# Monitoring satellite solar reflectance gain changes through the use of cross-calibration and deep convective cloud targets

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*JMA Headquarters, Tokyo*
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# System to Transfer & Monitor Solar Channel Calibrations

- Establish a well-calibrated reference instrument
  - MODIS on Terra or Aqua *(Minnis et al.,2008)*
- Transfer calibration from reference to target satellite
  - Determine spectral relationship between reference & target channels
  - Cross-calibrate reference & target channels (e.g., *GOES-8*)
  - Establish primary target sensor as new reference for transfer to satellites in other time periods (e.g., *GOES-8 to NOAA-14*)
- Determine degradation in primary & 2$^{nd}$, 3$^{rd}$,… order target gains,
  - Continued cross-calibrations (degradation relative to other satellites)
  - Deep Convective Calibration (degradation relative to “known” target)
- Transfer reference calibration to 2$^{nd}$, 3$^{rd}$, order targets
  - Calibrates the relative gains

# LEO-to-GEO/LEO or GEO-to GEO/LEO Cross-Calibration

*Nearly Simultaneous Ray-matched Technique (NSRT)*

- Match data & compute average radiance *L* , brightness temperature *T*, or Count *C* within a 0.5° region using constraints

  - $\Delta$SZA < 5°, $\Delta$VZA < 10°, $\Delta$RAA < 15°, $\Delta$t < 15 min, no sunglint

  - *L*: VZA < 30° for L/G & < 15° for L/L; *T*: VZA < 45°

- Normalize all solar channels to common solar constants

- Normalize each radiance to a common SZA

- Perform linear regression

$$X_{ref} = a\, Y_{sat} + b$$

X = *L* or *T*; Y = *L*, *T*, or *C*

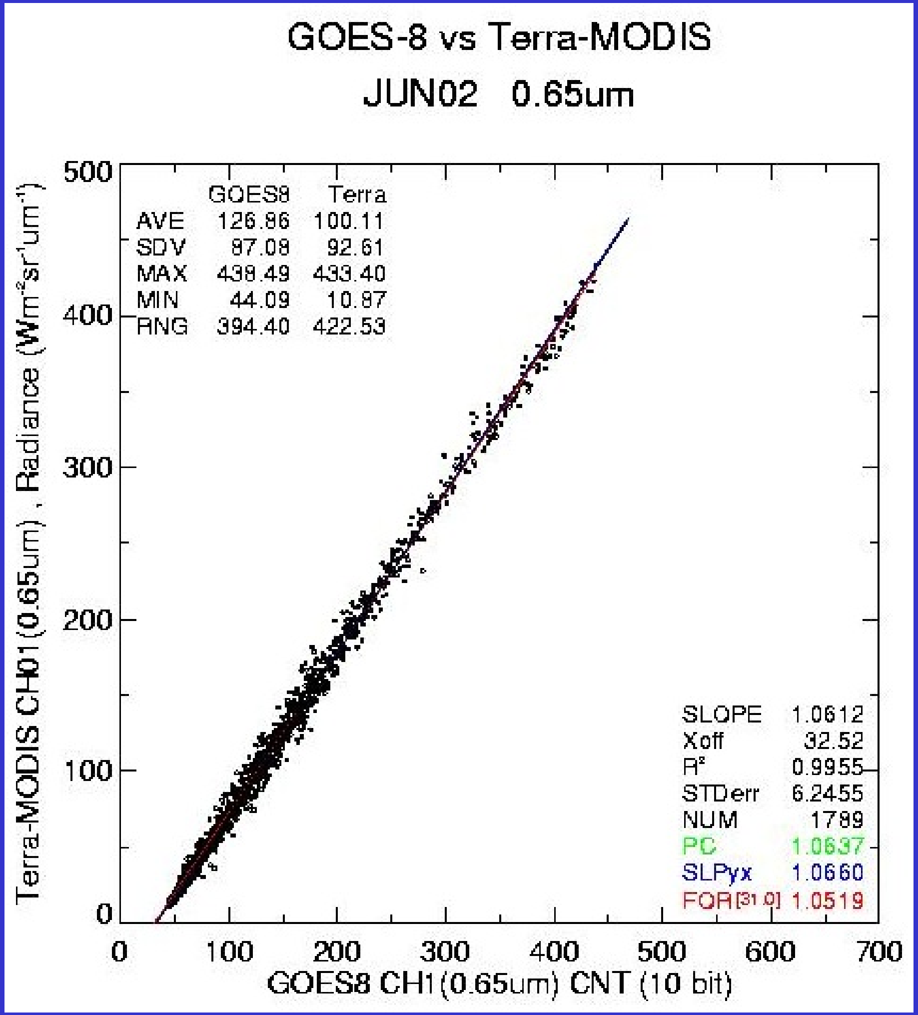
- Compute trends in *a*(*t*) and *b*(*t*) from sets of coefficients

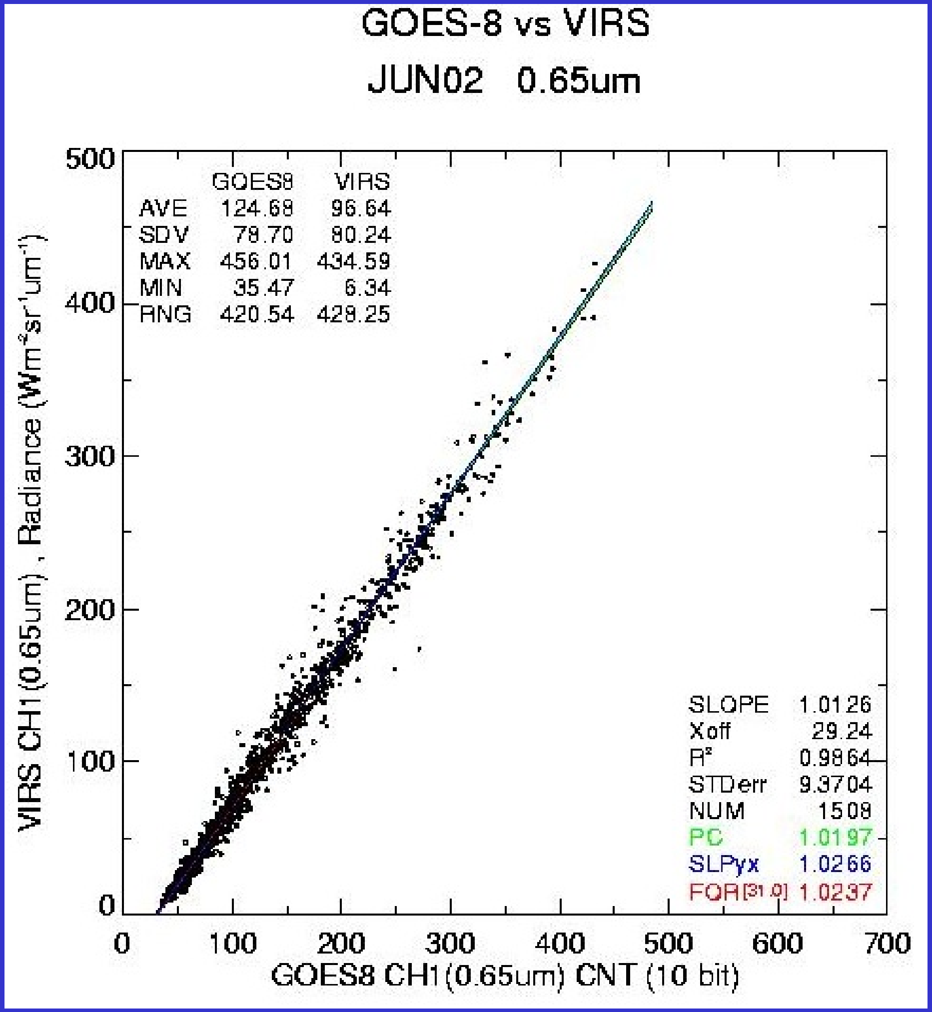
$$a = c_o + c_1\, DSR + c_2\, DSR^2; \qquad b = d_o + d_1\, DSR + d_2\, DSR^2$$

