Suomi NPP SDR Science and Products Review
ATMS SDR Data Quality

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Suomi NPP SDR Validated Product Review

NOAA Center for Weather and Climate Prediction (NCWCP)

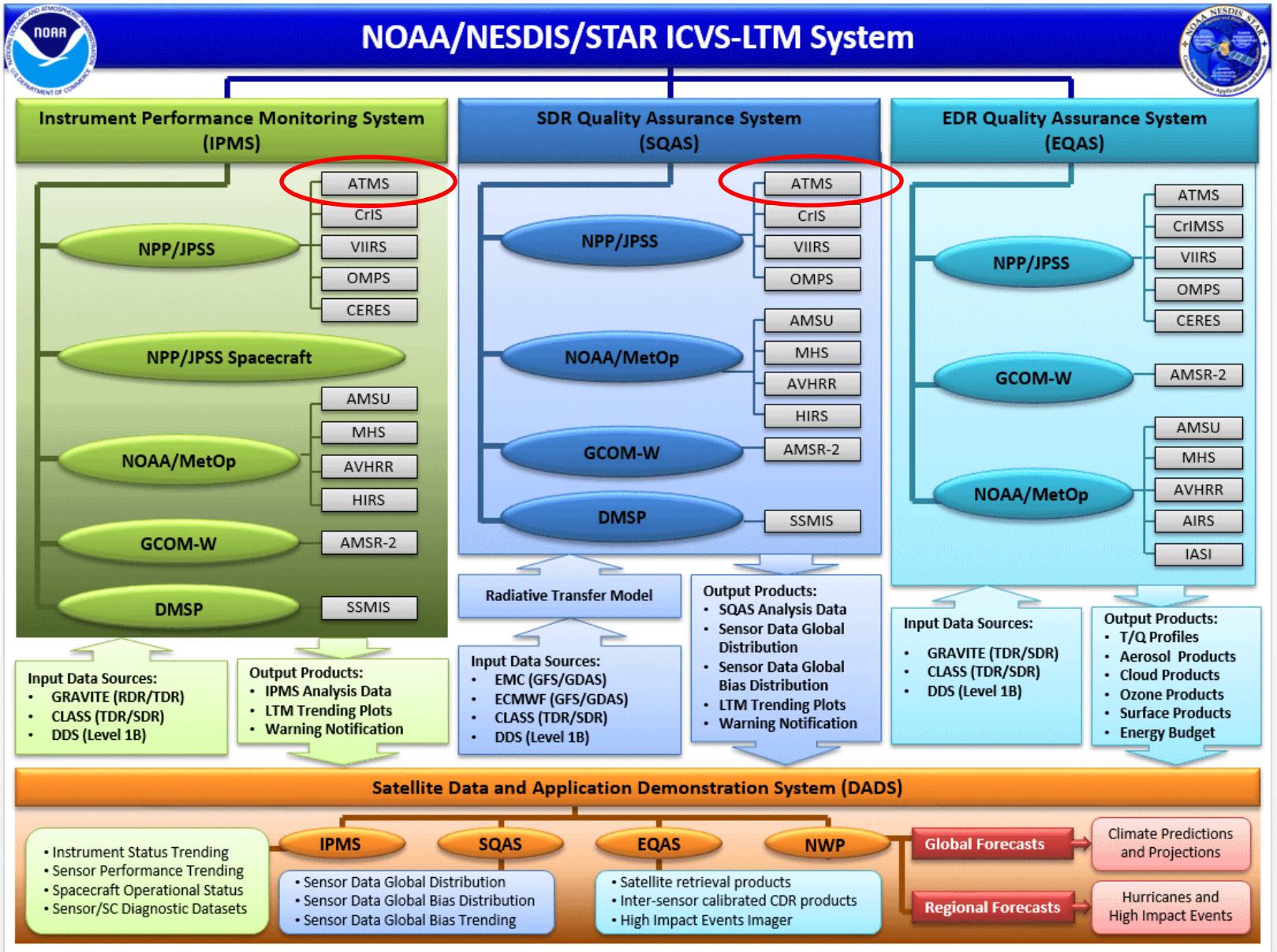
5830 University Research Park, College Park, Maryland

December 18 - 20, 2013

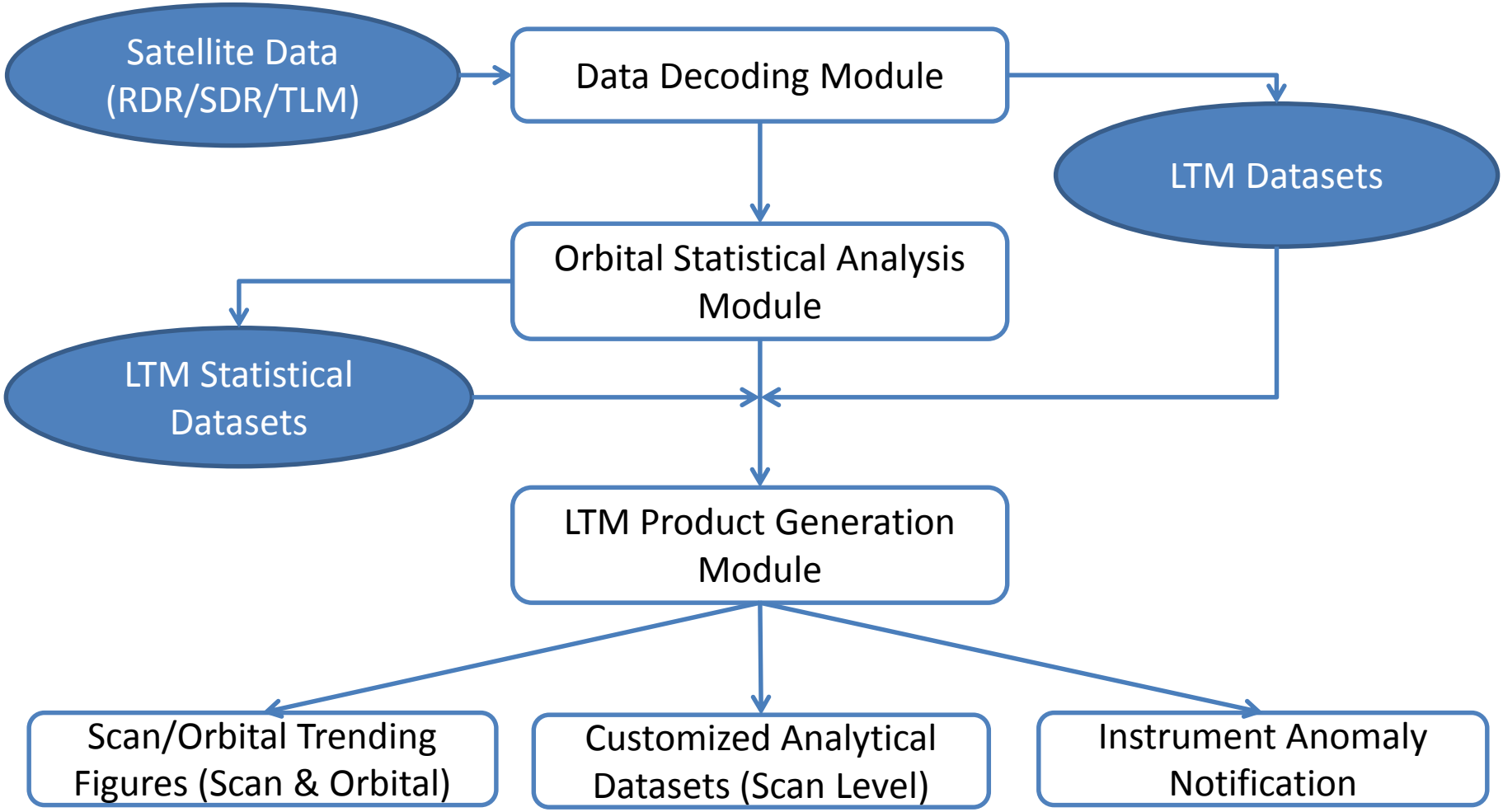
Outlines

- Introduction to STAR ICVS-LTM for ATMS
- Accomplishments Since Provisional Review
- ATMS Instrument Status and Data Quality Report
- Summary and Future Plan

