NOAA-21 ATMS Validated Maturity Review Material

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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
- ATMS Data Product Requirements
- Part One – Instrument Performance
  - Post-launch Cal/Val Timeline – Updated after Provisional Maturity
  - Post-launch Testing (PLT) Status Assessment
  - Instrument On-orbit Performance
  - Post-launch Cal/Val Tasks – Updated after Provisional Maturity
- Part Two – Science Data Quality
  - Calibration Updates after Provisional Maturity and Evaluation
  - On-orbit Science Data Quality Assessment
  - Imagery Product Development
  - Future Plan
- NOAA-21 ATMS Validated Maturity Highlights
- Summary and Conclusion

JPSS ATMS Cal/Val Team

Name	Organization	Affiliation
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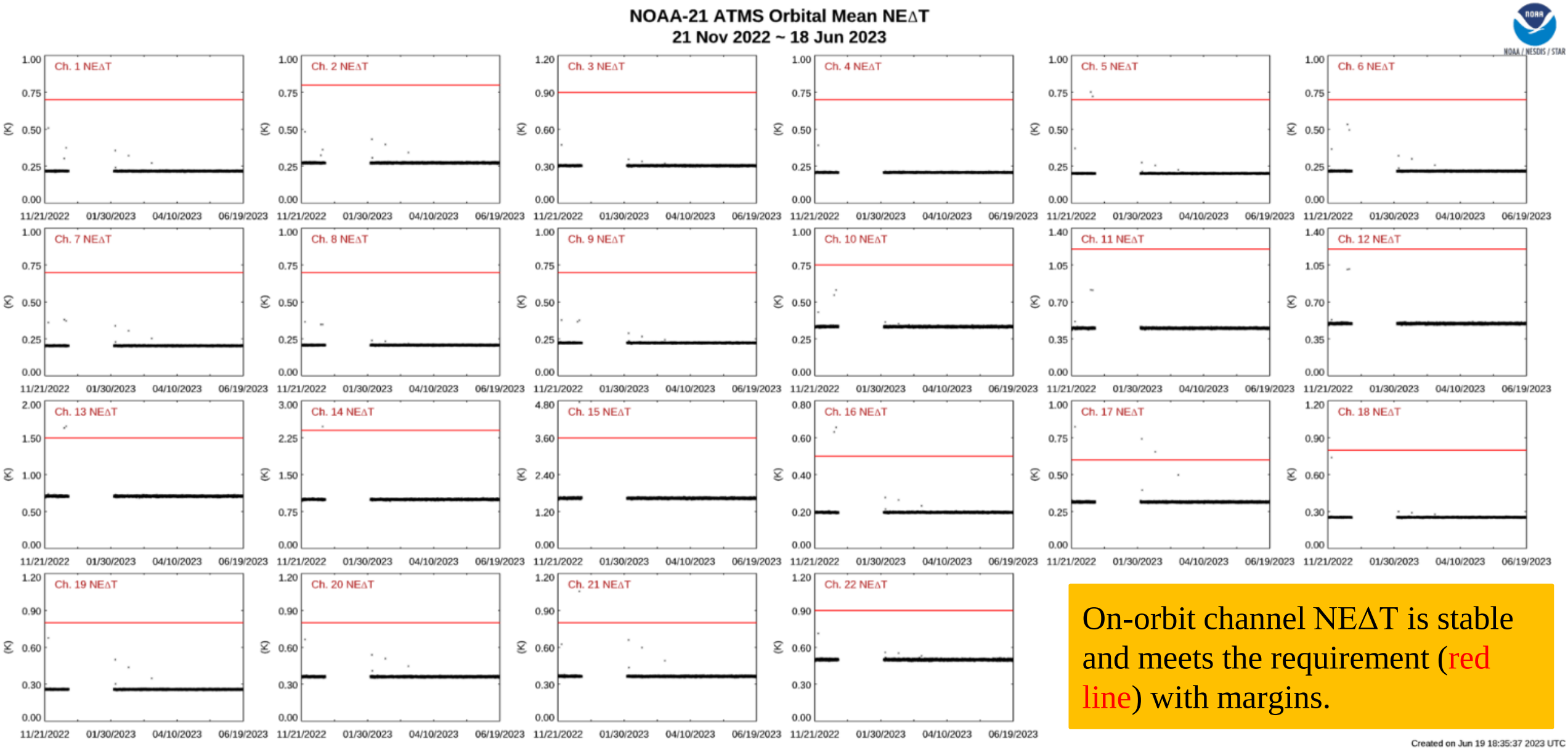
James Fuentes	ATMS Instrument Vendor	Northrop Grumman – Azusa
James G. Kam	ATMS Instrument Vendor	Northrop Grumman – Azusa

ATMS Flight Requirements with On-orbit Assessment

Ch.	Center Frequency (MHz)	Polarization	Max Bandwidth (MHz)	Static Beamwidth (Deg)	Dynamic Range (K)	Calibration Accuracy (K)	NEΔT @300K (K)	NOAA-21 On-orbit NEΔT
1	23800	QV	270	5.2	3-330	1.0	0.7	0.215
2	31400	QV	180	5.2	3-330	1.0	0.8	0.272
3	50300	QH	180	2.2	3-330	0.75	0.9	0.303
4	51760	QH	400	2.2	3-330	0.75	0.7	0.207
5	52800	QH	400	2.2	3-330	0.75	0.7	0.200
6	53596±115	QH	170	2.2	3-330	0.75	0.7	0.215
7	54400	QH	400	2.2	3-330	0.75	0.7	0.202
8	54940	QH	400	2.2	3-330	0.75	0.7	0.207
9	55500	QH	330	2.2	3-330	0.75	0.7	0.221
10	57290.344(f_o)	QH	330	2.2	3-330	0.75	0.75	0.332
11	f_o± 217	QH	78	2.2	3-330	0.75	1.2	0.450
12	f_o±322.2±48	QH	36	2.2	3-330	0.75	1.2	0.493
13	f_o±322.2±22	QH	16	2.2	3-330	0.75	1.5	0.707
14	f_o±322.2±10	QH	8	2.2	3-330	0.75	2.4	0.994
15	f_o±322.2±4.5	QH	3	2.2	3-330	0.75	3.6	1.626
16	88200	QV	2000	2.2	3-330	1.0	0.5	0.195
17	165500	QH	3000	1.1	3-330	1.0	0.6	0.315
18	183310±7000	QH	2000	1.1	3-330	1.0	0.8	0.252
19	183310±4500	QH	2000	1.1	3-330	1.0	0.8	0.257
20	183310±3000	QH	1000	1.1	3-330	1.0	0.8	0.360
21	183310±1800	QH	1000	1.1	3-330	1.0	0.8	0.362
22	183310±1000	QH	500	1.1	3-330	1.0	0.9	0.497

NOAA-21 ATMS On-orbit NEΔT



On-orbit channel NEΔT is stable and meets the requirement (red line) with margins.

PART ONE

NOAA-21 ATMS Instrument Performance Evaluation

Presented by

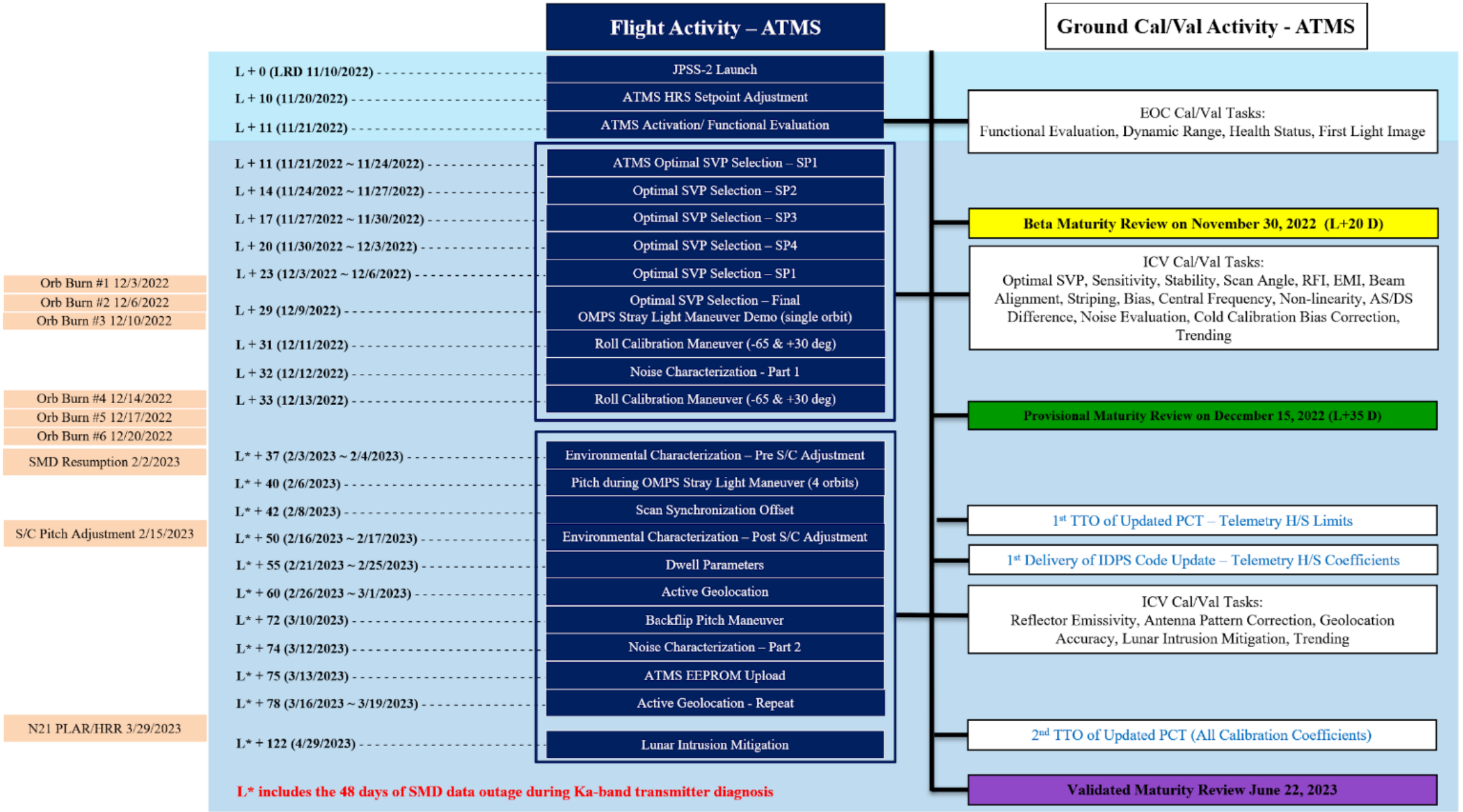
Edward J. Kim

NOAA-21 ATMS Performance Requirement Waivers

J2 Waiver	Description	Science	Science Rationale
JPSS-W033	CH2 Beamwidth Non-compliance	Concur	Small exceedance that is in-family with S-NPP and N-20
JPSS-W034	CH17 Bandwidth Non-compliance	Concur	Small exceedance on a window channel and is captured by SRF
JPSS-W035	CH11 Center Freq. Stability	Concur	Small exceedance (0.1 MHz) at extreme instrument temperature (50°C)
JPSS-W036	CH3 Passband Rejection	Concur	Power contained in Out-of-band region is insignificant compared to passband power and is captured in SRF
JPSS-W037	CH12 Sideband Balance	Concur	Imbalance captured by SRF and RTM analysis shows small impact to radiances
JPSS-W041	CH11 Bandwidth Non-compliance	Concur	Small exceedance at extreme instr. temp. (-10°C)
JPSS-W070	CH16 Cold Calibration Accuracy from Earth Radiation	Concur	Higher-level calibration accuracy requirement is met with margin

SDR team has reviewed and concurs with all science performance requirement waivers

NOAA-21 ATMS Post-launch Cal/Val Timeline



PLT Summary (1 of 3)

- A total of 13 ATMS-related PLTs were performed
  - 10 ATMS-specific; 3 system-level (OMPS Limb Straylight, Rolls, and Pitch Offset)
  - Two new for NOAA-21:
    - ATMS-CrIS Scan Synchronization Evaluation PLT
    - OMPS Limb Straylight Maneuver PLT

- All PLTs were successfully completed
  - Data collected are of satisfactory quality and completeness
  - Science analysis and evaluations performed (Active Geolocation evaluation and analyses to be complete)

- PLT reports released in NASA CM
  - Include science analysis results and lessons learned
  - Forward work to release Lunar Intrusions Mitigation and Active Geolocation PLT reports

- Forward work:
  - Completion of Active Geolocation analysis
  - Completion and release of Lunar Intrusion Mitigation and Active Geolocation PLT reports
  - Use of scan profile switching for lunar intrusion mitigation (from Lunar Intrusion Mitigation PLT)

All PLTs successfully completed. Forward work to complete PLTs reports and evaluation on incorporation of results in operational algorithms.

