TISA (Time-Space Averaging) Update

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17th CERES-II Science Team Meeting
Newport News, May 1-3, 2012

Outline

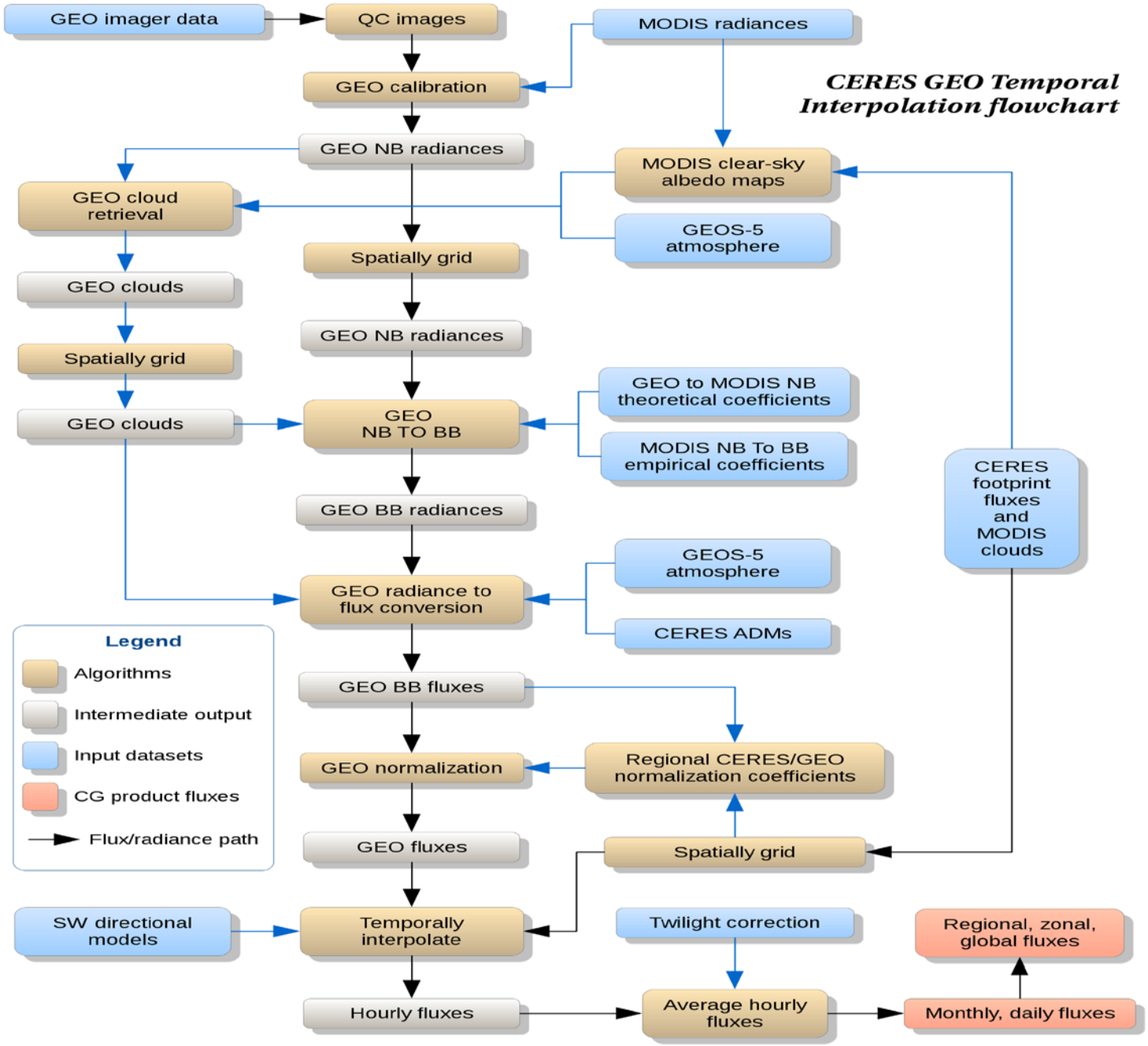
- TISA Edition4 improvement
- GEO/SCIAMACHY calibration
- Diurnal flux validation using GERB
- Flux by cloud-type
- CERES prototype ordering tool improvements
- SSF level-2 visualizer demonstration
  - Cristian Mitrescu

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.


CERES GEO Temporal Interpolation flowchart
GEO imager data
QC images
MODIS radiances
GEO calibration
GEO NB radiances
MODIS clear-sky albedo maps
GEO cloud retrieval
GEOS-5 atmosphere
Spatially grid
GEO clouds
GEO NB radiances
Spatially grid
GEO to MODIS NB theoretical coefficients
GEO clouds
GEO NB TO BB
MODIS NB To BB empirical coefficients
CERES footprint fluxes and MODIS clouds
GEO BB radiances
GEOS-5 atmosphere
GEO radiance to flux conversion
CERES ADMs
Legend
Algorithms
Intermediate output
Input datasets
CG product fluxes
Flux/radiance path
GEO BB fluxes
GEO normalization
Regional CERES/GEO normalization coefficients
GEO fluxes
Spatially grid
SW directional models
Temporally interpolate
Twilight correction
Regional, zonal, global fluxes
Hourly fluxes
Average hourly fluxes
Monthly, daily fluxes

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

GSICS

- The World Meteorological Organization (WMO) Global Space based Inter-Calibration System (GSICS) community to monitor, improve and harmonize data quality from operational satellites for climate monitoring
  - CMA, CNES, EUMETSAT, ISRO, IMD, JAXA, JMA, KMA, NASA, NIST, NOAA, ROSHYDROMET, USGS, WMO
- GSICS studies have demonstrated the benefit of using hyper-spectral infrared instruments to correct GEO IR data using either IASI or AIRS
  - CERES ED4 to use GSICS IR corrections beginning in 2002 (AIRS)
- GSICS planning on using CERES DCC and GEO/SCIAMACHY methods to correct GEO visible data
- D. Doelling, and P. Minnis have attended GSICS annual meetings since 2008 gaining valuable insight in GEO and MODIS/VIIRS calibration issues

MODIS Collection 5 to 6 calibration improvements (Jack Xiong)

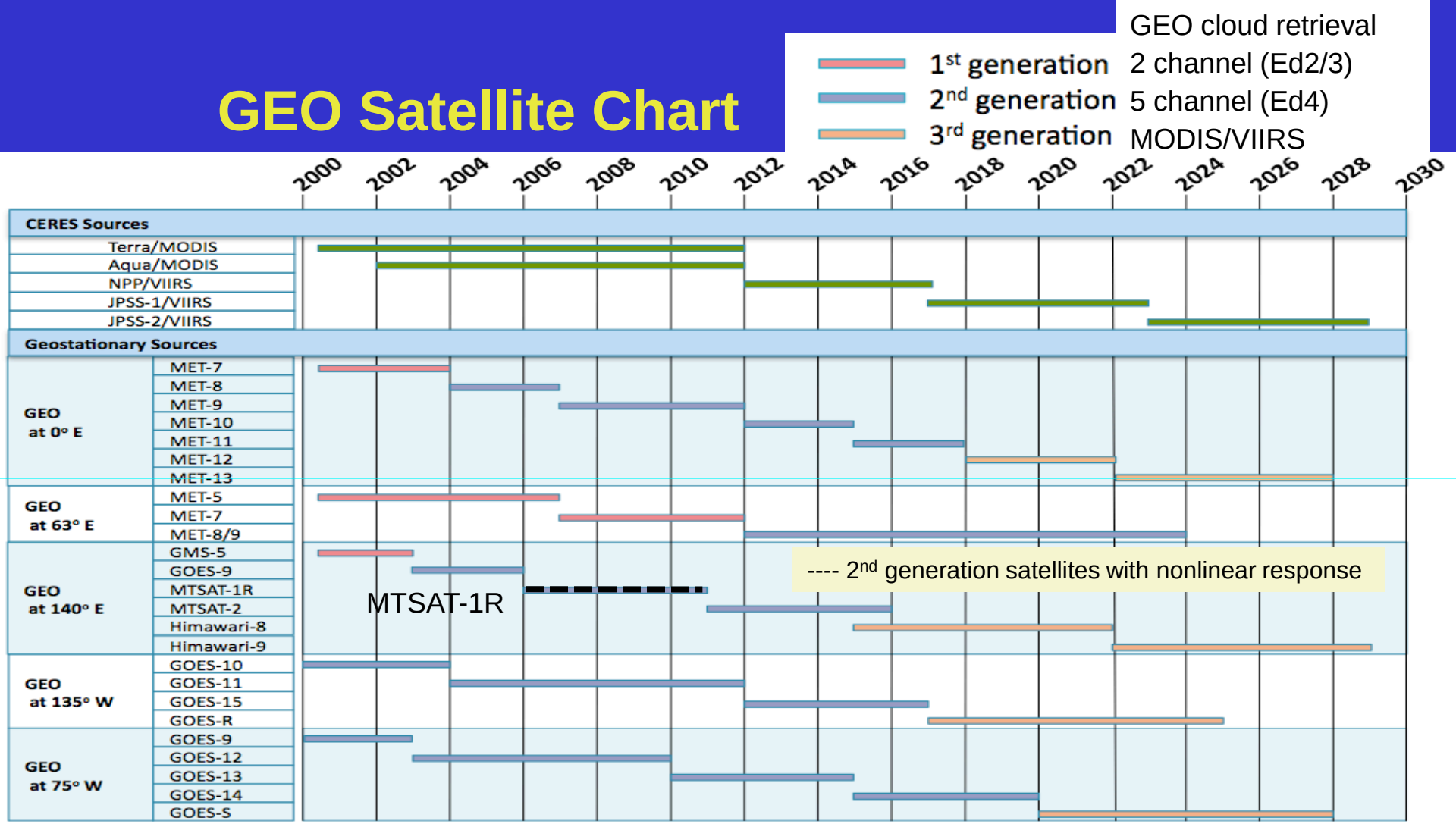
- MODIS Collection 6 calibration and algorithms have been approved
  - 1-year to process the entire Aqua and Terra record (20x)
- Most improvements were for Terra-MODIS
  - Terra-MODIS 3.7µm and CO2 channels were calibrated against IASI by Chris Moeller and corrections were implemented
  - No change for Aqua-MODIS IR
  - Terra-MODIS visible channels have been corrected for scan angle dependencies
  - Removed the calibration anomalies in 2003 (diffuser door in open position) and 2009 (absolute calibration adjustment)
  - Virtually no correction for Aqua-MODIS visible

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 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

GEO LW NB to BB Improvements

	Edition 2/3	Edition 4
LW NB to BB	• Simple Window (11µm) limb-darkening function from radiance to flux • Simple Window flux and column weighted humidity global regression	• Two step approach - GEO to MODIS NB spectral conversion based on MODTRAN - SSF based MODIS NB to BB • 11µm, 12µm and WV channels
LW ADM (radiance to flux conversion)		• CERES LW ADM
GEO/CERES normalization	• Instantaneous	• 5° by 5° regional normalization

GEO SW NB to BB Validation

	Edition 2/3	Edition 4
SW NB to BB	• Two step approach - GEO to MODIS NB spectral conversion based on MODTRAN - SSF based MODIS NB to BB	• Validate two step approach • Some 1st generation GEO satellite channels are nearly broadband, test GEO to BB • For Meteosat-8/9 use 0.65µm and 0.86µm channels to test procedure for 3rd generation GEO
SW ADM (radiance to flux conversion)	• CERES-TRMM SW ADM	• CERES-TRMM SW ADM
GEO/CERES normalization	• 5° by 5° regional normalization	• 5° by 5° regional normalization

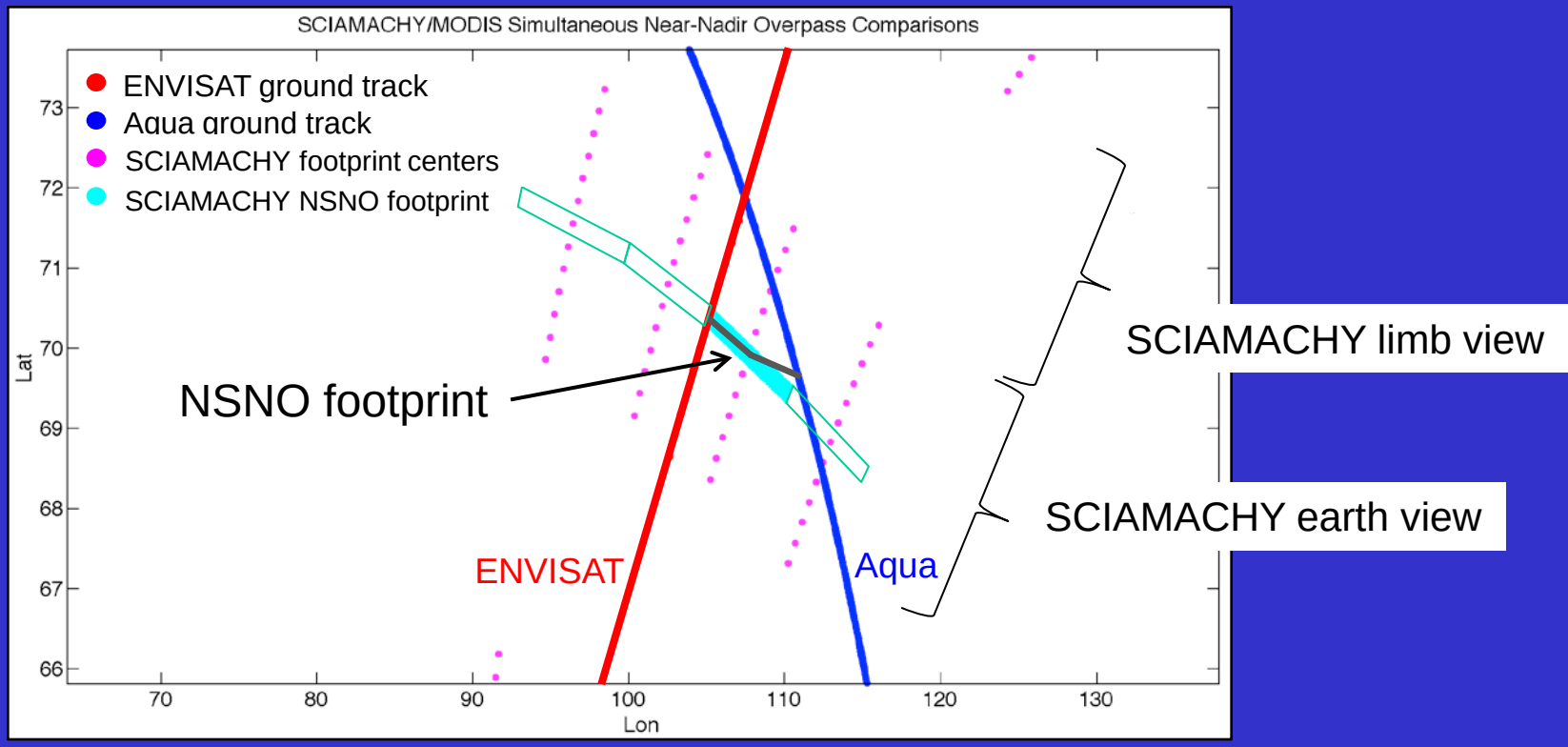
TISA Edition 4 (SYN, CERES/GEO) Improvement Summary

- 1-hour GEO temporal resolution
  - Ed2: 3-hour GEO temporal resolution
  - MTSAT-1R sensor nonlinearity correction by optimizing the pixel point spread function
  - Test half-hour temporal increments (GMT based)
- Merge Terra and Aqua together for SYN stream
  - Aqua radiometrically scaled to Terra in Edition3
  - Ed2: Individual satellite records
- 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
- GEO cloud retrievals to take advantage of all GEO channels available
  - Ed2: 2-channel Visible and IR channel cloud retrievals
- LW NB to BB, implement NB to BB angular model, and regional normalization
- SW NB to BB validate Edition2 approach

GEO/SCIAMACHY-hyperspectral ray-match calibration

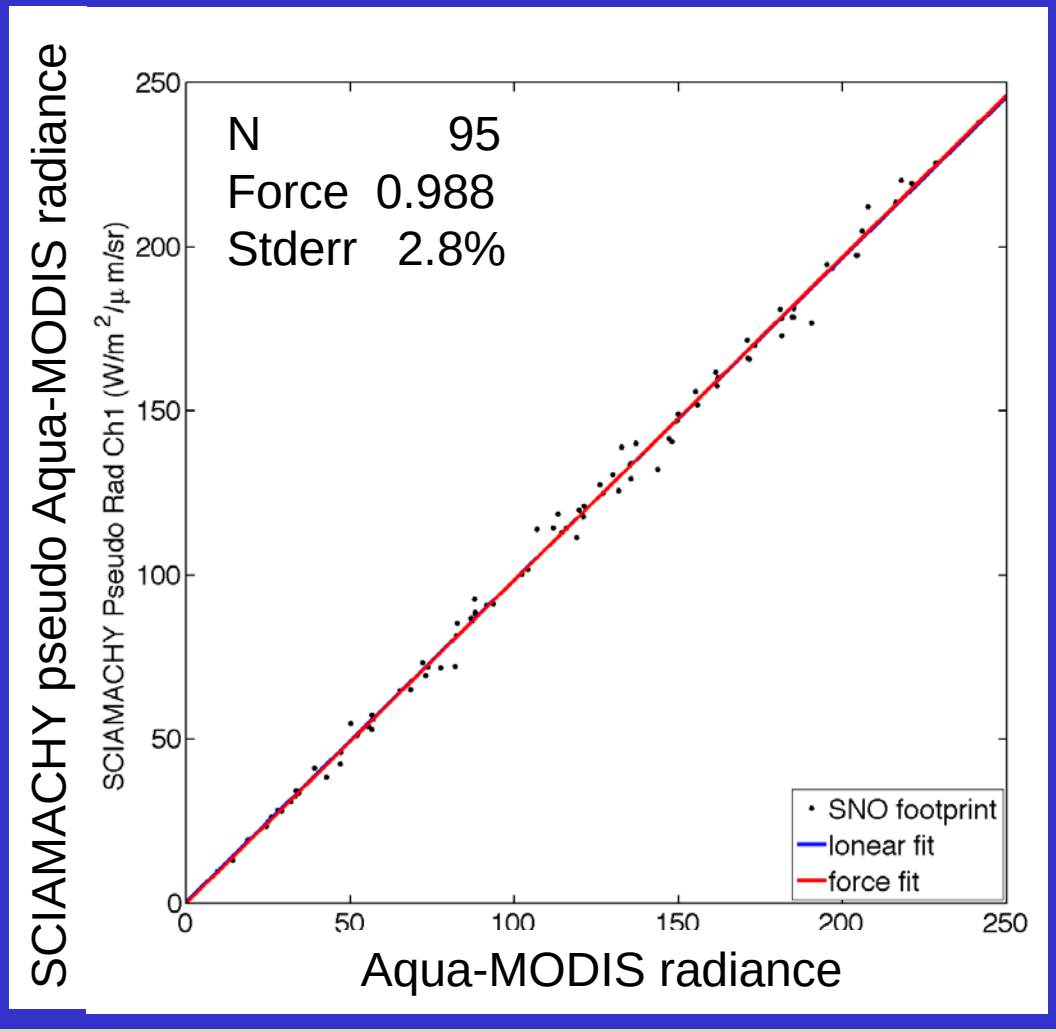
- Use Aqua-MODIS as the visible reference for all comparisons
  - Aqua-MODIS more stable than Terra-MODIS
  - Not based on if Aqua or Terra-MODIS is brighter
- Inter-calibrate SCIAMACHY and Aqua-MODIS 0.65µm channel using NSNOs
  - Determine SCIAMACHY stability compared against Aqua-MODIS
  - Determine relative calibration difference
- Inter-calibrate GEO with SCIAMACHY pseudo (GEO SRF) radiances using ray-matching
  - Validate with ray-matched Aqua-MODIS and GEO calibration

