TISA (Time-Space Averaging) Update

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SSAI

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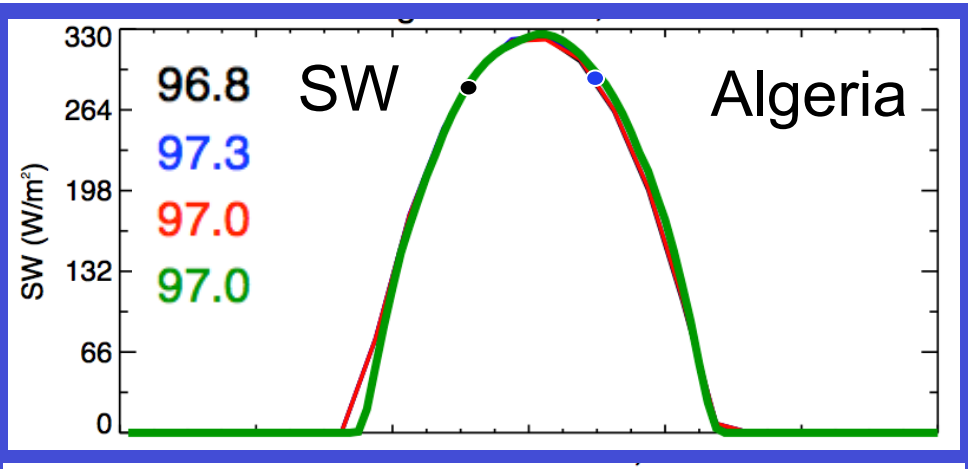
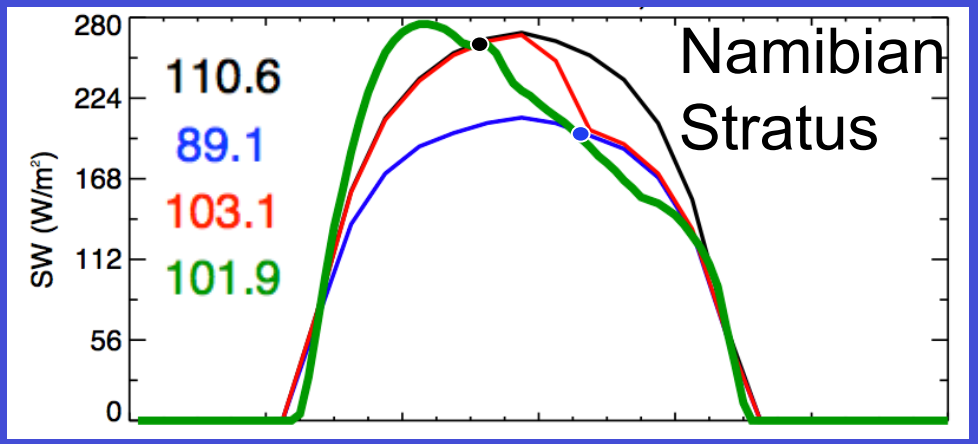
Outline

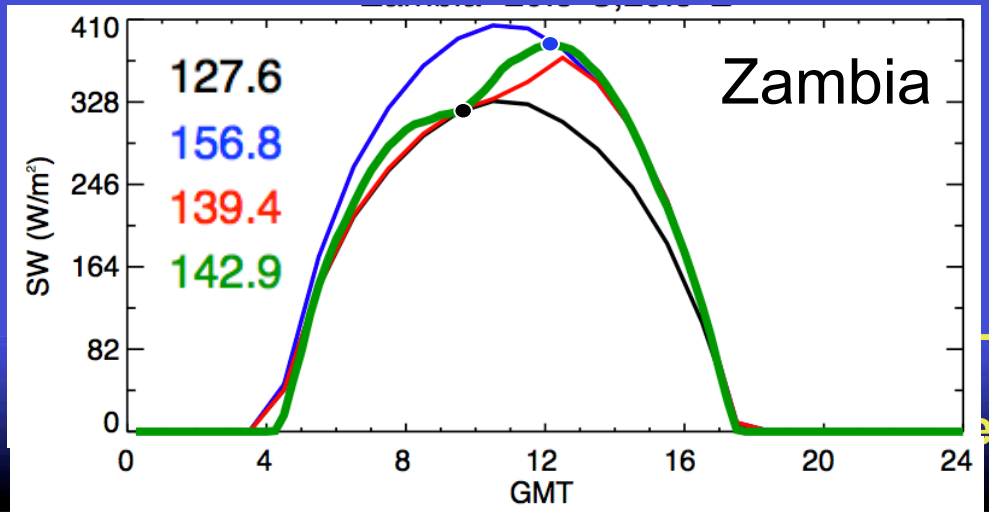
- CERES constant meteorology diurnal temporal averaging
  - SSF1deg, nonGEO, CERES-only or CO
- CERES enhanced geostationary diurnal temporal averaging
  - SYN1deg, GEO, CERES+GEO or CG
- LW NB to BB
- Introduction of 5-channel GEO cloud retrievals
- Ordering Tool

Introduction

- CERES provides level 3 daily/monthly 1° by 1° lat/lon regional/zonal/global observed broadband TOA fluxes and associated cloud/aerosol properties and in atmosphere and surface fluxes
  - CERES is onboard the Terra (10:30 AM local time), Aqua (1:30 PM), and NPP (1:30 PM) platforms
  - CERES needs to estimate the change in TOA fluxes between CERES measurements to derive daily fluxes
- ***CERES-only (CO or SSF1deg product) Method: constant meteorology*** between measurements (Similar to ERBE)
  - SW: assume clouds observed at measurement time are constant over the day and estimate the flux accounting only for changes in sun position
  - LW: over ocean, linear interpolate LW fluxes in time and over land assume a half-sine fit to estimate land heating



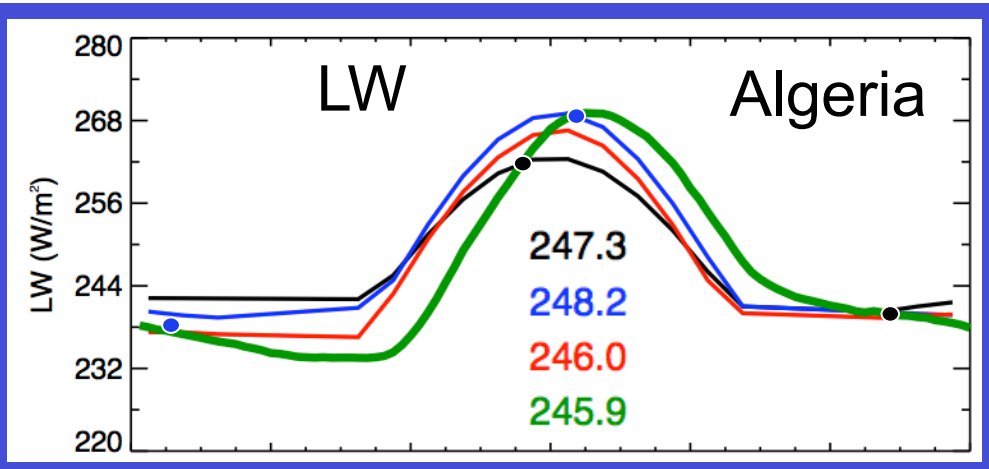


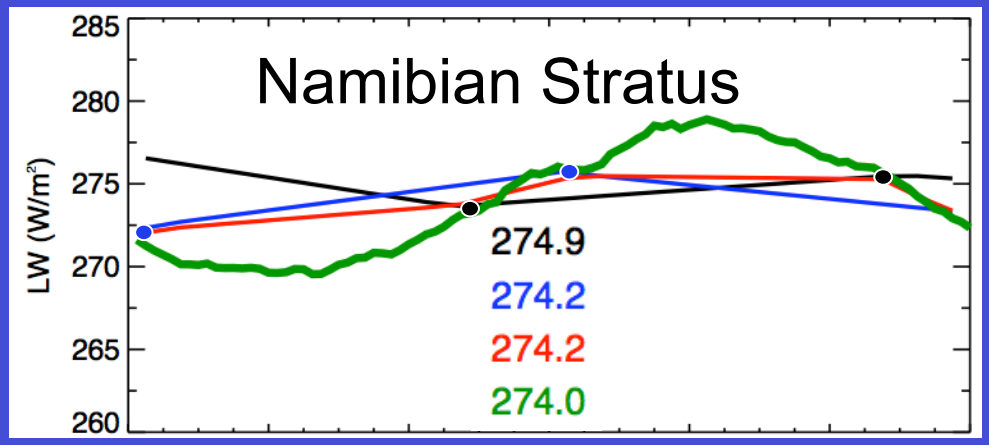


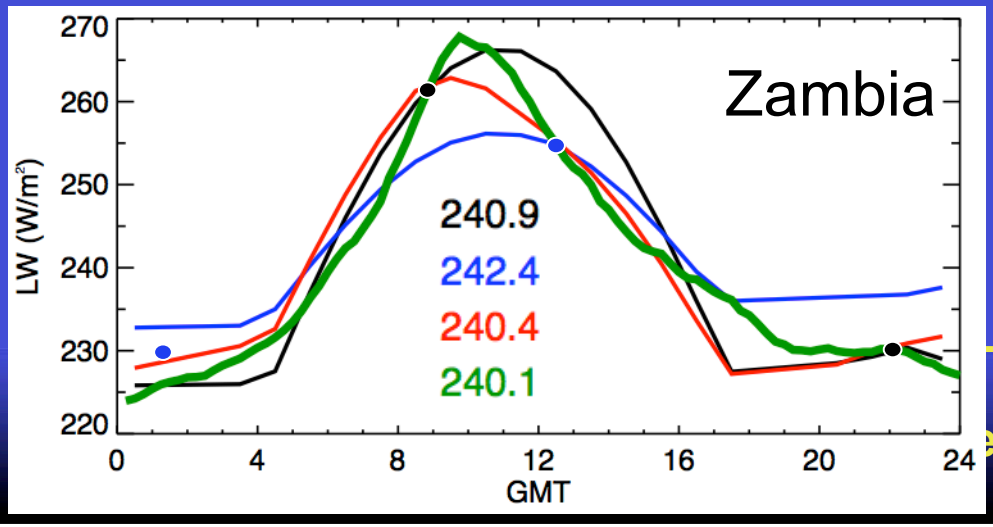
Regional monthly hourly and monthly TOA SW flux for January 2005 by satellite based on constant meteorology

Legend
Terra (10:30 AM)
Aqua (1:30 PM)
Terra+Aqua
GERB (truth)

- Clear-sky regions have predictable monthly mean SW flux
- The monthly mean SW flux in diurnally varying cloud regions will be a biased as function of satellite sampling time







Regional monthly hourly and monthly TOA LW flux for January 2005 by satellite based on constant meteorology

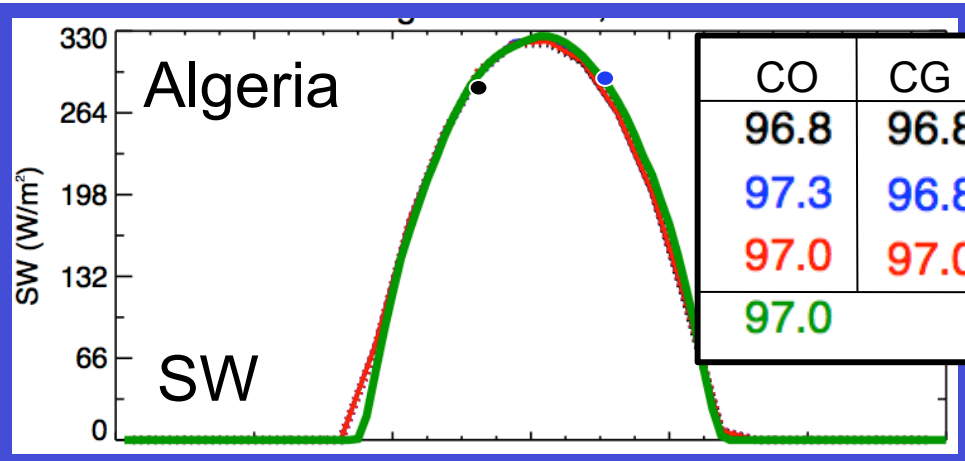
Legend
Terra (10:30 AM)
Aqua (1:30 PM)
Terra+Aqua
GERB (truth)

- GERB LW fluxes verify that land heating lags the solar cycle
- The monthly LW flux in diurnally varying cloud regions are close to the GERB monthly mean, however they do not reflect the true diurnal cycle

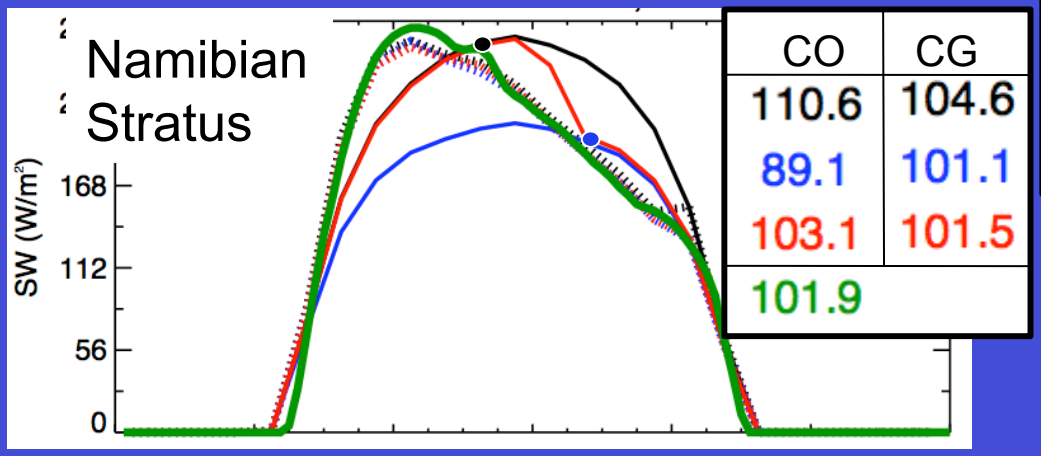
Can 3-hourly GEO data infer the flux in between CERES obs?

Method 2: GEO temporal interpolation (CG or SYN1deg product)

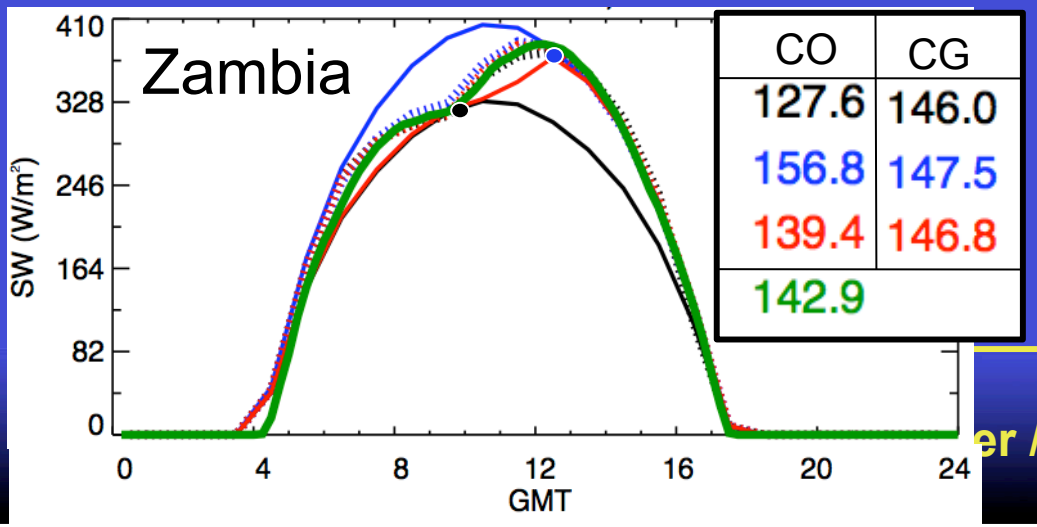
- Use 3-hourly 5-geostationary derived BB fluxes to estimate the diurnal flux signal in between CERES Terra (10:30AM) or Aqua (1:30PM) flux measurements to compute the daily mean fluxes
- GEO SW BB flux algorithm
  - Calibrate the GEO NB visible and IR radiances against MODIS and derive GEO cloud properties that are globally uniform
  - Convert GEO NB radiances to BB radiances using MODIS/ CERES empirical and theoretical models to account for GEO spectral response
  - Use the CERES ADMs, scene selection based on GEO cloud properties, to convert the GEO BB radiances into fluxes
  - Carefully normalize the GEO BB fluxes with coincident CERES observed fluxes to maintain the CERES instrument calibration
  - The 5x5 regional normalization removes GEO flux dependencies as a function of cloud amount, solar zenith angle, view angle, and region



CO	CG
96.8	96.8
97.3	96.8
97.0	97.0
97.0	



CO	CG
110.6	104.6
89.1	101.1
103.1	101.5
101.9	

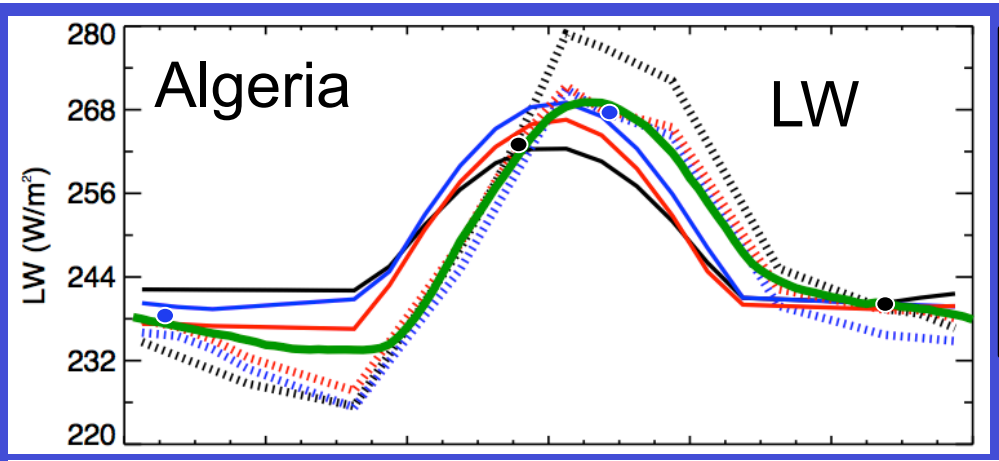


CO	CG
127.6	146.0
156.8	147.5
139.4	146.8
142.9	

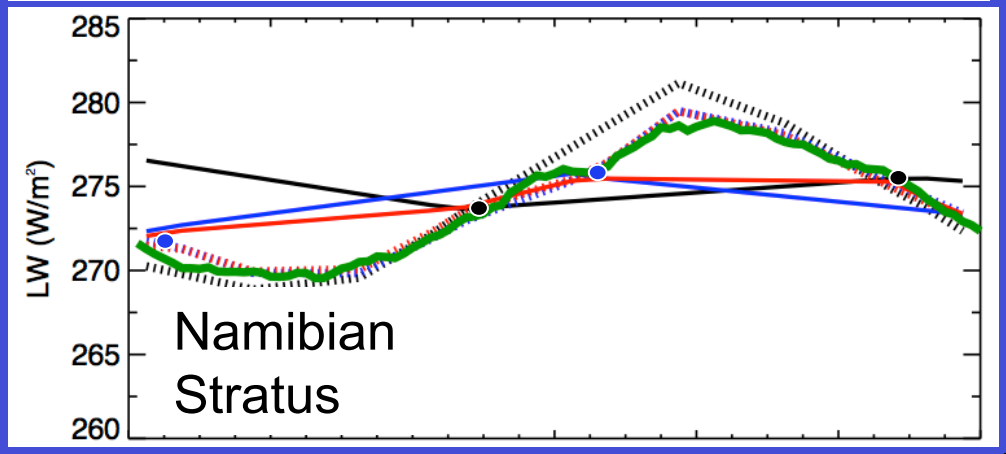
Regional monthly hourly and monthly TOA SW flux for January 2005 by satellite

Legend	
Terra (10:30 AM)	CO solid lines (Ceres-Only)
Aqua (1:30 PM)	
Terra+Aqua	CG dotted lines (Ceres&Geo)
GERB (truth)	

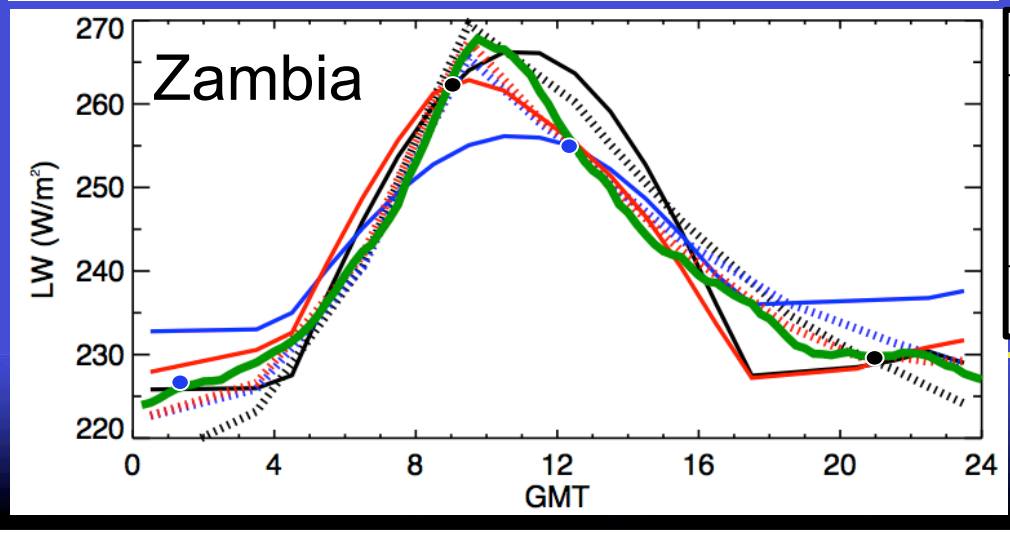
- The 3-hourly GEO derived BB fluxes follow the GERB fluxes and are more consistent by satellite sampling
- The single satellite CG cases are nearly as good as the dual satellite CG case



