Provisional Maturity Science Review For NOAA-21 OMPS SDR Algorithm

Presented by Banghua Yan (STAR OMPS SDR)
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Date: 03/30/2023

JPSS 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
- NOAA-21 PLT Timeline
- Provisional Maturity Performance Validation
  - On-orbit instrument performance assessment
  - NOAA-21 OMPS NM and NP SDR performance assessment
- Users/Downstream-Products feedback
- Risks, Actions, Mitigations
  - Potential issues, concerns
  - Mitigations
- Path forward towards the Provisional maturity stage
- Summary

Maturity Review - Exit Criteria

- Provisional Maturity Performance is well characterized:
  - 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:
  - Cal/Val Plan and Schedules
  - Product Requirements
  - Provisional Maturity Performance
  - Risks, Actions, Mitigations
  - Path forward (to the next maturity stage)

PROVISIONAL MATURITY REVIEW MATERIAL

Outline*

- Algorithm Cal/Val Team Members
- Product Overview/Requirements
- Pre-launch/Post-launch Performance Matrix/Waivers (Starry)
- NASA NOAA-21 OMPS HRR & Handover Briefing (Glen and Colin)
- OMPS NM/NP Instrument and Data Performance Assessments from STAR
  - OMPS PLT Timeline
  - OMPS NM and NP instrument performance assessment
  - OMPS NM and NP Post-launch data performance assessment
  - OMPS NM and NP data quality long-term monitoring from ICVS
- User Feedback Summary (details are deferred to the OMPS EDR Beta review presentation)
- Risks, Actions, and Mitigations
- Documentation (Science Maturity Check List)
- Conclusion
- Path Forward

* All sections without presenter assignment will be presented by Banghua

NOAA-21 OMPS SDR Algorithm Cal/Val Team

Name	Organization	Major Task
Banghua Yan (Project team lead)	NOAA/STAR/SCDAB	Project task plan and performance monitoring; OMPS instrument SDR cal/val science development and plan; monthly/quarterly/annual/review reports; ATBD update; first light image report
Trevor Beck	NOAA/STAR/SCDAB	Operational OMPS ADL code update and delivery with updated LUTs; OMPS RDR reader development; offline OMPS ADL code development; First light image report; ATBD update
Glen Jaross	NASA	OMPS instrument pre-launch calibration; OMPS SDR SCDB data set support; OMPS instrument performance maintenance support
Junye Chen	GST/SSAI	NOAA-21 OMPS wavelength registration; NOAA-21 NM and NP SDR calibration algorithm improvements; OMPS bi-weekly solar LUT derivation
Xin Jin (50%)	GST/SSAI	SNPP/NOAA-20/NOAA-21 OMPS dark, gain and nonlinearity calibration algorithm and code development; OMPS solar raw flux code development; weekly dark LUTs
Steven Buckner	GST/SSAI	OMPS data noise characterization analysis; OMPS solar LUTs; SNPP OMPS sensor degradation; Inter-sensor comparison with Tropomi; JSTAR weekly reports
Jingfeng Huang (50%)	GST/SSAI	VCRTM interface development for OMPS NM/NP radiance simulations; OMPS polarization impact assessment; validations of NOAA-21 OMPS SDR using RTMs
Likun Wang (~30%)	UMD/CISESS	OMPS NM SDR geolocation accuracy algorithm development; OMPS x-sensor radiometric calibration bias analysis among three missions; first light image support
Sirish Uprety	UMD/CISESS	OMPS solar calibration and NM wavelength shift algorithm improvements; SL analysis; OMPS SDR calibration and data quality validation; OMPS inter-sensor radiometric calibration bias analysis
Ding Liang (ICVS)	GST	OMPS RDR and SDR long-term monitoring via ICVS website system; OMPS NP solar intrusion aanalysis; inter-sensor comparison; first light image support
Vanistarry Manoharan (DPMS)	SAIC	OMPS SDR DRs/CCRs support

Acknowledge C. Pan, L. Flynn, M. Liu, C. Seftor, T. Kelly, B. Das, L. Dunlap, R. Mundakkara, J. Liu, Z. Zhang, D. Stuhmer, E. Beach, R. Lindsay, STAR CRTM, JSTAR and DPMS teams for their valuable support in different aspects or stages.

Acknowledgements

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- *Thank the ICVS team D. Liang and N. Sun for their intensive support to the OMPS NRT monitoring.*
- *Thank the NASA OMPS group G. Jaross, C. Seftor, T. Kelly, R. Mundakkara for their support in sharing pre-launch and LEOA information of the instruments.*
- *Thank the STAR OMPS EDR team L. Flynn, J. Liu, Z. Zhang, E. Beach, R. Lindsay for providing many valuable information associated with the OMPS SDR cal/val.*
- *Thank M. Liu, Y. Chen, M. Chen, Y. Ma, P. Liang for their big support to the CRTM OMPS simulation.*
- *Thank the STAR JPSS team A. Young, I. Guch, M. Divakarla, J. Weinrich for their great support to the work*
- *Last but not least, a big thank goes to the ASSISTT and JPSS DPMS teams, B. Das, L. Zhou, L. Dunlap, V. Manoharan, X. Liu, and D. Stuhmer for their speedy implementation of the all updates. Without their very efficient efforts and actions, it is impossible to make our timely updates associated with the DRs/CCRs into operation.*

NOAA-21 NM SDR Requirements

Budget Term	Requirement/Allocation
Wavelength range	300-380
Horizontal cell size	≤ 17 km @ nadir
SNR radiance @17 x17km^2	≥300 (195 for NOAA-21 NM 10 x12km^2)
Irradiance uncertainty	*< 7%*
Wavelength registration accuracy	*<0.01 nm*
Intra-orbital wavelength variation	*<0.01 nm*
Radiance uncertainty	*< 8%*
OOB Stray Light	≤10%
Maximum Albedo Calibration	<2%
Geolocation Error	≤ 8.5 km @nadir (AT)

NOAA-21 NP SDR Requirements

Budget Term	Requirement/Allocation
Wavelength range	250-310
Horizontal cell size	≤ 50 km @ nadir
SNR radiance@50x50km^2	varies with wavelength λ
*Irradiance uncertainty**	*< 7%*
*Wavelength calibration**	*<0.01 nm*
*Intra-orbital wavelength variation**	*<0.01 nm*
*Radiance uncertainty**	*< 8%*
Maximum Albedo Calibration	<2%
OOB Stray Light	< 5%
Geolocation Error	≤ 25 km @nadir (AT)

*Follow NOAA-20 NP SDR requirement

Wavelength nm	SNR
250 - 273.6	7
273.6 - 283.1	20
283.1 -287.7	40
287.7-292	52
292-310	80

NOAA-21 OMPS NM and NP SDR Waivers (Presenter: Starry)

CCR	Title	Description
19-4768	OMPS Nadir Stray Light GSegDPS Waiver at 252nm	Waiver requesting relaxation of stray light requirement for NOAA-21 OMPS Nadir Profiler for 252nm from 5% to 7.3%. Rationale: The Nadir Profiler passes the stray light requirement of 5% at all wavelengths channel except for the shortest wavelength channel at 252nm.
19-1799	OMPS Nadir Stray Light PRD Waiver at 252 NM	Waiver requesting relaxation of stray light requirement O_PRD-11438 from 5% to 7.3% at 252nm only. Rationale: The Nadir Profiler passes the stray light requirement of 5% at all wavelength channels except for the shortest wavelength channel at 252nm.
19-0292	OMPS Nadir Stray Light MMSS and FSRD Waiver at 252nm	Waiver requesting relaxation of stray light requirement for NOAA-21 OMPS Nadir Profiler for 252nm from 5% to 7.3%. Artifacts regarding comparative performance to J1 and NOAA-21 OMPS instrument and relevant science impact are attached to 472-CCR-19-1799.
18-0246	Flow-Down of Approved NOAA-21 OMPS Nadir Resolution/SNR Requirements to the FSRD	The Flight Segment Requirements Document (FSRD) Rev B CCR (470-CCR-17-0195) included incorporation of approved mission-level changes to OMPS Nadir Mapper horizontal resolution (approved as NJO-2016-014 Rev C) and OMPS Nadir wavelength coverage requirement specifications (approved as NJO-2017-008 Rev B). This CCR has no impacts to Level 3 OMPS PRD requirements or to NOAA-21 SRD requirements.

NOAA-21 OMPS NM/NP Pre-launch Performance Matrix (Presenter: Starry)

ADR	CCR	Title	Description	Projected Build	Status
9633	5577	NOAA-21 OMPS Nadir Mapper (NM) geolocation code change for off-nadir geolocation error correction	Correct the mistake in the formula for calculating the OMPS geolocation unit vectors	Mx7	In Operation 7/18/22
9905	5513	NOAA-21 OMPS Mounting Matrix Updates (pre-dynamic)	Update the J02 OMPS Mounting Matrix using NOAA-21 satellite pre-dynamic data	Mx7	In Operation 7/18/22
9908	5926	NOAA-21 OMPS Nadir Version Table Update N_TIM_PAT_VER Value	An update to the Nadir Version Table for OMPS-TBL-VERS-GND-PI_j02 is required to account for raw data record (RDR) from the redundant side of the instrument.	Mx7	In Operation 7/18/22
9959	5997	NOAA-21 OMPS Nadir Mapper (NM) operational sample table includes 3 additional CCD spectral-columns that have no valid irradiance coefficients	1) NOAA-21 OMPS-NM operational sample table includes 3 additional CCD spectral-columns that have no valid irradiance coefficients. 2) NASA delivered new coefficients to NOAA STAR in January 2023	Mx7	**In Operation (03/09/2023)**
9960	5997	NOAA-21 OMPS Nadir Mapper (NM) and NOAA-21 Nadir Profiler (NP) show significant/unacceptable discrepancies in albedo coefficients	1) NOAA-21 OMPS-NM and NOAA-21 OMPS-NP show significant/unacceptable discrepancies in albedo coefficients between 300-310 nm. 2) NASA delivered the updated NOAA-21 NM radiance coefficients in February 2023	Mx7	**In Operation (03/09/2023)**
10037	6101	NOAA-21 OMPS pre-launch LUTs update	10 OMPS LUTs needed to be updated pre-launch	At NOAA-21 launch	In Operation
10039	6112	NOAA-21 OMPS Total Column code change and OMPS-TC MACROPIX and EV-SAMPLE tables update	An incorrect table was used for the OMPS-TC MACROPIX and EV-SAMPLE tables for J02 TC-OMPS.	Mx8	Expected May 2023
10044	6135	NOAA-21 OMPS Mounting Matrix Coefficients Update (post dynamic)	NOAA-21 OMPS post TVAC sensor mounting matrix coefficients update	At NOAA-21 launch	In Operation

NOAA-21 OMPS NM/NP Post-launch Performance Matrix (Presenter: Starry)

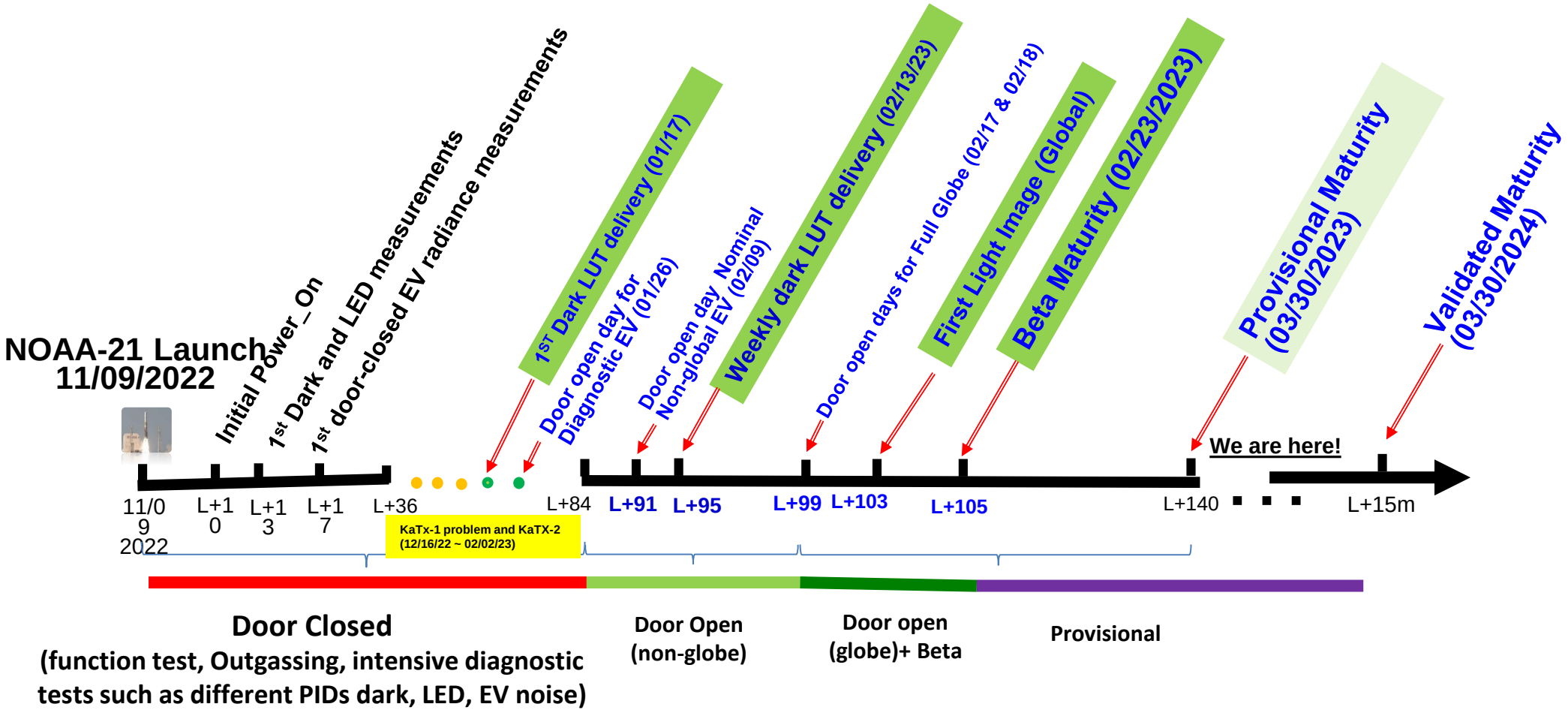
ADR	CCR	Title	Description	Projected Build	Status
10281	6439	Fix a 3-pixel-wavelength shift error in the NOAA-21 OMPS TC wavelength table	The NOAA-21 OMPS NM radiance shows a large discrepancy with NOAA-21 OMPS NP in the range from 300 to 310 nm due to an about 3-pixel-wavelength shift error. This issue was caused by mismatched OMPS NM wavelength table	Mx7	In Operation 03/09/2023
10281	6439	NOAA-21 OMPS NM and NP wavelength scale registration	Update the NOAA-21 OMPS nadir sensor wavelength tables due to the wavelength shift from ground to orbit	Mx7	In Operation 03/09/2023
10303	6463	NP Wavelength & OSOL Update	An update to the NOAA-21 NP wavelength and solar OSOL tables to capture the wavelength shift of the NP since 9 February. In the meantime, the updated OSOL table also fixed the 12-pixel shift error detected in the NOAA-21 NP solar flux SDR data (see the analysis later)	Mx7	In Operation **03/23/2023**
10308	6475	NOAA-21 OMPS NM OSOL and wavelength LUT update	Incorrect value of QC used in the NOAA-21 OMPS algorithm for the nadir sensor has led to discontinuity of the NM SDR data at 84-86 cross track pixels. This will be fixed with the updated OMPS NM OSOL and wavelength LUTs.	Mx7	Plan to deliver to ASSISTT on 04/03

Part I: From NASA OMPS HRR & Handover Briefing for NOAA-21 Nadir Sensors by Glen and Colin (see a separate ppt file)

Part II: From STAR OMPS SDR Team for NOAA-21 Nadir Sensor Instruments and Data Assessments by Banghua

(in combination with the ICVS monitoring results)

NOAA-21 OMPS Nadir Mapper and Nadir Profiler PLT Timeline[1,2]

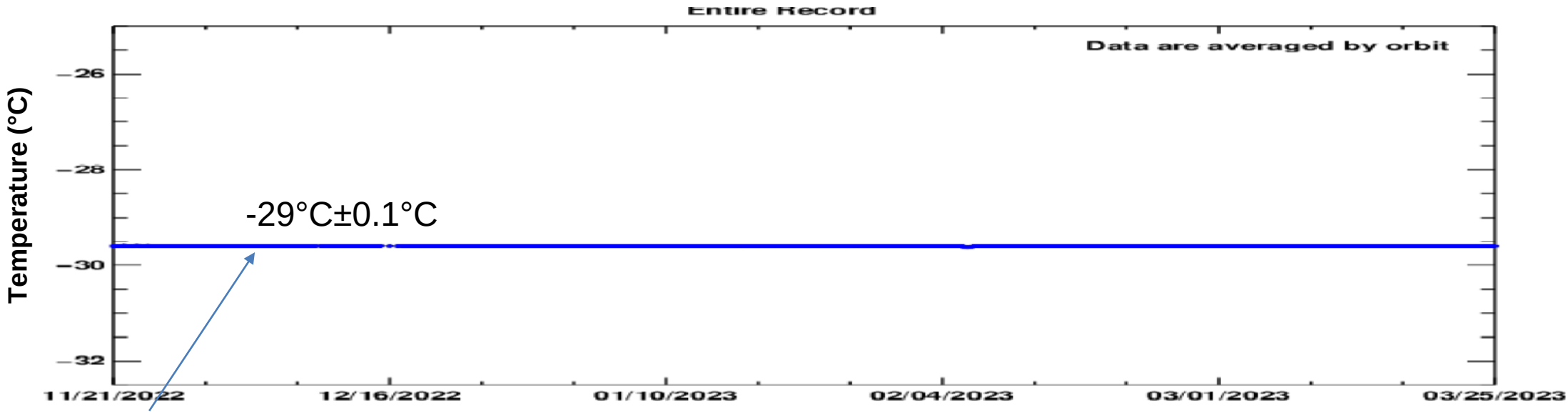


[1] Courtesy of NASA OMPS Group for sharing the NOAA-21 OMPS PLT Activity Schedule

[2] Timeline is not shown on scale

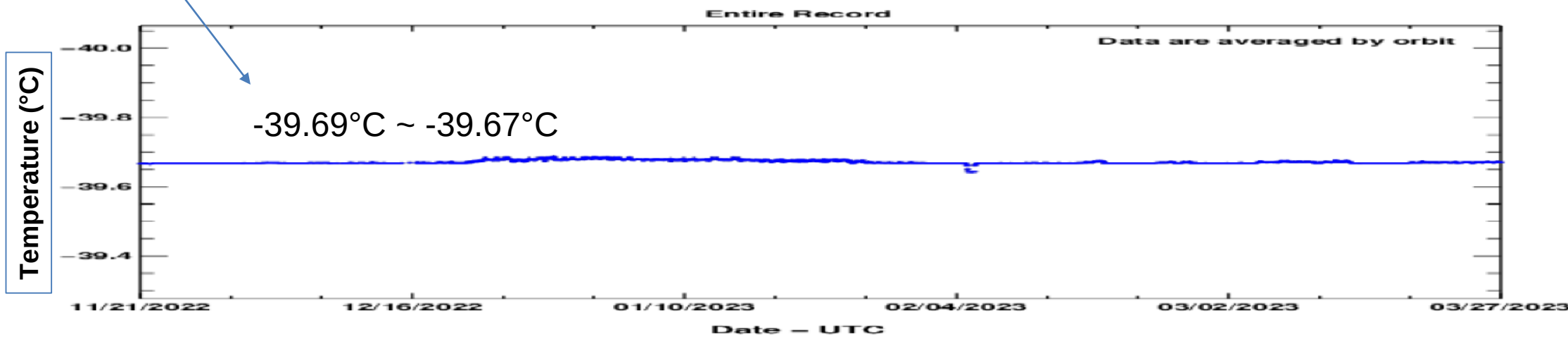
OMPS CCD Temperature Monitoring from ICVS

OMPS NM

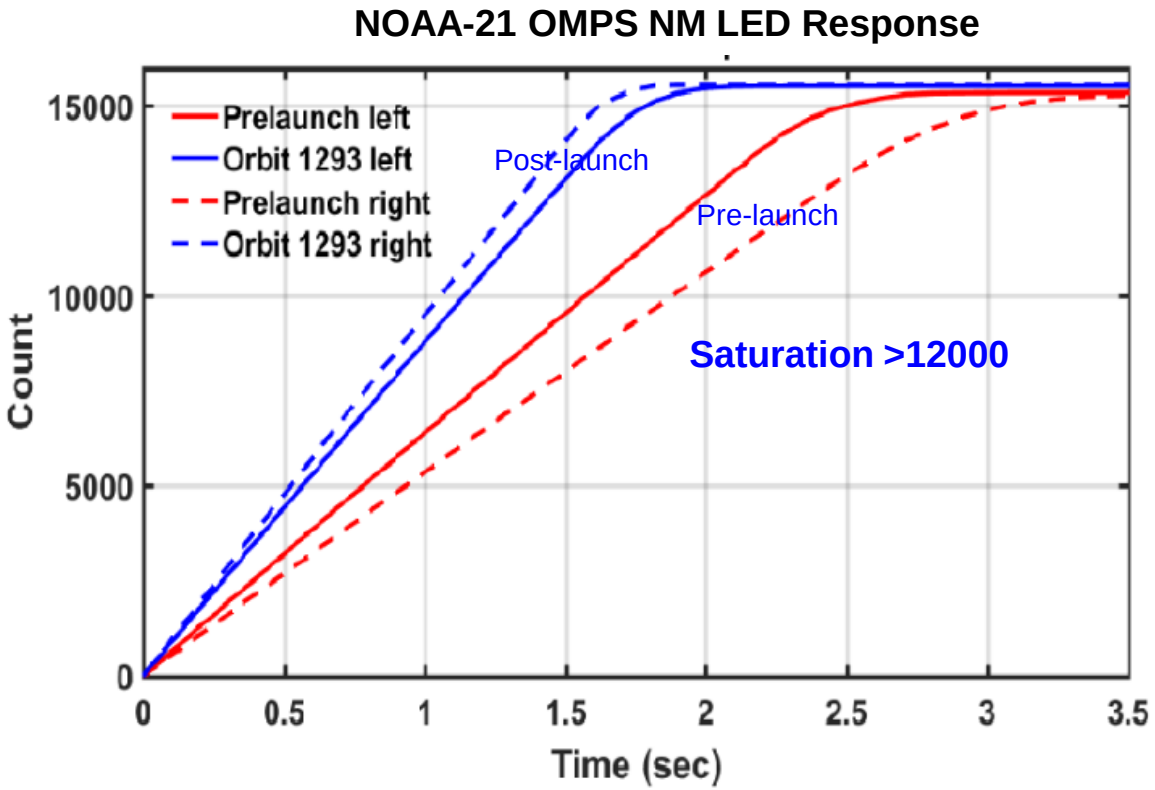


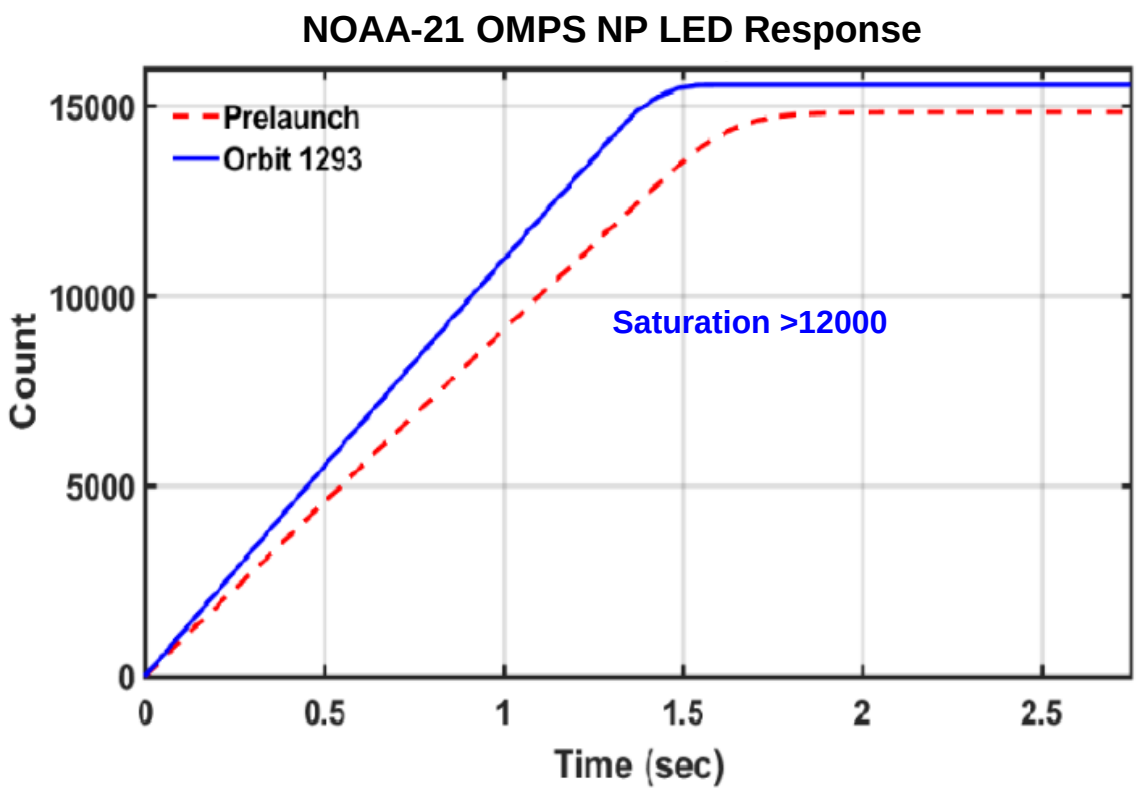
NOAA-21 OMPS NM/NP CCD temperatures are very stable

OMPS NP



OMPS Instrument Performance: CCD Signal Dynamic Range





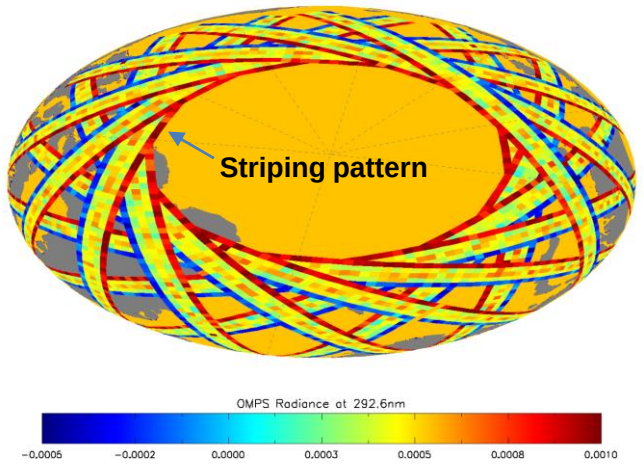
NOAA-21 OMPS CCD raw counts dynamic range:

- Saturation happens after 12000 counts

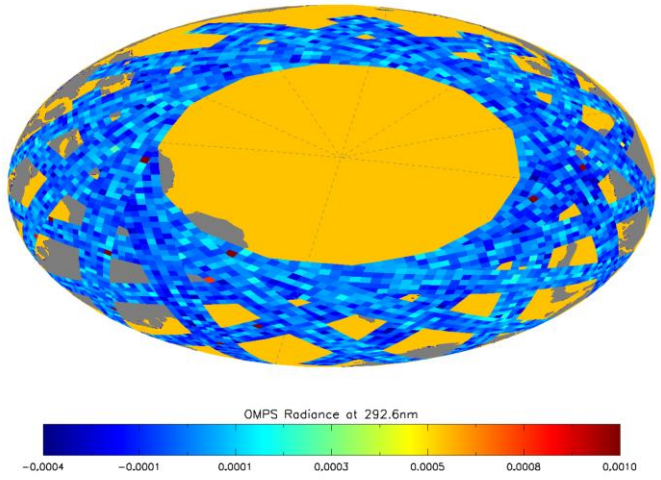
Impact of On-Orbit Dark Look-Up Table (LUT) Implementation

- The analysis showed that the pre-launch dark LUT caused anomalous features (striping pattern) in the door-close J2 OMPS NM and NP radiance data. An example for NP is given in Fig. a)
- With a postlaunch dark rate LUT, the above striping feature was significantly mitigated (see Fig. b)
- The first dark rate LUT was delivered on 01/17/2023
  - Fixed the striping and other unexpected features in the door-closed EV radiance image D (01/17)
  - Started the weekly dark LUT delivery since 02/13/2023

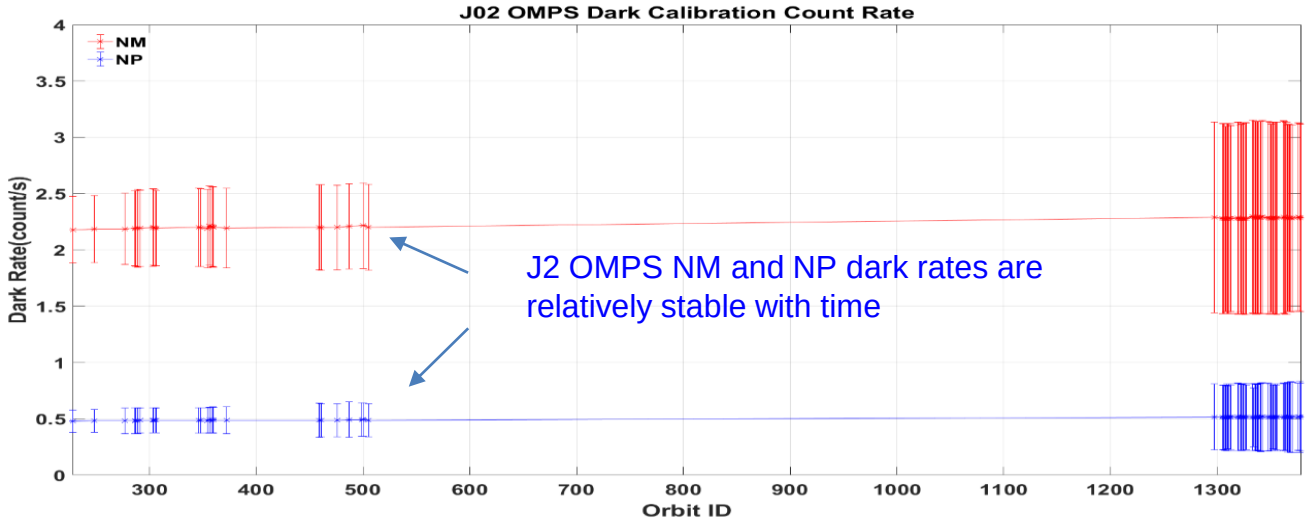
(a) Operational NOAA-21 OMPS NP Door-Close Radiance (A prelaunch dark LUT or JCT3 TVAC version)



(b) J2 OMPS NP Door-Close Radiance (A post-launch dark LUT based on on-orbit data)



