NOAA-20 ATMS STATUS

ATMS SDR Team

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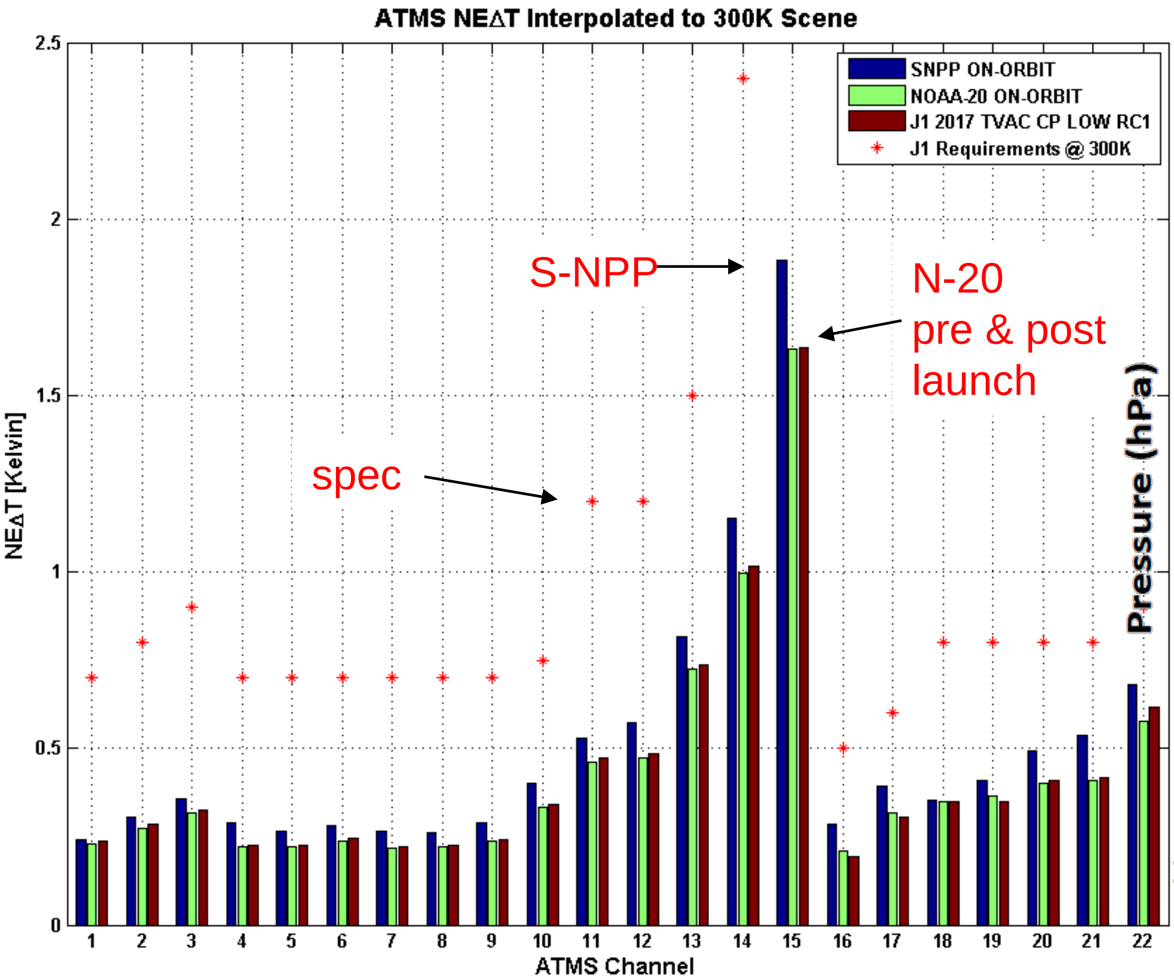
Presented by Ed Kim

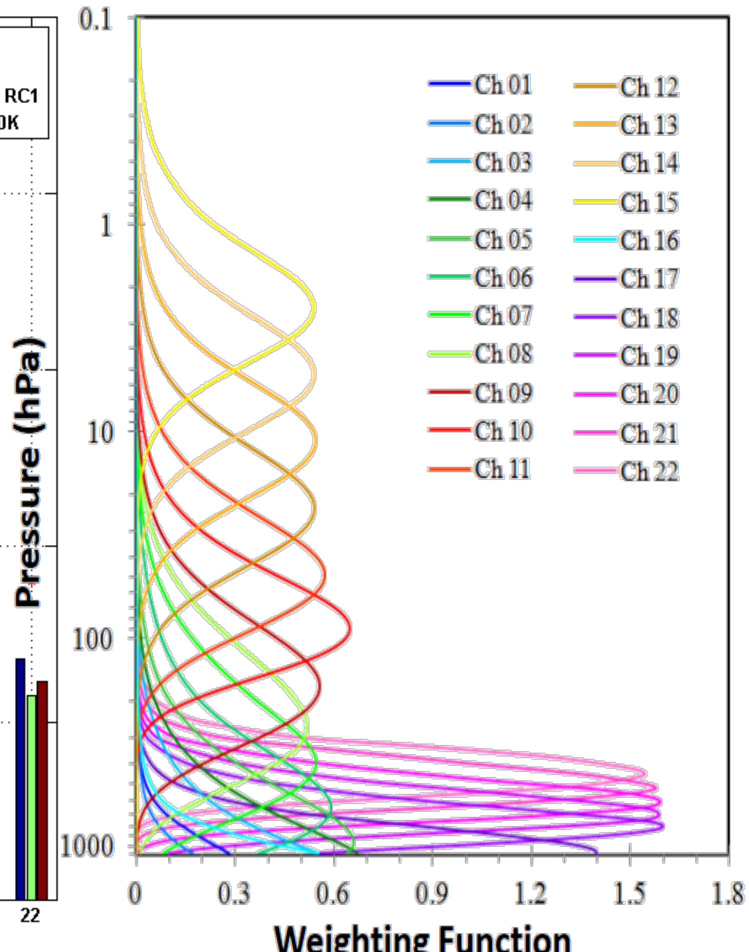
6 March 2019

ATMS Sensitivity (NEDT)

