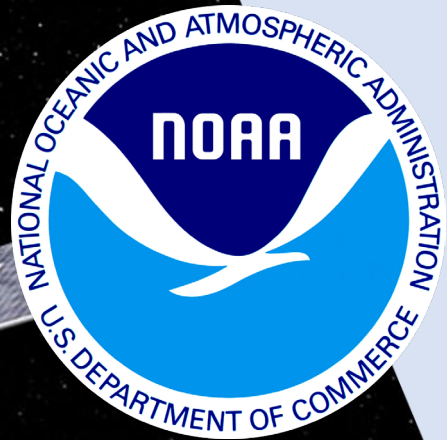


All-weather LST: Methodology and experiment



NOAA
National Satellite and
Information Service

July 27, 2023

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Objective and data source

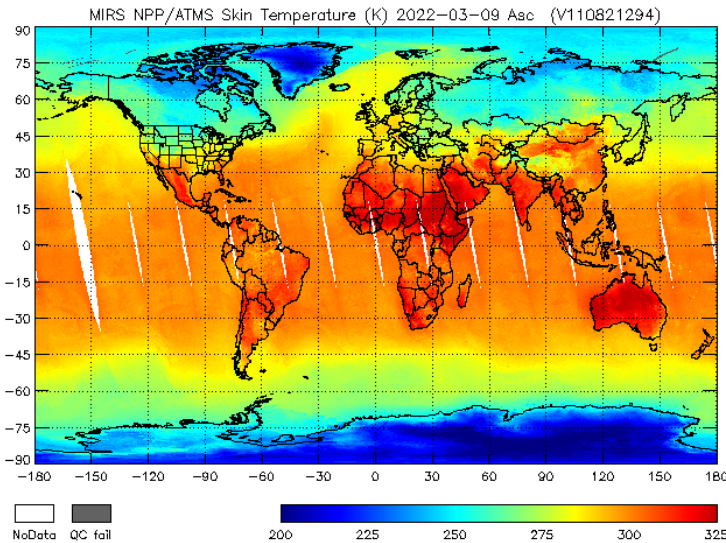
Objective:

- Develop all-weather LST based on the fusion of microwave LST and thermal infrared LST

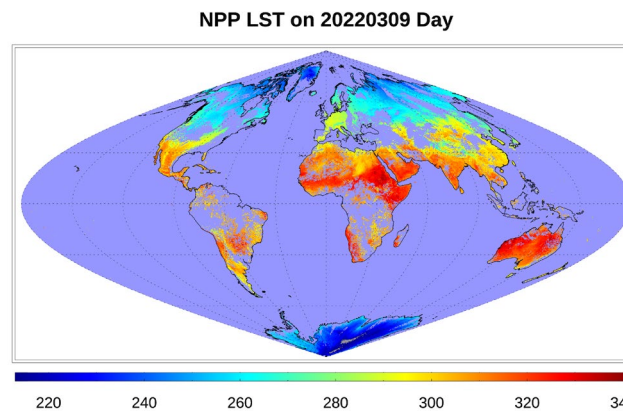
Data source:

- **MIRS** provides **L2 microwave LST** operationally available from NOAA CLASS
- The daily global **L3 VIIRS LST** product has a spatial resolution of **0.009** degree
- Ancillary data such as **NDVI, SRTM slope, emissivity**, etc. for MIRS LST downscaling

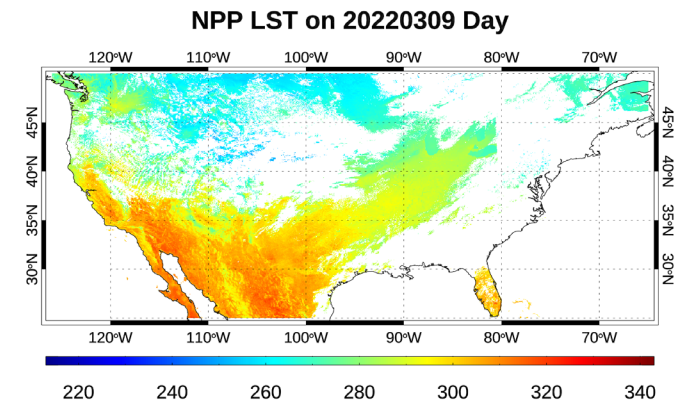
MIRS LST



L3 global VIIRS LST



L3 CONUS VIIRS LST





Challenges

Challenges:

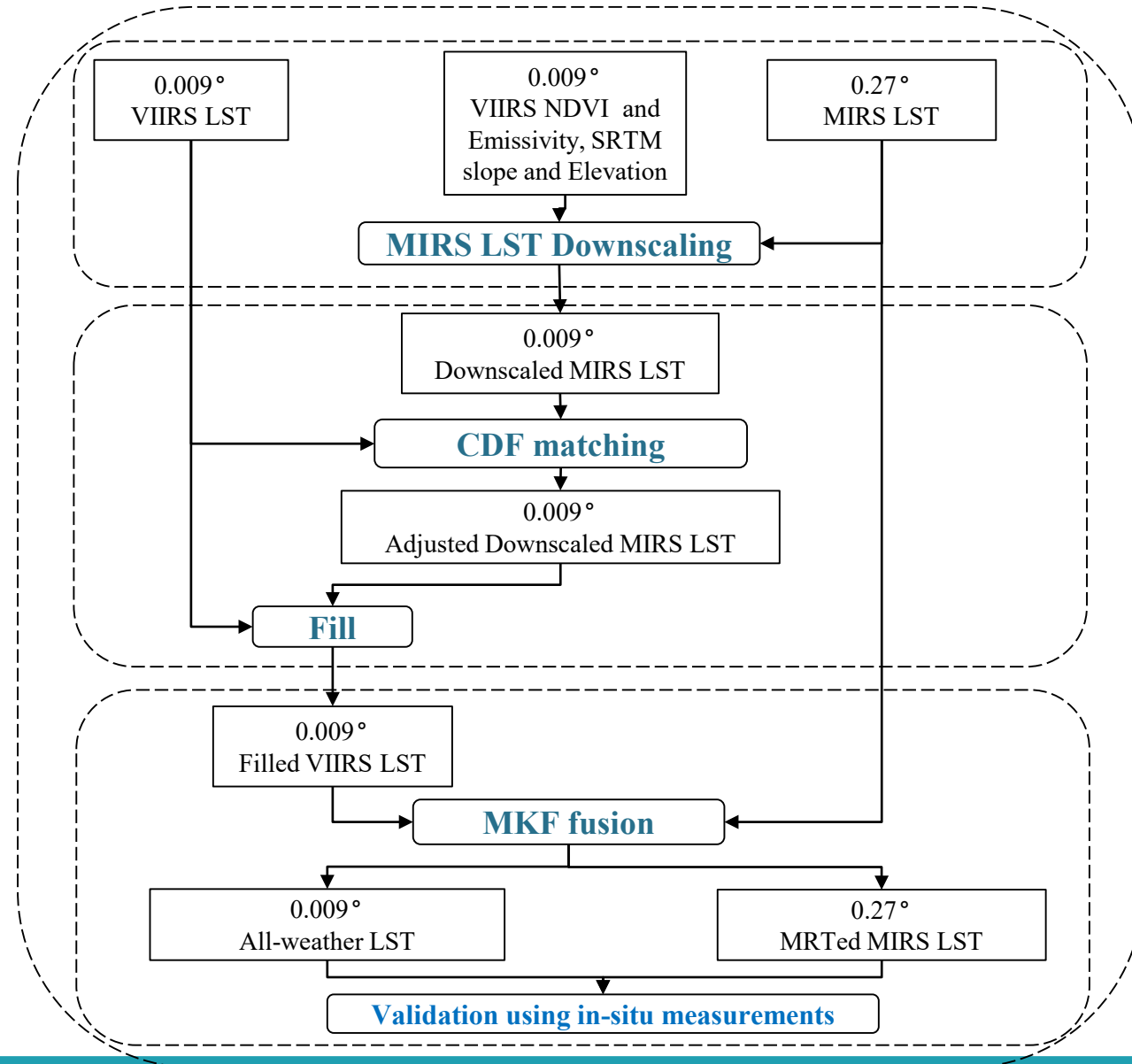
- There are many **missing values** in the VIIRS LST data, and there is a significant **spatial resolution difference** between VIIRS and MIRS LST data. The difference can lead to **step discontinuities or excessive smoothness** in the fused results.
- The relatively **low accuracy** of the MIRS LST data **limits the accuracy** of the fused LST data.

Overall flow chart

LST fusion strategy is based on cumulative distribution function (CDF) matching and multiresolution Kalman filtering (MKF)

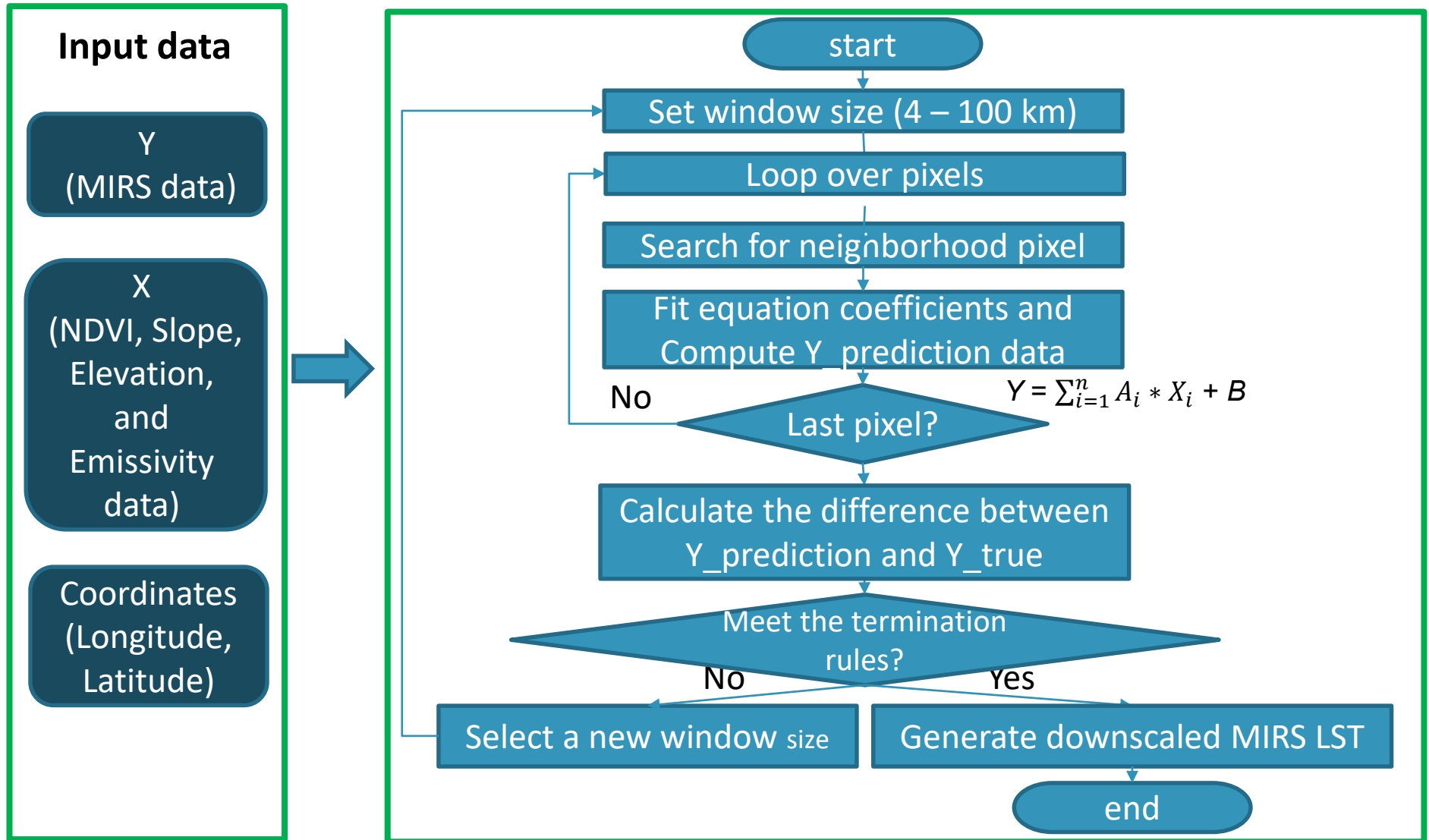
Three processing steps:

- 1) MIRS LST downscaling
- 2) VIIRS LST gap filling
- 3) MKF fusion



Method introduction-MIRS LST downscaling

Downscaling
based on
Geographically
weighted
regression
(GWR)



Method introduction-CDF Matching

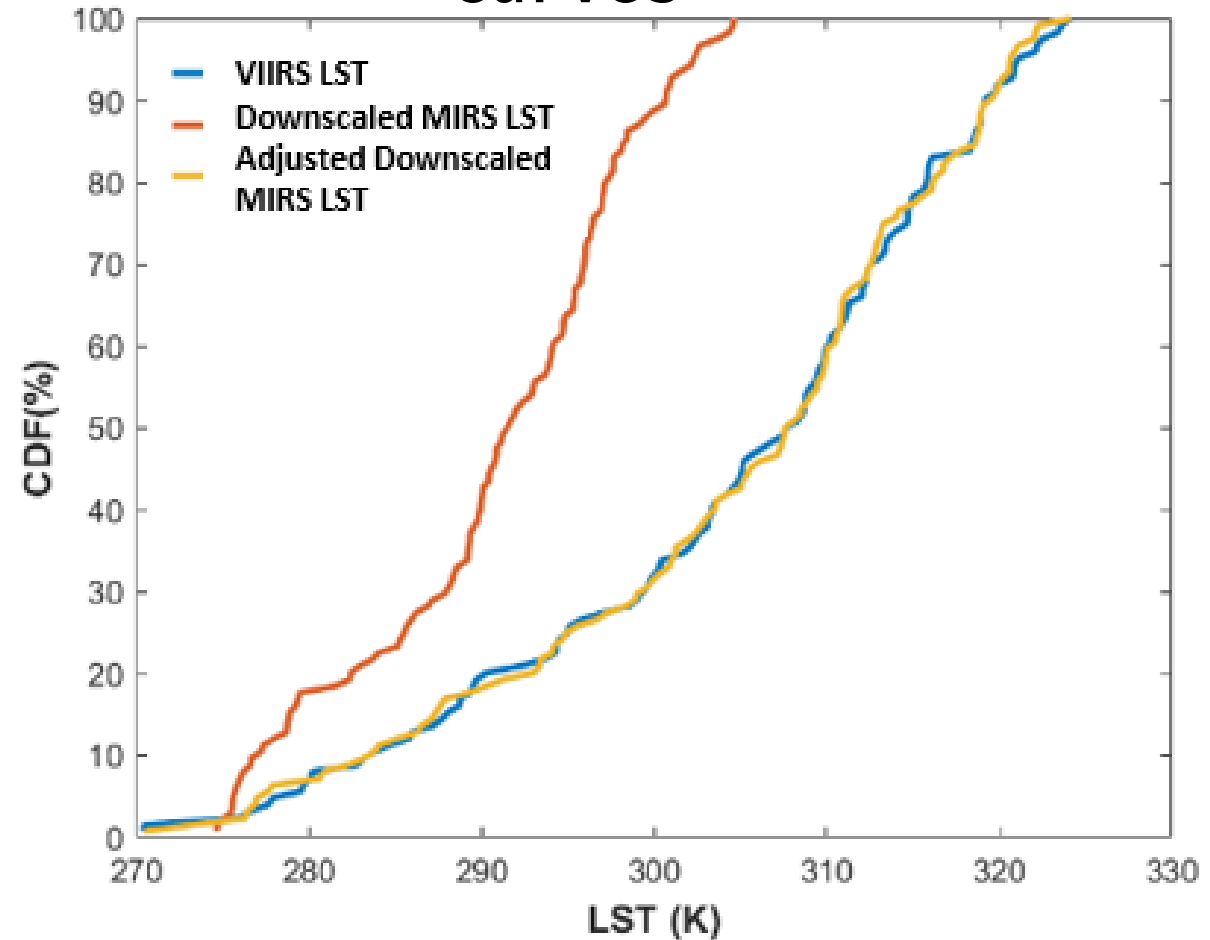
Cumulative Distribution Function (CDF) Matching

