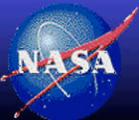


# SRBAVG Ed2E and SYN/AVG ZAVG: Validation/Status

D. Doelling, D. Keyes, M. Nordeen,  
C. Nguyen, R. Raju, M. Sun  
SSAI

7<sup>th</sup> CERES-II Science Team Meeting  
Newport News, VA, Apr 24-26, 2007

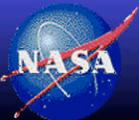


**NASA Langley Research Center / Atmospheric Sciences**



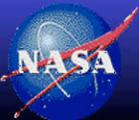
# Outline

- Review CERES monthly gridded products
- SYN/AVG/ZAVG status
  - Validation by Fred Rose, Paul Stackhouse
- SRBAVG status
  - Daily products
  - Terra and Aqua
- Terra-Aqua comparisons
  - Tests the temporal interpolation accuracy
- Annual global mean TOA fluxes
  - All-sky, clear-sky and cloud forcing
- CERES/GERB comparisons
  - Use GERB to validate GEO
- Conclusions and future studies



# CERES Monthly Gridded Products

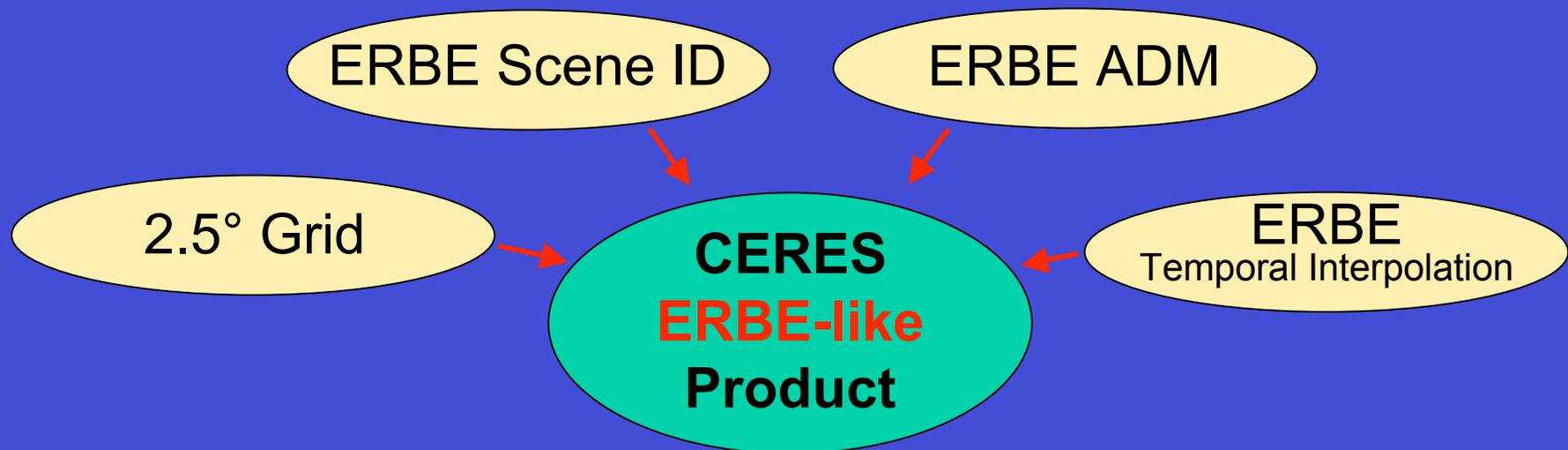
- CERES products
  - Regional radiative fluxes and cloud properties at TOA, surface and profile levels
- There are 4 main CERES product groups
  - ERBE-like
    - Uses ERBE algorithms to derive fluxes
  - SRBAVG Non-GEO
    - Uses the CERES ADMs and MODIS cloud properties to derive fluxes
  - SRBAVG GEO
    - Adds geostationary fluxes to improve temporal sampling
  - SYN/AVG/ZAVG
    - Produces global synoptic maps and radiative transfer fluxes



# ERBE-like Product

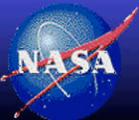
- Product Features:

- Based on ERBE algorithms and in the same format (ES-4 & ES-9) as the original ERBE scanner dataset (1985-1989)



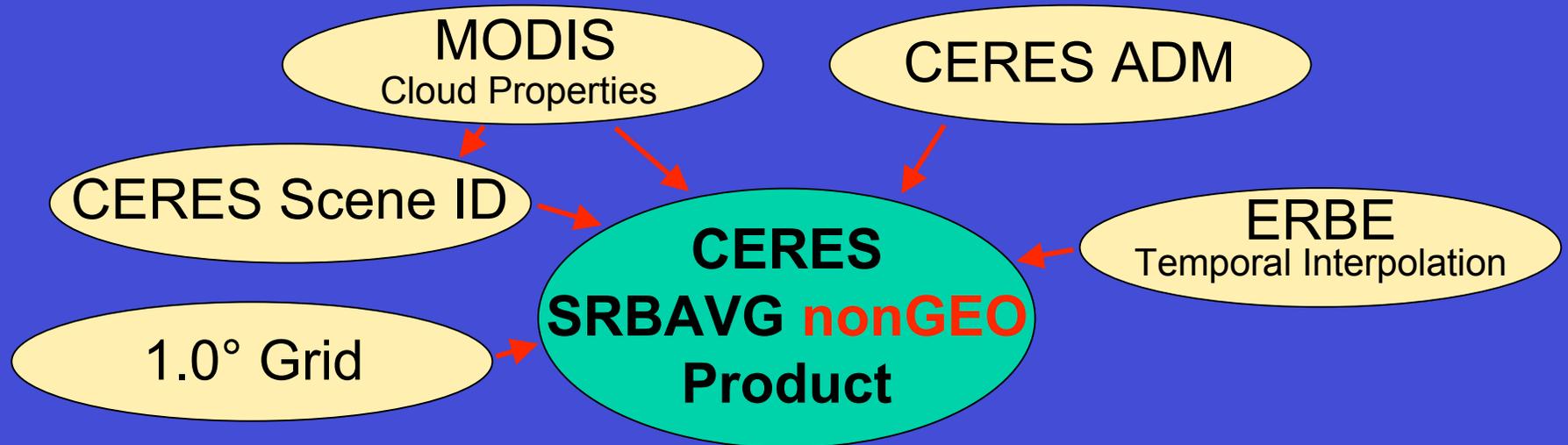
- Appropriate Usage:

- To compare with historical ERBE (1985-1989) fluxes to ensure that flux differences are not associated with CERES algorithm improvements

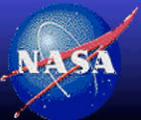


# SRBAVG nonGEO Product

- Product Features:
  - TOA fluxes and MODIS cloud properties



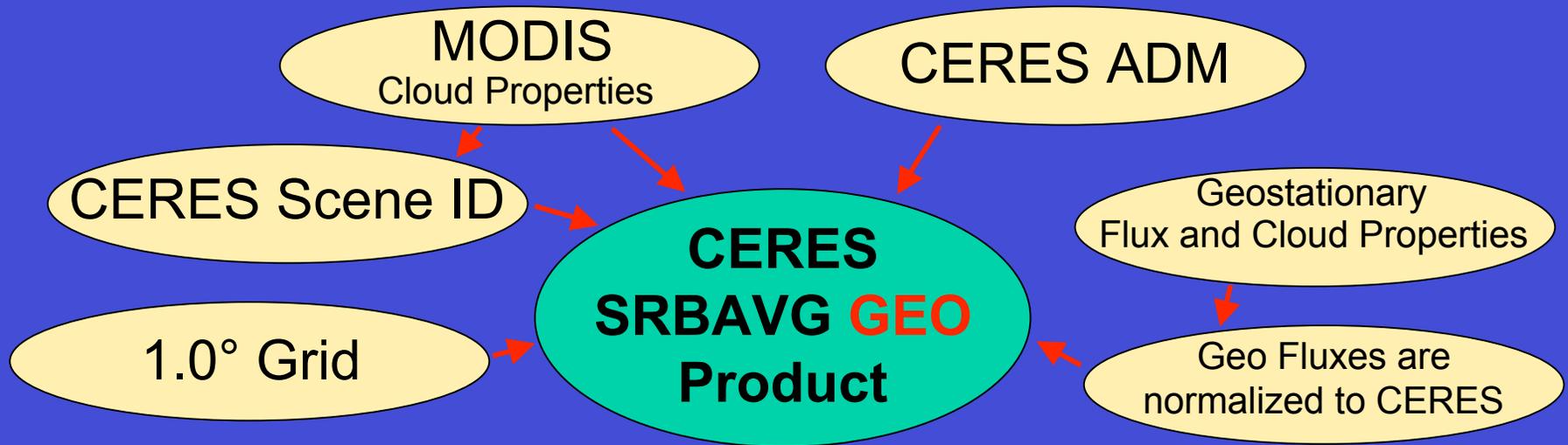
- Fluxes and cloud properties are sampled only during Terra overpasses



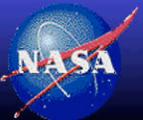
# SRBAVG GEO Product

- Product Features:

- TOA and surface fluxes and MODIS/GEO cloud properties
- Uses 3-hourly geostationary derived fluxes and cloud properties to interpolate between CERES observations

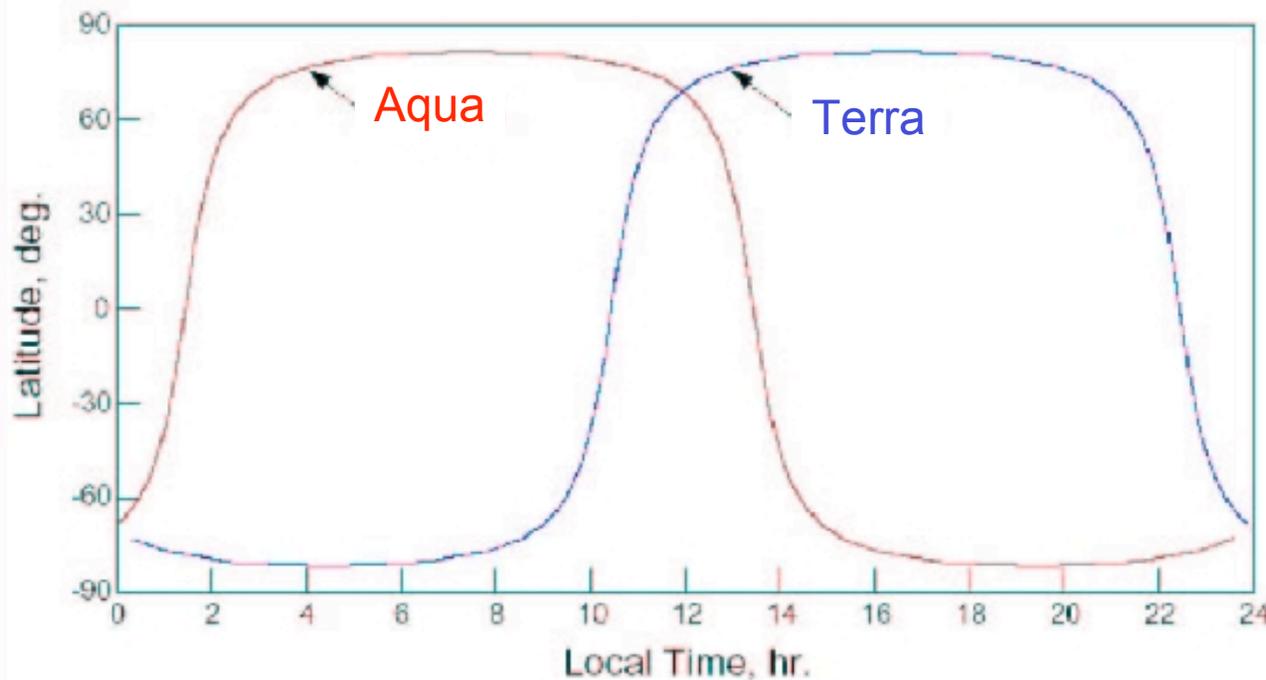


- The SRBAVG GEO product incorporates the diurnal cycle



# Why Include GEO Fluxes?

Terra(10:30AM) and Aqua (1:30PM) Temporal Sampling

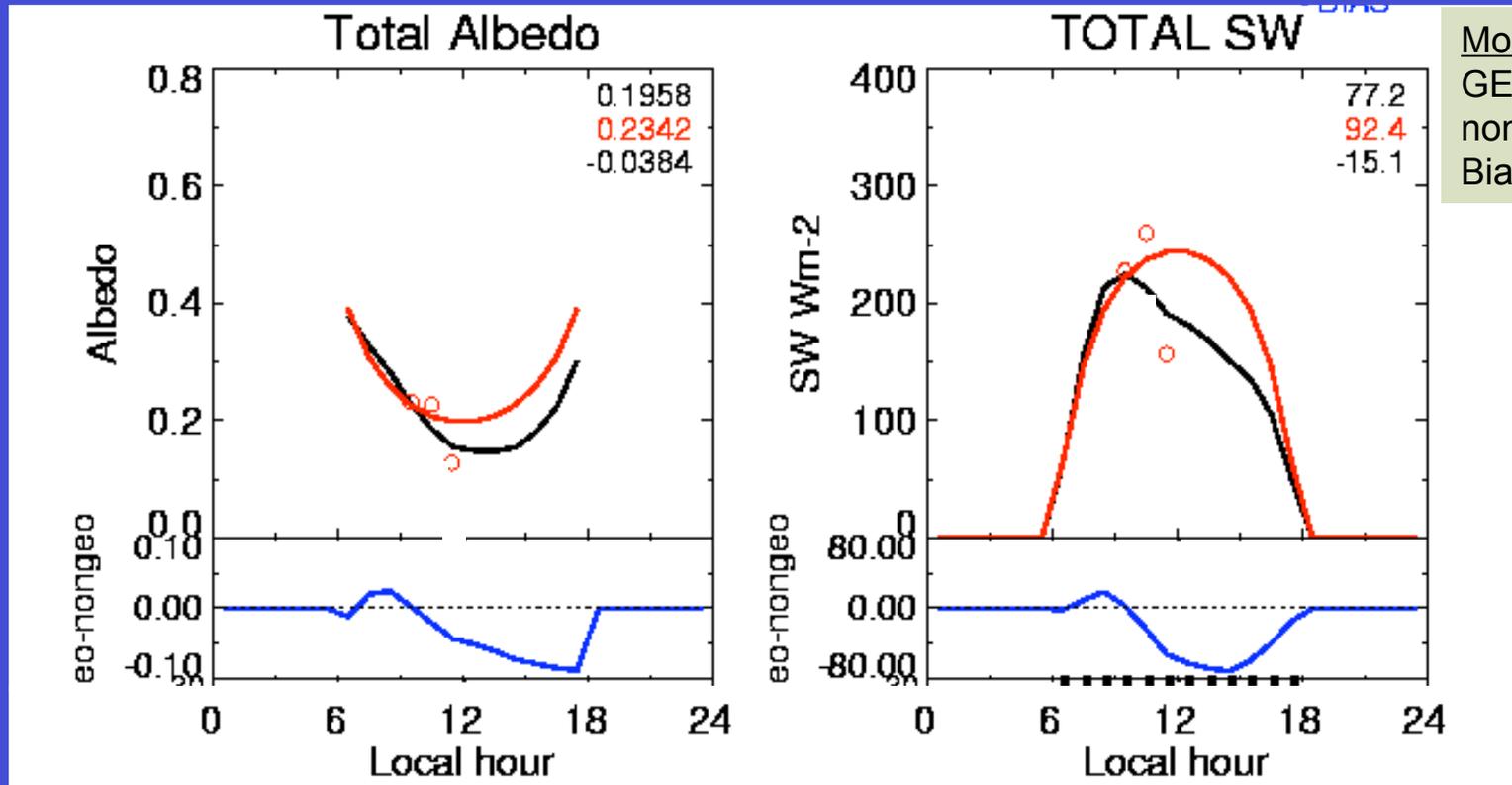


- Most regions sampled twice a day with either Terra or Aqua
- Terra & Aqua sample the poles up to 14 times/day
- Even after combining Terra and Aqua 8 hour gaps exist

- 3-hourly GEO fluxes adequately samples the diurnal cycle between  $\pm 60^\circ$  latitude
- The Terra Aqua time difference is greatest in the southern oceans

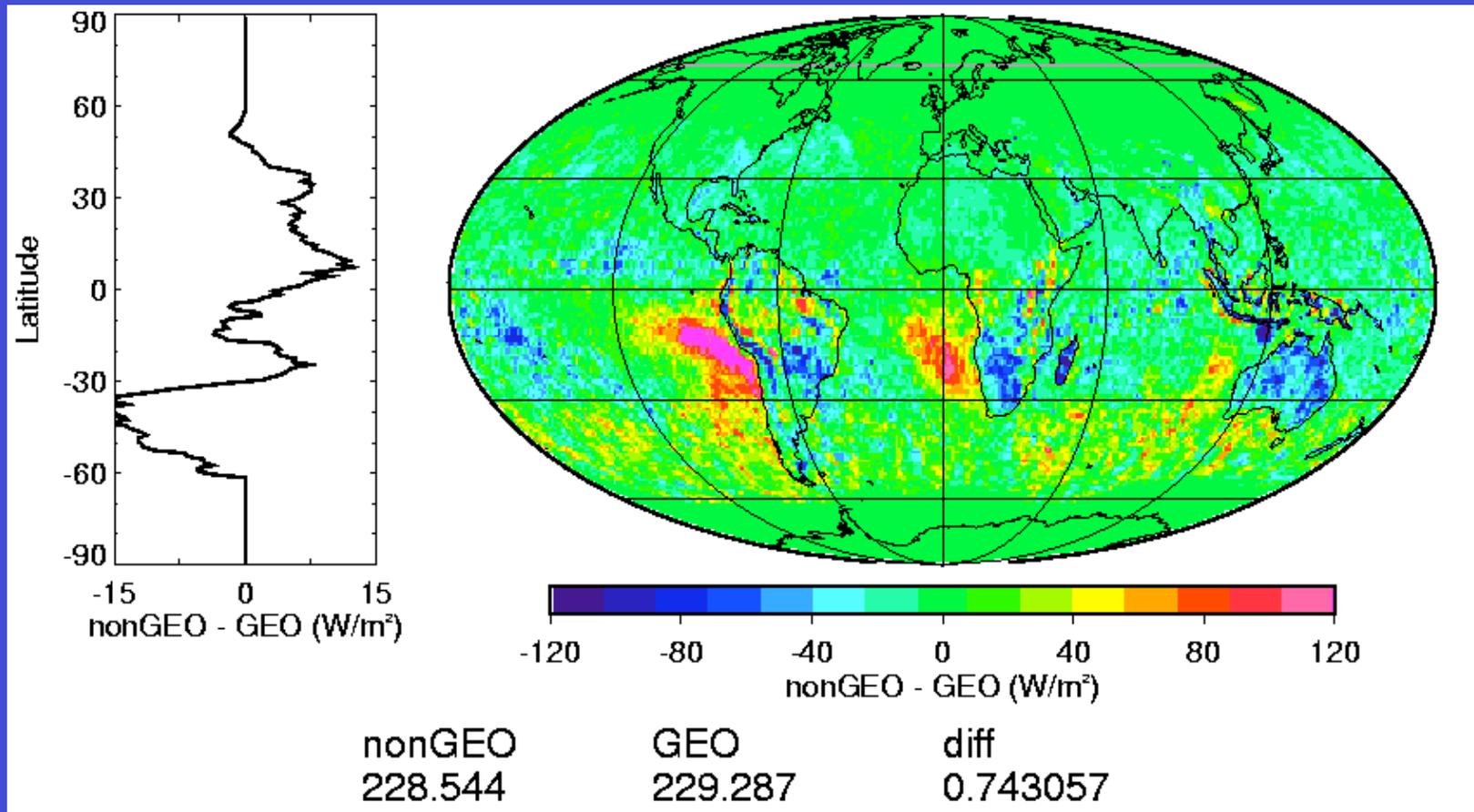


# Monthly Hourly Albedo and SW Flux over Ecuadorian Stratus for Terra, July 2001



- Directional models describe albedo as a function of solar zenith angle and are scene dependent
- ERBE temporal interpolation assumes constant meteorology (cloud properties) through out the day
- GEO temporal interpolation uses 3-hourly GEO fluxes and clouds

