

VIIRS J1 - J4 status update

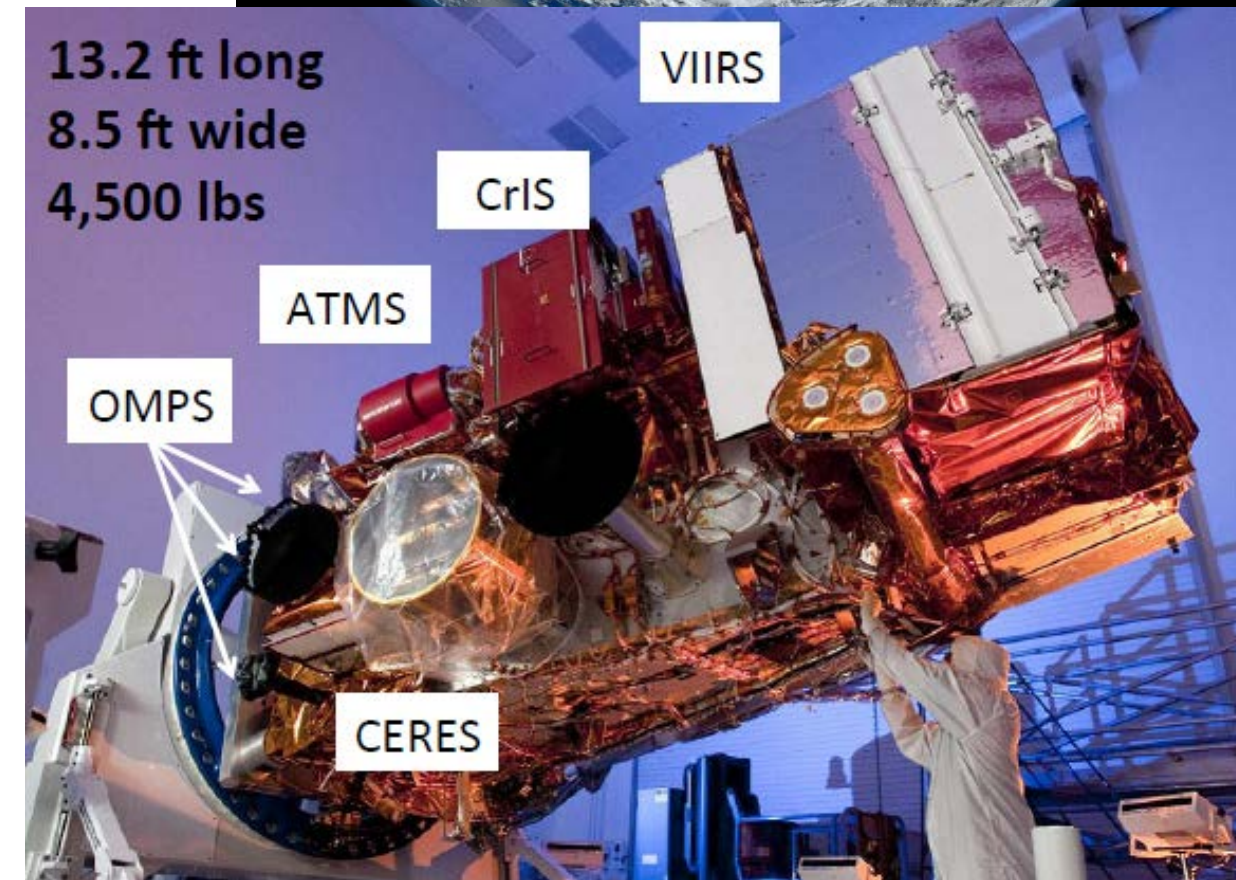
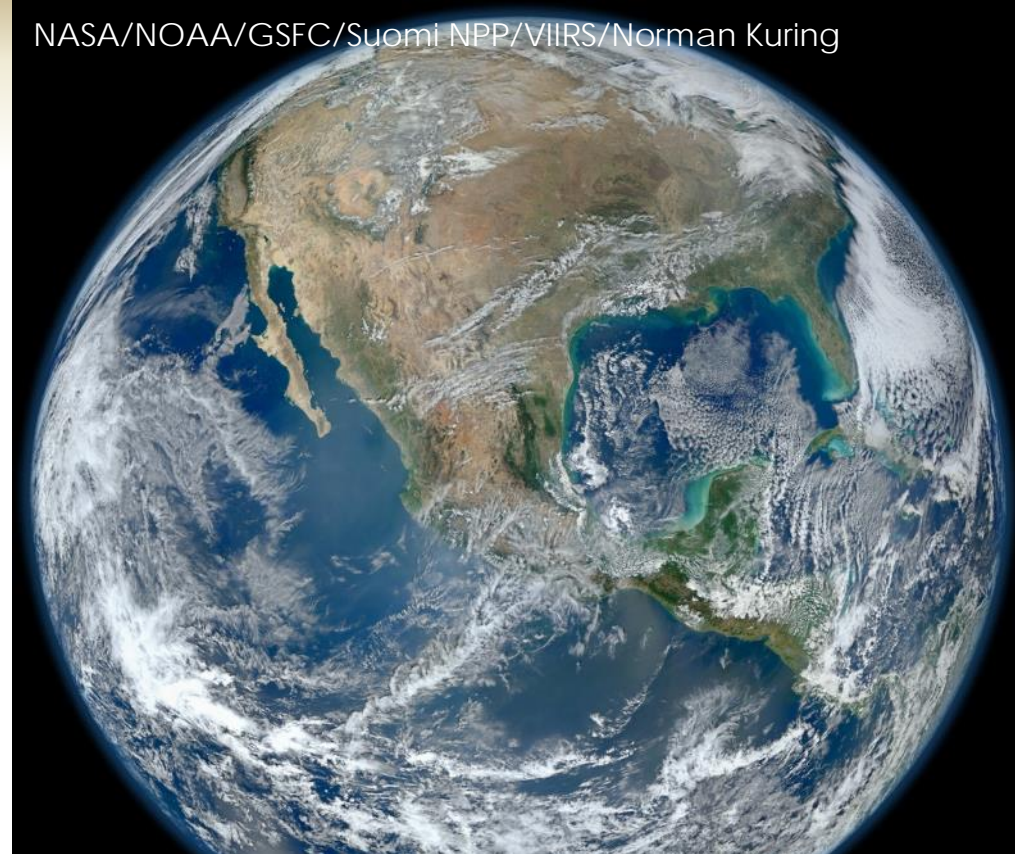
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VIIRS reminder

