JPSS Land Surface Temperature Product

Yunyue Yu

NOAA/NESDIS/STAR

Yunyue.Yu@noaa.gov

Yuling Liu, Peng Yu, Heshun Wang

UMD/ESSIC

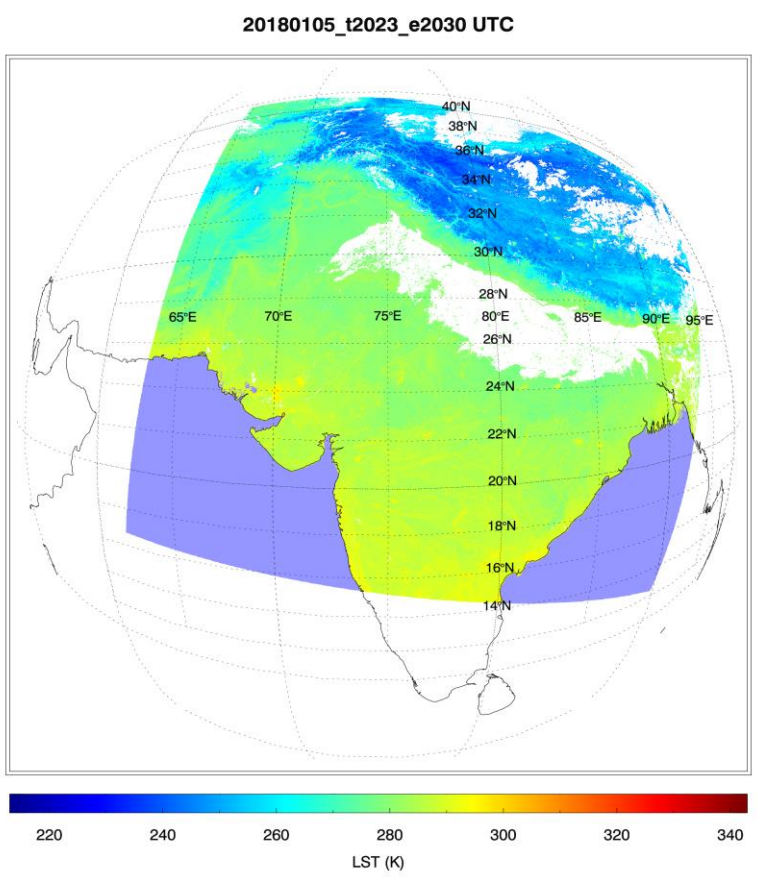
Outline

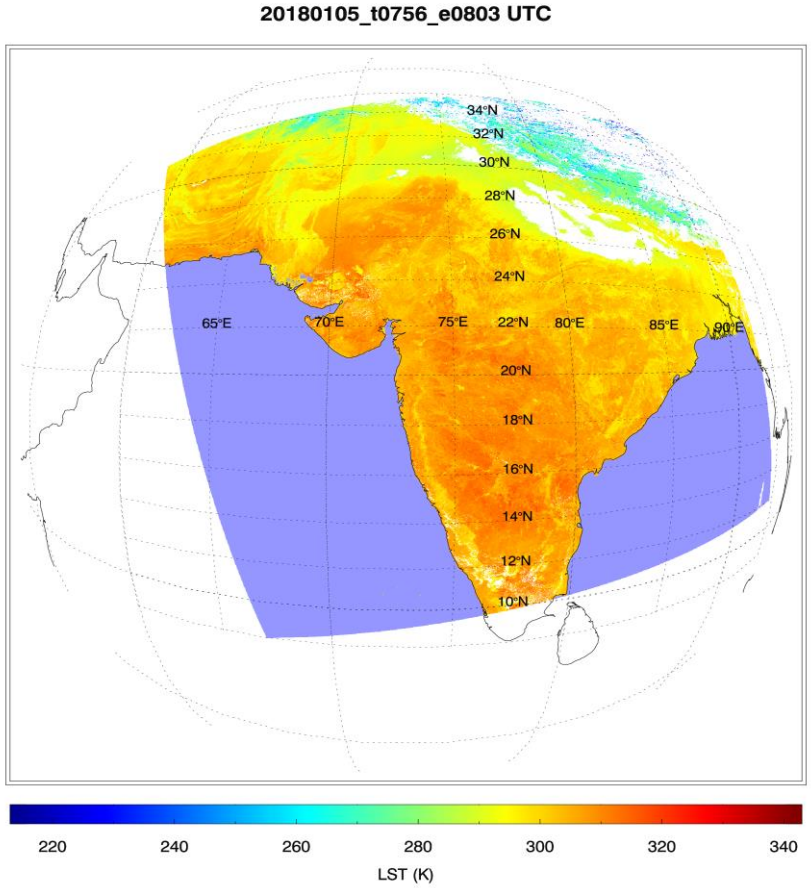
- Cal/Val Team Members
- JPSS LST Production Overview
  - Enterprise LST algorithm for NDE
  - NOAA 20 LST status
  - Gridded VIIRS LST product development
  - Emissivity development
  - Long Term Monitoring
- Interactive communication with users
- Summary and Path Forward

Cal/Val Team Members

PI	Organization	Team Members	Roles and Responsibilities
Ivan Csiszar	NOAA/NESDIS/SATR		Land Lead, Project Management
Yunyue Yu	NOAA/NESDIS/SATR		EDR Lead, algorithm development, validation, team management
		Yuling Liu	product monitoring and validation ; algorithm development
		Heshun Wang	algorithm improvement, emissivity development
		Peng Yu	product validation tool, monitoring, applications
Walter Wolf	NOAA/NESDIS/SATR		System Integration, Transition
		Valerie Mikles	System Integration, Transition
		Marina Tsidulko	STAR IT support
Jack Kain	NOAA/EMC/NCEP		User readiness
		Weizhong Zheng	User readiness : Model LST verification
		Yihua Wu	User readiness : Model LST verification

Enterprise LST Algorithm





Regression Form: $Ts = A_0 + A_1T_{11} + A_2(T_{11} - T_{12}) + A_3\varepsilon + A_4\varepsilon(T_{11} - T_{12}) + A_5\Delta\varepsilon$

Status:

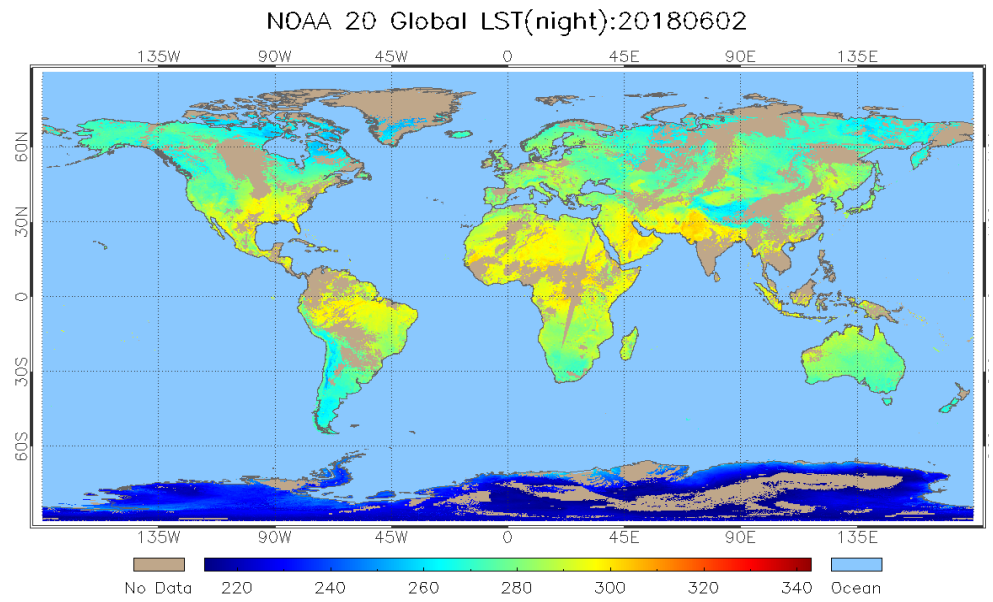
- The ASSIST Near Real Time (NRT) run of the enterprise LST has been started from end of June 2018
- The NDE Operational Readiness Review is scheduled in Sept 2018, operational run about one month afterward.
- The LST ATBD is Updated accordingly