CO	CG
247.3	246.6
248.2	243.5
246.0	245.8
245.9	



CO	CG
274.9	274.3
274.2	274.1
274.2	274.1
274.0	

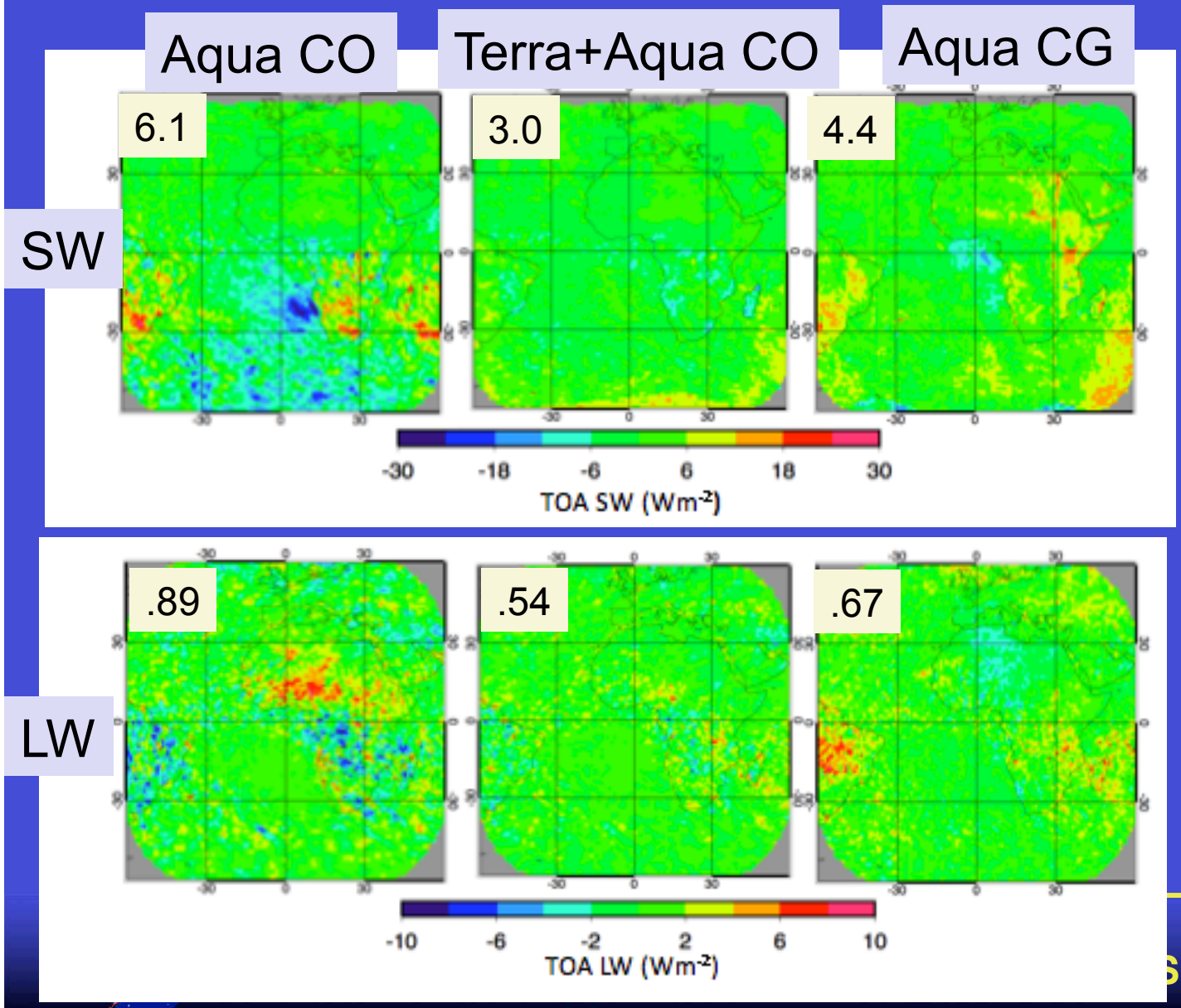


CO	CG
240.9	240.2
242.4	240.2
240.4	240.1
240.1	

Regional monthly hourly and monthly TOA LW flux for January 2005 by satellite

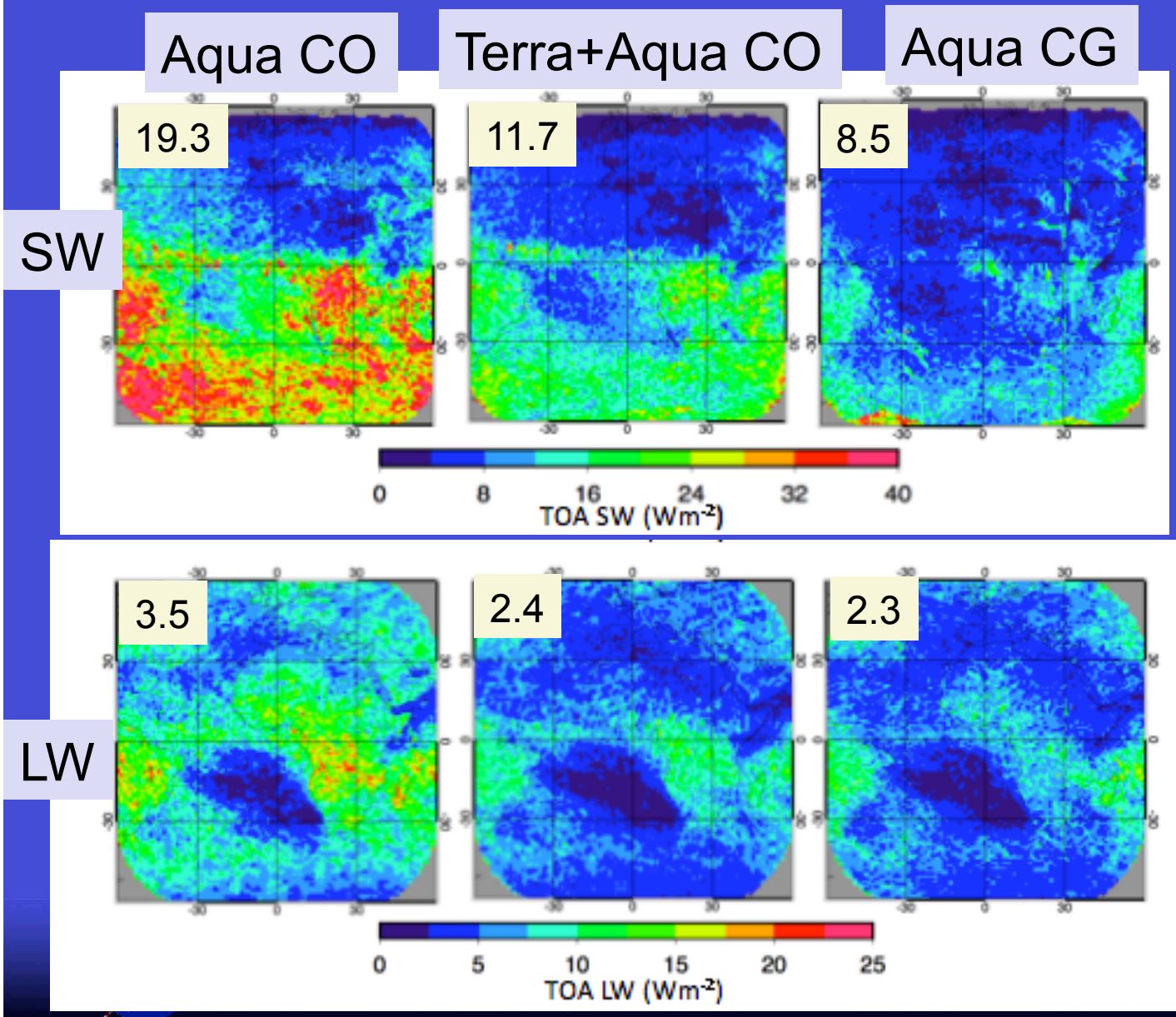
- All methods seem to closely estimate the monthly mean, but differ in defining the diurnal cycle

Monthly RMS error, Jan 2005



- At the monthly level the combined Terra and Aqua only dataset is as good as the single satellite+GEO dataset, since the GEO fluxes have residual artifacts
- The Ed3 SYN1deg (CG) product contains the combined Terra/Aqua/GEO dataset

Daily RMS error, Jan 2005



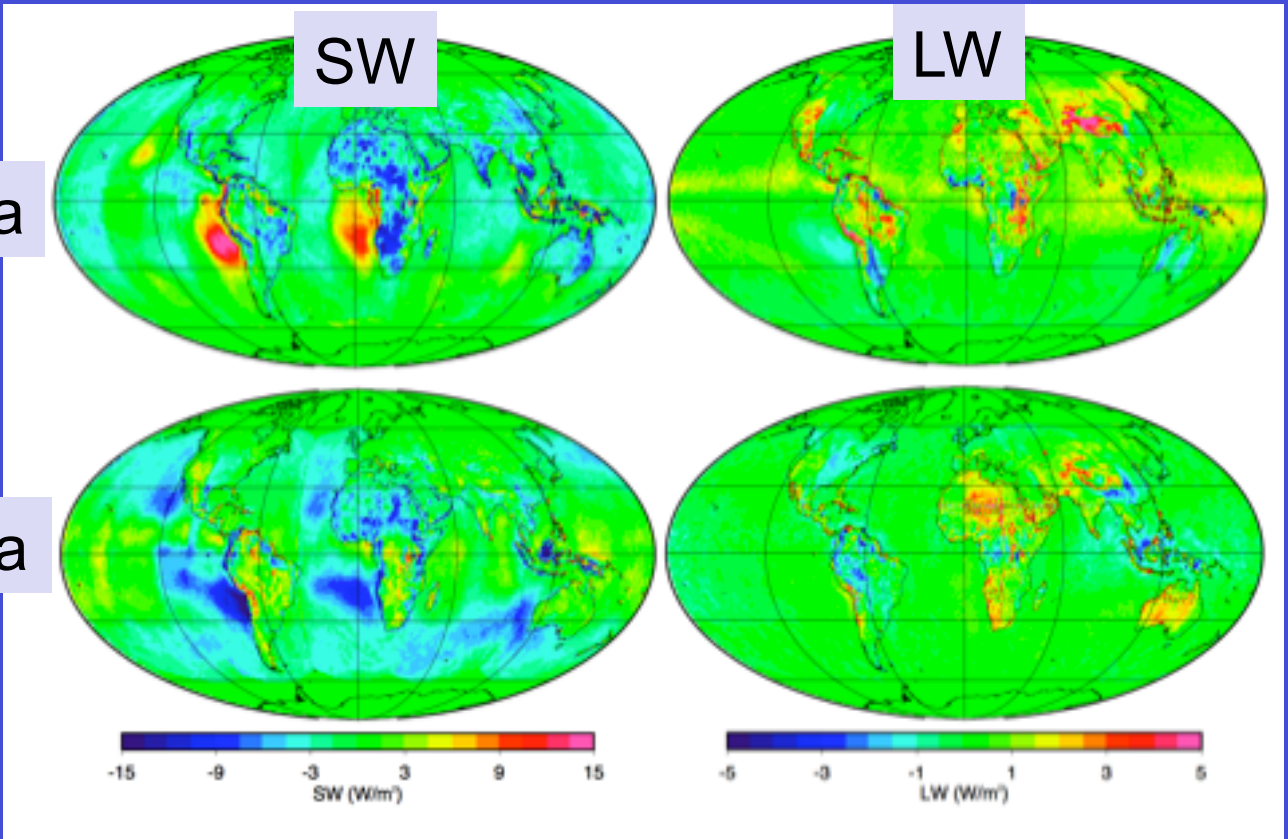
- At the daily level the combined Terra+Aqua only dataset is not as good as a single satellite and GEO dataset

CERES – GERB, LW, Jan 2005

(%)	Dataset	SW				LW			
		Bias	Month RMS	Day RMS	3-Hr RMS	Bias	Month RMS	Day RMS	3-Hr RMS
CO	Terra	0.4	6.2	19.9	37.9	0.11	0.80	3.4	6.0
	Aqua	-1.2	6.1	19.3	36.8	0.06	0.89	3.5	6.0
	T+A	-0.4	3.0	11.7	28.0	0.11	0.54	2.4	4.6
CG	Terra	1.6	4.9	9.1	19.0	0.29	0.68	2.2	3.6
	Aqua	1.7	4.4	8.5	18.1	0.21	0.67	2.3	3.6
	T+A	1.3	3.5	7.8	16.7	0.22	0.53	1.9	3.1

- Greatest impact of GEO temporal averaging are in higher temporal scales
- GEO artifacts still impact the monthly mean temporal averaging

CO – CG Comparison, 9-year mean (Jul02-Jun11)



	Terra		Aqua	
Wm-2	CO	CG	CO	CG
SW	96.6	97.7	96.4	97.7
LW	239.4	238.9	238.9	238.8
Net	4.4	3.7	5.0	3.8

- 9-year regional differences can be as large as 25 and 8 Wm^{-2} in the SW and LW respectively
- However, accounting for the diurnal cycle only increases the global SW flux ~1.2 Wm^{-2} and decreases the LW ~ 0.3 Wm^{-2}

Conclusions

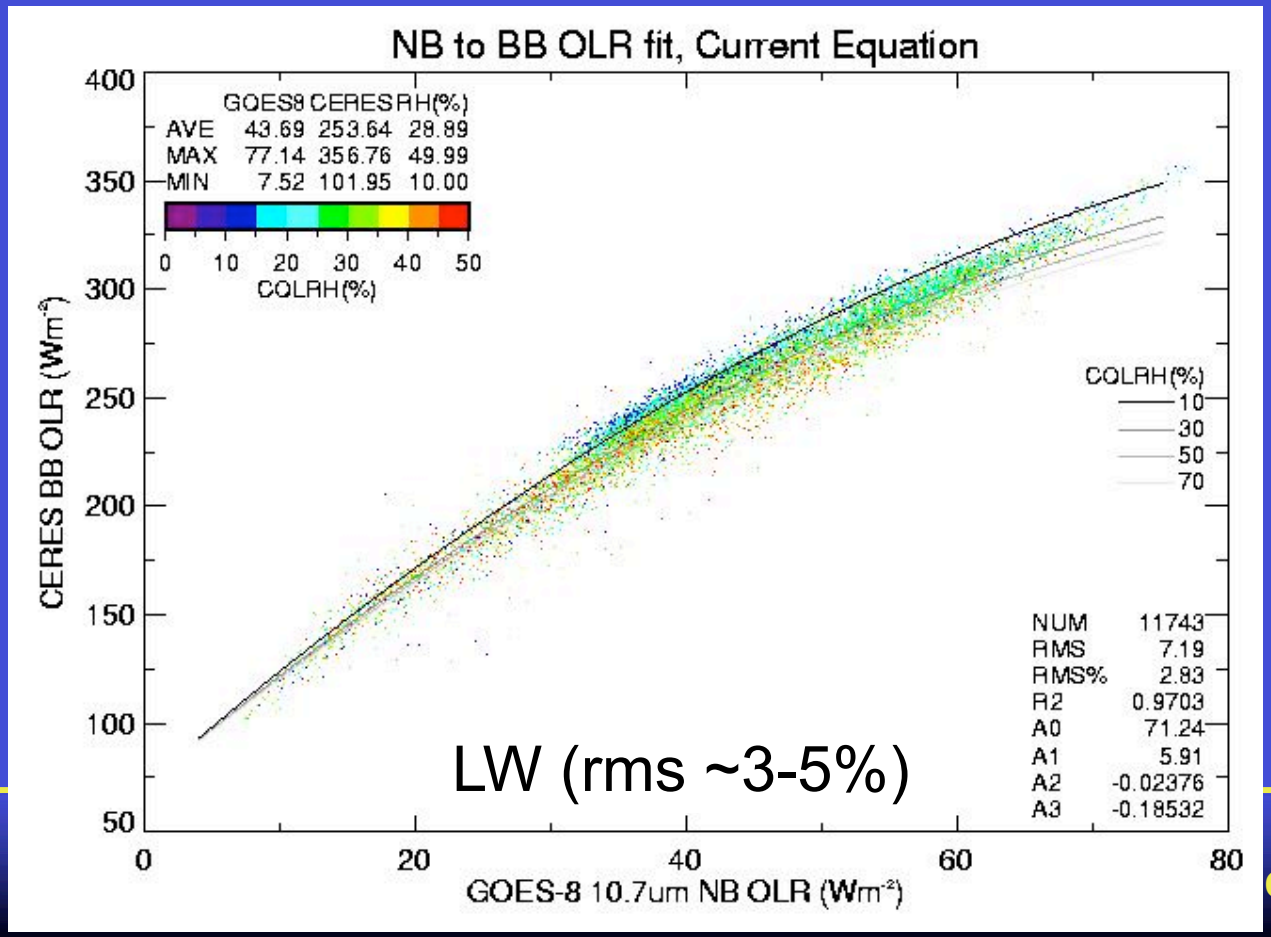
- CERES SYN1deg (level 3) incorporates 3-hourly GEO derived BB fluxes to estimate the fluxes between CERES observations
  - SYN1deg Ed3a is the combined Terra, Aqua and GEO dataset
  - SSF1deg product is the CERES-only constant meteorology
  - Order here http://ceres.larc.nasa.gov
- Accounting for the diurnal cycle increases the global SW flux ~1.2 Wm^{-2} and decreases the LW ~ 0.3 Wm^{-2}
- 9-year regional differences can be as large as 25 and 8 Wm^{-2} in the SW and LW respectively
- The SYN method reduces the monthly regional RMS error by 20% and the daily by half

GEO LW NB to BB Improvements

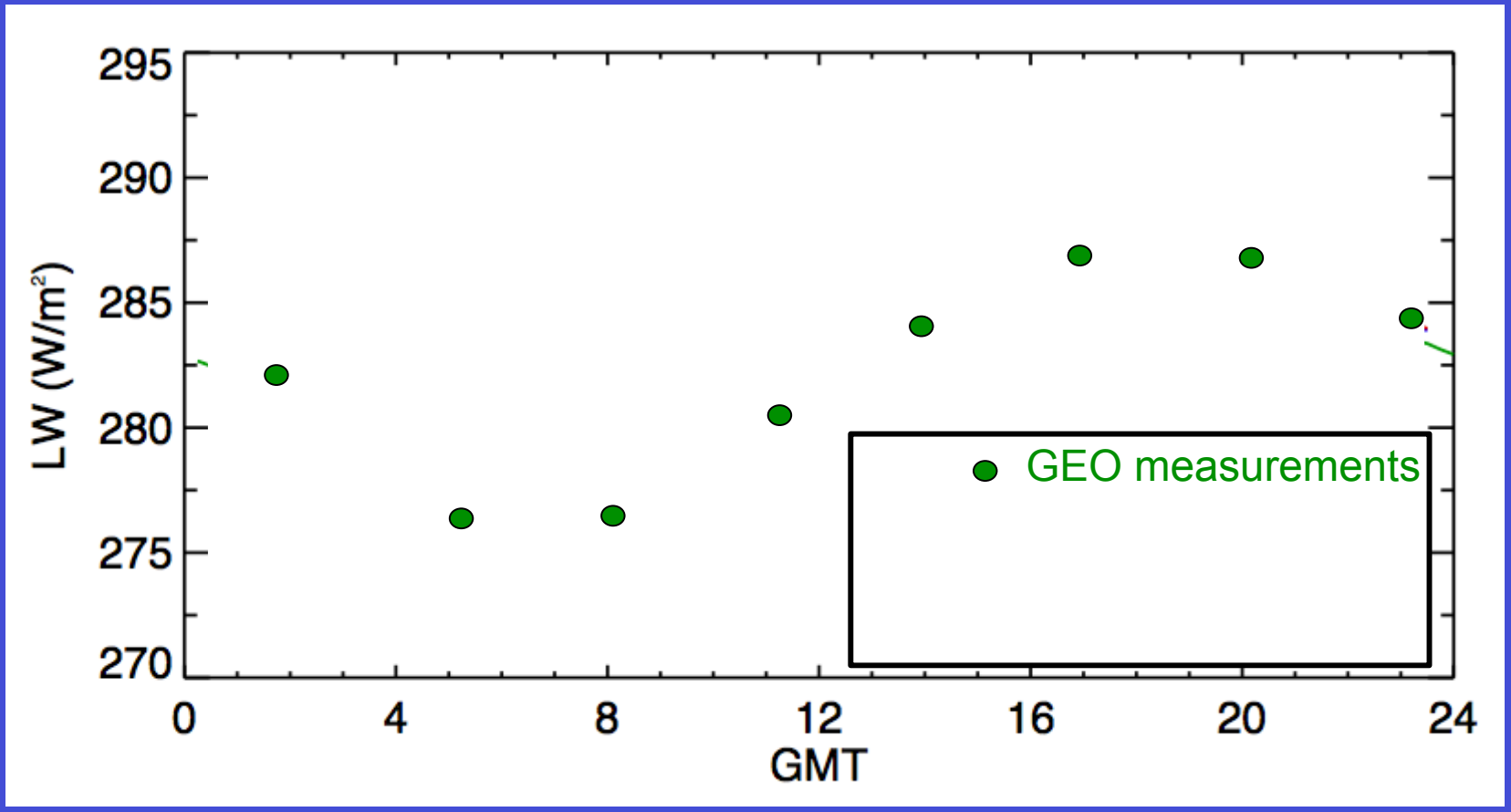
	Edition 2/3	Edition 4
GEO resolution Cloud code	• 3-hourly • 2-channel code (visible and IR)	• 1-hourly • 5-channel code (visible and multiple IR)
LW NB to BB	• Simple Window (11μm) limb-darkening function from radiance to flux	• WN (11μm) + WV (6.7μm) to BB radiance conversion based on ADM scene types
LW ADM (radiance to flux conversion)	• Simple Window flux and column weighted humidity global regression	• CERES LW ADM
GEO/CERES normalization	• Instantaneous	• 5° by 5° regional normalization

Ed2 Narrowband-to-Broadband Conversion

- Apply a limb darkening function to the 11μm channel to derive OLR_{NB}
- $OLR_{BB} = a_0 + a_1*OLR_{NB} + a_2*OLR_{NB}\text{^}2 + a3*OLR_{NB}*\ln(colRH[\%])$
- Separate relationships for land, ocean
- Column (height) weighted RH, increase weight in upper atmosphere

