VALIDATED MATURITY REVIEW MATERIAL

# NOAA-20 OMPS NP SDR Report


## STAR OMPS SDR Team

With contributions from NASA OMPS Instrument Group,
NOAA STAR ICVS Team, OMPS EDR Team, and JSTAR Team

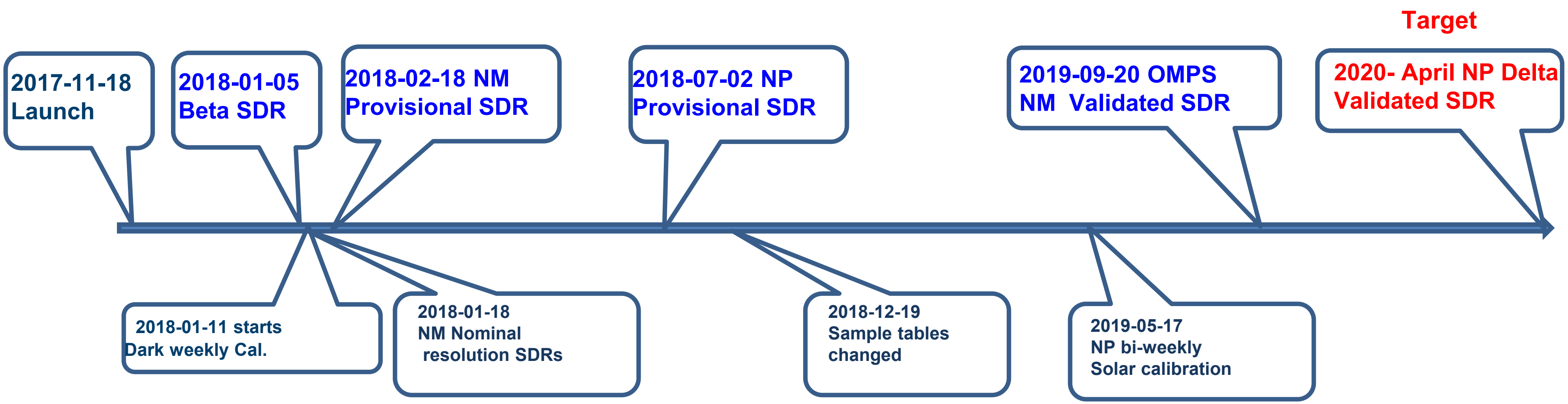
# Outline

- OMPS SDR Cal/Val Team and Project (STAR/Yan)
- Product Requirements (JPSS/Dunlap)
- OMPS NP Sensor Performance Review (NASA/Jaross)
- NOAA-20 NP SDR Performance Validation (UMD/Pan and STAR/Yan)
  - Operational Calibration Improvements
  - SDR Performance Validation
  - Documentation (Science Maturity Check List)
  - Summary and Path Forward
- Downstream Product Feedback (STAR/Flynn)
- Discussions (Review Board)

# OMPS SDR Cal/Val Team

| Team Member | Organization | Primary Roles |
|---|---|---|
| Banghua Yan (Project team lead) | NOAA/STAR | Project task plan and performance monitoring; instrument and product cal/val science development; dark calval algorithm development |
| Trevor Beck | NOAA/STAR | Diagnostics and improvement of RDR through SDR processing package; NP high resolution code; TVAC data analysis; SDR reprocessing |
| Chunhui Pan (NOAA Technical Lead) | UMD | SDR cal/val science and algorithm development; LUTs derivation; TVAC data analysis; SDR calval algorithm analysis reports |
| Glen Jaross (R. Mundakkara and C. Seftor) | NASA | Interact with vendor to deliver cal/val related sensor tables, data and documents; report and analyze issues present in sensor performance |
| Xiaozhen Xiong | GST | ADL offline verification of weekly dark and biweekly solar LUTs; OMPS SDR validation; DR/CCR analysis; SDR data reprocessing |
| Junye Chen | GST | Dark and other SDR calval algorithm development; TVAC analysis; geolocation and mounting matrix; SDR calval algorithm development |
| Ding Liang (ICVS) | GST | OMPS SDR inter-sensor validation; SDR data reprocessing; DR/CCR analysis; LTM OMPS SDR via ICVS |
| Eve-Marie Devalier (25%) | GST | Maintain weekly dark auto run and delivery |

# Operational SDR Milestones



# Major Calibration Activities Towards NOAA-20 NP Validated Review

- For NOAA-20 NP,
  - Dark and smear correction (√)
  - Radiance data SNR assessment (√)
  - Stray light contamination correction and error assessment (√)
  - Day-1 solar irradiance calculation and wavelength shift (√)
  - Solar and Earth-View (EV) wavelength variation assessment (√)
  - In-flight non-linearity correction and error assessment (√)
  - EV radiance albedo calibration uncertainty assessment (√)
  - Geolocation uncertainty assessment (√)
- For inter-sensor calibration,
  - SNPP and NOAA-20 NP sensor spectral characteristic difference identification (√)
  - NOAA-20 NP calibration adjustment to mitigate SNPP and NOAA-20 NP sensor differences (√)
  - Inter-sensor comparisons between SNPP and NOAA-20 NP SDR (√)
  - Comparison between NOAA and NASA NP SDR (√)
  - Inter-sensor comparison between Aura OMI and NOAA-20 NP
- For LTM monitoring capability,
  - ICVS update to monitor NP instrument and SDR data quality (√)

# Issues from 2019 September-Review and Responses

| Item # | Comment | Action/Response | Status |
|---|---|---|---|
| 1 | Calibration NP wavelengths to 0.01 nm requirement needs to be addressed | Improved inflight wavelength registration to meet requirement (Slide # 11) | closed |
| 2 | Certain NOAA-20 NP SDR inter-sensor calibration latitude dependency when compared with SNPP | The latitude dependency is related to NOAA-20 and SNPP SDR instrument differences that are confirmed (slides #15, 16, and 25). Future work is to further improve the consistency between SNPP and NOAA-20 NP | Closed |
| 3 | Stray-light calibration near 250 nm to 1.0% accuracy requirement needs to be addressed | We use the STAR stray light model to show the 1% accuracy requirement is met (slide # 10) | Closed |
| 4 | Show what .01 nm wavelength error looks like, and better understand the difference between the SNPP & NOAA_20 | Added a new graph about the 0.01 nm wavelength error sensitivity to the review presentation (slides # 11, #47-49; conducted an intensive analysis to investigate two instrument spectral differences (slides # 15, 16, and # 25) | Closed |
| 5 | Why relatively large difference in radiance ratio between NOAA and NASA SDR over the south polar region | Conducted an analysis about the cause: small radiance over the south polar region are relatively noisy (low SNR values, the backup slide # 46) easily causing large radiance ratio difference; NASA data is still in a provisional maturity level | Closed |
| 6 | NP geolocation error needs to be addressed | Performed an analysis to quantify the geolocation error. The performance meets the requirement (slide # 19) | Closed |

# Achievement Highlights Since 2019 September Review

- Major Accomplishments since 2019 September Review: Reach Validated Maturity!
  - Completed intensive SDR calibration towards validated maturity
    - Identified and confirmed SNPP and NOAA-20 NP spectral differences (slides #15 and 16)
    - Improved NOAA-20 NP calibration algorithms to reduce the inconsistency between SNPP and NOAA-20 NP SDR
      - Processed and analyzed three versions (V1 to V3) NOAA-20 NP SDRs (Version differences referred to backup slides# 50 &51) (**V3** the final)
    - Investigated the root cause of radiometric calibration difference latitude dependency between SNPP and NOAA-20 NP SDR (Slides # 15, 16, and 25; on-going task)
  - Assessed V3 (validated maturity) NOAA-20 OMPS SDR data
    - Comparison with radiative transfer model simulation
    - NOAA and NASA SDR data comparison
    - Inter-sensor radiometric comparison between SNPP and NOAA-20 NP (10 months data)
    - Inter-sensor comparison between Aura OMI and NOAA-20 NP
  - Improved long term monitoring capability of sensor and product performance via ICVS

# NOAA-20 NP SDR Performance Requirements (from L1RD-S table 4.4.2.1)

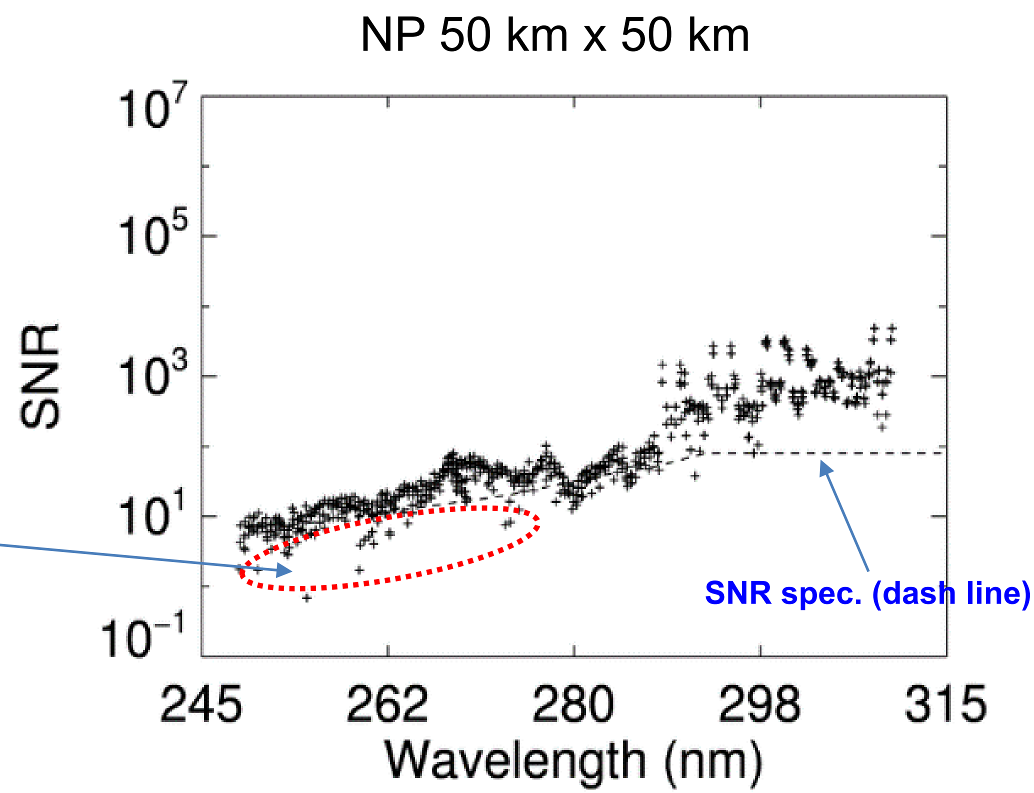
| Parameter | Requirement | New Performance |
|---|---|---|
| Wavelength Range | 250-310 nm | 248.2 – 312.1 nm |
| Bandwidth (FWHM) | <1.1 nm | <1.1 (0.86-1.09) nm |
| Samples/FWHM | >2.3 | 2.38 |
| Horizontal Cell Size | <50 km @ nadir | 50 km @ nadir |
| SNR Uncertainty | 7-80 (λ dependent)* | 7-80 (λ dependent) |
| λ-registration | 0.01 nm | 0.01 nm |
| Albedo Calibration Uncertainty | <2% | <2.0 exception for 1 channel of 2.15% |
| Out-of-Band (OOB) Stray Light Uncertainty | <1% | 0.75% |

*SNR in the L1RD-S is based on a 250 x 250 km footprint, the values presented here are extrapolated for a 50 x 50 km footprint

# Earth View SNR Assessment

**NOAA-20 NP SNR from Earth view meets requirement**

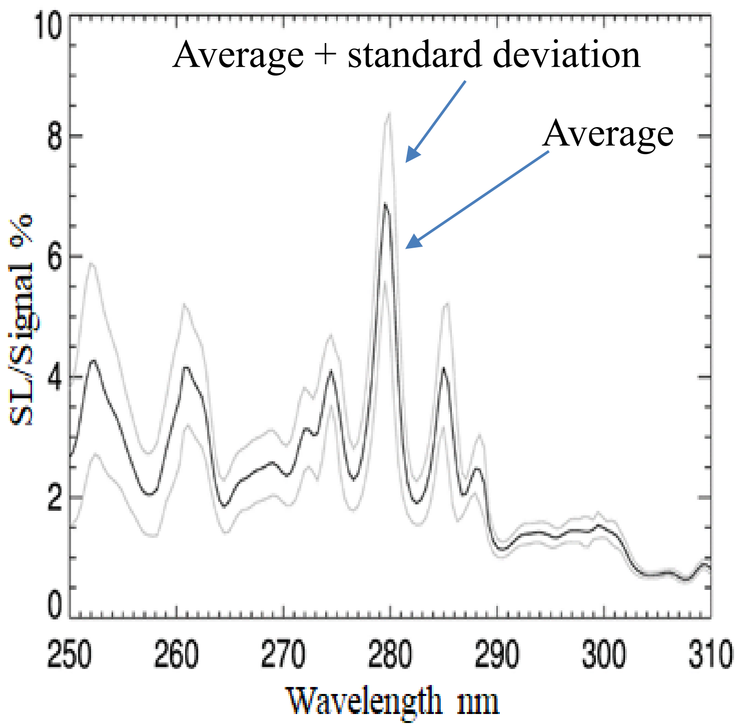
- Data Source: 3800 SDR granules from reprocessed data on April 25, 2019
- Data confidence level was 100%. No data was removed.
- NP short wavelengths were influenced by high energy transient particles.
- SNR features during ten months (selected one day per month) are consistent with the figure here




✓ ***Meet the requirement*** (SAA pixels are excluded)!

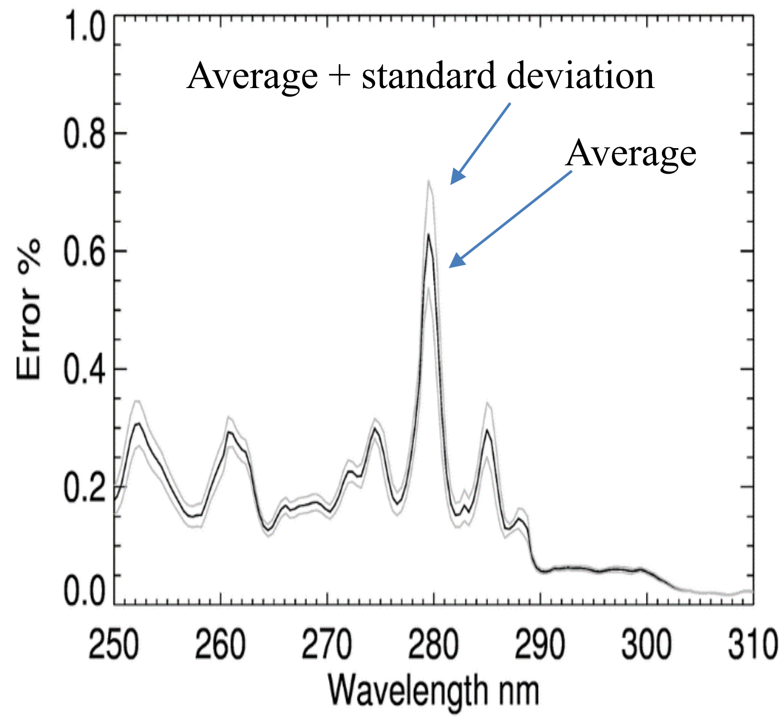
# Stray Light Calibration Error Assessment

Percentage of stray light in signal




Average percent of Out-of-band (OOB) stray light that model computed to signal is 0.5% ~ 6.9% depending upon wavelength. (from792 Earth images).

Calibration Error (%)



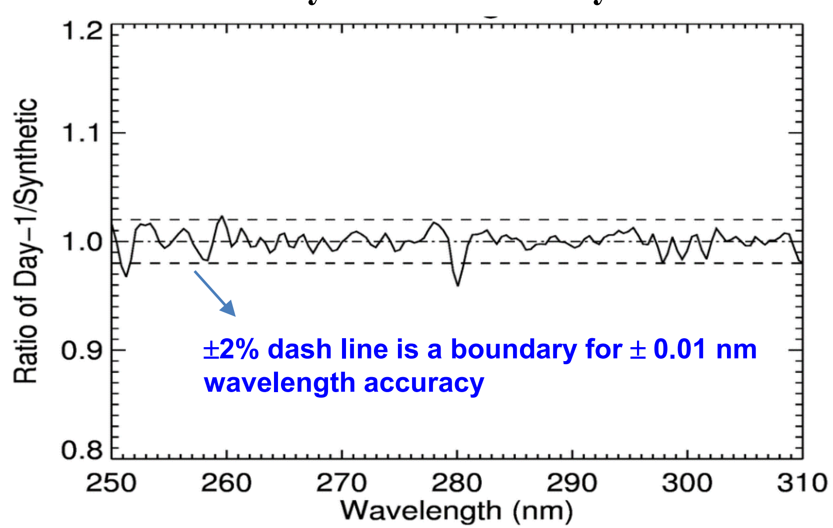

Comparison of SDR captured stray light signal with modeled stray signal. Gray lines indicate standard deviation from 792 EV images.

