# Land Surface Temperature Production and Validation Tool Development for GOES-R Mission

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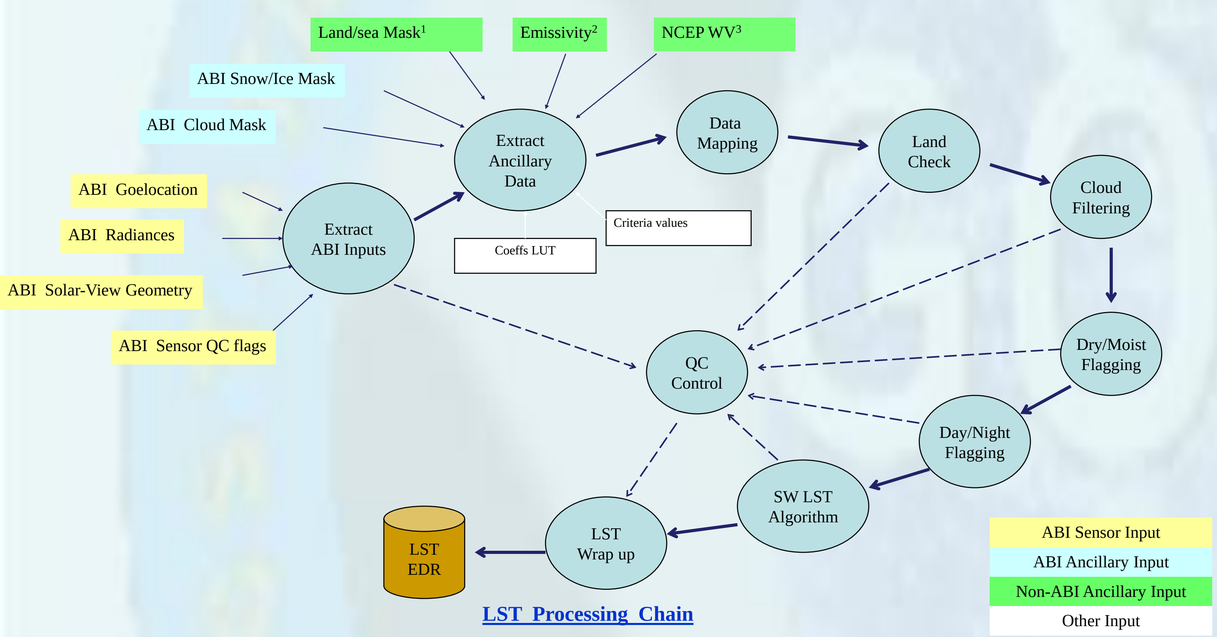
## Introduction

Development of land surface temperature (LST) algorithm for the U.S. Geostationary Operational Environmental Satellite (GOES) R series (GOES-R) satellite mission has been conducted since 2006 at the U.S. National Oceanic and Atmospheric Administration (NOAA) SaTellite Applications and Research center (STAR). While the 100% readiness delivery of the LST algorithm package was delivered in 2010, LST group of Land applications and product team of the GOES-R Applications Working Group (AWG) has being worked on development of validation tools for the GOES-R LST product since then. The tasks include the tools for satellite-satellite and satellite-ground data match-up, stringent cloud filtering, site characterization and corrections of ground LST measurements, user-friendly graphic interface, and possible adjustment of the algorithm coefficients. Ground data sets from the GOES coverage area (mainly over US) and the MSG (European geostationary satellite) coverage have been collected, processed and compared with the corresponding GOES-R proxy satellite data (MODIS and SEVIRI, respectively).

