



Enterprise VIIRS LST Production for JPSS Mission: Validation and Application



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Enterprise JPSS VIIRS LST Product Introduction

NDE Land Surface Temperature Product

➤ Based on split window technique

$$T_s = C_0 + C_1 T_{11} + C_2 (T_{11} - T_{12}) + C_3 \varepsilon + C_4 \varepsilon (T_{11} - T_{12}) + C_5 \Delta \varepsilon$$

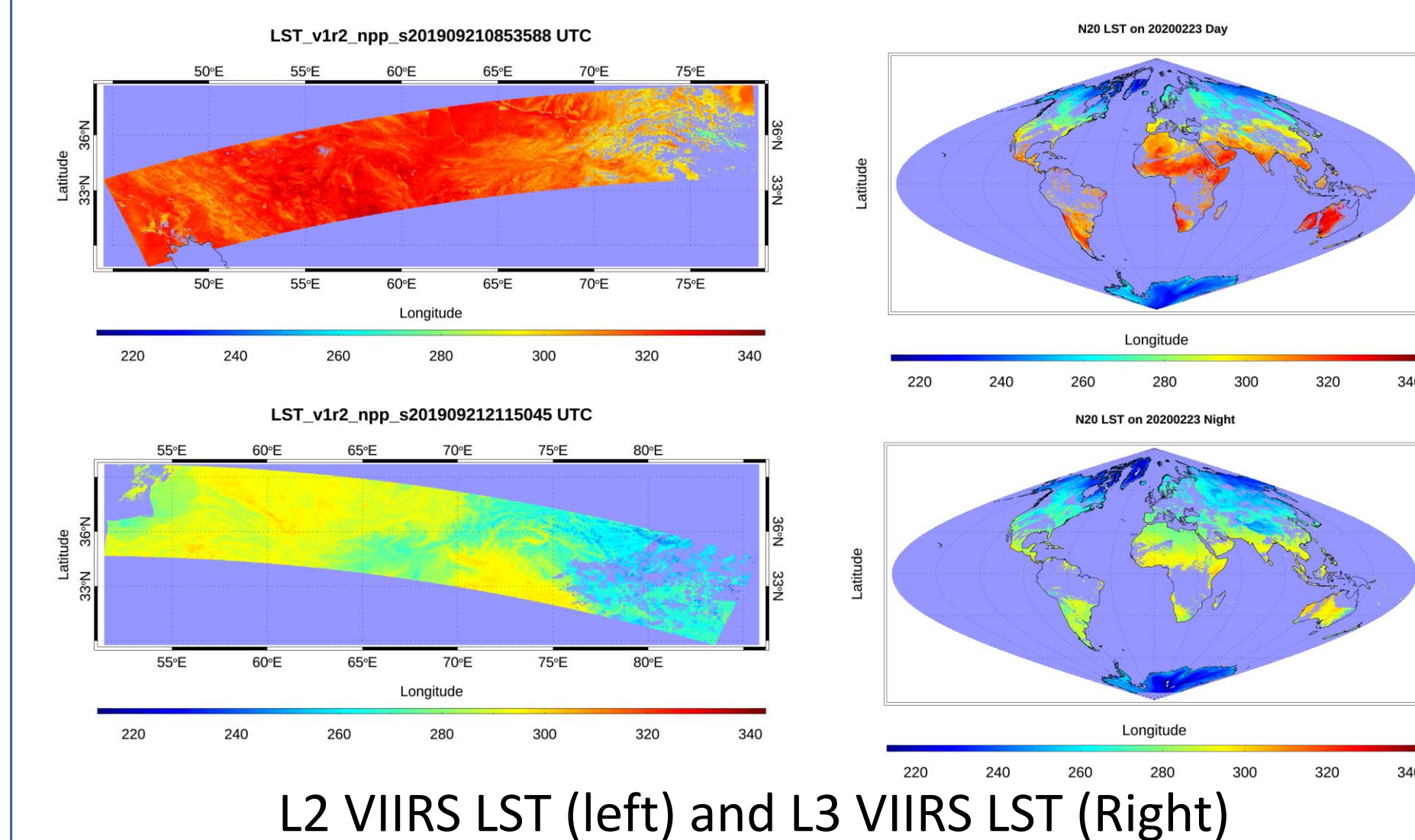
T_{11} and T_{12} : the TIR split-window channel BTs

