

CERES Science Team Meeting at LLNL

Overarching Goal: *To enhance the tie between the climate modeling/diagnostic and observational communities.*

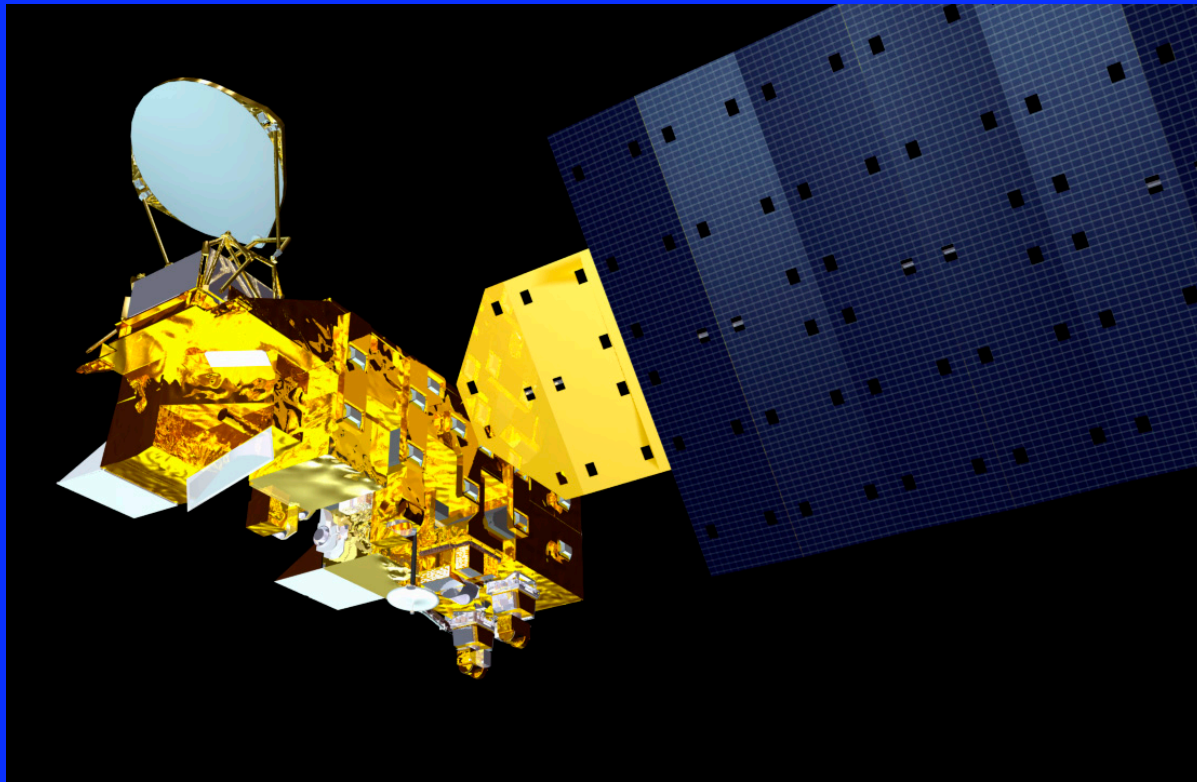
- The Fall CERES Science Team meeting is usually held close to or at a climate modeling center: NCAR, GFDL, UK Met Office, Canadian Climate Center, NASA GISS, CSU (Randall), LMD.
- PCMDI at LLNL is a world leader in climate model diagnostics/intercomparison.
- Recent NASA-PCMDI initiative provides added incentive for holding this meeting now.

Specific Goals:

- Update the climate science community on the latest CERES data product developments.
- Provide a forum to discuss the latest science results based upon CERES and other related observations.
- Interact with LLNL scientists involved in the recent PCMDI-NASA initiative to include NASA satellite observations in the CMIP5 archive.

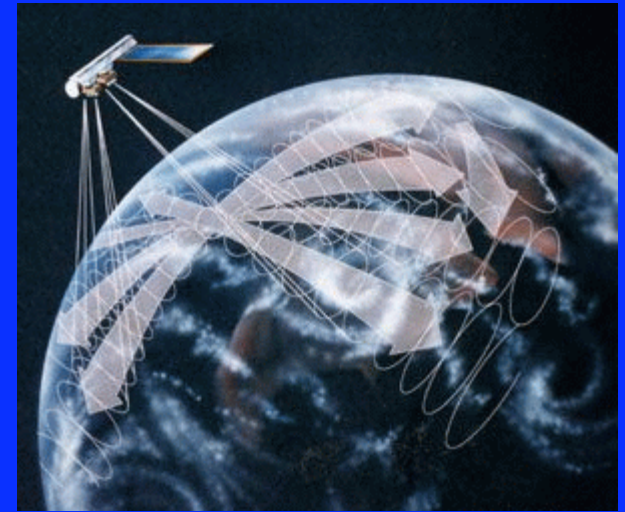


Clouds and the Earth's Radiant Energy System (CERES) Overview



Norman G. Loeb, NASA LaRC
CERES Science Team Meeting Oct 4, 2009, Livermore, CA

CERES Objectives



- Provide continuous long-term Earth Radiation Budget observations at the top-of-atmosphere, within-atmosphere and surface together with coincident cloud, aerosol and meteorological data.
- To enable improved understanding of the natural variability of the climate system and how it is responding to climate forcing.
- To provide data products for climate model evaluation and improvement.

CERES Instruments

- 5 instruments on 3 satellites (TRMM, Terra, Aqua) for diurnal and angular sampling. FM5 and FM6 to be flown on NPP and JPSS-1, respectively.
- Narrow field-of-view scanning radiometer with nadir footprint size of 10 km (TRMM); 20 km (Terra, Aqua, NPP, JPSS-1).
- Measures radiances in 0.3-5 μm , 0.3-200 μm and 8-12 μm (FM6 replaces WN with LW channel)
- Capable of scanning in several azimuth plane scan modes: fixed (FAP or crosstrack, rotating azimuth plane (RAP), programmable (PAP).
- Coincident Cloud and Aerosol Properties from VIRS/MODIS/VIIRS. Required for scene identification and addressing CERES science questions.