Provides visible and infrared imagery and global observations of land, atmosphere, cryosphere and oceans

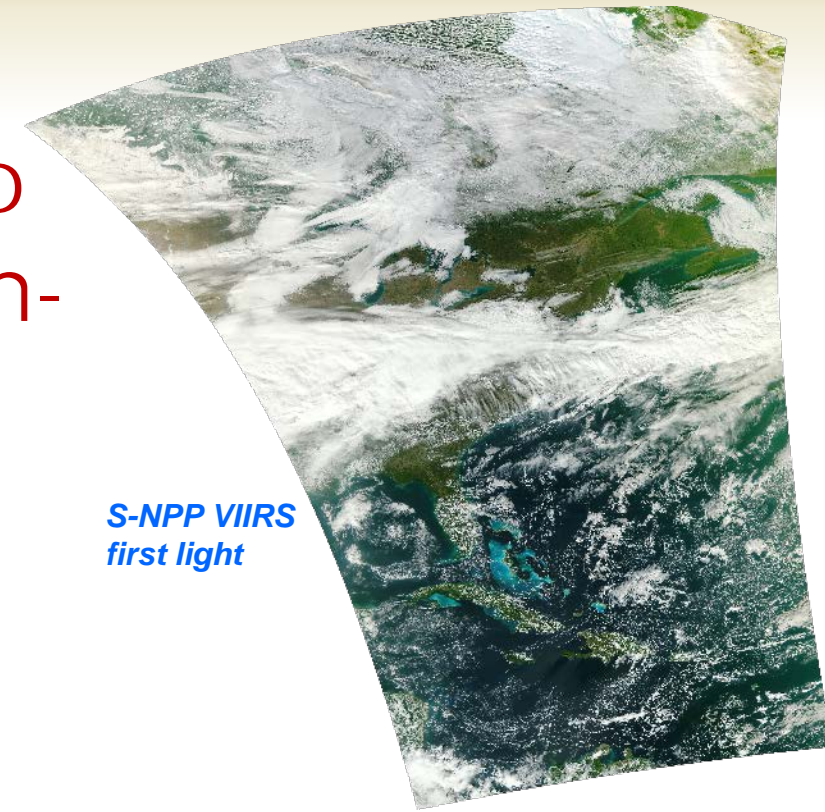
- Generates critical environmental products about snow and ice cover, clouds, fog, aerosols, fire, smoke plumes, dust, vegetation health, phytoplankton abundance and chlorophyll
- Extends and improves measurements initiated by AVHRR and MODIS
 - Better spatial resolution
 - Larger swath
 - Day/Night Band



What you should get from this talk

VIIRS is primarily an operational sensor but is also part of a legacy of sensors to understand earth-atmosphere system