PLT Summary (2 of 3)

Dates (UTC)	NOAA-21 PLT Number and Name	Description	Comments
11/21/22	J2-ATMS-6104 ATMS Activation PLT	ATMS powered on and transitioned to operational mode	**Successful.** Instrument powered on and transitioned to operational mode in RC1 configuration.
11/21/22 – 11/22/22 11/23/22 – 11/24/22	J2-ATMS-6110 ATMS Functional Evaluation PLT	Diagnostic mode data collect. Evaluate start of scan vs. beam position 1 timing; evaluate noise levels of test channels	**Successful.** Data collected and analyzed. Test repeated to allow more instrument stabilization (lessons learned). BP1 timing and noise levels satisfactory.
11/21/22 – 12/8/22	J2-ATMS-6106 Cold Calibration Position Selection PLT	Collect three days of data at each scan profile (scan profile 1 performed twice). Select the scan profile that will minimize the side lobe interference in the antenna	**Successful.** Data collected and analyzed. Selected scan profile 1 (least count variation among the four space views).
11/21/22 – 03/28/23	J2-ATMS-6222 ATMS Trending PLT	Long term trending of ATMS temperatures, currents, voltages, and selected other telemetry throughout LEO&A	**Successful.** Data collected and trended.
12/09/22; 02/06/23	J2-SYS-6097 OMPS Limb Straylight Maneuver PLT	S/C pitch for eight consecutive orbits for OMPS lunar viewing. During four of these orbits, ATMS performs a constant velocity scan. Science will evaluate contamination from S/C platform.	**Successful.** Data collected and analysis performed. Evaluated near-field S/C contamination outside the Earth View sector and created model correction algorithms. Future work is planned prior to implementing the corrections in the operational SDR algorithm.
12/11/22; 12/13/22	J2-SYS-6098 ATMS Rolls PLT	Spacecraft roll of -65 deg and +30 deg. Evaluate cross-track scan bias, magnitude of sidelobe contamination, and radiometric equivalency of Earth View and Space View sectors	**Successful.** Data collected, and analysis performed. Two data collects for each roll. Successfully validated the pre-launch antenna patterns, measured the magnitude of the cross-track scan bias and sidelobe contamination, and evaluated the cold calibration correction values.
12/12/22; 03/12/23	J2-ATMS-6112 Noise Characterization PLT	Point and Stare at an On-board Calibration Target and Cold Space to characterize noise	**Successful.** Data collected, and analysis performed. Lesson learned on command angle. On-orbit Noise Power Spectrum (NPS) was computed; performance is comparable to instrument-level TVAC testing.

PLT Summary (3 of 3)

Dates (UTC)	PLT Number and Name	Description	Comments
02/03/23 – 02/04/23 **02/16/23 – 02/17/23**	J2-ATMS-6109 Environmental Characterization PLT	A constant velocity, continuous sampling scan mode is enabled. Evaluates sidelobe contamination at different scan positions	**Successful.** Data collected, and analysis performed. Executed twice: before and after spacecraft pitch adjustment maneuver. Radiometric environment was characterized. Supported SP1 as optimal SVS sector. Supported assessments that the 2/15/23 S/C Pitch Adjustment had negligible impact on ATMS science data.
02/21/23 – 02/25/23	J2-ATMS-6107 Dwell Parameters PLT	Dwell on available dwell points for one orbit	**Successful.** 58 dwell sessions successfully performed and data collected.
02/26/23 – 03/01/23 **03/16/23 – 03/19/23**	J2-ATMS-6105 Active Geolocation PLT	Point and stare at 49 coastline crossings to perform geolocation analysis	**Successful.** Data collected. Test repeated to correct scan angles (lessons learned). Forward work to complete analysis.
03/07/23; 03/13/23	J2-ATMS-6113 Scan Synchronization Offset PLT	Analysis of ATMS and CrIS scan synchronization to determine if adjustment needed to ATMS scan timing offset via EEPROM load	**Successful.** Timing offset adjustment not needed; EEPROM load delivered for Cold Cal Bias Cal Packet update.
03/10/23	J2-SYS-6094 Pitch Offset PLT	S/C “backflip“ pitch maneuver during eclipse. Evaluate non-uniformities/biases in instrument antenna field and instrument susceptibility to RFI from KaTx	**Successful.** Data collected and analysis performed. Observed non-uniformities /biases; root cause and implications under evaluation. Performed reflector emissivity retrieval. No evidence of RFI from KaTx.
04/29/23	J2-ATMS-6111 Lunar Intrusion Mitigation PLT	Switch scan profile to scan profile 4 to evaluate if switching the scan profile will minimize data loss during lunar intrusion events	**Successful.** Data collected and analysis performed. Evidence of reduced impact to SV data collect by SP switch. Viability of method in operations to be evaluated by SDR team.

NOAA-21 ATMS Post-launch Cal/Val Tasks

Task #	Title	Teams	Data Available Date & Related PLTs
1	Proxy Instrument Data	NOAA/STAR, MIT/LL, NASA/GSFC, NG	Pre-launch
2	Independent Analysis of TVAC Data	NOAA/STAR, MIT/LL, NG, NASA/GSFC	Pre-launch
3	Analysis of Antenna Pattern Data	NOAA/STAR, MIT/LL, NG	Pre-launch
4	Analysis of Spectral Response Function (SRF)	NASA/GSFC, MIT/LL, NOAA/STAR	Pre-launch
5	Parameter Trending	NOAA/STAR, MIT/LL	L+11
6	Functional Evaluation	MIT/LL, NOAA/STAR, NG	L+11, Activation/Functional Evaluation PLTs
7	Dynamic Range Evaluation	MIT/LL, NASA/GSFC, NOAA/STAR	L+11
8	Digitization Artifacts	MIT/LL, NOAA/STAR, NG	L+11
9	Scan Angle Evaluation	NOAA/STAR, MIT/LL, NG, NASA/GSFC	L+11
10	Temperature Stabilization	MIT/LL, NASA/GSFC, NOAA/STAR, NG	L+11
11	Radiometric Sensitivity Evaluation	NOAA/STAR, MIT/LL, NASA/GSFC, NG	L+11
12	NWP Bias Characterization	NOAA/STAR	L+11
13	Optimal Space View Selection	MIT/LL, NOAA/STAR, NASA/GSFC, NG	L+26, Optimal SVP Selection PLT
14	Striping Analysis and Noise Evaluation	NOAA/STAR, MIT/LL	L+32, Noise Characterization – Part 1 PLT
15	GPS-RO Bias Characterization	NOAA/STAR	L+36

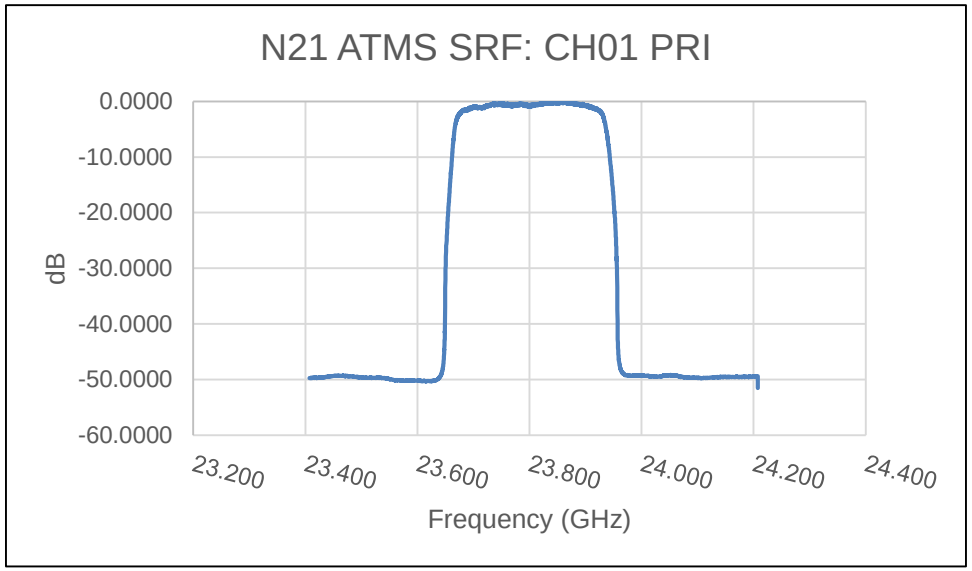
NOAA-21 ATMS Post-launch Cal/Val Tasks

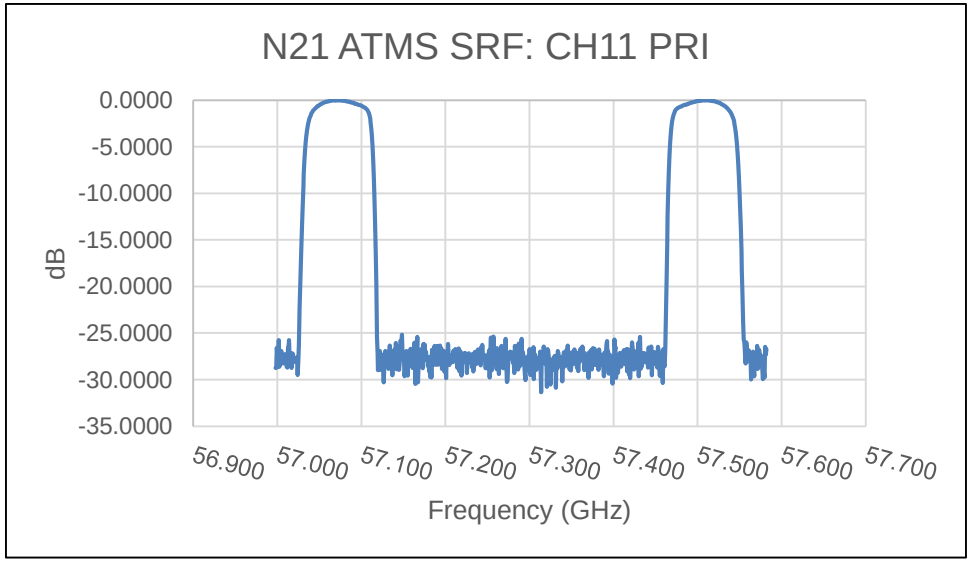
Task #	Title	Teams	Data Available Date & Related PLTs
16	SNO Bias Characterization	NOAA/STAR	L+36
17	Geolocation Verification and Correction	NOAA/STAR, NASA/GSFC	L+36
18	Instrument to Spacecraft Alignment	NOAA/STAR, NG	L+36
19	Continuous Sampling Mode	NOAA/STAR, MIT/LL	L+46, Environmental Characterization PLT
20	Lunar Intrusion Evaluation	NOAA/STAR, NASA/GSFC	L+51, Lunar Intrusion Mitigation PLT
21	Point and Stare Data for Gain Fluctuation Assessment	MIT/LL, NOAA/STAR, NASA/GSFC, NG	L+59, Noise Characterization – Part 2 PLT
22	Pitch Maneuver Analysis	NOAA/STAR, MIT/LL, NASA/GSFC, NG	L+71, Backflip Pitch Maneuver PLT
23	EMI From Spacecraft Transmitter	MIT/LL, NOAA/STAR, NG	L+71, Backflip Pitch maneuver PLT
24	TDR to SDR Conversion Analysis	NOAA/STAR, MIT/LL	L+71, Backflip Pitch Maneuver PLT
25	Effective Field of View	NOAA/STAR	L+71, Roll & Pitch Maneuver PLTs
26	Polarization Response Angle	NOAA/STAR	L+71, Backflip Pitch Maneuver PLT
27	Central Frequency Stability Assessment	MIT/LL, NOAA/STAR	L+80
28	SDR Validation through Product Retrievals	NOAA/STAR	L+80
29	Warm Load and Space View Bias	NOAA/STAR, NG, MIT/LL	L+80, Roll Maneuver PLT
30	Spatial Resampling Assessments	NOAA/STAR	L+80, Scan Offset PLT (EDR)
31	Terrestrial and Direct TV Sources RFI Detection	MIT/LL, NOAA/STAR	L+80
32	NUCAPS/MiRS Convergence	NOAA/STAR	L+80

NOAA-21 ATMS SRFs

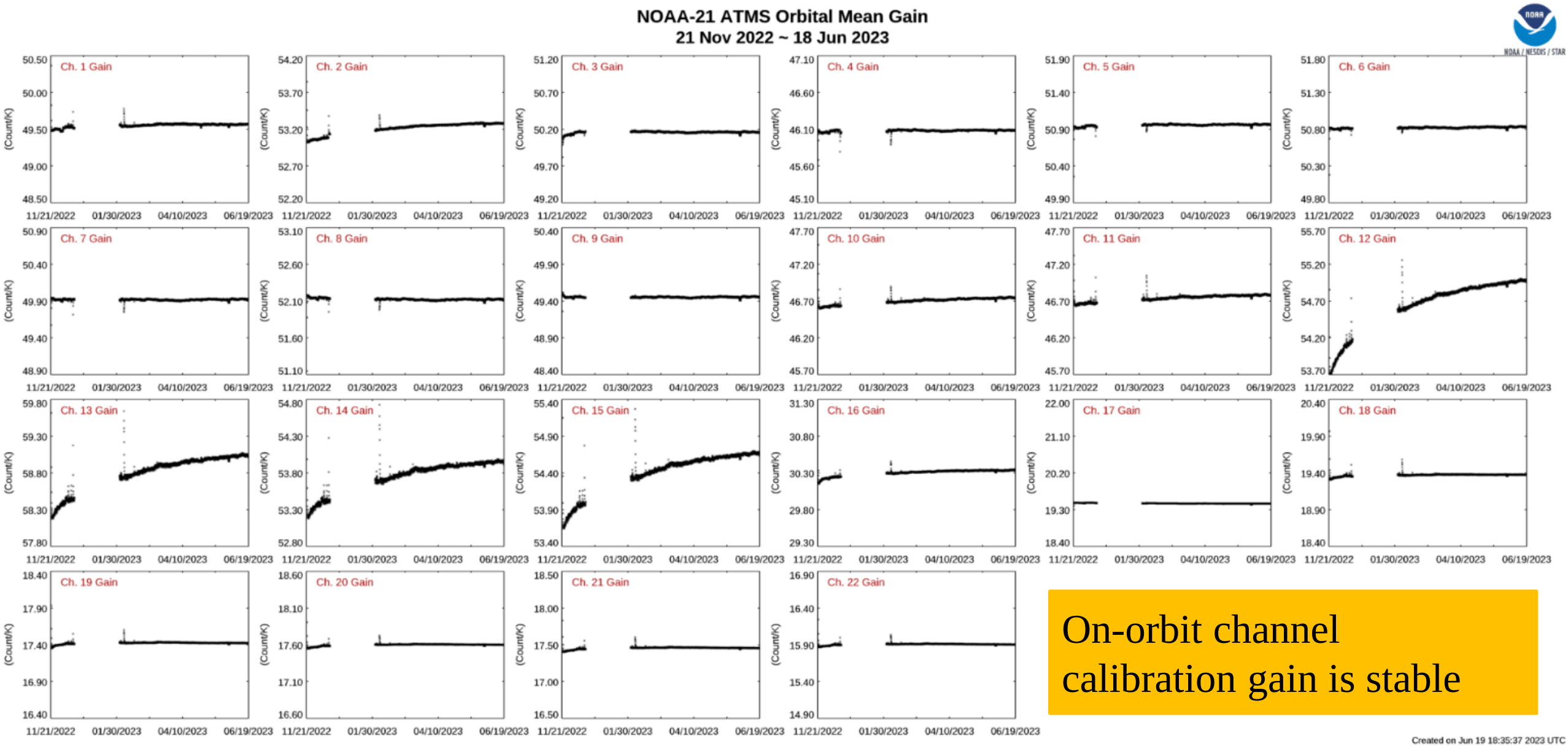
- NOAA-21 ATMS SRFs are in final review for updated release
  - Initial release on 11/01/2020
  - Available on NOAA STAR ATMS website: https://www.star.nesdis.noaa.gov/jpss/ATMS.php

