Beta Maturity Science Review For NOAA-21 Visible Infrared Imaging Radiometer Suite (VIIRS) Sensor Data Record (SDR)

Presented by VIIRS SDR Team
Date: 2/23/2023

JPSS/GOES-R Data Product Validation Maturity Stages - COMMON DEFINITIONS (Nominal Mission)

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.

Maturity Review - Entry Criteria

- Product Requirements
- Pre-launch Performance Matrix/Waivers
- Beta Maturity Performance Validation
  - On-orbit instrument performance assessment
    - instrument and product characteristics verified/validated
    - pre-launch concerns/waivers, mitigation and evaluation attempts with on-orbit data
- Users/Downstream-Products feedback
- Risks, Actions, Mitigations
  - Potential issues, concerns
- Path forward (to the Provisional maturity stage)
- Summary

Maturity Review - Exit Criteria

- Beta Maturity Performance is well characterized and meets/exceeds the requirements:
  - On-orbit instrument performance assessment
    - Provide summary for each identified instrument and product characteristic you have validated/verified as part of the entry criteria
    - Provide summary of pre-launch concerns/waivers mitigations/evaluation and address whether any of them are still a concern that raises any risk.
- Updated Maturity Review Slide Package addressing review committee's comments for:
  - Calibration/Validation (Cal/Val) Plan and Schedules
  - Product Requirements
  - Beta Maturity Performance
  - Risks, Actions, Mitigations
  - Path forward (to the Provisional maturity stage)

NOAA-21 Visible Infrared Imaging Radiometer Suite (VIIRS) Sensor Data Record (SDR)

BETA MATURITY REVIEW

Outline

- Algorithm Cal/Val Team Members
- Product Overview and Requirements
- Evaluation of instrument/algorithm performance to specification requirements
  - Instrument performance
  - Algorithm version, processing environment
  - Evaluation of the effect of required algorithm inputs
  - Quality flag analysis/validation
  - Error Budget
- User Feedback
- Downstream Product Feedback
- Risks, Actions, and Mitigations
- Documentation (Science Maturity Check List)
- Conclusion
- Path Forward

JPSS VIIRS Cal/Val Team

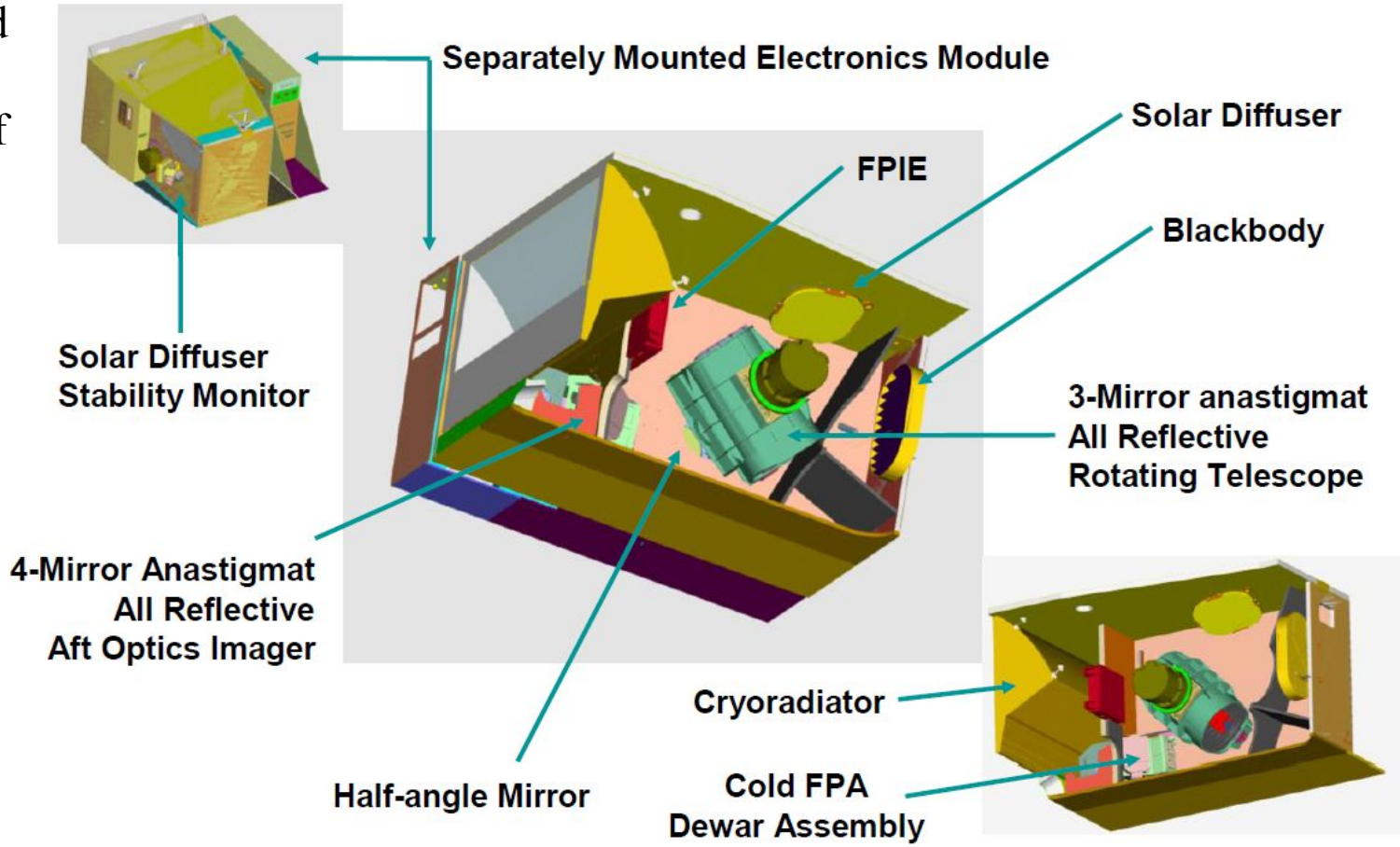
Name	Organization	Major Task
Changyong Cao	NOAA/STAR	NOAA STAR VIIRS Cal/Val Team Lead
Slawomir Blonski	GST, Inc. @ NOAA/STAR	Instrument science; POC for operations; STAR VIIRS Cal/Val Team
Wenhui Wang	UMD/CISESS @ NOAA/STAR	TEB cal/val/CPM; STAR VIIRS Cal/Val Team
Xi (Sean) Shao	UMD/CISESS @ NOAA/STAR	DNB/lunar cal/orbits; STAR VIIRS Cal/Val Team
Taeyoung (Jason) Choi	GST, Inc. @ NOAA/STAR	Solar/lunar cal; STAR VIIRS Cal/Val Team
Bin Zhang	UMD/CISESS @ NOAA/STAR	NOAA STAR VIIRS Cal/Val Team
Yan Bai	UMD/CISESS @ NOAA/STAR	Image quality/Envi/web; STAR VIIRS Cal/Val Team
Khalil Ahmad	GST, Inc. @ NOAA/STAR	Data analysis/Image quality/reprocessing; VIIRS Cal/Val Team
Priya Pillai	GST, Inc. @ NOAA/STAR	Cloud/RTM/data quality; STAR VIIRS Cal/Val Team
Tom Liu	UMD/CISESS @ NOAA/STAR	Data analysis/anomaly; STAR VIIRS Cal/Val Team
Dave Moyer & Team	Aerospace	Postlaunch to prelaunch traceability
Jack Xiong/R. Wolfe & team	NASA	NASA VIIRS Characterization Support Team
Chris Moeller & team	CIMSS	VIIRS RSR development, TEB validation, RTM, User interaction

NOAA-21 VIIRS Instrument

- VIIRS is a scanning imaging radiometer onboard Suomi NPP and JPSS satellites that produces global imagery and radiometric measurements of land, atmosphere, cryosphere, and oceans in the visible and infrared bands with moderate spatial resolutions at 22 spectral bands;

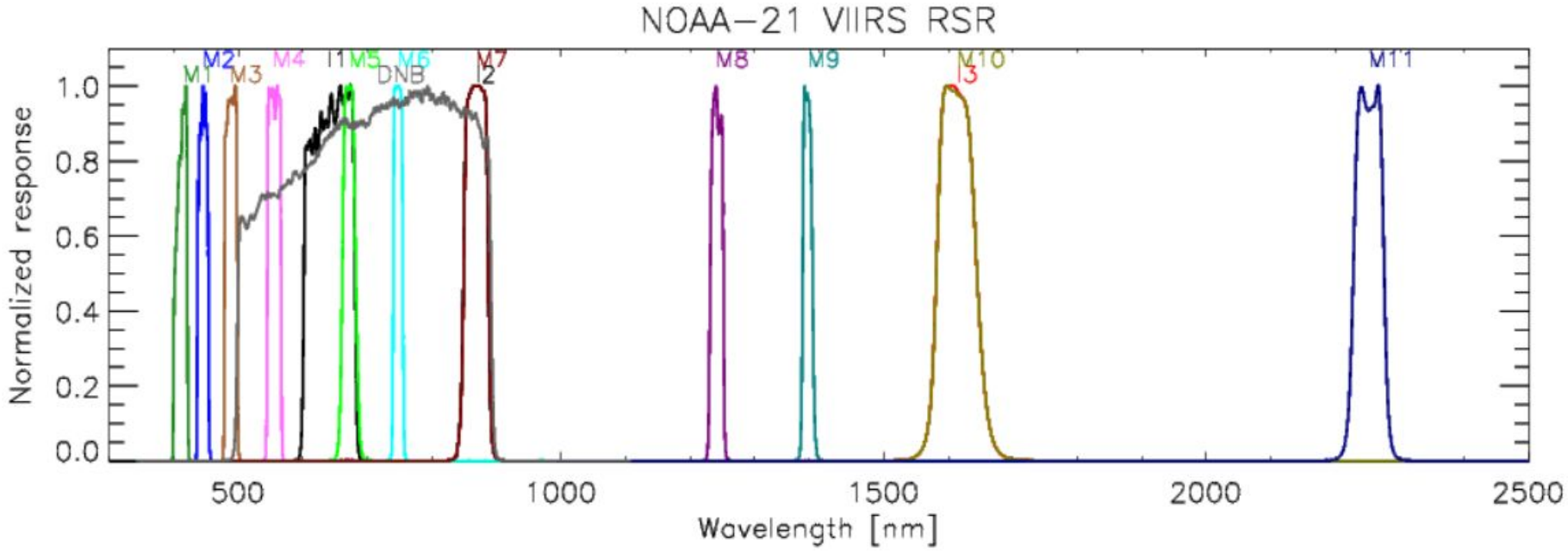
- The operationally produced VIIRS data are widely used globally to monitor hurricanes/typhoons, cloud and aerosol properties, ocean color, sea and land surface temperature, ice motion and temperature, active fires, and Earth's albedo.

- The VIIRS data support the operational production of at least 26 Environmental Data Records(EDRs);



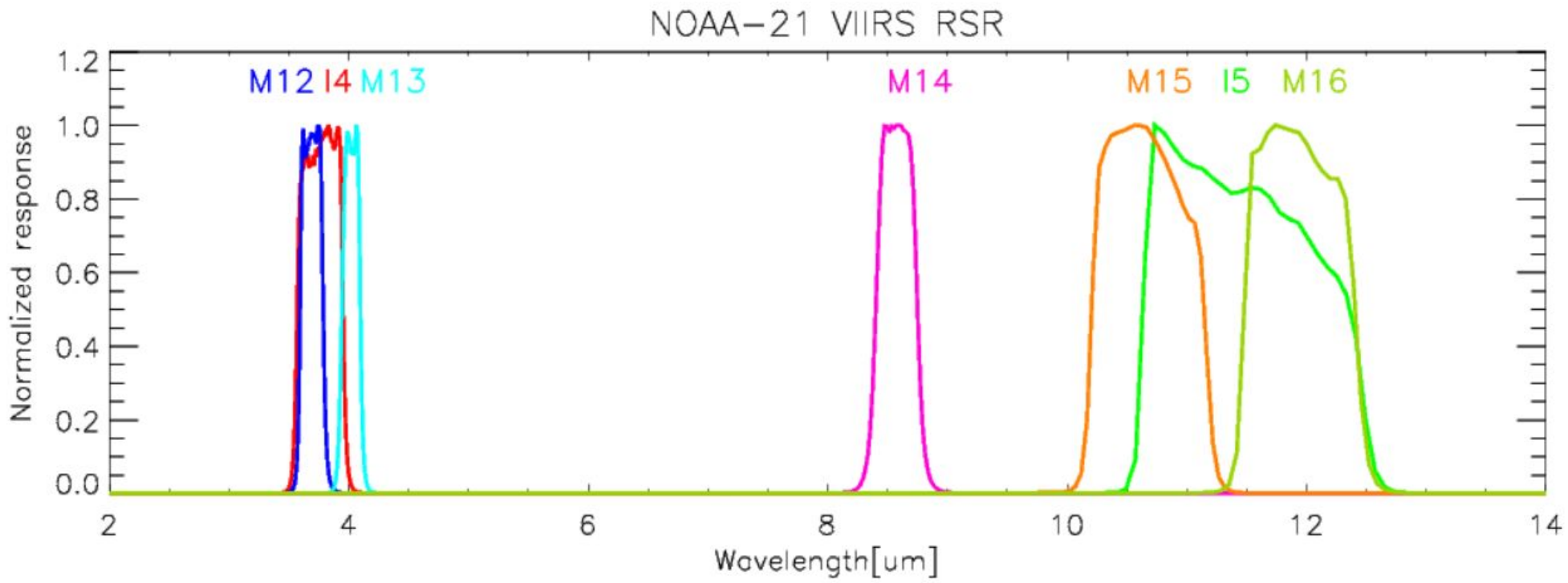
VIIRS Spectral Bands: Reflective Solar Bands (RSB)/ Day/Night Band (DNB)

- Spectral Bands of VIIRS RSBs and DNB
  - RSBs cover a spectral range from 0.412 μm to 2.25 μm
  - There are 14 RSBs with 3 image bands (I1-I3) and 11 moderate bands (M1-M11)
  - RSB band calibration is dependent on Solar Diffuser (SD) and Solar Diffuser Stability Monitor (SDSM) observations
  - The required RSB calibration uncertainty is within 2%
  - DNB is a panchromatic band with spectral range 0.5μm - 0.9 μm



VIIRS Spectral Bands: Thermal Emissive Bands (TEB)

- Spectral Responses of VIIRS TEBs
  - There are 7 bands with 2 image band (I4, I5) and 5 moderate bands (M12-M16)
  - Calibration sources are Onboard Blackbody (BB) with six thermistors and space view



VIIRS Sensor Data Record (SDR) Requirements

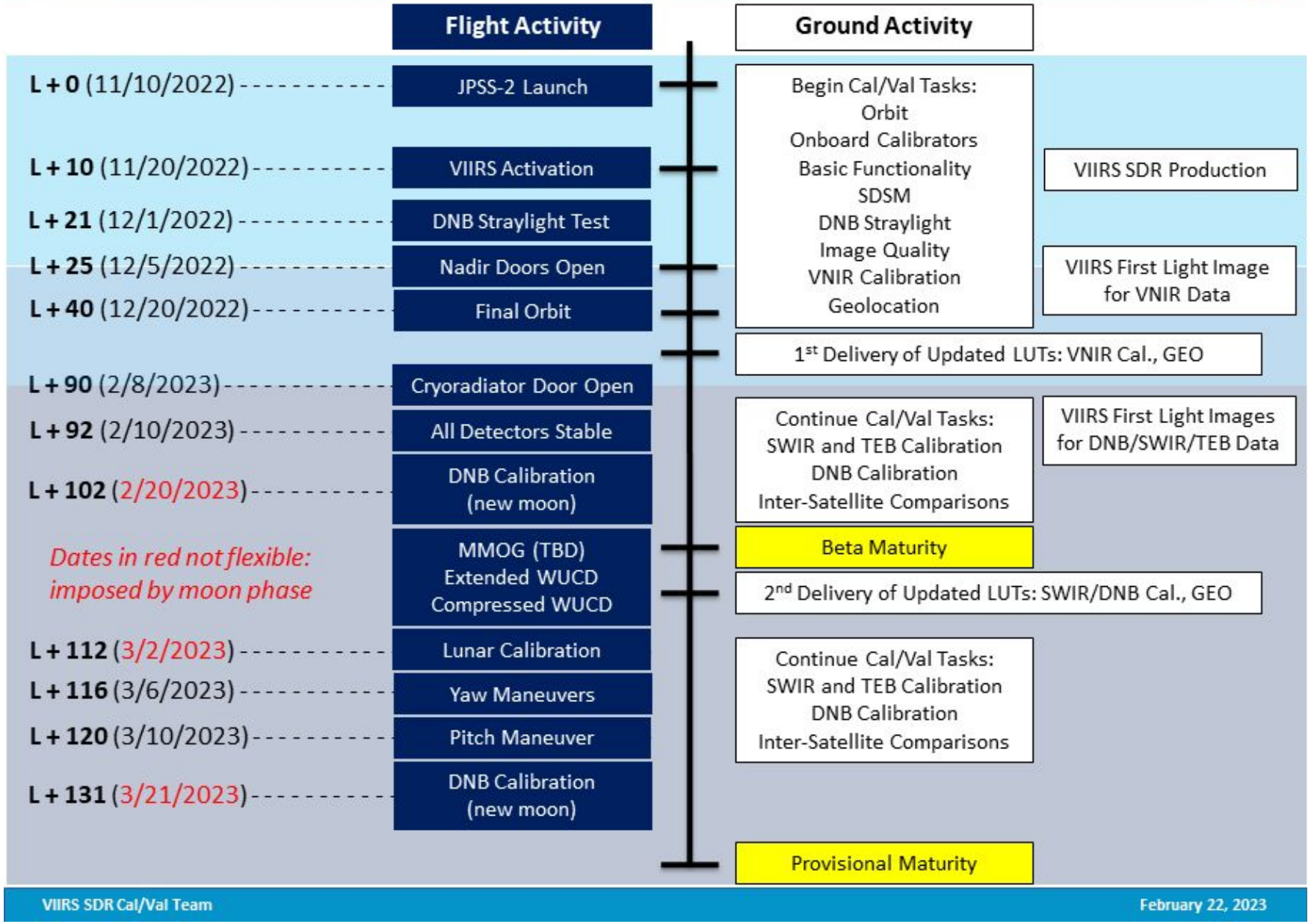
Band		Center Wavelength (nm)	Maximum FOV @ Nadir (km)	Maximum FOV @ Edge-of-Scan (km)	Ltyp or Ttyp (spec)	Specification SNR (RSB & DNB) NEDT (TEB)	Accuracy Specification
RSB	M1	412	0.8	1.6	155, 44.9 (LG, HG)	316, 352 (LG,HG)	2%
	M2	445	0.8	1.6	146, 40 (LG, HG)	409, 380 (LG,HG)	2%
	M3	488	0.8	1.6	123, 32 (LG, HG)	414, 416 (LG,HG)	2%
	M4	555	0.8	1.6	90, 21 (LG, HG)	315, 362 (LG,HG)	2%
	M5	672	0.8	1.6	68, 10 (LG, HG)	360, 242 (LG,HG)	2%
	M6	746	0.8	1.6	9.6	199	2%
	M7	865	0.8	1.6	33.4, 6.4(LG, HG)	340, 215 (LG,HG)	2%
	M8	1240	0.8	1.6	5.4	74	2%
	M9	1378	0.8	1.6	6	83	2%
	M10	1610	0.8	1.6	7.3	342	2%
	M11	2250	0.8	1.6	1.0	90	2%
	I1	640	0.4	0.8	22	119	2%
	I2	865	0.4	0.8	25	150	2%
	I3	1610	0.4	0.8	7.3	6	2%
TEB	M12	3700	0.8	1.6	270	0.396	0.7% (0.13 K)
	M13	4050	0.8	1.6	380, 300 (LG, HG)	0.107, 0.423 (LG, HG)	0.7% (0.13 K)
	M14	8550	0.8	1.6	270	0.091	0.6% (0.26 K)
	M15	10763	0.8	1.6	300	0.07	0.4% (0.22 K)
	M16	12013	0.8	1.6	300	0.072	0.4% (0.24 K)
	I4	3740	0.4	0.8	270	2.5	5% (0.97 K)
	I5	11450	0.4	0.8	210	1.5	2.5% (1.5 K)
DNB	DNB	700	0.8	0.8	$3x10^{-9}$ (w/cm^2-sr)) (HG)	6	5%, 10%,30% (LG,MG,HG)