Input data

Reference Data (VIIRS LST)

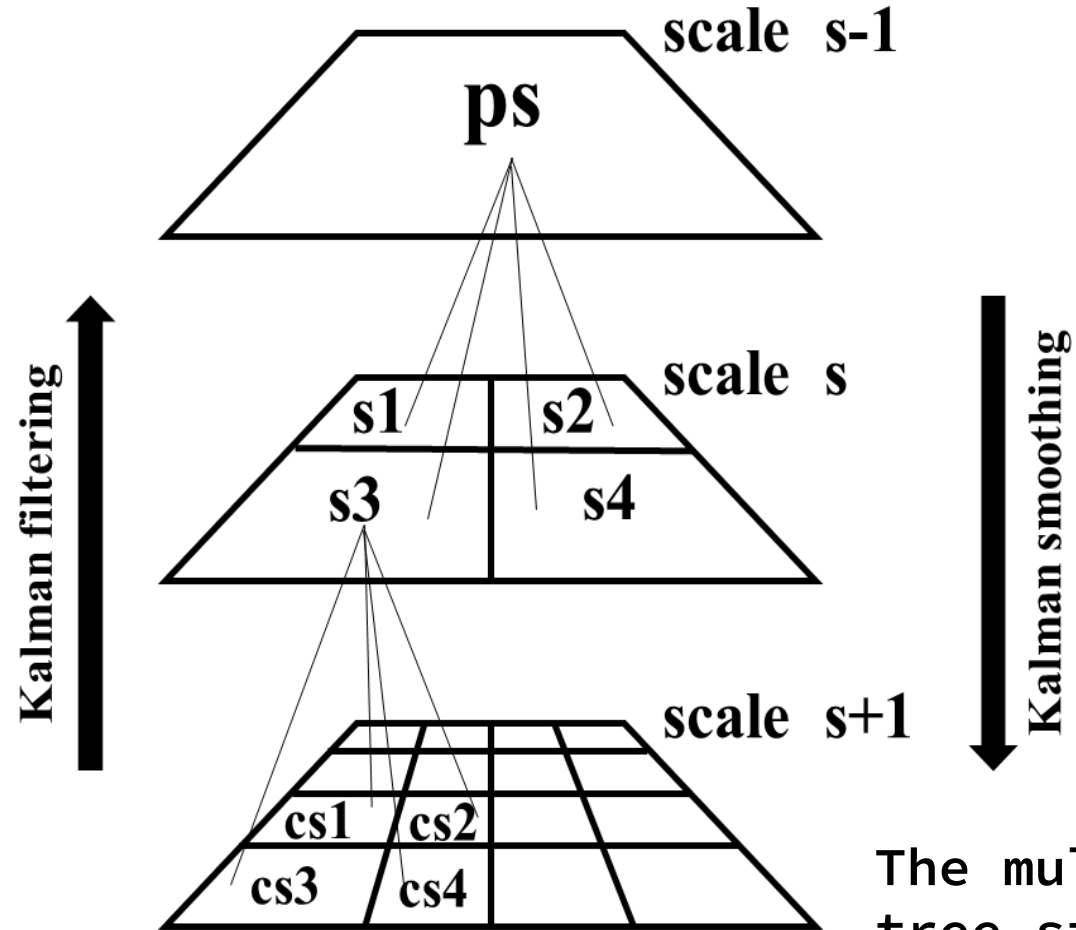
Target Data (Downscaled MIRS LST)

CDF curves



Method introduction-MKF

Multiresolution Kalman Filtering (MKF)



The multiscale
tree structure
of
the MKF
framework

Date

All weather LST Output

Format: NetCDF

Region: CONUS

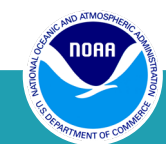
Description: **Daily** gridded LST with a spatial resolution of **0.009** degree in separate files for day and night, respectively.

All_Weather_LST_20200101_Day.nc

Variable Name	Descriptions	Data type	Unit	Valid Range	Fill Value	Scale Factor	Offset
LST_Day	Daily daytime LST	Signed short	K	2600-28600	-32768	0.005	200
QC_Day	Quality control flag for daytime LST	Signed byte	None		-128	NA	NA
View_Time_Day	Time for daytime LST observation	Signed byte	0.1 hr	[-120,120]	-128	0.1	12

All_Weather_LST_20200101_Night.nc

Variable Name	Descriptions	Data type	Unit	Valid Range	Fill Value	Scale Factor	Offset
LST_Night	Daily nighttime LST	Signed short	K	2600-28600	-32768	0.005	200
QC_Night	Quality control flag for nighttime LST	Signed byte	None		-128	NA	NA
View_Time_Night	Time for nighttime LST observation	Signed byte	0.1 hr	[-120,120]	-128	0.1	12



