Suomi NPP VIIRS SDR Provisional Product Highlight

Changyong Cao, VIIRS SDR Team Managerial Lead

Suomi NPP SDR Product Review,
NOAA Center for Weather and Climate Prediction (NCWCP)
5830 University Research Park, College Park, Maryland
October 23 - 24, 2012
Product Maturity Definition

• Beta (L+150)
  – 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 (Beta+2mo)
  – 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 (L+20mo)
  – 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
The VIIRS SDR team:

• Verifies and ensures well-calibrated, & well-navigated SDR data

• Ensure SDR data quality and science integrity in the following areas:
  
  – Radiometric calibration
  – Spectral calibration
  – Geo-spatial calibration/navigation
  – Verification of SDR data
  – Instrument performance issues
### Table: 3.1.5.6.1-1  Sensitivity requirements for VIIRS Sensor reflective bands

<table>
<thead>
<tr>
<th>Band</th>
<th>Center Wavelength (nm)</th>
<th>Gain Type</th>
<th>Single Gain</th>
<th>High Gain</th>
<th>Low Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<tr>
<td>.</td>
<td>.</td>
<td>.</td>
<td>-</td>
<td>44.9</td>
<td>155</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
<td>Ltyp</td>
<td>352</td>
<td>316</td>
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<tr>
<td>M2</td>
<td>445</td>
<td>Dual</td>
<td>-</td>
<td>40</td>
<td>146</td>
</tr>
<tr>
<td>M3</td>
<td>488</td>
<td>Dual</td>
<td>-</td>
<td>32</td>
<td>123</td>
</tr>
<tr>
<td>M4</td>
<td>555</td>
<td>Dual</td>
<td>-</td>
<td>21</td>
<td>90</td>
</tr>
<tr>
<td>M5</td>
<td>672</td>
<td>Dual</td>
<td>-</td>
<td>10</td>
<td>68</td>
</tr>
<tr>
<td>M6</td>
<td>746</td>
<td>Single</td>
<td>9.6</td>
<td>199</td>
<td>-</td>
</tr>
<tr>
<td>M7</td>
<td>865</td>
<td>Dual</td>
<td>-</td>
<td>6.4</td>
<td>33.4</td>
</tr>
<tr>
<td>M8</td>
<td>1240</td>
<td>Single</td>
<td>5.4</td>
<td>74</td>
<td>-</td>
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<tr>
<td>M9</td>
<td>1378</td>
<td>Single</td>
<td>6</td>
<td>83</td>
<td>-</td>
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<tr>
<td>M10</td>
<td>1610</td>
<td>Single</td>
<td>7.3</td>
<td>342</td>
<td>-</td>
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<tr>
<td>M11</td>
<td>2250</td>
<td>Single</td>
<td>0.12</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>I1</td>
<td>640</td>
<td>Single</td>
<td>22</td>
<td>119</td>
<td>-</td>
</tr>
<tr>
<td>I2</td>
<td>865</td>
<td>Single</td>
<td>25</td>
<td>150</td>
<td>-</td>
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<tr>
<td>I3</td>
<td>1610</td>
<td>Single</td>
<td>7.3</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
- The units of spectral radiance for L_{typ} are watt m^{-2} sr^{-1} µm^{-1}.
- The SNR column shows the minimum required (worst-case) SNR that applies at the end-of-scan. Elsewhere in the scan, aggregation will yield a larger SNR.
- Within the same gain setting, at radiances larger than L_{typ}, the SNR will be larger than what is specified in this table.

**Absolute radiometric calibration uncertainty for uniform scenes:** < 2%
### Table 3.1.5.6.2-1  Sensitivity requirements for VIIRS Sensor emissive bands

