GOES-R LST Validation Activities and Coordination with JPSS

Presented By: Yunyue Yu
NOAA/NESDIS/STAR

Team Members: Peng Yu, Yuling Lui, Heshun Wang, Yuhan Rao, Zhen Song
UMD/CICS

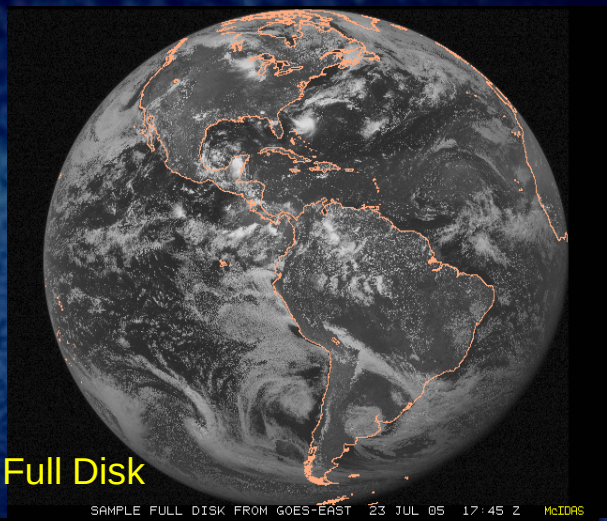
Funded by the GOES-R AWG, GOES-R Proving Ground (Field Campaign), and STAR JPSS

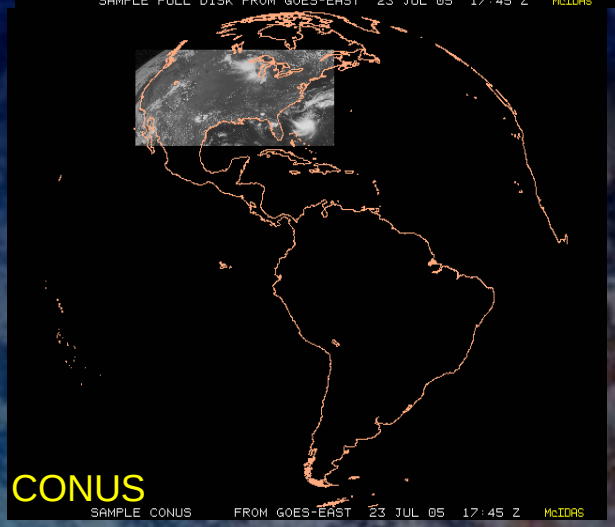
Outline

- GOES-R LST Products
- Development of GOES-R LST Validation Tool
- Coordination With JPSS
- Further Enhancement/Improvement

LST Products

- The ABI Land Surface Temperature (LST) algorithm generates the baseline products of land surface skin temperatures in three ABI scan modes: *Full Disk, CONUS, Mesoscale*;
- Has a good heritage; will add to the LST climate data record;





Products

Product	Accuracy	Precision	Range	Refresh Rate	Resolution
LST (CONUS)	2.5 K	2.3 K	213 ~ 330 K	60 min	2 km
LST (Full Disk)	2.5 K	2.3 K	213 ~ 330 K	60 min	*10 km*
LST (Mesoscale)	2.5 K	2.3 K	213 ~ 330 K	60 min	2 km

Qualifiers

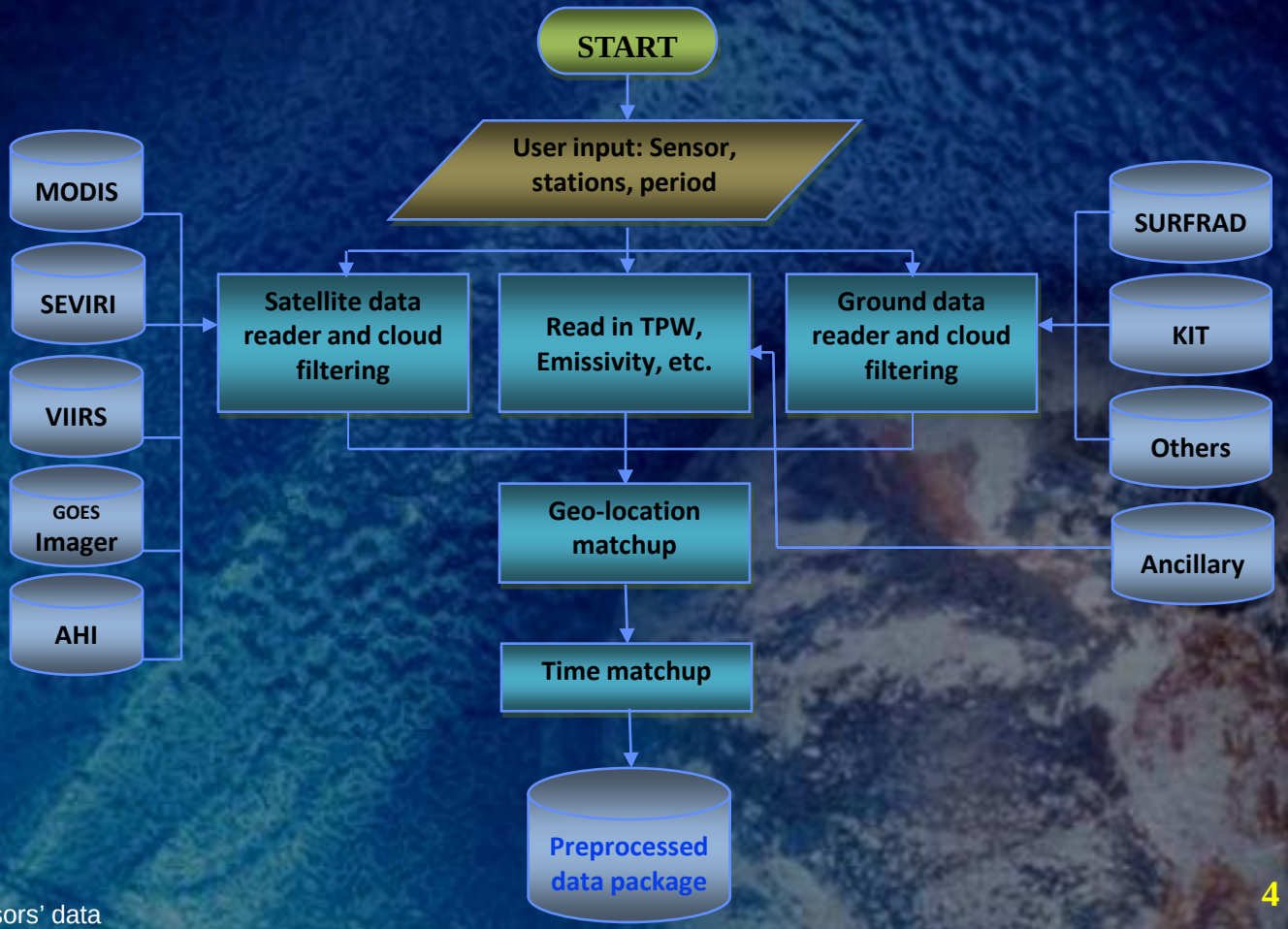
Product	Temporal Coverage	Product Extent	Cloud Cover Conditions	Product Statistics
LST (CONUS)	Day and Night	LZA < 70	Clear Conditions associated with threshold accuracy	Over specified geographic area
LST (Full Disk)	Day and Night	LZA < 70	Clear Conditions associated with threshold accuracy	Over specified geographic area
LST (Mesoscale)	Day and Night	LZA < 70	Clear Conditions associated with threshold accuracy	Over specified geographic area

Development of GOES-R LST Validation Tool

Preprocessing Module

Modulated processing of the validation dataset

- reader: Reads satellites, ground sites, and auxiliary data
- Spatial and temporal match-up: match the satellite obs to the ground sites' location and time
- Apply satellite cloud mask if available
- Satellite and ground site LST estimation/ extraction
- Preprocessed data set (relevant variables)