*DSR* = days since reference date

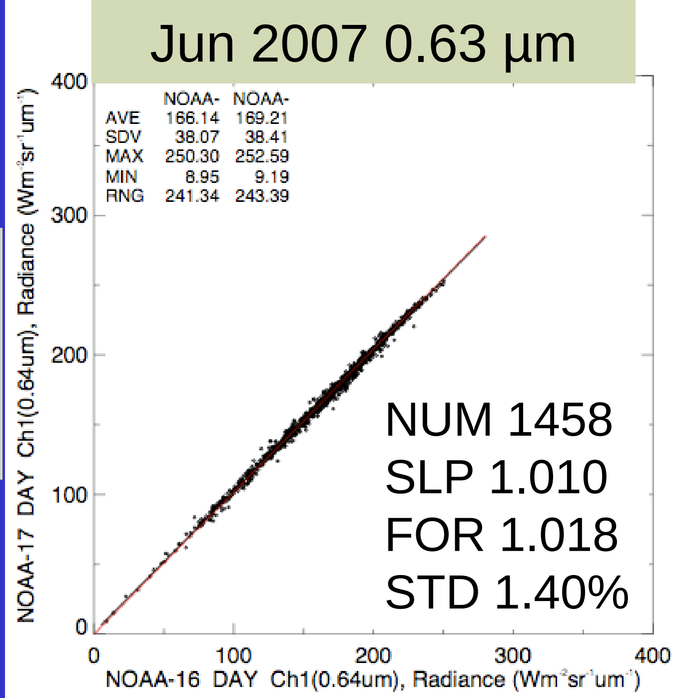
*Minnis et al., JTech, 2002*

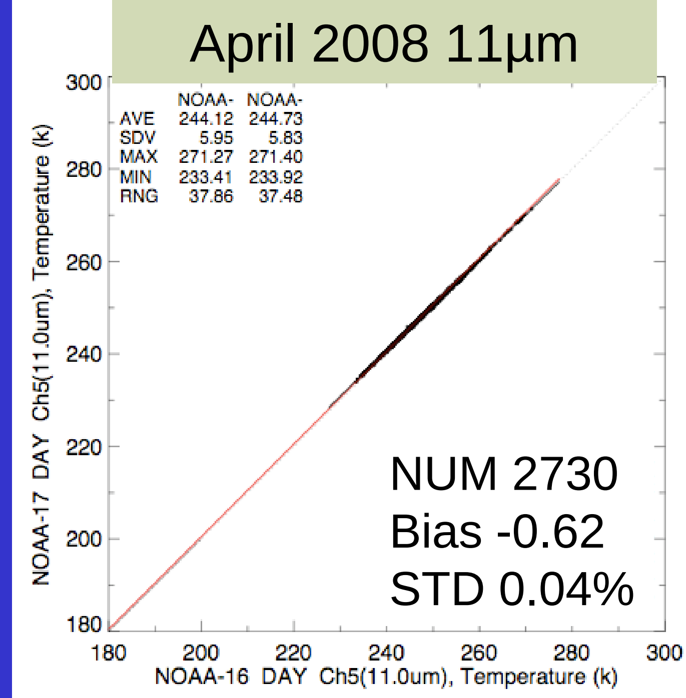
# Examples of LEO-to-GEO Normalizations



Off Nadir

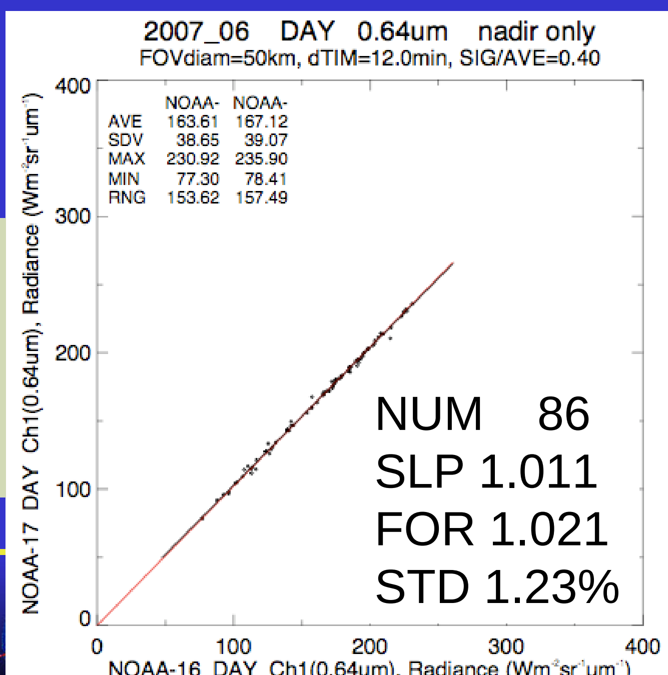


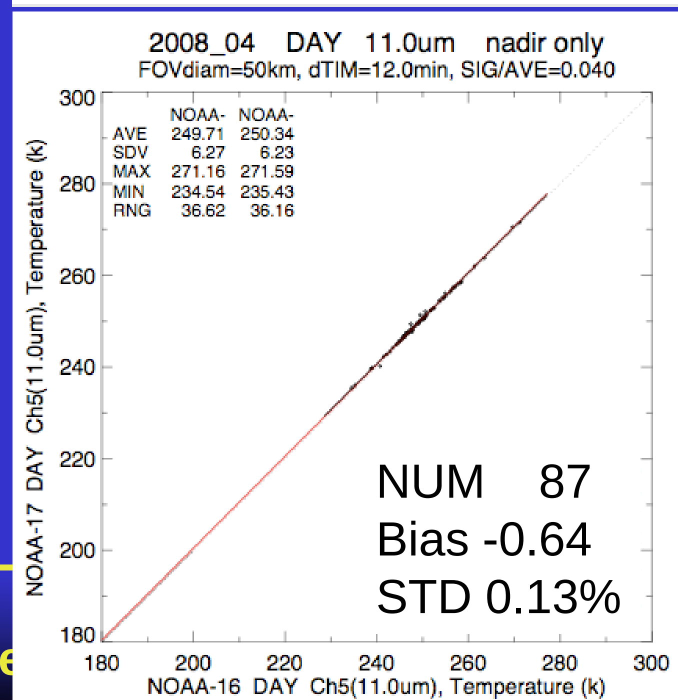




# NSRT vs SNO

N16/N17 NSRT
ΔT < 12min
FOV= 50km

Nadir only



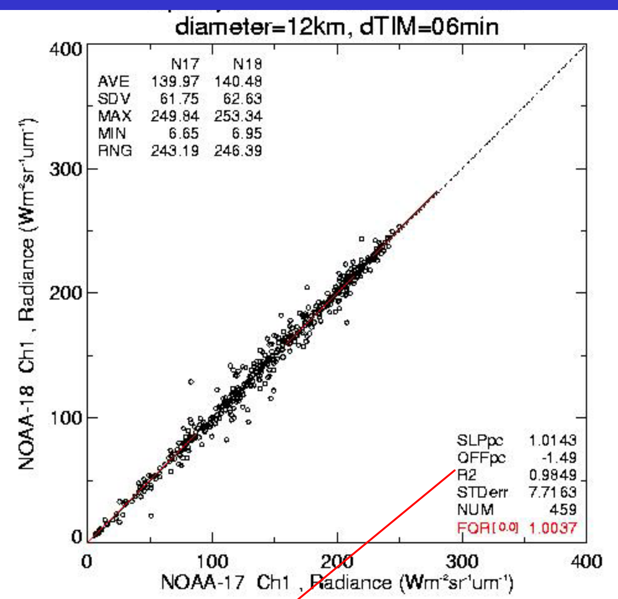



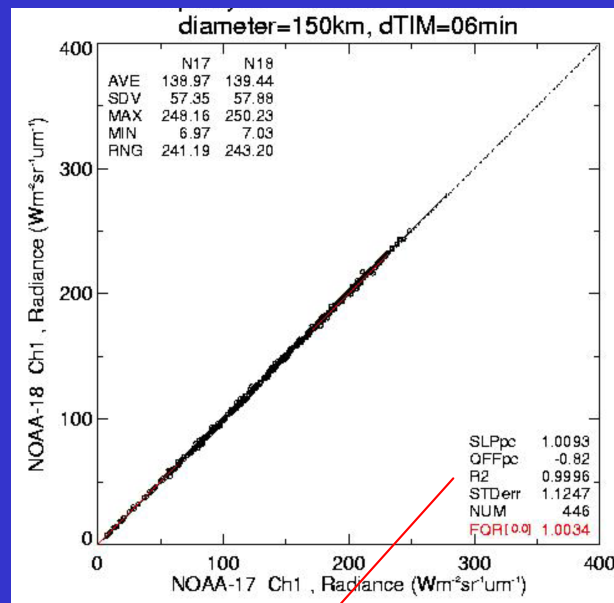

N16/N17 SNO
ΔT < 12min
FOV= 50km

NSRT as accurate as SNO

NASA LANGLEY CLOUD AND RADIATION GROUP

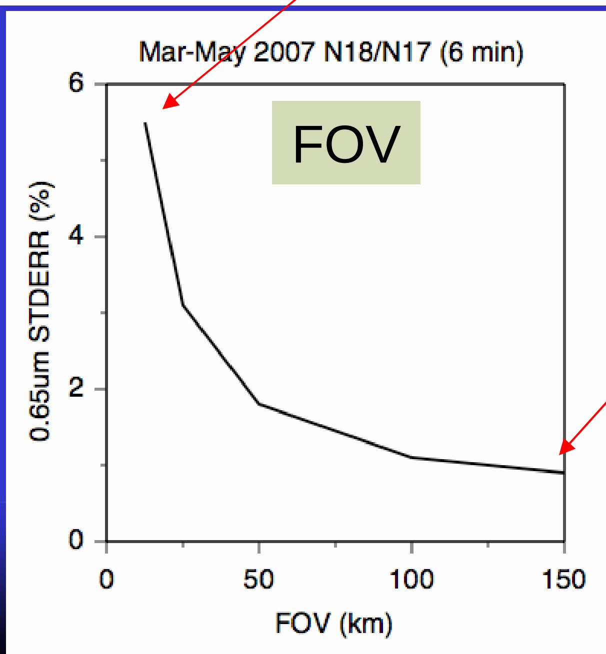
# AVHRR N18/N17 Visible standard error (%)

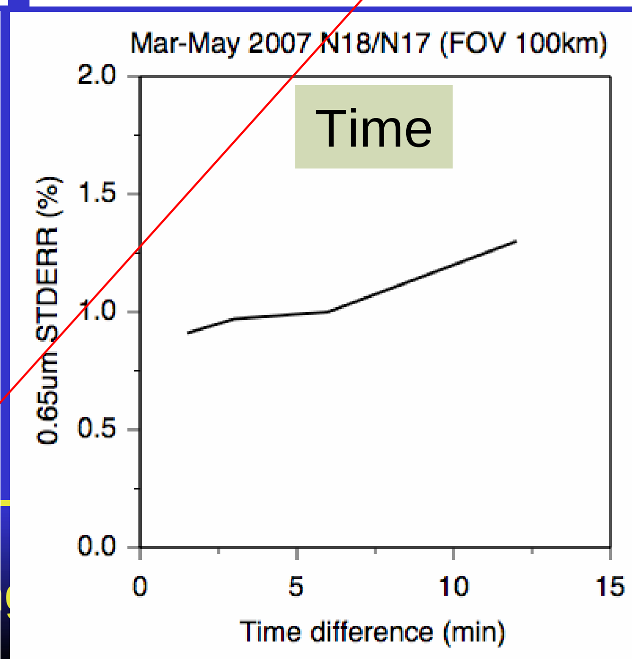


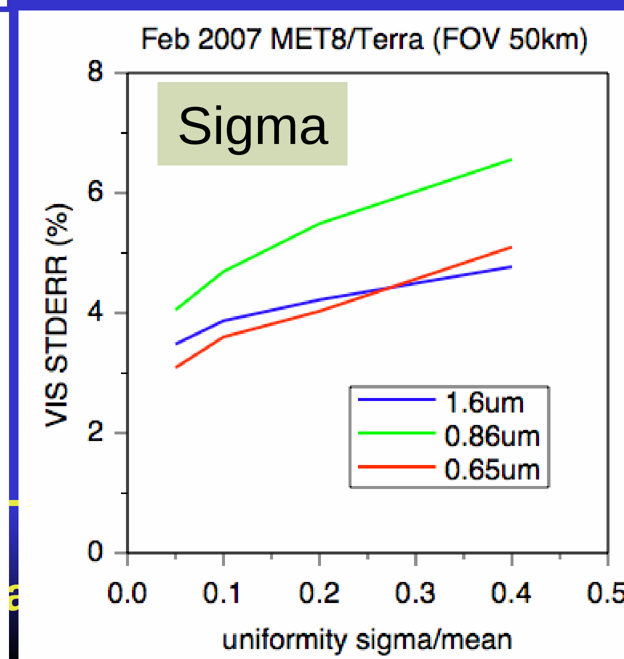




- Visible stderr < 1% by
  - -Increasing FOV
  - -Decreasing time difference
  - -Decreasing spatial sigma

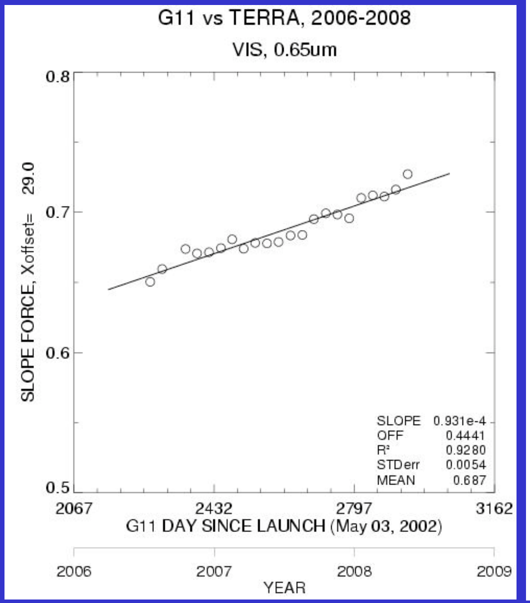
When response functions are identical

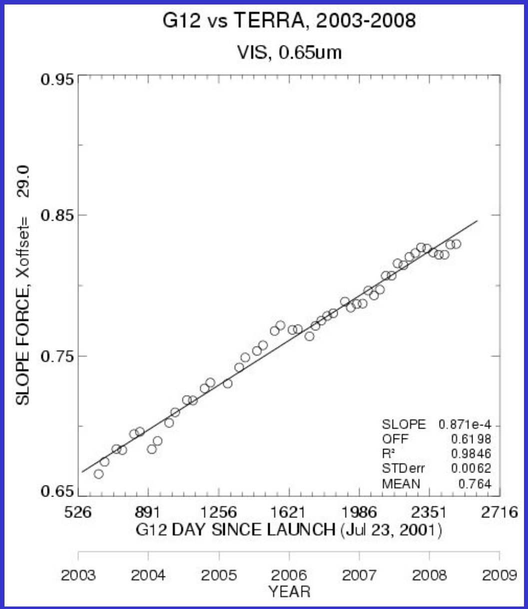


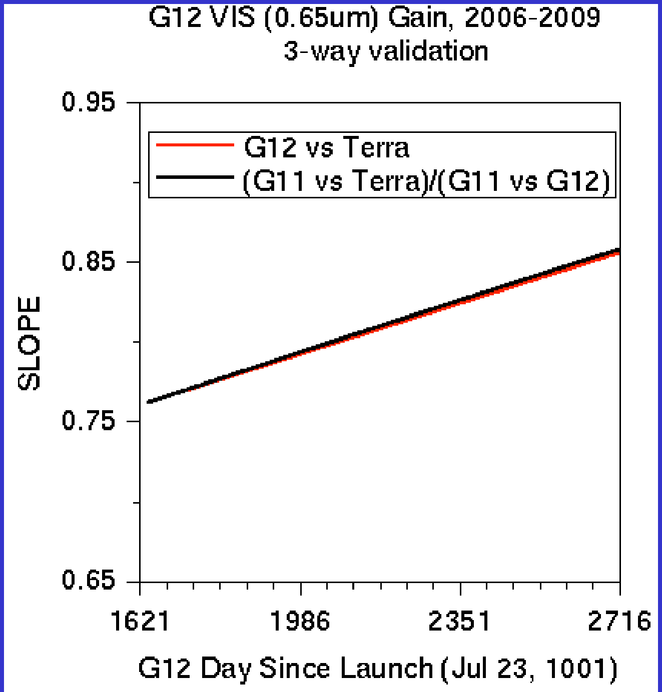



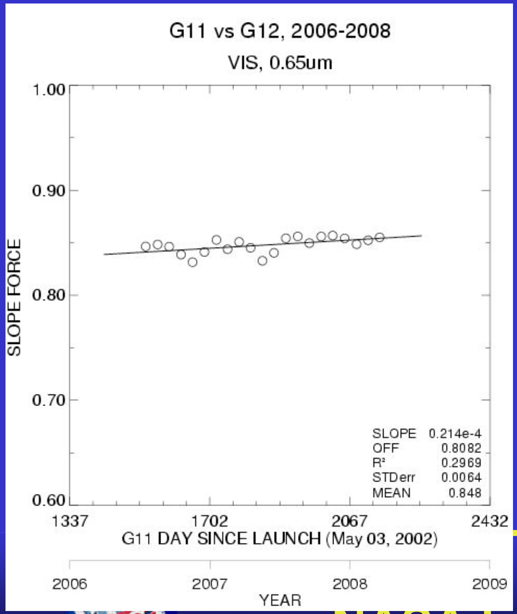



# G11/G12/Terra-MODIS 3-Way Validation - Secondary Reference




Can a GEO serve as a secondary reference satellite?
- calibrate one GEO w/LEO
- transfer LEO gain to other GEOs & LEOs

