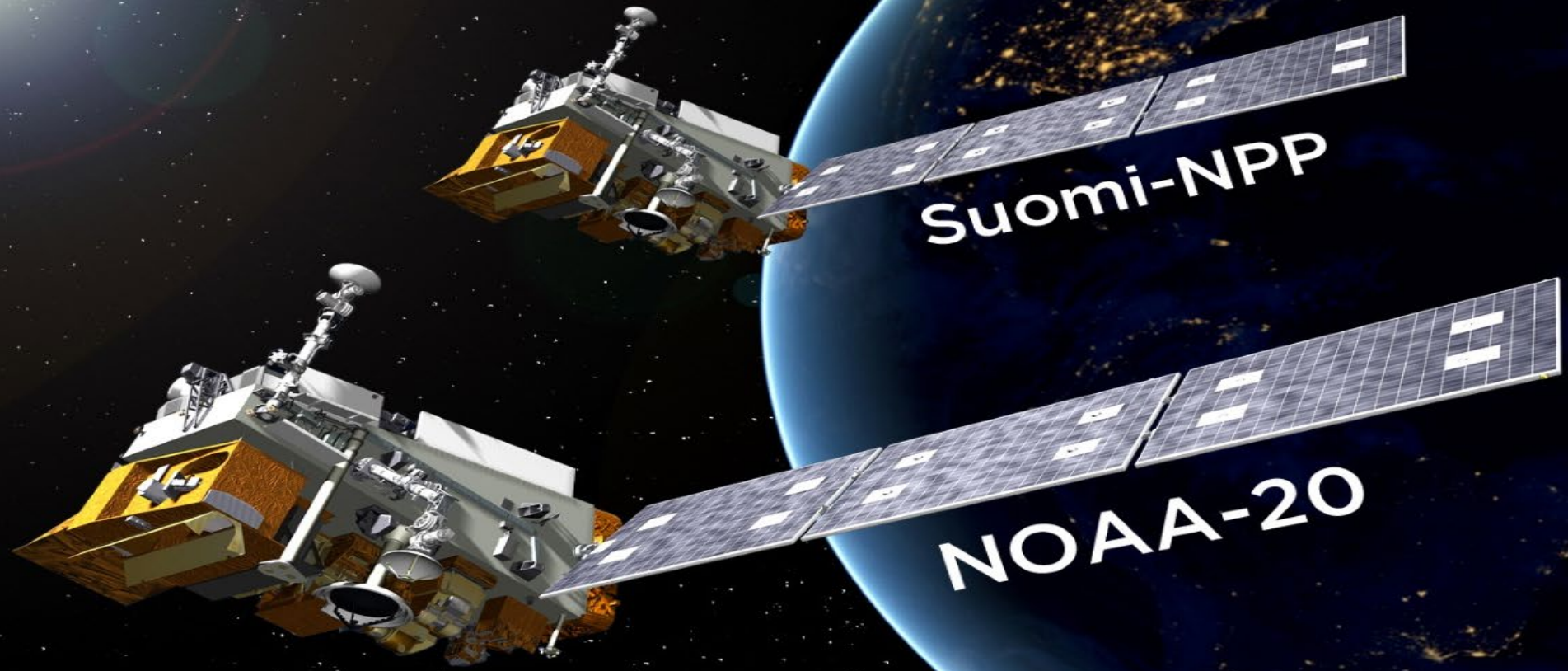
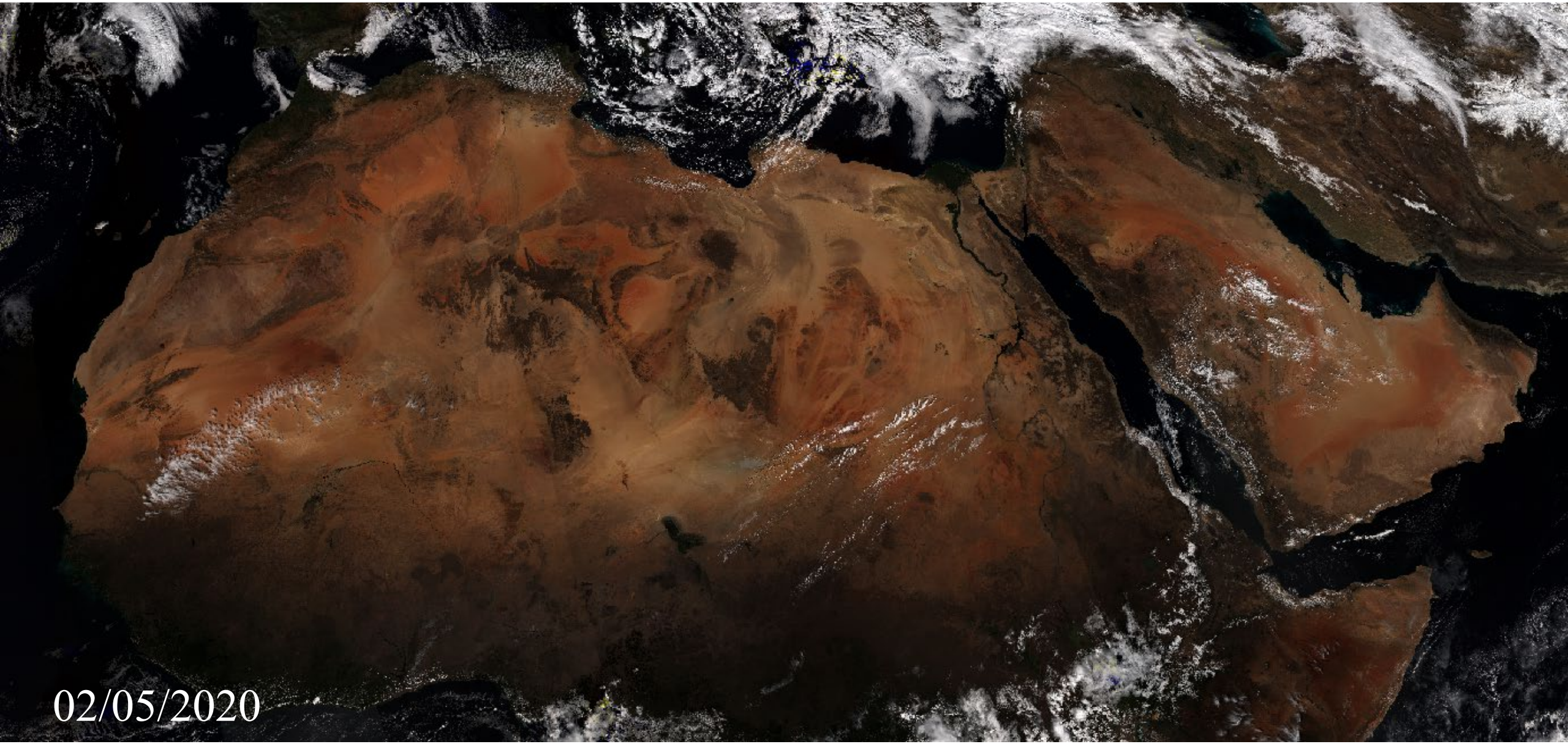
Validated Maturity Science Review For NOAA-20 Surface Reflectance Algorithm



Presented by Ivan Csiszar

Date: 2020/06/18

NOAA-20 VIIRS True Color Surface Reflectance Image: R (M5), G (M4), B (M3)



JPSS Data Products Maturity Definition

1. Beta

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

2. Provisional

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

3. Validated

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

Validated Maturity Review - Entry Criteria

- Product Requirements
- Pre-launch Performance Matrix/Waivers
- Validated Maturity Performance Validation
  - On-orbit instrument performance assessment
    - Identify all of the instrument and product characteristics you have verified/validated as individual bullets
    - Identify pre-launch concerns/waivers, mitigation and evaluation attempts with on-orbit data
- Users/EDRs feedback
- Risks, Actions, Mitigations
  - Potential issues, concerns
- Path forward
- Summary

Validated Maturity Review - Exit Criteria

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

VALIDATED MATURITY REVIEW MATERIAL

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-20 Surface Reflectance Cal/Val Team and stakeholders

Name	Organization	Major Task
Ivan Csiszar	NESDIS/STAR	Surface Reflectance product managerial lead
Eric Vermote	NASA GSFC	Algorithm development, validation
Jim Ray	SSAI@NASA	Validation
Mike Wilson	IMSG@STAR	STAR ASSIST integration
Yunyue (Bob) Yu	NESDIS/STAR	STAR Land Product Development Science Team Lead
Heshun Wang	UMD/CISESS	Validation
Hanjun Ding	OSPO	OSPO PAL, transition to operations

Product Overview/Requirements

- Surface reflectance is defined as the spectral (narrowband), bi-directional reflectance that would be measured in the absence of the atmosphere. The Surface Reflectance product corrects for the atmosphere by removing effects of scattering and absorption from atmospheric gases and aerosols.
- For JPSS VIIRS Surface Reflectance is derived for bands M1,M2, M3, M4, M5, M7, M8, M10, M11, I1, I2, I3
- JPSS Ground Segment Data Product Specification (DPS) requirements:

DPS	Requirement
DPS-826	The Surface Reflectance product shall provide the narrowband, bi-directional surface reflectance, globally, in clear conditions, in daytime, at the refresh rates of the instrument
DPS-828	The Surface Reflectance product shall provide surface reflectance with a measurement accuracy of 0.005 + (0.05 times the retrieved surface reflectance value)
DPS-829	The Surface Reflectance product shall provide surface reflectance with a measurement precision of 0.005 + (0.05 times the retrieved surface reflectance value)

Processing Environment and Algorithms

- ESPC NDE version
  - 2.0.16
- Algorithm version
  - SR v1.1 + LUT Patch (operational)
  - SR v1.2 (science team - includes patch for high aerosol flag)
- Version of LUTs used
  - V1.5.06.02
- Version of PCTs used
  - N/A
- Description of environment used to achieve validated maturity stage
  - STAR computing environment
  - NDE operational environment
  - NASA Land SIPS and associated R&D systems

Enterprise Surface Reflectance LUTs

File Name	File Description
Aot	Binary lookup table of 20 aerosol optical thicknesses
Vzen	Binary lookup table of 40 viewing zenith angles
Szen	Binary lookup table of 38 solar zenith angles
VIIRS-SR-IncScatAngles-LUT_v1.5.06.02_LP	Binary lookup table containing the scattering angle increment
VIIRS-SR-ScatAngDims-LUT_v1.5.06.02_LP	Binary lookup table containing the location of the maximum scattering angle corresponding to 105 different pairs of solar and sensor zenith angles
VIIRS-SR-IP-AC-INT_v1.5.06.02_LP	Binary lookup table containing a variety of ancillary information including max/min boundaries of retrieved surface reflectance, max/min for aerosol optical depth, max/min for GFS fields (water vapor, ozone, surface pressure), aerosol model limits, Rayleigh optical depth coefficients, and transmittance coefficients for ozone (1 value), water vapor (3 values), and other gasses (6 values)
Reflec	Binary lookup table of reflectivities. This is a four-dimensional table with dimensions of aerosol model (4), aot (20), M-band channel (9), and scattering angle (5527).
Trans	Binary lookup table of transmittances. This is a four-dimensional table with dimensions of aerosol model (4), aot (20), M-band channel (9), and solar zenith angle (15).
Albedo	Binary lookup table of albedos. This is a three-dimensional table with dimensions of aerosol model (4), aot (20), and M-band channel (9).

Evaluation of algorithm performance to specification requirements

- Findings/Issues from Provisional Review
  - I3 QF issue
  - Limited validation (NH winter only)
- Improvements since Provisional Review
  - Algorithm Improvements
    - New “High Aerosol” quality flag (science code only)
  - LUT / PCT updates
    - None in the operational product
- Algorithm performance evaluation
  - Validation data sets (type, periods, coverage)
    - STAR ST generated global 16-day sample (February 5- 21, 2020)
    - NASA ST generated global 4-month sample (January 1 – May 1, 2020)
      - Datasets use new “High Aerosol” flag – allow for more data to be analyzed
  - Validation strategies / methods
    - Accuracy - precision – uncertainty (APU) against AERONET data
  - Validation results (see slides in the presentation)
  - Long term monitoring readiness

Evaluation of the effect of required algorithm inputs

- Required Algorithm Inputs
  - Primary Sensor Data
    - VIIRS bands I1, I2, I3, M1, M2, M3, M4, M5,M7, M8, M10, M11, geolocation
  - Ancillary Data
    - GFS (surface pressure, total column ozone, total precipitable water) through cloud mask
  - Upstream algorithms
    - Enterprise Cloud Mask, Cloud Height, Aerosol Optical Thickness
  - LUTs / PCTs
    - No change since Provisional review
- Evaluation of the effect of required algorithm inputs
  - VIIRS SDR performance monitoring through ICVS and maturity reviews

Accuracy assessment

- Establish traceability between NOAA and NASA ST products
  - Direct comparison
  - Comparison of validation statistics over limited sample
- Leverage NASA ST validation results over broader sample
- Validation is performed by comparing the VIIRS surface reflectance products to a reference obtained from correcting the TOA reflectance using the 6SV radiative transfer code and the AERONET data (optical thicknesses, size distribution, indices of refraction and water vapor)
  - Very accurate atmospheric correction around the AERONET sites (9km x 9km)
  - Accuracy, Precision and Uncertainty (APU) values are derived from this comparison
- For the current validation exercise
  - APU statistics were derived from ~4 months of data from January 1 – May 1, 2020, using up to 107 AERONET globally

Validation Metrics

- Accuracy (A) = the bias

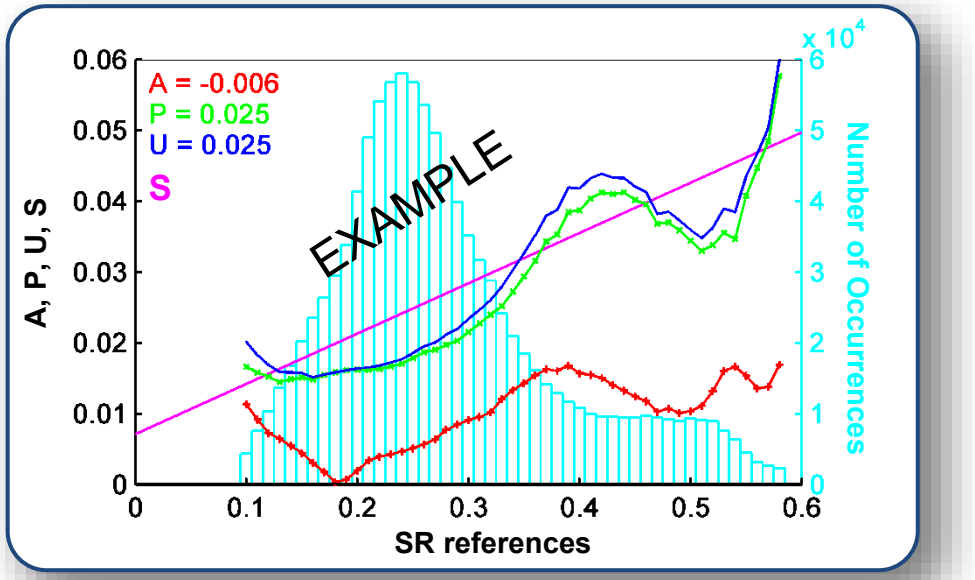
$$A = \frac{1}{N} \times \sum_{i=1}^{N} \varepsilon_i$$

- Precision (P) = the repeatability

$$P = \sqrt{\frac{1}{N-1} \times \sum_{i=1}^{N} (\varepsilon_i - A)^2}$$

- Uncertainty (U) = the actual statistical deviation

$$U = \sqrt{\frac{1}{N} \times \sum_{i=1}^{N} \varepsilon_i^{\,2}}$$



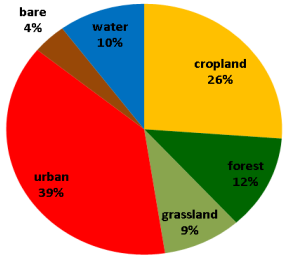
- Specification (S) = A and P requirement (per DPS)

From Vermote and Kotchenova, 2008
(modified for JERD requirements)

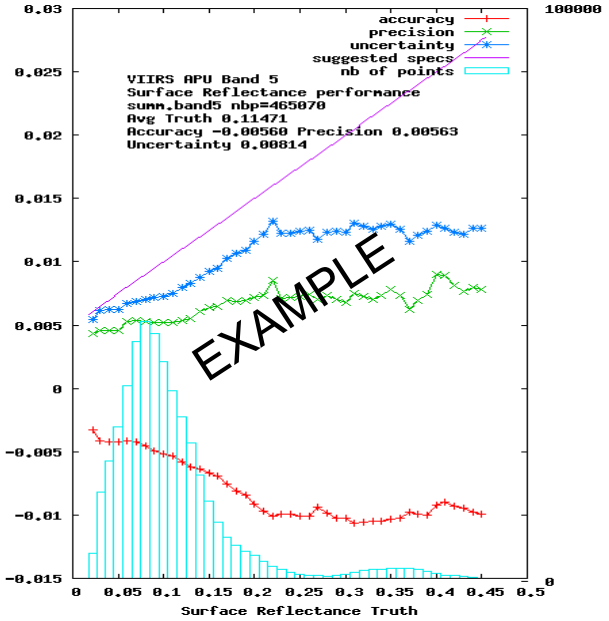
Accuracy assessment: AERONET validation

- AERONET data
  - Very accurate atmospheric correction around the AERONET site (9km x 9km)

AERONET Sites (left) and the associated Land cover distribution (right) used for SR validation.



Estimates of BRDF corrected surface reflectance for VIIRS band M5



Atmospherically corrected TOA reflectances derived from Level 1 subsets → Reference data set

comparison ⟷

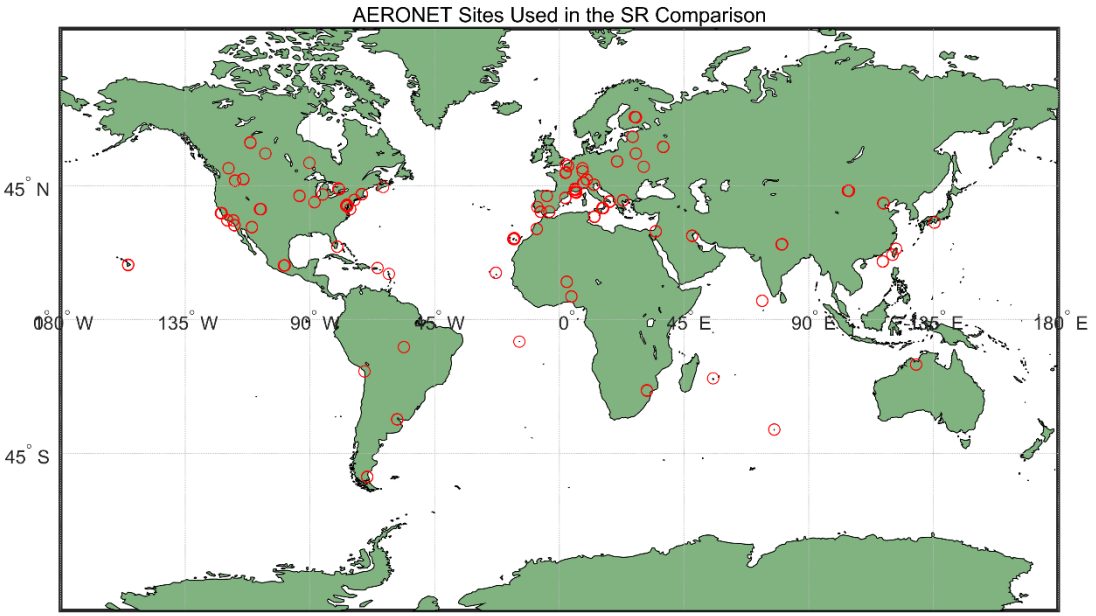
Subsets of Level 1 data processed using the standard surface reflectance algorithm

Vector 6S → Atmospherically corrected TOA reflectances derived from Level 1 subsets

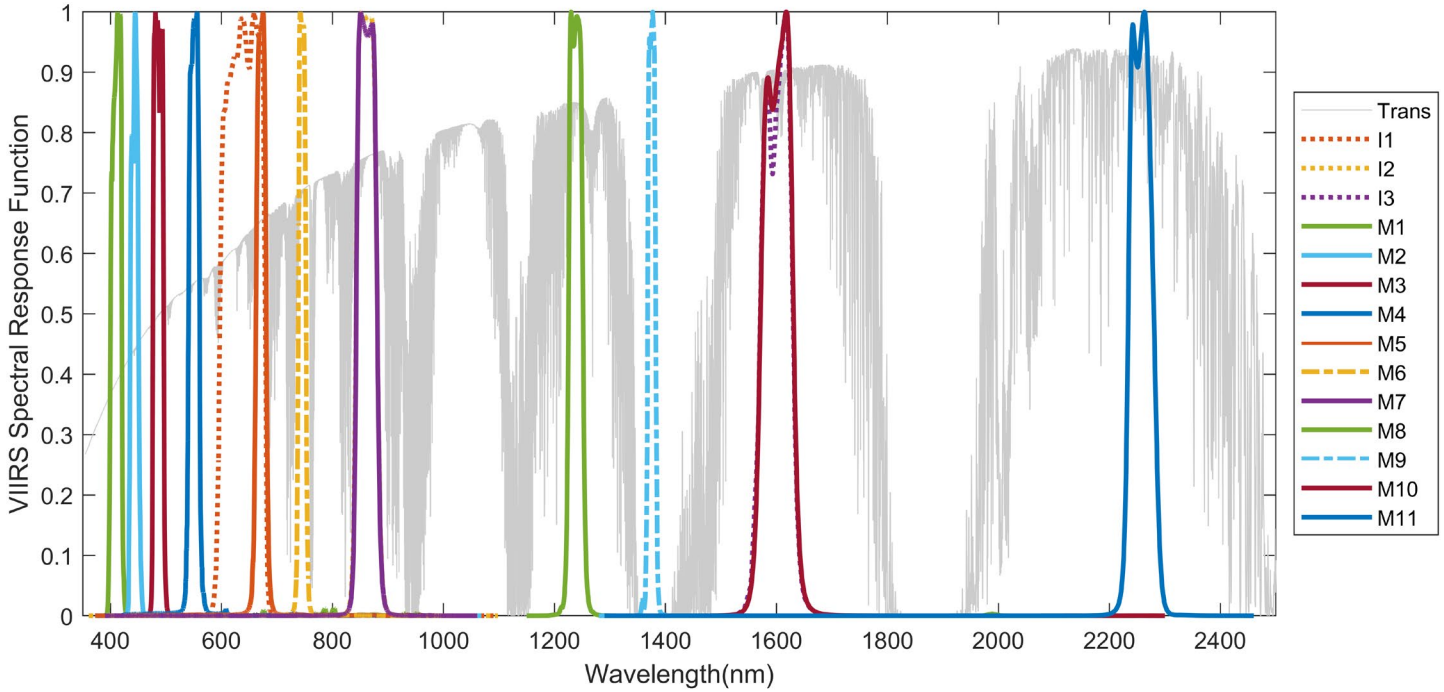
AERONET measurements (τ_{aer}, H_2O, particle distribution Refractive indices, sphericity) → Atmospherically corrected TOA reflectances derived from Level 1 subsets

AERONET Subset Data Matchups

- 16 days (20200205 – 20200221)
- 80 sites as the location map shows, 588 matchups in total
- S-NPP VIIRS 12 channel SR (I1-3, M1-11, except M6 and M9)
- Subset size: 75km (around 100*100 M band pixels)

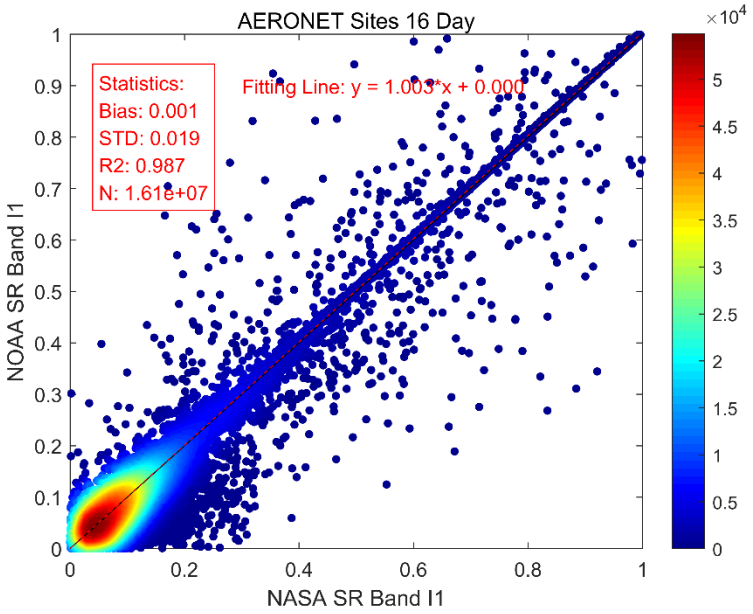


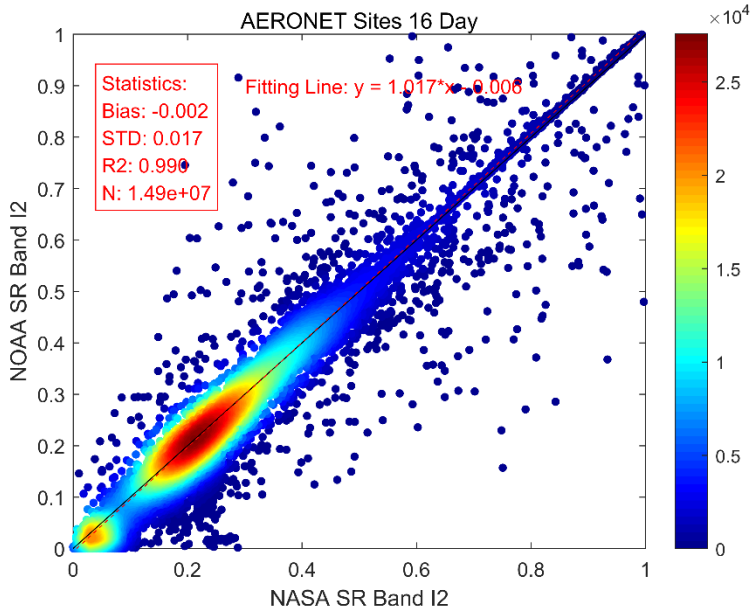
Evaluation Sites Distribution

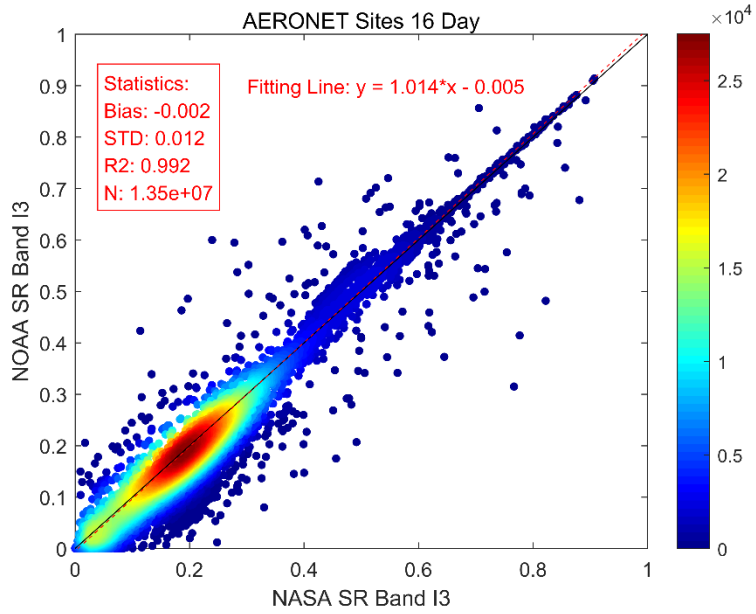


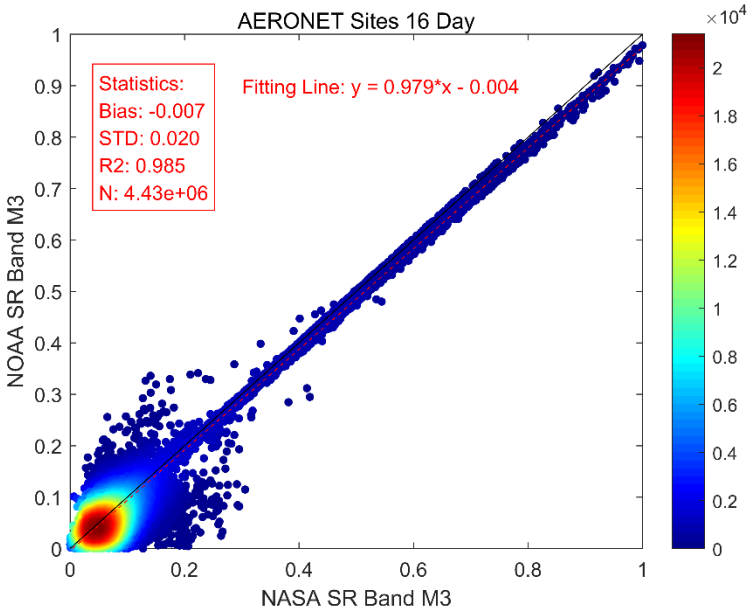
VIIRS Reflective Bands Spectral response function

SR NOAA-NASA Intercomparison (All Valid Range SR)



