NICST Internal Status Report
January 14, 2009

Outline --Arthur

Objectives:

- **Examine the August, 2008 SIS(100) Calibration Data, reported in** *VIIRS[1]10.15.010.doc*.
- **Examine the SIS Radiance Model described in** *VIIRS[1].02.18.012.doc* **and** *SIS Drift Models.ppt*.
  - **Examine methodologies for modeling SWIR band drifting.**

Sources:

- *VIIRS[1].10.15.003_SIS100_Draft_Cal_Report.doc*, 4/22/08 (February 2008 Calibration Data)
- *VIIRS[1].02.18.012.doc*, Following SIS(100)-1 Spectral Radiance Drift in the VIIRS Bands Using the Radiance Monitor data, 7/28/08 (SIS Radiance Model)
- *VIIRS[1].10.15.010.doc*, SIS(100)-1 Calibration of August, 2008, 9/17/08 (August 2008 Calibration Data)
- *SIS(100)-1_Cal_lamp_configurations_Summary_final.xls* (August 2008 Calibration Data)
- *SIS Drift Models.ppt*, Modeling SIS100 Radiance Drift in the VIIRS Bands (SIS Radiance Model)

Using the SIS(100) Radiance Model

- **Given a set of known radiances at known wavelengths, the model should accurately predict radiance values at other wavelengths.**

$$L(\lambda) = R(\lambda)\cdot \varepsilon(\lambda,T)\frac{1}{\lambda^5}\cdot \exp\left(a+\frac{b}{\lambda}\right)\cdot\left(C_n\lambda^n + C_{n-1}\lambda^{n-1} + \ldots + C_1\lambda + C_0\right)$$

- **STEP 1: Set the polynomial equal to 1, and rearrange to obtain:**

$$a\lambda + b = \lambda\cdot\ln\left(\frac{L(\lambda)\cdot\lambda^5}{R(\lambda)\cdot\varepsilon(\lambda,T)}\right)$$

  - **Use known radiances at known wavelengths to calculate right-hand side.**
  - **Perform linear fit to obtain a, b coefficients.**
  - **Recall:** $b = {-c_2}/{T}$

- **STEP 2: Rearrange model equation to isolate polynomial:**

  - **Using fitted a, b, perform polynomial fit to obtain $C_0, C_1, \ldots, C_n$**

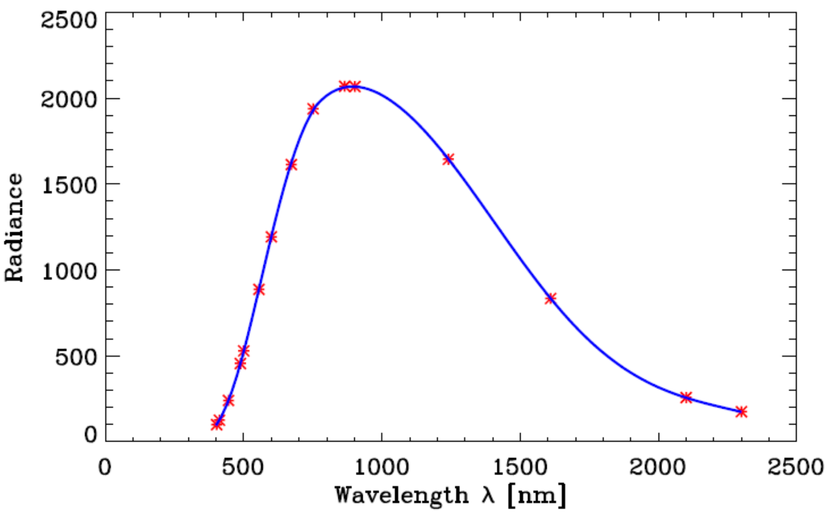
$$C_0 + C_1\lambda + \ldots + C_n\lambda^n = \frac{L(\lambda)\cdot\lambda^5}{R(\lambda)\cdot\varepsilon(\lambda,T)\cdot\exp\left(a+\frac{b}{\lambda}\right)}$$

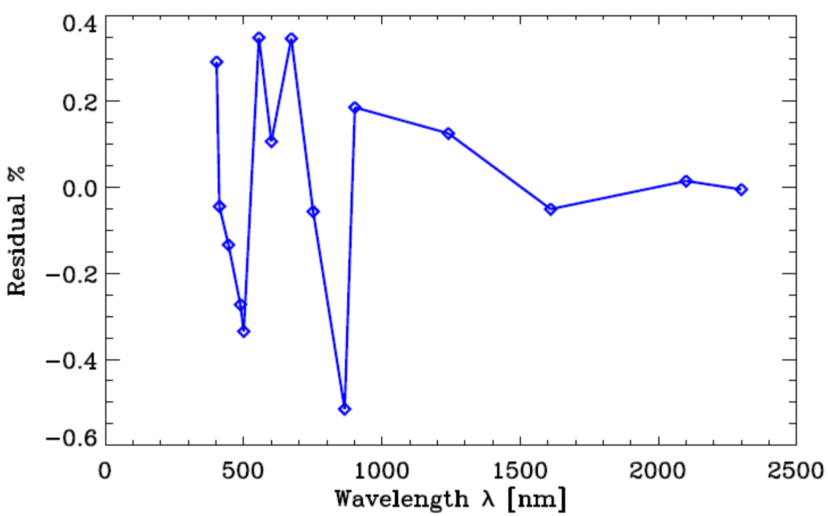
- **For both steps, it is necessary to determine the proper values over which to perform fitting.**

Model Results: Calibration Data

15 calibration points (VisNIR + SWIR)

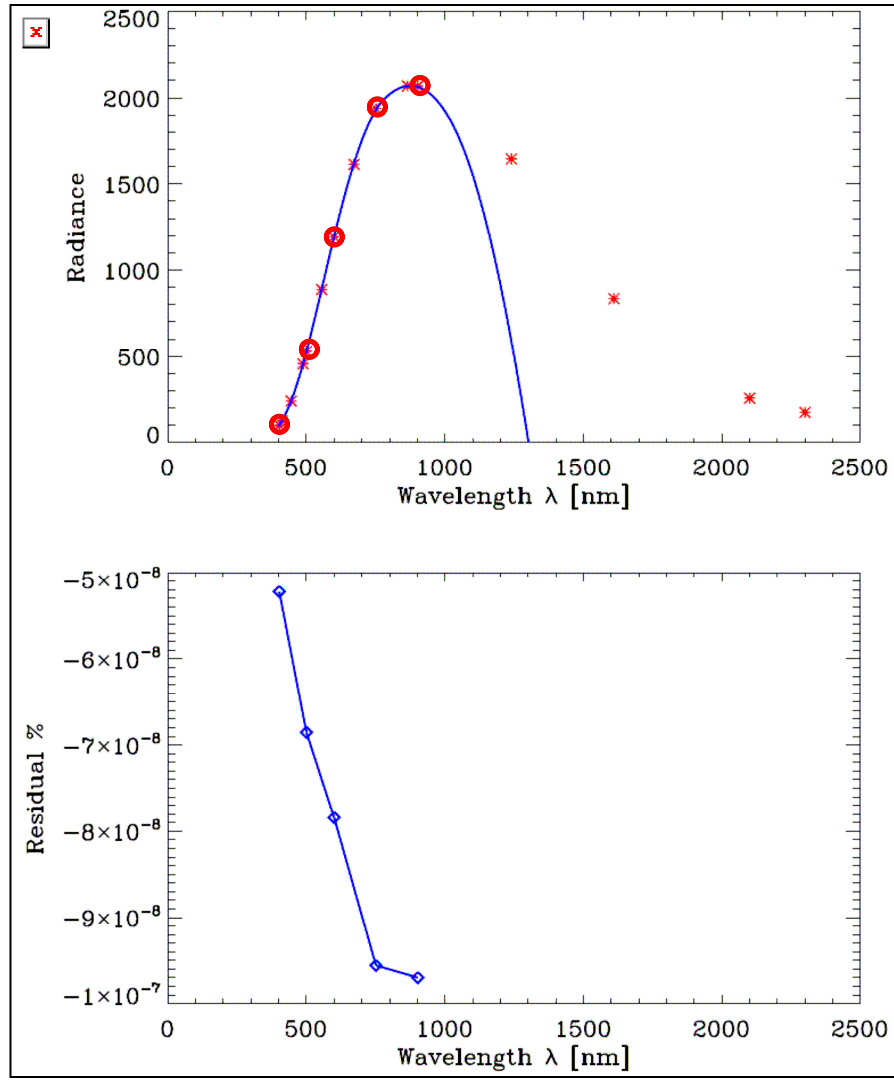
Calibration data $L_{0.0.18}$





5 calibration points (VisNIR only)

Calibration data $L_{0.0.18}$



SIS(100) Radiance Model – SWIR (Ratio)

- For each set of radiance monitor data (radiance values at F1, F2, F3, F4, F5), perform STEP 1 of the Radiance Model.
  - This yields a and b, and therefore color temperature: $T = {}^{-c_2}\!/_{b}$
- From the first set of radiance monitor data, use the results as a baseline:
  - The color temperature from the first data set is T_0
  - The resulting approximate radiance is $L_0(\lambda) = R(\lambda)\cdot\varepsilon(\lambda)\dfrac{1}{\lambda^5}\cdot\exp\left(a - \dfrac{c_2}{T_0\lambda}\right)$
- For subsequent sets of radiance monitor data, calculate the ratio to the first data set values:

$$L(\lambda) = L_0(\lambda)\cdot\left(\frac{T_0}{T}\right)^4\cdot\frac{\exp\left({}^{c_2}\!/_{\lambda T_0}\right)}{\exp\left({}^{c_2}\!/_{\lambda T}\right)}$$

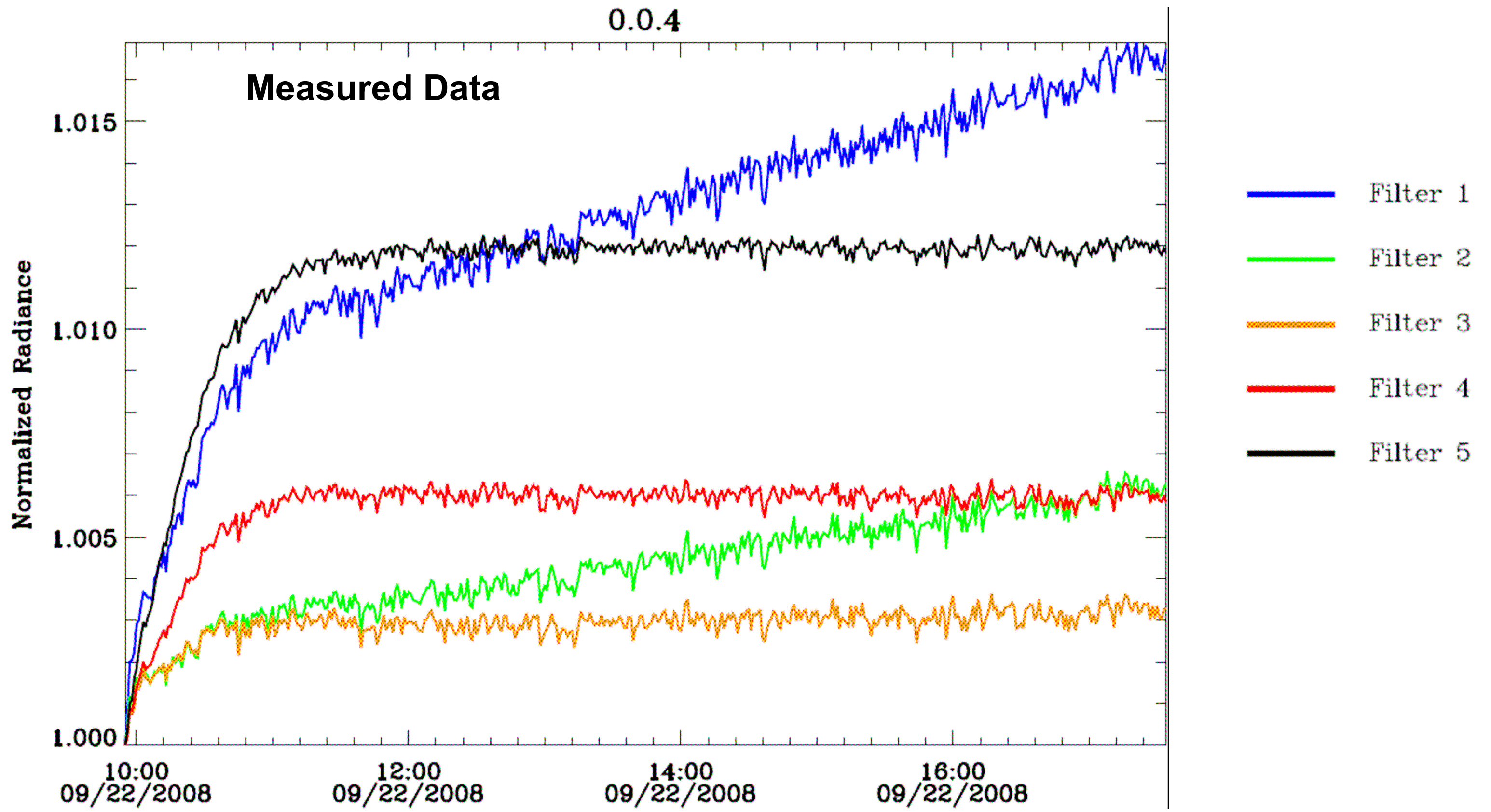
- This allows for tracking of *changes* (drift) in the SWIR band radiances, but not the actual radiance values.
- This method is described in *VIIRS[1].02.18.012.doc*. (7/28/08)
- The $(T_0/T)^4$ factor comes from another set of physical equations cited by SBRS, but does not originate from Planck's equation, and is not a part of the Radiance Model equation.

SIS(100) Radiance Model – SWIR (Model3)

- An alternative method for calculating SWIR band radiance is to use a combination of radiance monitor data and calibration data, in order to obtain a set of input data that spans the VisNIR and SWIR ranges.
  - This method is described in *SIS Drift Models.ppt (Reinhard Menzel)*
  - Different selections of RM and calibration data were attempted.
  - In all cases, "STEP 1" (*a* and *b*) was performed with only RM data.
  - One possible combination of data (called "Model 3"):
    - For VisNIR, 4^{th} order polynomial derived from radiance monitor data. (This is simply the Radiance Model.)
    - For SWIR, 4^{th} order polynomial derived from calibration data in SWIR range AND radiance monitor data at 751 and 902 nm.
- Concerns with this method:
  - The exact choice of which calibration data to use (and which RM data to use) significantly affects the results.
  - The same set of calibration data is used for all time-values of radiance monitor data.

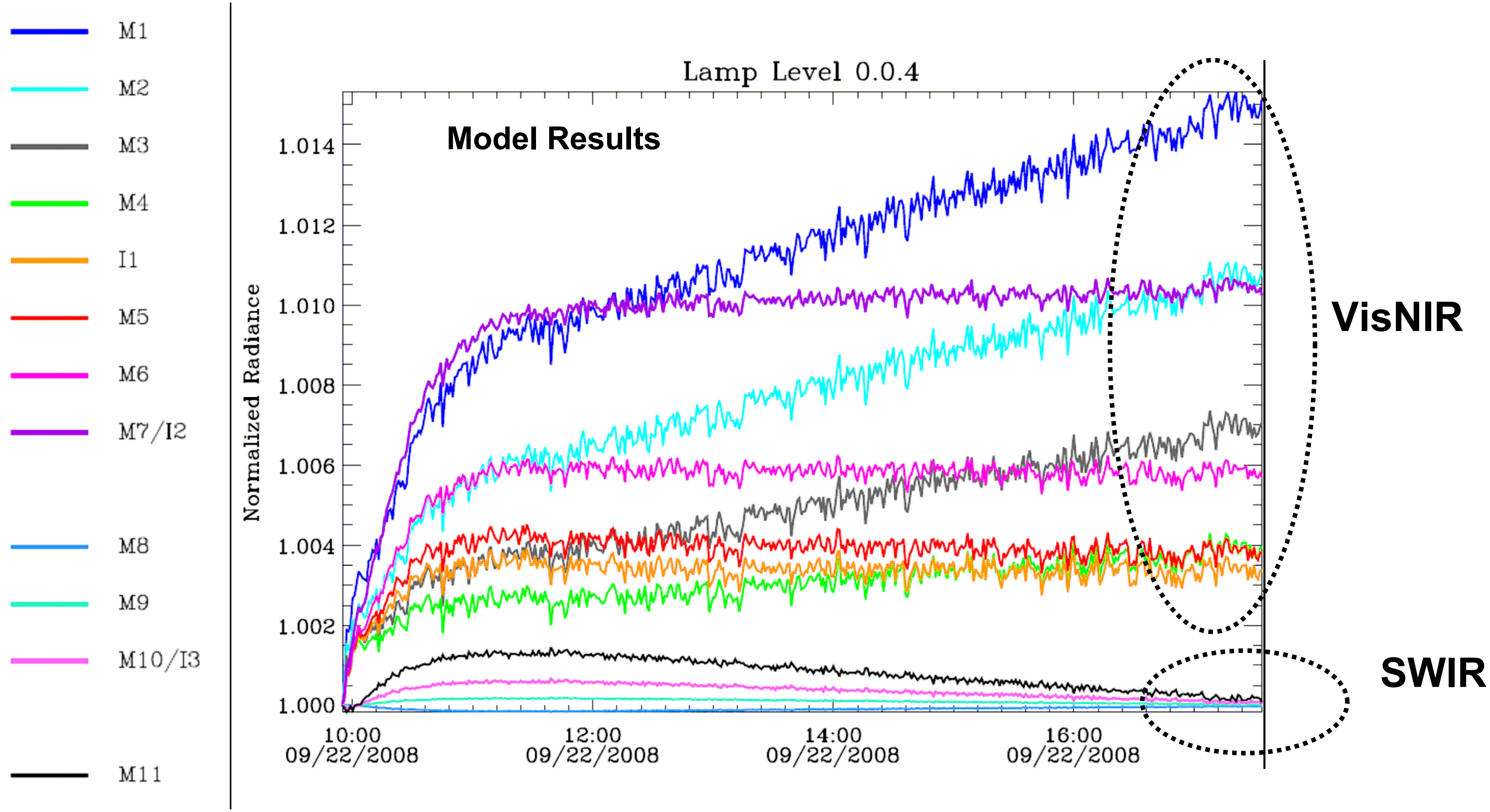
Radiance Monitor Data: 9/22/08

- Radiance Monitor data from 9/22/08.
- All values are normalized to initial (t=0) value.
- Filter 1 (402nm) and Filter 2 (500nm) show drifting beyond warm-up.
- In presenting this data, SBRS omitted the first ~10 minutes of data, which made the overall drift smaller.



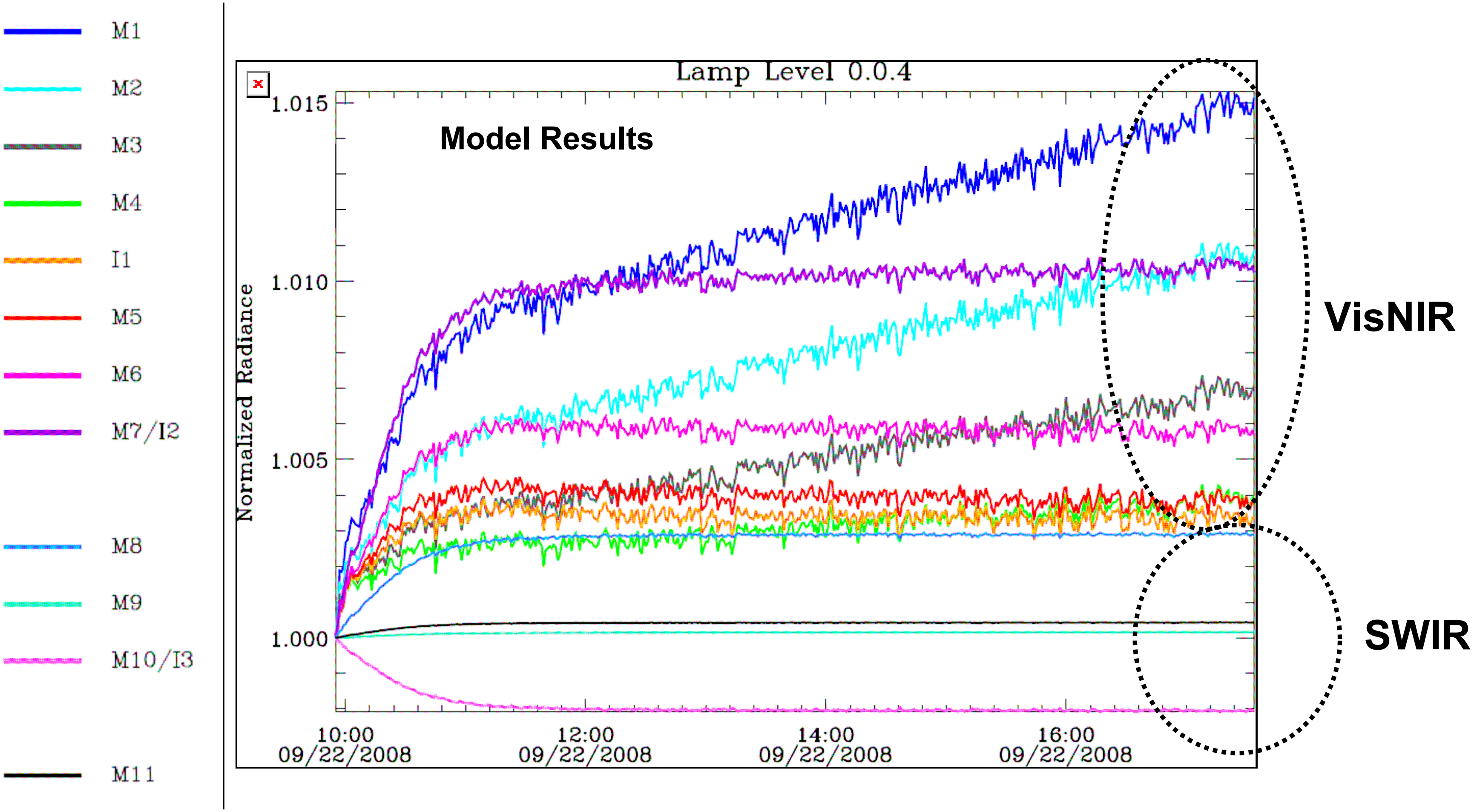
SIS(100) Radiance Model – SWIR (Ratio)

- **The ratio method is applied to Radiance Monitor data from 9/22.**
  - **SWIR band drift is < 0.2% over 7+ hours.**
- **For VisNIR bands, Radiance Model is applied (not ratio method).**



SIS(100) Radiance Model – SWIR (Model3)

- The model method is applied to Radiance Monitor data from 9/22.
  - SWIR band drift is < 0.3% over 7+ hours.
- For VisNIR bands, Radiance Model is applied (not Model3).



