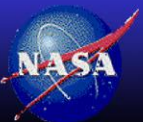


The Aqua-MODIS calibration transfer using DCC

David Doelling, Conor Haney, Ben Scarino,
Rajendra Bhatt, Arun Gopalan

GSICS Annual Meeting, Darmstadt Germany,
March 24-28, 2014

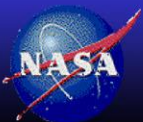


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3 methods to transfer the Aqua-MODIS calibration to GEO using DCC

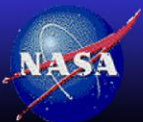
1. Aqua-MODIS BRDF corrected DCC multi-year mean radiance over the GEO domain
 - Assume the same DCC are captured by both Aqua-MODIS and GEO, although not coincident and by the same viewing conditions, only use GEO DCC during Aqua overpass times
 - Rely on DCC BRDF model to remove sampling dependencies
2. Aqua-MODIS BRDF corrected DCC monthly mean radiance over the GEO domain
 - This may remove seasonal cycle present in both Aqua and GEO
3. Aqua-MODIS/GEO DCC raymatching
 - Similar to Aqua-MODIS/GEO all-sky ray-matching except restrict only to DCC identified regions
 - Use coincident matched angled DCC radiance pairs



Aqua-MODIS BRDF corrected DCC mode radiance over GEO domain

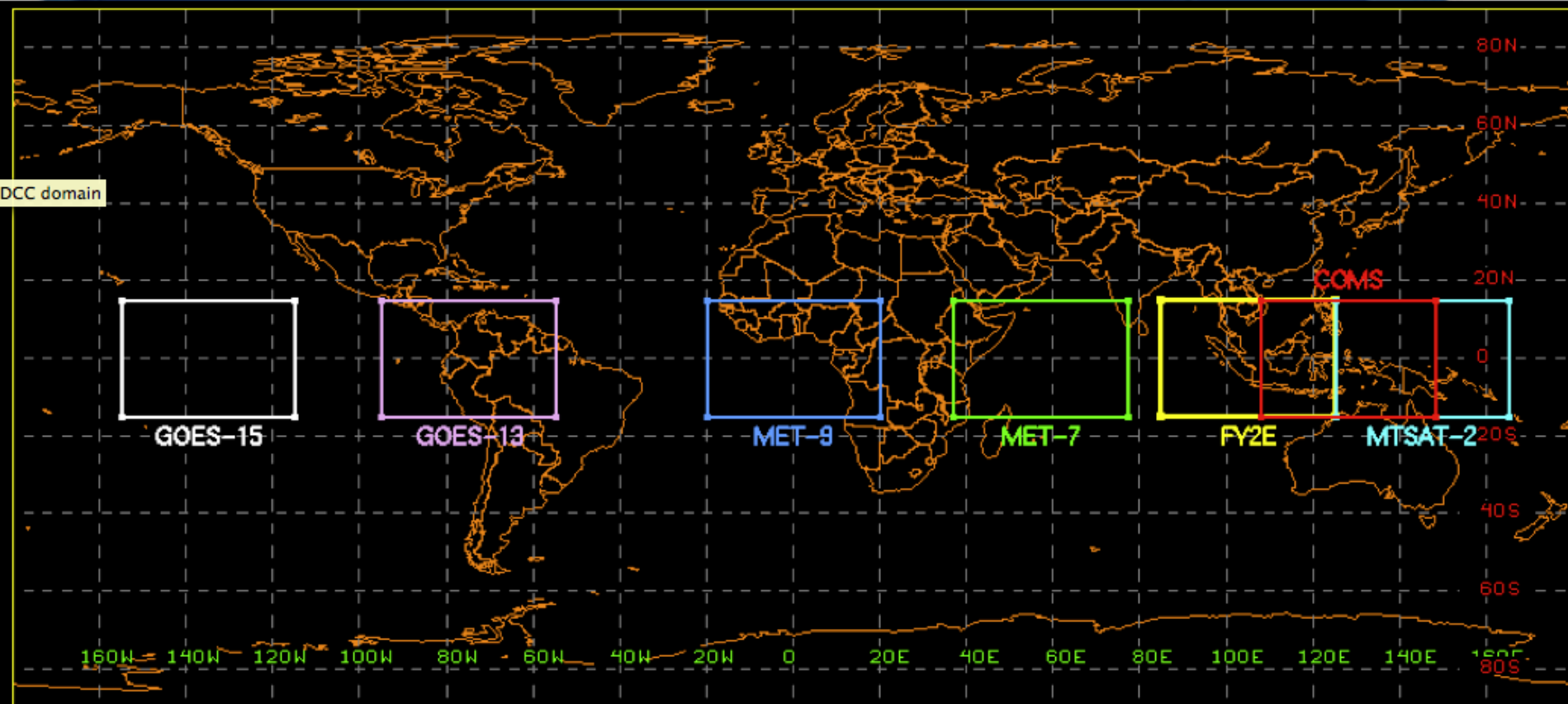
- Use same GEO and Aqua-MODIS criteria to obtain the MODIS monthly BRDF corrected DCC mode radiance over the GEO domain