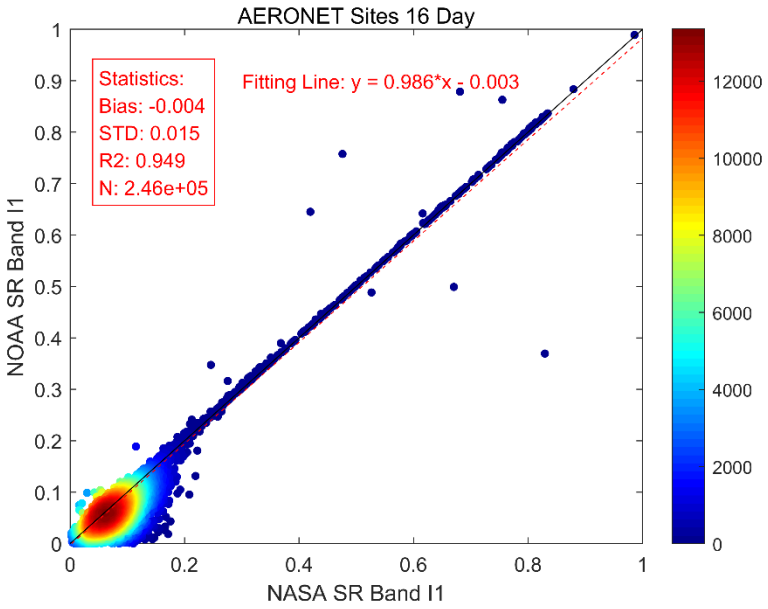


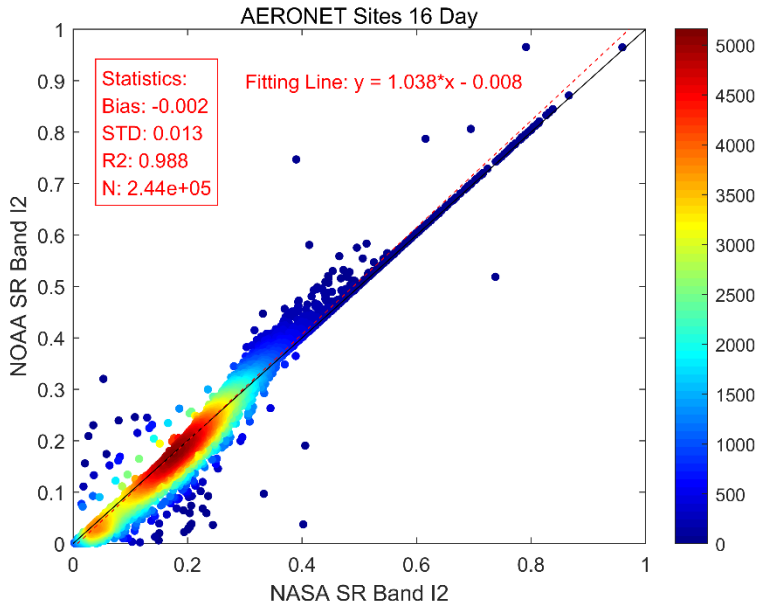


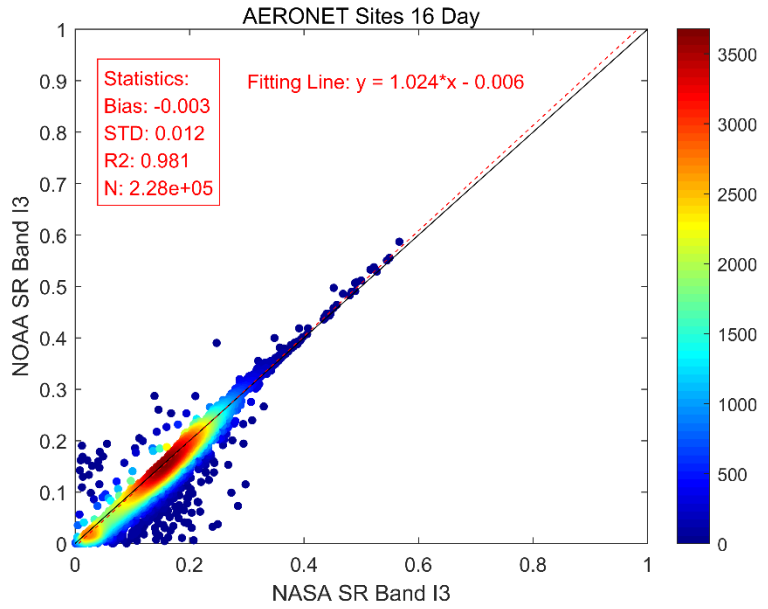


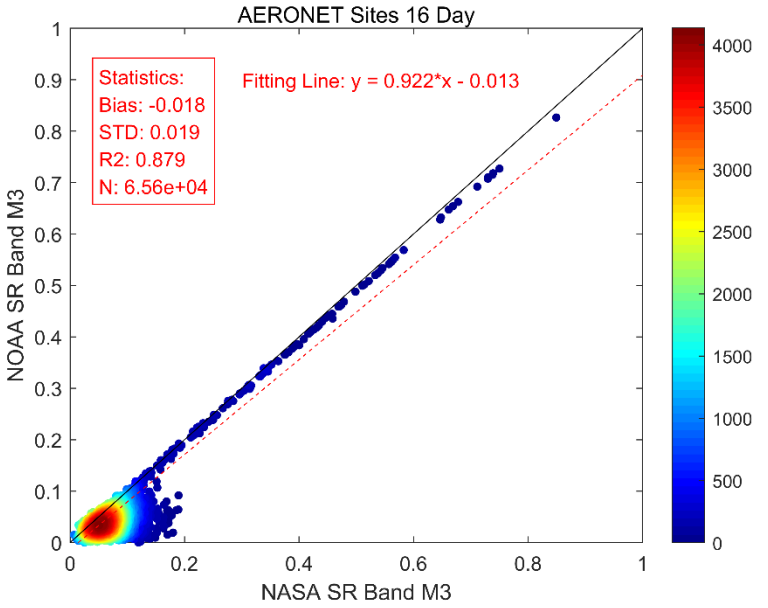
- 16 days (20200205 – 20200221)
- 80 sites, 588 matchups in total
- Filters
  - SR within [0, 1]

SR NOAA-NASA Intercomparison (Clear-Sky Pixels)



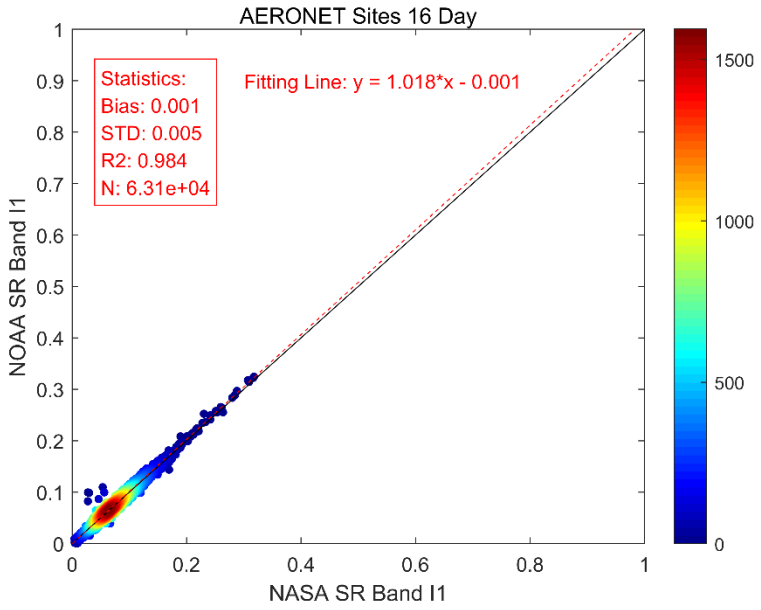


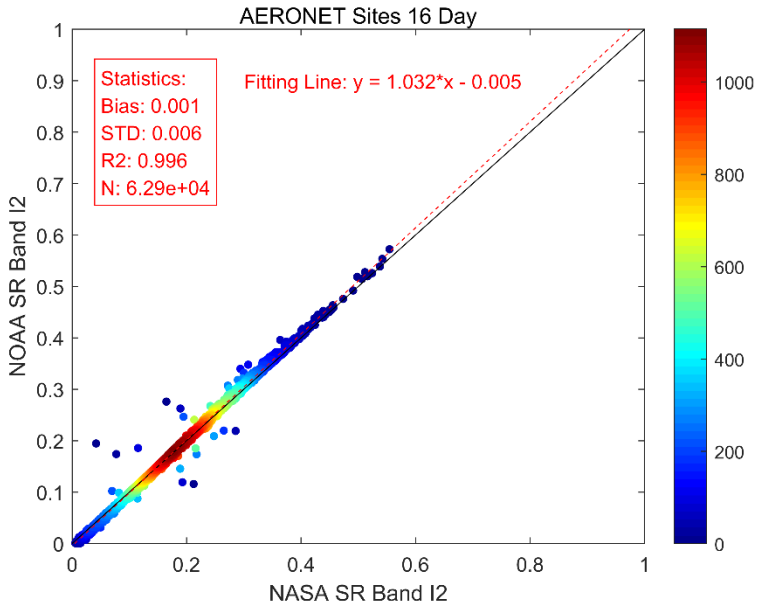


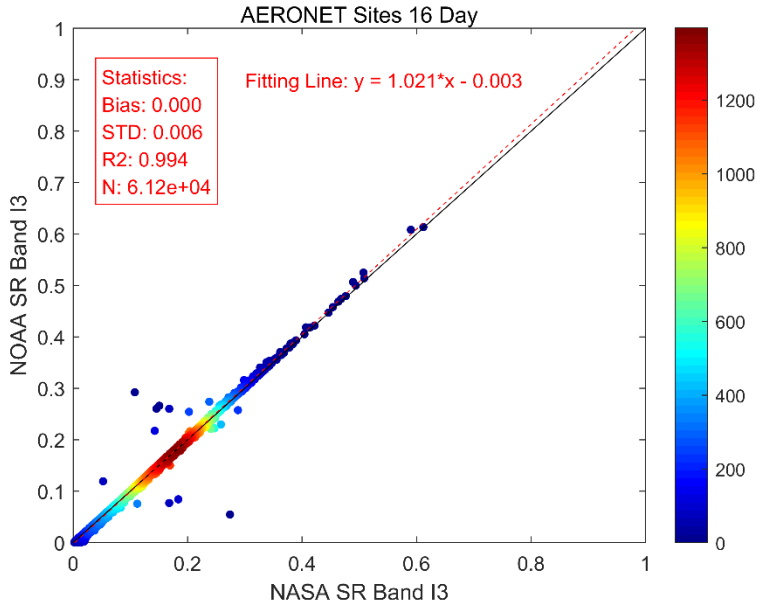


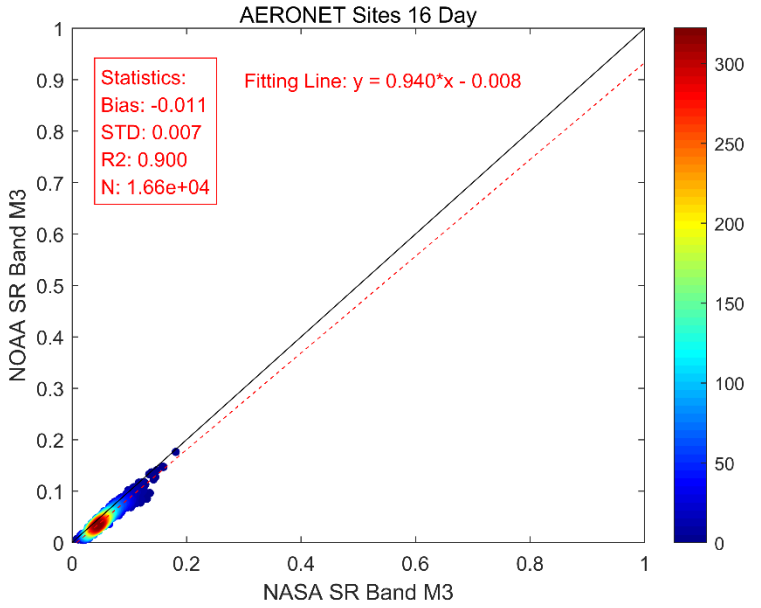
- 16 days (20200205 – 20200221)
- 80 sites, 588 matchups in total
- Filters
  - SR within [0, 1]
  - Land pixel only
  - Confidently clear only

SR Intercomparison using higher quality data



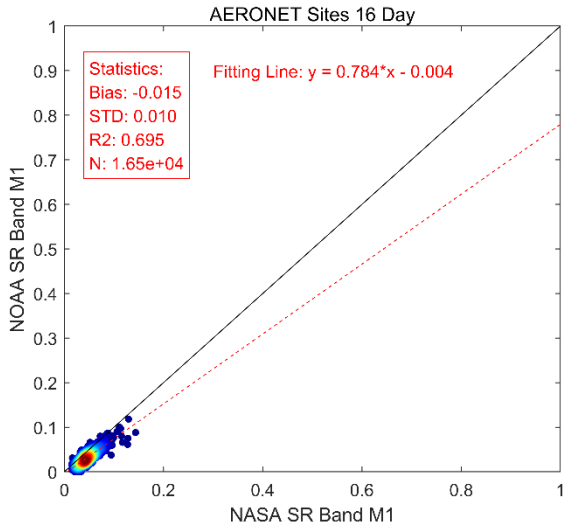


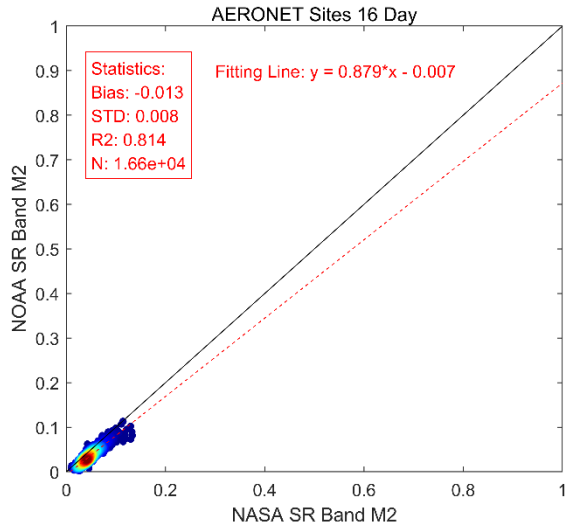


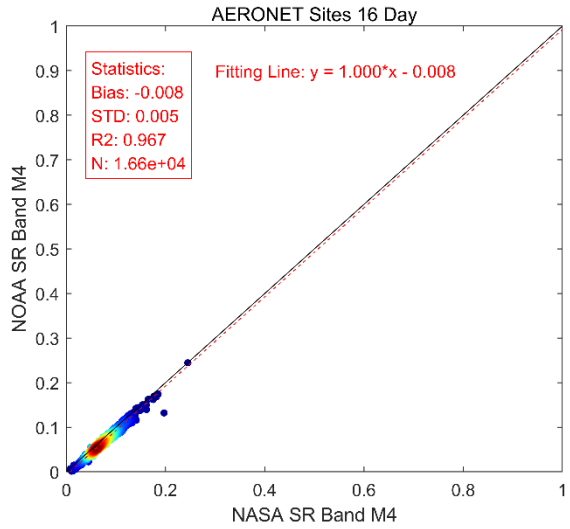


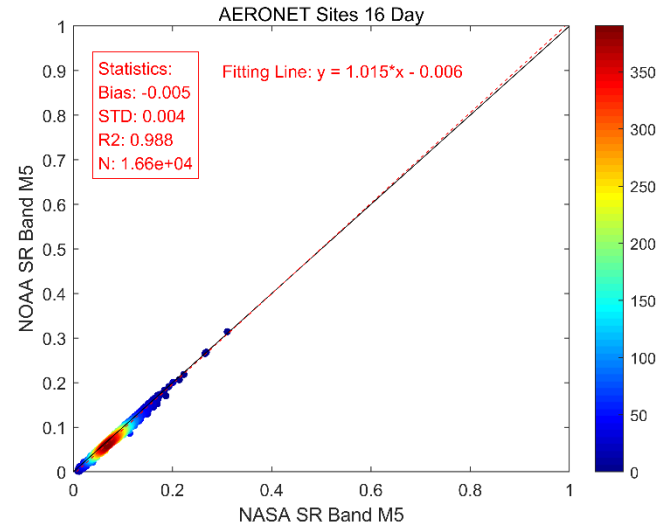
- 16 days (20200205 – 20200221)
- 80 sites, 588 matchups in total
- Filters
  - SR within [0, 1]
  - Confidently Clear, Cloud Mask Quality medium or high, no cloud shadow
  - No reflective or emissive cirrus
  - No Snow, Land pixel only
  - Not heavy aerosol, aerosol quantity is low

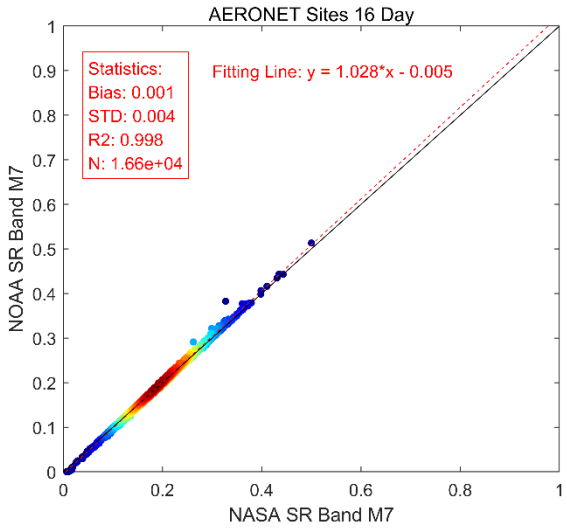
SR Intercomparison using higher quality data