Processing Environment and Algorithms

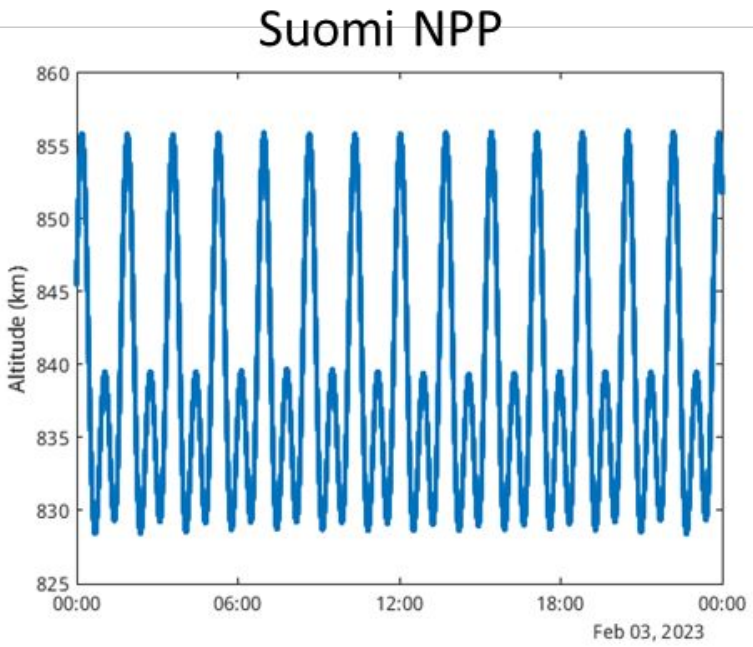
- Description of processing environment and algorithms used to achieve the beta maturity stage:

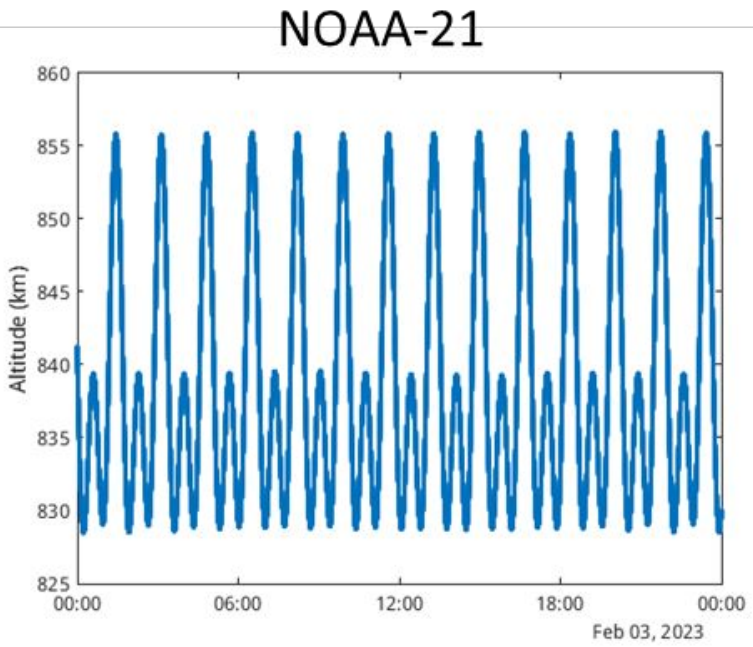
	Description	Effective Date
Algorithm version	IDPS Block 2.3 Release Mx 7	July 18, 2022
Version of LUTs	VIIRS LUT Updates from ADR 8821-8823, 10038	Aug.-Sep. 2022
Updated LUTS	4 LUTs (RSB F factor, geolocation)	January 12, 2023

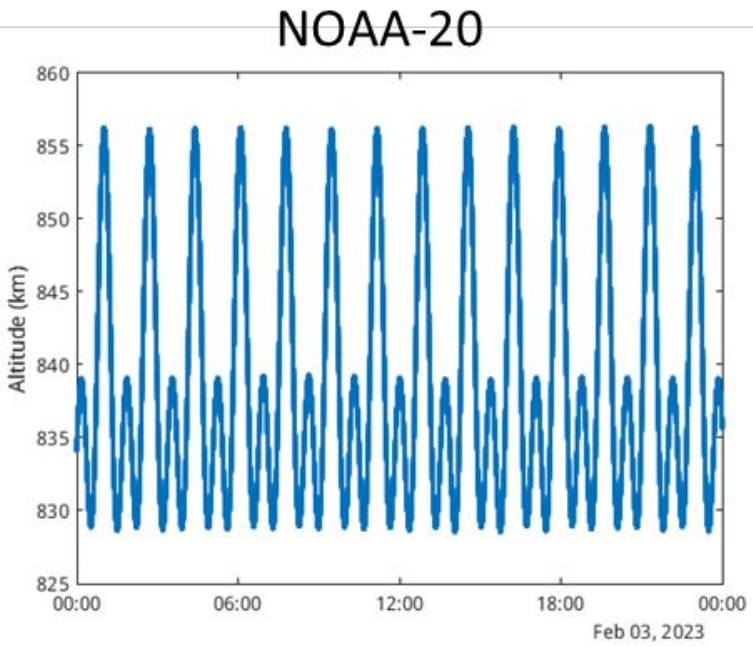
Post-Launch NOAA-21 VIIRS SDR Cal/Val Timeline

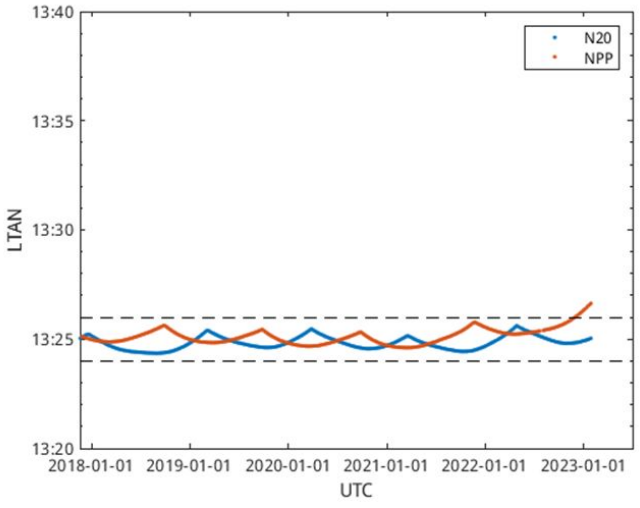


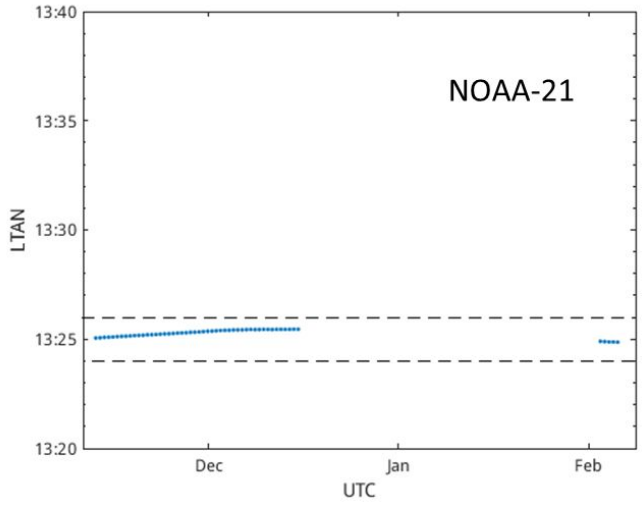
Spacecraft Altitude and Orbit Inclination







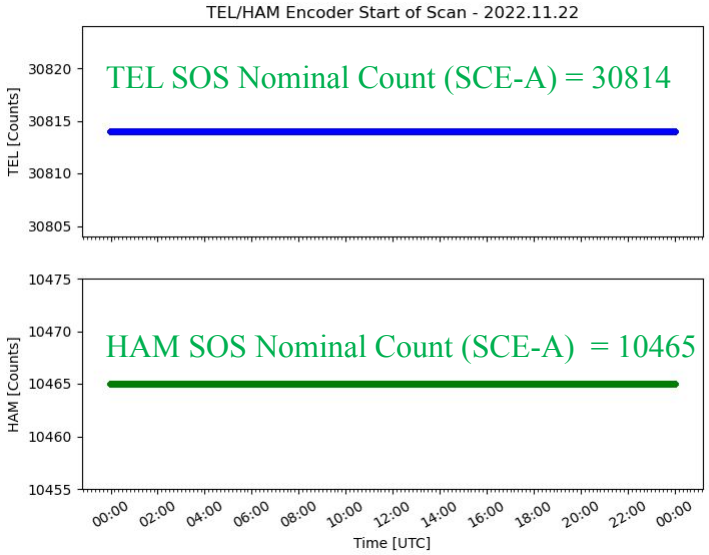




- Altitude consistent among the JPSS spacecraft, with the expected orbit phasing (after completion of the NOAA-21 “orbit raising” on December 20, 2022)
- LTAN (Local Time of Ascending Node, i.e., northbound equator crossing) remains in the expected range of 1 minute from the 13:25 (1:25 PM) goal

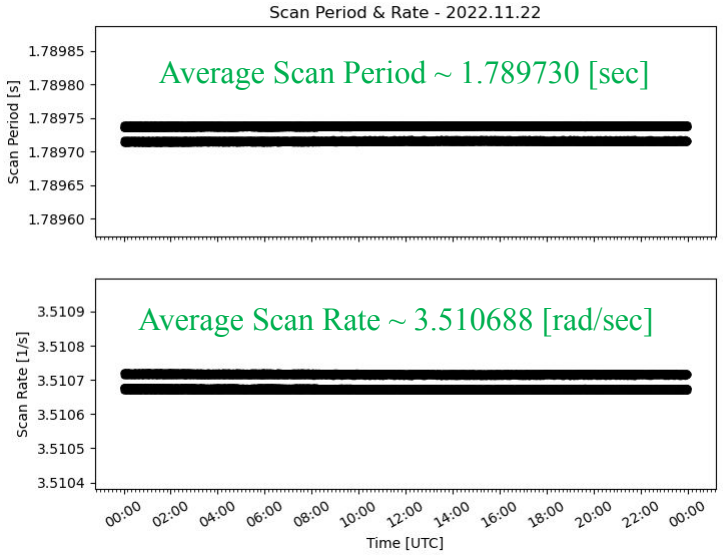
Earth Scan Monitoring

TEL/HAM Encoder Start Values



The TEL and HAM encoder start-of-scan (SOS) values are stable and in agreement with Scan Control Electronics Side-A (SCE-A) pre-launch nominal values

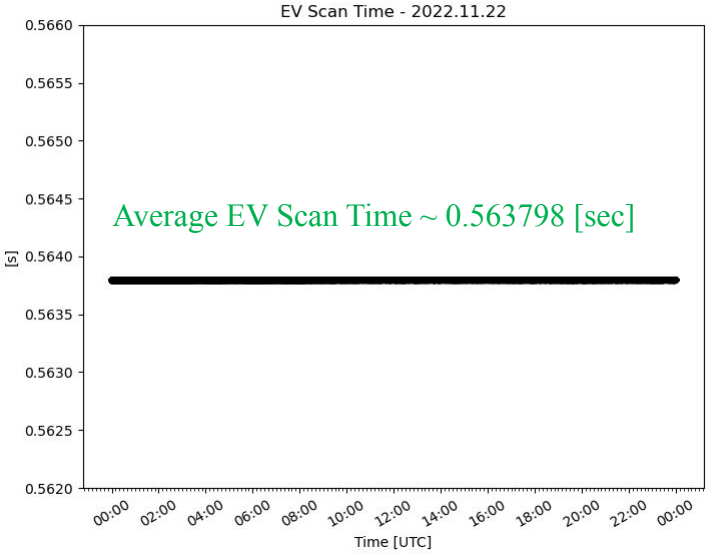
Scan Period / Scan Rate



Scan Period = time difference between two consecutive SOS timestamps

Scan Rate = 2π / Scan Period

Earth View (EV) Scan Time



EV Scan Time = Time difference between EV end-of-scan (EOS) and start-of-scan (SOS) timestamps

VIIRS scan parameters are stable and consistent with pre-launch values

VIIRS Post-launch Cal/Val Tasks

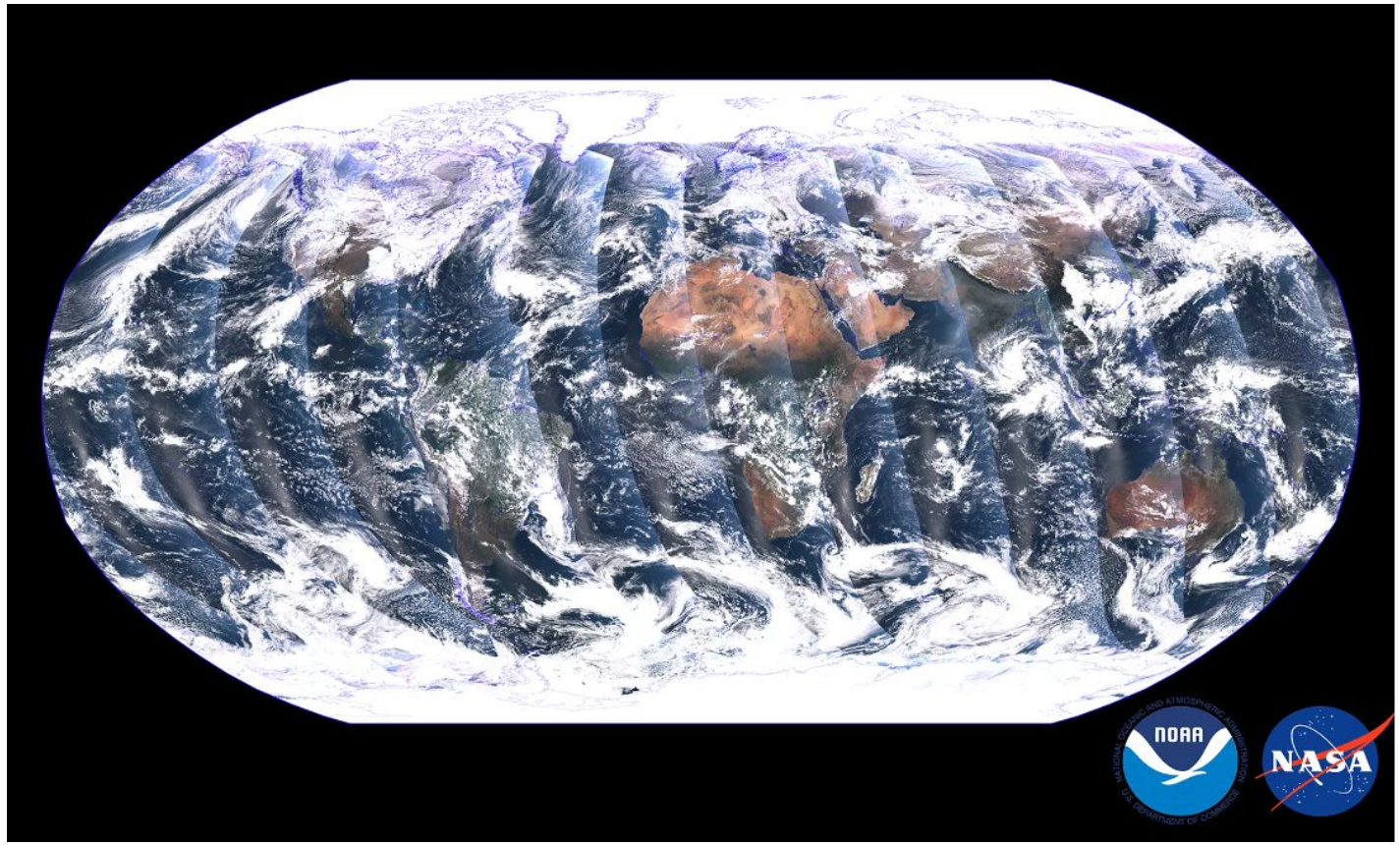
Successfully performed PLTs are highlighted

Task ID	Title
	Tasks Started after Instrument Activation
GEO-1	Initial Validation of Spacecraft Ephemeris and Attitude Data
GEO-2	Initial Validation of VIIRS Encoder Data, Scan Time, Scan Period, and Scan Rate Stability
FPF-2	Detector Operability and Noise Verification with Nadir Door Closed: RSB VNIR, DNB
FPF-6	DC-Restore Functionality and Performance Check
FPF-7	Calibrator Visual Inspection
PLT-X	DNB Straylight with Nadir Doors Closed (no sector rotation)
CSE-1	SD and SDSM Characterization
CSE-2	Onboard Calibrator Black Body (OBCBB) Temperature Uniformity
CSE-4	Temporal Analysis of SD Signal over Polar Region
CSE-5	Temporal Analysis of Solar Diffuser Stability Monitor (SDSM) Data
PTT-1	Operability, Noise, SNR Verification
PTT-6	Telemetry Trending Monitoring
PTT-10	RSBAutoCal Calibration Object Trending, Evaluation & LUT Updates
	Tasks Started after Nadir Doors Open
IMG-1	Crosstalk, Echo, and Ghost Investigation
IMG-2	Image Analysis (Striping, Glints and Other Artifacts)
RAD-7	SDR Comparison with S-NPP & N20 VIIRS
RAD-8	SDR Comparison with MODIS
GEO-3	Assess Reasonableness of First-Period SDR Geolocation
GEO-4 to 7	Analyze First-Period VIIRS GCP Residuals
GEO-9	Develop and Test Initial Geolocation LUT Updates
PTT-2	RDR Histogram Analysis

