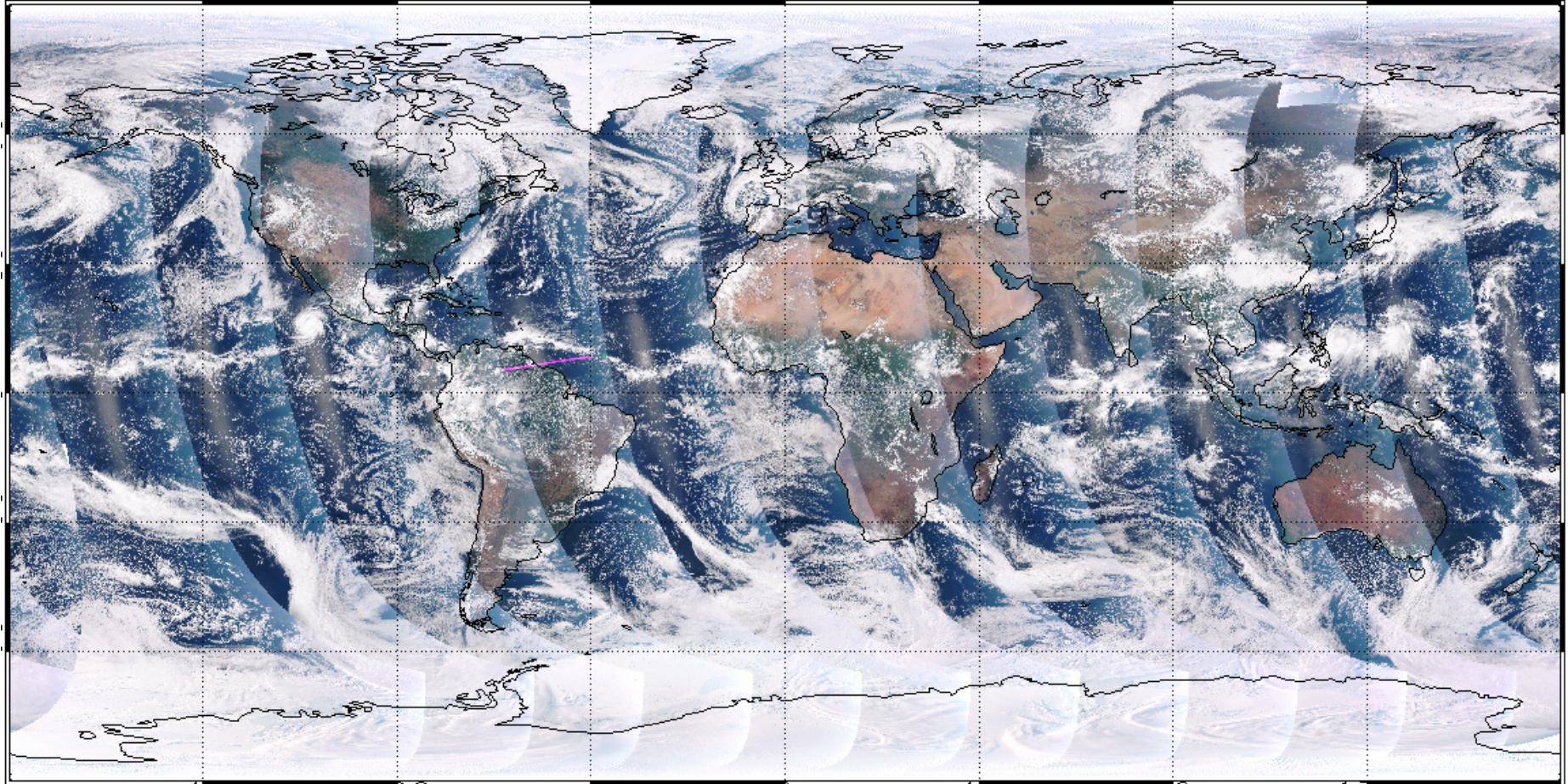




# Suomi NPP VIIRS SDR Postlaunch Cal/Val NOAA Report on Progress and Challenges



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**NOAA/NESDIS/STAR**

With contributions from NOAA and NASA scientists

*Presented at the CEOS WGCV-35, Hyderabad, India, 24-28 September 2012*

# VIIRS Sensor Data Records

- SDRs (Sensor Data Records) = Level 1b  
= calibrated, geolocated radiance, reflectance, and brightness temperature
- 22 types of SDRs
  - 16 Moderate resolution (MOD)
    - 11 Reflective Solar Bands (RSB)
    - 5 Thermal Emissive Bands (TEB)
  - 5 Imaging resolution (IMG)
    - 3 RSB, 2 TEB
  - 1 Day Night Band (DNB) imaging, broadband
- 6 non-gridded geolocation products
  - MOD ellipsoid, MOD terrain corrected, MOD unaggregated, IMG ellipsoid, IMG terrain corrected, DNB
- 2 gridded geolocation products
  - MOD, IMG



