Integrated Cal/Val System (ICVS) Readiness for J1 VIIRS

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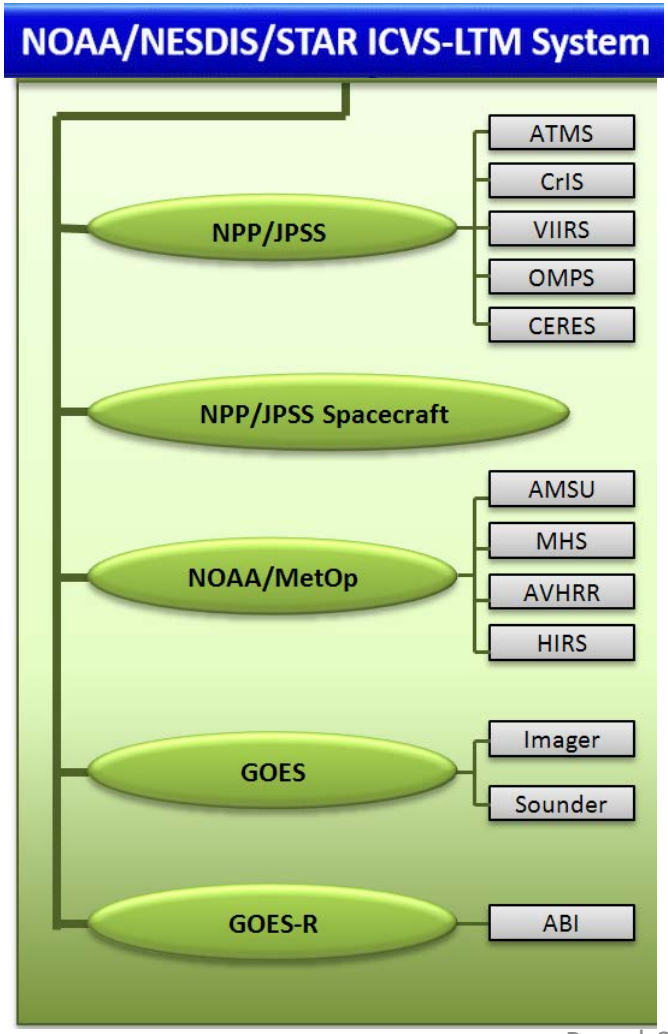
Date: August 26, 2015

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  - Thermal Emissive Band (TEB)
  - Day Night Band (DNB)
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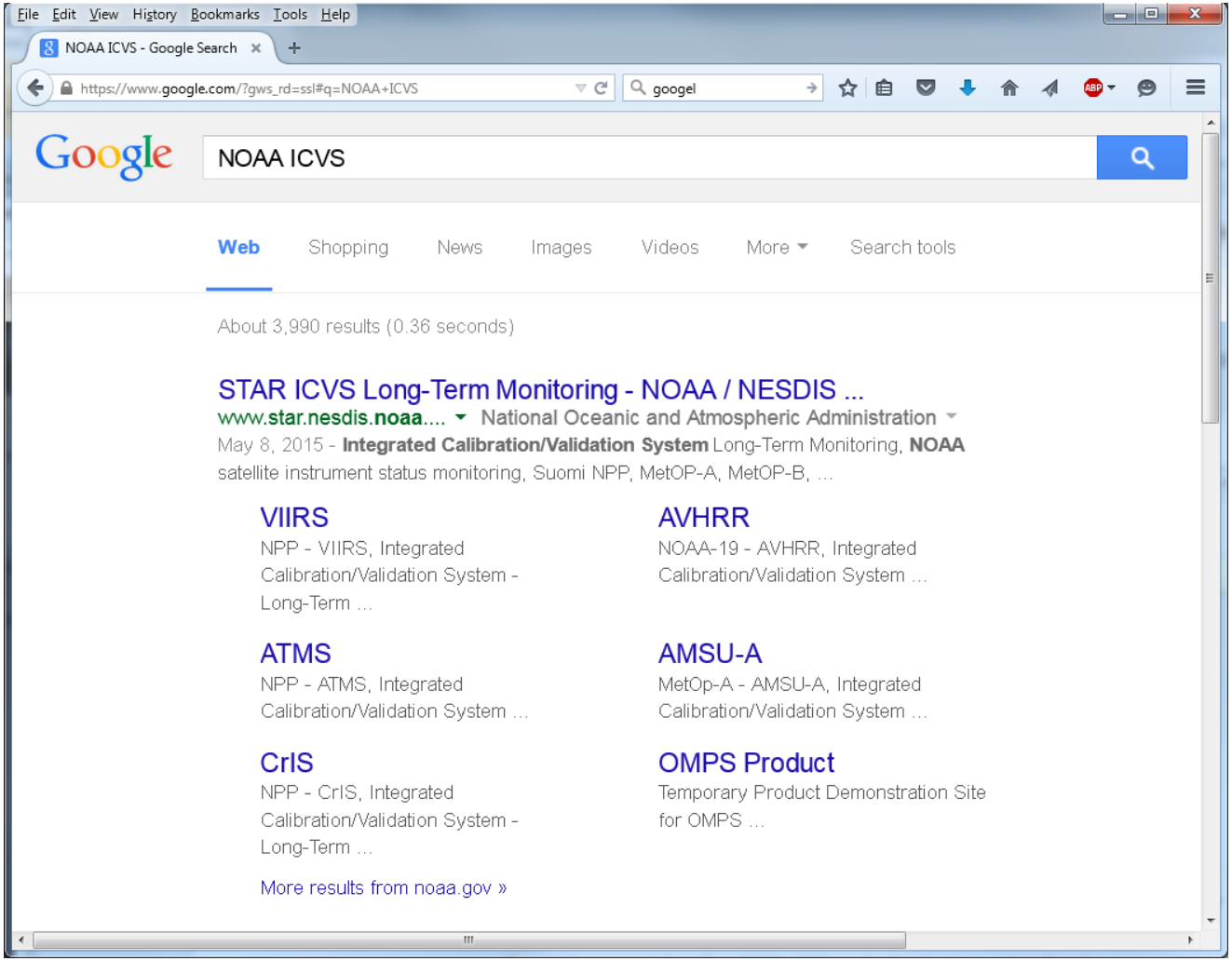
Introduction