Comparison of J1 Pre-Launch, NOAA-20 on-orbit, SNPP on-orbit

V. Leslie & I.Osaretin, MIT LL

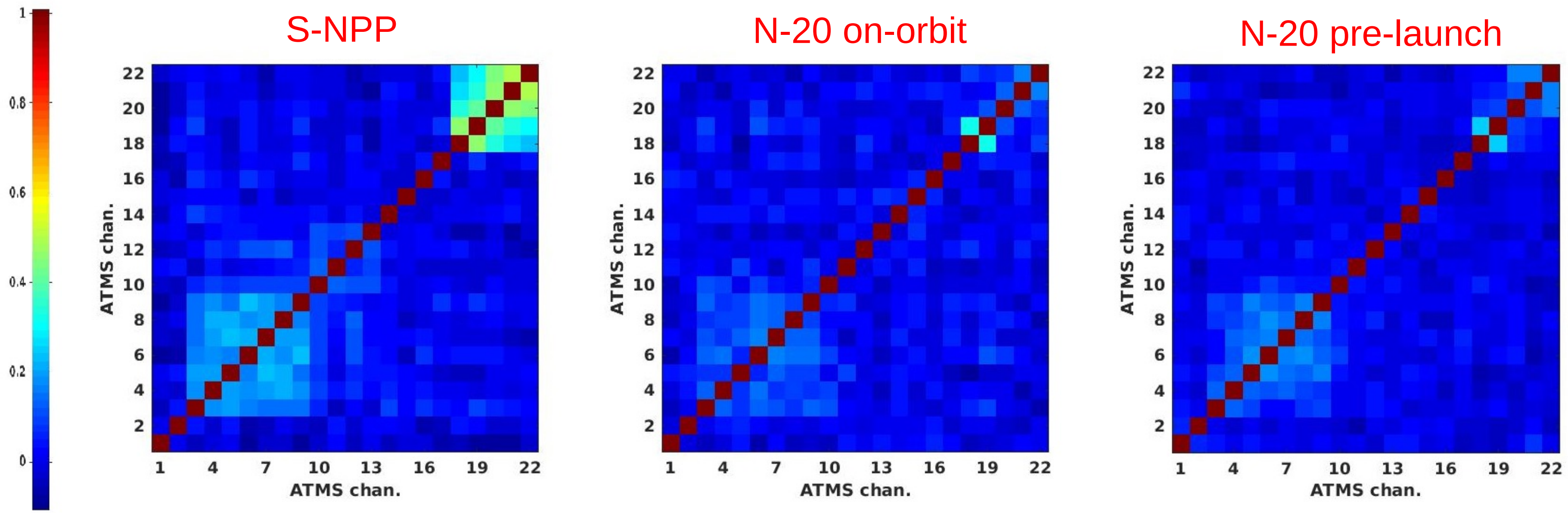




N-20 NEDT on-orbit ~ same as pre-launch and better than S-NPP

ATMS Inter-Channel Correlation

Comparison of J1 Pre-Launch, NOAA-20 on-orbit, SNPP on-orbit

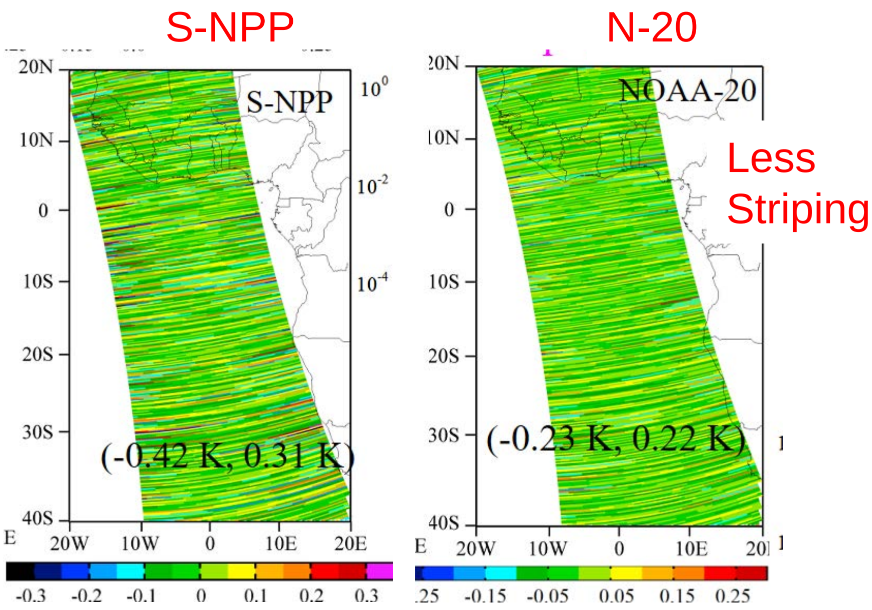


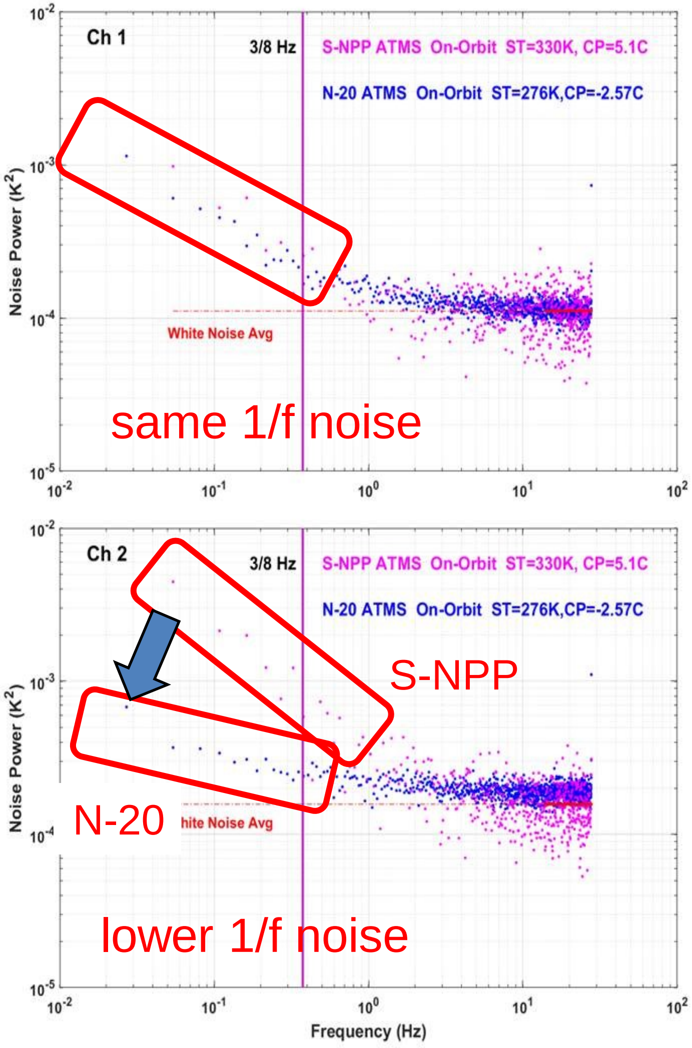
V. Leslie & I.Osaretin, MIT LL

N-20 Noise Correlation Much Better than S-NPP for all Channels

ATMS Noise Power Spectra

NOAA STAR





- On-orbit noise power spectra match well with Instrument TVAC results
- Same or better for most channels compared to S-NPP
- Channels with < 1/f noise will have less striping

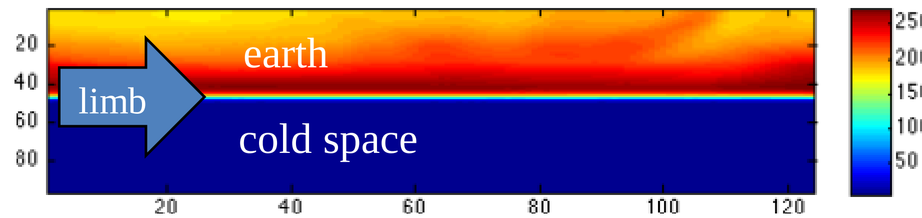
J.Lyu/ NASA GSFC

NOAA-20 Maneuvers

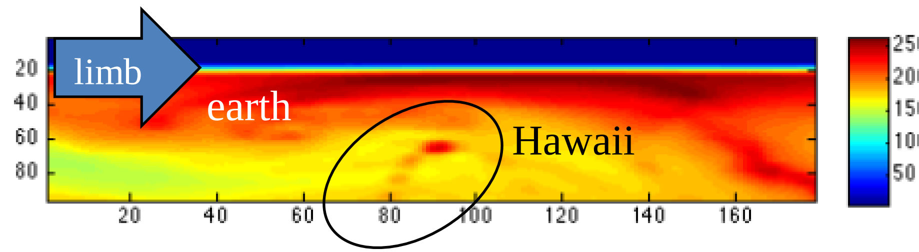
- **Rolls -65deg & +30deg**
  - Antenna pattern/sidelobe check
- **Backflip Maneuver**
  - Antenna pattern/sidelobe check
  - Sidelobe contamination characterized