SCIAMACHY Aqua-MODIS NSNO (top view)



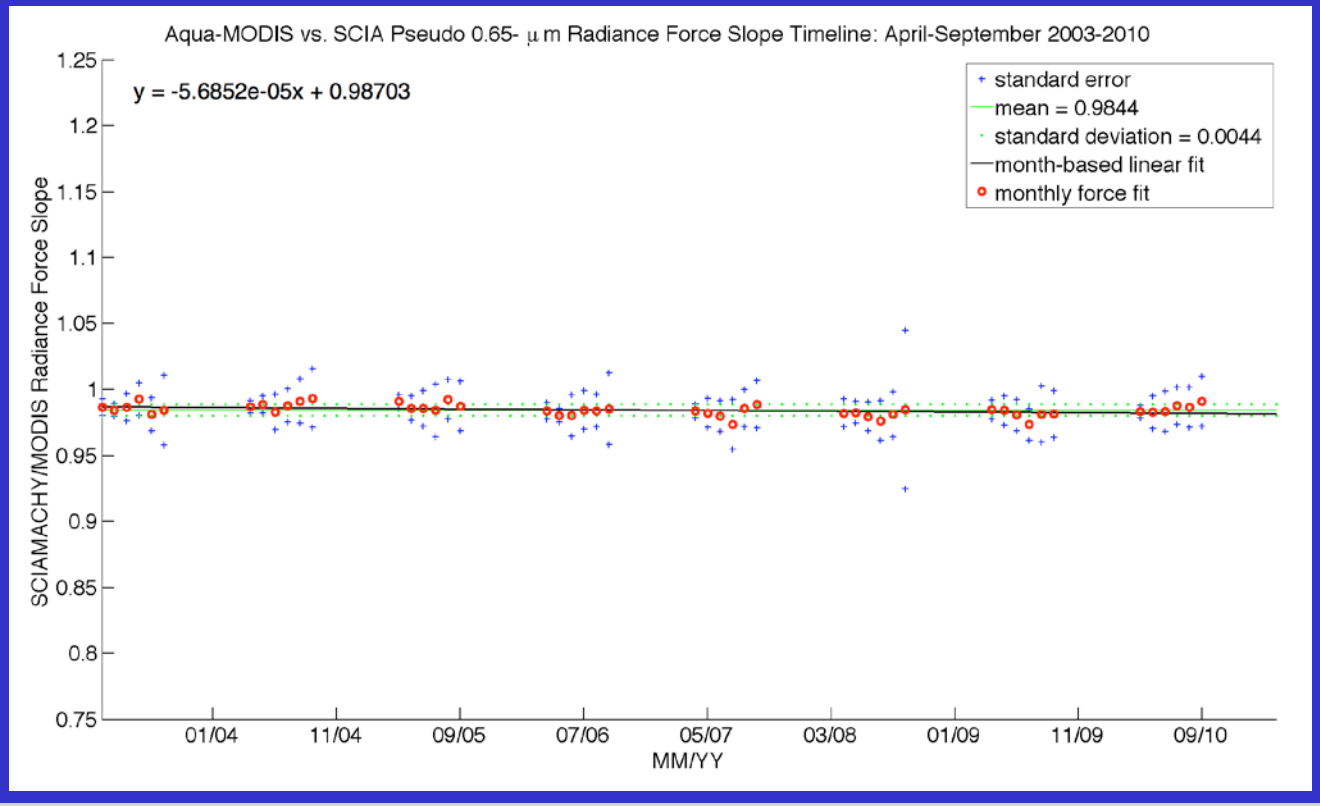
- There are 4 30x240km SCIAMACHY cross-track footprints
- NSNO local time is 11:45AM, near local noon, assuring azimuthal match
- The Envisat and Aqua ground intersect is at 71°N and occurs 14 x daily
- Perform monthly regressions of SCIAMACHY and Aqua radiance pairs between April and September, pairs must have SZA<70°

SCIAMACHY Aqua-MODIS 0.65µm, July 2010



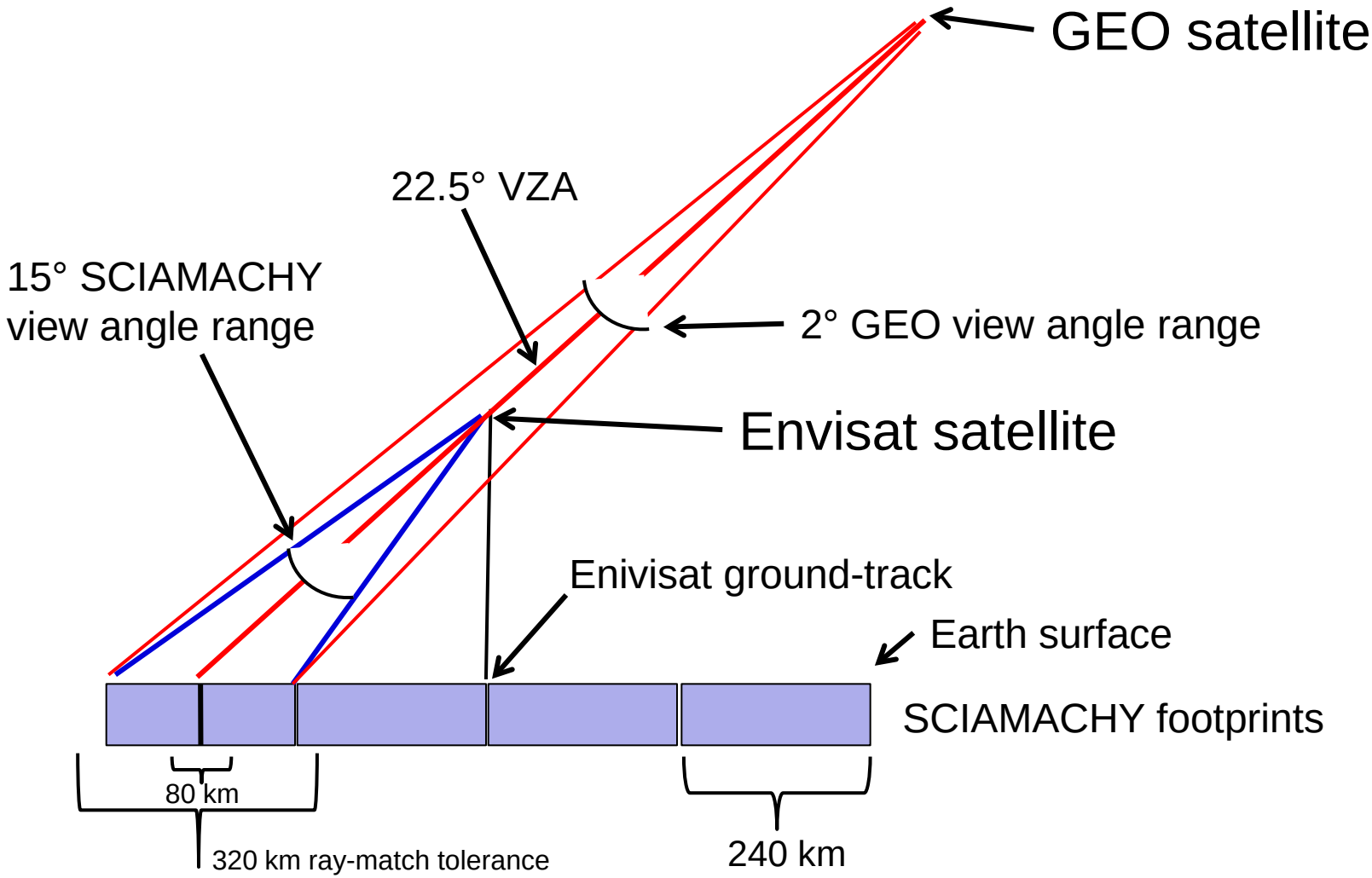
- 15 minute coincident, <70° SZA
- ~1300 2-km sub-sampled MODIS pixels are averaged into a 30x240km SCIAMACHY footprint

SCIAMACHY Aqua-MODIS 0.65µm, 2004-2010

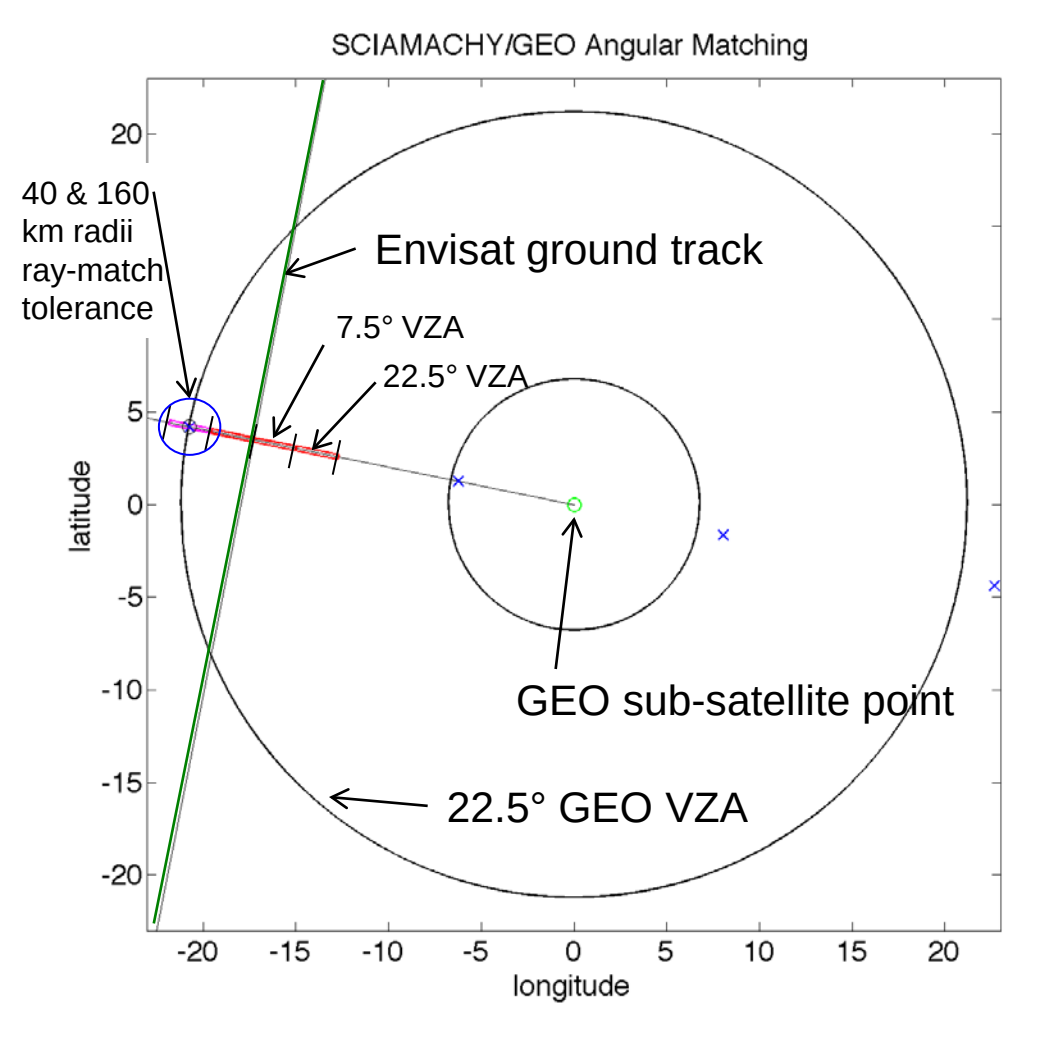


- Monthly standard deviation of force fits = 0.44%
- Relative temporal trend of -0.2%/decade
- SCIAMACHY is temporally calibrated as well as Aqua-MODIS
- both use solar diffusers for on orbit calibration
- both are within their uncertainty of 2% at 0.65µm

GEO SCIAMACHY precise ray-matching (side view)

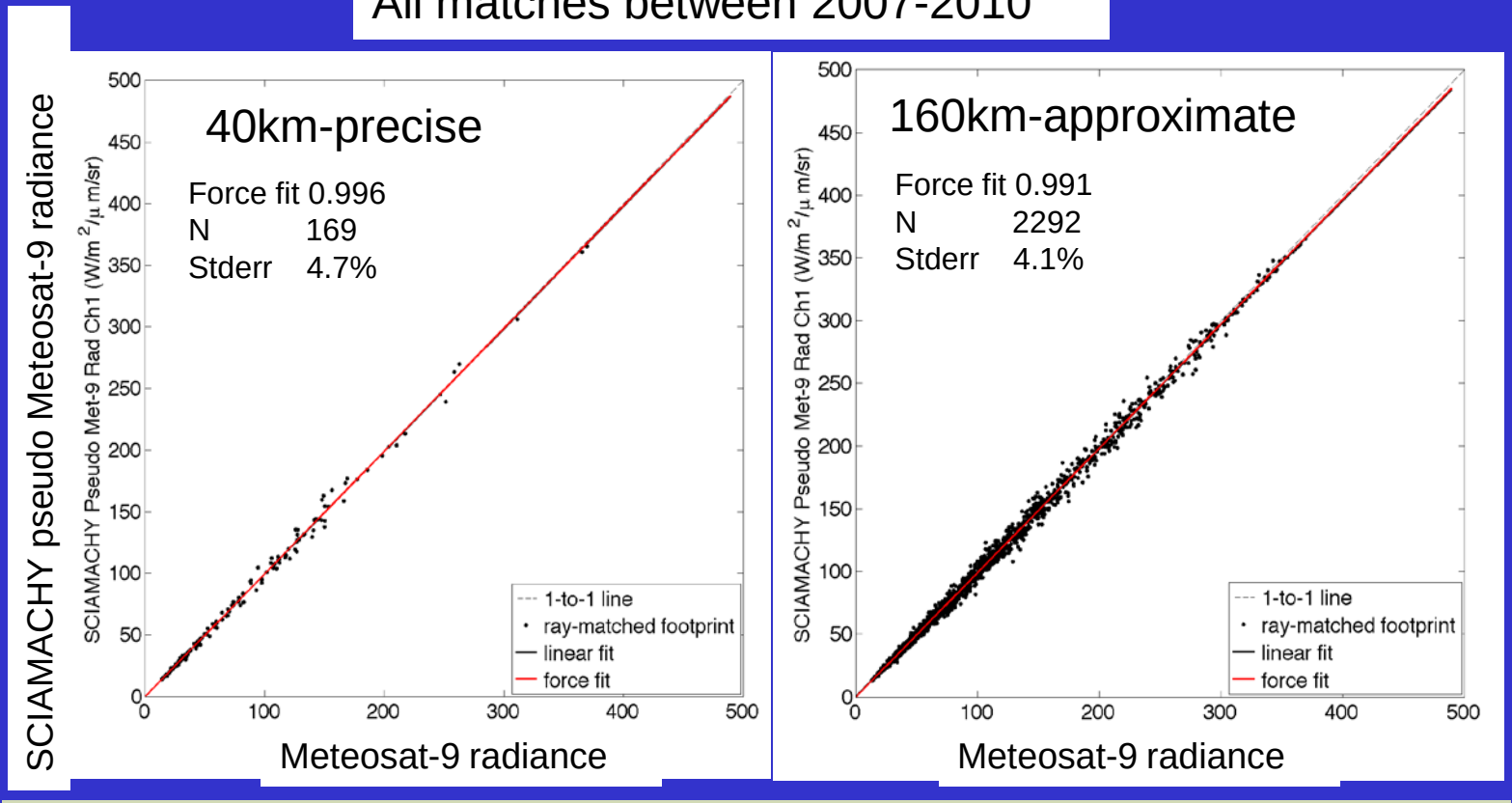


GEO SCIAMACHY precise ray-matching (top view)



SCIAMACHY Meteosat-9 0.65µm ray-match

All matches between 2007-2010



- Use CERES Meteosat-9 calibration
- The force fits are within 0.5%, well within the uncertainty of 4%
- 13 times more points with approximate method