✓ ***Meet the requirement!***

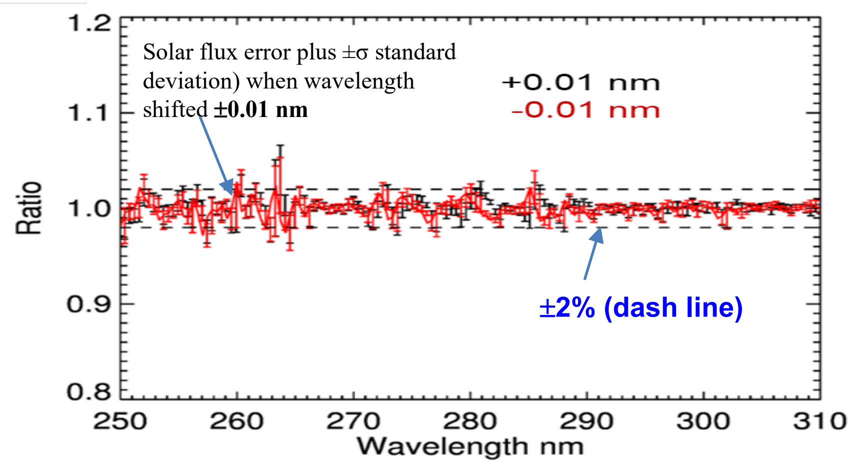
# Day-1 Solar Wavelength Calibration Accuracy Assessment

- Corrections/calculations made for NOAA-20 NP Day-1 calibration:
  - Correction for goniometry variation, nonlinearity, dark, smear and stray light signals
  - Prelaunch wavelength dependent sensor spectral feature change
  - Prelaunch wavelength dependent of sensor degradation
  - Sensitivity change when sensor transitioned from ground to orbit
  - Solar activity impact to the solar flux measurement
- No direct method to judge accuracy of absolute wavelength calibration.
  - Ratio of solar flux to synthetic flux is used as indirect judgement
  - Sensitivity study find a ±0.01 nm shift in wavelengths causes about 2% solar flux change.
  - Calibration is generally within 2% for most of the channels, i.e., accuracy level at 0.01 nm.
  - Few channels slightly exceeds 2% bound, that is due to radiometric calibration error and uncertainty in reference solar spectrum. It is not related to wavelength calibration error.

**Ratio of Day-1 Solar flux to Synthetic flux**




**Solar flux ration to ± 0.01 nm wavelength shift**

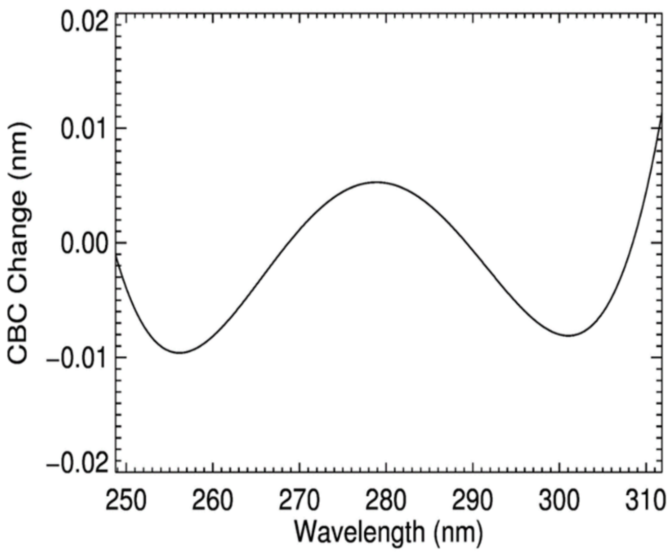



✓ ***Meet the requirement!***

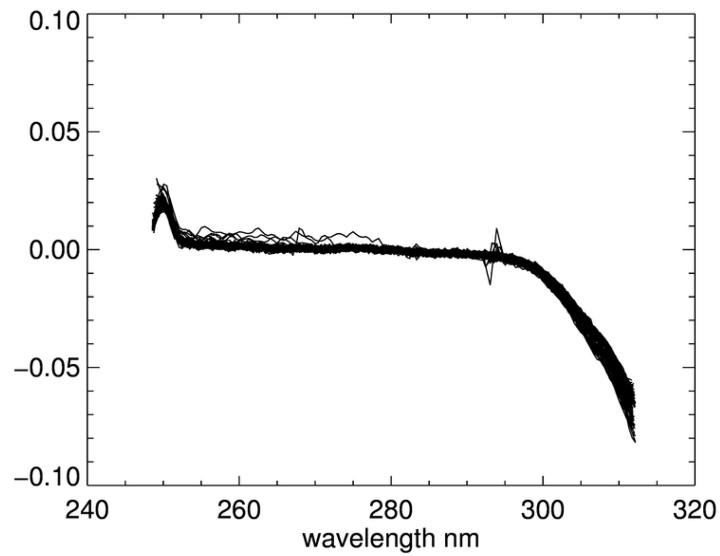
# Wavelength Updated from Provisional Review

Wavelengths were updated from provisional calibration

- Computed wavelength changes relative to provisional data
- Added sensitivity correction to in-flight wavelength registration




- Wavelength registration was updated
- Difference from provisional calibration calculated for each wavelength channel

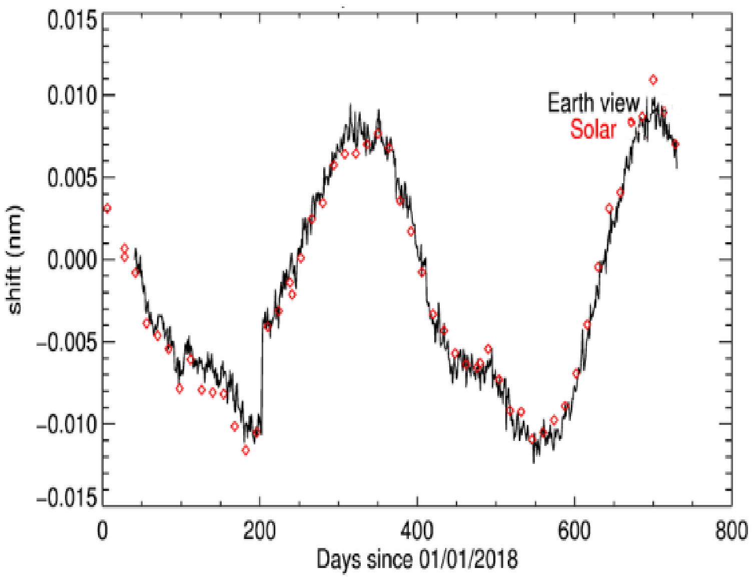



N20 sensitivity correction to account for Ground to orbit sensor sensitivity change

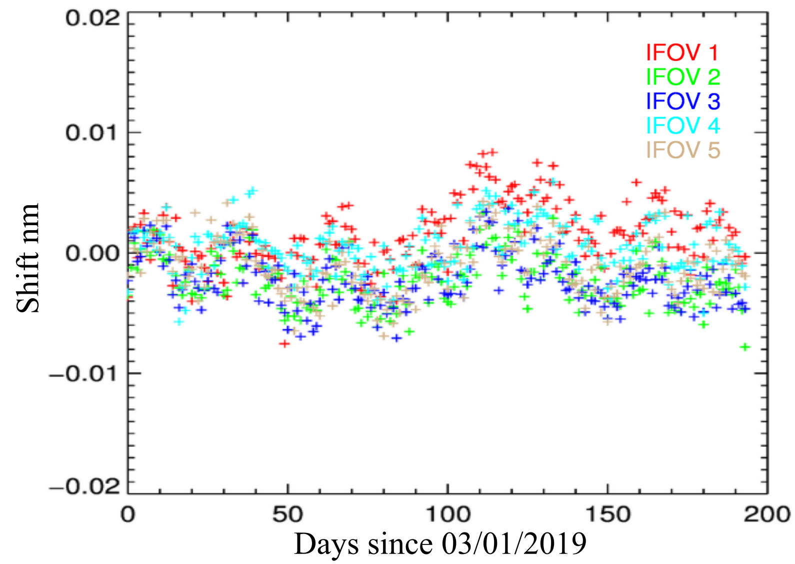
# In-flight Wavelength Calibration Error Assessment

NOAA-20 NP wavelength shows relative large annul pattern. Requested by EDR team, Bi-weekly calibration is being conducted to keep the annual pattern <0.01 nm

Annual Wavelength Fluctuation




Wavelength Calibration accuracy



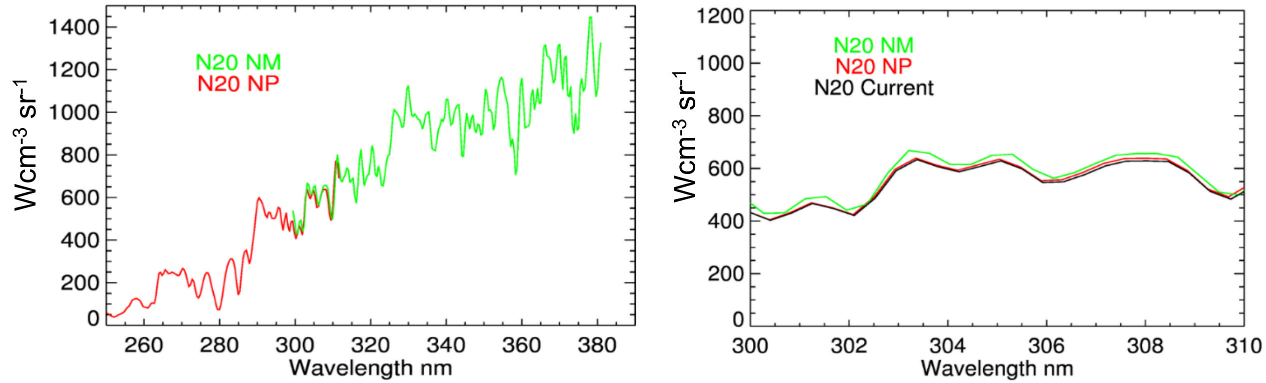

Spectral wavelengths changes from measured Earth spectrum and solar spectrum relative to the first in-flight normal Earth measurements.

Bi-weekly routine wavelength calibration meets 0.01 nm requirement

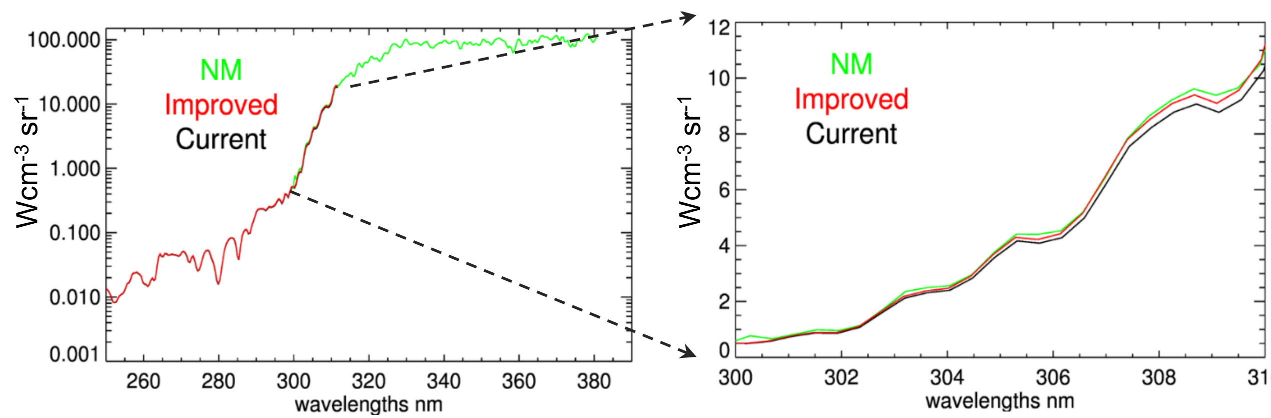
✓ ***Meet the requirement!***

# NOAA-20 NP and NM Consistency in 300-310 nm

Good irradiance consistency



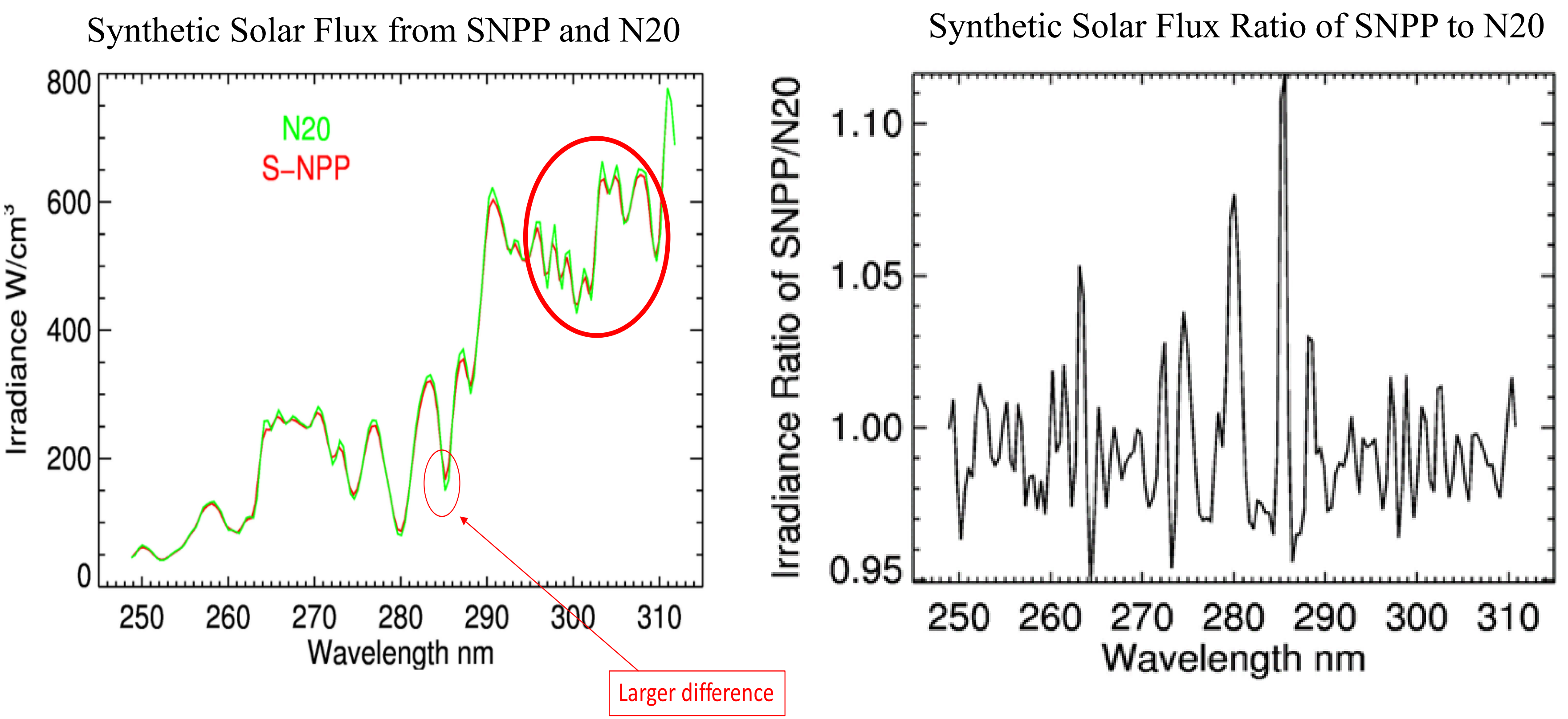

Good radiance consistency




Data source:
Reprocessed
On Dec. 31, 2019

Good radiometric and wavelength consistency are found between N20 NM and N20 NP in overlap region of 300 – 310 nm.