	Tasks Starting after Cryo-radiator Door Open
IMG-3	Moon Echo and Ghost Check
CSE-6	Yaw Maneuver Analysis
RAD-4	Response vs. Scan Angle (RVS)
RAD-9	RSB Radiance/Reflectance Validation – Radiometric Sites
RAD-11	In-Band Spectral Radiance Comparison with CrIS
RAD-14	Emissive Band Response Characterization (WUCD)
RAD-15	Moon in Space View Correction
RAD-18	Lunar Data Analysis - Roll Maneuver
RAD-19	Analysis of Pitch Maneuver Data
RAD-20	SDR Reprocessing and Updates
RAD-24a	Offline F/H Factor Analysis, Prediction and Validation Tool
RAD-24b	Offline TEB F-Factor Monitoring
PTT-4	DNB Offset and Gain Ratios Determination
PTT-7	Update Uploadable Tables ID5, ID33-35: DNB Offsets
WAV-4	DNB straylight assessment and correction LUT development
WAV-5	DNB radiometric/geolocation monitoring using point sources
WAV-6	VIIRS saturation monitoring

GEO Geolocation/Geometric Evaluation
FPF Function Performance and Format Evaluation
CSE Calibration System Evaluation
PTT Performance and Telemetry Trending
IMG Image Quality Evaluation
RAD Radiometric Evaluation

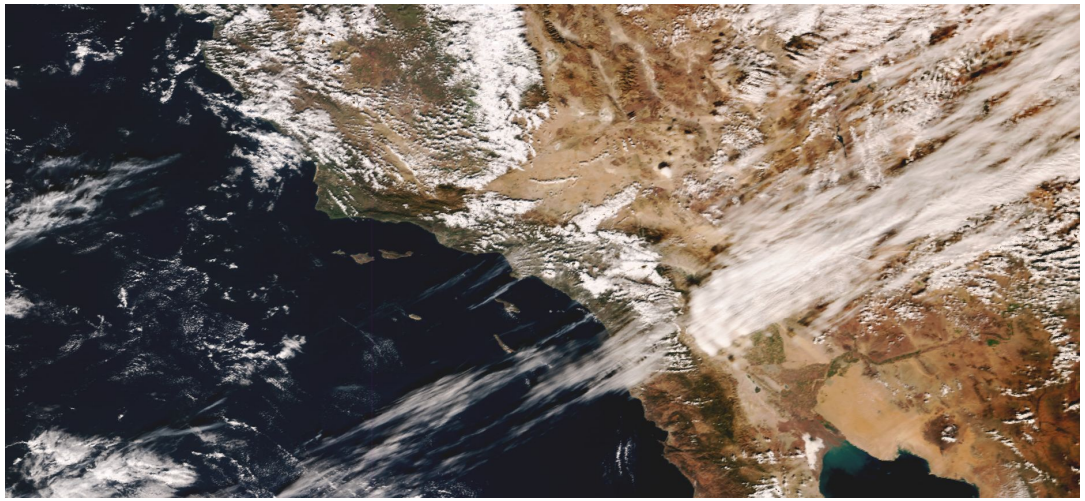
NOAA-21 VIIRS First Light Images: VIS/NIR Bands



Bands M5, M4, M3 shown as RGB

High resolution version (120MB) available at:
https://ncc.nesdis.noaa.gov/NOAA-21/N21FirstVIIRSGlobalTrueColor.png

- Earth observations from NOAA-21 VIIRS started on December 5, 2022 with the first granule acquired at 17:33 UTC
- NOAA-21 VIIRS first light true color global image from Dec. 5 and Dec. 6, 2022 prepared by STAR VIIRS SDR team and was selected in the NOAA/NESDIS public release

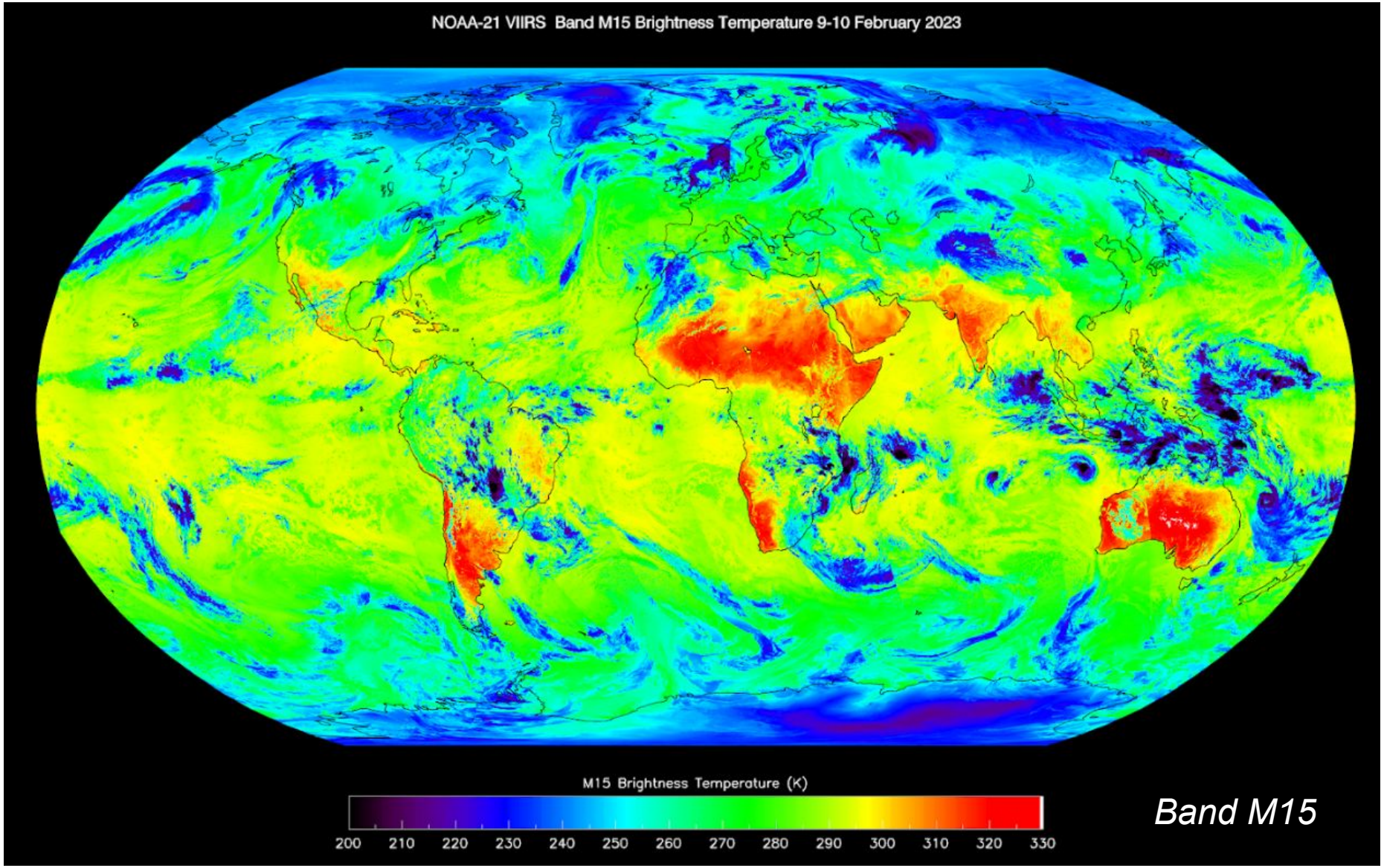


https://ncc.nesdis.noaa.gov/Regional/

First Light Images: TEB

- NOAA-21 VIIRS S/MWIR and LWIR bands CFPA (I3 to I5 and M8 to M16) reached operating temperature (82K) around 18:45 UTC on Feb. 10, 2023

- All thermal bands are working nominally



First Light Images: DNB

- NOAA-21 VIIRS DNB images have been produced since February 9, 2023; DNB detectors reached operating temperature around 14:00 UTC on February 9, 2023.

- No major artifacts observed on global image but requires further evaluation during new moon on 2/20.

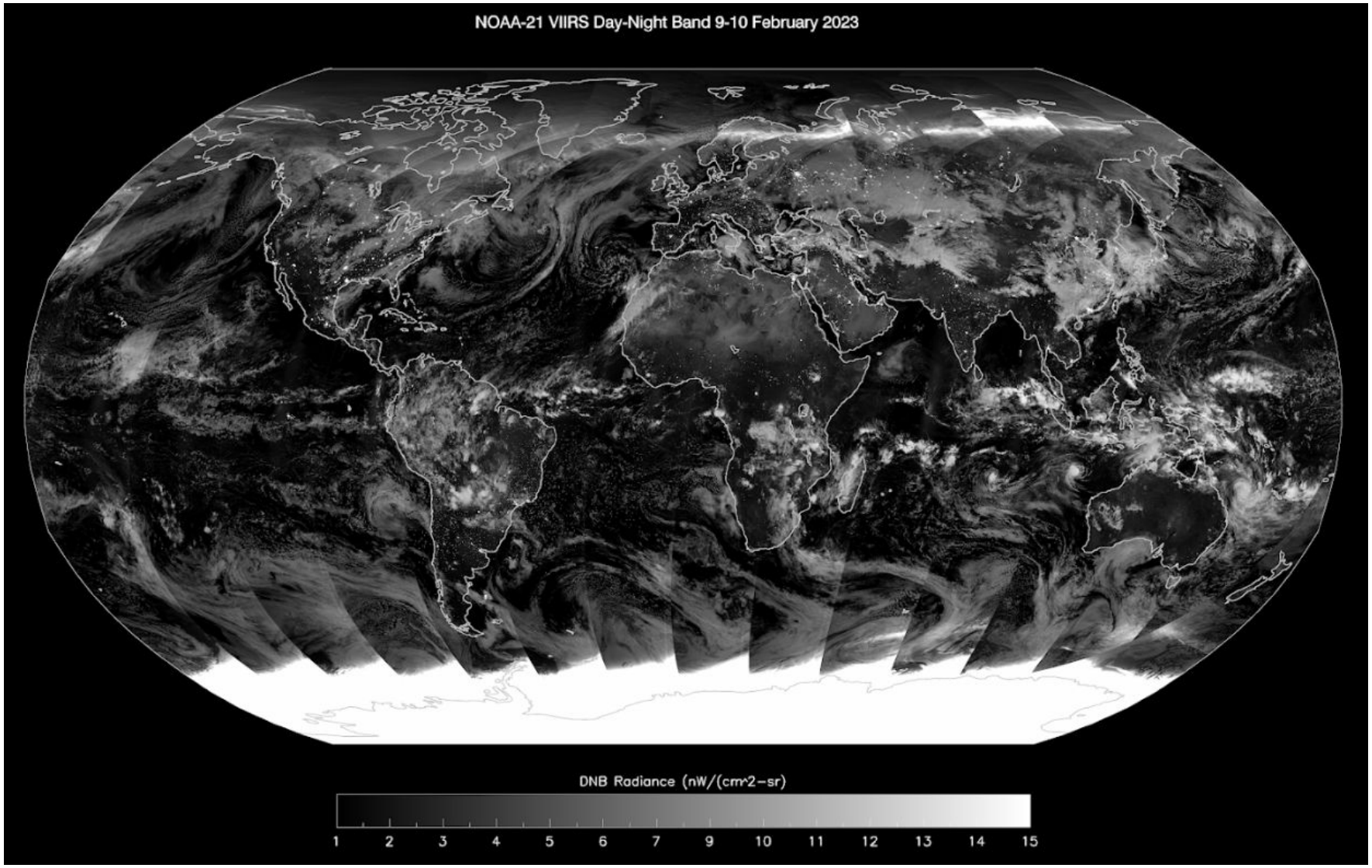
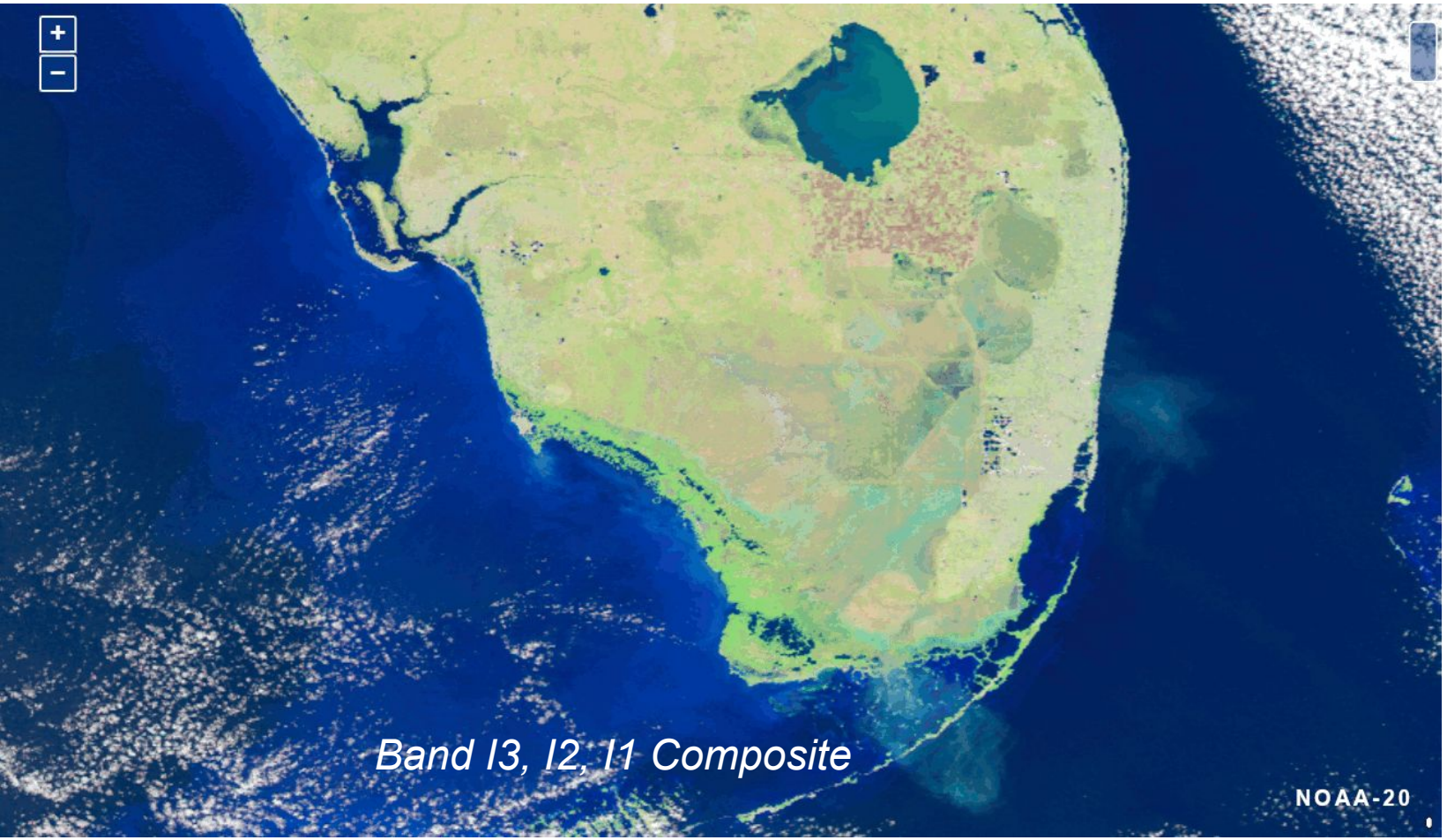
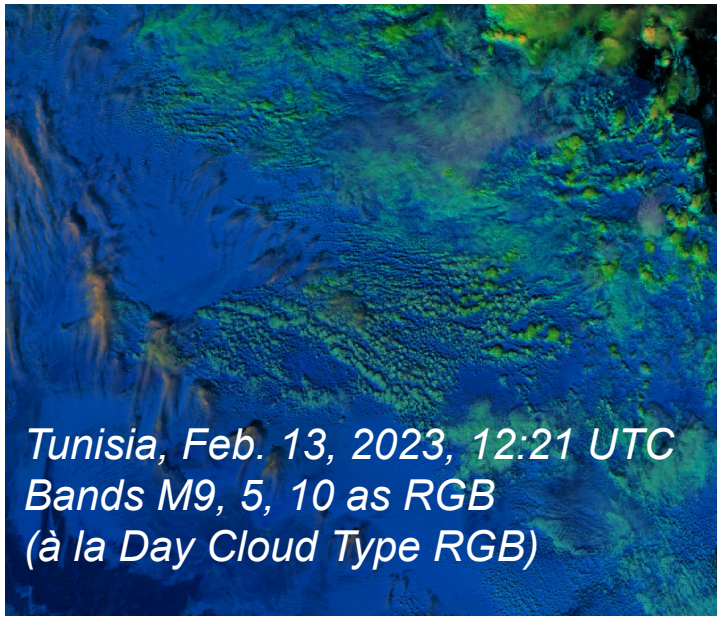
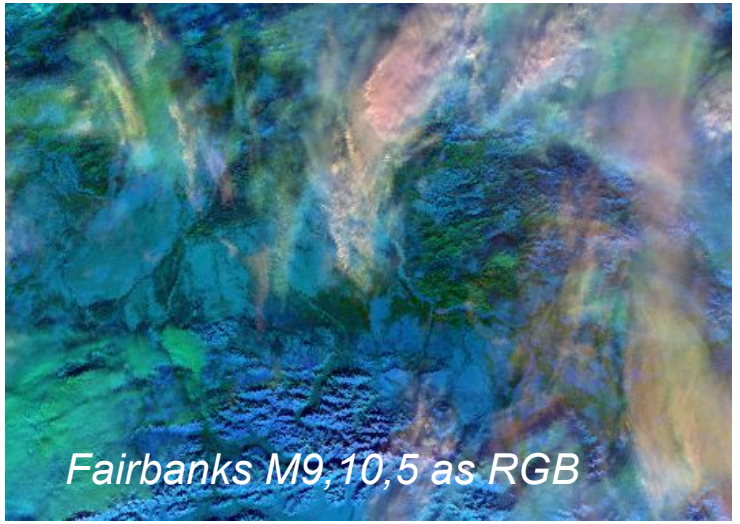