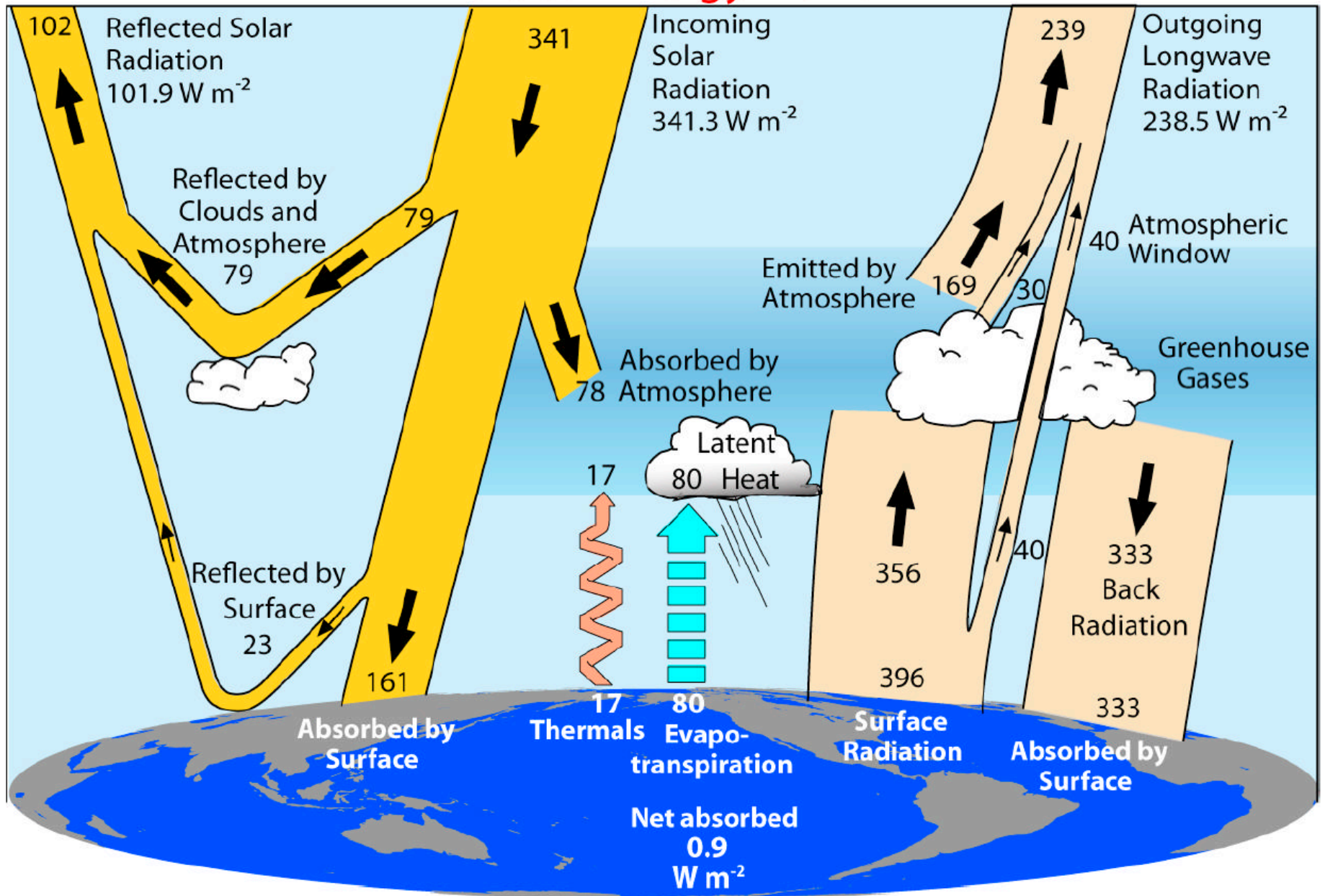
Enabling Climate Data Record Continuity

CERES Flight Schedule

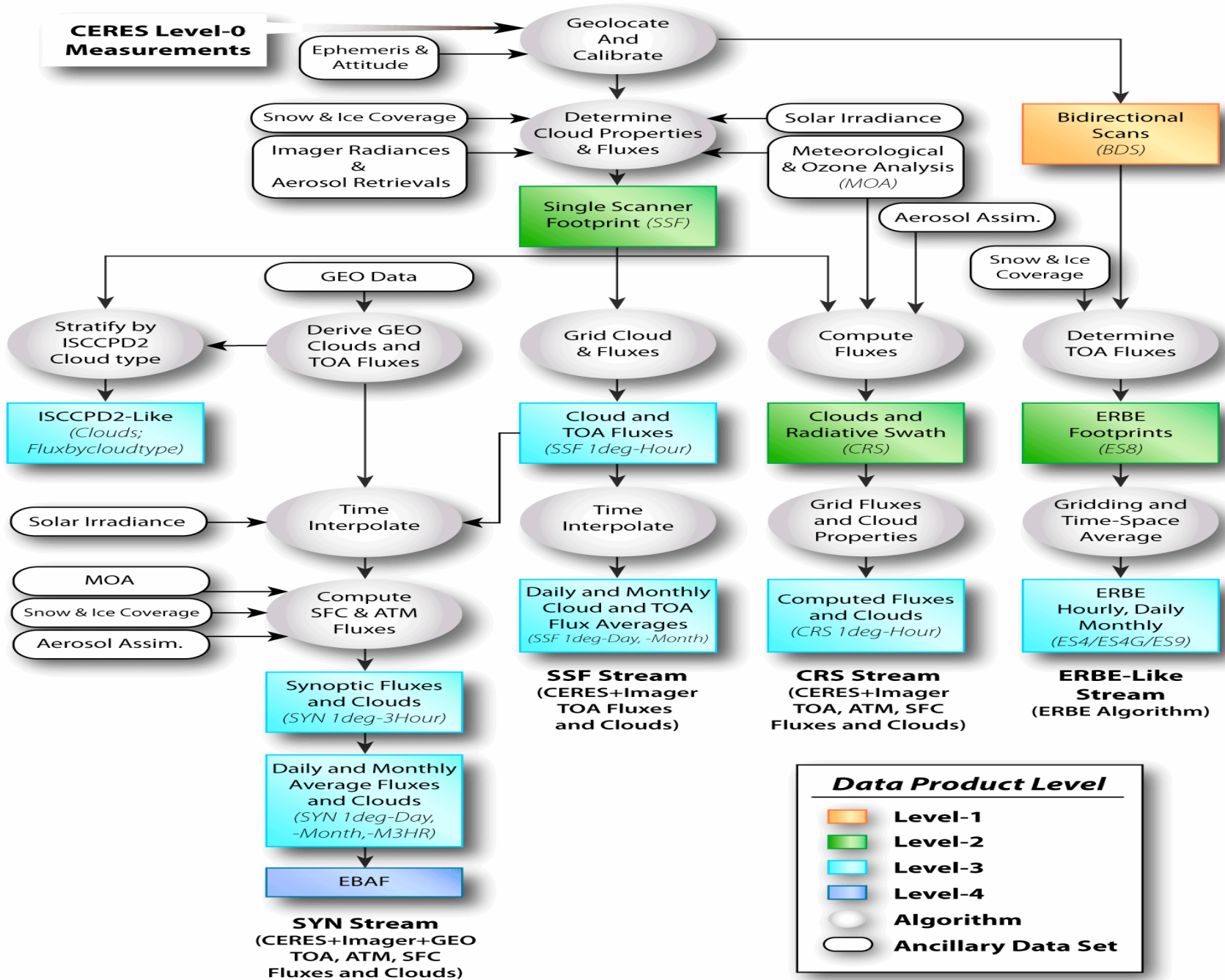
Spacecraft	Instruments	Launch	Science Initiation	Collected Data (Months)
TRMM	PFM	11/97	1/98	9
Terra	FM1, FM2	12/99	3/00	133 +
Aqua	FM3, FM4	5/02	6/02	106 +
<i>NPP</i>	<i>FM5</i>	<i>10/11</i>	-	-
<i>JPSS - 1</i>	<i>FM6</i>	<i>2016 (TBR)</i>	-	-
<i>JPSS - 2</i>	<i>ERBS</i>	<i>2021 (TBR)</i>	-	-

40 + Instrument Years of Data

Global Energy Flows $W m^{-2}$



CERES Data Processing Flow

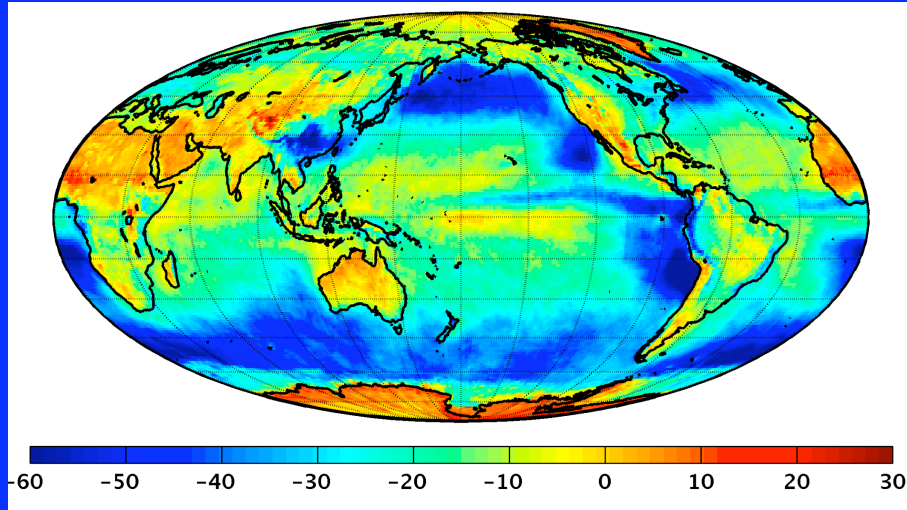


Climate Variable	NIST 2002 Report		Capability Demonstrated by CERES on Terra	
	Accuracy (1 σ)	Long Term Stability (1 σ) (per decade)	Accuracy (1 σ)	Long Term Stability (1 σ) (per decade)
SW TOA Flux (Avg \approx 100 Wm $^{-2}$)	1 Wm $^{-2}$ (1%)	0.3 Wm $^{-2}$ (0.3%)	1 Wm $^{-2}$ (1%)	0.2 Wm $^{-2}$ (0.2%)