# Synthetic Solar Flux Comparison between SNPP and N20

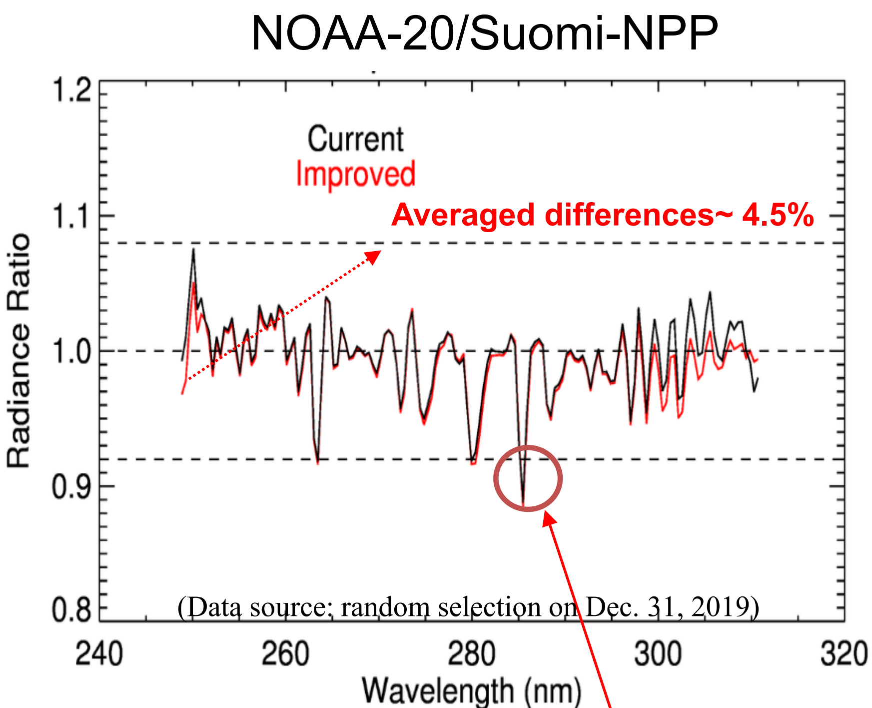



- Synthetic solar flux is convolved by sensor band pass with solar reference spectrum.
- **<u>Two sensors are different in spectral property</u>**: band passes and wavelength registration
  - Ratio of radiance and/or irradiance from two sensors are relative large than expected.
  - relative large radiometric difference between SNPP and N20 will cancel in albedo ratio

Solar reference files: Shorter than 250 nm: HiResSolarRef.h5; longer than 250 nm: use OMI data SolarRefSpec_Dobber_et_al_May2008.txt

# Radiance Comparison between SNPP and N20

- Use SNPP as reference to compute radiance ratio of N20 to SNPP:
  - Check the consistency between SNPP and N20.
- Average radiance differences between SNPP and NOAA-20 NP (red color) for all channels is about 4.5%, less than the 8% radiometric requirement if we use SNPP SDR as a benchmark.
  - Compared with the operational data, a better consistency exists at wavelengths (>280 nm)
  - One channel @285 nm accede 8%, that is due to instrument difference between SNPP and NOAA-20.
- For channels that have relative large radiometric difference between SNPP and N20 will cancel in albedo ratio

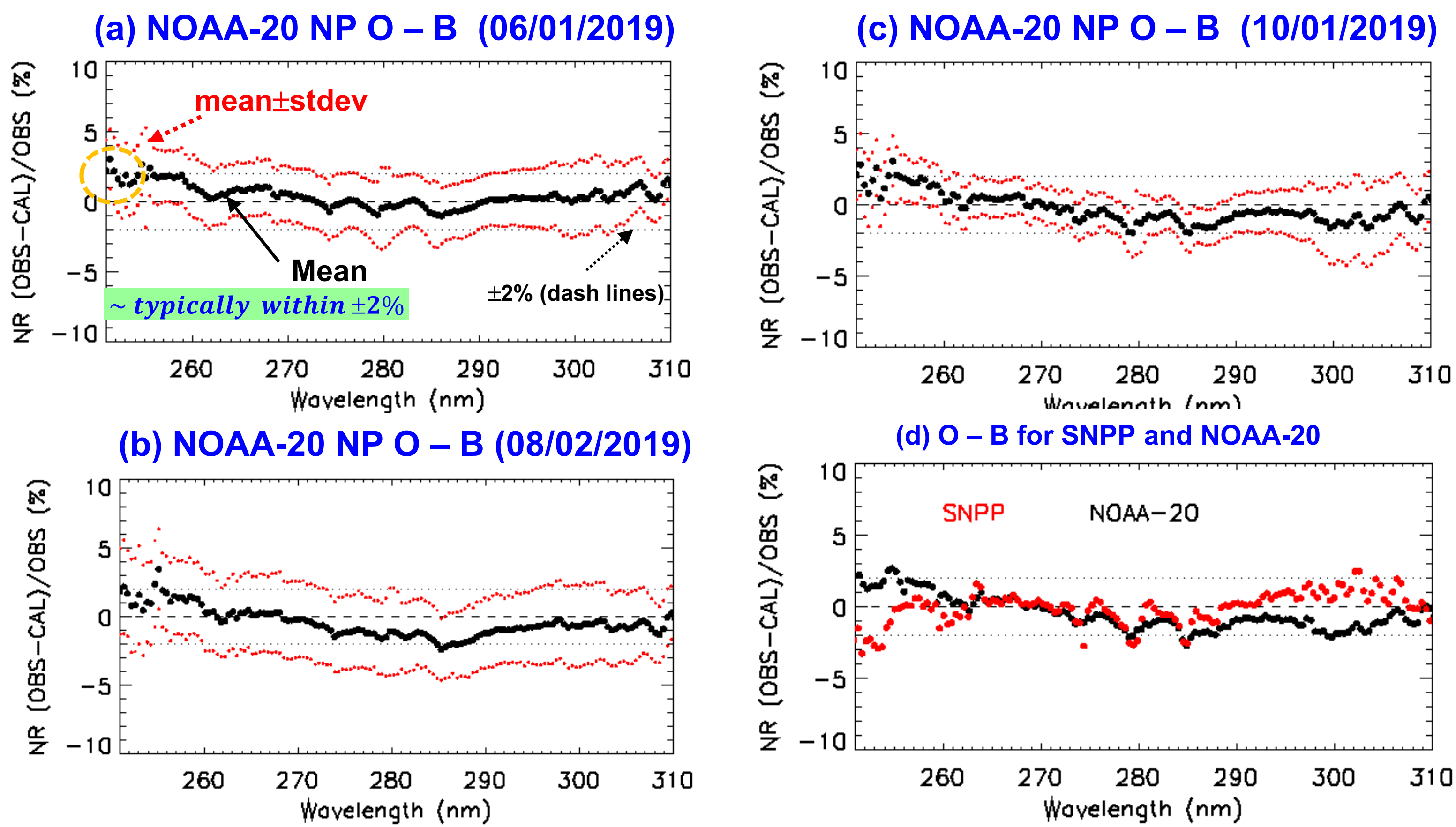



Large difference is due to instruments' difference. Same pattern is found in solar flux ratio, which is canalled in albedo ratio

✓ ***Meet the requirement (considering the instrument difference)!***

# NOAA-20 NP Radiance Quality Assessment against TOMRAD Simulations

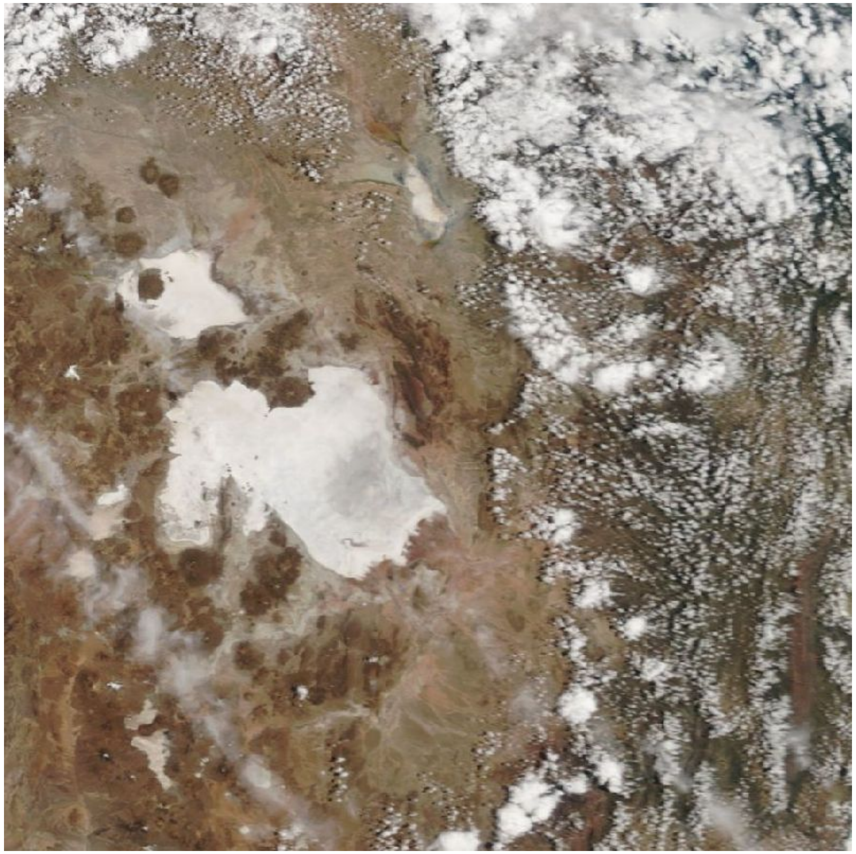
## OBS: Observations' CAL: Simulations

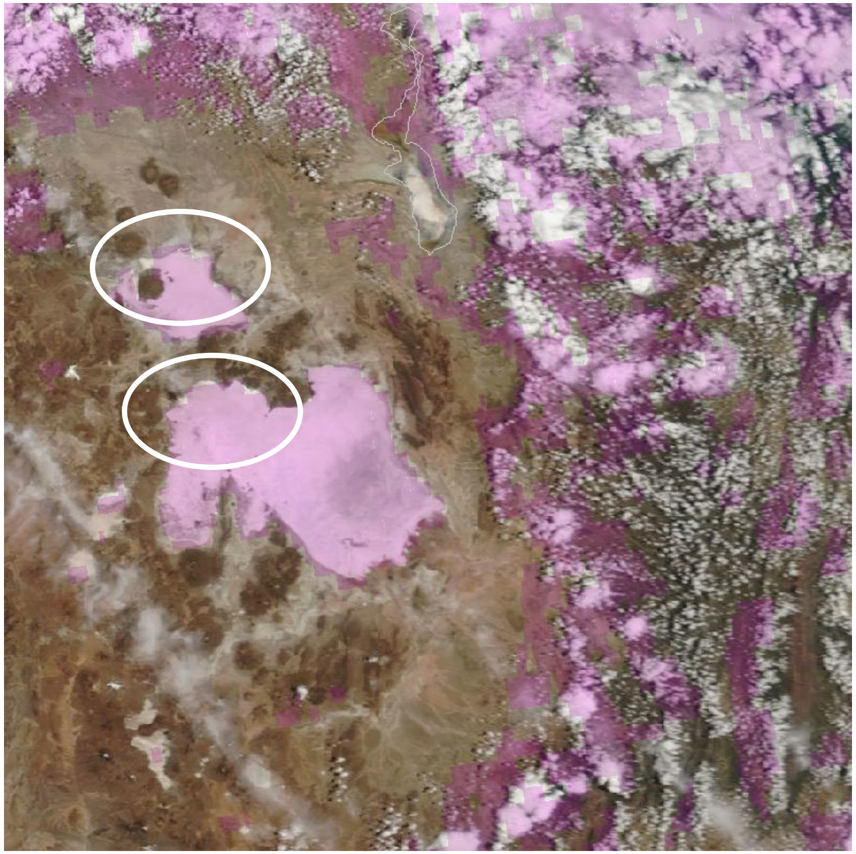



For most of the channels, NOAA-20 NP radiometric radiance difference remain within ±2% against TomRad simulations. Wavelengths smaller than 255 nm have relative large error slightly exceed 2%.

# Geo-location Accuracy Validation (NASA)

- Comparison of N20 OMPS w/r to S-NPP VIIRS RGB also indicates a small offset of < 5 km along track and < 3 km cross track (see within ellipses)
- OMPS reflectivity data from 15-55% overlaid on top of VIIRS image





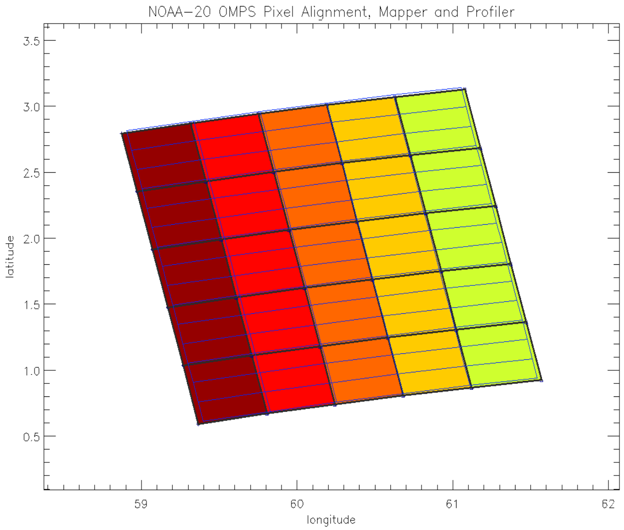
Salar de Uyuni – 15 January 2018

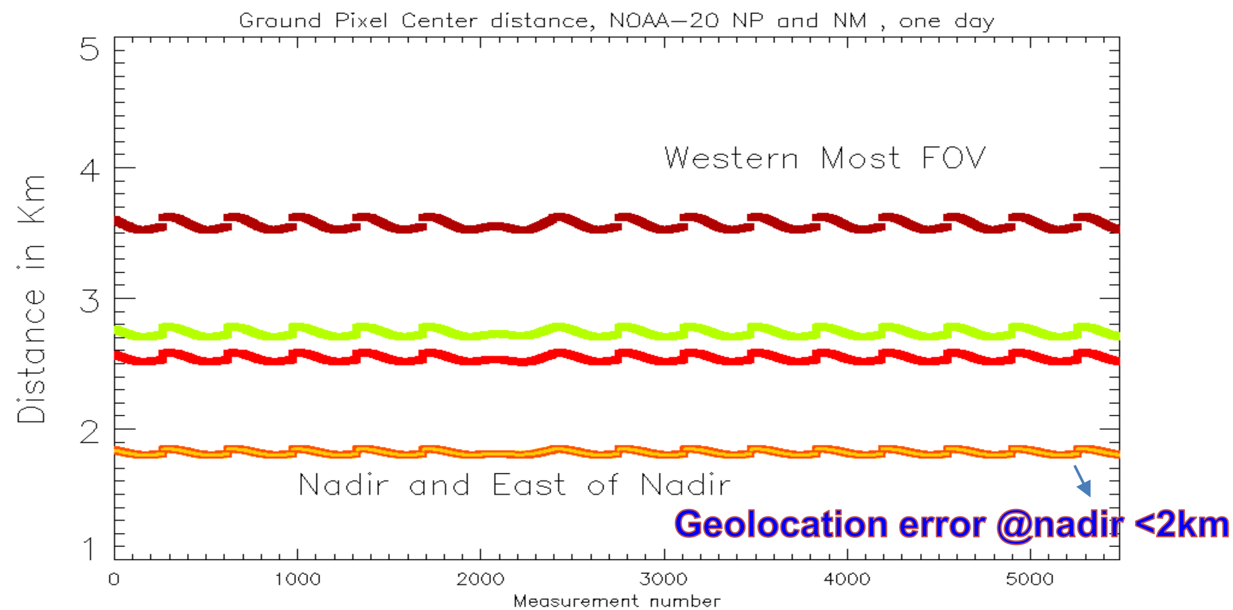
Credit: NASA

✓ ***Meet the requirement for NM (Nadir)***

# NOAA-20 NP Geolocation Validation against NM

Feb. 13, 2019




## NOAA-20 OMPS-NP Average Ground Pixel Distance

| Pixel Index | Geolocation Error (km) | Swath Location |
|---|---|---|
| 0 | 3.56 | Western Most |
| 1 | 2.54 | |
| **2** | **1.82** | **Nadir** |
| 3 | 1.82 | |
| 4 | 2.7 | Eastern Most |

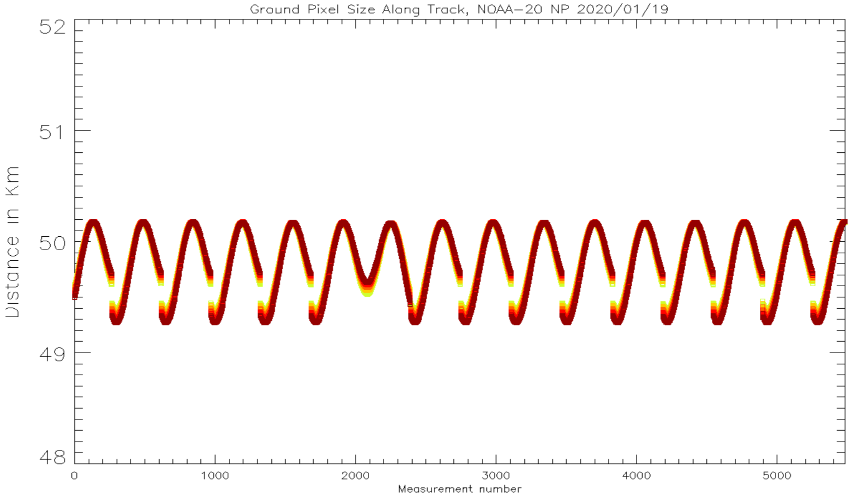
# Horizontal Nadir-Cell Size Assessment

- Randomly select one day of the data (01/19/2020)
- Computed along- and cross-track ground cell pixel sizes
- The average ground cell size at nadir is 49.8 km by 49.6 km, meeting the requirement
  - The averaged cell sizes based on 14 orbits of the data are listed in the table

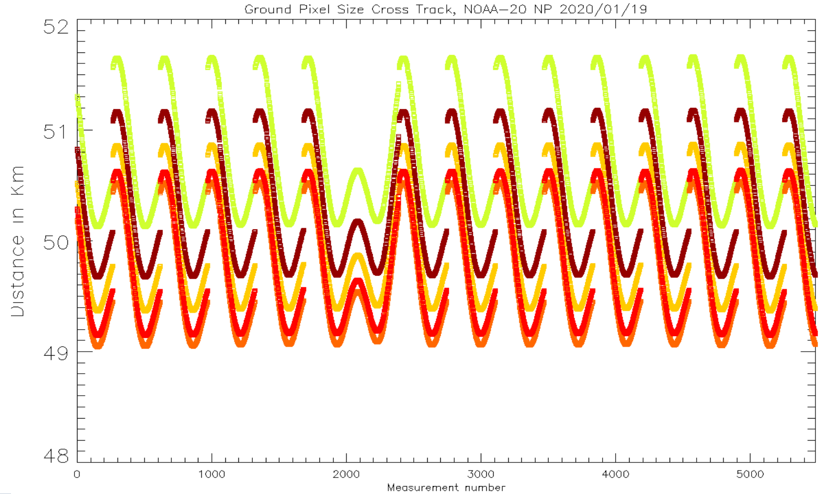
**Table Averaged ground pixel sizes**

| Cell Pixel Index | Averaged Cell Size (Km) | |
|---|---|---|
| | Along Track | Cross Track |
| 1 | 49.812 | 50.749 |
| 2 | 49.810 | 49.978 |
| 3 | 49.805 | 49.649 |
| 4 | 49.797 | 49.750 |
| 5 | 49.786 | 50.283 |
| Mean | **49.8** | **49.6km** |

**(a) Along track ground pixel size variation in a day**




**(b) Cross-track ground pixel size variation in a day**



# NP SDR Performance Summary

| Budget Term | Requirement/Allocation | Performance |
|---|---|---|
| Wavelength Range | 250-310 nm | 248.2 – 312.1 nm |
| Bandwidth (FWHM) | <1.1 nm | <1.1 (0.86-1.09) nm |
| Samples/FWHM | >2.3 | 2.38 |
| Horizontal cell size | ≤ 50 km @ nadir | ≤ 50 km @ nadir |
| SNR radiance@50x50km$^2$ | varies with wavelength λ | meet |
| Irradiance uncertainty | < 7% | < 2% |
| wavelength λ calibration | <0.01 nm | <0.01 nm for most of wavelength channels |
| intra-orbital wavelength variation | <0.01 nm | <0.01 nm |
| OOB Stray Light | < 1% | < 0.75% |
| Radiance uncertainty | < 8% | < 4.5% on average |
| λ-independent albedo calibration | <2% | <2% for most of wavelength channels |
| Geolocation Error | ≤ 5 km | ≤ 5 km @ nadir |

Performance evaluation uses offline ADL SDRs generated with most recent calibration LUTs
A few channels' wavelengths update will be made to provide better consistency with SNPP data.