Test
- compare G11-Terra/G11-G12 & G12-Terra monthly gains
- monthly gains within 0.2% between 2006 and 2009

# Extending a Reference in Time

- Monitor changes in gain against an invariant target
  - surface site (desert, ice cap, etc.)
  - deep convective cloud (DCC) albedo
- Transfer reference during overlap periods
  - apply gain changes to adjust the new reference

# Deep Convective Cloud  (DCC) calibration

- DCC: cold, bright, stable, tropopause level, and nearly-isotropic targets located near equator
  - observed by all GEO & LEO satellites
- DCC easily identified by a simple IR threshold
  - IR sensor calibrations well known
  - VIS & IR co-registration needed, good navigation not required
- Collective of identified DCC analyzed for degradation
  - ~ 0.5% of all tropical pixels identified as DCC
- DCC calibration monitors stability or degradation over time
  - Does not provide absolute calibration
- DCC are invariant geographically and inter-annually
  - ozone and water vapor absorption impact is small
- Volcanic stratospheric aerosols: a big unknown in DCC stability
  - affect broadband albedo; narrowband albedo?

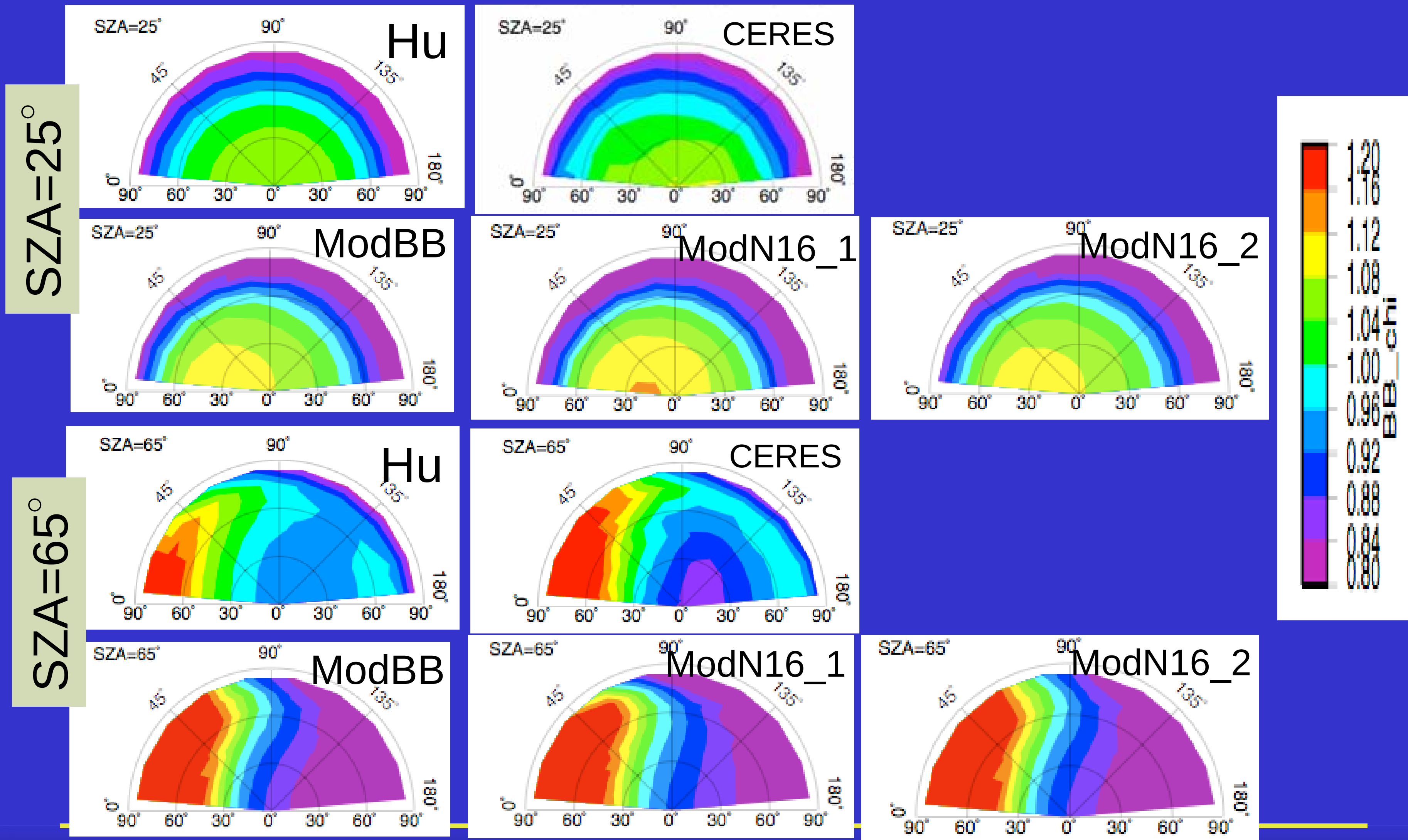
# DCC Calibration Procedure

- Identify DCC GAC pixels, ~ 0.5% of all tropical pixels
  - T(11µm) < 205° K
  - ±20° latitude, all longitudes
- Convert DCC pixel radiances to overhead sun irradiance
  - Use CERES ADM and directional models
  - Limit VZA < 40° and SZA < 40°, no sun glint
- Construct monthly PDFs over lifetime of satellite
  - Use the $\sigma$(0.65 µm) and $\sigma$(11 µm) to sharpen the PDF
- Plot modes & means of the monthly DCC irradiances
  - Normalize the radiances and multiply by given gain factors
- Validate DCC degradation
  - Use SNO or NSRM, Ch1/Ch2 ratios
  - NOAA15 to MetOp-A only high gain counts are DCC calibrated

# DCC RTM & CERES ADMs and Directional models

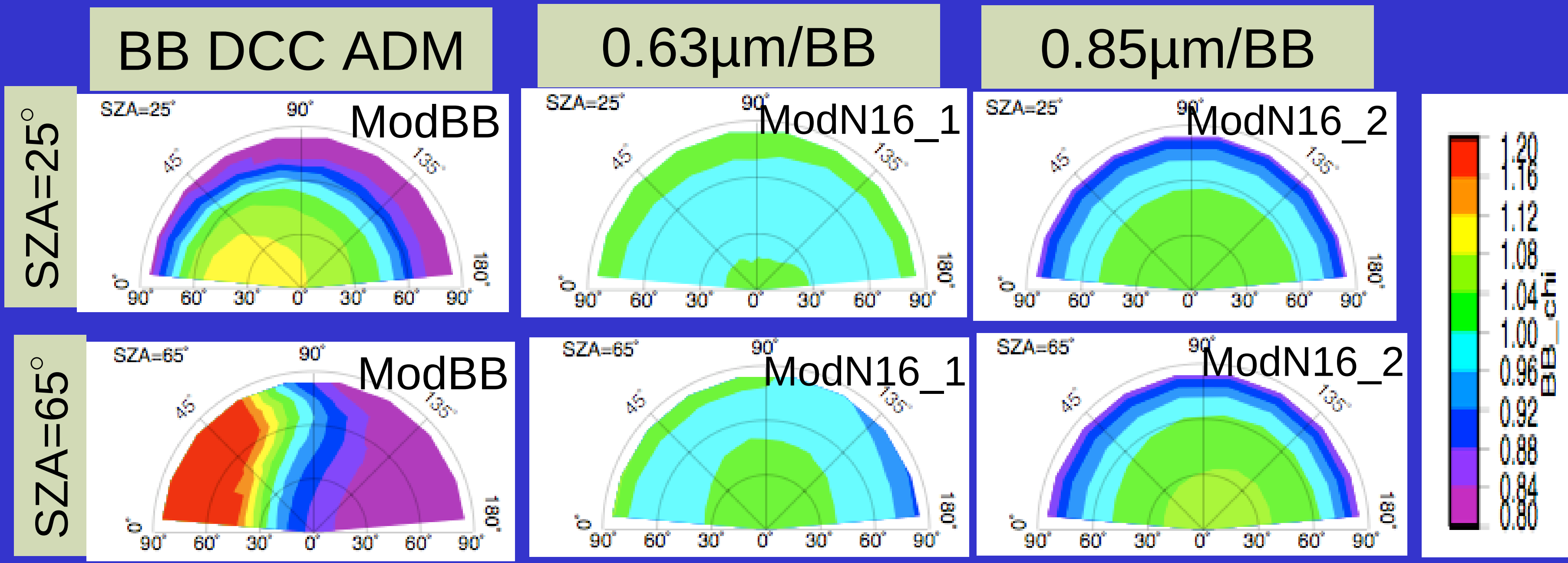
- Modtran (broadband & narrowband)
  - Cloud optical depth = 125, Cloud top height = 15km, ice particle diameter= 60µm, McClatchy Tropical Profile
- Hu Model (broadband only)
  - Modtran absorption & DISORT scattering, Cloud opt depth = 120
- CERES-TRMM Model (broadband only)
  - Angular binned CERES radiances, Cloud opt depth = 50, Overcast ice bin, TRMM orbit ensures all SZA
- ADMs ($\chi$) & DRMs ($\delta$) convert radiances to overhead sun
  - $M(SZA) = \pi L(SZA) / \chi(SZA)$
  - $M(SZA = 0^\circ) = M(SZA) / \delta(SZA)$
  - **$L(SZA = 0^\circ)$** $= M(SZA = 0^\circ) / \pi$