GEO parameter	DCC threshold
Window brightness temperature	BT11 μ m < 205°K
Brightness temperature homogeneity	Standard deviation of 3x3 pixels BT11 μ m < 1°K
Visible radiance homogeneity	Standard deviation of 3x3 pixels visible radiance < 3%
Solar zenith angle	SZA < 40°
View zenith angle	VZA < 40°
Local time range at GEOSat longitude	12:00 PM < image time < 3:00 PM



GEO domains

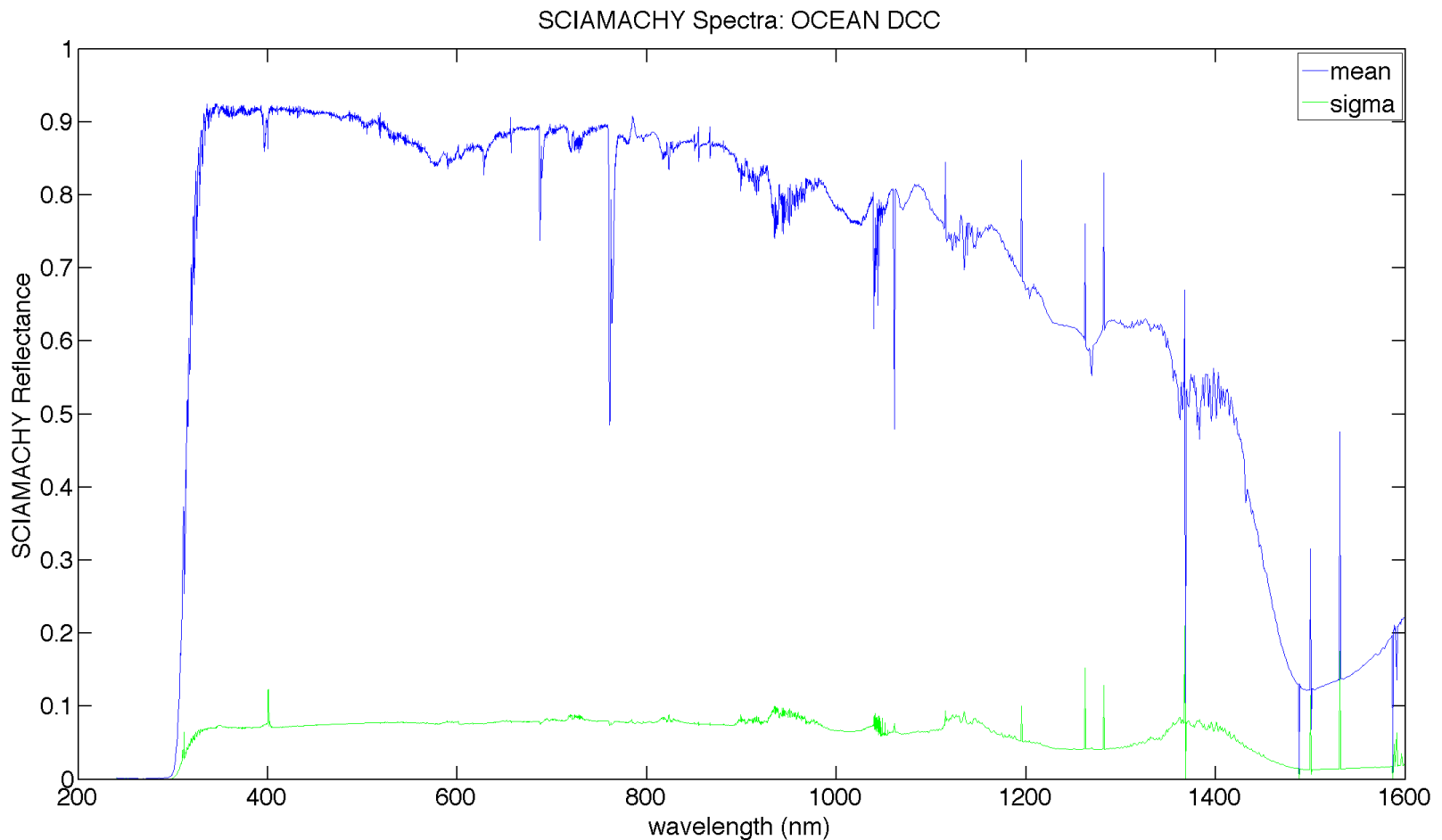
- $\pm 15^\circ$ N/S and $\pm 20^\circ$ E/W centered on the GEO sub-satellite point