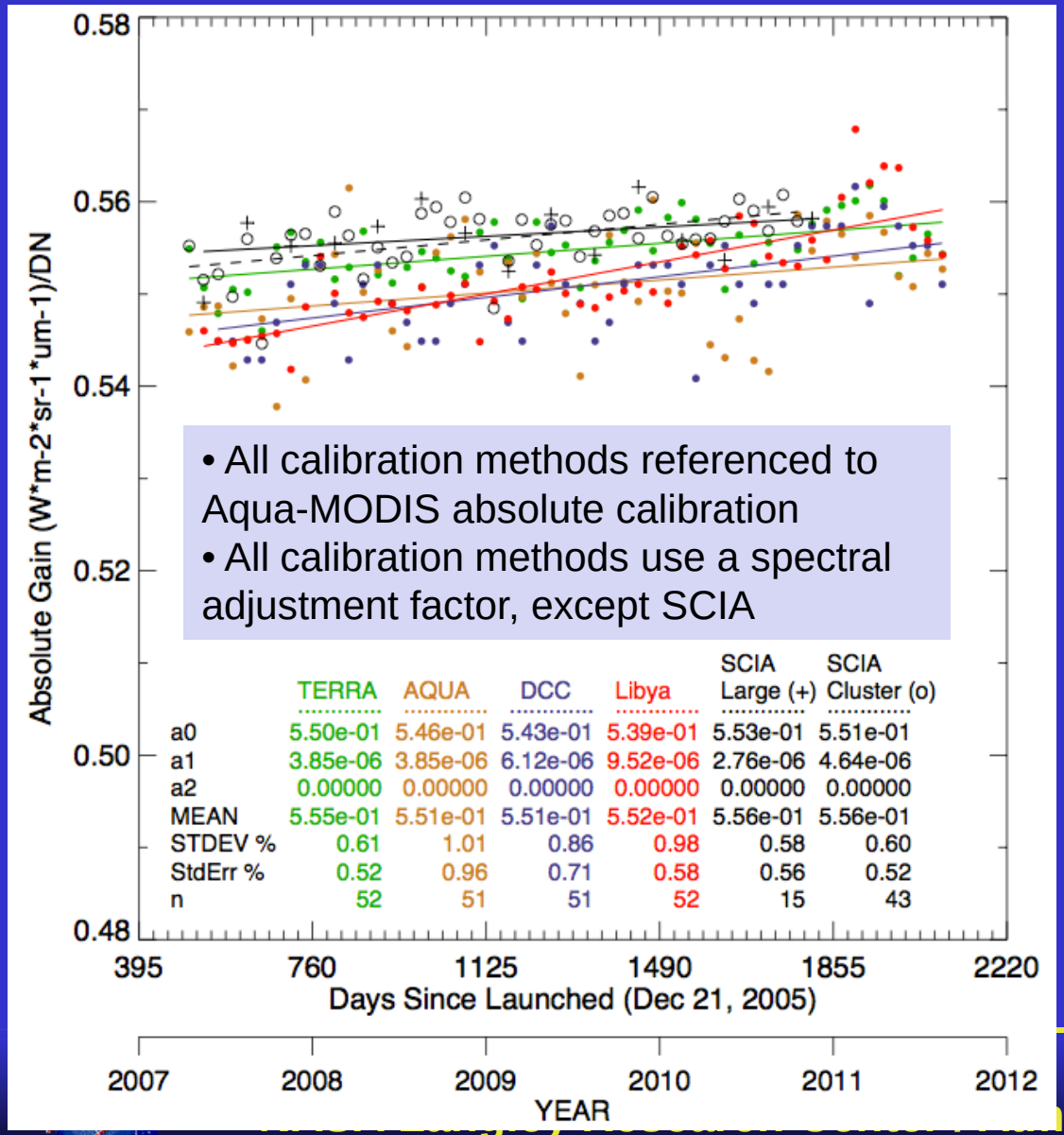
Comparison of precise and approximate SCIAMACHY/Met-9 force fit 2007-2010

(Precise/Approximate)

Precise/Approximate Dataset	#	SCIAMACHY/Met-9 0.65µm force fit	Standard error (%)
Met-9 0.65 µm	169/2292	0.996/0.991	4.7/4.1
Met-9 0.86 µm	158/2212	0.983/0.978	4.4/4.0
Met-9 HRV	76/1082	0.998/0.988	5.9/5.0
Met-8 0.65 µm	114/1641	0.983/0.988	4.9/4.4
Met-8 0.86 µm	114/1641	0.999/1.004	4.5/4.2
GOES-11 0.65 µm	84/1315	0.990/0.992	4.7/6.2

- All force fits are within 0.5%, well within the uncertainty of ~4%
- All approximate ray-matching is not adding any angular biases

Meteosat-9 0.65µm gain comparison



• All calibration methods referenced to Aqua-MODIS absolute calibration
• All calibration methods use a spectral adjustment factor, except SCIA

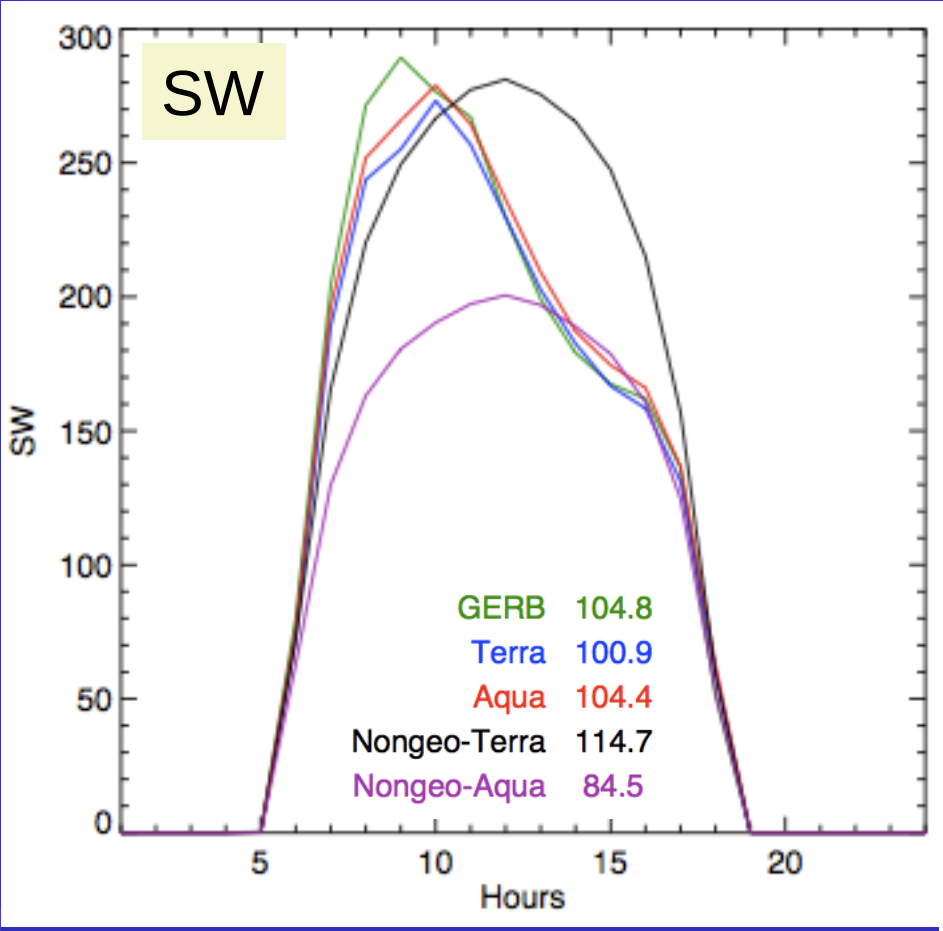
	TERRA	AQUA	DCC	Libya	SCIA Large (+)	SCIA Cluster (o)
a0	5.50e-01	5.46e-01	5.43e-01	5.39e-01	5.53e-01	5.51e-01
a1	3.85e-06	3.85e-06	6.12e-06	9.52e-06	2.76e-06	4.64e-06
a2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
MEAN	5.55e-01	5.51e-01	5.51e-01	5.52e-01	5.56e-01	5.56e-01
STDEV %	0.61	1.01	0.86	0.98	0.58	0.60
StdErr %	0.52	0.96	0.71	0.58	0.56	0.52
n	52	51	51	52	15	43

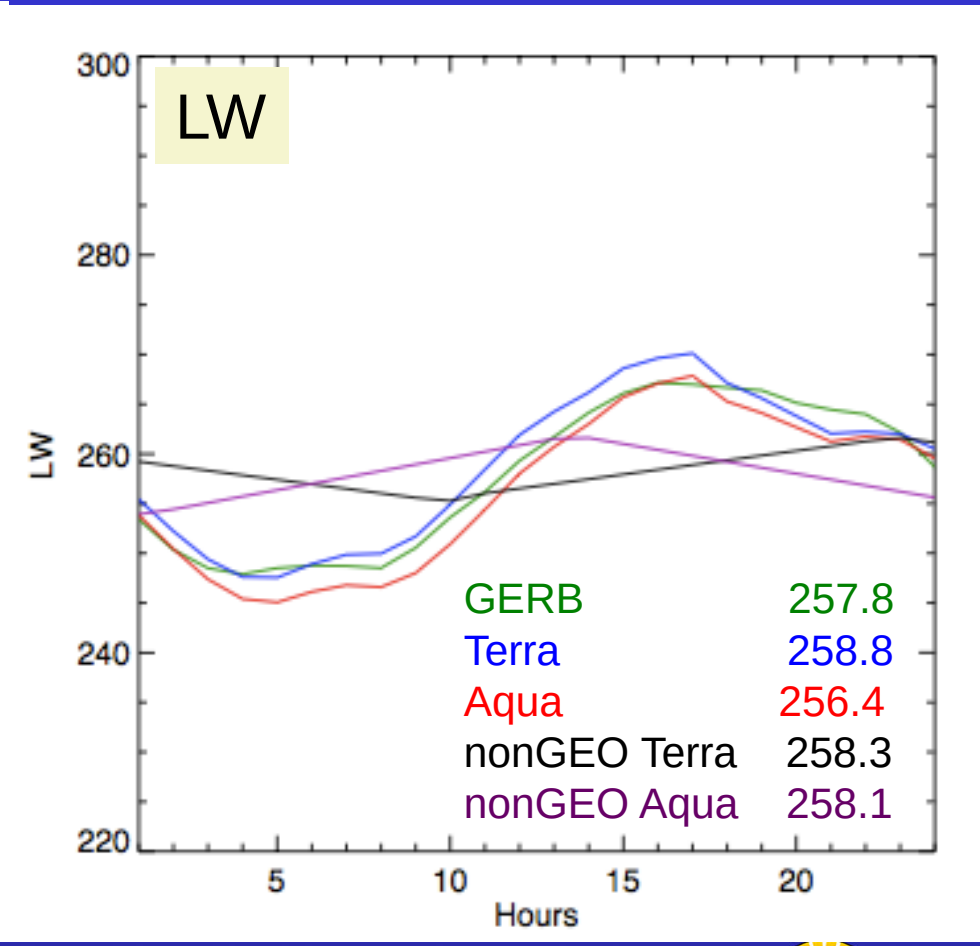
- SCIAMACHY/Meteosat-9 0.65µm calibration is within 1% of all other calibration coefficients
- Has one of the lowest standard errors at ~0.55%
- SCIAMACHY based GEO calibration as good as other methods and has the advantage of not needing any spectral corrections
- The calibration can be used to verify spectral corrections of other methods

CERES temporal averaging validation with GERB

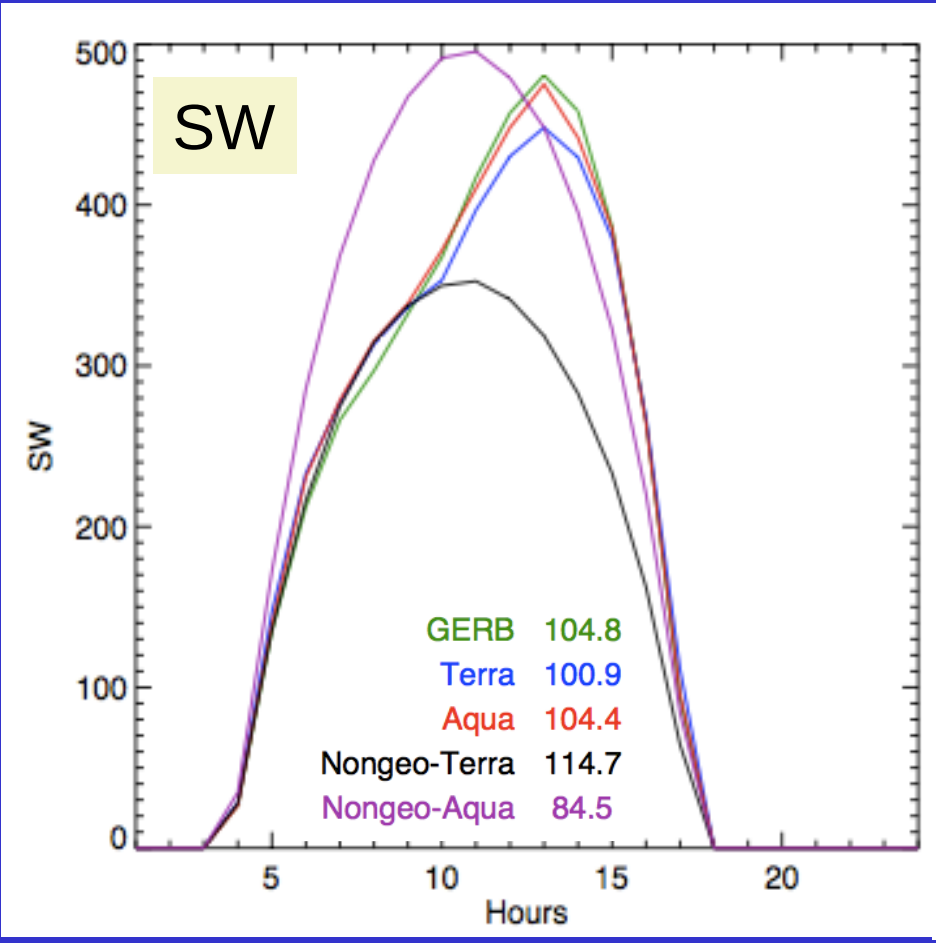
- CO Ceres-Only temporal averaging:
  - The SW TOA fluxes account for albedo changes with solar zenith angle assuming the cloud properties are constant.
  - 600 scene specific diurnal albedo models
  - LW flux is linearly interpolated between measurements, except over land where the half sine diurnal model is used
- CG CERES Geostationary temporal averaging
  - Use 3-hourly GEO derived and CERES observed fluxes to more accurately model the flux and cloud variability between CERES measurements.
- Show GERB (Jan 2005) and CG compared with CO method temporal averaging results

