***VIIRS VIIRS-Surf-Type-EDR, Provisional Data Quality***

***Date: (insert date that 474-CCR-14-1700 (DR7552) goes into operations)***

***Read-me for Data Users***

The Joint Polar Satellite System (JPSS) Algorithm Engineering Review Board approved the release of the Visible Infrared Imager Radiometer Suite Surface Type Environmental Data Record (VIIRS-Surf-Typ-EDR) to the public with a Provisional level quality as of ***(insert date that 474-CCR-14-1700 (DR7552) goes into operations).*** Because Surface type is a granulated version of the QSTIP updated with snow and fire data, declaration of provisional maturity of the VIIRS-Surface Type-EDR implies the same maturity of the QST-IP. Provisional quality is defined as:

* Product performance has been demonstrated through analysis of a large, but still limited number of independent measurements obtained from selected locations, time periods, or field campaign efforts
* Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose
* Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists
* Product is recommended for operational use (user decision) and in scientific publications

The Board recommends that users be informed of the following product information and characteristics when evaluating the VIIRS-Surf-Type-EDR.

1. **Product status:** The VIIRS-Surf-Type-EDR represents continuity with NASA EOS MODIS and NOAA POES AVHRR land cover products. VIIRS-Surf-Type-EDR is an input to VIIRS LST EDR in addition to other uses. Based on the extensive MODIS/AVHRR global land cover product user base, this VIIRS product will be used by real-time resource and disaster management; ecosystem monitoring; numerical weather, climate and hydrological prediction models. The current VIIRS-Surf-Type-EDR was designed to satisfy the JPSS L1RD requirements for VIIRS Surface Type.

The algorithm for the VIIRS-Surf-Type-EDR is to regrid VIIRS Quarterly Surface Type IP (QST IP) to VIIRS 750m swath granules with quality flags indicating snow and fire pixels using VIIRS snow/ice EDR and Active Fire ARP. The VIIRS QST IP is generated with monthly gridded composited VIIRS NDVI, SR and Brightness Temperatures of 2012.

1. **Product Contents:** The VIIRS-Surf-Type-EDR contents are summarized in Table 5.1.1-1 of the “*JPSS Ground Project Document 474-00448-02-19-B0200*:Joint Polar Satellite System (JPSS) Algorithm Specification Volume II: Data Dictionary for the Surface Type” as copied below:

Table: 5.1.1-1 VIIRS Surface Type EDR Data Content Summary

| **Name** | **Description** | **Data Type** | **Aggregate Dimension (N = Number of Granules)** | **Granule Dimension** | **Units** |
| --- | --- | --- | --- | --- | --- |
| SurfaceType | Surface Type | unsigned 8-bit char | [N\*768, 3200]  | [768, 3200]  | unitless |
| VegetationFraction | Vegetation Fraction | unsigned 8-bit char | [N\*768, 3200]  | [768, 3200]  | unitless |
| QF1\_VIIRSSTEDR | Pixel Level Quality Flags | unsigned 8-bit char | [N\*768, 3200]  | [768, 3200]  | unitless |
| QF2\_VIIRSSTEDR |  | unsigned 8-bit char | [N\*768, 3200]  | [768, 3200]  | unitless |
| Confidence | QST IP Pixel Confidence  | unsigned 8-bit char | [N\*768, 3200]  | [768, 3200]  | percent |
| VegetationFractionFactors | Scale = First Array Element; Offset = 2nd Array Element | 32-bit floating point | [N\*2]  | [2]  | unitless |

The two quality flag bytes contain the following information:

QF1\_VIIRSSTEDR:

|  |  |  |
| --- | --- | --- |
| **Bit** | **Description** | **Values** |
| 0 | Fire detected in pixel (from the VIIRS Cloud Mask) | 0 – false; 1- true. |
| 1 | Snow or Ice in Pixel (fraction detected within the pixel exceeded threshold). Applies up to SZA<=85 deg. | 0 – false; 1- true. |
| 2 | Vegetation in Pixel (Vegetation fraction detected within the pixel exceeded threshold) | 0 – false; 1- true. |
| 3-4 | Cloud Confidence Indicator (Indication of whether ‘M’ band pixel confidently clear, probably clear, probably cloudy or confidently cloudy) | 0 – Confidently clear; 1 – Probably clear; 2 – Probably cloudy; 3 – Confidently cloudy. |
| 5 | Exclusion - Sun Glint in pixel (as indicated in the VIIRS Cloud Mask) | 0 – false; 1- true. |
| 6 | Input Data Quality degraded/bad (Quality of Surface Type is degraded or not retrieved due to bad surface reflectance data in horizontal cell) | 0 – false; 1- true. |
| 7 | Spare |  |