Summary

- SIS(100) was calibrated in August, 2008: *VIIRS[1].10.15.010.doc*.
    - Calibration was performed separately for 10W, 45W, 200W lamp sets.
    - Conversion to RC-2 lamp levels is verified (except 10.7.9, 10.7.8).
    - Interpolation to M6, I1 is verified within 0.8%.
- Radiance Model is examined (using Calibration data).
    - Model is based on Planck's Equation, modified by a polynomial.
    - Given input data spanning 400nm ~ 2300nm, Model successfully fits SIS(100) radiance profile (except at 1378nm and 2250nm).
    - Given input data spanning 400nm ~ 900nm, Model successfully fits SIS(100) radiance profile up to 900nm.
- Radiance Model is applied to Radiance Monitor data from Sept 22~23, 2008.
    - VisNIR bands exhibit up to 1% warm-up drift over ~1st hour.
        - Bands M1, M2, M3 exhibit up to 0.6% drift after warm-up.
        - Bands M4, I1, M5, M6, M7/I2 exhibit <0.1% drift after warm-up.
    - SWIR band results differ (using 2 drift models), but all results predict <0.3% drift including warm-up.

EXTRA SLIDES

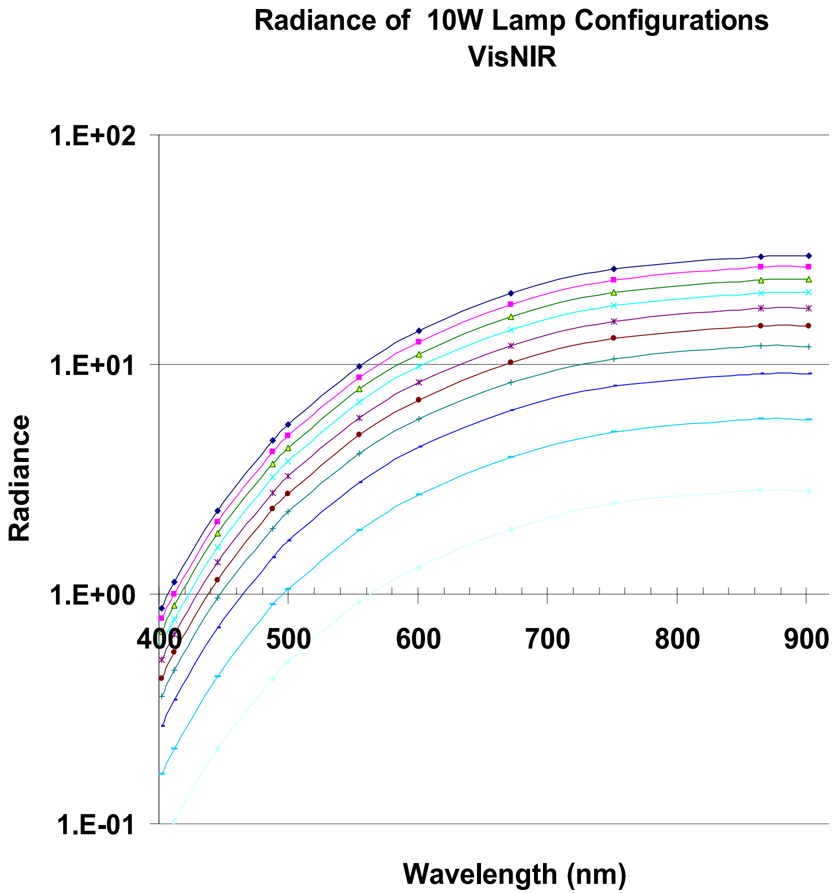
SIS(100) Calibration Radiance

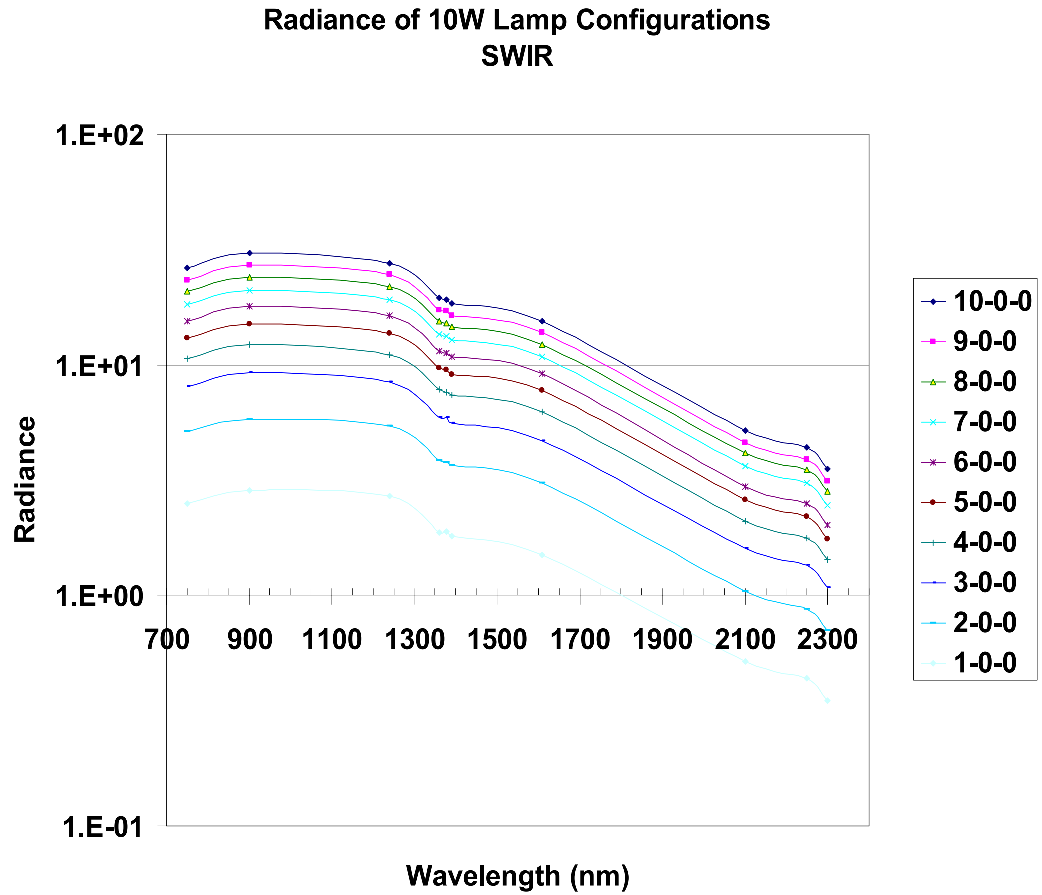
- **In pre-TV testing, the SIS(100) was calibrated by Raytheon using a CARY-14 spectrophotometer.**
- **The most recent calibration was performed in August, 2008, and reported in** *VIIRS[1].10.15.010.doc***.**
- **The calibration was performed for 19 wavelengths ranging from 402nm to 2300nm, listed to the right.**
- **The calibration wavelengths cover all 5 stability monitor filters, as well as all but 2 of the VIIRS band wavelengths. I1 (640nm) and M6 (746nm) were not calibrated.**
- **The calibration was performed twice for wavelengths 751nm and 902nm. These values will be averaged in the analysis.**
- **The calibration was performed separately for each set of lamp bulbs.**
  - **10 levels for the 10W bulbs (10.0.0, 9.0.0, …, 1.0.0).**
  - **9 levels for the 45W bulbs (0.9.0, 0.8.0, …, 0.1.0).**
  - **18 levels for the 200W bulbs (0.0.18, 0.0.17, …, 0.0.1).**
- **The calibration data is provided:** *SIS(100)-1_Cal_lamp_configurations_Summary_final.xls*

	Calibration Wavelength [nm]	VIIRS Band	Radiance Monitor Filter
VISNIR	402		F1
	412	M1	
	445	M2	
	488	M3	
	500		F2
	555	M4	
	600		F3
		I1	
	672	M5	
		M6	
	751		F4
	865	M7/I2	
	902		F5
SWIR	751		F4
	902		F5
	1240	M8	
	1360		
	1378	M9	
	1390		
	1610	M10/I3	
	2100		
	2250	M11	
	2300		

SIS(100) Calibration Radiance

- Calibration radiance values for 10W lamp levels.





- Calibration values at 1360nm, 1378nm, and 1390nm exhibit a dip due to water vapor absorption.

- Calibration values at 2250nm (M11) exhibit a bump.

SIS(100) Calibration Radiance at RC-2 Lamp Configurations

- **From the calibration report (*VIIRS[1].10.15.010.doc*):**
  - **The calibration values from each lamp set are given in Tables 5, 7, 9, 11, 13, 15. These radiance values are given at each of the 19 calibration wavelengths.**
  - **The lamp set data values are summed to yield the values at the RC-2 configuration levels (Tables 30, 31, 32, 33, 34, 35). These RC-2 radiance values are given at the 12 VIIRS band center wavelengths. For example:**

$$L_{10.9.18} = L_{10.0.0} + L_{0.9.0} + L_{0.0.18}$$

At 412nm (M1):

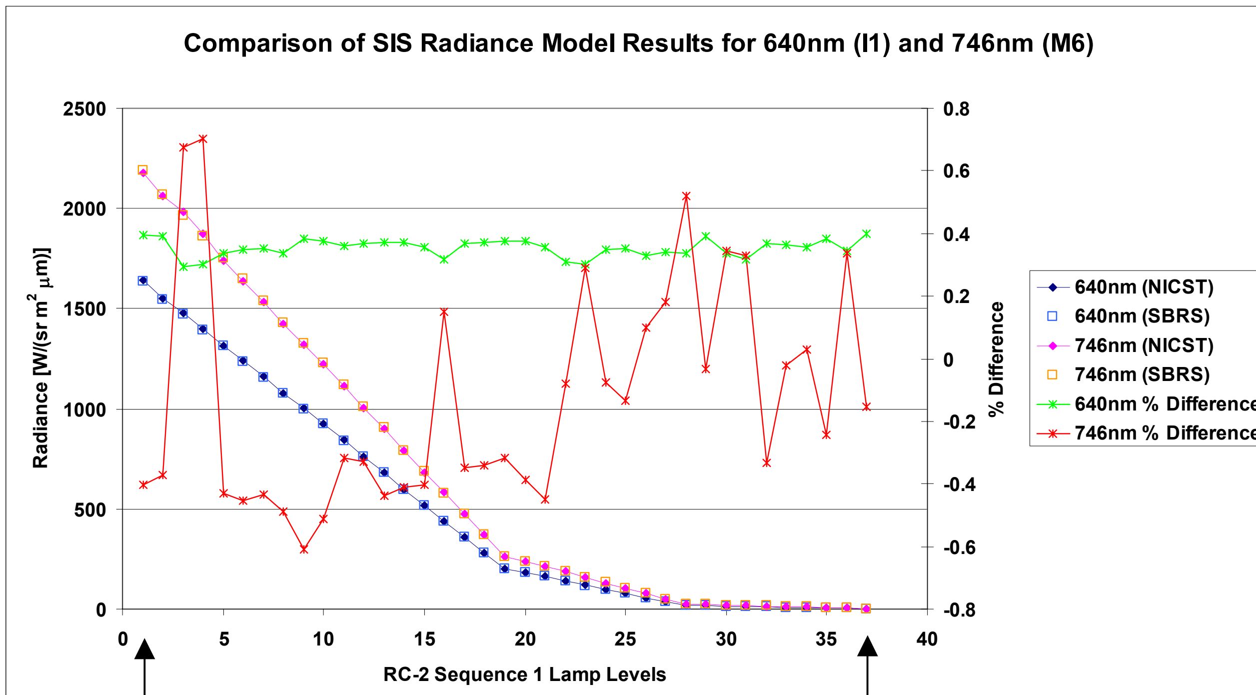
$$L_{10.9.18} = \underbrace{1.127 + 17.31 + 125.4}_{\text{Tables 5, 9, 13}} = \underset{\text{Table 30}}{143.8}$$

  - **Concern: The values given for RC-2 Lamp Sequence 2 (Table 32), levels 10.7.9 and 10.7.8 (the 2nd and 3rd levels), do not seem to match up to a sum of the corresponding values from the lamp set data. Up to 5% error.**
  - **The RC-2 radiance values for 640nm (I1) and 746nm (M6) cannot be obtained by simple addition, since there are no calibration values at these two wavelengths. The reported values are obtained through the SIS Radiance Model.**
    - **NICST reproduced these values to within 0.8%.**

Using SIS(100) Radiance Model: I1 and M6

- For most VIIRS bands, the radiance values at RC-02 lamp levels were calculated by directly summing the calibration radiance values (from the separate lamp sets).
- Bands I1 (640nm) and M6 (746nm) could not be obtained this way, since calibration was not performed at those two wavelengths.
- SIS(100) Radiance Model was applied to the summed radiance values at the 11 calibration wavelengths in VisNIR: 402, 412, 445, 448, 500, 555, 600, 672, 751, 865, and 902nm. (The calibration data at higher wavelengths was omitted to improve accuracy.)

- SBRS results for I1 and M6 are listed in *VIIRS[1].10.15.010.doc*, Table 30, alongside the values for other VIIRS bands (obtained by summing).
- NICST results are in excellent agreement, with less than 0.8% difference.
- Small difference due to:
  - R*ε values
  - Averaging of 751 and 902nm calibration radiances



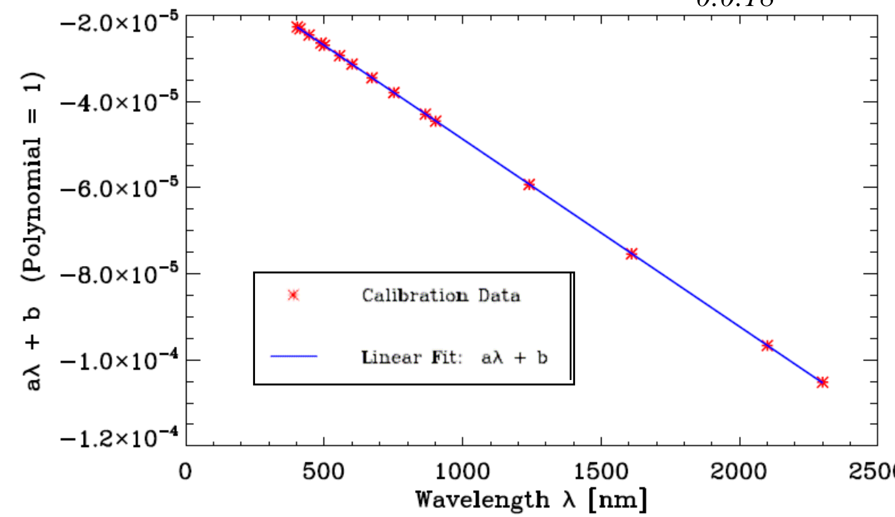
lamp level 1 = 10.9.18

lamp level 37 = 1.0.0

SIS(100) Radiance Model using 15 Calibration Points

- **Assess the model at known (calibration) radiance values.**
  - **Calibration data at λ_{cal}=1360nm, 1378nm, 1390nm, and 2250nm are excluded.**
  - **Plug calibration L_{cal}, λ_{cal} into model to calculate a, b, and C_0 , …, C_n**
  - **Use resulting coefficients to calculate L_{model} at same wavelengths λ_{cal}**
  - **Compare L_{cal} and L_{model}.**

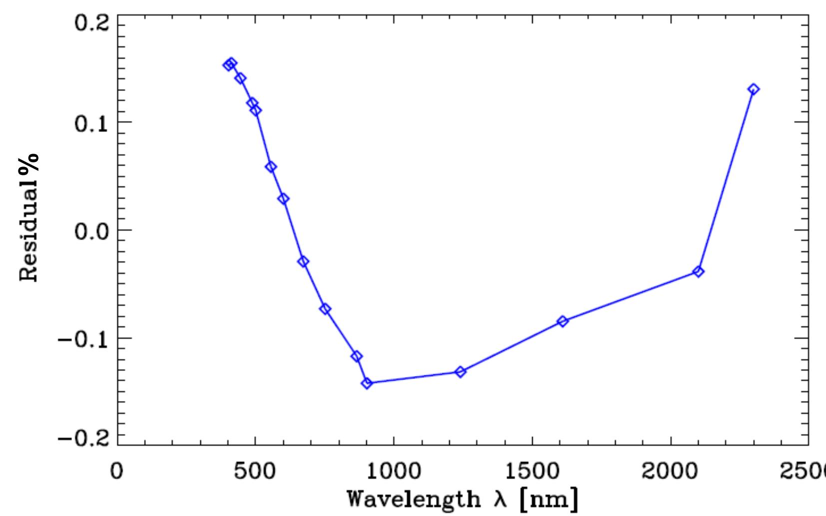
Calibration data $L_{0.0.18}$



- **STEP 1: Set polynomial to 1.**

$$a\lambda + b = \lambda_{cal} \cdot \ln\left(\frac{L_{cal}(\lambda_{cal}) \cdot \lambda_{cal}^5}{R(\lambda_{cal}) \cdot \varepsilon(\lambda_{cal}, T)}\right)$$

  - **Calibration data exhibits a linear relationship for right-hand side, suitable for linear fitting.**
  - **Percent difference between calibration values and fit values is less than 0.2%.**



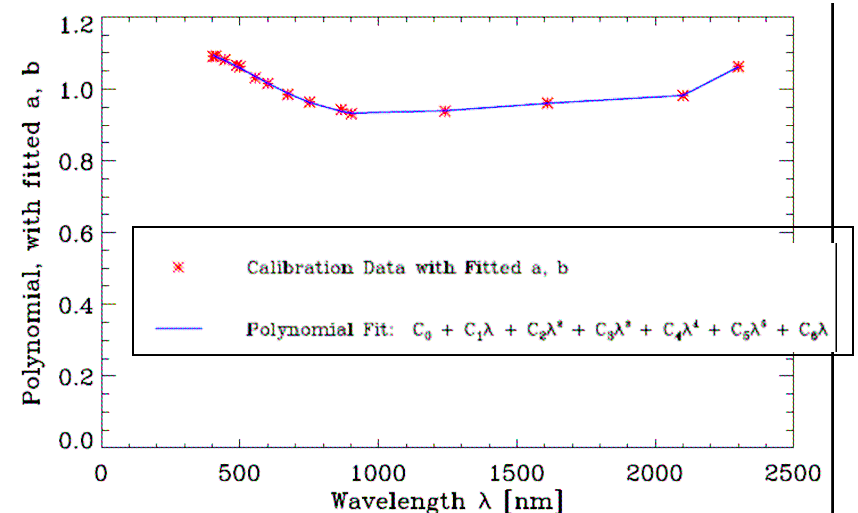
SIS(100) Radiance Model using 15 Calibration Points

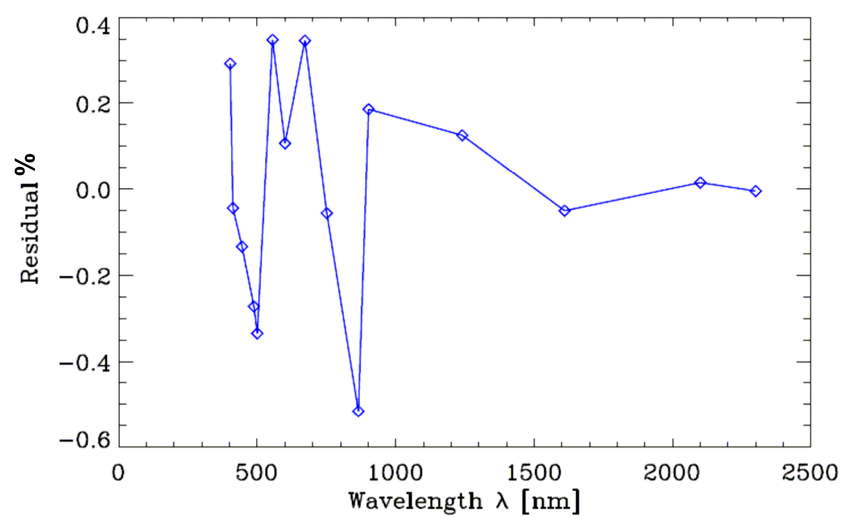
▪**STEP 2: Fit polynomial to 6th order.**

$$C_0 + C_1\lambda + \ldots + C_n\lambda^n = \frac{L_{cal}(\lambda_{cal})\cdot\lambda_{cal}^5}{R(\lambda_{cal})\cdot\varepsilon(\lambda_{cal},T)\cdot\exp\left(a+\frac{b}{\lambda_{cal}}\right)}$$

- **Right-hand side is calculated using calibration data and the fitted a, b from STEP 1.**
- **Percent difference between calibration values and fit values is less than 0.6%.**
- **Calibration data at λ_{cal}=1360nm, 1378nm, 1390nm, and 2250nm are excluded.**

Calibration data $L_{0.0.18}$





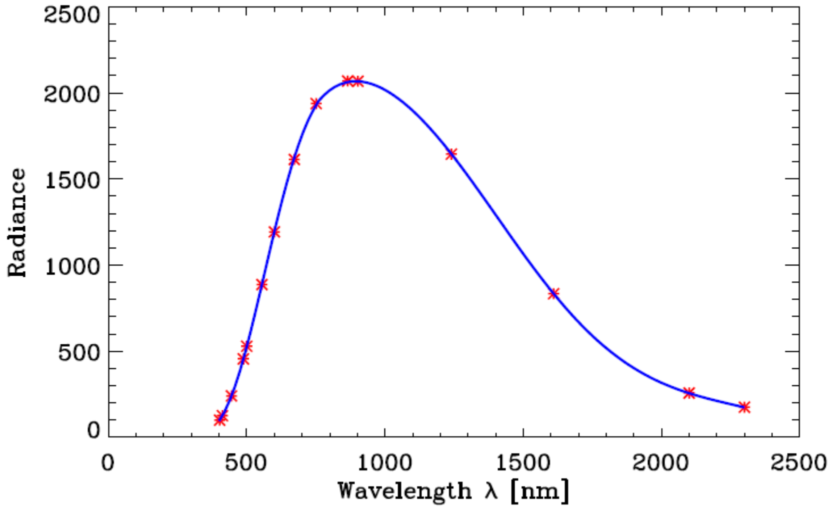
SIS(100) Radiance Model using 15 Calibration Points