# DCC ADMs (χ) Comparison



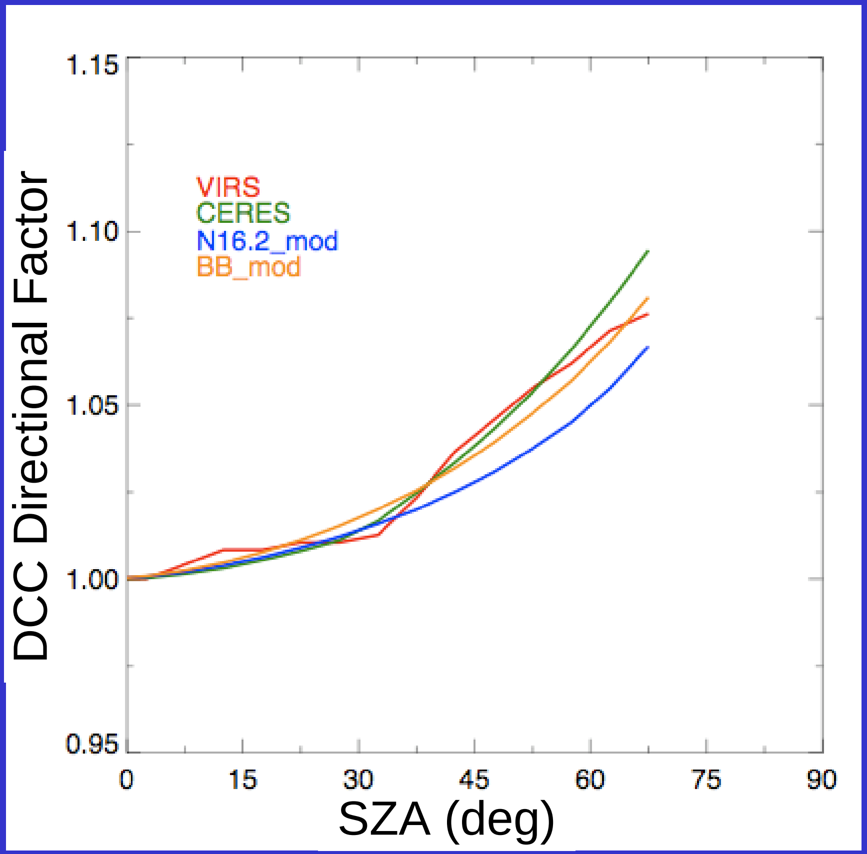

- DCC ADM is relatively Lambertian for SZA < 40° & VZA < 40°
- DCC ADMs similar for SZA < 40°

# Comparison of DCC NB/BB ADM ($\chi$) ratios




- DCC NB/BB ratio is very close to unity for VZA <40°
- Mainly a view angle adjustment between narrowband and broadband DCC ADM models
    - greater ratio range for near-IR than for the VIS (ch 1)
- To account for 3-D effects in the theoretical NB model, compute ratios of CERES/ModBB as function of angles, then apply ratios to Mod_NB values

# Solar-zenith angle dependence of DCC albedo

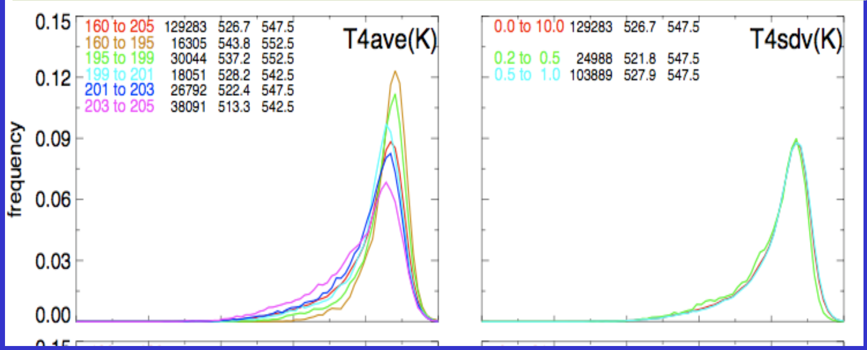


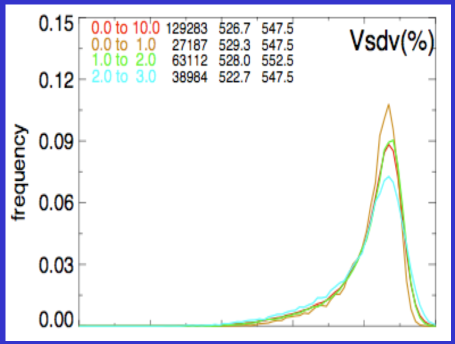

**DCC Directional Models, δ(SZA)**

- VIRS: 0.65-µm model based on TRMM 46-day precessionary cycle, cross-track mode
- CERES: BB model based on azimuthal bi-axial scan mode on TRMM
- N16_2 & BB_mod are Modtran RTM-based results
- All models similar for SZA < 40° ; VIRS not as smooth, uses CERES BB ADM, views fewer angles than CERES

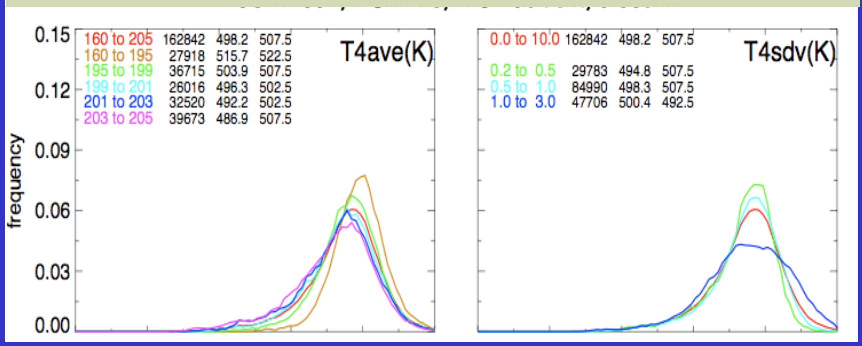
# NOAA-16, 0.65 µm, DCC PDFs

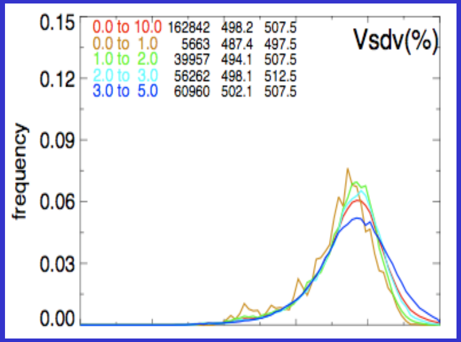
## August 2001, SZA~30°




## June 2007, SZA~60°

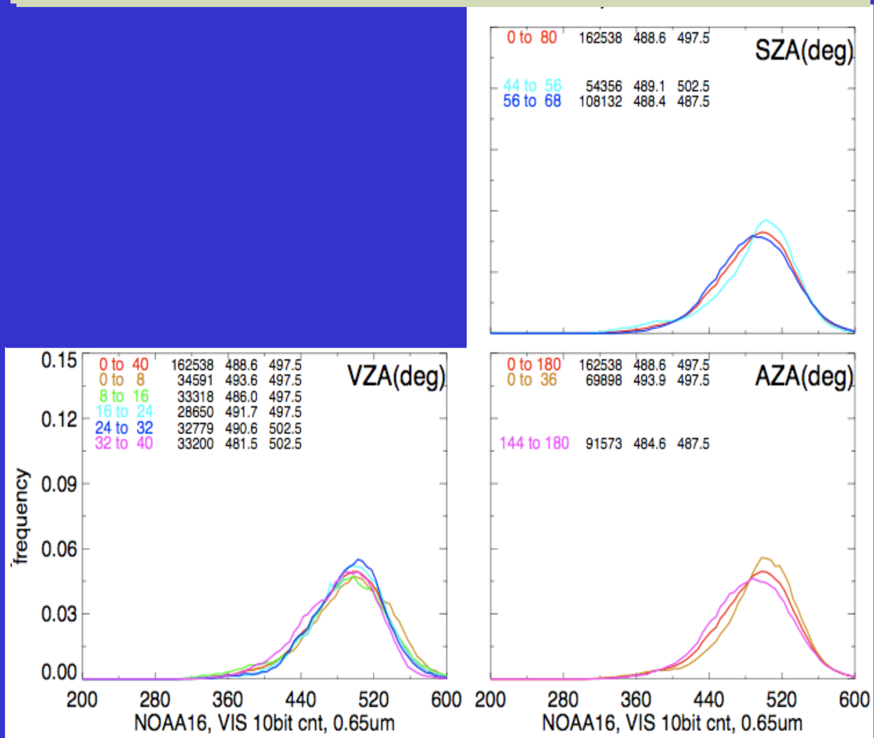


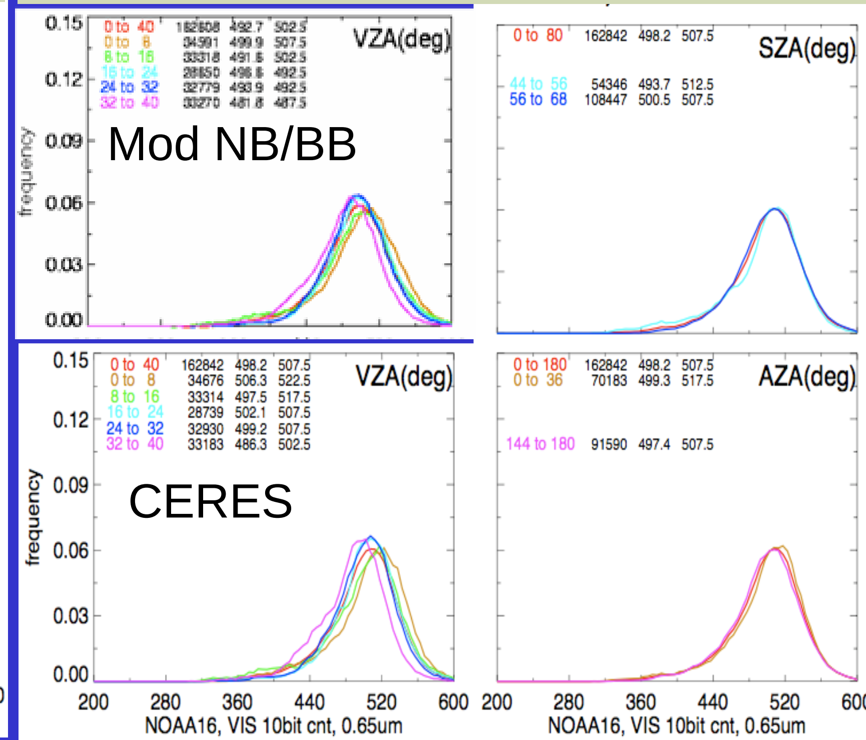

- Slight dependency of peak and shape on 11-µm temperature threshold
- $\sigma(0.65)$ and $\sigma(11.0)$ sharpen the PDF

# NOAA-16, 0.65 µm, DCC PDFs

June 2007, SZA~60° NO ADM



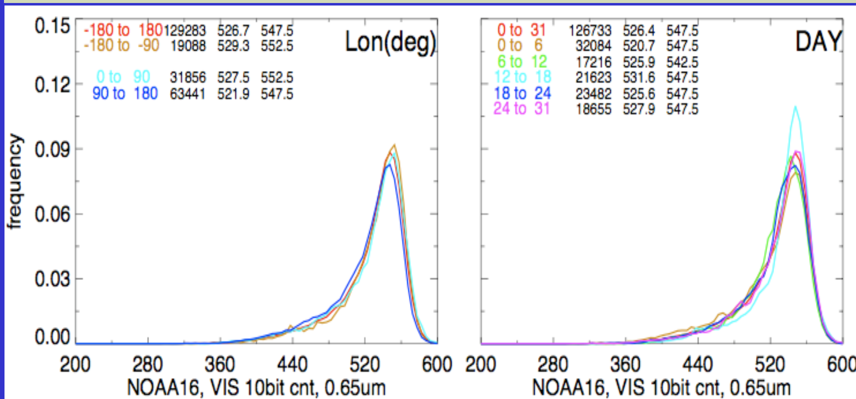

June 2007, SZA~60°



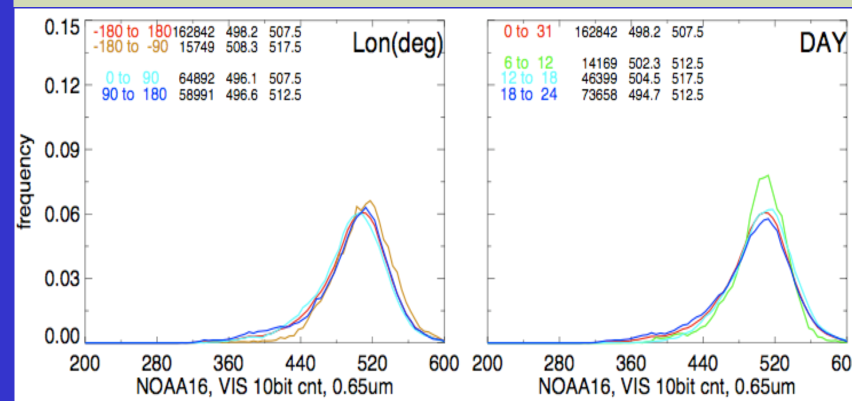

- CERES ADM is very good except for VZA at high SZA
- Similar results for 0.85-µm channel (not shown)

