Section 7
Terra-SRCA Performance

Logistics of Section 7

The materials presented in the Workshop are provided in the electronic copy as Section 7 - JX. The complete materials, including all charts provided in the Workshop Briefing are provided in the electronic copy as Section 7, Background - JX. Charts 3, 4 and 6 in the Workshop Briefing show page references. These page references are pointing to charts in Section 7, Background.

Summary- SRCA Spatial (1)

- ♦ The current co-registration (Day#308, corrected for the difference between the IAC and the SRCA) ranges from -0.12 to 0.08km along-scan and from -0.13 to 0.16km along-track (p.7 - 8).

- ♦ The SRCA spatial tests indicate that the inclination angles of two mirror sides are 2.5 arc-seconds in both along-scan and along-track directions. These angles are the "defects" from parallelism for the mirror sides (p.9).

- ♦ The SRCA test data confirm that the Focal Plane Assembly (FPA) behave as rigid bodies, shifting at the 10m range, but do exhibit some variation from prelaunch Nominal plateau co-registration. Changes in electronic X-talk due to different I_{twk}/V_{det} configurations are apparent (p.10 - 12).

Summary- SRCA Spatial (2)

- After the first 80 days on-orbit the FPA positions are stabilized. In comparison with prelaunch at Nominal plateau, the FPA shifts are (relative to band 1on Day#308 (p.13 - 14):

	VIS	NIR	SMWIR	LWIR
Along-scan (m)	-11	-1	13	-31
Along-track (m)	36	-10	-45	-57

- We see no variation in registration patterns between electronic A-side and B-side electronics at I_{twk}/V_{det} of 79/110, to within our measurement resolution of about 5m or less (p.15 - 18).

- The detector/band shifts at eight positions along the orbit show that the SMWIR FPA has a 7m variation and LWIR FPA has a 16m variation (relative to band 2, VIS FPA is not available due to low SNR) (p.19 - 21).

Housekeeping information about the SRCA spatial testing

- The SRCA full spatial is executed in Operational Activity (OA-23) which measures the detector position shifts in along-scan direction and band centroid shifts in along-track direction.
- OA-24 measures the shifts only in along-scan direction.
- OA-25 measures shifts in along-scan direction with 1W lamp on. This OA allows to measure the possible FPA shifts at different positions of one-orbit.
- Eleven tests have been operated but with seven data sets available for side A. The data lost are mainly at the beginning of MODIS operation.
- One test for the spatial mode along-scan has been operated at eight orbit positions.

Summary - SRCA Spectral

- The SRCA monochromator parameters: half angle between incident and exit beam, β, and grating motor offset angle, θ_{off}, determine the wavelength scale, grating angle (degree) vs. wavelength, λ. Test data indicate these two parameters are stable (p.25).

- Three shape peaks of didymium filter are utilized as wavelength calibrators so that the SRCA is capable of wavelength self-calibration.

- The band center wavelengths have limited change of ±0.15 nm for $\lambda<1\mu m$(required by the specification) for bands 9 - 19 (p.26 - 33).

- Band 8 response profiles show some changes on-orbit but are similar to prelaunch Valley Forge results (p.34 - 36).

- The spectral calibration should not depend upon the sides of electronics. Due to the limitation of data sets, it is difficult to evaluate the effect of side switching on the center wavelength shifts.

- A radiance uncertainty of ±0.3% will be introduced if the prelaunch response is utilized (p.37).

SRCA operation in spectral mode

- The SRCA spectral mode is operated in spacecraft darkness so that the noise level of the reference SiPD signal keeps prelaunch level.

- Complete data set of 2 × 8-10 granules are needed to determine the self-calibrated wavelength scale and to depict the detector responses for nearly half number of the MODIS bands. Any disruption of the data collection/transferring may cause failure to the calibration. We have incomplete data for Day#70, 77, 112, 133, and 216.

- Six test data sets are available: Day#049 (30W and 10W), 061 (30W and 10W), 091 (10W only), 161(30W and 10W), 189 (30W and 10W), and 329 (30W and 10W) (Side B).

Comparison of band 8 response profiles measured by the SRCA

- Band response reconstruction approach is applied to monitor possible change in the spectral response profile. The slit function of the SRCA is calculated using Fourier Transform technique by comparison of the test responses between the SpMA and the SRCA Nominal plateau and is assumed unchanged on-orbit.

- The center wavelength shifts for band 8 show evident variation over channels. One of the motivations can be the low SNR in the measurement of their responses.

- We observed that the center wavelength shift does not change evidently for Day# 061, 161, and 189 but a bias exists between orbit Day#189 (side A) and Day#329 (Side B) because of a raising of the sub-peak response at shorter wavelength region.

- The response profiles on-orbit are similar to that for Valley Forge Cold/Hot plateaus.

- Further monitoring and interpretation of the change are necessary.

Section 7, Background
Terra-SRCA Performance

Logistics of Section 7

The materials presented in the Workshop are provided in the electronic copy as Section 7 - JX. The complete materials, including all charts provided in the Workshop Briefing are provided in the electronic copy as Section 7, Background - JX.

SRCA in spatial mode

Summary- SRCA Spatial (1)

- The current co-registration (Day#308, corrected for the difference between the IAC and the SRCA) ranges from -0.12 to 0.08km along-scan and from -0.13 to 0.16km along-track (p.7 - 8).

- The SRCA spatial tests indicate that the inclination angles of two mirror sides are 2.5 arc-seconds in both along-scan and along-track directions. These angles are the “defects” from parallelism for the mirror sides (p.9).

- The SRCA test data confirm that the Focal Plane Assembly (FPA) behave as rigid bodies, shifting at the 10m range, but do exhibit some variation from prelaunch Nominal plateau co-registration. Changes in electronic X-talk due to different I_{twk}/V_{det} configurations are apparent (p.10 - 12).

Summary- SRCA Spatial (2)

- After the first 80 days on-orbit the FPA positions are stabilized. In comparison with prelaunch at Nominal plateau, the FPA shifts are (relative to band 1on Day#308 (p.13 - 14):

	VIS	NIR	SMWIR	LWIR
Along-scan (m)	-11	-1	13	-31
Along-track (m)	36	-10	-45	-57

- We see no variation in registration patterns between electronic A-side and B-side electronics at I_{twk}/V_{det} of 79/110, to within our measurement resolution of about 5m or less (p.15 - 18).

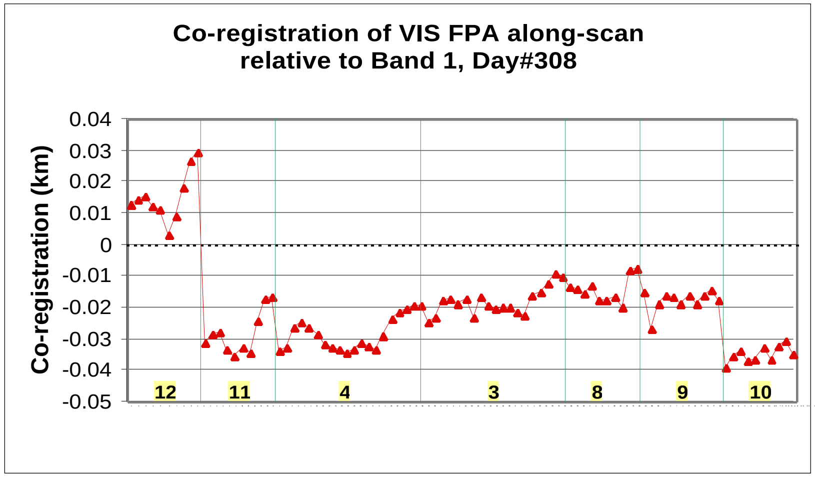
- The detector/band shifts at eight positions along the orbit show that the SMWIR FPA has a 7m variation and LWIR FPA has a 16m variation (relative to band 2, VIS FPA is not available due to low SNR) (p.19 - 21).

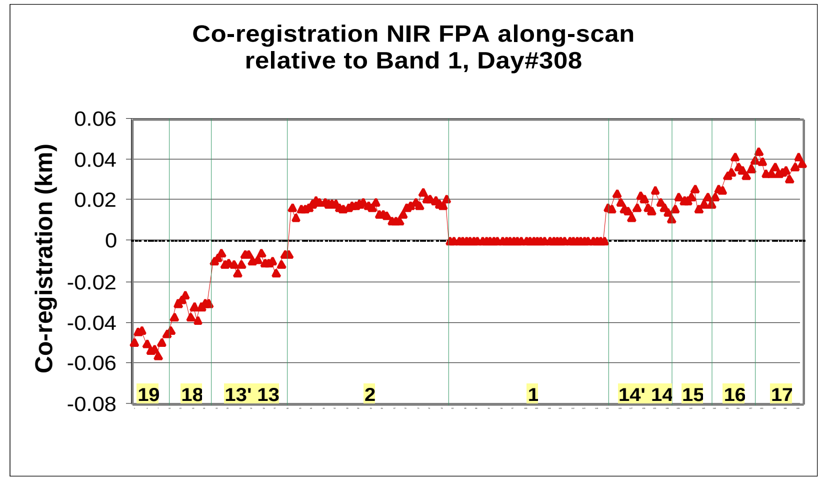
Housekeeping information about the SRCA spatial testing

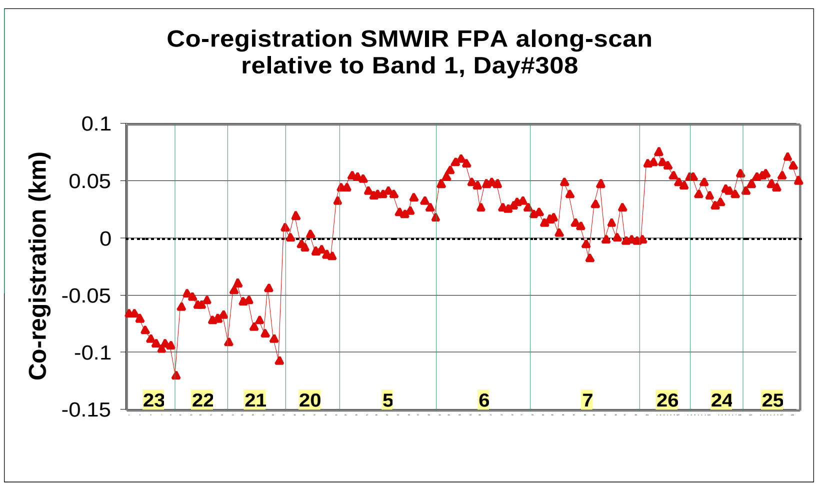
- The SRCA full spatial is executed in Operational Activity (OA-23) which measures the detector position shifts in along-scan direction and band centroid shifts in along-track direction.
- OA-24 measures the shifts only in along-scan direction.
- OA-25 measures shifts in along-scan direction with 1W lamp on. This OA allows to measure the possible FPA shifts at different positions of one-orbit.
- Eleven tests have been operated but with seven data sets available for side A. The data lost are mainly at the beginning of MODIS operation.
- One test for the spatial mode along-scan has been operated at eight orbit positions.

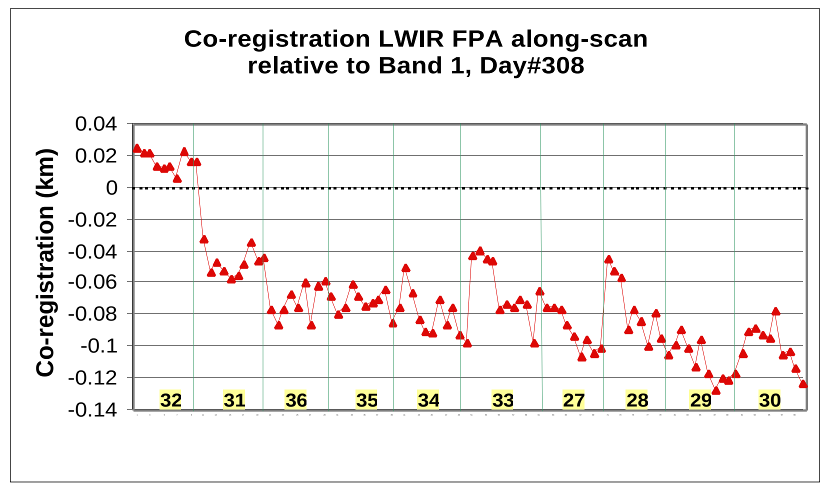
Updated co-registration along-scan

The co-registration on-orbit along-scan ranges between -0.12 to +0.08km.



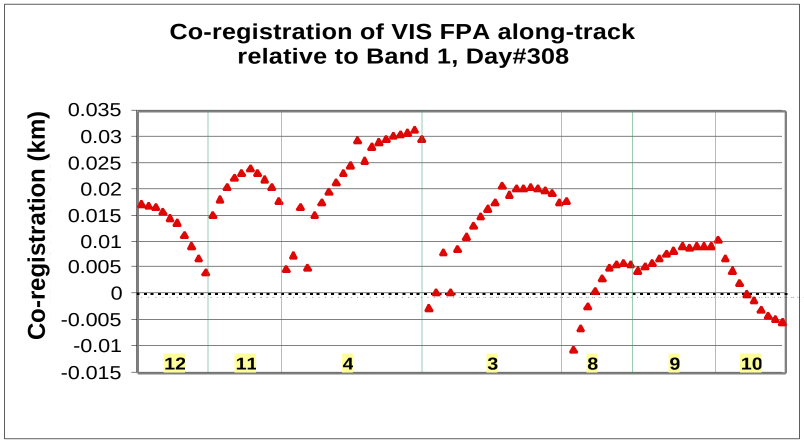


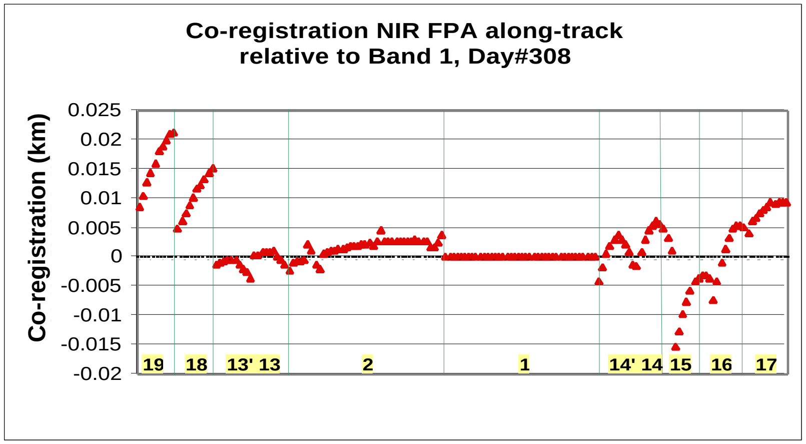


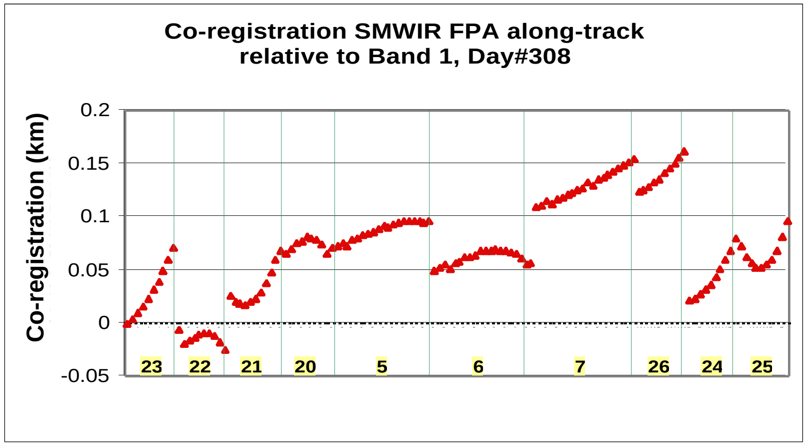


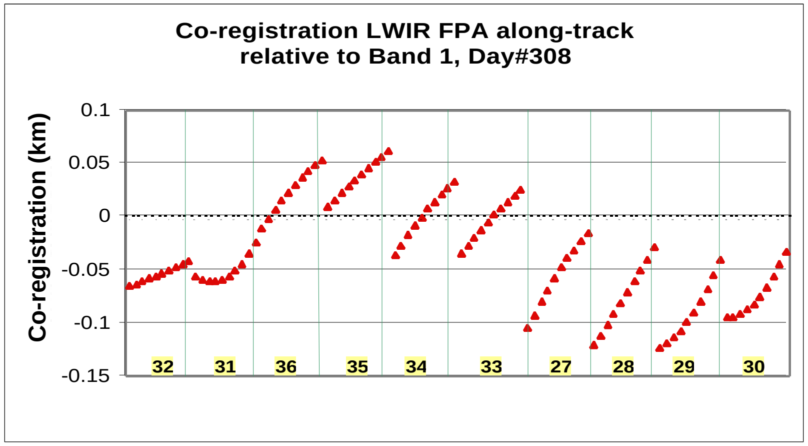
Up-dated co-registration along-track

- ♦ The co-registration on-orbit along-track ranges between -0.13 to +0.16km.
- ♦ The IAC tested limited number of detectors. The co-registration values for the others are interpolated ones by using other test sources.



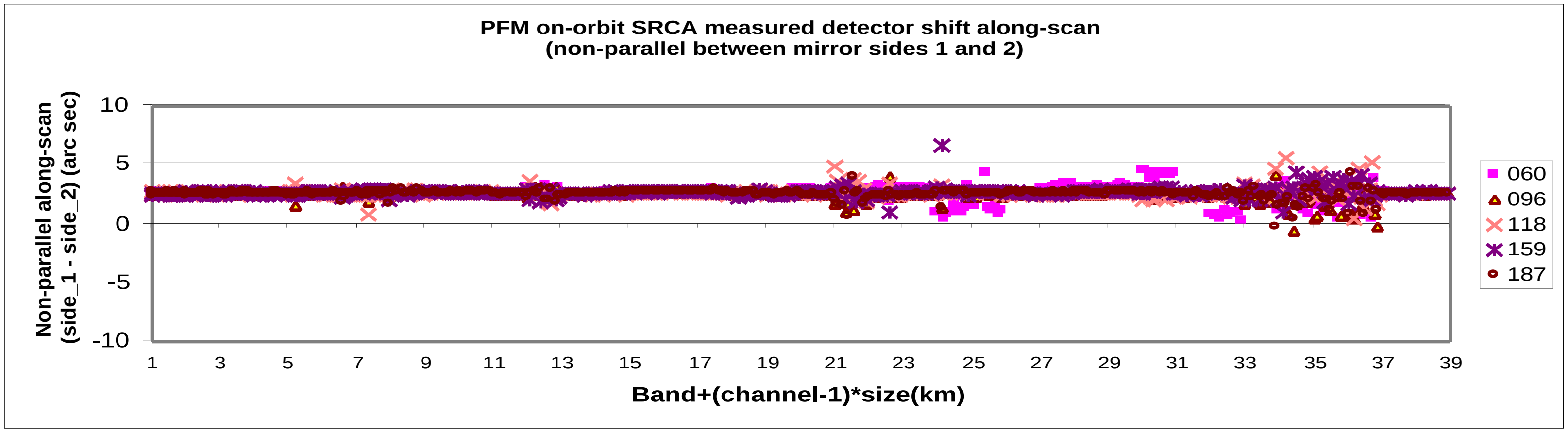


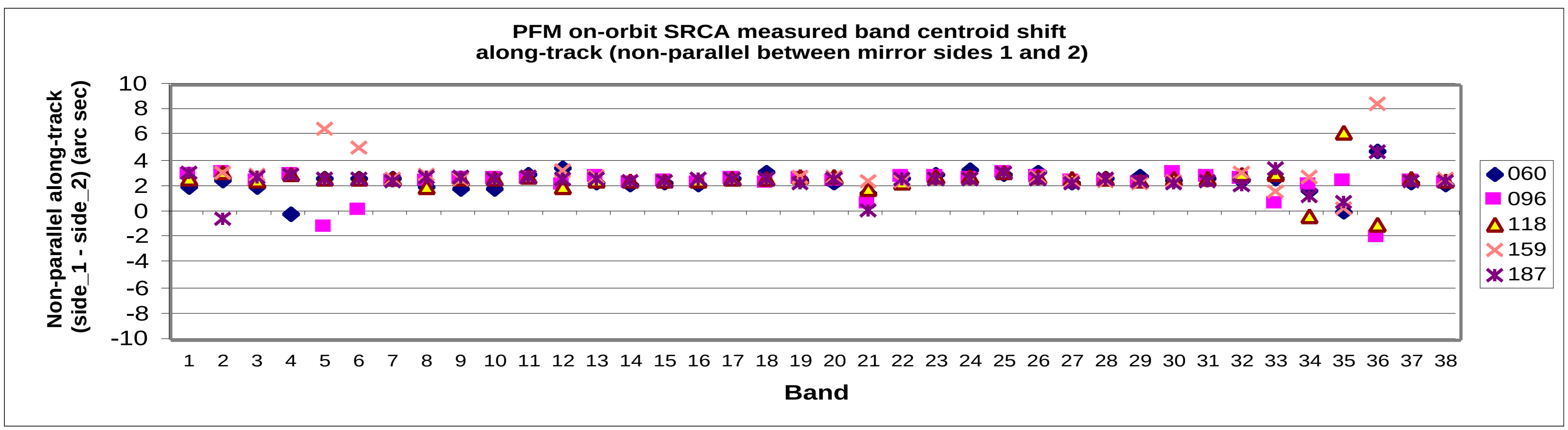




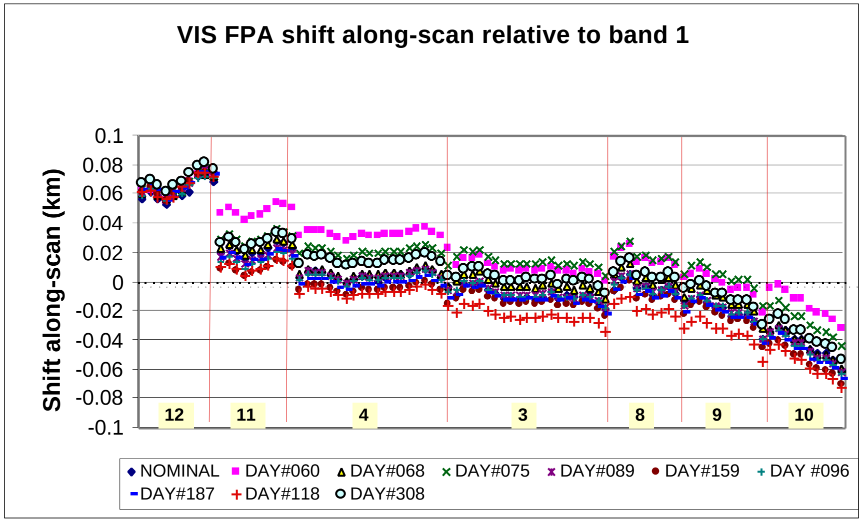
Mirror side inclination

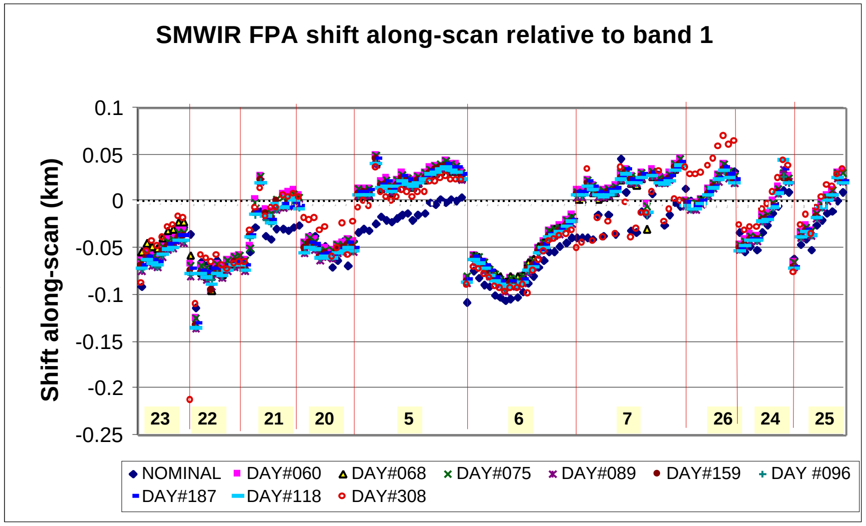
♦ The inclination angles between the two mirror sides are 2.5 arc-second along-scan and 2.5 arc-second along-track.

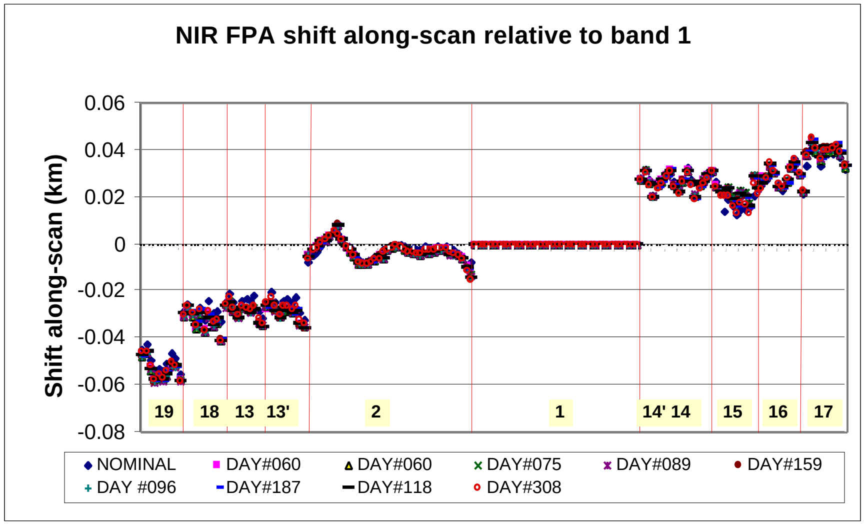


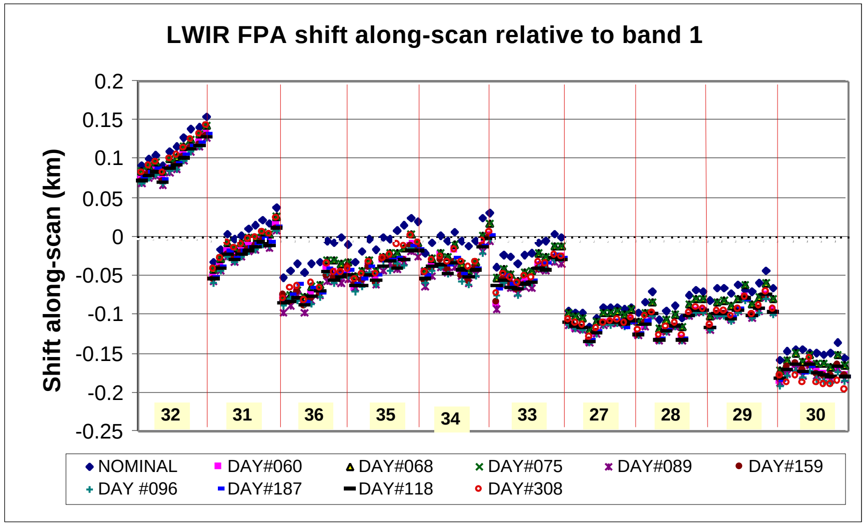


Detector position shifts along-scan measured by the SRCA



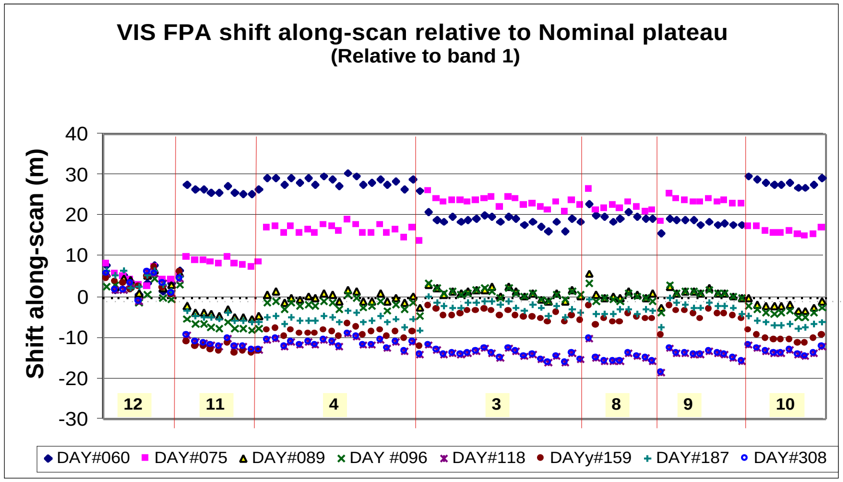


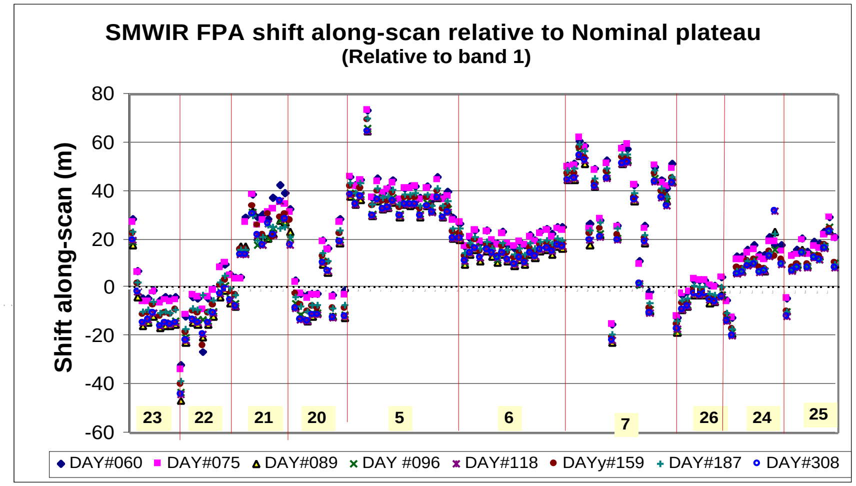


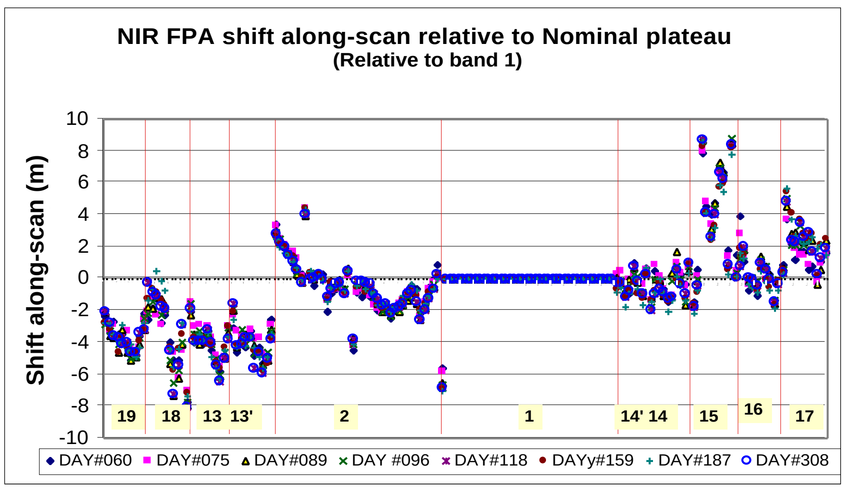


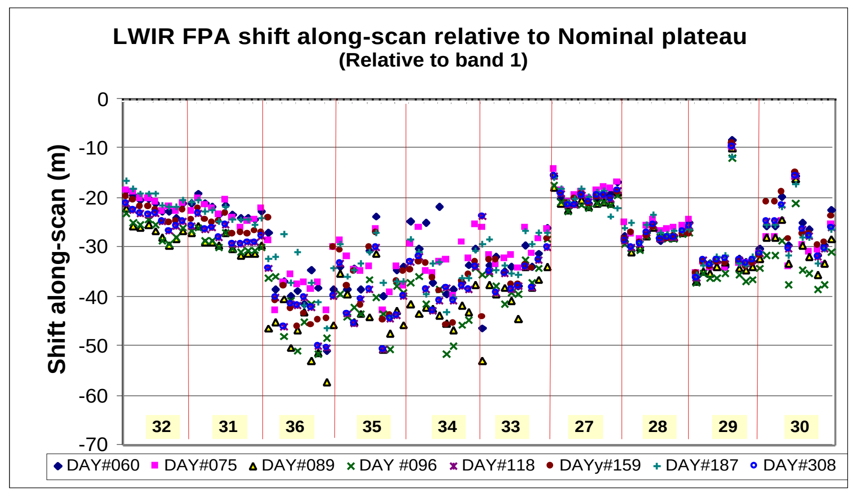
Detector position shifts along-scan relative to prelaunch Nominal plateau

♦ The detector shift pattern is well followed up after MODIS was stabilized on-orbit.