Outlines

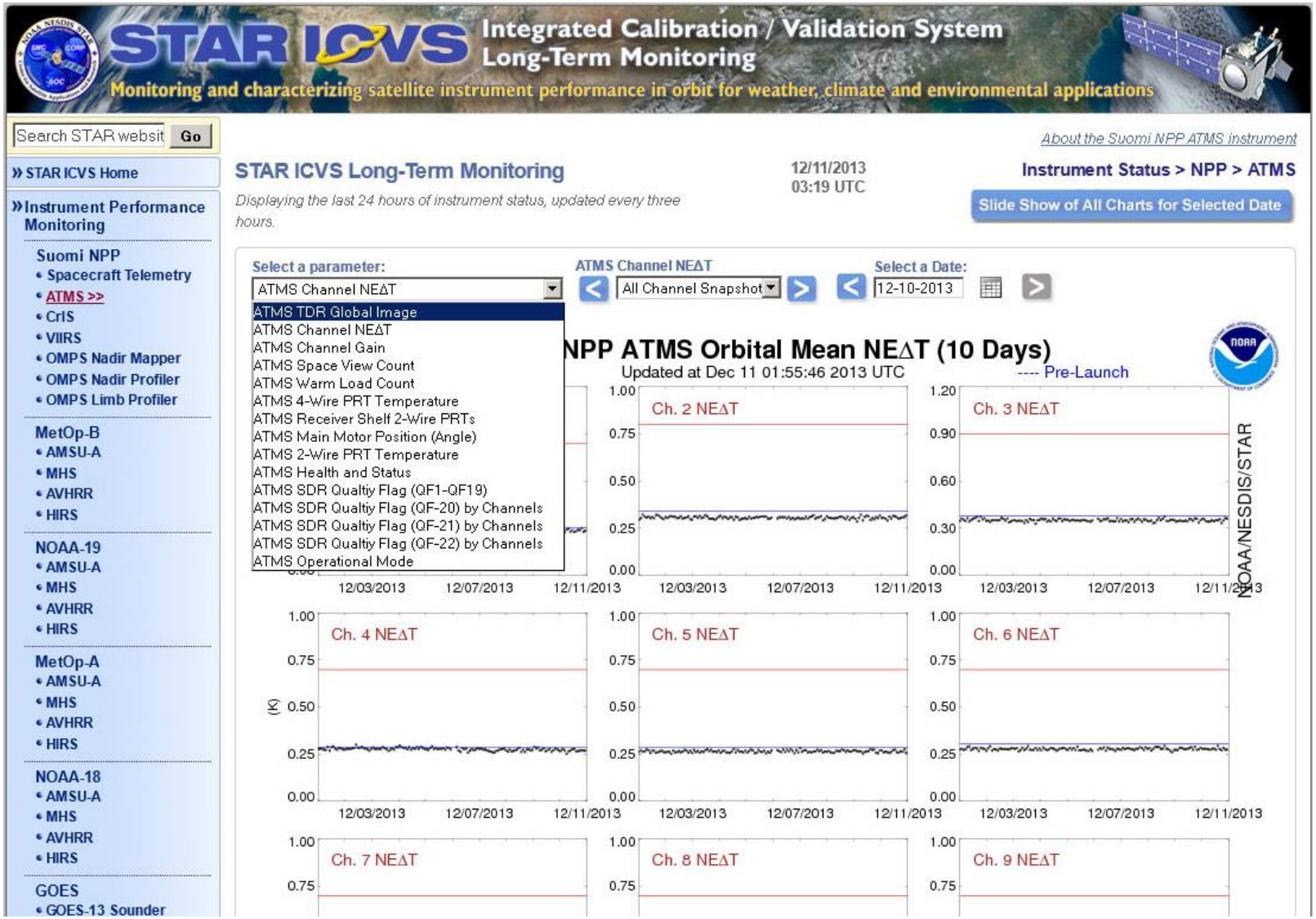

NOAA/NESDIS/STAR ICVS-LTM System
Instrument Performance Monitoring System (IPMS)
ATMS
CrIS
VIIRS
OMPS
CERES
NPP/JPSS
NPP/JPSS Spacecraft
AMSU
MHS
AVHRR
HIRS
NOAA/MetOp
GCOM-W
AMSR-2
DMSP
SSMIS
Input Data Sources:
• GRAVITE (RDR/TDR)
• CLASS (TDR/SDR)
• DDS (Level 1B)
Output Products:
• IPMS Analysis Data
• LTM Trending Plots
• Warning Notification
SDR Quality Assurance System (SQAS)
ATMS
CrIS
VIIRS
OMPS
NPP/JPSS
AMSU
MHS
AVHRR
HIRS
NOAA/MetOp
AMSR-2
GCOM-W
SSMIS
DMSP
Radiative Transfer Model
Input Data Sources:
• EMC (GFS/GDAS)
• ECMWF (GFS/GDAS)
• CLASS (TDR/SDR)
• DDS (Level 1B)
Output Products:
• SQAS Analysis Data
• Sensor Data Global Distribution
• Sensor Data Global Bias Distribution
• LTM Trending Plots
• Warning Notification
EDR Quality Assurance System (EQAS)
ATMS
CrIMSS
VIIRS
OMPS
CERES
NPP/JPSS
AMSR-2
GCOM-W
AMSU
MHS
AVHRR
AIRS
IASI
NOAA/MetOp
Input Data Sources:
• GRAVITE (TDR/SDR)
• CLASS (TDR/SDR)
• DDS (Level 1B)
Output Products:
• T/Q Profiles
• Aerosol Products
• Cloud Products
• Ozone Products
• Surface Products
• Energy Budget
Satellite Data and Application Demonstration System (DADS)
• Instrument Status Trending
• Sensor Performance Trending
• Spacecraft Operational Status
• Sensor/SC Diagnostic Datasets
IPMS
SQAS
EQAS
NWP
• Sensor Data Global Distribution
• Sensor Data Global Bias Distribution
• Sensor Data Global Bias Trending
• Satellite retrieval products
• Inter-sensor calibrated CDR products
• High Impact Events Imager
Global Forecasts
Regional Forecasts
Climate Predictions and Projections
Hurricanes and High Impact Events

Introduction to ICVS-LTM for ATMS



Introduction to ICVS-LTM for ATMS

http://www.star.nesdis.noaa.gov/icvs/status_NPP_ATMS.php



Introduction to ICVS-LTM for ATMS

Parameters	Descriptions	Dimensions	Purpose
Channel NEΔT	Noise equivalent differential temperature	22 channels	sensitivity trending
Warm Count	Warm target count	4 readings/channel 22 channels	Onboard calibration target trending
Space view Count	Space view count	4 readings/channel 22 channels	Onboard calibration target trending
Channel Gain	Calibration gains for each channel	22 channels	Calibration trending
4-Wire PRT Temperature	Warm load platinum resistance thermometer (PRT) temperature	2 bands	Stability trending
2-Wire PRT Temperatures	Receiver shelf temperature, Scan drive mechanism temperature, IF module temperature, etc.	31 temps	Instrument health status
Instrument telemetry	Scan drive power supply voltage, Receiver voltage, etc.	36 parameters	Instrument health status
Scan Angle	Scan Drive Main Motor Position (Angle)	25 positions	Scan Dive Main Motor stability
TDR Global Images	TDR global images (ascending and descending)	22 channels	SDR data quality
SDR Quality Flags	Granule level, scan level, and channel level quality flag	19 scan level 3 channel level (22*3)	SDR data quality
Spacecraft Maneuver / ATMS Operational Mode	Detect spacecraft maneuver and ATMS working mode	2 scan level	Instrument status

Accomplishments

LTM for ATMS system enhancements and New Capability:

- Added daily ATMS instrument status and performance monitoring
- Provide Daily Analytic Data Files for Users
- Add scan drive main motor related parameters and scan angle monitoring
- Add ATMS SDR quality flag global distribution and time series monitoring
- Update ATMS SDR data quality (O-B) bias monitoring
- Update ICVS-LTM for ATMS web pages

Instrument Health and Status

ATMS instrument channel sensitivity (NEΔT) meet specification since launch

Noise Equivalent Differential Temperature (NEΔT)

$$NE\Delta T = \frac{\sqrt{\frac{1}{N_s \times 4}\sum_{i=1}^{N_s}\sum_{j=1}^{4}[C^w(i,j)-\overline{C^w}]^2}}{\frac{1}{N_s}\sum_{i=1}^{N_s}\frac{\overline{C^w(i)}-\overline{C^c(i)}}{\overline{T_b^w(i)}-T_b^c}}$$