## GOES-R LST Generation

A regression split window algorithm has been applied to generate GOES-R LST product using brightness temperature data ($T_{11}$ and $T_{12}$) at channels *11 μm* and *12 μm*, respectively. Mean emissivity *(ε)* of the two channels is utilized explicitly in the algorithm.

$$T_s = C + A_1 T_{11} + A_2 (T_{11} - T_{12}) + A_3 \varepsilon + D(T_{11} - T_{12})(\sec\theta - 1)$$




LST Processing Chain

## Functionality of Validation Tools

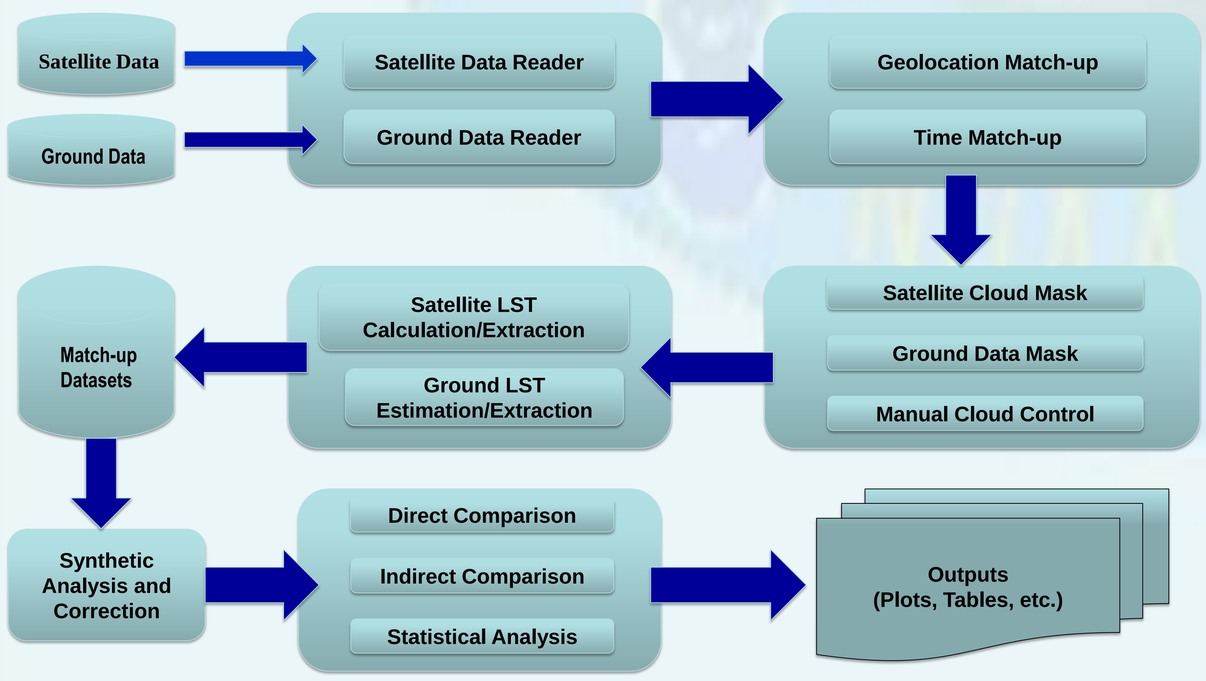
### Routine validation tools

- Characterizations of SURFRAD and CRN ground sites
- Routinely acquired matchup data sets of satellite and ground Data
- Ground LST estimation
- Procedures for converting point ground LST to "pixel" ground LST
- Direct comparisons and statistics for each ground LST *vs* satellite LST for last *x* months
- Time series plots of selected coincident LST and ground LST for last *x* months