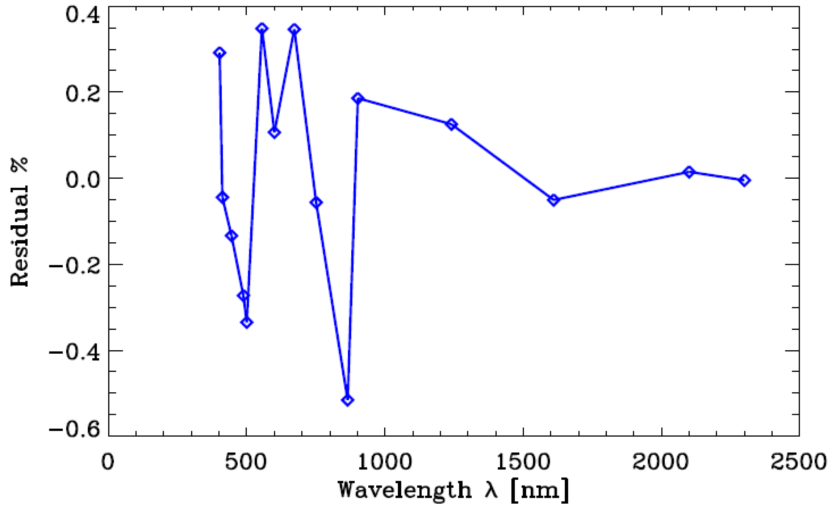
- **Given a set of known radiances at known wavelengths, the model should accurately predict radiance values at other wavelengths.**

$$L(\lambda)=R(\lambda)\cdot\varepsilon(\lambda,T)\frac{1}{\lambda^5}\cdot\exp\left(a+\frac{b}{\lambda}\right)\cdot\left(C_n\lambda^n+C_{n-1}\lambda^{n-1}+\ldots+C_1\lambda+C_0\right)$$

- **Percent difference between model results and calibration values is less than 0.6%.**
- **Calibration data at λ_{cal}=1360nm, 1378nm, 1390nm, and 2250nm are excluded.**
- **The Radiance Model very accurately tracks this set of 15 Calibration points.**
- **Result: The Radiance Model accurately models the SIS(100) radiance, when given appropriate calibration data covering the VisNIR and SWIR ranges.**
- **The Radiance Model does not track anomalies in the calibration data at 1378nm and 2250nm.**

Calibration data $L_{0.0.18}$





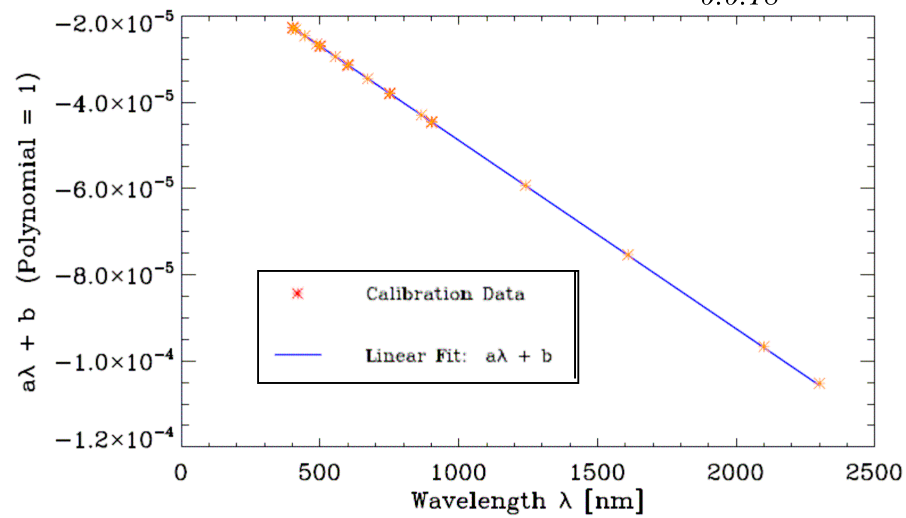
SIS(100) Radiance Model using 5 Calibration Points

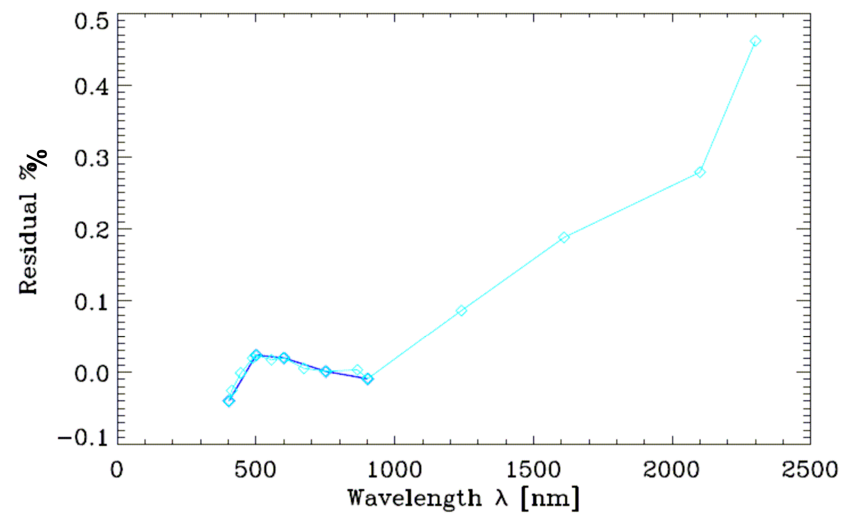
- **Assess the model at Stability Monitor Filter wavelengths.**
  - **Only the Filter wavelengths are used, λ_{cal}=402nm, 500nm, 600nm, 751nm, 902nm.**
- **STEP 1: Set polynomial to 1.**

$$a\lambda + b = \lambda_{cal} \cdot \ln\left(\frac{L_{cal}(\lambda_{cal}) \cdot \lambda_{cal}^5}{R(\lambda_{cal}) \cdot \varepsilon(\lambda_{cal}, T)}\right)$$

  - **Calibration data exhibits a linear relationship for right-hand side, suitable for linear fitting.**
  - **Percent difference between calibration values and fit values is less than 0.5%, even for points beyond the input (filter) wavelength range.**
  - **Percent difference for the VisNIR range is less than 0.1%.**

Calibration data $L_{0.0.18}$





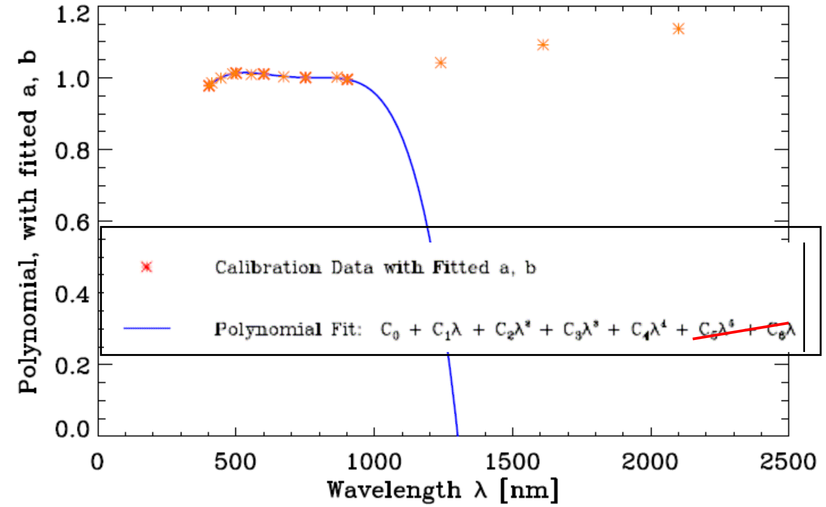
SIS(100) Radiance Model using 5 Calibration Points

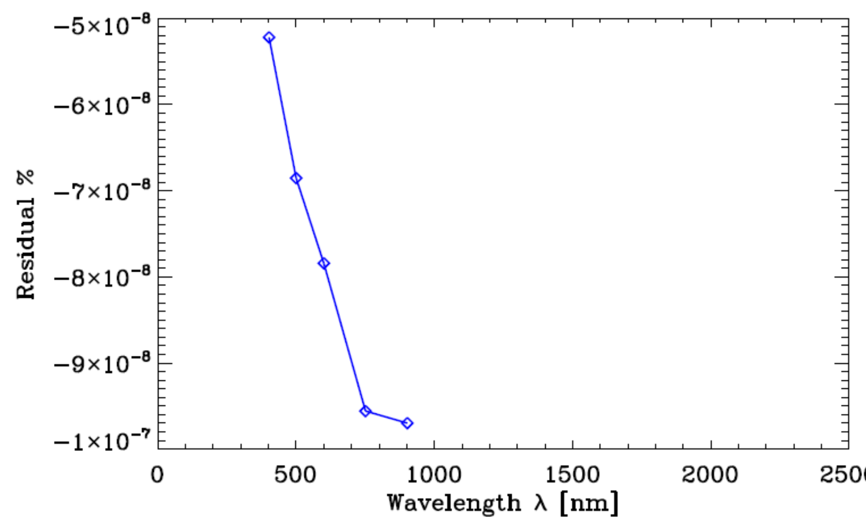
- **STEP 2: Fit polynomial to 4th order.**

$$C_0 + C_1\lambda + \ldots + C_n\lambda^n = \frac{L_{cal}(\lambda_{cal}) \cdot \lambda_{cal}^5}{R(\lambda_{cal}) \cdot \varepsilon(\lambda_{cal}, T) \cdot \exp\left(a + \frac{b}{\lambda_{cal}}\right)}$$

  - **Right-hand side is calculated using calibration data and the fitted a, b from STEP 1.**
  - **Since only 5 input points are used, the polynomial can only be fitted to 4th order.**
  - **Unused calibration points are plotted in orange for comparison.**
  - **Percent difference between calibration values and model results is extremely small *for input (filter) wavelengths*.**
  - **The model blows up for wavelengths outside the range of the input (filter) wavelengths.**

Calibration data $L_{0.0.18}$





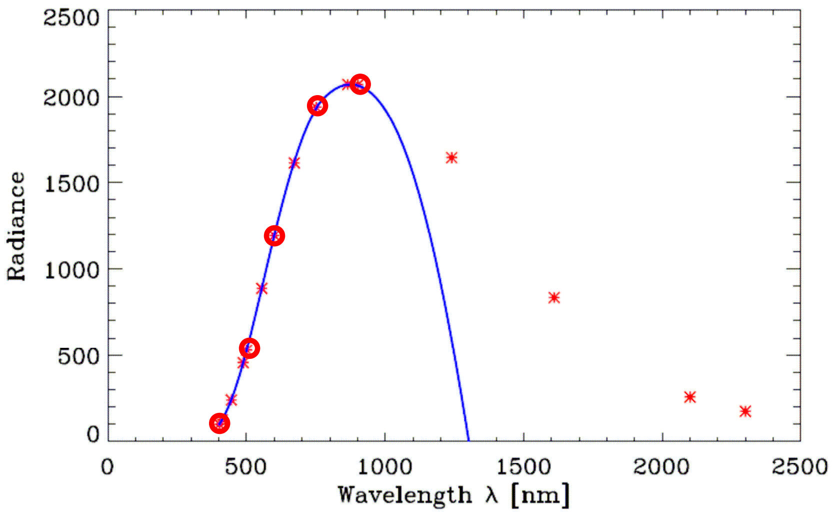
SIS(100) Radiance Model using 5 Calibration Points

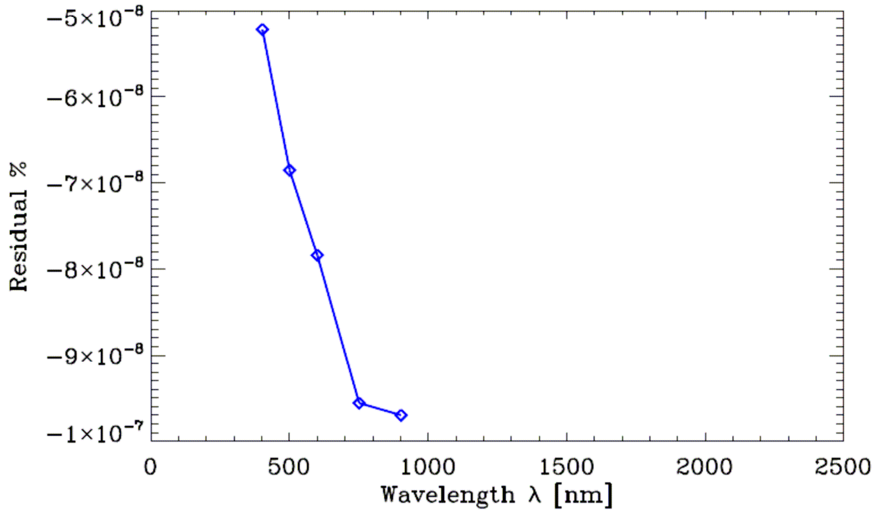
- **Given a set of known radiances at known wavelengths, the model should accurately predict radiance values at other wavelengths.**

$$L(\lambda) = R(\lambda) \cdot \varepsilon(\lambda, T) \frac{1}{\lambda^5} \cdot \exp\left(a + \frac{b}{\lambda}\right) \cdot \left(C_n \lambda^n + C_{n-1} \lambda^{n-1} + \ldots + C_1 \lambda + C_0\right)$$

- **Percent difference between calibration values and model results is extremely small *for input (filter) wavelengths*.**
- **The model blows up for wavelengths outside the range of the input (filter) wavelengths (SWIR).**

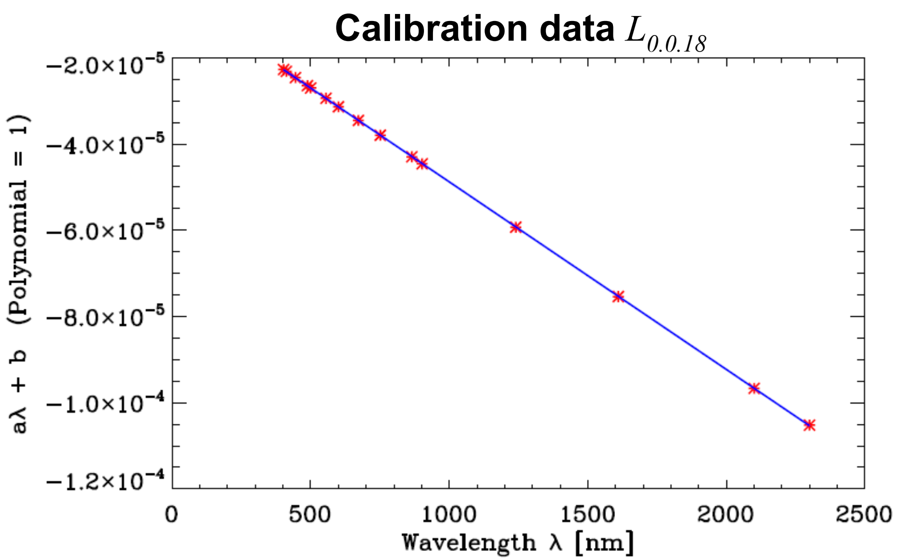
Calibration data $L_{0.0.18}$

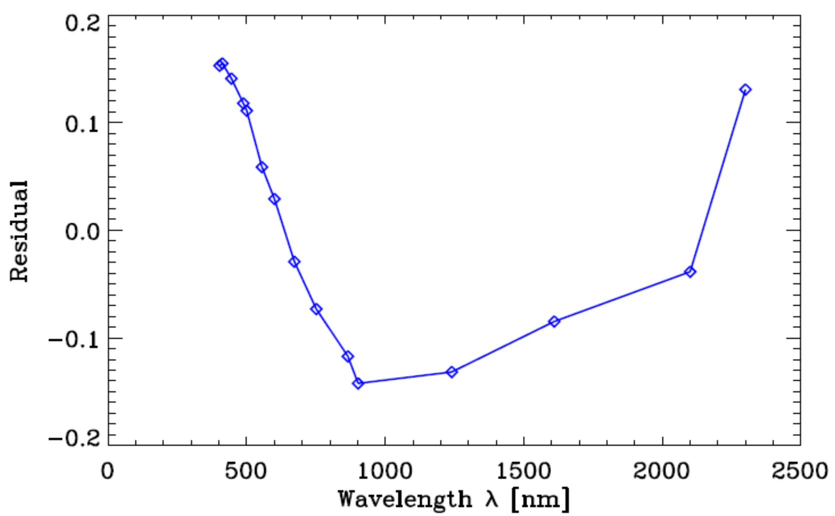




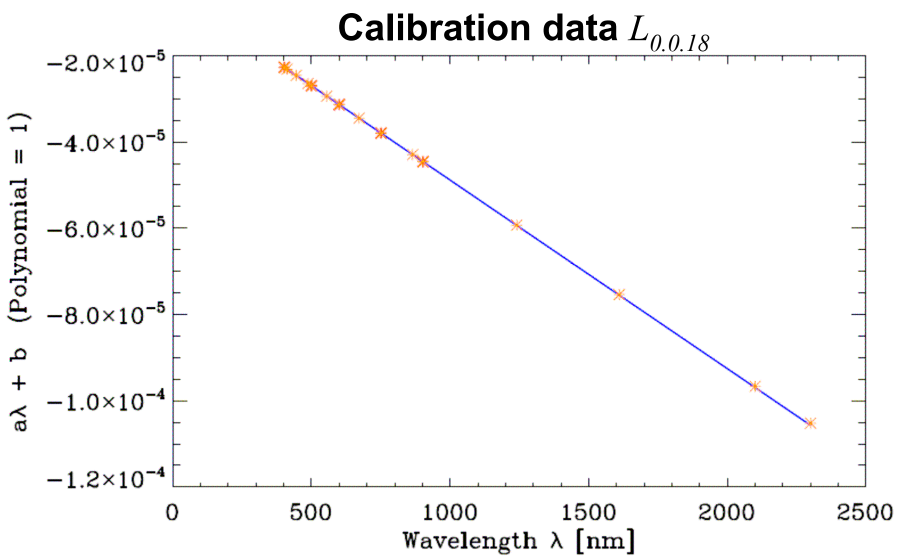
STEP 1: a, b

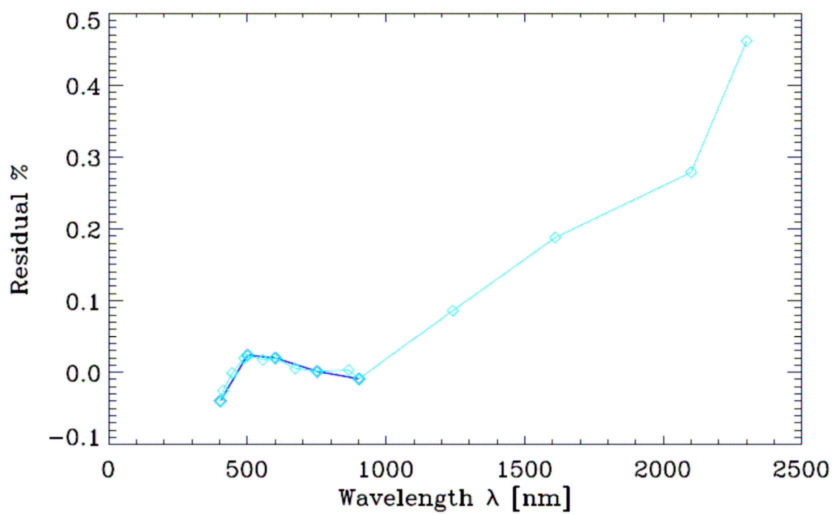
15 calibration points (VisNIR + SWIR)





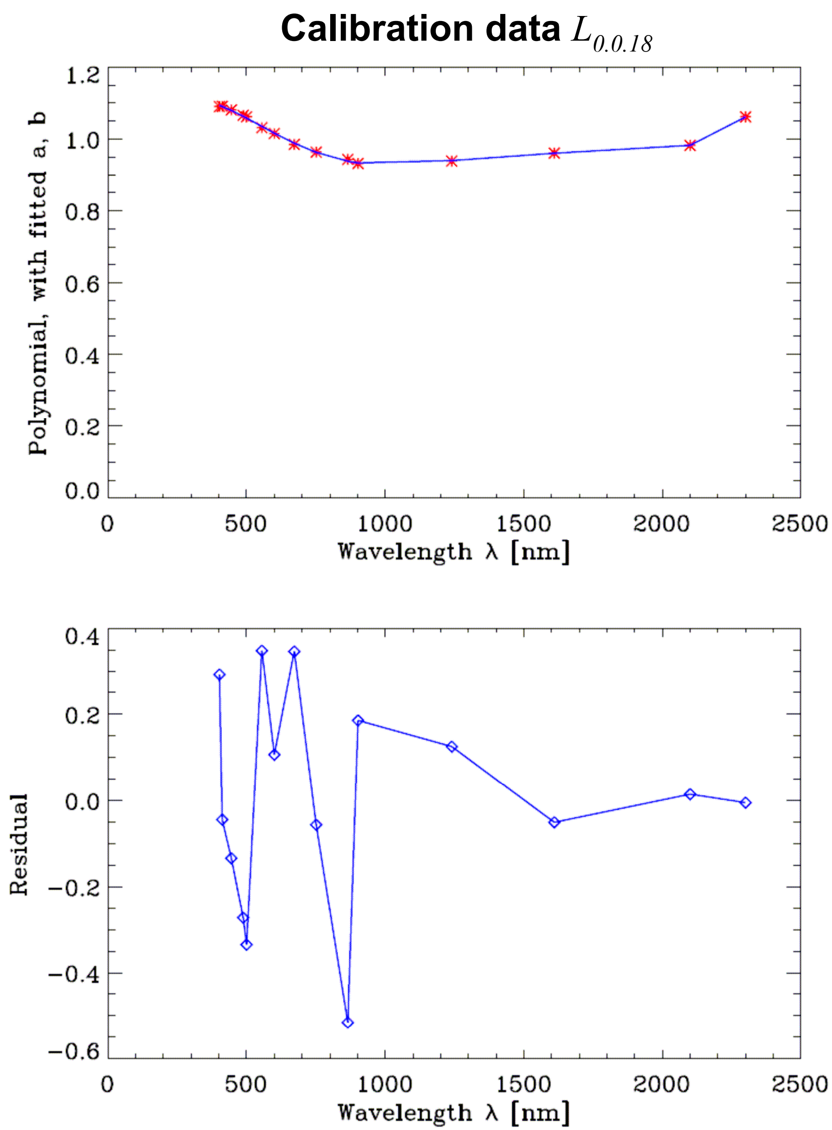
5 calibration points (VisNIR only)