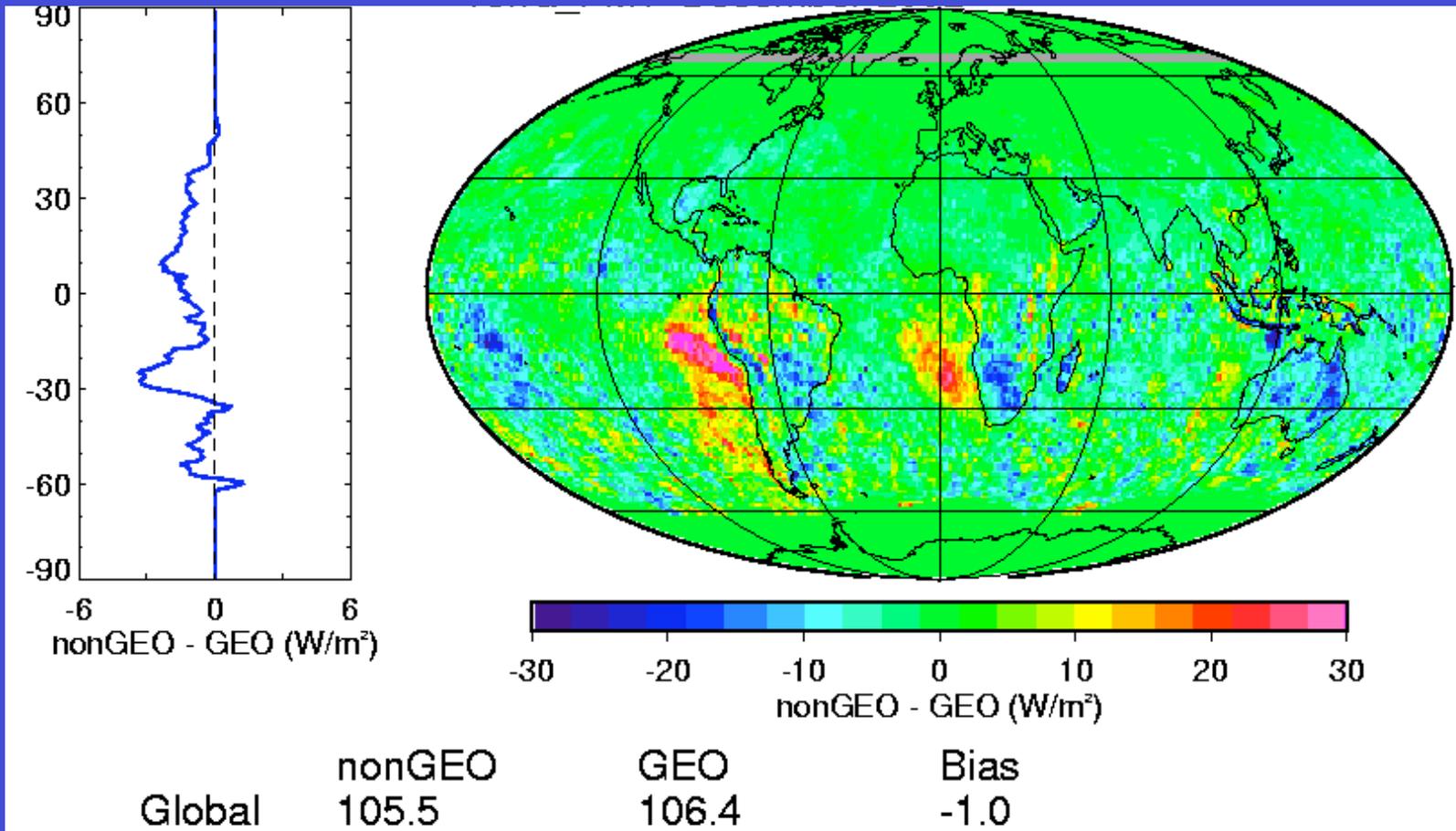
# nonGEO - GEO SW 14:30 monthly hourly mean Dec 2002



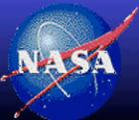
- Blue afternoon convection, Red afternoon cloud clearing
- Regional instantaneous differences can be  $\sim 100 \text{ Wm}^{-2}$



# nonGEO - GEO SW monthly mean Dec 2002

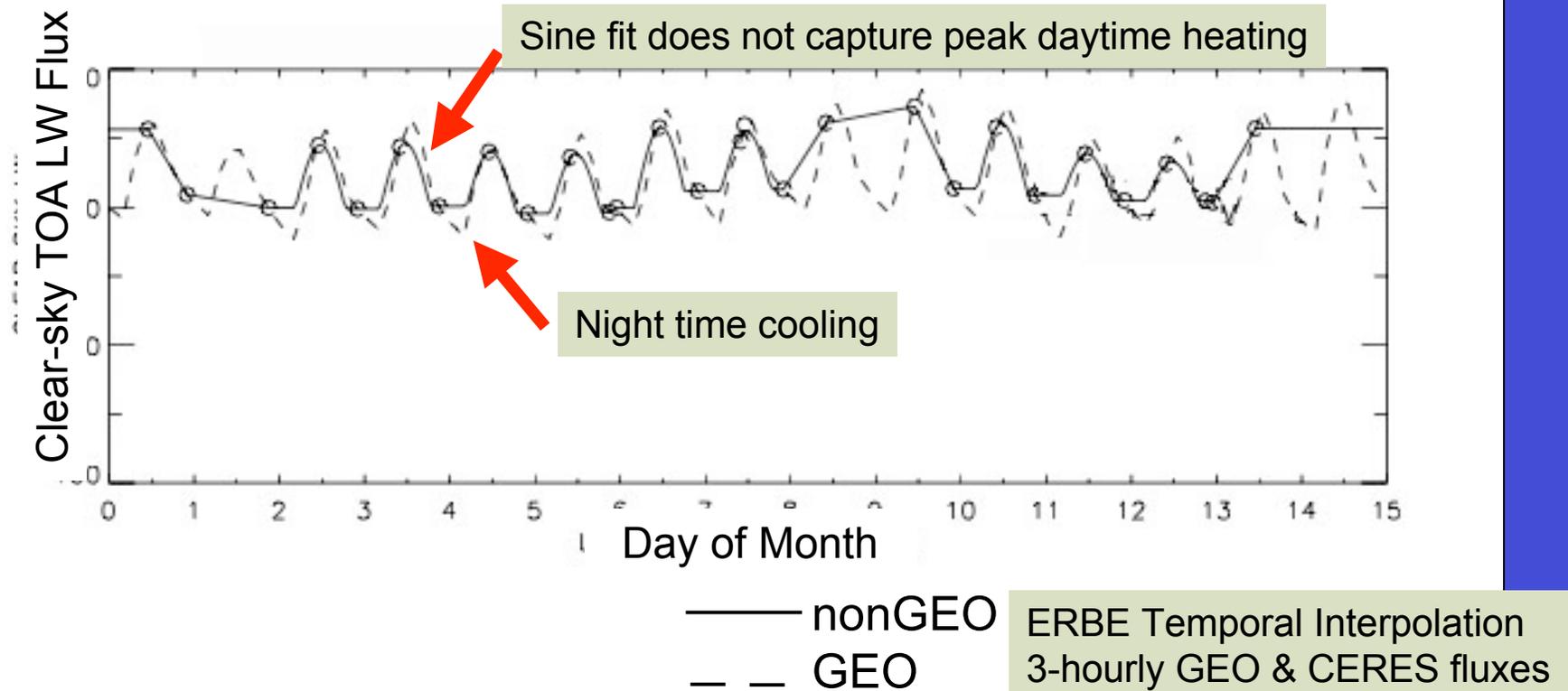


- Blue afternoon convection, Red afternoon cloud clearing
- Regional monthly differences can be  $\sim 20 \text{ Wm}^{-2}$



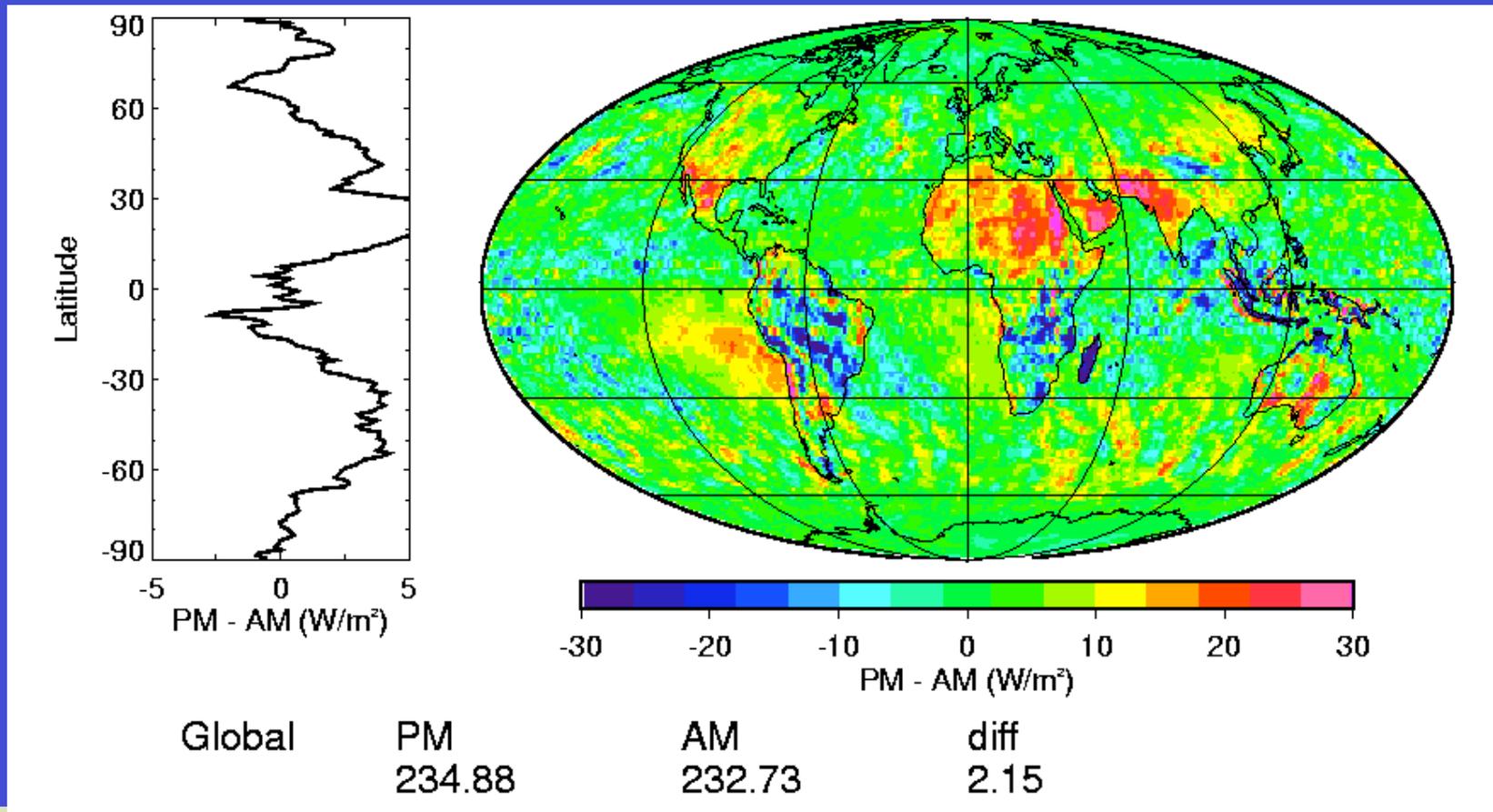
# Clear-sky TOA LW Flux

June 2001, Terra FM-1, Arizona Desert

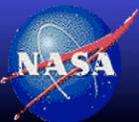


- ERBE temporal interpolation linearly interpolates between measurements over oceans
- Over land a half-sine fit is used to model diurnal heating if night time observations exist

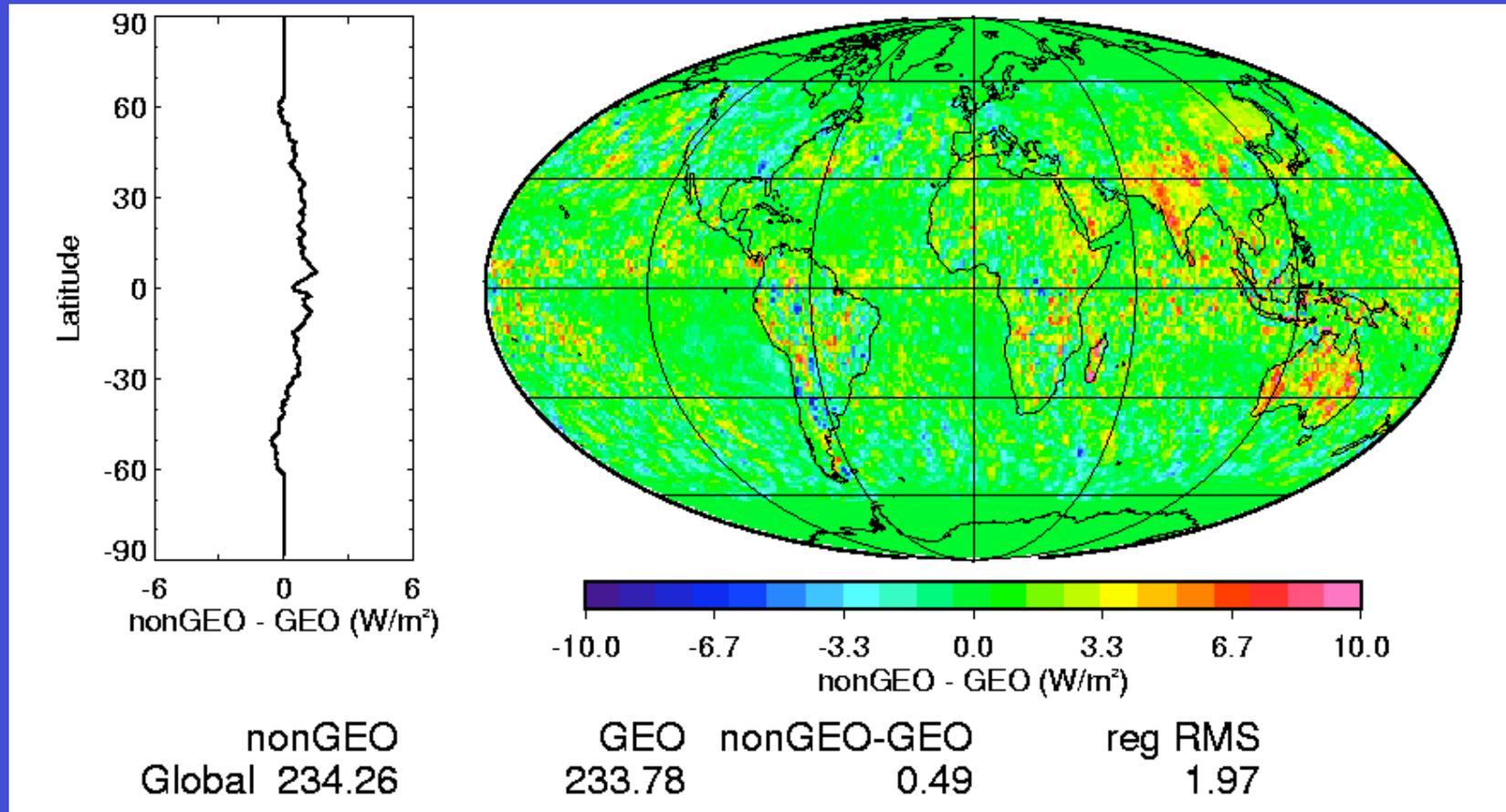
# GEO LW 16:30 (PM) - 7:30 (AM) monthly hourly mean Dec 2002



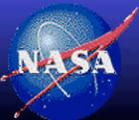
- For land: blue afternoon convection, red thermal lag
- PM-AM differences can be  $\sim 30 \text{ Wm}^{-2}$



# nonGEO - GEO LW monthly mean Dec 2002



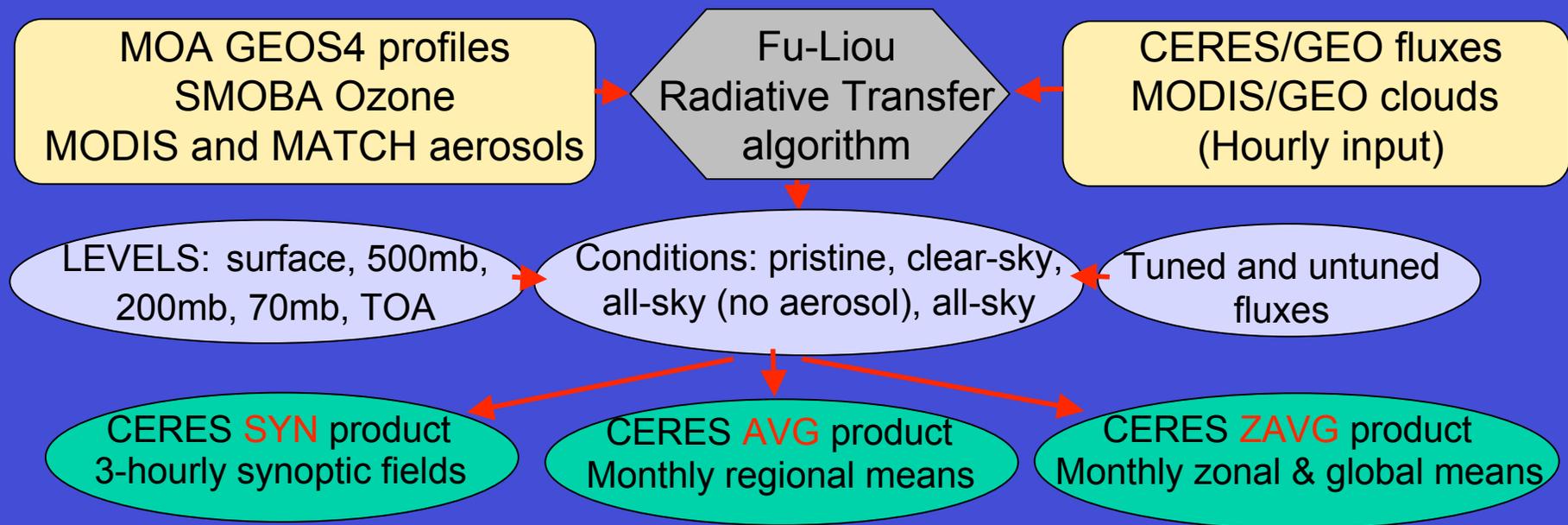
- On a global basis the LW diurnal signal is small



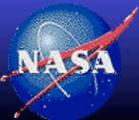
# SYN/AVG/ZAVG Product

- Product Features:

- Surface, TOA, and atmosphere Fu-Liou radiative transfer modeled fluxes consistent with CERES observed TOA fluxes and cloud properties



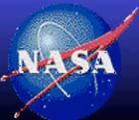
- SYN fluxes and cloud properties can be compared directly with climate model results at the 3-hourly or monthly level



# Product Sequence

- **SSF**
  - CERES footprint flux and clouds
- **CRS**
  - SARB (Fu-Liou radiative transfer) footprint profile fluxes
- **SSF + CRS -> FSW**
  - 1° gridded flux, clouds and SARB profile fluxes at instantaneous Terra overpass times
- **FSW + GGEO -> TSI**
  - Add GEO clouds and fluxes and temporally interpolate all parameters at hourly GMT increments completely
- **TSI->SYNI**
  - Compute SARB fluxes hourly

\* Not publicly released



# Product Sequence

- **SYNI->SYN** (9 GB/month)
  - create 3-hourly synoptic SARB product
- **SYN->AVG** (0.6 GB/month)
  - Sum all 3-hourly fluxes to compute monthly mean and monthly hourly GMT based product
- **AVG->ZAVG** (4 MB/month)
  - Compute zonal and global monthly means
- This sequence is only processed for the instrument in cross-track

\* Not publicly released

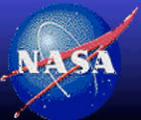


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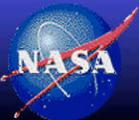
# SYN/AVG/ZAVG Issues

- MODIS (MOD04) aerosol optical depths are currently interpolated over all hourboxes
  - PROBLEM: Occasionally MODIS AOTs are unreasonably large in cloudy scenes
  - SOLUTION: No interpolation between default MODIS AOTs
  - During cloudy events SARB will use MATCH aerosols
- Daily clear-sky albedo, when not measured by Terra, uses the monthly mean clear-sky albedo (nonGEO)
  - PROBLEM: Regions with daily snow and ice variations will not have the correct surface characteristics.
  - SOLUTION: Correlate snow percentage with clear-sky albedo to estimate the daily clear-sky albedo
- SZAs computed at top of GMT hour
  - PROBLEM: biases in monthly mean fluxes
  - SOLUTION: Maintain accurate 3-hourly and monthly mean fluxes and clouds by computing integrated regional and GMT hourbox SZAs and taking into account twilight flux and oblate spheroid correction
  - Lose ability to compare at instantaneous model times, no need to adjust modeled fluxes 3-hourly GMT fluxes to integrated fluxes
- Improve cloud temporal interpolation algorithm, not all exception handling in place. 99.5% of all cases are valid.