LW TOA Flux (Avg \approx 240 Wm $^{-2}$)	1 Wm $^{-2}$ (0.4%)	0.2 Wm $^{-2}$ (0.08%)	1 Wm $^{-2}$ (0.4%)	0.35 Wm $^{-2}$ (0.14%)

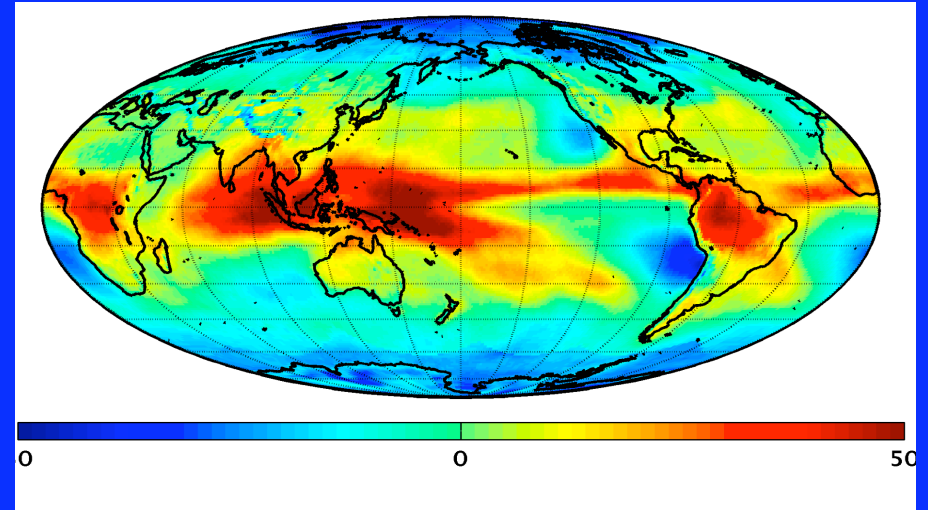
- 1) CERES stability values are relative agreement between observed decadal trends in CERES, SeaWIFS and AIRS for Solar and OLR respectively. Failures in CERES/EOS in flight calibration subsystems prevents an absolute determination of stability.
- 2) Accuracy is defined as the maximum systematic error bound at any point during the nominal mission design lifetime and must account for any variations in systematic error (i.e. stability) over this period of time.
- 3) Stability is defined as the variation of systematic error allowable over the nominal mission design lifetime.
- 4) Stability is one term in the overall accuracy budget.

