VIIRS Land Surface Temperature EDR Release, Provisional Data Quality
Effectivity Date: 7 April 2014
Read-me for Data Users

The Joint Polar Satellite System (JPSS) Algorithm Engineering Review Board released the VIIRS Land Surface Temperature Environmental Data Records (VIIRS-LST-EDR) to the public with a Provisional level maturity on 7 April 2014 in conjunction with IDPS operational implementation of the DR7493 LUT update.   Provisional quality is defined as:

- Product quality may not be optimal
- Incremental product improvements still occurring
- Version control is in effect
- General research community is encouraged to participate
- Users urged to consult the EDR product status
- Ready for operational evaluation

The Board recommends that users be informed of the following product information and characteristics when evaluating the VIIRS-LST-EDR:

1. **Background.**
   VIIRS-LST-EDR is a moderate band pixel-by-pixel determination of effective land surface skin temperature. It provides continuity with NASA EOS MODIS and NOAA POES AVHRR LST production, and also with international missions such as (A)ATSR. VIIRS design allows for full (high) resolution LST measurements over global land cover including coastal and inland water, under clear, probably clear and probably cloudy conditions. VIIRS-LST-EDR is expected to be used by weather forecasting models, Agriculture monitoring, drought prediction and monitoring, ecosystem monitoring; climate studies etc.

2. **Performance Evaluation**
   The internal evaluation on the quality flag, maps, geolocation etc. reveals no significant problems with upstream SDR, EDRs and IPs, except that nighttime snow cover information from snow product EDR may be problematic. The preliminary results from external evaluations including inter-comparison with MODIS Aqua LST data, validation against ground truth data and near real time monitoring of the LST product indicate that the *VIIRS-LST-EDR* production performs as designed.

   A 3-byte quality flags (QAs) set is provided for each LST retrieval. The QA information includes :
   a. byte 1: LST quality, algorithm, day/night, input SDR quality
   b. byte 2: within LST measurement range (or not), cloud indicator, AOT condition, sun glint
   c. byte 3: land/water background, surface type

Internal evaluation on the QAs has been performed and the QAs are functioning appropriately. Users are advised to first rule out the pixels with fill values when using quality flags. The default fill value is set as 127 for byte1 and 254 for byte 2 and 255 for byte3.

3. **Product status and accuracy assessment including error budget**
   This provisional version VIIRS-LST-EDR is based upon a split window (SW) regression algorithm that applies data of VIIRS thermal infrared bands M15 and M16 centered at wavelength 10.8 μm and 12.0 μm, respectively. The algorithm coefficients are clarified by 17 surface types defined by the international Geosphere-Biospher Programme (IGBP), as well as day ($0^o \leq$ Solar Zenith Angle $\leq 85^o$) and night conditions for each surface type. The VIIRS-LST-EDR values are available for those pixels with cloud confidences of "confident clear", "probably clear", and "probably cloudy". The measurable LST value range is from 183.2 K to 350 K.

   The accuracy/precision is evaluated using ground data from SURFRAD during the monitoring period from January, 2012 to March, 2013 and the results suggest that the nighttime LSTs for most surface types meet the L1RD requirements (accuracy 2.5K, precision 1.4K) and daytime LSTs over some surface types such as IGBPs 6, 7 meet the requirements but some are not. Note that the ground data from SURFRAD can only represent a limited set of surface types. Therefore, the evaluation was also performed through ground truth computed from radiative transfer model (i.e., the radiance-based validation). Cross-comparison with MODIS Aqua LSTs presents consistent LST measurements between VIIRS and MODIS LSTs.

   It is found that cloud contamination is still a problem to impact the LST retrieval. In-pixel heterogeneity of land surfaces is a major difficult to accurately validate the VIIRS LST data.

4. **Considerations, Known Issues, Closed DRs, and Assessment of any Open DRs**.
   Due to the surface type-dependent feature of the VIIRS-LST-EDR algorithm, inconsistency of the LST measurements are observed spatially and temporally. In spatial, artificial LST variation may occur due to the algorithm coefficient difference between the adjacent surface types. In temporal, seasonal inconsistency is still observed which maybe because of the considerable spectral variation in emissivity for different land surface type and emissivity variation within a surface type. More work is needed to further improve the VIIRS-LST-EDR product in the next validated version (v1).

