The JPSS Beta/Provisional Maturity Science Review For Suomi-NPP CrIS SDR Side-1 Product

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JPSS NOAA NASA

SNPP CrIS Side Switch Beta/Provisional Review: Recovery of The Side-1 LWIR and SWIR Bands

The CrIS SDR Algorithm Calibration and Validation Science Team

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Dave Tobin, University of Wisconsin/SSEC
Larrabee Strow, UMBC
Dave Johnson, NASA LaRC

July 21, 2021

Outline

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  - Noise (NEdN).
  - Spectral Calibration.
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Executive Summary: Beta/Provisional Review

- Intensive calibration and validation activities have been conducted by the CrIS SDR Algorithm Calibration and Validation Science Team after the Side Switch Activities Performed by OSPO Satellite Engineering and Operations and L3Harris from July 12-14, 2021.
- All planned activities have been *Successfully Completed On-time*.
- The SNPP CrIS Sensor is becoming stable after the side switch and no more sensor tuning activities have been recommended by the CrIS SDR Cal/Val Science Team.
- The SNPP CrIS Side-1 LWIR and SWIR bands are functional, while the MWIR band is non-operational.
- Comprehensive assessment results demonstrate the SNPP CrIS Side-1 Sensor Data Record (SDR) product meets the JPSS Level-1 Requirements. Calibration fine-tuning is being discussed at this time.
- The SNPP CrIS Side-1 SDR product meets the JPSS Beta Maturity Level and could transit to the Provisional Maturity Level after corresponding approval.
- The CrIS SDR Algorithm Calibration and Validation Science Team recommends the potential transition of the SNPP CrIS Side-1 SDR product to the JPSS Validated Maturity Level within 1-2 months.

CrIS SDR Algorithm Calibration and Validation Science Team and Support Collaborators

Name	Organization	Team	Major Task
Flavio Iturbide-Sanchez	NOAA/STAR **Cal/Val Team**	GST: Kun Zhang, Denis Tremblay, Erin Lynch. UMD: Peter Beierle, Zhipeng Wang	Science lead and project management; SDR team coordination and algorithm test in IDPS; algorithm/software update and maintenance; noise, geolocation, radiometric and spectral characterization; inter-comparison; long-term SDR data quality and monitoring; science support.
Dave Tobin	U. of Wisconsin (UW) **Cal/Val Team**	Hank Revercomb, Joe Taylor, Bob Knuteson, Lori Borg, Michelle Loveless, Dan Desolver	Radiometric calibration; radiometric error budget and uncertainty; noise characterization; non-linearity correction; polarization correction; inter-comparison; science support.
Larrabee Strow	U. of Maryland Baltimore County (UMBC) **Cal/Val Team**	Howard Motteler, Sergio de Souza-Machado, Chris Hepplewhite, Steven Buczkowski	Spectral calibration, neon calibration system; self apodization correction (e.g. ILS parameters); inter-FOV variability; inter-comparison; radiometric stability; science support.
Dave Johnson	NASA Langley	Yana Williams	NASA flight support; instrument science.
Joe Predina	Logistikos	Richard Hertel, James Isaacs, Shankar Atre	Optimal laser wavelength setting; noise; calibration algorithm; instrument science.
Sara Glass/Clayton Buttles	L3 Harris	Lawrence Suwinski, Don Ripplinger, Jeff Garr, and Rebecca Malloy.	Instrument manufacturer; On-ground and on-orbit instrument characterization and support.
Deirdre Bolen	JPSS/JAM		Discrepancy Report support.

JPSS Data Products Maturity Definition

1. Beta

- Product is minimally validated, and may still contain significant identified and unidentified errors.
- Information/data from validation efforts can be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose.
- Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists.

2. Provisional

- Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from selected locations, time periods, or field campaign efforts.
- Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.
- Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists.
- Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.

3. Validated

- Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).
- Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level.
- Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.
- Product is ready for operational use based on documented validation findings and user feedback.
- Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

SNPP CrIS Side-2 LWIR Band Anomaly Description

- The SNPP CrIS sensor had a **Side-2 Long Wavelength (LW) Signal Processor failure** on May 21, 2021 at about 11:20 EDT.
- The **instrument did not autonomously reset** as it has done in the past.
- The CrIS **soft and hard reset commands were executed** in order to recover the LWIR band, but **the LW processor halted immediately** after in each case.
- First assessments of the instrument telemetry indicates a **signature similar to that observed when S-NPP CrIS mid-wave failed on the Side-1 ("A") electronics**, which drove the decision to switch to Side-2 ("B") electronics on June 24, 2019.
- **During the SNPP CrIS Side-2 Anomaly, MWIR and SWIR bands were nominal while the LWIR band was inoperative.**
- **SNPP CrIS Side-1 LWIR band recovery activities have been conducted on July 12, 2021 as scheduled.**

Summary is based on Harry Solomon (KBR / JPSS Mission Manager) Report provided on May 21, 2021.

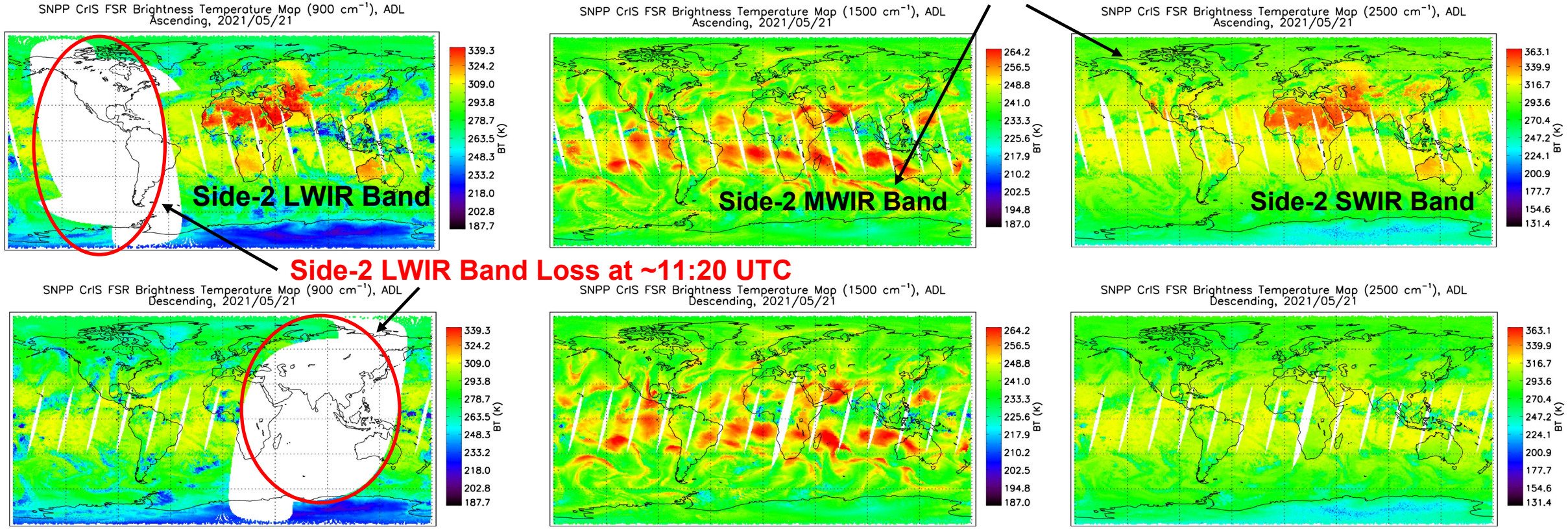
Potential Root Source of the SNPP CrIS Anomaly

- The **most probable root source** of Side-2 LWIR band anomaly **is associated with the LWIR Signal Processor reaching its Total Ionizing Dose of radiation** after nearly 10-years in operations*.
- It is expected that **radiation susceptibility** observed in the SNPP CrIS sensor **is significantly reduced after the redesign of the signal processor circuitry for NOAA-20 and subsequent CrIS sensors**.

** SNPP SIDE 2 LW SIGNAL PROCESSOR RESET ISSUE STATUS AND RECOMMENDATION Report, June 15, 2021, L3HARRIS.*

The Loss of the Side-2 LWIR Band on May 21, 2021

MW and SW band are nominal After the Side-2 LW Anomaly.



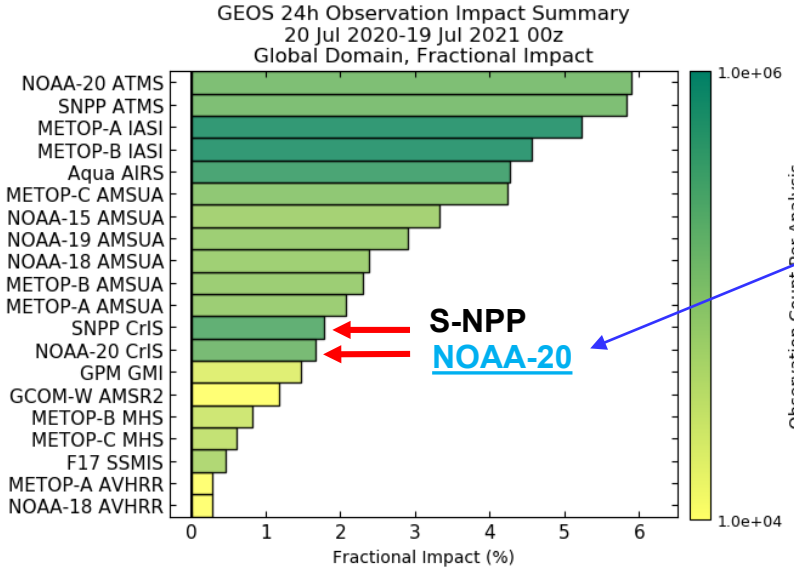
Increased Impact of NOAA-20 CrIS after the Loss of SNPP CrIS Side-2 LWIR Observations

- Over the past year, both **S-NPP CrIS and NOAA-20 CrIS instruments have shown similar impacts on weather forecasts, as indicated by the Forecast Sensitivity and Observation Impact (FSOI) fractional impact scores** from NASA GMAO (left figure).
- For the month shown in the figure on the right, S-NPP CrIS observations were not assimilated.
- **The fractional impact of NOAA-20 CrIS observations has increased to compensate for the loss of S-NPP CrIS observations following the anomaly**.

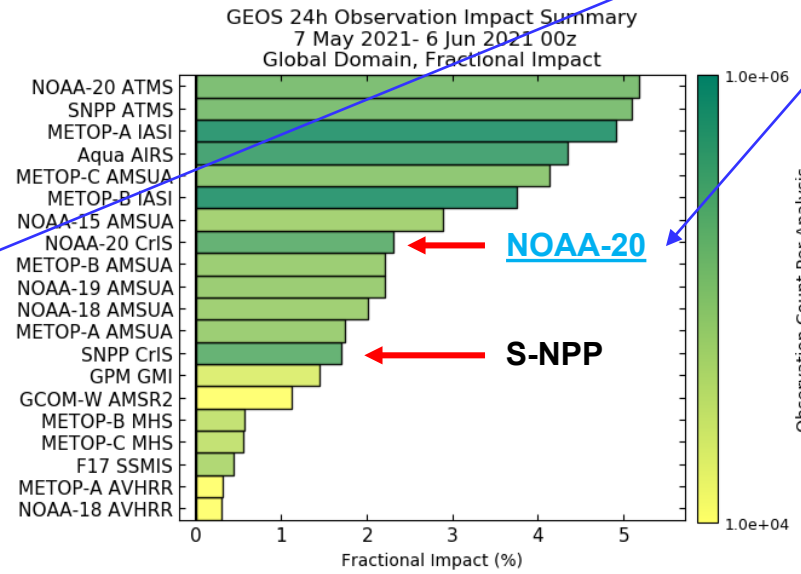
The NOAA-20 CrIS Forecast Impact has Increased After the SNPP CrIS Anomaly

FSOI Scores for Radiance Observations

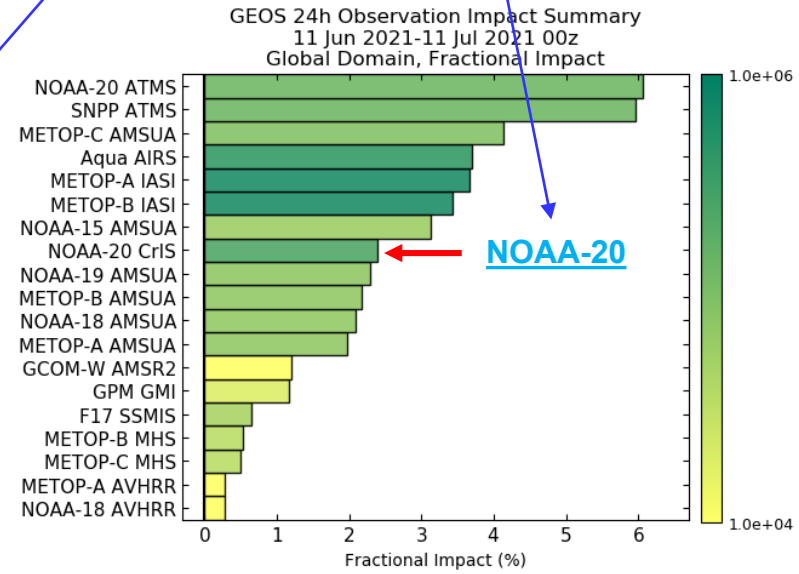
Past Year



May 2021 (with SNPP CrIS Anomaly)



June 2021 (with no SNPP)



Figures from https://gmao.gsfc.nasa.gov/forecasts/systems/fp/obs_impact/

Justification to Switch Back to Side-1 Electronics

The sensor side switch was recommended in order to mainly recover the Side-1 long-wave infrared (LWIR) observations after the permanent loss of the Side-2 LWIR band on May 21, 2021. The LWIR channels are critical for providing tropospheric and lower stratospheric temperature information and have been assimilated by operational NWP centers. This option reduces the impact to NWP and Direct Broadcast Users. Presently, NCEP assimilates 92 CrIS LWIR band channels, while ECMWF assimilates 111 CrIS LWIR channels.

In contrast, only 8 CrIS MWIR band channels are assimilated at NCEP and 37 MWIR band channels are assimilated at ECMWF. Presently, no CrIS SWIR band channels are assimilated at those two major NWP centers.

The SNPP CrIS Recovery Cal/Val Plan

Activity No.	Cal/Val Activities for the Switch to SNPP/CrIS Side-1 Electronics	Main Responsible(s)	Start / Completion Date[1]	Deliveries	Delivery Status: Completed, In Progress, Not Initiated, Scheduled	Timeline (weeks, MM/DD) in Year 2021						
						1 7/12-7/14	1 7/15-7/18	2 7/19-7/25	3 7/26-8/1	4 8/2-8/8	5 8/9-8/15	6 8/16-8/22
1	**Instrument Side-Switch and Tuning (interferogram centering) using Side-1 EPv40. Ended with EPv41.**	L3Harris, NASA LaRC	7/14/2021	Technical Report, Upload EPv41	Completed							
2	Intensive sensor monitoring	STAR	7/12-8/22	Technical Report	In Progress							
3	Assessment of the Phase of ICT Spectra (consitency with Side-1 before 2019 MWIR anomaly)	STAR/UW	7/21/2021	Technical Report	Completed							
4	Generation of new ILS parameters, as part of the Spectral Calibration	UMBC	7/21/2021	Technical Report	Completed							
5	Bit Trim Mask Verification, as part of the PGA gain setting	STAR	7/21/2021	Technical Report	Completed							
6	Evaluation of Non-linearity	UW	7/21/2021	Technical Report	Completed							
7	Evaluation of Spectral Uncertainty	UMBC, UW, STAR	7/21/2021	Technical Report	Completed							
8	Evaluation of Geolocation Uncertainty	STAR	7/21/2021	Technical Report	Completed							
9	Evaluation of Radiometric Calibration Uncertainty	UW	7/21/2021	Technical Report	Completed							
10	Evaluation of Instrument Noise Performance	STAR, UW	7/21/2021	Technical Report	Completed							
11	FOV-to-FOV Radiometric Consistency	UW, UMBC, STAR	7/21/2021	Technical Report	Completed							
12	**Beta Maturity Level Review**	CrIS SDR Team	7/21/2021	Technical Report	Scheduled			Beta Level Review				
13	Generation of a 3-day SDR dataset with Updated ILS Parameters to Share with Team for Evaluation without geolocation optimization. **Generate intermediate EPv41a.**	STAR	-	SDR at NSR/FSR in HDF	Not Initiated							
14	Generation of new mapping angles and assessment of the Geolocation Calibration	STAR	-	Technical Report	Not Initiated							
15	Generation of a 3-day SDR dataset, with optimized calibration coefficients for Verification **in Preparation for EPv42**. **Distribute data to Users (NWP, NUCAPS, etc).**	STAR	-	SDR at NSR/FSR in HDF	Not Initiated				Distribute Offline Data to Users			
16	Evaluation of SDRs (>3 days) Using Offline ADL with **EPv42** Information	UW, UMBC, STAR	-	Technical Report	Not Initiated							
17	**Provisional Maturity Level Review**	CrIS SDR Team/Users	7/21/2021	Technical Report	Scheduled			Provisional Level Review			Provisional Level Review	
18	**Prepare EPv42** for uploading (xml file and documentation)	STAR	-	**EPv42**	Not Initiated							
19	**Approval and Upload of EPv42**	Flight Working Group/OSPO	-	**Upload EPv42**	Not Initiated							Toward Validated Level. 1-2 months Intensive Cal/Val

All planned activities have been successfully completed

Operational data available for Group 1 and 2 Users

Scheduled for July 21, 2021

Operational data available for Group 3 Users

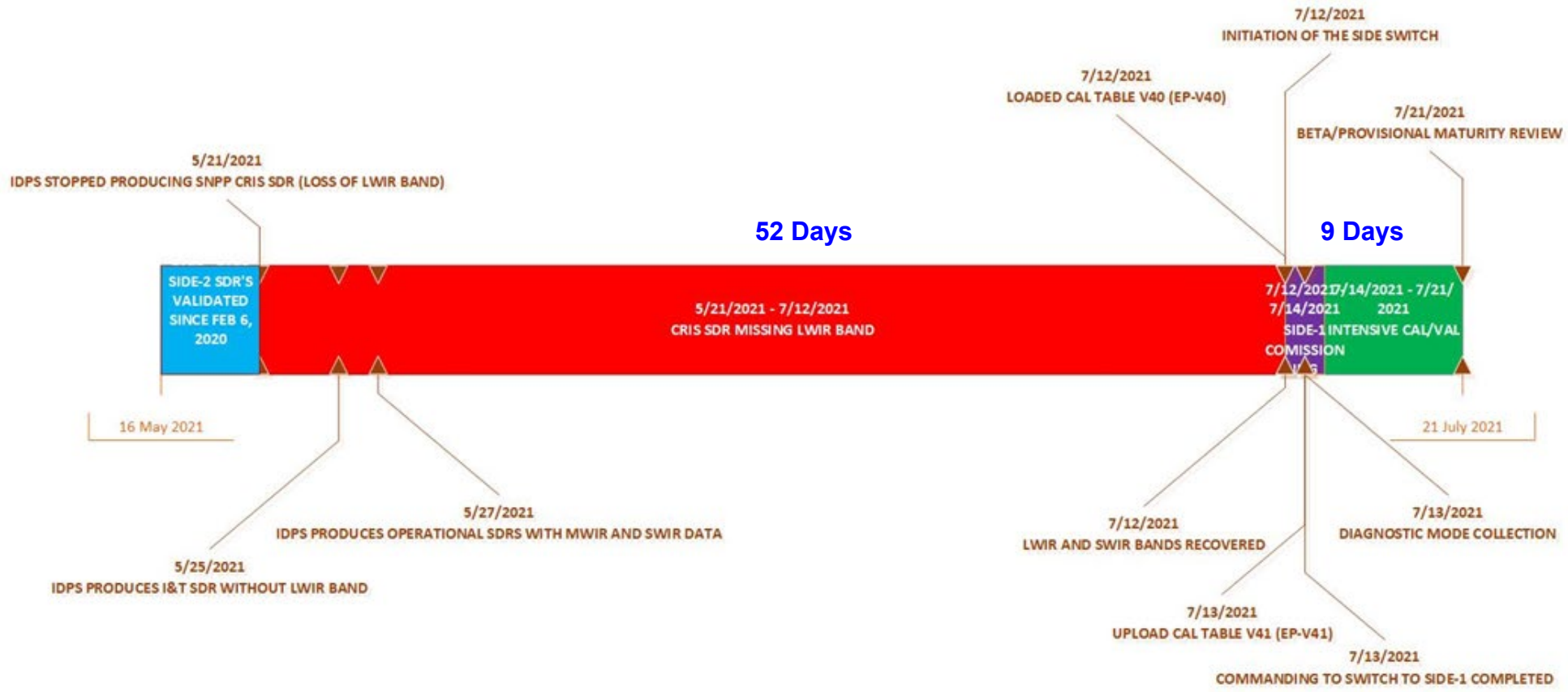
Data Access Level During the Cal/Val Process

Group 1 can get everything	Group 2 can get once beta	Group 3 will only get data once provisional (everyone not specifically in group 1 or 2 is in group 3)
NCEP_EMC	NCEP_SPC	NCMRWF (India) International
NCF-SBN	NCEP_SWPC	TWC (Commercial)
NCEP_IDP (NCO)	NCEP_NHC	Accuweather (Commercial)
NCEP_WCOSS (NCO)	NCEP_AWC	Barons (Commercial)
ESPC_SFS	NCF-DD	Blue Sky (Commercial)
ESPC_SAB	EUMETSAT	Roffers (Commercial)
NOAA_STAR	CANADA_MC	KOREA MA
NOAA_NCEI_CO_SPADES	BIG_DATA	BRAZIL_CPTEC
ESPC_HRIT	NAVY_FNMOC	**All other users**
ESPC_WEB	JAPAN_JMA	
NASA_MSFC_GLM	AF_AFWA (557th, but getting G16 via GRB)	
OSPO_GNC-A	NAVY_NAVO	
NOAA_CLASS		
ESPC_NIC		
ESPC_IMS		
NASA_GSFC		
Other ESPC Internals		

- Users have been identified from the PDA distribution list obtained on July 8, 2021 from Donna Mcnamara (donna.mcnamara@noaa.gov).
- These access level groups have been coordinated between JPSS and GOESS.

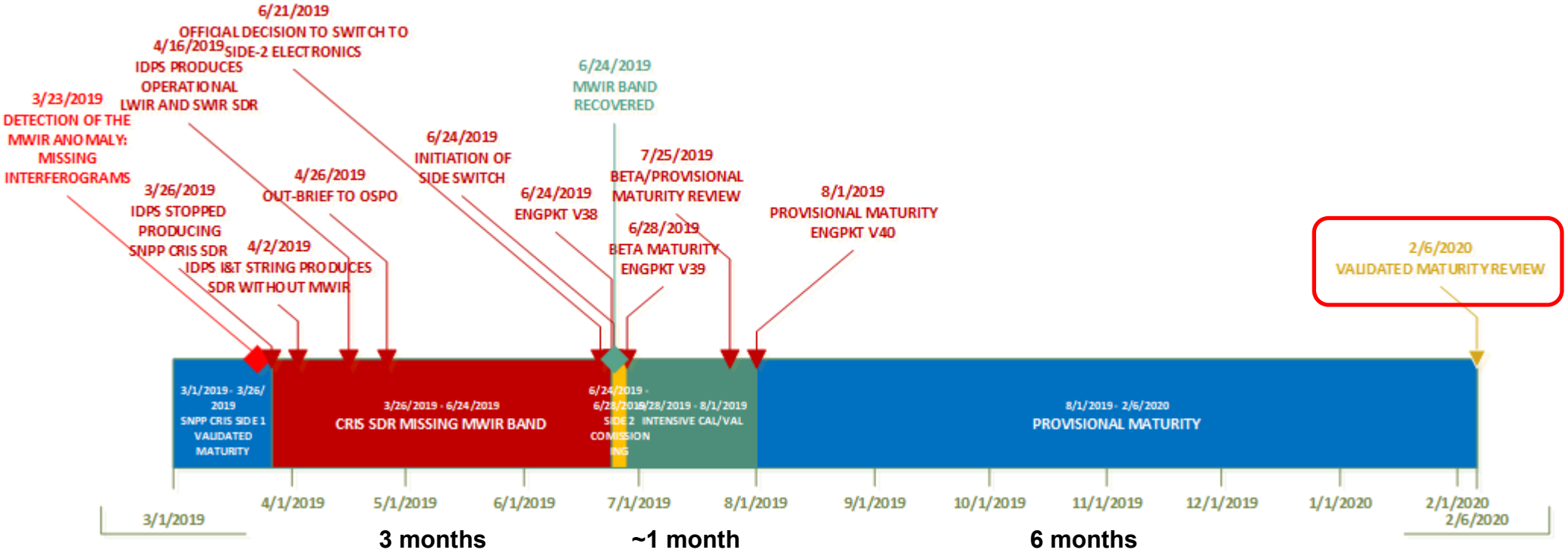
SNPP/CrIS Major Events and Milestones: Switching Back to Side-1 Electronics

- 1 Day to Recover the LWIR Band
- 2 Days of Instrument Tuning
- 9 Days for Demonstrating Beta and Provisional Level



SNPP/CrIS Major Events and Milestones: Switching to Side-2 Electronics

1 Day to Recover the MWIR Band
5 Days for Instrument Tuning
15 Days for Demonstrating Beta Level
15 Days for Demonstrating Provisional Level
6 months for Demonstrating Validated Level



- **Date of Side-2 Meetings:** 2019-03-29, 2019-04-12, 2019-05-01, 2019-05-15, 2019-05-29, 2019-06-26, 2019-07-03, 2019-07-17, 2019-07-25.
- **Delivered daily reports to the JPSS Managers after side switch.**

Main CrIS SDR Cal/Val Science Team Activities

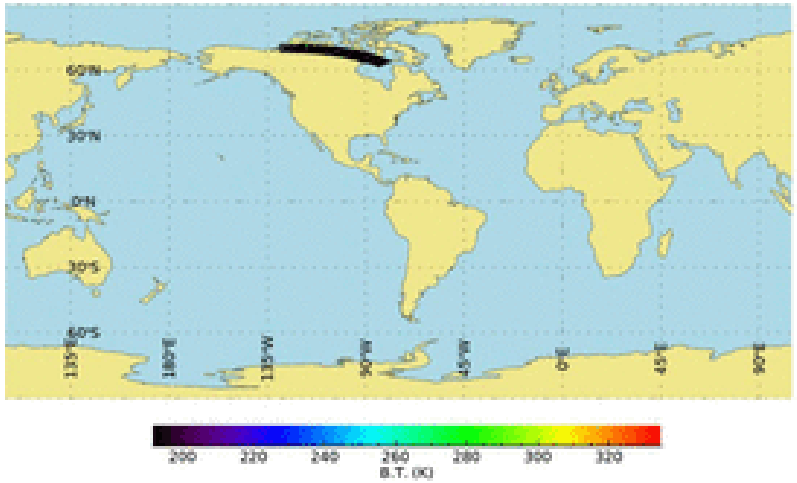
SNPP CrIS Side-1 SDR Comprehensive Assessments Toward Beta/Provisional Maturity Level:

- **Sensor Performance:**
  - **Time series of telemetry parameters before and after side switch.**
  - **Bit trim mask verification (as part of the PGA gain settings).**
- **SDR Radiometric Performance:**
  - **Quantitative analysis of radiometric consistency between NOAA-20 and SNPP CrIS.**
  - **Quantitative analysis of FOV-2-FOV radiometric variability and consistency as part of nonlinearity correction verification.**
  - **Spectral ringing quantification and evaluation.**
  - **Radiometric inter-comparisons against IR sensors and comparisons against simulated observations.**
  - **Qualitative radiometric analysis based on Earth observations on global scale.**
  - **ICT/DS magnitude and phase analysis.**
- **SDR Spectral Performance: Quantitative assessment of the spectral accuracy (relative and absolute).**
- **SDR Radiometric Noise Performance:**
  - **Quantitative analysis of noise trending performance after side switch.**
- **SDR Geolocation Performance: Quantitative assessment of Geolocation accuracy.**

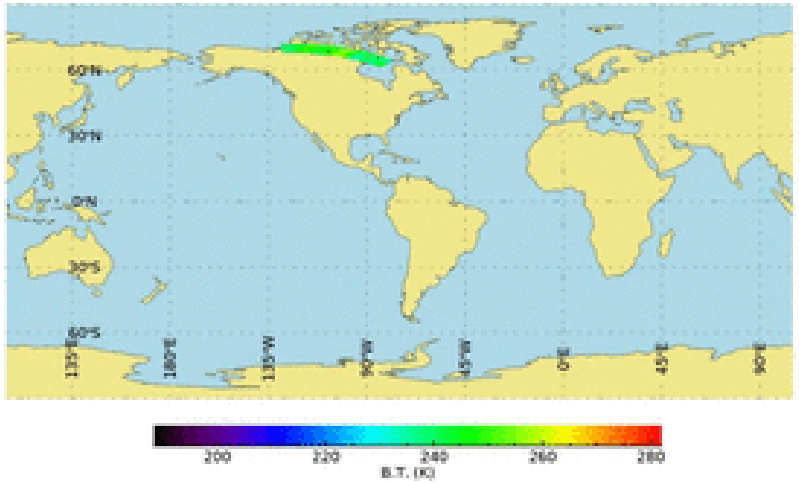
SNPP CrIS SDR Brightness Temperature and Quality Flag Maps At the SNPP Side Switch (*Animation*)

SNPP CrIS Side-1 July 12, 2021, Brightness Temperature Maps

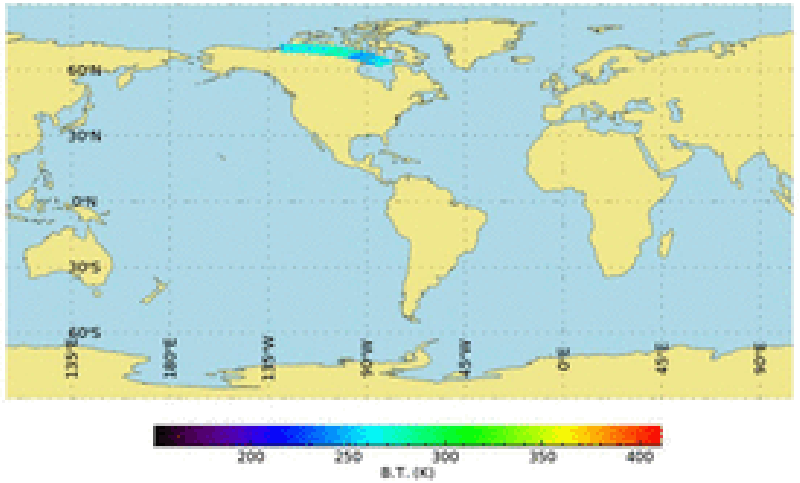
S-NPP CrIS Brightness Temperature @ 900 cm^{-1} (LWIR)



S-NPP CrIS Brightness Temperature @1598 cm^{-1} (MWIR)

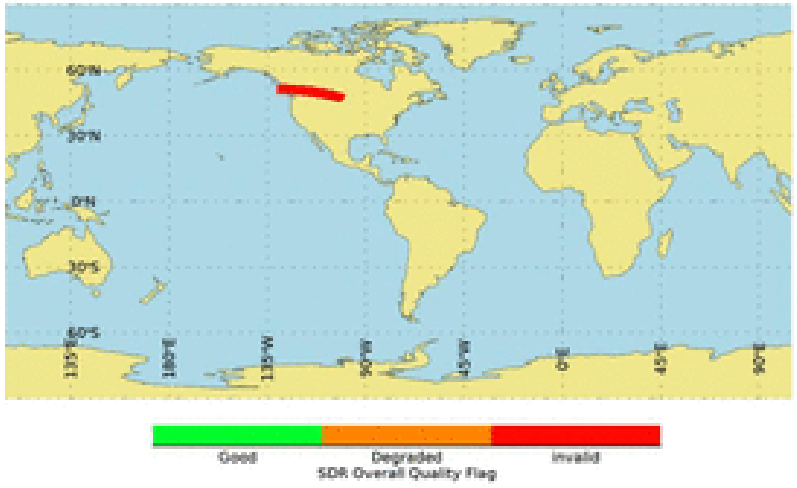


S-NPP CrIS Brightness Temperature @2455 cm^{-1} (SWIR)

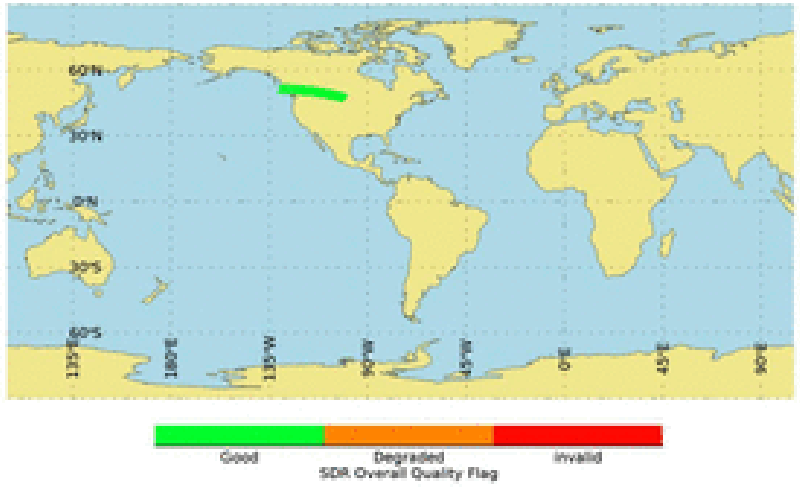


SNPP CrIS Side-1 July 12, 2021, SDR Quality Flag

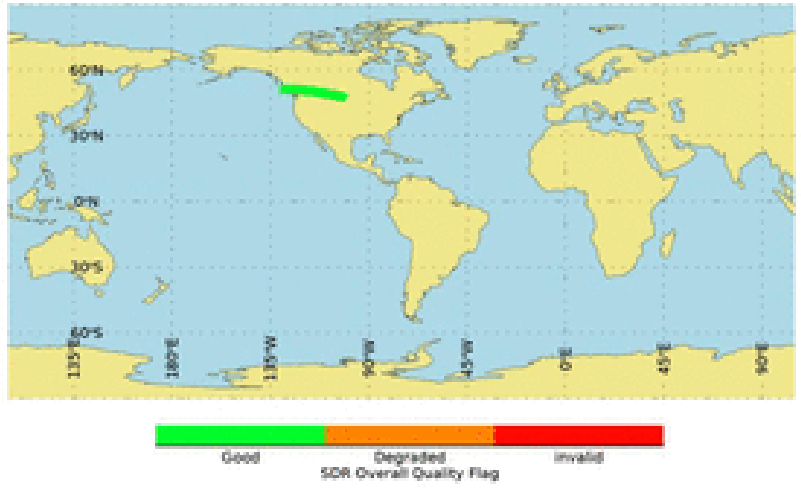
S-NPP CrIS LWIR SDR Quality Flag



S-NPP CrIS MWIR SDR Quality Flag

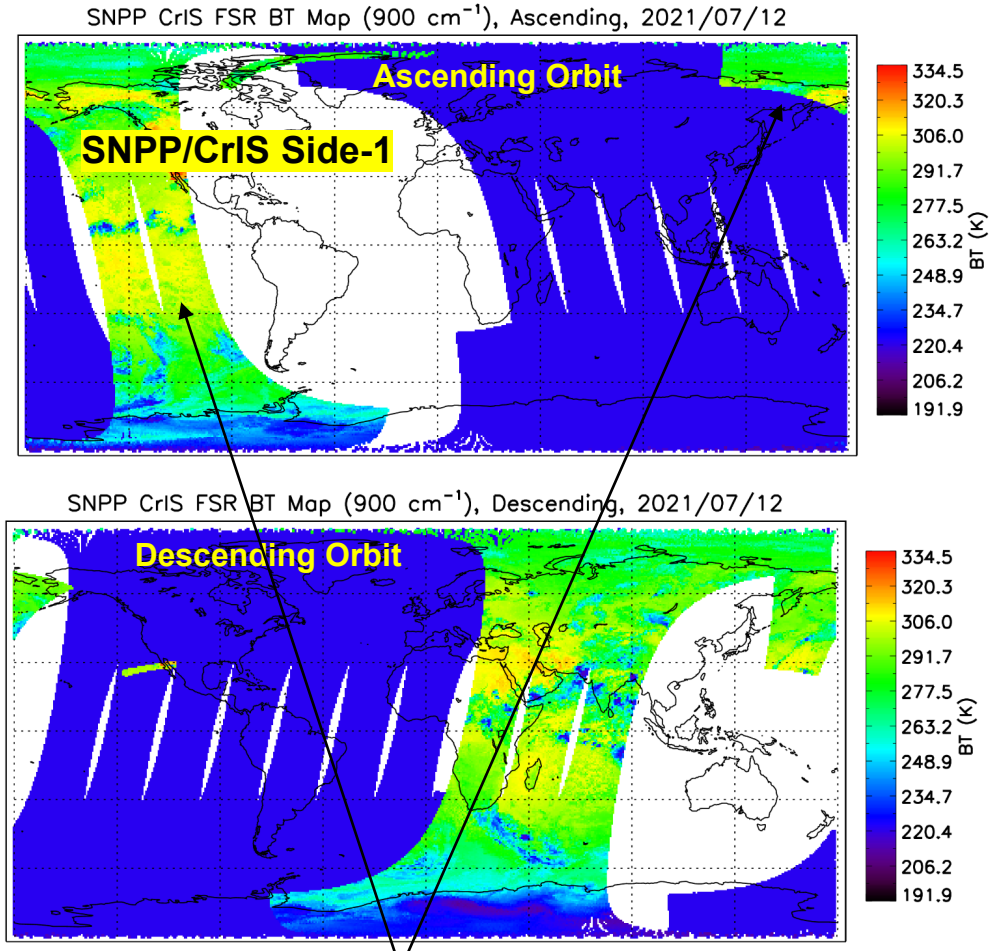


S-NPP CrIS SWIR SDR Quality Flag



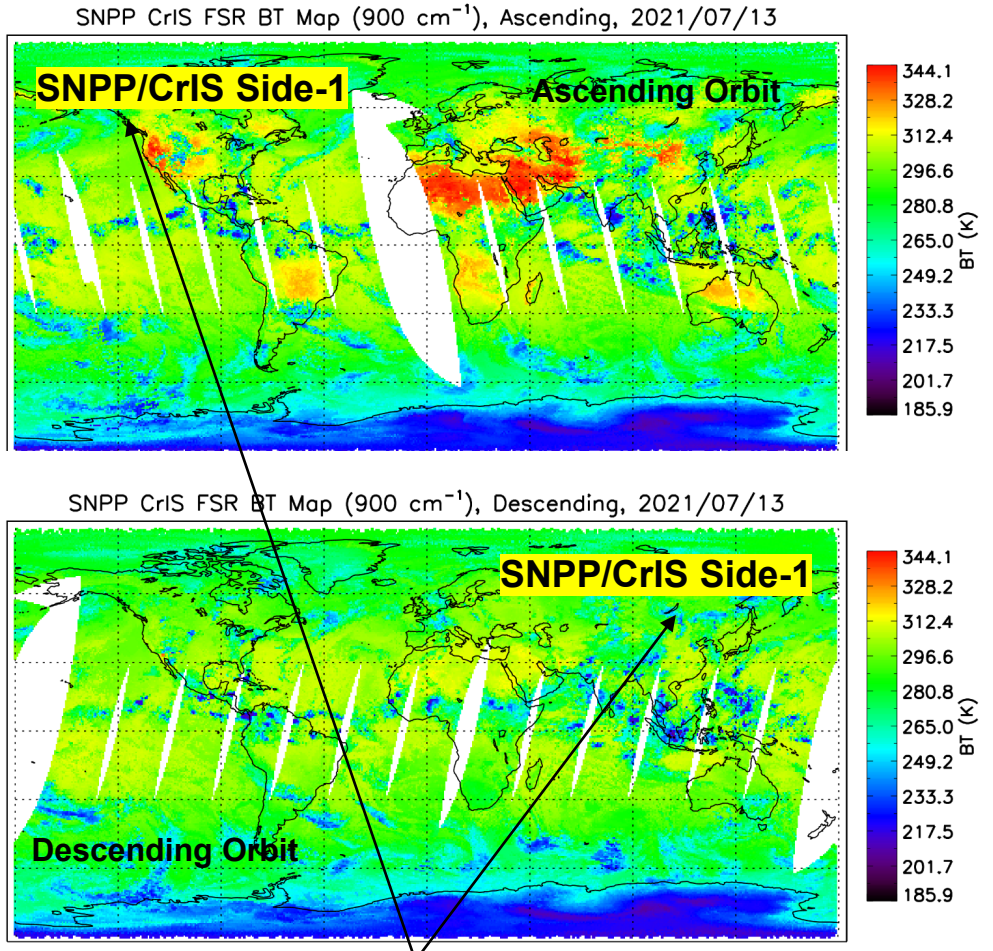
Recovery of the SNPP CrIS Side-1 LWIR (Functional): Switching Back to Side-1 Circuitry (1/3)

