TISA Working Group Report

CERES TISA Sublead: D. Doelling

TISA: D. Keyes, C. Nguyen, M. Nordeen, R. Raju, M.Sun, F. Wrenn

GEO calibration: R. Bhatt, C. Haney, B. Scarino, A. Gopalan

Sub-setter: C. Chu,E. Heckert, C. Mitrescu, P. Mlynczak

19th CERES Science Team Meeting

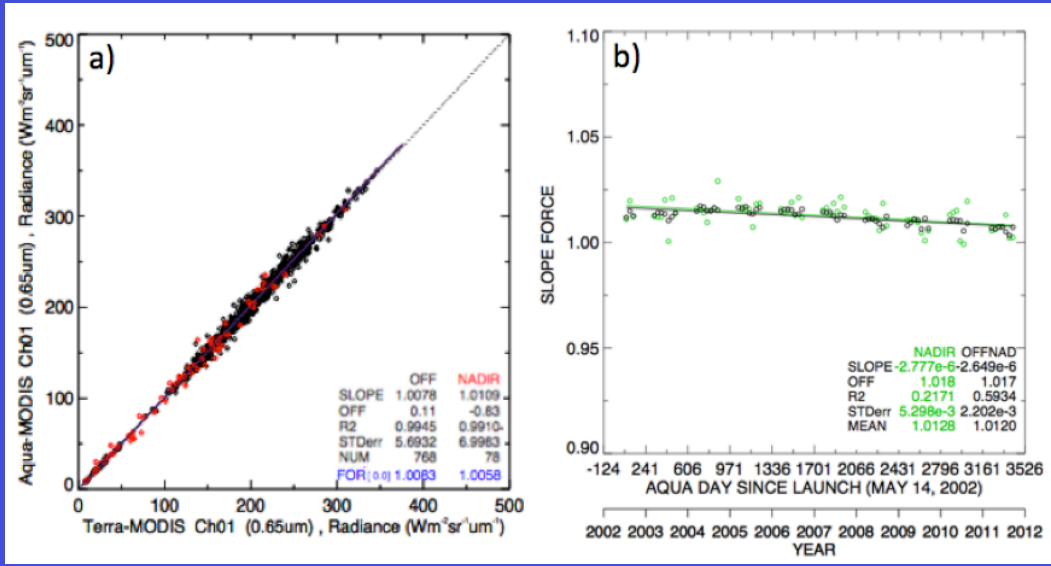
Scripps Institution of Oceanography, La Jolla, CA, October 29-31, 2013

TISA Ed4 improvements

	Ed2	Ed4
GEO calibration	Terra-MODIS Collection 5 reference Terra-MODIS/GEO ray-matching	Aqua-MODIS Collection 6 reference Terra-scaled-to and Aqua-MODIS/GEO ray-matching Deep convective cloud and desert SCIAMACHY based spectral band adjustment MTSAT-1R adjusted point spread function
GEO clouds	Visible and 11μm cloud retrievals Assumed particles size Assume night time emissivity = 1 MODIS clear-sky albedo maps Phase, 253°K threshold	Visible and 3.7,11, and 12μm cloud retrievals/mask 3.7μm channel retrieved particle sizes Emissivity based on 3.7,11 and 12 (good for thin clouds) GEO specific clear-sky maps Multiple IR channel threshold (MODIS lapse rate?)
GEO LW flux	Simple global parameterization based on WN radiance column weighted RH Instantaneous normalization	WN and WV to BB LW ADM 5° by 5° LW regional normalization
GEO SW flux	GEO visible->MODIS 0.65μm->BB CERES SW TRMM ADM 5° by 5° SW regional normalization	Investigate visible to BB conversion Investigate GEO derived clear-sky TOA flux accuracy
Temporal interpolation	TRMM SW directional models LW linear interpolation 3-hourly GEO	GEO 1-hourly observations (no temporal interpolation)
Surface fluxes	GEOS and MODIS skin temperatures GEOS 4.0/5.2 merged dataset Untuned surface fluxes	Include GEO derived skin temperatures GEO 5-channel clouds (test normalized to MODIS) Surface fluxes tuned to TOA using cloud overlap 2000 to present GEOS 5.4 dataset Spectral & SZA dependent surface albedo
Validation	Terra/Aqua-CERES & GERB TOA fluxes ground site fluxes	Include Megha-Tropique

GEO Ed4 visible calibration

- Aqua-MODIS 0.65μm channel C6 calibration reference for GEO in Ed4, Terra-MODIS used in Ed2
- Scale Terra to Aqua-MODIS using polar SNOs

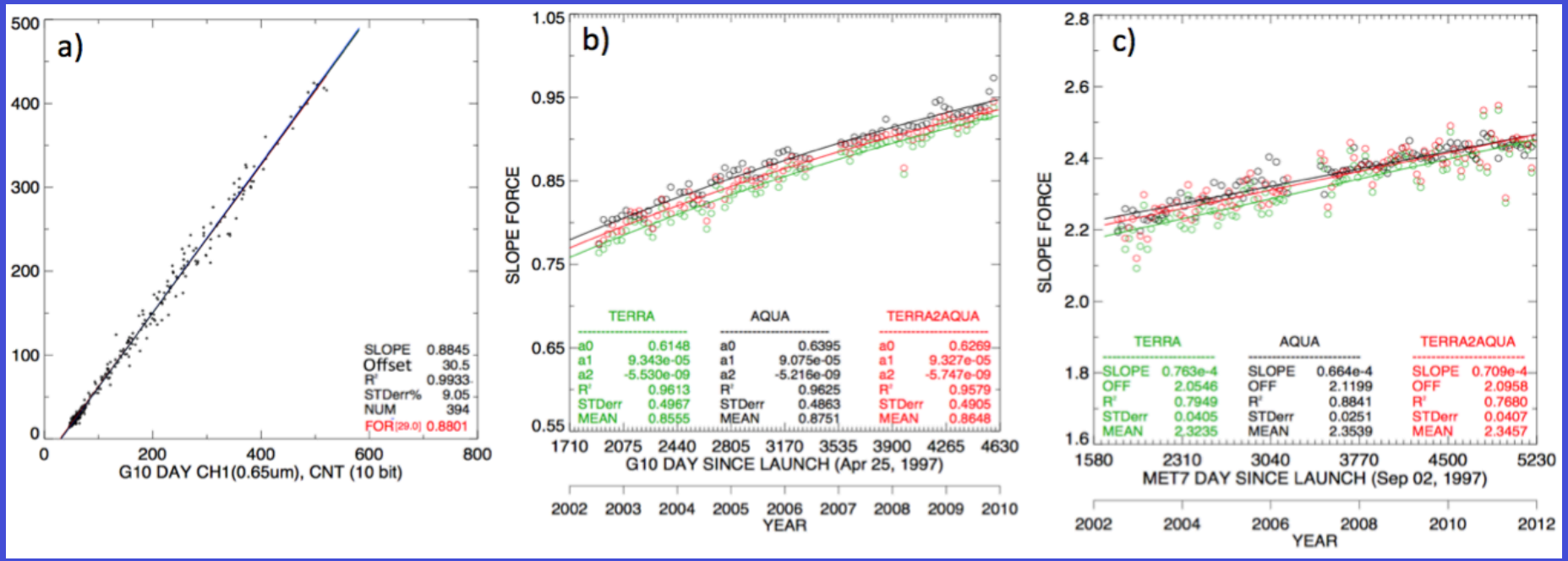


Terra and Aqua-MODIS C5/C6 stability in %/decade over invariant earth targets

MODIS Band		Terra						Aqua					
		Deserts		Dome C		DCC		Deserts		Dome C		DCC	
μm	#	C5	C6	C5	C6	C5	C6	C5	C6	C5	C6	C5	C6
0.65	1	-2.1	-0.9	-1.6	0.4	-2.5	-0.4	0.0	-1.4	0.5	-0.5	-0.1	-0.9

GEO Ed4 visible calibration

- Use coincident co-angled, co-located GEO visible and MODIS 0.65μm to transfer the MODIS calibration to GEO from both Terra and Aqua



- After scaling Terra to Aqua, Terra-MODIS can be used to verify the Aqua-MODIS calibration

GEO visible calibration

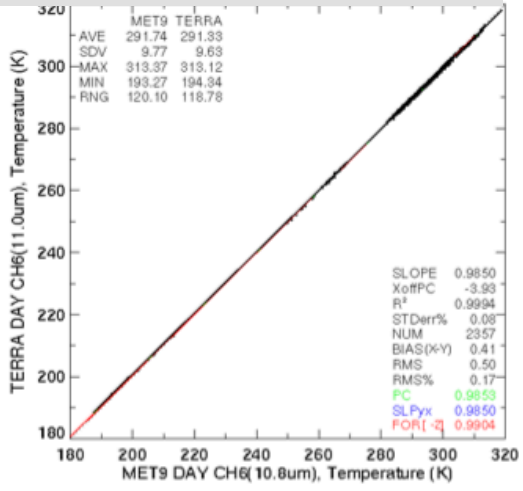
- Calibrate GEOs with both Terra-scaled and Aqua-MODIS 0.65μm channel
- Most GEOs within 0.5% except GOES-West
- Spectral Band Adjustment Factor (SBAF) removes the spectral GEO/MODIS response function difference (SRF) based on SCIAMACHY

Satellite	GEO Record		GEO longitude	SBAF (%)	Terra-Aqua mean gain (%)		Trend stderr(%)	
	Start	End			C6	Scaled	Terra	Aqua
GOES-9	Apr 2003	Oct 2005	155°E	1.1	-1.7	-0.5	0.5	0.5
GOES-10*	Jul 2002	Dec 2009	135°/60° W	1.3	-2.2	-1.2	0.5	0.5
GOES-11	Jul 2006	Dec 2011	135°W	1.4	-2.3	-1.5	1.2	0.8
GOES-12°	Apr 2003	Dec 2011	75°/60°W	1.2	-1.5	-0.6	0.5	0.5
GOES-13	Apr 2010	Dec 2011	75°W	0.8	-0.9	-0.2	0.2	0.6
Meteosat-5	Jul 2002	Jan 2007	63°E	2.1	-0.3	+0.9	5.2	2.2
Meteosat-7#	Jul 2002	Dec 2011	0°/57°E	2.1	-1.3	-0.3	4.1	2.5
Meteosat-8	May 2004	Mar 2007	3°W	0.3	-1.4	-0.2	0.4	0.6
Meteosat-9	Apr 2007	Dec 2011	0° E	0.3	-0.4	+0.3	0.3	0.5

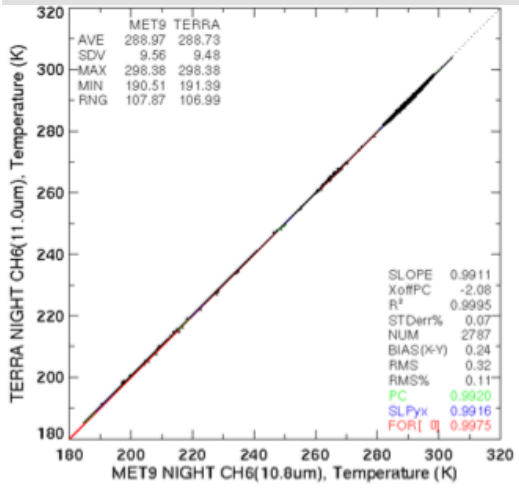
- GEO Ed4 cloud code using Aqua-MODIS C6 calibration

GEO IR calibration

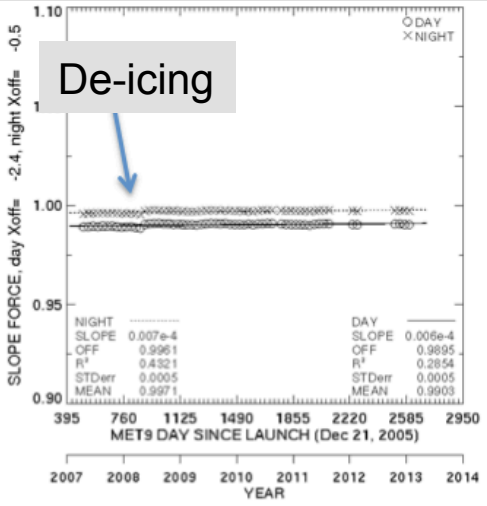
Met9/Terra-MODIS 11μm Night, March 2012



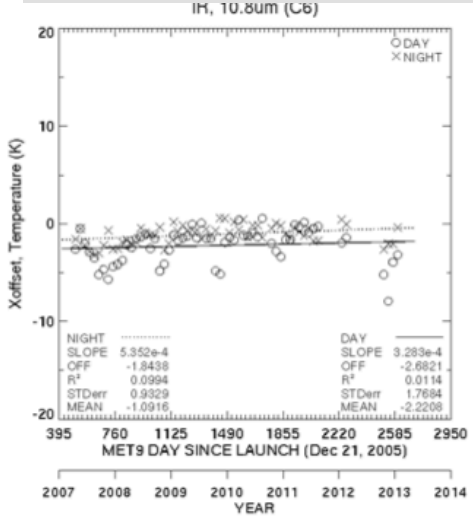
Met9/Terra-MODIS 11μm Day, March 2012



Met9/Terra-MODIS slopes



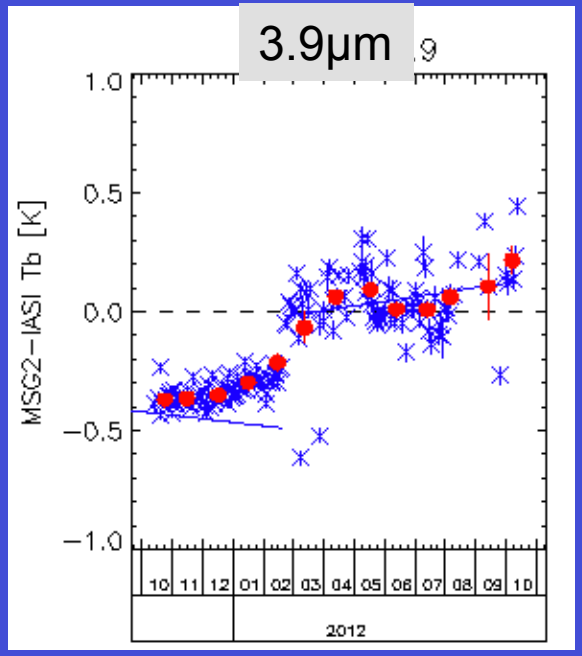
Met9/Terra-MODIS offset

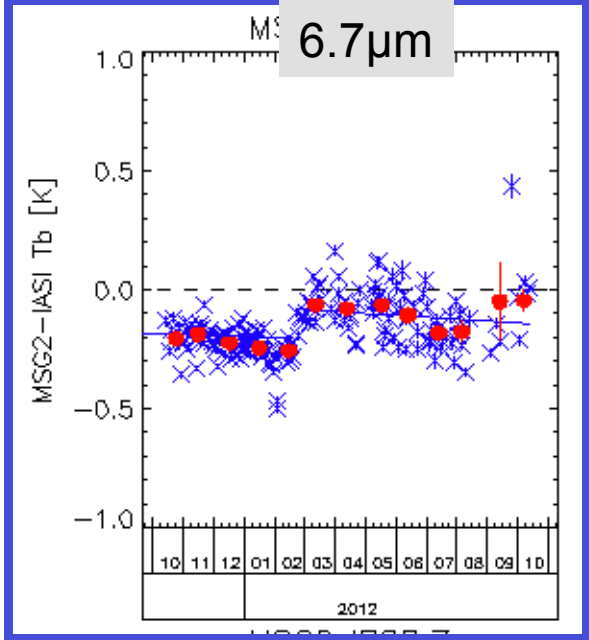


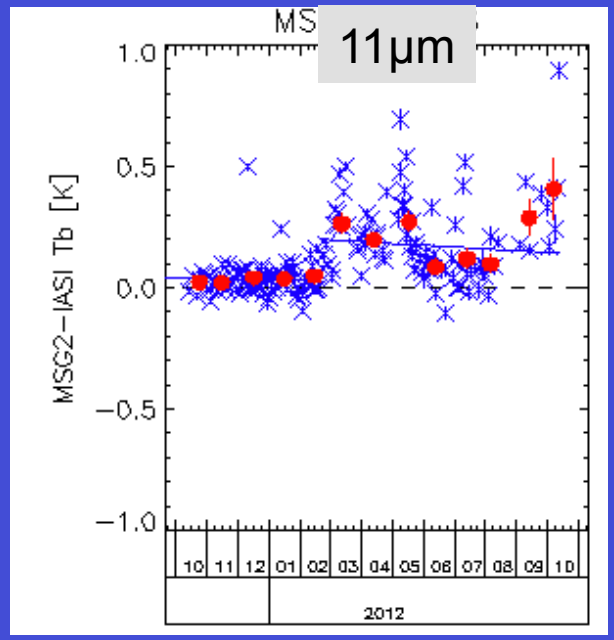
- Ed2 GEO IR WN was calibrated against C5 Terra-MODIS 11μm
- Compare GEO IR 11μm, 6.7μm, 3.9μm with C5 &C6 Terra-MODIS, C5 Aqua-MODIS and GSICS (AIRS and IASA hyper-spectral)