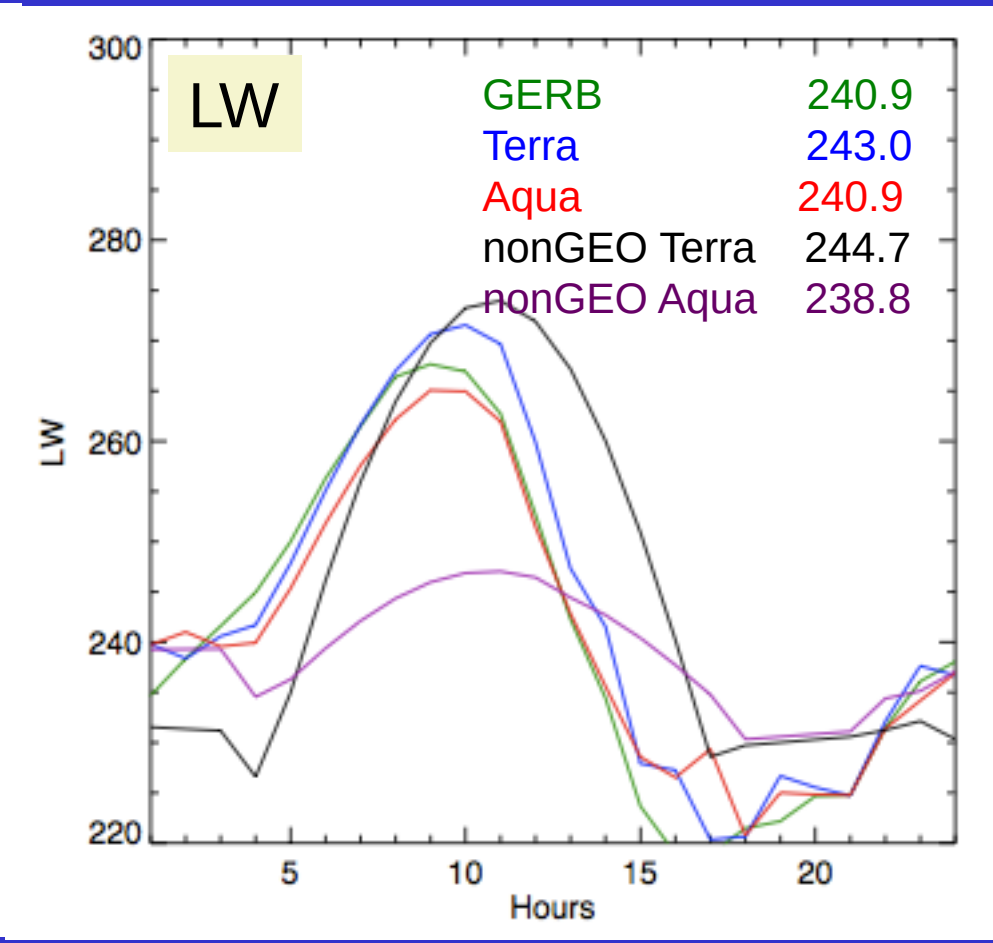
Namibian Stratus, Jan 2005



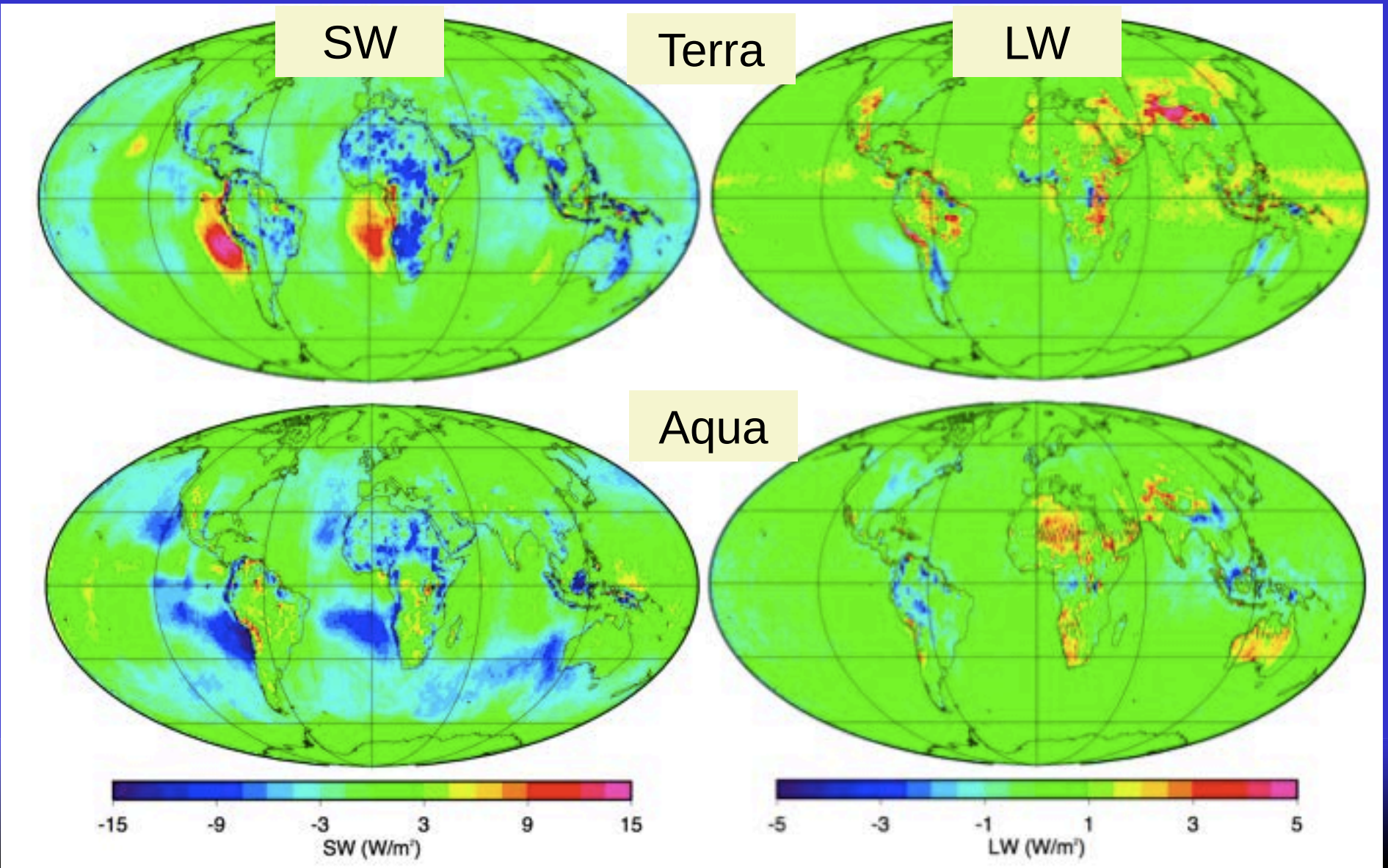


South African Convection, Jan 2005





nonGEO (SSF1deg, CO) – GEO (SYN1deg, CG)
July 2002 to June 2011

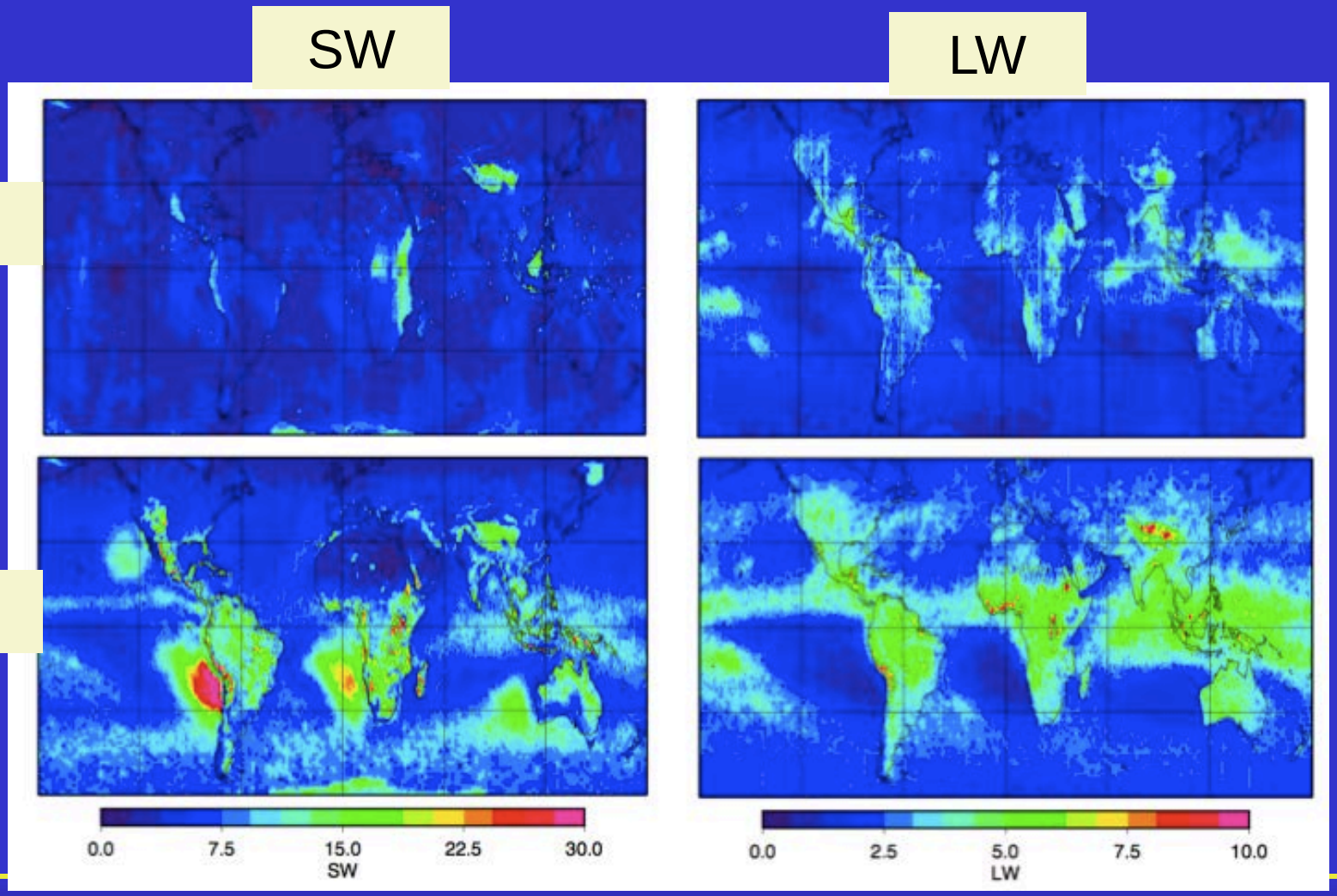


July 2002 to June 2011 global flux means

	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

- CG increases the global SW by ~1 Wm-2, stratus cloud brighter in near sunrise and land convection near sunset
- CG decreases the global LW slightly, neither Terra nor Aqua capture afternoon convection
- CO-CG regional SW and LW difference can exceed 25 and 8 Wm-2, respectively, however global they cancel

Terra – Aqua, July 2002 to July 2011



Terra – Aqua, July 2002 to July 2011, RMS differences

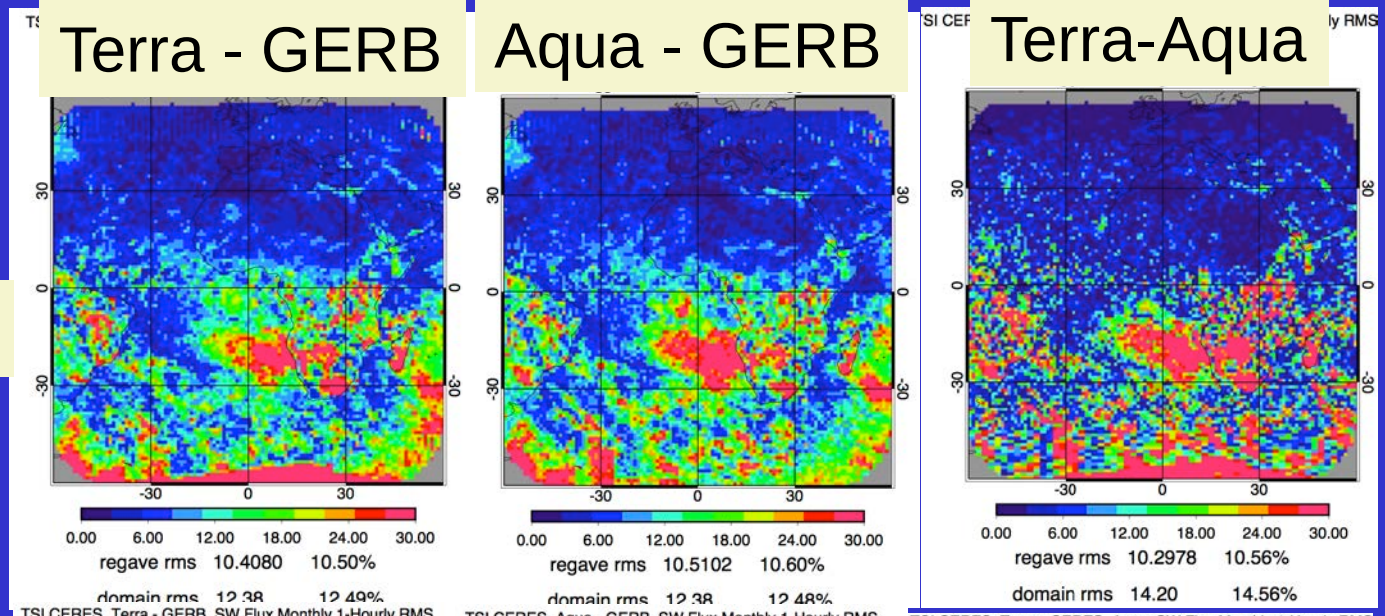
(%)	SW		LW	
Dataset	Month	Day	Month	Day
CO	9.6	30.4	1.3	12.4
CG	4.5	8.5	0.9	3.2

- The monthly regional 60°N to 60°S Terra minus Aqua regional RMS flux difference for CG is reduced by 50% and 30%, compared to CO, for SW and LW, respectively
- The daily RMS error is reduced by a factor of 4

