

***Provisional Maturity Science Review
For NOAA-20 OMPS
Total Ozone EDR – V8TOz***



***Presented by Lawrence E. Flynn
Date:2018/10/02***

Disclaimer

"The contents of this presentation are mine personally and do not necessarily reflect any position of the US Government or the National Oceanic and Atmospheric Administration."

JPSS Data Products Maturity

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.

- Product Requirements
- Provisional Maturity Performance Validation
 - On-orbit instrument performance assessment
 - Identify all of the instrument and product characteristics you have verified/validated
- Users/EDRs feedback
 - Product is on NDE I&T, Access is involved.
- Risks, Actions, Mitigations
 - Potential issues, concerns
- Path forward to Validated Maturity
- Summary

- Provisional 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
- Updated Provisional Maturity Slide Package addressing review committee's comments for:
 - Cal/Val Plan and Schedules
 - Product Requirements
 - Provisional Maturity Performance
 - Risks, Actions, Mitigations
 - Path forward to Validated Maturity

- 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
- Risks, Actions, and Mitigations
- Documentation (Science Maturity Check List)
- Conclusion
- Path Forward

Ozone Cal/Val/Alg Team Membership

	Name	Organization	Task
Lead	Lawrence Flynn	NOAA/NESDIS/STAR	Ozone EDR Team
Sub-Lead	Irina Petropavlovskikh	NOAA/ESRL/CIRES	Ground-based Validation
Sub-Lead	Craig Long	NOAA/NWS/NCEP	Product Application
Sub-Lead	Trevor Beck	NOAA/NESDIS/STAR	Trace Gas Algorithm Development
Member	Jianguo Niu	STAR/IMSG/SRG	Algorithm development, trouble shooting, Limb Profiler science
Member	Eric Beach	STAR/IMSG	Validation, ICVS/Monitoring, Data management
Member	Zhihua Zhang	STAR/IMSG	V8 Algorithms implementation and modification
JAM	Laura Dunlap	JPSS/Aerospace	Coordination
Adjunct	Bigyani Das	STAR/AIT	Deliveries
PAL	Vaishali Kapoor	OSDPD	Atmospheric Chemistry Product Area Lead

OMPS TC EDR Performance Characteristics

	Threshold	Objective
Ozone TC Applicable Conditions 1, 2.		
a. Horizontal Cell Size	50 x 50 km ² @ nadir	10 x 10 km ²
b. Vertical Cell Size	0 - 60 km	0 - 60 km
c. Mapping Uncertainty, 1 Sigma	5 km at Nadir	5 km
d. Measurement Range	50 - 650 milli-atm-cm	50-650 milli-atm-cm
e. Measurement Precision	.	.
1. $X < 0.25$ atm-cm	6.0 milli-atm-cm	1.0 milli-atm-cm
2. $0.25 < X < 0.45$ atm-cm	7.7 milli-atm-cm	1.0 milli-atm-cm
3. $X > 0.45$ atm-cm	2.8 milli-atm-cm + 1.1%	1.0 milli-atm-cm
f. Measurement Accuracy	.	.
1. $X < 0.25$ atm-cm	9.5 milli-atm-cm	5.0 milli-atm-cm
2. $0.25 < X < 0.45$ atm-cm	13.0 milli-atm-cm	5.0 milli-atm-cm
3. $X > 0.45$ atm-cm	16.0 milli-atm-cm	5.0 milli-atm-cm
g. Latency	90 min.	15 min.
h. Refresh	At least 90% coverage of the globe Every 24 hours (monthly average)	24 hrs.
i. Long-term Stability	1% over 7 years	0.5 % over 7 years
1. Threshold requirements only apply under daytime conditions with Solar Zenith Angles (SZA) up to 80 degrees.	1 milli-atm-cm = 1 DU	
2. The EDR shall be delivered for all SZA.		
3. SO2 exclusion removed.		

- Product performance requirements from JPSS L1RD supplement (threshold) versus observed/validated/JERD Vol. II

Attribute	Threshold	Observed/validated
Geographic coverage	90% Daily Global Earth	SLA < 70° (80%) SLA<80° (90%)
Vertical Coverage	0-60 km	0-60 km (RT tables, physics)
Vertical Cell Size	NA	NA
Horizontal Cell Size	50x50 km ² at nadir	50x17 km ² at nadir
Mapping Uncertainty	5 km at nadir	3 km at nadir (SDR Team)
Measurement Range	50 – 650 DU	90-700 DU (SDR range and past algorithm performance)
Measurement Accuracy		
X < 250 DU	9.5 DU	0 to -5 DU, vs. NPP
250 DU < X < 450 DU	13.0 DU	0 to -5 DU, vs. NPP
X > 450 DU	16.0 DU	Insufficient data
Measurement Precision		
X < 250 DU	6.0 DU	2.3 DU RMSDD, 6.0 DU NPPMU
250 DU < X < 450 DU	7.7 DU	2.3 DU RMSDD, 6.0 DU NPPMU
X > 450 DU	2.8 DU + 1.1%	Insufficient data

- Description of processing environment and algorithms used to achieve Provisional maturity stage:
 - Algorithm version V8TOz_v3r1 at NDE I&T using IDPS I&T SDRs.
 - LUTs used RT Tables from pre-launch and Soft Calibration Adjustment from 4/2018.
 - Effective date: August 10, 2018 .
- V8TOz v3, v4 and v5 and r#
 - Current v3r1: New handling of Error Code 8 and bad radiances.
 - Future v4: Code to use EOFs for outlier detection and noise reduction for OMPS NM SDRs.
 - Future v5: Code to add cloud top pressure.
 - We plan to use revision numbers for future updates to soft calibration adjustment tables with separate tracking of S-NPP and NOAA-20 updates. **Tables will be dual with before and after entries to allow temporal interpolation.**

Data sources and naming convention

- There are two sources of products from NDE, the operational string and the integration and testing string (I&T). NDE runs new revisions on the I&T before moving them to operations and they are currently only running the NOAA-20 OMPS EDRs on the I&T. The I&T at NDE uses the SDRs from the I&T at IDPS.
- We also make products at STAR either to compare with NDE or to test updates and revisions or because we want to create the EDRs with reprocessed SDRs.
- The EDRs have soft calibration adjustments and these are updated either as we make comparisons on the path to validation or when the SDRs have changed. There is a time lag for the EDR adjustments after and SDRs change.
- There are satellite, version and revision numbers in the files names that track some of these changes. For examples,

V8TOZ-

EDR_v3r0_npp_s201808012302421_e201808012303196_c201808020130010.nc

is version 3, revision 0 for S-NPP

- And

V8TOZ_OP/V8TOZ-

EDR_v3r1_j01_s201808201212230_e201808201213005_c201808201416070.nc

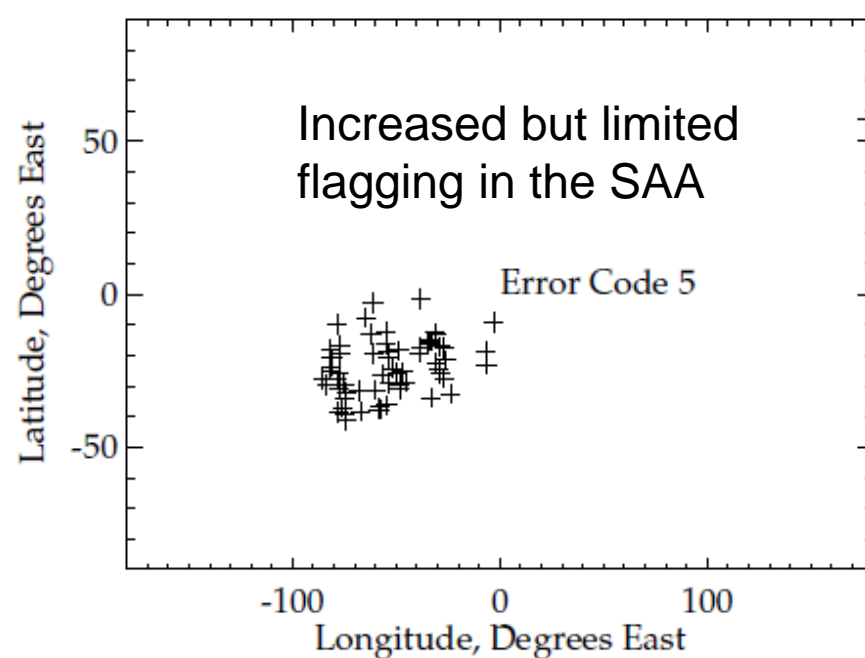
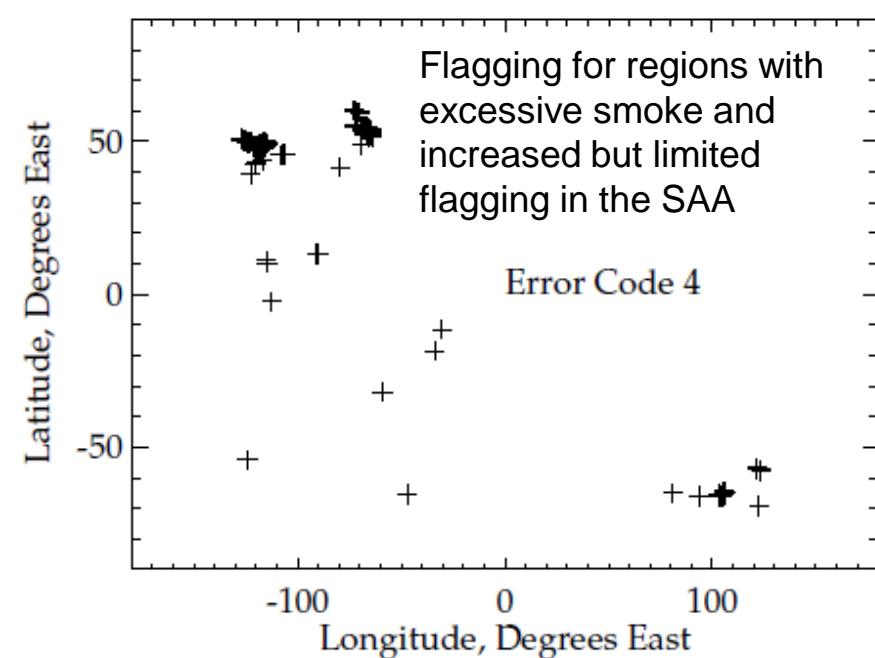
is version 3, revision 1 for NOAA-20

Required algorithm inputs

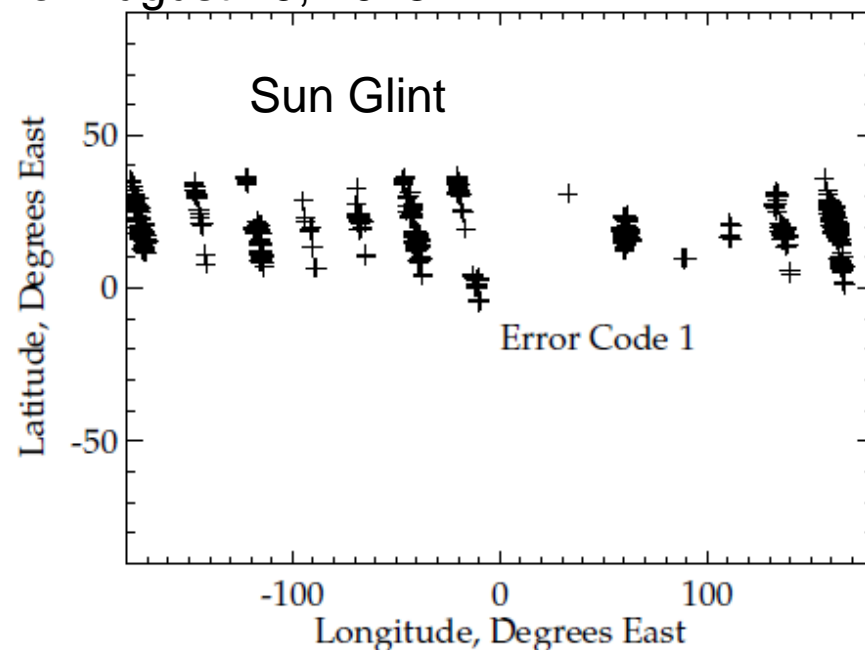
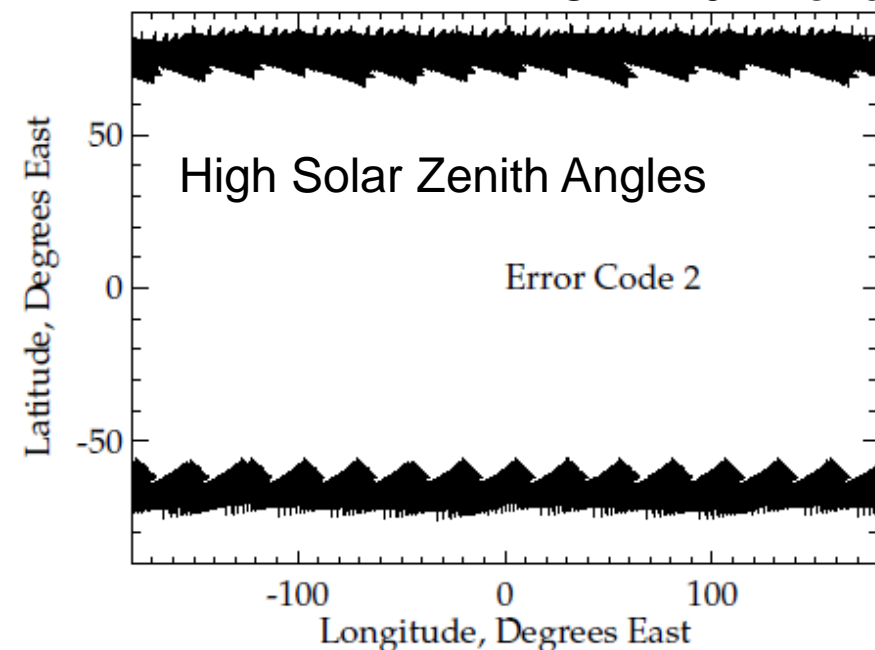
- Required Algorithm Inputs
 - Primary Sensor Data
 - NOAA-20 OMPS NM SDR and GEO
 - Ancillary Data
 - Ozone and cloud top pressure climatologies.
 - Upstream algorithms
 - OMPS SDR
 - LUTs / PCTs
 - Radiative Transfer Tables
 - N-value Adjustment Table

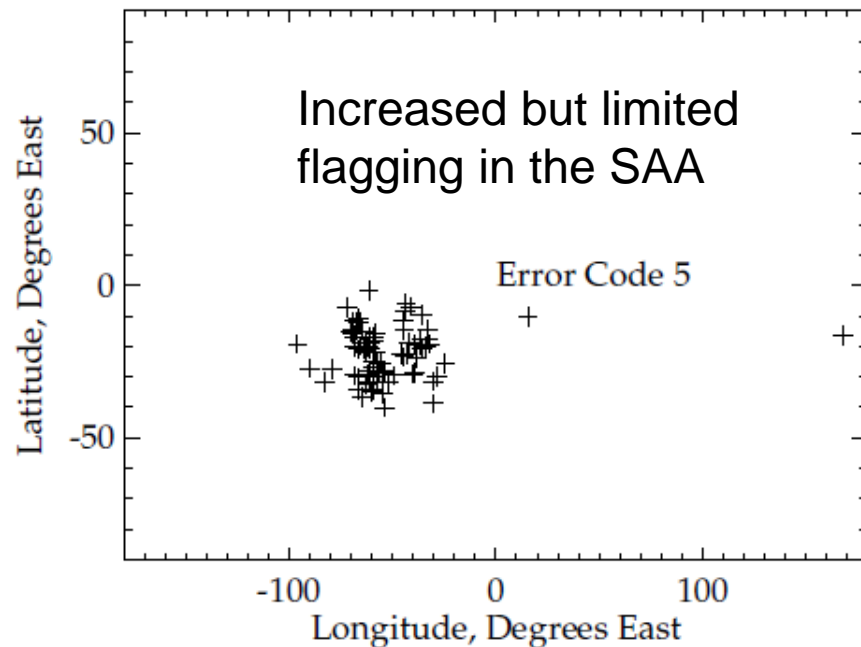
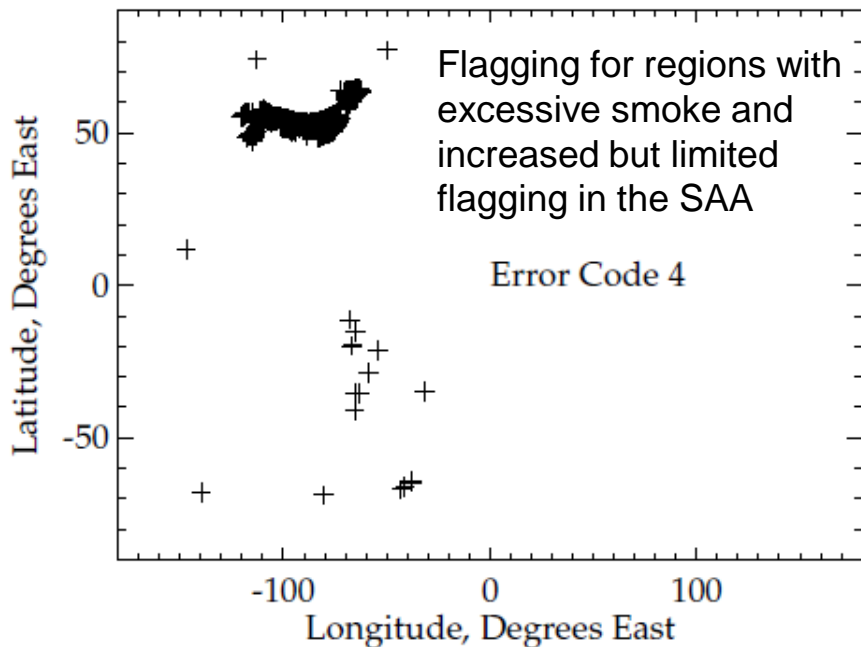
JPSS V8TOz Error Codes

Output	Type	Description
ErrorFlag	16-bit signed integer	Good – 0
		Good retrieval SZA $\leq 84^\circ$
		Glnt – 1
		Open water with sun glint geometry present
		SZA - 2
		Good retrieval SZA $> 84^\circ$
		Aerosol – 3
		360 nm residual $>$ threshold
		Shape – 4
		Residual at unused ozone wavelength $> 4 \sigma$
		SO2 – 5
		SO2 Index $> 4 \sigma$
		NC – 6
		Algorithm does not converge
		Residual – 7
		Absolute residual > 32
		+10
		Add 10 for Descending Orbit data

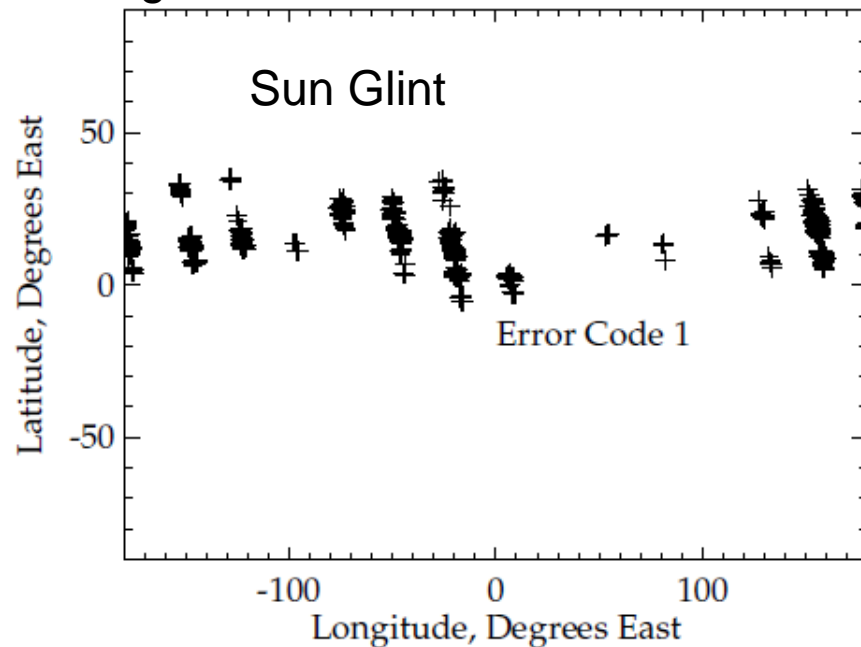
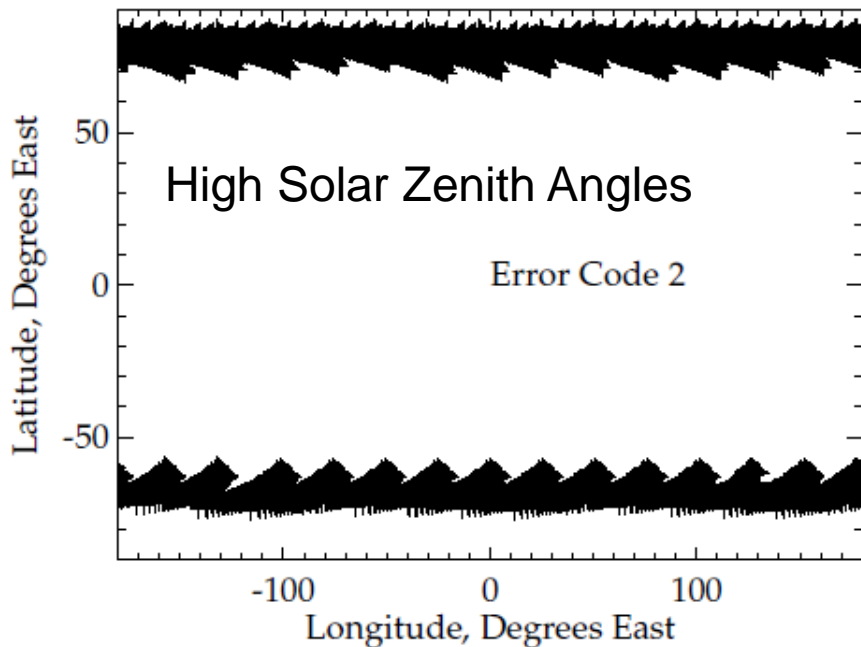