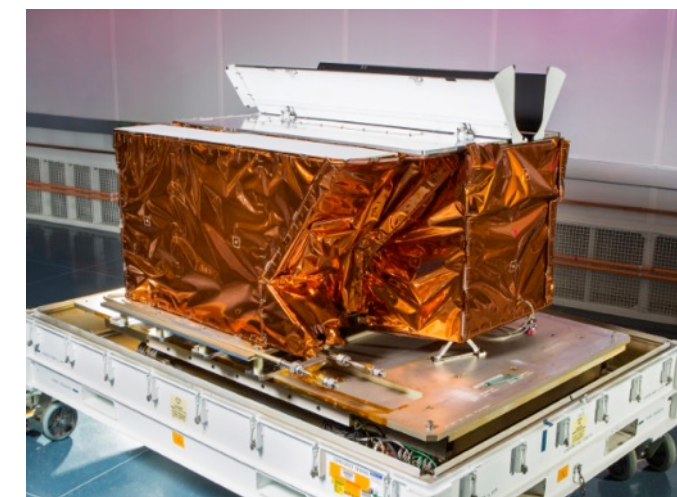
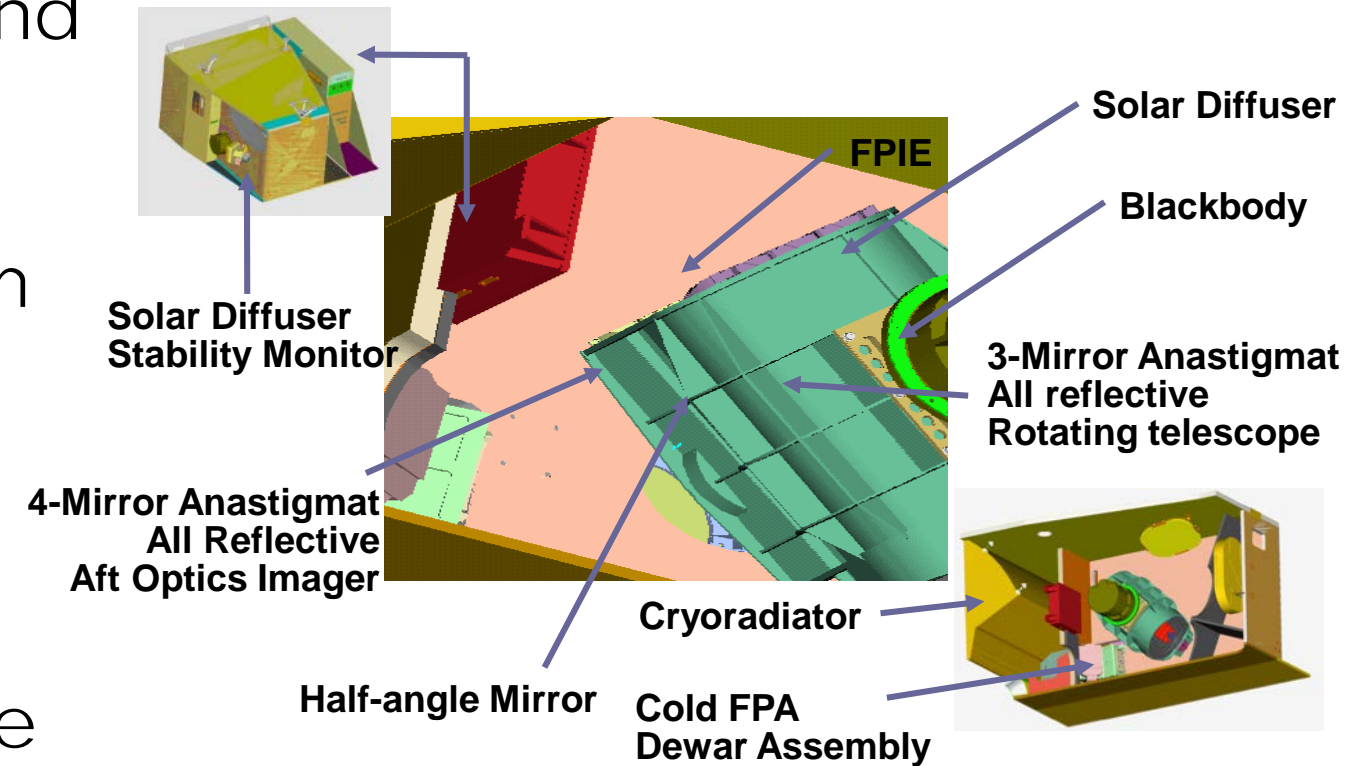
- S-NPP, J1, J2, J3, J4 have same basic design but will not be identical
- The more sensors we build, the more we learn about behavior of current systems and the future builds
- J1 VIIRS is well understood and should provide a worthy follow-on to S-NPP VIIRS
- J2 is on its way to being as well understood as J1
- J3 and J4 have already begun component-level hardware assembly