GEOs have onboard black-bodies so they are fairly stable except for de-icing events

GSICS Met-9 IR calibration and monitoring

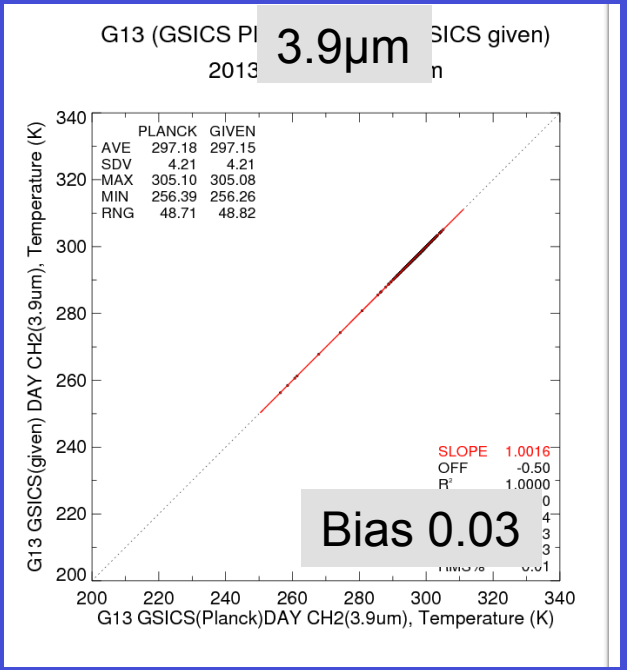


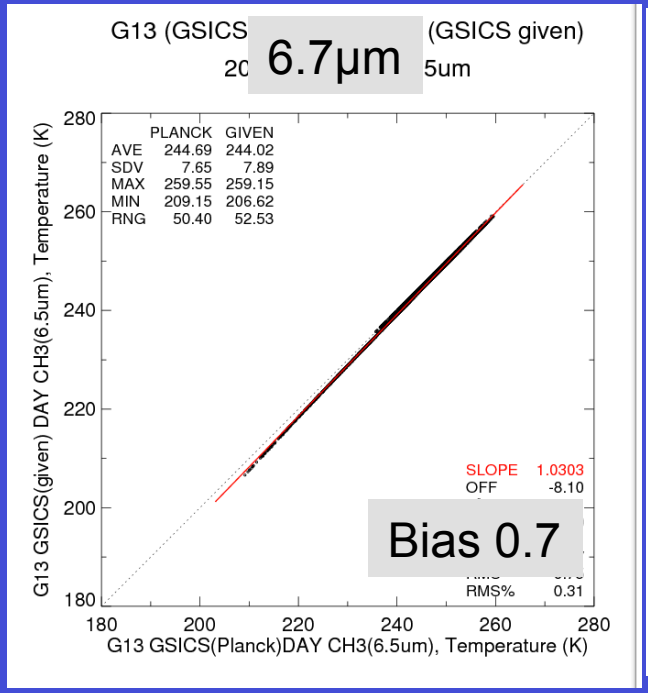


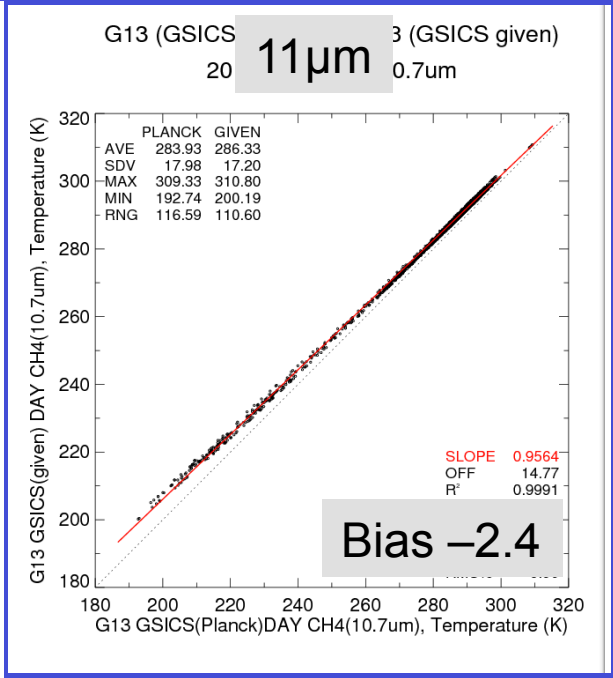


- Met-9 conducts de-icing events annually to improve IR sensor response
- GSICS uses AIRS and IASI hyper-spectral radiances to account for difference in spectral response and as a calibration reference and stability
- MODIS is not as accurate as IASI, which is the GSICS IR calibration reference

GSICS GOES-13 applied GSICS calibration March 2013







- Compare all MODIS based GEO IR calibration from 2003 with GSICS
- Especially the GEO 3.9µm channel where MODIS does not have a similar band

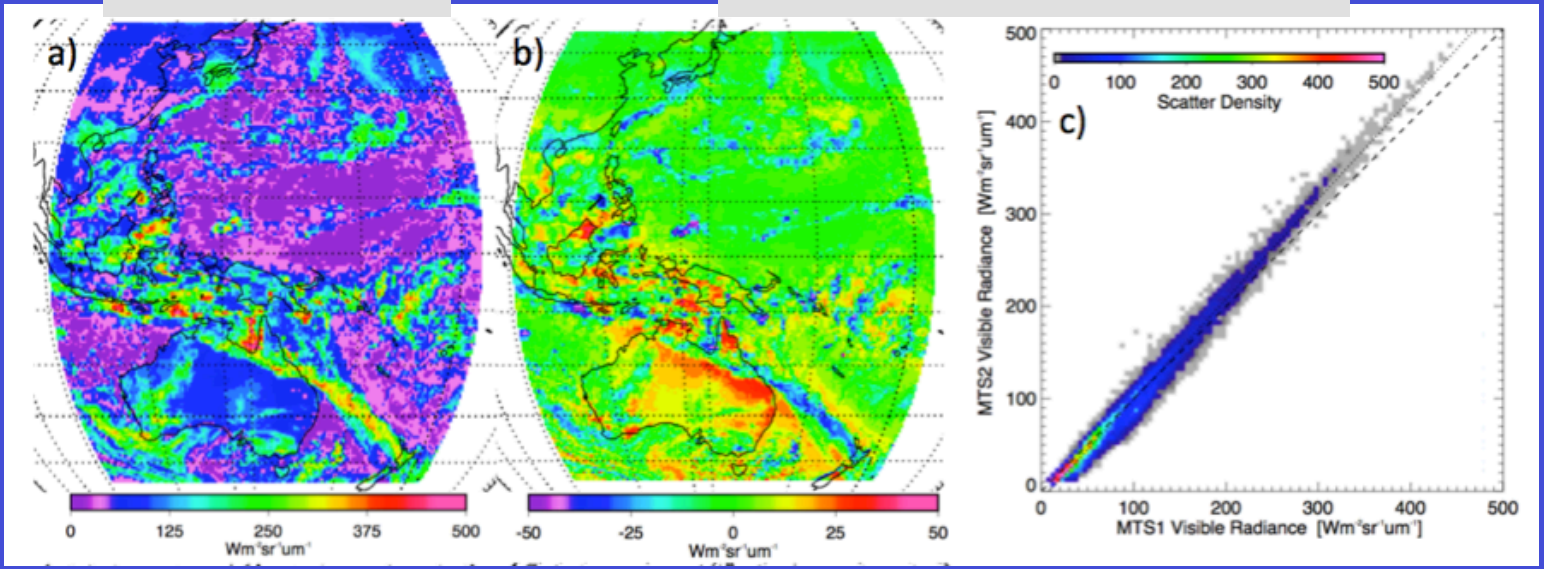
- GSICS IR calibrations should be finished in 2 weeks
- Terra-MODIS C6/GEO IR calibrations almost finished
- Terra and Aqua-MODIS C5 IR calibration finished

MTSAT-PSF correction

- MTSAT-1R optical path is blurred causing clear-sky ocean radiances surrounding bright clouds to be overestimated
- Use point spread function to remove radiance contribution from surrounding pixels up to 800-km

MTSAT-1R vis

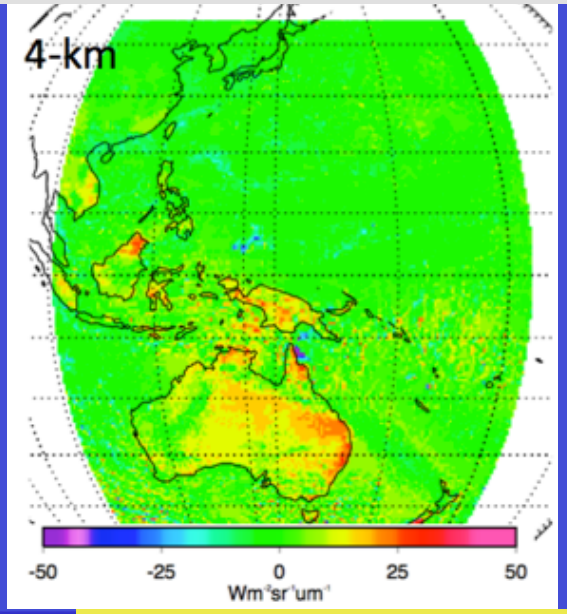
MTSAT-1R minus MTSAT-2

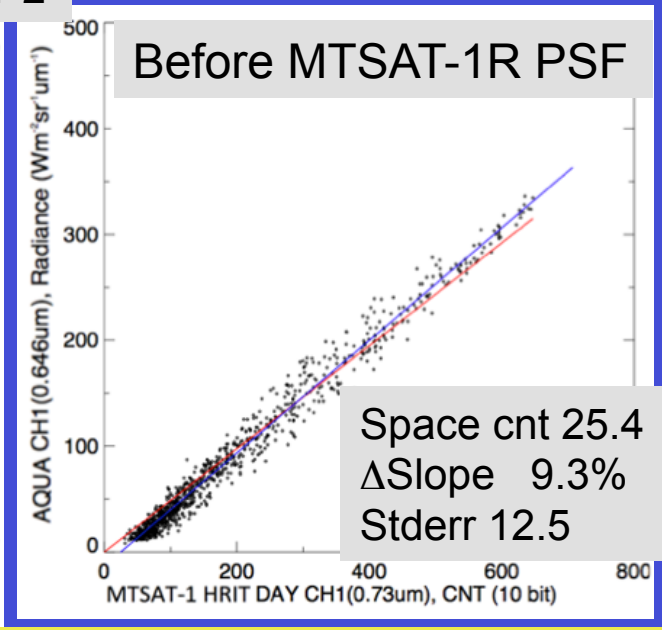


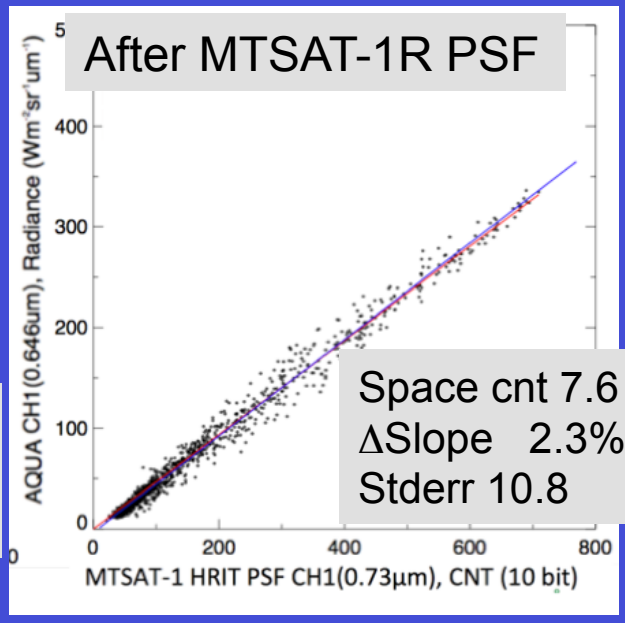
MTSAT-1R /MODIS intercalibration

- Compare monthly Oct 2007 MTSAT-1R and Aqua-MODIS visible radiance pairs before and after PSF correction
- Compare the linear regression and slope through 0

MTSAT-1R PSF minus MTSAT-2





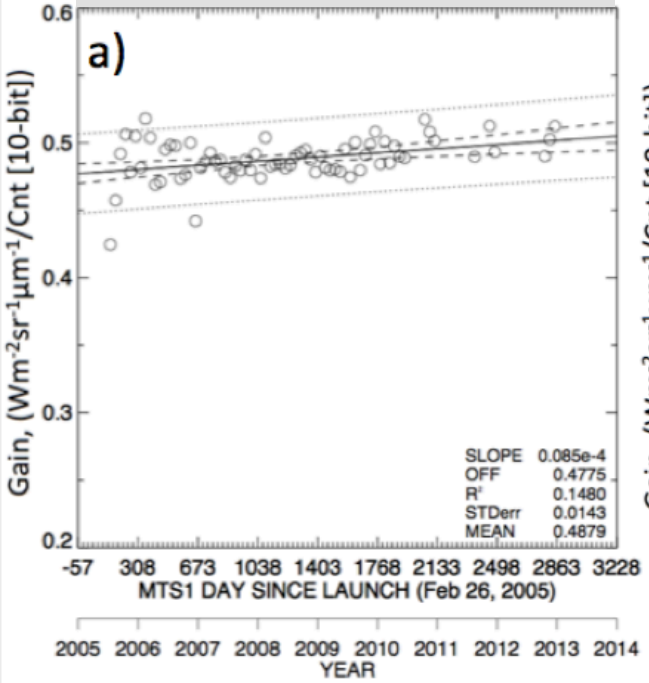


- MTSAT-1R space count closer to 0 and force fit and linear regression similar
- Slope difference is greatly reduced