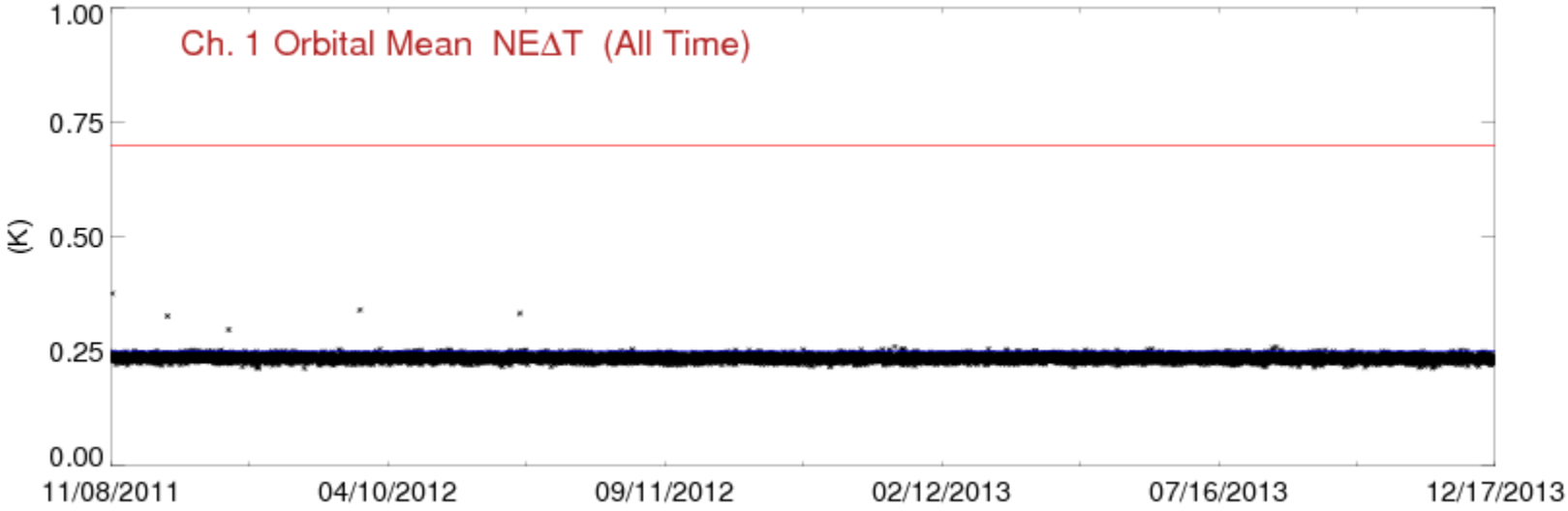
T_b^w PRT Temperature

T_b^c Cosmic Background Temperature

$\overline{C^w}$ Averaged Hot Load Count

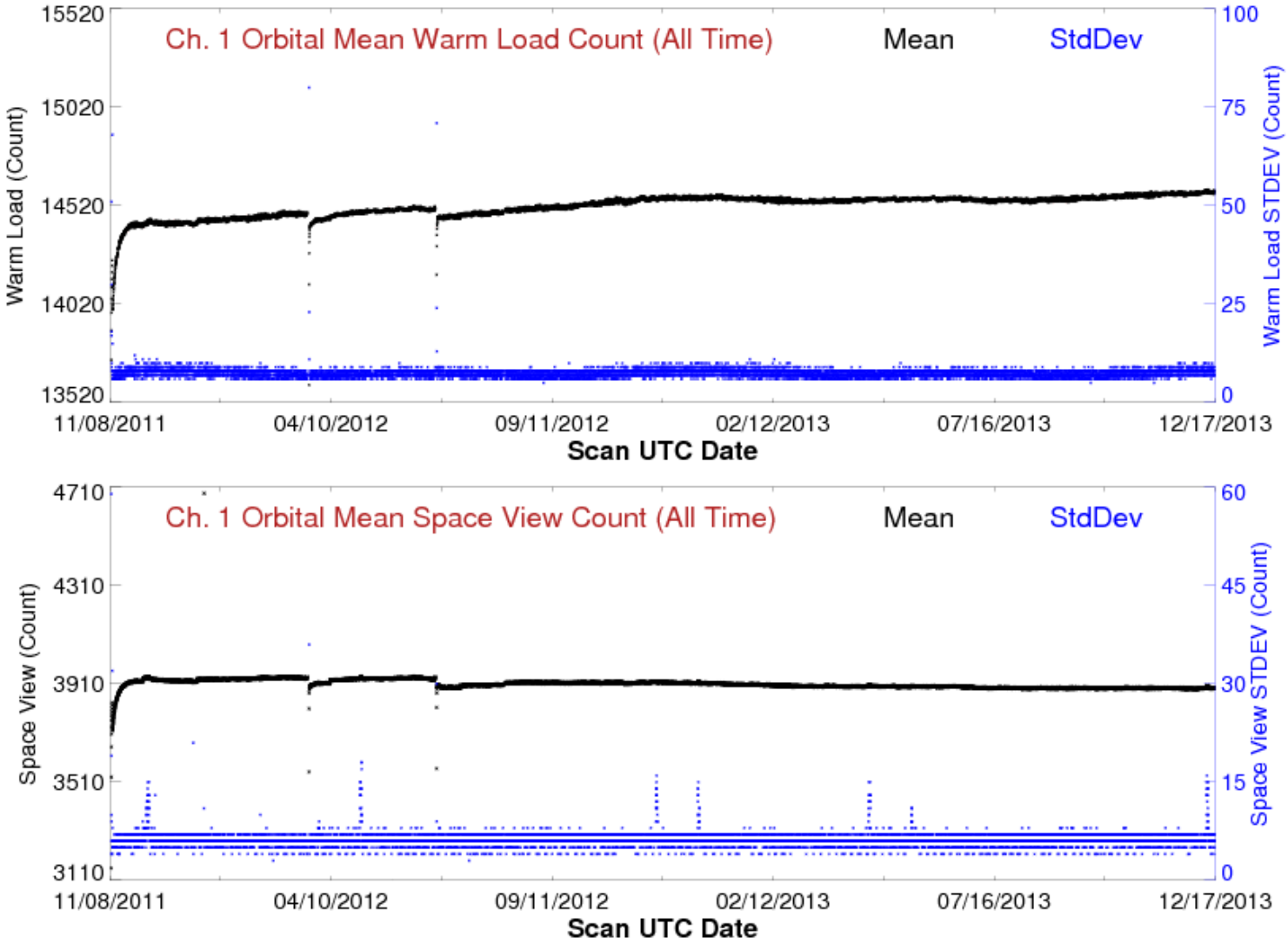
$\overline{C^c}$ Averaged Cold Space View Count

