Mable
- ✓ SIZRS 140/150

Courtesy of Christy Hansen



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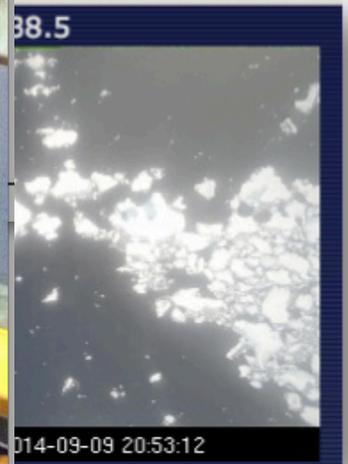
image of sea ice/LVIS



C-130 video Screen Sh



wd/nadir cam/SSFR



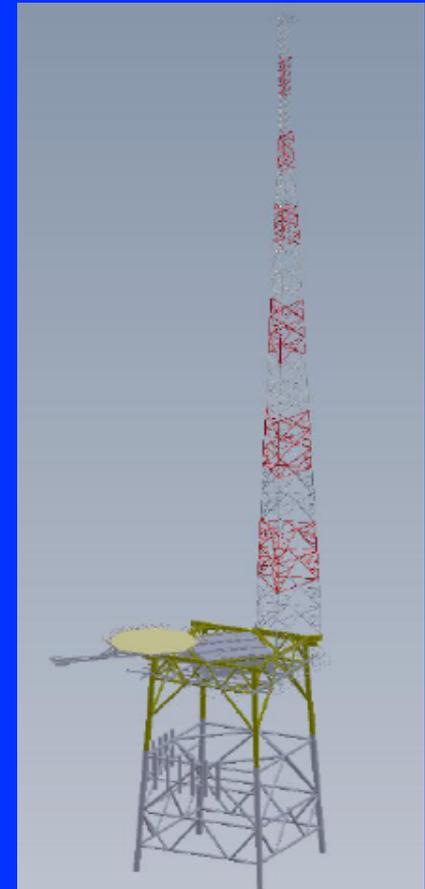
ARISE Science Report
<https://espo.nasa.gov/>

FLIGHT PLANNING DISCUSSION, REV 100



COVE

- DOE purchased Chesapeake Lighthouse (CLT) to create RFORE -- Reference Facility for Offshore Renewable Energy.
- Goal was to construct a 100 m tower for wind research.
- However, cost of 100m tower is higher than \$10M DOE cap (\$15M).
- Thus, DOE is returning CLT to GSA for auction.
- In parallel, they are evaluating the suitability of CLT and other sites for a downscaled project that will last 2-3 years.
- Safety is still an issue for DOE, though.
 - A 3-year project at CLT will likely require more structural inspections of the housing level (\$??), paint (\$0.5-1M), and a hazmat cleanup (\$300k).
- Meanwhile, the COVE project is still collecting data.
- COVE MPLNET will move to CAPABLE site at LaRC, pending LAFB approval.



Future Earth Radiation Budget Missions

- Responsibility for sustained climate measurements transferred from NOAA to NASA.
- CERES FM6 to launch on JPSS-1 in Nov 2016.
 - CERES team to produce Earth Radiation Budget Climate Data Records using CERES FM6, closely following FM5/SNPP approach.
- Radiation Budget Instrument (RBI) Status:
 - Draft RFP released in April, 2013
 - Industry-Day April 30, 2013
 - Official RFP release: June 14, 2013
 - Award: Spring 2014
 - RBI delivery date: Spring 2019.
 - Launch on JPSS-2: November 2021.

Upcoming Conferences & Meetings of Interest

The Climate Symposium 2014

- October 13–17, 2014, Darmstadt, Germany

Fall American Geophysical Union

- December 15–19, 2014, San Francisco, CA

3rd International A-Train Symposium 2015

- March 4–6, 2015, Southern California

EGU General Assembly 2015

- April 12–17, 2015, Vienna, Austria

Spring CERES Science Team Meeting

- April 28-30 (Tentative), 2015, Hampton, VA

Gordon Research Conference

- July 26–31, 2015, Bates College, Lewiston, ME

International Radiation Symposium 2016

- April 17-23, 2016, Auckland, New Zealand

Other News

- **SORCE** successfully transitioned to a new “hybrid” operating mode on Monday, Feb. 24th, 2014.
- The hybrid mode allows **SORCE** to take solar measurements again after an approximate 6-month hiatus due to the loss of another battery cell.
- “Hybrid” Mode: Every orbit **SORCE** makes solar observations during the daylight part of the orbit, and then put itself into safe-hold every eclipse (to conserve power during nighttime).
- Goal is to operate **SORCE** until after the **TSIS** launch in 2017 (likely on **ISS**).
- **Total Solar Irradiance Calibration Transfer Experiment (TCTE)** launched November 19, 2013. Mission duration: 18 months.
- Successful **SORCE/TCTE** cross-calibration campaign occurred between Dec 22-Dec 28, 2013.
- **CERES** team is switched to V15 **SORCE TIM** for Feb03-Jun13.
- For July 2013 onwards, **RMIB TSI** composite (mainly **DIARAD/VIRGO** instrument on **SOHO**) is being used (anchored to **SORCE TIM V15**).

Other News

- CALIPSO – Functioning nominally
- CloudSat – Returned to the A-Train. Nominal Daylight Only Operations (DO-Op) continue.
- Global Precipitation Measurement (GPM) - GPM Core Observatory satellite launched on February 27th, 2014.
- Deep Space Climate Observatory (DSCOVR) – Launch in January 2015.
 - ROSES Solicitation: A.22, DSCOVR Earth Science Algorithms.
 - LaRC received grant to generate NISTAR fluxes (Minnis/Su Co-Pis).
- Cloud-Aerosol Transport System (CATS) launch to the ISS (December 2014).

End