  - Scan Bias (flat field) determined
  - Reflector Emissivity much better than SNPP
  - Minor lunar intrusion; no significant impact

Maneuver results good

-65 Roll



+30 Roll

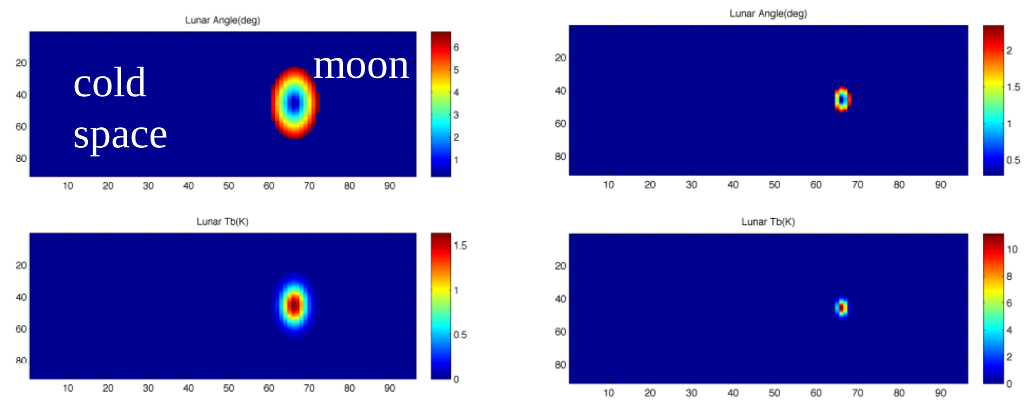


NOAA STAR

Backflip

Channel-01

Channel-16



Results from Commissioning

- ✓ Space view profile #1 declared optimal
- ✓ Channel NEΔTs stable and lower than S-NPP
- ✓ Noise power spectra same or better for most channels vs. S-NPP
- ✓ Image striping slightly less than S-NPP
- ✓ Inter-channel noise correlation << S-NPP
- ✓ Channel on-orbit effective field-of-view (EFOV), earth sidelobes effects, and antenna pattern derived maneuvers → nominal
- ✓ No *significant* RFI from Ka transmitters so far
- ✓ Passive lunar intrusion coefficients derived (currently off-line fixed); evaluating alternative active mitigation technique
- ✓ No heater activation EMI observed
- ✓ Active geolocation tested for first time; faster determination of pointing accuracy appears achievable