Note: this flow chart is for all proxy satellite sensors' data

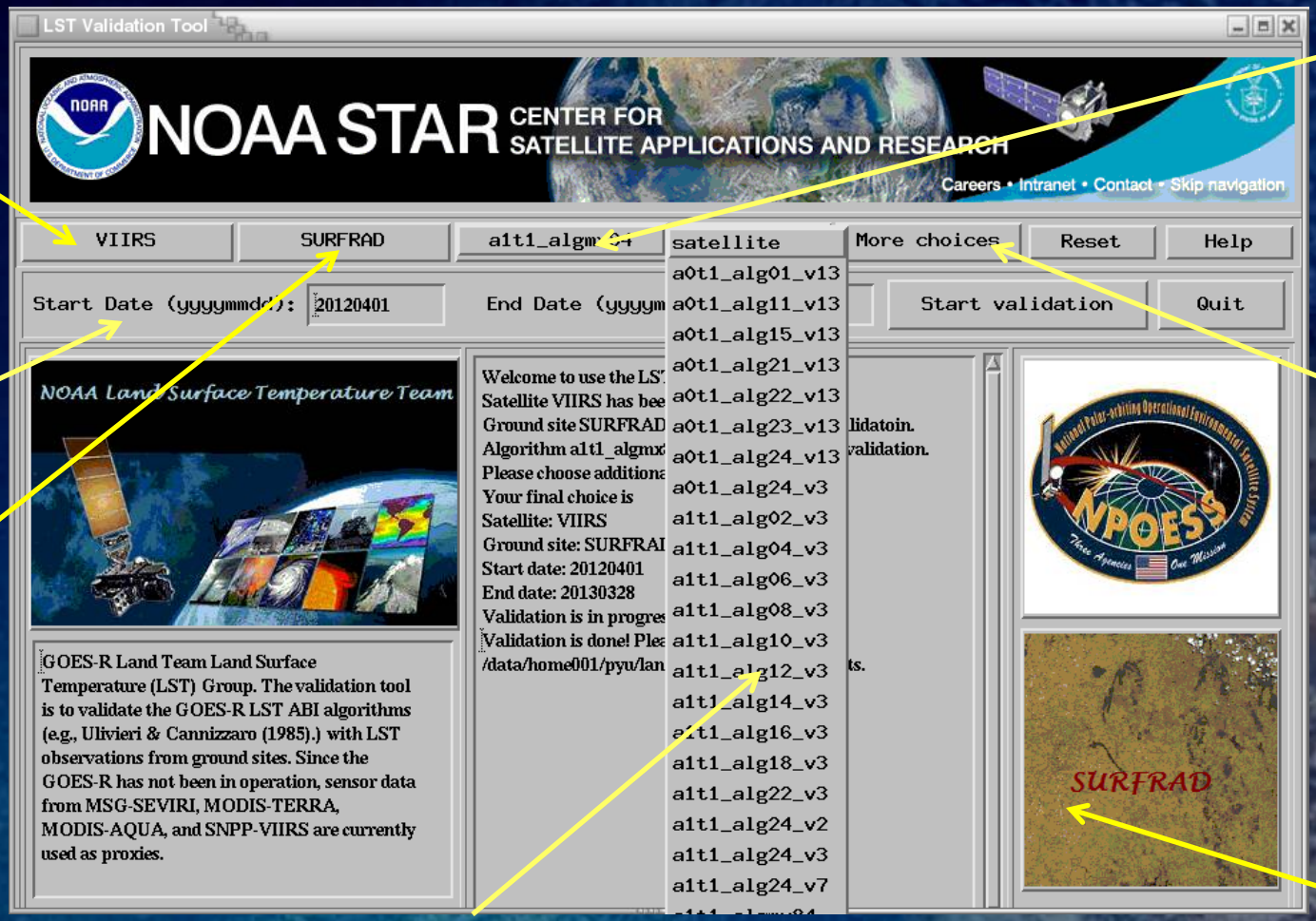
Validation Tools Update

Preprocessed dataset

- 26 variables: enough for the current applications for GOES-R LST validation, *e.g.*, additional cloud filtering procedures
  - » Temporal information: Year, Jday of the year, Hour, Minute
  - » Data from the ground site: downwelling radiance and its std during the last 15 minutes (for additional cloud filter), upwelling radiance, LST, and broadband emissivity
  - » Data from the satellite sensor: BT4 (~4 micrometer), BT11 (3x3 boxes centered at the matched pixel), BT12, and LST
  - » Auxiliary data: zenith angle, emissivity, TPW, dry/wet, day/night
- Specific file naming convention: "*sat-gnd-sit-startday-endday.dat*"
- ASCII format
- Flexibility: allows user to validate satellite LST observations currently not included in the tool
- Output of the preprocessing module, input for the validation module
- Dramatically improve the performance of the validation work – generate outputs almost instantly

Routine LST Validation Interface

Interface to algorithm evaluation and product validation



Selection of Multi-sensor proxy

Validation period

In-situ data selection

Algorithm selection

QC and cloud screening

Algorithm /product evaluation and improvement

User-friendly GUI

Validation Tools Update
-- A GUI interface

Satellite chooser

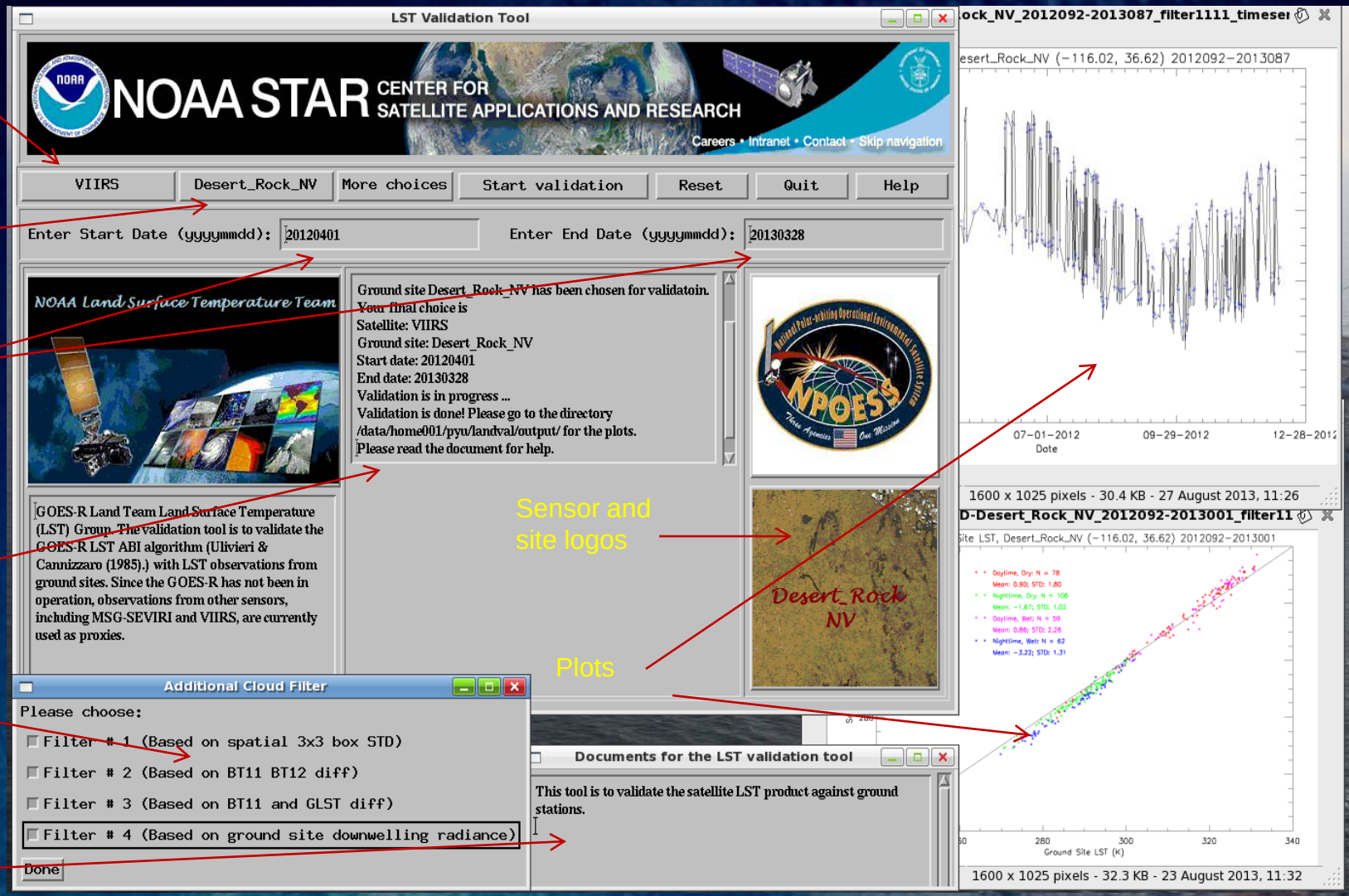
Ground site chooser

Start and end dates

Tool feedbacks

Additional cloud filter module

Tool documents



Towards Field Campaign for LST Validation

Components of LST Validation

- In-situ measurement comparisons and analyses
- Cross-satellite comparisons and analyses
- Successful applications –users promotion

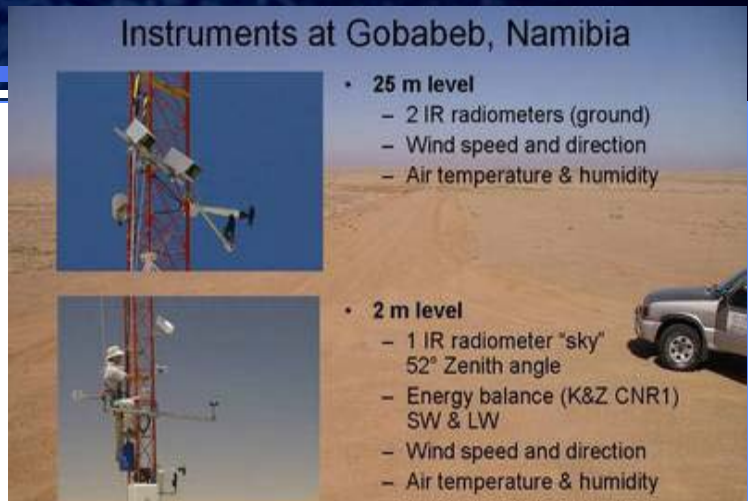
Strategy of In-situ measurement comparisons and analyses