- Updates since prior release:
  - Frequency change from ambient air to vacuum
    - Impacts channels that use non-hermetic filters (CH1-9, 16, 18, and 19)
  - Normalization of amplitudes to the peak of the SRF
  - The impact on BT is small



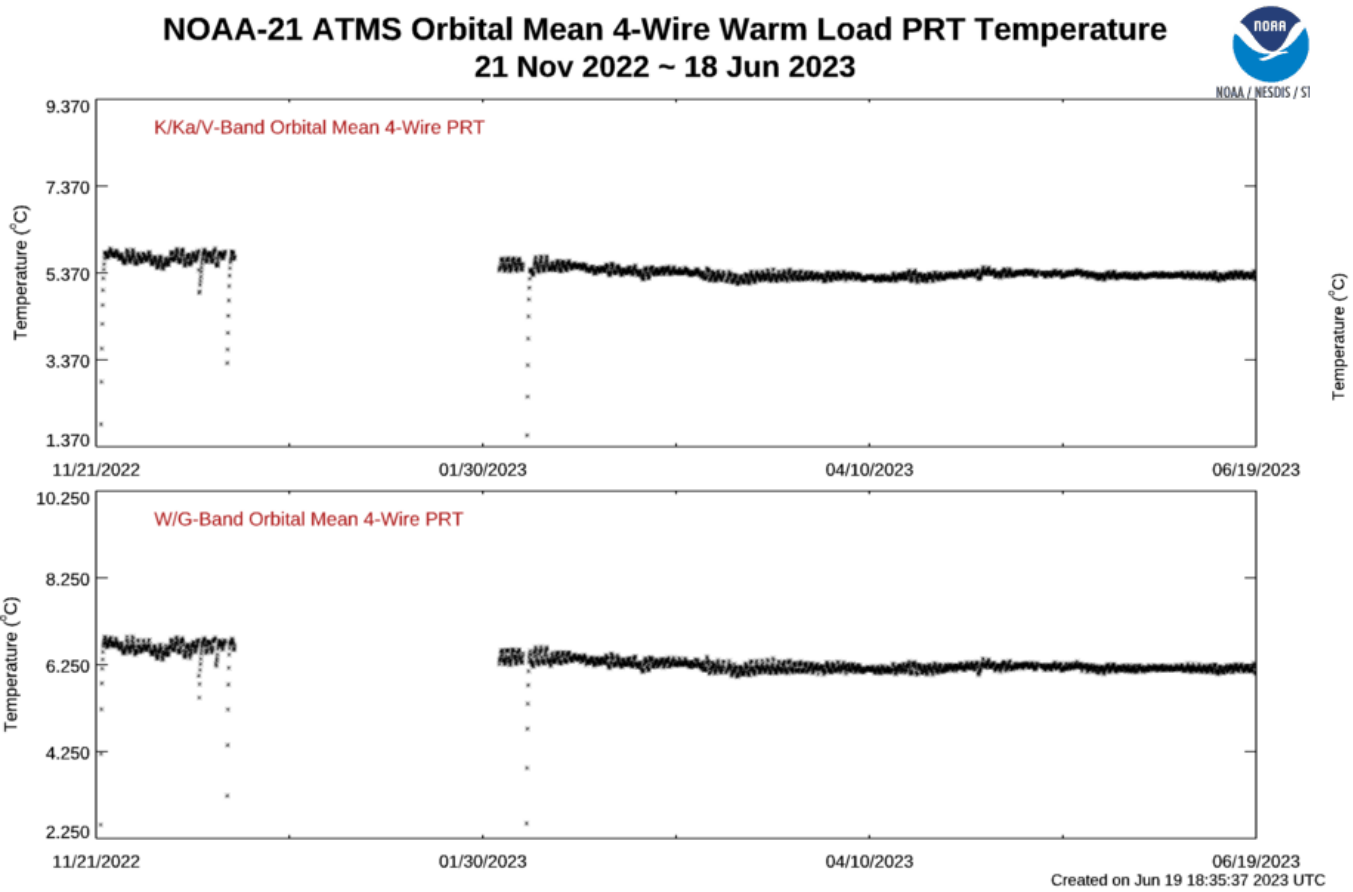


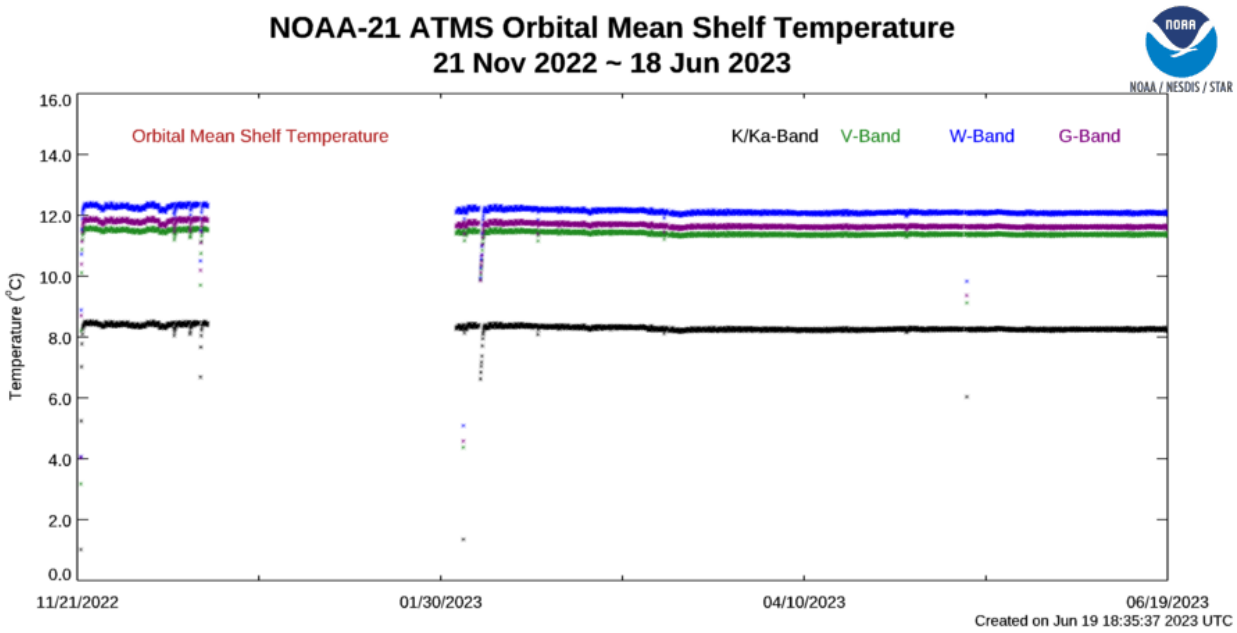
NOAA-21 ATMS On-orbit Calibration Gain



On-orbit channel calibration gain is stable

NOAA-21 ATMS On-orbit Instrument Temperatures





On-orbit internal calibration target and instrument temperatures are stable

PART TWO

NOAA-21 ATMS Science Data Product Quality Improvement and Evaluation

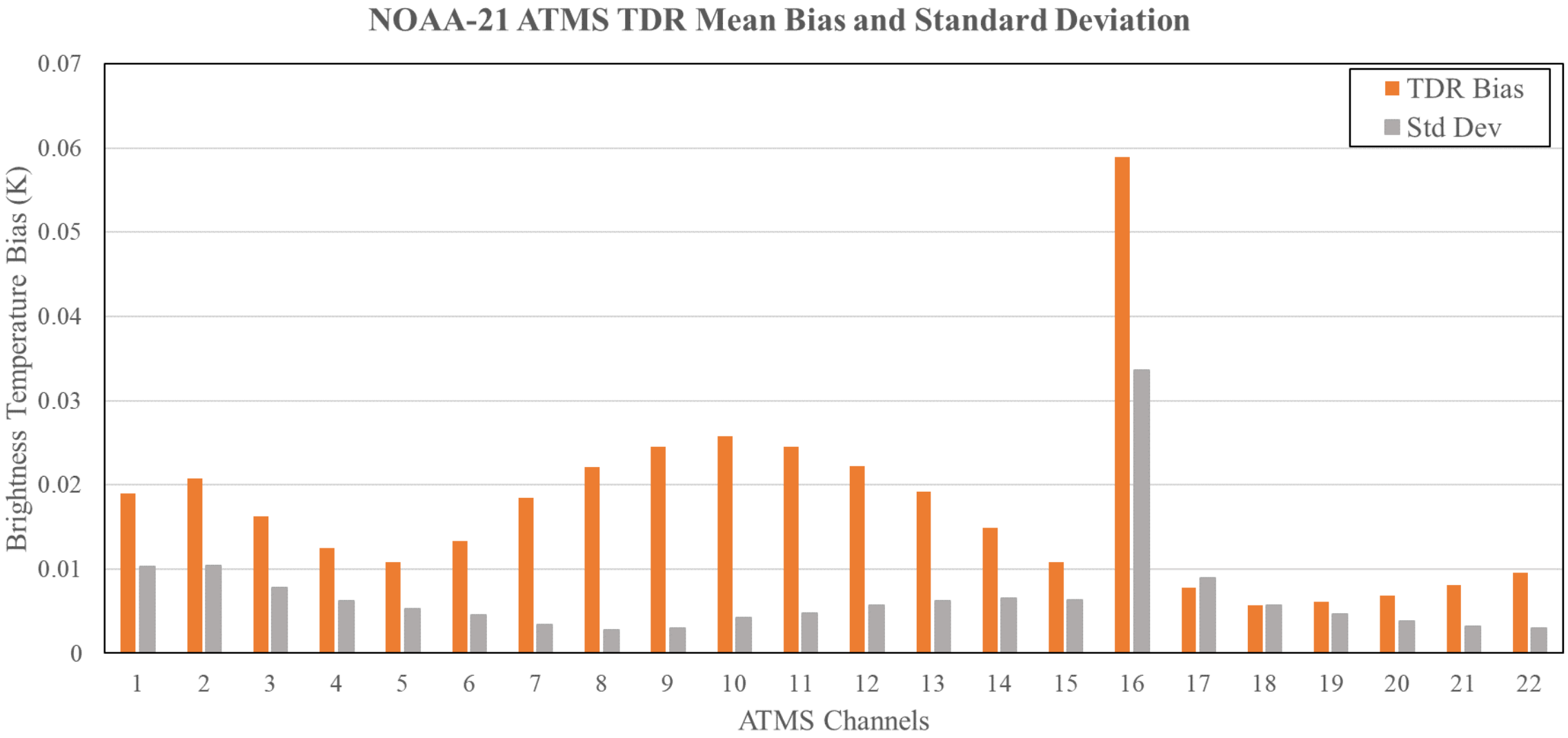
Presented by

Ninghai Sun

NOAA-21 ATMS Post-Provisional Calibration Improvements

- NOAA-21 cold bias correction coefficients update – Roll Maneuver PLT
- NOAA-21 reflector emissivity updates – Pitch Maneuver PLT
- NOAA-21 TDR-to-SDR conversion coefficients updates – Antenna Pattern Measurements
- NOAA-21 beam pointing angle updates