- STAR Integrated Cal/Val System (ICVS) Long Term Monitoring (LTM) system goals
  - Provide near real time and long term instrument status and performance monitoring
  - Provide near real time and long term SDR/EDR level 1 data product quality monitoring
  - Provide real time support for sensor calibration activities
  - Provide quick and preliminary estimate of satellite data impact in NWP applications
  - Ensure the integrity of the climate data records from broader satellite instruments

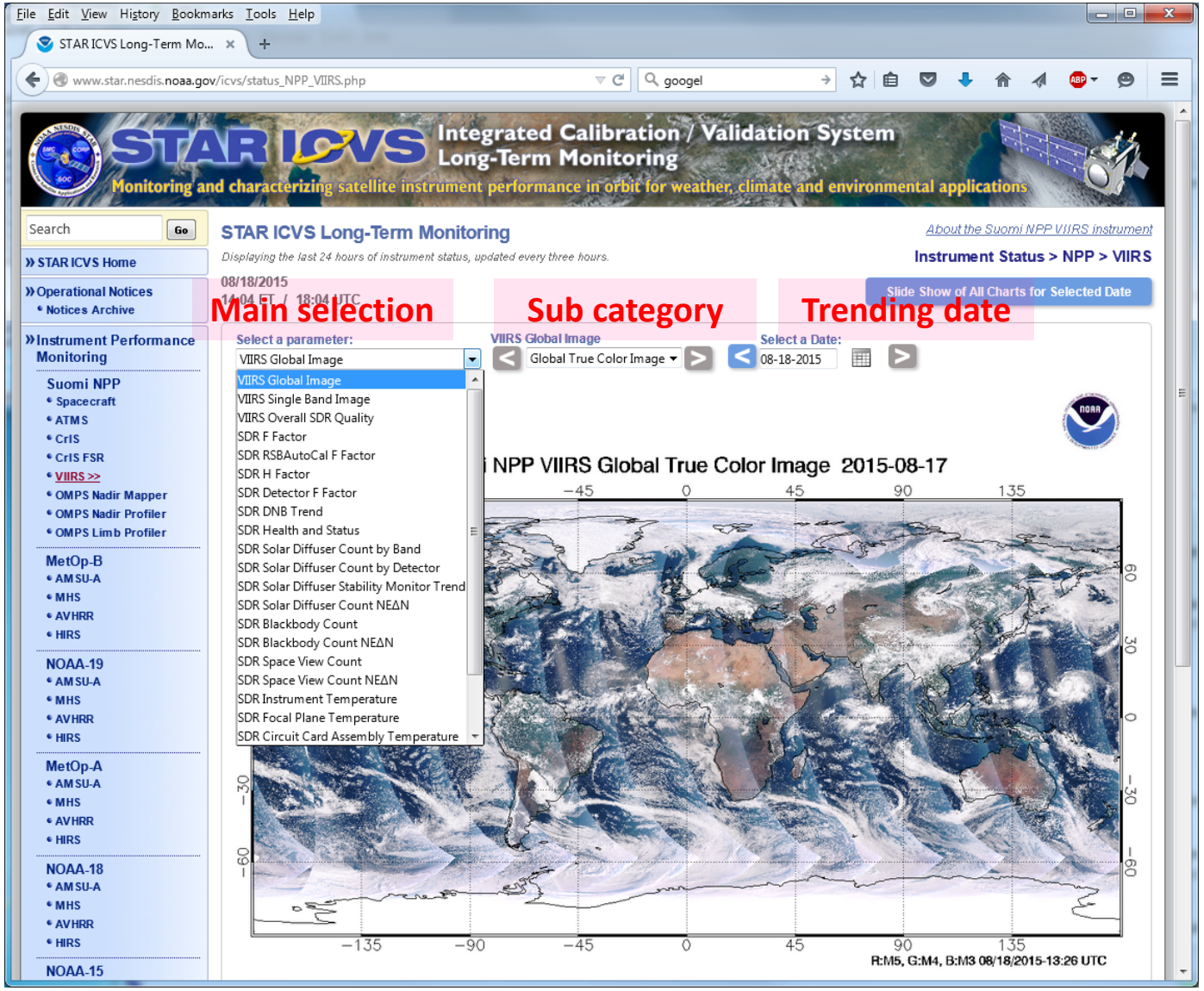


Introduction

- Website is at http://www.star.nesdis.noaa.gov/icvs/index.php
- Or search Google by 'NOAA ICVS'