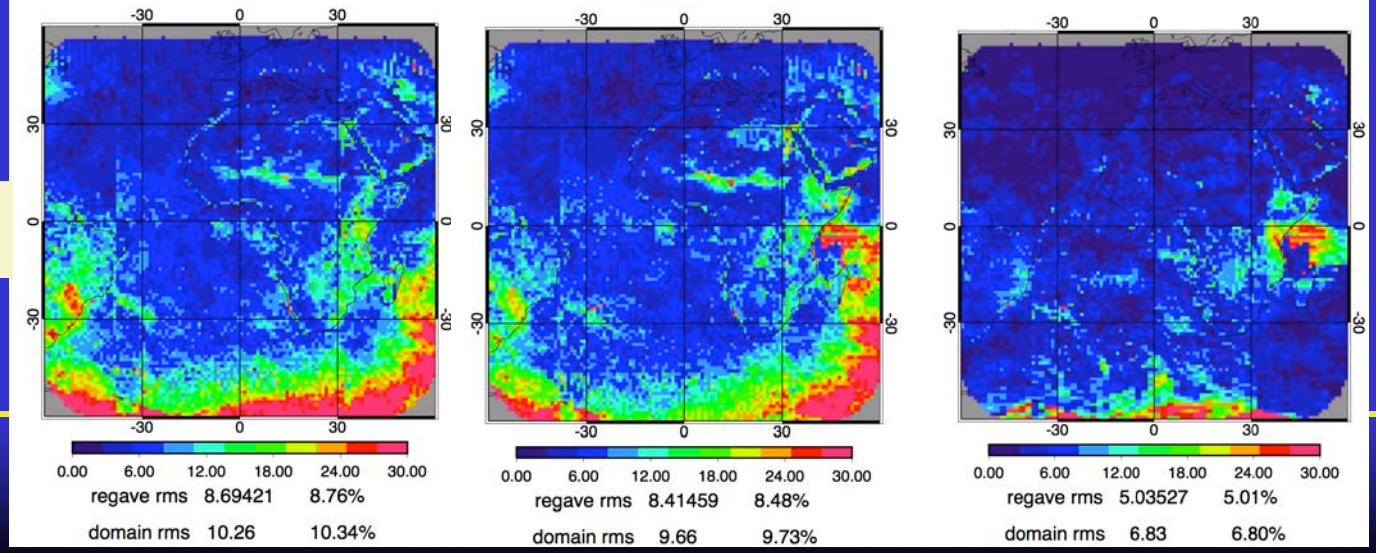
Monthly Hourly SW RMS error, Jan 2005

Terra - GERB | Aqua - GERB | Terra-Aqua

CO



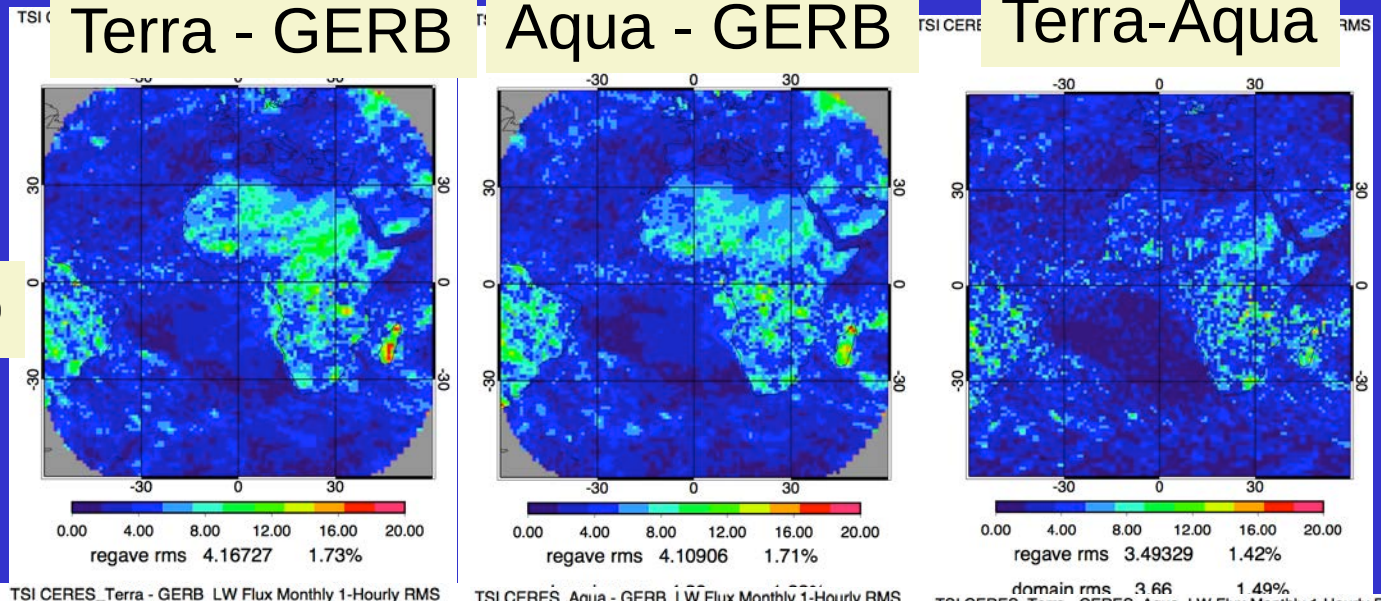
CG



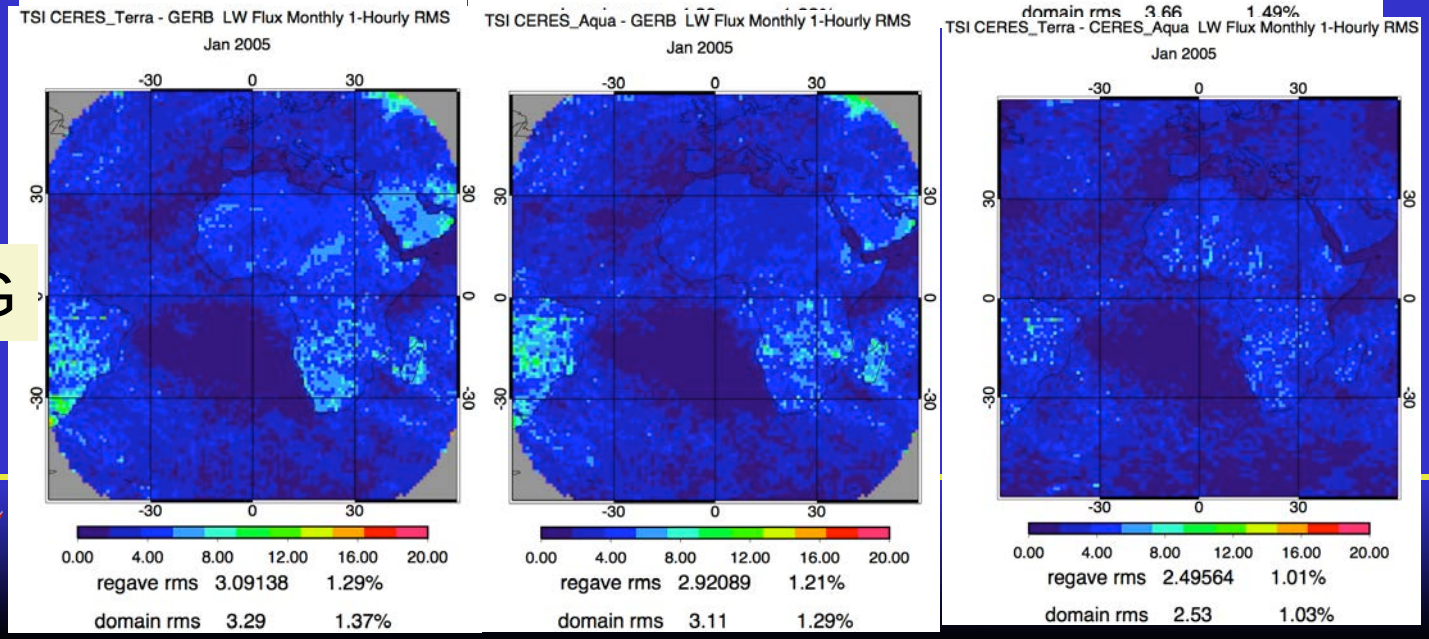
Monthly Hourly LW RMS error, Jan 2005

Terra - GERB | Aqua - GERB | Terra-Aqua

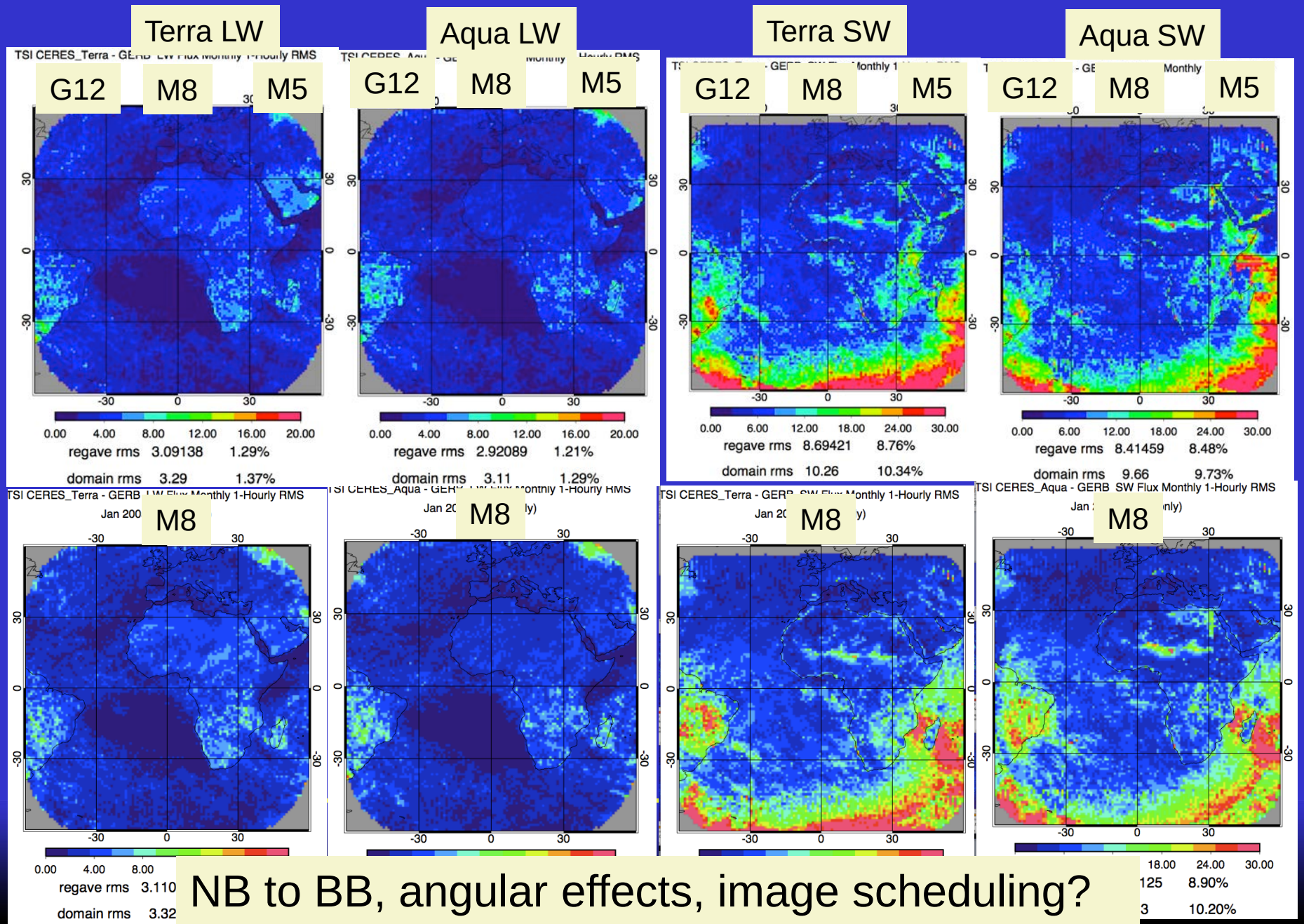
CO



CG



Monthly Hourly CERES – GERB RMS errors, Jan 2005



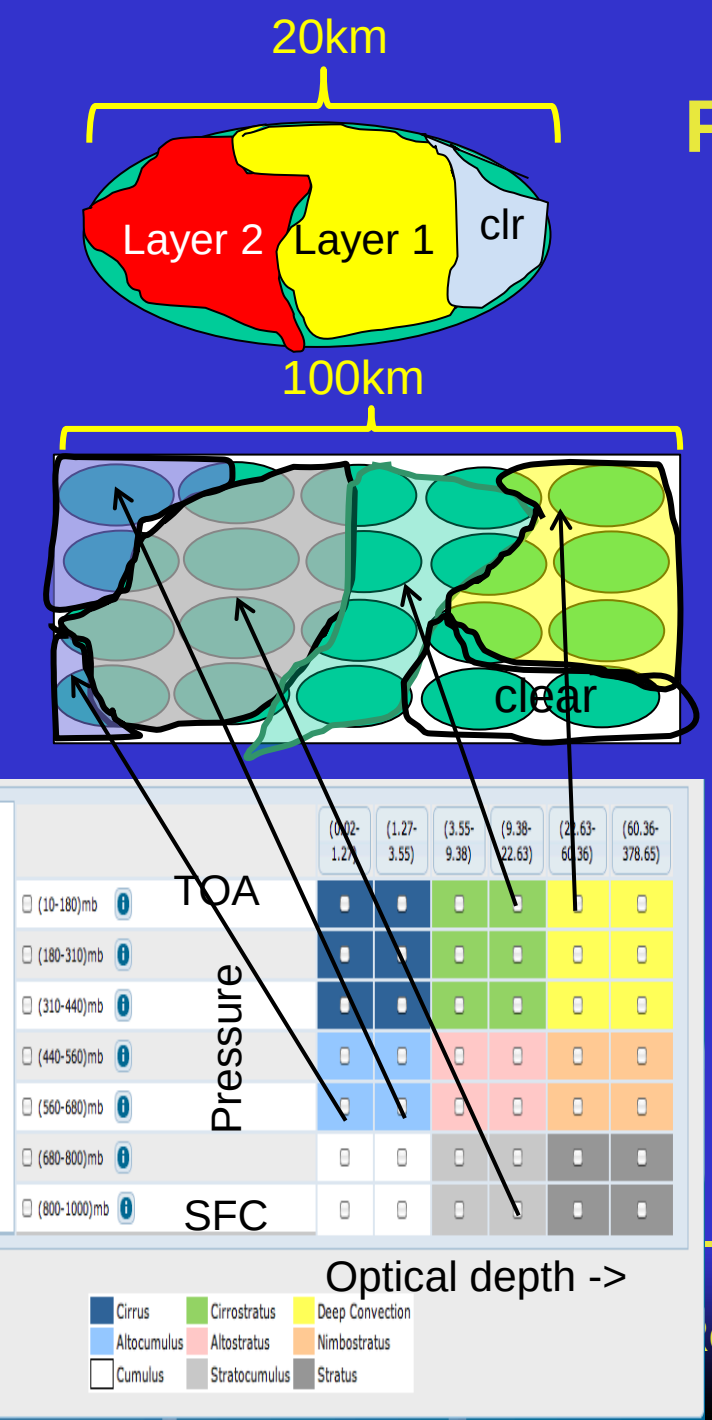
NB to BB, angular effects, image scheduling?

GERB Validation Summary, July 2004

Suffix	Dataset	Day SW RMS	3-Hr SW RMS	Day LW RMS	3-Hr LW RMS
CO	Terra	18.3	32.5	3.0	5.0
	Aqua	17.6	31.4	3.0	5.0
	Terra_Aqua	13.1	24.4	2.0	3.7
CG	Terra	9.9	19.6	2.0	3.3
	Aqua	10.0	19.9	1.9	3.1
	Terra_Aqua	9.1	18.4	1.6	2.8

- CG reduces the daily RMS error by 50% and 33% for SW and LW, respectively
- CO Terra+Aqua not as good as CG single satellite
- CG reduces the 3-hourly RMS error by 33% for SW and LW
- CO Terra+Aqua has little reduction over single satellite

Flux-by-cldtype



- CERES measures 20km footprint fluxes
- Footprint is subdivided into clear and 1 or 2 cloud layers, based on MODIS 2-km pixel level retrievals
- Subdivided fluxes obtained from MODIS NB to CERES BB radiance monthly correlations and radiance to flux using CERES ADMs
- Instantaneous footprint subdivided fluxes are then binned into 1° by 1° regions according to ISCCP cloud types (6 optical depths, 7 pressure levels) and clear-sky
- Modelers may then compare computed individual cloud property fluxes with CERES during Aqua or Terra overpasses

Flux by Cloud Type Algorithm

SSF Footprints

↓

NB2BB: clear/cld1/cld2 ← **Monthly NB2BB coefficients**
- 0.65, 0.86, 2.1 µm MODIS to BB CERES
- Use clear and overcast footprints

↓

BB2Flx: clear/cld1/cld2 ← **ADM**
- Use clear/overcast models

↓

Normalize layer fluxes with footprint observed

↓

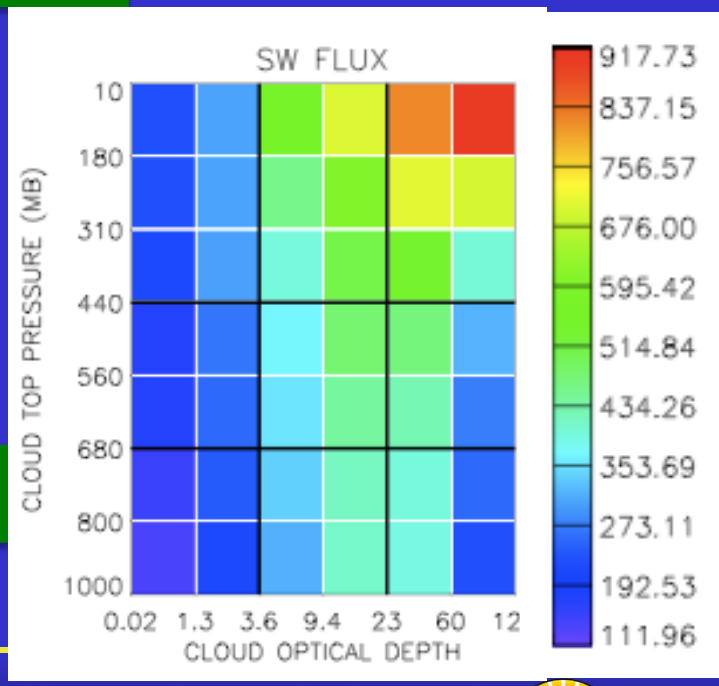
Sort cloud/flux into D2like cloud types

↓

Grid SSF into 1x1 → NetCDF for modeler

↓

Monthly Average → QC observational mean

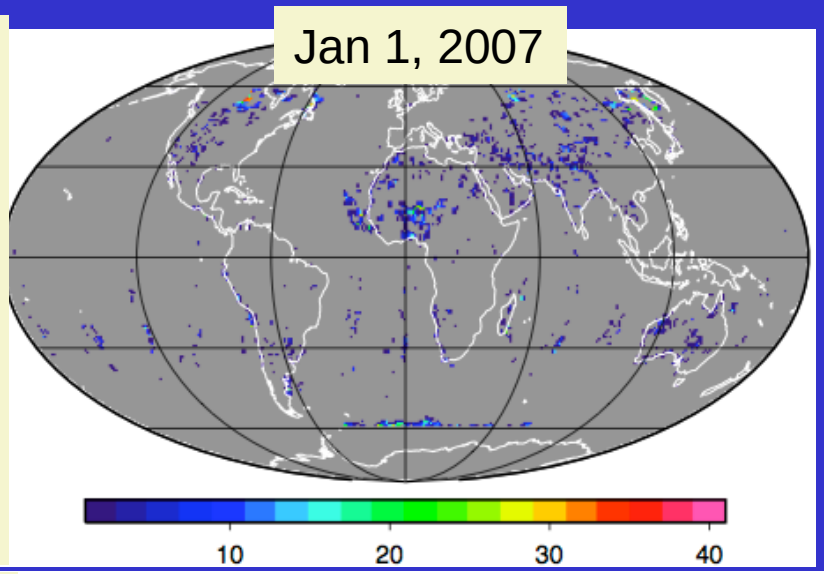


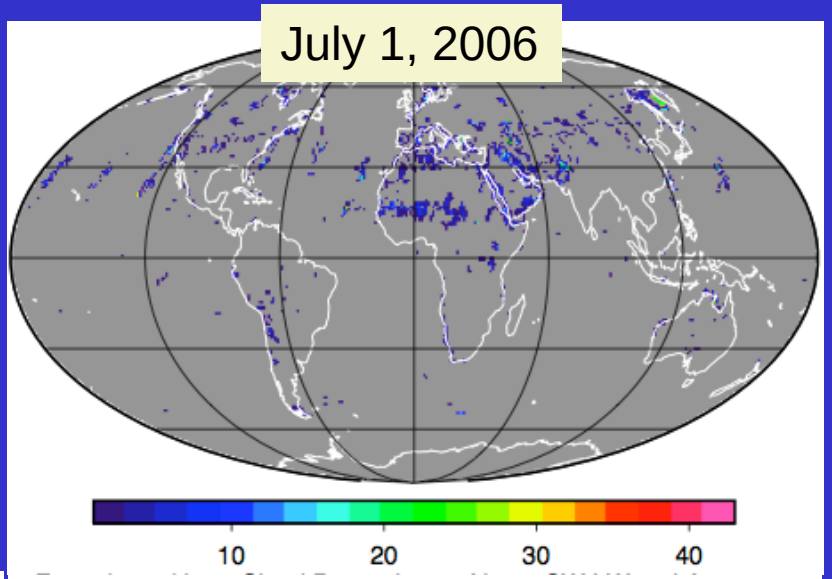
Layer NB to BB criteria

- Footprint has a cloud fraction and associated optical depth and effective pressure derived from MODIS
- Footprint snow fraction < 10%
- Footprint does not contain glint
- Footprint between ±60° in latitude
- How many regions have complete coverage of footprints with NB to BB fluxes?
- Modeler will assume complete 1x1 degree spatial coverage
- What number of footprint coverage is needed to maintain robust statistics?

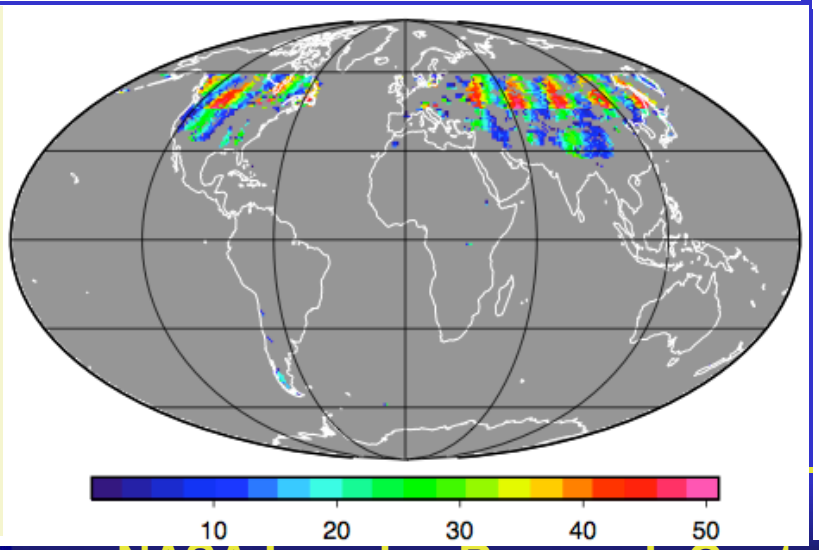
Footprints with no cloud retrievals or contain snow

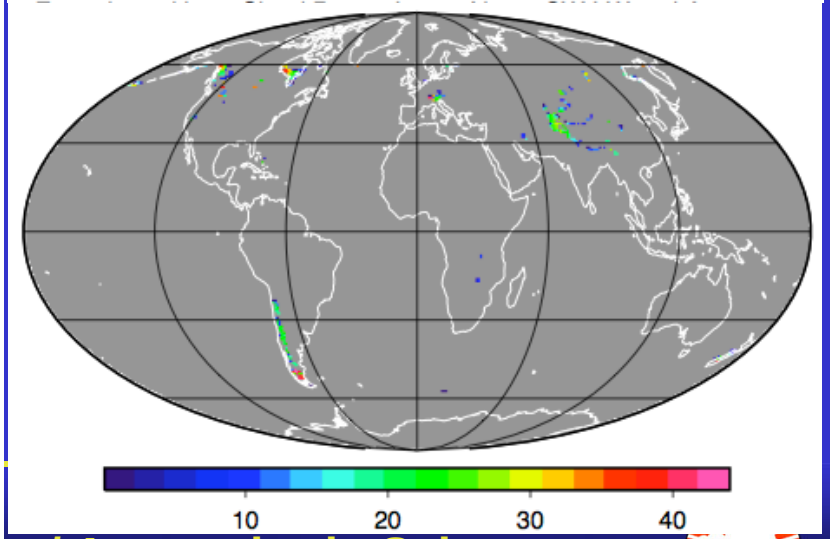
Footprints per region with no cloud retrievals