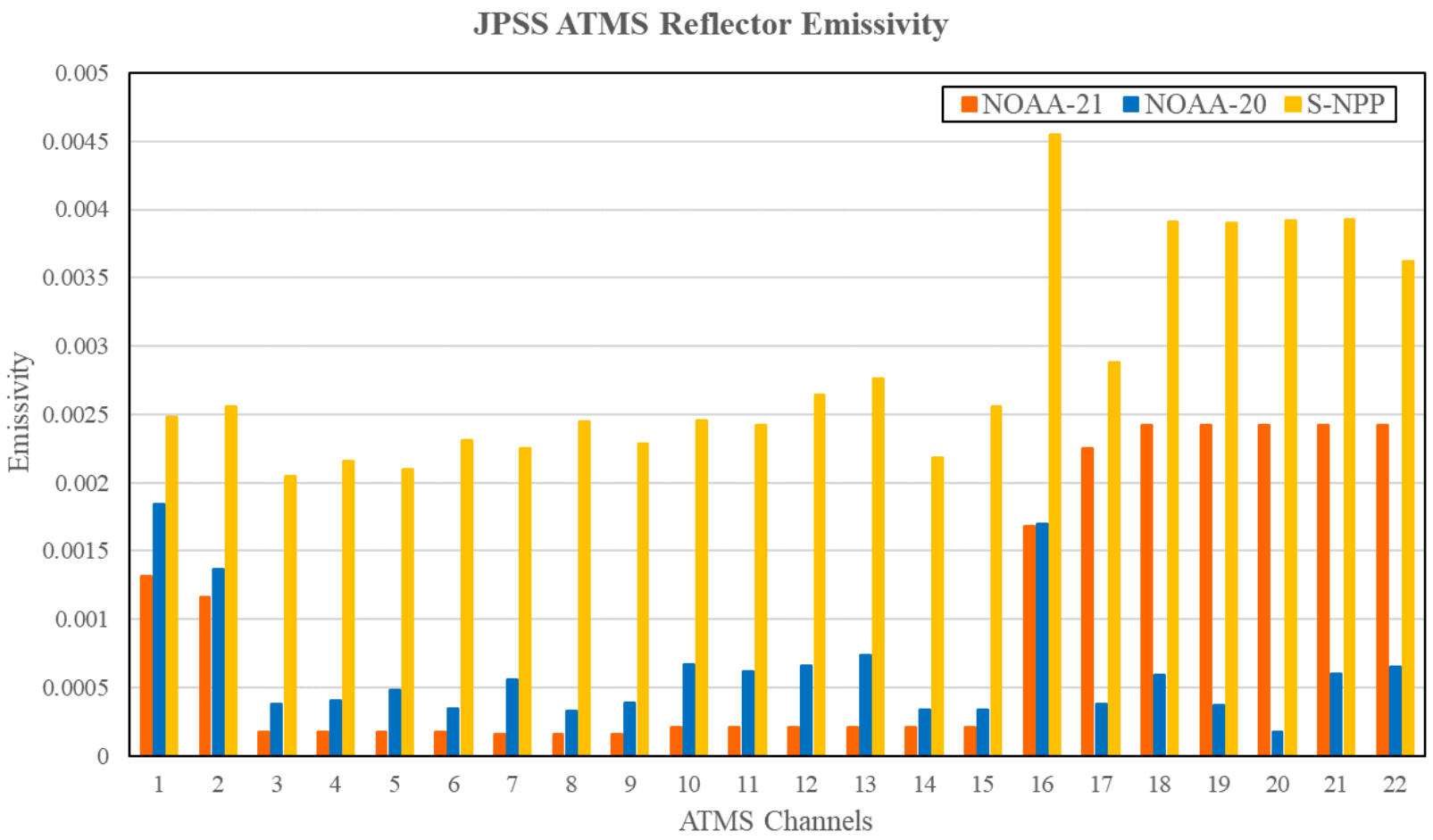
NOAA-21 ATMS Cold Bias Correction Coefficients Update



A small positive systematic global mean TDR bias observed after the cold bias correction coefficient update

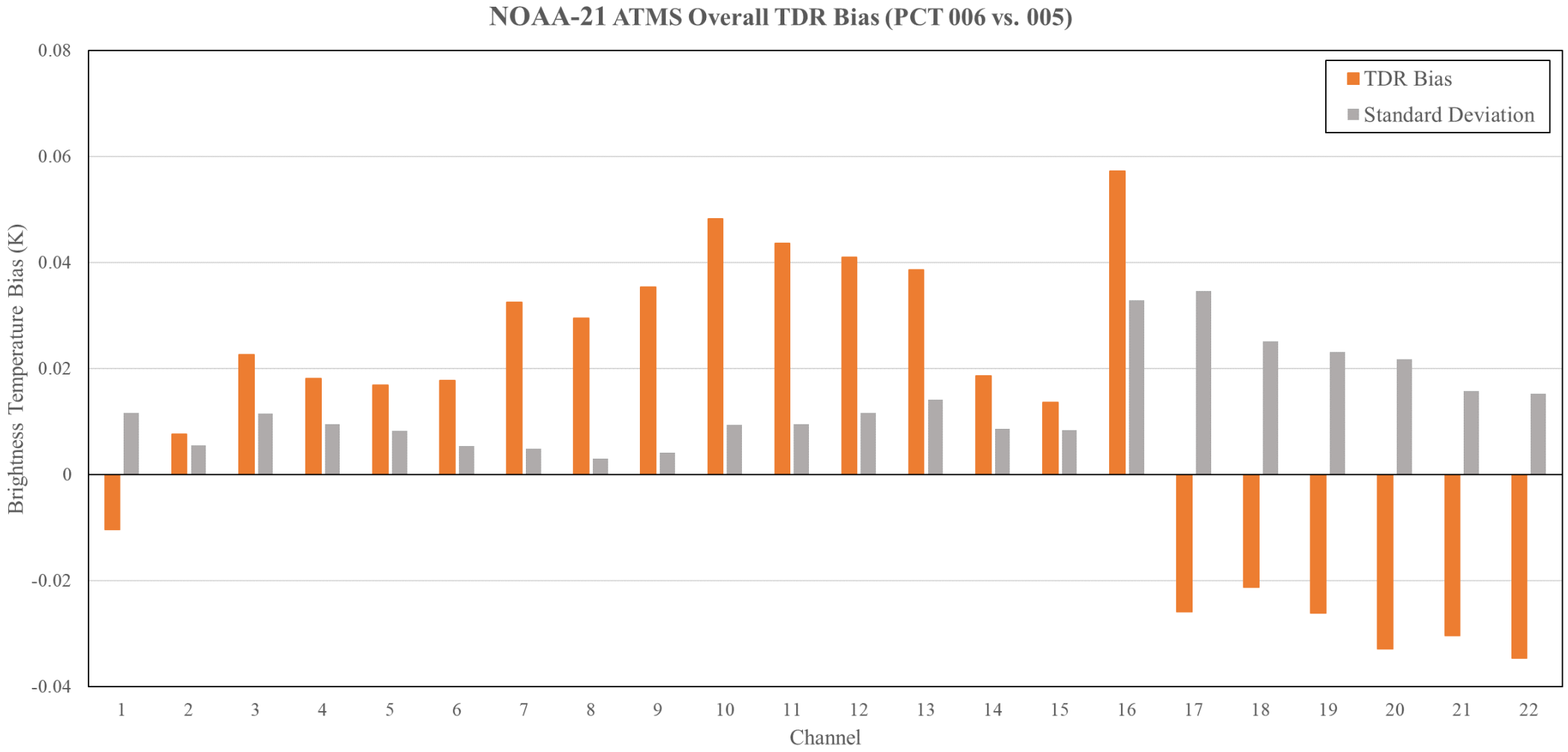
NOAA-21 ATMS Reflector Emissivity Update

Ch.	NOAA-21	NOAA-20	S-NPP
1	0.00132	0.00184	0.00248
2	0.00116	0.00137	0.00256
3	0.00018	0.00038	0.00205
4	0.00018	0.00041	0.00216
5	0.00018	0.00048	0.00210
6	0.00018	0.00035	0.00231
7	0.00016	0.00056	0.00225
8	0.00016	0.00033	0.00245
9	0.00016	0.00039	0.00229
10	0.00021	0.00067	0.00246
11	0.00021	0.00062	0.00242
12	0.00021	0.00066	0.00264
13	0.00021	0.00074	0.00276
14	0.00021	0.00034	0.00218
15	0.00021	0.00034	0.00256
16	0.00168	0.00170	0.00455
17	0.00225	0.00038	0.00288
18	0.00242	0.00059	0.00391
19	0.00242	0.00037	0.00390
20	0.00242	0.00018	0.00392
21	0.00242	0.00060	0.00393
22	0.00242	0.00065	0.00362



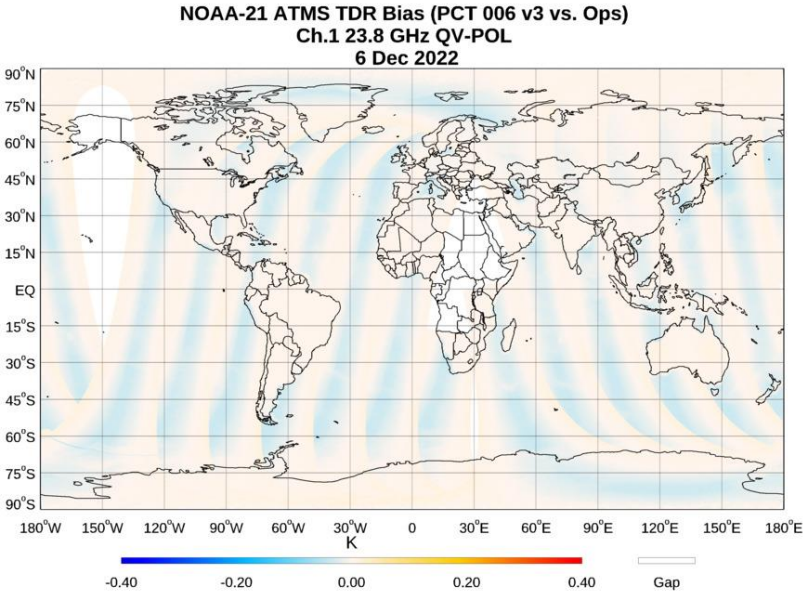
- Retrieved from Pitch-over Maneuver PLT
- Lower K/Ka/V/W-bands while higher G-band emissivity compared to NOAA-20

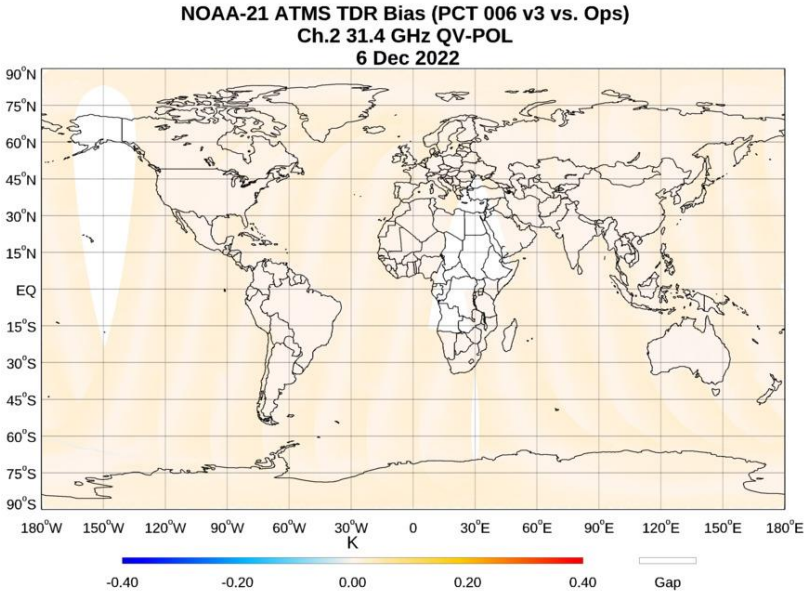
NOAA-21 ATMS Antenna Temperature Data Record (TDR) Update

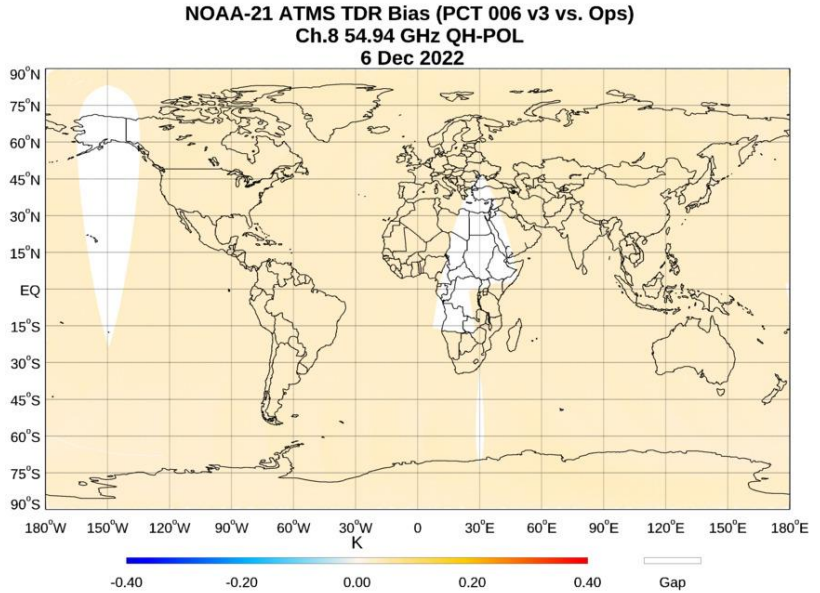


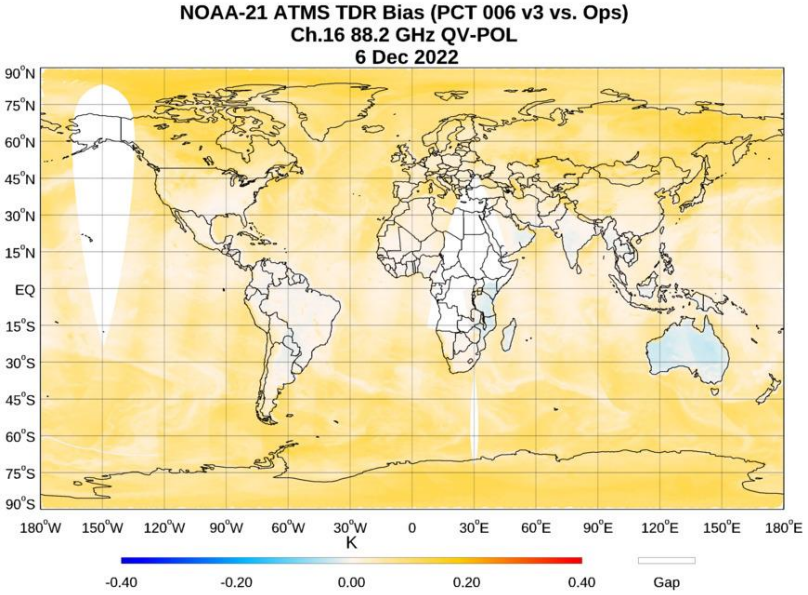
- Overall TDR changes from both ColdBiasCorrection and Emissivity updates
- A decrease trend in G-band channels is due to the update of on-orbit emissivity