ε and $\Delta \varepsilon$: mean emissivity at the TIR spectrum, and the emissivity difference LUT {C} dimension: Day/night, View Zenith Angle, Total Column Water Vapor

➤ Granule (L2) and gridded (L3) LST product for both SNPP

VIIRS and NOAA 20 VIIRS

➤ L2 VIIRS LST has been in operational and the L3 VIIRS LST was just put into operational.



L2 VIIRS LST (left) and L3 VIIRS LST (Right)

NDE Land Surface Temperature access

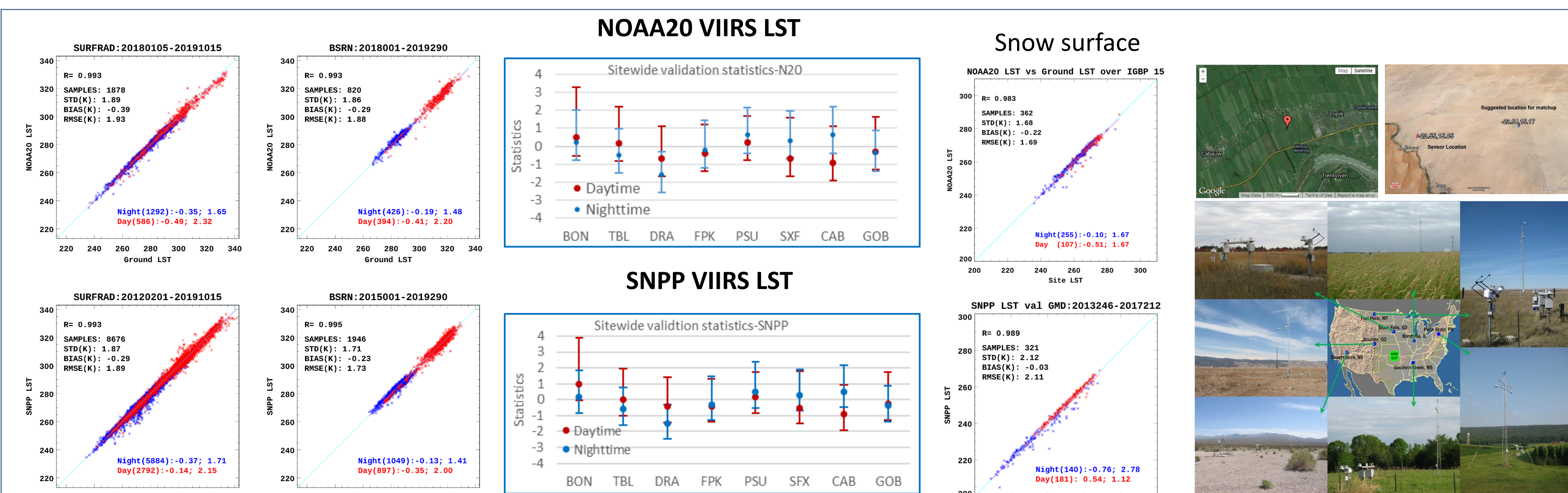
➤ The L2 enterprise VIIRS LST is available at NOAA CLASS under group of "JPSS VIIRS Product(granule)(JPSS-GRAN)". available at

https://www.avl.class.noaa.gov/saa/products/psearchJPSS_GRAN

➤ The L2 enterprise SNPP VIIRS data has been available since 06/06/2019 and J01 VIIRS LST has been available since 09/18/2019. Both are in the updated version v1r2 with most recent updates implemented.