N_s The number of smoothing scan lines



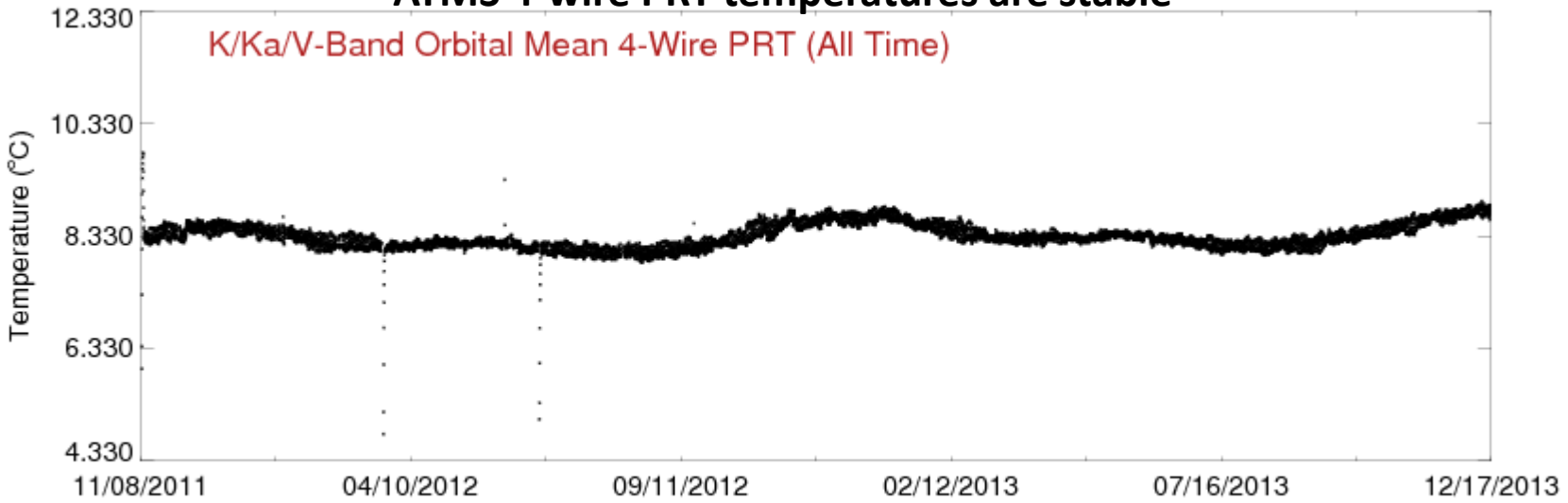
Instrument Health and Status

ATMS space view cold count and warm load count are stable

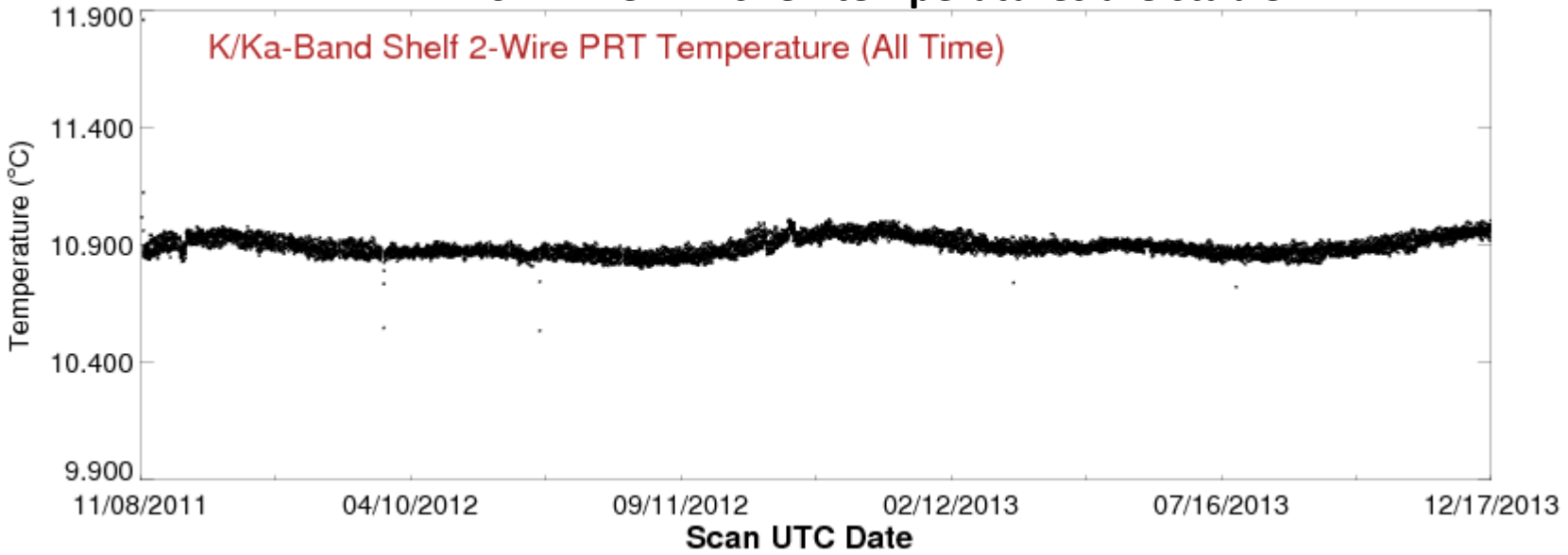


Instrument Health and Status

ATMS 4-wire PRT temperatures are stable

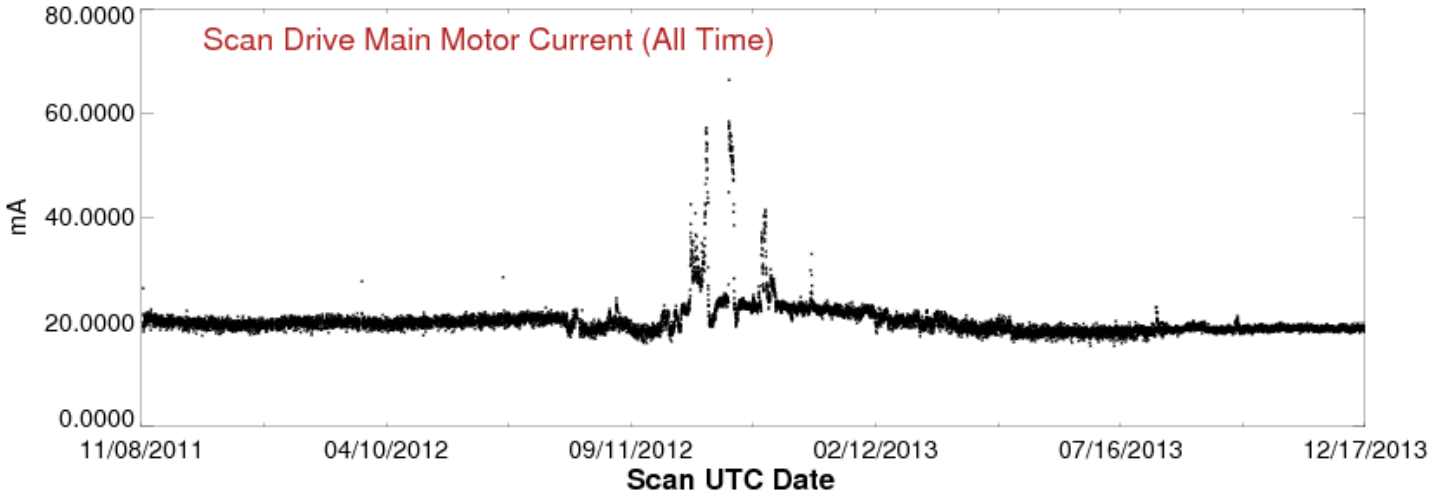


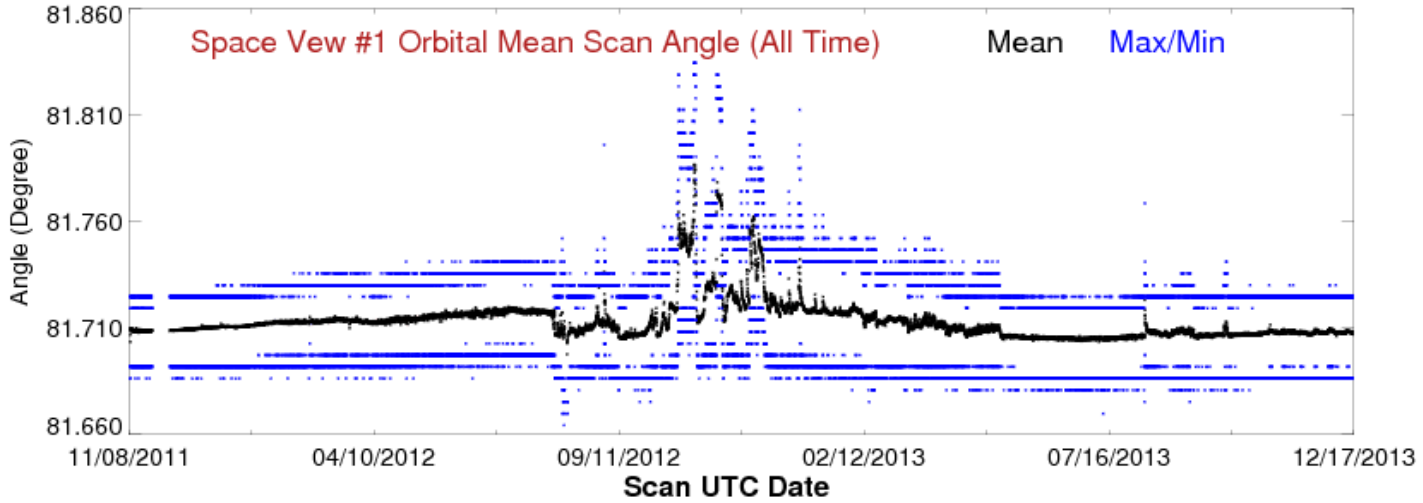
ATMS 2-wire PRT shelf temperatures are stable



Instrument Health and Status

ATMS scan drive main motor current anomaly detected (within red lines)





ATMS SDR Data Quality Flag

Granule QF-1	Granule QF-2	Granule QF-3	Granule QF-4
SPA_P5V_A/B_VMON	RCV_P15V_ANA_VMON	W_RFE_PRT	G2_IF_PRT
SPA_P15V_A/B_VMON	RCV_N15V_ANA_VMON	SAW_FILT_PRT	W_SHELF_PRT
SPA_N15V_A/B_VMON	K_RFE_PRT	W_IF_PRT	KKA_SHELF_PRT
RCV_P6V_RF_VMON	KA_RFE_PRT	W_PRI_GDO_PRT	G_SHELF_PRT
RCV_P12V_RF2_VMON	V_RFE_PRT	W_RED_GDO_PRT	V_SHELF_PRT
RCV_P15V_RF_VMON	V_PRI_PLO_PRT	G_PRI_GDO_PRT	RCVPS_A_PRT
RCV_N15V_RF_VMON	V_RED_PLO_PRT	G_RED_GDO_PRT	RCVPS_B_PRT
	V_IF_PRT	G1_IF_PRT	OCXO_PRI_PRT

Granule QF-5	Granule QF-6	Granule QF-7	Granule QF-8
OCXO_RED_PRT	SD_PS_PRT	VD_REF_A_MOD2	SD_P12V_VMON
DSPA_1553_PRT	V_PLO_A_LOCK_VMON	VD_REF_A_MOD3	SD_N12V_VMON
DSPB_1553_PRT	V_PLO_B_LOCK_VMON	VD_REF_A_MOD4	MAIN_MOTOR_CUR
SPA_PS_A_PRT	HK_2WREST1_A	VD_GND_A_MOD1	COMP_MOTOR_CUR
SPA_PS_B_PRT	HK_2WREST2_A	VD_GND_A_MOD2	RESOLVER_VMON
DSPA_PROC_PRT	4W_GND_A	VD_GND_A_MOD3	SD_MAIN_MOTOR_VEL
DSPB_PROC_PRT	2W_GND_A	VD_GND_A_MOD4	SD_COMP_MOTOR_VEL
SD_MECH_TEMP	VD_REF_A_MOD1	SD_P5V_VMON	SD_MAIN_LOOP_ERROR

