Validated Maturity Science Review For NOAA-20 Aerosol Detection Product

Presented by
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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.

Algorithm Cal/Val Team Members

Name	Organization	Major Task
Pubu Ciren	IMSG/NOAA	Aerosol Detection Product development/validation
Brent Holben	NASA/GSFC	AERONET observations for validation work
Amy Huff	PSU	User outreach and product validation
Edward J. Hyer	NRL	Product validation, assimilation activities
Shobha Kondragunta	NOAA/NESDIS	Co-lead (aerosol detection and user outreach)
Istvan Laszlo	NOAA/NESDIS	Co-lead (aerosol optical depth)
Hongqing Liu	IMSG/NOAA	Visualization, algorithm development, validation
Lorraine A. Remer	UMBC	Documentation and validation
Arthur Russakof	IMSG/NOAA	Algorithm integration
Ivan Valerio	IMSG/NOAA	Aerosol Detection validation and Long-term monitoring/website maintenance
Hai Zhang	IMSG/NOAA	Algorithm coding, validation within IDEA

Validated Maturity Review - Entry Criteria

- Product Requirements

Product	Threshold	Objective	Notes
ADP	Dust, smoke, volcanic ash	Dust, smoke, volcanic ash, sea salt	
Smoke plume	0 to 150 μg/m^3	0 to 200 μg/m^3	
Accuracy			
ADP	80%		
Smoke	70%		
Dust	80%		
Ash	60%		Dust can be mis-identified as ash
Mixed Aerosol		80%	Report not only dominant aerosol but other aerosol components as well

Processing Environment and Algorithms

- Description of processing environment and algorithms used to achieve validated maturity stage:
  - Algorithm version
    - V2r0 based on July 2018 DAP
    - DAP delivered in December 2018
  - Version of LUTs used
    - Not applicable
  - Version of PCTs used
    - Not applicable
  - Effective date
    - When the software bug is fixed. TBD

Evaluation of the effect of required algorithm inputs

Band Name	Nominal Wavelength Range (µm)	Nominal Central Wavelength (µm)	Horizontal Sample Interval (Km) (Along-Track×Along-Scan)		Algorithm Use
			Nadir	Edge of Scan	
M1	0.402-0.422	0.412	0.742×0.259	1.60×1.58	Dust/Smoke
M2	0.436-0.454	0.445	0.742×0.259	1.60×1.58	Dust/smoke
M3	0.478-0.498	0.488	0.742×0.259	1.60×1.58	Dust/Smoke
M4	0.545-0.565	0.555	0.742×0.259	1.60×1.58	Smoke
M5	0.662-0.682	0.640	0.742×0.259	1.60×1.58	Dust/Smoke
M6	0.739 – 0.754	0.746	0.742×0.776	1.60×1.58	Smoke
M7	0.846-0.885	0.865	0.742×0.259	1.60×1.58	Dust/Smoke
M8	1.230-1.250	1.24	0.742×0.776	1.60×1.58	Dust/Smoke
M9	1.371-1.386	1.378	0.742×0.776	1.60×1.58	Dust
M10	1.580-1.640	1.61	0.742×0.776	1.60×1.58	Smoke
M11	2.225-2.275	2.25	0.742×0.776	1.60×1.58	Dust/Smoke
M12	3.660-3.840	3.70	0.742×0.776	1.60×1.58	Dust/Smoke
M13	3.973-4.128	4.05	0.742×0.259	1.60×1.58	Smoke
M14	8.400-8.700	8.55	0.742×0.776	1.60×1.58	
M15	10.263-11.263	10.763	0.742×0.776	1.60×1.58	Dust/Smoke
M16	11.538-12.488	12.013	0.742×0.776	1.60×1.58	Dust

Look-up Tables: None

Ancillary Data: Land/water mask and snow/ice mask

Evaluation of the effect of required algorithm inputs/Product Precedence

Name	Type	Description	Dimension
Solar zenith angle	input	Pixel solar zenith angle	grid (xsize, ysize)
Solar azimuth angle	input	Pixel solar azimuth angle	grid (xsize, ysize)
Satellite zenith angle	input	Pixel satellite zenith angle	grid (xsize, ysize)
Satellite azimuth angle	input	Pixel satellite azimuth angle	grid (xsize, ysize)
Latitude	input	Pixel latitude	grid (xsize, ysize)
Longitude	input	Pixel longitude	grid (xsize, ysize)
QC flags	input	VIIRS quality control flags with level 1b data	grid (xsize, ysize)

	Name	Type	Source	Dimension
VIIRS Product Precedence Data	Cloud mask	input	JPSS VIIRS level 2 cloud product	grid (xsize, ysize)
	Snow/Ice mask	input	JPSS VIIRS level 2 Snow/Ice Product	grid(xsize, ysize)
	Volcanic ash	input	JPSS VIIRS level 2 Volcanic ash Product	grid(xsize, ysize)
	Sun glint mask	input	Internally determined but needs information on viewing geometry	grid(xsize, ysize)
	Day/night flag	input	Internally determined but needs information on viewing geometry	grid(xsize, ysize)
Ancillary Data	Land/Water mask	Input	1 km dataset http://glcf.umiacs.umd.edu/data/landcover	grid(xsize,ysize)
	Snow/ice mask	Input	Interactive Multisensor Snow and Ice Mapping System (IMS) (http://nsidc.org/data/g02156.html) snow/ice mask	grid(xsize,ysize)

VALIDATED MATURITY REVIEW MATERIAL

Entry Criteria from Beta Maturity Review

- ✓ Further analysis of the data by stratifying the product over land and over water
- Thresholds for various tests specific to NOAA-20 VIIRS as it is in a different orbit (different geometry) and some minor differences in SRFs . Requires several months/at least a year worth of data to do the analysis
- ✓ Algorithm changes to IR-Visible part of the algorithm Based on GOES-R (IR-Visible) experience, mainly the way confidence values are estimated
  - If multiple tests are needed to determine dust/smoke and only one test passes, report confidence based on that test. This change will increase the detections
  - Equal weight given to all spectral tests. Use only the most important test in determining confidence value
- ~~Combine solar/satellite zenith angle criteria with confidence flags~~
- ✓ In nadir view geometry, rely on IR-Visible part of the algorithm to minimize false positives (***Zhang, H., P. Ciren, S. Kondragunta, I. Laszlo, JARS, 2018***)

Revised Algorithm package (DAP) delivered in July 2018 and implemented. However, **ASSIST introduced a bug into the code** which is impacting the product performance in NDE operations

Data Analysis

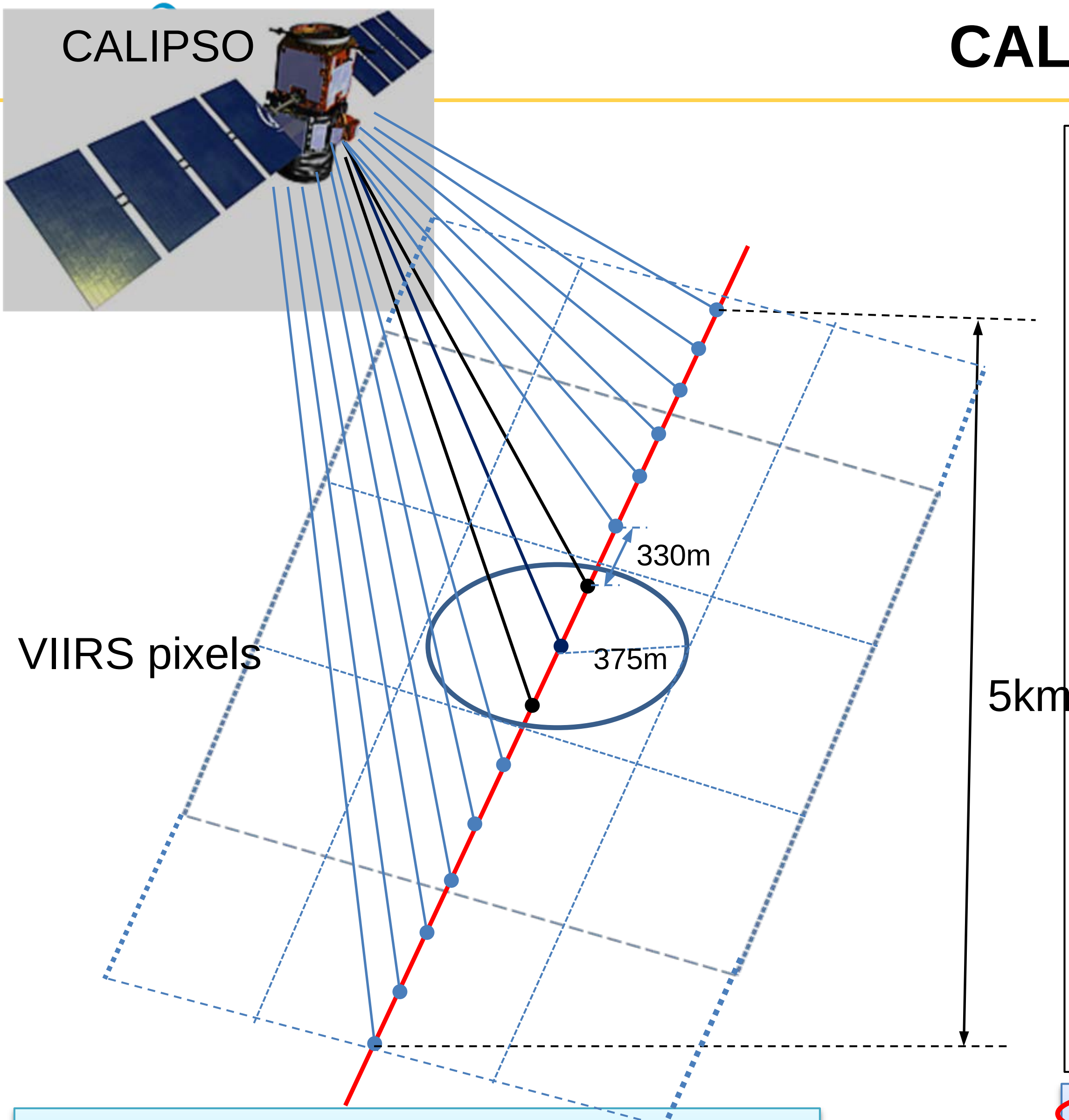
DATA

- One year (January 4 – December 31, 2018) of VIIRS Aerosol Detection Product (ADP) generated by running the algorithm offline
  - SNPP VIIRS with operational SDRs and IDPS VCM as input
  - NOAA-20 VIIRS with operational SDRs and IDPS VCM as input
- Correlative satellite data
  - CALIPSO Vertical Feature Mask (VFM) that identifies smoke and dust
  - TROPOMI Aerosol Index
- Correlative ground truth
  - AERONET Angstrom Exponent based dust/smoke classification

ANALYSIS

- Case studies of dust and smoke episodes
  - NOAA-20 vs. SNPP
  - NOAA-20 vs. TROPOMI
- Time series
  - NOAA-20 vs. SNPP Absorbing Aerosol Index
- Summary metrics
  - NOAA-20 vs. CALIPSO
  - NOAA-20 vs. AERONET

CALIPSO Matchup Criteria



- Time difference: ±30 minutes
- Spatially, VIIRS pixel within ± 375m of the middle CALIPSO profile is selected. 5 x 5 pixels surrounding that pixel are included
- Middle three profiles of CALIPSO are used to determine aerosol type in the column
  - All three profiles need to be cloud-free;
  - Dominant aerosol type is determined through the calculation of dust (or smoke) fraction (i.e., no of dust (or smoke) layers divided by the no. of aerosol layers from surface to top. A particular type of aerosol has to be >80%
- VIIRS ADP data are filtered for high quality.

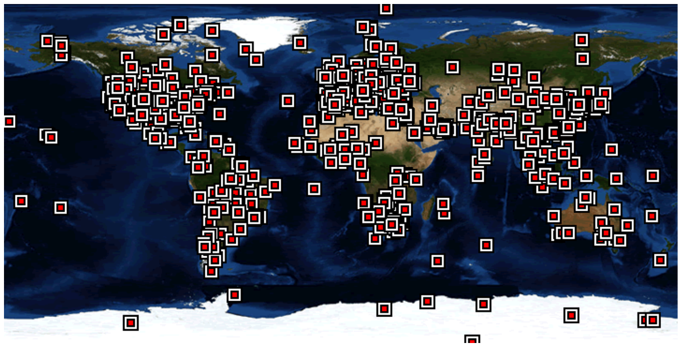
True Positive (TP): VIIRS and CALIPSO say dust
True Negative(TN): VIIRS and CALIPSO say no dust
False Negative(FN): VIIRS says no dust but CALIPSO says dust
False Positive(FP): VIIRS says dust when CALIPSO says no dust

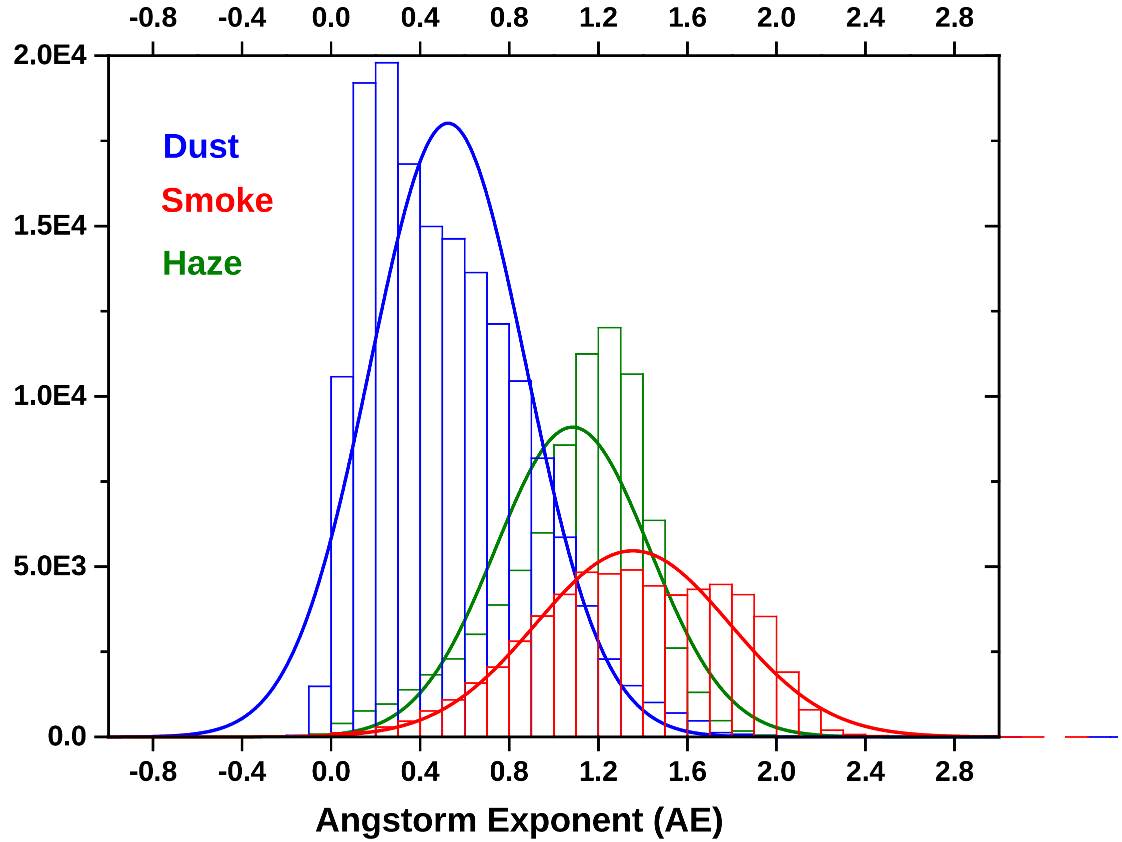
Close to 100%

POCD = TP/(TP+FN)
Accuracy = (TP+TN)/(TP+TN+FP+FN)
POFD = FP/(FP+TP)

Close to 0%

AERONET Matchup Criteria

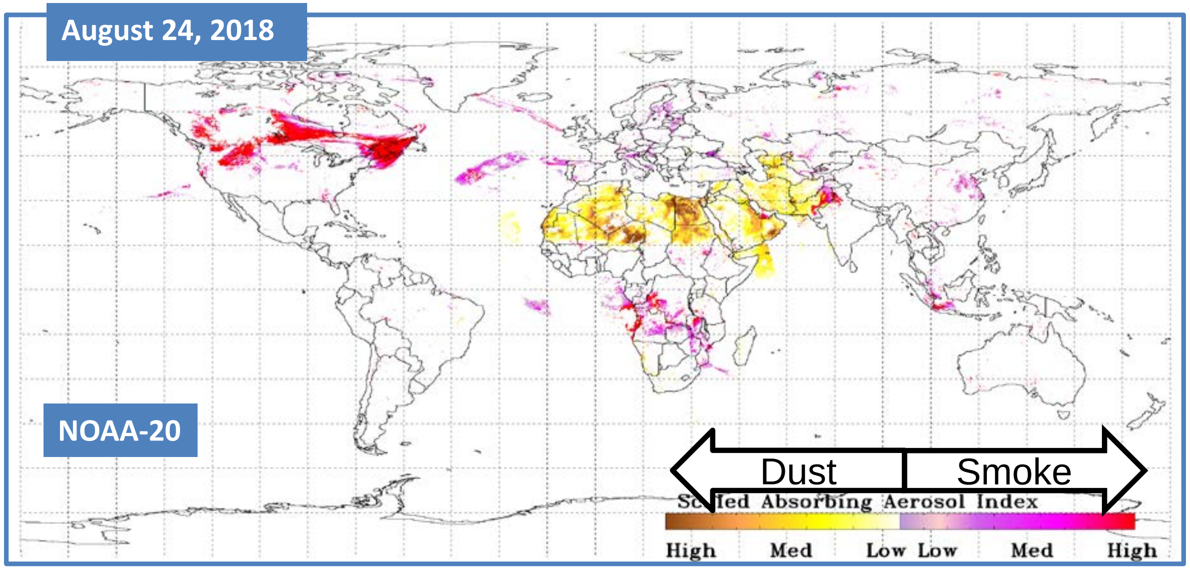


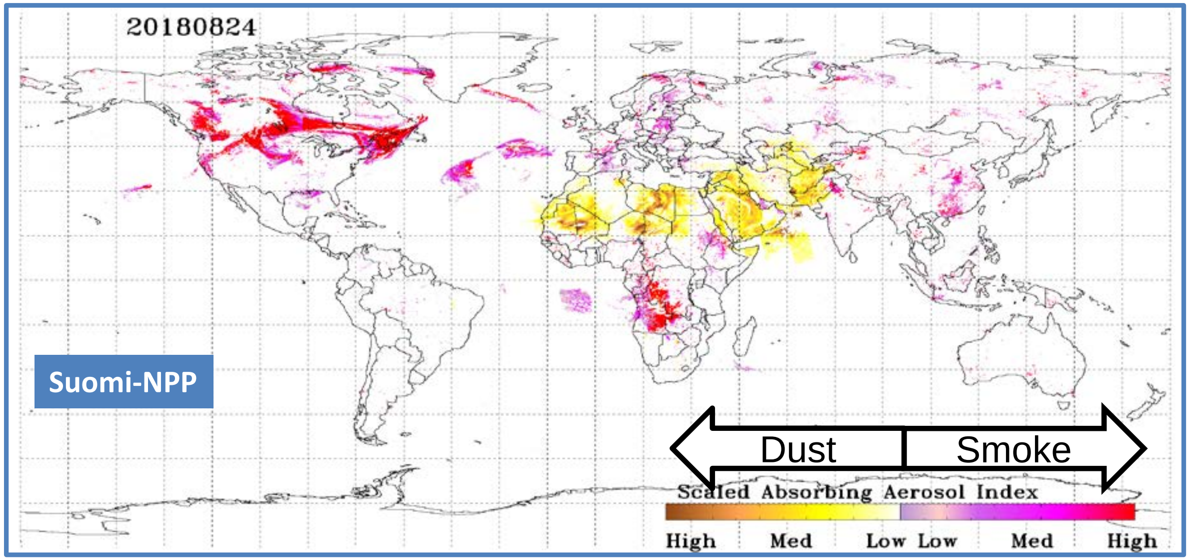


AERONET Smoke: AOD > 0.2 and Angstrom Exponent > 1.0
AERONET Dust: AOD > 0.2 and Angstrom Exponent < 0.5

AERONET and NOAA-20 within ±30 min
NOAA-20 VIIRS > 750 pixels within 27.5 km radius of AERONET