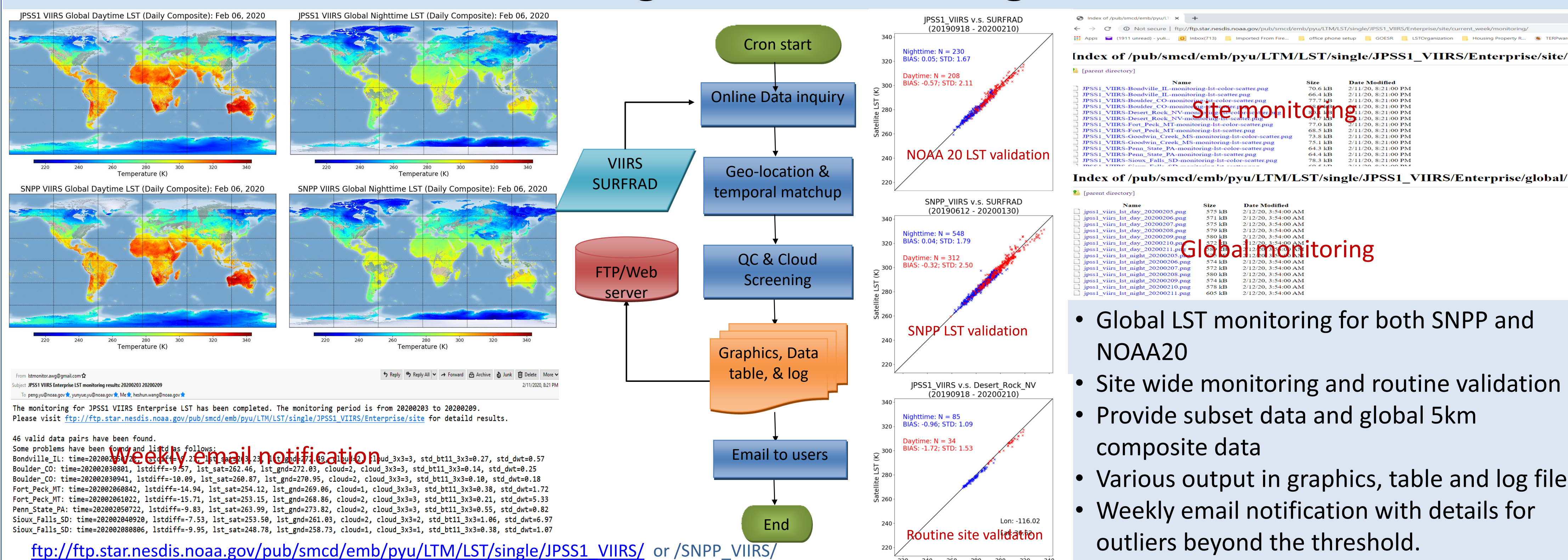
➤ Also available at SCDR under data type "VIIRS-LST" for STAR internal users and interested groups.

Ground Validation



- Six sites from SURFRAD network in Continental US; two sites from BSRN network in Netherland and Namibia; one site in Summit, Greenland.
- For SNPP LST validation: over seven years of SURFRAD observations from Feb. 2012 to Oct. 2019 ; over four years of BSRN observations from January 2015 to Oct. 2019 were used. For NOAA 20 LST validation: the data covers the time period from Jan. 2018 to Oct. 2019.
- Overall good agreement; consistent performance between SNPP and NOAA20 LST; LST over snow surface is affected by cloud contamination

