



GOES-16 Land Surface Temperature Status

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Product Overview Validation Results Cross-Sensor Comparison Results Path to Enterprise Summary





Product Overview



LST Product Background



- LST is the instantaneous temperature of the earth "skin"
- One of the Essential Climate Variables (ECVs) by the GCOS of the WMO
- Emissivity-explicit retrieval algorithm is used for GOES-16 LST EDR generation. It was selected among nine candidate algorithms. $T_s = C + A_1T_{11} + A_2(T_{11} - T_{12}) + A_3\varepsilon + D(T_{11} - T_{12})(\sec \theta - 1)$
- GOES-16 LST EDR consists of three products: Full Disk (FD), CONUS, and Meso-scale (MESO1 and MESO2)
- Product is expected to be used by weather forecasting models, agriculture monitoring, drought prediction, ecosystem monitoring, and climate studies, etc.



GOES-16 LST Overview

LST EDR Mission Requirement

Products	LST (Skin): CONUS	LST (Skin): Full Disk	LST (Skin): Mesoscale	
Geographic Coverage	CONUS	Full Disk	Mesoscale	
Horizontal Resolution	2km	10km	2km	
Mapping Accuracy	1km	5km	1km	
Measurement Range (K)	213 - 330	213 - 330	213 - 330	
Measurement Accuracy ¹ (K)	2.5	2.5	2.5	
Measurement Precision (K)	2.3	2.3	2.3	
Refresh Rate	60 minutes	60 minutes	60 minutes	
Vendor Allocated Ground latency	3236 seconds	806 seconds	159 seconds	
Extent Qualifier	Local Zenith Angle < 70	Local Zenith Angle < 70	Local Zenith Angle < 70	

¹ The measurement accuracy 2.5 K is conditional with 1) known emissivity, 2) know atmospheric correction, and 3) 80% channel correction; 5K otherwise.

LST Availability

ics-md

- good pixel availability
 - input data not out of space
 - input data not bad data
 - input data not missing
- not over ocean
- clear or probably clear
 - not probably cloudy
 - not cloudy

LST data and more details are available at http://www.class.ncdc.noaa.gov



Product QFs



PQI Definition

Byte	Bit	Flag	Source	Effect		
1	0 - 1	Empty		Reserved for future use		
	2 – 3	Availability	SDR	00=normal, 01=out of space, 10=bad data, 11=missing data		
	4 – 5	Surface Type*	Land/sea Mask	00=land, 01=snow/ice, 10=in-land water, 11=sea		
	6 – 7	Cloud Index	Cloud Mask	00=clear, 01=probably clear, 10=probably cloudy, 11=cloudy		
	0 - 1	Atmospheric	ICT	00=dry atmosphere (wv<=2.0g/cm ²); 01=moist		
		Condition	LJI	atmosphere(wv>2.0g/cm ²); 10= very moist(wv>5.0/cm ²)		
	2	Day/Night	SDR	0=day (solar zenith <= 85 deg), 1=night		
2	3	View Angle	LST	0=normal, 1=large view angle (LZA>55 deg)		
	1 5	LST Quality	LST	00=normal, 01=cold surface (<250 K & >=213K), 10= out of		
	4 - 5			range (not in 213-330K)		
	6	Emissivity Quality	LST	0=normal, 1=historical emissivity		
	7	Empty		Reserved for future use		
		DQF Definition				
Byte	Bit	Flag	Source	Effect		
	0	Empty		Reserved for future use		
	1	Availability	SDR	0=normal, 1=out of space, bad data, missing data		
1	2	Cloud Index	Cloud Mask	0=clear or probably clear, 1=probably cloudy, or cloudy		
	3	View Angle	LST	0=normal, 1=large view angle (LZA>70°)		
	4	Surface type	Land/sea mask	0 = land, including inland water, 1= water		
	5	LST Quality	LST	0=normal, 1= out of range (not in 213-330K)		
	6-7	Empty		Reserved for future use		
2	0-7	Empty		Reserved for future use		

GOES-16 Product Validation Schedule



GOES-16 Post-Launch Science Product Validation Schedule



Note: All dates are coordinated with the Flight/MOST PLT SOE group and the T&H team and are subject to change.