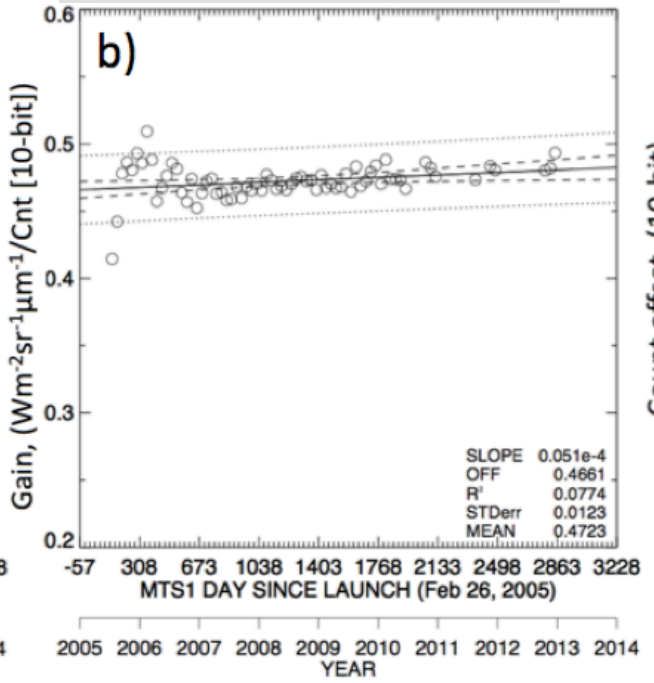
MTSAT-1R calibration

- Compare monthly gains before and after MTSAT-1R PSF correction

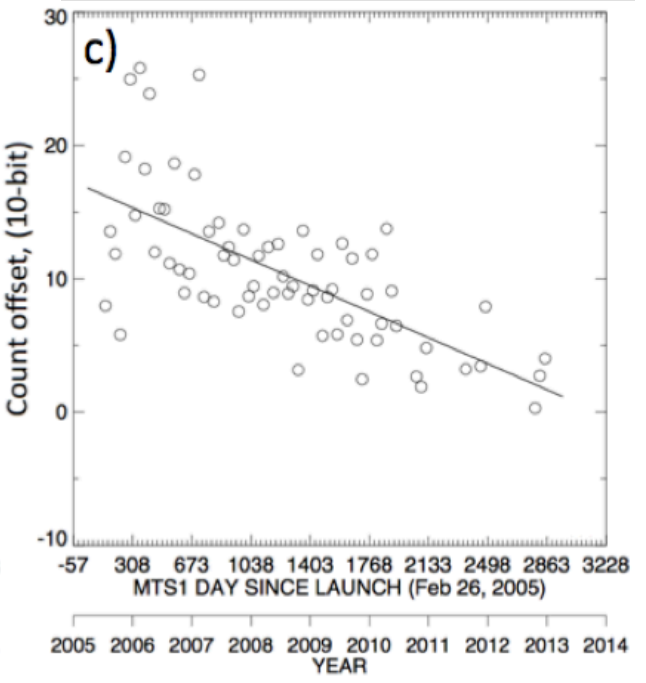
Before MTSAT-1R PSF



After MTSAT-1R PSF



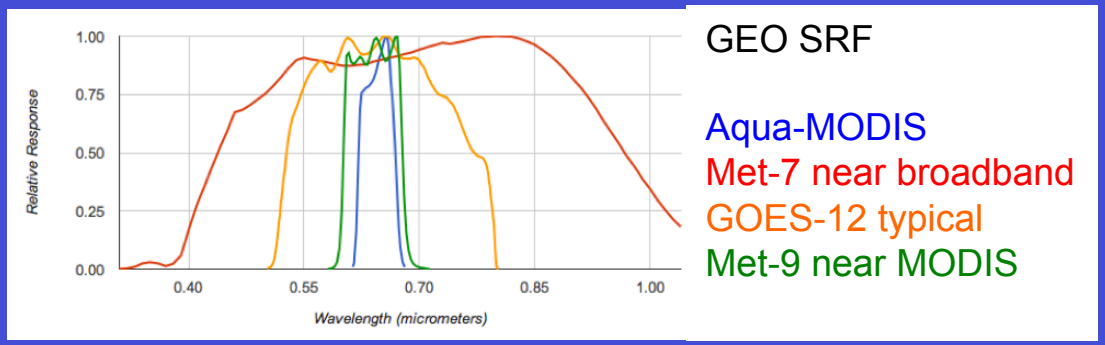
MTSAT-1R space counts



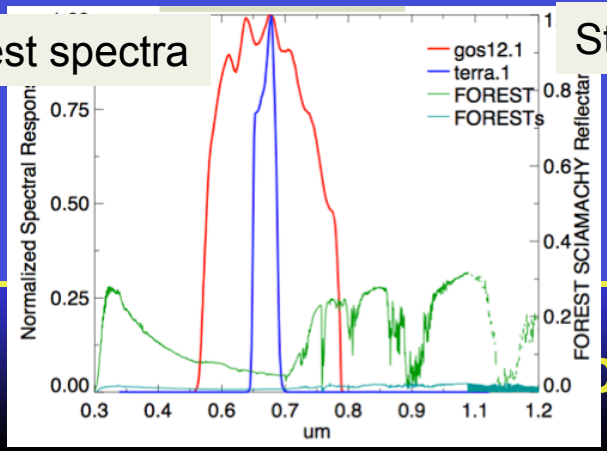
- Post 2007 monthly gain noise reduced by 1/3
- Already incorporated into the GEO Ed4 cloud code

SW NB to BB improvement

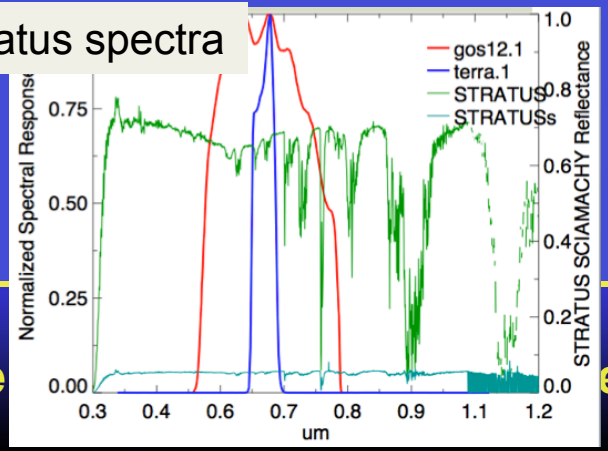
- Ed2 GEO radiance->(theoretical)->MODIS radiance->(SSF empirical)->BB radiance
  - Use same cloud fraction, optical depth and phase bins as CERES TRMM SW ADM
- Some GEO spectral response functions (SRF) are nearly broadband, does it make sense to convert MODIS SRF?



Forest spectra



Stratus spectra



SW NB to BB improvement

- Quantify improvement, using coincident CERES and GEO derived BB fluxes, based on these datasets, Jan 2010
  - GEO radiance = Broadband radiance (no modeling)
  - Use Lusheng's theoretical model's to convert from GEO to BB (optical depth dependent)
  - Or linearly regress the radiances of the optical depth bins (not dependent on optical depth)
  - Ed2 GEO->MODIS->BB (no normalization)
  - Ed2 normalized

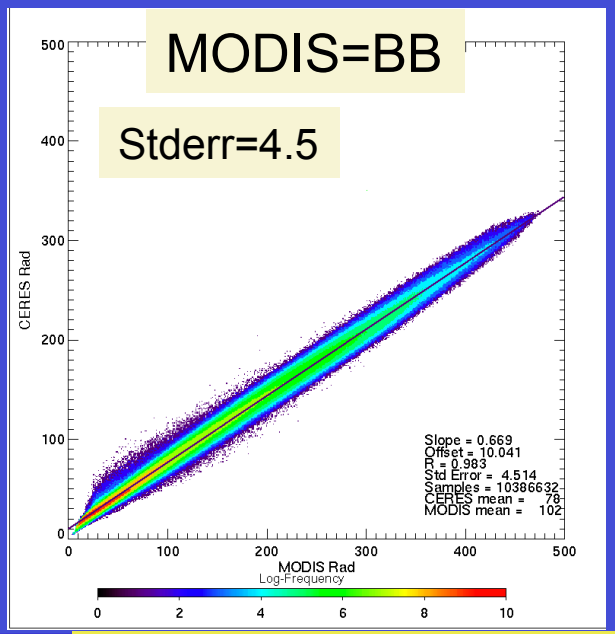
MODEL	Bias	RMS
GEO = BB	11.4	28.3
opt bin	9.4	23.1
opt regress	7.9	20.6
Ed2	2.3	17.8
Ed2-normalized	0.3	14.5

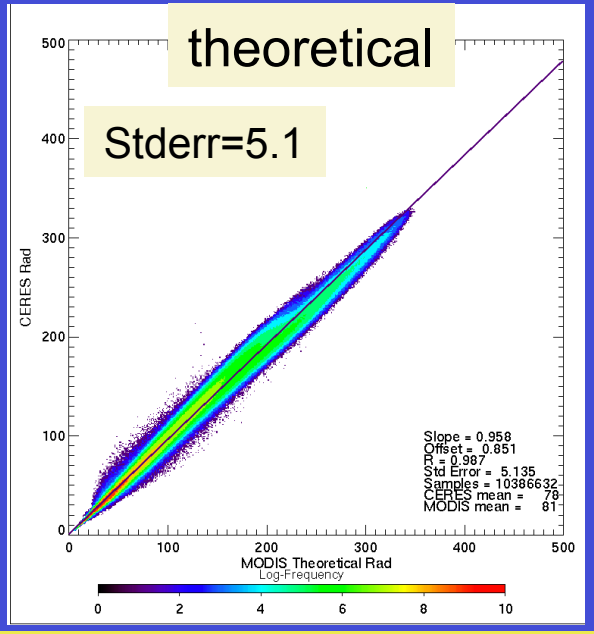
Bias	Met-9 ~MODIS	Met-7 ~BB	MTSAT ~BB	GOES-11 typical	GOES-12 typical
Opt bin	18.0	4.5	1.9	15.5	19.5
Opt reg	9.8	5.4	1.4	12.9	17.3
Ed2	3.1	1.0	-6.9	7.4	10.5
RMS	**Met-9**	**Met-7**	**MTSAT**	**GOES-11**	**GOES-12**
Opt bin	27.0	19.8	19.7	23.1	26.6
Opt reg	19.3	19.7	17.8	21.6	25.3
Ed2	14.3	18.8	18.4	17.4	20.2

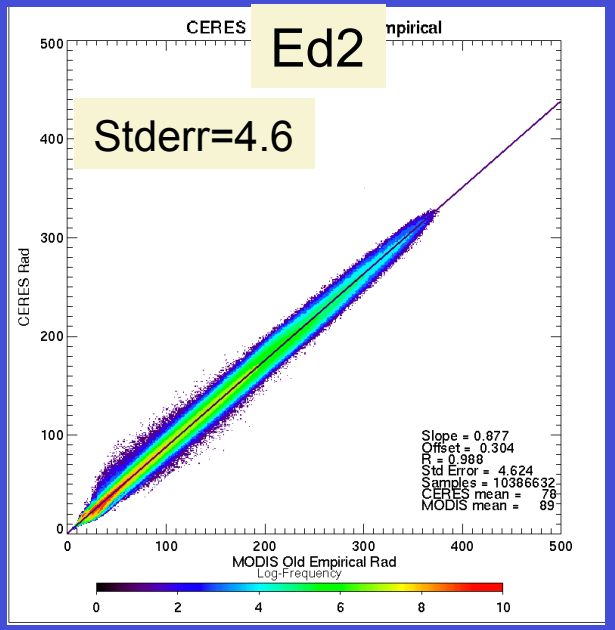
- The SW NB to BB has reduced the RMS from 28.3 to 17.8 from using no model
- Ed2 better than using GEO->BB theoretical model
- Note the reduced theoretical biases and RMS for GEOs that have ~BB SRFs

SW NB to BB improvement

- The greatest GEO NB to BB uncertainties are for GEOs with ~MODIS like SRFs
- The GEO/CERES matching is very limited in both space and time
- Use the Terra MODIS/CERES SSF Jan 2010 to evaluate the theoretical model, no spatial or temporal matching errors
- Also the TRMM VIRS/CERES SSF Jan 1998
- Look at Megha-Tropique ScaRaB visible and broadband footprint radiances, for this case the visible channel looks like a GOES SRF







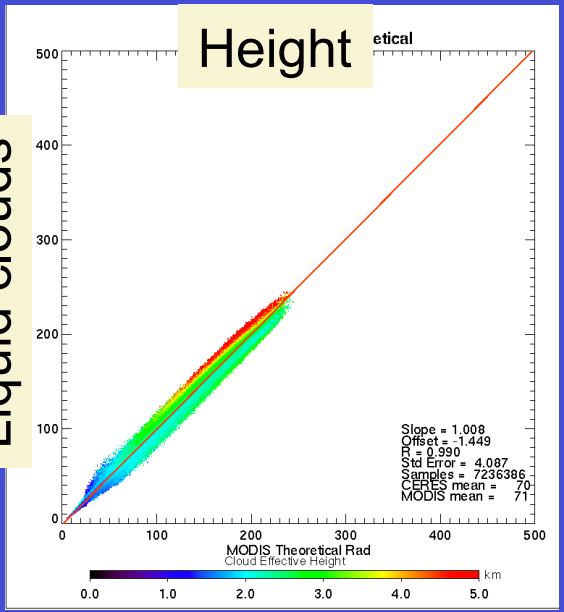
Ocean-only

- The MODIS=BB could have cloud property, angular dependencies
- The theoretical model has bi-modal distribution

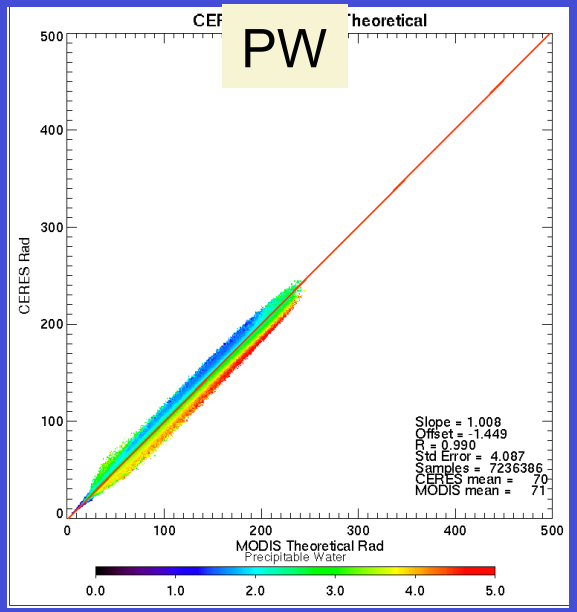
Theoretical model NB to BB dependencies (Terra)

Liquid clouds

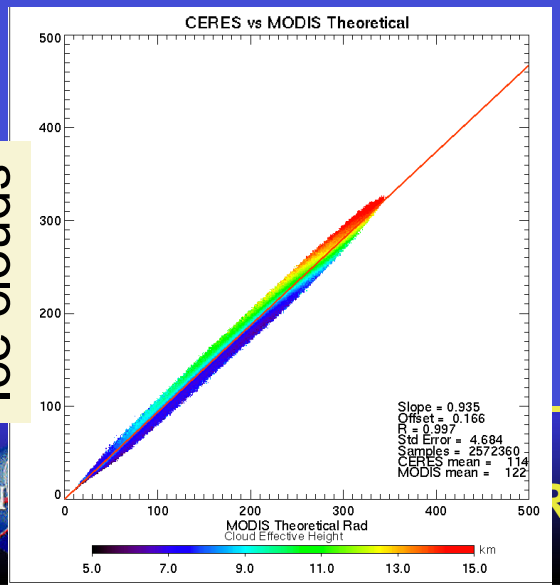
Height

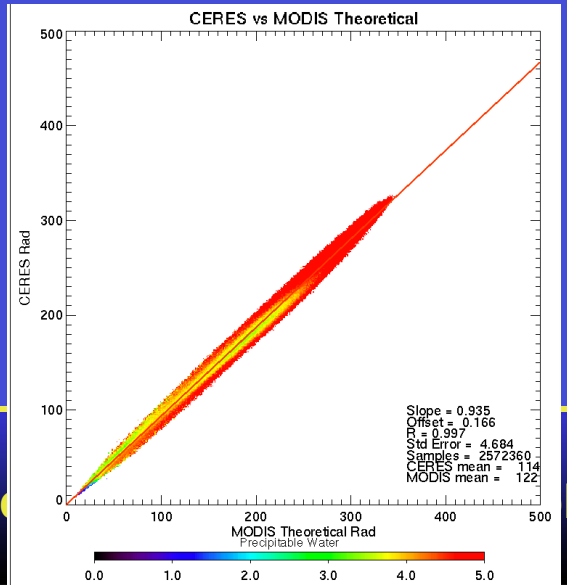


PW



Ice clouds





Theoretical model

- Ocean surface
- Tropical atmosphere
- Cloud height 2-3 km, and 7-12 km
- Mie water and Ping Yang ice (model from Sunny) micro-physics
- Corr-k absorption

