Provisional Maturity Science Review For
NOAA-21 Surface Reflectance

Prepared by
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Version 1: 01/24/2024

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

1. Beta

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

2. Provisional

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

3. Validated

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

Outline

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

NOAA-21 Surface Reflectance Cal/Val Team

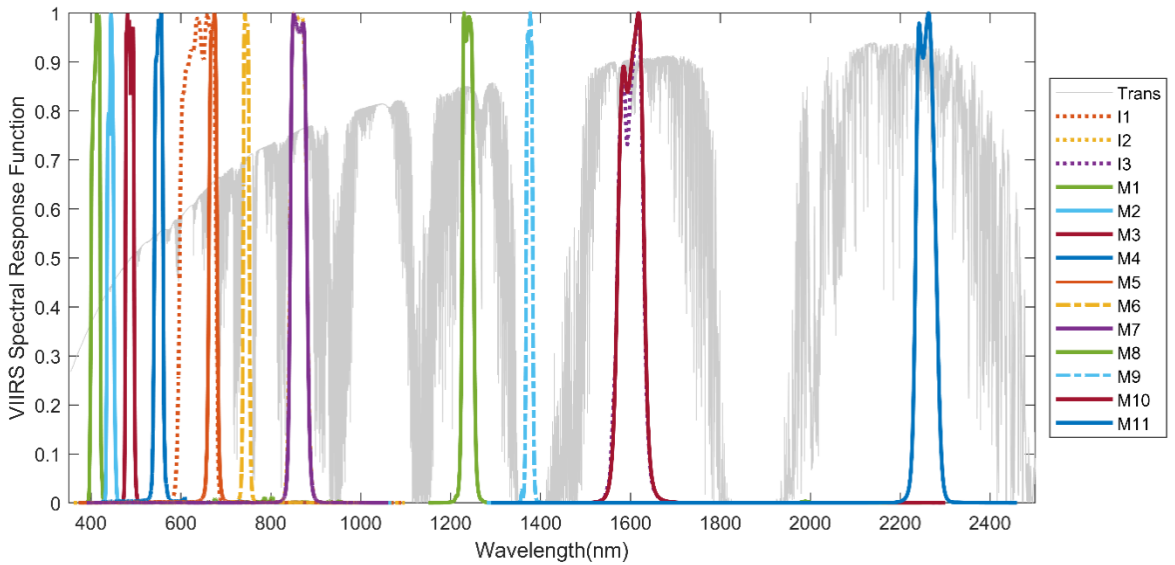
Algorithm Cal/Val Team Members

	Name	Organization	Major Task
JSTAR Science	Ivan Csiszar	NESDIS/STAR	Project Management
	Yunyue Yu	NESDIS/STAR	Team management, algorithm development, validation advises
	Yuan Zhou	UMD/CISESS	Integration support
	Heshun Wang	UMD/CISESS	algorithm improvement, product calibration/validation
	Eric Vermote	NASA GSFC	Consulting support
JPSS ASSISTT	Priyanka Roy	GAMA-1	Algorithm System integration
	Michaele Wilson	GAMA-1	Algorithm System integration
	Brandon Laufer	GAMA-1	Algorithm System integration
OSPO Team	Hanjun Ding	OSPO	OSPO PAL, transition to operations
	Yufeng Zhu	OSPO	OSPO PAL, transition to operations
Users	Xiwu(Jerry) Zhan	NESDIS/STAR	STAR Surface Type team
	Corrine Cater	UMD/CISESS	STAR VI team

Product Overview

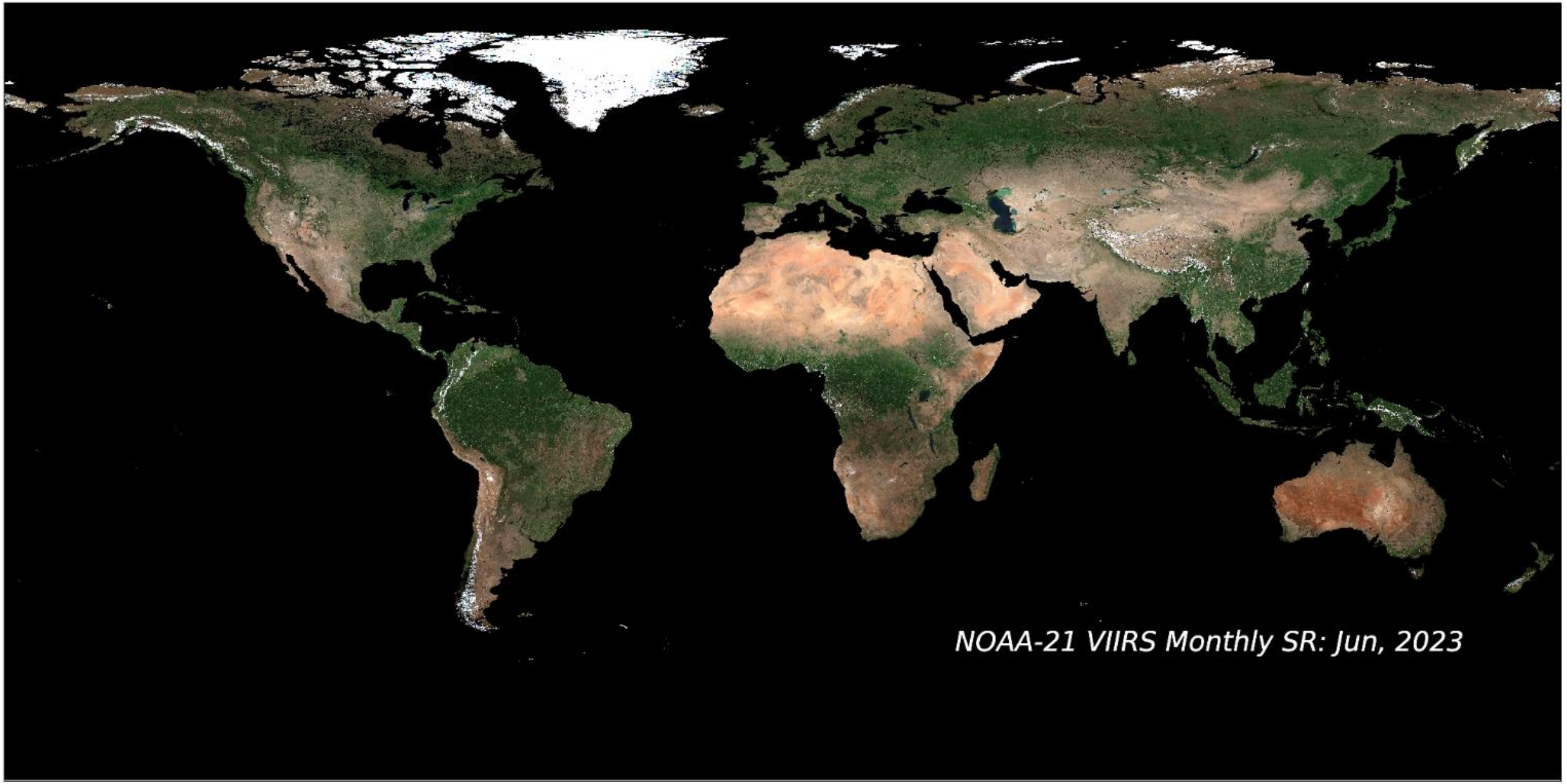
Surface reflectance (SR) is the most fundamental remotely sensed surface parameter, providing the primary input for most of the higher-level land products which rely on the solar reflective characters, including vegetation indices and leaf area index, land cover, and albedo. Therefore, the quality of SR product is critical to a bunch of downstream products.

- The VIIRS SR product is directly heritage from collection 5 MODIS and that it has been validated to stage 1 (Land PEATE adjusted version). MODIS algorithm refinements from Collection 6 have been integrated as well.
- The IDPS algorithm was initially transitioned to NDE, now has completed the cloud transition (NCCF).
- The JPSS SR products provide directional surface reflectance values for **VIIRS 12 bands** centered at 0.412 µm, 0.445 µm, 0.488 µm, 0.555 µm, 0.645 µm, 0.672 µm, 0.865 µm (two different spatial resolutions), 1.24 µm, 1.61 µm (two different spatial resolutions), and 2.25 µm.
- The level 2 SR product are produced at **750m resolution for M bands and 375m for I Bands**.



VIIRS Solar Reflective Bands Spectral Response Function

NOAA21 Monthly SR True Color Image



Product Overview/Requirements

- Product performance requirements from JPSS Data Product Specification (DPS)

Attribute	DPS	Requirement/Threshold	Performance
Geolocation	JERD-2441	The algorithm shall produce a surface reflectance product with a horizontal cell size of 0.80 km for radiometric and 0.40 km for imagery bands.	
Mapping uncertainty	JERD-2529	The algorithm shall produce a surface reflectance product with a mapping uncertainty, 3 Sigma, of the VIIRS SDR pixel geolocation uncertainty	
Valid range	JERD-2530	The algorithm shall produce a surface reflectance product with a measurement range of 0-1. (Note 1)	
Accuracy	JERD-2531	0.005+0.05ρ. (Note 2)	
Precision	JERD-2532	0.005+0.05ρ. (Note 2)	

Note 1: The actual retrieved range of Surface Reflectance is -0.1 to 1.6 .
Note 2: The symbol ρ denotes the retrieved surface reflectance. The APU metrics are applicable in conditions of low-to-moderate atmospheric turbidity (AOT (0.55μm) x m <1) where m is the air mass. The performance is degraded for the SR at wavelengths lower than 0.55μm by at least a factor 2. The SR errors may also be higher under partly cloudy and snow conditions.