# NOAA-16, 0.65 µm, DCC PDFs

## August 2001, SZA~30°

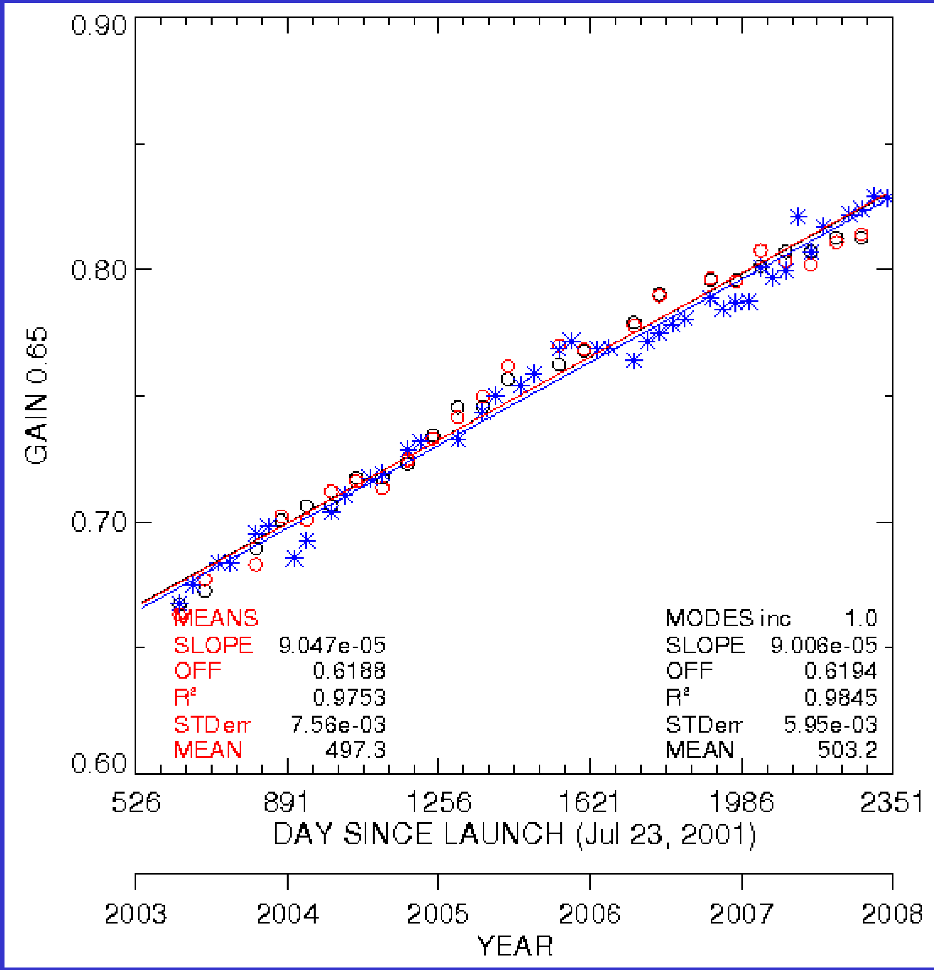



## June 2007, SZA~60°




- No dependency with longitude or day of month
  - can use same approach for GEOs at any longitude

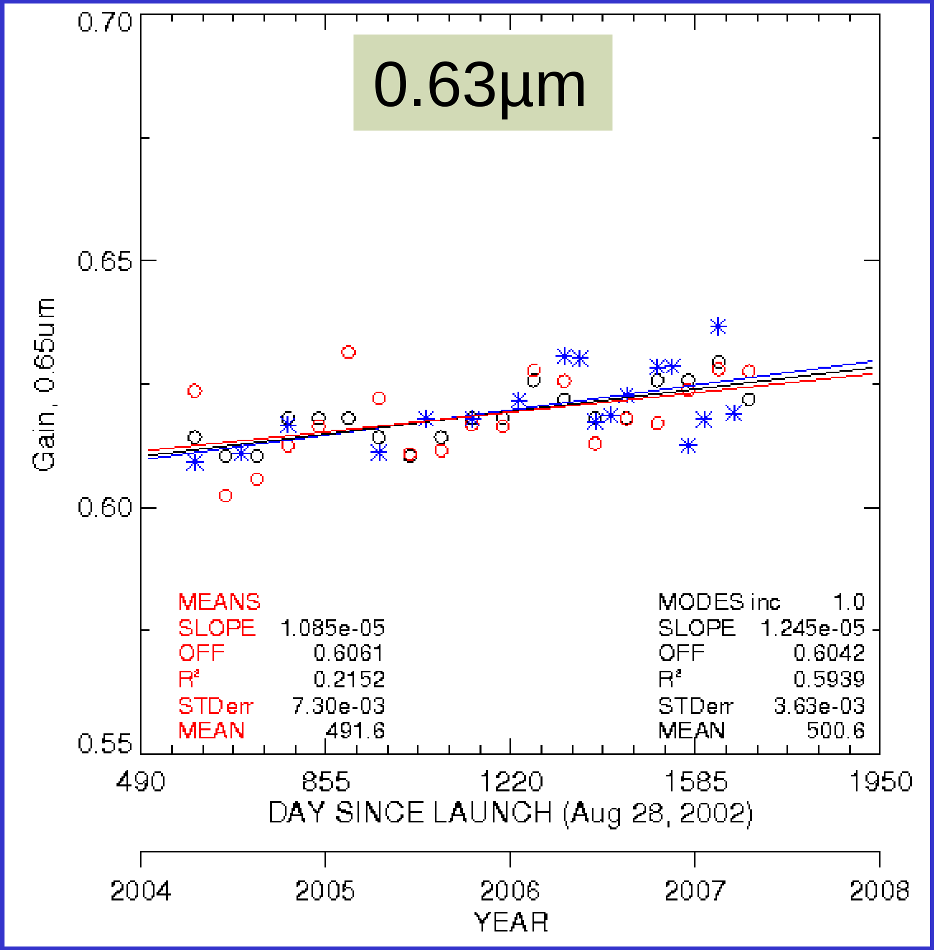
# Comparison of GOES-12 visible gain degradation




- * G12/Terra 8.99e-5
- ○ DCC mode 9.01e-5
- ○ DCC mean 9.05e-5

- 3 gain trends are within 0.7%
- mode & Terra differ by 0.2%
  - discontinuities in 03 & 06 due to Terra cal changes

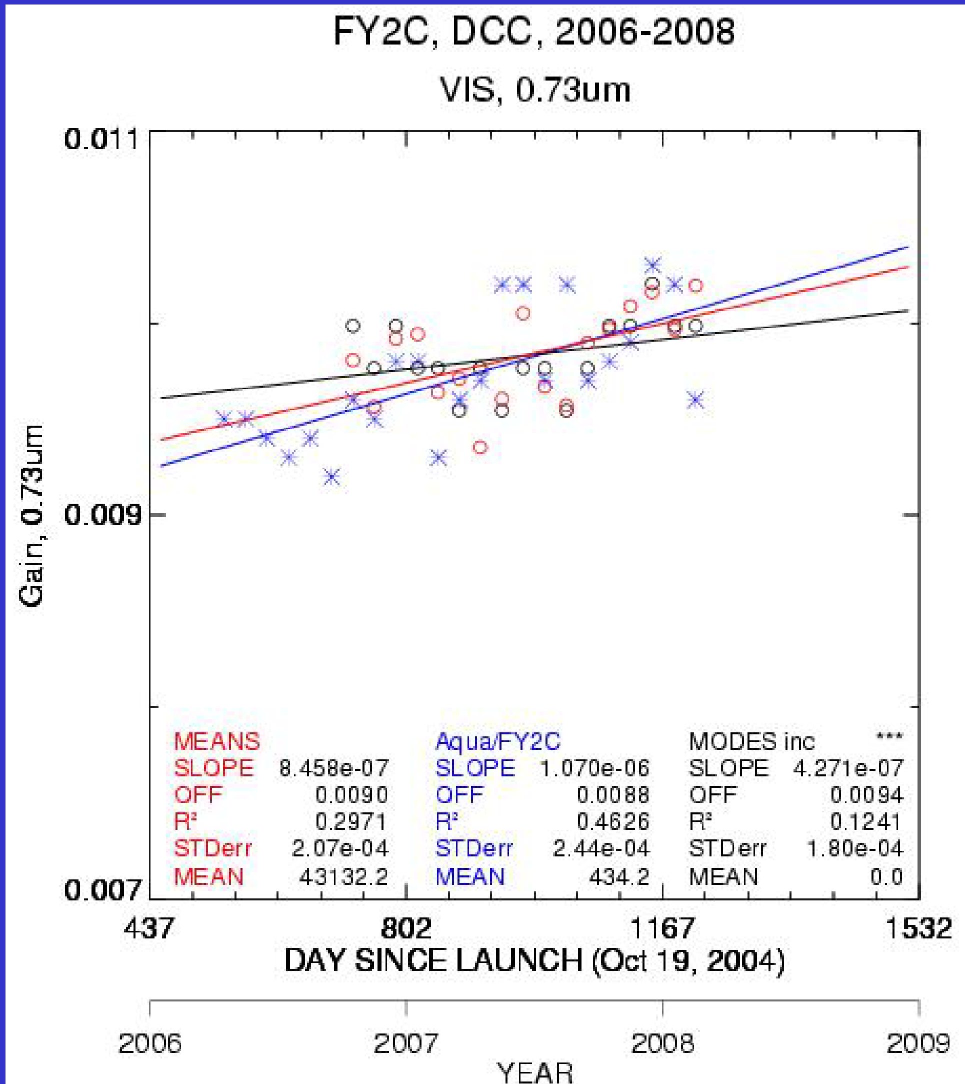
# Comparison of MET8 visible gain degradation




* MET8/Terra1.29e-5
○ DCC mode 1.25e-5
○ DCC mean 1.09e-5

- MET8/Terra and DCC mode trends are in best agreement (0.3% over 3.5 years)
- mode may be most robust parameter for DCC

# Comparison of FY-2C visible gain degradation




* FY2C/Terra 1.07e-6
○ DCC mode 4.27e-7
○ DCC mean 8.46e-7

- Trend errors (>50% over 1.7 years) unacceptable
  - 6-bit digitization
  - stray light effects
  - short time period
  - non-linearities

(Doelling)

# Spectral Corrections: Theoretical or Empirical

- **Spectral filter functions vary from imager to imager**
  - Atmospheric scatter & absorption vary with wavelength
  - Surface & cloud reflectance, emissivity vary with wavelength
  - Need to correct intercalibrated radiances

- **Approach**
  - Use radiative transfer models or spectral observations to compute

$L_{sat}[L_{ref}(K)]$, $K$ = sfc type

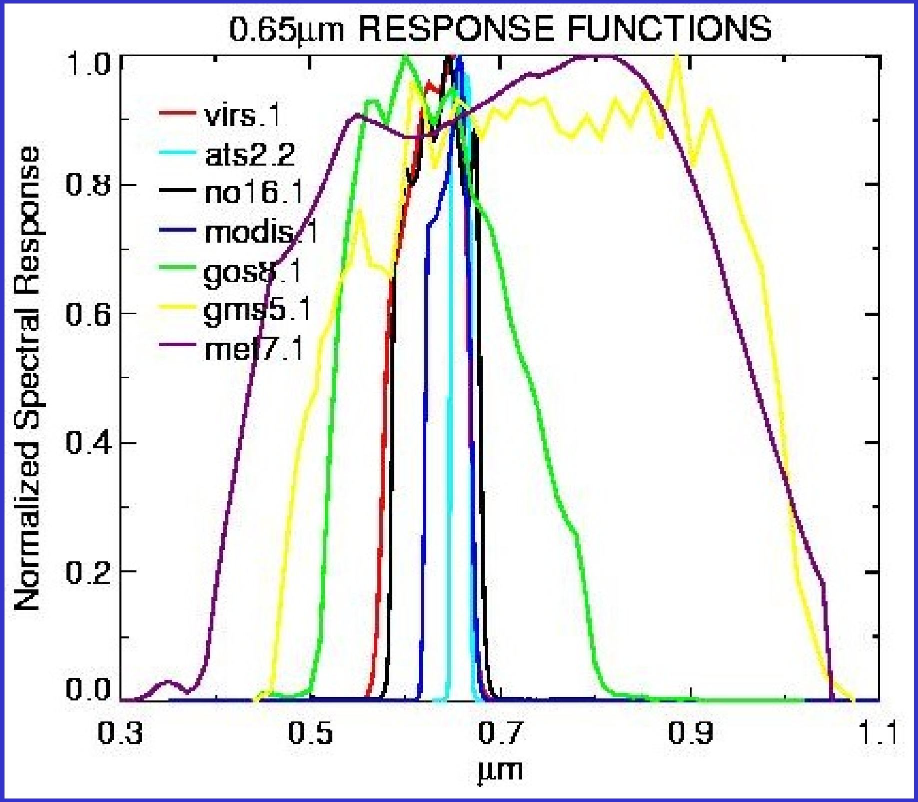
Compute $L_x$ for range of atmospheres, clouds, & aerosols for all imagers $x$