Global Distribution of Dust and Smoke





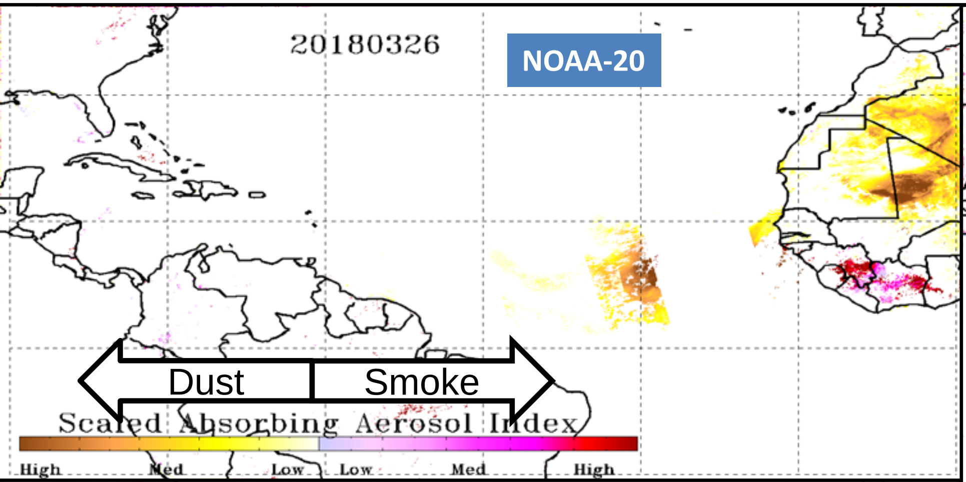
$$AAI = -100\left[\log_{10}\left(\frac{R_{0.41}}{R_{0.44}}\right) - \log_{10}\left(\frac{R'_{0.41}}{R'_{0.44}}\right)\right]$$

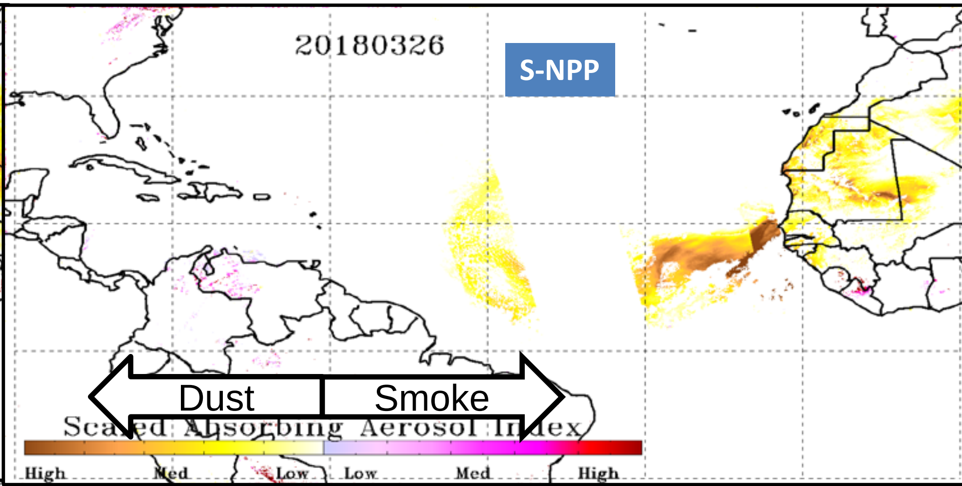
$$DSDI = -10\log_{10}\left(\frac{R_{0.41}}{R_{2.2}}\right)$$

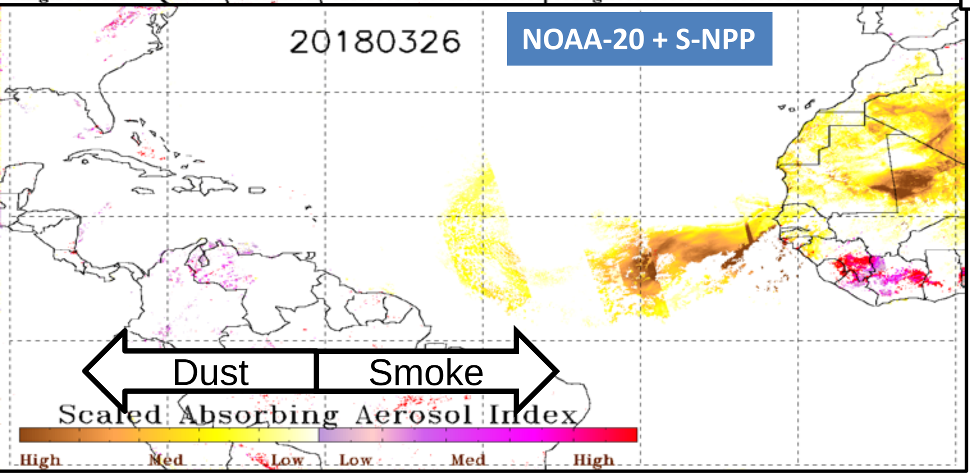
Index	Threshold (Land)	Threshold (Water)
AAI	>11.5	>4
DSDI	>0	>10

SSAI = AAI-Threshold

Trans-Atlantic Dust Transport



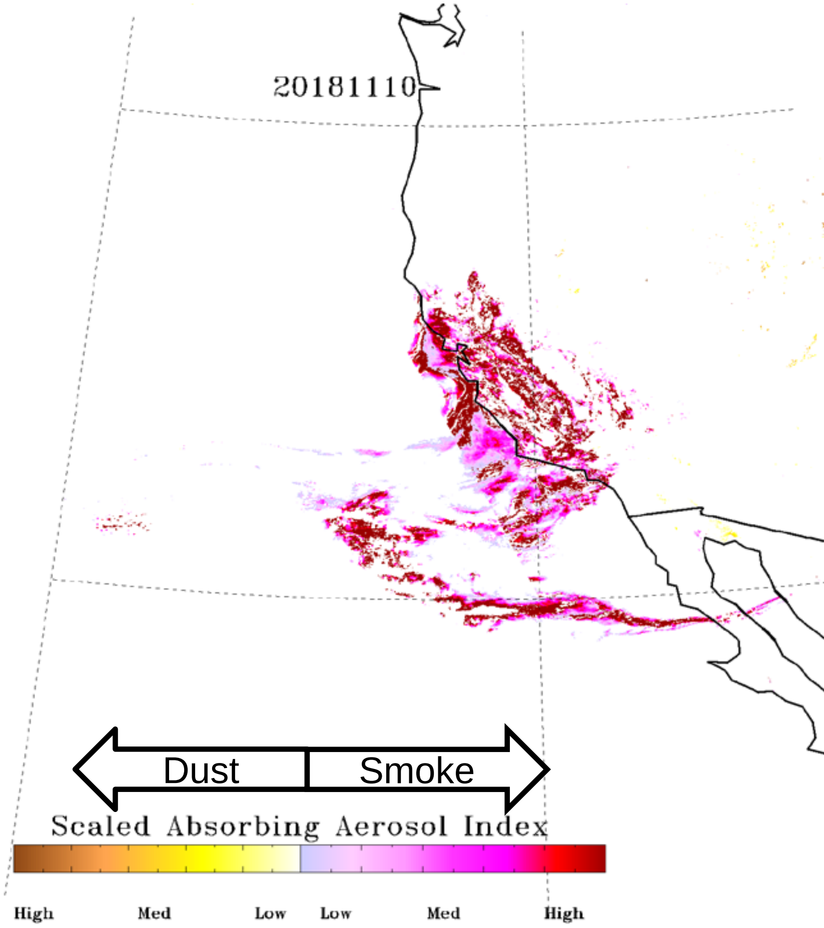


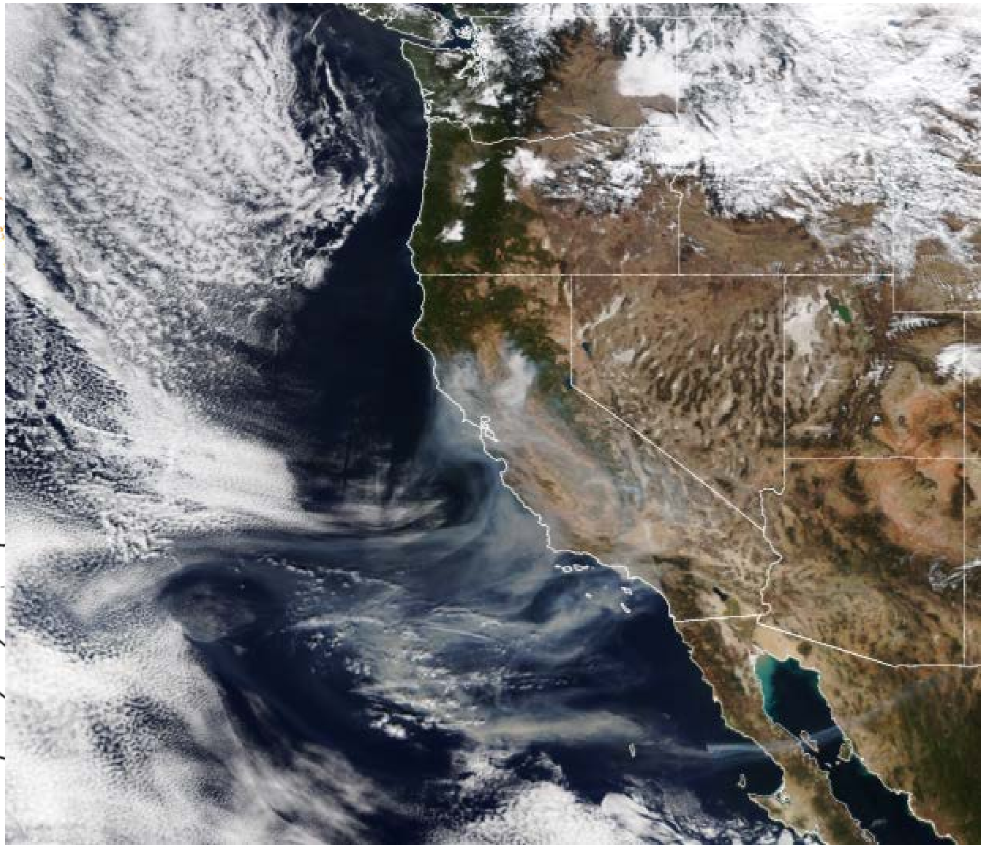


Combining ADP from NOAA-20 and S-NPP can increase the coverage, especially over ocean where sunglint regions are different.

Smoke from California Camp Fire on November 10, 2018

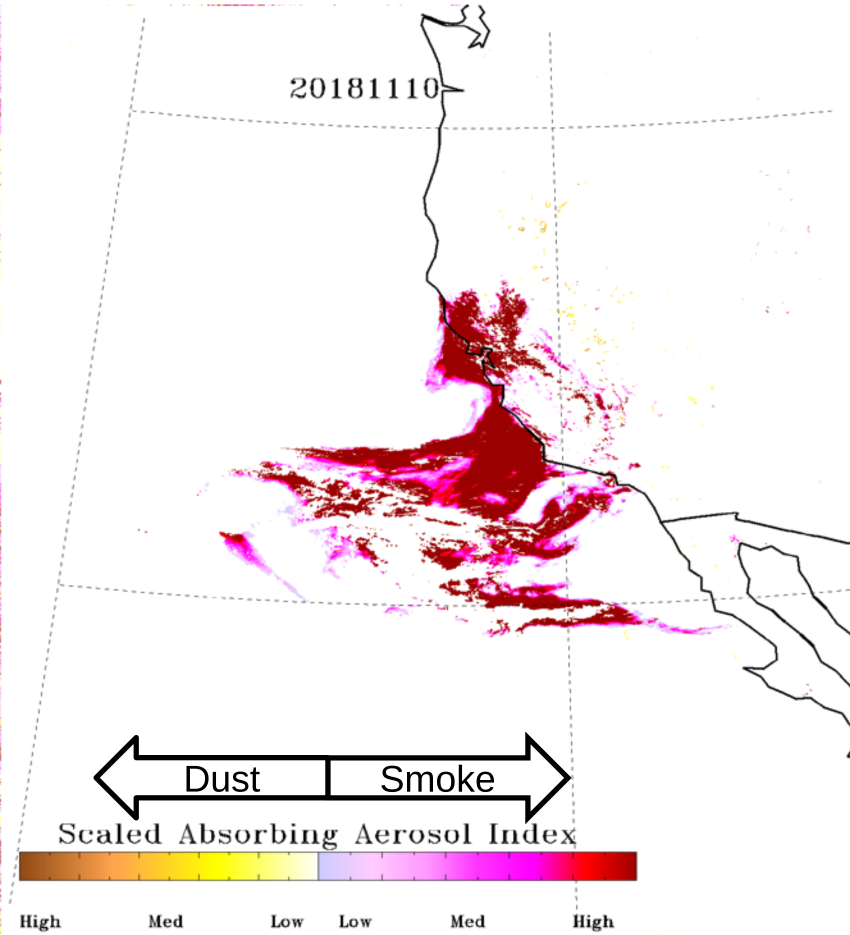
NOAA-20

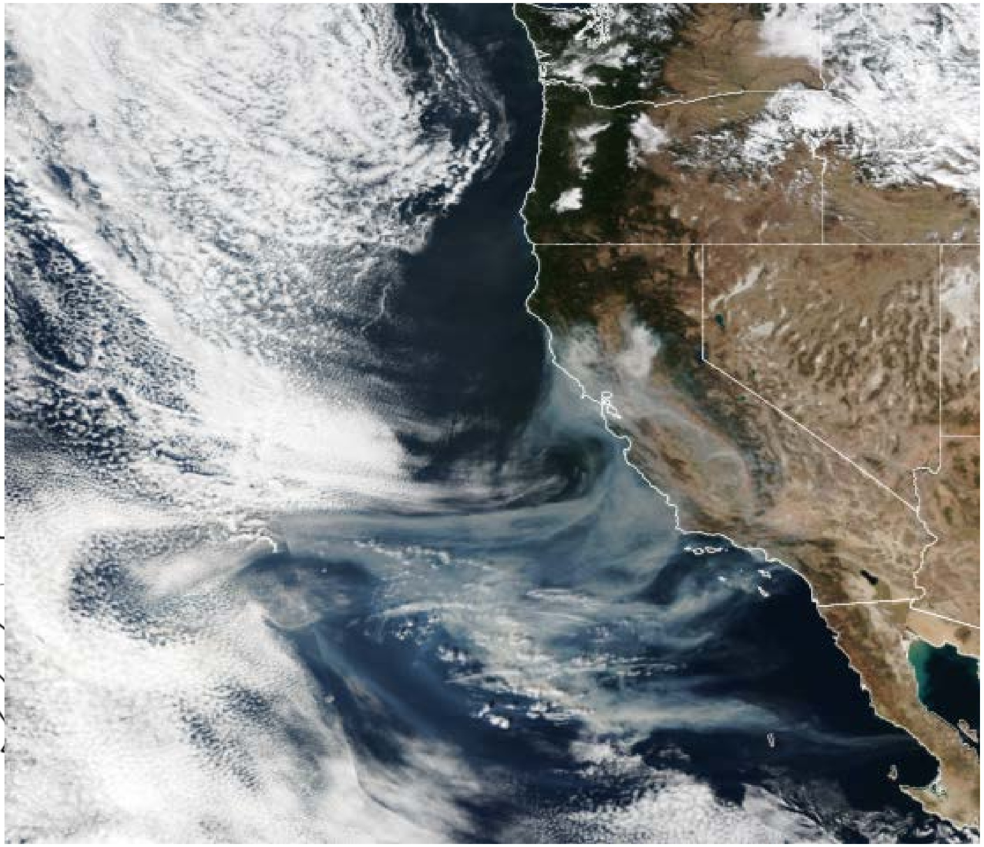




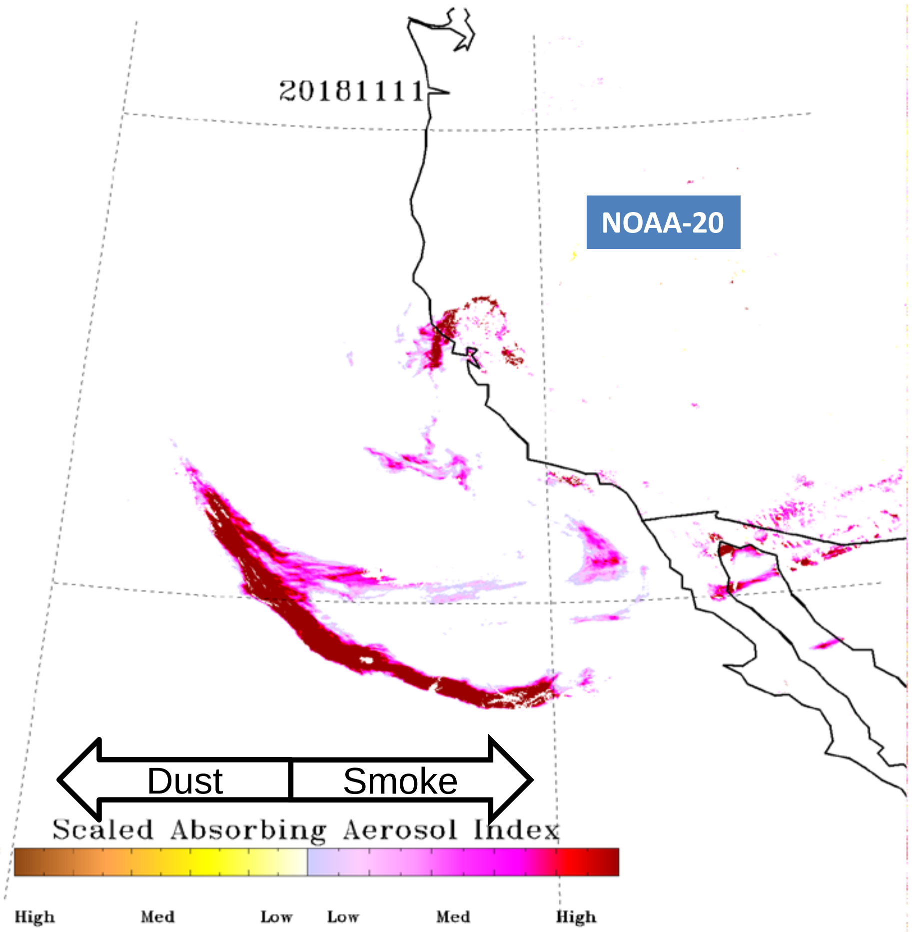
Smoke from California Camp Fire on November 10, 2018