<table>
<thead>
<tr>
<th>Band</th>
<th>Center Wavelength (nm)</th>
<th>Gain Type</th>
<th>Single Gain</th>
<th>Dual Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High Gain</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>Ttyp</td>
</tr>
<tr>
<td>M12</td>
<td>3700</td>
<td>Single</td>
<td>270</td>
<td>0.396</td>
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<tr>
<td>M13</td>
<td>4050</td>
<td>Dual</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M14</td>
<td>8550</td>
<td>Single</td>
<td>270</td>
<td>0.091</td>
</tr>
<tr>
<td>M15</td>
<td>10763</td>
<td>Single</td>
<td>300</td>
<td>0.070</td>
</tr>
<tr>
<td>M16</td>
<td>12013</td>
<td>Single</td>
<td>300</td>
<td>0.072</td>
</tr>
<tr>
<td>I4</td>
<td>3740</td>
<td>Single</td>
<td>270</td>
<td>2.500</td>
</tr>
<tr>
<td>I5</td>
<td>11450</td>
<td>Single</td>
<td>210</td>
<td>1.500</td>
</tr>
</tbody>
</table>

**Notes:**
- The NEdT column corresponds to the minimum required (worst-case) SNR that applies at the end-of-scan. Elsewhere in the scan, aggregation will yield a larger SNR.
- Within the same gain setting, at scene temperatures larger than Ttyp, the SNR will be larger than at Ttyp.
- For reference, the NEdT values in Table 15 are related to the noise equivalent spectral radiance (NEdL) by the following formula:

Source: JPSS VIIRS Performance Requirement Document
Code 472 472-00124
Table: 3.1.5.9.2.3-1  Absolute radiometric calibration uncertainty of spectral radiance for moderate resolution emissive bands

<table>
<thead>
<tr>
<th>Band</th>
<th>(\lambda_c) ((\mu)m)</th>
<th>190K</th>
<th>230K</th>
<th>270K</th>
<th>310K</th>
<th>340K</th>
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</thead>
<tbody>
<tr>
<td>.</td>
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<td></td>
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</tr>
<tr>
<td>M12</td>
<td>3.7</td>
<td>7.0%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
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<tr>
<td>M13</td>
<td>4.05</td>
<td>5.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>M14</td>
<td>8.55</td>
<td>12.3%</td>
<td>2.4%</td>
<td>0.6%</td>
<td>0.4%</td>
<td>0.5%</td>
</tr>
<tr>
<td>M15</td>
<td>10.763</td>
<td>2.1%</td>
<td>0.6%</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>M16</td>
<td>12.013</td>
<td>1.6%</td>
<td>0.6%</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Table: 3.1.5.9.2.4-1  Radiometric calibration uncertainty for imaging emissive bands

<table>
<thead>
<tr>
<th>Band</th>
<th>Center Wavelength (nm)</th>
<th>Calibration Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>I4</td>
<td>3740</td>
<td>5.0%</td>
</tr>
<tr>
<td>I5</td>
<td>11450</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Source: JPSS VIIRS Performance Requirement Document Code 472 472-00124
VIIRS On-orbit Performance

-SNR and NEDT

![Graphs showing SNR and NEDT performance for various VIIRS bands](image-url)
VIIRS On-orbit Performance Table

- SDRs = L1b = 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
  - DNB, IMG, IMG terrain corrected, MOD, MOD terrain corrected, MOD unaggregated
- 2 gridded geolocation products
  - MOD, IMG