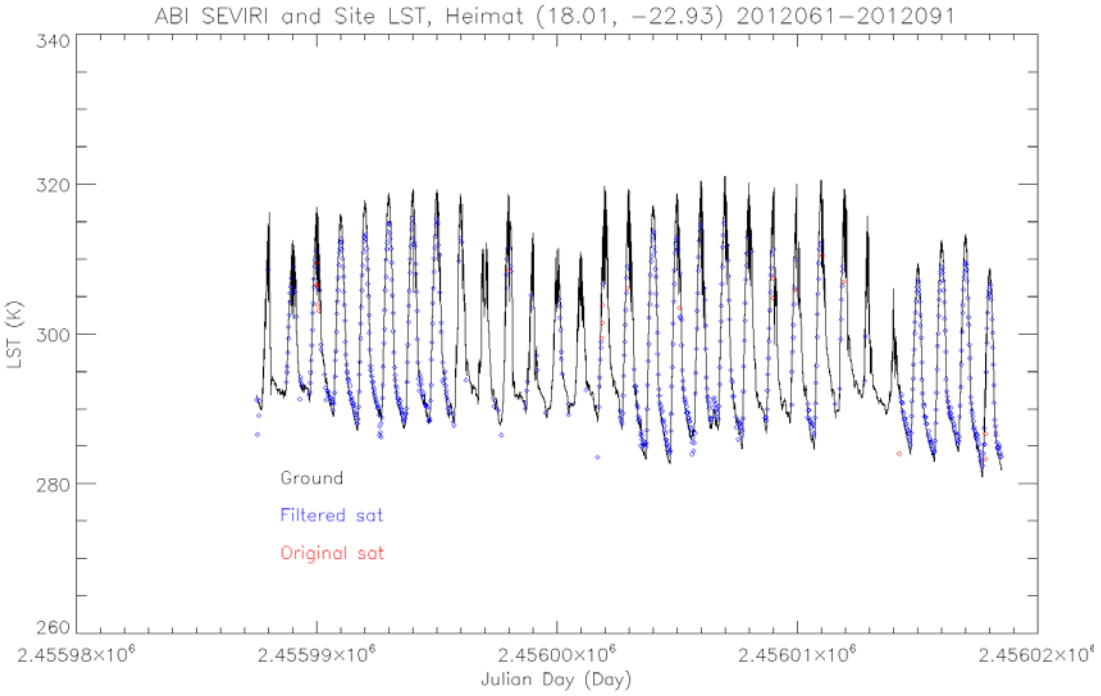
- Existing ground station observations (e.g. SURFRAD Network), as long-term data source
- Field campaign data plays three important roles
  - High quality observations for direct comparison and analysis
  - Calibrating co-site ground station observations
  - Characterizing heterogeneity feature of co-site ground station
- Towards the field campaign readiness
  - Platform: low altitude, small unmanned aerial vehicle (UVA)
  - Instrument readiness : accurate infrared radiometers covers ABI bands
  - Site selection: better to cover SURFRAD/CRN station
  - Data processing and algorithms: noise filtering, spatial characterization, calibration to station data, etc.
  - Coordination with the Field Campaign Team.

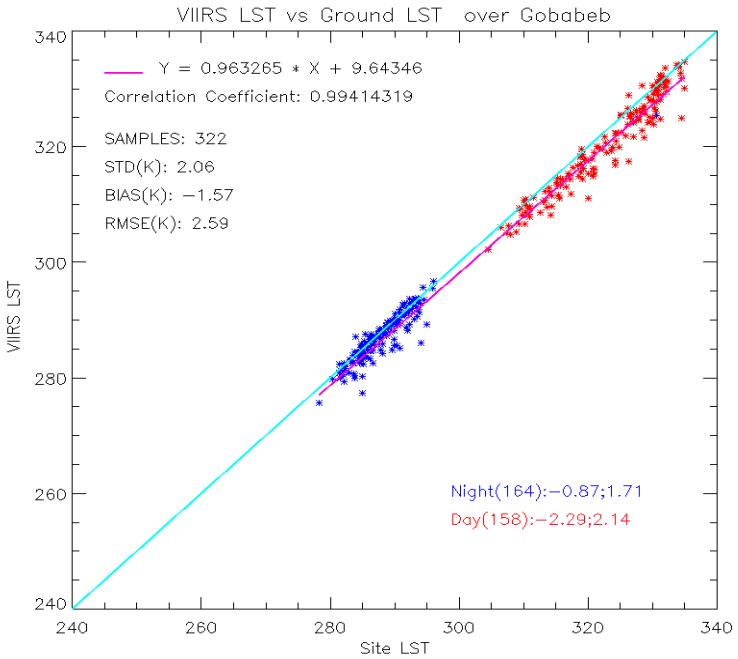
In-situ Data Validation

Case studies of in-situ data comparison in Africa (Gobabeb and Heimat, Namibia)

*the Africa site data provided by Frank Goettsche (KIT & EUMETSAT Land SAF), through LST validation collaboration