**Meet Requirements!**

# NOAA-20 NP SDR Data Quality Validation

- **Purposes**
  - NOAA-20 NP SDR data quality assessment
  - SNPP & NOAA-20 NP data quality consistency check
  - NOAA-20 NP SDR data quality stability check (10 months data test)
- **Methodologies**
  - NOAA and NASA SDR data comparison
  - Direct comparison between NOAA-20 and SNPP NP using the 32-Day averages of Nvalues that has a scaling comparable to the column ozone
  - Inter-sensor comparison between NOAA-20 NP and Aura OMI
  - NOAA-20 NP SDR data quality validation against TOMRAD simulations (slide # 17: |mean radiance difference| <2%)
- **Data Source and Coverage**
  - Operational (Provisional) and V3 NOAA-20 NP SDR data
  - Mar. ~ Dec., 2019 (Courtesy of N. Sun for processing 10 months of SDR data from V1. to V3.)

# NOAA and NASA NP SDR Data Comparison

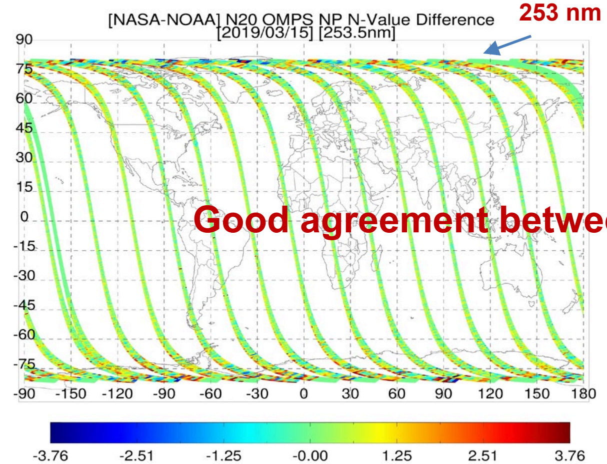
- Data Source
  - NOAA SDR Data: V3 calibrated data towards Validated Quality
  - NASA SDR Data: Provisional Quality
- One day of NOAA-20 NP SDR data per month from March through December 2019 are compared
- **A good agreement is observed**, with the mean N-value difference (absolute) smaller than 0.3
  - For the most of the channels in particular channels greater than 300 nm, the differences are less sensitive to latitude
  - 253.5 nm shows large differences nearby 80° polar regions due to very small and noisy radiance values

(Courtesy of R. Stanfield)

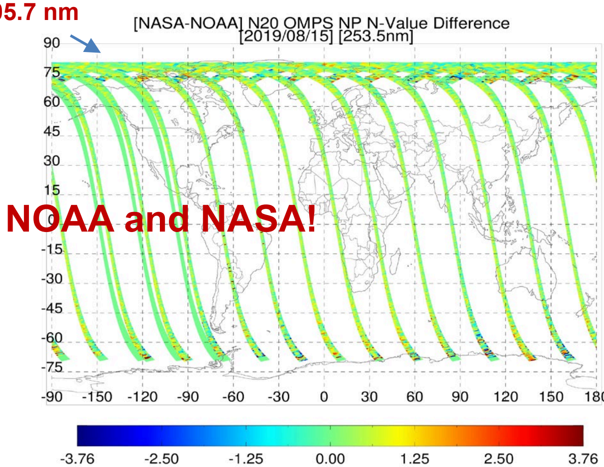
**(a) N-value Difference Global Distributions (NASA- NOAA) (Animated)**

03/15/2019

253 nm ~ 305.7 nm



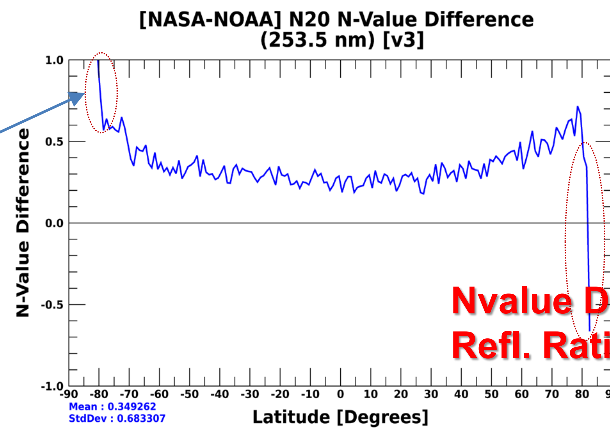

08/15/2019




Good agreement between NOAA and NASA!

**(b) Longitudinal Mean N-value Difference (NASA- NOAA) (Animated)**

03/15/2019

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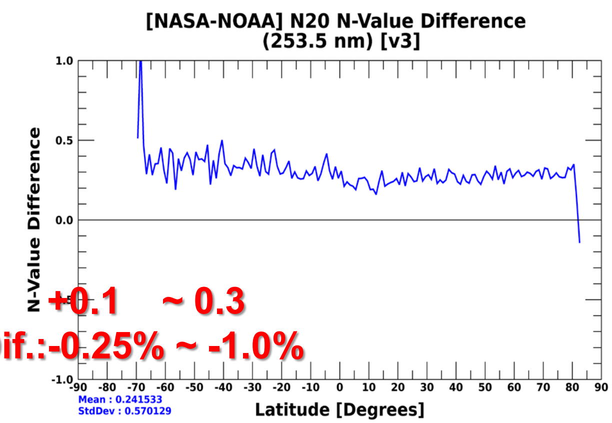
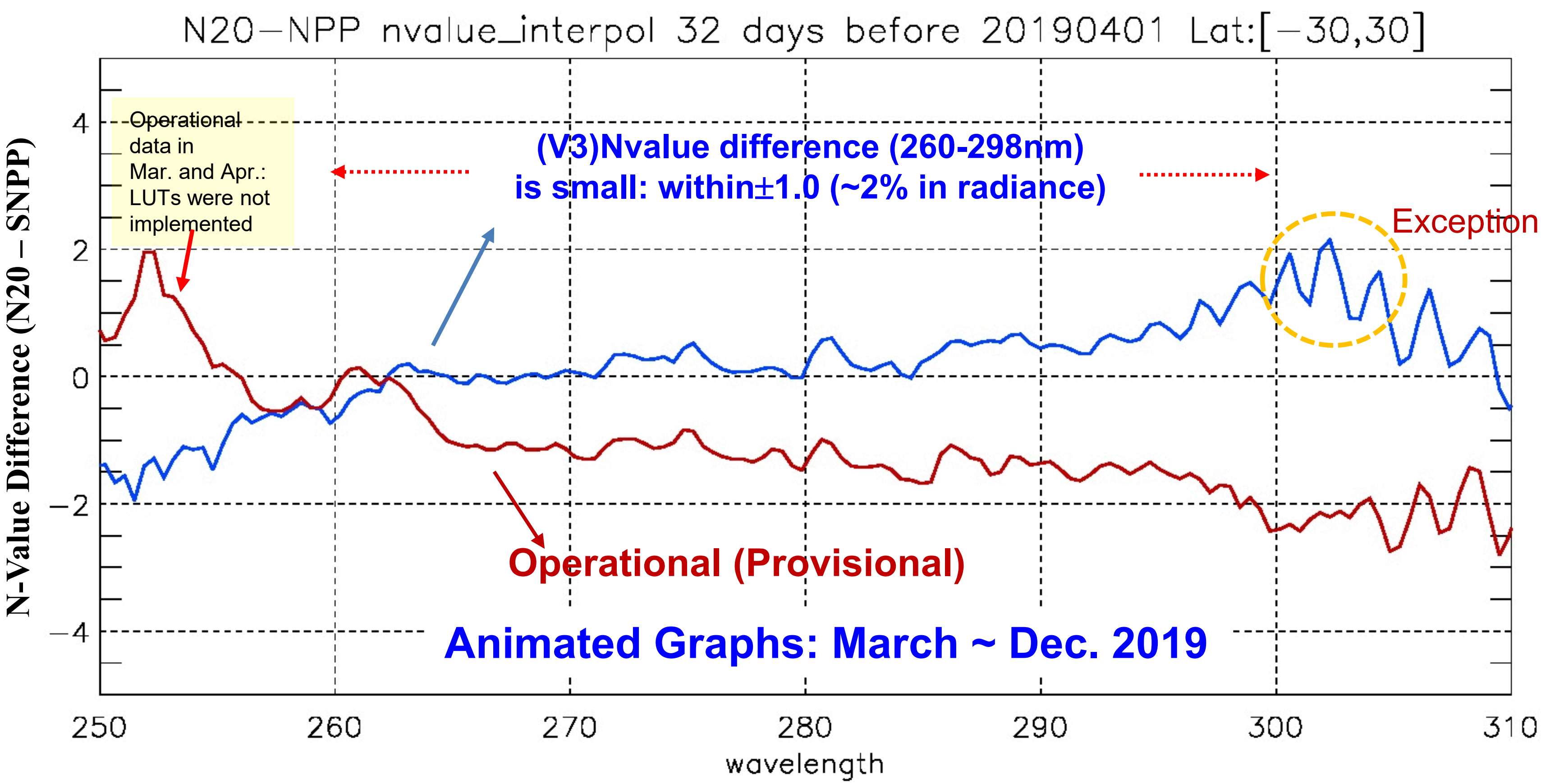



Nvalue Dif.: +0.1 ~ 0.3

Refl. Ratio Dif.:-0.25% ~ -1.0%

# 32-Day Averaged N-value (Differences between NOAA-20 and N20 NP SDR

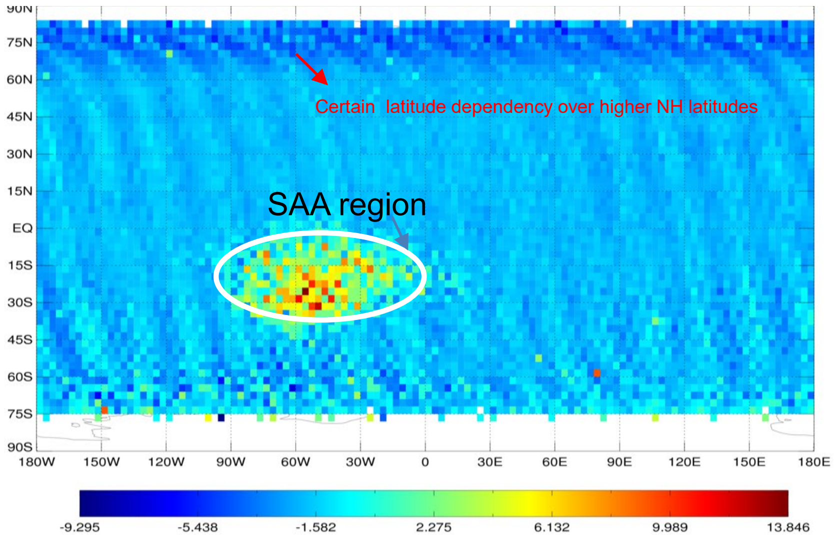



(Major considerations in computation: proper QCs; N-value calculation for each pixel; gridded N-value at 3x3 degrees)

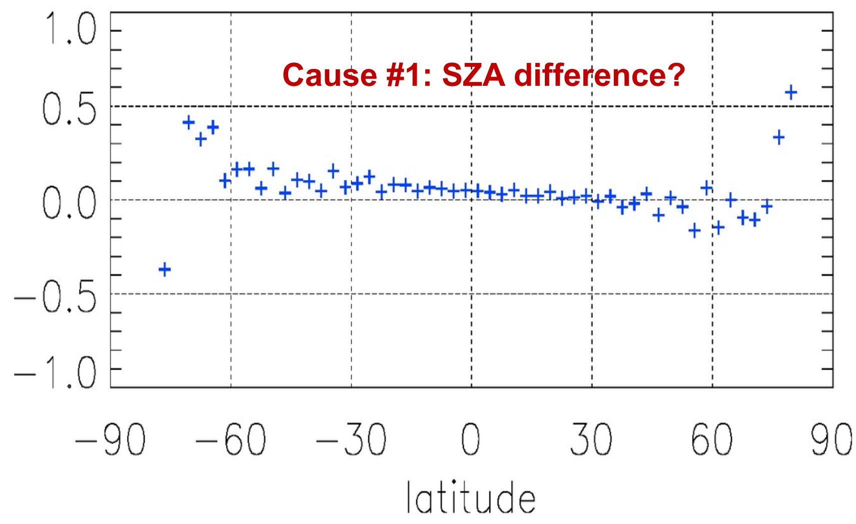
Conclusion: V3 LUTs (V3.) significantly improve SNPP and NOAA-20 NP SDR data consistency. **Differences at channels between 260 and 298 nm are typically within ±1.0 in N-values that is about 2% in radiance.** The difference of wavelength 301.9 nm are slightly larger than 2.

# Latitude Dependent N-value/Radiance Difference Analysis between NOAA-20 and SNPP NP SDR

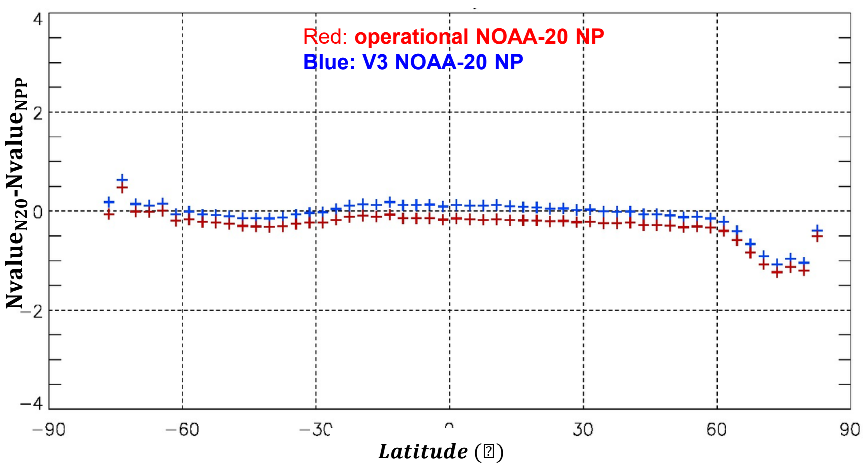
(a) 32-Day Averaged N-Value Difference (N20 – SNPP) at 283 nm



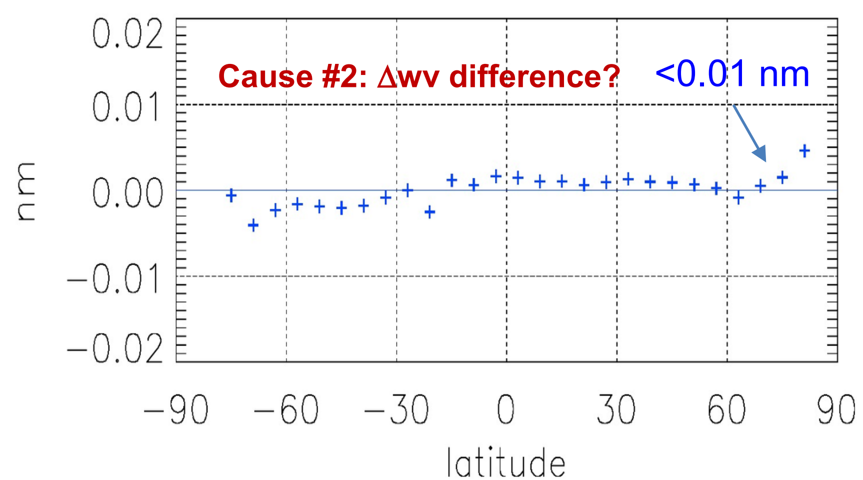

$(c)100 * log$




(b) Global mean of Averaged N-Value Difference at 283 nm vs. Latitude




$(d)$ Relative wavelength shift vs. latitude



# Inter-Sensor Comparison between NOAA-20 NP and Aura OMI

- Inter-sensor comparison is conducted for NOAA-20 NP and Aura OMI UV1 channels primarily in solar flux, by selecting one day per month among April, June, August, October and December 2019
- Aura OMI was launched in July 2004. Below is its in-flight performance (Pieternel et al., 2018)
  - Solar radiance measurements are used for research and applications (OMI irradiance calibrations were derived by normalizing to the KNMI reference solar spectrum)
  - Reflectance at 273.6 nm is compared for demonstration, because radiance data is affected by so-called row-anomaly (Schenkeveld et. al., 2017)
  - QCs flags are applied to OMI radiance data (good data distribute primarily tropical area)

**Table 1 Aura OMI and NOAA-20 NP Major Specifications**

| Parameter | OMI UV-1 | N20 NP |
|---|---|---|
| Wavelength range | 264-311nm | 249-312nm |
| Channels | 159 | 151 (current) |
| Spectral Sampling interval | 0.32 nm | 0.42 nm |
| Cross-track pixel numbers | 30 | 5 |
| Nadir pixels size | 13km x 48km | 50 km x50km |
| Spectral Resolution | 0.42nm | 1.0nm |
| Nadir Viewing Zenith Angle | 1.5 | 0.2 |