<table>
<thead>
<tr>
<th>Band No.</th>
<th>Driving EDR(s)</th>
<th>Spectral Range (nm)</th>
<th>Spatial Resolution (km)</th>
<th>Band Gain</th>
<th>In Temp</th>
<th>Lin Max</th>
<th>Spec SNR</th>
<th>Measured SNR</th>
<th>Measured SNR</th>
<th>Measured SNR</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Ocean Color Aerosol</td>
<td>0.402 - 0.422</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>High</td>
<td>44.9</td>
<td>135</td>
<td>352</td>
<td>616.6</td>
<td>575</td>
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<tr>
<td>M2</td>
<td>Ocean Color Aerosol</td>
<td>0.438 - 0.454</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>High</td>
<td>40</td>
<td>127</td>
<td>30</td>
<td>622.4</td>
<td>564</td>
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<tr>
<td>M3</td>
<td>Ocean Color Aerosol</td>
<td>0.478 - 0.496</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>High</td>
<td>52</td>
<td>107</td>
<td>416</td>
<td>690</td>
<td>611</td>
</tr>
<tr>
<td>M4</td>
<td>Ocean Color Aerosol</td>
<td>0.545 - 0.565</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>High</td>
<td>21</td>
<td>70</td>
<td>362</td>
<td>581.1</td>
<td>522</td>
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<tr>
<td>M5</td>
<td>Ocean Color Aerosol</td>
<td>0.662 - 0.682</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>High</td>
<td>10</td>
<td>59</td>
<td>242</td>
<td>366.6</td>
<td>321</td>
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<tr>
<td>N6</td>
<td>Atmosph. Correct.</td>
<td>0.739 - 0.754</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Low</td>
<td>68</td>
<td>651</td>
<td>360</td>
<td>827.9</td>
<td>673</td>
</tr>
<tr>
<td>M8</td>
<td>Cloud Particle Size</td>
<td>1.230 - 1.250</td>
<td>0.742 - 0.776</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>5.4</td>
<td>165</td>
<td>74</td>
<td>273</td>
<td>233</td>
</tr>
<tr>
<td>M9</td>
<td>Cirrus/Cloud Cover</td>
<td>1.371 - 1.386</td>
<td>0.742 - 0.776</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>6</td>
<td>71.1</td>
<td>13</td>
<td>25</td>
<td>231</td>
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<tr>
<td>N8</td>
<td>Imagery Clouds</td>
<td>3.550 - 3.930</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>700</td>
<td>353</td>
<td>1.5</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>M10</td>
<td>Snow Fraction</td>
<td>1.580 - 1.640</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>7</td>
<td>72.5</td>
<td>6</td>
<td>172</td>
<td>149</td>
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<tr>
<td>M11</td>
<td>NDB</td>
<td>2.225 - 2.275</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>6</td>
<td>31.8</td>
<td>10</td>
<td>25</td>
<td>21.3</td>
</tr>
<tr>
<td>M12</td>
<td>SST</td>
<td>3.973 - 4.126</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>300</td>
<td>343</td>
<td>0.107</td>
<td>0.04</td>
<td>0.04</td>
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<tr>
<td>M13</td>
<td>SST</td>
<td>8.400 - 8.700</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>270</td>
<td>336</td>
<td>0.091</td>
<td>0.06</td>
<td>0.06</td>
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<tr>
<td>M14</td>
<td>Cloud Top Properties</td>
<td>10.263 - 11.263</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>300</td>
<td>343</td>
<td>0.07</td>
<td>0.03</td>
<td>0.03</td>
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<tr>
<td>M15</td>
<td>Cloud Imagery</td>
<td>10.500 - 12.400</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>210</td>
<td>340</td>
<td>1.5</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>M16</td>
<td>SST</td>
<td>11.538 - 12.468</td>
<td>0.742 - 0.259</td>
<td>1.60 x 1.58</td>
<td>Single</td>
<td>300</td>
<td>340</td>
<td>0.072</td>
<td>0.04</td>
<td>0.03</td>
</tr>
</tbody>
</table>

(1) The Aerospace Corporation (2) NASA NICSE
HST uses 3 in-scan pixels of aggregation at Nadir
Source: VIIRS users guide. On orbit values are updated based on the Murphy table for RSB, provided by Aerospace; TEB values are provided by STAR and NASA.
Major Progress Since Beta

- Implemented the scan-by-scan updates of the RSB radiometric calibration coefficients (F-factors) for a better mitigation of the RTA throughput degradation anomaly, with continued weekly updates of the look-up tables
- Updates to the SD and SDSM attenuation screens transmission look-up tables for improved offline derivation of the radiometric calibration coefficients
- Updates of the radiometric gain coefficients for RSB and DNB
- SZA limit for production of TOA reflectance data extended from 85 to 89 degrees
- Partial correction of handling on-board calibrator measurements during Moon in Space View events
- MX6.3&6.4 implementation (require further validation):
  - Corrected gain switching sequences problem
  - New quality flagging for HAM/RTA sync loss and sector rotation events
- Continued bias time series analysis between VIIRS and MODIS
- Continued longterm trending and monitoring
VIIRS Rotating Telescope Assembly (RTA) Mirror Degradation

• VIIRS RTA mirror degradation continues as predicted (currently about ~30% in the 0.86 bands)

• Root cause of the degradation is traced to Tungsten/Tungsten oxide contamination in the manufacturing process prelaunch

• The impact of the responsivity degradation is mitigated through weekly calibration updates

• The remaining effect of the degradation is decreased signal to noise ratio, although its impact to products is still negligible

The VIIRS RTA degradation is quantified by its response to the onboard solar diffuser.