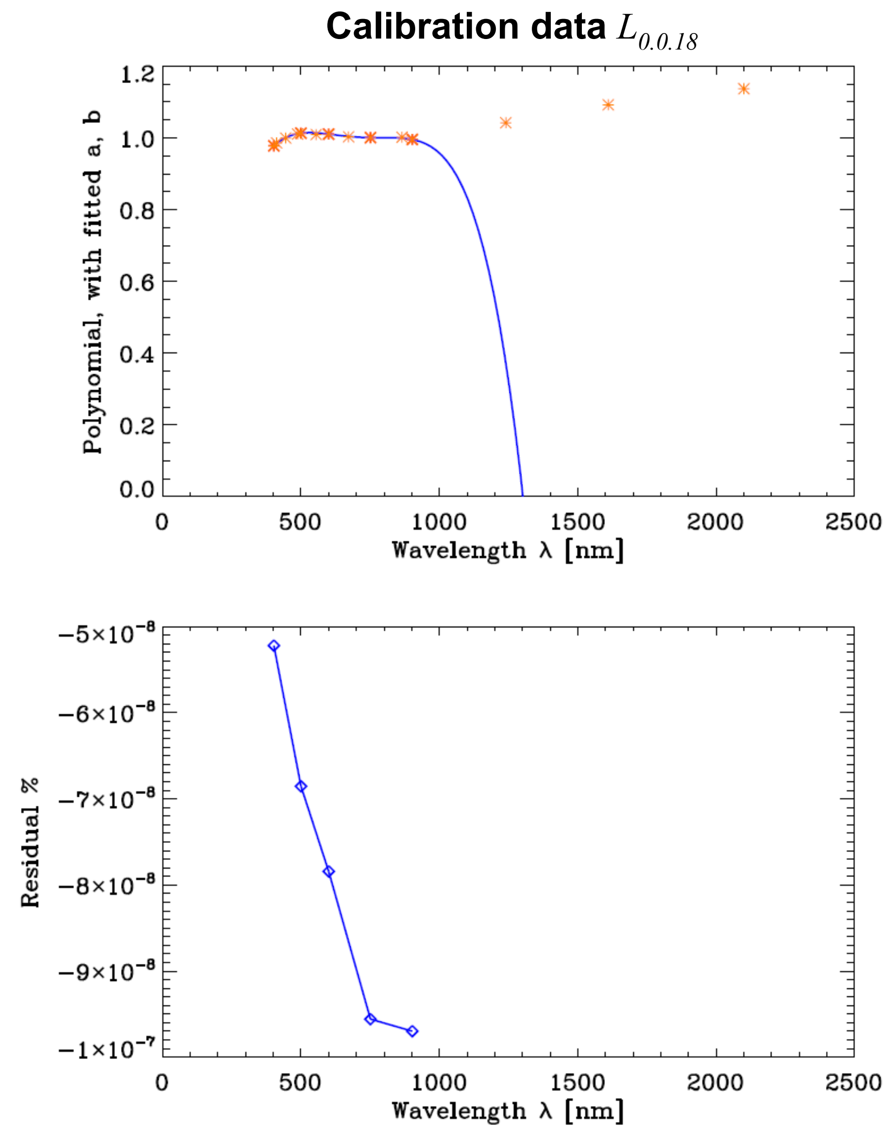


STEP 2: polynomial

15 calibration points (VisNIR + SWIR)



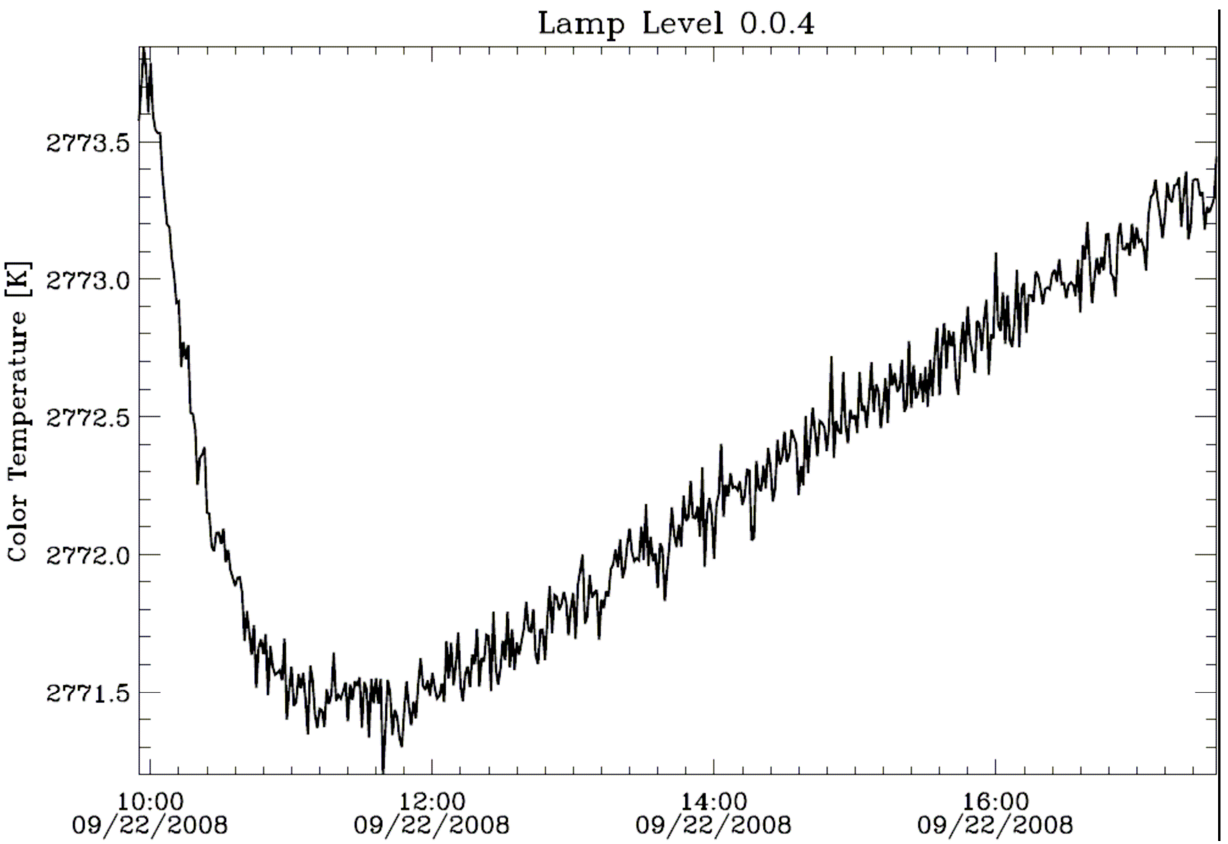
5 calibration points (VisNIR only)



SIS(100) Radiance Model – Temperature

- The derived color temperature for Radiance Monitor data from 9/22.
- After initial period, the T gradually increases.
  - This increase, coupled with the $(T_0/T)^4$ factor in the ratio method, results in a predicted downward drift in radiance for SWIR bands.

$$T = {}^{-c_2}\!/_{b}$$



Internal Status Update

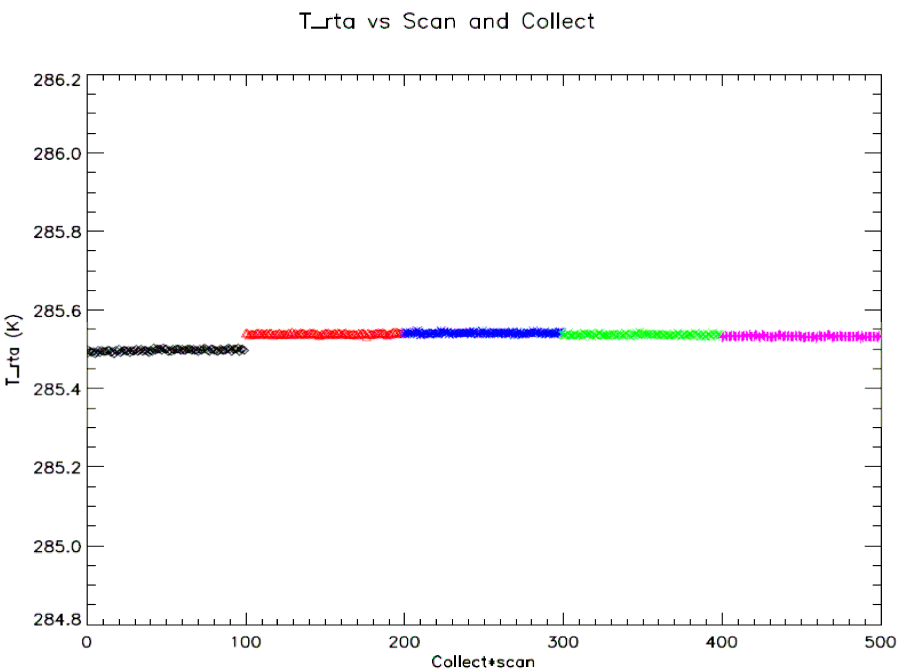
January 13, 2009

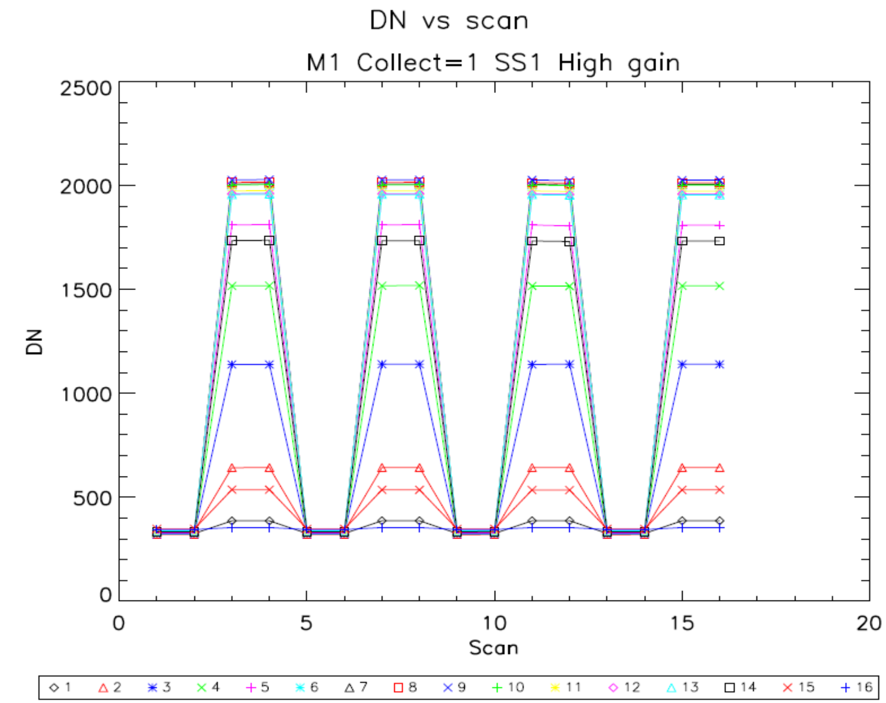
Jeff McIntire
NICST / NASA

Completed and Ongoing Tasks

- Progress since 11/14/2008
- Tool development / improvement for VIIRS FU1 TV
    - FP-16 IB and OOB crosstalk (parts 1 and 2)
    - RC-05 (parts 1 – 4)
- Preparation for TV testing
  - FP-15 / FP-16
    - Anomalous detectors in SMWIR FPA
    - NICST_MEMO_08_042
    - NICST_MEMO_09_001
  - RC-05
    - EDU TEB Murphy Chart
    - Updated M13 gain switching routines
    - Three Plateau comparison
    - EFR 2386: BCS ARD confirmed
      - Need to confirm OBC ARD with Raytheon
- Quicklook tools
  - Temperature trending
  - DN trending (telescope fixed [4 scan cycle] and scanning)

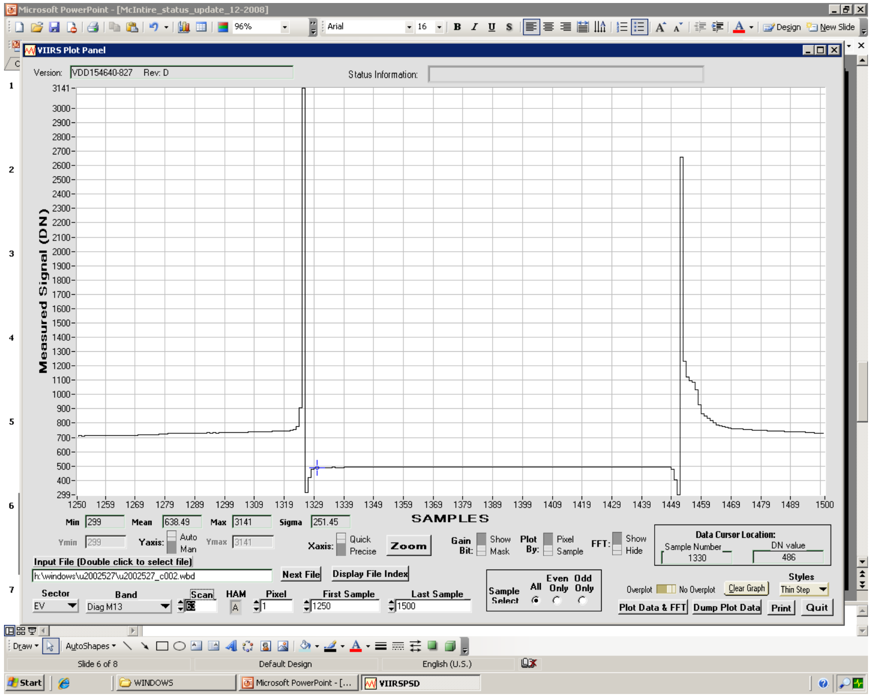
Quicklook Tools

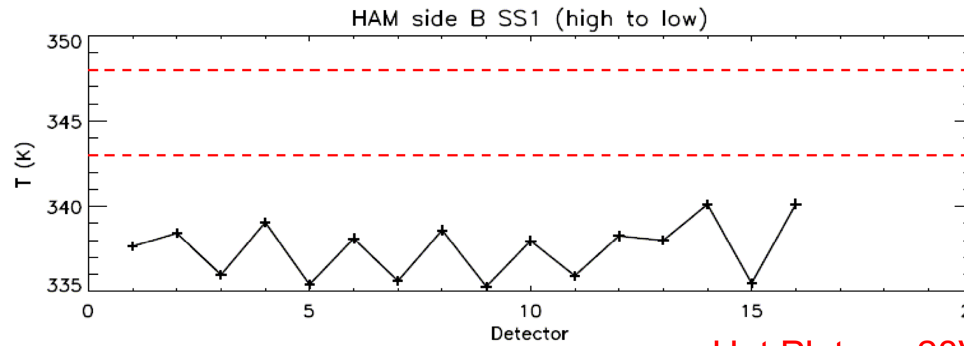




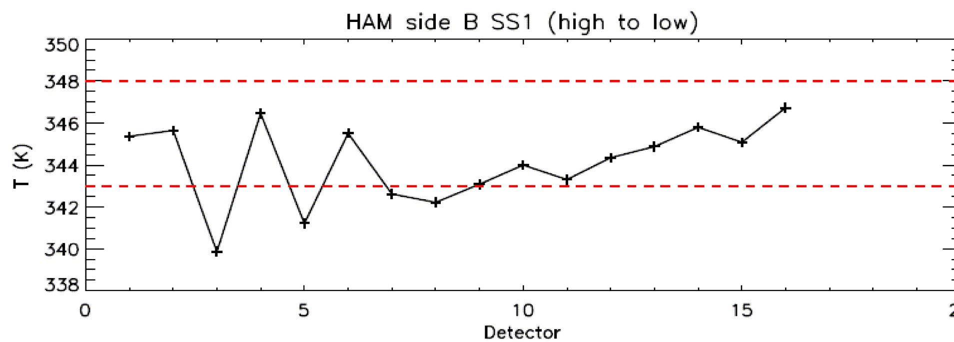
- Temperature trending
  - RTA, CAV, SH, HAM, OBC, OMM, FPAs, ASPs, BCS, SVS, and TMC
  - Standard deviations of OBC thermistor temperatures
- DN trending
  - (fixed telescope) DN_{EV}, standard deviation, and slope vs scan
  - (rotating telescope) DN_{EV}, DN_{SV}, DN_{OBC} vs scan, standard deviation and slope of EV, OBC, SV vs scan, slope of EV, OBC vs collect

EDU M13 Gain Switching (RC-05)

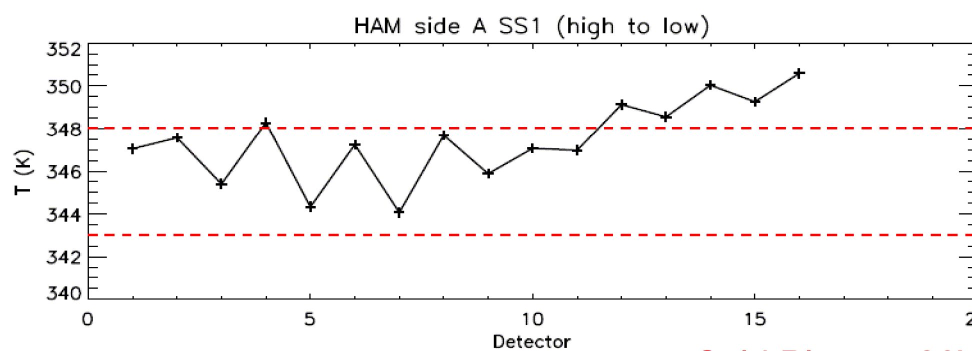




Hot Plateau 28V



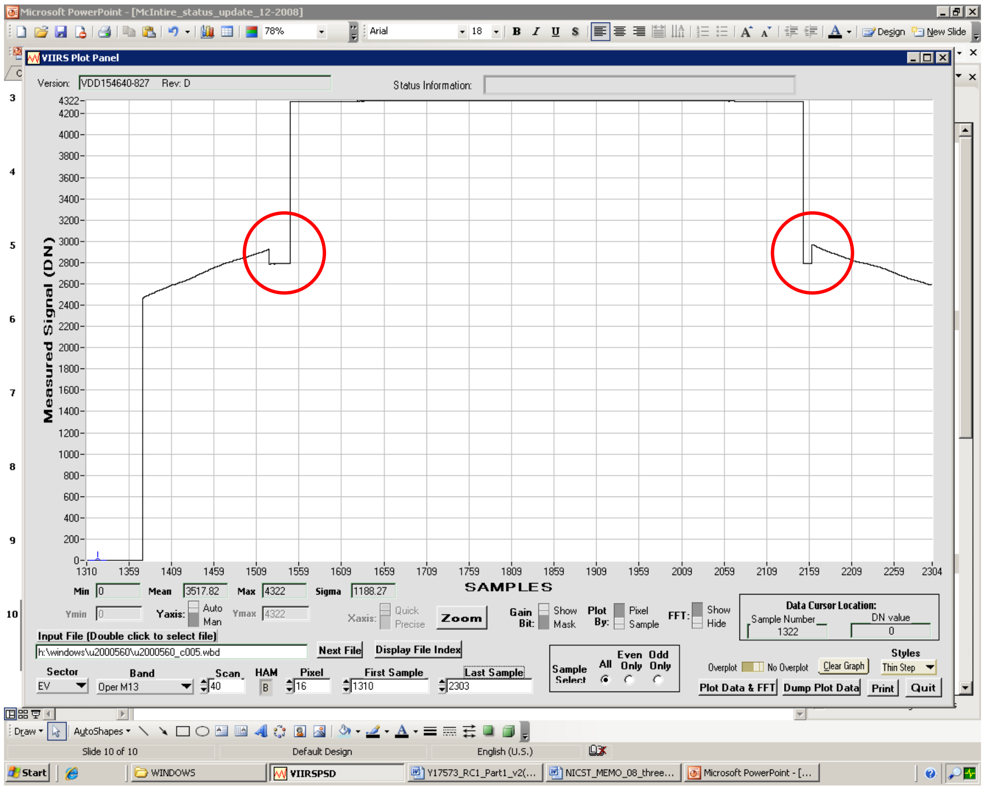
Nominal Plateau 28V



Cold Plateau 28V

- SRV0468: M13 gain switch between 343 K – 348 K (f/6)
- Do to rapid increase in DN near switch point, calculation determines minimum switch temperature
- No gain switch anomalies found in DN
- Plateau dependence (SV or OBC offset gets larger from Cold to Hot)