Image Quality: Short Wave InfraRed (SWIR) Bands







GReVS: https://ncc.nesdis.noaa.gov/Regional/

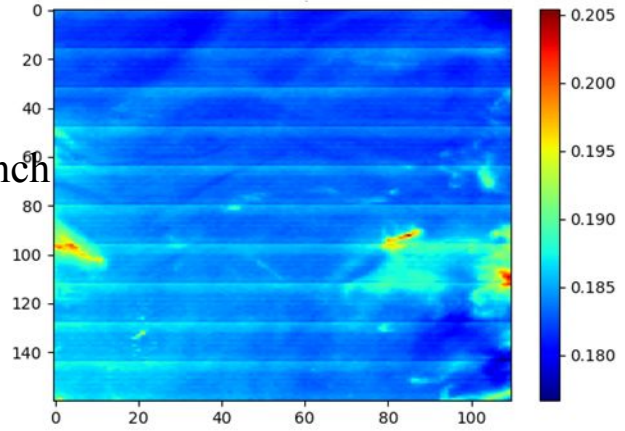
Image Quality - Striping Analysis

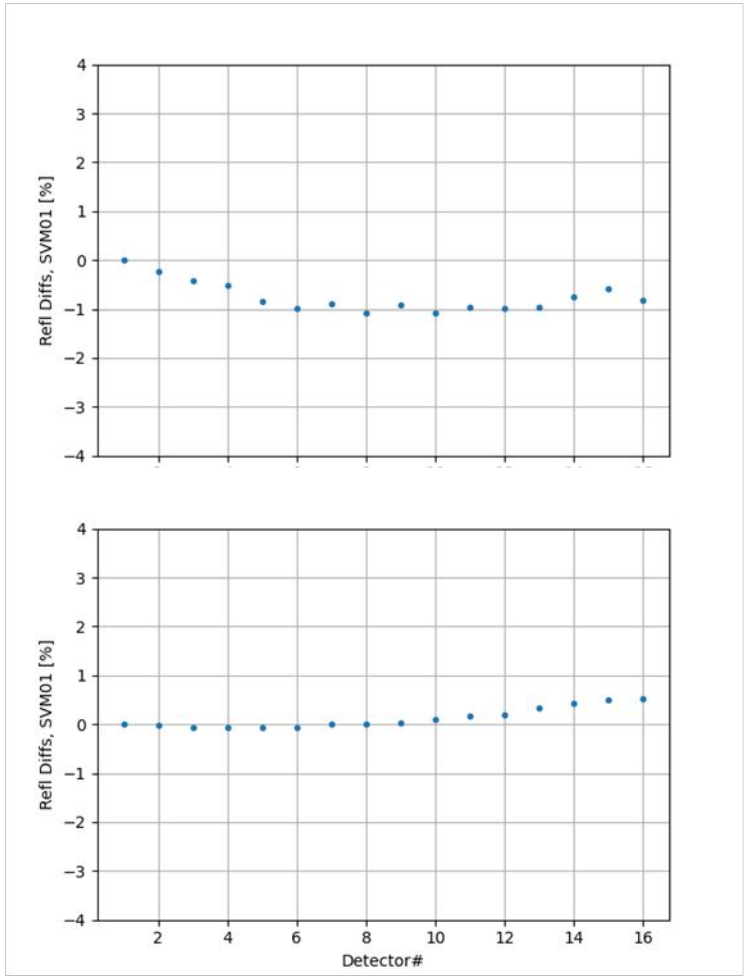
Band M1 Reflectance

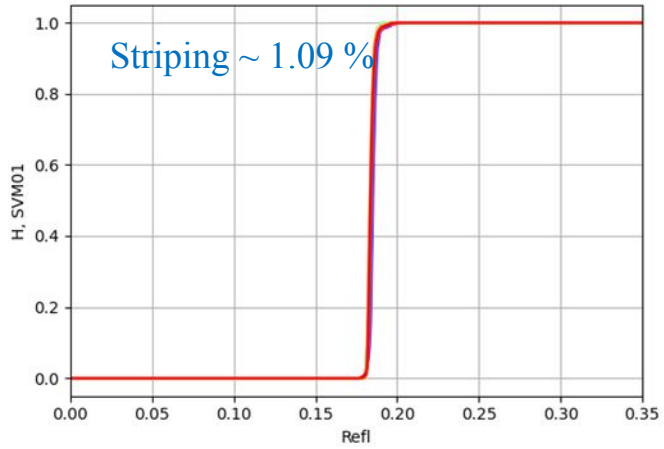
Normalized Detector-level Differences

VIIRS Striping Index (VSI)

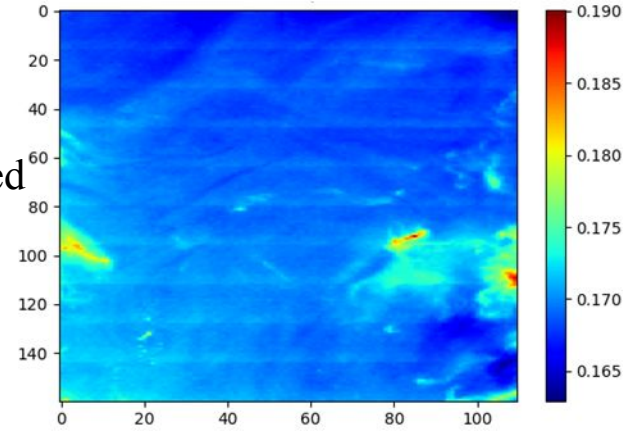
Pre-launch

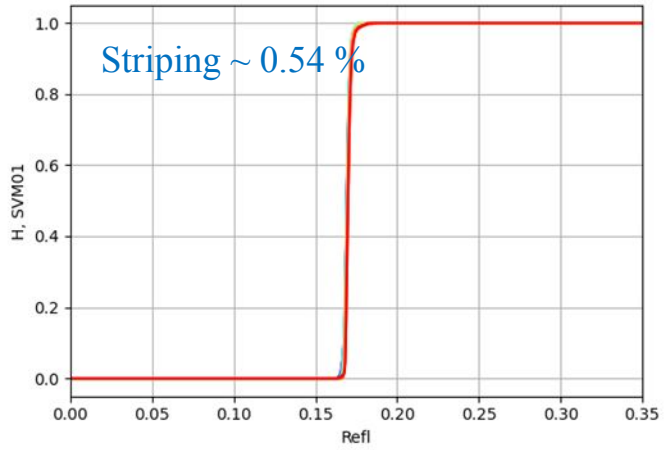






Updated

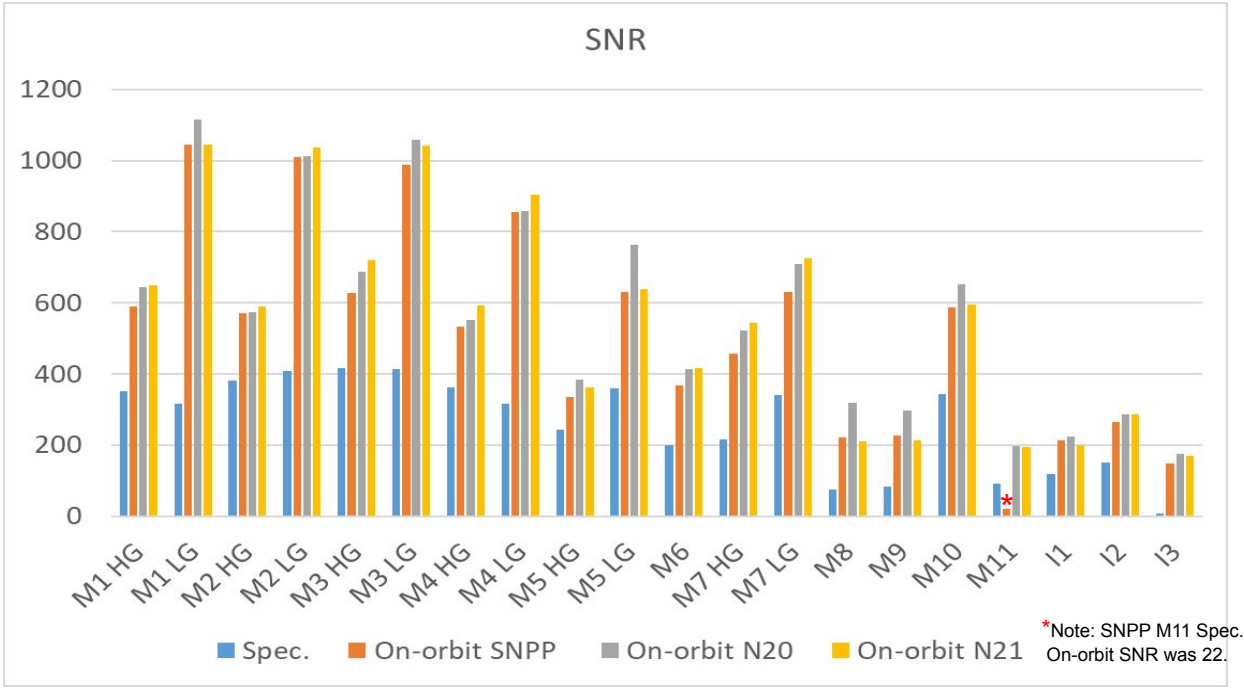




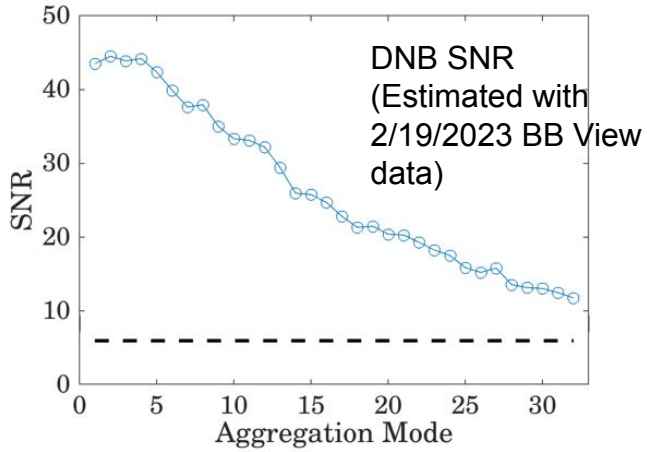
- Striping example observed over Mediterranean Sea for band M1 SDR data produced using pre-launch (top) and updated (bottom) F-predicted LUTs
- Significant striping reduction (improvement) is observed for most VIIRS VIS\NIR bands after the calibration LUT update

Reflective Solar Band (RSB) Noise / Signal to Noise Ratio (SNR)

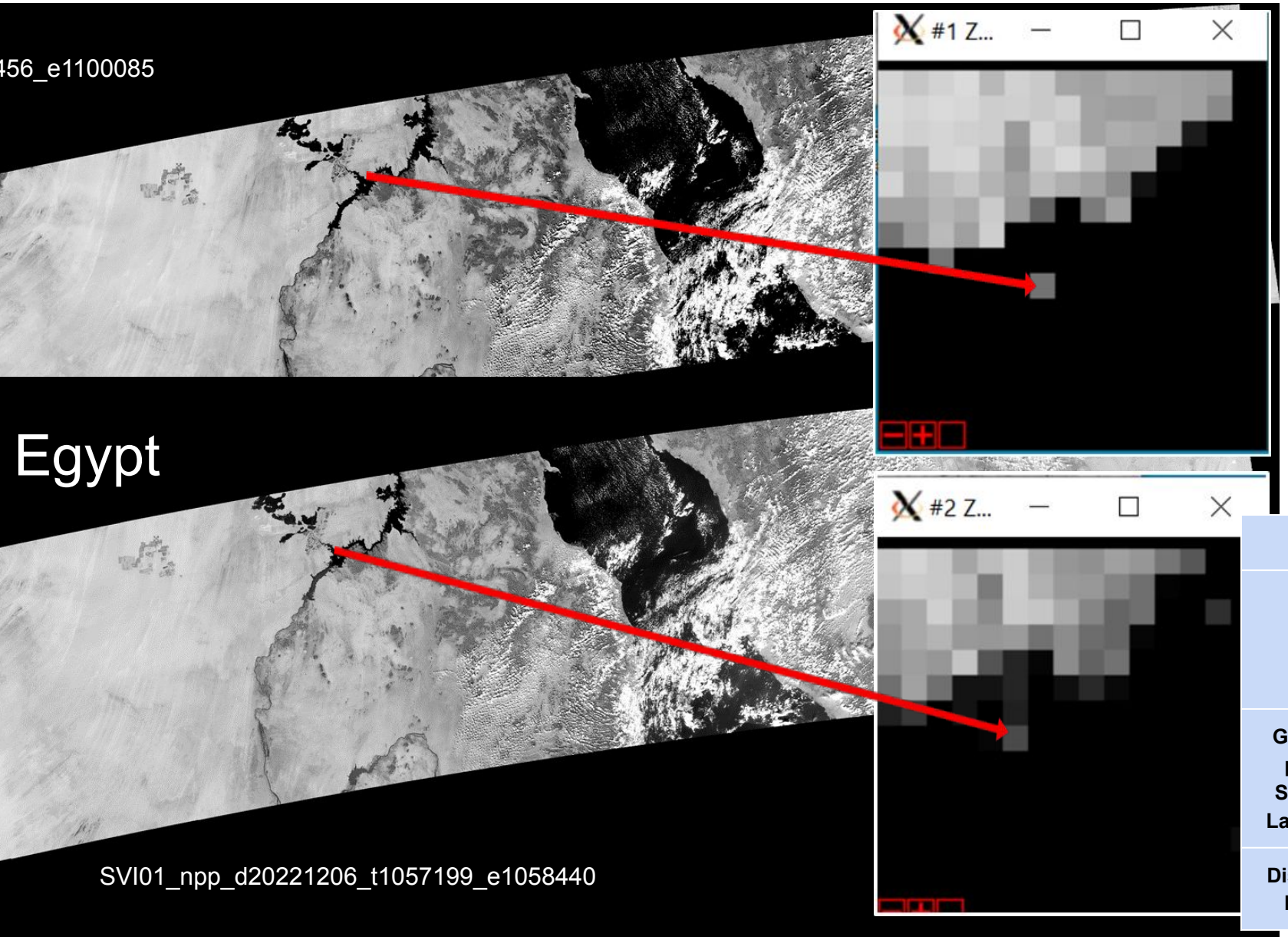
Band	L_{typ}	Spec.	SNR on-orbit
M1 HG	44.9	352	650
M1 LG	155	316	1045
M2 HG	40	380	589
M2 LG	146	409	1036
M3 HG	32	416	718
M3 LG	123	414	1041
M4 HG	21	362	592
M4 LG	90	315	903
M5 HG	10	242	362
M5 LG	68	360	638
M6	9.6	199	417
M7 HG	6.4	215	544
M7 LG	33.4	340	724
M8	5.4	74	211
M9	6	83	214
M10	7.3	342	596
M11	1	90	194
I1	22	119	198
I2	25	150	287
I3	7.3	6	171



- Signal to Noise Ratio (SNR) for RSBs is calculated by the Solar Diffuser (SD) observations on 2/13/2023 around 01:42.
- L_{typ} unit: W/m^2-sr-µm
- SNR on-orbit of a given band is average over all detectors of the band.
- The on-orbit SNR estimation met the Spec. for all RSBs.



Initial Geolocation Comparison for VIIRS I-1 (NOAA-21 vs. SNPP)



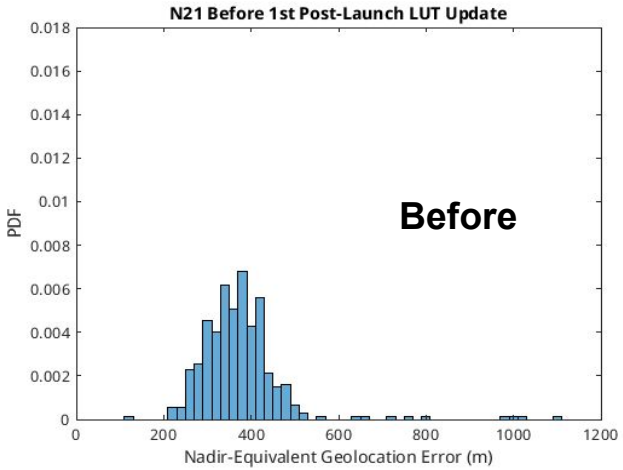
Results

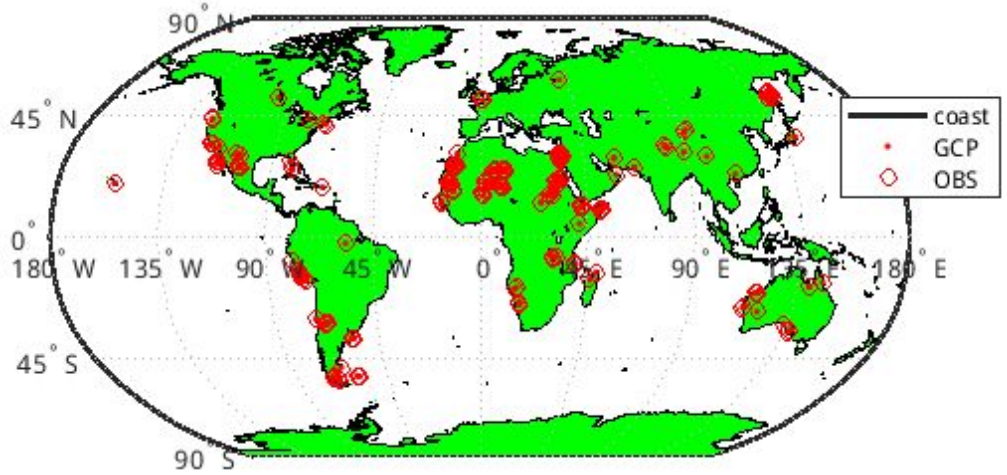
	NOAA21	S-NPP
Data	SVI01_j02_d20221206_t1058456_e1100085_b00371_c20221206122228032786_oeac_ops.h5	SVI01_npp_d20221206_t1057199_e1058440_b57560_c20221208141916395503_oeac_ops.h5
Ground point Source Lat/Long	22.584655N 31.812548E	22.580947N 31.814680E
Distance Error	0.391km	0.079km