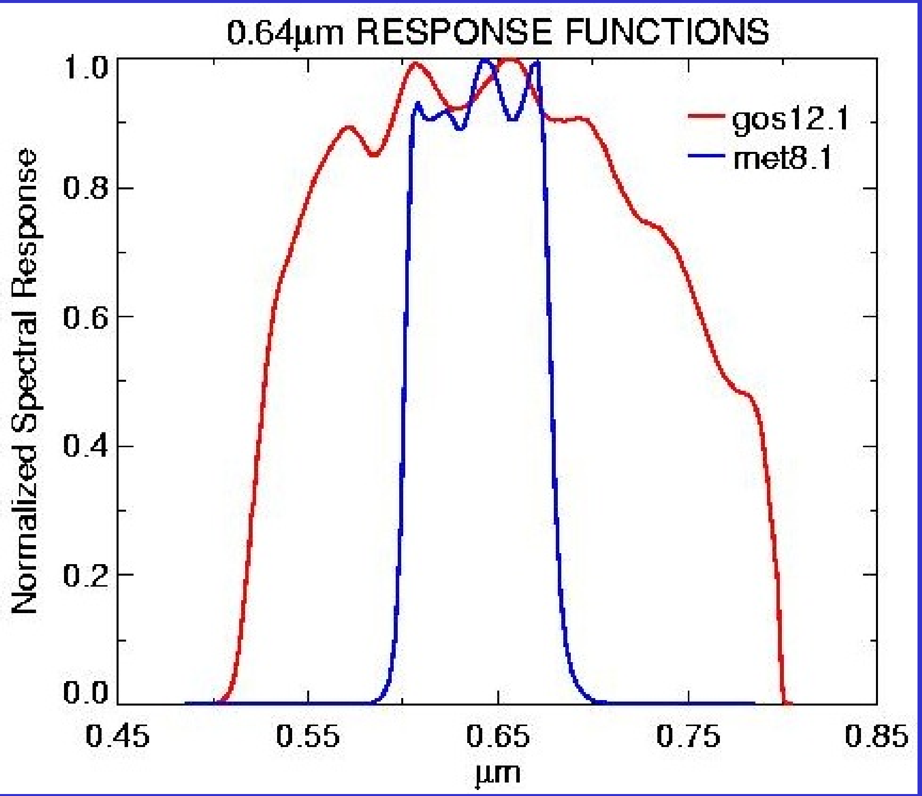
$$L_{sat}(K) = f(L_{ref}(K))$$

- Given normalized value of $L'_{sat}$ from intercalibration, compute final value as

$$L_{sat}(K) = f(L'_{sat}(K))$$

# Visible Channel Spectral Response Functions

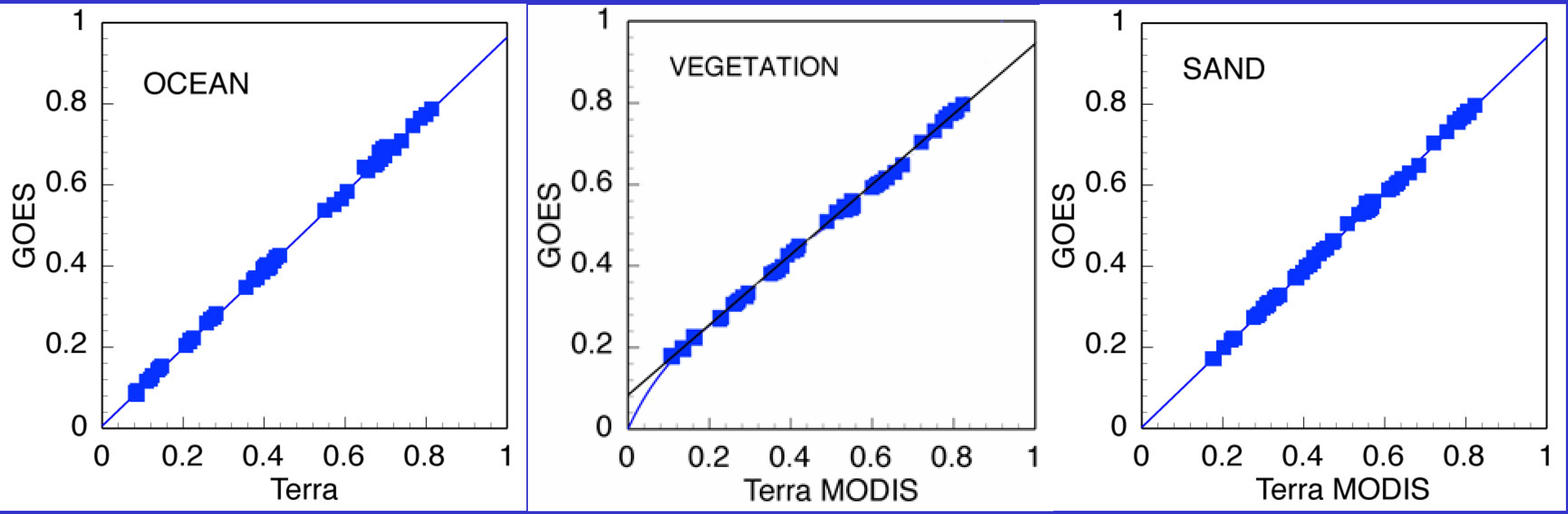



Similar variations seen in other channels!

# Examples of Spectral Corrections, MODIS to GOES

0.65 µm




Ocean and sand are very similar, vegetation brighter for GOES

# Theoretical Spectral Corrections to *Terra* MODIS Ocean + Clouds

| Satellite | a | b |
|---|---|---|
| GOES | 0.9584 | 0.0056 |
| Meteosat-7 | $A(\mu_o)$ | $B(\mu_o)$ |
| Meteosat-8 | 0.9741 | 0.0036 |
| MTSAT-1R | $C(\mu_o)$ | $D(\mu_o)$ |
| VIRS | 0.9540 | 0.0109 |
| N14 | 0.9484 | 0.0030 |

- Broader bands have SZA dependence
- SEVIRI closest to MODIS

*Nguyen et al., JTech, 2009*

# SCIAMACHY Spectra

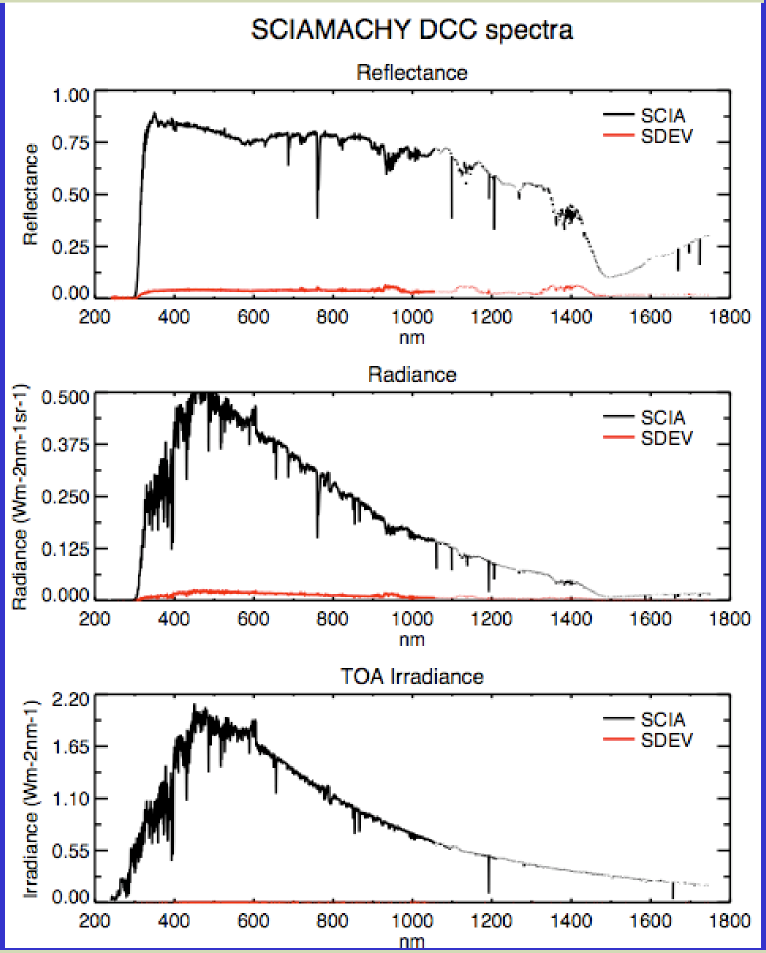
- SCIAMACHY SCanning Imaging Absorption SpectroMeter for Atmospheric CHartographY
  - Spatial Resolution: 32 x 215 km
  - Spectral resolution: varies between 0.24-2.38 µm (7 sensors)
  - Radiometric accuracy: 4%
  - Envisat Orbit: sun-synchronous, 794 km, 98.55° inclination, 10:00 AM local solar time descending node

- Footprint scene Identification taken from nearest MODIS swath (10:30AM)
  - Could also use AATSR or other satellite (GEO or LEO)

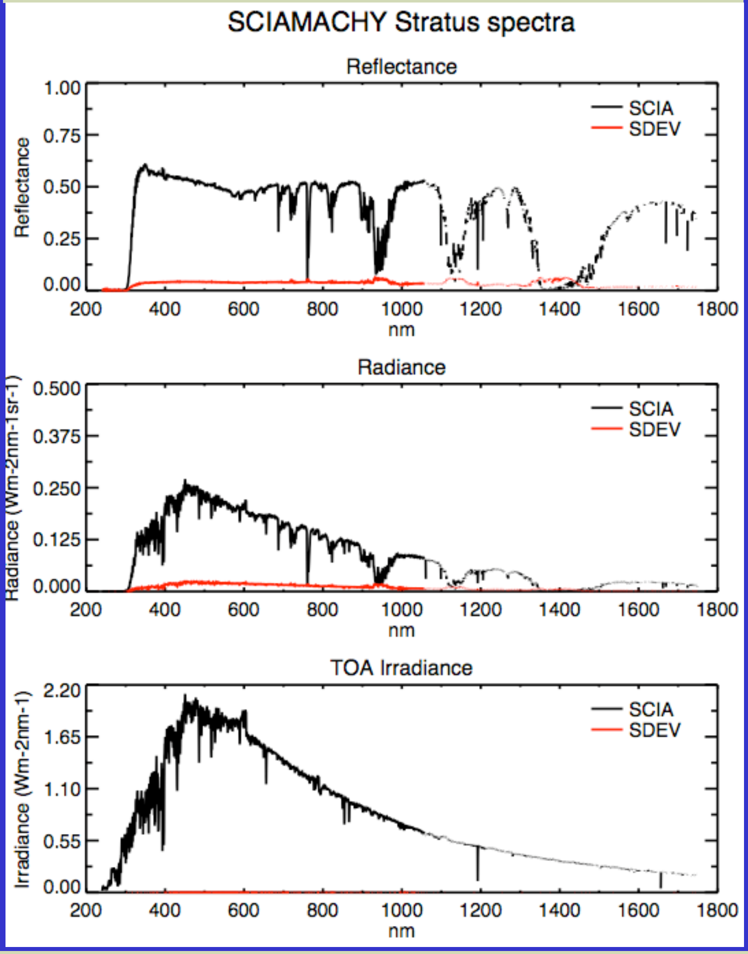
- Collected footprints during July 2003
  - For DCC & stratus spectra, SZA < 40°, VZA < 10°, LAT < ±30°, ~130 footprints, average $L_x$ / cos(SZA)

