Suomi NPP SDR Science and Products Review
Integrated Cal/Val System (ICVS) Instrument Long-Term Monitoring (LTM)

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Center for Satellite Applications and Research
National Environmental Satellite, Data and Information Service

Outline

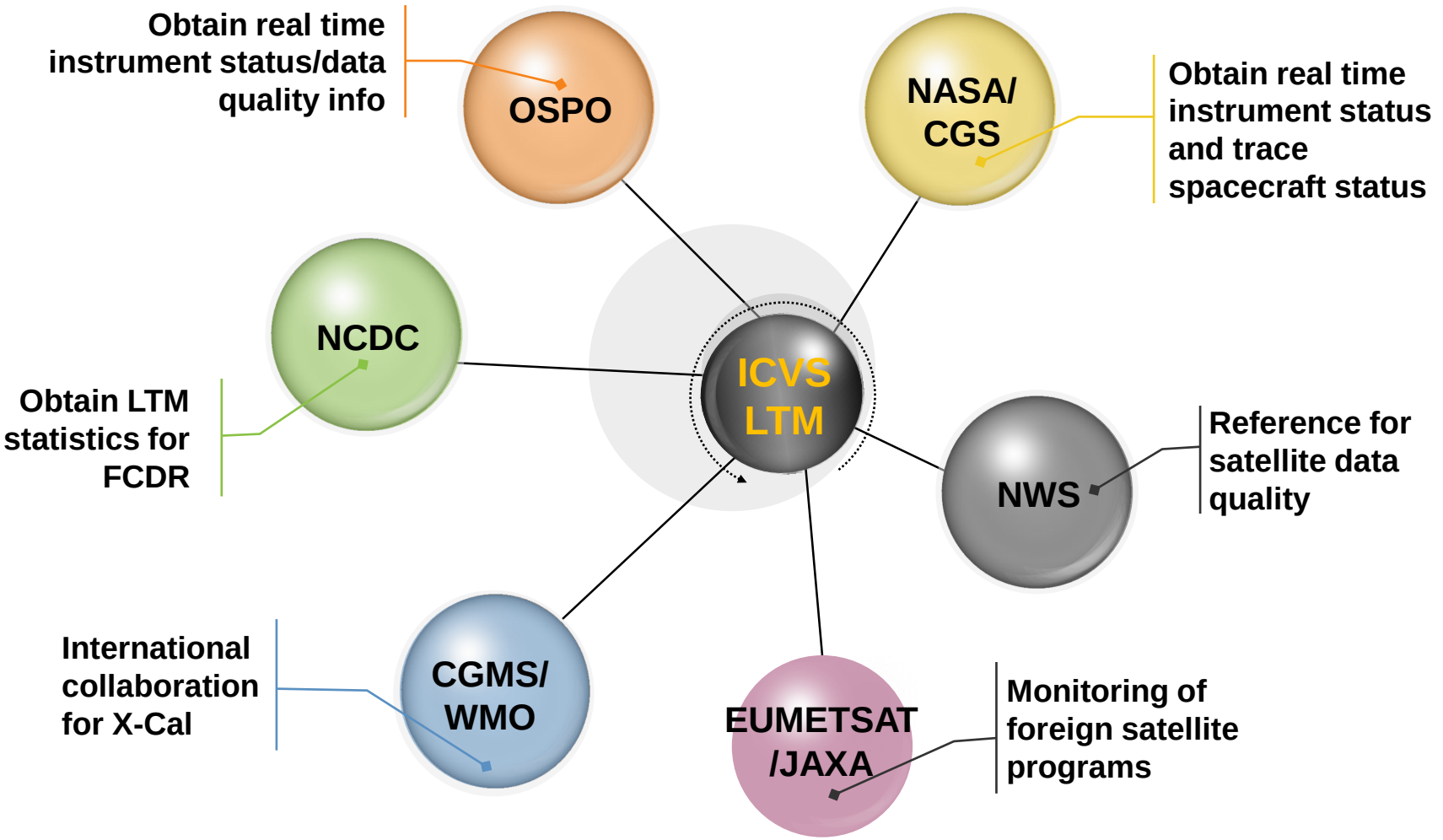


- Objectives
- Primary Users
- System Components/Interface
- Current Status - Demonstration
- Path Forward

Objectives

1. Provide real-time satellite status, instrument performance, and data quality monitoring for operational missions
2. Provide long-term satellite and instrument stability/performance and data quality monitoring for satellite climate change study
3. Provide the root-cause analysis for the instrument anomalies and the recommendation for risk mitigation
4. Support the transition of calibration results to operations

Primary Users



NOAA/NESDIS/STAR ICVS-LTM System

Instrument Performance Monitoring System (IPMS)

- NPP/JPSS
  - ATMS
  - CrIS
  - VIIRS
  - OMPS
  - CERES
- NPP/JPSS Spacecraft
- NOAA/Metop
  - AMSU
  - MHS
  - AVHRR
  - HIRS
- 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)

- NPP/JPSS
  - ATMS
  - CrIS
  - VIIRS
  - OMPS
- NOAA/Metop
  - AMSU
  - MHS
  - AVHRR
  - HIRS
- GCOM-W
  - AMSR-2
- DMSP
  - SSMIS

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)

- NPP/JPSS
  - ATMS
  - CrIMSS
  - VIIRS
  - OMPS
  - CERES
- GCOM-W
  - AMSR-2
- NOAA/Metop
  - AMSU
  - MHS
  - AVHRR
  - AIRS
  - IASI