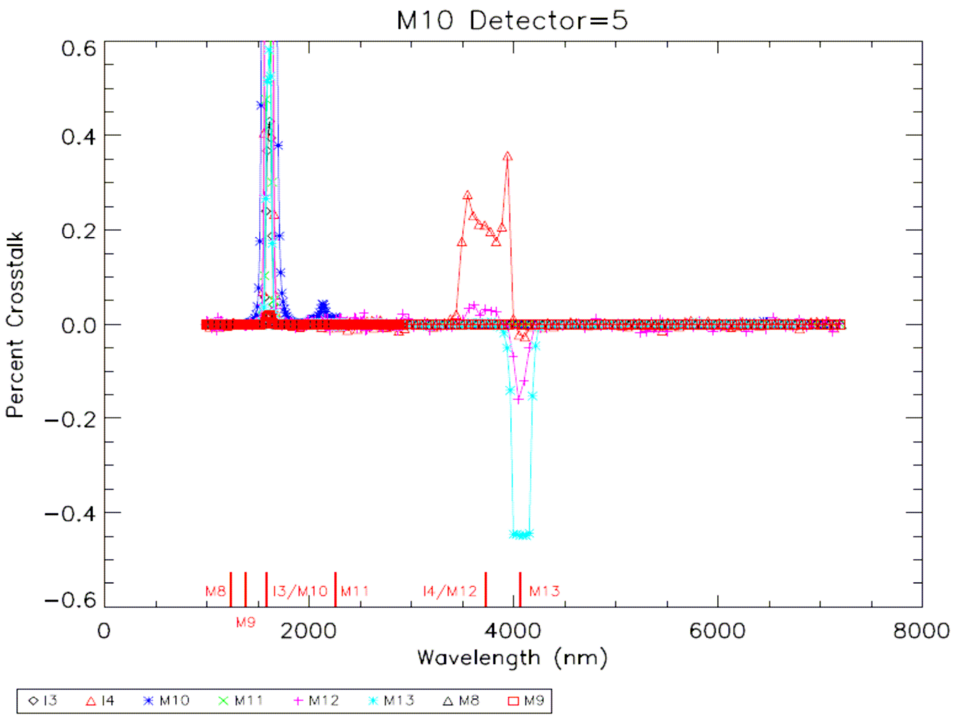
EDU M13 Gain Switching (RC-01)

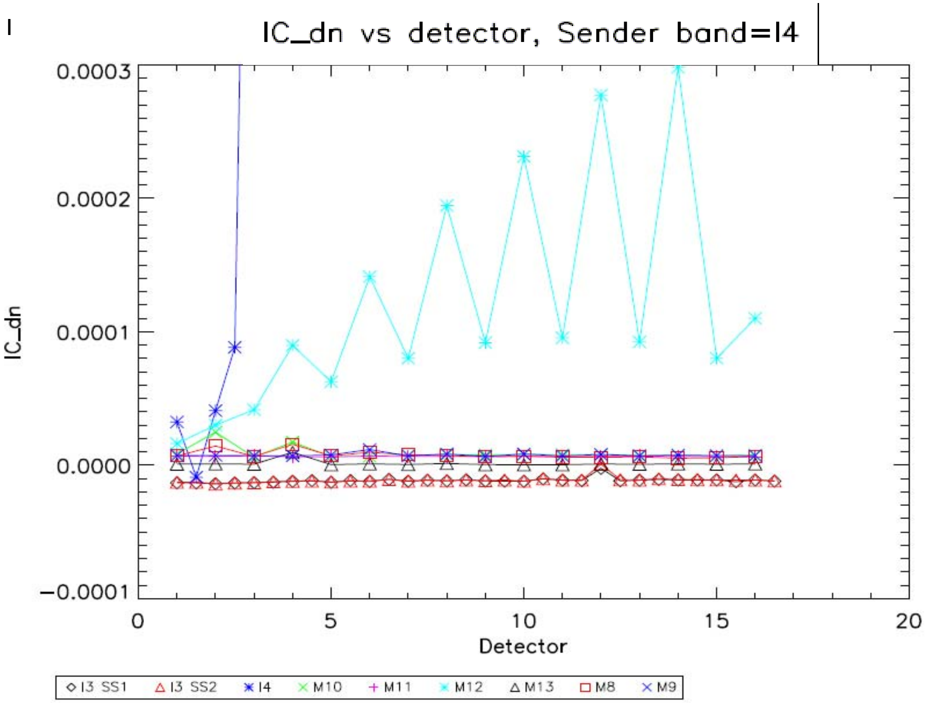


dn at gain switch		
Detector	NICST	Raytheon
1	1178.7	1174.2
3	1159.6	1155.4
5	1148.4	1144.5
7	1143.5	1139.5
9	1142.1	1138.7
11	1159	1154.9
13	1199.9	1196.2
15	1216.4	1211.1

- SRV0468: M13 gain switch between 343 K – 348 K (f/6)
- Gain switch anomalies found in DN for even detectors (smoother transition)
- Good agreement with Raytheon for dn at gain switch
- Specification met for odd detectors

FP-16 Crosstalk

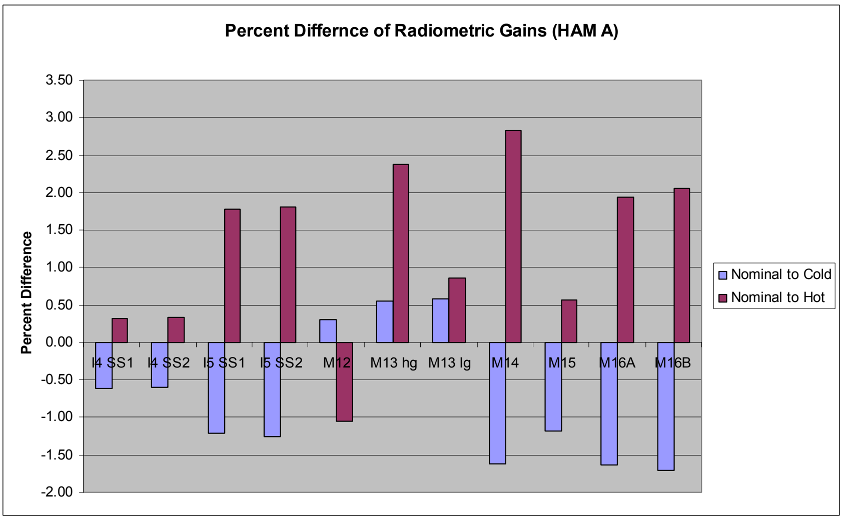


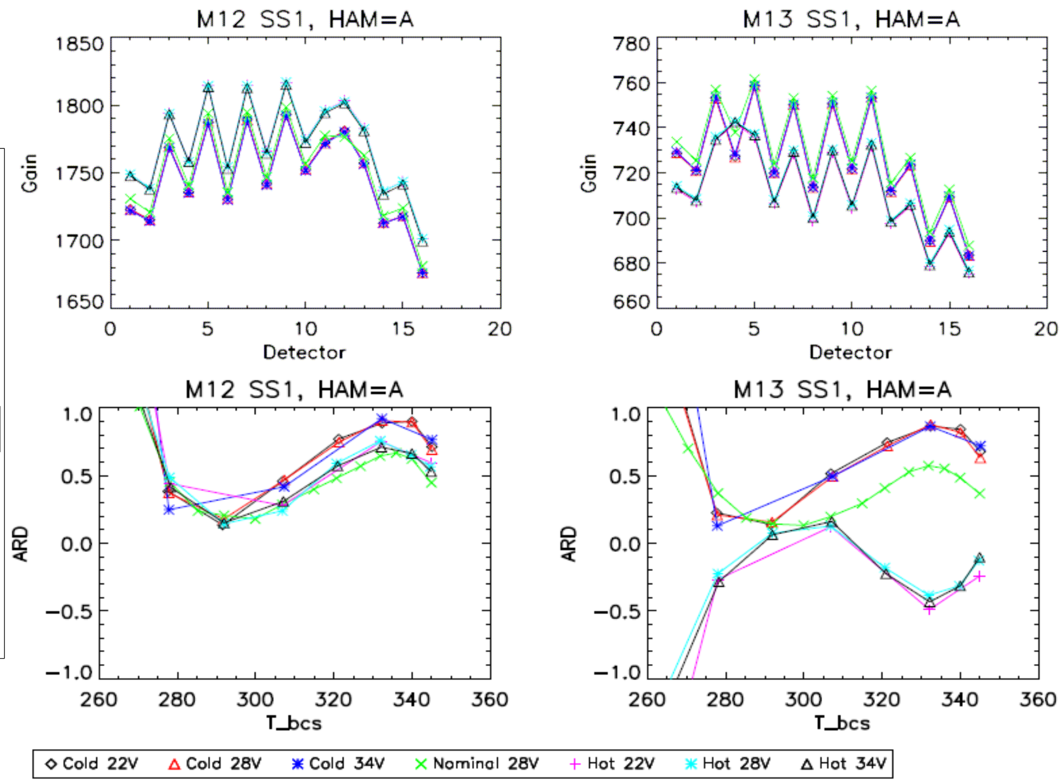


- FP-16 OOB crosstalk
    - OOB dn and Percent Crosstalk (OOB L/SpMA L) calculated
- Telemetry shutter mapping used

- FP-16 IB crosstalk
    - IB dn and IC_dn, IC_L calculated
- Comparison to noise: CNR, CNR_m
- SRV0631: IC_spec

RC-05 Three Plateau





- Plateau variation: Gain, RRNL, RRCU, SNR and NEdT at T_{TYP}, ARD, and RRU
- BCS: Less than 3% change in gains from Nominal to Hot or Cold (less than 0.3% over voltage)
- OBC: Less than 4% change in gains from Nominal to Hot or Cold (warm-up or cool-down)
- BCS ARD: change in behavior for M13 at hot plateau (result of different behavior in fitting residual)

2008 Performance Overview

- Tests Analyzed (joined December 2007)
  - VIIRS EDU
    - FP-15 / FP-16 (crosstalk and OOB response for VisNIR, SMWIR, and LWIR) – in collaboration with Tom Schwarting
    - RC-05 (radiometric calibration) – in collaboration with Sanxiong Xiong and Chunhui Pan
  - VIIRS FU1
    - FP-13 (static and dynamic crosstalk for SMWIR and LWIR) – in collaboration with Tom Schwarting and Chunhui Pan
- Memos (11 released, 12 total)
  - 3 on FP-13 (2008 NICST memos 4, 10, and 15)
  - 5 on RC-05 (2008 NICST memos 24, 25, 26, 35, and 36)
  - 3 on FP-16 (2008 NICST memos 31 and 42 and 2009 NICST memo 1)
  - Drafts (1 on RC-05)
- Reports (3 released)
  - 1 on FP-13 (2008 NICST report 2)
  - 2 on RC-05 (2008 NICST reports 11 and 18)
- Internal group presentations (6 total)
  - 4 on FP-13, 1 on FP-16, and 1 on RC-05

Released Memo / Report	Test
NICST_MEMO_08_004	FP-13 static crosstalk
NICST_MEMO_08_010	FP-13 static crosstalk
NICST_MEMO_08_015	FP-13 dynamic crosstalk
NICST_MEMO_08_024	RC-05 part 1 Nominal Plateau - characterization
NICST_MEMO_08_025	RC-05 part 1 Nominal Plateau - sensitivity
NICST_MEMO_08_026	RC-05 part 2 Nominal Plateau - characterization
NICST_MEMO_08_031	FP-16 shutter map investigation
NICST_MEMO_08_035	RC-05 parts 1 and 2 Cold Plateau - characterization
NICST_MEMO_08_036	RC-05 part 1 Cold Plateau - sensitivity
NICST_MEMO_08_042	FP-16 OOB Crosstalk
MICST_MEMO_09_001	FP-16 IB Crosstalk
NICST_REPORT_08_002	FP-13 static crosstalk
NICST_REPORT_08_011	RC-05 part 1 Nominal Plateau
NICST_REPORT_08_018	RC-05 BCS – OBC comparison, Nominal Plateau

Internal Status Update

January 13, 2008

Reported by T. Schwarting

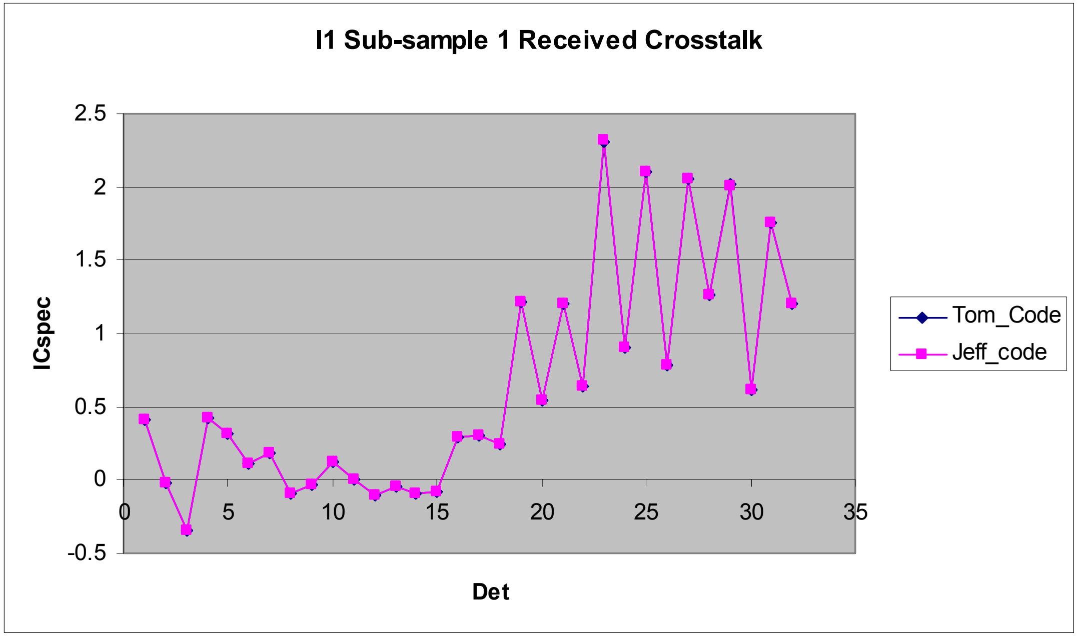
Current Tasks

- Crosstalk (w/Jeff)
  - FP-15/16 (Training)
    - Characterize EDU band-to-point Crosstalk
    - Assess compliance
    - Ready for FU-1 Thermal Vacuum Testing
  - FP-13 Comparison
    - Memo Draft in Progress
- Quick look Tool Development
  - Test tools developed by Jeff and Sergey
- RC-3
  - Training for Thermal Vacuum testing
- Data Archiving
  - Update test information on NICST server
  - Upload and archive data sent from El Segundo

EDU Crosstalk

- Finalized FP-15/16 analysis tools for use in Thermal Vacuum testing
  - Compared w/Jeff's tools
    - Same result for all crosstalk parameters and in all focal planes
- Released memo documenting new SMWIR/LWIR FP-15 results.
  - Out of spec. crosstalk in many bands and detectors
  - Anomalous in-band Signal in SMWIR bands

Crosstalk Received by I1

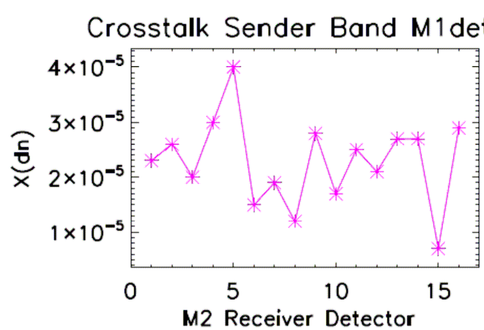


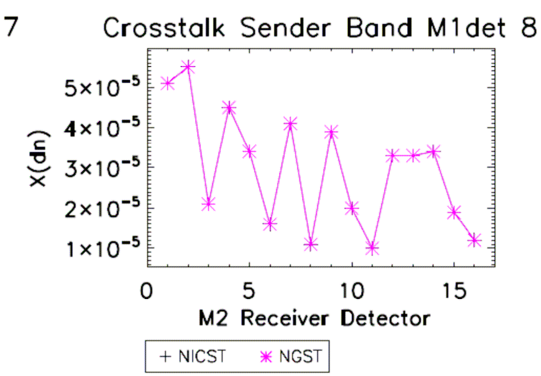
Crosstalk assessment with the specification was almost identical using either version of the code.

Typical plot shown for M1 sender, UAID 2001782, FP-16 in-band.

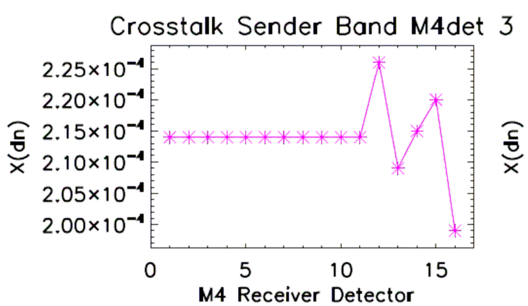
FP-13 Comparison with NGST

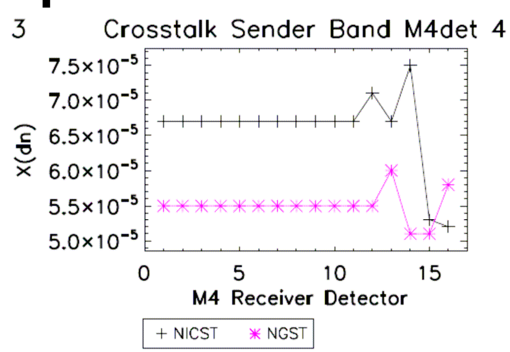
- Crosstalk was consistent with NGST for most bands





- Different in-band replacement algorithms





Memos and Reports 2008

- Memos

  2008
  - FU-1 VisNIR Static Point-to-Point Crosstalk Maps from FP-13 Ambient Phase 2 Testing: NICST_Memo_08_16
  - FU-1 Along-Scan Spectral band Registration from Ambient Phase 1 testing: NICST_Memo_08_19
  - FU-1 Along-Track Band-to-Band Registration from Ambient Phase 1 Testing: NICST_Memo_08_28
  - VIIRS EDU SMWIR and LWIR Band-to-Point Crosstalk Assessment from FP-15: NICST_Memo_08_41

  2009
  - Comparison of VIIRS FU1 Crosstalk from FP-13 with NGST - Draft
- Reports

  2008
  - Comparison of VisNIR Point-to-Point Static Crosstalk Map from FP-13: NICST Report_008_016

Working Status --Sam

- RC05 related (continued work):
  - Finished Jeff's major RC05 data analysis tool suite testing with EDU TV test data sets (including some latest updates/additions)
  - Worked with Jeff, Che, and Chunhui on some issues, including dn_max, dn_sat, M13 gain switching, etc
  - For coming FU1 TV test data analysis, started the modifying/updating of previous RC05 codes
- Other major supportive works done:
  - Based on Chunhui's request, worked on the retrieval consistency examination for the raw DN between the data extractor and PSD tools, and verified they are OK;
  - Based on Jeff's request, worked with him and supported his LRV tool re-installation and EDD look-up-table related issues, figured out some related problems he had;
  - Based on Sergey's request, worked with him for his EDU data extractor usage related (tool configuration and scripts related);
  - Reviewed and verified the results for FU1 SD/SDSM BRF coefficients derivation memo drafted by Junqiang;
  - Based on Chunhui's request, started monitoring on-site Data Analysis and Decision Support (DADS) cluster development, participated a series telecon meetings; monitoring the review status for several GSEs

Working Status -- Sam

- Current works:
  - Continue to work on RC05 related (latest algorithm or methodology updates; FERs; Tiger team meeting related; and verify and compare the results related)
  - Other TV test data processing and analysis preparation
  - Based on Chunhui's request, continue to monitor DADS cluster development and the latest status for some GSEs

Recent NPP progress

N. Che

Work in NPP (1)

- Completed IDL code (vs 2. draft) to generate FU1 SIS(100) radiance using monitor data based on SBRS algorithm. Set new baseline data for SWIR bands.

Work in NPP (2)

- Completed EDU RC-02 and RC-03 gain comparison and gain variation assessment for RSB (NICST_REPORT_08_026) and presented to the Gov meeting.

Main conclusions: (1) EDU RSB gains are stable. (2) It is inadequate to compare gain from RC-02 and RC-03 due to differences in test objective and test configuration. (3) The gain variation from Nominal to Hot plateaus is less than 3% for majority bands and 5% maximum.