# SCIAMACHY spectra

## Deep Convective Clouds




## Maritime Stratus Clouds

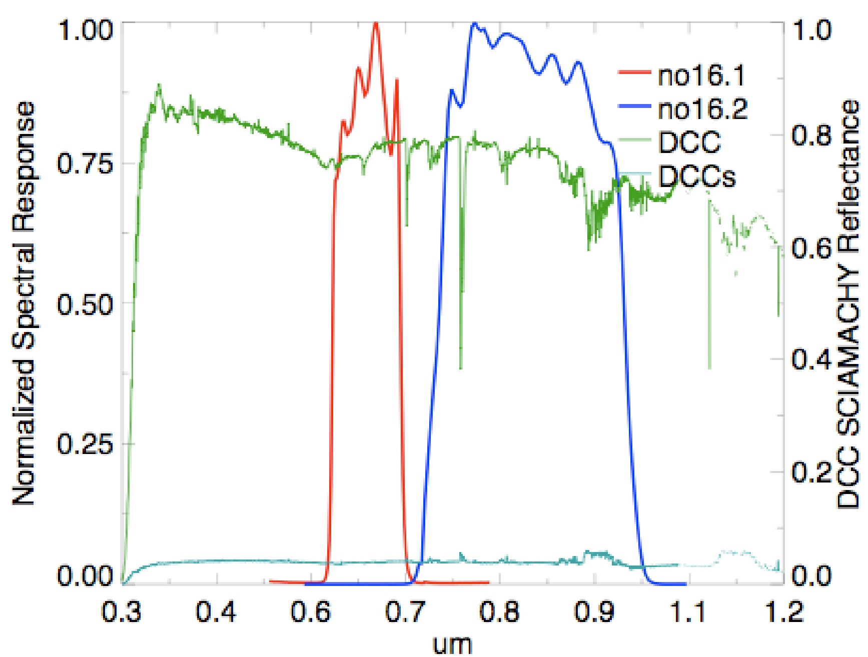



- Minimal water vapor absorption in near-IR for DCCs
- Both stratus (z < 4km) & DCC have very small reflectance Std Devs
- Std Dev miniscule for irradiance

** Spectra courtesy of SCIAMACHY*

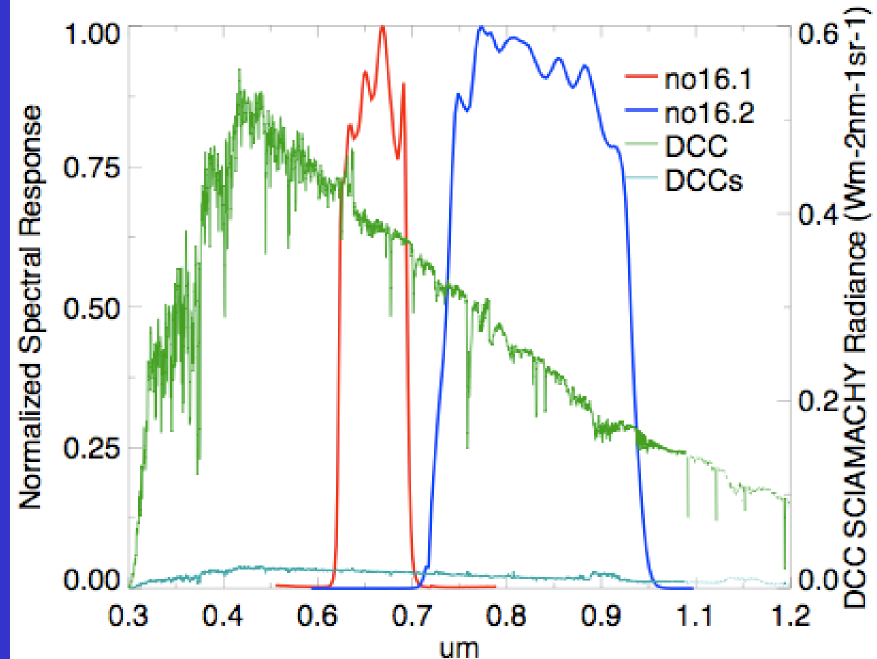
# NOAA-16 AVHRR & SCIAMACHY DCC spectra

## Reflectance




| SAT | Cum | SCs | SCt | Rads | Radt | Ref |
|---|---|---|---|---|---|---|
| no16.1 | 0.6337 | 1608.1 | 1619.4 | 392.8 | 395.5 | 0.7672 |
| no16.2 | 0.8542 | 1003.9 | 1008.7 | 238.9 | 240.1 | 0.7478 |
| RATIO | | 1.6019 | 1.6054 | 1.6438 | 1.6470 | |

## Radiance



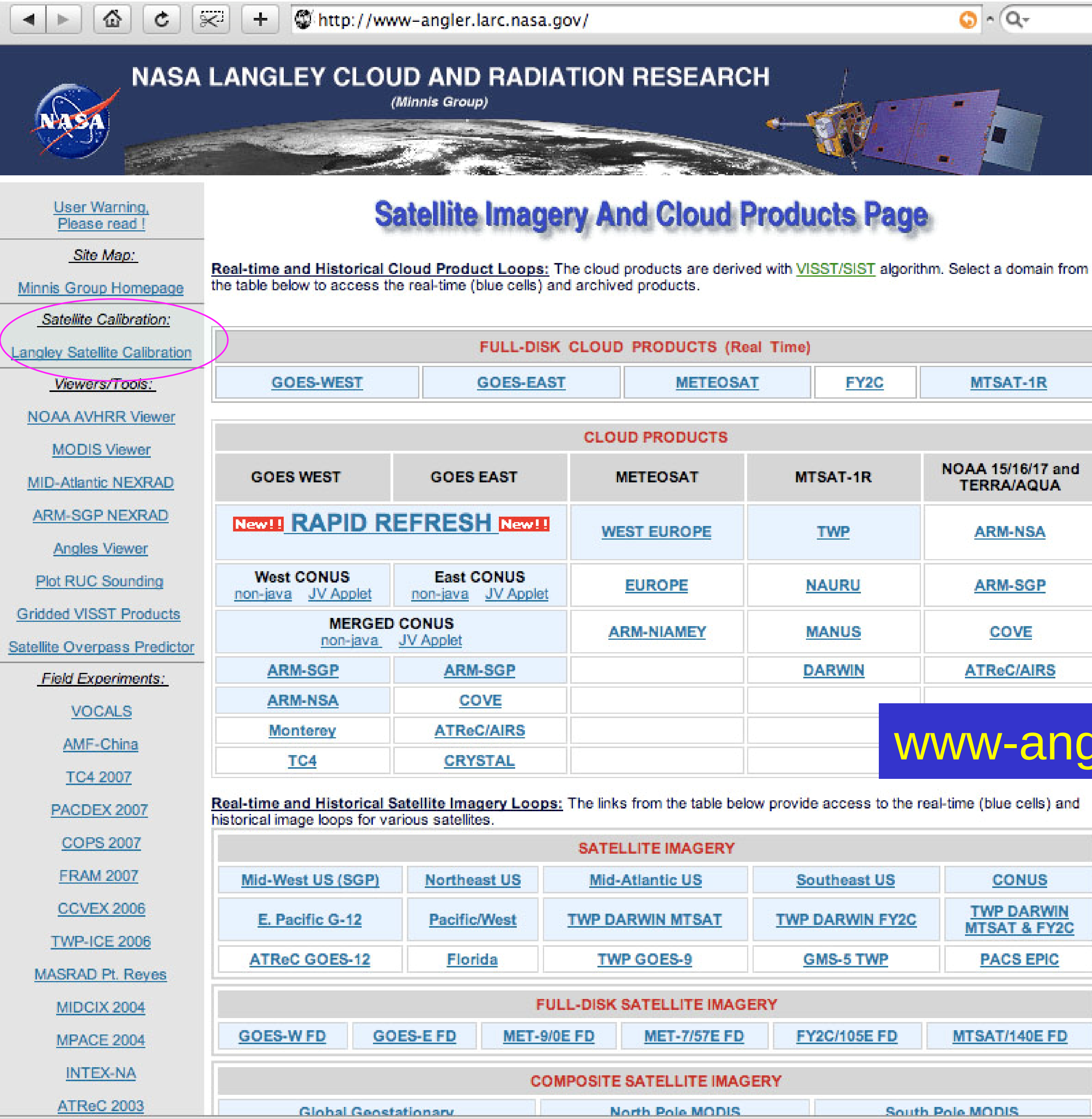

| SAT | Cum | SCs | SCt | Rads | Radt | Ref |
|---|---|---|---|---|---|---|
| no16.1 | 0.6337 | 1608.1 | 1619.4 | 392.8 | 395.5 | 0.7672 |
| no16.2 | 0.8542 | 1003.9 | 1008.7 | 238.9 | 240.1 | 0.7478 |
| RATIO | | 1.6019 | 1.6054 | 1.6438 | 1.6470 | |

- Solar constant ratio between 0.63 & 0.85-µm channels similar to DCC ratio
- DCC 0.63 & 0.85-µm reflectances differ by 0.02



* Spectra courtesy of SCIAMACHY

# Access to Calibration Page via Cloud Products Page


http://www-angler.larc.nasa.gov/

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(Minnis Group)

User Warning, Please read !
Site Map:
Minnis Group Homepage
Satellite Calibration:
Langley Satellite Calibration
Viewers/Tools:
NOAA AVHRR Viewer
MODIS Viewer
MID-Atlantic NEXRAD
ARM-SGP NEXRAD
Angles Viewer
Plot RUC Sounding
Gridded VISST Products
Satellite Overpass Predictor
Field Experiments:
VOCALS
AMF-China
TC4 2007
PACDEX 2007
COPS 2007
FRAM 2007
CCVEX 2006
TWP-ICE 2006
MASRAD Pt. Reyes
MIDCIX 2004
MPACE 2004
INTEX-NA
ATReC 2003

## Satellite Imagery And Cloud Products Page

**Real-time and Historical Cloud Product Loops:** The cloud products are derived with VISST/SIST algorithm. Select a domain from the table below to access the real-time (blue cells) and archived products.

| FULL-DISK CLOUD PRODUCTS (Real Time) | | | | |
|---|---|---|---|---|
| GOES-WEST | GOES-EAST | METEOSAT | FY2C | MTSAT-1R |

| CLOUD PRODUCTS | | | | |
|---|---|---|---|---|
| GOES WEST | GOES EAST | METEOSAT | MTSAT-1R | NOAA 15/16/17 and TERRA/AQUA |
| New!! RAPID REFRESH New!! | | WEST EUROPE | TWP | ARM-NSA |
| West CONUS non-java JV Applet | East CONUS non-java JV Applet | EUROPE | NAURU | ARM-SGP |
| MERGED CONUS non-java JV Applet | | ARM-NIAMEY | MANUS | COVE |
| ARM-SGP | ARM-SGP | | DARWIN | ATReC/AIRS |
| ARM-NSA | COVE | | | |
| Monterey | ATReC/AIRS | | | |
| TC4 | CRYSTAL | | | |

**Real-time and Historical Satellite Imagery Loops:** The links from the table below provide access to the real-time (blue cells) and historical image loops for various satellites.

| SATELLITE IMAGERY | | | | |
|---|---|---|---|---|
| Mid-West US (SGP) | Northeast US | Mid-Atlantic US | Southeast US | CONUS |
| E. Pacific G-12 | Pacific/West | TWP DARWIN MTSAT | TWP DARWIN FY2C | TWP DARWIN MTSAT & FY2C |
| ATReC GOES-12 | Florida | TWP GOES-9 | GMS-5 TWP | PACS EPIC |

| FULL-DISK SATELLITE IMAGERY | | | | | |
|---|---|---|---|---|---|
| GOES-W FD | GOES-E FD | MET-9/0E FD | MET-7/57E FD | FY2C/105E FD | MTSAT/140E FD |

| COMPOSITE SATELLITE IMAGERY | | |
|---|---|---|
| Global Geostationary | North Pole MODIS | South Pole MODIS |

www-angler.larc.nasa.gov

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# Current LaRC Calibration Page

- Provides latest GEO VIS channel calibration from NSRT applied to Terra MODIS
- References relevant to the results
- Just a start, more coming…

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

+ NASA Portal
+ Preferences

Search: Keywords + GO

− Minnis Group Home | + Cloud Products | + Satellite Imagery | + Field Experiments | + Related References

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+ Projects
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+ Viewers / Tools
+ Satellite Calibration
+ Contrails
+ Related References
+ User Warning !