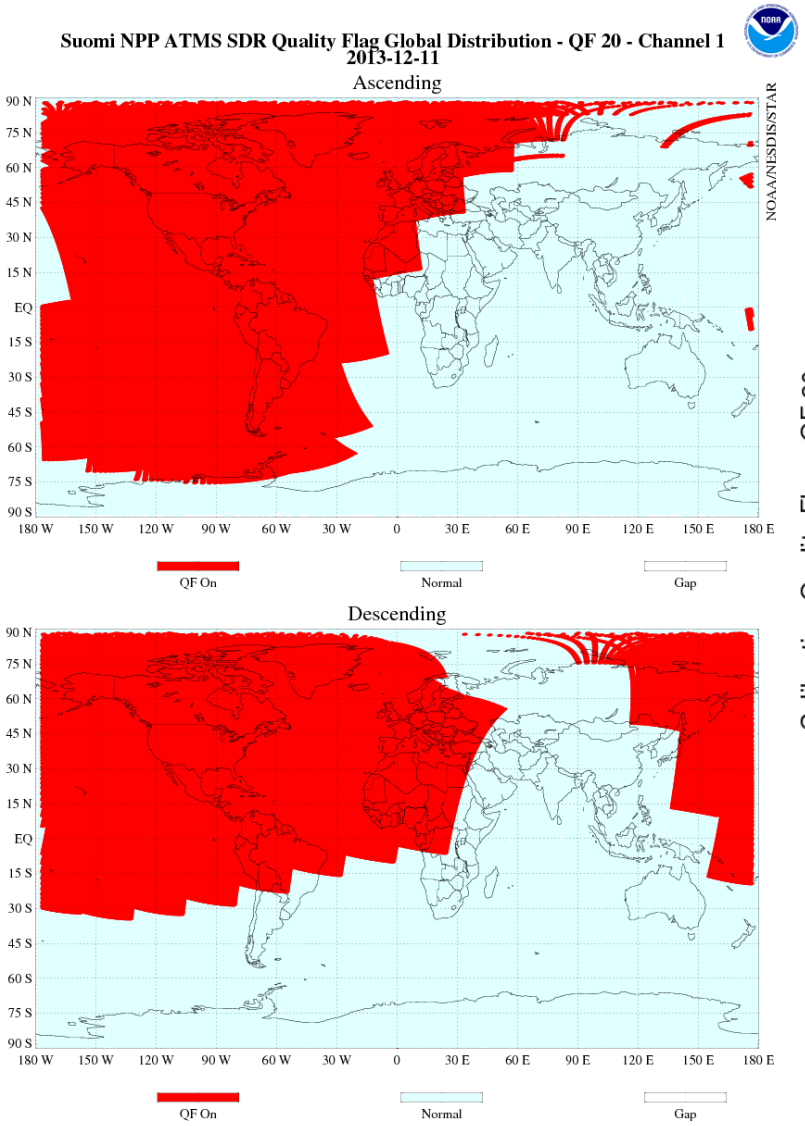
Granule QF-9	Granule QF-11	Scan QF-12	Scan QF-13
SD_MAIN_LOOP_INT_ERROR	Quadratic Correction On	KAV PRT #1 Conversion Error	WG PRT #1 Conversion Error
SD_MAIN_LOOP_VEL_ERROR		KAV PRT #2 Conversion Error	WG PRT #2 Conversion Error
SD_COMP_LOOP_ERROR		KAV PRT #3 Conversion Error	WG PRT #3 Conversion Error
SD_MAIN_MOTOR_REQ_VOLTAGE		KAV PRT #4 Conversion Error	WG PRT #4 Conversion Error
SD_COMP_MOTOR_REQ_VOLTAGE		KAV PRT #5 Conversion Error	WG PRT #5 Conversion Error
SD_FEED_FORWARD_VOLTAGE		KAV PRT #6 Conversion Error	WG PRT #6 Conversion Error
COMP_MOTOR_POS		KAV PRT #7 Conversion Error	WG PRT #7 Conversion Error
		KAV PRT #8 Conversion Error	

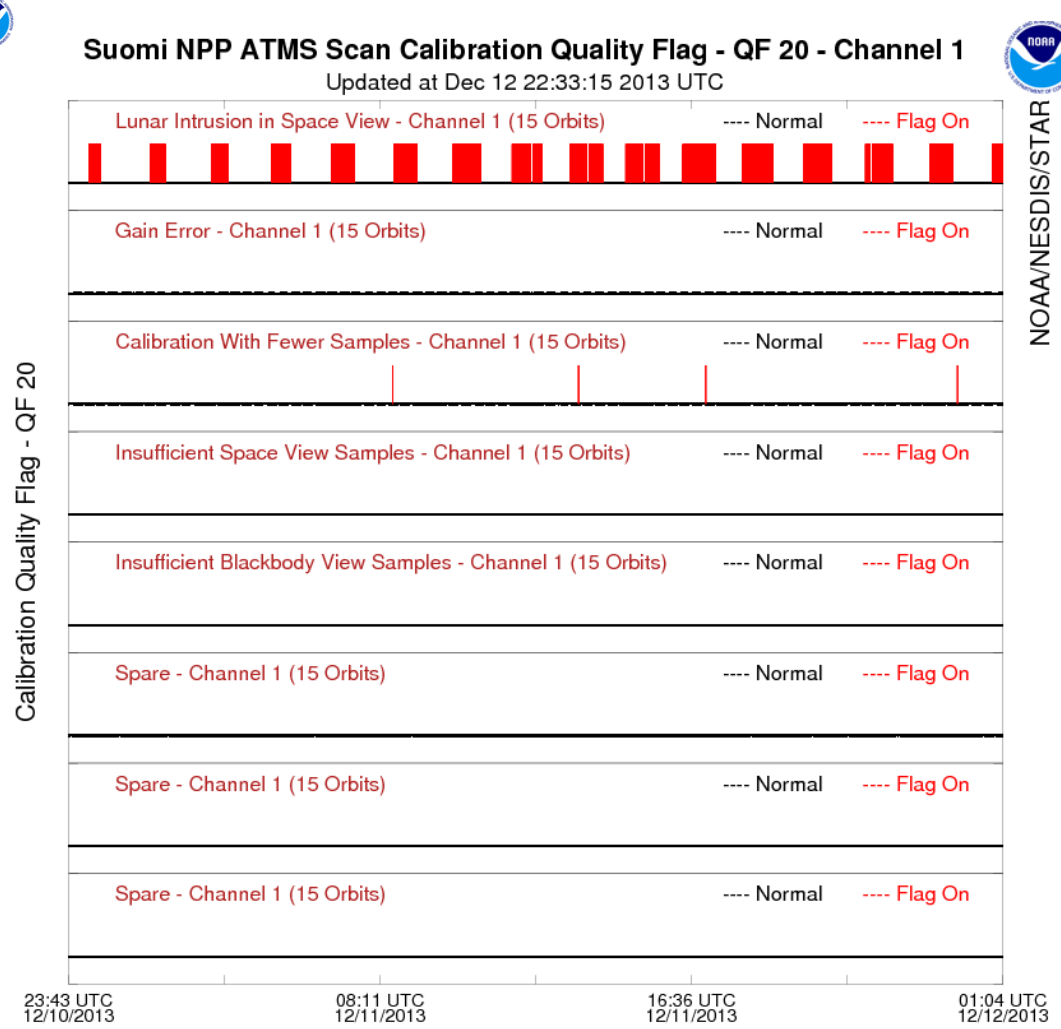
ATMS SDR Data Quality Flag

Scan QF-14	Scan QF-15	Scan QF-16	Scan QF-17
K/Ka-Band Shelf PRT Conversion Error	KAV PRT #1 Out of Range	WG PRT #1 Out of Range	KAV PRT #1 Temperature Inconsistency
V-Band Conversion Error	KAV PRT #2 Out of Range	WG PRT #2 Out of Range	KAV PRT #2 Temperature Inconsistency
W-Band Conversion Error	KAV PRT #3 Out of Range	WG PRT #3 Out of Range	KAV PRT #3 Temperature Inconsistency
G-Band Conversion Error	KAV PRT #4 Out of Range	WG PRT #4 Out of Range	KAV PRT #4 Temperature Inconsistency
	KAV PRT #5 Out of Range	WG PRT #5 Out of Range	KAV PRT #5 Temperature Inconsistency
	KAV PRT #6 Out of Range	WG PRT #6 Out of Range	KAV PRT #6 Temperature Inconsistency
	KAV PRT #7 Out of Range	WG PRT #7 Out of Range	KAV PRT #7 Temperature Inconsistency
	KAV PRT #8 Out of Range		KAV PRT #8 Temperature Inconsistency
Scan QF-18	**Scan QF-19**	**Scan QF-20 at Channels**	**Scan QF-21 at Channels**
WG PRT #1 Temperature Inconsistency	Time Sequence Error	Lunar Intrusion in Space View	Space View #1 Out of Range
WG PRT #2 Temperature Inconsistency	Data Gap	Gain Error	Space View #2 Out of Rang
WG PRT #3 Temperature Inconsistency	KAV PRT Sufficiency	Calibration With Fewer Samples	Space View #3 Out of Range
WG PRT #4 Temperature Inconsistency	WG PRT Sufficiency	Insufficient Space View Samples	Space View #4 Out of Range
WG PRT #5 Temperature Inconsistency	Space View antenna position error	Insufficient Blackbody View Samples	Blackbody View #1 Out of Range
WG PRT #6 Temperature Inconsistency	Blackbody antenna position error		Blackbody View #2 Out of Range
WG PRT #7 Temperature Inconsistency			Blackbody View #3 Out of Range
			Blackbody View #4 Out of Range
Scan QF-22 at Channels	**Scan Level S/C Status**		
Space View #1 Inconsistency	Spacecraft Maneuver Mode		
Space View #2 Inconsistency	ATMS Operational Mode		
Space View #3 Inconsistency			
Space View #4 Inconsistency			
Blackbody View #1 Inconsistency			
Blackbody View #2 Inconsistency			
Blackbody View #3 Inconsistency			
Blackbody View #4 Inconsistency			