*Extent of a four-granule  
VIIRS SDR image*

*Bands M5, M4, M2  
shown as RGB*



MOD M5, M4, M2 as RGB



IMG I3 (SWIR)





# VIIRS SDR Cal/Val Team

- NOAA/NESDIS/STAR
- The Aerospace Corp.
- NASA/VCST
- University of Wisconsin
- MIT Lincoln Laboratory
- Raytheon
- NGAS

## VIIRS 58 Cal/Val tasks:

- Functional Performance & Format Evaluation (7)
- Calibration System Evaluation (7)
- Image Quality Evaluation (4)
- Radiometric Evaluation (24)
- Geometric Evaluation (9)
- Performance and Telemetry Trending (7)

## Interacting with:

- Data Products and Algorithms teams
- NCEP users
- NSOF operators
- Environmental Data Record (EDR) teams


VIIRS SDR team weekly teleconferences, reports, technical tag-ups, blogs, and wiki

# EDRs Derived from VIIRS SDRs

<b>Land (10)</b>	Active Fires (Application Related Product)
	Land Surface Albedo
	Land Surface Temperature
	Ice Surface Temperature
	Snow Ice Characterization
	Snow Cover/Depth
	Vegetation Index
	Surface Type
	Soil Moisture
	Net Heat Flux
<b>Ocean (2)</b>	Sea Surface Temperature (KPP)
	Ocean Color/Chlorophyll
<b>Imagery (1) and Clouds (8)</b>	Imagery (KPP)
	Cloud Mask (Intermediate Product)
	Cloud Optical Thickness
	Cloud Effective Particle Size
	Cloud Top Pressure
	Cloud Top Temperature
	Cloud Base Height
	Cloud Cover/Layers
	Precipitable Water
<b>Aerosols (3)</b>	Aerosol Optical Thickness
	Aerosol Particle Size
	Suspended Matter
<b>Low Light Imaging (1)</b>	Near Constant Contrast (NCC) Imagery

# VIIRS Calibration Knowledge Base and Data Access

- Simply Google “NOAA NCC” to access the Calibration Knowledge Base, which has a wealth of information on VIIRS, including user’s guide, relative spectral response, SNO predictions, image gallery, standardized parameters, sample code, conference presentations, etc.
- VIIRS SDR data are now available on an ftp site (last 90 days) at: <ftp://ftp-npp.class.ngdc.noaa.gov/>, or you can always go to the NOAA CLASS at <http://www.class.noaa.gov>



NCC

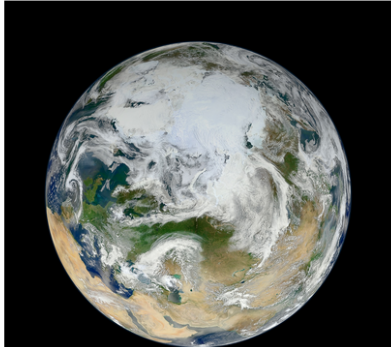
You are here: Foswiki > NCC Web > VIIRS

[Edit](#) [Attach](#)

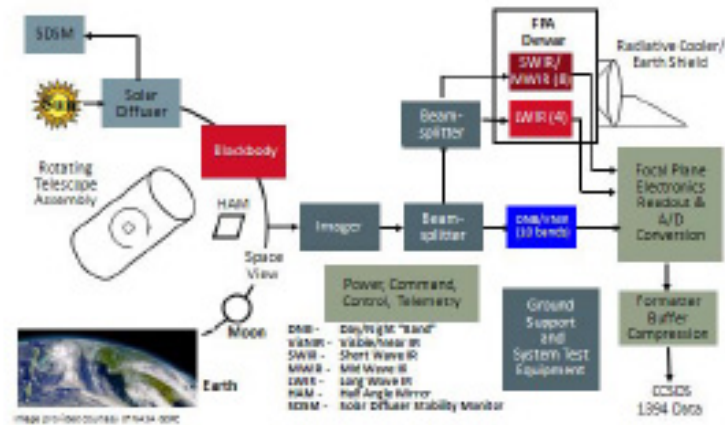
## Visible Infrared Imaging Radiometer Suite (VIIRS)

The VIIRS instrument is a scanning radiometer with multi-band imaging capabilities that make it extremely useful for moderate-resolution imagery as well as numerous applied measurements including cloud and aerosol detection and properties, ocean color, sea and land surface temperature, ice motion and temperature, fire detection, and Earth's albedo. It is scheduled to fly on the NPP and JPSS satellite missions. For more information, please click on one of the links below.