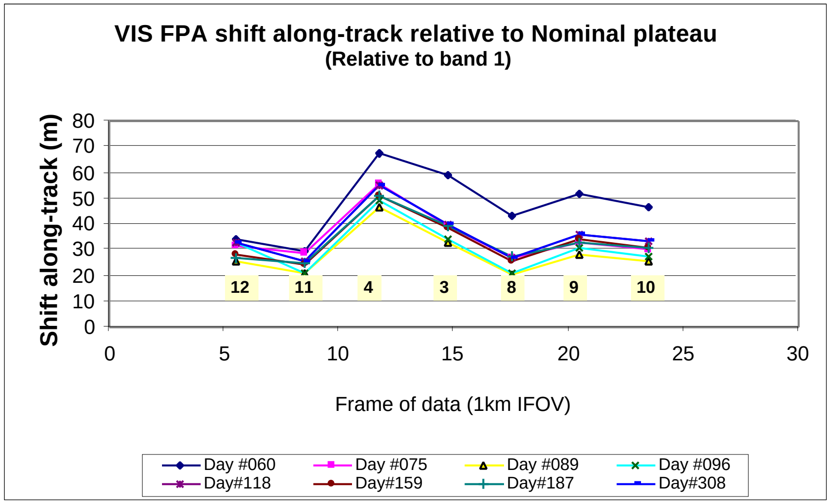


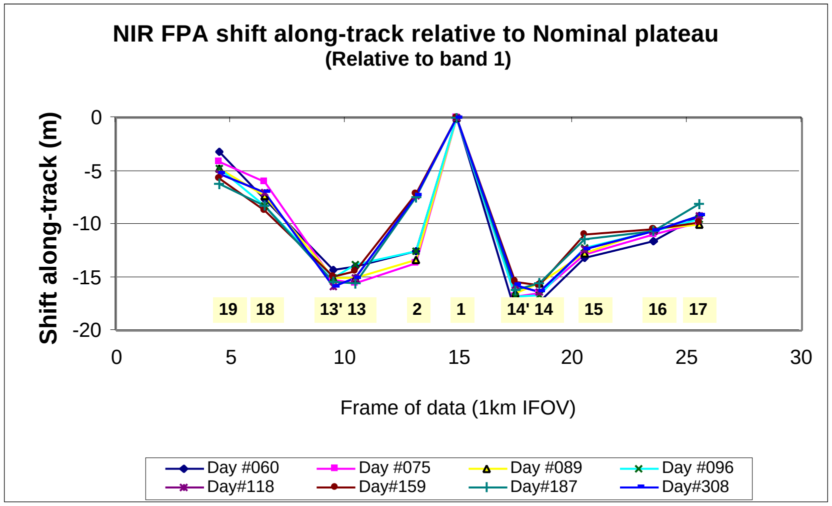


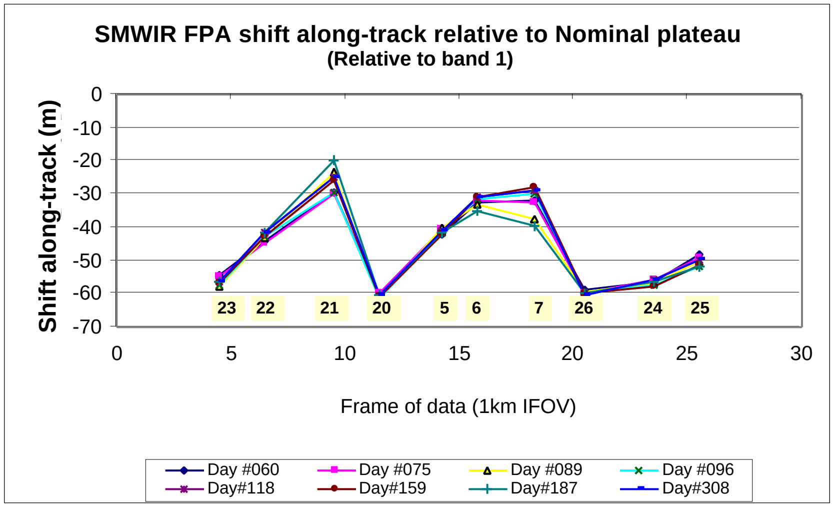


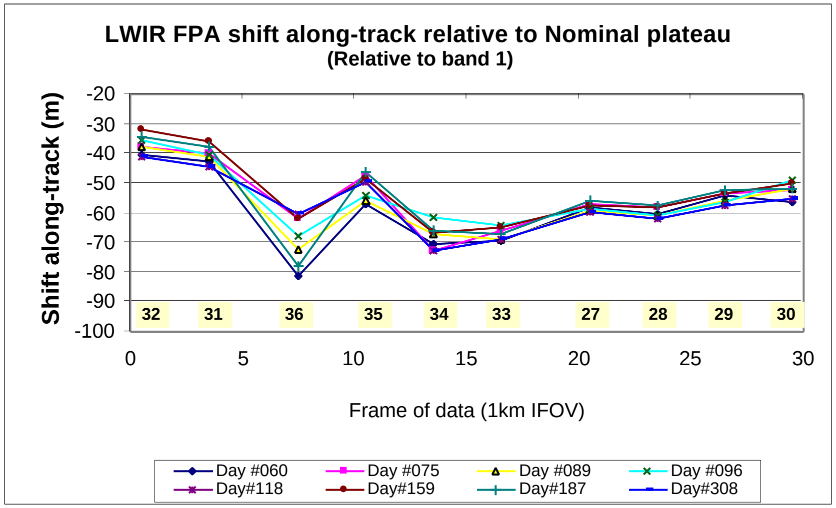


Band centroid shifts along-track relative to prelaunch Nominal plateau

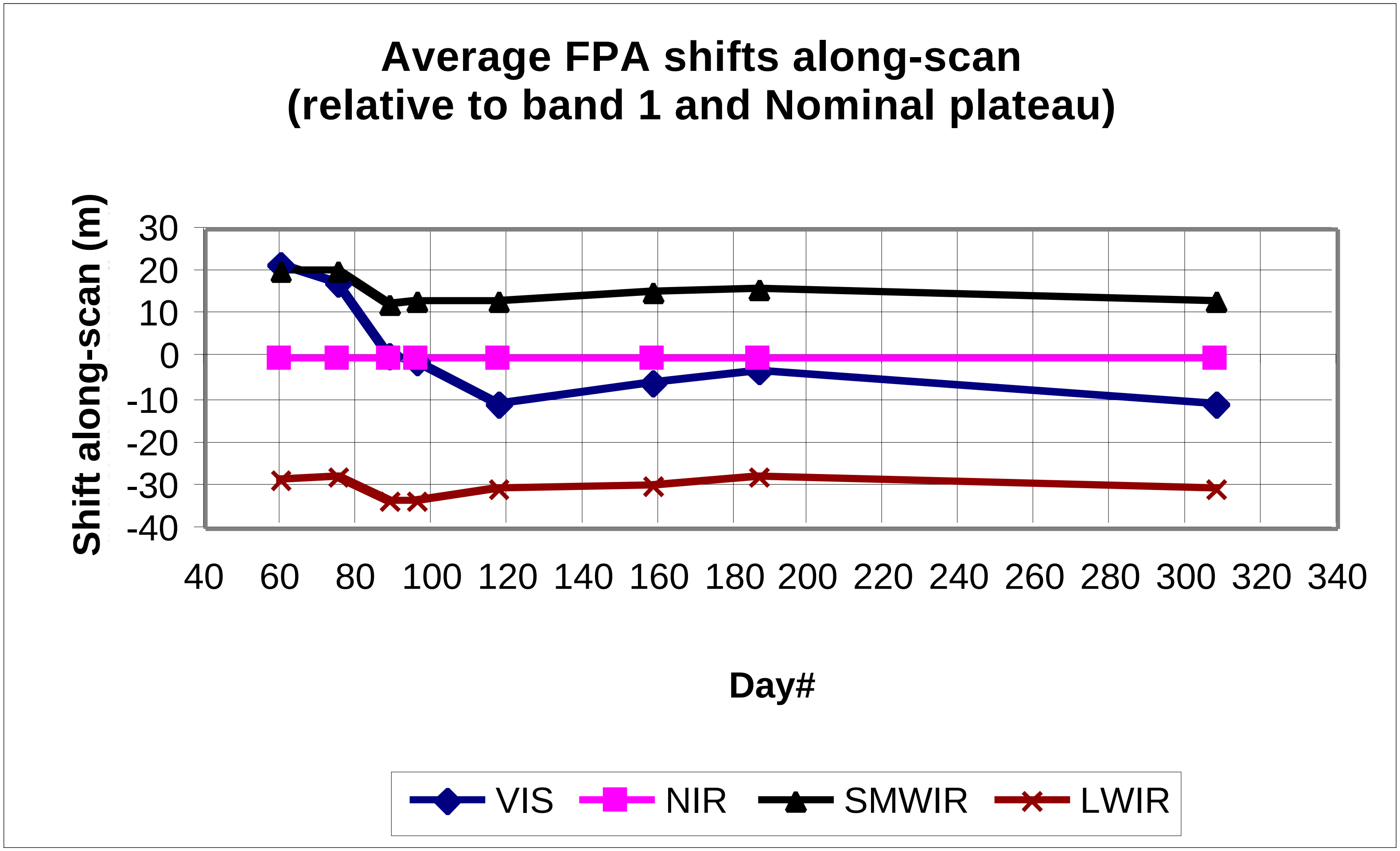




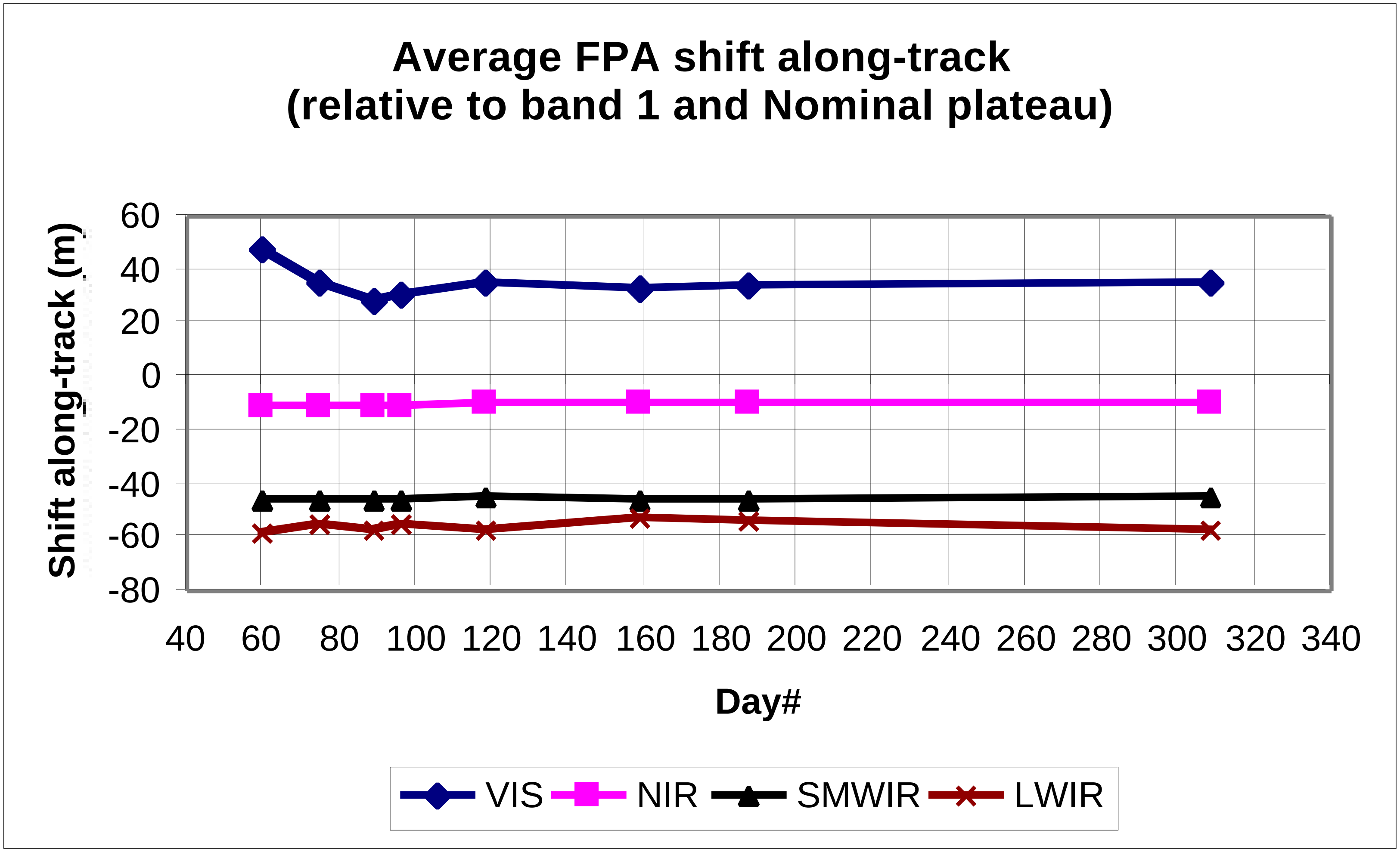




FPA shifts along-scan relative to prelaunch Nominal plateau

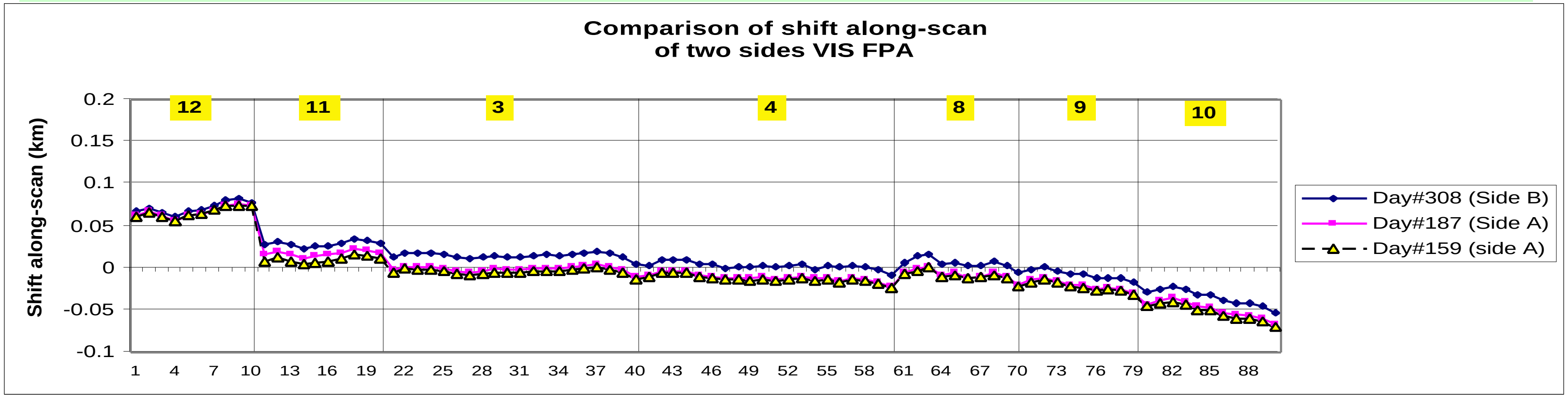


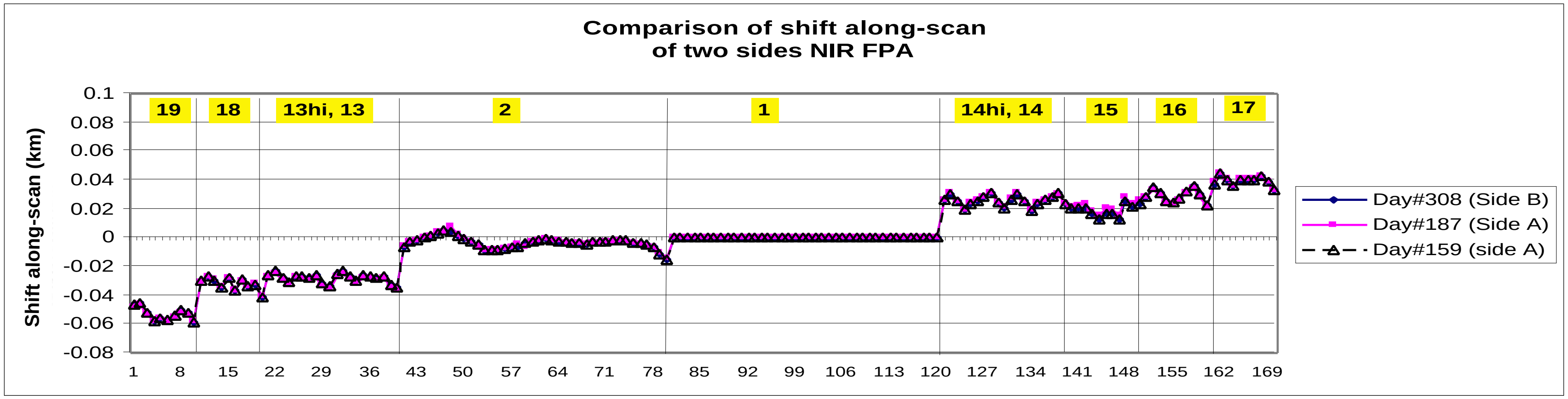
FPA shifts along-track relative to prelaunch Nominal plateau



Comparison of shifts along-scan for both electronic sides

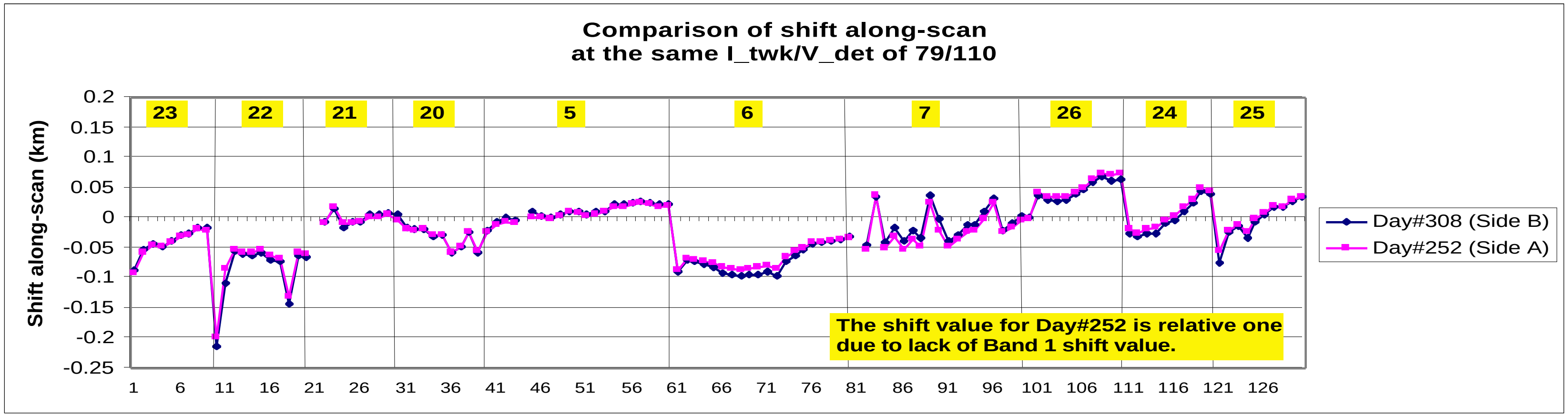
- The detector shift patterns along-scan for both VIS and NIR FPAs have a minimum change. It is difficult to judge that VIS FPA shift is due to electronics side change because the data sets for comparison are 150 days apart.

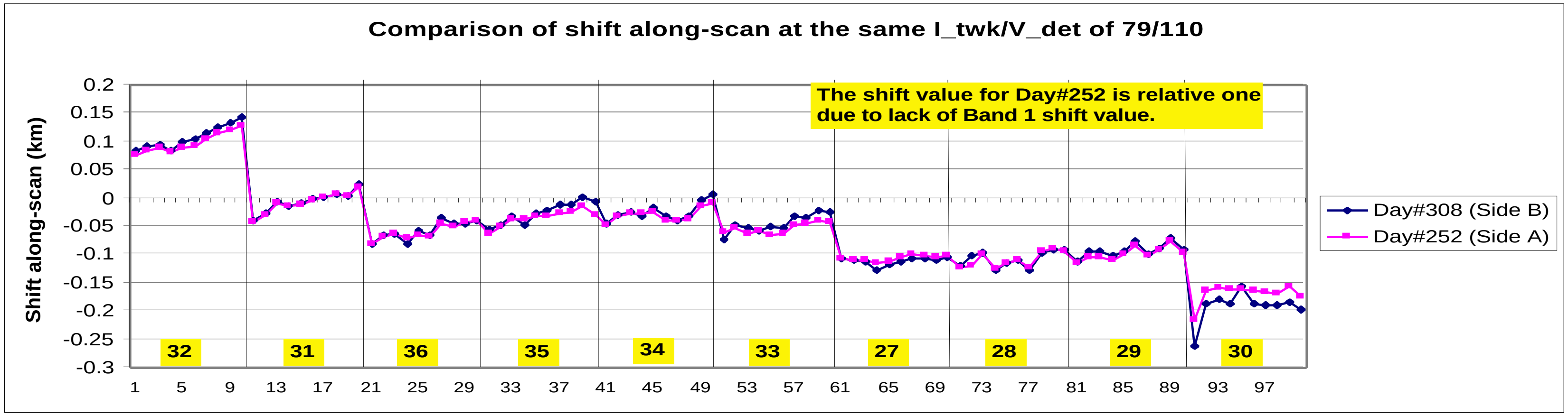




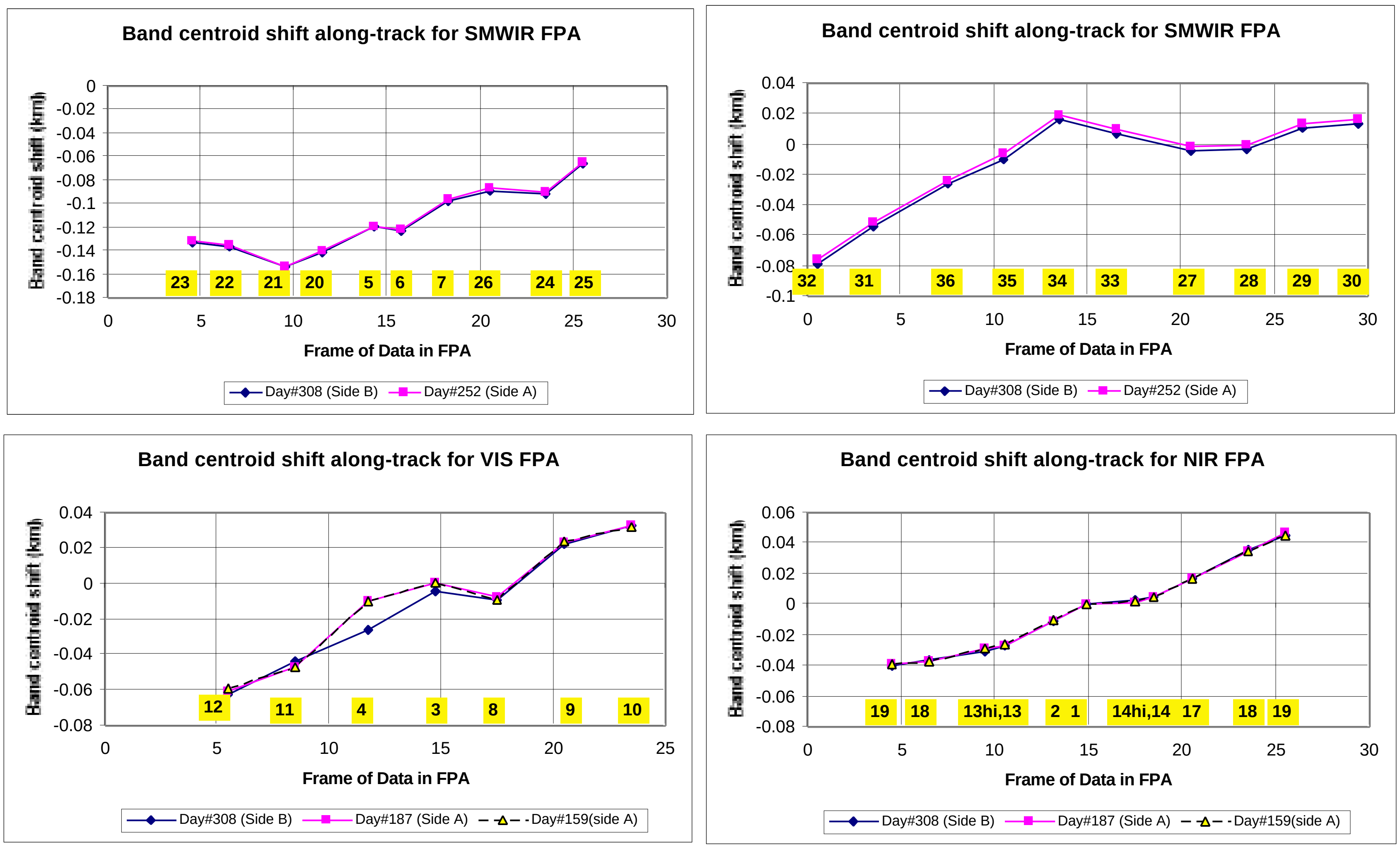
Comparison of shifts along-scan for both electronic sides (SMWIR and LWIR for the same I_{twk}/V_{det})

♦ Switching the sides of electronics causes a minimum change to the detector position shifts except for band 30.





Comparison of shifts along-track for both electronic sides (SMWIR and LWIR for the same I_{twk}/V_{det})



Comparison of shifts along-track for both electronic sides summary

- The band averaged shift changes are

Along-scan ---- 11.0m for VIS FPA, 0.0m for NIR FPA,
0.4m for SMWIR FPA, -1.4m for LWIR FPA

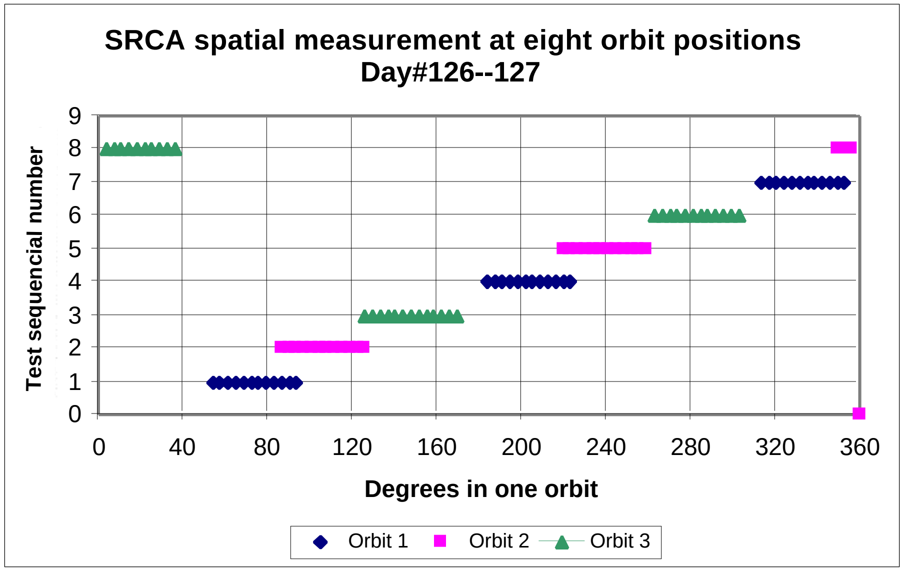
Along-track ---- 0.0m for VIS FPA*, 0.0m for NIR FPA,
1.1m for SMWIR FPA, 2.8m for LWIR FPA

***** -- Except for band 4 where the shift along-track is differed for side B.***

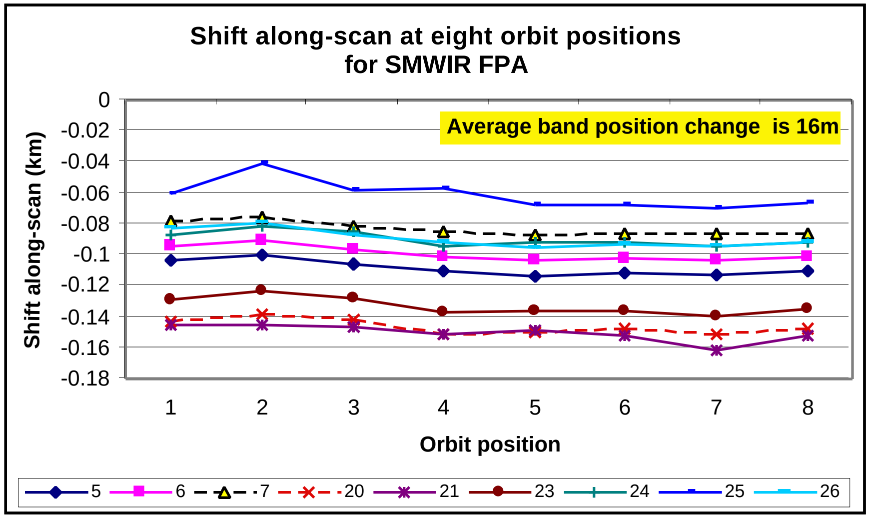
Operation of SRCA spatial along-scan at different positions in an orbit

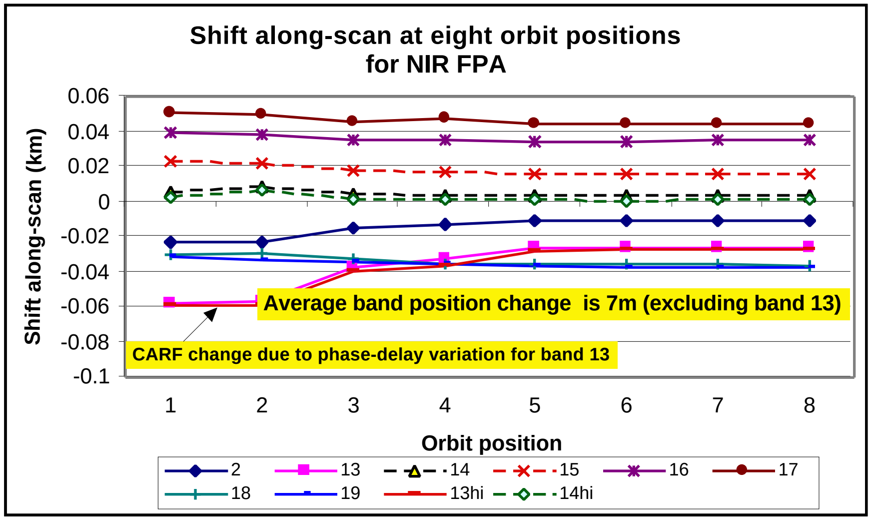
- Thermal constrains for the SRCA precluded setting all positions within an orbit for a single orbit. Three consecutive orbits were used here.
- The SRCA IR source (395K) and 1W lamp are on.