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

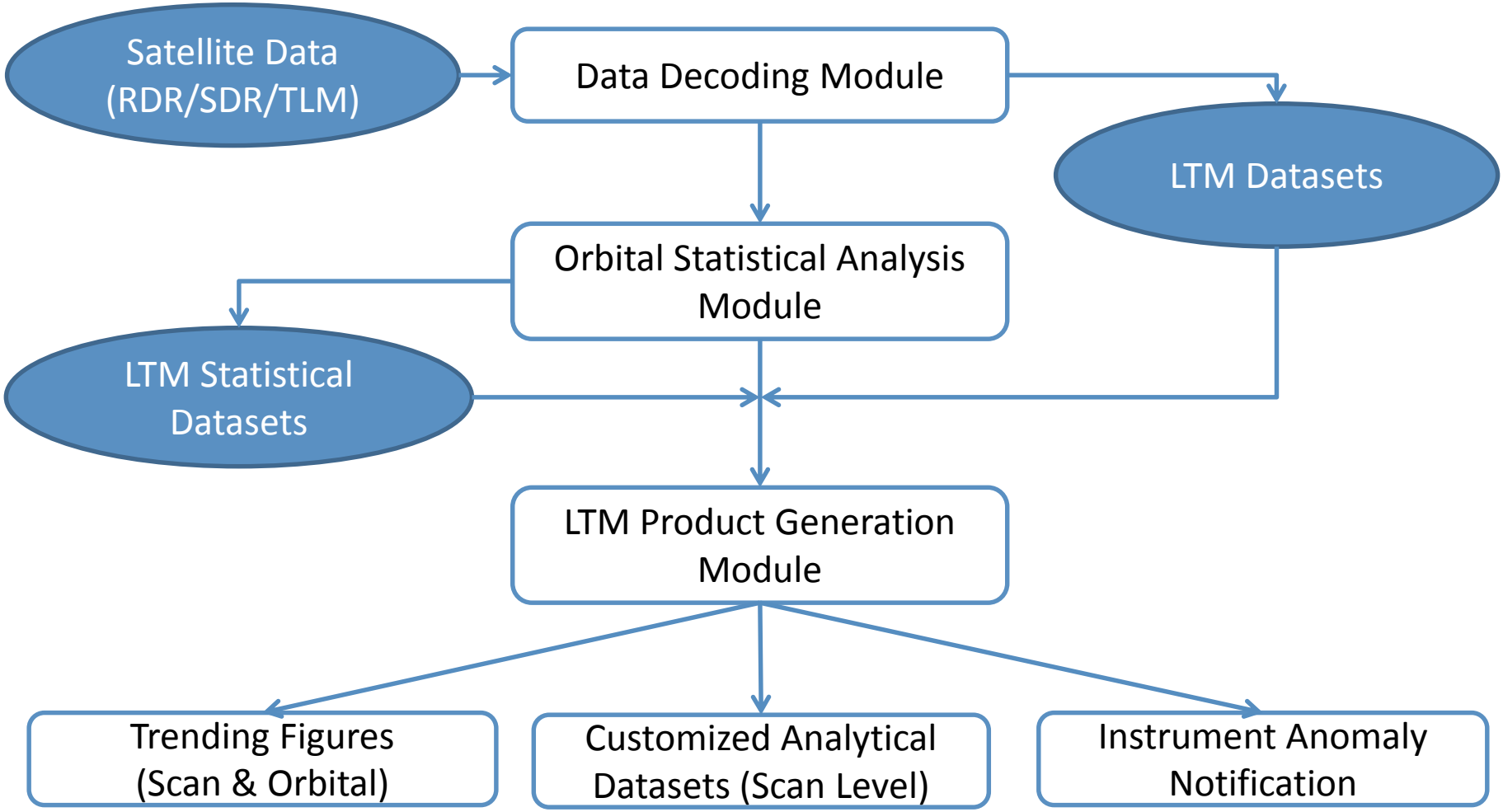
IPMS

SQAS
- Sensor Data Global Distribution
- Sensor Data Global Bias Distribution
- Sensor Data Global Bias Trending

EQAS
- Satellite retrieval products
- Inter-sensor calibrated CDR products
- High Impact Events Imager

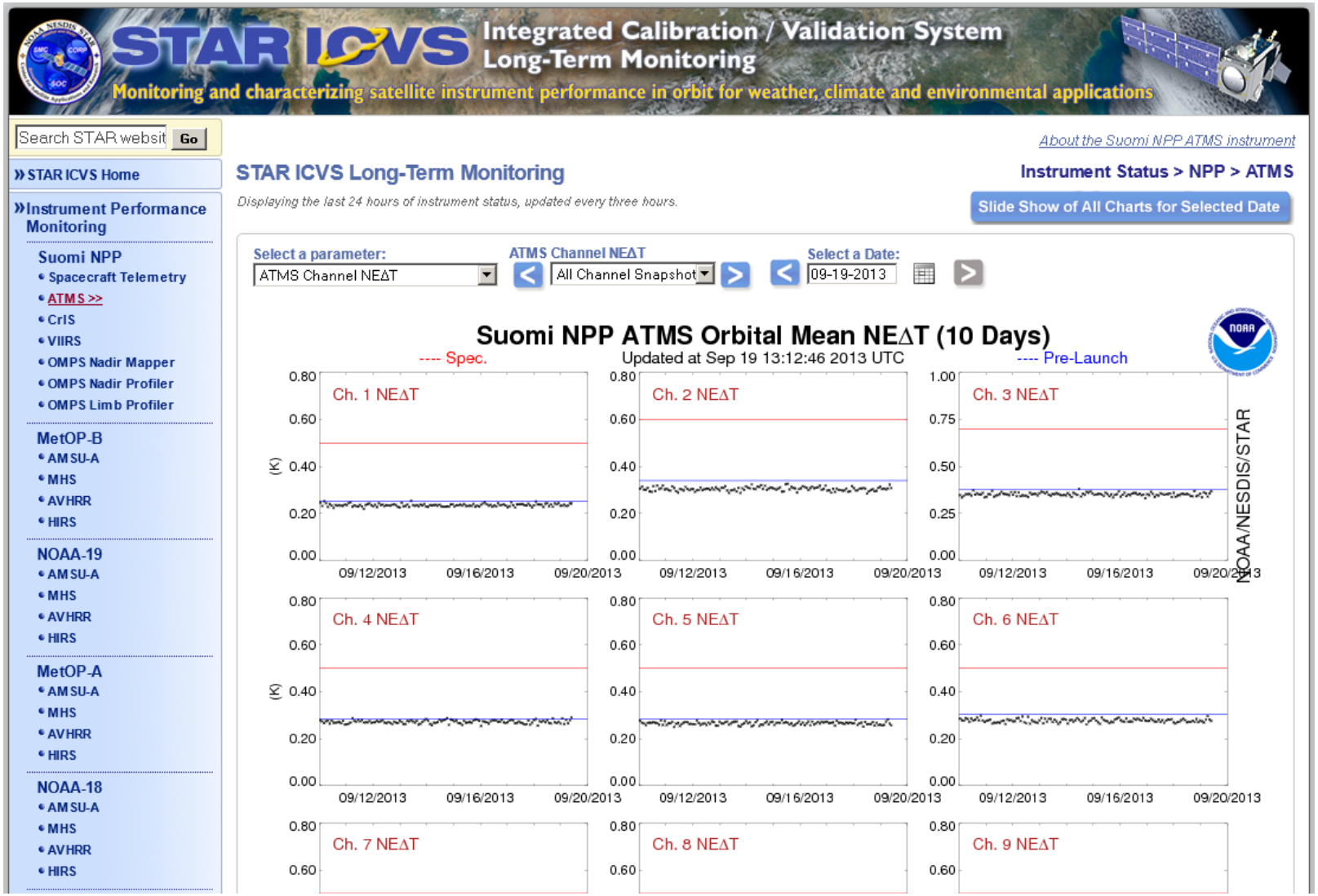
NWP
- Global Forecasts → Climate Predictions and Projections
- Regional Forecasts → Hurricanes and High Impact Events