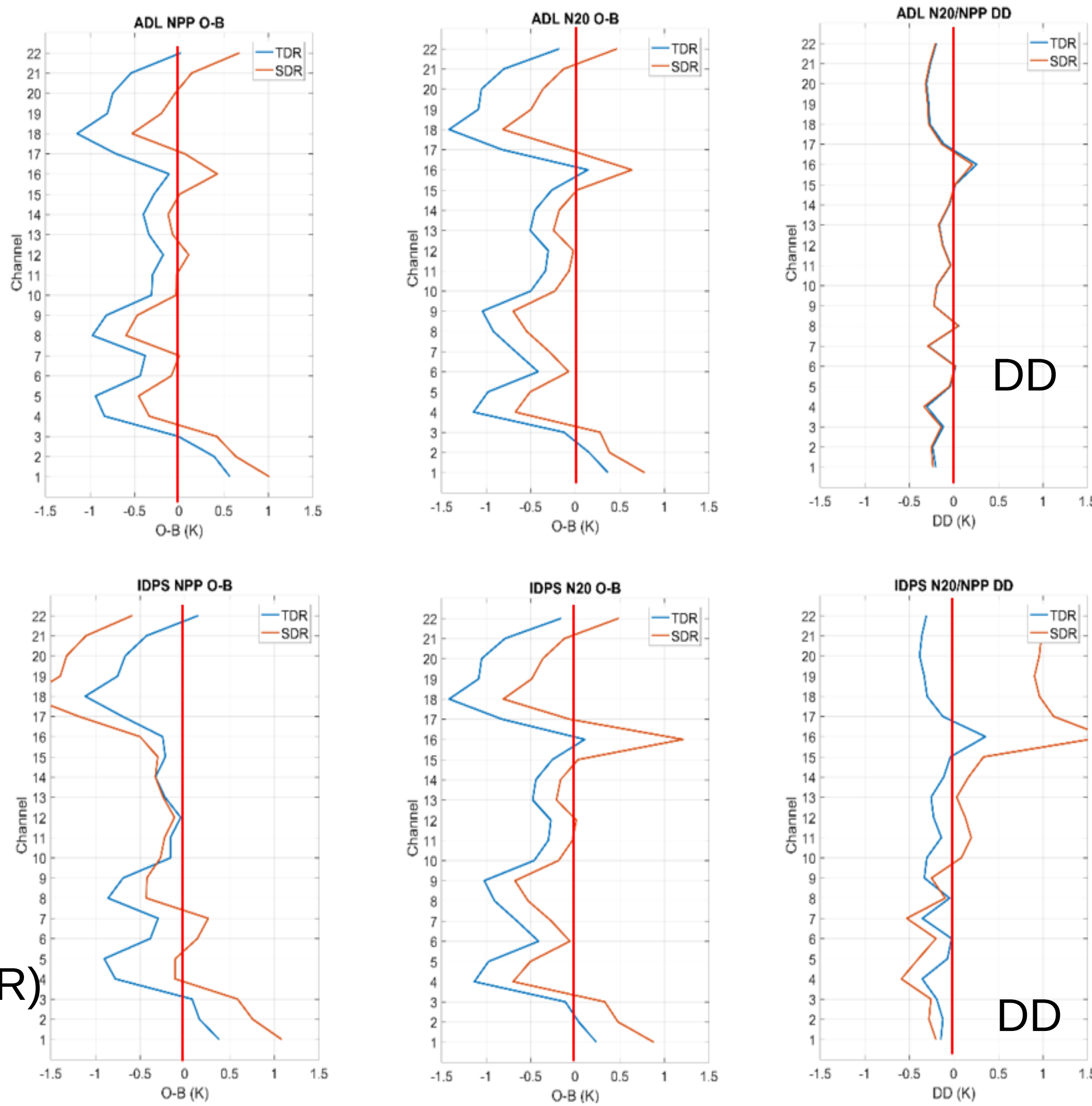
S-NPP/NOAA-20 ATMS TB Inter-comparison

Updated

(emissivity corr in TDR & SDR)

OPS

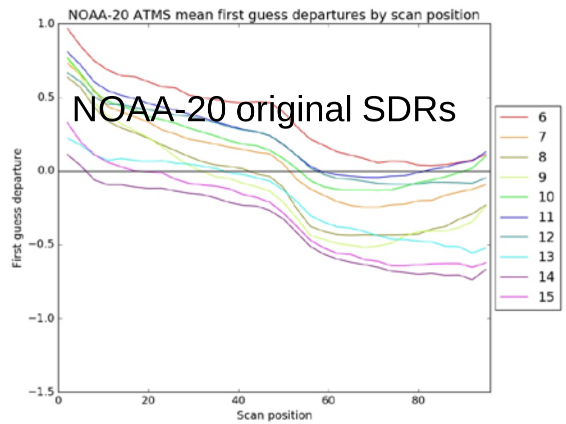
(ant corr in SDR, no emissivity corr in TDR or SDR)

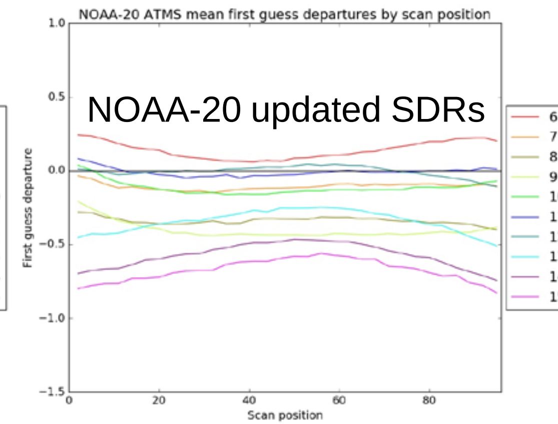


In DD plots, emissivity correction improvement (blue curves closer to zero); mainly ch 11 & 16; overall improvement small (bottom vs top DD plots). SDR improvement big for higher channels, mostly from updated antenna correction coefficients. NPP and N20 ATMS sensors ~same, expect SDR DD curves to be ~similar, and they are (top DD plot). This is all consistent w/ ECMWF results.