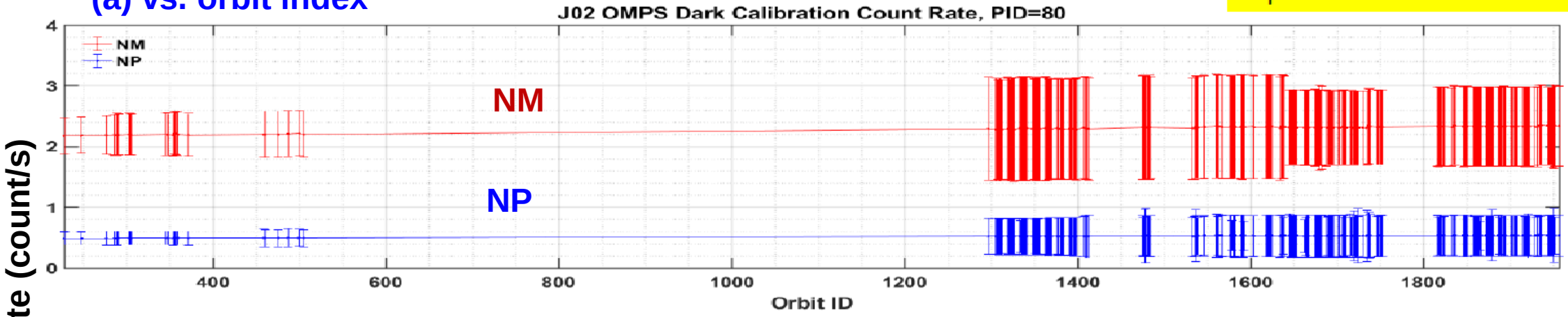
(c) J2 OMPS NM and NP Dark Rate Time Series



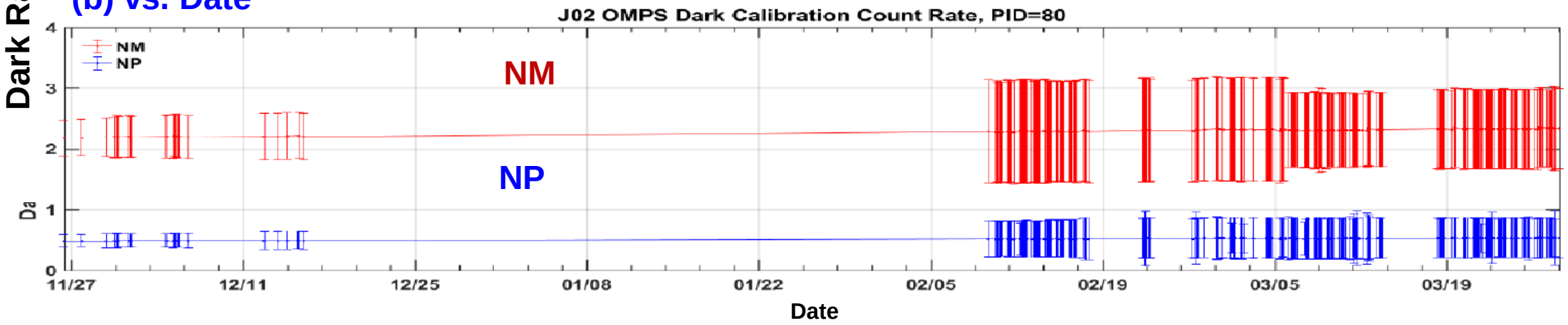
OMPS NM and NP Dark Rate Monitoring

Updated to orbit 1957

(a) vs. orbit index



(b) vs. Date

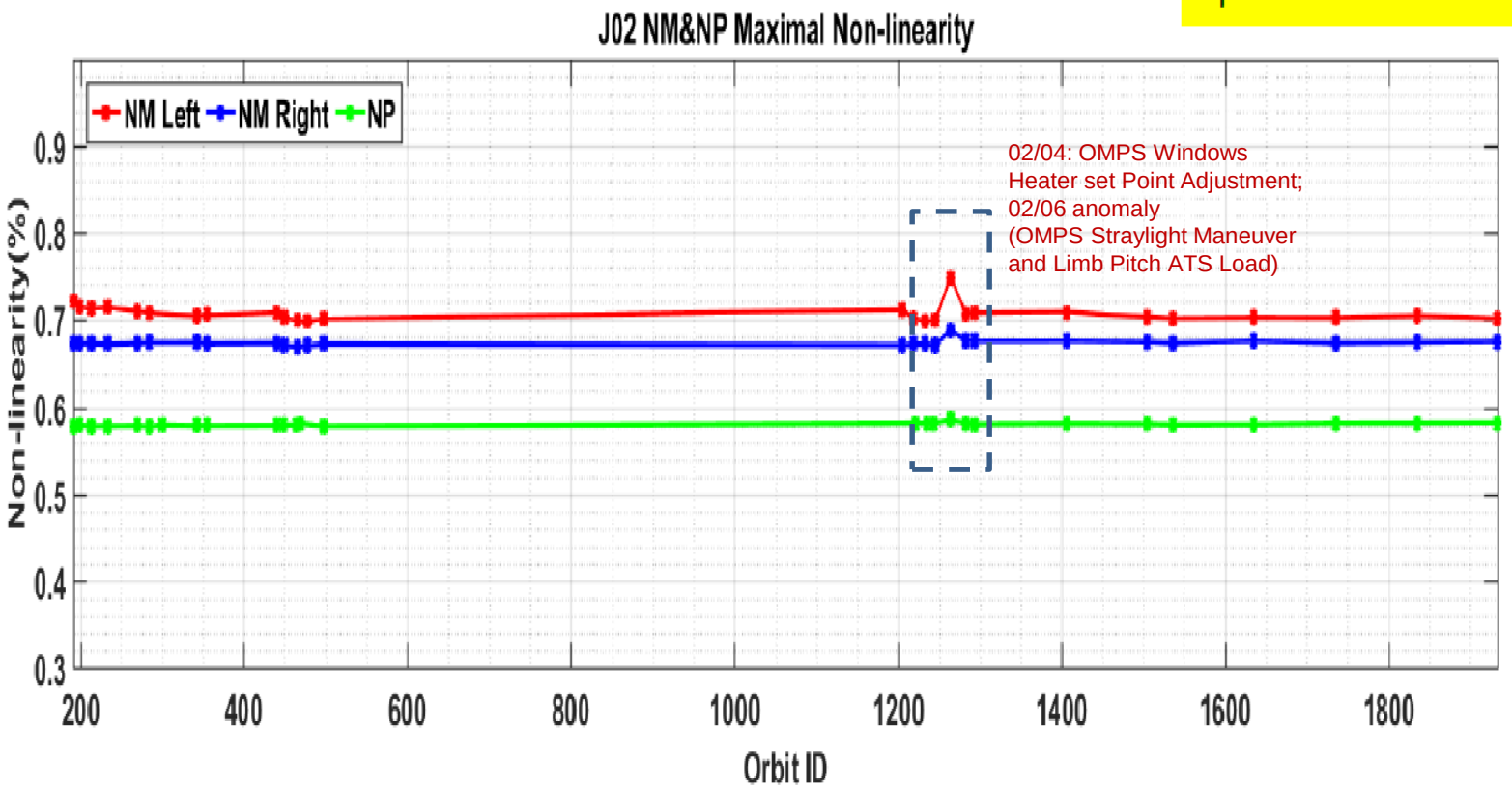


- The first delivery for the dark LUT started on 01/17/2023;
- The weekly dark LUT delivery started on 02/13/2023;
- The OMPS NM/NP CCD dark rate with time is relatively stable.

OMPS On-Orbit Nonlinearity Performance: Meet Requirement

- NOAA-21 OMPS NM and NP on-orbit nonlinearity performs stably: the system nonlinearity is less than 0.75%
  - Time series of maximum nonlinearity for the NOAA-21 OMPS NM (left and right CCD) and NP is shown in the figure.
  - The maximum nonlinearity is constantly smaller than 0.7%, within the requirement of 2%

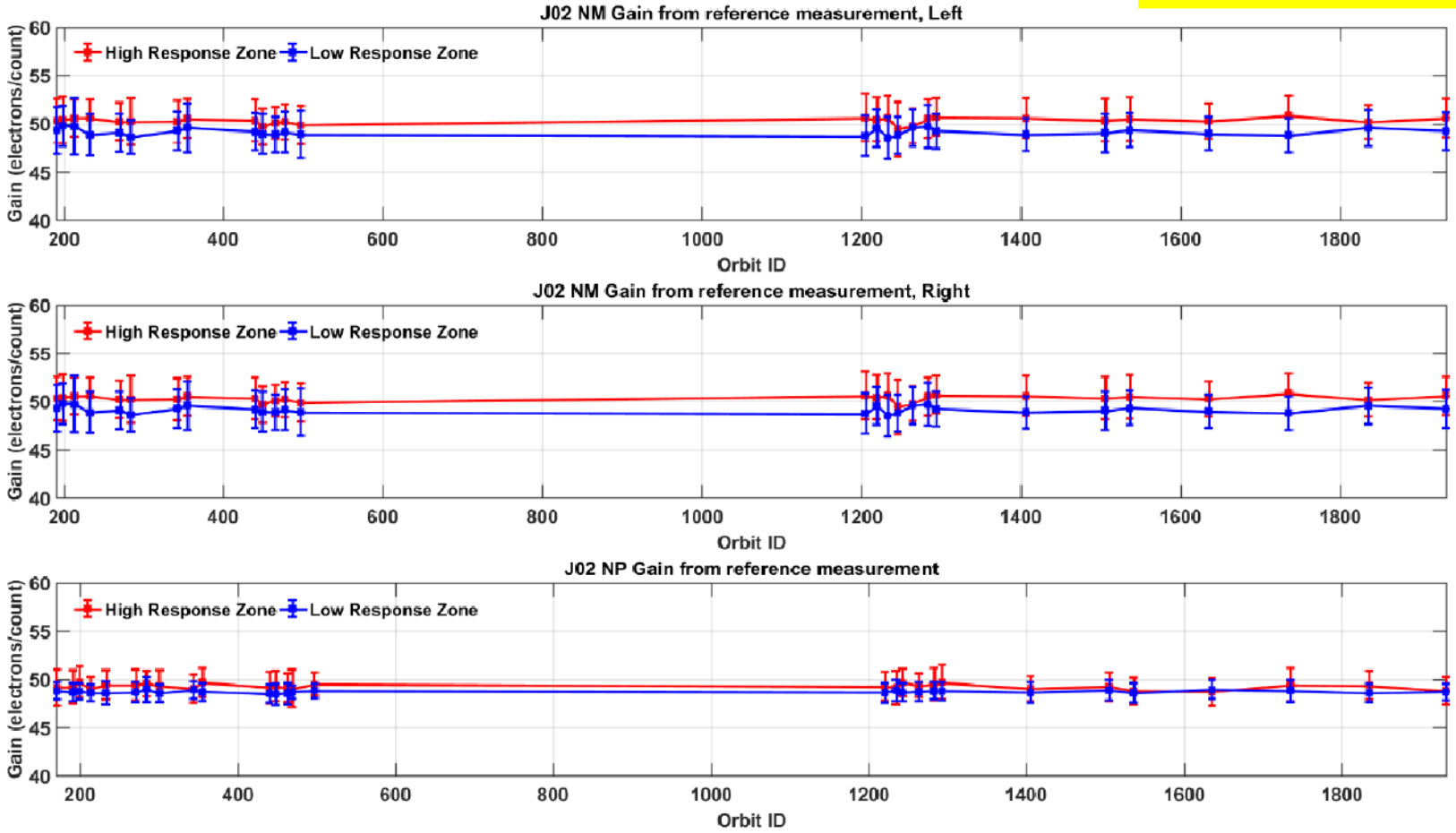
Updated to orbit 1933



OMPS Gain Performance: Stable

- The NOAA-21 OMPS NM and NP system gains (electron#/count) are assessed based on the LED data by using the mean variance method that was used in the SNPP and NOAA-20 OMPS (Kowalewski et al., 2012)
- Time series of the NOAA-21 NM and NP gains are showed in the figure, demonstrating a relatively stable gain with small offsets relative to the pre-launch TVAC values.

Updated to orbit 1933

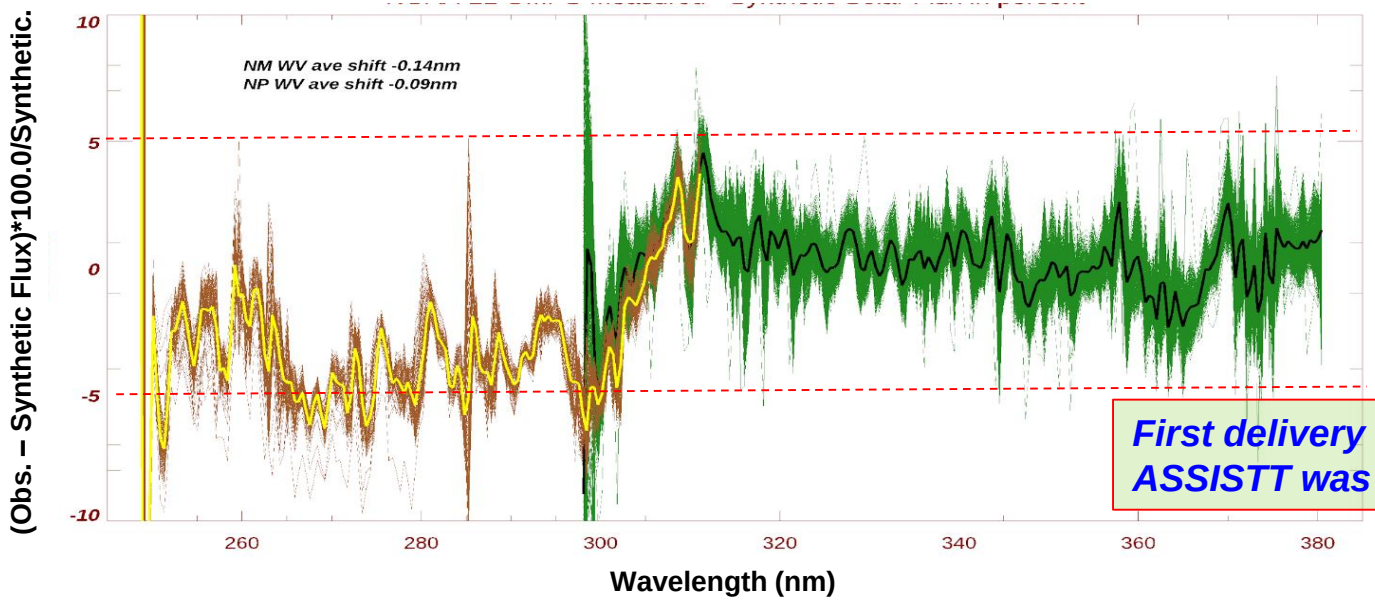


Relatively stable with time: within ±1%

Wavelength Registration Changes (1st Version)

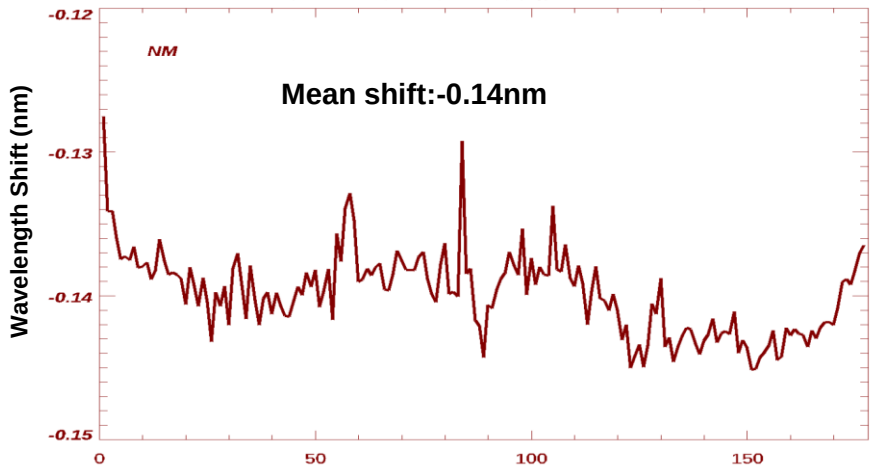
- The J2 OMPS NM and NP wavelength registration is changed due to the instrumental thermal temperature change from ground to orbit.
- The NM/NP wavelength changes relative to the pre-launch (a synthetic solar spectrum) are determined based on the first solar diffusor measurement data. The methodology is similar to the OMPS ATBD methodology).
- The preliminary results show that the wavelength mean changes are **-0.14 nm for NM and -0.09 nm for NP**.
- Further improvement is needed by considering a possible solar activity impact correction.

(a) J2 OMPS Nadir Solar Spectrum Difference between WV-Shifted Obs. and Synthetic (%)

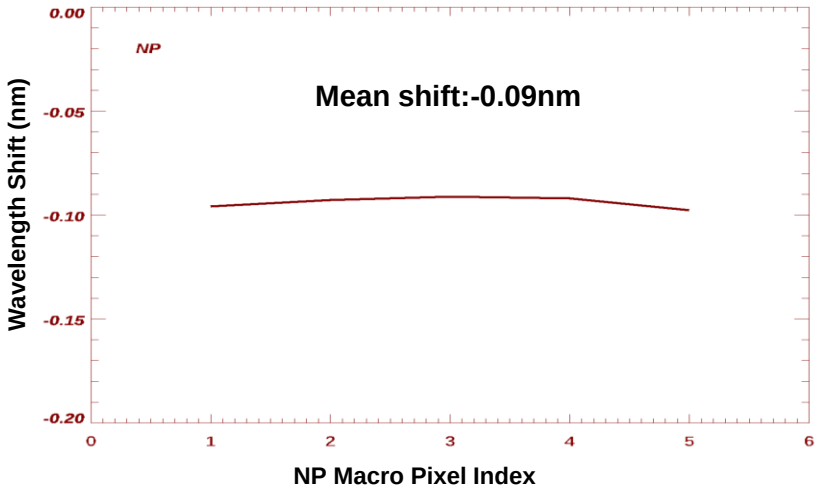


First delivery of the LUTs to ASSISTT was made on 03/01

(b) NM Wavelength Shift vs. Cross-Track Position

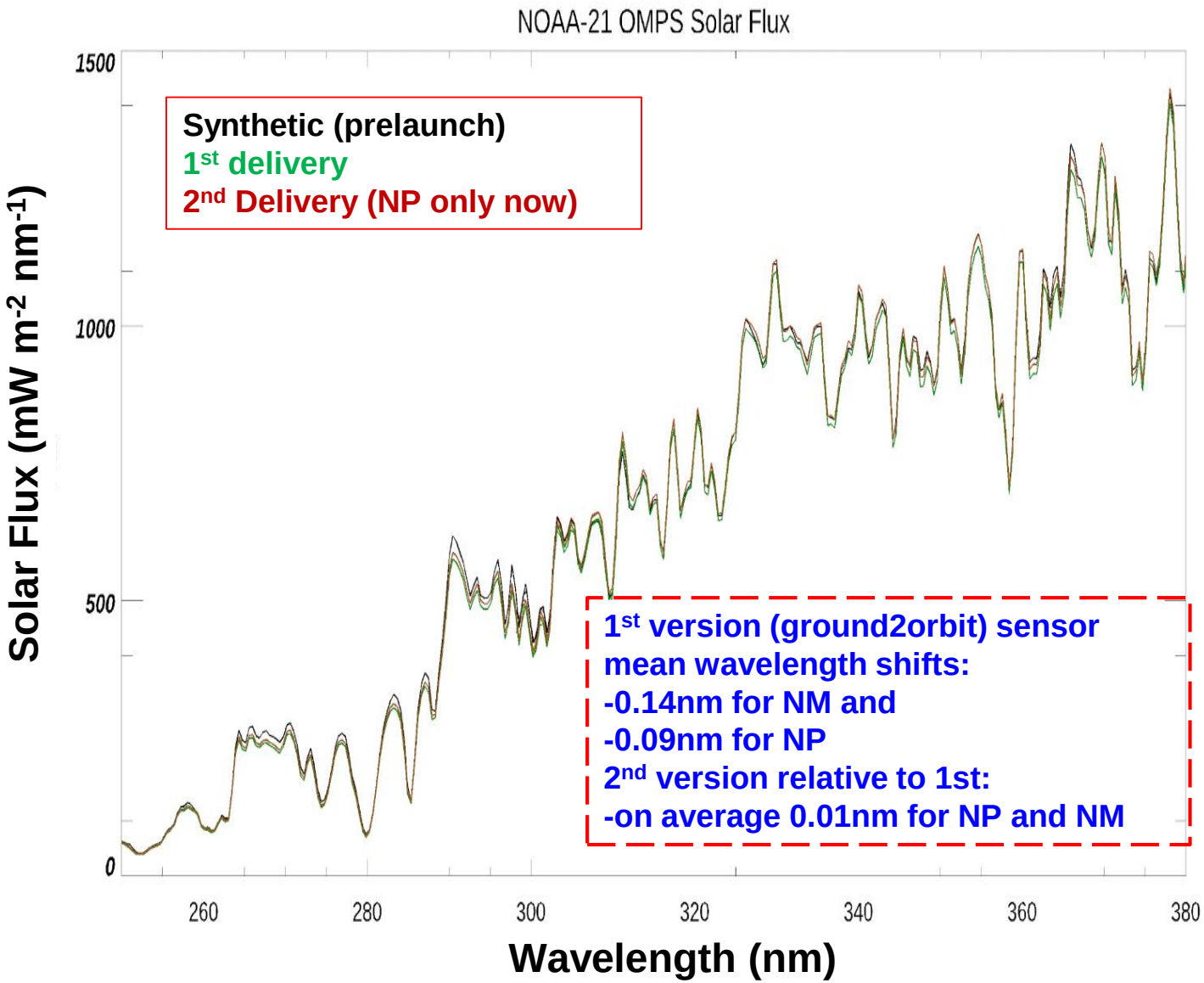


(c) NP Wavelength Shift vs. Cross-Track Position



OMPS NM and NP Wavelength Registration Update

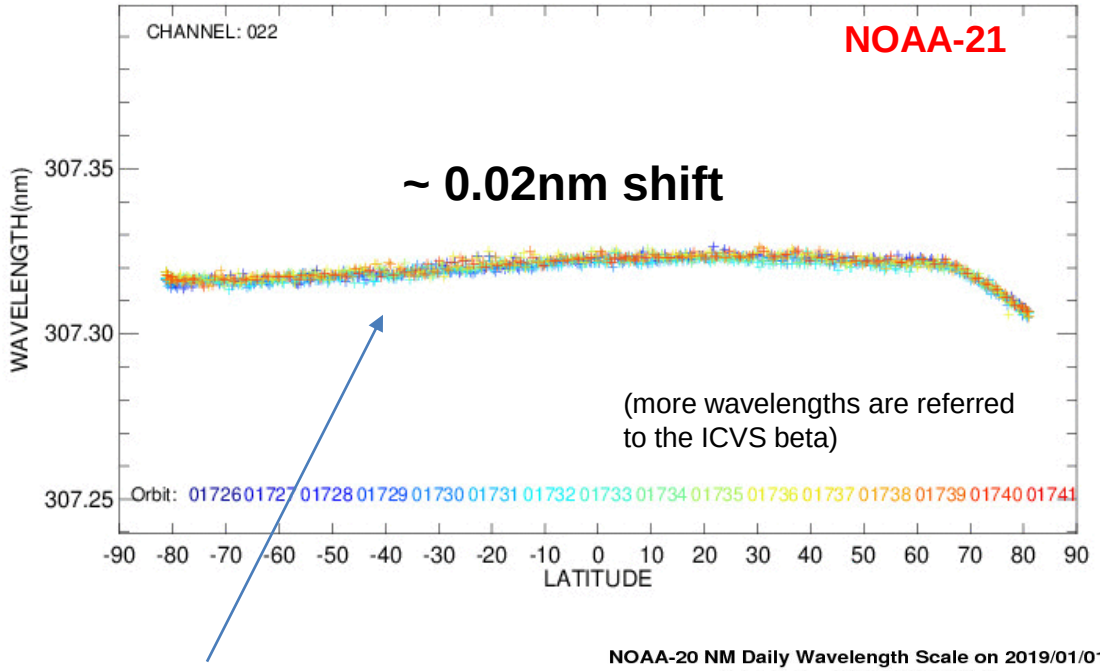
- So far, six measurements are made for solar flux data via the solar working diffuser
  - 02/09,02/17,02/26,03/03,03/12,03/19
- Based on the 02/17 solar flux data,
  - On 03/01, 1st NM and NP wavelength and OSOL LUTs were delivered (also fixing the 3-pixel-shift problem in NM radiance data) *(Slide #23 ~ 26).*
- Based on the 03/19 solar flux data,
  - On 03/21, 2nd NP wavelength and OSOL LUTs were delivered, as a regular bi-weekly delivery (also fixing the 12-pixel-shift problem) *(Slides from 27 to 30*).
  - 2nd NM wavelength and OSOL LUTs are to be delivered, fixing the discontinuity issue at the macro-pixels from 82 to 84 (*Slides from 31 to 32*).
  - Detailed analyses for the NASA SIPS solar flux L1B data are referred to slides #59 to 61 in backup portion



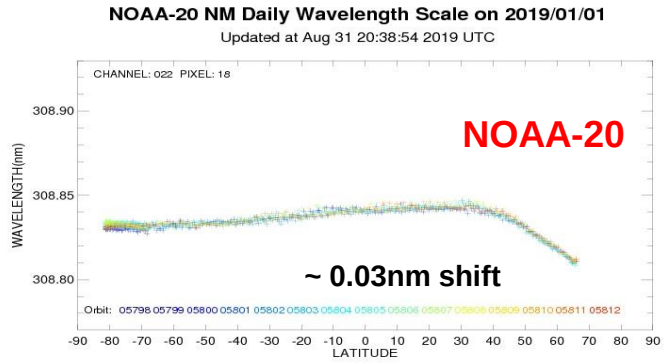
NOAA-21 OMPS NM Intra-Orbit Wavelength Shift Performance Monitoring from ICVS

- The operational ADL processing uses an automatic algorithm (Flynn et al. 2013) to characterize the NOAA-21 OMPS NM intra-orbit wavelength shift and corrections.
- The ICVS provides a regular monitoring for the OMPS NM intra-orbit wavelength shift features including NOAA-21 (https://www.star.nesdis.noaa.gov/icvs-beta/status_J02_OMPS_NM.php).
- The NOAA-21 NM shows a stable intra-orbit wavelength shift pattern so far, with a variation of 0.02nm.

NOAA-21 OMPS NM Intra-Orbit Wavelength Shift at 307.35nm (03/12 ~ 03/23, available nominal data) (Animated)

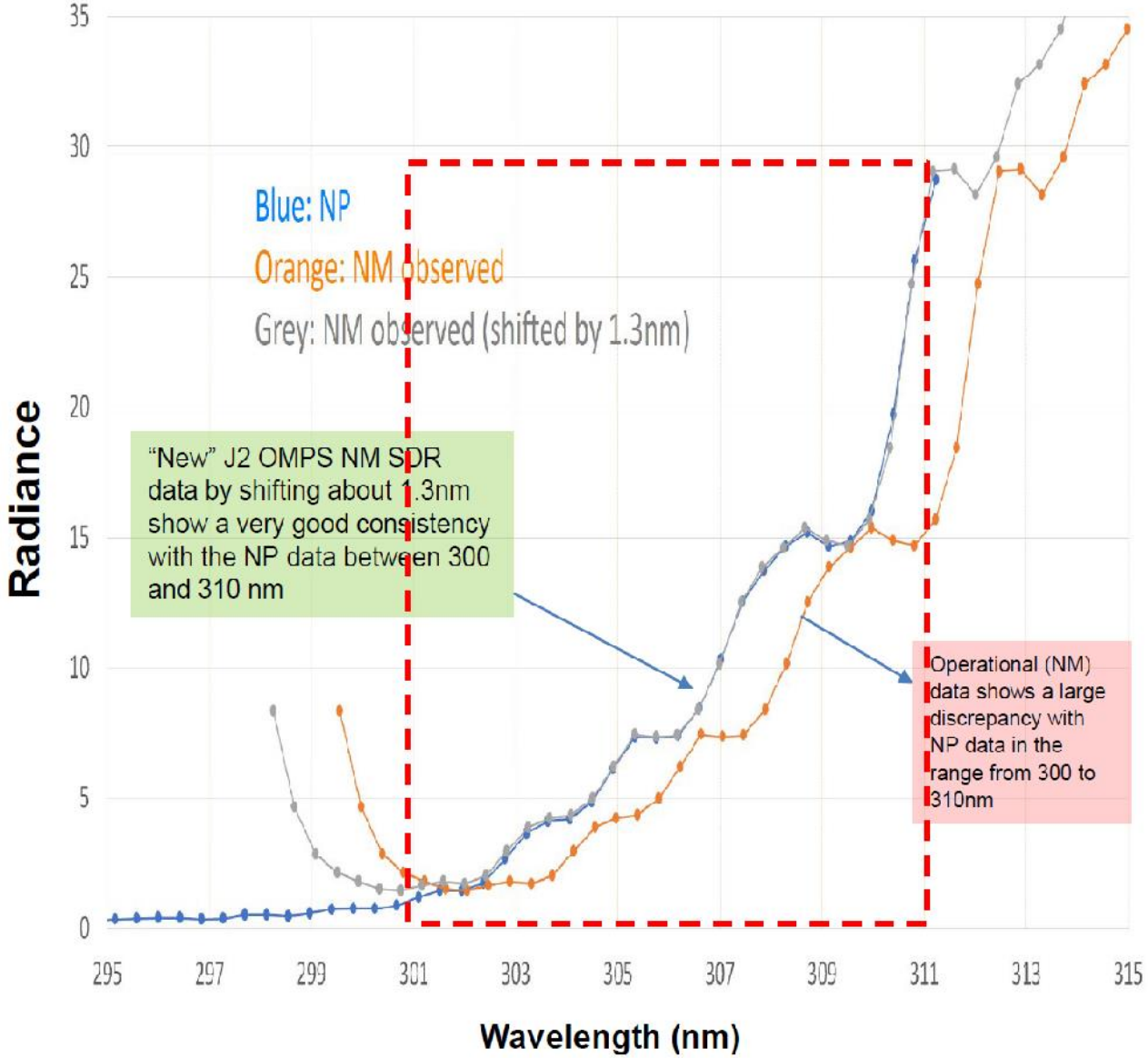


The NOAA-21 OMPS NM shows a stable intra-orbit wavelength shift pattern with time, with a shifted range within 0.02nm that is slightly smaller than the NOAA-20 (~ 0.03nm)



One Action from the NOAA-21 OMPS SDR Beta Review: 3-Pixel-Shift Issue (well done, 03/09 Operation)