# SYN/AVG/ZAVG Status

- Terra Beta3 SYNI currently completed from Mar00-Apr04
  - Complete 5 years of Beta3 SYNI (Mar00-Oct05)
- Terra Beta3 SYN/AVG/ZAVG is publicly available as soon as each month is processed
  - Currently Mar00-Feb02 completed
  - Data quality summary has been written listing all the caveats
  - **Do not publish Beta versions**
- Beta4 SYN/AVG/ZAVG projected processing Fall 2007
  - All algorithm improvements to be implemented
  - 3 years of Terra validation and some Aqua
- Edition2 SYN/AVG/ZAVG projected processing Summer 2008
  
- Fred Rose will show Beta3 results
- Paul Stackhouse will show the Beta3 results compared with other surface flux datasets



# TISA Data Management

Time Interpolation and Spatial Averaging

## LaRC Site - Production Data

[Home](#) -> [Production Data](#) -> [TISA SYN Data Validation](#) -> [SYN 3-Hourly Plots](#)

Home

Related Links

Contact Us

### TISA SYN Data Validation

[SYN 3-Hourly Plots](#)

### CERES TISA SRBAVG Data Validation

Cloud Effective Pressure

Flux and Cloud Parameters

Method A and Method B Difference

Method A/B and ES-4 Difference

Time Series Plot

SRBAVG & ES-4 Comparison

SRBAVG & ISCCP Comparison

### TISA GGEO Data Validation

[GGEO 3-Hourly Plots](#)

[Cloud Plots](#)

[GGEO QC Reports](#)

[GGEO-CERES Comparisons](#)

### TISA SYN Data Validation for CERES Processing

#### SYN 3-Hourly Plots

Year:	2000
Month:	March
StartDay:	01
StartHour:	01
StopDay:	02
StopHour:	01
Type:	<input checked="" type="checkbox"/> Observed All-sky TOA SW <input type="checkbox"/> Observed All-sky TOA LW <input type="checkbox"/> Observed All-sky TOA NET <input type="checkbox"/> Cloud Amount (%) <input type="checkbox"/> Cloud Optical Depth (log) <input type="checkbox"/> Cloud Temperature (K) <input type="checkbox"/> Cloud Phase <input type="checkbox"/> Cloud Top Pressure (mb) <input type="checkbox"/> Cloud Bottom Pressure (mb) <input type="checkbox"/> Cloud Ice Diameter (um) <input type="checkbox"/> Cloud Liquid Radius (um) <input type="checkbox"/> Cloud Emissivity <input type="checkbox"/> (MODIS) Aerosol Optical Depth(0.55um) <input type="checkbox"/> All-sky TOA SW Untuned-Observed <input type="checkbox"/> All-sky TOA LW Untuned-Observed <input type="checkbox"/> Tuned TOA SW Cloud Forcing <input type="checkbox"/> Tuned TOA LW Cloud Forcing <input type="checkbox"/> Tuned TOA SW Aerosol Forcing <input type="checkbox"/> Tuned Surface Down SW Aerosol Forcing <input type="checkbox"/> All-sky Surface UV Index <input type="checkbox"/> Tuned Clear-sky Surface Albedo <input type="checkbox"/> Tuned All-sky Surface SW Down <input type="checkbox"/> Tuned All-sky Surface LW Down <input checked="" type="checkbox"/> Tuned All-sky Surface SW NET <input type="checkbox"/> Tuned All-sky Surface LW NET <input type="checkbox"/> Tuned All-sky TOA SW <input type="checkbox"/> Tuned All-sky TOA LW

### Related Information

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

[View CERES Data Product Summaries](#)

[Order CERES Data via the Langley Web Ordering Tool](#)

Web page has 3-hourly SYN images for all processed months

pheric Sciences



<http://earth-www.larc.nasa.gov/cgi-bin/cgiwrap/tisa/tisa.pl?app=SYNPLOT&js=yes>

## Tuned All-sky Surface SW NET

Terra 200003 SYN

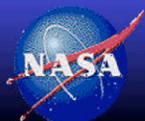
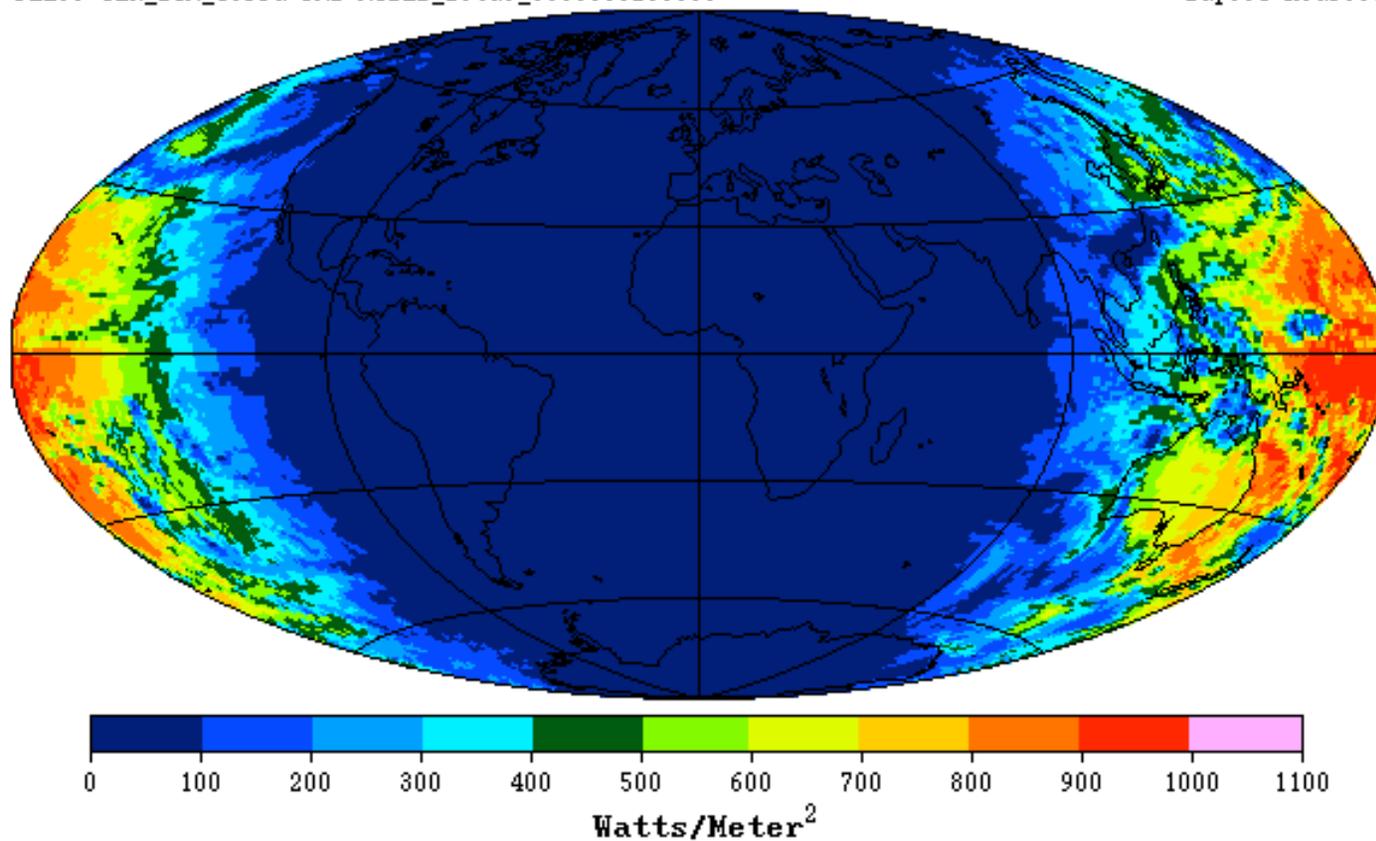
Processed: 2007/ 4/ 9

1-deg Equal Angle Nested

Synoptic Hour

File: CER\_SYN\_Terra-FM2-MODIS\_Beta3\_005003.200003

Day:01 Hour:01



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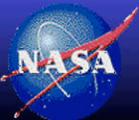


## Comparison of annual global mean fluxes

MAR00 – Feb01	SW	LW	NET
ZAVG tuned + Rev1	98.09	237.40	5.85
ZAVG untuned	98.50	237.17	5.67
SRBAVG GEO + Rev1	97.88	237.04	6.41
*Solar integration $\Delta$ ZAVG-SRBAVG	0.53		

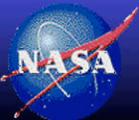
\* SYN1 did not properly integrate the SW flux diurnally, SZA computed at the GMT half hour

- No great shifts in the global means
- Most of the SYN1 input is from GEO, although CRS has +2% SW bias from CERES measurements



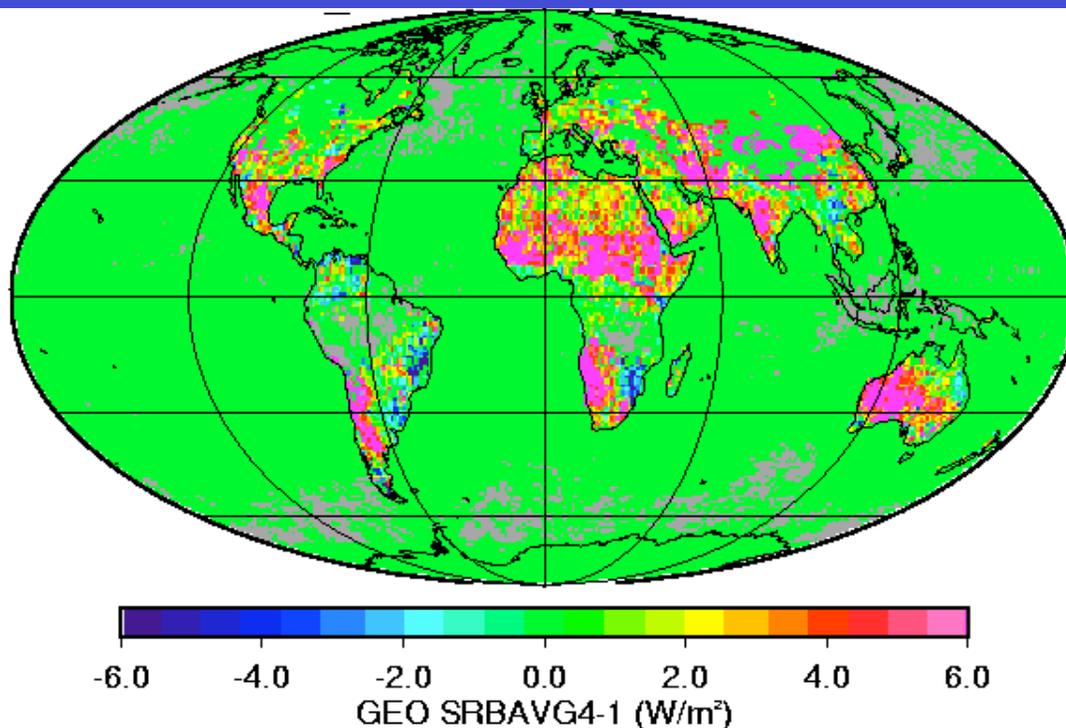
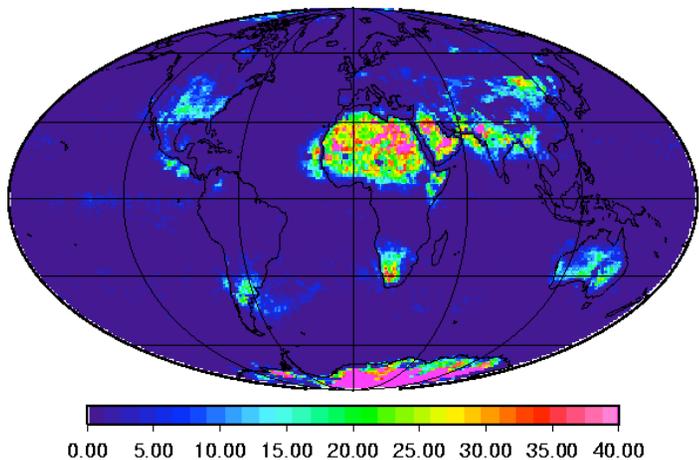
# SRBAVG-Daily

- Separate the GEO and nonGEO flux and cloud parameters
  - SRBAVG-daily<sub>1</sub> is the GEO (GEO & CERES) TOA, surface fluxes and clouds
  - SRBAVG-daily<sub>2</sub> is the nonGEO (CERES-only) TOA fluxes and MODIS clouds
- SRBAVG-daily<sub>2</sub>: also includes the MODIS product aerosols
  - daily 0.55 $\mu$ m Land aerosols (not in SRBAVG1)
  - daily 0.55 $\mu$ m, 0.87 $\mu$ m, 2.13 $\mu$ m Ocean aerosols
    - 0.65 $\mu$ m and 1.6 $\mu$ m (Ignatov aerosols) in SRBAVG1 product
  - Monthly zonal incoming solar flux
  - Daily Snow/Ice coverage maps (snow+ice+IGBP)
- SRBAVG-daily provides # of measurements on a daily and monthly hourly basis
- Make sure the average of the daily fluxes is equivalent to the SRBAVG monthly mean

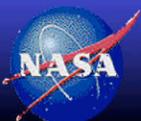


# Averaged daily - monthly mean clear-sky LW flux nonGEO Jan 2001

# of nonGEO clear-sky LW  
measurements during Jan 2001



SRBAVG5	SRBAVG1	Bias	reg RMS
262.78	262.27	0.51	2.27

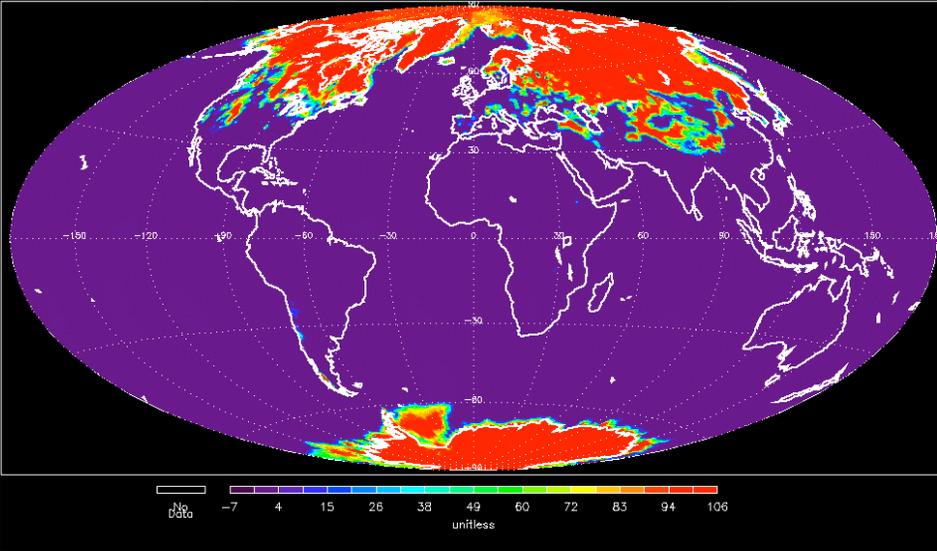


- SRBAVG1 uses monthly-hour half-sine fit,
- SRBAVG-Daily uses daily half-sine fits.

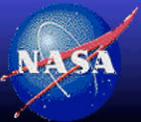
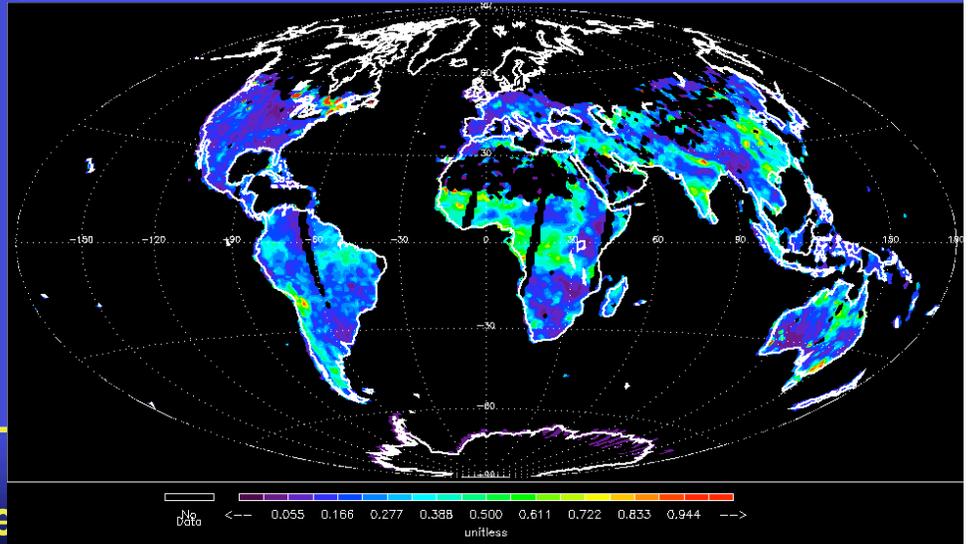
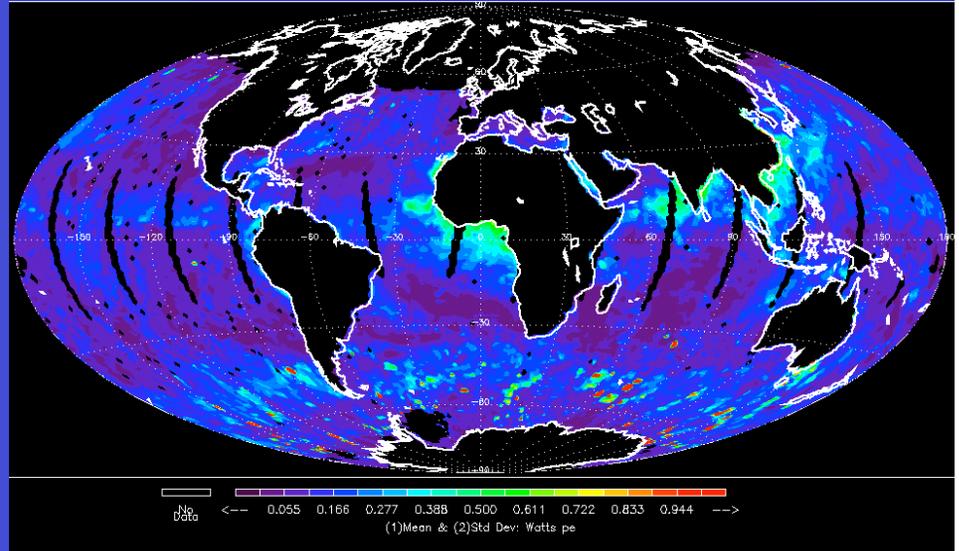


Jan 15, 2003

### Snow Coverage



### 0.55 $\mu$ m MODIS AOT



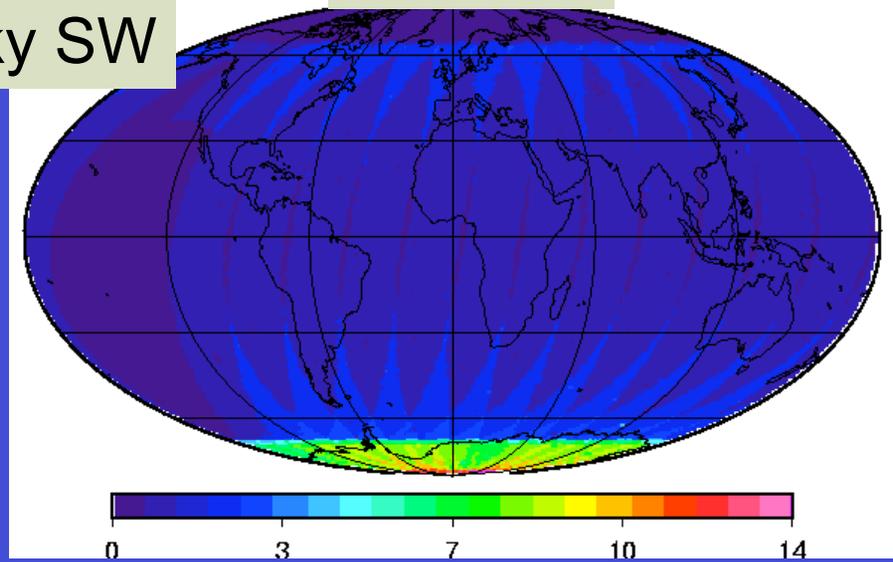
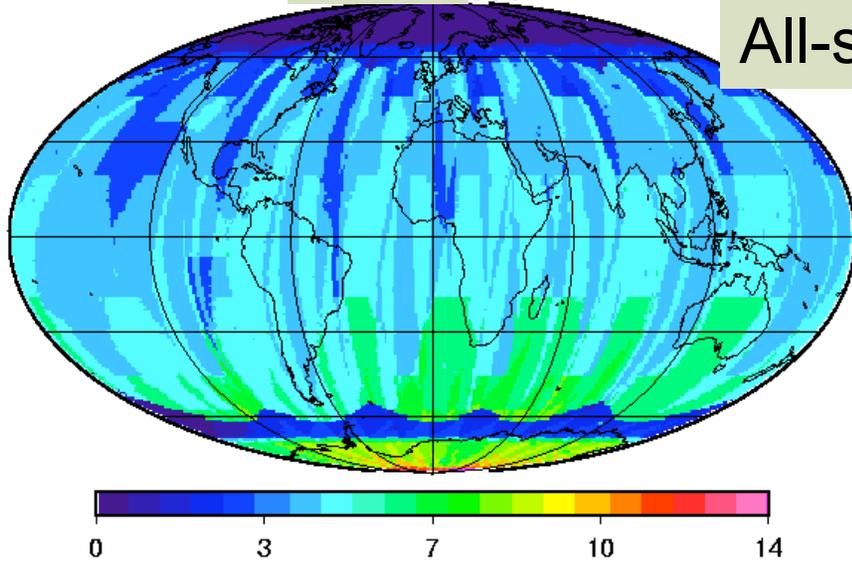
NASA Langley Research Center