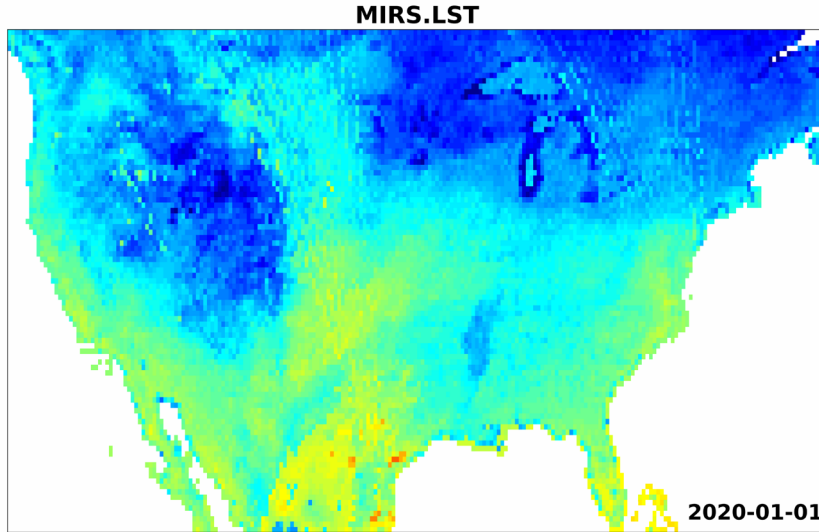
All weather LST Output-Quality flag

Bits	Long Name	Comments
1 & 0	Data Source	00=VIIRS LST (Input data) 01=Downscaled MIRS LST (CDF matching process) 10=Interpolated MIRS LST (will have) 11=MIRS LST (MKF process)
3 & 2	VIIRS Quality/ Cloud Condition	00=Confidently clear 01=Probably clear 10=Probably cloudy 11=Confidently cloudy
5 & 4	Land/water	00=Land 01=Snow/ice 10=In land water 11=Coastal/sea water
7 & 6	Empty	For future use