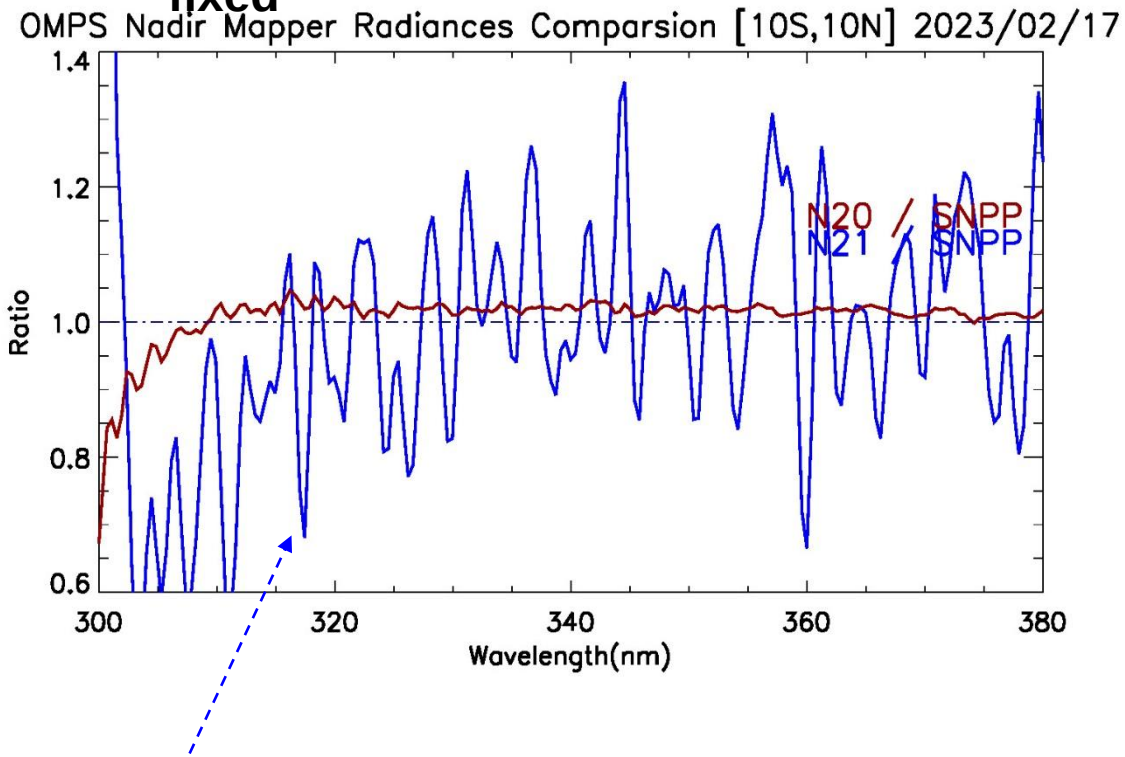
- DR 10281: NOAA-21 OMPS NM wavelength 3pixel-shift error
  - A 3-pixel shift issue was detected in the NOAA-21 OMPS NM wavelength table. This issue can cause the inconsistency in EV radiance in the range from 300 to 310 nm between the J2 OMPS NM and NP (see Figure).
  - Solution: Updated the four LUTs (OSOL and wavelength LUTs).
- The updated LUTs were successfully implemented on 9 March 2023 @16:10 GMT



(LAT: 8.65°N~9.08 °N; LON: -104.98 °W ~ -104.52) °W

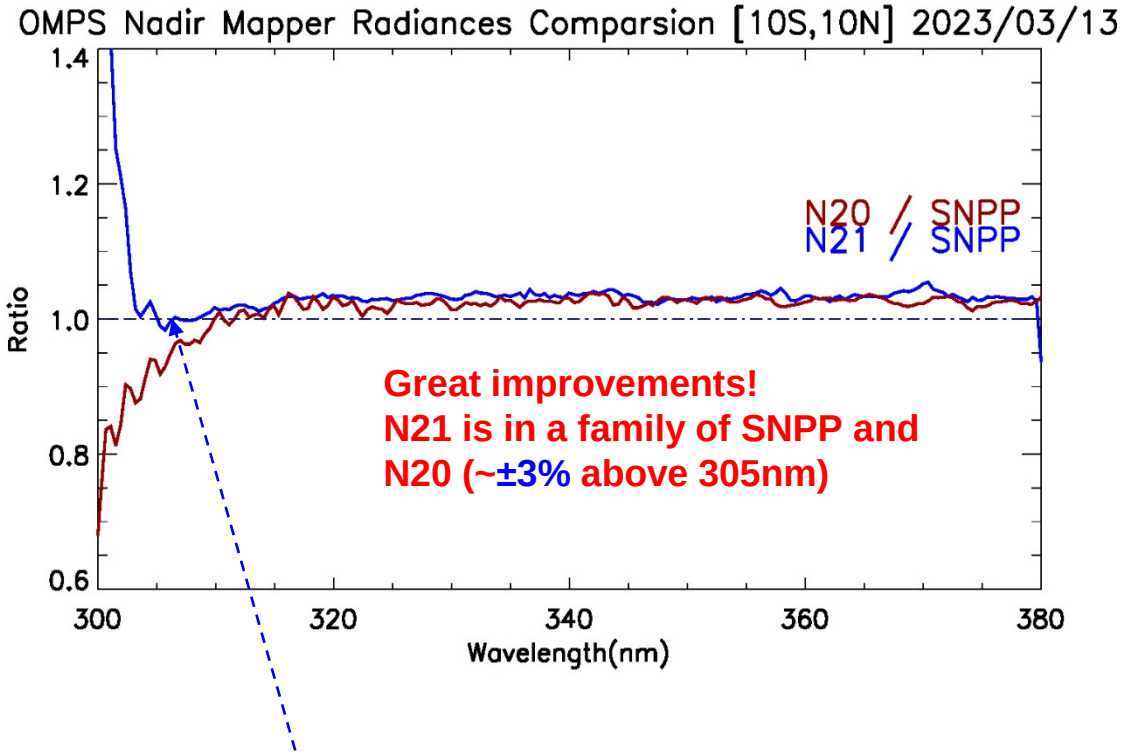
Verification of the Updated LUTs (Especially 3-Pixel-Shift-Correction)

(a) Before the 3pixel-shift-issue was fixed



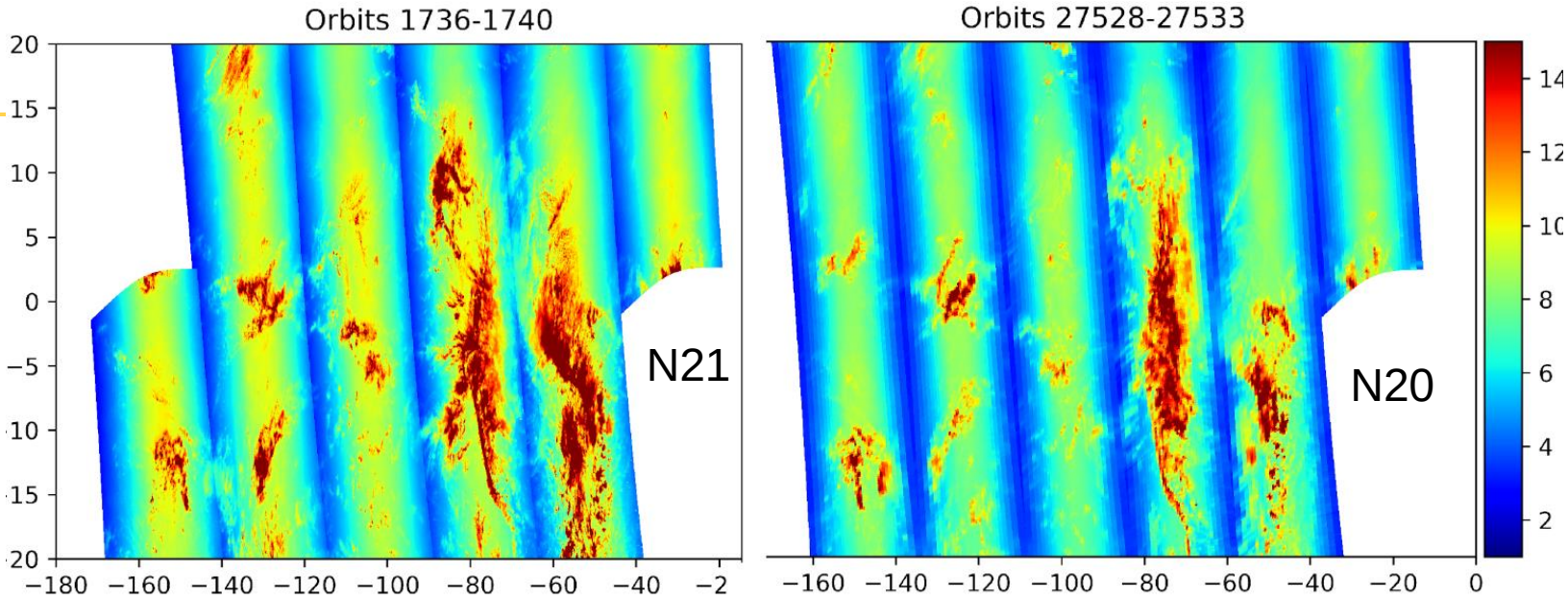
N21/SNPP radiance ratio significantly deviates from one with large fluctuations

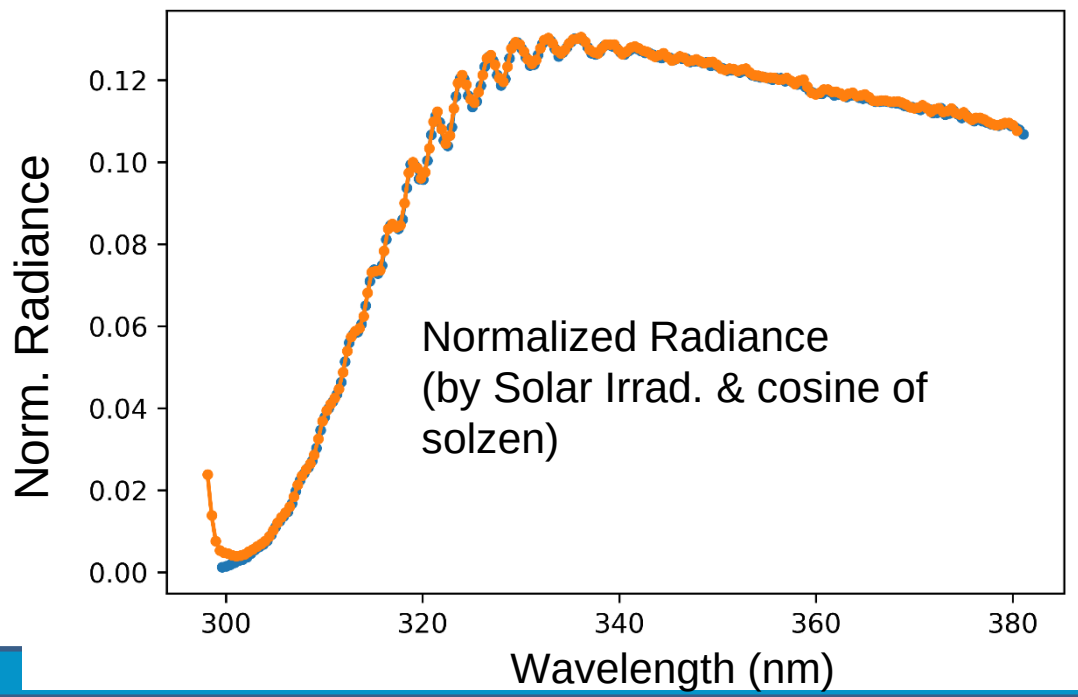
(b) After the 3pixel-shift-issue was fixed

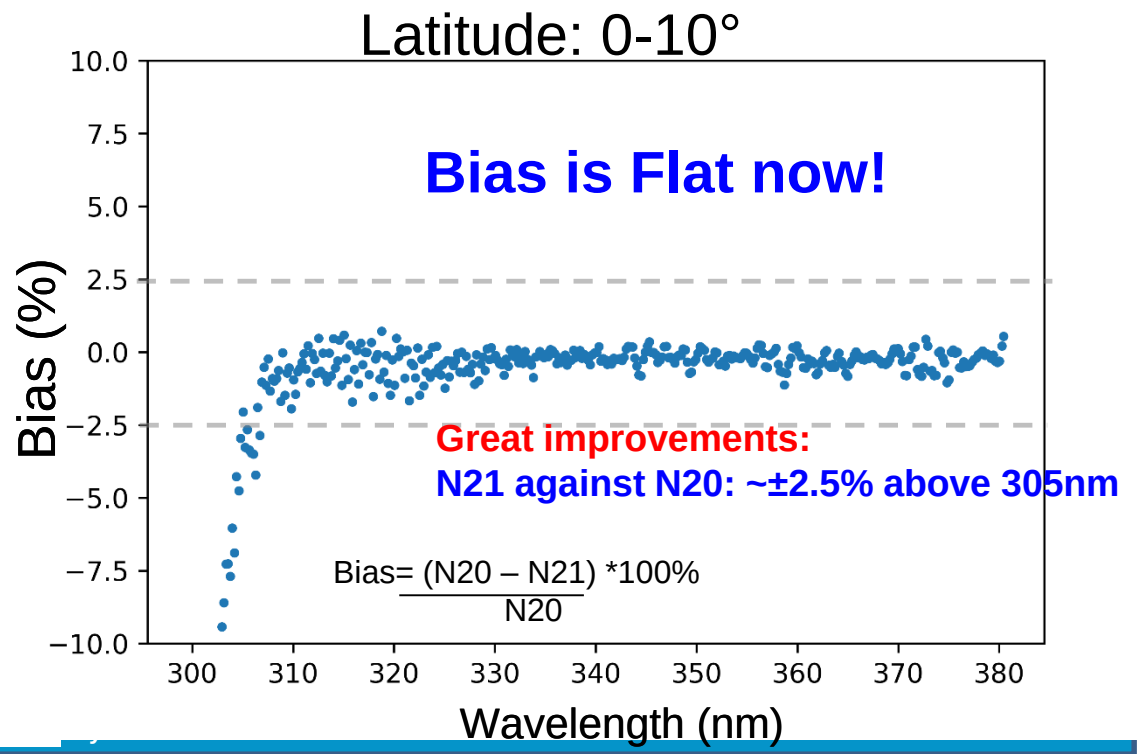


N21/SNPP radiance ratio is very close to one with a relatively uniform variations except below 305nm

Another Demonstration: Comparing N21 and N20 (0-10° Latitude) using the data on 03/13 (New LUTs):



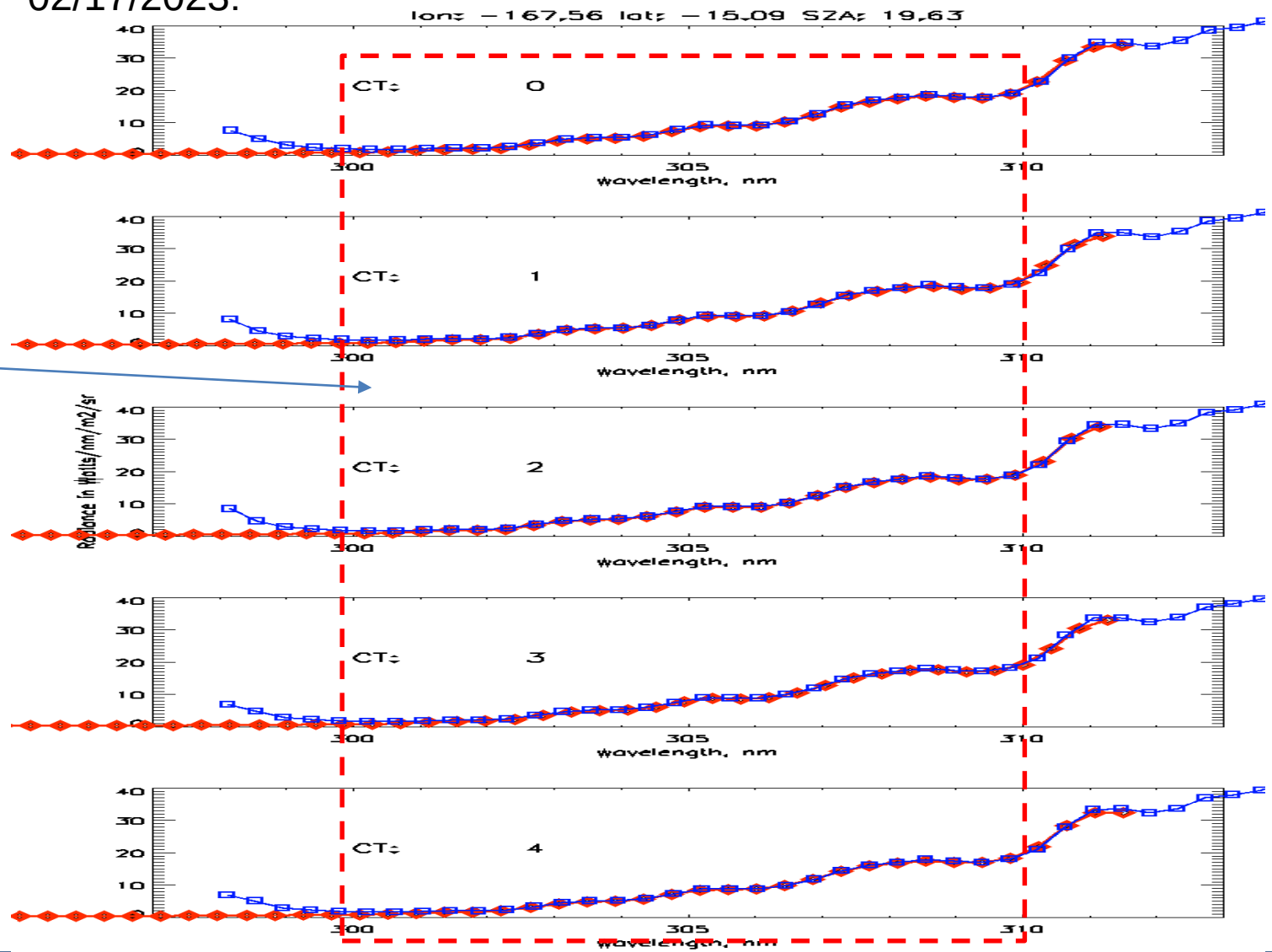




Demonstration on NOAA-21 OMPS NM and NP Radiance in the overlapped range between 300 to 310 nm (New LUTs)

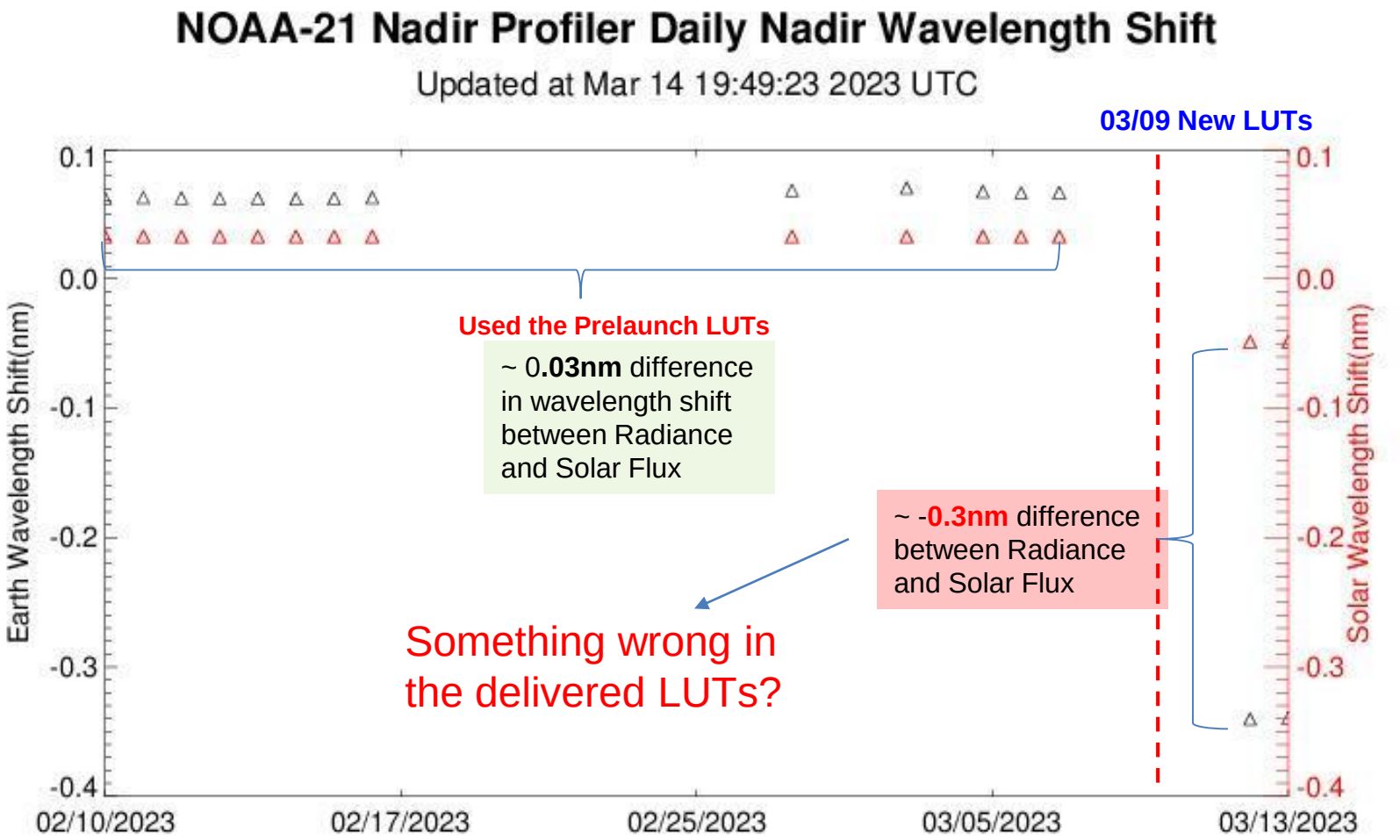
02/17/2023:

Use of the updated LUTs results in a much consistent radiance between the NM and NP in the range between 300nm and 310 nm



New Issue # 1: A 12-Pixel-Shift Problem Detected in NOAA-21 NP Solar Flux Data*

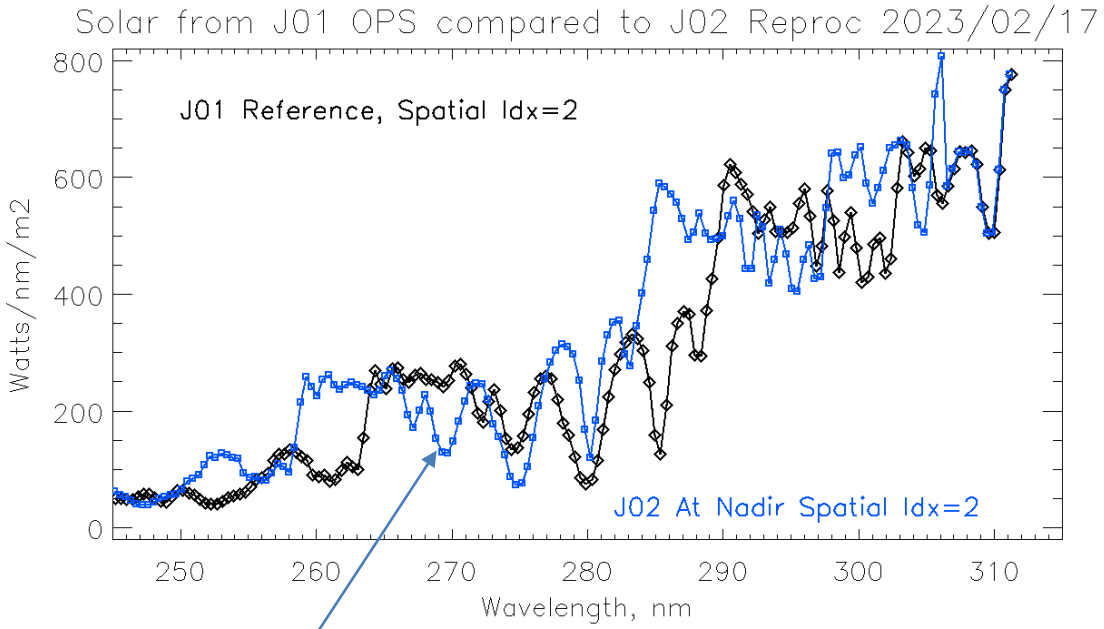
(Well Done; New Table into Operation on 03/23)



*The figure was generated by D. Liang in the ICVS team; the problem was reported by L. Flynn in the OMPS EDR team

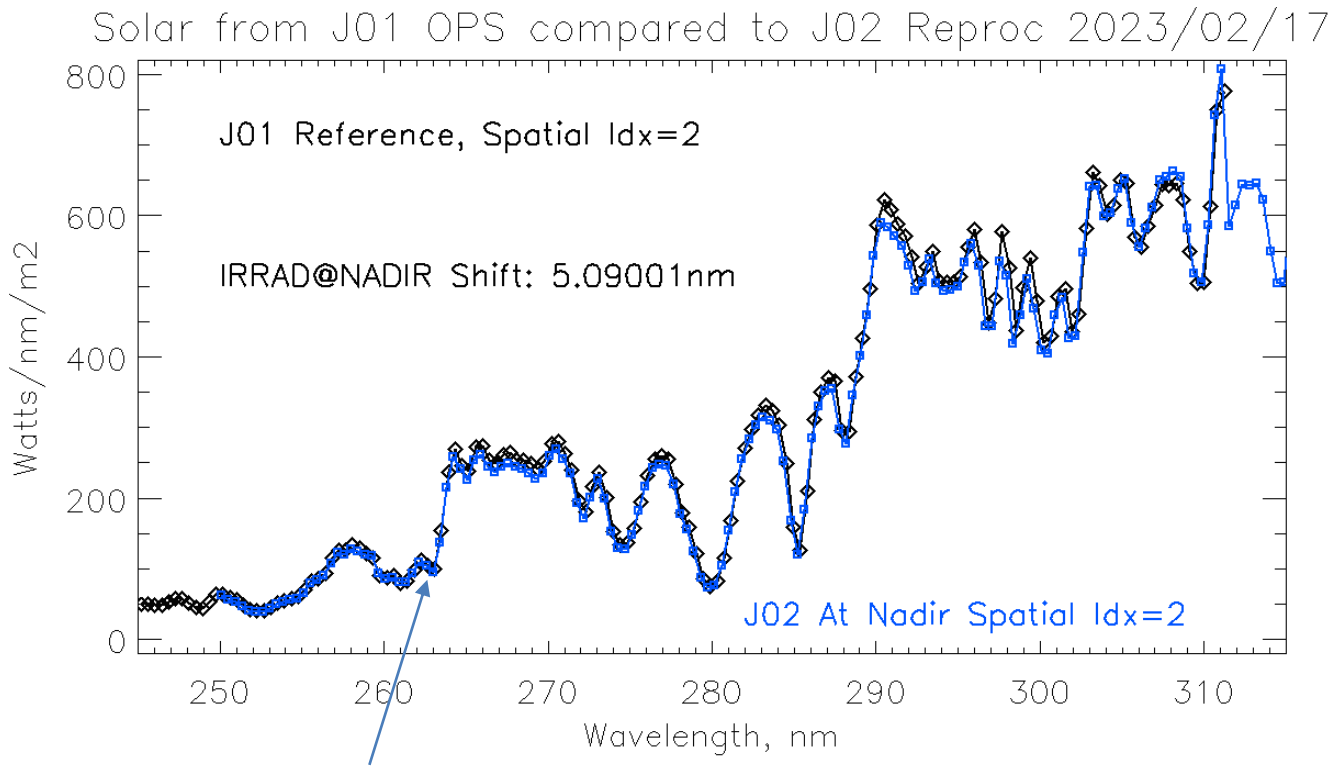
Impact of 12-Pixel-Shift Problem on NOAA-21 NP Solar Flux Data

(a) In the presence of the 12-pixel-shift issue



NOAA-21 solar irradiance spectrum significantly deviates from the NOAO-20 spectrum

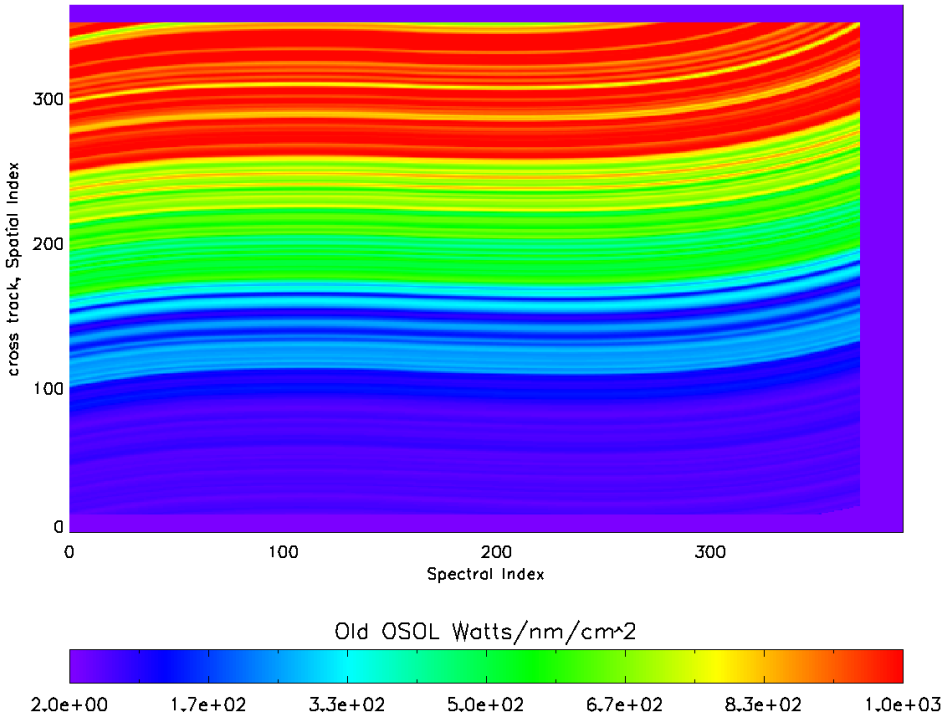
(b) Fixing the 12-pixel-shift issue



NOAA-21 solar irradiance spectrum is very comparable to the NOAO-20 spectrum

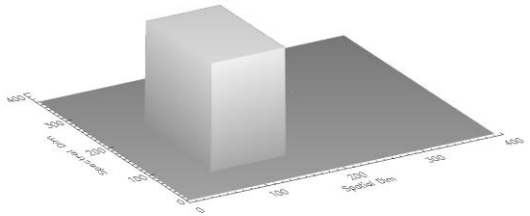
Root Cause to the 12-Pixel-Shift Problem in the DR10281-Delivered NOAA-21 OMPS-NP-OSOL LUT

Solar NP OSOL Table without problem

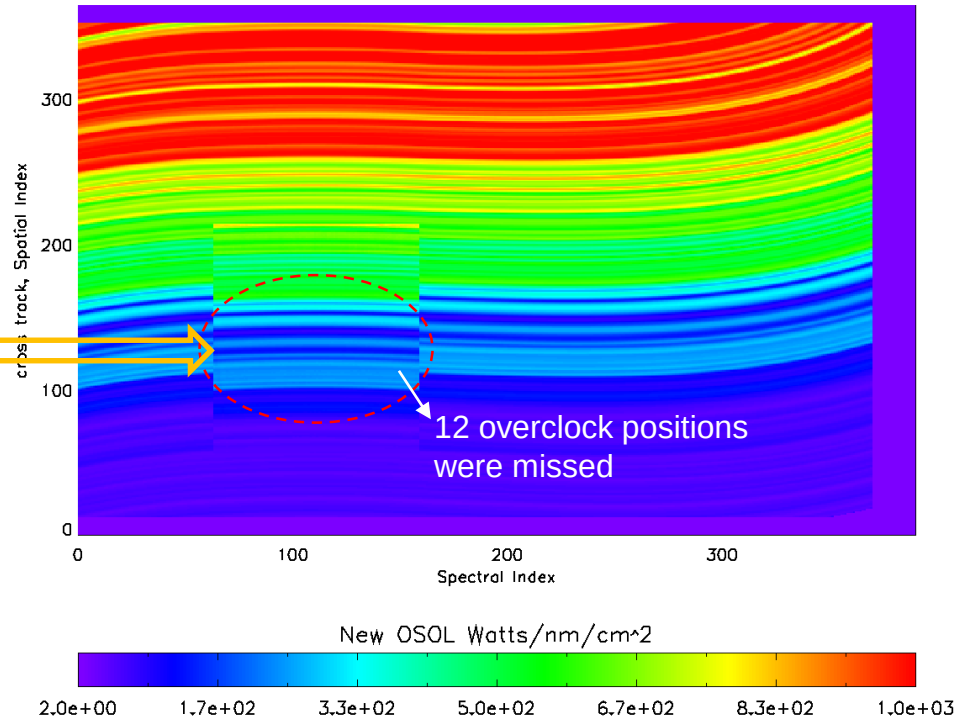


The 12-pixel-shift error causes about 5.01nm error for the NOAA-21 OMPS NP-OSOL (i.e., ~5.01nm shift in the SDR solar irradiance data)