0.86um bands

VIIRS RTA mirror degradation since launch

Solar diffuser

BB view

Earth view

SV
On-orbit degradation (UV light interacting with tungsten) of RTA mirror reflectance modulates VisNIR and SWIR RSR.

Reflectance degradation example here based upon using RTA primary mirror “TWM” witness sample measurements extrapolated to 4 mirrors by power law.
Cross Comparison with Aqua/MODIS

For on-orbit radiometric uncertainty evaluation

https://cs.star.nesdis.noaa.gov/NCC/SNOPredictions
• VIIRS bias relative to MODIS decreased by 4% during early April.
• The decreasing bias trend is consistent at ocean surface and Desert.
Cross Comparison with Aqua/MODIS

<table>
<thead>
<tr>
<th>VIIRS Bands</th>
<th>Ocean Bias (V-M)×100%/M</th>
<th>Desert Bias (V-M)×100%/M</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 (402m-422nm)</td>
<td>1.50%</td>
<td>1.10%</td>
</tr>
<tr>
<td>M2 (436nm-454nm)</td>
<td>0.28% ± 0.07%</td>
<td>0.50%</td>
</tr>
<tr>
<td>M3 (478nm-498nm)</td>
<td>0.36% ± 0.08%</td>
<td>0.45%</td>
</tr>
<tr>
<td>M4 (545nm-565nm)</td>
<td>0.47% ± 0.18%</td>
<td>1.10%</td>
</tr>
<tr>
<td>M5 (662nm-682nm)</td>
<td>7.82% ± 0.02%</td>
<td>1.70%</td>
</tr>
<tr>
<td>M6 (739nm-754nm)</td>
<td>Saturated</td>
<td>-0.50%</td>
</tr>
<tr>
<td>M7 (846nm-885nm)</td>
<td>2.68% ± 0.24%</td>
<td>3.50%</td>
</tr>
<tr>
<td>M8 (1230nm-250nm)</td>
<td>4.80% ± 0.17%</td>
<td>3.30%</td>
</tr>
</tbody>
</table>
TEB band Biases at SNOx

V-M BT (K) vs. DOY (From 01/01/2012)

Channels:
- Ch 12
- Ch 15
- Ch 16
- Geo Cal/Val focuses on Geolocation, BBR and LSF
- Filed, supported and/or resolved over 20 geometric related DRs (major ones listed on following slide)
- Achieved high geolocation accuracy (~80 meter)
- Updating the VIIRS SDR User’s guide with latest information
VIIRS as Geolocation Reference Standard
Assessing MetOP-B/AVHRR

VIIRS vs. MetOp-A

VIIRS vs. MetOp-B

Metop-A on Sep 26 at 17:25

Metop-B on Oct 3 at 17:31

VIIRS on Oct 3 at 20:42
Observing Hurricane Isaac with unprecedented 375m resolution in the infrared

Aug. 28, 2012
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 and JPSS satellite missions. For more information, please click on one of the links below.

Google “NOAA NCC”
Noise is not a significant function of the target signal for the TEB bands.
VIIRS SDR 58 Cal/Val Tasks

STAR
- SDR VALIDATION
  - SDR COMPARISON WITH MODEL (RAD-7)
  - SDR COMPARISON WITH AVHRR (RAD-8)
  - SDR COMPARISON WITH MODIS (RAD-9)
- Performance and Telemetry Trending (PTT-1-5- all)

UNIVERSITY OF WISCONSIN
- SPECTRAL EVALUATIONS
  - OUT-OF-BAND (OOB) SPECTRAL LEAKAGE (RAD-1)
  - IN-BAND SPECTRAL RADIANCE COMPARISON WITH CRIS (RAD-12)
  - RELATIVE SPECTRAL RESPONSE REFINEMENTS
- HAM REFLECTANCE (RVS) INFLUENCE ON RADIOMETRIC CALIBRATION (RAD-04)
- AIRCRAFT BASED CAL/VAL OF VIIRS SDR RADIANCE (RAD-18,-20, -21)