Day-1 of Side-1 LWIR Recovery Activities
July 12, 2021



Side-1 LWIR Band Functional after side switch on July 12, 2021

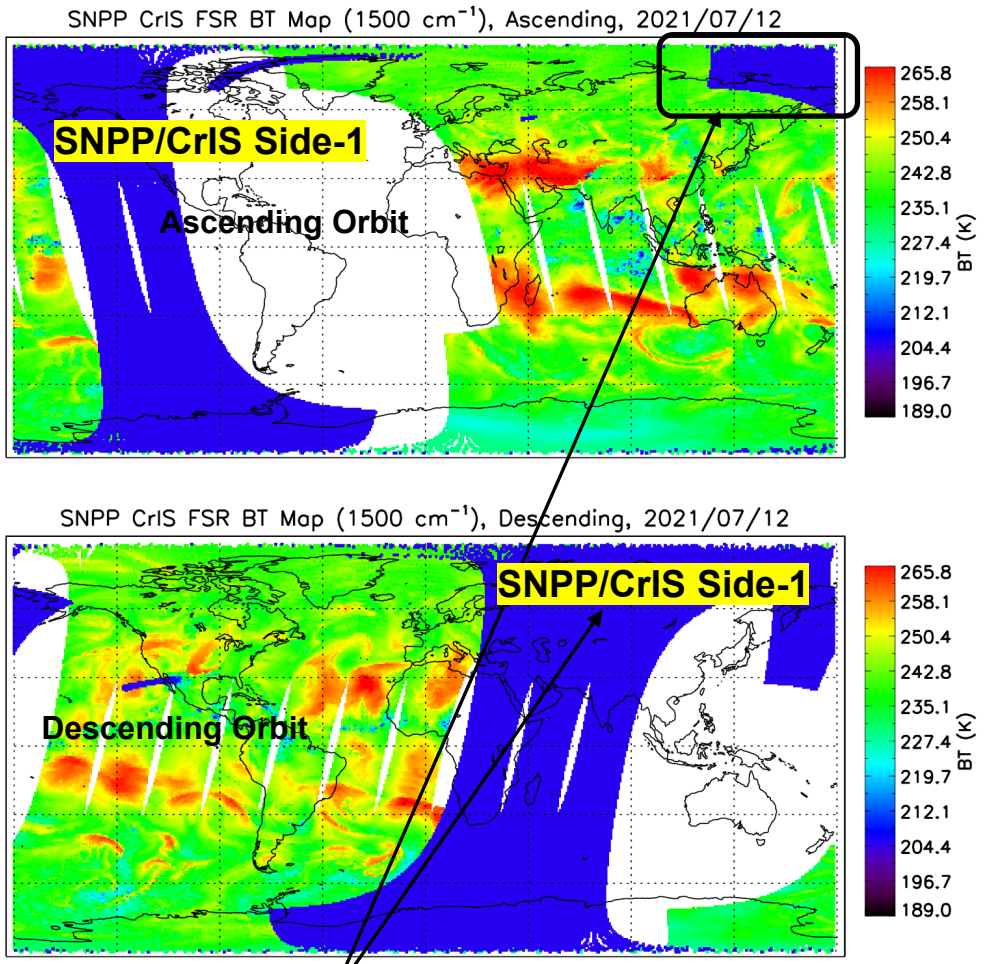
Day 2 of Recovery Activities
July 13, 2021



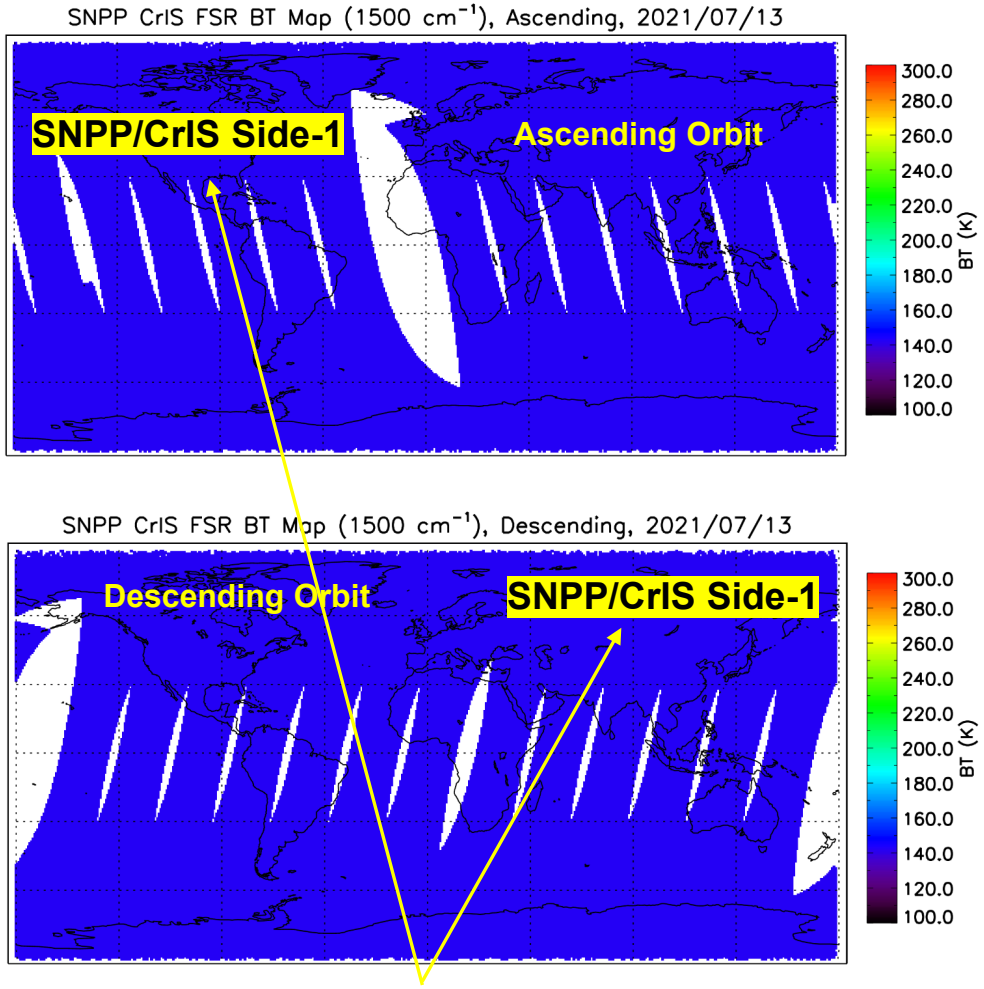
Side-1 LWIR Band continues nominal 1-day after the side switch on July 12, 2021

Recovery of the SNPP CrIS Side-1 MWIR (Non-Functional): Switching Back to Side-1 Circuitry (2/3)

Day 1 of Recovery Activities
July 12, 2021



Day 2 of Recovery Activities
July 13, 2021

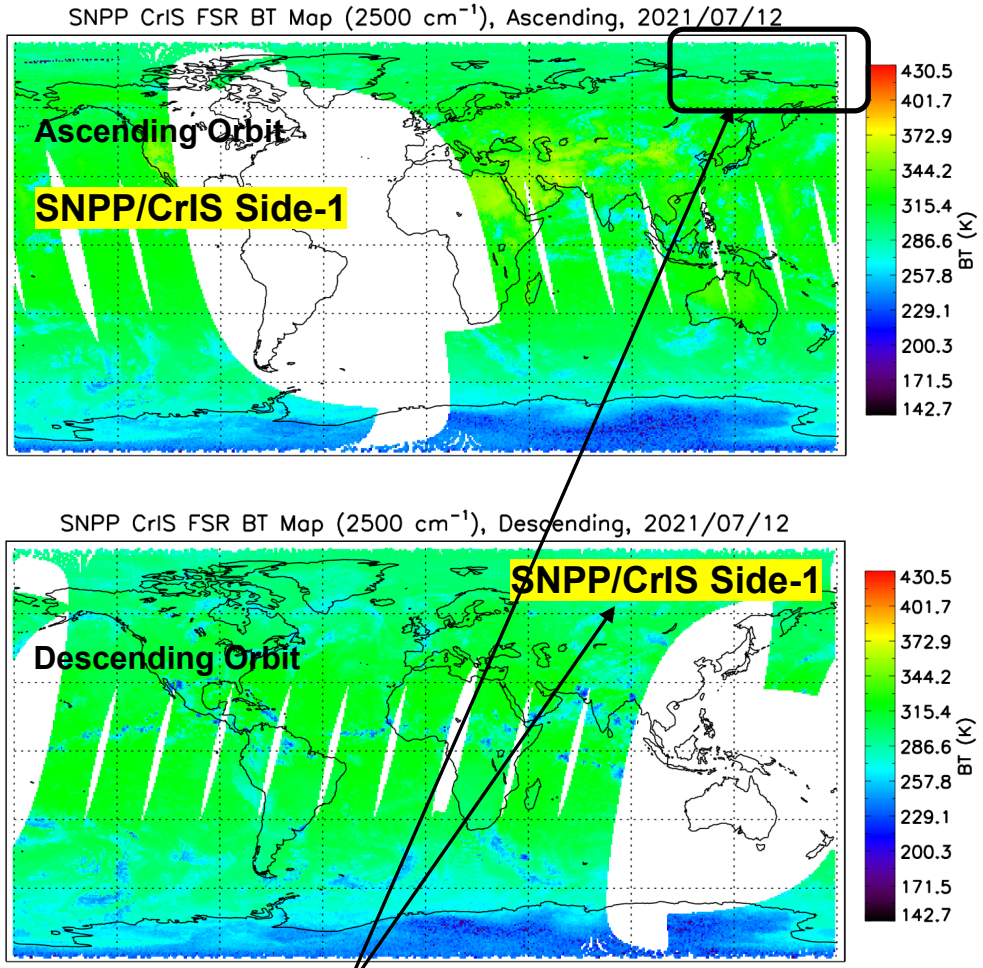


Loss of Side-1 MWIR Band Since March 2019

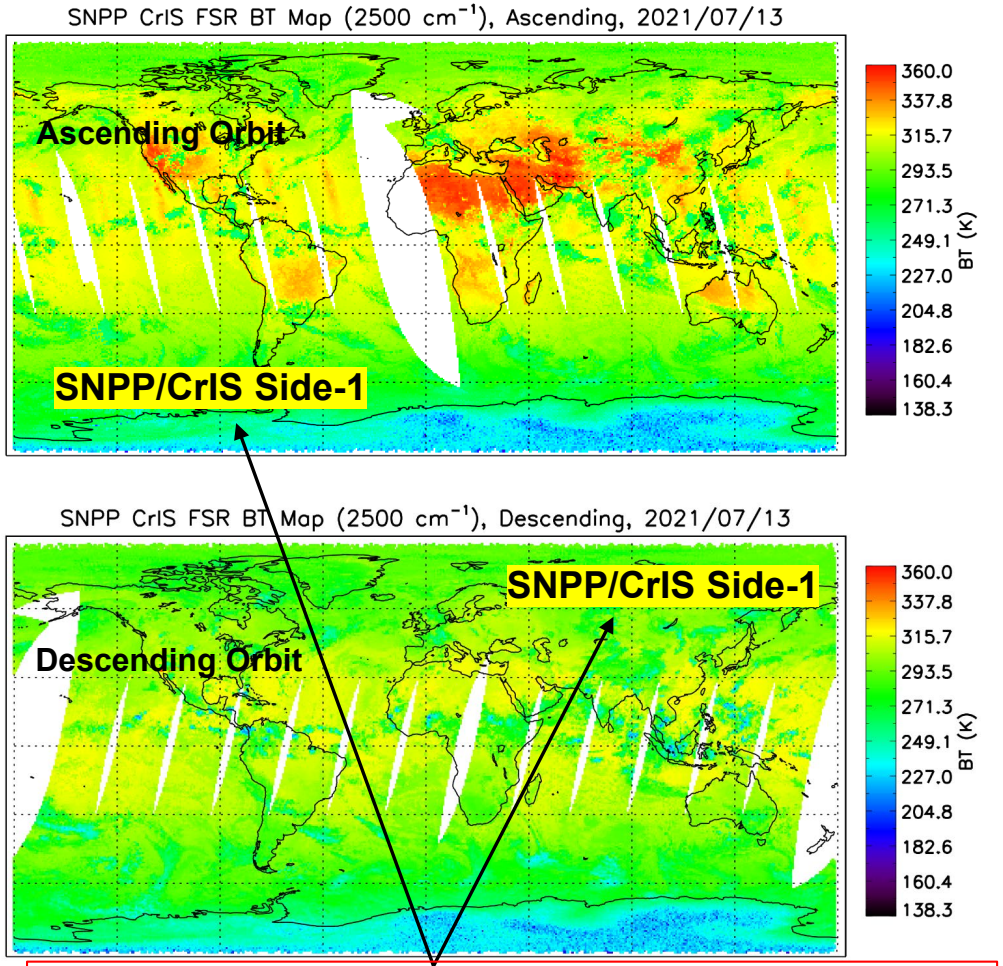
Side-1 MWIR Band Not Restored After the Side Switch on July 12, 2021

Recovery of the SNPP CrIS Side-1 SWIR (Functional): Switching Back to Side-1 Circuitry (3/3)

Day 1 of Recovery Activities
July 12, 2021



Day 2 of Recovery Activities
July 13, 2021

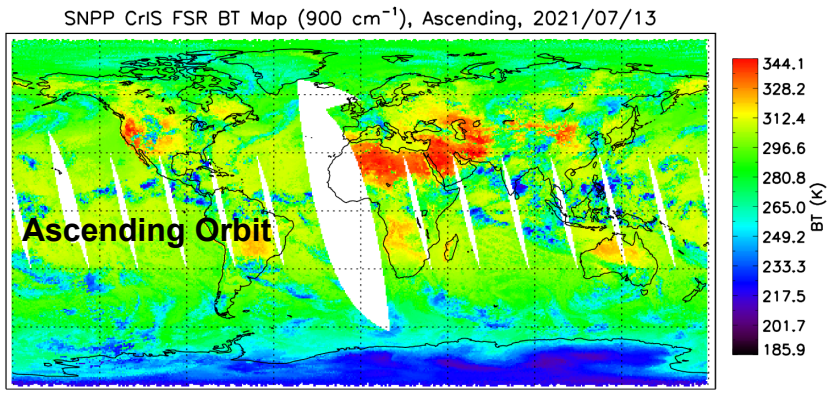


Side-1 LWIR Band Functional after side switch on July 12, 2021

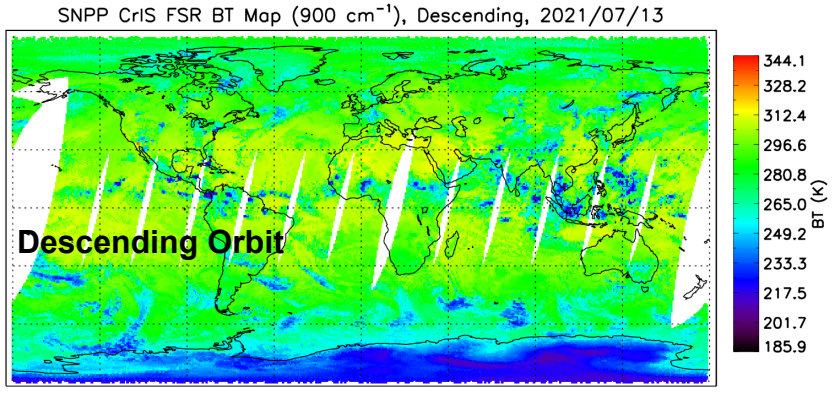
Side-1 LWIR Band continues nominal 1-day after the side switch on July 12, 2021

Global Brightness Temperature Maps of the Recovered SNPP CrIS Side-1 LWIR Band

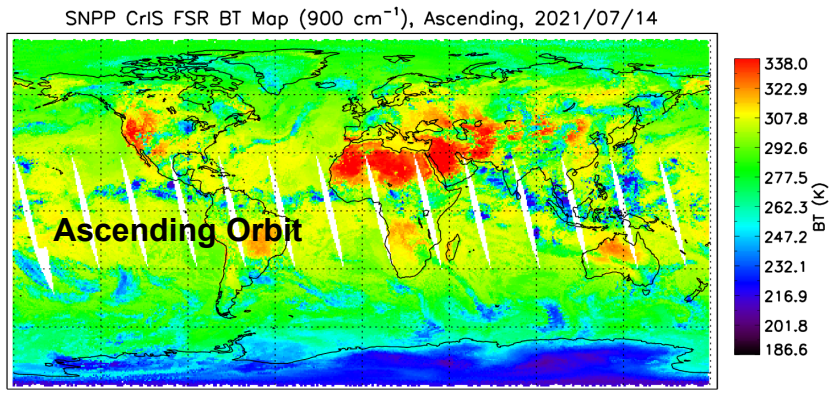
Day 2 of Recovery Activities
July 13, 2021



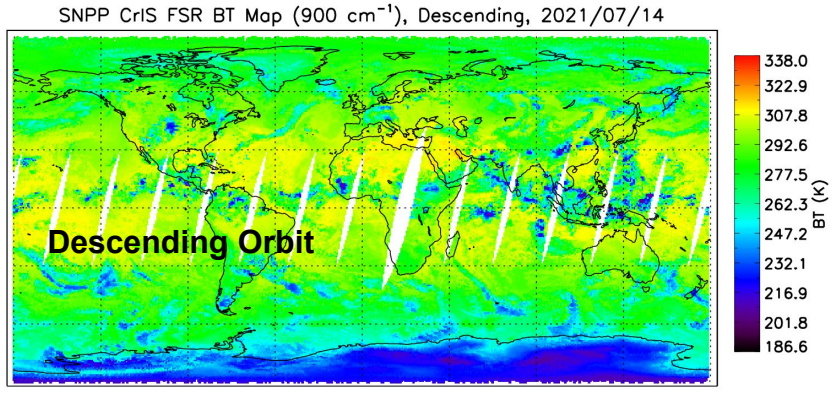
SNPP/CrIS Side-1



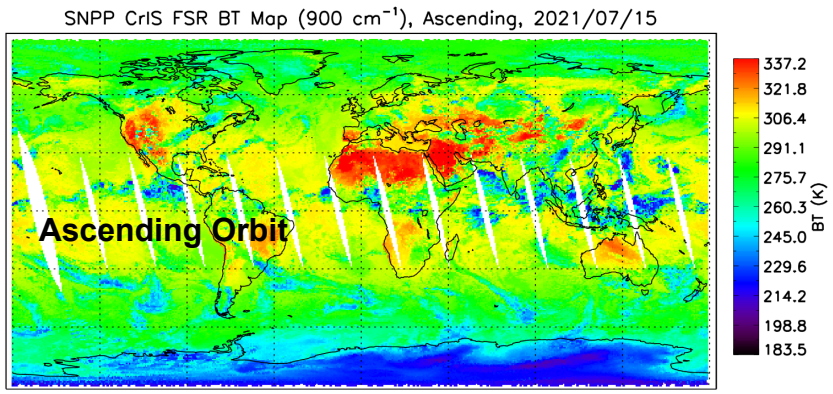
Day 3 of Recovery Activities
July 14, 2021



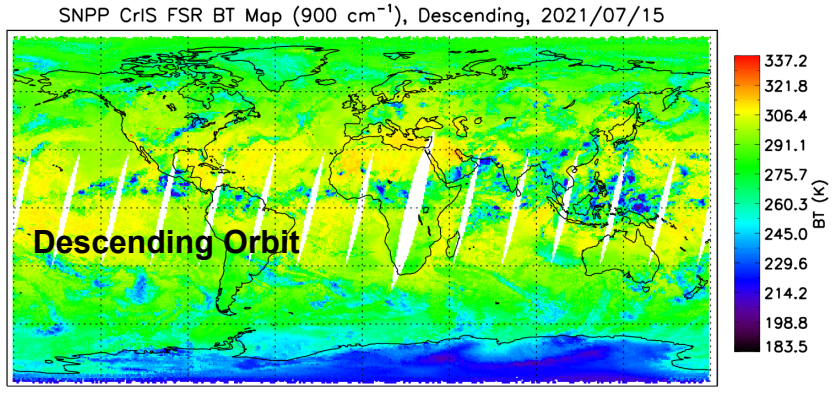
SNPP/CrIS Side-1



Day 4 of Recovery Activities
July 15, 2021



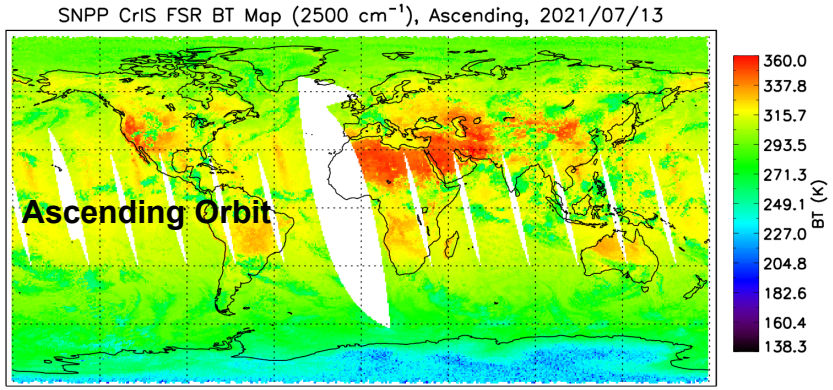
SNPP/CrIS Side-1



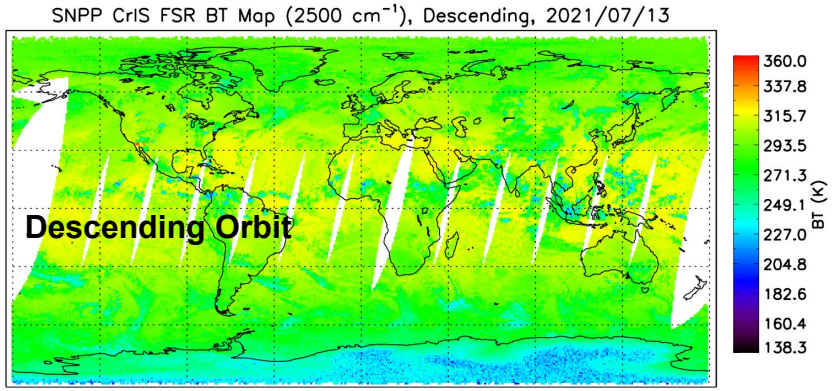
- Side-1 LWIR Band continues nominal after the side switch on July 12, 2021.
- No more data gaps at LWIR are observed after the completion of side switch commanding on July 13, 2021.

Global Brightness Temperature Maps of the Recovered SNPP CrIS Side-1 SWIR Band

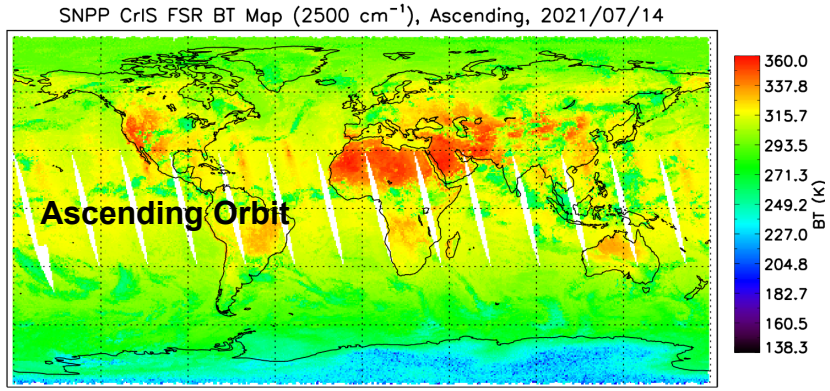
Day 2 of Recovery Activities
July 13, 2021



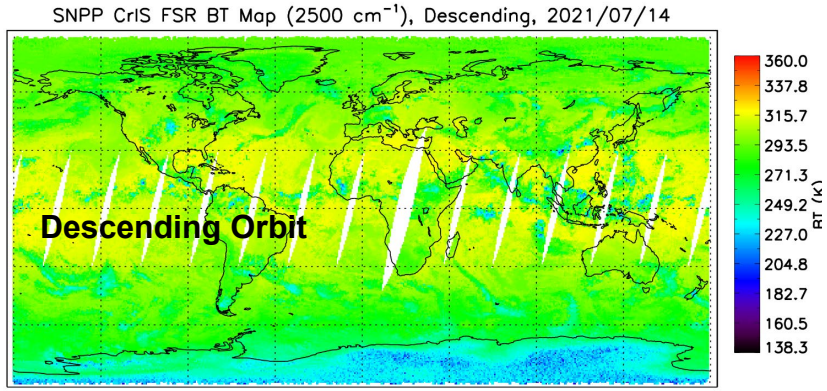
SNPP/CrIS Side-1



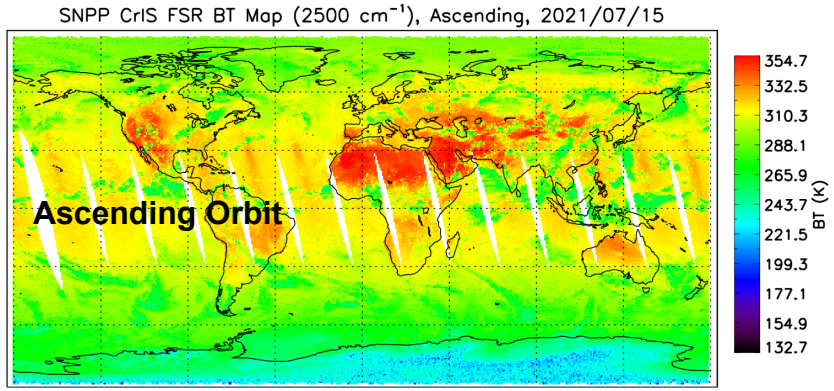
Day 3 of Recovery Activities
July 14, 2021



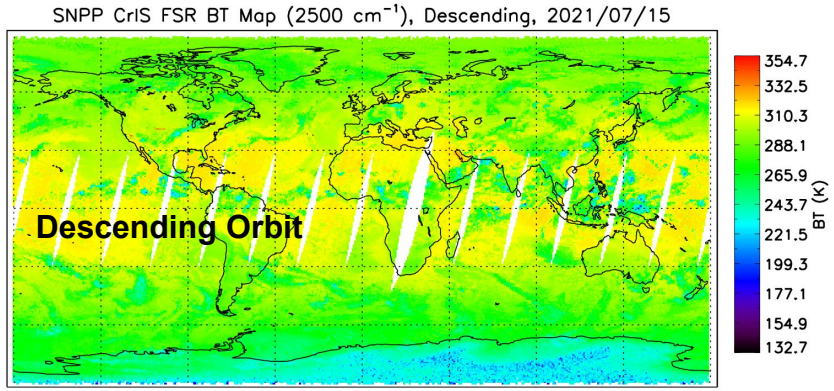
SNPP/CrIS Side-1



Day 4 of Recovery Activities
July 15, 2021



SNPP/CrIS Side-1



- Side-1 SWIR Band continues nominal after the side switch on July 12, 2021.
- No more data gaps at SWIR are observed after the completion of side switch commanding on July 13, 2021.

SNPP CrIS Science Telemetry (1)

ICT Temperature

- ICT temperature has stabilized since the side switch on July 12.

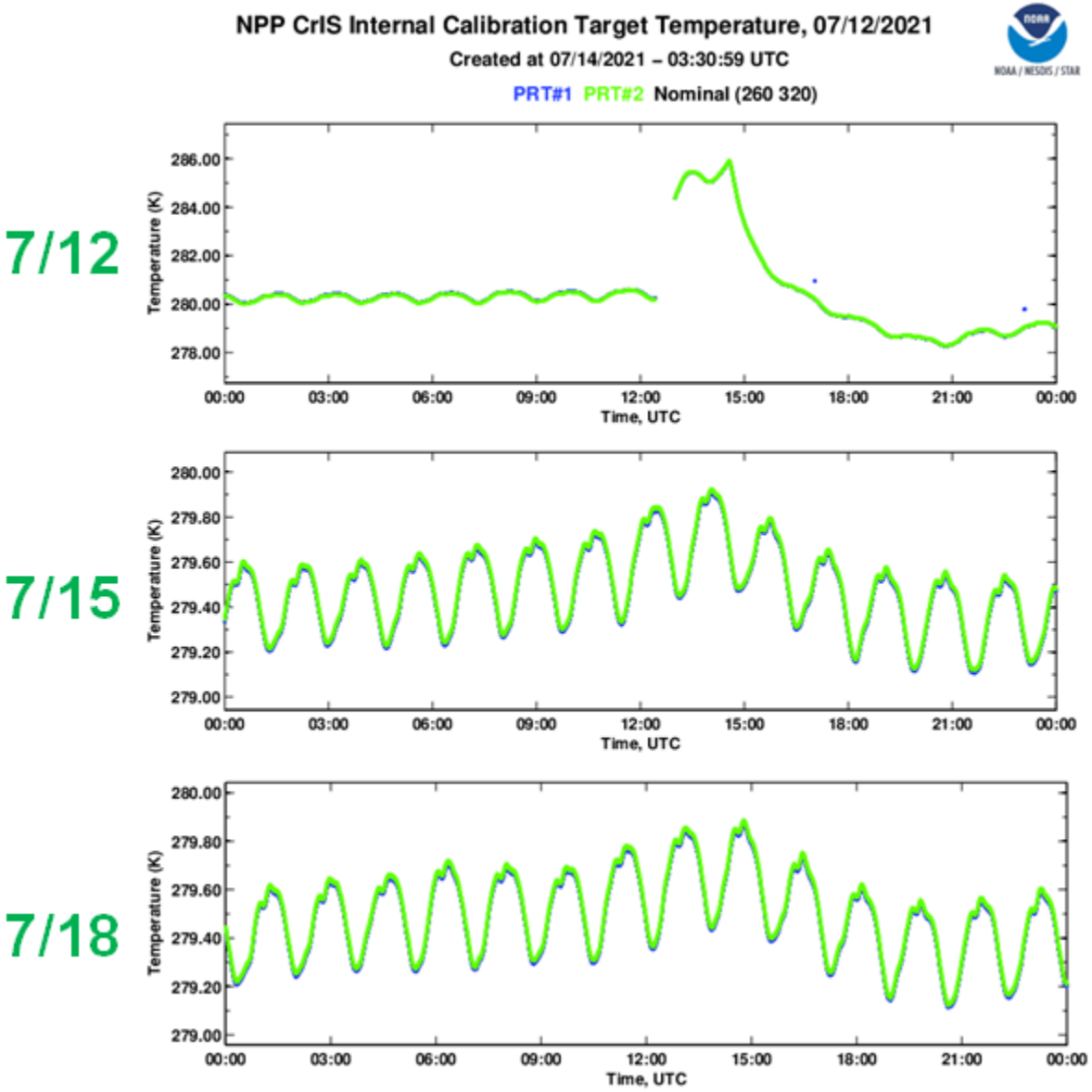
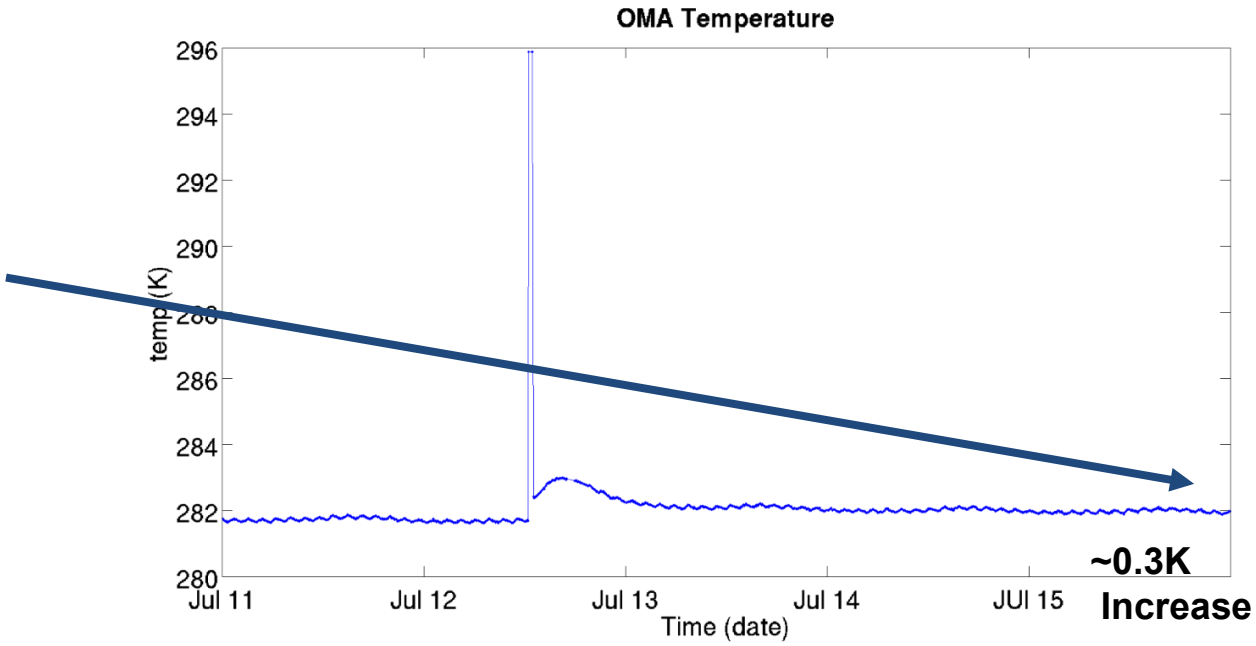


Figure Courtesy of ICVS

SNPP Science Telemetry (2)

Optical Mechanical Assembly (OMA) Temperature

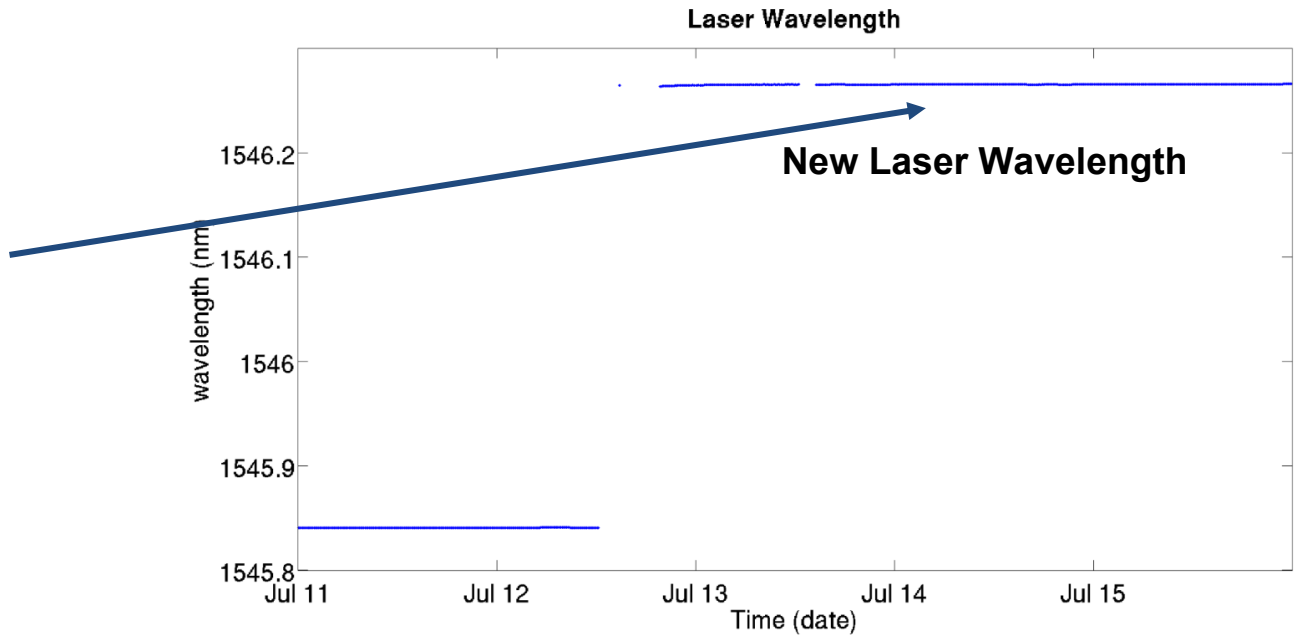
- OMA structure has stabilized since the side switch (July 12).
- OMA returning close to nominal values with a temperature increase of ~.3K.