Net Cloud Radiative Effect (TOA, ATM, SFC) (CERES)

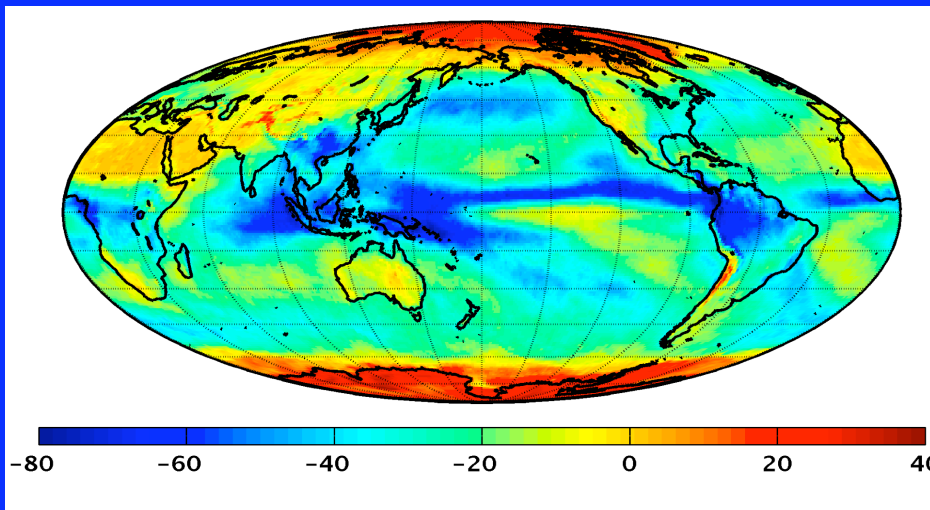
Top-of-Atmosphere (-20.6 Wm^{-2})



Within-Atmosphere (2 Wm^{-2})



Surface (-22.3 Wm^{-2})