# # of daily observations: Jan 17, 2001

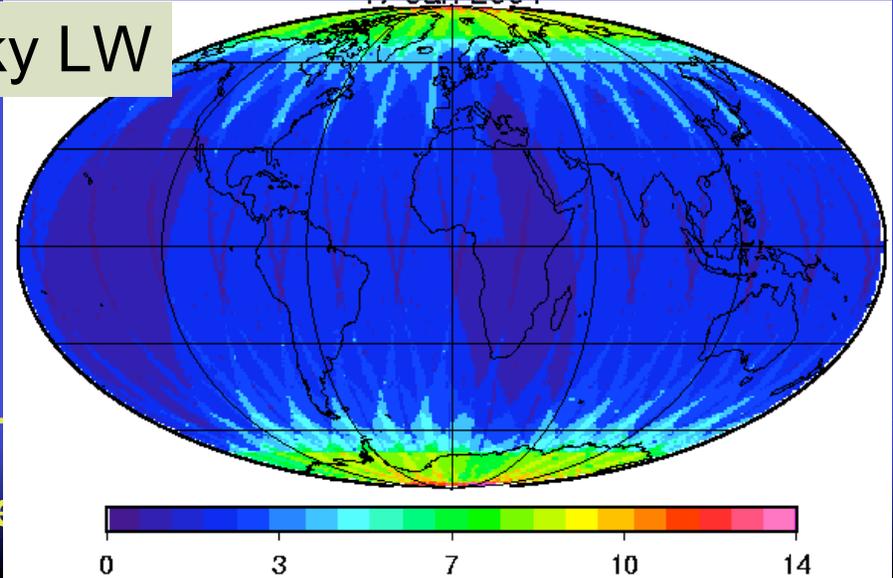
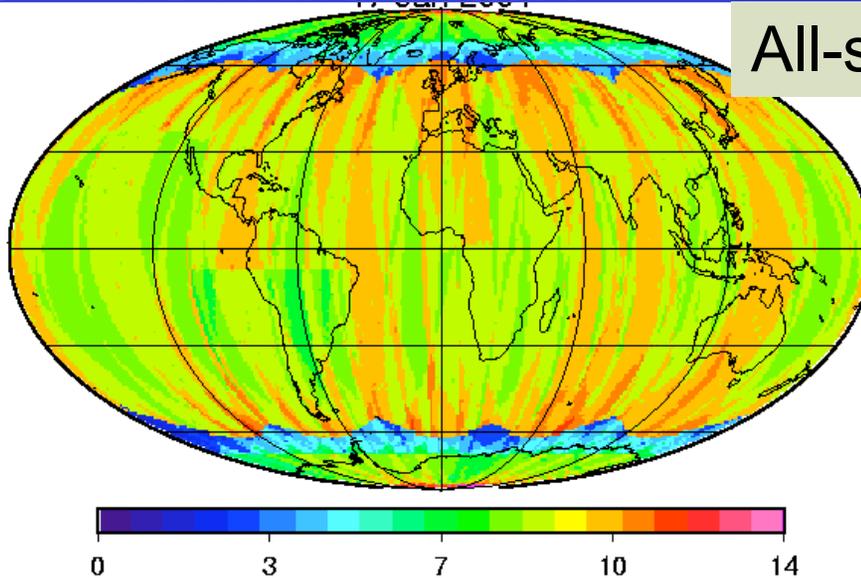
GEO

nonGEO

All-sky SW



All-sky LW

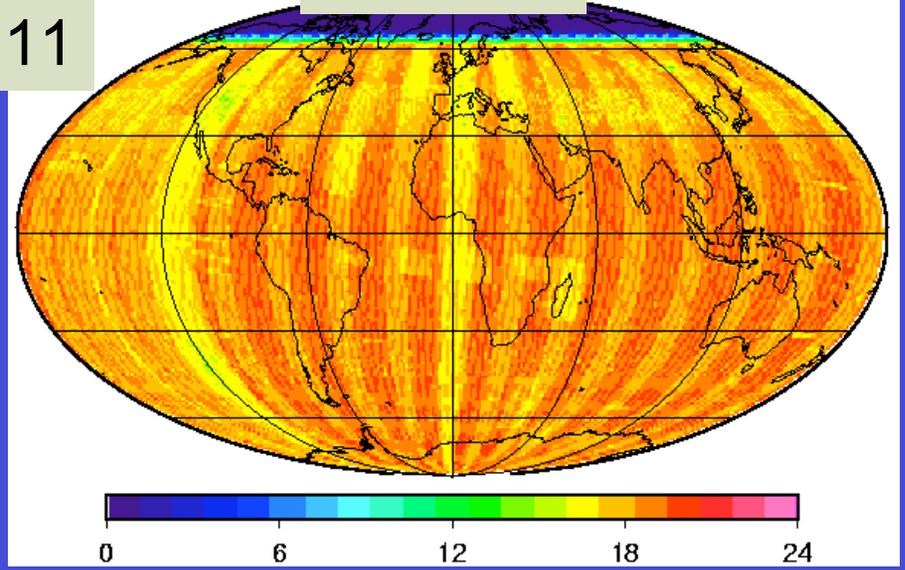
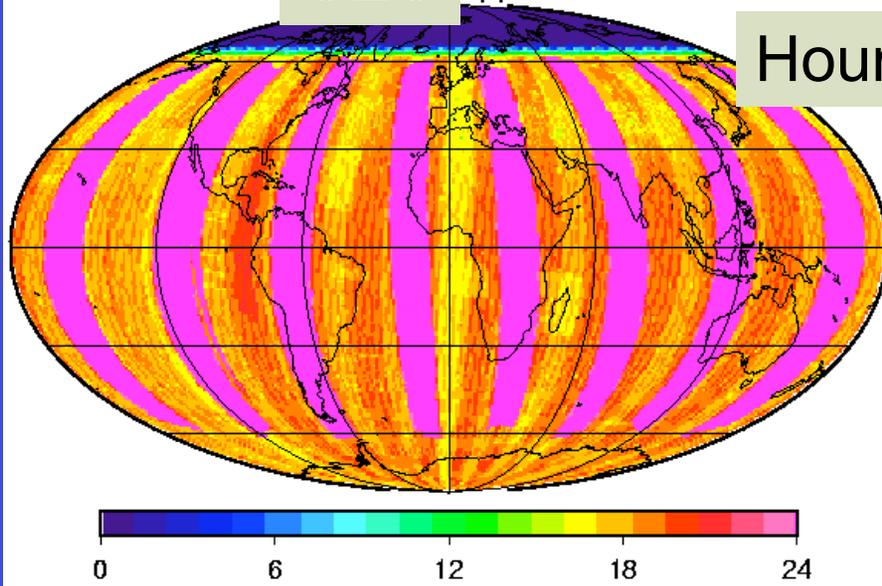


# # all-sky SW of hourly observations: Jan 2001

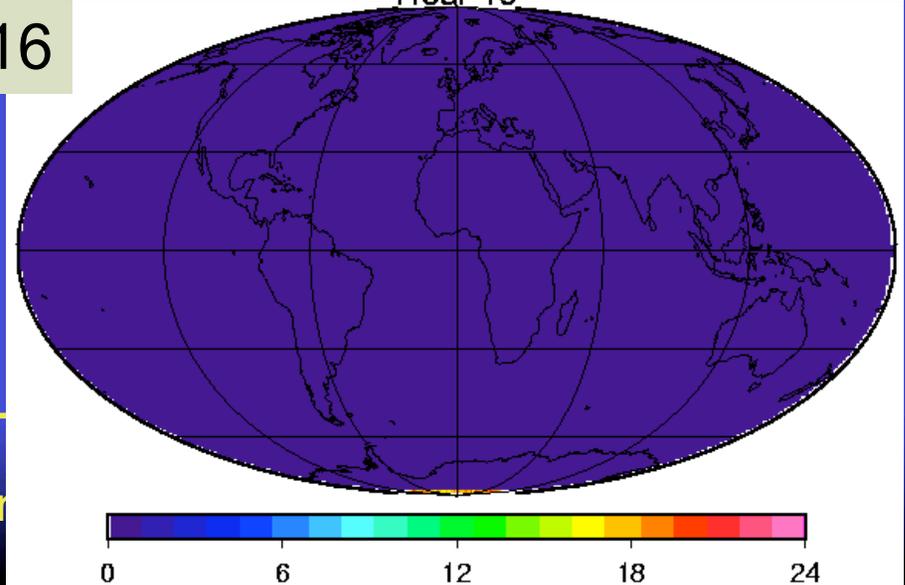
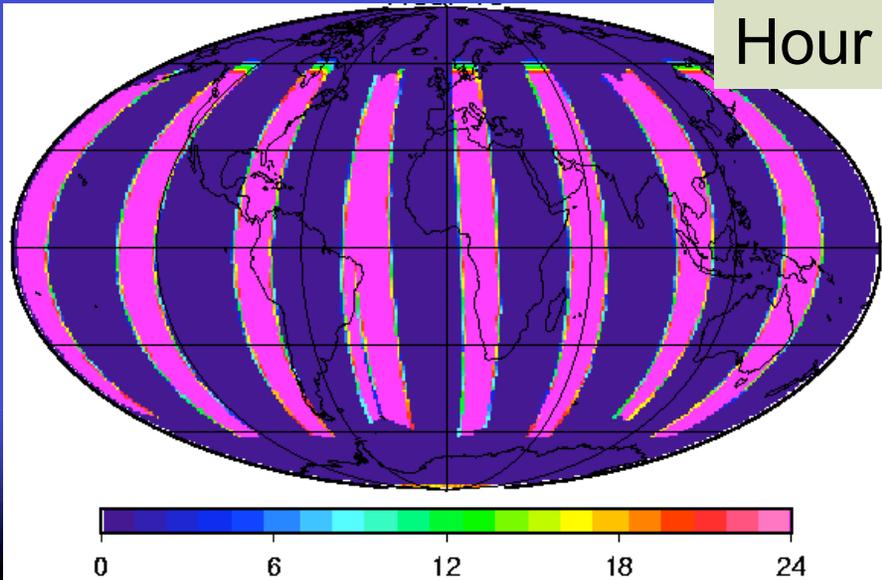
GEO

nonGEO

Hour 11

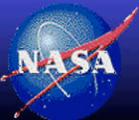


Hour 16



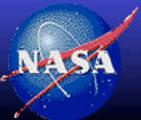
# SRBAVG-ISCCPd2like

- GOAL: produce monthly mean cloud properties consistent with ISCCP D2 product format
  - Average cloud properties as a function of cloud height and optical depth
  - User community already familiar with data format, to describe the dynamic state
- Not possible with current Ed2 processing
  - SFC and GGEO spatially grids footprint cloud properties into 4 layers based on height
  - Cloud optical depth frequency is not retained
  - Major code changes needed, TISA resources better spent getting other CERES datasets out
- Develop prototype dataset off-line with UK-MET office



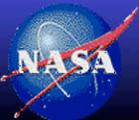
# SRBAVG status

- SRBAVG Ed2E and Aqua Ed2A has been delivered
  - Contains the daily flux and cloud properties
  - Corrected the RAPS mode GGEO/CERES SW normalization error
  - Terra Ed2E and Aqua Ed2A are identical algorithms
- Process Terra from Mar00-Oct05 and process Aqua from Jul00-Oct05
  - Available this summer
- Future SRBAVG processing
  - Deliver Nov05-Dec05 GGEO code to handle MTSAT calibration
  - Process Jan06-Jun06 after SSF is produced
  - Process Jul06-Dec06 after SSF is produced and GGEO code is modified to handle GOES-11 radiances~ time frame



# Comparison of crosstrack and RAPS SW flux

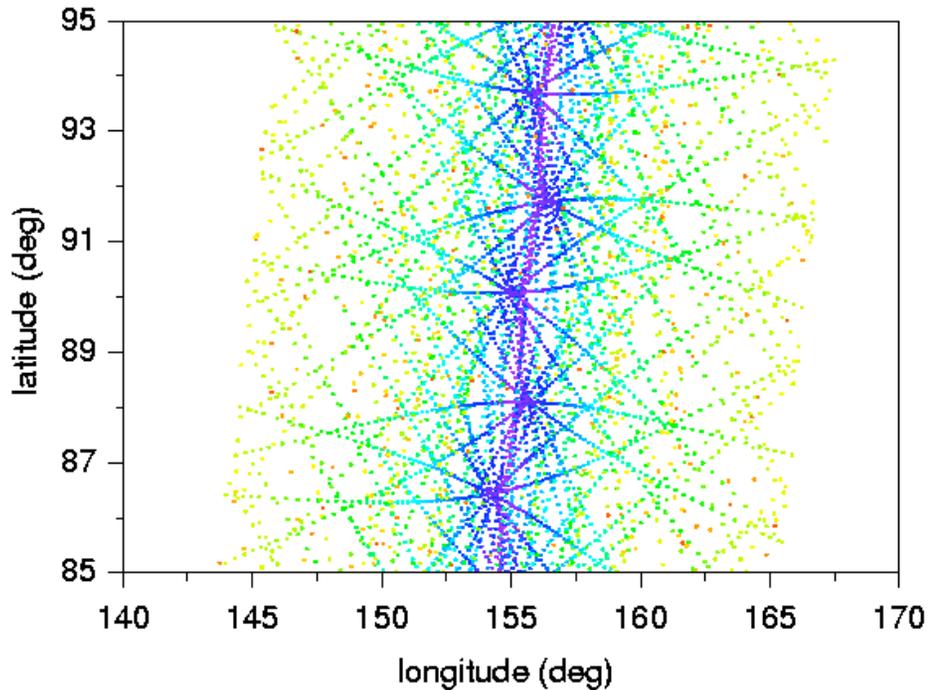
- Purpose
  - How consistent are the monthly means from cross-track and RAPS instrument for the same product?
  - What are the effects of RAPS not completely sampling a  $1^\circ$  region?
  - How well does the SW regional normalization technique work in RAPS mode?
  - Can the CERES instrument calibration differences be observed in the monthly mean products?
- Methodology
  - Compare the nonGEO - GEO fluxes from both crosstrack and RAPS mode
  - Compare the RAPS - crosstrack fluxes from both GEO and nonGEO product
- Error discovered in the SW regional normalization technique in Terra Ed2D RAPS mode



# Aqua July 28, 2004 scan patterns

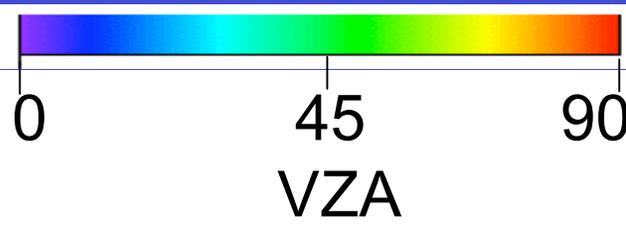
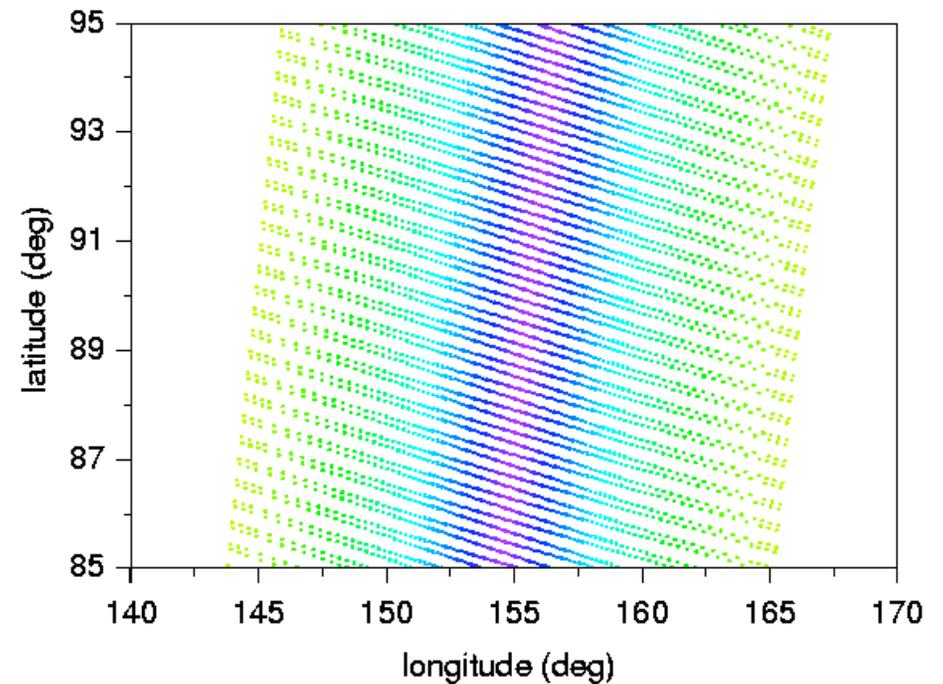
RAPS