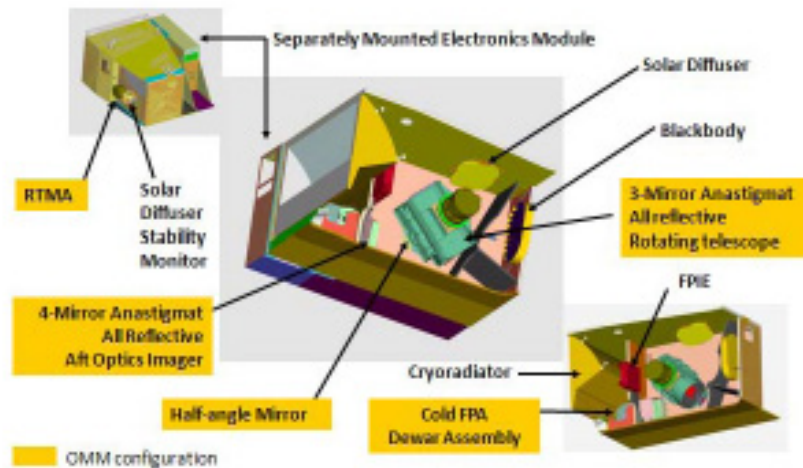
<a href="#">News</a>	<a href="#">About VIIRS</a>	<a href="#">Conference Presentations</a>
<a href="#">VIIRS SDR Data Format</a>	<a href="#">VIIRS Users Guide</a>	<a href="#">VIIRS Spectral Response Functions</a>
<a href="#">VIIRS Calibration ATBD</a>	<a href="#">NPP/AQUA SNO Predictions</a>	<a href="#">VIIRS Software Tools</a>
<a href="#">CasaNosa</a>	<a href="#">Data on GRAVITE</a>	<a href="#">SDR/EDR Team</a>
<a href="#">VIIRS at Cal/Val Sites</a>	<a href="#">Lunar Calendar for DNB</a>	<a href="#">Standardized Calibration Parameters</a>
<a href="#">VIIRS Image Gallery</a>	<a href="#">VIIRS On-orbit Performance Table</a>	<a href="#">Moon in Space View Events</a>
<a href="#">VIIRS Longterm Monitoring</a>	<a href="#">VIIRS Event Log Database (experimental)</a>	




# The VIIRS Instrument



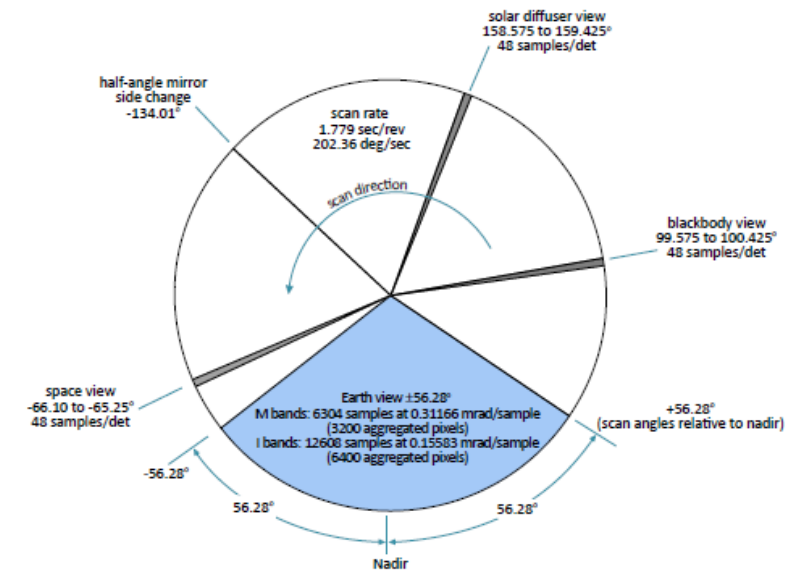
(a) Block Diagram



(b) Components

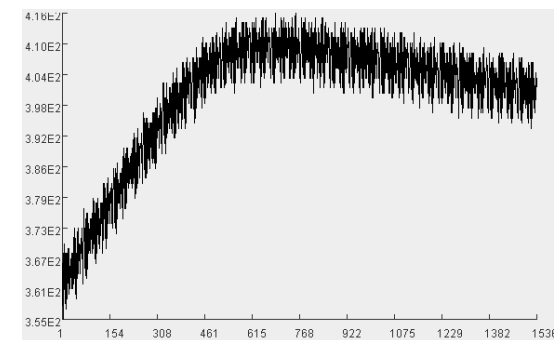
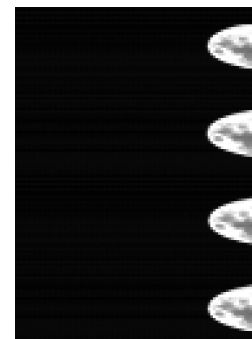
# VIIRS Onboard Calibration Comparisons

VIIRS	MODIS	AVHRR
Rotating telescope w/ half angle mirror	Paddle Mirror (large RVS effect)	45 deg mirror (image pixel rotation at high scan angles)
V-Grooved Blackbody	V-Grooved Blackbody	Honeycomb Blackbody
Space view	Space view	Space view
Solar diffuser + screen (VisNIR + <b>DNB</b> )	Solar diffuser + screen + <b>door</b> (VisNIR)	Vicarious (desert)
Solar diffuser stability monitor	Solar diffuser stability monitor	-
Lunar cal	Lunar cal	-
None	Spectroradiometric Calibration Assembly ( <b>SRCA</b> )	None