ATMS SDR Data Quality Flag

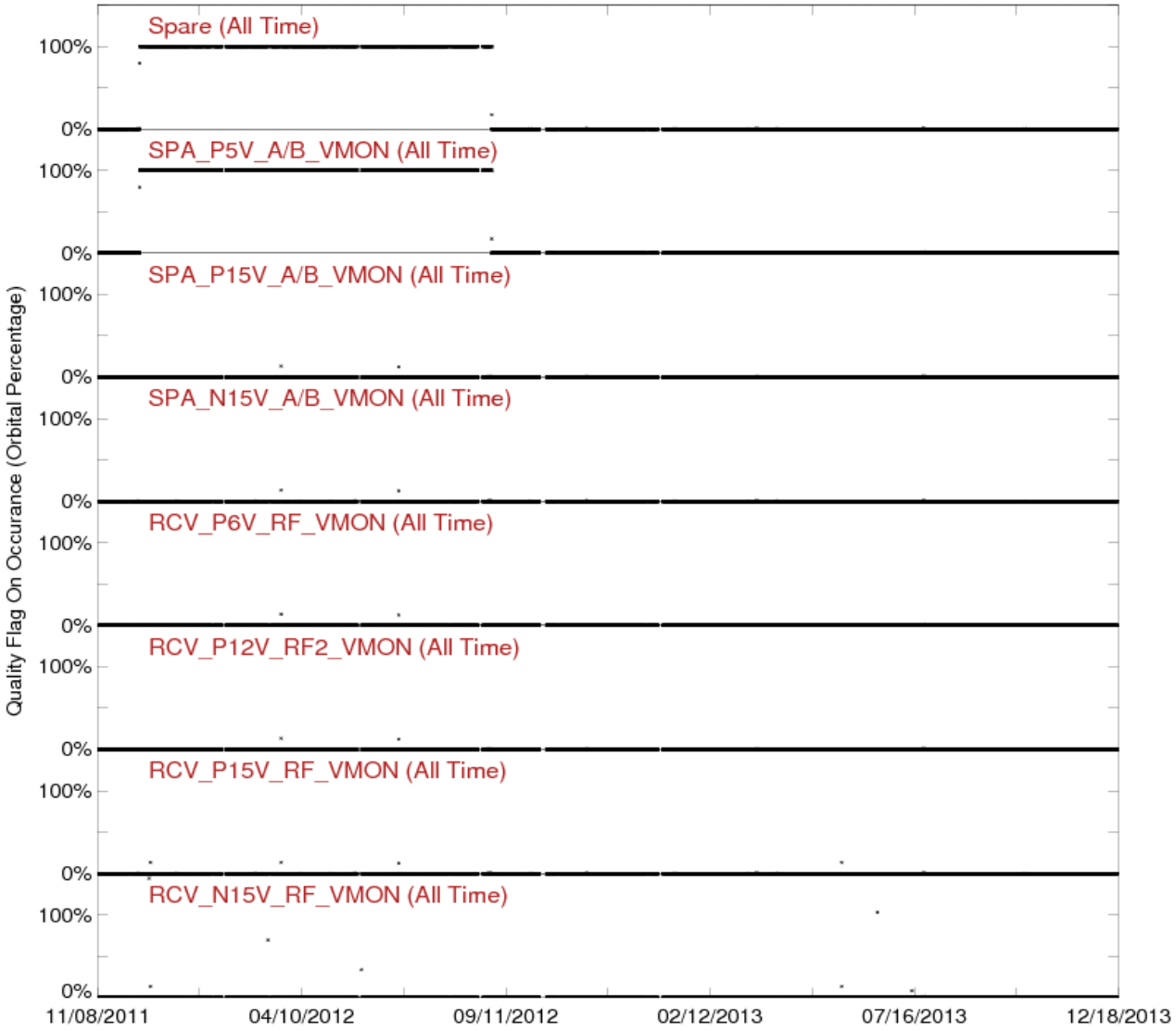
ATMS SDR quality flags for anomaly detection





