



**MEMORANDUM FOR:** The JPSS Program Record  
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**SUBJECT:** NOAA-20 ATMS TDR/SDR validate maturity status  
**DATE:** 6/15/2018

**Validated maturity status declaration for ATMS TDR/SDR**

**Maturity Review Date:** 6/15/2018  
**Effective Date:** 7/05/2018  
**Operational System:** IDPS with ATMS PCT Version 007

**1. Background:**

The Joint Polar Satellite System-1 (JPSS-1) was successfully launch on November 18, 2017 and renamed NOAA-20 after reached the polar orbit. Eleven days after launch, on November 28, 2017, the NOAA-20 Advanced Technology Microwave Sounder (ATMS) was activated and started to collect science data. Like the Suomi NPP ATMS, NOAA-20 ATMS is a cross-track scanning radiometer with 22 channels at frequencies ranging from 23 to 183 GHz, permitting the measurements of the atmospheric temperature and moisture profiles under most weather conditions.

The ATMS SDR team consists of experts from NOAA, NASA, MIT Lincoln Laboratory, Colorado State University, and industry partners Northrop Grumman and Raytheon. The team has worked intensively for post-launch instrument performance optimization and ATMS SDR pre- and post-launch calibration and validation.

NOAA-20 ATMS data product has been declared beta maturity on December 11, 2017 after the preliminary data quality check. NOAA-20 ATMS data product has been declared provisional maturity on January 23, 2018 after the extended instrument performance characterization and data quality improvement.

**2. Validated maturity stage definition:**

- 1) Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).
- 2) 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.
- 3) Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.

- 4) Product is ready for operational use based on documented validation findings and user feedback.
- 5) Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

### **3. Justifications for declaring ATMS TDR/SDR data products validated maturity:**

After NOAA-20 ATMS provisional maturity on January 23, 2018, ATMS SDR team members continue the assessment and analysis of both ATMS on-orbit normal scanning data and special post-launch tasks (PLT) data, including ATMS science RDR, telemetry RDR, diagnostic RDR, TDR, SDR, and GEO data products. Based on the more than six months of continuous study and monitoring of ATMS data, the following assessments of the ATMS instrument and data products are given:

- 1) Space view profile #1 is chosen as the optimal space view profile;
- 2) On-orbit NE $\Delta$ T is well characterized and shows slightly better performance than S-NPP;
- 3) Temperature stabilization has been checked and demonstrates a relatively low gain drift;
- 4) Effective FOV size, antenna pattern, and earth side lobe evaluations have been performed using roll maneuver data;
- 5) Geolocation accuracy is assessed based on near six months on-orbit data and shows better accuracy than S-NPP;
- 6) Inter-comparison results between NOAA-20 and S-NPP ATMS indicate a relatively lower antenna temperature (TDR) in NOAA-20;
- 7) Striping noise is evaluated and shows a significant improvement compared to S-NPP;
- 8) Channel correlation assessment results indicate a much lower correlation in NOAA-20 than that in S-NPP;
- 9) Noise characterization data is analyzed and illustrates a comparable result with pre-launch TVAC data;
- 10) PCT update (007) to turn on calibration count upper and lower boundary check to improve quality control and update TDR to SDR conversion coefficients to improve the SDR data quality has been submitted for operational implementation in early May, 2018. This PCT update successfully mitigates the ATMS cross scan asymmetry and further reduced the systematic difference between TDR and SDR.
- 11) Errors and artifacts in the data products after provisional maturity are documented;
- 12) The random calibration count jump event is disappeared after the flight software update;
- 13) The channel 18 and 19 gain faster decreasing trend is flattened out;
- 14) NOAA-20 ATMS TDR data has been utilized in NOAA/NWS operational NWP system on May 30, 2018 and May 22, 2018 in ECMWF;
- 15) NOAA MIRS team has generated and analyzed offline NOAA-20 total precipitable water EDR products and is satisfied with the EDR accuracy.