Gain comparison between RC-02 and RC-03 is inadequate due to their difference in the test configuration

Items	RC-02	RC-03
Illumination level	38+ lamp level	one lamp levels
Calibration time	~ 39 hours	~8 hours (1st 11 UAIDs)
T_inst and T_ASP	Uncorrected	Uncorrected
Gain calculation	In/Out or dn vs L	Ratio of dn/L (one point)
Integration time	Nominal	Changed

Band	Gain (High)						Diff (Gain_RC2/Gain_RC3-1)*100			
	RC_03		RC_02(In/Out)		RC_02(dn_vs_L)		In/Out to RC3		dn/L to RC3	
	Nominal	Hot	Nominal	Hot	Nominal	Hot	Nominal	Hot	Nominal	Hot
M1	43.96	44.64	42.56	40.61	42.91	41.99	-3.18	-9.03	-2.39	-5.94
M2	43.38	44.35	42.61	41.14	42.74	41.95	-1.77	-7.23	-1.48	-5.41
M3	40.93	41.77	38.83	38.43	39.20	38.87	-5.13	-7.99	-4.23	-6.93
M4	53.11	53.15	51.30	51.37	49.78	49.28	-3.41	-3.35	-6.28	-7.30
M5	66.89	66.40	71.57	70.95	71.96	71.06	7.01	6.85	7.58	7.02
M7	160.99	161.45	155.67	153.19	155.65	152.62	-3.30	-5.12	-3.32	-5.47
M6	151.38	149.80	123.81	122.36	122.15	120.19	-18.21	-18.32	-19.31	-19.76
M8	25.64	25.71	24.18	23.74	24.27	24.01	-5.70	-7.67	-5.32	-6.60
M9	63.21	63.09	73.77	70.29	74.22	72.10	16.69	11.42	17.41	14.29
M10	84.53	84.53	80.82	79.61	82.51	81.02	-4.39	-5.83	-2.39	-4.16
M11	182.42	181.25	176.63	171.03	175.38	171.41	-3.17	-5.64	-3.86	-5.43
I1	7.68	7.78	7.23	7.26	7.25	7.27	-5.91	-6.73	-5.60	-6.59
I2	16.12	16.20	15.37	14.89	14.96	14.85	-4.64	-8.12	-7.21	-8.34
I3	67.21	67.02	63.43	62.28	64.78	63.74	-5.62	-7.07	-3.60	-4.90

Gain comparison between Nominal and Hot plateaus In RC-02

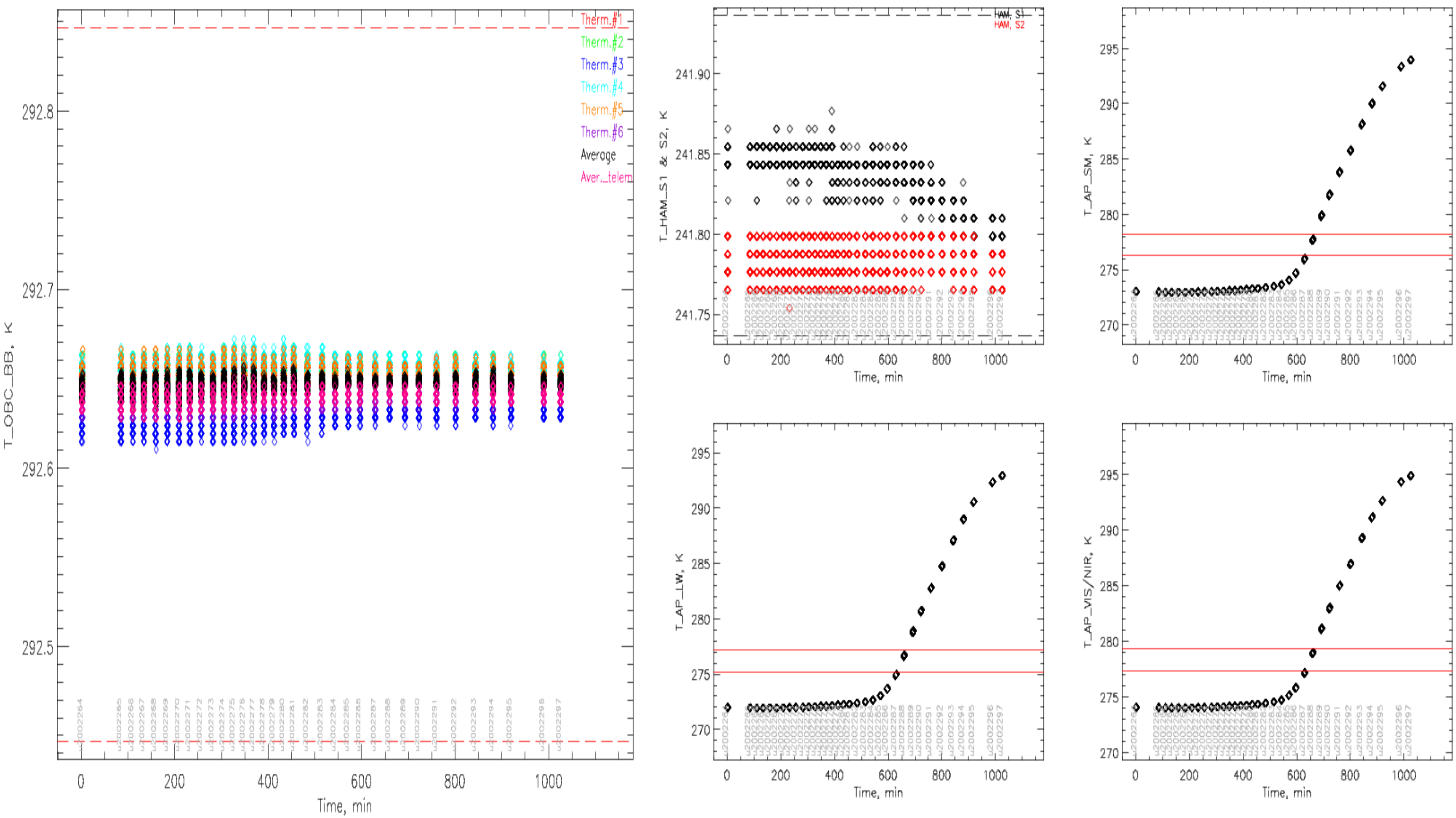
Band	Gain (High)								
	RC_03			RC_02(In/Out)			RC_02 (dn vs L)		
	Nominal	Hot	Diff (%)	Nominal	Hot	Diff (%)	Nominal	Hot	Diff (%)
M1	43.96	44.64	1.54	42.56	40.61	-4.60	42.91	41.99	-2.15
M2	43.38	44.35	2.22	42.61	41.14	-3.46	42.74	41.95	-1.85
M3	40.93	41.77	2.04	38.83	38.43	-1.04	39.20	38.87	-0.83
M4	53.11	53.15	0.07	51.30	51.37	0.14	49.78	49.28	-1.01
M5	66.89	66.40	-0.72	71.57	70.95	-0.86	71.96	71.06	-1.24
M7	160.99	161.45	0.29	155.67	153.19	-1.59	155.65	152.62	-1.95
M6	151.38	149.80	-1.05	123.81	122.36	-1.18	122.15	120.19	-1.61
M8	25.64	25.71	0.27	24.18	23.74	-1.82	24.27	24.01	-1.09
M9	63.21	63.09	-0.20	73.77	70.29	-4.71	74.22	72.10	-2.86
M10	84.53	84.53	0.00	80.82	79.61	-1.50	82.51	81.02	-1.81
M11	182.42	181.25	-0.64	176.63	171.03	-3.17	175.38	171.41	-2.26
I1	7.68	7.78	1.34	7.23	7.26	0.46	7.25	7.27	0.27
I2	16.12	16.20	0.54	15.37	14.89	-3.12	14.96	14.85	-0.69
I3	67.21	67.02	-0.27	63.43	62.28	-1.81	64.78	63.74	-1.61

Progress Report, October 2008 – January 2009

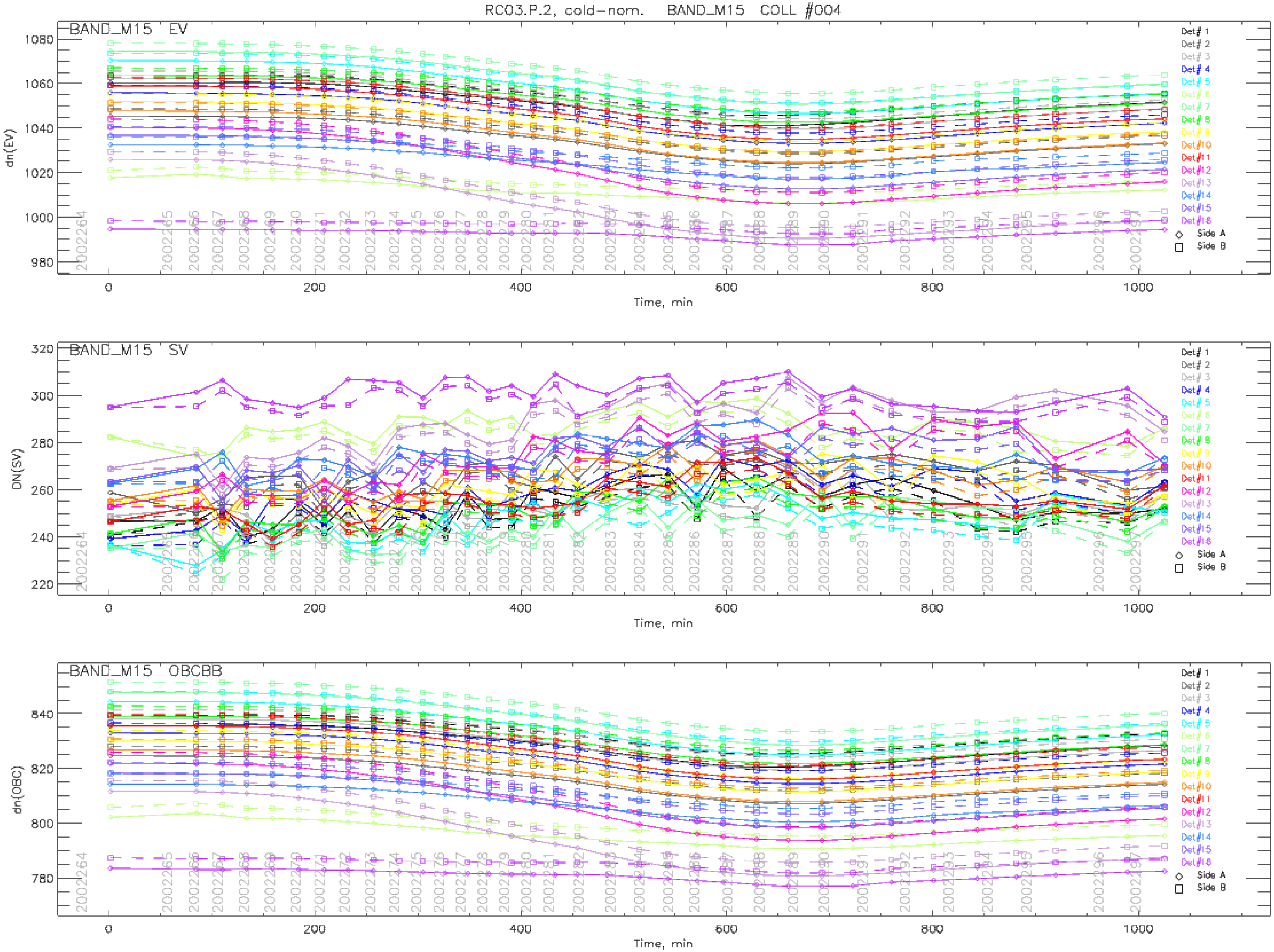
S. Marchenko

- Vignetting Function of the Solar Attenuation Screen (VIIRS) – Oct. ’08; an internal report delivered in Nov. ’08.
- QA software package for radiometric (scanning) tests, for RSB & TEB bands – Nov.-Dec. ’08; the software was delivered for an independent testing in Dec.; currently – implementation of suggested corrections.
- Analysis of the RC-3 test data (TEBs of EDU) – Nov.-Dec.; completed, ready for an internal presentation.
- Analysis of the FP-2 FU1 data; commenced in Jan. ’09.

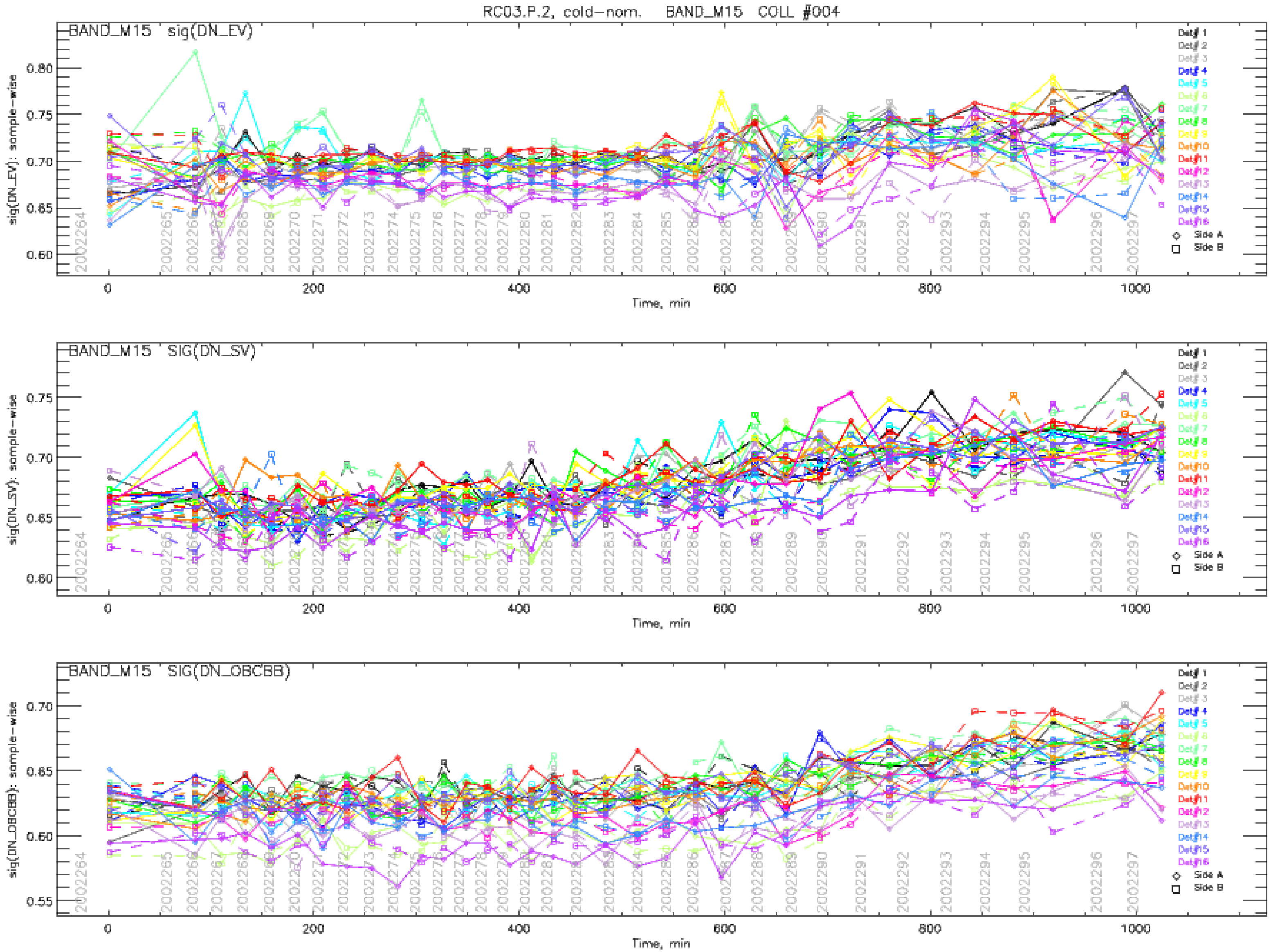
QA software: telemetry



QA software: dns



QA software: sigmas



RC-3 test summary (EDU, TEB): ARD

Band	Cold-to-nominal	Nominal	Nominal-to-hot	Hot
I4				
I5				
M12				
M13				
M14 *			d: 7,16 Max dev ~ 0.40%	
M15 *				
M16A *				
M16B *				

Within specs	1x <specs< 1.5x	1.5x <specs< 2.0x	>2x specs

Spec: for T_{scene}=310K

* M14-M16: see EFR2386 (eroom)

RC-3 test summary (EDU, TEB): RRU (collect-averaged)

Band	Cold-to-nominal	Nominal	Nominal-to-hot	Hot
I4				
I5				
M12				
M13	Max =1.35/1.34 (HAM A & B; same UAID)	Max =1.26/1.24 (HAM A & B; same UAID)	Max =1.33/1.34 (HAM A & B; same UAID)	Max =1.25/1.27 (HAM A & B; same UAID)
M14 *		Max =1.60/1.05 (HAM A & B; same UAID)	Max =1.34/1.27 (HAM A & B; same UAID)	
M15	Max =1.92/1.90 (HAM A & B; same UAID)	Max =1.30/1.30 (HAM A & B; same UAID)	Max =1.93/1.94 (HAM A & B; same UAID)	Max =1.30/1.29 (HAM A & B; same UAID)
M16A				
M16B	Max =1.02/0.99 (HAM A & B; same UAID)			

Within specs	1x <specs< 1.5x	1.5x <specs< 2.0x	>2x specs

Spec: RRU < 1.0

* M14: d#1 is excluded

RC-3 test summary (EDU,TEB): stability (collect-averages)

Band	Cold-to-nominal	Nominal	Nominal-to-hot	Hot
I4	d: 1,5,23,31 Max dev =0.12			d: 9,13,14,31 Max dev=0.14
I5	d: 8,15 Max dev=0.13		d: 6 Max dev=0.10	d: 8 Max dev=0.13
M12			d: 12 Max dev=0.14	
M13	d: 1-4,6-12,14-16 Max dev=0.17		d: 1-16 Max dev=0.18	
M14 *			d: 7,16 Max dev=0.15	
M15				
M16A				
M16B				

Within specs	1x <specs< 1.5x	1.5x <specs< 2.0x	>2x specs

Spec: abs(ΔL)<0.1% during 1 orbit (~100 min)

* M14: d#1 is not considered

RC-03 Part 2 RSB

Melanie Blackburn

Nianzeng Che

RC-03 Part 2 Analysis

- Examines radiometric response stability between calibrations

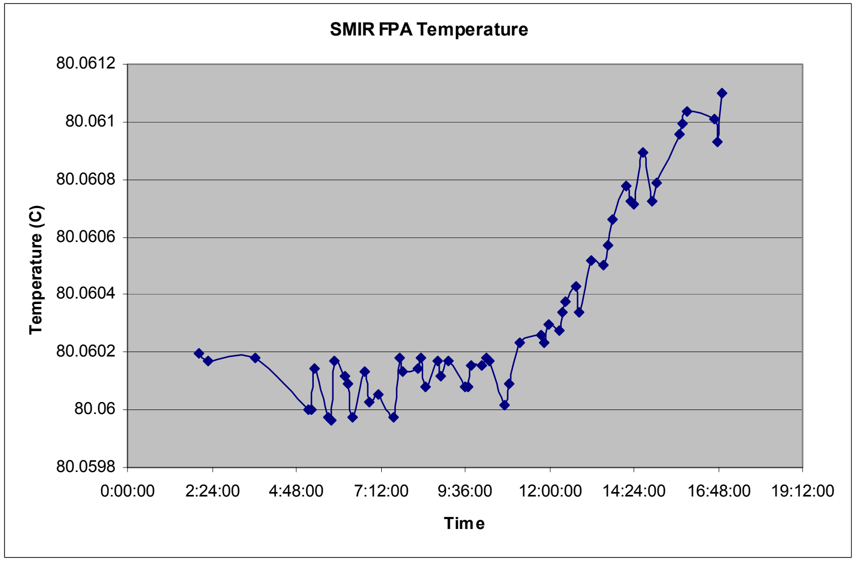
- Transition between temperature plateaus in tvac
  - cold to nominal transition (UAIDS 2002264-2002296)
    - no SIS monitor data available so not analyzed
  - nominal to hot transition (UAIDS 2002665-2002683)

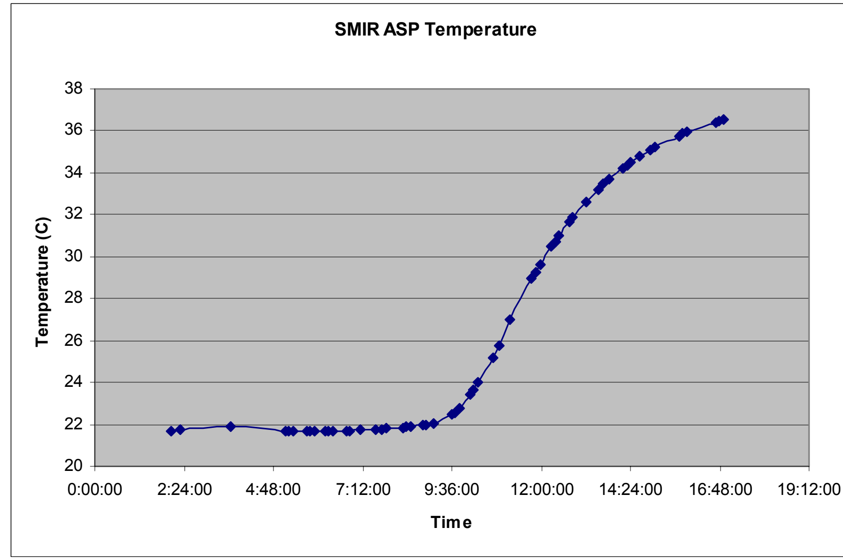
- Two Stages:
  - Increase VNIR FPA temperature while keeping ASP temperature relatively stable
  - VNIR FPA temperature relatively stable while increasing ASP temperature

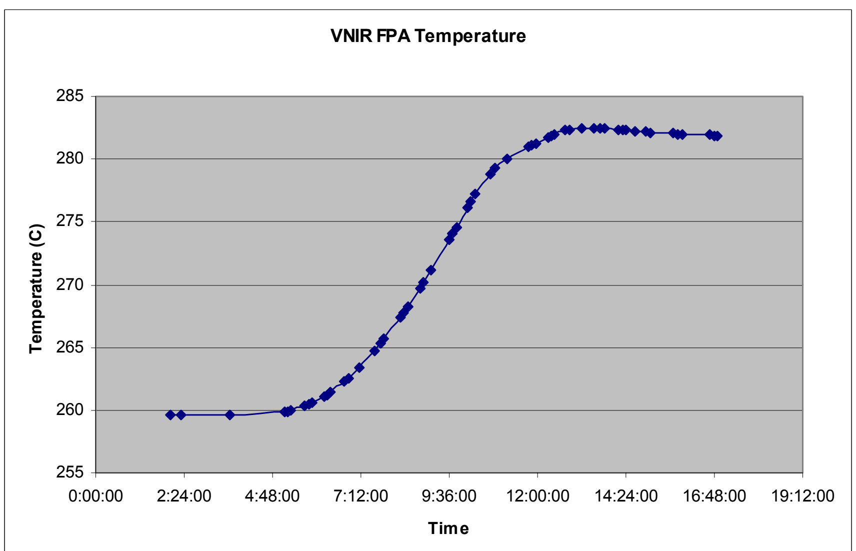
- Calculate gain change relative to first effective data

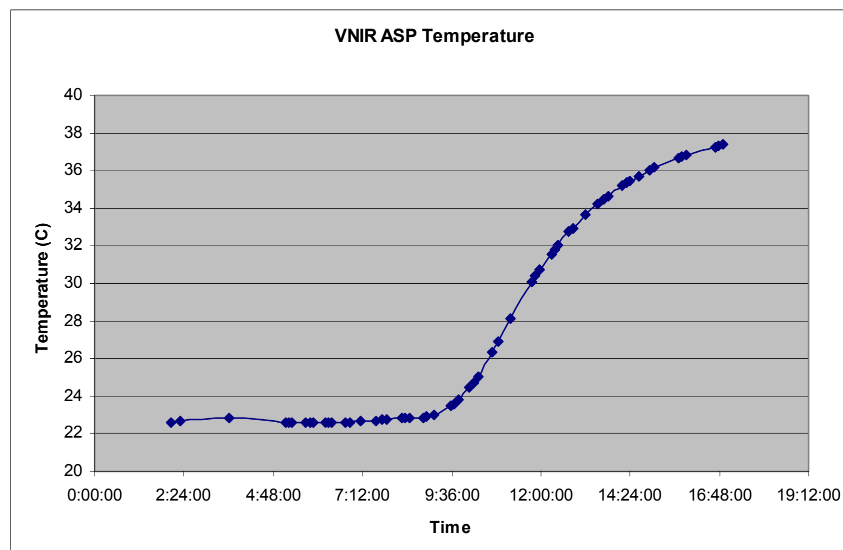
- Determine VNIR FPA and ASP temperature coefficients to get gain change correction, and calculate gain consistency