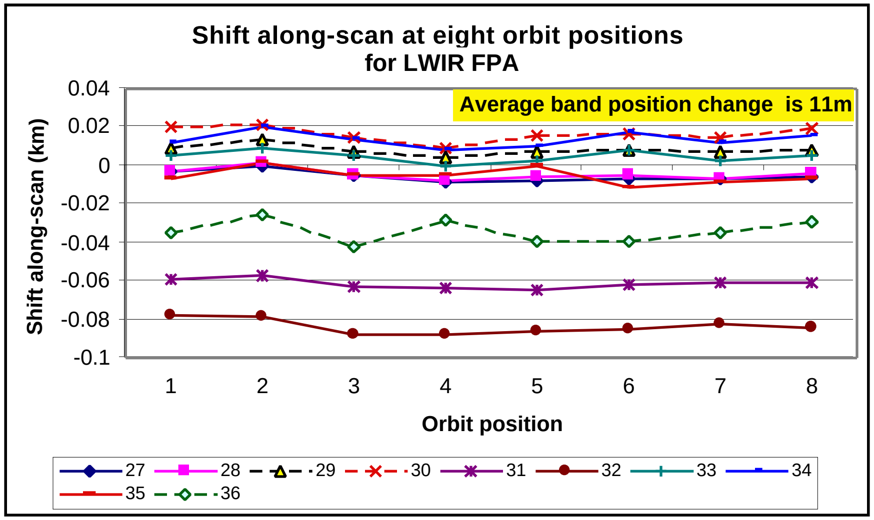
Test sequence	Date		Post	Start	End	
1	5-May	126	0	22:53:49	23:20:26	Day mode
4	6-May	127	1	0:45:03	1:11:40	Day mode
7	6-May	127	2	2:36:17	3:02:54	Day mode
2	5-May	126	3	23:30:52	23:57:29	Day mode
5	6-May	127	4	1:22:06	1:48:43	Day mode
8	6-May	127	5	3:13:20	3:39:57	Night mode
3	6-May	127	6	0:07:55	0:34:32	Night mode
6	6-May	127	7	1:59:09	2:25:46	Night mode



Comparison of shifts along-scan at different positions in an orbit







- **The averaged band position changes are: 7m (NIR FPA); 16m (SMWIR FPA); 11m (LWIR FPA)**
- **VIS FPA data are not available due to low signal under 1W lamp illumination.**

SRCA in spectral mode

Summary - SRCA Spectral

- **The SRCA monochromator parameters: half angle between incident and exit beam, β, and grating motor offset angle, θ_{off}, determine the wavelength scale, grating angle (degree) vs. wavelength, λ. Test data indicate these two parameters are stable (p.25).**

- **Three shape peaks of didymium filter are utilized as wavelength calibrators so that the SRCA is capable of wavelength self-calibration.**

- **The band center wavelengths have limited change of ±0.15 nm for λ<1μm(required by the specification) for bands 9 - 19 (p.26 - 33).**

- **Band 8 response profiles show some changes on-orbit but are similar to prelaunch Valley Forge results (p.34 - 36).**

- **The spectral calibration should not depend upon the sides of electronics. Due to the limitation of data sets, it is difficult to evaluate the effect of side switching on the center wavelength shifts.**

- **A radiance uncertainty of ±0.3% will be introduced if the prelaunch response is utilized (p.37).**

SRCA operation in spectral mode

- The SRCA spectral mode is operated in spacecraft darkness so that the noise level of the reference SiPD signal keeps prelaunch level.

- Complete data set of 2 × 8-10 granules are needed to determine the self-calibrated wavelength scale and to depict the detector responses for nearly half number of the MODIS bands. Any disruption of the data collection/transferring may cause failure to the calibration. We have incomplete data for Day#70, 77, 112, 133, and 216.

- Six test data sets are available: Day#049 (30W and 10W), 061 (30W and 10W), 091 (10W only), 161(30W and 10W), 189 (30W and 10W), and 329 (30W and 10W) (Side B).

Stability of the monochromator parameters

- The nominal values of the two monochromator parameters are: $\beta = 15°$ and $\theta_{off} = 0°$.
- The measured two parameters provide wavelength self-calibration to the SRCA monochromator by

$$\lambda = \frac{2A}{m}\sin(\theta + \theta_{off})\cos\beta$$

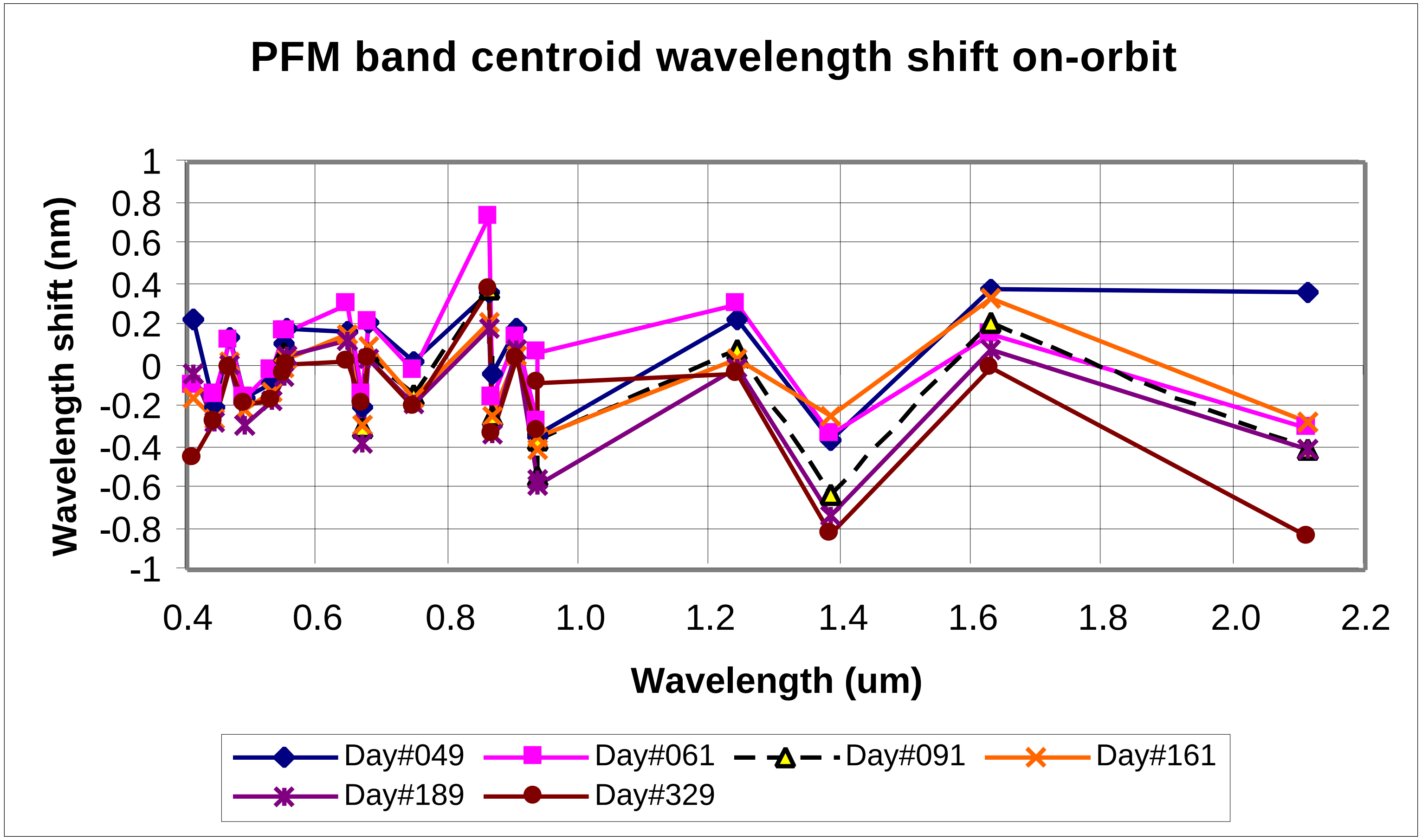
Where λ is the wavelength of monochromatic beam corresponding to grating angle of θ; A is grating spacing; and m is diffraction order.

PFM SRCA monochromator parameters

Test case	β	θ_off
Day#049, 30W	14.996	0.001
Day#049, 10W	15.033	0.003
Day#061, 30W	15.049	0.003
Day#061, 10W	15.146	0.006
Day#091, 30W		
Day#091, 10W	15.079	0.004
Day#161, 30W	15.052	0.004
Day#161, 10W	15.026	0.002
Day#189, 30W	15.051	0.004
Day#189, 10W	15.053	0.003
Day#329, 30W	15.043	0.004
Day#329, 10W	15.098	0.005

Band averaged center wavelength shifts on-orbit

- The measured band average center wavelength shift varies within ±0.15nm (λ<1μm) for bands 9 - 19.

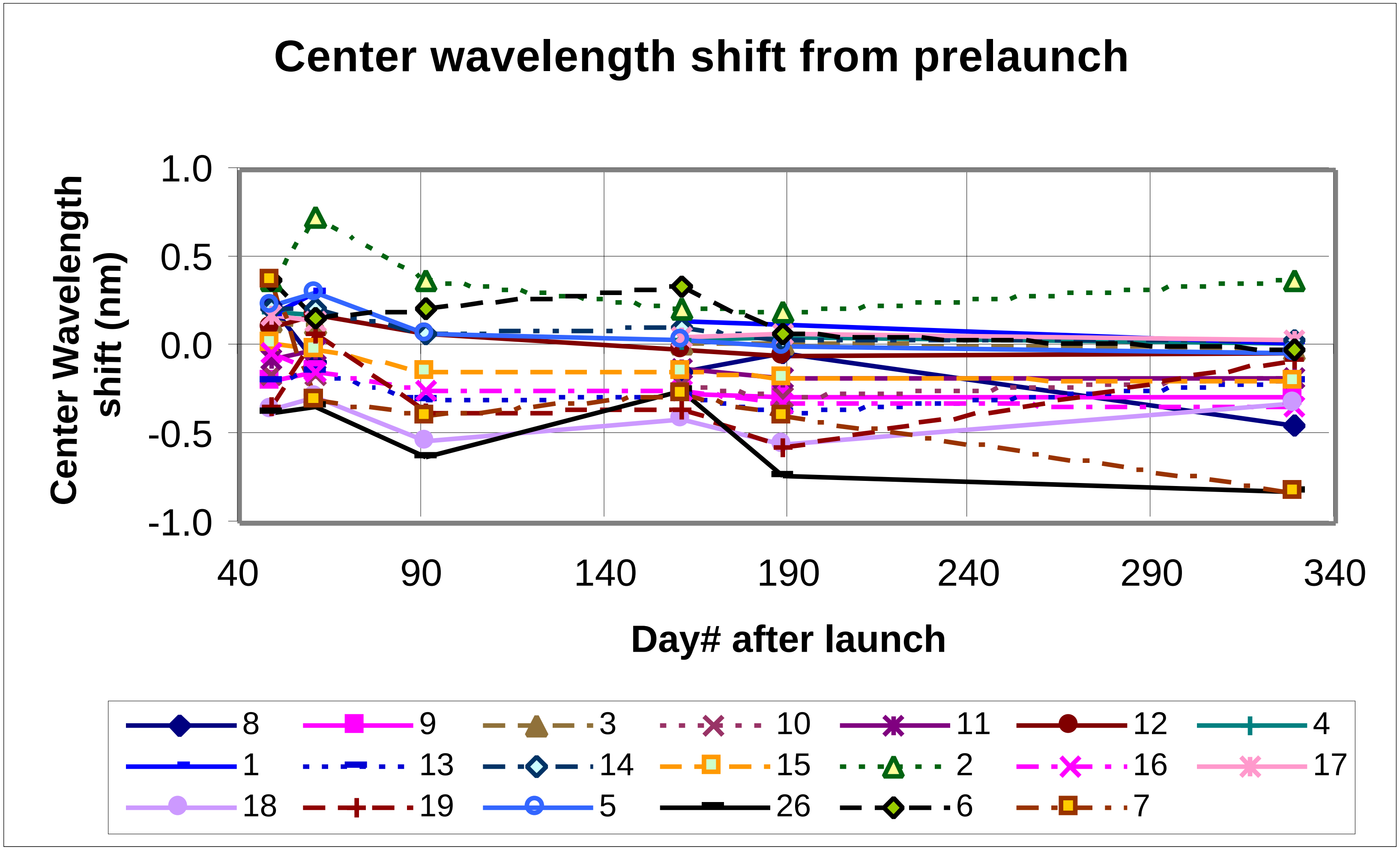


Band averaged center wavelength shifts on-orbit

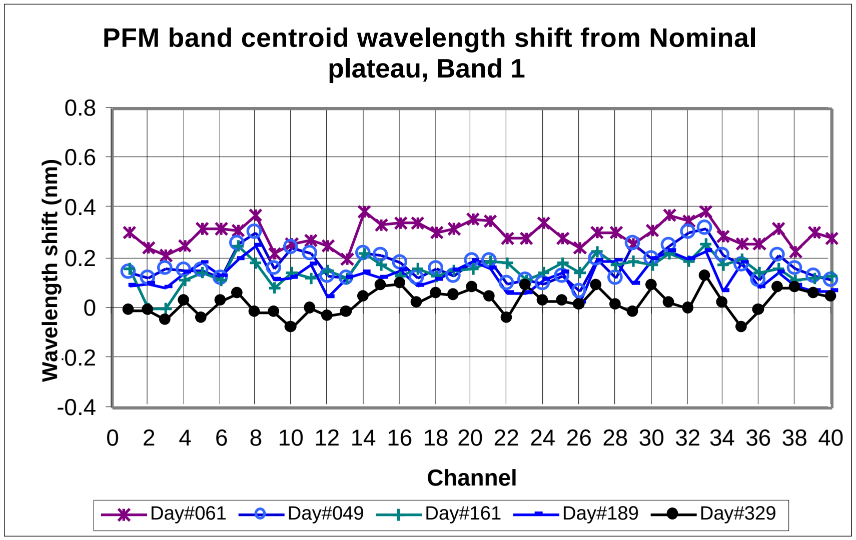
♦ The switching of the sides of the electronics should not change the band response. However, band 8 did show shift towards the short wavelength for Day#329 (Side B) in comparison with Days 161 and 189 (Side A).

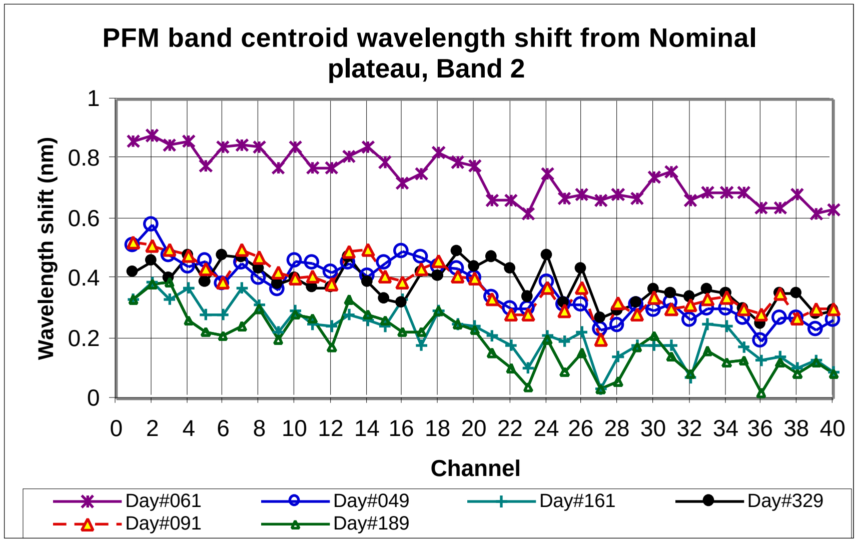
Band	Center wavelength	Center wavelength shift from prelaunch(nm)					
	up-to-date (#329)	Day#049	Day#061	Day#091	Day#161	Day#189	Day#329
8	0.4114	0.23	-0.09		-0.15	-0.04	-0.45
9	0.4418	-0.2	-0.14		-0.26	-0.28	-0.28
3	0.4657	0.14	0.12		0.02	0.01	-0.01
10	0.4868	-0.16	-0.16		-0.22	-0.29	-0.18
11	0.5296	-0.08	-0.02		-0.13	-0.17	-0.17
12	0.5469	0.11	0.17	0.07	-0.01	-0.05	-0.03
4	0.5537	0.19	0.17		0.03	0.05	0.01
1	0.6463	0.17	0.3		0.15	0.13	0.02
13	0.6656	-0.2	-0.14	-0.3	-0.29	-0.38	-0.19
14	0.6770	0.21	0.22	0.07	0.1	0.03	0.03
15	0.7464	0.02	-0.02	-0.14	-0.15	-0.18	-0.2
2	0.8568	0.37	0.74	0.38	0.22	0.19	0.38
16	0.8660	-0.03	-0.15	-0.25	-0.25	-0.33	-0.34
17	0.9043	0.18	0.14		0.05	0.08	0.03
18	0.9354	-0.35	-0.28	-0.54	-0.41	-0.55	-0.32
19	0.9362	-0.34	0.07	-0.37	-0.35	-0.58	-0.08
5	1.2421	0.23	0.31	0.08	0.04	0	-0.03
26	1.3814	-0.37	-0.34	-0.63	-0.25	-0.73	-0.82
6	1.6294	0.38	0.16	0.21	0.34	0.08	-0.01
7	2.1142	0.37	-0.3	-0.4	-0.27	-0.4	-0.83

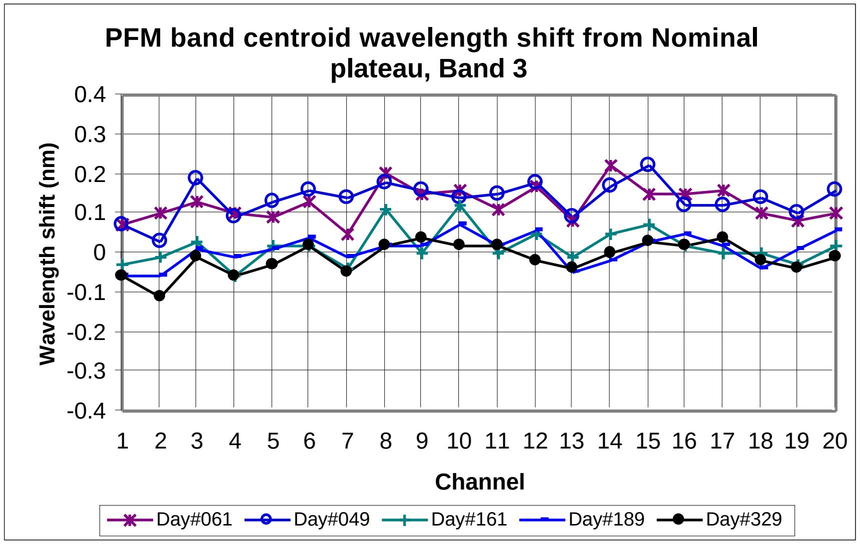
Center wavelength shift over time

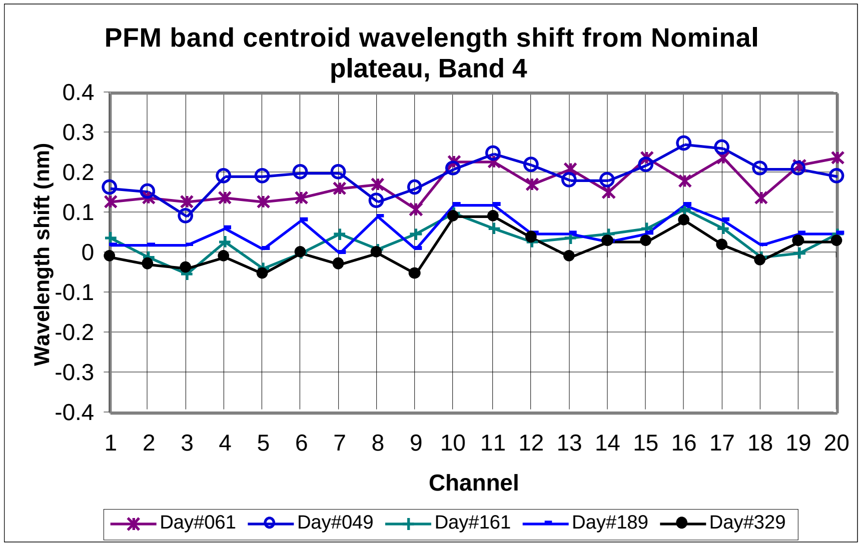


Center wavelength shift relative to Nominal plateau (1)

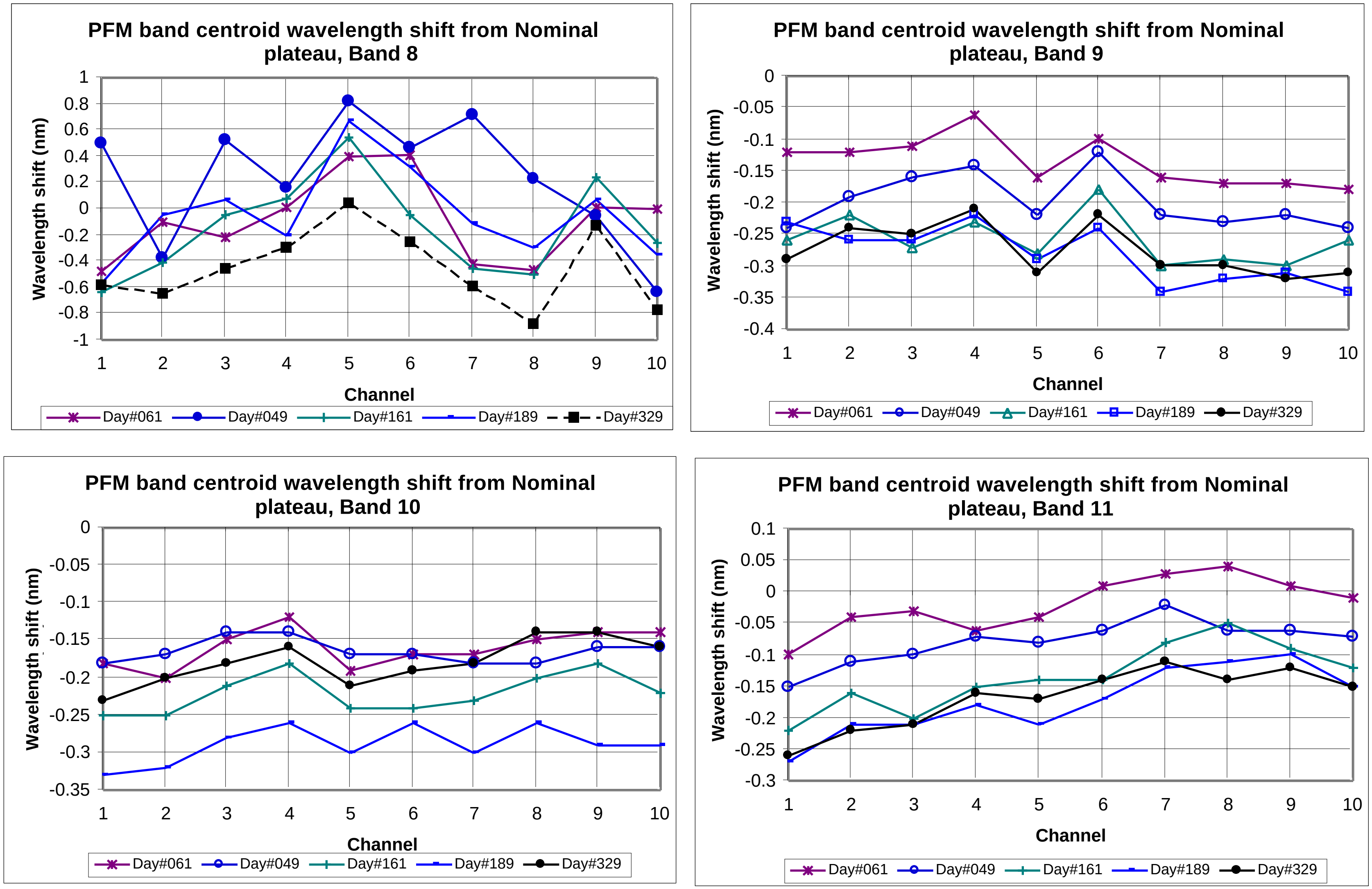




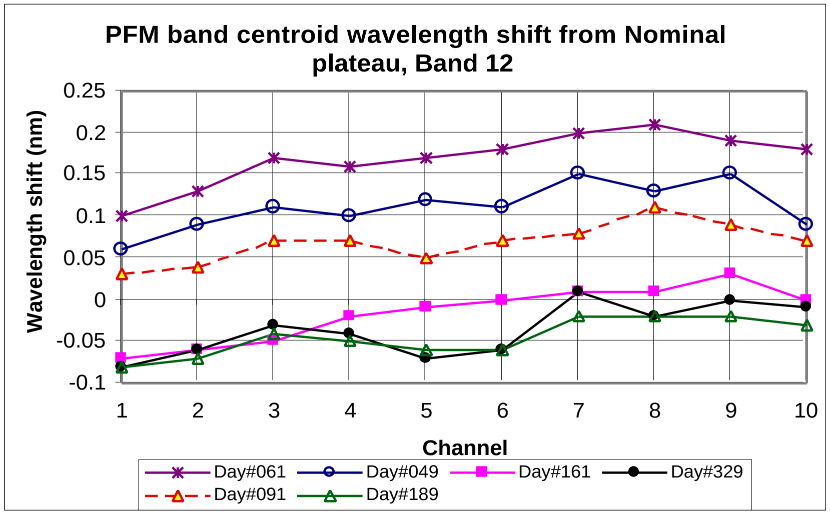


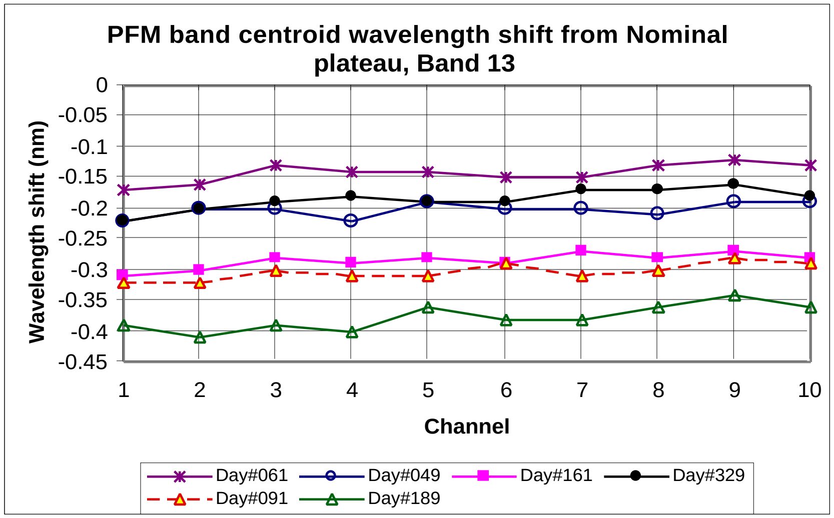


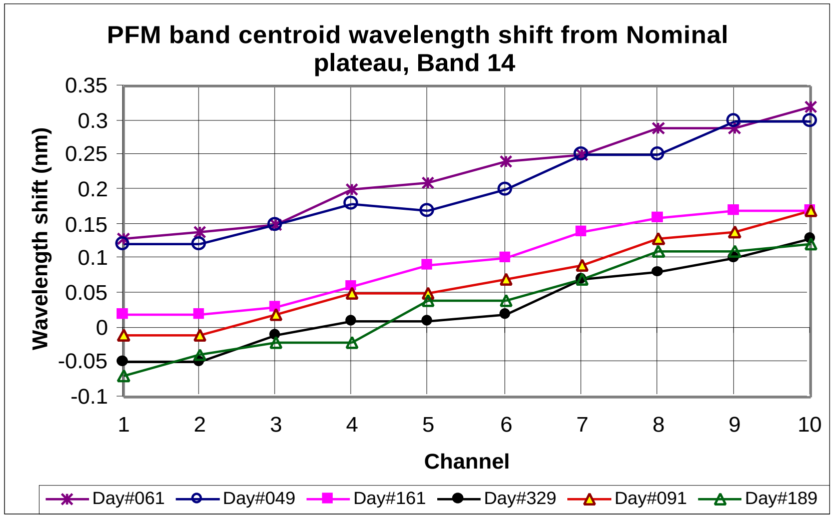
Center wavelength shift relative to Nominal plateau (2)

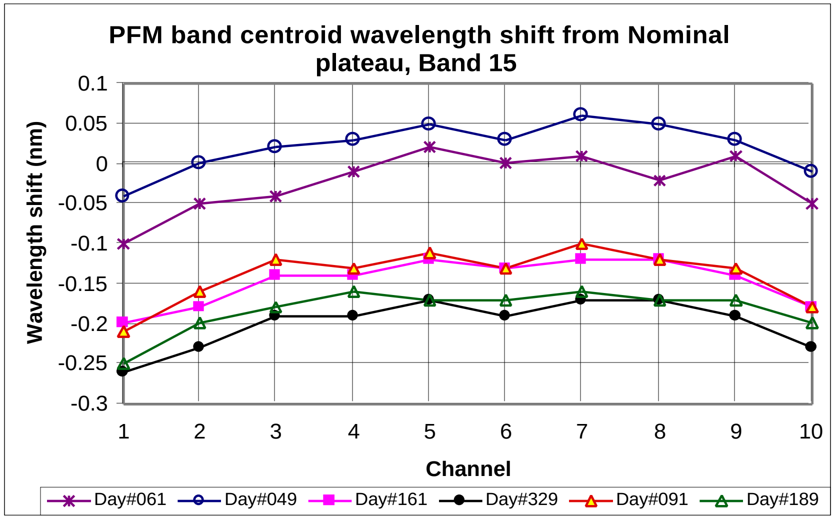


Center wavelength shift relative to Nominal plateau (3)