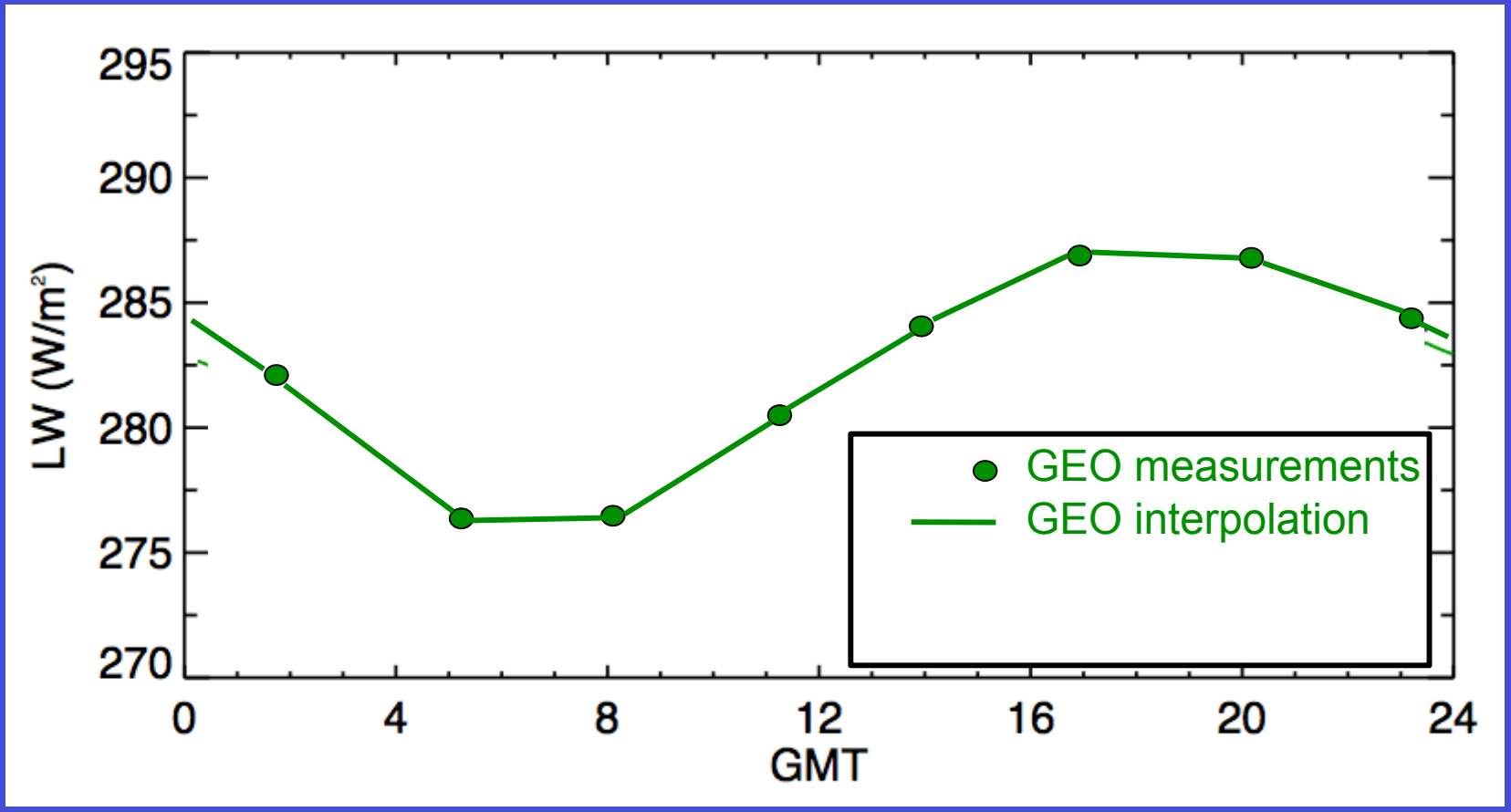


LW instantaneous normalization



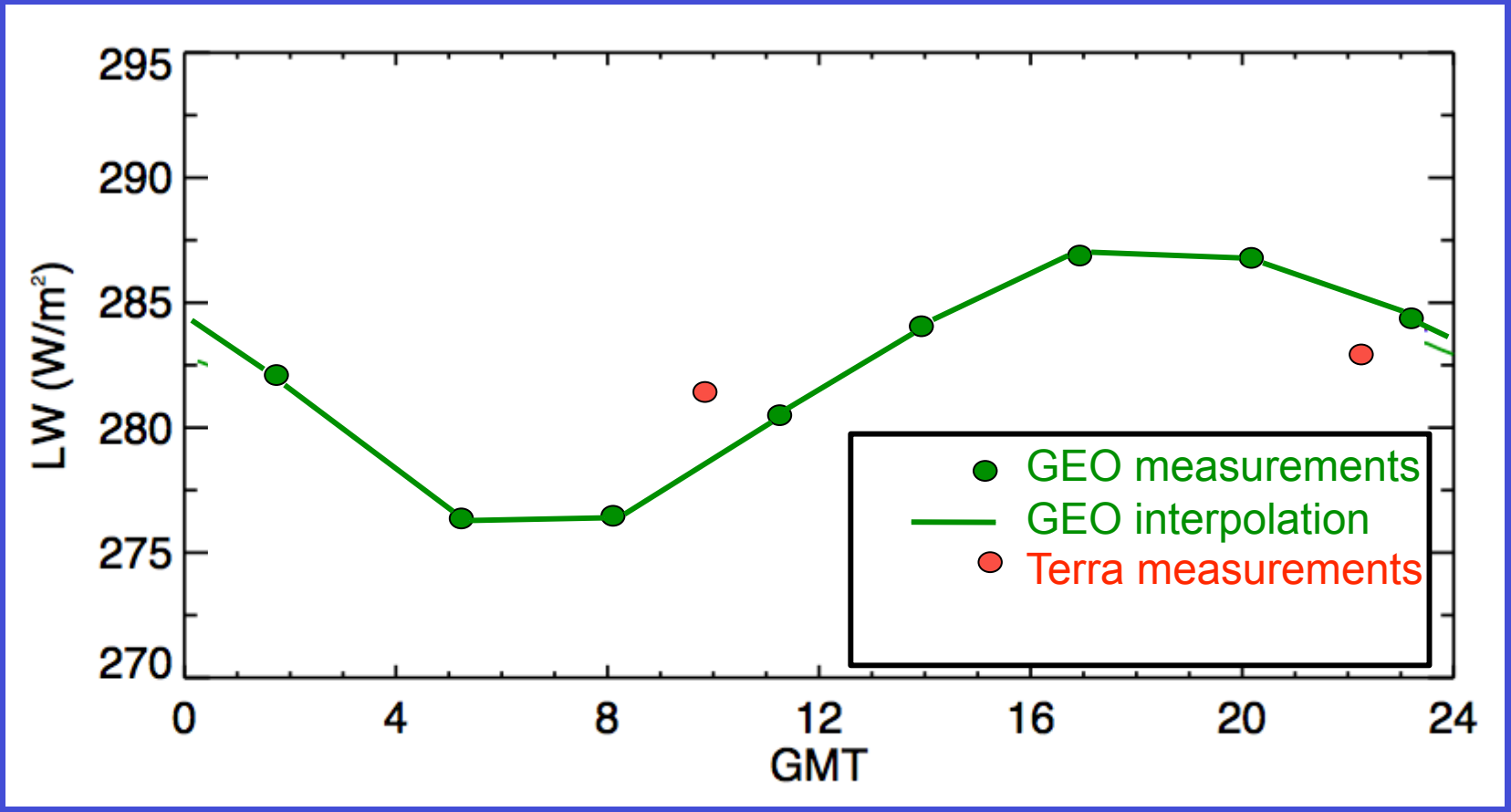
- 3-hourly GEO derived broadband fluxes

LW instantaneous normalization



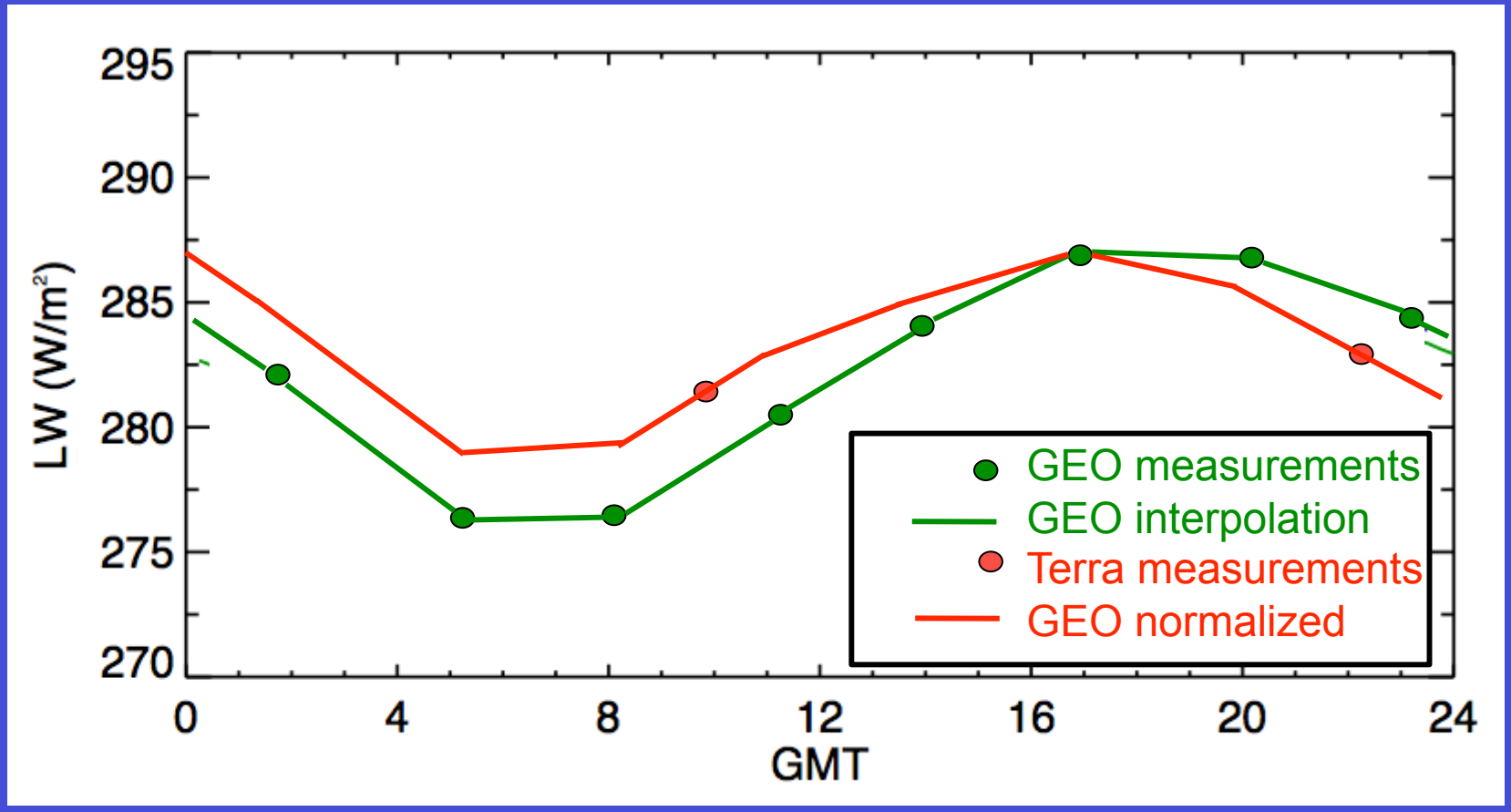
- 1-hourly interpolated GEO broadband fluxes

LW instantaneous normalization



- Plot the Terra LW fluxes for the day

LW instantaneous normalization



- Normalize the GEO hourly interpolated fluxes onto the Terra fluxes
- This ensures that the CERES LW instrument calibration is maintained

CERES – GERB, LW, Jan 2005

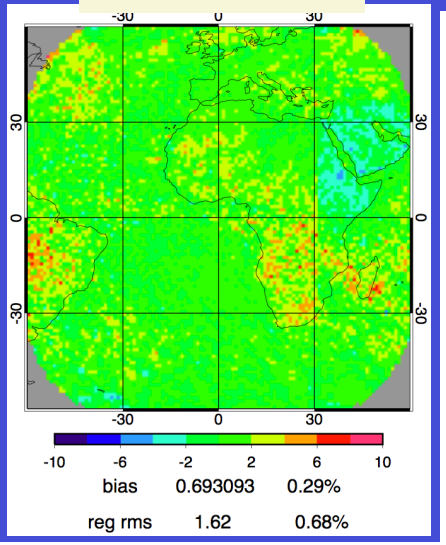
- First, try 1-hourly through Ed 2 LW NB to BB

(%)	Sat	Bias	Month RMS	Day RMS	3-Hr RMS	1-hour RMS	M3hour RMS	M1hour RMS
CO (no GEO)	Terra	0.11	0.80	3.41	6.01	5.98	1.70	1.81
	Aqua	0.06	0.89	3.54	6.02	6.02	1.67	1.77
	T+A	0.11	0.54	2.37	4.62	4.60	1.30	1.43
CG 3hour	Terra	0.29	0.68	2.24	3.55	3.78	1.17	1.30
	Aqua	0.21	0.67	2.34	3.60	3.82	1.06	1.20
	T+A	0.22	0.53	1.86	3.12	3.39	0.91	1.07
CG 1hour	Terra	0.39	0.86	2.22	3.86	3.83	1.29	1.43
	Aqua	0.33	0.90	2.34	3.88	3.86	1.16	1.31
	T+A	0.32	0.75	1.88	3.48	3.45	0.99	1.16

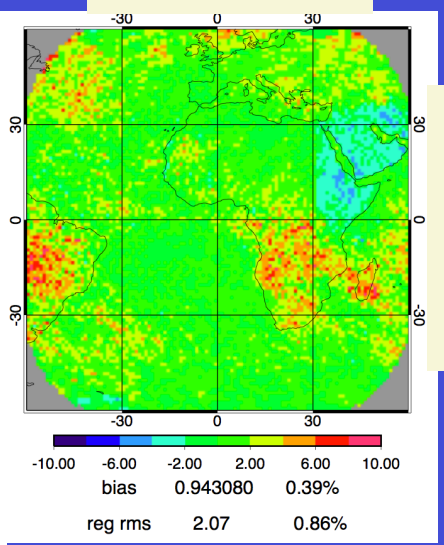
- 1-hour instantaneous normalization is worse than 3-hour
- Even worse than nonGEO for bias and Month RMS

CERES – GERB, instantaneous LW normalization, Jan 2005

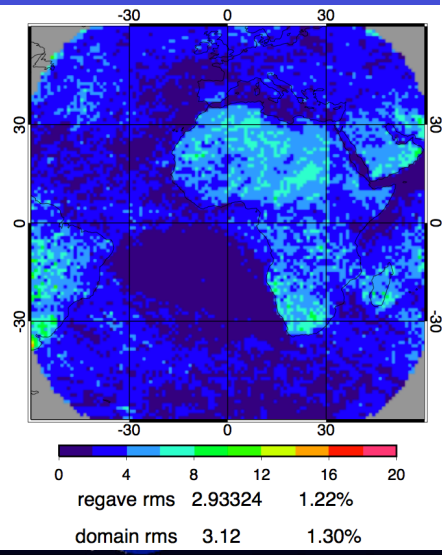
3-hour inst

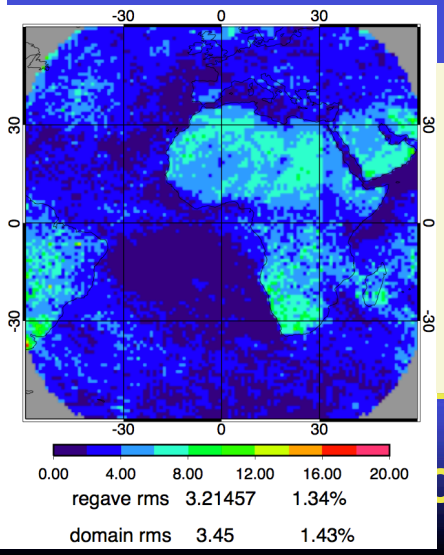


1-hour inst



Month bias



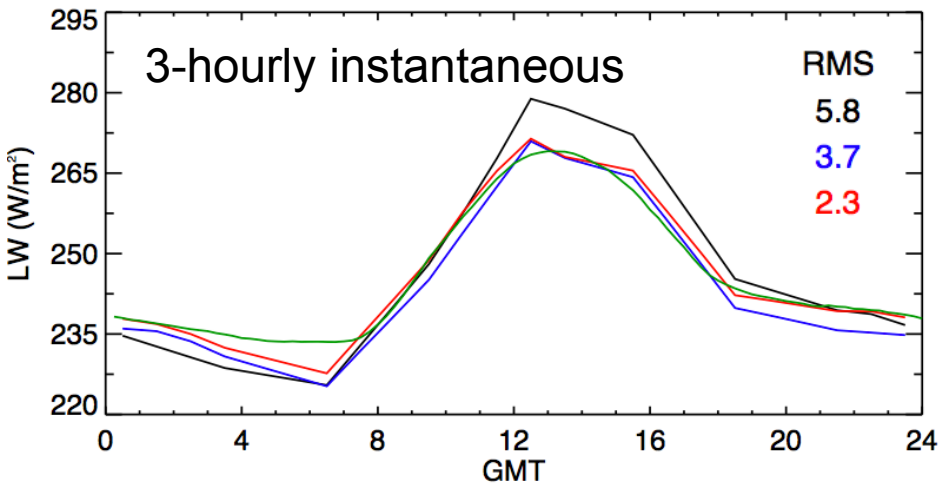


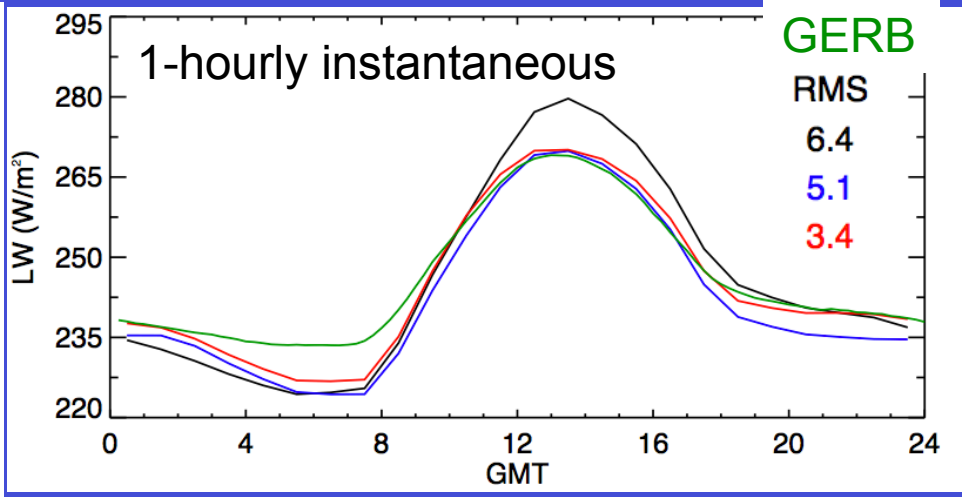
M1hour RMS

Center / Atmospheric Sciences

LW normalization, Algeria, 30.5° N, 0.5° E

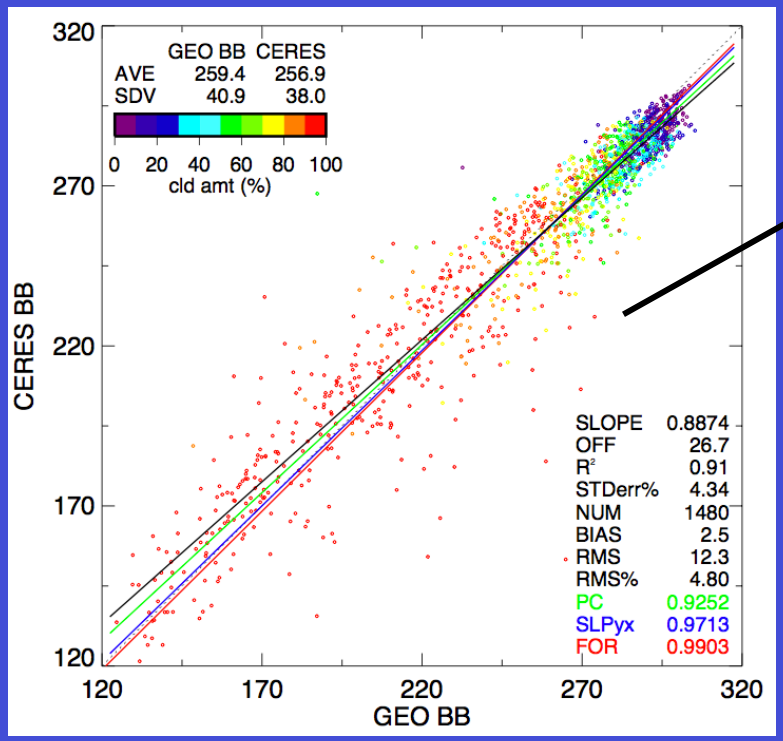
Terra
Aqua
T+A
GERB

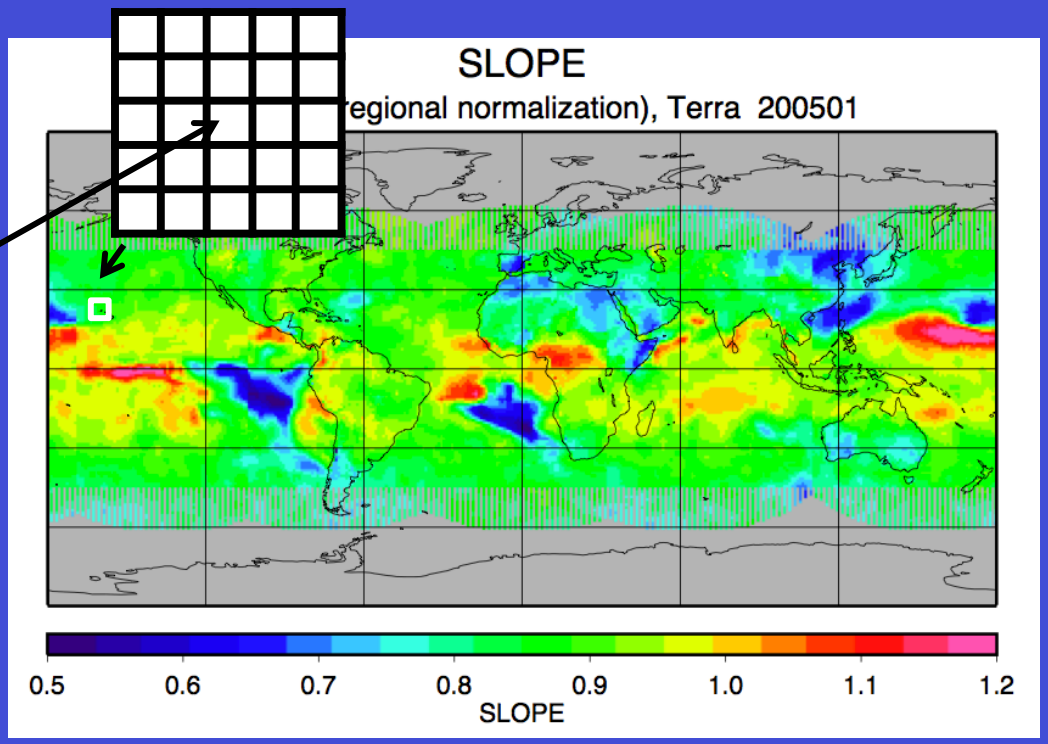




- 3-hour GEO flux temporal resolution is the limit with LW instantaneous normalization
- Maybe the instantaneous (within 60 minute) flux pair match time needs to be reduced

LW 5x5 regional normalization

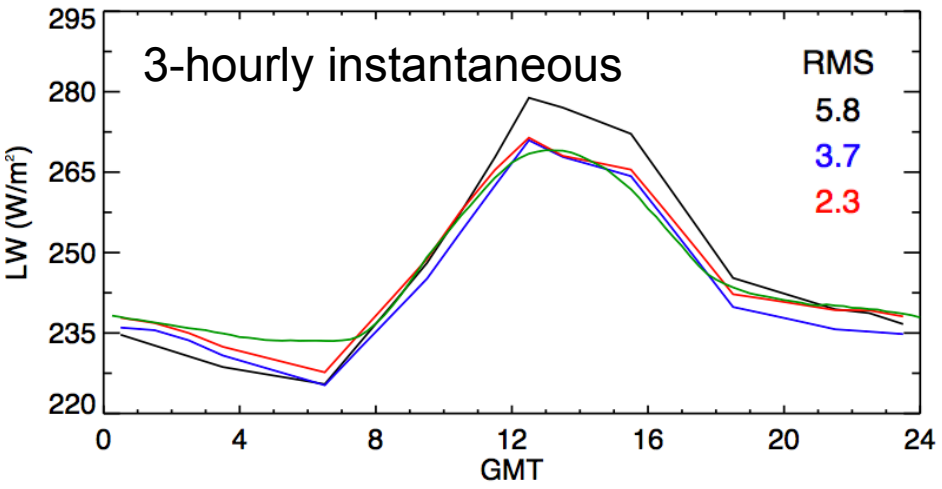


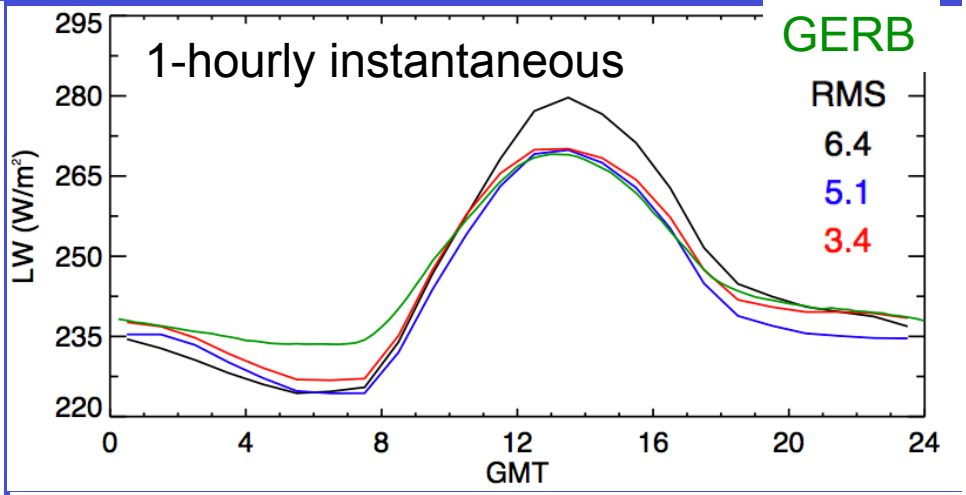


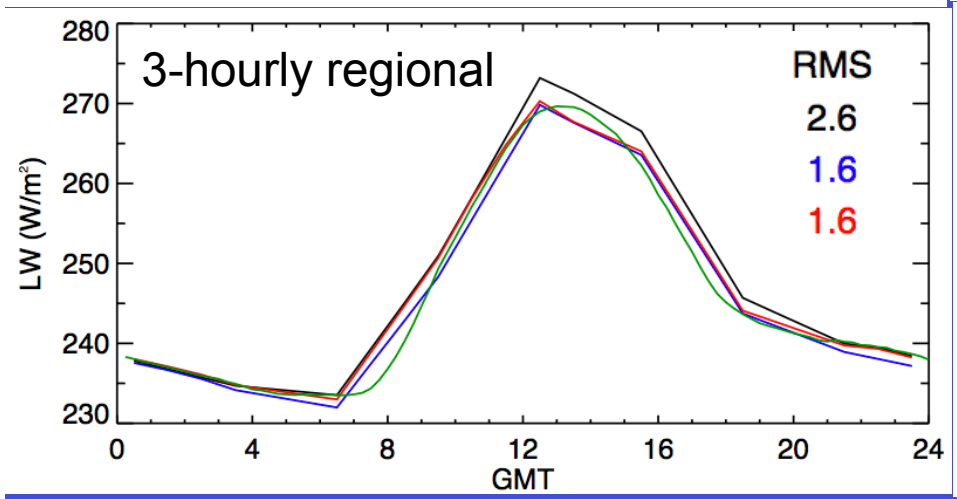
- For each CERES LW measurement find the closest GEO derived BB flux in time
- Must also match by GEO satellite, and surface type
- Use the surrounding 5x5 regions to obtain enough matches to linearly regress the fluxes