Transition From Nominal-Hot Temperature Plateau



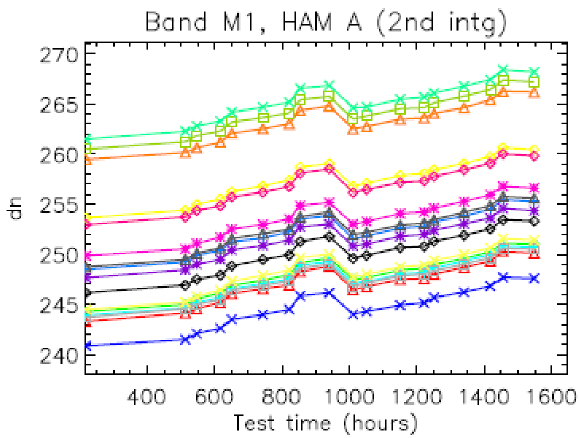


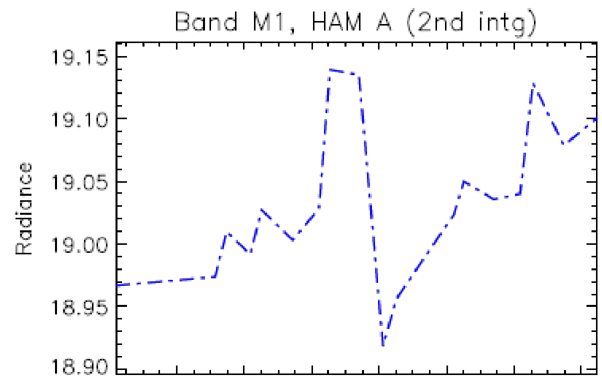


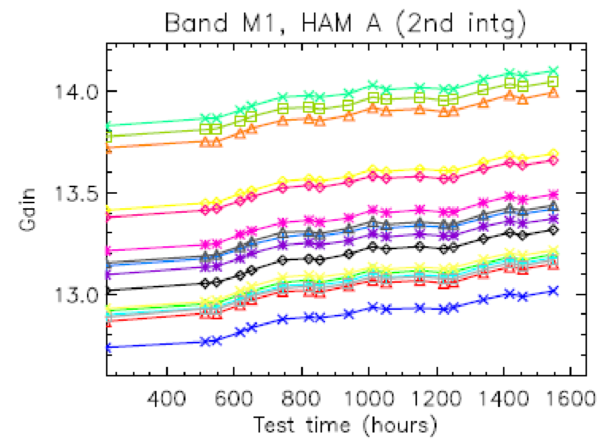


Calculating Gain Change

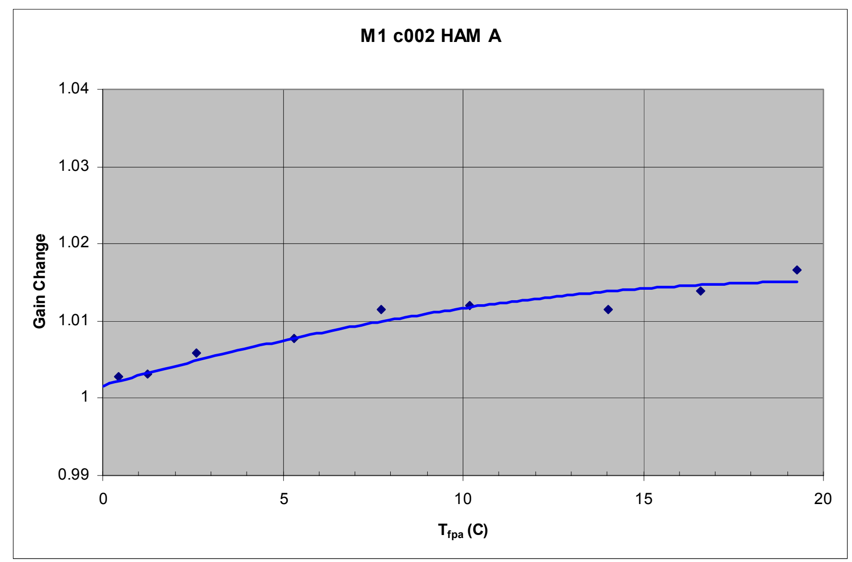
- Use SIS Monitor-corrected radiance to determine gain (dn/L_{sis})







- Calculate gain change relative to first effective data
  - Find that quadratic fitting is better for FPA temps
  - Linear fitting is sufficient for ASP temps

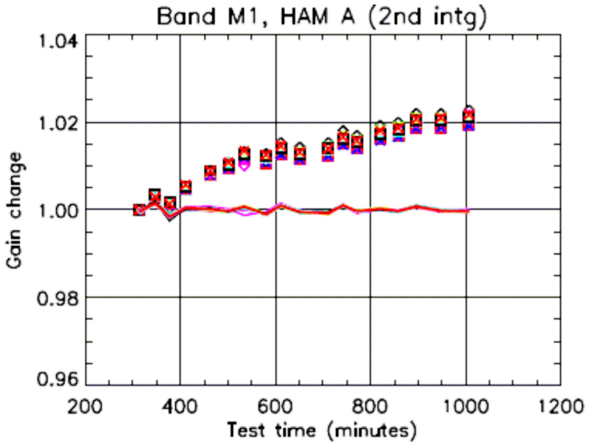


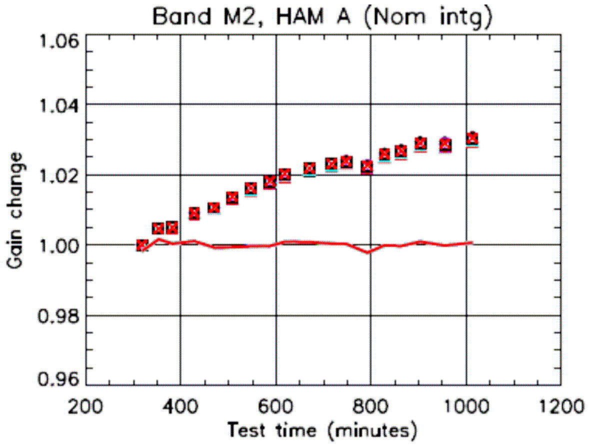
Temperature Coefficients & Gain Change Correction

- Use fitting function to determine temperature coefficients of the gain change from the two temperatures

$$\partial G(b,d,s,m,t) = A(0) + A(1)T_{VNIR\_FPA\_nom}(t) + A(2)T_{VNIR\_FPA\_nom}(t)^2 + A(3)T_{ASP\_nom}(t) + A(4)T_{ASP\_nom}(t)^2$$

where $T_{VNIR\_FPA\_nom}(t) = T_{VNIR\_FPA}(t) + 13°$ and $T_{ASP\_nom}(t) = T_{ASP}(t) - 20°$





- Gain variation after VNIR FPA and ASP temperature correction is less than 0.2% for all bands other than M9 and I3

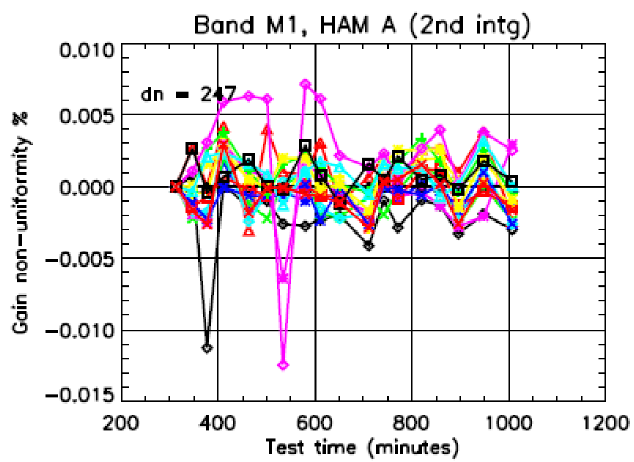
Gain Consistency

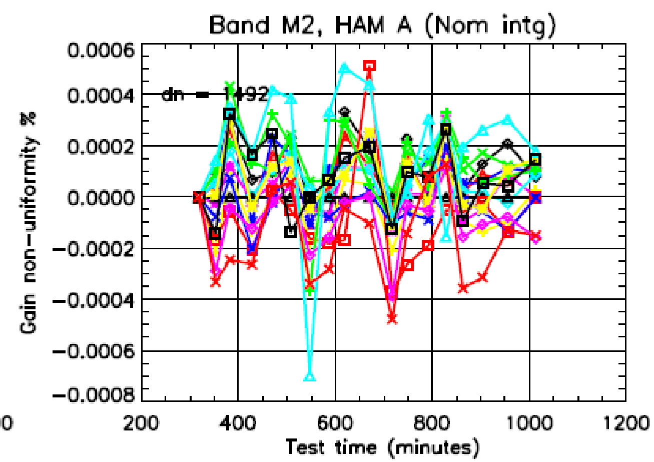
- Important because there's no way to track gain consistency when on orbit with only the solar diffuser at the specified orbital position
  - Gain ratio calculated by:

$$\partial G_{min}^{max}(b,t) = \frac{max}{min}\left[\frac{\left(\partial G(b,d,s,m,t) - \partial G(b,d,s,m,0)\right) - \left(\partial G(b,mid,s,m,t) - \partial G(b,mid,s,m,0)\right)}{G\left(b,d,s,m,\bar{t}\right)} \cdot 100\right]$$

where t bar = average gain over tests

- Gain consistency less than 0.04%, except for band I3 (<0.14%)





Work Summary Since 11/18/2008 -- CP

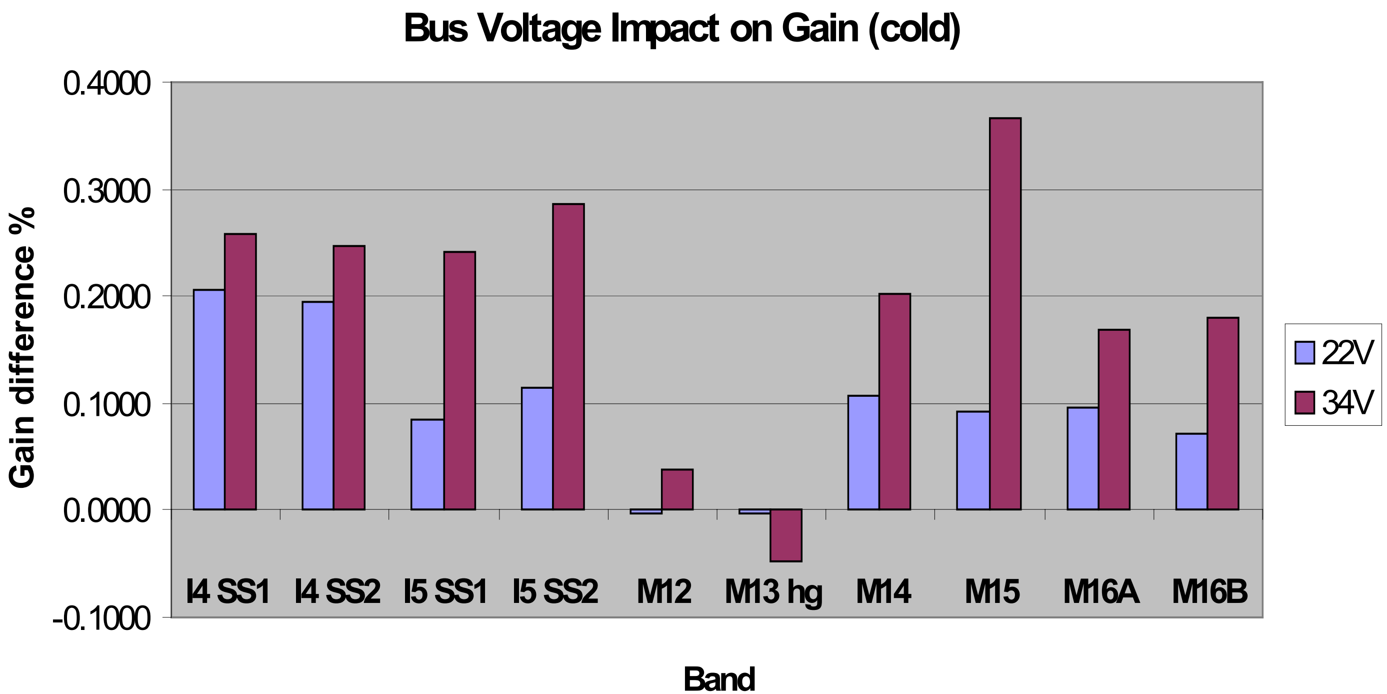
Team work

•Planed, scheduled and lead NICST technical activities collaborated with other teams on test data analysis, status tracking for anomalies, GSE and T-VAC plan
• Group supported various technical meetings with VT/Gov. teams
• Archived all necessary data and documents

Individual Technical Performance:

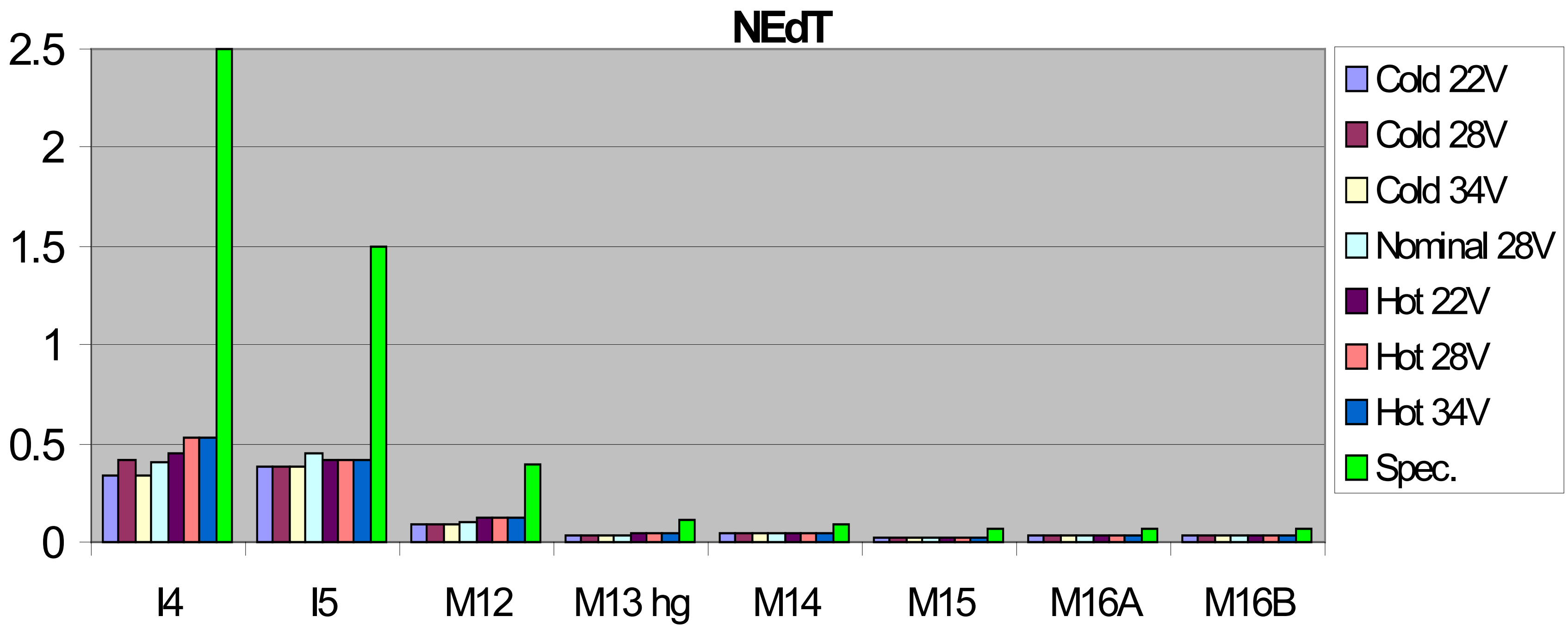
• Implemented and developed algorithms and methodologies for RC02 data analysis
• Drafted a memo summarized VIIRS RSB RC from EDU T-VAC & FU1 ambient. Proposed data analysis plan for FU1 RC02 in T-VAC
• Investigated and reported T-inst Impact on RSB RC and compared the results w/ MODIS
• Confirmed and Reported anomalies in RC model for M12-M14 and I3 w/ a comparison w/ MODIS
• Summarized EDU TEB RC05 sensor performance parameters (w/ Jeff)
• Investigated and reported bus voltage impact on RC for all TEB and RSB bands
• Worked w/ JS &TS for FP-15/16 crosstalk algorithm implementation
• Implementing and developing RSR algorithms using EDU data

Bus Voltage vs. Gain (Cold)



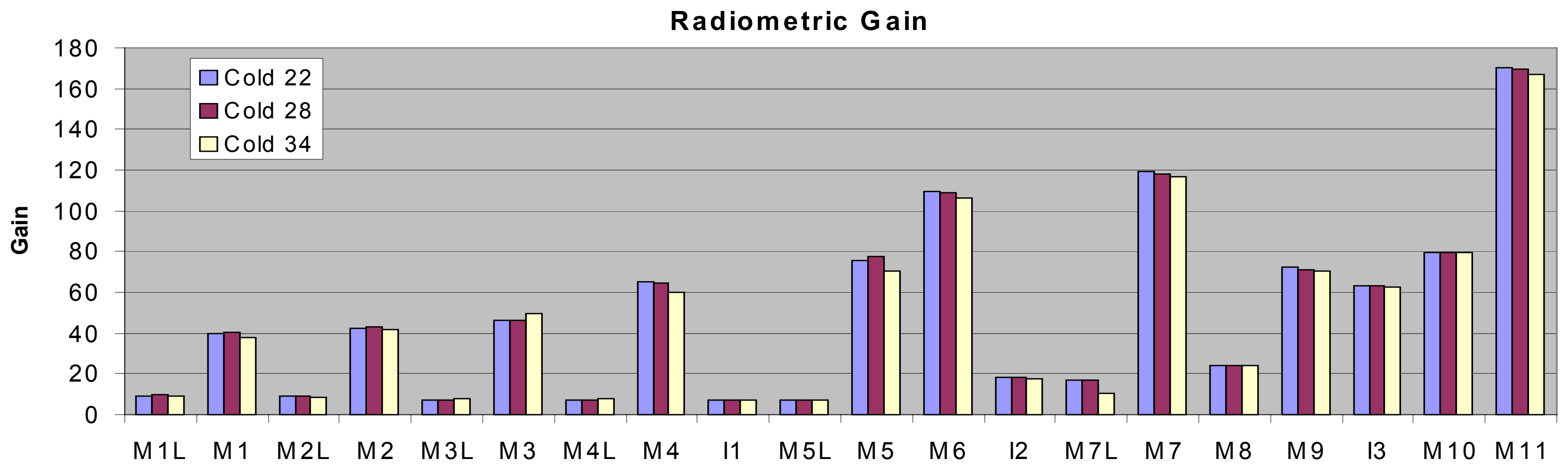
- Gain is averaged over all detectors (M14 detector 1 is excluded)
- Using 28 voltage as a nominal value.
- Gain difference (%) is computed using $(1\text{-gain}/\text{gain}_{28v})*100$
- Gain difference between 28v~34v is relative large.
- For cold temp. plateau, the bus voltage impacts on the radiometric gain is less than 0.4%.