Sample Table:

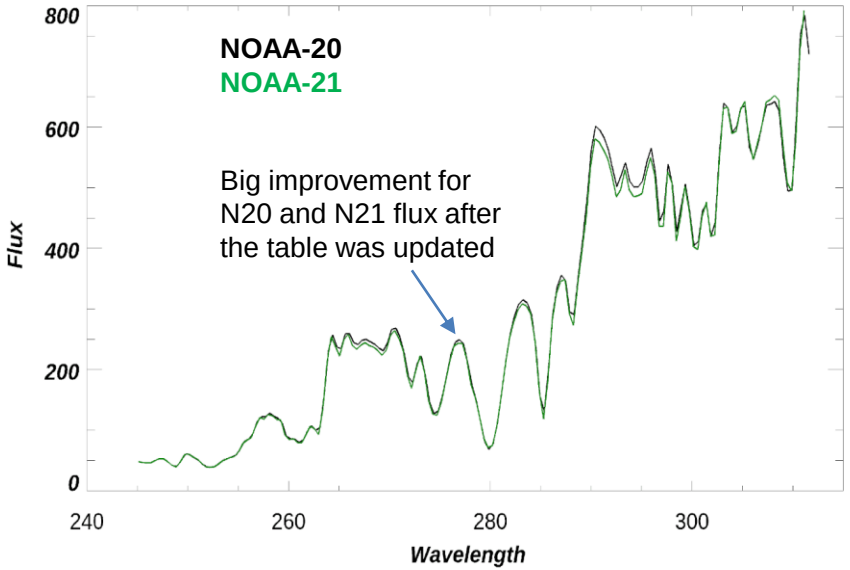


Solar NP OSOL Table with the problem (delivery 03/09)

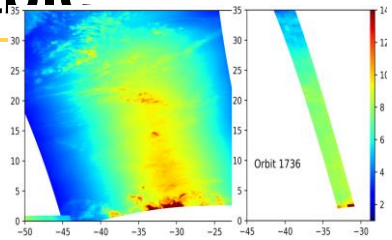


Validation of the Updated NOAA-21 OMPS NP OSOL Table

(a) OMPS NP Solar Flux Comparison between NOAA-20 and NOAA-21

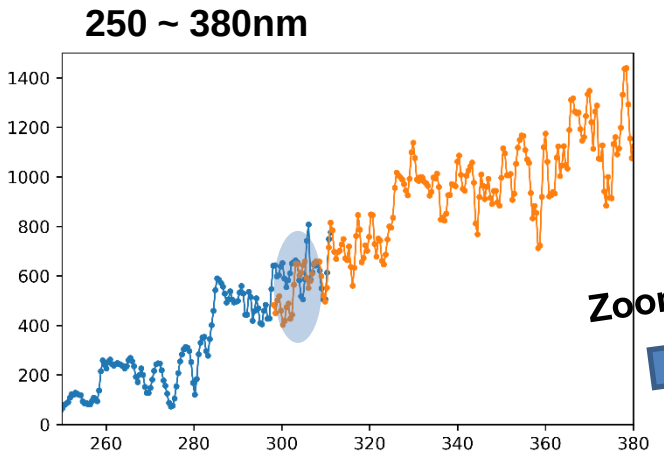


(b) OMPS NP Solar Flux Comparison between NOAA-21 NM and NP in 300 to 310nm

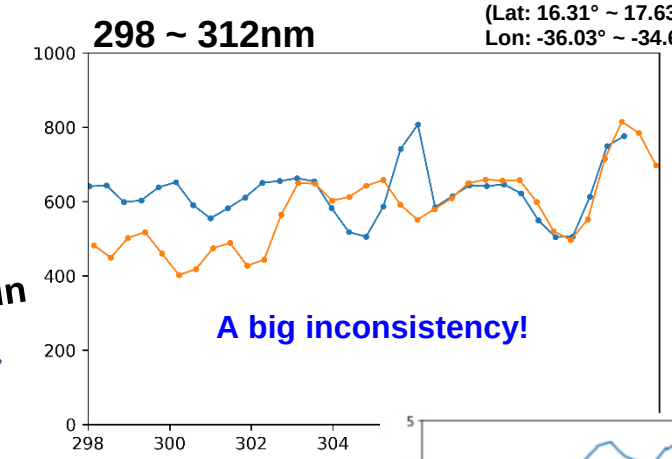


(Lat: 16.31° ~ 17.63°; Lon: -36.03° ~ -34.63°)

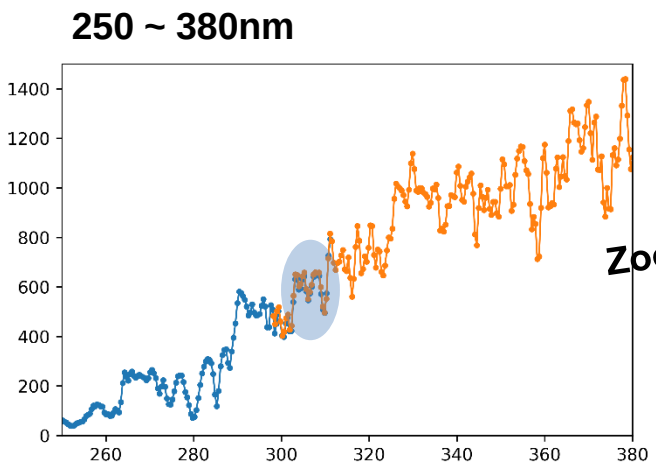
(1) Old OSOL LUT



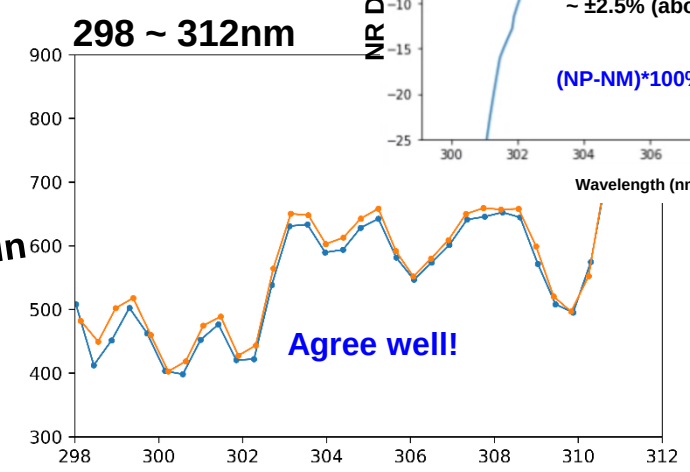
Zoom-in

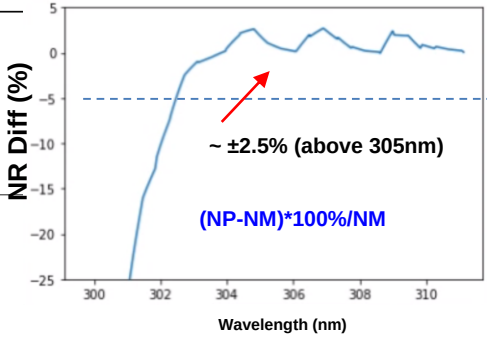


(2) New OSOL LUT



Zoom-in



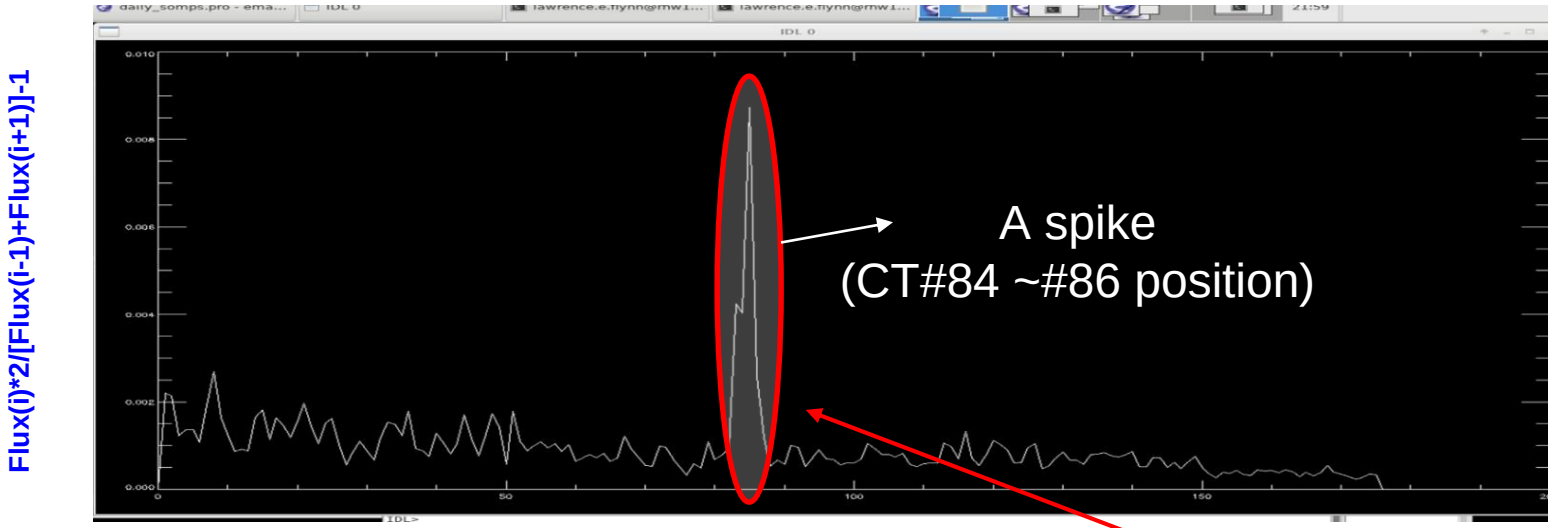


- An updated OSOL table for NOAA-21 OMPS NP was implemented into the operational processing on 03/24/2023.
- The new results demonstrate a much improved consistency between NOAA-21 NP EV radiance and solar flux comparison, the NOAA-20 and NOAA-21 NP flux comparison.
  - NM and NP normalized radiance (NR) averaged differences are within ±2.5% above 305nm.

New Issue# 2: A Wavelength Discontinuity Issue for NOAA-21 OMPS NM Spectrum nearby 85th Cross-Track Position

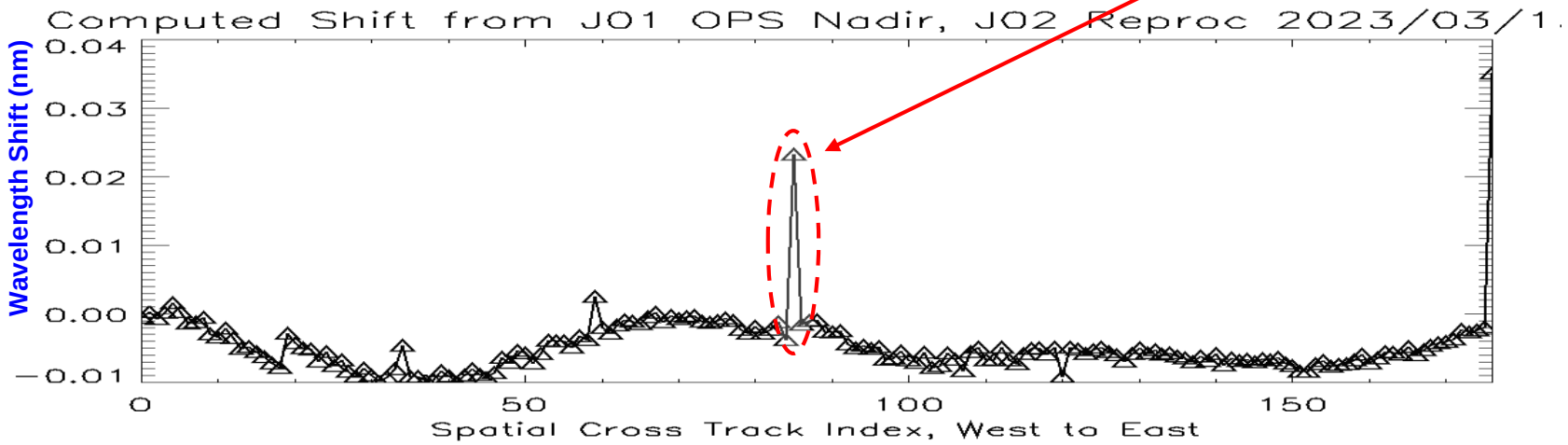
- A wavelength discontinuity issue was detected in the NOAA-21 OMPS NM SDR solar spectrum nearby the 85th cross-track position.
  - Th problem was captured when the NOAA-21 NM by checking each cross-track solar flux spectrum to the average of the solar flux for the adjacent spectra (see the upper panel figure; courtesy of L. Flynn)
  - The similar feature was detected by comparing the NOAA-20 and NOAA-21 OMPS NM solar spectrum (See the lower panel figure)
- The problem was caused by a big fluctuation in the previously derived wavelength shifts) (See next slide)

(a) Each cross-track solar flux spectrum to the average of the solar flux for the adjacent spectra: Flux(i)*2/[Flux(i-1)+Flux(i+1)]-1



Values from #84 to #86 are out of family!

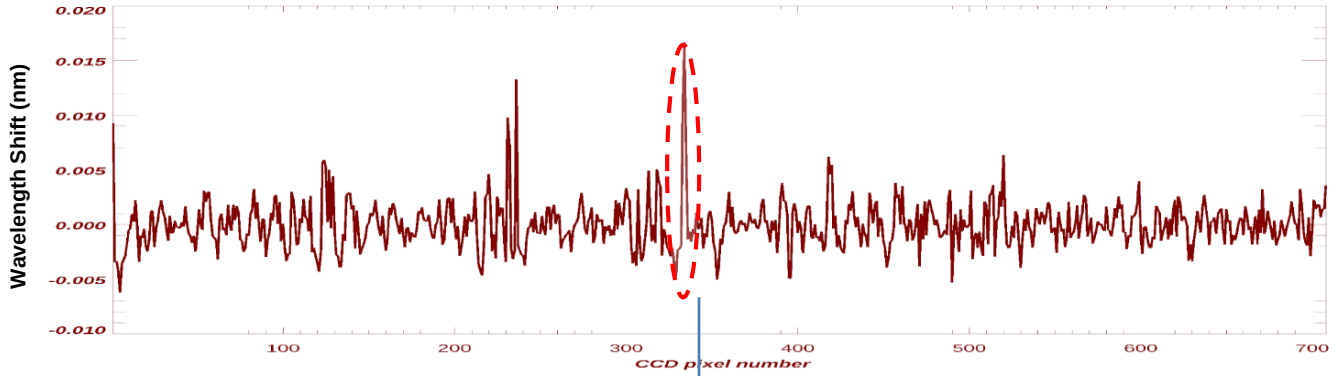
(b) NOAA-21 NM Solar Spectrum Wavelength Shifts Relative to NOAA-20



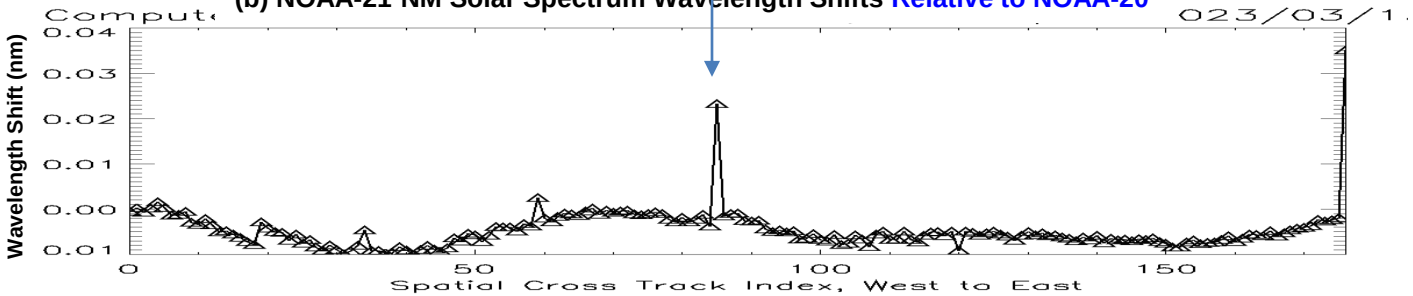
Root Cause and Solution to the Wavelength Discontinuity Problem

- The on-orbit NOAA-21 OMPS NM wavelength registration was conducted using the solar raw flux data for the wavelength shift estimation of the sensor from ground to orbit.
  - In 1st the algorithm, there are no proper QC criteria
    - Relatively large fluctuations especially at the 84th-86th CT positions.
  - In 2nd version , a proper QC was used to remove outliers.
    - Large fluctuations disappear.
- A new DR/CCR have been opened to update NOAA-21 NM OSOL and wavelength LUTs.
  - The updated LUTs are expected to deliver to the ASSISTT on 04/03/2023

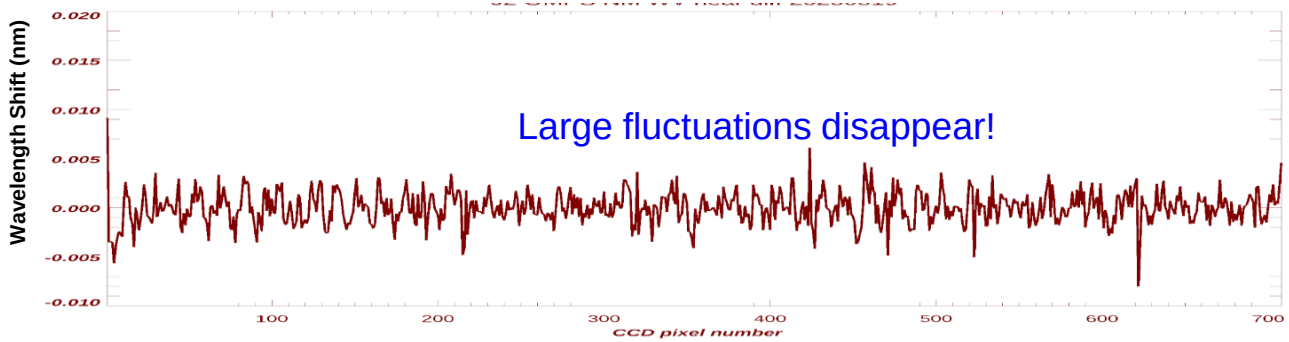
(a) NOAA-21 NM Wavelength Shift vs. CT Position (Ground to Orbit; Old Version)



(b) NOAA-21 NM Solar Spectrum Wavelength Shifts Relative to NOAA-20

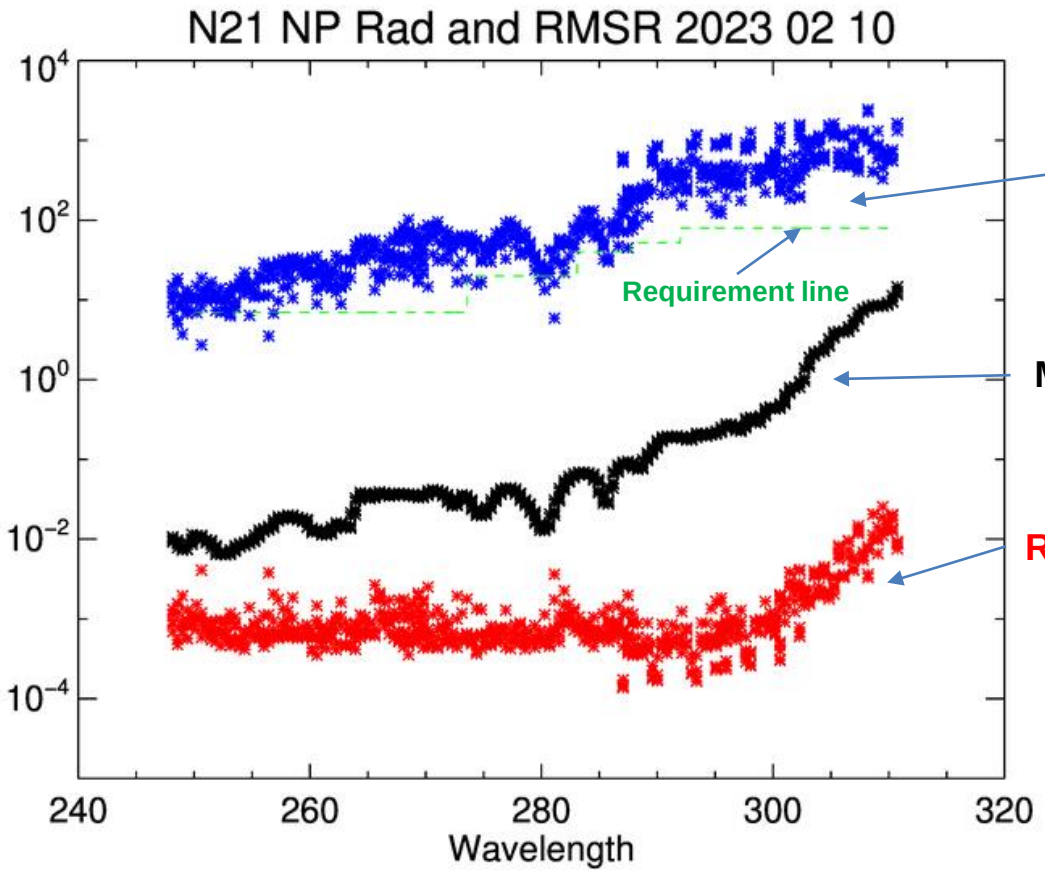


(c) NOAA-21 NM Wavelength Shift vs. CT Position (Ground to Orbit; Updated Version)



Earth View Noise Meets Requirements
(NP: 250 ~ 310nm; NM:305~380nm)

(a) NOAA-21 OMPS NP SNR

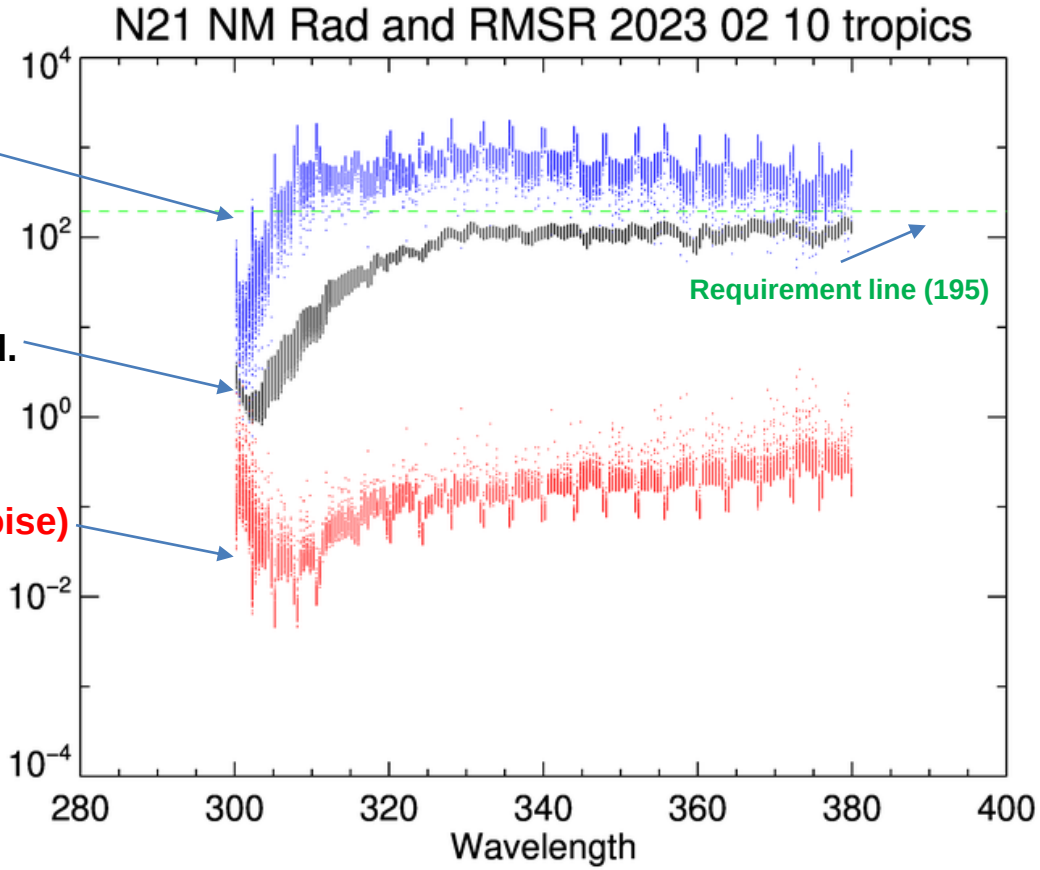


SNR

Mean Rad.

RMSR (Noise)

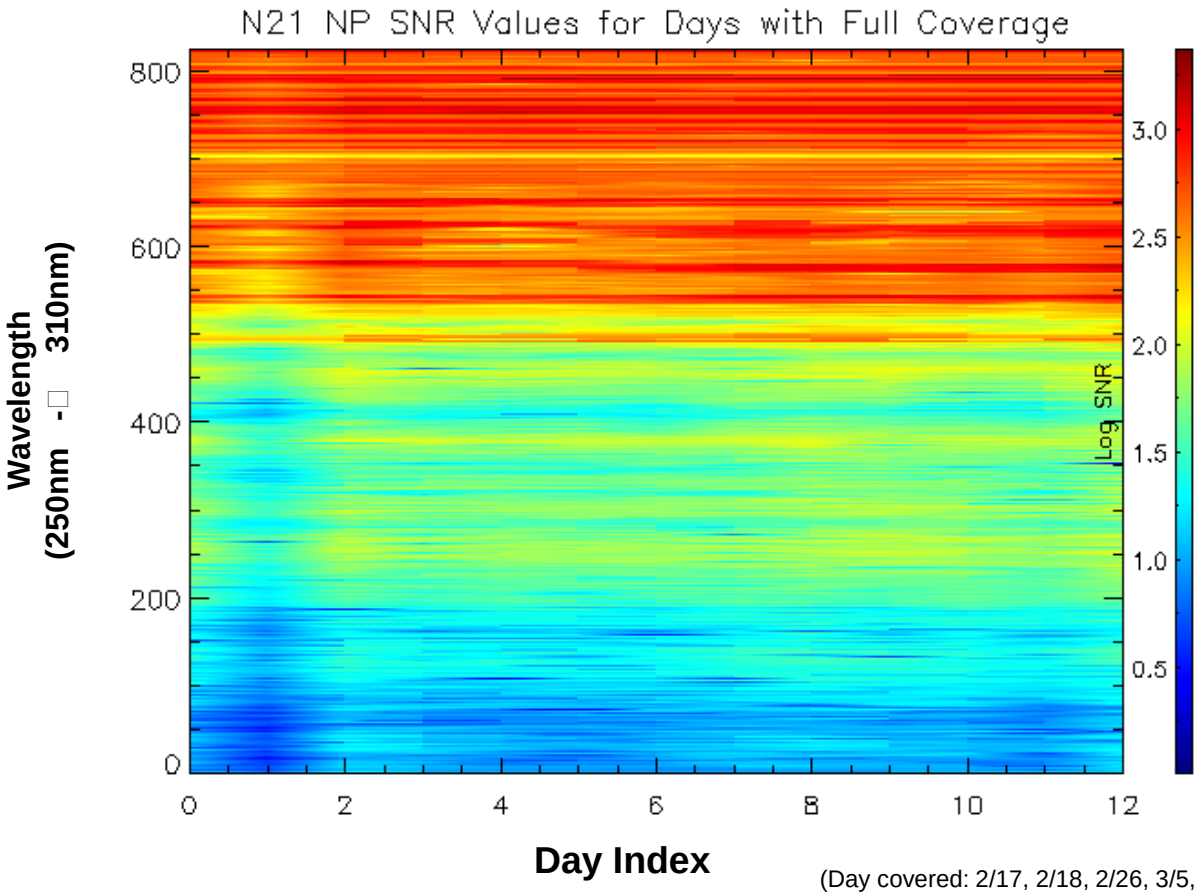
(b) NOAA-21 OMPS NM SNR



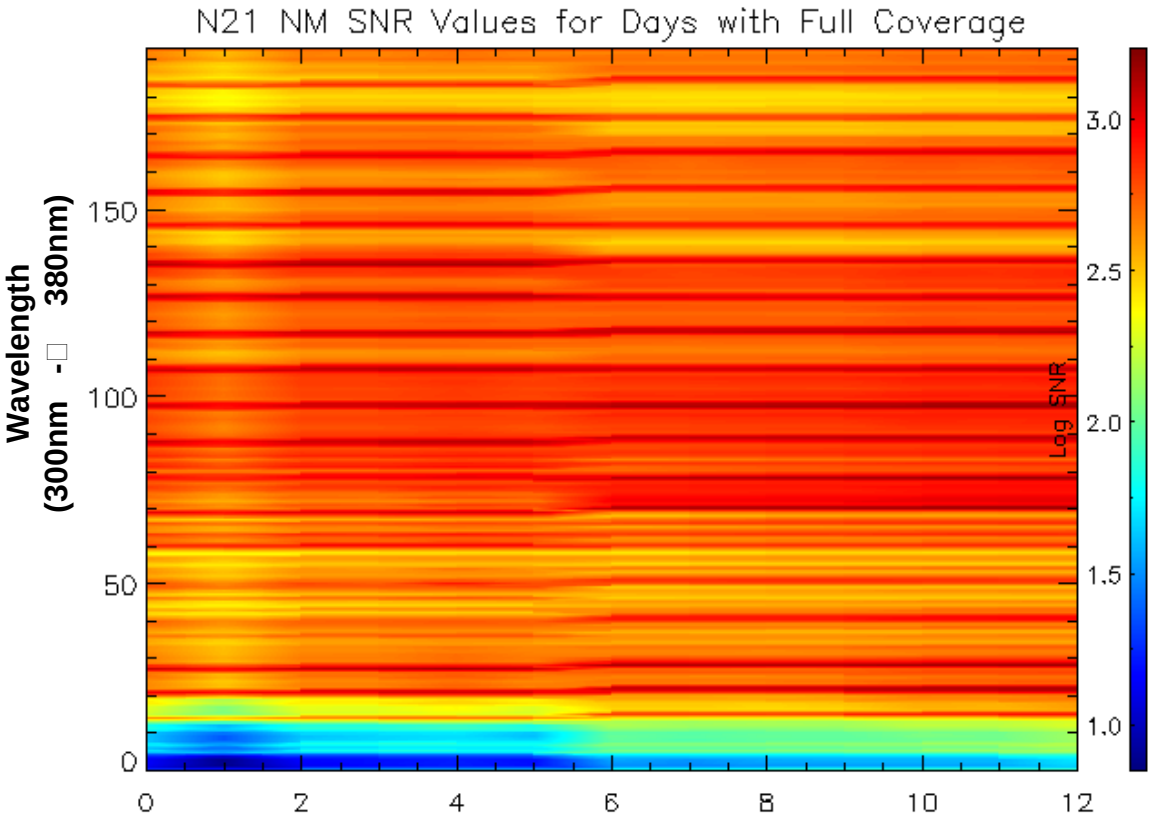
Both NOAA-21 OMPS NM and NP meet the SNR requirements except for part of the dichroic range (300 ~ 305nm) for NM