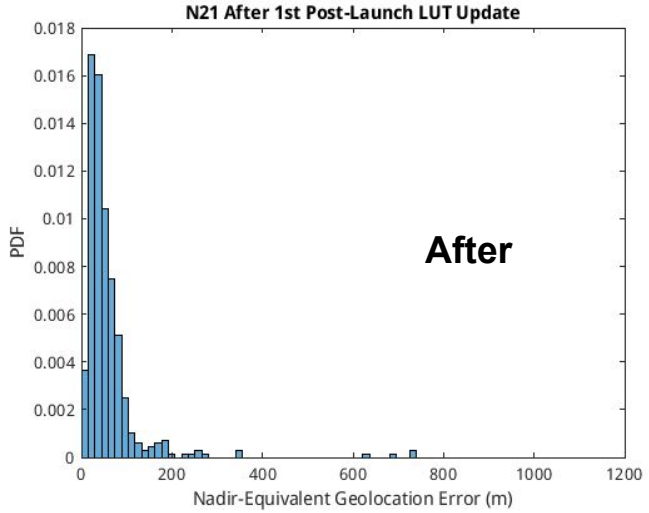
Geolocation Accuracy

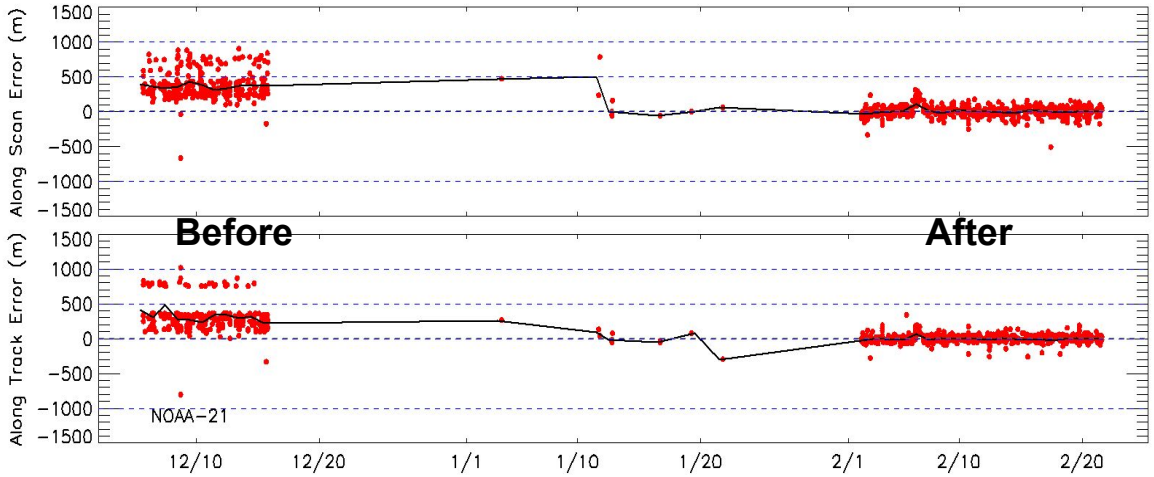
- The initial CPM-based evaluation with a limited number of ground control-point (GCP) matchups showed that the nadir-equivalent geolocation errors are approximately 400 m

- Initial optimization of the mounting matrix reduced the geolocation errors from around 400 m to less than 200 m

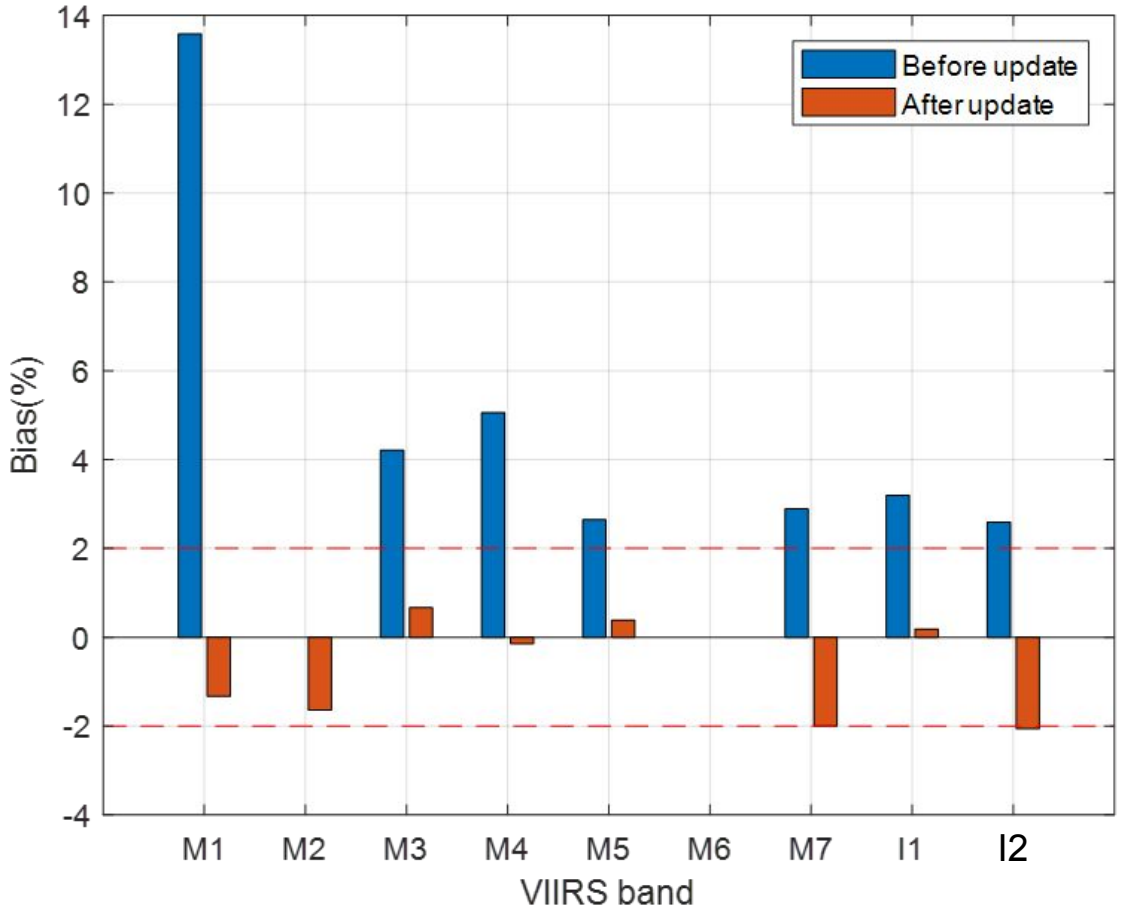








Radiometric Bias Evaluation: NOAA-21 vs. NOAA-20 VIIRS VIS/NIR Comparison at SNO using Aqua MODIS as Reference

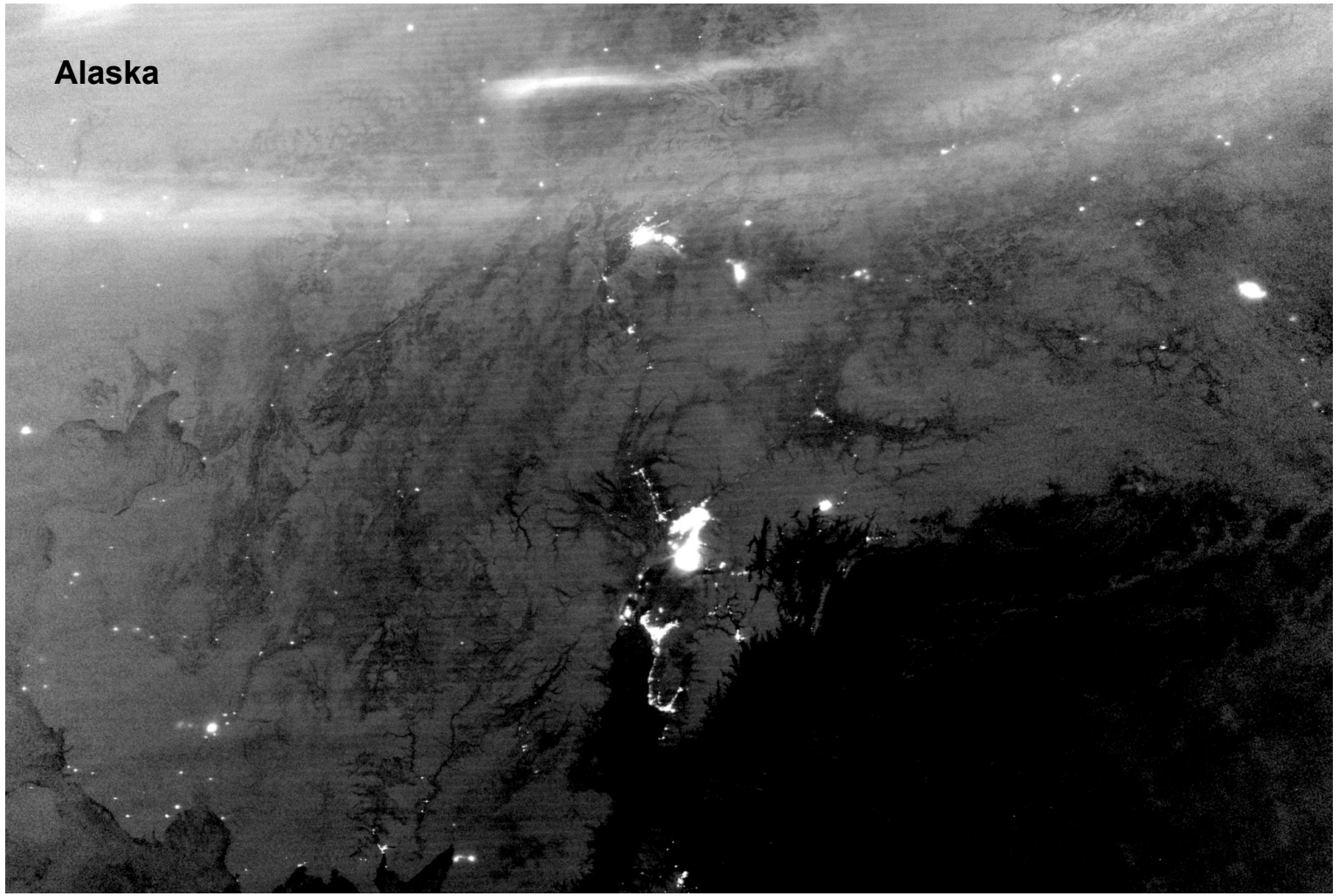


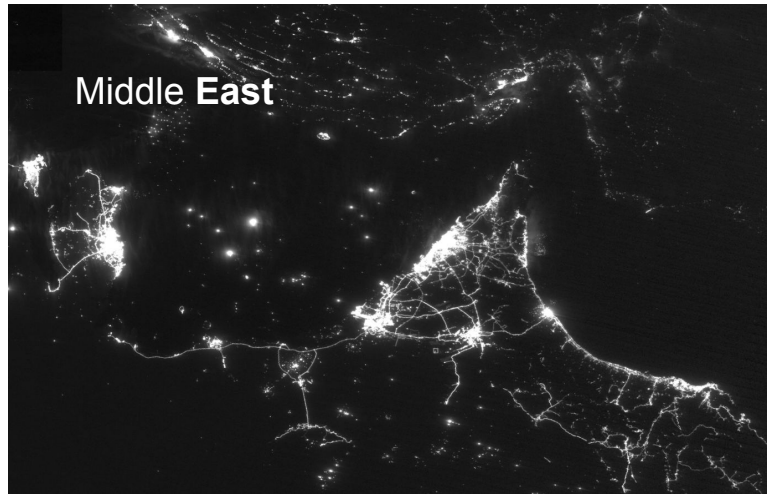
NOAA-21 vs. NOAA-20 VNIR Biases Before and after NOAA-21 Calibration Update

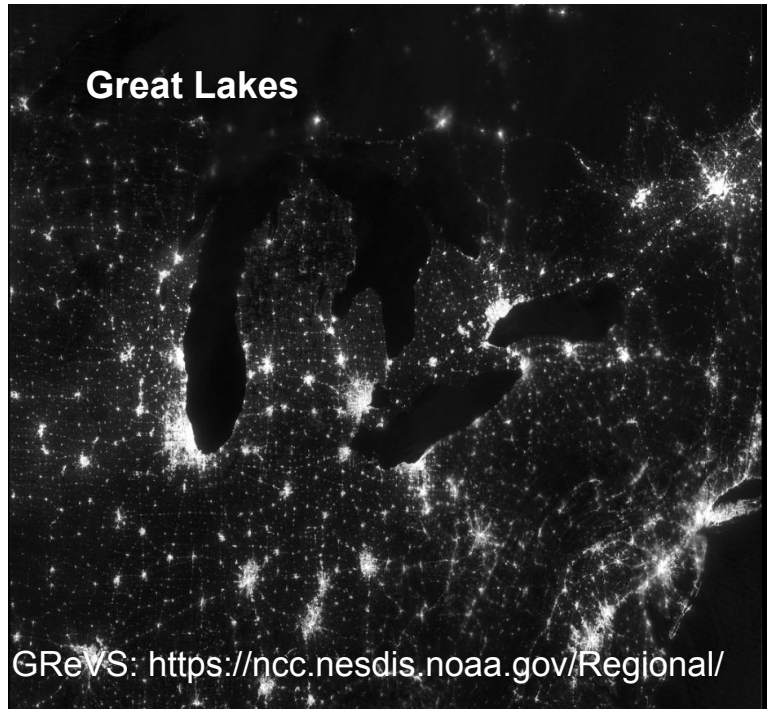
	Bias before N21 update (%)			Bias after N21 update		
	N21-AUQA	N20-AQUA	N21-N20	N21-AUQA	N20-AQUA	N21-N20
M1	9.639±0.334	-3.946±0.780	13.585	-6.222±0.304	-4.889±0.672	-1.333
M2	NaN	-6.773±2.678	NaN	-9.593±0.475	-7.949±0.867	-1.644
M3	5.581±0.465	1.370±0.943	4.211	1.197±0.487	0.532±0.919	0.664
M4	2.217±0.491	-2.838±1.083	5.055	-3.313±0.448	-3.169±0.971	-0.144
M5	3.273±0.557	0.628±1.143	2.645	1.582±0.521	1.201±1.137	0.382
M6	NaN	NaN	NaN	NaN	NaN	NaN
M7	3.050±0.626	0.163±1.329	2.887	-2.029±0.641	-0.029±1.337	-2.000
I01	-1.712±0.502	-4.907±1.389	3.194	-4.729±0.595	-4.913±1.275	0.184
I02	2.484±0.603	-0.108±1.455	2.592	-2.347±0.766	-0.285±1.562	-2.062

- Radiometric bias of NOAA-21 VIIRS VIS/NIR (M1-M5, M7) channels are within 2% bias relative to NOAA-20