IPMS Working Flow Diagram

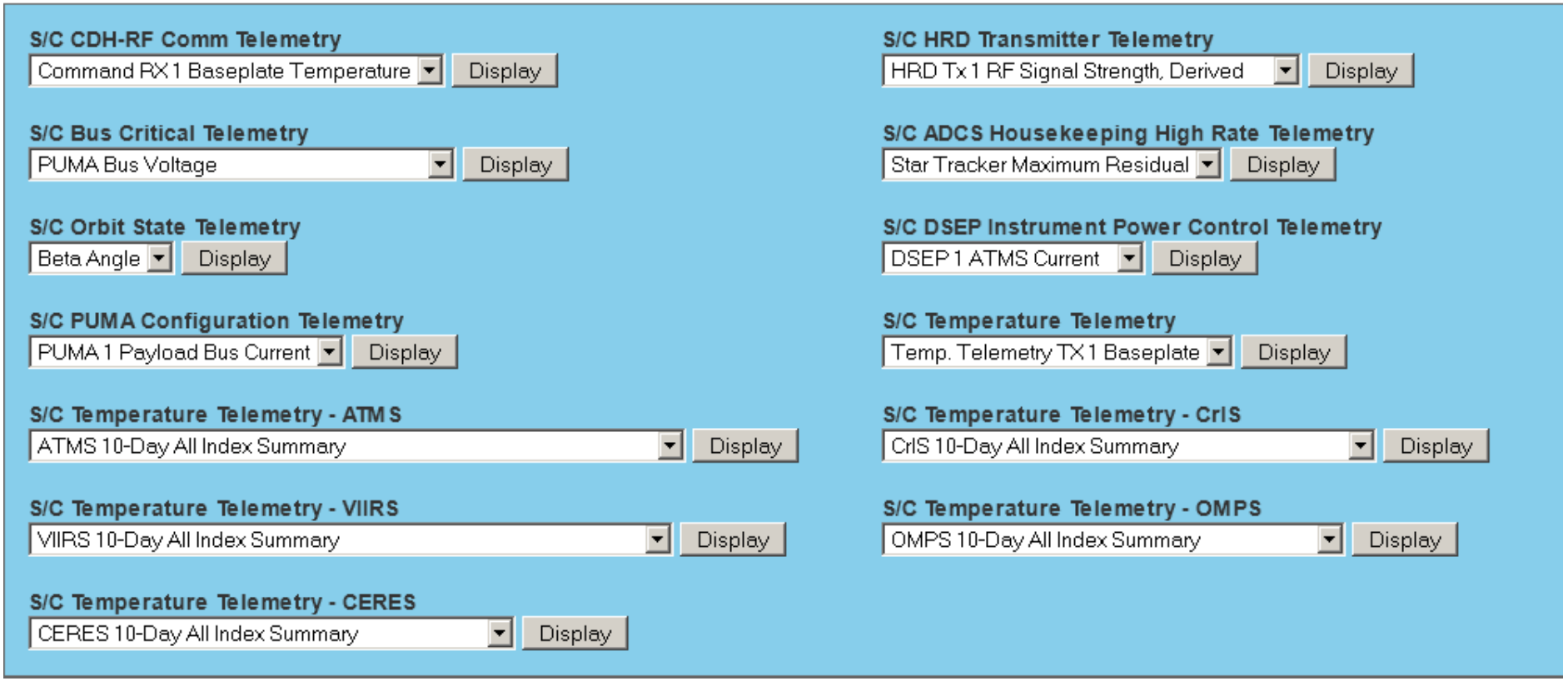


STAR ICVS-LTM Website

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



S-NPP Spacecraft LTM Parameters



100+ Parameters Provided in Real Time for S-NPP Spacecraft

S-NPP Spacecraft Customized Datasets

1. Scan Year
2. Scan Julian Day of the year
3. Scan UTC second from the midnight
4. Scan Orbit number
5. PUMA Bus Voltage
6. PUMA Total Bus Current
7. PUMA Battery 1 Voltage
8. PUMA Battery 2 Voltage
9. PUMA Battery 1 Pressure
10. PUMA Battery 2 Pressure
11. Wheel 1 Speed/Direction
12. Wheel 2 Speed/Direction
13. Wheel 3 Speed/Direction
14. Wheel 4 Speed/Direction
15. Gyro (TARA) 1 Motor Current
16. Gyro (TARA) 2 Motor Current
17. Gyro (TARA) 3 Motor Current
18. Reaction Wheel 1 Motor Current
19. Reaction Wheel 2 Motor Current
20. Reaction Wheel 3 Motor Current
21. Reaction Wheel 4 Motor Current
22. System Pressure
23. Propulsion Deck -Z Temperature
24. Propulsion Tank Temperature (Gas Side)
25. Control Frame Rate X
26. Control Frame Rate Y
27. Control Frame Rate Z
28. Command RX 1 Baseplate Temperature
29. Command RX 2 Baseplate Temperature
30. Command Receiver 1 Signal Strength, Derived
31. Command Receiver 2 Signal Strength, Derived
32. Command Receiver 1 Loop Stress, Derived
33. Command Receiver 2 Loop Stress, Derived
34. Star Tracker Maximum residual
35. Total System Momentum 1
36. Total System Momentum 2
37. Total System Momentum 3

FORMAT=(I4,1X,I3,1X,I5,1X,I5,33(1X,F10.4))

****

2013 68 83560 7074 32.4800 26.2400 32.3418 32.4018 952.2000 970.9200
378.9400 -549.7661 -399.8575 -549.7661 0.2960 0.2880 0.2920 0.1620 -
0.6480 -0.3240 -0.4860 370.7336 13.5563 15.9864 -0.0006 -0.0590
0.0000 10.3897 9.3147 -106.9608 -103.9399 2890.5425 2886.5098 0.0001 -
1.3824 -1.8048 0.0064
2013 68 83561 7074 32.4800 26.2400 32.3418 32.4018 952.2000 970.9200
375.3022 -546.2799 -400.3122 -550.3724 0.2960 0.2880 0.2920 0.0000 -
0.6480 -0.4860 -0.4860 370.7336 13.5563 15.9864 0.0006 -0.0596
0.0000 10.3897 9.3147 -106.9608 -103.9399 2890.5425 2886.5098 0.0001 -
1.3696 -1.7984 0.0064
2013 68 83562 7074 32.4800 25.5800 32.3418 32.4018 952.2000 970.9200
375.6053 -546.8862 -404.8595 -555.2229 0.2960 0.2880 0.2920 0.1620 -
0.6480 -0.4860 -0.4860 370.7336 13.5563 15.9864 -0.0006 -0.0590
0.0000 10.3897 9.3147 -106.9608 -103.9399 2890.5425 2886.5098 0.0001 -
1.4144 -1.8048 -0.0192
2013 68 83563 7074 32.3200 26.2400 32.3418 32.4018 952.2000 970.9200
376.6664 -552.4945 -401.8280 -552.4945 0.2960 0.2880 0.2920 0.0000 -
0.8100 -0.3240 -0.6480 370.7336 13.5563 15.9864 0.0006 -0.0596
0.0000 10.3897 9.3147 -106.9608 -103.9399 2890.5425 2886.5098 0.0000 -
1.3376 -1.8432 0.0640
2013 68 83564 7074 32.4800 26.2400 32.3418 32.4018 952.2000 970.9200
373.9380 -550.2209 -403.9500 -550.2209 0.2960 0.2880 0.2920 0.0000 -
0.8100 -0.4860 -0.4860 370.7336 13.5563 15.9864 -0.0006 -0.0596
0.0000 10.3897 9.3147 -106.9608 -103.9399 2890.5425 2886.5098 0.0000 -
1.4016 -1.7984 -0.0192
201368 83565 7074 32.3200 26.2400 32.3418 32.4018 952.2000 970.9200
375.3022 -550.5240 -404.5563 -550.5240 0.2960 0.2880 0.2920 0.0000 -
0.6480 -0.4860 -0.4860 370.7336 13.5563 15.9864 0.0006 -0.0596
0.0000 10.3897 9.3147 -106.9608 -103.9399 2890.5425 2886.5098 0.0001 -
1.3312 -1.7728 0.0000
……

S-NPP ATMS LTM Parameters

Parameters	Descriptions	Dimensions	Purpose
Channel NE∆T	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