	GOES-15	GOES-13	MET-9	MET-7	FY2E	COMS	MTSAT-2
Orbit	135°W	75°W	0W	57°E	105°E	128°E	145°E

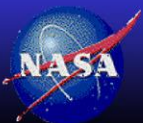
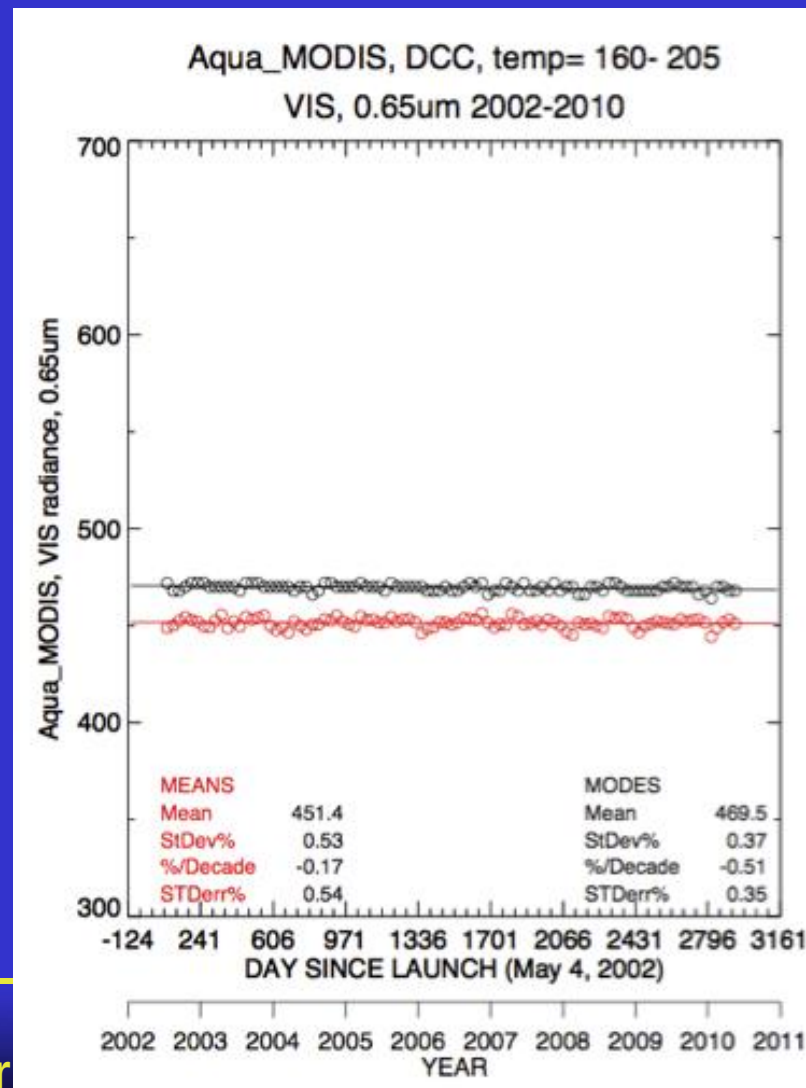
SCIAMACHY DCC spectra

- SCIAMACHY DCC hyper-spectral radiances are used as spectral band adjustment factors



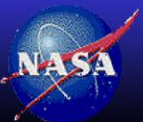
Aqua-MODIS BRDF corrected DCC mode radiance

- The 10-year mean of the BRDF corrected DCC monthly mode Aqua-MODIS radiances is used as the predicted DCC radiance
- Maybe the monthly mode radiance variability is correlated to the GEO variability
- The largest uncertainty is whether GEO and Aqua-MODIS 205° K is similar
- A 0.7% difference in MODIS DCC mode radiance is observed for a 5° K temperature difference @205° K, however, the trend was identical

