STAR Algorithm and Data Products (ADP)
Beta Review

Suomi NPP Surface Type EDR Product

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Surface Type EDR Lead
2/20/2013
VIIRS Surface Type EDR Team Goals

- **Xiwu Zhan (NOAA/NESDIS/STAR)**
  - Surface Type EDR lead, User outreach
- **Chengquan Huang (UMD/Geography)**
  - Algorithm development lead
- **Kuan Song (UMD/Geography)**
  - Algorithm development
  - QST Product generation
  - User readiness
- **Mark Friedl (Boston University)**
  - Cal/Val lead
- **Damien Sulla-Menashe (Boston University)**
  - Ground truth data development
  - Product validation
  - MODIS land cover products as QST IP seed
Science Needs for Surface Type Products

- Modeling studies
  - Land surface parameterization for GCM
  - Biogeochemical cycles
  - Hydrological processes
- Carbon and ecosystem studies
  - Carbon stock, fluxes
  - Biodiversity
- Feed to other VIIRS products
  - BRDF/Albedo
  - Land surface temperature (LST)
- Surface type change monitoring
  - Burned areas
  - Snow covers
  - Flooding/deforestation/etc (TBD)
## L1RD Requirements

*Current IDP product was designed to meet heritage NPOESS requirements. Beta evaluation is done against those heritage requirements. Precision and accuracy numbers are to be corrected in the JPSS L1RD.*

### Table 4.5.4.2 - Surface Type (VIIRS)

<table>
<thead>
<tr>
<th>EDR Attribute</th>
<th>Threshold</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SURF Applicable Conditions:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Both clear and partly cloudy sky conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Horizontal Cell Size</td>
<td>1 km at Nadir</td>
<td>1 km at Edge of Scan</td>
</tr>
<tr>
<td>b. Mapping Uncertainty, 3 Sigma</td>
<td>5 km</td>
<td>1 km</td>
</tr>
<tr>
<td>c. Measurement Range</td>
<td>17 IGBP classes specified in Table 4.5.4.1</td>
<td>17 IGBP classes</td>
</tr>
<tr>
<td>d. Measurement Precision *</td>
<td>10%</td>
<td>0.1%</td>
</tr>
<tr>
<td>e. Measurement Accuracy *</td>
<td>70% correct for 17 types</td>
<td>2%</td>
</tr>
<tr>
<td>f. Refresh</td>
<td>At least 90% coverage of the globe every 24 hours (monthly average)</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

v2.0, 9/23/12
Overview of VIIRS Surface Type EDR

- Describes surface condition at time of each VIIRS overpass
- Produced for every VIIRS swath/granule
  - Same geometry as any VIIRS 750m granule
- Two major components
  - Gridded Quarterly Surface Type (QST) IP mapped to the swath/granule space
    - VIIRS QST IP not available yet (requires one full year of data, VIIRS gridding just turned on)
    - Currently use MODIS land cover (LC) as QST IP seed
  - Includes flags to indicate snow and fire based on
    - Active fire Application Related Product (ARP)
    - Snow EDR
## History of ST EDR Related DRs

<table>
<thead>
<tr>
<th>Date</th>
<th>DR #</th>
<th>Reason</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/18/2011</td>
<td>4452</td>
<td>ST rename vegetation fraction</td>
<td>NDE provides separate GVF product in future</td>
</tr>
<tr>
<td>11/18/2011</td>
<td>4458</td>
<td>C5 Decision tree replacement</td>
<td>UMD to upgrade QST IP algorithm with SVM in future</td>
</tr>
<tr>
<td>11/18/2011</td>
<td>4459</td>
<td>QST IP goes to annual</td>
<td>To be approved in future</td>
</tr>
<tr>
<td>05/22/2012</td>
<td>4707</td>
<td>Update QST IP seed data</td>
<td>Completed with MODIS C5 LC</td>
</tr>
<tr>
<td>09/12/2012</td>
<td>4900</td>
<td>Remove new QST IP Seed fill values</td>
<td>Completed with update MODIS C5 LC</td>
</tr>
<tr>
<td>01/14/2013</td>
<td>7002</td>
<td>VIIRS ST EDR Beta review</td>
<td>In progress</td>
</tr>
</tbody>
</table>
What to look for in this review

- Verify current MODIS C5 Land Cover product used as QST IP seed
- Snow flags in Snow EDR copied to ST EDR properly
- Fire flags in Fire ARP copied to ST EDR properly
- Thematic accuracy not assessed at this time.