Calibration Target Monitoring

Microwave Remote Sensing Two-Point Calibration Equation

$$T_b = T_b^w + \frac{C^s - \overline{C^w}}{\overline{C^w} - \overline{C^c}}(T_b^w - T_b^c) + Q$$

T_b^w	Hot Load PRT Temperature
T_b^c	Cosmic Background Temperature
C^s	Earth Scene Count
$\overline{C^w}$	Averaged Hot Load Count
$\overline{C^c}$	Average Cold Space View Count
Q	Non-linearity Correction Term

Channel Performance Evaluation

Noise Equivalent Differential Temperature (NEΔT)

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

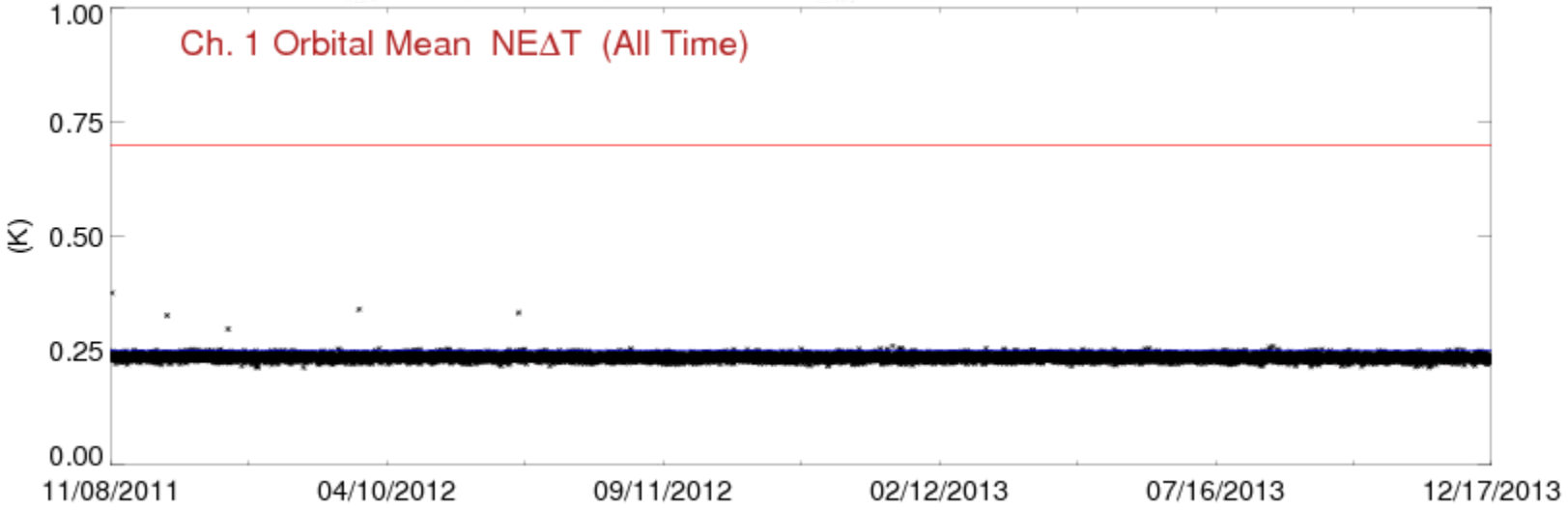
T_b^w PRT Temperature

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



S-NPP VIIRS LTM Parameters

Parameters	Descriptions	Dimensions	Usage
Telemetry temperatures	BB, RTA, cavity, HAM, FPA, cooler, Mainframe, Circuit Card Assembly	21 temps	Instrument Healthy status
SD_Counts	VIIRS observation DN of Solar diffuser for band I1~I3, M1~M11, DNB over band average	14 bands	Degradation trending
SD NEΔN	Noise NEΔN for SD signal of solar bands	14 bands	SNR trending
SD_Counts by detectors	VIIRS observation DN of Solar diffuser I1~I3, M1~M11, DNB over detector average	14bands *32d	degradation for Detector uniform
SDSM signal	SDSM signal of SD and Sun in every orbit	8 bands	SD trending
SV_Counts	VIIRS observation Space view DN for 22 bands	22bands	Background signal trending
SV NEΔN	Dark Noise NEΔN for Space view signal	22bands	Dark noise signal
BB_Counts	VIIRS observation Blackbody DN for 22 bands	22 bands	IR gain derivation
BB NEΔN	Noise NEΔN for black body signal	22bands	IR NEDT derivation
F factors and H factors	Degradation of Solar bands based on SD signal and SDSM	14 bands	Solar bands degradation
IR NEΔT	Noise equivalent temperature for IR bands M4, M5, M12-M16	7 IR bands	IR bands noise
IR Calibration Gain	Calibration gains for IR bands M4, M5, M12-M16	7 IR bands	IR bands calibration trending