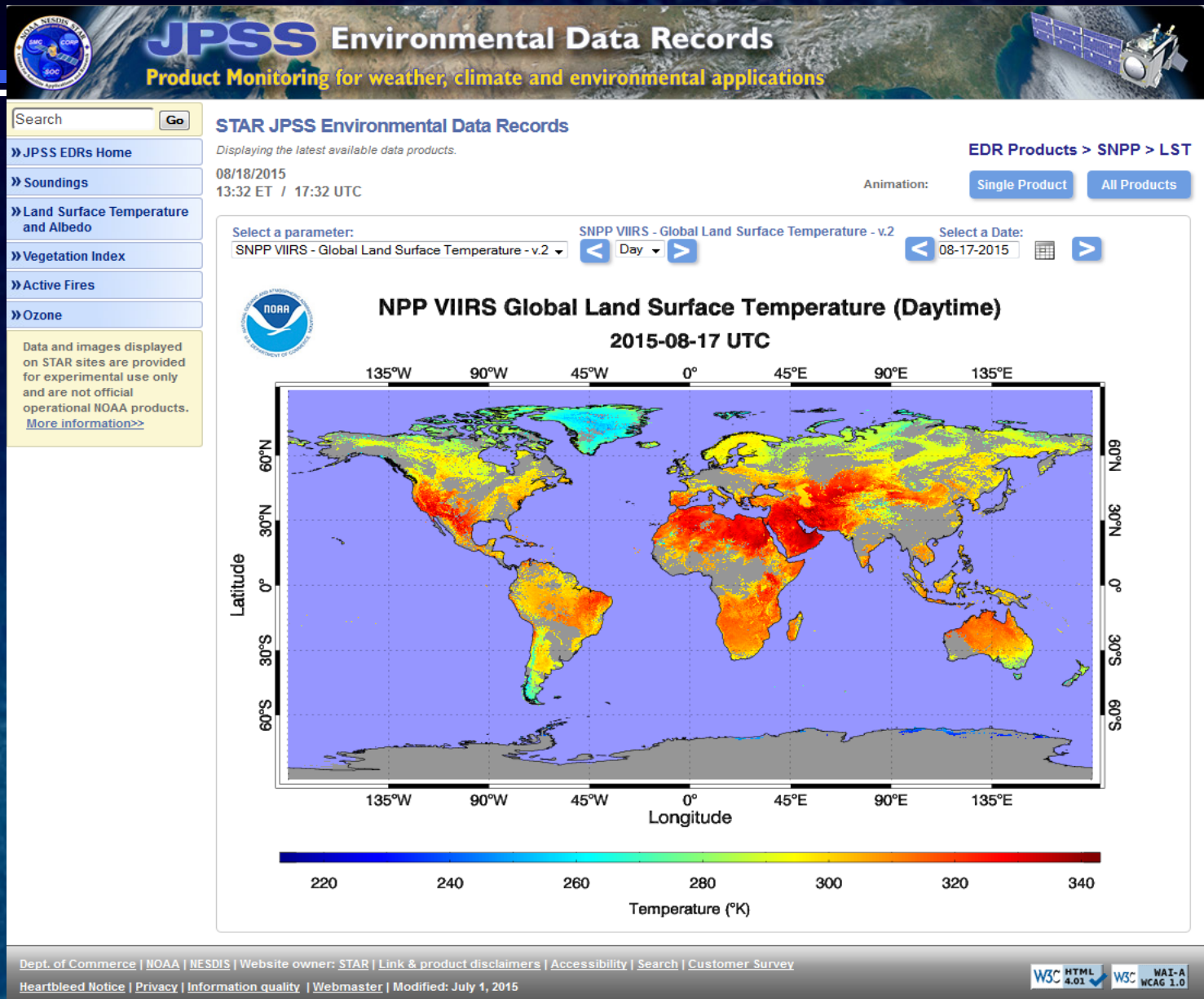




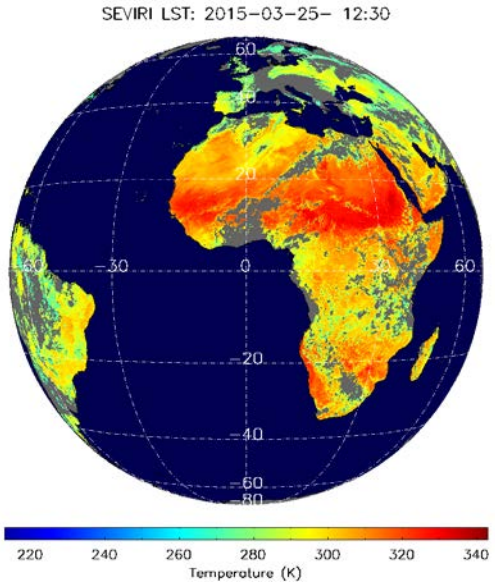
Routine Monitoring

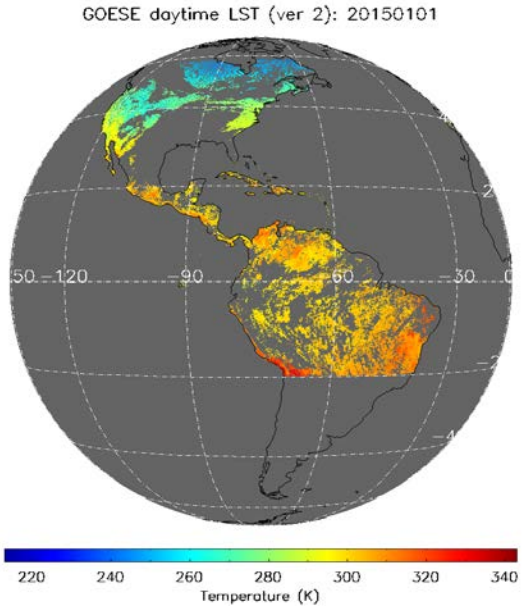
Route Monitoring through webpage

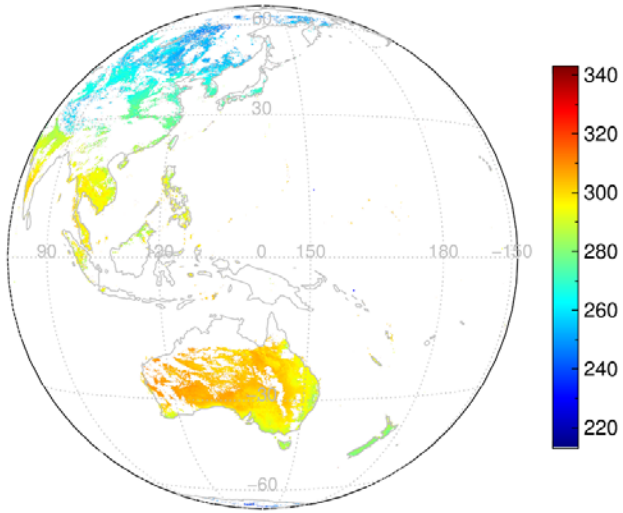
A STAR Webpage of LST routine monitoring has been set up for JPSS program. A similar webpage will be created for GOES-R mission after launch of the satellite (Mar 2016)