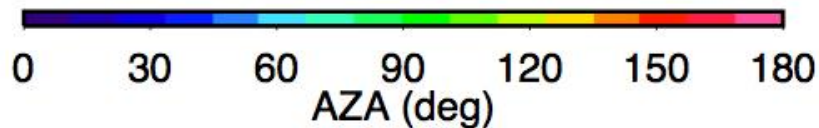
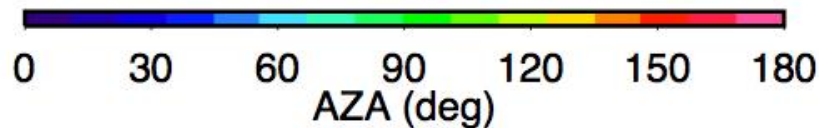
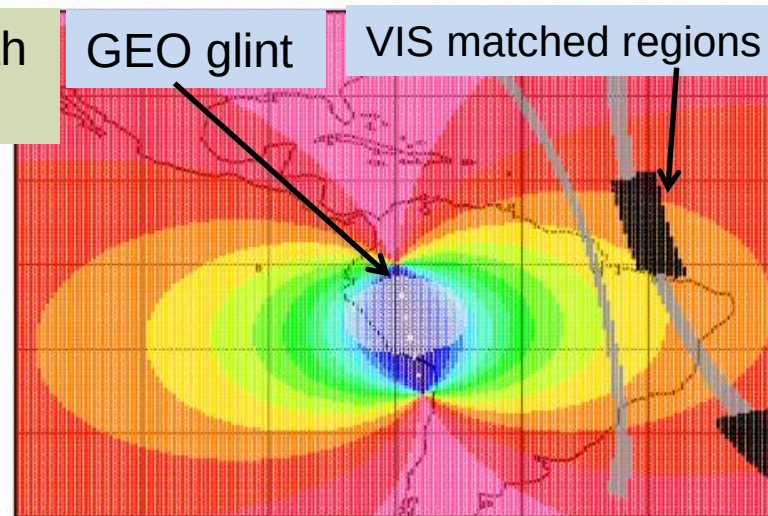
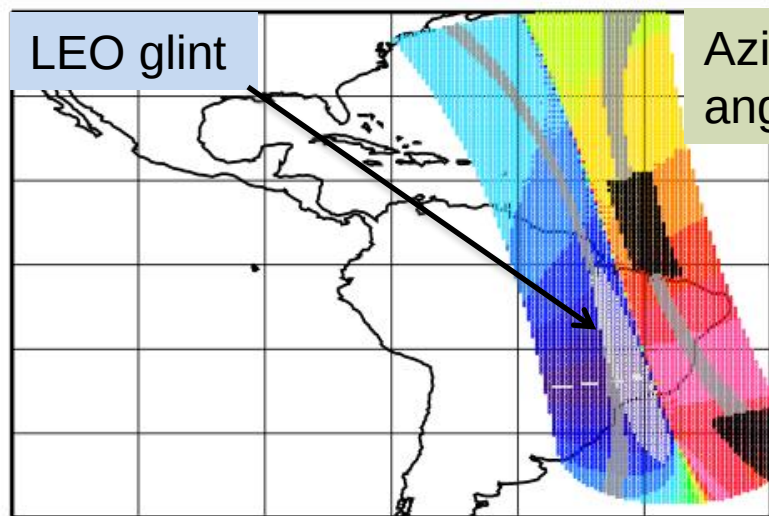
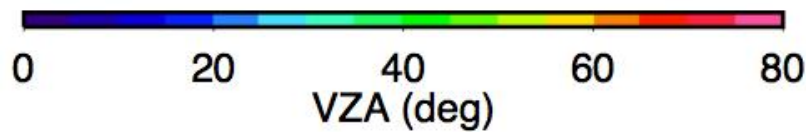
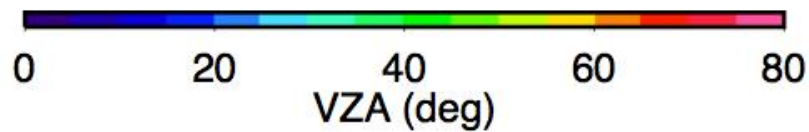
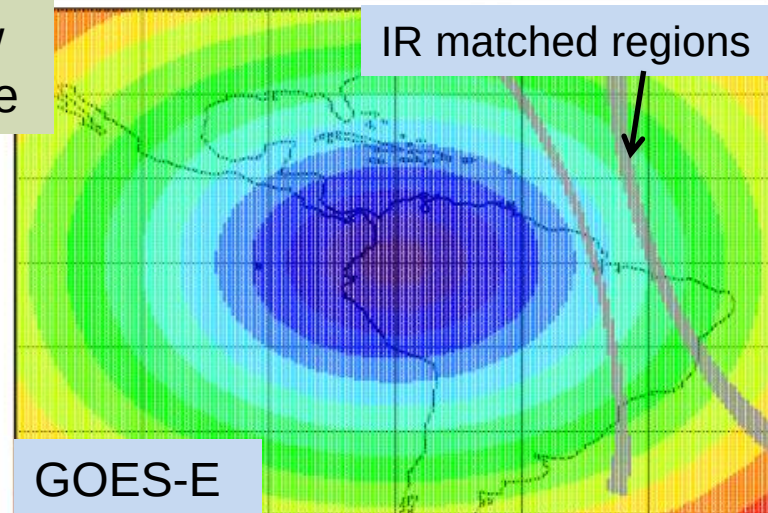
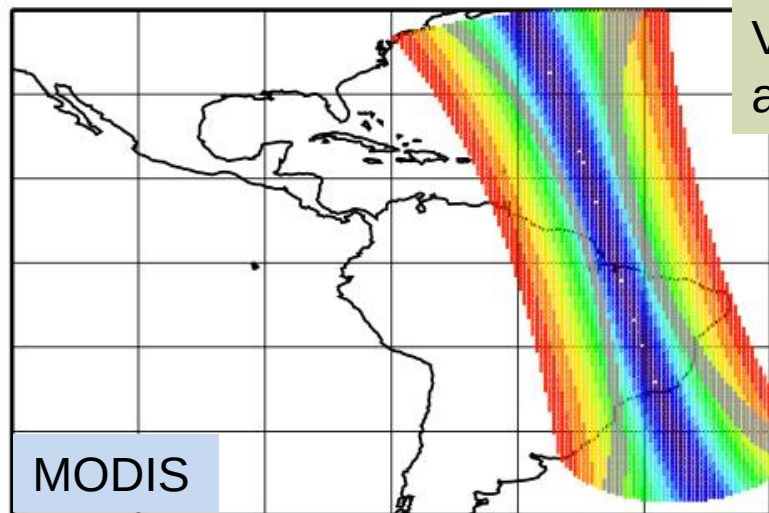