Calculation of F-Factor

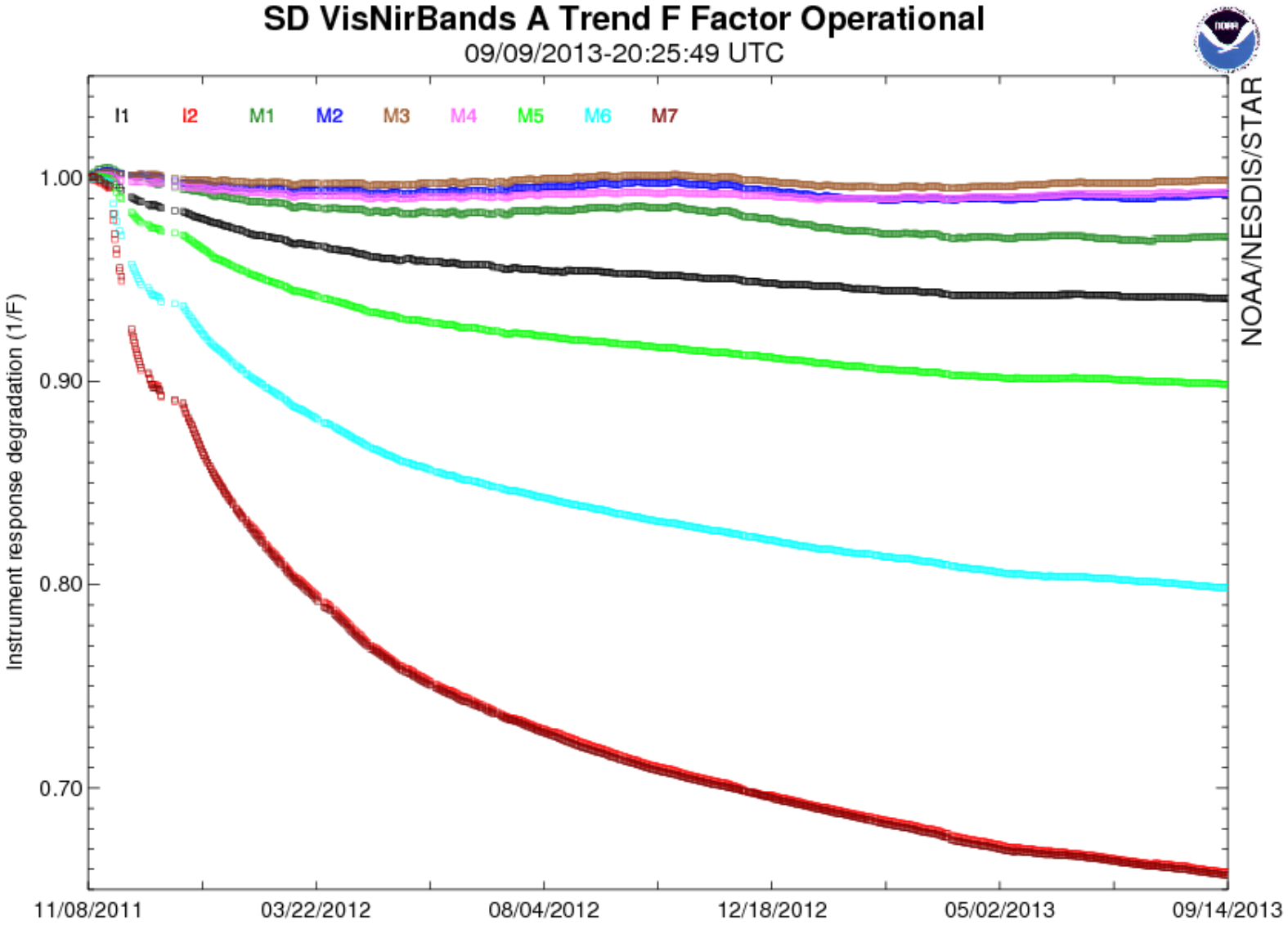
For Reflective Solar Band,

$$F = \frac{RVS(\theta_{sd,}B)}{N_{acq}} \cdot \left(\frac{\overline{d_{se}}}{d_{se}}\right)^2 \cdot \sum_{n=0}^{N_{acq}-1} \left(\frac{\cos(\theta_{inc}(t_n)) \cdot \overline{L_{nsd}}(\phi_h(t_n), \phi_v(t_n), B}{\sum_{j=0}^{2} c_j \cdot \overline{dn_{sd}}(t_n)^j} \right)$$

For Thermal Emission Band,

$$F = RVS(\theta_{obc}) \cdot \frac{\left\{ \begin{array}{l} \left(1 - \frac{1}{RVS(\theta_{obc})}\right) \cdot \left[\left(\frac{1}{\overline{\rho_{rta}(\lambda)}} - 1 \right) \cdot \overline{L(T_{rta}(t), \lambda)} - \frac{\overline{L(T_{ham}(t), \lambda)}}{\overline{\rho_{rta}(\lambda)}} \right] \\ + \overline{\varepsilon_{obc}(\lambda)} \cdot \overline{L(T_{obc}(t), \lambda)} + \overline{L_{obc_rfl}(T_{sh}(t), T_{cav}(t), T_{tele}(t), \lambda)} \end{array} \right\}}{\sum_{j=0}^{2} c_j \cdot \overline{dn_{obc}}(t_n)^j}$$

S-NPP VIIRS LTM Parameters



S-NPP CrIS LTM Parameters

Telemetry Parameters	Description
RDR_TLM_ICT_PRTTemp	ICT PRT temperature
RDR_TLM_OMA_Temp	OMA structure temperature
RDR_TLM_StageCooler_Temp	Stage 1/2/3/4 cooler temperature
RDR_TLM_Other_Temp	BS/SB/Telescope Temperature
RDR_Laser_Diode	Laser diode current & temperature
RDR_Servo_Error	SSM Cross/In-track servo error over 30 FORs

Housekeeping Parameters	Description
SSMelectronicsboardTemp	SSM electronics board Temperature
ServoMotorwindingTemp	Cr- & In-Track Motorwinding Temperature
PorchswingVelocity	Porchswing Velocity
MotorCurrent	Porchswing/DA-X/DA-Y Motor Current
DA_XY_Tilt_Err	DA-X & DA-Y Tilt Error

Instrumental Responses	Description
SSMelectronicsboardTemp	SSM electronics board Temperature
ServoMotorwindingTemp	Cr- & In-Track Motorwinding Temperature
PorchswingVelocity	Porchswing Velocity
MotorCurrent	Porchswing/DA-X/DA-Y Motor Current
DA_XY_Tilt_Err	DA-X & DA-Y Tilt Error