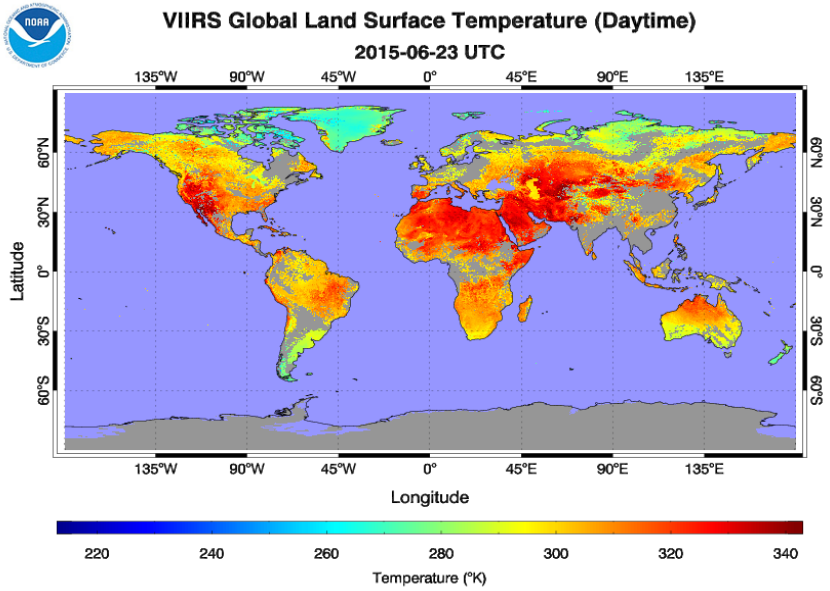


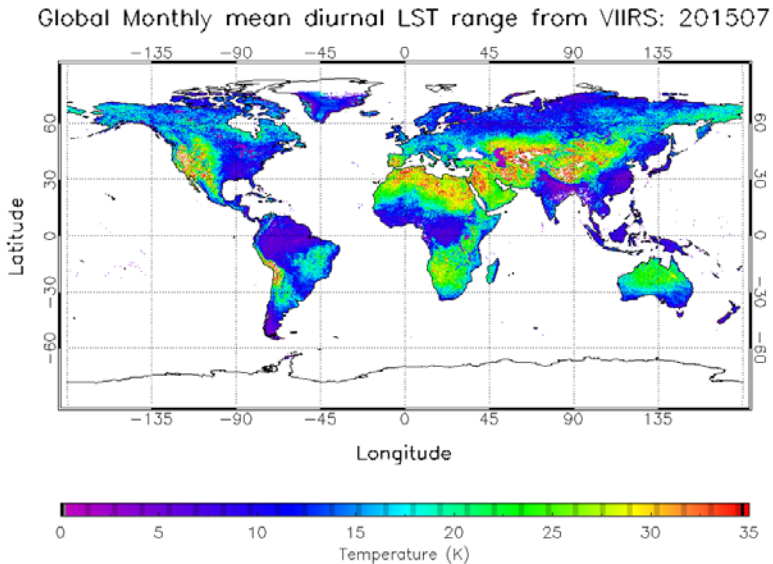
Monitoring -- LST images



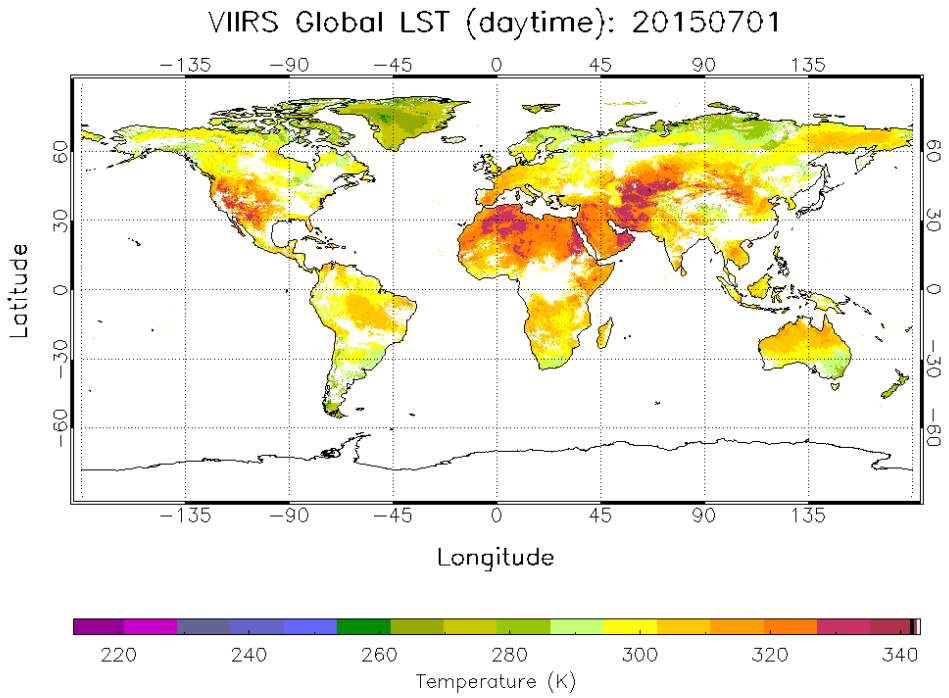


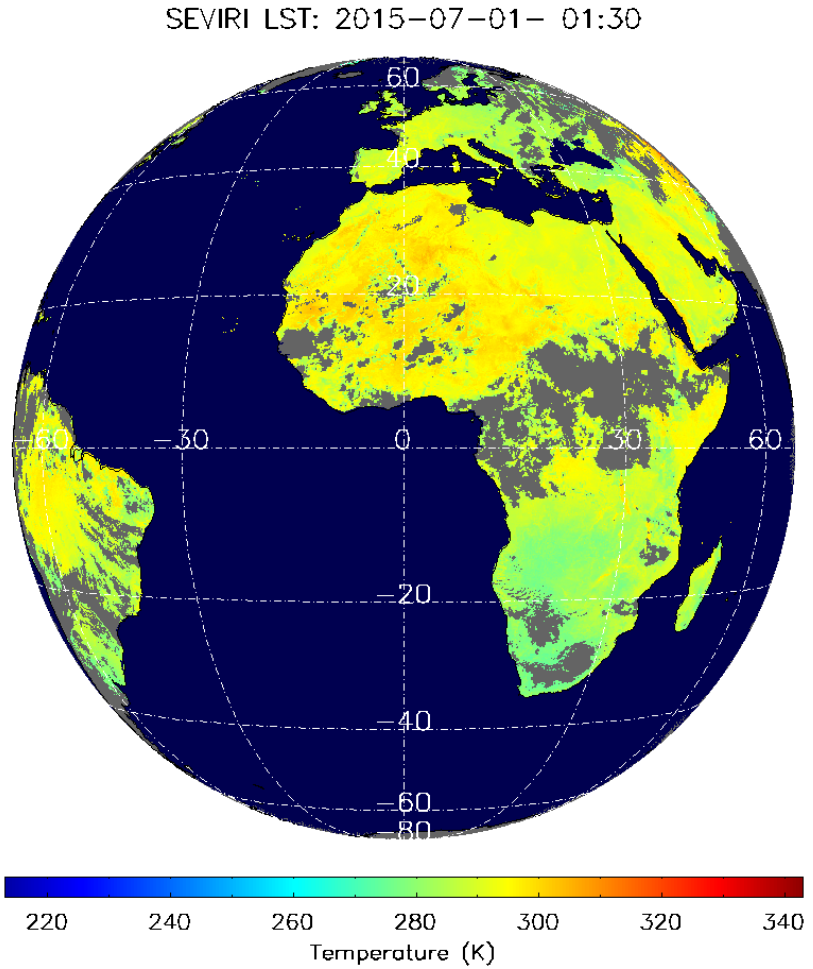


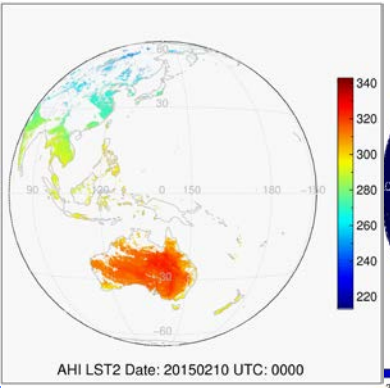


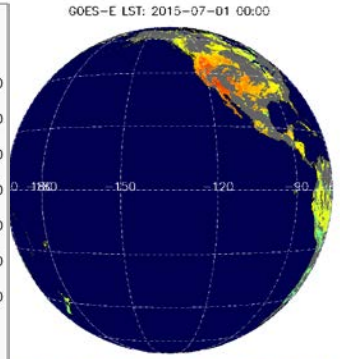


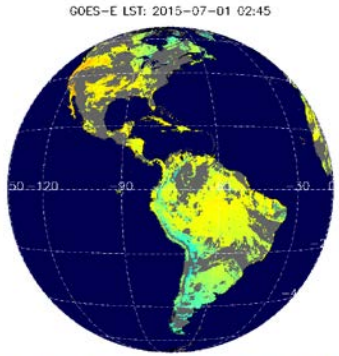
Monitoring -- Animation of Time Series



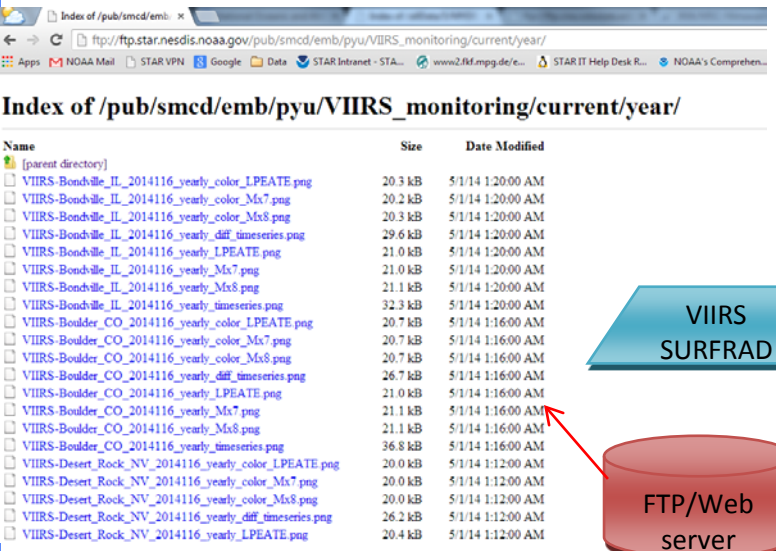


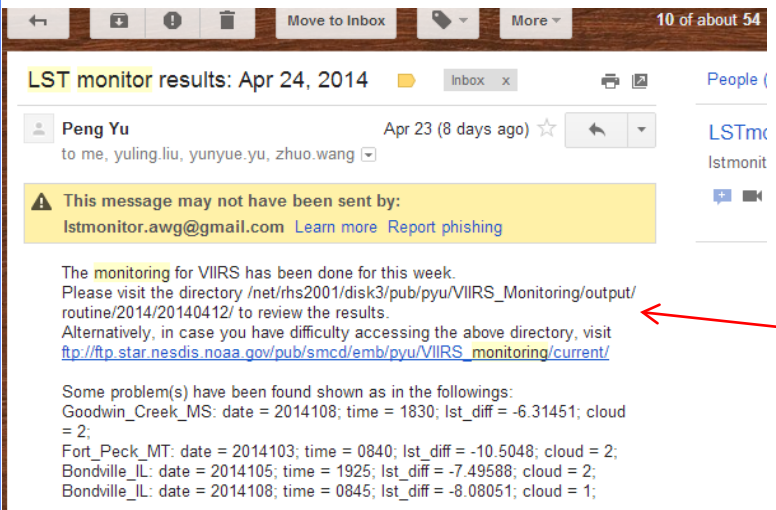