NGAS
- ASF/PGE DEVELOPMENT
- CODE EVALUATION AND SUPPORT
- RADIOMETRIC EVALUATIONS
- DNB IMAGE ANALYSIS
- DNB CALIBRATION SUPPORT (RAD-26)
- DUAL GAIN ANOMALY FLAGGING (RAD-25)
- GEOMETRIC ANALYSIS SUPPORT (GEO-X)
- QUALITY FLAG VALIDATION & UPDATE (RAD-27)
- BRIGHT PIXEL ALGORITHM VERIFICATION

LINCOLN LABORATORY
- STRAYLIGHT VIIRS RSB SOLAR DIFFUSER STRAYLIGHT - ANALYSIS OF NON-POLAR SD DATA (CSE-3)

RAYTHEON
- IDPS Support
- ADL Support
VIIRS SDR 58 Cal/Val Tasks -continued

AEROSPACE

• EOC TASKS
  – OPERABILITY, NOISE, SNR VERIFICATION WITH NADIR DOOR CLOSED (FPF-2)
  – DUAL GAIN BAND AND DNB TRANSITION VERIFICATION (FPF-4)
  – DC-RESTORE FUNCTIONALITY AND PERFORMANCE CHECK (FPF-6)
  – CALIBRATOR VISUAL INSPECTION (FPF-7)

• RSB CALIBRATION
  – SD AND SDSM CHARACTERIZATION (CSE-1)
  – TEMPORAL ANALYSIS OF SD SIGNAL OVER POLAR REGION (CSE-4)
  – TEMPORAL ANALYSIS OF SOLAR DIFFUSER STABILITY MONITOR (SDSM) DATA (CSE-5)
  – DNB OFFSET VERIFICATION (PTT-4)
  – DNB OFFSET/GAIN DETERMINATION (RAD-26)

• TEB CALIBRATION
  – EMISSIVE BAND RESPONSE CHARACTERIZATION (RAD-15)

• RADIOMETRIC EVALUATIONS
  – OPERABILITY, NOISE, SNR VERIFICATION (PTT-1)
  – RDR HISTOGRAM ANALYSIS (PTT-2)
  – NOISE AND SNR FOR UNIFORM EV SCENES (PTT-3)
  – ELECTRONIC GAIN MEASUREMENT (PTT-5)
  – CROSSTALK, ECHO, AND GHOST INVESTIGATION (IMG-1)
  – CROSSTALK FROM EMISSIVE BANDS TO REFLECTIVE BANDS (RAD-2)

• GEOLOCATION & GEOMETRIC ANALYSIS
  – INITIAL VALIDATION OF SC AUXILIARY EPHEMERIS AND ATTITUDE DATA(GEO-1)
  – INITIAL VALIDATION OF VIIRS ENCODER DATA, SCAN TIME, SCAN PERIOD, AND SCAN RATE STABILITY(GEO-2)
  – ASSESS REASONABLENESS OF FIRST- PERIOD SDR GEOLOCATION (GEO-3)
  – BUILD FIRST-PERIOD SIMULATED VIIRS IMAGES FROM GCP CHIPS, (5) BUILD FIRST PERIOD VIIRS IMAGE CHIPS FROM SELECTED SDR PIXELS,(6) PERFORM FIRST PERIOD VIIRS SIMULATED IMAGE MATCH-UP (GEO-4-5-6)
  – ANALYZE FIRST PERIOD VIIRS GCP RESIDUALS (GEO-7)
  – ANALYZE INITIAL INTRA-ORBIT THERMAL EFFECTS ON GEOLOCATION (GEO-8)
  – DEVELOP AND TEST INITIAL GEOLOCATION PARAMETER & THERMAL LUT UPDATES (GEO-9)
  – LSF/MTF VALIDATION (IMG-4)
  – BAND-TO-BAND REGISTRATION (BBR) VERIFICATION (RAD-17)
# Most Significant Open DRs