Footprints per region with snow>10%

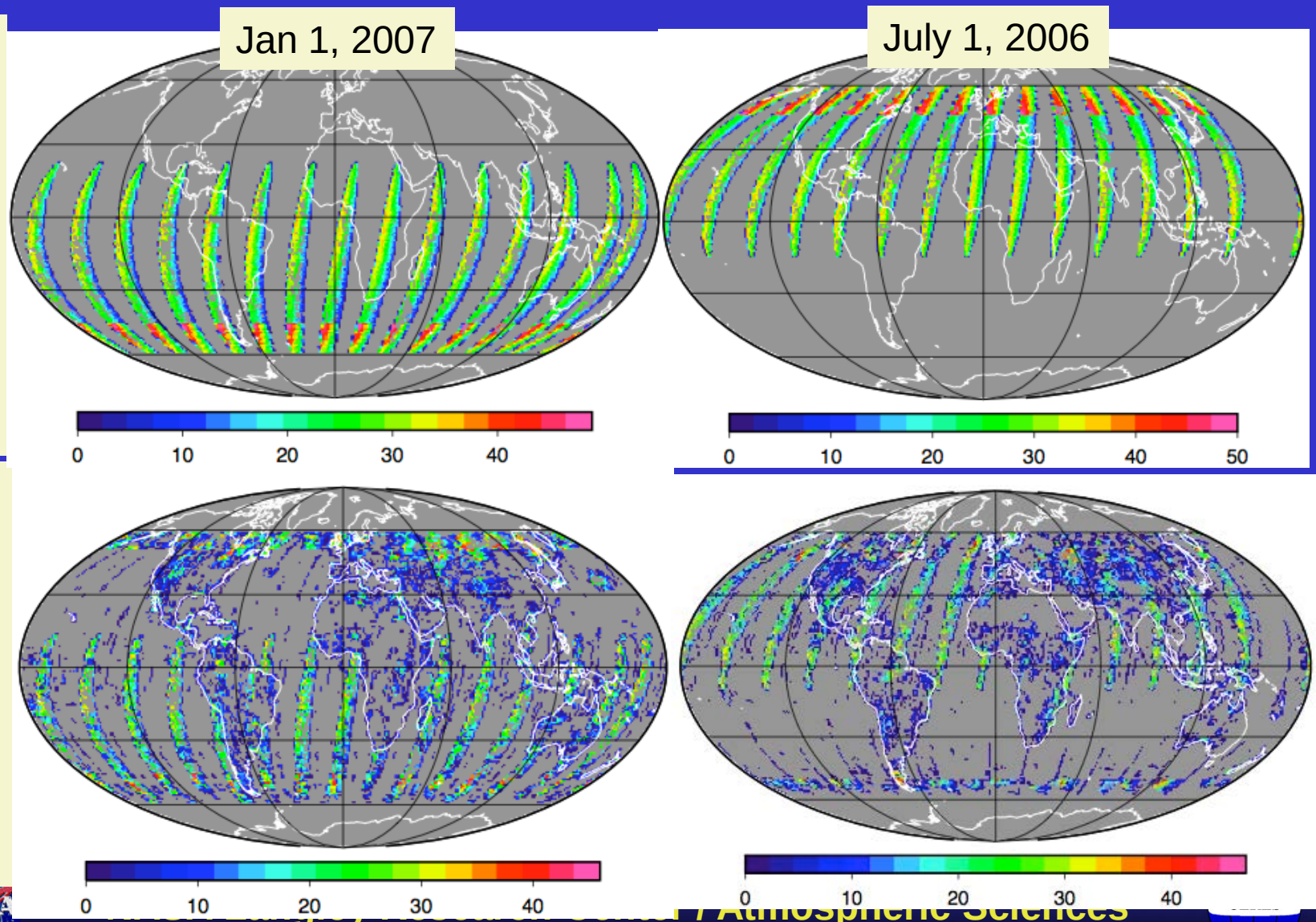




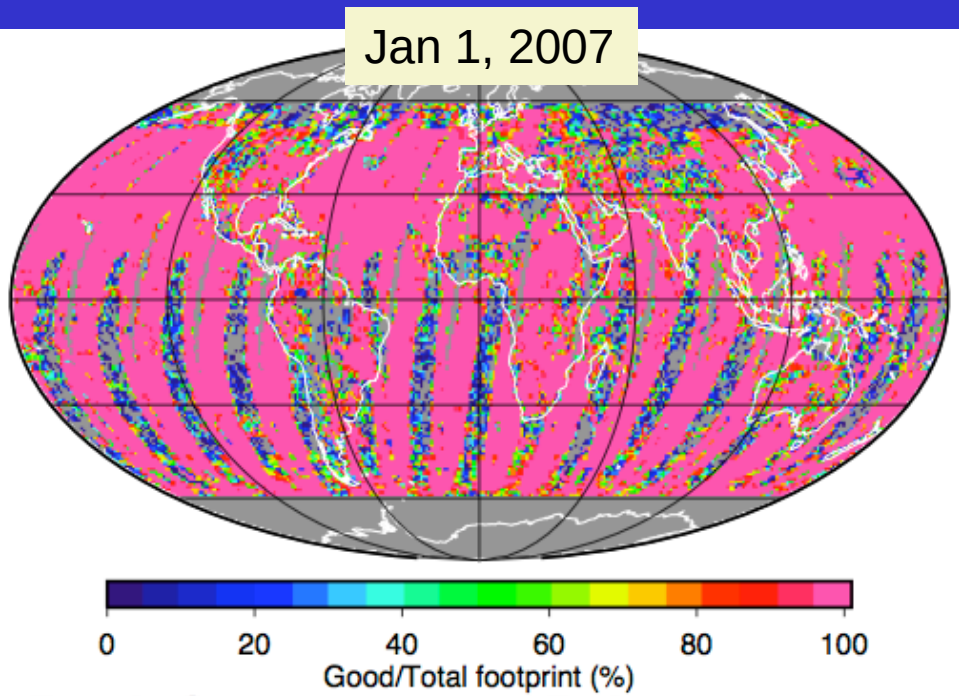
Footprints that contain glint and no NB to BB

Footprints per region with glint >60%

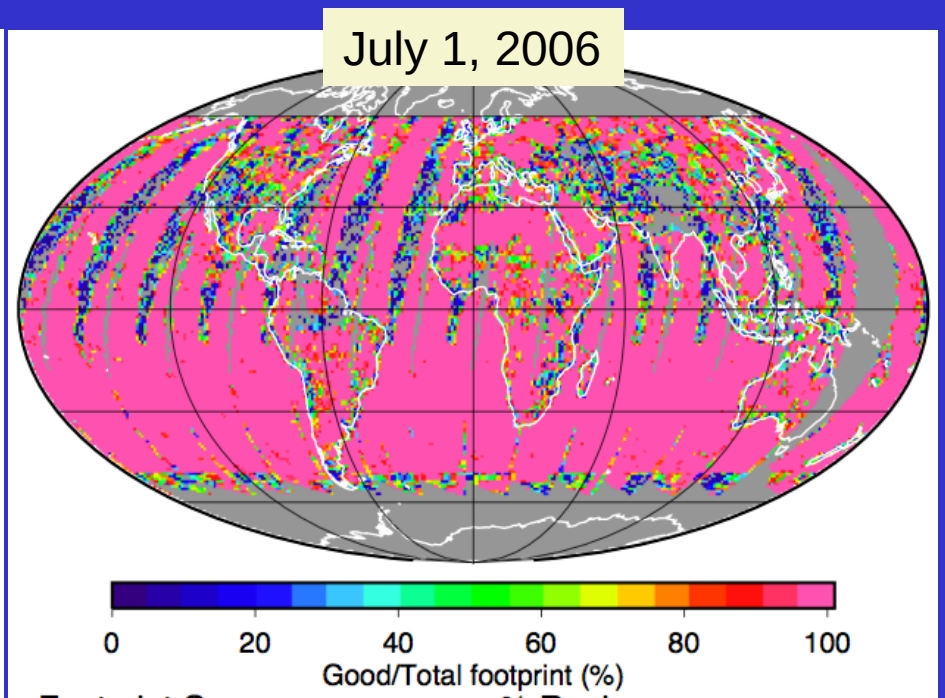
Footprints per region with no NB/BB fluxes



Regional Footprint Coverage



Footprint Cover	% Region
99%	58.1
90%	63.6
80%	68.8
70%	73.0
50%	81.1
25%	89.7



Footprint Cover	% Region
99%	63.3
90%	68.5
80%	73.1
70%	77.1
50%	84.1
25%	91.9

Footprint Flux Normalization

- Clear-sky BB from clear-sky footprint MODIS to CERES radiance pair regression
- Cloud layer BB from overcast footprint MODIS to CERES radiance pair regression

- Ratio tuning => clear-sky NB to BB error **=** cloud layer NBtoBB error

Poor Man's Tuning

$Flux_{NBtoBB} = f_{Clear}Flux_{Clear} + f_{Layer1}Flux_{Layer1} + f_{Layer2}Flux_{Layer2}$

$R = Flux_{observed}/Flux_{NBtoBB}$

$Flux_{normalized} = R*f_{Clear}Flux_{Clear} + R*f_{Layer1}Flux_{Layer1} + R*f_{Layer2}Flux_{Layer2}$

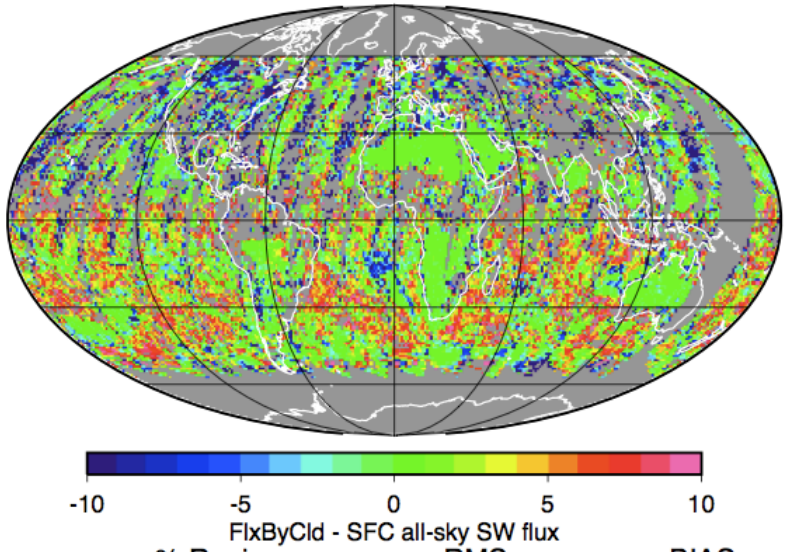
$Flux_{Clear\ normalized} = R*Flux_{Clear}$

$Flux_{Layer1\ normalized} = R*Flux_{Layer1}$

$Flux_{Layer2\ normalized} = R*Flux_{Layer2}$

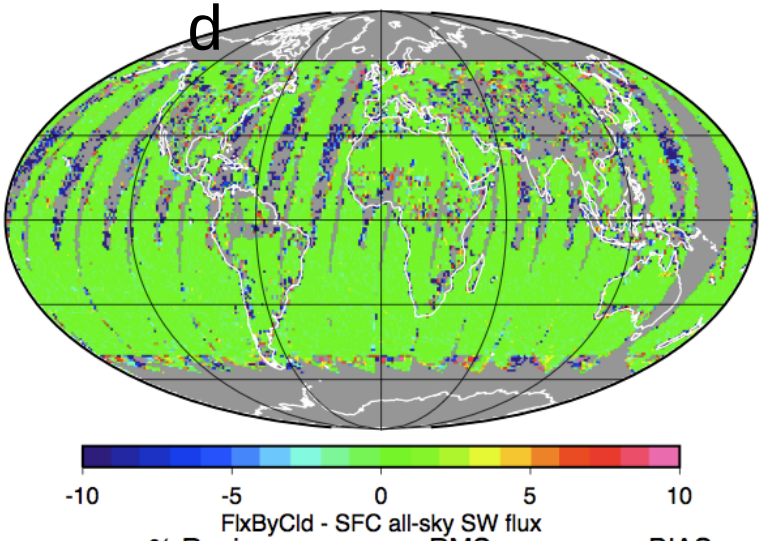
Flux_cldtype – SSF1deg SW all-sky July 1, 2006

Untuned



Footprint Cover	% Region	RMS	BIAS
99%	62.7	6.6	2.4
90%	67.8	6.7	2.4
80%	72.3	7.0	2.5
70%	76.0	7.4	2.5
50%	82.1	8.1	2.6
25%	88.1	8.9	2.5

Tuned

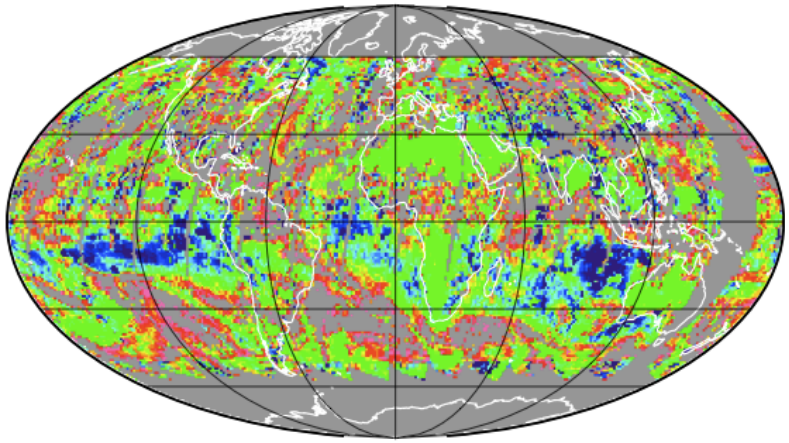


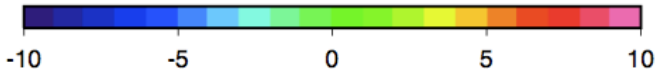
Footprint Cover	% Region	RMS	BIAS
99%	62.9	1.0	0.0
90%	68.0	1.5	0.1
80%	72.6	2.5	0.2
70%	76.4	3.6	0.3
50%	82.6	5.0	0.4
25%	88.7	6.3	0.4

- Tuning is needed to remove NB to BB all-sky bias
- Regions with little footprint cover have large RMS error after tuning

Flux_cldtype – SSF1deg LW all-sky July 1, 2006

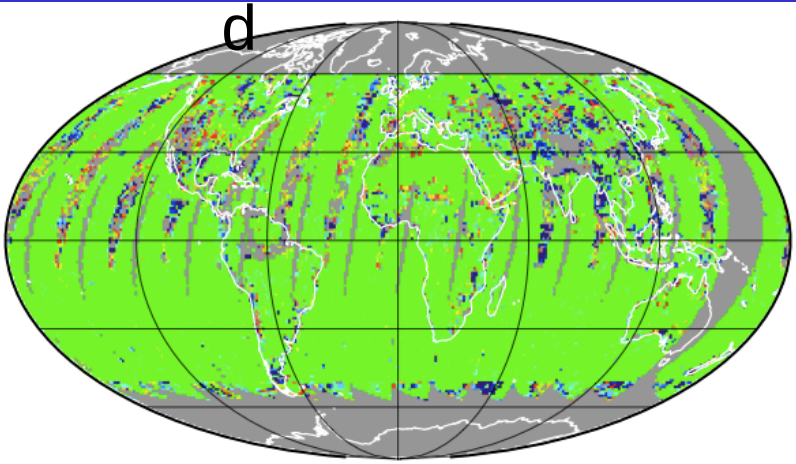
Untuned





Footprint Cover	% Region	RMS	BIAS
99%	62.9	7.3	3.6
90%	68.1	7.3	3.6
80%	72.7	7.3	3.6
70%	76.6	7.3	3.6
50%	83.6	7.5	3.6
25%	91.1	7.8	3.5

Tuned

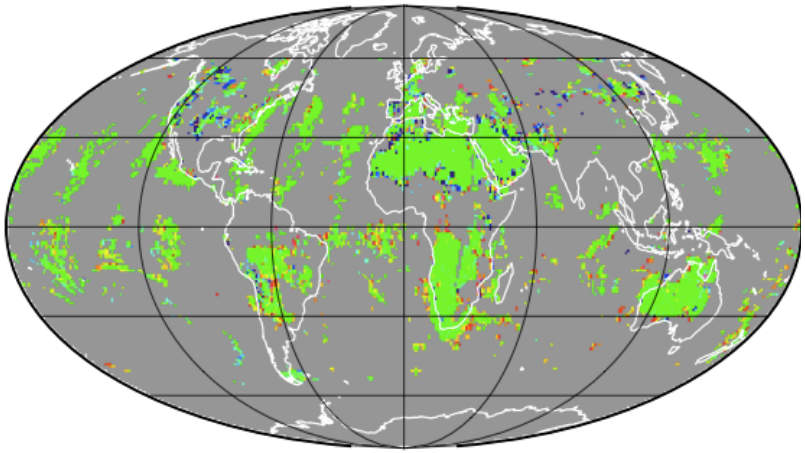


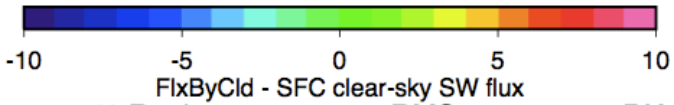
Footprint Cover	% Region	RMS	BIAS
99%	62.9	0.6	0.0
90%	68.1	0.7	0.0
80%	72.7	0.8	0.0
70%	76.6	1.1	-0.0
50%	83.6	2.0	-0.1
25%	91.2	3.1	-0.2

- Tuning is needed to remove NB to BB all-sky bias
- RMS error less dependent on footprint coverage

Flux_cldtype – SSF1deg SW clear-sky July 1, 2006

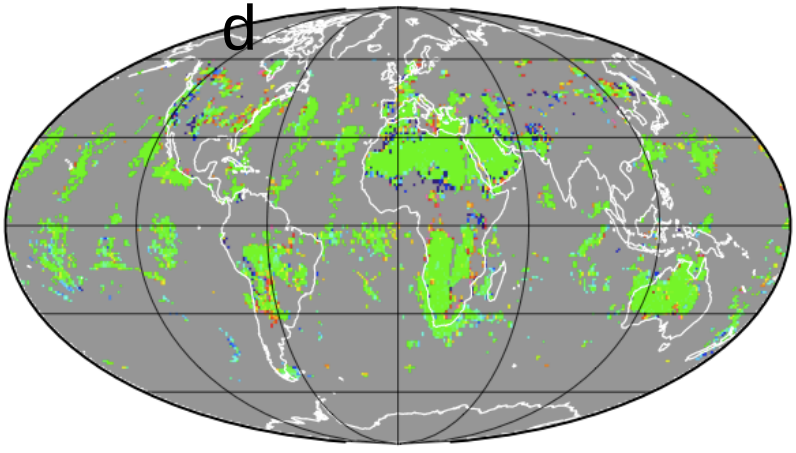
Untuned

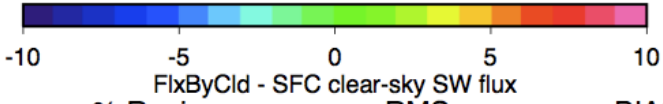




Footprint Cover	% Region	RMS	BIAS
99%	10.0	2.7	0.9
90%	11.5	3.0	1.0
80%	12.9	3.4	1.0
70%	14.0	3.5	0.9
50%	16.0	3.9	0.9
25%	18.4	4.4	0.8

Tuned



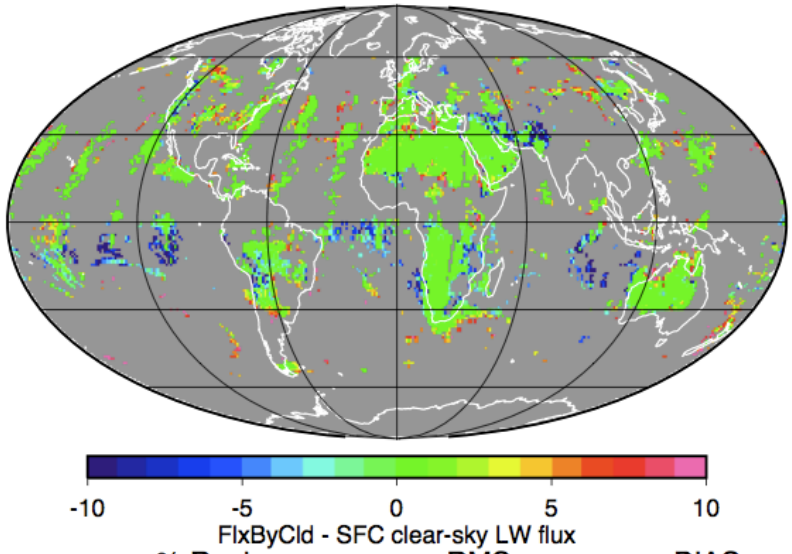


Footprint Cover	% Region	RMS	BIAS
99%	10.0	2.6	0.4
90%	11.5	3.0	0.5
80%	12.9	3.3	0.5
70%	14.0	3.5	0.5
50%	16.0	3.9	0.5
25%	18.4	4.4	0.4