Introduction



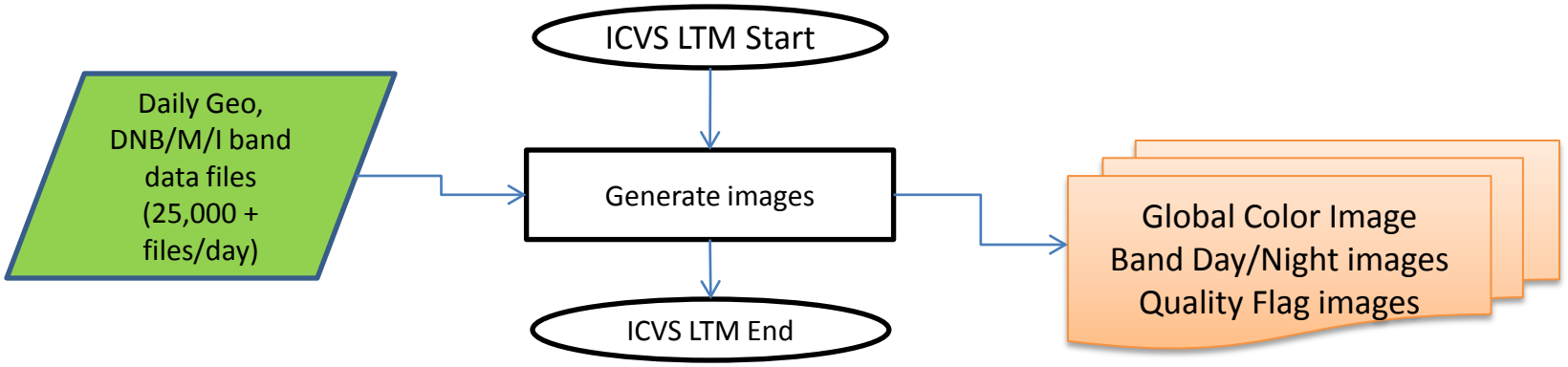
Introduction

Parameters	Descriptions	Dimensions	Usage
Global Image	Global true color image and single band image	38	VIIRS Imagery/Products
SDR Quality Flag	SDR data product quality flags	22	Check SDR data quality
F/H factor tending	H-factor, RSB F-factors, Operational vs. ICVS F-factor comparisons, Operational vs. RSBAutoCal F-factors, TEB Linear Gain, DNB LUTs	58	Degradation trending
Telemetry/Temperature	BB, RTA, cavity, HAM, FPA, cooler, Mainframe, Circuit Card Assembly, instrument current/voltage	41	Instrument Healthy status
SD Counts	VIIRS observation DN of Solar diffuser for band I1~I3, M1~M11, DNB over band average	28	Degradation trending
SD NEΔN	Noise NEΔN for SD signal of solar bands	14	NEDT Trending
SDSM Counts	SD, Sun, Ratio trending for all the 8 detectors	8	degradation for Detector uniform
BB Counts	VIIRS observation Blackbody DN for 22 bands	22	IR gain derivation
BB NEΔN	Noise NEΔN for black body signal	22	IR NEDT derivation
SV Counts	VIIRS observation Space view DN for 22 bands	22	Background signal trending
SV NEΔN	Dark Noise NEΔN for Space view signal	22	Dark noise signal
HAM/RTA No Sync	Indicates No Synchronization between RTA and HAM	1	Notification generated
Alaska Images	Alaska EDR Images	12	Animated Images

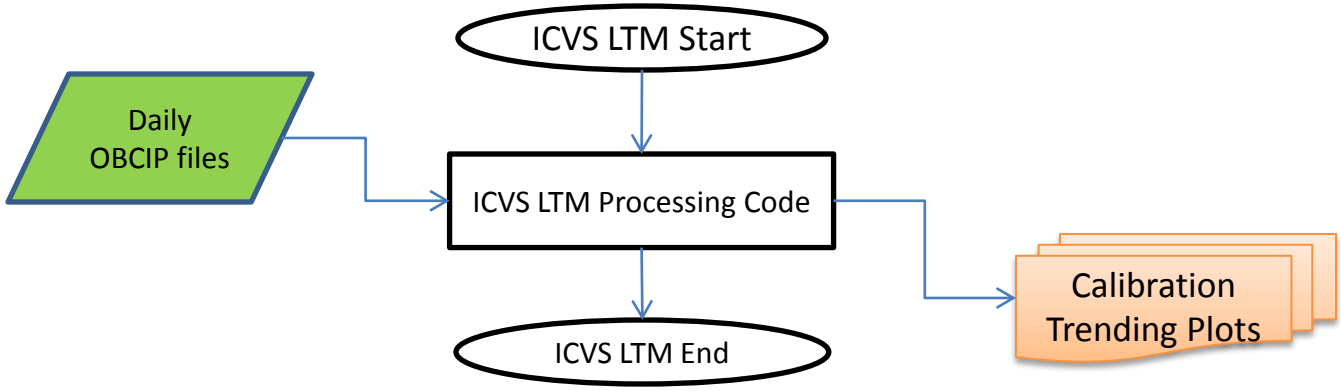
*** 323 trending plots are generated in near real time**