The detailed justifications for declaring ATMS TDR/SDR validated maturity is attached. The following is a table summarizing the ATMS channel NE $\Delta$ T specification and on-orbit values.

Ch.	Center Freq. (MHz)	Pol	NOAA-20 NEAT Specification (K)	NOAA-20 NEAT On-orbit (K)
1	23800	QV	0.7	0.23
2	31400	QV	0.8	0.27
3	50300	QH	0.9	0.31
4	51760	QH	0.7	0.22
5	52800	QH	0.7	0.22
6	53596±115	QH	0.7	0.23
7	54400	QH	0.7	0.22
8	54940	QH	0.7	0.22
9	55500	QH	0.7	0.23
10	57290.344( $f_0$ )	QH	0.75	0.32
11	$f_0 \pm 217$	QH	1.2	0.44
12	$f_0 \pm 322.2 \pm 48$	QH	1.2	0.46
13	$f_0 \pm 322.2 \pm 22$	QH	1.5	0.69
14	$f_0 \pm 322.2 \pm 10$	QH	2.4	0.97
15	$f_0 \pm 322.2 \pm 4.5$	QH	3.6	1.58
16	88200	QV	0.5	0.22
17	165500±925	QH	0.6	0.32
18	183310±7000	QH	0.8	0.35
19	183310±4500	QH	0.8	0.36
20	183310±3000	QH	0.8	0.41
21	183310±1800	QH	0.8	0.42
22	183310±1000	QH	0.9	0.58

**4. ATMS validated maturity TDR & SDR data product caveats**

The following caveats are offered to the validated product users:

- 1) TDR data present noticeable striping in terms of NWP O-B field, particularly in temperature sounding channels. However, the striping index is lower than that of S-NPP and the striping



## *Read-me for Data Users*

- noise is still within the requirement of ATMS channel noise (NE $\Delta$ T)
- 2) Due to the loss of communication, ATMS all data was lost from 09:31 to 11:34 GMT on December 6, 2017.
  - 3) ATMS was shut off toward the end of noise characterization activity around 01:04 GMT on December 20, 2018, due to the high scan drive main motor current, which is higher than the yellow limit. ATMS is resumed near 06:46 GMT. The data gap is non-recoverable;
  - 4) Large number of ATMS GEO data is obtained by using TLE instead of spacecraft diary due to the delay of spacecraft diary data from December 9 to December 14, 2017. The application of TLE in geolocation calculation instead of spacecraft diary data will degrade the accuracy, but will still meet the requirement.
  - 5) ATMS SDR data before January 23, 2018 have relatively large error for most of channels.
  - 6) ATMS SDR data between January 23, 2018 and June 14, 2018 have relatively larger cross scan asymmetry. Such asymmetry issue is addressed after validated maturity from June 14, 2018.

### **5. Path forward**

The team will move forward to perform the following work to improve ATMS TDR/SDR data product quality during the LTM period after validated maturity:

- 1) Continue to monitor ATMS instrument stability and performance, as well as TDR/SDR data quality;
- 2) Analyze lunar intrusion data to determine the optimal lunar intrusion mitigation plan;
- 3) Implement reflector emission correction algorithm and update associated processing coefficients table to further improve TDR and SDR data quality;
- 4) Characterize the instrument performance following the NOAA-20 ATMS Calibration/Validation Plan

Additional information is available in the ATMS Algorithm Theoretical Basis Document (ATBD) and provisional maturity review briefing, which can be accessed at:

<https://www.star.nesdis.noaa.gov/jpss/Docs.php>

Pre-operational NOAA-20 ATMS near real time status and performance monitoring password protected web page is available using the following URL at:

[https://www.star.nesdis.noaa.gov/icvs/status\\_N20\\_ATMS.php](https://www.star.nesdis.noaa.gov/icvs/status_N20_ATMS.php)

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