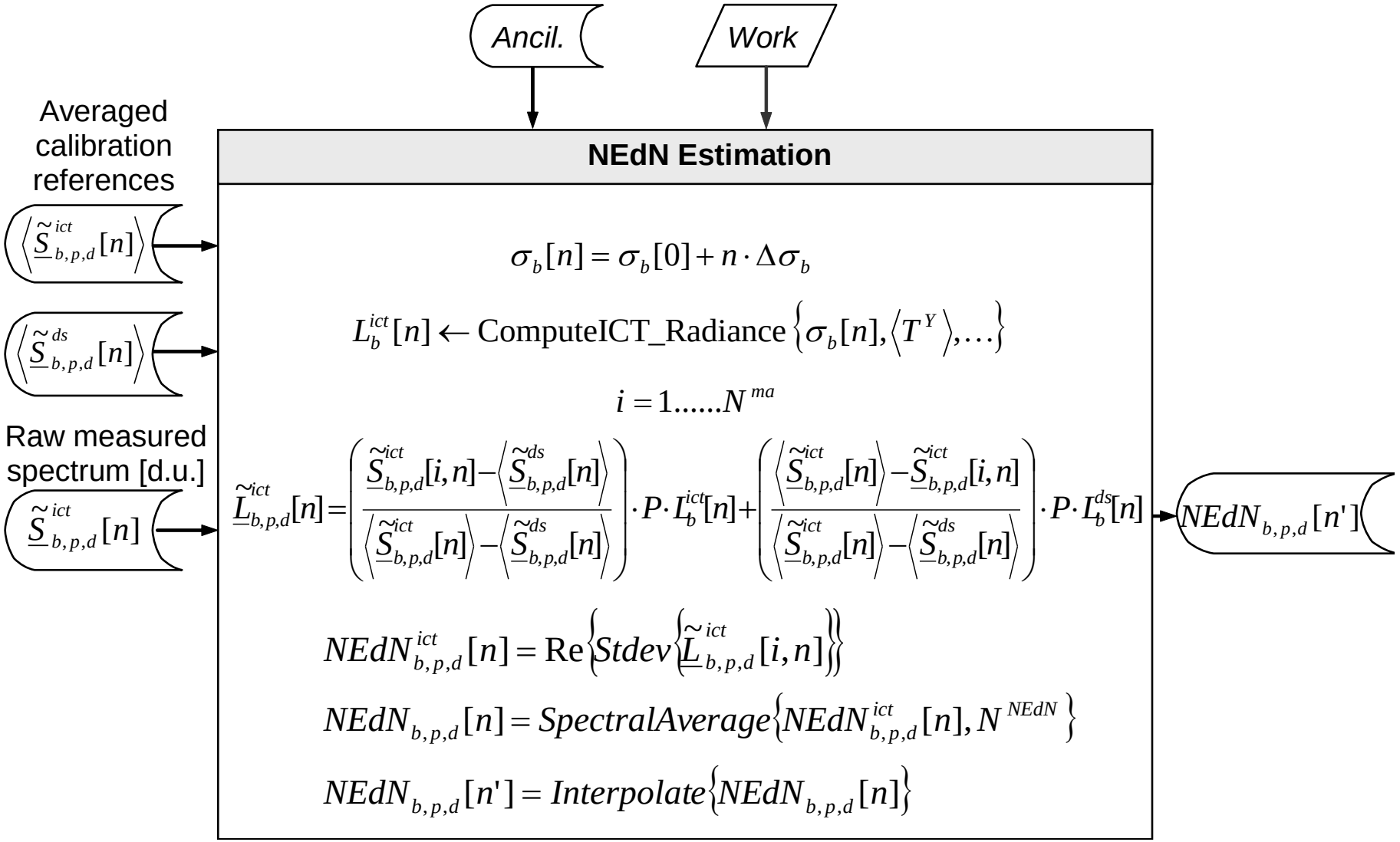
S-NPP CrIS LTM Parameters

Name	Description
npp_cris_window_map	11 µm (900 cm^{-1}) BT map
npp_cris_H2O_map	6.7 µm (1500 cm^{-1}) BT map
npp_cris_window2_map	4.0 µm (2500 cm^{-1}) BT map
npp_cris_O3_map	9.7 µm (1030 cm^{-1}) BT map
npp_cris_SDR_Quality_map	SDR overall QF map
npp_cris_SDR_Quality	SDR overall QF time series over 9 field of views (FOV)
npp_cris_SDR_MAX_SD_imgy	Max std. dev. of imaginary NEDN per scan
npp_cris_SDR_AVG_NEDN	Average spectral NEdN of the day
npp_cris_SDR_MAX_NEDN	Maximal spectral NEdN of the day
npp_cris_SDR_AVG_imgy	Average spectral imaginary part of the day
npp_cris_SDR_MAX_imgy	Maximal spectral maginary part of the day
npp_cris_sdr_Invalid_Radiometric_Calibration	Radiometric Cal. Invalidity flag over 9 FOVs
npp_cris_sdr_Invalid_Spectral_Calibration	Spectral Cal. Invalidity flag over 9 FOVs
npp_cris_sdr_FCE_Correction_Failed	FCE Correction Failed flag over 9 FOVs
npp_cris_sdr_FCE_Detection	FCE Detection flag over 9 FOVs
npp_cris_sdr_Invalid_Geolocation	Geolocation Invalidity flag over 9 FOVs
npp_cris_sdr_Invalid_RDR	RDR Invalidity flag over 9 FOVs
npp_cris_sdr_Bit_Trim_Failed	Bit Trim Failed flag over 9 FOVs
SDR_Laser_Wavelength	3 laser wavelength parameters
SDR_NumberOfValidPRTTemps	# of valid PRT temp count
Scan_Level_QF1	6 Scan-level QFs
SDR_DS_Symmetry	Asymmetry in DS IGMs
SDR_ICT_Temp_Stab_Cons	ICT temp stability & consistency
SDR_DS_WindowSize	DS WindowSize
SDR_ICT_WindowSize	ICT WindowSize
SDR_DS_SpectralStability	DS Spectral Stability
SDR_ICT_SpectralStability	ICT Spectral Stability
SDR_ImpulseNoise_Count	Impulse Noise over 9 FOVs
SDR_SDRFringe_Count	SDR Fringe over 9 FOVs

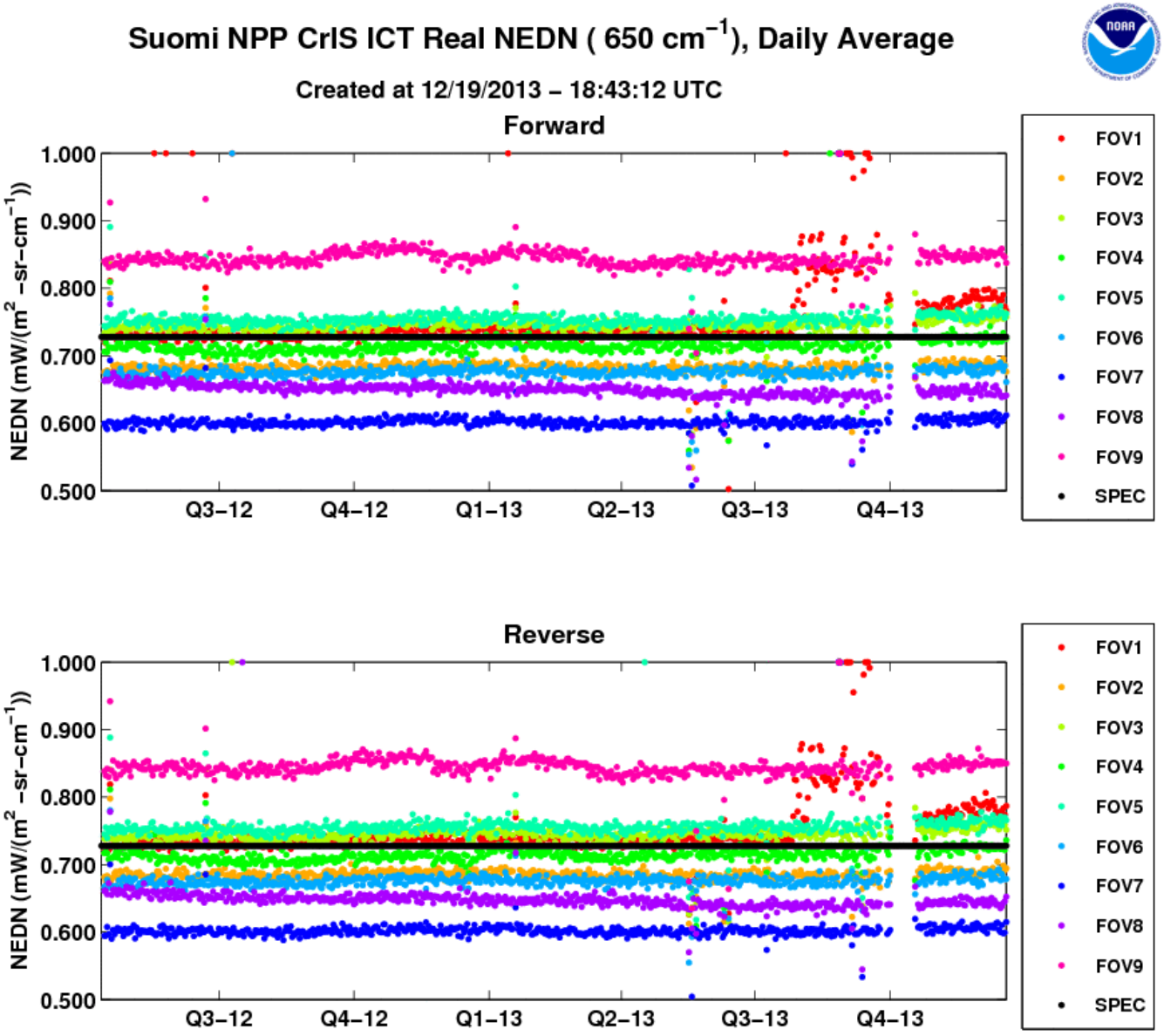
S-NPP CrIS LTM Parameters

Name	Description
SDR_ES_ZPDFringe_Count	ES ZPD Fringe over 9 FOVs
SDR_ES_ZPDMagnitude_Count	ES ZPD Magnitude over 9 FOVs
npp_cris_sdr_Day_Night	Day/Night flag over 9 FOVs
SDR_Lunar_Intrusion_QF2	Lunar Intrusion flag
npp_cris_SDR_Spectrum_NP	Spectral Rad/BT at North Pole
npp_cris_SDR_Spectrum_EQ	Spectral Rad/BT at Equator
npp_cris_SDR_Spectrum_SP	Spectral Rad/BT at South Pole
npp_cris_imgy900_map	11 µm (900 cm^{-1}) imgy. rad. map
npp_cris_imgy2500_map	4 µm (2500 cm^{-1}) imgy. rad. map
NPP SDR global bias	Selected channels including global distribution and time series