J1 Readiness Status

- ICVS LTM Code Structure
  - ICVS LTM Imagery Process (C++ / FORTRAN / IDL)



  - ICVS LTM Calibration/Telemetry Process (IDL)

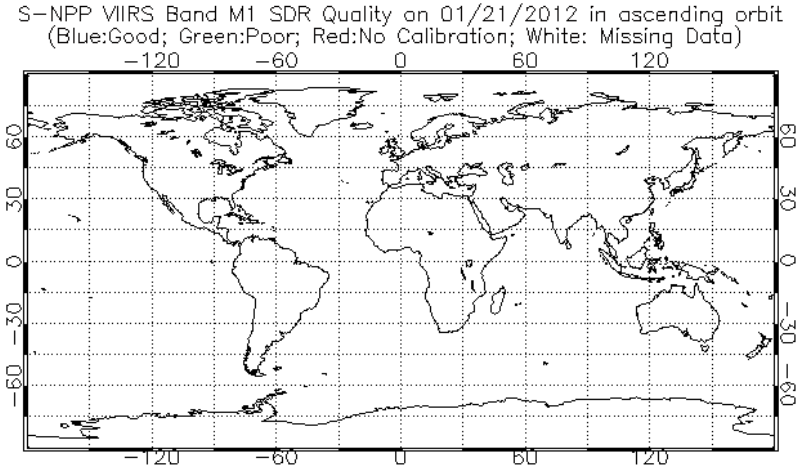


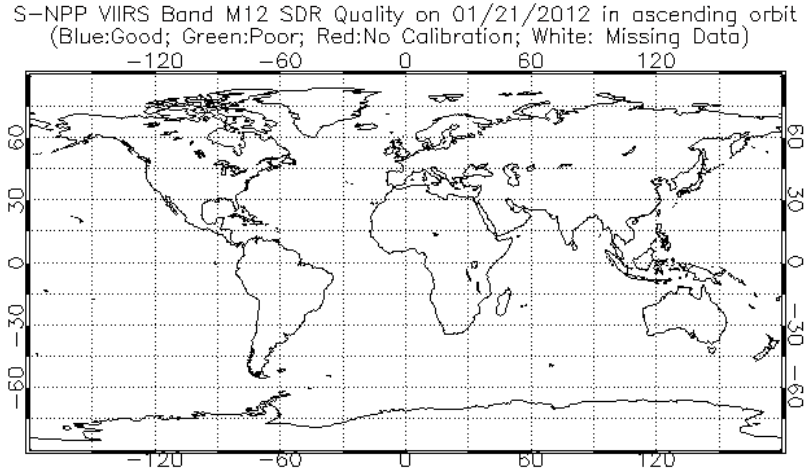
J1 Readiness Status

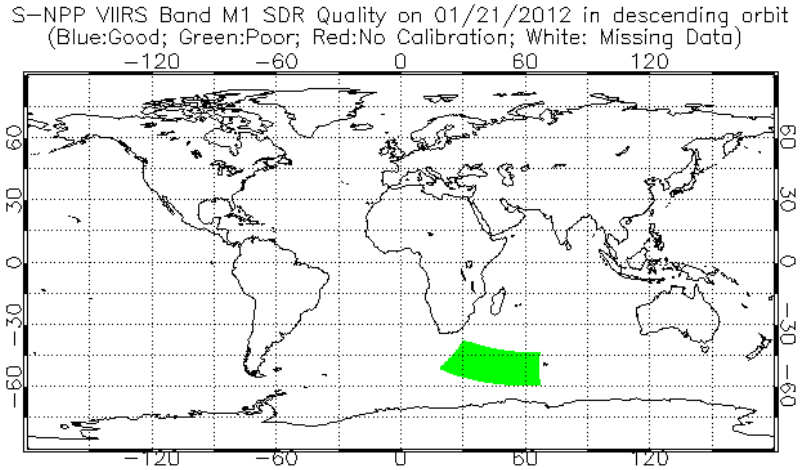
- ICVS Code Functionality Check
  - J1 proxy data is generated using 14 orbits of S-NPP data set on Jan. 21, 2012 (MDR 28).
  - Including S/C Diary RDR.
  - Processed to generate SDR using Block 2.0 ADL.
    - Only 3 granules are available from 21:37~21:41 (nighttime)
      - IVOBC_j01_d20120121_t2137026_e2138268_b01213_c20150813172512004324_NULu_int.h5
      - SVM01_j01_d20120121_t2137026_e2138268_b01213_c20150813172511144379_NULu_int.h5
  - The J1 proxy data formats are exactly the same as S-NPP format in OBCIP, Geo, and band image data files.