ABI Scan Mode



GOES-16 Full Disk LST 2017-07-25T11:30:38.1Z - 2017-07-25T11:41:14.8Z UTC

- □ Scan Mode 3:
 - o Full disk every 15 minutes
 - o CONUS every 5 minutes
 - Mesoscales (2 locations) every 1 minute: Locations vary on demands
 - o Hourly LST for all three modes

GOES-16 CONUS LST 2017-07-25T11:52:18.8Z - 2017-07-25T11:54:56.1Z UTC









 Scan Mode 4:
Full disk every 5 minute
Hourly LST for full disk
Hourly LST for CONUS (Retrieval is carried out after

CONUS data are extracted from Full Disk.

Full Disk LST







CONUS LST









MESO LST













Validation Results



Validation results with SURFRAD



Sites	Record #	BIAS (K)	STD (K)	RMSE (K)
Bondville	356	0.15	1.85	1.86
Boulder	305	-1.16	1.45	1.86
Desert Rock	437	-3.23	1.21	3.45
Fort Peck	229	-0.54	1.89	1.96
Goodwin Creek	649	0.49	2.45	2.49
Penn State	204	-0.30	2.37	2.38
Sioux Falls	465	0.54	2.06	2.12

LST inspection and validation results are updated at ftp://ftp.star.nesdis.noaa.gov/pub/smcd/emb/pyu/LTM/single/GOE SR ABI/





Validation results with SURFRAD







Cross-Sensor Comparison Results



Comparison with VIIRS LST

GOES-16 CONUS ABI LST (2017-03-28 UTC 09:32)



213 223 233 243 253 263 273 283 293 303 313 323 333 343

Min: 244

Max:299

Aggregated VIIRS LST (2017-03-28 UTC 09:32)

ABI LST - viirs lst (2017-03-28 UTC 09:32)



-8 -7 -6 -5

-3

-2 -1

0

-4

5 6

NOAA

Comparison with VIIRS LST comparison





NOAR





Enterprise LST algorithm

Moving Forward: An enterprise algorithm

- Algorithm: $T_s = C + A_1 T_{11} + A_2 (T_{11} T_{12}) + A_3 \varepsilon + A_4 \varepsilon (T_{11} T_{12}) + A_5 \Delta \varepsilon$
- Emissivity difference term
- Formula stratified by satellite view zenith angle instead of one single angle correction term
- Stratified also by day/night and water vapor ranges.
- Practical consideration: 2 km spatial resolution for FD LST and higher temporal resolution for all products.
- Applicable to both ABI and VIIRS sensors.

Sites	Record #	Baseline		Enterprise	
		BIAS (K)	STD (K)	BIAS (K)	STD (K)
Bondville	649	-0.46	1.64	0.74	1.43
Boulder	728	-2.08	1.26	-0.93	1.28
Desert Rock	872	-5.60	1.54	-3.28	1.39
Fort Peck	870	-1.48	1.19	-0.23	1.22
Goodwin Creek	721	-0.21	2.36	1.38	2.22
Penn State	399	-0.53	2.21	0.48	2.19
Sioux Falls	832	-0.34	2.07	0.84	1.96



Enterprise LST Validation w/ SURFRAD







Baseline LST v.s. Enterprise LSTs-md

GOES-16 Full Disk LST 2017-06-30T00:30:38.3Z - 2017-06-30T00:41:14.9Z UTC 20° 120°W 60°W 30°W 90°W 50°W CST: 18:30 20°S 40°S 60°S 220 300 240 260 280 320 340

GOES-16 Full Disk Enterprise LST 2017-06-30T00:00:38.3Z-2017-06-30T00:11:14.9Z UTC

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Summary



- GOES-16 ABI LST reached Beta maturity on May 24th, 2017.
- Routine visual inspection yields satisfactory results, no major issues were found.
- LST quality was assessed with SURFRAD in-situ observations. Results from most sites meet the mission requirement. However, significant underestimate was found at the Desert Rock site.
- GOES-16 LST was compared with SNPP VIIRS LST, good agreement between the two was found.
- Some minor problems were identified in the product, mostly related to the quality flag. This does not have impact on the product quality.
- The enterprise algorithm is currently being tested and will be implemented in the future.