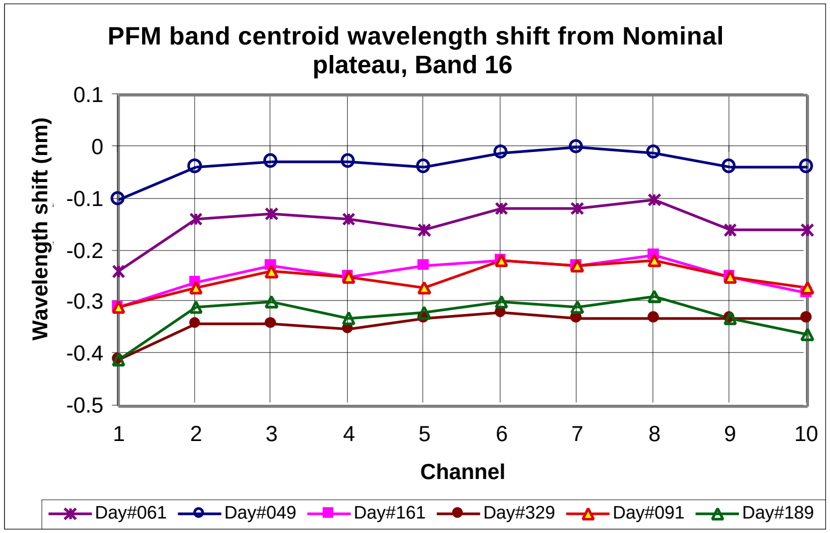


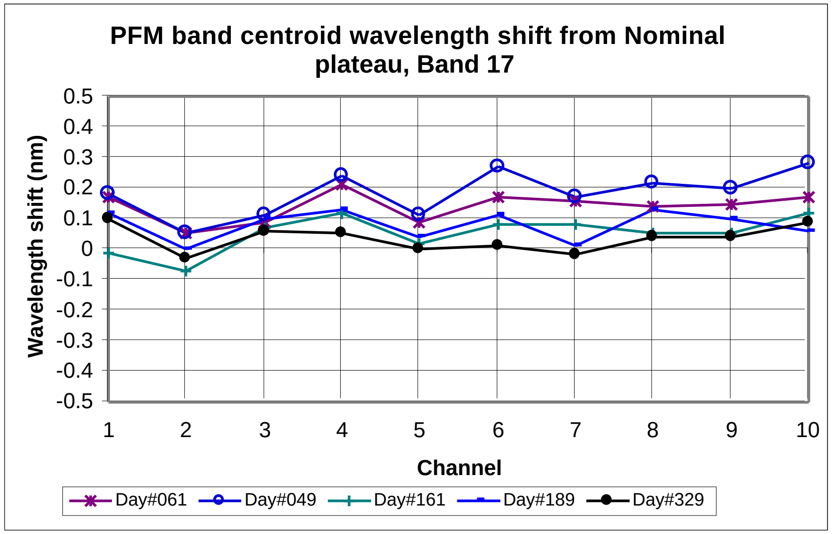


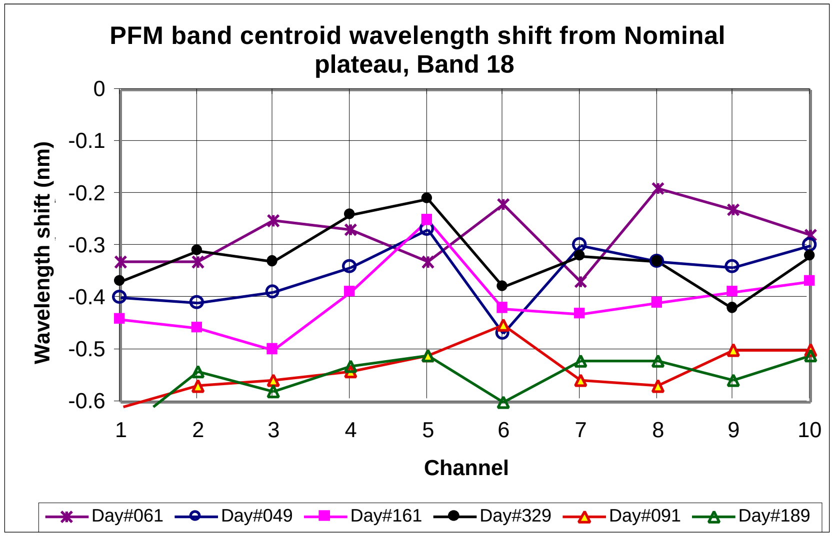


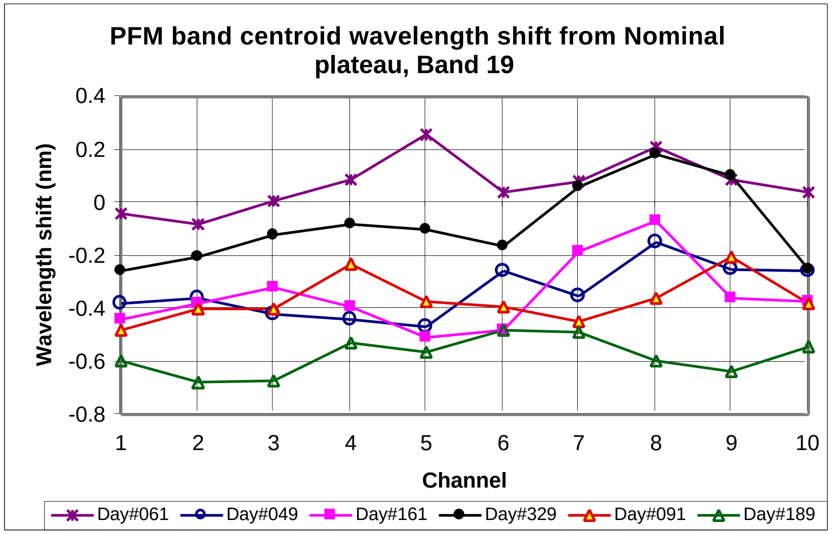


Center wavelength shift relative to Nominal plateau (4)



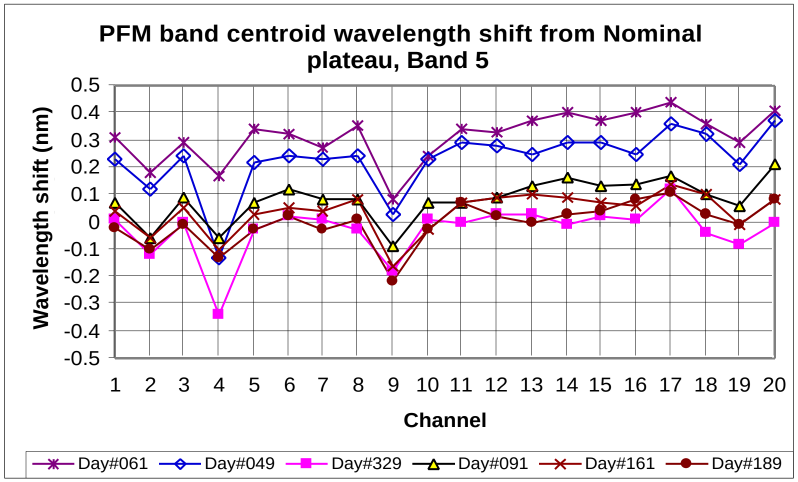


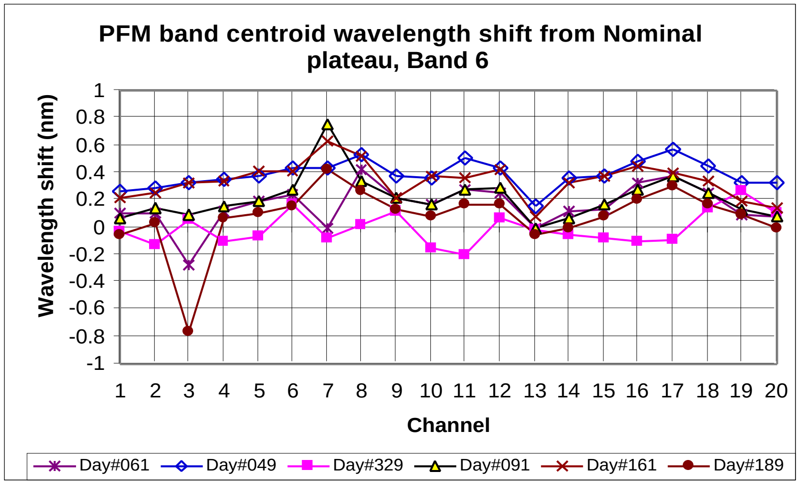


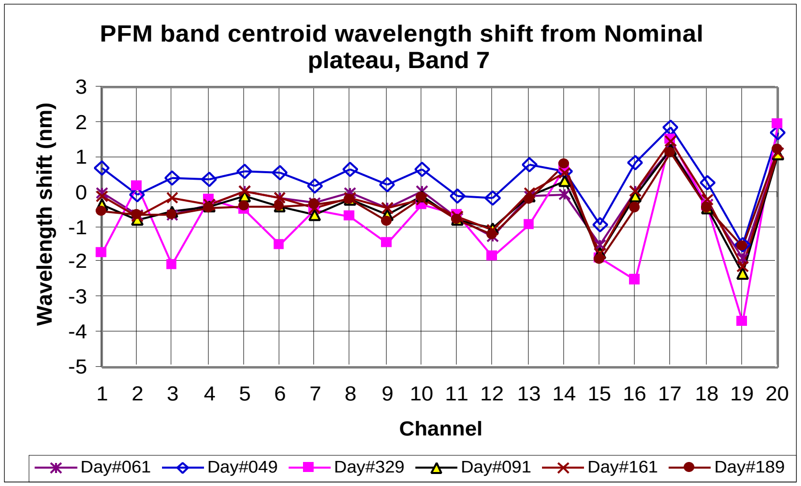


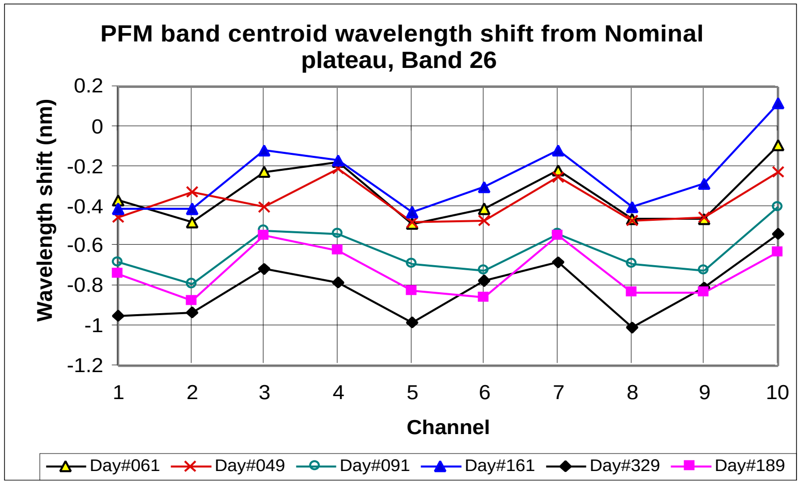
Center wavelength shift relative to Nominal plateau (5)

♦ Band response signals are not normalized by the SRCA reference SiPD signal.





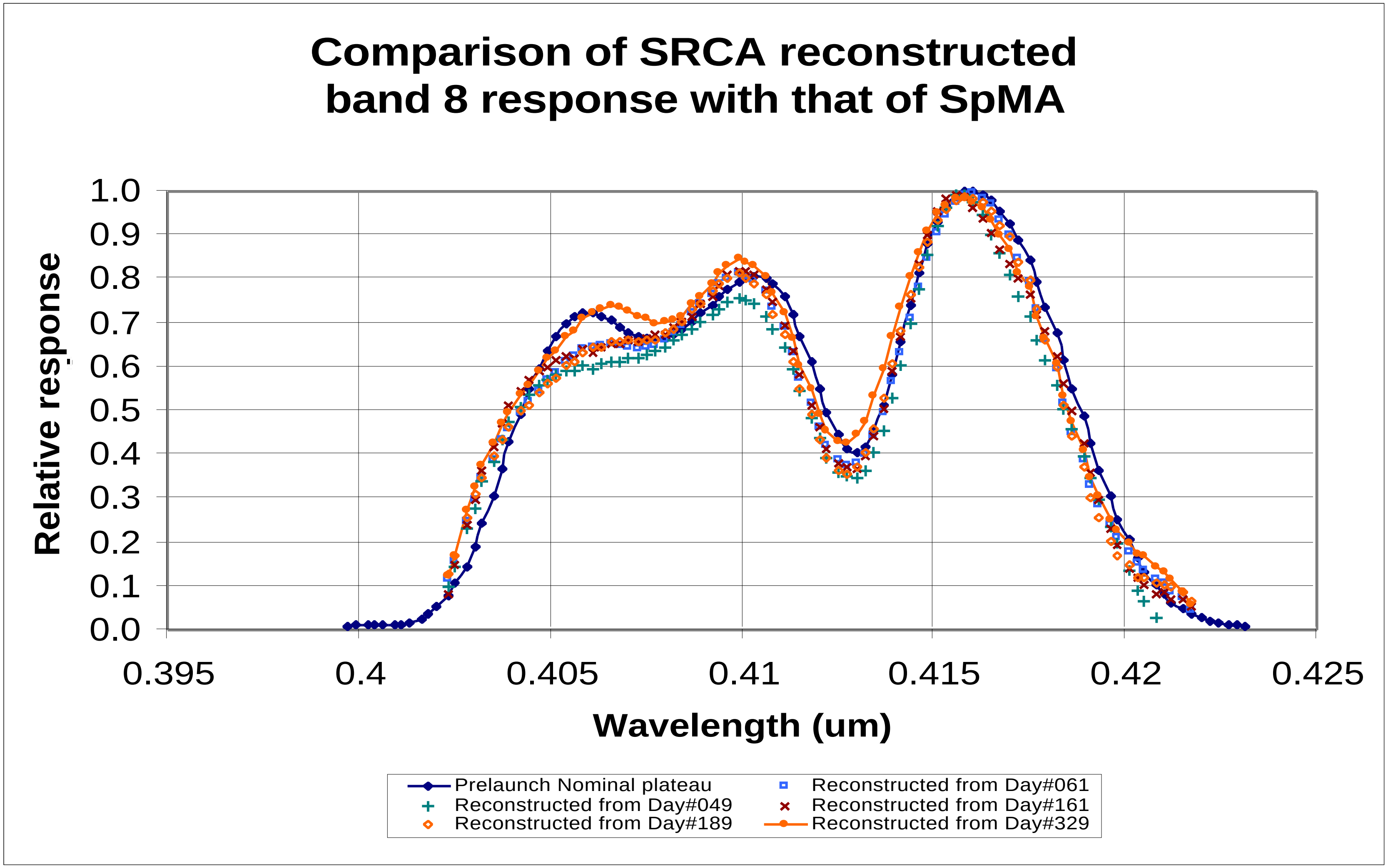




Comparison of band 8 response profiles measured by the SRCA

- Band response reconstruction approach is applied to monitor possible change in the spectral response profile. The slit function of the SRCA is calculated using Fourier Transform technique by comparison of the test responses between the SpMA and the SRCA Nominal plateau and is assumed unchanged on-orbit.
- The center wavelength shifts for band 8 show evident variation over channels. One of the motivations can be the low SNR in the measurement of their responses.
- We observed that the center wavelength shift does not change evidently for Day# 061, 161, and 189 but a bias exists between orbit Day#189 (side A) and Day#329 (Side B) because of a raising of the sub-peak response at shorter wavelength region.
- The response profiles on-orbit are similar to that for Valley Forge Cold/Hot plateaus.
- Further monitoring and interpretation of the change are necessary.

Reconstructed band 8 response profiles from the SRCA measurement



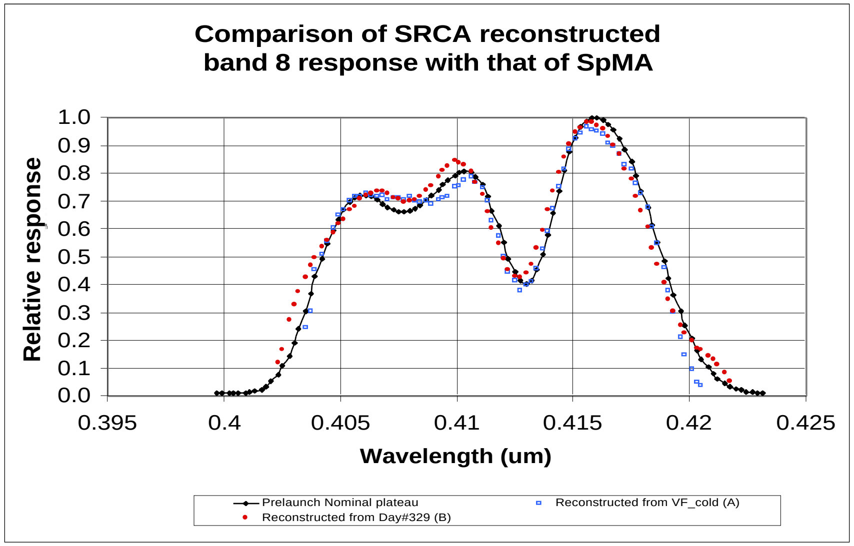
Reconstructed band 8 response profiles from the SRCA measurement In comparison with Valley Forge tests

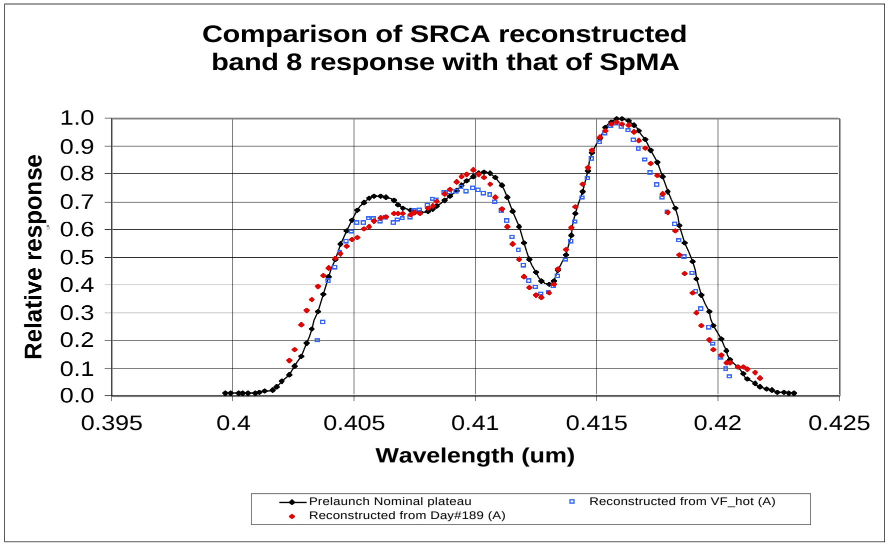
The reconstructed band 8 relative responses on-orbit can be categories into: one with three peaks and one with two peaks. When they are compared with Valley Forge test data. We can observe:

(1) Day#329 (side B) is similar to VF_cold profile.

(2) The other days on-orbit (side A) are similar to VF_hot profile.

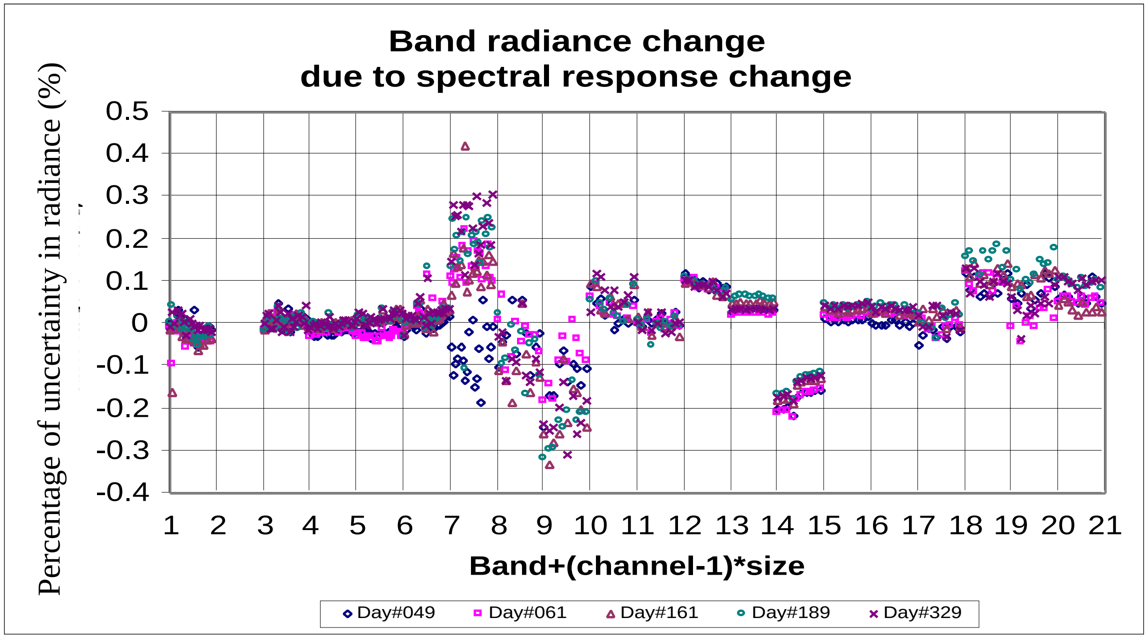
(3) In comparison with Nominal plateau, the response profiles at VF had already moved towards short wavelength and have about 0.2nm more shift (towards short wavelength) on-orbit.





Estimated radiance change due to spectral response change

- The current center wavelength shift and response change will introduce radiance uncertainty of ±0.3% for band 9; ±0.2% for bands 8, 14, 18 and 19; and ±0.1% for the other bands (λ<1μm) if the prelaunch responses are utilized.
- The light source for this calculation is the Sun spectrum.
- MCST has not used the updated center wavelengths in the internal calibration.



Section 8
ECAL Performance

Electronic Calibration (ECAL)

- ECAL Objectives
- ECAL Results
- ECAL Diagram
- ECAL Functionality
- ECAL on Orbit

- Background Charts

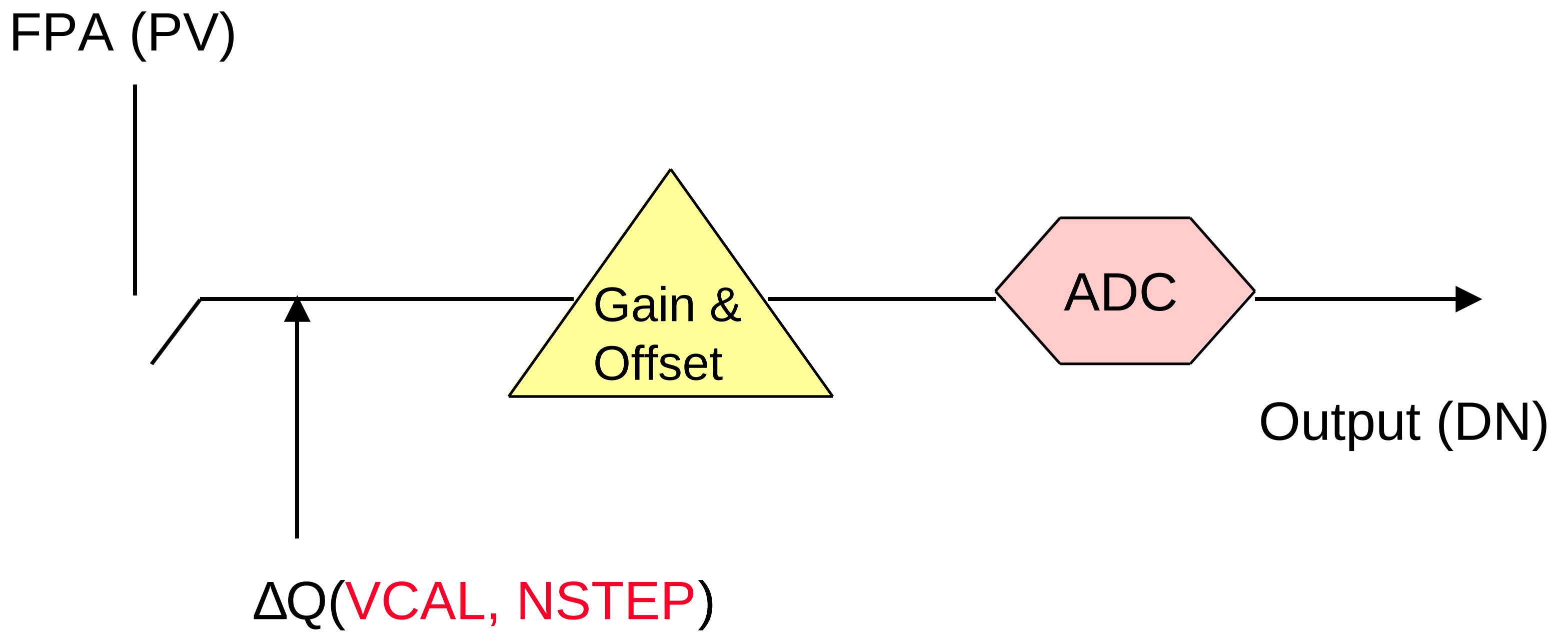
ECAL Objectives

- Monitor MODIS Electronics.
- Retrieve and monitor the electronic non-linearity.
- Monitor Electronic gain, noise, and detector functionality.
- Retrieve electronic saturation.
- Retrieve and monitor the focal planes sampling time (time delay between bands implemented in the flight software).

ECAL Results

- Non-linearity is stable for most bands and not conclusive for other bands, especially band 2.
- Electronic gain is performing as expected.
- Premature saturation (below 4095) is observed for bands 1, 2 and 17 for the A side electronics, and for bands 1, 2, 17, 18, and 19 for the B side electronics.
- The focal planes sampling time is as expected.

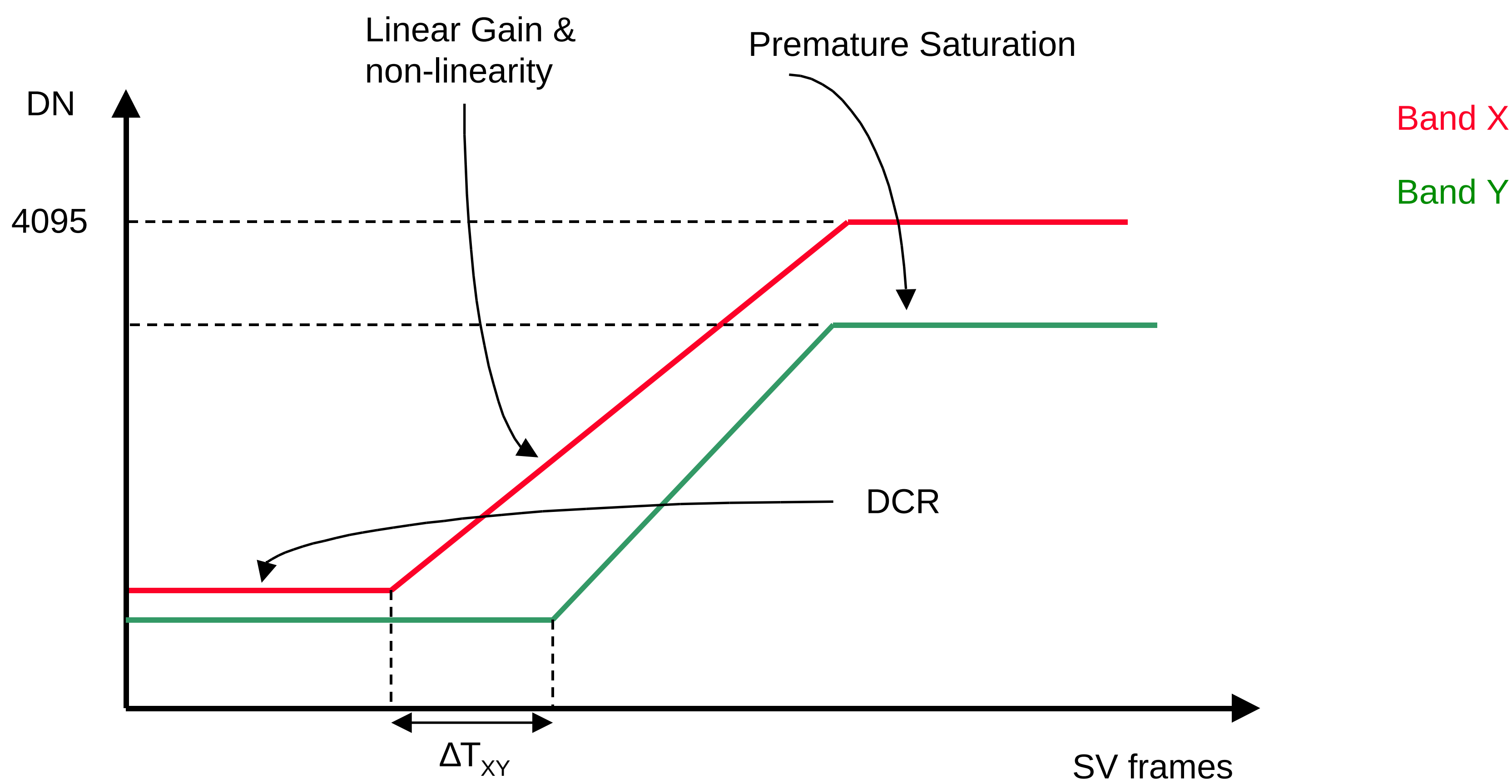
ECAL Diagram



ECAL Functionality
(PV bands 1-30)

- The FPAs are disconnected from the circuit.
- ECAL charge is injected at each frame number.
- Charge is accumulated from each frame until saturation is reached.
- Reset is not applied between charge injection.
- ECAL adjustable parameters are VCAL and NSTEP to control the charge injected.