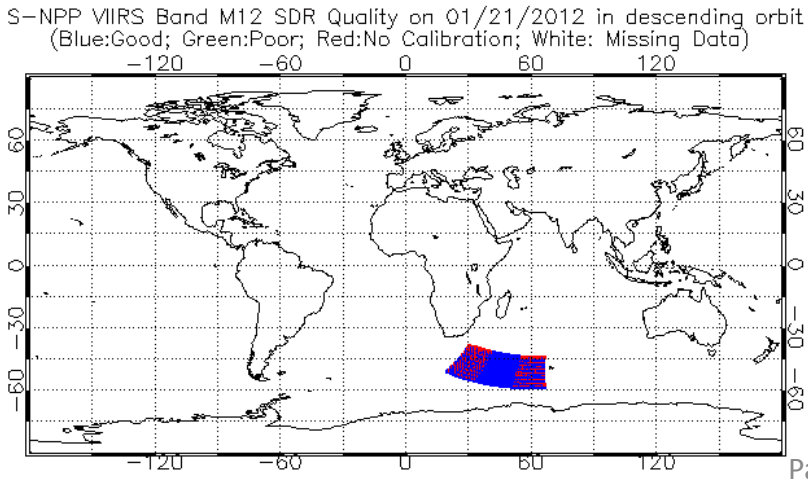
J1 Readiness Status

- ICVS Code Functionality Check
  - QF images are successfully generated.