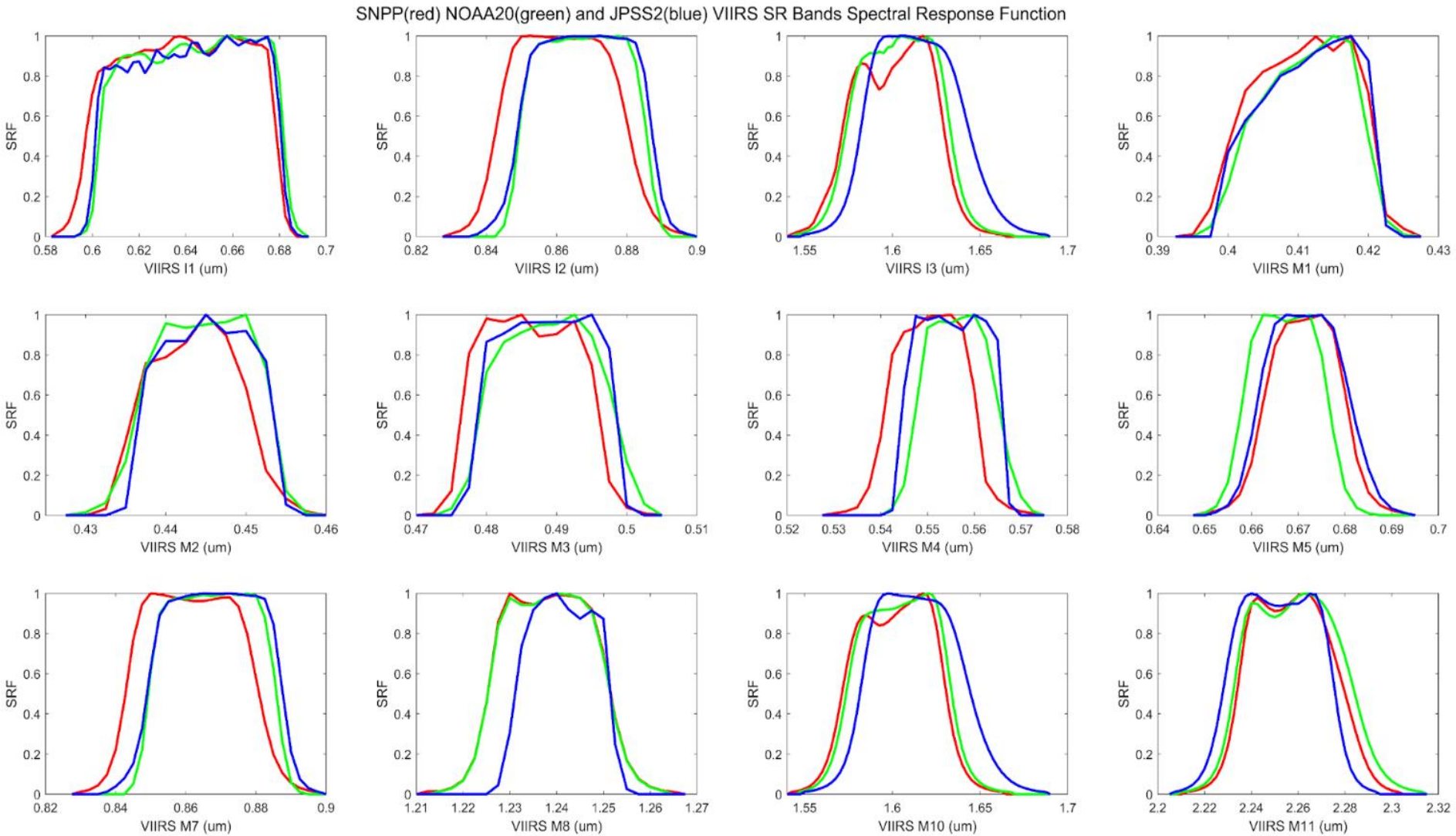
Processing Environment and Algorithms

- Description of processing environment and algorithms used to achieve the maturity stage:
  - Algorithm version: v1r2, v1r3
  - Version of LUTs used: v1.5.06.02_LP.
  - Version of PCTs used: SR v1r0
  - Effective date: Jan 6, 2022 (v1r2), Oct 31, 2023 (v1r3)

- Datasets used for Provisional Review
  - Data used for this provisional review was from NDE/NCCF PDA I&T stream,
  - Data period: Mar 16 – Dec 31, 2023
  - AERONET measurements matched with satellite data for validation.

Note: two version data are used in this provisional review, the v1r2 (03/16/2023 – 10/30/2023) and v1r3 (11/01/2023-12/31/2023). Compared with v1r2, v1r3 updated both the LUT and part of quality flags.

V1r3 SR LUT Update



Spectral Response Function Comparison (NPP/N20 vs N21)

LUT update

- In v1r2, all three satellites share same LUTs; in v1r3 an independent LUTs derived using latest spectral response function.
- In v1r3, abandon some approximations, using the accurate information in the LUT derivation.
- Update gases coefficients to keep consistent with NASA SR algorithm.

VIIRS SR LUT

File name	Dimension	Description
VIIRS-SR-IP-AC-INT_v1.5.06.02_LP	9+12*11	Binary lookup table containing a variety of ancillary information including the range of retrieved surface reflectance, aerosol optical depth, GFS fields, aerosol model limits, Rayleigh optical depth coefficients, and transmittance coefficients for ozone, water vapor and other gasses
VIIRS-SR-ScatAngDims-LUT_v1.5.06.02_LP	NSOLZA*NSENZA	Binary lookup table containing the location of the maximum scattering angle corresponding to 105 different pairs of solar and sensor zenith angles
VIIRS-SR-IncScatAngles-LUT_v1.5.06.02_LP	1	Binary lookup table containing the scattering angle increment
reflect	NMOD*NAOT*NBND*NANG	4-D Binary lookup table of reflectance.
trans	NMOD*NAOT*NBND*NSOLZA	4-D Binary lookup table of transmittances.
albedo	NMOD*NAOT*NBND	3-D Binary lookup table of albedos.
aot	NAOT	Binary lookup table of 20 aerosol optical thicknesses
szen	NSENZA	Binary lookup table of 20 viewing zenith angles
vzen	NSOLZA	Binary lookup table of 21 solar zenith angles

Dimension: NMOD (4), NAOT (20), NBND (10), NSOLZA (21), NSENZA (20), NANG (5527)

V1r3 SR QF Update

Background:

- VIIRS Enterprise Cloud Mask (ECM) product is an import input data for SR product, many Quality Flags are directly from the cloud mask and cloud height product.
- VIIRS ECM has upgrade from version 1 (ECM1, v2r3) to version 2 (ECM2, v3r2)
- Compared with ECM1, ECM2 has made a couple of updates, includes
  - EMC2 update the threshold value, that means the cloud mask with different results.
  - The structure of the first 20 bits was left unchanged from ECM1. However, the rest of the bits will vary from sensor to sensor. That lead to the issues of reflective cirrus test and emissive cirrus test, which are no longer available in ECM2.

- In v1r3, Cirrus mask will only exist as the Thin Cirrus Mask (QF7, bit 4, which is consistent between ECM1 and ECM2)
- Reflective and Emissive cirrus test (QF2, bit 6 & 7) will be obsolete and set to 0.

QF1: 0-1 cloud mask quality (obsolete - permanently set to 11);
00 -- poor 01 -- low 10 -- medium 11 -- high
QF2: 7 thin cirrus emissive (obsolete - permanently set to 0);
0 -- no cloud 1 -- cloud
6 thin cirrus reflective (obsolete - permanently set to 0);
0 -- no cloud 1 -- cloud
QF7: 1 adjacent to cloud (obsolete - permanently set to 0);
0 -- no 1 -- yes

Quality Flags

Legend: Same or Similar | Some Differences due to different inputs | Imperfect Bit Mapping Between Products | NDE product can not produce this bit.

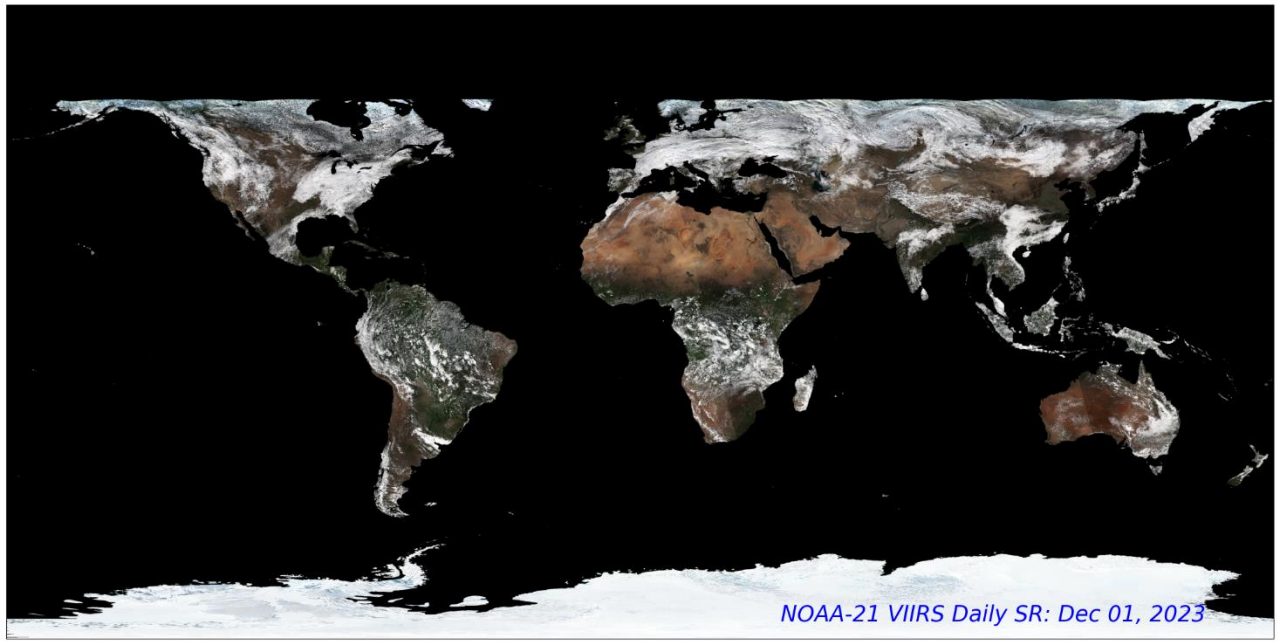
	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
QF1	Cloud Mask Quality		Cloud Detection Confidence		Day/Night Flag	Low Sun Flag	Sun Glint Flag (Partial Issue)	(unused)
QF2	Land/Water Mask			Cloud Shadow	Heavy Aerosol	Snow/Ice Flag	Reflective Cirrus Test	Emissive Cirrus Test
QF3	Bad M1 SDR	Bad M2 SDR	Bad M3 SDR	Bad M4 SDR	Bad M5 SDR	Bad M7 SDR	Bad M8 SDR	Bad M10 SDR
QF4	Bad M11 SDR	Bad I1 SDR	Bad I2 SDR	Bad I3 SDR	AOT Quality	Missing AOT	Invalid Aer. Model	Missing Prec. Water
QF5	Missing Column O3	Missing Surf Pressure	Quality of M1 Ret.	Quality of M2 Ret.	Quality of M3 Ret.	Quality of M4 Ret.	Quality of M5 Ret.	Quality of M7 Ret.
QF6	Quality of M8 Ret.	Quality of M10 Ret.	Quality of M11 Ret.	Quality of I1 Ret.	Quality of I2 Ret.	Quality of I3 Ret.	(unused)	
QF7	Snow Present	Cloud Adjacency	Aerosol Quantity		Thin Cirrus Flag	(unused)		