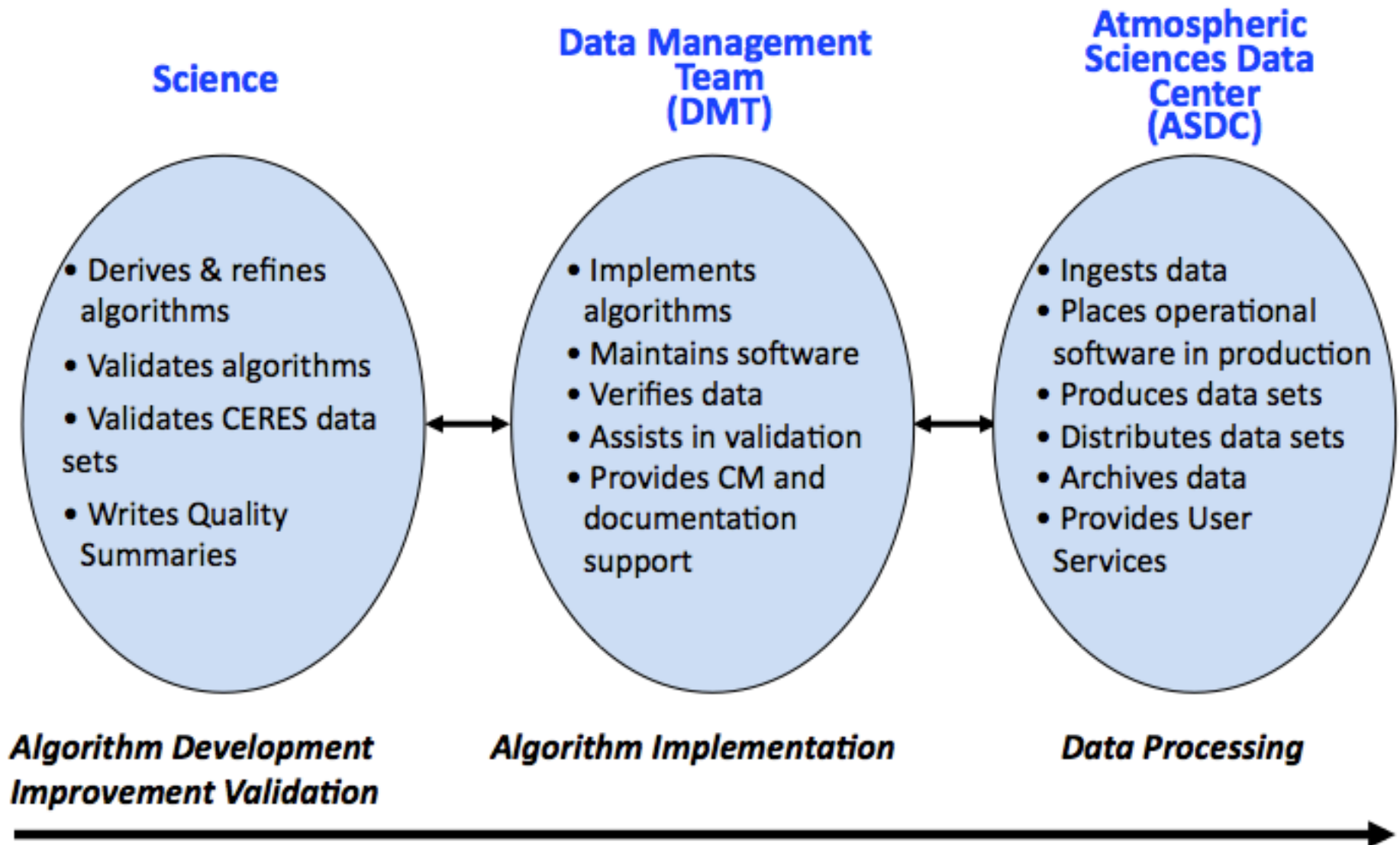
High Clouds

- SW & LW CRE cancel at TOA (both large).
- SW CRE (cooling) dominates at SFC.
- Positive within-atmos net CRE (warming).

Low Clouds

- SW CRE (cooling) dominates at TOA.
- SW & LW CRE cancel at SFC (both large).
- Negative within-atmos net CRE (warming).

CERES Organization



CERES Meeting Objectives

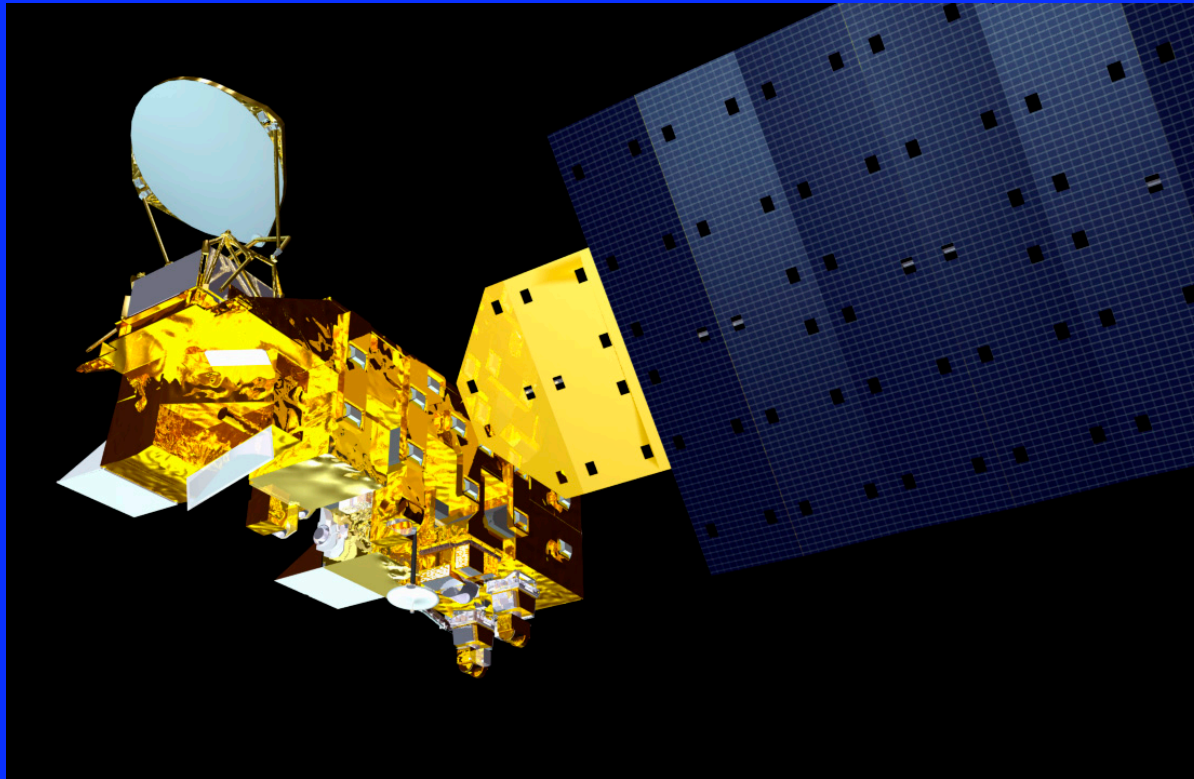
1) CERES Instrument, Algorithm and Validation Status:

- Status of CERES/NASA/EOS/Senior Reviews and CERES on NPP and JPSS-1, JPSS-2.
- Terra and Aqua SW/LW/TOTAL channel calibration; CERES FM5, FM6 Update.
- **Edition 4 cloud algorithm status**
- TOA Flux/Inversion Update: Upcoming Edition4 improvements
- SOFA status.
- New EBAF-SFC effort.
- Time and Space Interpolation Update: New comparisons with GERB.
- ISCCP-like MODIS & GEO Data Products; fluxbycloudtype product
- Data Management Team Update: Terra/Aqua/NPP
- Atmospheric Sciences Data Center (ASDC) Update
- S'COOL Update

2) Invited and co-I presentations from science community.



State of CERES



Norman G. Loeb, NASA LaRC

CERES Science Team Meeting October 4, 2011, Livermore, VA

NASA Earth Science

- NASA Administrator is Charles Bolden, Jr.
- AA for Space and Earth Science is Chuck Gay (**acting**).
- Head of Earth Science is Mike Freilich.
- Jack Kaye is Associate Director for R&A.
- David Considine is NASA HQ Modeling lead and CERES Program Scientist.
- Hal Maring remains Radiation Sciences program lead.
- Steve Volz is the Earth Science Deputy for Missions.

CERES Team Leads

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

CERES Working Groups:

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

NASA Senior Review

- Proposals (Terra & Aqua) submitted March 4th.
- Panel review May 3 (Terra) and May 4 (Aqua).
- July: Publication of the panel's report.

- The report recommended extending all 12 missions evaluated under the Senior Review. Terra and Aqua proposals were given highest ranking in science merit, relevance and product maturity, with medium technical risk.

- Official guidance specific to each mission, including budget allocations were received Sept 27.