**Fig. 1 Five-Day Averaged Irradiance Ratio (OMI/NP)** (4/26,6/26,8/26,10/26,12/26 in 2019)

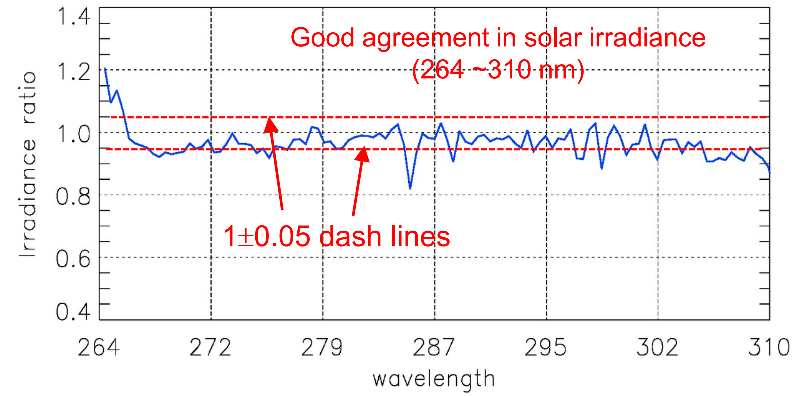
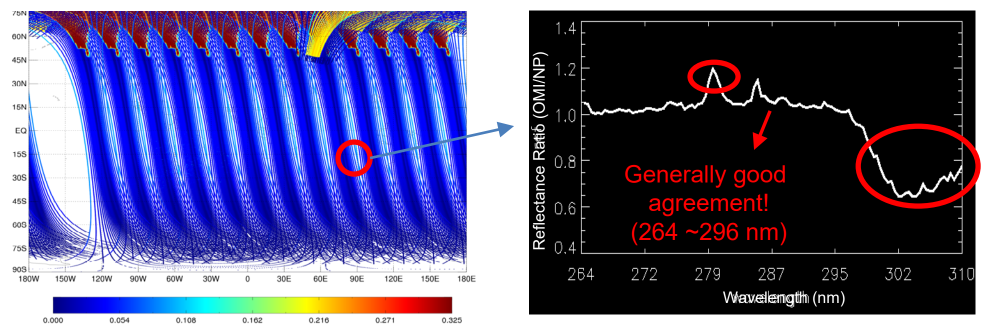



**Fig. 2 An Example about Reflectance Ratio (OMI/NP)**

(a) OMI Radiance (mW m$^{-2}$ nm$^{-1}$ sr$^{-1}$) at 273.6 nm (8/26/2019)

(b) OMI/NP Reflectance Ratio at UV1 Channels

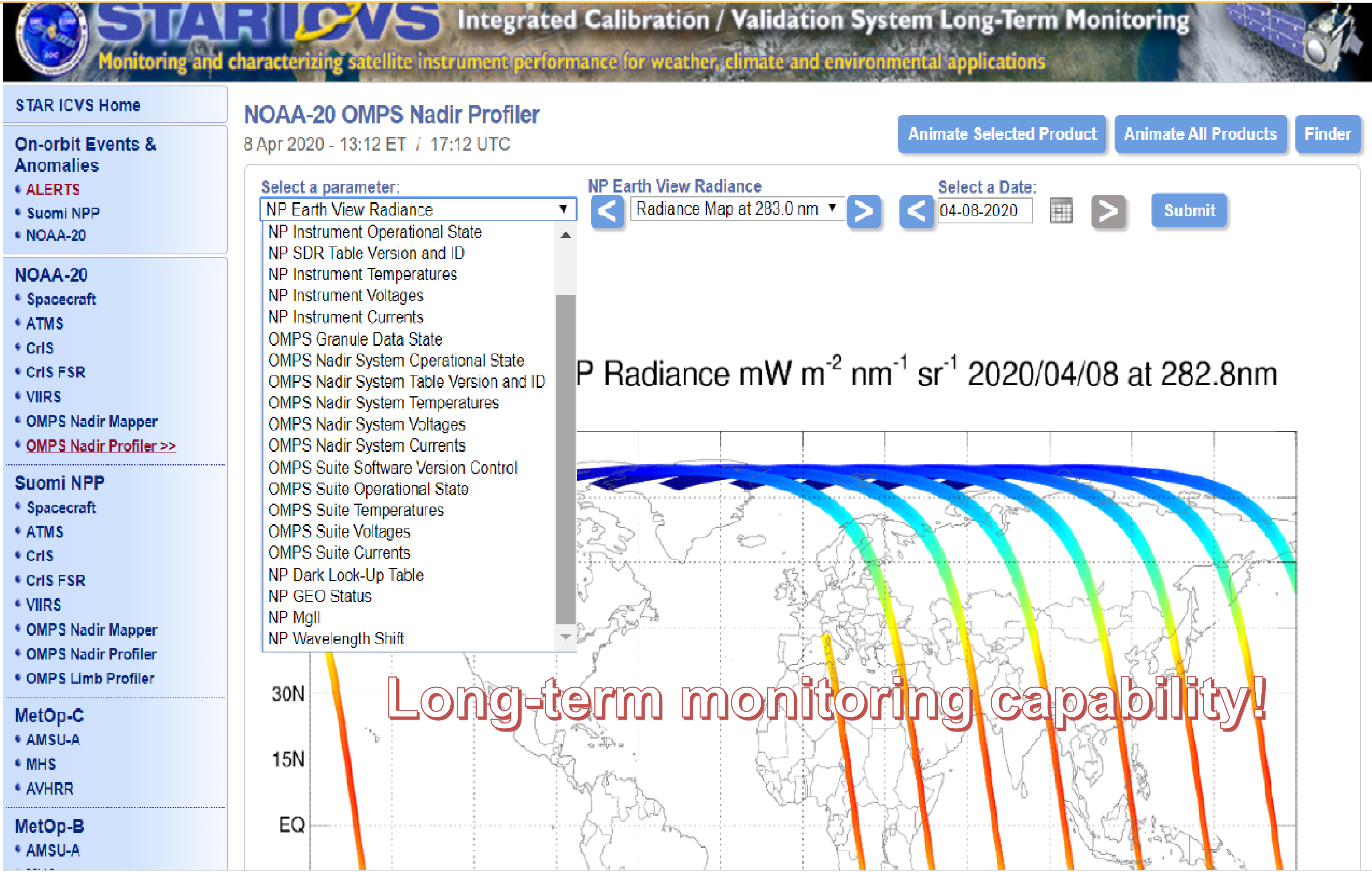



OMI quality instability

**Table 2 Daily mean reflectance ratio at 273 nm (OMI /NP)**

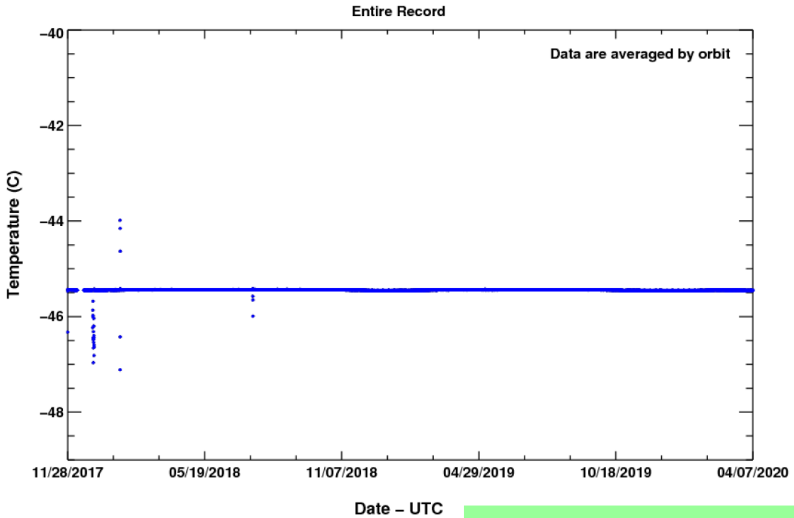
| Date | 4/26 | 6/26 | 8/26 | 10/26 | 12/26 |
|---|---|---|---|---|---|
| Refl. Ratio (OMI/NP) | 1.026 | 1.048 | 1.031 | 1.0169 | 0.949 |

# Long-Term Monitoring for OMPS NP via ICVS

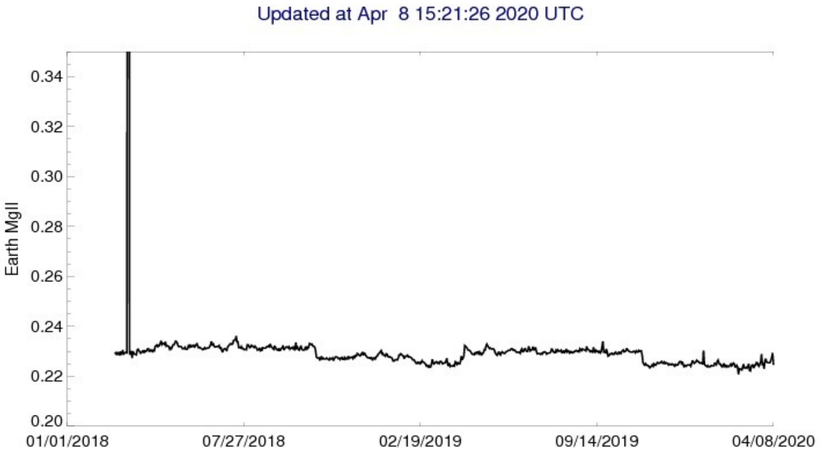


# Monitoring Examples for OMPS NP via ICVS

## (a) NOAA-20 NP Instrument Temperature Time Series

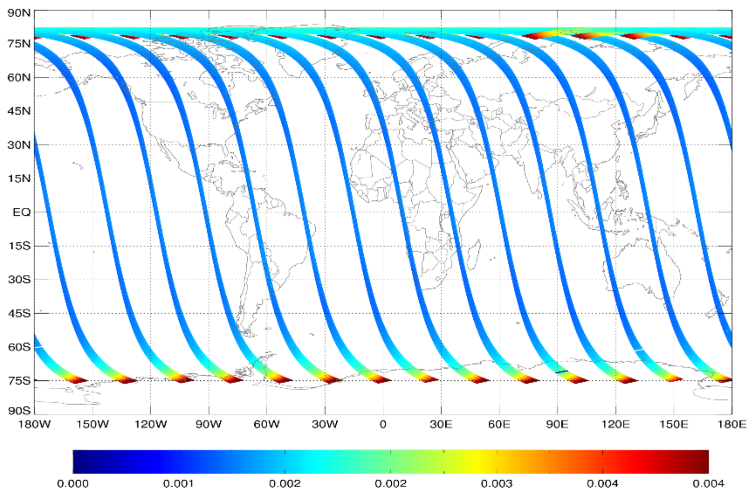



## (c) NOAA-20 NP Earth View Mgii Index Time Series

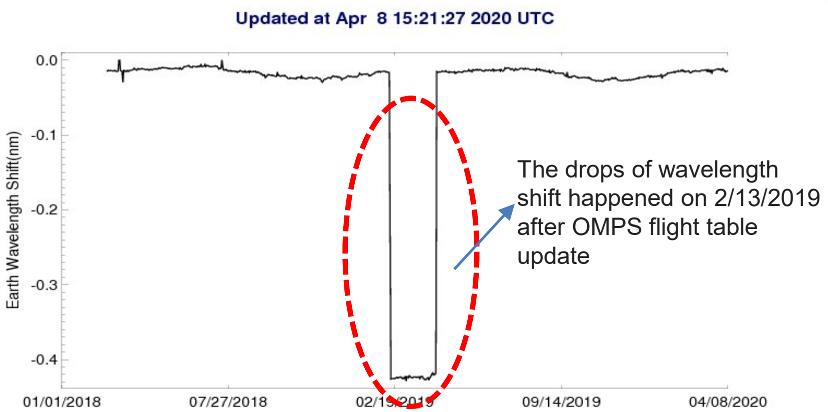



The NP instrument shows a relatively stable performance

## (b) Daily NP Reflectance at 282.8 nm (04/06/2020)




## (d) NOAA-20 NP Daily Mean Wavelength Shift Time Series



# User Feedback (see separate presentation)

- STAR OMPS EDR team:

# Check List - Validated Maturity

| Validated Maturity End State | Assessment |
|---|---|
| Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal). | Performance has been demonstrated globally and seasonally (covering ten months of data) |
| 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. | Caveats have been provided in the readme file for all major known anomalies and artifacts. |
| Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose. | A variety of methods have been used to quantify the radiometric biases through quantitative analysis. |
| Product is ready for operational use based on documented validation findings and user feedback. | User feedbacks: generally positive |
| Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument | Yes. The OMPS SDR and ICVS teams will continue providing stewardship for mission life. |

**Meet validated maturity**

# Documentation

| Science Maturity Check List | Yes ? |
|---|---|
| ReadMe for Data Product Users | Yes |
| Algorithm Theoretical Basis Document (ATBD) | Yes (NASA GSFC JPSS OMPS NP ATBD; A updated version for NOAA-20 NP is in progress) |
| Algorithm Calibration/Validation Plan | Yes |
| (External/Internal) Users Manual | Yes |
| System Maintenance Manual (for ESPC products) | JPSS Operational Algorithm Description (OAD) for NP and NM |
| Peer Reviewed Publications<br>(Demonstrates algorithm is independently reviewed) | Yes for SNPP<br>(2-3 NOAA-20 NP manuscripts are in preparation) |
| Regular Validation Reports (at least. annually)<br>(Demonstrates long-term performance of the algorithm) | Yes (ICVS-OMPS is presented at annual meetings and conferences) |

# Risks/Issues, Actions and Mitigations

- **Challenges**
  - Continue to investigate difference between SNPP and NOAA-20 NP SDR

- **Actions and Mitigations**
  - Coordinate with EDR team together to further improve SDR data usefulness

# Summary and Conclusions

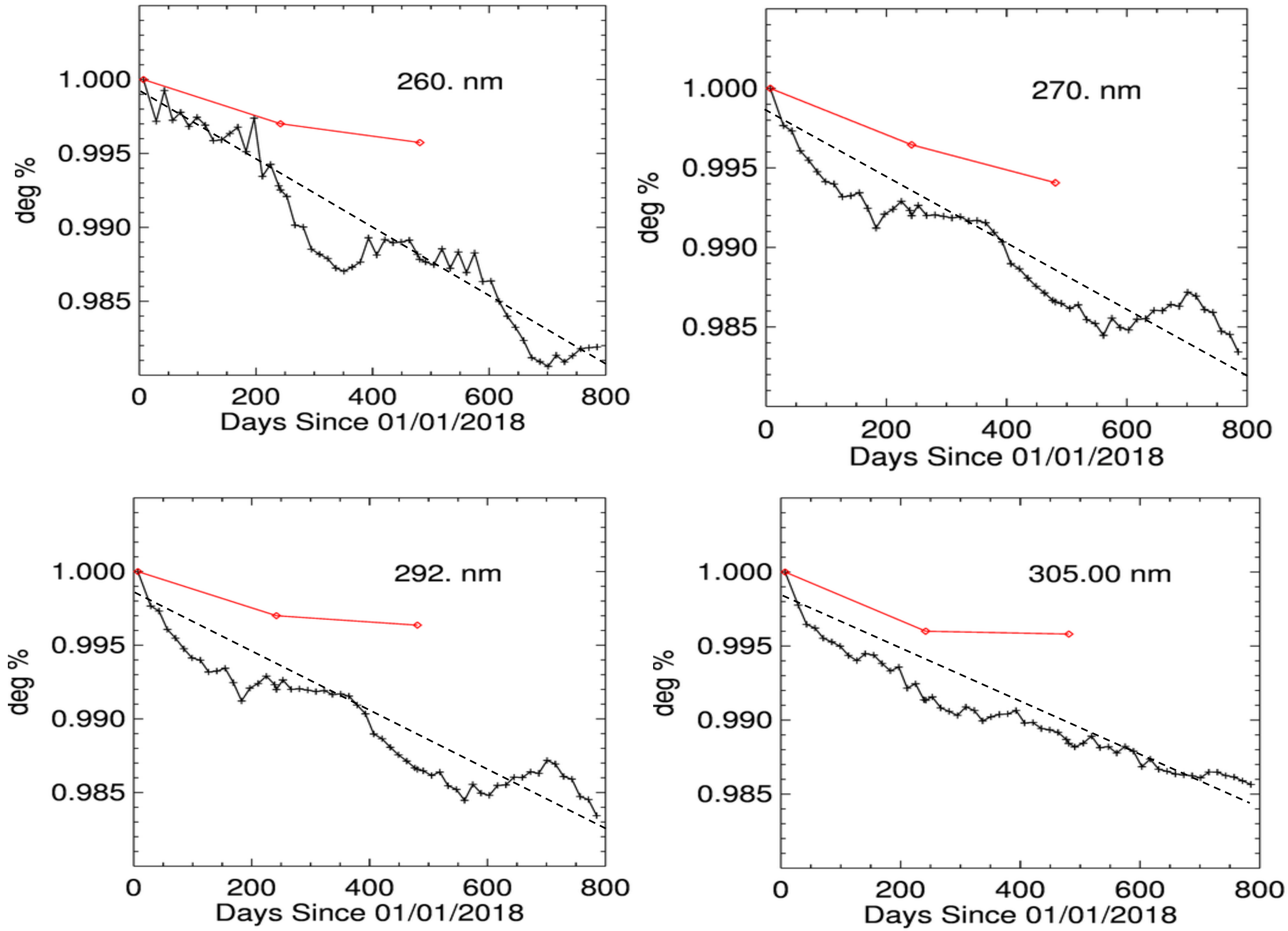
- **NOAA-20 OMPS NP instrument performance is good and stable**
- **NOAA-20 NP SDR calibration is well characterized, generally meeting the requirements**
  - NOAA-20 NP SDR data quality is stable since Provisional Review
  - NOAA-20 NP SDR data generally meets all requirements
  - Long-term monitoring functions via ICVS are available
  - NOAA-20 NP SDR data (provisional maturity) is used in the operational OMPS EDR system, while the V3 data with validated maturity has shared with the EDR team on 03/19/2020.
    - Product is ready for operational use based on documented validation findings and user feedback