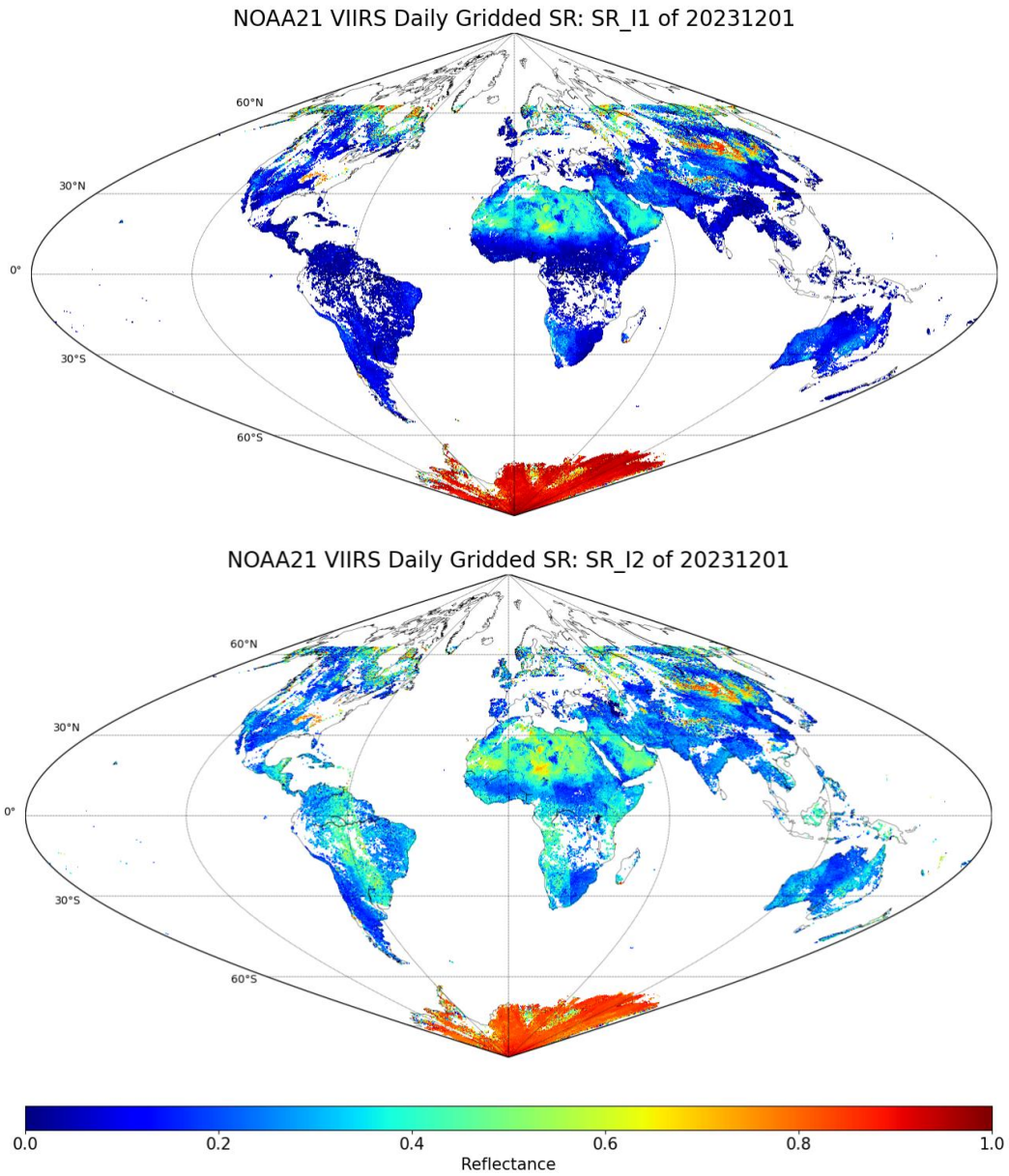
Evaluation of algorithm performance to specification requirements

- Algorithm performance evaluation
  - Product Visual Check
  - Validation data sets (type, periods, coverage)
  - Validation strategies / methods
  - Validation results
  - Long term monitoring readiness
- Inter-sensor comparison
  - Compare with S-NPP and NOAA-20

NOAA21 RGB True Color and Single Band SR Visual Check

Visual check has been performed to check the SR data. A long-term monitoring data are used for the quality check, the data range, map pattern are reasonable as the figures shows. Single band SR are also check for details of each channels.

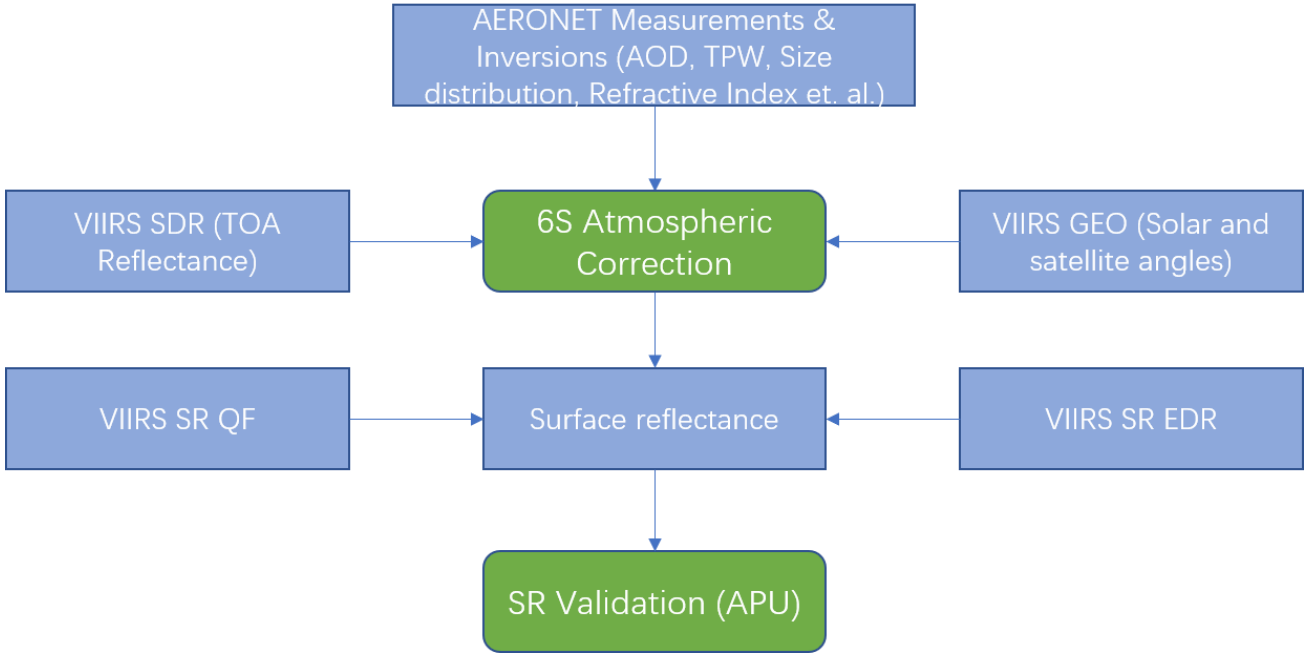




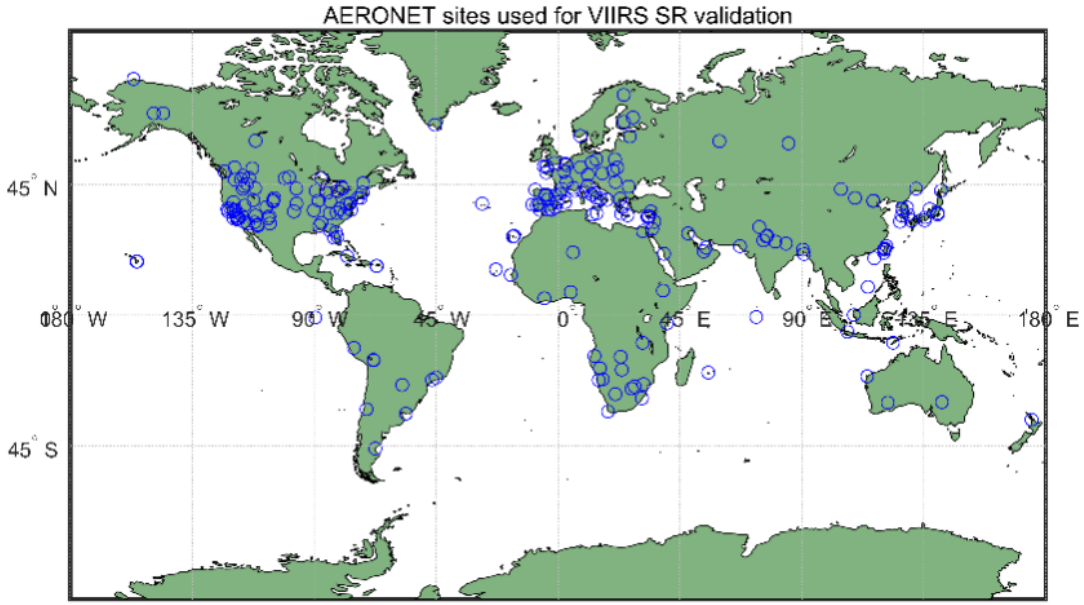
SR Validation datasets and methods

VIIRS SR validation at AERONET

- The matchup tool to select the valid AERONET measurements along with the inversions, then match with the VIIRS SDR and SR EDR subset (51*51 M band pixels).
- The validation tool first atmospherically correct VIIRS TOA reflectance using the AEROENT in-situ data (AOD550, TPW), and then evaluate the VIIRS SR product.
- The AERONET sites are globally distributed as figure shows bellow.