NOAA-21 OMPS NP and NM SNR Time Series: Stability Check

OMPS NP



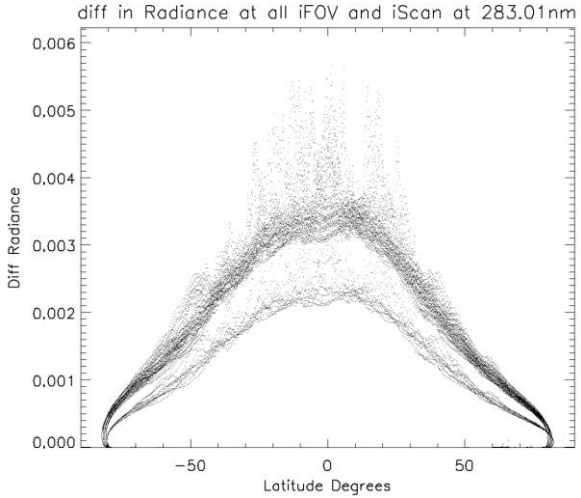
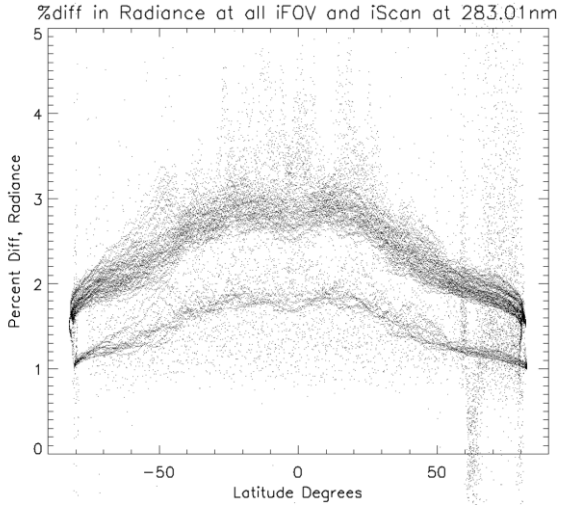
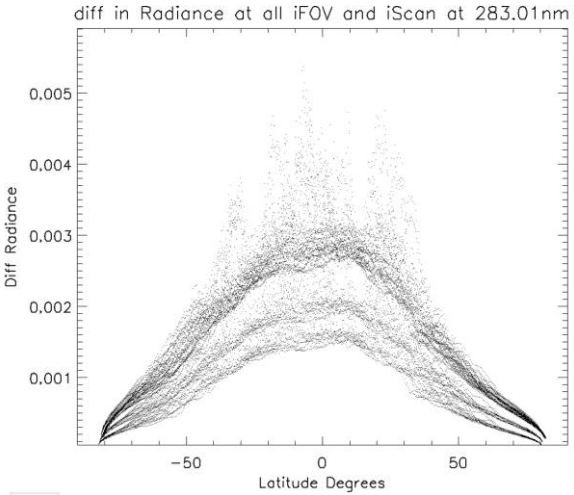
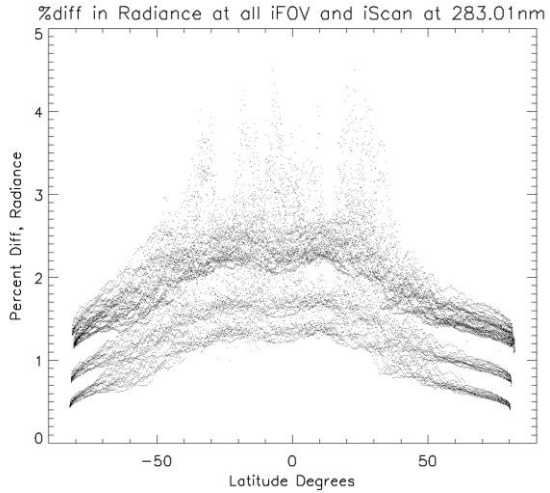
OMPS NM



(Day covered: 2/17, 2/18, 2/26, 3/5, 3/6, 3/7, 3/12, 3/13, 3/19, 3/20, 3/21, 3/22, 3/23)

Both NOAA-21 OMPS NM and NP show a stable SNR performance so far. They generally meet the SNR requirements except for part of the dichroic range (300 ~ 305nm) for NM

Comparison of Stray Light Correction (SLC) at 283nm between NOAA-20 and NOAA-21 NP

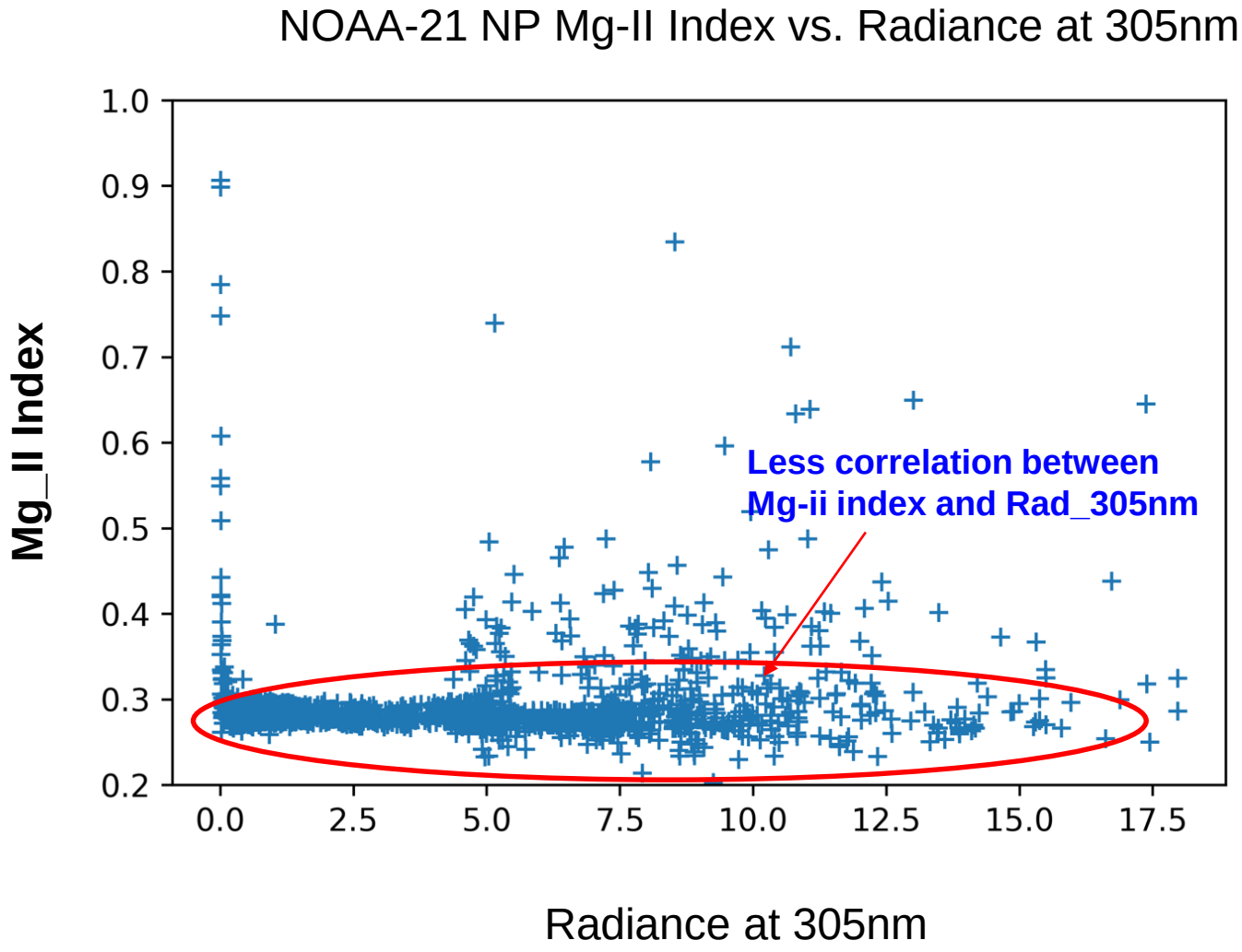
	Radiance Difference	Radiance Difference (%)
NOAA-21 NP		
NOAA-20 NP		

NOAA-21 NP has a similar SL correction performance to NOAA-20 (An offline ADL test w/wo SLC)

(Radiance Difference = Radiance without SLC - Radiance with SLC)

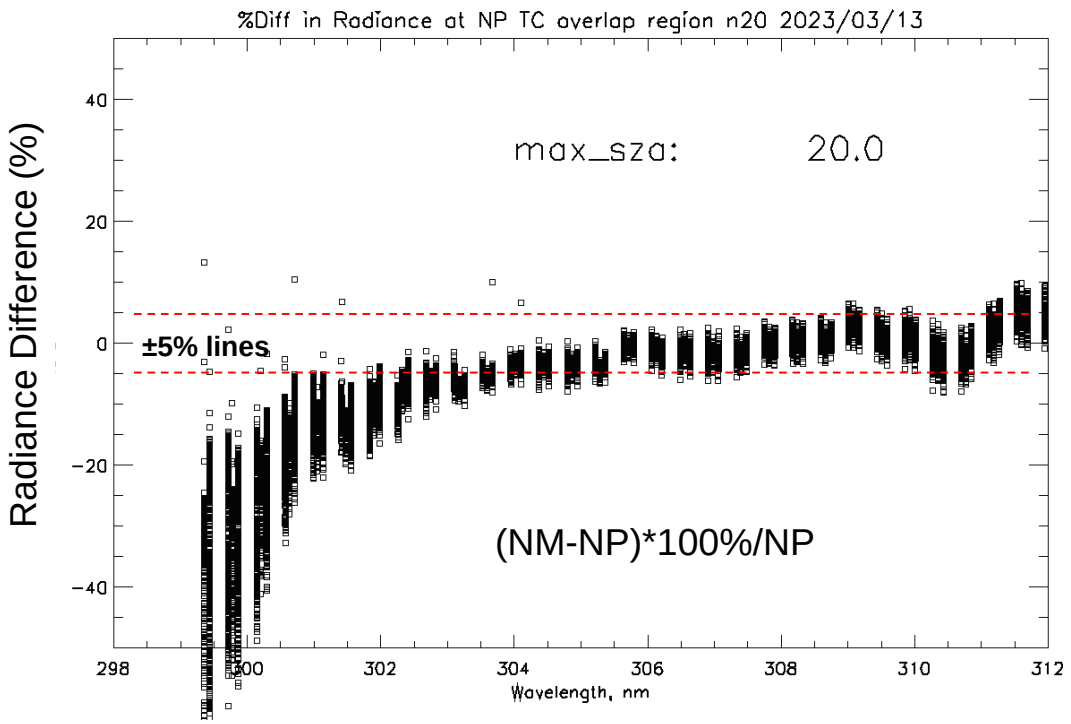
Stray Light Preliminary Analysis via a Scattering Plot for NOAA-21 OMPS NP SDR Data

- The OMPS stray light (SL) components, which can originate from both spectral and spatial scattered light, can be described by an instrument's point spread function (PSF) (OMPS ATBD).
- Two pre-launch SL correction tables based on the PSF data have been applied to the operational ADL processing for NOAA-21 OMPS NM and NP.
- Check if the EV radiance data still experience significant SL effects.
  - Mg-II index =(Rad_280*2.0/(Rad_277+Rad_282)
  - A scattering plot is analyzed between the Mg-II core-to-wing ration variation with radiance at 305nm for NOAA-21 NP (the method was initialized by L. Fynn)
    - Less correlation is observed, demonstrating residual SL effect should not be large around 280nm.

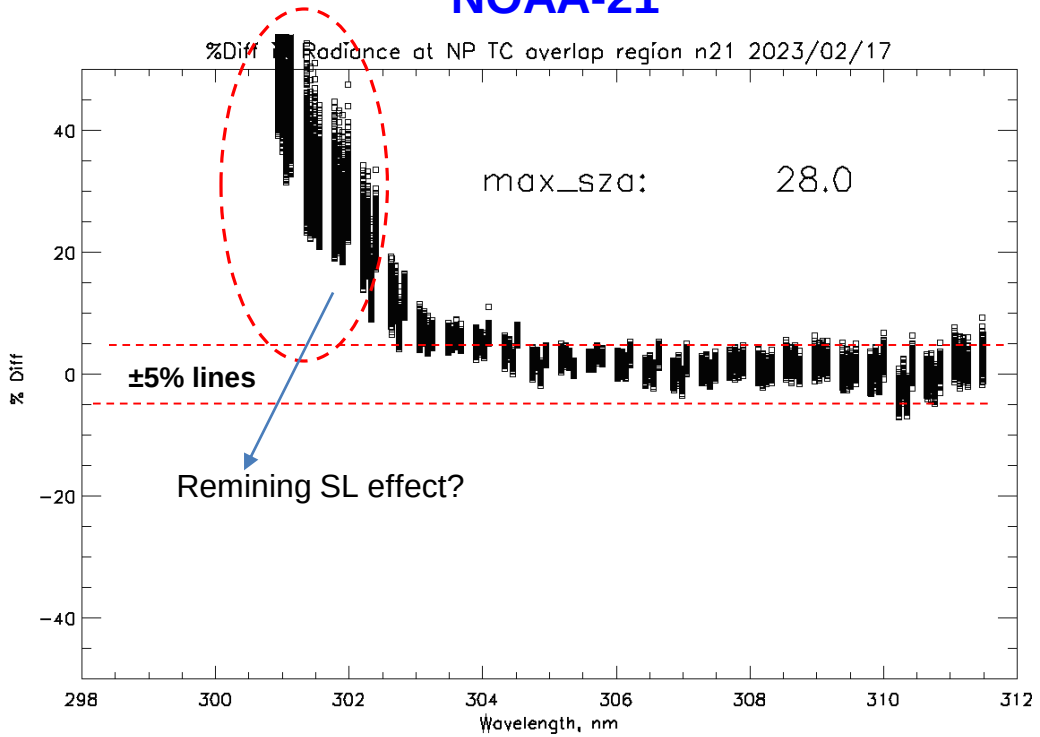


OMPS NM and NP Radiance Consistency for NOAA-20 and NOAA-21

NOAA-20



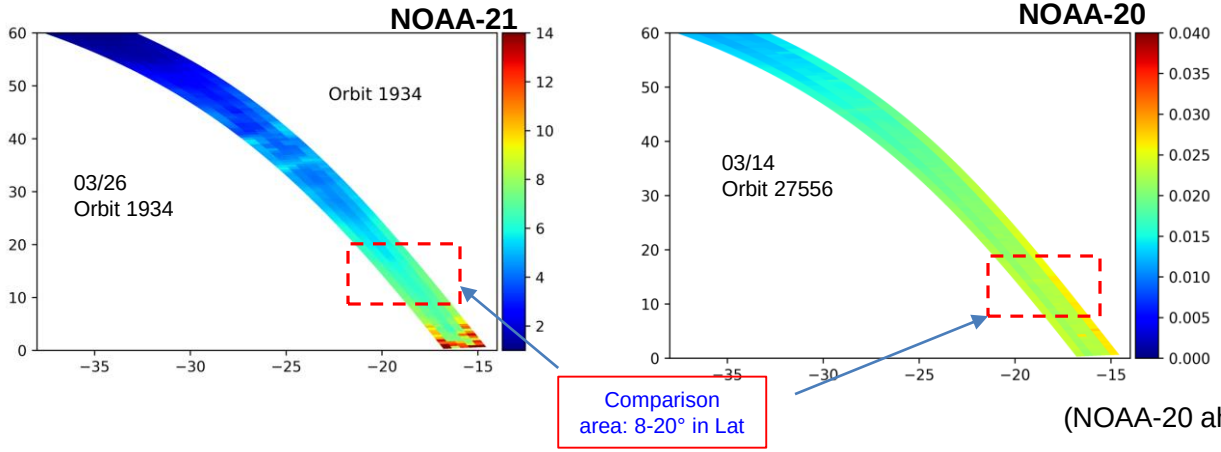
NOAA-21

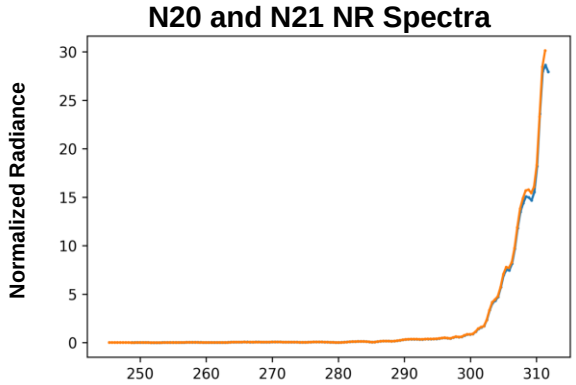


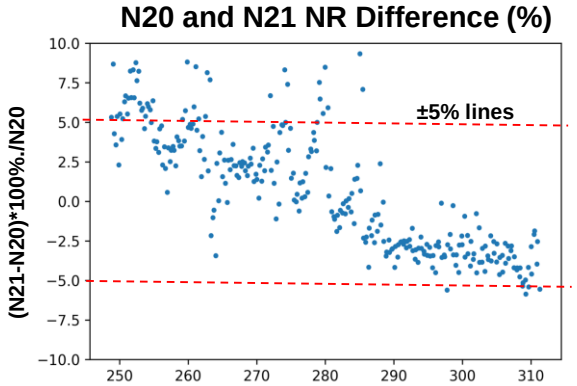
- NOAA-21 NP and NM radiance shows a good consistency in the range from 303 to 310nm with differences within ±5%.
- A relatively large inconsistency remains below 303nm, partially indicating the performance of the SL correction is to be improved. The dichroitic effect also impacts the differences.

Comparison of OMPS NP and NM Radiance between NOAA-21 and NOAA-20: More Examples

(a) Normalized Radiance Comparison between NOAA-21 and NOAA-20 NP (03/26; new NP wavelength LUT)

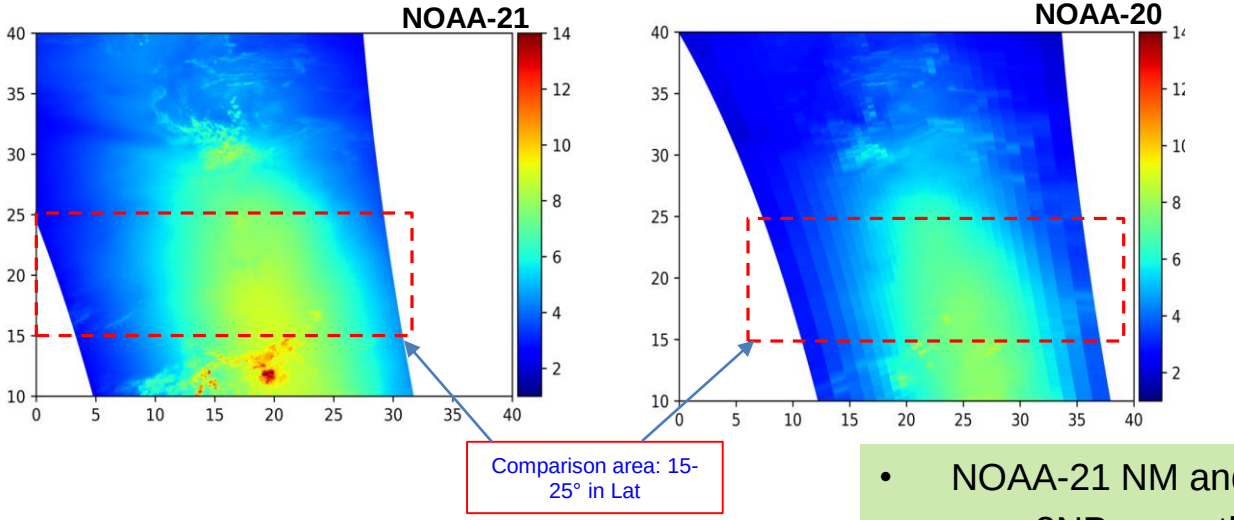


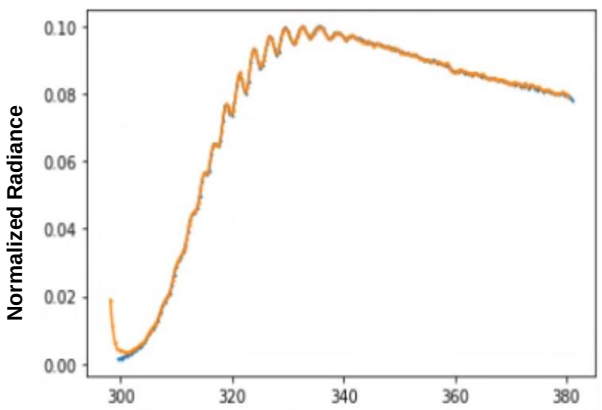


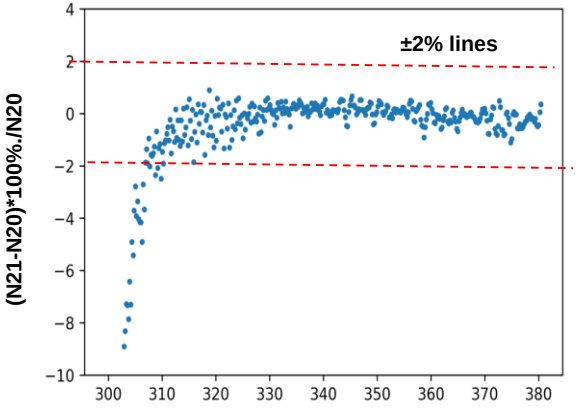


(NOAA-20 ahead about 25 mins of NOAA-21)

(b) Normalized Radiance Comparison between NOAA-21 and NOAA-20 NM (03/23; 3-pixel-shift issue was fixed)





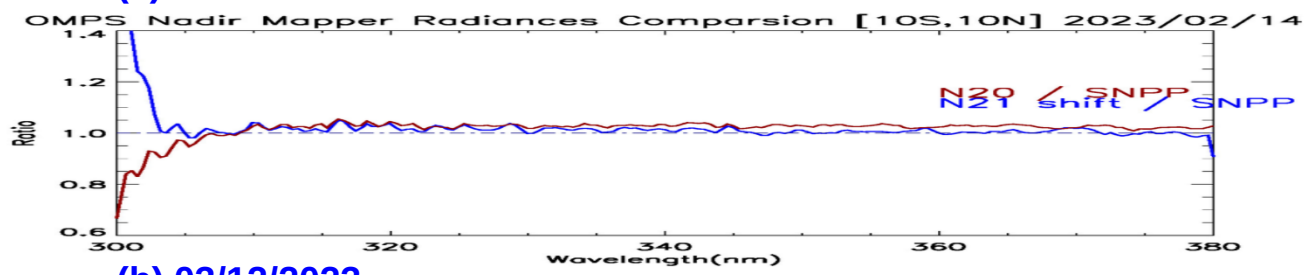


- NOAA-21 NM and NP SDR data agree well with NOAA-20 data
  - 2NPs: mostly within ±5%;
  - 2NMs: mostly within ±2% above 305nm

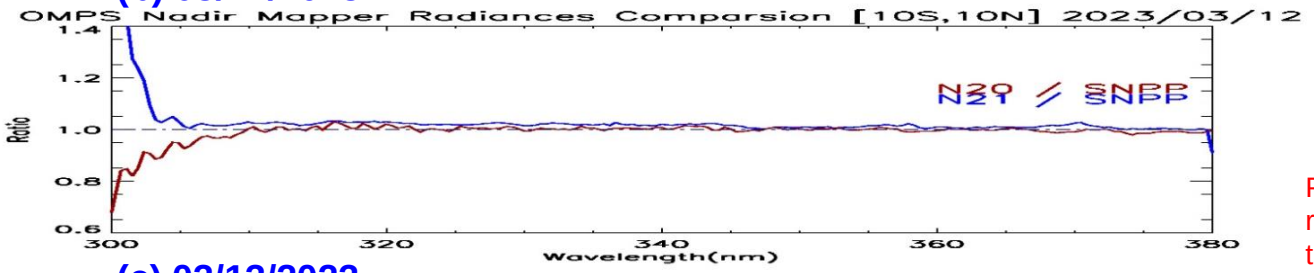
Comparison of NOAA-21 OMPS NM Radiance with SNPP and NOAA-20: More Examples from ICVS

- More examples are given here based on the ICVS inter-sensor comparison monitoring results (https://www.star.nesdis.noaa.gov/icvs-beta/comparison_OMPS.php).
  - The ratio is a averaged of radiance differences between NOAA-21 and SNPP; NOAA-20 and SNPP by using the data between ±10° in latitude.
  - NOAA-21 NM agrees with NOAA-20 and SNPP with margins.
    - Averaged differences are typically less than 3% for the wavelengths above 305nm.
    - The differences increase largely at wavelengths close to 300 nm due to the dichroic effect.

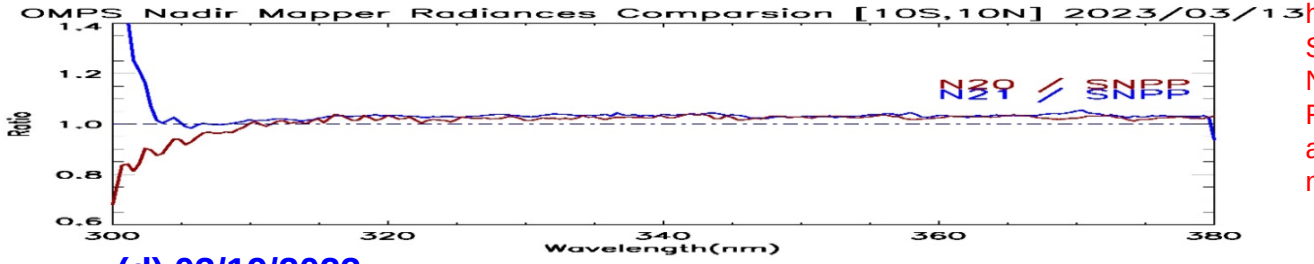
(a) 02/14/2023



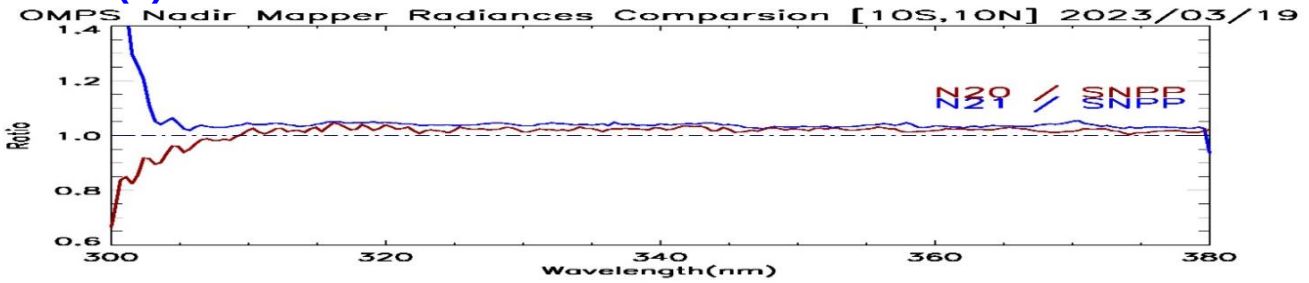
(b) 03/12/2023



(c) 03/13/2023



(d) 03/19/2023

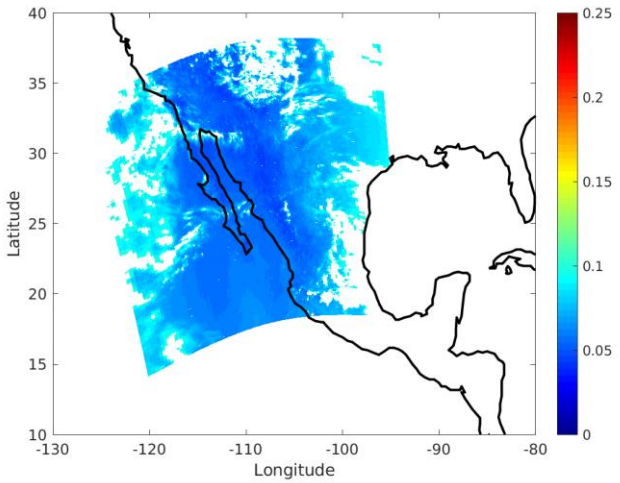


Preliminary results show that NOAA-21 is slightly higher than SNPP and NOAA-20. Further analysis is needed.