ECAL Output



Linear Gain &
non-linearity
Premature Saturation
DN
4095
DCR
ΔT XY
SV frames
Band X
Band Y

ECAL On Orbit

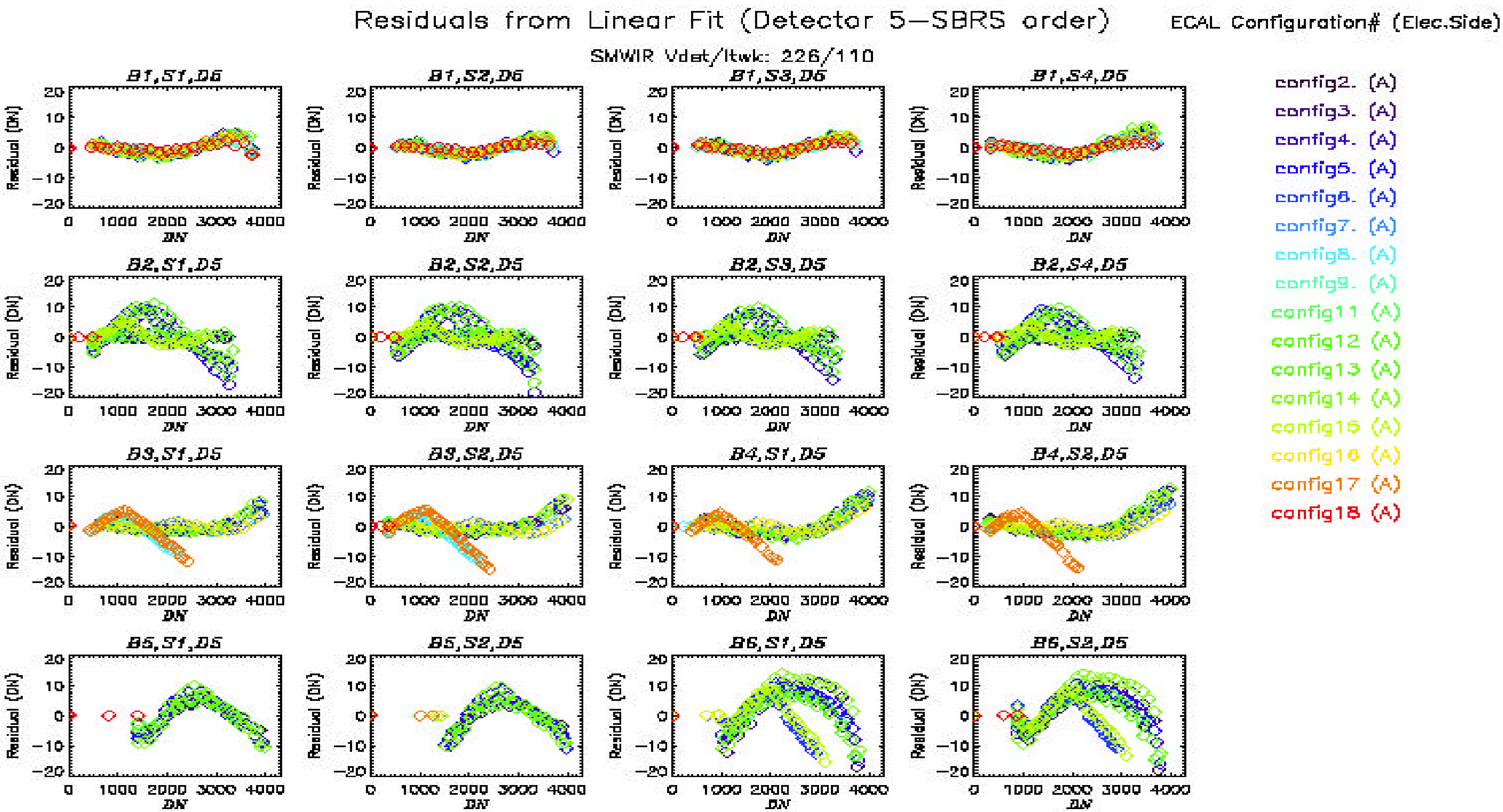
- ECAL function can be executed as needed.
- Duration 2 minutes for the PV bands and 4 minutes for the PC bands.
  - **L1B Product is compromised or lost in the Thermal Emissive Bands when ECAL is performed**
- ECAL is accomplished through the SV sector.
- RSB background subtraction switched to BB in L1B.
- TEB science data is invalid and flagged in L1B as such.

Section 8
ECAL Performance BACKGROUND

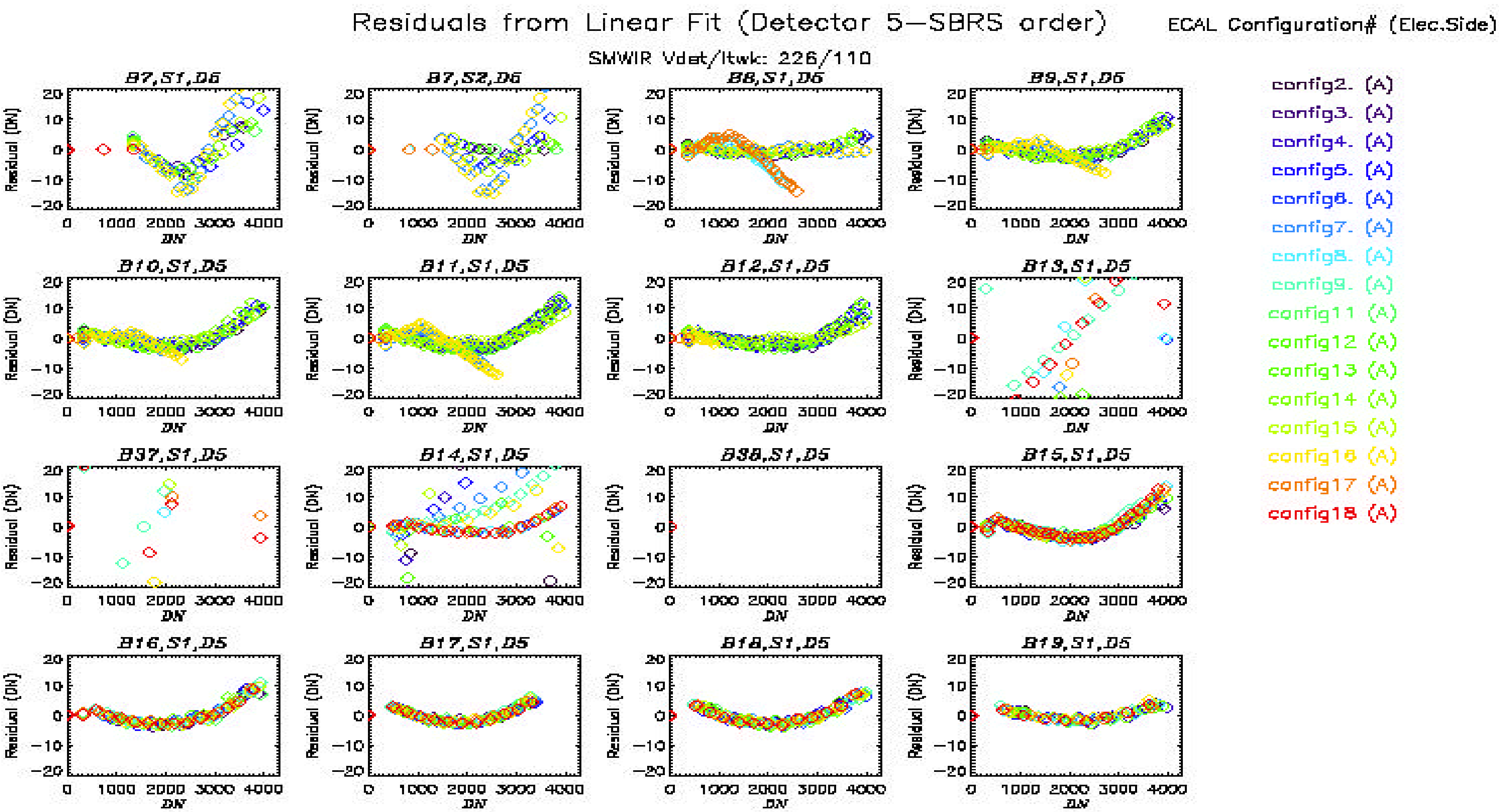
Background Charts

- Electronic non-linearity performance.
- Electronic gain performance.
- Saturation performance.

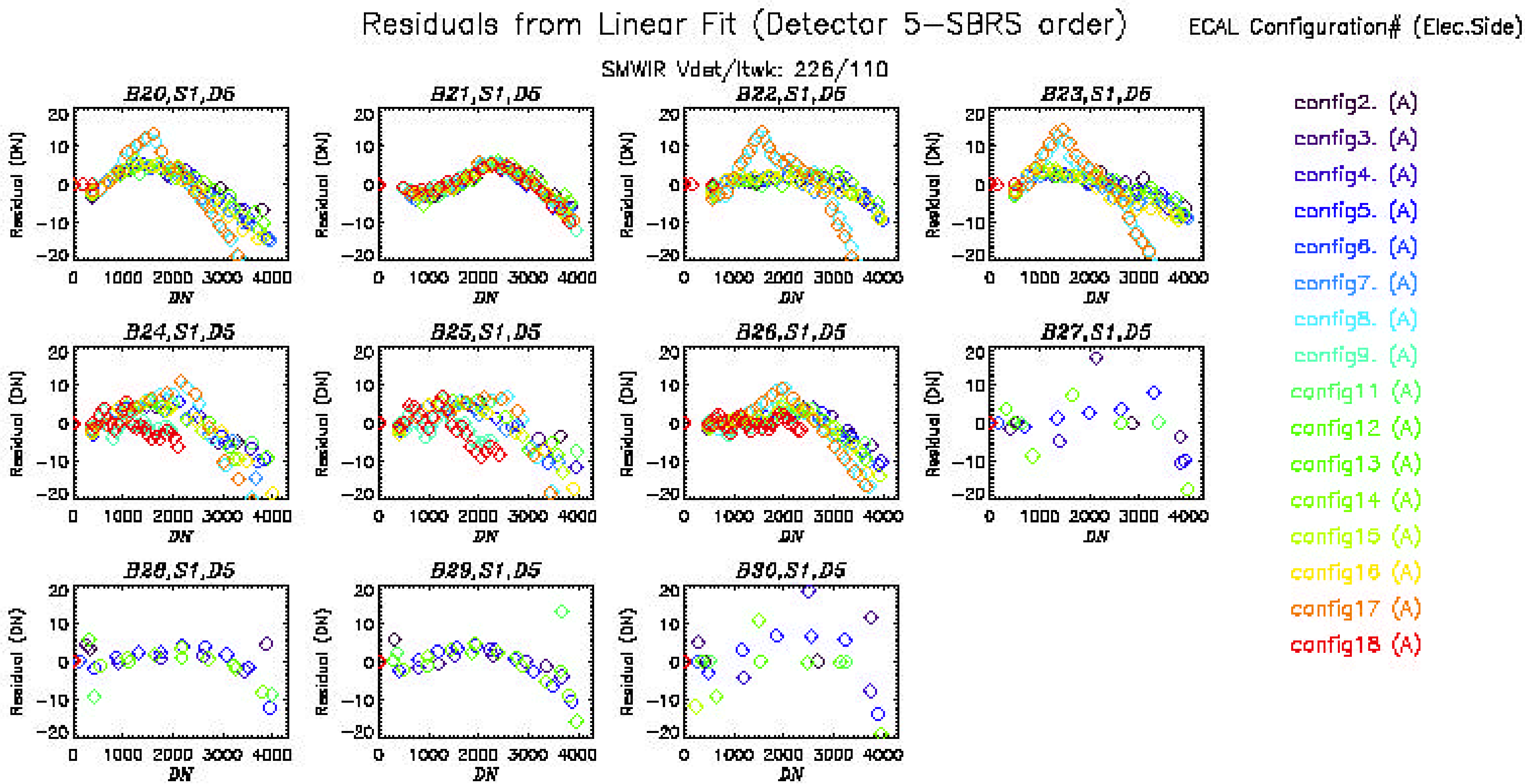
Non-linearity Performance



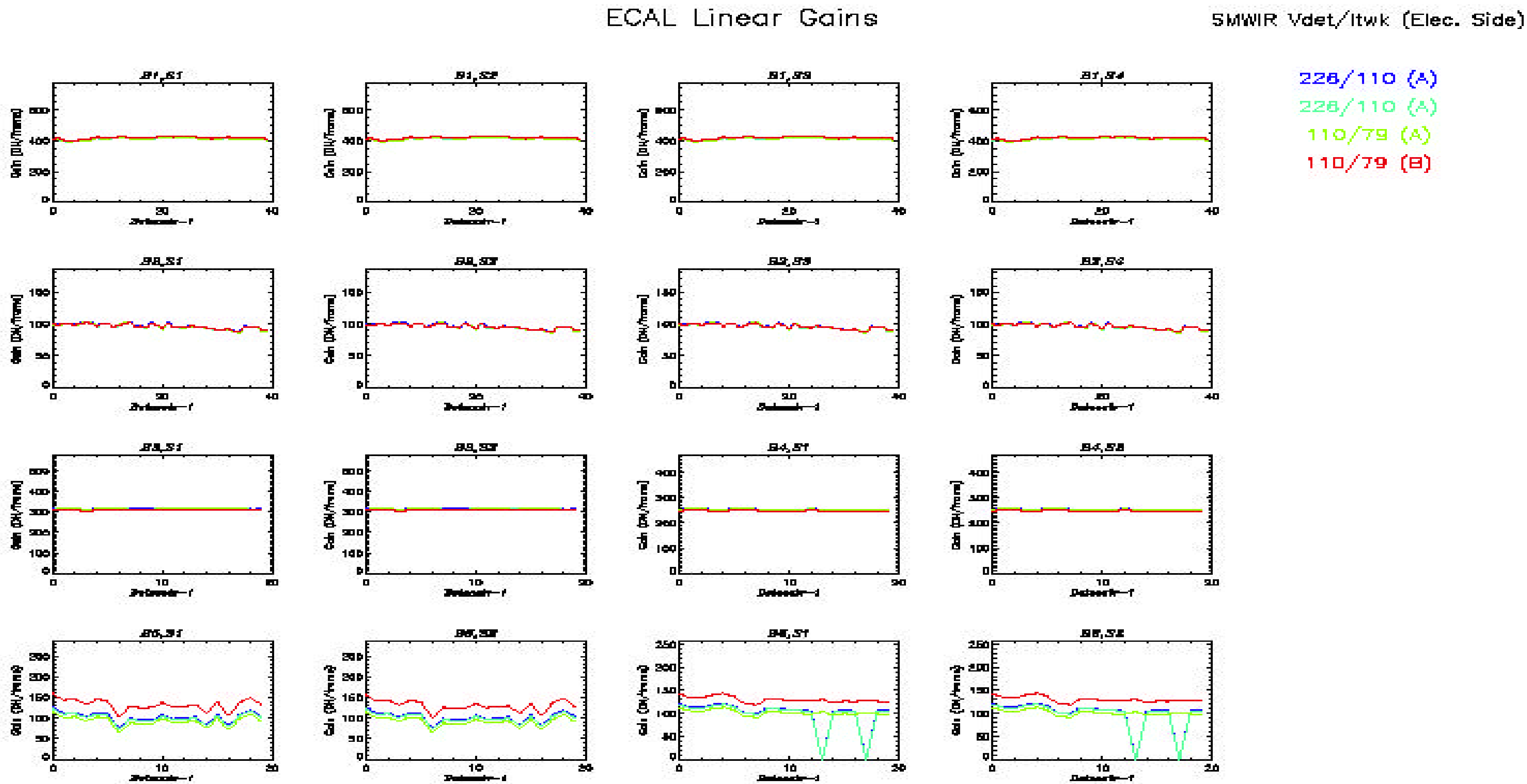
Non-linearity Performance (cont.)



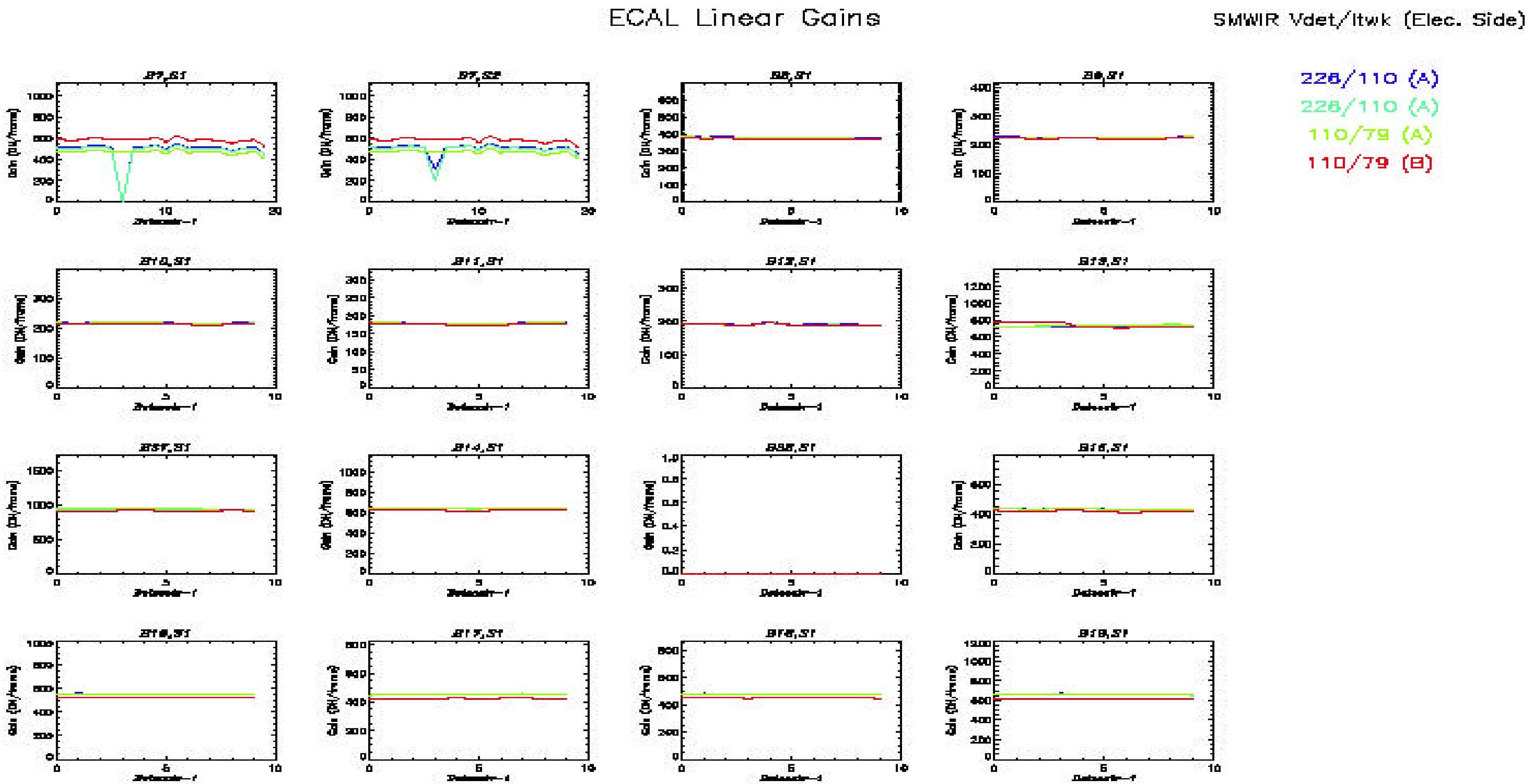
Non-linearity Performance (cont.)



Gain Performance



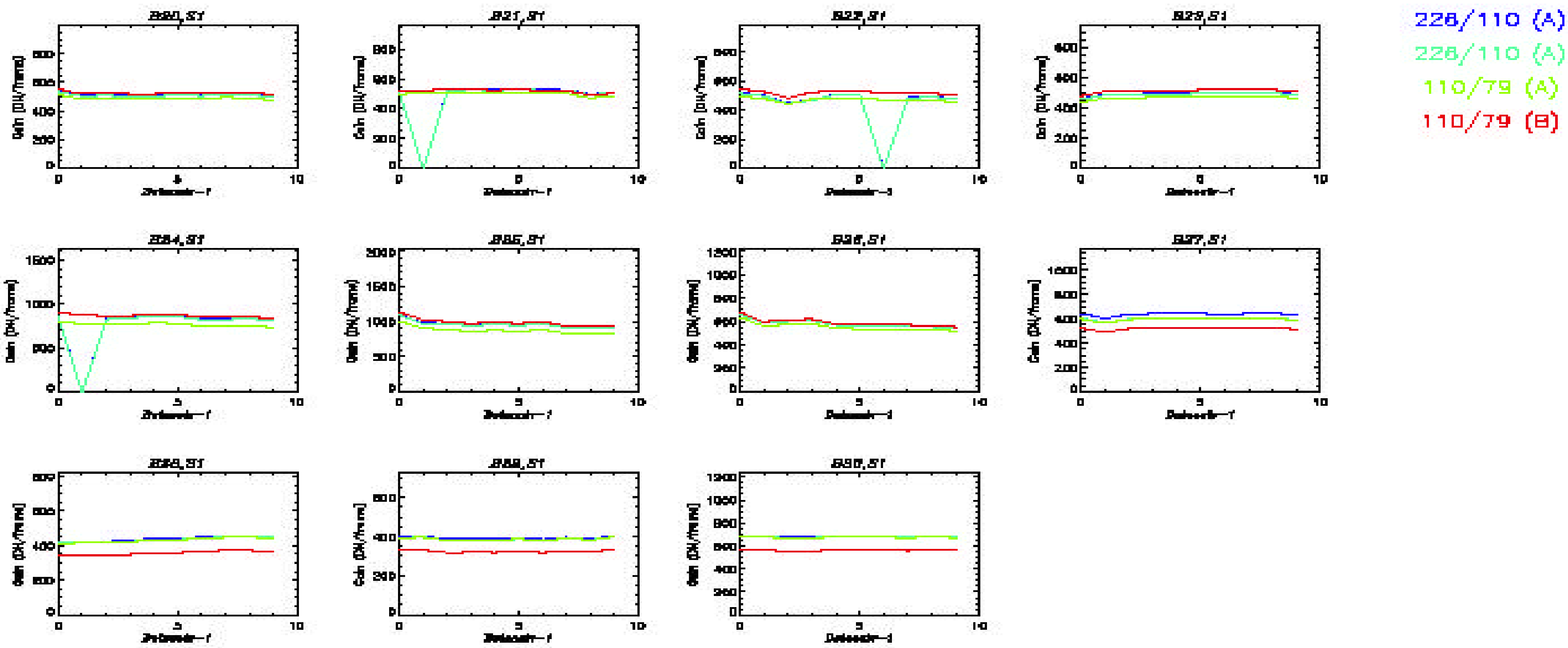
Gain Performance (cont.)



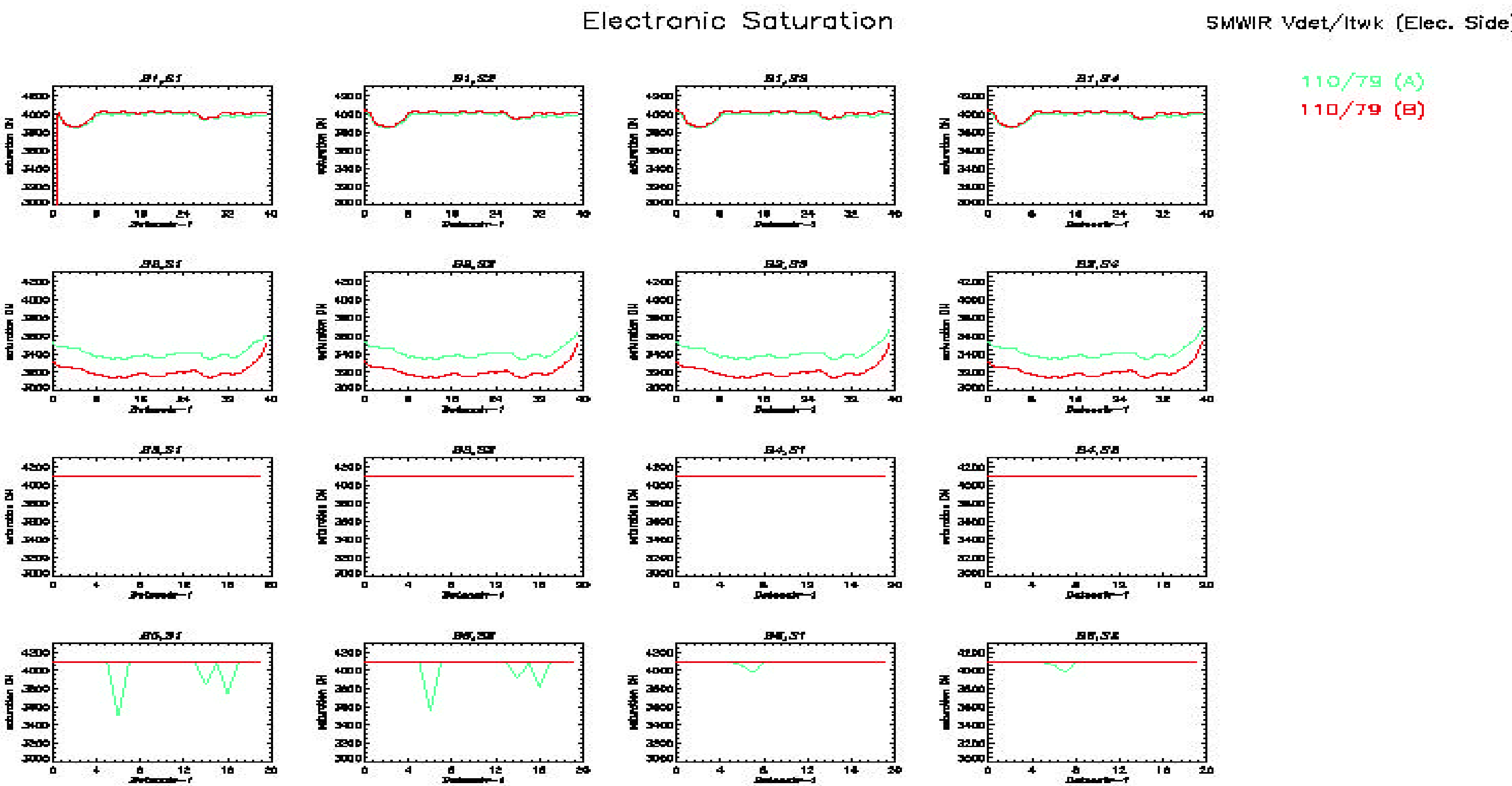
Gain Performance (cont.)

ECAL Linear Gains

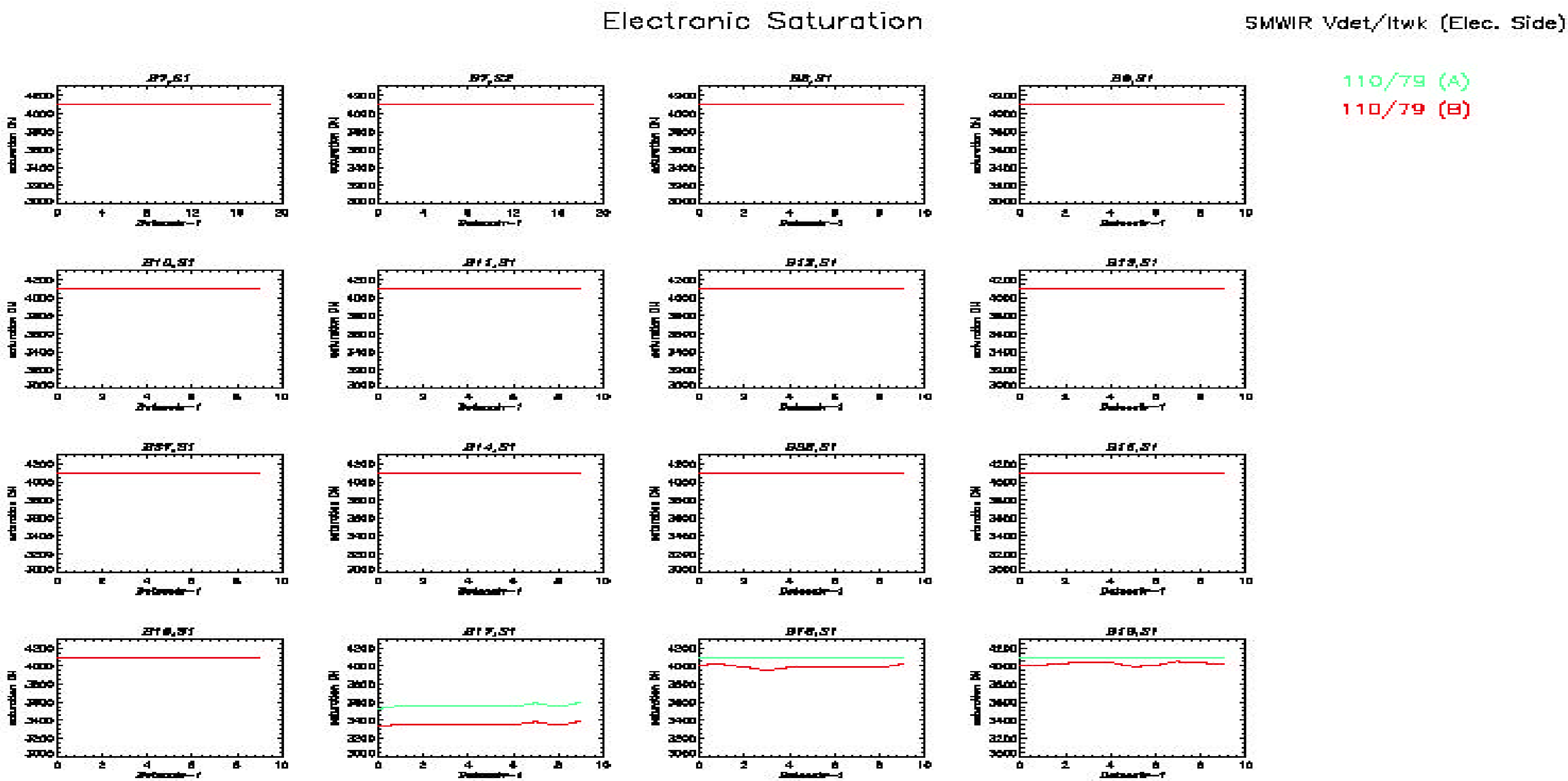
SMWIR Vdet/Itwk (Elec. Side)



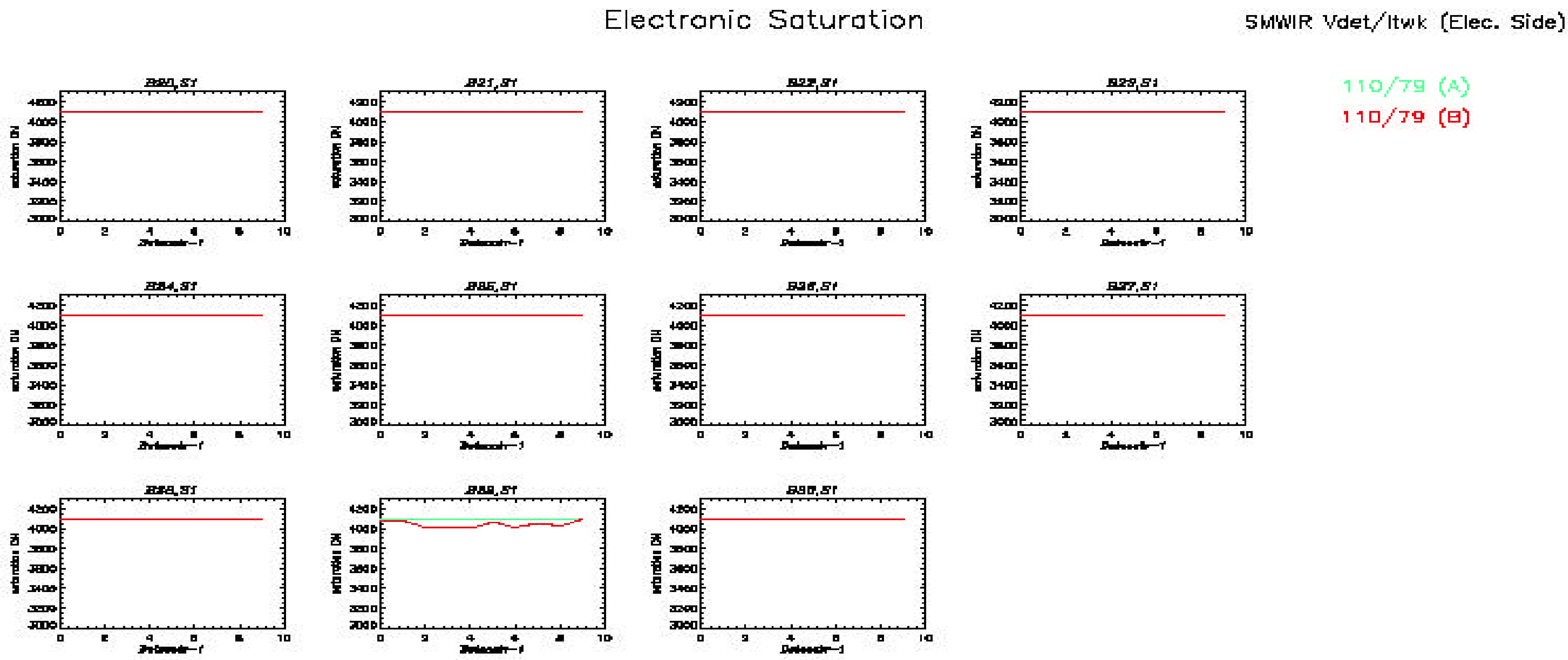
Electronic Saturation



Electronic Saturation (cont.)