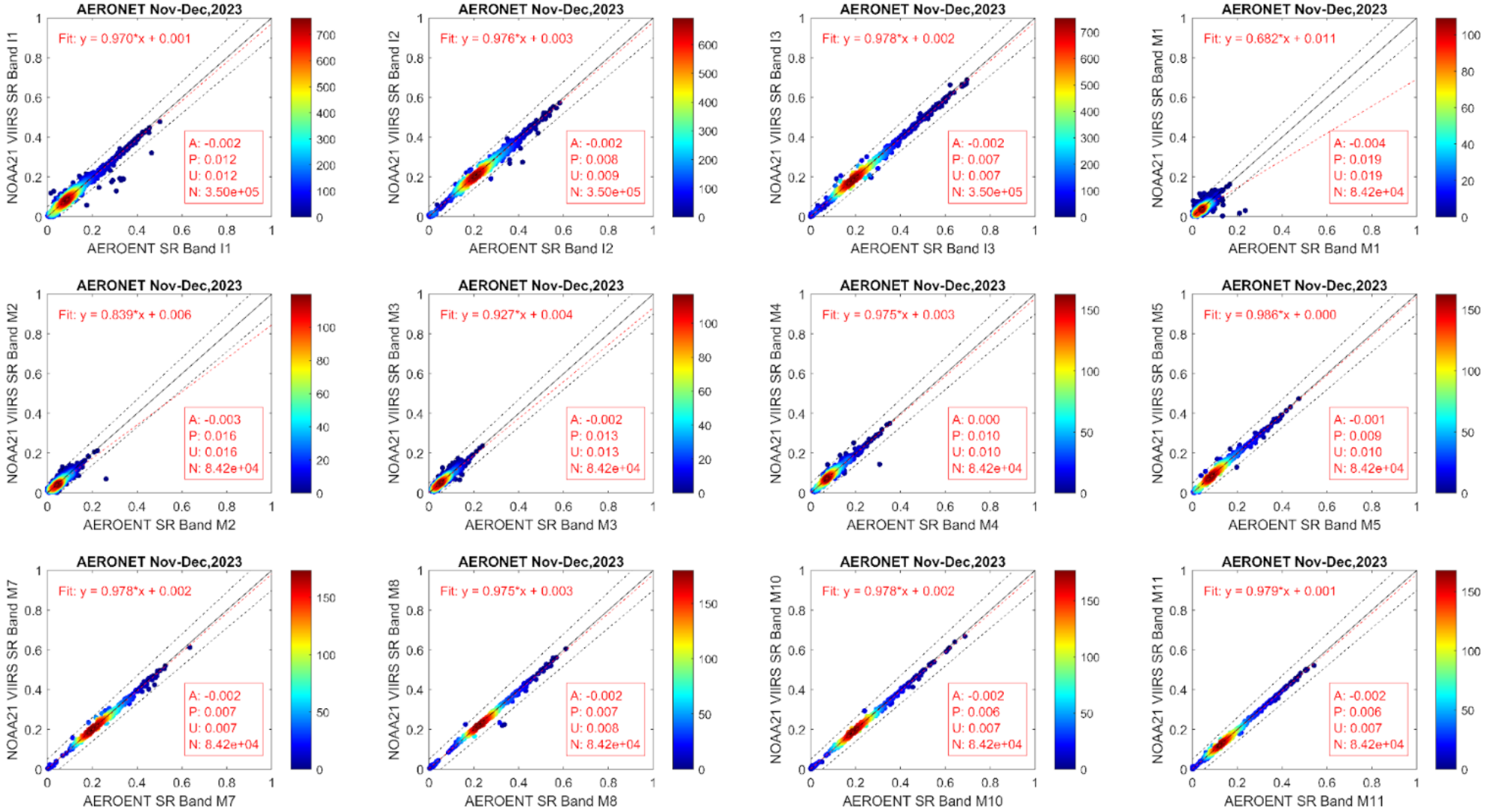


The AERONET SR validation method flowchart



The location of AERONET sites used in the SR validation.

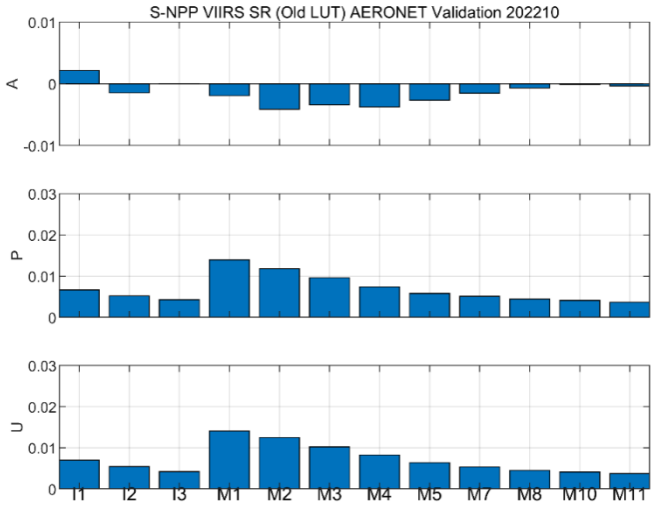
SR Evaluation at AERONET (scattering plot, v1r3)

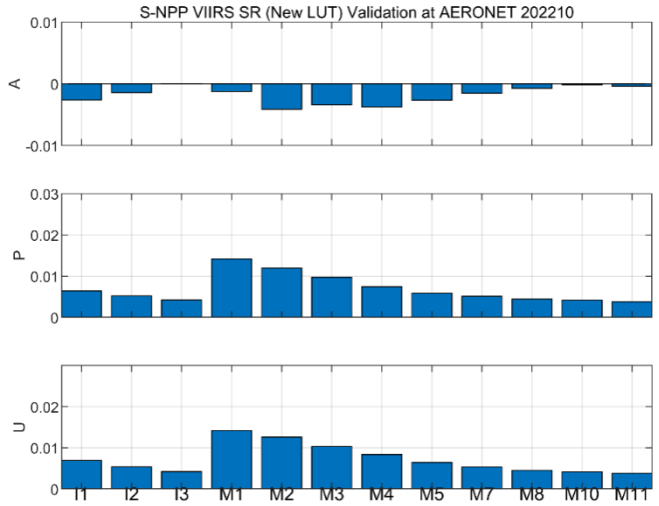


For the good quality data (clear sky, no cloud shadow, no heavy AOD), most data are within the requirements (the dash line)
The shorter wavelength bands (M1-M2) a little bit worse, but still meet the requirement (two times of the other channels)

v1r2 and v1r3 AERONET validation comparison

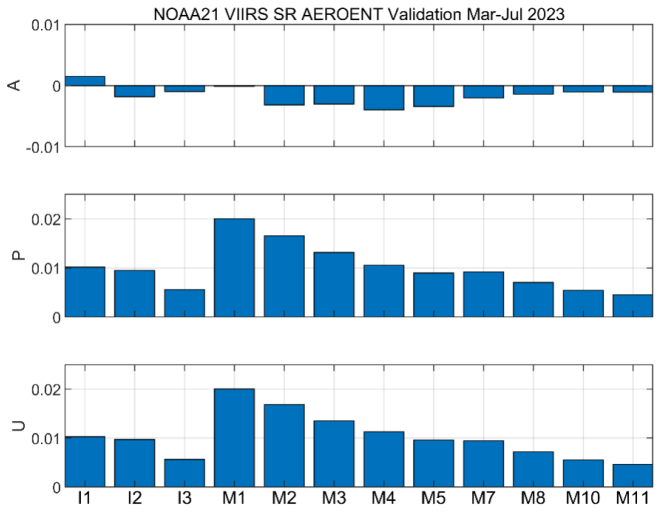
- APU statistics for same datasets (SNPP, Oct, 2022)

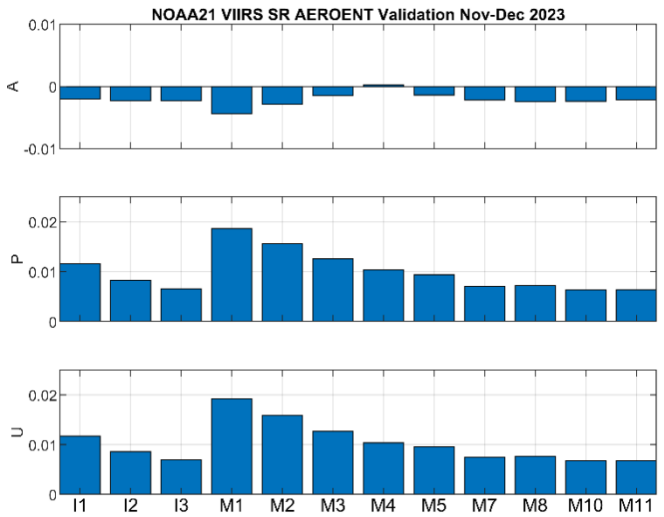




- In v1r2, I1 band use some approximation, leading to a opposite bias (positive bias, while other channels show slight negative bias)
- v1r3 LUT fix this issue, with consistent validation bias.

