ACTIVE FIRES: SDR QUALITY, REPLACEMENT CODE AND I-BAND PRODUCT

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Outline

• SDR quality flag issues

• Product status
  – IDPS
  – replacement code (J1)
  – I-band product status

• Validation
SDR QUALITY
## Reference Table for QA bits

<table>
<thead>
<tr>
<th>QF1_VIIRSMB</th>
<th>Description</th>
<th>Datum Offset</th>
<th>Data Type</th>
<th>Legend Entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANDSDR 1 byte(s) 768 3200</td>
<td>Quality - Indicates calibration quality due to bad space view offsets, OBC view offsets, etc or use of a previous calibration view</td>
<td>0</td>
<td>2 bit(s)</td>
<td>Name Value</td>
</tr>
<tr>
<td></td>
<td>Poor - Reflectance or EBBT out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Calibration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not Used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saturated Pixel - Indicates the level of pixel saturation</td>
<td>2</td>
<td>2 bit(s)</td>
<td>Name Value</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All Saturated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Some Saturated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>None Saturated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not Used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Missing Data - Data required for calibration processing is not available for processing</td>
<td>4</td>
<td>2 bit(s)</td>
<td>Name Value</td>
</tr>
<tr>
<td></td>
<td>All data present</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EV RDR data missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cal data (SV, CV, SD, etc.) missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermistor data missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiation out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reflectance or EBBT out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Both Radiance and Reflectance/EBBT out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Out of Range - Calibrated pixel value outside of LUT threshold limits</td>
<td>6</td>
<td>2 bit(s)</td>
<td>Name Value</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cal data (SV, CV, SD, etc.) missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermistor data missing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### QA Definition

- **5**: Poor Cal - Some saturated
- **18**: No Calibration - None Saturated - EV RDR Data Missing
- **33**: Poor Cal - None Saturated - Cal Data Missing
- **34**: No Calibration - None Saturated - Cal Data Missing
- **50**: No Calibration - None Saturated - Thermistor Data Missing
- **129**: Poor Cal - None Saturated - All Data Present - Reflectance or EBBT Out of Range
- **193**: Not used – Radiance out of range
- **65**: Poor – Reflectance or EBBT out of range

(165 cal data missing)
• All pixels > 358 K flagged as having poor calibration
• Partially saturated pixels have high radiance but $T_b = 192$ K
• Mysterious spike in calibration quality near 335 K
• Mysterious “ravine” in calibration quality near 322 K

NB. QF1 ≠ 0 curve does not include trim (QF1 = 2) or fill (QF1 > 247).
• Brightness temperatures near 362 K are incorrect
• Gap in brightness temperatures from 365 K – 380 K

NB. QF1 ≠ 0 curve does not include trim (QF1 = 2) or fill (QF1 > 247).
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NB. QF1 ≠ 0 curve does not include trim (QF1 = 2) or fill (QF1 > 247).
Generic VIIRS SDR Problems

• Non-unique mapping of radiance to brightness temperature near saturation
  – Example: M15 radiance of $20.50 \text{ W m}^{-2} \text{ sr}^{-1} \text{ um}^{-1}$ assigned $T_b = 360.1 \text{ K}, 363.8 \text{ K}, 363.9\text{ K}, 364.1 \text{ K}, 381 \text{ K},$ etc. within same granule (2014 080 06:55)

• Ongoing confusion between sensor specification and actual sensor capabilities in SDR software lookup tables
Generic VIIRS SDR Problems

• QF1 bits often set haphazardly
  – M13: All pixels > 358K flagged as “poor quality, calibration data missing”
  – Reflective bands: River edges and cloud shadows often non-informatively flagged as “poor quality”
  – Reflective bands: Invalid QF1 values of 35 and 163 occur in ~1,000 pixels/day
  – Currently impossible to reliably filter bad input data via QFs without also considering radiance and reflectance/brightness temperature
Generic VIIRS SDR Problems

• “Folded” radiance values due to saturation not flagged as invalid
  – Observed in M5 (dual gain), M7 (dual gain), and M11 (single gain)
  – Reflectance values look normal (0.02 – 0.6)
  – QF1 = 0
“Folded” radiance values with QF1 = 0
Sun glint example (20140701 16:45)

“Folded” radiance values with QF1 = 0
Generic VIIRS SDR Problems

• On-board aggregation bug
  – Affects all non-dual gain bands
  – No reliable method to detect corrupt radiance values arising as a result of this bug
2014 Global M5 QF1 Values (dual gain)
Generic VIIRS SDR Problems

• Disproportionally affect the VIIRS fire product
• Poorly documented outside of the JPSS program
  – In particular, details and dates
PRODUCT STATUS
West Fork Complex: 6/14 - 7/4/2013
Landsat-8 background: July 31, 2013
West Fork Complex: 6/14 - 7/4/2013

Landsat-8 background: July 31, 2013

- Papoose
- West Fork
- Windy Pass
- Pagosa Springs
West Fork Complex: 6/14 - 7/4/2013

Landsat-8 background: July 31, 2013

VIIRS FRP
MW
- 0 - 97
- 98 - 248
- 249 - 469
- 470 - 924
- 925 - 2389
VIIRS 750m Fire Algorithm Update/Refinement: Implementation of MODIS Collection 6 Equivalent

- False alarm rates as a function of tree cover
- MODIS results based on +2,300 reference ASTER scenes

- Probability of detection as a function of tree cover
VIIRS 750m Fire Algorithm Update/Refinement: Implementation of MODIS Collection 6 Equivalent

False alarm rates as a function of tree cover

MODIS results based on +2,300 reference ASTER scenes

Probability of detection as a function of tree cover
Rim fire, CA: Aug. 17th - Sept. 6th

VIIRS IDPS
Peak day and count: August 22nd, 263
Total count = 2382

VIIRS replacement
Peak day and count: August 26th, 300
Total count = 2713
Global fires from I-band data

VIIRS 375 m fire algorithm output showing the accumulated daytime nominal confidence fire pixels (upper left), low confidence daytime pixels (upper right), nighttime fire pixels (purple; lower left), and SAMA-related low confidence nighttime pixels (dark blue; lower right) during 1–30 August 2013.

I-Band Active Fire Detection Algorithm Status

• Fire product being displayed online through proving ground website: http://viirsfire.geog.umd.edu/

• Fire product being generated in pseudo-operational mode (NRT) by US Forest Service and South African partners with very positive results (http://demo.afis.co.za/)

• In house I-band algorithm re-processing to use NASA’s LandPEATE archive 3110 data for consistent investigation of product performance since sensor activation

• Continue research of I-band SDR anomalies and quality flag idiosyncrasies impacting fire-affected and other unique pixel conditions (e.g.: saturation (complete/partial), radiance folding)

• Continue research exploring potential M and I band hybrid fire algorithm

• I-band science algorithm to be ported to IPOPP Direct Broadcast package (pending NASA funding)

• I-band fire product application development to continue in support of wildland fire diagnostics/forecasting (pending NASA funding)
VALIDATION
VIIRS Active Fire Detection and Retrieval (FRP) Validation Using Multiple Near-Coincident Fine Resolution Reference Data Sets

Background RGB: Near-coincident Wildfire Airborne Sensor Program (WASP)

Dashed/thick lines indicate detected fire pixels

Prescribed Fire Combustion and Atmospheric Dynamics Research (RxCADRE) project (FL/2012)
Initial results over select sites indicate good overall agreement (<10%) among near-coincident surface-leaving fire retrievals acquired under clear sky conditions.