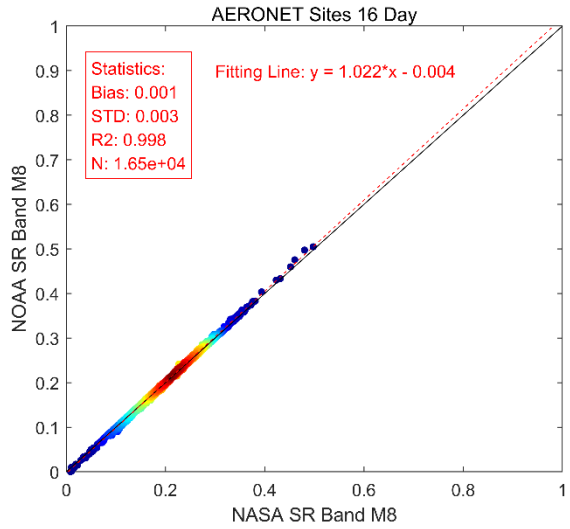


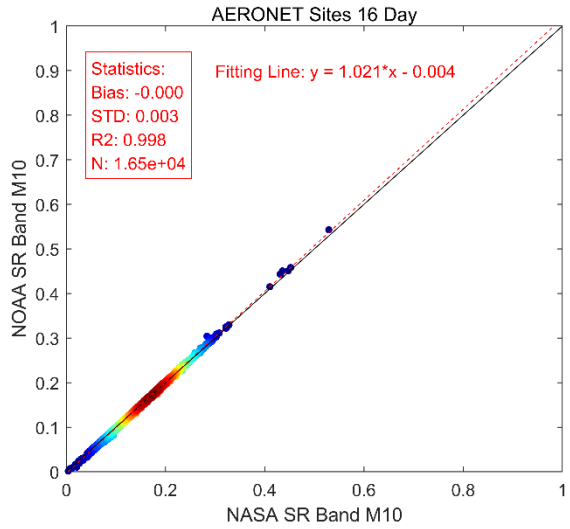


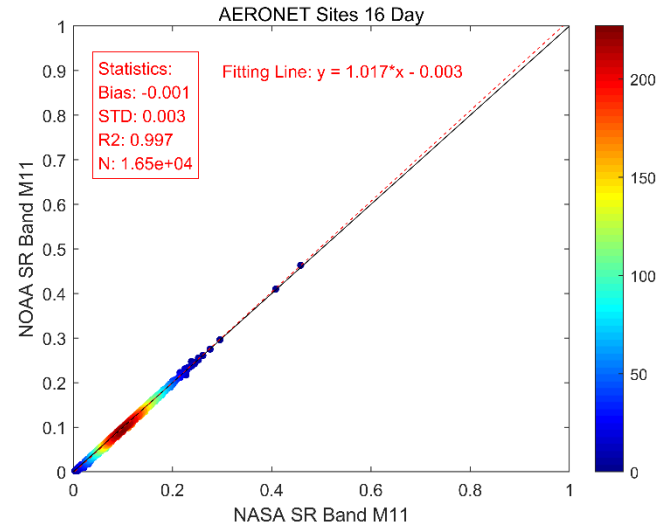




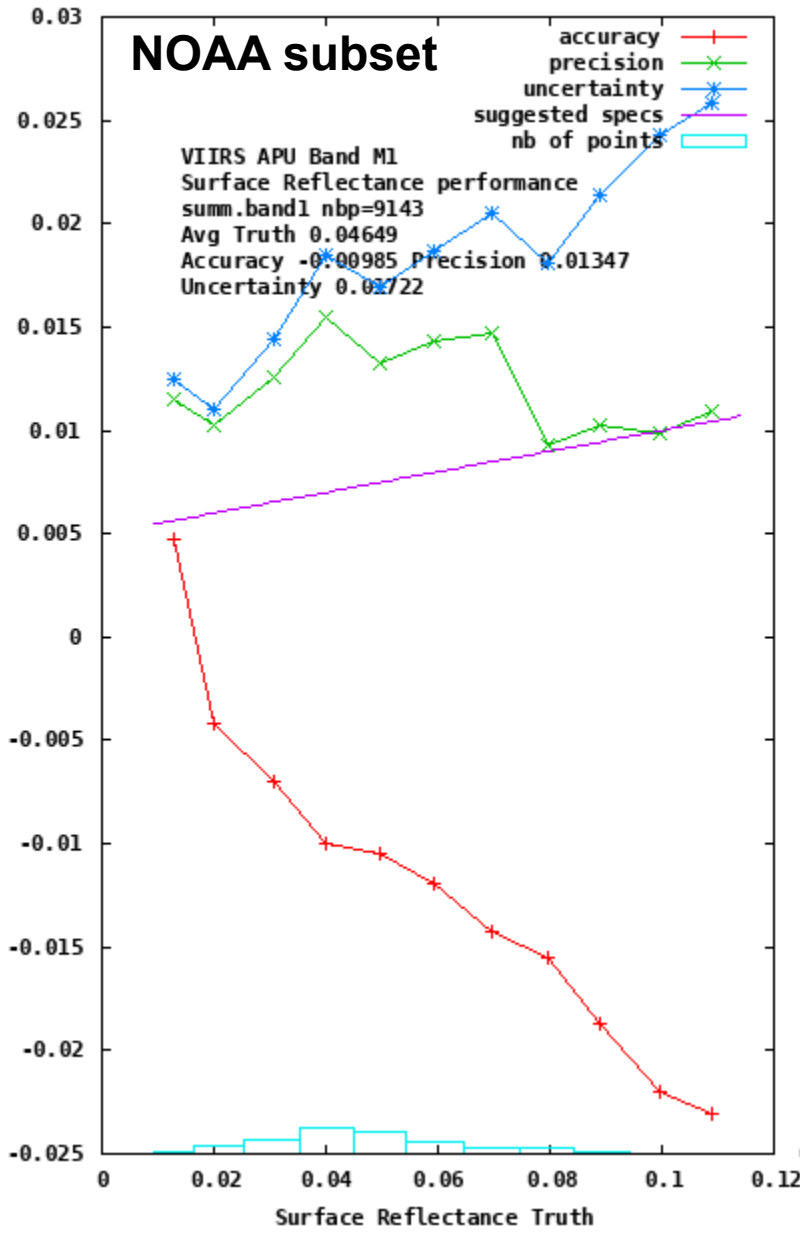


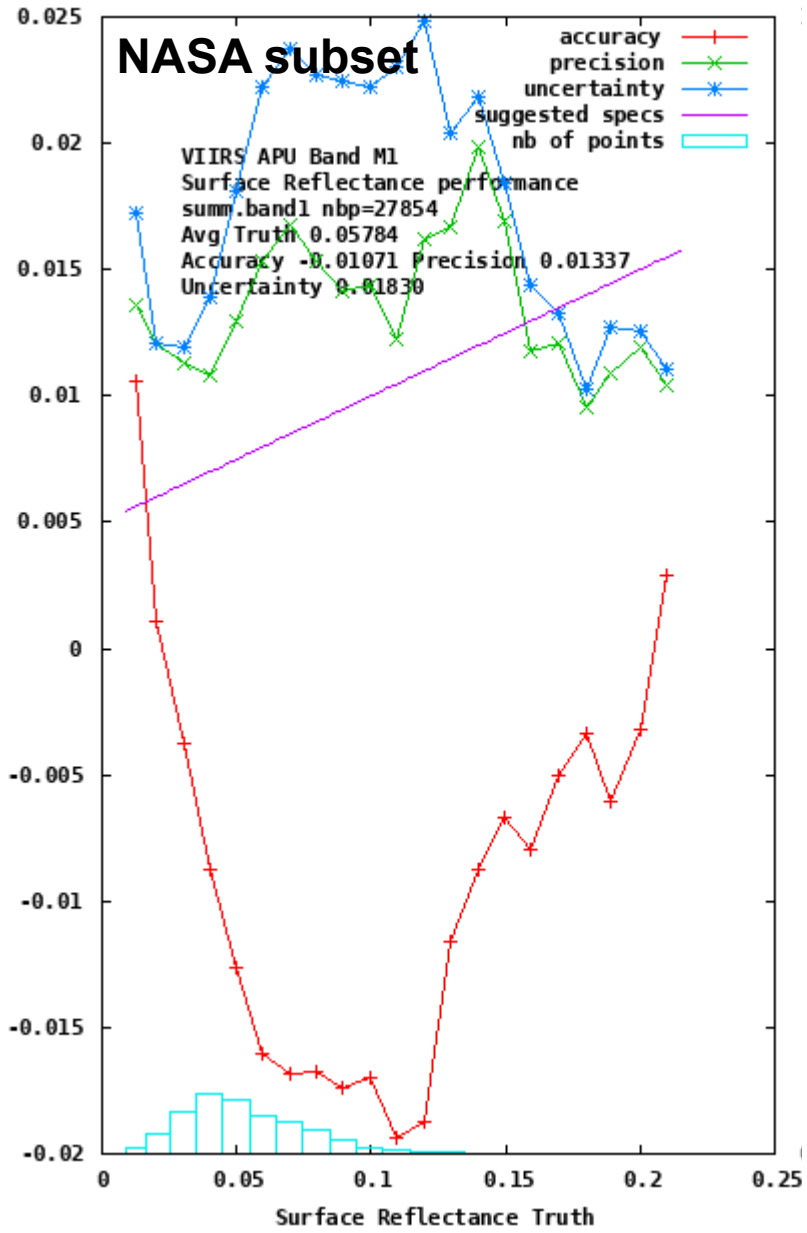


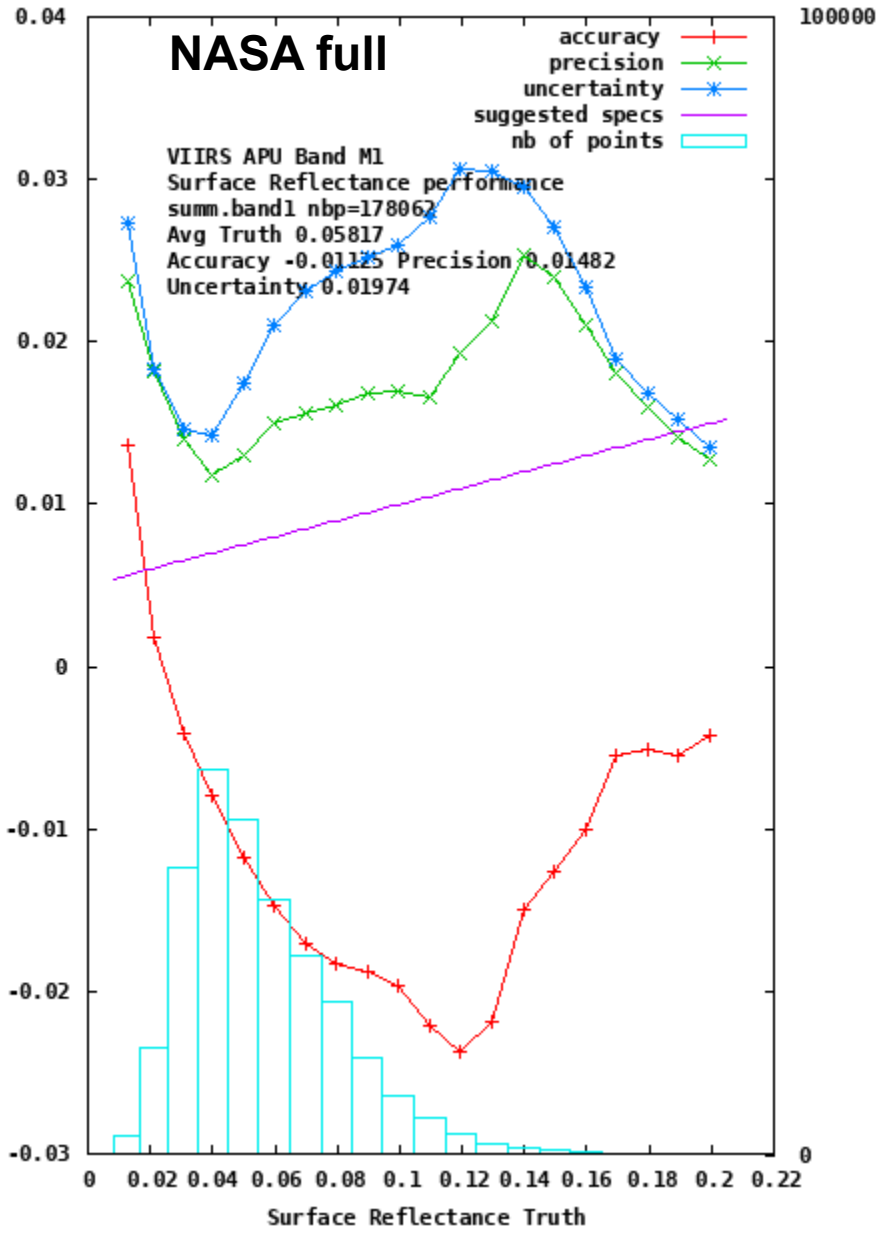




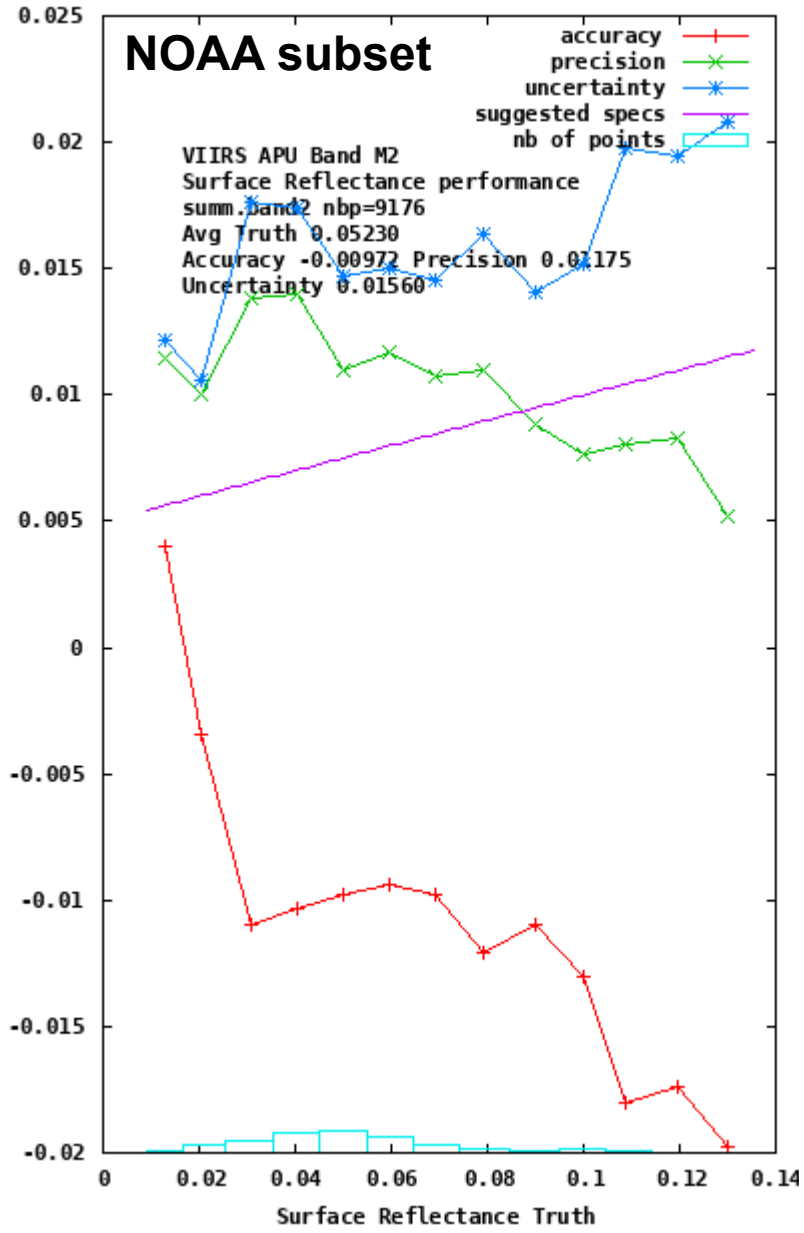
Product performance: M1

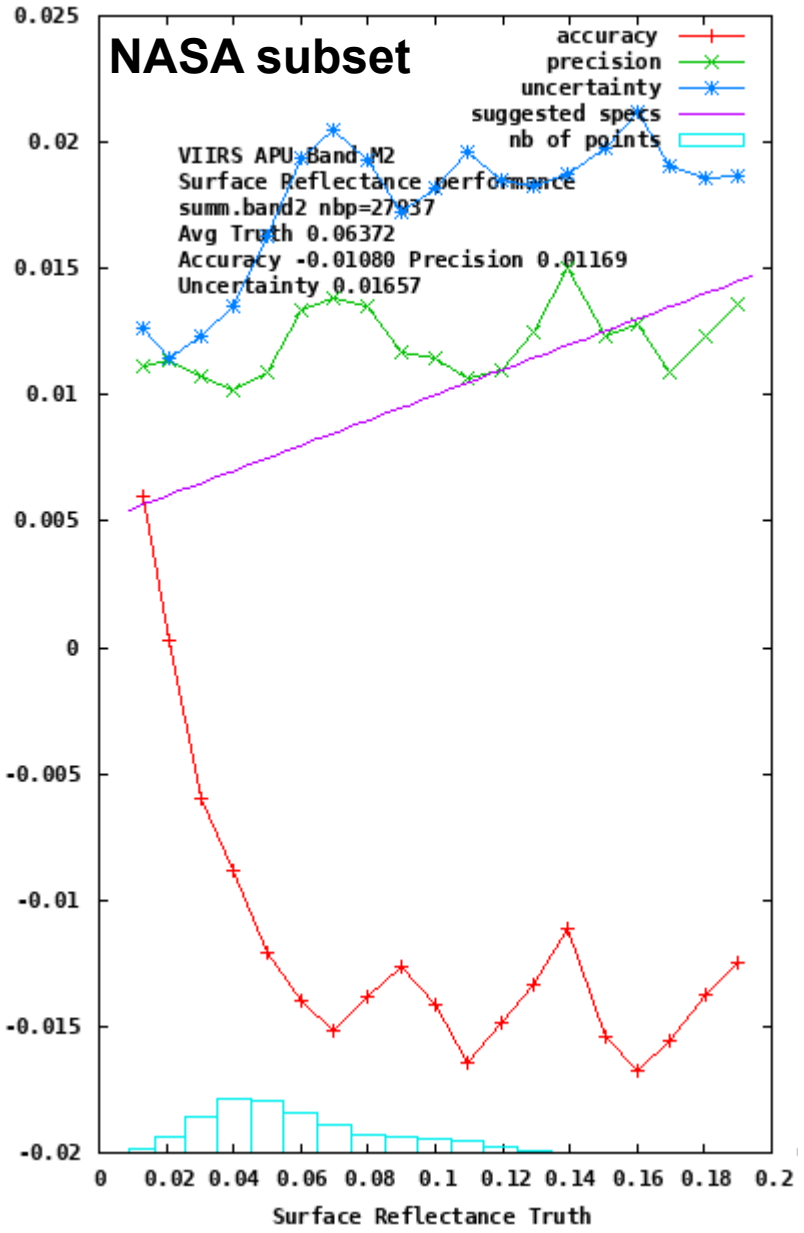


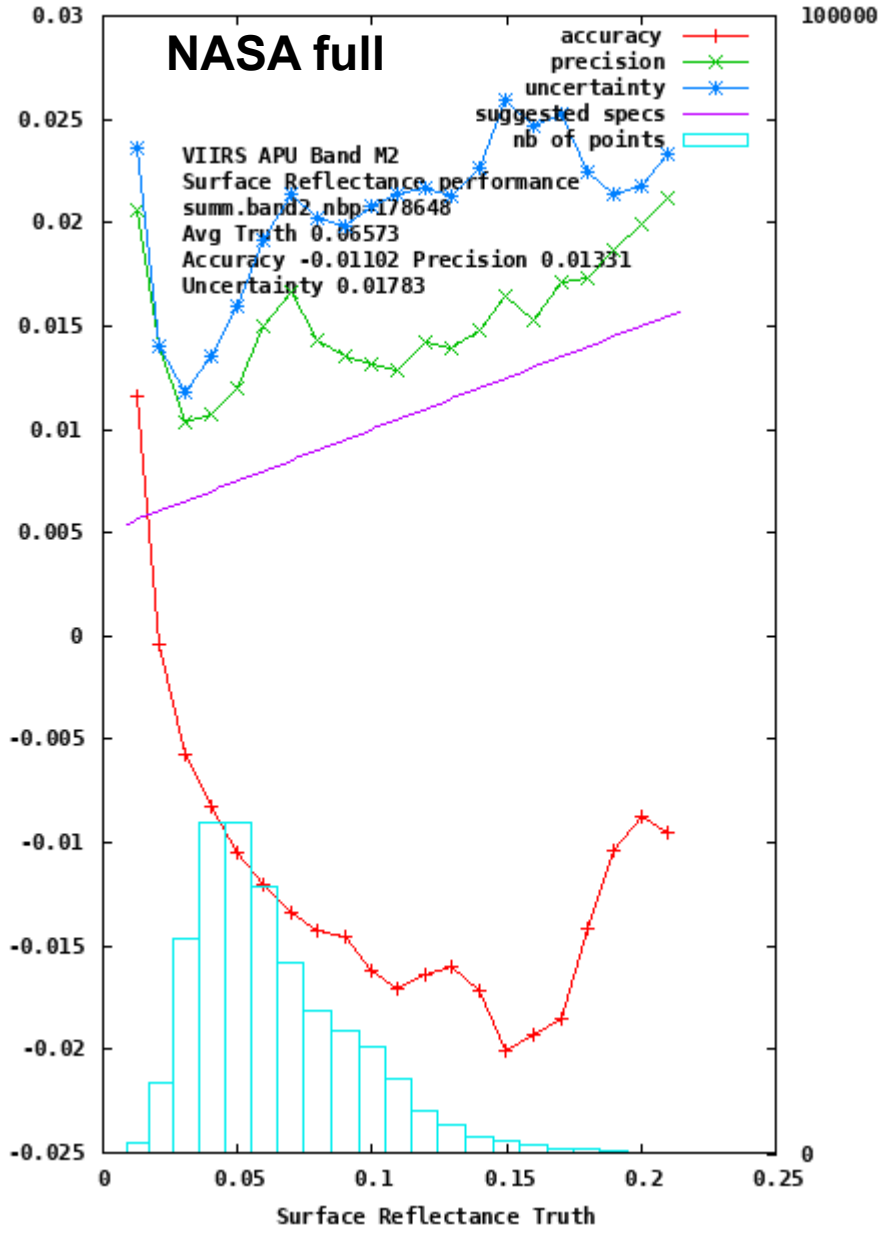




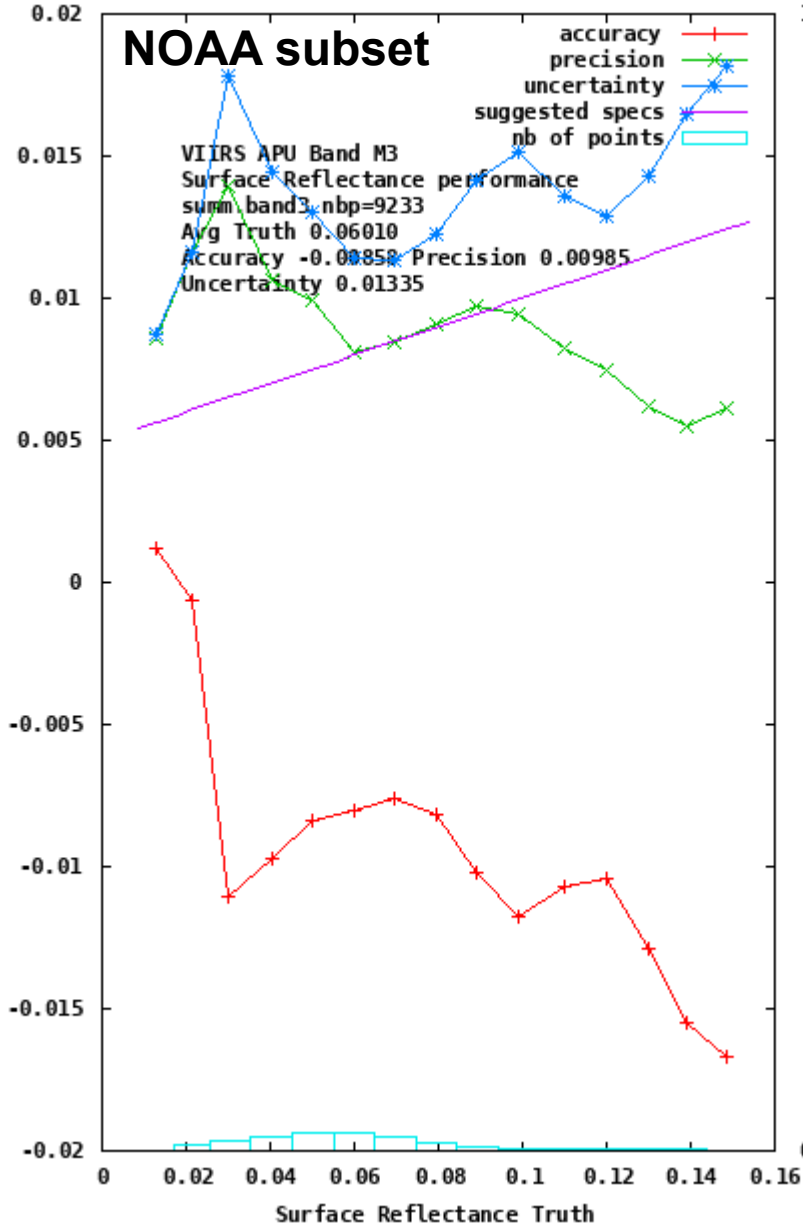
Product performance: M2

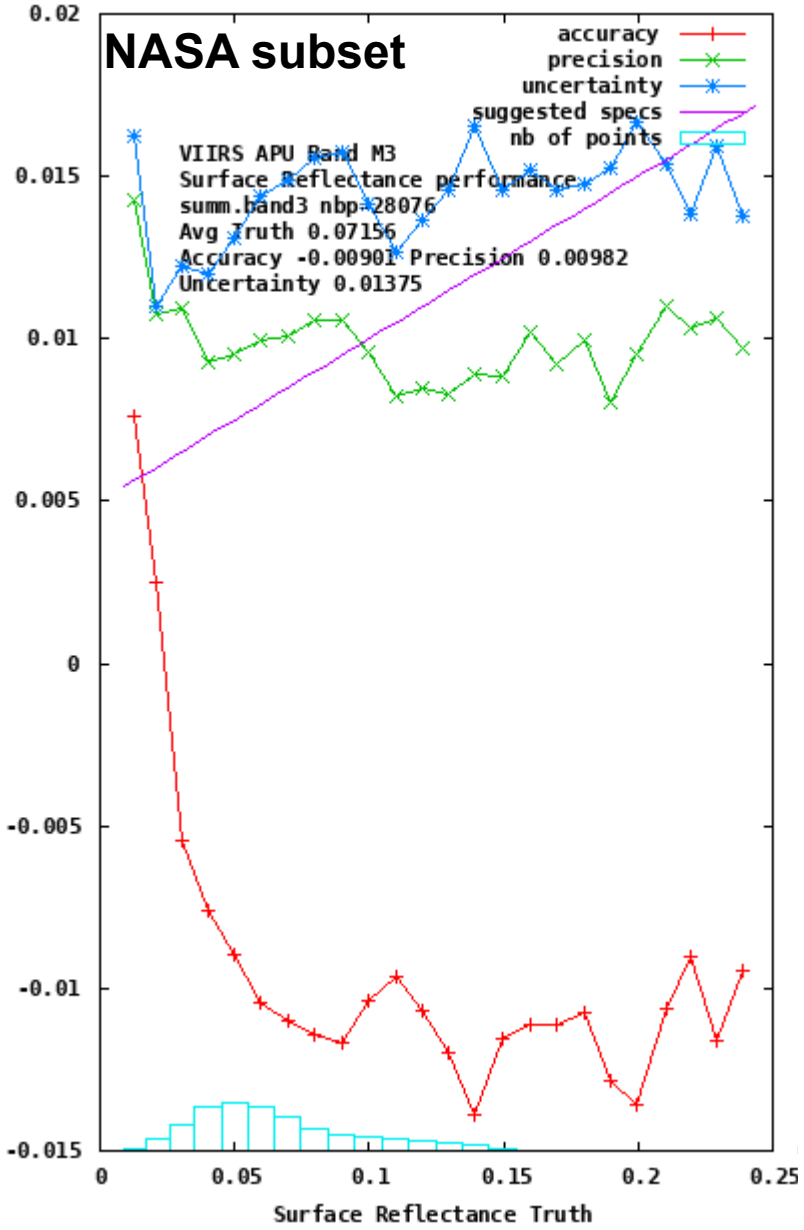


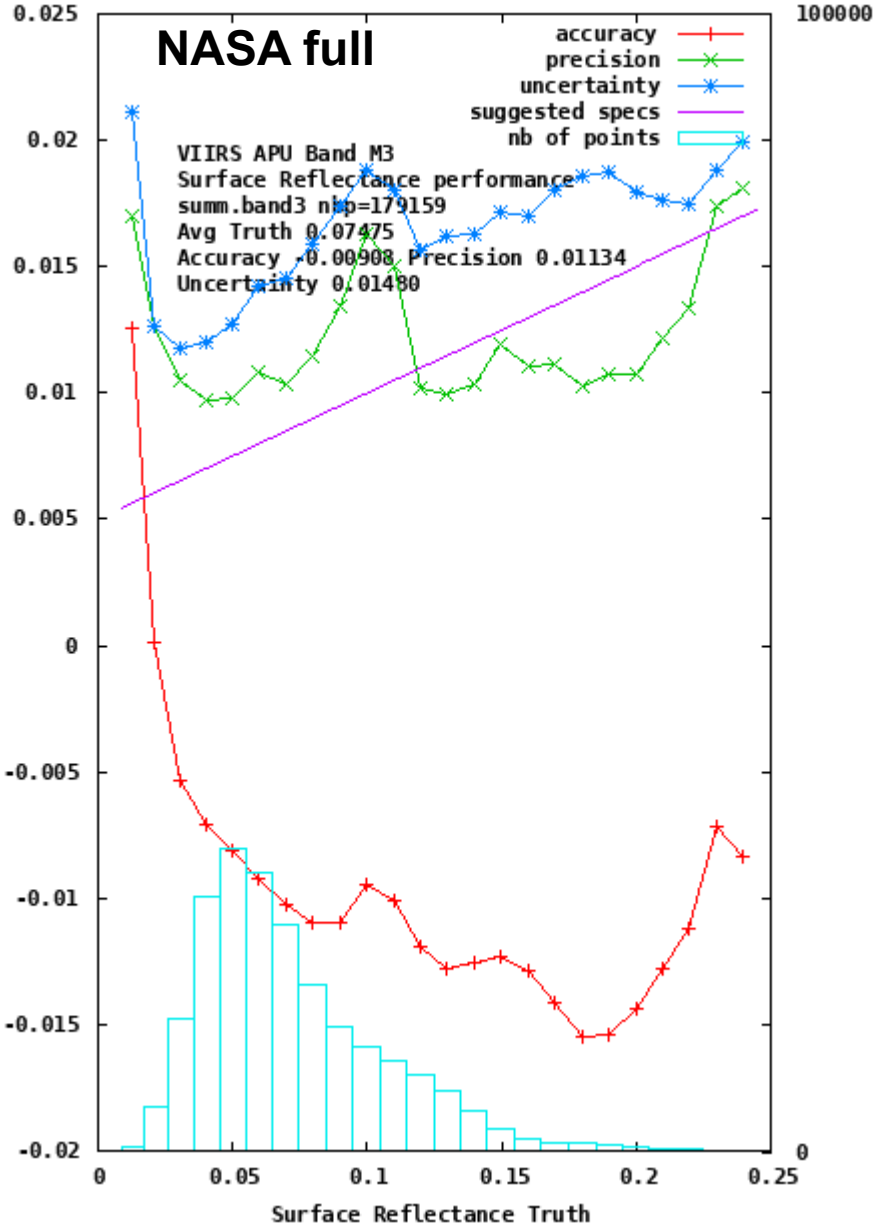




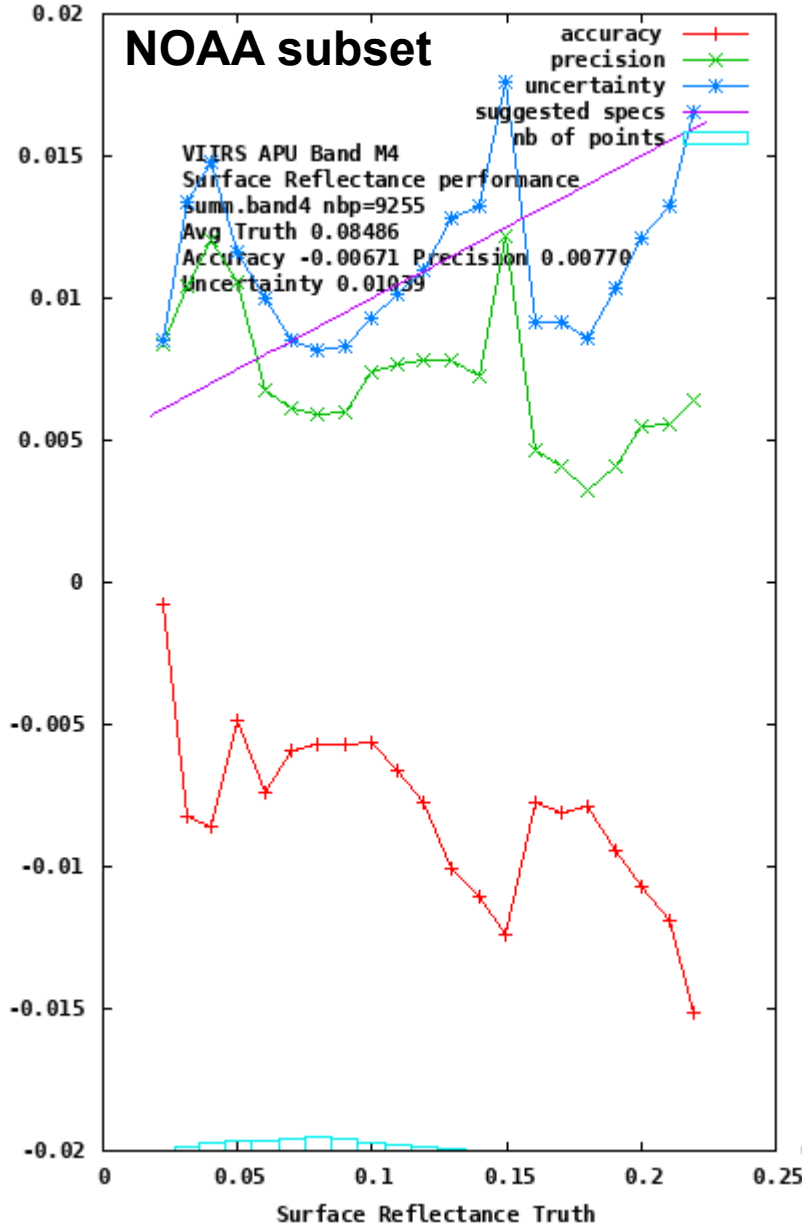
Product performance: M3

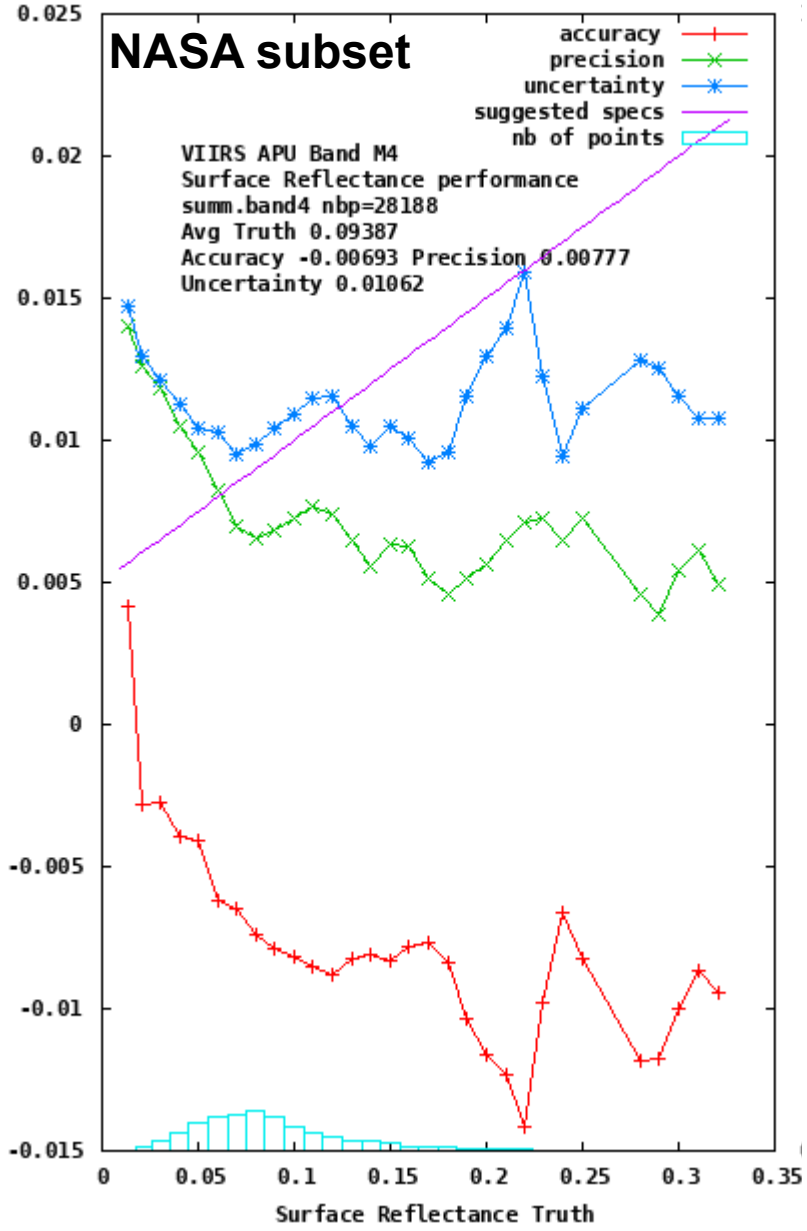


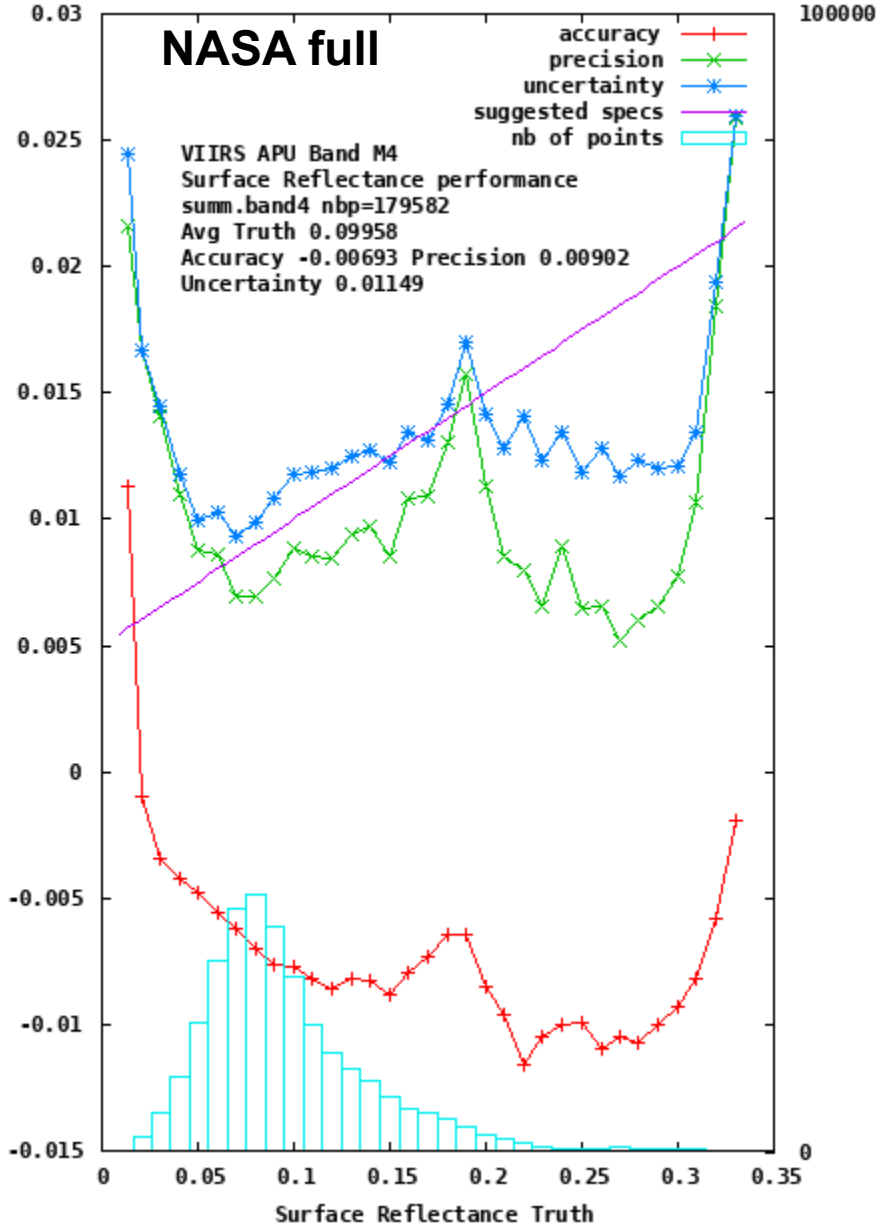




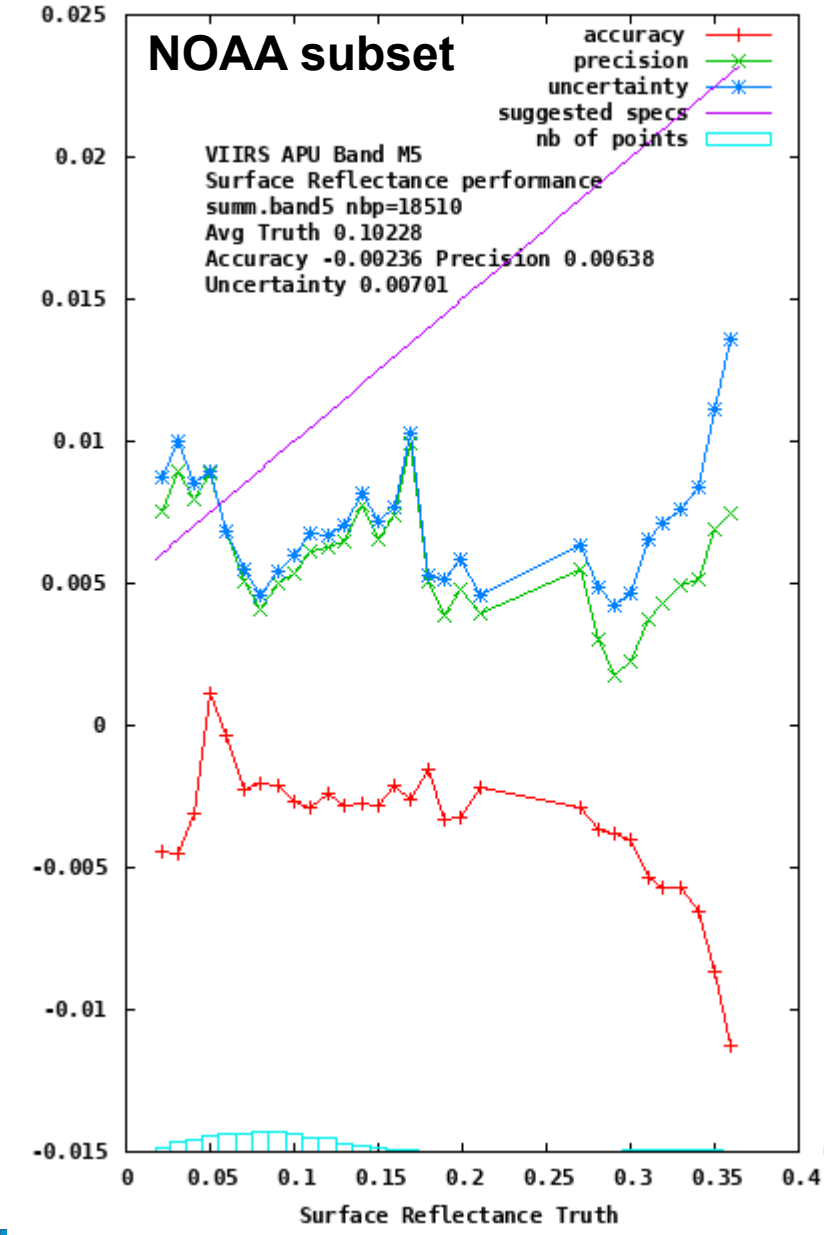
Product performance: M4

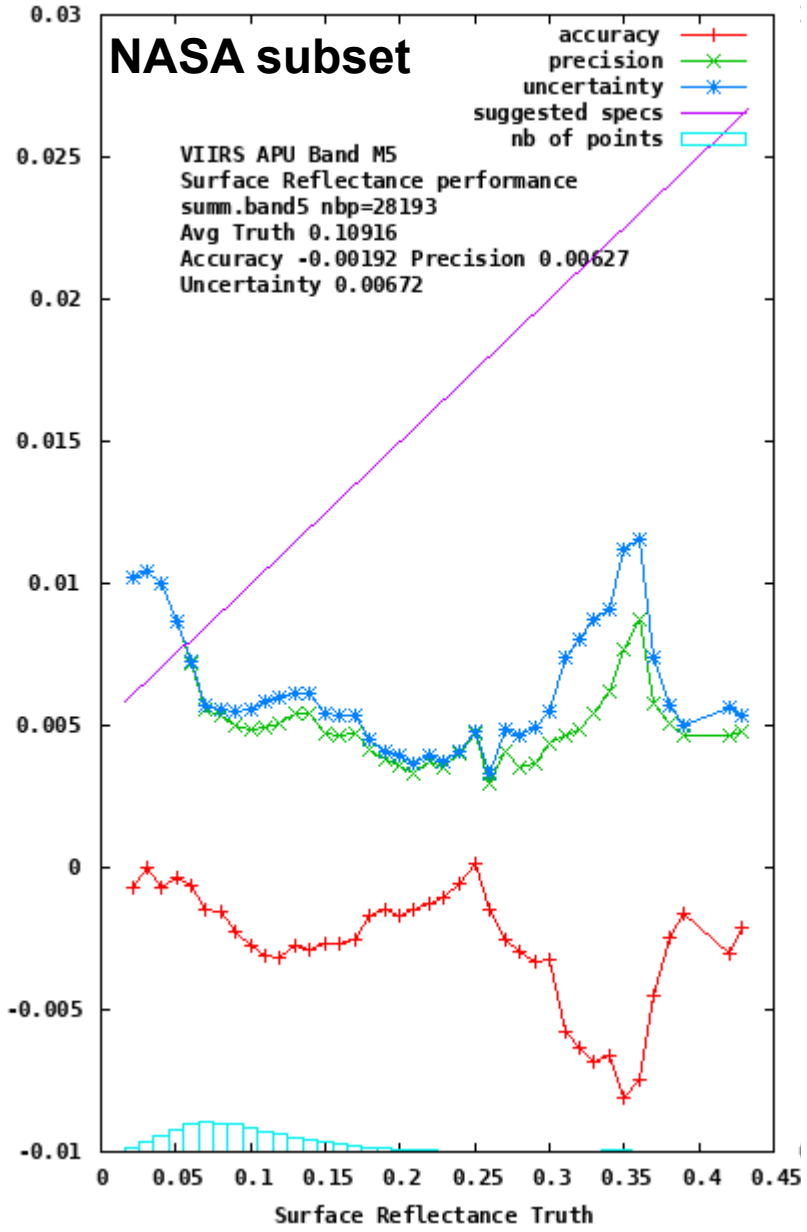


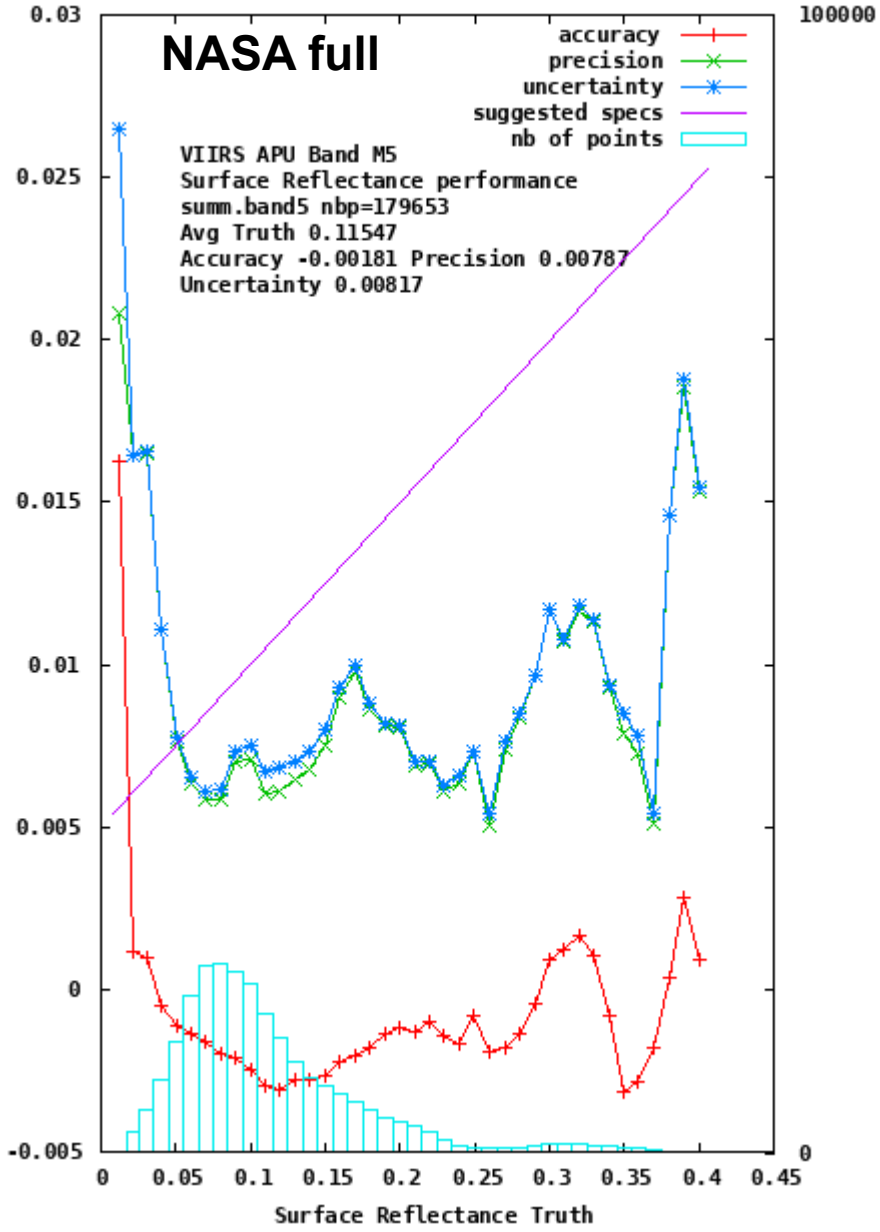