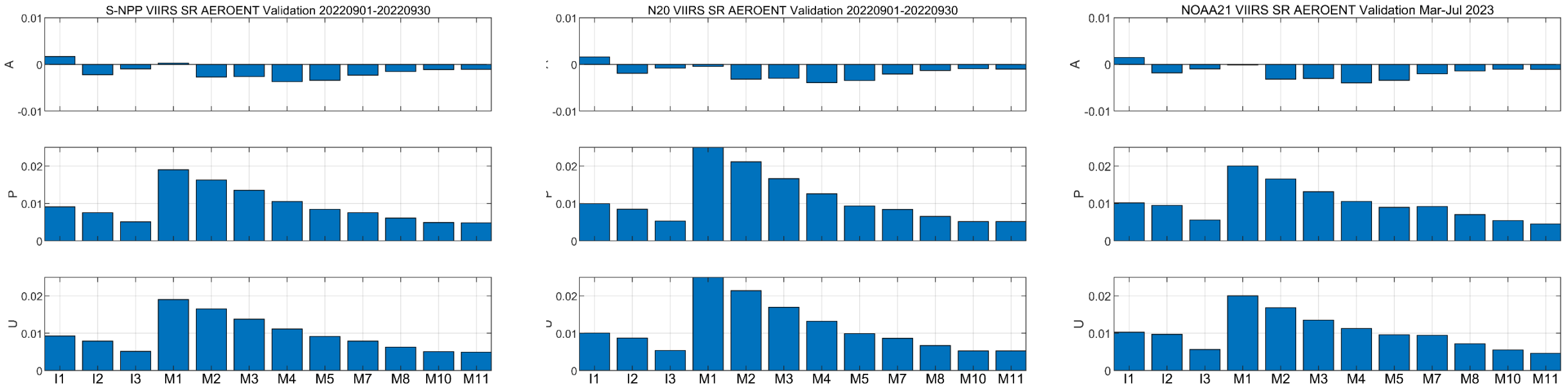
- N21 SR validation results (v1r2 Mar-Jul, 2023, v1r3: Nov-Dec, 2023)





- The NOAA21 operational SR validation verified the LUT update impact.
- V1r3(right) has correct the inconsistency issue for I1 band compared with v1r2 (left)

Inter-Comparison between SNPP, NOAA20 and NOAA21

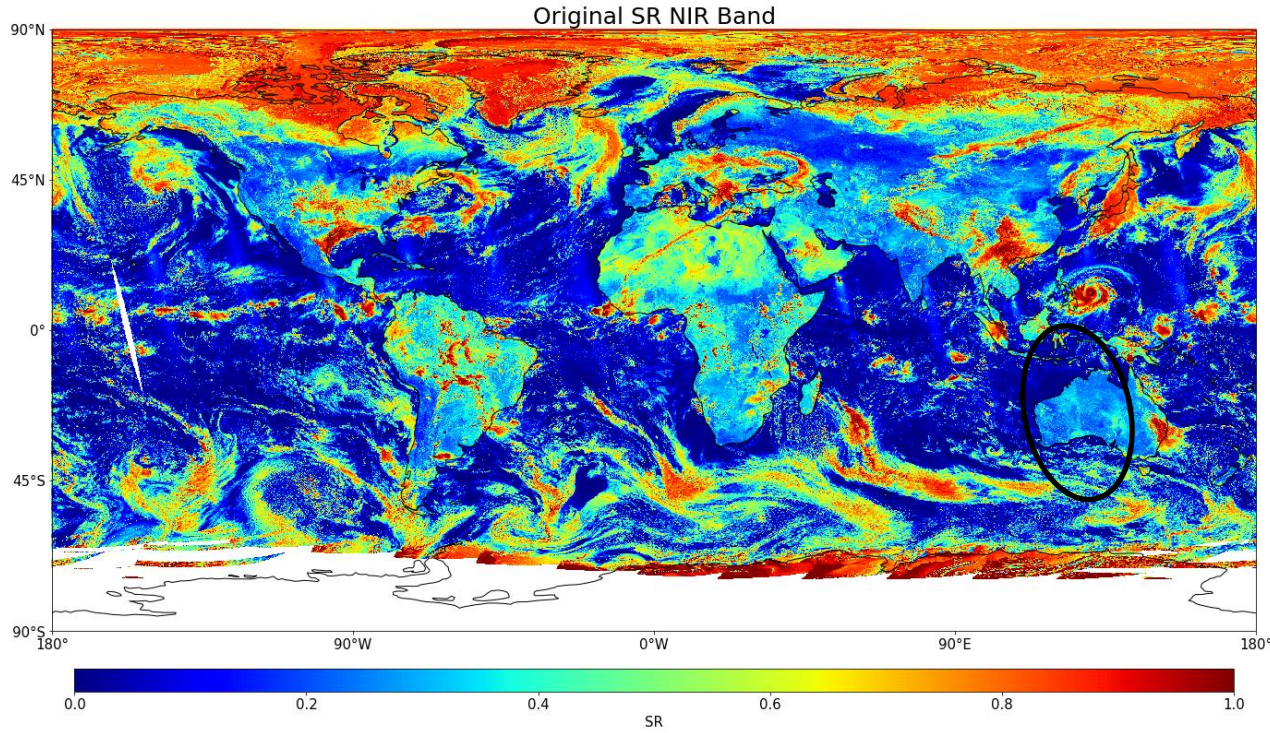


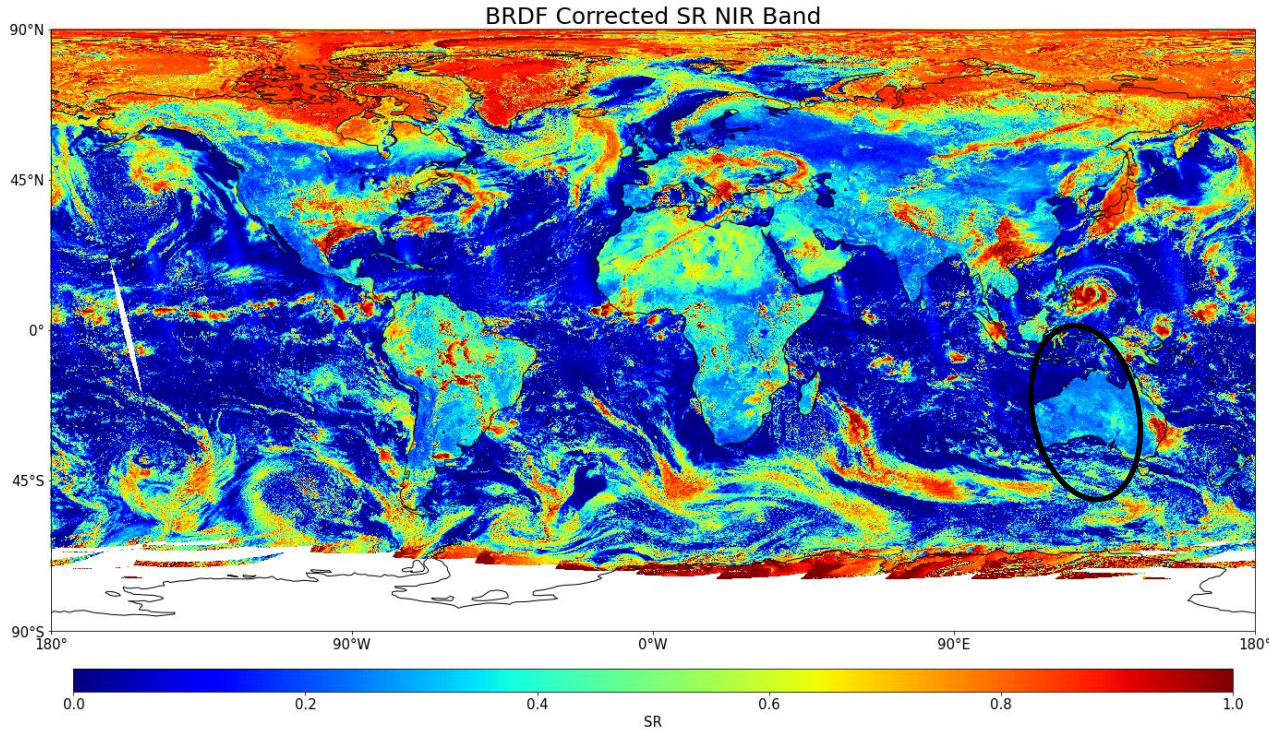
- The NOAA21 SR validation at AERONET shows comparable performance with SNPP and NOAA20
- The short wavelength (M1-M3) band with larger uncertainty due to the intrinsic issue.
- Other bands with good performance

- Directional SR inter-comparison between different satellite/sensor are challenging due to angle sensitive.
- A BRDF corrected SR inter-comparison in under going, some preliminary results are included in the backup slides.

Inter-Comparison: SR BRDF Correction

SR direct comparison is a challenge due to the view and solar angle difference; a BRDF correction approach is under investigation using BRDF coefficients derived from long-term MODIS SR data by NASA SR science team.





A BRDF Correction case for the global data, NIR band, the correction significantly improved the discontinuity due to the view geometry difference from two tracks (e.g. Australia area)

The VIIRS SR Mitigation Algorithm Development

- **Background:** There are 4 aerosol models in AOD product, but the dust model is with large uncertainty, leading to a negative bias in AERONET validation (Fig 1).
- **Impact:** since the dust model (including misclassified) become a dominate type in the global, the AERONET validation shows an overall underestimation (over corrected).
- **Mitigation method:** For the dust model regions, re-set the aerosol model to be one of the rest three non-dust models.
- **Test data:** Clear sky data at global sites of a whole month (Dec,2022)
- **Result:** shorter wavelength bands a little bit worse (M1, M2 band), M3 is comparable, other bands improved.
- **Risk and concern:** The mitigation method significantly improve the SR performance, particularly for the widely used vegetation bands such as I1, I2, I3, M3. It might bring larger uncertainty at the real dust area, but since these data most time unusable, so the sacrifice is acceptable.