FM3 RAPS



XTRK

FM4 cross-track

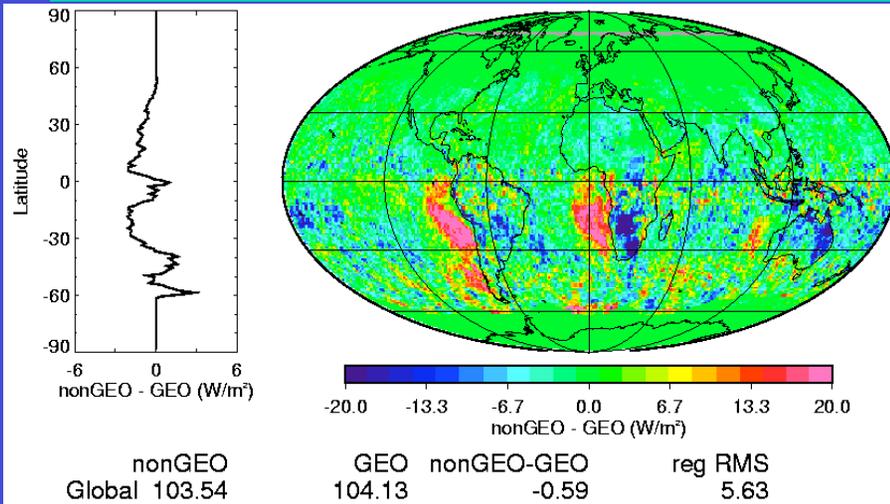


- XTRK only scans to 65° VZA, RAPS scans to 87° VZA

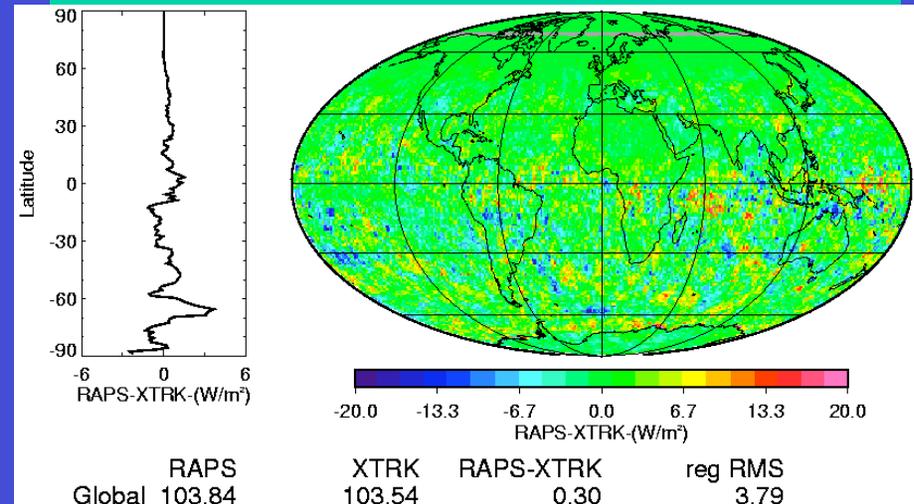


# Terra SW January 2002

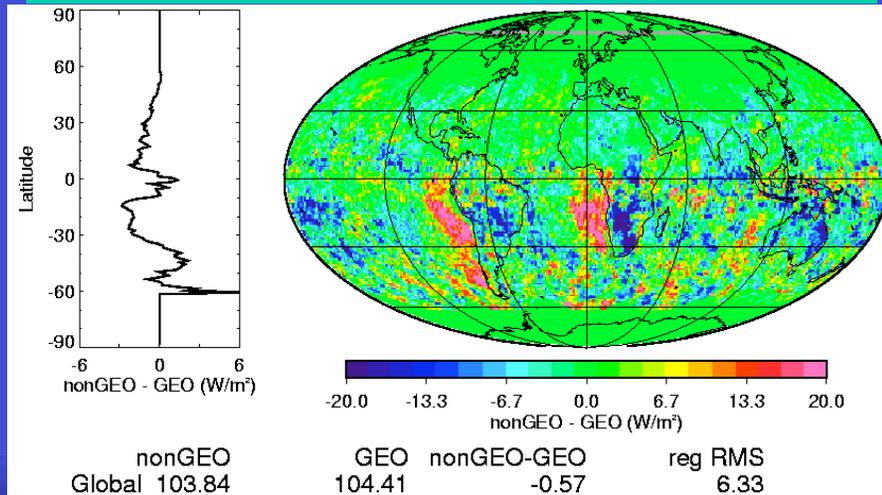
## nonGEO - GEO XTRK



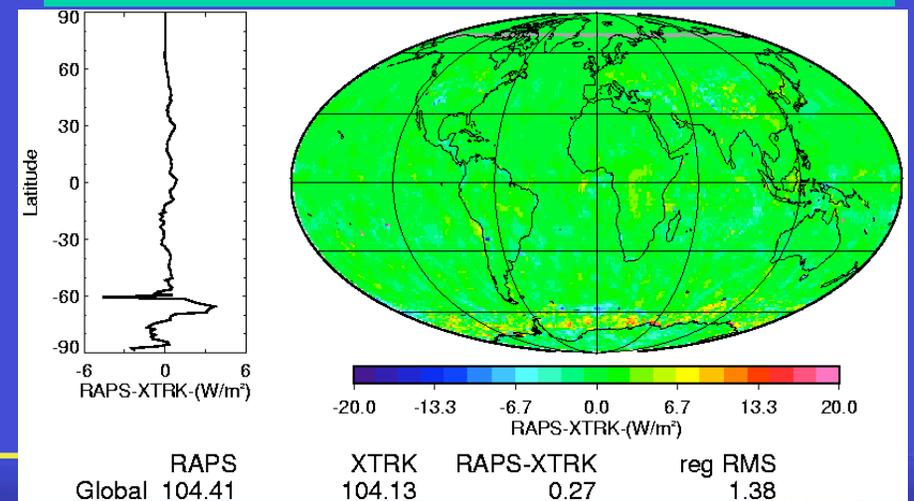
## RAPS -XTRK nonGEO



## nonGEO - GEO RAPS



## RAPS - XTRK GEO

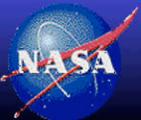


• Note the nonGEO - GEO global flux is consistent between XTRK and RAPS

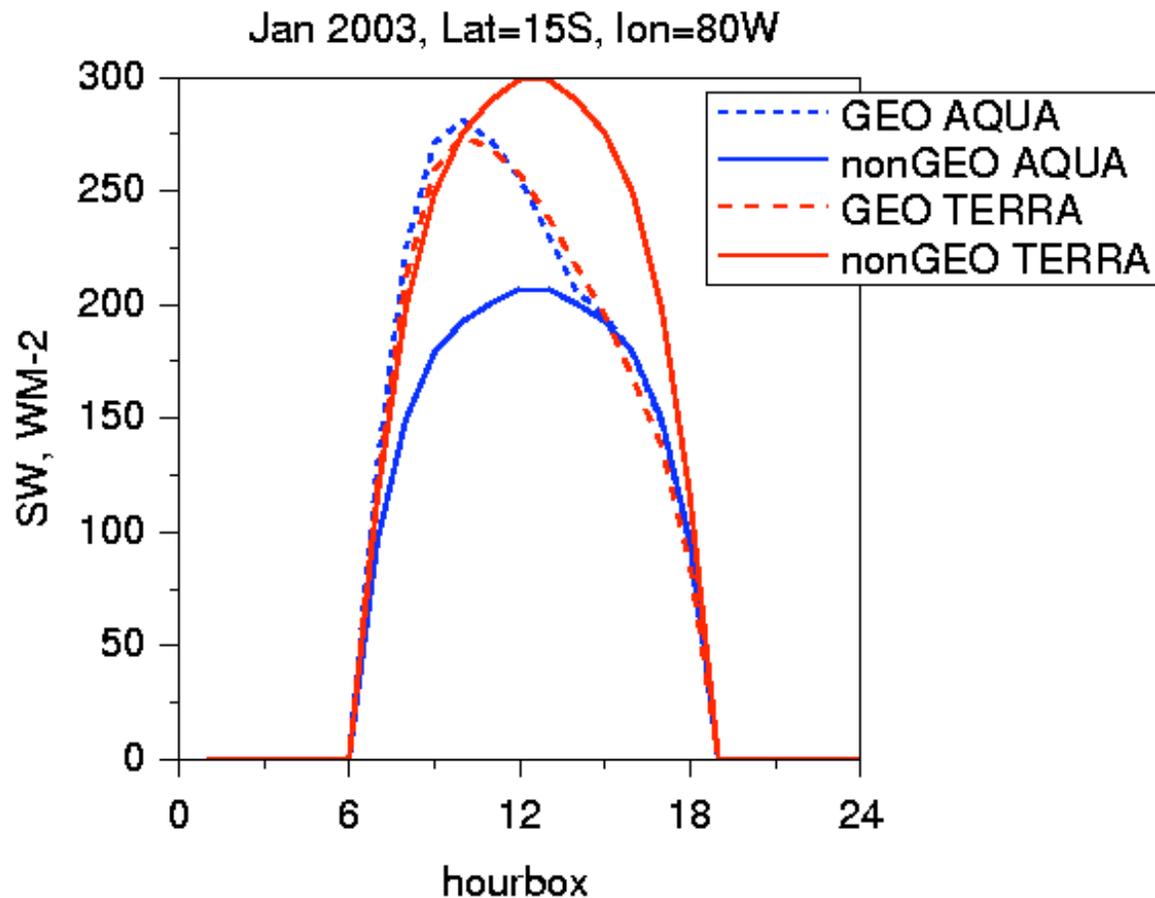
• Note the reduced RAPS-XTRK RMS of GEO compared with nonGEO

# Terra - Aqua Monthly Comparisons

- The flux difference represents the total interpolation error from the NB-BB, CERES instrument calibration, ADMs, and GEO/CERES normalization
- Aqua/Terra monthly mean flux consistency tested
- GEO product regional monthly mean difference should be smaller than nonGEO, since it accounts for the diurnal cycle
  - Compare the regional differences
  - Compare the global means
- CERES instrument calibration differences effect the Terra-Aqua global mean biases



# Terra - Aqua SW Peruvian Stratus, Jan 2003



- The Terra - Aqua GEO product difference is minimal

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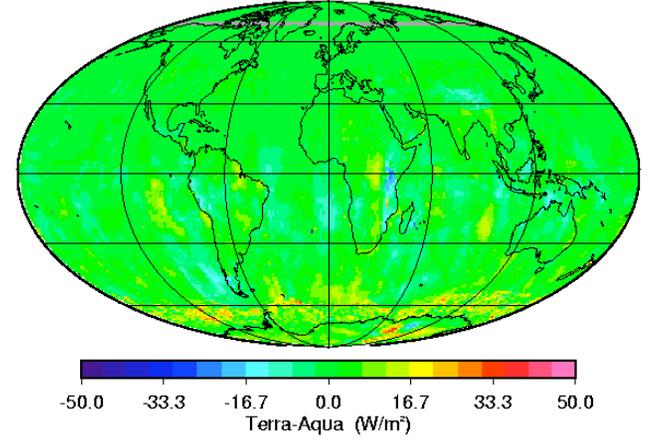
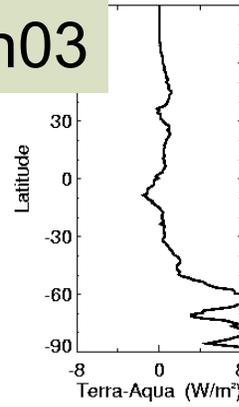
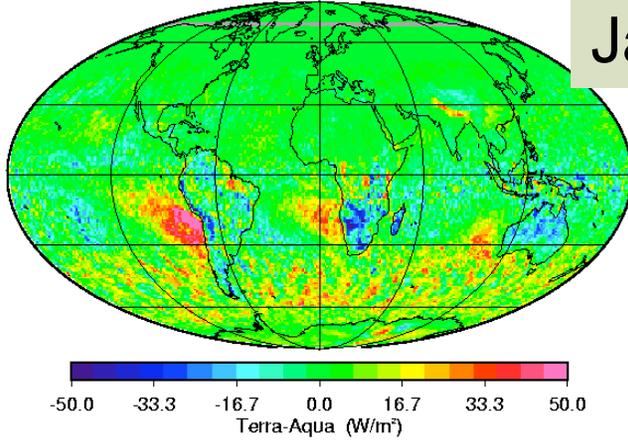
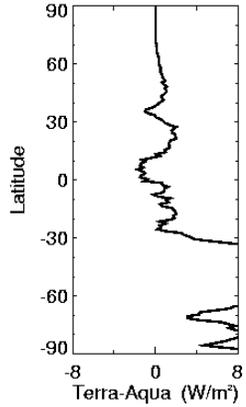


# Terra - Aqua SW

nonGEO

GEO

Jan03



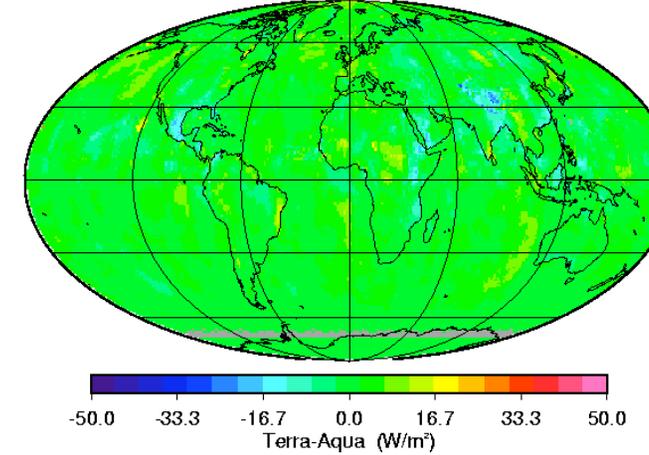
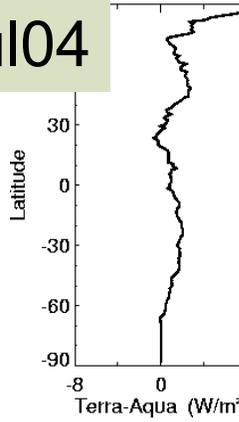
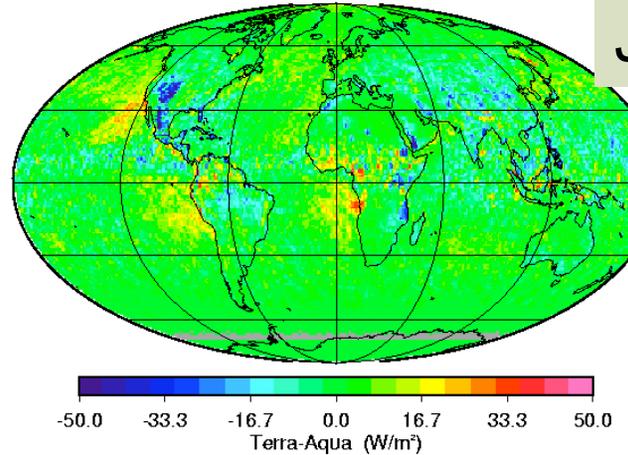
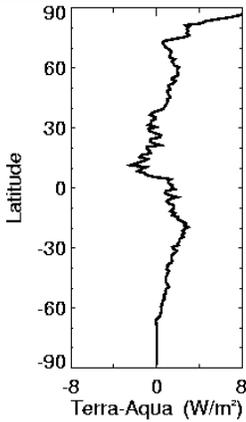
	Terra	Aqua	Terra-Aqua	reg RMS	reg BIAS
Global	103.60	101.09	2.52	10.71	2.37
				reg SIGMA	
				10.45	

Terra=CER\_SRBAVG1\_Terra-FM1-MODIS\_Edition2D\_015026.200301  
Aqua=CER\_SRBAVG1\_Aqua-FM3-MODIS\_Beta6\_016029.200301

	Terra	Aqua	Terra-Aqua	reg RMS	reg BIAS
Global	104.12	103.07	1.05	4.10	0.68
				reg SIGMA	
				4.05	

Terra=CER\_SRBAVG1\_Terra-FM1-MODIS\_Edition2D\_015026.200301  
Aqua=CER\_SRBAVG1\_Aqua-FM3-MODIS\_Beta6\_016029.200301

Jul04



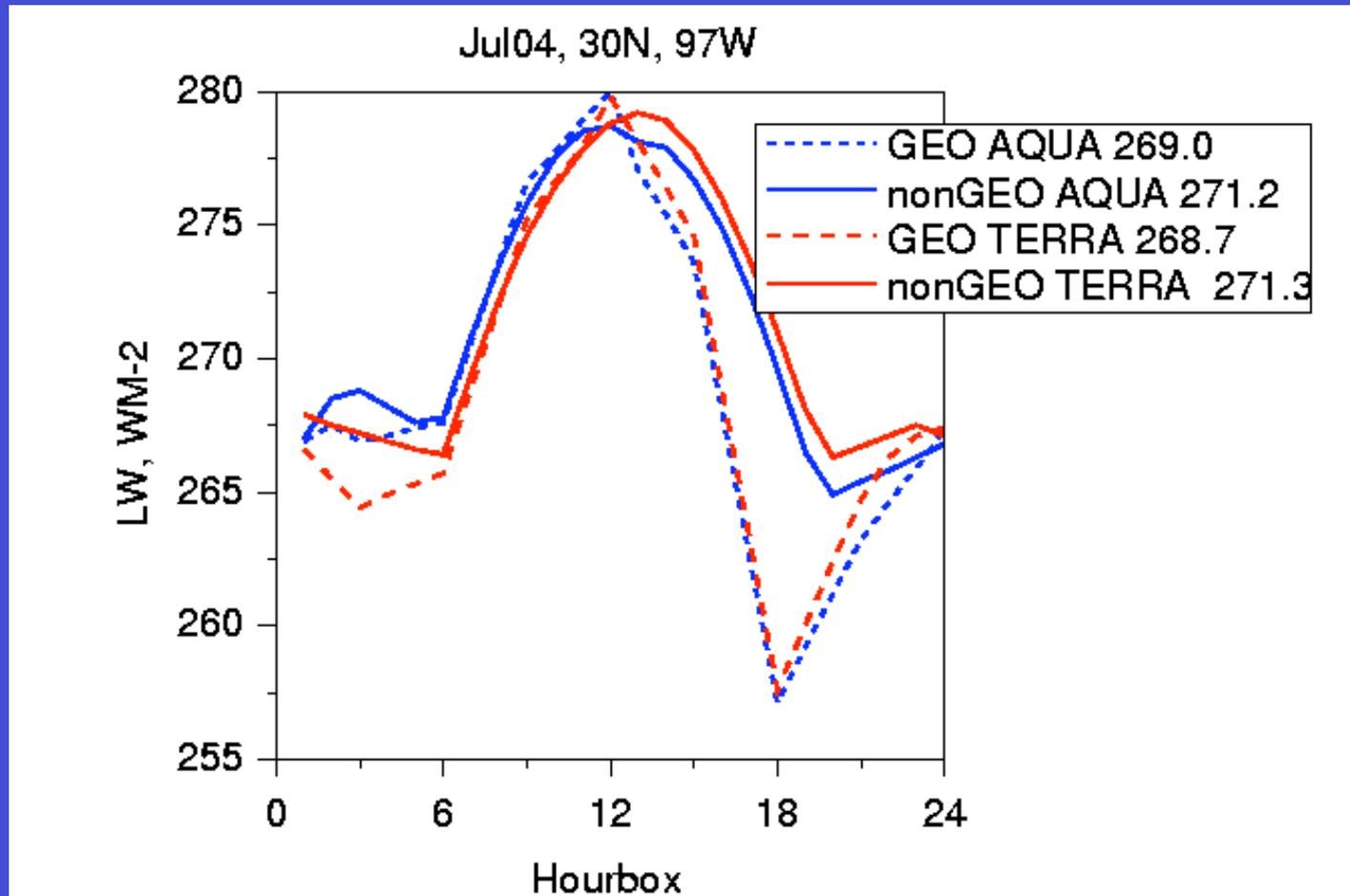
	Terra	Aqua	Terra-Aqua	reg RMS	reg BIAS
Global	90.39	89.58	0.81	7.85	0.76
				reg SIGMA	
				7.81	

Terra=CER\_SRBAVG1\_Terra-FM1-MODIS\_Edition2D\_016028.200407  
Aqua=CER\_SRBAVG1\_Aqua-FM4-MODIS\_Beta6\_016029.200407

	Terra	Aqua	Terra-Aqua	reg RMS	reg BIAS
Global	91.53	90.32	1.21	3.84	1.22
				reg SIGMA	
				3.64	

Terra=CER\_SRBAVG1\_Terra-FM1-MODIS\_Edition2D\_016028.200407  
Aqua=CER\_SRBAVG1\_Aqua-FM4-MODIS\_Beta6\_016029.200407

# Terra - Aqua LW Texas, July 2004



- The Terra-Aqua product differences are minimal
- The nonGEO - GEO monthly mean difference is only 2.5 Wm-2



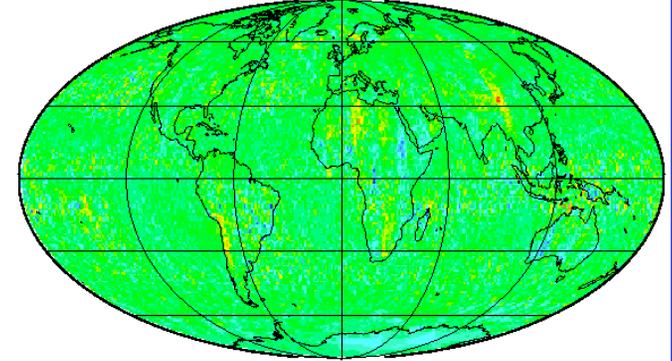
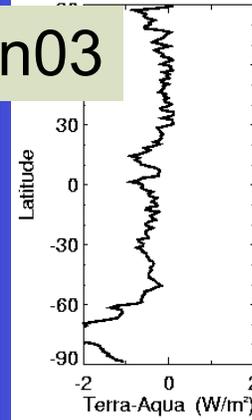
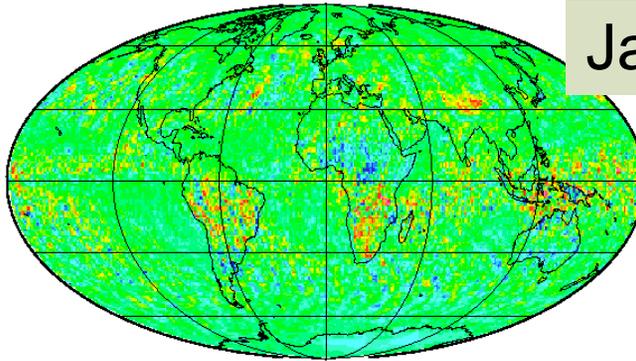
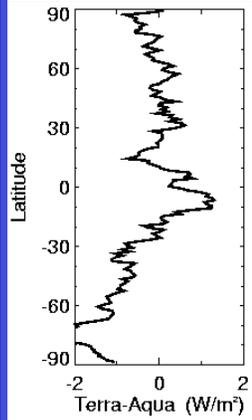
# Terra - Aqua LW

nonGEO

GEO

Jan03

Jul04

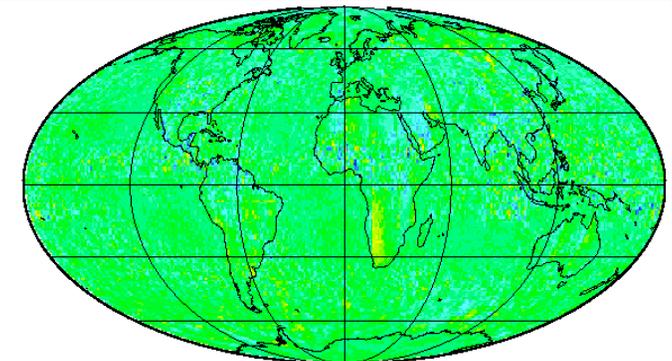
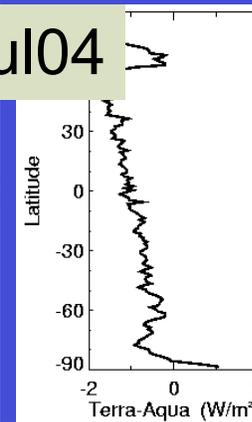
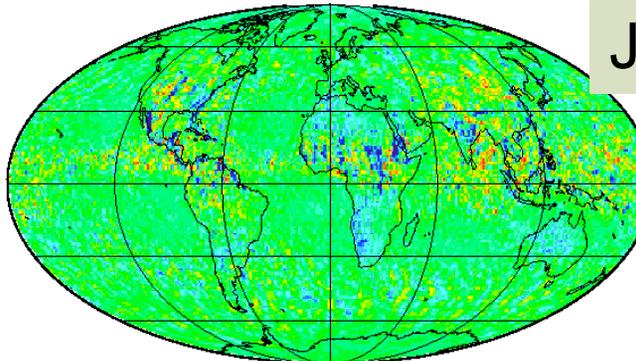
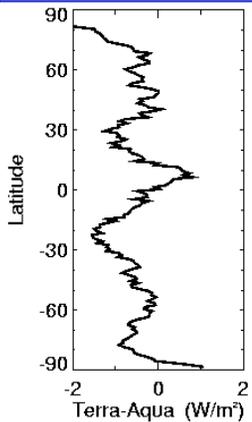