- Sub-footprint clear-sky is slightly brighter than footprint

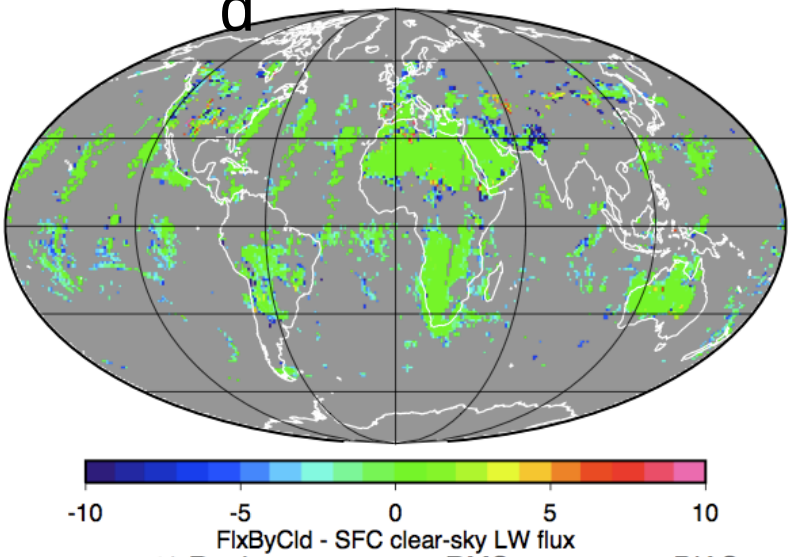
Flux_cld – SSF1deg LW clear-sky July 1, 2006

Untuned



Footprint Cover	% Region	RMS	BIAS
99%	10.0	4.0	0.2
90%	11.5	4.0	0.2
80%	12.9	3.9	0.3
70%	14.0	3.9	0.3
50%	16.0	3.9	0.3
25%	18.4	4.0	0.3

Tuned

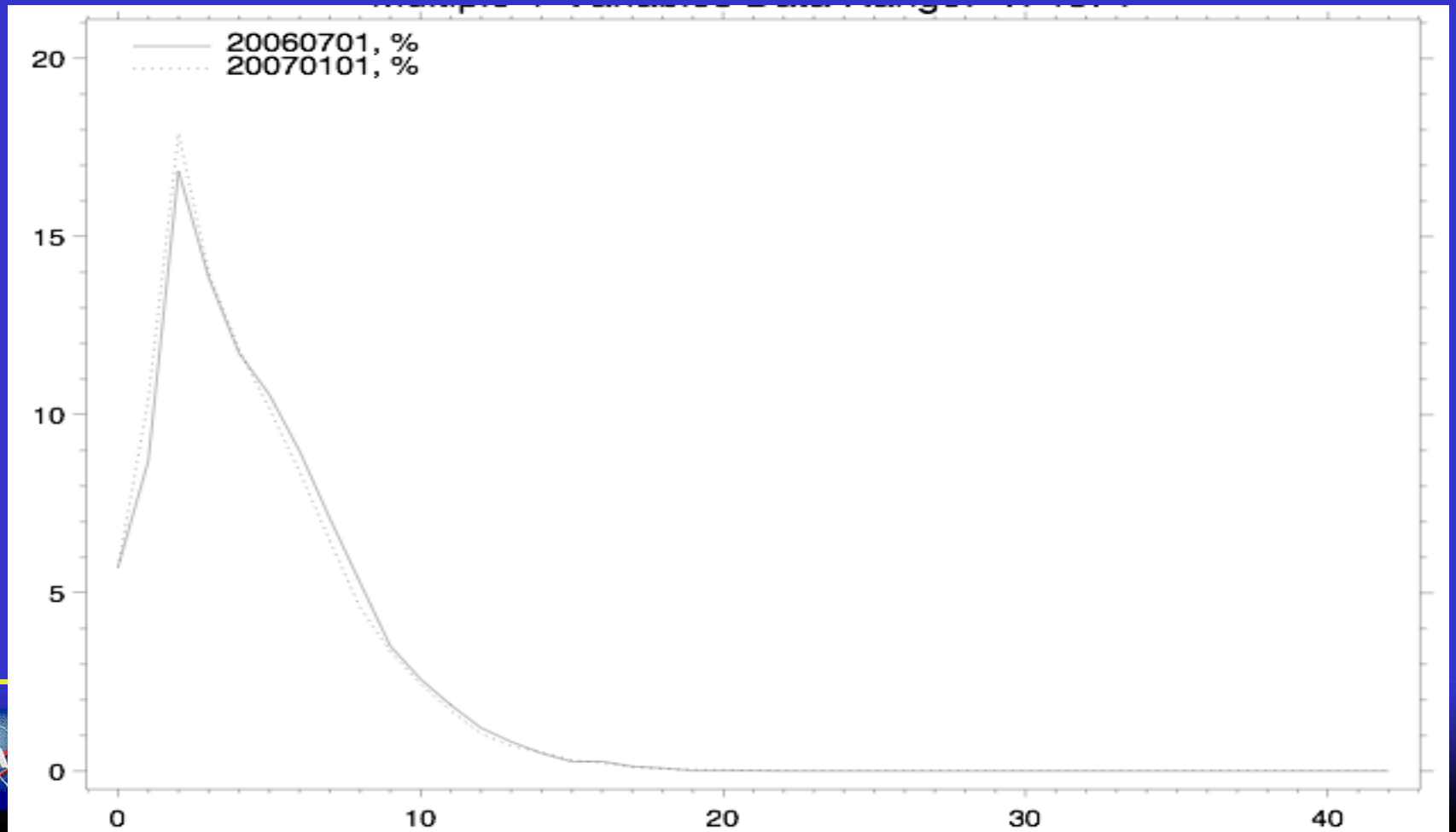


Footprint Cover	% Region	RMS	BIAS
99%	10.0	2.1	-1.1
90%	11.5	2.2	-1.2
80%	12.9	2.3	-1.2
70%	14.0	2.4	-1.2
50%	16.0	2.5	-1.2
25%	18.4	2.7	-1.2

- Sub-footprint clear-sky is slightly colder than footprint

Flux_by_cloudtyp netCDF file

- netCDF file only writes out regional cloud types that have data, most regions only have ~2 cloud types
- Full dimensioned file 85MB/day, netCDF=15 MB/day



Flux_by_cloud type

- Partial coverage clear-sky footprints fluxes differ from complete coverage clear-sky footprints
  - Partial clear-sky areas are more humid and have greater aerosols and greater chance for cloud contamination
  - Partial clear-sky footprints have colder and brighter clear-sky fluxes than total coverage
- 80% regional footprint coverage needed for reliable fluxes translates to 75% areal coverage between 60°N to 60°S
- Check tuning with using overcast regions
- Try another tuning approach by assuming NB radiance ratios = BB radiance ratios
- Sensitivity study of cloud type fluxes as a function of tuning approach
- Close to sending beta netCDF file to potential users

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

ASDC System Administrators: B. Loyall, C. Harris, R. Dubois, S. Mercier, B. Bresina

ASDC CERES web pages: J. Perez, J. Kusterer, L. Parker, M. Watkinson, P. Mlynczak, E. Kizer

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

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 Quality Summary				Browse & Subset

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.

Data Product	Description	Parameter	Resolution	Version/ 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.

EBAF-Surface Ed2.6r Ordering Page

Parameters

		All Sky	Clear Sky
Surface Fluxes	Shortwave Flux Down		
	Shortwave Flux Up		
	Longwave Flux Down		
	Longwave Flux Up		
Surface CRE Fluxes	Shortwave Flux Down		
	Shortwave Flux Up		
	Longwave Flux Down		
	Longwave Flux Up		

Temporal Resolution

- Monthly Mean
- Climate

Currently available
Surface fluxes consistent with EBAF

Spatial Resolution

- Regional (1° x 1° global grid)
- Zonal mean
- Global mean

North 90
West 0 reset 360 East
-90 South

Map

Time Range

Available Time Range: 3/1/2000 to 2/28/2010

From: 03 - 2000 (MM-YYYY) To: 02 - 2010 (MM-YYYY)

ISCCP-D2like Ed2A-Beta

CERES ISCCP-D2like Ordering Page

Return to ISCCP-D2like Product Information

ISCCP-D2like Browse and Subset Products

Temporal Resolution	Data Product	Descripition	Cloud Sources (daytime only)	Cloud Properties	Order Data
Monthly & Monthly 3-Hourly	ISCCP-D2like	3 optical depth bins 3 cloud pressure bins	Terra-MODIS Aqua-MODIS GEO Merged	Cloud Area Fraction Cloud Pressure Cloud Temperature Water Path Particle Size Optical Depth IR Emissivity	Browse & Subset
Monthly & Monthly 3-Hourly	ISCCP-D1like	6 optical depth bins 7 cloud pressure bins	Terra-MODIS Aqua-MODIS	Cloud Area Fraction only	Browse & Subset

- The "Merged" cloud source combines Terra-MODIS, Aqua-MODIS, and GEO cloud properties.
- MODIS nighttime ISCCP-D1like & ISCCP-D2like products are available at the ASDC.
- MODIS cloud properties are not from the official NASA Goddard MODIS cloud products.

ISCCP-D2like Cloud Source Information

Cloud Sources (daytime only)	Sampling frequency	Data Range
Terra-MODIS	10:30 AM local time	3/2000 - 12/2010
Aqua-MODIS	1:30 PM local time	7/2002 - 12/2010
GEO	3-hourly; 0,3,6,.. GMT	3/2000 - 12/2010
Merged	Terra/Aqua/GEO	3/2000 - 12/2010

Currently Beta
Edition2A in about a month when DAAC completes Merge

ISCCP-D2like parameters

Parameters

Cloud Parameters	Liquid	Ice
Cloud Fraction	☐	☐
Cloud Effective Pressure	☐	☐
Cloud Effective Temperature	☐	☐
Cloud Optical Depth	☐	☐
Water Path	☐	☐
Water Particle Radius	☐	☐
Infrared Emissivity	☐	☐

Cloud Types

Cloud Types	Thin (0.02-3.55)	Mid-Thick (3.55-22.63)	Thick (22.63-378.65)
High (10-440)mb	☐	☐	☐
Mid (440-680)mb	☐	☐	☐
Low (680-1000)mb	☐	☐	☐

Cirrus	Cirrostratus	Deep Convection
Altocumulus	Altostratus	Nimbostratus
Cumulus	Stratocumulus	Stratus

ISCCP-D1like parameters

Parameters

- Cloud Area Fractions
  - Total Cloud Fraction
  - Liquid Cloud Fraction
  - Ice Cloud Fraction

Cloud Types

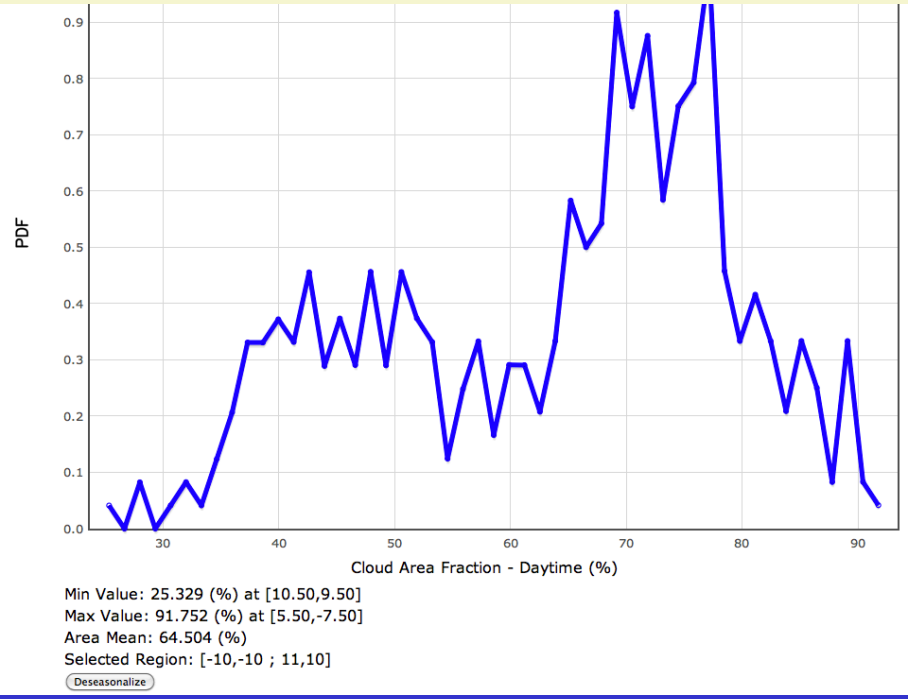
- Cloud Types

	(0.02-1.27)	(1.27-3.55)	(3.55-9.38)	(9.38-22.63)	(22.63-60.36)	(60.36-378.65)
(10-180)mb						
(180-310)mb						
(310-440)mb						
(440-560)mb						
(560-680)mb						
(680-800)mb						
(800-1000)mb						

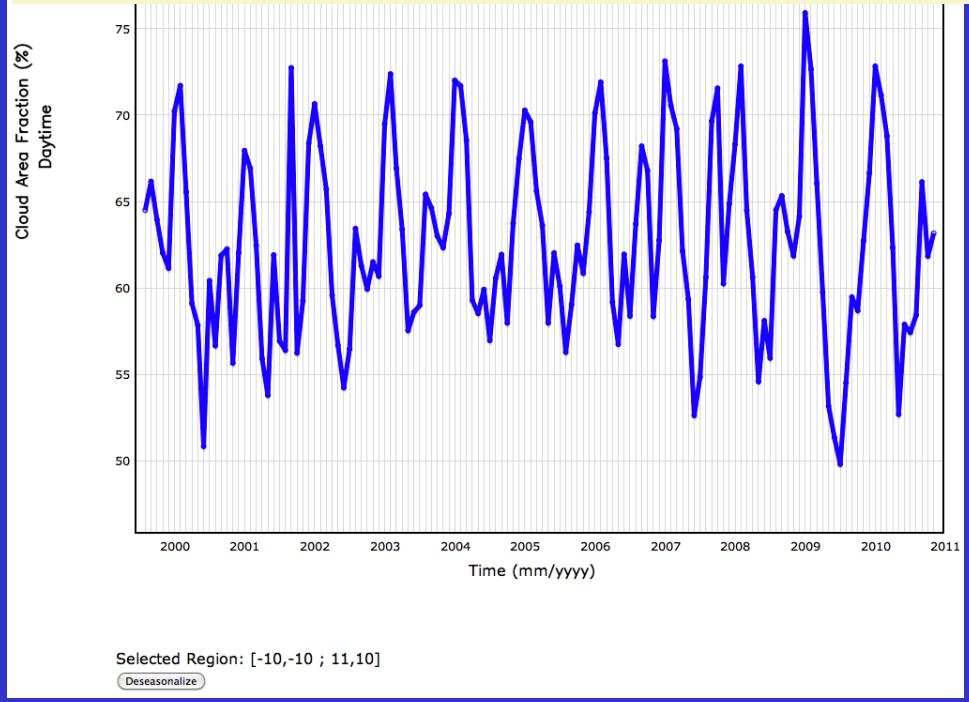
Cirrus	Cirrostratus	Deep Convection
Altocumulus	Altostratus	Nimbostratus
Cumulus	Stratocumulus	Stratus

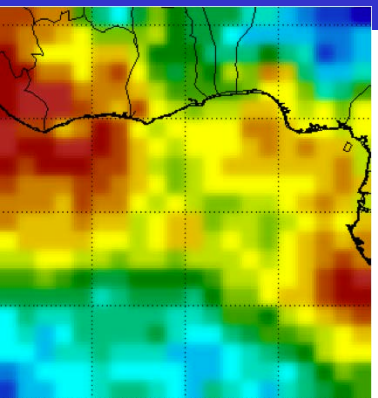
New Feature: (part of Demo)
User selected region histogram or time series

Single month PDF of selected region



Monthly time series of selected region





Start Slide Show | Slower | Faster

Min/Max Values: 10 - 100 replot

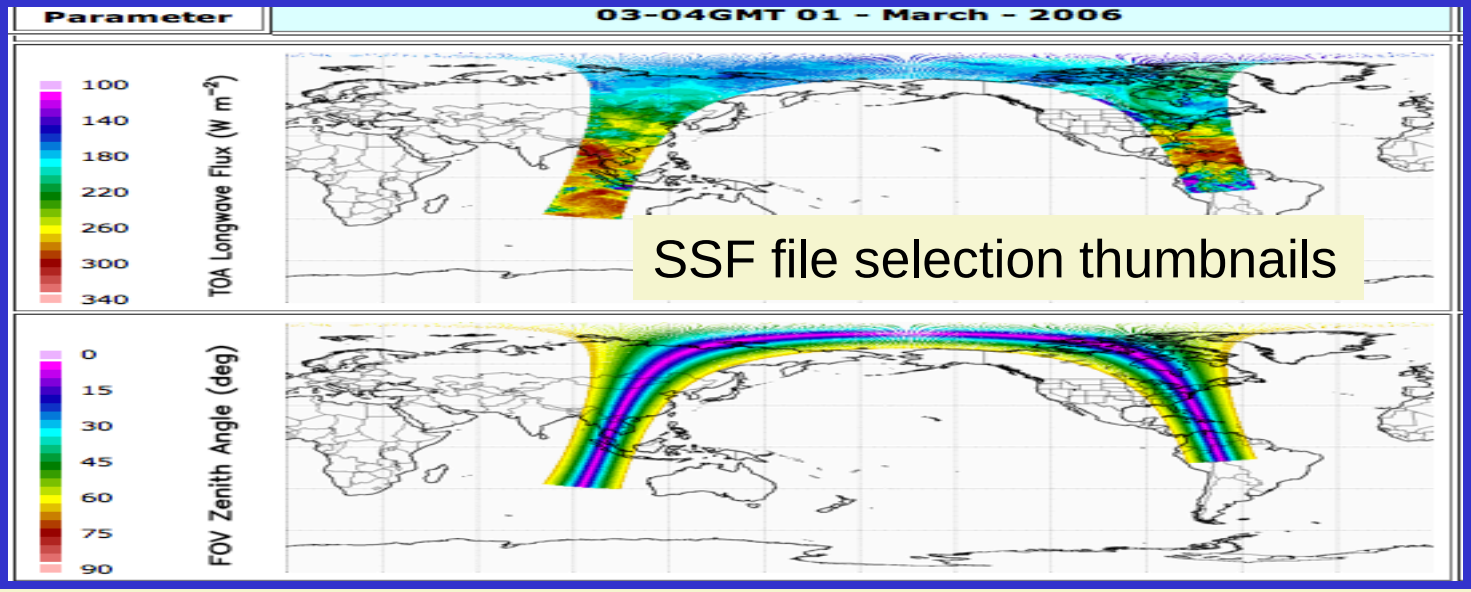
Number of colors: 24 reset

Enable Google Earth

Save Data as ASCII File | Save Image as png | Histogram | Area Mean Time Series

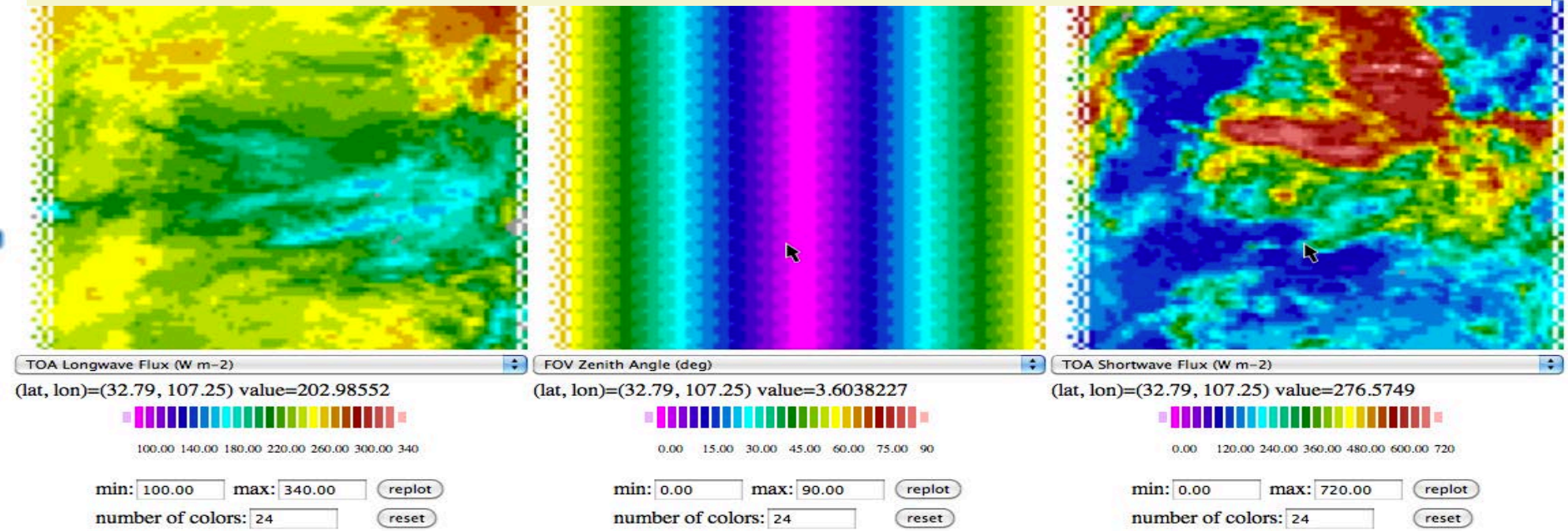
SSF level-2 visualization

(part of Demo)