Figure 6. Flow diagram showing the processing chain for the VIIRS Surface Type EDR.
Comparison of ST EDR and MODIS C5 LC

- Verify current IDPS QST IP seed is consistent with MODIS C5 LC product
- MODIS C5 LC
  - 1KM
  - Gridded: Sinusoidal
  - Delivered to IDPS by BU
- ST EDR
  - 750 M @ nadir, larger off nadir
  - Swath/granule
  - From LPEATE’s IDPS copy
- Data preparation for comparison
  - Convert the ST EDR from swath to the gridded space using LPEATE gridding tool
- Known limitations:
  - Resampling in map conversion is known to cause 1-2 pixel shifts. Small surface type patches may get dropped off.
  - MODIS LC is resampled once (gridded space to swath space) when used to create ST EDR
  - The ST EDR is resampled again (swath space to gridded space) before it is compared with MODIS C5 data
  - Hence, ST EDR will be similar but not identical to MODIS C5 LC in the following comparisons.
Global Mosaic of Gridded ST EDR Matches MODIS C5 Product

Gridded ST EDR for
day 12/31/2012

Note: Small differences are due to resampling in map conversion between gridded space and swath space.
US eastern coast, red pixels in the middle are the Baltimore-Washington area

Great Lakes and NE US
More Comparison of ST EDR and MODIS C5 LC

London and SE England

Sri Lanka
Comparison of Snow EDR and Snow QC flag in ST EDR

- **ST EDR**
  - Swath, 750 m @ nadir
  - Snow pixels has value of 1 in QC flag
  - From LPEATE’s IDPS copy

- **Snow EDR**
  - Swath, 375 m @ nadir
  - From LPEATE’s IDPS copy

- **Data processing for comparison**
  - Every 2 x 2 snow EDR pixels aggregated to match ST EDR pixels
  - If > 2 pixels in the 2x2 snow EDR window are snow, flag snow in the ST EDR
  - To avoid impact of resampling, comparison made in swath space
Granule-Level Snow Pixel Counts Near Identical in ST EDR and Snow EDR

All Granules Acquired on 12/31/2012

All Granules Acquired on 02/05/2013

Comparison of Granule-Level Snow Pixel Count

Each point represent one VIIRS granule
Detailed Comparison of Snow Flags in ST EDR and VIIRS Snow EDR

North Antarctica
Acquired @ 08:50 on 12/31/2012

Legend

Snow
Non-snow

Eastern Siberia
Acquired @ 21:15 on 12/31/2012
More Comparison of Snow Flags in ST EDR and VIIRS Snow EDR

North of Baikal, Russia
Acquired @ 04:45 on 02/05/2013

North Spain
Acquired @ 13:10 on 02/05/2013
Gridded Snow in ST EDR for US

02/05/2013

Background: Microsoft Bing Map
Comparison of Fire ARP and Fire QC flag in ST EDR

- **ST EDR**
  - Swath, 750 m @ nadir
  - Fire pixels has value of 1 in QC flag
  - From LPEATE’s IDPS copy

- **Fire ARP**
  - Vector format showing location of fire pixels, no imagery product
  - From LPEATE’s IDPS copy

- **Data preparation for comparison**
  - Convert Fire ARP vector file to imagery product (used in the following comparison)
  - Compare Fire ARP with fire flag in ST EDR
Granule Fire Pixel Counts Identical in ST EDR and Fire EDR

All Granules Acquired on 12/31/2012

All Granules Acquired on 02/05/2013

Each point represent one VIIRS granule
Zoom-in Comparison of Fire Flags

Algeria
Acquired @ 23:55
on 02/05/2013

El Salvador
Acquired @ 18:05
on 02/05/2013

Legend
- Fire
- Non-fire
Zoom-in Comparison of Fire Flags

Fire ARP

Nigeria
Acquired @ 12:35 on 12/31/2012

Legend

Fire

Non-fire

Scandinavia
Acquired @ 11:20 on 02/05/2013

Fire Flag in ST EDR
Surface Type Validation Preparation

- Response and analysis design essentially complete
- Majority of effort focused on building site database (by manual interpretation, supervised classification)
Beta Consideration and Remaining Issues

- **Surface Type EDR Algorithm Functions as Designed**
  - MODIS C5 land cover product used as QST IP seed
  - Small differences between MODIS C5 and ST EDR due to map conversion
  - Fire flag in ST EDR updated properly using Fire ARP
  - Snow flag in ST EDR updated properly using Snow EDR
- Generating **VIIRS QST IP** is **in progress**
- Explicit **validation** remains **crucial**
Future Plans

• Near Term:
  • Complete validation data development by Summer 2013
  • Generate and validate VIIRS QST IP before May 2013
  • Deliver new VIIRS QST IP to IDPS from June 2013

• Longer Term:
  • Upgrade QST IP algorithm for improved accuracy
  • Upgrade ST EDR algorithm for more surface type change monitoring
  • Validate QST IP and ST EDR with validation data