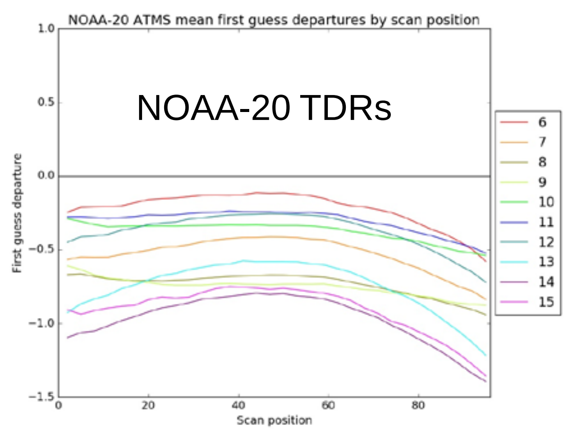
Scan biases (cloud screened data before bias correction)

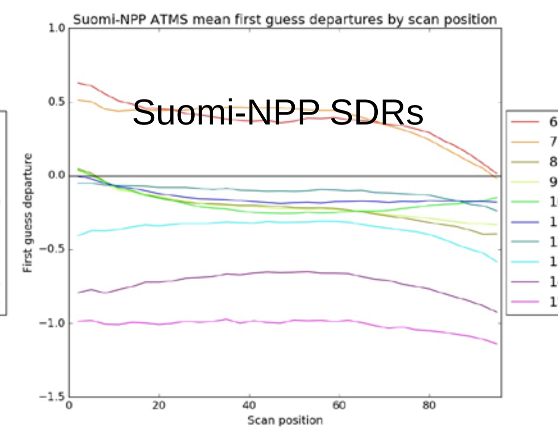
- NOAA-20 updated SDRs have much more symmetric scan biases than NOAA-20 original SDRs





- NOAA-20 updated SDRs have more symmetric and smaller magnitude scan biases than NOAA-20 TDRs





- NOAA-20 updated SDRs have more symmetric and smaller magnitude scan biases than Suomi-NPP SDRs

SDR data improved because
1.Improved antenna pattern measurements for J01, especially in W and G bands
2.Improved antenna pattern correction algorithm based on On-orbit environment test data
3.More accurate antenna reflector emission correction model