- Responses to ESD from missions are due Oct 30.

Selected Quotes from 2011 Senior Review Report

“The government agencies all gave Aqua the highest ranking of all missions, and scientific citations of Aqua data now exceed 10,000, leaving no doubt that this mission should continue to be funded.”

“The Panel really wants to commend the Terra team on excellent work...Terra is a workhorse satellite, generating high quality products from multiple instruments.”

“Continuity of CERES Terra data is needed to maintain a continuous record into the NPOESS era. The Terra platform is expected to remain fully functional through 2017 (battery, fuel, subsystems performance).”

NASA Senior Review Budget Guideline

Aqua:

- 7% reduction in budget to Aqua science teams and Mission Operations (GSFC).

Terra:

- 7% reduction in budget to Terra science teams and Mission Operations.

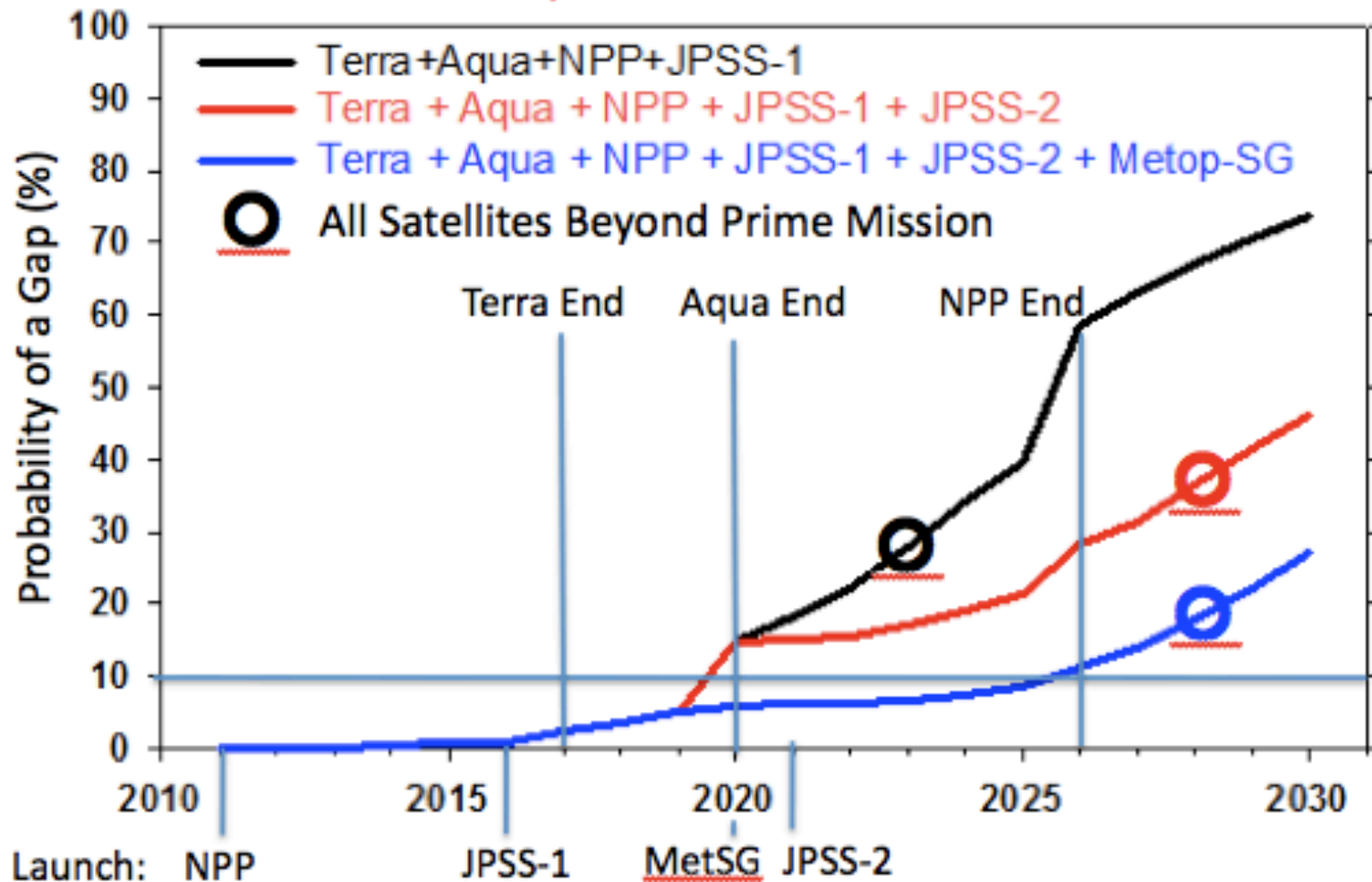
Note: NPP budget not part of Senior Review.

Impact: Will need to do more with less than originally anticipated.

Future CERES Missions

- CERES FM5 Official Launch: Oct 25, 2011
- CERES FM6 to launch in 2016 on JPSS-1.
- CERES Follow-on (JPSS-2) in 2021. Current fiscal environment raises some concern. Not funded in FY 2013 and funding for it was removed in the FY2012 proposed budget.
- CERES Follow-on on Metop-SG highly unlikely. Would require NOAA to donate CERES-like instrument.
- Europeans considering flying a ScaRaB instrument instead. Being considered at EUMETSAT. Lots of hurdles to overcome, however.

Gap Risk Assessment



Assumptions

CERES Terra: 2000–2017
 CERES Aqua: 2002–2020
 CERES NPP: 2011–2026
 CERES JPSS-1: 2016–

ERBS Post-EPS: 2020–
 ERBS JPSS-2: 2021–

(double risk 7 years after launch for new missions)

NASA-PCMDI (Program for Climate Model Diagnosis and Intercomparison) Effort

- NASA initiative to provide observational datasets to the Earth System Grid for CMIP5 model-data comparison.
- CERES TOA LW & SW radiation datasets were identified by PCMDI and NASA as being desirable for this initiative.
- ESG Gateway hosted by the Program for Climate Model Diagnosis and Intercomparison
- CERES provided the following to the ESG Gateway in July 2011:
 - TOA Outgoing Longwave Radiation (rlut)
 - TOA Outgoing Clear-Sky Longwave Radiation (rlutcs)
 - TOA Incident Shortwave Radiation (rsdt)
 - TOA Outgoing Shortwave Radiation (rsut)
 - TOA Outgoing Clear-Sky Shortwave Radiation (rsutcs)
- CERES Team working on adding surface radiative fluxes (EBAF-SFC) by May CERES STM. (Seiji Kato's SARB presentation).