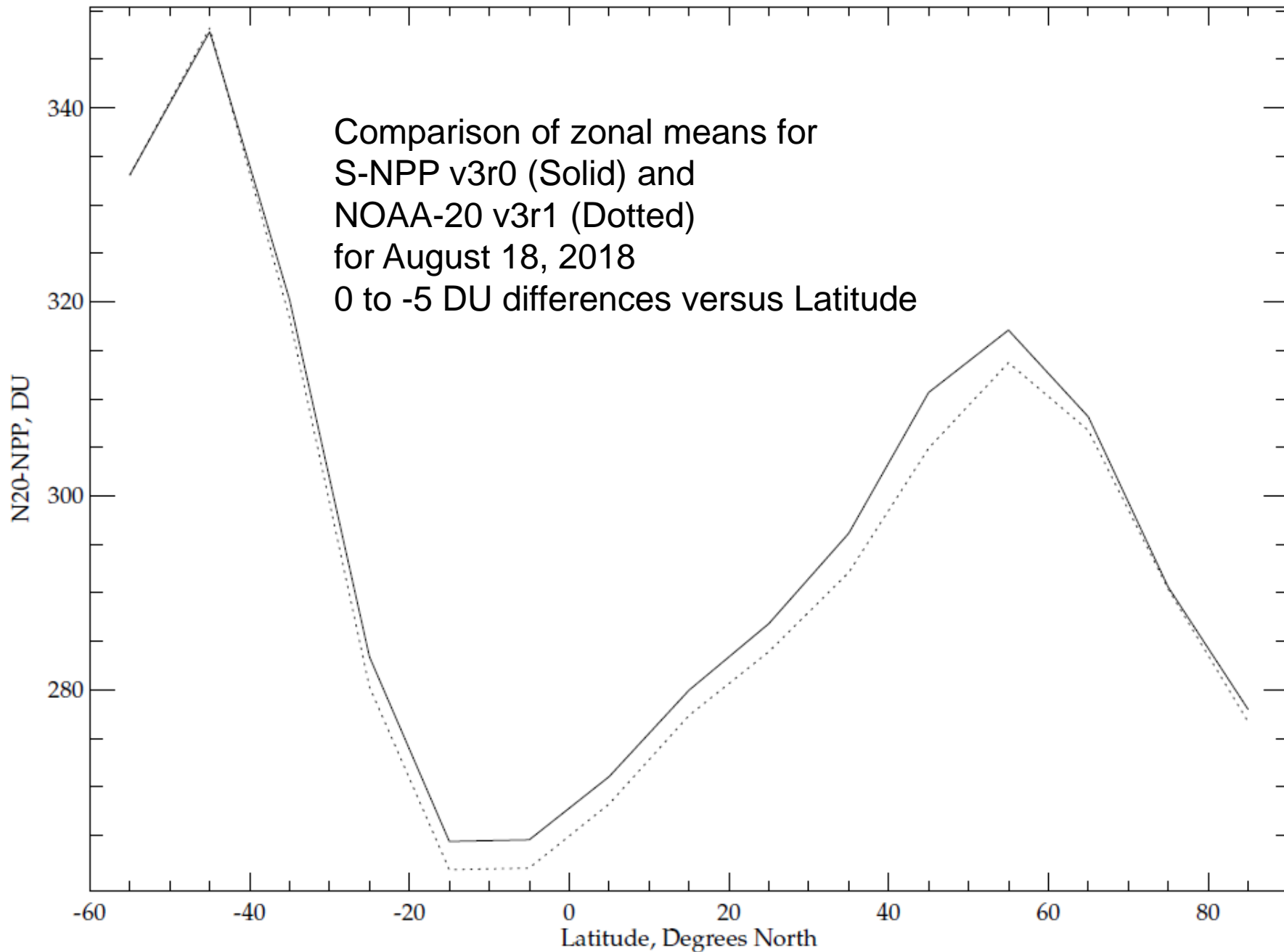
NOAA-20 Error codes for August 19, 2018





NOAA-20 Error codes for August 23, 2018





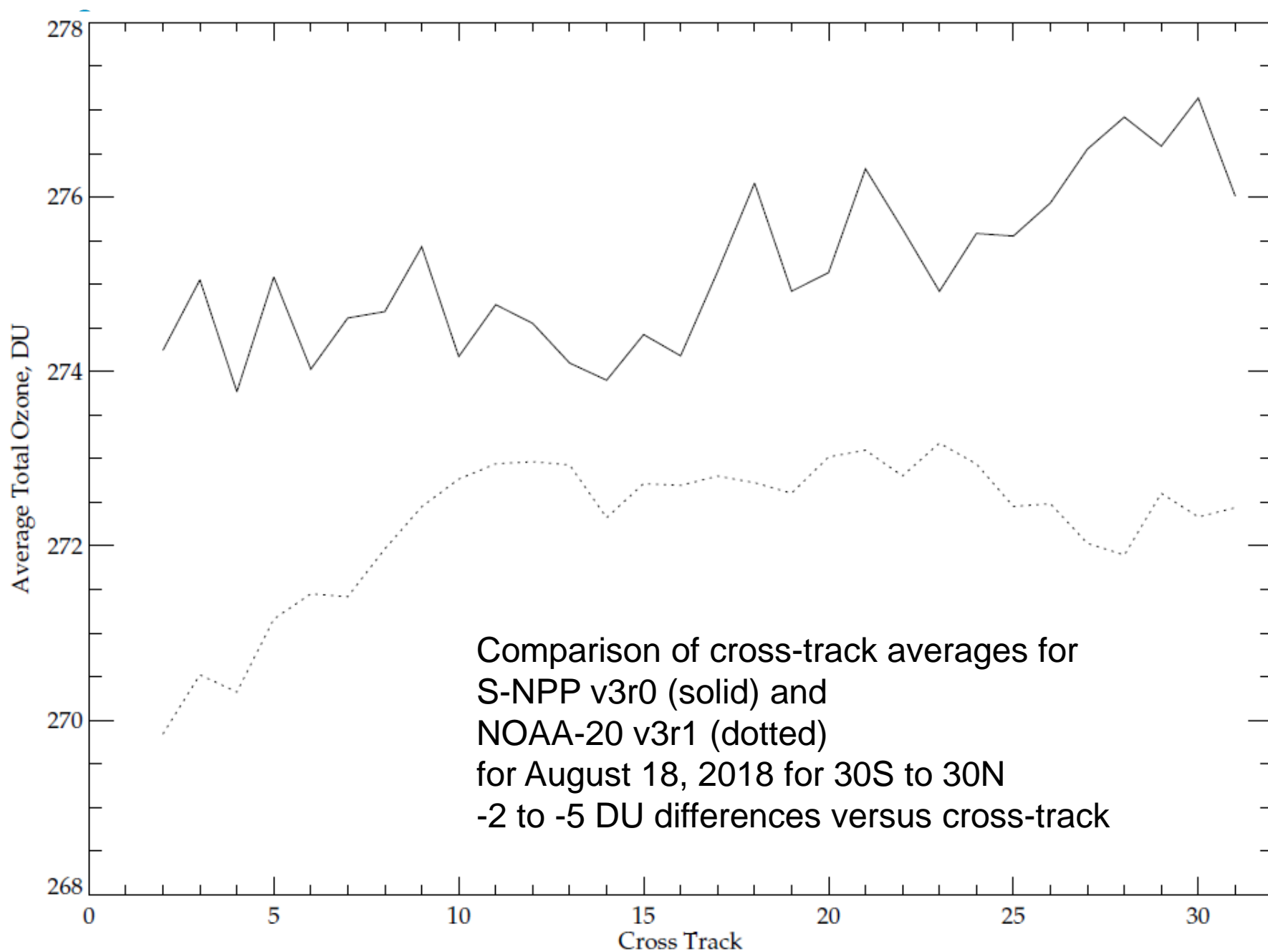
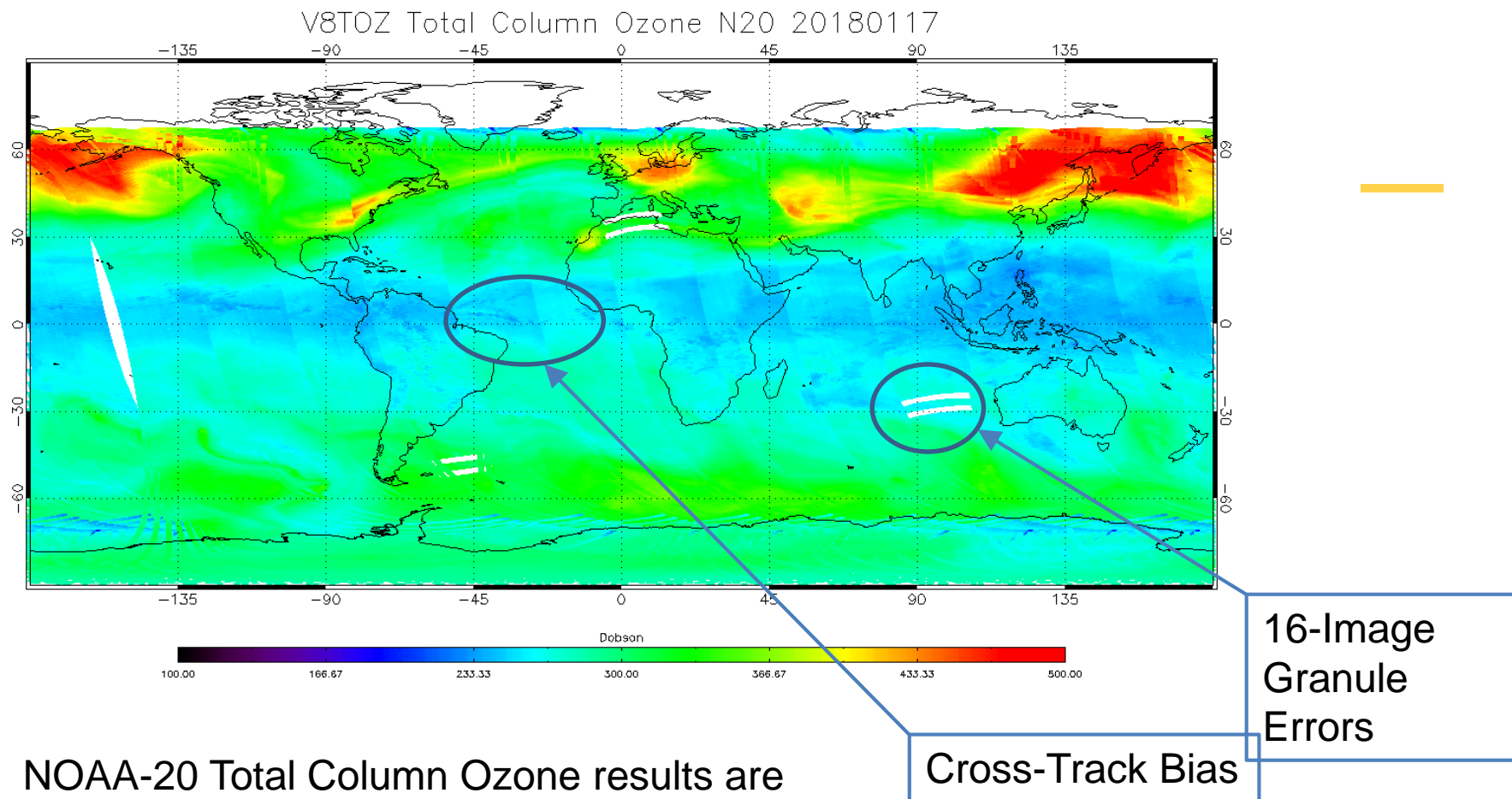


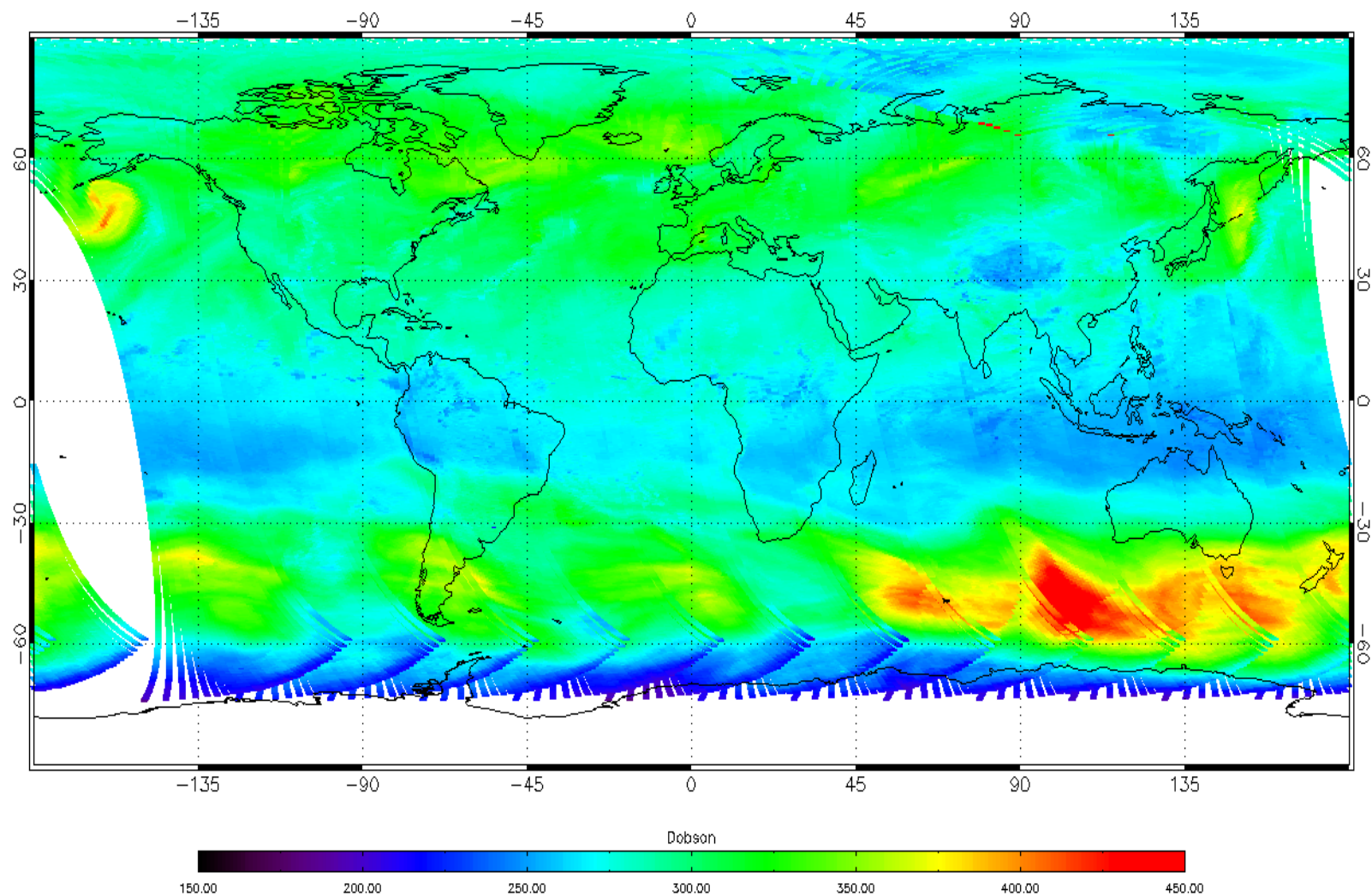
FIGURE FROM BETA MATURITY REVIEW



NOAA-20 Total Column Ozone results are in-family with S-NPP products with known deficiencies.