Electronic Saturation (cont.)

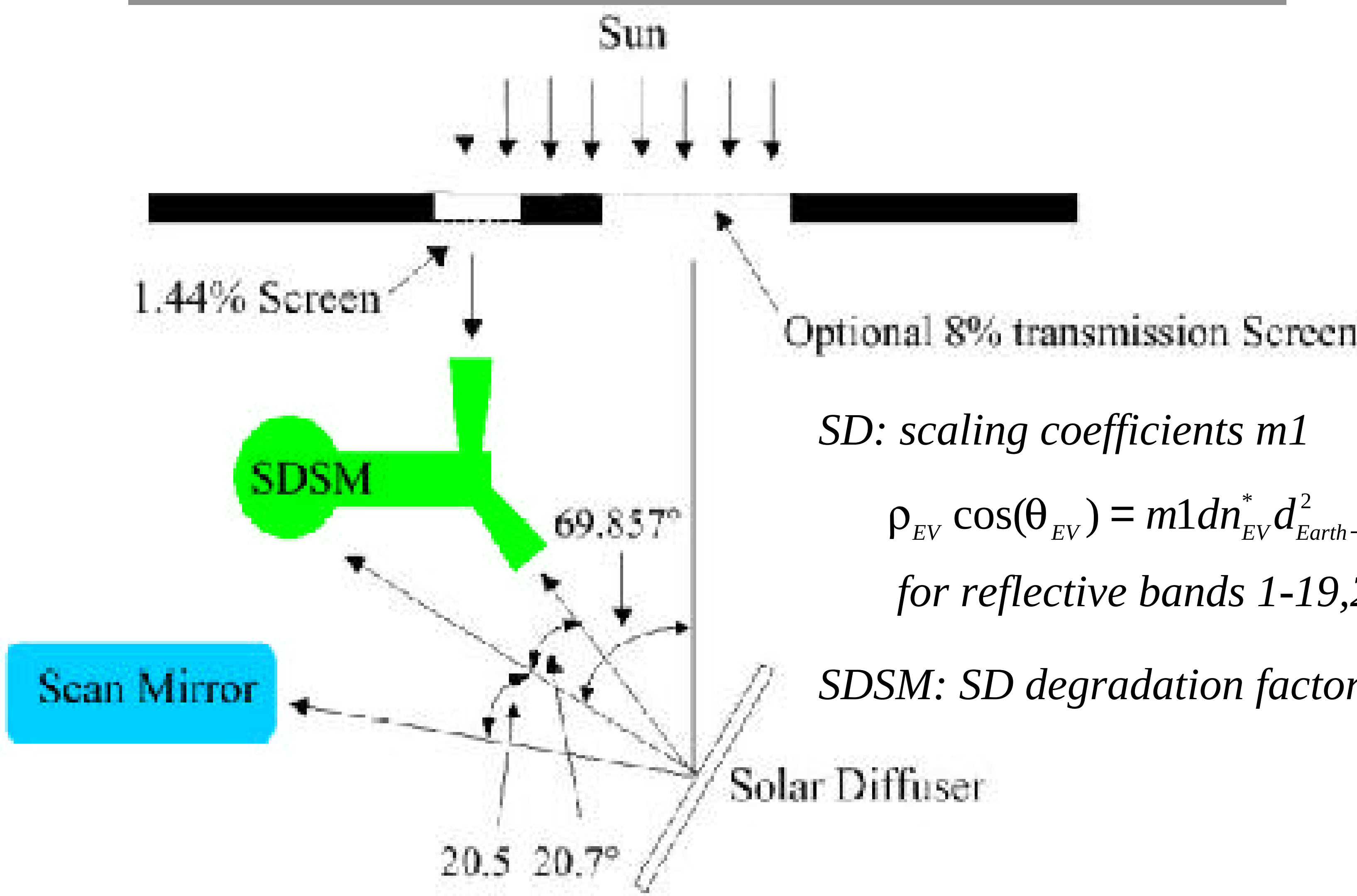


Section 9
SD/SDSM Performance

Objectives

- SDSM was designed to track changes in SD BRF and allow inference of changes in remainder of MODIS optics
- Permanently placed 1.44% transmission screen has induced significant structure into SDSM response
- Intricate analysis techniques are being developed to detect underlying signal from screen induced structures
- To date SDSM results has not been used in operational algorithm

Solar Diffuser (SD) and Solar Diffuser Stability Monitor (SDSM)



SD: scaling coefficients m1

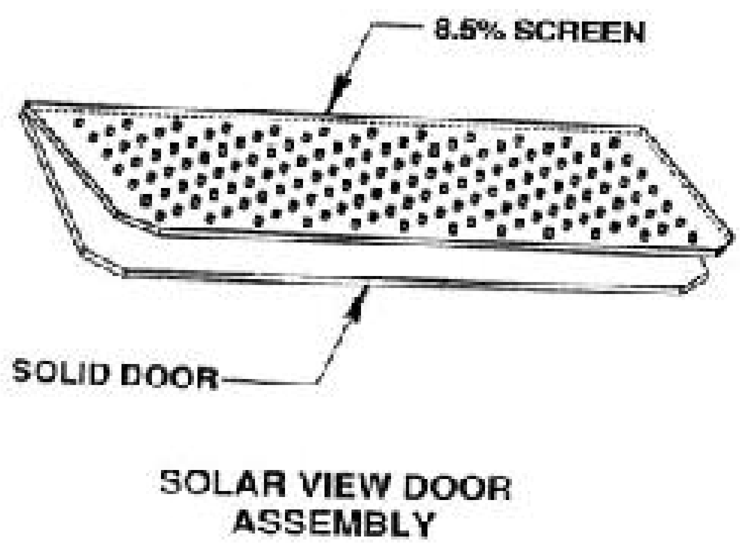
$$\rho_{EV}\cos(\theta_{EV}) = m1\,dn^{*}_{EV}\,d^{2}_{Earth-Sun,EV}$$

for reflective bands 1-19,26

SDSM: SD degradation factor Δ

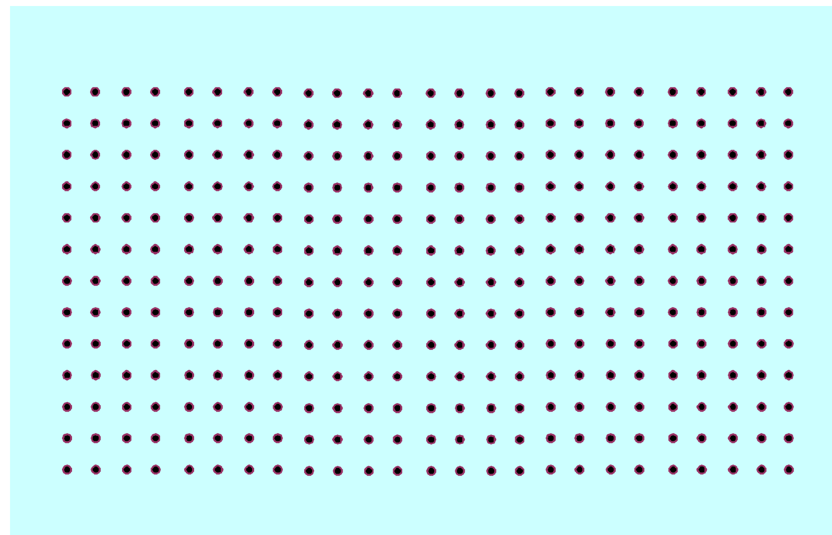
SD Screen and SDSM Sun-View Screen

- SD screen



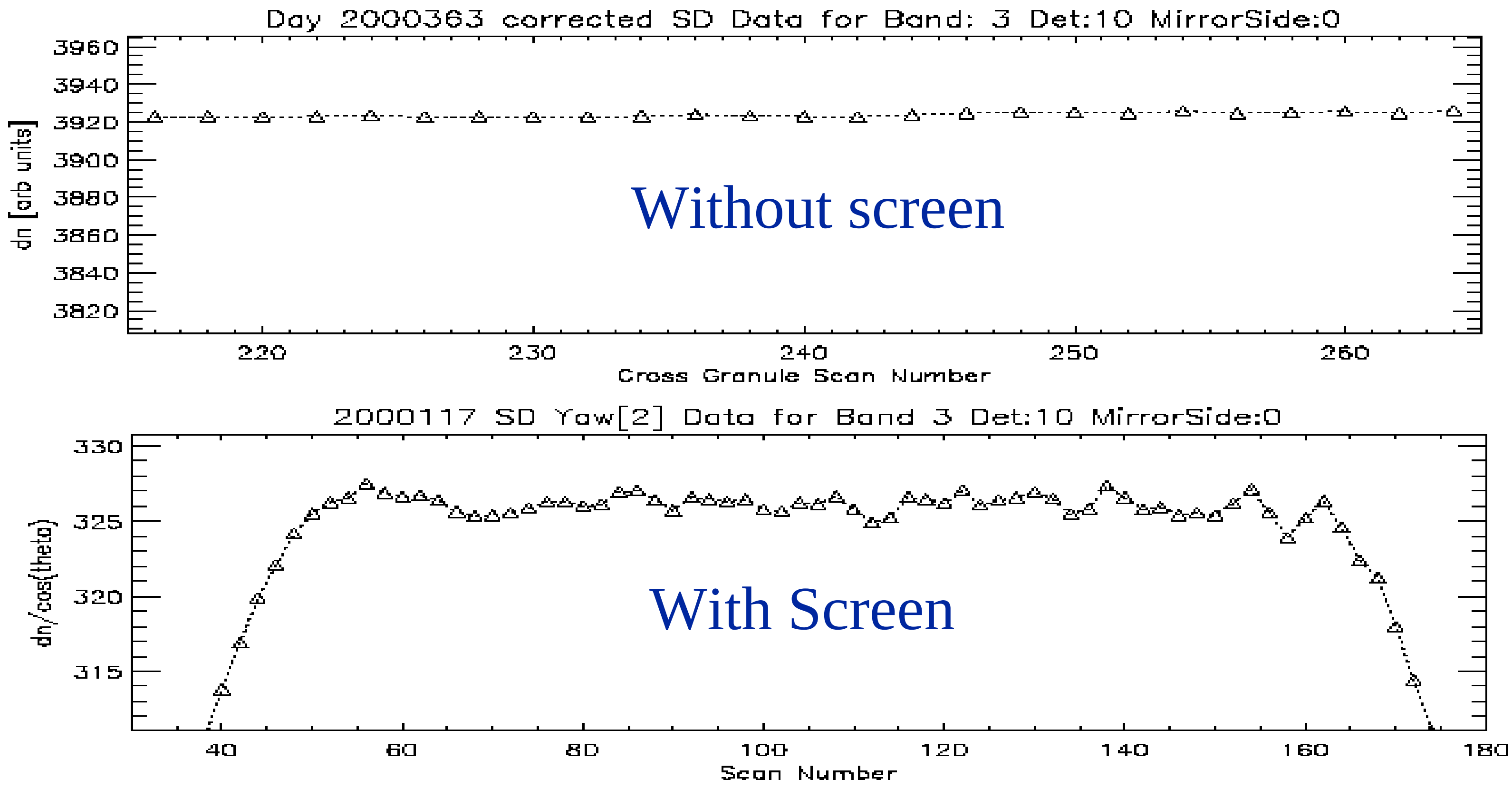
This is required because the ocean bands all saturate for SD screen-open solar measurements.

- SDSM Sun-view Screen



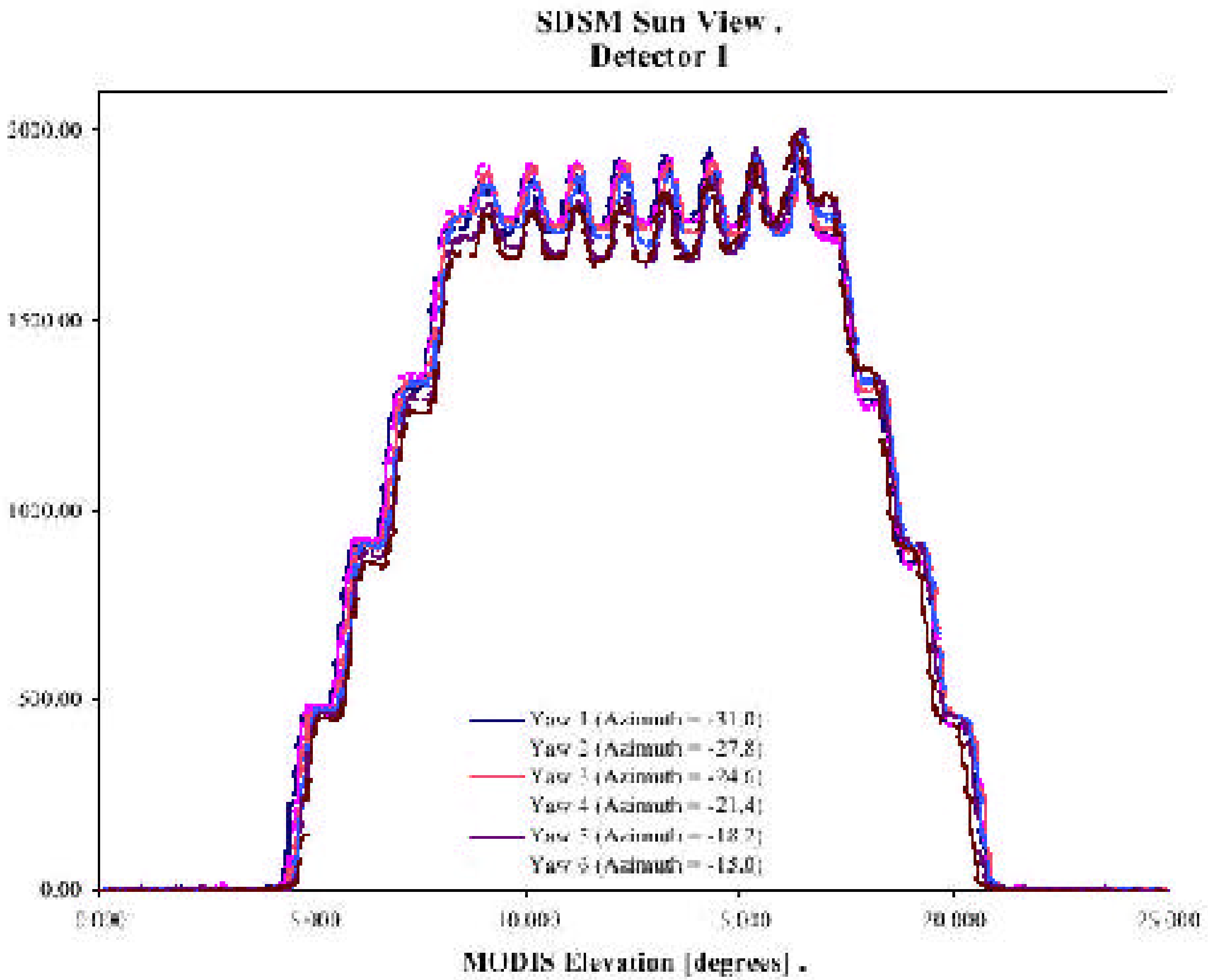
1.44% screen

Effect of the SD Screen on SD Response



We believe that these patterns from SD screen are part of the reason that we get channel-to-channel calibration differences within the ocean solar bands

Effect of screen on SDSM Sun-View response



SD Degradation Factor

- SDSM SD response

$$dc_{SD}(\theta_M, \varphi_M, D, SD)$$

- SDSM Sun-View response

$$dc_{Sun}(\theta_M, \varphi_M, D)$$

- Normalized SDSM response

$$\overline{dc}_{SD}(D, SD) = \frac{dc_{SD}(\theta_M, \varphi_M, D, SD)}{\cos(\theta_{SD})BRF(\theta_{SD}, \varphi_{SD})}$$

- Normalized SDSM Sun-View response

$$\overline{dc}_{Sun}(D) = dc_{Sun}(\theta_M, \varphi_M, D) / f(\theta_M, \varphi_M)$$

- SD degradation factor

$$\Delta_{SD} = \overline{dc}_{SD}(D, SD) / \overline{dc}_{Sun}(D)$$

dn is our term for signal in MODIS bands (1-36)

dc is our term for signal in SDSM bands (1-9)

Afterall the SDSM is a ratioing radiometry

Modeling of SDSM Sun-View

- Approach: Geometric optics
- Elements of MODIS involved:
  - MODIS coordinate system
  - Square aperture stop (SAS)
  - Sun view screen (SVS)
- Steps:
  - MODIS to SAS: $\theta_M, \varphi_M \rightarrow \theta_{SAS}, \varphi_{SAS}$
  - SAS to SVS: $\alpha, \beta, \gamma, x0, y0; \theta_{SAS}, \varphi_{SAS} \rightarrow \theta_{SVS}, \varphi_{SVS}$
  - Pinholes: Projection of SAS on SVS, Vignetting effect

Square Aperture Stop and Sun View Screen

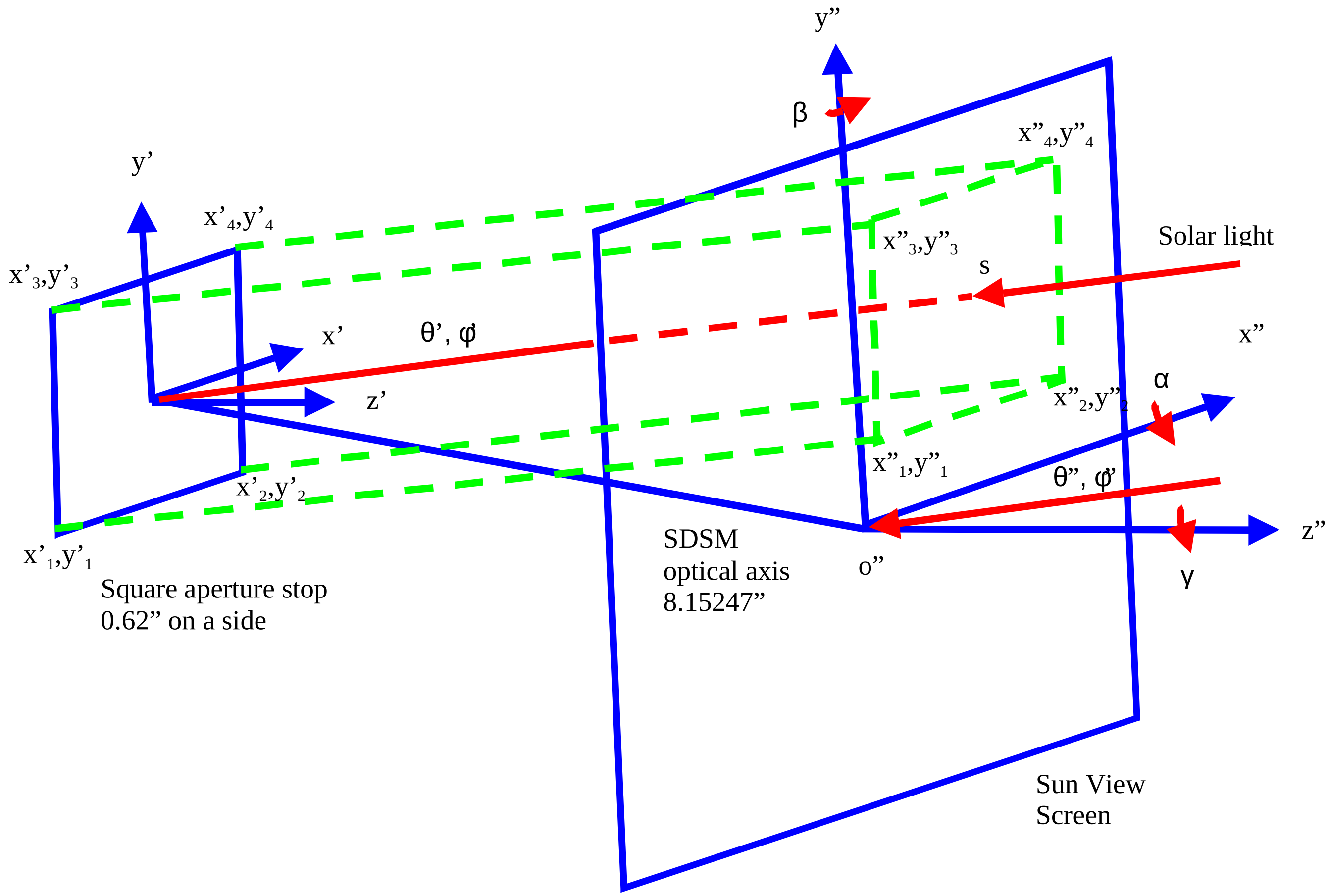


Figure 1. Coordinate systems of SDSM square aperture stop and Sun View Screen and their relationship.

Five Parameters: α, β, γ, x0, y0

Projection of SAS and Pinholes on the SDSM Screen

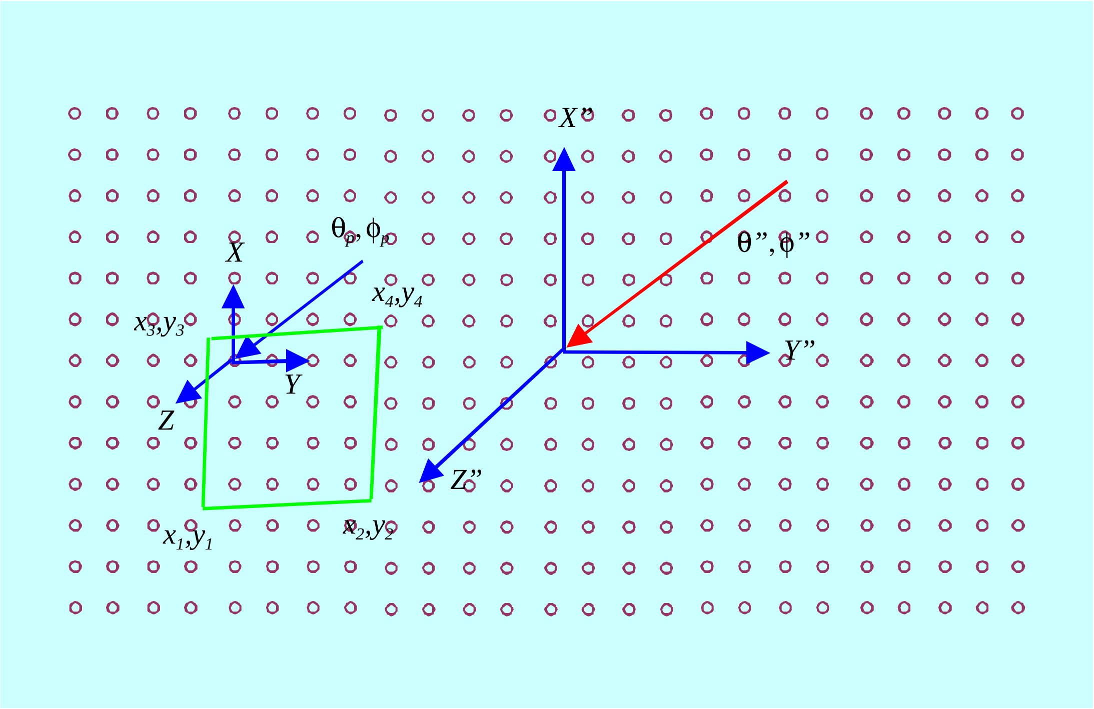
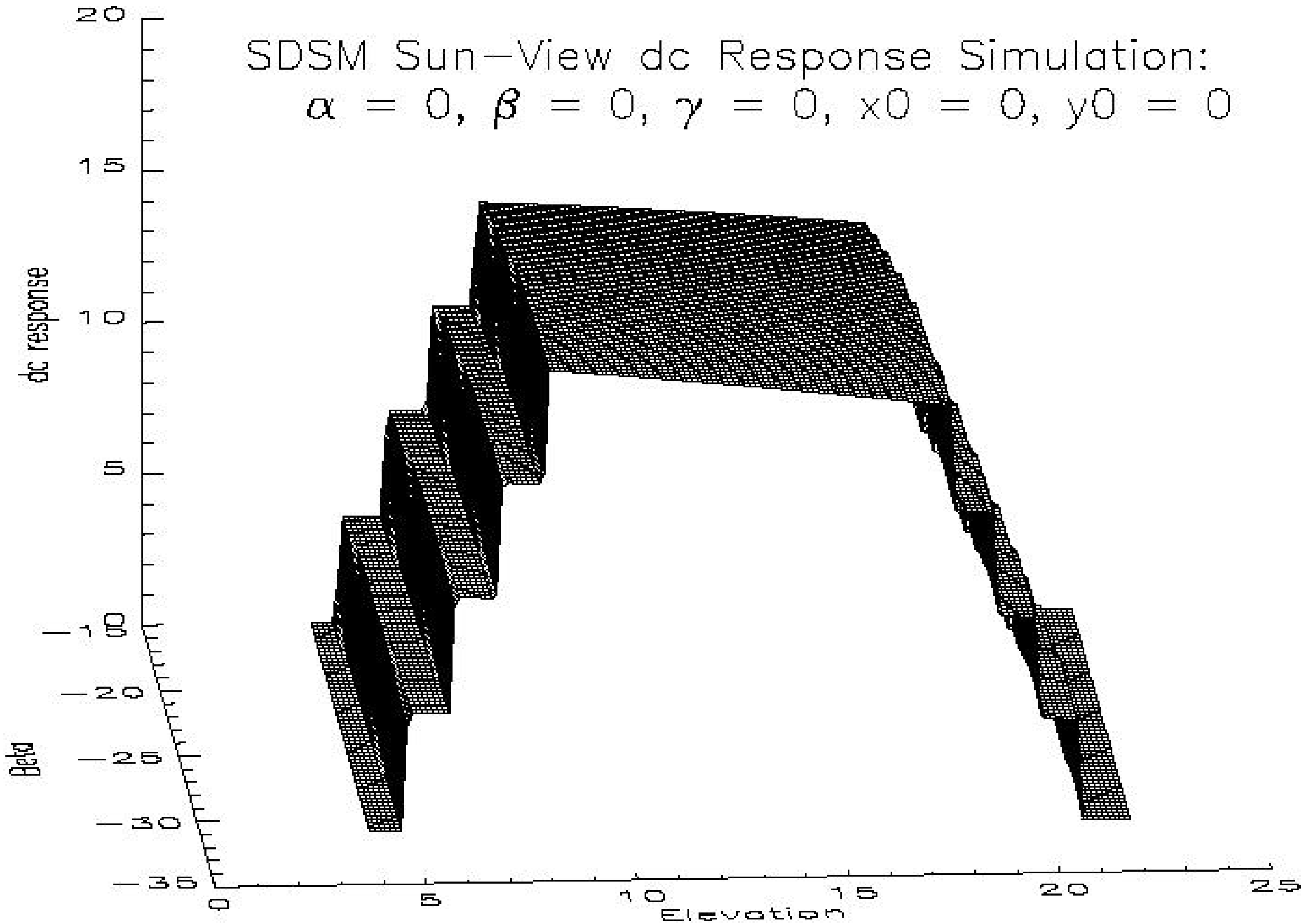


Figure 2. The Sun View Screen: 4.5" long, 2.39" wide, and 0.005" thick. There are totally 325 pinholes etched in a squire pattern with center 0.155" apart in both directions. The pinhole net has 13 rows and 25 columns. The diameter of a pinhole is 0.021".