Terra	Aqua	Terra-Aqua	reg	RMS	reg BIAS
Global 235.33	235.46	-0.14		2.94	-0.03
			reg	SIGMA	
				2.94	

Terra=CER\_SRBVAVG1\_Terra-FM1-MODIS\_Edition2D\_015026.200301  
Aqua=CER\_SRBVAVG1\_Aqua-FM3-MODIS\_Beta6\_016029.200301

Terra	Aqua	Terra-Aqua	reg	RMS	reg BIAS
Global 234.73	235.17	-0.43		1.77	-0.37
			reg	SIGMA	
				1.73	

Terra=CER\_SRBVAVG1\_Terra-FM1-MODIS\_Edition2D\_015026.200301  
Aqua=CER\_SRBVAVG1\_Aqua-FM3-MODIS\_Beta6\_016029.200301



Terra	Aqua	Terra-Aqua	reg	RMS	reg BIAS
Global 241.38	241.94	-0.56		2.98	-0.55
			reg	SIGMA	
				2.93	

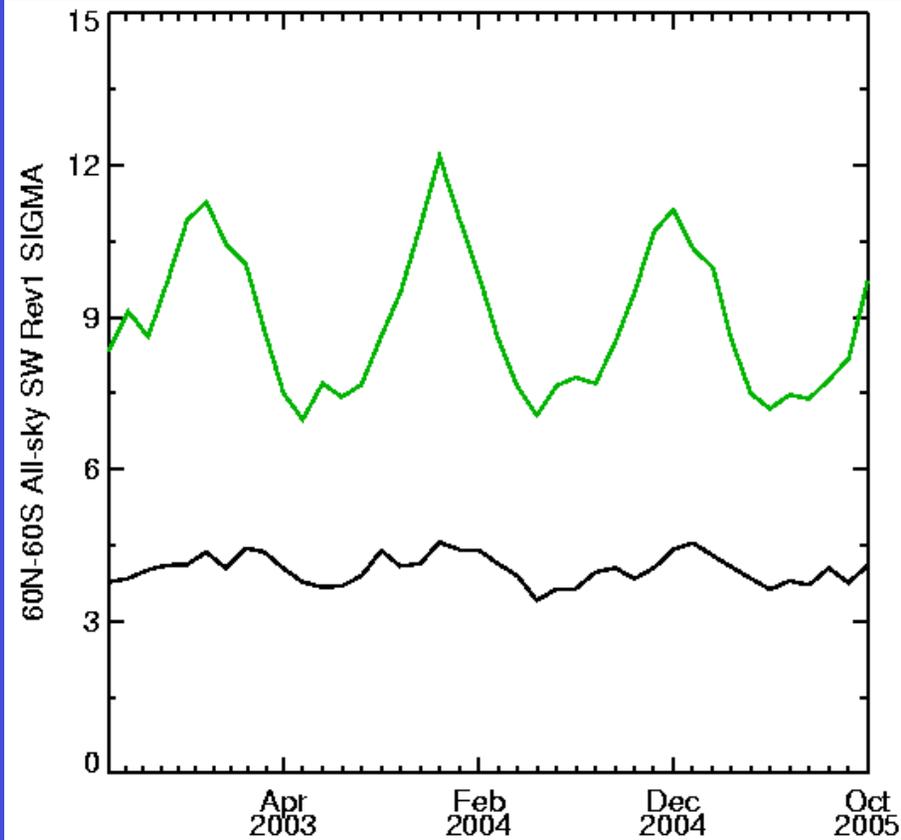
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Aqua=CER\_SRBVAVG1\_Aqua-FM4-MODIS\_Beta6\_016029.200407

Terra	Aqua	Terra-Aqua	reg	RMS	reg BIAS
Global 240.83	241.83	-1.00		1.96	-1.04
			reg	SIGMA	
				1.67	

Terra=CER\_SRBVAVG1\_Terra-FM1-MODIS\_Edition2D\_016028.200407  
Aqua=CER\_SRBVAVG1\_Aqua-FM4-MODIS\_Beta6\_016029.200407

# Terra FM1 - Aqua 60°N-60°S regional sigma

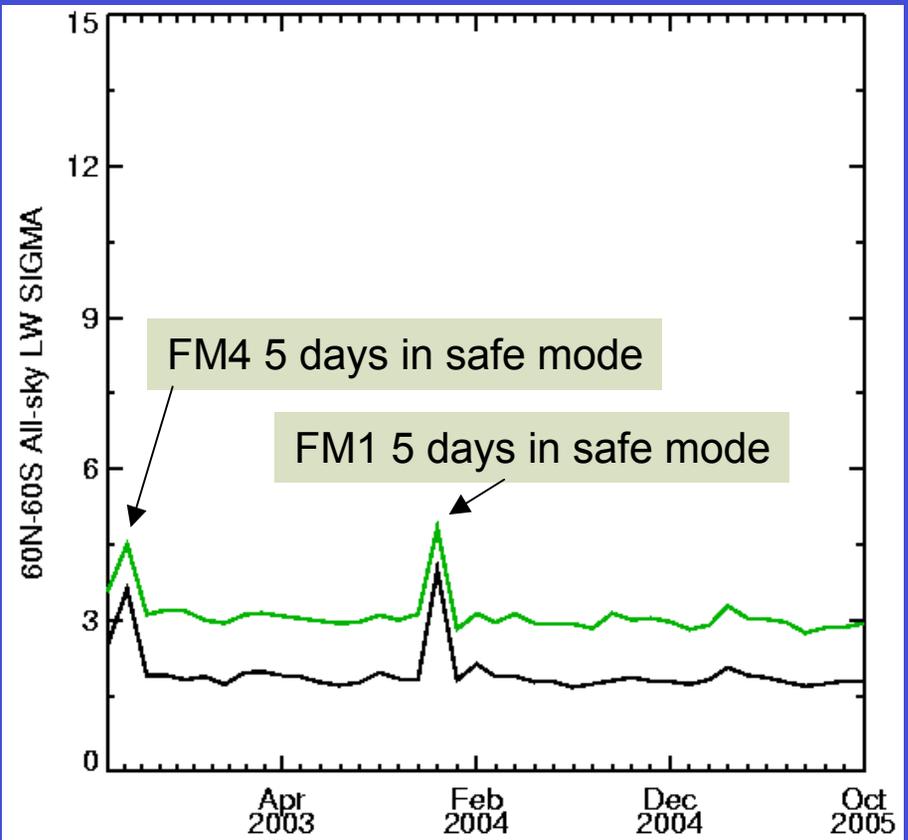
SW



ALL-SKY SW Rev1 SIGMA Avg **55% reduction**

nonGEO	—	8.9
GEO	—	4.0

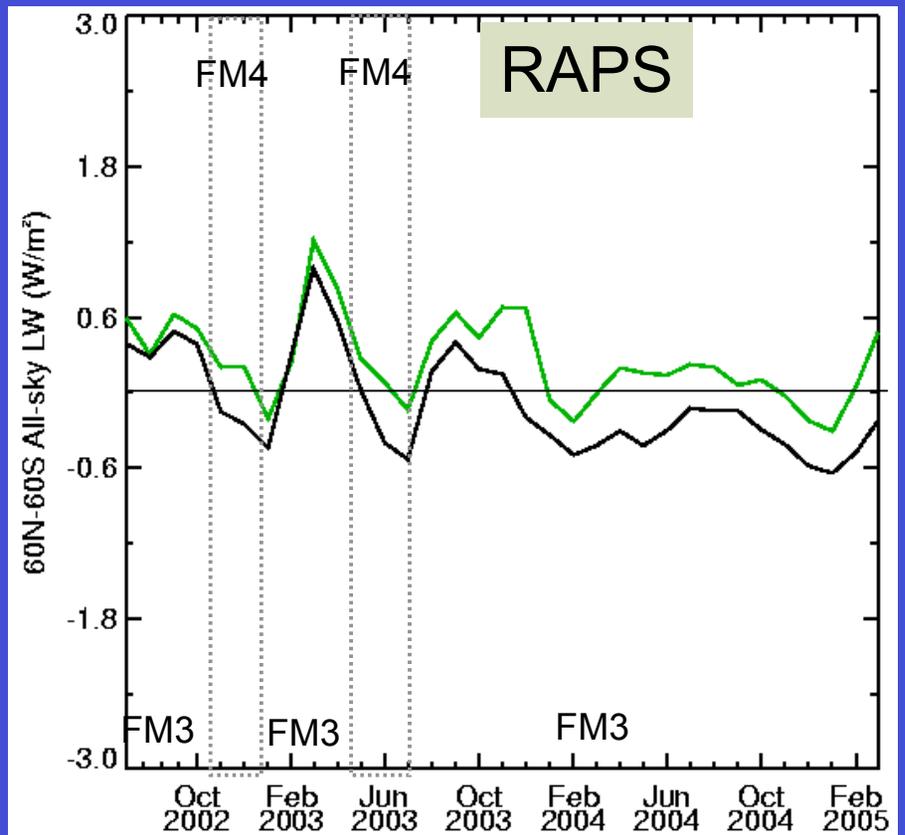
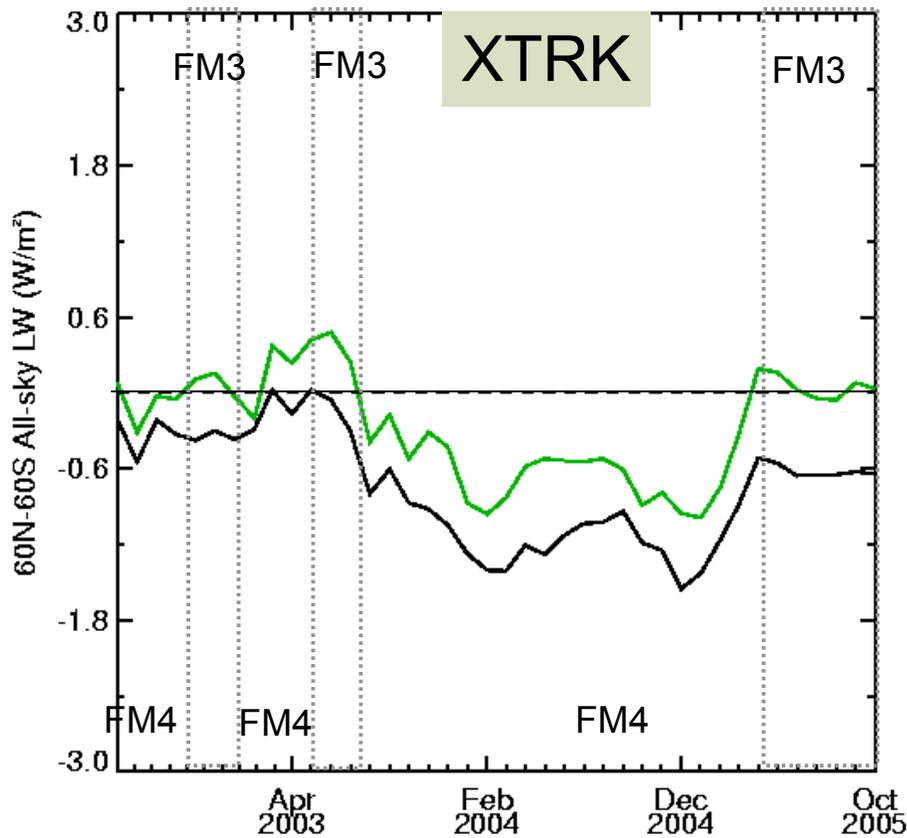
LW



ALL-SKY LW SIGMA A **35% reduction**

nonGEO	—	3.1
GEO	—	2.0

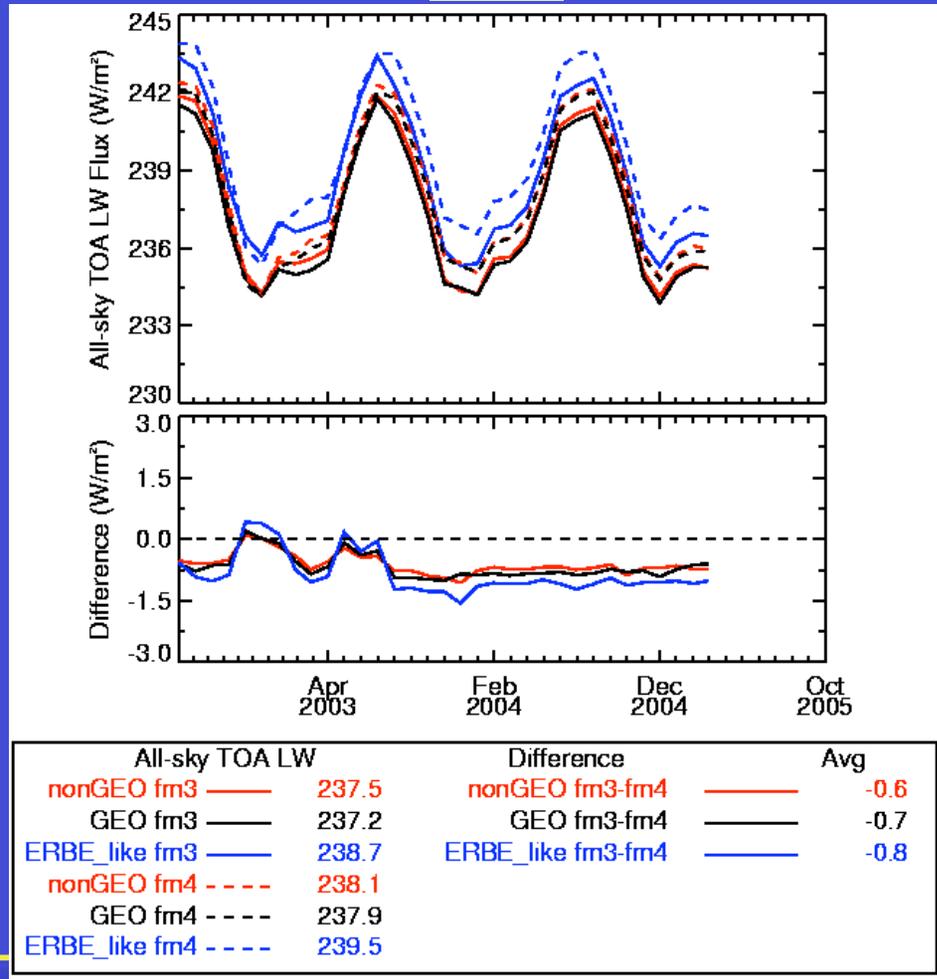
# Terra FM1 - Aqua 60°N-60°S LW bias



- Calibration differences between FM3 and FM4 effect the bias,
- nonGEO > GEO, since neither CERES satellite captures the land 18 LT convection