Other News

- New AIRS Science Team Leader is Joao Teixeira
- JAXA GCOM-W to join the A-Train (LRD: November 2011 – March 2012)
- ScaRaB on Megha-Tropiques launch – October 12, 2011.

AMSR-E (Aqua):

- April 2007: Noticeable increase in Antenna Drive Electronics (ADE) motor current and commanded torque was observed.
- AMSR-E Antenna Drive Assembly (ADA) began exhibiting significantly noisier behavior in July 2011.
- Experienced much worse problems in the past few days than anything previously experienced.
- Normal behavior for an instrument well beyond its design life (3-years). Similar behavior of the QuickScat drive motor.

Other News

Cloudsat:

- April 17: Experienced a spacecraft battery anomaly. Started drifting away from CALIPSO.
- June 18: CloudSat executed orbit lowering maneuver and safely passed under Aqua.
- Week of Sept 25: Began bringing the radar back to operations over the following few weeks.
- Eventually, CloudSat may return to the A-Train.
- Because of the spacecraft battery issues, CloudSat will no longer be able to operate during nighttime.

Upcoming Conferences & Meetings of Interest

WCRP Open Science Conference

- October 24-28, Denver, CO.

Fall AGU:

- Aqua@10 Union Session, Dec 5-9, 2011.

92nd AMS Annual Meeting

- Jan 22-26, 2012, New Orleans, LA

CMIP5 Analysis Workshop

- Mar 5-9, 2012, Honolulu, Hawaii

Workshop on the Physics of Climate Models

- 20-23 Mar 2012, Caltech, Pasadena, CA, USA

IGARSS 2012

- Aqua@10 Session, July 22-27, 2012, Munich, Germany

International Radiation Symposium (IRS) 2012

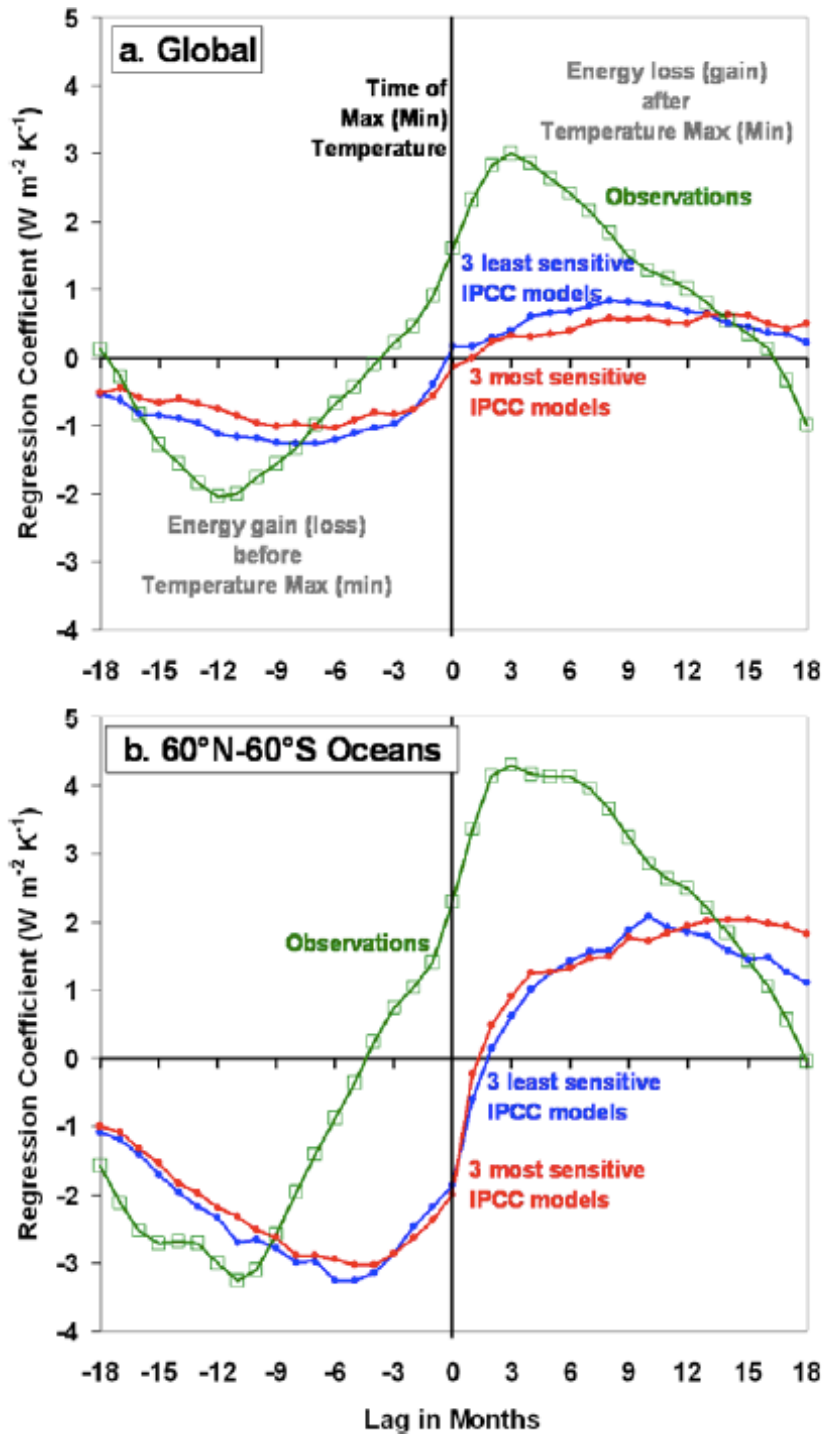
- August 5-12, 2012, Berlin, Germany

AOGS-AGU Joint Assembly

- August 13-17, 2012, Singapore.