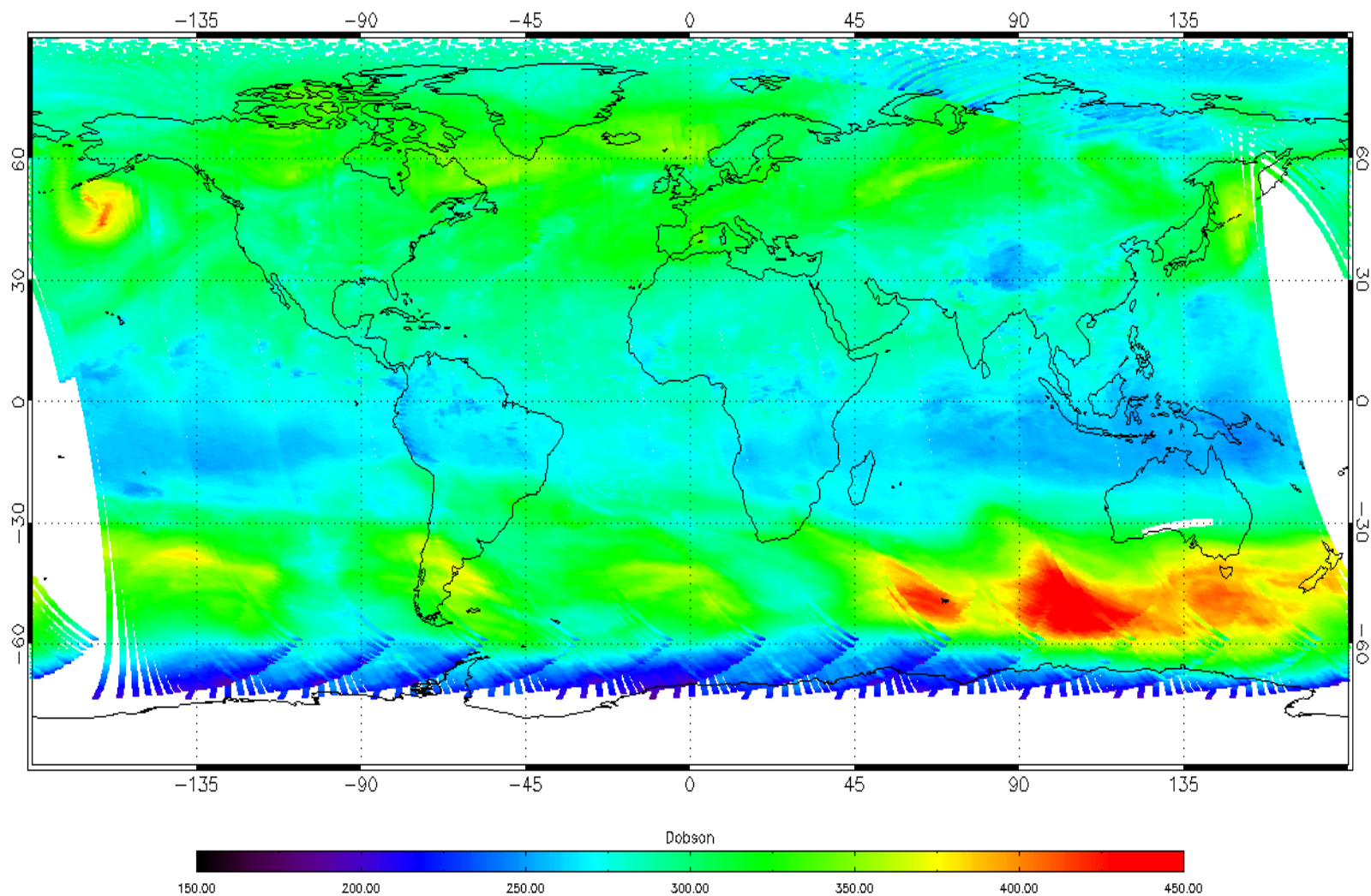
Total Ozone from NOAA-20 OMPS

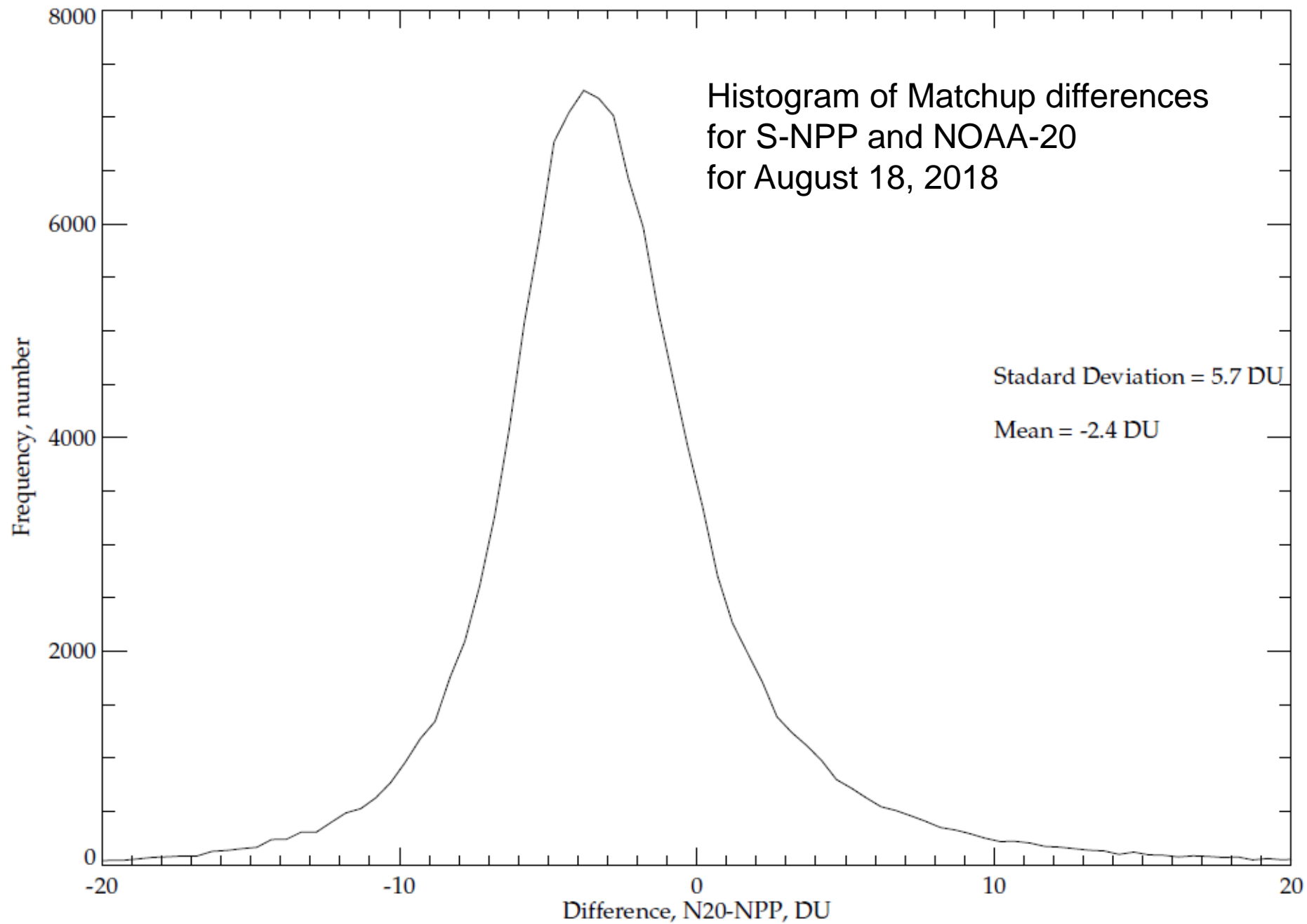
V8TOZ Total Column Ozone N20 20180818

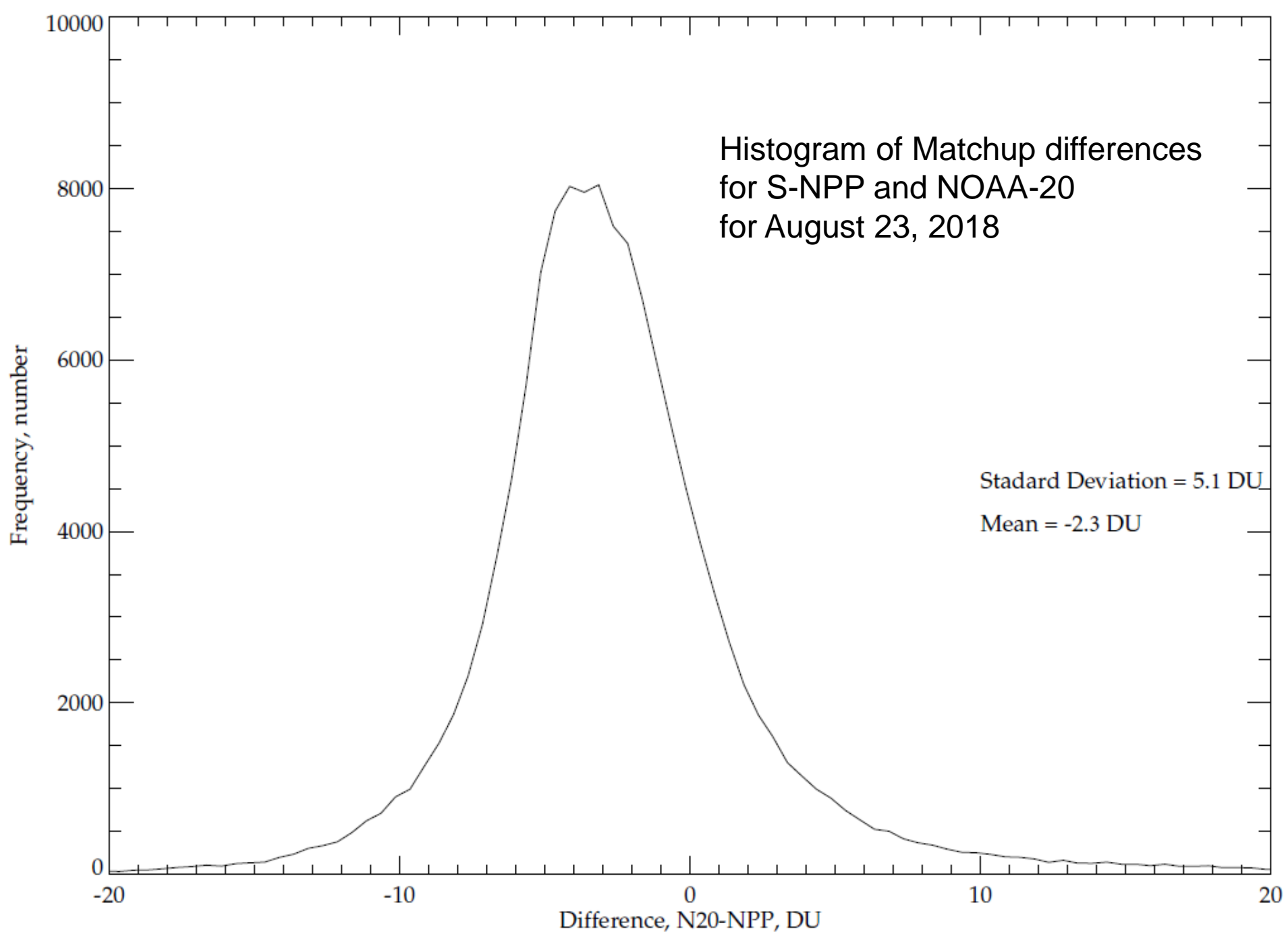


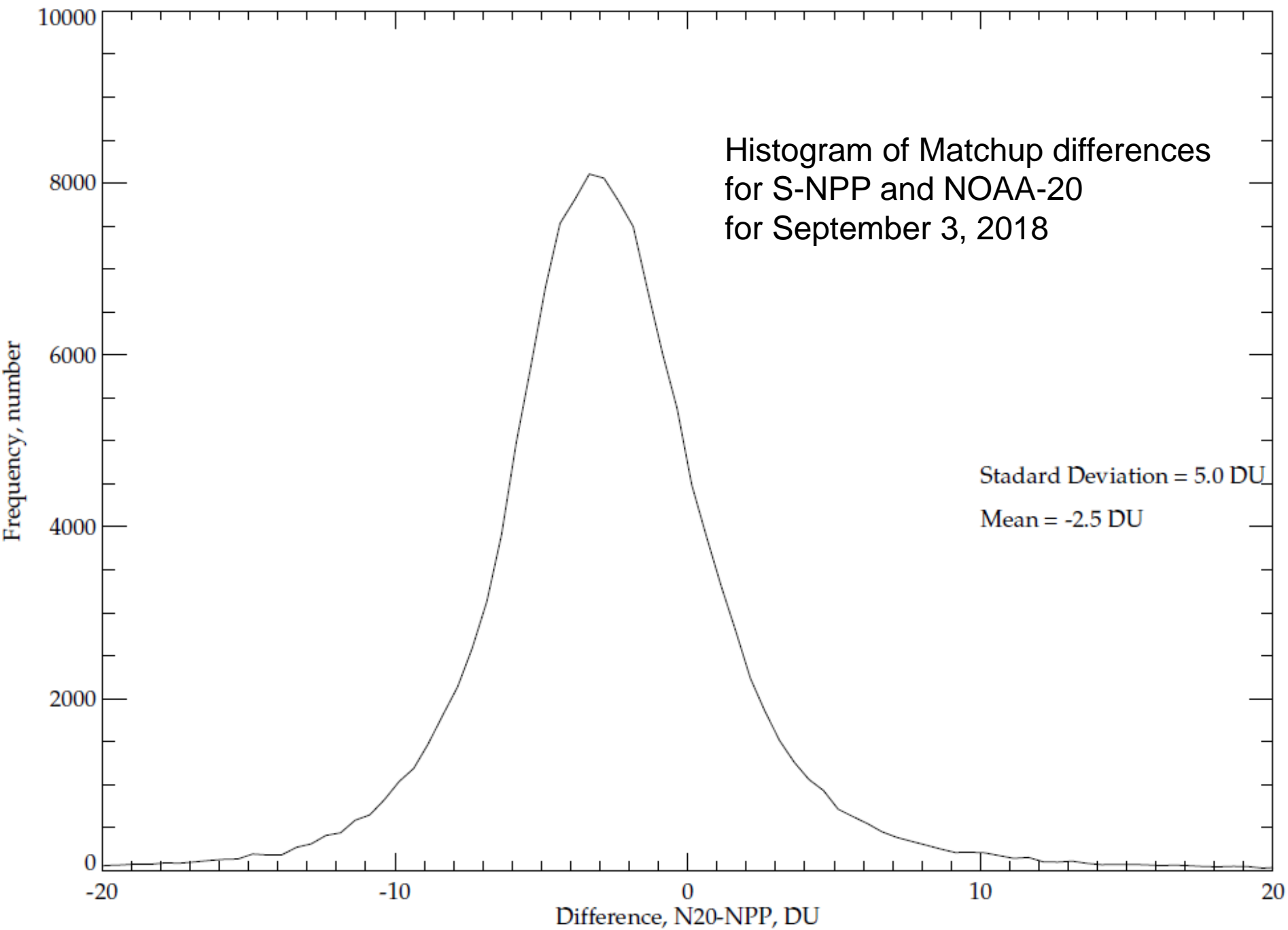
Total Ozone from S-NPP OMPS

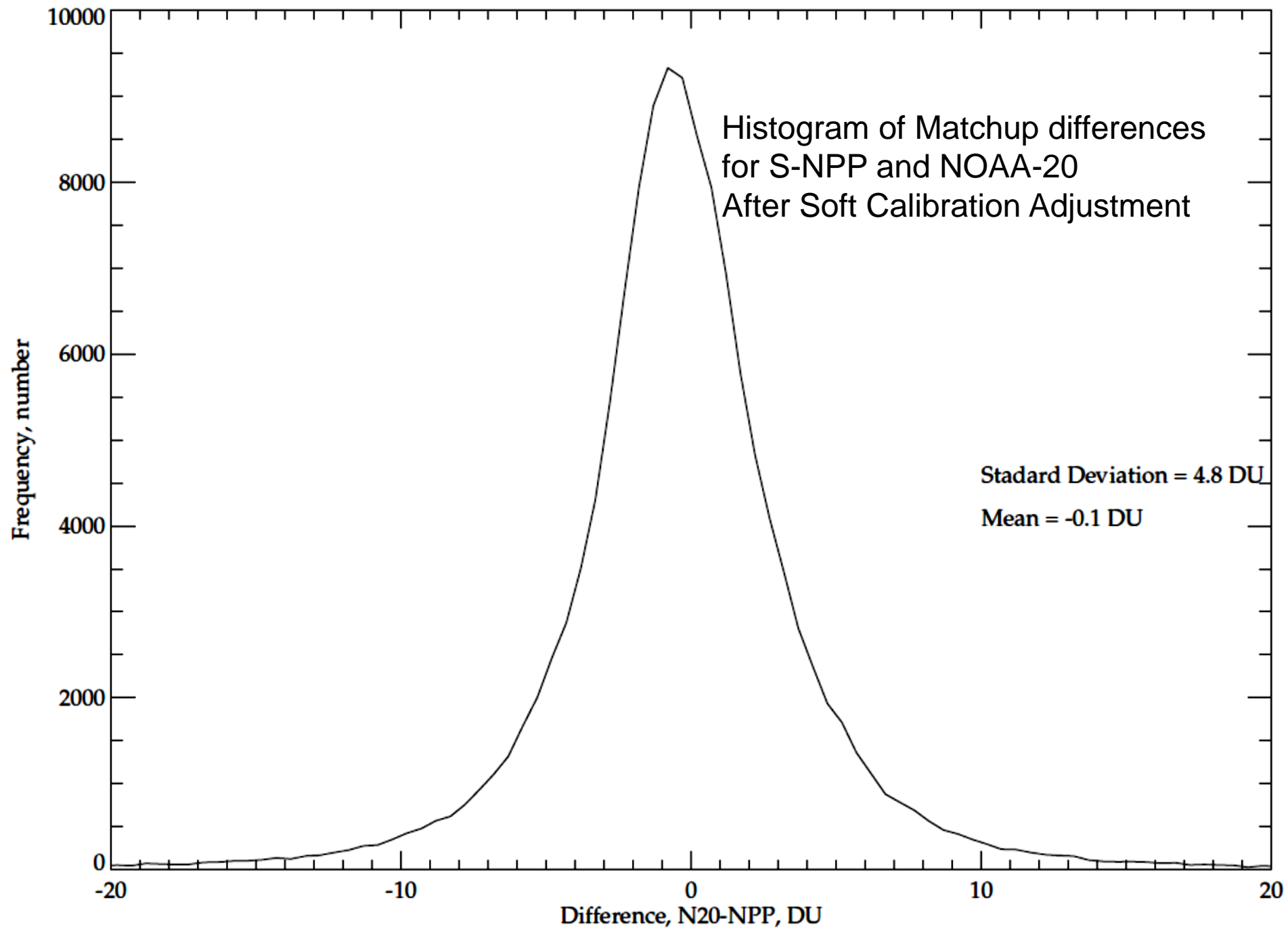
V8TOZ Total Column Ozone SNPP 20180818











Precision from Internal Double Differences:

	8/16/2018		8/23/2018		9/03/2018		9/21/2018	
	#	RMSD	#	RMSD	#	RMSD	#	RMSD
X < 250 DU	14716	2.4 DU	24769	2.3 DU	27542	2.3 DU	53439	2.7 DU
250 < X < 450 DU	468170	2.3 DU	474966	2.3 DU	473838	2.3 DU	460501	2.3 DU
X > 450 DU	79	2.1 DU	294	1.8 DU	235	2.3 DU	130	4.2 DU

Differences from zonal means, 10-degree latitude bands:

Range	-5 to 0 DU	-4 to 0 DU	-4 to 0 DU	-4 to 0 DU
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Differences from cross-track means:

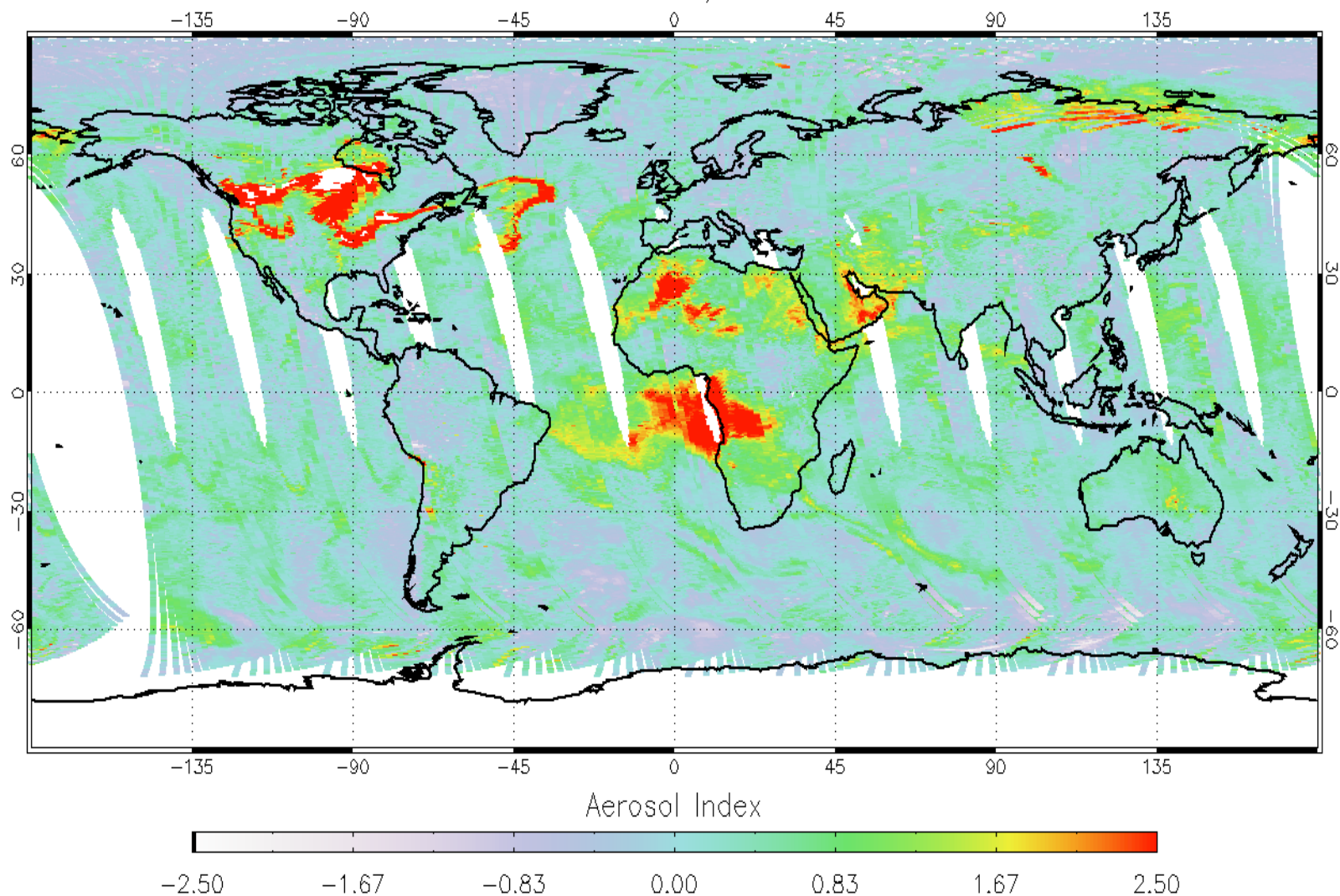
Range	-5 to -1 DU	-5 to -1 DU	-5 to -1 DU	-4 to -1 DU
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Histogram >125000 points per daily direct matchups:

Standard Deviation	5.7 DU	5.1 DU	5.0 DU	4.6 DU
Average Bias	-2.4 DU	-2.3 DU	-2.5 DU	-2.5 DU

Aerosol Index from NOAA-20 OMPS

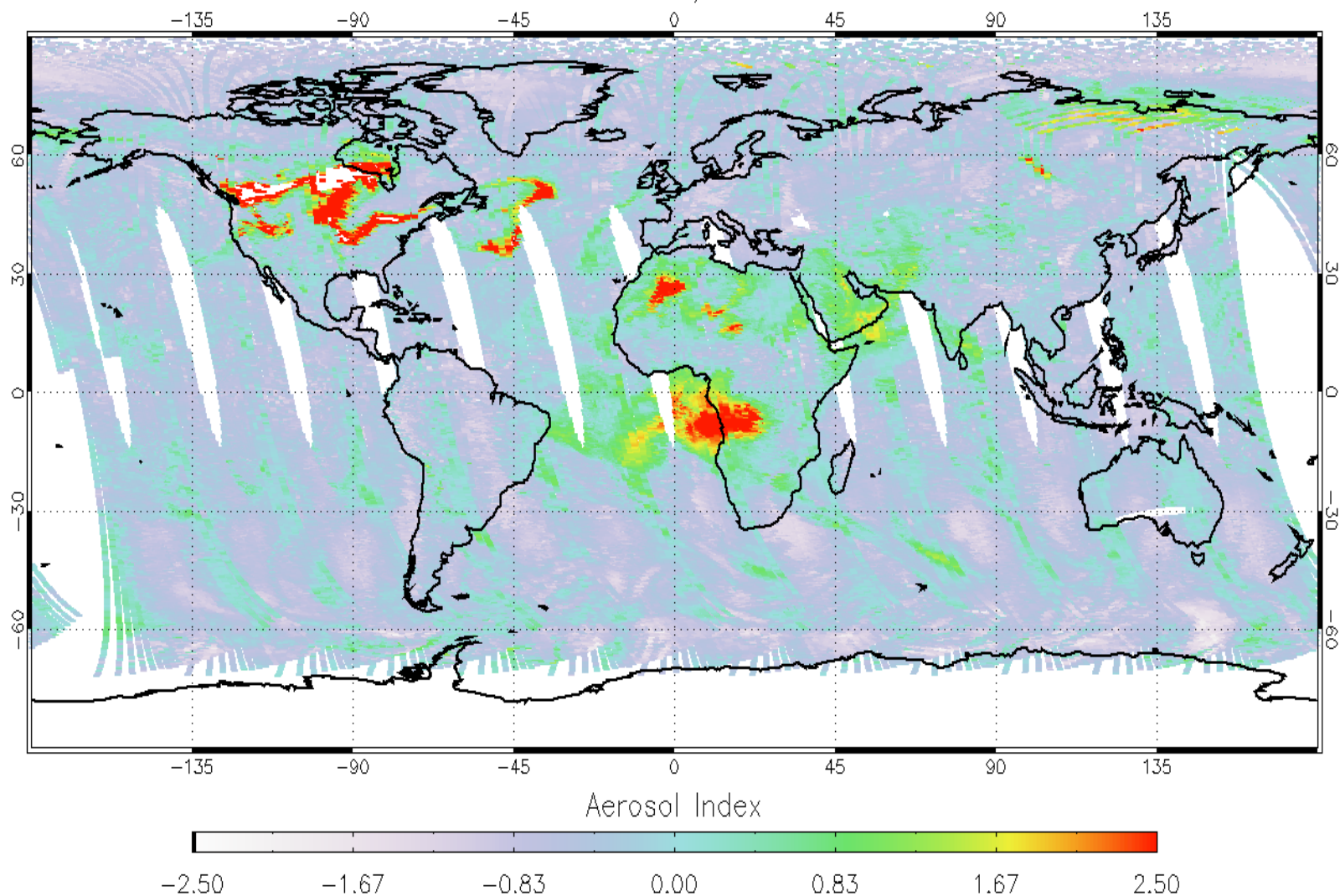
V8T0Z Aerosol Index, N20 20180818



Slight positive bias (0.3)

Aerosol Index from S-NPP OMPS

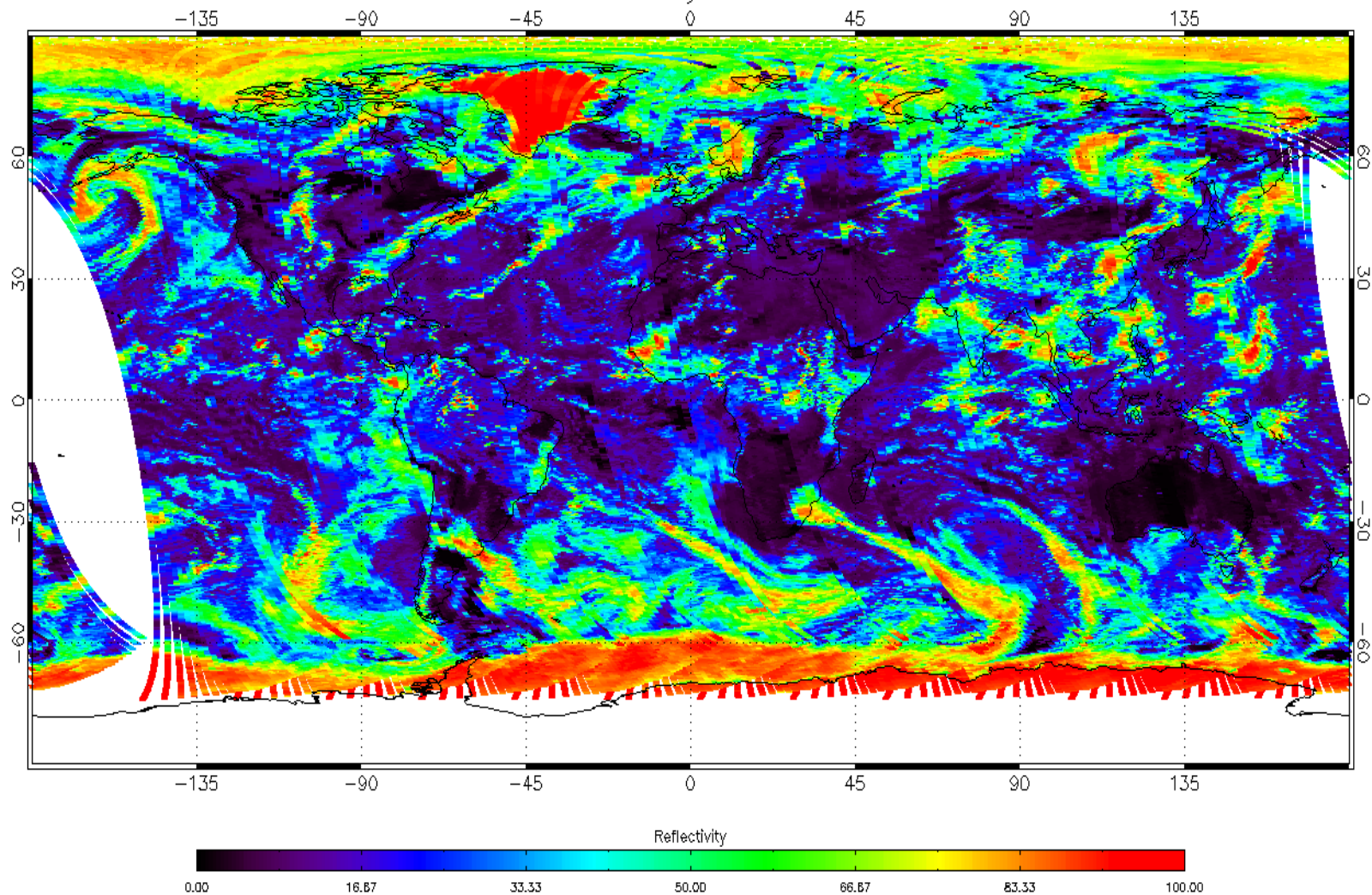
V8TOZ Aerosol Index, SNPP 20180818



Slight negative bias (-0.3)

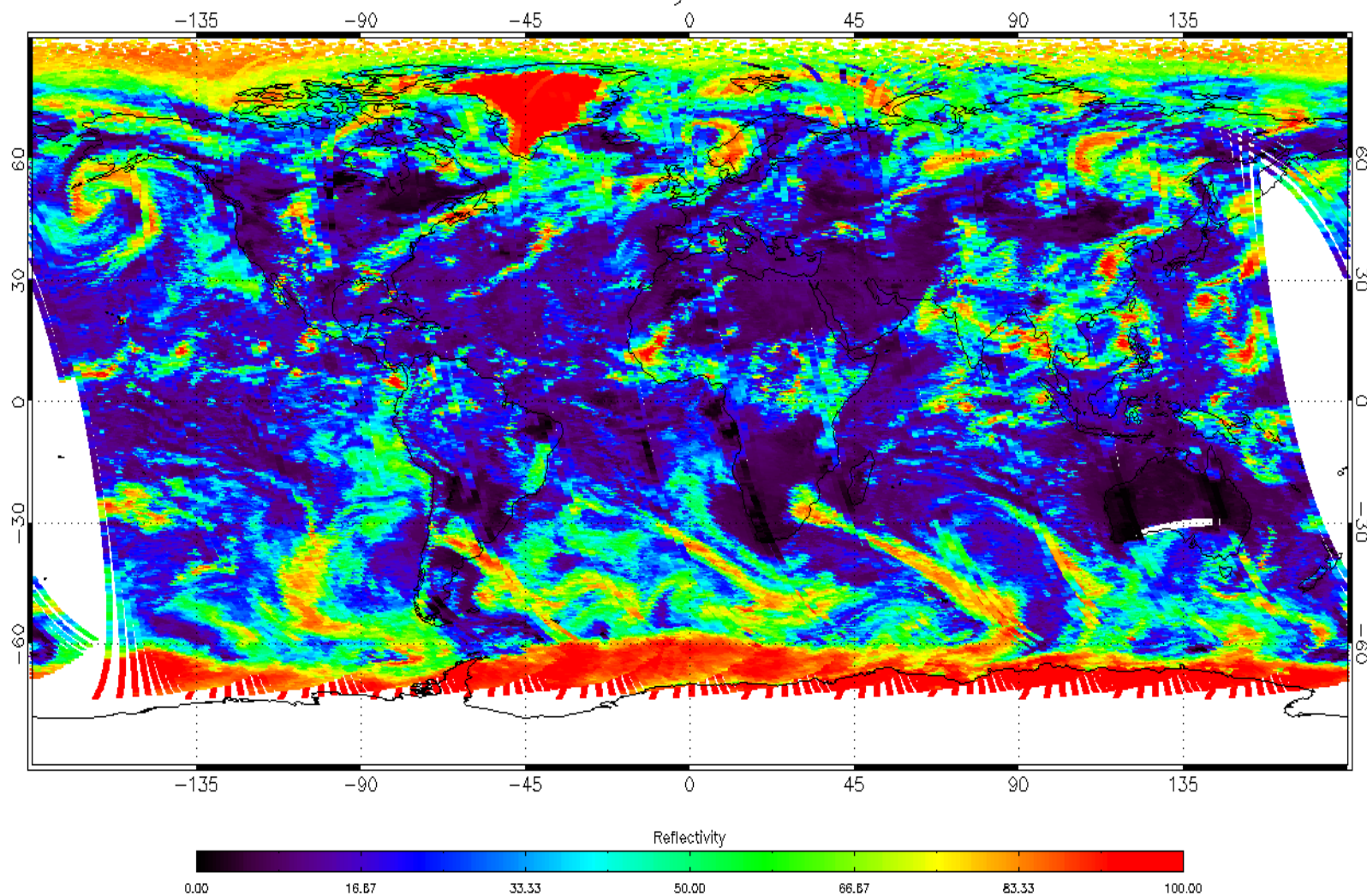
Effective Reflectivity from NOAA-20 OMPS

V8T0Z Reflectivity N20 20180818



Effective Reflectivity from S-NPP OMPS

V8TOZ Reflectivity SNPP 20180818



Caveats for Provisional EDR product users (1/2)

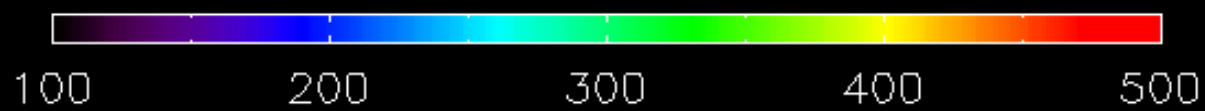
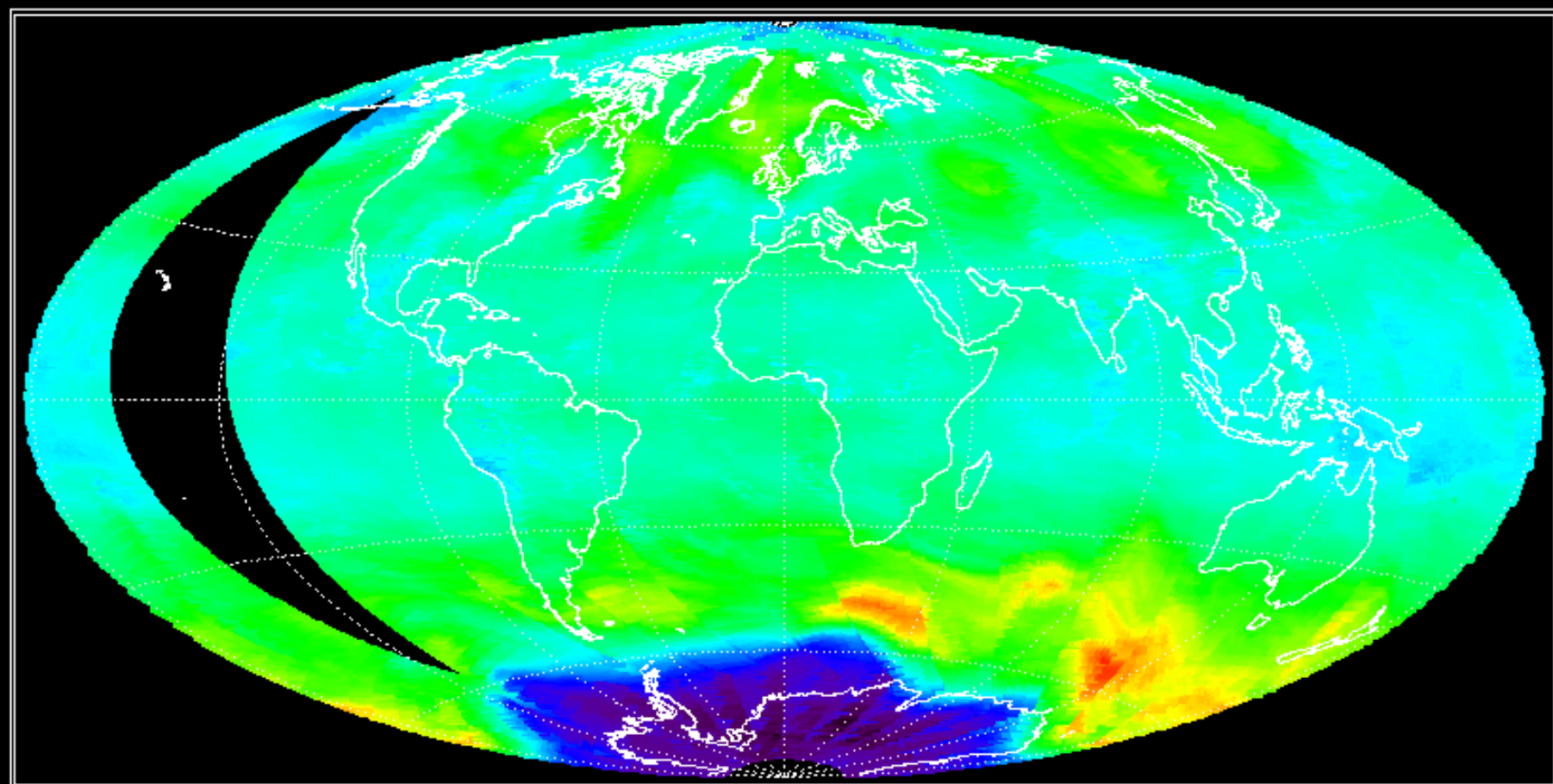
- The OMPS NM SDR processing can drop scans when the RDRs contain 16 scans in a granule. A fix to correct this problem (CCR 18-3829) will transfer to IDPS operations with Block 2.1 Mx3 on October 1, 2018. The extra scan currently leads to the loss of a full granule and an offset in the next granule matchup between the NM and NP. This correction is in the current IDPS/NDE I&T production as of August 10, 2018;
- The current recommendation is to only use products for cross-track positions #3 to #33 as some small geolocation errors for the extreme viewing angles are under investigation. The current recommendation is to only use products with Error Flag values of 0 and 1 (instead of the standard recommendation to use 0, 1 and 2) as the effects of channel calibration biases are magnified at higher solar zenith angles;
- The first round of updates to the NOAA-20 OMPS sample tables do not provide good enough matchups between the NP and NM FOVs as needed by the V8Pro algorithm. A new set of nadir mapper sample tables have been tested and will be implemented (DR 8617). A full set of SDR tables (including wavelength, solar, and stray light) have been developed for use with the new sample table. It is expected that the EDR team will need to deliver a new V8TOz adjustment table for use with the new SDRs. The new sample table is expected to be in use by the end of November;

- The NM SDRs have some cross-track biases which appear in the retrieved EDRs as striping in the V8TOz product maps. The current soft calibration is not optimal; there are cross-track variations in the total ozone and reflectivity and there is a small bias (0.3) in the aerosol index values. These problems will be reduced as new tables are put into IDPS processing but a final set of soft calibration adjustments will need to be devised for implementation at NDE to reduce the EDR biases to validated maturity levels;
- The V8TOz is infrequently setting residual limit flags (Error Codes 4 and 5) in the South Atlantic Anomaly more frequently for NOAA-20 than is observed for S-NPP. This is expected from the smaller FOVs provided by the NOAA-20 products;
- The V8TOz products with the most recent SDRs cannot be used to validate the retrievals for situations with total ozone greater than 450 DU. These high values are found primarily in the northern hemisphere in the late winter and early spring; and
- Tuning and refinement of the stray light corrections for the NM SDRs are continuing. Changes in these will impact the absolute accuracy of the V8TOz EDRs and affect the final V8TOz EDR adjustments.