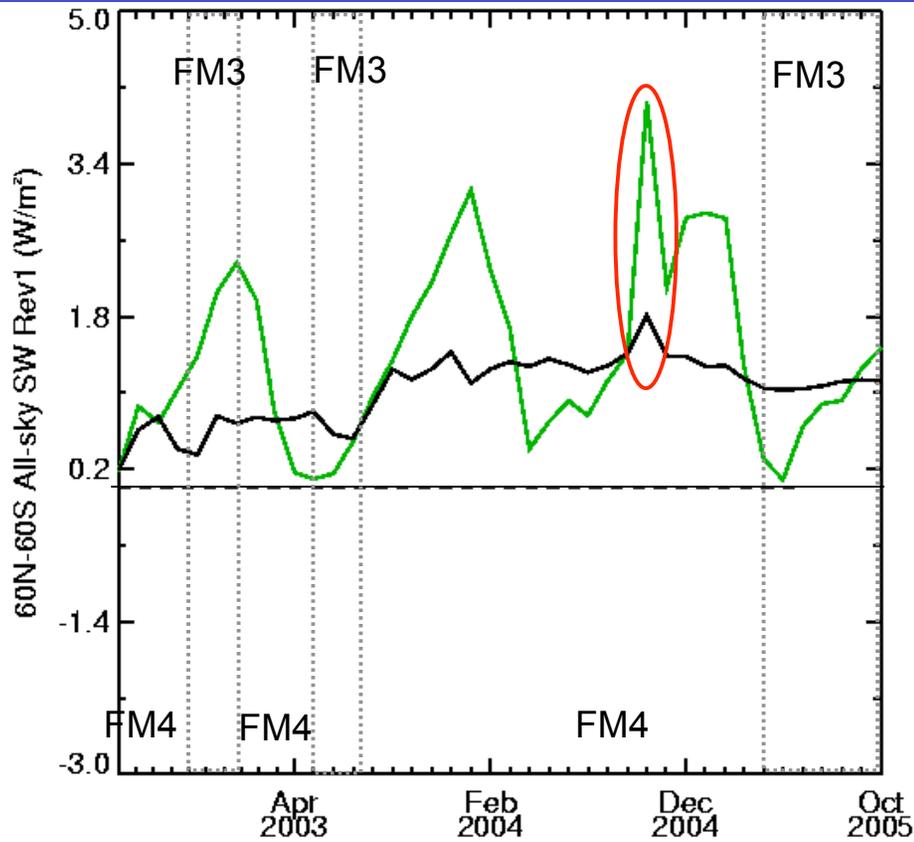
# FM3 - FM4 global means

LW



# Terra FM1 - Aqua 60°N-60°S SW bias

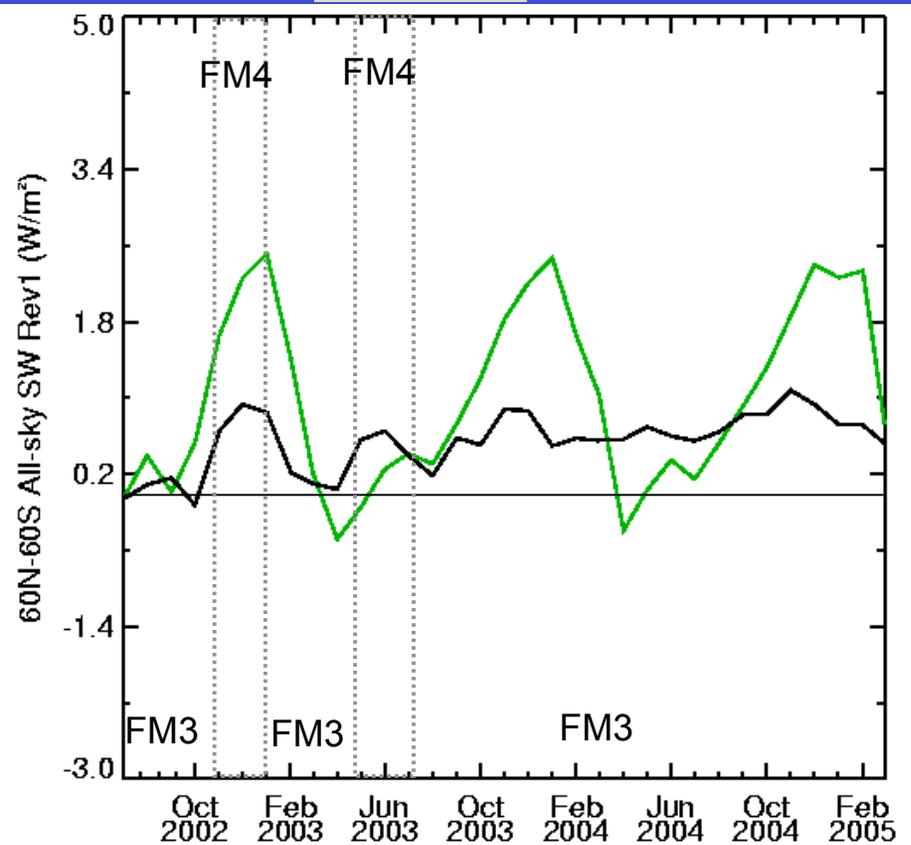
XTRK



ALL-SKY SW Rev1 BIAS 30% reduction

nonGEO 1.4  
GEO 1.0

RAPS

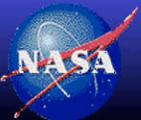
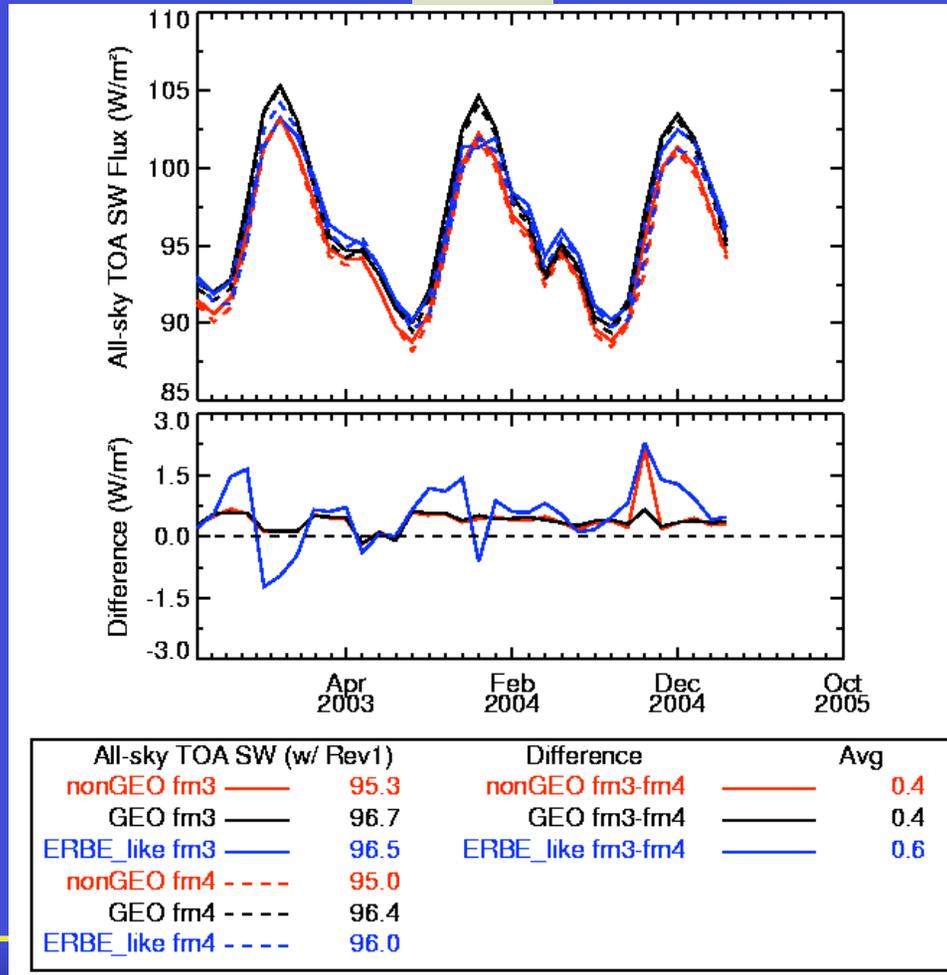


ALL-SKY SW Rev1 BIAS 50% reduction

nonGEO 1.0  
GEO 0.5

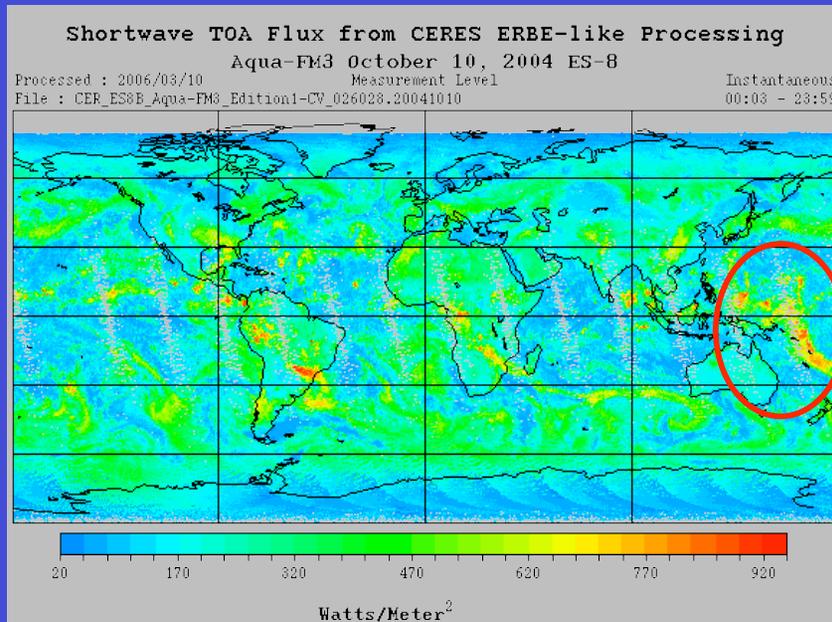
# FM3 - FM4 global means

SW

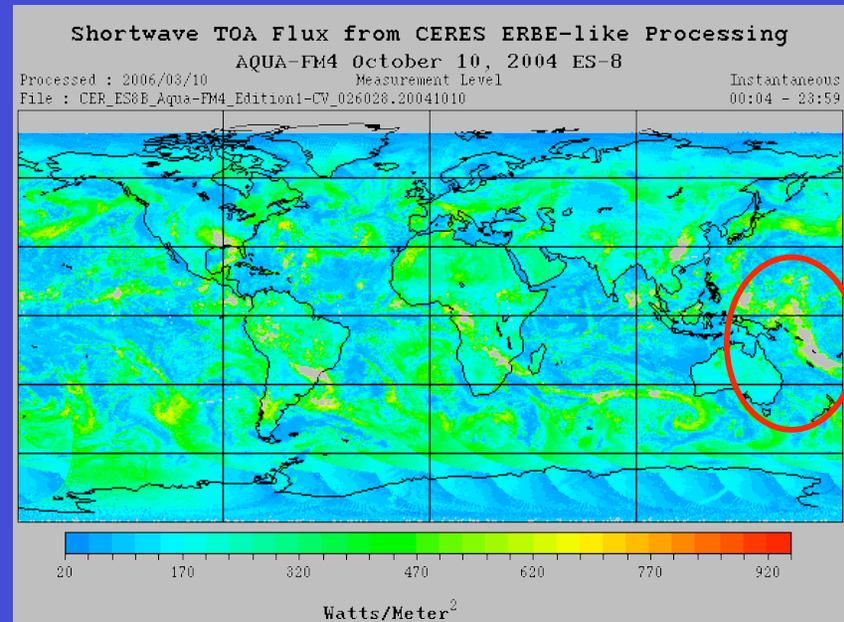


# Aqua ES8 footprint SW flux Oct 10, 2004

## FM3



## FM4



- FM4 Total and SW channels saturated between Oct 1-12, 2004
- FM4 SW flux missing in deep convective regions
- FM4 monthly global mean SW flux was underestimated by 1.5 Wm<sup>-2</sup> and the tropical by 3.0 Wm<sup>-2</sup>
- GEO/CERES SW normalization did not underestimate the FM4 flux



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## TOA global 3-year flux means

Jul02-Jun05	ERBE-like		nonGEO		GEO	
(Wm-2)	Terra	Aqua	Terra	Aqua	Terra	Aqua
OLRtot	239.0	239.6	237.7	238.1	237.2	237.9
SWtot	97.9	96.0	96.6	95.1	97.6	96.4
NETtot	4.4	5.7	7.1	8.2	6.6	7.0
OLRcs	266.5	267.8	266.6	267.3	264.3	265.5
SWcs	49.1	49.6	51.1	49.4	51.0	49.3
NETcs	25.7	24.0	23.3	24.5	26.1	25.3
OLRcf	27.5	28.2	28.9	29.2	27.2	27.6
SWcf	-48.8	-46.6	-45.5	-45.7	-46.6	-47.1
NETcf	-21.3	-18.2	-16.6	-16.5	-19.4	-19.4

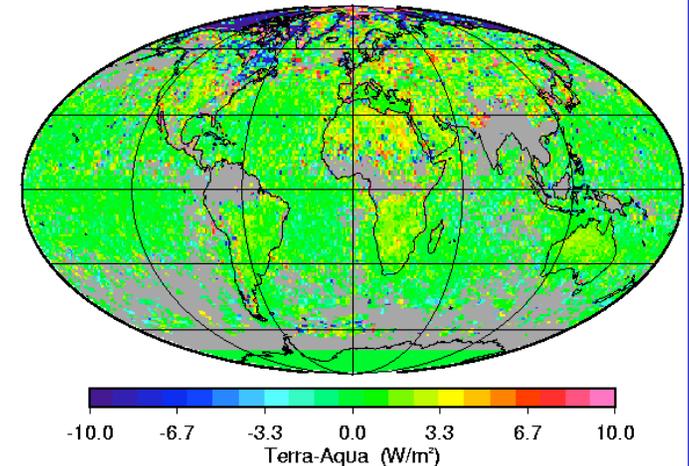
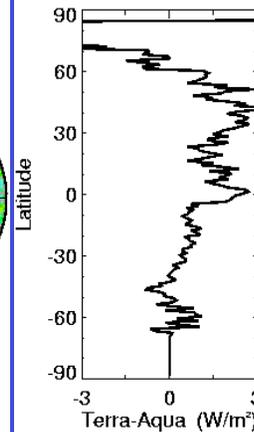
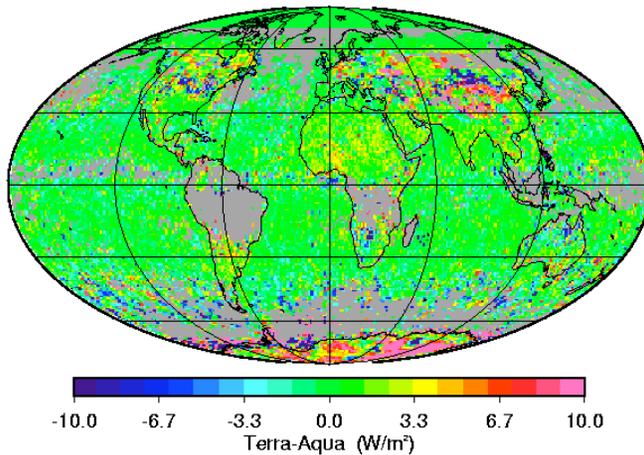
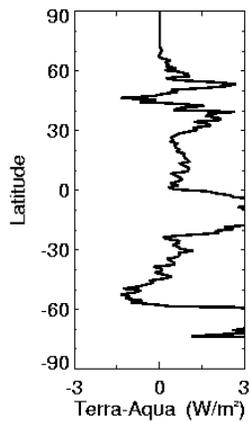
• XTRK comparison FM1, FM4 / Atmospheric Sciences



# Terra-Aqua nonGEO SW clear-sky

Jan03

Jul04



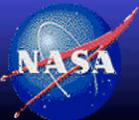
	Terra	Aqua	Terra-Aqua	reg RMS	reg BIAS
Global	53.13	51.41	1.72	4.39	0.40
				reg SIGMA	
				4.37	

Terra=CER\_SRBAVG1\_Terra-FM1-MODIS\_Edition2D\_015026.200301  
Aqua=CER\_SRBAVG1\_Aqua-FM3-MODIS\_Beta6\_016029.200301

	Terra	Aqua	Terra-Aqua	reg RMS	reg BIAS
Global	46.97	46.05	0.92	3.46	0.76
				reg SIGMA	
				3.38	

Terra=CER\_SRBAVG1\_Terra-FM1-MODIS\_Edition2D\_016028.200407  
Aqua=CER\_SRBAVG1\_Aqua-FM4-MODIS\_Beta6\_016029.200407

- Terra clear-sky is greater over land
- Snow regions have the greatest differences

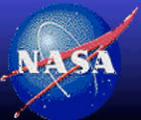


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# GERB Ed1/CERES Ed2 Validation

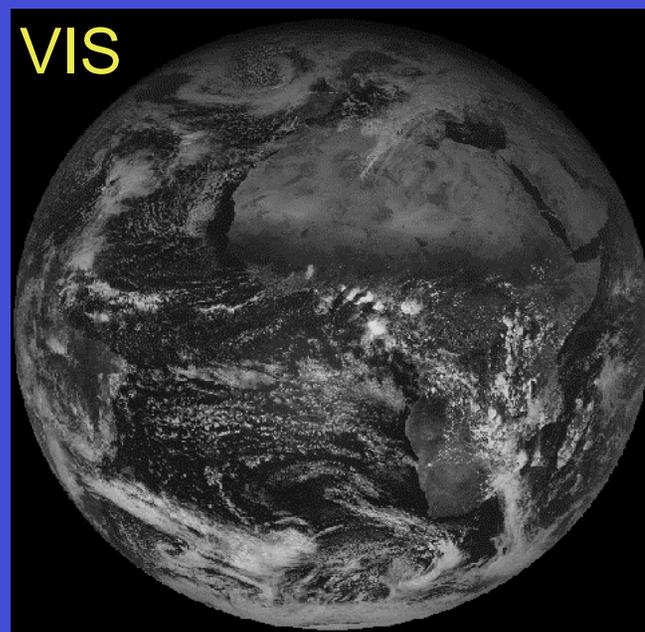
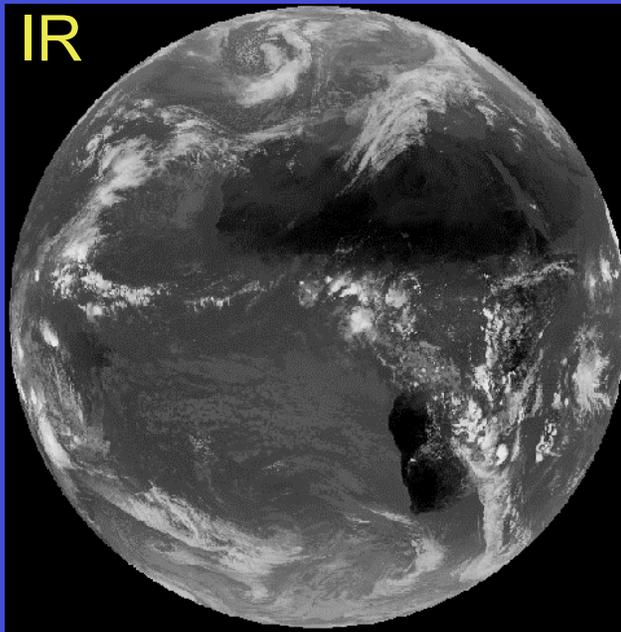
- GERB best independent high-resolution (15 min, 60km) data to test GEO diurnal interpolation accuracy
- GERB has evolved from version 998 to Edition1
  - Navigation improvement
  - Spectral correction applied
  - Processing 40 days behind real-time
  - Back processed to Dec 2005
- Compare GERB Ed1 and CERES FM3 Ed2 gridded fluxes within 7 minutes for December 2005
  - Are the flux biases similar to the GERB Quality statement?
  - Are the sigmas reasonable in order to normalize GERB to CERES?
- Future work: compare GEO fluxes with GERB



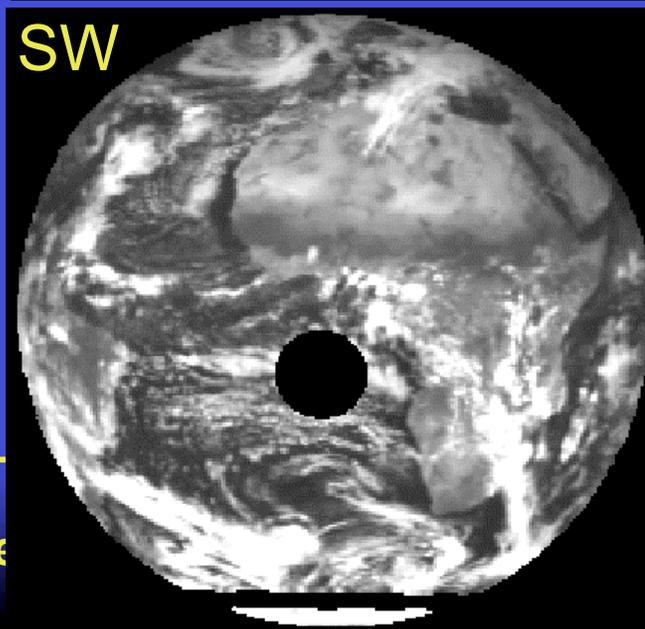
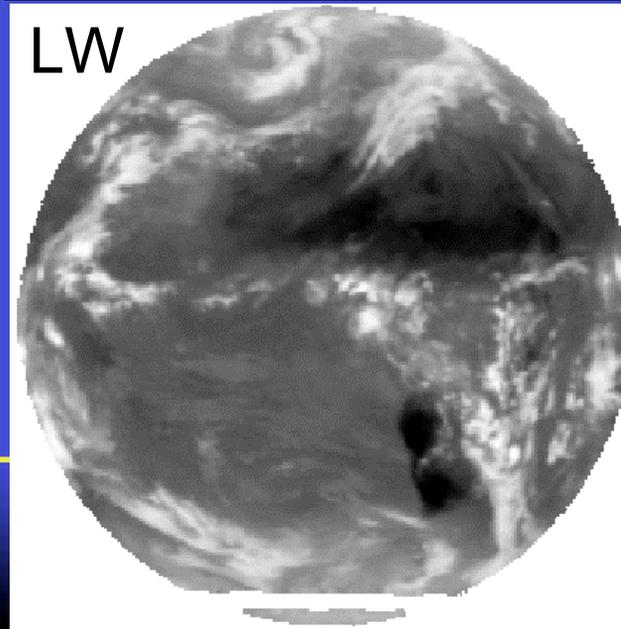
# GERB and MET8 comparison

Dec 01, 2006 12:00 GMT

MET8



GERB



ente



# GERB - CERES Ed2 version comparison

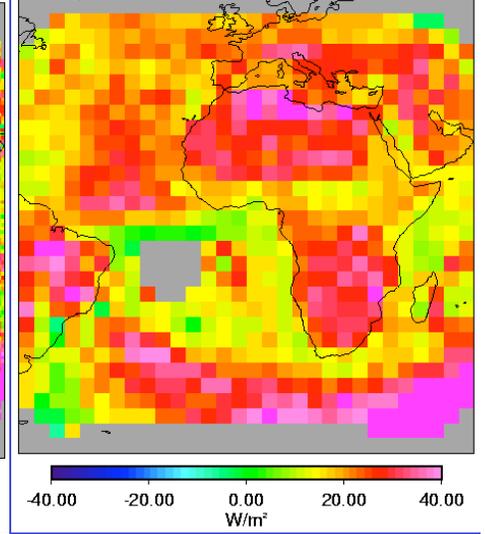
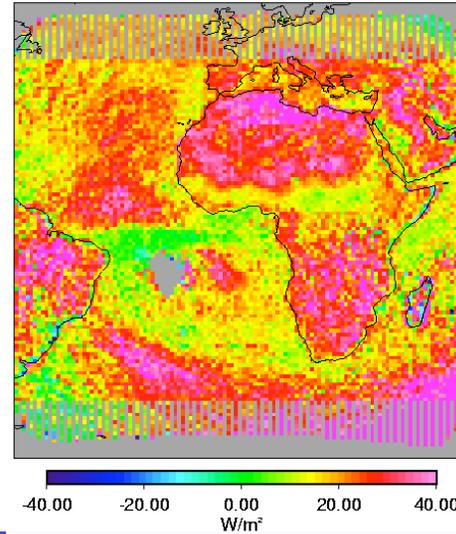
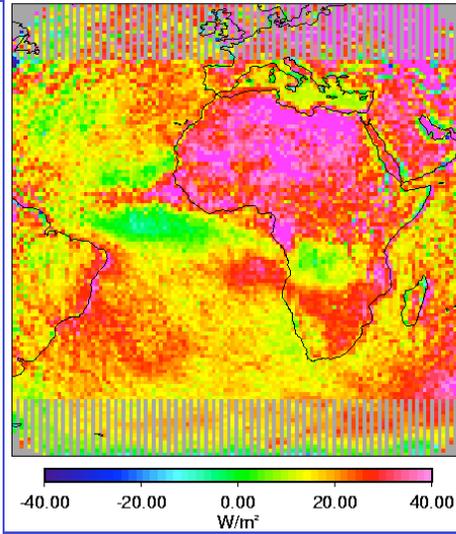
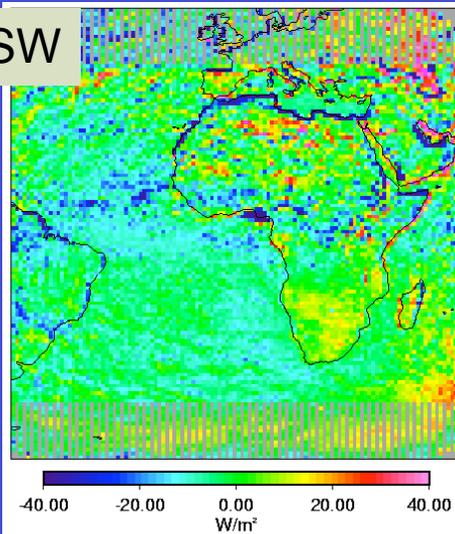
1x1Jul04 V2