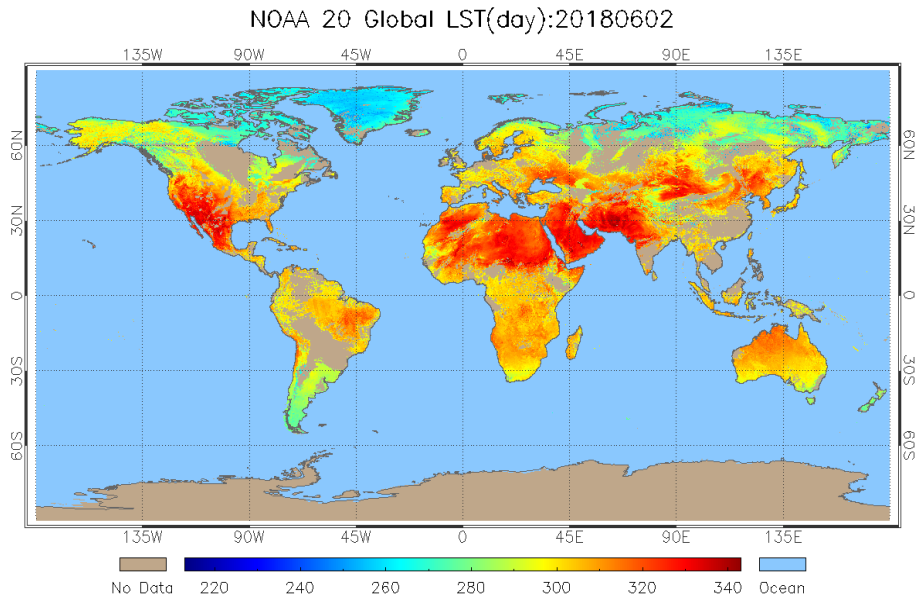
Performance Overview

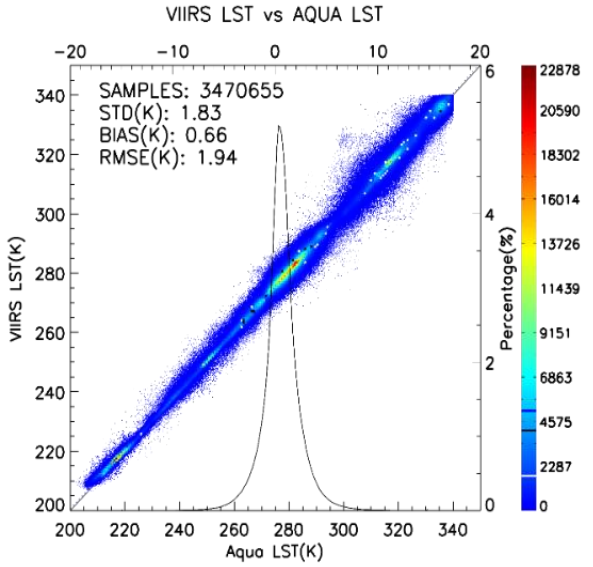
Validation method	Summarized Results* Bias (STD)	Notes
Comparisons with ground measurements	SURFRAD: -0.08(2.26) sxf: -0.48(2.50) tbl:-0.16(1.54) gwn:-0.91(3.35) psu:-0.25(1.62) dra:-0.83(1.69) fpk:-0.44(1.56) bon:-0.72(2.46)	Statistics of the differences are based on the enterprise VIIRS LSTs against ground LST estimates from 7 **SURFRAD** sites, 1 GMD site and 2 BSRN sites, for a time period of total 7 weeks in four seasons. The results are constrained by ground data quality control, cloud filtering procedure and upstream data quality.
	GMD over SUM -0.25(1.12)	
	BSRN over CAB -0.63(1.73) BSRN over GOB -1.23(1.52)	
Cross satellite Comparison	0.01(2.49) -0.18(2.80): daytime 0.46(1.43): nighttime	The cross comparisons are performed between enterprise VIIRS LSTs and MODIS AQUA LSTs. The results are constrained due to regional sampling limitation, i.e. over Africa, US, South America, Australia and Canada. It is also constrained due to temporal sampling limitation, sensor difference, and observation angle difference etc.

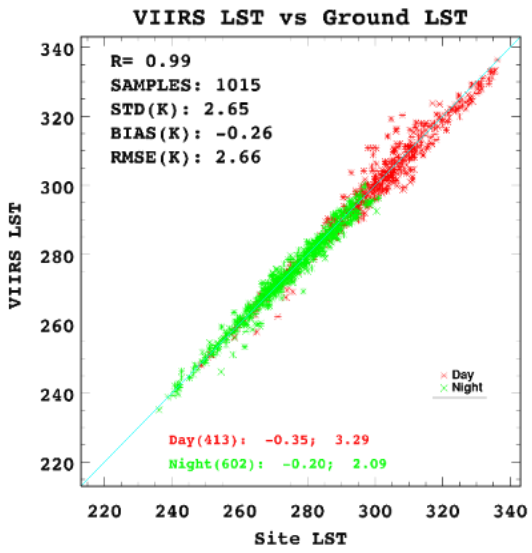
**Bias (STD) of L1RD threshold: 1.4 (2.5K)*

NDE NOAA-20 LST Status



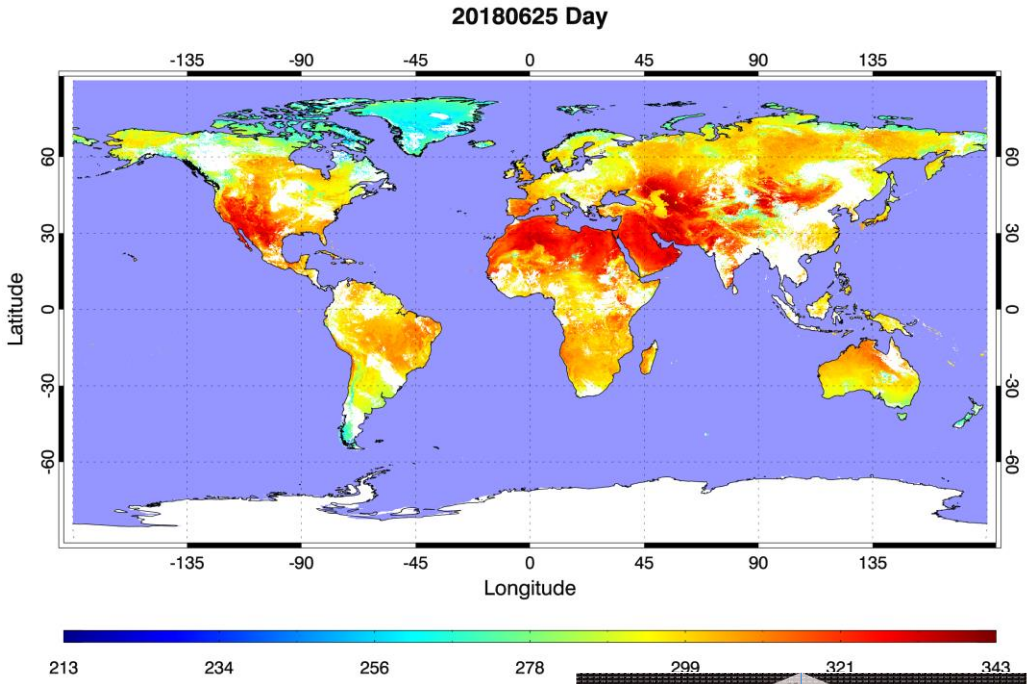


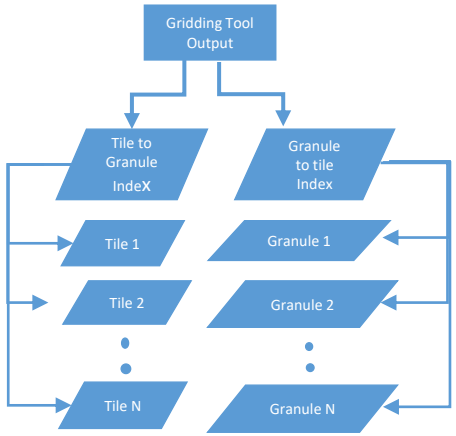




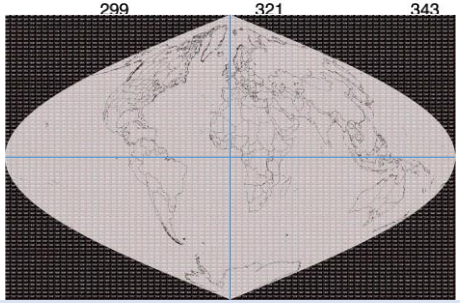
- The enterprise LST algorithm is applied for NOAA-20 LST production (NDE)
- Beta maturity Review was done in July 2018
- Calibration and validation is on the way for Provisional maturity (Dec 2018)