# Path Forward

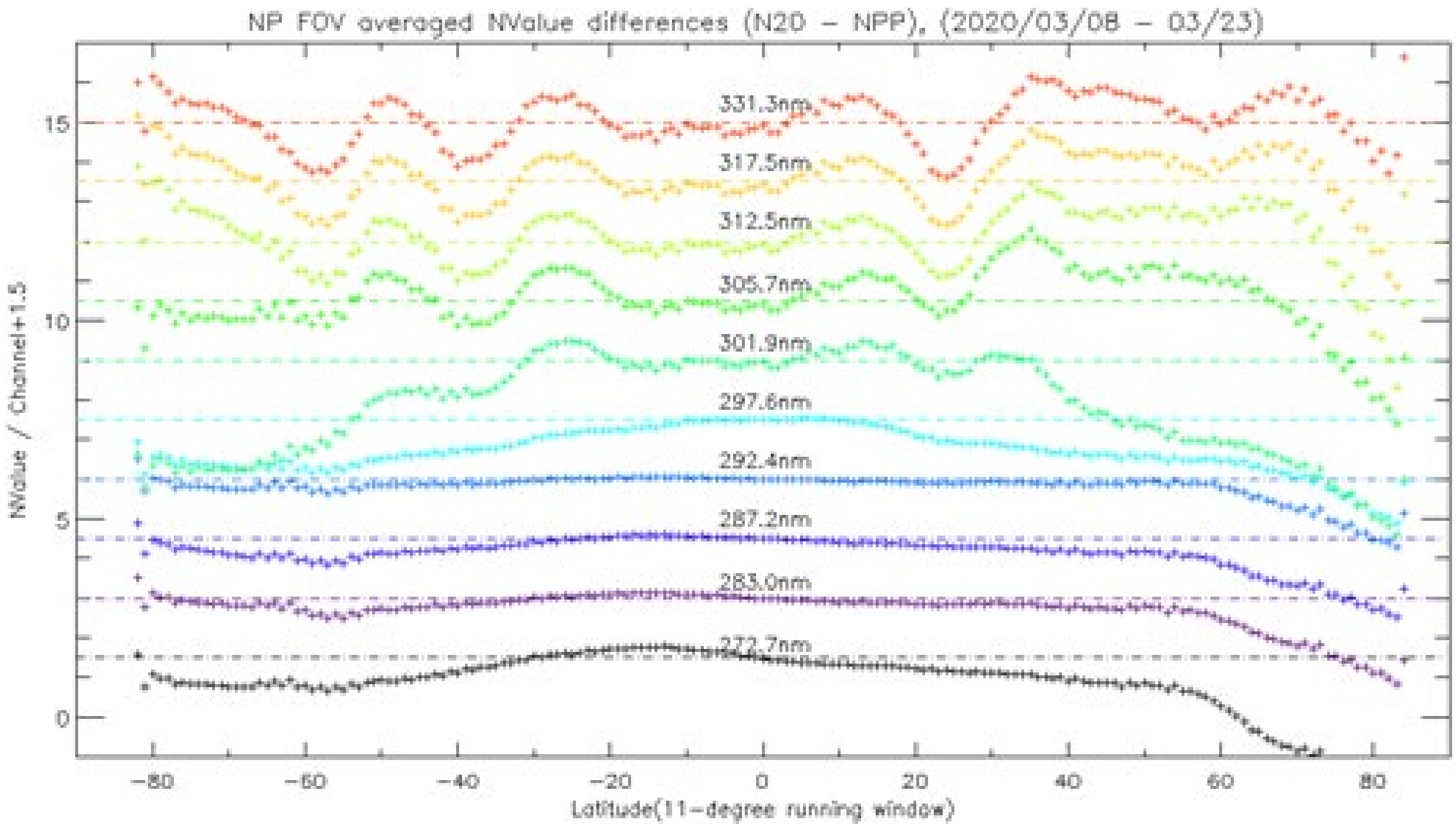
- Will improve NOAA-20 SDR data long-term monitoring
  - Provide V3 NOAA-20 NP SDR data since January 2020 for EDR team
  - Stay abreast of EDR Team activities and concerns that may indicate action is needed by the SDR team
  - Re-process all historical NOAA-20 NP SDR data since launch using newly validated calibration LUTs
  - Improve ICVS to provide NRT monitoring for more instrument and calibration parameters that affect SDR data performance

- backup

# NOAA-20 NP Sensor Degradation Monitoring (tobeupdated)



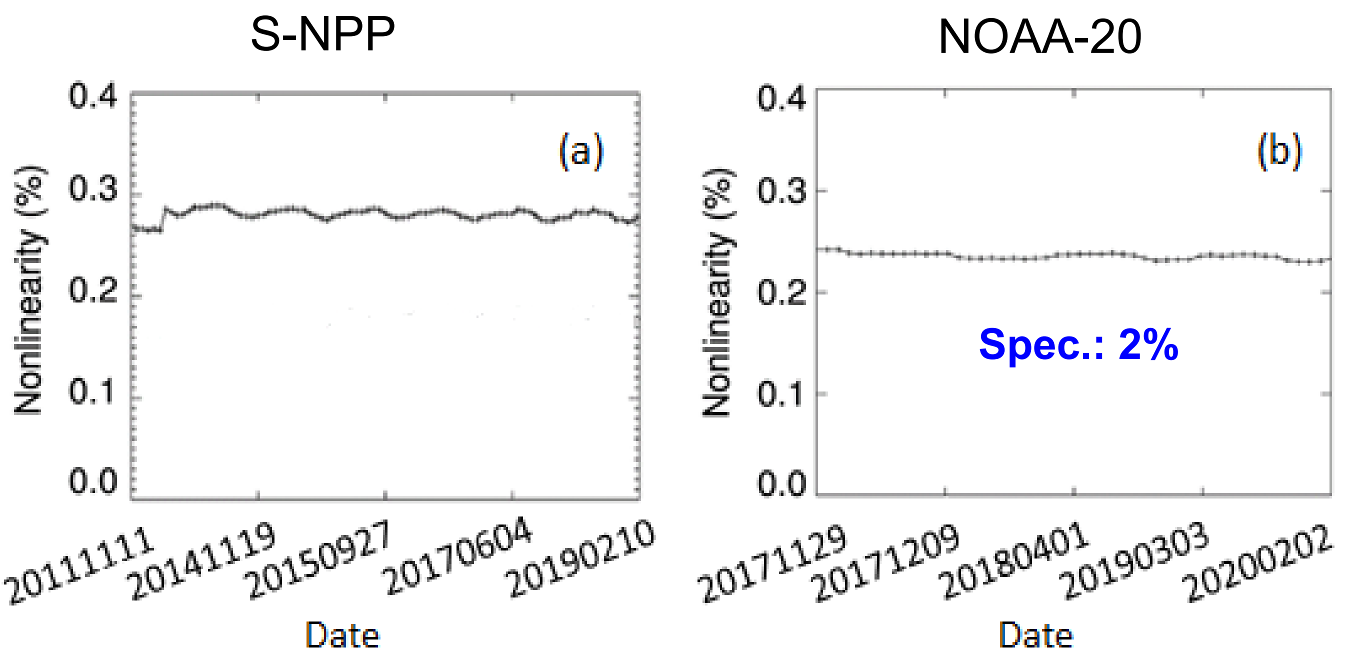
# EDR analysis for NM and NP consistency check (300-310 nm)




Wavelengths > 310 nm come from NM; < 310 nm come from NP

(Courtesy of Larry)

# Non-linearity Accuracy Assessment

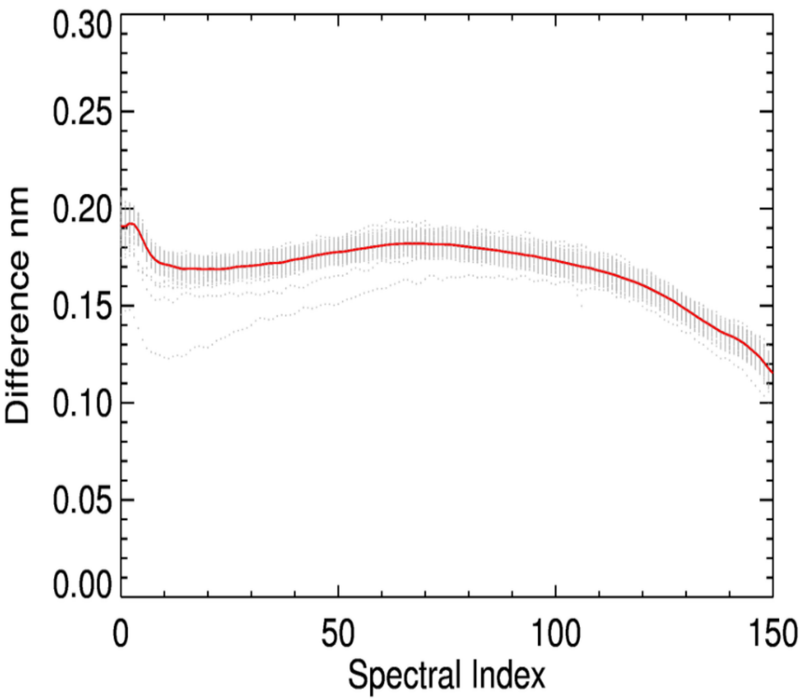



- Sensor system nonlinearity assessment shows both SNPP and N20 meets 2% requirement.
- Both sensors' linearity performance are stable since launch.

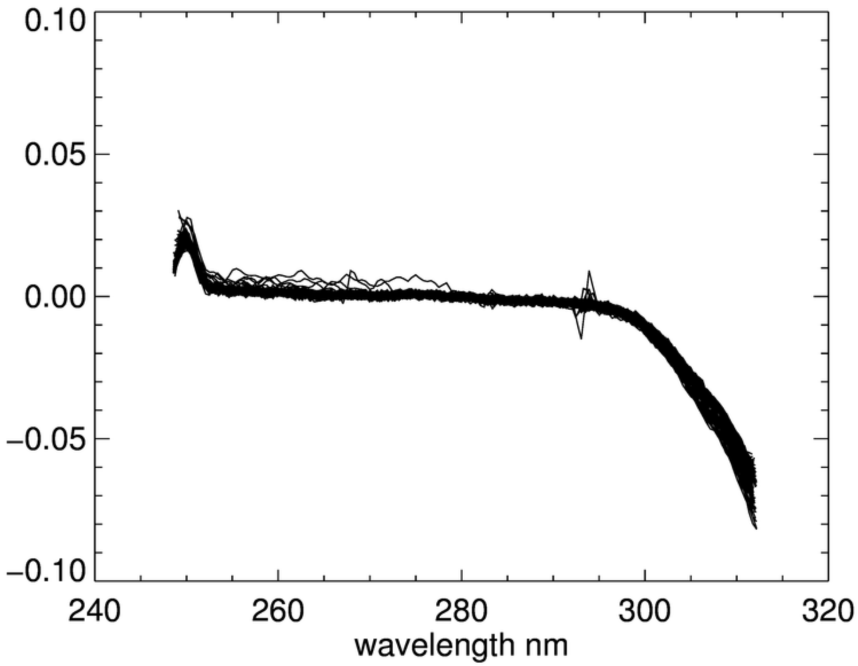
✓ ***Meet the requirement***

# Changes in Band Center Wavelength from Ground to Orbit

N20 Wavelength Change (Overall)

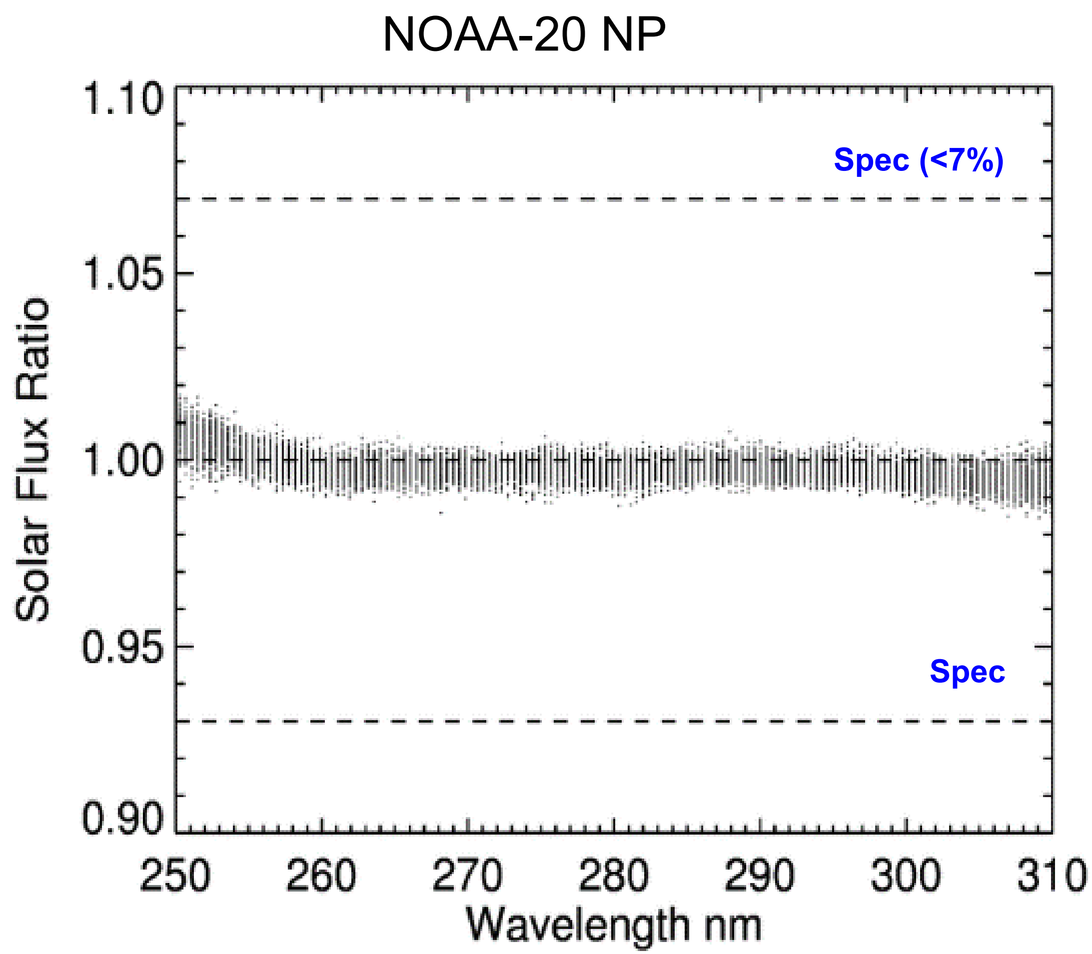



N20 Sensitivity Correction



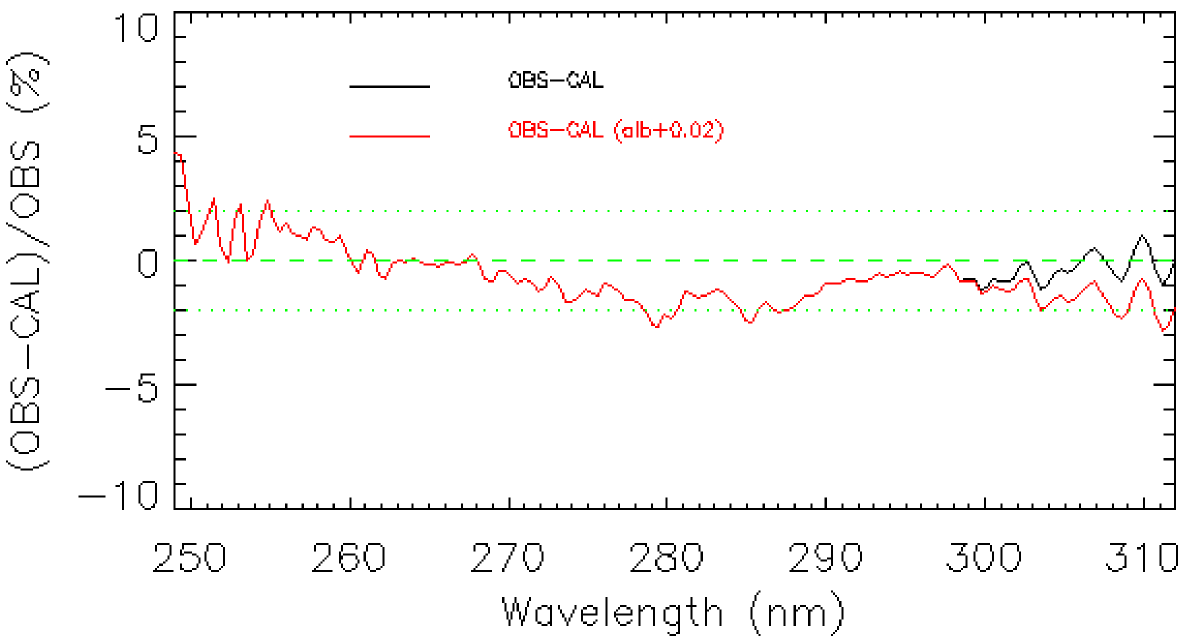
# Solar Measurement Difference between Two Diffusers

- Use the reference diffuser as a bench marker to check the working diffuser measurements.
- The measurements were conducted at the same day August 29, 2018
- Average difference < 1.5%, which is smaller than SNPP NP (~ 5%)