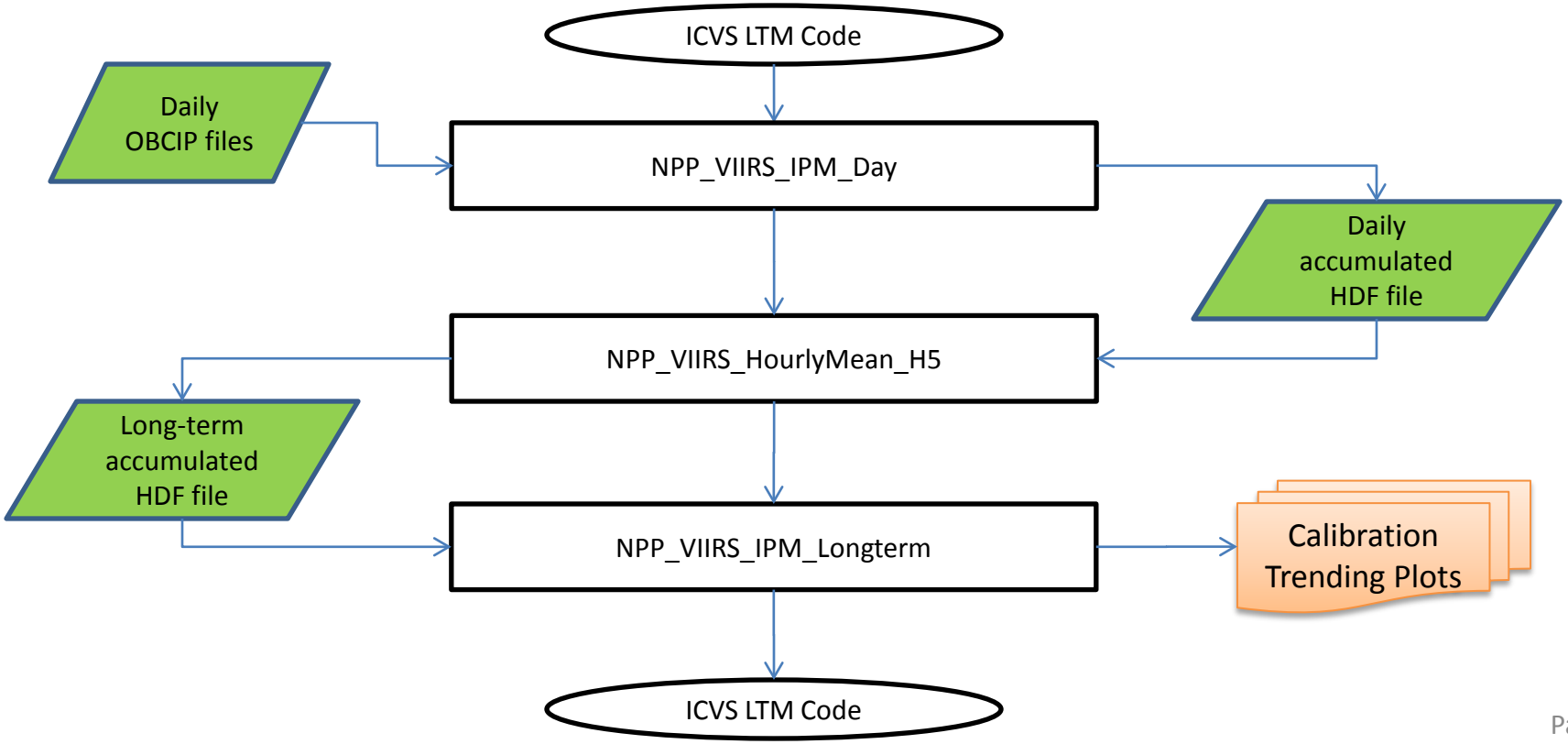






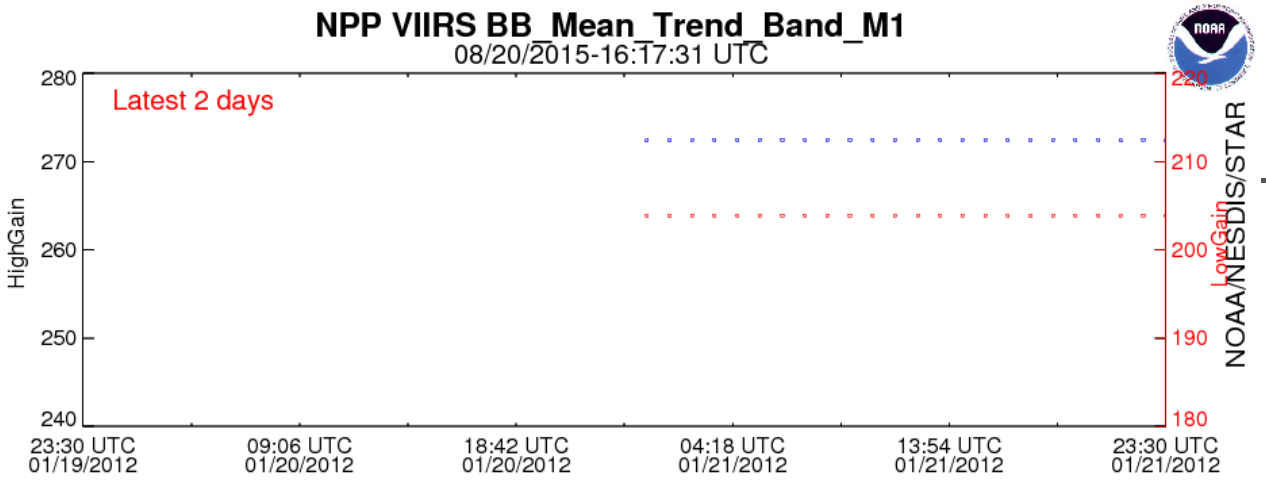
J1 Readiness Status

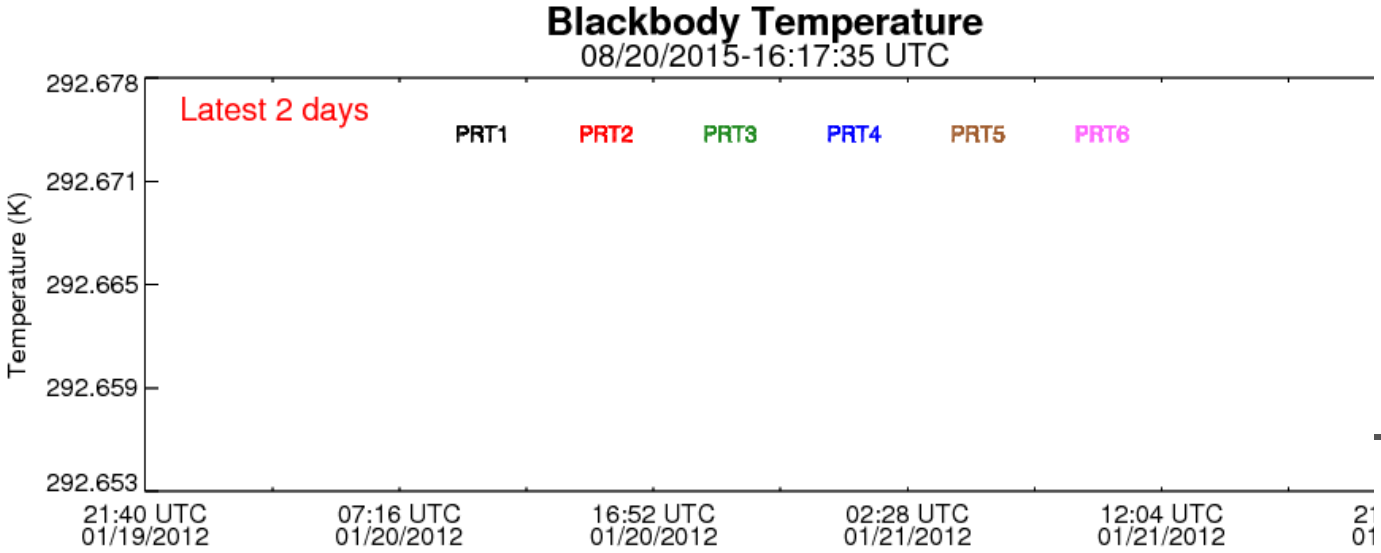
- ICVS Code Functionality Check
  - ICVS LTM Code Structure
    - ICVS LTM Calibration/Telemetry Process (IDL)
      - J1 proxy data does not include SD or SDSM data → code was modified.
      - Successfully generated intermediate HDF files and trending plots.