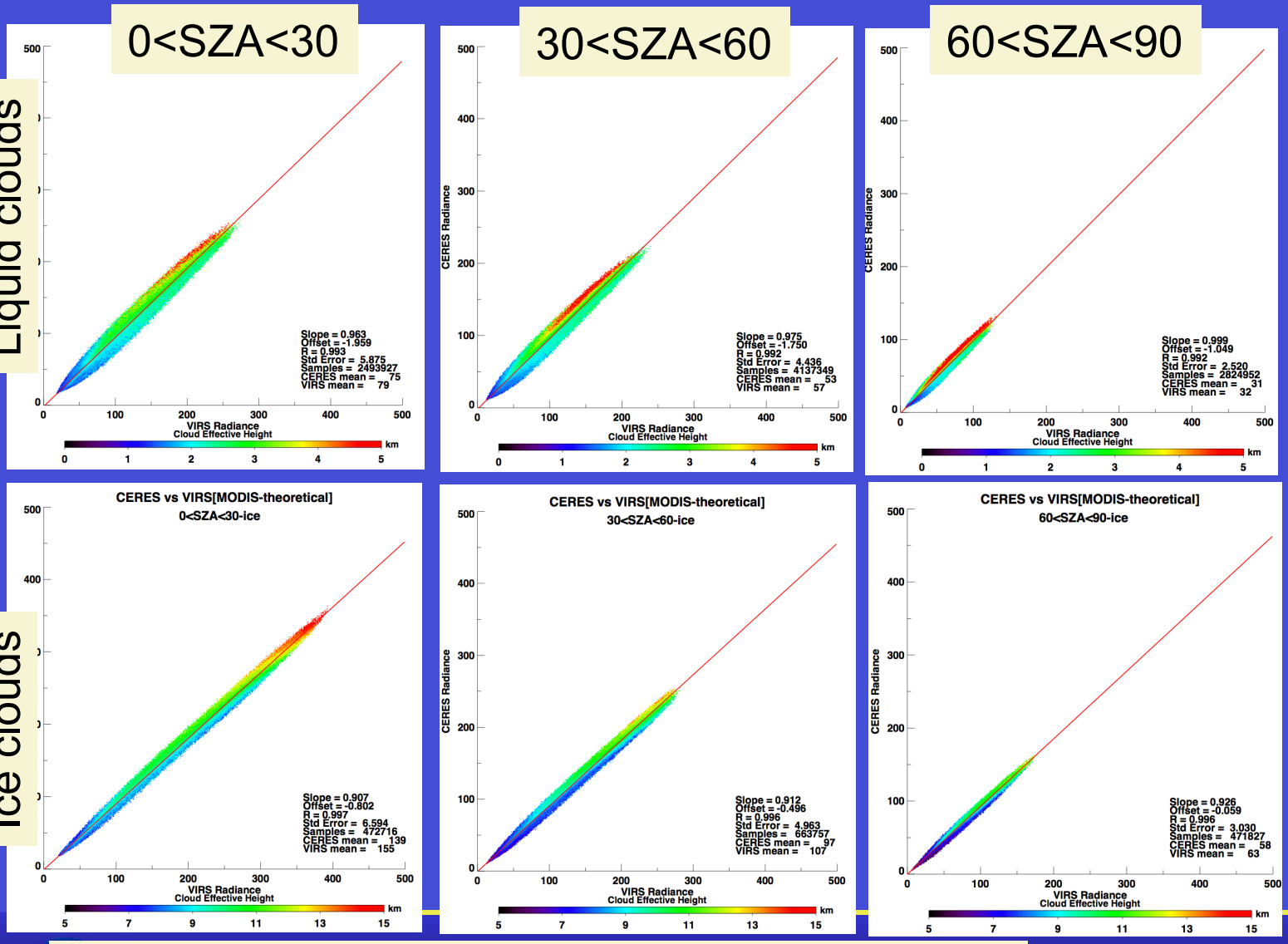
Look at dependencies according to cloud fraction, optical depth, PW, height, phase

- PW water cloud dependency
- Cloud height ice cloud dependency
- Ice slope < liquid slope~1

Theoretical model cloud height dependencies (TRMM)

Liquid clouds

Ice clouds



- Cloud height dependency increases with SZA
- Ice slope<liquid slope~1, slope increases slightly with SZA

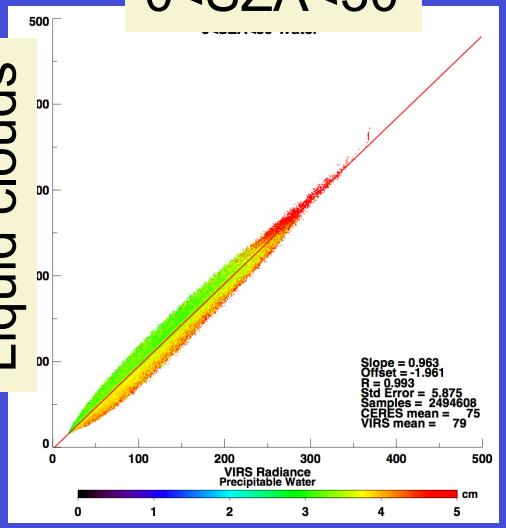
Theoretical model PW dependencies (TRMM)

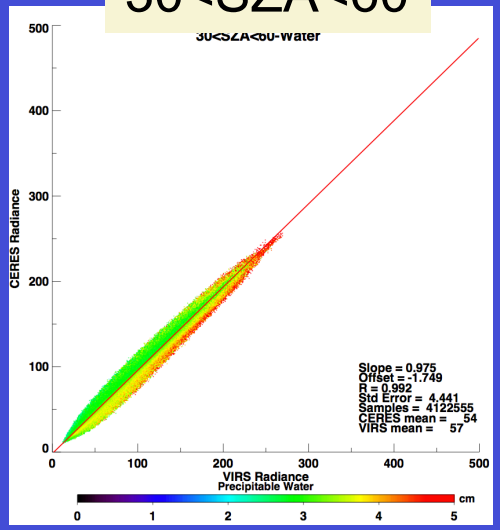
0<SZA<30

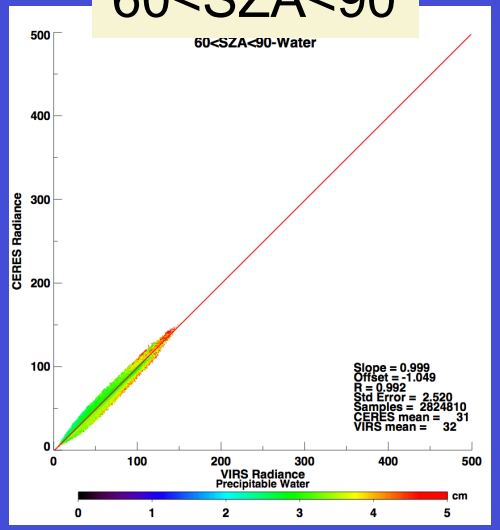
30<SZA<60

60<SZA<90

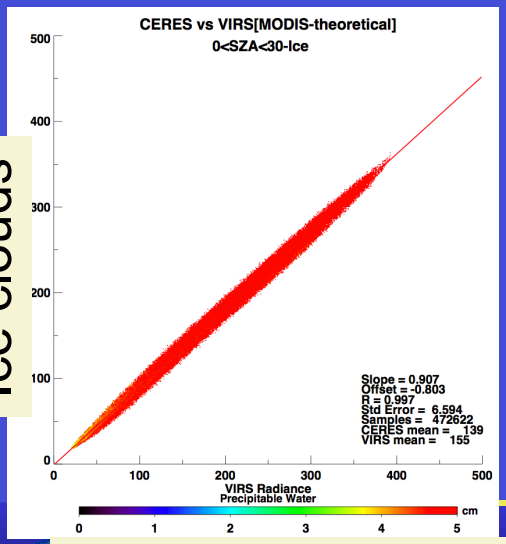
Liquid clouds

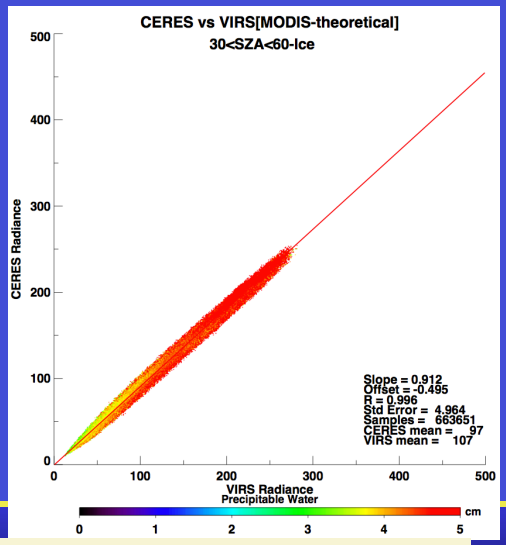


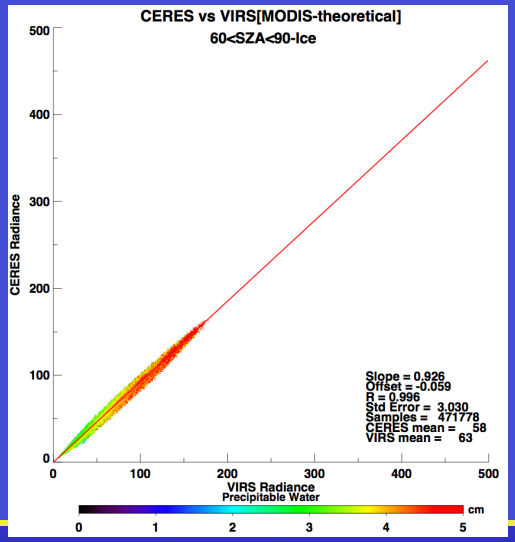




Ice clouds





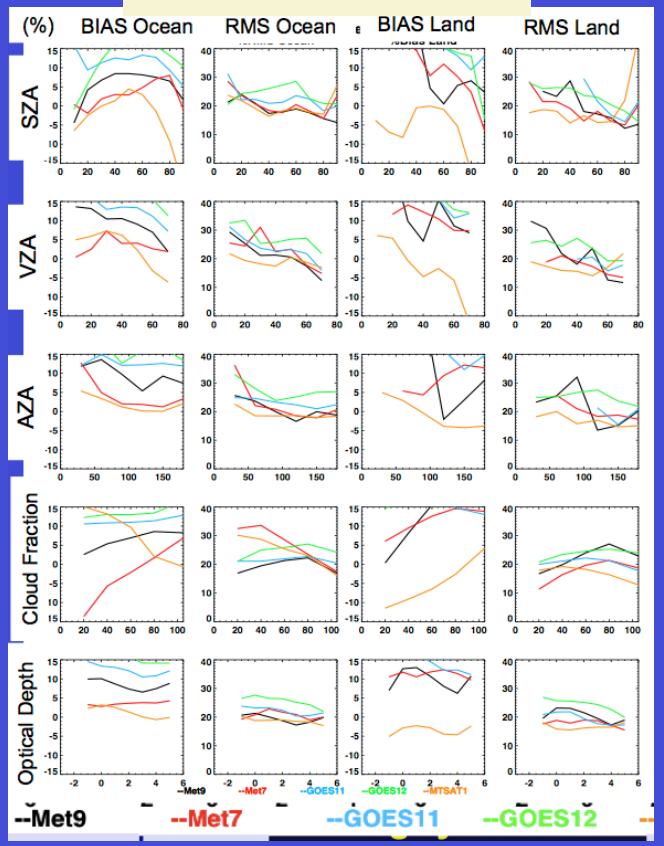


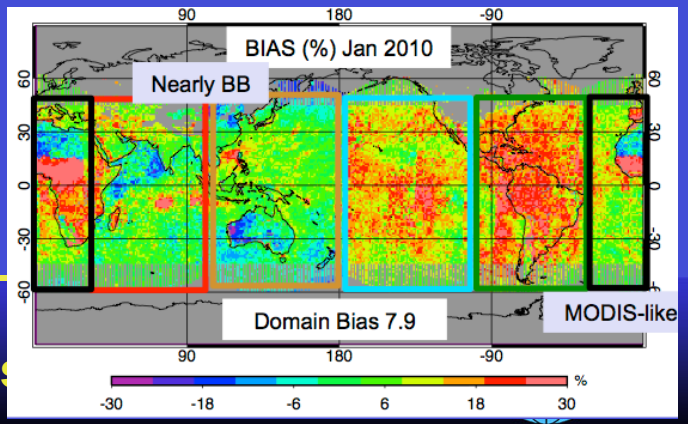
- PW dependency constant with SZA for liquid,
- PW dependency increases with SZA for ice

SW NB to BB improvements

- The SW NB to BB theoretical model underestimates the slope for ice and is very close for water clouds
  - Slight dependencies as a function of cloud height and PW
  - Consistent results across all SZAs based on TRMM, this is important for GEO derived BB SW fluxes
- Derive post theoretical model adjustment factors to remove the dependencies
  - The TRMM NB to BB encompasses all angles
- Validate using Jan 2010 GEO/CERES coincident matches for improvement
  - Check as a function of angle and cloud properties

theoretical model





GEO derived LW flux improvement

	Edition 2	Edition 4
GEO resolution	3-hourly	1-hourly
GEO clouds	2-channel Visible and WN(11μm)	5-channel Visible and multi IR channel
LW NB to BB radiance conversion	WN limb darkening function (VZA dependence)	WN & WV(6.7μm) NB to BB radiance conversion Try either radiance based or ADM scene types*
LW BB radiance to flux conversion	WN and column weighted global parameterization	Try either radiance based or CERES TRMM LW ADM*
GEO/CERES flux normalization	Instantaneous	5x5 regional normalization

• The radiance approach eliminates the Tsfc, Tcld, cloud fraction, and IR emissivity bins, and uses only surface type, PW, and VZA bins

ED2/3 GEO LW NB to BB flux algorithm

- The WN radiance is converted to NB flux using limb darkening function (VZA)