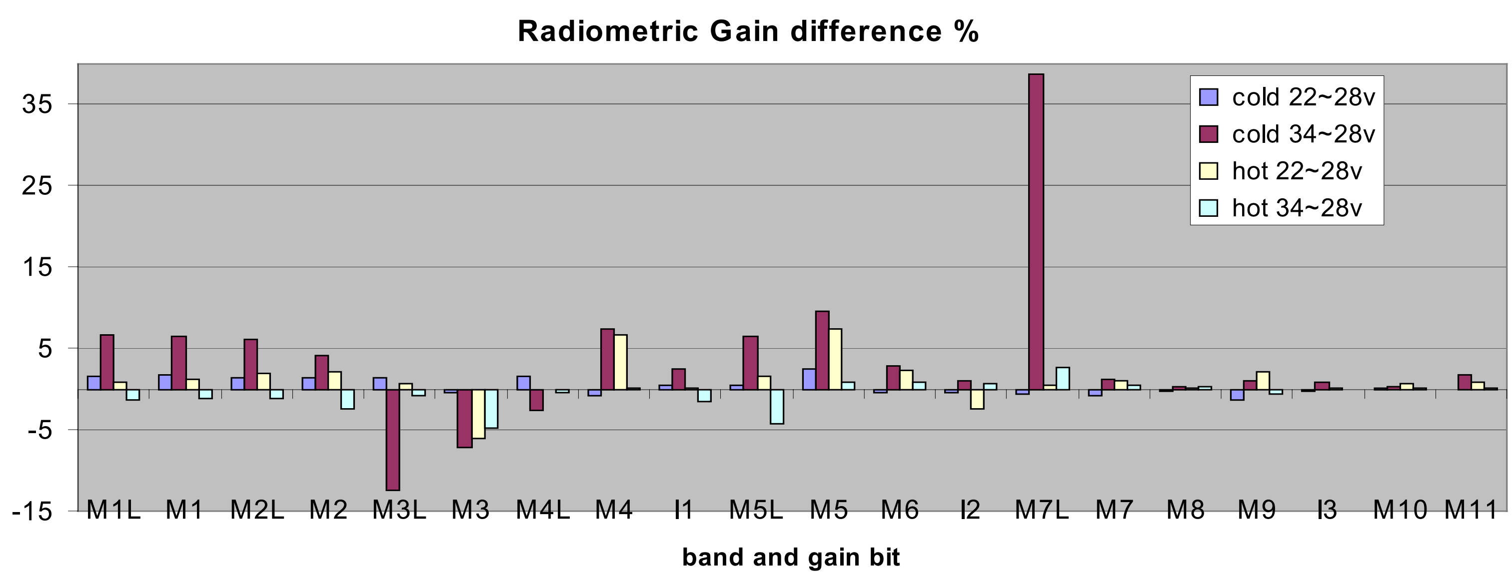
Bus Voltage Impacts on TEB NEdT



•NEdT meets the Spec. (M14 detector 1 is excluded)

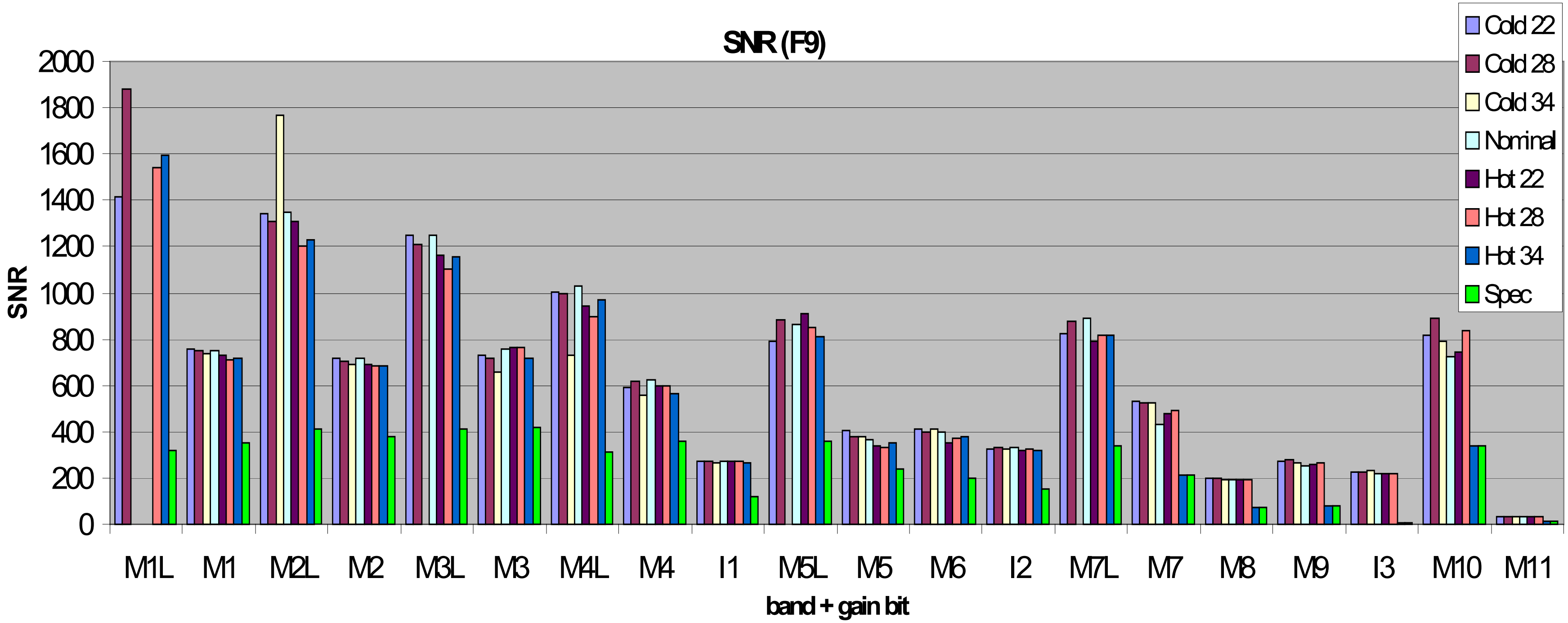
Bus Voltage Impact on RSB Gain (F6)





source: Y20981 RC-02 data

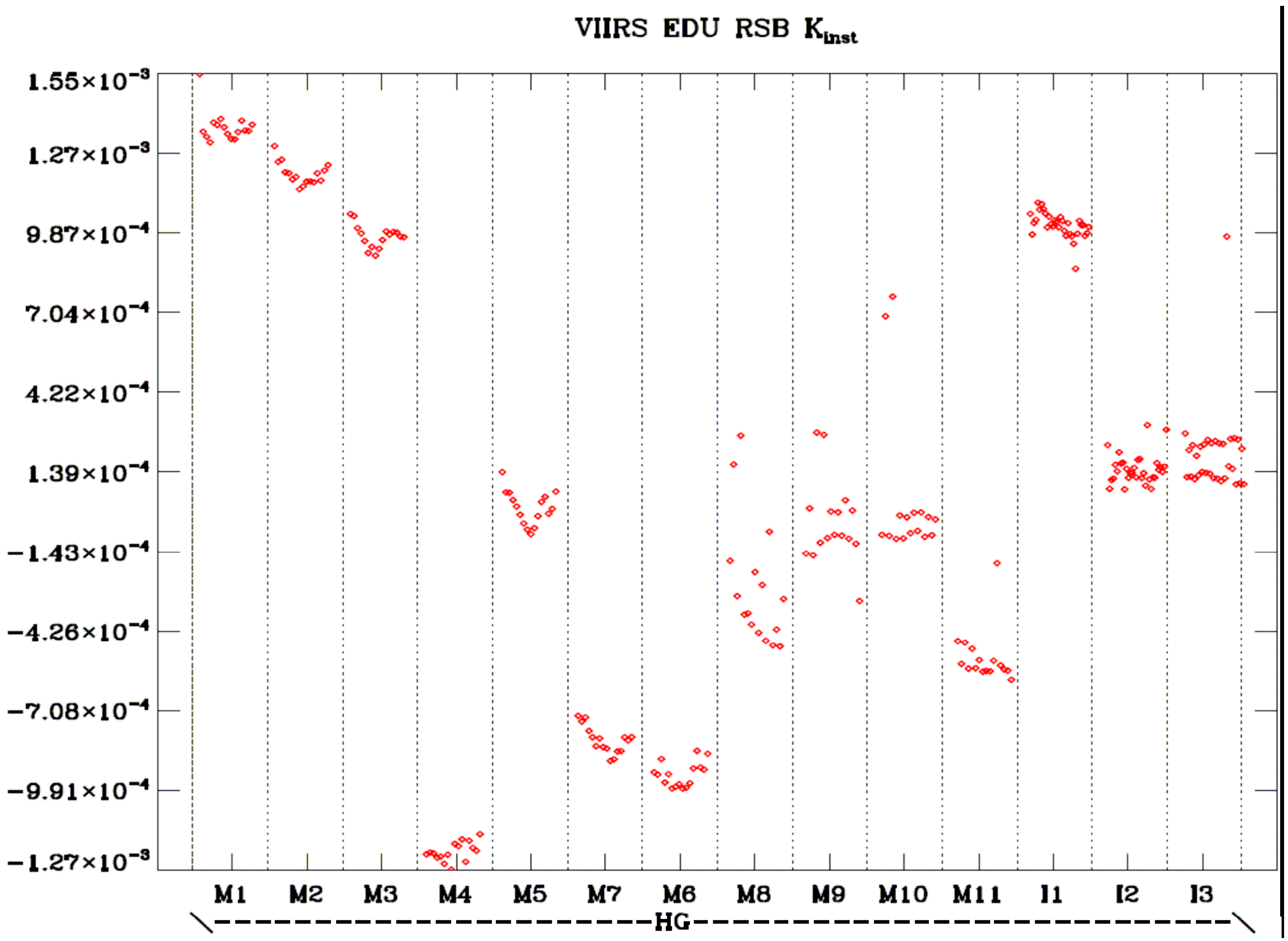
Bus Voltage Impact on RSB SNR(F9)



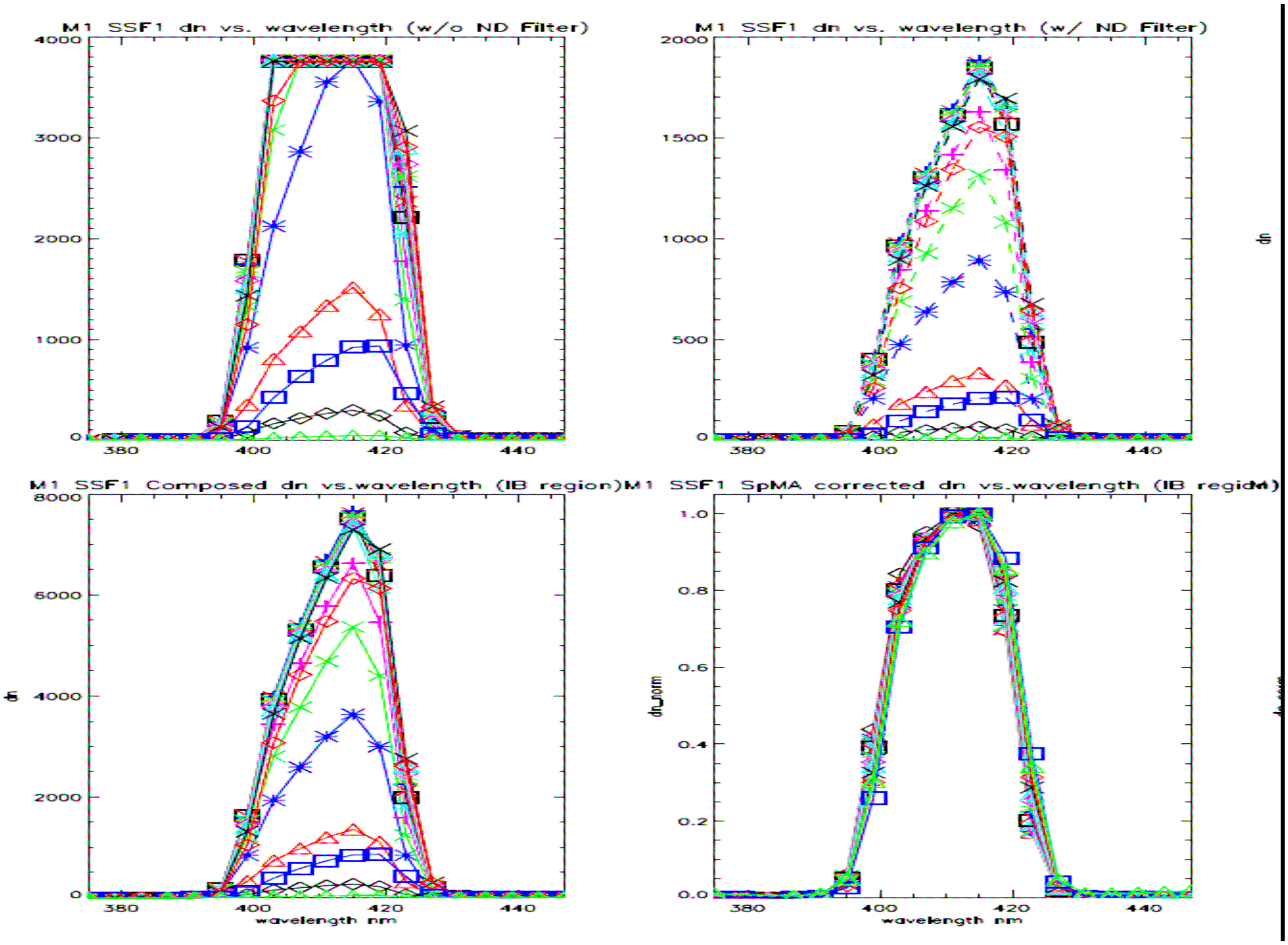
source: Y20981 RC-02 data

All bands meet the Spec. at different voltage

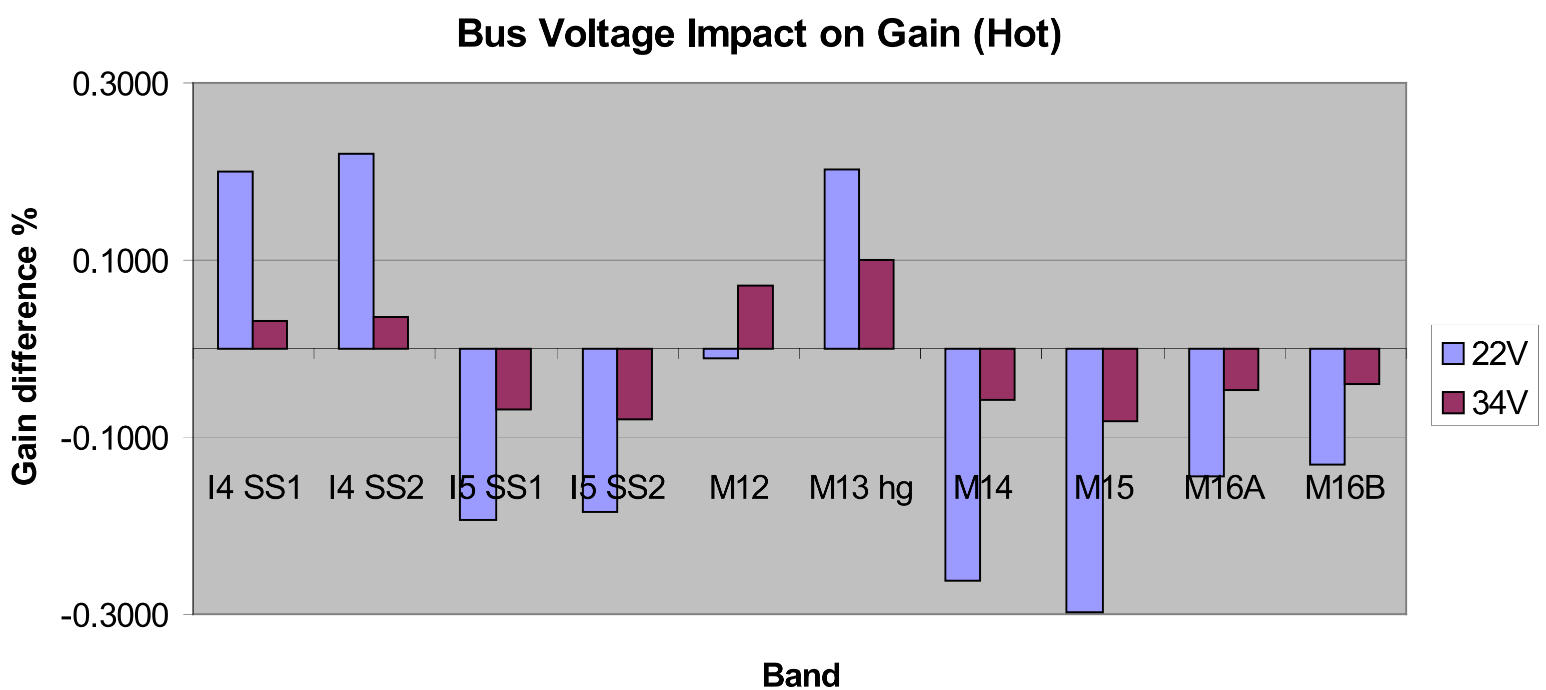
K_inst: T_inst impact on RSB:



RSR Data Analysis



Bus Voltage vs. Gain (Hot)



- Gain is averaged over all detectors (M14 detector 1 is excluded)
- Using 28 voltage as nominal value
- Gain difference (%) is computed using (1-gain/gain$_{28v}$)*100
- Gain difference between 28v~34v is relative small
- For the hot temp. plateau, the bus voltage impacts on the radiometric gain is less than 0.3%.

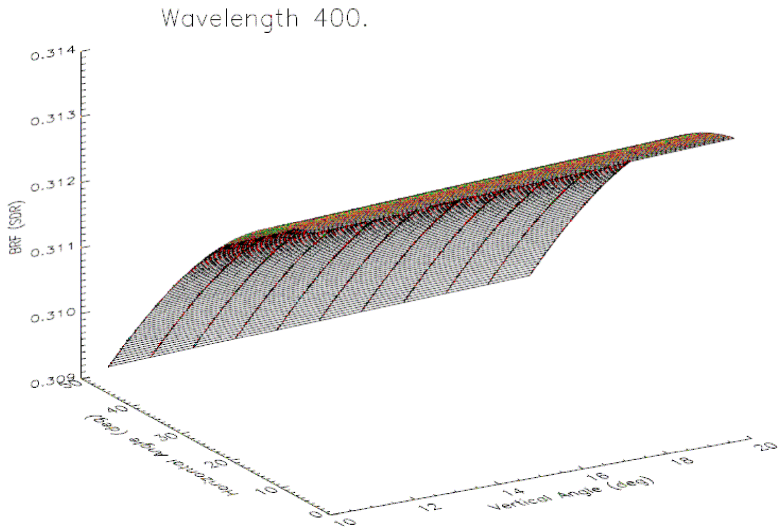
Junqiang Sun

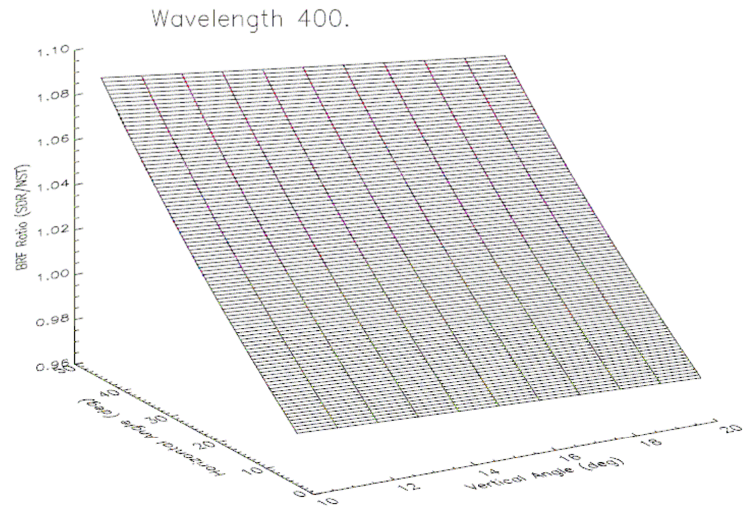
- **Polarization**
  - ➢ All data were analyzed and polarization parameters were derived for all VISNIR bands
  - ➢ Two memos were released and four (or more) presentations were presented at various meetings
  - ➢ The comments and suggestions about the VIIRS FU1 polarization characterization were provided for post TV polarization testing
- Lunar planner tool
  - ➢ Tool was finished. A memo was written and submitted. The lunar opportunities for FU1 in next two years were predicted.
  - ➢ Modifications related to input and output were done
  - ➢ It was demonstrated for NICSE

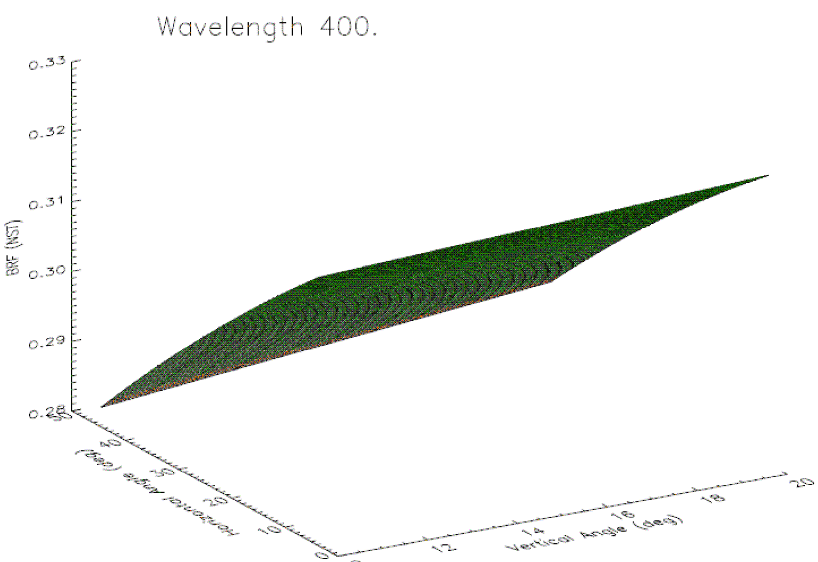
Junqiang Sun

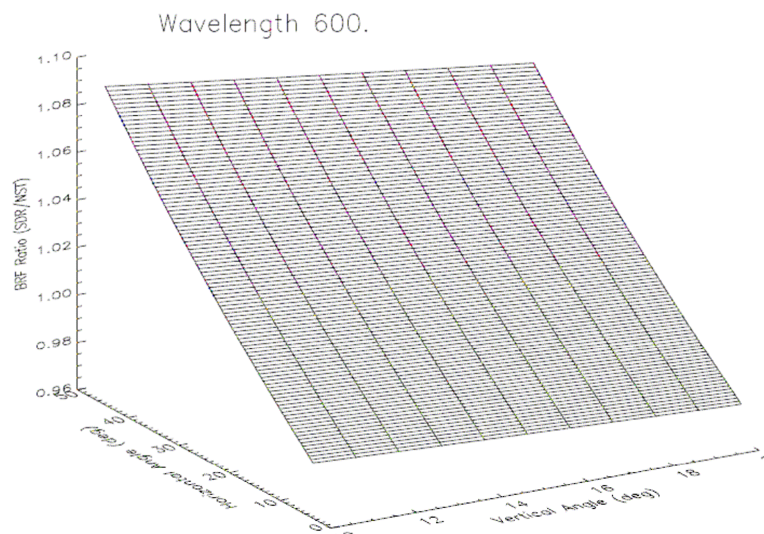
- SD BRF for VIIRS and SDSM views
  - The measured BRF were fitted to quadratic forms
  - Transformation between the SD and satellite coordinate systems was found and implemented
  - A presentation package was finished and presented
  - A memo was written and submitted
  - SD BRF and coordinate system for SD BRF in the SDR code were investigated
  - With the fitted BRF, the BRF table for FU1 SD calibration was calculated
  - Comparison between our table and that in the current SDR code showed that the BRFs in the SDR code should not be derived from the measured data

Junqiang Sun









Junqiang Sun

- RSR
  - ➢ Started to work on this issue and will do the TV data analysis on this topics
- RC2
  - ➢ Started to work on this issue and will do the TV data analysis on this topics
- RC3
  - ➢ Read test and calibration procedures
- SDSM calibration
  - ➢ Started to work on this issue
- SD calibration
  - ➢ Started to work on this issue

Vincent Chiang

Recent progress:

EDU data analysis:

- Revisit RC3 TEB part 1 and part 2 analysis.

SDR Ops code and LUT:

- Extraction of BRDF and Solar Irradiance LUTs.
- Comparison of above LUTs between Science code and Ops code.
- Code/LUT testing with modified LUTs.

On-orbit tool development:

- Test procedures for 3 tools: (1) LUT update (2) Lunar view planner (3) OBC-IP reader.
- OBC-IP reader tool.
- Perform tool testing.

Currently working on:

FU1 TV application:

- RC3 analysis backup

On-orbit application:

- Telemetry raw packets reader tool
- Emissive bands scan to scan calibration
- Emissive bands calibration using BB cycle
- Ops code/LUT testing with other modification