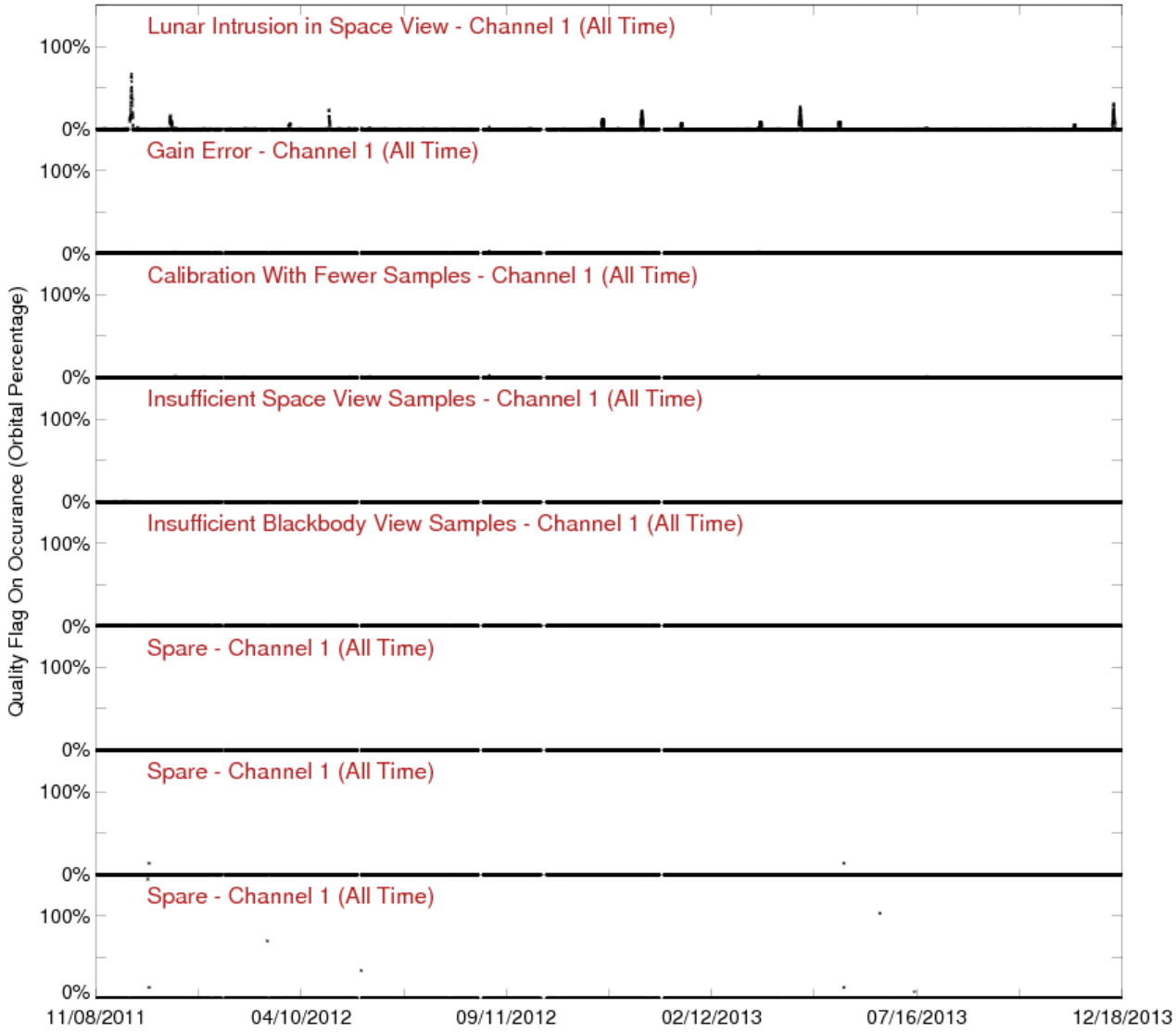
ATMS SDR Data Quality

ATMS SDR quality flags LTM QF-1 ~ QF-19



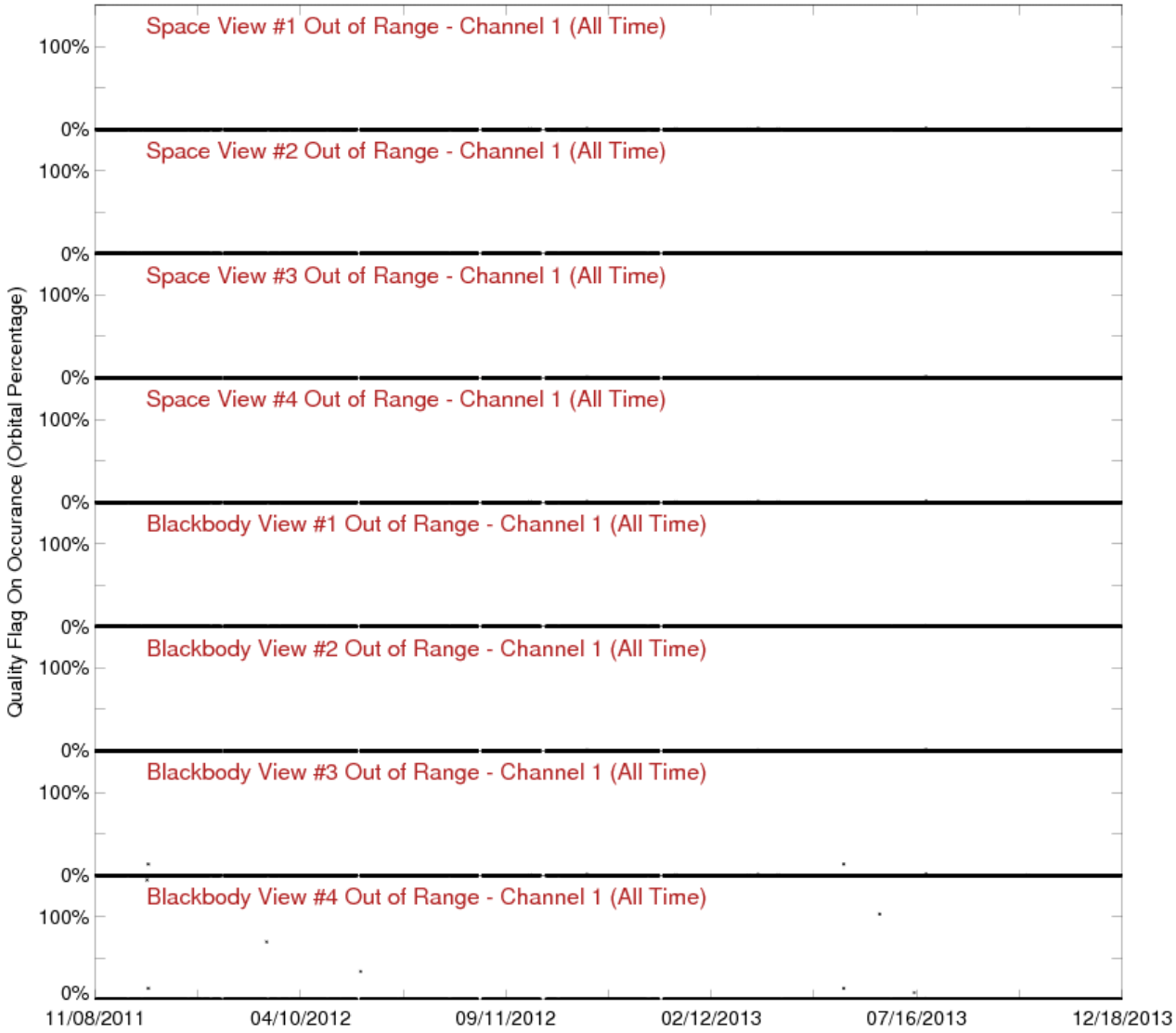
ATMS SDR Data Quality

ATMS SDR quality flags LTM QF-20 Channel 1 ~ 22



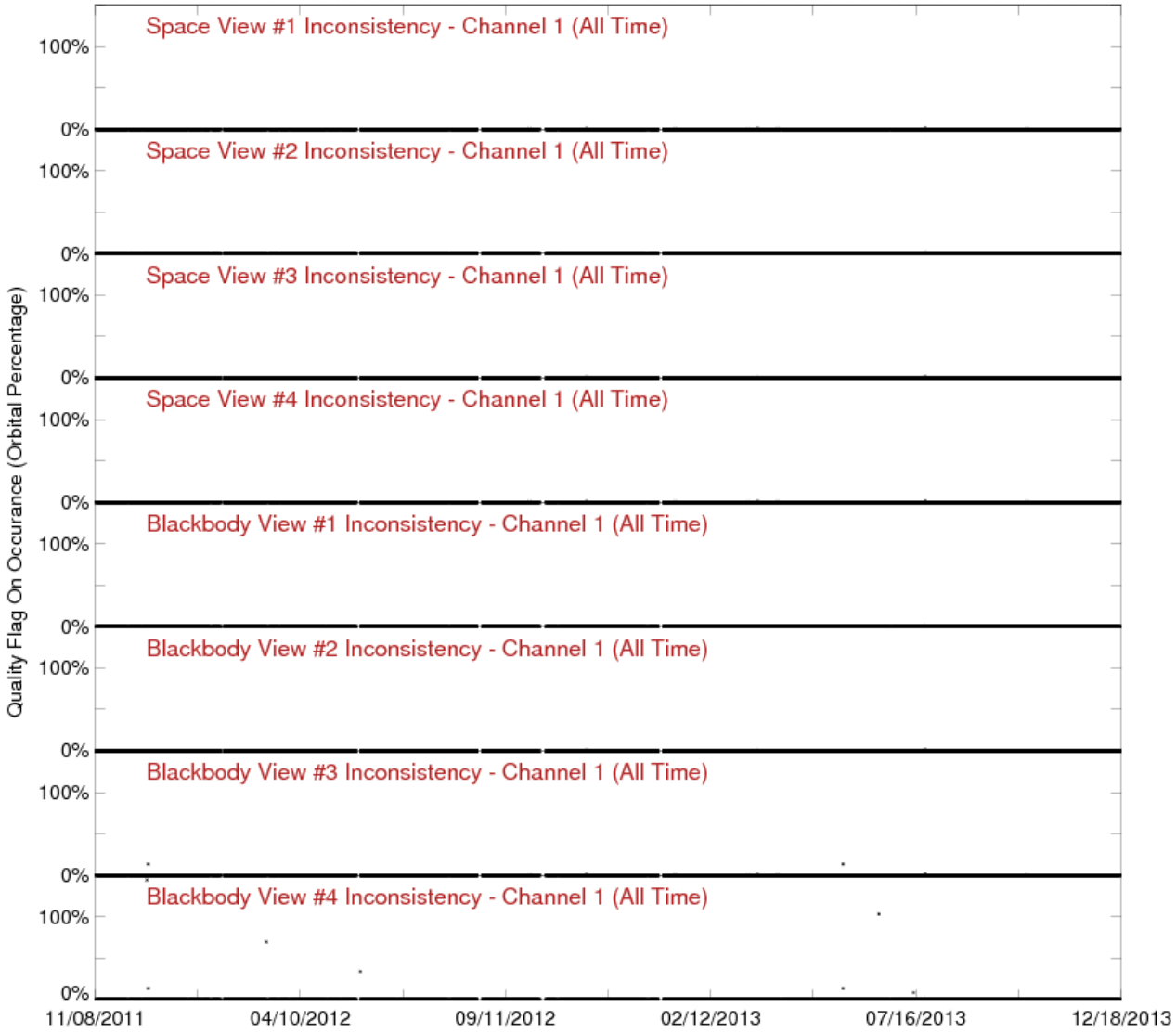
ATMS SDR Data Quality

ATMS SDR quality flags LTM QF-21 Channel 1 ~ 22



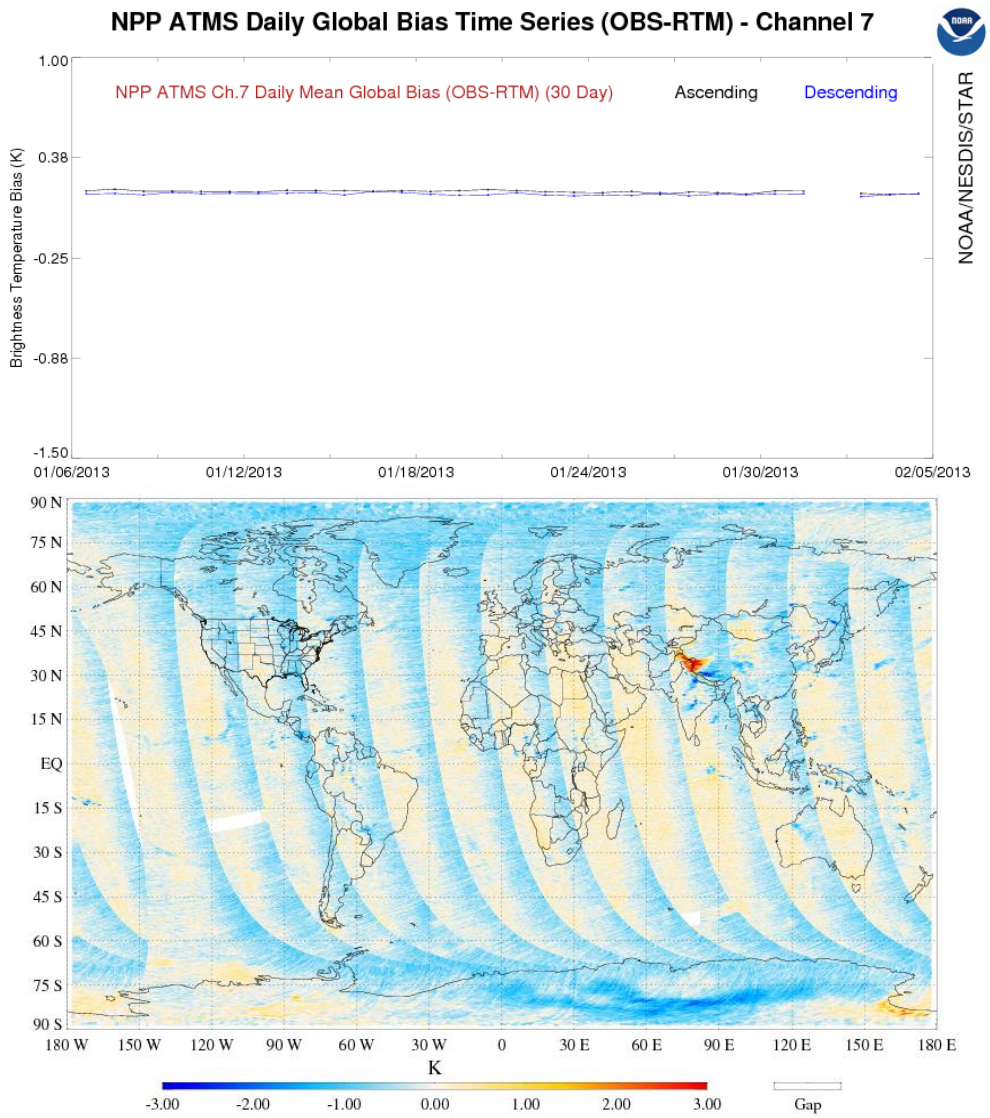
ATMS SDR Data Quality

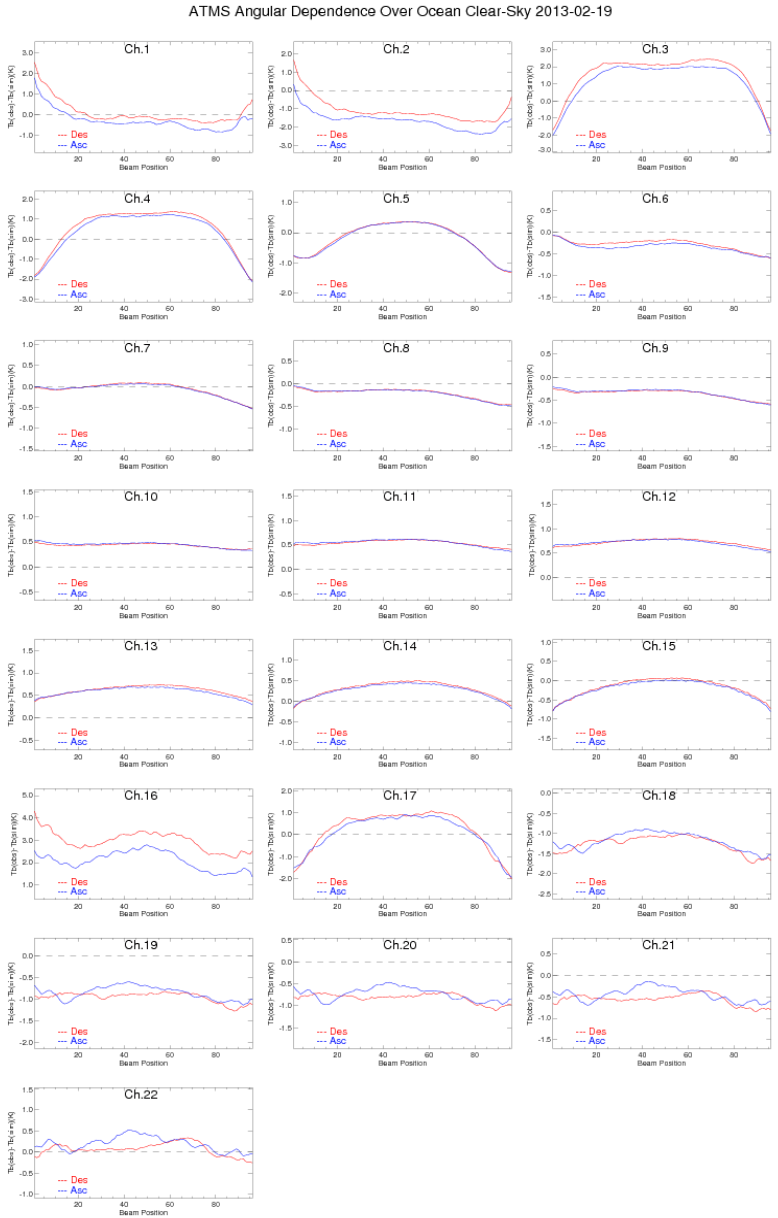
ATMS SDR quality flags LTM QF-22 Channel 1 ~ 22



ATMS SDR Data Quality

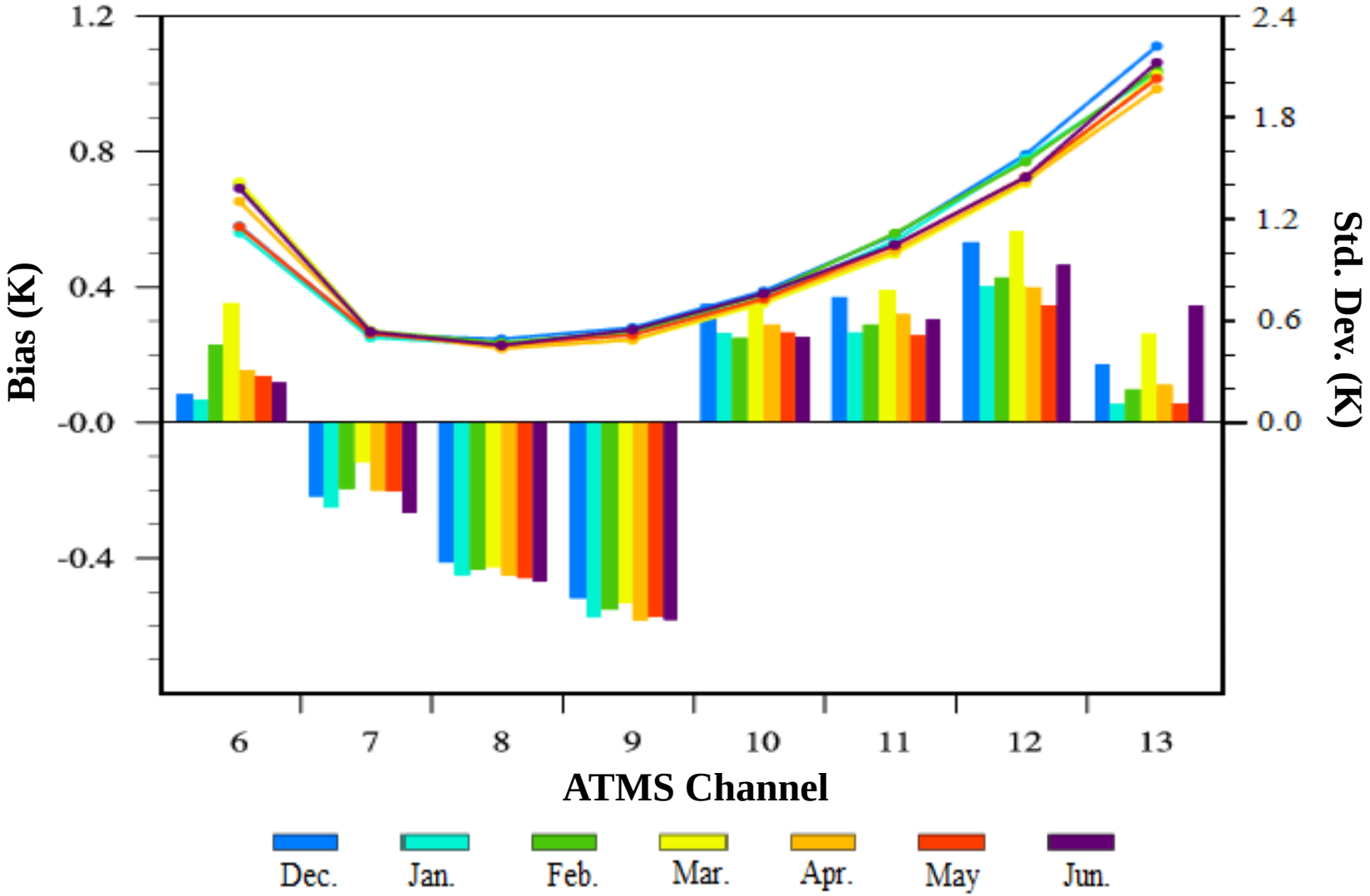
ATMS SDR bias characterization w.r.t. NWP





ATMS SDR Data Quality

ATMS SDR bias characterization w.r.t. GPS RO



Summary and Future Plan

Summary:

- Suomi NPP ATMS on-orbit instrument sensitivity (NEΔT) meet specification since launch
- Suomi NPP ATMS on-orbit SDR bias meet specification since launch

Future Plan:

- Reinforce interaction with users, including SDR teams and Flight Segment
- Reprocess ATMS RDR/TDR/SDR data to produce all daily LTM plots
- Add SDR bias trending monitoring w.r.t. GPS-RO products
- Update existing SDR bias trending monitoring w.r.t. NWP forecast field
- Improve automatic instrument/data quality anomaly notification function
- Provide bi-weekly instrument performance analysis report