SNPP Science Telemetry (3)

Laser Wavelength

- Laser Wavelength jumped to a new value during the side switch, due to using a new laser for Side-1 different by 0.4 nm
- New laser wavelength matches the original laser wavelength from before the first side switch (Side-1 in 2019).



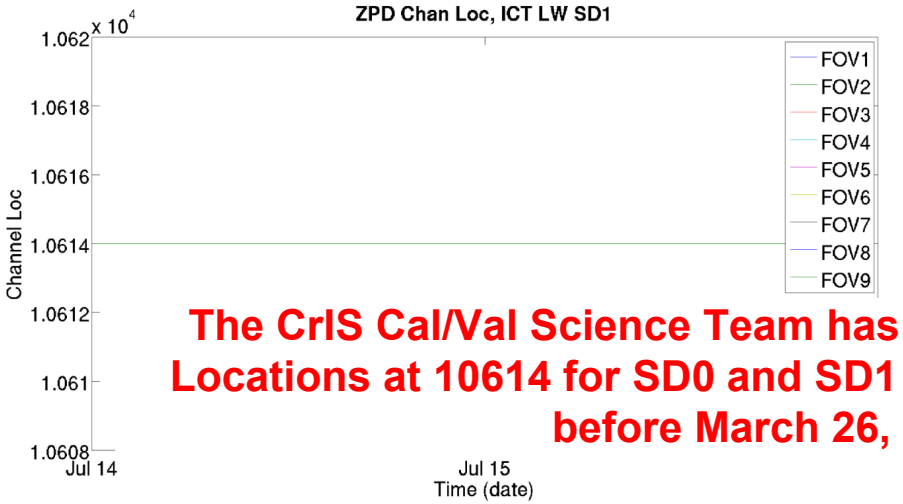
SNPP ZPD Location, ICT Scene

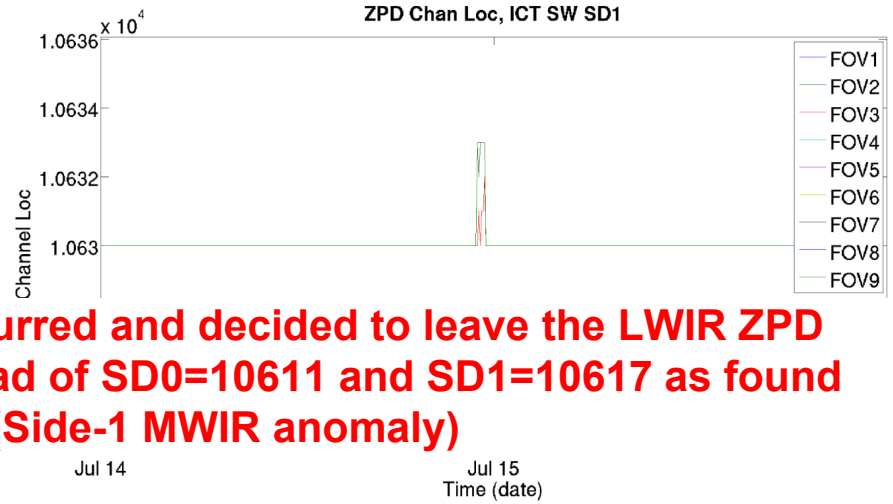
ZPD Locations Are Stable

LW Band

SW Band

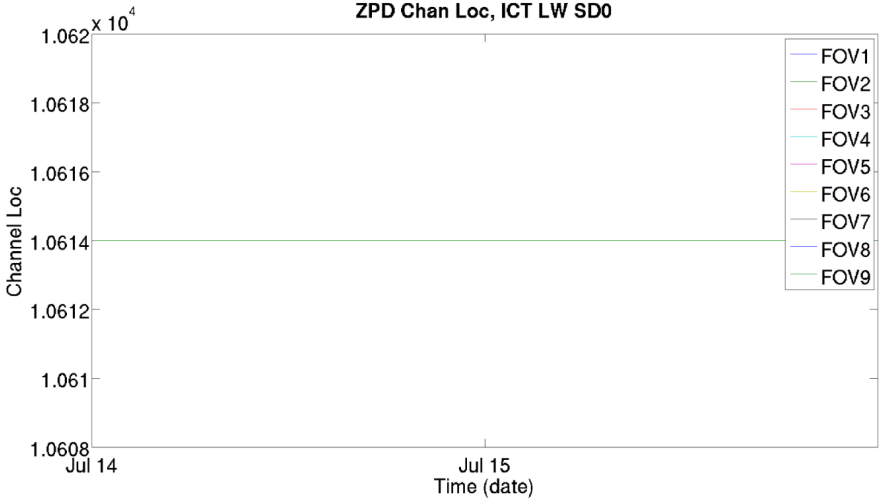
Sweep Dir. 1

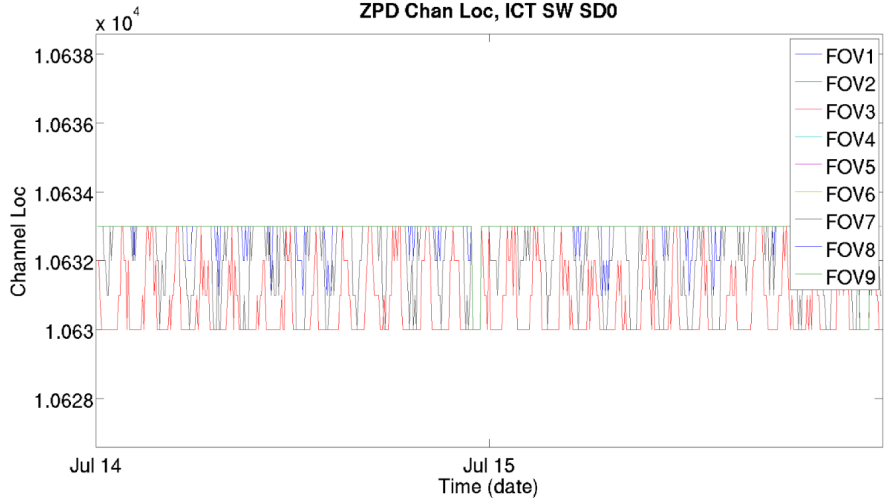




The CrIS Cal/Val Science Team has concurred and decided to leave the LWIR ZPD Locations at 10614 for SD0 and SD1 instead of SD0=10611 and SD1=10617 as found before March 26, 2019 (Side-1 MWIR anomaly)

Sweep Dir. 0





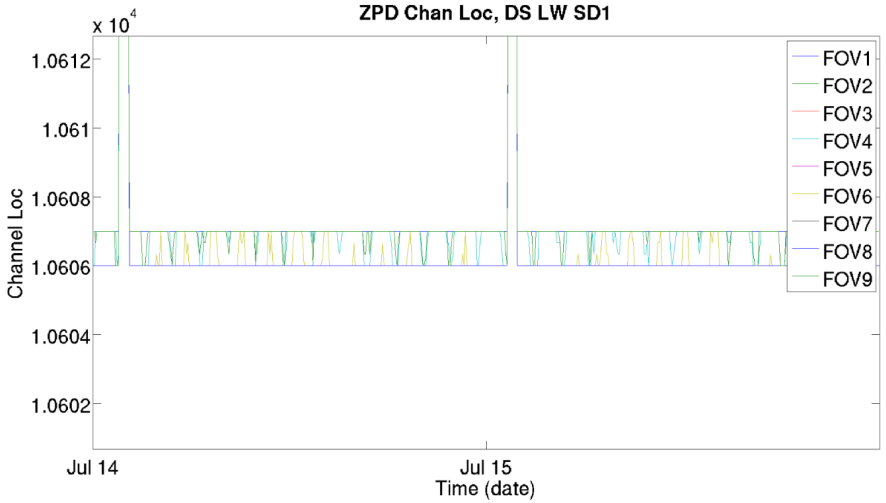
SNPP ZPD Location, DS Scene

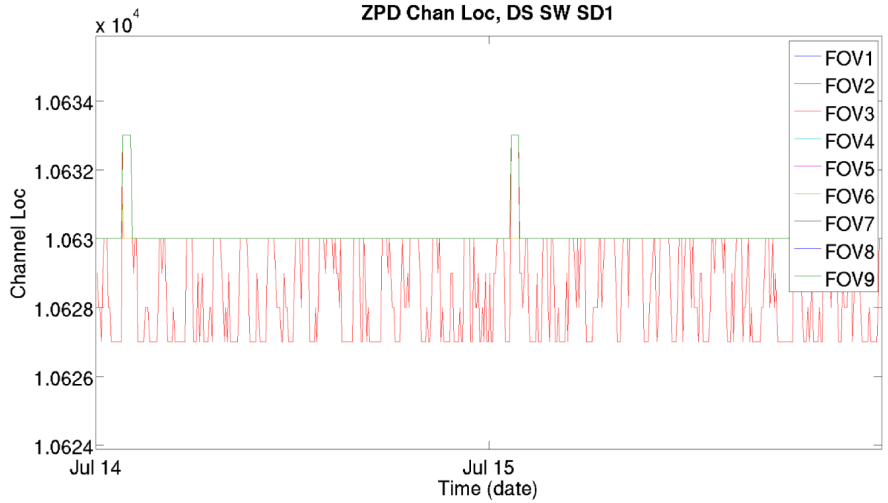
ZPD Locations Are Stable

LW Band

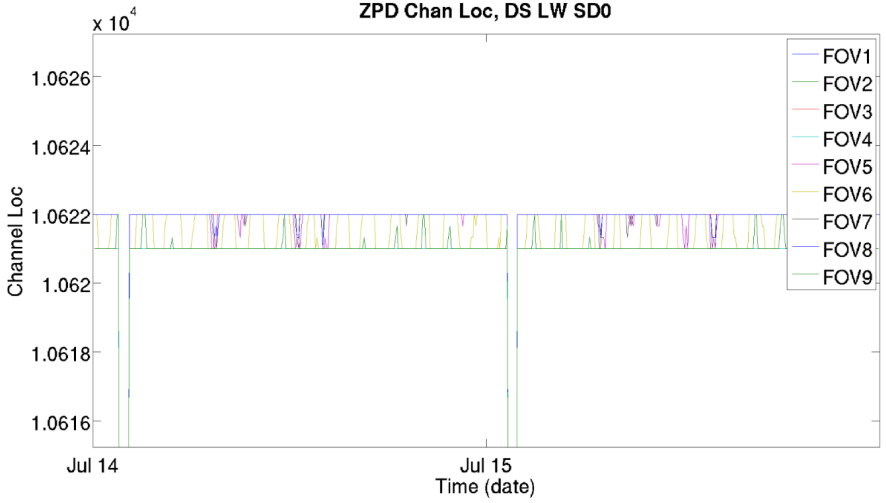
SW Band

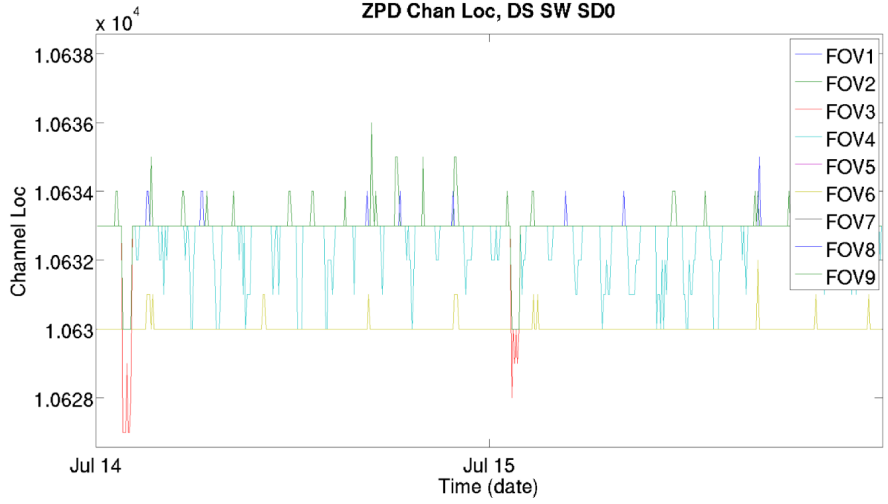
Sweep Dir. 1





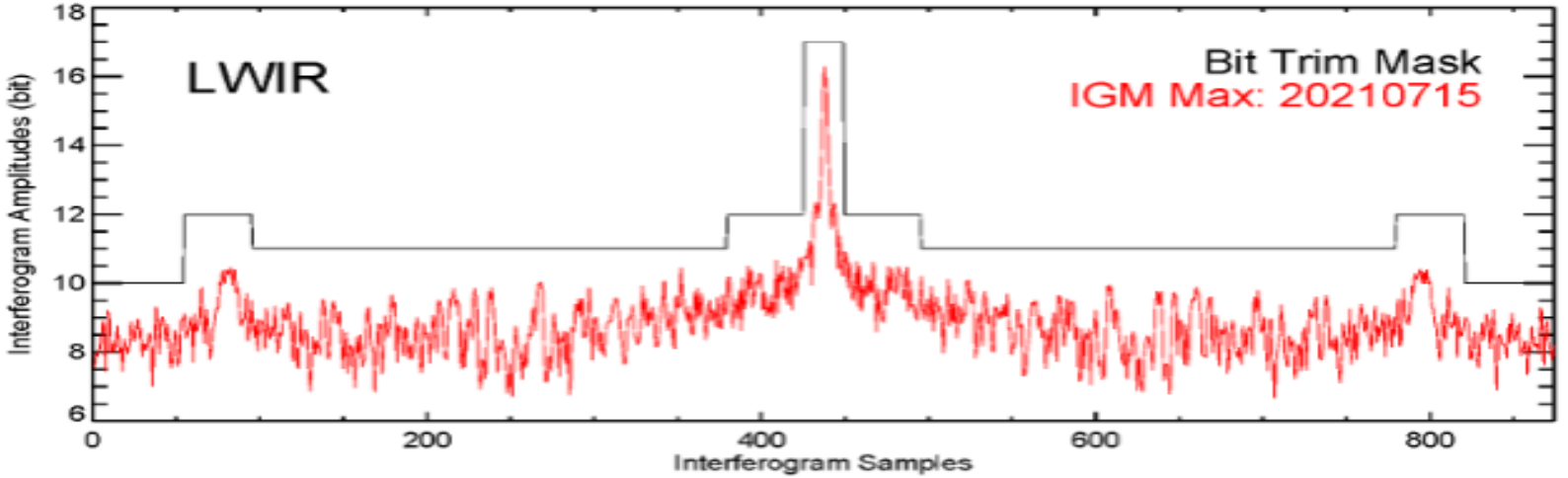
Sweep Dir. 0

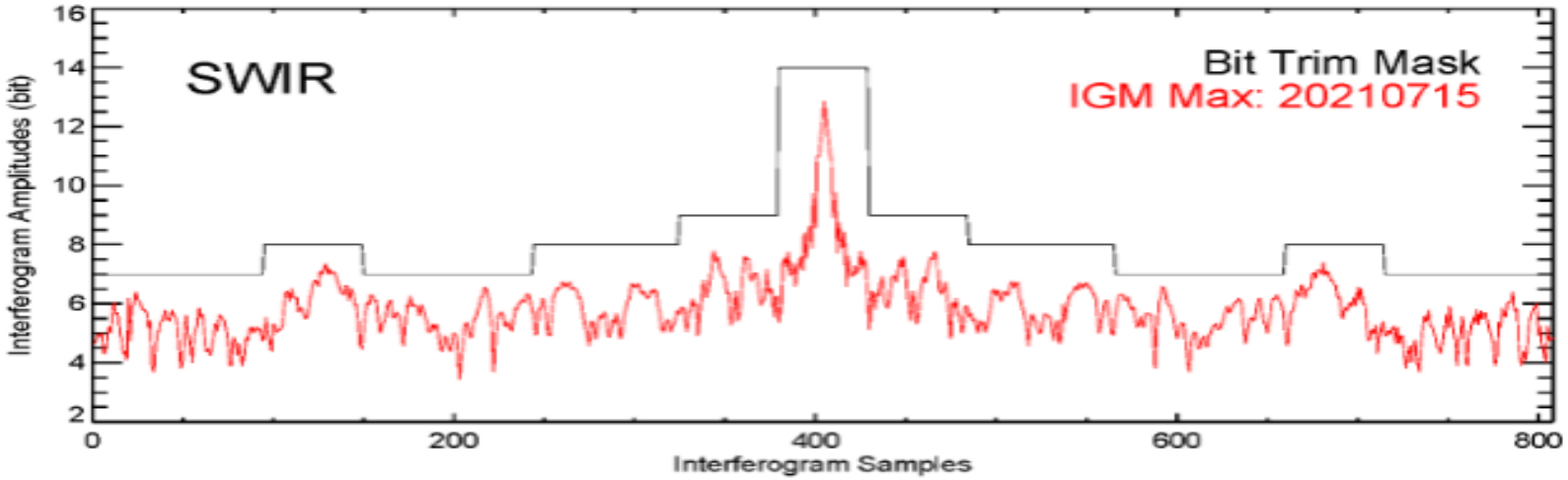




SNPP CrIS Side-1 Bit Trim Mask Verification

- The bit-trim mask was validated using 15 July, 2021 SDR as inputs. The results confirm the sizes of the mask exceed the maximum bits needed to transmit the Earth view scenes.



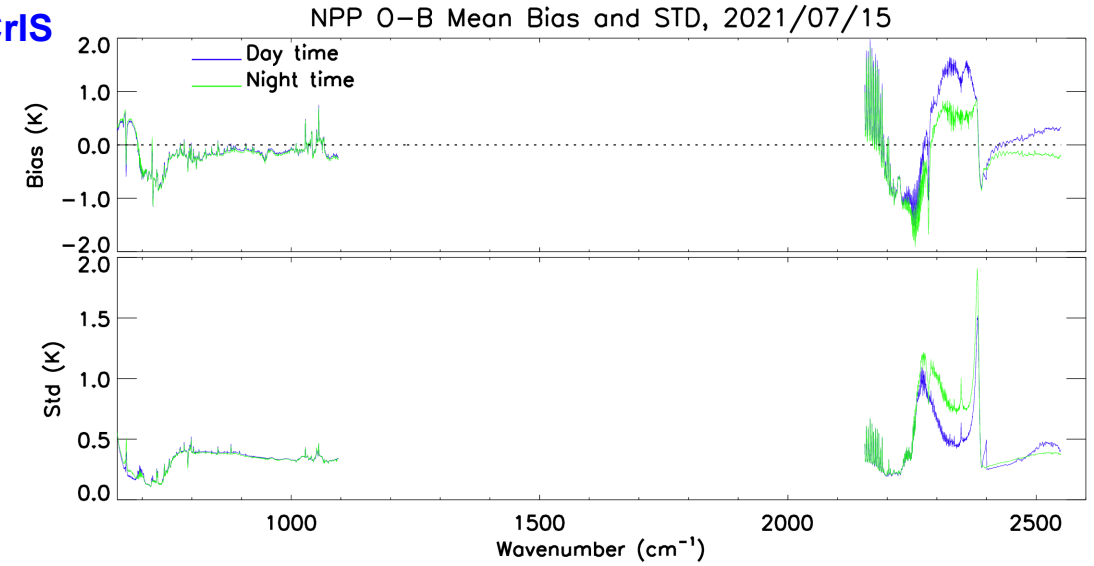


Maximum observed brightness temperature for July 15, 2021

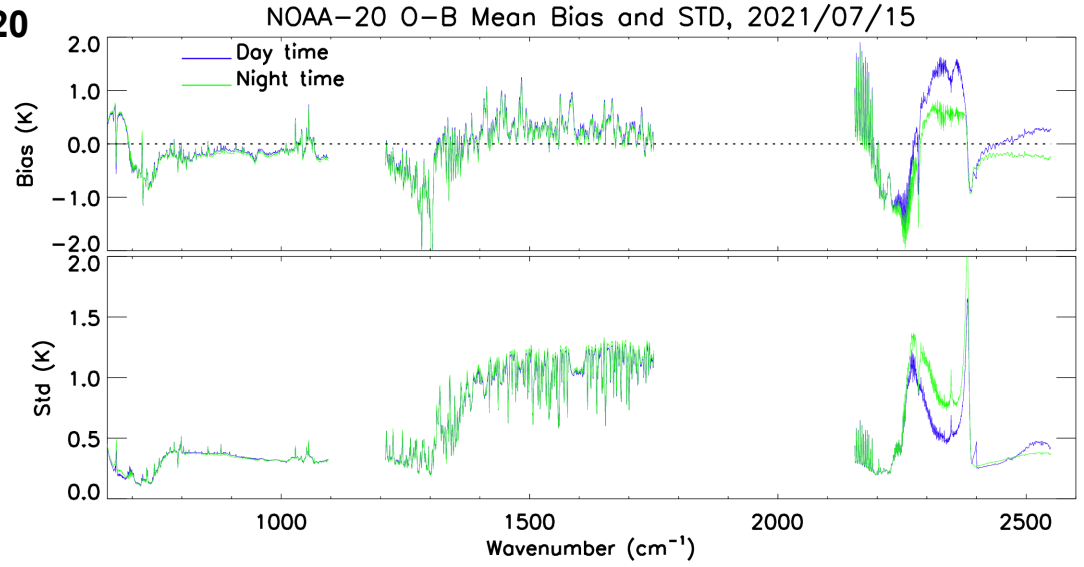
- LWIR (900 cm^{-1}): 337.2 K
- SWIR (2455 cm^{-1}): 359.0 K

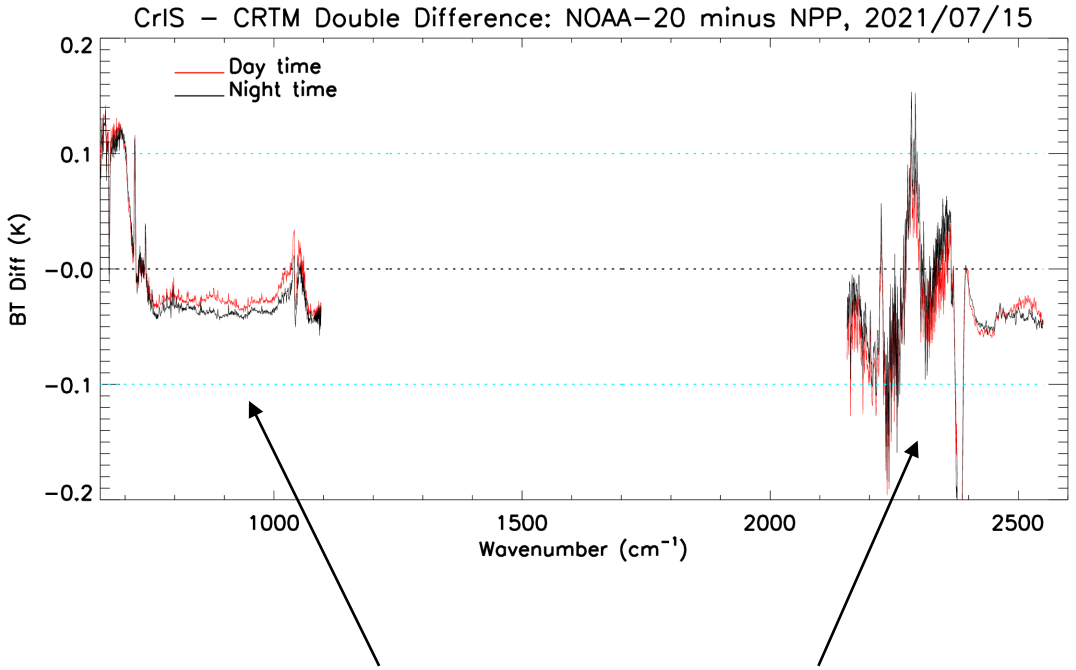
Radiometric Differences Between SNPP Side-1 and NOAA-20 CrIS

SNPP CrIS Side-1



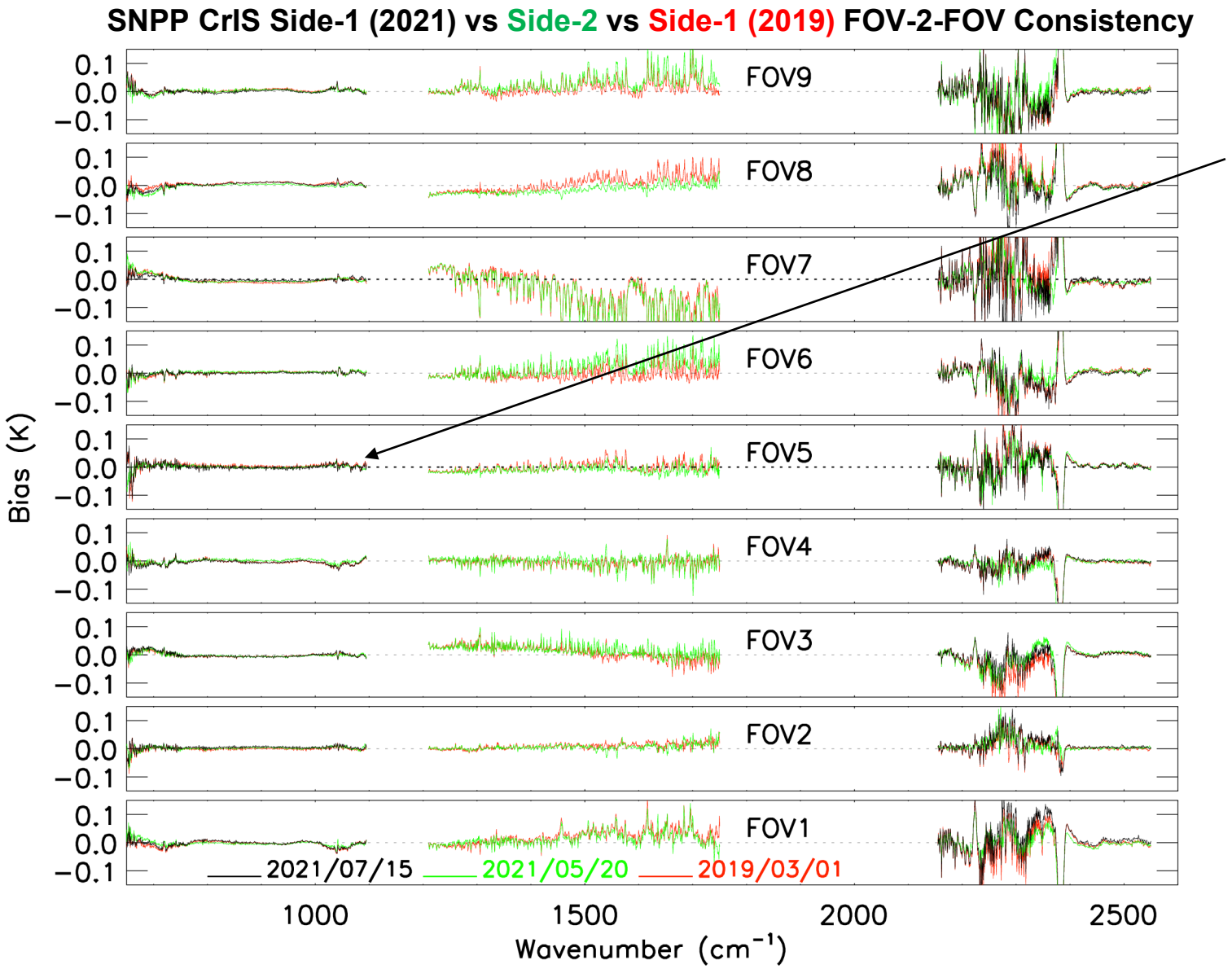
NOAA-20 CrIS





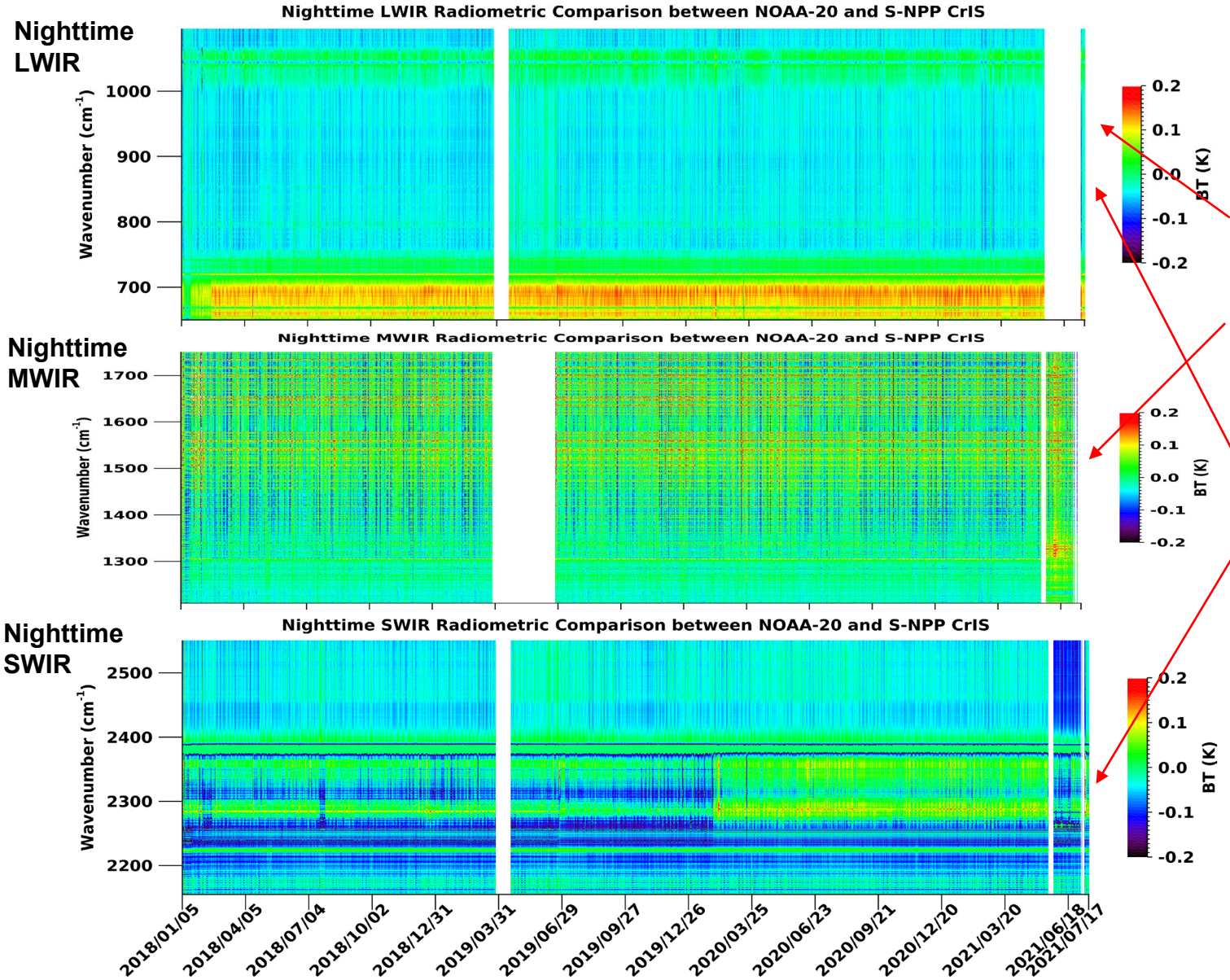
- **Radiometric differences are within +/- 0.1 K** for most of channels in the LWIR and SWIR bands. It shows a **consistent radiometric performance between two CrIS instruments after the SNPP switching back to side-1**.
- SNPP CrIS side-1 lost the MWIR band permanently.
- All FOVs and FORs for clear-sky observations over ocean surface between +/- 65 deg latitude were selected for **July 15, 2021**.

FOV-2-FOV Radiometric Consistency for SNPP CrIS Side-1



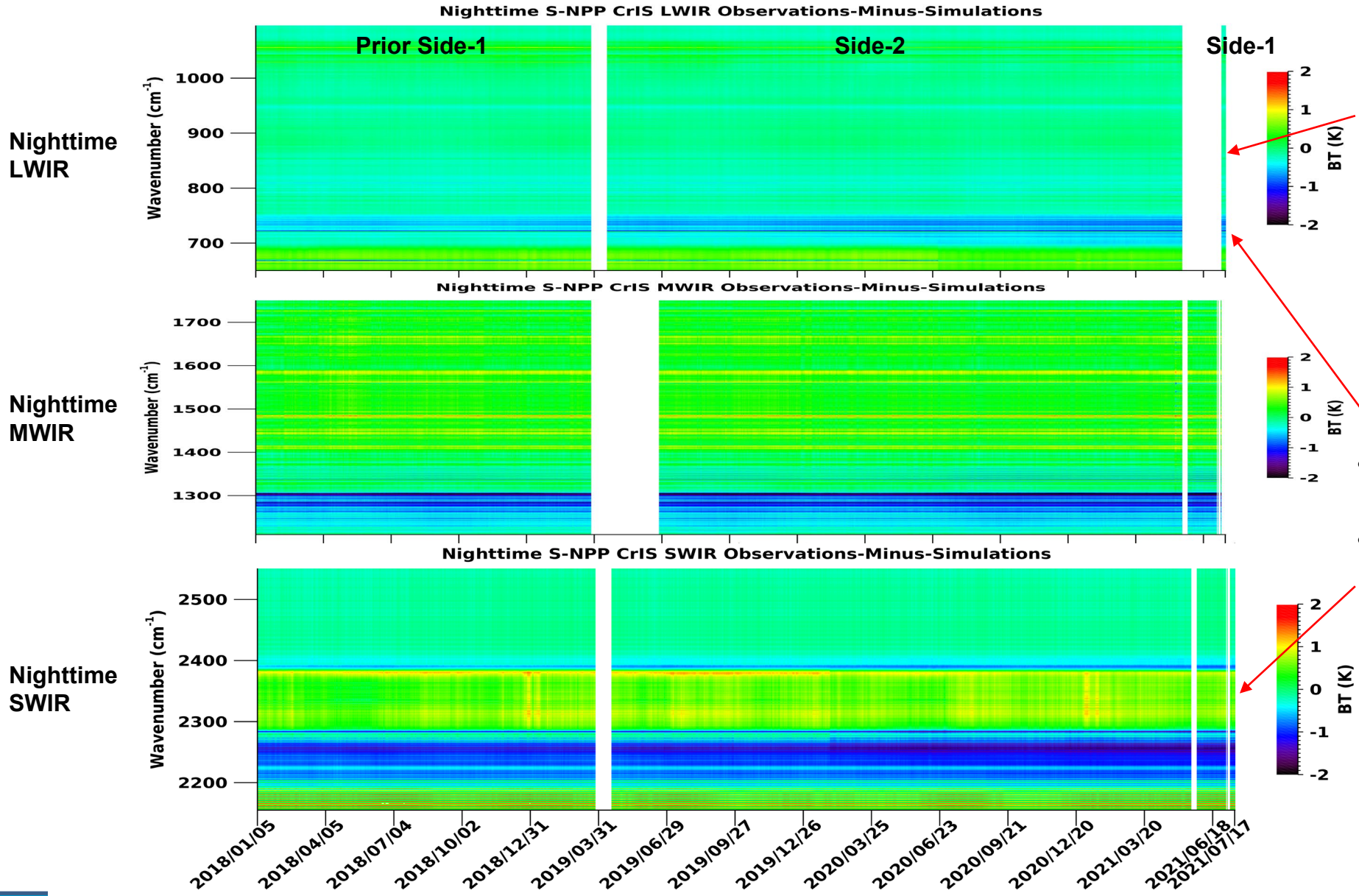
- The **FOV-2-FOV relative radiometric variability is within +/- 0.1 K at LWIR** band and for majority of channels at SWIR band after the SNPP CrIS side-1 switch (July 2021). **This result well agrees with that in the UMBC assessment led by L. Strow.**
- The FOV-2-FOV consistency is observed between SNPP CrIS side-1 (2021-07-15), side-2 (2021-05-20) and side-1 (2019-03-01) at LWIR and SWIR bands.
- **Very small differences of FOV-2-FOV radiometric variability at LWIR band demonstrate that the non-linearity is consistent between SNPP CrIS side-1 (2021) and side-1 (2019). This result agrees with UW's conclusion about the SNPP non-linearity.**
- **This result was derived based on CrIS observations** and collocated CRTM simulations over clear-sky and ocean surfaces **for July 15 and May 20, 2021, and March 1, 2019.**

Long-Term Trending of Radiometric Consistency Between NOAA-20 and SNPP CrIS



- SNPP CrIS LWIR band was recovered by switching back to side-1 on July 12, 2021.
- SNPP CrIS MWIR data stopped after the switch.
- SNPP CrIS side-1 shows radiometric consistency with NOAA-20 CrIS at LWIR and SWIR bands. **Majority of channels are within +/- 0.1 K after the side switch.**
- **No significant radiometric changes observed** for SNPP CrIS side-1 compared with the long-term radiometric performance of SNPP CrIS side-2 and the prior side-1.