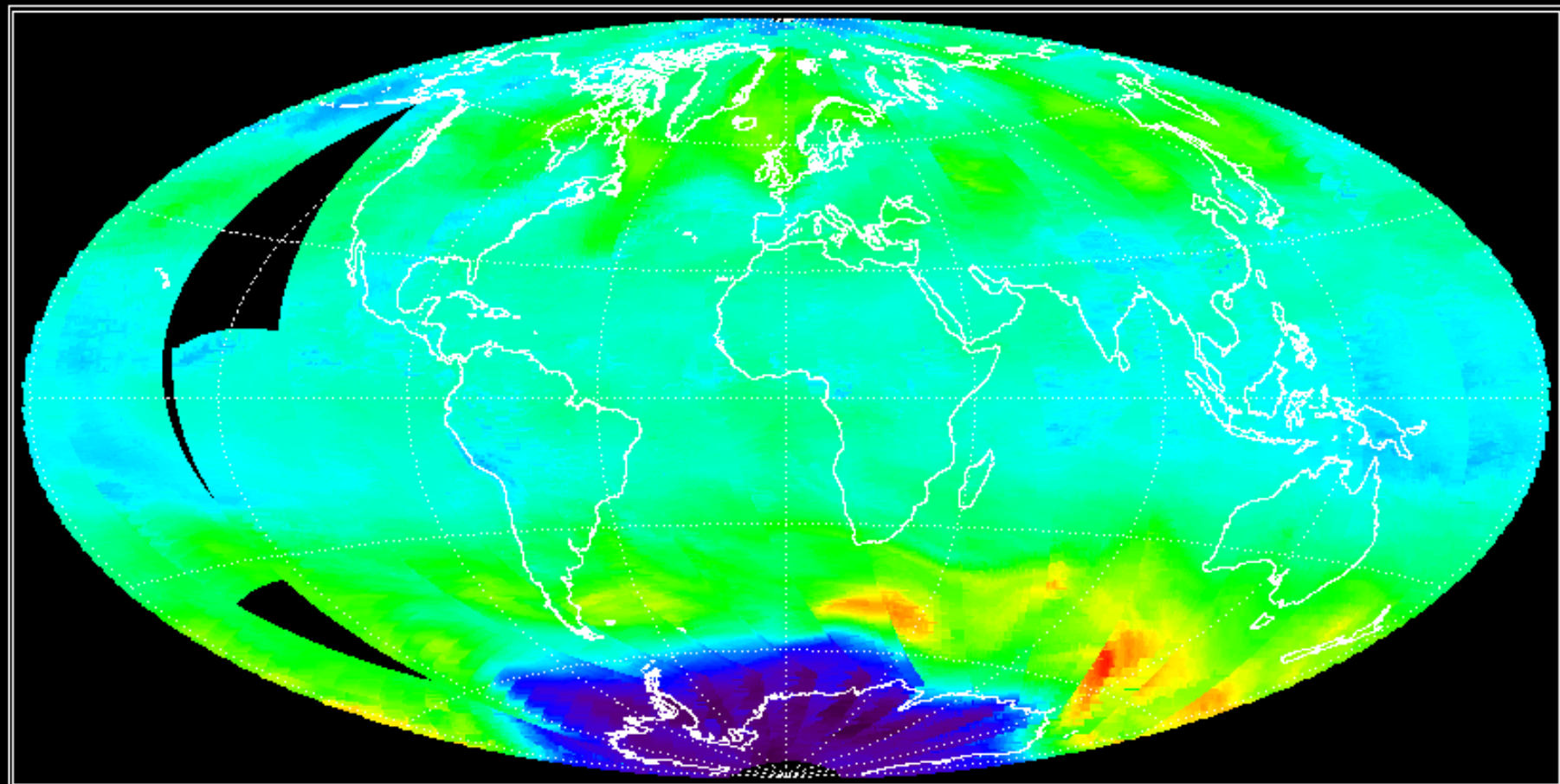
Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Haixia Liu	NWS	Ozone Assimilation	User has been evaluating S-NPP V8TOz BUFR and will add NOAA-20 BUFR.
Craig Long	NCEP	Ozone Monitoring	User has been using S-NPP Total Ozone to monitor the ozone layer / ozone hole and will use NOAA-20 Total Ozone as well this year.

Craig Long: I have looked at several days of September for the S-NPP and N20 V8TOz products on your web pages and cannot see any differences except due to orbital tracks and time differences in between. NCEP is eagerly awaiting the promotion from Beta to Provisional so that we can use the NOAA-20 V8TOz products to help to monitor this year's Ozone Hole.

OMPS V8 Total Ozone for 20180921



N20 OMPS V8 Total Ozone for 20180921



Risks, Actions, and Mitigations

- Provide updates for the status of the risks/actions identified during the previous maturity review(s); add new ones as needed

Identified Risk	Description	Impact	Action/Mitigation and Schedule
NDE Table Updates	Soft Calibration adjustment tables will be updated as SDRs mature. We do not know how long this process will take.	Delays in reaching validated maturity	Identify a process similar to the “Fast Track” table approach at IDPS.
NDE Code Updates	Code to reduce the effects of noise and outliers is being developed. These improvement will enter the queue for implementation at NDE.	Delays in reaching validated maturity for Medium FOVs	Should be a delta delivery as only 30 lines of code in one subroutine and one new data set will be added.

Science Maturity Check List	Yes / No
ReadMe for Data Product Users (Provisional)	Yes (NOAA-20)
Algorithm Theoretical Basis Document (ATBD)	Yes (V8TOz)
Algorithm Calibration/Validation Plan	Yes (JPSS-1 Ozone)
(External/Internal) Users Manual	Yes (V8TOz)
System Maintenance Manual (for ESPC products)	Yes (V8TOz)
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes (V8TOz alg. and V8TOz S-NPP)
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	For S-NPP

Requirement Check List – OMPS Ozone V8TOz

JERD	Requirement	Meet Requirement (Y/N)?
JERD-2423	The algorithm shall produce an ozone total column product that has a horizontal cell size of 50 x 50 km ² at Nadir	Yes, 50x17 km ² can be aggregated.
JERD-2450	The algorithm shall produce an ozone total column product that has a vertical cell size of 0-60 km	Yes, physics and RT Table construction.
JERD-2451	The algorithm shall produce an ozone total column product that has a mapping uncertainty, 1 sigma, of 5 km at Nadir	Yes, SDR Validation
JERD-2452	The algorithm shall produce an ozone total column product that has a measurement range of 50-650 milli-atm-cm	Yes, SDR range and V8TOz Performance
JERD-2453	The algorithm shall produce an ozone total column product that has a measurement precision of: 6.0 milli-atm-cm for $X < 0.25$ atm-cm, 7.7 milli-atm-cm for $0.25 < X < 0.45$ atm-cm, and 2.8 milli-atm-cm + 1.1% for $X > 0.45$ atm-cm	2.3 DU DD, 2.0 DU DD, 5.7 DU MU Insufficient data
JERD-2454	The algorithm shall produce an ozone total column product that has a measurement accuracy of: 9.5 milli-atm-cm for $X < 0.25$ atm-cm, 13.0 milli-atm-cm for $0.25 < X < 0.45$ atm-cm, and 16.0 milli-atm-cm + 1.1% for $X > 0.45$ atm-cm	0 to -5 DU Zonal mean / Cross-track -2.4 DU Matchup with 5.7 DU 1-sigma

Check List - Provisional Maturity

Provisional Maturity End State	Assessment
Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from select locations, periods, and associated ground truth or field campaign efforts.	Comparison to S-NPP V8TOz EDR with seven years of data products. Limitations noted in ReadMe.
Product analysis is sufficient to communicate product performance to users relative to expectations (Performance Baseline).	Comparison to S-NPP V8TOz EDR with seven years of data products.
Documentation of product performance exists that includes recommended remediation strategies for all anomalies and weaknesses. Any algorithm changes associated with severe anomalies have been documented, implemented, tested, and shared with the user community.	Soft Calibration approach has been used for S-NPP OMPS and GOME-2. The outlier detection and noise reduction approach uses standard Empirical Orthogonal Function procedures for signal compression.
Product is ready for operational use and for use in comprehensive cal/val activities and product optimization.	With limits as noted in the ReadMe.

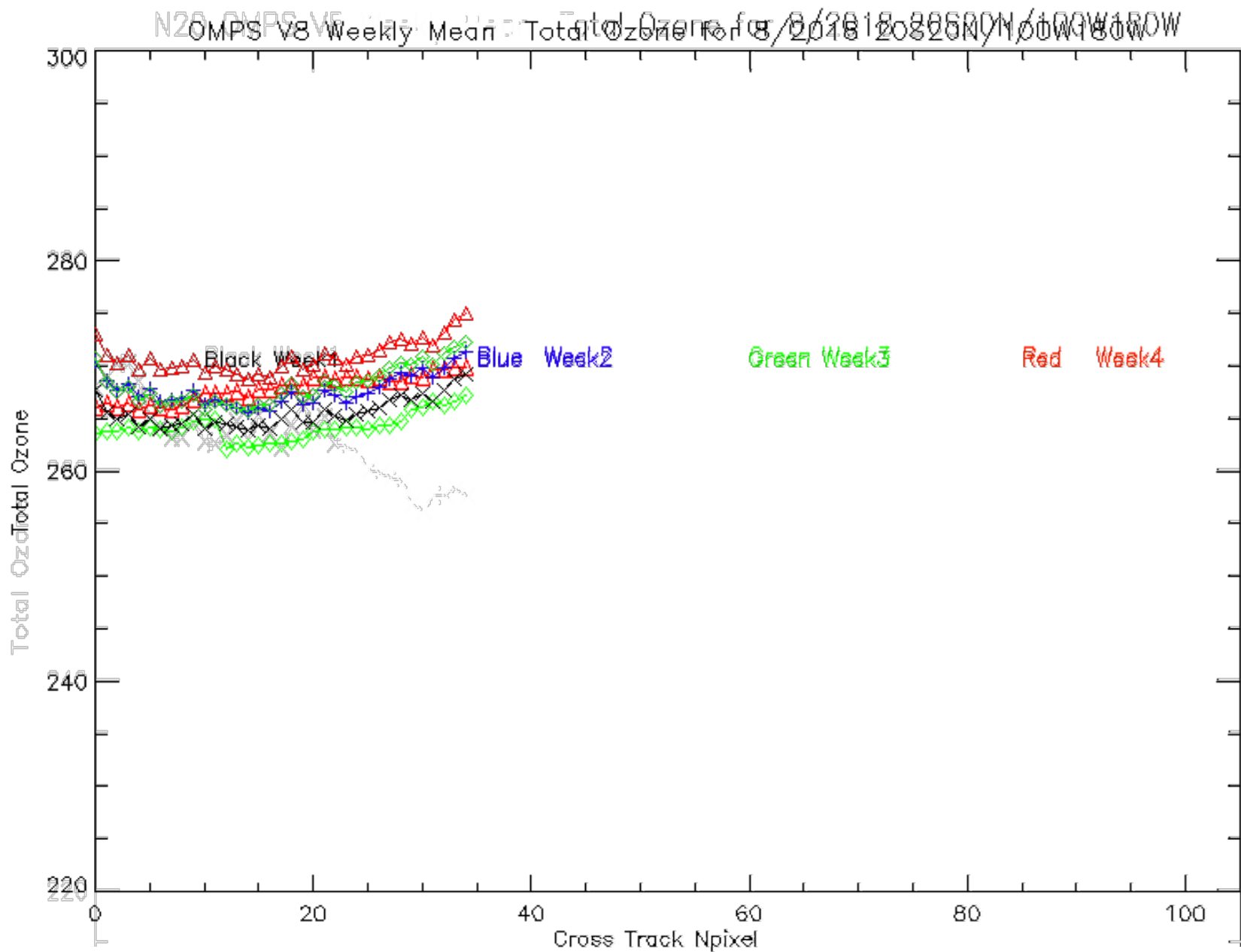
- Cal/Val results summary:
 - Team recommends algorithm provisional maturity
 - Caveats provide on two slides and in Readme

- SDR and EDR team communication is essential.
- Updates to Soft Calibration will be made with input from users on desired “truth” data.
- Code to identifier outliers and reduce noise is under development.
- Validated Maturity target is February 2019 pending implementation of new sample tables for OMPS NM.
- Collect statistics for V8TOS performance over volcanic events with large SO₂ releases.

- Continue to make comparisons of Equatorial Pacific regional means, zonal latitudinal means, and global matchups for V8TOz and V8TOS with those for S-NPP. Compare total ozone products to ground-based measurements by using overpass data sets for Dobson and Umkehr stations. Compare BUFR products to current assimilation forecasts;
- Estimate cross-track bias in the 12 channels used in the V8TOz EDRs from weekly statistics segregated by cross-track position;
- Investigate methods to reduce the effects of transient signals and noise in the medium resolution NM SDR on the V8TOz EDRs. The planned approach uses Empirical Orthogonal Functions from analysis of the covariance matrix to identify and remove outliers and increase the measurement precision for the selected V8TOz channels;
- Track the impact of continued improvements in the SDR as planned by the SDR team; and
- Provide deliveries of adjustment tables and code changes for V8TOz to NDE as SDR maturity progresses and stabilizes and validation results are analyzed and updated.

Useful web sites:

- https://www.star.nesdis.noaa.gov/smcd/spb/OMPSSDemo/proOMPSbeta.TOZ_N20_V8.php
- https://www.star.nesdis.noaa.gov/jpss/EDRs/products_ozone.php#
- https://www.star.nesdis.noaa.gov/icvs/status_N20_OMPS_NM.php
- https://www.ospo.noaa.gov/data/atmosphere/ozone/Products_atmosphere_OMPS.html



Notes from first review

Ozone v8TOz (Total Column)

- Ozone TC is at BETA because only 1 day of data validation was shown and there are still updates to be delivered to NDE. Request the science teams do additional validation after the updates have been integrated into NDE I&T.
- "Final" updates will not be available until after all SDR updates are available and examined.
- Caveat statements provided for readme files were well received. Is there a need for periodic updates caveat statements (readme files) for SNPP based on findings?
- Recommend provisional be effective once IDPS Mx3 is in operations

LF Comment: currently running on IDPS I&T).

- • Many changes soon to happen. Were all seemingly small, but in aggregate, concerned that there could be issues and differences.

LF Comment: Most changes are for SDR and it is Provisional.

- • Slide 9 - for geographic coverage, recommend the 90% daily global earth is done per requirements for validated review. How does "SZA < 70°" translate to % earth covered?

LF Comment: SZA < 80° satisfies 90% coverage. SZA<70 Degrees is still over 80%.

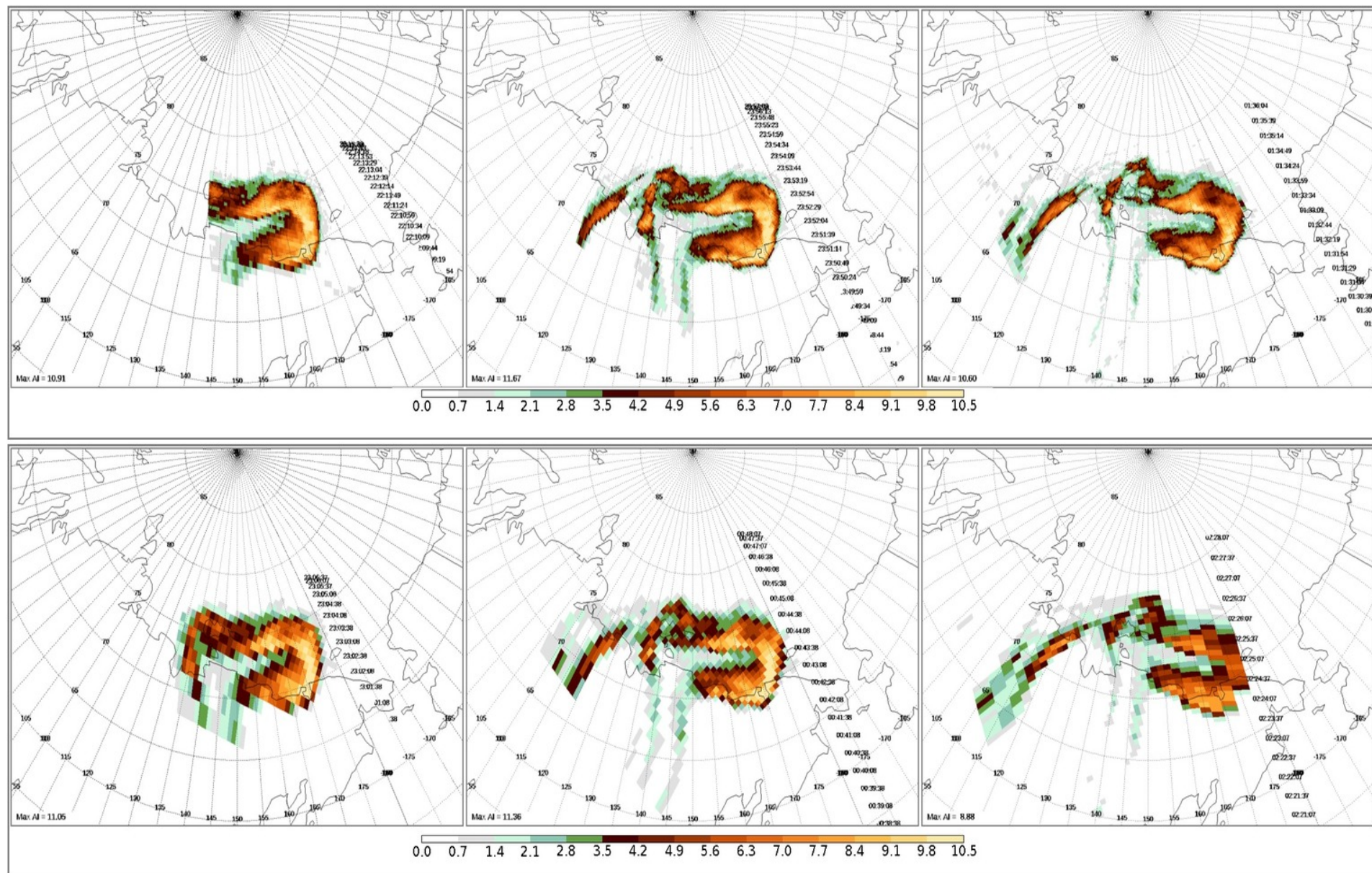
LF Comment: The coverage for NOAA-20 is the same as for S-NPP.

- • Slide 9 - for validated review, need to show data for > 450DU, even if insufficient, show the samples achieved.
- • Slide 28 - user feedback of two bullets is insufficient. Doesn't say how the evaluation of data has been, what issues they have seen, and suitability to use data.

- DR8616 16-scan granule problem Block 2.1 Mx3 TTO to IDPS 9/24/2018.
- DR8615: NP macropixel calculations
 - CCR 18-3829 TTO to IDPS July 2, 2018.
- New Day 1 Solar and Wavelength Scale tables are in testing for NOAA-20 OMPS NM and NP.
- DR_8617 demonstrated the updated tables could not meet validated stage requirements because of the FOV mismatch between TC and NP.

- New versions of the following tables are needed for NOAA-20 OMPS to reach Validated Maturity:
- OMPS-TBL-VERS-GND-PI
- OMPS-TC-TIMINGPATTERN-GND-PI
- OMPS-TC-EV-SAMPLE-GND-PI
- OMPS-TC-MACROTABLE-GND-PI
- OMPS-TC-WAVELENGTH-GND-PI
- OMPS-TC-OSOL-LUT
- OMPS-TC-STRAYLIGHT-LUT
- OMPS-TC-CF-EARTH-GND-PI

Aerosol Index Resolutin: NOAA-20 (top) vs. S-NPP (bottom)



Key Issue for Path Forward for V8Pro

- ADR 8730 New DR. Counts not uniformly distributed for NOAA-20 OMPS NP. This has been traced to discretization errors from the non-linearity correction. A path forward with a new flight non-linearity and adjustments to the calibration coefficients is proceeding.
- Test data was taken with NOAA-20 OMPS using the new sample tables -- 140 5-pixel for NM and rectangular NP. Tables are under development to make operational 103x15 granule NM SDRs. The SDR team will be requesting that the instrument be switched to the 140 5-pixel mode. We will need to adjust the V8Pro Glueware to handle the NMmacropixels with [10,10,10,10,5,10,5,10,10,10,10] pixels
- We will need to provide new adjustment tables once these changes are implemented and new SDR data are available.



BETA MATURITY FOR NOAA-20 OMPS

L. Flynn and NOAA-20 OMPS EDR and SDR Teams

March 15th, 2018

April 18th, 2018

Summary of Findings for Total Ozone EDR

- NOAA-20 OMPS Nadir Mapper / V8TOz EDR*
 - EOF analysis of measurements shows good SNRs, similar intra-orbit wavelength shift and expected patterns of information content.
 - EDRs show good results for this stage of maturity.
 - EDRs produced for lowxlow and lowxmedium FOV granules: 35x5 and 35x15
 - Version 3 Revision 1 tested at STAR for mediumxmedium 103x15.
 - Stray light – need additional check of measurements in the overlap region from 300 nm to 310 nm with NP for validation.
 - 16-image granule SDR Processing error due to variable processing times; Code fix tested at STAR. Missing SDR granules will not produce EDR products.
 - Mismatch in current Medium to Low SDR FOV Cross-track aggregation leads to FOV blurring for EDR products. Will be resolved with new OMPS NM tables.
 - Team needs 8-day averages with corrected SDRs to compute cross-track bias statistics and validate versus S-NPP.

* Version 3 Revision 0 at NDE Operations and I&T

Summary of Findings for Ozone Profile EDR

- NOAA-20 OMPS Nadir Profiler / V8Pro EDR*
 - EOF analysis of measurements shows good SNRs. Outliers are larger by linear factors in FOV size not square root factors. EDRs will be adversely affected by this noise.
 - EDRs show good results for this stage of maturity.
 - Output error for Profile Error Code 8 cases (Excessively large initial residual – Flag is correctly set). Code fix will be delivered to NDE with Provisional Table updates.
 - Code error in cross-track macropixel computation; fix expected at IDPS in July 2018.
 - New OMPS Nadir Profile sample table needed to match OMPS Nadir Mapper FOV.
 - Temporal aggregation of 15-scan NM RDRs to 5-scan RDRs causes offset between NM and NP. This was resolved with 15-scan SDR products in use since 3/30/2018.
 - Radiation in the SAA has a large effect on radiances for 50x50km² FOVs, some just outside of geographic flagged region.
 - Some cases of negative radiances are found in the auroral oval.
 - Dichroic effects on wavelength/bandpass and on calibration from 0.2-nm shift not yet accounted for in SDR calibration tables or EDR bandpass adjustments.
 - Possible overcorrection for stray light (not shown) leads to negative correlation between reflectivity and upper level ozone.