Overview of pre-launch testing objectives

Characterize overall performance and identify potential noncompliance issues

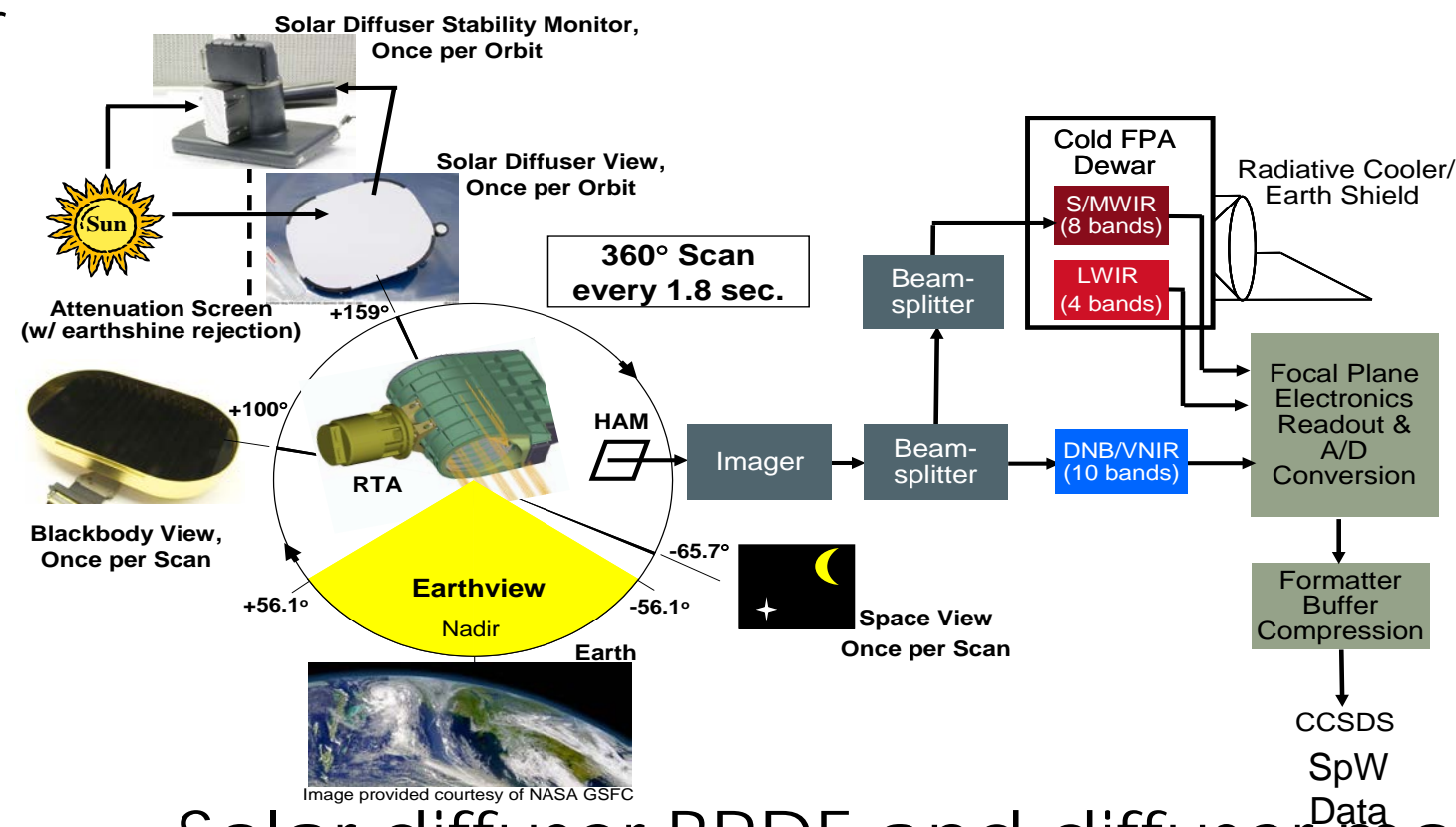
- Testing includes radiometric, geometric, and spectral performance
- Component and Sub-system Level
- Sensor Level ambient, pre-thermal vacuum (TVAC), TVAC, and post-TVAC
- Observatory Level
- Ensure sensor performance meets design requirements
- Check that sensor data quality will achieve overall science objectives
- Allows key sensor performance parameters to be derived for on-orbit operation and calibration
- Support mitigation strategies to address noncompliance issues



Pre-launch characterization/calibration

Tests also include evaluation of the full system including
onboard calibrators

- Radiometric - SNR/NE Δ T, detector gains and dynamic range
- Spectral - In-band and out-of-band relative response
- Spatial and geometric including band-to-band registration, modulation transfer function, and pointing
- Thermal testing
- Electromagnetic interference
- Response versus scan-angle
- Vibration testing



- Solar diffuser BRDF and diffuser monitor screen transmission function
- Polarization sensitivity
- Blackbody emissivity
- Stray light

Test data evaluation is a team effort

Collaborative and independent assessments by sensor vendor (Raytheon SAS) and government teams

- Government Team includes Aerospace Corp., U. of Wisconsin, NASA, NOAA
- Periodic reviews
 - Data Review Boards to evaluate results presented by sensor team
 - Data Analysis Working Group to evaluate results primarily from government team
 - Special technical interchange meetings
 - Regular briefing at NOAA VIIRS SDR meetings