Long-Term Trending of Radiometric Accuracy for SNPP CrIS Side-1 Observations-minus-Simulations (O-B)



Nighttime LWIR

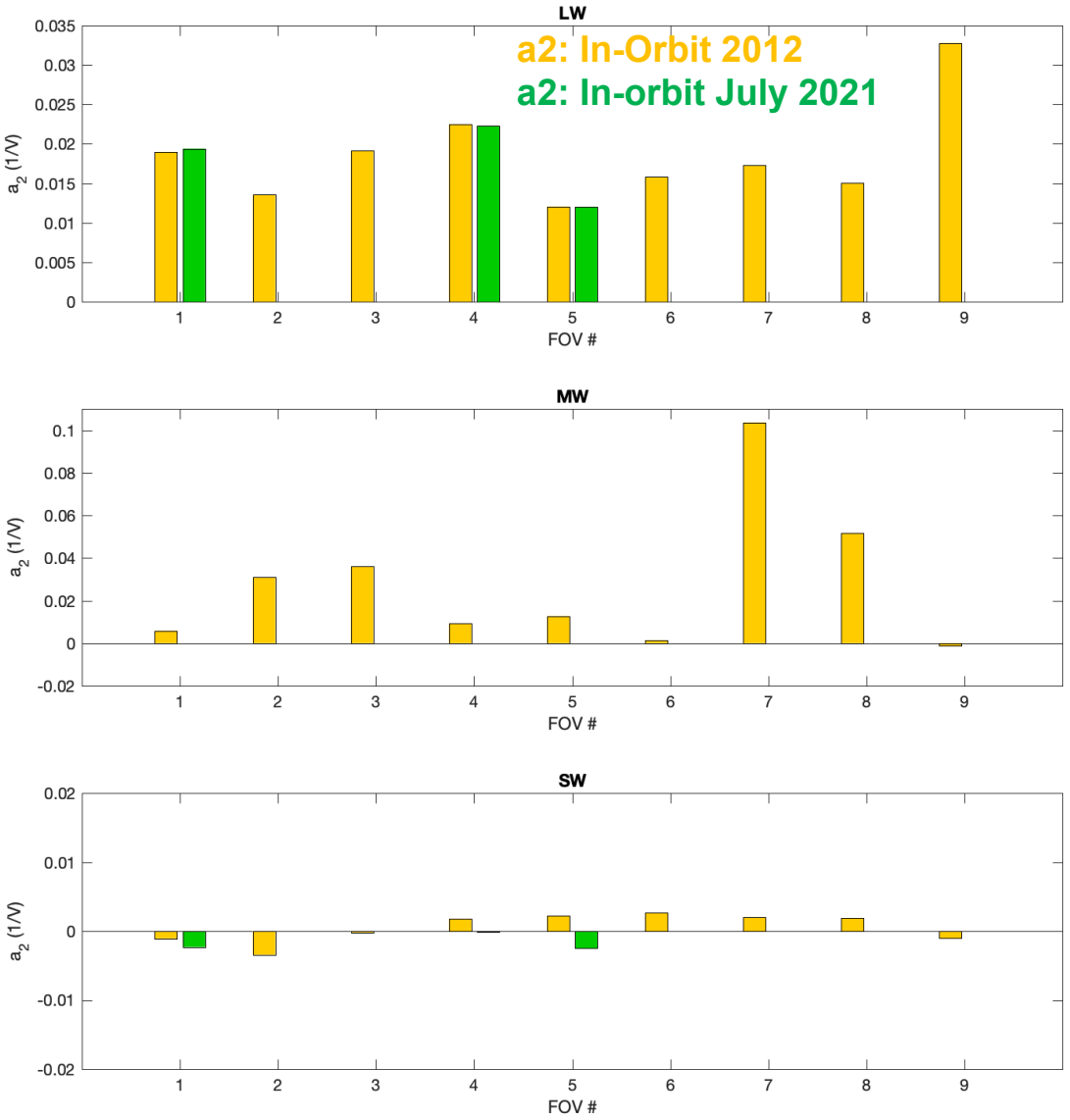
Nighttime MWIR

Nighttime SWIR

- SNPP CrIS LWIR recovery after the side switch on July 12, 2021

- **O-B consistency between the side-1 and the side-2**
- **O-B consistency between the side-1 and the prior side-1**

Assessment of SNPP CrIS Nonlinearity Correction Coefficients

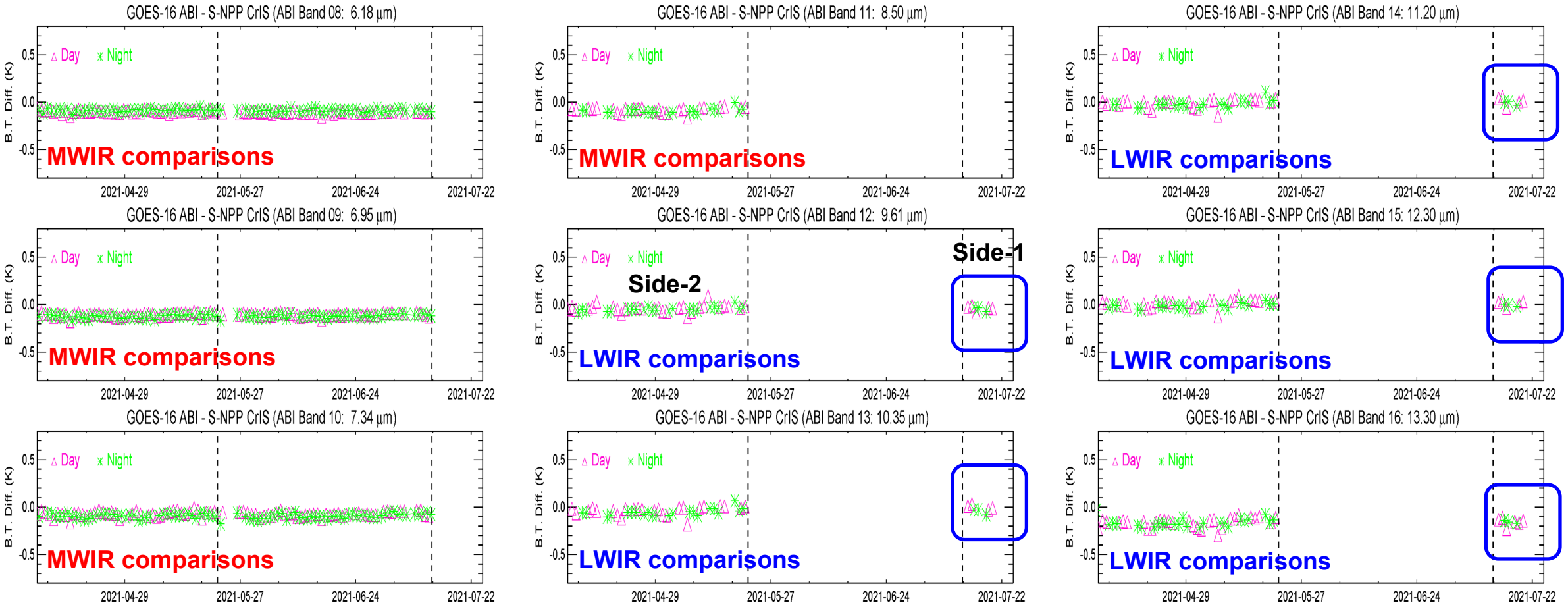


- SNPP CrIS Diagnostic Mode (DM) data were collected on July 13, 2021 as part of the side-1 switch commanding.
- The nonlinearity correction coefficients (known as a_2 values) were estimated using the July 13 DM data over Deep Space (DS) views.
- It is shown that a_2 estimates from the 2021 DS DM data (green) agree well with a_2 estimates from the 2012 DS DM data (yellow). **This result supports the recommendation of not changing the a_2 values.**

Provided by Dave Tobin at UW/SSEC

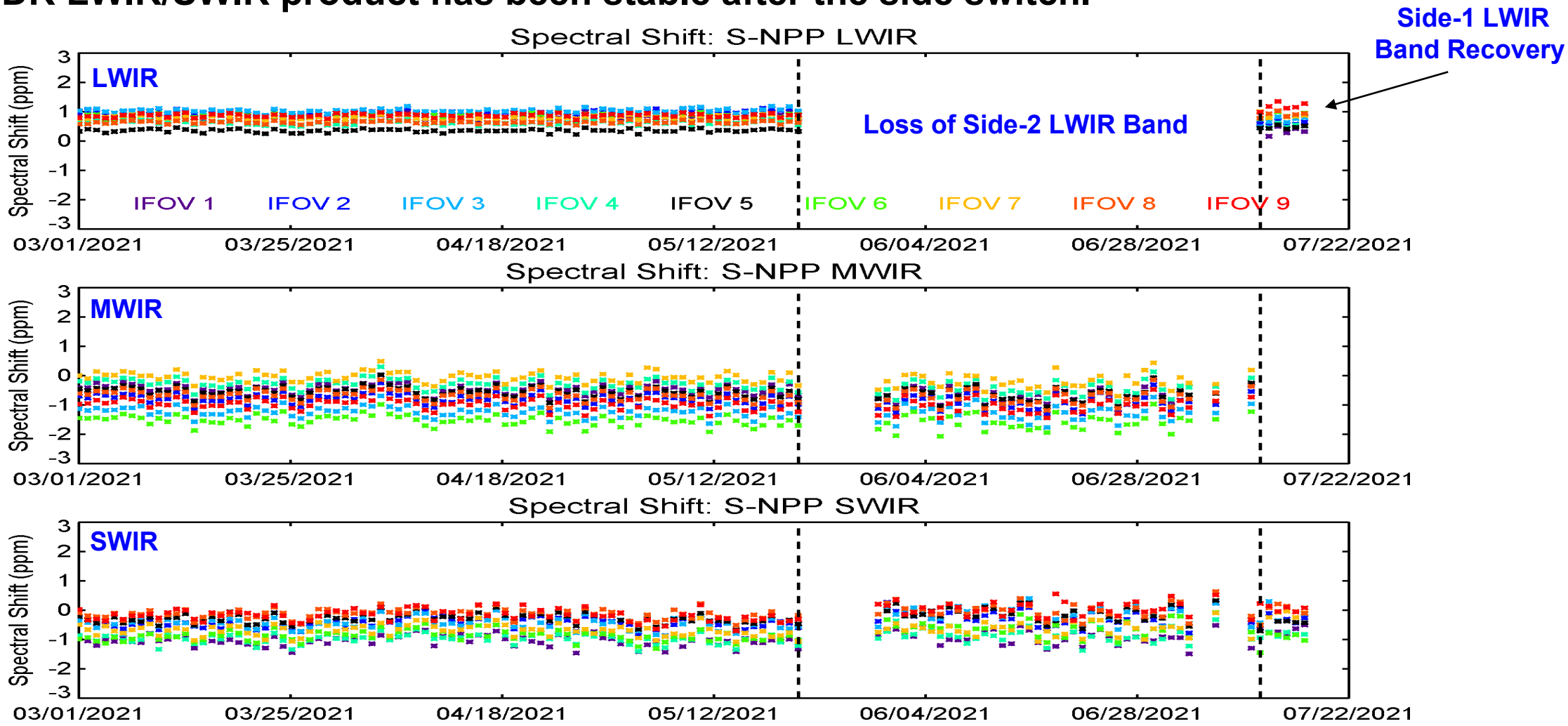
SNPP CrIS Side-1 SDR/ABI Radiometric Inter-comparisons

- **ABI bands 8-11 correspond to CrIS MWIR band and bands 12-16 correspond to CrIS LWIR** band. The comparison of the two instruments show **CrIS Side-1 LWIR SDR production has resumed and stable, and MWIR SDR non-functional** after the side switch on 12 July.

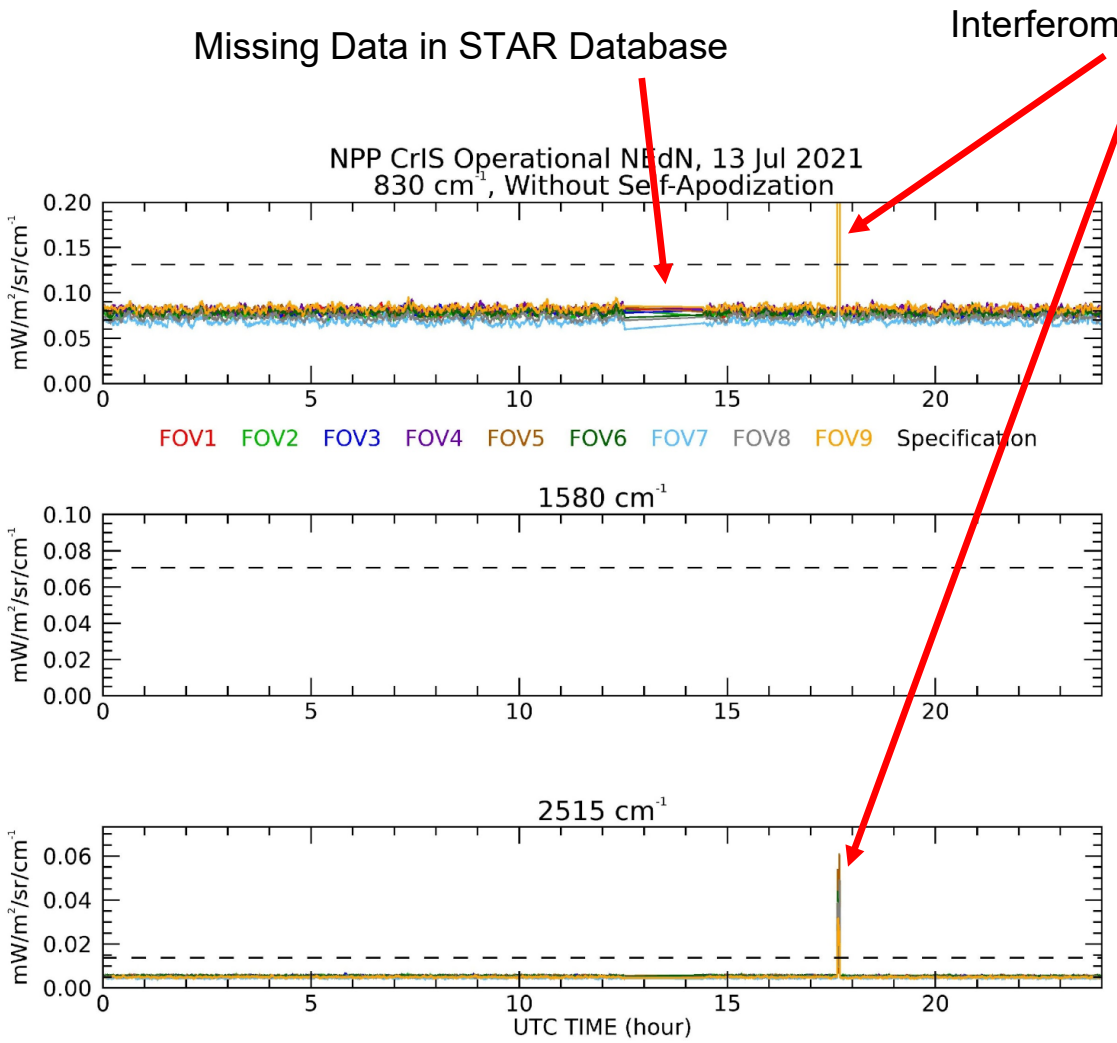


SNPP CrIS Side-1 SDR: Spectral Assessment

The spectral assessment results show the spectral performance of the SNPP CrIS Side-1 SDR LWIR/SWIR product has been stable after the side switch.



SNPP CrIS Side-1 SDR Noise on July 13, 2021



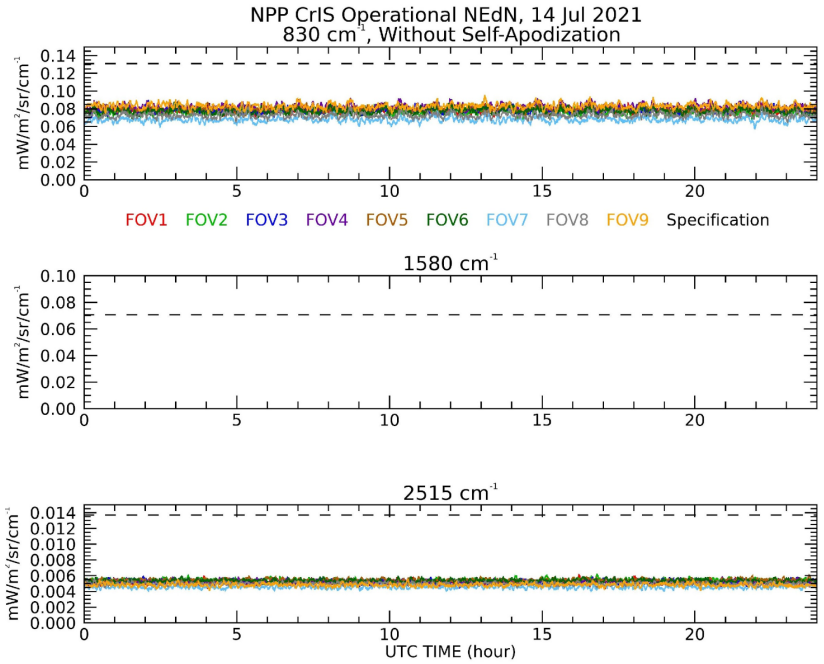
Side 1 LWIR NEdN Is nominal.

Side 1 MWIR NEdN Not operational.

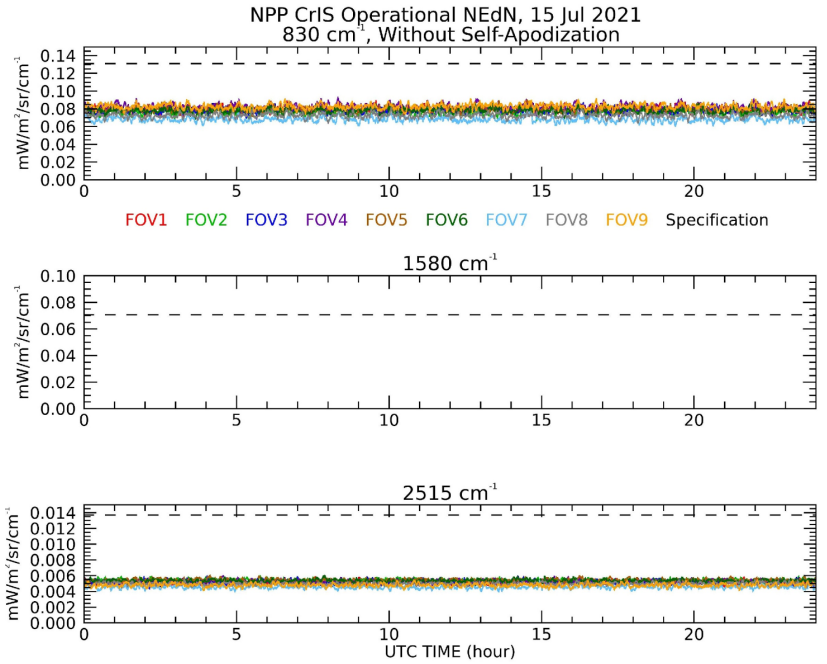
Side 1 SWIR NEdN Is nominal.

SNPP CrIS Side-1 SDR Noise on 7/14/2021 and 7/15/2021

07/14/2021

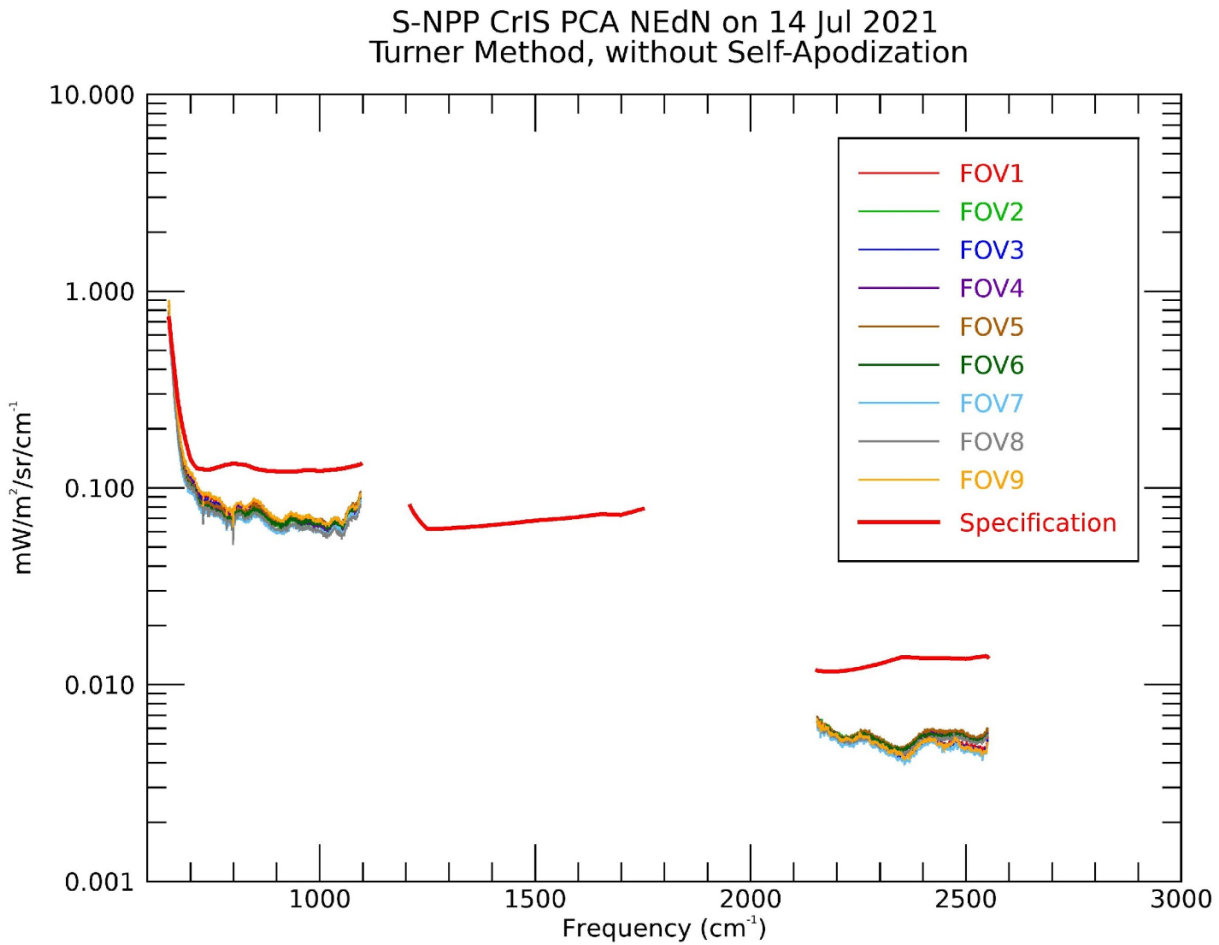


07/15/2021



The SNPP CrIS Side-1 SDR NEdN is very stable.

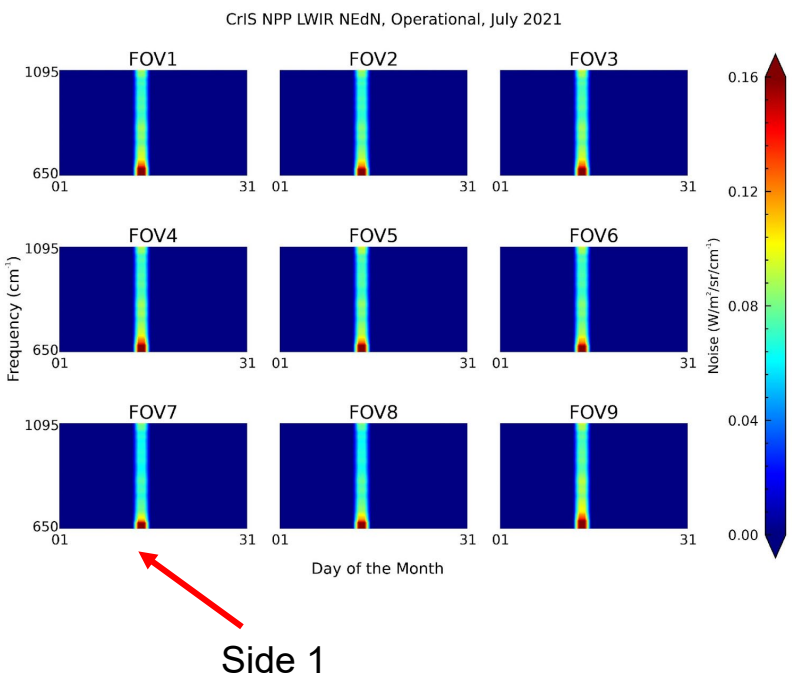
SNPP CrIS Side-1 SDR (PCA Method) on 7/14/2021



Radiometric Noise on SNPP CrIS Earth View Calibrated observations meet the requirements with margin for all FOVs.

Operational Noise in July 2021

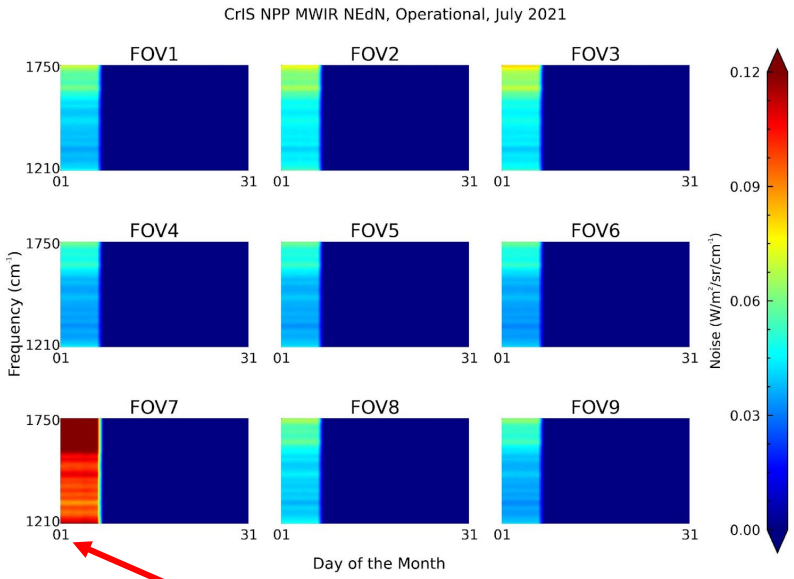
LWIR Time Series



Side 1

LWIR Side-1 NEdN is nominal (see previous slides)

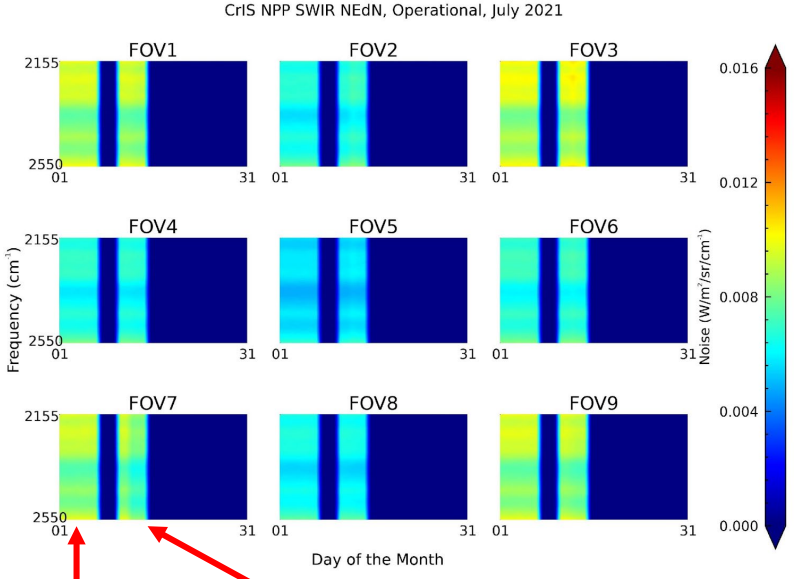
MWIR Time Series



Side 2

MWIR Side-1 NEdN is no longer operational.

SWIR Time Series



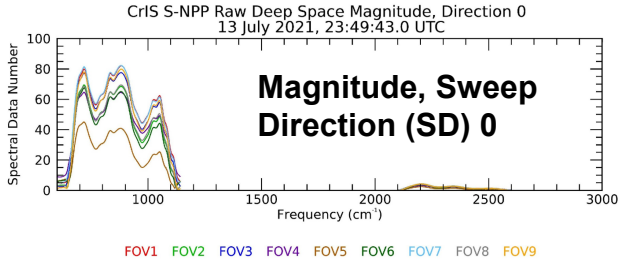
Side 2 Side 1

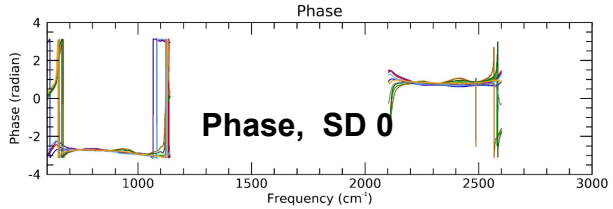
SWIR Side-1 NEdN is consistent with Side-2.

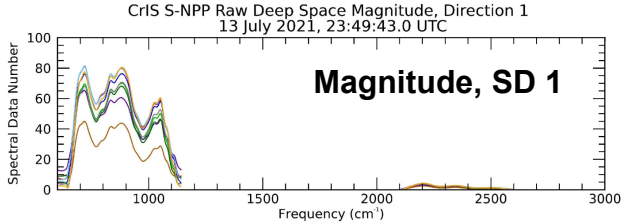
Dark blue in the above figures indicates no data available.

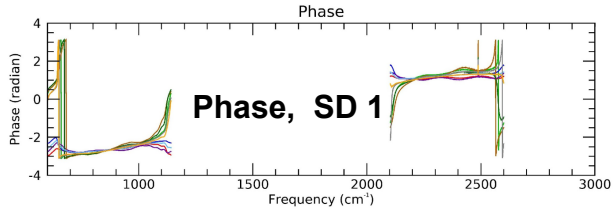
DS/ICT Magnitude and Phase, July 13, 2021, 23:55 UTC

Deep Space

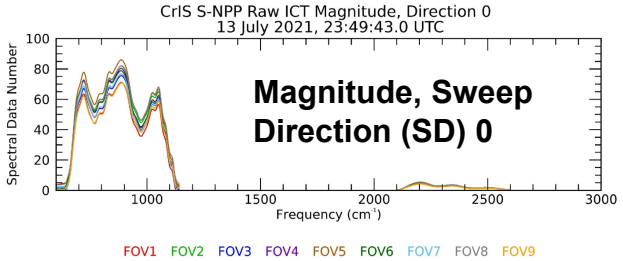


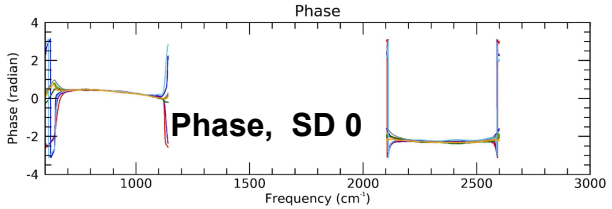


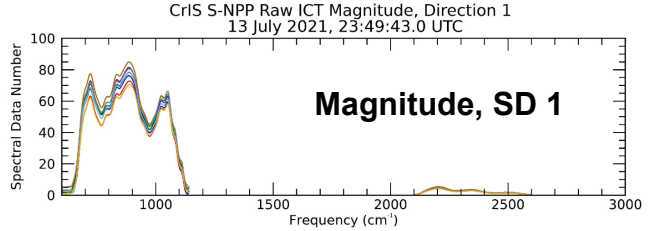


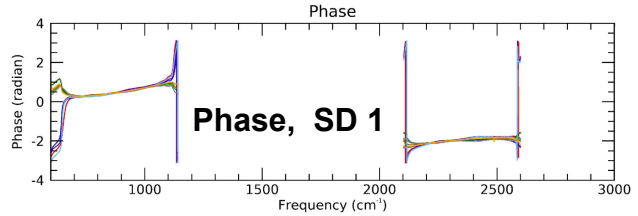


ICT





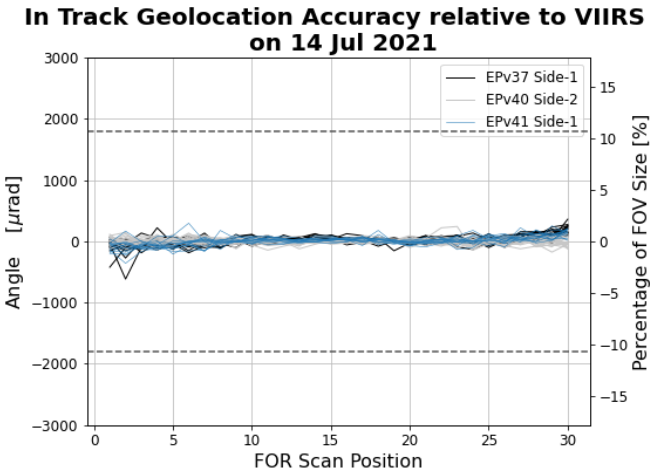


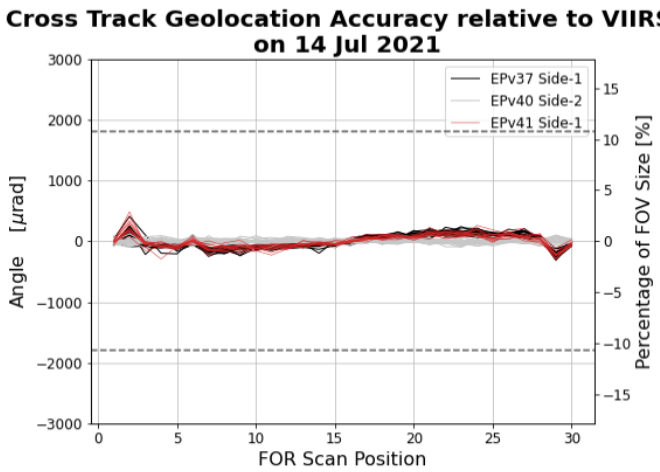


- No issues found with magnitude and phase.
- According to UW, phase differs from 2019, certainly due to a ZPD change.