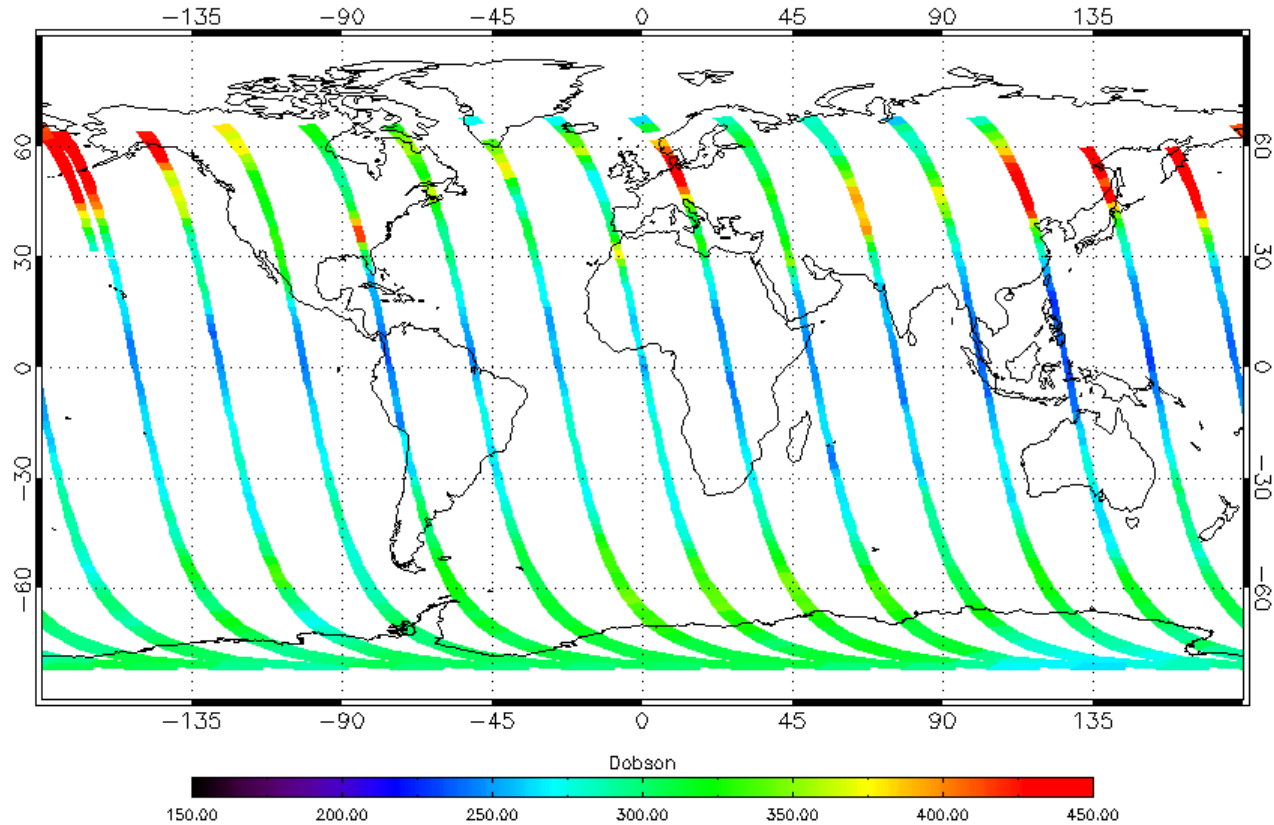
* Version 3 Revision 1 at NDE Operations and I&T

Provisional Delivery to NDE planned for May

- Planned code, script and table changes at NDE
 - Given the range of SDR FOV sizes, we will provide dynamic SDR sizing adjustment for NM SDRs in codes, not control scripts. That is, the NDE operator will not need to know when the SDRs have switched to new sample tables and make manual adjustments to the scripts.
 - Improved handling of end of orbit, end of day, and duplicate granules
 - Fix for Profile Error Code 8 output EDR content for V8Pro.
 - Check FOV alignment accuracy for NM and NP within code by computing average latitude and longitude of contributing FOVs.
 - New adjustment tables for V8TOz and V8Pro
 - Requires access to SDRs with better sample tables
 - Requires access to SDRs with better stray light corrections
 - Test data processing to confirm LFSO2 is ready for smaller FOV V8TOz EDRs from NOAA-20 and improve 15-granule processing.

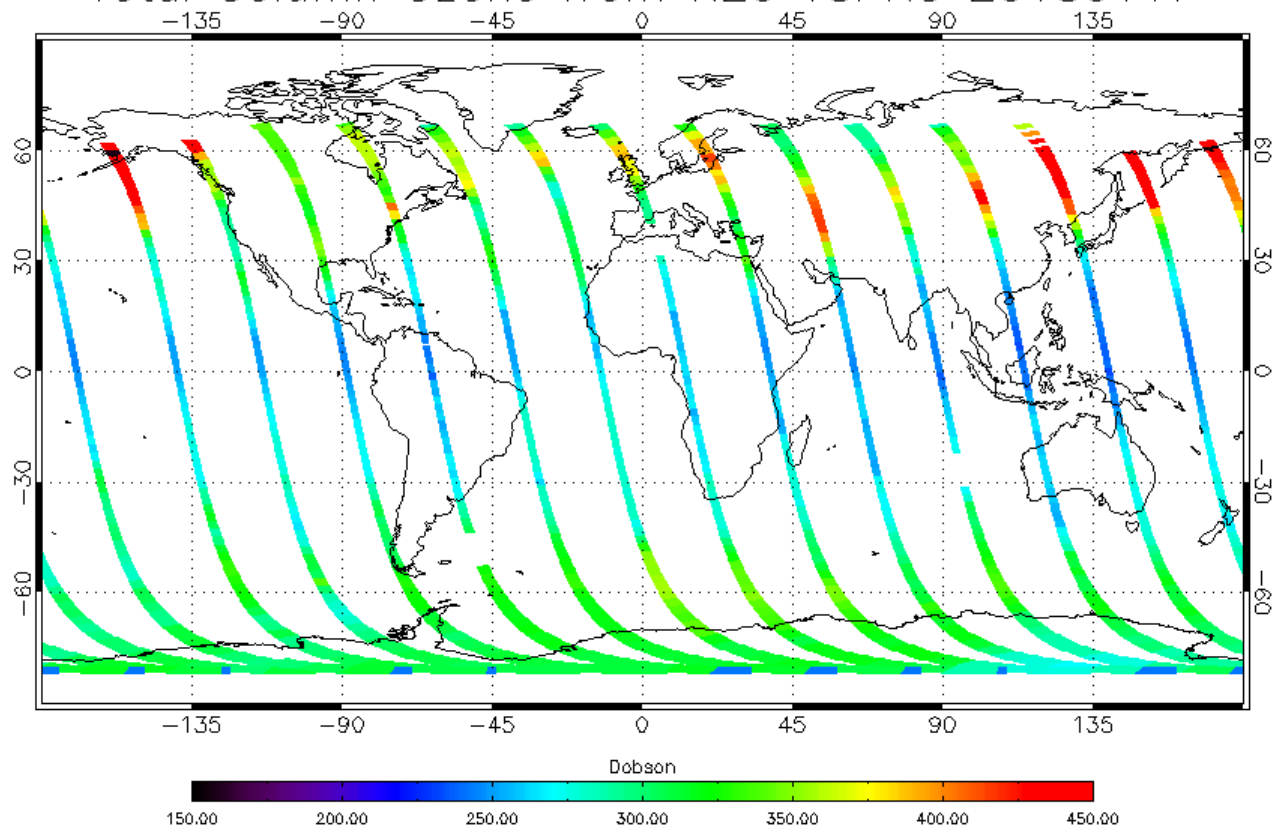


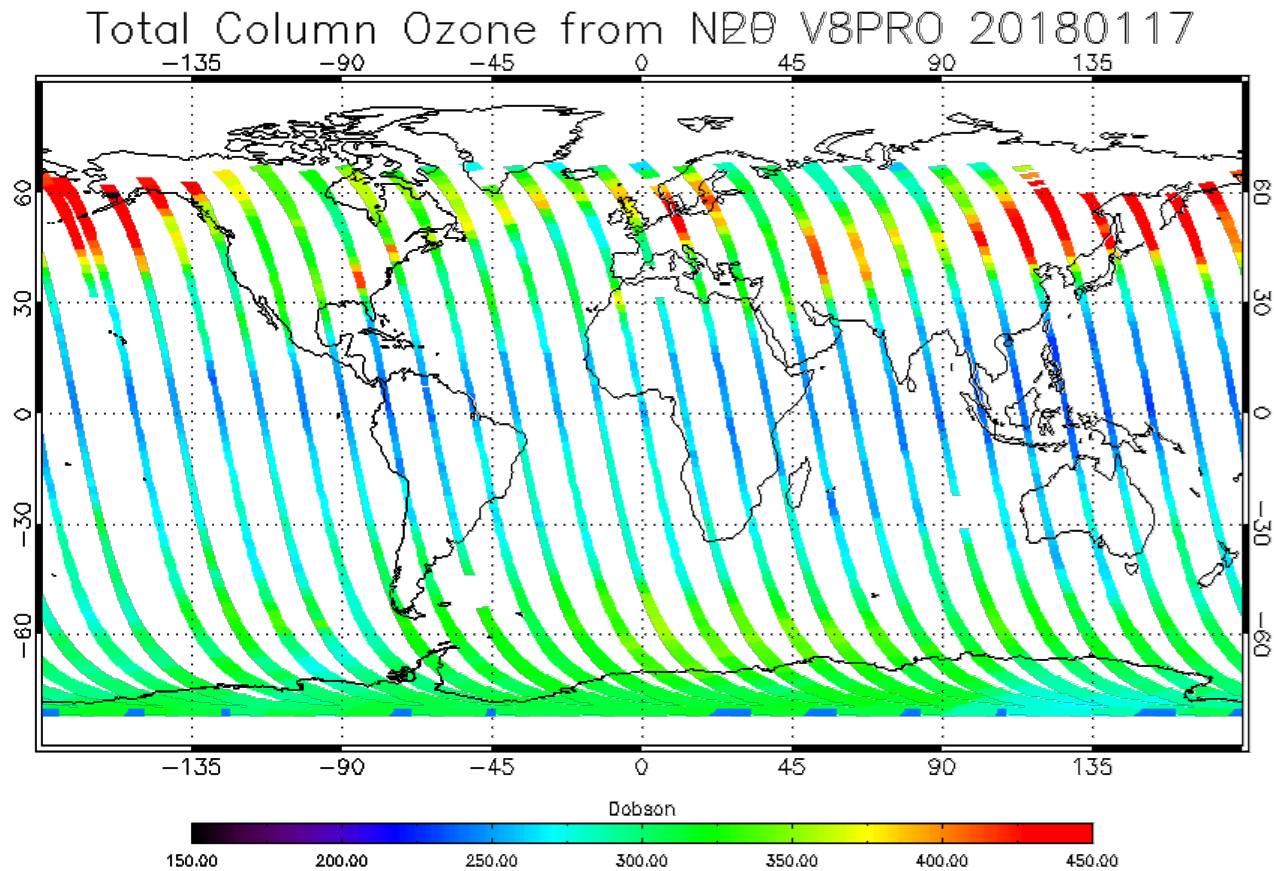
Total Column Ozone from NPP V8PRO 20180117