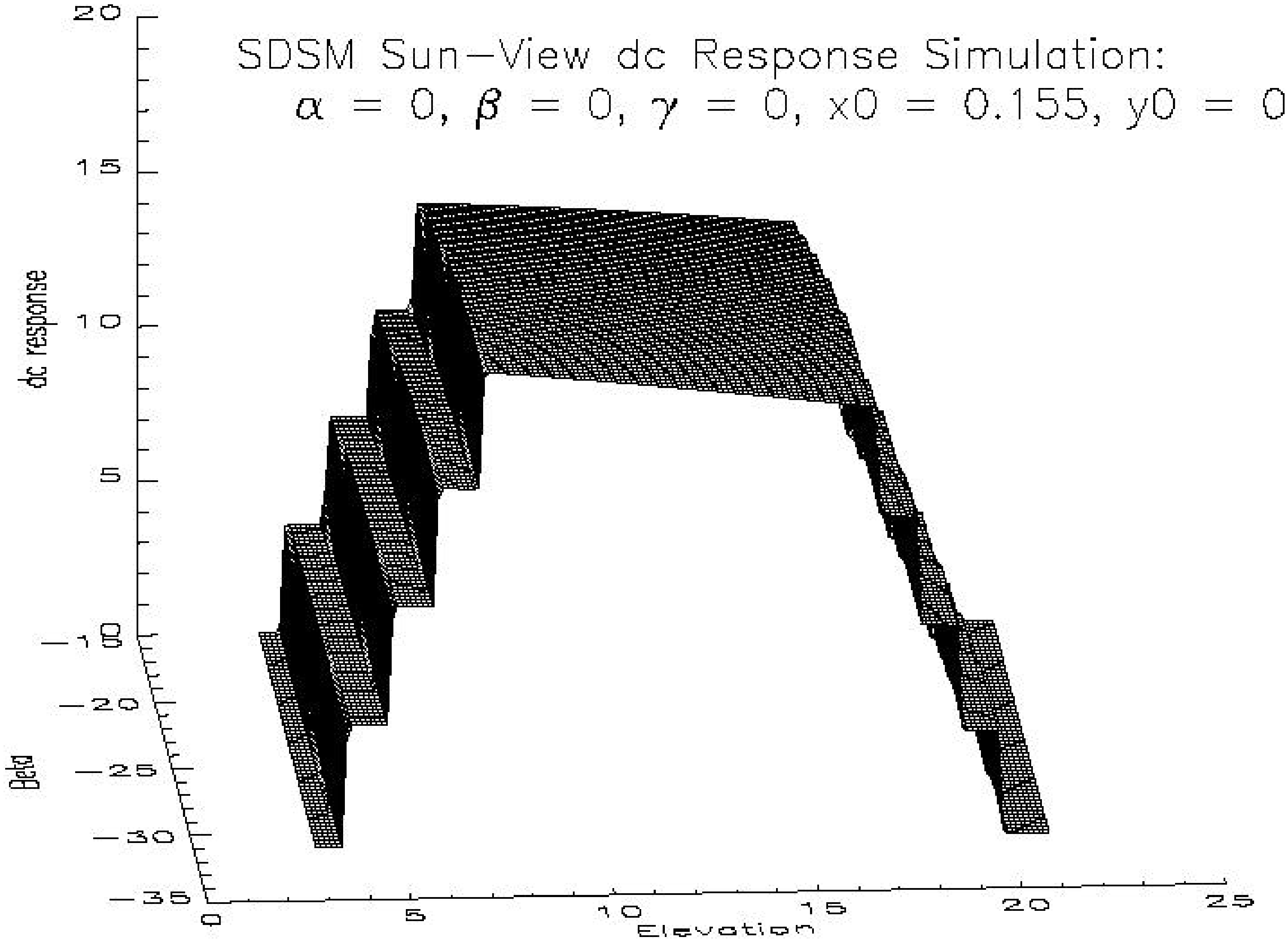
Simulation Results

Nominal Orientation



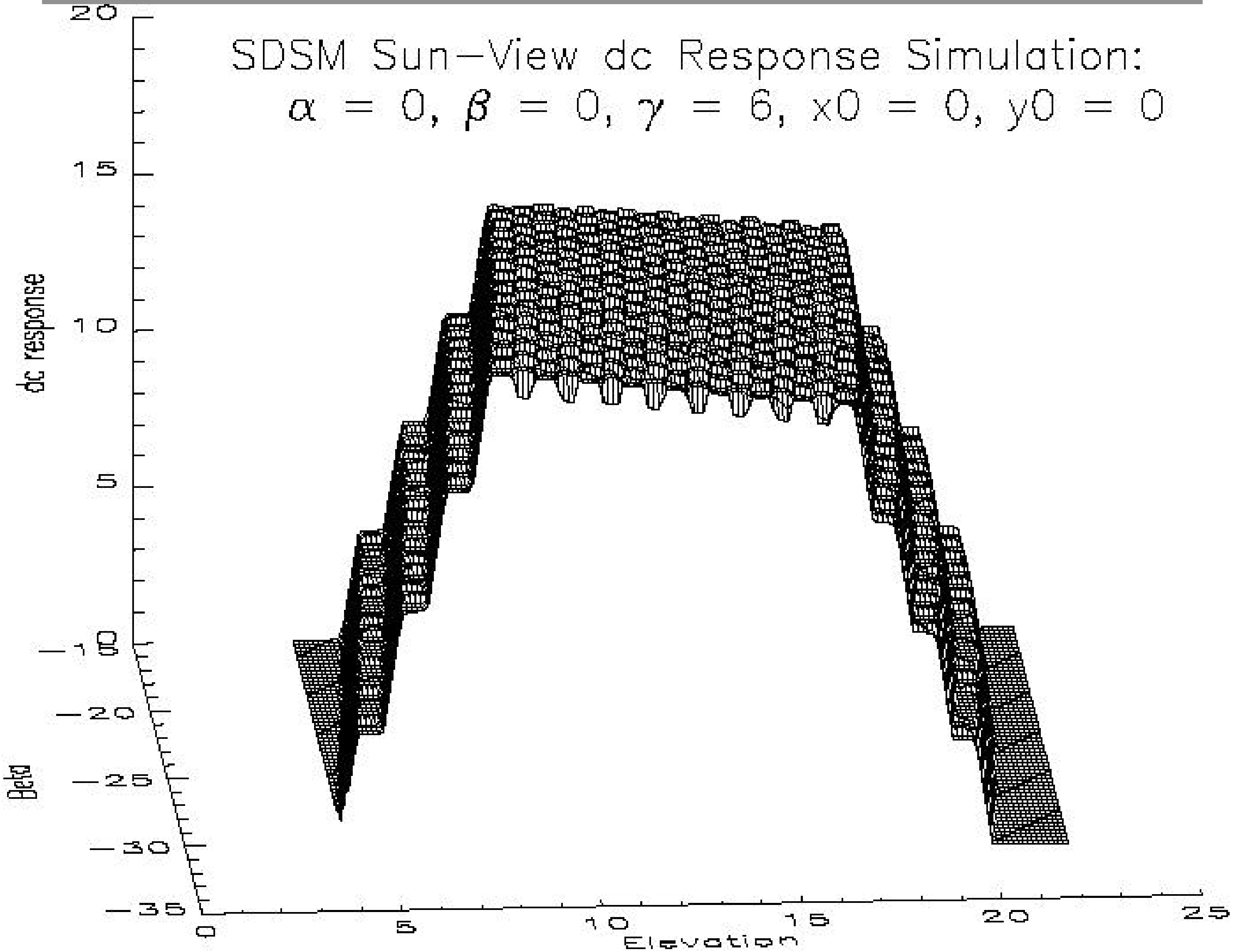
Simulation Results

Translation in X



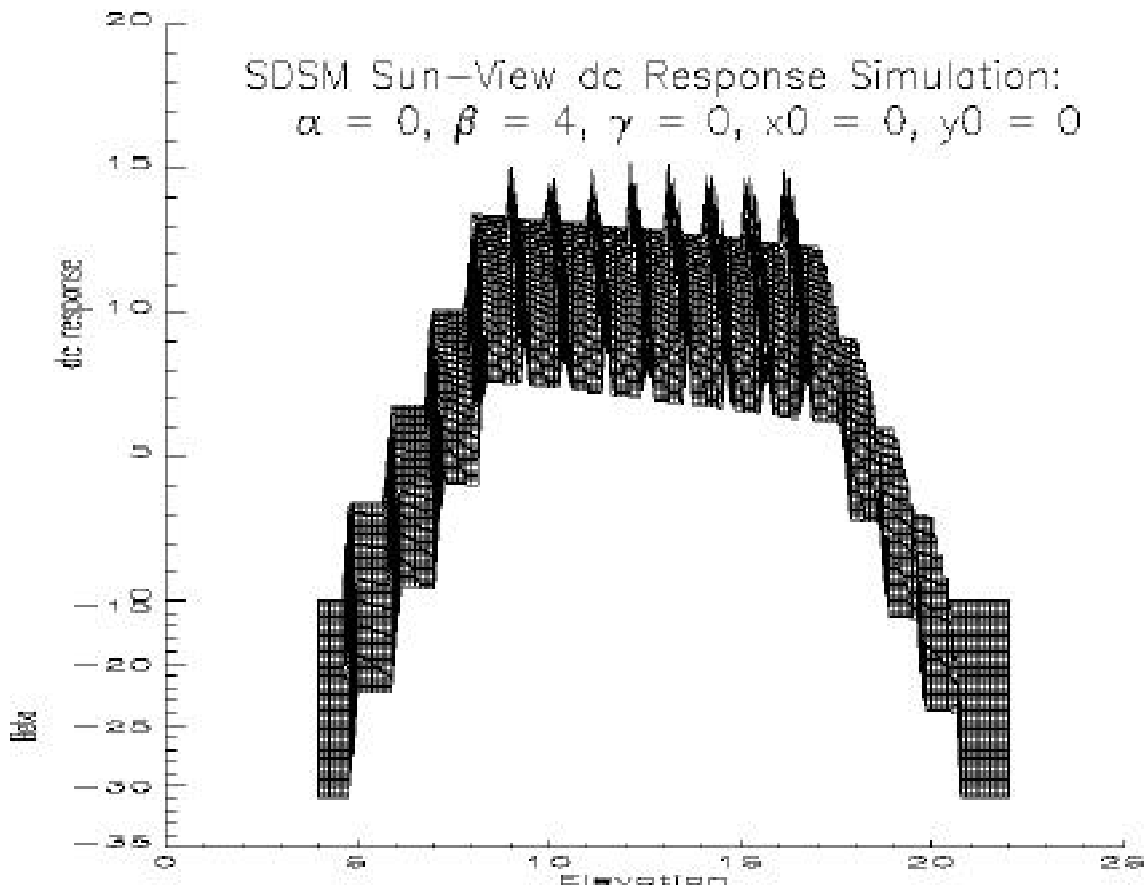
Simulation Results

Pinholes Rotated, Still In-plane with Aperture



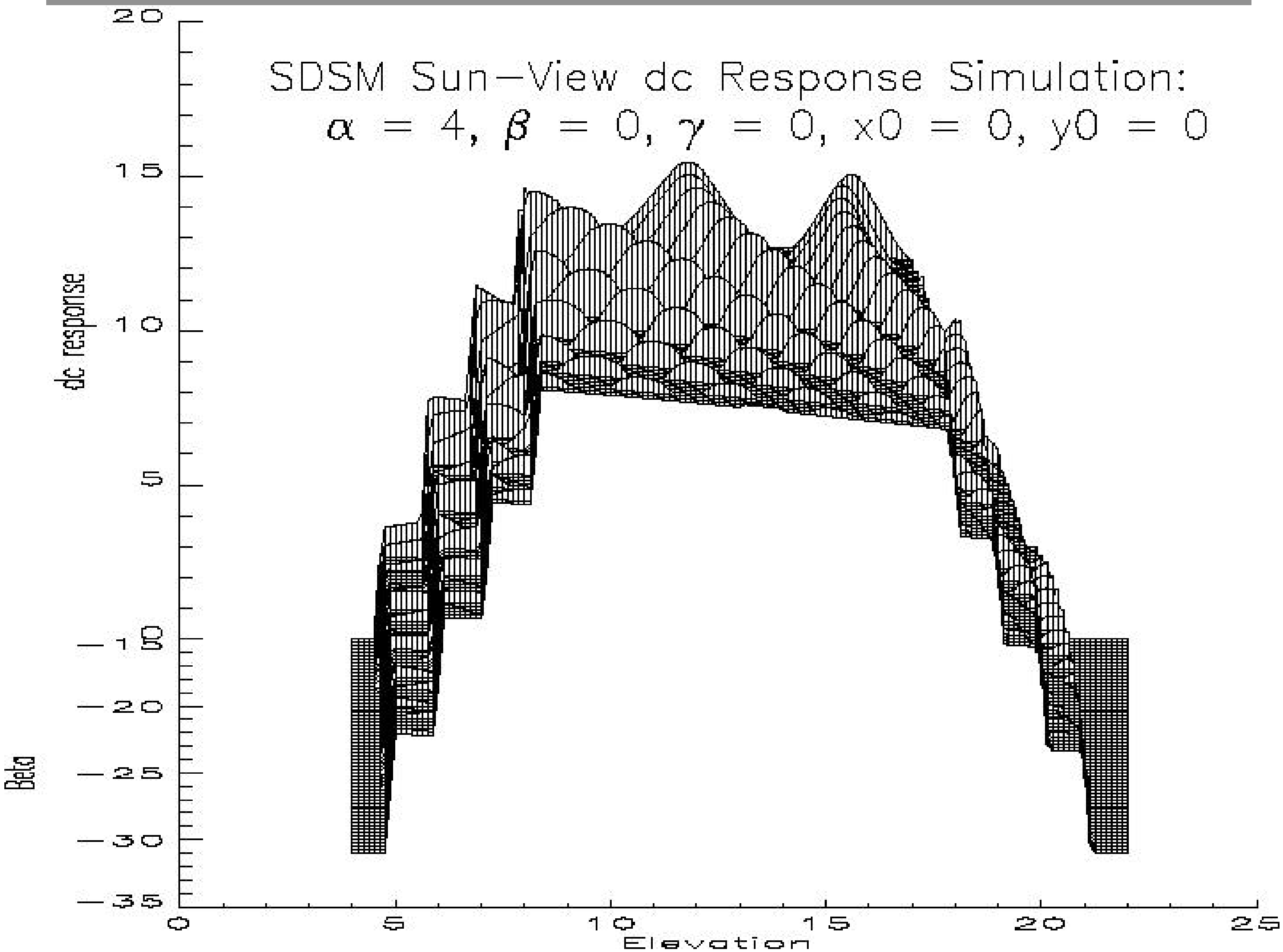
Simulation Results

Pinholes Rotated Out-of-Plane with Aperture



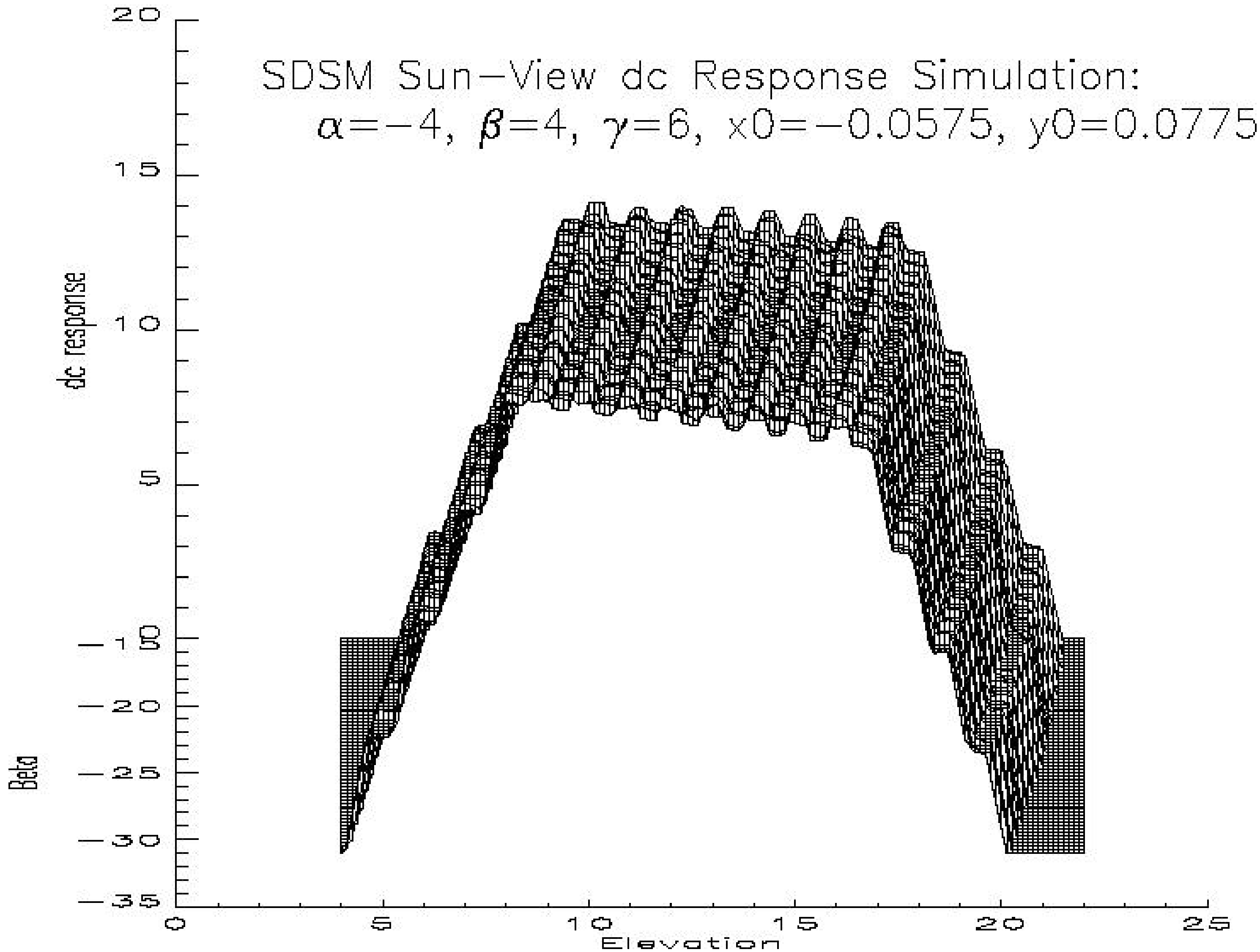
Simulation Results

Pinholes Rotated Out-of-Plane with Aperture



Simulation Results

Complex Rotation and Translation



Discussions

- Preliminary model results support notion that rotation with some out-of-plane component in SDSM screen could induce observed structures in SDSM Sun-view response
- SDSM screen was “cut out” and replaced when MODIS was on spacecraft at launch, due to concern that original screen would cause saturation in signal

Future Work

- Determine $\alpha, \beta, \gamma, x0, \text{and } y0$ by fitting the measured dc_{Sun} on day 2000117 with least-mean-square method
- Compare the simulated dc_{Sun} with those measured on other days
- If the model works fine, the simulated $f(\theta_M, \varphi_M)$ can be applied to evaluate the SD degradation factor.
- Modeling of SD dn's for screen down

Section 10
Improvements Since Last STM

Improvement Since Last STM

- New SMIR FPA Vdet
  - **All detectors are functional** & less electronic crosstalk
- Switch to B-side Configuration
  - No formatter reset so far
- New PC Optical Crosstalk Coefficients (reviewed in section 13)
  - Coefficients derived from the lunar observation are used in the LUT
- SWIR Thermal Leak
  - New algorithm and new coefficients **(reviewed with correct application of SWIR correction)**
- New Algorithm to compute <DN_{SV}> with Moon in SVP

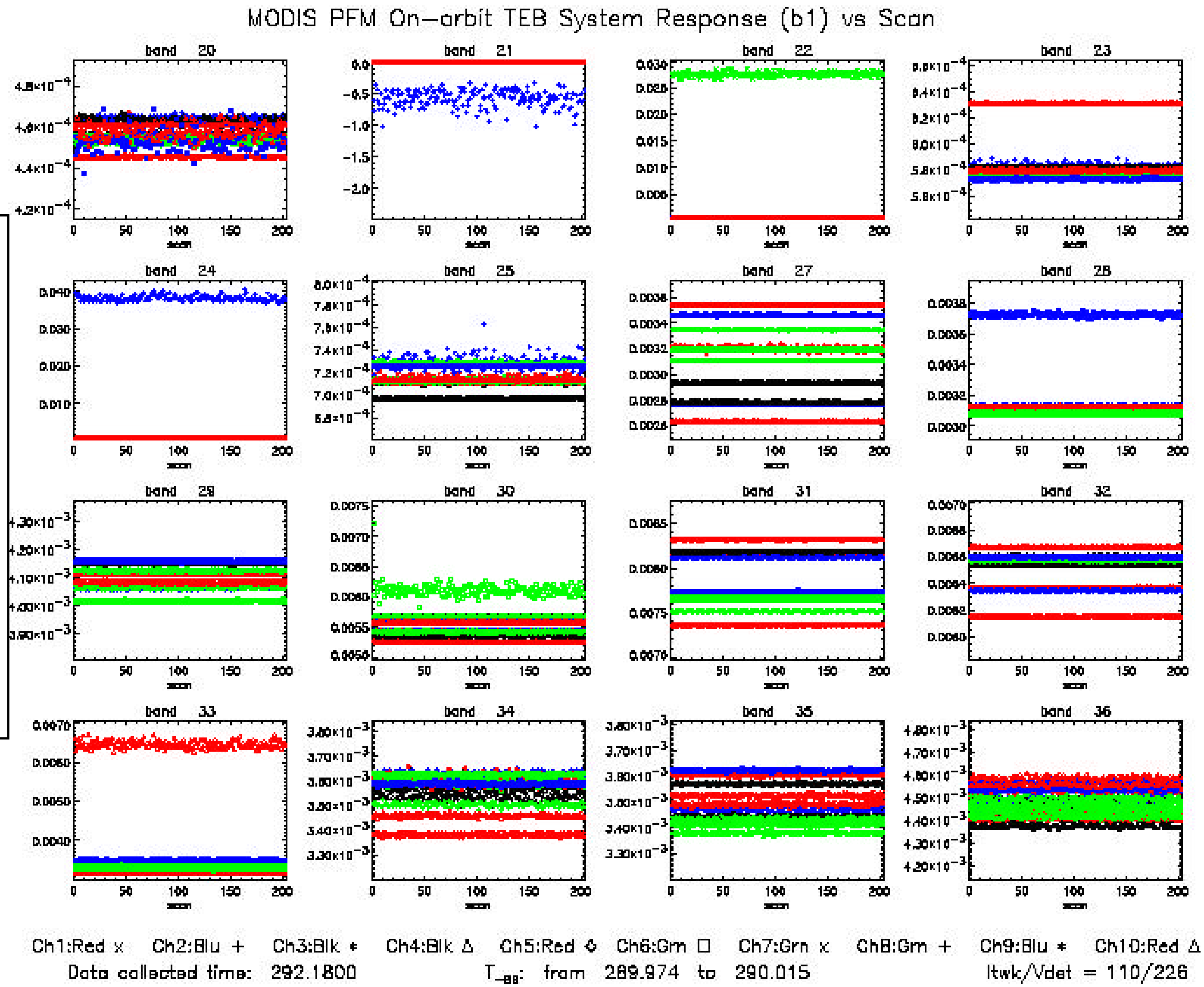
Improvement Since Last STM

- B14H m_1 Estimate (reviewed in section 5)
  - B14H saturated with SD screen down
  - Derived B14H m1 using ratio to B14L from the Earth scene data
- Code indexing Bugs Related to Calibration and L1B Product
  - **Correct application of TEB RVS**
  - **Correct application of PC crosstalk**
  - **Correct application of SWIR correction**
  - Indexing bug corrected for TEB b1 scan averaging following a sector rotation or Ecal

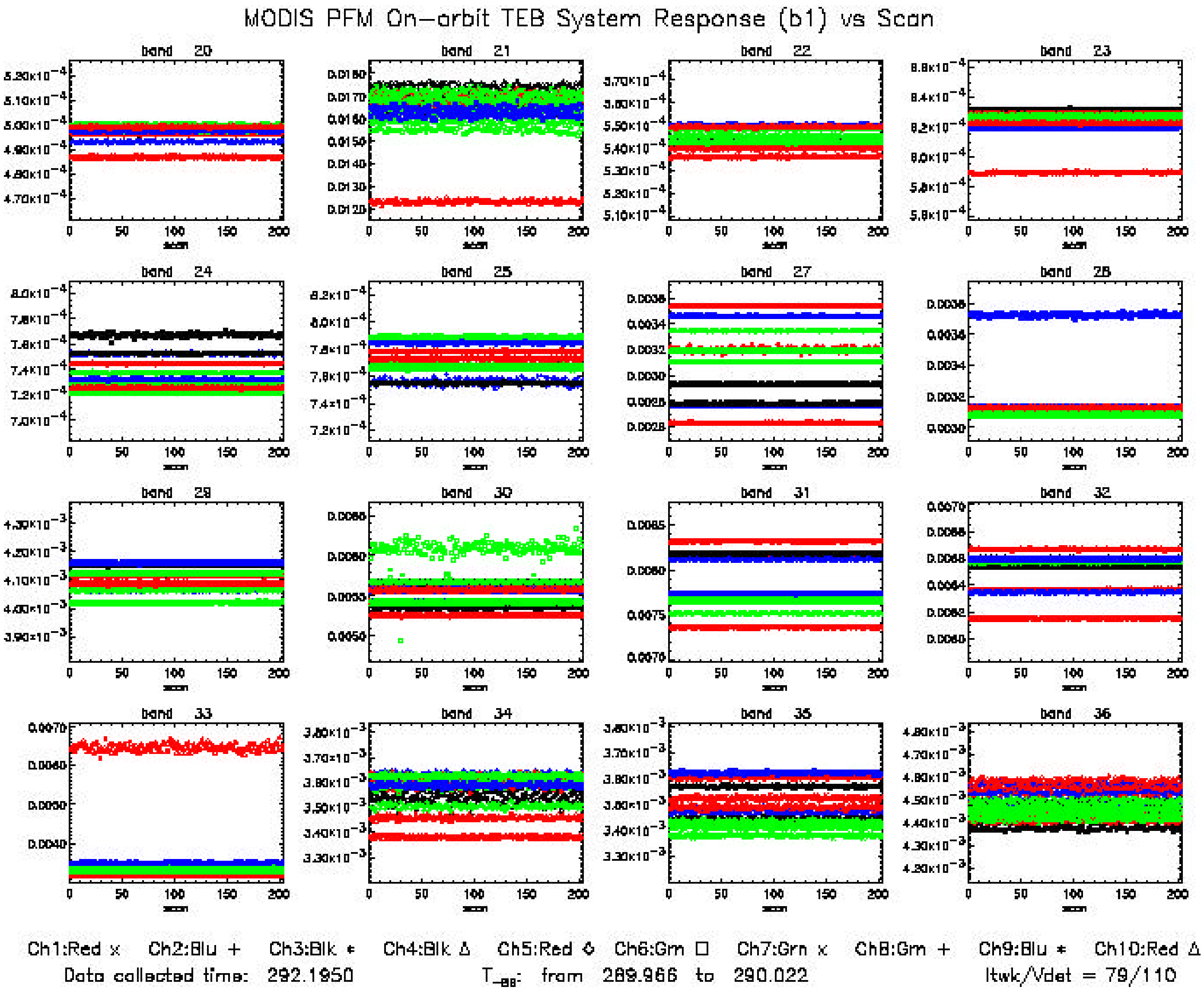
Several Nonfunctional Detectors in Vdet = 226 configuration

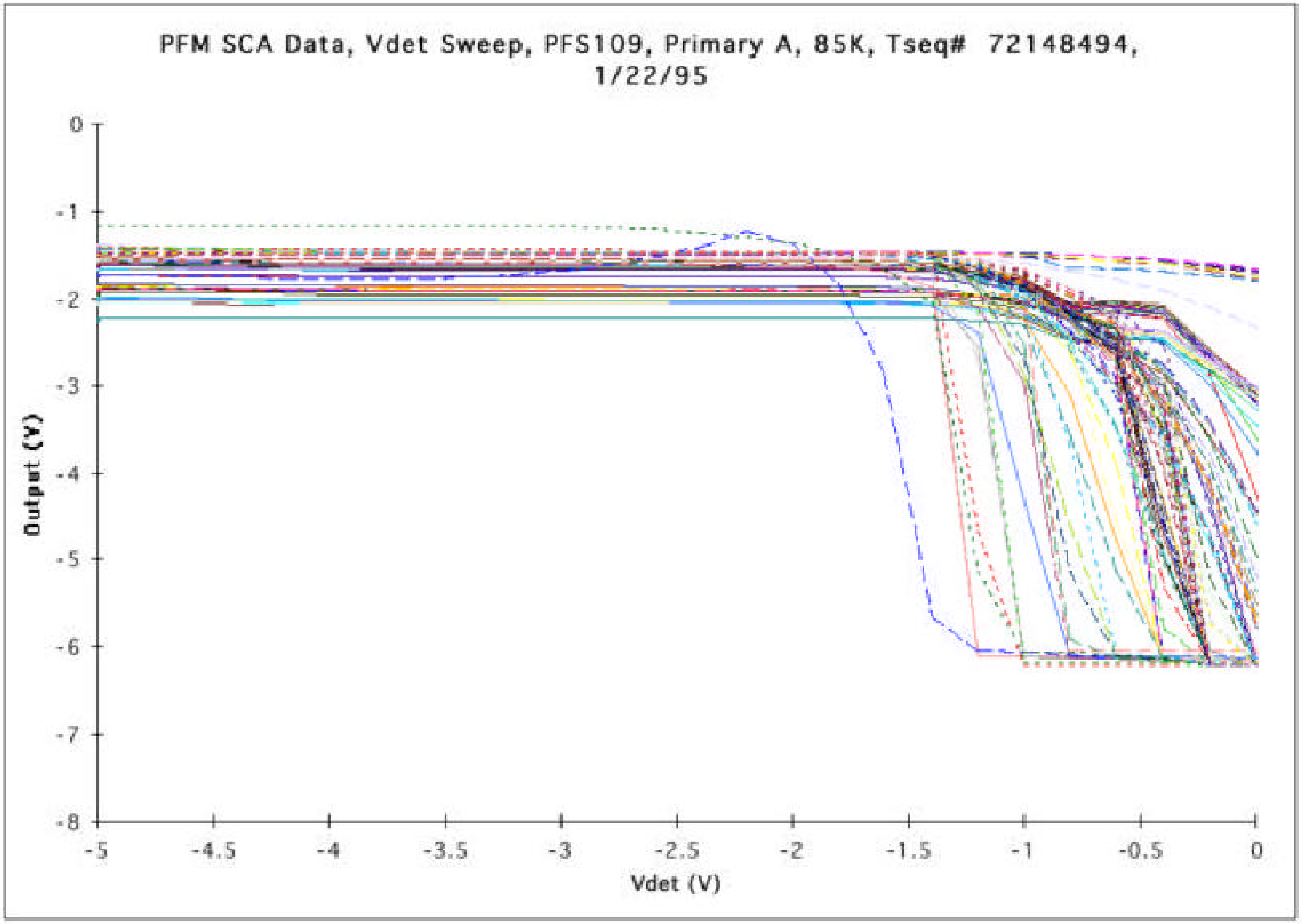
Nonfunctional Detectors in Product Order

B6: D3
B6: D7
B7: D14
B21: D9
B22: D4
B24: D9



All Detectors Are Functional in Vdet = 110 configuration




PFM SCA Data, Vdet Sweep, PFS109, Primary A, 85K, Tseq# 72148494, 1/22/95
0
-1
-2
-3
-4
-5
-6
-7
-8
Output (V)
-5
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
Vdet (V)

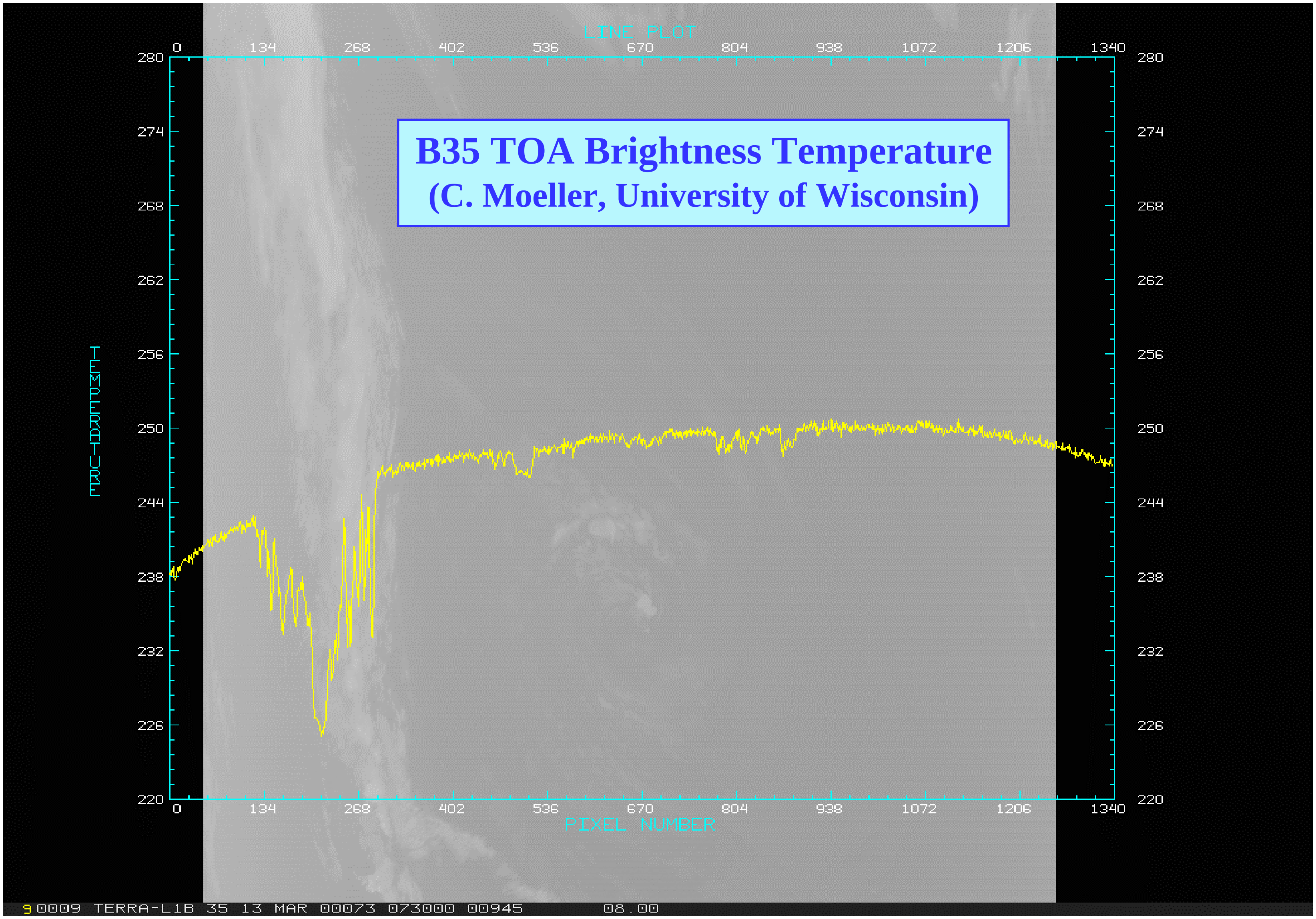
Correct Application of TEB RVS

TEB TOA Radiance Retrieval Algorithm

$$L_{EV} = \frac{[a_0^{BCS}(T_{instr}) + b_1^{BB} \; dn_{EV} + a_2^{BCS}(T_{instr}) \; dn_{EV}^2] - (rvs_{SVS}^{sm} - rvs_{EV}^{sm}) \; L(T_{SM})}{rvs_{EV}^{sm}}$$