Long Term Monitoring



Cross-comparison with AQUA MODIS LST

AQUA MODIS LST Product

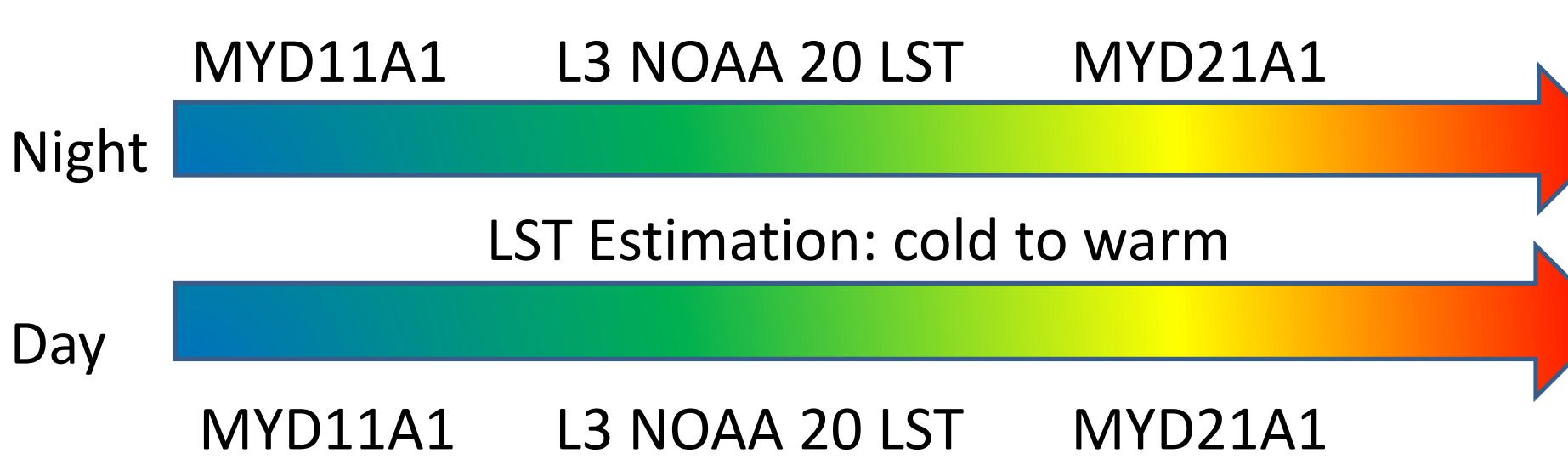
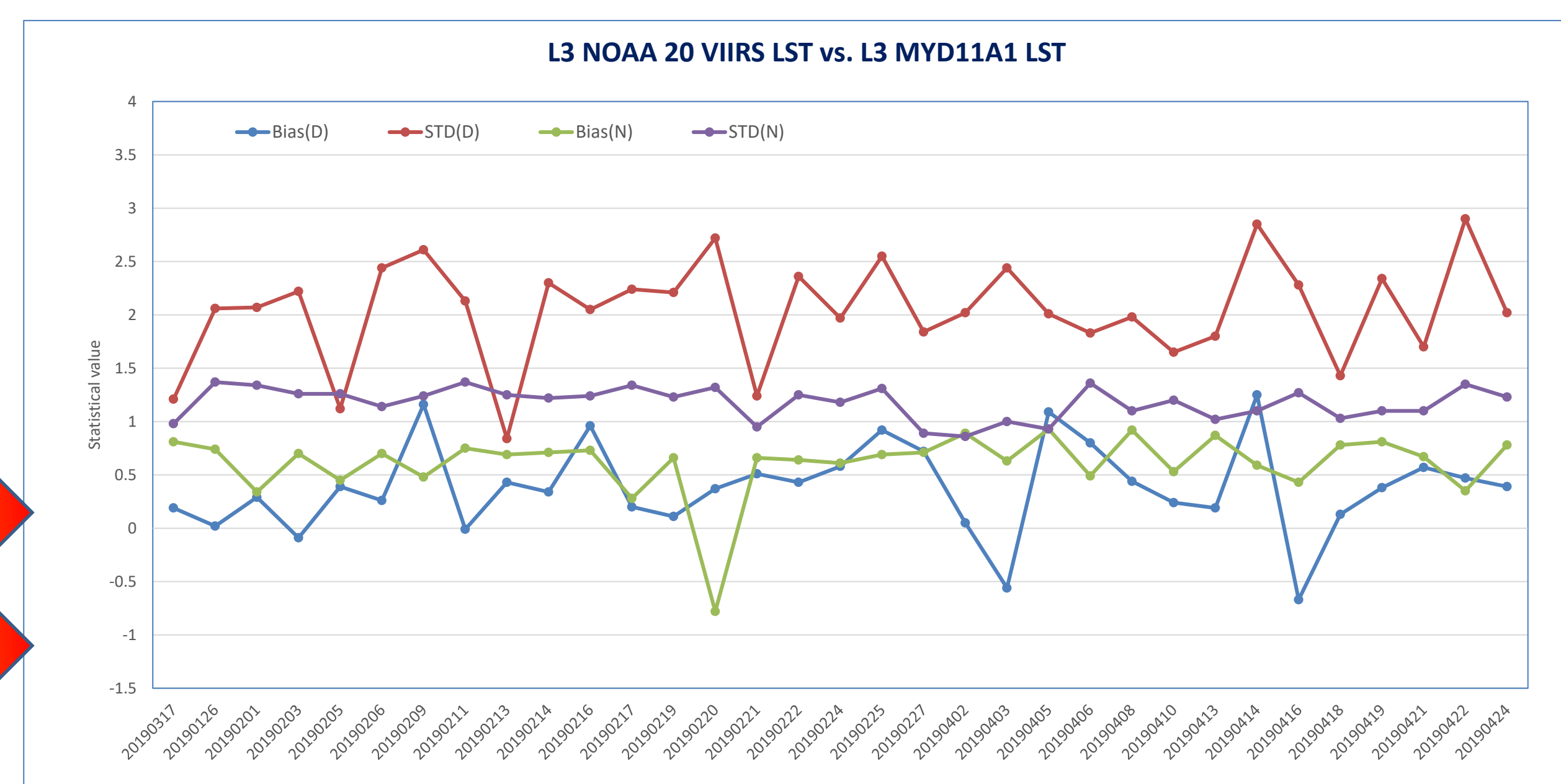