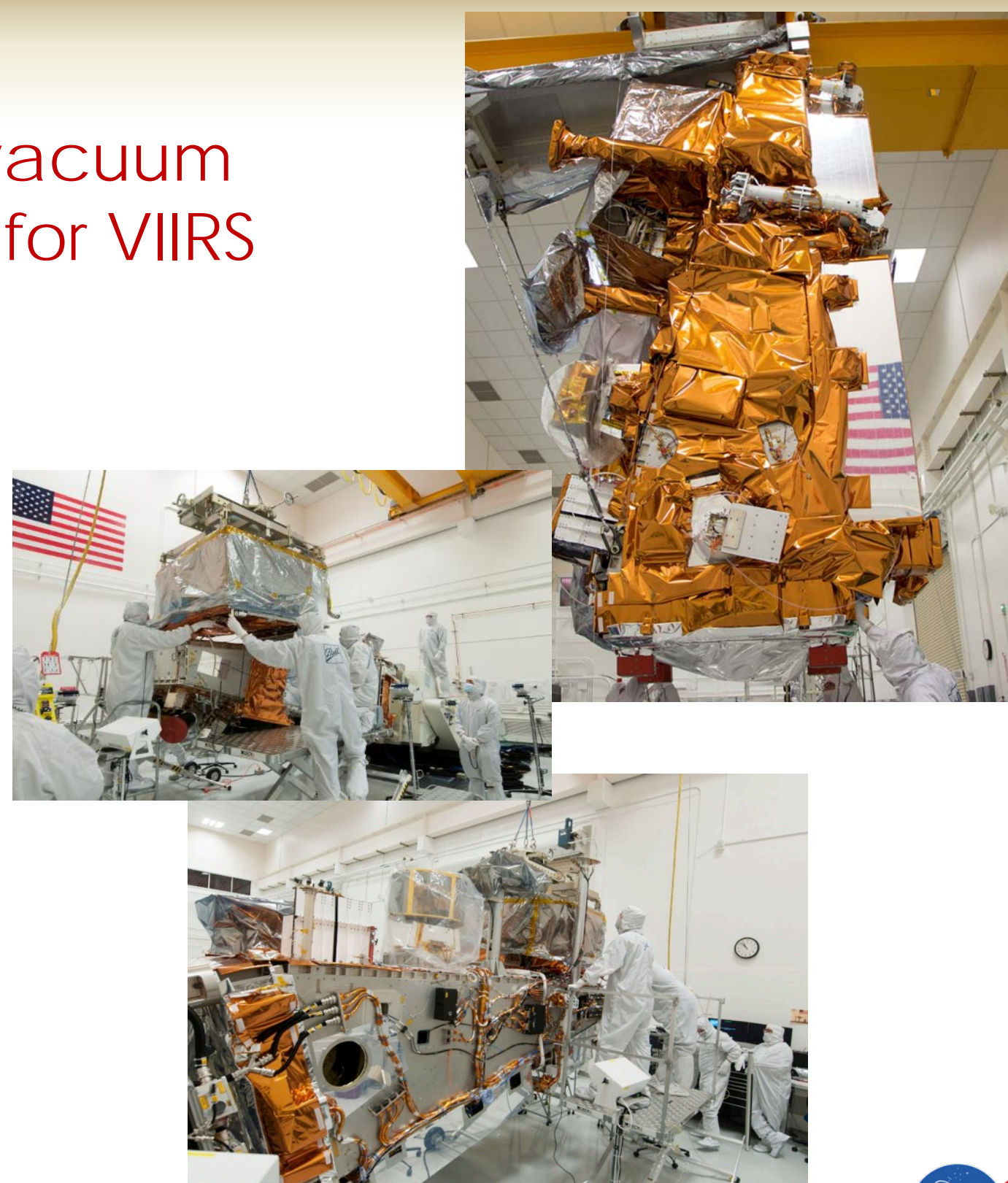


Raytheon/NASA Team – J1 Sensor Shipping from RTN

J1 VIIRS

Initial J1 observatory-level thermal vacuum (TVAC-1) testing showed no issues for VIIRS

- TVAC-2 indicated cryoradiator thermal margin was lower than expected based on J1 Sensor TVAC test data
 - Led to added testing for other plateaus within the TVAC-2 testing
 - Radiometric performance is met at the 3 temperature setpoints but predicted M14 SNR margin at end of life does not meet requirement
- VIIRS is bagged and ready for shipment to Vandenberg