Gridded LST product development

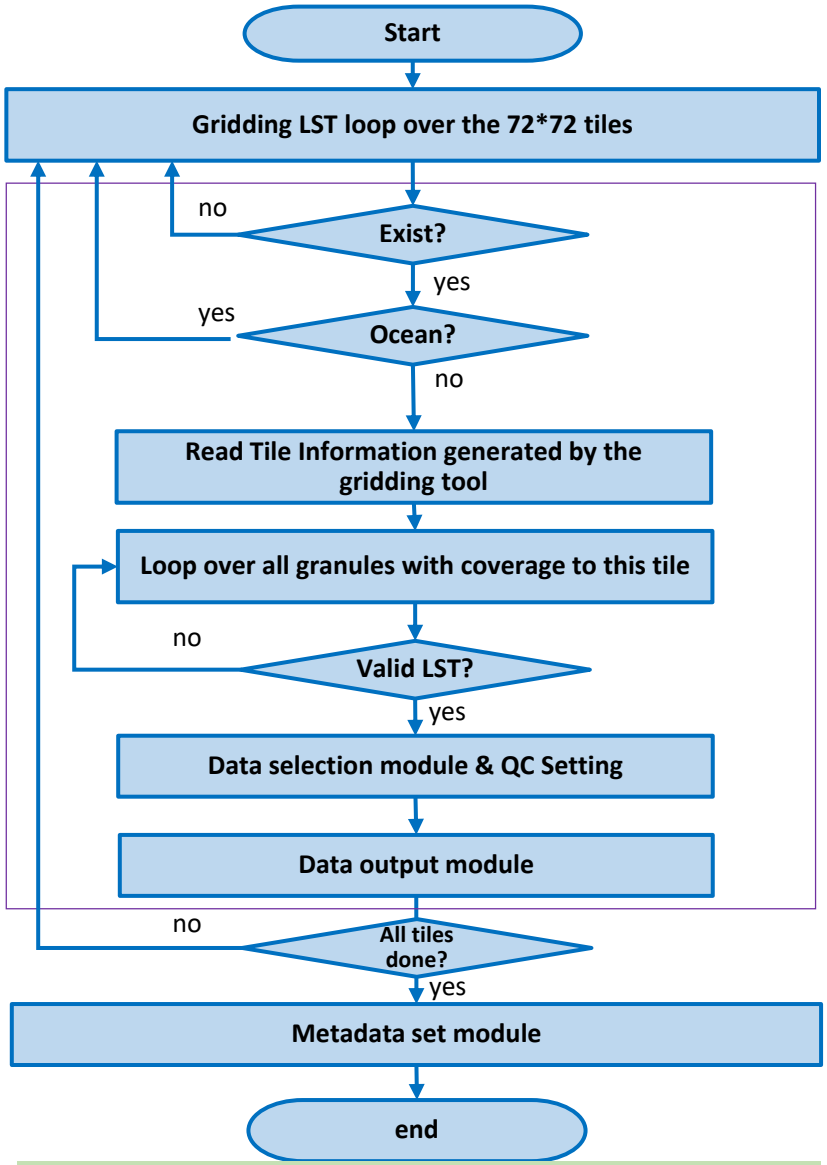




Gridding tool output structure



- A gridding tool generates grid-pixel mapping IPs which are used as input for the gridded LST production
- The gridded LSTs are computed tile by tile
- A tool will be provided to convert the tile dataset to the final LST product.



High level flow chart of gridded LST using the gridding tool

Emissivity Data Development

LSE Product Main Features

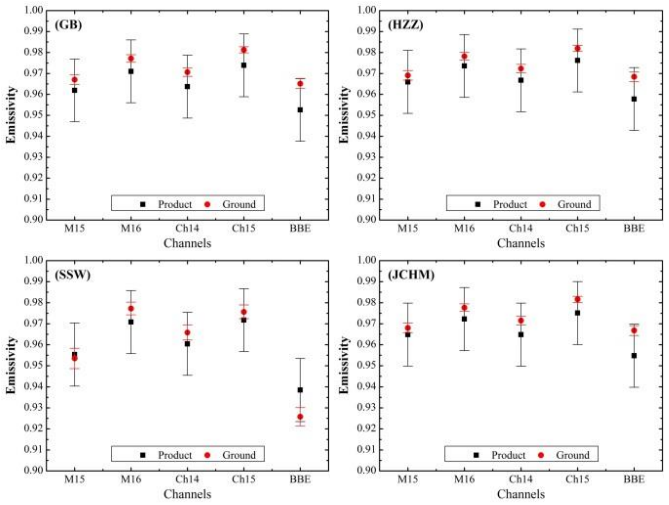
- Daily product with global coverage at 0.009 degree grid.
- Including 5 bands: VIIRS and ABI split window channels and 8-15um broadband.
- Pixel by pixel quality flag, grouping LSE uncertainty into four level and vast majority with an error of less than 1.5%.

Ground LSE Measurements

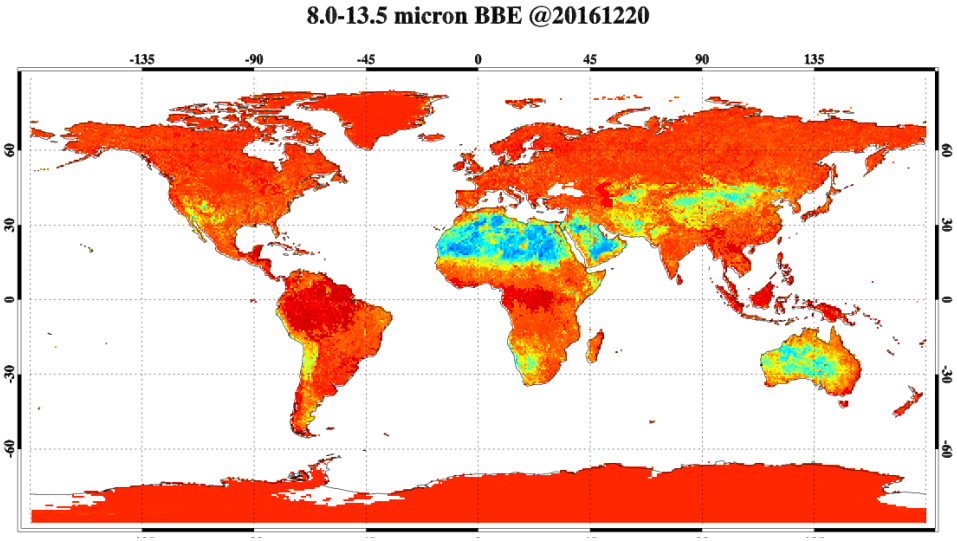
- Four bare sites at northwest of China measured by BOMEM MR340 FTIR.
- Sand Samples from Three deserts measured using Nicolet iS50 FTIR.