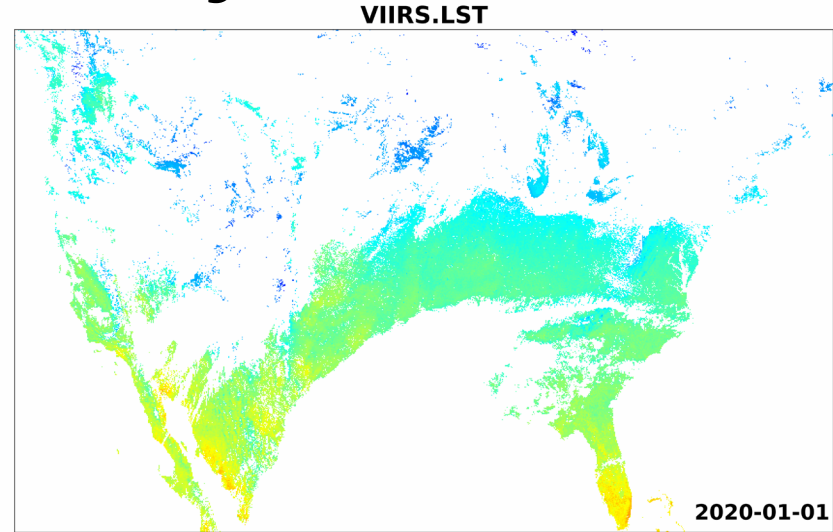


All weather LST-Daytime

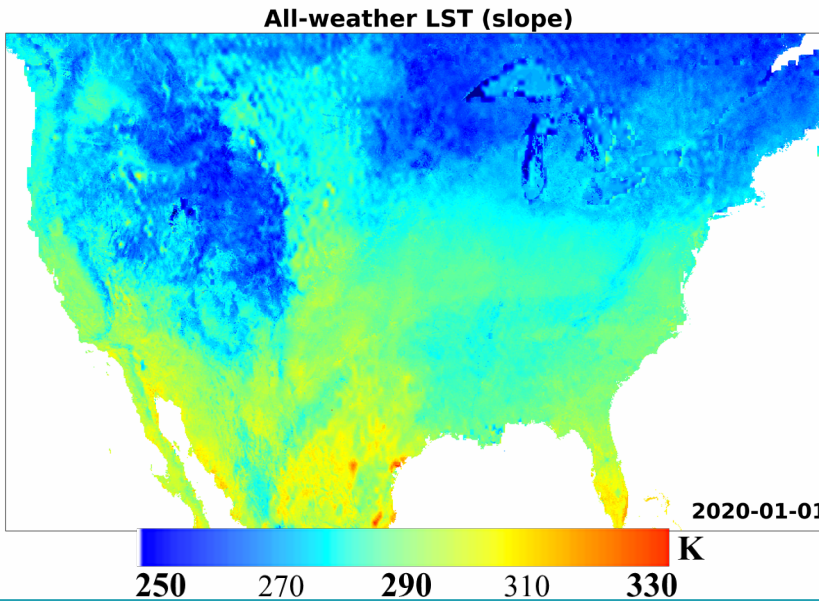
MIRS LST



VIIRS LST



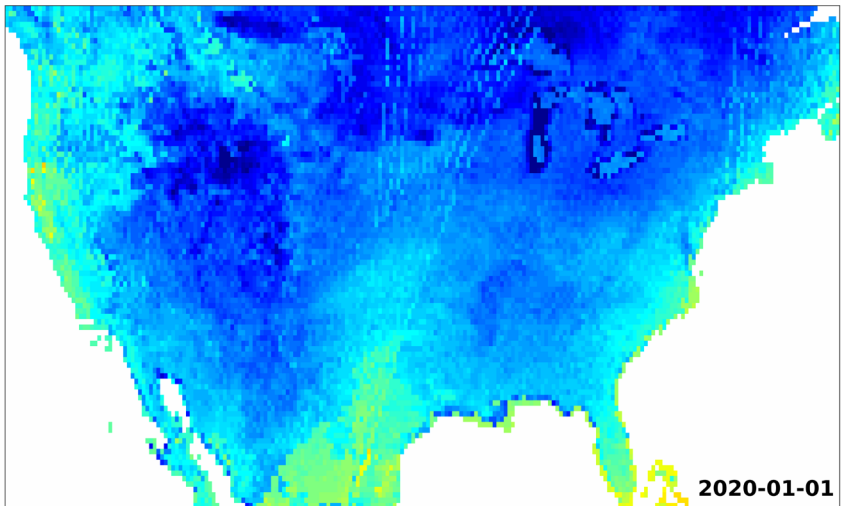
All weather LST



- The image displays the daytime MIRS LST(top left), VIIRS LST(top right) and all weather LST(bottom left).
- Note that the VIIRS LST only shows the observations with clear skies.
- All weather LST provides complete data coverage with the same high spatial resolution as VIIRS.

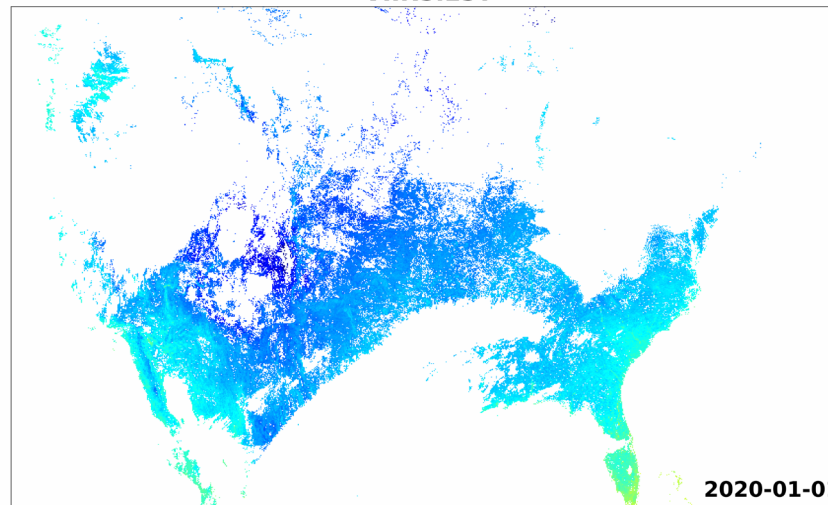
All weather LST-Nighttime

MIRS.LST

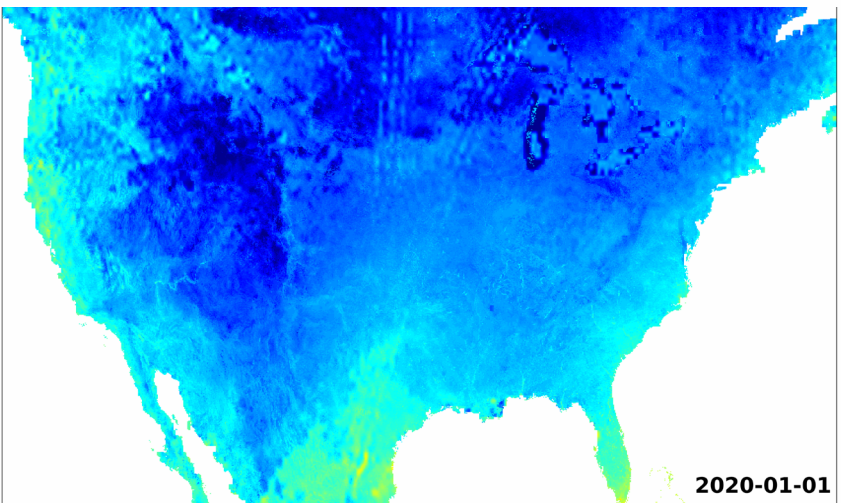


MIRS LST

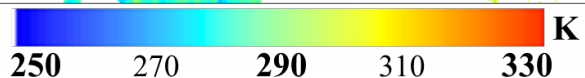
VIIRS.LST



VIIRS LST



All weather LST



- The image displays the nighttime MIRS LST(top left), VIIRS LST(top right) and all weather LST(bottom left).
- Note that the VIIRS LST only shows the observations with clear skies.
- All weather LST provides complete data coverage with the same high spatial resolution as VIIRS.

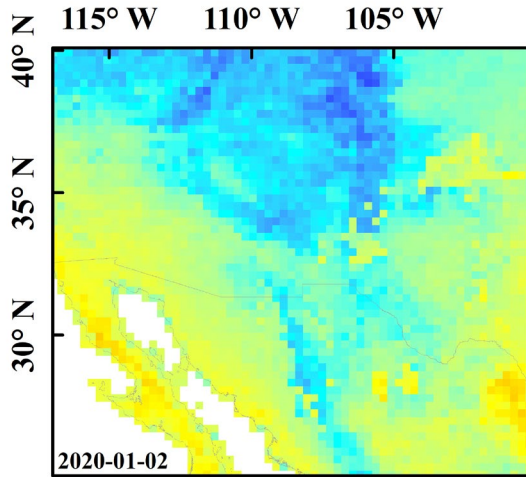
All weather LST

Nighttime

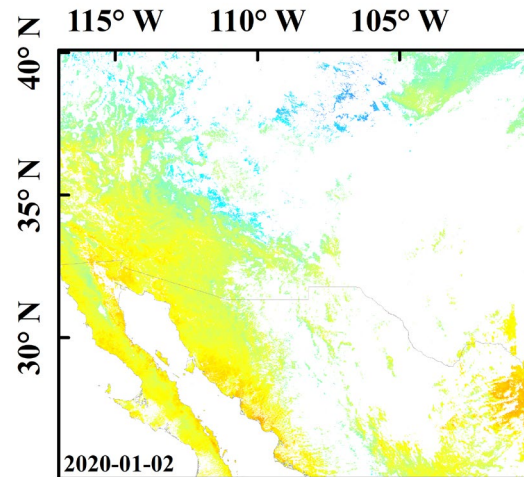
- Features:
- High spatial resolution
 - Complete data coverage