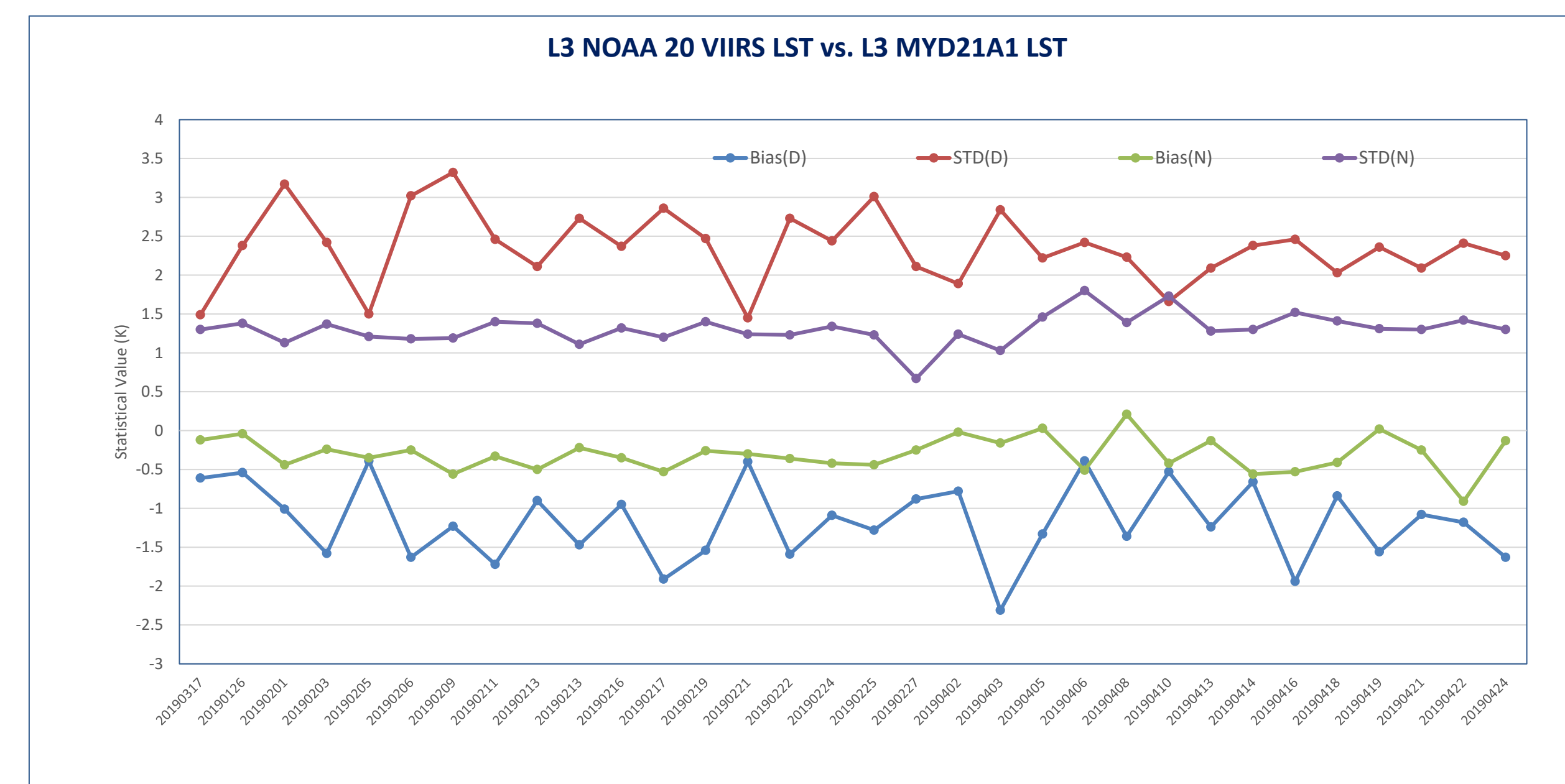
➤ MYD11A1: Split window algorithm