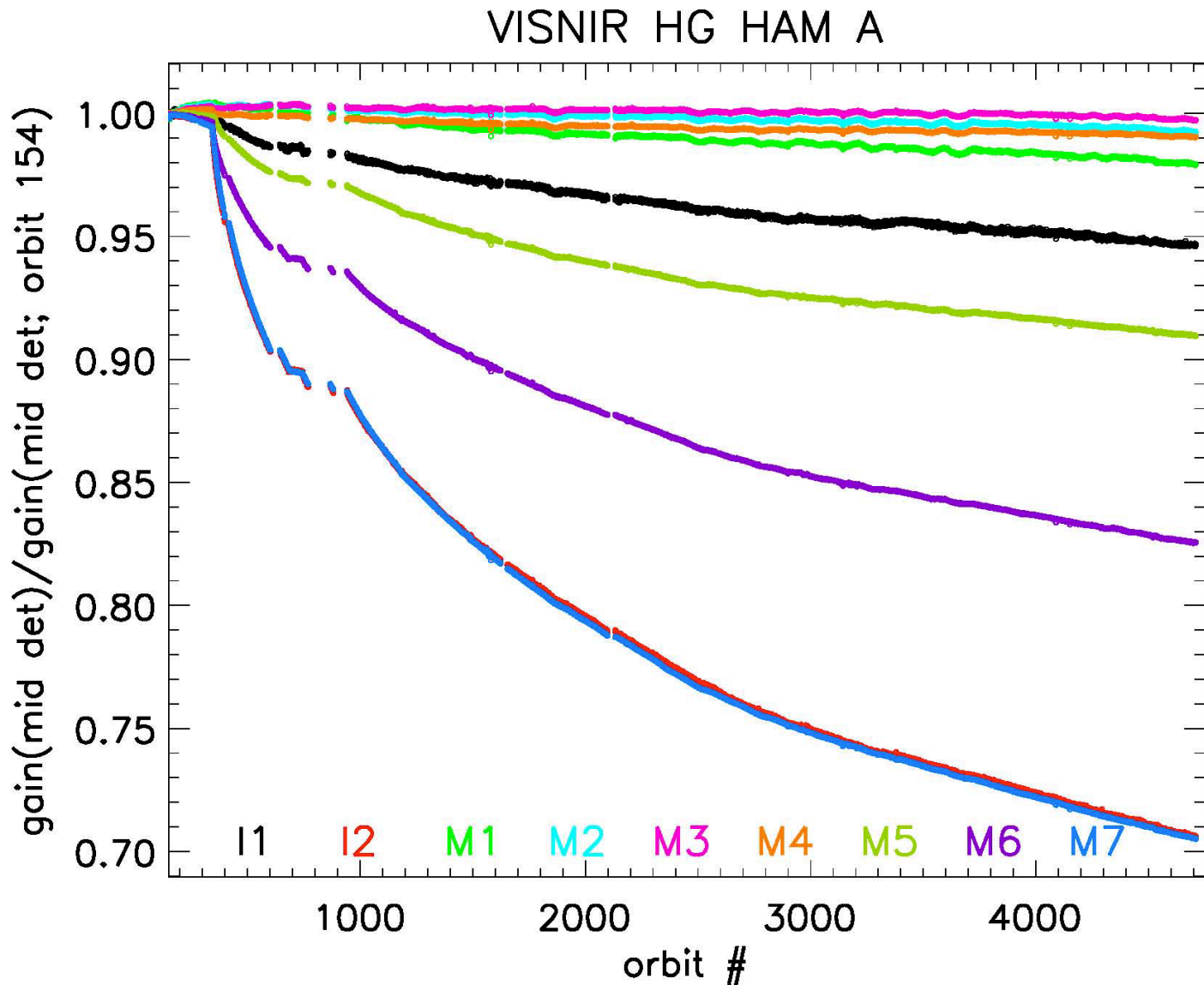


Source: VIIRS SDR User's Guide (v1.01)