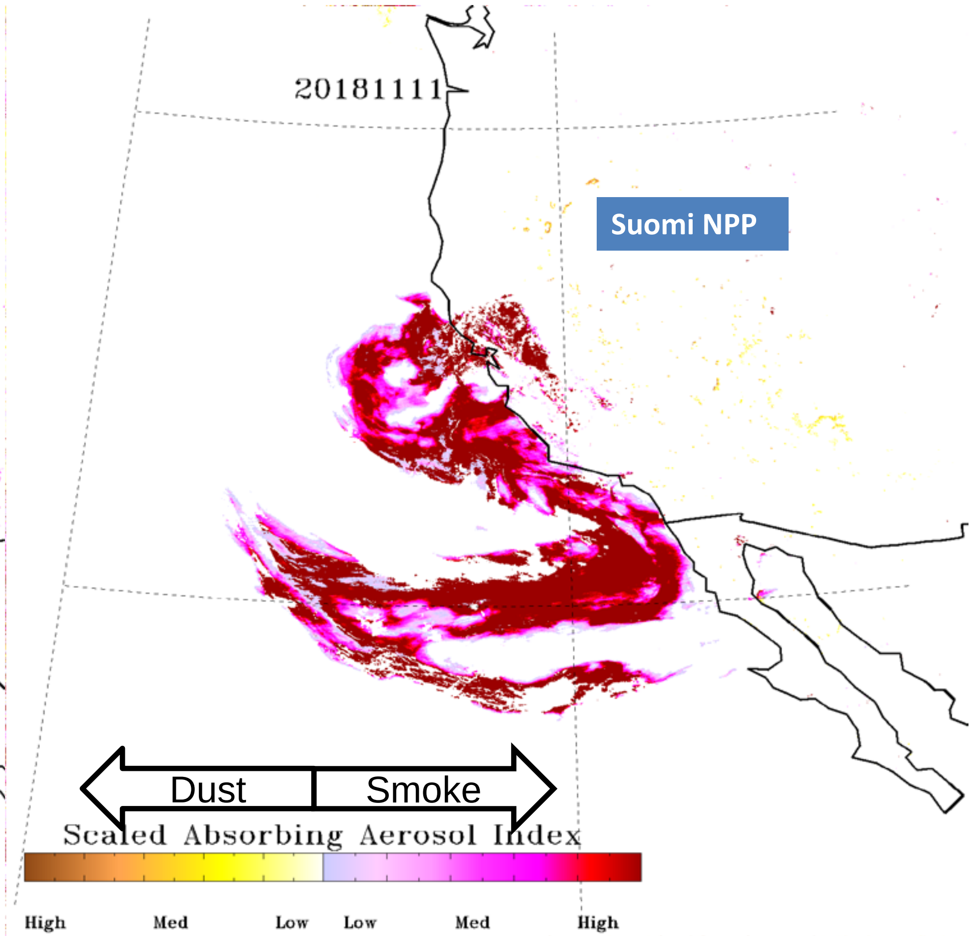
Suomi-NPP





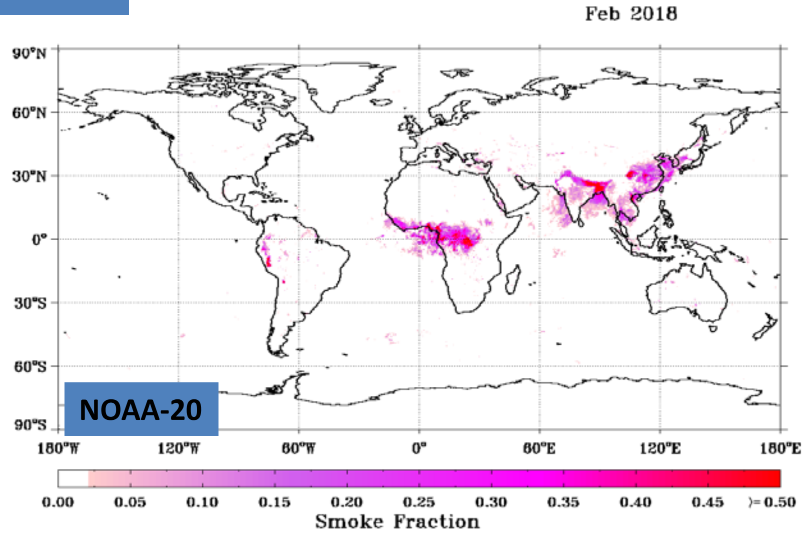
Smoke from California Camp Fire on November 11, 2018

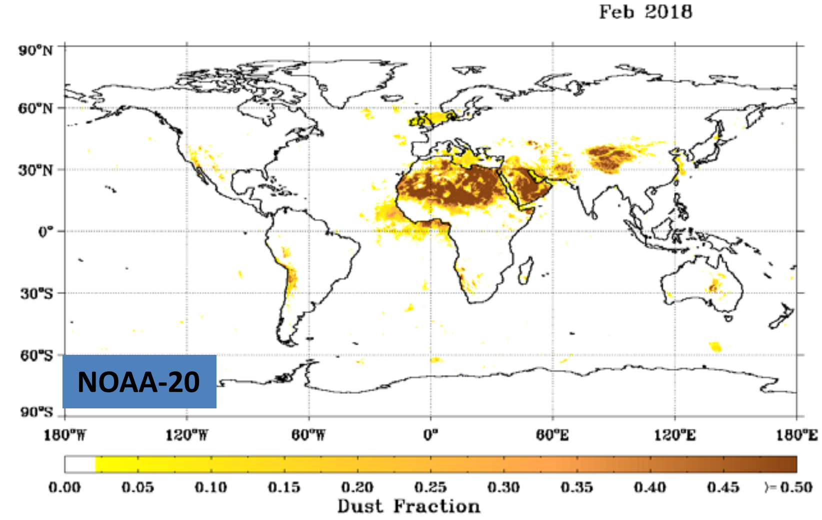


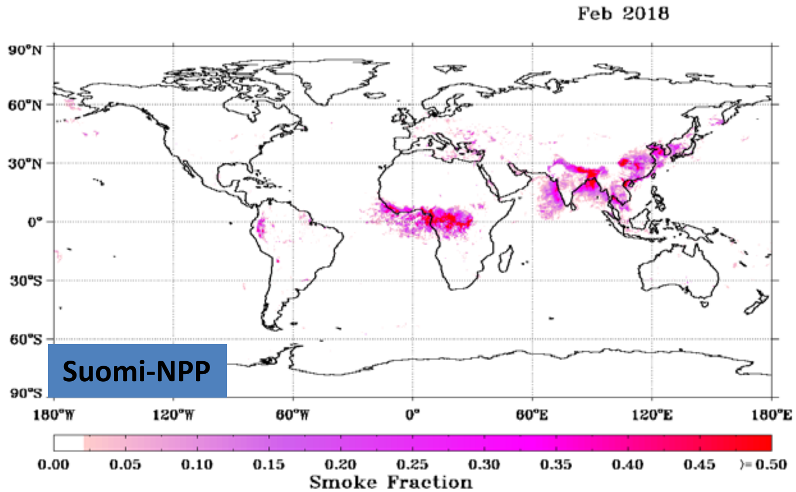


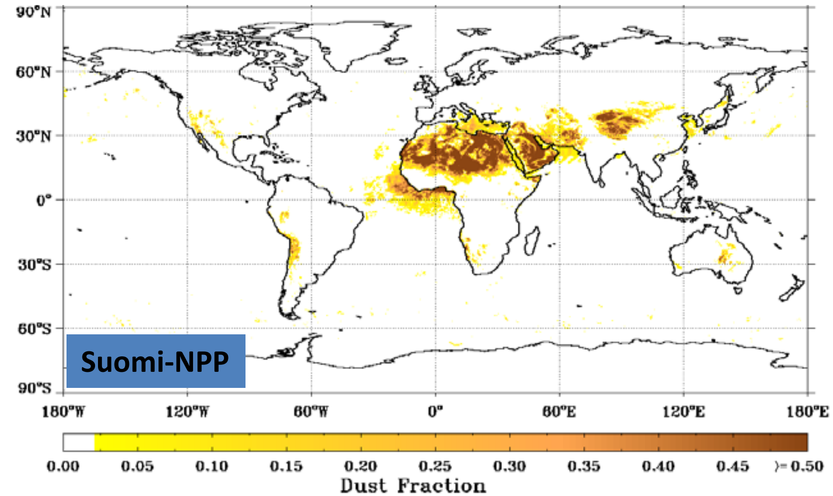
Global Smoke and Dust Fraction for February 2018

0.25ºX0.25º







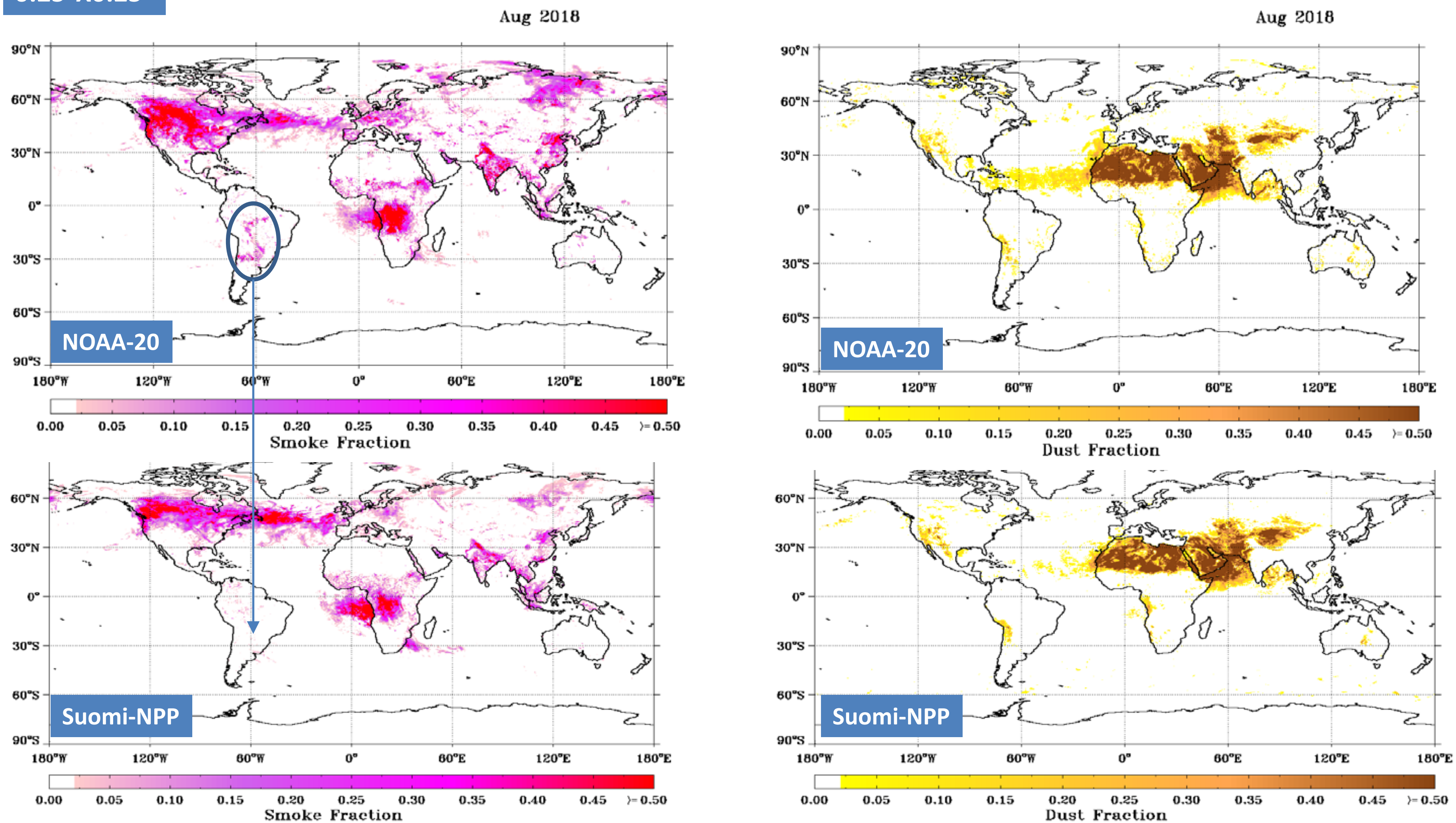


Dust Fraction: Dust/(Dust+Smoke+None)

Smoke Fraction: Smoke/(Smoke+Dust+None)

Global Smoke and Dust Fraction for August 2018

0.25ºX0.25º

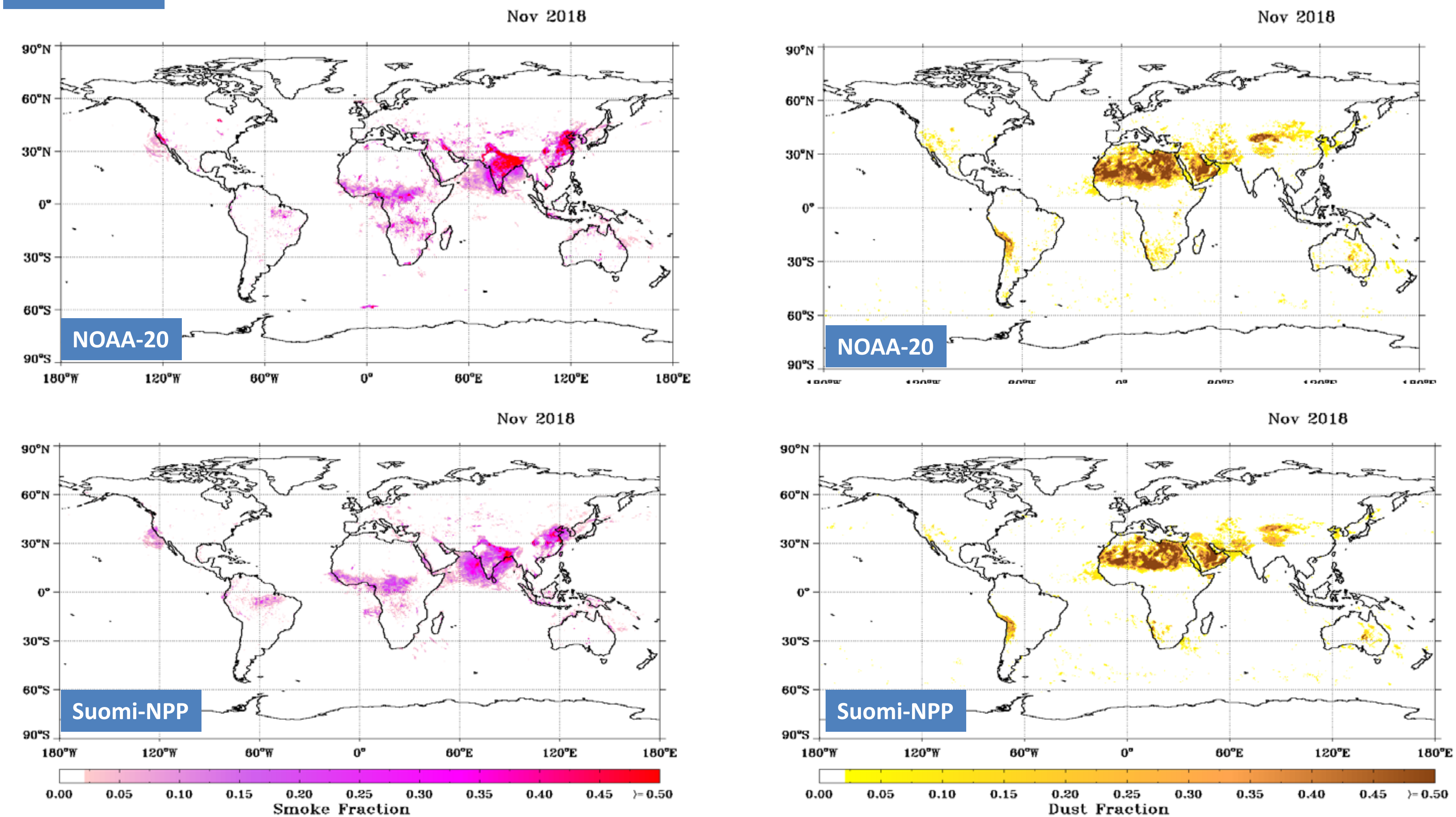


Dust Fraction: Dust/(Dust+Smoke+None)

Smoke Fraction: Smoke/(Smoke+Dust+None)

Global Smoke and Dust fraction for November 2018

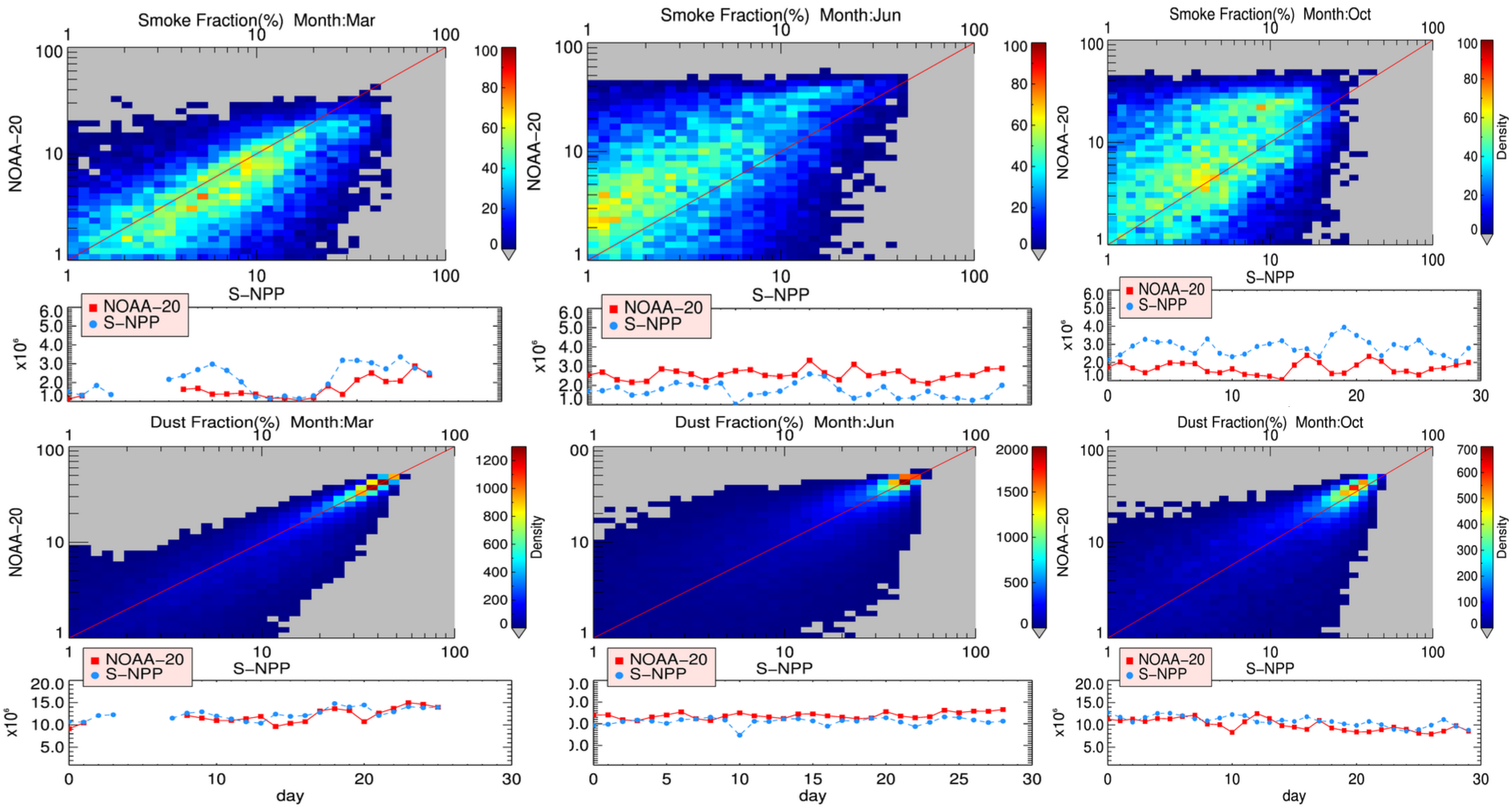
0.25ºX0.25º



Dust Fraction: Dust/(Dust+Smoke+None)

Smoke Fraction: Smoke/(Smoke+Dust+None)

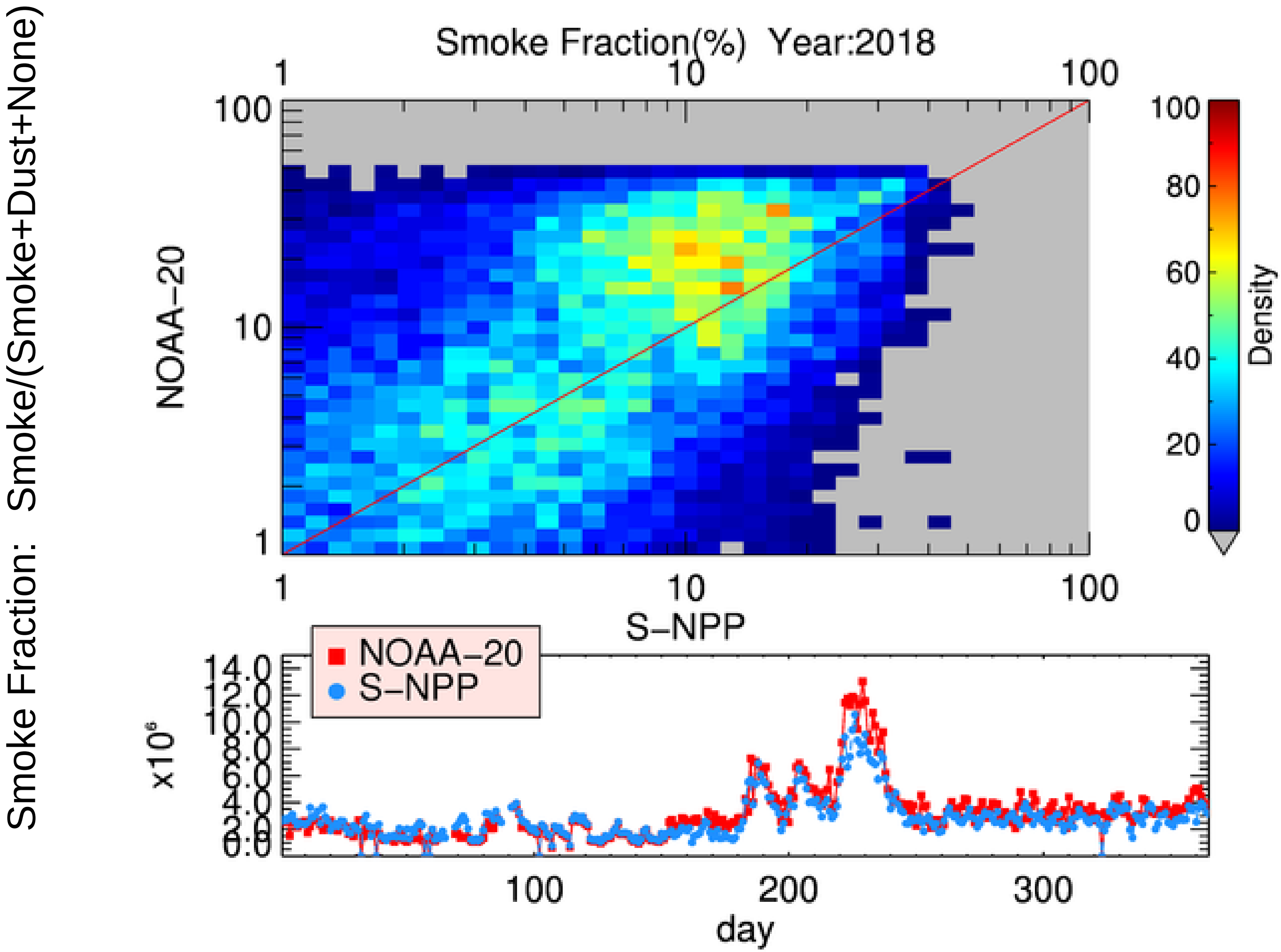
Monthly Smoke and Dust Fraction: NOAA-20 vs. SNPP