QF1\_VIIRSSTEDR:

|  |  |  |
| --- | --- | --- |
| **Bit** | **Description** | **Value** |
| 0 | Exclusion: AOT > 1.0 (AOT in horizontal cell > 1.0 on the slant path (AOT @550nm)) | 0 – false; 1- true. |
| 1 | Vegetation fraction out of range (Veg Frac < 0 or Veg Frac > 1)) | 0 – false; 1- true. |
| 2-3 | Exclusion: Solar Zenith Angle (Solar Zenith Angle at center of Horizontal Cell.) | 0 – SZA < 70°; 1 - 70° <= SZA < 85°; 2 -SZA > 85° |
| 4 | Is IVSIC (rolling snow/ice tiles) used instead of VIIRS Snow EDR | 0 – false; 1- true. |
| 5-7 | Spare |  |

1. **Product evaluation**:

Validation of the EDR includes two components: First, surface type labels and quality flags in the EDR granule files are consistent with the QST IP, VIIRS snow EDR and Fire ARP; and second, QST IP accuracy meets the JPSS L1RD requirements for VIIRS Surface Type.

Based on intensive comparisons of the surface type labels and quality flags of VIIRS-Surf-Type-EDR granule files in the past months (up to August 2014) with the IDPS test data, VIIRS snow/ice EDR and VIIRS fire ARP, performance of the Suomi NPP VIIRS-Surf-Type-EDR is good. Visual evaluation of VIIRS-Surf-Type-EDR was accomplished globally and in different world regions using data from both Land PEATE (NASA) and IDPS (NOAA). The results from both systems were found to be in agreement. As the quality of VIIRS-Surf-Type-EDR is a function of performance of the VIIRS QST IP seed, snow EDR and active fire ARP algorithms, the joint analysis of the three products VCM, AOD and VIIRS-Surf-Type-EDR was conducted for a number of scenes.

Quantitative validation was based on the comparisons of number of pixels of each surface type, snow/ice, or active fire between VIIRS-Surf-Type-EDR and QST IP, snow/ice EDR, or active fire ARP. Although pixel number counts do not match perfectly, the differences are less than 0.01% generally for each surface type. The differences might have been caused by gridding and regridding processes between different spatial resolutions (e.g. 1km grid to VIIRS 750m pixel, VIIRS 375m pixel to VIIRS 750 pixel at different positions of a scene). However, the differences are generally less than 0.01% for all surface type labels.

The VIIRS VIIRS-Surf-Type-EDR provisional maturity “effectivity” date coincides with IDPS implementation of the 474-CCR-14-1700 VIIRS Based QST\_QST-LWM update (DR7552) on ***(insert date that 474-CCR-14-1700 (DR7552) goes into operations)***. That is the effective date from which the VIIRS -Surf-Type-EDR operational products at CLASS will be of provisional maturity.

1. **Known errors:**
2. VIIRS-Surf-Type-EDR might have been designed to monitor land surface type changes such as burned areas, snow/ice covers, flooded areas, and deforested/urbanized areas. But current VIIRS-Surf-Type-EDR label or quality flag do not provide this information except the fire and snow/ice cover labels imported from the Fire ARP and Snow/Ice EDR. We recommend upgrading the VIIRS-Surf-Type-EDR algorithm by adding a surface type change detection function.
3. VIIRS-Surf-Type-EDR was designed to provide Vegetation Cover Fraction as a data layer. But the parameters used in the VCF calculation may not be correct (namely maximum and minimum NDVI of each pixel or regions). This function of the VIIRS-Surf-Type-EDR is moved to a VIIRS Green Vegetation Fraction (GVF) product via a NOAA-NESDIS NDE project.

Additional information on VIIRS and Land Surface Reflectance algorithm theoretical basis document (ATBD) are available at <http://www.star.nesdis.noaa.gov/jpss/ATBD.php>

The VIIRS SDR Read-me for Provisional Data Quality is also available at the CLASS Homepage.

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