<https://cs.star.nesdis.noaa.gov/NCC/VIIRS>



# VIIRS Mirror Degradation Status

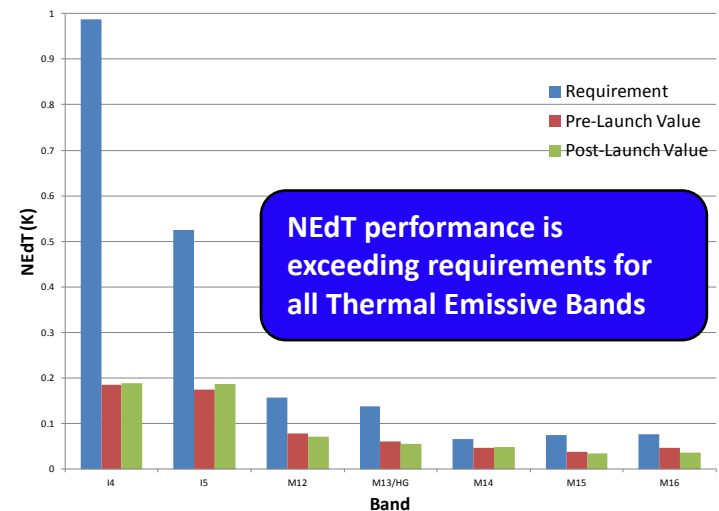
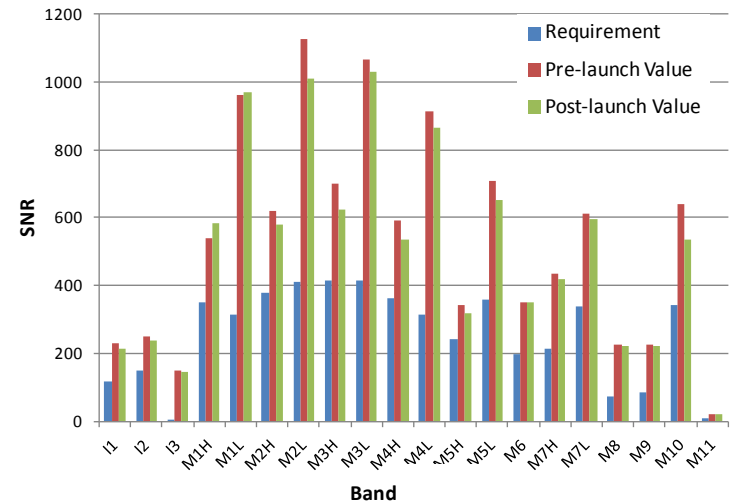




# VIIRS SDR Product Maturity

- Achieved Beta Status in April 2012
  - Early release product, initial calibration applied, minimally validated and may still contain significant errors
  - Available to allow users to gain familiarity with data formats and parameters
  - Product is not appropriate as the basis for quantitative scientific publications studies and applications
- Provisional Status Review Planned for October 2012
  - Product quality may not be optimal
  - Incremental product improvements are still occurring as calibration parameters are adjusted with sensor on-orbit characterization
  - General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing
  - Users are urged to contact NPP Cal/Val Team representatives prior to use of the data in publications
- Validated/Calibrated Status Expected in 2013
  - On-orbit sensor performance characterized and calibration parameters adjusted accordingly
  - Ready for use by the Centrals, and in scientific publications
  - There may be later improved versions

**SNR performance is exceeding requirements for all Reflective Solar Bands**

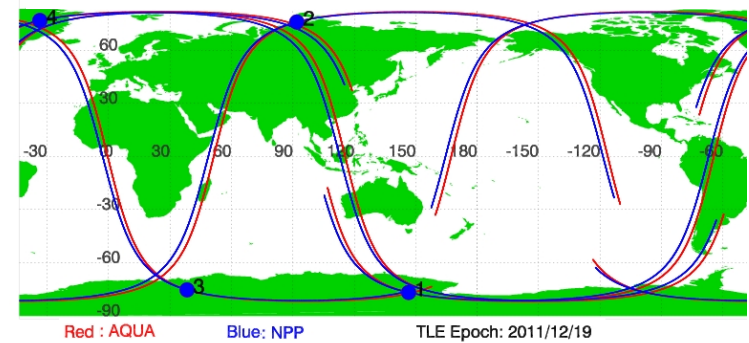


**NEdT performance is exceeding requirements for all Thermal Emissive Bands**

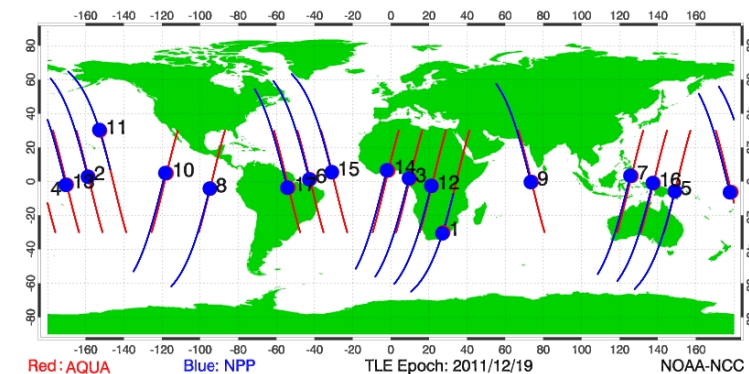
# SNO and SNO Extension to Low Latitudes

	SNO	SNOx
Time diff	30 sec	~10 mins
Nadir distance	< 10 km	~100 km
Location	Polar regions	Low latitudes
Surface	Snow/ice/ tundra	Ocean, desert, forest, etc.
Uncertainty factors	High solar zenith angle (SZA), ozone, ground truth	Sun glint, clouds, atmosphere, SZA difference
Use for inter-comparisons	Radiometric, Spectral	Radiometric, Geospatial, RVS, spectral