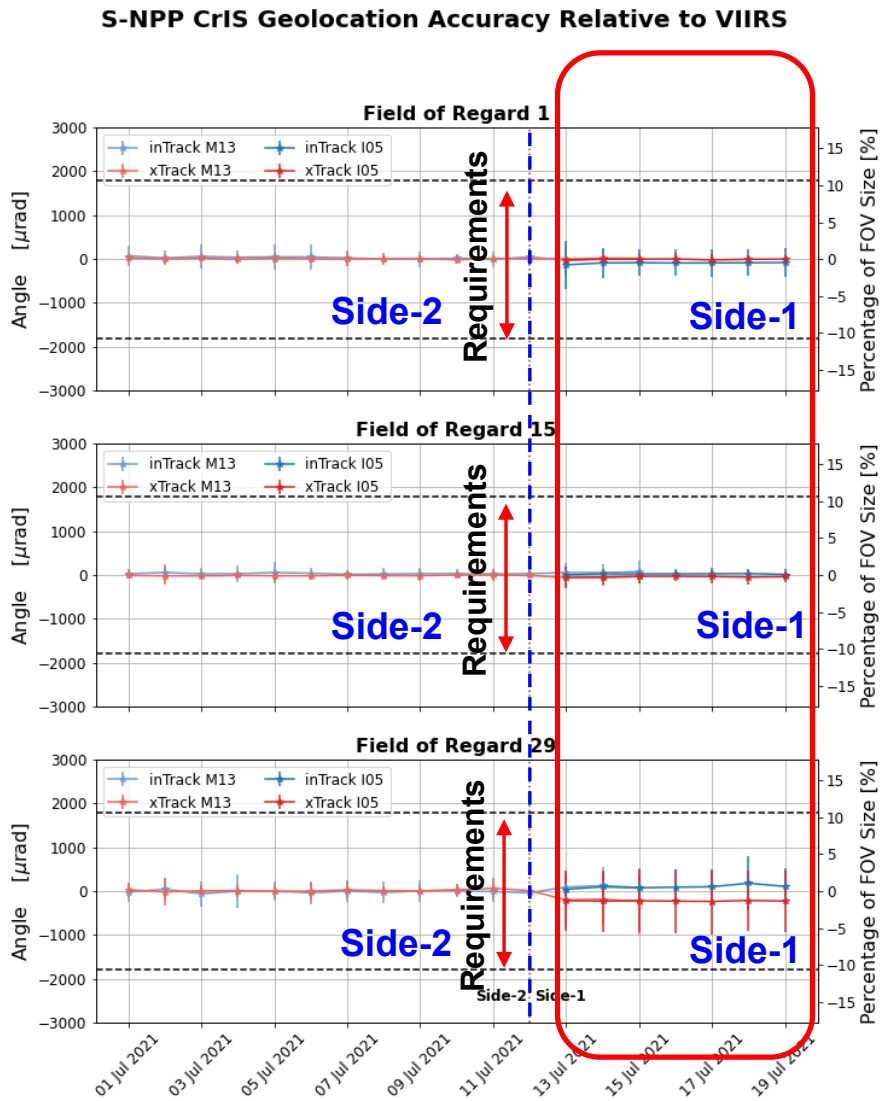
SNPP CrIS Side-1 SDR Geolocation Accuracy Assessment

- **The geolocation accuracy relative to VIIRS is shown before and after the side switch on 12 July 2021 (right).**
- Following the Side-2 LWIR anomaly and before the side switch, the accuracy relative to VIIRS is assessed using the VIIRS M13 band and the CrIS SWIR band. Following the side switch the accuracy is also assessed using the VIIRS I5 band and the CrIS LWIR.
- **The new Side-1 EP v41 uses the geolocation mapping angle parameters from EP v37, the side-1 engineering packet prior to switch to side-2 in 2019.**
- **Compared to the mapping angle parameters in EP v40 optimized for Side-2, the offset relative to VIIRS is larger for side-1 and has a scan angle dependence.** Shown below are the orbits from 14 July 2021 compared to several orbits from the side-1 prior to 24 June 2019 (black curves) and side-2 prior to 21 May 2019 (gray curves).
- **The Side-1 geolocation accuracy is consistent with the prior Side-1 performance and is within the specification.**





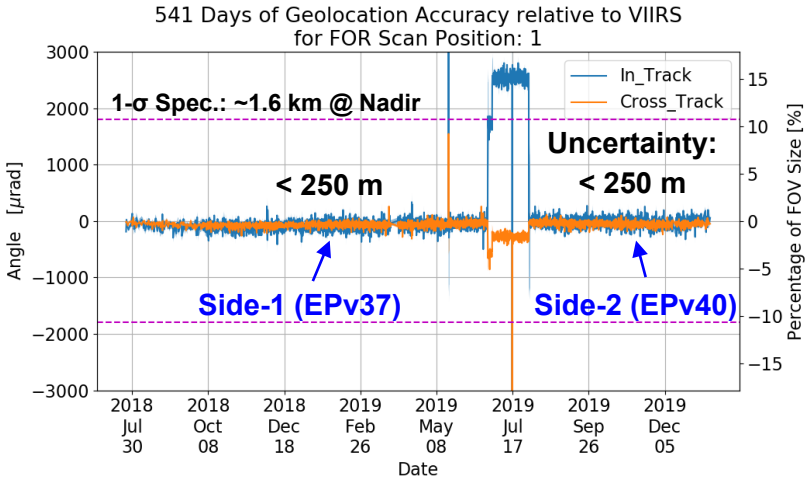
The SNPP CrIS Side-1 SDR Geolocation Meets the Requirements



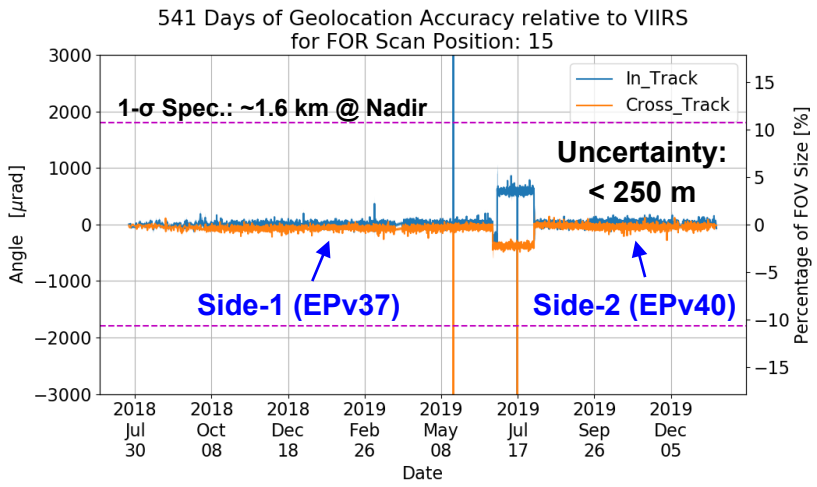
Potential Geolocation optimization is being discussed

Geolocation Uncertainty: Long-Term Trending Side-1 vs Side-2

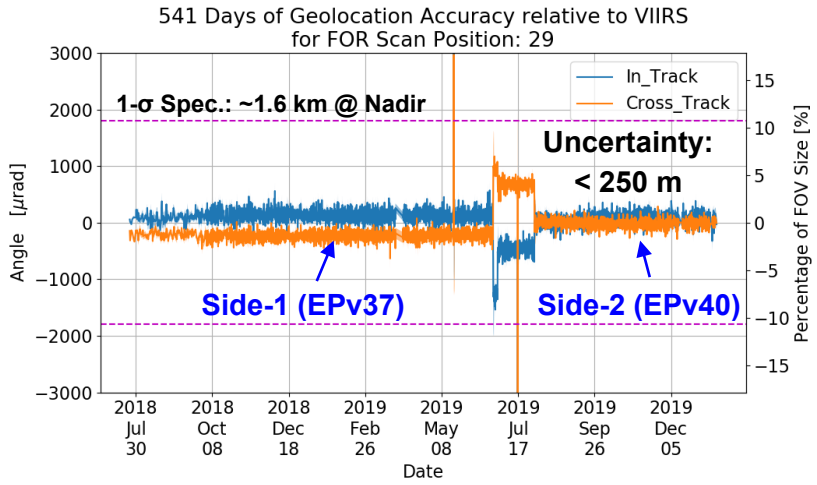
FOR1



FOR15



FOR30



SNPP/CrIS Side-1 Overall Performance

SNPP/CrIS FSR SDR Side-1 uncertainties (blue) vs. requirements (black)

Band	Spectral Range (cm^{-1})	Resolution (cm^{-1})	Number of Channels	NEdN* ($mW/m^2/sr/cm^{-1}$)	Frequency Uncertainty (ppm)	Geolocation Uncertainty** (km)	Radiometric Uncertainty @287K BB¥ (%)	Radiometric Stability @287K BB (%)
LWIR	650-1095	0.625	713	0.099 (0.14)	2 (10)	1.0*** (5)	0.16 (0.45)	0.17 (0.40)
MWIR	1210-1750	0.625	865	N/A (0.084)	N/A (10)	N/A (5)	N/A (0.58)	N/A (0.50)
SWIR	2155-2550	0.625	633	0.00728 (0.014)	2 (10)	1.0*** (5)	0.40 (0.77)	0.28 (0.64)

* Mean value averaged over 9 FOVs and over entire band.

** Geolocation uncertainty is based on the largest 3-sigma value found over all scan angles (FORs). Accounts for in-track and cross-track errors. The specification is based on 3-sigma mapping uncertainty of 5 km (474-00448-01-03_JPSS-SRS-Vol-I-Part-3_0200G-2).

¥ S-NPP RU does not accounts for the polarization correction effect. RU values with polarization correction are expected to be lower than those reported in the table.

*** The 3-sigma uncertainty is estimated based on a few days after the side switch.

Risks, Actions, and Mitigations

- No major risks have been identified.

SNPP CrIS Side-1 Provisional Maturity SDR Data Product Caveats

- **MWIR data is not available for the SNPP CrIS Side-1 SDR product.**
- No Discrepancy Reports have been entered for SNPP CrIS Side-1 SDR product.

Requirement Check List – CrIS SDR (FSR)

Band	Longwave		Mid-wave		Shortwave	
Attribute	Requirement	Meet Req?	Requirement	Meet Req?	Requirement	Meet Req?
Wavenumber (cm^{-1})	650-1095	YES	1210-1750	**N/A**	2155-2550	YES
Spectral Range (μm) (J1MSS-1586)	9.13-15.38	YES	5.71-8.26	**N/A**	3.92-4.64	YES
Spectral Resolution (cm^{-1}) (J1MSS-2440)	0.625	YES	0.625	**N/A**	0.625	YES
Polarization	NS	-	NS	-	NS	-
Radiometric Uncertainty @ 287K BB (%) (J1MSS-1584)	0.45	YES	0.58	**N/A**	0.77	YES
Radiometric Stability @ 287K BB (%) (J1MSS-1592)	0.40	YES	0.50	**N/A**	0.64	YES
Maximum NEdN ($mW/(m^2\text{-}sr\text{-}cm^{-1})$) (J1MSS-1583)	0.45 @ 670 cm^{-1} 0.15 @ 700 cm^{-1} 0.15 @ 850 cm^{-1} 0.15 @ 1050 cm^{-1}	YES	0.078 @ 1225 cm^{-1} 0.064 @ 1250 cm^{-1} 0.069 @ 1500 cm^{-1} 0.075 @ 1700 cm^{-1}	**N/A**	0.013 @ 2200 cm^{-1} 0.014 @ 2350 cm^{-1} 0.014 @ 2550 cm^{-1}	YES
Nadir FOV (km) (J1MSS-1590)	15	YES	15	**N/A**	15	YES
Spectral Uncertainty (ppm) (J1MSS-1587)	10	YES	10	**N/A**	10	YES

JPSS GSRD Table B-3 + J1MSS (J1 Mission Systems Specification) NS = Not Specified

Documentations (Check List, 1 slide)

Science Maturity Check List	Yes ?	Where
ReadMe for Data Product Users	Yes	Review Directory
Algorithm Theoretical Basis Document (ATBD)	Yes	https://www.star.nesdis.noaa.gov/jpss/Docs.php
Algorithm Calibration/Validation Plan	Yes	https://www.star.nesdis.noaa.gov/jpss/Docs.php
(External/Internal) Users Manual	Yes	https://www.star.nesdis.noaa.gov/jpss/Docs.php
Operational Algorithm Description Document (OAD)	Yes	https://jointmission.gsfc.nasa.gov/documents.html 474-00071
Peer-Reviewed Publications (Demonstrates algorithm is independently reviewed)	In Progress	
Regular Validation Reports (at least. annually) (Demonstrates long-term performance of the algorithm)	In Progress	

Check List - Beta Maturity

Beta Maturity End State	Assessment
Product is minimally validated, and may still contain significant identified and unidentified errors	Yes
Information/data from validation efforts can only be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose	Yes
Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists	Yes

Rationale for Beta Maturity

1. Product is minimally validated, and may still contain significant identified and unidentified errors.

   Evaluation of the first week of SNPP/CrIS SDR Side-1 data, following the switch to Side-1 electronics, demonstrated the SNPP CrIS Side-1 Sensor Data Record (SDR) product meets the JPSS Level-1 Requirements.

2. Information/data from validation efforts can be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose.

   Evaluation results contain qualitative and quantitative assessment of the quality of the SDR data product. Quality monitoring and calibration improvements are in progress.

3. Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exist.

   Reports to assess the quality of the SNPP CrIS SDR product have been delivered on regular basis to JPSS and STAR Managers after the Side-2 LWIR band anomaly identification on May 21, 2021. Location of reports is listed below:

   1. Anomaly and Assessment Report: https://drive.google.com/file/d/1NJCzLdgMKJGOa9itkHEh8zpdZl-ozemr/view?usp=sharing.
   2. Quality Monitoring Report: https://drive.google.com/file/d/1y35wBlp5QZ2AejeS5C5awJG0TRnNfEff/view?usp=sharing.
   3. Assessment and Monitoring Report: https://drive.google.com/file/d/1JtcC0VsJOBJ575JK2Jwsfb9jZUztumZg/view?usp=sharing.
   4. NWP Impact Report: https://drive.google.com/file/d/1HAnW0m0dK-4FyY31O-IGDnhENanqOcXZ/view?usp=sharing.
   5. One Month Assessment Report: https://drive.google.com/file/d/1REgu_3wJsZ1UCDy5NptLvBlGPx42QCrA/view?usp=sharing.
   6. Day-1 Report: https://drive.google.com/file/d/1G73yCnxpYJNWfbOIFrF6eTsRARyiahZX/view?usp=sharing.
   7. Day-2 Report: https://drive.google.com/file/d/1gFqmwbJlttxQWhNT3l0_iYI5OFdqSU1j/view?usp=sharing
   8. Week-1 Report: https://drive.google.com/drive/folders/1pkt8i48ub4IMeOG6UpXm9ilYRhinGap6?usp=sharing.

Check List - Provisional Maturity

Provisional Maturity End State	Assessment
Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from select locations, periods, and associated ground truth or field campaign efforts.	Yes
Product analysis is sufficient to communicate product performance to users relative to expectations (Performance Baseline).	Yes
Documentation of product performance exists that includes recommended remediation strategies for all anomalies and weaknesses. Any algorithm changes associated with severe anomalies have been documented, implemented, tested, and shared with the user community.	Yes
Product is ready for operational use and for use in comprehensive cal/val activities and product optimization.	Yes

User Feedback

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Ken Pryor ken.pryor@noaa.gov	NOAA/STAR NUCAPS Team	Atmospheric Sounding	July 20, 2021

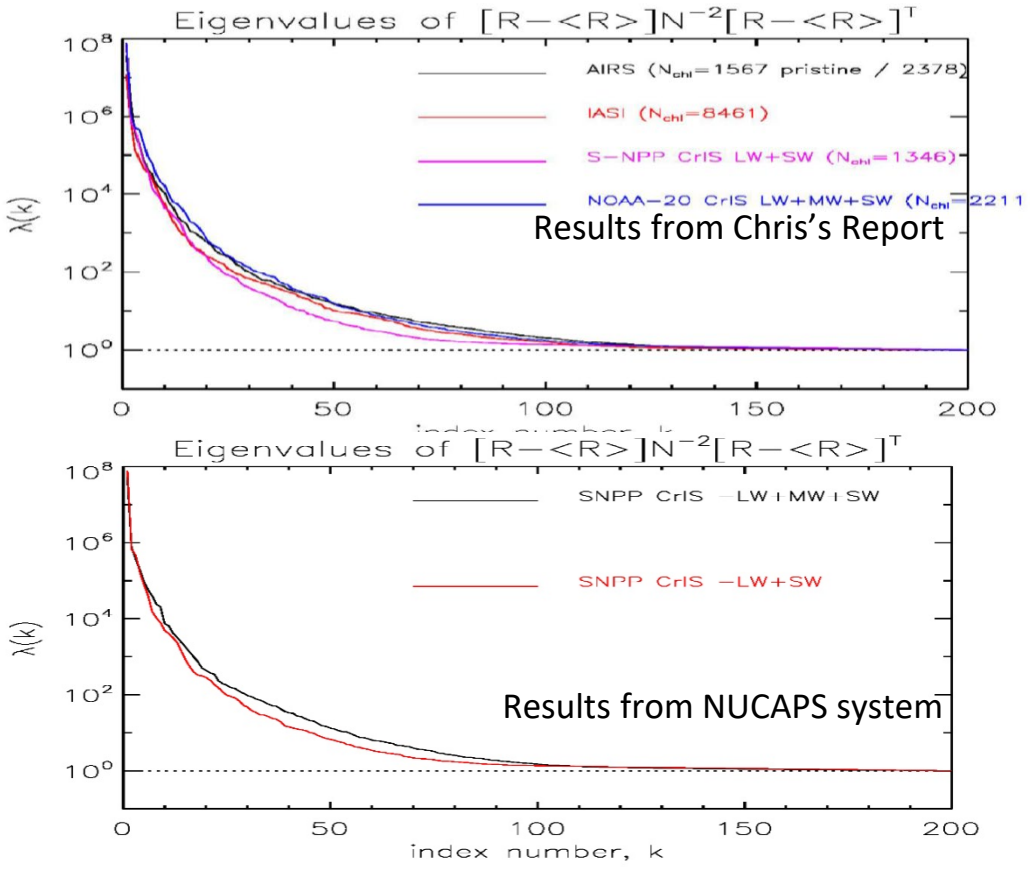
Preliminary results from the NUCAPS Team, demonstrate that Temperature and Water Vapor profiles can be retrieved using SNPP CrIS Side-1 LWIR/SWIR observations (in addition to ATMS Microwave observations), while meeting the JPSS Level-1 Requirements. Major impact is associated with the lack of MWIR observations, causing slight degradation in the temperature profile product, and more noticeable degradation in water vapor profile.

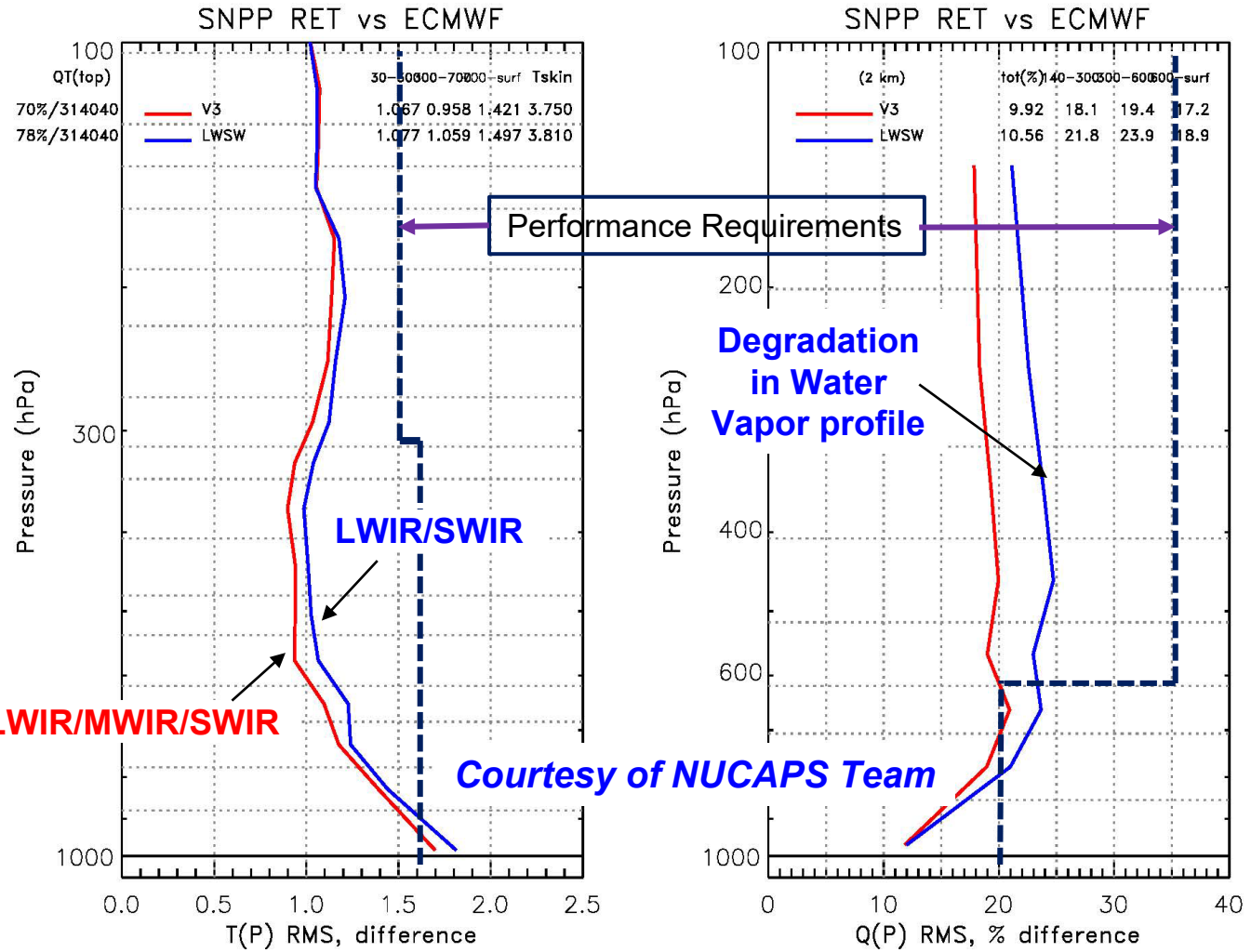
NUCAPS Report is located in the designated electronic location designated for the “JPSS Beta/Provisional Maturity Science Review For Suomi-NPP CrIS SDR Side-1 Product”.

NUCAPS V3.0 System for S-NPP LW/SW (Side-1 Switch) - Results

- Updated All-sky and clear regression using LW/SW bands Results verified with Chris Barnet's results (2019)
- Emissivity First Guess replaced with Combined ASTER an MODIS emissivity over Land (CAMEL)
- **CH4, SO2 are not retrieved; CO and CO2 are retrieved, but needs to check QC/QA**

Focus day (20200715) evaluation of
S-NPP NUCAPS LW/SW system (blue curve) with NOAA-20 OPS (LW/MW/SW) (red curve)
RMS Differences with ECMWF for S-NPP (LW/SW) and NOAA-20
Temperature Water Vapor





Rationale for Provisional Maturity

1. Product performance has been demonstrated through analysis of large, but still limited (i.e. not necessarily globally or seasonally representative) number of independent measurements obtained from selected locations, time periods, or field campaign efforts.

   The performance of the SNPP/CrIS SDR data product has been demonstrated globally over 1-week after the successfully switching to Side-1 electronics.

2. Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.

   Analysis are sufficient to demonstrate the quality of the SNPP/CrIS SDR data product, meeting or exceeding the JPSS Level-1 Requirements for radiometric, spectral, geolocation, and noise performance.

3. Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists.

   No anomalies have been identified in the quality of the SNPP/CrIS SDR data product. In addition to this Review, documentation can be found in the material delivered to the JPSS and STAR managers after the initiation of the instrument Recovery Activities on July 12, 2021.

4. Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.

   The quality of the SNPP/CrIS SDR data product is sufficient to be used in operational environment, since it meets the JPSS Level-1 Requirements.

Major CrIS Cal/Val Science Team Observations

- All required assessments for the SNPP CrIS Beta/Provisional Maturity Level have been initiated and proceeded with preliminary results.
- SNPP CrIS side-1 science telemetry is operating as expected with stabilized parameters.
- SNPP CrIS side-1 SDR products have consistent performance in radiance, noise, spectral accuracy and geolocation accuracy before and after the recent side switch.
- SNPP CrIS FOVs show good radiometric agreement in the LWIR band, which implies there is no need to change the nonlinearity values in the EP v41 (See the presentation "*3a - CrIS-VIIRS-Sidee1Return.pptx*" by UW).
- The ringing characteristics show good agreement between SNPP CrIS side-1 in 2019 and 2021, which confirms that the small ZPD offsets observed after the recent side switch are not producing a significant artifact (See the presentation "*3b - lblrtm_calcs__snpp_side_switch_for_lw__20210716p.pptx*" by UW).
- Radiometric and spectral calibration assessment suggests that SNPP CrIS is operating as well as it did before the side change (See the presentation "*2 - strow.pdf*" by UMBC).

Path Forward for the SNPP/CrIS Instrument

1. **Continue monitoring the instrument long-term stability and performance, as well as the SDR data quality with corresponding feedback from Users.**
2. Continue to inter-compare the instrument against other sensors (including the NOAA-20/CrIS, IASI, VIIRS, and ABI), in order to further assess the radiometric calibration (uncertainty/stability). At the Validated review this assessment will be reported to confirm the results reported in this review.
3. Continue assessing the instrument noise, radiometric, spectral and geolocation calibration, as well as the instrument yield rate.
4. **Based on the instrument performance and quality of the SDR products over a long-term validation period, the transition to the Validated maturity level is planned. The initial recommendation is 1-2 months after reaching the JPSS Provisional maturity level.**

Documentation Location

Location designated for the "JPSS Beta/Provisional Maturity Science Review For Suomi-NPP CrIS SDR Side-1 Product" on July 21, 2021:

https://drive.google.com/drive/folders/1vXr8ZVCG3-A3fShR7NuzZpeUMuNK1Dm3?usp=sharing

Additional Documentation:

- **Commissioning Timeline (NASA Flight):**
  1 - SNPP_071221_sideswitch Commissioning Timeline.pptx
- **Spectral Assessment (UMBC):**
  3 – strow.pdf
- **Radiometric Assessment (UW):**
  4a - CrIS-VIIRS-Sidee1Return.pptx
  4b - lblrtm_calcs__snpp_side_switch_for_lw__20210716p.pptx
- **NUCAPS Team Feedback:**
  5 - NUCAPS_LW_SW_final.pptx
- **ReadMe document:**
  SNPP_CrIS_Side1_Beta_Readme_2021_07_21_Rev1.0.pdf

Acknowledgements

Acknowledgement and thanks are extended to all individuals and organizations participating in the intensive Side Switch and Recovery Activities of the SNPP/CrIS Instrument, an example of Team Effort, Hard Work, Dedication and Professionalism: **NOAA, NASA, University of Wisconsin, University of Maryland Baltimore County, L3HARRIS, Logistikos, Raytheon, MIT**.

SNPP CrIS Side Switch and Commissioning Timeline

David Johnson

Beta/Provisional Data Review

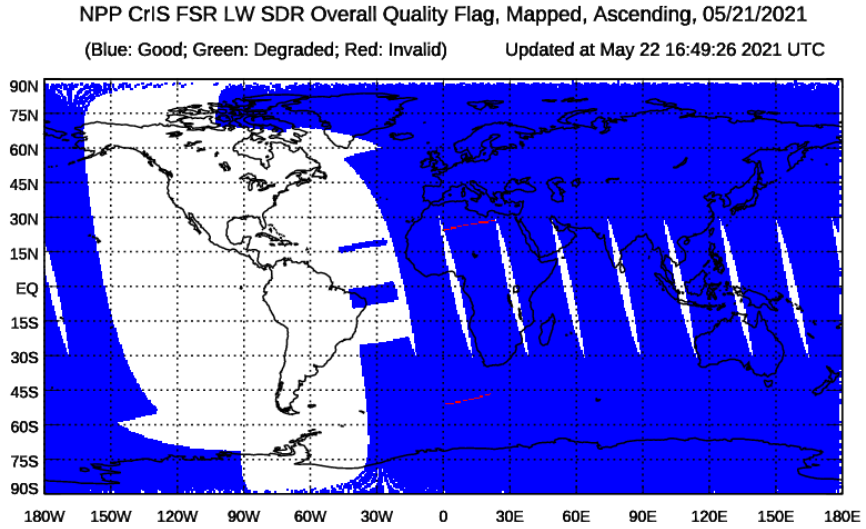
7/21/2021

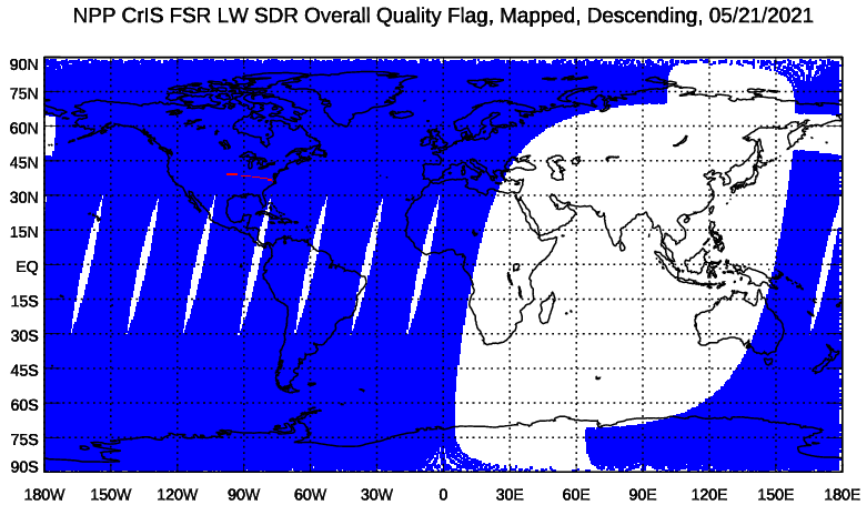
LW Anomaly Timeline

- 5/21/2021: LW signal processor goes into reset on side 2:
  - First SEFI error at 7:42:01 GMT
  - First wake-up error at 14:22:52 GMT
  - SNPP CrIS LW signal processor CCA goes into reset at 15:42:10 GMT
- SP reset on 5/21 and instrument power cycle on 5/25 did not resolve the issue
- 6/15/2021: L3Harris provides recommendation to switch back to side 1 to recover LW (and SW) at the expense of the MW (that failed in 2019)
- 7/12-13/2021: Commanding to switch to side 1 completed.

LW Data loss on 5/21/2021

From STAR ICVS





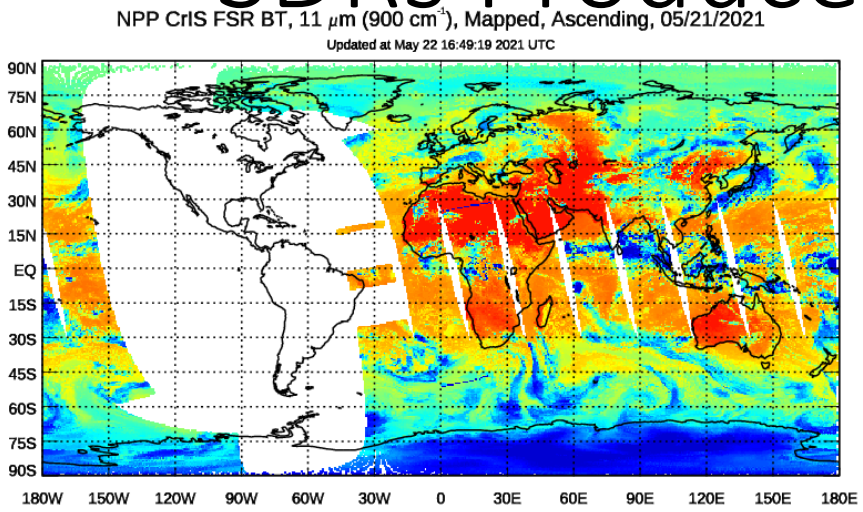
SNPP Side 1 Commissioning Timeline, Day 1

- 7/12:
  - SVL, 11:07-11:21
    - Verify side 2 memory contents
  - TDRSS, 12:20-12:37
    - Power down side 2
  - SVL, 12:48-13:02
    - Power up side 1, load cal table 40
    - Power up interferometer
  - TDRSS, 13:28-13:49
    - Power up SSM
    - Perform immediate neon calibration, power up signal processors, confirm side 1 MW SP still non-functional, LW and SW are operational. Load FIR filter coefficients.
  - TDRSS, 14:54-15:14
    - Configure SP, collect bias tilt data
  - SVL, 16:13-16:25
    - Continue tilt data collections
  - SVL, 17:57-18:07
    - Finish tilt collections, start SSM torque null measurement
  - SVL, 19:39-19:50
    - Finish null position measurement, restore SSM configuration

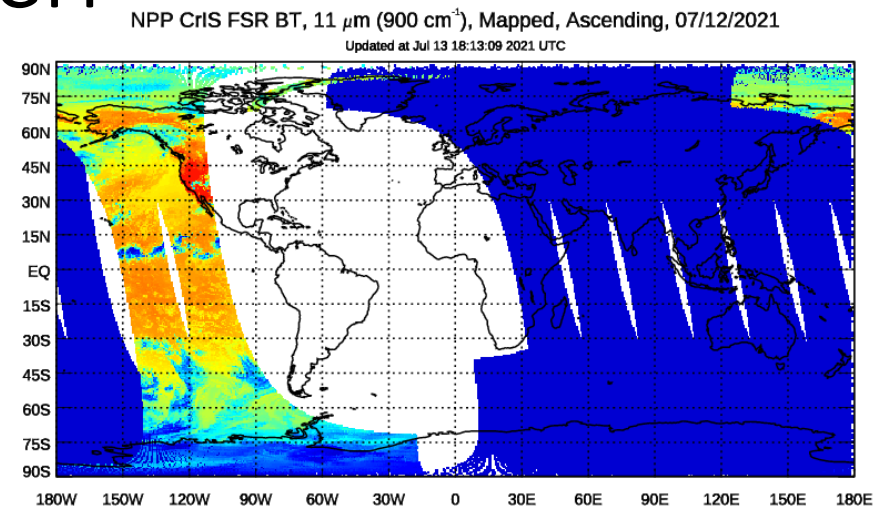
SNPP Side 1 Commissioning Timeline, Day 2

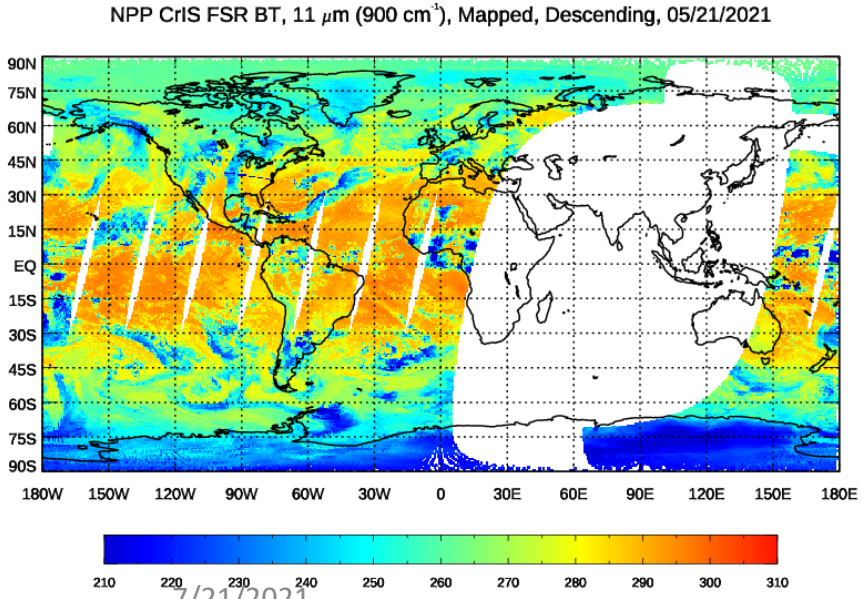
- 7/13:
  - SVL, 12:29-12:43
    - Diagnostic mode data collection, FOV 1
  - TDRSS, 13:20-13:40
    - DM data collection, FOV 5
  - SVL, 14:12-14:25
    - DM collection, FOV 4
  - SVL, 15:53-16:06
    - Complete restoring normal mode full resolution interferogram configuration
    - Updated SSM config
  - SVL, 17:37-17:49
    - Update ZPD offset, bias tilts, and upload cal table V41 with updated SSM torque null position and Vinst values.
  - SVL, 19:20-19:31 and 21:02-21:15
    - Persist current configuration (?), and dump and verify memory contents.