Total Column Ozone from N2O V8PRO 20180117

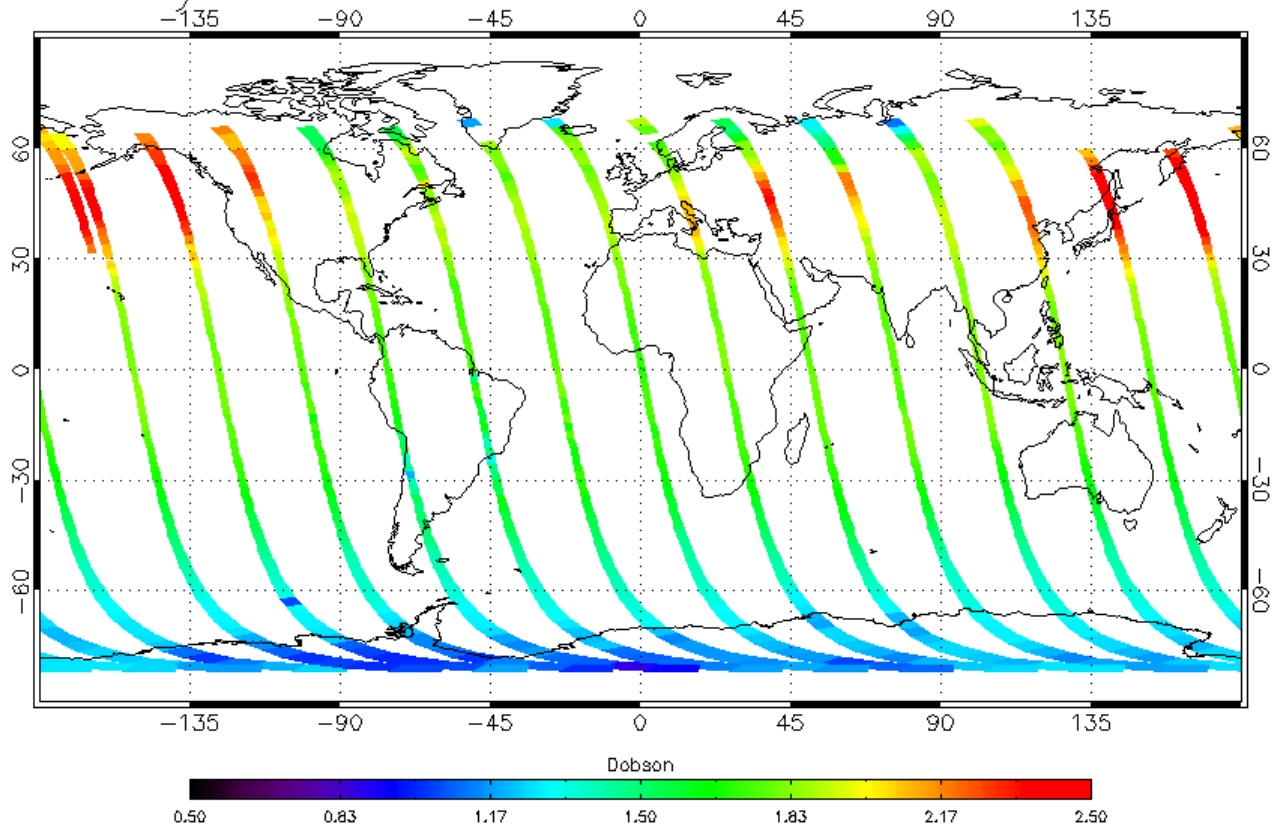




S-NPP and NOAA-20 OMPS Nadir Profile Total Column EDRs show good consistency

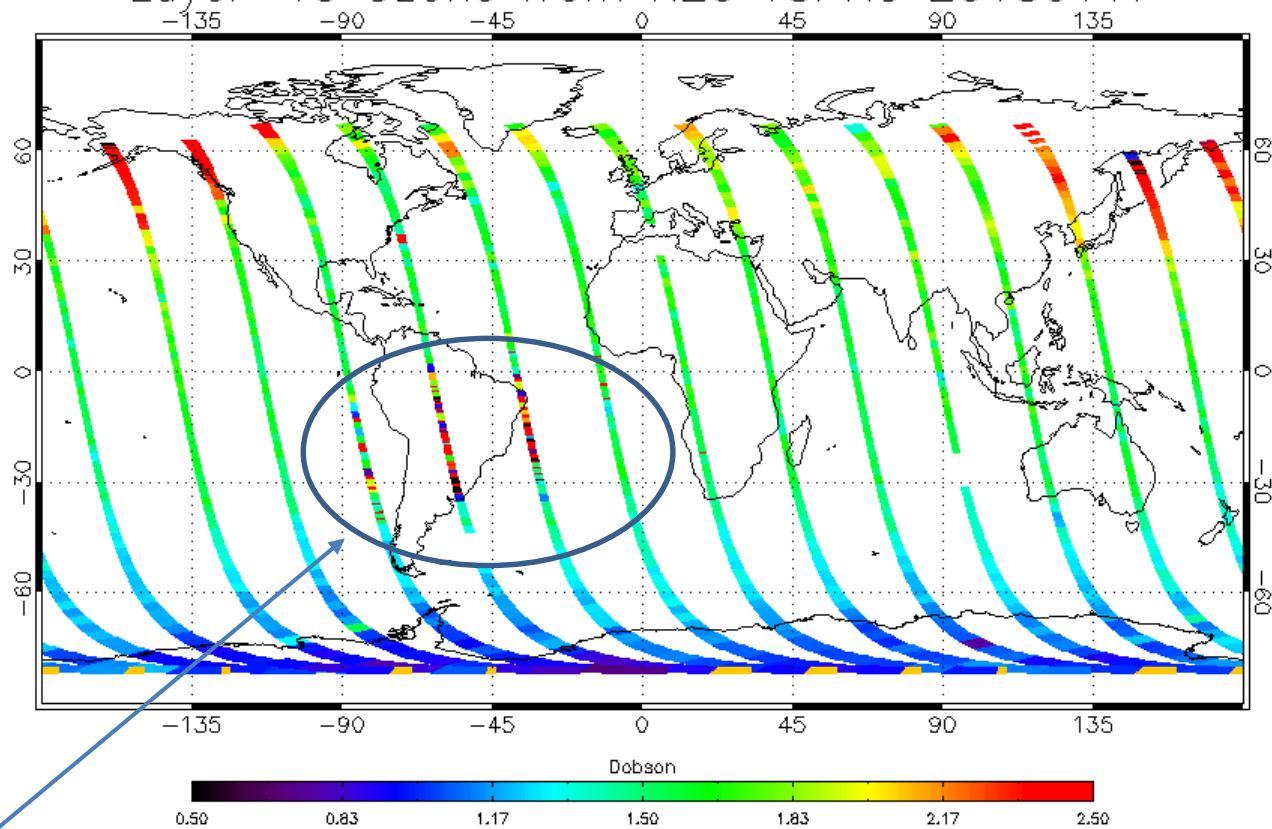


Layer-15 Ozone from NPP V8PRO 20180117

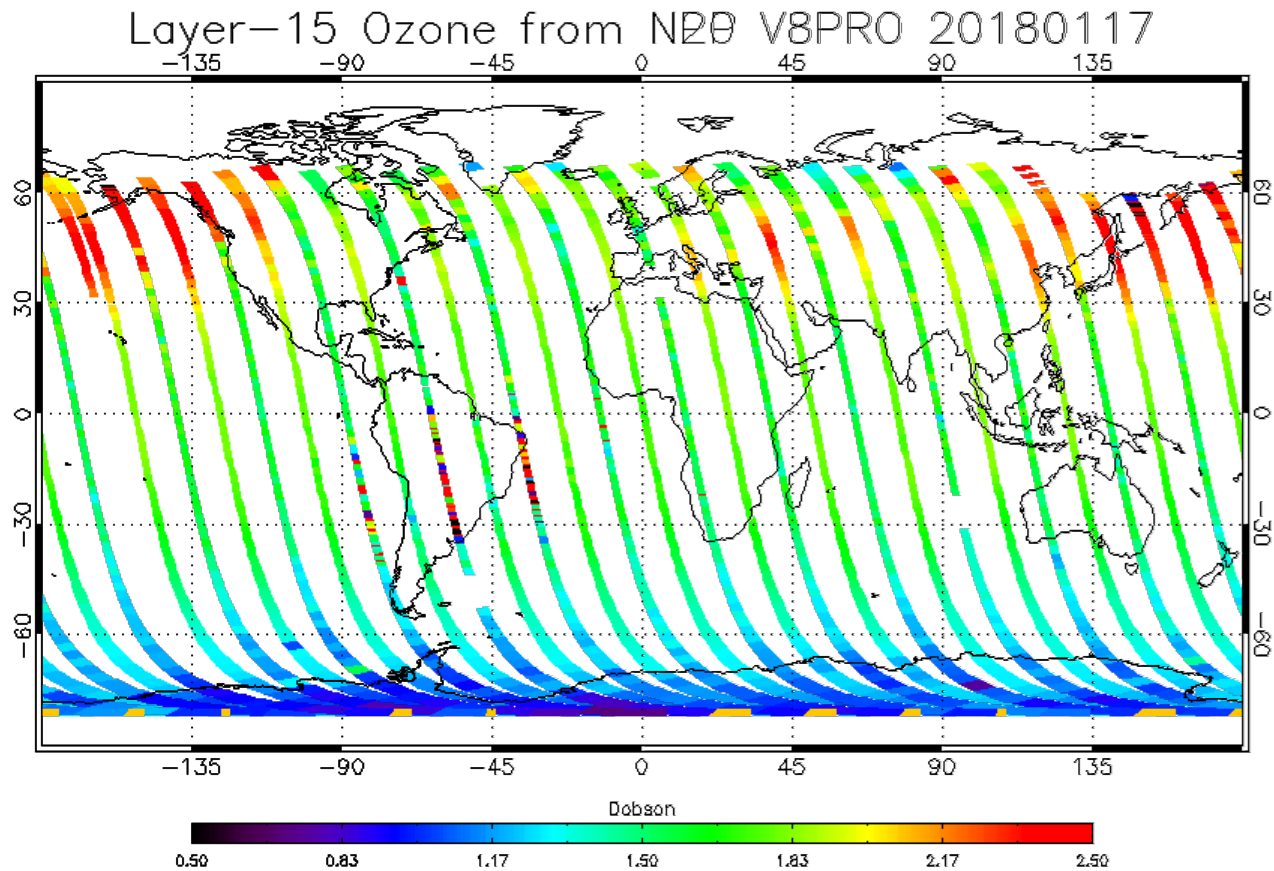




Layer-15 Ozone from N20 V8PRO 20180117

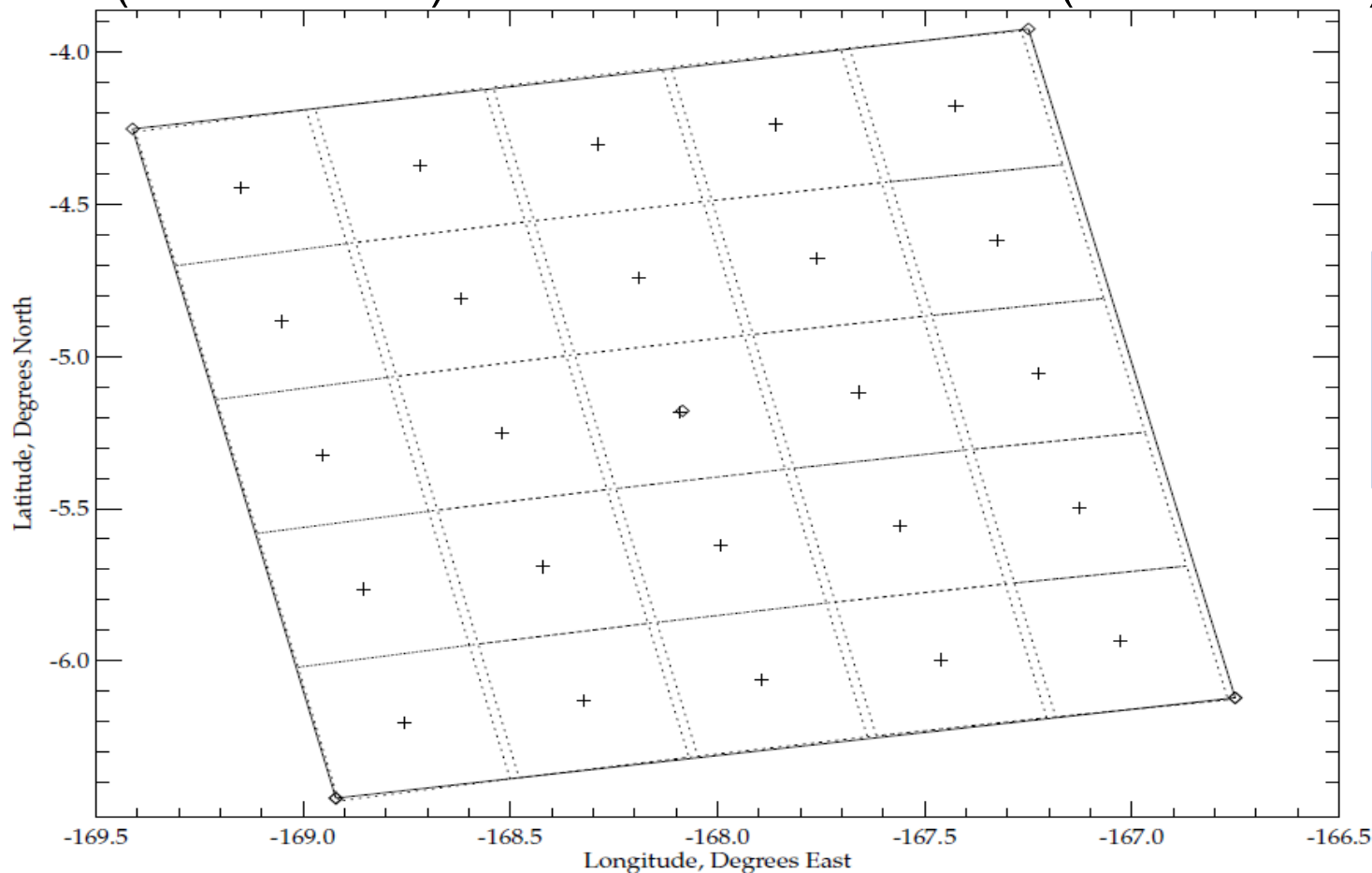


South Atlantic Anomaly



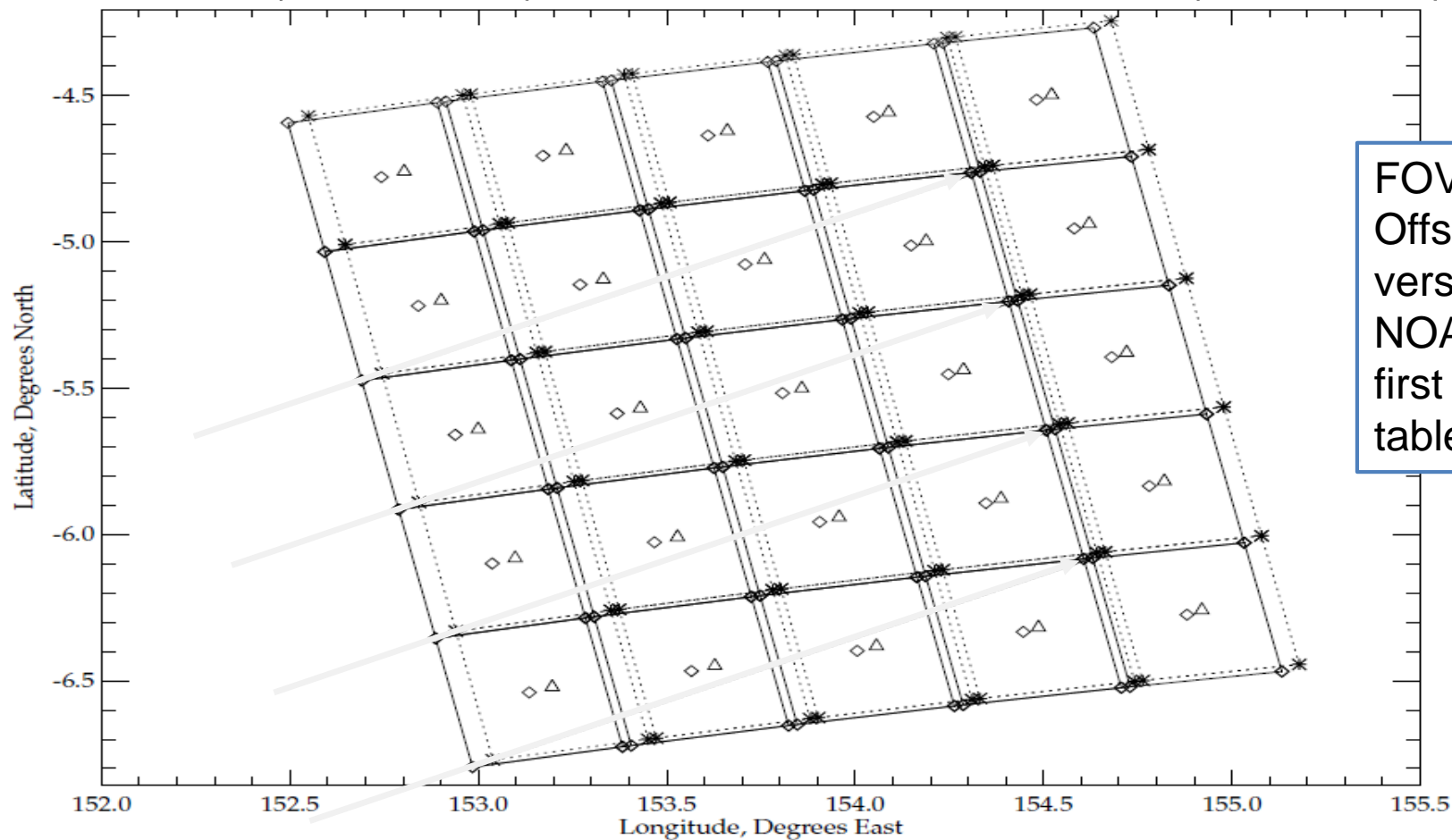
S-NPP and NOAA-20 OMPS Nadir Profile Layer Ozone EDRs show good consistency

Sample Matchup of FOVs for one Granule of S-NPP Nadir Mapper (Dotted and +) and S-NPP Nadir Profiler (Solid and <=>)

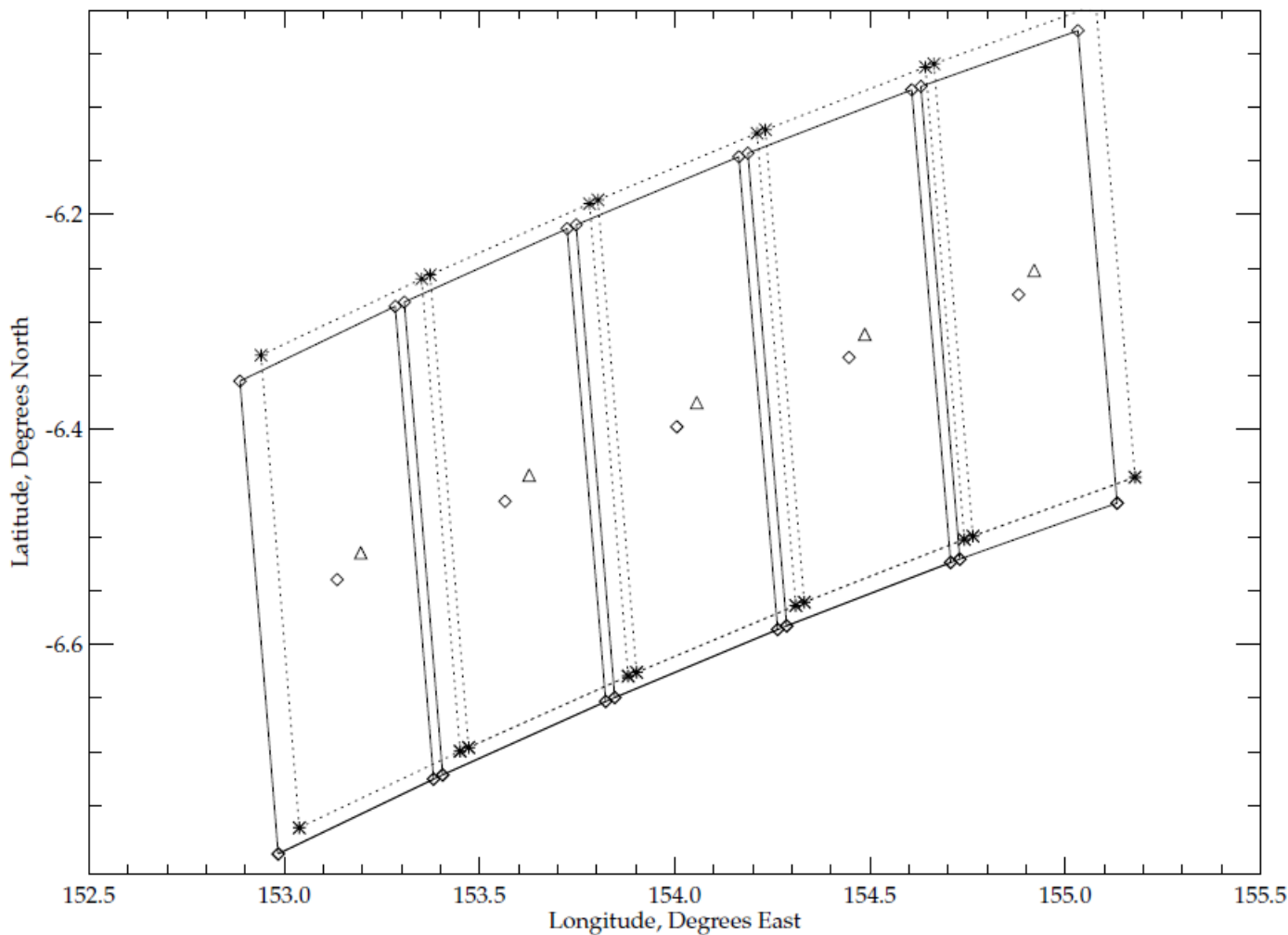


Boundaries match within one pixel width

Sample Matchup of FOVs for one Granule of NOAA-20 Nadir Mapper (Dotted & Δ) and NOAA-20 Nadir Profiler (Solid & $<>$)

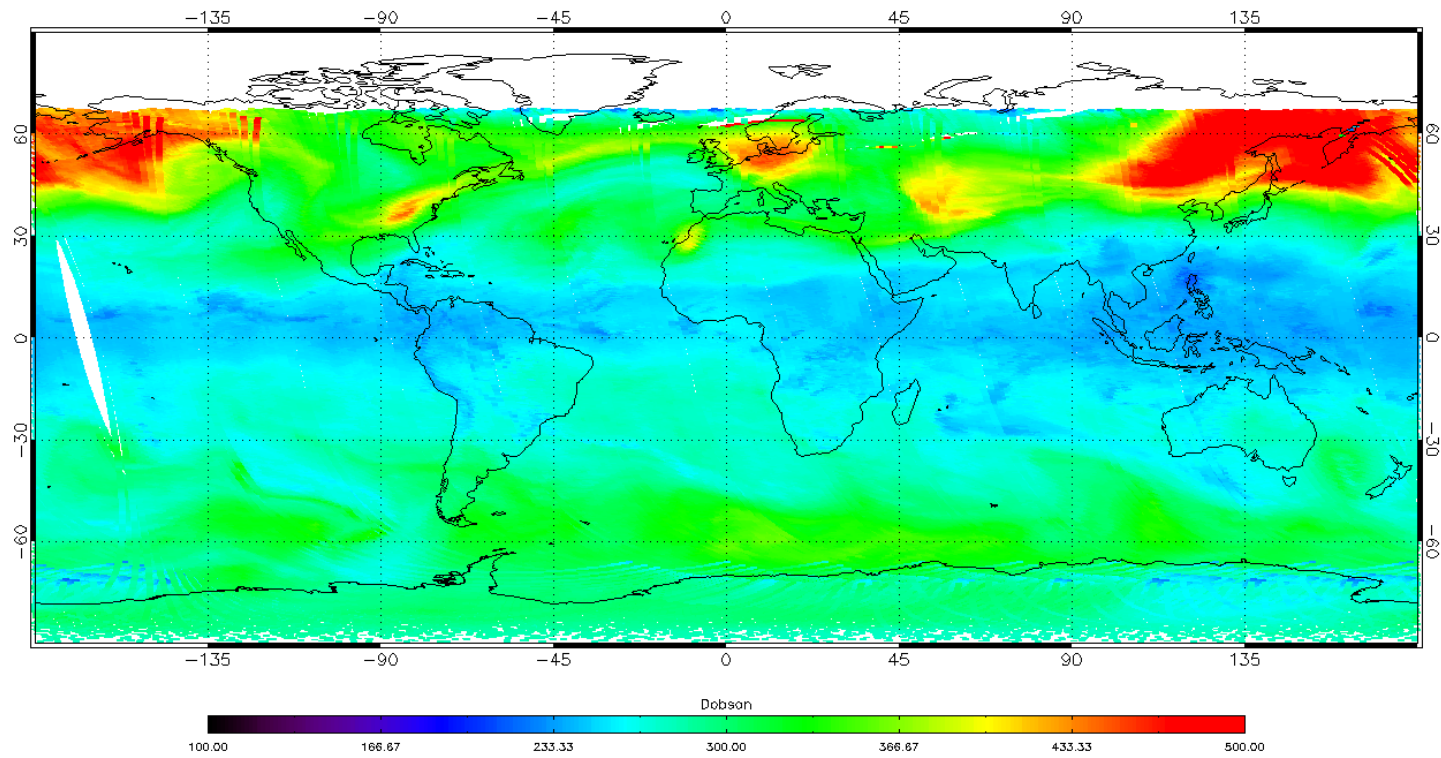


FOV Match-Up
Offset for NM
versus NP for
NOAA-20 with
first sample
tables.

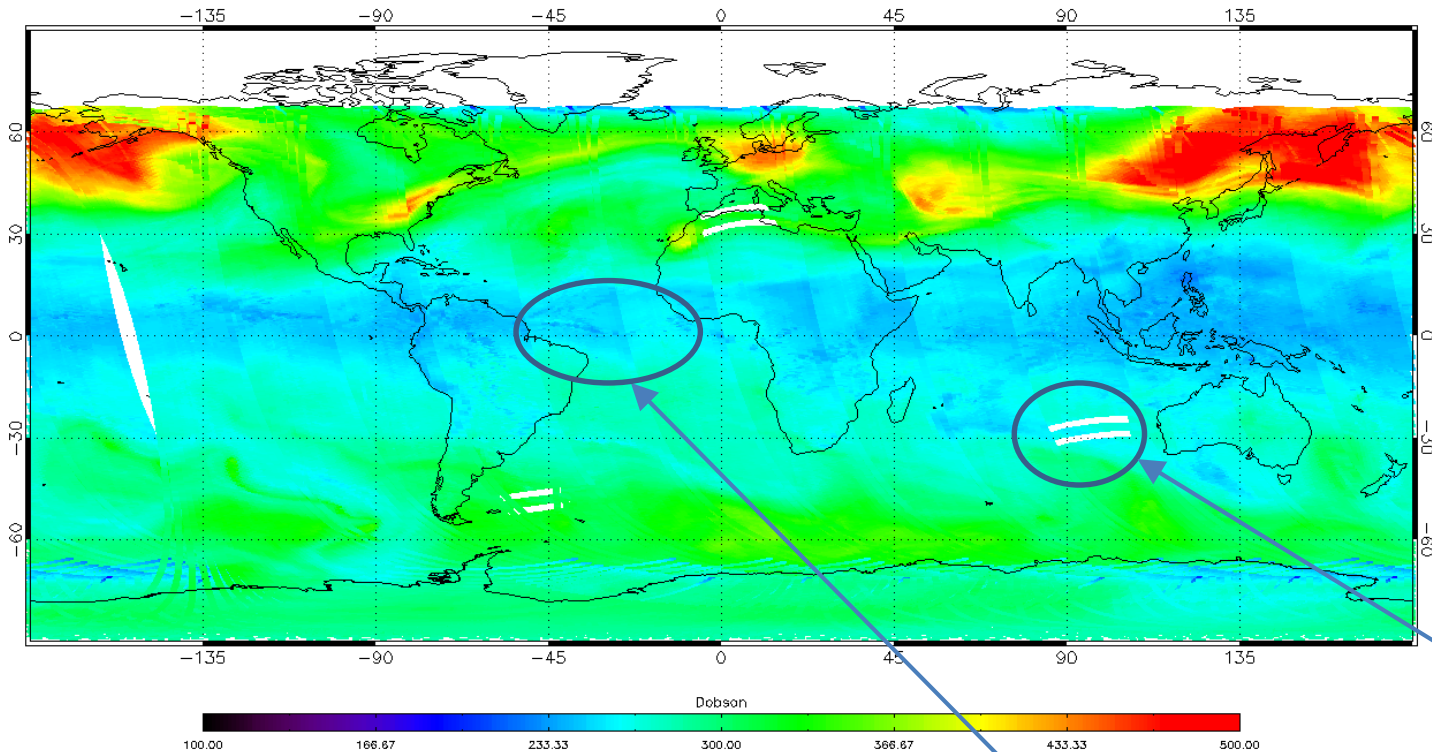


FOV Match-Up:
Same as Slide 14 but just for the lowest row / first scan.
Note the along-track offsets – top and bottom shifts of ~2 km.