J1 Readiness Status

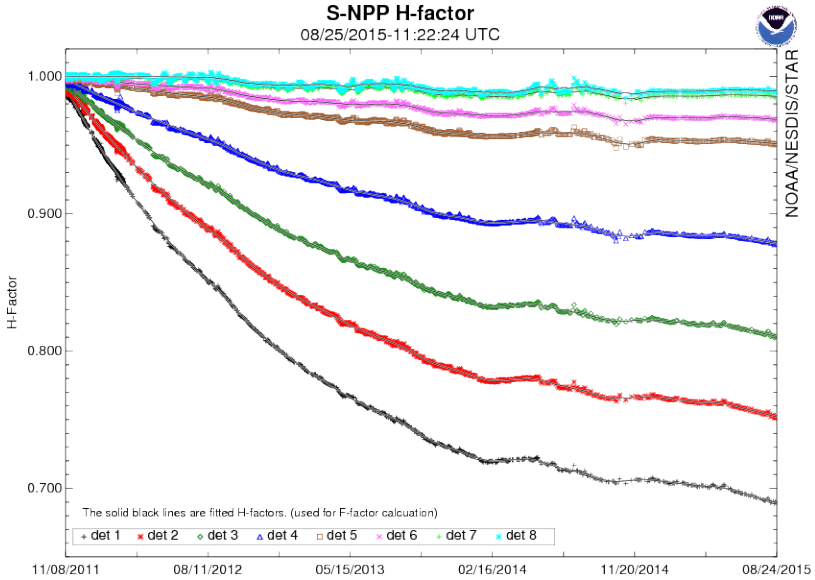
- ICVS Code Functionality Check
  - Calibration trending & telemetry plots are successfully generated.

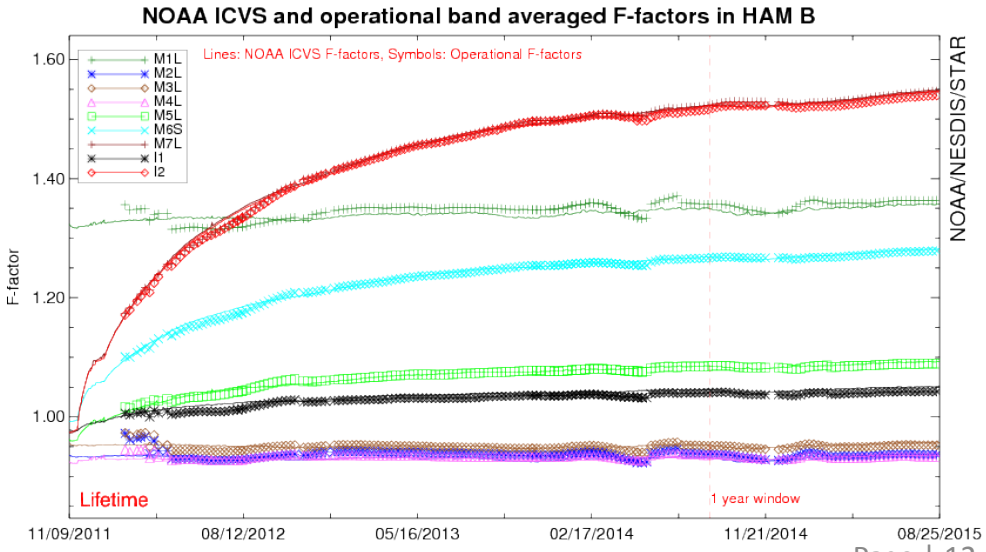




Major Accomplishments

- Developed ICVS H / F-factors
  - Independently developed to validate operational F-factor LUTs.
  - H/F-factors
  - Detector dependent F-factors
  - Operational F-LUTs vs. ICVS F-factors
  - Operational F-LUTs vs. RSBAutoCal F-factors (GRAVITE)





Future Improvements for J1

- RSB Calibration
  - Intermediate trending plots will be included from F-factor calculation
    - C coefficient trending plots
      - Detector and electronics temperature trending plots
    - $L_{sun\ model}$ and $L_{sun\ observation}$ trending plots
    - τ_{sds} and SD SNR trending plots

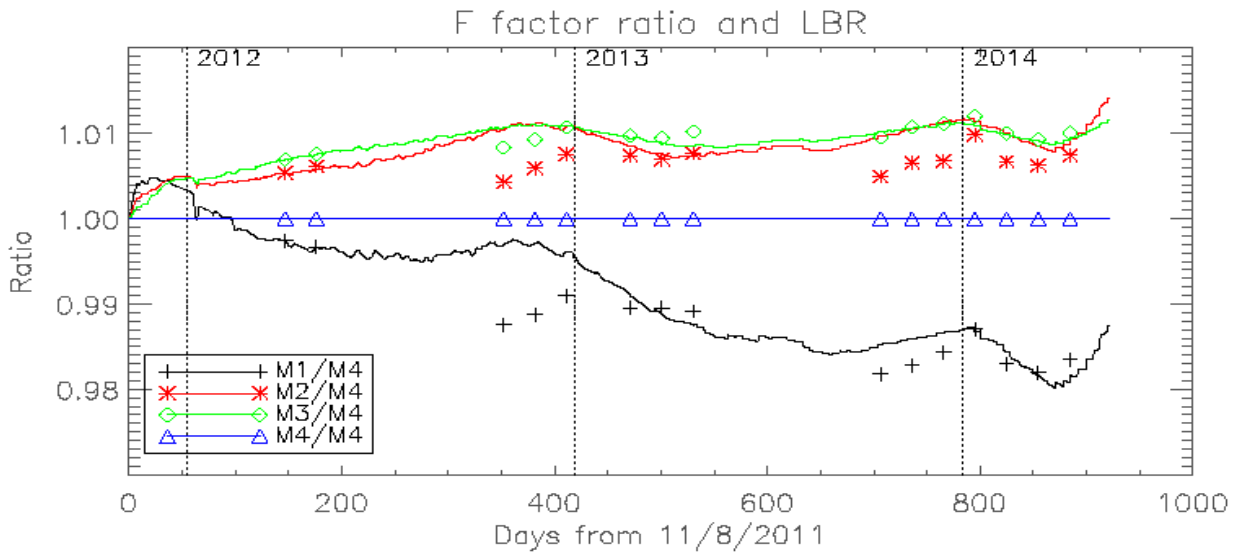
$$F = \frac{L_{Sun_Model}}{L_{Sun_Observation}} = \frac{Computed_L_{Sun}}{Observed_L_{Sun}}$$