- **NB flux => BB flux (OLR)**

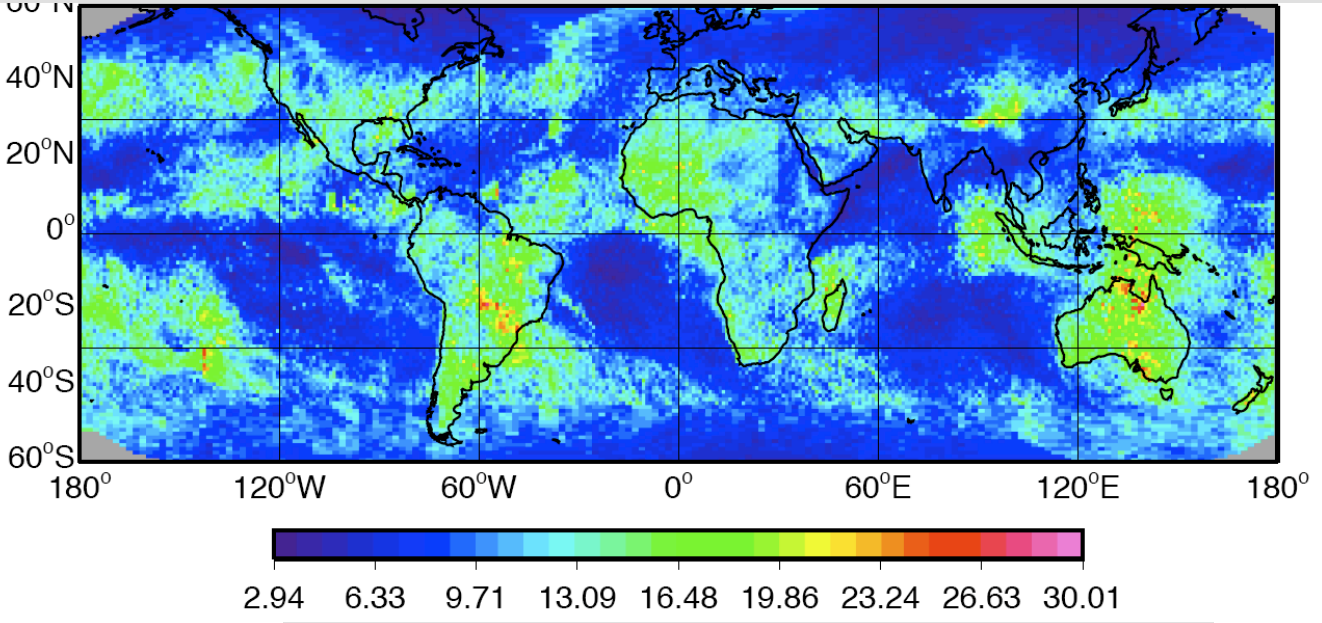
$$OLR_{BB} = a_0 + a_1 F_{NB} + a_2 F_{NB}^2 + a_3 F_{NB} \ln(RH)$$

Column Relative Humidity

NB flux

- Static global coefficients for ocean and land separately

SYN1deg Ed3A GEO and Terra CERES matched within 1.5 hours, Jan 2006



Average regional RMS 8.4 Wm^{-2} ~3.5%

GEO derived flux approach

- Derive SSF MODIS/CERES WN + WV empirical NB to BB coefficients
  - Not enough GEO/CERES coincident co-angled co-located measurements
  - ADM approach: As a function of Surface type(6), PW(3), Tdiff(5), VZA(7), Cloud(5), IR Emissivity(6) NB to BB and then CERES TRMM LW ADM
  - Radiance approach: Surface type(6), PW(3), VZA(7), Rad(6) direct NB radiance to BB flux approach
- Correct the WN and WV GEO IR temperatures to match the MODIS spectral response functions
  - All GEOs since the 1980's have WV channel
  - Compare the impact of not using the WV, not correcting the WV with WV
- Quantify improvement using coincident 1-hourly GERB and CERES LW flux measurements
  - Compare Ed2, to the Ed4 radiance approach
  - Compare instantaneous and 5x5 regional normalization

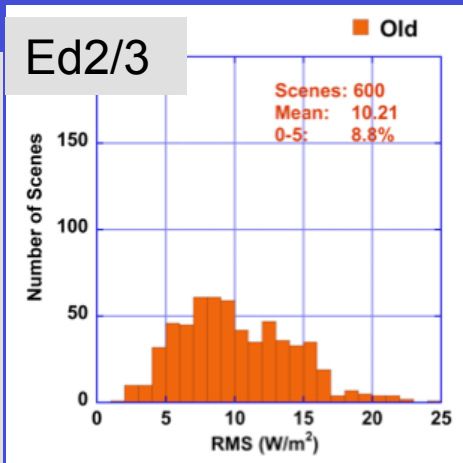
Ed2/3 NB radiance to BB flux

- Showed the advantage of adding 6.72μm Water Vapor Channel based SSF-Ed4 (MODIS radiance and CERES flux)
- Scene types:
  - **Ocean/land (6):** Ocean, Forests, Savannas, Grass-Crop, Dark and Bright Deserts.
  - **Day/Night (2) , Clear/cloud (2), Precipitable Water (4)**
  - **Viewing Zenith Angle (7):** 0°-70°, every 10°

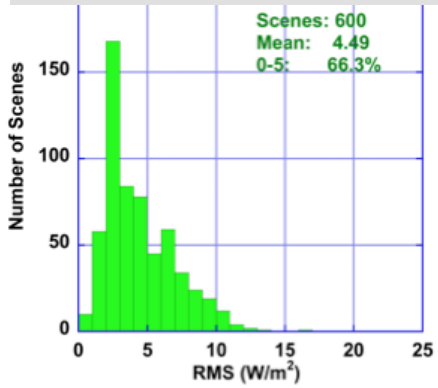
Total: 672 scene types

SSF April 2000

Ed2/3



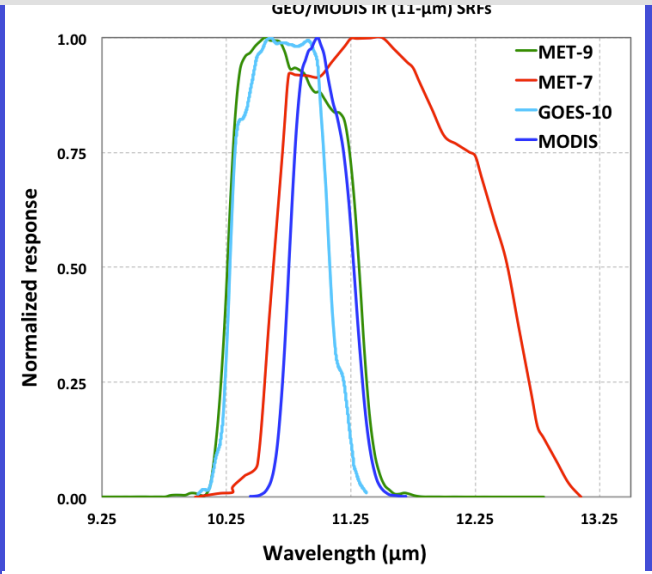
Ed4 radiance approach

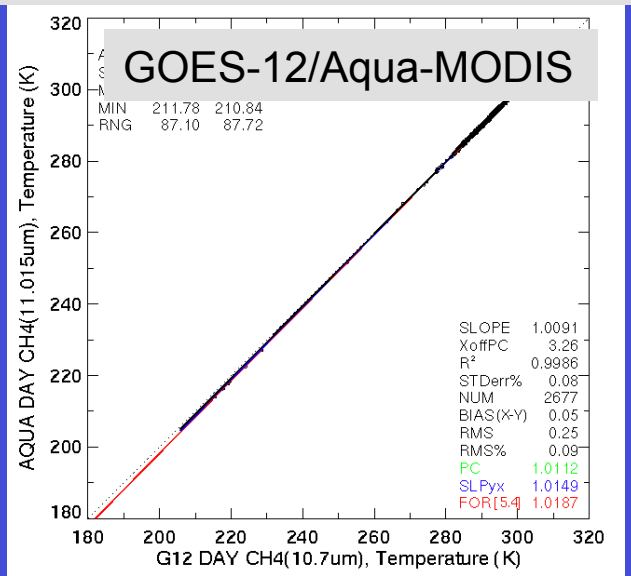


Conclusion: >50% RMS reduction using both IR & WV

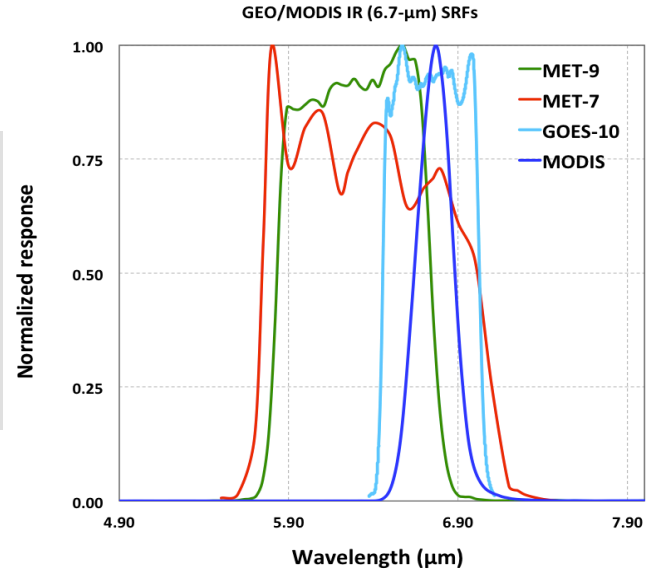
Adjust the GEO radiance to match MODIS spectral response

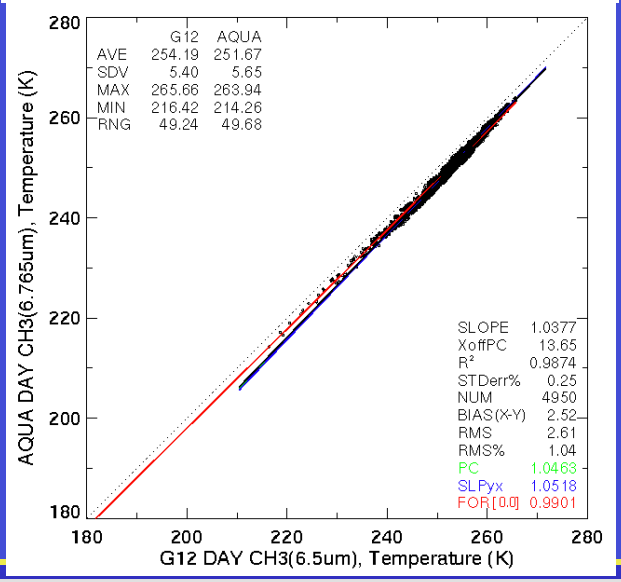
WN (11μm)





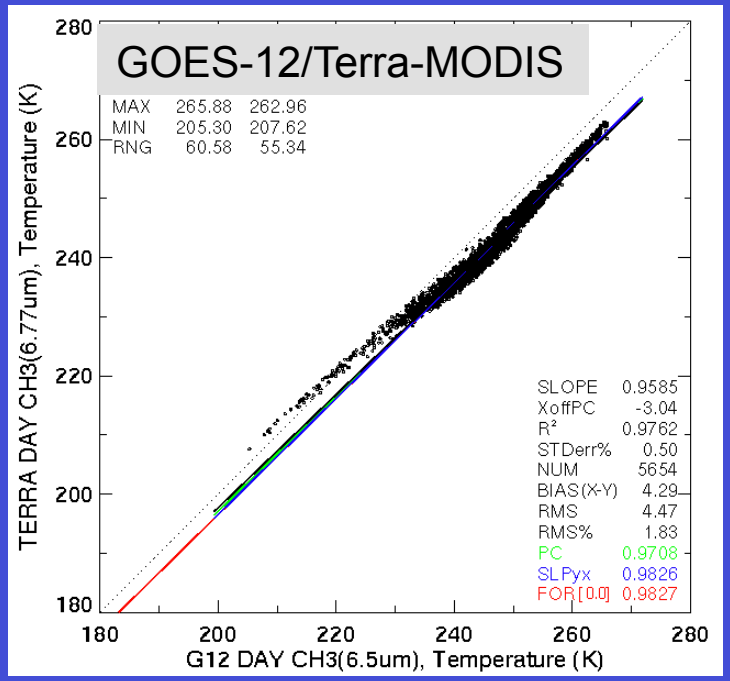
WV (6.5μm)

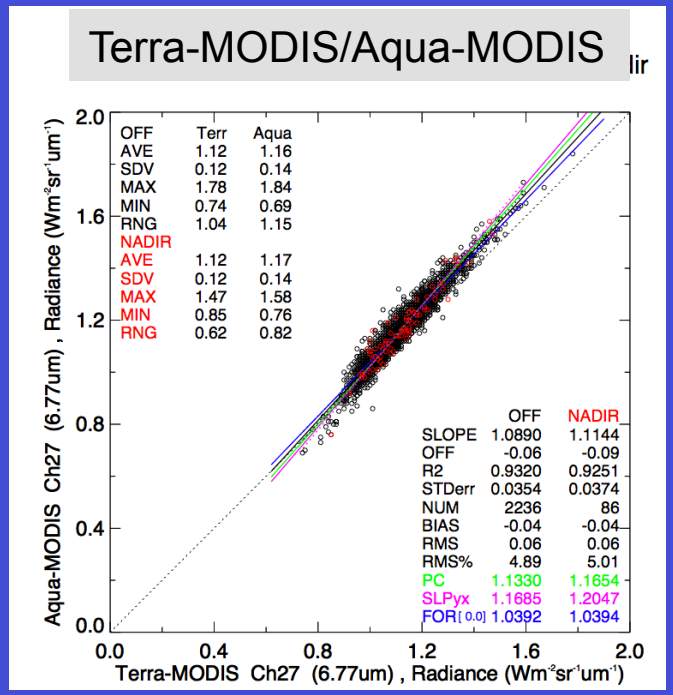




- Perform monthly regressions of coincident temperature pairs during both day and night
- Regress the slope and offset temporally over the lifetime of GEO record

Terra-MODIS WV electronic cross-talk issues





Sun et al. 2011 IEEE

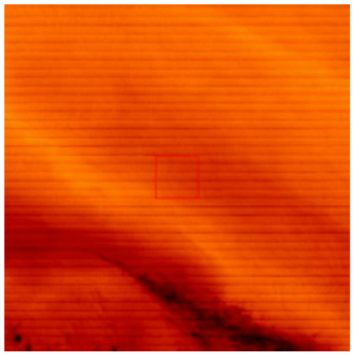


Figure 1. Terra MODIS band 27 EV image on December 23, 2001, 200x at Baja, California.

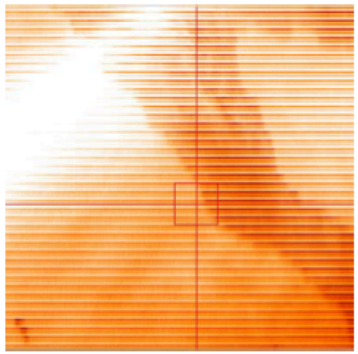
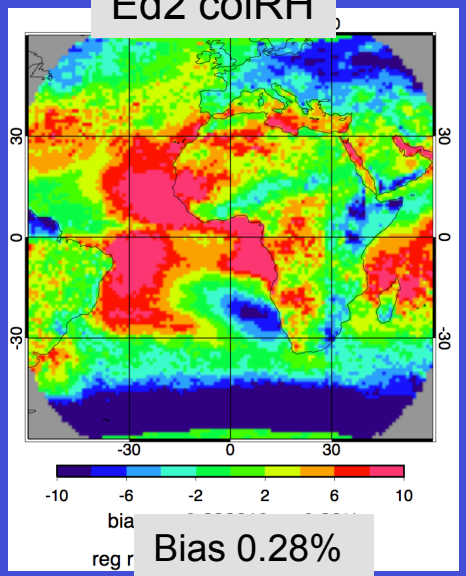
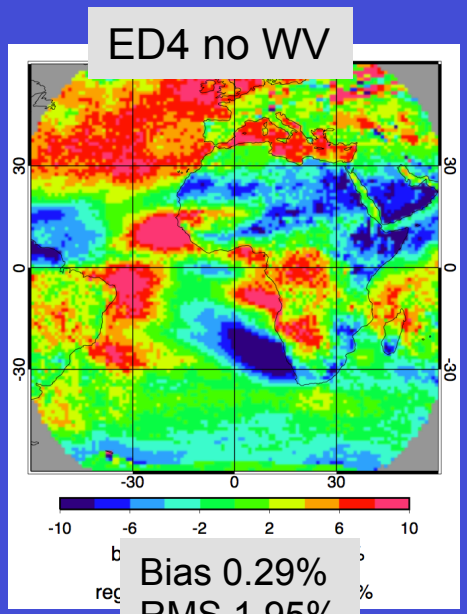


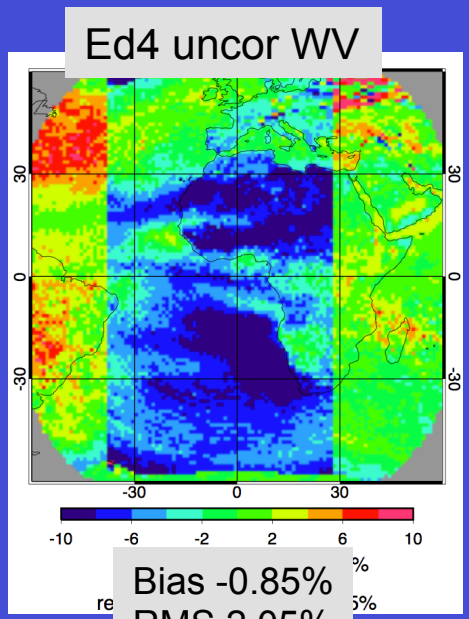
Figure 2. Terra MODIS band 27 EV image on June 23, 2010, 200x at Baja, California.