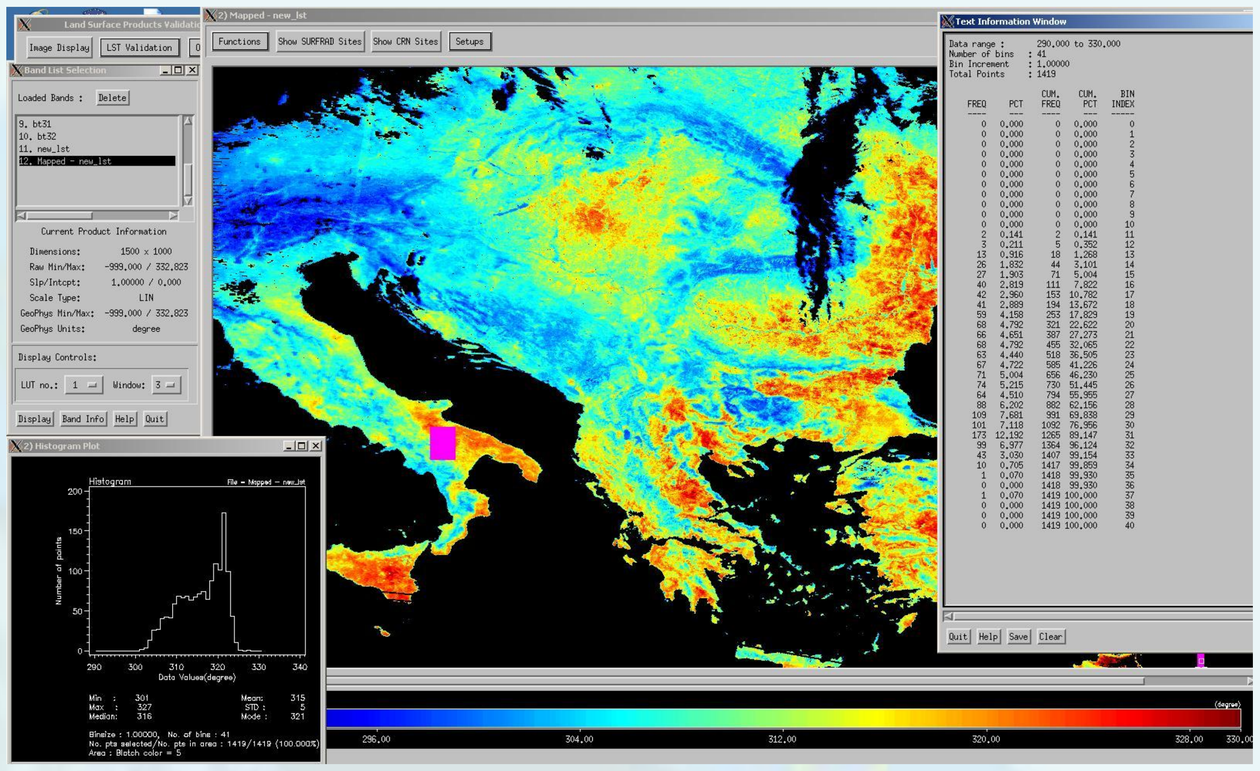
### Deep-Dive Validation

- All of the routine validation tools
- Data sets consisting of multiple years of clear radiances coincident with ground LSTs
- Indirect comparison and statistics for each ground LST *vs* ground LST climatology for last x years
- Comparisons and statistics for GOES-R LST *vs* other satellite LST
- Routines for calibrating LST algorithm coefficients using the validation results