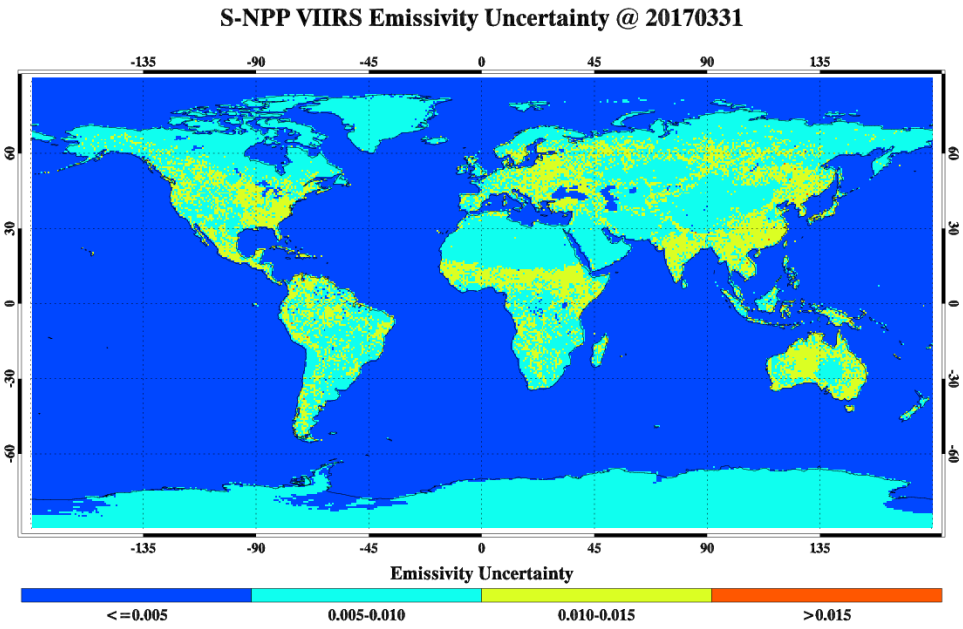
Validation Results

- Split-window channel LSE uncertainty within 0.6%
- Broadband LSE uncertainty within 1.2%.



4-site validation Results





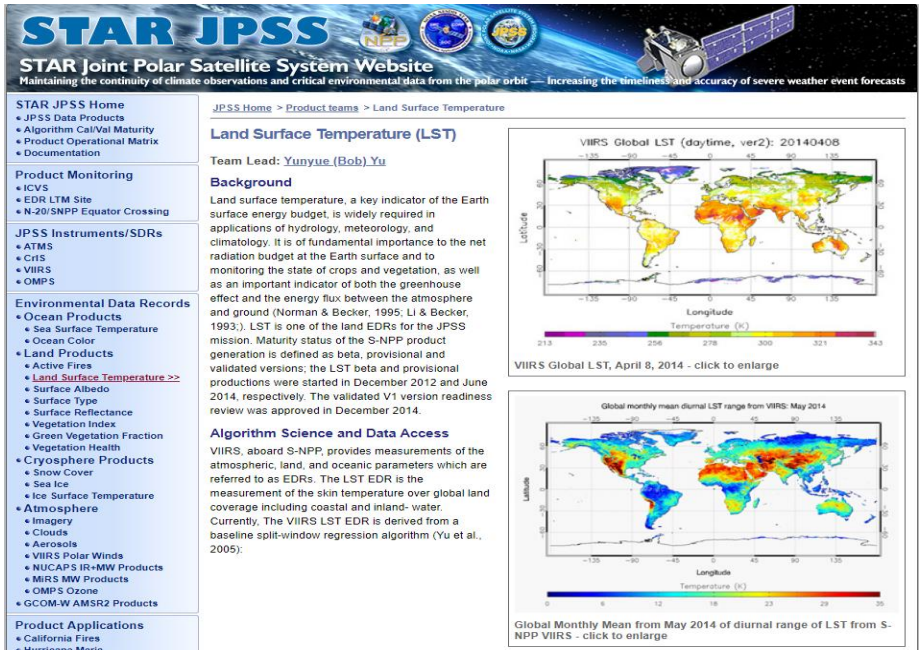
Long-term monitoring

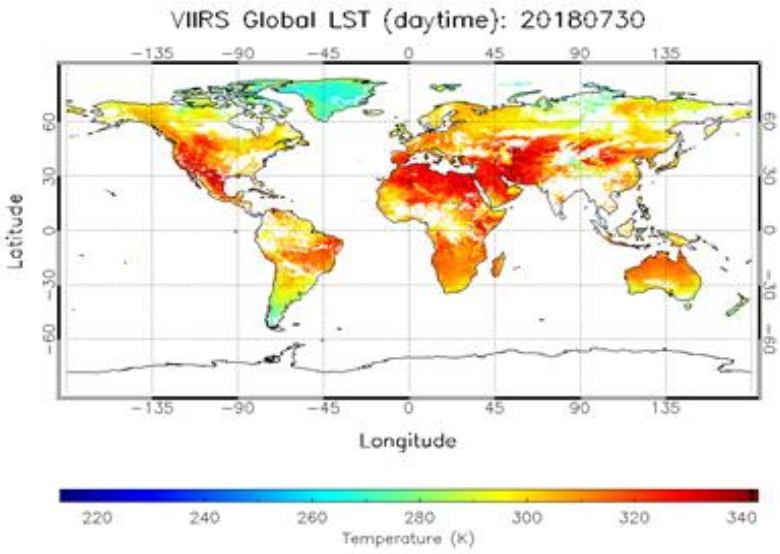
- **Monitoring/Validation tool maintenance and extension**

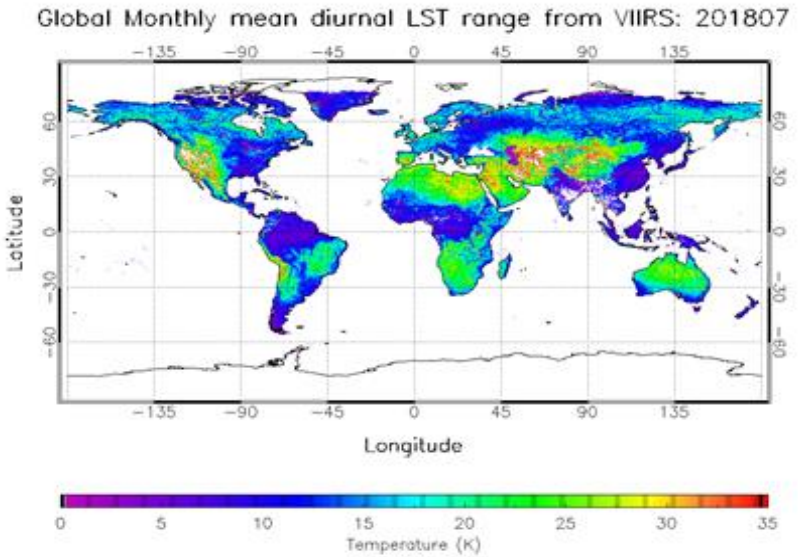
✓ The monitoring tool routinely generates daily global VIIRS LST maps, and the diurnal temperature range (DTR) from the operational VIIRS LST EDR data and validation with SURFRAD data.

✓ NOAA 20 data has been added into the monitoring system.

✓ ftp site for image distribution and notification is working routinely. The data is available at ftp://ftp.star.nesdis.noaa.gov/pub/smcd/emb/pyu/VIIRS_monitoring/.







Interactive communication with users

External Users

– USDA Agricultural Research Services(Martha Anderson)

-- USDA Forest Service (Brad Quayle)

– Academy – Univ. of Maryland (Konstantin Vinnikov, Shunlin Liang, Cezar Kongoli)

– Army Research Lab (Kurt Preston)

– EUMETSAT LSA SAF LST group (Isabel Trigo, Project Manager)

– ESA/ESRIN, Italy (Simon Pinnock & Olivier Arino)

– Univ. Of Edinburgh, UK (Chris Merchant)

– OBSPM, and LSCE, France (Catherine Prigent & Carlos Jimenez, and Catherine Ottlé)

– Universitat de les Illes Balears, Spain (Maria Antonia Jimenez Cortes)

– eLEAF, The Netherlands (Henk Pelgrum & Wim Bastiaanssen)

– Centre for Ecology and Hydrology, UK (Rich Ellis)

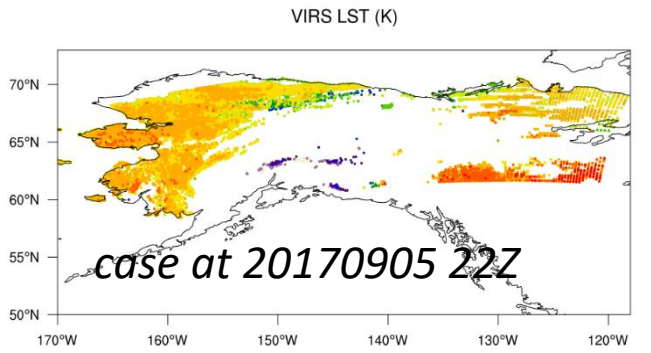
– Institute of Geodesy and Cartography, Poland (Katarzyna Dabrowska-Zielinska)