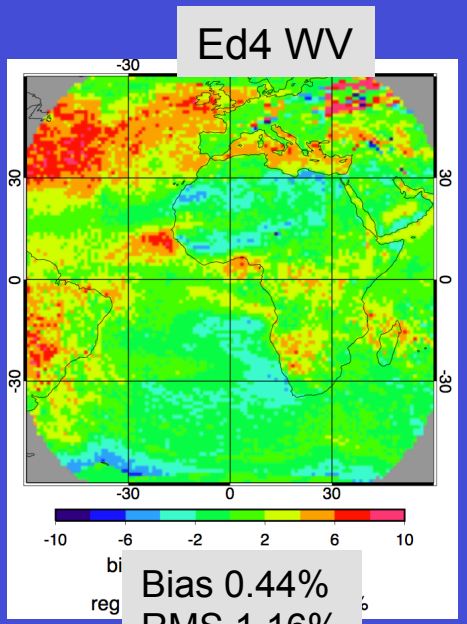
- LW NB to BB coefficients to be derived only using Aqua-MODIS SSFs
- C6 Terra-MODIS has some what mitigated this effected.
- Need to wait for Terra C6 radiances in the SSF product

WN + WV NB to BB Radiance approach



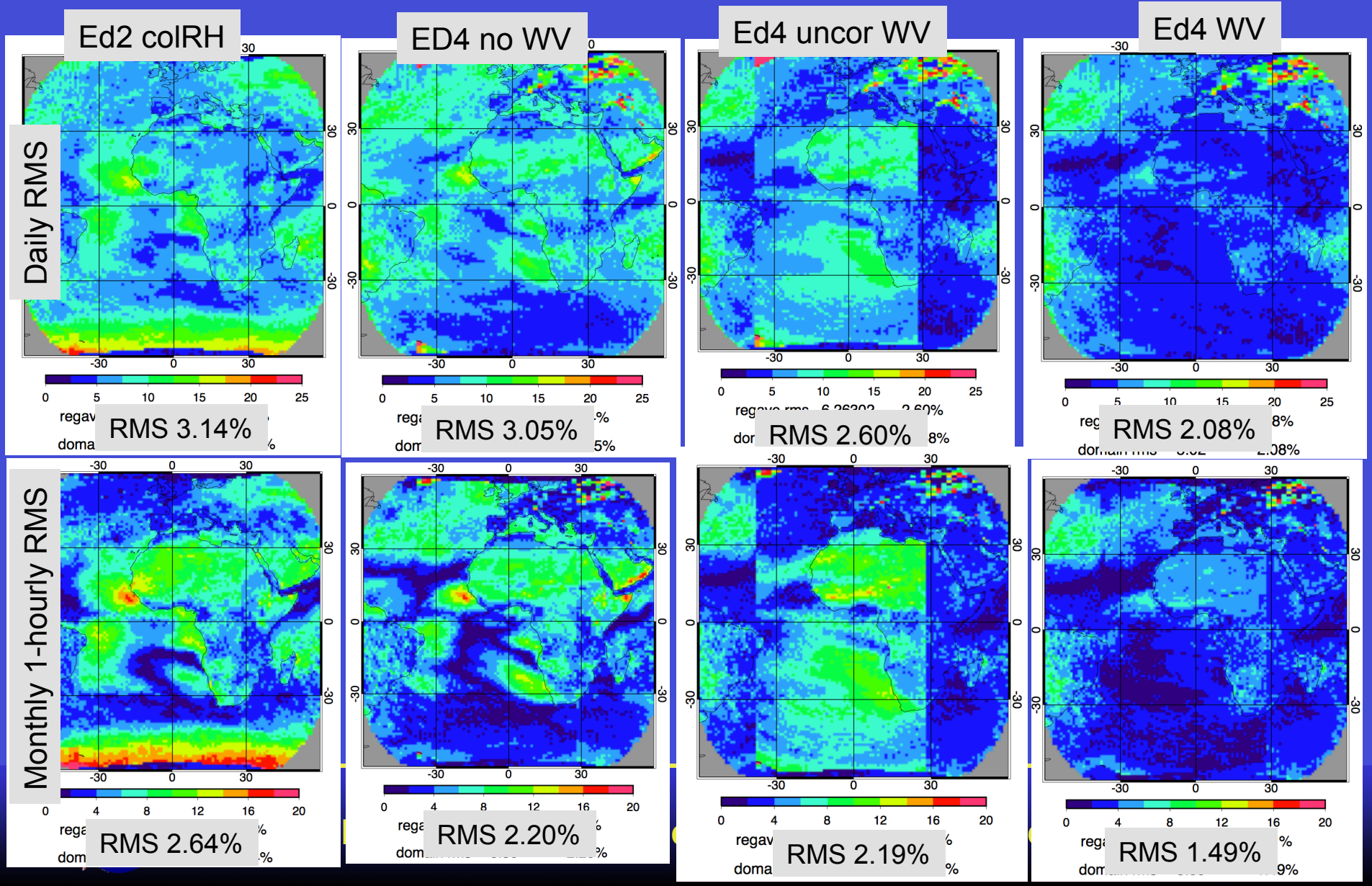






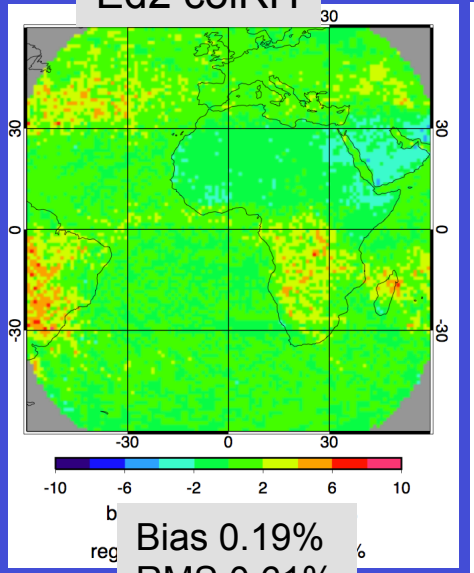
- Ed4 WN + WV radiance approach has reduced the RMS error by a half, which is due to the introduction of the WV channel.
- GEOS column weighted RH is a poor substitute for WV channel radiances.
- The GEO WV radiance must be corrected to reduce the bias and RMS error before normalization

Daily and M1-hour Radiance approach



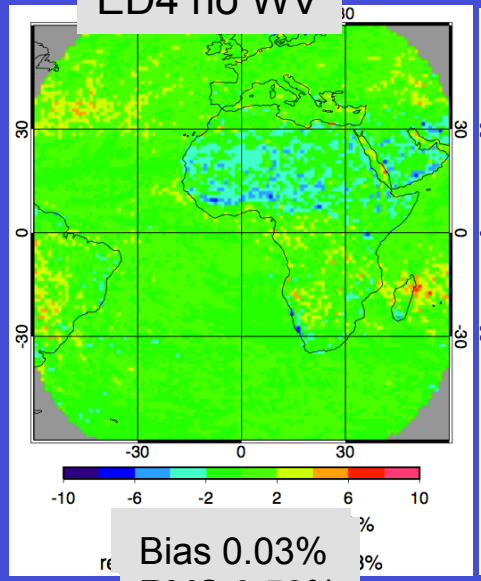
Radiance approach after normalization

Ed2 colRH



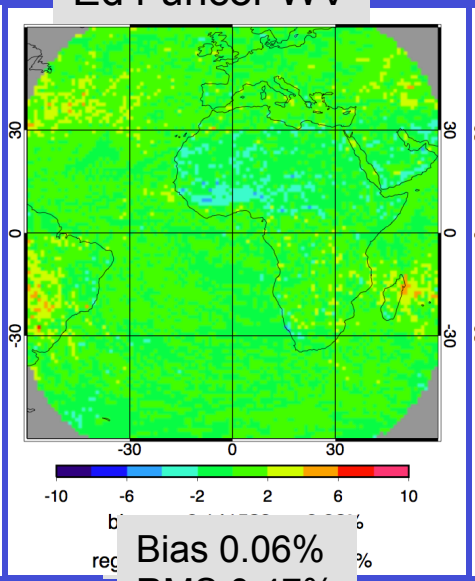
Bias 0.19%
RMS 0.61%

ED4 no WV



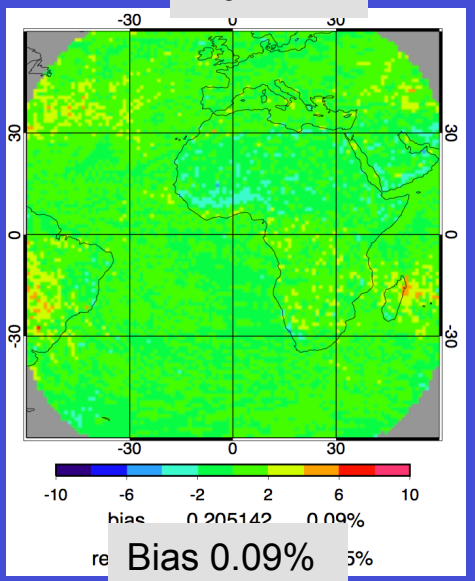
Bias 0.03%
RMS 0.58%

Ed4 uncor WV



Bias 0.06%
RMS 0.47%

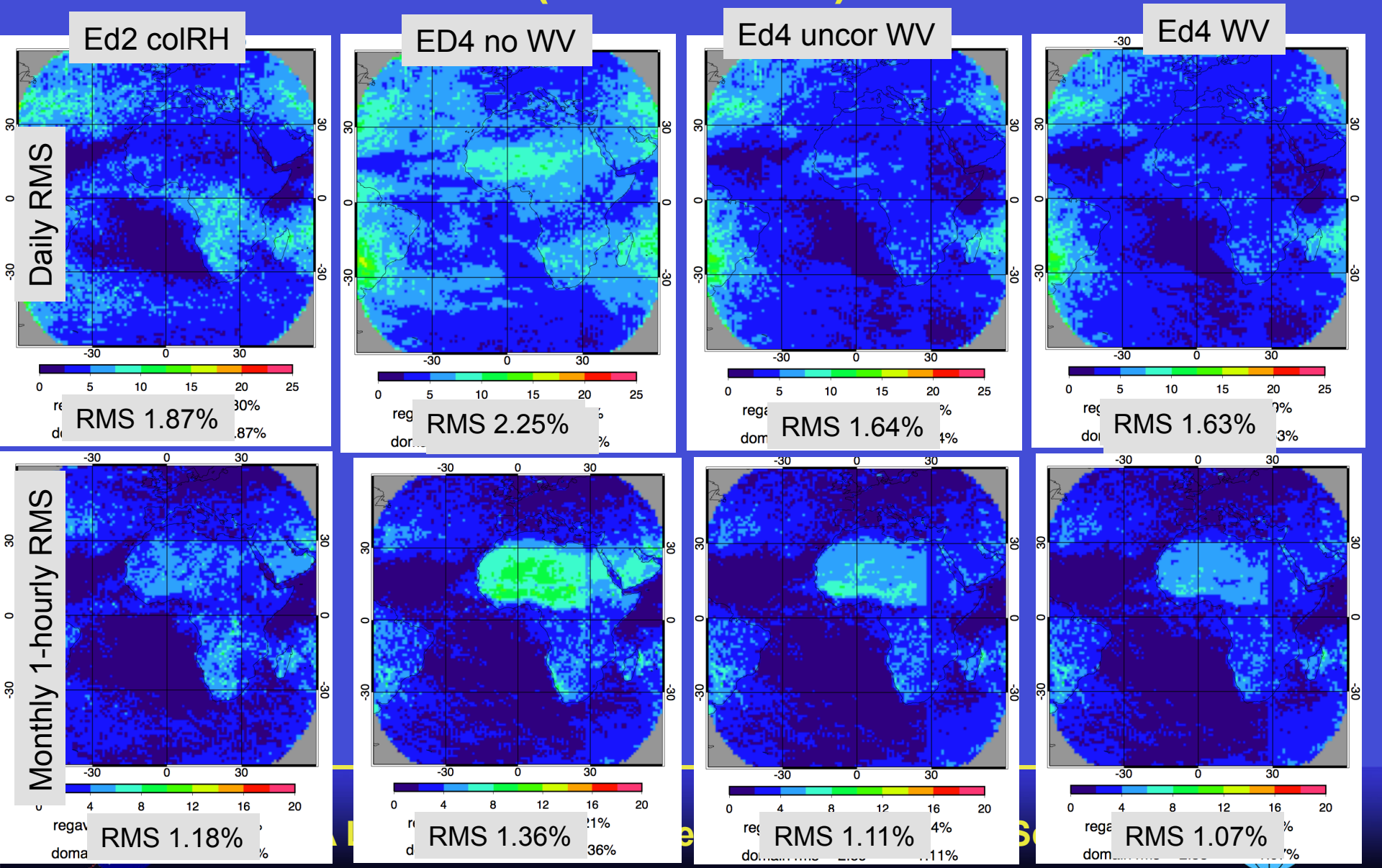
Ed4 WV



Bias 0.09%
RMS 0.45%

- Regional normalization has mitigated the uncorrected (with MODIS) GEO WV temperatures
- GEOS column weighted humidity and WN only are similar after regional normalization
- Ed4 is a ~25% improvement over Ed2 and is mainly due to the GEO WV channel

Daily and M1-hour Radiance approach (normalized)



Normalization on the radiance approach

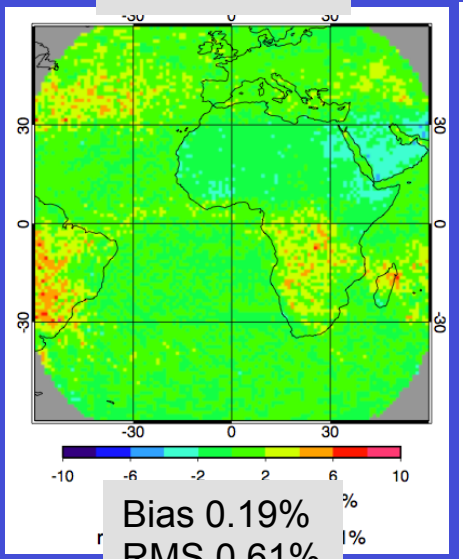
Before Norm (%)	Ed2	No WV	Uncor WV	ED4
Bias	0.28	0.29	-0.85	0.44
Monthly RMS	2.40	1.95	2.05	1.16
Daily RMS	3.14	3.05	2.68	2.08
3-hourly RMS	4.15	3.92	3.46	2.96
M1-hourly RMS	2.64	2.20	2.19	1.49