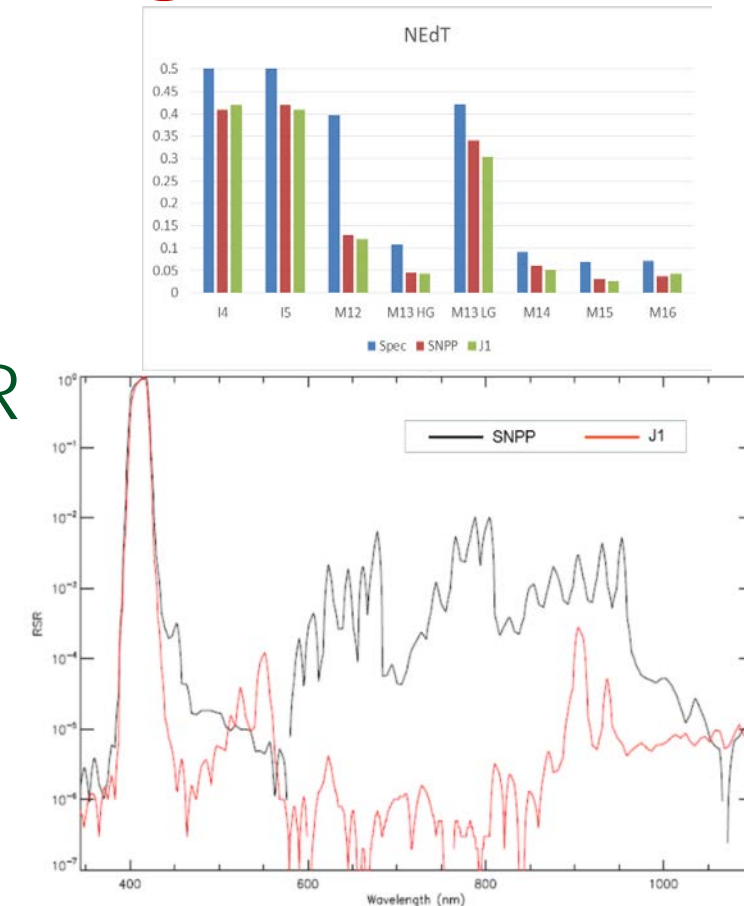


VIIRS J1 installation on the Spacecraft

Reminder – key changes to J1 relative to S-NPP

Lessons learned in the testing and evaluation of S-NPP VIIRS led to several modifications to J1 VIIRS including:

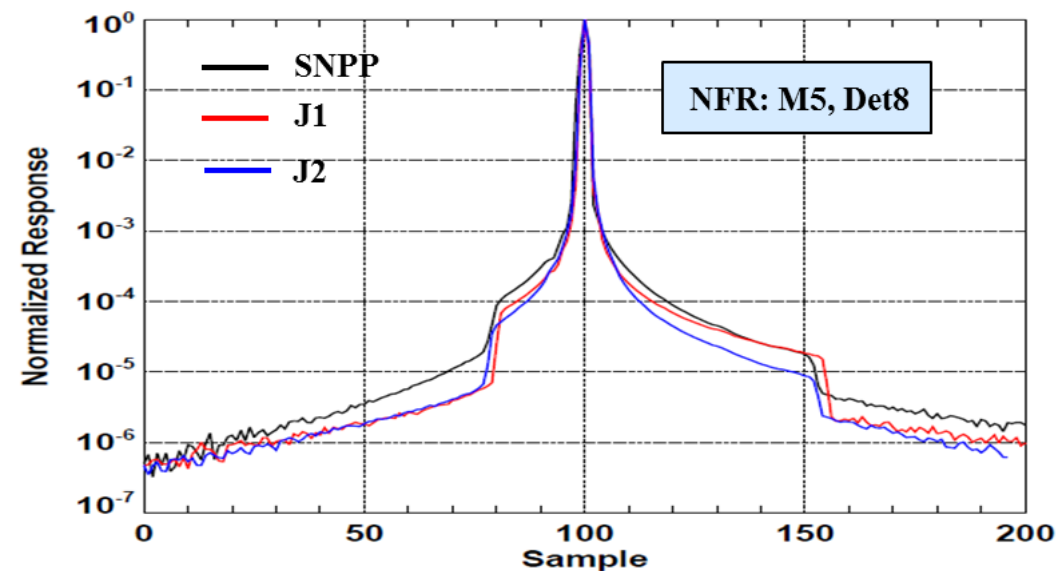
- RTA Mirrors Changed from nickel coated to VQ
 - Improved spatial stability with temperature
- Dichroic 2 Coatings Redesigned
 - Improved spatial performance between SMWIR & LWIR
- Eliminated Throughput Degradation Due to Tungsten
 - Improved radiometric sensitivity
- Enhanced VisNIR Integrated Filter Coating Change
 - Improved crosstalk, out-of-band performance
 - But, led to higher polarization sensitivity for Bands M1 – M4
- Build variations between J1 and S-NPP led to several performance differences between the two including 15 performance waivers and their associated mitigation plans or impact evaluations



J2 VIIRS currently in TVAC testing

Performance testing and evaluation is following similar path as done for S-NPP and J1

- Evaluating J2 relative to J1
- Pre-TVAC testing with GLAMR (GSFC Laser for Absolute Measurement of radiance tunable laser
- PER took place last fall followed by vibration, electromagnetic interference and compatibility (EMI/EMC), pre-TVAC
- TVAC testing began earlier this summer