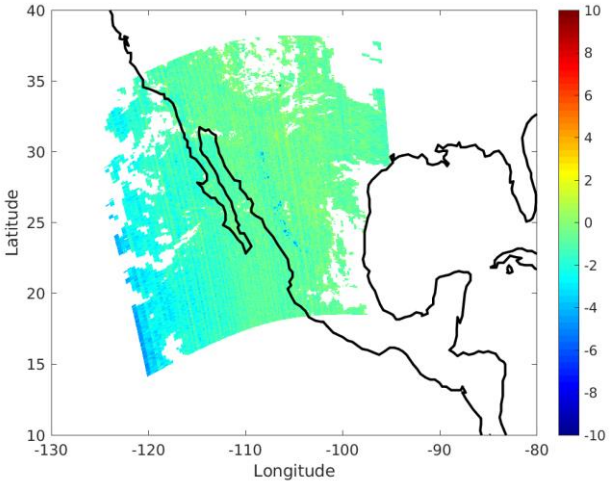
NOAA-21 NM Radiance Deviations from CRTM Simulations Relative to Two Reflectivity Channels

- The CRTM v.3 (Liu and Cao 2021) is applied to the OMPS NM radiance simulations under clear skies.
  - Raman scattering effect is still not included in the CRTM, thus causing ripple pattern in current O-B spectral features
  - An comprehensive interface package was added to the CRTM for SNPP, NOAA-20 and NOAA-21 OMPS NM/NP (Huang et al., 2021 and 2022 AMS conferences)
  - Surface reflectivity at 347.6 nm and 371.8 nm are derived using OMPS NM SDR data (Liu et al, 2022).
  - Other ancillary information to the CRTM simulations use the EUMETSAT NWP analysis data (see Huang et al. 103rd AMS presentation)
- The O – B represents the deviations of observations (O) from the simulations (B) relative to the two reflectivity channels.
  - The mean O – B values are typically within ±5% for the channels above 310nm, and can be up to 20% below 305nm that are in the dichroic wavelength range.
  - The CRTM simulation accuracy and the data errors are contributors to the large O – B values (absolute value)

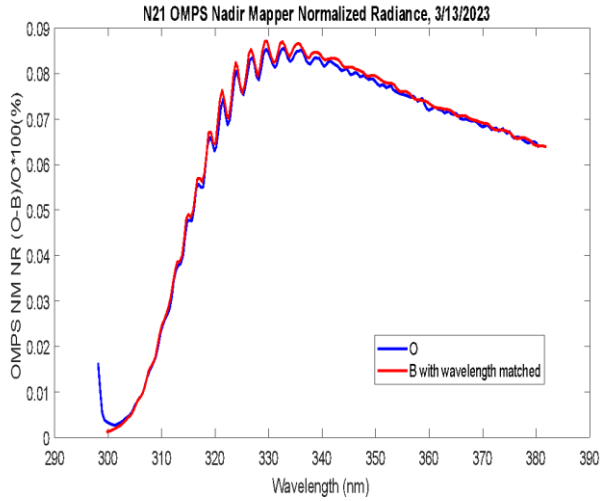
(a) NOAA-21 NM Observation at 378.8nm



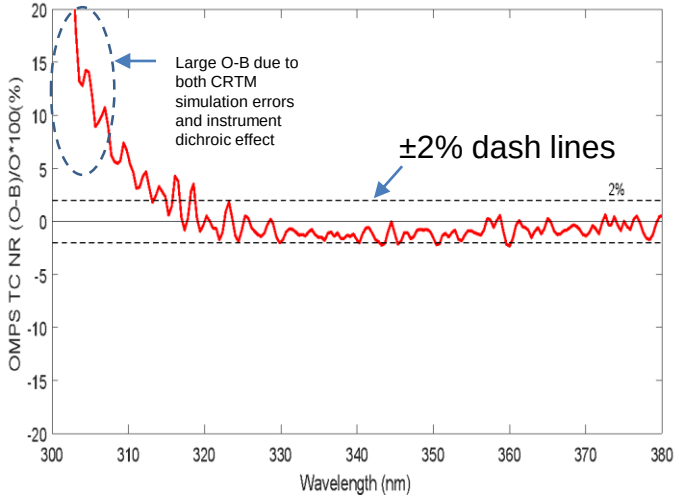
(b) O - B Image at 378nm for the NOAA-21 NM



(c) Mean Normalized Radiance (NR) Spectrum



(c) Mean NR (O – B)/O (%) vs. Wavelength

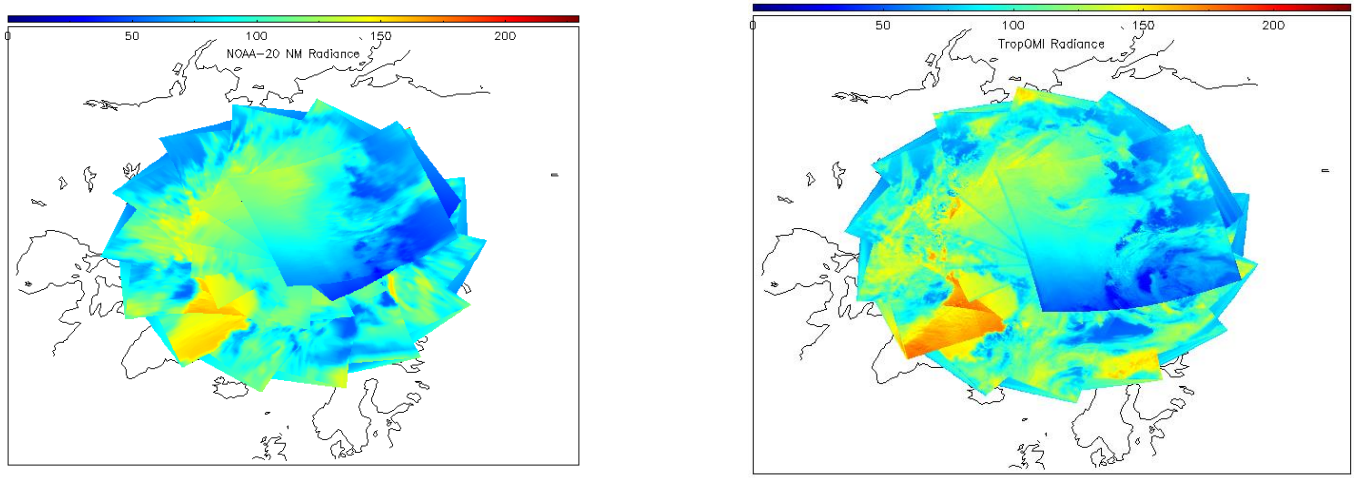


Potential for Inter-Sensor Comparison between OMPS and TROPOMI

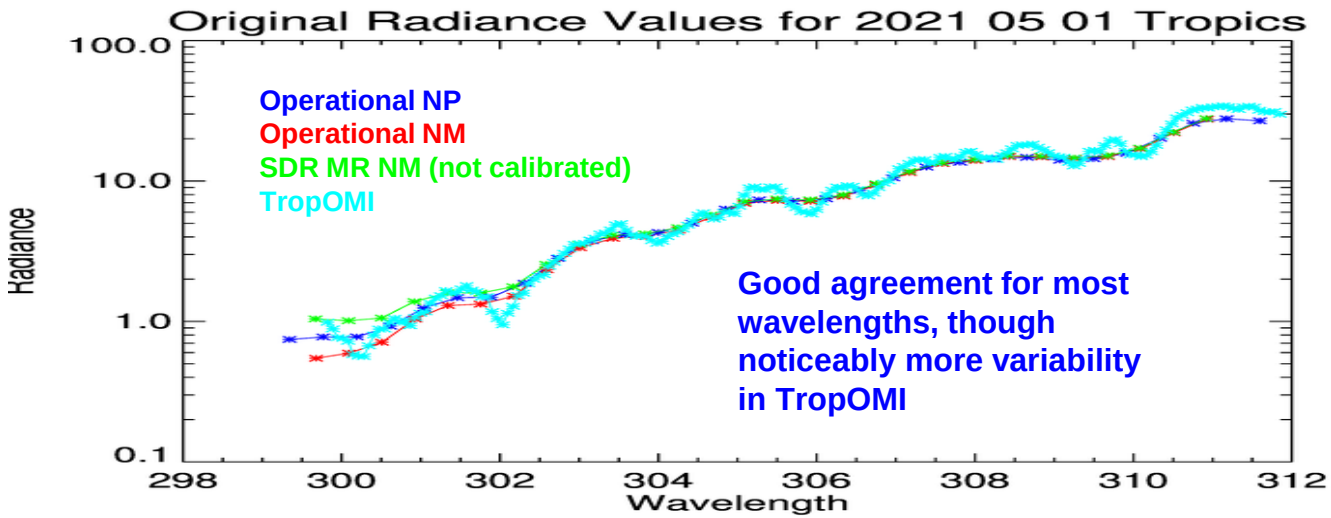
- Sentinel-5P TropOMI UV bands have overlapping wavelengths to the OMPS NM and NP
  - OMPS NM: 300 ~ 380 nm
  - OMPS NP: 250 ~ 310 m,
  - TROPOMI UV:: 270 ~ 495 nm: 0.55 nm spectral resolution; 7x28 km^2 (Launched on 10/13/2017)
- A ray-matching method (Doelling et al. 2011) was applied to the inter-sensor comparison between OMPS and TROPOMI, which took into account location, time, solar zenith angle, viewing angle, and more

OMPS NM, TROPOMI	Ray-Match Threshold
Time Difference (mins)	50
Solar Zenith Angle Diff. (°)	< 3.0
View Angle Diff. (°)	< 4.0
Azimuthal Angle Diff. (°)	< 3.0

(a) NOAA-20 OMPS NM (35X2621) (05/01/2021) (b) TropOMI (448X5786)

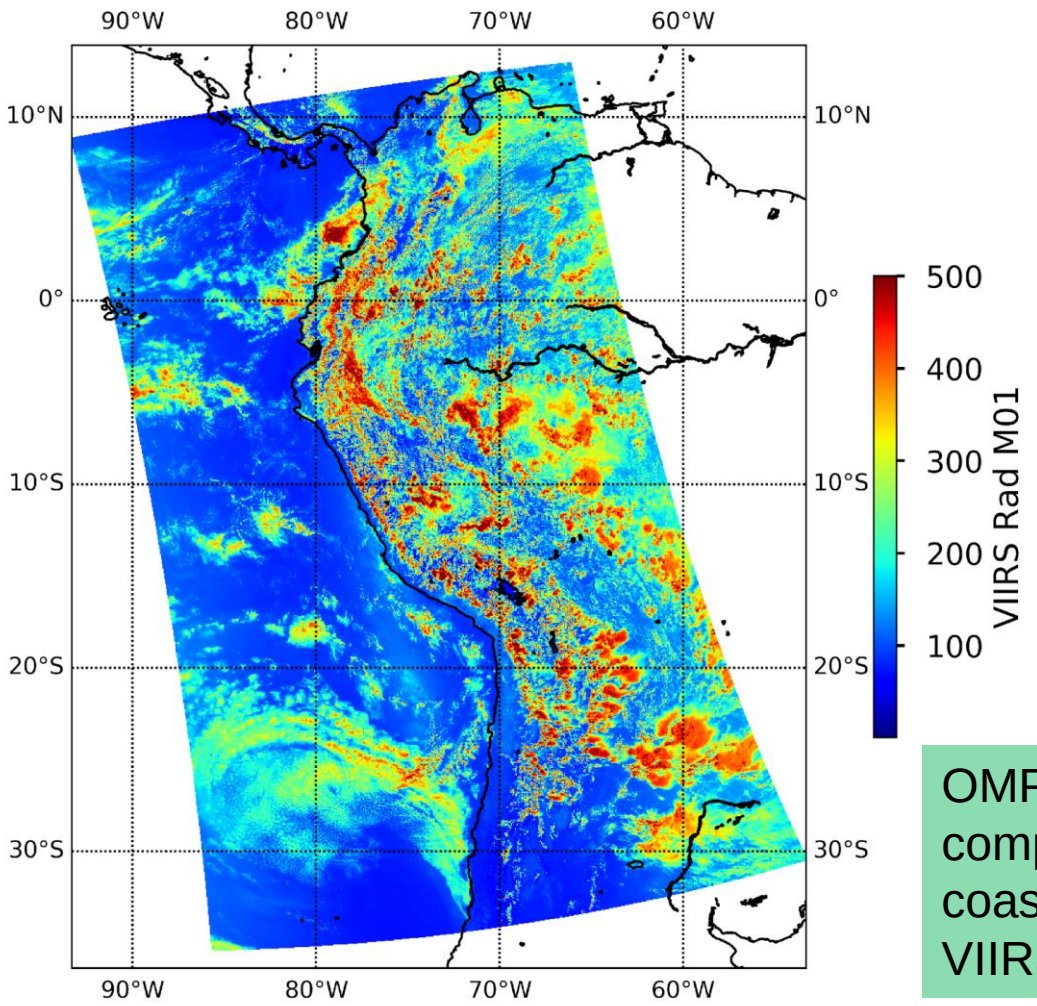


(c) Mean Radiance Comparison vs. Wavelength



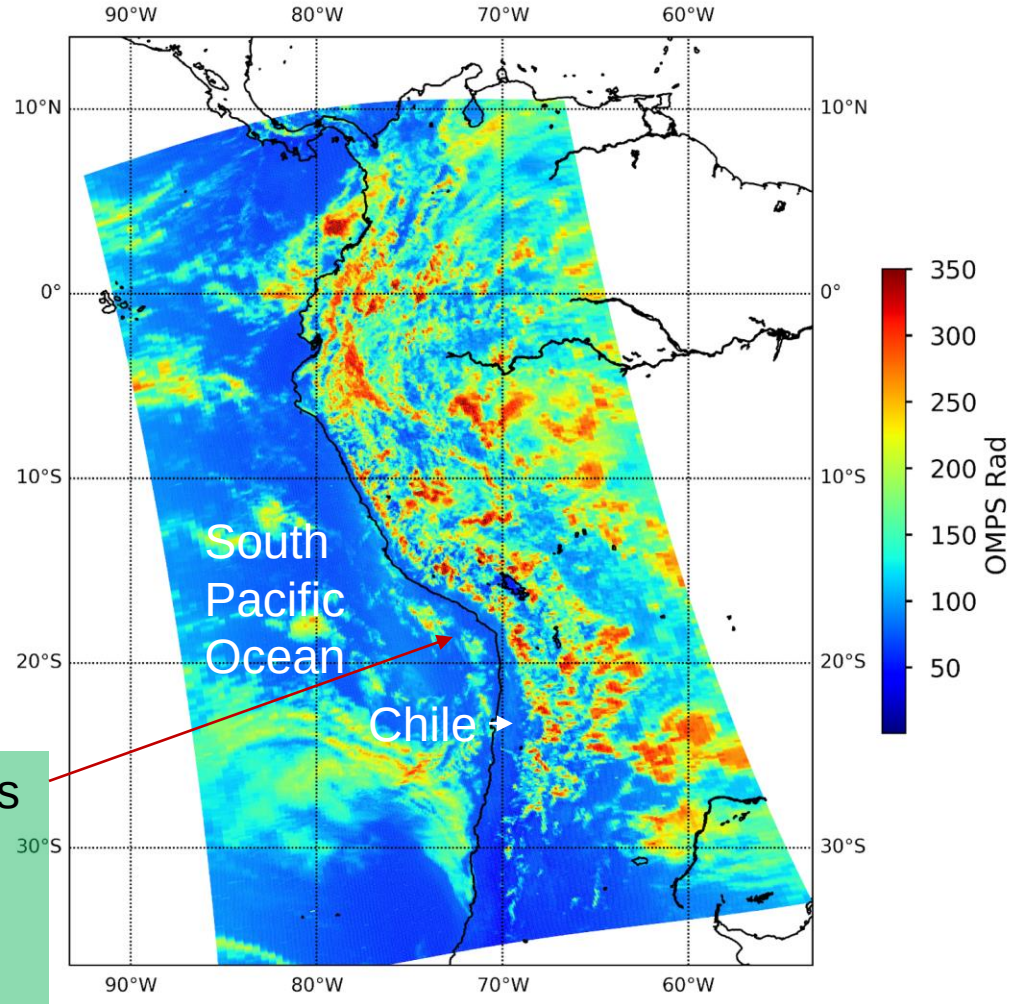
A similar analysis will be applied to the NOAA-21 OMPS data when more data are available!

OMPS Geolocation Check in Comparison with VIIRS



NOAA-21 VIIRS M1 Band

OMPS NM has comparable coastlines to VIIRS M1

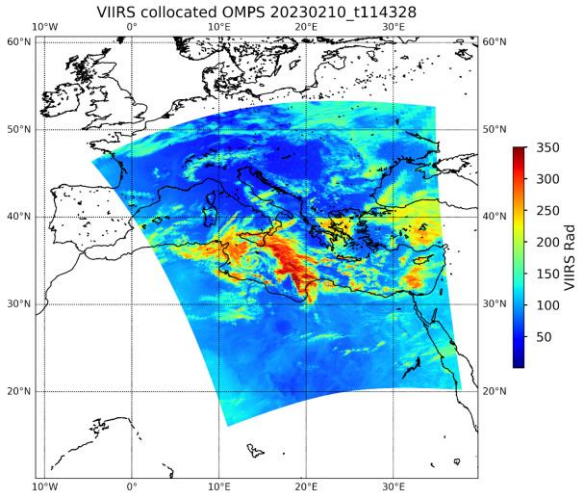


NOAA-21 OMPS NM 380nm

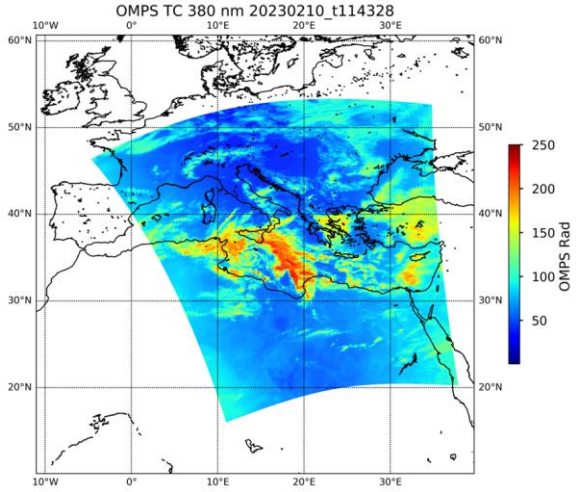
NOAA-21 OMPS NM Geolocation Assessment (1/3): Geolocation Accuracy Relative to VIIRS*

- Geolocation registration is an important calibration work, which contains CCD pixel look angles for the Field Angle Map (FAM) LUT and is used to compute the pointing direction (unit vectors) of each individual CCD pixel in the OMPS SDR operational processing.
- An algorithm was developed to estimate the geolocation accuracy of the OMPS NM SDR data from SNPP to NOAA-21 (Wang et al. 2022).
- The algorithm was applied to the NOAA-21 OMPS NM SDR data.
  - VIIRS M1 band data on 02/10 collocated with the OMPS 380nm data.
  - A high correlation is observed between the OMPS 380nm and VIIRS M1 band radiance data.
  - A small perturbation is applied to the OMPS SDR data to have the best correlation between the two data sources.

(a) Collocated VIIRS M1 Band (750m nadir, 3200 pixel per scan)



(b) OMPS 380nm (12x10km nadir, 177 pixel per scan)



(c) OMPS 380nm vs. VIIRS M1

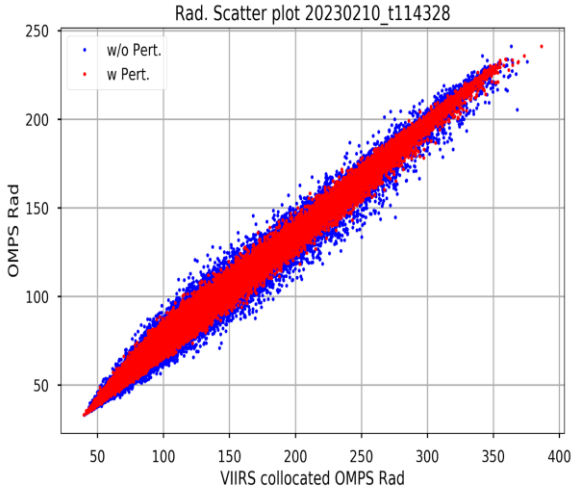
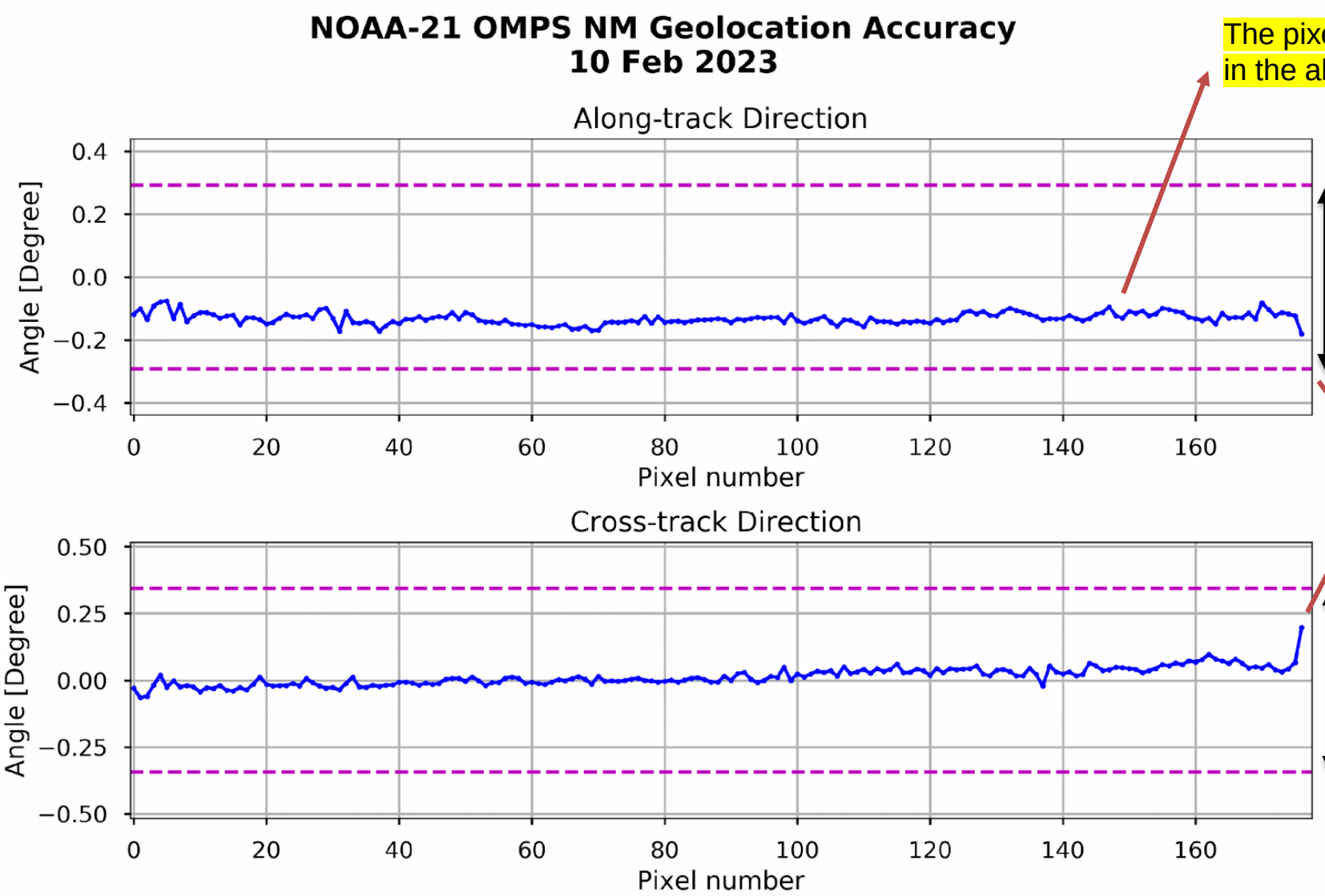


Figure (a) VIIRS band 1 image. (b) OMPS NM 380 nm. (c) Scattering plot of OMPS radiance at 380 nm and VIIRS radiance at 410 nm with (red dots) /without (blue dots) the perturbation.

(Refer to Wang et al., AMS conference)

NOAA-21 OMPS NM Geolocation Assessment (2/3): Geolocation Accuracy Relative to VIIRS*



The pixels were shifted ~0.1 degree (1.5 km at nadir) in the along-track direction

Corresponding to 8.5 km at nadir

The worst performance is at the edge pixel 176 (DR10039 code error)

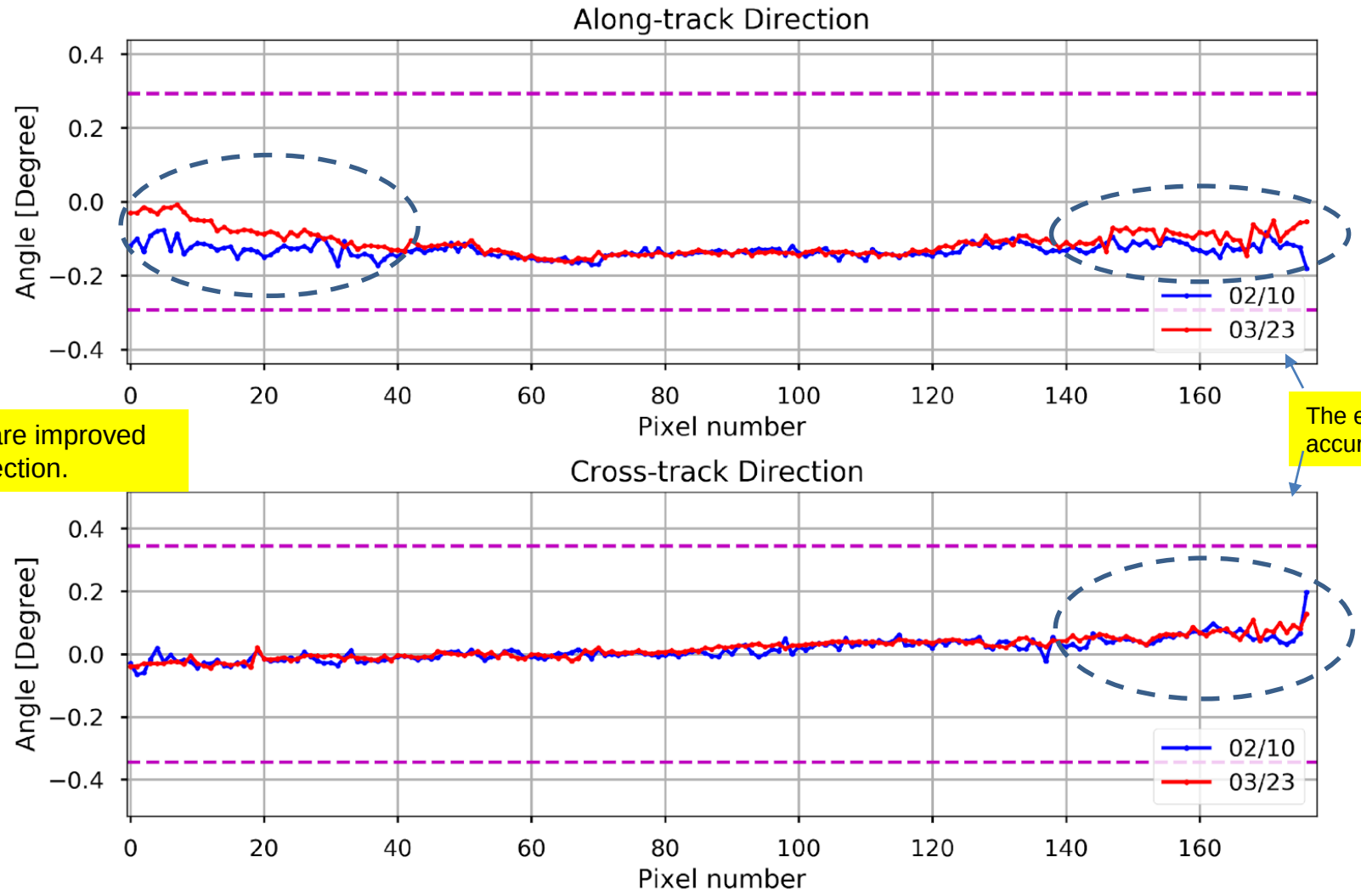
Corresponding to 10.0 km at nadir

*Further assessment is needed in the future.
- Instruments are in the orbit test stage
- OMPS NM spectral calibration is not done yet.
- VIIRS geolocation evaluation is still undergoing.

Geolocoation accuracy relative to VIIRS within the subpixel level (~ less than half of pixel size)

(Reference: Wang et al. 2022)

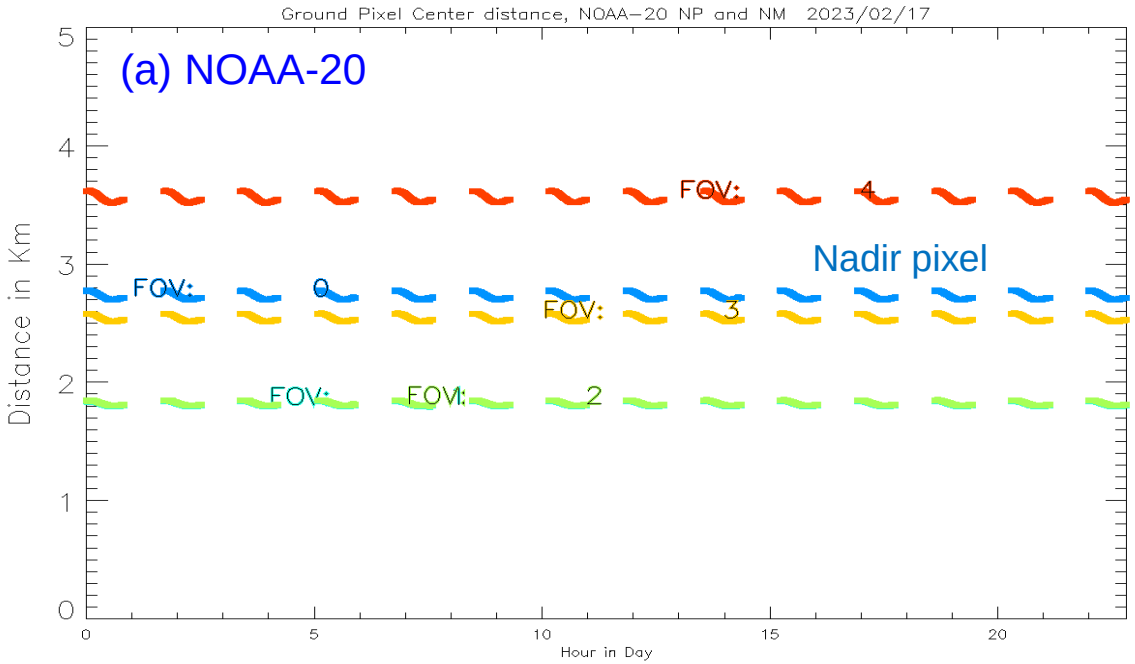
NOAA-21 OMPS NM Geolocation Assessment (3/3): Geolocation Accuracy Update Relative to VIIRS*

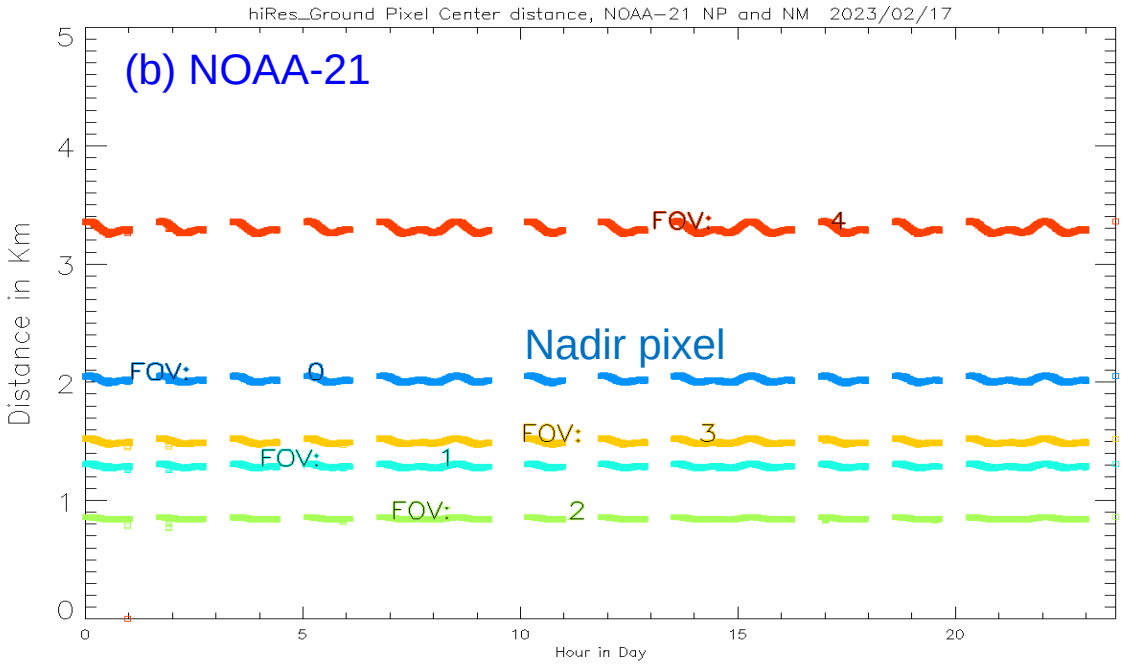


The geolocation relative to VIIRS is well within subpixel level (~1/2 pixel level)

NOAA-21 OMPS NP Geolocation Assessment Relative to OMPS NM

Ground Pixel Center Distance between NM and NP (km)





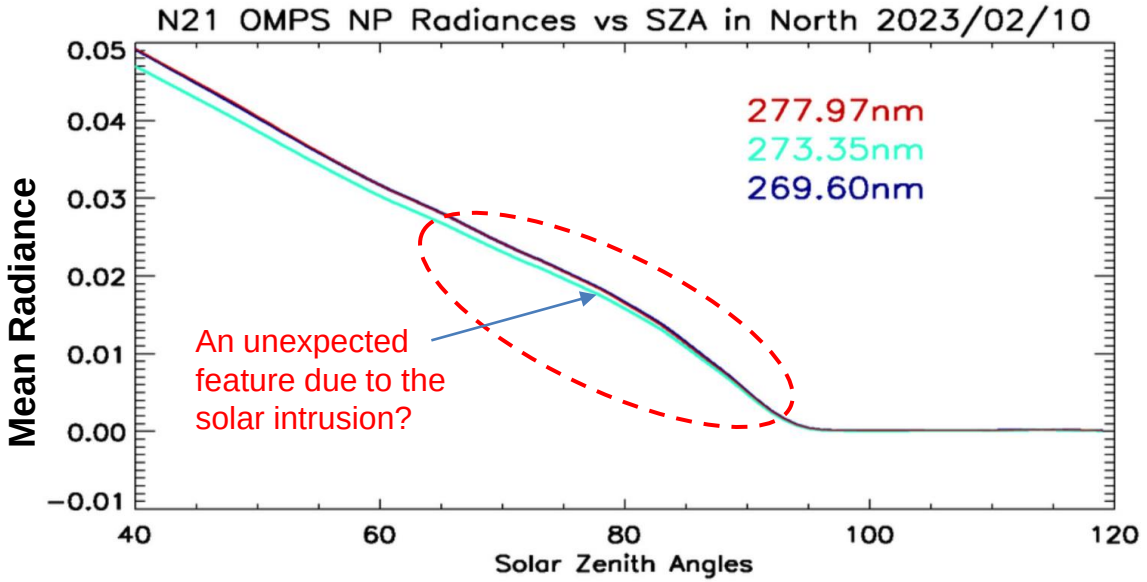
The N21 NP geolocation accuracy meets the requirement (less than ½ pixel resolution), where the interpixel distance are smaller than the N20.