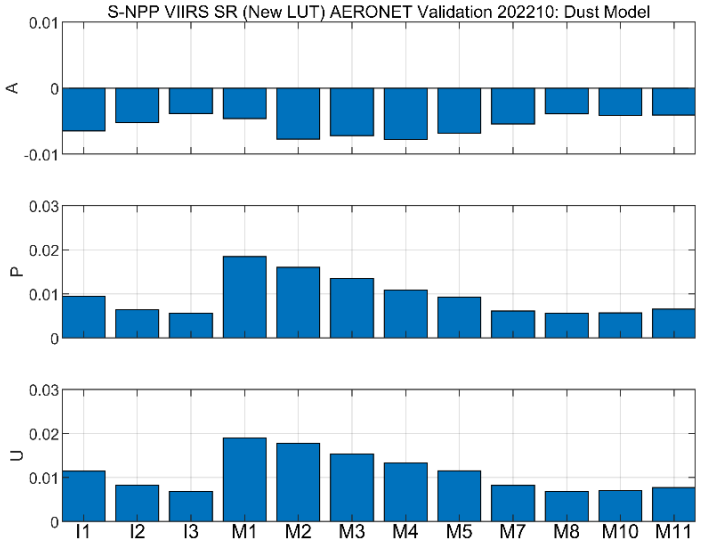


Fig 1. dust model pixels SR validation results.

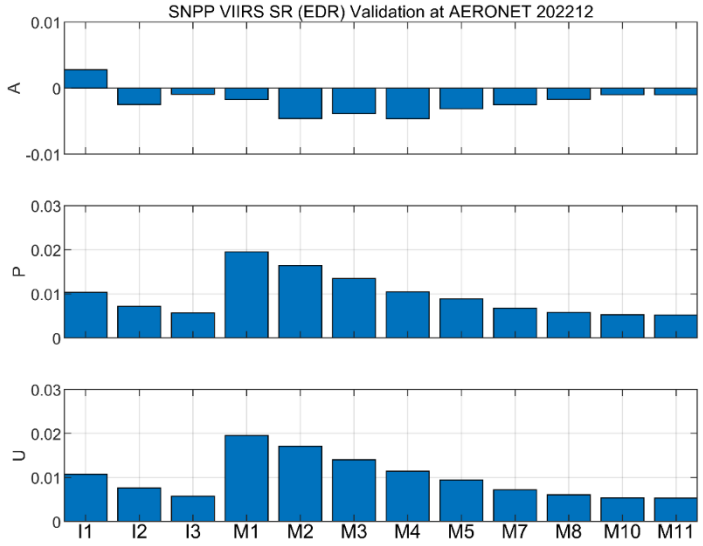


Fig 2. current SR validation results.

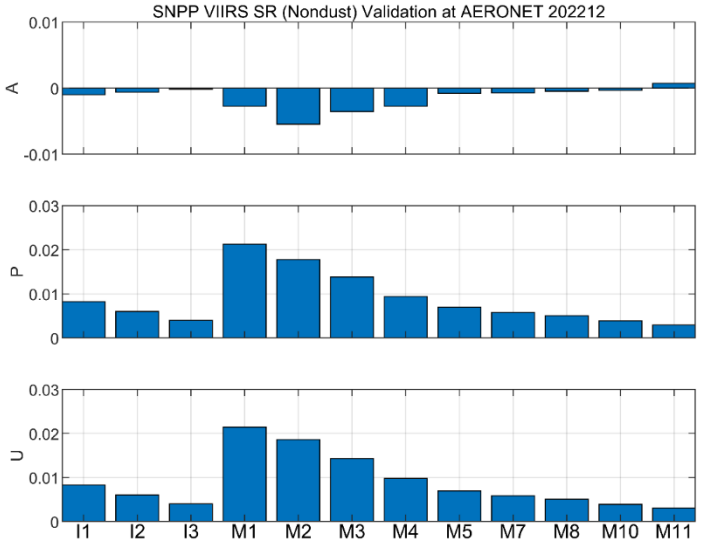
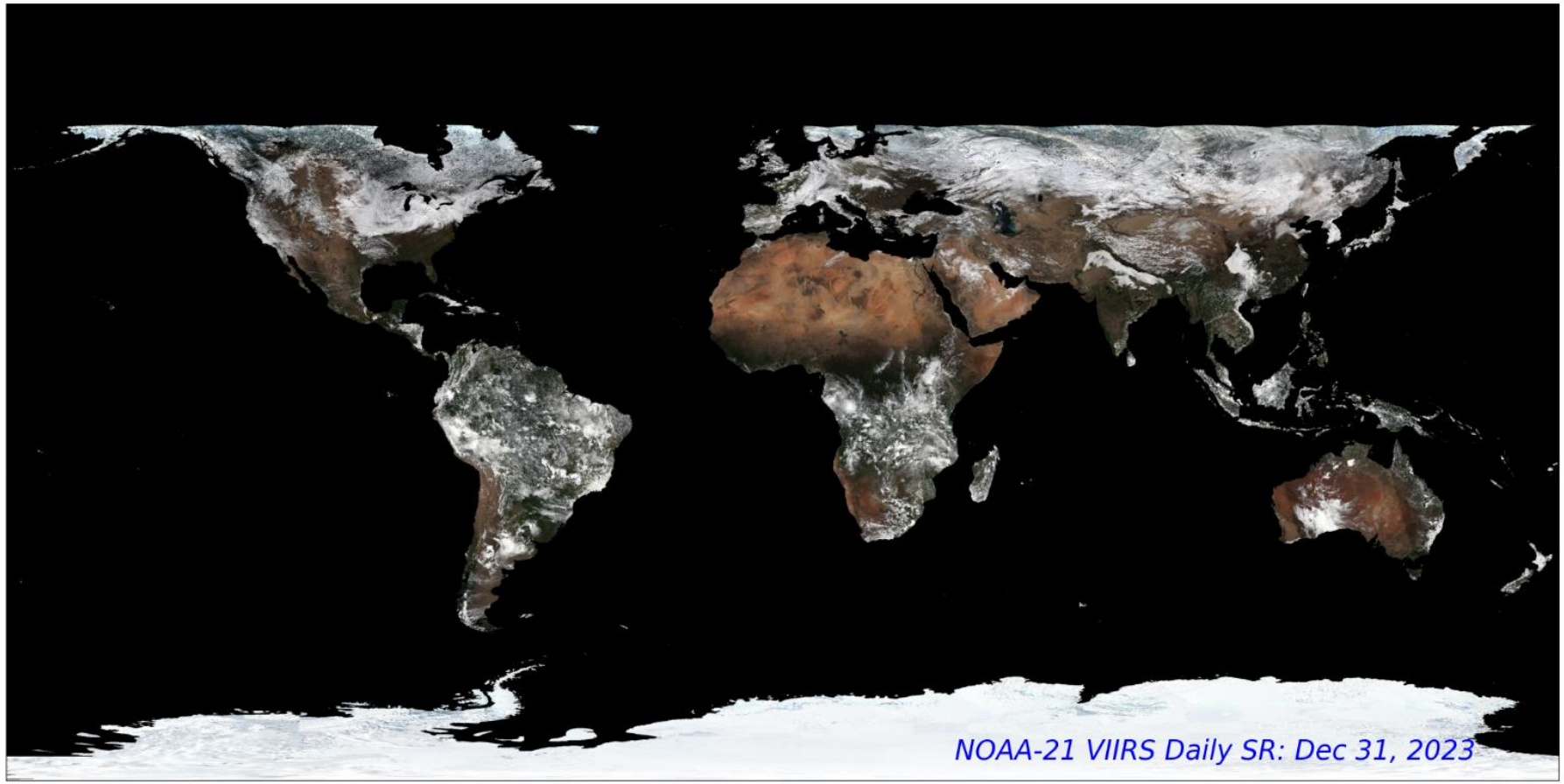
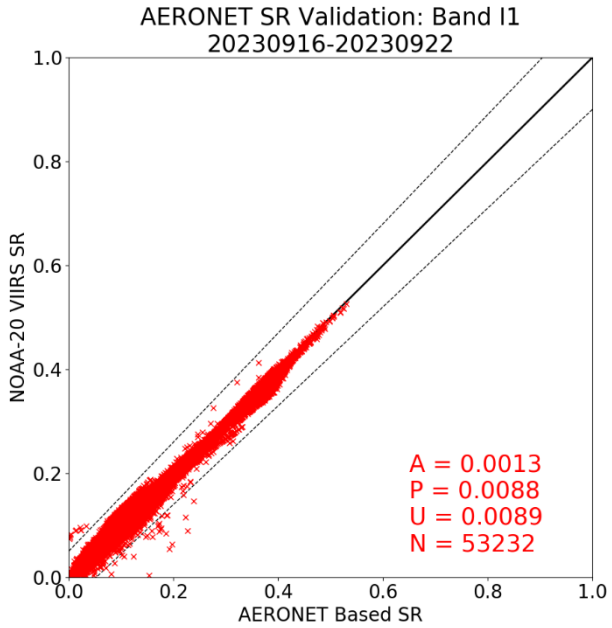


Fig 3. mitigation method validation results.