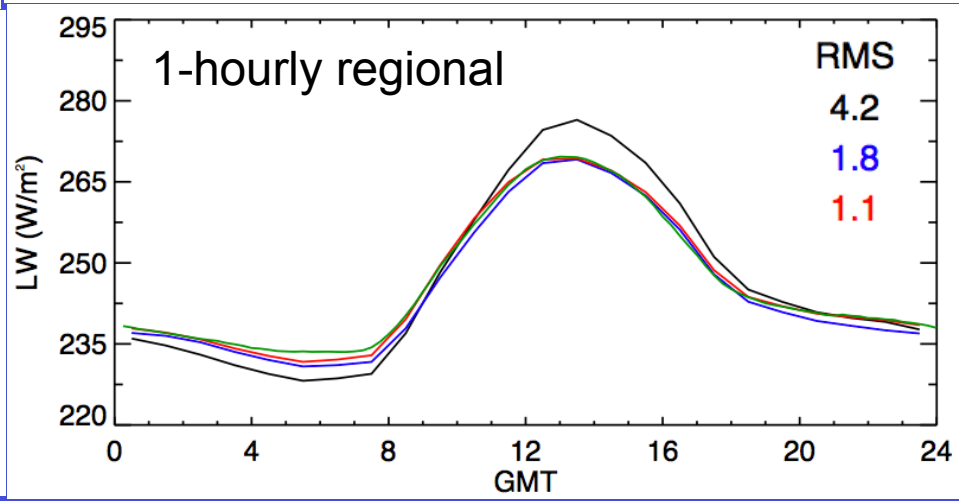
LW normalization, Algeria, 30.5° N, 0.5° E

Terra
Aqua
T+A
GERB



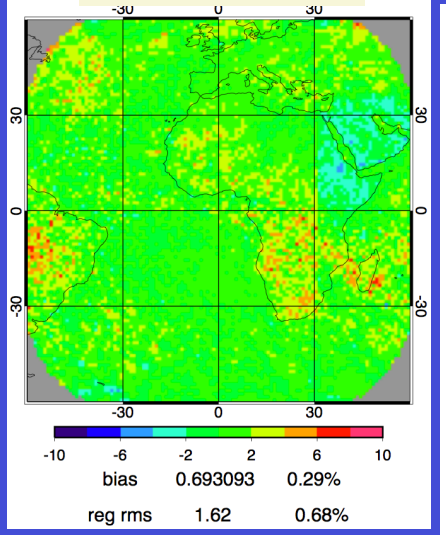




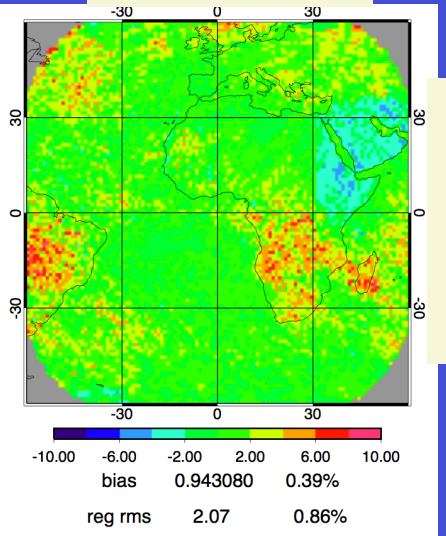


CERES – GERB, by LW normalization method, Jan 2005

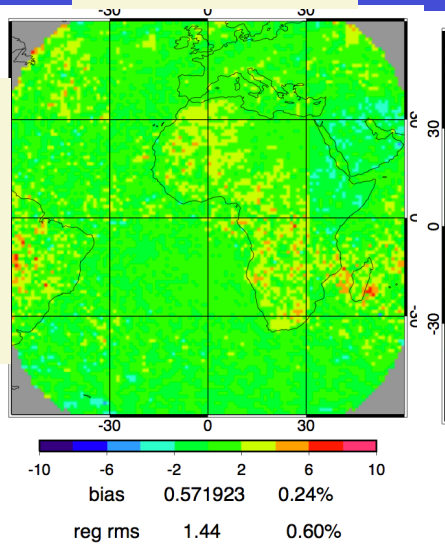
3-hour inst



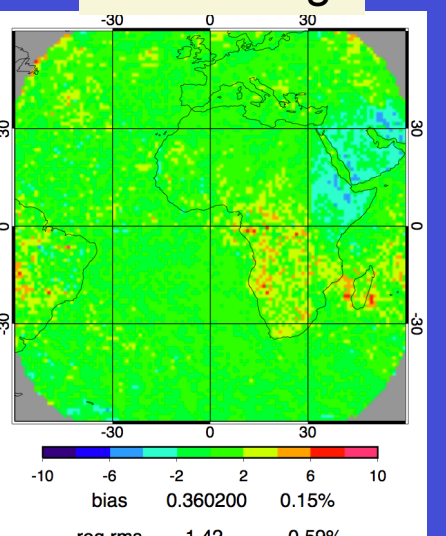
1-hour inst



3-hour reg

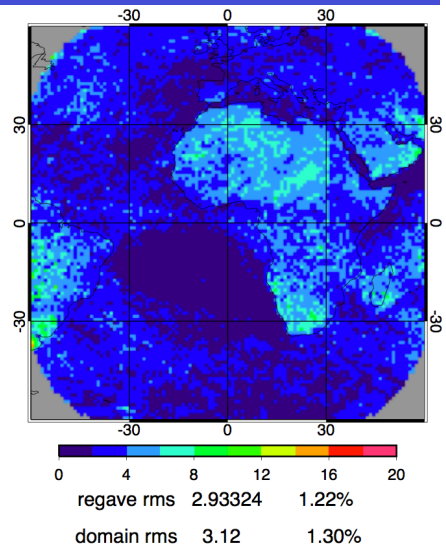


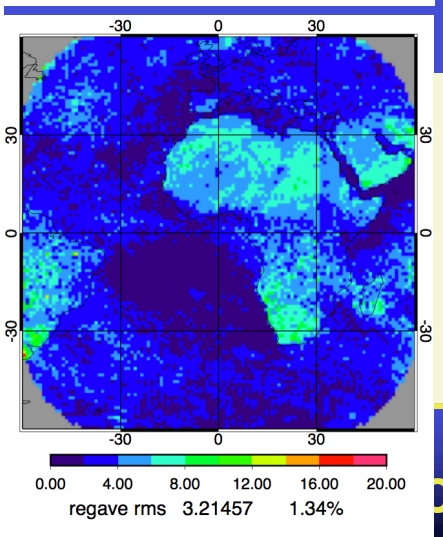
1-hour reg

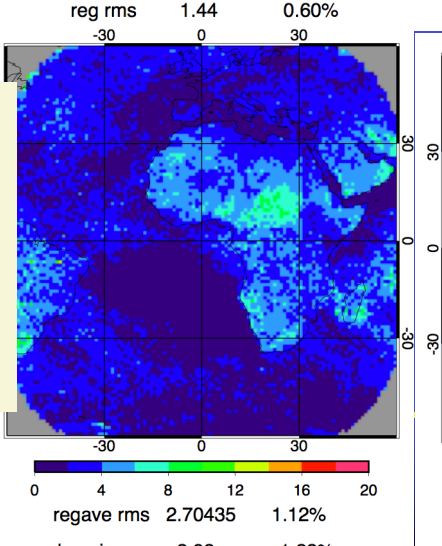


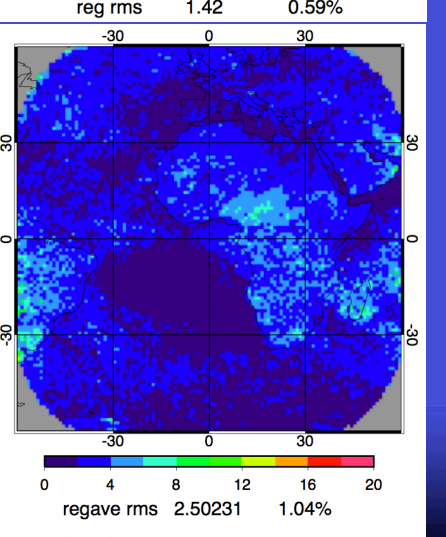
Month bias

M1hour RMS









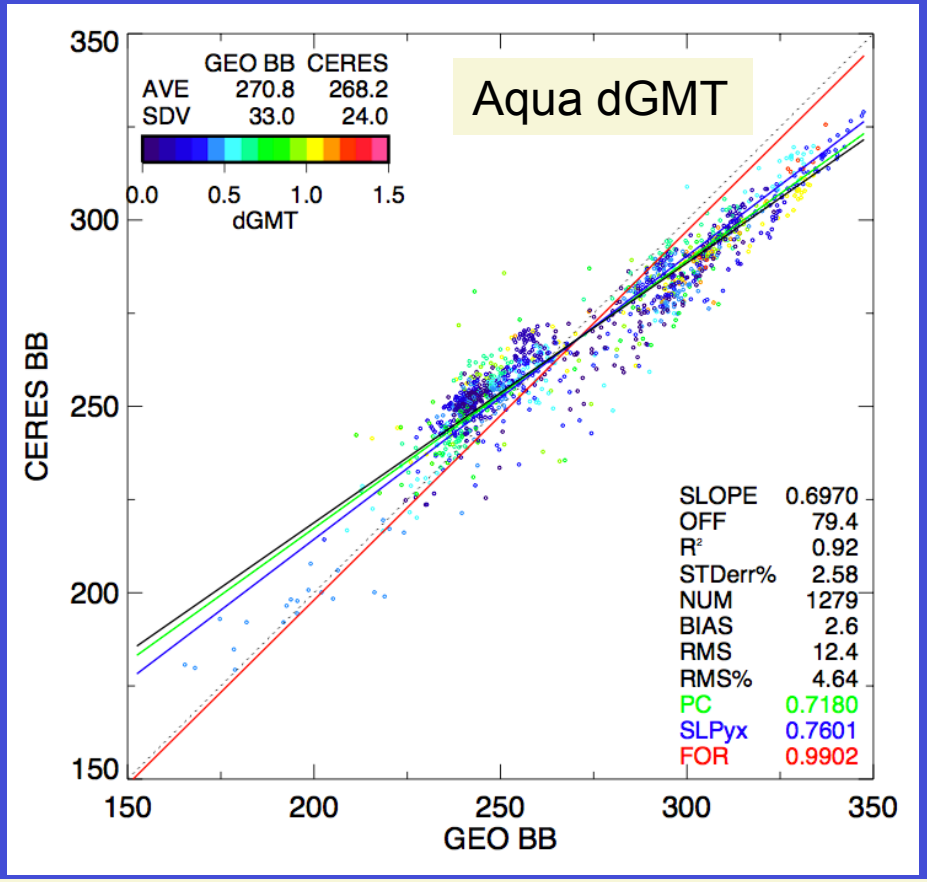
Comparison of LW normalization with GERB, Jan 2005

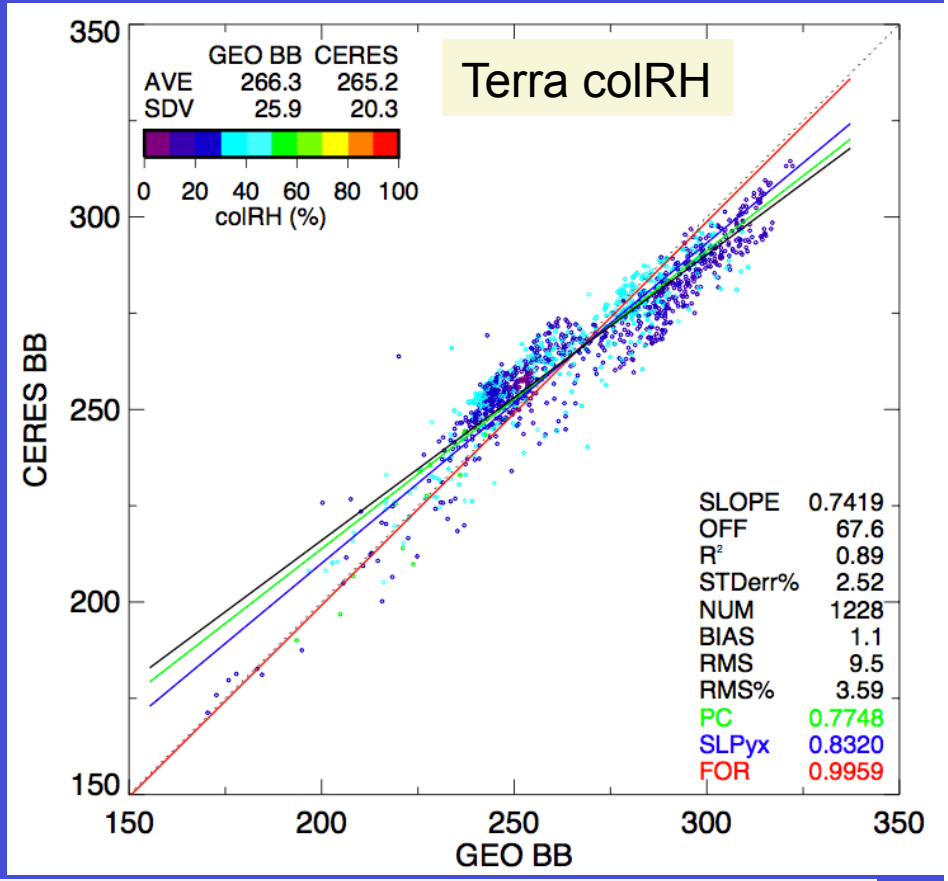
Terra	Bias	Month	Day	3-hour	1-hour	M3hour	M1hour
1hr inst	0.39	0.86	2.22	3.86	3.83	1.29	1.43
1hr reg	0.15	0.59	2.04	3.17	3.48	1.08	1.22
3hr inst	0.29	0.68	2.24	3.55	3.78	1.17	1.30
3hr reg	0.25	0.61	2.17	3.43	3.61	0.98	1.10
nonGEO	0.11	0.80	3.41	6.01	5.98	1.70	1.81

T+A	Bias	Month	Day	3-hour	1-hour	M3hour	M1hour
1hr inst	0.32	0.75	1.88	3.48	3.45	0.99	1.16
1hr reg	0.16	0.48	1.75	2.84	3.18	0.84	1.00
3hr inst	0.22	0.53	1.86	3.12	3.39	0.91	1.07
3hr reg	0.23	0.49	1.80	3.06	3.29	0.86	1.00
nonGEO	0.11	0.54	2.37	4.62	4.60	1.30	1.43

- The Terra+Aqua LW regional normalization is an improvement over nonGEO
- There is a slight RMS error increase in M1hour RMS for single satellites

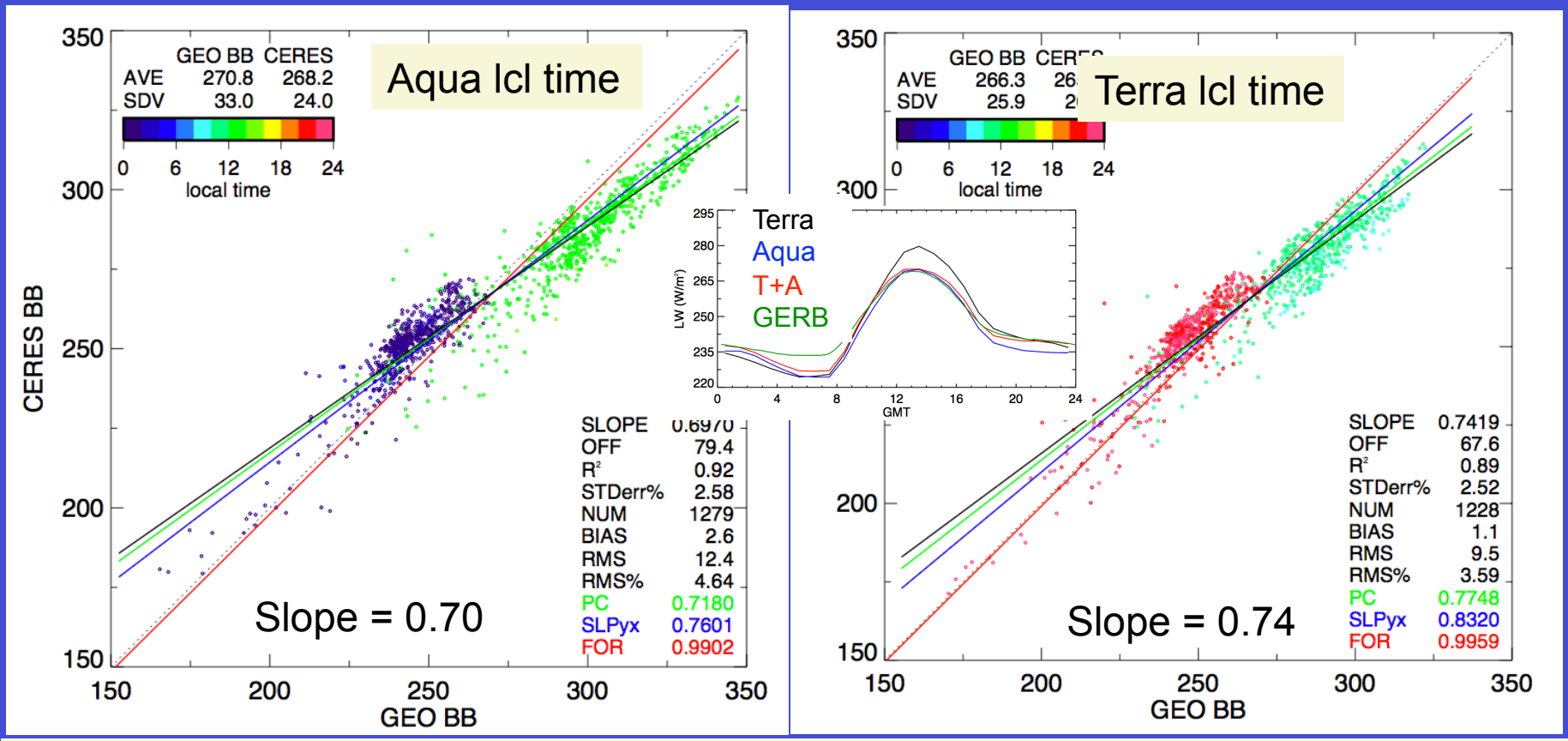
GEO BB vs CERES LW flux
Egypt, 22.5° N, 22.5° E





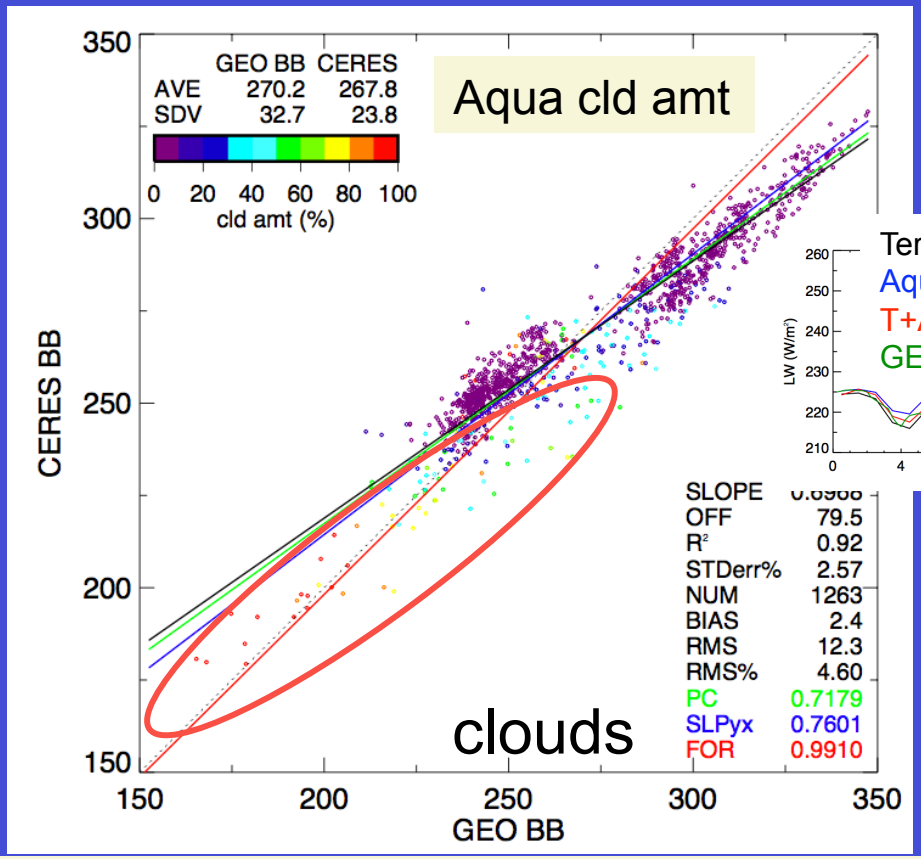
- The flux pair scatter is not dependent on time difference or column weighted RH

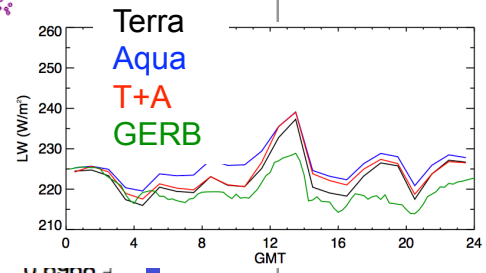
GEO BB vs CERES LW flux
Egypt, 22.5° N, 22.5° E



- There is a discontinuity between day and night desert GEO fluxes
- The slopes are different between Terra and Aqua, since Aqua has warmer fluxes
- That is why the Terra overestimates the flux during the day
- This should not be a problem with improved NB to BB