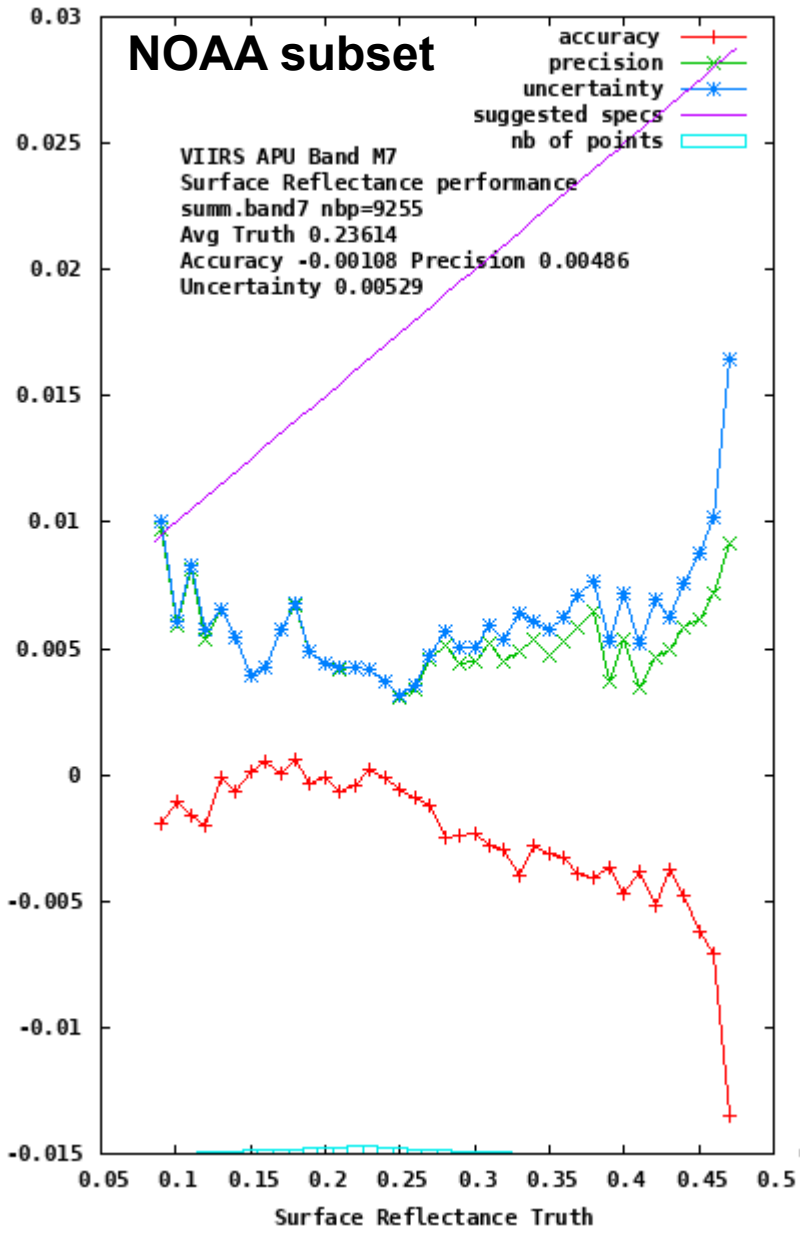
Product performance: M5

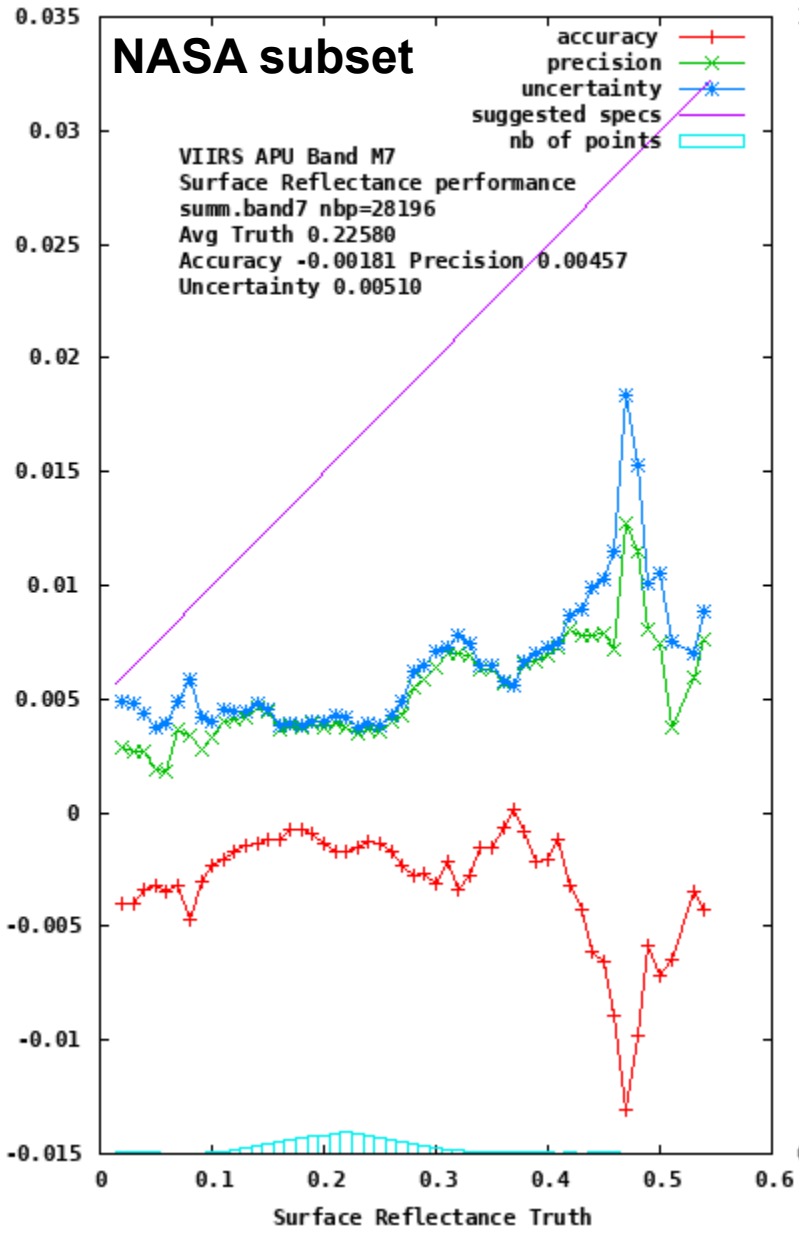


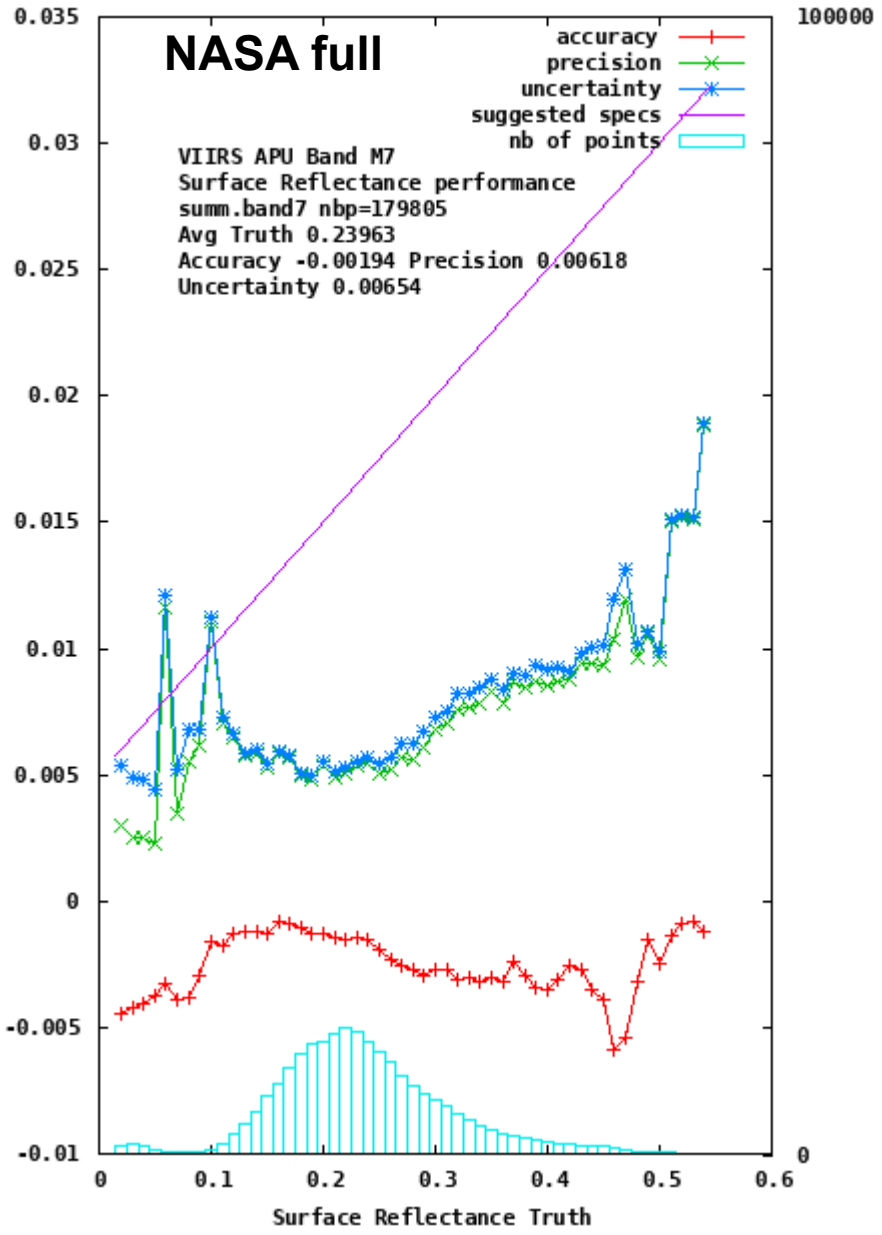




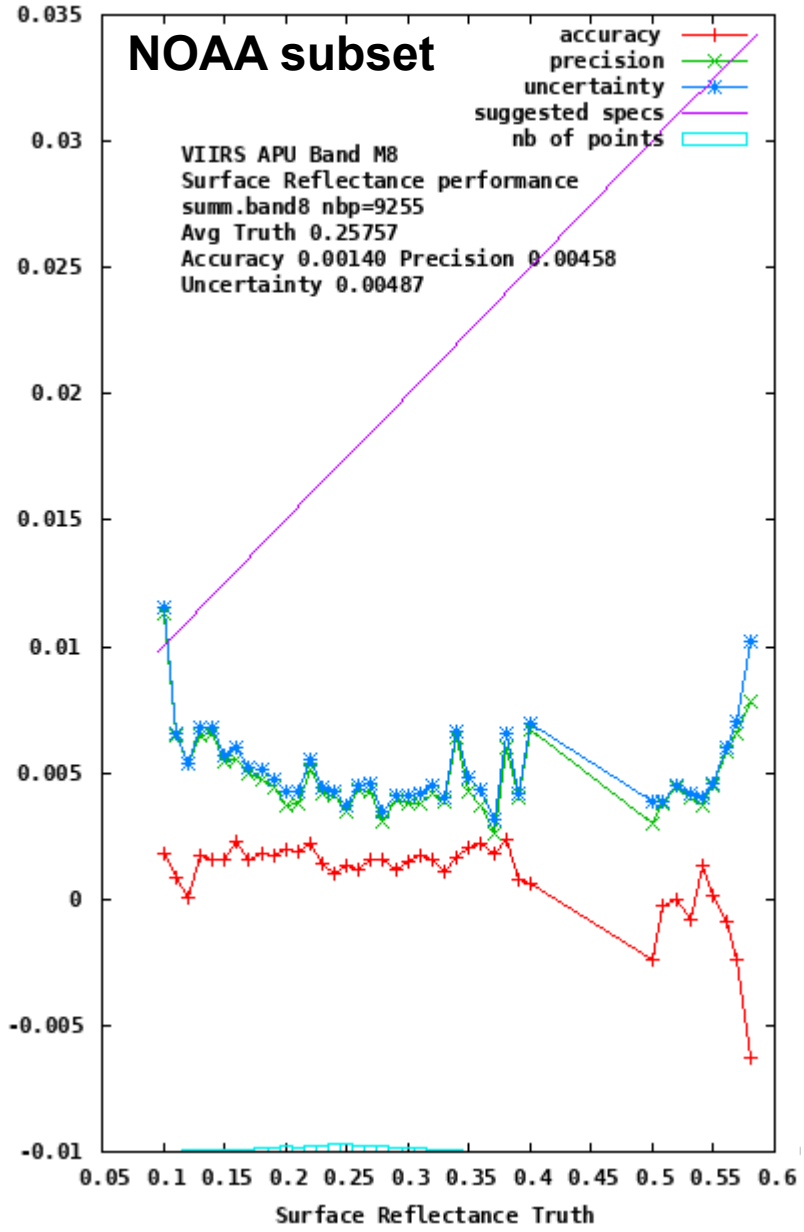
Product performance: M7

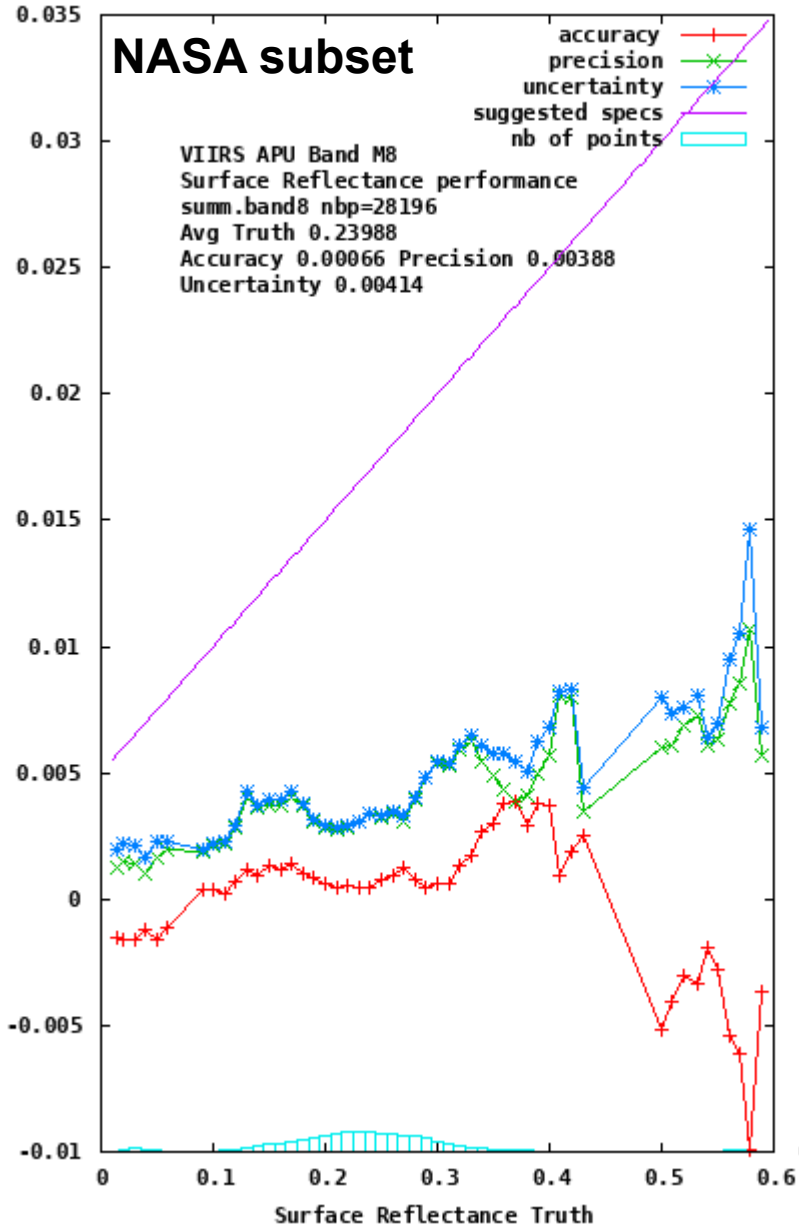


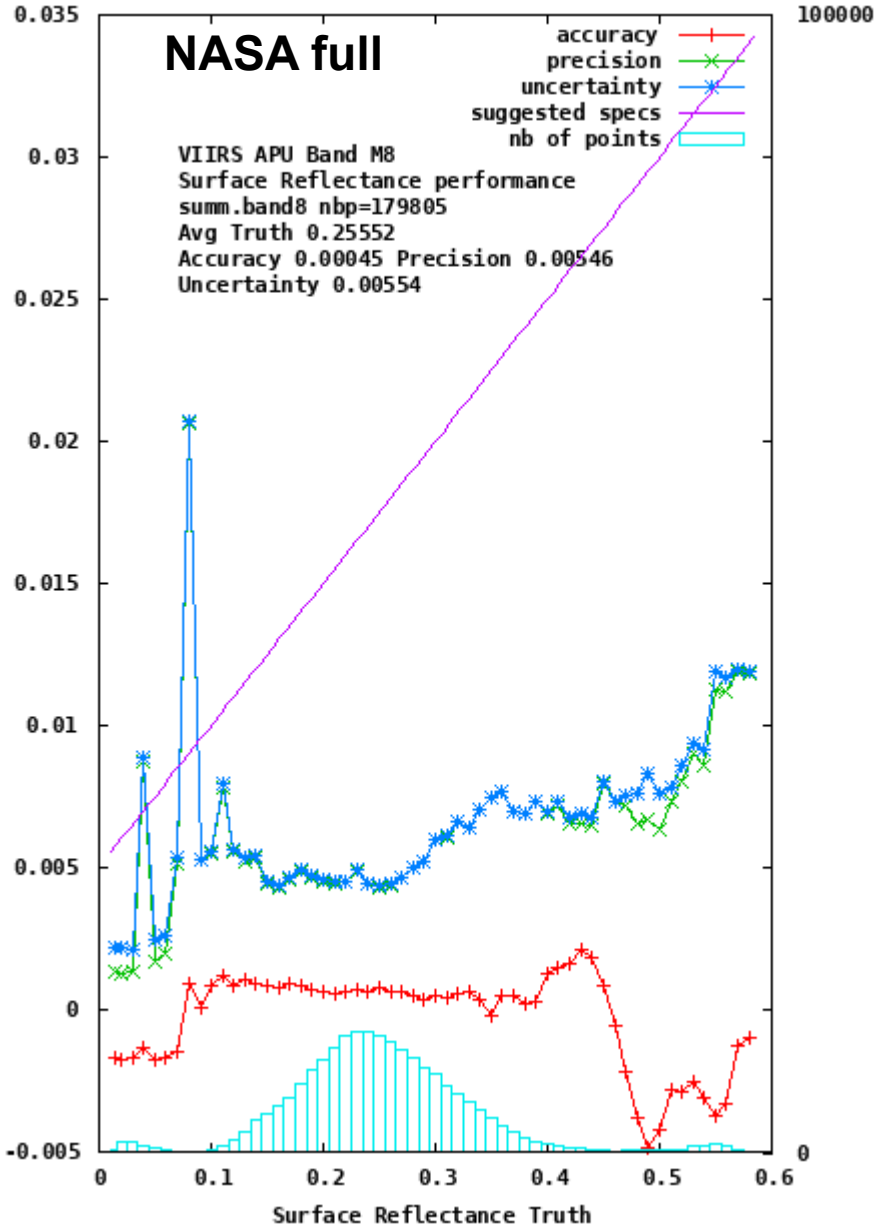




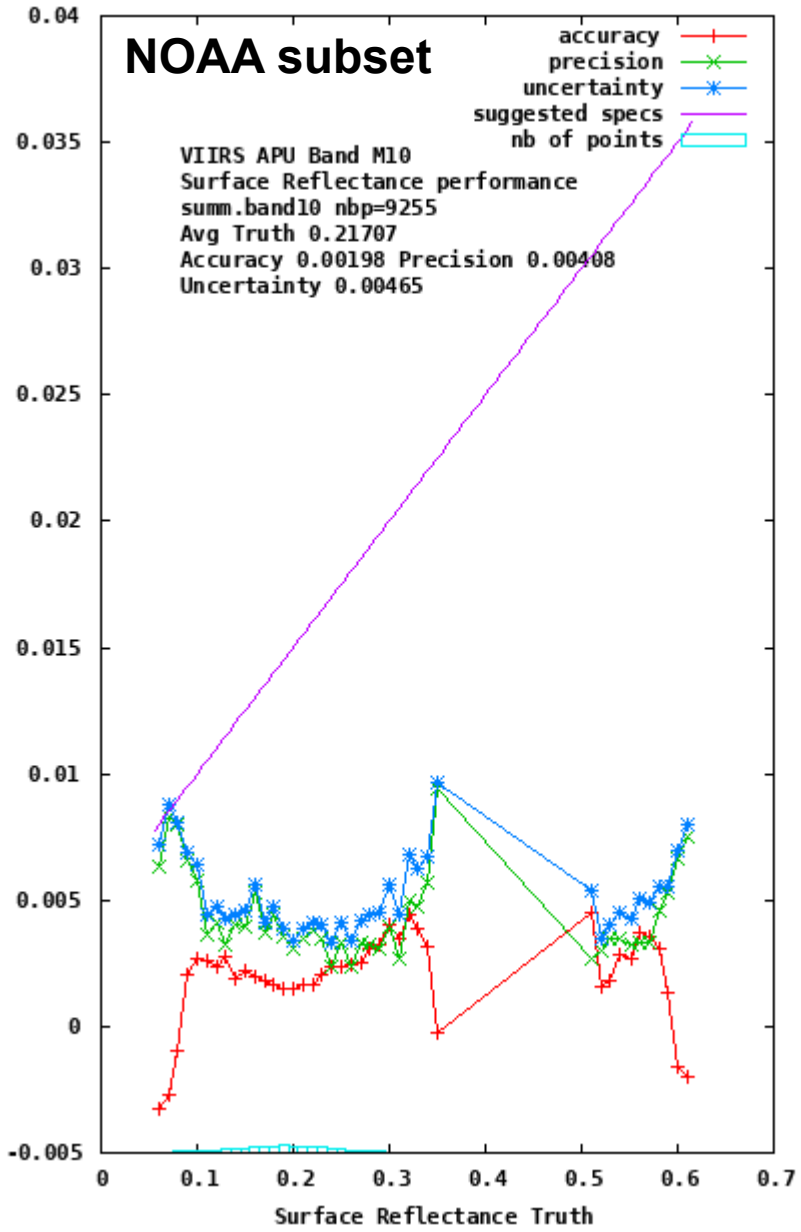
Product performance: M8

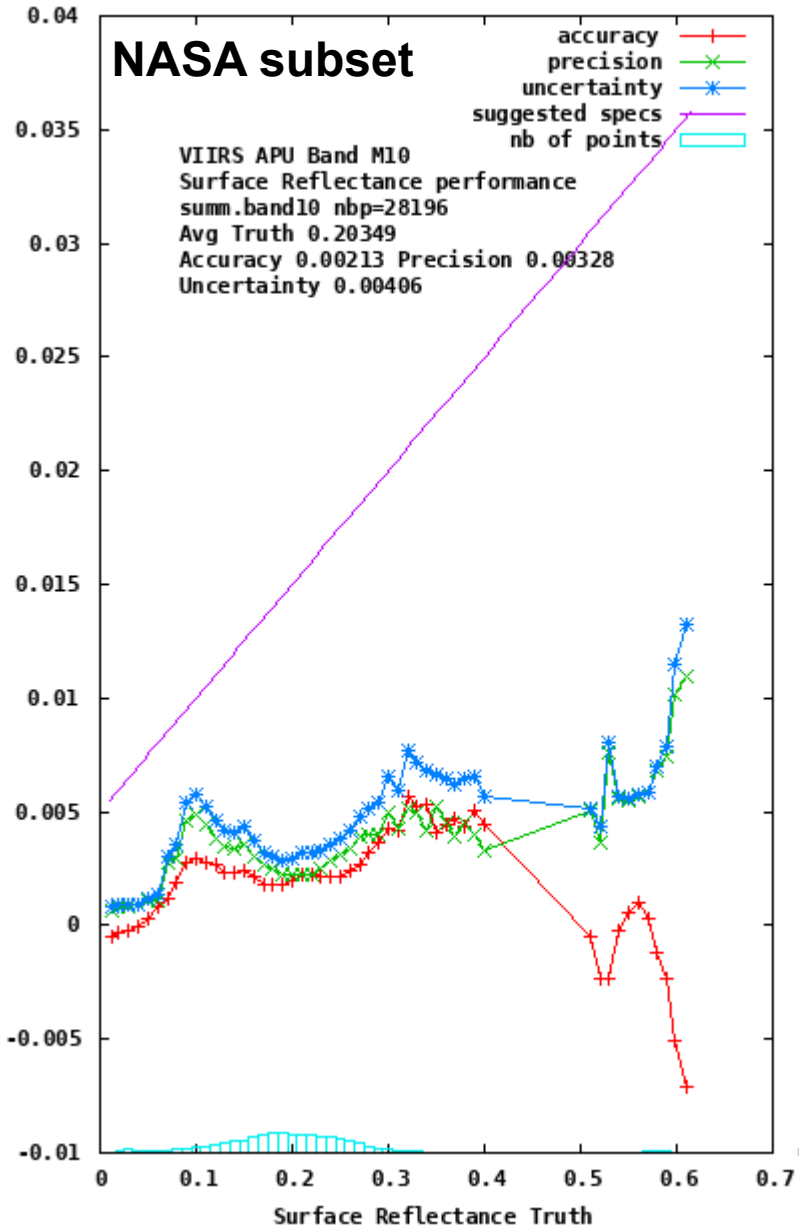


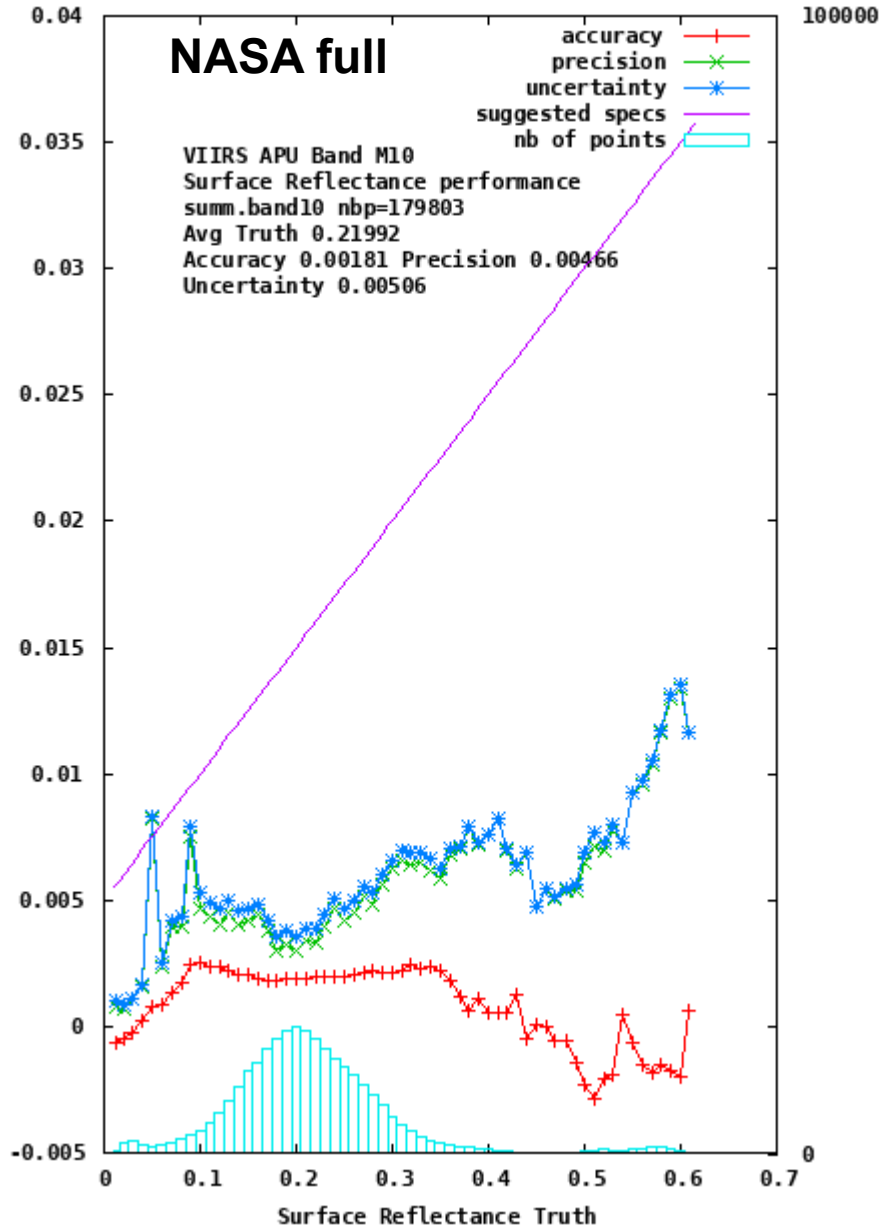




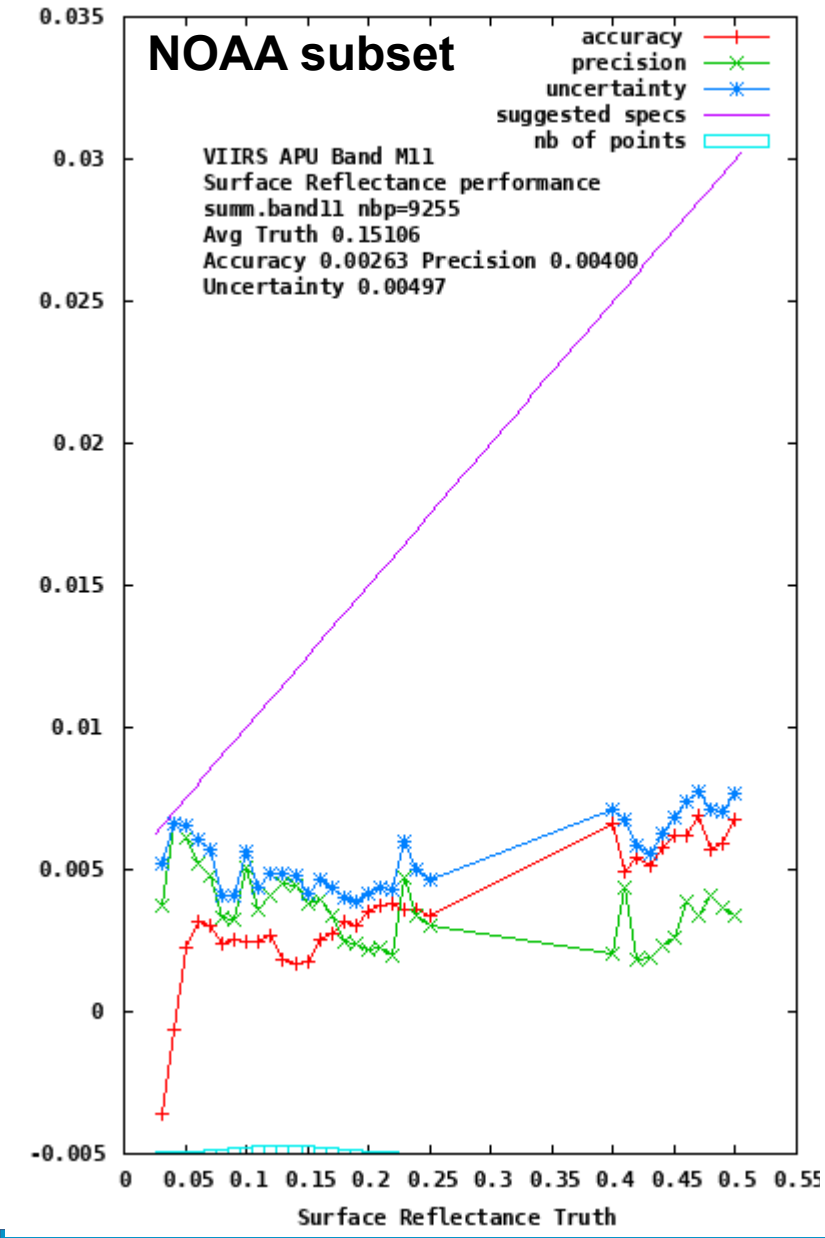
Product performance: M10

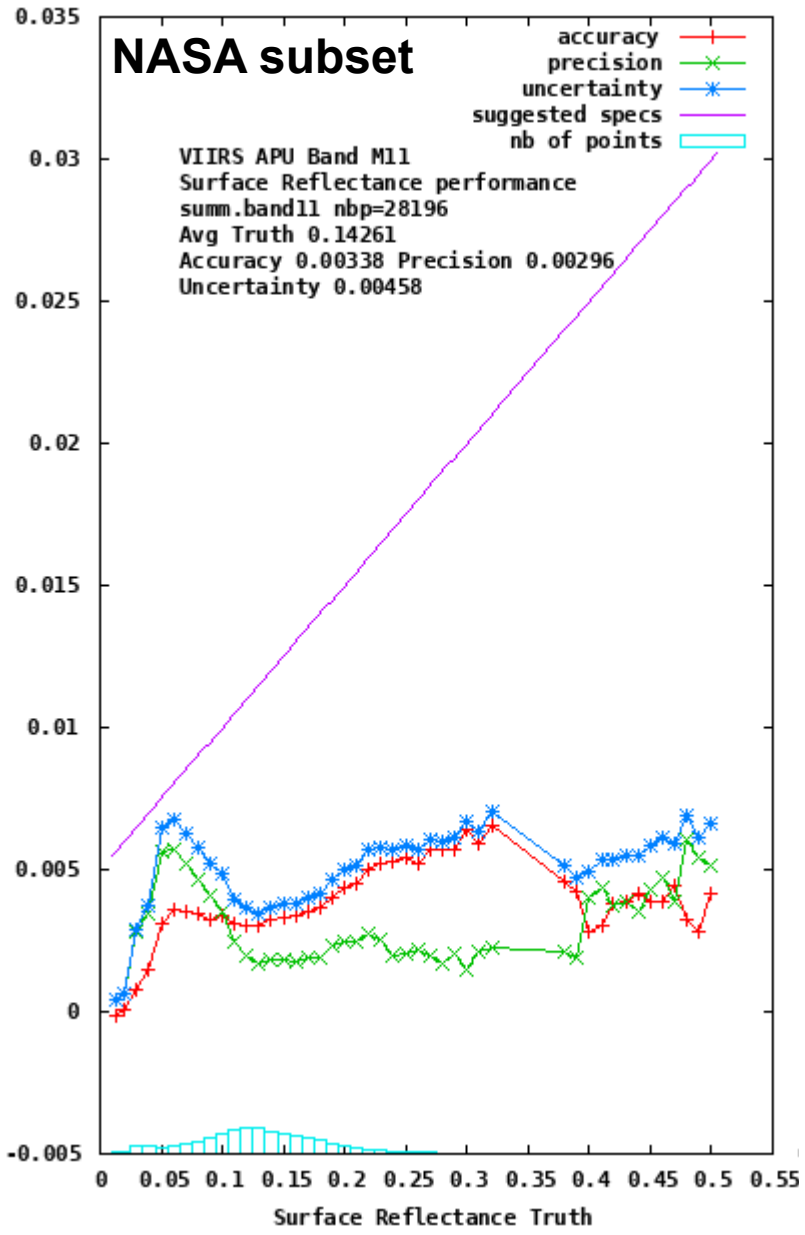


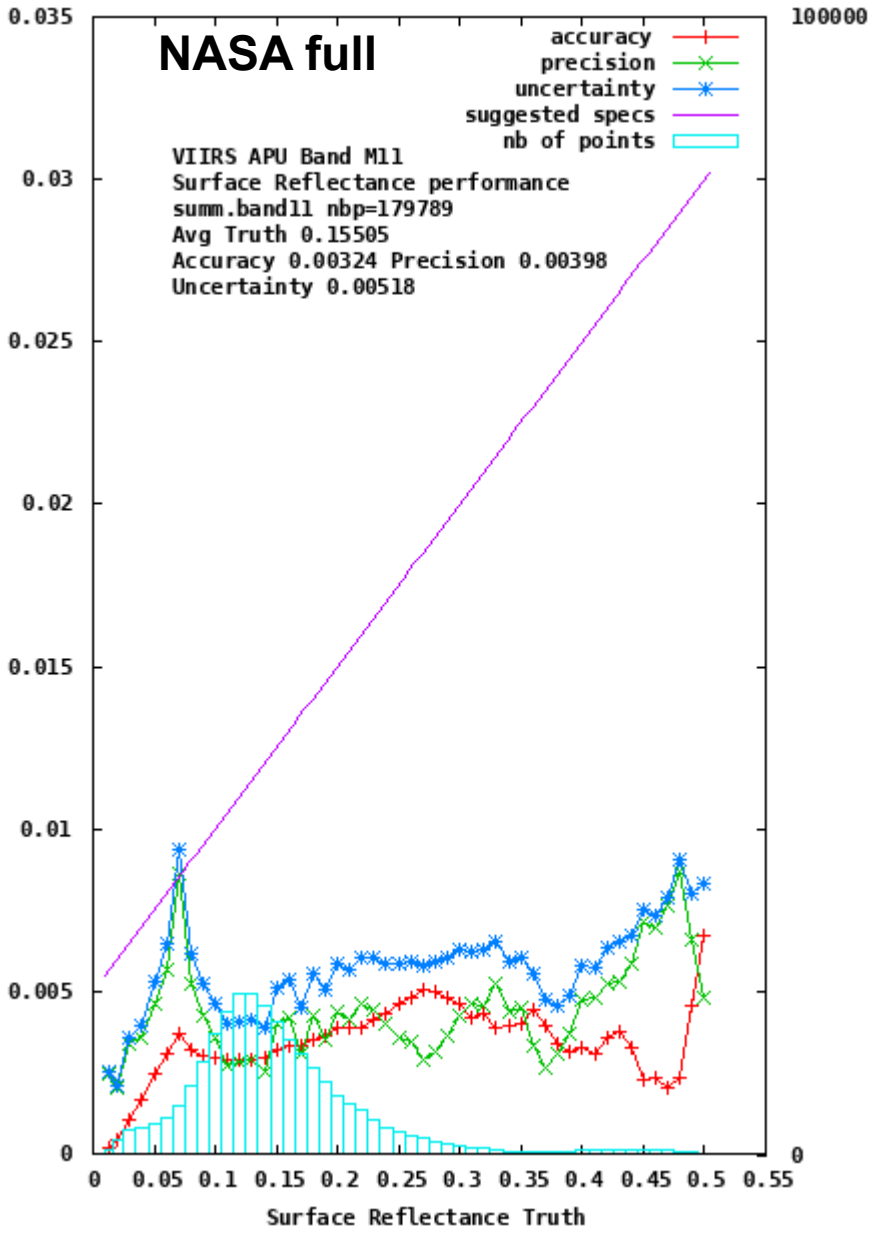




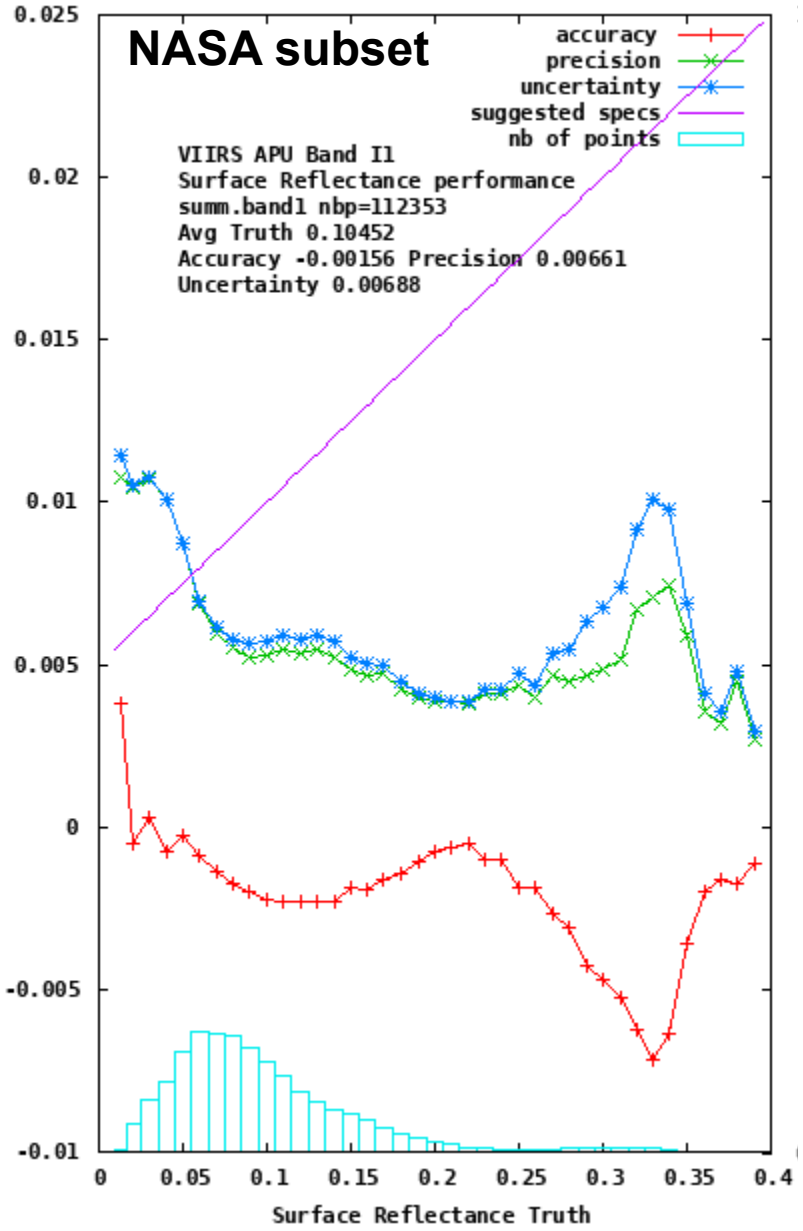
Product performance: M11

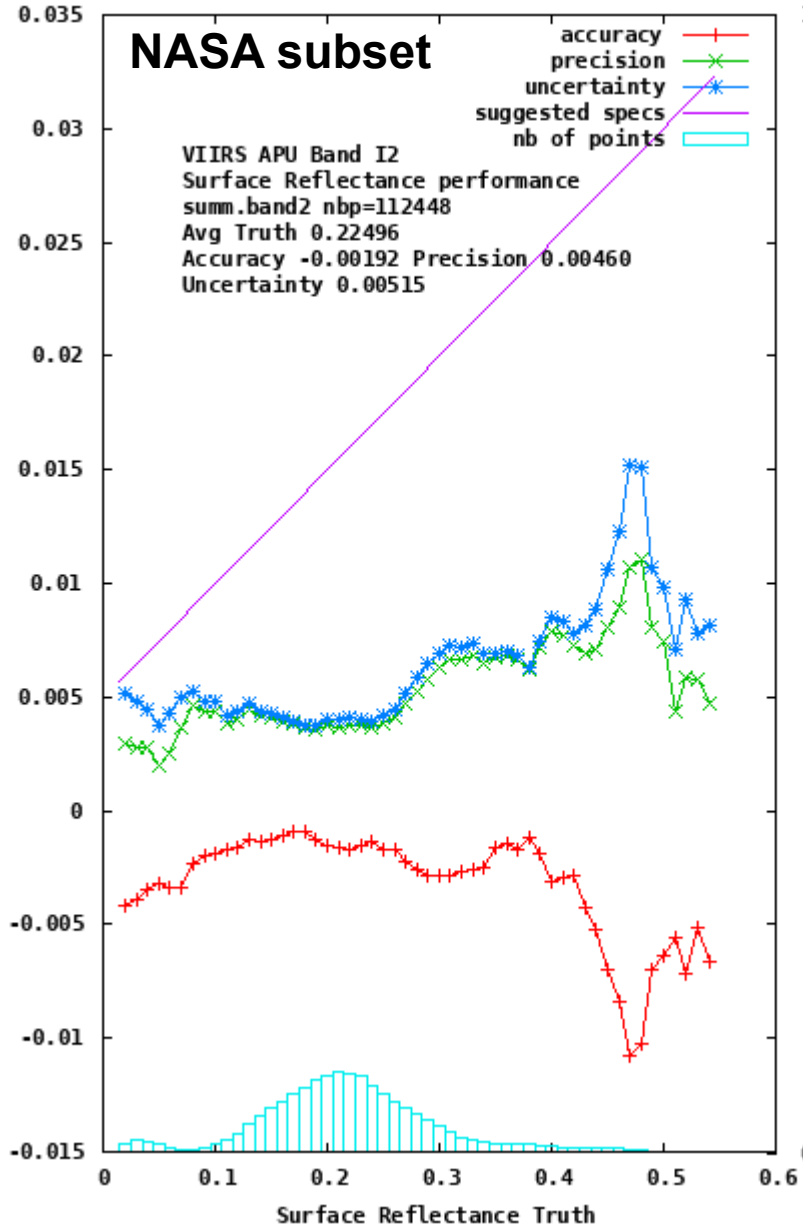


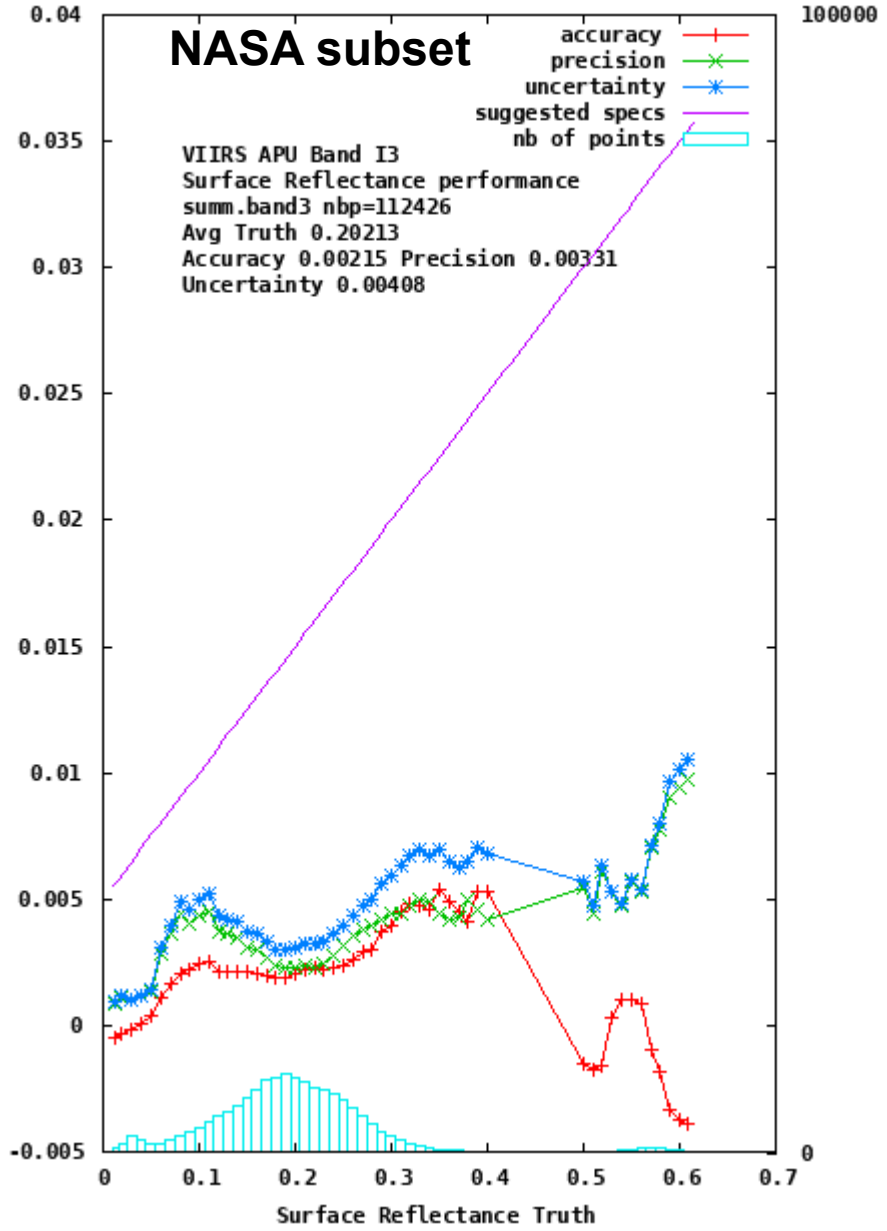




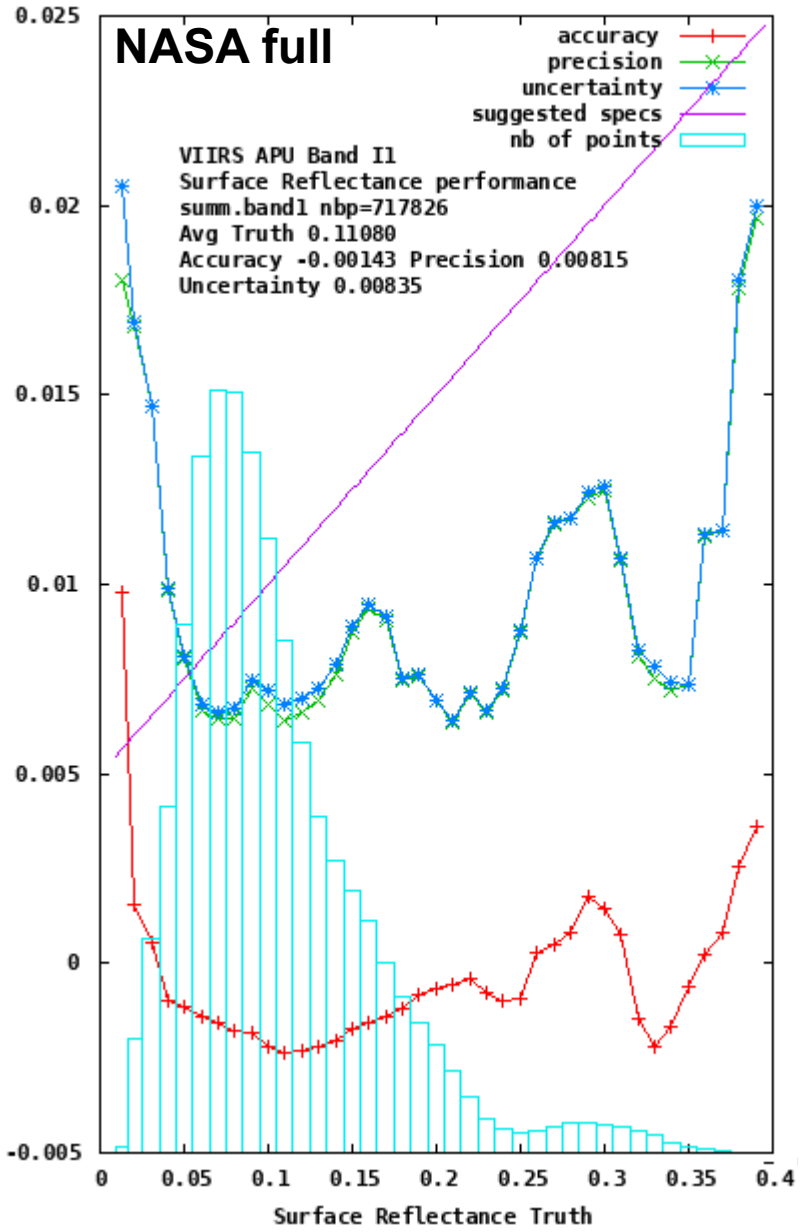
Product performance: I-bands

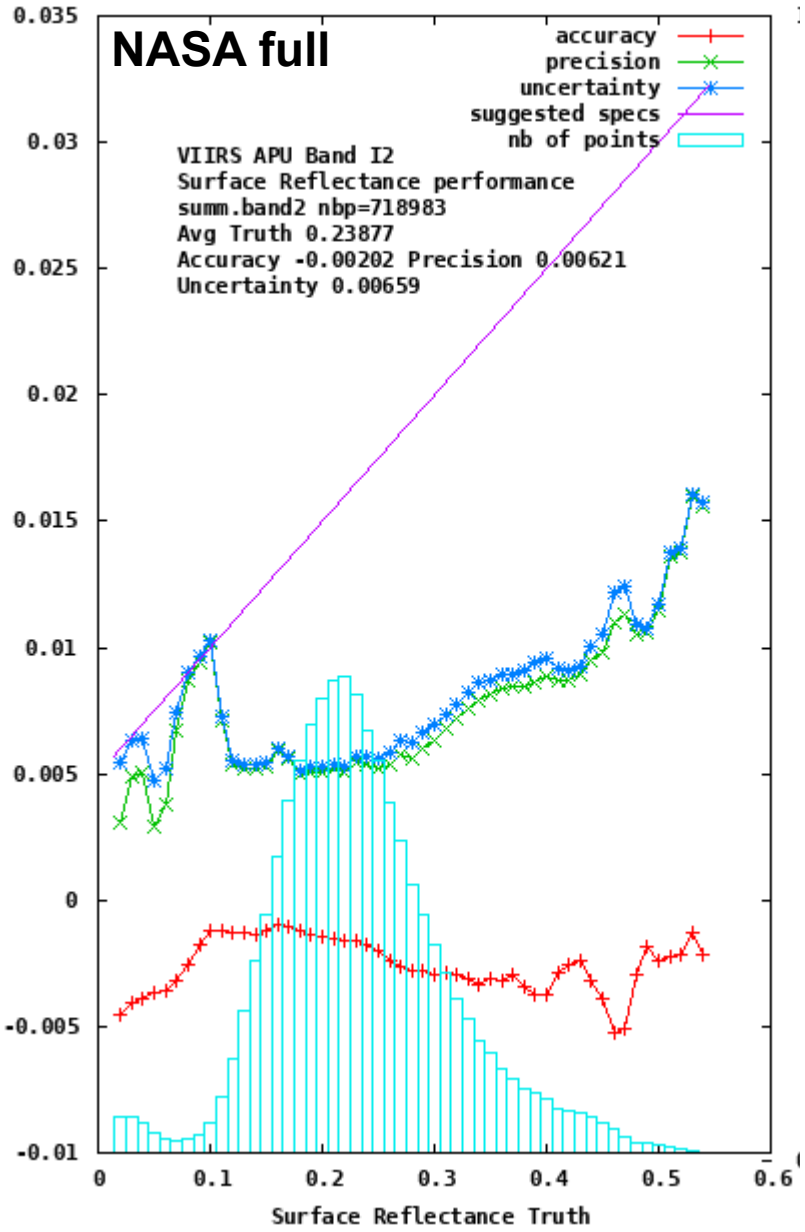


