MEMORANDUM FOR:	The JPSS Program Record
SUBMITTED BY:	JPSS VIIRS Land Surface Temperature Team Lead, Yuneyu Yu
CONCURRED BY:	JPSS Algorithm Management Project Lead, Lihang Zhou
	JPSS STAR Program Manager, Satya Kalluri
APPROVED BY:	JPSS Program Scientist, Mitch Goldberg

SUBJECT:	NOAA-20 Land Surface Temperature EDR Validated maturity status
DATE:	**11**/21/2019

Validated maturity status declaration for VIIRS Land Surface Temperature EDR

Maturity Review Date:	**11**/21/2019
Effective Date:	**11**/21/2019
Operational System:	**NDE, Version #v1r2**

The JPSS Algorithm Maturity Readiness Review Board approved the release of the NOAA-20 JPSS VIIRS Land Surface Temperature EDR to the public with a Validated maturity level quality as of 11/21/2019 (effective date), based on JPSS Validation Maturity Review held on 11/21/2019 (link to review artifacts).

1. Maturity stage definition (reference to the AMM webpage for maturity definition: http://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php)
   - Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).
   - Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level.
   - Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.
   - Product is ready for operational use based on documented validation findings and user feedback.
   - Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

2. Algorithm Description:
   List of Products (Collection Short Name (CSN))
   - NOAA 20 VIIRS LST

   Product requirements/Exclusions (L1RDS)

	JPSS VIIRS LST
Products	Threshold
Measurement Accuracy(bias)	1.4 K

Measurement Precision(1 sigma)	2.5 K
Measurement Range	213 – 343 K
Refresh Rate	At least 90% coverage of globe every 12 hours(monthly average)
Horizontal Resolution	1 km
Geographic coverage	Granule, over land

Quality flags (Table)

byte	bit	Flag	Source	description
1	1-0	LST quality	LST	00=high, 01=medium, 10=low, 11=no retrieval
	3-2	Cloud condition	Cloud mask	00=confidently clear, 01=probably clear,10=probably cloudy,11=confidently cloudy
	4	SDR quality	SDR	0=normal, 1=bad data
	5	Aerosol Optical Thickness at 550 nm (slant path)	AOT	0=within range(AOT<=1.0);1=outside range (AOT >1 or AOT no retrieval)
	7-6	Land surface cover	land/sea mask snow/ice mask	00=land;01=snow/ice;10=in land water;11=coastal/sea water
2	9-8	Water vapor condition	Tpw input	00=very dry atmosphere(wv<1.5g/cm^2) ; 01= dry [1.5,3); 10=moist atmosphere(3,4.5]; 11= very moist[4.5+)
	10	Emissivity uncertainty	Emissivity	0=within LSE uncertainty requirement(<=0.015); 1=outside range(>0.015)
	11	Degradation by large viewing angle	SDR	0=no degradation, 1=large view degradation (>40 degree)
	12	Day/night flag	SDR	0=night(solar zenith angle > 85degree), 1=day
	13	Thin cirrus	Cloud Mask	0= no thin cirrus, 1= thin cirrus(only available for daytime)
	14	Active fire	Cloud mask	0= no active fire, 1= active fire
	15	Reserved		Reserved for future use

Note that the bits in a quality flag is numbered from right (bit index #0) to left (bit index #7) with a default value of 1. Therefore for each bit, "1" also represents the situation of missing data. And the bits value is calculated from right to left, e.g. bits 1-0 xy (10), x is bigger bit and y is smaller bit, its value is equal to $2^1=2$. A visual example of this format is shown below.

Bit Index #	7	6	5	4	3	2	1	0
	0	0	1	0	1	0	1	0

Product evaluation/validation

Four methods as shown below have been used in the product evaluation/ validation.

- Global and regional NOAA 20 LST data long term monitoring.
- Theoretical evaluation of the NOAA 20 LST LUT
- Validation against the ground LST data from SURFRAD and BSRN
- Cross comparison with other satellite LST products including SNPP VIIRS LST, AQUA MODIS LST

Product availability/reliability
  - {VIIRS LST EDR} data were produced since 01/05/2018.
Algorithm performance dependence
  - The Algorithm performance is dependent on the sensor data quality. The sensor data is assumed to be well calibrated both in radiance and geolocation. The sensor noise level is assumed to be within NEDT requirements.
  - The algorithm performance relies on the quality of upstream dataset such as enterprise cloud mask, total water vapor uncertainty etc.
  - The algorithm performance is dependent on the total water vapor condition and viewing geometry condition. The algorithm performance is degraded under moist condition and large viewing angles.
  - The algorithm performance has regional and seasonal dependency.
Known errors/issues/limitations

3. Changes since last maturity stage
  - The quality flag bits order has been updated to be consistent with the JPSS EDR product convention.
  - Permanent snow information obtained from emissivity product is used together with the VIIRS snow cover product for snow pixel flag

4. Review board recommendations
   Input from Review board?

5. Path Forward/Future Plan
  - Product refinement
    - The LST LUT update is in the plan.
    - Uncertainty estimation at pixel level
    - Method to identify outlier and reduce ground measurement noise is under development.
  - Water Vapor correction
    - Further studies are needed for the LST retrieval under high temperature and moist conditions
  - Global /Comprehensive Validation
    - Long term monitoring tool
    - Global in situ data collection

  o Extend the cross satellite comparisons. (Sentinel, SEVIRI, AHI, GOES 17 …)
- Promote VIIRS LST data usage in NOAA climate model application.

6. Additional Items to note
   NA

Additional information is available in the {JPSS VIIRS LST EDR} algorithm theoretical basis document (ATBD) and validation maturity review briefing, which can be accessed at:
   https://www.star.nesdis.noaa.gov/jpss/documents/ATBD/ATBD_EPS_Land_LST_v1.0.pdf

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