Daytime

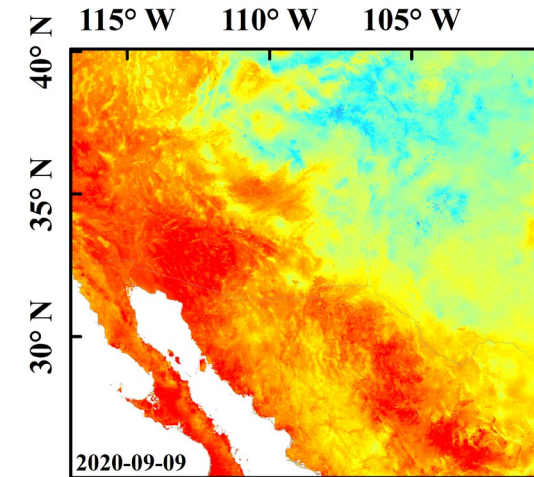
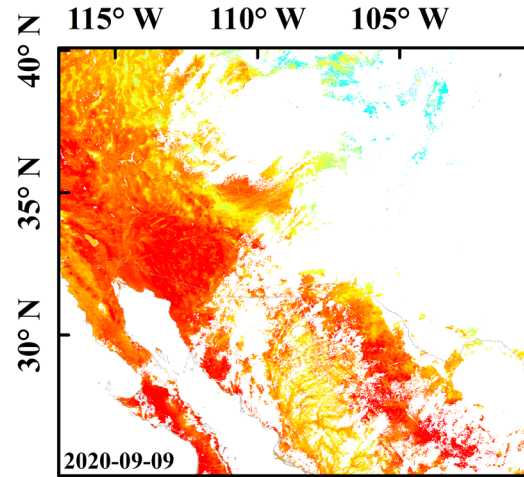
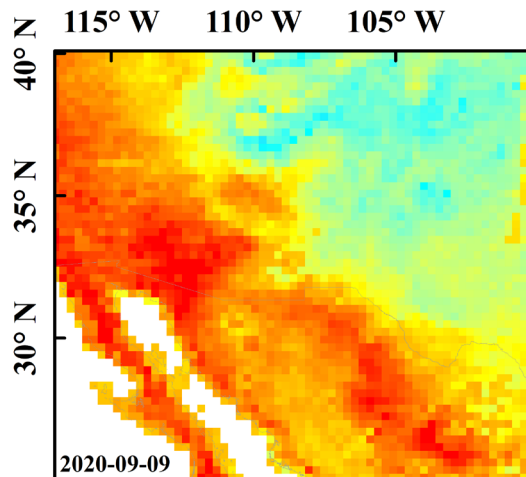
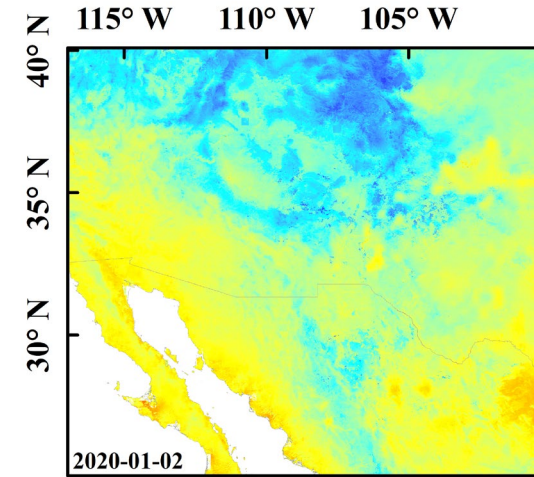
MIRS LST