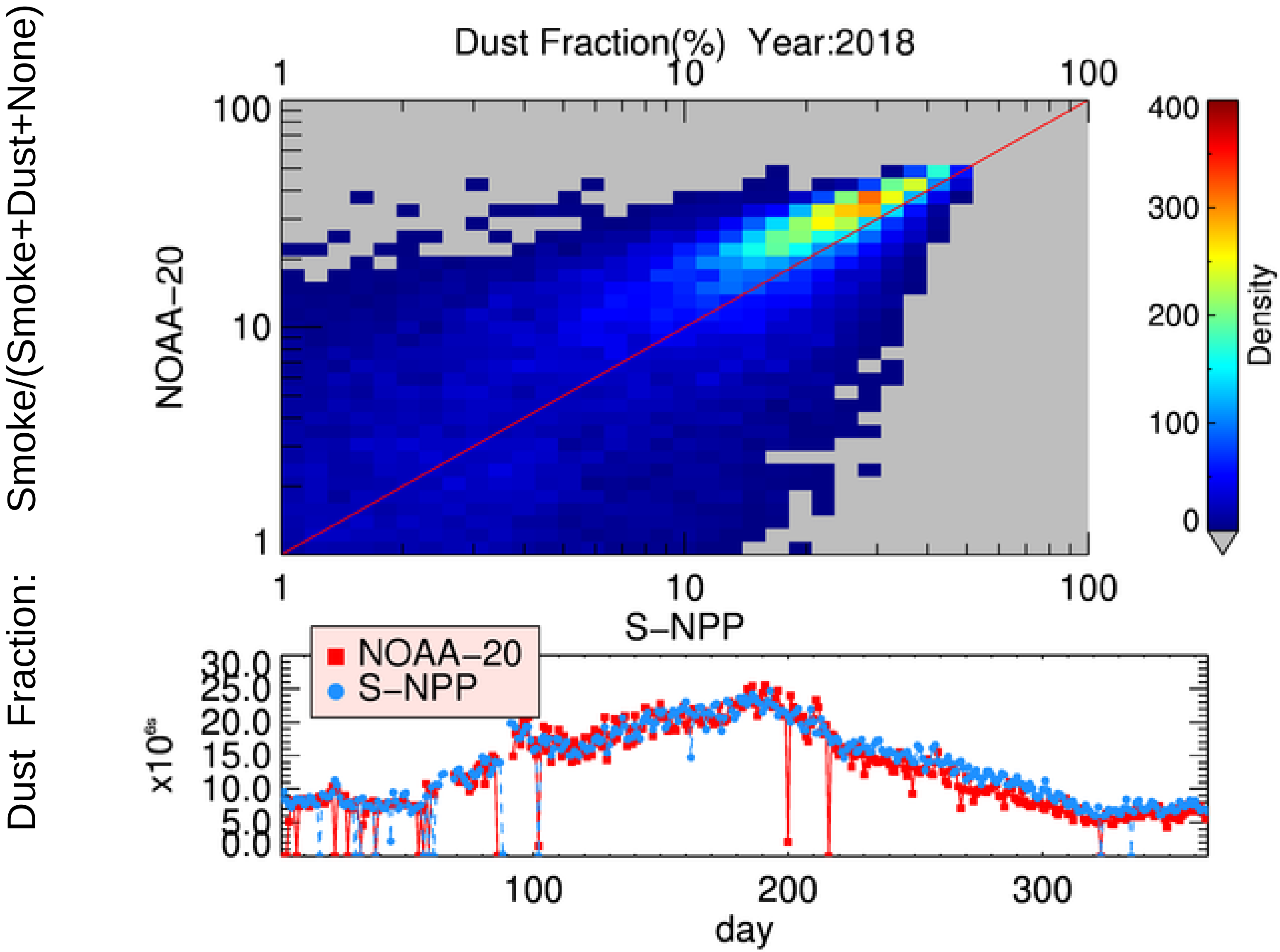
Dust Fraction: Dust/(Dust+Smoke+None)

Smoke Fraction: Smoke/(Smoke+Dust+None)

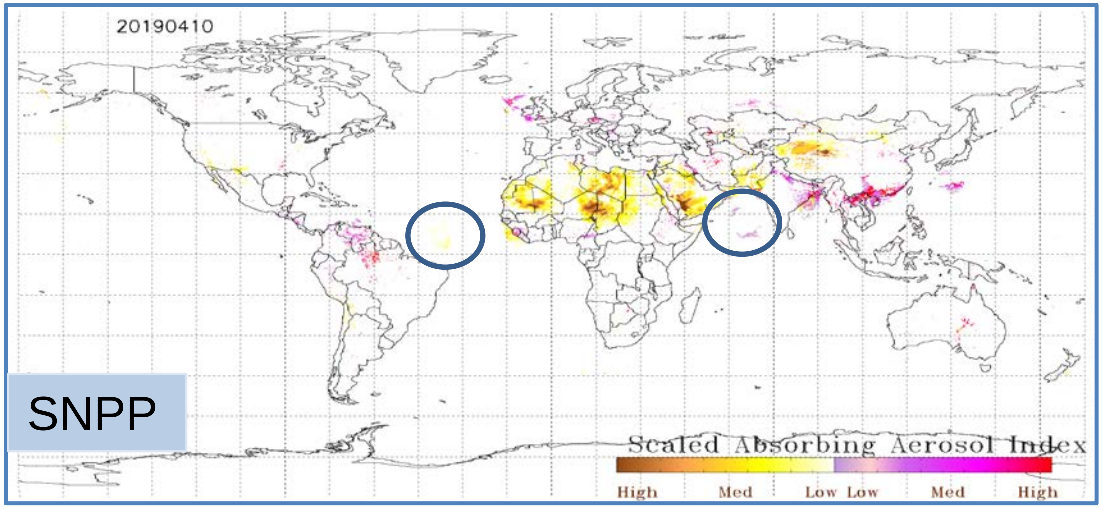
Time Series of Smoke Fraction: NOAA-20 vs. SNPP

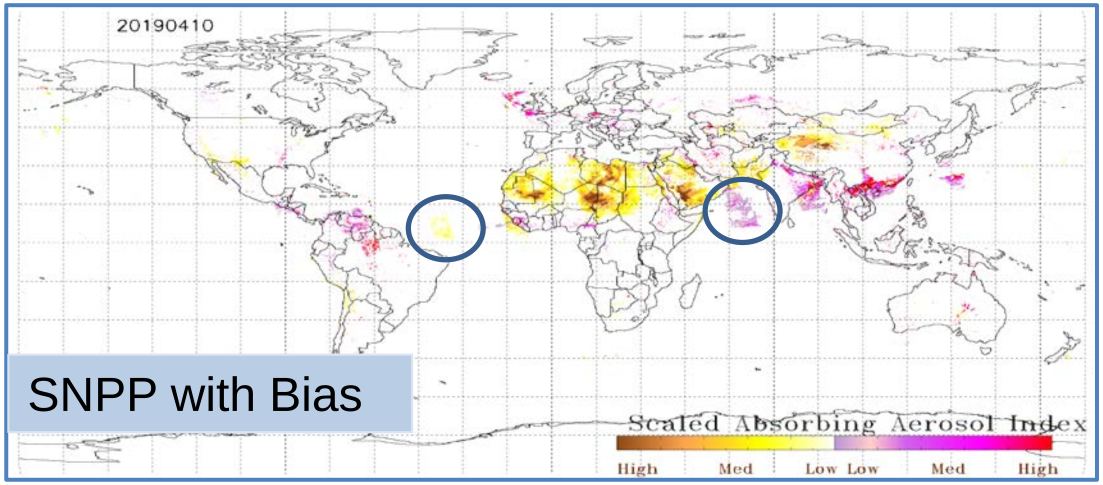


Time Series of Dust Fraction: NOAA-20 vs. SNPP



Impact of Calibration Differences





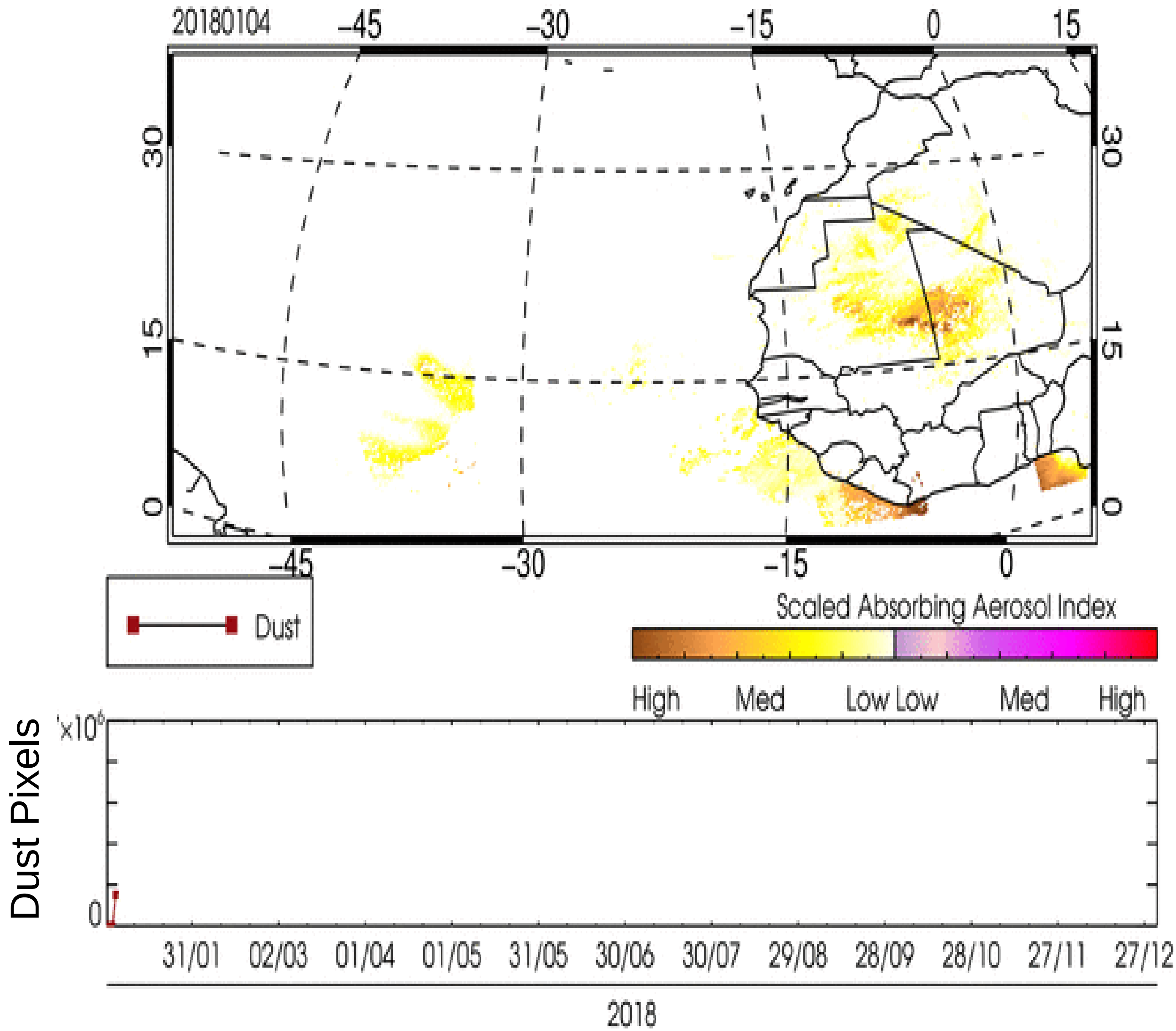
NOAA-20 = SNPP * (1+bias)

M1: -3% M2: -1.7% M3: -2.6%
M4: -3.2% M5: -5% M7: -3.8%
M8: -2.7% M9: -1.2% M10: -1.9%
M11: -2.2%

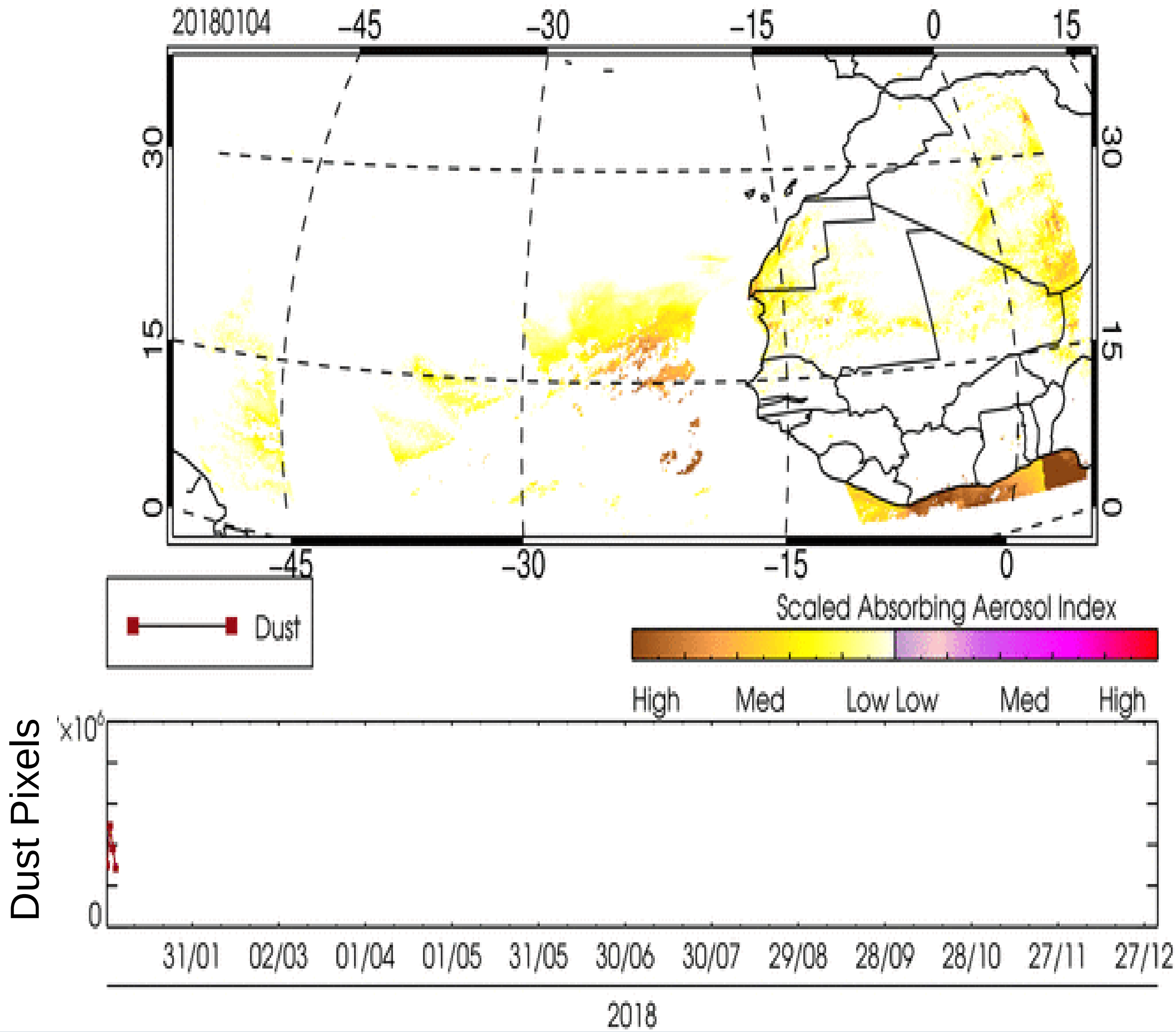
No. of smoke pixels changes : 5%
No. of dust pixels changes: <1%

- More smoke (mainly over ocean) is detected after reducing the reflectance according above
- Slight increase of dusty pixels (over ocean).
- Impact from cloud mask is not considered.

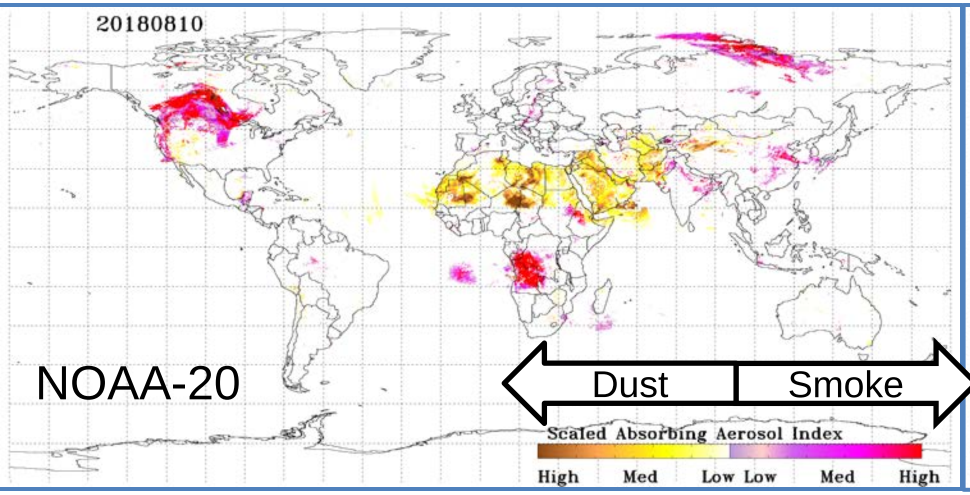
Time Series of Dust Fraction Observed by NOAA-20

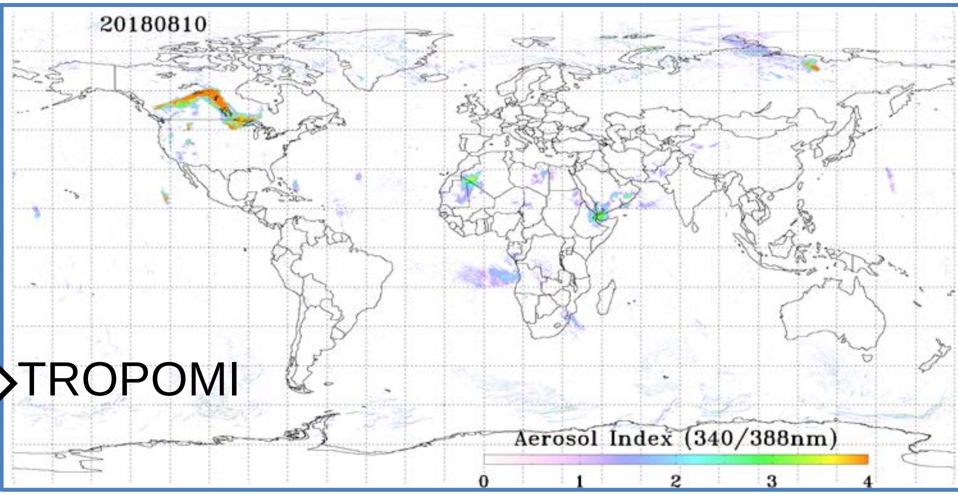


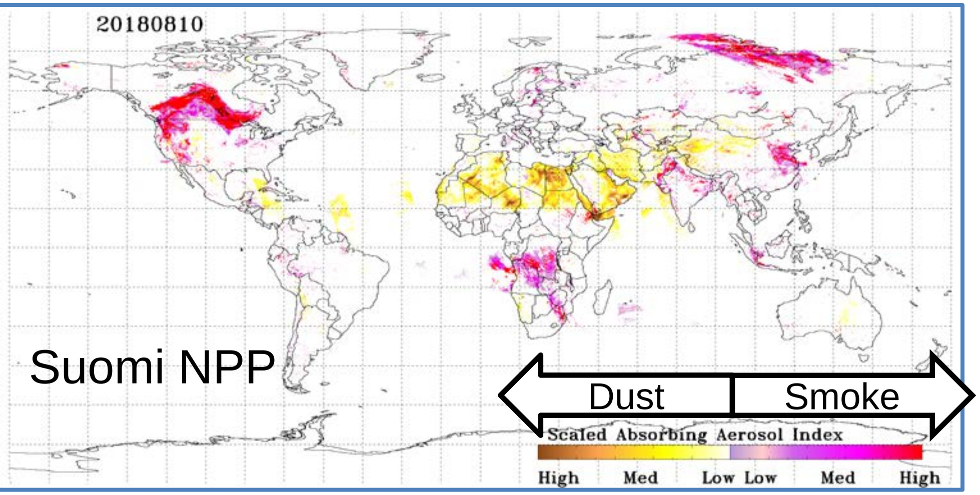
Time Series of Dust Fraction Observed by Suomi NPP