## SNO (Simultaneous Nadir Overpass)



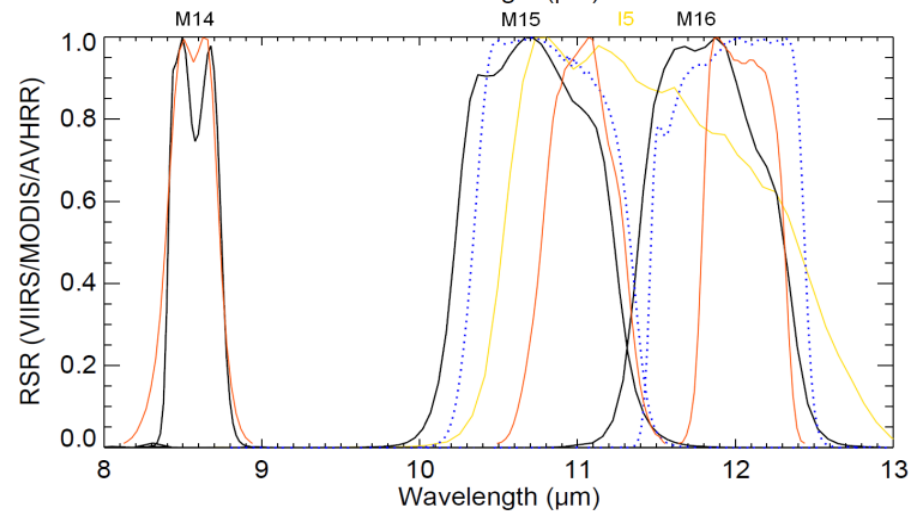
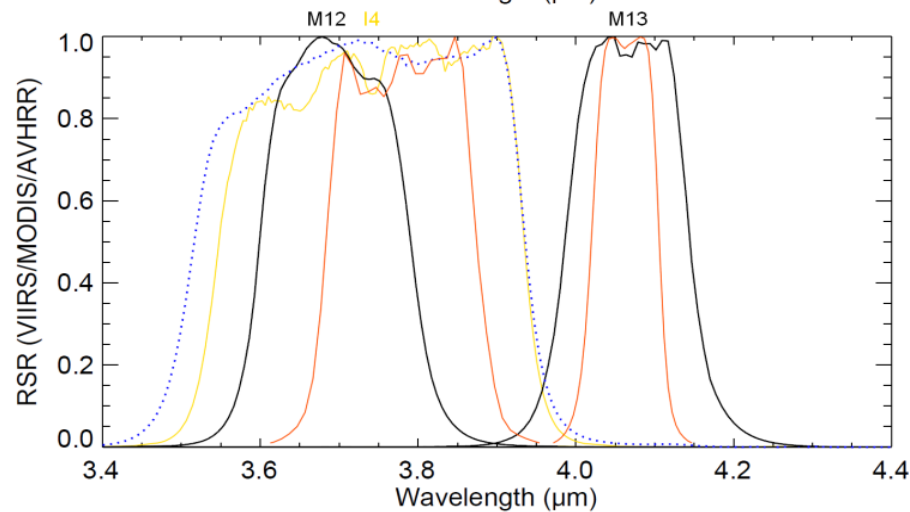
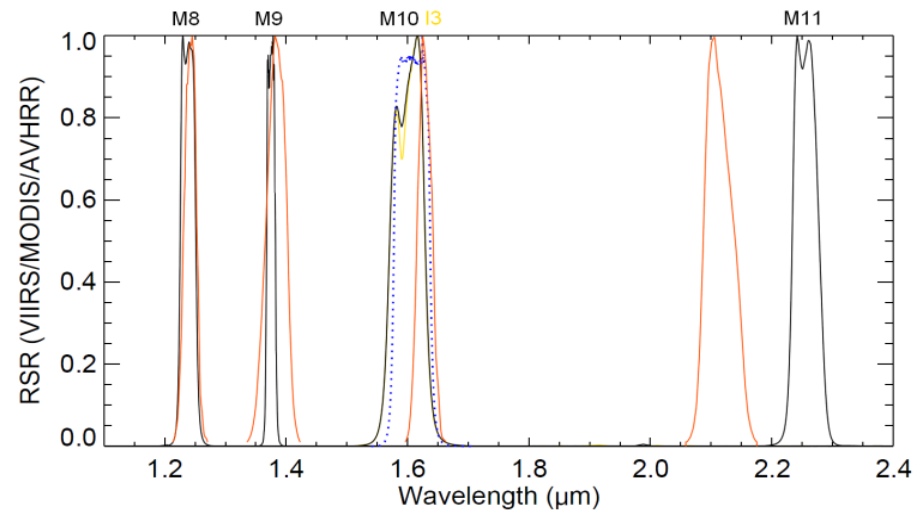
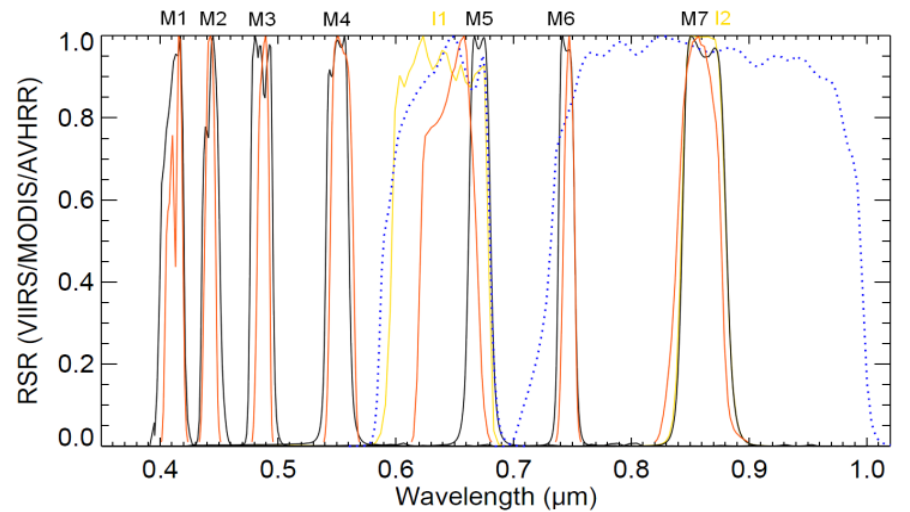
## SNOx (SNO extension to low latitudes)