➤ MYD21A1: TES algorithm

NOAA 20 VIIRS LST product

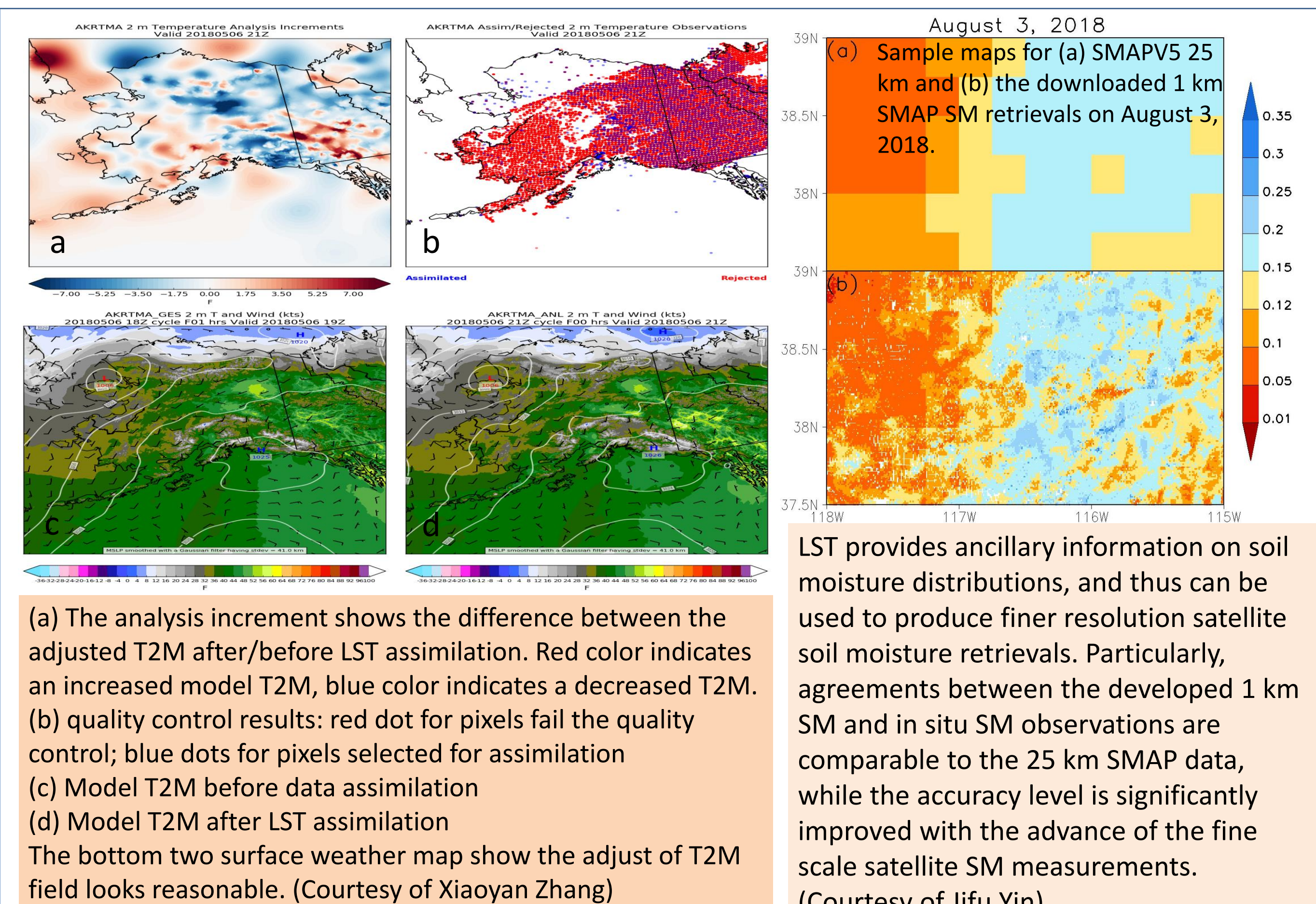
The global L3 data in Jan, Feb, Mar and Apr. 2019 were used for the cross comparison between L3 N20 VIIRS LST and MYD11A1 LST and MYD21A1 LST. Global mean difference was analyzed for daytime and nighttime LST.

Attribute Analyzed		Analysis/Validation Result
Cross satellite Comparison	L3 NOAA 20 LST vs MYD11A1	Nighttime: 0.61(1.18) Daytime:0.38 (2.04)
	L3 NOAA 20 LST vs MYD21A1	Nighttime: -0.30(1.31) Daytime:-1.20 (2.36)



User Applications and feedback

- **NCEP/EMC Modeling**
 - VIIRS NDE LST product is in operational need for model output verification purpose
- **RTMA/URMA system data assimilation**
 - To assimilate VIIRS LST into RTMA system to adjust the 2m air temperature
- **Near real time 1 km SMAP soil moisture (SM) product development**
 - VIIRS LST data is used as an input in the NRT 1 km SMAP Soil Moisture Data Product development
- **Temporal and spatial variability of daytime land surface temperature in Houston**
 - SNPP VIIRS LST data is used as a reference to compare with aircraft LST observations during the NASA's DISCOVER-AQ (Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality) field campaign in September, 2013..



LST provides ancillary information on soil moisture distributions, and thus can be used to produce finer resolution satellite soil moisture retrievals. Particularly, agreements between the developed 1 km SM and in situ SM observations are comparable to the 25 km SMAP data, while the accuracy level is significantly improved with the advance of the fine scale satellite SM measurements. (Courtesy of Jifu Yin)

Summary

- The enterprise VIIRS LST products has a pretty good agreement with the ground measurements from SURFRAD, BSRN and GMD stations based on multiple years of data validation.
- The enterprise NOAA 20 VIIRS LST is in between the L3 MYD11A1 and MYD21A1 LST for both daytime and nighttime.
- The long term monitoring is ready for both SNPP and NOAA 20 VIIRS LST.
- LST application has been used in model LST verification, data assimilation to adjust 2m Tair and 1 km soil moisture product development etc. Ready to provide long term climate data records for users.