DCC ray-matching

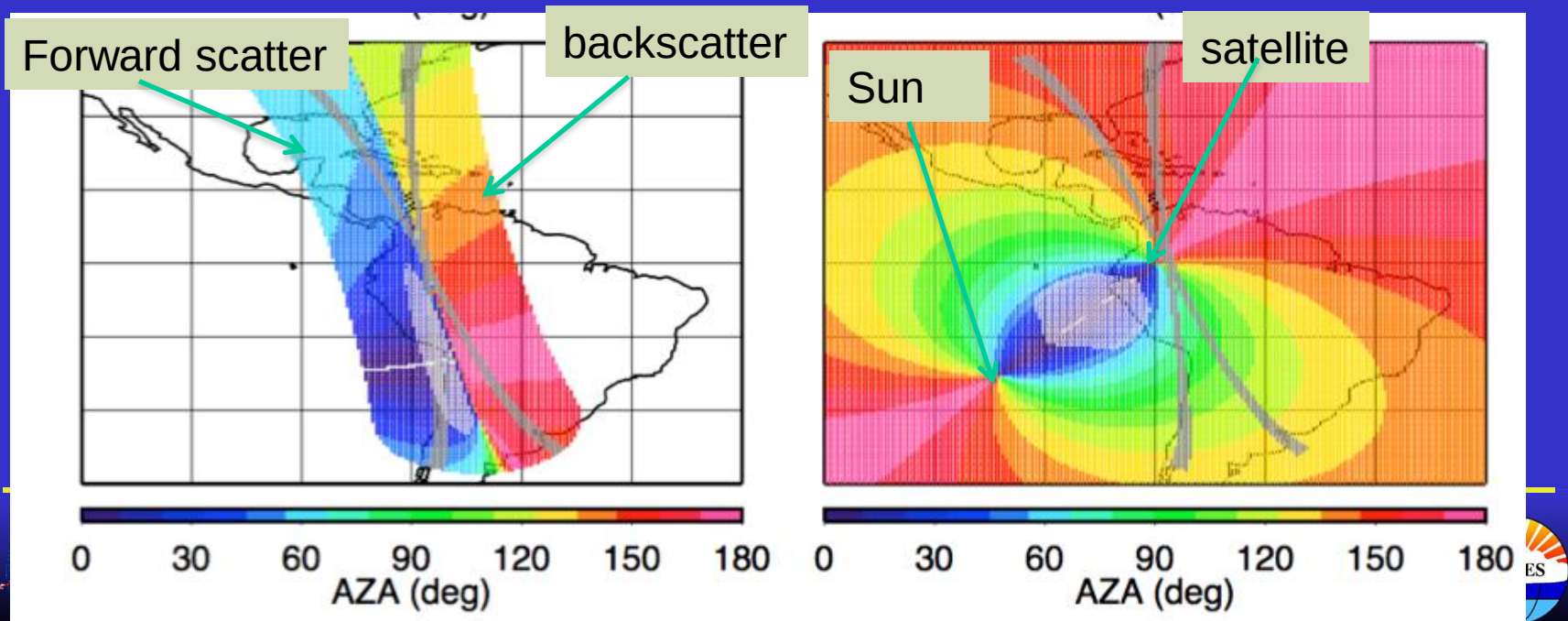
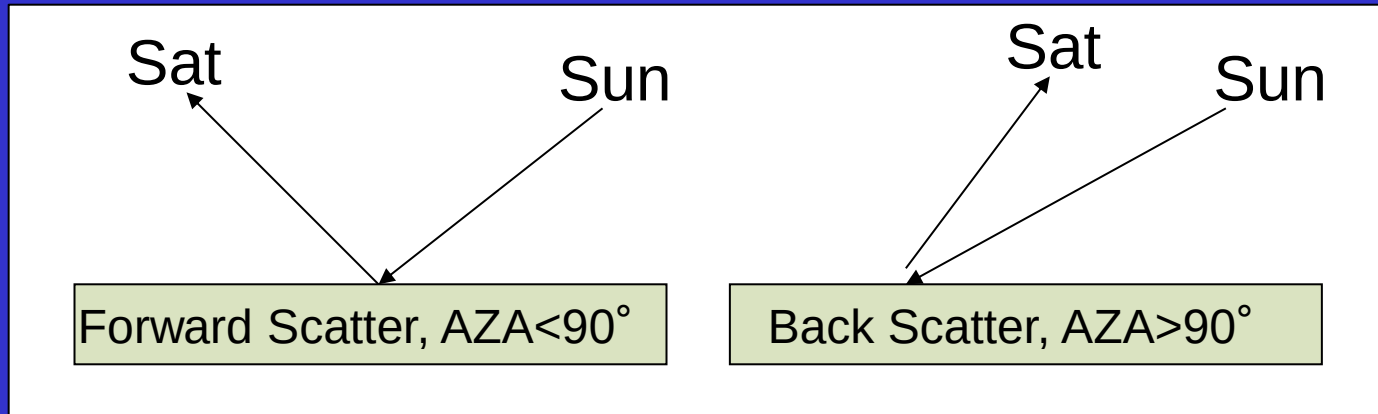
- Identify DCC cells in Aqua 1-km pixel level data
 - Use several cell sizes to find optimum size
 - The mean pixel level temperature $< 205^{\circ}$ K
 - Compute standard deviation of pixel level visible radiances and temperatures of both the core pixels and the adjacent pixels.
 - Using GEO angle prediction software, determine if the MODIS and GEO view and azimuthal angles are within 15°
 - Write out MODIS center latitude and longitude and time
- Based on MODIS time and navigation order GEO images within 15 minutes to compute similar statistics as MODIS
 - To avoid cell overlap over an image, start with the coldest cell and remove adjacent cells within coldest cell
- Regress monthly Aqua-MODIS/GEO visible radiance pairs
 - Use various thresholds and cell sizes to find lowest standard error