SDRs Produced After Switch

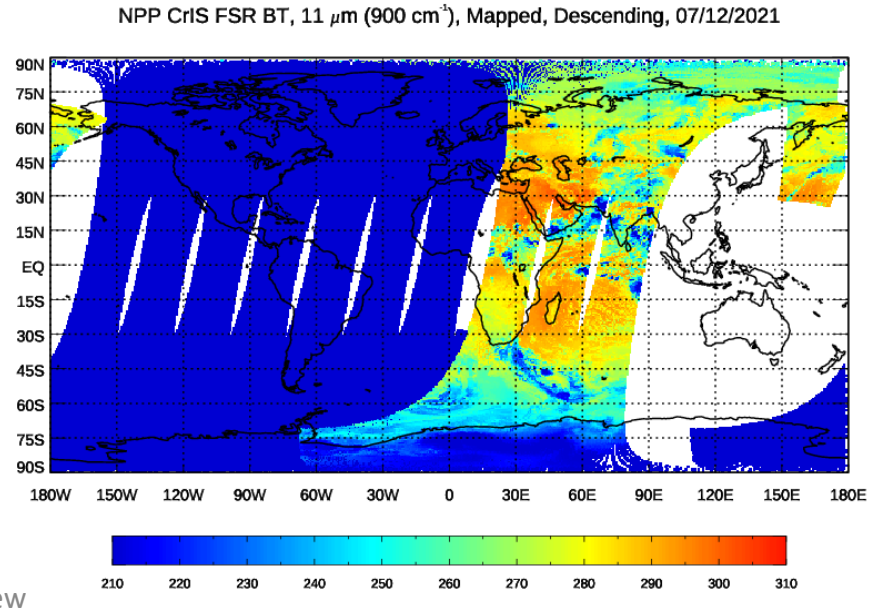


Side 2, 5/21/2021, day of anomaly





Side 1, 7/12/2021, day of switch



Evaluation of Spectral Calibration and Radiometric Accuracy after the July 2021 Side Switch

L. Larrabee Strow and CrIS STAR Team (UMBC, NESDIS/STAR)

April 21, 2021

Introduction

- We analyzed IDPS SDRs from July 14 from T0 to T22 (data source was NOAA CLASS)
- All observations were match to ECMWF
- A clear ocean subset was also produced for radiometric calibration evaluation

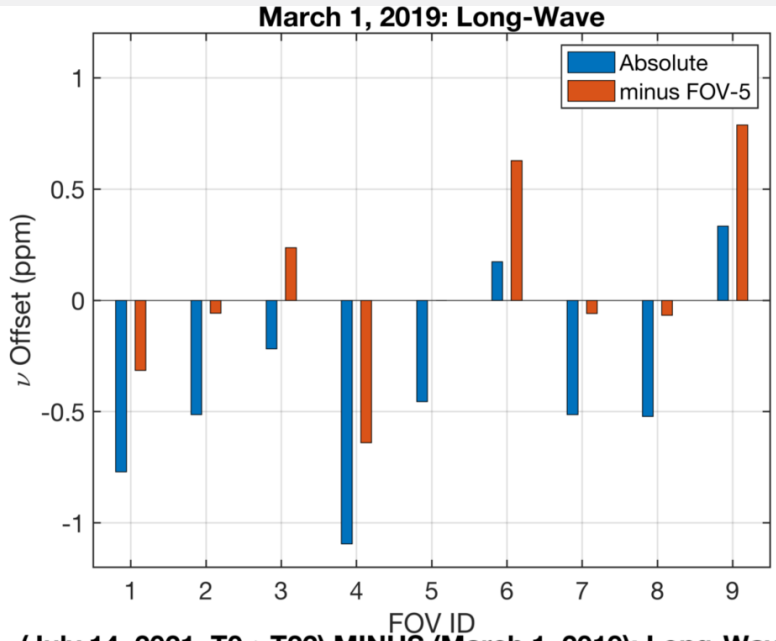
Spectral Calibration

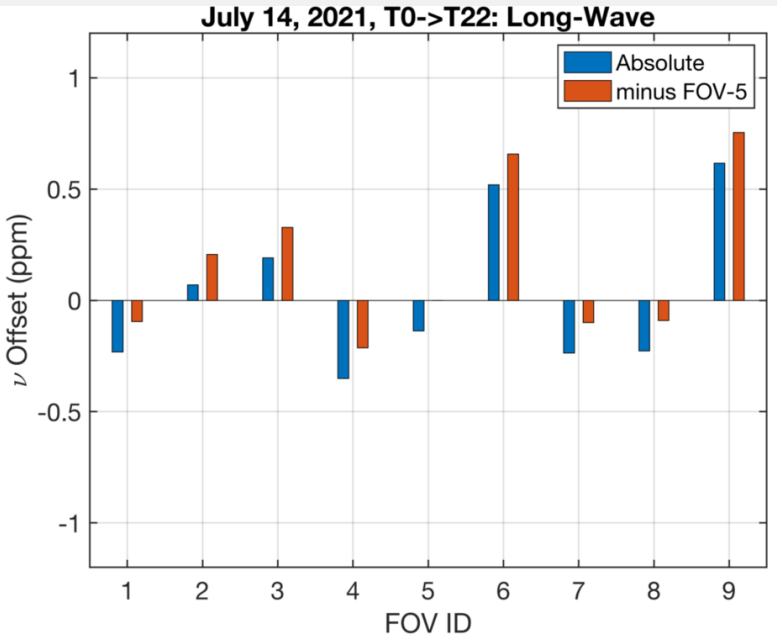
- Our spectral calibration algorithm was applied to the matched ECMWF data that contains all observations.
- This code does not look for pristine clear, it just requires the observations and calculations (clear sky) to match within some threshold (a few K).
- Additional filtering of bad matches is done by removing observations that have low (<0.998) correlation coefficients between Obs and Cal.
- We concentrated on the longwave.

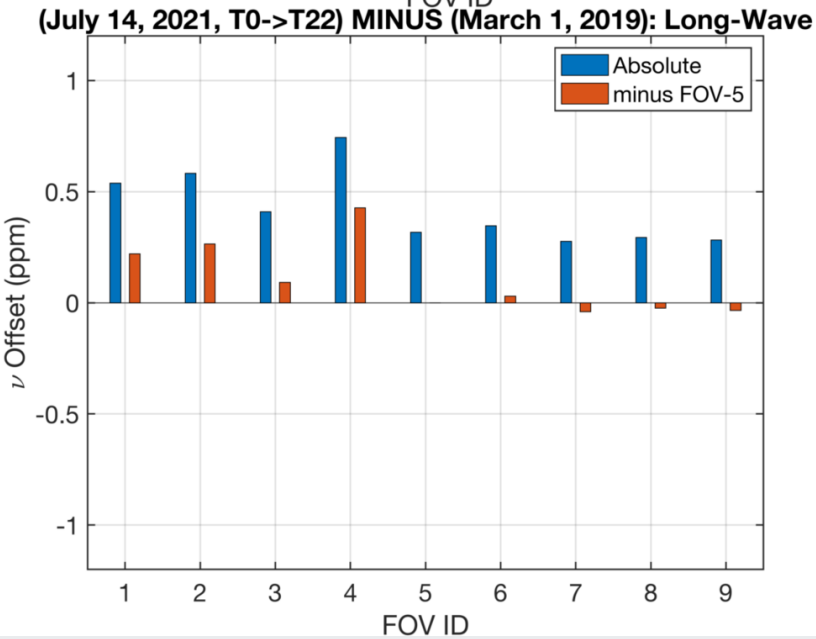
Radiometric Assessment

- Biases versus ECMWF using clear ocean scenes are used
- Biases are broken out by FOV to mostly look for any non-linearity issues

July 14 Longwave Spectral Calibration



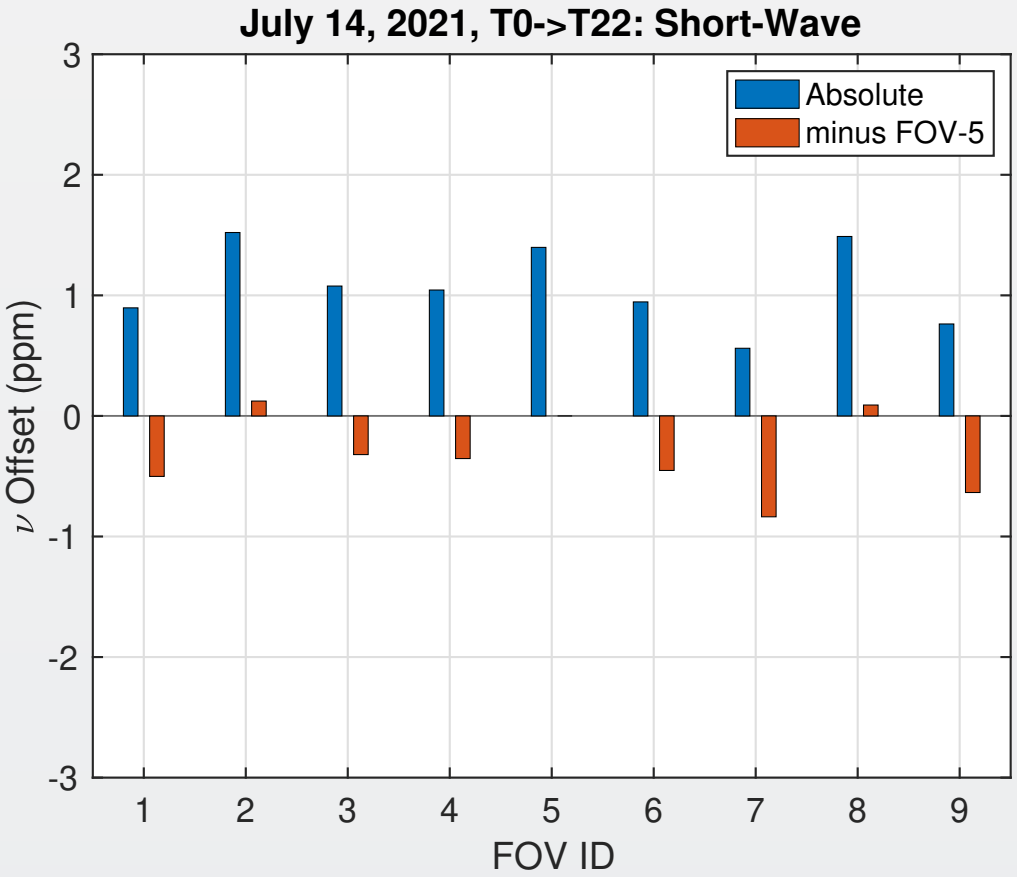




Takeaway

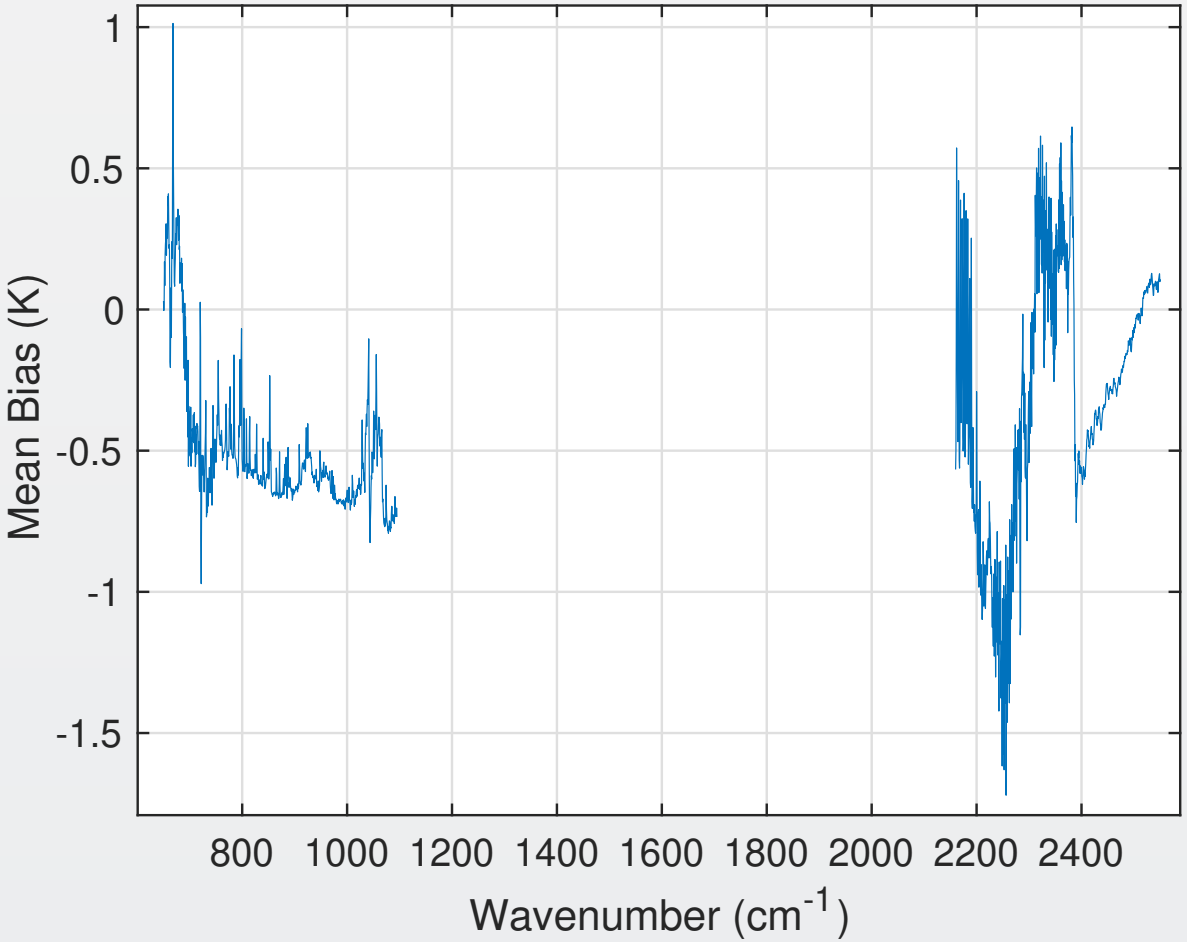
- The spectral cal differences between March 2019 and July 2021 are mostly <0.5 ppm
- The pattern of the offsets cannot be reliably fit with a focal plane offset
- The Neon offset appears to be ~0.3 ppm. Very small.
- Note: the July 2021 and March 2019 data were regenerated at the same time, with the same exact codes.

Shortwave Spectral Calibration



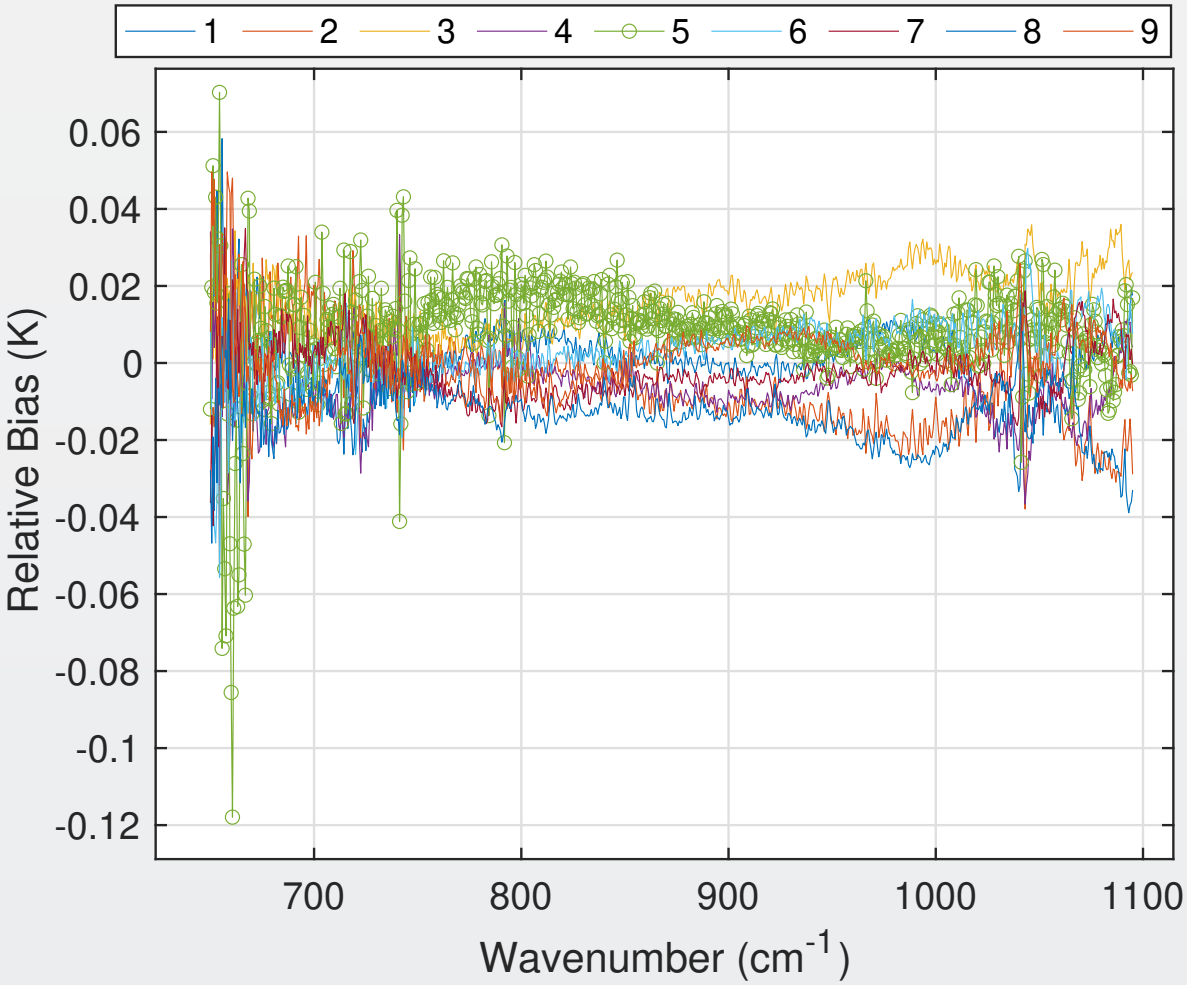
Have not yet re-run March 2019 but these results suggest no change to focal plane and Neon is well within expectations.

Radiometric Results: Bias



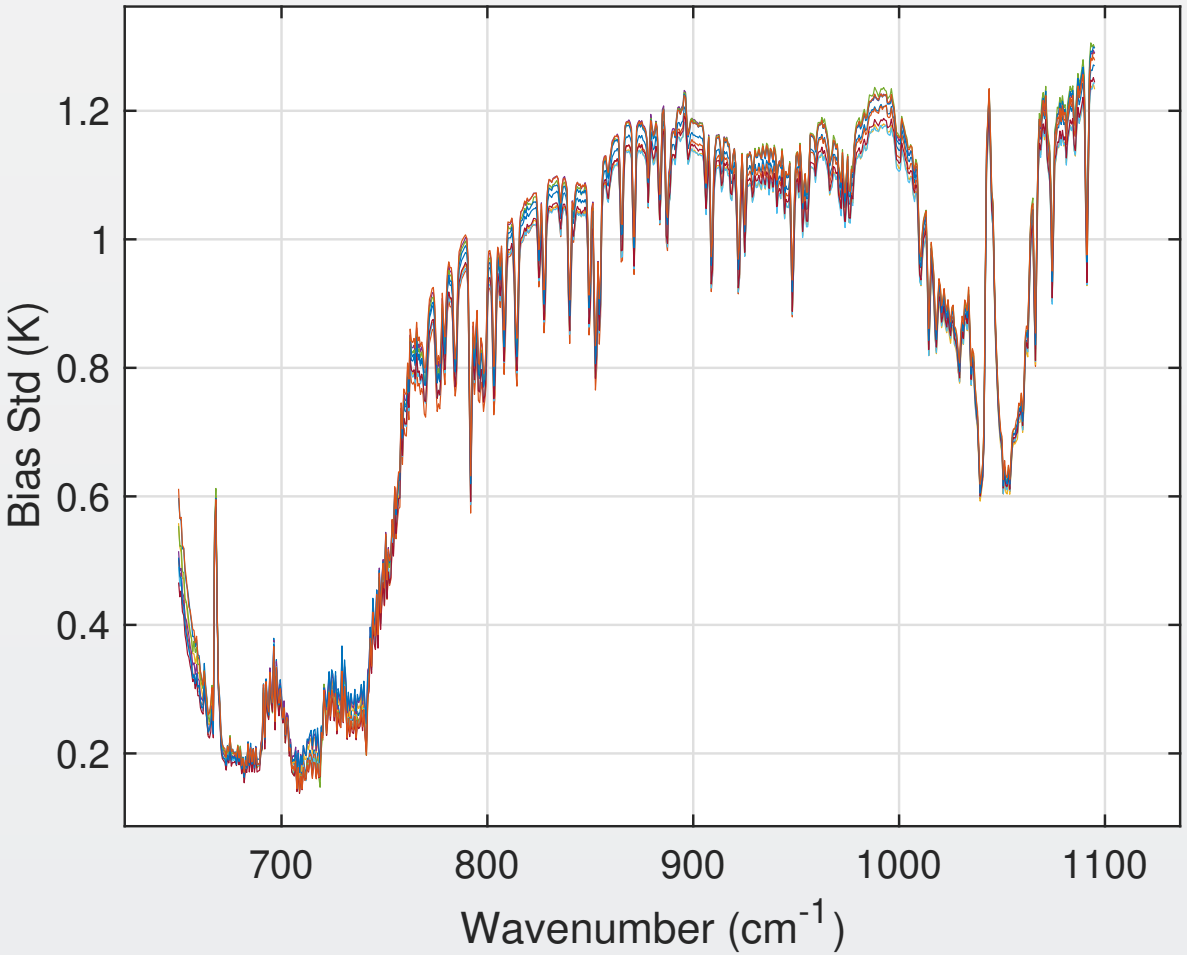
- Ascending and descending so shortwave has a tilt due to solar
- Incorrect CO_2, CH_4, N_2O, and CO used, can be corrected
- Basically looks good.

Radiometric Results: Relative Bias (mean bias removed)



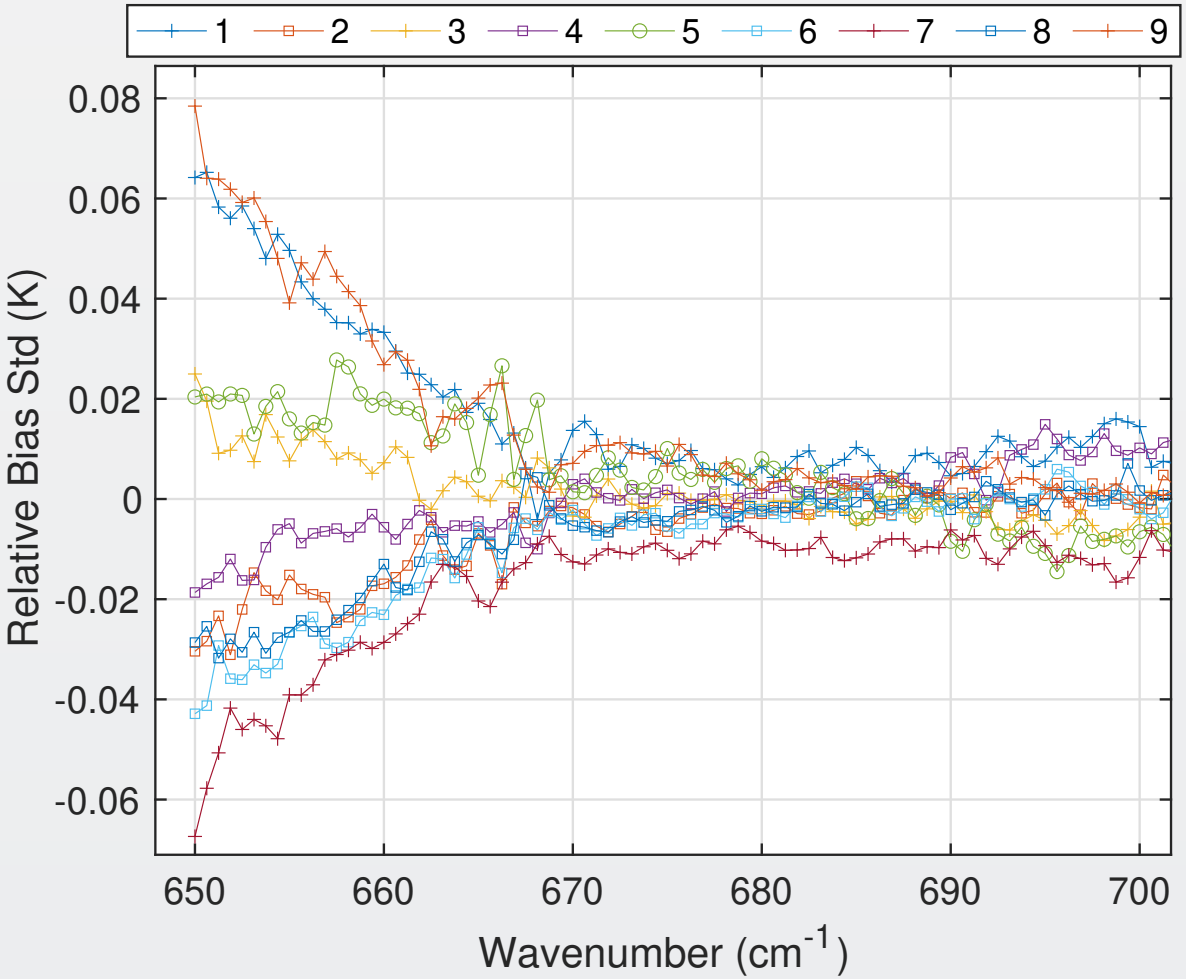
All FOVs show very similar biases. Suggests there are no non-linearity issues.

Radiometric Results: Bias Standard Deviation



Looks good, as expected. Window dominated by SST variability.

Radiometric Results: Relative Bias Standard Deviations



No surprises. Corners generally higher than sides, center.

Conclusions

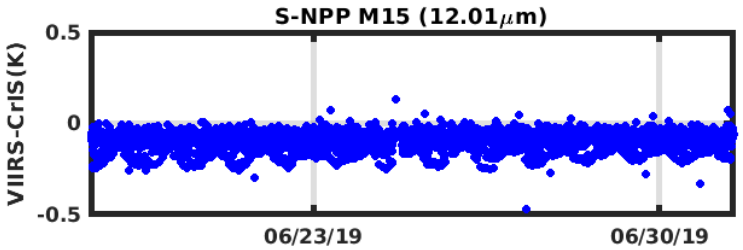
- Radiometric and spectral calibration assessment suggests SNPP CrIS is operating as well as it did before the Side change.
- Any spectral changes would be hard to validate

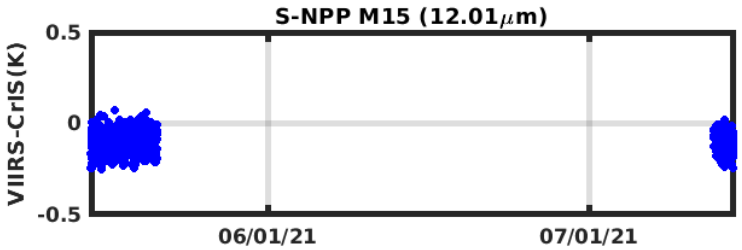
VIIRS - CrIS Analysis Following Return to Side 1

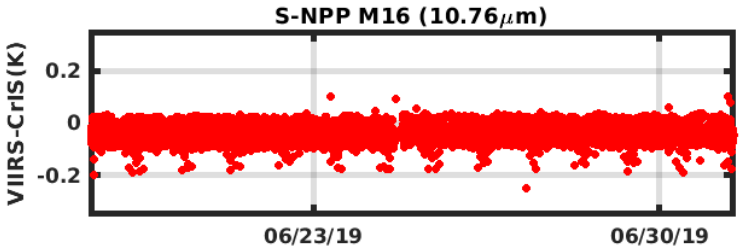
UW SSEC CrIS Science Team

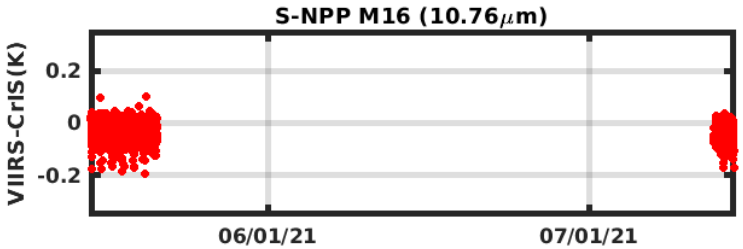
16 July 2021

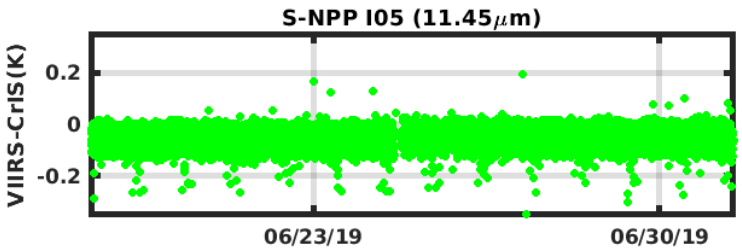
VIIRS – CrIS Timeseries

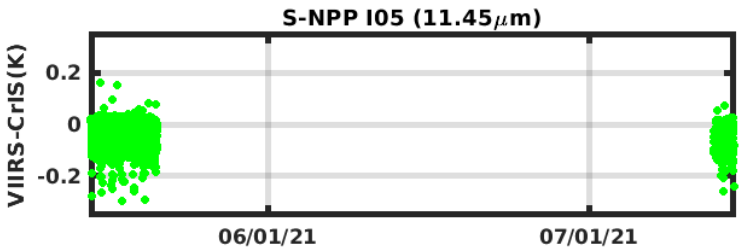


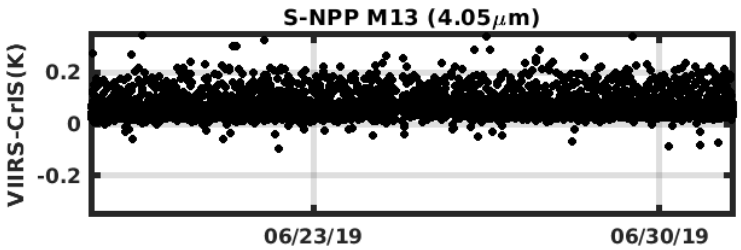


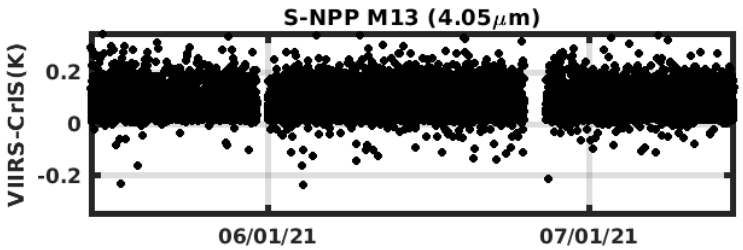






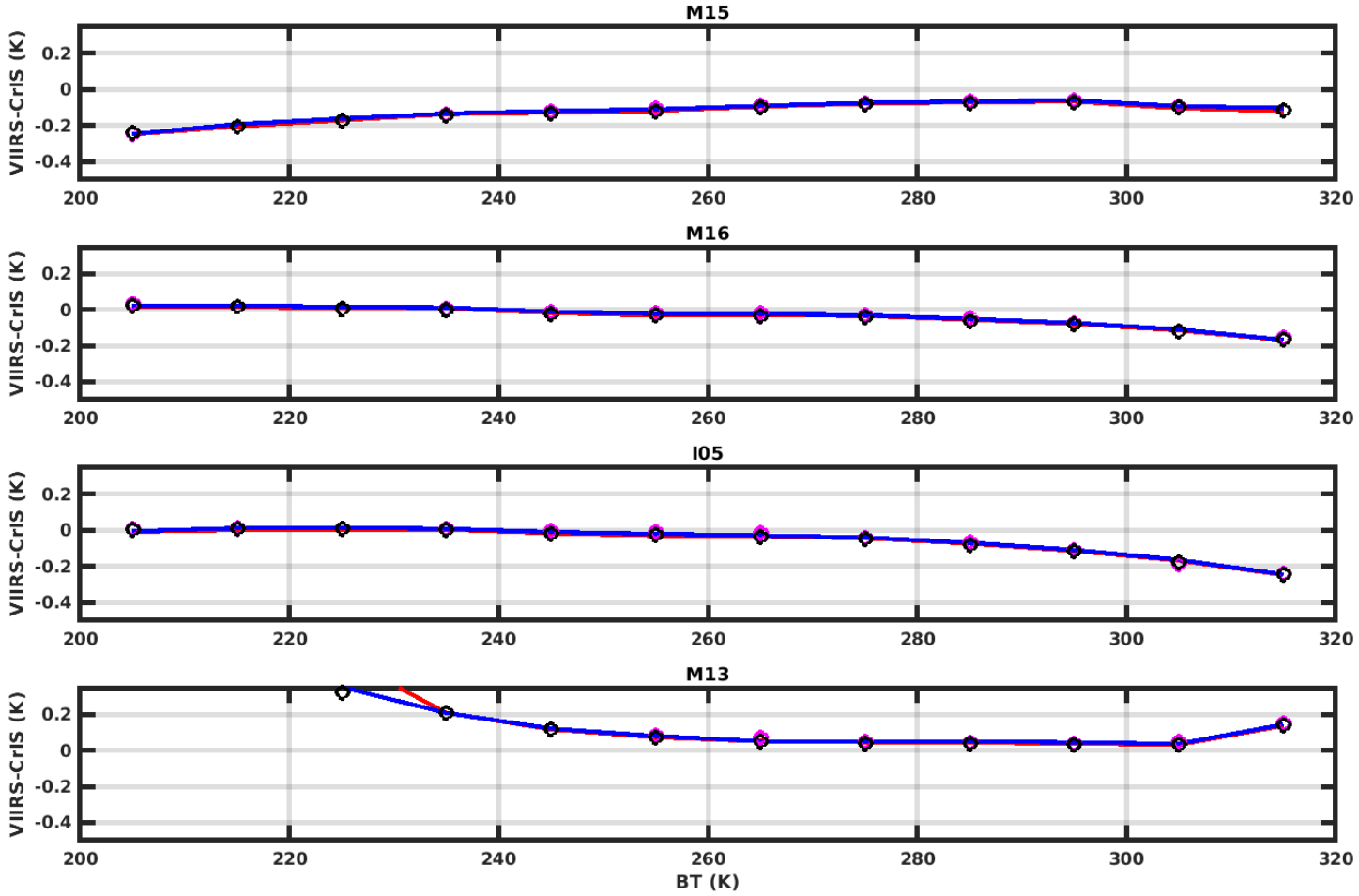






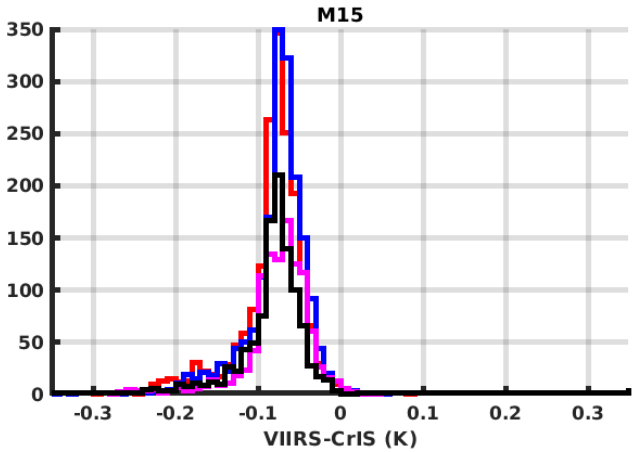
VIIRS – CrIS as a function of Scene Temperature

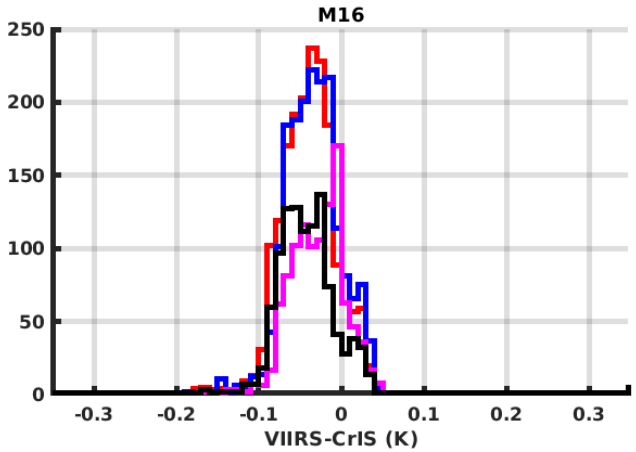
Blue line:	Five-day mean prior to side-2 switch (9 Jun 2019 - 13 Jun 2019)
Red line:	Five-day mean after side-2 switch (26 Jun 2019 - 30 Jun 2019)
Magenta circles:	Three-day mean prior to side 2 LW failure (5 May 2021 - 7 May 2021)
Black circles:	Three-day mean after return to side-1 (13 Jul 2021 - 15 Jul 2021)