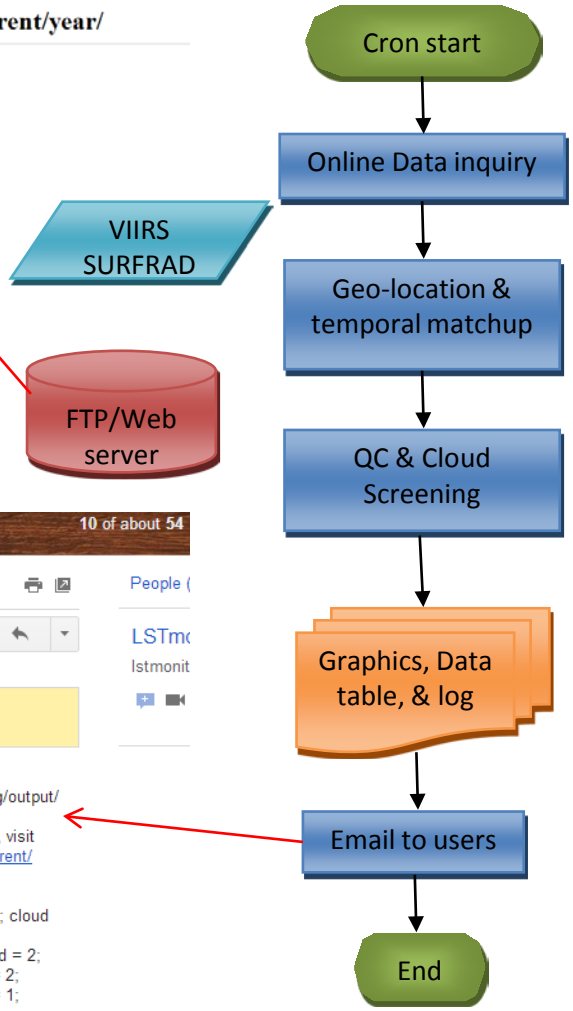


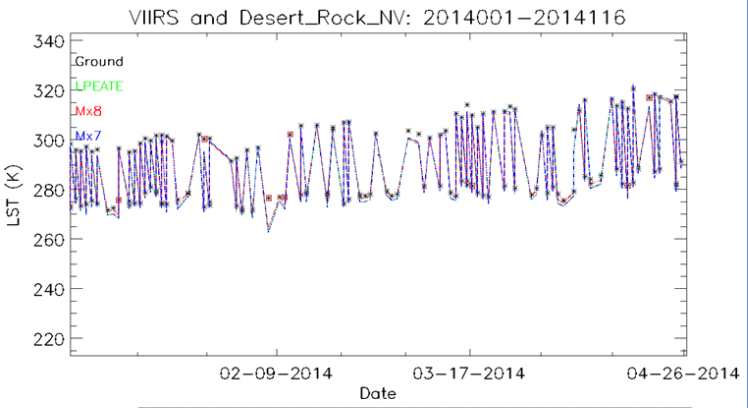


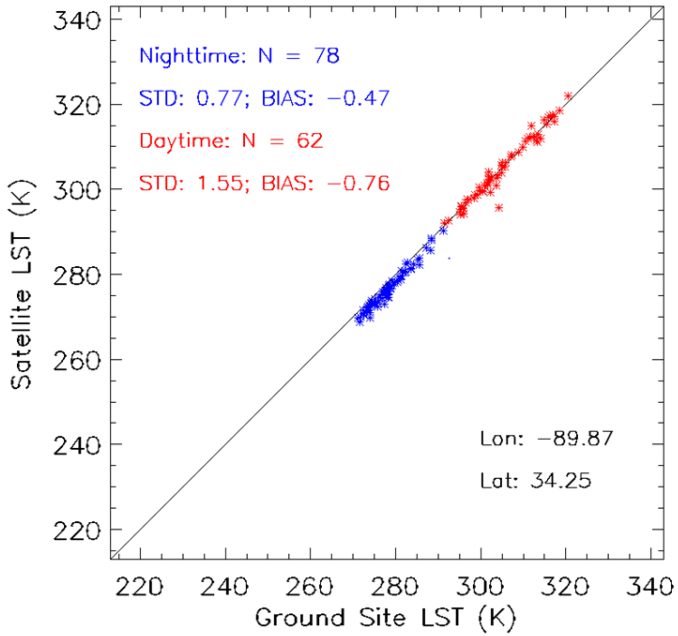
Alert System





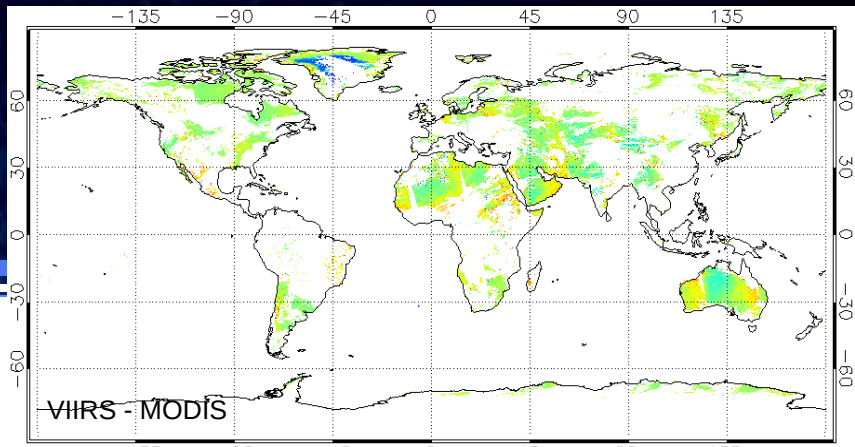


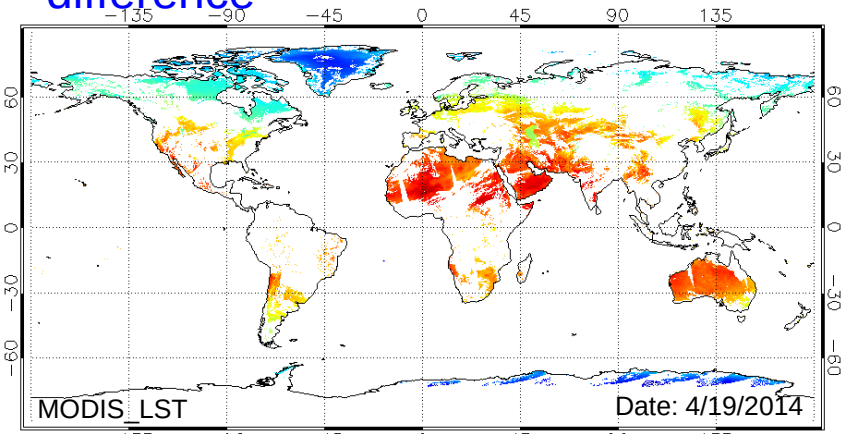


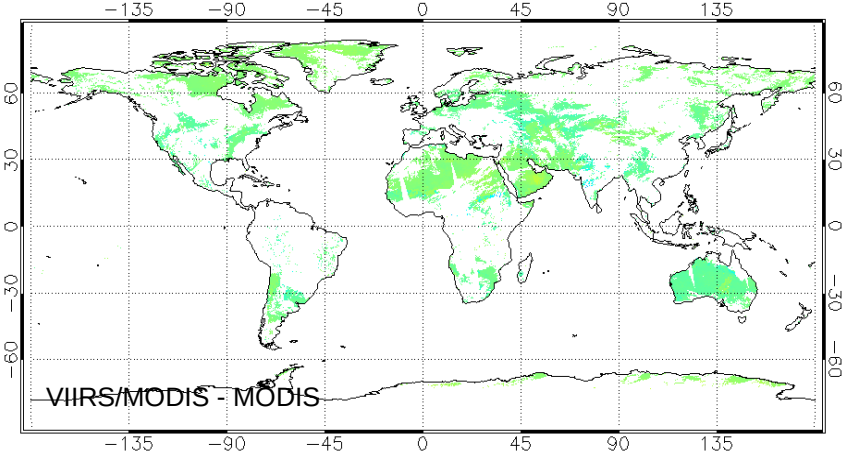


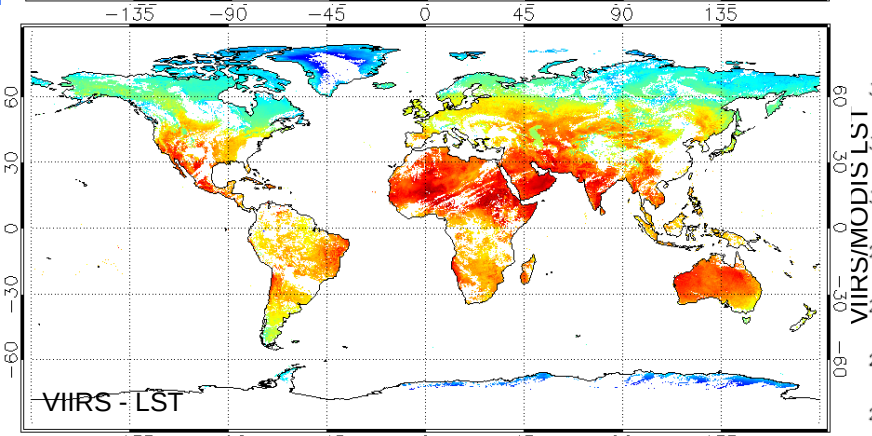
Cross-Satellite Comparison

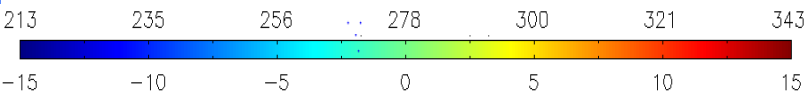
Cross-satellite Comparison: dataset difference