NOAA-20 and SNPP vs. TROPOMI





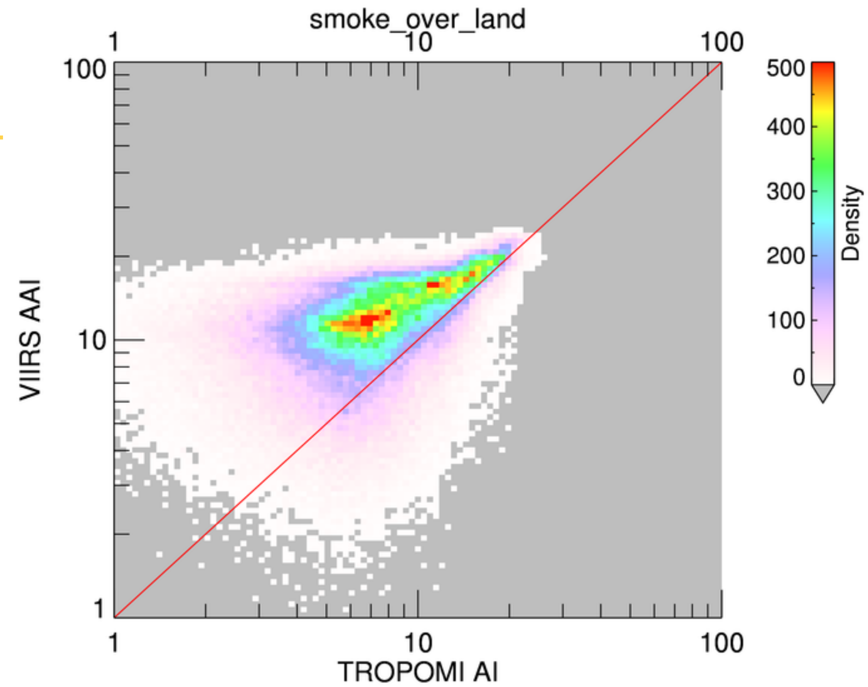


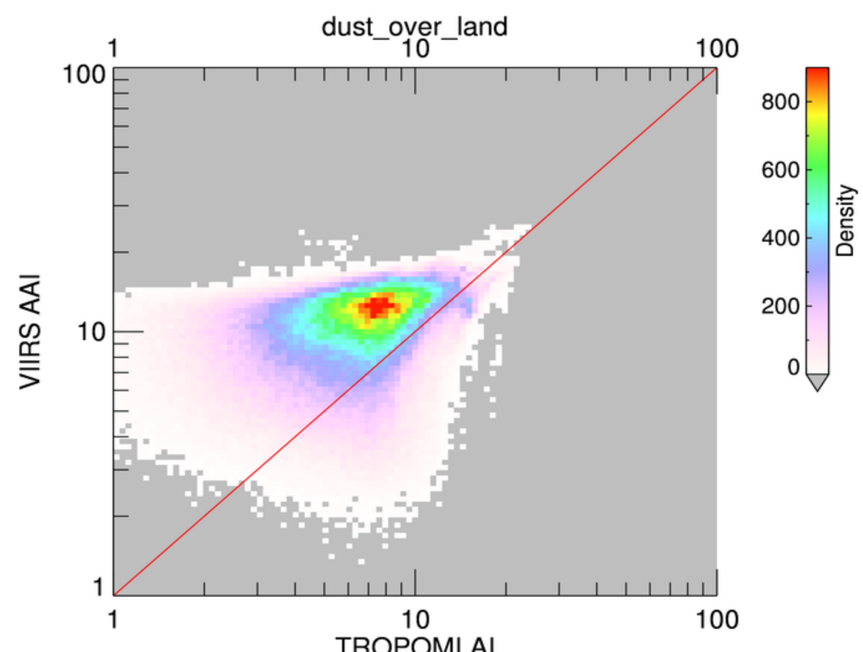
SNPP and TROPOMI have similar observation time. NOAA-20 observation times are different from SNPP/TROPOMI by ~50 minutes

VIIRS Aerosol Index:	412 nm and 440 nm
TROPOMI Aerosol Index:	340 nm and 388 nm

S5P TROPOMI vs. SNPP VIIRS Aerosol Index over Land

- Four days of data: April 1, 10, 24, 25 2019
- TROPOMI Aerosol Index (AI) is retrieved using 340 nm and 388 nm. Remapped from 7 km to 0.25º x 0.25º
- VIIRS Aerosol Index is retrieved using 412 nm and 440 nm. Remapped from 750 m resolution to 0.25º x 0.25º
- Perfect one to one correlation not expected as these quantities are different
  - Surface contribution not removed in VIIRS AI whereas TROPOMI removes surface contribution
  - Spectral dependence of aerosol absorption and surface reflectance is different in the UV vs. Visible wavelengths





S5P TROPOMI vs. SNPP VIIRS Aerosol Index over Land

- Four days of data: April 1, 10, 24, 25 2019
- TROPOMI Aerosol Index (AI) is retrieved using 340 nm and 380 nm. Remapped from 7 km to 0.25º x 0.25º
- VIIRS Aerosol Index is retrieved using 412 nm and 440 nm. Remapped from 750 m resolution to 0.25º x 0.25º
- Perfect one to one correlation not expected as these quantities are different
  - Surface contribution not removed in VIIRS AI whereas TROPOMI removes surface contribution
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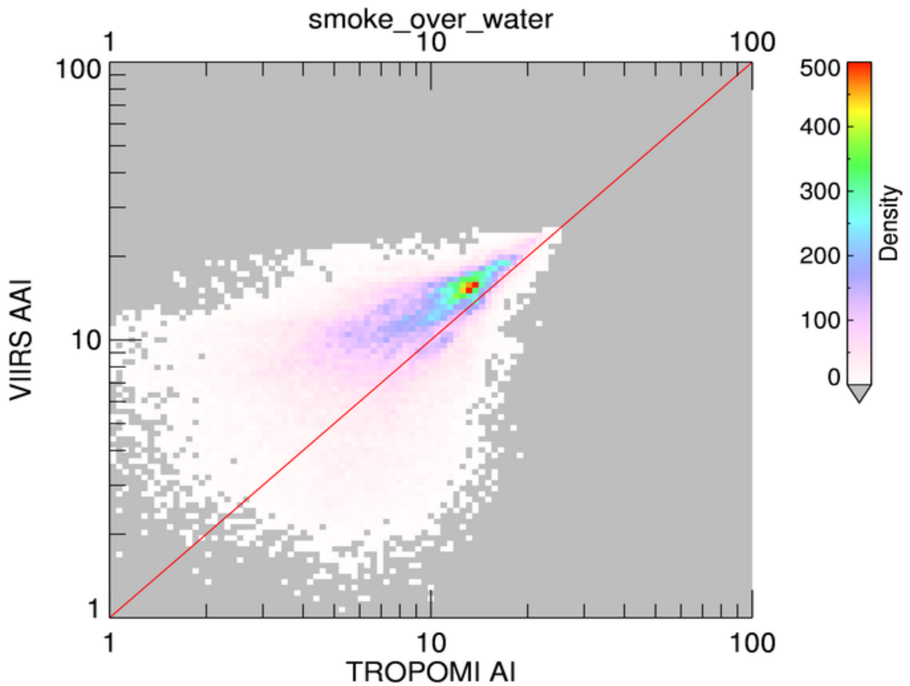

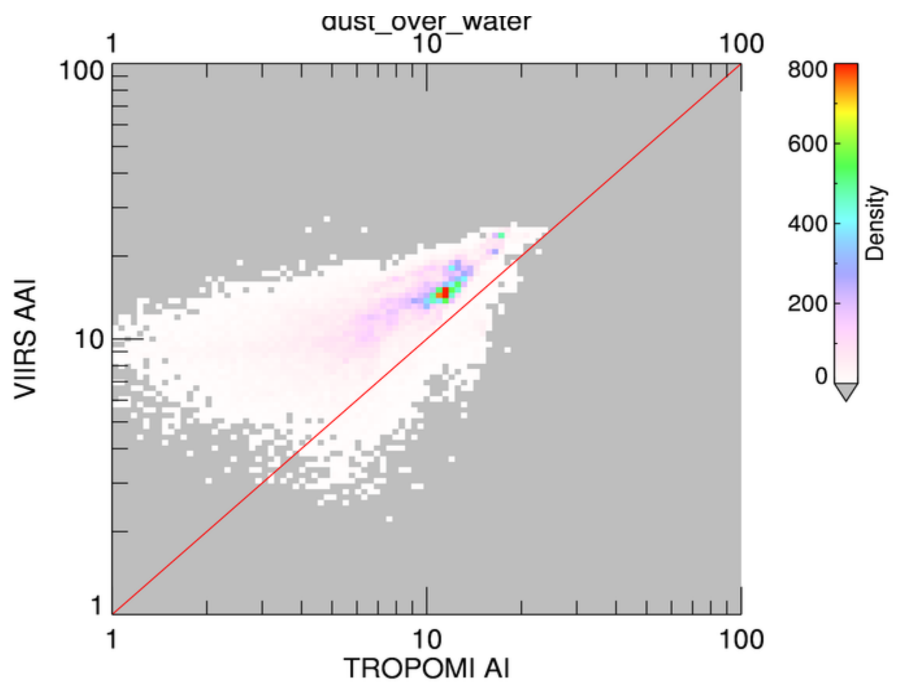

S5P TROPOMI vs. NOAA-20 VIIRS Aerosol Index over Land

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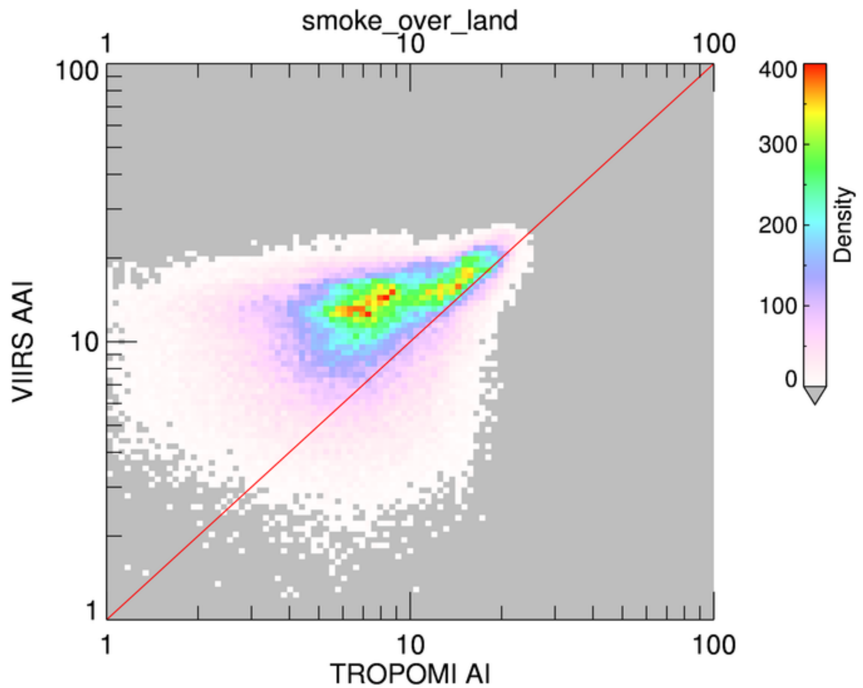
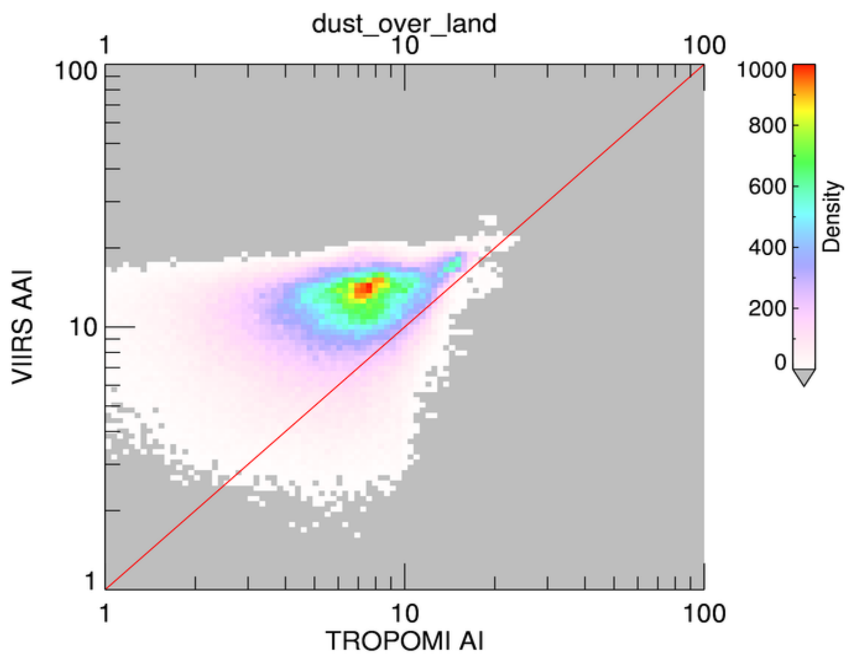
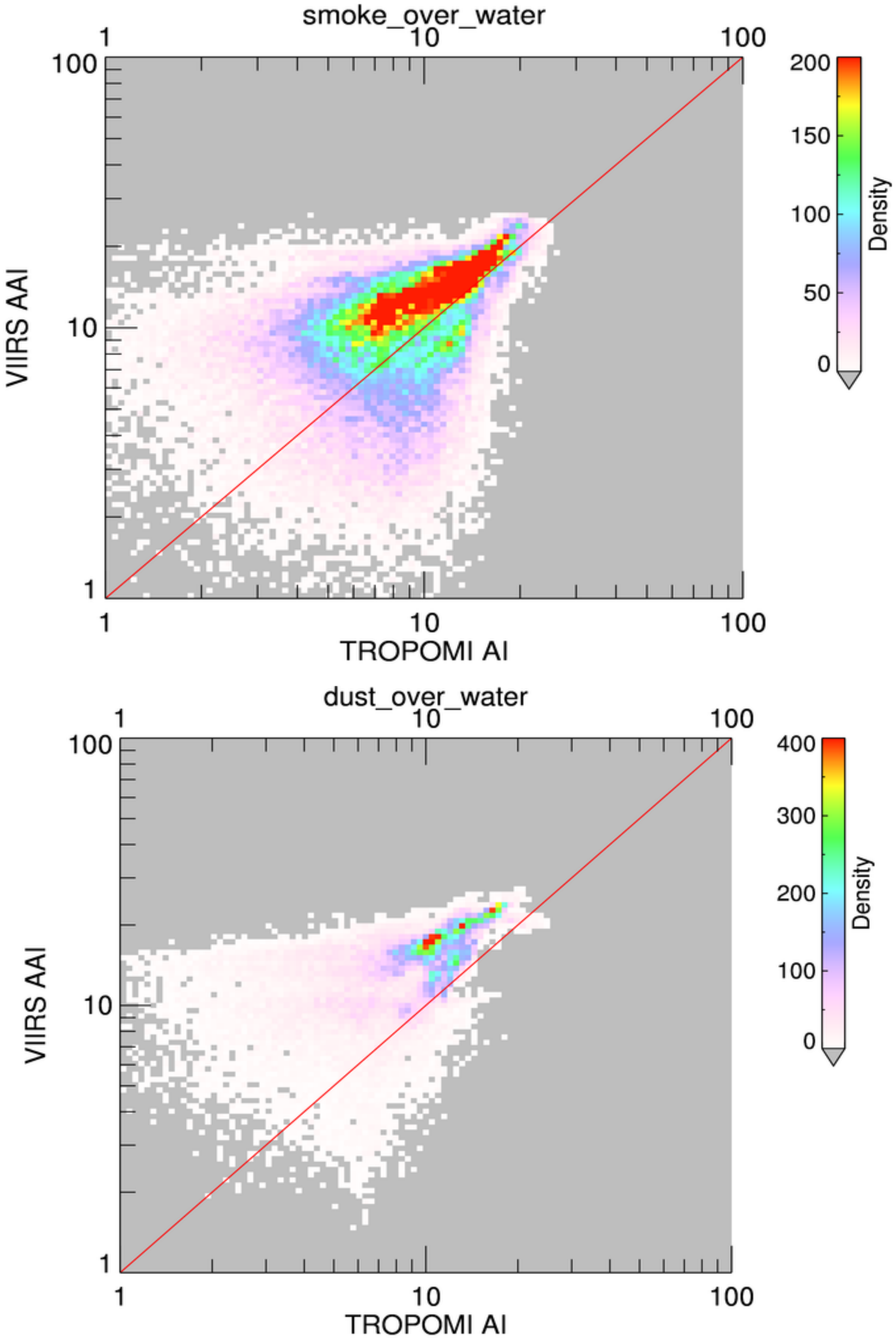


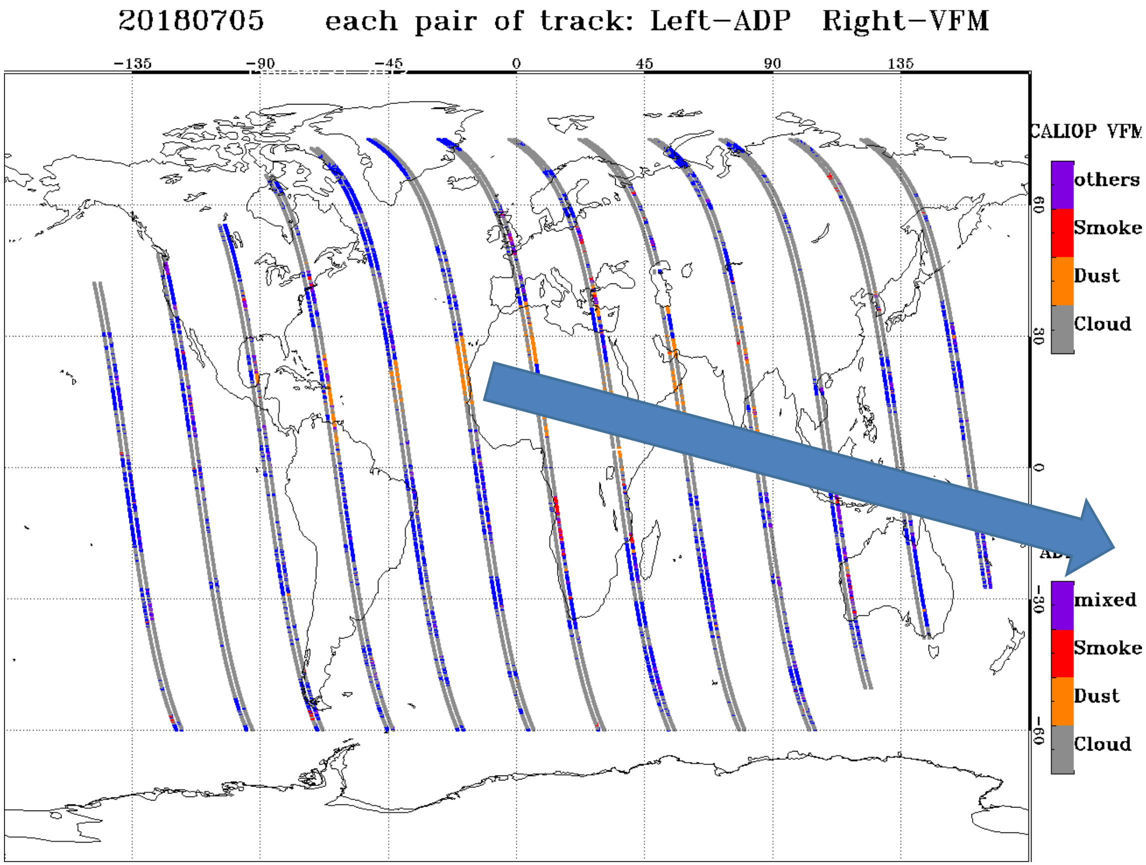


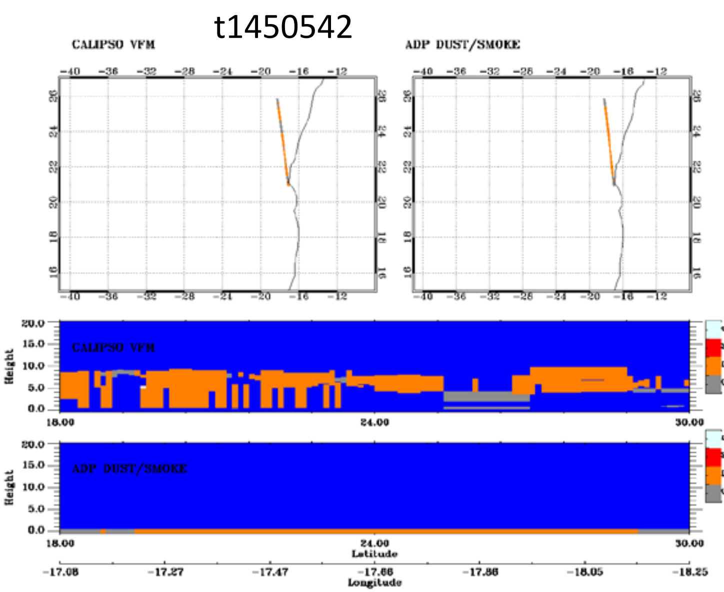
S5P TROPOMI vs. NOAA-20 VIIRS Aerosol Index over Water