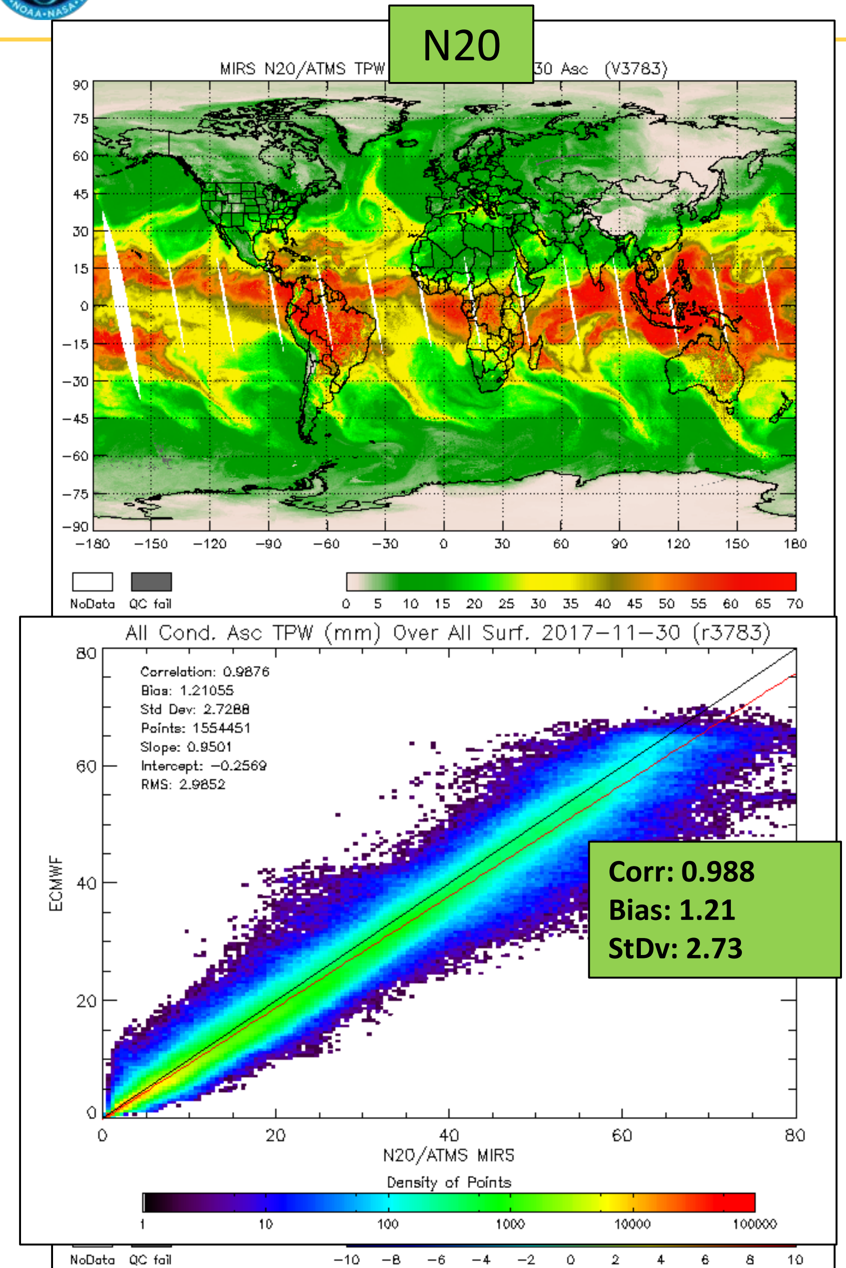
Peter Weston and Niels Bormann

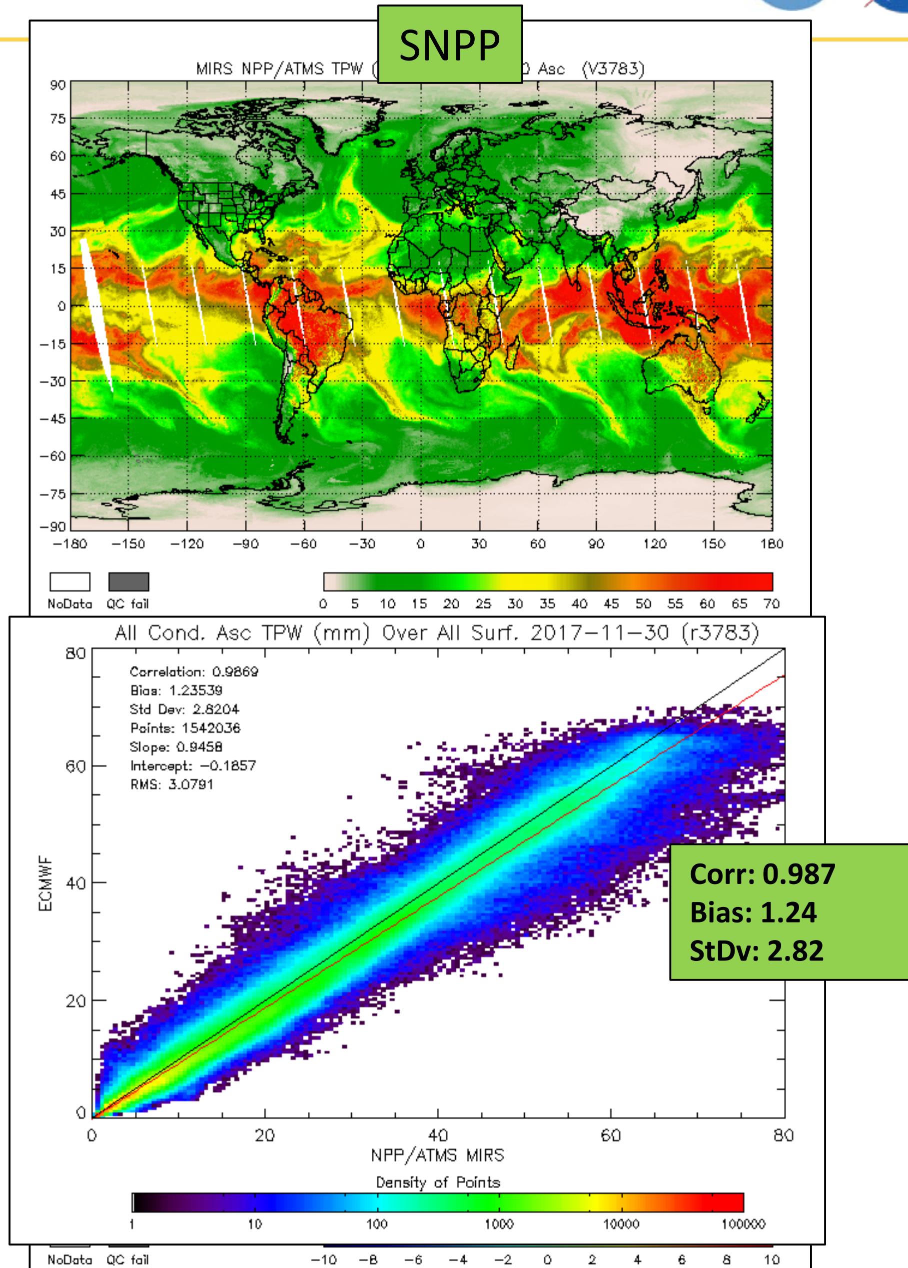
Selected ATMS Comments from ECMWF

- Data quality looks better than Suomi-NPP:
  - Similar biases
  - Smaller standard deviation of first guess departures and diagnosed observation errors
  - Weaker striping signal than Suomi-NPP ATMS
- Improved first guess fits to:
  - Temperature observations (AMSU-A, CrIS, GPSRO)
  - Humidity observations (MHS, GEO CSRs)
- Indicates improved accuracy of short range temperature and humidity forecasts
- Neutral to slightly positive forecast scores

Generally positive feedback from ECMWF

Total Precipitable Water (2017-11-30), beta maturity at day-1





Conclusion

- NOAA-20 ATMS working well since activation
- NOAA-20 ATMS post-launch performance is comparable to pre-launch performance; No Ka-band transmitter RFI and heater induced EMI observed so far
- All commissioning successful,
  - space view profile #1 declared optimal
  - maneuver-related activities successful
- NOAA-20 ATMS TDR/SDR compare well to S-NPP ATMS
  - NEΔTs stable since activation and slightly lower than S-NPP
  - Inter-channel noise correlation much lower than S-NPP
- ATMS SDR is significantly improved. MiRS products achieved beta maturity at day-1. TDR/SDR products are operational at major NWP centers. Some centers are working on the ATMS RDR data for climate studies.
- Antenna pattern correction is included in SDR
- TDR emissivity correction in testing, not quite yet in OPS

NOAA-20 ATMS on-orbit performance compares well with S-NPP ATMS. NOAA-20 ATMS TDR and SDR products look better.

JPSS Radiance Timeline

S-NPP Launch 28-Oct-2011
N-20 Launch 18-Nov-2017

Sensor-Spacecraft	Algorithm	Activation	Beta	Provisional	Validated
ATMS-SNPP	SDR-L1b	08-Nov-2011	Jan-2012 (2 m)	Oct-2012 (1 yr)	Dec-2013 (2 yr 2 m)
ATMS-N20	SDR-L1b	29-Nov-2017	11-Dec-2017 (2 wk)	23-Jan-2018 (2 m)	June-2018 (8 m)
CrIS-SNPP	SDR-L1b	14-Dec-2011	Apr-2012 (5 m)	Oct-2012 (11 m)	Dec-2013 (2 yr)
CrIS-N20	SDR-L1b	3-Jan-2018	17-Jan-18 (2 m)	16-Feb-18 (3 m)	Aug-2018 (10 m)

Maturity milestones reached earlier for N20!