VIIRS LST

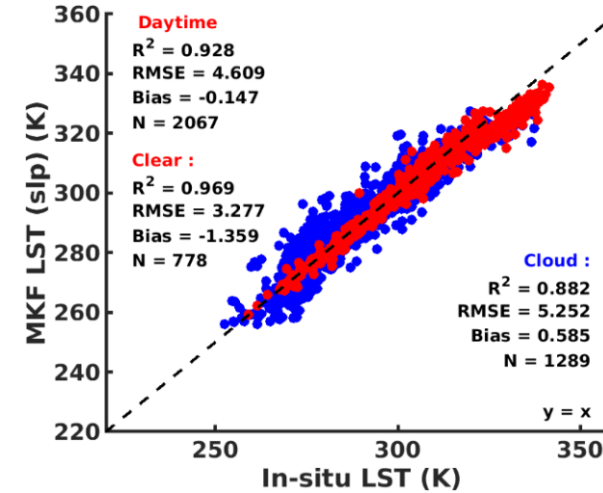
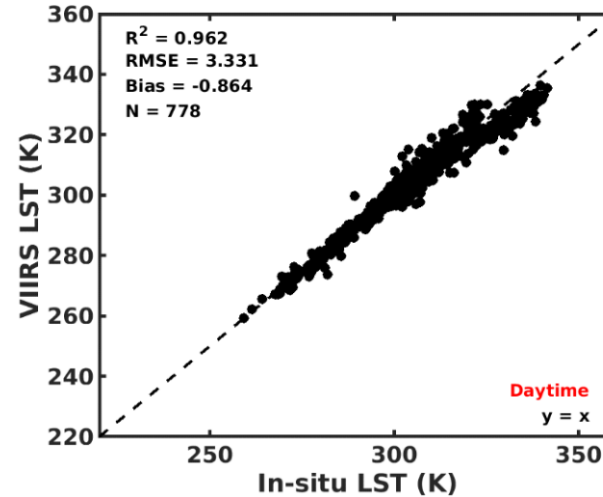
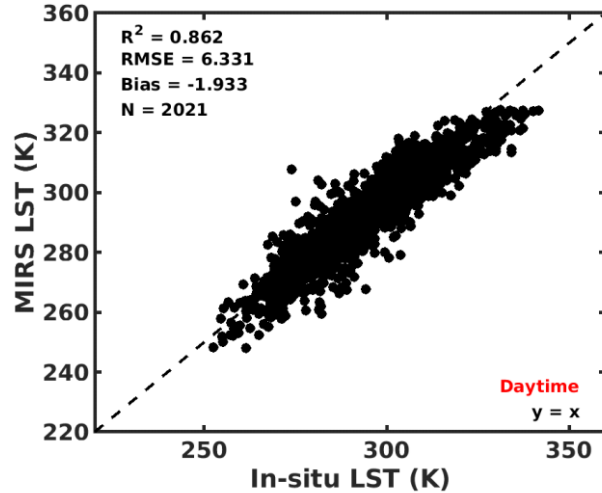


All-weather LST

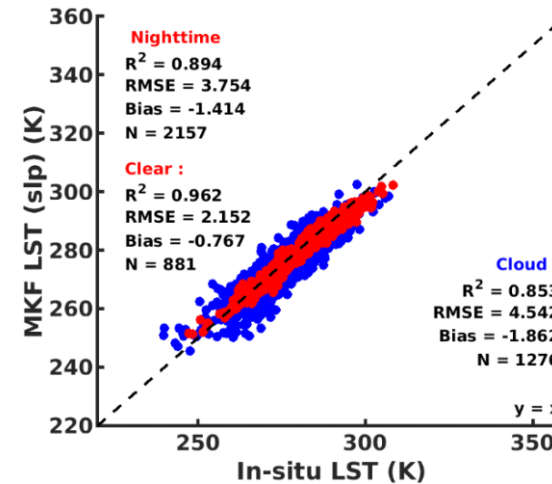
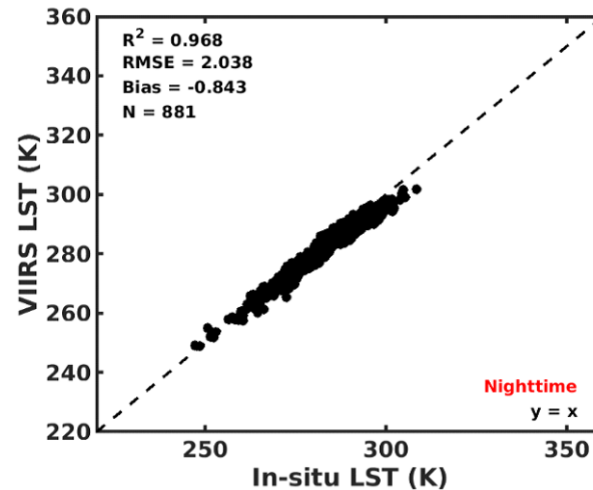
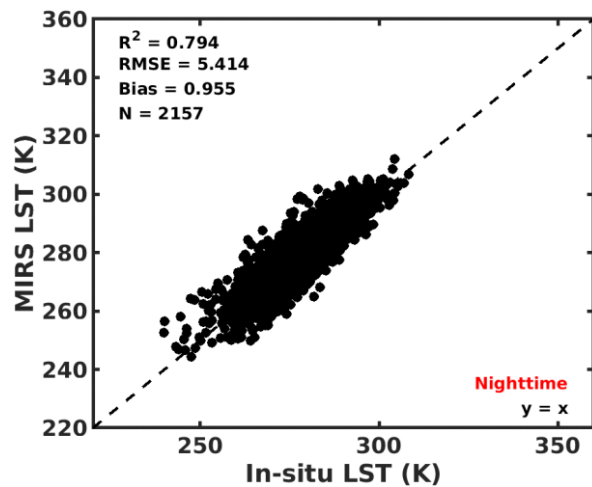


Preliminary Validation-SURFRAD

Daytime



Nighttime



- Ground in-situ measurements from SURFRAD are used to validate all weather LST
- The data from 2020 is utilized in this study.
- The validation results are presented for MIRS LST(left), VIIRS LST(middle) and all weather LST(right) for daytime(top) and nighttime(bottom)
- The results demonstrate an improved accuracy compared to MIRS LST.



Summary

- All weather LST is developed based on the fusion of MIRS LST and VIIRS LST.
- The all weather LST features high spatial resolution, complete coverage, and improved accuracy. The preliminary evaluation results indicate promising performance.
- An experimental dataset is available for user testing. The data covers the CONUS domain for the time period of January 2020.



Thanks!

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