- Nadir is marked in green as FOV2. FOV0 and FOV4 are the outermost pixels.
- More analyses are referred to slide # 62 to 63 in backup

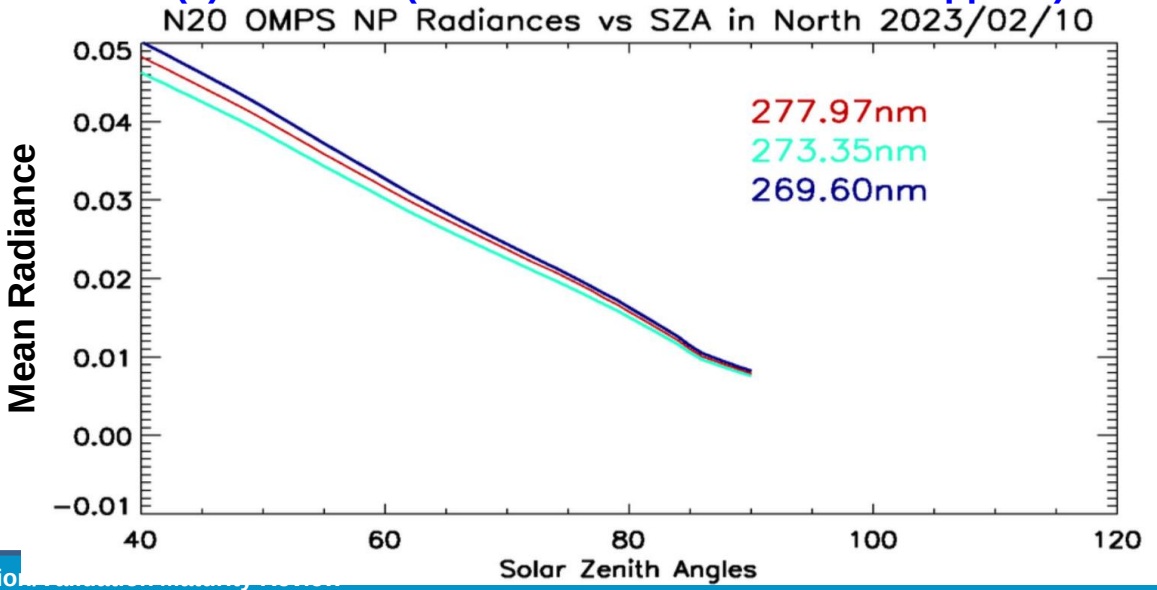
NOAA-21 NP Solar Intrusion Issue: Preliminary Check

- Mostly due to the OMPS instrument innermost baffle vane, the solar intrusion persistently occurs for the NOAA-20 OMPS NP at high solar zenith angle (SZA) over Northern Hemisphere (NH) (Jaross and Huang 2020).
- The solar intrusion is expected to exist for J2 OMPS NP, but the correction is not turned on in the current operational ADL processing package.
- With the preliminary analysis, the solar intrusion seems to exist in the J2 OMPS NP data below 300 nm over the NH when the SZA is high (see the figure). However, further investigation is needed to confirm this impact.

(a) NOAA-21 (No solar intrusion correction is applied)

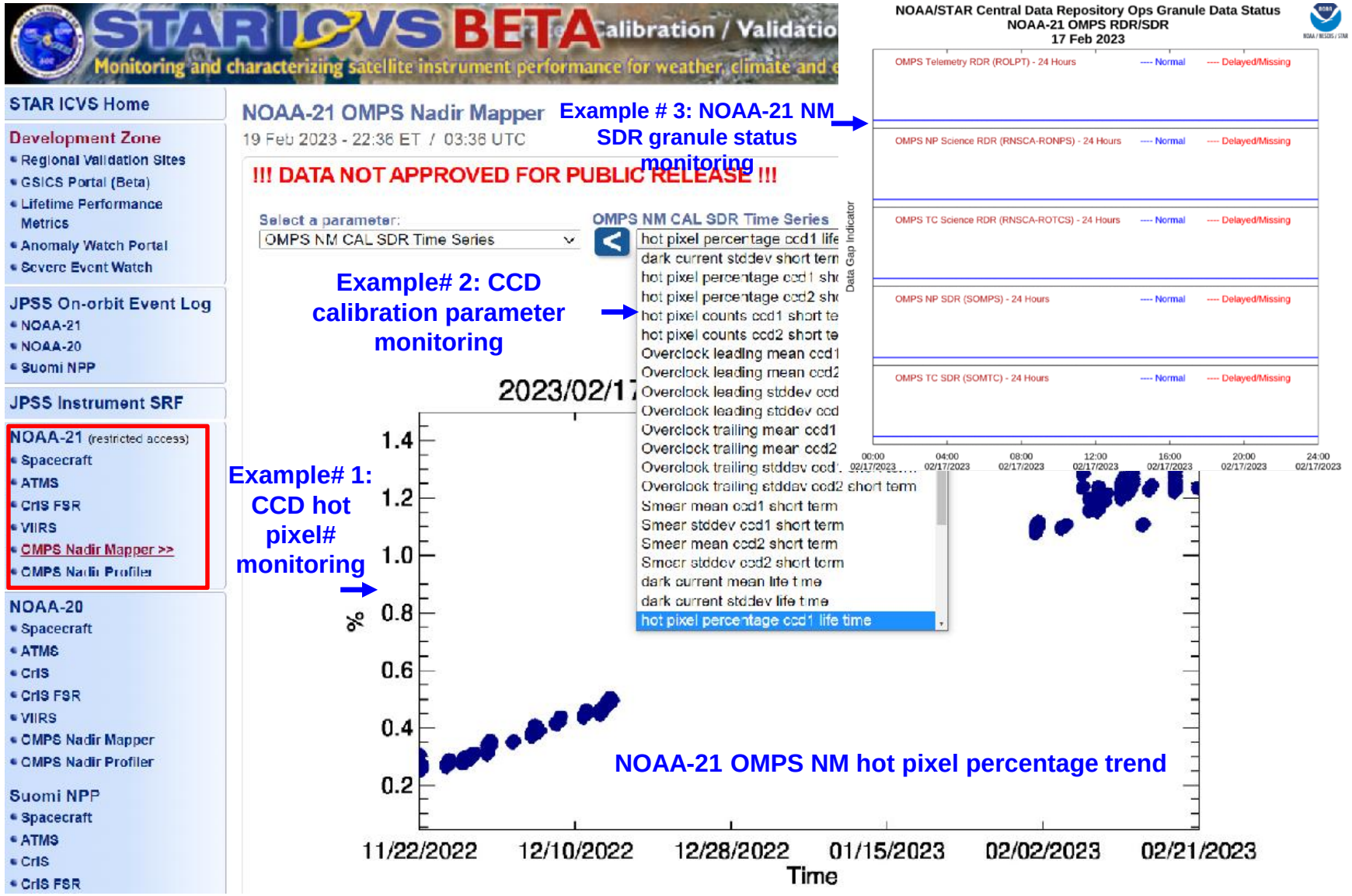


(a) NOAA-20 (Solar intrusion correction is applied)



Long-Term Monitoring of NOAA-21 OMPS NM and NP Data

- The ICVS has developed a beta version of the monitoring tool for NOAA-21 OMPS NM/NP instrument, calibration/telemetry RDR and SDR data quality in a near-real time mode (https://www.star.nesdis.noaa.gov/icvs-beta/status_J02_OMPS_NM.php).
- The monitoring parameters include the instrument performance (temperature, CCD dark, smear, hot pixel, etc.), EV-radiance, reflectance, data quality flag, and other calibration parameters.
- Examples are given on the right panel for the NOAA-21 OMPS NM CCD hot pixel percentage trend and others.



(Courtesy of ICVS D. Liang)

User Feedback

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Larry Flynn	NOAA/STAR/SMCD	OMPS Ozone retrieval	The products are of good quality with five known concerns and one unevaluated concern from the point of view of their use as input for V8Pro and V8TOz. Known Concerns 1. The OMPS NP has significant solar stray light for the Northern Hemisphere at SZA > 62. A correction similar to the one developed for the NOAA-20 OMPS NP is needed. 2 and 3. The OMPS NM & NP has some level of disagreement in the overlap region from 300 to 310 nm. Some part of this is probably the stray light correction for the OMPS NM for the shortest wavelengths. 4. The sample table fix for CT #177 will be implemented with Mx 8/9. 5. New solar and wavelength scale tables are needed for three near-nadir pixels for the OMPS NM. This is expected to be resolved next week. Unevaluated concern: we have not evaluated the performance of the stray light correction for the OMPS NP. We expect to be able to reach provisional maturity for the EDRs with the current SDR performance. We will need to have an OMPS NP solar stray light correction to reach validated maturity. Need for coordination for any calibration changes for the SDR with the soft calibration adjustments for the EDR.

Risks, Actions, and Mitigations

- Provide updates for the status of the risks/actions identified during the previous maturity review(s); add new ones as needed

Identified Risk/Issue	Description	Impact	Action/Mitigation and Schedule
Issue # 1	Wavelength scale registration change	Big impact on NM and NP SDR data quality	Four updated tables implemented into operation on 03/09/2023 *(Done)*
Issue # 2	NOAA-21 OMPS NM wavelength pixel-shift error	NOAA-21 OMPS NM radiance data quality	Two updated tables implemented into operation on 03/09/2023 *(Done)*
Issue # 3	NOAA-21 OMPS NP solar flux 12-pixel-shift error	NOAA-21 OMPS NP solar flux data quality	Two updated tables implemented into operation on 03/23/2023 *(Done)*
Issue # 4	NOAA-21 OMPS NM wavelength shift discontinuity error at CT# 84-86	NOAA-21 OMPS NM data quality at CT# 84-86	Two updated have been derived; plan to deliver to the ASSISTT as a fast track on 04/03/2023 *(To-Be-Done)*

Documentations (Check List, 1 slide)

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	Draft is done (internal review)
Algorithm Theoretical Basis Document (ATBD)	The OMPS (SDR&EDR) ATBD exits but it needs to be updated: in progress (Target: by April)
Algorithm Calibration/Validation Plan	Yes
(External/Internal) Users Manual	N/A
System Maintenance Manual (for ESPC products)	N/A
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	In plan
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	Yes

Check List - Provisional Maturity

Provisional Maturity End State	Assessment
○ Product performance has been demonstrated through analysis of a large, but still limited 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.	Yes. ○ Improved the NOAA-21 OMPS NM and NP calibration algorithms (fixed three problems) ○ Product performance of NOAA-21 OMPS NM and NP SDR has been demonstrated through the analysis for more than 15 days of data sets in multiple ways. - The OMPS NM and NP SDR data shows a good quality. - The SDR data agree well with SNPP and NOAA-20, within averaged differences of ±5% for NP and ±3% for NM at most of the NM channels. - The geolocation accuracy of the OMPS NM and NP SDR data meet the requirement - The OMPS NM and NP SDR data meet the SNR requirements. ○ A total of 3 calibration problems have been identified(target with operation 04/06) ○ The readme is in progress.
Information/data from validation efforts can only be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose	Yes. (The NOAA-21 OMPS NM/NP SDR data are being tested in the OMPS EDR retrievals, showing a fine comparison with the SNPP/NOAA-20 products.)
Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists	Yes.

Lesson Learned from NOAA-21 OMPS NM 3-pixel Issue

- Background: the 3 pixel shift issue in J2 OMPS NM SDR data
  - The clearest explanation of what happened was that NOAA-21 used a new higher resolution format and different set of sample tables than both SNPP and NOAA-20.
  - Root causes:
    - JCT3 TVAC used the same sample tables now in use but there was no Earth View (EV) radiance signal in the tests. Everything was door closed. So, it is challenging to verify the wavelength shift problem without true EV radiance data.
    - There were no available on-orbit measurements with real EV signal based on the pre-launch calibration tables before door open.
- Potential impact on future J3/J4 missions and mitigations:
  - Potential impact:
    - When NOAA-22/23 is launched in future, if the sample tables are not the same as NOAA-21, there will be a higher probability that similar kinds of errors will be repeated.
  - Mitigation # 1: use the same sample tables as NOAA-21
    - It would have been easy to detect that there was a problem and it would have been corrected much earlier through the JCT test data sets.
  - Mitigation # 2: measure a few orbits of on-orbit door-open OMPS operational nominal SDR data as early as possible after the satellite launch
    - make a few orbits of on-orbit door-open OMPS operational nominal SDR data measurements as early as possible before the global data measurements are made
    - Test the consistency of the EV radiance data for a new mission in comparison with existing OMPS SDR data
    - Implement any updated LUTs to fix captured issues into the operational processing before the full orbits of the data are measured
  - Mitigation # 3: provide the simulated OMPS EV radiance data that use the same calibrations tables (e.g., sample table, wavelength table) as those for the new mission, which is comparable to EV radiance
    - A good accuracy of RTM is needed.
    - An early test can be conduced

Lesson Learned from Two New NOAA-21 Problems

- Two new problems:
  - The 12-pixel-shift error: it occurred in the solar flux in the SDR data, which were generated based on the solar flux OSOL table.
  - The wavelength shift discontinuity error: it occurred at two specific cross-track positions.
- Lesson learned:
  - It is important to validate the solar flux table by running an offline ADL.
  - It is important to check the consistency of the wavelength shift along the cross-track position.

Conclusion (1/2)

- Cal/Val results summary:
  - NOAA-21 OMPS NM and NP instrument performs stably, and the SDR data show a reasonable quality with a good agreement with SNPP and NOAA-20
    - On average, the SNR meet the requirements
    - Geolocation accuracy meets the requirement
    - NM and NP data consistencies in the range from 303 to 310 nm are mostly within ±5%.
    - OMPS NM SDR data agree with both SNPP and NOAA-20 typically with margins of ±3 % for the channels above 305nm.
    - OMPS NP SDR data agree with both SNPP and NOAA-20 typically with margins of ±5 %.
    - *Ozone products from NOAA-21 OMPS SDR data show a reasonable feature (from the user feedback)*

Conclusion (2/2)

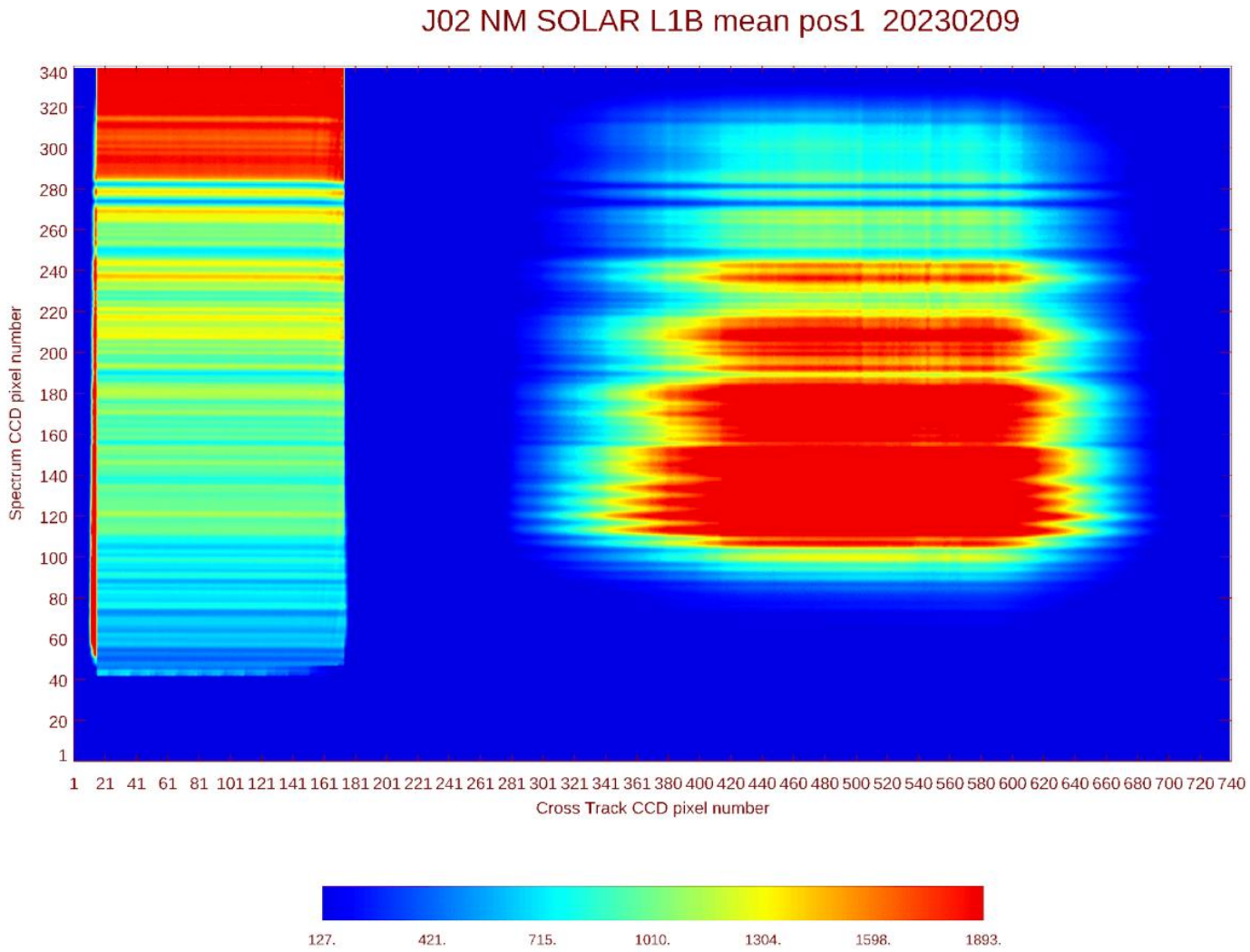
- Cal/Val results summary:
  - **Team recommends algorithm provisional maturity**
    - Product is recommended for potential operational use and in scientific publications after consulting product status documents.
      - Address pre-launch concerns/waivers: yes.
      - Caveats: 3 calibration issues are identified (2 well done; 1 to be fixed in operational processing)
      - The 3-pixel-shift problem in NOAA-21 NM radiance (Beta Review action): In operation on 03/09
      - The 12-pixel-shift problem in NOAA-21 NP Solar flux table (A new problem): In operation on 03/23
      - The wavelength discontinuity problem in NOAA-21 NM at 84-86 cross-track pixels (A new problem): target 04/06 into operation
        - » Plan to deliver the updated NM OSOL and wavelength LUTs into the ASSISTT on 04/03
        - » It is expected that the new LUTs can be implemented into the operational processing 04/06

Plan Future Cal/Val Activities towards Validated Review

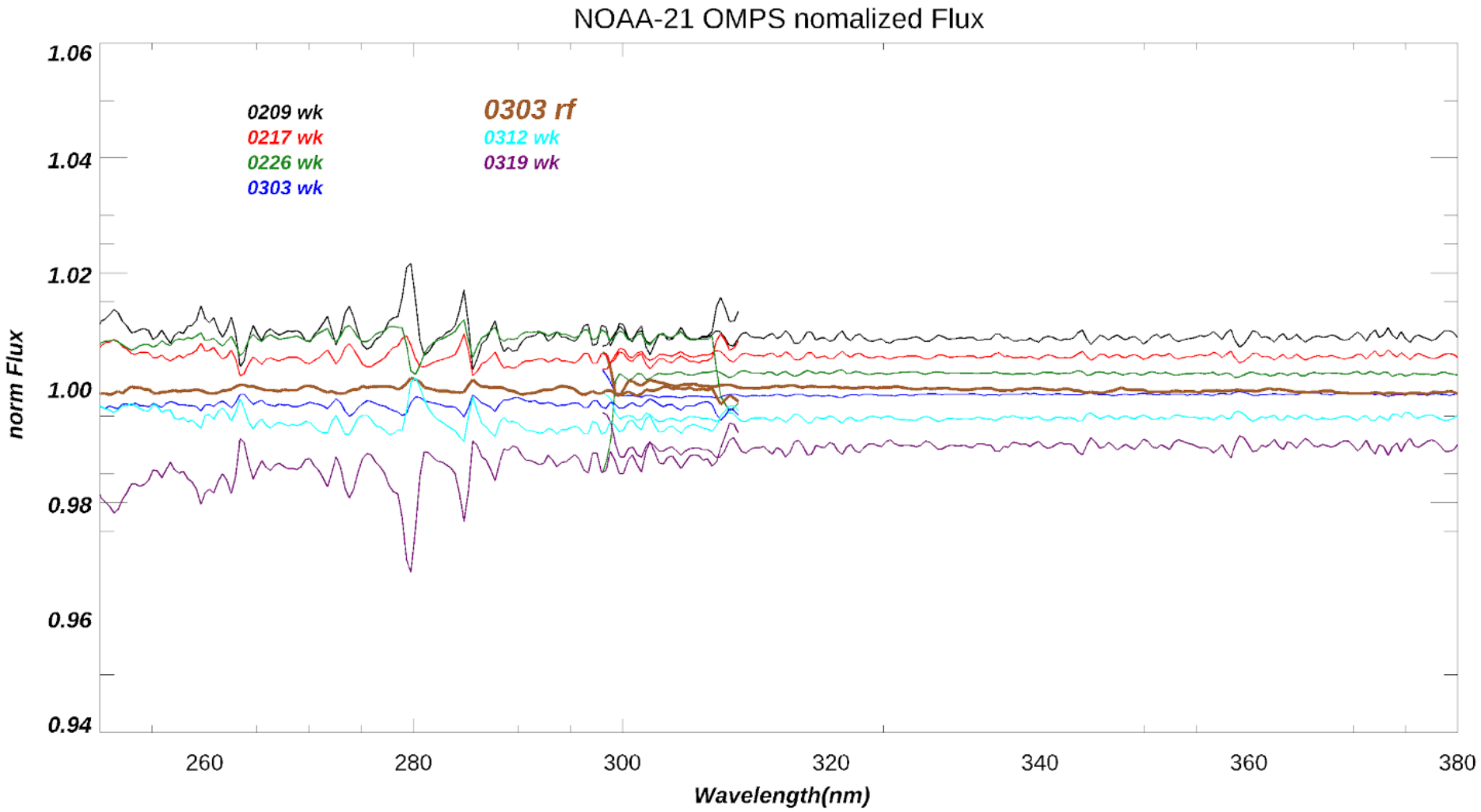
- Planned Detailed Cal/Val Activities towards Provisional review
  - Deliver the DR#10308 LUTs to the ASSISTT on 04/03 (wavelength shift discontinuity error)
  - Continue the following analyses
    - Regular deliveries for the NOAA-21 NM/NP dark and NP wavelength LUTs
    - NOAA-21 OMPS NM and NP wavelength registration accuracy improvement
    - SNR calculation method improvement
    - Geolocation accuracy of NOAA-21 OMPS NM/NP data
    - Solar intrusion effect for NOAA-21 NP
    - Stray light correction performance
  - Further quantify the NOAA-21 data quality towards the scientific requirements using multiple methods
    - NM and NP SDR data quality consistency
    - Inter-sensor radiometric calibration uncertainties (e.g., JPSS instruments, TropOMI, GEMS)
    - RTM simulations
  - Improve the simulation accuracy of the CRTM for OMPS NP and NM in coordination with CRTM team (M. Liu, M. Chen, P. Ling, and others)
  - Assess impact of a different solar reference spectrum (e.g., GSICS-recommended one) on NOAA-21 SDR data quality
- Future Cal/Val activities / milestones
  - Validated review: March 2024

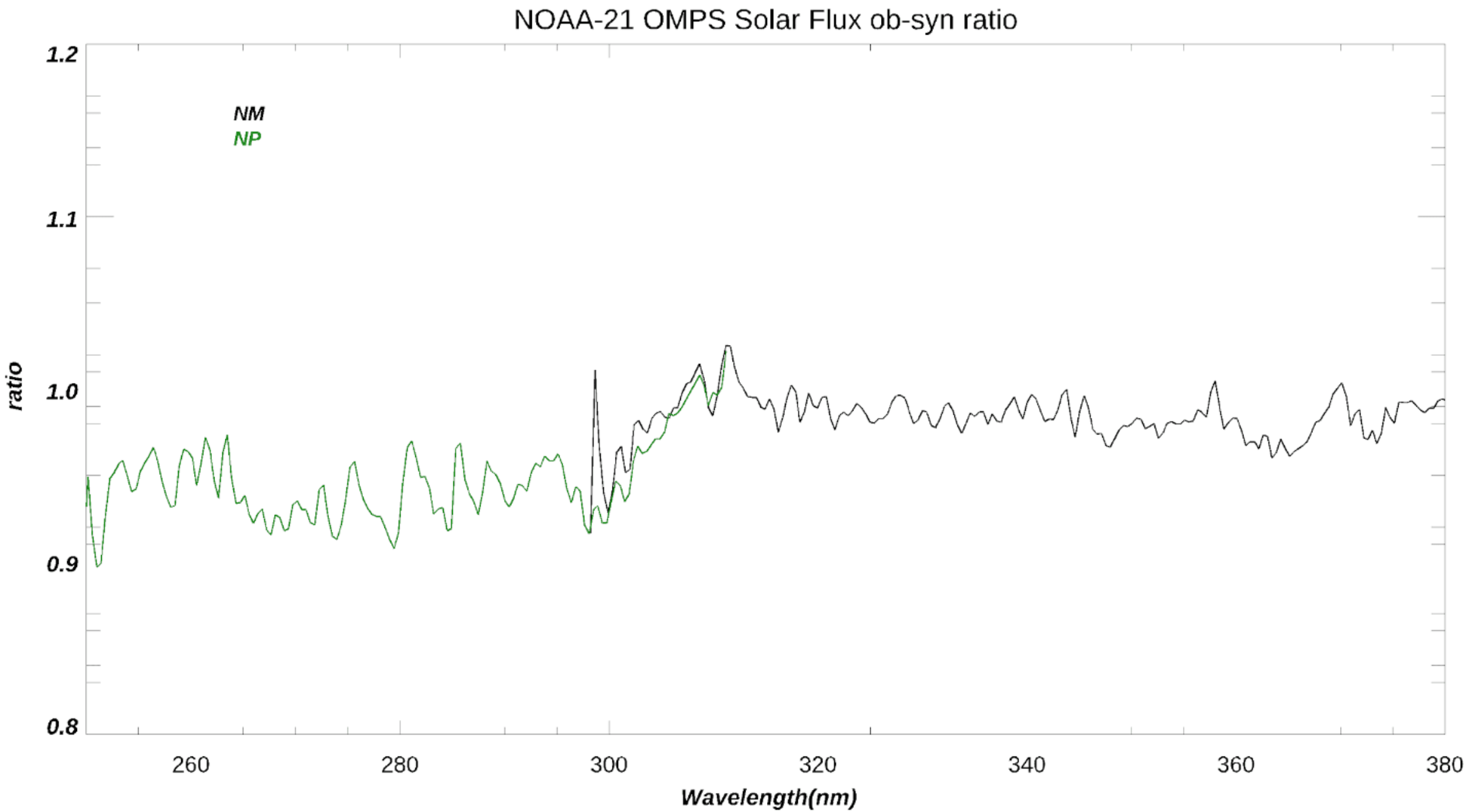
- backup

NOAA-21 NM Solar L1B Mean at Different Positions (Animated)



NOAA-21 OMPS NM/NP Raw Solar Flux Data: Trend Track since 02/07

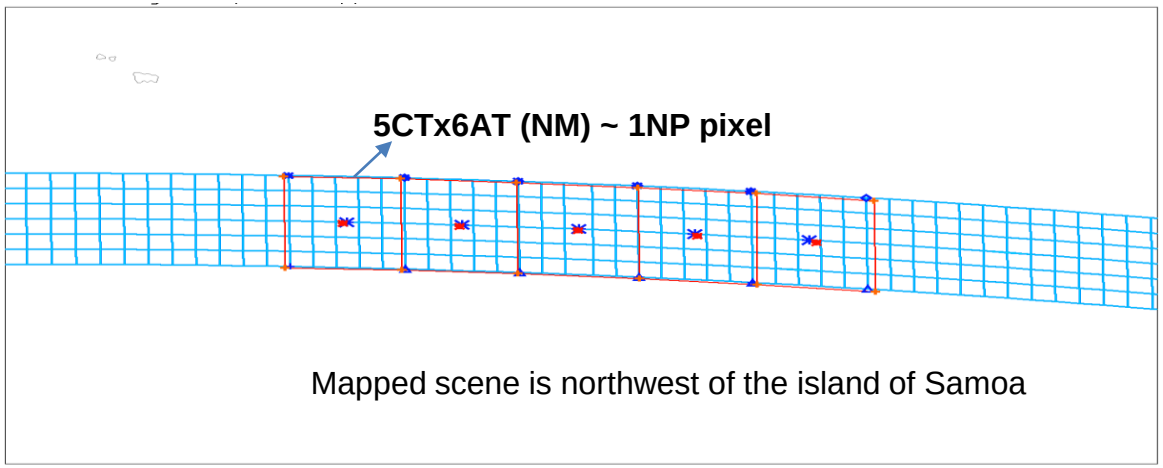



NOAA-21 OMPS Solar Flux ob-syn ratio
NM
NP
ratio
1.2
1.1
1.0
0.9
0.8
260
280
300
320
340
360
380
Wavelength(nm)