   Note that prior to August 10, 2012, the LST EDR data from CLASS is retrieved from the dual split window algorithm. The split window LST was implemented into operation after then.

Nighttime snow/ice cover information from Snow EDR may not be right, resulting the nighttime snow surface LST derivation may have significant error.

Quality of the LST EDR relies very much on the correct classification of surface types from surface type EDR. Any fixes or improvement from the surface type EDR will be reflected in future versions of the LST EDR product.

Quality of the LST EDR is critically sensitive to the performance of VIIRS cloud mask (VCM), which remained suboptimal. The fixes and improvement are underway and will be reflected in future versions of the LST EDR.

Since VIIRS-LST-EDR beta release, three DRs have been opened and 3 DRs have been closed. Table 1 gives DR status of the VIIRS-LST-EDR product.

Table 1. DR status of VIIRS-LST-EDR

Date	DR#	Description	Status
12/31/13	7479	DR VIIRS LST_SWLST LUT Update	**Development of the improved LUT in work**
02/09/13	7055	LST QA is "low quality" when thin cirrus/active fire is set .	**Closed 5/29/12**. 474-CCR-13-1030 Implemented in IDPS Mx8.0
12/12/12	5028	LST QA not set correctly in all-ocean granules	**Closed 3/31/13**. Rejected b/c No land products over ocean will ever be used; illustrates larger IDPS architecture issue that land products should not be produced over ocean
12/12/12	5027	VIIRS LST should have NA fill in all-ocean granules	Closed. **474-CCR-13-1056** implemented in IDPS Mx8.0
11/26/12	4983	VIIRS LST beta Maturity.	**Closed 1/25/13**. 474-CCR-12-0773 deployed in ops
02/28/12	4608	Split-window algorithm - Baseline Coefficient files. LUT update #2 (same as"Updated LUT" in slides): DR 4608/CCR 12-0355: Corrects errors for both dual split window and split window.	**Closed 06/10/12**. Split Window algorithm implemented in IDPS baseline on 10 Aug, 2012.
02/15/12	4582	LST Day Night Land Water Misidentification, The LST EDR appears to have a coding error that may have incorrectly mixed up the Day/Night flag with the Land/Water and Surface Type QA Flag within the QF Byte 3 of the LST EDR...	**Closed 03/29/12**. Rejected because EDR team did not observe such error.

		This same Day/Night flag is being correctly encoded in the bit3 of QF Byte1 of the LST EDR.	
09/14/11	*4353*	Snow/ice field is always "no snow" at night if the Quarterly Surface Type does not indicate so. "Temporal snow" can only be directed daytime by snow/ ice EDR	***Closed 04/26/12***. Reallocated to Cryo team as new DRs: 4699 Out of Date snow cover seeded grid & 4700 Alternative snow/ice grid needed to support algorithms; Both have been addressed.
02/14/11	*4203*	The OPS LST code, both v1.5.00.48 and v1.5.03.00, do not verify that the value for the Surface Type input falls within the valid range prior to calculating LST	***Closed 1/9/13***. Rejected because not a problem to LST production since LST code does check the ST.

5. Feedback from key users

Not available yet.

6. **Summary of Findings and Recommendation**: The VIIRS-LST-EDR has met all provisional criteria. VIIRS-LST-EDR has shown marked improvement after beta release. Evaluation results show improved performance for some surface types such as IGBP 6, 7,10,12,14 and 16. Daytime VIIRS-LST-EDR gets significantly improved over some surface types and the performance is close or better than requirements e.g. IGBP 714 daytime. Some surface types get improved but the performance still exceeds the requirement, e.g. IGBP 10 at daytime. The seasonal pattern gets weak in the provisional version. Feedback from users and our continuous evaluations have been occurring since beta. The documentation up-to-date. The VIIRS-LST-EDR provisional maturity is effective as of 7 april 2014, the date that VIIRS LST_SWLST LUT Update (DR 7479) was implemented in IDPS. That is the "effective" date forward from which the VIIRS-LST-EDR products archived at CLASS will be of provisional maturity

Additional information on VIIRS and Land Surface Temperature 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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