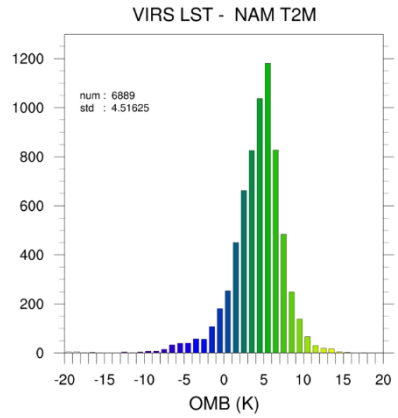
Provide test datasets for

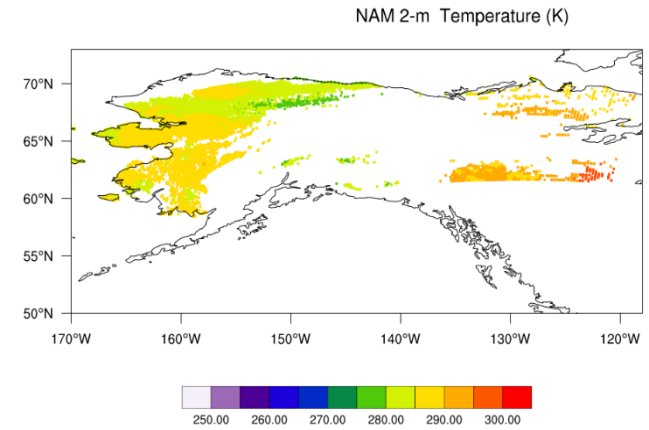
- NCEP/EMC weather forecasting model output verification
- NCEP/EMC land surface air temperature prediction model

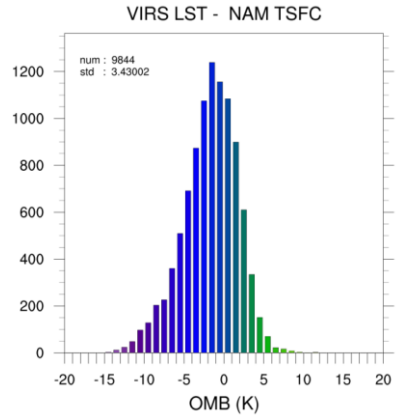
Current Users feedback

VIIRS LST vs Model 2m Temp

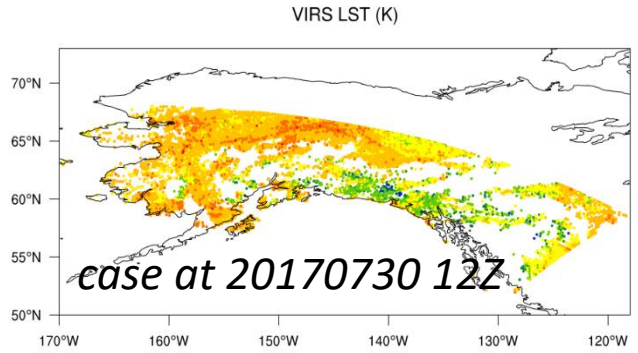


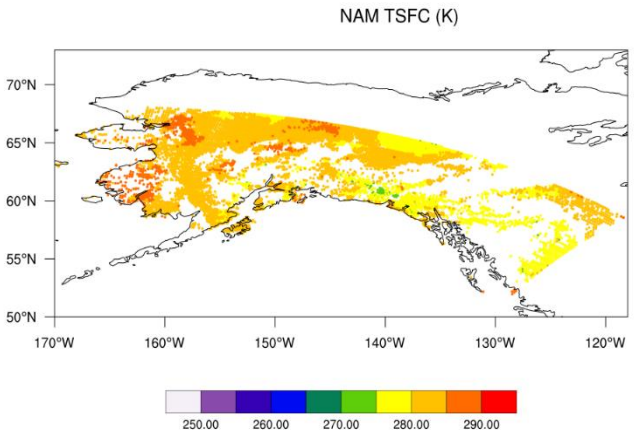






VIIRS LST vs Model TSFC





- EMC requested the granule VIIRS LST for studies on assimilating VIIRS LST into RTMA/URMA to improve air temperature prediction over Alaska area.
- The preliminary results are very encouraging therefore EMC is going to subscribe the VIIRS LST data

Summary

- Enterprise LST algorithm progress
  - The enterprise LST algorithm will be run in NDE by Oct 2018.
  - Local ent-LST dataset is available upon request
  - Daily emissivity dataset is available also
- NOAA 20 LST beta maturity reviewed
- Gridded LST design and development
  - CDR will be conducted in Sept/Oct 2018
  - Daily product, grid size 0.009.
  - Quality flags and metadata are available.
- Long-term monitoring – fairly matured for the science team
- Active communication with users

Future Plans/Improvements

- Comprehensive validation, Alg Calibration
- QF improvement
- Product maturity Progress
- Emissivity Data evaluation
- Operational Gridded LST done by Sept 2019
- Extension of the cross satellite LST comparison e.g. Sentinel 3.
- International collaboration on the ground data collection for LST validation.
- Users interactive communication

JPSS Land Surface Albedo

Yunyue Yu
NOAA/NESDIS/STAR
Yunyue.Yu@noaa.gov

Shunlin Liang, Dongdong Wang,
Yuan Zhou, Jingjing Peng
UMD/CICS

Outline

- Cal/Val Team Members
- VIIRS LSA Production Overview
  - New LSA algorithm for NDE
  - NOAA-20 LSA status
  - Algorithm Performance
- NDE Gridded LSA Product
- Updates to Sea Ice Surface Albedo Algorithm
- User feedbacks
- Summary

Cal/Val Team Members

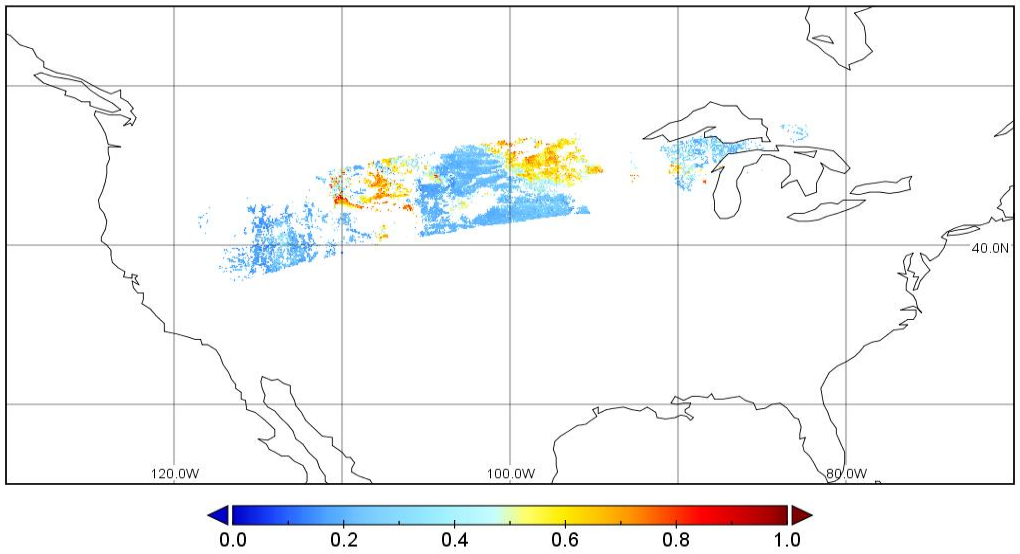
PI	Organization	Team Members	Roles and Responsibilities
Ivan Csiszar	NOAA/NESDIS/SATR		Land Lead, Project Management
Yunyue Yu	NOAA/NESDIS/SATR		EDR Lead, algorithm development, validation, team management
		Jingjing Peng	Algorithm development, validation, monitoring
Shunlin Liang	UMD/CICS		Algorithm development, validation
		Dongdong Wang	Algorithm development, validation, monitoring
		Yuan Zhou	Algorithm development, validation, monitoring
Walter Wolf	NOAA/NESDIS/SATR		System Integration, Transition
		Valerie Mikles	System Integration, Transition
		Marina Tsidulko	STAR IT support
Jack Kain	NOAA/EMC/NCEP		User readiness
		Weizhong Zheng	User readiness : Model albedo application, verification
		Yihua Wu	User readiness : Model albedo application, verification