DNB Image Quality



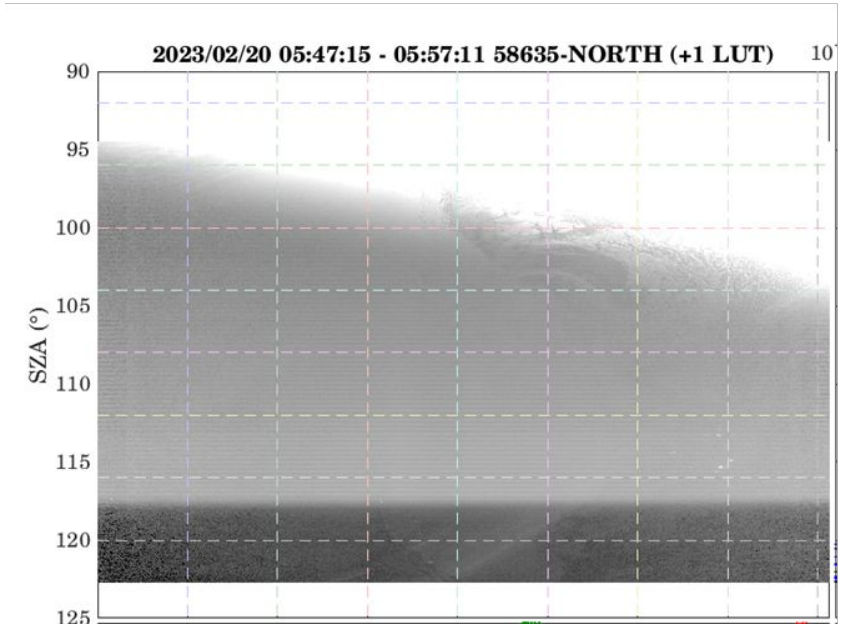




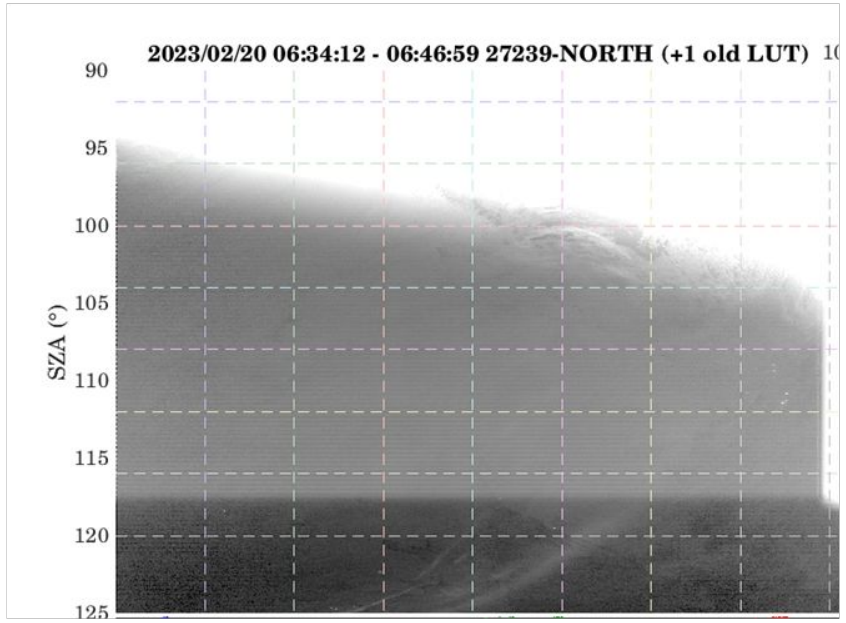
Initial DNB Stray Light Assessment

Northern Hemisphere

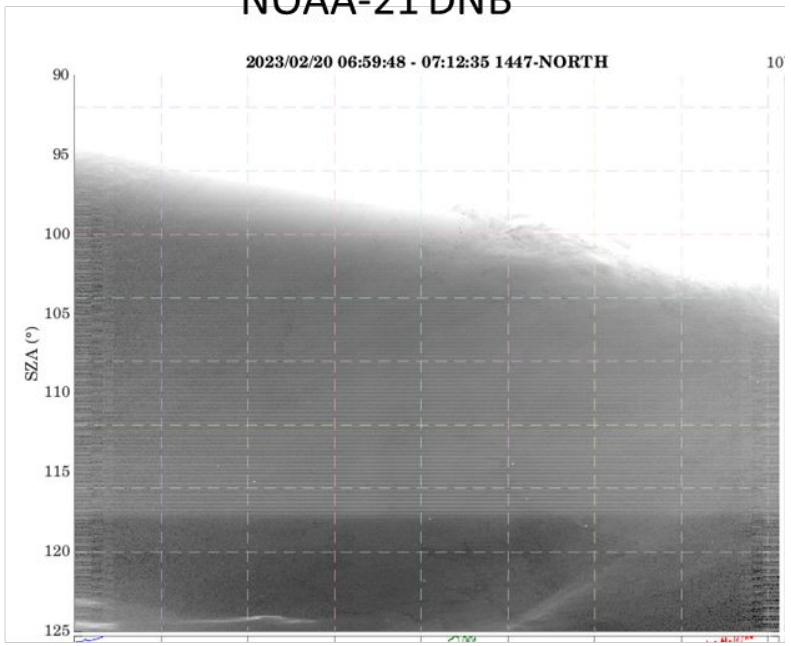
SNPP DNB



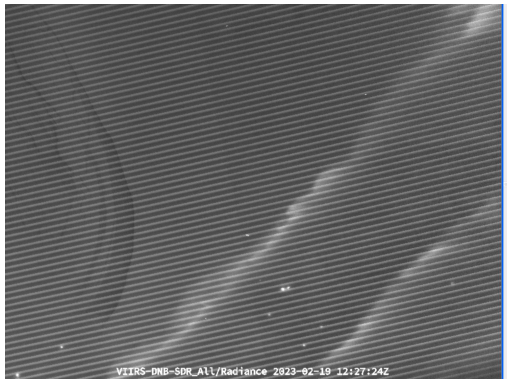
NOAA-20 DNB



NOAA-21 DNB

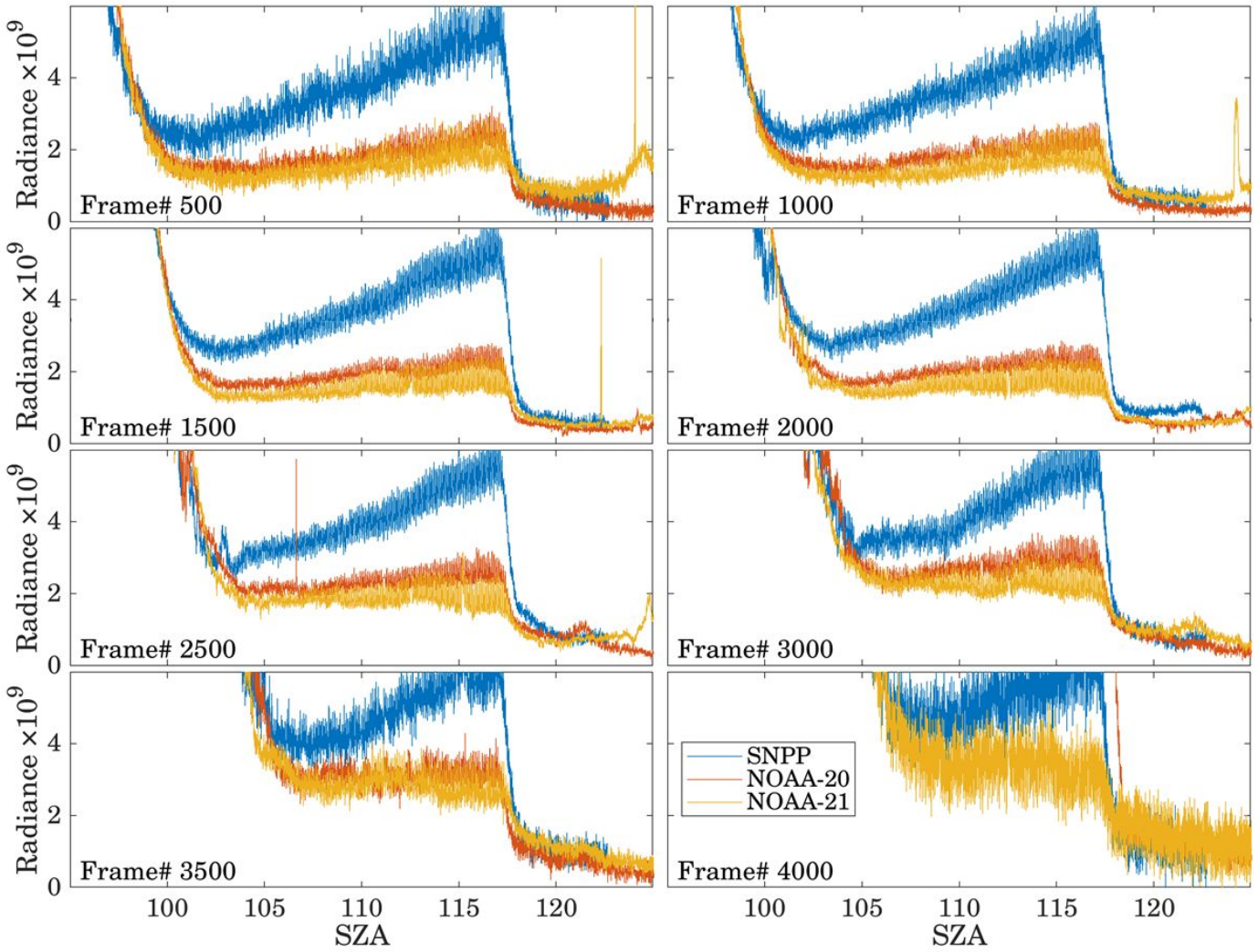


- Select orbits of NOAA-21/NOAA-20/SNPP around similar time on new moon day (Feb. 20, 2023)
- NOAA-21 DNB stray light observed over both the northern and southern hemispheres.
- Further evaluation of DNB new moon day data with updated calibration will be carried out to determine if the development of stray light correction tables is necessary.



Zoom-in view; Courtesy of William Straka

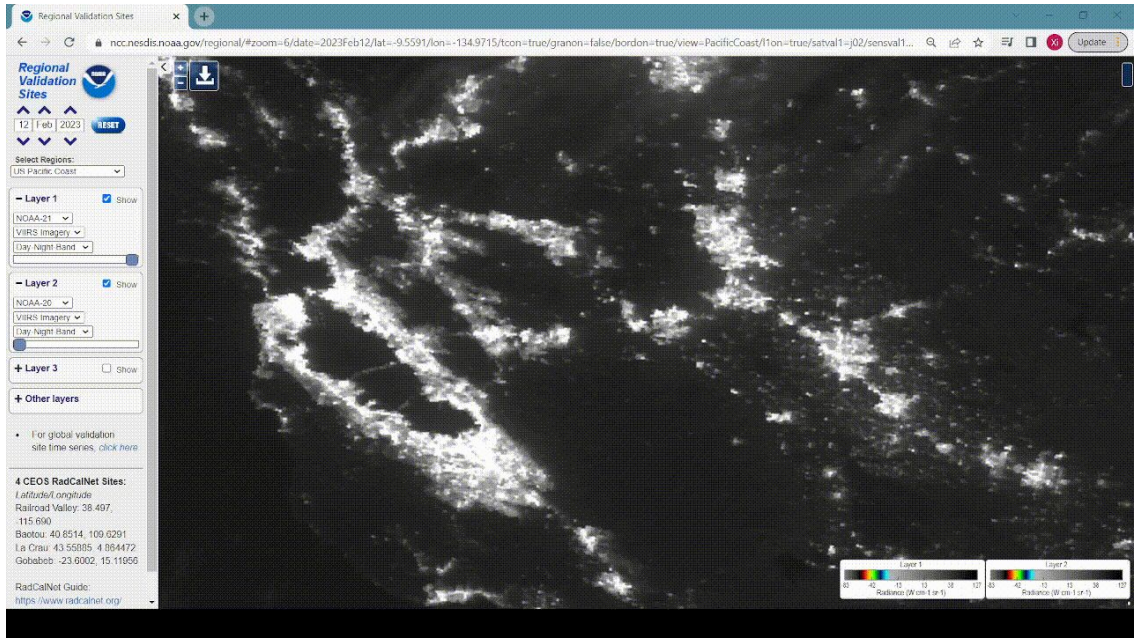
Comparison of NOAA-21/NOAA-20/SNPP DNB Stray Light over Northern Hemisphere



- NOAA-20 DNB stray light is significantly lower than SNPP DNB
- NOAA-21 DNB stray light over northern hemisphere is slightly reduced (~20%) in comparison to NOAA-20 DNB.

DNB Geolocation Accuracy

Overlay analysis using the GReVS system (https://ncc.nesdis.noaa.gov/Regional/



GReVS: https://ncc.nesdis.noaa.gov/Regional/

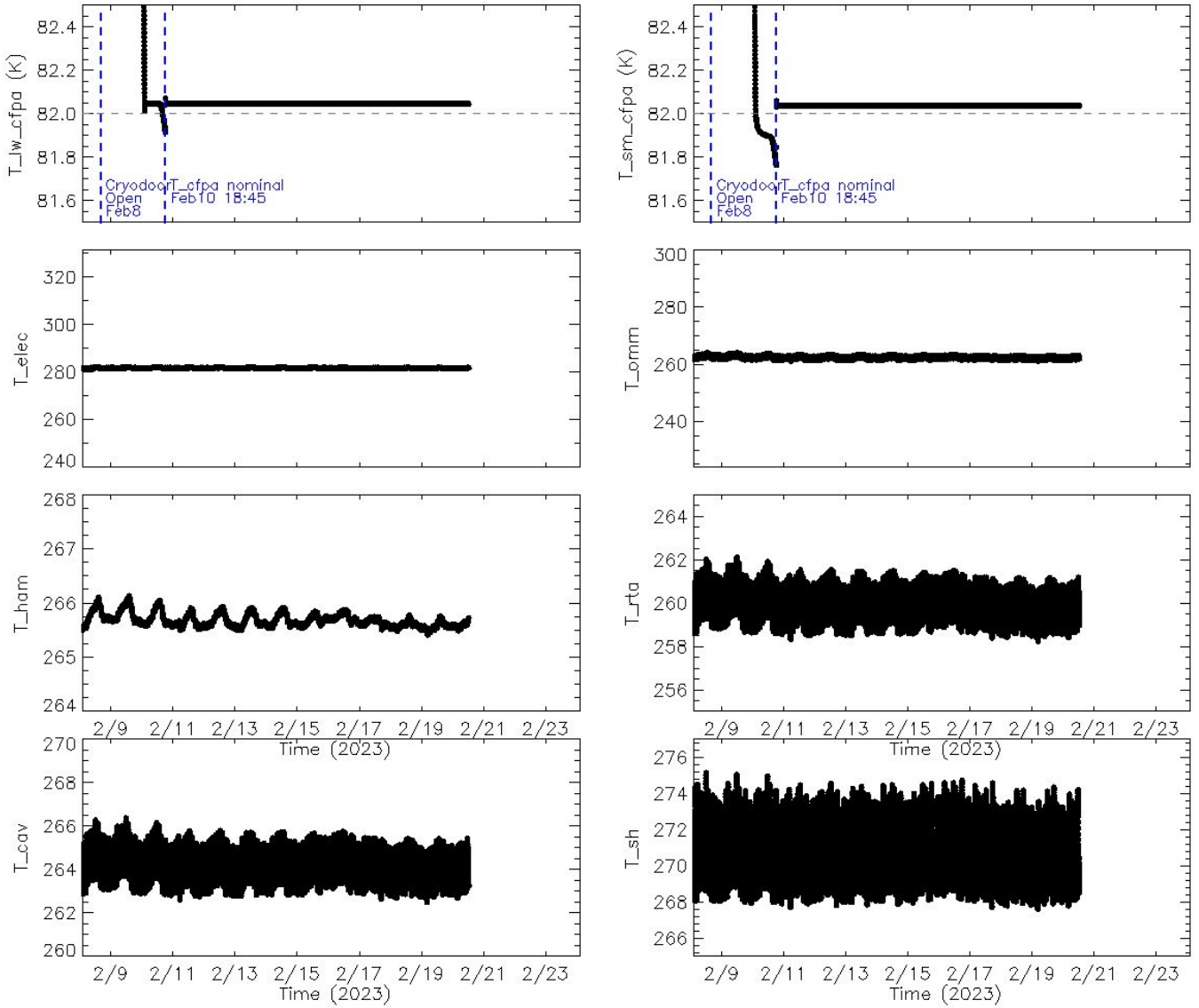
Comparison between SNPP and NOAA-20 DNB for Bridge Lights in San Francisco Bay (Feb. 12, 2023)

NOAA-21 and NOAA-20 DNB Co-Registration Verification

Initial assessment of NOAA-21 DNB geolocation accuracy indicates that it is consistent with NOAA-20 DNB

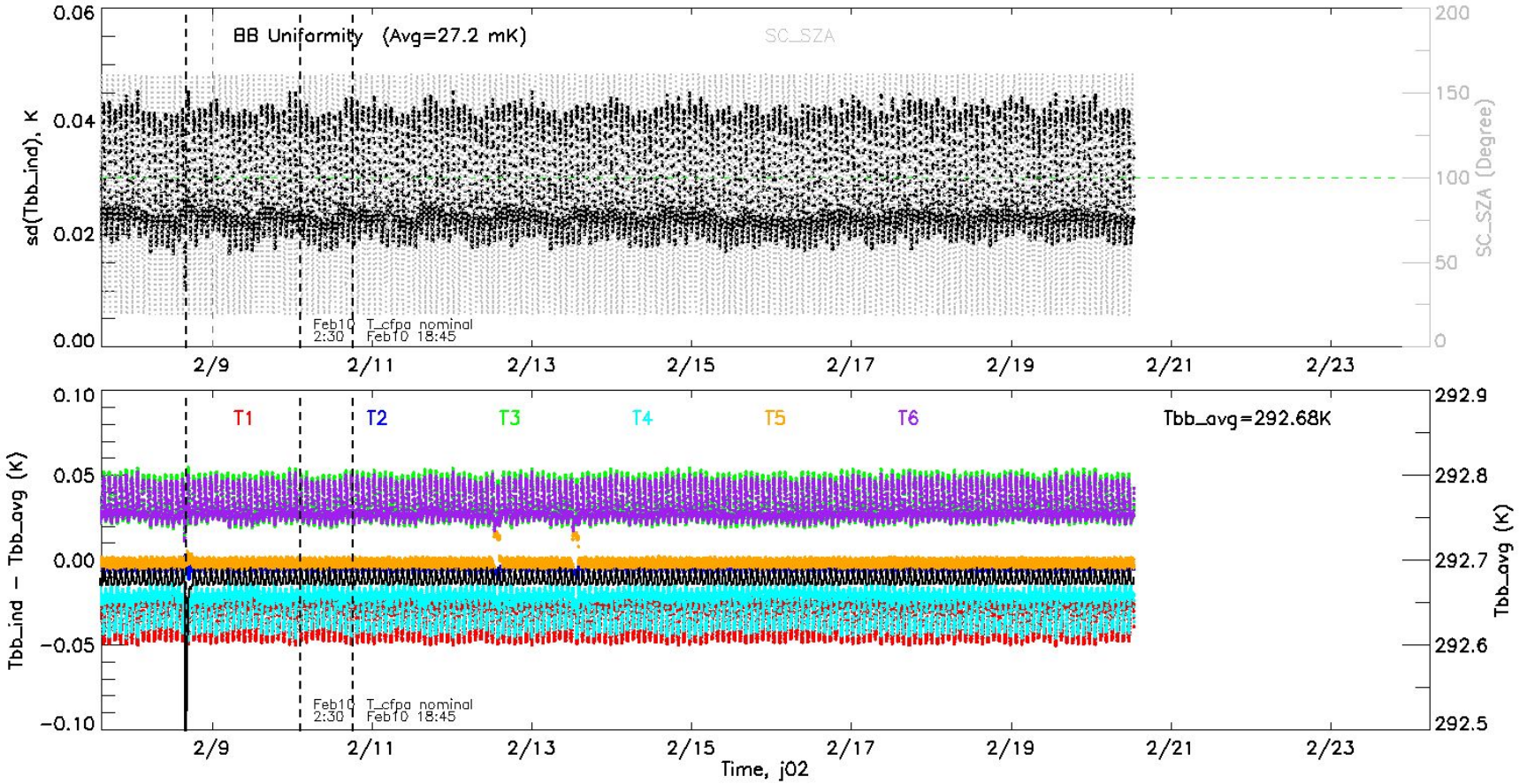
Instrument Temperature Telemetry

- Cryo-cooler door opened on February 8, 2023, LWIR and S/MWIR CFPA temperatures have stabilized since February 10, 18:45 UTC
  - Setpoint temperature: 82 K
  - LWIR heater power ~93.5 mW
  - Instrument temperatures have been stable during nominal operations.