V8TOZ Total Column Ozone NPP 20180117



V8TOZ Total Column Ozone N20 20180117



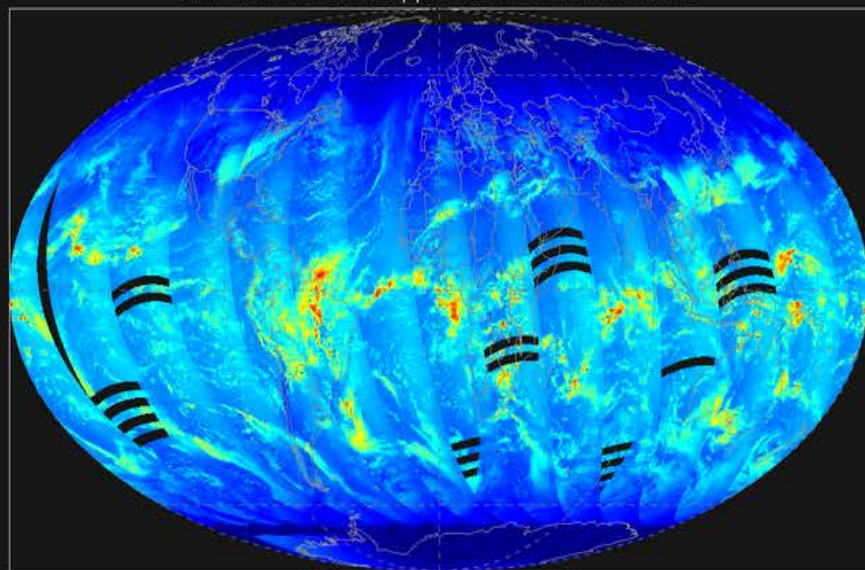
16-Image
Granule
Errors

Cross-Track Bias

NOAA-20 Total Column Ozone results are in-family with S-NPP products (on the preceding slide) with known deficiencies.

Raytheon-devised Cross-granule retrieval fix for 16- Image RDRs tested at STAR by SDR Team

N20 OMPS Nadir Mapper Radiance at 318.0nm

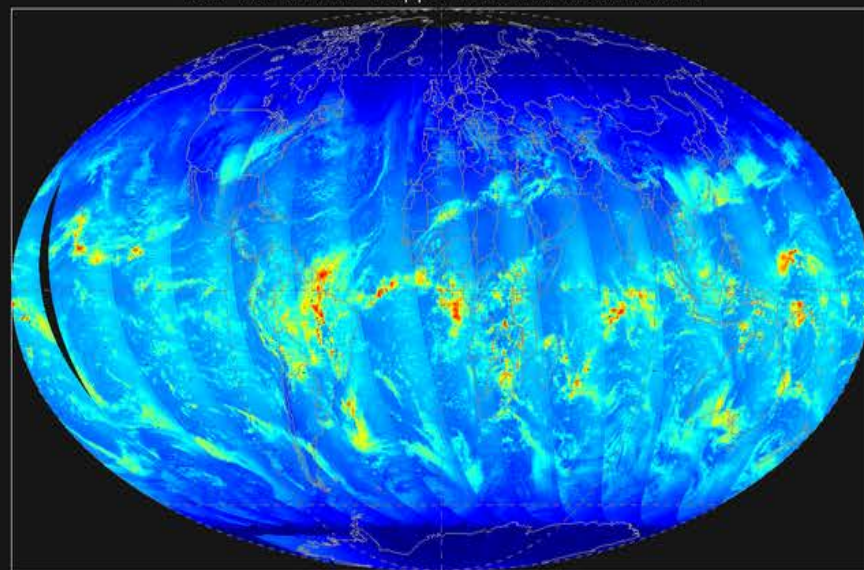


N20 OMPS Watts/cm²/nm/Sr 2018/02/21 at 318.0nm



before_xGran_2018-02-21.png

N20 OMPS Nadir Mapper Radiance at 318.0nm

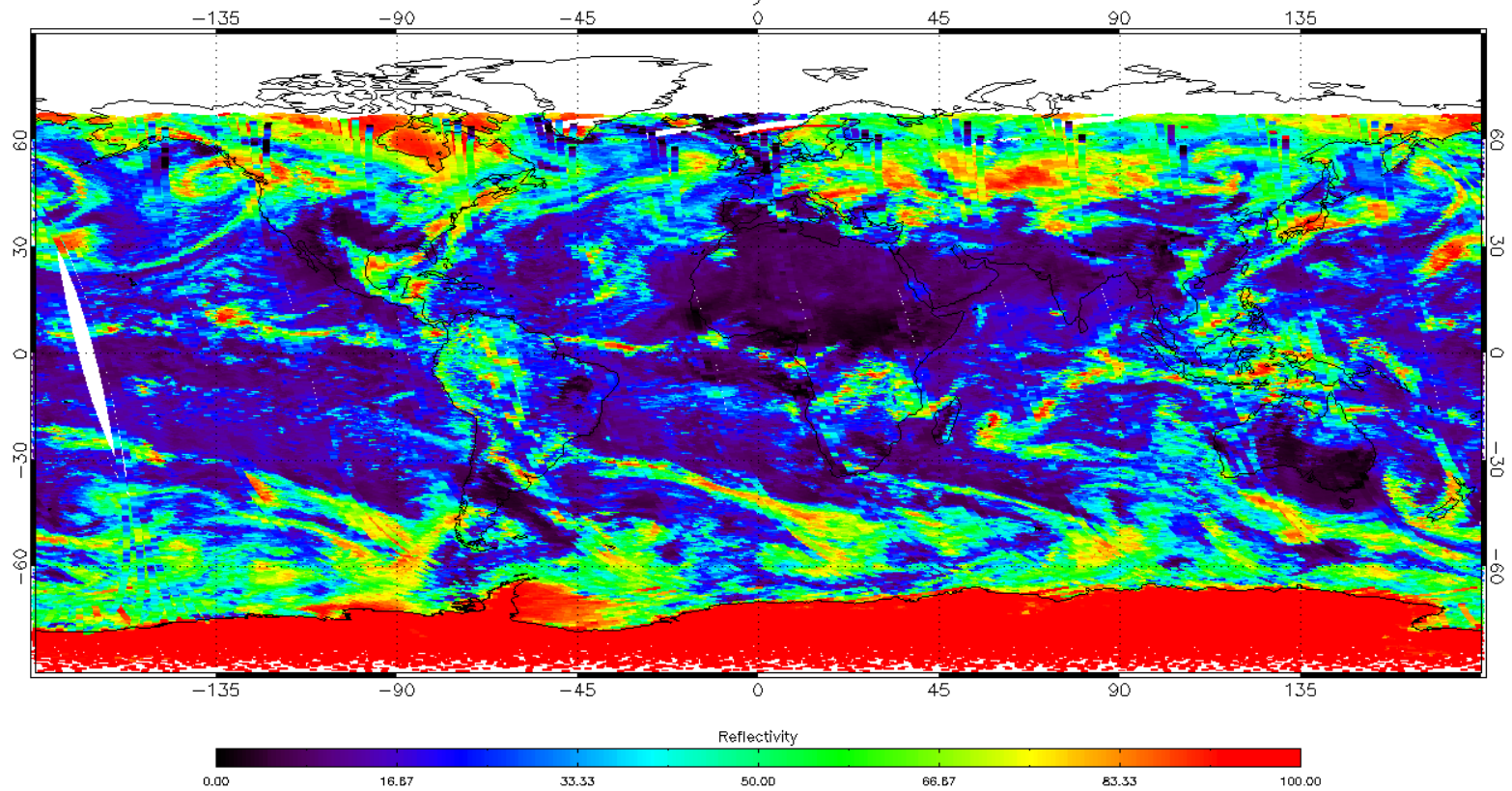


N20 OMPS Watts/cm²/nm/Sr 2018/02/21 at 318.0nm

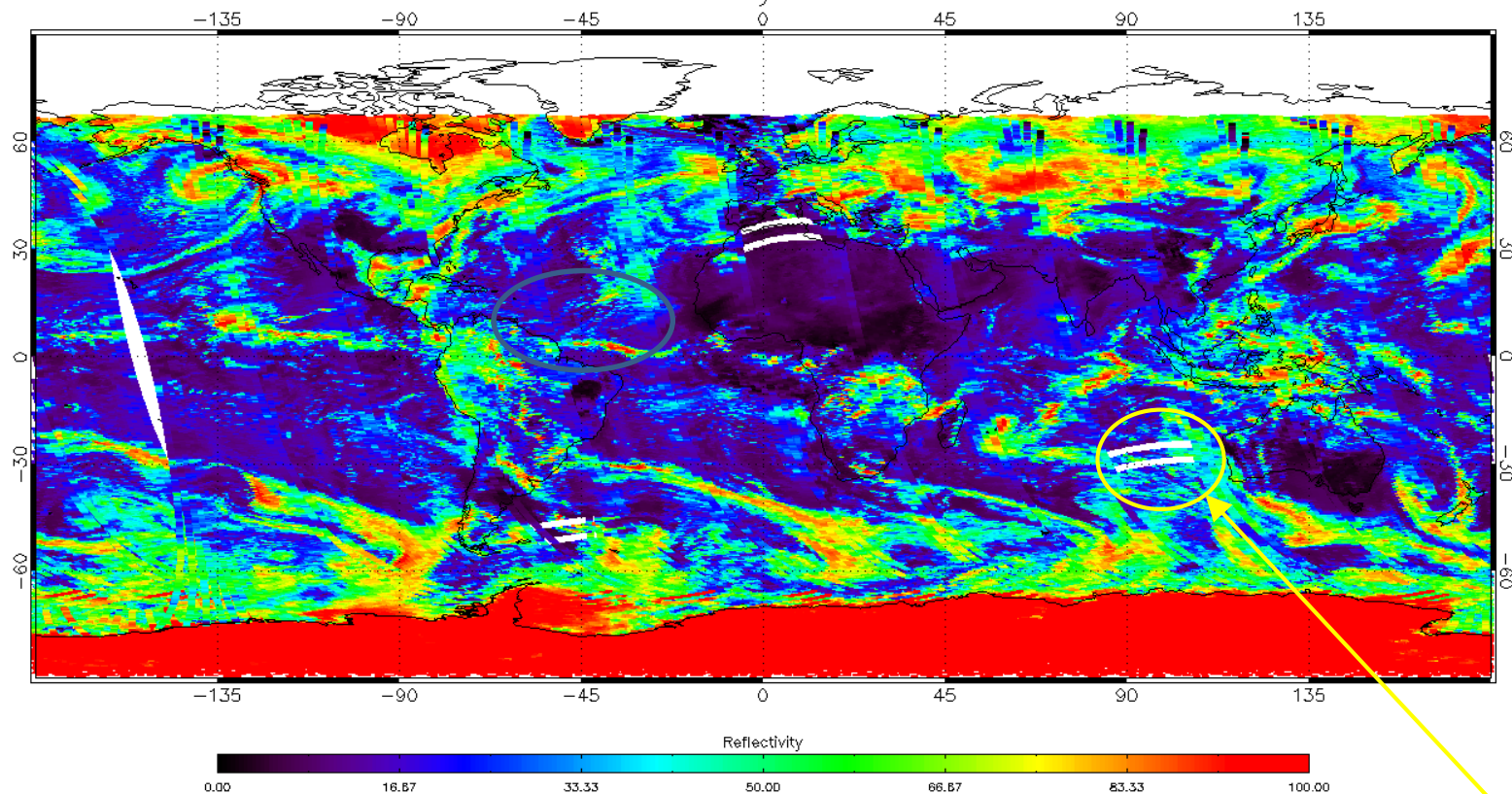


with_xGran_DR_8616_2018_02_21.png

V8TOZ Reflectivity NPP 20180117



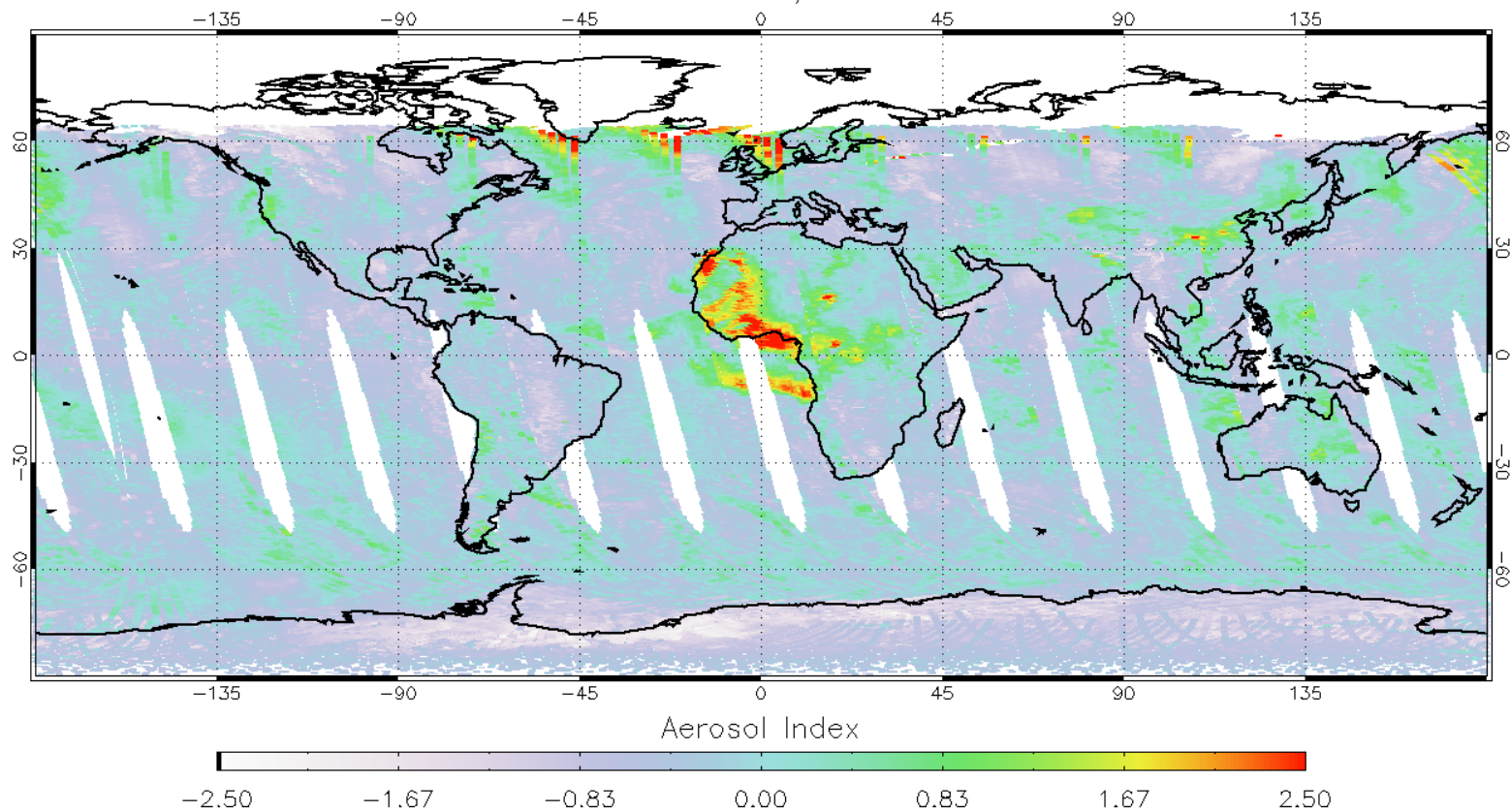
V8T0Z Reflectivity N20 20180117



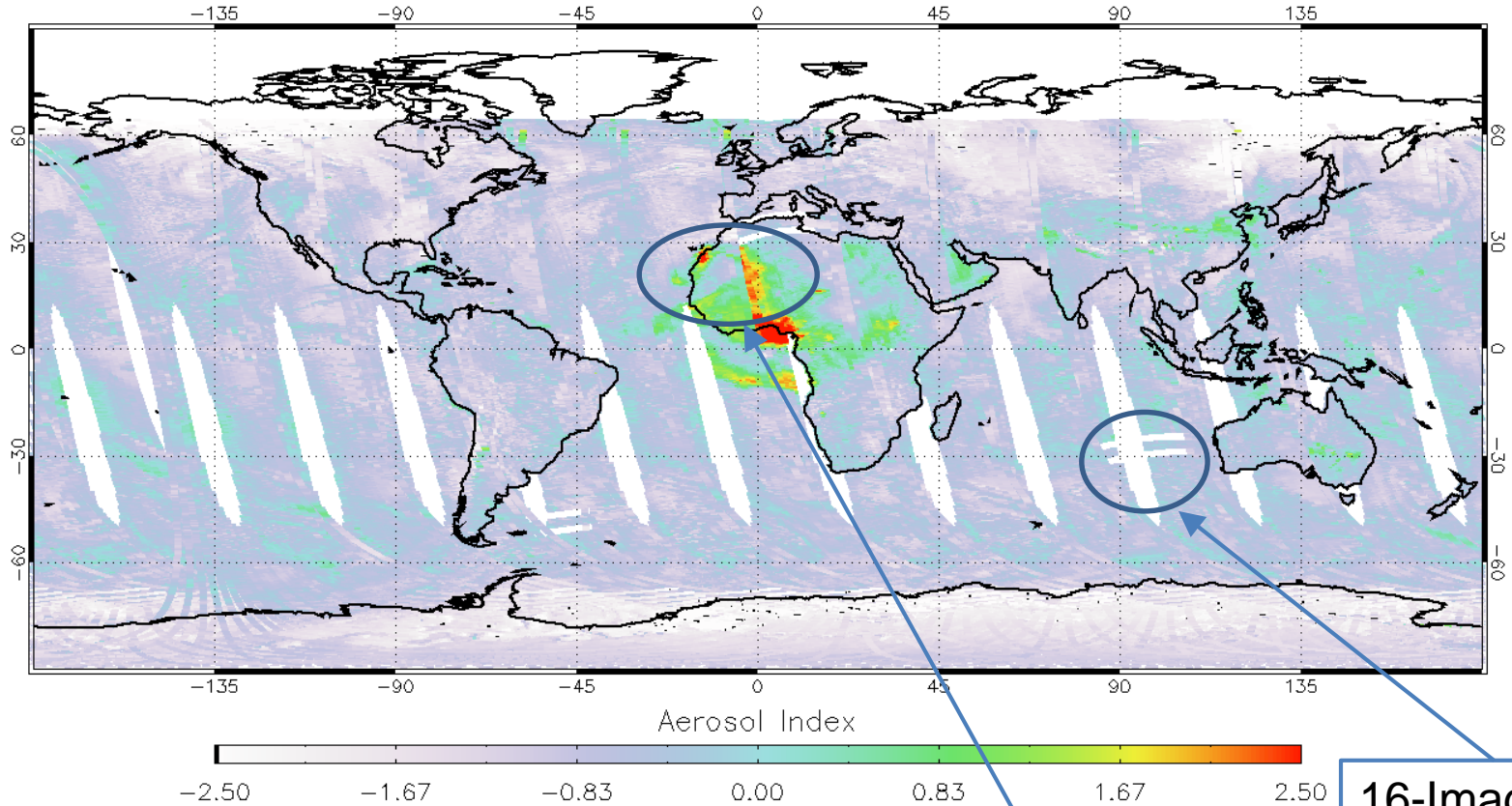
NOAA-20 Effective Reflectivity results are in family with S-NPP products (on the preceding slide) with known deficiencies.

16-Image
Granule
Errors

V8T0Z Aerosol Index, NPP 20180117



V8T0Z Aerosol Index, N20 20180117



NOAA-20 Absorbing Aerosol Index results are in family with S-NPP products (on the preceding slide) with known deficiencies.

16-Image Granule Errors
Cross-Track Bias

Summary & Conclusions

- The NOAA-20 OMPS Ozone EDR and BUFR products are ready for users to examine. They have proper formatting and reasonable values for content.
- Deficiencies in the OMPS SDRs are known, and the SDR Team has paths forward to improve the products.
- Minor code and script changes will be provided to NDE for the V8Pro, V8TOz and LFSO2 codes in a May 2018 delivery.
- Final adjustment tables for the EDR products will be developed by using off-line STAR SDR processing.
- Product quality will improve as SDR and EDR Team adjustments and corrections enter the IDPS and NDE processing systems.