After Norm (%)	Ed2	No WV	Uncor WV	ED4
Bias	0.01	0.03	0.06	0.09
Monthly RMS	0.53	0.58	0.47	0.45
Daily RMS	2.09	2.25	1.64	1.63
3-hourly RMS	3.11	3.27	2.63	2.60
M1-hourly RMS	1.11	1.36	1.11	1.07

- Regional normalization is most effective at monthly time-scales
- Regional normalization has mitigated the need for WV corrections
- ColRH is not much better than using no WN channel only

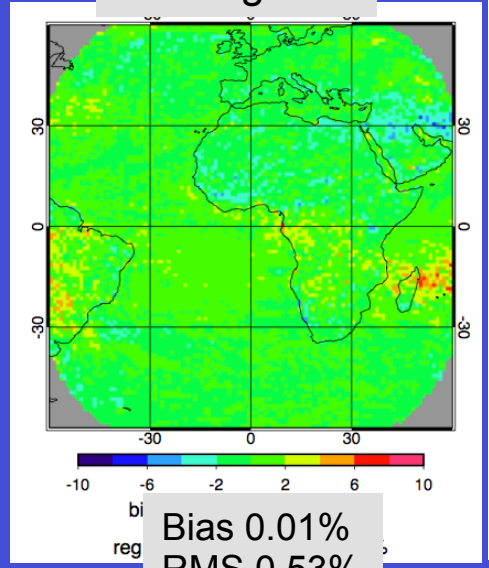
Instantaneous vs Regional Normalization

Ed2 instant



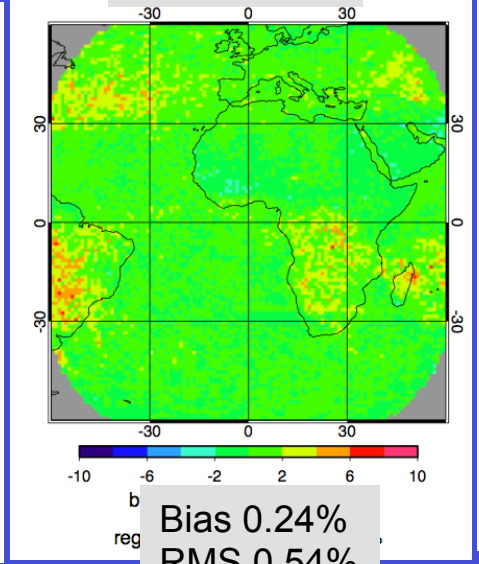
Bias 0.19%
RMS 0.61%

Ed2 regional



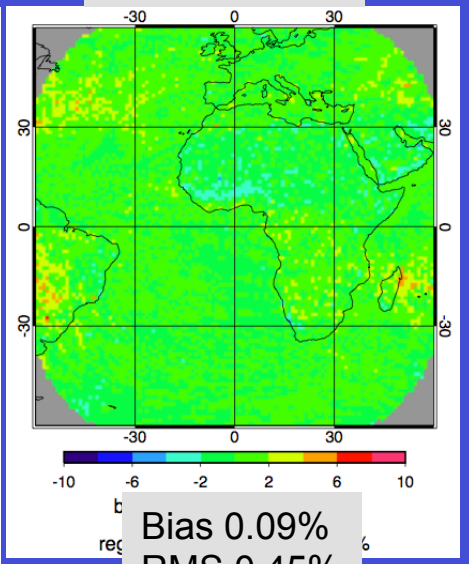
Bias 0.01%
RMS 0.53%

Ed4 instant



Bias 0.24%
RMS 0.54%

Ed4 regional



Bias 0.09%
RMS 0.45%

- Instantaneous normalization: Hourly GEO derived Broadband fluxes are normalized instantaneously with the CERES observed fluxes. Assumes that the GEO and CERES scene are the identical to correct for the NB to BB and ADM differences.
- Regional normalization: Coincident GEO derived BB and CERES observed flux pairs over a 5x5 regional domain are regressed monthly. Assumes that the NB to BB and ADM corrections are linear.

Instantaneous vs Regional Normalization

(%)	Ed2 Inst	Ed2 Reg	Ed4 Inst	Ed4 Reg
Bias	0.19	0.01	0.24	0.09
Monthly RMS	0.61	0.53	0.54	0.45
Daily RMS	1.87	2.09	1.80	1.63
3-hourly RMS	3.06	3.11	2.92	2.60
M1-hour RMS	1.18	1.11	1.07	1.07

- Regional normalization is more effective in removing the bias.
- Regional normalization reduces the monthly regional RMS by 15-20% over instantaneous normalization
- Both methods dependent on the quality of the GEO derived BB fluxes

LW NB to BB conclusions

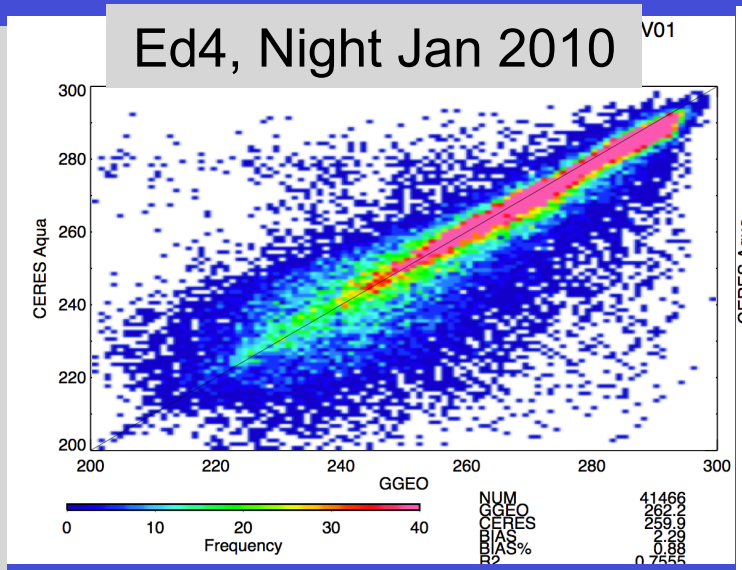
- Ed4 radiance approach is an improvement over Ed2
  - Regional normalization nearly reduced the monthly bias to 0 over instantaneous normalization and the monthly RMS by 15-20%, smaller reductions for higher temporal resolutions
  - Regional normalization reduced the bias <0.1% and the monthly and daily RMS by 60% and 25%
  - The addition of the WV channel reduced the non-normalized monthly and daily RMS error by 40% and 30%
  - The non-normalized WV must be corrected to the MODIS WV temperature, however the normalized uncorrected WV is similar to the corrected WV
- Test the ADM binning approach
  - Works best if the GEO cloud properties are similar to MODIS
- The Ed4 approach is being tested by the SARB group

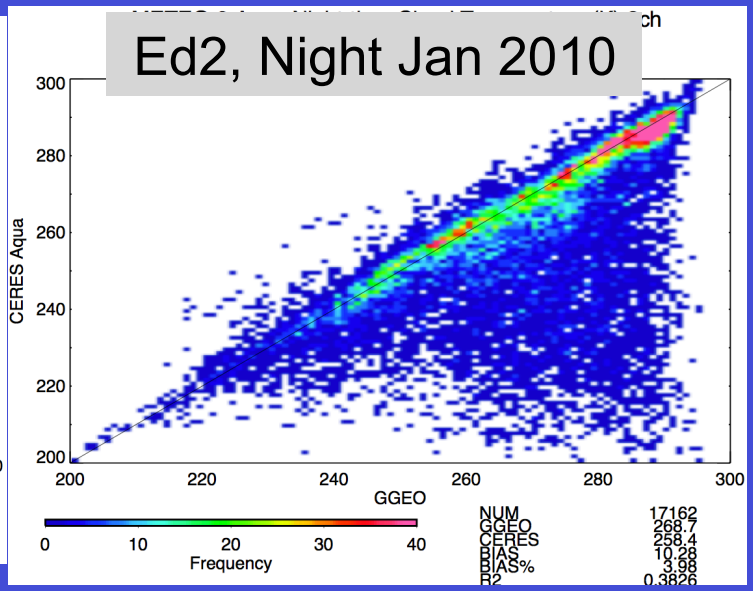
GEO cloud properties

	ED2	Ed4
channels	Visible and 11μm	Visible, 3.7μm, 11μm
Image resolution	3-hourly	1-hourly
Particle size	Water = 10μm, Ice = 60μm	3.7μm retrieved
Emissivity	Night = 1	Based on 3.7, 11 and 12μm at night
Clear-sky mask	GEOS-4/5 temperature threshold, MODIS monthly clear-sky albedo maps	Multi-channel cloud mask
Cloud top/base	GEOS-4/5	GEOS-4/5 with MODIS code revised lapse rate
Skin temperature	GEOS-4/5	retrieved

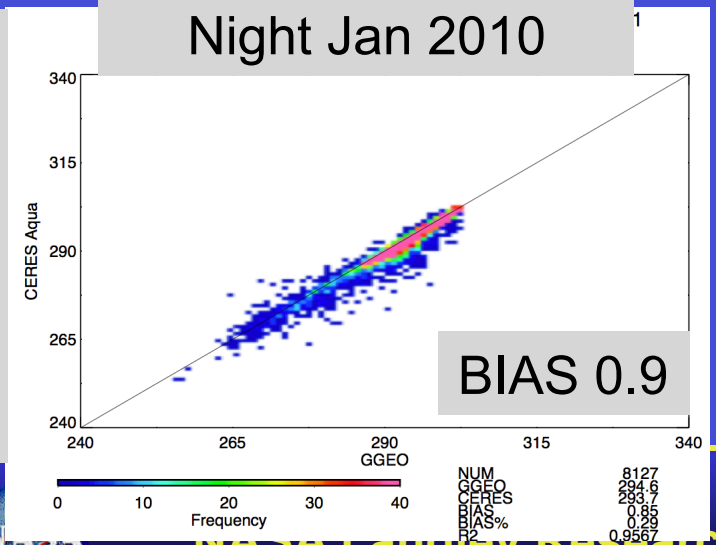
GEO Ed4 retrieval improvements

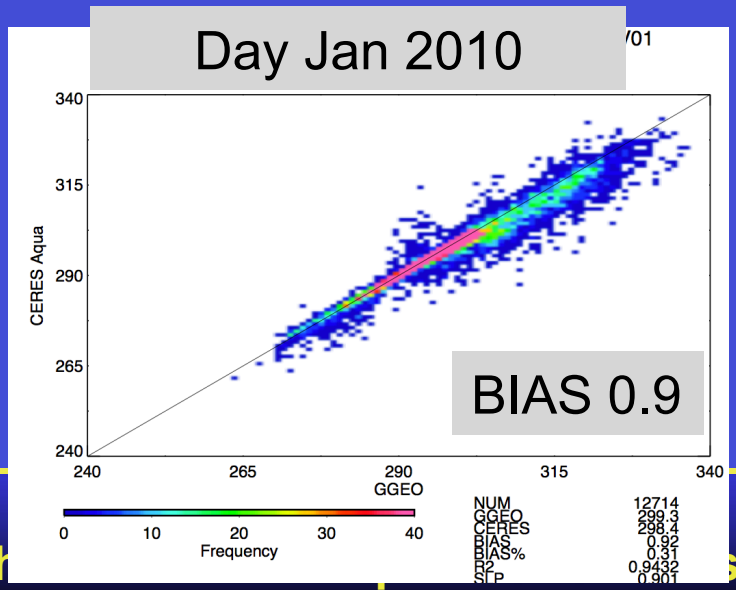
Met-9/Aqua Tcloudtop





Met-9/Aqua Tskin





TSI/SYN1deg delivery

- Jan 2010 (Ed4 GEO, Ed2 MODIS), July 2004 (Ed4 GEO and MODIS), Apr 2008 (Ed4 GEO and MODIS)
  - GOES-9,10,11,12 and MTSAT-1, Met-8,9 will be analyzed
  - GOES-13,15 and MTSAT-2 will be analyzed for month in 2012/2013
- Bad scan lines can be removed using the GEO netCDF files
- In case cloud properties need to be rerun, the current GEO netCDF files can be used as input
  - No need to reclean or reorder McIDAS imager data or reapply MTSAT-1 PSF correction
- SARB group needs for Ed4
  - SSF MODIS cloud and base temperatures.
  - GEO derived skin temperature and cloud and base temperatures
- GEO Ed4 5-channel cloud retrievals can be processed in 4 months

- Primary validation: SYN1deg diurnal fluxes with surface and GERB fluxes

Fluxbycloudtype Product

- MODIS cloud properties and CERES fluxes stratified by cloud pressure layer and cloud optical depth similar to the ISCCP-D2like 42 cloud types

Algorithm

- CERES footprint clear, and layer fluxes are derived from MODIS multiple band radiance to CERES radiance coefficients derived from clear and overcast CERES footprints
- Footprints with snow fraction > 10%, ocean glint, sparse MODIS to BB bin sampling, nighttime, and poleward of 60° are not considered
- The clear and layer radiances are converted to flux using CERES ADM (clear and overcast models)
- The clear and layer fluxes are then normalized to the footprint flux
- The footprint clear and layer fluxes are then sorted into 1° by 1° regions and by D2like cloud types (6 optical depths, 7 pressure levels, and clear)

Application

- Modelers may then compare computed individual cloud property fluxes with CERES during Aqua or Terra overpasses

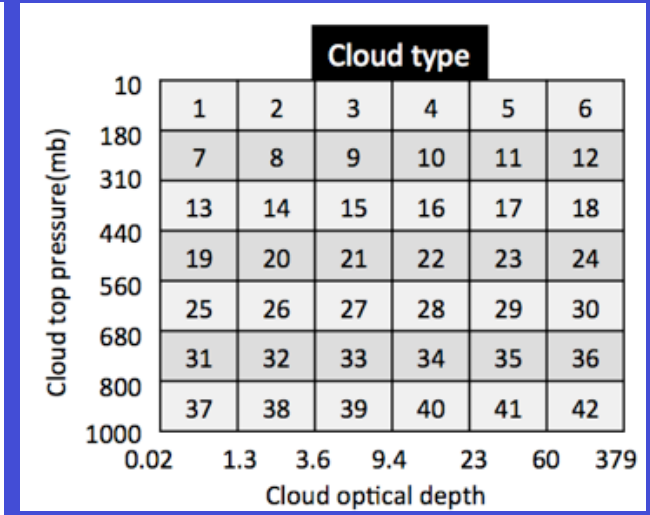
Validation

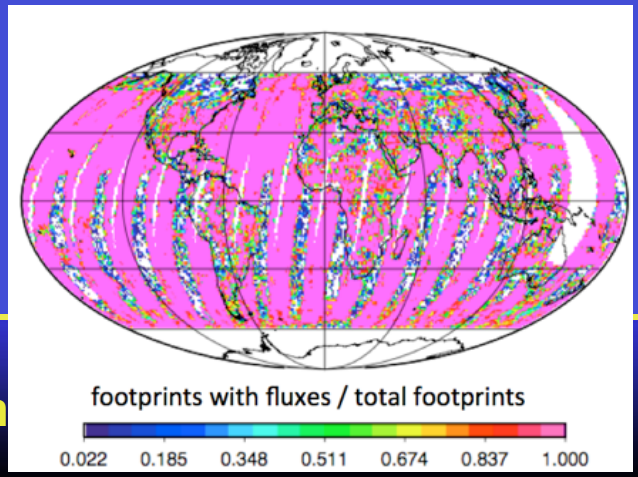
- Validate by comparing the total cloud properties and fluxes with the SSF1deg