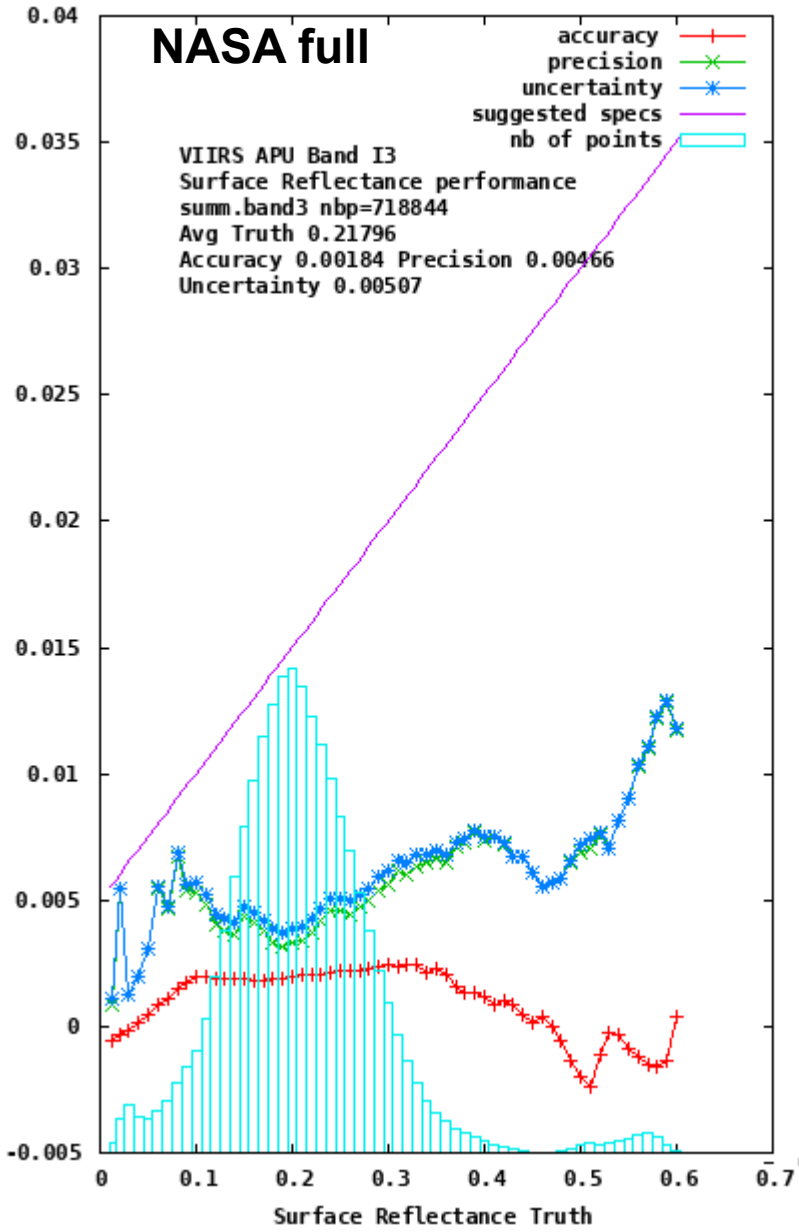




Product performance: I-bands





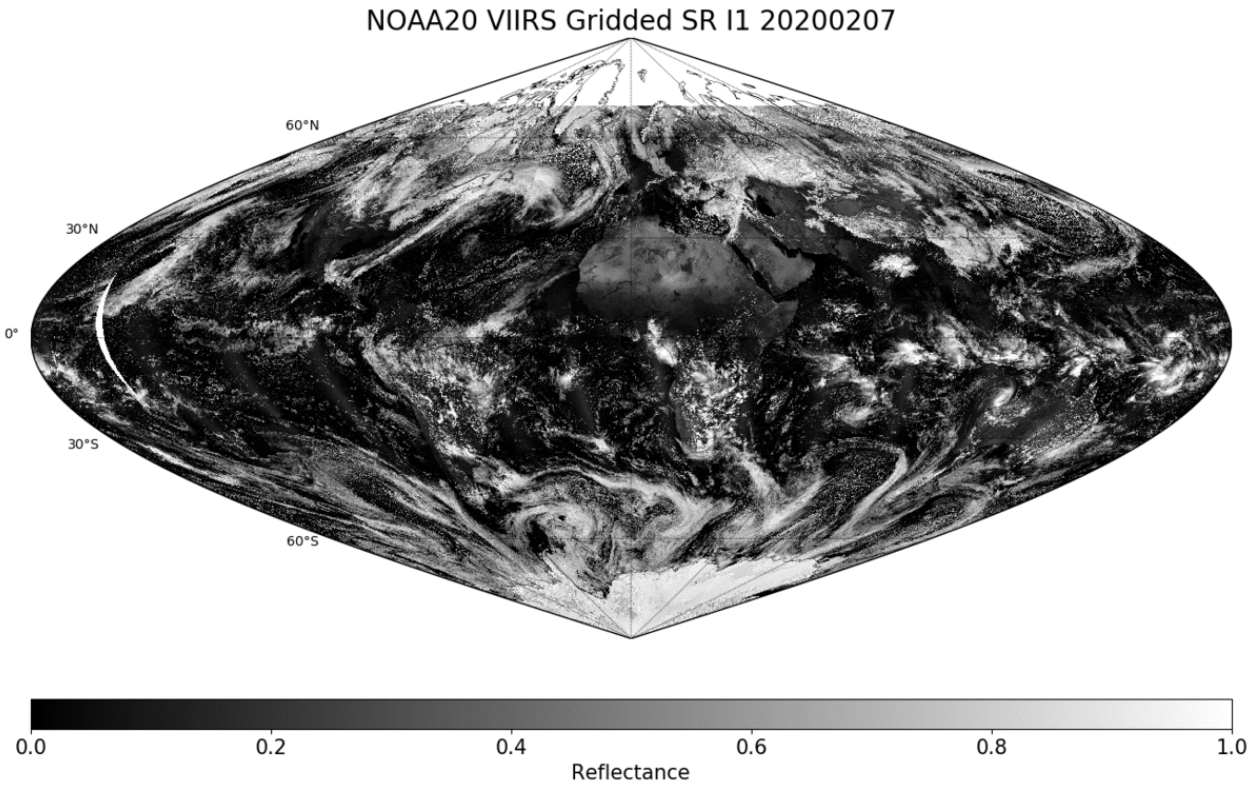


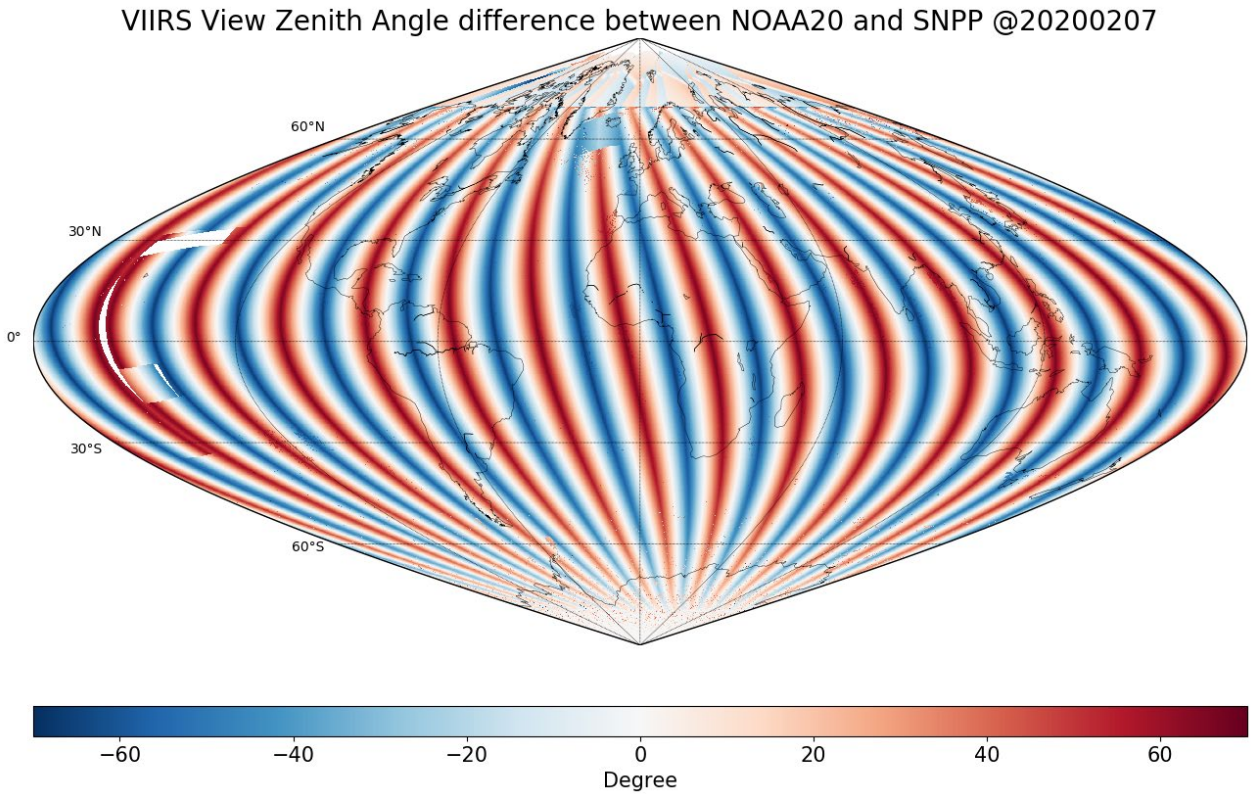
Error Budget

Compare analysis/validation results against requirements, present as a table. Error budget limitations should be explained. Describe prospects for overcoming error budget limitations with future improvements of the algorithm, test data, and error analysis methodology. A: accuracy; P: precision (Note: Y/N denote overall patterns)

Attribute Analyzed	DPS Threshold	Pre-Launch Performance	On-orbit Performance	Meet Requirement?	Additional Comments
M1	0.005+0.05ρ	N/A	-0.01125/0.01482	Y/N	Accuracy/Precision
M2	0.005+0.05ρ	N/A	-0.01102/0.01331	Y/N	Accuracy/Precision
M3	0.005+0.05ρ	N/A	-0.00908/0.01134	Y/N	Accuracy/Precision
M4	0.005+0.05ρ	N/A	-0.00693/0.00902	Y/Y	Accuracy/Precision