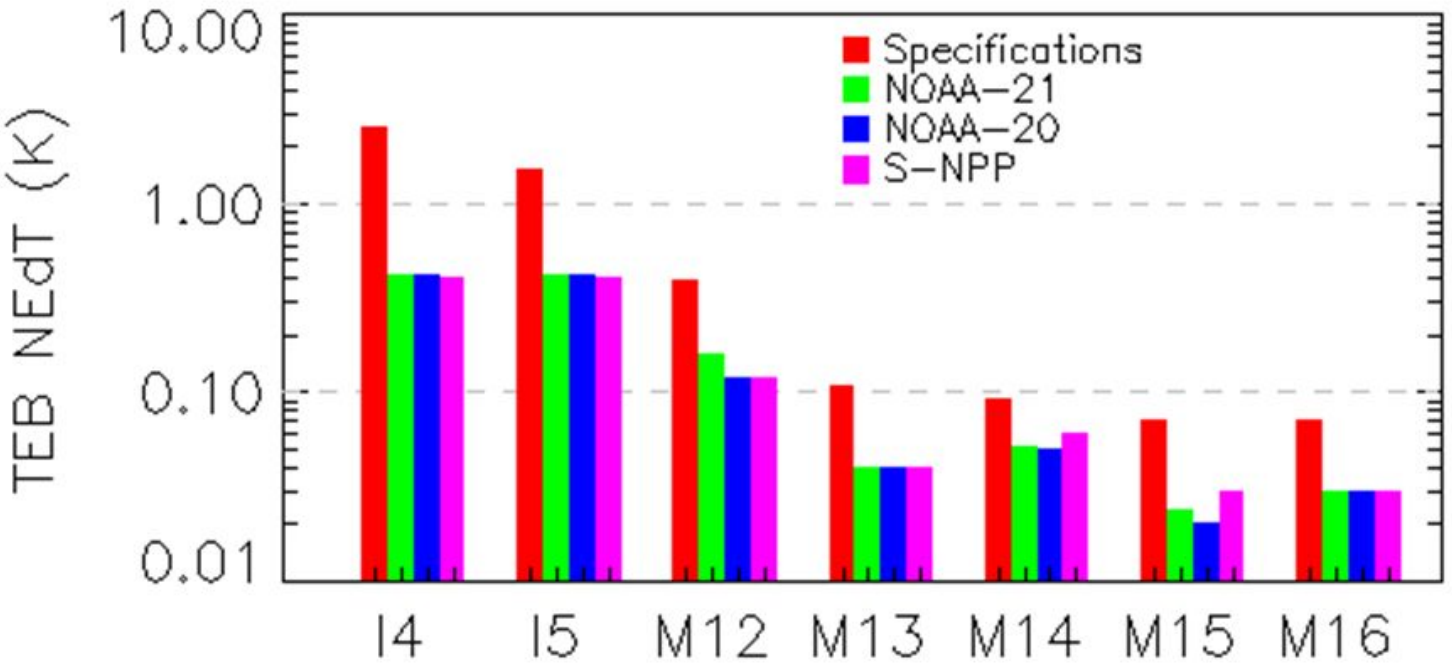
OBC BB Temperature and Uniformity

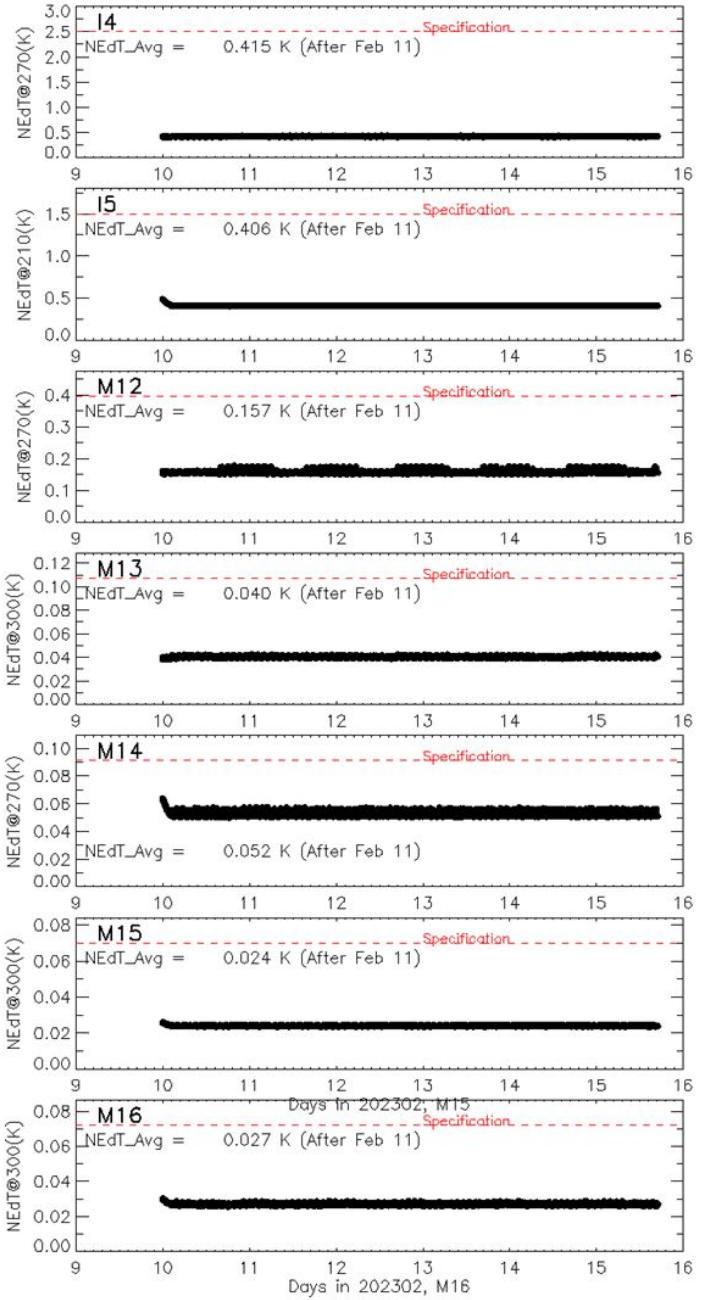
- Blackbody temperature and uniformity have been very stable.
  - Uniformity ≤30 mK for majority of times.
  - consistent with prelaunch results, as expected.



TEB Noise/NEdT

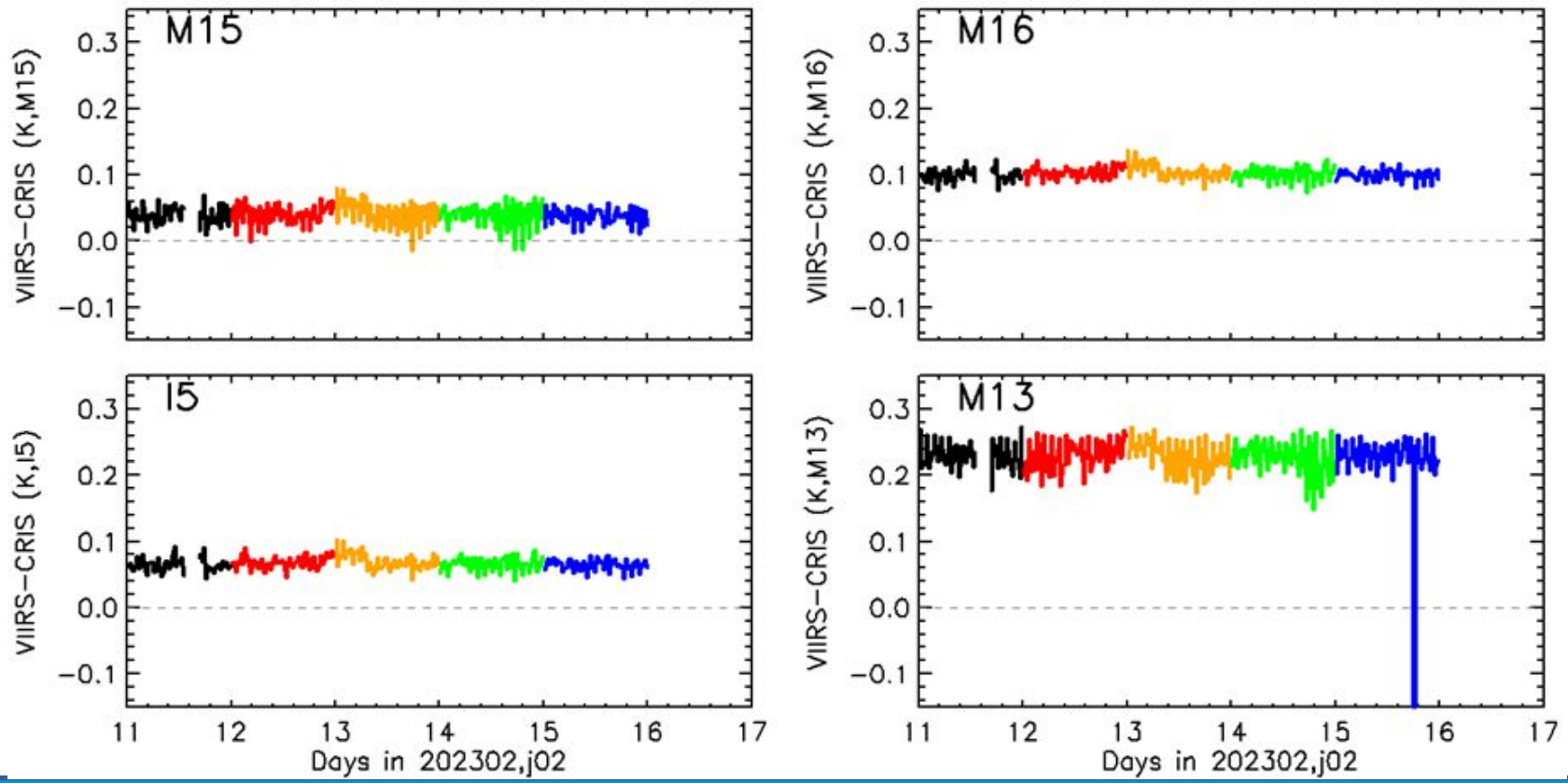
- NOAA-21 VIIRS TEB NEdTs are comparable to NOAA-20/S-NPP
  - All far below specifications
  - M12 shows slightly larger NEdT than N20/NPP.



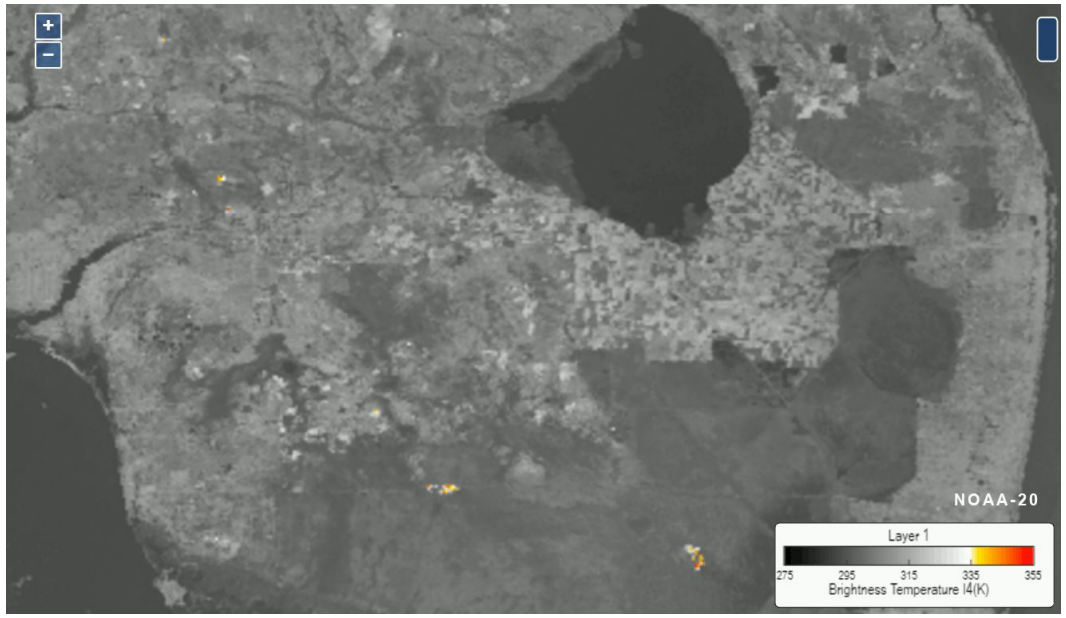


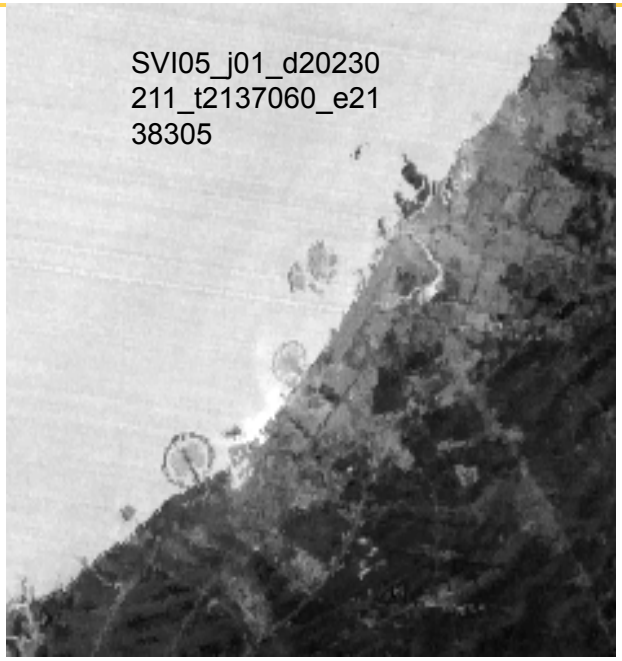
Comparison of NOAA-21 VIIRS with Co-Located CrIS Observations

- VIIRS I5 and M15-M16 agree well with CrIS .
  - Within 0.1 K, comparable to NOAA-20 and S-NPP
- VIIRS M13: BT bias ~0.22 K
  - Slightly larger than that of NOAA-20 and S-NPP.
  - Will be further analyzed after more data are available.

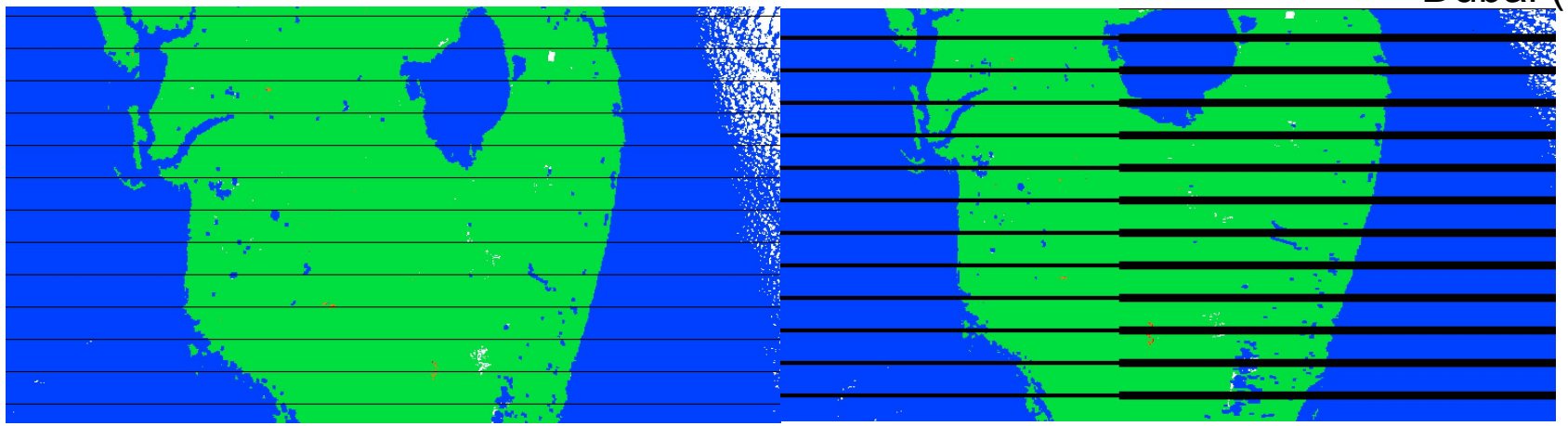


TEB Initial Assessment



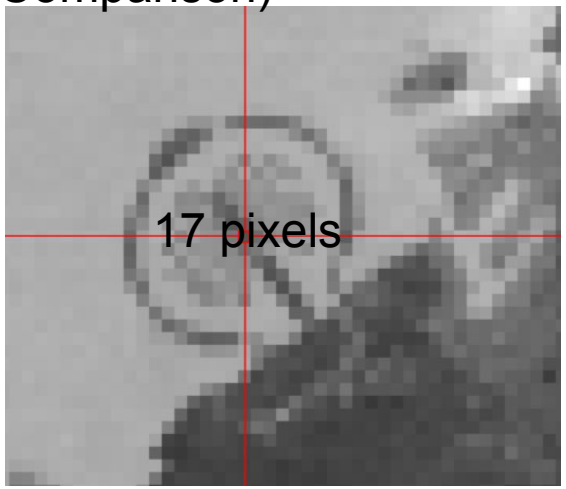


Source: GReVS https://ncc.nesdis.noaa.gov/Regional/

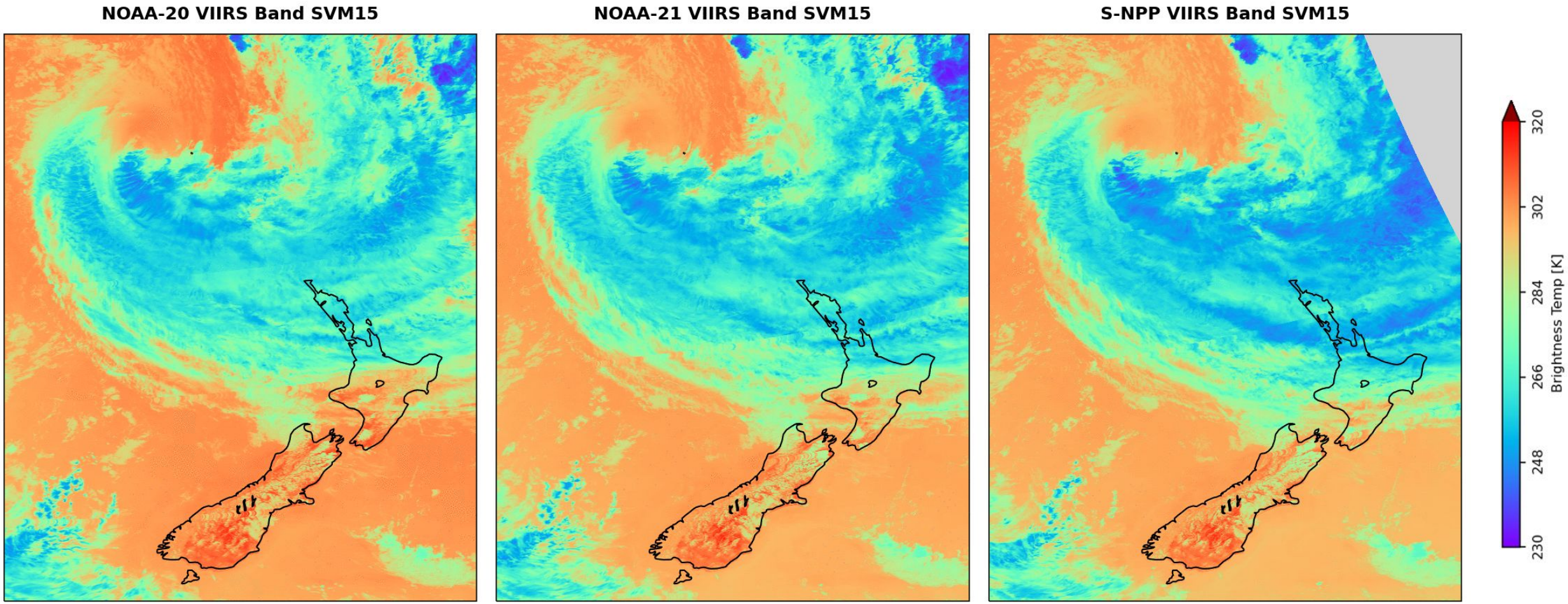


I-4 Day time comparison between NOAA 21 and 20
Hot spot check with Fire Masks provided by Ivan Cisiszar

Dubai (I-5 Comparison)