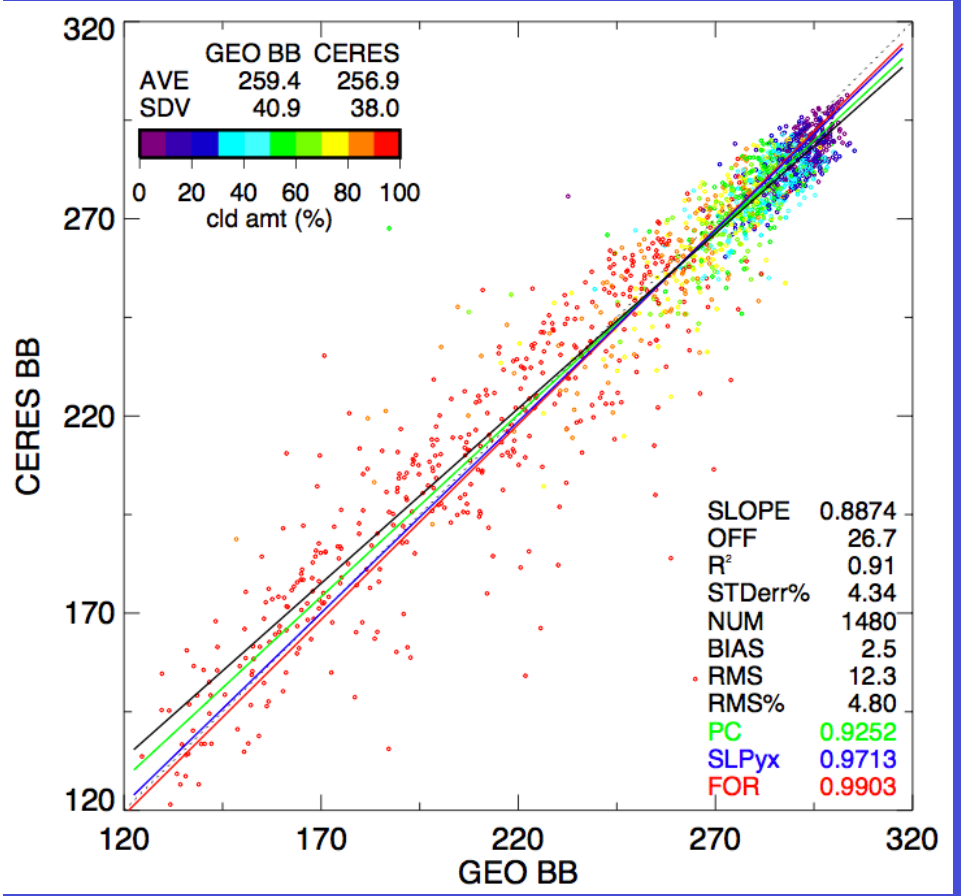
GEO BB vs CERES LW flux
Egypt, 22.5° N, 22.5° E

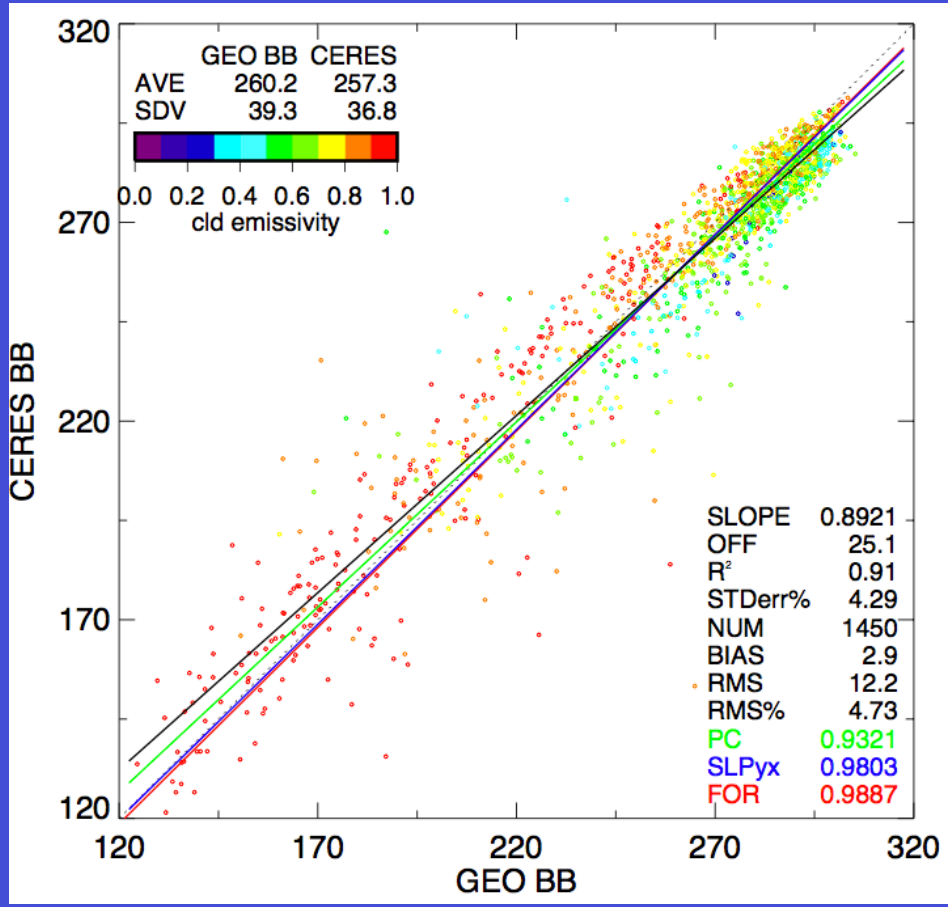




- Note there is a stratification of flux pairs by cloud amount over deserts
- The cloudy fluxes will be overestimated over deserts
- This should not be a problem with improved NB to BB

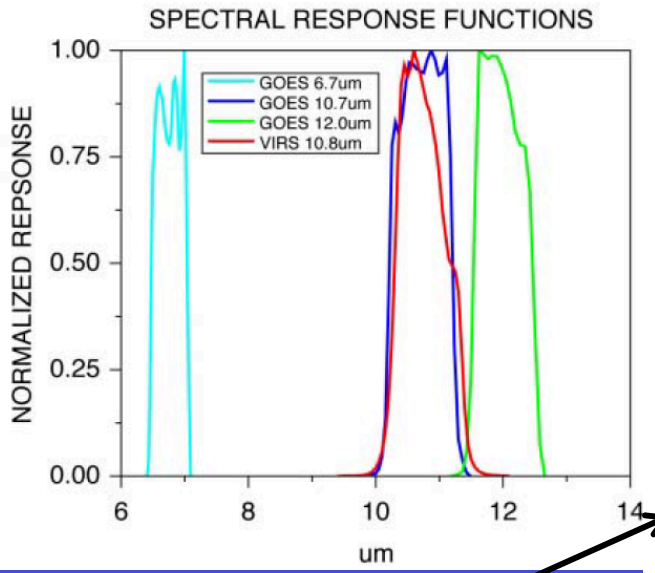
GEO BB vs CERES LW flux
Central Pacific, 22.5° N, 168.5° W





- There is a stratification of flux pairs according to cloud emissivity
- This should not be a problem with improved NB to BB

Edition 4 IR & WV to BB radiance conversion



- GEO/CERES Time mismatch
- VIRS and CERES on TRMM

Table 2. Satellite channels (defined by the left and middle columns) radiances and their squares are regressed with CERES OLR from January to August 1998 and the rms errors are given in the right column.

Satellite	Channel (μm)	RMS Error (Wm^{-2})
GOES-8	6.7	22.94
GOES-8	10.7	7.98
GOES-8	12.0	7.03
GOES-8	10.7 + 12.0	7.04
GOES-8	10.7 + 6.7	6.03
GOES-8	12.0 + 6.7	5.80
GOES-8	12.0 + 6.7 + 10.7	5.82
VIRS	10.8	7.87
VIRS + GOES-8	10.8 + 6.7	4.58
CERES	Window	6.44
CERES + GOES-8	Window + 6.7	3.34

Doelling et al 2003, Annual ARM science Team Meeting

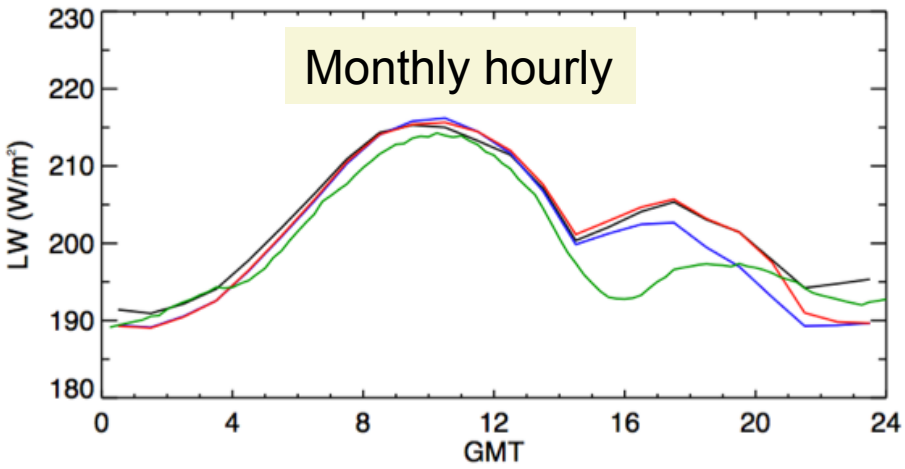
See “TISA LW Narrowband to Broadband Radiance Algorithm and CERES Simulator” by Moguo Sun on Thursday at 2:30 PM

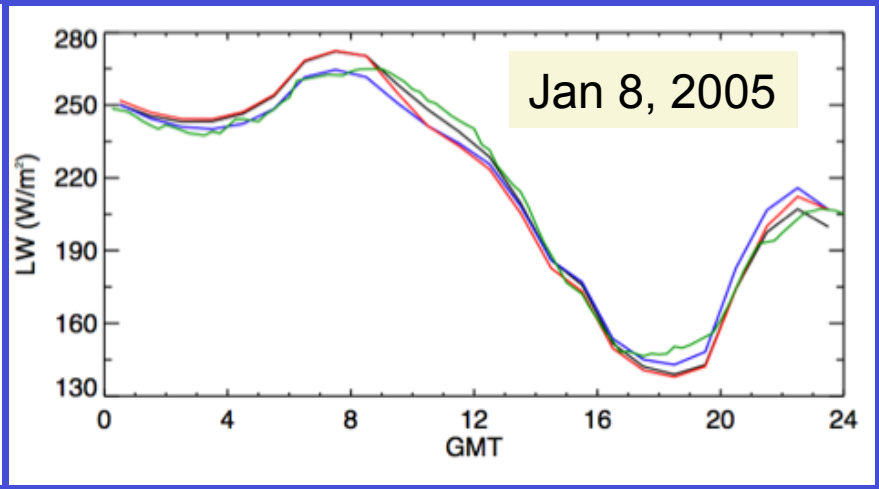
- Use SSF MODIS 11μm and 6.7μm and CERES BB radiances to determine coefficients according to scene type
  - Surface type, Day/night, cloud amount, PW and VZA
- Compare with current 4 coefficient fit with colRH term

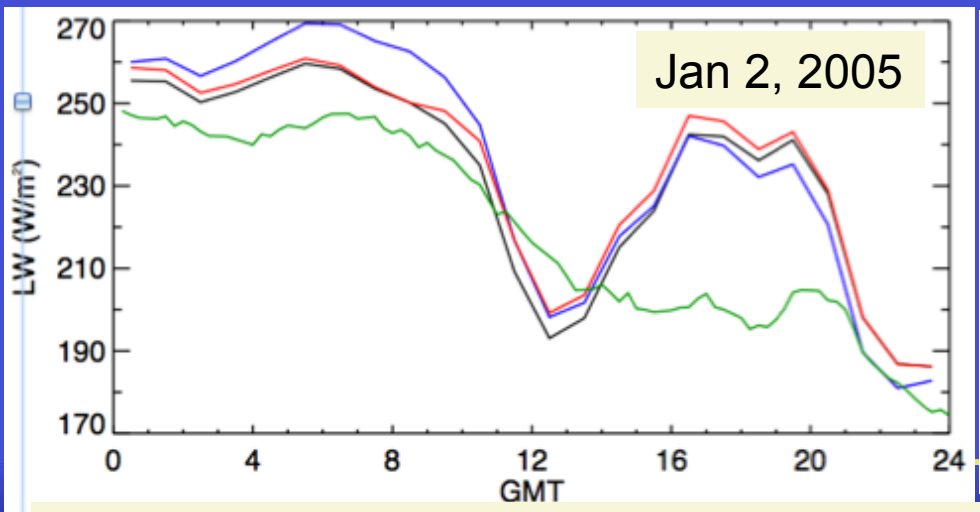
Method	Radiance ($Wm^{-2}sr^{-1}$)		Flux (Wm^{-2})	
	RMS	RMS< 1	RMS	RMS< 5
IR+colRH	1.99	14%	10.2	9%
IR+WV	1.19	69%	4.5	66%
IR+WV+12μm	1.14	70%		

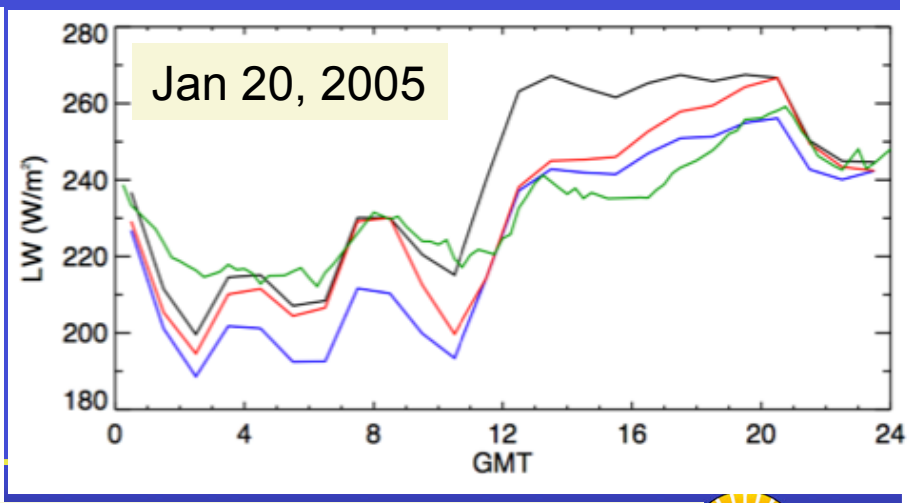
- 50% reduction in RMS error if WV is included and stratified by scenes
- As predicted the 12μm channel did not have an impact

hourly GEO LW regional normalization
Tanzania, 12.5°S 33.5°E









- In the TISA WG, there is no shortage of interesting cases to work on

LW NB to BB Conclusion

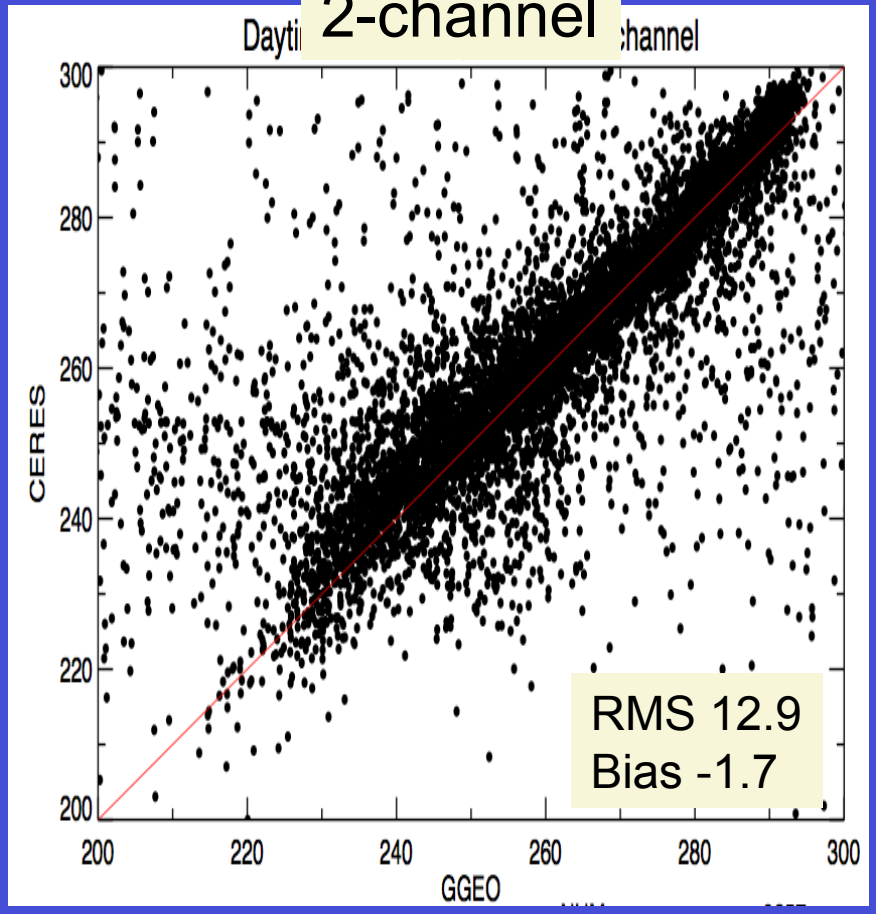
- LW instantaneous normalization is limited to 3-hourly GEO Fluxes with current simple NB to BB conversion
- LW regional normalization more closely resembles GERB with 1-hourly GEO sampling than 3-hour
- GEO+Terra+Aqua LW regional normalization is an improvement over Terra+Aqua nonGEO
  - This was not the case for instantaneous normalization
- Further improvements anticipated in the LW regional normalization
  - GEO IR + WV NB to BB radiance conversion
  - CERES ADM radiance to flux conversion as a function of scene type

GEO 5-channel cloud retrievals

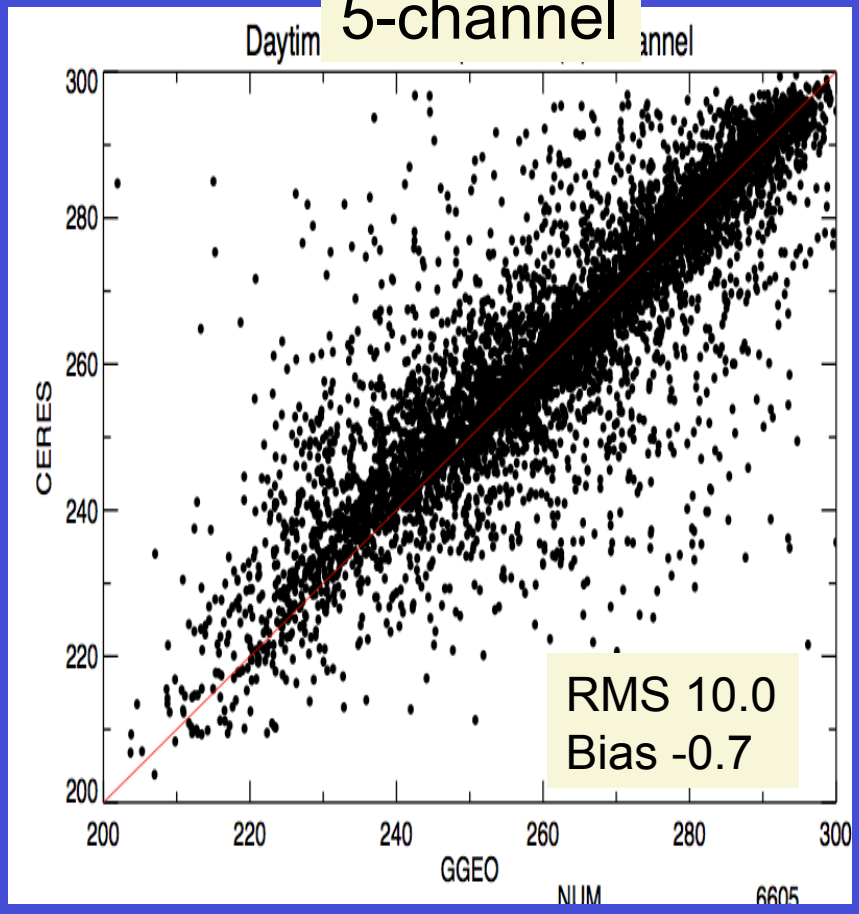
- Cloud WG to process 12 years of 1-hourly GEO 5-channel cloud retrievals and be saved at 8-km resolution in netCDF compressed format.
  - Uncompressed estimated at 85TB/10years compressed 17TB/ 10years
- Spatially grid the cloud properties and put into the TISA GGEO framework
  - 5-channel retrievals also provide particle size, LWP/IWP, and cloud heights.
- Perform GEO comparisons with MODIS at coincident matched angles for QC
  - Utilize subsetter capabilities
- Finalize GEO cloud retrieval code for 15 satellites before July 2013 based on 4 seasonal months/satellite