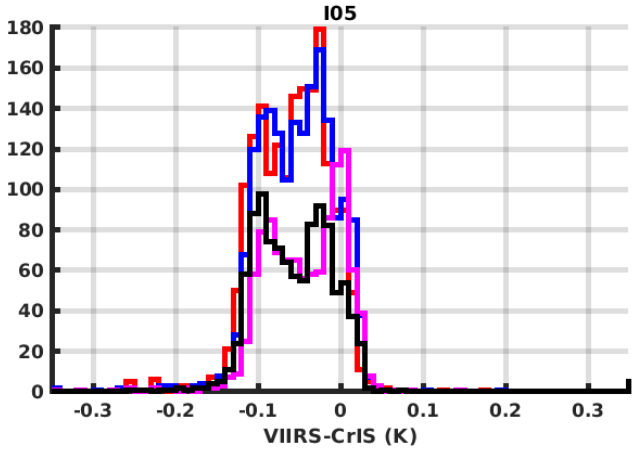


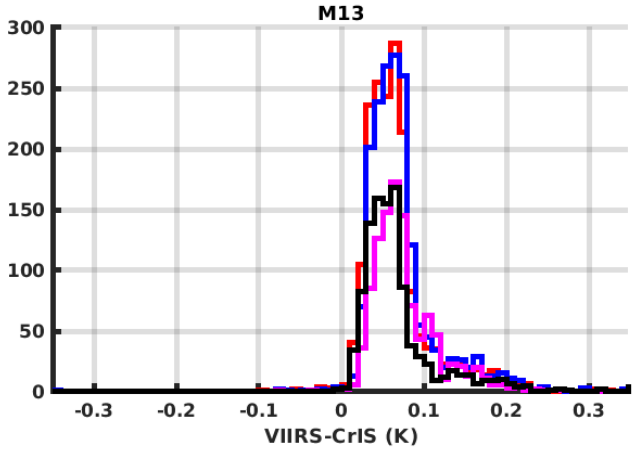
VIIRS – CrIS difference distribution

Blue: Five-day mean prior to side-2 switch (9 Jun 2019 - 23 Jun 2019)
Red: Five-day mean after side-2 switch (26 Jun 2019 - 30 Jun 2019)
Magenta: Three-day mean prior to side 2 LW failure (5 May 2021 - 7 May 2021)
Black: Three-day mean after return to side-1 (13 Jul 2021 - 15 Jul 2021)



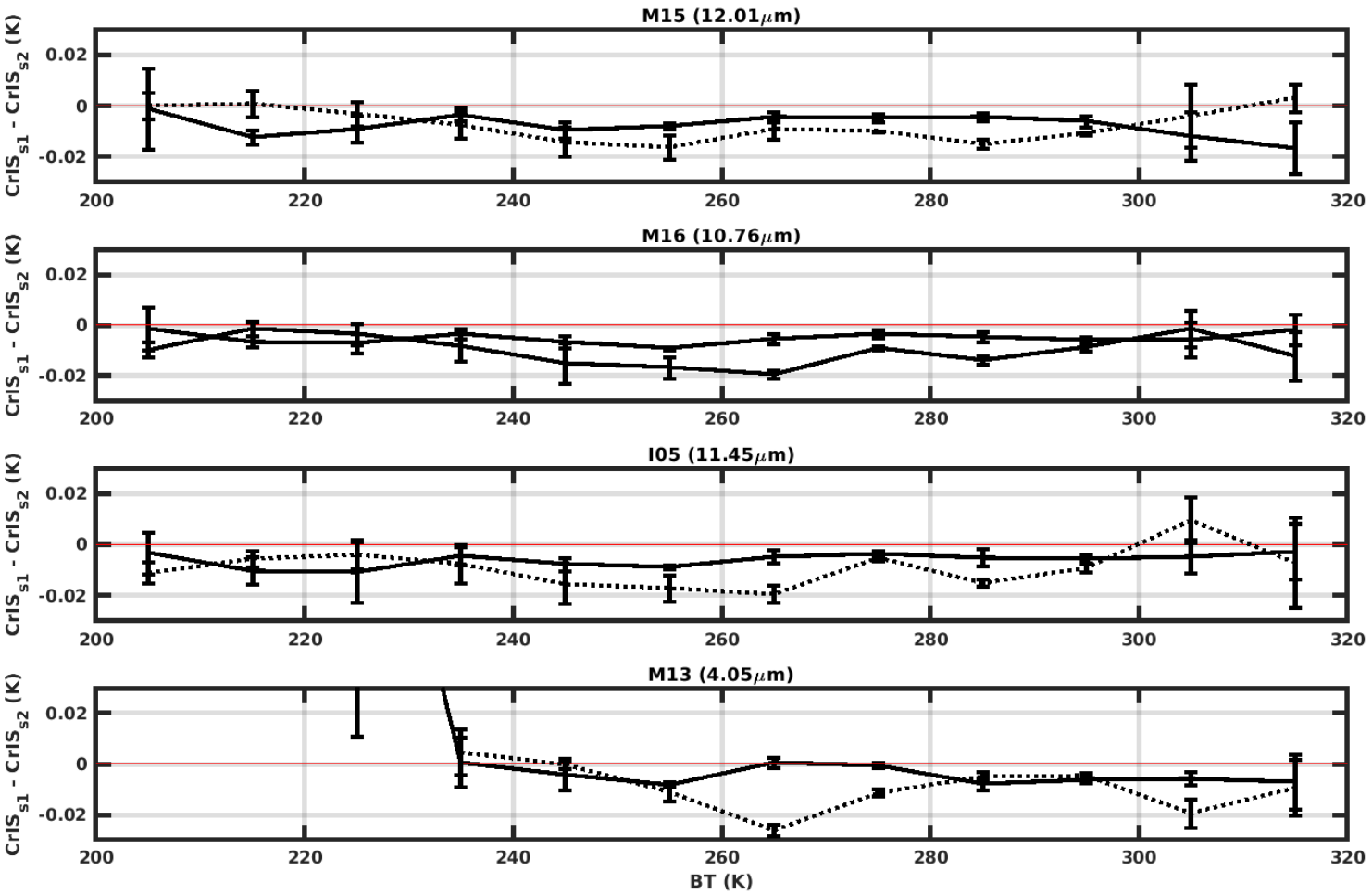






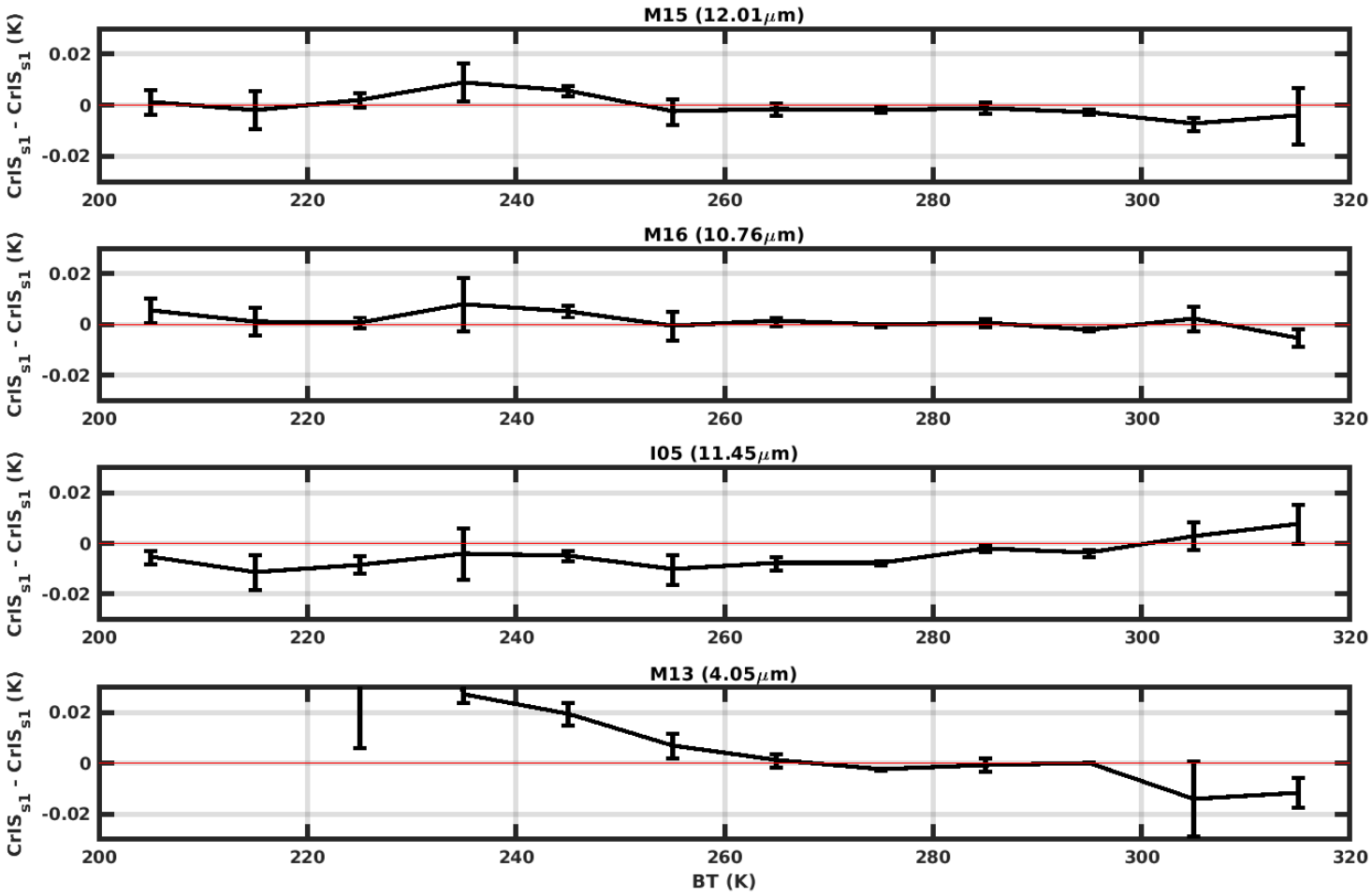
VIIRS – CrIS side-1 – side-2 differences as a function of scene temperature

Solid: Five-day mean side-1 (9 - 13 Jun 2019) – side-2 (26 – 30 Jun 2019)
Dashed: Three-day mean side-1 (13 - 15 Jul 2021) – side-2 (5 – 7 May 2021)

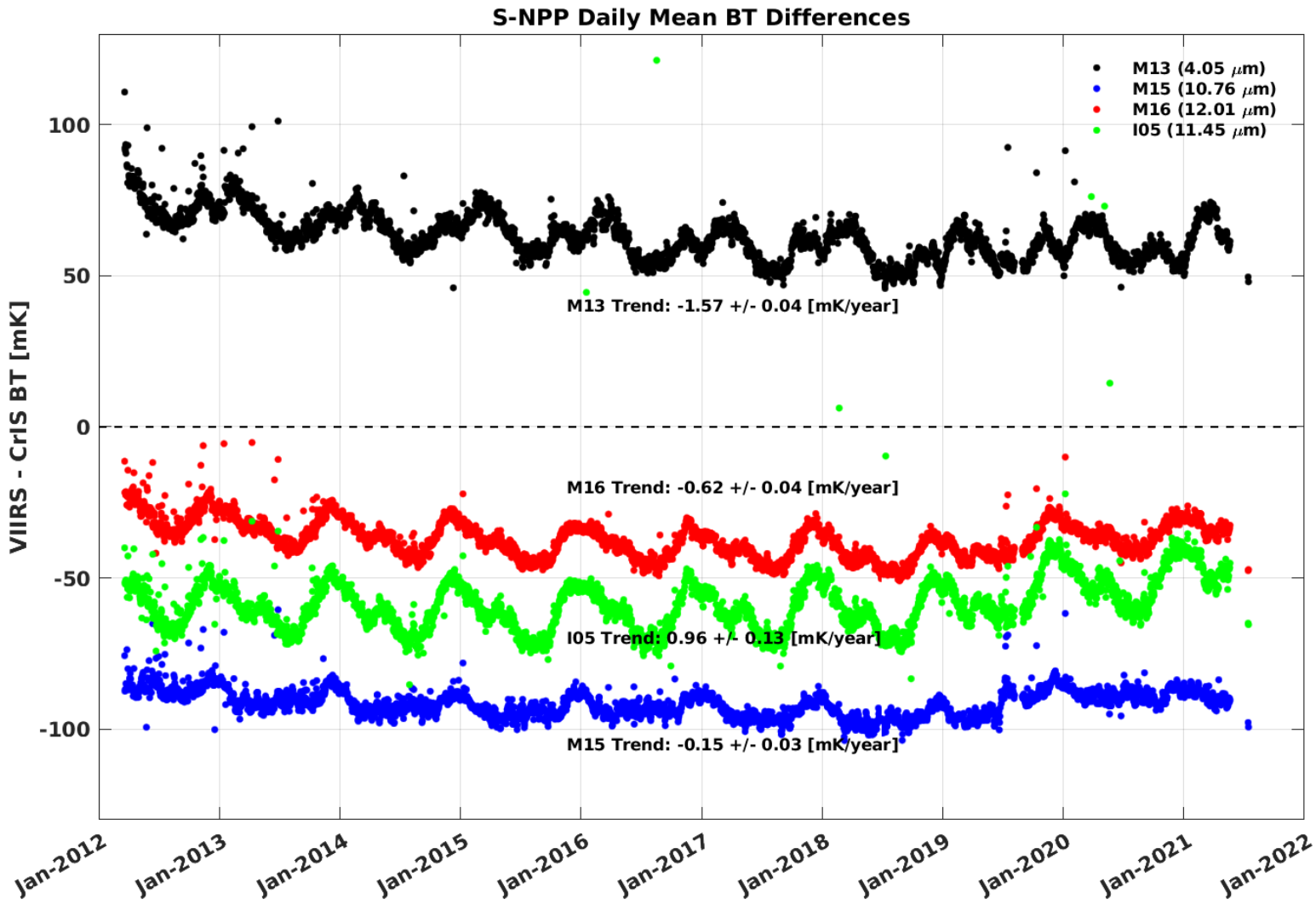


VIIRS – CrIS side-1 differences

Three-day mean side-1 (13-15 Jul 2021) – side-1 (14-15 Jul 2018)



VIIRS – CrIS Mission Timeseries



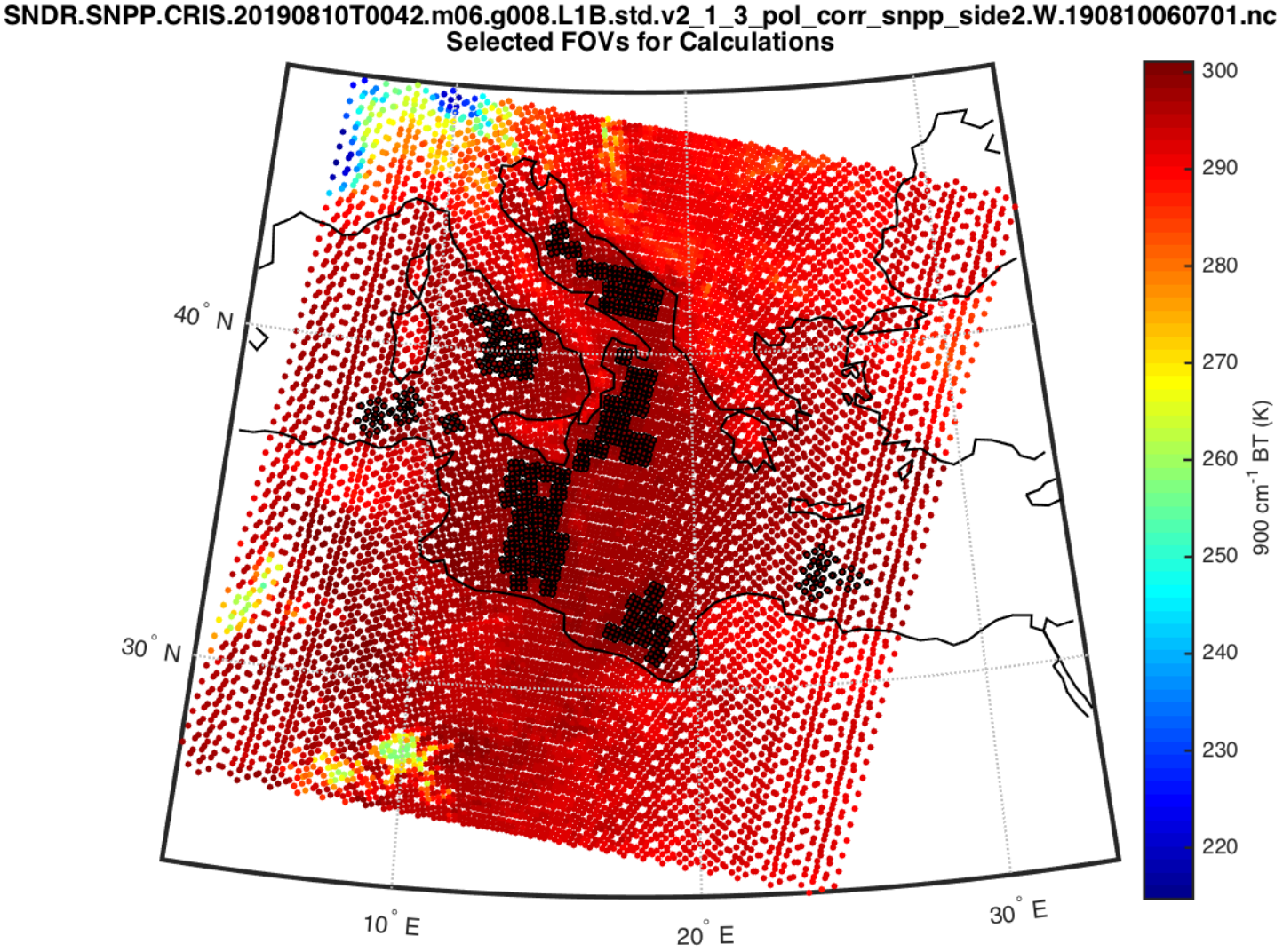
Pre & Post NPP Side Switch for LW Outage: LBLRTM Calc Case Study over Mediterranean Sea

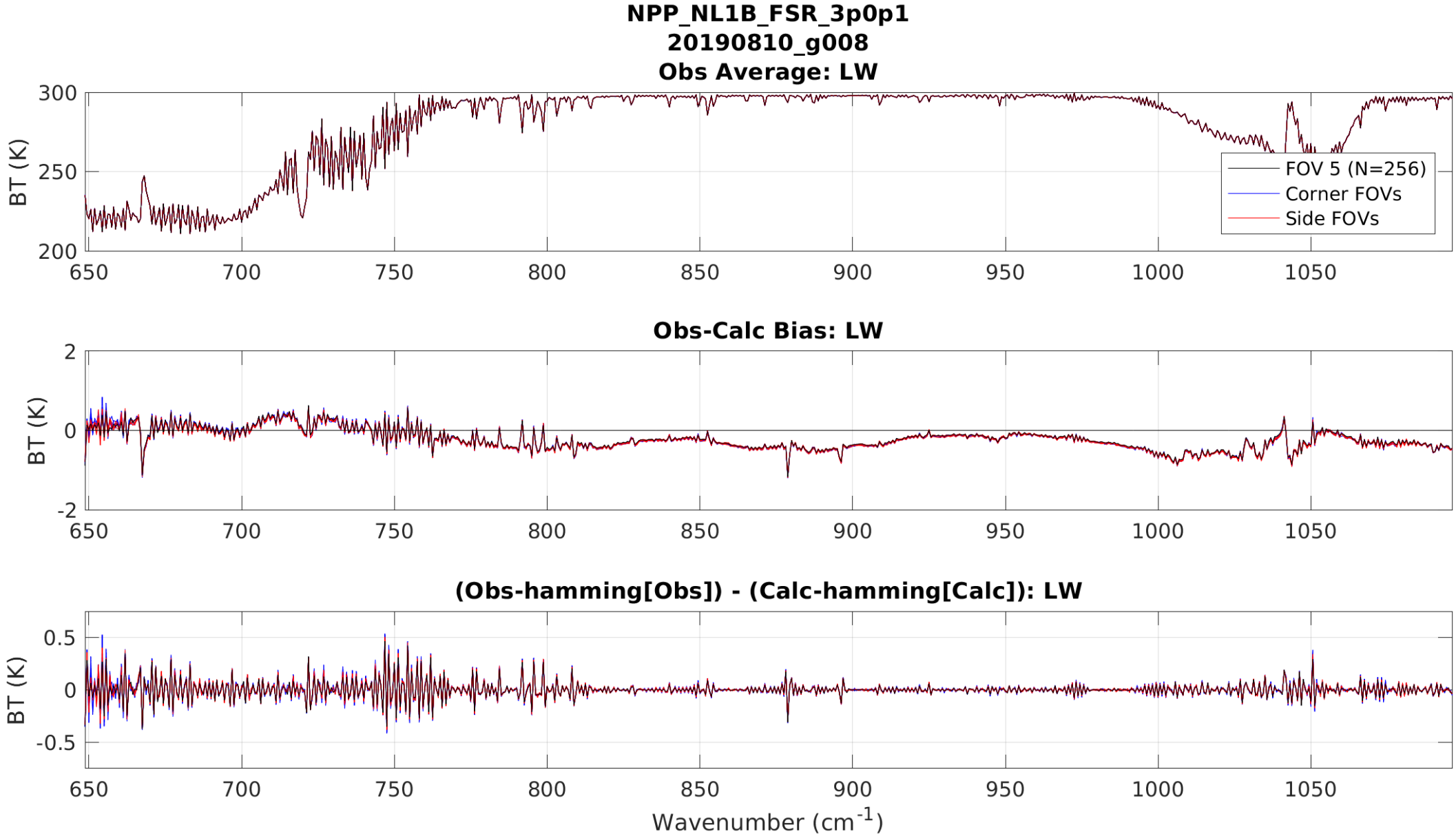
MLL

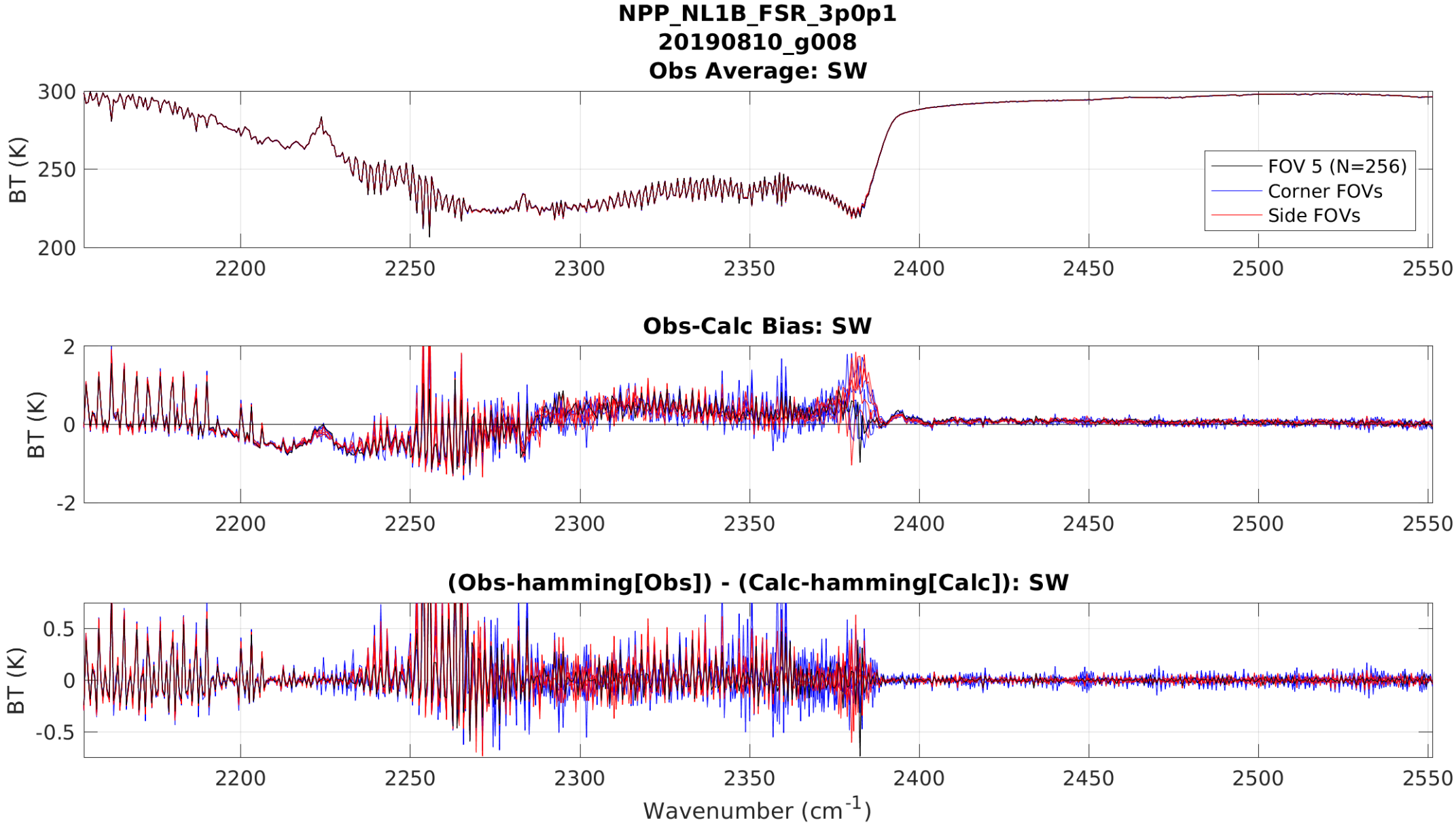
2021 07 15

Pre-Side Switch (from Side 2 to Side1)

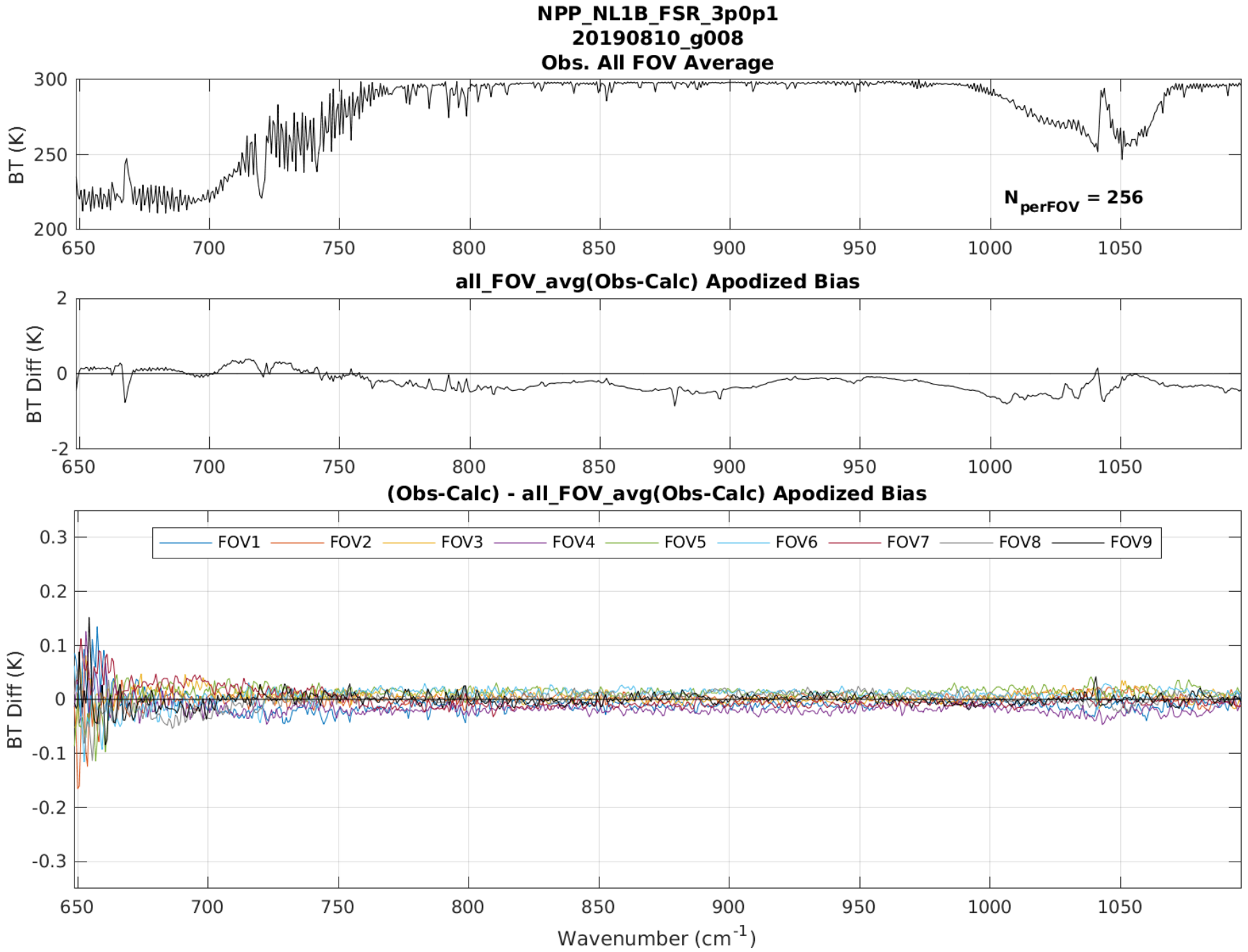
August 10th, 2019



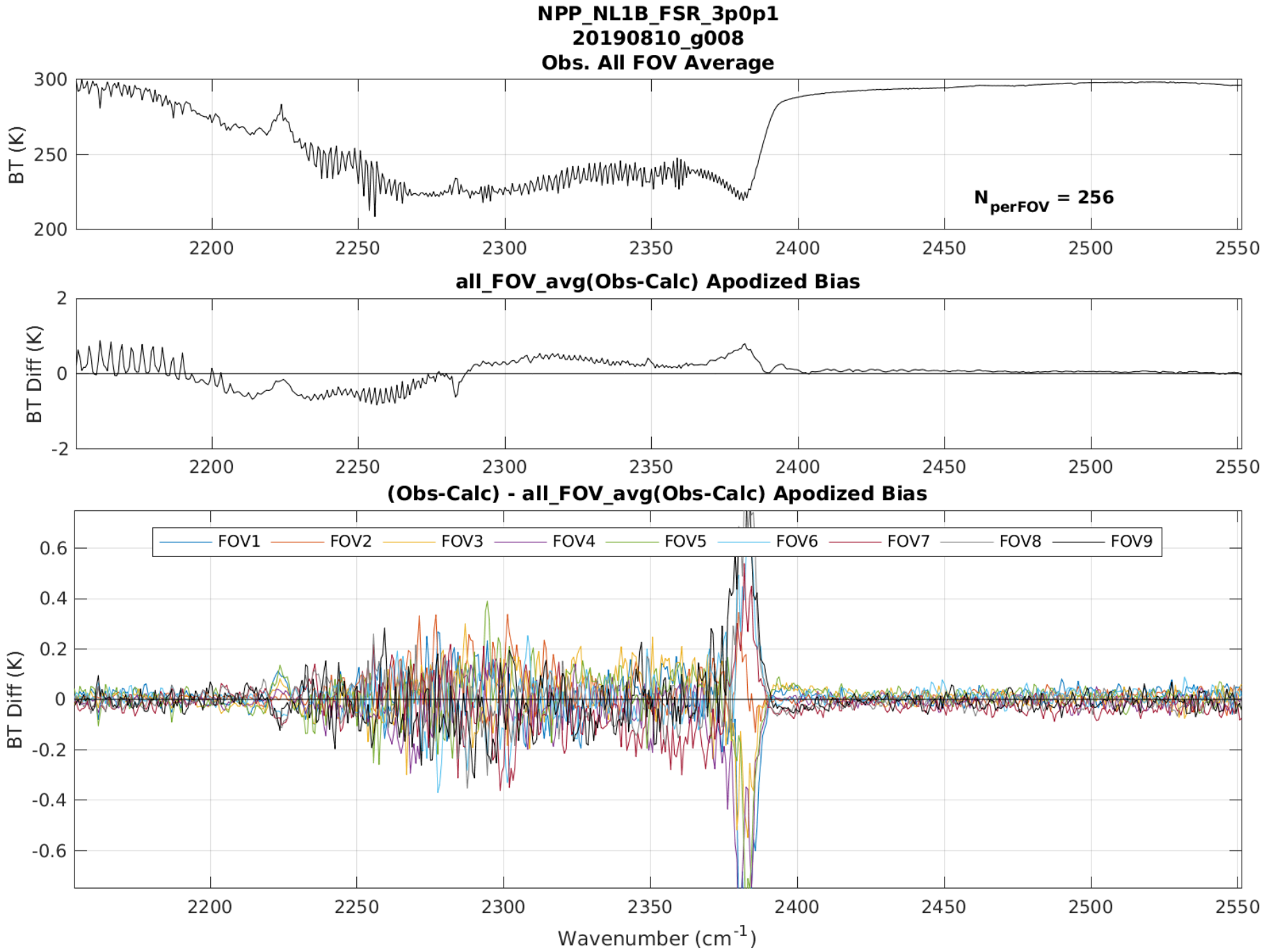

NPP_NL1B_FSR_3p0p1
20190810_g008
Obs Average: LW
BT (K)
300
250
200
650
700
750
800
850
900
950
1000
1050
FOV 5 (N=256)
Corner FOVs
Side FOVs
Obs-Calc Bias: LW
BT (K)
2
0
-2
650
700
750
800
850
900
950
1000
1050
(Obs-hamming[Obs]) - (Calc-hamming[Calc]): LW
BT (K)
0.5
0
-0.5
650
700
750
800
850
900
950
1000
1050
Wavenumber (cm-1)

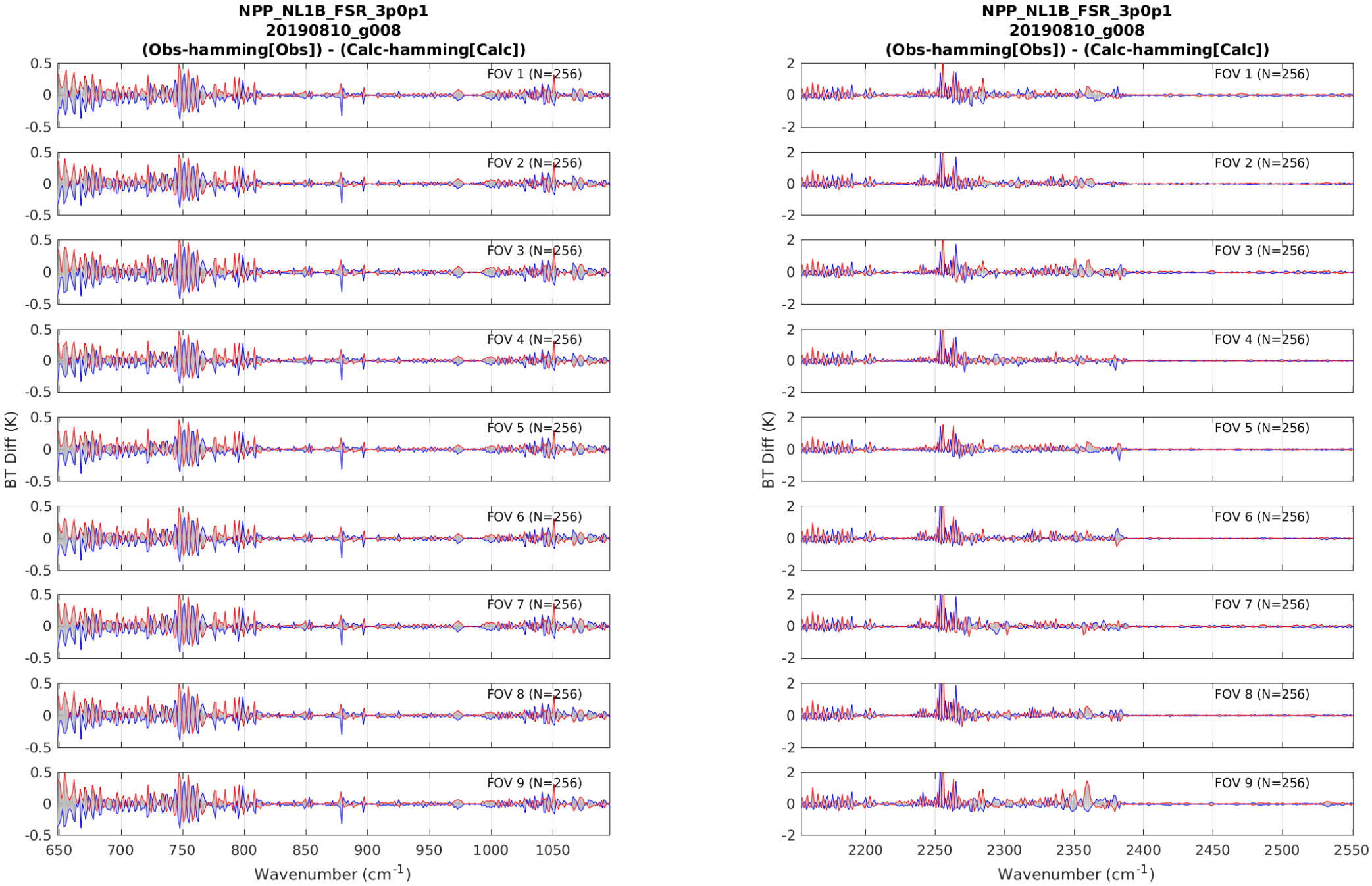

NPP_NL1B_FSR_3p0p1
20190810_g008
Obs Average: SW
BT (K)
300
250
200
2200
2250
2300
2350
2400
2450
2500
2550
FOV 5 (N=256)
Corner FOVs
Side FOVs
Obs-Calc Bias: SW
BT (K)
2
0
-2
(Obs-hamming[Obs]) - (Calc-hamming[Calc]): SW
BT (K)
0.5
0
-0.5
Wavenumber (cm-1)