The SNO/SNOx as well as daily SNPP orbital predictions are available at:

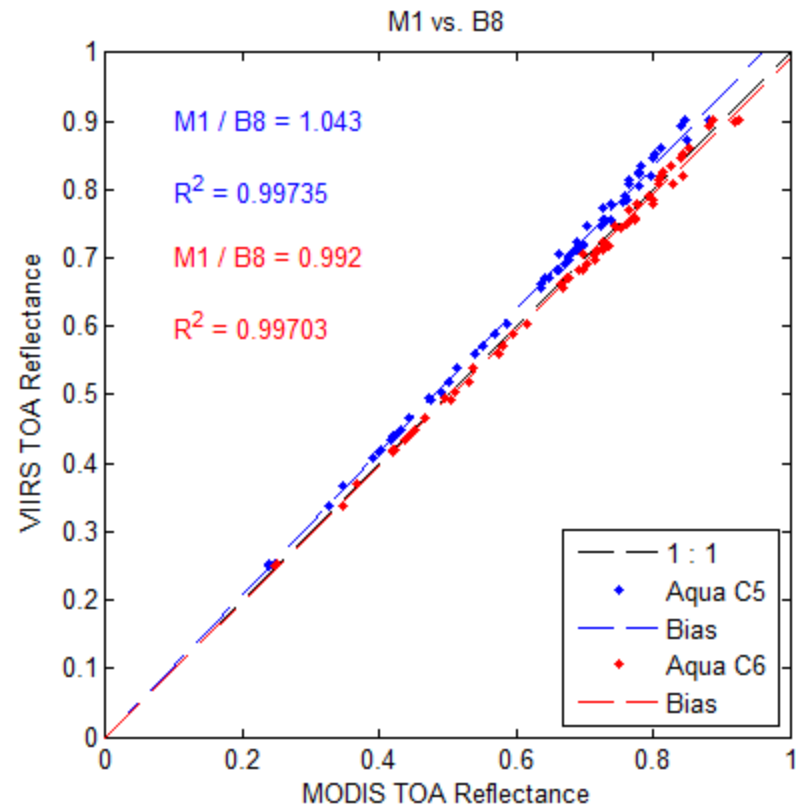
<https://cs.star.nesdis.noaa.gov/NCC/SNOPredictions>