VIIRS NDE LSA Product

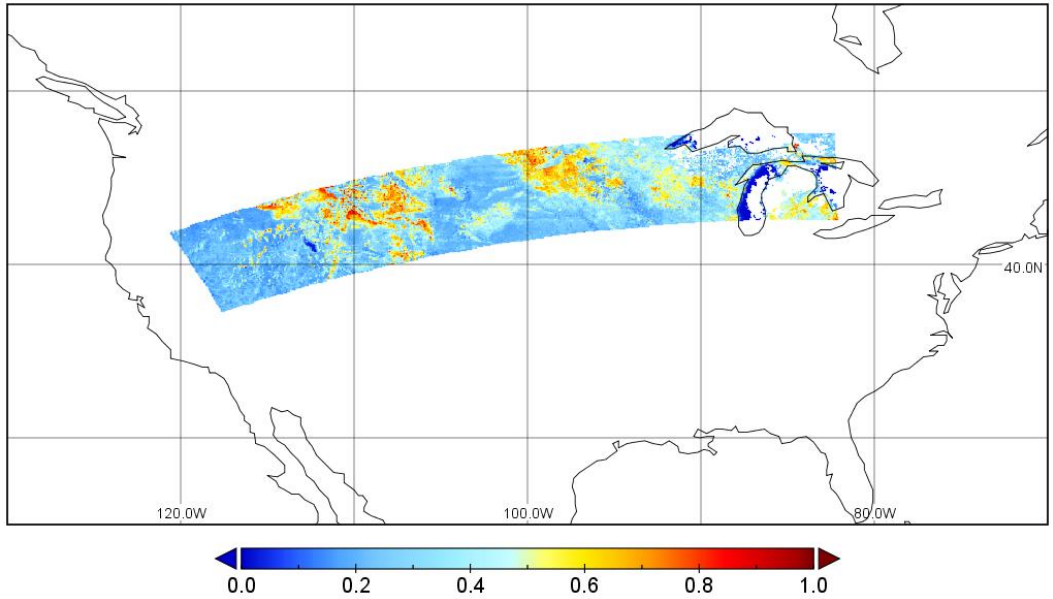
Status:

- The ASSIST Near Real Time (NRT) run of the NDE LSA has been started from end of June 2018
- The NDE Operational Readiness Review is scheduled in Sept 2018, operational run about one month afterward.
- The LSA ATBD is Updated accordingly

SNPP VIIRS Albedo Product (IDPS) (Jan 22th, 2015)



SNPP VIIRS Albedo Product (NDE) (Jan 22th, 2015)



Issues of IDPS LSA product

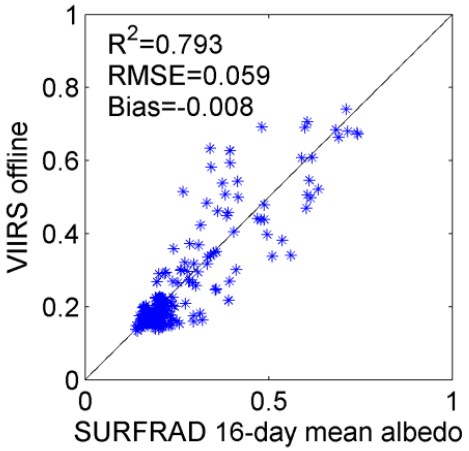
- Missing values
- Uncertainties from a single observation

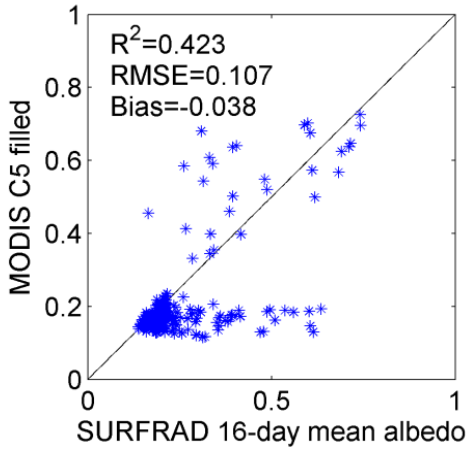
Feature of NDE LSA product

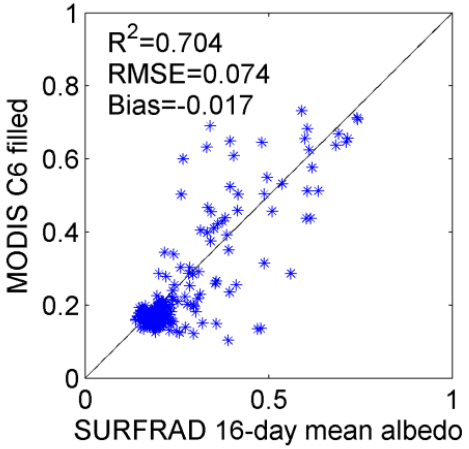
- Gap-filled
- Noise-reduced

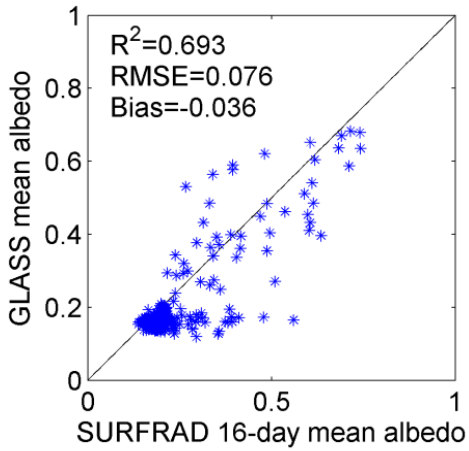
Performance Overview

- Surface-specific LUTs were developed
  - Generic
  - Desert
  - Snow
  - Sea-ice
- Climatology of albedo was used to fill data gaps and reduce retrieval uncertainties
- Validation results suggest the VIIRS NDE algorithm is accurate