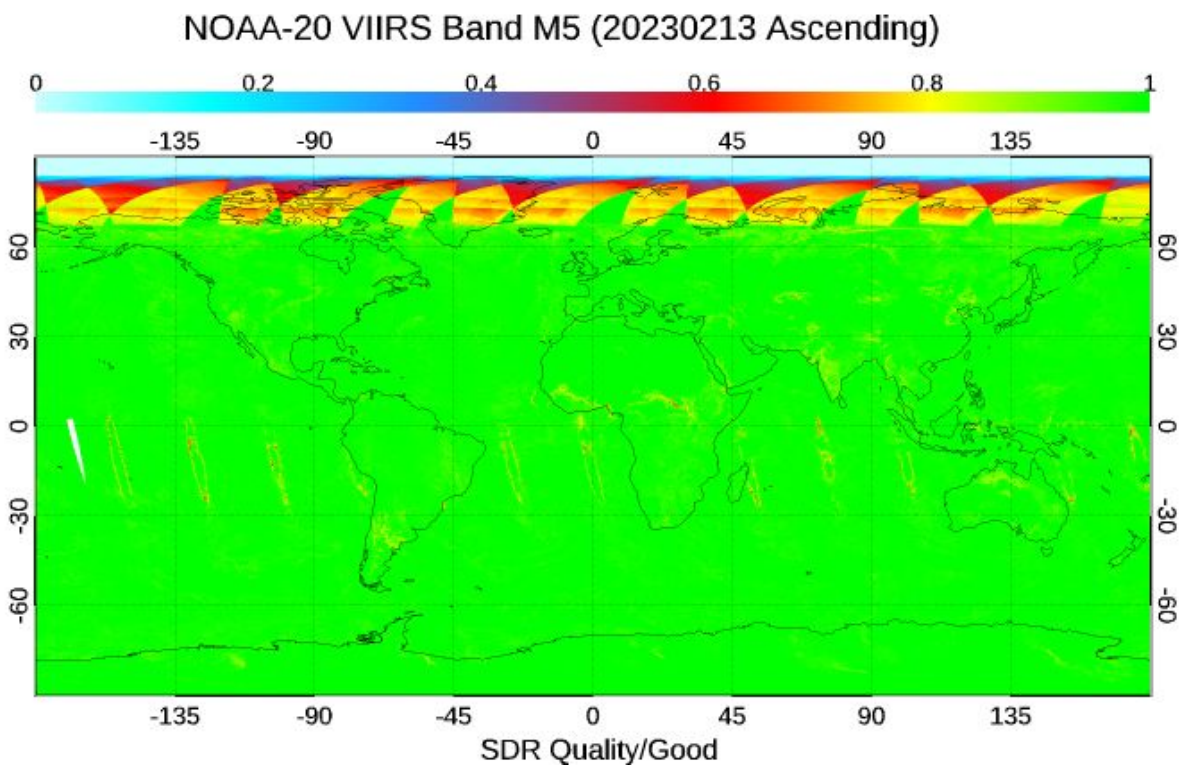


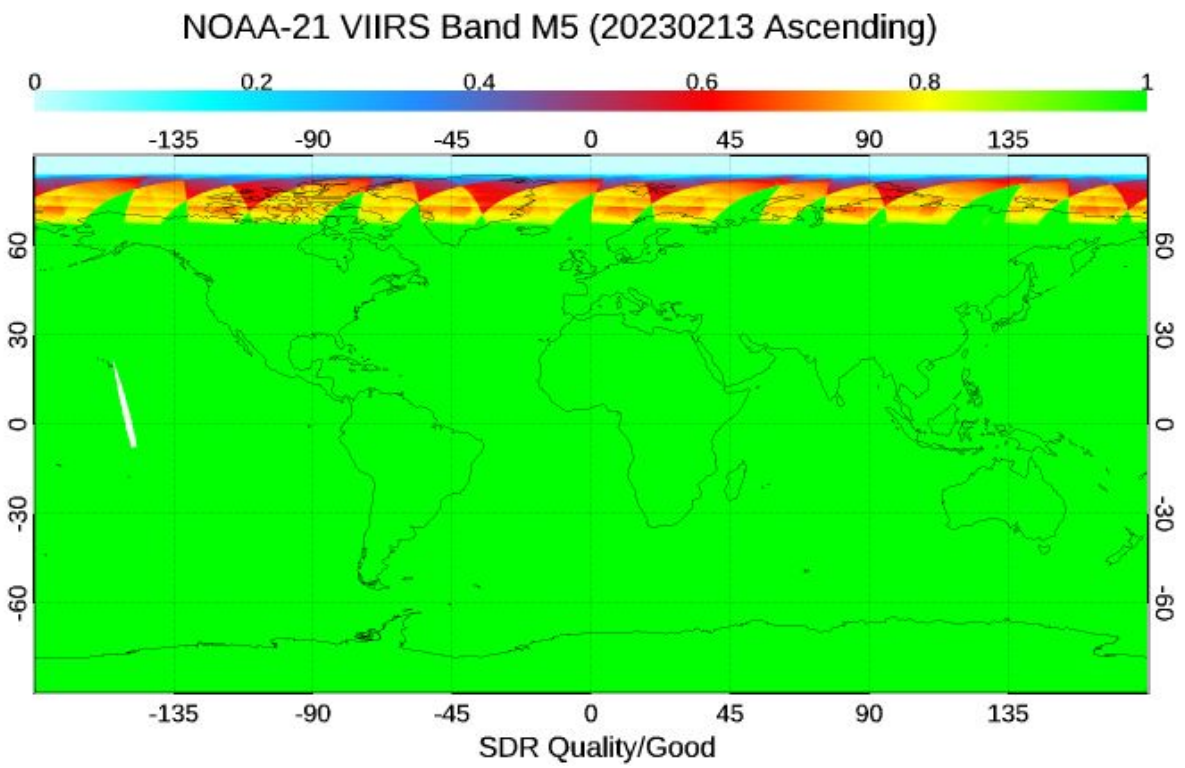
TEB Image Example - Cyclone Gabrielle



Band M15 observations (11~15 Feb 2023) of Cyclone Gabrielle over New Zealand, acquired by VIIRS sensors onboard NOAA-20, NOAA-21, and S-NPP satellites, respectively.

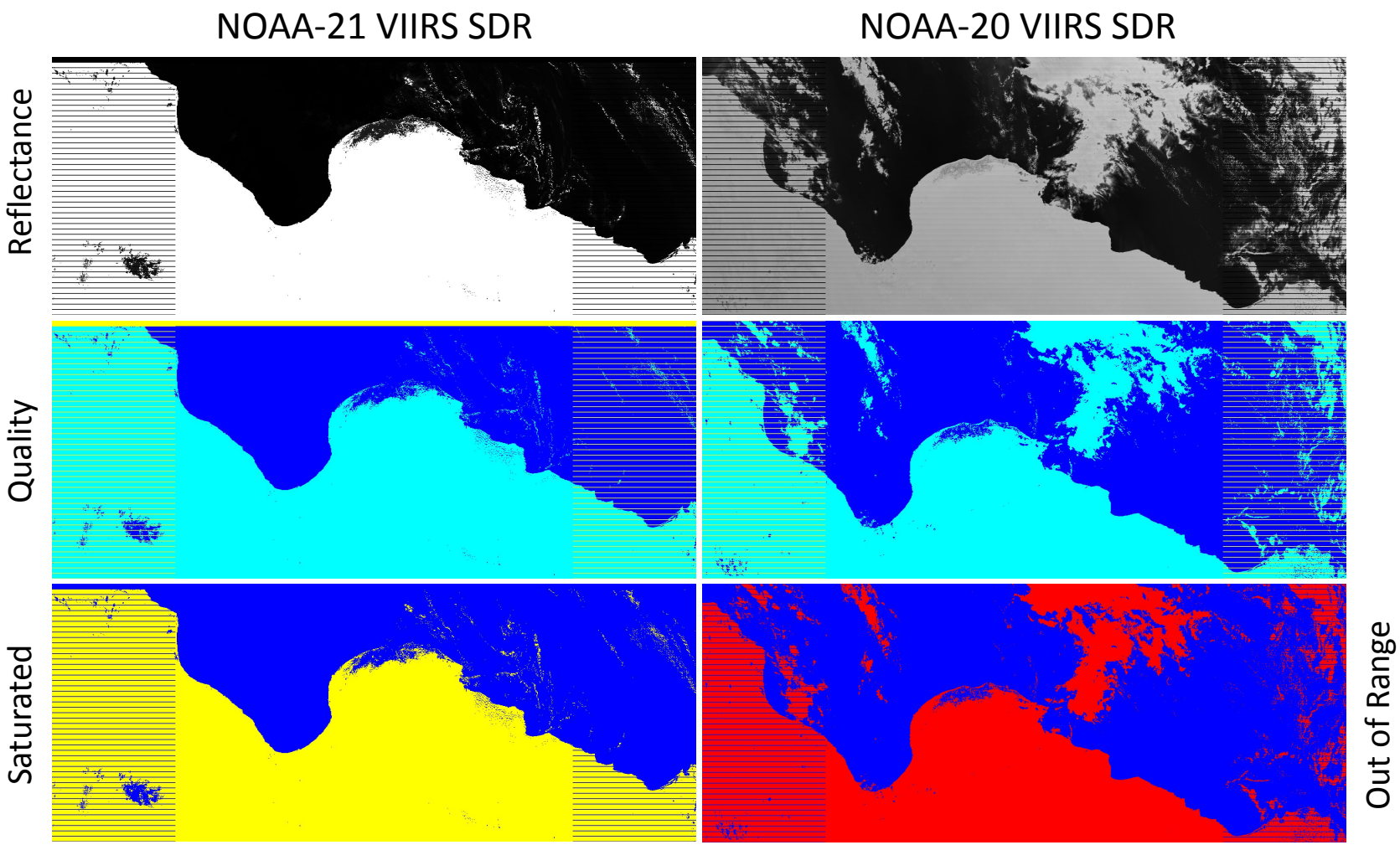
Quality Flag Changes: Dual-Gain Anomaly





- Dual-gain anomaly flagging as “poor quality” disabled for NOAA-21 VIIRS
- Flagging of this anomaly for Suomi NPP and NOAA-20 VIIRS is not accurate and may be corrected in the future (current EDR products not affected since users were advised to ignore this flag)

Quality Flag Changes: Band M6 Saturation



Saturation in analog-to-digital converter:
- Marked as “saturated” in QF1(bit 3-4)

Saturation in analog amplifier:
- Marked as “out-of-range” in QF1 (bit 7-8)

Sample granules acquired over the North African coast on Dec. 7/9, 2022

- For SNPP and NOAA20 VIIRS, M6 signal saturates the analog amplifiers and leads to "rollover" over land and clouds; produces incorrect radiance/reflectance values, and was flagged as “out-of-range”
- For NOAA-21 VIIRS, instrument modified such that "digital" saturation in the A2D converter occurs for L > ~55 $W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$ (L_{max} = 41 $W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$); Those pixels are marked as "saturated" in QF1, but currently have arbitrary values assigned to radiance (70 $W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$) and reflectance (1.6)
- These extreme values will be corrected in the next IDPS release (Mx8), currently planned for transition to operations on May 25, 2023

Error Budget

Band		Center Wavelength (nm)	Maximum FOV @ Nadir (km)	Maximum FOV @ Edge-of-Scan (km)	Specification SNR (RSB & DNB) NEDT (TEB)	Performance (Initial Assessment)	Accuracy Specification	Performance (Initial Assessment)
RSB	M1	412	0.8	1.6	316, 352 (LG,HG)	1045, 650 (LG, HG)	2%	-1.32%
	M2	445	0.8	1.6	409, 380 (LG,HG)	1036, 589 (LG, HG)	2%	-1.64%
	M3	488	0.8	1.6	414, 416 (LG,HG)	1041, 718 (LG, HG)	2%	0.66%
	M4	555	0.8	1.6	315, 362 (LG,HG)	903, 592 (LG, HG)	2%	-0.14%
	M5	672	0.8	1.6	360, 242 (LG,HG)	638, 362 (LG, HG)	2%	0.38%
	M6	746	0.8	1.6	199	417	2%	
	M7	865	0.8	1.6	340, 215 (LG,HG)	724, 544 (LG, HG)	2%	-2.00%
	M8	1240	0.8	1.6	74	211	2%	Need Cal. Update
	M9	1378	0.8	1.6	83	214	2%	Need Cal. Update
	M10	1610	0.8	1.6	342	596	2%	Need Cal. Update
	M11	2250	0.8	1.6	90	194	2%	Need Cal. Update
	I1	640	0.4	0.8	119	198	2%	0.18%
	I2	865	0.4	0.8	150	287	2%	-2.06%
	I3	1610	0.4	0.8	6	171	2%	Need Cal. Update
TEB	M12	3700	0.8	1.6	0.396	0.16	0.7% (0.13 K)	
	M13	4050	0.8	1.6	0.107	0.04	0.7% (0.13 K)	
	M14	8550	0.8	1.6	0.091	0.05	0.6% (0.26 K)	
	M15	10763	0.8	1.6	0.07	0.02	0.4% (0.22 K)	
	M16	12013	0.8	1.6	0.072	0.03	0.4% (0.24 K)	
	I4	3740	0.4	0.8	2.5	0.42	5% (0.97 K)	
	I5	11450	0.4	0.8	1.5	0.41	2.5% (1.5 K)	
DNB	DNB	700	0.8	0.8	6	11.8	5%, 10%,30% (LG,MG,HG)	Need Cal. Update

User Feedback

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Ivan Csiszar	STAR	Fire	Comparison results with NOAA20 show reasonable
William Straka	U. of Wisconsin	Imagery	Good quality except minor DNB striping on scan edge
Bill Line	STAR/CIRA	Imagery	See next presentation
Menghua Wang	STAR	Ocean Color	NOAA-21 SDR at visible and NIR bands are quite reasonable. However, SWIR band radiances appear to be low.

Risks, Actions, and Mitigations

Identified Risk	Description	Impact	Action/Mitigation and Schedule
1	TEB: Proposed changing the Cold Focal Plane Array (CFPA) set point temperature from 82 to 80 K; May introduce uncertainties in using the current set of calibration coefficients for TEBs.	TEB SDR quality	Need to evaluate the radiometric performance of NOAA-21 VIIRS TEBs and update calibration coefficients when needed.
2	DNB traces of stray light over both the northern and southern hemispheres	DNB SDR	Additional evaluation of DNB data during new moon will be needed to determine if further correction is necessary
3	RSB: Uncertainties in the solar diffuser degradation monitoring can introduce additional biases in RSB calibration.	RSB Calibration	Yaw maneuvers will be carried out to better characterize solar diffuser reflectance. To further address this with long term radiometric stability monitoring using lunar calibration, vicarious target, deep convective cloud and simultaneous nadir overpass (SNO) calibration methods.

Documentations (Check List, 1 slide)

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	Yes
Algorithm Theoretical Basis Document (ATBD)	Yes
Algorithm Calibration/Validation Plan	Yes
(External/Internal) Users Manual	Yes
System Maintenance Manual (for ESPC products)	N.A.
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Many for SNPP/NOAA-20; Coming for NOAA-21
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	Annual VIIRS SDR performance report

Check List - Beta Maturity

Beta Maturity End State	Assessment
Product is minimally validated, and may still contain significant identified and unidentified errors	NOAA-21 VIIRS instrument performance and science data (SDR/GEO) have been verified through early orbit checkout (EOC) data analysis. No significant error has been found affecting data quality.
Information/data from validation efforts can only be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose	NOAA-21 VIIRS science data have met the beta maturity requirements and can be used to make initial qualitative or limited quantitative assessments for downstream products.
Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists	NOAA-21 VIIRS beta maturity science data quality README file has been created for user reference. Calibration related documents are also released to support general data users.

NOAA-21 VIIRS Beta Maturity Status

- VIIRS SDR for all four major categories (RSB, TEB, DNB and GEO) were checked;
- All calibration related parameters were checked;
- Initial On-orbit NEΔT and SNR are characterized; On-orbit SDR bias was characterized based on preliminary comparisons with NOAA-20 VIIRS;
- All major SDR/GEO quality flags were checked;
- Errors and artifacts in the data products were documented. Solutions have been proposed and evaluated, but not necessarily implemented; Preliminary channel striping noise was assessed;
- All data products can be used for making initial qualitative or limited quantitative assessments.
- Feedbacks from NOAA STAR EDR teams including Fire, Imagery, and other teams are generally positive about the data quality based on initial assessments.

VIIRS SDR Cal/Val Findings: NOAA-21 VIIRS SDR has achieved beta maturity since Feb. 11, 2023 (specifically: Feb. 10, 2023, 18:45 UTC, orbit 1313)

Path Forward (1-2 slides)

1. Prepare and submit LUT updates to implement improved calibration and error correction coefficients in the operational ground processing system
2. Continue monitoring VIIRS instrument stability and performance, as well as SDR data quality
3. Analyze yaw and pitch maneuver data to improve onboard calibration and ground processing
4. Analyze lunar calibration data to independently characterize solar diffuser degradation
5. Further evaluate NOAA-21 pre-launch waiver related issues and address them as appropriate
6. M13/I-4 fire band evaluation (such as SRF change, saturation)
7. Further quantify geolocation accuracy
8. Characterize the instrument performance following the NOAA-21 VIIRS Calibration/Validation Plan

Potential Benefits of 3 JPSS Satellites

What would be values and benefits for the products to keep three JPSS satellites on orbit (NOAA-21 NOAA-20, and SNPP)?

- Increased revisit frequency; Benefit most for observations of transient phenomena (such as fire, glint, BRDF)
- More opportunities for cloud free observations
- Further improve accuracy and consistency

Revisit Time Comparison with Two and Three-Satellite Constellation

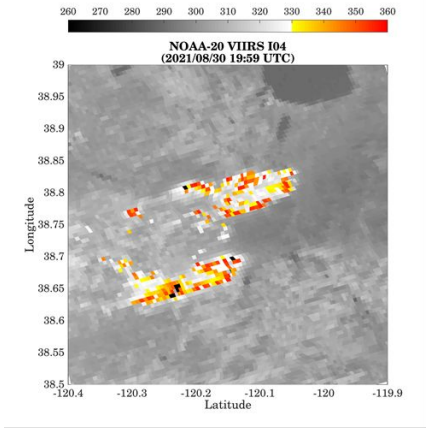
Los Angeles, California

Los Angeles	Max (H)	Min	Mean (H)	Mean Daily Revisit	Daily Revisit (< 1 hour)
Two Satellites	12.37 (H)	50 min	5.95 (H)	4	2
Three Satellites	11.95 (H)	25 min	3.96 (H)	6	4

Fairbanks, Alaska

Fairbanks	Max (H)	Min	Mean (H)	Mean Daily Revisit	Daily Revisit (< 1 hour)
Two Satellites	12.08 (H)	50 min	2.64 (H)	9	7
Three Satellites	12.08 (H)	25 min	1.76 (H)	13.6	11.5

NOAA-20 VIIRS I04



California Caldor Fire on August 30, 2021

Fire intensified within 50 min

SNPP VIIRS I04