- Four days of data: April 1, 10, 24, 25 2019
- TROPOMI Aerosol Index (AI) is retrieved using 340 nm and 380 nm. Remapped from 7 km to 0.25º x 0.25º
- VIIRS Aerosol Index is retrieved using 412 nm and 440 nm. Remapped from 750 m resolution to 0.25º x 0.25º
- Perfect one to one correlation not expected as these quantities are different
  - Surface contribution not removed in VIIRS AI whereas TROPOMI removes surface contribution
  - Spectral dependence of aerosol absorption and surface reflectance is different in the UV vs. Visible wavelengths



Validation: NOAA-20 ADP vs. CALIPSO VFM

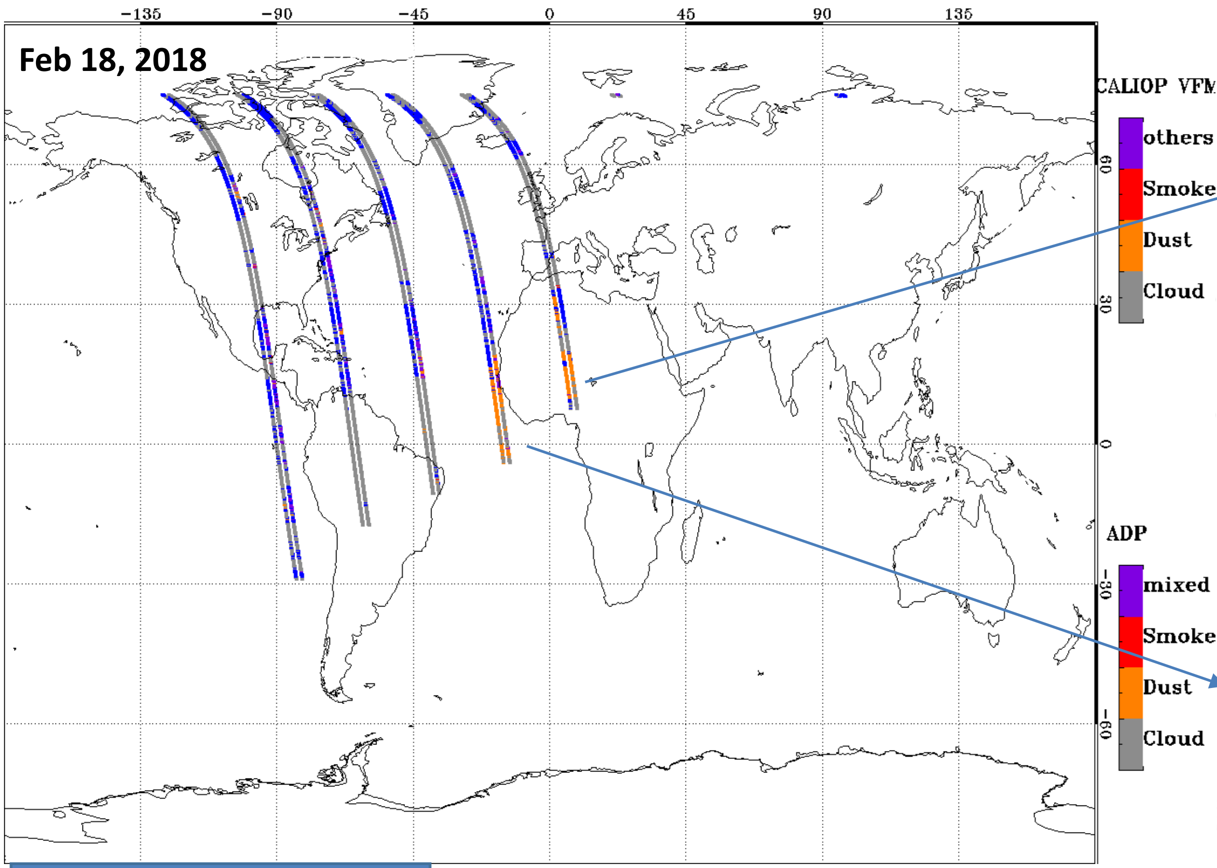


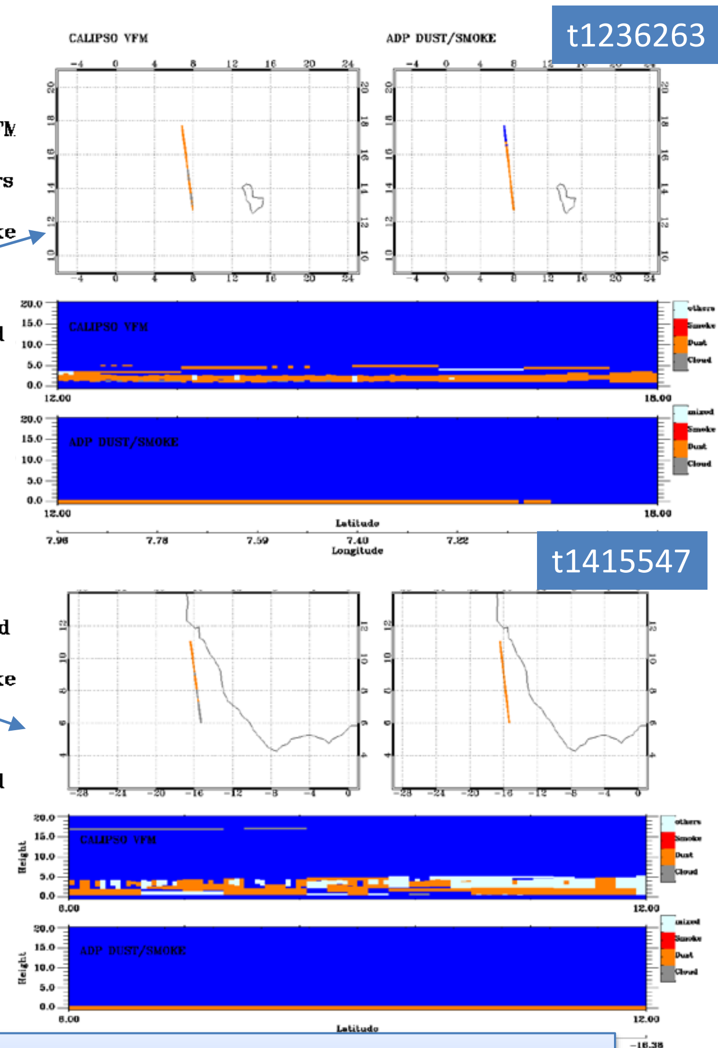


For each pair of track:
Left: NOAA-20 ADP
Right: CALISPO VFM

Accuracy	96%
POCD	89%

Validation: NOAA-20 ADP vs. CALIPSO VFM





For each pair of tracks:
Left: ADP
Right: CALISPO VFM

Metric	t1415547	t1236263
Accuracy	95%	78%
POCD	100%	100%

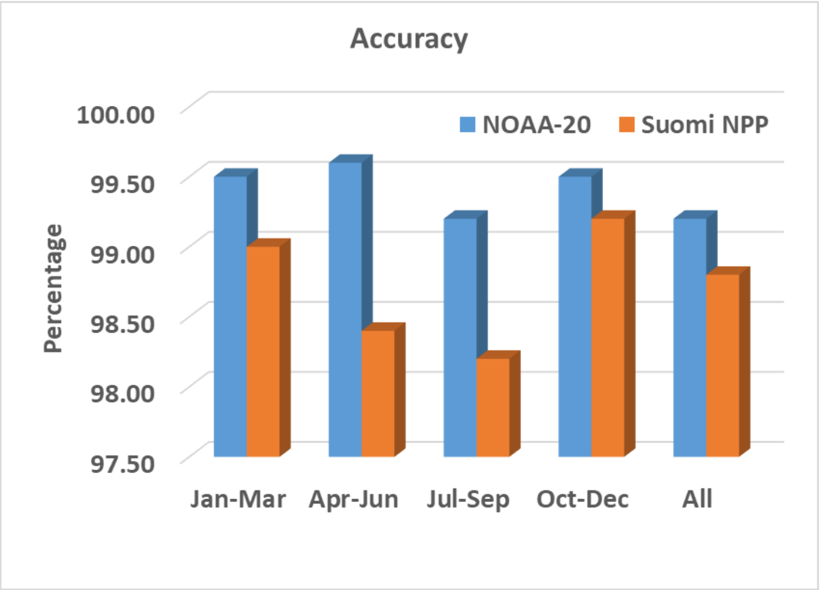
POCD = TP/(TP+FN)
Accuracy = (TP+TN)/(TP+TN+FP+FN)
POFD = FP/(FP+TP)

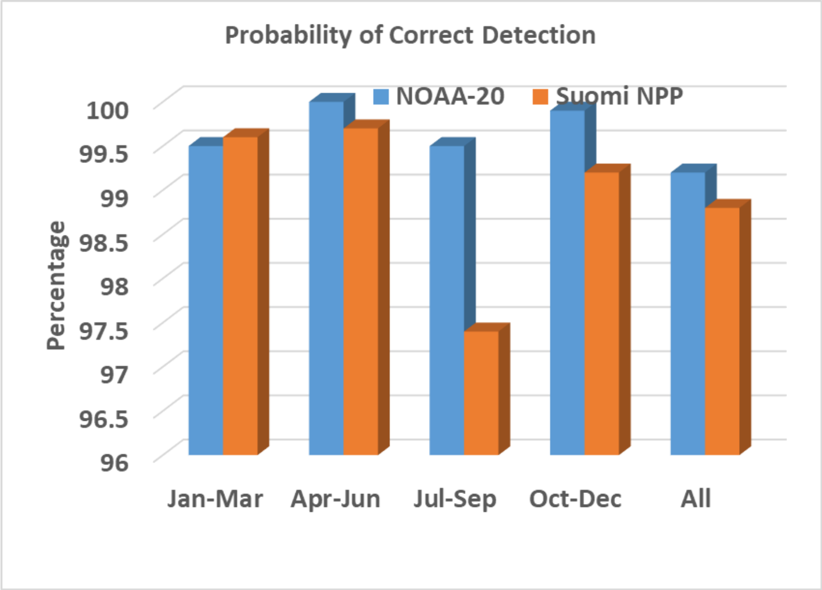
Summary of Performance of VIIRS ADP vs. CALIPSO

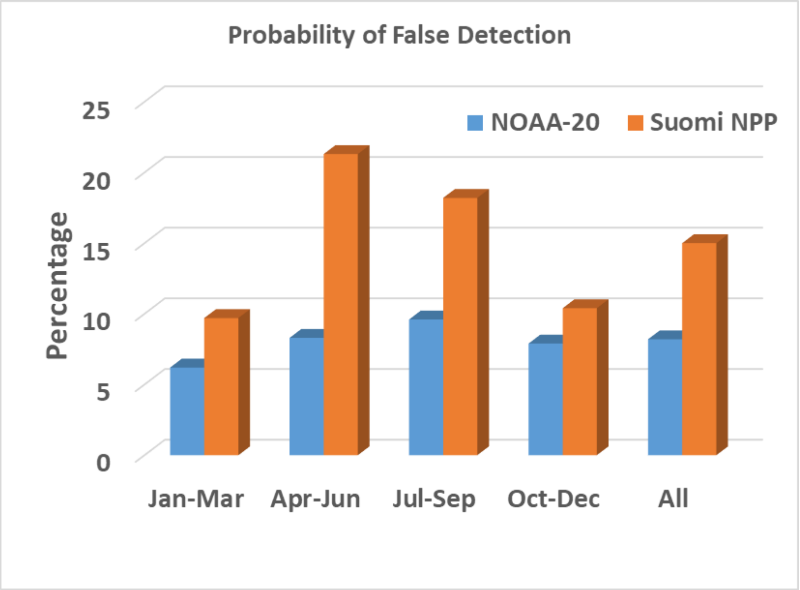
Smoke

Time period	Satellite	True positive	True negative	False positive	False negative	Accuracy	POCD	POFD
Jan. – Mar.	NOAA-20	3103	44430	205	13	99.5	99.5	6.2
	S-NPP	4497	47477	483	17	99.0	99.6	9.7
Apr. – Jun.	NOAA-20	3113	64863	283	0	99.6	100.0	8.3
	S-NPP	2851	46784	772	7	98.4	99.7	21.3
Jul. – Sep.	NOAA-20	4465	65421	492	19	99.2	99.5	9.6
	S-NPP	4494	58175	1001	119	98.2	97.4	18.2
Oct. – Dec.	NOAA-20	1531	26749	132	1	99.5	99.9	7.9
	S-NPP	2664	39673	311	20	99.2	99.2	10.4
01/01-12/31/2018	NOAA-20	12403	201671	1112	33	99.1	99.2	8.2
	S-NPP	14520	192527	2570	165	98.7	98.8	15.0

VIIRS ADP Performance Metrics Summary for Smoke: Matchups with CALIPSO







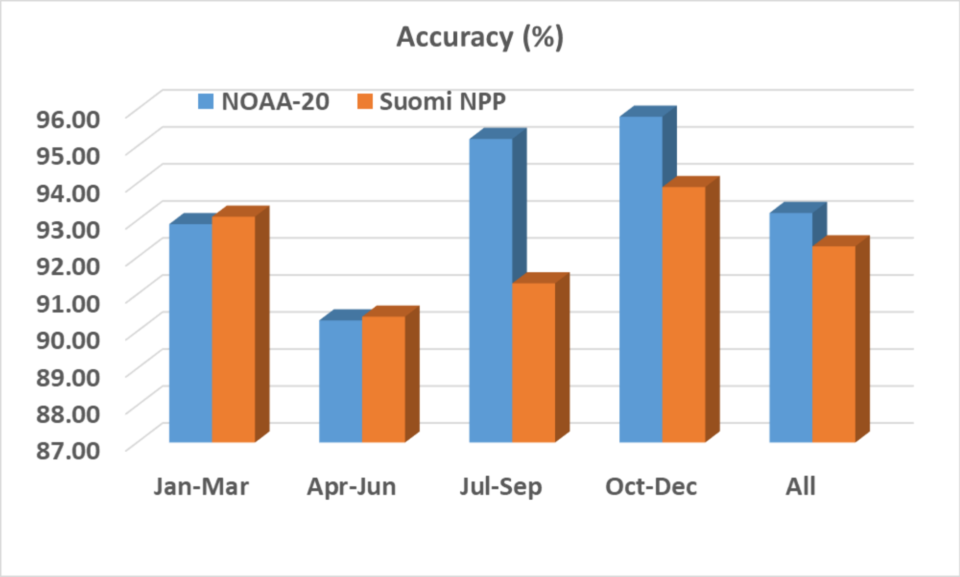
Suomi NPP has more false smoke detections than NOAA-20

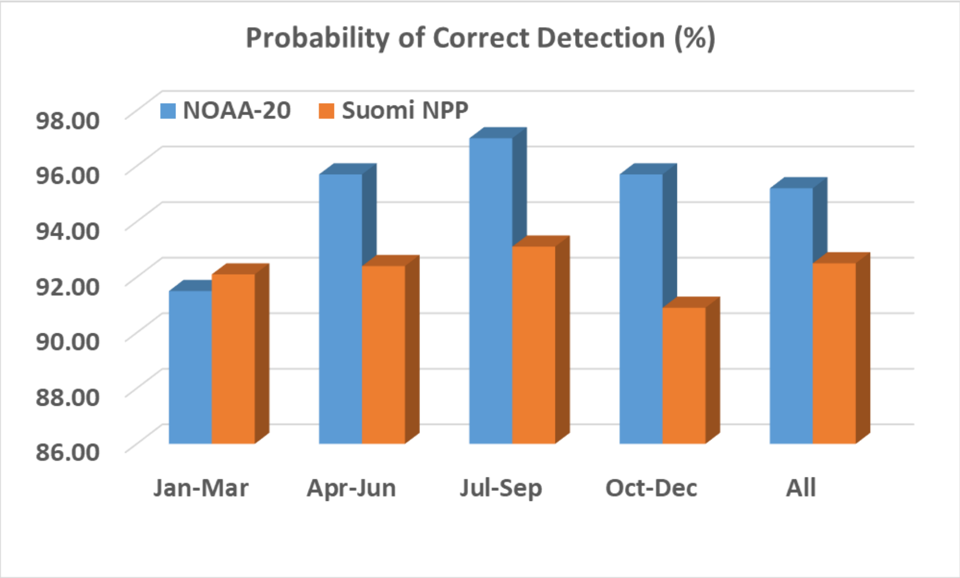
Summary of Performance of VIIRS ADP vs. CALIPSO

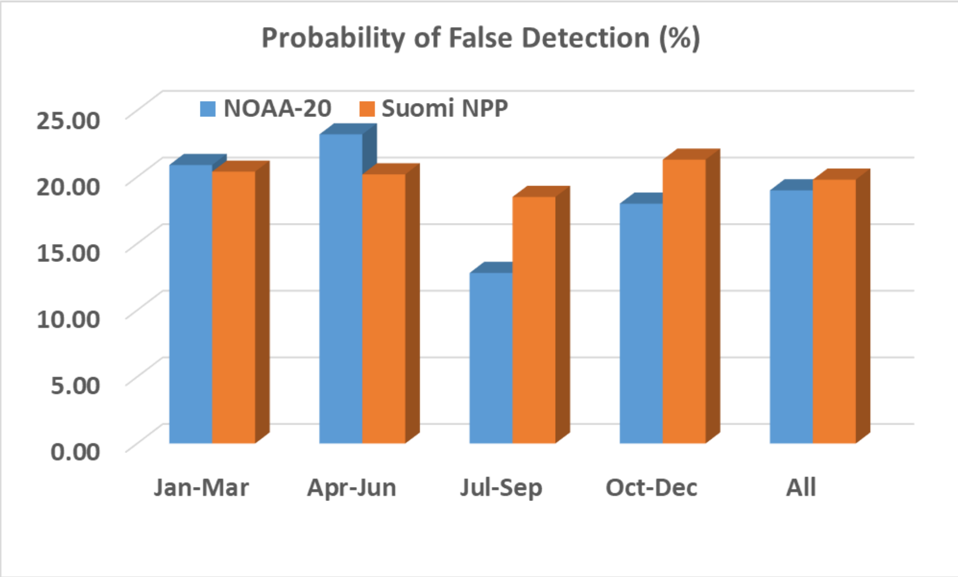
Dust

Time period	Satellite	True positive	True negative	False positive	False negative	Accuracy	POCD	POFD
Jan. – Mar.	NOAA-20	17256	64178	4591	1609	92.9	91.5	20.9
	S-NPP	19373	70771	4970	1657	93.1	92.1	20.4
Apr. – Jun.	NOAA-20	29559	66164	8959	1320	90.3	95.7	23.2
	S-NPP	21818	54930	5519	1746	90.4	92.4	20.2
Jul. – Sep.	NOAA-20	26829	67856	3953	822	95.2	97.0	12.8
	S-NPP	24838	53613	5637	1842	91.3	93.1	18.5
Oct. – Dec.	NOAA-20	7637	38671	1679	343	95.8	95.7	18.0
	S-NPP	8410	39572	2283	840	93.9	90.9	21.3
01/01-12/31/2018	NOAA-20	81383	236969	19183	4094	93.2	95.2	19.0
	S-NPP	74739	219292	18409	6085	92.3	92.5	19.8