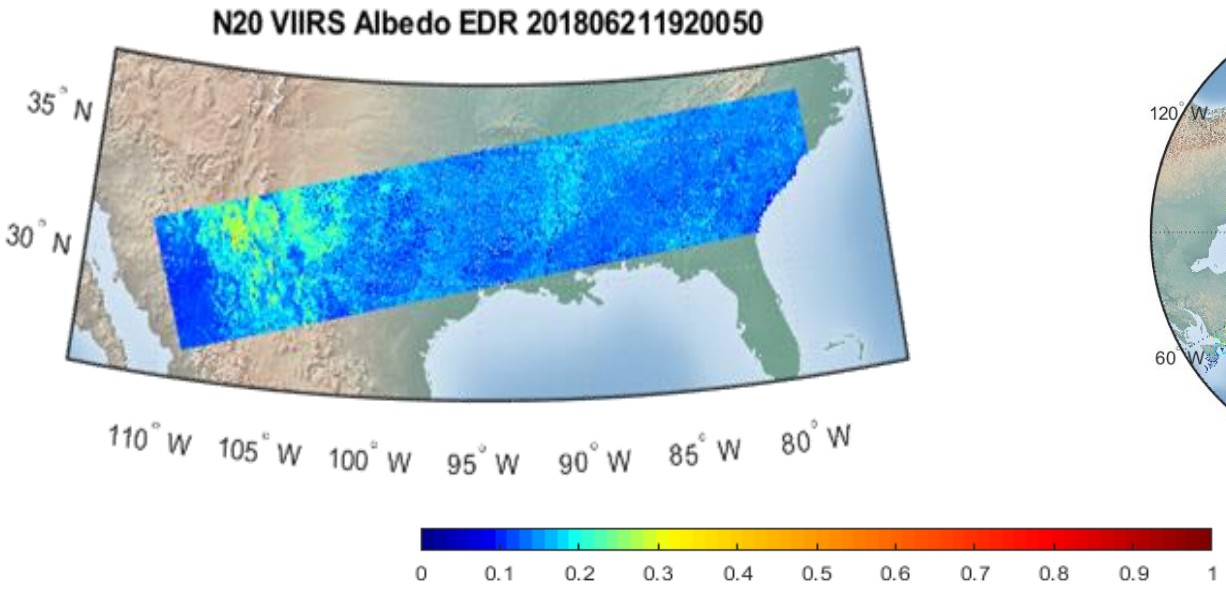


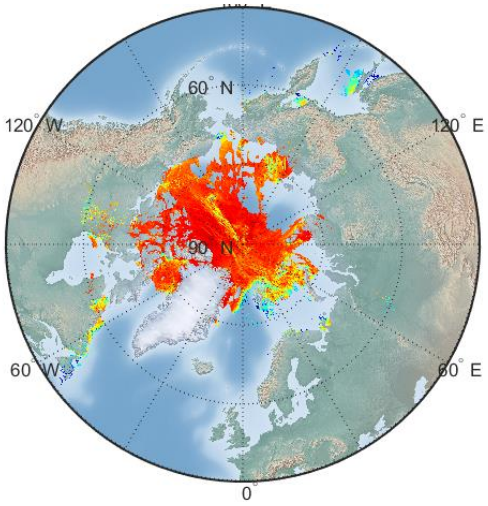
Validation results of 16-day mean albedo from VIIRS and MODIS by comparing against SURFRAD measurements

	Reqs.	Pre-TRR validation		Post-TRR validation	
		land	sea ice	SURFRAD	Ozflux
Accuracy	0.08	0.008	0.028	-0.005	0.02
Precision	0.05			0.05	0.035

TRR: Test Readiness Review

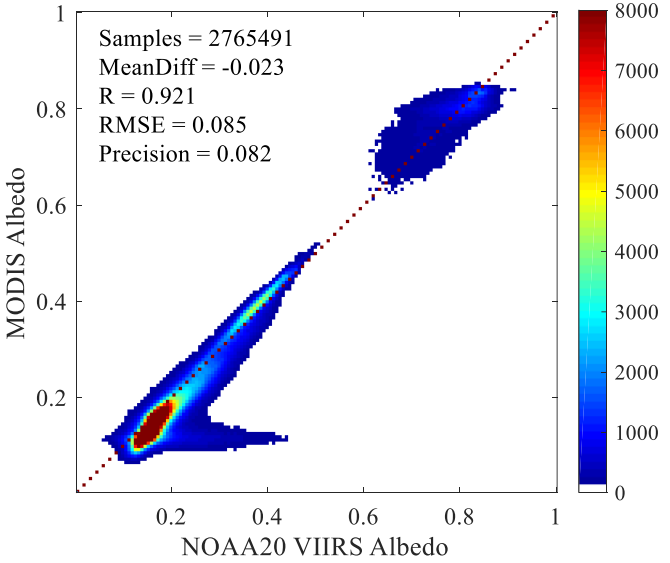
NOAA-20 VIIRS Albedo Status





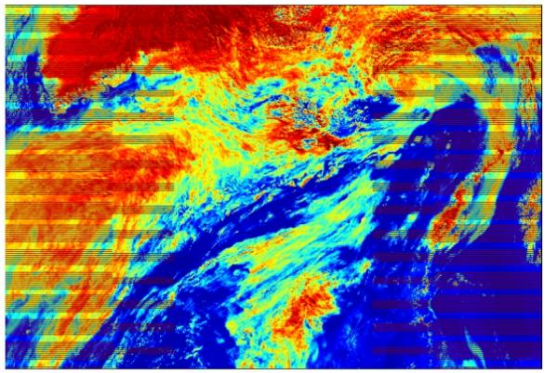
- The NDE SNPP LSA algorithm is applied for NOAA-20 LSA production (NDE)
- Beta maturity Review was done in July 2018
- Calibration and validation is on the way for Provisional maturity (Dec 2018)

Summer Case: 20180609

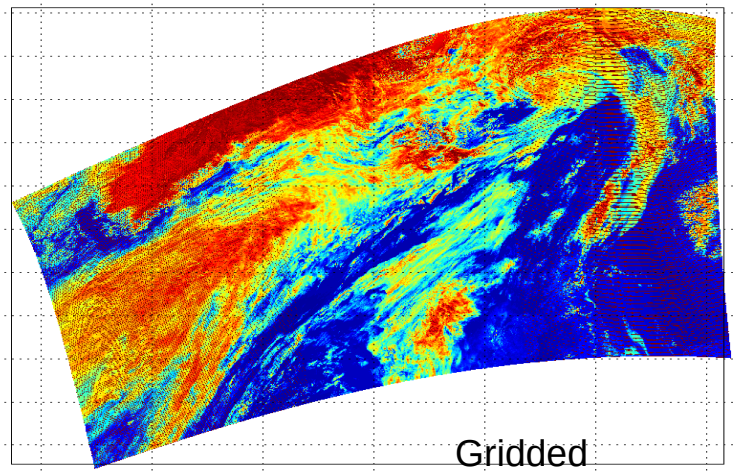


Gridded LSA Product Development

(GranuleID, i, j) ------ (TileID, x, y)