<table>
<thead>
<tr>
<th>DR #</th>
<th>Description</th>
<th>Provisional Status Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>4663</td>
<td>Modified Operational Code for Increased RSB Calibration Autonomy</td>
<td>No (new algorithm tested)</td>
</tr>
<tr>
<td>4911</td>
<td>Moon in Space View of Bounding Granule for RSB Calibration</td>
<td>No (recurring code errors)</td>
</tr>
<tr>
<td>4589</td>
<td>Improved SDSM Screen Transmission LUT</td>
<td>No (offline processing)</td>
</tr>
<tr>
<td>4716</td>
<td>Day-Night Band Stray Light</td>
<td>No (correction planned)</td>
</tr>
<tr>
<td>4890</td>
<td>VIIRS DNB Geolocation Residual Error Recommendation</td>
<td>No (correction planned)</td>
</tr>
<tr>
<td>4710</td>
<td>Warm-Up/Cool-Down Tests Need to Be Flagged</td>
<td>No (infrequent occurrence)</td>
</tr>
<tr>
<td>4742</td>
<td>Erratic Solar Eclipse Flag</td>
<td>No (infrequent occurrence)</td>
</tr>
<tr>
<td>4767</td>
<td>HAM/RTA Sync Loss and Sector Rotation Need to Be Flagged</td>
<td>No (infrequent occurrence)</td>
</tr>
<tr>
<td>4894</td>
<td>Unexpected High Values of Satellite Zenith Angles</td>
<td>No (infrequent occurrence)</td>
</tr>
<tr>
<td>4913</td>
<td>Missing Terrain-Corrected Geolocation Data</td>
<td>No (unknown solution)</td>
</tr>
<tr>
<td>4916</td>
<td>Missing Radiance/Reflectance/Temperature Data</td>
<td>No (unknown solution)</td>
</tr>
<tr>
<td>4892</td>
<td>Wrong RSR LUT Used in Mx6.2 from 8/9 to 9/5/2012</td>
<td>No (procedure corrected)</td>
</tr>
<tr>
<td>4917</td>
<td>IDPS Incorrect Handling of Leap Seconds</td>
<td>No (procedure corrected)</td>
</tr>
</tbody>
</table>
RTA degradation
• RTA degradation anomaly challenged the RSB calibration team to maintain RSB calibration uncertainty and stability within requirements/desirements.
• F-factor trend change
• Ongoing RTA degradation anomaly is modulating VIIRS VisNIR and SWIR RSR.

Scan Sync Loss

Operational code:
• Uncertainties/errors in IDPS processing software/code may still exist
• Multiple files and missing files are still being found
• Automated calibration for the solar bands

NIST support: Flight vs. Ground
• Instrument spec vs. science enhancements
• SDR science peer review process
• Using standardized SOW
• MOU and reporting processes and procedures

Process and coordination:
• Need to streamline reporting and meetings

Early VIIRS SDR data and reprocessing

OBC-BB Thermistors variation:
  F-factor variation during WUCD
  F-factor orbital Variations

DNB Stray light Issue

SC Counter overflow anomaly & SBC anomaly (1394)

SDSM Spectral Leak

A-side vs. B-side
Issues and Challenges

• **Geolocation accuracy near spacecraft maneuvers** needs to be better understood (not as accurate)

• **BBR, LSF, and the moon**
  - Accurate assessment of BBR for bands saturated by the moon
  - Additional analyses is needed for better spatial characterization (BBR and LSF) using lunar and ground targets (for all agg modes) – challenging

• **Other**
  - Digital Elevation Model (DEM) and Land/Water (L/W) mask need to be updated
  - Occasional short high frequency attitude oscillations (~1 per orbit for ~2 minutes)
  - Within orbit thermal correction may be needed with additional LUT (mitigation planned via MODIS style correction)

• **DNB geolocation needs to be terrain correction**

• **M13 low gain calibration points**

• **Resources and funding support** to sustain NPP post-launch Cal/Val activities (to compete with J1+ VIIRS pre-launch Cal)