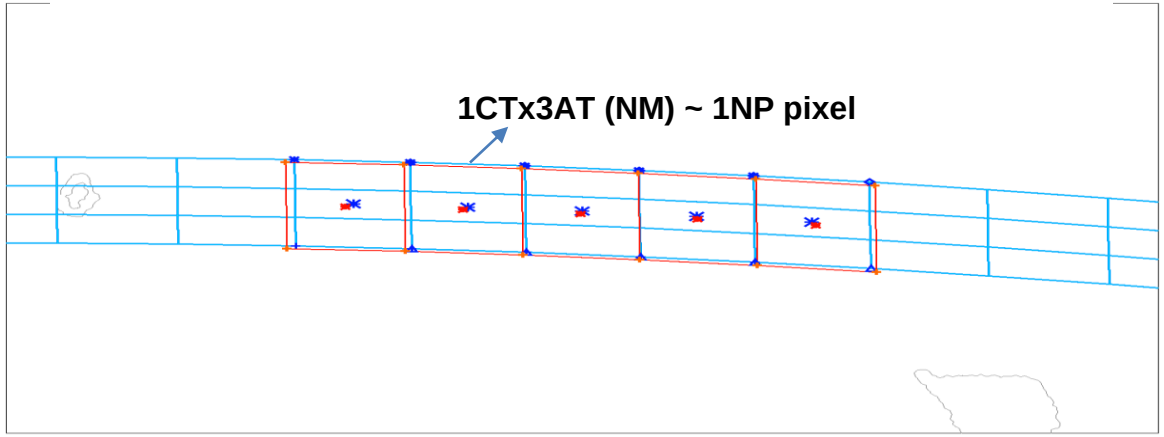
NOAA-21 OMPS NP Geolocation Assessment Relative to OMPS NM (1/3)

- The NOAA-21 OMPS NP geolocation accuracy is assessed against the NOAA-21 OMPS NM (see the upper panel)
  - Red: NP ground pixel corners, centers, edges. One 7.5 second scan, 5 NP pixels
  - Blue: TC ground pixel corners, centers, edges. Three 2.5 second scans
  - There 5CT (cross-track) and 6AT(along-track) TC ground pixels per each NP pixel
- As a comparison, for the NOAA-20 NP (lower panel)
  - Red: NP ground pixel corners, centers, edges. One 7.5 second scan, 5 NP pixels
  - Blue: TC ground pixel corners, centers, edges. Three 2.5 second scans
  - There 1CT and 3AT TC ground pixels per each NP pixel

(a) NOAA-21 NM Pixels Mapped to NP Ground Pixels

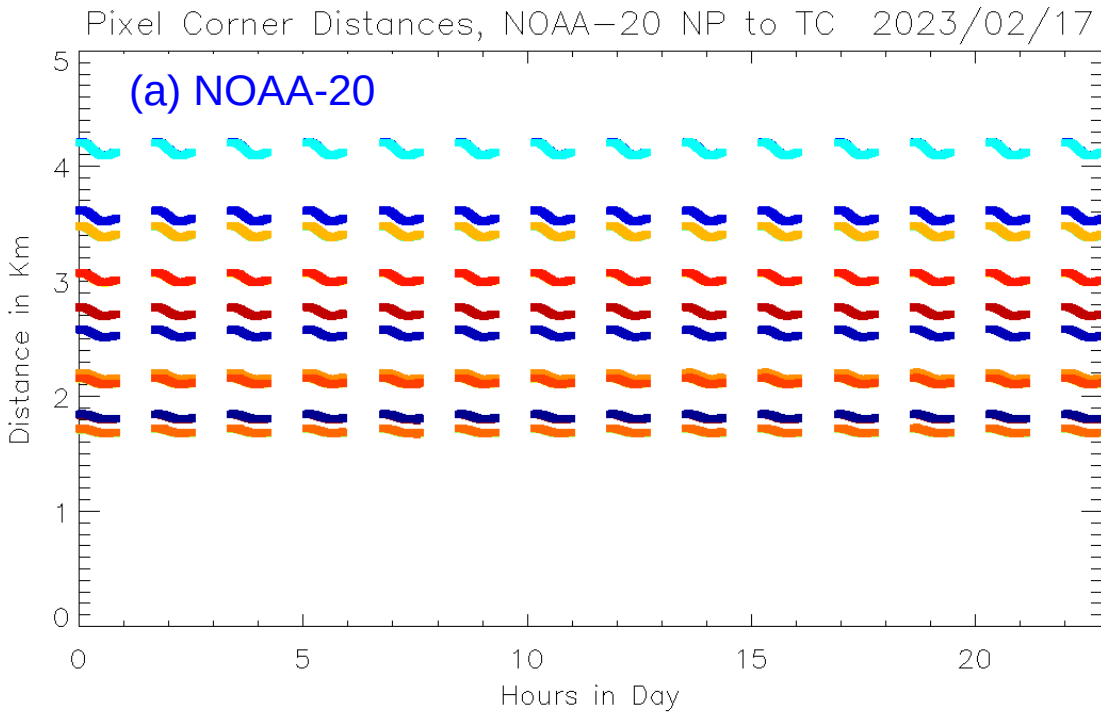


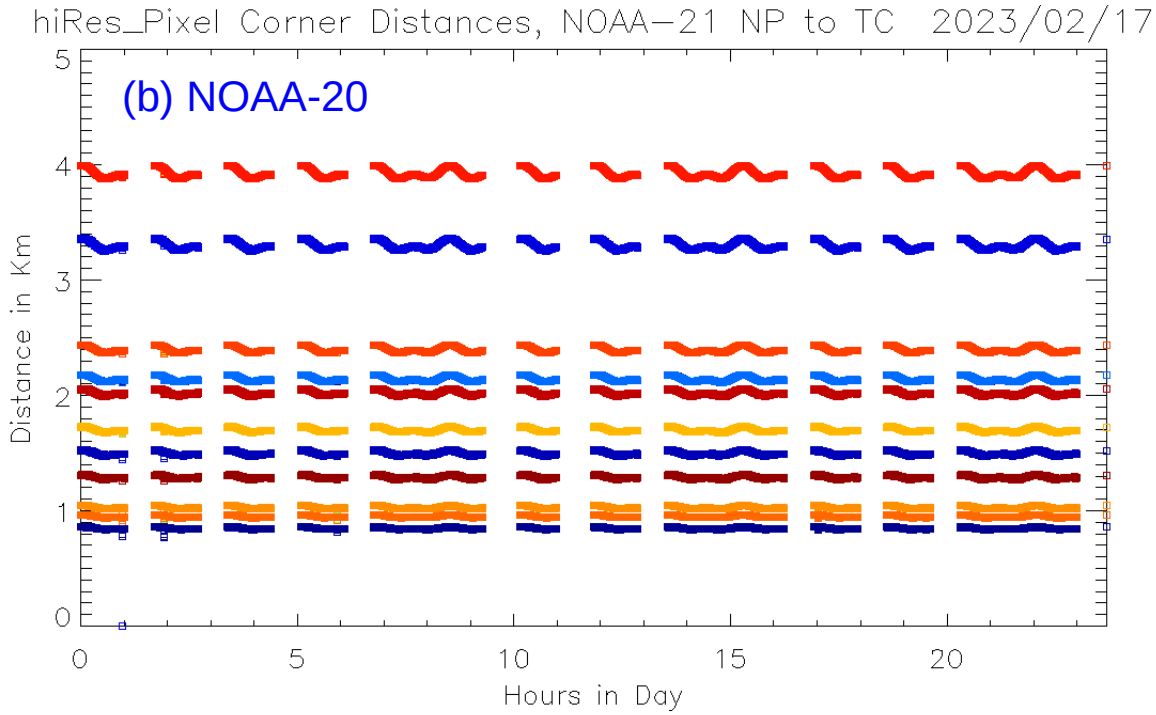
(b) NOAA-20 NM Pixels Mapped to NP Ground Pixels



NOAA-21 OMPS NP Geolocation Assessment Relative to OMPS NM (2/2)

Ground Pixel Corner Distance between NP and NM (km)



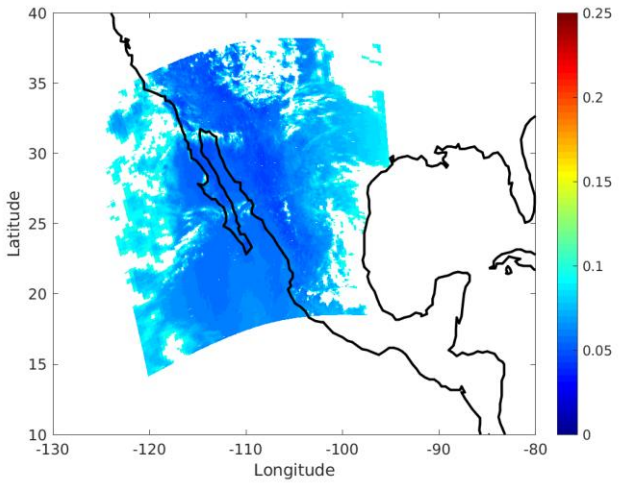


- There are 20 lines across: Four corner distances for each of 5 NP ground pixels.
- The corner locations are marked for the representative scenes in slides 2,3.
- The corner distances are smaller for NOAA-21.

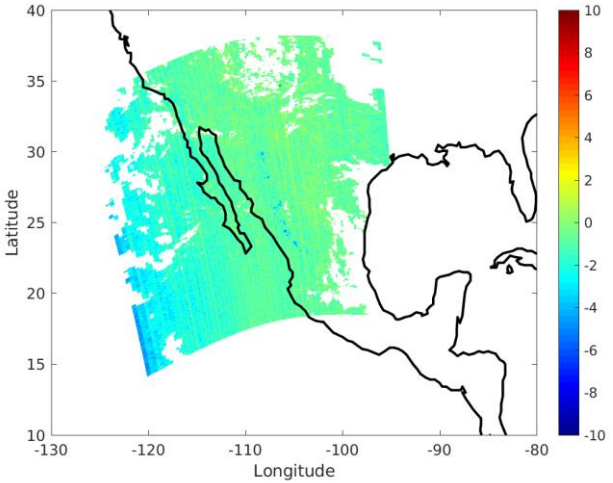
NOAA-21 NM Radiance Deviations from CRTM Simulations Relative to Two Reflectivity Channels

- The CRTM v.3 (Liu and Cao 2021) is applied to the OMPS NM radiance simulations under clear skies.
  - Raman scattering effect is still not included in the CRTM, thus causing ripple pattern in current O-B spectral features
  - An comprehensive interface package was added to the CRTM for SNPP, NOAA-20 and NOAA-21 OMPS NM/NP (Huang et al., 2021 and 2022 AMS conferences)
  - Surface reflectivity at 347.6 nm and 371.8 nm are derived using OMPS NM SDR data (Liu et al, 2022).
  - Other ancillary information to the CRTM simulations use the EUMETSAT NWP analysis data (see Huang et al. 103rd AMS presentation)
- The O – B represents the deviations of observations (O) from the simulations (B) relative to the two reflectivity channels.
  - The mean O – B values are typically within ±5% for the channels above 310nm, and can be up to 20% below 305nm that are in the dichroic wavelength range.
  - The CRTM simulation accuracy and the data errors are contributors to the large O – B values (absolute value)

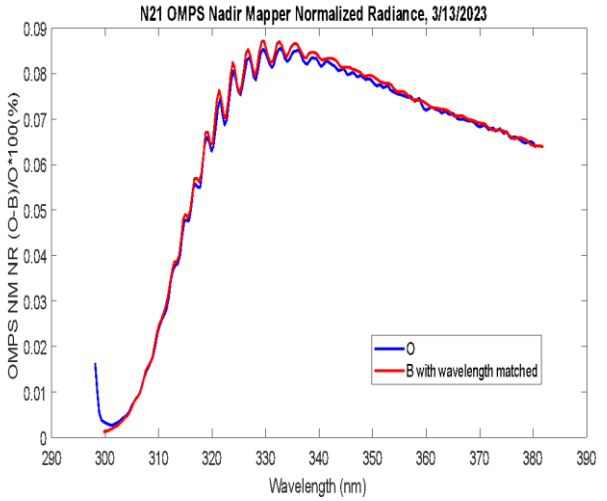
(a) NOAA-21 NM Observation at 378.8nm



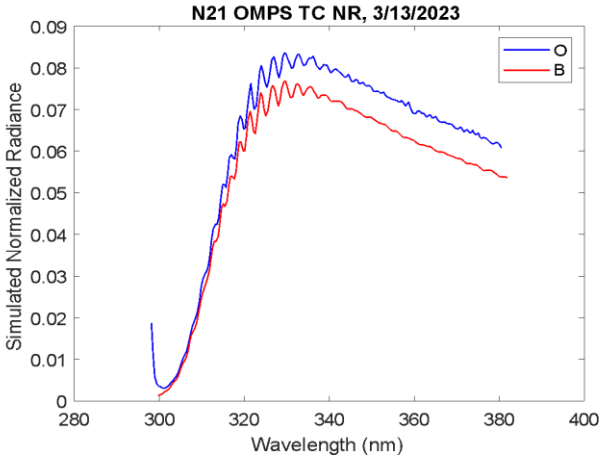
(b) O - B Image at 378nm for the NOAA-21 NM



(c) Mean Normalized Radiance (NR) Spectrum (N21's surface reflectance)



(d) Mean Normalized Radiance (NR) Spectrum (N20's surface reflectance)

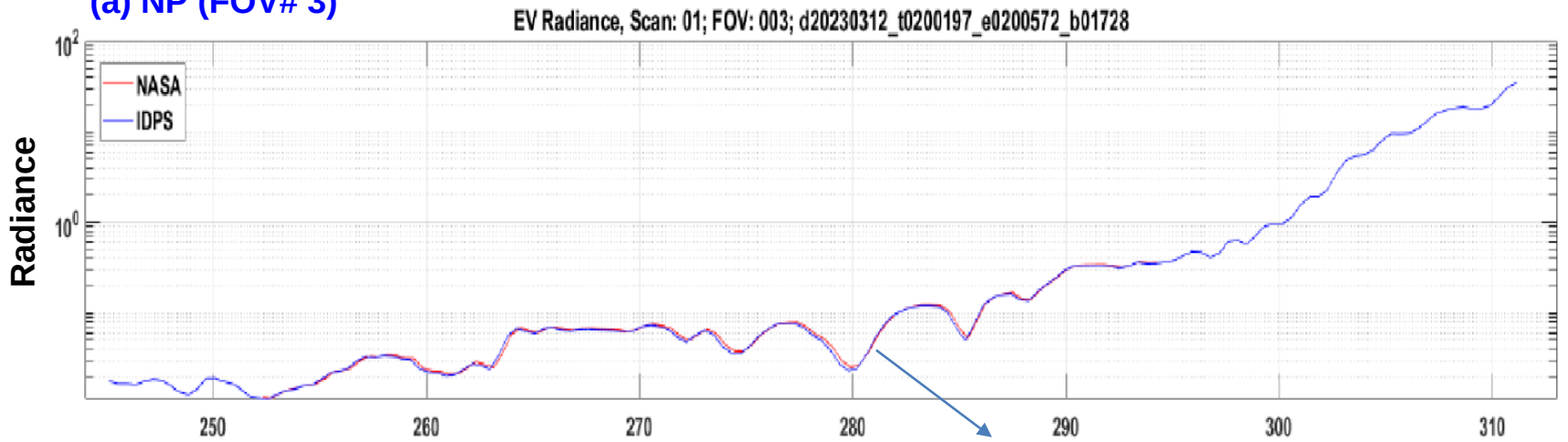


Cross-Validation of NOAA-21 NM and NP SDR Data between NOAA and NASA Data Source: Preliminary Analysis

- A preliminary analysis was conducted for cross-validation of the NOAA-21 OMP SDR data between the NOAA and NASA Data source.
  - The two data sources have independent calibration algorithms and implementation process
- Data coverage:
  - Date: 03/12/2023 data
  - Only compared a few scans spanning three locations (low, middle and high latitudes)
- The figures are the results over tropical area.
  - The preliminary results show that the quality of the two data source is comparable and in a family.
  - More comparisons will be done future

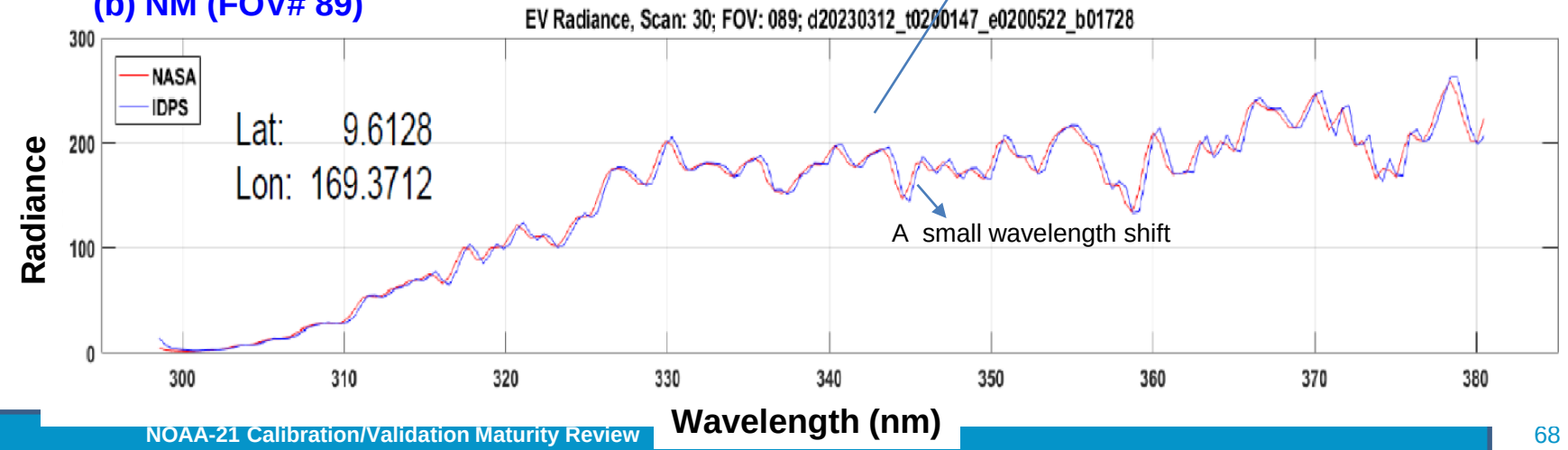
NOAA-21 OMPS NM and NP Radiance Comparison between NOAA and NASA Data

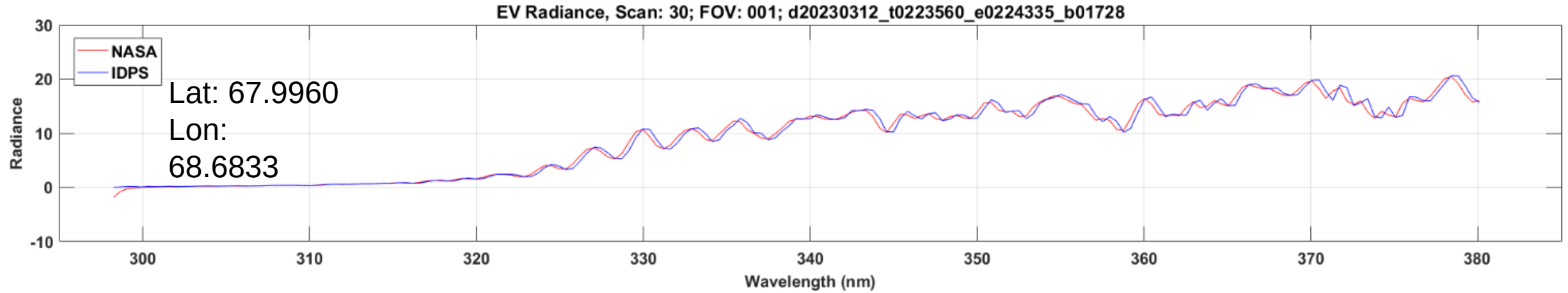
(a) NP (FOV# 3)

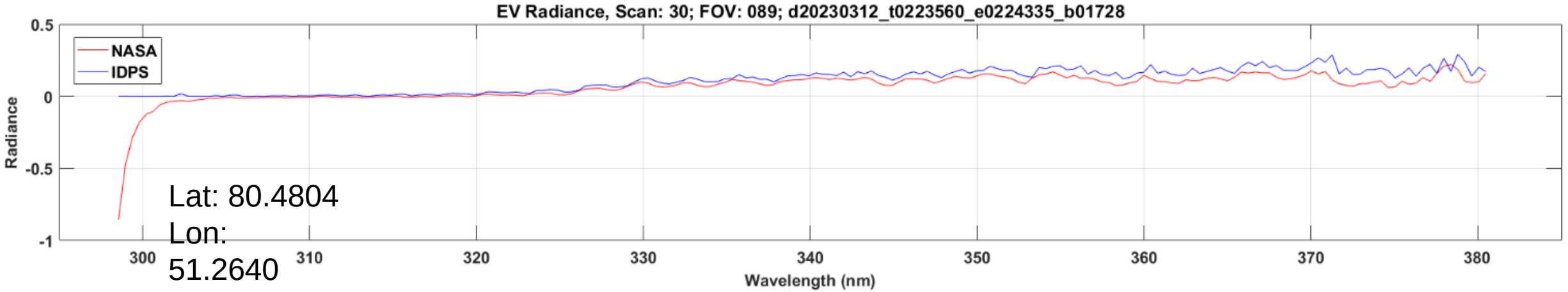


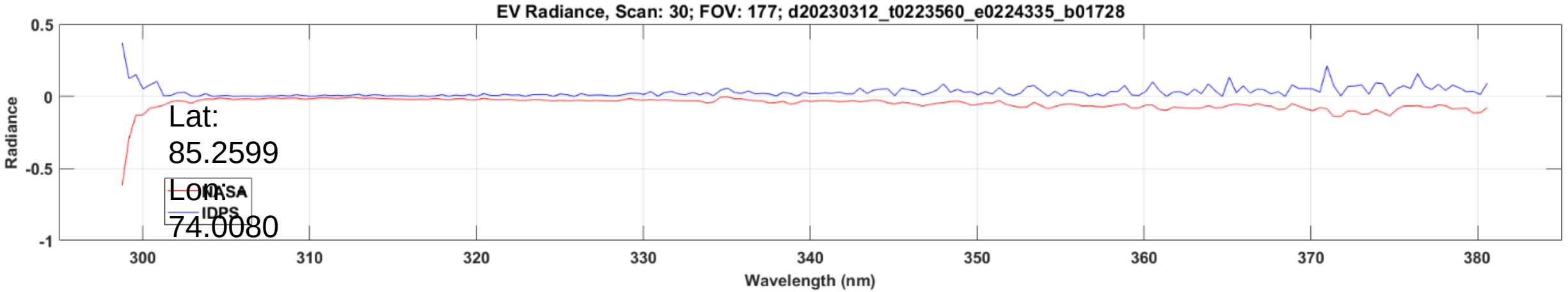
NOAA and NASA data are in a family

(b) NM (FOV# 89)



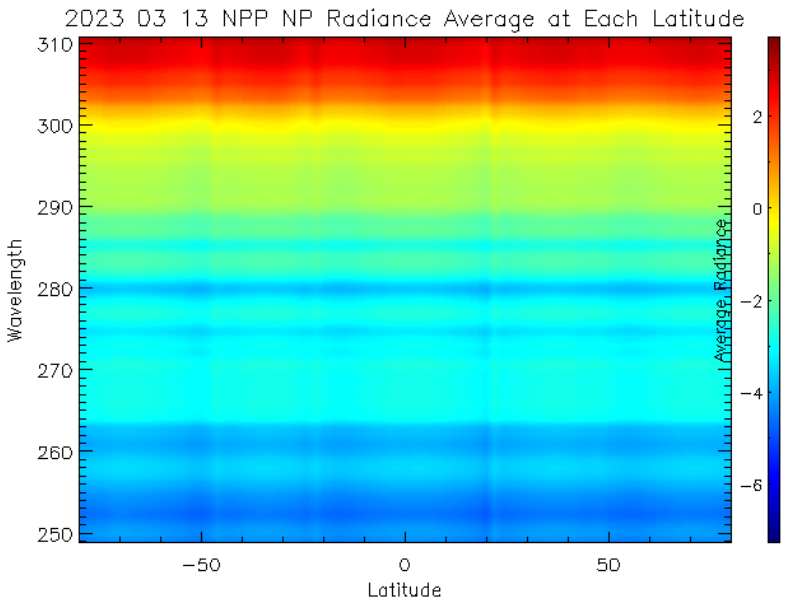

EV Radiance, Scan: 30; FOV: 001; d20230312_t0223560_e0224335_b01728
NASA
IDPS
Lat: 67.9960
Lon:
68.6833
Radiance
Wavelength (nm)


EV Radiance, Scan: 30; FOV: 089; d20230312_t0223560_e0224335_b01728
NASA
IDPS
Lat: 80.4804
Lon:
51.2640
Radiance
Wavelength (nm)

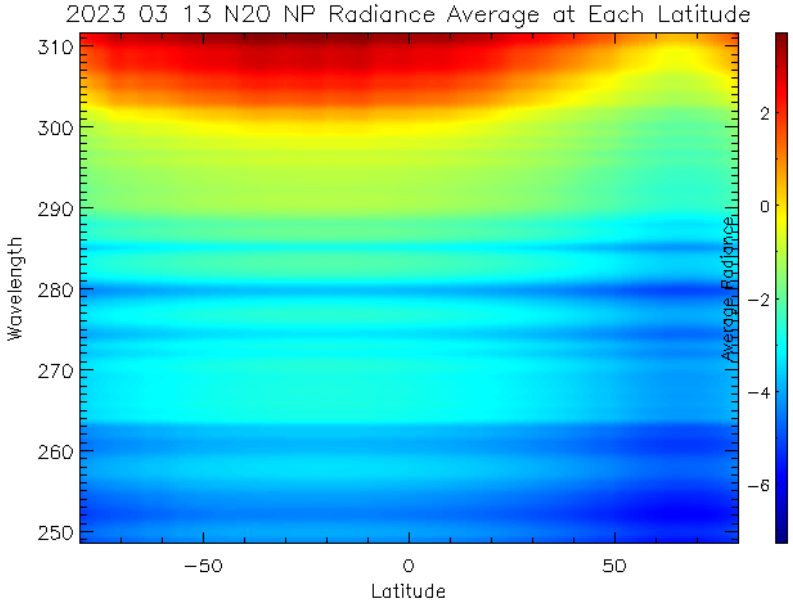

EV Radiance, Scan: 30; FOV: 177; d20230312_t0223560_e0224335_b01728
Lat:
85.2599
Lon:
74.0080
NASA
IDPS
Radiance
Wavelength (nm)

Comparison of OMPS NP Radiance for SNPP, NOAA-20, NOAA-21: Longitudinal Average

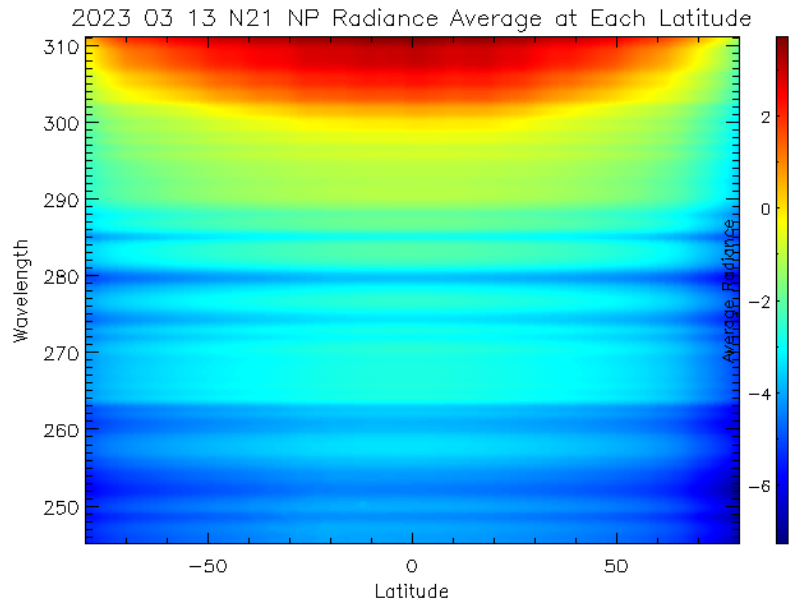
SNPP NP (1CTx1CT)



NOAA-20 NP (5CTx 5CT)



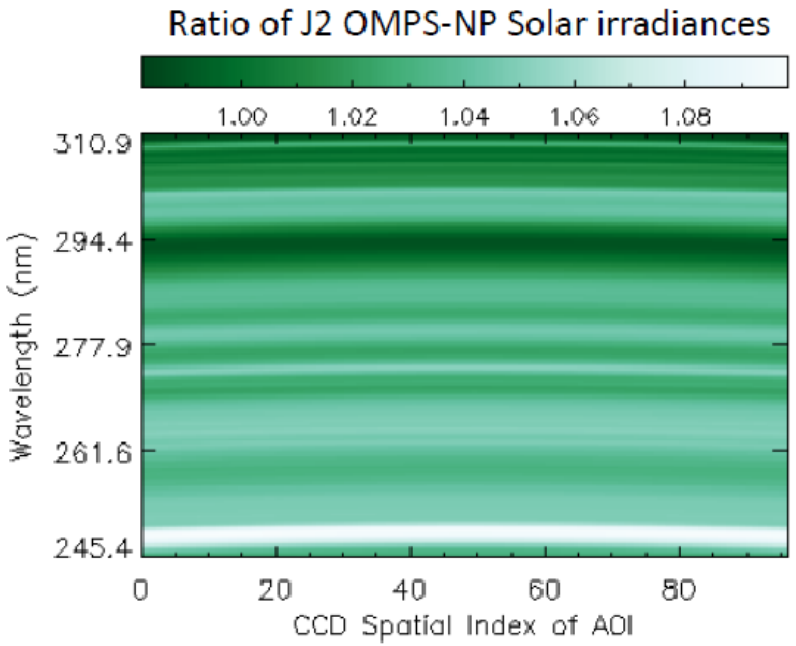
NOAA-21 NP (5CTx 5CT)

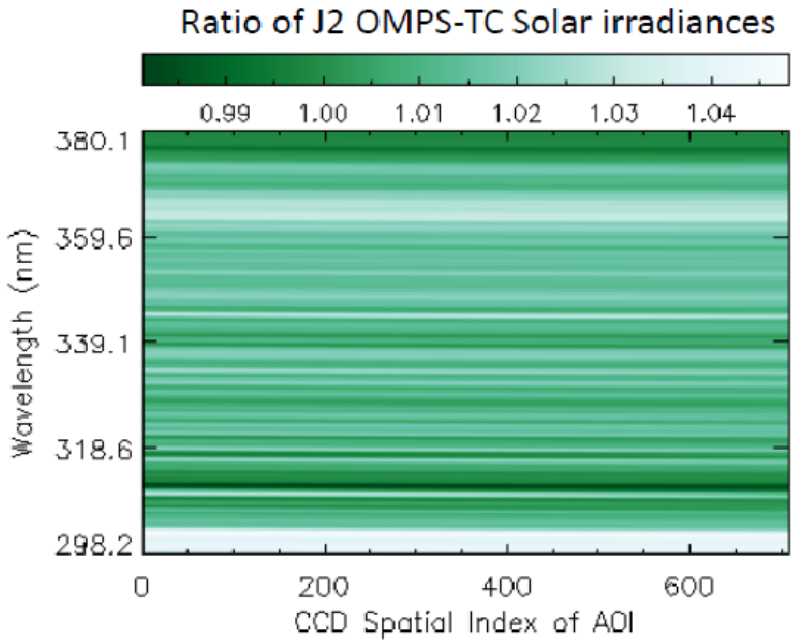


The Results demonstrate that the observations from three NPs are in a family. The differences are caused primarily by different viewing conditions (time and spatial resolution).

Ratio Difference of J2 OMPS Solar Irradiance

Current_used/GSICS_recommanded





The figures show the difference ONLY. It is not intended to judge the data quality. Further investigation is under way to evaluate accuracy of the solar reference data