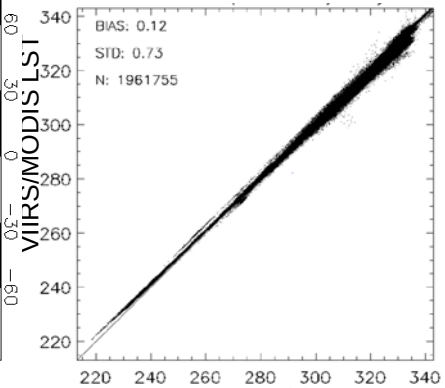








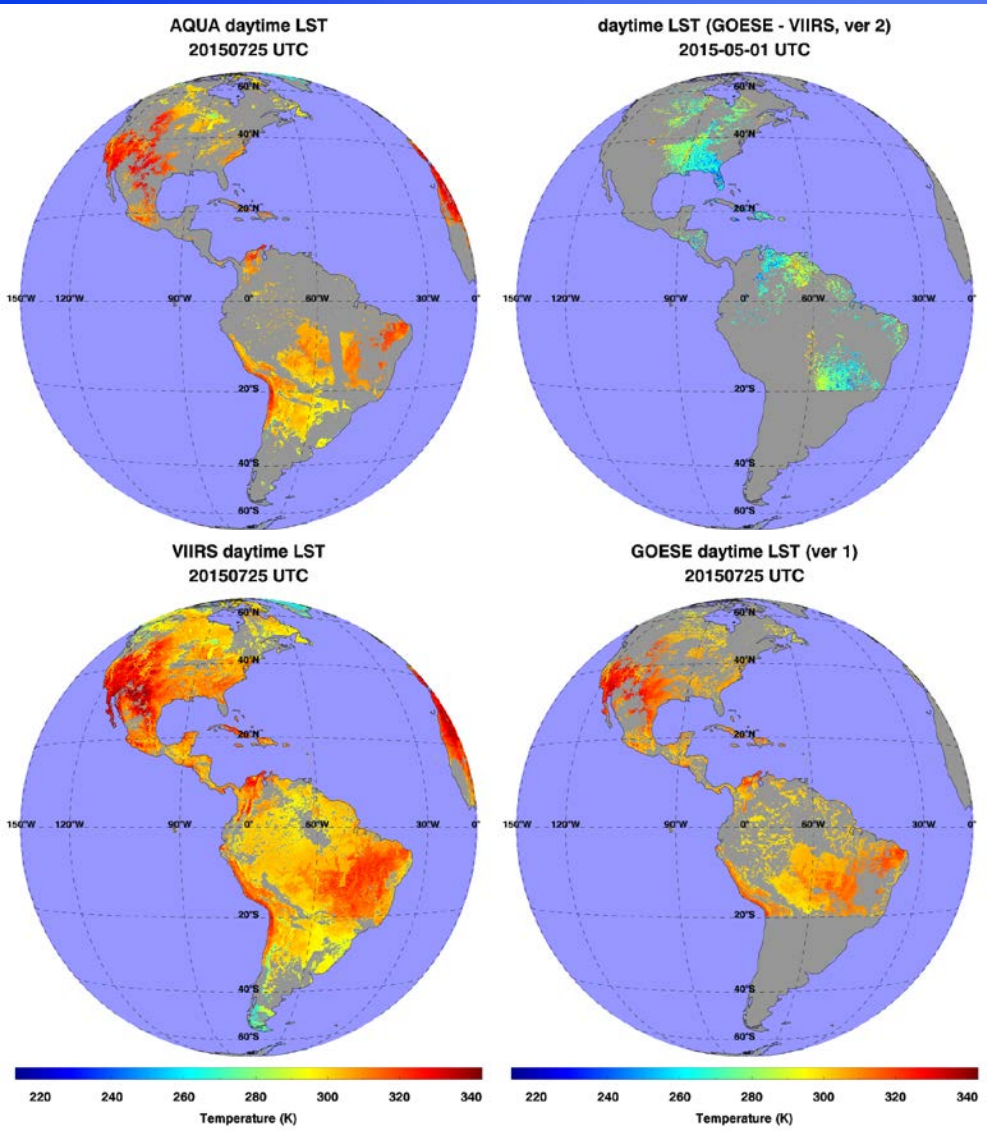




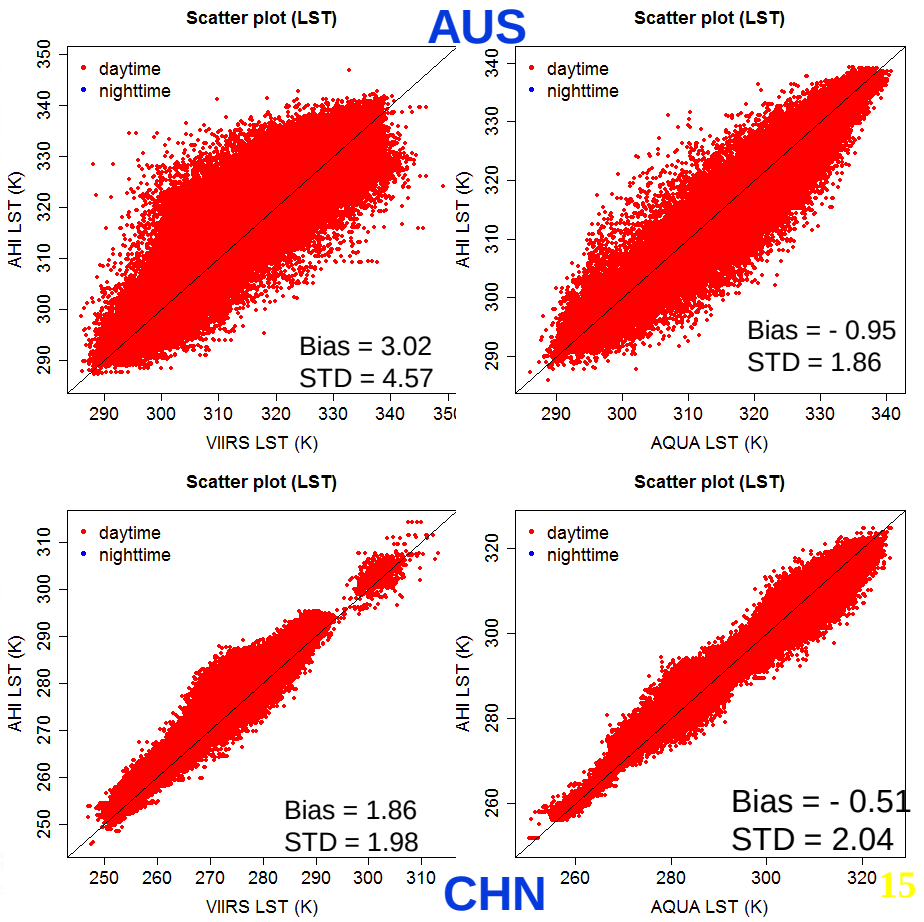
Cross-satellite LST comparison is used in VIIRS LST evaluation.

Caution: Time difference is a significant impact; granule level comparison is needed.