VIIRS ADP Performance Metrics Summary for Dust: Matchups with CALIPSO







About 20% false dust detection for both Suomi NPP and NOAA-20

Summary of Performance of VIIRS ADP vs. CALIPSO

Smoke

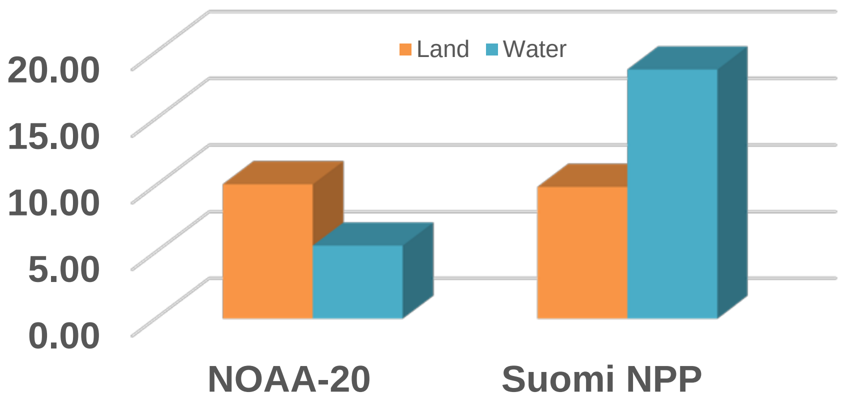
Surface type	Satellite	True positive	True negative	False positive	False negative	Accuracy	POCD	POFD
land	**NOAA-20**	**6810**	**97448**	**766**	**13**	**99.2**	**99.8**	**10.1**
	S-NPP	**7539**	**77034**	**827**	**9**	**99.0**	**99.8**	**9.9**
water	**NOAA-20**	**5775**	**86808**	**339**	**20**	**99.6**	**99.6**	**5.5**
	S-NPP	**7743**	**102187**	**1782**	**157**	**98.2**	**98.0**	**18.7**

Dust

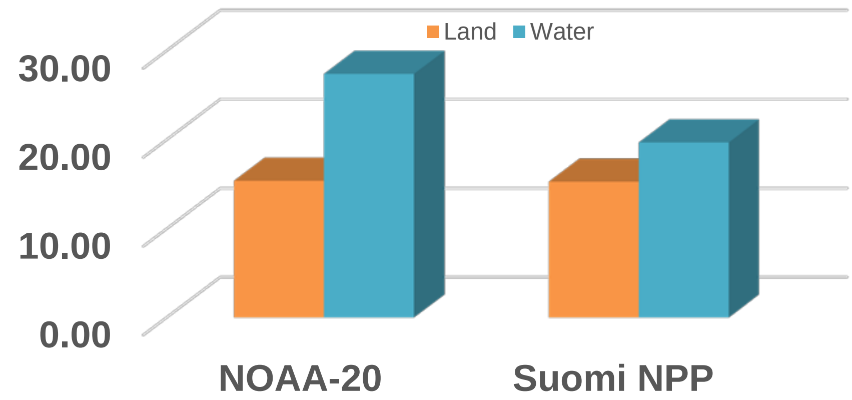
Surface Type	Time Period	True positive	True negative	False positive	False negative	Accuracy	POCD	POFD
land	**NOAA-20**	**19006**	**72923**	**3450**	**2412**	**94.0**	**88.7**	**15.4**
	S-NPP	**22705**	**89492**	**4102**	**2109**	**94.7**	**91.5**	**15.3**
water	**NOAA-20**	**61884**	**146804**	**23465**	**1587**	**89.2**	**97.5**	**27.4**
	S-NPP	**58167**	**129910**	**14307**	**4314**	**90.1**	**93.1**	**19.7**

Summary of Performance of VIIRS ADP vs. CALIPSO

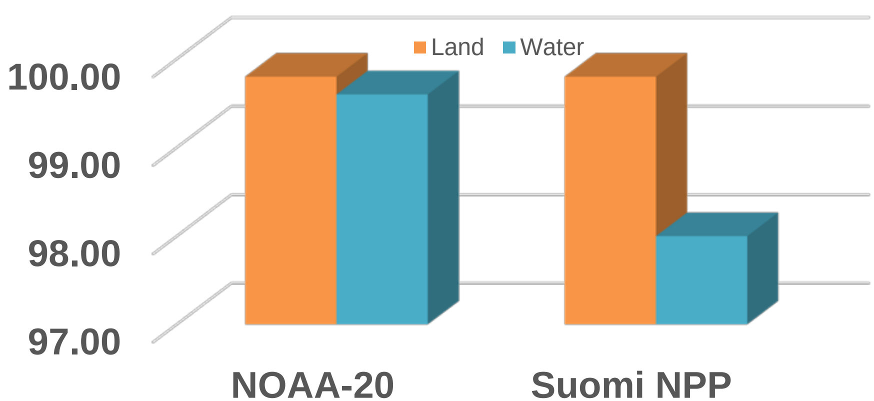
Probability of False Detection (%): Smoke



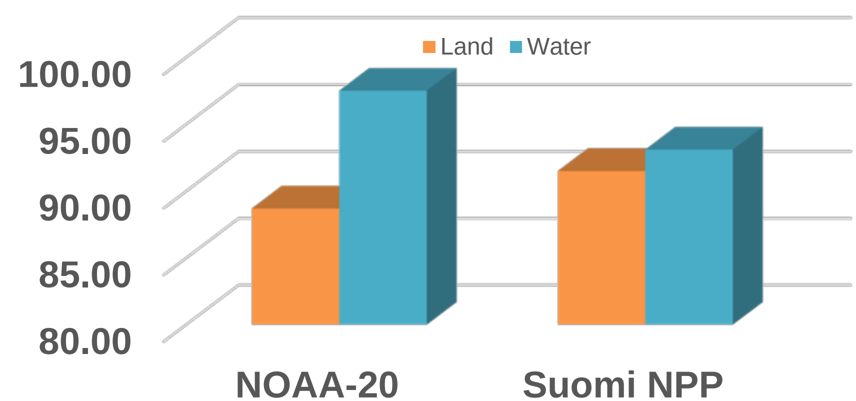
Probability of False Detection (%): Dust



Probability of Correct Detection (%): Smoke



Probability of Correct Detecion (%): Dust



Probability of false dust detection over water higher than land for both Suomi NPP and NOAA-20

Summary of VIIRS ADP vs. AERONET

Smoke

Satellite	True positive	False positive	False negative	True negative	Accuracy	POCD	POFD
NOAA-20	5287	1171	784	49533	96.6	87.1	18.1
S-NPP	6207	1519	629	47577	96.2	90.7	19.7

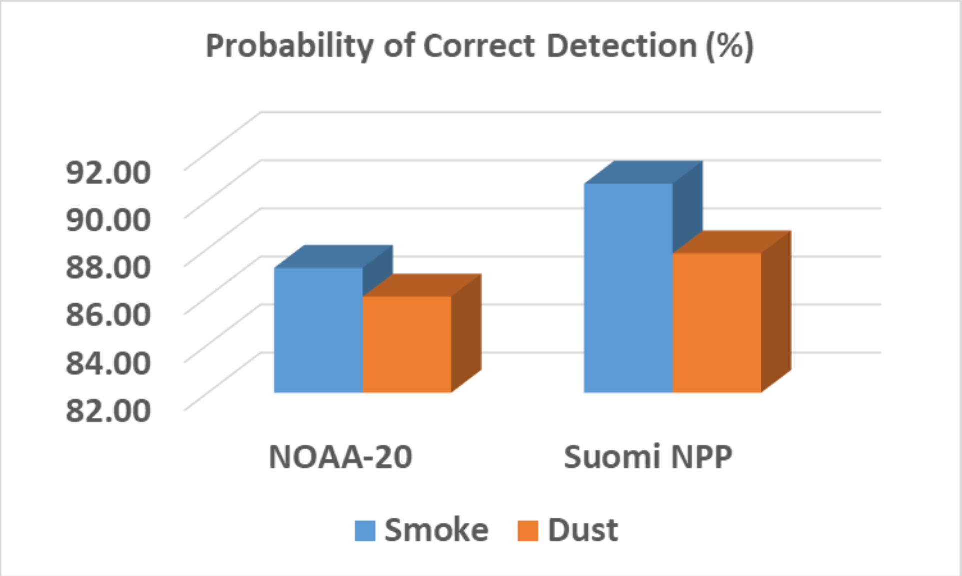
Dust

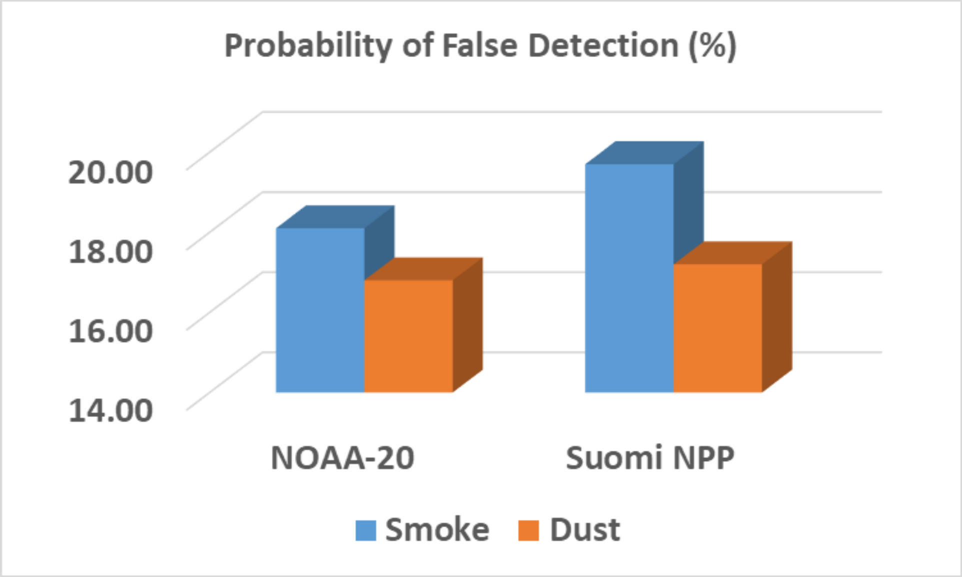
Satellite	True positive	False positive	False negative	True negative	Accuracy	POCD	POFD
NOAA-20	1885	381	308	10362	94.6	86.0	16.8
S-NPP	2053	425	228	10231	94.5	87.8	17.2

40

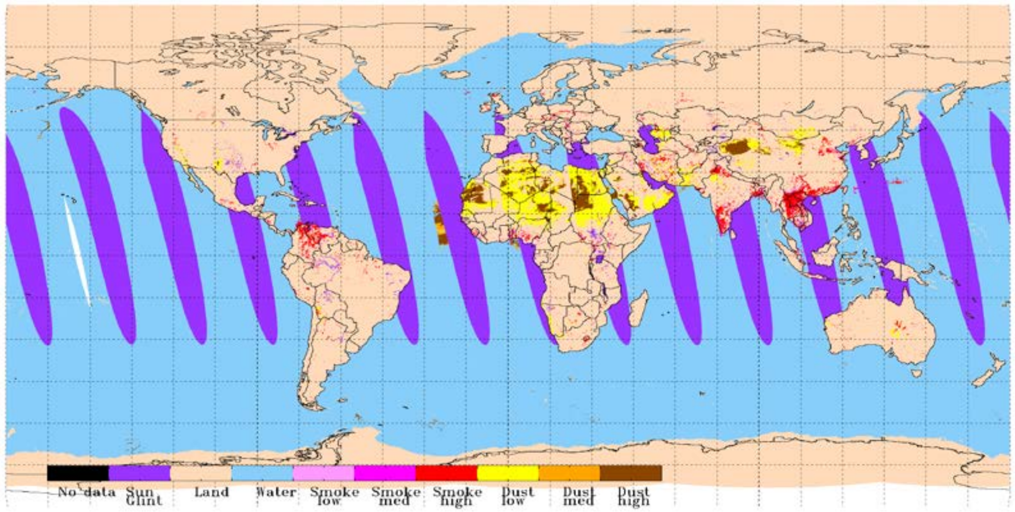
Summary of Performance of VIIRS ADP vs. AERONET

- NOAA-20 and SNPP VIIRS ADP product meets performance requirement (80% for dust over land and smoke over land; 70% for smoke over water)
- Probability of False Detection is higher for SNPP smoke compared to NOAA-20
- Performance metrics cannot be stratified for Water and Land because most AERONET stations are over land





Quality flag analysis/validation



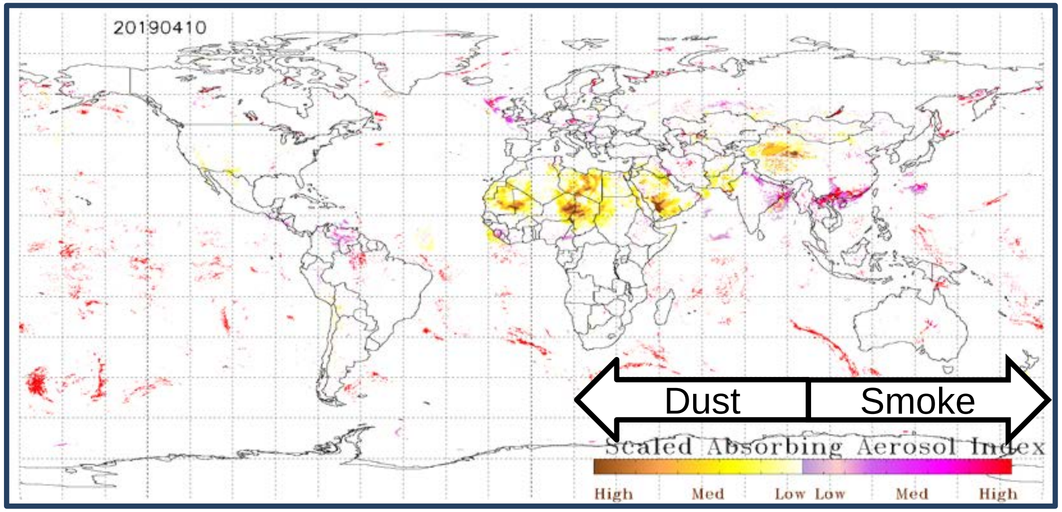
- No screening for large solar/satellite zenith angles (values are provided in output for users)
- Internal screening for clouds and snow/ice

Confidence value determined based on how close the spectral difference test is to the threshold.

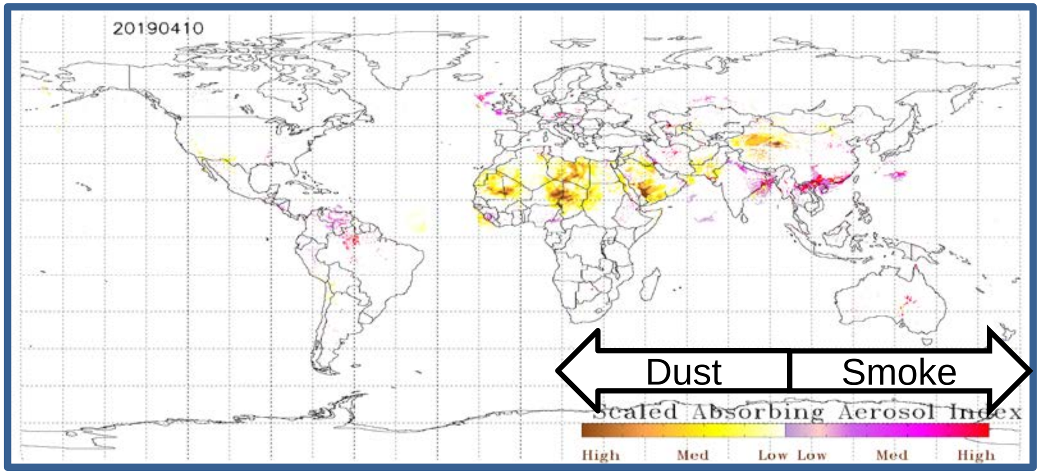
Confidence Flag	Criteria
High	**Confidence Value > 0.5**
Medium	**0.25 < Confidence Value < 0.5**
Low	**Confidence Value < 0.25** Pixel adjacent to cloud Turbid water Bright pixel Pixel adjacent to snow/ice Cloud shadow Glint
No Retrieval	Cloud Snow/ice

Current Operational Output from NDE

Operational (with bug)



Local Science code



- Implementation in framework introduced a bug. Array for Rayleigh scattering optical depth is wrong
- Did not show up in the selected test granules. DAP was delivered to NDE in July 2018
- As soon as STAR noticed the artifact on LTM website displaying I&T data, ASSIST was notified.
- A new DAP was delivered in December 2018

Impact:

- **False smoke detection over ocean on the edge of clouds**

Error Budget

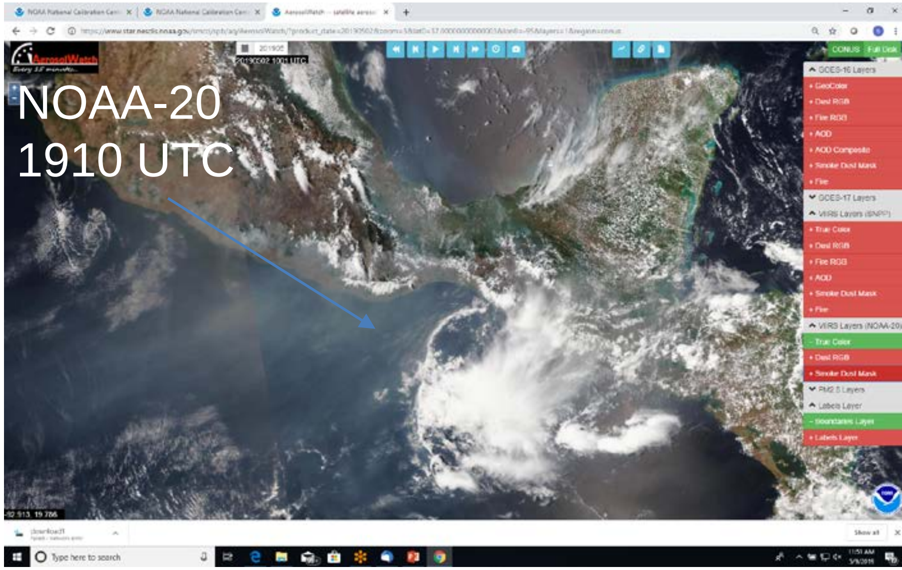
Attribute Analyzed	L1RD Threshold	Pre-Launch Performance	On-orbit Performance	Meet Requirement?	Additional Comments
Dust over land	80%	N/A	88.7%	Yes	Based on off-line algorithm processing
Dust over water	80%	N/A	97.5%	Yes	Based on off-line algorithm processing
Smoke over land	80%	N/A	99.8%	Yes	Based on off-line algorithm processing
Smoke over water	70%	N/A	99.6%	Yes	Based on off-line algorithm processing