M5	0.005+0.05ρ	N/A	-0.00181/0.02787	Y/Y	Accuracy/Precision
M7	0.005+0.05ρ	N/A	-0.00194/0.00618	Y/Y	Accuracy/Precision
M8	0.005+0.05ρ	N/A	-0.00045/0.00546	Y/Y	Accuracy/Precision
M10	0.005+0.05ρ	N/A	-0.00181/0.00466	Y/Y	Accuracy/Precision
M11	0.005+0.05ρ	N/A	0.00324/0.00398	Y/Y	Accuracy/Precision
I1	0.005+0.05ρ	N/A	0.00313/0.02393	Y/Y	Accuracy/Precision
I2	0.005+0.05ρ	N/A	-0.00388/0.03486	Y/Y	Accuracy/Precision
I3	0.005+0.05ρ	N/A	-0.00571/0.05479	Y/Y	Accuracy/Precision

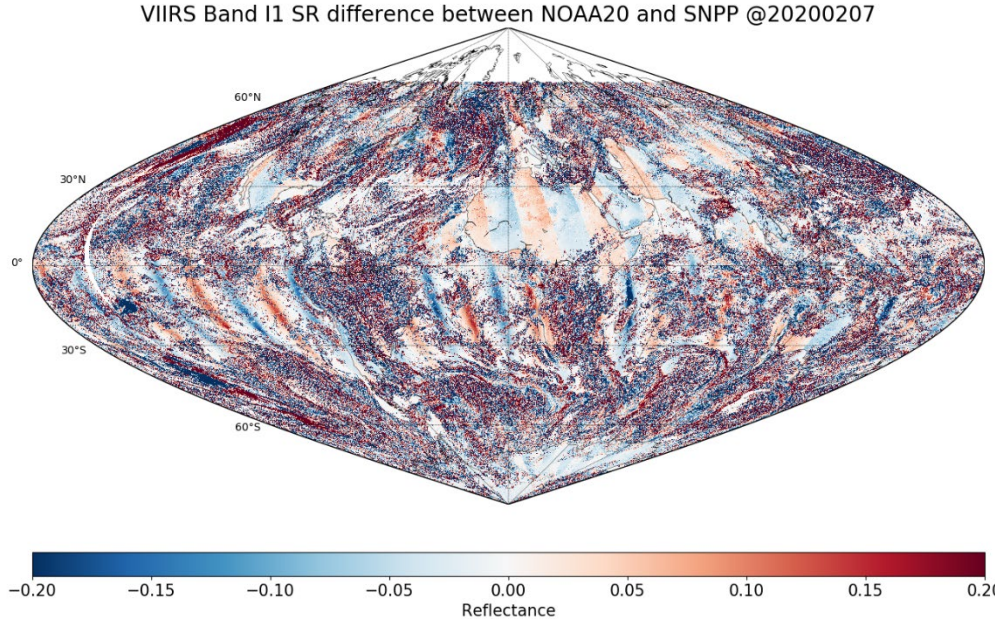
NOAA-20 and Suomi NPP SR Difference

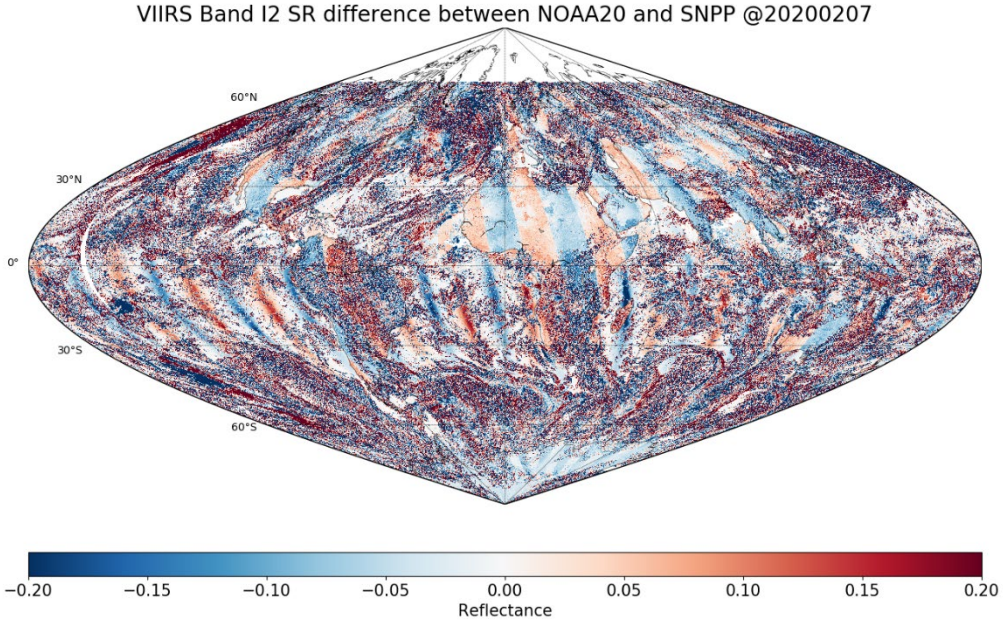


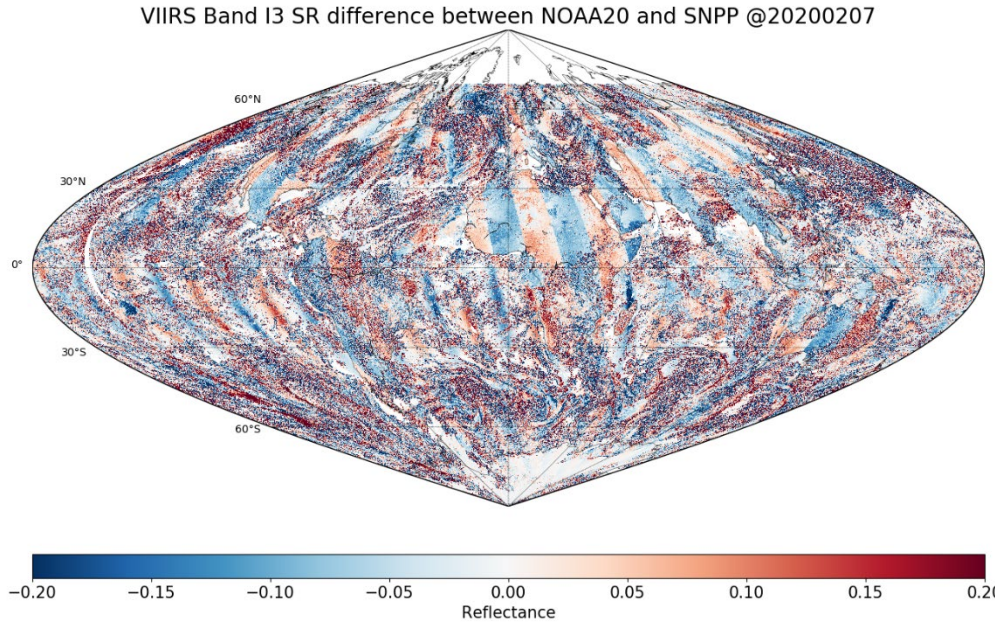


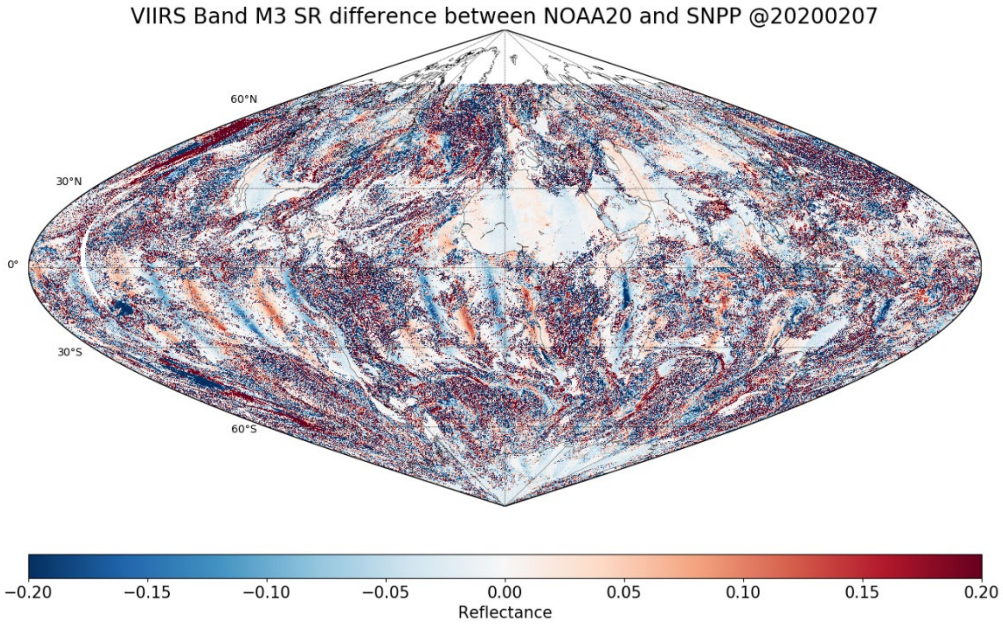
- NOAA20 is 50min ahead of S-NPP
  - Cloud movement
  - Solar angles do not change too much, but view angles with big difference, VZA could up to 70 degree.
- AOD source are different.