Met-9/MODIS daytime cloud temperature comparison, Jan 2010

2-channel

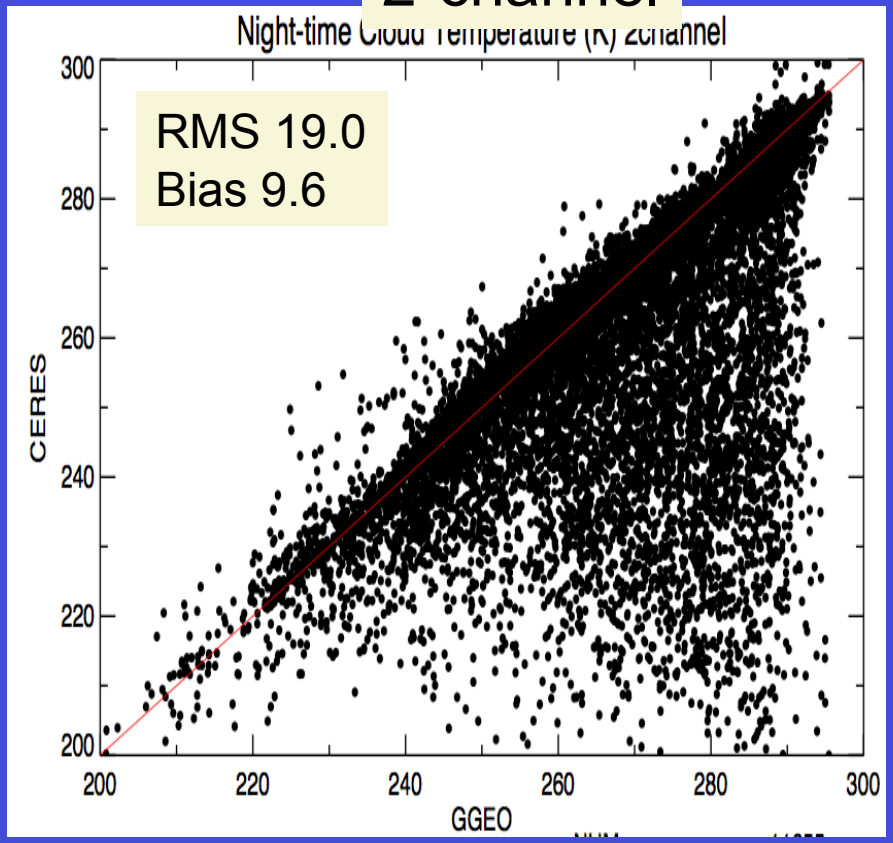


5-channel

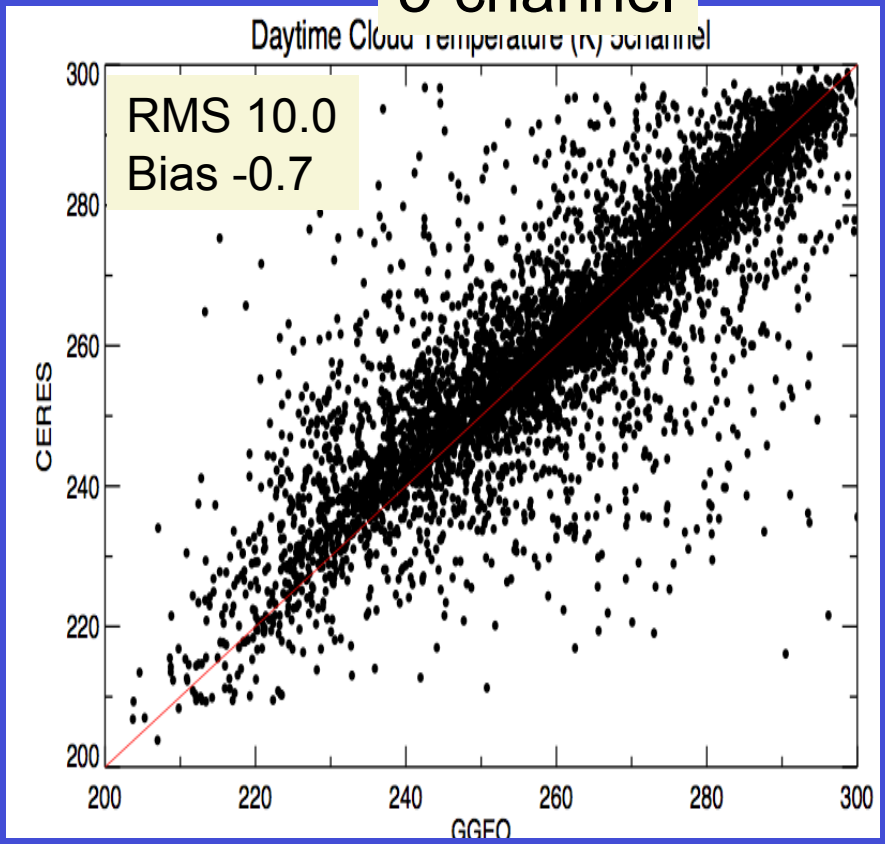


Met-9/MODIS nighttime cloud temperature comparison, Jan 2010

2-channel



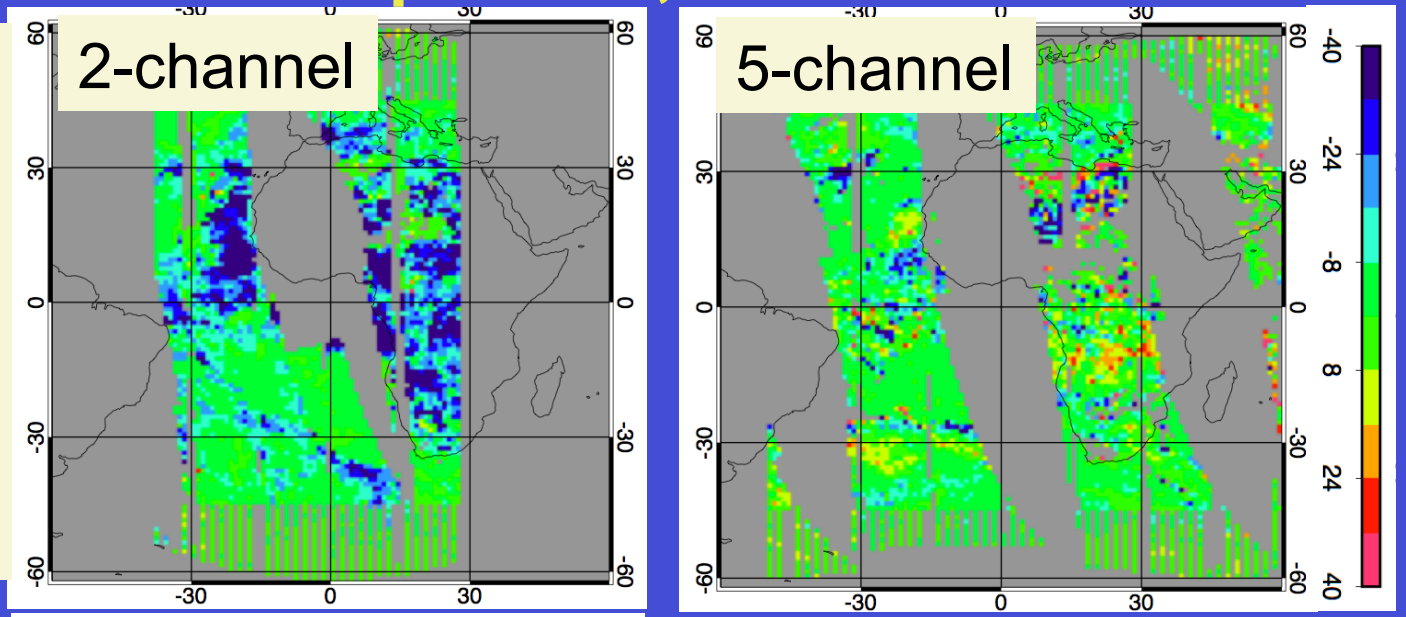
5-channel



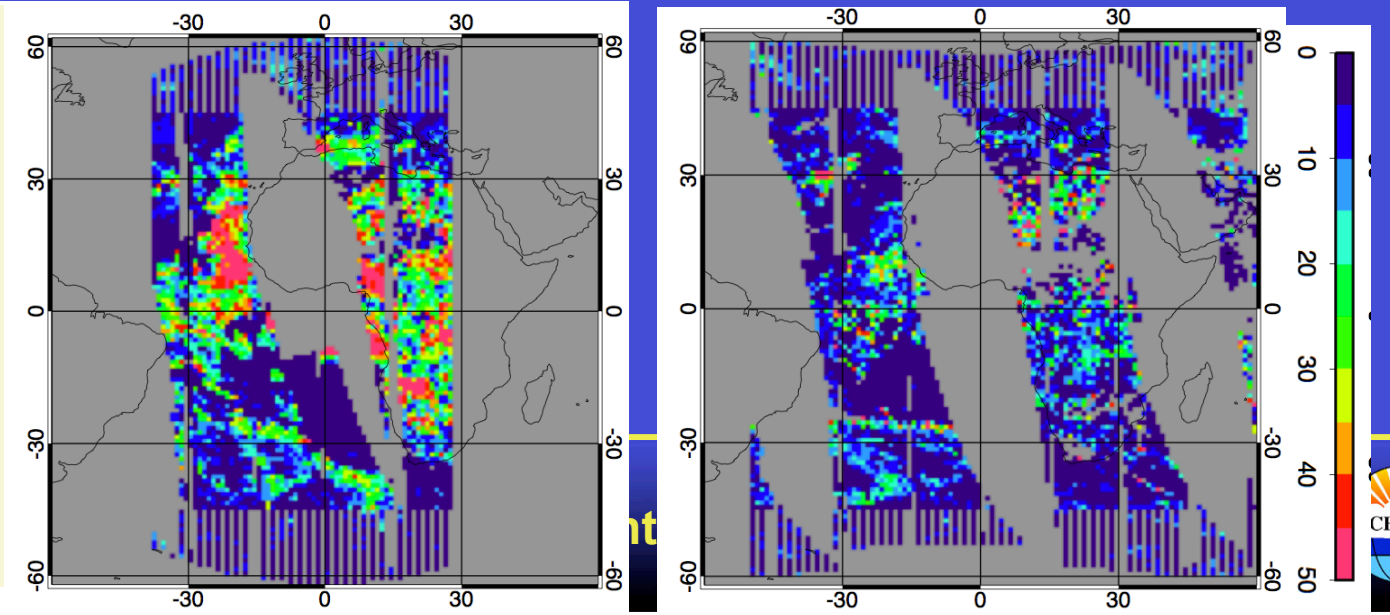
- At night 2-channel code assumed black codes
- 5-channel retrieval has similar day and night statistics

Met-9/MODIS nighttime cloud temperature (K°) comparison, Jan 2010

GEO-CERES bias



GEO-CERES RMS



CERES Prototype Ordering Tool

Ordering Tool: C. Chu, C. Mitrescu, P. Mlynczak

Web Pages: P. Mlynczak, E. Kizer, E. Heckert

ASDC SSF Level2 subsetting: W. Baskins, P. Piatko

CERES Ordering Tool - Highlights of Its Capabilities,
Cristian Mitrescu , 11:50 am Thursday, Oct 25

http://ceres.larc.nasa.gov/index.php
Google: CERES NASA

Past User Quotes

"I think it is important that NASA delivers the data to the US public, obtained with their tax dollars, in a way that are useful for greater good and do not remain confined to only a selected group. "

(User comment, August 24, 2009)

User needs to order the monthly SYN HDF files for 2 parameters.

"That's horrible! It's taking days for me to download all of the data from 2000 to 2005: each file is about 250 MB, so takes about 5 minutes to download. At this rate, it will take more than a week to download the data."

(User comment, August 5, 2011)

Update: Sub-setter has incorporated SYN1deg data

Latest User Quotes

"I am a graduate student making heavy use of CERES Level II data as part of my research. … Also, thanks for making such a great data product and ordering tool. "

(User comment, October 8, 2012)

These pages are nice!! I just downloaded some EBAF data in seconds. It's not only in netcdf, but there is a reader in IDL provided. You guys are making my whole day -- or possibly month.

(User comment, October 17, 2012)

New products since the last CERES STM

Level 4: Spatially (regional, global, etc.) and temporally (daily, monthly, etc) averaged fluxes where the net flux has been energy balanced.

Data Product	Description	Parameter	Resolution	Version/ Availability	Order Data
EBAF-TOA	Monthly and climatological averages of TOA clear-sky (spatially complete) fluxes, all-sky fluxes, and cloud radiative effect (CRE), where the TOA net flux is constrained to the ocean heat storage. **Data Quality Summary**				Browse & Subset
EBAF-Surface	Monthly and climatological averages of computed surface clear-sky fluxes, all-sky fluxes, and cloud radiative effect (CRE), consistent with the CERES EBAF-TOA fluxes. **Data Qu**				Browse & Subset

SYN1deg-lite replaced with SYN1deg all parameters

Level 3: Spatially (regional, global, etc.) and temporally (daily, monthly, etc) averaged fluxes and clouds.

Data Product	Description	Parameter	Resolution	Version/ Availability	Order Data
SYN1deg	CERES geostationary (GEO) enhanced temporally interpolated TOA fluxes, MODIS and 3-hourly GEO cloud properties, MODIS aerosols, and computed TOA, surface and profile fluxes consistent with the observed TOA fluxes, clouds and aerosols. **Data Quality Summary**				Browse & Subset
SSF1deg	CERES constant meteorology temporally interpolated TOA fluxes, MODIS clouds and aerosols. **Data Quality Summary**				Browse & Subset
ISCCP-D2like	CERES-MODIS and GEO daytime cloud properties stratified by ISCCP cloud types and in the similar D2 format. **Data Quality Summary**				Browse & Subset

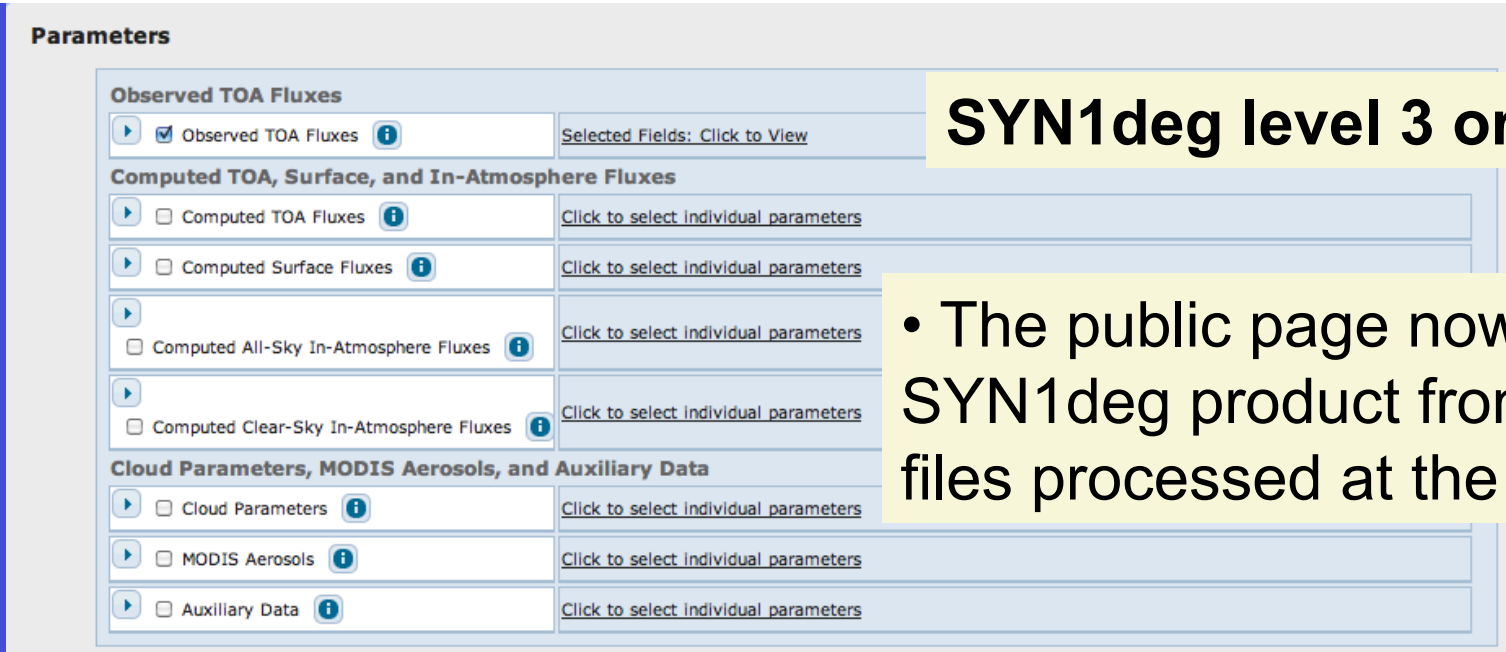
Level 2: CERES instantaneous footprint level (20km nominal) fluxes and cloud properties

SSF level 2 now available from 2000 to 2011

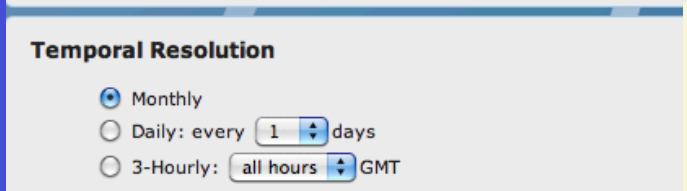
Data Product	Description	Parameter	Resolution	Availability	Order Data
SSF	CERES observed TOA flux, MODIS clouds and aerosols and parameterized surface fluxes. **Terra Data Quality Summary** **Aqua Data Quality Summary**		FOV*		Browse & Subset

*FOV: Field-of-View instantaneous footprint data.

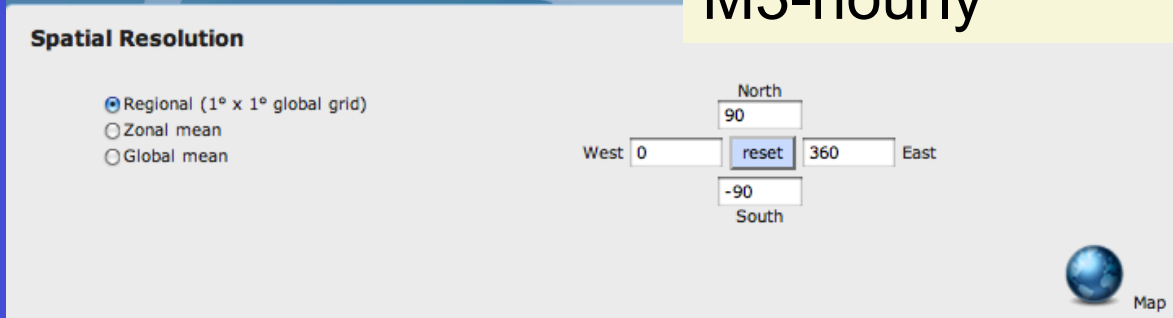
SYN1deg level 3 order page

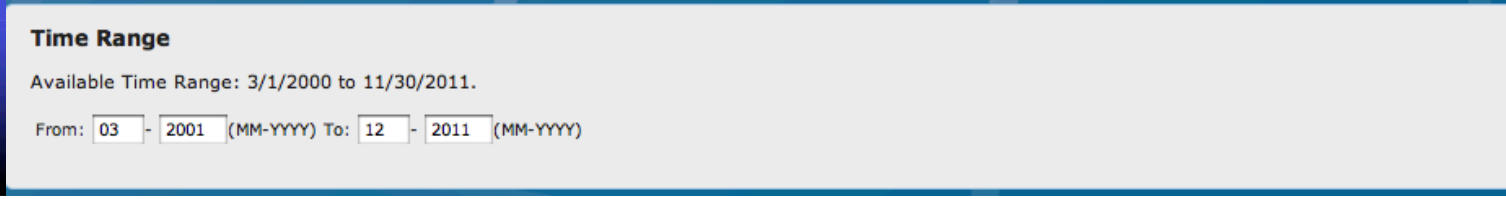


- The public page now has the SYN1deg product from the HDF files processed at the DAAC



- Public page: month and day
- Internal page: testing 3-hourly and M3-hourly





SSF level 2 order page

Parameters

Time/Location/Angles	Selected Fields: Click to View
CERES Observed TOA Fluxes and Radiances	Selected Fields: Click to View
Surface Fluxes	Click to select individual parameters
Surface Parameters	Click to select individual parameters
GEOS-5 Atmosphere Parameters	Click to select individual parameters
Cloudy Footprint Area	Selected Fields: Click to View
MODIS Land Aerosols	Click to select individual parameters
MODIS Ocean Aerosols	Click to select individual parameters

Spatial Resolution

Footprint (20 km nominal)

North 27
West 20.5 reset 21.0 East
26.5 South

Map

Satellite

Terra (3/2006 - 12/2010)
Aqua (1/2006 - 12/2010)

Time Range

Available Time Range: 3/1/2006 to 12/31/2010.
*** Missing dates: 2008/12/21, 2008/12/22

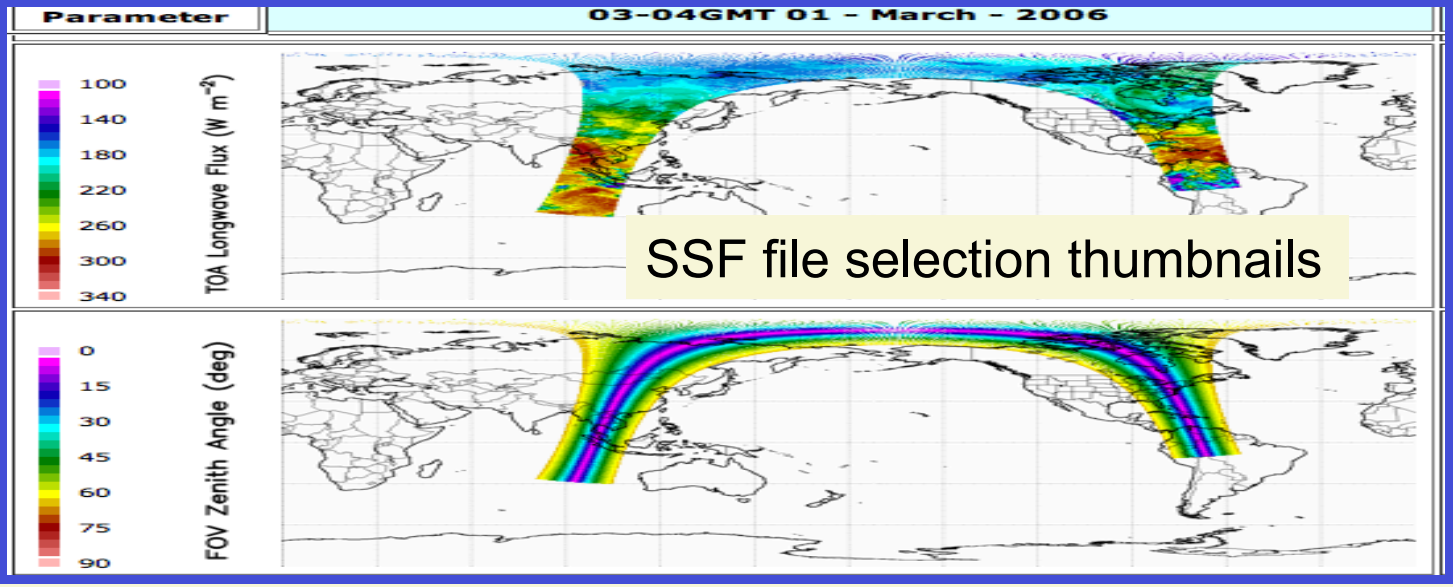
From: 03 - 01 - 2006 (MM-DD-YYYY) To: 12 - 31 - 2010 (MM-DD-YYYY)

- Previous range 2006-2010
- Current range 2000-2011
- The tool automatically picks the cross-track instrument

CERES

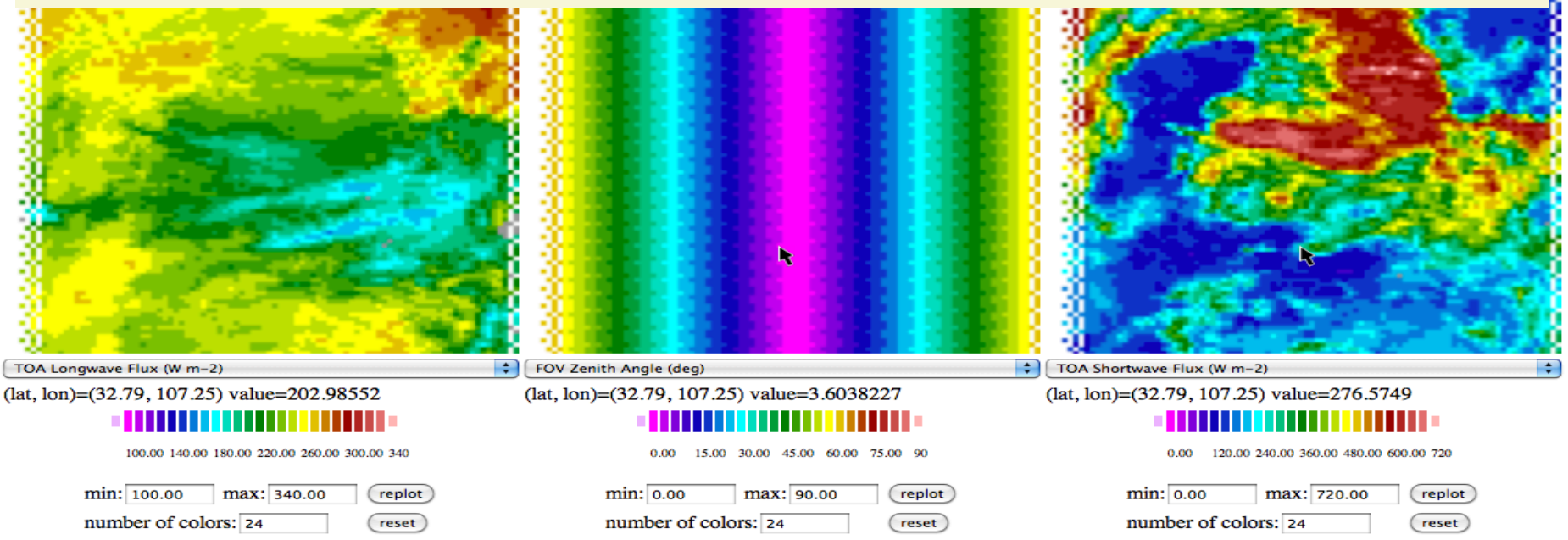
SSF level-2 visualization

(part of Demo)



SSF file selection thumbnails

Interactive visualization of selected parameters along the SSF ground track



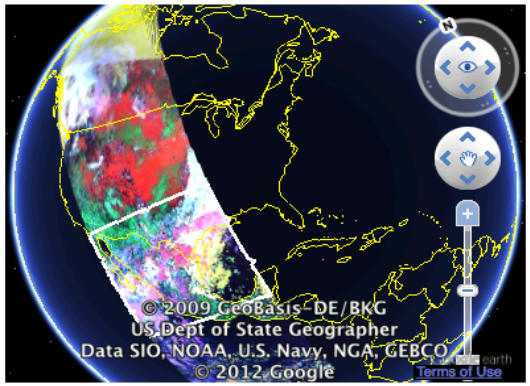
MODIS cloud visualization package

AquaValR1-Beta1-Ed4

2007-01-15 21:7:30 GMT

CER_ECV_Aqua-MODIS_AquaValR1-Beta1-Ed4_400400.2007011520

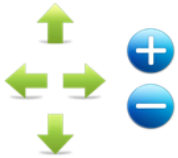
Previous Granule Next Granule



RGB

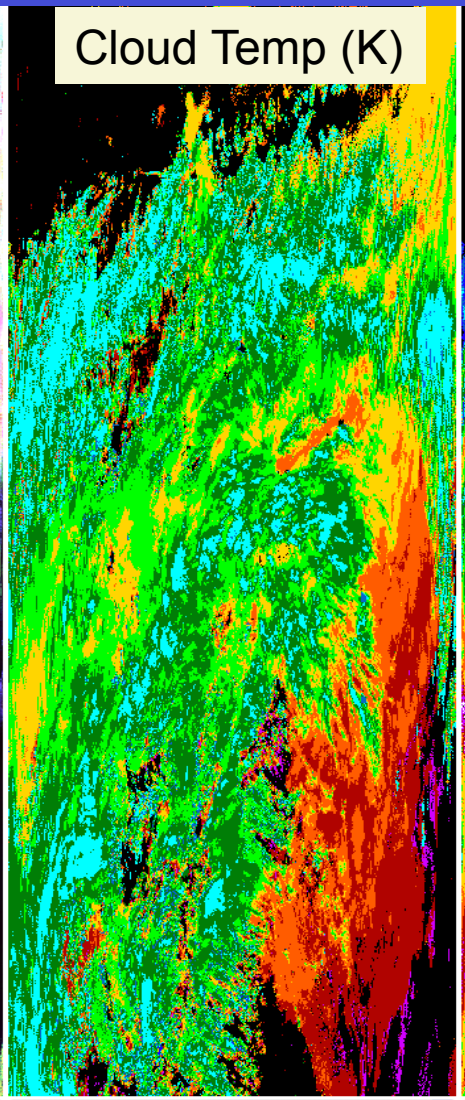
Pan/Zoom Control

Press z key and rotate mouse wheel can zoom in/out the images.