Difference of All FOV Avg from Individual FOVs



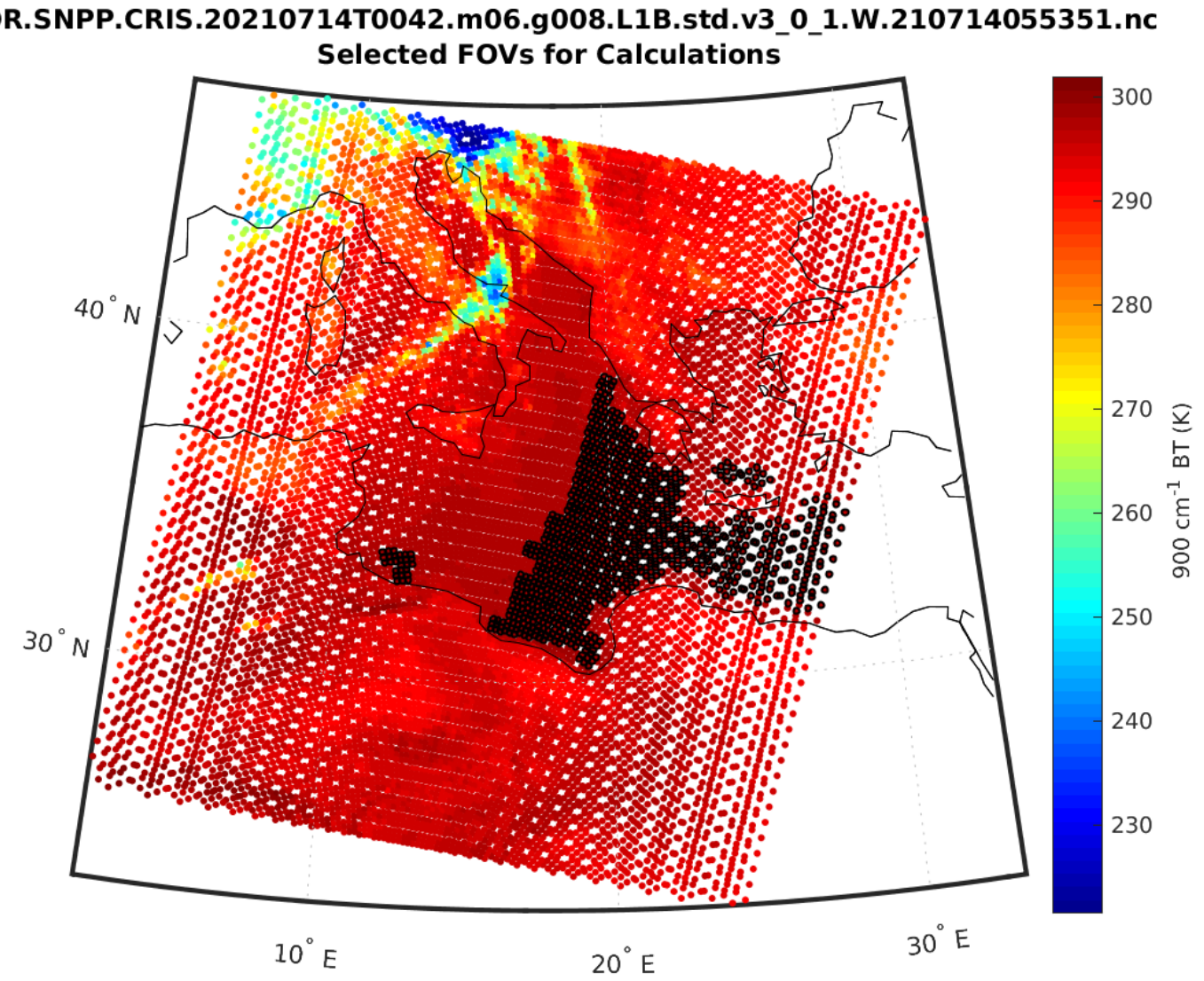
Difference of All FOV Avg from Individual FOVs



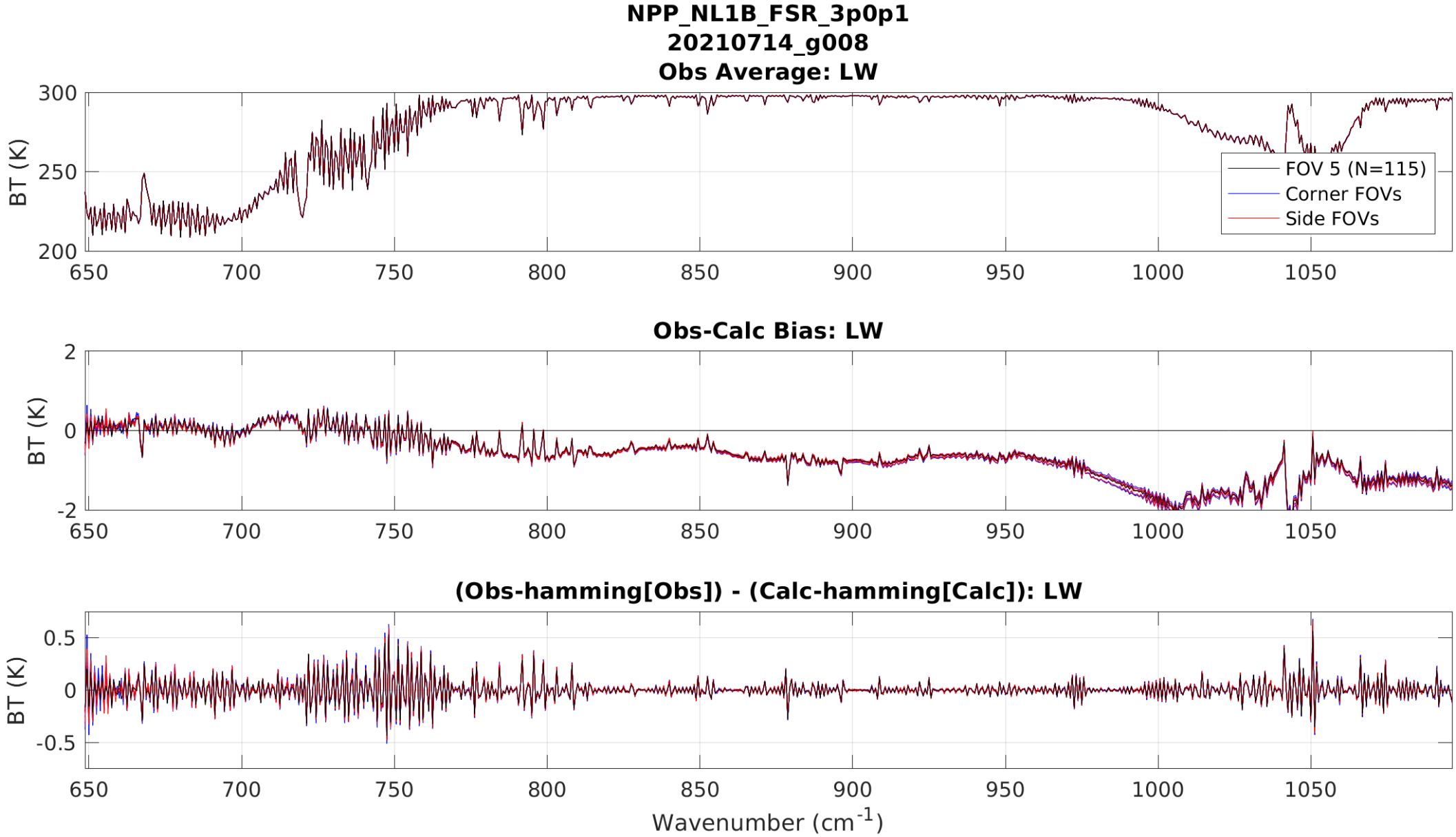


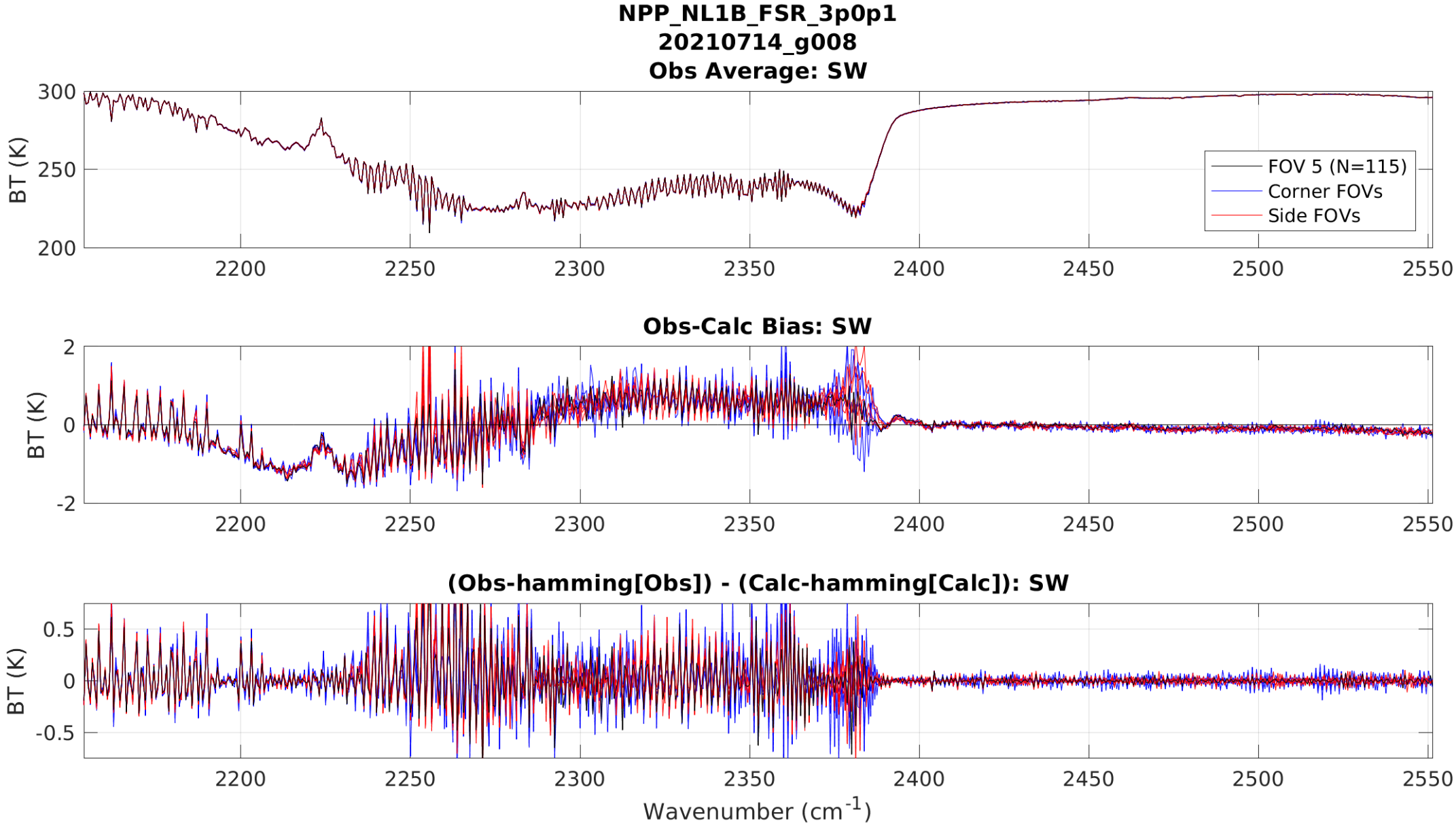
Excessive Spectral Ringing for all 9 FOVs

Post-Side Switch (from Side 2 to Side1)
July 14th, 2021

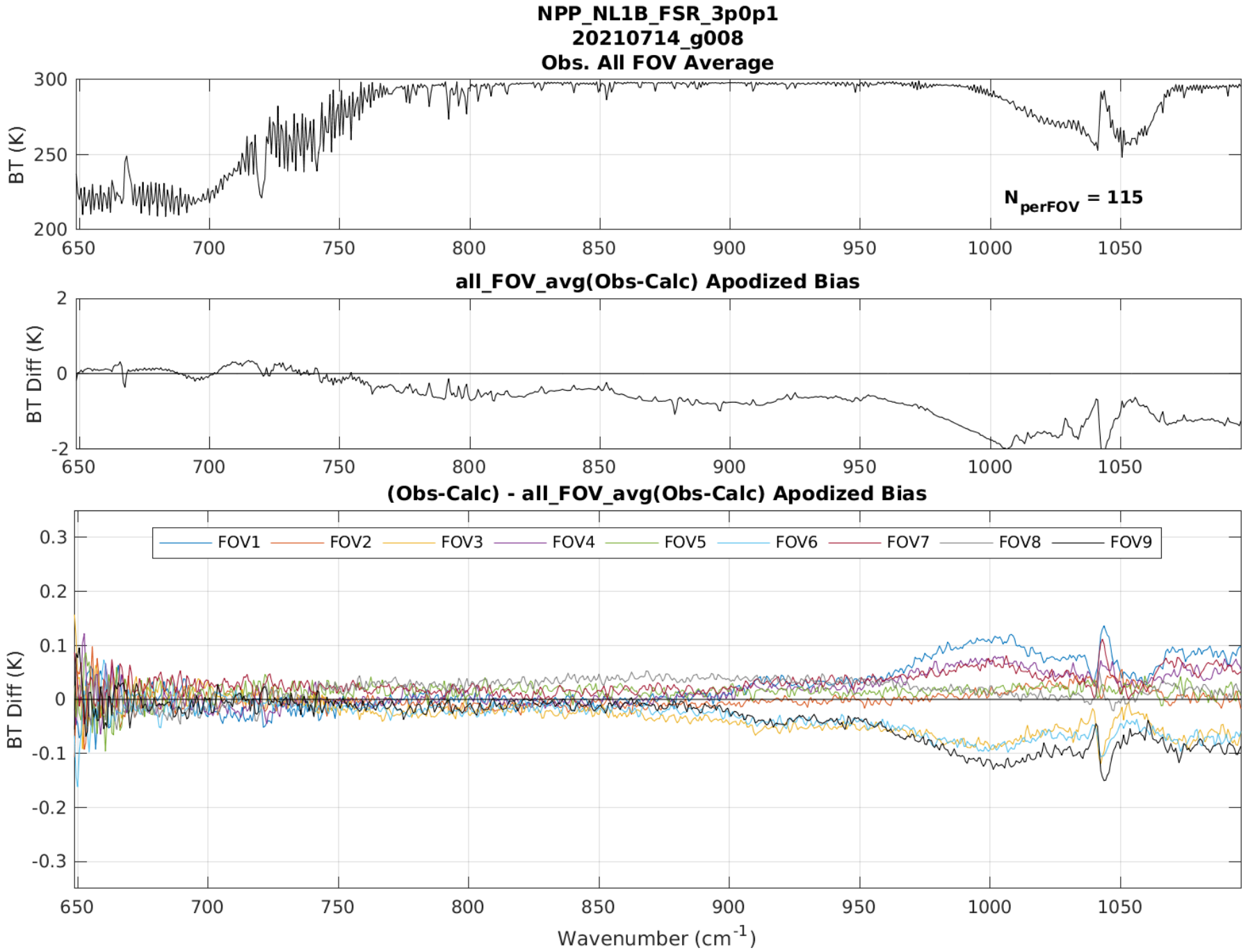


***Note that the FORs used from this granule are offset to one side of nadir!!!!

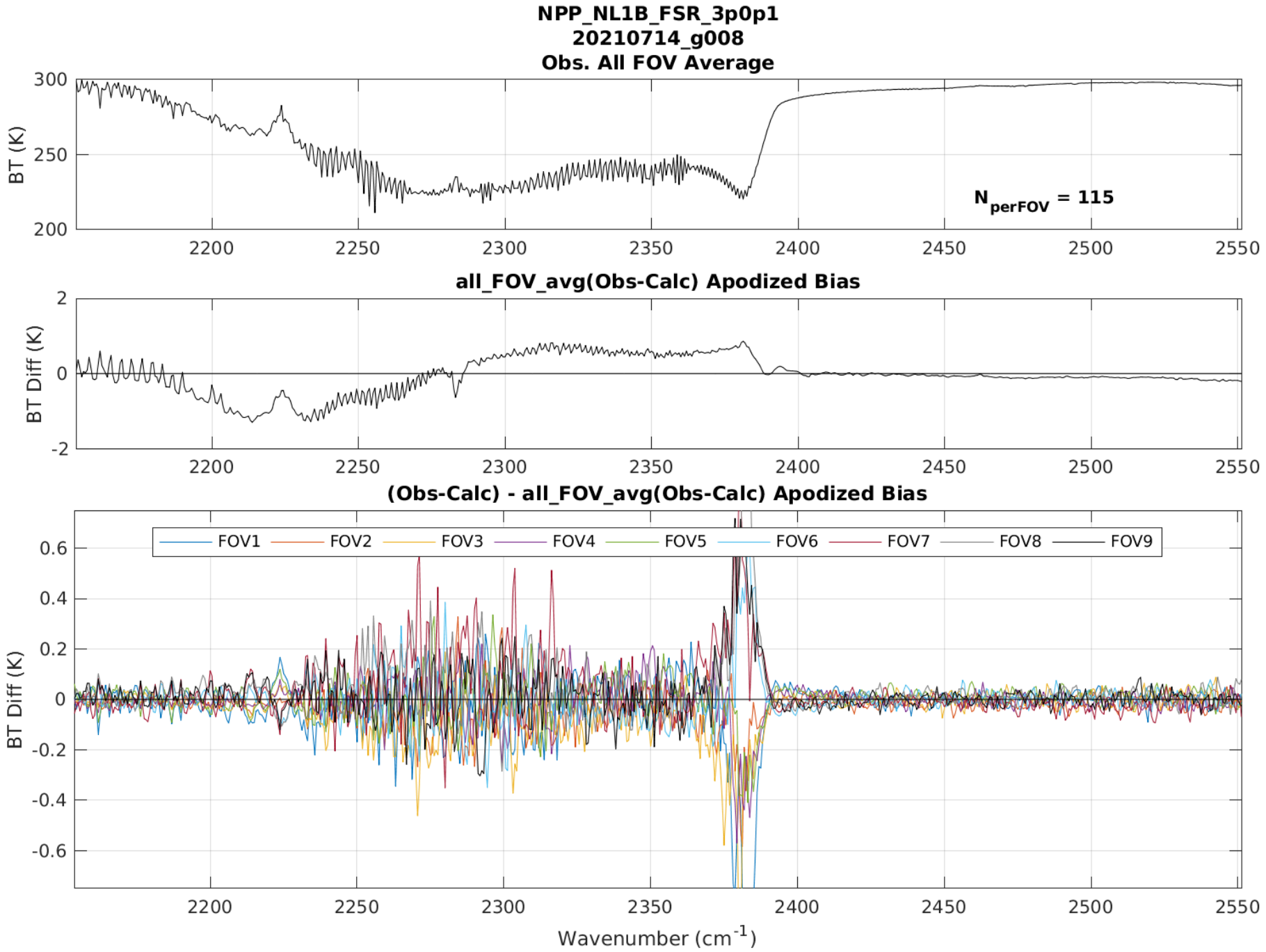

NPP_NL1B_FSR_3p0p1
20210714_g008
Obs Average: LW
BT (K)
300
250
200
650
700
750
800
850
900
950
1000
1050
FOV 5 (N=115)
Corner FOVs
Side FOVs
Obs-Calc Bias: LW
BT (K)
2
0
-2
650
700
750
800
850
900
950
1000
1050
(Obs-hamming[Obs]) - (Calc-hamming[Calc]): LW
BT (K)
0.5
0
-0.5
650
700
750
800
850
900
950
1000
1050
Wavenumber (cm-1)

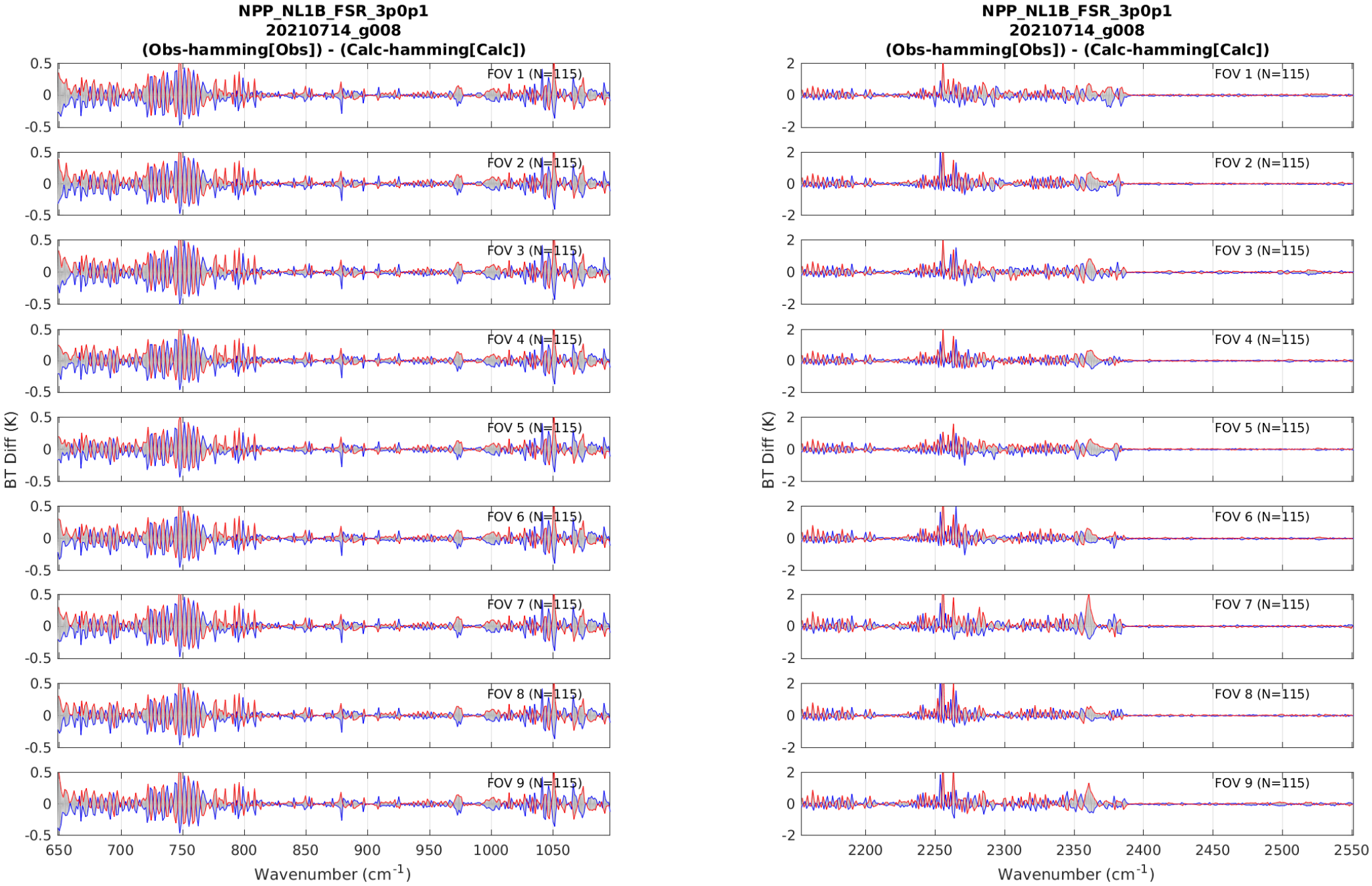

NPP_NL1B_FSR_3p0p1
20210714_g008
Obs Average: SW
BT (K)
300
250
200
2200
2250
2300
2350
2400
2450
2500
2550
FOV 5 (N=115)
Corner FOVs
Side FOVs
Obs-Calc Bias: SW
BT (K)
2
0
-2
(Obs-hamming[Obs]) - (Calc-hamming[Calc]): SW
BT (K)
0.5
0
-0.5
Wavenumber (cm-1)

Difference of All FOV Avg from Individual FOVs



Difference of All FOV Avg from Individual FOVs





Excessive Spectral Ringing for all 9 FOVs

S-NPP (LW/SW) NUCAPS Retrievals 07/21/2021

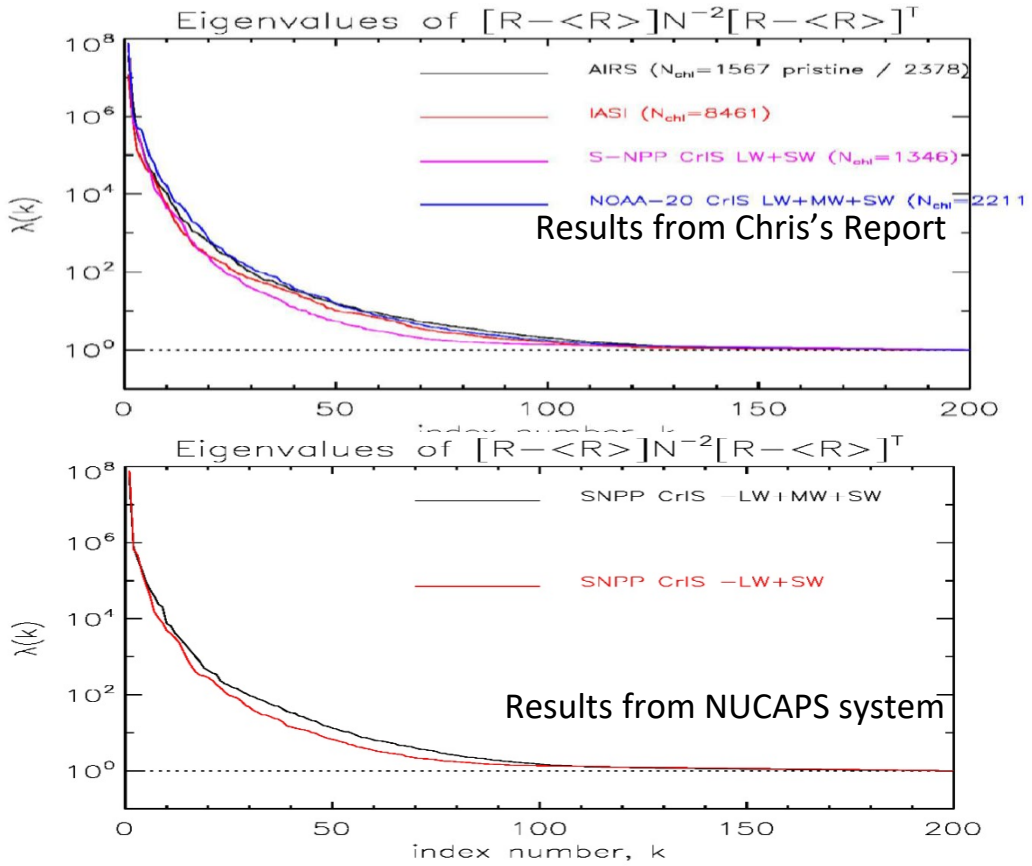
Summary on NUCAPS Team Preparedness for S-NPP LW/SW Switch

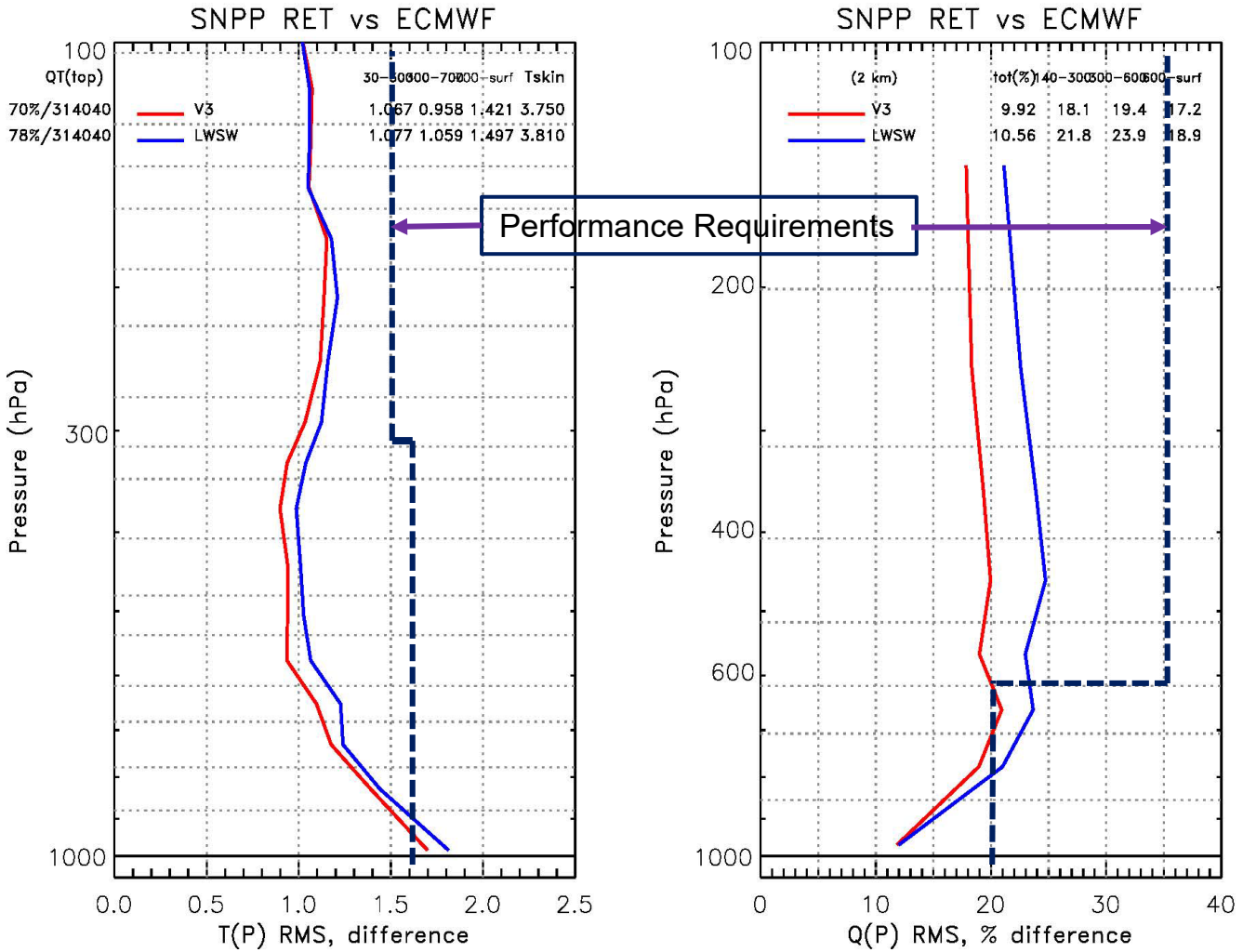
- Developed a prototype S-NPP LW/SW version to demonstrate NUCAPS retrievals
  - Evaluated NUCAPS products from the S-NPP (LW/SW) system for a focus day (07/15/2021) with ECMWF, and also a comparison with NOAA-20 NUCAPS version 3.0 with all CriS bands (LW/MW/SW)
    - Next Slide: RMS Differences (NOAA-20: LW/MW/SW *vs.* ECMWF), (S-NPP:LW/SW *vs.* ECMWF)
    - S-NPP (LW/SW) retrievals show slight degradation of temperature profile product, and noticeable degradation in water vapor profile.
    - CH4 is not retrieved from the S-NPP (LW/SW) system; CO and CO2 trace gases are retrieved but requires product QA/QC verification.
    - Need to ensure code integrity so that the 'products not produced or affected' are properly QC'd in the NUCAPS output product file
- JPSS Program should decide whether to move forward with a DAP for S-NPP (LW/SW) operationalization considering the pros and cons (degradation of product quality)
- NUCAPS team plans to deliver S-NPP (LW/SW) system as part of the J2-Ready NUCAPS DAP after analyzing QC/QA, and any impacts on CO and CO2 products.
- Need to post a caveat into the CLASS S-NPP products and DB products
- Users should recognize that the S-NPP (LW/SW) products may have slight degradation compared to NOAA-20 (LW/MW/SW) products.

NUCAPS V3.0 System for S-NPP LW/SW (Side 1 Switch) - Results

- Updated All-sky and clear regression using LW/SW bands Results verified with Chris Barnet's results (2019)
- Emissivity First Guess replaced with Combined ASTER an MODIS emissivity over Land (CAMEL)
- CH4, SO2 are not retrieved; CO and CO2 are retrieved, but needs to check QC/QA

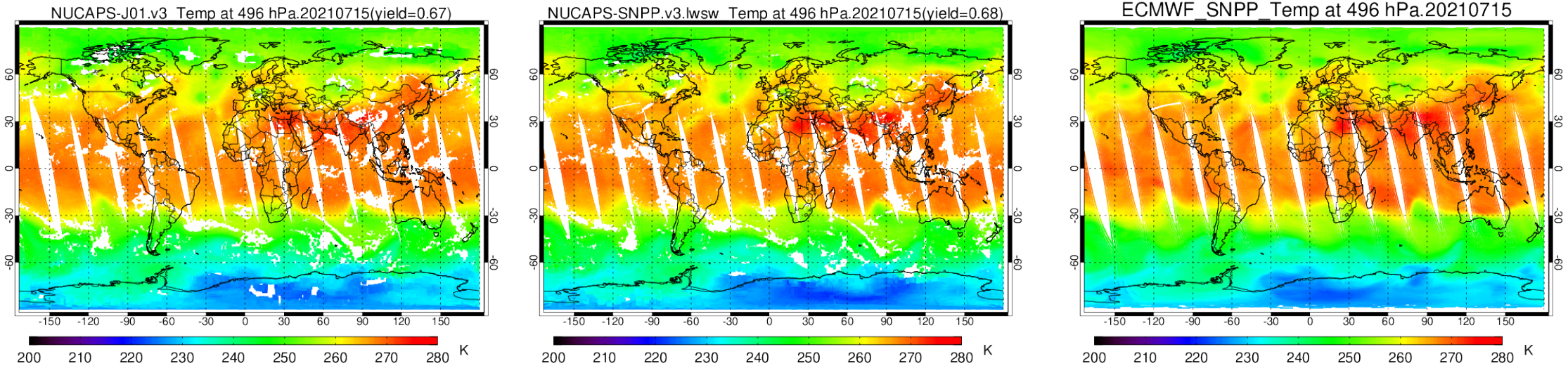
Focus day (20200715) evaluation of
S-NPP NUCAPS LW/SW system (blue curve) with NOAA-20 OPS (LW/MW/SW) (red curve)
RMS Differences with ECMWF for S-NPP (LW/SW) and NOAA-20
Temperature Water Vapor



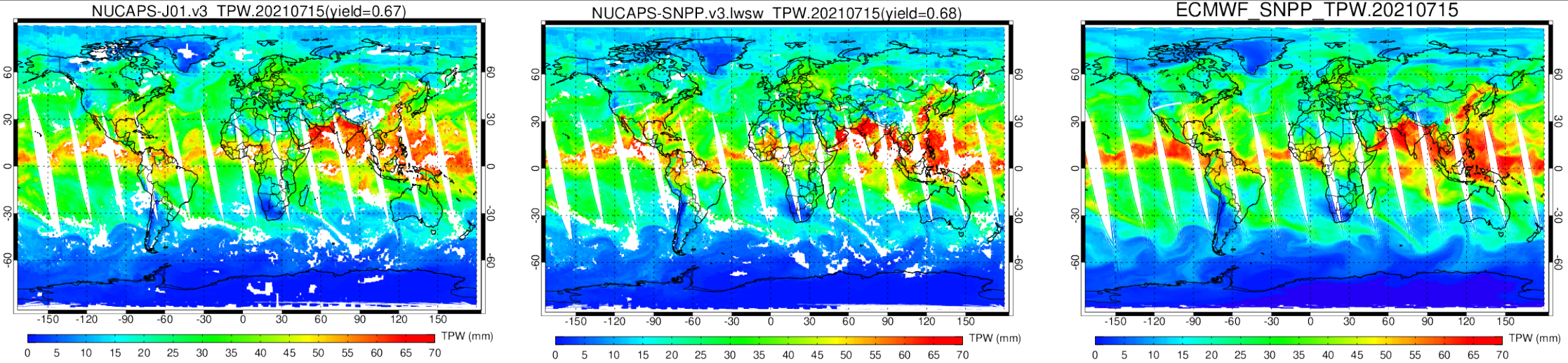


NUCAPS Temperature and Water Vapor Maps for 07/15/2021
NOAA-20 (all bands), S-NPP(LW/SW), ECMWF

NOAA-20 Temperature @500 hPa	S-NPP (LW/SW) Temperature@500 hPa	ECMWF Temperature@500 hPa



NOAA-20 Total Precipitable Water	S-NPP (LW/SW) Total Precipitable Water	ECMWF Total Precipitable Water



Backup Slides

NUCAPS JPSS (NOAA-20, S-NPP) products use by PGRR & Direct Broadcast users

- Cold air aloft to know T(p) at flight altitudes: No significant impact.
- Wildfire and air quality applications – CO product: Possible minor impact, NUCAPS team need to verify QC/QA
- Severe weather forecasting at WFO: Significant water vapor degradation
  - WFOs and Direct Broadcast users use AWIPS AVTP and AVMP products for stability and CAPE parameters, mid-troposphere water vapor, and derived total precipitable water.
  - Water vapor retrieval degradation is significant and downstream users can easily notice the degradation
  - NOAA-20 products are in AWIPS and S-NPP products are not part of AWIPS, but DB users may be using both NOAA-20 and S-NPP products.