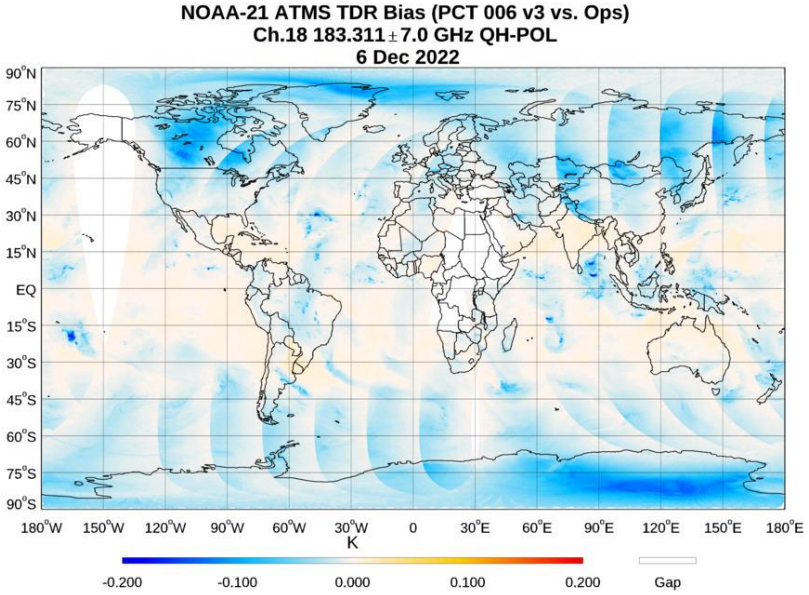
NOAA-21 ATMS Antenna Temperature Data Record (TDR) Updates





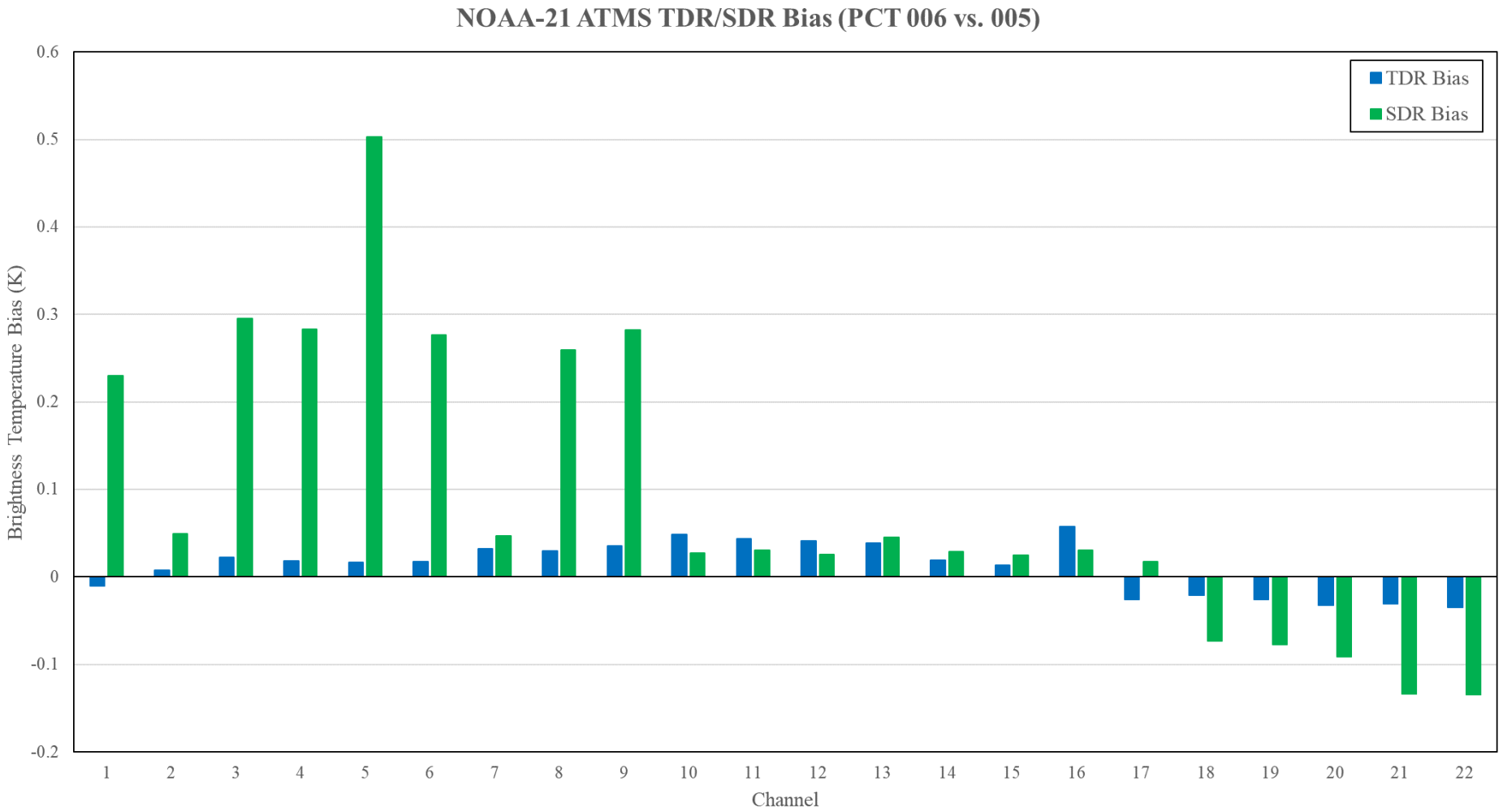






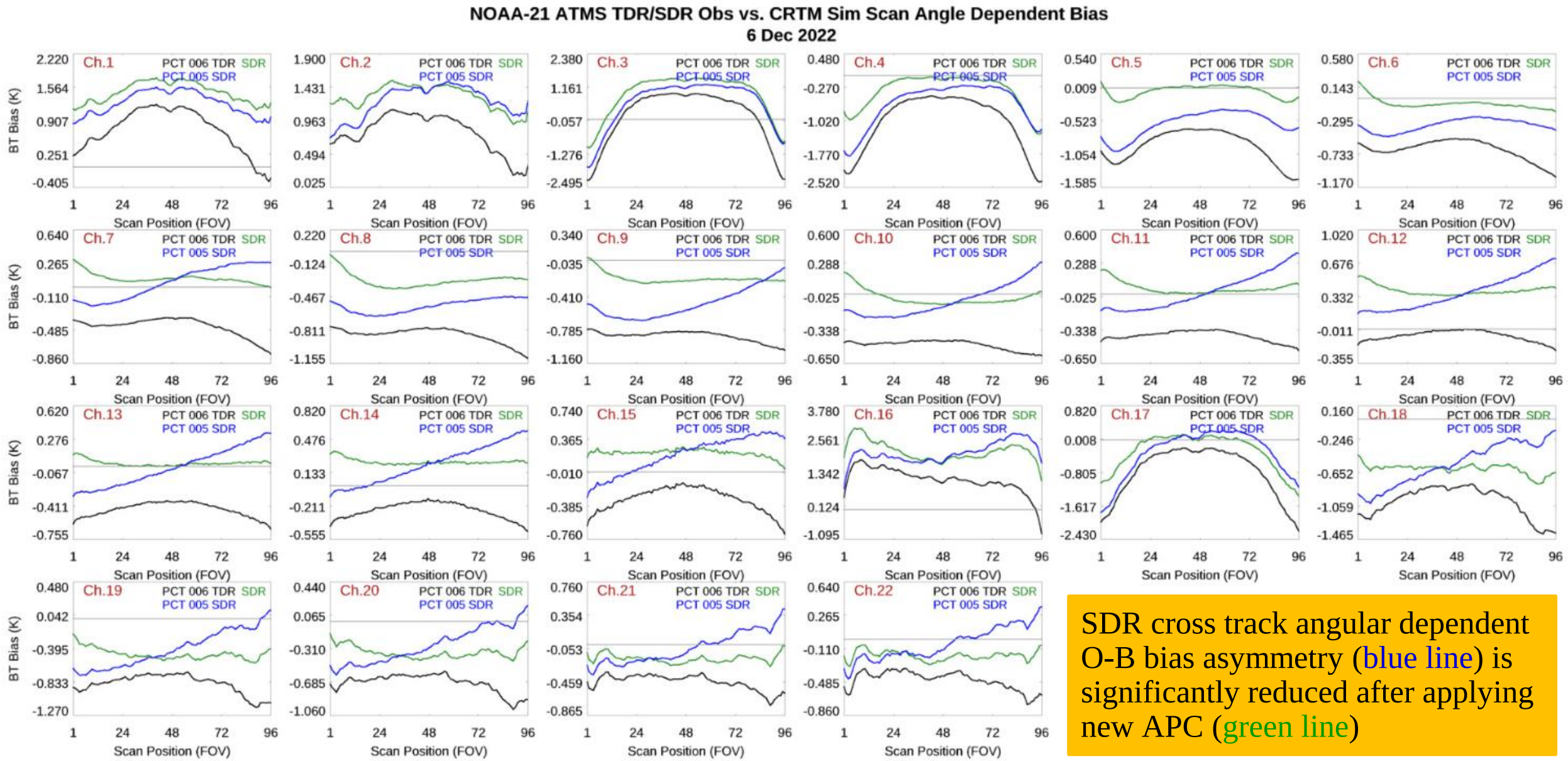
TDR bias map before and after calibration coefficient updates at selected channels of each band

NOAA-21 ATMS Sensor Data Record (SDR) Updates



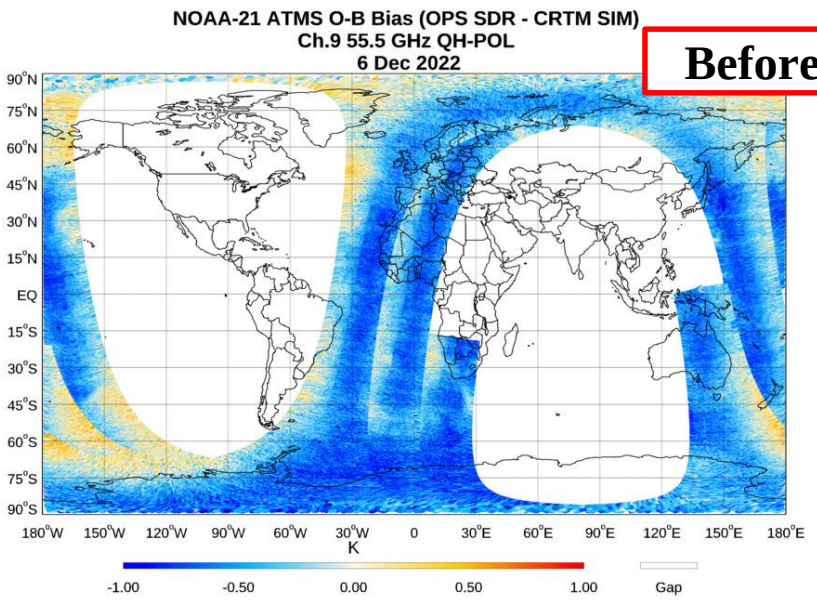
- Overall SDR changes come from both TDR and Antenna Pattern Correction (APC) updates
- SDR changes at low V-band and G-band are larger than TDR

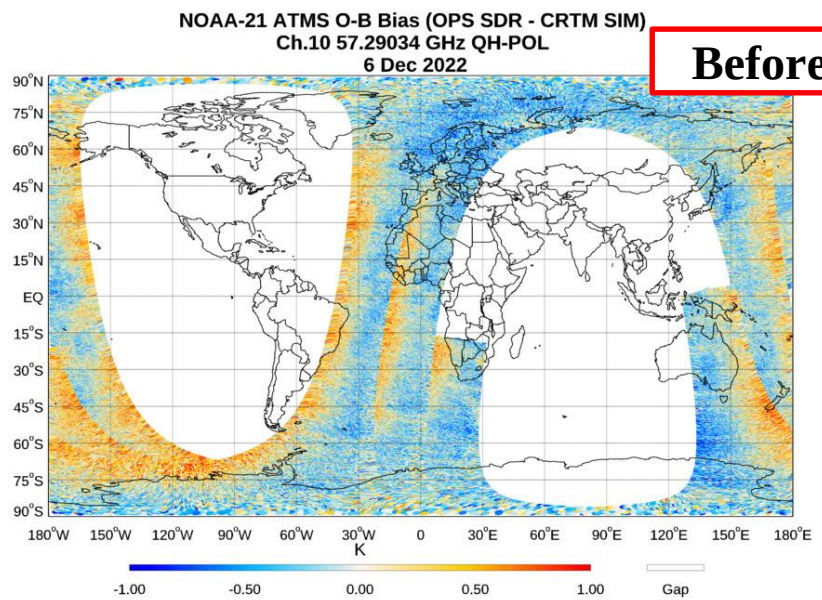
NOAA-21 ATMS Sensor Data Record (SDR) Updates