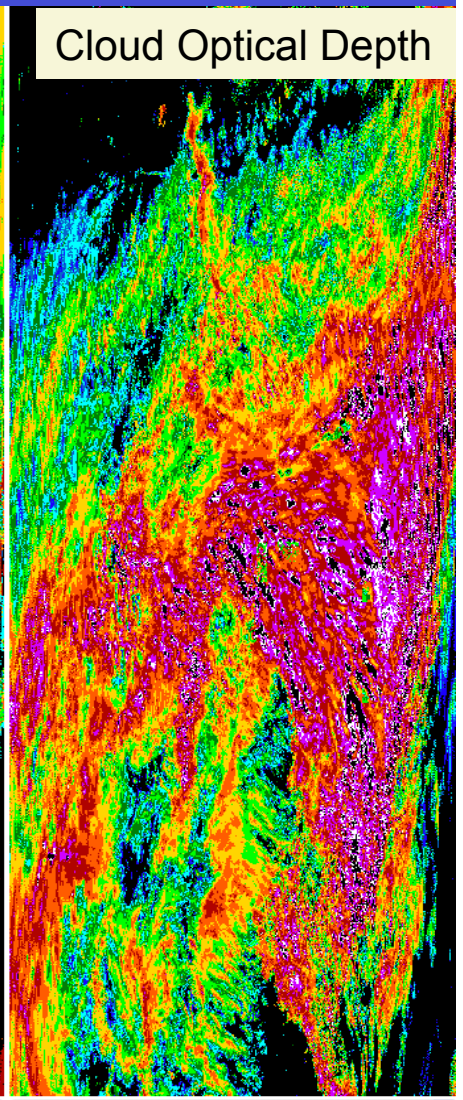


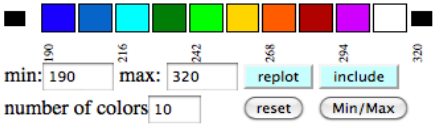
RGB

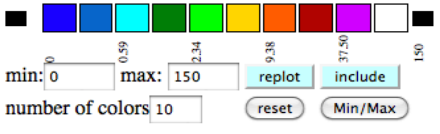
Eff_Cld_Temp[K]



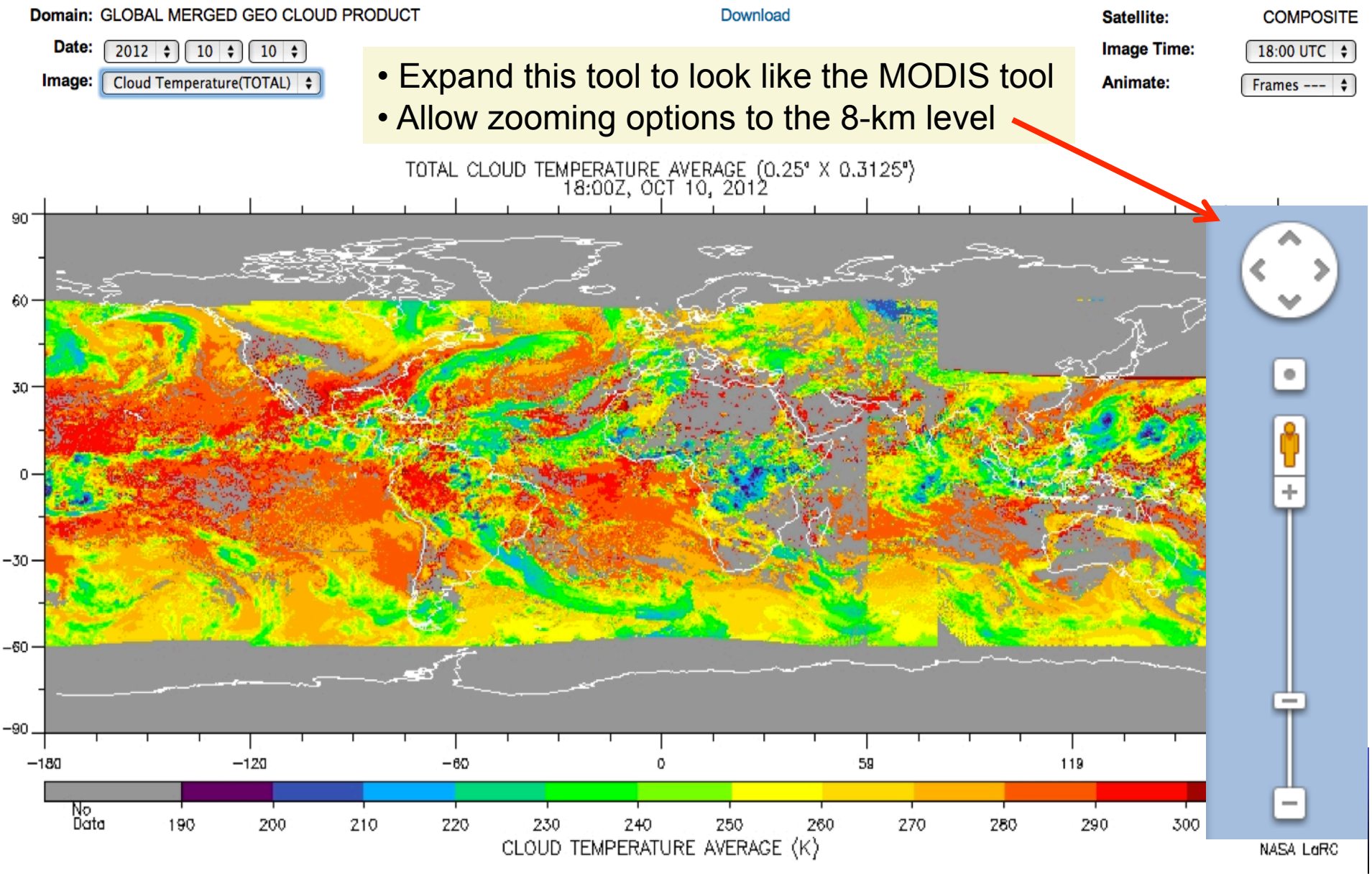
Eff_Cld_Optical_Depth





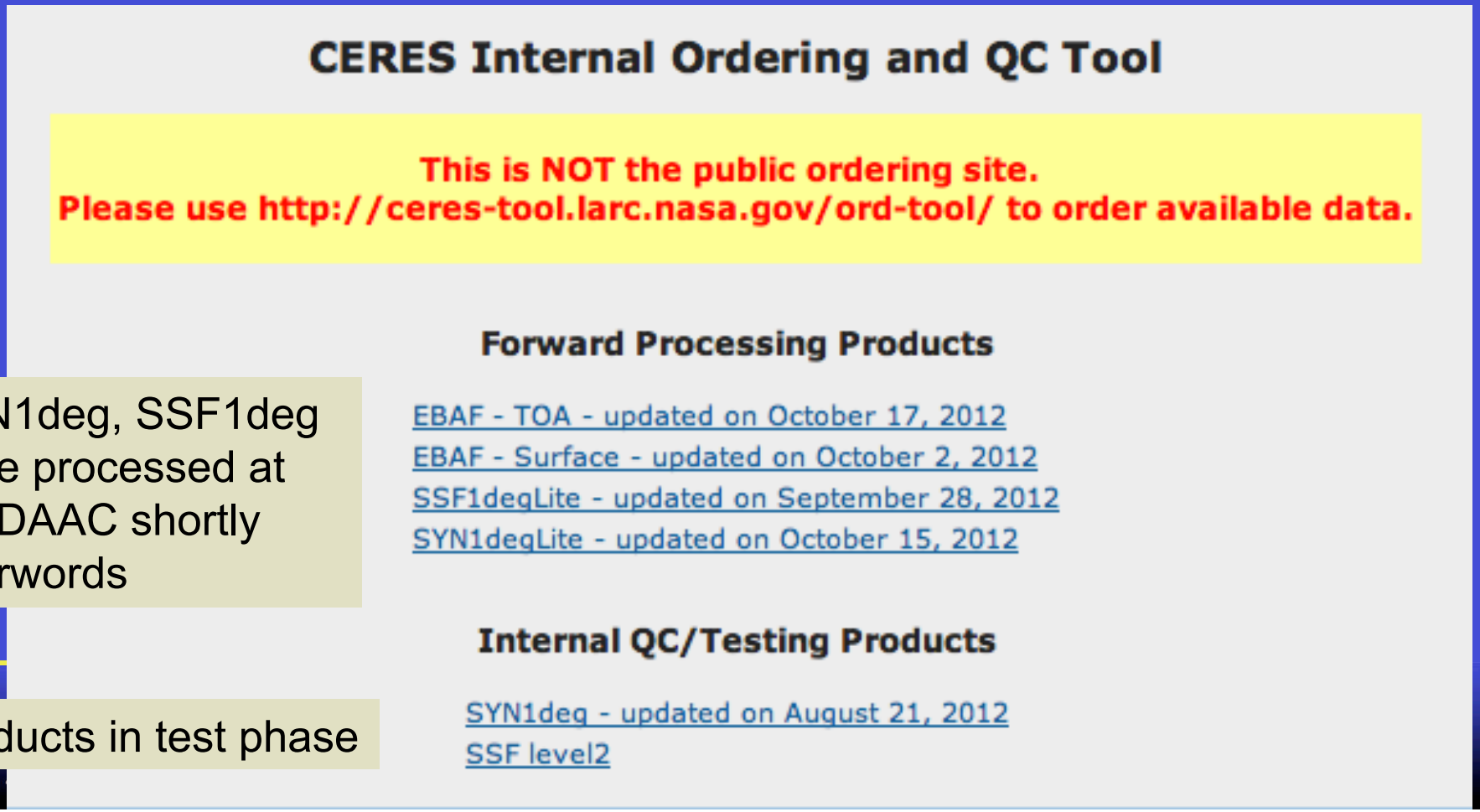


5 channel GEO cloud visualization tool



CERES internal web site for product review http://ceres-subset8.larc.nasa.gov/ord-tool

- Visualization provides parameter quality of control and quickly find outliers and review of parameters



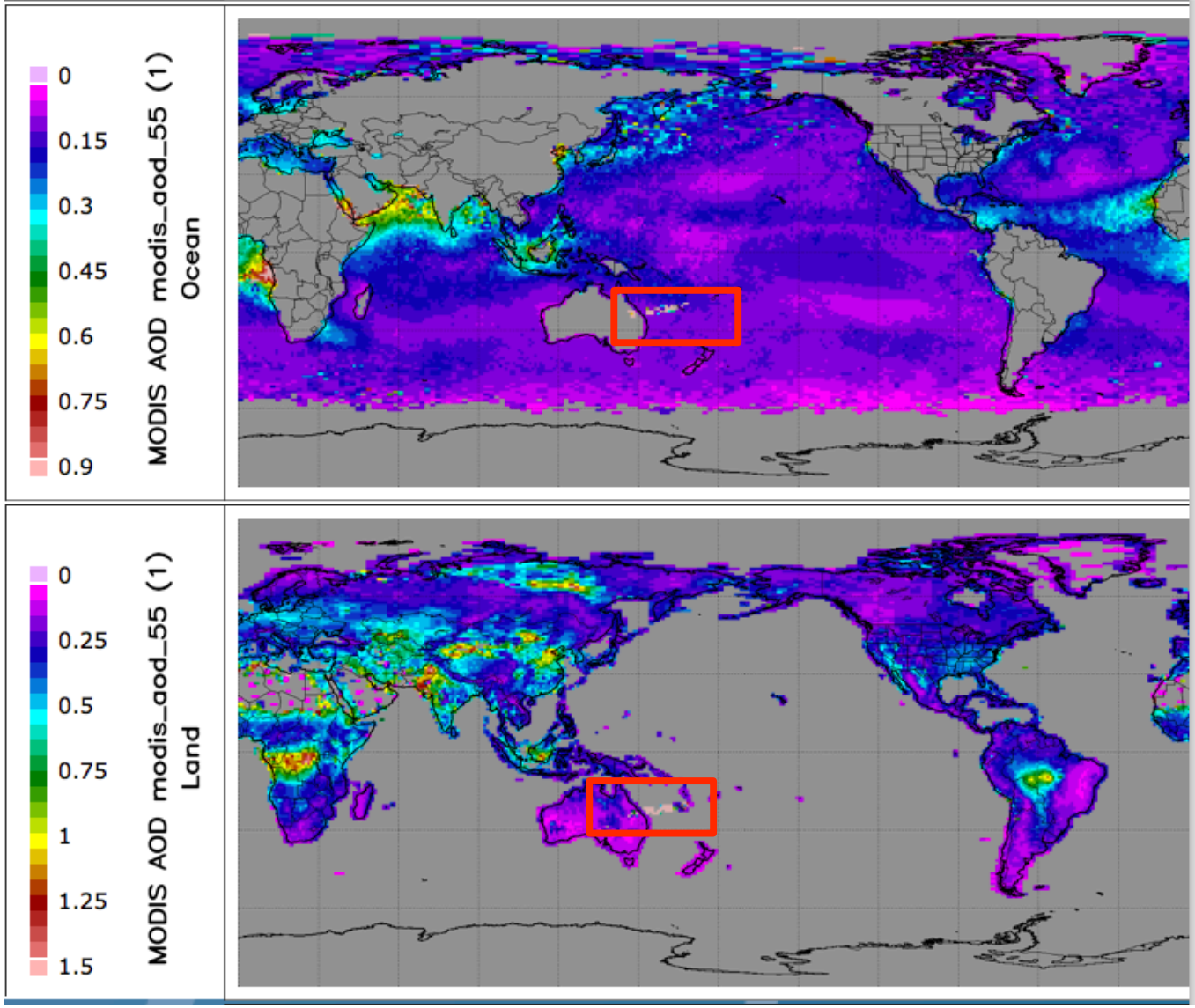
SYN1deg, SSF1deg to be processed at the DAAC shortly afterwords

Products in test phase

CERES_SYN1deg-Month_Terra-Aqua-MODIS_Ed3A - Regional Data Plots

March – 2001 ... November – 2011 Selection Page | Help

Parameter	August - 2002

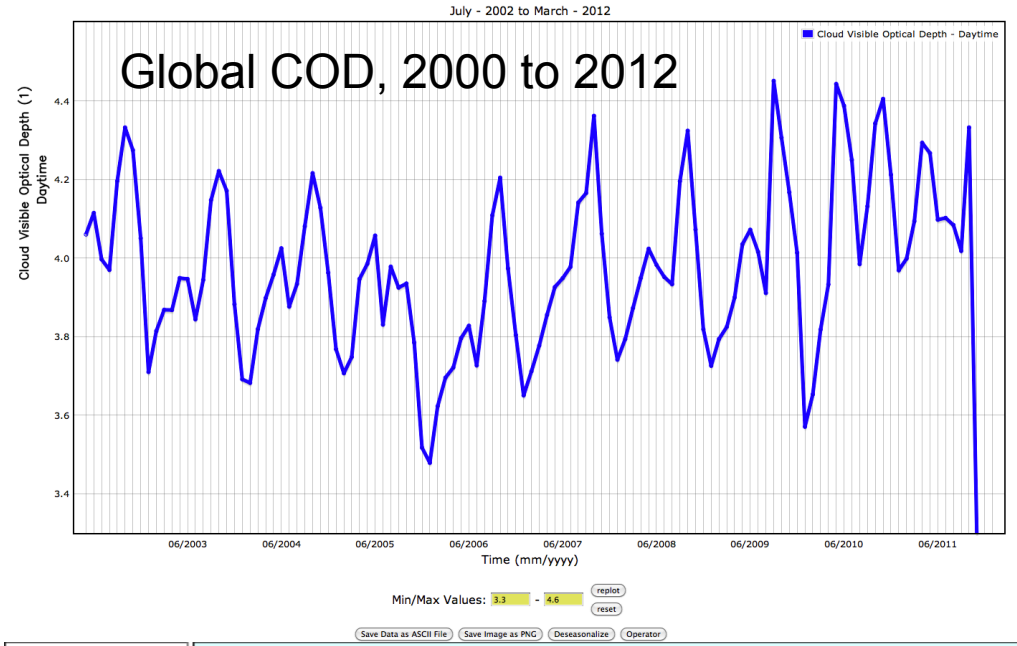


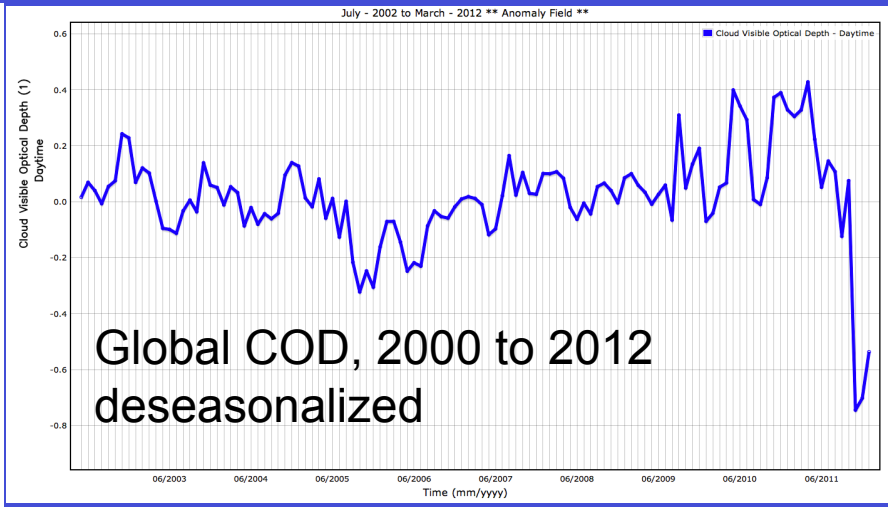
Example of product QC capable on the subsetter

SYN1deg anomalous MODIS aerosols in August 2002

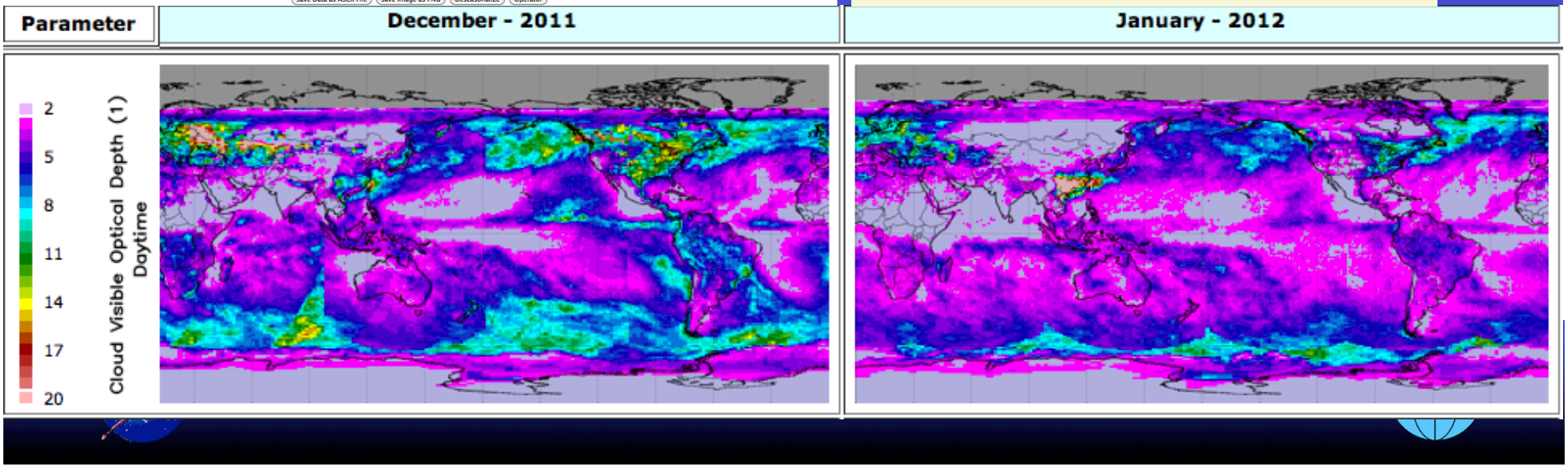
c Sciences

GEO cloud optical depth bug in 2012



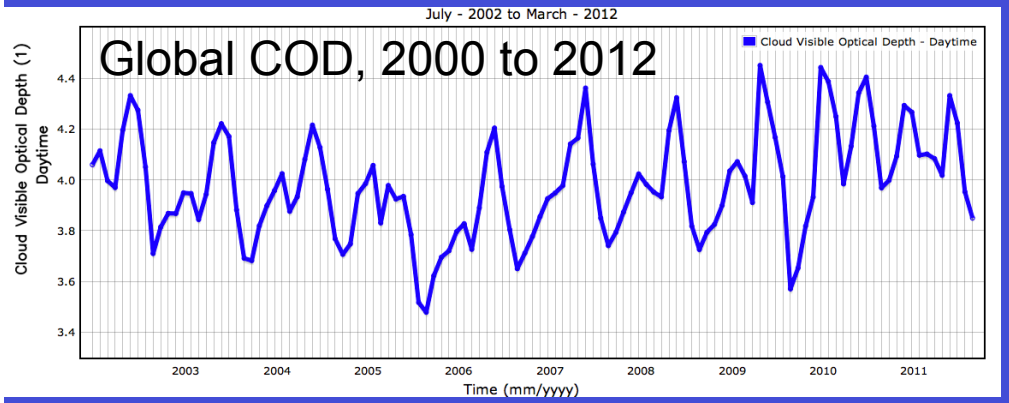


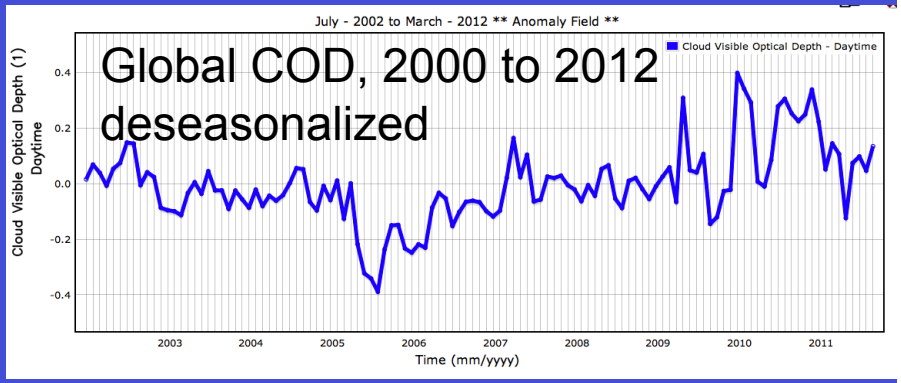
Verified in monthly plots

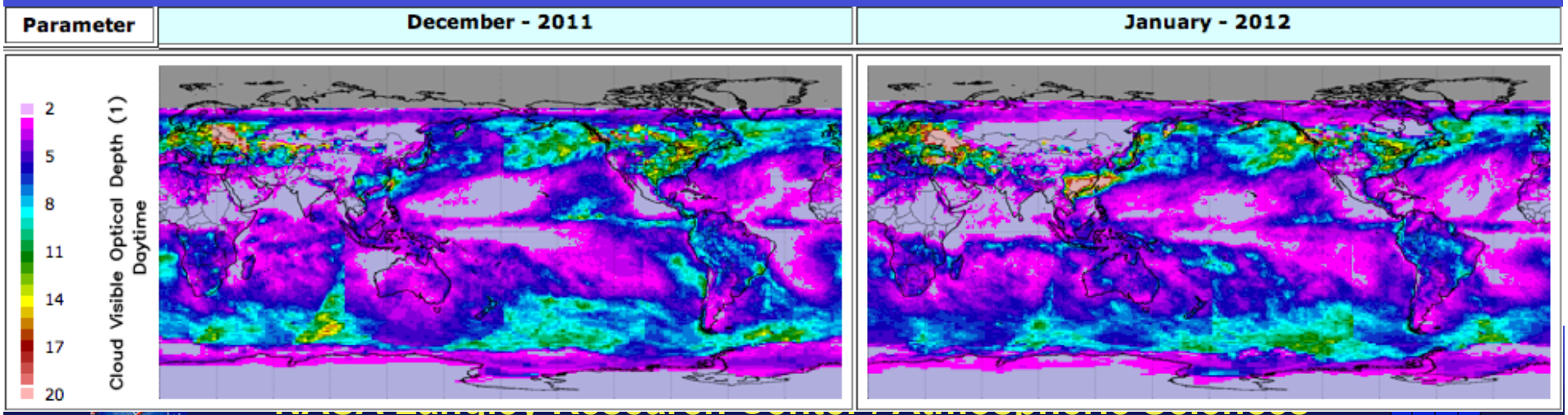


GEO cloud optical depth bug removed

Raja reran the 6 months, no changes to the code







CERES User Activity

Number of Users (Unique by Product and Time Period)