NOAA21 SR Long Term Monitoring Readiness





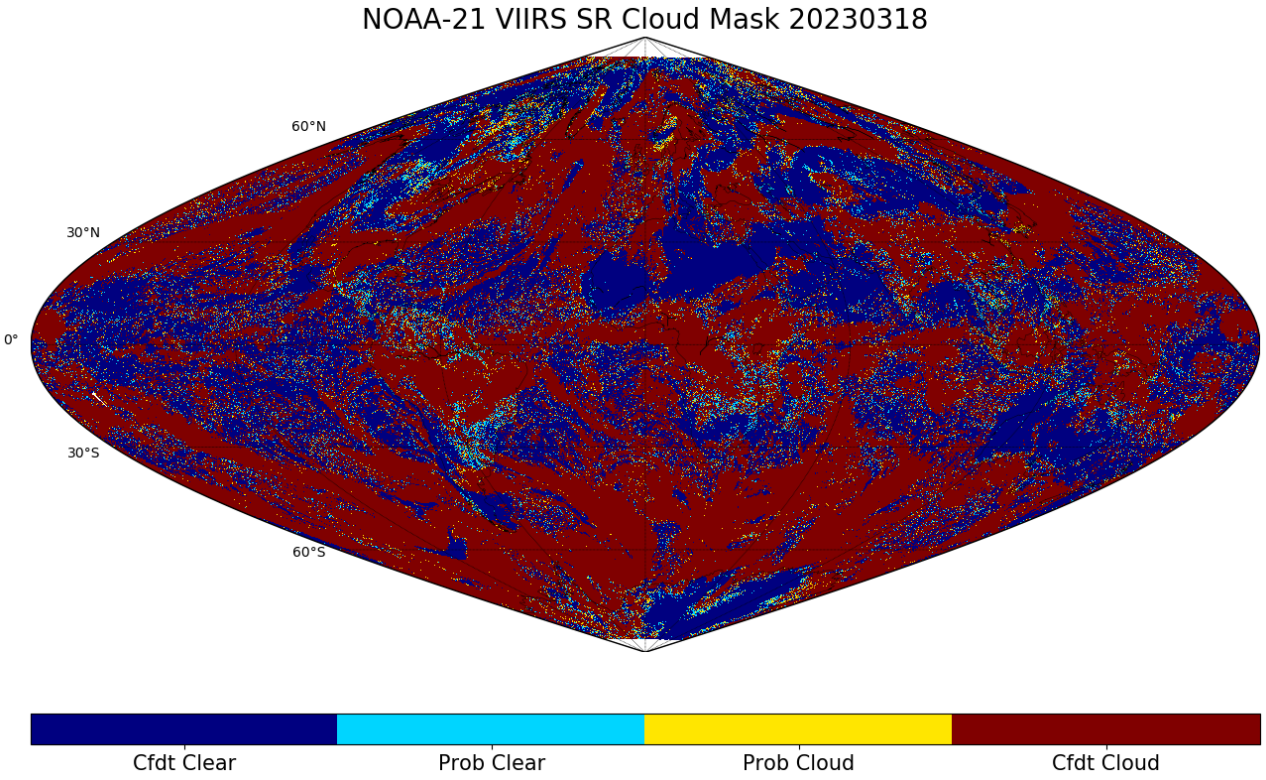
Global daily gridded true color images are routinely generated and posted on the website for monitoring, a weekly AERONET routine validation was performed as well.
https://www.star.nesdis.noaa.gov/smcd/emb/land/animation.php?product=SR&variable=SR-Land&sat=JPSS2

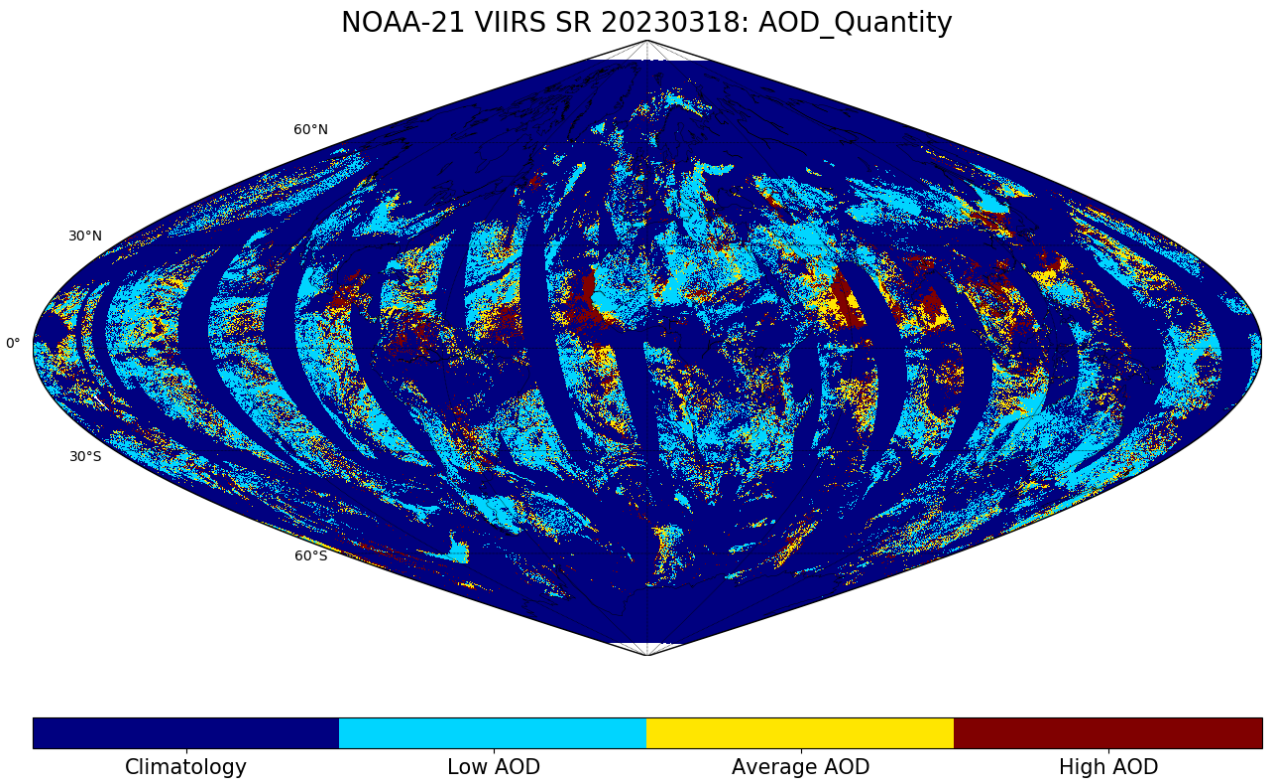
SR Quality flag

	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
QF1	Cloud Mask Quality*		Cloud Detection Confidence		Day/Night Flag	Low Sun Flag	unused	unused
QF2	Land/Water Mask			Cloud Shadow	Heavy Aerosol	Snow/Ice Flag	Reflective Cirrus test*	Emissive Cirrus test*
QF3	Bad M1 SDR	Bad M2 SDR	Bad M3 SDR	Bad M4 SDR	Bad M5 SDR	Bad M7 SDR	Bad M8 SDR	Bad M10 SDR
QF4	Bad M11 SDR	Bad I1 SDR	Bad I2 SDR	Bad I3 SDR	AOT Quality	Missing AOT	Invalid Aer Model	Missing TPW
QF5	Missing Column O3	Missing Surf Pres.	Quality of M1 Retr.	Quality of M2 Retr.	Quality of M3 Retr.	Quality of M4 Retr.	Quality of M5 Retr.	Quality of M7 Retr.
QF6	Quality of M8 Retr.	Quality of M10 Retr.	Quality of M11 Retr.	Quality of I1 Retr.	Quality of I2 Retr.	Quality of I3 Retr.	unused	unused
QF7	Snow Present	Cloud Adjacency*	AOD Quantity Flag		Thin Cirrus	unused	unused	unused

* Obsolete due to the cloud mask product change.

NOAA21 QF (Cloud Mask & AOD Quantity)





Two most frequently used QFs: the cloud mask and AOD quantity check, after the latest update (v1r2) the low AOD Flag increase while High AOD percentage reduce.

Cloud Mask Difference Between v2r3 and v3r2

- Cloud Mask (Confidence level)

Granules of whole day (~550), compared the Cloud mask confidence (0: confidently clear, 1: probably clear, 2: probably cloudy, 3: confidently cloudy). Col: v2r3 (ECM1), Row: v3r2 (ECM2)

202306	ECM2-0	ECM2-1	ECM2-2	ECM2-3	SUM
ECM1-0	**0.2381**	0.0267	0.0102	0.0114	0.2863
ECM1-1	0.0167	**0.0093**	0.0083	0.0127	0.0469
ECM1-2	0.0066	0.0057	**0.0087**	0.0389	0.0599
ECM1-3	0.0023	0.0037	0.0095	**0.5915**	0.6070
SUM	0.2636	0.0453	0.0367	0.6544	

Cloud Shadow Mask (0: no, 1: yes)

202306	ECM2-0	ECM2-1	SUM
ECM1-0	**0.9503**	0.0165	0.9668
ECM1-1	0.0211	**0.0122**	0.0332
SUM	0.9713	0.0287	

- The cloud mask has a good agreement for confidently clear and confidently cloudy.
- The correlation of probably clear/cloudy are not so good.
- Overall, the ECM2 with reduced (~2%, 28.5%□ 26.5%) confidently clear pixels compared with ECM1
- The Cloud shadow with relatively good agreement.

Evaluation of the effect of required algorithm inputs

- Required Algorithm Inputs
  - Primary Sensor Data
    - *VIIRS I1, I2, I3, M1,2,3,4,5,7,8,10,11 band, and Geolocation data.*
  - Ancillary Data
    - *GFS (surface pressure, total column ozone, total precipitable water)*
  - Upstream algorithms
    - *Enterprise Cloud Mask, Cloud Height, Aerosol Optical Thickness*
  - LUTs / PCTs
    - *LUT explanation & the new LUT Test*
- Evaluation of the effect of required algorithm inputs
  - VIIRS SDR performance monitoring through ICVS and Provisional review results
  - VIIRS AOD provisional review

Algorithm inputs: Primary Sensor Data

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

- The on-orbit SNR estimation met the Spec. for all RSBs.

Geolocation Accuracy

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

Radiometric Bias Evaluation

- NOAA-21 vs. NOAA-20 VIIRS VIS/NIR Comparison at SNO using Aqua MODIS as Reference: Radiometric bias of NOAA-21 VIIRS VIS/NIR (M1-M5, M7, I1, I2) channels are within 2% bias relative to NOAA-20

Issue need pay attention

- NOAA-21 VIIRS short-wavelength infrared (SWIR) band gain changes are faster than expected. Close monitoring of these changes for all SWIR bands and updating the radiometric calibration coefficients are carried out to address this issue.
- Dual-gain anomaly flagging as “poor quality” disabled for NOAA-21 VIIRS, current EDR products not affected since users were advised to ignore this flag

From NOAA-21 VIIRS SDR Provisional Review (03/30/2023)

Algorithm inputs: AOD & Cloud Mask/Heigh

AOD Product (From AOD team)

- Based on the analysis of about three months of VIIRS AOD from the three satellites we also find the quality of the high-quality NOAA-21 AOD over land to be similar to those from NOAA-20 and S-NPP. The global averages of biases relative to AERONET are -0.022, -0.026 and -0.025 for NOAA-21, NOAA-20 and S-NPP, respectively. All three products somewhat underestimate the AOD relative to AERONET. Regional and seasonal differences can be smaller or larger than these.