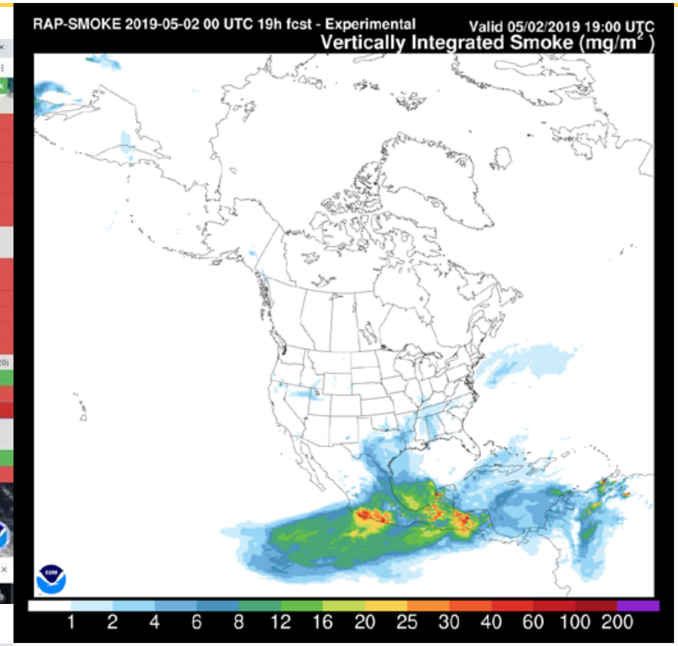
Based on CALIPSO comparisons

User Feedback

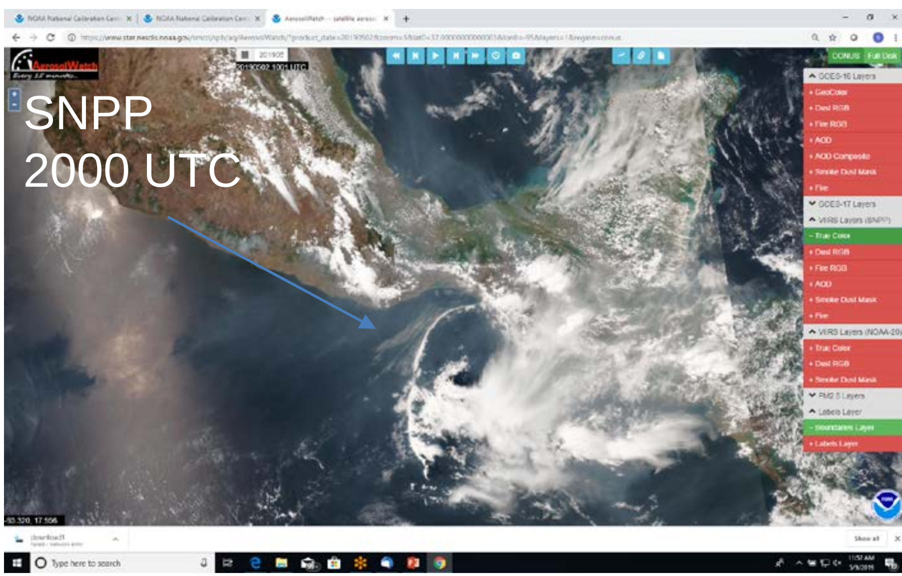
Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Ravan Ahmadov	ESRL	HRRR and RAP model verification and assimilation	Testing ongoing
Bill Murphey	Georgia Department of Natural Resources	Air quality forecasting	Email sent May 3, 2019: “I know I've used Aerosol Watch a good bit along with the smoke and AOD options from VIIRS data, and it does a nice job with a few of our more recent smoke events during March across GA and AL. We've had a few interesting PM/smoke events near approaching frontal systems as well, so sometimes it's a little tough to separate the smoke from low clouds. I will take a peek next week, and also will forward this to Tao, who is one of our best AQ forecasters. I'm pretty sure he also has used some of these products. Hope all is going well up yall's way! Hope to see yall in September or October for the AQPG meeting.”
Cary Gentry	Forsyth County Office of Environmental Assistance and Protection	Air quality forecasting	Email sent May 10, 2019: “AerosolWatch is an invaluable tool for air quality forecasting. The Smoke/Dusk Mask layer of NOAA-20 comes in very handy during higher PM2.5 events for my area. In addition, the FRP helps me determine the fire location(s) which is critical for PM2.5 forecasts.”

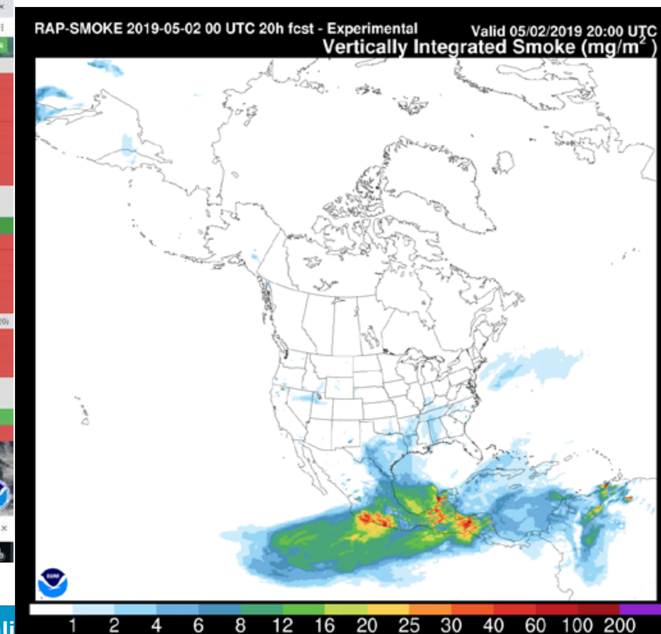
Model Forecast vs. VIIRS Observations





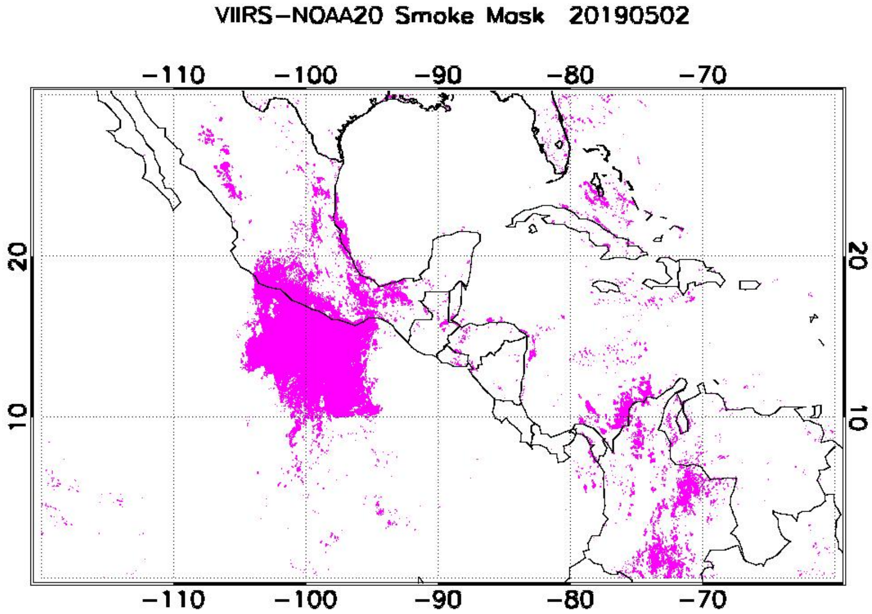
RAP
19 UTC

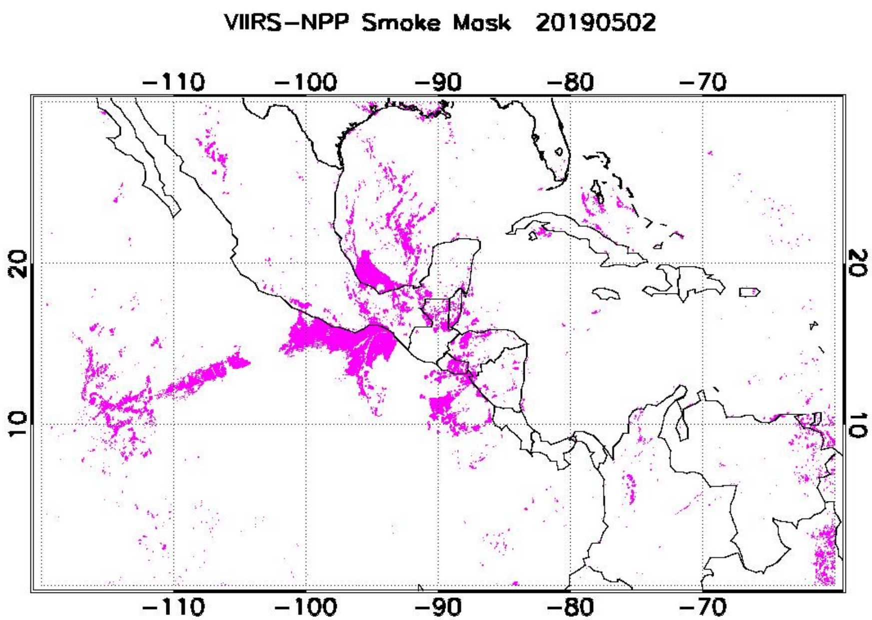


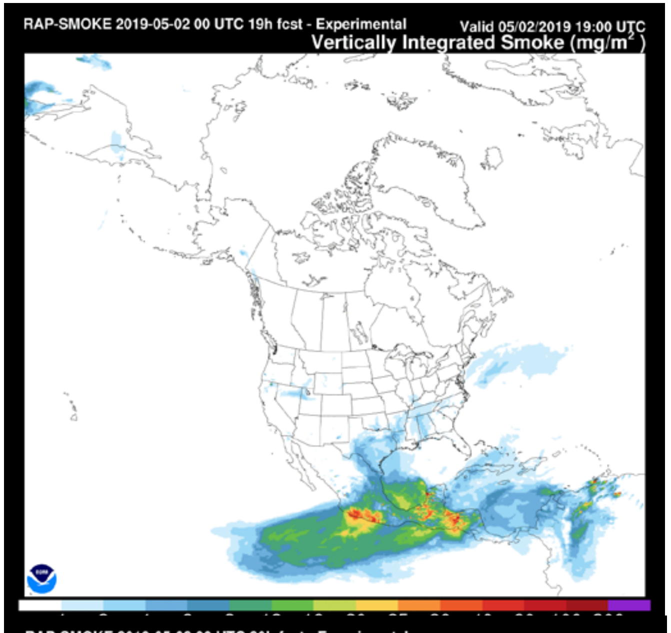


RAP
20 UTC

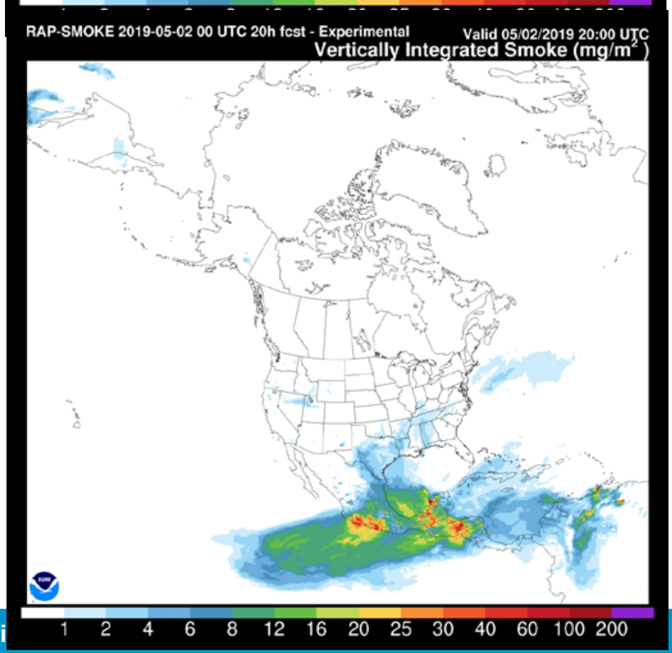
Model Forecast vs. VIIRS Observations





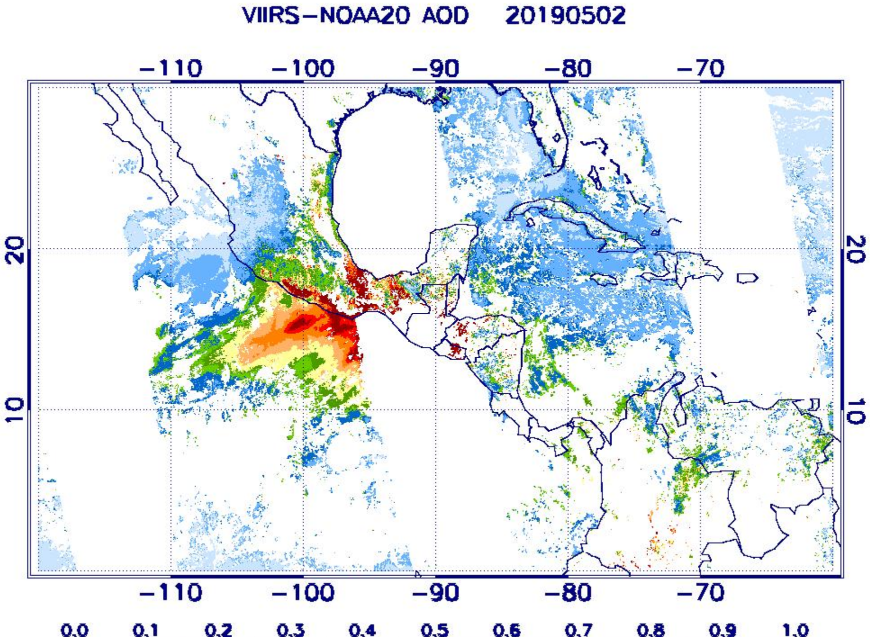


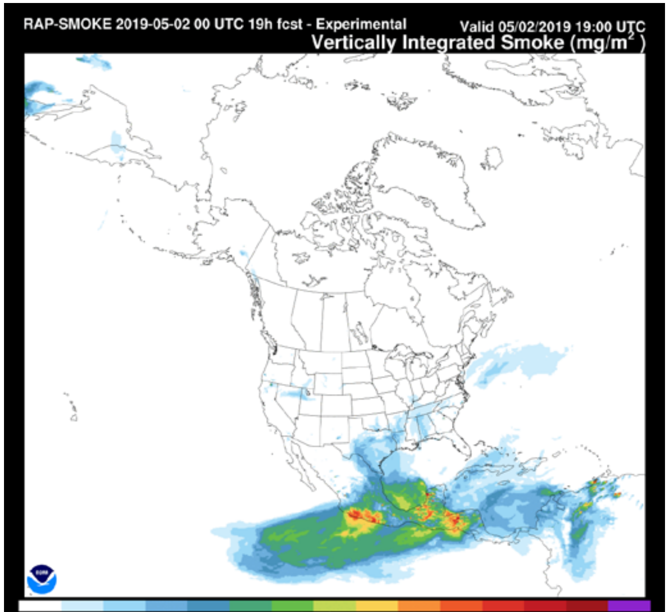
RAP
19 UTC



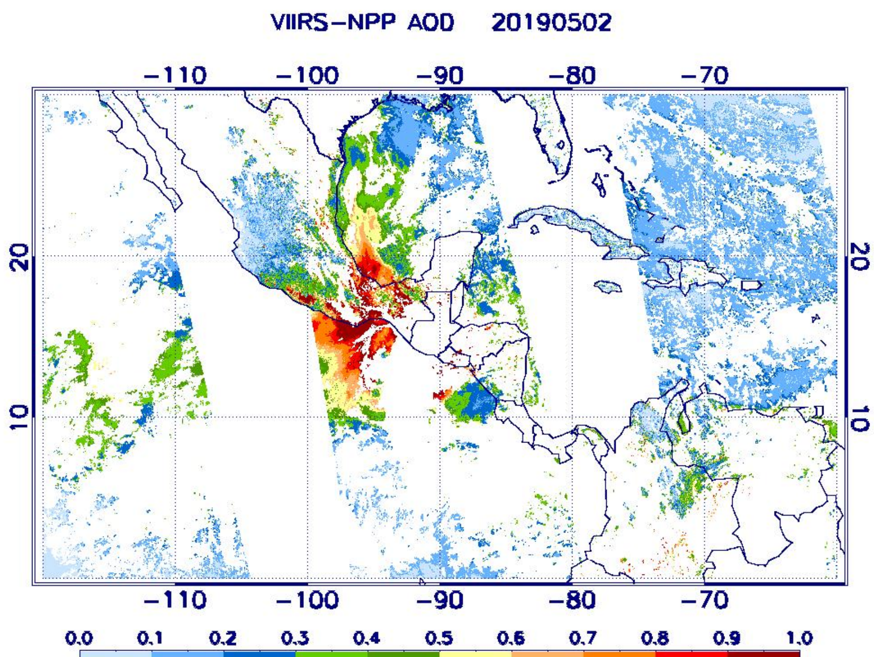
RAP
20 UTC

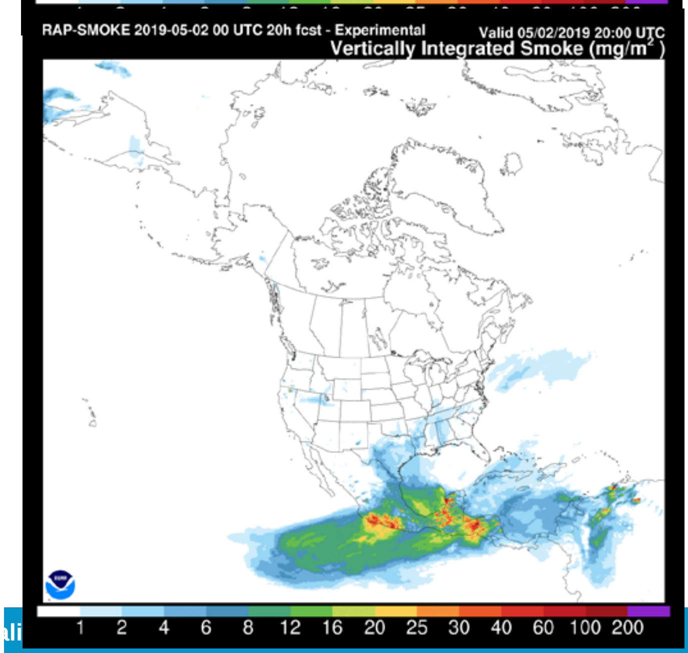
Model Forecast vs. VIIRS Observations





RAP
19 UTC





RAP
20 UTC

Downstream Product Feedback

Algorithm	Product	Downstream Product Feedback - Reports from downstream product teams on the dependencies and impacts

Risks, Actions, and Mitigations

Identified Risk	Description	Impact	Action/Mitigation and Schedule
Six month DAP delivery cycle	A lack of mechanism to update code changes (emergency bug fixes) is a concern	Product quality	Allow science teams to make quick emergency fixes
SDR calibration	Differences between NOAA-20 and SNPP VIIRS calibration	Product quality	(1) Ability to tweak thresholds for spectral tests and updating thresholds in NDE operations; (2) Reprocessing capability (short-term and long-term) must be available
Framework	Regression testing between science team and ASSIST, ASSIST and NDE inadequate?	Algorithm implementation	(1) Audit framework (2) ADR log (3) Change process tracker

Documentations (Check List, 1 slide)

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	In preparation
Algorithm Theoretical Basis Document (ATBD)	Yes (under revisions)
Algorithm Calibration/Validation Plan	Yes
(External/Internal) Users Manual	Yes
System Maintenance Manual (for ESPC products)	Not sure
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes (Zhang et al., JARS, 2018)
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	Briefings at JPSS annual meeting

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).	Yes
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.	Team has to publish reports, papers and present at conferences to bring visibility
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.	Yes, after the bug fix
Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument	Yes

Conclusion

Team concludes that NOAA-20 VIIRS ADP product meets requirements and deemed validated.

Product can be used by users after the bug is fixed.

Main concerns are:

- Suomi NPP VIIRS smoke false detections are higher than NOAA-20
- Suomi NPP and NOAA-20 VIIRS have ~20% false dust detections, especially over water

Path Forward

- Lessons learned for NOAA-20 Cal Val
  - Algorithm not running in NDE or I&T at launch has been a big concern. Even after algorithm started running in the I&T, granule dropouts issue (never understood why?) took a long time to get fixed
- Planned improvements
  - Work with SDR team to determine calibration concerns, if any, and reprocess as needed
  - Implement smoke concentration. Approach is TBD
- Future Cal/Val activities / milestones
  - S5P TROPOMI comparisons
  - GOES-16 ADP comparisons
  - Reprocess full SNPP VIIRS ADP record and generate dust and smoke climatologies
  - Promote the use of ADP along with AOD in data assimilation
- Improved user engagement and preparedness, especially with NCEP
- Keep engagement with ECMWF users open

Validated Maturity Review - Exit Criteria

- Validated Maturity Performance is well characterized and meets/exceeds the requirements:
  - On-orbit instrument performance assessment
    - Completed with CALIPSO and AERONET comparisons
- Updated Validated Maturity Slide Package addressing review committee's comments for:
  - Cal/Val Plan and Schedules - ongoing
  - Product Requirements - yes
  - Validated Maturity Performance - yes
  - Risks, Actions, Mitigations - yes
  - Path forward - yes