Products	FY10	FY11	FY12	FY13
EBAF-TOA	21	126	191	10
EBAF-Surface			79	5
SYN1deg-lite	25	115	149	5
SSF1deg-lite	29	102	96	4
ISCCP-D2like			25	
SSFlevel2			59	5
Total	53	242	357	22

- FY is between October to September
- 560 unique total number of users so far

Visualization Activity

Total Number of Users (Unique by time period)

FY10	FY11	FY12	FY13	Total Unique Users
53	242	357	22	560

Number of Browsers (Unique by Email)

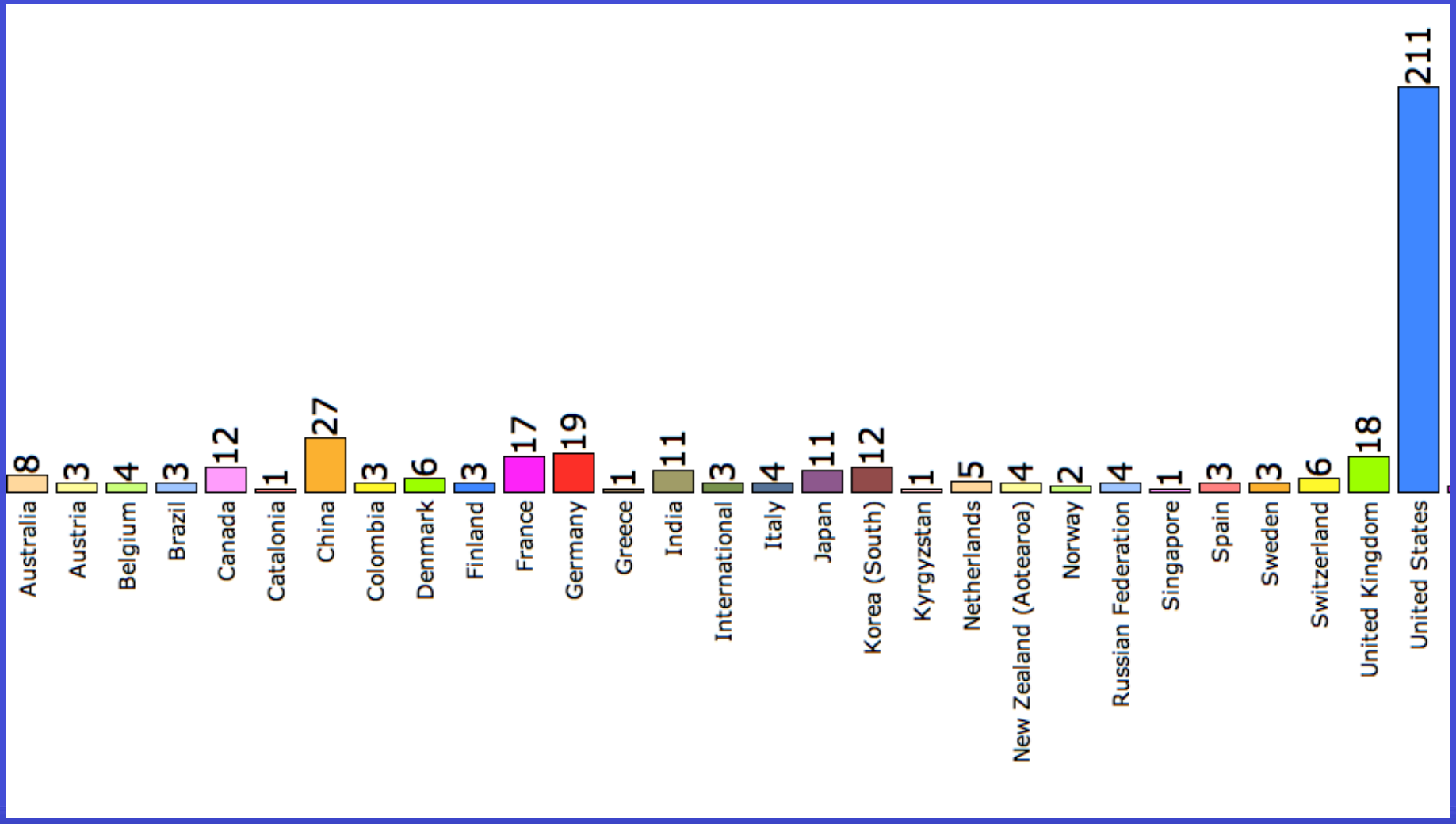
FY10	FY11	FY12	FY13	Total
33	136	179	11	298

Number of Browses Performed

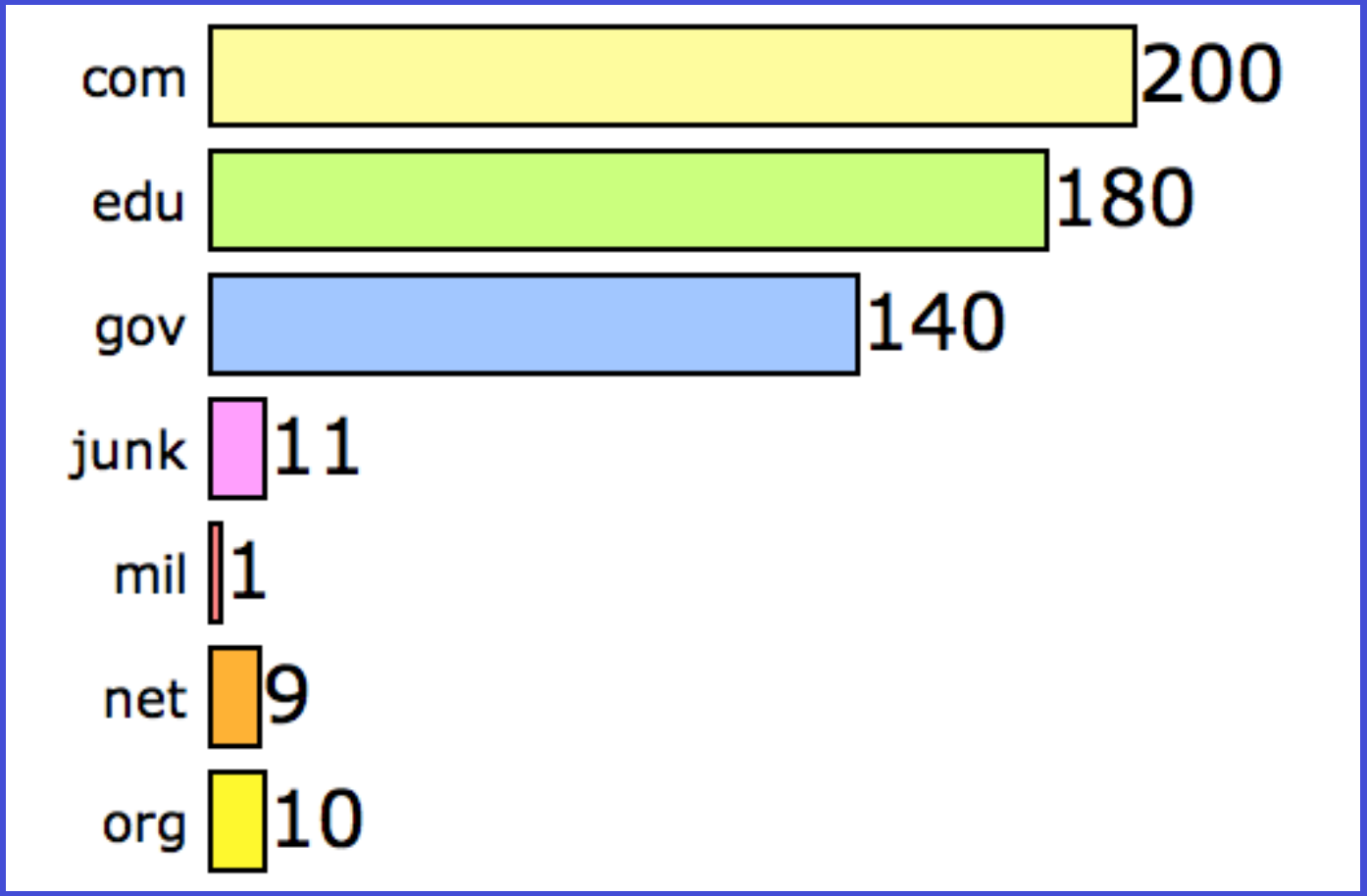
FY10	FY11	FY12	FY13	Total
641	1,711	2,338	63	4753

- Half of the users are visualizing
- On average 16 visualization events per user
- One visualization event is a set of ~150 thumbnail plots

Country origin of the 560 CERES email users



Categories of the 560 CERES email users



Number of Orders per Product

Number of Orders

Products	FY10	FY11	FY12	FY13	Total
EBAF-TOA	42	380	571	6	999
EBAF-Surface			158	5	163
SYN1deg-lite	62	483	608	16	1,169
SSF1deg-lite	103	518	584	2	1,207
ISCCP-D2like			42		42
SSFlevel2			119	8	127
Total	207	1,381	2,082	37	3,707

of files ordered on the subsetter compared to number of files needed if ordered from archive

Number of Files (Equivalent to ASDC)

Products	FY10	FY11	FY12	FY13	Total	# of orders
EBAF-TOA	42	380	571	6	999	999
EBAF-Surface			158	5	163	163
SYN1deg-lite	5,745	27,502	16,344	1,720	51,311	1,169
SSF1deg-lite	9,874	43,284	11,621	23	64,802	1,207
ISCCP-D2like			4,084		4,084	42
SSFlevel2			642,400	91,980	734,380	127
Total	15,661	71,166	675,178	93,734	855,739	3,707

- EBAF products are contained in a single netCDF file (1 to 1 reduction)
- SYN1deg/SSF1deg/ISCCP-D2like are in monthly HDF files (50 to 1 reduction)
- SSF level 2 footprint are in hourly HDF files (5800 to 1 reduction)

- Maximum subsetter file size is 2 GB

CERES Ordering Tool Summary

- New subsetted products:
  - SYN1deg full parameter product from DAAC HDF files
  - SSF level 2 temporal coverage extended from 2000 to 2011
- New features:
  - New statistic tools (internal only)
  - Cross and within product parameter comparison tool
- CERES internal subsetter available for validation of products before delivery of code
  - Available to other subsystems to help with QC
  - http://ceres-subset8.larc.nasa.gov/ord-tool/

CERES subsetter 6 month goals

- Extend the EBAF, SYN1deg-lite, SSF1deg-lite, between Jan to Jun 2012
  - These products will have 6 months updates at every CERES STM
- Build the SYN1deg-3Hour, -M3Hour subsetter
  - Now feasible since there is access behind the firewall
  - Might include limited subsetting of 1-hourly flux and cloud properties over limited sites - designed for the surface flux community
  - DAAC has completely processed the dataset
- GEO pixel level cloud retrieval visualization tool
  - Similar to the MODIS cloud retrieval visualization tool
- Develop level-3 product comparison tools
  - CERES and other PCDMI datasets
  - CERES product comparison

TISA Edition 4 Improvement Summary

- 1-hour GEO temporal resolution
  - MTSAT-1R sensor nonlinearity correction by optimizing the pixel point spread function
  - Automate GEO bad scan line removal
- Multi-tiered GEO calibration approach, based on Aqua-MODIS calibration
  - Ed2: GEO/Terra-MODIS ray-match calibration transfer
  - Take into account the band spectral response
  - Convert to VIIRS from Aqua-MODIS
- 5 channel GEO cloud retrievals with Cloud group
- LW NB to BB
  - IR + WV to GEO BB radiance
  - Use CERES LW ADM to convert from BB radiance to flux
  - LW regional normalization
- SW NB to BB
  - Test GEO NB to BB for GEO BB, instead of converting to MODIS band and then to BB
- Validation with GERB and Megha-tropiques TOA fluxes
- Validation of ground site fluxes with SARB group

TISA deliveries

- Terra/Aqua SSF1deg-Month Edition3, Oct 2012
- Terra/Aqua Flux-by-Cloud-type Edition 3, Dec 2012
- Terra/Aqua SSF1deg-hour Edition 4, Jun 2013
- Terra/Aqua SSF1deg-Month Edition 4, Jul 2013
- NPP SSF1deg-hour Edition 1, Jul 2013
- NPP SSF1deg-Month Edition 4, Jul 2013
- Terra/Aqua TSI/SYNI/SYN1deg-Month Ed4, Dec 2013
- NPP TSI/SYNI/SYN1deg-Month Ed1, April 2014
- Terra/Aqua ISCCP-D2like Edition 4, May 2014
- Terra/Aqua Flux-by-Cloud-type Edition 4, Sep 2014

Back Up Slides

TISA papers

- **TISA Papers Submitted**
- D. R. Doelling, N Loeb, D. F. Keyes, M. L. Nordeen, D. Morstad, B. A. Wielicki, D. F. Young, M. Sun, Geostationary Enhanced Temporal Interpolation for CERES flux products, *J. Tech*., To be submitted May 2012
- Sun, Moguo, Robert Cess, D. R. Doelling, 2011, Interpretation of cloud structure anomalies over the tropical Pacific during the 1997/98 El Nino, *Journal of Geophysical Research*, submitted February 2011

GEO Calibration publications

- **Calibration Papers Published**
- **Doelling, D. R., C. Lukashin, P. Minnis, B. Scarino, and D. Morstad**, 2012: Spectral reflectance corrections for satellite intercalibrations using SCIAMACHY data. Geosci. Remote Sens. Lett., **9**, pp 119-123, doi:10.1109/LGRS.2011.2161751
- **Calibration Papers Submitted**
- Aisheng Wu, X. Xiong, **D. Doelling, D. Morstad**, A. Angal, and **R. Bhatt**, 2011, Characterization of Terra and Aqua MODIS VIS, NIR and SWIR Spectral Bands Calibration Stability, Submitted to IEEE *Geoscience and Remote Sensing Letters*, Nov 2011
- G. Chander, N. Mishra, D. L. Helder, D. B. Aaron, A. Angal, T. Choi, X. Xiong, **D. Doelling**, 2011, Applications and Limitations of Spectral Band Adjustment Factors (SBAF) for Cross-calibration, IEEE *TGRS*, Nov 2011
- **Bhatt, R., D. R. Doelling, D. Morstad, B. R. Scarino, A. Gopalan**, "Desert-based absolute calibration of successive geostationary sensors using a daily TOA radiance model", Submitted to IEEE *Geoscience and Remote Sensing Letters*, Feb 2012.
- **D. R. Doelling, D. Morstad, B. R. Scarino, R. Bhatt, A. Gopalan**, "The characterization of Deep Convective Clouds as an invariant calibration target and as a visible calibration technique", Submitted to IEEE *Geoscience and Remote Sensing Letters*, Feb 2012.
- **D. R. Doelling, B. R. Scarino, D. Morstad, A. Gopalan, R. Bhatt, C. Lukashin, P. Minnis**, "The calibration of geostationary visible imagers using operational hyper-spectral SCIAMACHY radiances", Submitted to IEEE *Geoscience and Remote Sensing Letters*, Feb 2012.

GEO visible Calibration Improvements

	Edition 2/3	Edition 4
Calibration Reference	Terra-MODIS Collection 5	• Aqua-MODIS Collection 6 • Terra-MODIS radiometrically scaled to Aqua-MODIS
Reference Calibration Transfer	• GEO/Terra-MODIS ray-matching	• GEO/Terra-MODIS ray-matching • GEO/Aqua-MODIS ray-matching • Deep Convective Clouds (DCC) • Deserts • GEO/SCIAMACHY ray-matching • Combine results for final calibration
Spectral band adjustment factor (SBAF)	No GEO/MODIS SBAF	• GEO/MODIS SBAF • DCC and desert SBAF • not necessary for GEO/SCIAMACHY
GEO updates	• 2-3 year incremental updates	• One set of calibration coefficients over the GEO lifetime
GEO IR calibration	GEO/Terra-MODIS ray-matching	• Use GSICS GEO IR calibration corrections based on either IASI or AIRS

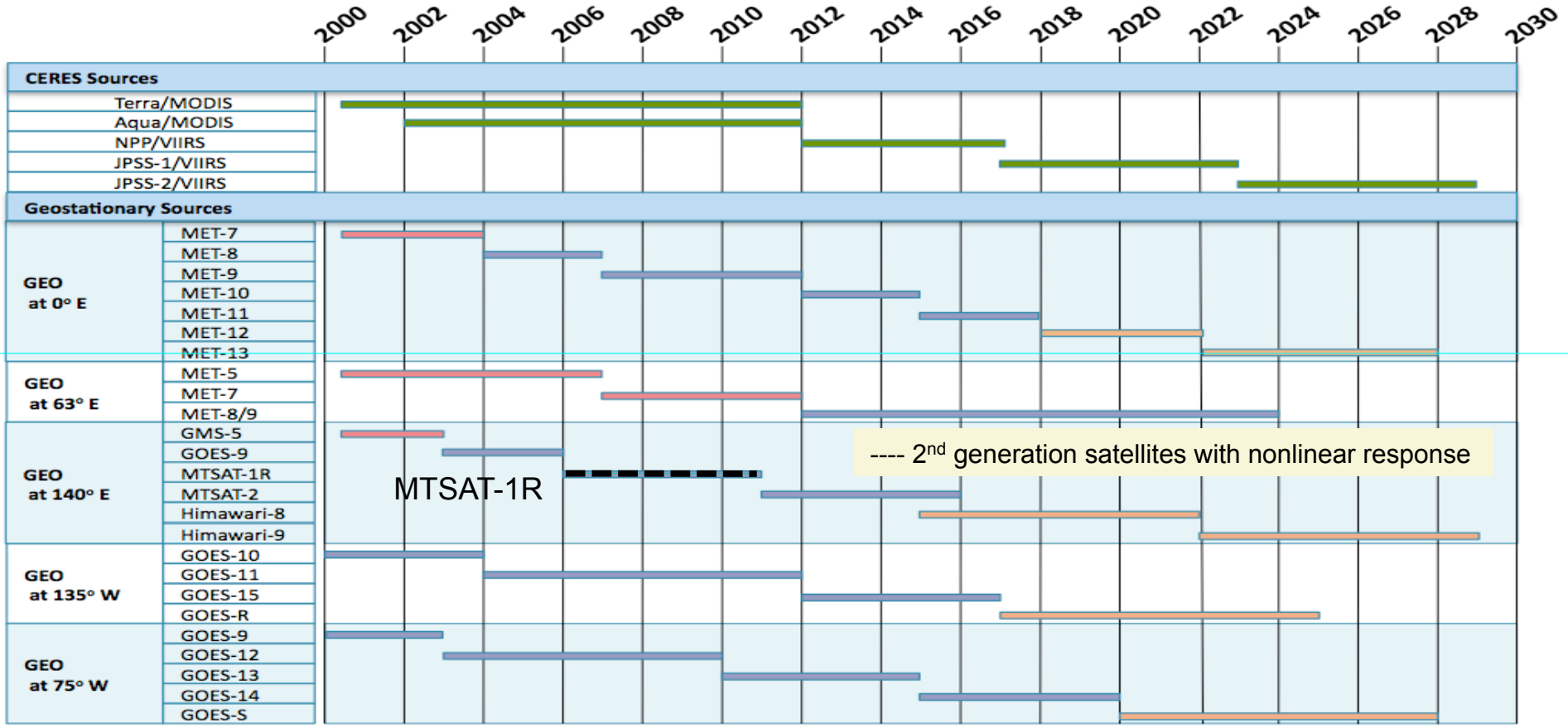
GEO cloud property improvements

Parameter	Edition 2/3 (2 channel VIS and IR)	Edition4 (multi-channel)
Cloud particle size	Assume 10μm radii water and 60μm diameter ice	Obtained explicitly from the 3.7μm channel (daytime only) Night combination of 3.7,11 and 12
Water path	Assumed particle size	Use retrieved cloud particle sizes
Night IR emissivity	Assume 1	Based on optical depth (good for optical thin clouds) Possibly utilize WV channel
Cloud effective Cloud base and top	No adjustment at night Based on ground site	Based on emissivity New parameterizations based on Cloudsat
Optical depth	Day only	Night, use 11μm (small optical depths)
Cloud mask	Visible and IR only Use MODIS 0.65 clear-sky albedo-map	Based on all channels Use GEO specific clear-sky maps
Cloud phase	253°K cloud effective Temperature threshold	Mulit-channel and threshold algorithm

Rabi will present

GEO Satellite Chart

GEO cloud retrieval
1st generation 2 channel (Ed2/3)
2nd generation 5 channel (Ed4)
3rd generation MODIS/VIIRS



GEO satellites	1st	2nd	3rd
Channels	3 (VIS,WN,WV)	5 (AVHRR) 9=Met8/9 (15min FD)	16 (MODIS) 15 min FD
IR resolution	4km	4km	2km
VIS resolution	1km	1km	0.65μm @0.5km
VIS calibration	no	no	Solar Diffuser