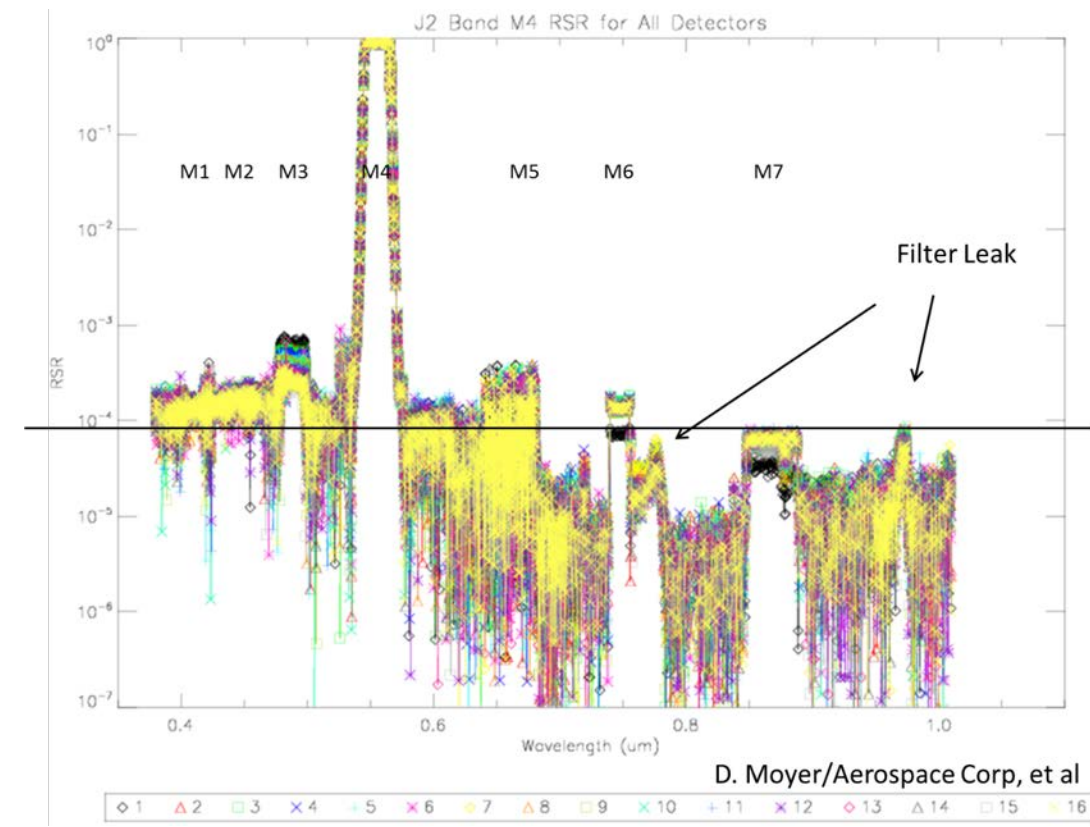
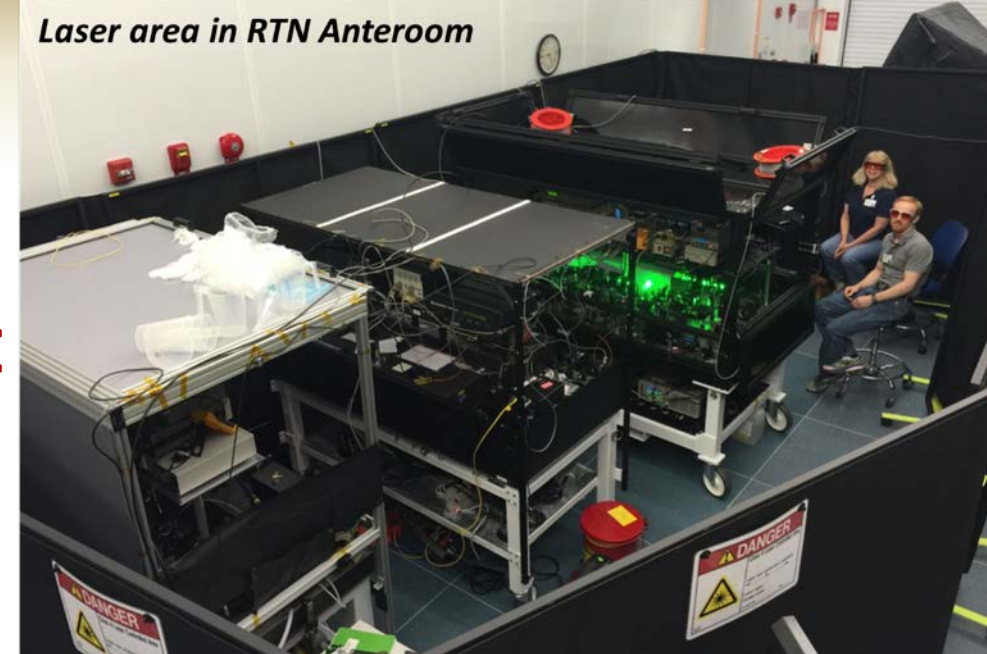