img_goes13_aqua_2011_01001_16_ir

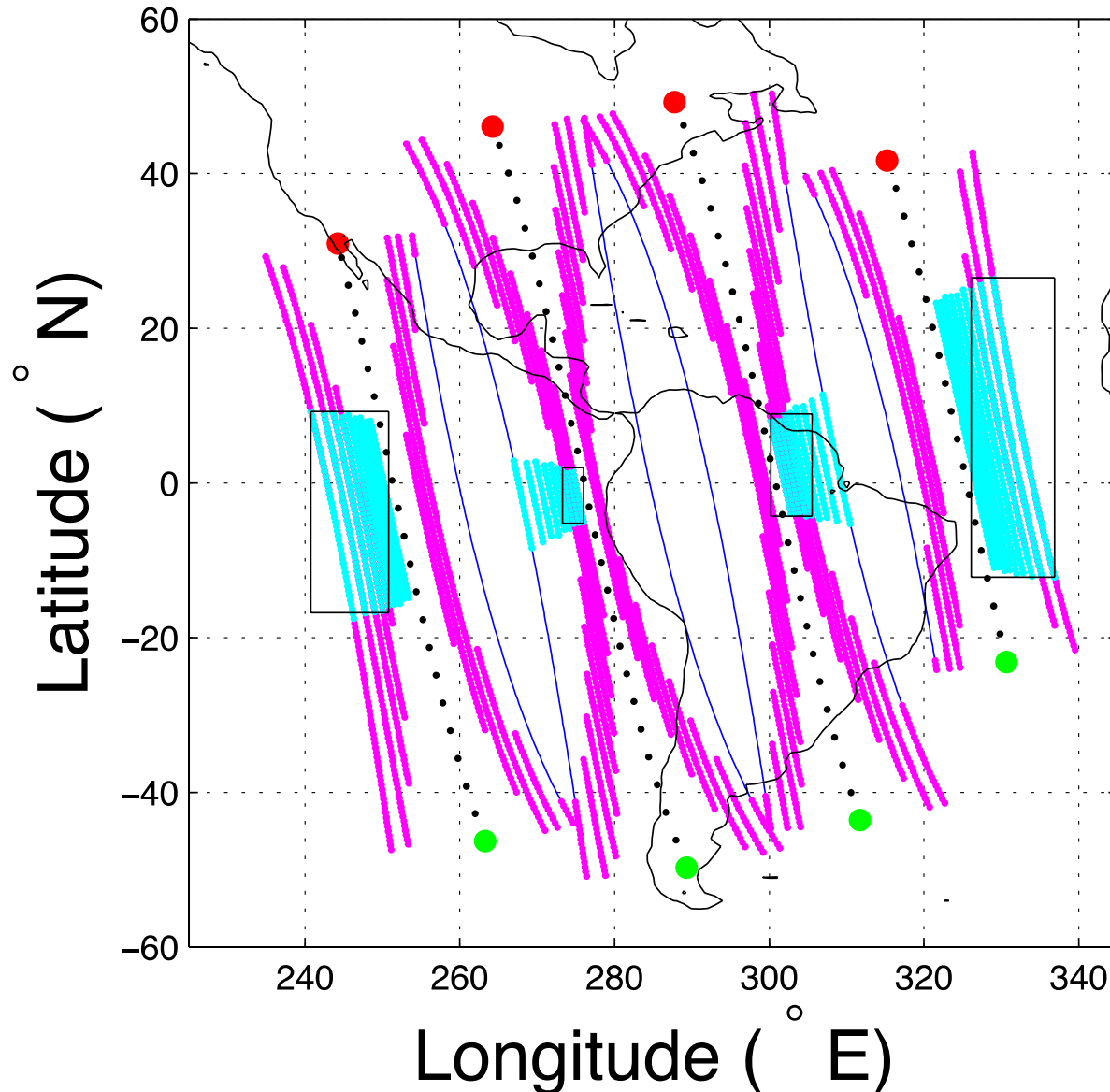


Azimuth angle defined

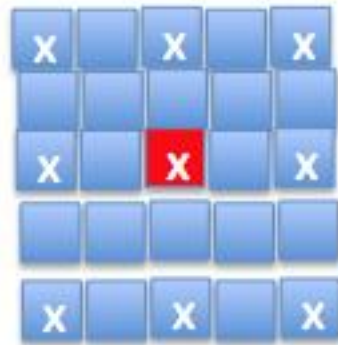


Predictor Enhancements

Aqua vs. GOES 13. Jan 2, 2011

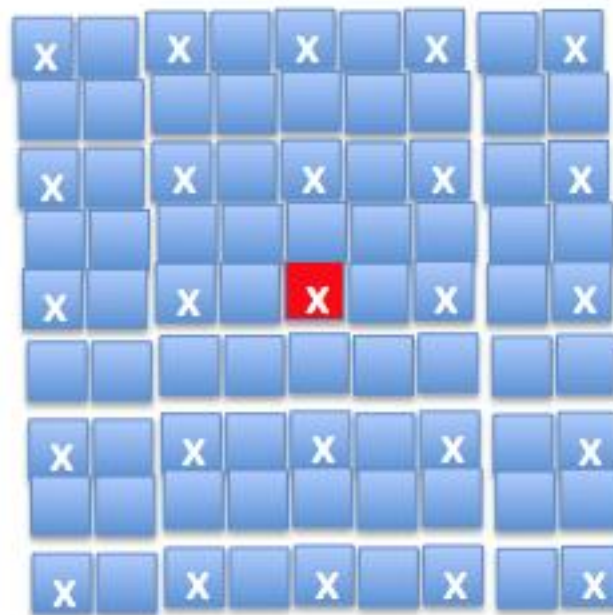


Spatial Matching



5x5km cell

ray3

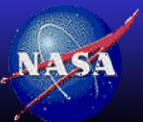


9x9km sigma cell

 MODIS 1-km pixel
Sub-sampled at 2-km

 GEO 1-km VIS pixels

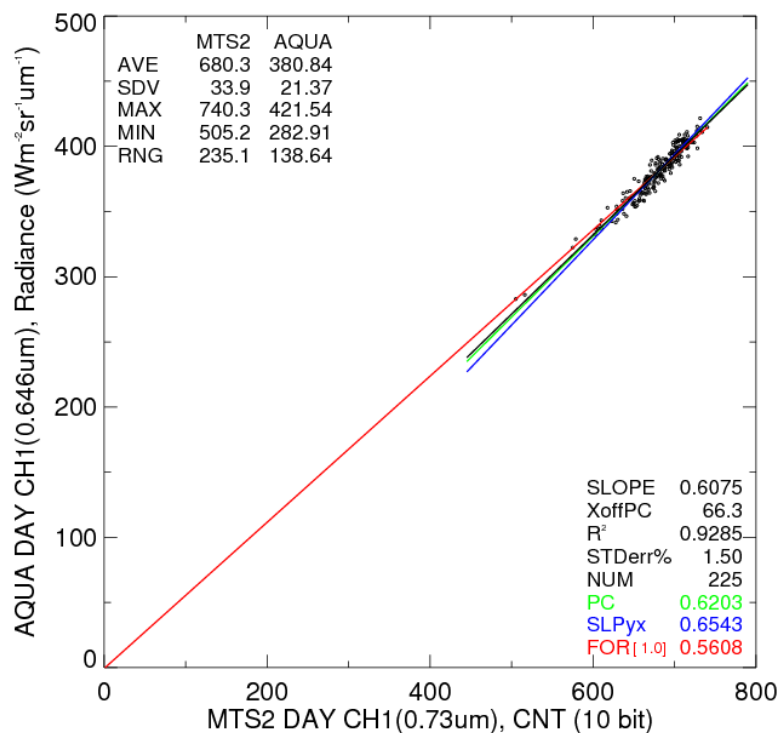
 Center cell pixel



GEO IR image with cell points

DCC MTS2 vs AQUA (SBAF corrected) (C6)

2011_07 DAY 0.646um



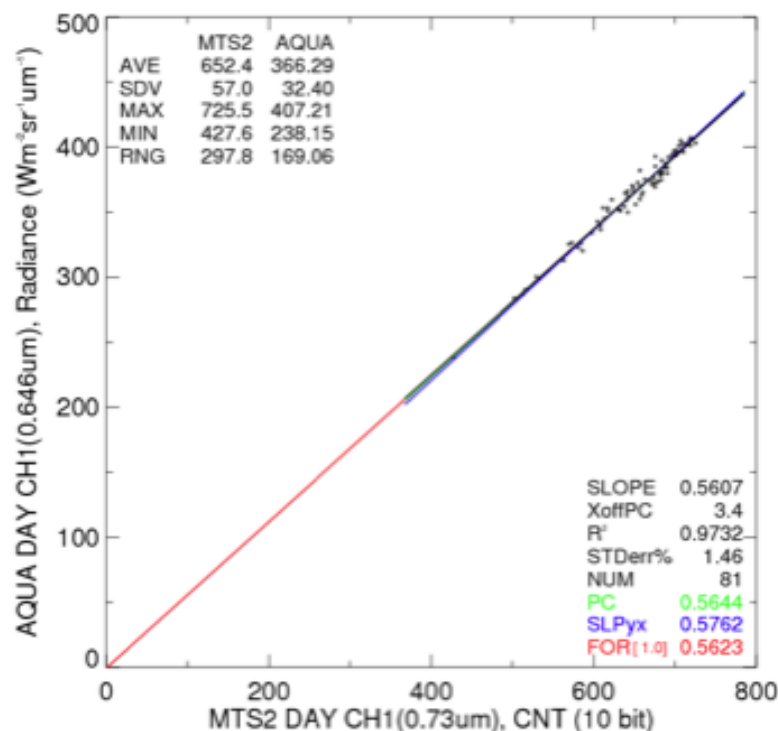
COLD_RAY5

SBAF=3.28000e-05x² +0.929958x + -0.606184