CERES In the News

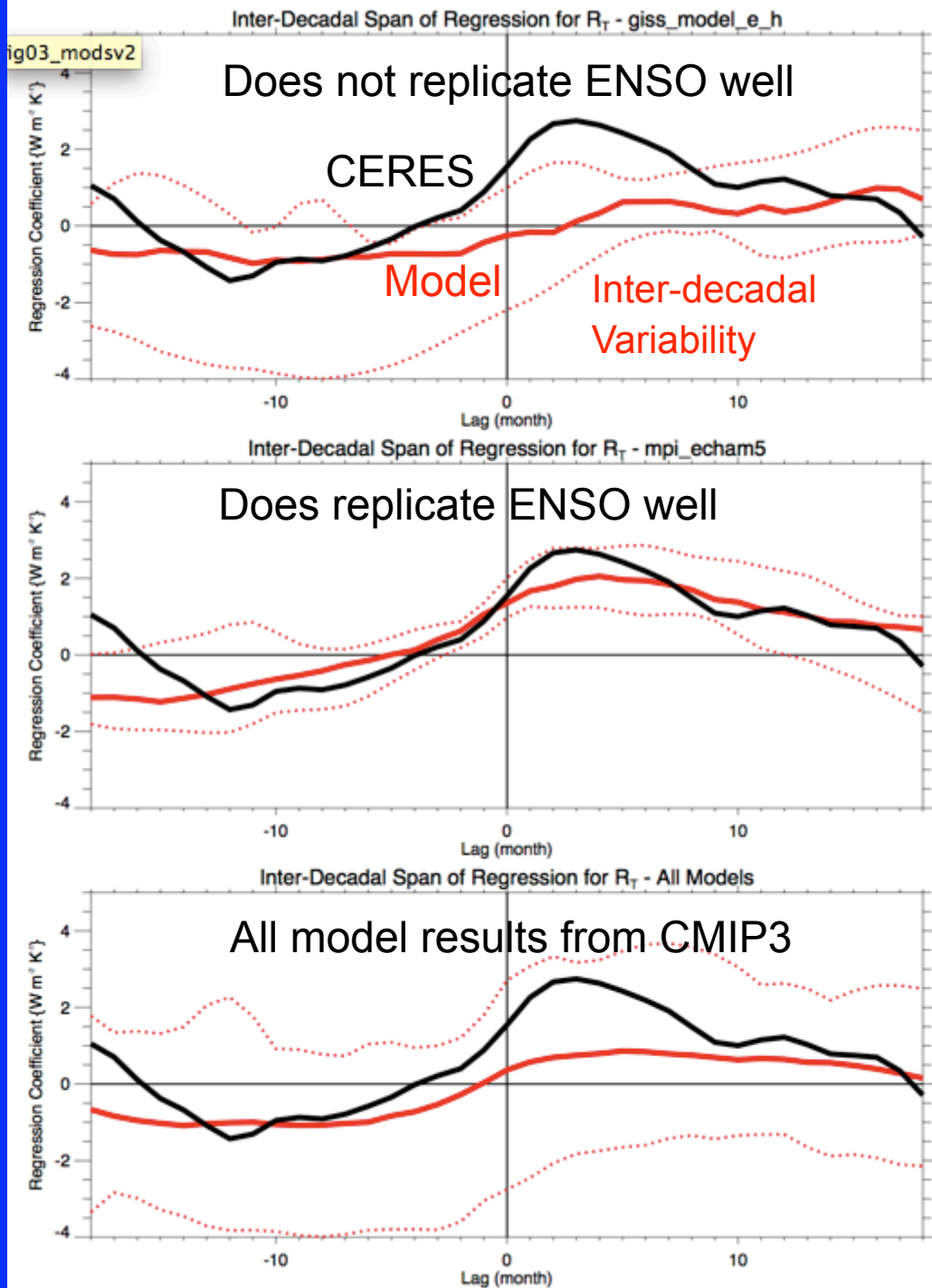
- Recent papers by Spencer and Braswell (2011) and Lindzen and Choi (2011) use CERES data.
- Claim Earth is emitting more radiation to space than expected based upon comparison of 10 year CERES obs and 100 year GCM simulations.
- Press coverage: UAH press release, Fox News, Forbes blog.
- Headlines of note: “New NASA Data Blow Gaping Hole In Global Warming Alarmism”; “Climate models get energy balance wrong, make too hot forecasts of global warming”
- Climate science community point to gaping holes in the analysis and interpretation of the results.
- Editor (Remote Sensing) resigns.



Lagged Regressions Between Surface Temperature and Net Radiative Flux

- Lead and lag regression coefficients between monthly surface temperature anomalies and Net radiative flux anomalies in observations *versus coupled climate models*.
- *Global temperature variations during past decade were largely radiatively forced: net radiative gain (loss) precedes temperature maxima (minima).*
- *Net radiative loss (gain) follows temperature maxima (minima).*
- *The presence of time varying radiative forcing in satellite radiative flux measurements corrupts the diagnosis of radiative feedback.*

Spencer and Braswell, 2011 (Rem. Sens.)



Lagged Regressions Between Surface Temperature and Net Radiative Flux

- No statistical significance of results, error bars or uncertainties are given either in the figures or discussed in the text.
- *The observations cover a 10 year period. The models cover a 100 year period for the 20th century.*
- *Should consider each decade of the 20th century individually and quantify the inter-decadal variability.*
- *Model that replicates the observations better has high sensitivity while the other has low sensitivity.*
- *Clouds are not a forcing of the climate system (except for the small portion related to human related aerosol effects). Clouds mainly occur because of weather systems (e.g., warm air rises and produces convection, and so on).
Trenberth & Fasullo response*

End