CrIS NEΔN Estimation



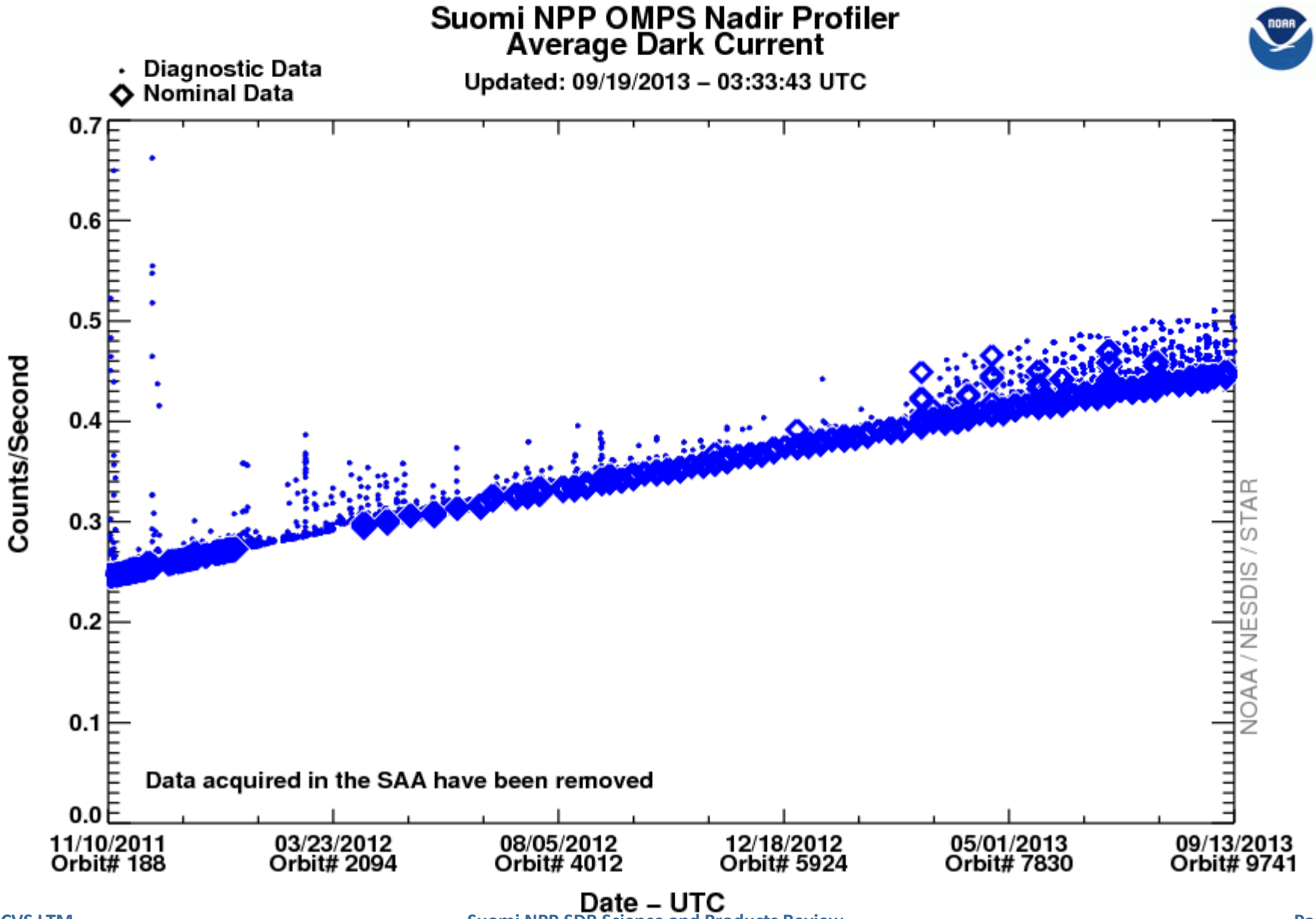
S-NPP CrIS Instrument Status LTM



S-NPP OMPS LTM Parameters

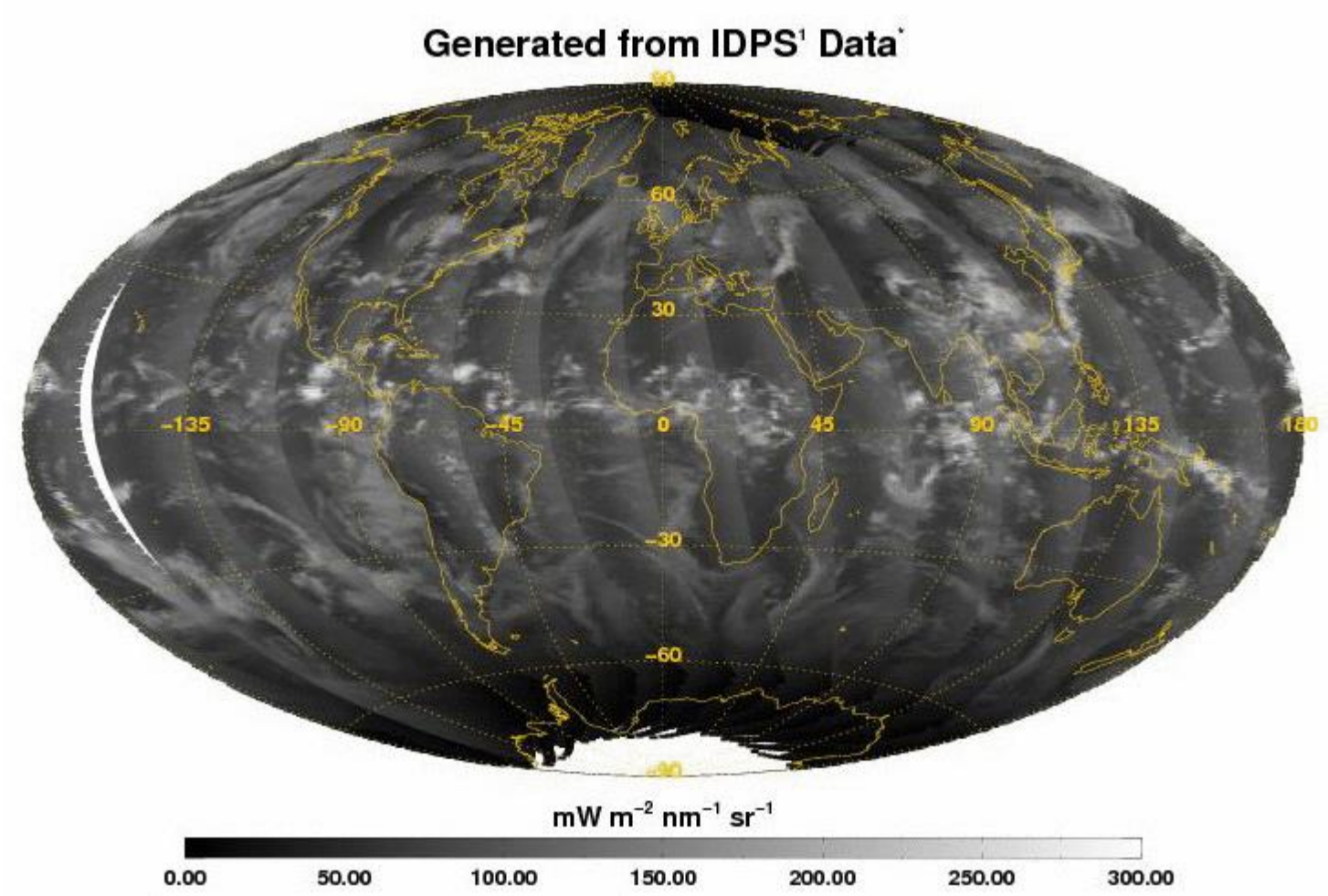
Parameters	Purpose
Instrument Status • Four temperatures for TC • Eight temperatures for NP • Examples: CCD, Window, Conduction Bar, Housing, Telescope, …	Monitor variation of instrument status Watch for health and safety issues Assist anomaly investigation
Instrument Performance • Specified requirements • Examples: Linearity, Dark Count, Hot Pixels, Solar Cal	Monitor variations in instrument performance Verify compliance with specifications Assist anomaly investigation
Operation Status • 12 for TC • 15 for NP • Examples: LUT versions, ID, …	Monitor operation and processing status Assist anomaly investigation
Product Quality • Self-consistency • Inter-comparison	Evaluate product quality in relation to other monitoring