SVS < 0.03, SIGMA_IR < 2.0

DCC MTS2 vs AQUA (SBAF corrected) (C6)

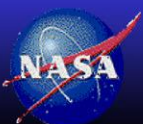
2011_07 DAY 0.646um



COLD_RAY15

SBAF=3.28000e-05x² +0.929958x + -0.606184

SIGMA_IR < 5.0

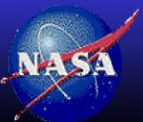


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Optimum threshold table

	ray3	ray9	ray15	Ray5
5° K	2913, 3.33, 0.5651	267,1.93,0.5648	81,1.46,0.5623	994, 2.47, 0.5653
2° K	2050, 2.81,0.5638	112,1.55,0.5632	25,1.08,0.5627	593,2.04,0.5638
1° K	720,2.21,0.5635	19,1.20,0.5633		138,1.68,0.5649
10%	2862,3.00,0.5642	270,1.65,0.5635	75,1.27,0.5622	969,2.20,0.5645
5%	2014,2.29,0.5624	155,1.40,0.5622	39,1.11,0.5600	619, 1.76,5631
3%	1065,2.03,0.5614	45,0.69,0.5608	9,0.44,0.5619	273,1.55,0.5613
15°	3136,3.77,0.5656	326,2.13,0.5657	98,1.49,0.5631	
10°	1926,3.39,0.5658	193,1.80,0.5663	60,1.26,0.5648	
5°	831,3.16,0.5667	81,1.99,0.5669	22,2.06,0.5667	



Conclusions

- Using 30-km DCC cells is similar to using 5-km cells with homogeneity tests in deriving the lowest linear regression standard errors
- All cell sizes and homogeneity thresholds give similar GEO calibration gains within 0.5%
- The DCC ray-matching methodology is more reliable than using the MODIS BRDF corrected mode radiance
 - However, for historical satellite, this is still the only method.