1x1Jul04 V999

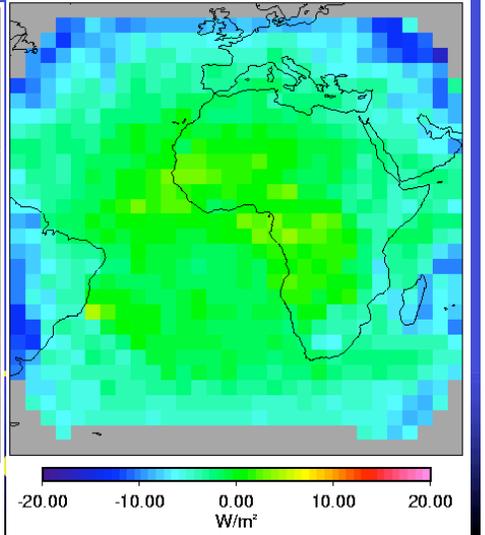
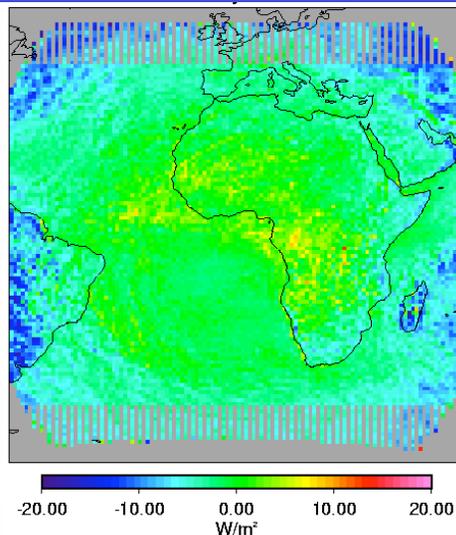
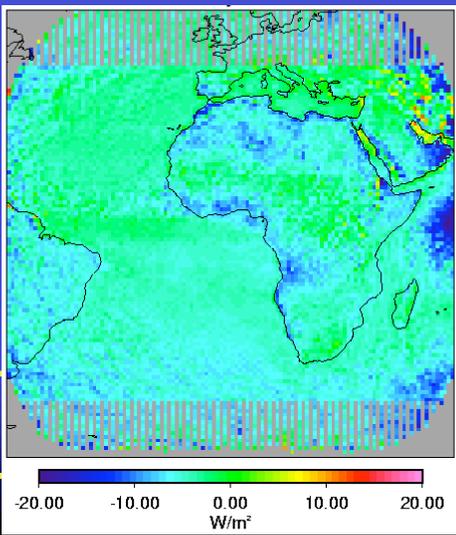
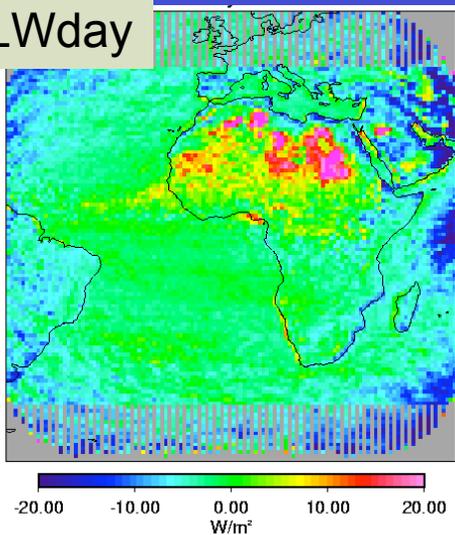
1x1Dec05 Ed1

4x4Dec05 Ed1

SW



LWday

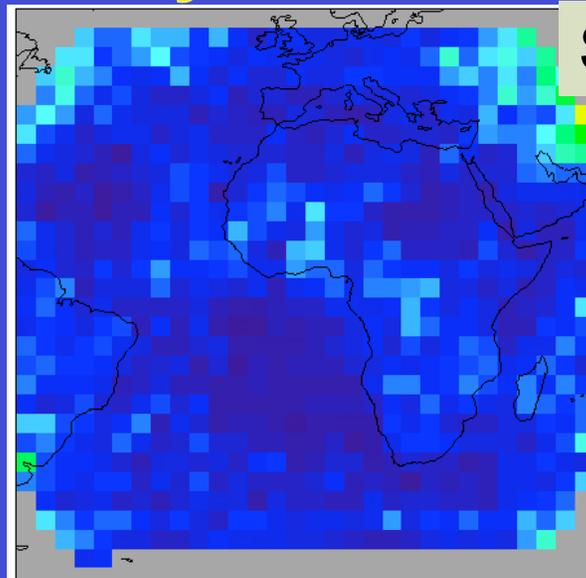
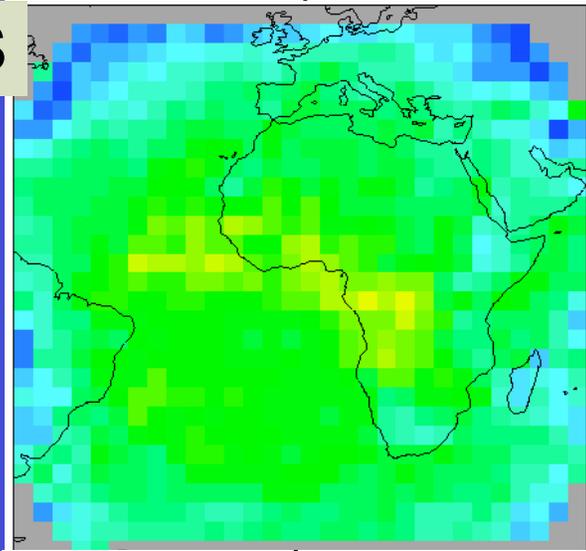


# GERB - CERES LW day flux bias

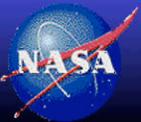
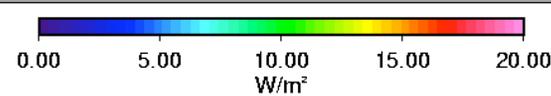
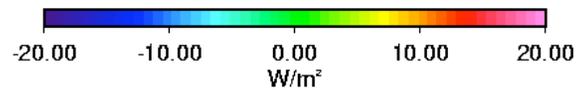
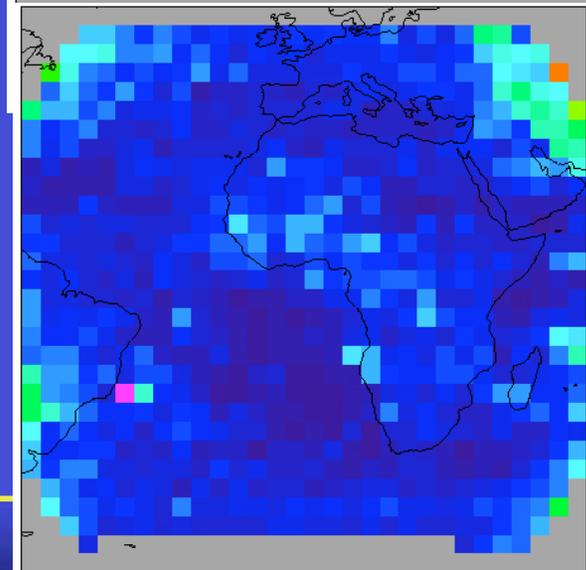
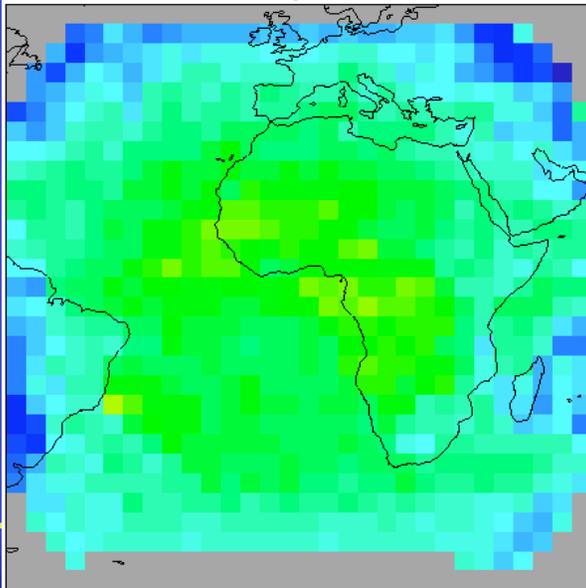
BIAS

SIGMA

Terra



Aqua

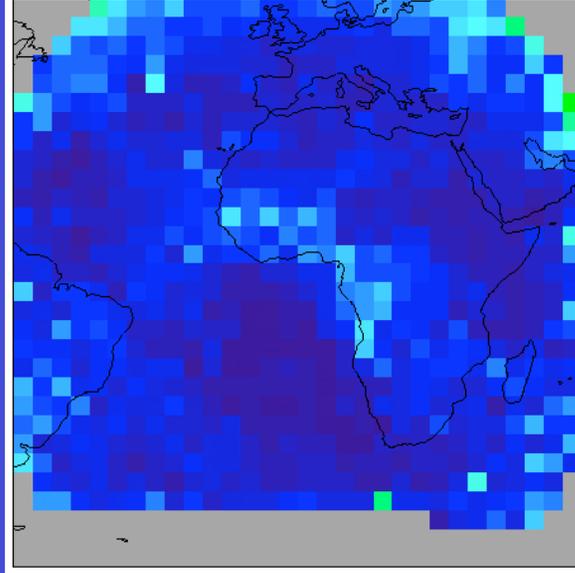
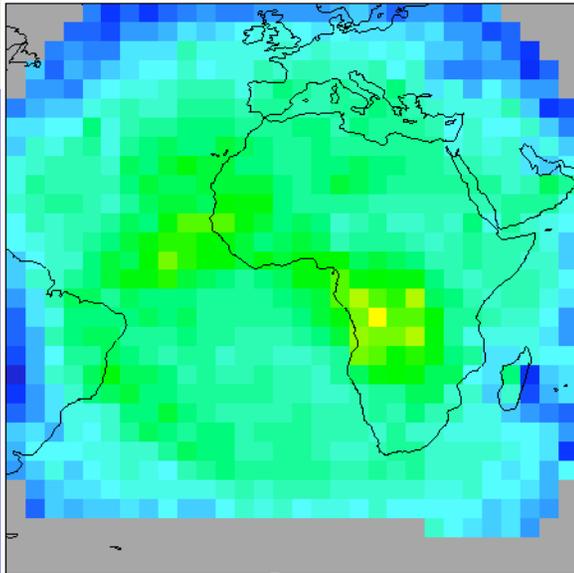


# GERB - CERES LW night flux bias

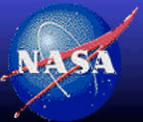
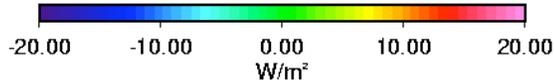
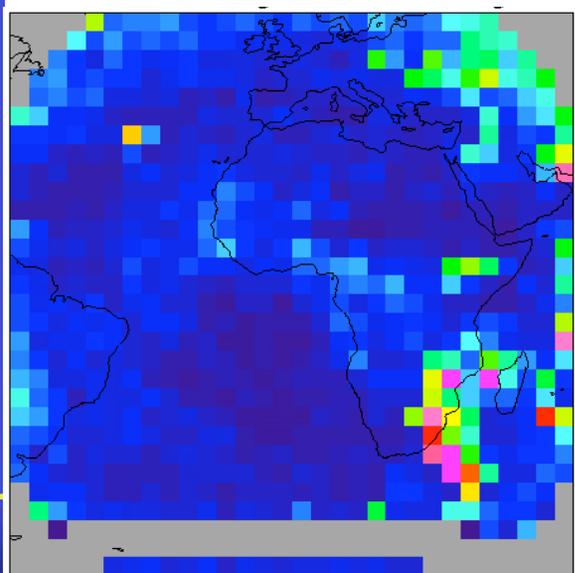
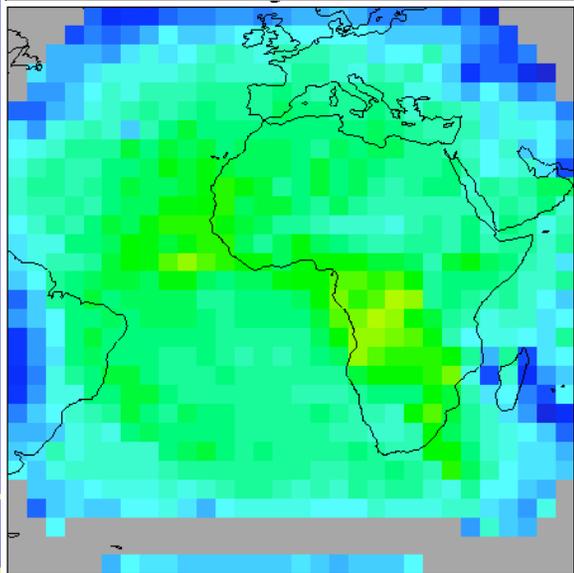
BIAS

SIGMA

Terra



Aqua

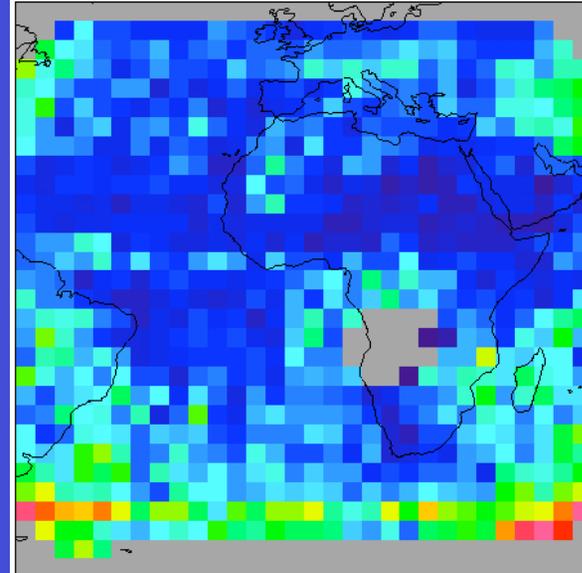
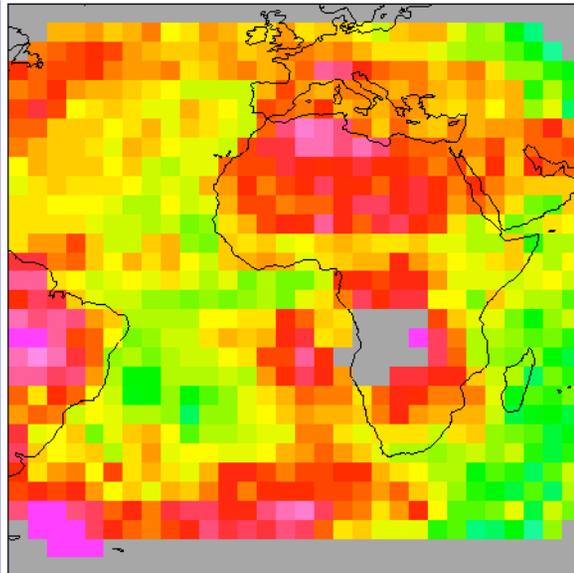


# GERB - CERES SW bias

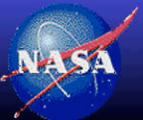
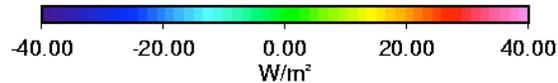
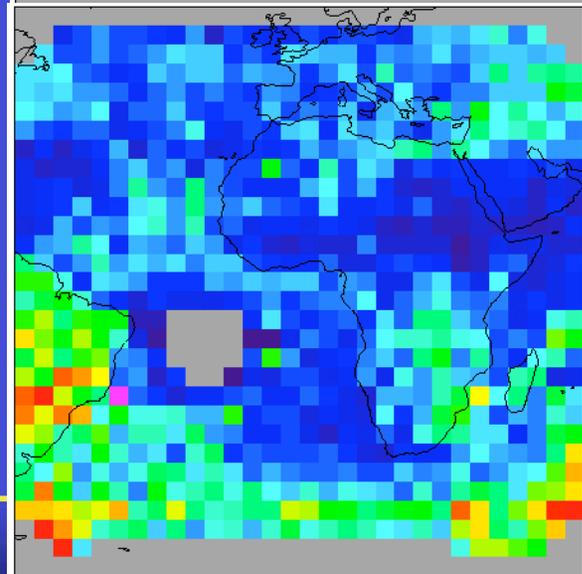
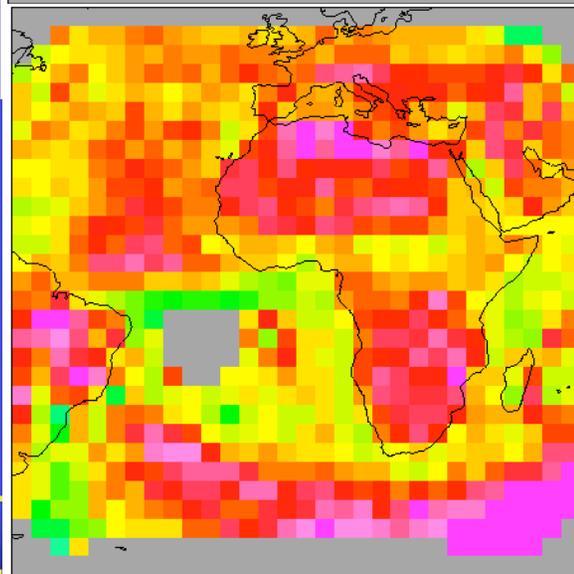
BIAS

SIGMA

Terra



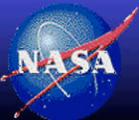
Aqua



## Comparison of GERB-CERES fluxes

(%)	GERB – TERRA		GERB – AQUA	
	Dec05 FM1 TISA	Dec04 FM2 GERB	Dec05 FM3 TISA	Dec04 FM3 GERB
LW day	-0.8	-0.8	-1.3	-1.6
LW night	-1.8	-1.3	-1.7	-1.9
SW	6.0	5.9	8.1	7.9

- Dec05 and GERB Quality Summary results are similar



## Comparison of GERB-CERES fluxes

(%)	GERB – TERRA		GERB – AQUA	
	Dec05 FM1 TISA	Dec04 FM2 GERB	Dec05 FM3 TISA	Dec04 FM3 GERB
LW day	-0.8 1.3	-0.8	-1.3 1.2	-1.6
LW night	-1.8 1.4	-1.3	-1.7 1.2	-1.9
SW	6.0 4.3	5.9	8.1 4.8	7.9

### Regional sigma (%)

- CERES/GEO SW regional normalization 8-12%



## Future Validation Efforts

- Comparison of GEO BB fluxes with SARB
  - Compare observed CERES fluxes and SARB un-tuned fluxes from MODIS cloud properties as a baseline
  - Compare GEO derived broadband fluxes and SARB un-tuned fluxes from GEO cloud properties at Terra overpasses
  - Errors due to both NB to BB and cloud property errors
- Terra-GEO CERES-TRMM flux comparisons
  - TRMM precesses all hours in 23 days, limited to March 2000 tropics
  - Diurnally compare coincident CERES-Terra and GGEO derived fluxes with TRMM
  - Compare nonGEO and GEO interpolated fluxes with TRMM
  - Determine difference of 1-hour and 3-hour CERES/GEO normalization
  - Test new LW narrowband to broadband and temporal interpolation techniques