SEARCH LANGLEY + GO

**NASA Fact**

The acronym "NASA" stands for National Aeronautics and Space Administration.

+ More NASA facts...

Satellite Calibration

## NASA Langley Satellite Calibration Page

**Post Launch Calibration Equations**

| Satellite | Go | dg1 | dg2 | Co | Reference Date | Operation Date |
|---|---|---|---|---|---|---|
| GOES-12 | 0.6350 | 7.795E-4 | 0 | 29 | Jul 23, 2001 | Apr 01, 2003 |
| GOES-11 | 0.4696 | 1.211E-4 | 0 | 29 | May 03, 2002 | Jun 21, 2006 |
| GOES-10(pre Jan'04) | 0.4776 | 2.2182E-4 | 0 | 29 | Apr 25, 1997 | Aug 27, 1998 |
| GOES-10(post Jan'04) | 0.7194 | 0.5320E-4 | 0 | 29 | Apr 25, 1997 | Aug 27, 1998 |
| GOES-9(yr96-98) | 0.5373 | 1.2344E-4 | 0 | 29 | May 23, 1995 | Jan 11, 1996 |
| GOES-9(yr03-05) | 0.4193 | 0.9795E-4 | 0 | 29 | May 23, 1995 | May 22, 2003 |
| GOES-8 | 0.5620 | 2.2223E-4 | -2.4310E-8 | 29 | Apr 13, 1994 | Jun 01, 1996 |
| Meteosat-7 | 1.9890 | 4.7010E-4 | -8.2590E-8 | 4.9 | Sep 02, 1997 | Jun 03, 1998 |
| Meteosat-8 | 0.6369 | -0.069E-4 | 0 | 51 | Aug 28, 2002 | Dec 12, 2002 |
| Meteosat-9 | 0.5328 | 0 | 0 | 51 | Dec 21, 2005 | Apr 11, 2007 |
| FY2C | 0.0079 | 0.0190E-4 | 0 | 1.0 | Oct 19, 2004 | Jul 2005 |
| MTSAT-1 | 0.0098 | -0.006E-4 | 0 | 0 | Feb 26, 2005 | Jun 28, 2005 |

**Radiance Calculation from Calibration Equations:**

For a given satellite, the post-launch calibration formula is:

$$L_v = (g_2 d^2 + g_1 d + g_0)(C - C_0)$$

where $L_v$ is the normalized VIRS radiance in $Wm^{-2}m^{-1}sr^{-1}$, $g_0$ is the initial gain, $g_1$ and $g_2$ is first and second order polynomial term of the gain trend, d is the days since the reference date (or launch date), $C_0$ is the offset count, and C is the raw 8 or 10-bit count. Note, FY2C counts (C) are squared.

**Publications**

Minnis, P., L. Nguyen, D.R. Doelling, D.F. Young, W.F. Miller, D.P. Kratz: **Rapid Calibration of Operational and Research Meteorological Satellite Imagers. Part I: Evaluation of Research Satellite Visible Channels as References.** *J. Atmos. Oceanic Technol.*, **19**,1233-1249, 2002.

More References ...



NASA Official: Patrick Minnis
Website Curator: Louis Nguyen
+ Contact Langley
+ Contact Team Members

Team Login

# Experimental Web Page: Details of intercalibrations NOAA-9 & 10 AVHRR

− Home | + Cloud Products | + Satellite Imagery | + Field Experiments | + Related References

## Calibration Pair - N09 vs N10

| Individual Monthly Scatter Plot of N09 vs N10 | Jan. | Feb. | Mar. | Apr. | May. | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | | | | | | | | | | | | 1 2 3d 4d 5d Raw Data |
| 1987 | | | | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | | | 1 2 3d 4d 5d Raw Data |
| 1988 | | | | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | | | |

| Visible Timeline Plot | xoff | r2 | std | num | SLPpc | SLPfor |
|---|---|---|---|---|---|---|
| Channel 1 | View | View | View | View | View | View |

| Infrared Timeline Plot | yoff | xoff | SLPpc | num | rmsp | std | bias | rms | SLPfor | r2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Channel 2 | _ | View | View | View | _ | View | _ | _ | View | View |
| Channel 3 | View | _ | View | View | View | View | View | View | View | View |
| Channel 4 | View | _ | View | View | View | View | View | View | View | View |
| Channel 5 | View | _ | View | View | View | View | View | View | View | View |

# Experimental Web Page: Scatterplot example of intercalibration NOAA-9 & 10 AVHRR

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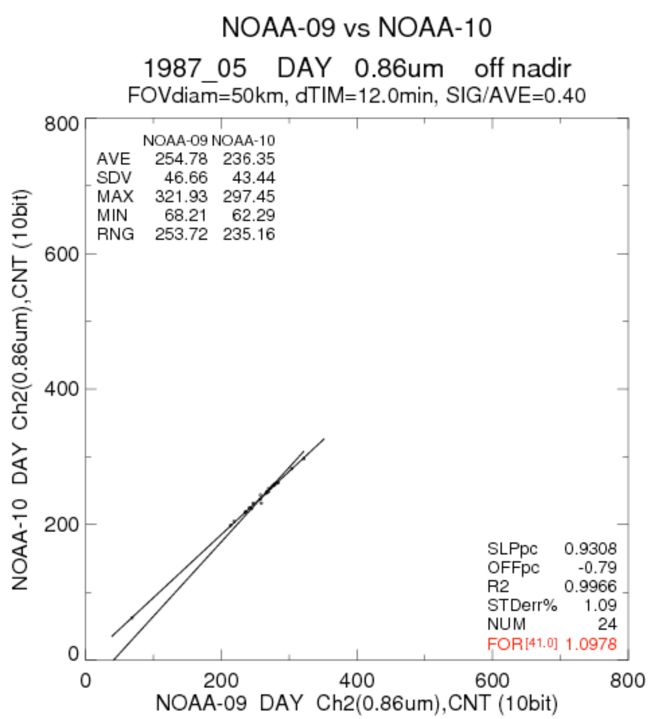
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | | | | | | | | | | | | 1 2 3d 4d 5d Raw Data |
| 1987 | | | | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | | | 1 2 3d 4d 5d Raw Data |
| 1988 | | | | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | 1 2 3d 4d 5d Raw Data | | | |

| Visible Timeline Plot | xoff | r2 | std | num | SLPpc | SLPfor |
|---|---|---|---|---|---|---|
| Channel 1 | View | View | View | View | View | View |

| Infrared Timeline Plot | yoff | xoff | SLPpc | num | rmsp | std | bias | rms | SLPfor | r2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Channel 2 | _ | View | View | View | _ | View | _ | _ | View | View |
| Channel 3 | View | _ | View | View | View | View | View | View | View | View |
| Channel 4 | View | _ | View | View | View | View | View | View | View | View |
| Channel 5 | View | _ | View | View | View | View | View | View | View | View |

Close




- Scatterplots for all relevant channels
  - day & night for T
- trend lines, biases, etc.
  - 3 fit types
- access to text files also

# Experimental Web Page:

## Example of intercalibration GOES-10 vs other satellites

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Search: Keywords + GO

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Project Home - LaRC Working Project (ID: 3)

Satellite Calibration Page → GOES-10 compared to TERRA-MODIS

### Experimental Satellite Calibration for GOES-10

| GOES-10 | |
|---|---|
| Launch: | 1997-04-25 |
| Operational: | 1998-04-27 |
| Decommission: | |
| Cur Subsat Pos: | |
| Replaced G09 (W USA; 135W) | |

Compare GOES-10 to: 101 - TERRA-MODIS

Monthly Plots

**Visible Timeline plots (0.65 μm)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| slp | xoff | r2 | std | num | Gave | Lave | SLPpc | SLPyx | SLPfor |

**Infrared Timeline plots**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |

There are no Spectral Response Functions generated for this data set.



- select reference satellite
- select plot type

ences

# Experimental Web Page:

## Example of intercalibration GOES-10 vs Terra

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

+ NASA Portal
+ Preferences

Search: Keywords + GO

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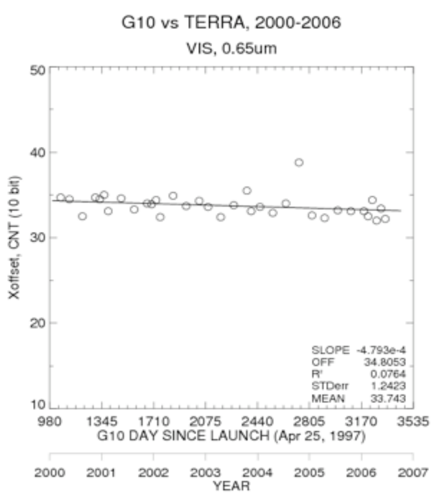
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| slp | xoff | r2 | std | num | Gave | Lave | SLPpc | SLPyx | SLPfor |

**Infrared Timeline plots**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |
| slp | yoff | r2 | std | num | bias | rms | rmsp | Gave | Lave | SLPpc | SLPyx | SLPfor |

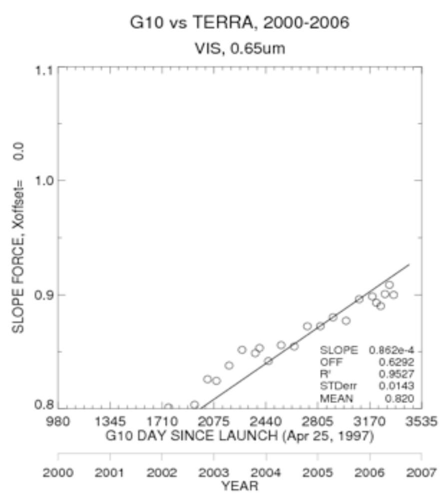
There are no Spectral Response Functions generated for this data set.

Lock




Click to Enlarge Plot

Lock




Click to Enlarge Plot

Semi-Publish



- select multiple plots
  - e.g., offset & gain
- DCC plots & overlays will be made available also

# Conclusions and Future Work

- Anchor GEO/LEO calibrations to MODIS
  - Use LEO/MODIS NSRM transfers, establish secondary references
  - Estimate uncertainties using 3-way transfers
  - Examine quirks in Terra (Aqua appears to be best behaved)
- Perform DCC calibration for all NOAA AVHRRs & GEOs
  - Compare DCC calibrations with MODIS NMST primary & secondary transfers
    - Examine best DCC parameter: mode, mean, or highest percentile?
  - Tie 0.63 & 0.85-µm calibrations using DCC & secondary references
  - Test use of DCC as absolute calibration resource
    - DCC assumes invariant albedo, measure with MODIS, apply to targets?
- Develop solar-channel spectral correction functions, $f(L'_{sat}(K))$
  - Compute spectral albedos from SCIAMACHY spectra

# Future Work Continued

- Transfer calibration MODIS calibrations back/fwd in time
  - DCC, GEO or LEO during lifetime of satellite
  - NSRT, GEO or LEO to transfer between AM/PM
  - Other published & CEOS/GSICS calibrations: e.g., desert, Antarctica
  - Assess uncertainties
    - *multiple methods (e.g., DCC, 3-way, variability along trend)*
    - *examine trends in retrieved parameters (e.g., LWP, COD)*

- Continue development of web page
  - finish the various links
  - coordinate with GSICS
  - document