JPSS Retrieval Timeline

S-NPP Launch 28-Oct-2011
N-20 Launch 18-Nov-2017

Sensor-Spacecraft	Algorithm	Activation	Beta	Provisional	Validated
MIRS SNPP (ATMS only)	Temperature/ Water Vapor	08-Nov-2011	Apr-2012 (6 m)	Aug-2014 (2 yr 10 m)	Oct-2016 (5 yr)
MIRS N20 (ATMS only)	Temperature/ Water Vapor	29-Nov-2017	21-Mar-2018 (5 m)	Sep-2018 (1 yr)	Sep-2019 (2 yr)
NUCAPS SNPP (ATMS + CrIS)	Temperature/ Water Vapor	14-Dec-2011	Aug-2012 (9 m)	Jan-2013 (1 yr 1 m)	Sep-2014 (2 yr 10 m)
NUCAPS N20 (ATMS + CrIS)	Temperature/ Water Vapor	3-Jan-2018	Jun-2018 (6 m)	Sep-2018 (9 m)	Sep-2019 (1 yr 9 m)

Maturity milestones reached earlier for N20!

JPSS Anomaly Reporting

https://www.star.nesdis.noaa.gov/icvs/SNPP_Anomalies.php

STAR ICVS Integrated Calibration / Validation System Long-Term Monitoring

Monitoring and characterizing satellite instrument performance for weather, climate and environmental applications

ICVS Home > S-NPP On-orbit Events & Anomalies Table

S-NPP On-orbit Events & Anomalies Table

Cumulative Zip file of all MX Releases, (ZIP, 1.57 MB, 6/30/2016)

Click column headings to sort; Type in the "Search" box to query table contents.

Updated: 8/3/2018

All events | ATMS | CrIS | VIIRS | OMPS

Show 30 entries Search:

Event	Date	Time (UTC)	End (UTC)	Instrument(s)	Retrieved From	CCR	Notes
Drag Make-Up Maneuver (DMU) (28)	7/17/18	16:10	16:23	ACOV	OSPO Planning Calendar	---	Slew: 16:10:00-16:23:04z, 0.7s Burn: 16:16:00:00-16:16:00:70z, OMPS Decon: 16:00-16:27:06z
Block 2.1_Mx2 Transition to Operations	7/2/18	14:50	-:--	ACOV	C/V Leads Archive	---	---
Roll Maneuver for VIIRS Lunar Calibration	5/25/18	4:59	5:07	ACOV	OSPO Planning Calendar	---	04:59:34-05:06:33z, Center of Dwell 05:03:04, -2.13 degrees
Block 2.1_Mx1 Transition to Operations	4/30/18	14:35	-:--	ACOV	C/V Leads Archive	---	---
Roll Maneuver for VIIRS Lunar Calibration	4/25/18	19:25	19:37	ACOV	OSPO Planning Calendar	---	19:25:34-19:37:34z, Center of Dwell 19:30:34z, -3.06 degrees
Block 2.1_Mx0 Transition to Operations	3/5/18	17:00	-:--	ACOV	C/V Leads Archive	---	---
Drag Make-up Maneuver (DMU) (27)	2/28/18	17:49	18:02	ACOV	C/V Leads Archive	---	No Slew, 17:48:59-18:02:03, Burn: 17:54:59-17:55:01, OMPS Decon 17:38:59-18:06:03
Roll Maneuver for VIIRS Lunar Calibration	2/26/18	5:34	5:40	ACOV	C/V Leads Archive	---	-1.13 degrees
Roll Maneuver for VIIRS Lunar Calibration	1/27/18	20:08	20:20	ACOV	C/V Leads Archive	---	Center of Dwell at 20:13:15, -4.223 degrees
SCC Clock Slope Update	1/24/18	-:--	-:--	ACOV	NPP ATR	---	---

Easy to find anomalies from STAR ICVS

Future Activities

- ✓ Keep analyzing post-launch data, such as pitch maneuver, active geolocation, lunar intrusion, and so on, to better characterize NOAA-20 ATMS on orbit performance
- ✓ Implement key instrument performance and data quality monitoring packages for long term trending (much already available on NOAA/STAR ICVS website)
- ✓ Further improvements in TDR & SDR algorithms
- ✓ Switch to active geolocation?
- ✓ Support data product end users, antenna pattern model for radiance assimilation
- ✓ Write users manual
- ✓ JPSS-2 ATMS pre-launch preparation

NOAA-20 ATMS First Light Image
(First Light Image for the Entire JPSS Series)