Cloud Product (Cloud mask & Cloud Height)

- VIIRS SR use cloud confidence levels, land water type, cirrus test, sun glint and snow/ice from VIIRS enterprise cloud mask EDR and the cloud shadow from Cloud Height EDR as the main data source for the quality flags.
- By comparing with SNPP and NOAA20 related flags, NOAA-21 with good consistency and similar pattern.

Error Budget

Attribute Analyzed	DPS	Requirement/ Threshold	Pre-Launch Performance	On-orbit Performance			Meet Requirement?	Additional Comments
				NOAA-21	NOAA-20	S-NPP		
Accuracy	JERD -2531	0.005+0.05ρ	NA	<±0.003 <±0.006 for M1-4	<±0.003 <±0.006 for M1-4	<±0.003 <±0.006 for M1-4	Yes	
Precision	JERD -2532	0.005+0.05ρ	NA	<0.012 <0.02 for M1-4	<0.012 <0.02 for M1-4	<0.012 <0.02 for M1-4	Yes	For the good quality data

The symbol ρ denotes the retrieved surface reflectance. The APU metrics are applicable in conditions of low-to-moderate atmospheric turbidity (AOT (0.55µm) x m <1) where m is the air mass. The performance is degraded for the SR at wavelengths lower than 0.55µm by at least a factor 2. The SR errors may also be higher under partly cloudy and snow conditions.

User Feedback

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Veronica Lance	NOAA	Coastal Watch	NOAA Coast Watch Central (the central processing team housed in STAR) is generating true color images using the VIIRS Land Surface Reflectance product
Jerry Zhan /Chengquan Huang	NOAA/UMD	Surface type	We have been able to process the NetCDF files of your NDE surface reflectance product for developing the VIIRS Annual Global Surface Type Map.
CLASS	NOAA	Archive	VIIRS surface reflectance are archived in the NOAA CLASS system, where they are available to the general public.
Corrinne Cater	UMD/CISESS	VI	we did not see any issues that might have been caused by problems with SR. the NOAA-21 SR is fit for the purpose of generating VI and GVF
Zhangyan Jiang	IMSG	GVF	

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	Description	Impact	Action/Mitigation and Schedule
Dust aerosol model	The misclassified dust aerosol model might have larger uncertainty	Increased SR uncertainty	A mitigation algorithm is under development to reduce the uncertainty for the misclassified dust aerosol.

Documentations

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	Yes
Algorithm Theoretical Basis Document (ATBD)	Yes
Algorithm Calibration/Validation Plan	Yes
(External/Internal) Users Manual	Yes
System Maintenance Manual (for ESPC products)	Yes
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes for NPP, N20/N21 under preparation
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 (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from select locations, periods, and associated ground truth or field campaign efforts.	Validated over globally distributed AERONET sites, the data covers from March to December 2023. No significant issue found
Product analysis is sufficient to communicate product performance to users relative to expectations (Performance Baseline).	Comprehensive evaluation analysis have been performed.
Documentation of product performance exists that includes recommended remediation strategies for all anomalies and weaknesses. Any algorithm changes associated with severe anomalies have been documented, implemented, tested, and shared with the user community.	No documentation of product performance available yet. Will document once anomalies detected.
Product is ready for operational use and for use in comprehensive cal/val activities and product optimization.	Product used for operational downstream products like vegetation index, leaf area index, and no significant issues have been reported yet.

Conclusion

- Cal/Val results summary:
  - Team recommends algorithm provisional maturity
    - The SR value and QFs are performed as expected, no obvious issue is found, v1r3 with cirrus QFs updated along with the cloud mask data.
    - The AERONET validation shows the SR with good quality could meet the requirements, and v1r3 fixed issues found in v1r2.
    - Good consistence with SNPP, NOAA20 product.
    - The reprocess SDR is under tested, close monitoring for shortwave IR band (M8, M10 and M11) which are reported with degradation issue according to SDR team.
    - Users and downstream products have not found significant issues for NOAA21 SR.
    - Effective date: VIIRS SR reach Provisional Review (01/25/2024)

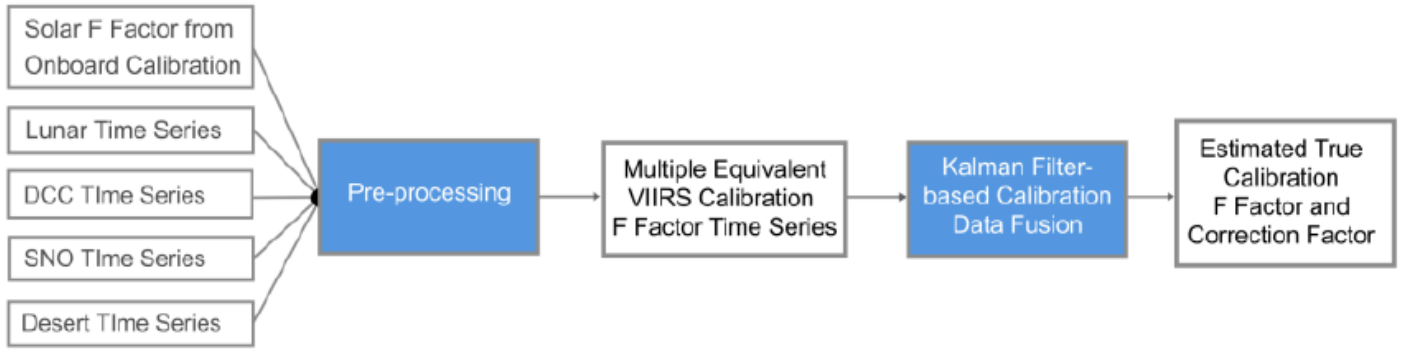
Path Forward

- Lessons learned for NOAA-21 Cal/Val
  - Independent in-situ measurements are limited. SDR data uncertainty or inconsistency could not be detected by AERONET validation.
- Planned improvements
  - Integrating the mitigation algorithm to reduce the uncertainty caused by the misclassified dust aerosol model.
  - Use reprocessed SDR to generate SR for better consistence between JPSS satellites.
- Future Cal/Val activities / milestones
  - Inter-comparison with NASA VJ2-09 product (once available)
  - Inconsistency between JPSS satellites analysis and impact evaluation.
  - Long term and routinely validation at AERONET and update on website.
  - Collect more high-quality in-situ surface reflectance for the validation.
  - Further collaboration with the vegetation team to evaluate the performance

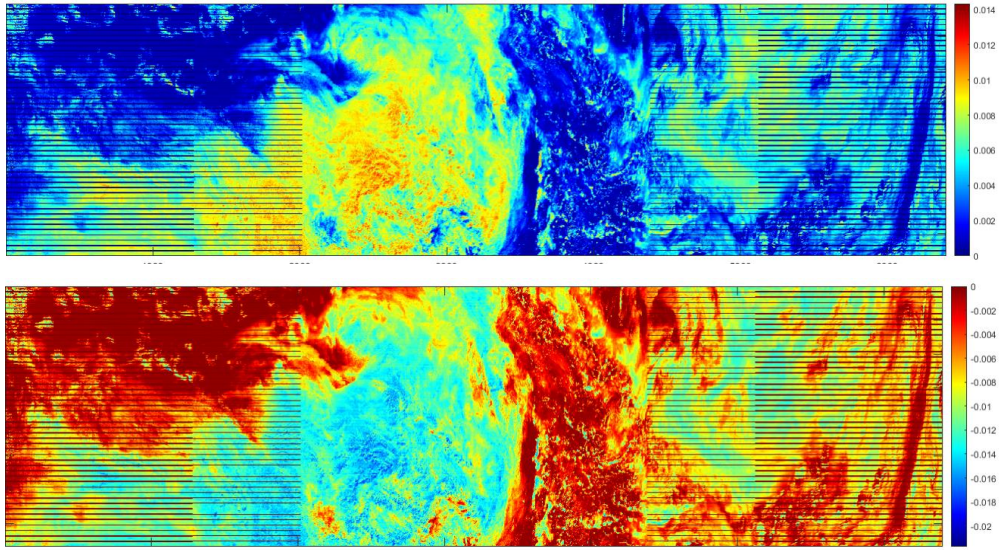
Backup Slides For Reference

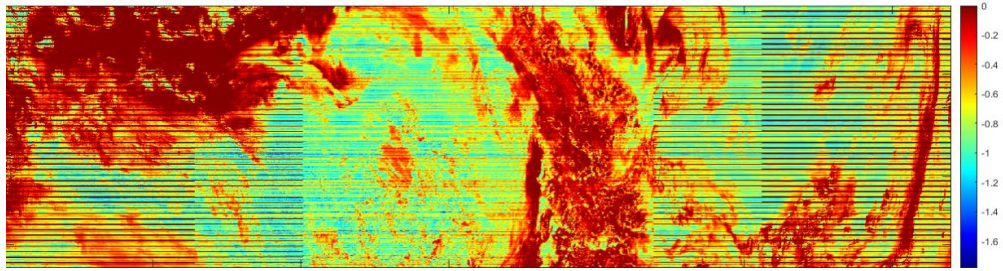
Inter-comparison: Inconsistence issue and reprocessed SDR

- Reprocess VIIRS SDR Method (Cao et. al, 2021)



- VIIRS SR Insistency
- The consistency issue has big impact on the product continuity and the blended product development
- The reprocessed SDR is under tested to see the improvement and explore the method to apply on VIIRS SR.
- The inconsistency impact on vegetation product will be evaluated, and the reprocessed improvement will be assessed as well.





TOA Reflectance Difference (Reprocessed – Operational)
For VIIRS I1, I2, and I3 bands)