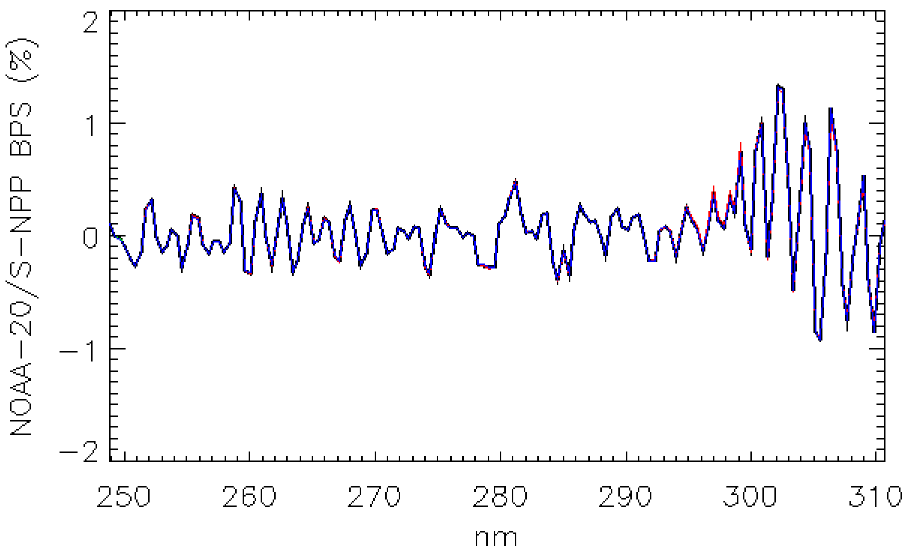



✓ ***Meet the requirement!***

# Sensitivity to Albedo



# Impact of Bandpass to the observations




- By switching S-NPP BPS to NOAA-20 in simulations;
- Compared the difference of simulated NR ;
- Using Clear ocean cases;
- The difference of NR (Normalized Reflectance)
  is about 0.5 ~1%

# NOAA-20 NP Geolocation Validation against NM (2/2)

| Date | Western | | Nadir | | Eastern |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 2019/01/01 | 2.75275 | 7.41017 | 6.24952 | 5.09442 | 8.63858 |
| 2019/02/01 | 2.75108 | 7.40545 | 6.24555 | 5.09123 | 8.63302 |
| -----NEW FLIGHT AND GROUND TABLES on Feb 13, 2019 --------- | | | | | |
| 2019/03/01 | 3.56155 | 2.54106 | 1.81928 | 1.81792 | 2.73386 |
| 2019/04/01 | 3.55647 | 2.53746 | 1.81678 | 1.81542 | 2.72999 |
| 2019/05/01 | 3.55145 | 2.53383 | 1.81413 | 1.81284 | 2.72624 |
| 2019/06/01 | 3.54888 | 2.53200 | 1.81281 | 1.81159 | 2.72441 |
| 2019/07/01 | 3.55150 | 2.53469 | 1.81557 | 1.81432 | 2.72698 |
| 2019/08/01 | 3.55205 | 2.53426 | 1.81446 | 1.81319 | 2.72675 |
| 2019/09/01 | 3.56521 | 2.54696 | 1.82683 | 1.82563 | 2.73970 |
| 2019/10/01 | 3.56423 | 2.54476 | 1.82366 | 1.82226 | 2.73725 |
| 2019/11/01 | 3.56287 | 2.54199 | 1.81996 | 1.81863 | 2.73495 |
| 2019/12/01 | 3.57731 | 2.55556 | 1.83296 | 1.83182 | 2.74911 |
| 2019/12/30 | 3.56772 | 2.54544 | 1.82244 | 1.82116 | 2.73886 |
| 2020/01/01 | 3.56784 | 2.54553 | 1.82251 | 1.82124 | 2.73894 |
| 2020/01/19 | 3.56463 | 2.54324 | 1.82093 | 1.81982 | 2.73682 |
| 2020/02/01 | 3.56456 | 2.54319 | 1.82084 | 1.81953 | 2.73633 |
| 2020/03/01 | 3.56122 | 2.54077 | 1.81909 | 1.81793 | 2.73409 |

The field of view of TC and NP did not match (DR8617)

Meet spc. (nadir)

✓ ***Meet the requirement for NP (Nadir)***

# Pre-launch Major Concerns/Waivers Mitigations/Evaluation

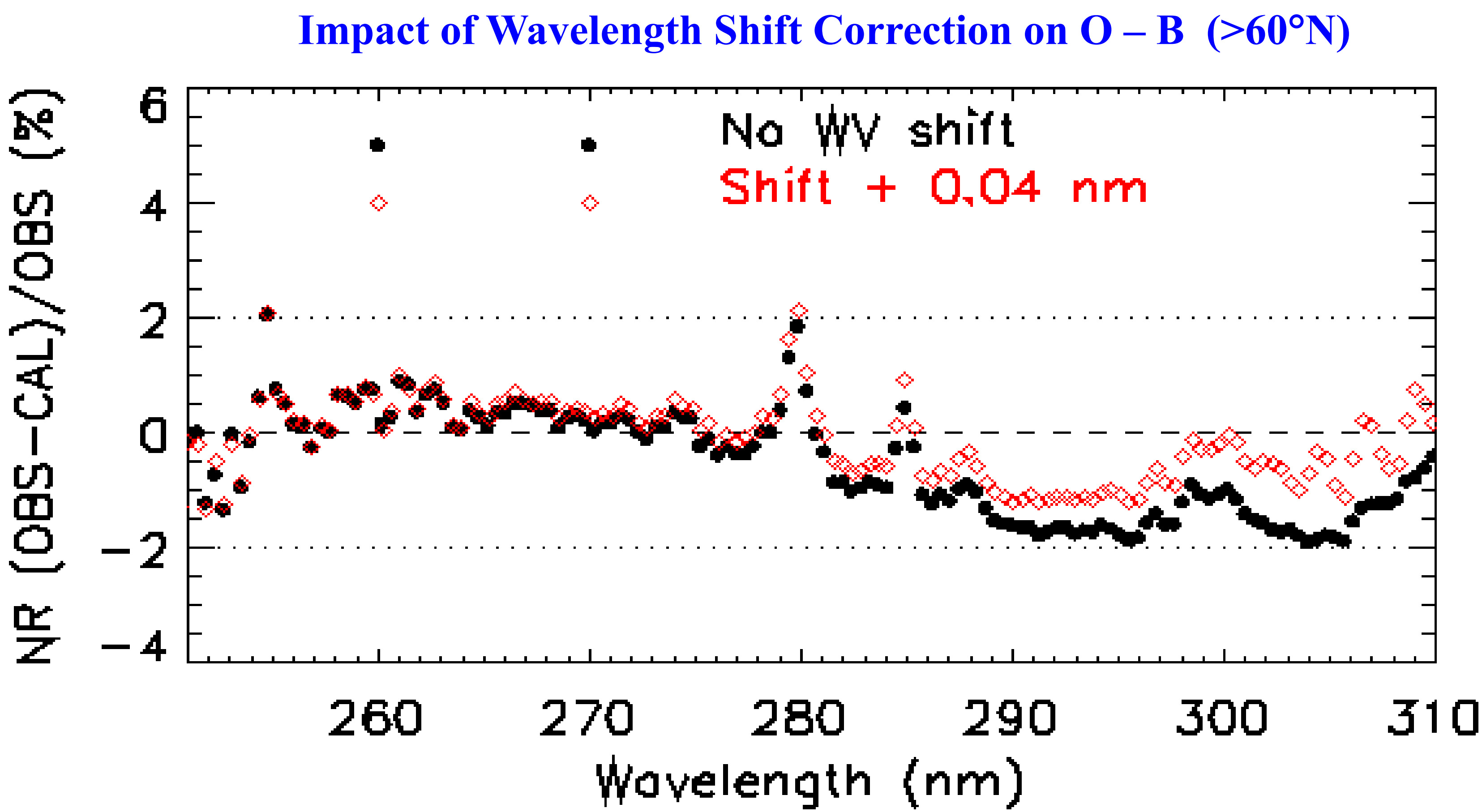
- Waiver 21742-W-215 Nadir Profiler Short Wavelength Throughput Loss

- Waiver against O_PRD-11308 for Nadir Profiler to allow albedo accuracy to be increased from 0.5% to 3**%** for wavelengths between 250 and 260 nm

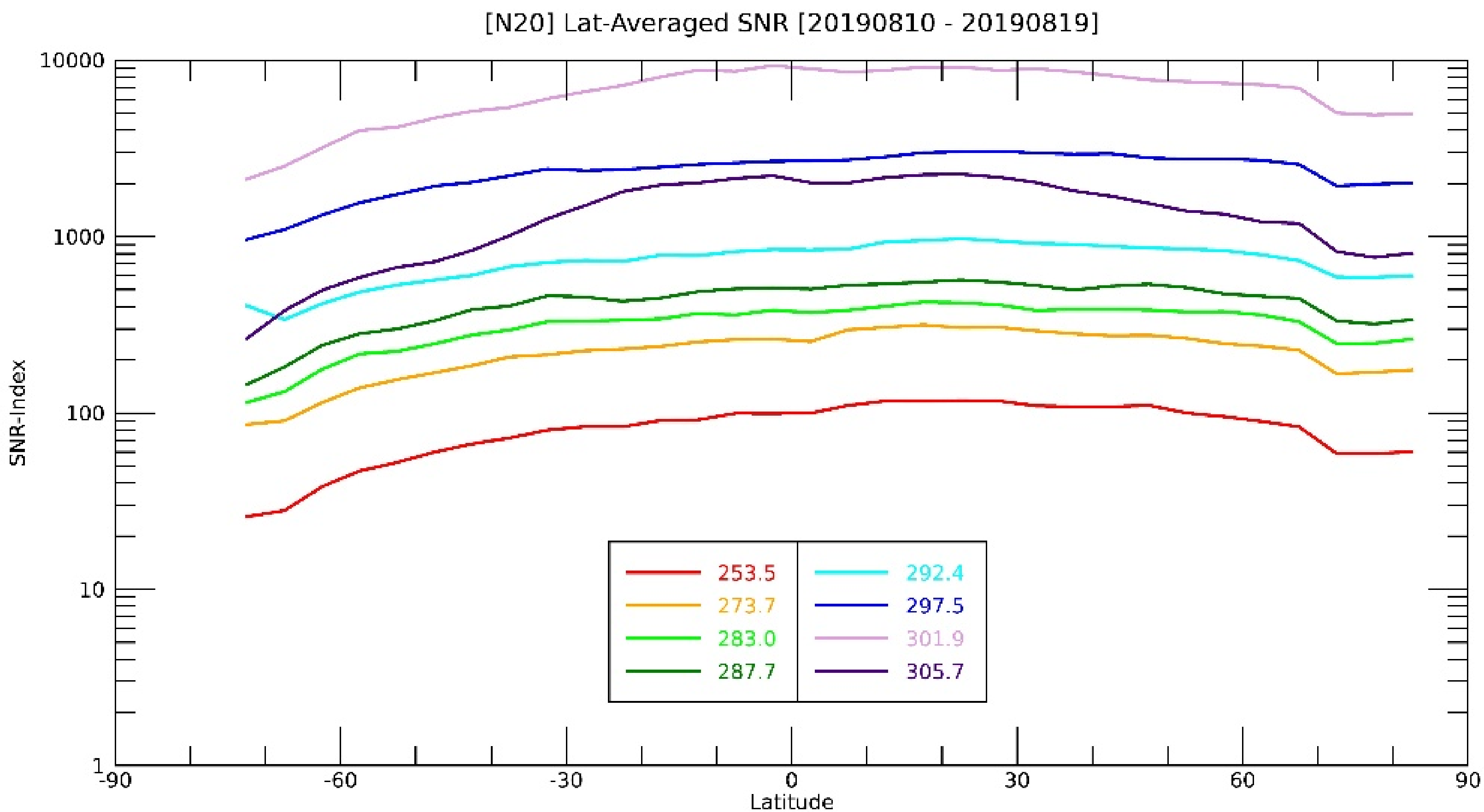
➢ No evidence of noticeable short wavelength throughput loss. The up to date sensor degradation is approximately less than 1%. We keep monitoring the drift. No concern at this stage

➢ Foreign object debris (FOD) was found right after N20 launch in linearity calibration. ( the FOD was at approximately [520,85] in reduced CCD frame coordinates, at ~315 nm channel and affects 312.5 nm and/or 317.5 nm). No impact of the FOD on OMPS calibration data as well as Earth view data

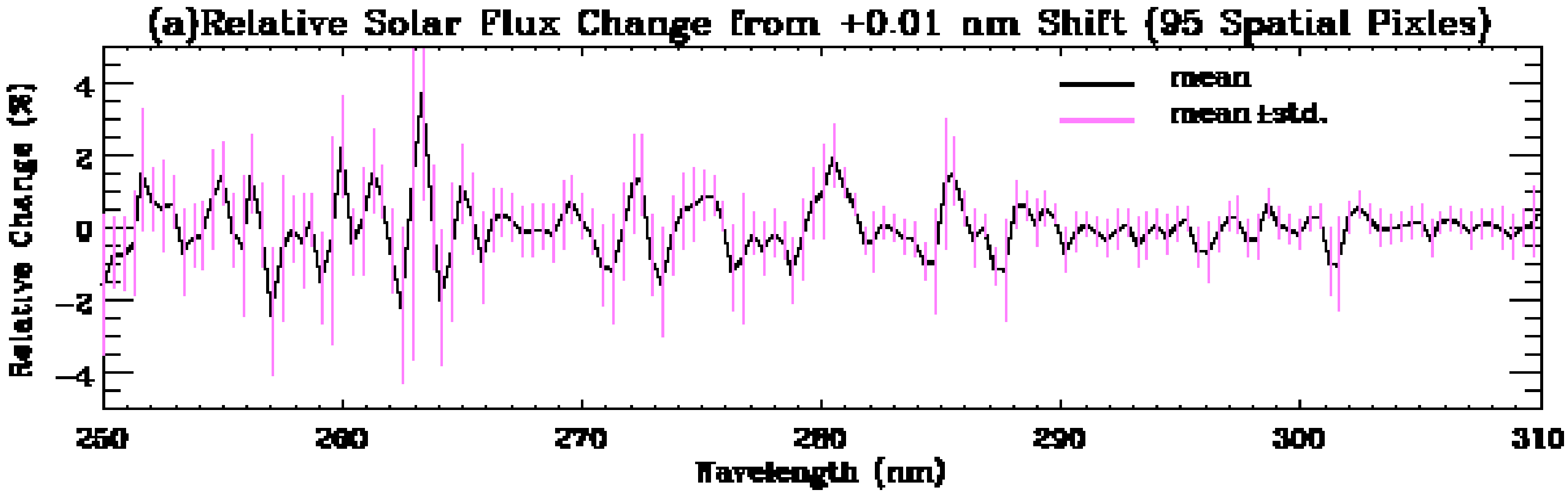
# Relative Wavelength Shift Correction Assessment