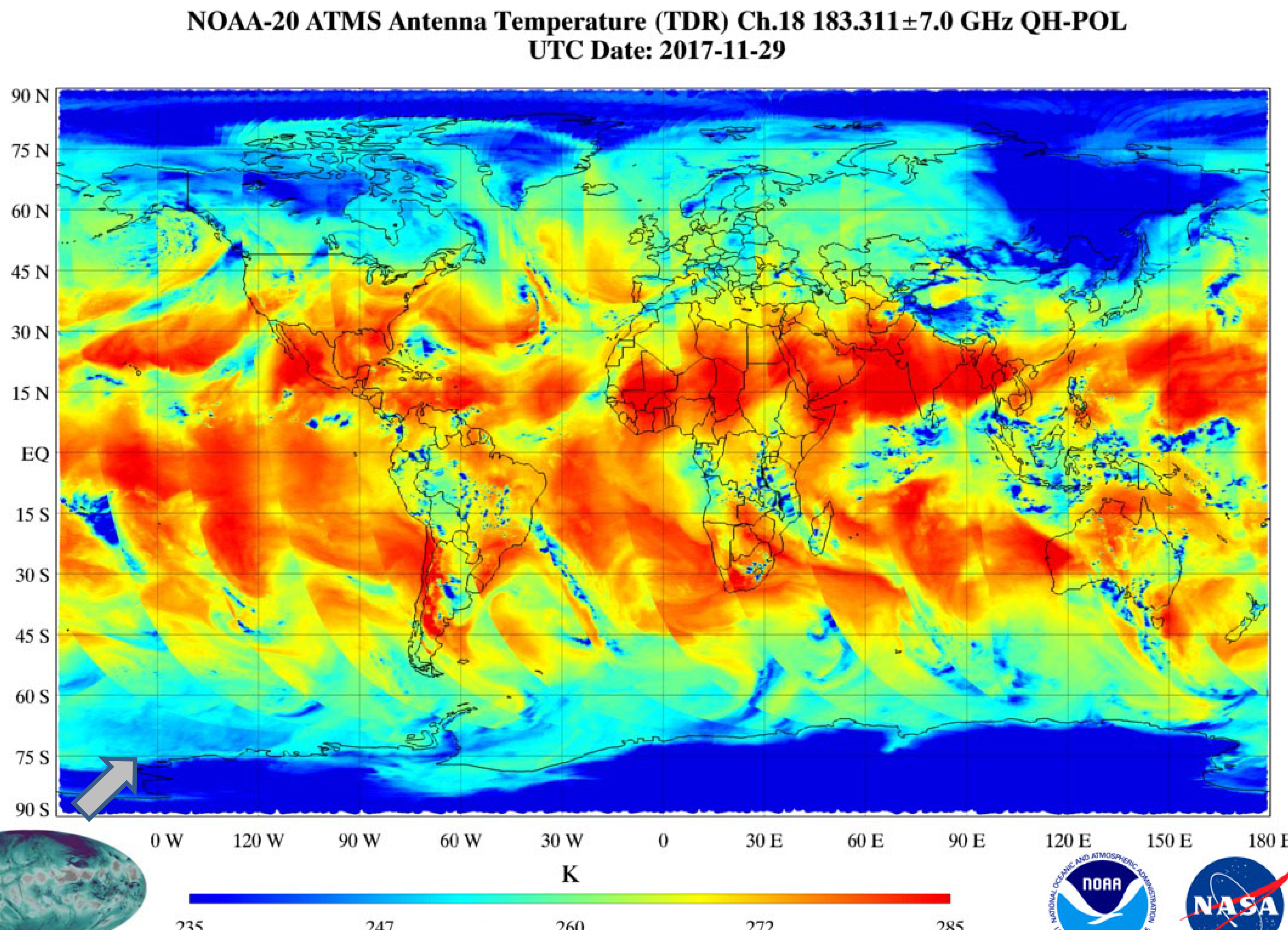
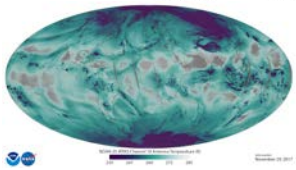


Image from NOAA STAR



ATMS Cal/Val Team Members

PI	Organization	Team Members	Roles and Responsibilities
Quanhua (Mark) Liu	NOAA/STAR	Ninghai Sun (technical lead), Hu Yang, Xiaolei Zou, Lin Lin	Project management, SDR team coordination and algorithm test in IDPS, ATMS calibration/validation and geolocation science support, ATMS TDR/SDR data quality and monitoring
Edward Kim	NASA	Craig Smith, Joseph Lyu, Lisa McCormick	Liaison NASA flight team and NG Azusa, and independent SDR assessments, manage PLT and data analyze
Vince Leslie	MIT/LL	Idahosa Osaretin, Mark Tolman	ATMS instrument performance and data quality assessments, PLT data evaluation
Wesley Berg	CSU/CIRA		ATMS and GPM WG band cross-calibration
Deirdre Bolen	JPSS/JAM		ADR/PCR support

ATMS Instrument Specifications

Ch.	Center Freq.(MHz)	POL	Bandwidth Max. (MHz)	Frequency Stability (MHz)	Calibration Accuracy (K)	NEΔT (K)	3-dB Bandwidth (deg)	Remarks	Characterization at Nadir
1	23800	QV	270	10	1.0	0.7	5.2	AMSU-A2	Window-water vapor 100 mm
2	31400	QV	180	10	1.0	0.8	5.2	AMSU-A2	Window-water vapor 500 mm
3	50300	QH	180	10	0.75	0.9	2.2	AMSU-A1-2	Window-surface emissivity
4	51760	QH	400	5	0.75	0.7	2.2		Window-surface emissivity
5	52800	QH	400	5	0.75	0.7	2.2	AMSU-A1-2	Surface air
6	53596±115	QH	170	5	0.75	0.7	2.2	AMSU-A1-2	4 km ~ 700 mb
7	54400	QH	400	5	0.75	0.7	2.2	AMSU-A1-1	9 km ~ 400 mb
8	54940	QH	400	10	0.75	0.7	2.2	AMSU-A1-1	11 km ~ 250 mb
9	55500	QH	330	10	0.75	0.7	2.2	AMSU-A1-2	13 km ~ 180 mb
10	57290.344(f_o)	QH	330	0.5	0.75	0.75	2.2	AMSU-A1-1	17 km ~ 90 mb
11	f_o± 217	QH	78	0.5	0.75	1.2	2.2	AMSU-A1-1	19 km ~ 50 mb
12	f_o±322.2±48	QH	36	1.2	0.75	1.2	2.2	AMSU-A1-1	25 km ~ 25 mb
13	f_o±322.2±22	QH	16	1.6	0.75	1.5	2.2	AMSU-A1-1	29 km ~ 10 mb
14	f_o±322.2±10	QH	8	0.5	0.75	2.4	2.2	AMSU-A1-1	32 km ~ 6 mb
15	f_o±322.2±4.5	QH	3	0.5	0.75	3.6	2.2	AMSU-A1-1	37 km ~ 3 mb
16	88200	QV	2000	200	1.0	0.5	2.2	89000	Window H_2O 150 mm
17	165500	QH	3000	200	1.0	0.6	1.1	157000	H_2O 18 mm
18	183310±7000	QH	2000	30	1.0	0.8	1.1	AMSU-B	H_2O 8 mm
19	183310±4500	QH	2000	30	1.0	0.8	1.1		H_2O 4.5 mm
20	183310±3000	QH	1000	30	1.0	0.8	1.1	AMSU-B/MHS	H_2O 2.5 mm
21	183310±1800	QH	1000	30	1.0	0.8	1.1		H_2O 1.2 mm
22	183310±1000	QH	500	30	1.0	0.9	1.1	AMSU-B/MHS	H_2O 0.5 mm