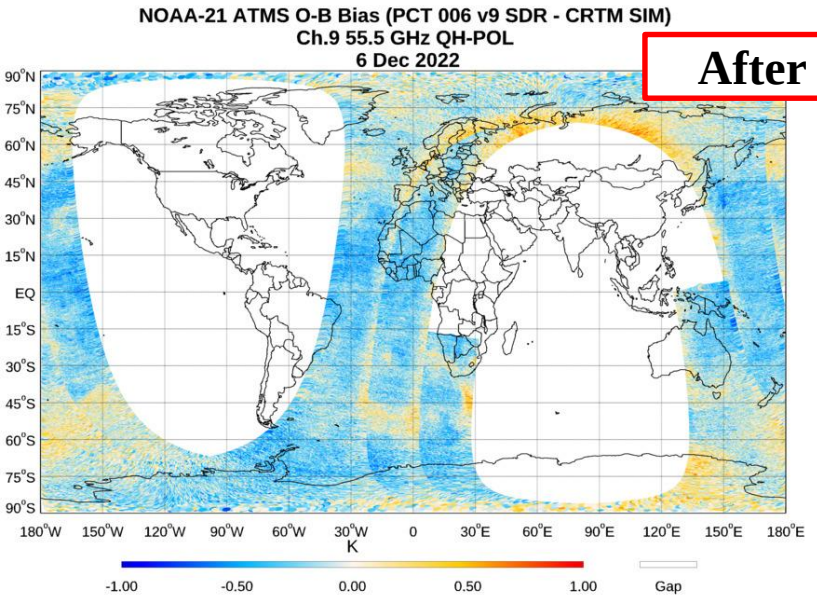


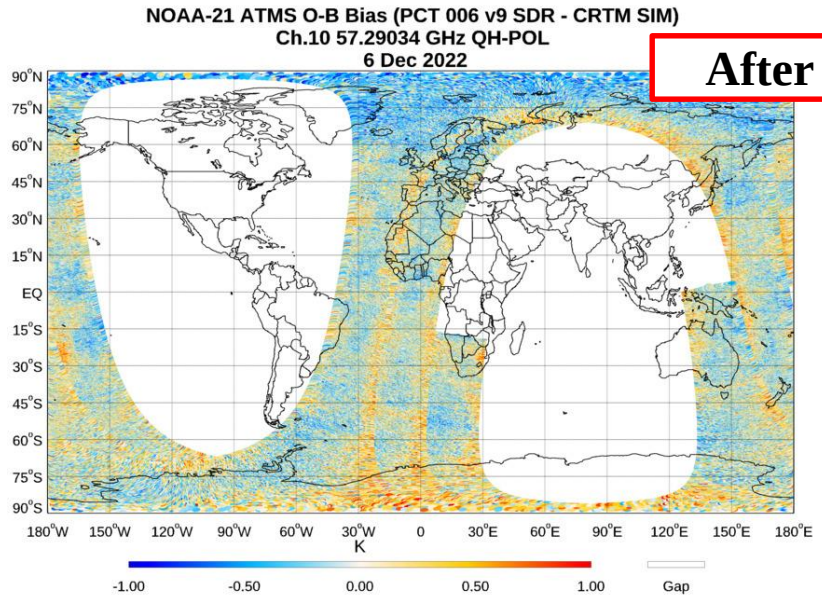
SDR cross track angular dependent O-B bias asymmetry (blue line) is significantly reduced after applying new APC (green line)

NOAA-21 ATMS Sensor Data Record (SDR) Updates



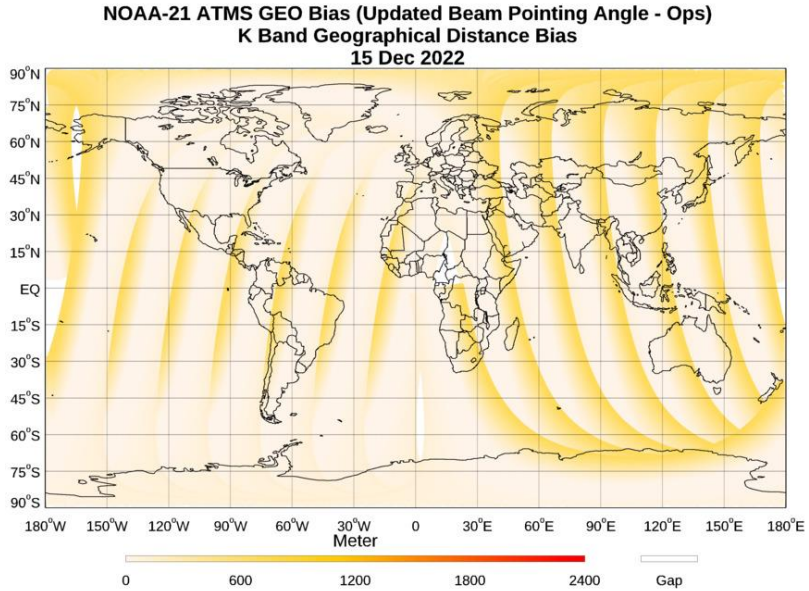


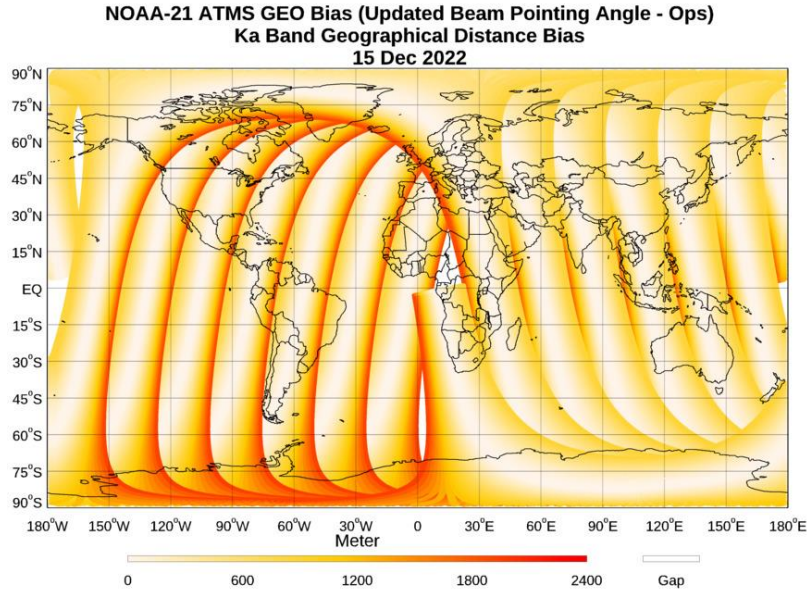


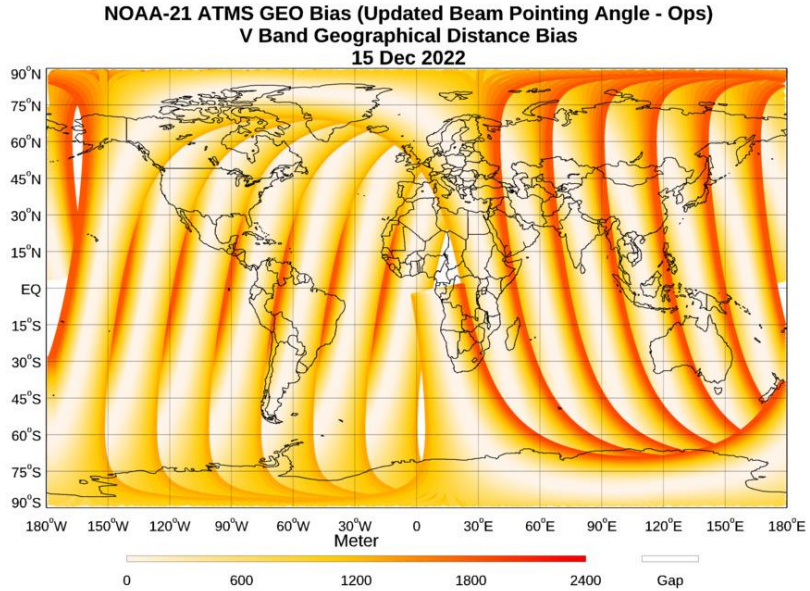


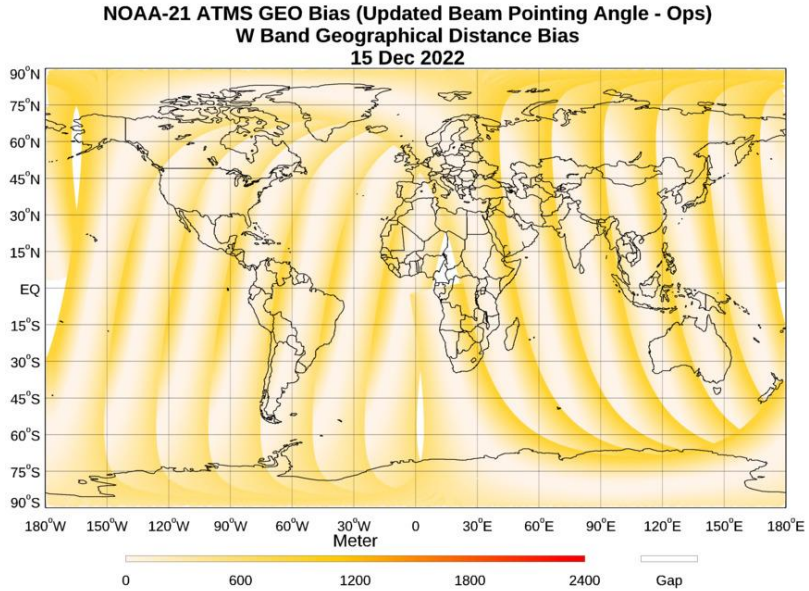
- SDR vs. CRTM simulation map at V-band channels
- Cross track O-B asymmetry is reduced after the APC coefficients updates

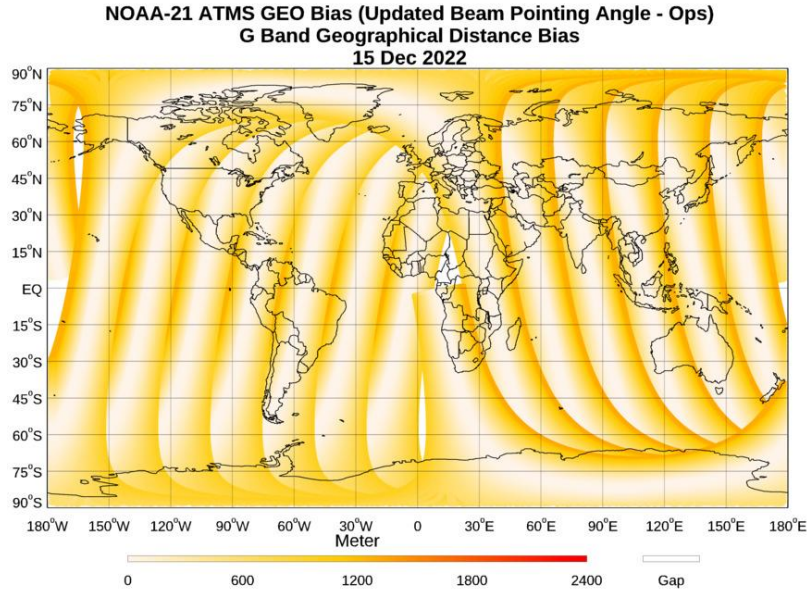
NOAA-21 ATMS Beam Pointing Angle Updates