• **Instrument and spacecraft maneuver**

• **Transition to operations**

• **J1, J2 and beyond**
• Geolocation – Provisional

• Radiometry
  – RSB SDRs – Provisional with the following caveats
    • User community expects 0.3% calibration stability and desires 0.1% stability or better, but current code and LUT update process provide approximately 1% stability
    • Requires continued frequent calibration update to account for the degradation
  – TEB SDRs – Provisional

• Spectral – Provisional (modulated RSR available for user evaluation)

• The VIIRS SDR team will continue assessing the radiometric uncertainties and resolve performance issues, working closely with the user community
• backup
FY-13 Schedule and Milestones

• Task 1: VIIRS SDR Team Management and Coordination (ongoing)
  – Continued support to the DRAT process
  – Lead the VIIRS SDR team
  – Organize sensor evaluation
  – Document performance and progress; recommend changes and updates to software and LUTs
  – Maintain and update the calibration knowledge base on the web
  – Coordinate interactions with other teams (CrIS, EDR) and NIST
  – Reporting and meetings/telecons
  – Taking assigned actions by AERB, DRAT, DPA, PDA, ADP

• Task 2: Update VIIRS SDR Algorithm Theoretical Basis Document (ATBD)
  – Many sections of the ATBD are either out of date or contain erroneous information and need to be updated or rewritten. This include but not limited to the calibration equations (144 calibration equations!)
  – Quality flags need to be updated
FY-13 Schedule and Milestones

• Task 3: VIIRS SDR calibration and validation, cross sensor calibration
  – Routine online SNO predictions and dissemination
  – Continue inter-comparisons with MODIS, CrIS, and AVHRR (including MetOp-B)
  – Mitigation of sensor degradation (version control of F and H LUTs)
  – Collaborate with NASA on lunar calibration
  – Instrument performance matrix and monitoring
  – Collaborate with EDR teams and help general users
  – Image data (including DNB) analysis and evaluation
  – Cal/val using vicarious calibration sites
  – Deliverables (Sept 2013)
    • Reports on instrument performance,
    • Technical reports and journal papers
    • Revised user’s guide
    • Extended image gallery
    • Sub-version control of F and H LUTs
FY-13 Schedule and Milestones

• Task 4: JPSS-1 VIIRS Pre-launch Test Support
  – Coordination with prelaunch test segment of the flight project through NASA instrument scientists and managers
  – Coordination of NIST SOW and participation
  – Provide feedback to flight wrt VIIRS onorbit performance and issues
  – Prelaunch test data analysis
  – Participate in TIM with vendor and flight
  – Support anomaly resolution and waiver analysis
  – Mature and fine-tune J1 spectral test program
  – Deliverables
    • Technical reports on findings and results
    • Weekly and monthly reports

• Task 5: NGAS VIIRS SDR Science Transition
  – Transition DNB software to improve straylight reduction and geolocation for operational use
FY-13 Schedule and Milestones

Other

• Task 6 Calibration algorithm enhancements & LUT
  - Full automation of RSB calibration targeted for Mx7 IDPS code release in April 2013
  - Improvement of TEB radiometric performance with implementation of ADR 4780 code change in Mx7
  • Data analysis for LUT development
  • Gravite, ADL etc.
  • Ongoing cal/val

• Task 7 Special Sensor Calibration and Operation Support
  • Support planning and scheduling of various calibration maneuvers.
  • Perform data analysis for special calibration and operation activities (e.g. on-orbit lunar observations).
  • Provide documentation review and support for sensor performance evaluation and anomaly resolution.
  • Serve as the POC of VIIRS SDR team with the NPP Operation Team.
  • Prepare and present the VIIRS SDR team with results derived from special test data analysis
FY-13 Schedule and Milestones

• Task 8 VIIRS On-orbit Calibration Support
  – Evaluate sensor OBC functions and their on-orbit performance.
  – Derive key SDR calibration parameters using data collected from instrument OBC.
  – Help identify and address issues that are critical for SDR algorithm and look-up-table (LUT) improvements.
  – Calibration and Validation Review Support
  – Deliverables:
    • Document and report the findings to the VIIRS SDR team.