$$F = \frac{\cos(\theta_{inc}) \cdot \left[E_{sun} \cdot \tau_{sds} \cdot BRDF(t)\right] \cdot RVS_{SD}}{c_0 + c_1 \cdot dn_{SD} + c_2 \cdot dn_{SD}^2}$$

Future Improvements for J1

- RSB Calibration and Validation
  - Lunar Band Ratio (LBR)
  - Lunar F-factor using Miller or ROLO model

$$\mathrm{LBR(B)} = \frac{\sum L_{Pixel}(B)}{\sum L_{Pixel}(Band\ M4)}$$



Future Improvements for J1

- TEB Calibration
  - Current TEB calibration in ICVS webpage is 'linear slope'.

$$Linear\ \ Slope = \frac{L_{BB}}{DN_{BB} - DN_{SV}}$$

  - The official TEB F-factors and related trending plots will be added.
    - C Coffs., BB Temp., L_{ap}, L_{Bkgr}, εL_{BB}, etc.

$$F = \frac{L_{BB_Model}}{L_{BB_Observation}} = \frac{Computed_L_{BB}}{Observed_L_{BB}} = \frac{RVS_{BB} \cdot L_{ap} + L_{Bkgr}}{c_0 + c_1 \cdot dn_{BB} + c_2 \cdot dn_{BB}^2}$$

$$L_{ap} = \varepsilon L_{BB} + (1-\varepsilon)(F_{RTA}L_{RTA} + F_{BB_SH}L_{BB_SH} + F_{CAV}L_{CAV})$$

$$L_{Bkgr} = (RVS_{BB} - RVS_{SV}) \cdot \left[\frac{(1-\rho_{RTA})L_{RTA} - L_{HAM}}{\rho_{RTA}} \right]$$

Future Improvements for J1

- DNB Calibration
  - Gain, gain ratio, and intermediate values will be added to ICVS web.
  - Values will be compared to the delivered operational LUTs.

$$A(\text{det}, N_{agg}, LGS) = \frac{RVS_{SD} \cdot \cos(\theta_{inc}) \cdot E_{sun} \cdot \tau_{sds} \cdot BRDF(t)}{dn_{SD}(\text{det}, N_{agg}, LGS)}$$

$$dn_{SD}(\text{det}, N_{agg}, LGS) = DN_{SD}(\text{det}, N_{agg}, LGS) - DN_{SV}(\text{det}, N_{agg}, LGS)$$

$$BRDF(t) = H_{Norm}(t) \cdot BRDF(t_0), \quad H_{Norm}(t) = H(t) / H(t_0)$$

$$H(t) = \frac{dc_{SD} \cdot \tau_{SDSM}}{dc_{SUN} \cdot BRDF(t_0) \cdot \tau_{SDS} \cdot \cos(\theta_{inc}) \cdot \Omega_{SDSM}}$$

Gain transfer by ratios

$$A(\text{det}, N_{agg}, MGS) = \overline{R}_{M:L}(\text{det}, N_{agg}) \cdot A(\text{det}, N_{agg}, LGS)$$

$$A(\text{det}, N_{agg}, HGS) = \overline{R}_{H:M}(\text{det}, N_{agg}) \cdot A(\text{det}, N_{agg}, MGS)$$

Summary

- STAR Integrated Cal/Val System (ICVS) Long Term Monitoring (LTM) system provides comprehensive near real time and long term instrument status and performance monitoring.
  - From imagery global coverage to detailed radiometric calibration status.
- STAR ICVS LTM code is ready for J1.
  - Functionality has been validated using J1 proxy data
  - Generated quality flag images
  - Generated intermediate daily/long-term calibration HDF files.
  - Generated telemetry plots successfully.
- STAR ICVS LTM capabilities will be improved.
  - By adding intermediate RSB F-factor trending plots.
  - Lunar Band Ratio (LBR) and lunar F-factor validation
  - Improving TEB calibration related plots
  - DNB calibration detailed trending plots.