NOAA-20 and Suomi NPP SR Difference

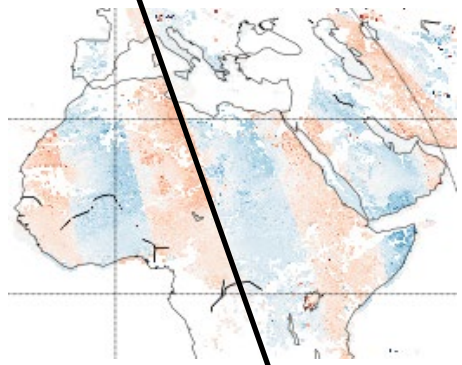




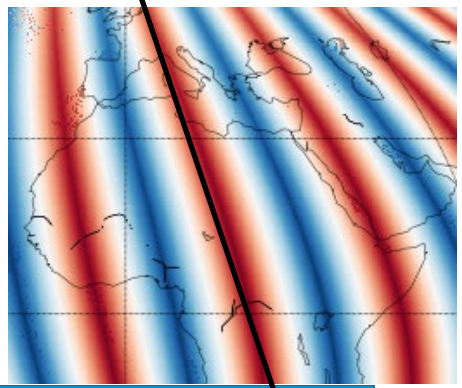




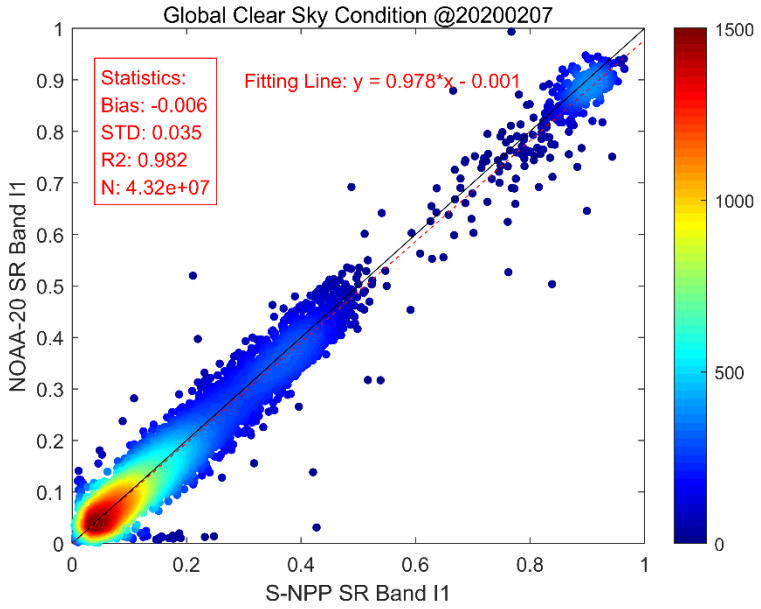
- Daily SR difference between NOAA20 and SNPP (I1-3 & M3)
- Satellite Azimuth angle bring the stripe in SR difference map

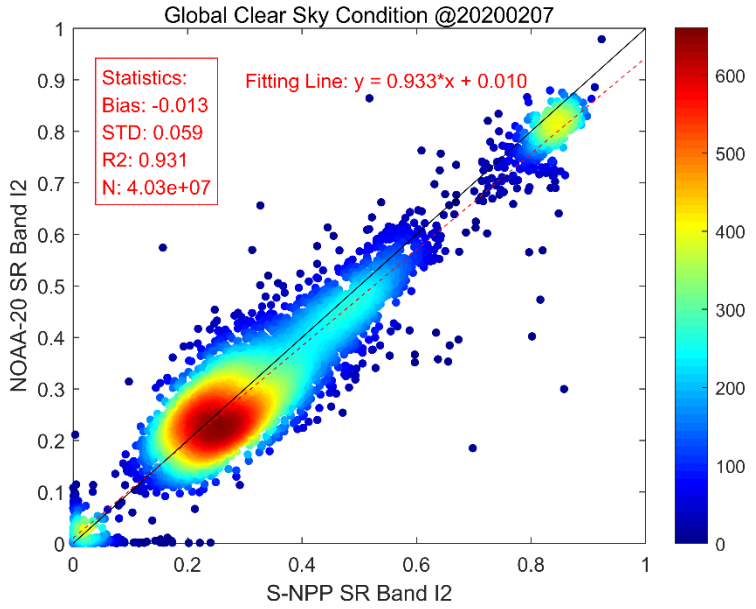


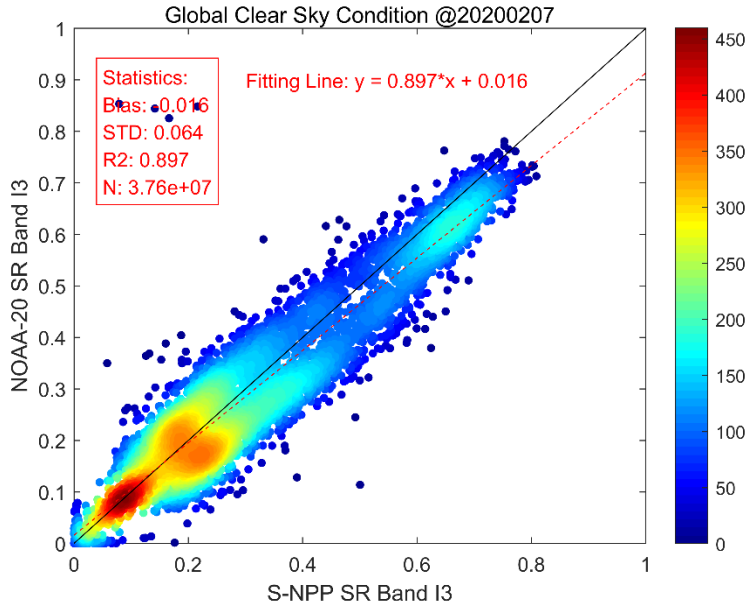
Satellite orbit nadir track

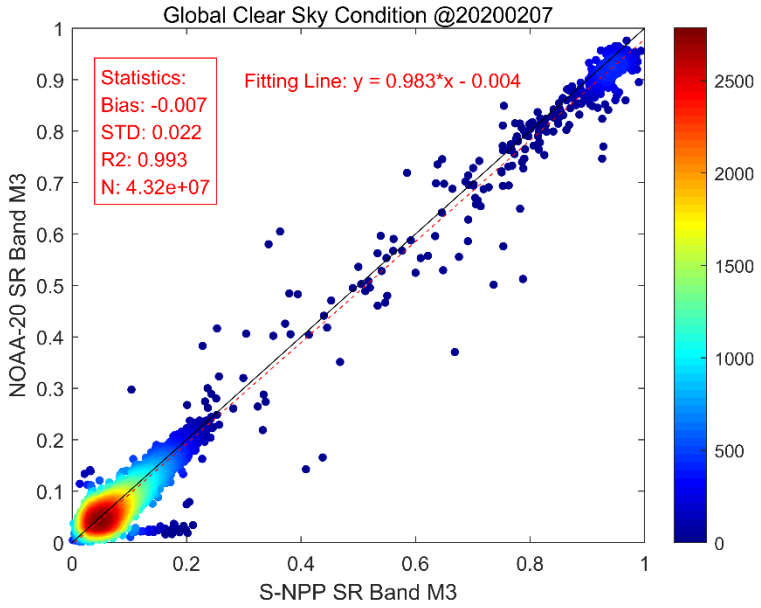


NOAA-20 and Suomi NPP SR Difference

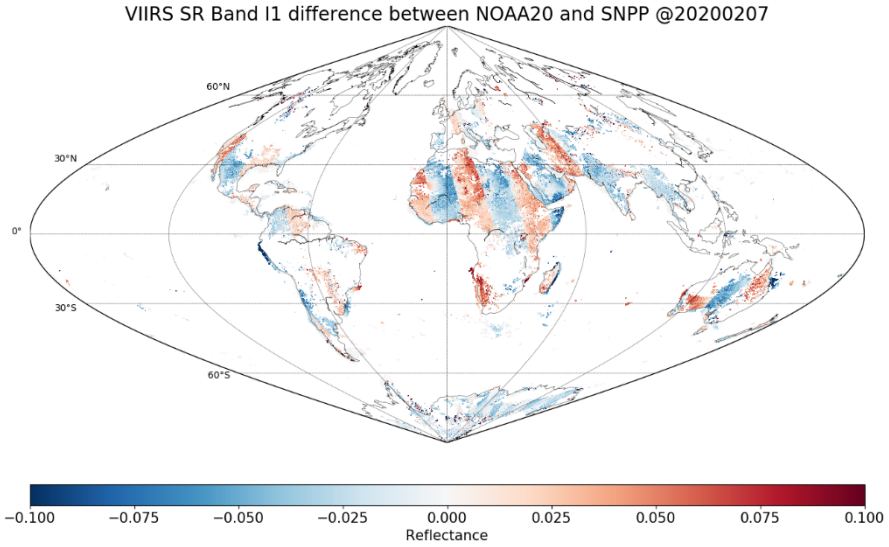




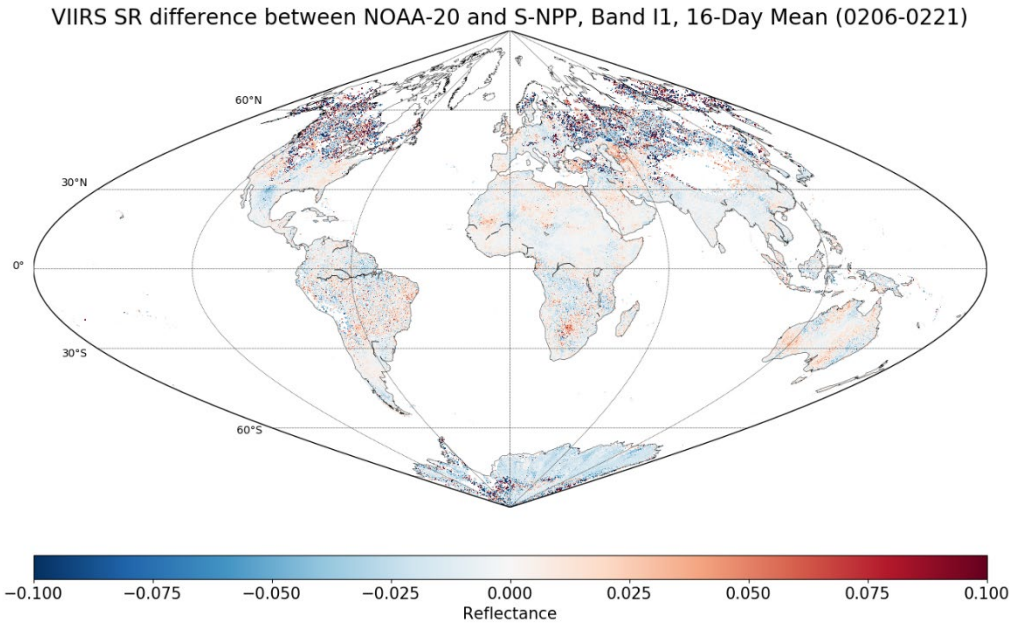


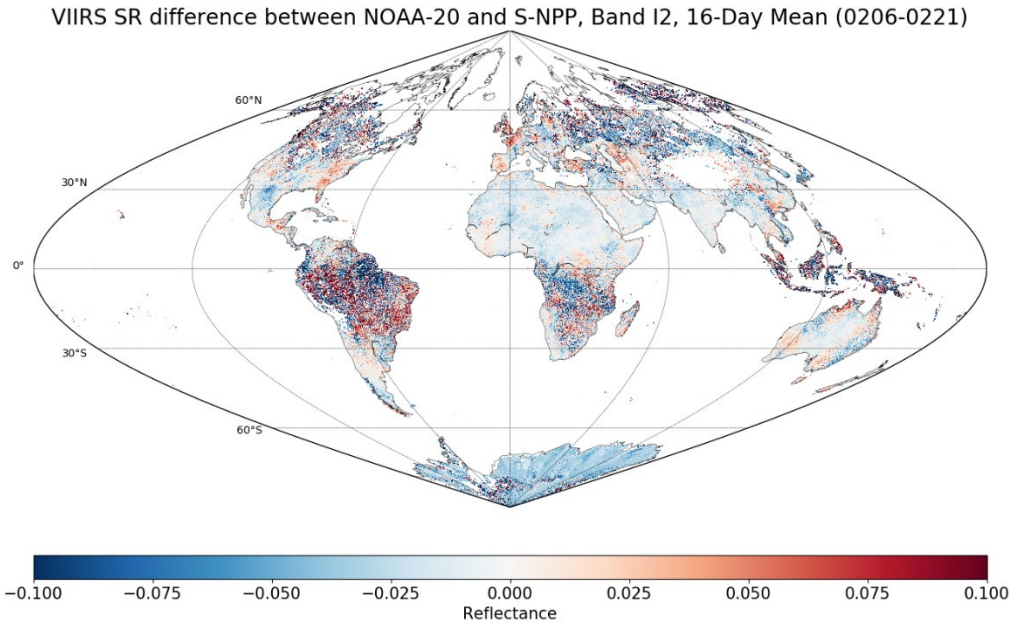


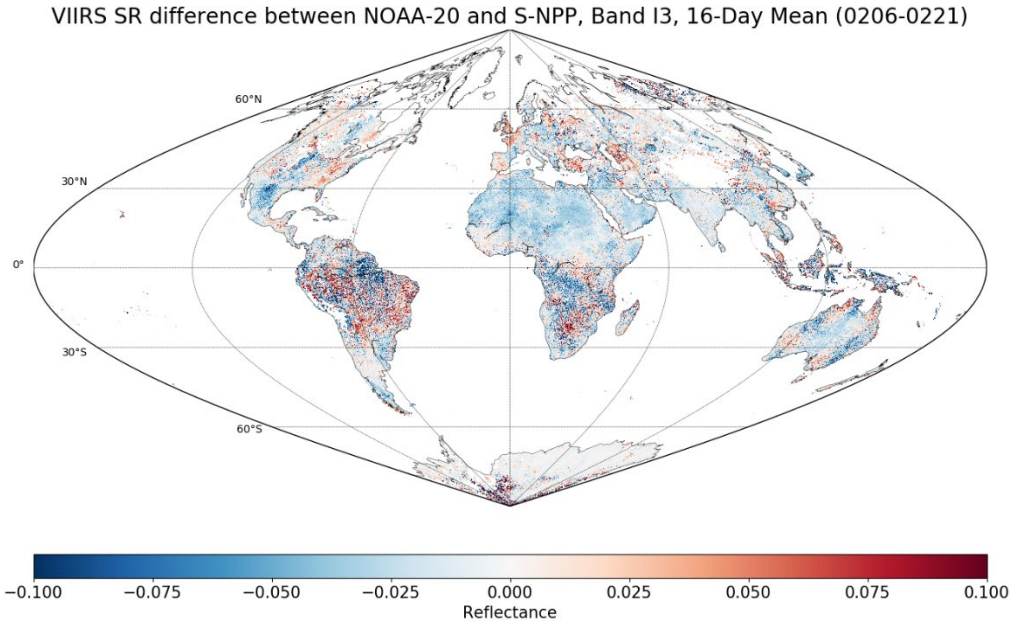
- Date: 20200207
- Global data in Sinusoidal projection
- Filters
  - SR within [0, 1]
  - Confidently clear only
  - Land pixel only

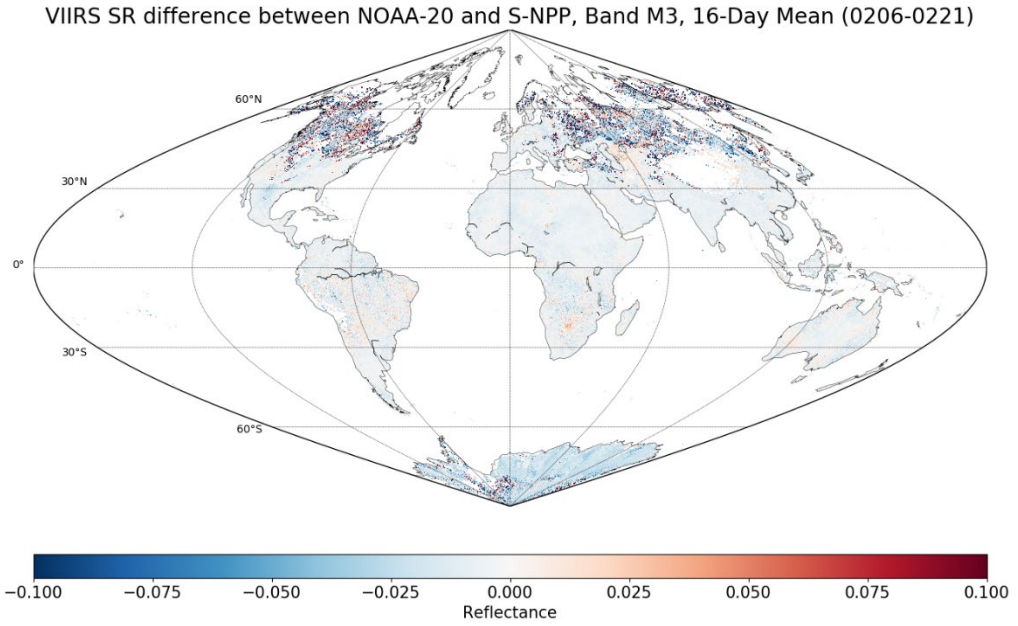


NOAA-20 and Suomi NPP SR Difference (16-Day Average)

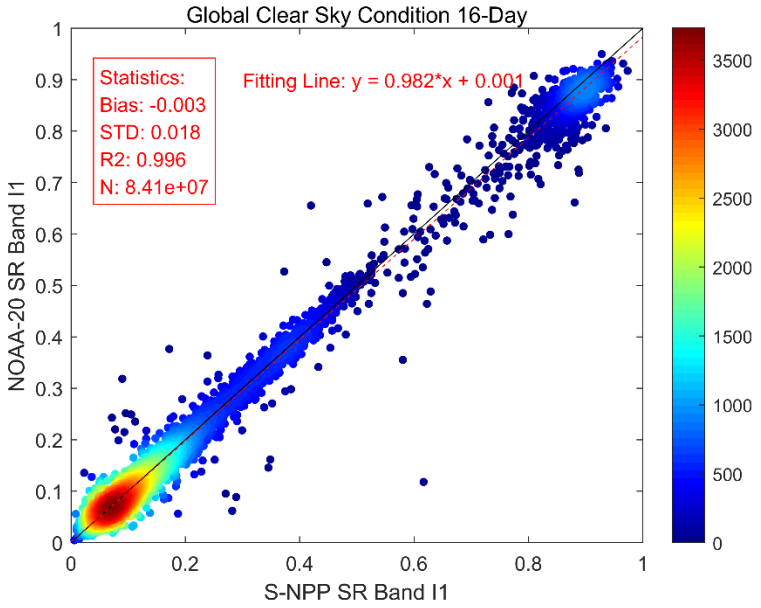


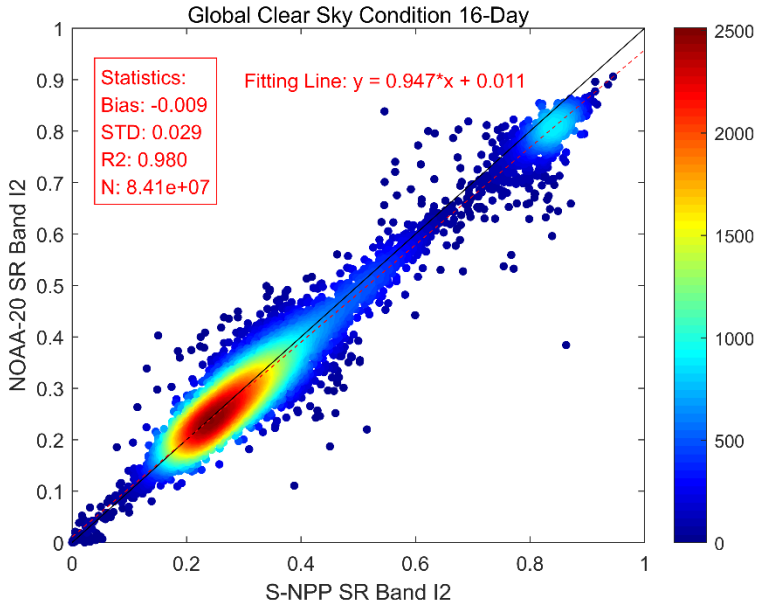


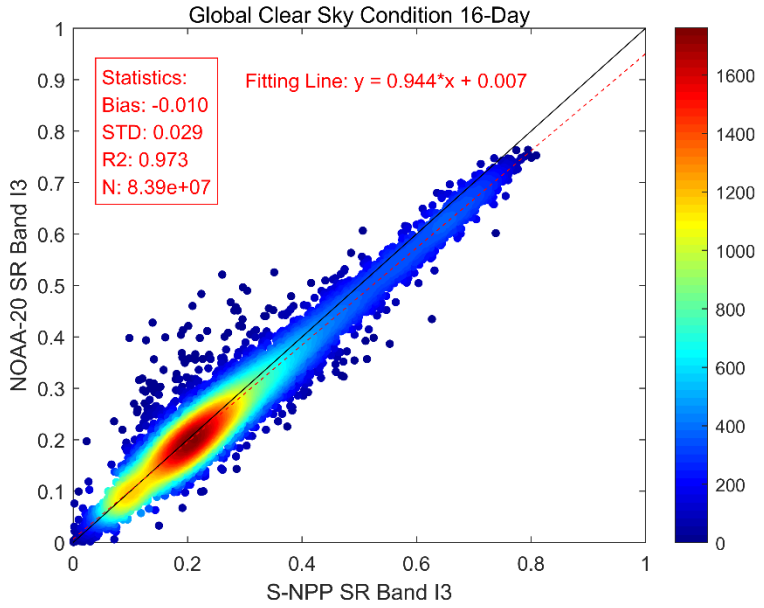


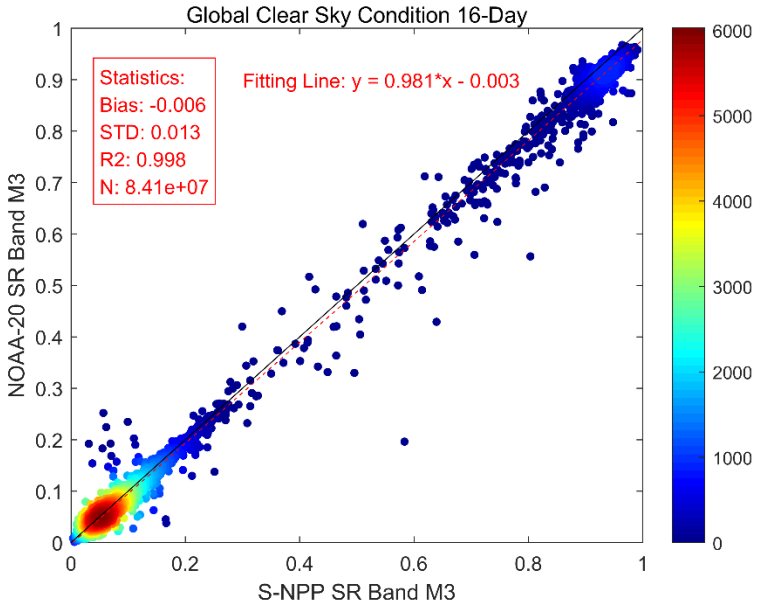


NOAA-20 and Suomi NPP SR Difference (16-Day Average)



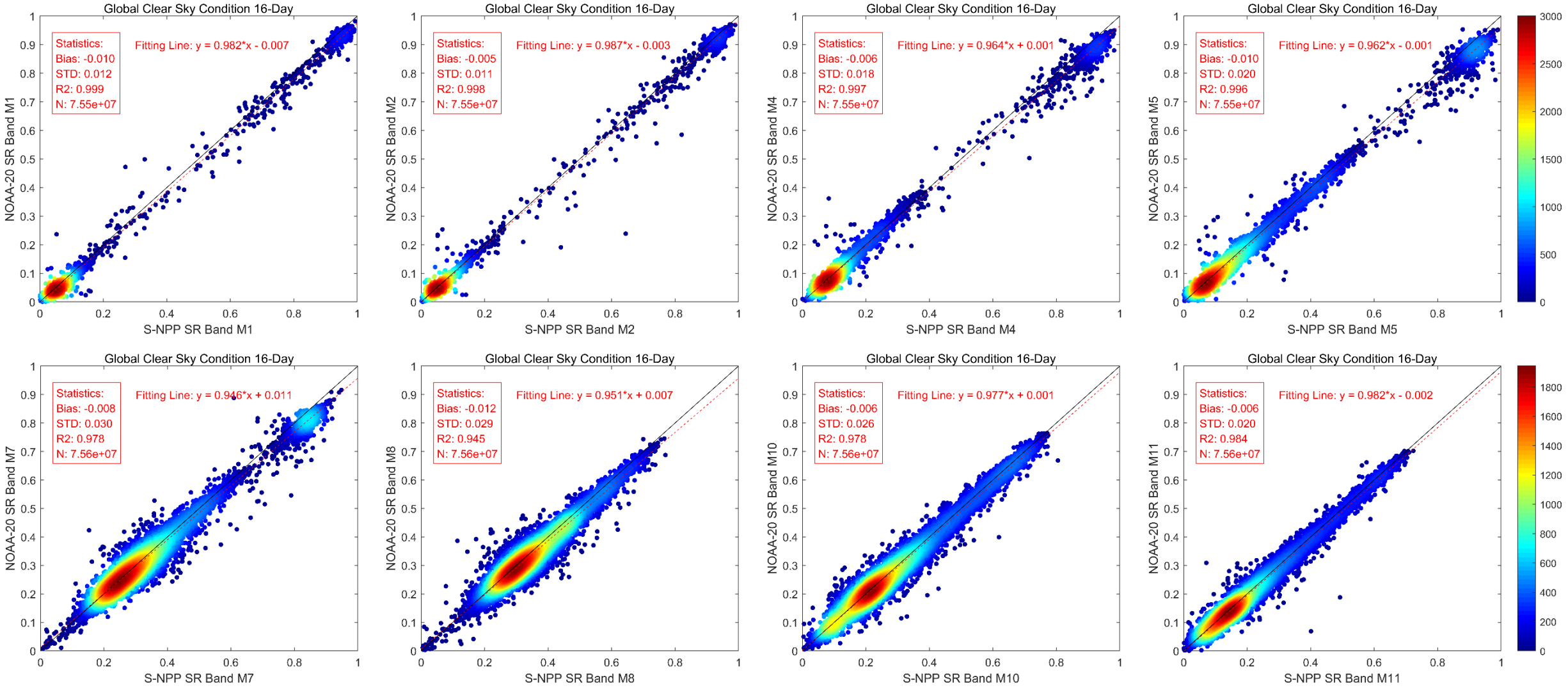






- Date: 2020206-20200221 16-Day average
- Global data in Sinusoidal projection.
- Filters
  - SR within [0, 1]
  - Confidently clear only
  - Land pixel only
  - At least 3 clear days in this 16-day period

NOAA-20 and Suomi NPP SR Difference (continue)



VIIRS M Band inter-comparison between NOAA-20 and S-NPP

Quality flag analysis/validation

- Defined Quality Flags
  - Variable
  - Description
  - Value
- Quality flag analysis/validation
  - Test / example / ground truth data sets
  - Analysis / validation results
  - Analysis / validation plan

Quality Flags (2/1)

QF1

Bit #	Meaning
7	Spare
6	Sun Glint: 0: no sun glint detected 1: sun glint detected
5	Low Sun Mask 0: high 1: low
4	Day/Night Flag 0: day 1: night
2-3	Cloud Detection and Confidence 00: confident clear 01: probably clear 10: probably cloudy 11: confidence cloudy
0-1	Cloud Mask Quality 00: poor 01: low 10: medium 11: high

QF2

Bit #	Meaning
7	Thin Cirrus Detected – Emissive Test 0: no cloud 1: cloud
6	Thin Cirrus Detected – Reflective Test 0: no cloud 1: cloud
5	Snow/Ice Flag 0: no snow/ice 1: snow or ice
4	Heavy Aerosol Mask 0: no heavy aerosol 1: heavy aerosol
3	Cloud Shadow Mask 0: no cloud shadow 1: shadow
0-2	Land/Water Background 001: deep ocean 010: shallow water 011: land 100: snow 101: arctic 110: Antarctic and Greenland 111: desert

QF3

Bit #	Meaning
7	Bad M10 SDR data 0: no 1: yes
6	Bad M8 SDR data 0: no 1: yes
5	Bad M7 SDR data 0: no 1: yes
4	Bad M5 SDR data 0: no 1: yes
3	Bad M4 SDR data 0: no 1: yes
2	Bad M3 SDR data 0: no 1: yes
1	Bad M2 SDR data 0: no 1: yes
0	Bad M1 SDR data 0: no 1: yes

QF4

Bit #	Meaning
7	Missing Precipitable Water data 0: no 1: yes
6	Invalid Land AM input data 0: valid 1: invalid or over ocean
5	Missing AOT input data 0: no 1: yes
4	Overall Quality of AOT 0: good 1: bad
3	Bad I3 SDR data 0: no 1: yes
2	Bad I2 SDR data 0: no 1: yes
1	Bad I1 SDR data 0: no 1: yes
0	Bad M11 SDR data 0: no 1: yes

Quality Flags (2/2)

QF5

Bit #	Meaning
7	Overall Quality of M7 Surface Reflectance Data 0: good 1: bad
6	Overall Quality of M5 Surface Reflectance Data 0: good 1: bad
5	Overall Quality of M4 Surface Reflectance Data 0: good 1: bad
4	Overall Quality of M3 Surface Reflectance Data 0: good 1: bad
3	Overall Quality of M2 Surface Reflectance Data 0: good 1: bad
2	Overall Quality of M1 Surface Reflectance Data 0: good 1: bad
1	Missing Surface Pressure input data 0: no 1: yes
0	Missing total column ozone input data 0: no 1: yes

QF6

Bit #	Meaning
7	Unused
6	Unused
5	Overall Quality of I3 Surface Reflectance Data 0: good 1: bad
4	Overall Quality of I2 Surface Reflectance Data 0: good 1: bad
3	Overall Quality of I1 Surface Reflectance Data 0: good 1: bad
2	Overall Quality of M11 Surface Reflectance Data 0: good 1: bad
1	Overall Quality of M10 Surface Reflectance Data 0: good 1: bad
0	Overall Quality of M8 Surface Reflectance Data 0: good 1: bad

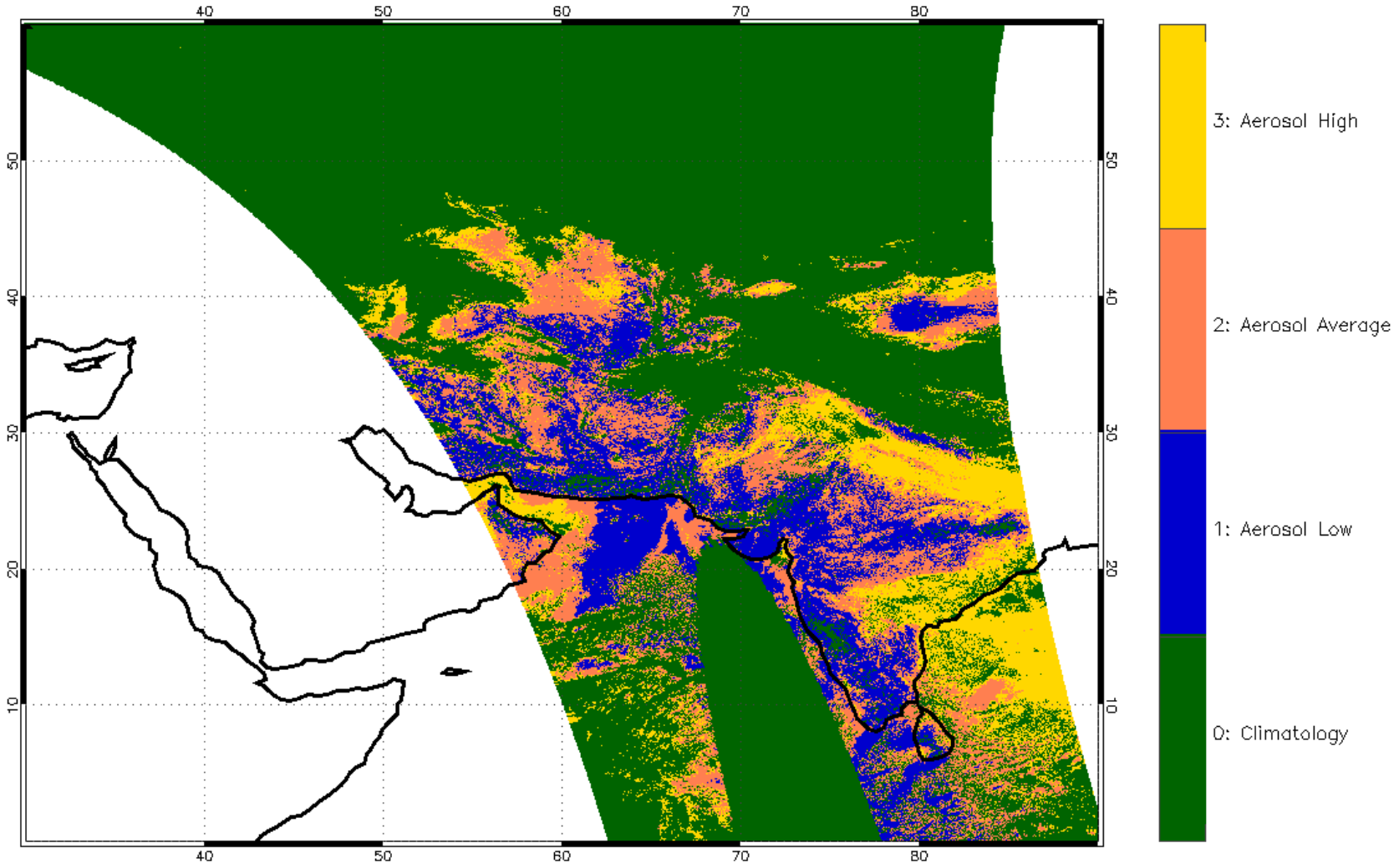
QF7

Bit #	Meaning
7	Unused
6	Unused
5	Unused
4	Thin Cirrus Flag 0: no 1: yes
2-3	Aerosol Quantity 00: climatology 01: low 10: average 11: high
1	Adjacent to Cloud (disabled) 0: no 1: yes
0	Snow Present 0: no 1: yes