SSF file selection thumbnails

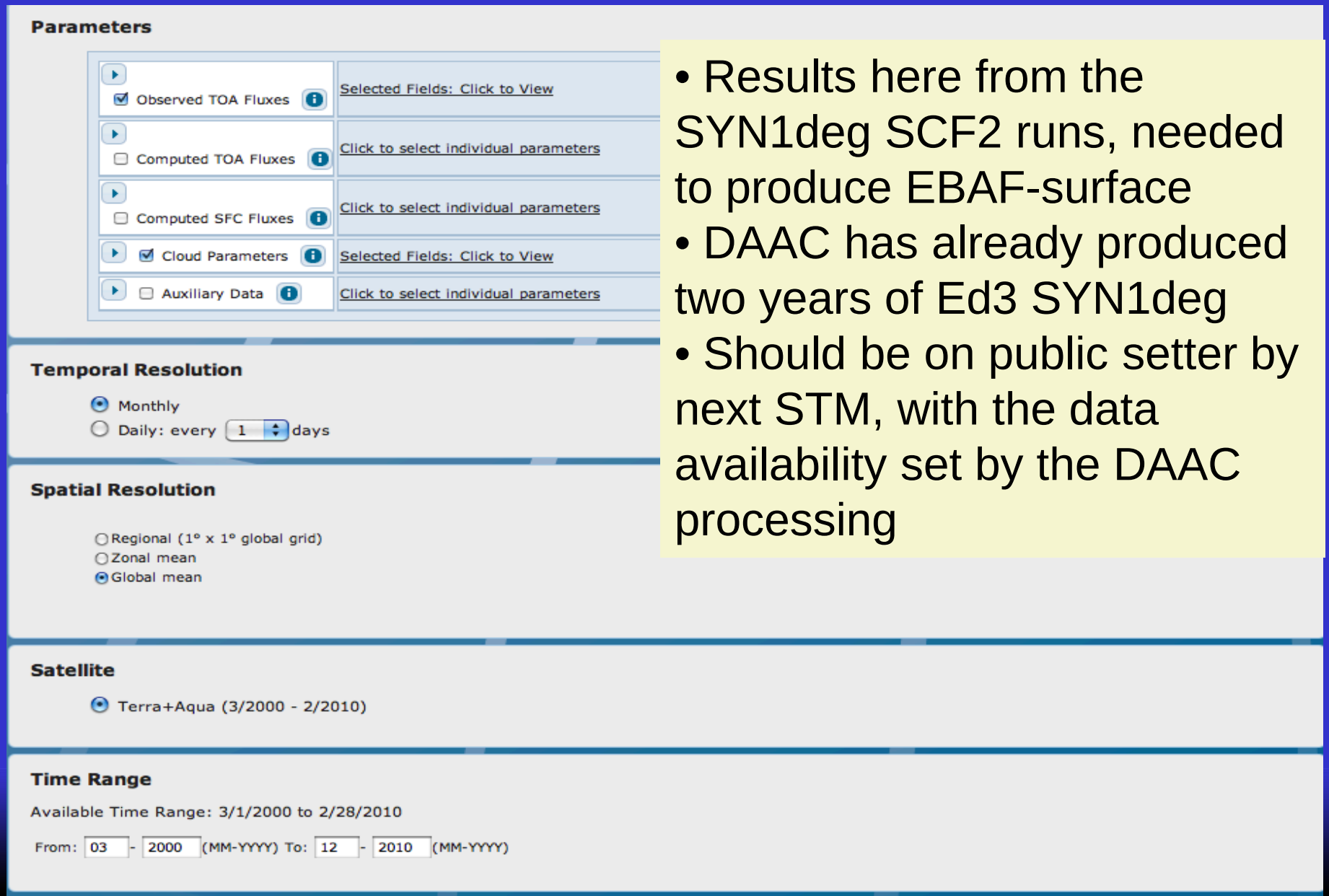
Interactive visualization of selected parameters along the SSF ground track



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

- Has been very successful validating the EBAF-Surface, ISCCP-D2like, and SYN1deg (AVG) to quickly find outliers and review of parameters

SYN1deg daily, monthly on the internal http://ceres-subset8.larc.nasa.gov/ord-tool/ CERES subsetter



- Results here from the SYN1deg SCF2 runs, needed to produce EBAF-surface
- DAAC has already produced two years of Ed3 SYN1deg
- Should be on public setter by next STM, with the data availability set by the DAAC processing

CERES ASDC web pages review and update

ATMOSPHERIC SCIENCE DATA CENTER

CERES Data and Information

Sample CERES ASDC web page

The Clouds and the Earth's Radiant Energy System (CERES) is a key component of the Earth Observing System (EOS) program. The CERES instruments provide radiometric measurements of the Earth's atmosphere from three broadband channels. The CERES missions are a follow-on to the successful Earth Radiation Budget Experiment (ERBE) mission. The first CERES instrument (PFM) flew on TRMM, four instruments are currently operating on the EOS *Terra* (FM1 and FM2) and *Aqua* (FM3 and FM4) platforms, and FM5 was launched on the *NPP* platform on October 28, 2011.

CERES Browse & Subset Tool
For guidance in selecting appropriate product, **subsetting**, visually **browsing** and **downloading** data in netCDF format.

Later this year migrate to new ASDC layout

Data Products

Level 4: Spatially (1°x1° lat/lon regional, 1° zonal, global) and temporally (monthly, climatological, etc.) averaged fluxes where the TOA net flux has been energy balanced.

Data Product	Description	Order Data
EBAF	TOA clear-sky (spatially complete) fluxes, all-sky fluxes, and cloud radiative effect (CRE) along with associated computed surface fluxes where the TOA net flux is constrained to the ocean heat storage.	Order Data

Level 3: Spatially (1°x1° lat/lon regional, 1° zonal, global) and temporally (daily, monthly, etc.) averaged fluxes and clouds.

Processing Stream	Description	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 in-atmospheric (profile) fluxes consistent with the observed TOA fluxes, clouds and aerosols.	Order Data
SSF1deg	CERES constant meteorology temporally interpolated TOA fluxes, MODIS clouds and aerosols.	Order Data
ISCCP-D2like	CERES-MODIS and GEO cloud properties stratified by ISCCP cloud types and in the similar D2 format.	Order Data
FLASHFlux	Near real-time daily averaged CERES observed TOA fluxes, parameterized surface fluxes, and MODIS clouds. Not of climate quality or to be appended with any other CERES dataset.	Order Data
ERBElike	TOA fluxes using algorithms identical to those used by ERBE.	Order Data

CERES ASDC web pages review and update

Level 2: Instantaneous footprint-level (20km nominal) fluxes and cloud properties.

Processing Stream	Description	Order Data
CRS	Computed TOA, surface and in-atmospheric (profile) fluxes using the MODIS clouds and aerosols on the SSF.	Order Data
SSF	CERES observed TOA fluxes, MODIS clouds and aerosols, and parameterized surface fluxes.	Order Data
CERES-MISR	MISR radiances associated with along-track CERES SSF data.	Order Data
CCCM	CALIPSO/CloudSat cloud and aerosols collocated with nadir-view CERES fluxes and clouds. Not for climate studies such as deriving a trend.	Order Data
FLASHFlux	Near real-time availability of CERES observed TOA fluxes, parameterized surface fluxes, and MODIS clouds and aerosols in the Level2 SSF format. Not of climate quality or to be appended with any other CERES dataset.	Order Data
ERBElike	TOA fluxes using algorithms identical to those used by ERBE.	Order Data

Level 1B: CERES instantaneous footprint-level (20km nominal) ephemeris and instrument level data.

Data Product	Description	Order Data
BDS	CERES geolocated and calibrated TOA filtered radiances.	Order Data

Sample CERES ASDC web page

Additional Information

Data Products	Documentation	Tools and Images	Relevant Links
• AVG • BDS • CRS • EBAF • ES-4 • ES-8 • ES-9 • FSW • ISCCP-D2like • SFC • SRBAVG • SSF • SSF1deg-lite • SYN • SYN1deg-lite • ZAVG	• CERES Online Documentation • Edition4 CERES Data Product processing flowchart • Edition2 CERES Data Product processing flowchart • Edition 2 CERES Processing Level Details • Processing Level Descriptions	• CERES Browse & Subset Tool (Beta) • ASDC Web Ordering Tool • Data Visualization Software (view_hdf) • Information on HDF • CERES Imagery and Articles • Examples of Spatial Extent and Scan Modes	• CERES Home Page • CERES Platforms | Aqua | Terra | TRMM • CERES Instrument Operations • CERES ARM Validation Experiment (CAVE) • CERES Surface and Atmospheric Radiation Budget (SARB) Properties • CERES/ARM Radiation Experiment (CARE) • Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS) • CLAMS Data Ordering

(sample) CERES ASDC SYN1deg stream page

SYN1deg Level3 Data Products

Level 3: Spatially (1°x1° lat/lon regional, 1° zonal & global) and temporally (daily, monthly, etc.) averaged fluxes and clouds.

Temporal Resolution	Data Product (Info link)	Description	Release Date	Spatial Resolution	File Format	Order Data
Monthly	SYN1deg-lite	CERES geostationary (GEO) enhanced temporally interpolated TOA fluxes, MODIS & 3-hourly GEO cloud properties, and MODIS aerosols.	**July 2011**	Regional Zonal Global	netCDF	Order Data browse & subset
	ZAVG	Computed TOA, surface and in-atmospheric (profile) fluxes consistent and along with the CERES GEO-enhanced temporally interpolated observed fluxes and clouds.	Nov 2005	Zonal Global	HDF	Order Data
	AVG	Computed TOA, surface and in-atmospheric (profile) fluxes consistent and along with the CERES GEO-enhanced temporally interpolated observed fluxes and clouds.	Nov 2005	Regional	HDF	Order Data
	SRBAVG	CERES GEO-enhanced and constant meteorology temporally interpolated TOA fluxes, parameterized surface fluxes, MODIS & 3-hourly GEO cloud properties, and MODIS clouds and aerosols.	Nov 2005	Regional Zonal Global	HDF	Order Data
Daily	SYN1deg-lite	CERES GEO-enhanced temporally interpolated TOA fluxes, MODIS & 3-hourly GEO cloud properties, and MODIS aerosols.	**July 2011**	Regional Zonal Global	netCDF	Order Data browse & subset
Monthly 3-Hourly	ZAVG	Computed TOA, surface and in-atmospheric (profile) fluxes consistent and along with the CERES GEO-enhanced temporally interpolated observed fluxes and clouds.	Nov 2005	Zonal Global	HDF	Order Data
	AVG	Computed TOA, surface and in-atmospheric (profile) fluxes consistent and along with the CERES GEO-enhanced temporally interpolated observed fluxes and clouds.	Nov 2005	Regional	HDF	Order Data
Monthly Hourly	SRBAVG	CERES GEO-enhanced and constant meteorology temporally interpolated TOA fluxes, parameterized surface fluxes, MODIS & 3-hourly GEO cloud properties, and MODIS clouds and aerosols.	Nov 2005	Regional Zonal Global	HDF	Order Data
3-Hourly	SYN	Computed TOA, surface and in-atmospheric (profile) fluxes consistent and along with the CERES GEO-enhanced temporally interpolated observed fluxes and clouds.	Nov 2005	Regional	HDF	Order Data
Hourly (Instantaneous Gridded)	FSW	Regional averages of instantaneous footprint computed fluxes [TOA, surface, and in-atmospheric (profile)], associated TOA observed fluxes, and cloud parameters only for the hours of satellite overpass (from CRS Level2 product).	Nov 2005	Regional	HDF	Order Data

Maps into CERES ASDC SRBAVG existing page

NASA Earth Data | Data Discovery | Data Centers | Community | Science Disciplines | Search EOSDIS

ATMOSPHERIC SCIENCE DATA CENTER

CERES SRBAVG Data Sets

- **Description**: Monthly TOA/Surface Averages (SRBAVG): Monthly and monthly hourly regional, zonal, and global averages of the TOA and surface LW and SW fluxes and cloud parameters for each 1-degree equal-angle region
- CERES data products are written in HDF format. (Information on HDF)
- **Select SRBAVG Parameters**: Clear-sky and All-sky TOA Fluxes, Surface (Radiative) Fluxes, OLR, Clear-sky and All-sky Albedo, Cloud Properties, Surface TypesList
- **SRBAVG Documents**: Description/Abstract
- **Tools**:
  - UNIX C shell scripts for extracting regional CERES geo and non-geo fluxes from the CERES SRBAVG1 HDF file. Readme | Software Package
  - Giovanni data visualization for Aqua SRBAVG FM-4

Available Data Products

For convenience in ordering a specific CERES data product, select the Data Set Name in the table below.

Spacecraft	Data Set Name (Select name to order)	Data Products Catalog (PDF)	Sample Software	Temporal Coverage (Monthly)
TRMM (covers opened 12/27/1997)	CER_SRBAVG_TRMM-PFM-VIRS_Edition2B. Quality Summary TRMM_Edition2B.	DPC_SRBAVG_R4V1	Readme R4-671 | Read Package (C)	01/1998 - 08/1998, 03/2000
Terra (covers opened 02/25/2000)	CER_SRBAVG_Terra-FM1-MODIS_Edition2D. CER_SRBAVG_Terra-FM2-MODIS_Edition2D. Quality Summary Edition2D-Terra and Aqua.			03/2000 - 10/2005
	CER_SRBAVG_Terra-FM1-MODIS_Edition2C. CER_SRBAVG_Terra-FM2-MODIS_Edition2C. Quality Summary Terra Edition2C.			03/01/2000 - 02/28/2003
Aqua (covers opened 06/18/2002)	CER_SRBAVG_Aqua-FM3-MODIS_Edition2A. CER_SRBAVG_Aqua-FM4-MODIS_Edition2A. Quality Summary Edition2D-Terra and Aqua.			07/01/2002 - 10/31/2005

Clouds and TOA/SFC Flux Processing | Processing Level Details

CERES Data and Information | ASDC Home Page | Access Data | Questions/Feedback | Obtain Plugins (PDF, PS, etc)

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[Privacy Policy and Important Notices]
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CERES order tool statistics

Legend:
May 2010 to April 2011
May 2010 to Sept 2011
May 2010 to April 2012

Across all products	Email (ordered)	IP (visualize, order)
Unique Users	136 214 323	272 316 438

Product	orders	files	Volume (GB)
EBAF	138 326 541	138 326 541	8.4 27.5 37.3
SSFlite	229 402 805	302 452 848	143 183 221
SYNlite	227 471 836	313 539 885	140 227 282

- 30% increase in number of unique email users over previous 6 months
- 26% of users not sharing email, down from 50% a year ago
- 62% 70% increase in # of orders files from previous 6 months period
- 30% decrease in data volume from previous 6 months, users ordering fewer parameters and/or time range

Categories of the 323 CERES email data users

Suffix	#
.gov (LaRC)	39
.gov (non LaRC)	16
.edu	67
.com	105
.country	96

Other Countries with 1 or 2 users:
Austria, Belgium, Brazil, Columbia, Finland, Granada, Kyrgyzstan, Norway, Spain, Switzerland, Sweden

Country	#
UK	12
France	10
Germany	9
China	7
Canada	6
Australia	5
Denmark	5
India	5
Japan	5
Korea	4
Italy	3
New Zealand	3
Netherlands	3
Russia	3

CERES Ordering Tool Summary

- New subsetted products:
  - EBAF-surface Ed2.6r
  - ISCCP-D2like-Ed2A-beta (Ed2A June 2012, finished at DAAC)
- New features:
  - SSF level 2 visualization
  - User selected region histogram or time series
- New capabilities:
  - CERES public subsetter machines behind the firewall and have access to the DPO
- CERES internal subsetter available for validation of products before delivery of code
  - http://ceres-subset8.larc.nasa.gov/ord-tool/
- Number of users continues to grow

CERES subsetter 6 month goals

- Convert the EBAF-Surface into CMIP CF compliant files
  - Test with CMOR checker
  - Place on the Goddard ESG Gateway for PCMDI studies
  - Place on the CERES subsetter
- Extend the EBAF, SYN1deg-lite, SSF1deg-lite, between July to December 2011
  - These products will have 6 months updates at every CERES STM
- Build the SYN1deg-3Hour, -Daily, -M3Hour, -Month
  - 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 already has 2000 and 2001 processed, ~October to complet
- CERES ASDC web page review and update
- Introduce level-3 product comparison tools
  - CERES and other PCDMI datasets
  - CERES product comparisons
- Combine ASDC and CERES ordering statistics