J2 VIIRS on vibe table

Reminder – key changes to J2 relative to J1

JPSS-2 VIIRS similar to predecessors, with multiple performance improvements including:

- Redesign of VisNIR integrated filter assembly (IFA) filter to reduce polarization sensitivity
- Changes to aft optics assembly (AOA) fold mirror #2
- Eliminated SWIR and DNB non-linearity issues seen in J1
- J2 test program includes lessons-learned:
 - Better efficiency
 - Cost reductions
 - Enhanced stray light testing
 - Shorter crosstalk testing
- Early results indicate no major issues with J2 VIIRS



J2 VIIRS is performing well

But, as with all sensors, there are features that will affect the quality of the data

- Studies of the optical results from J2 VIIRS indicated a scan underlap
 - Present in J1 VIIRS
 - Build variations in optics means that S-NPP VIIRS data minimally affected
 - Modifications to J2 VIIRS optical system and sampling approach has mitigated this issue
 - Effect on science should be limited
- Testing of the onboard blackbody uniformity returned a value that exceeds the subsystem uniformity requirement
 - Still in the early stages of determining possible cause
 - Unclear at this point whether it will impact J2 VIIRS performance

Other J2 features

- J2 testing has included added thermal tests to gain better understanding of the cryoradiator model
- Polarization characterization has a requirement that uncertainty is to be less than 0.5% (1 sigma) for scan angles less than 55.84 degrees
 - VIIRS instrument level polarization test uses a lamp-based, spherical integrating source (SIS)
 - On orbit VIIRS sees top of atmosphere (TOA) radiance based on solar illumination
 - Polarization model now has a better model for SIS – TOA uncertainty
 - Band M1 is most sensitive to SIS- TOA uncertainty
 - Issue found while attempting to determine the best optical elements to use for the J3 instrument
 - Possible additional testing after TVAC is being weighed that would better simulate the expected on-orbit solar spectrum

J3/J4 lessons learned

Instrument Heritage Review took place last year to determine possible modifications for J3/J4 relative to J2

- Decreased polarization sensitivity of M1 through appropriate selection and characterization of dichroic beamsplitters
- Eliminating near-IR out-of-band leak in solar diffuser stability monitor (SDSM) filters
- Satisfy end-user/science need to minimize scan-to-scan underlap
- Identifying methods to ensure system performance for J3/J4 after an expected 10+ years on the shelf
- J1+ Test & Verification Lessons Learned under evaluation for J3+

J3/J4 VIIRS is already beginning assembly

- Electronics Module circuit card assemblies (CCAs) in build+test, focal plane arrays (FPAs) in work (J2 Spares), opto-mechanical module procurements
- J3 DNB/FPIE Testing
- Raytheon exploring options for dichroic beamsplitter (DBSP-1) to reduce band M1 polarization
- Raytheon determined method to select solar diffuser panels with reduced susceptibility to on-orbit UV degradation
- Near-term future efforts
 - OMM lower level assembly builds
 - Continue EM and OMM electronic CCA builds
 - Start FPIE/DNB TVAC Test
- Work on the final integration of the J4 Spare DNB build

Getting ready for J1 launch - Post-launch tests - PLTs

J1 VIIRS has a clearer idea of how the sensor will be tested and evaluated during commissioning

- Thanks to the efforts from the JPSS flight team at GSFC, members of STAR at NOAA, and Raytheon
- PLTs based on the lessons learned during S-NPP testing
- Tailored toward the lessons learned during pre-launch tests
- Balance of
 - Vendor has to verify requirements for sell off
 - Early data points for instrument trending
 - One-off collections for sensor understanding
 - Early characterizations that can only be done shortly after launch

Example Post Launch Tests (PLTs)

Pitch Offset (Backflip) for Instrument Calibration
Spacecraft Jitter Characterization Post Launch
Consolidated SEU Trending
VIIRS Compressed Emissive Band Calibration
VIIRS Solar Diffuser Characterization Maneuver
VIIRS Lunar Roll Calibration and Sector Rotation
CERES Solar Calibration/ Interference/ Glint
Evaluation, & OMPS Solar Diffuser
Goniometric Calibration Maneuver
VIIRS Activation
VIIRS Dynamic Range and Linearity Verification
VIIRS Solar Diffuser Calibration

Conclusions

A five sensor development program for operational measurements is a challenge

- Lessons learned from S-NPP to J1 to TVAC testing of J2 have led to improvements along the way
 - Sensors will always have build-to-build variations
 - Collaboration between all groups involved has improved and led to better understanding of each subsequent sensor
- J1 VIIRS is bagged and ready for its post-launch testing
- J2 has been baked, shaken, irradiated, and is now in a cold, dark, airless place
- J3 and J4 are progressing through subsystem builds
- J1 and J2 both show differences from S-NPP but all indications are the data from both will be readily incorporated into the operational processing as well as fit within the longer history of previous sensors