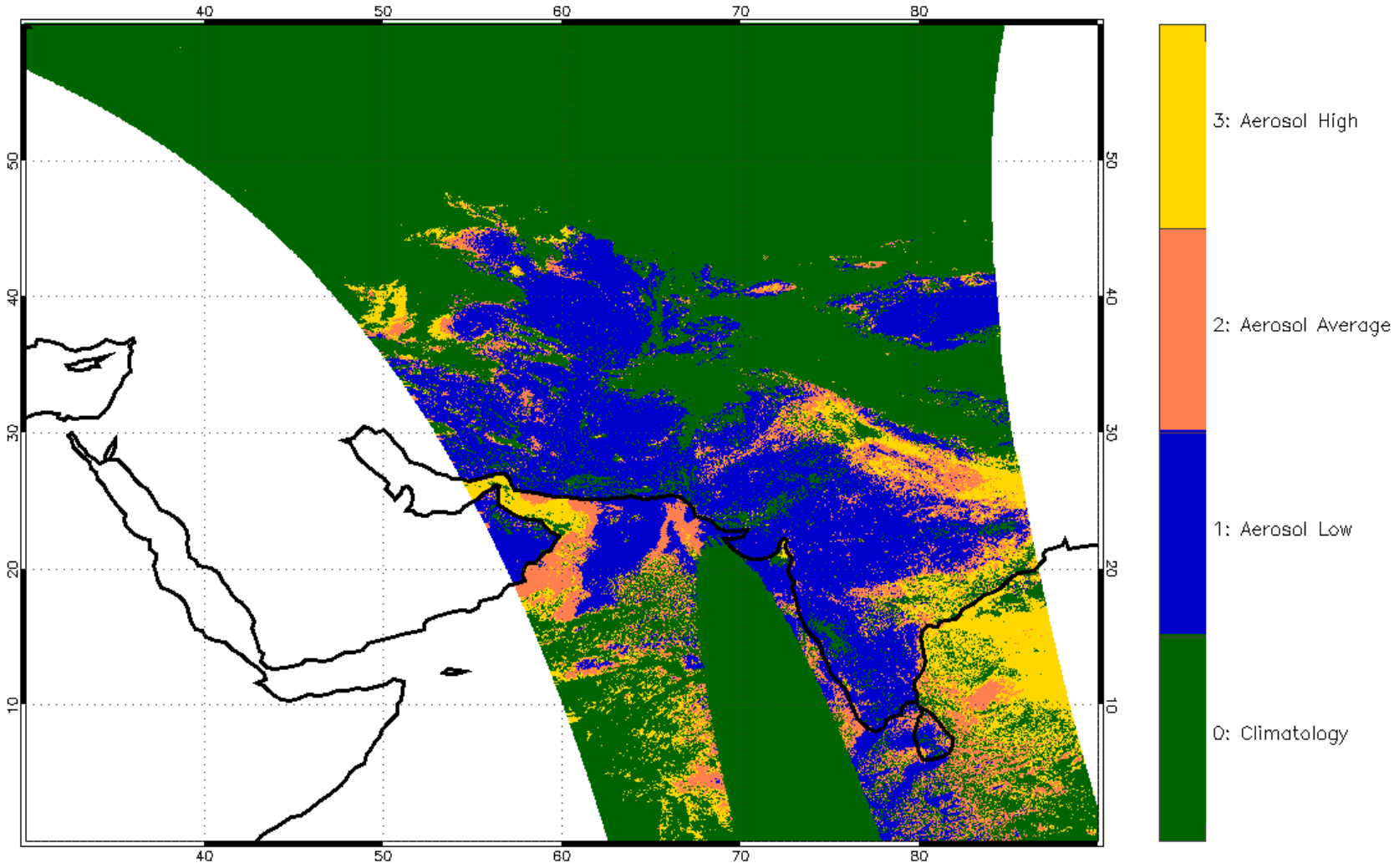
Aerosol Quantity Flag Update

- Update Aerosol Quantity (QF7 bits 2-3), SR Value does not change.
  - 00: Climatology
  - 01: Low AOD
  - 10: Medium AOD
  - 11: High AOD
- Update: change the indicator of AOD quantity
  - Previous Version: Atmospheric albedo - Molecular reflectance
  - New Version: SR (AOD=0.01) – SR (Real time AOD)
- Evaluation approach
  - Compare all variables (SR & QF) pixel by pixel for all the granules.
- Current OPS and Science patch have tiny precision differences in all radiances: never greater than 0.0001 and affecting <0.01% of pixels.
- Current OPS and Science patch change QF7 bits 2-3 (aerosol) by up to 20%+ per granule, though average is about 1%. Other bits not affected.
- Current OPS and STAR patch only impact QF7.
- STAR is identical to OPS for radiances.
- STAR is identical to Science for QF7.

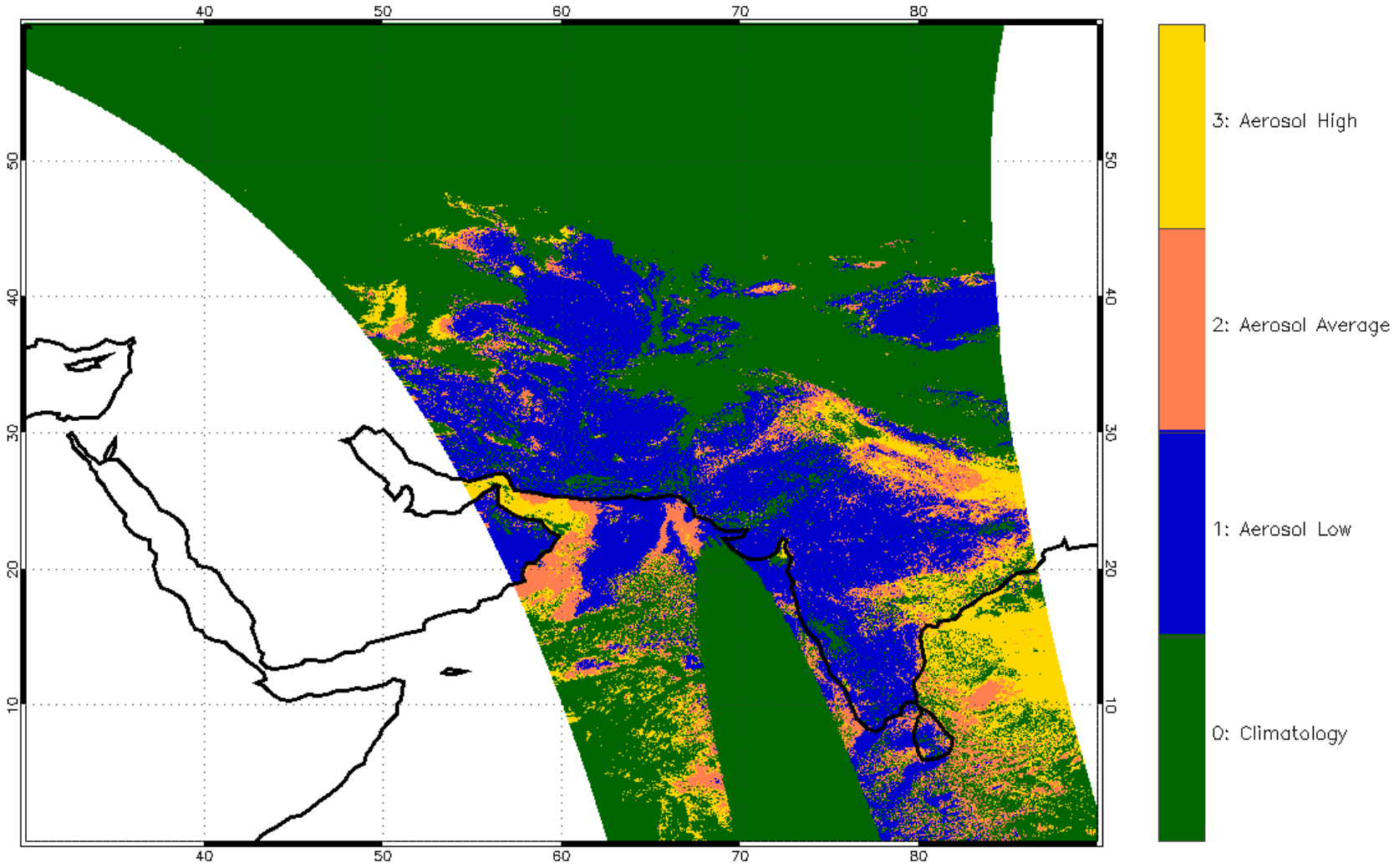
Current Version – Jan 31, 2020 over India



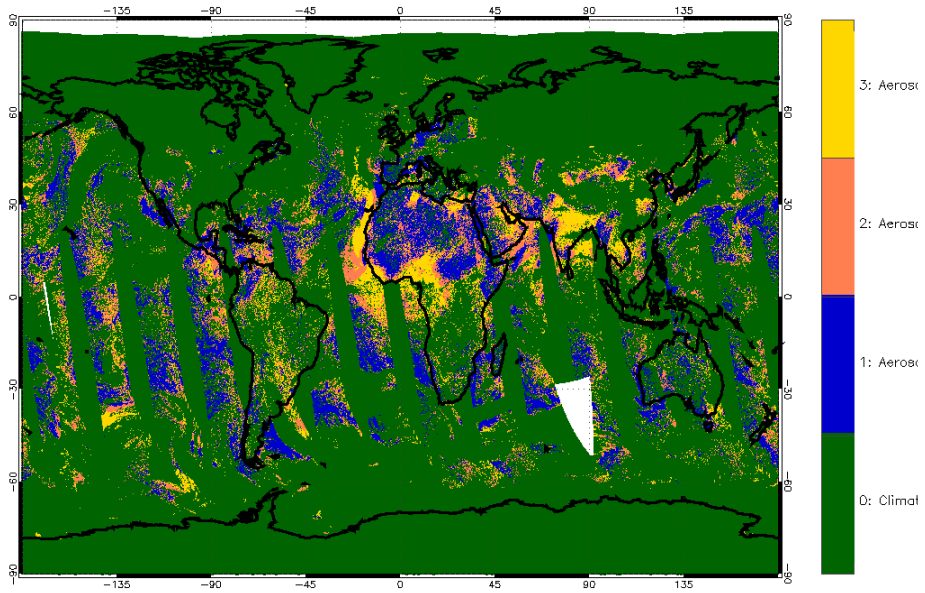
Science Patch – Jan 31, 2020 over India

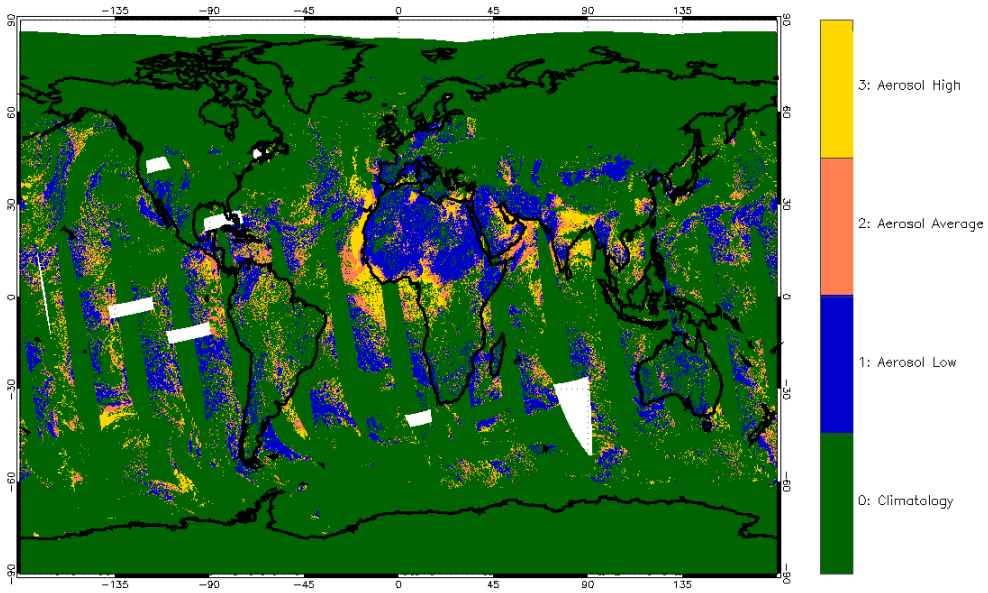


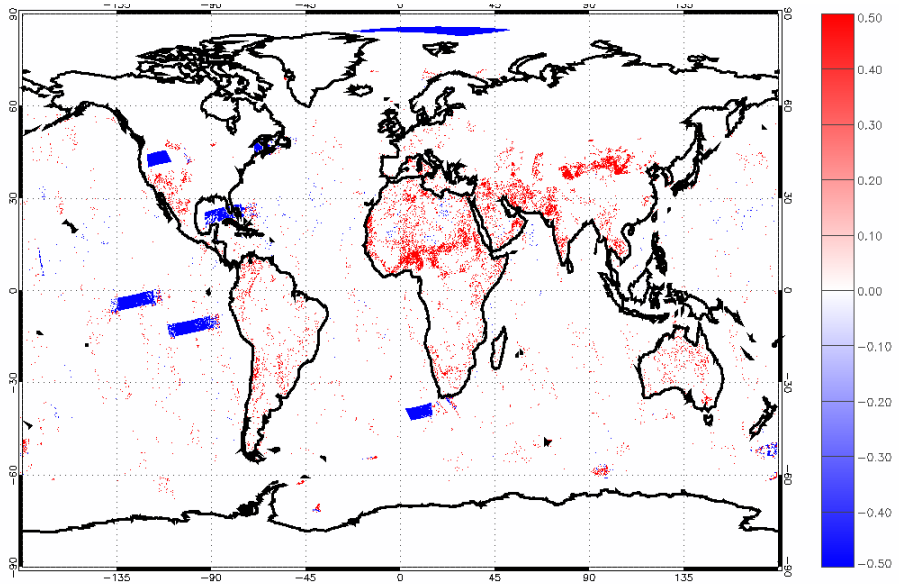
NOAA Patch – Jan 31, 2020 over India

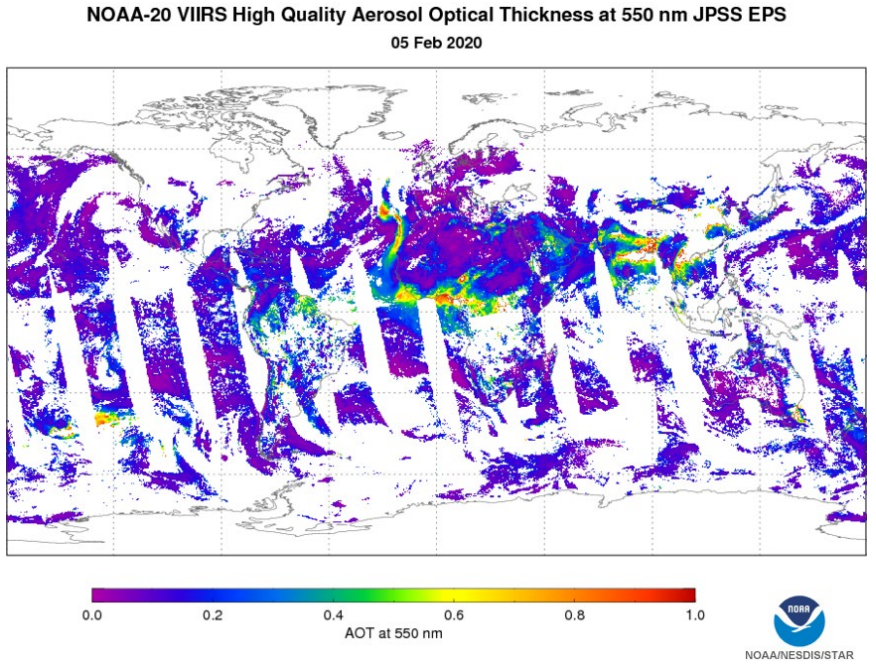


Aerosol Quantity Flag Update Results









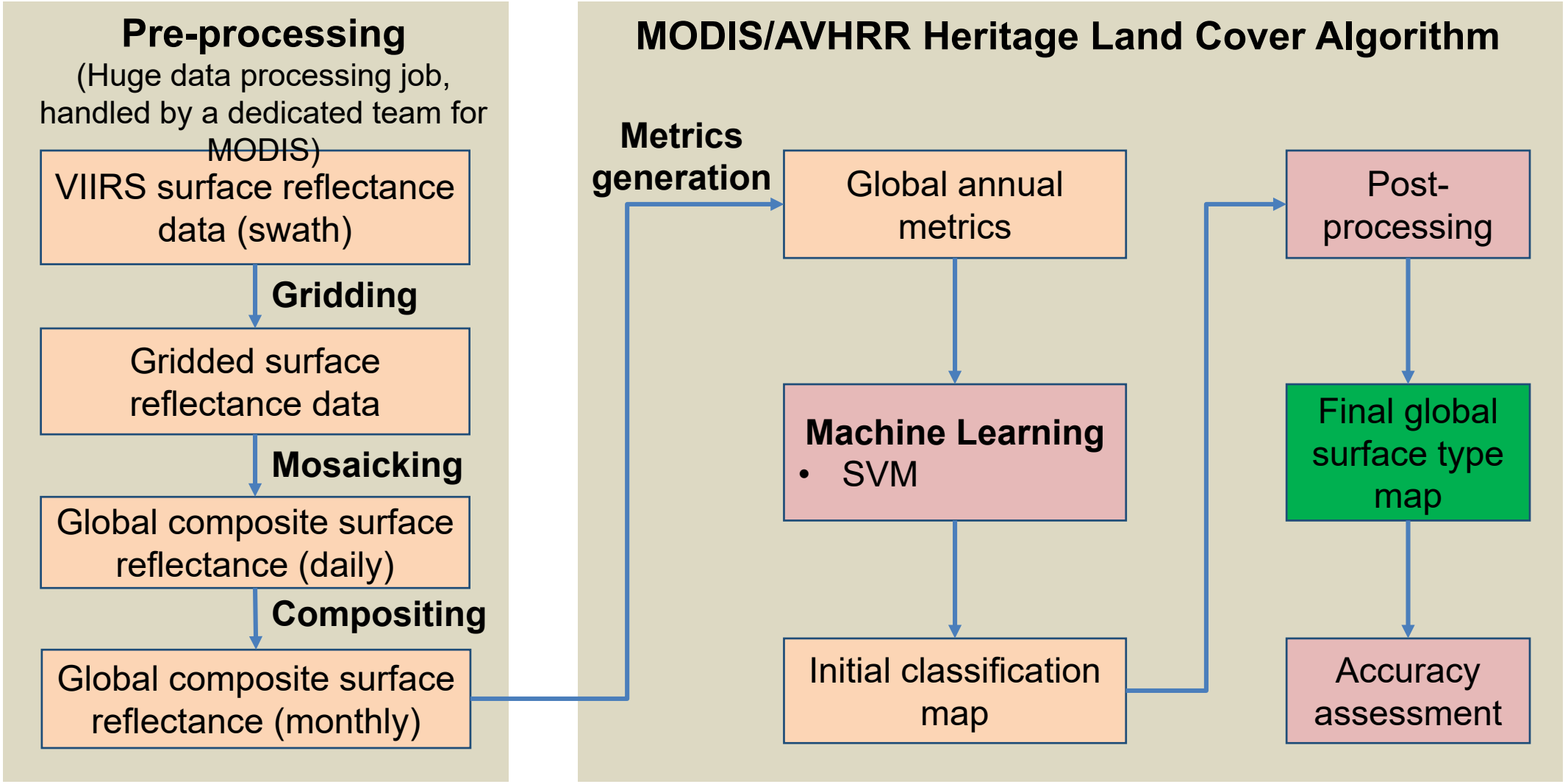
- Top Left: v1r1
- Top Right: v1r2
- Bottom Left: difference
- Bottom Right: NOAA20 AOD from STAR web

Only QF7 bit 2-3 are different
Other QFs and SRs are identical

Downstream product: Surface Type (Jerry Zhan, STAR, Chengquan Huang, UMD)

"**We have been able to process the NetCDF files of your NDE surface reflectance product for developing the VIIRS Annual Global Surface Type Map**. Surface reflectance and the associated geolocation data in granule files are the primary input for compositing monthly surface reflectance of all VIIRS land relevant channels and generating monthly classification metrics that are required for the surface type classification algorithm as well as the surface type training and validation data sets. Previously the surface reflectance data are downloaded from CLASS which were generated by the IDPS."(…)" **In the IDPS product, the data bands and lat/long bands were in separate files.** When creating gridded SR data, which is the first step of our processing flow, **we had to match the M band file of a granule with the lat/long file for that granule**, which had to be done very carefully. (…) **The NDE version got rid of these headaches for us**. (…) We no longer needed to worry about potential mismatches between the data bands with their lat/long bands. We didn't see different granule sizes with the NDE data, which was very helpful. **We never had a problem in creating gridded data from the NDE SR product.**

VIIRS Annual Surface Type



Downstream product: Vegetation Index (Bob Yu, STAR)

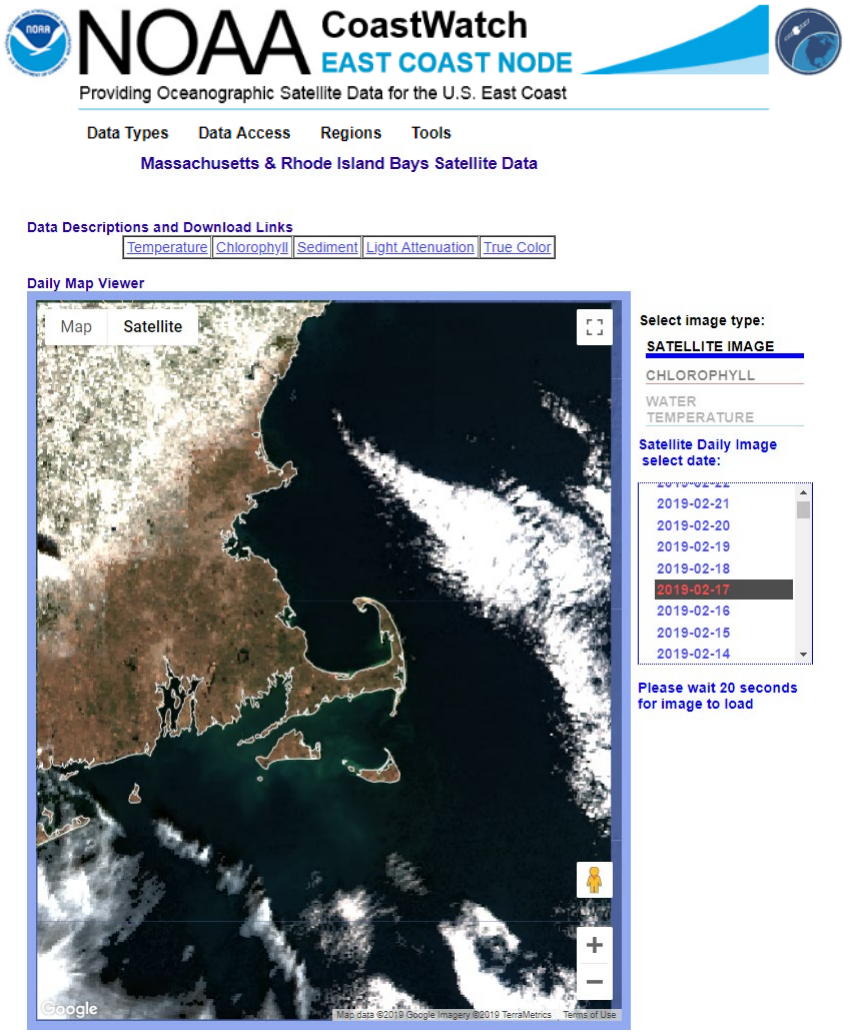
"VIIRS Surface Reflectance is an input for the production of VIIRS Top of Canopy Normalized Difference Vegetation Index (TOC NDVI) and Enhanced Vegetation Index (TOC EVI). Throughout our validation of TOC NDVI and TOC EVI, **we found no significant issues that could be traced to the NOAA20 Surface Reflectance input.** In addition, the consistency of TOC NDVI and TOC EVI, which are essentially band reflectance ratios, between SNPP and NOAA20 VIIRS suggests that the **surface reflectance products are consistent between SNPP and NOAA20 VIIRS** as well.

VIIRS Surface Reflectance is also an input for the production of Green Vegetation Fraction (GVF), since the current GVF computation process is an independent set. The derivation of GVF from surface reflectance is more complex than the derivation of vegetation indices, so GVF validation results are a less direct indicator of confidence in the surface reflectance input. However, the results of GVF validation were similar to those of vegetation indices in that they **did not indicate issues with the NOAA20 VIIRS surface reflectance product**. GVF results were also **consistent between SNPP and NOAA20 VIIRS, indicating consistency between the input surface reflectances**."

NOAACoastWatch/OceanWatch/PolarWatch as a user of VIIRS Land Surface Reflectance

- NOAA CoastWatch Central (the central processing team housed in STAR) is generating true color images using the VIIRS Land Surface Reflectance product, now for 9 CONUS regions: East Coast, (NorthEast and SouthEast US and Chesapeake Bay), West Coast, Hawaii, Gulf of Mexico (eastern and western), and Great Lakes (two views).
- Also running the full resolution (375 m) I-1 band (638 nm) Rho_s and nLw and I2 (842 nm) Rho_s for East Coast water quality
- CoastWatch East Coast Node established and runs the Satellite Near Real-time Water Quality Monitor to monitor water quality conditions along the U.S. east coast on a daily basis. In addition to such water quality products from satellite such as chlorophyll, turbidity and temperature, true color imagery from VIIRS surface reflectance provides views to see land, water and cloud features which help in interpreting the various satellite water quality parameters.

CoastWatch.NOAA.gov



Risks, Actions, and Mitigations

Identified Risk	Description	Impact	Action/Mitigation and Schedule
I3 QF issue	Bad detector is flagged correctly as "bad" SDR, but some SR retrievals are flagged as "good"	low	Users are advised to use the SDR quality flag as well. Assessment ongoing to identify code fix
Precision not meeting specifications	In the provisional analysis none of the bands met the precision requirement	medium	In the validated analysis all bands except M1-M3 met the precision requirement
Incomplete validation spatially	In the provisional analysis only 39 AERONET sites were used, mostly from NH	high	In the validated analysis up to 107 AERONET sites were used, distributed globally
Incomplete validation temporally	In the provisional analysis only 1month of SR data were used	high	In the provisional analysis 4 months of SR data were used

Documentations

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	Yes
Algorithm Theoretical Basis Document (ATBD)	Yes
Algorithm Calibration/Validation Plan	Yes, in preparation for J2
(External/Internal) Users Manual	Yes
System Maintenance Manual (for ESPC products)	Yes
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	As required

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).	Validation against 4 months of global AERONET 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.	Yes
Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.	Yes
Product is ready for operational use based on documented validation findings and user feedback.	Product is in operations and user feedback did not reveal any issues
Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument	Yes

Conclusion

- Cal/Val results summary:
  - Team recommends algorithm Validated maturity based on direct validation using AERONET data
  - 4 months of global data were analyzed
  - No known J2 pre-launch concerns/waivers
- Caveats
  - Further work is needed to confirm all QF performance and taking advantage of all information from upstream products
  - Further work is needed to optimize processing code (with no impact on performance)
  - Enterprise algorithm for surface reflectance: currently polar and geostationary approaches are different

Path Forward

- Expand user base and applications
  - Work with imagery team to demonstrate SR-based imagery products
  - STAR visualization systems
- Streamline production system
  - Adjust internal processing code
    - No impact on performance
  - Adjust quality flag algorithms and output
    - Needs further R&D
  - Make compatible with CEOS requirements
    - CARD4L-OSR: CEOS Analysis Ready Data for Land
- Lessons learned for N20 Cal Val
  - Close collaboration with VI team is critical
  - SR validation involves working with a very large volume of data
- Planned improvements
  - Implement High Aerosol quality flag in operations
- Future Cal/Val activities / milestones
  - Continuing product monitoring