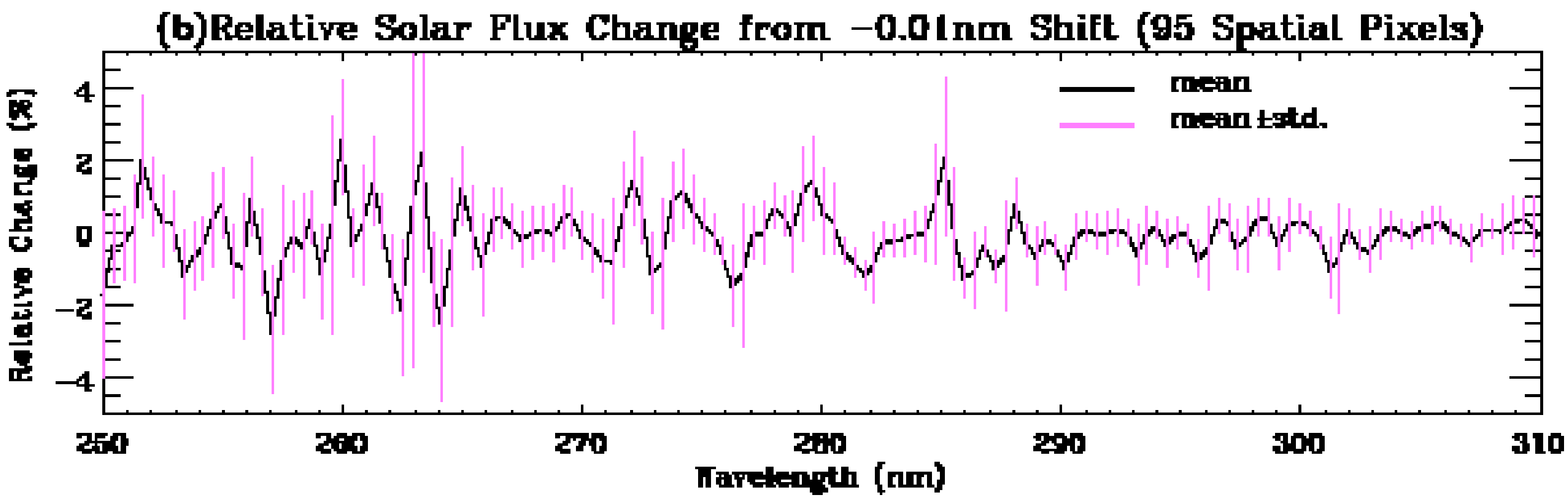


# NOAA-20 NP SDR Data SNR vs. Latitude



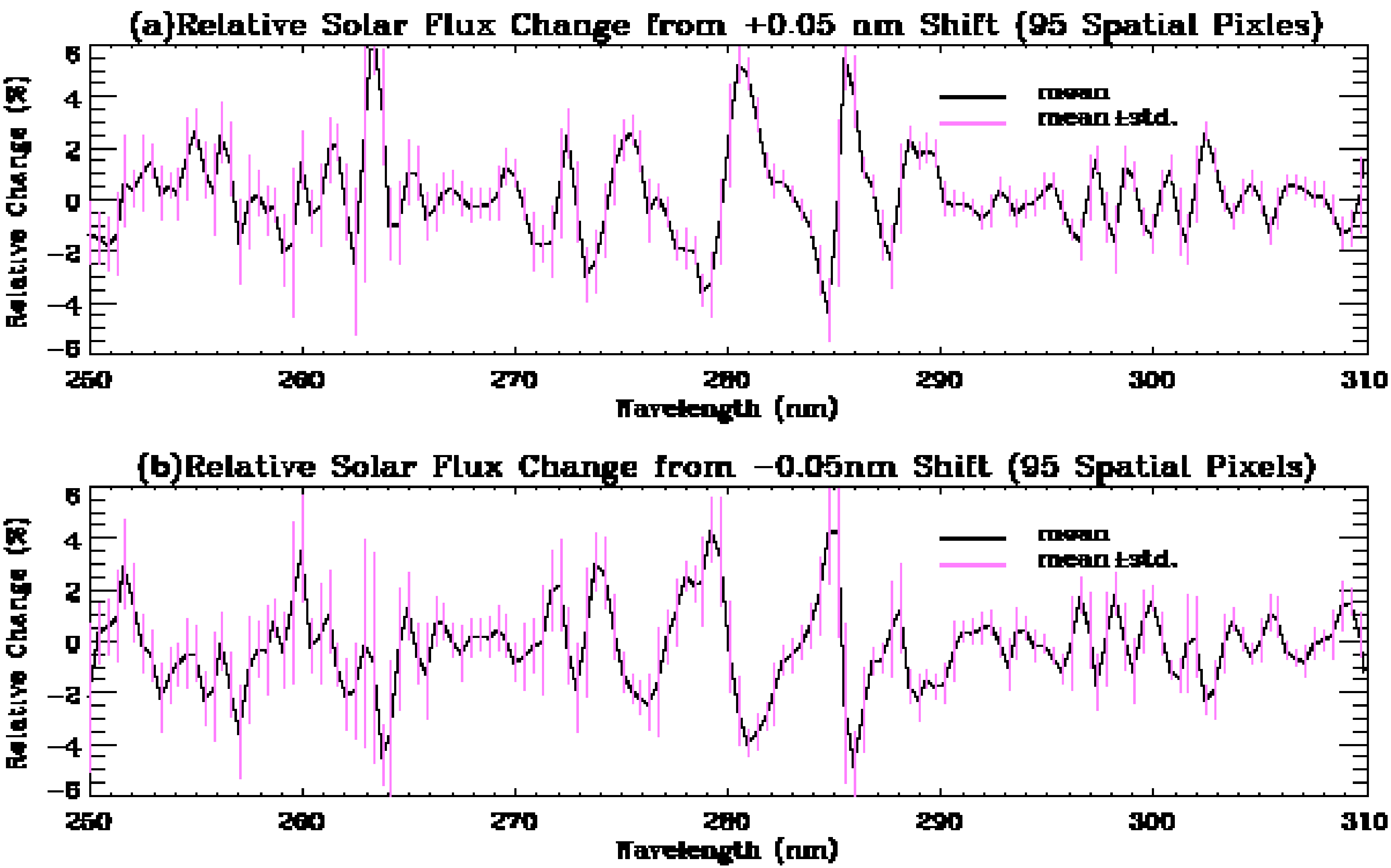
# Relative Solar Flux Changes from +/- 0.01 nm WV Shift: (New-Old)*100/Old



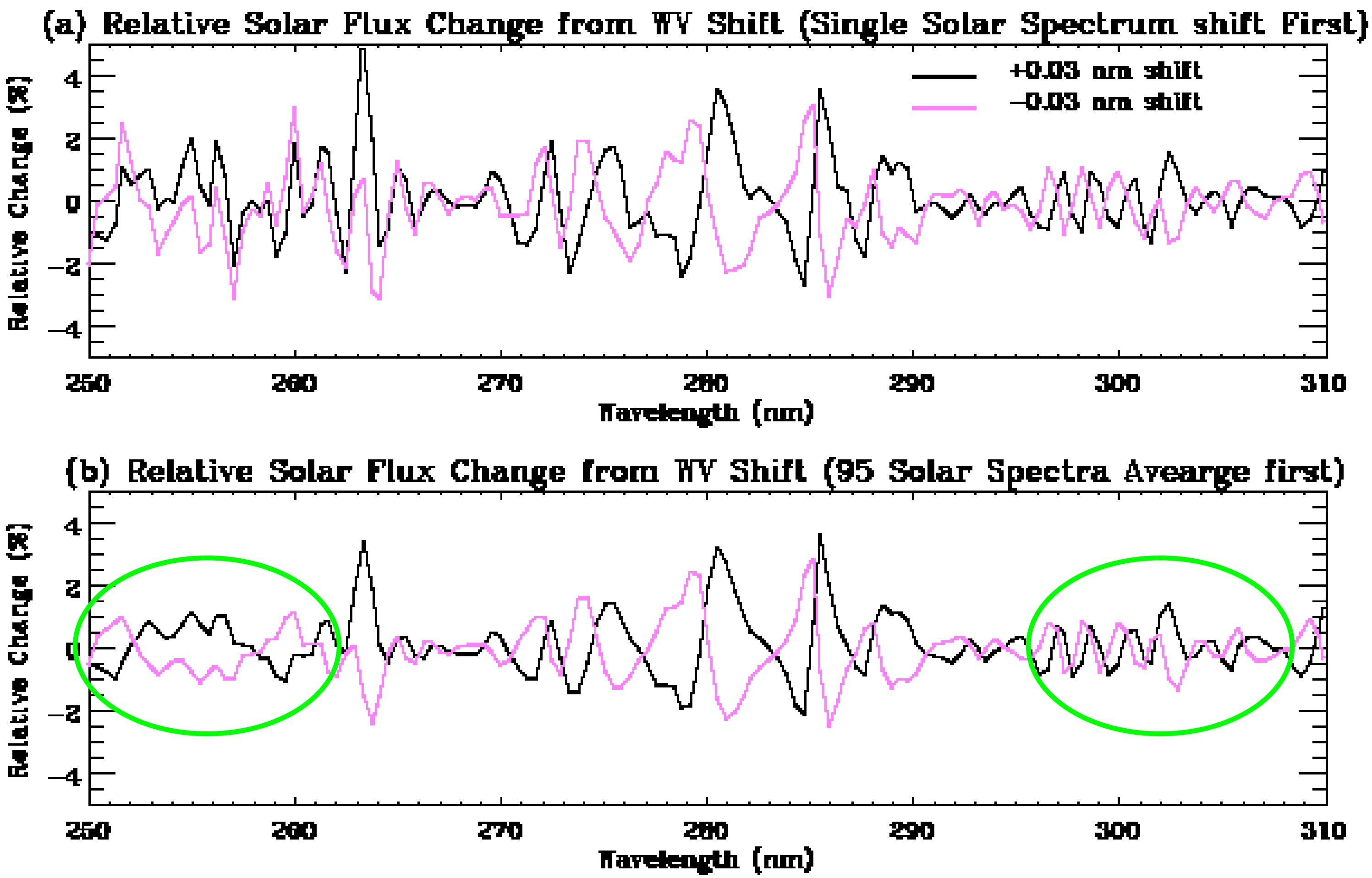

**|Mean|: <1.3% (majority channels)**

# Relative Solar Flux Changes from +/- 0.05 nm WV Shift: (New-Old)*100/Old




|Mean|: <3% (majority channels)

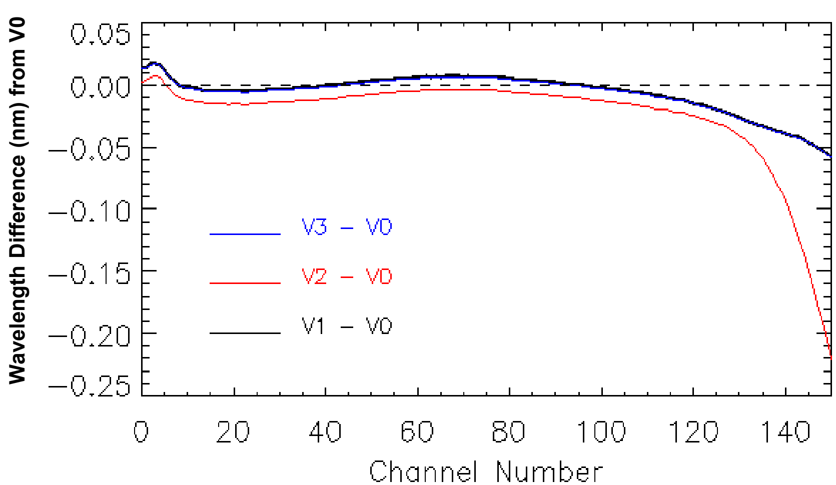
# Impact of Averaging Method on Solar Flux from ±0.03 Wavelength Shift



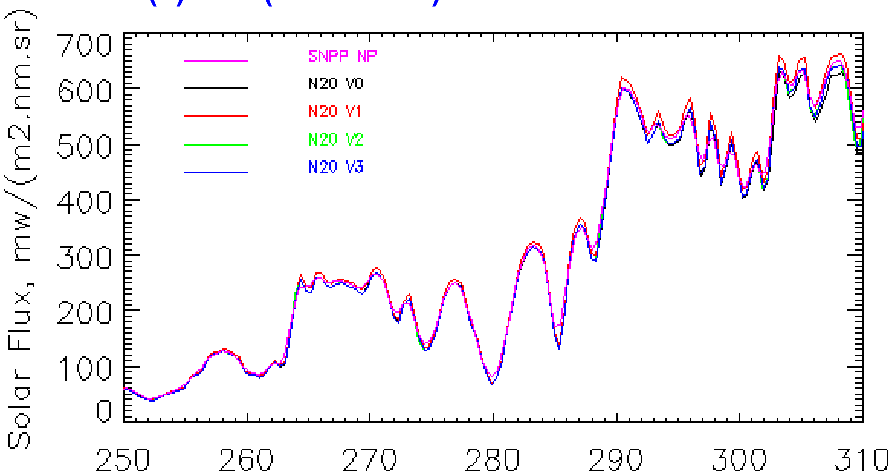

Different average methods cause big differences (phase/magnitude) in short/long wavelengths

# Comparisons of V0 (Operational) through V4 for NOAA-20 NP against SNPP Operational NP: Concept Demonstration

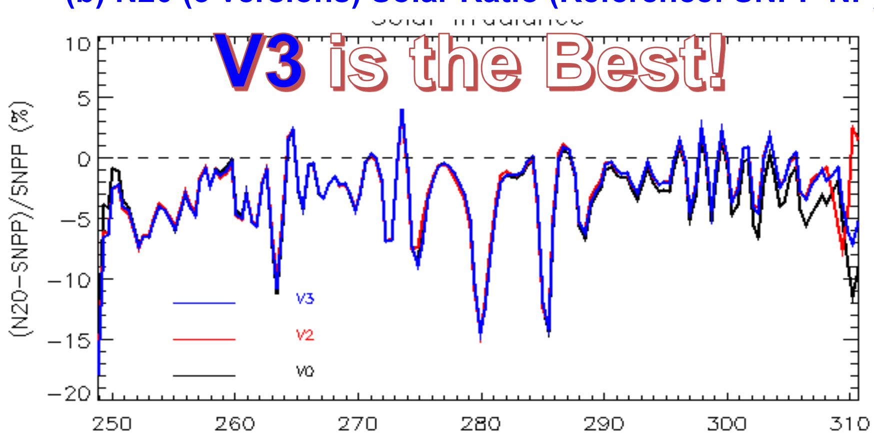
- In addition to operational version (V0), three (actually two) new versions are generated for NOAA-20 NP SDR data.
  - V0: Provisional or operational version
  - V1: same as V3 but it contains an error in solar flux calculation related to sun-earth distance correction
  - V2 and V3: use newly calibrated LUTs; generally the same except for adjusted wavelength shifts from 300 to 310 nm




(a) N20 (4 versions) and SNPP NP Solar Flux




(b) N20 (3 versions) Solar Ratio (Reference: SNPP NP)

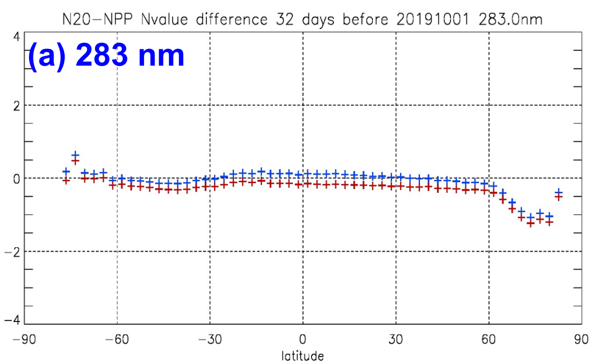


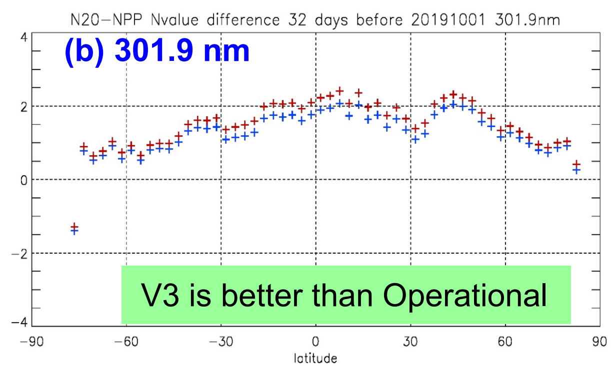

**Among the 4 versions, V3 demonstrates the best agreement with SNPP NP SDR solar flux.**

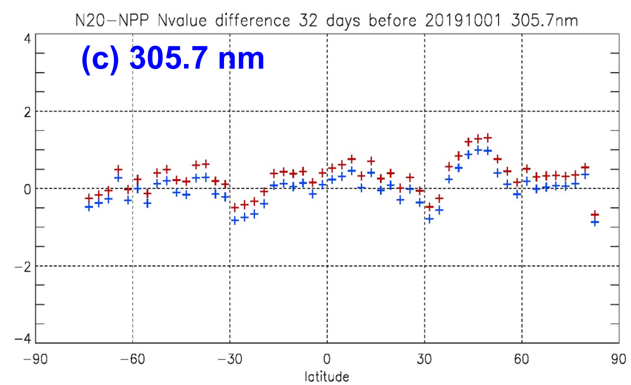
# Comparisons of 3 Versions NOAA-20 NP SDR against SNPP NP SDR Data: 32-Day Averaged N-Value Differences

## 32-Day Averages of N-value Differences between NOAA-20 and SNPP NP (Oct. 2019)

### (1) NOAA-20 Operational (Red) and V3 Versions (Blue)

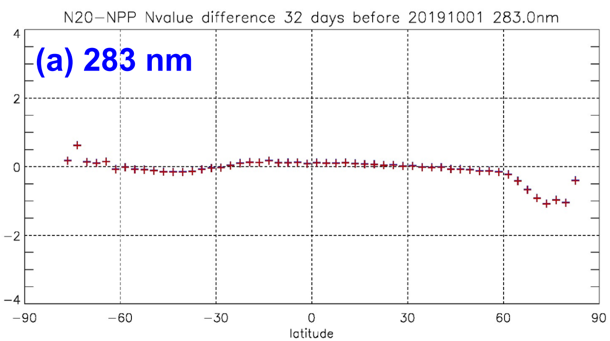


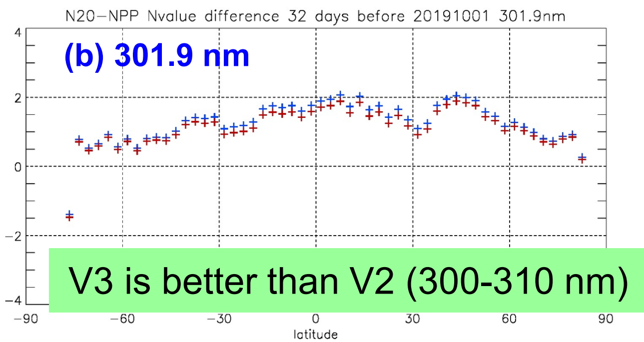



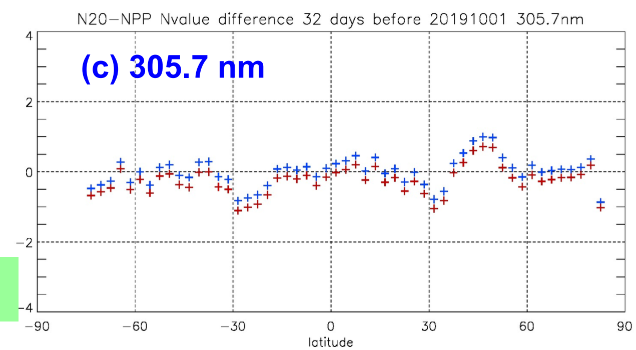




### (2) NOAA-20 V2 (Red) and V3 Versions (Blue)

Blue: $Nvalue_{N20}$(V3 reprocessed)-$Nvalue_{NPP}$




(V3 is selected as the validated maturity version)

# NP Stray Light Calibration Meets requirement

- Use NASA data as reference
- NP stray light calibration difference < 1% for the most of the wavelengths in 250-310 nm.
- Except for 255.2 nm and 254 nm at latitude < - 40 °C where measurement signal is small. Radiance difference between NOAA and NASA data is on order of 1.0E-4, and is negligible