• Task 9 Aircraft campaigns
  – SDR aircraft based Cal/Val exercise to assess VIIRS (and CrIS) radiometric performance

• Time lines:
  – October 2012: MX6.3 implementation
  – Late fall 2012: VIIRS SDR provisional status review
  – 2013: VIIRS SDR calibrated/validated review
  – 2013-14: transition to operations
  – Summer 2013: J1 prelaunch testing and data analysis
Path Forward (FY-13 thru FY-17)
(assume “FYxx” runs from April 1, 20xx to March 31, 20xx+1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Suomi NPP</th>
<th>JPSS J1</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY13</td>
<td>Complete ICV, VIIRS SDR provisional, ATBD, cross calibrated/validated, continue routine cal/val and LTM, aircraft</td>
<td>Prelaunch testing and data analysis, Requirements analysis and ground test plan review</td>
</tr>
<tr>
<td>FY14</td>
<td>Transition to operations</td>
<td>Prepare and analyze ground test data, Complete prelaunch tests and data analysis</td>
</tr>
<tr>
<td>FY15</td>
<td>Operational cal/val and long-term monitoring</td>
<td>Analyze ground test data and prepare for launch, Instrument delivery and spacecraft level tests</td>
</tr>
<tr>
<td>FY16</td>
<td>Operational cal/val and long-term monitoring</td>
<td>Analyze ground test data and prepare for launch and post-launch activities, J1 launch</td>
</tr>
<tr>
<td>FY17</td>
<td>Operational cal/val and long-term monitoring</td>
<td>J1 postlaunch check out and intensive cal/val</td>
</tr>
</tbody>
</table>
## Team Members’ Roles & Responsibilities

<table>
<thead>
<tr>
<th>SDR</th>
<th>Name</th>
<th>Organization</th>
<th>Funding Agency</th>
<th>Task</th>
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</thead>
<tbody>
<tr>
<td>Lead</td>
<td>Changyong Cao</td>
<td>NOAA/NESDIS/STAR</td>
<td>NJO</td>
<td>Lead VIIRS SDR Team</td>
</tr>
<tr>
<td>Lead</td>
<td>Frank Deluccia</td>
<td>The Aerospace Corp.</td>
<td>NASA</td>
<td>Lead VIIRS SDR Team</td>
</tr>
<tr>
<td>Org. lead</td>
<td>Mark Liu</td>
<td>NOAA/NESDIS/STAR</td>
<td>NJO</td>
<td>STAR lead/TEB cal/val</td>
</tr>
<tr>
<td>Org. lead</td>
<td>J. Xiong/R. Wolfe</td>
<td>NASA/VCST</td>
<td>NJO and Flight</td>
<td>VCST lead</td>
</tr>
<tr>
<td>Org. lead</td>
<td>Chris Moeller</td>
<td>U. Wisc.</td>
<td>NJO</td>
<td>SDR impact/RSR</td>
</tr>
<tr>
<td>Org. lead</td>
<td>Bill Johnsen</td>
<td>Raytheon</td>
<td>NJO</td>
<td></td>
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<tr>
<td>Org. lead</td>
<td>Lushalan Liao</td>
<td>NGAS</td>
<td>NJO</td>
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<tbody>
<tr>
<td>member</td>
<td>Blonski, Shao, Uprety, Pogo, Bai, Hu, Carey, et al.</td>
<td>NOAA/NESDIS/STAR</td>
<td>NJO</td>
<td>SDR cal/val support, DRAT, SNO&amp;vicarious</td>
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<tr>
<td>member</td>
<td>Oudrari, Wu, Lei, McIntire, Schwarting, Nishihama, Lin, Chiang, et al.</td>
<td>NASA/VCST</td>
<td>NASA/NOAA</td>
<td>Manuver, intercal, SDR cal/val support</td>
</tr>
<tr>
<td>member</td>
<td>Rausch, Moyer + 10 Staff (see backup slide)</td>
<td>Aerospace</td>
<td>NASA/NOAA</td>
<td>SDR Cal/Val Support</td>
</tr>
<tr>
<td>member</td>
<td>Mills, Chu, et al.</td>
<td>NGAS</td>
<td>NOAA/NASA</td>
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