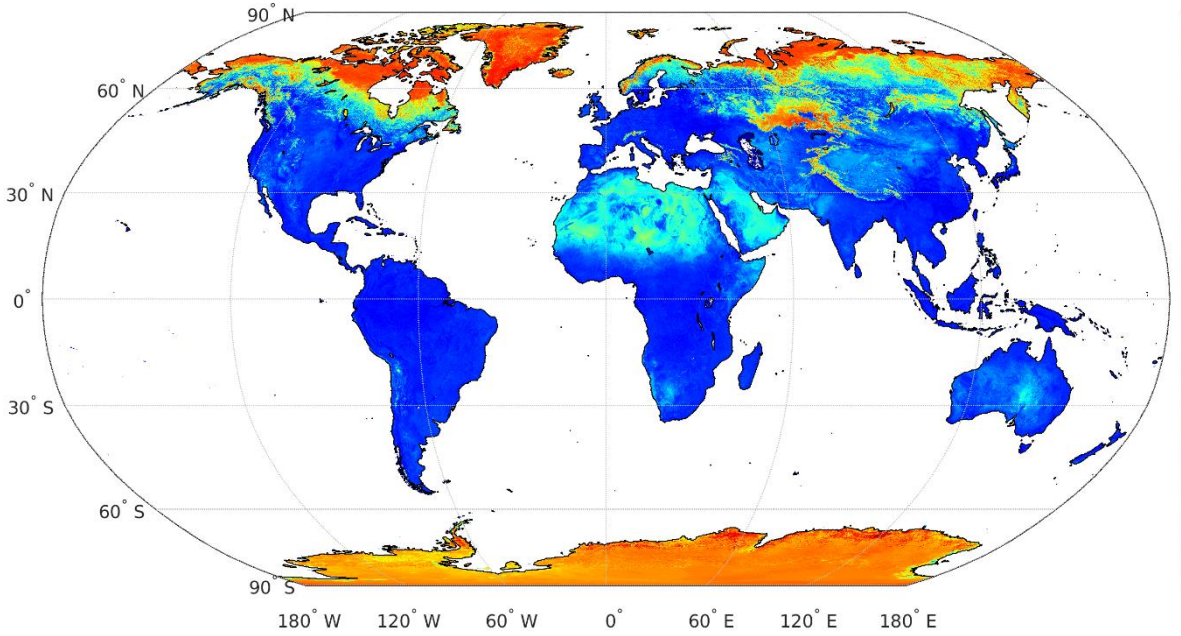


Granule



Gridded

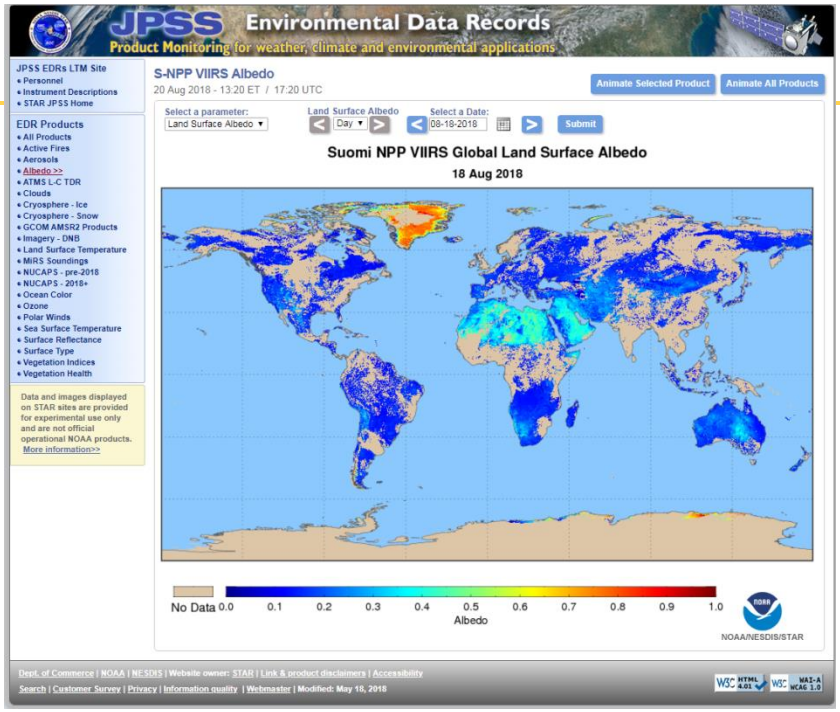
- A gridding tool generates grid-pixel mapping IPs which are used as input for the gridded LSA production
- The gridded LSAs are computed tile by tile
- A tool will be provided to convert the tile dataset to the final LSA product.

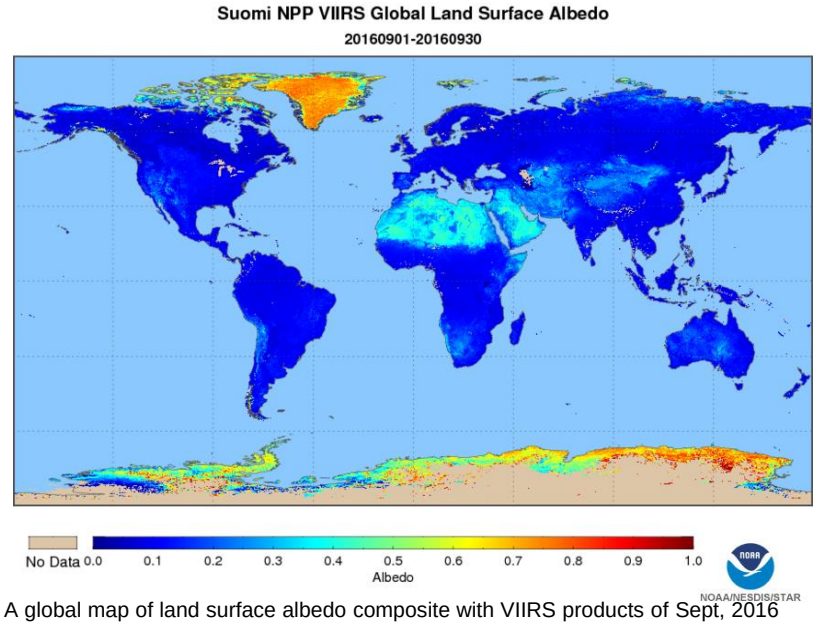


VIIRS LSA Long-term Monitoring

Developed a long-term monitoring tool

- Automatically validate against field measurements;
- Generate global composite maps on a regular basis ;
- Send alerts when abnormal results occurs;
- Update maps through WWW
- http://www.star.nesdis.noaa.gov/jpss/EDRs/products_Albedo.php





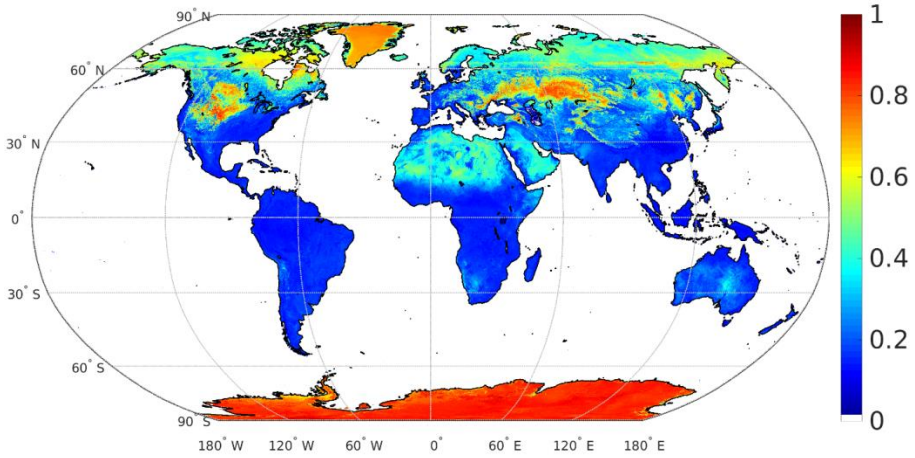
A global map of land surface albedo composite with VIIRS products of Sept, 2016

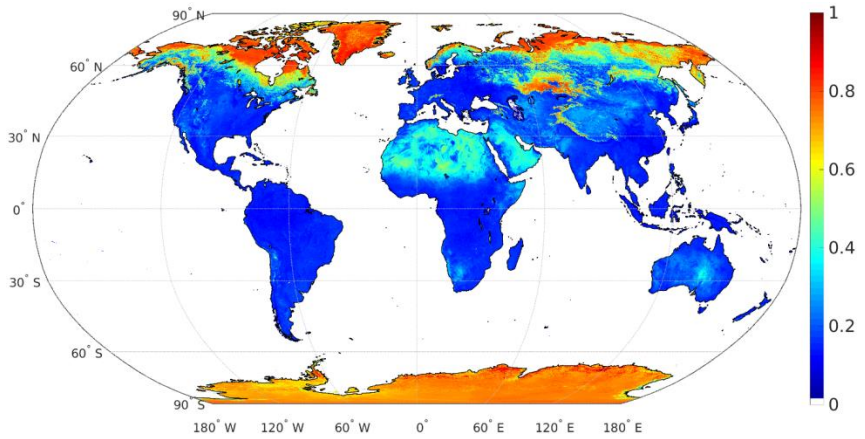
Interactive communication with users

- **U. S. Users:**
  - NOAA National Weather Service Environmental Modeling Center (Michael EK, Jesse Meng, Weizhong Zheng)
  - USDA Agricultural Research Services(Martha Anderson)
  - USDA Forest Service (Brad Quayle)
  - NOAA/NESDIS Center for Satellite Applications and Research (Jerry Zhan)
  - NOAA/NESDIS National Climate Data Center (Peter Thorne)
  - Academy -- University of Maryland (Konstantin Vinnikov, Shunlin Liang, Cezar Kongoli)
  - Army Research Lab (Kurt Preston)
- **Foreign Users**
  - EUMETSAT (Yves Govaerts)
  - Météo France (Jean-Louis Roujean)
  - Academy: Italy IASMA Research and Innovation Centre (Barbara Marcolla), Beijing Normal University (Qiang Liu)

Interactive communication with users

- The new gridded, gap-filled, noise-reduced product is developed to meet the requirements of modeling team and data analysis.
  - Working with the NCEP modeling team to test the application of new product
  - Customized the codes to generate tailored data sets.





Examples of albedo data customized for modeling team

Summary

- NDE Albedo Algorithm progress
  - The NDE Albedo algorithm will be run by Oct 2018
  - Feature: gap-filled, noise-reduced, sea-ice albedo
- NOAA-20 LSA beta maturity reviewed
- Gridded LSA design and development
  - CDR will be conducted in Sept/Oct 2018
  - Daily product, grid size 0.009.
  - Quality flags and metadata are available.
- Long-term monitoring – fairly matured for the science team
- Active communication with users

Future Plans/Improvements

- Comprehensive validation, Alg Calibration
- Operational Gridded LSA done by Sept 2019
- Product maturity Progress
- Albedo data reprocessing and evaluation
- Monitoring, validation tool at STAR environment
- Users interactive communication