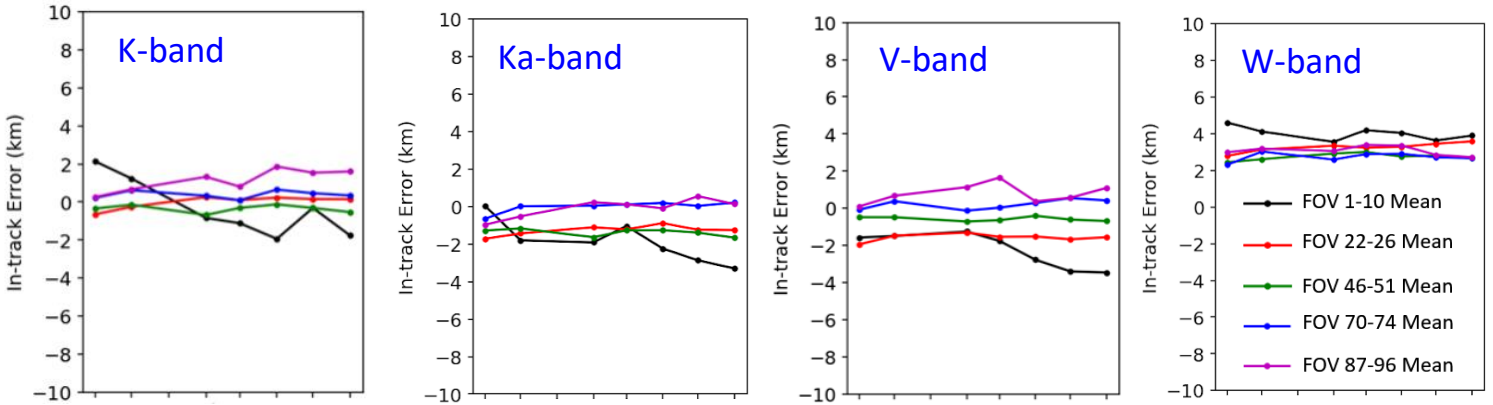


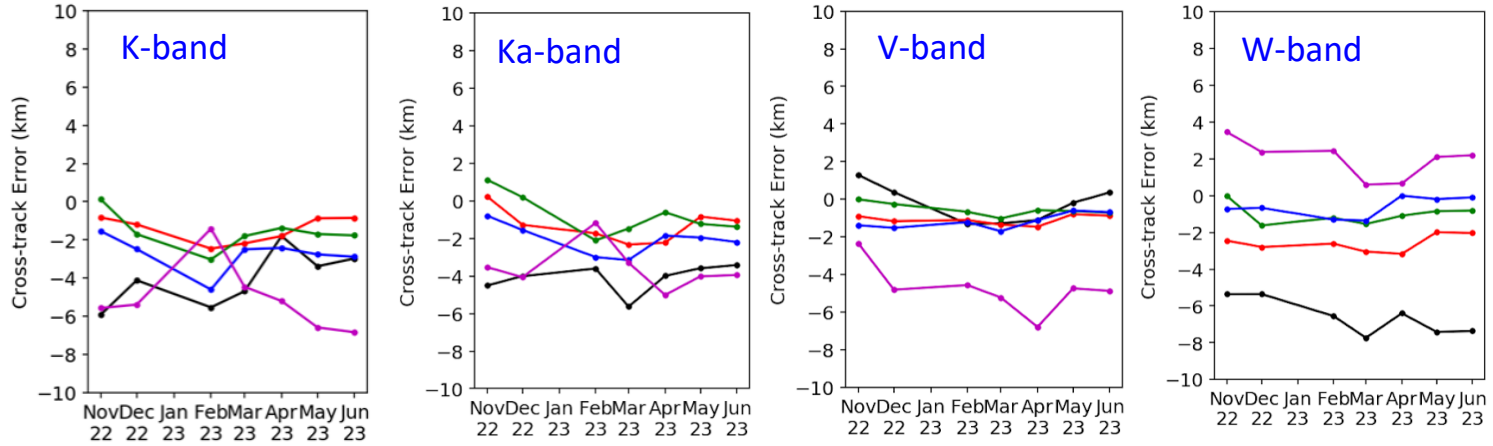




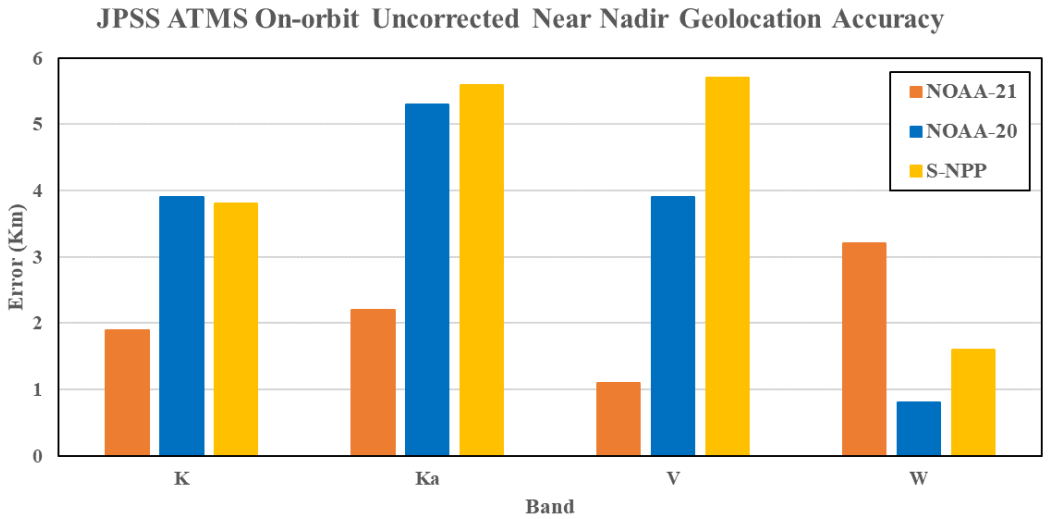
- Geophysical changes before and after beam pointing angle correction coefficients updates
- Major changes are observed near the limb sides

NOAA-21 ATMS Geolocation Accuracy Characterization



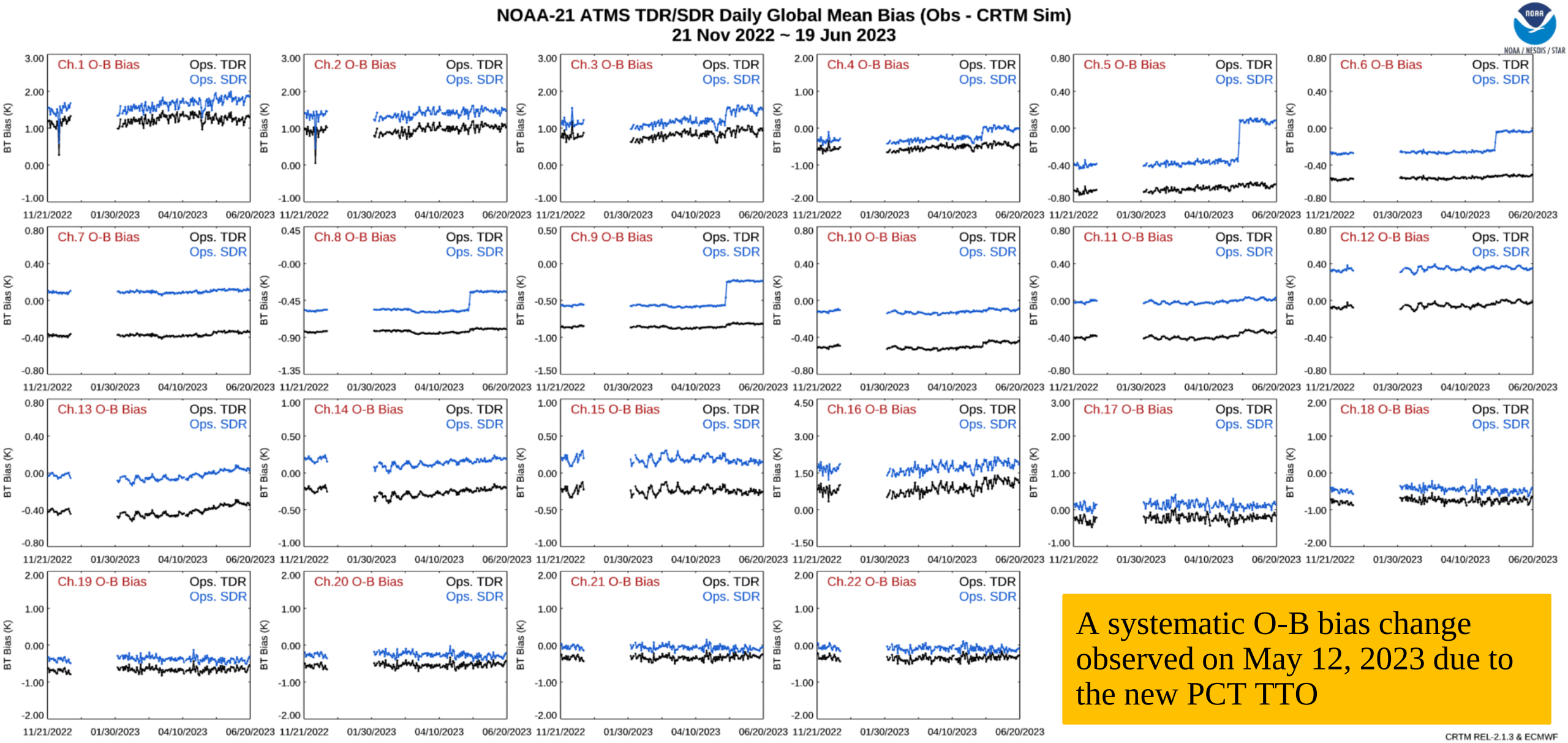


Band	NOAA-21 Nadir Error (Km)	NOAA-20 Nadir Error (Km)	S-NPP Nadir Error (Km)
K	1.9	3.9	3.8
Ka	2.2	5.3	5.6
V	1.1	3.9	5.7
W	3.2	0.8	1.6



- Inflation point method is not reliable for G-band channels. An under-development lunar observation method will cover all channels
- N21 ATMS monthly-average geolocation error is relatively stable over the full period of the post-launch validation period
- N21 ATMS K-/Ka/V- band near-nadir uncorrected geolocation error smaller, while W-band is larger, than N20 and NPP

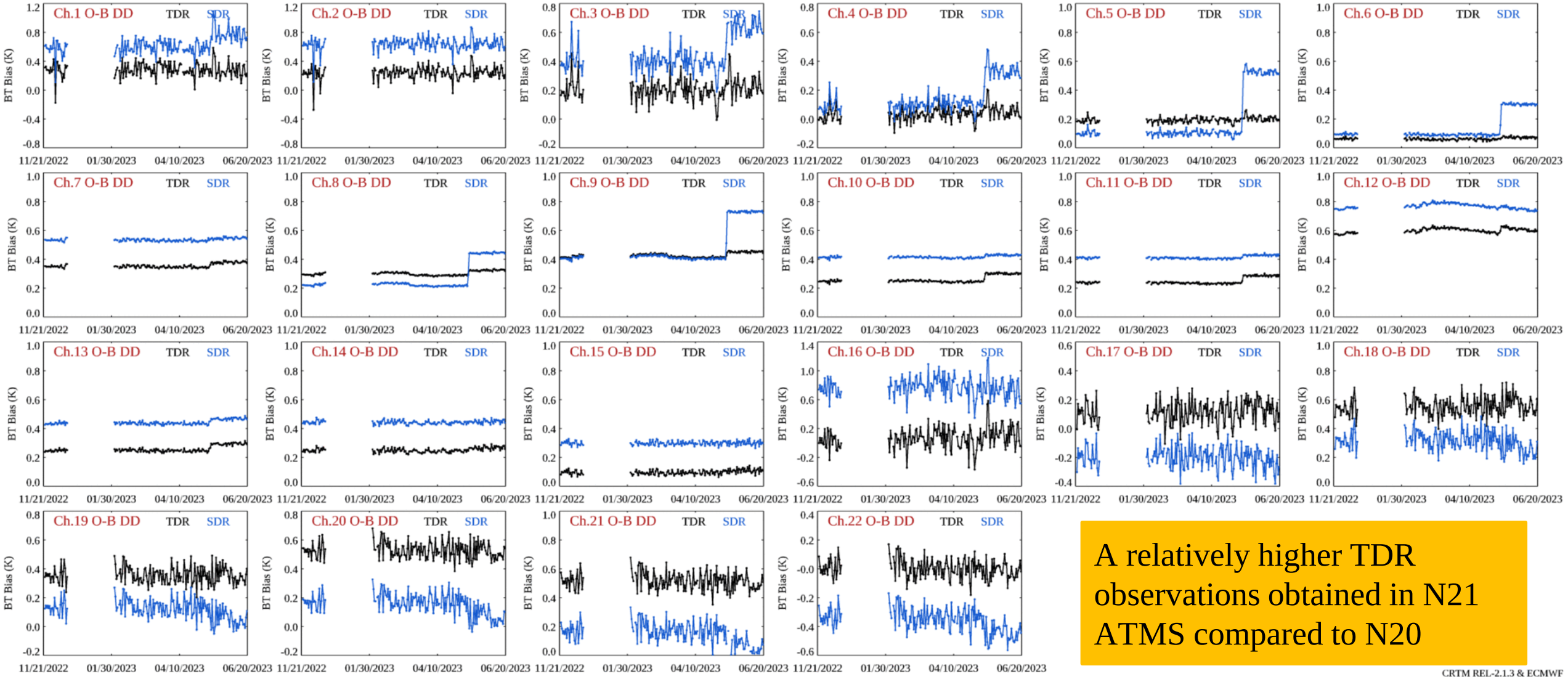
NOAA-21 ATMS Operational Data NRT Monitoring – Obs vs. CRTM Bias



A systematic O-B bias change observed on May 12, 2023 due to the new PCT TTO

NOAA-21 ATMS Inter-Sensor Comparison (O-B Bias Double Difference)

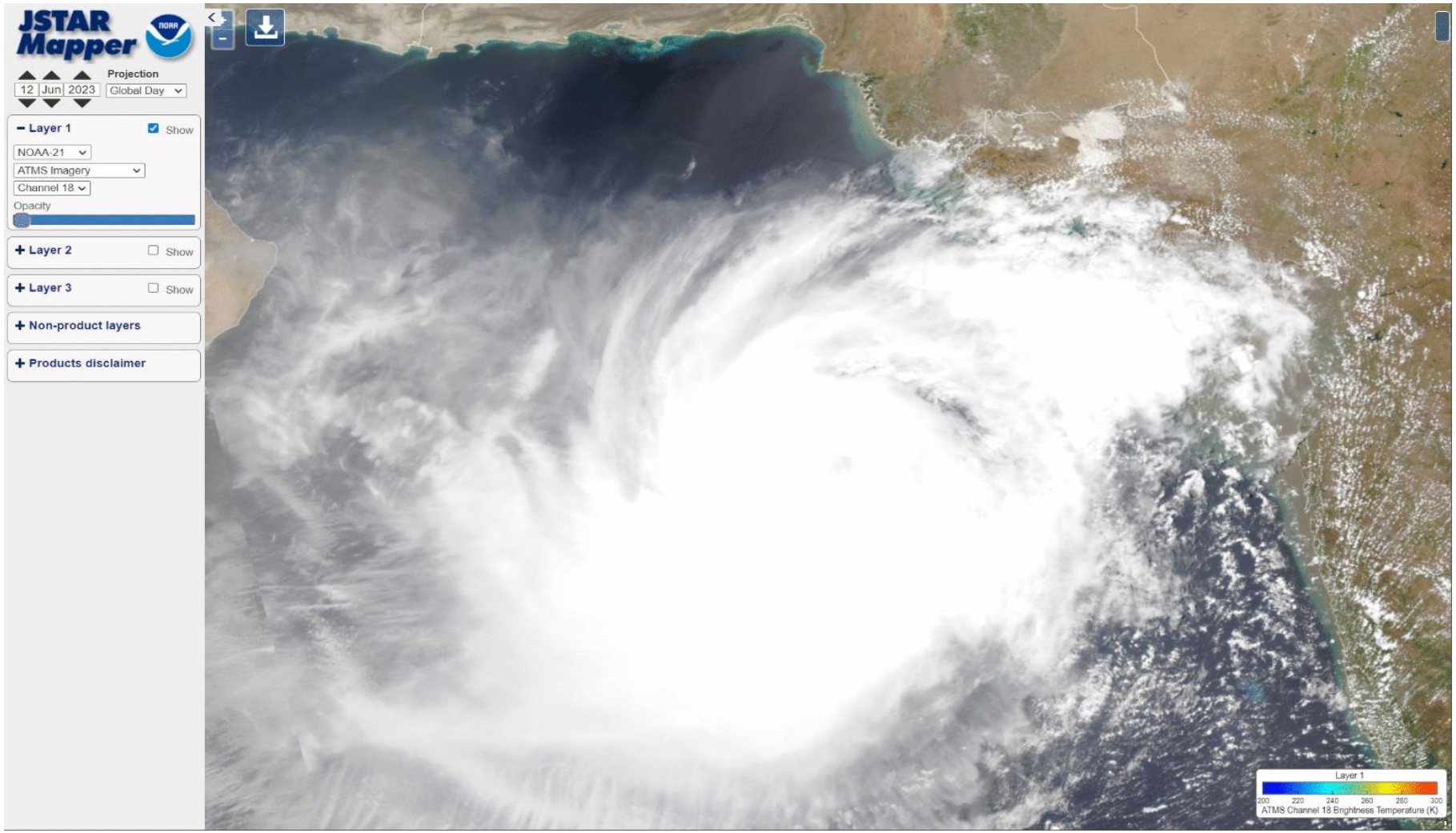
JPSS ATMS Daily Global Mean Obs-Sim Bias Inter-Sensor Double Difference
(N21 – N20)
21 Nov 2022 ~ 19 Jun 2023