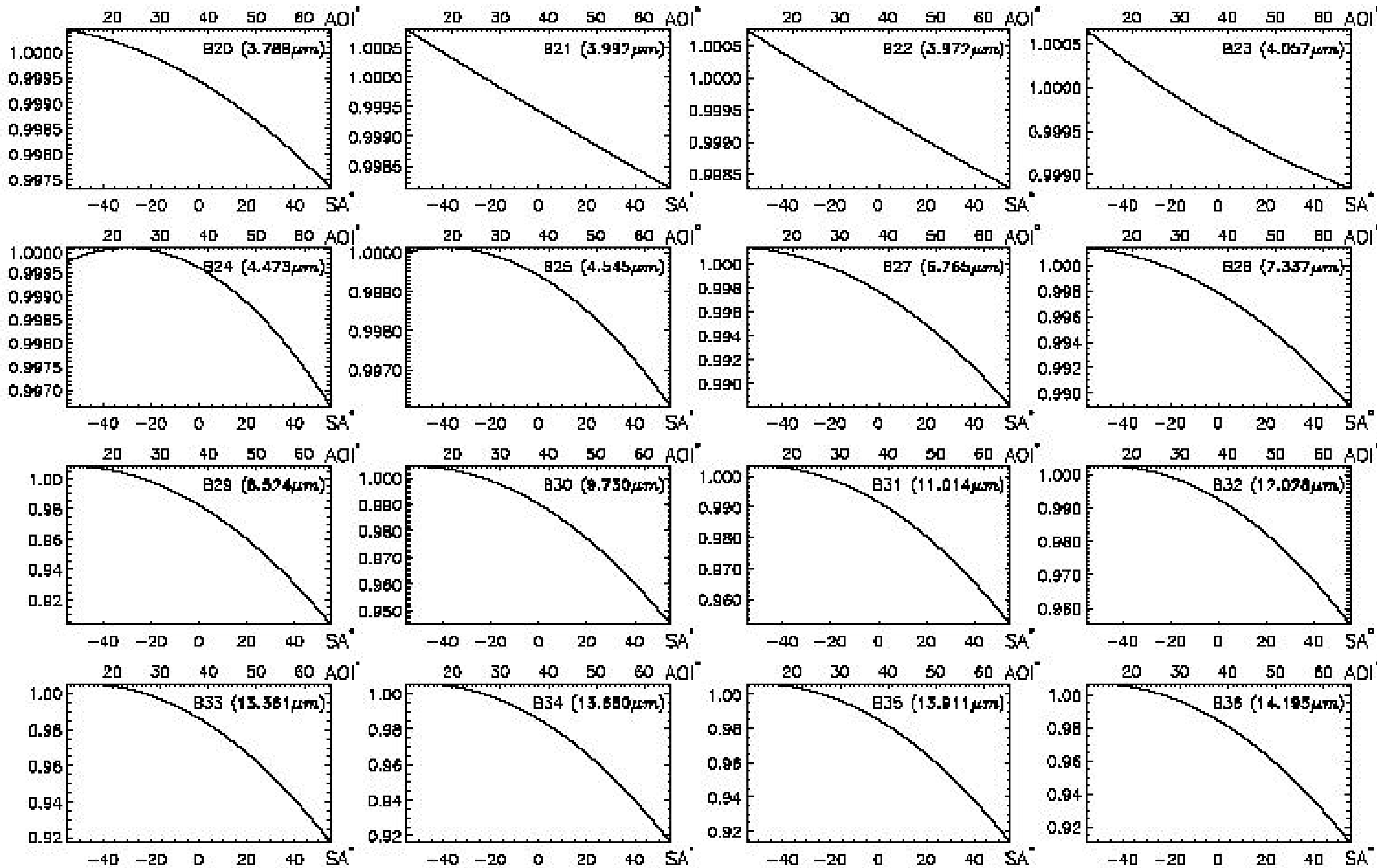
- TEB code RVS index error
  - Band index (0-15) used for detector index (0-159) for RVS and $L(T_{SM})$ terms
  - Scan angle dependent response not corrected for the TEB L1B product
  - Example - B35 TOA brightness temperature is colder at BOS than at EOS
- Code change made in L1B V2.4.2 (start from 2000162)

Results Before Index Error Fix



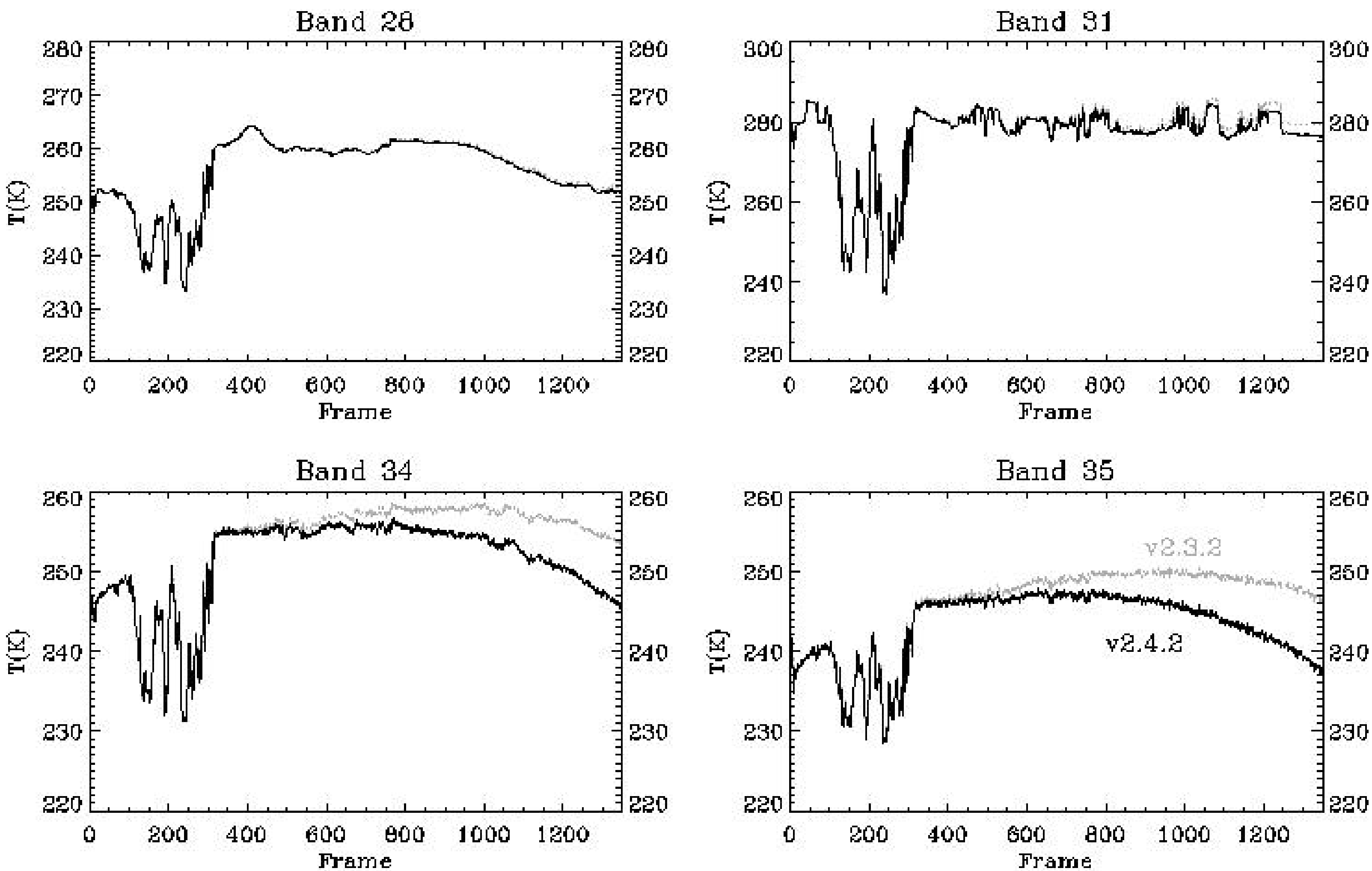
TEB Pre-launch RVS

Terra MODIS Pre-launch *Response Versus Scan Angle* (*RVS*)



Results After Index Error Fix

Figure 3. L1B v2.3.2 and v2.4.2 Brightness Temperature Retrieval on L1A:2000073.0730
(Scan# 79, Mirror 1, Ch 5)



Correct Application PC Crosstalk

For PC Bands 32-36:
Optical crosstalk from B31 is corrected on a scan by scan basis with proper frame offset

$$dn_{B32-36}^{correct}(F) = dn_{B32-36}^{measured}(F) - dn_{B31}(F + FO_{B32-36}) \; X_{B31->B32-36}$$

- Code logic error in PC Crosstalk Application
  - Last scan of B31 dn_{BB} from preprocessor was used
  - Impact is small - negligible for relative uniform scene
- Code change made in L1B V2.4.3 (start from 2000231)

Correct Application SWIR Correction

Originally in the L1B Code

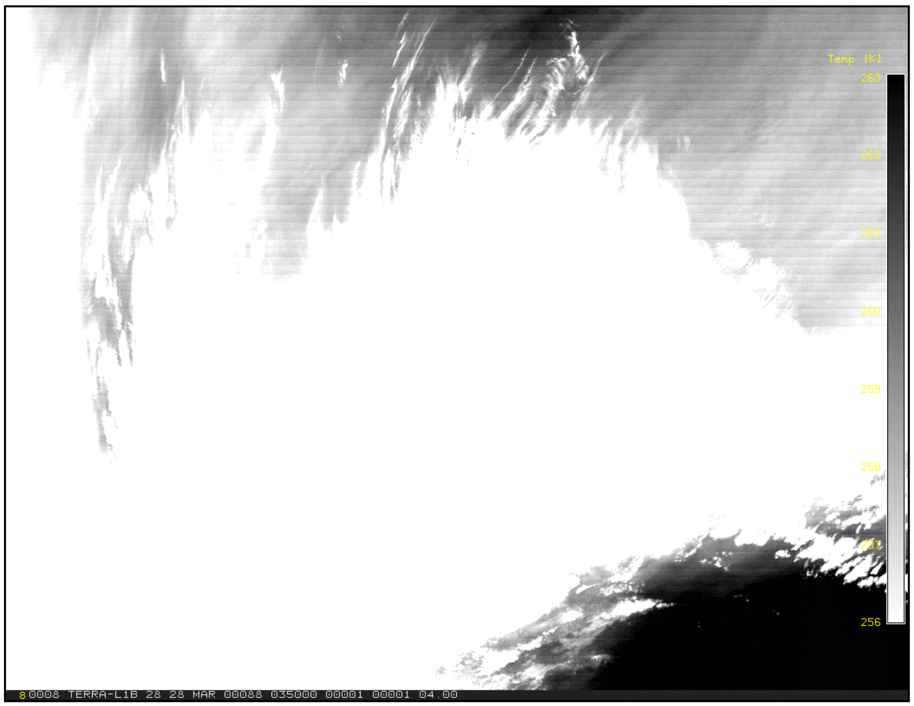
$$dn_{swir}^{correct} = dn_{swir}^{measured} - dn_{swir\_corr}$$

$$dn_{swir\_corr} \quad L_{B28}$$

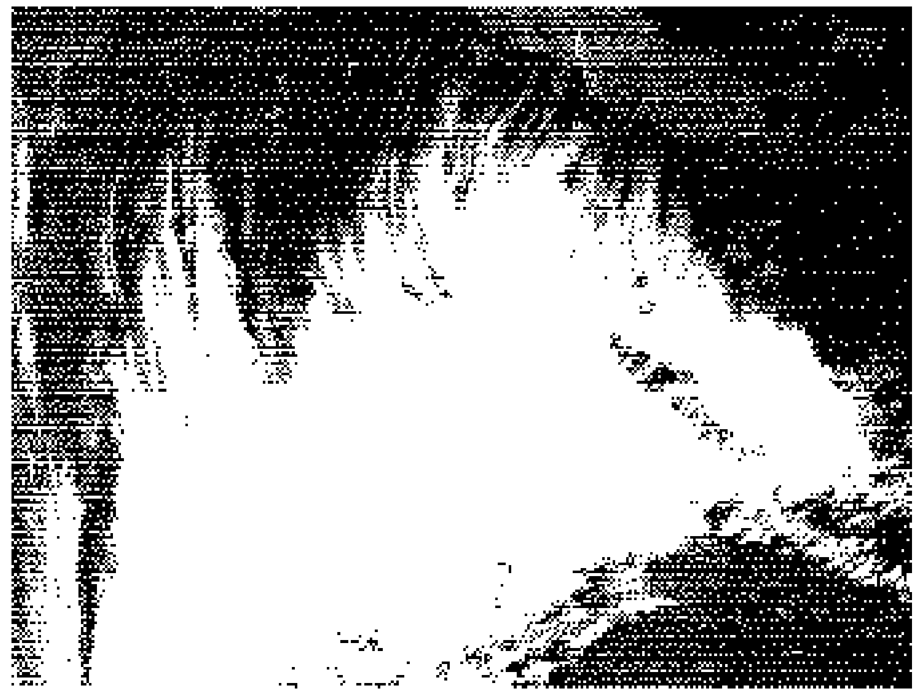
- SWIR out-of-band correction index error
  - Band 29 radiance was used instead of B28
  - Cuba scene example (B26 night time data)
- Code change made in L1B V2.4.4 (start from 2000287)
- New Algorithm implemented in L1B V2.5.4 (start from 2000328)

Cuba Night Scene Example

B28 (surrogate for 5.3um) does not see Cuba



B26 (1.38um) should not see Cuba at night

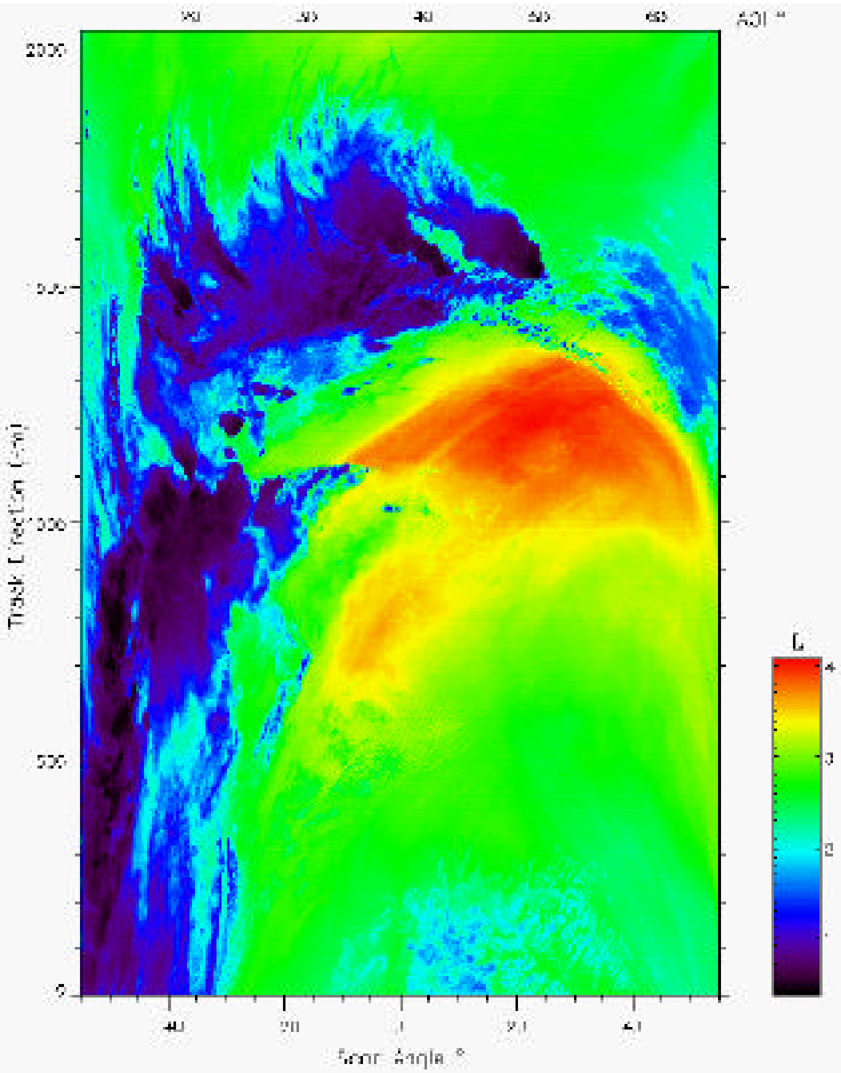


L1B images 2000088.0350
(C. Moeller, University of Wisconsin)

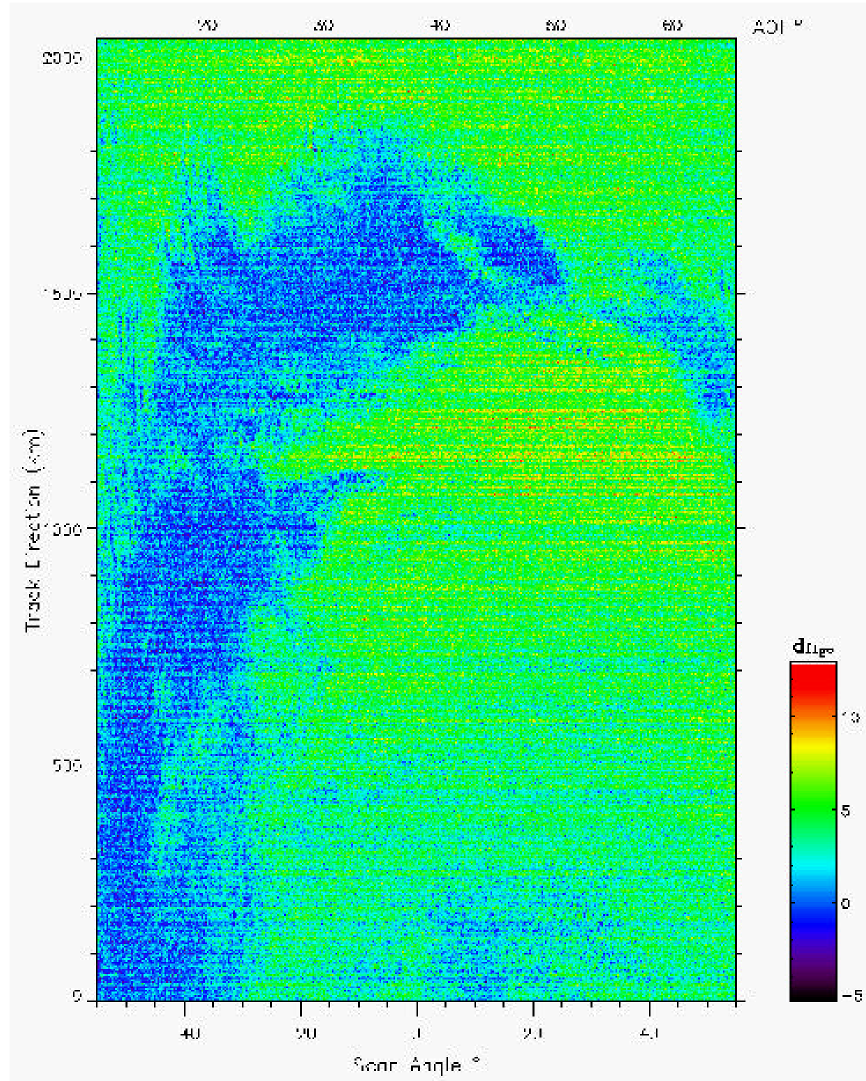
B28 and B26 Images

(2000088.0350)

B28 Radiance

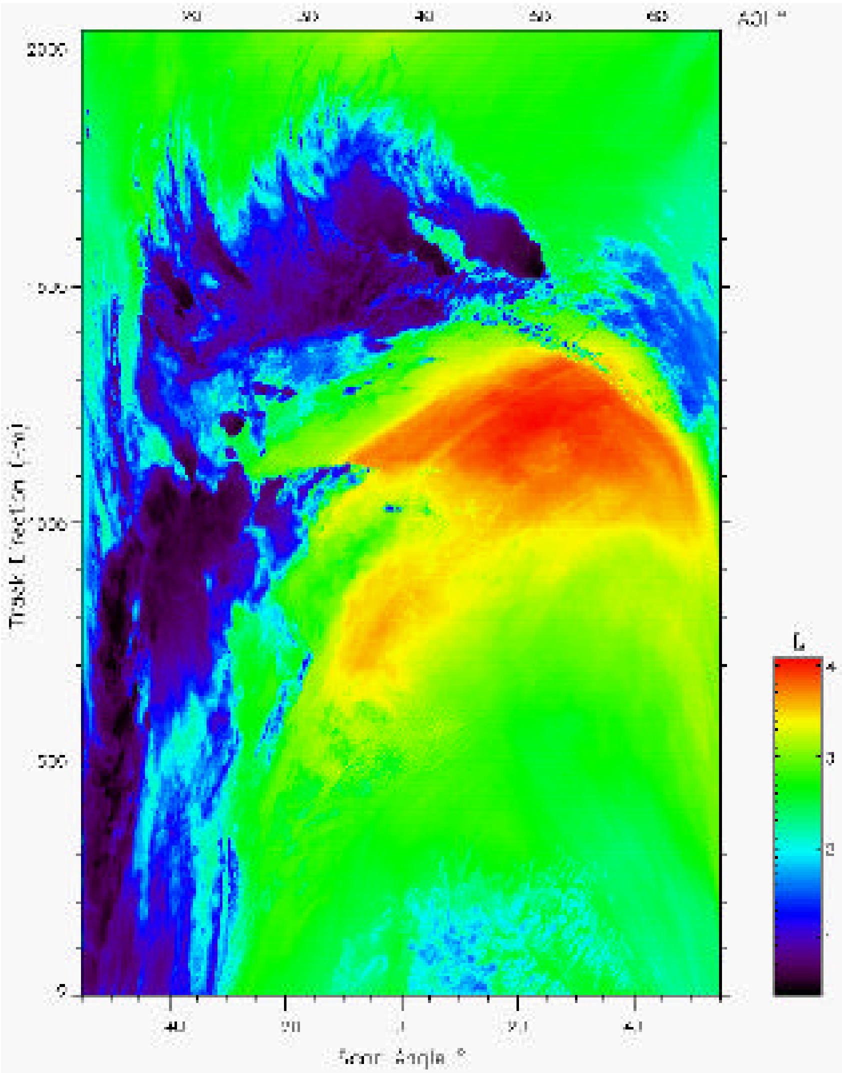


B26 dn - no correction

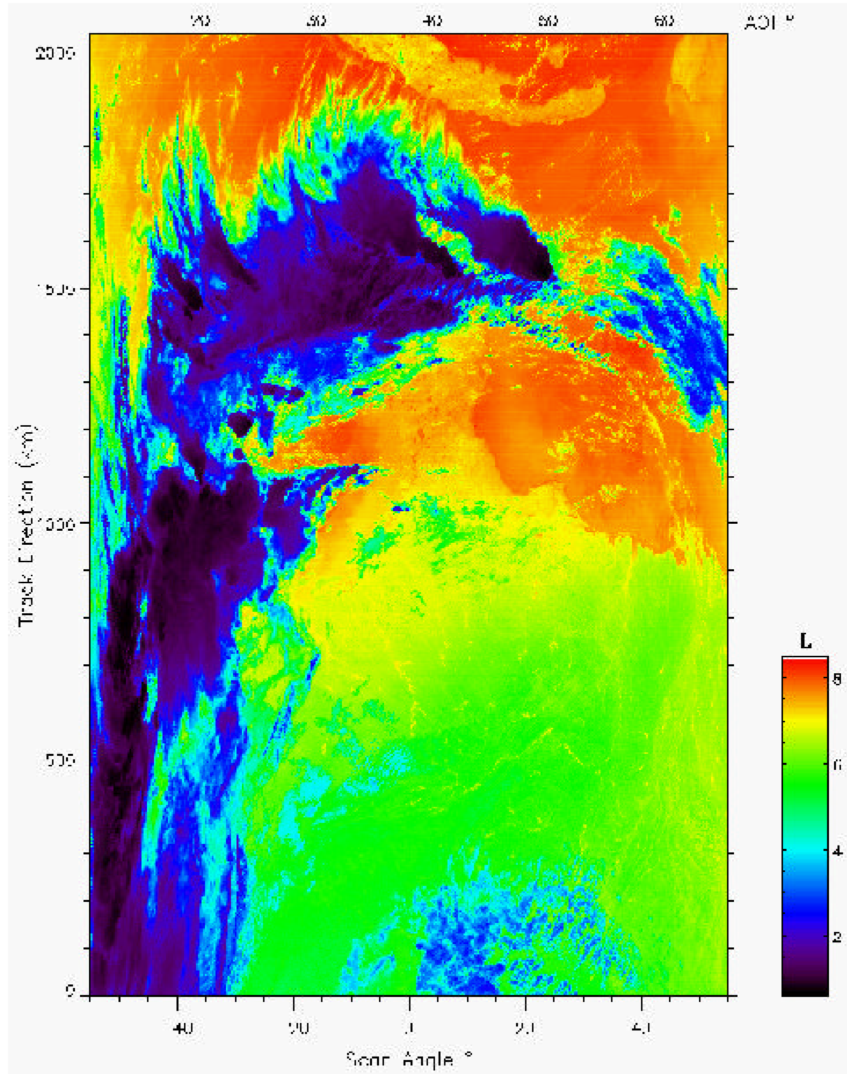


B28 and B29 Images
(2000088.0350)

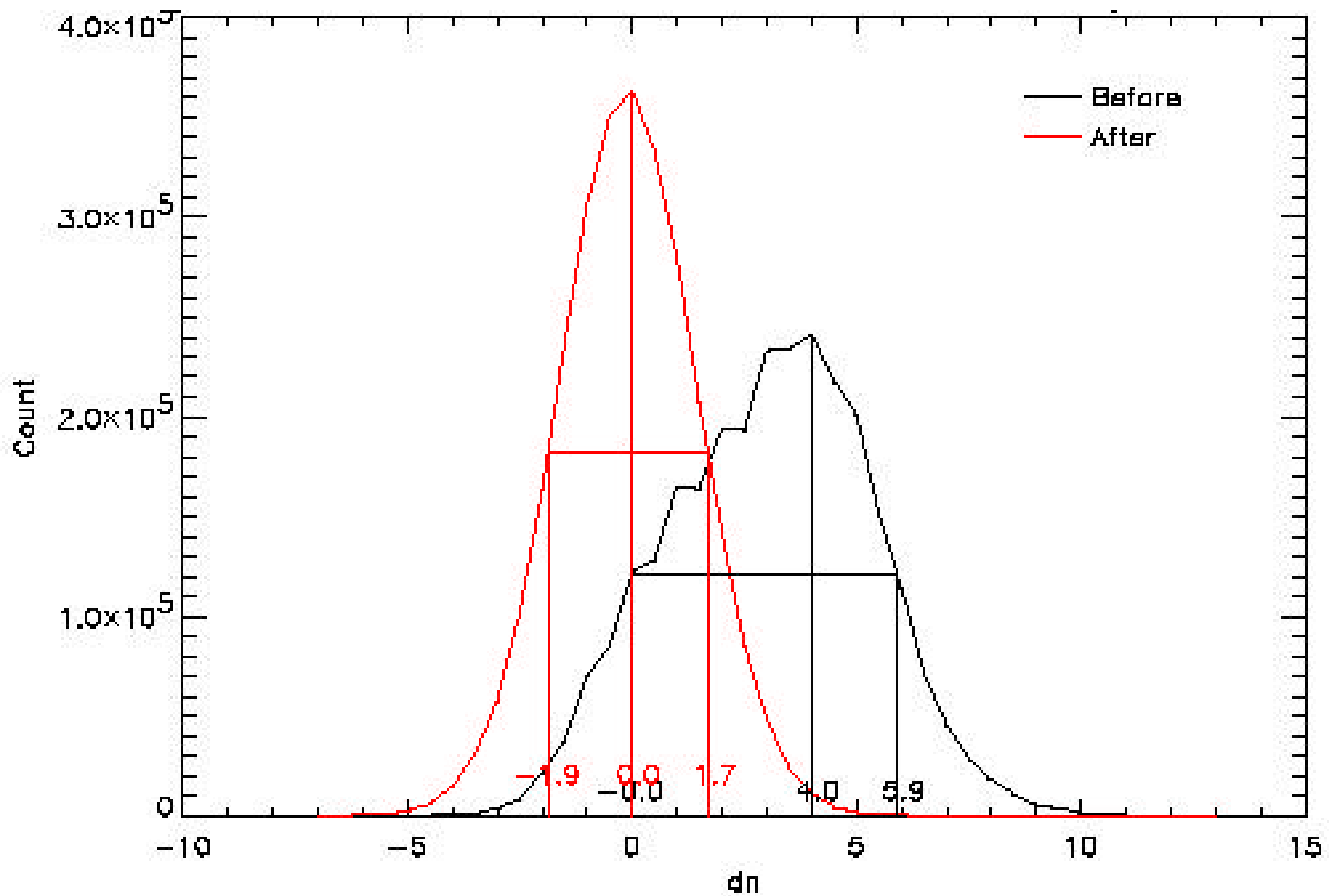
B28 Radiance (Ltyp=2.2 w/m²-μm-sr)



B29 Radiance (Ltyp=9.6 w/m²-μm-sr)



B26 dn Histograms
(2000088.0350)



The correction is made with coefficients derived from B28 dn dependence

SWIR dn (night time) vs B28 dn

(2000294.0020)