S-NPP OMPS NP Dark Current



S-NPP OMPS Radiance Map

S-NPP OMPS Total Column Radiance at 331 nm 2013-09-01 ~ 2013-09-10



Instrument Anomaly Notification

- Notify through e-mails
- Provide instrument status
- Provide data availability
- Provide data quality flag information

From Ninghai Sun <nsun@rhw1049.star1.nesdis.noaa.gov>
Subject **NPP ATMS Lunar Intrusion Detected (2013-12-10)**
12/11/2013 3:12 PM
To Ninghai Sun

```
NPP ATMS Space View Lunar Intrusion is Detected on 2013-12-10
Channel  1 Lunar Intrusion Affected Scan Numbers =    746
Channel  2 Lunar Intrusion Affected Scan Numbers =    746
Channel  3 Lunar Intrusion Affected Scan Numbers =    436
Channel  4 Lunar Intrusion Affected Scan Numbers =    402
Channel  5 Lunar Intrusion Affected Scan Numbers =    409
Channel  6 Lunar Intrusion Affected Scan Numbers =    406
Channel  7 Lunar Intrusion Affected Scan Numbers =    436
Channel  8 Lunar Intrusion Affected Scan Numbers =    411
Channel  9 Lunar Intrusion Affected Scan Numbers =    407
Channel 10 Lunar Intrusion Affected Scan Numbers =    436
Channel 11 Lunar Intrusion Affected Scan Numbers =    436
Channel 12 Lunar Intrusion Affected Scan Numbers =    436
Channel 13 Lunar Intrusion Affected Scan Numbers =    436
Channel 14 Lunar Intrusion Affected Scan Numbers =    436
Channel 15 Lunar Intrusion Affected Scan Numbers =    436
Channel 16 Lunar Intrusion Affected Scan Numbers =    334
Channel 17 Lunar Intrusion Affected Scan Numbers =    218
Channel 18 Lunar Intrusion Affected Scan Numbers =    221
Channel 19 Lunar Intrusion Affected Scan Numbers =    220
Channel 20 Lunar Intrusion Affected Scan Numbers =    222
Channel 21 Lunar Intrusion Affected Scan Numbers =    226
Channel 22 Lunar Intrusion Affected Scan Numbers =    231
!!! Please go to http://www.star.nesdis.noaa.gov/icvs/status_NPP_ATMS.php
    to check Lunar Intrusion geophysical location and duration time.
```

From Ninghai Sun <nsun@orbit082L.orbit2.nesdis.noaa.gov>
Subject **ICVS warning message (2012-07-08 04:28:08 UTC)**
12:28 AM
To Ninghai Sun

```
NOAA-19 AMSU-A Channel 8
NSS.AMAX.NP.D12189.S2346.E0137.B1759495    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.736
NSS.AMAX.NP.D12189.S2204.E2352.B1759394    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.738
NSS.AMAX.NP.D12189.S2021.E2209.B1759293    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.743
NSS.AMAX.NP.D12189.S1832.E2027.B1759092    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.738
NSS.AMAX.NP.D12189.S1652.E1837.B1758991    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.718
NSS.AMAX.NP.D12189.S1526.E1648.B1758989    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.677
NSS.AMAX.NP.D12189.S1346.E1532.B1758889    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.711
NSS.AMAX.NP.D12189.S1205.E1352.B1758788    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.659
NSS.AMAX.NP.D12189.S1024.E1211.B1758687    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.663
NSS.AMAX.NP.D12189.S0849.E1030.B1758586    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.686
NSS.AMAX.NP.D12189.S0706.E0854.B1758485    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.701
NSS.AMAX.NP.D12189.S0519.E0712.B1758384    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.719
NSS.AMAX.NP.D12189.S0330.E0525.B1758283    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.696
NSS.AMAX.NP.D12189.S0142.E0335.B1758182    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.689

NOAA-19 AMSU-A Channel 7
NSS.AMAX.NP.D12189.S2346.E0137.B1759495    NEdT within specification .
NSS.AMAX.NP.D12189.S2204.E2352.B1759394    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.253
NSS.AMAX.NP.D12189.S2021.E2209.B1759293    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.255
NSS.AMAX.NP.D12189.S1832.E2027.B1759092    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.266
NSS.AMAX.NP.D12189.S1652.E1837.B1758991    NEdT within specification .
NSS.AMAX.NP.D12189.S1526.E1648.B1758989    NEdT within specification .
NSS.AMAX.NP.D12189.S1346.E1532.B1758889    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.253
NSS.AMAX.NP.D12189.S1205.E1352.B1758788    NEdT within specification .
NSS.AMAX.NP.D12189.S1024.E1211.B1758687    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.250
NSS.AMAX.NP.D12189.S0849.E1030.B1758586    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.254
NSS.AMAX.NP.D12189.S0706.E0854.B1758485    NEdT within specification .
NSS.AMAX.NP.D12189.S0519.E0712.B1758384    NEdT within specification .
NSS.AMAX.NP.D12189.S0330.E0525.B1758283    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.252
NSS.AMAX.NP.D12189.S0142.E0335.B1758182    NEdT out of specification !!!! Spec. = 0.2500
Current =   0.252

NOAA-19 MHS Channel 3
NSS.MHSX.NP.D12189.S2346.E0137.B1759495    NEdT out of specification !!!! Spec. = 1.0000
Current = 3.0732
```

Path Forward

- Improve anomaly notification function
- Provide flexible customized datasets for analysis
- Improve ICVS-LTM system execution efficiency
- Provide support for more sensors and more parameters
  - Users submit request to ICVS-LTM
  - SDR team leads make the decision if the request is accepted and the priority
  - ICVS-LTM team adds the new parameter to current system and retroactive process data to build both daily variation and LTM trending plots
- Improve sensor bias monitoring module
- Improve function of current ICVS-LTM website