# VIIRS, AVHRR, and MODIS Spectral Response Comparisons



# Assessment of Radiometric Biases Between VIIRS and MODIS

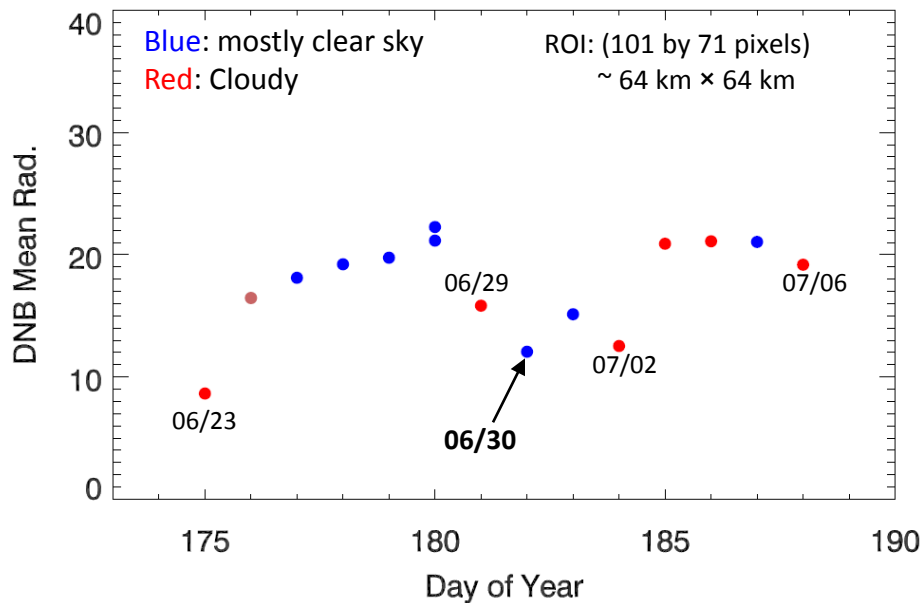
- A radiometric bias on the order of 5% between VIIRS band M1 and MODIS band 8 was found since February 2012
- After a thorough investigation by the VIIRS SDR team, the bias was found to be due to MODIS calibration drift in the Collection 5 (C5) data
- The bias disappears when VIIRS datasets are compared with the MODIS Collection 6 (C6) data, which was recently released by NASA to the public



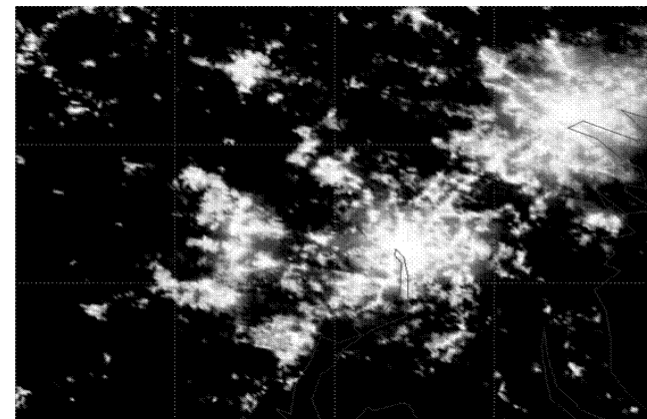
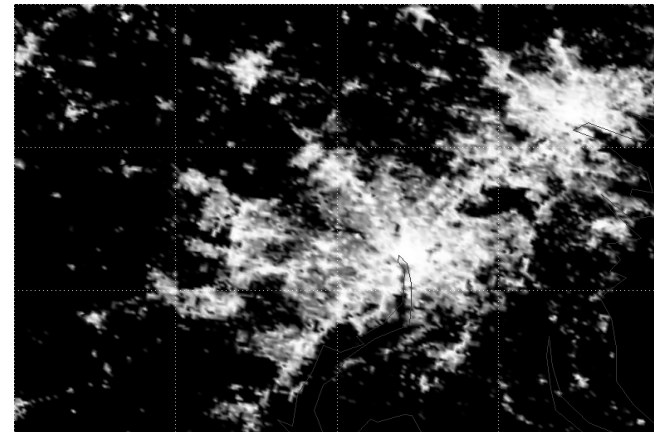


# Suomi NPP VIIRS Day Night Band

- Despite issues with stray light, DNB has been used to detect a major power outages in the Washington, DC on the night of June 29, 2012
- An analysis of the data after the storm showed that most areas had power restored within 3 days



*VIIRS DNB radiance time series before and after the power outage (6/29) shows that most of the power was restored in three days.*



*VIIRS DNB of the Washington/Baltimore area on June 26<sup>th</sup> (top) and June 30<sup>th</sup> (bottom): the suburbs west of DC and Baltimore show dark areas, in particular.*



# Challenges and Way Forward



- The dynamics of instrument degradations (mirror reflectivity, solar diffuser, and SDSM detectors) and their mitigation
- A-side vs. B-side electronics
- M6 band rollover when saturated
- Early VIIRS SDR data and reprocessing
- DNB stray light mitigation
- Further investigation of striping
- Instrument and spacecraft maneuvers
- Other issues:
  - Transition to operations
  - JPSS J1, J2 and beyond
  - Continue relying on the VIIRS SDR team for the heavy lifting

# Summary

- VIIRS radiometric performance is very good
  - Extensive pre-launch test program provided highly accurate calibration on orbit
  - SNR performance is consistent with pre-launch measurements and complies with requirements
  - Data quality appears to be comparable to that of MODIS (if not better)
  - RSB throughput degradation is being mitigated
  - DNB images are excellent except in regions affected by stray light
  - Additional tuning of SDR LUTs expected to improve radiometric quality
- VIIRS geometric performance is excellent ( $\sim 80$  m or  $\sim 1/4$  pixel)
- The VIIRS SDR team provides mission critical support, and will continue to work together to address challenges going forward and transition to operations