Fluxbycloudtype Parameters

- Because of the frequency of footprints, which have incomplete sub-footprint NB to BB fluxes, the regional instantaneous Fluxbycloudtype and SFC fluxes are also given

Regional Array Parameters	Cloud Array Parameters
Center Latitude	Cloud Type
Center Longitude	Cloud Fraction
GMT	Cloud Liquid Fraction
Solar Zenith Angle	Cloud Effective Temperature
View Zenith Angle	Cloud Effective Pressure
Azimuth Angle	Cloud Emissivity
Total Footprints	Optical Depth
Footprints with Clouds	Liquid water path (LWP)
Footprints with derived fluxes	Ice water path (IWP)
Derived clear-sky TOA SW flux	Liquid Particle Size
Derived clear-sky TOA SW flux (24 hour average)	Ice Particle Size
Derived clear-sky TOA LW flux	Derived cloud TOA SW flux
Observed all-sky TOA SW flux	Derived cloud TOA SW flux (24 hour average)
Observed all-sky TOA LW flux	Derived cloud TOA LW flux
Observed clear-sky TOA SW flux	
Observed clear-sky TOA LW flux	
Start cloud array Index	
End cloud array Index	

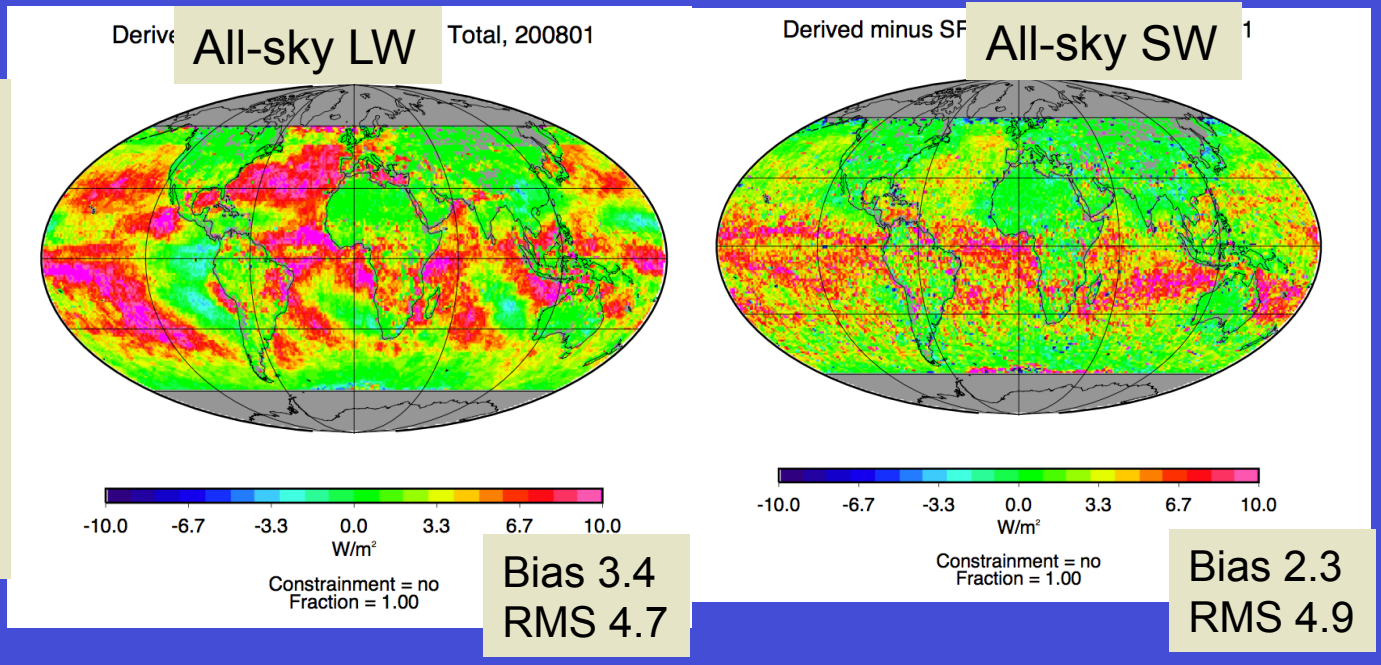




Fluxbycloudtyp – SFC all-sky flux, Jan 2008

- All-sky is the sum of the clear and cloud layered fluxes
- The NB to BB and ADM application is performed for each scene and NB to BB is based on overcast SSF fluxes

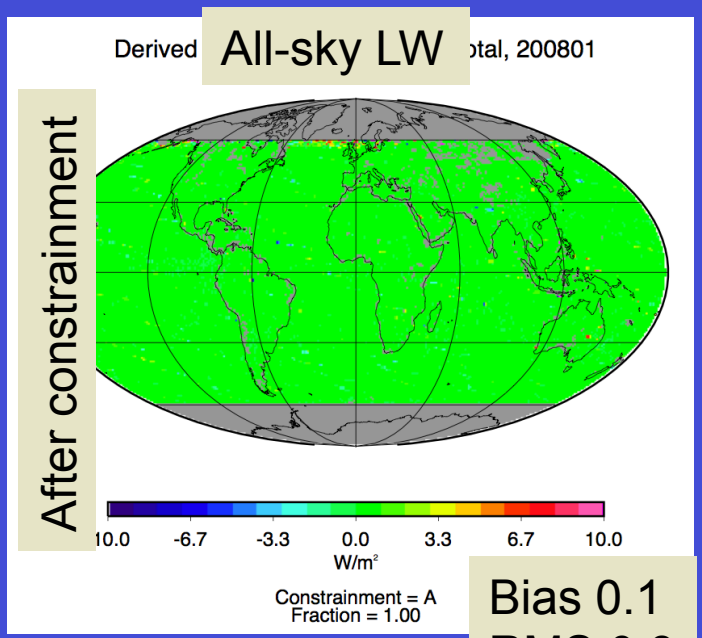
Before constrainment



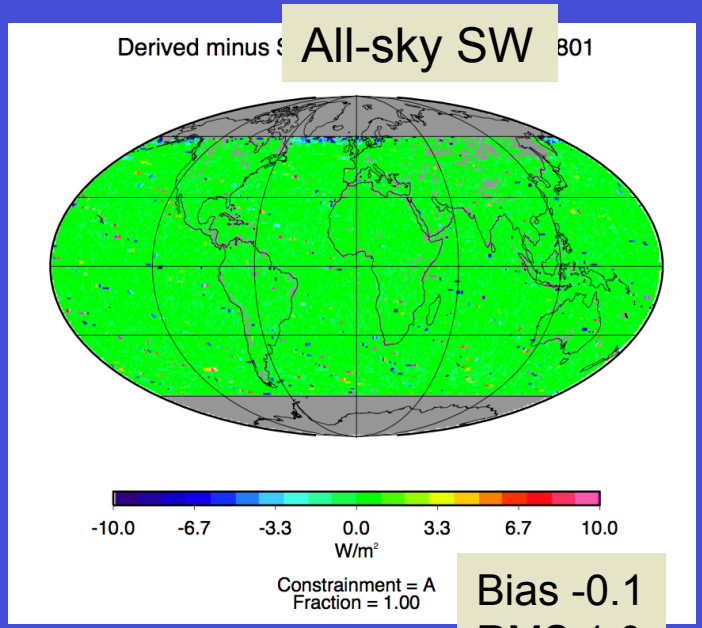
- Constrain the derived fluxes by performing all-sky normalization

$$flux_i^{constrained} = flux_i^{BB} * \left[\frac{flux^{CERES}_{footpr\,int}}{flux^{BB}_{footpr\,int}} \right], \text{ where } flux^{BB}_{footpr\,int} = \sum_{i=1}^{N} f_i flux_i^{BB}$$

Fluxbycloudtyp – SFC all-sky flux, Jan 2008



Bias 0.1
RMS 0.8



Bias -0.1
RMS 1.0

- QC product by evaluating the derived – SFC all-sky monthly flux
- Fluxbycloudtype Ed3 code is being delivered this week
- DQS has been written
- Comes with netCDF reader, IDL regional and 7x6 cloud type cloud property and flux plotting package

CERES visualization and ordering tool

- **Ordering Tool accomplishment since May 2013**
  - EBAF-TOA Ed2.7 extended through 6/2013 and at ASDC and NCCS ESGF node
  - EBAF-Surface Ed2.7 extended through 9/2012
  - EBAF Ed2.7 formatted for ESGF added
  - SYN1deg Ed3A extended through 3/2013
  - SSF1deg-lite Ed2.7 through 2/2013 added
  - ISCCP-D2like-Day Ed3A for Terra & Aqua through 9/2012 added
  - Improvements in processing time for SYN1deg 3Hour orders
  - Two new machines in 1268 for preproduction testing and internal OT use
  - OT statistics uploaded to ESDIS Metrics System
- **Visualization efforts**
  - Validation of CERES data
  - Migration of CAVE website to OT
  - Visualization of gridded and pixel GEO data begun

CERES User Activity

Unique users

FY = October to September

Unique by Product and Time Period)

Products	FY10	FY11	FY12	FY13	FY14
EBAF-TOA	21	126	191	349	15
EBAF-Surface			79	198	9
SYN1deg				275	11
SYN1deg-lite	25	115	149	15	
SSF1deg-lite	29	102	96	119	3
ISCCP-D2like			25	55	1
SSFlevel2			60	134	10
Total	53	242	358	704	42

Total Number of Users (Unique by time period)

FY10	FY11	FY12	FY13	FY14	Total Unique Users
53	242	358	704	42	1122

CERES OT statistics

Data Volume (GB)

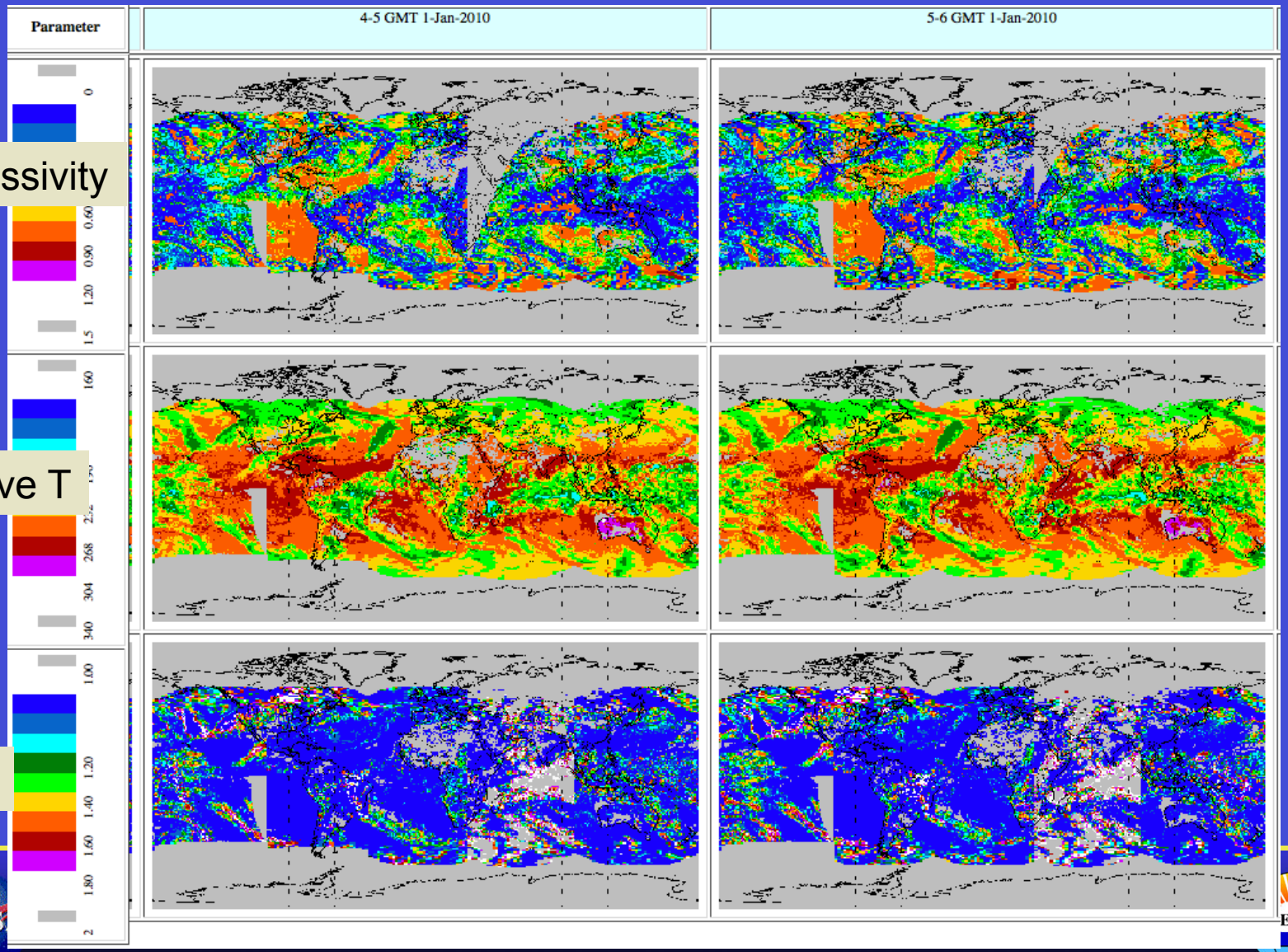
Products	FY10	FY11	FY12	FY13	FY14	Total
EBAF-TOA	0.6	23.9	40.8	64.1	3.1	132.5
EBAF-Surface			20.4	67.9	2.7	90.9
SYN1deg				3,319.6	2,104.5	5,424.2
SYN1deg-lite	6.8	283.9	308.2	52.4		651.3
SSF1deg-lite	559.1	1,634.5	542.7	360.4	1.8	3,098.5
ISCCP-D2like			89.6	89.9	0.0	179.5
SSFlevel2			2,141.0	4,609.1	515.6	7,265.6
Total	566.5	1,942.3	3,142.7	8,563.4	2,627.7	16,842.5

Data Months

Products	FY10	FY11	FY12	FY13	FY14	Total
EBAF-TOA	1,388	30,833	27,043	71,388	2,525	133,177
EBAF-Surface			13,829	37,094	1,161	52,084
SYN1deg				71,814	1,530	73,344
SYN1deg-lite	5,745	27,502	16,344	2,224		51,815
SSF1deg-lite	9,874	43,284	11,621	26,061	412	91,252
ISCCP-D2like			4,084	21,848	132	26,064
SSFlevel2			2,238	3,281	197	5,716
Total	17,007	101,619	75,159	233,710	5,957	433,452

Users have increasingly been ordering SSF level 2 and SYN1deg 3-hourly in large quantities. Ordering tool software able to handle the volume

GEO 1° gridded Ed4 cloud property visualization



IR emissivity

Effective T

Phase

Conclusions

- Work with Cloud and SARB working groups to implement Ed4 TSI and SYN1deg
- Must finalize GEO cloud properties in 3 months

Product	Terra/Aqua Ed4	NPP Ed1
Ed4 SSF1deg-Hour	Feb 28, 2014	March 14, 2014
Ed4 SSF1deg-Month	Mar 31, 2014	April 11, 2014
Ed4 TSI	Feb 28, 2014	April 30, 2014
Ed4 SYNI	Apr 11, 2014	May 9, 2014
Ed4 SYN1deg	Apr 25, 2014	
Ed4 ISCCP-D2like (all 3)	May 30, 2014	
Ed4 Flux-By-Cloud-Type	Sep 30, 2014	