A relatively higher TDR observations obtained in N21 ATMS compared to N20

CRTM REL-2.1.3 & ECMWF

JPSS ATMS Operational Imagery Products



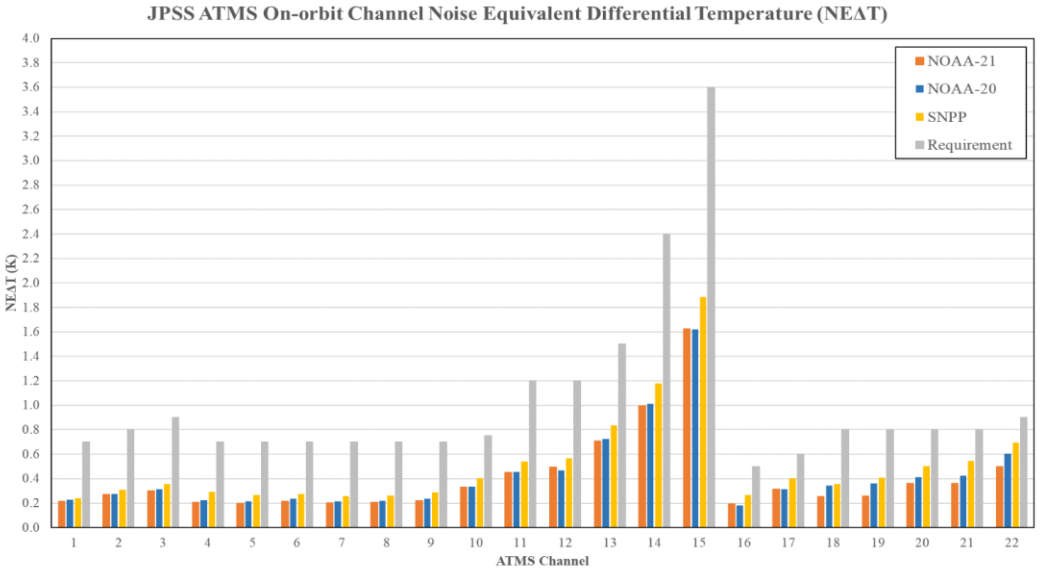
- NOAA-21 ATMS Channel 18 limb-corrected and AI based resolution enhanced imagery products over VIIRS TrueColor image
- Channel 6 and 16 also available to provide temperature sounding and surface features
- NOAA-20 and S-NPP ATMS imagers also available in NRT to support severe event watch

JPSS ATMS Cal/Val Team Future Plan

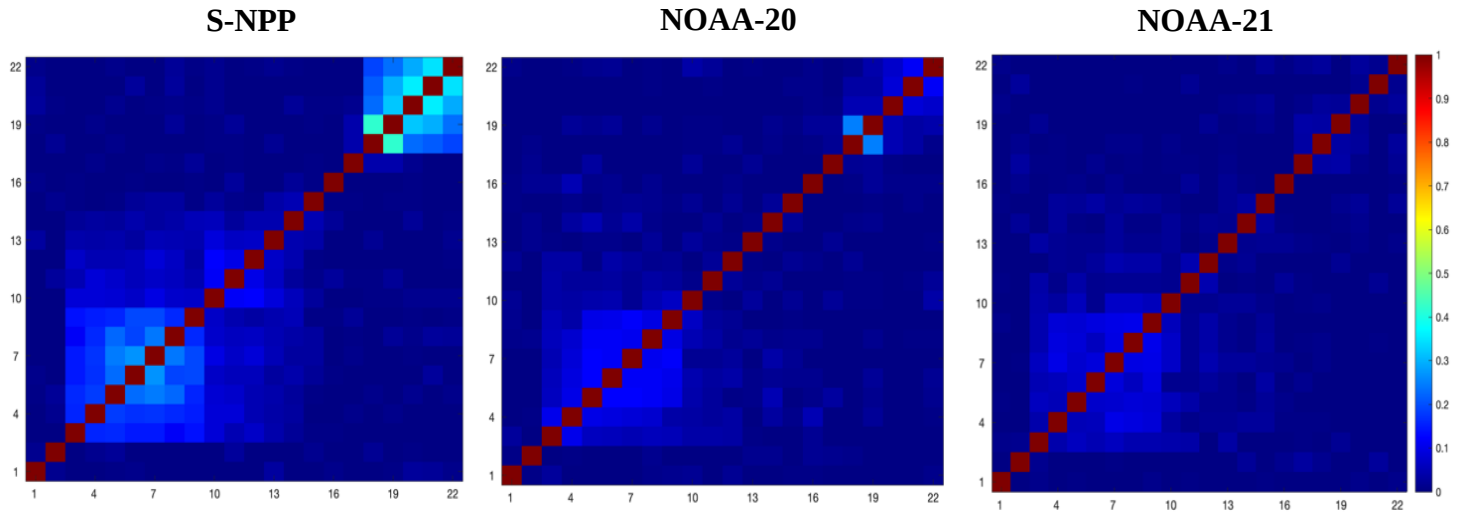
- Develop and implement dynamic cold bias correction algorithm/coefficients in IDPS
- Develop and implement satellite near field contamination correction algorithm/coefficients in IDPS
- Develop geolocation accuracy correction algorithm
- Implement band dependent satellite zenith angle output in GEO data
- Verify ATMS spectral response function (SRF) datasets and applications in RTM
- Update S-NPP and NOAA-20 APC correction coefficients as needed
- JPSS-3/4 ATMS pre-launch test data analysis

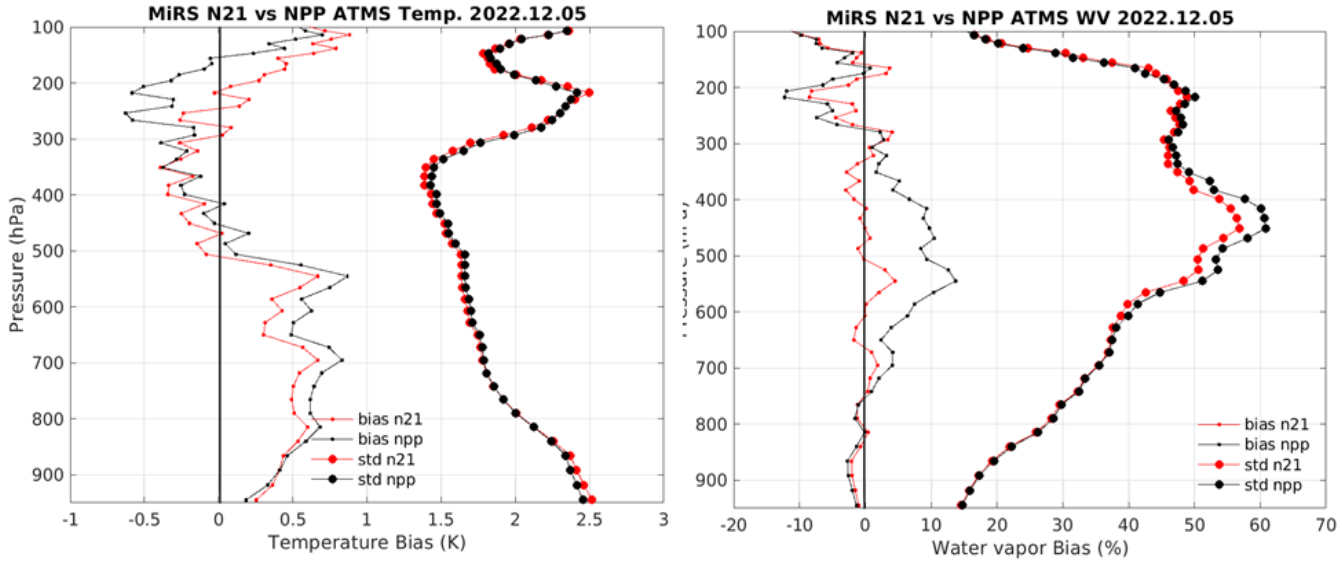
NOAA-21 ATMS SDR Validated Maturity Highlights

On-orbit channel NEΔT

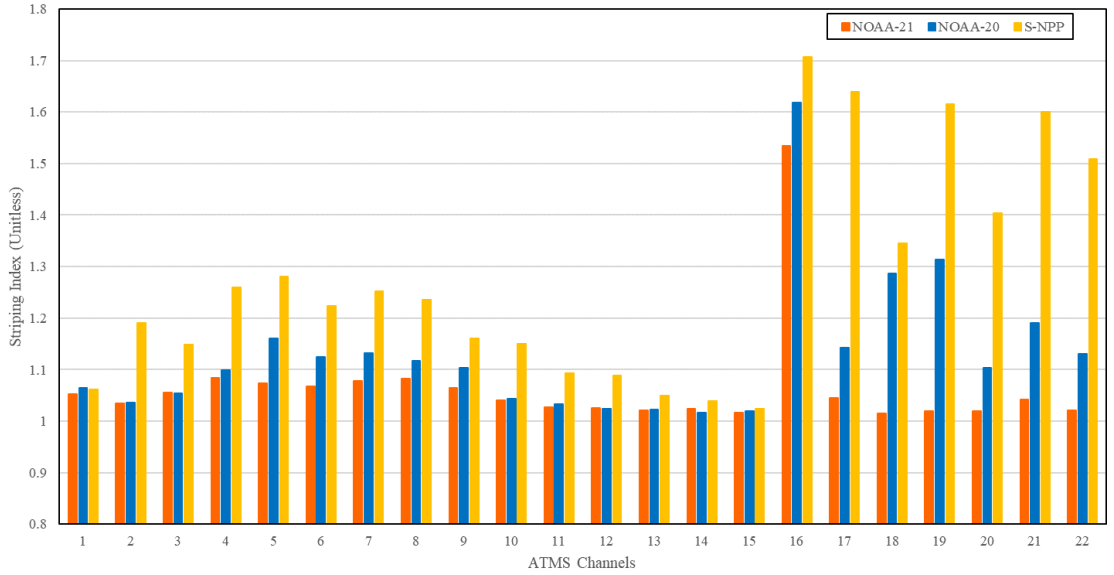


On-orbit channel to channel noise correlation





JPSS ATMS Striping Index (Ratio between along-track variation and cross-track variation



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).	NOAA-21 ATMS NRT instrument health status, performance, and science data quality have been monitored over global scale since launch. Products are available to public users.
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.	Multiple peer-reviewed publications have described the major updates in ATMS calibration algorithms and demonstrated the improvements in science data quality. ATMS SDR Algorithm Theoretical Basis Document (ATBD) has also been updated to reflecte the latest algorithm changes.
Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.	ATMS science data quality has been fully characterized. On-orbit calibration coefficients have been updated based on the Post-Launch Testing (PLT) data analysis.
Product is ready for operational use based on documented validation findings and user feedback.	Confirmed based on the feedback from ATMS downstream EDR and NWP users
Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument	Several ATMS calibration update tasks have been proposed to further improve the science data quality.

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
Instrument Calibration Data Book	Yes
Instrument Spectral Response Functions (SRF) Public Release	Yes
System Maintenance Manual (for ESPC products)	N/A
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	

NOAA-21 ATMS Validated Maturity Status Summary

- ✔ All NOAA-21 ATMS PLTs have been completed successfully;
- ✔ Through PLTs, cold calibration bias correction coefficients and reflector emissivity are retrieved. Instrument performance is fully characterized as well;
- ✔ Update of antenna pattern correction coefficients reduces the SDR angular dependent bias asymmetry;
- ✔ On orbit channel-to-channels noise correlations among S-NPP, NOAA-20, and NOAA-21 are analyzed. NOAA-21 ATMS is the best;
- ✔ NOAA-21 ATMS channel NEΔTs are stable and improved G-band performance compared to NOAA-20;
- ✔ Low noise of NOAA-21 ATMS water vapor channels improves MiRS water vapor EDR retrieval performance;
- ✔ NOAA/NWS/EMC started NOAA-21 ATMS pre-operational NWP testing from May 2023
- ✔ UKMO analysis proved “the NOAA-21 compares very favourably to NOAA-20 … the instrument stability is good too, both in terms of C-B and Nedt”.
- ✔ NRT instrument health status, performance, and science data quality monitoring details are referred to https://www.star.nesdis.noaa.gov/icvs/status_N21_ATMS.php

ATMS science team recommend the declaration of Validated maturity data quality for NOAA-21 ATMS TDR/SDR from May 12 15:51:52 UTC 2023 at Rev 2601