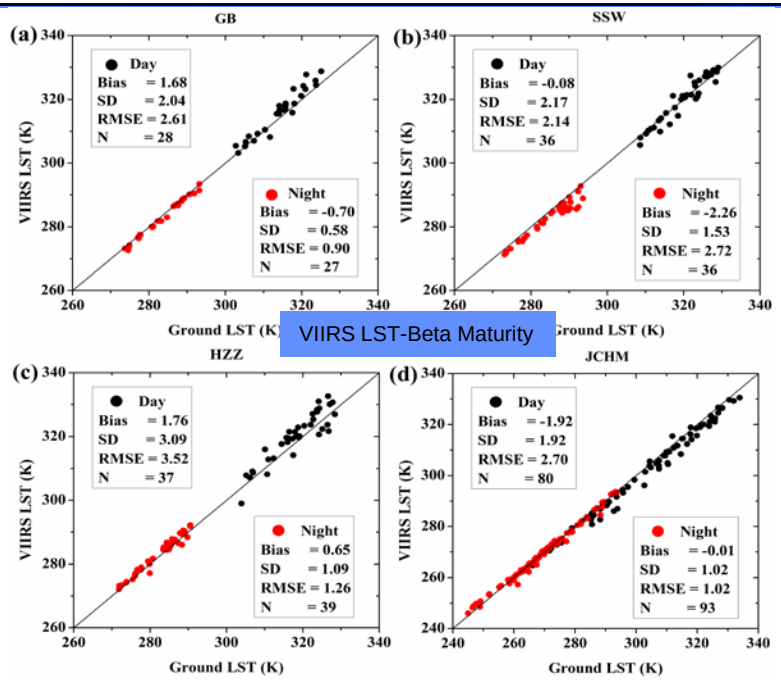
Cross-satellite comparisons



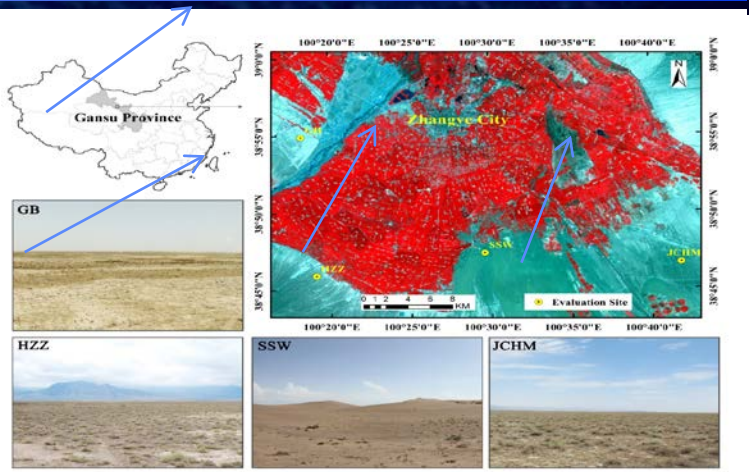
Geo-Leo LST comparisons

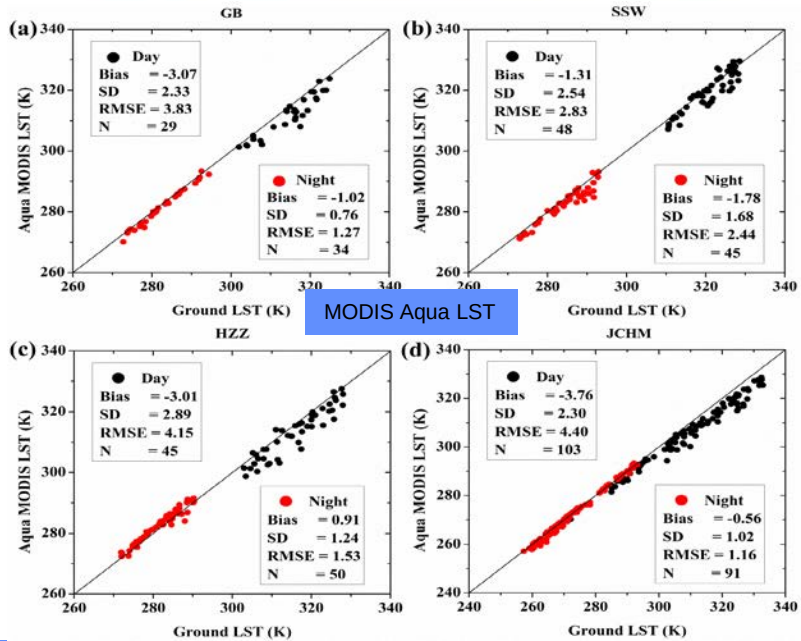


International cooperation



VIIRS LST-Beta Maturity





MODIS Aqua LST

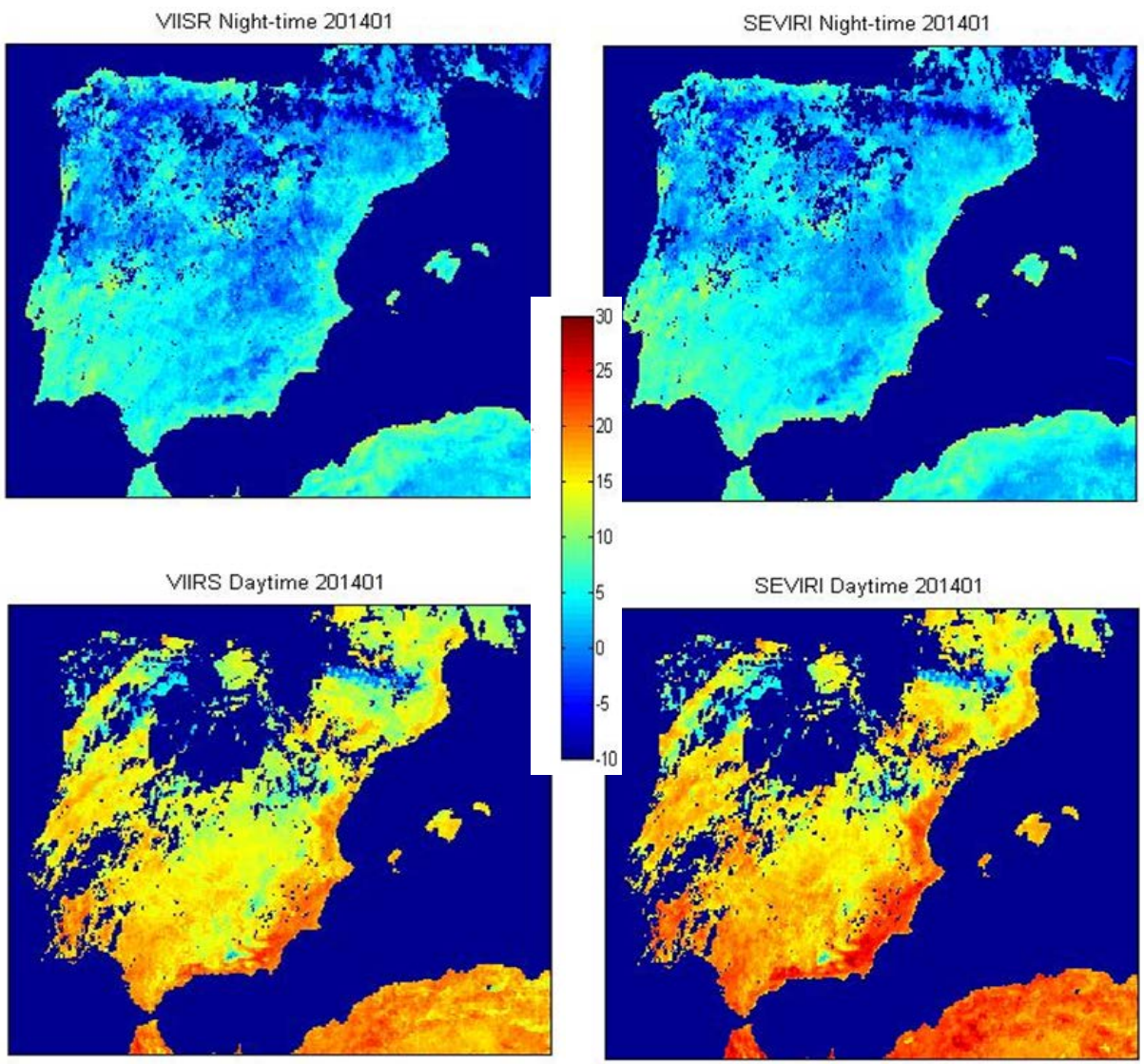
Data collection: arid area of northwest China (Heihe Watershed Allied Telemetry Experimental Research), from June 2012 to April 2013. Four barren surface sites were chosen for the evaluation.

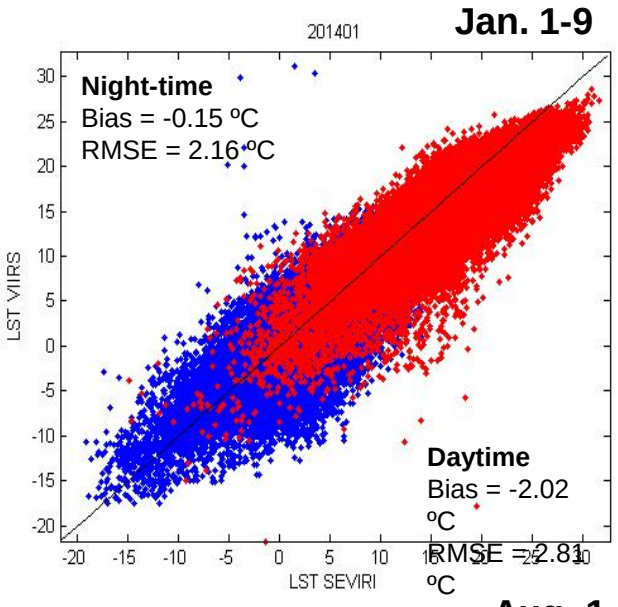
The result generally shows a better agreement for VIIRS LST than that for MODIS LST.

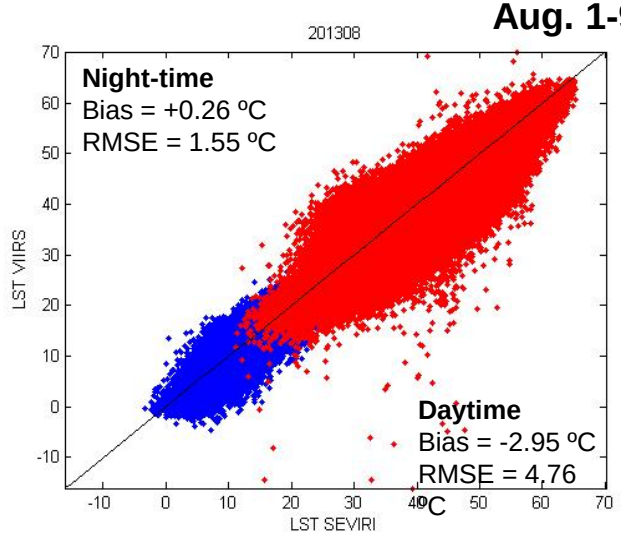
***China site data was obtained through a collaborative effort with Dr. Hua Li at Institute of Digital Earth and Remote Sensing, China Academy of Science**

Reference: *H. Li, D. Sun, Y. Yu, H. Wang, Y. Liu, Q. Liu, Y. Du, H. Wang and B. Cao(2014) , Evaluation of the VIIRS and MODIS LST products in an arid area of Northwest China Remote Sensing of Environment 02/2014; 142:111–121*

International cooperation







Courtesy of Isabel F. Trigo , through US-Portugal Bilateral cooperation program (on remote Sensing)

Further Enhancement /Improvement

- Validation tool improvement
  - » A web-based validation server
  - » practical use of the spot-to-pixel scaling method
  - » Field campaign participation (through national/international cooperation)
    - – High quality ground data is the key!
    - – Need the data over central and south of America
  - » Radiance-based LST validation method
  - » Cross-satellite comparison
    - – A visualization extension (comparisons with VIIRS, MODIS , Sentinel-3…)
  - » Three-measurement validation method
- Algorithm Enhancement /Improvement
  - » Emissivity data
  - » Additional cloud filtering for LST
  - » Water vapor correction
  - » Large angle correction
- Interactive with AIT, vender