## Routine Validation procedure

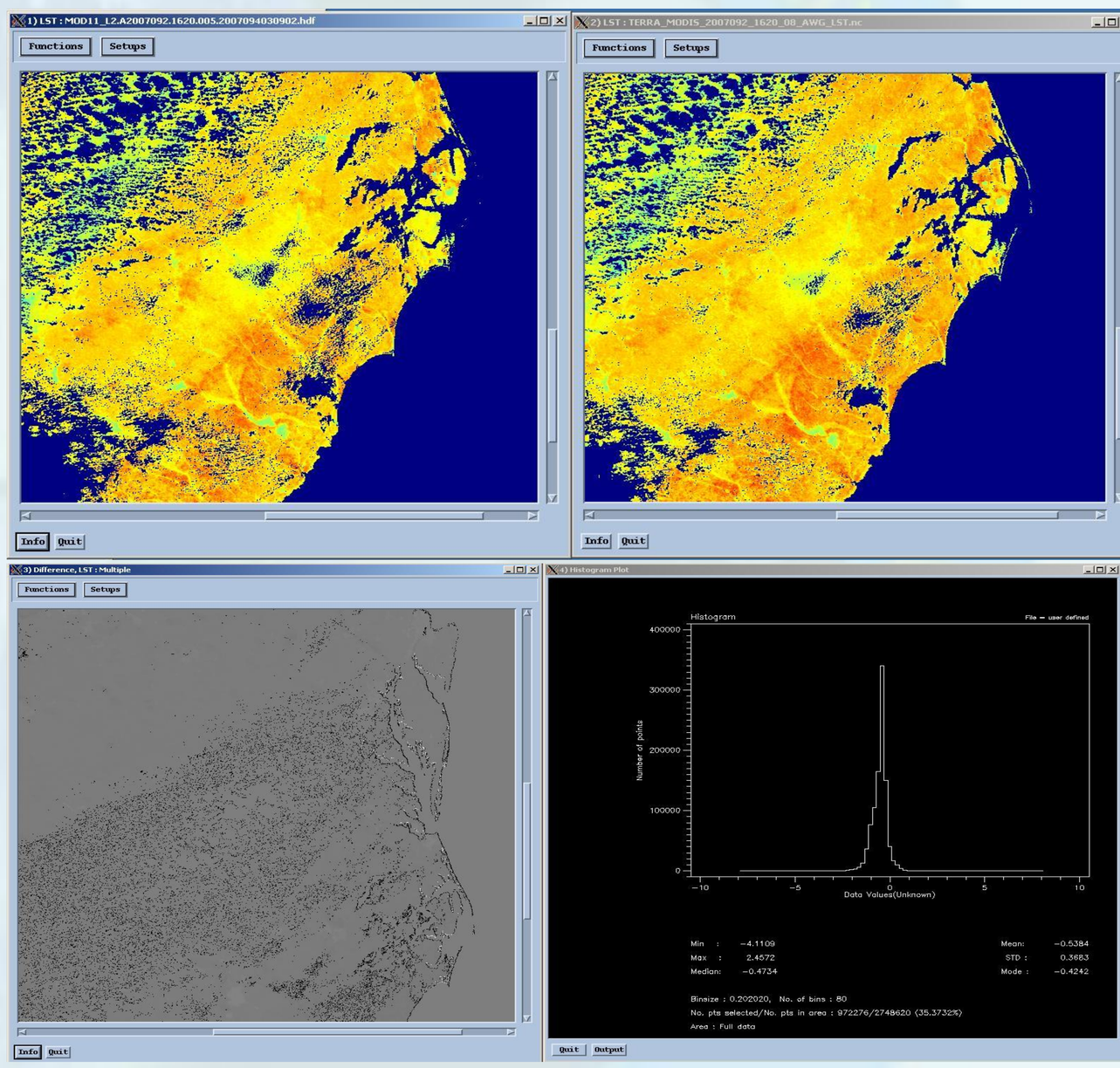



## Functional Graphical User Interface capability



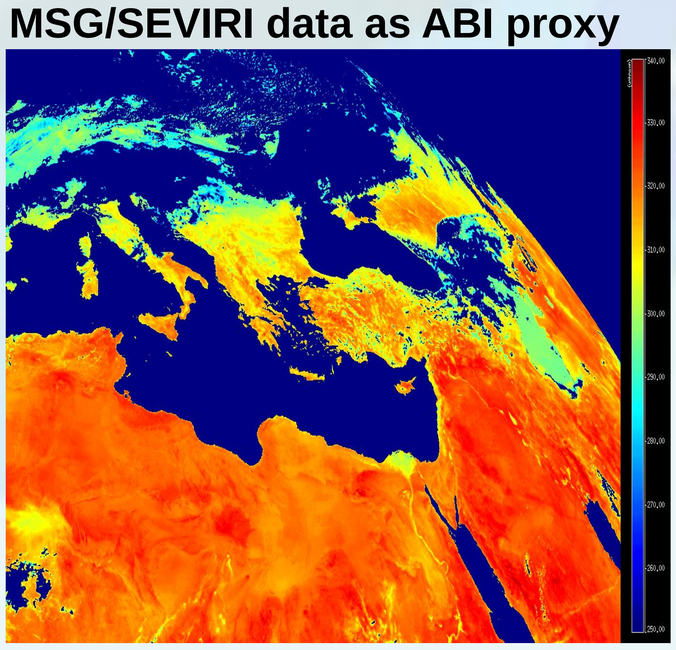
A screen shot of the LST Validation Tool. The tool proves rich image analysis capability for the LST evaluation with ground topography and surface vegetations. Regional extracted data values can be saved on disk daily for further climatology studies. Graphic output is also supported for all those opened windows.

## LST Comparisons: ABI proxy and MODIS



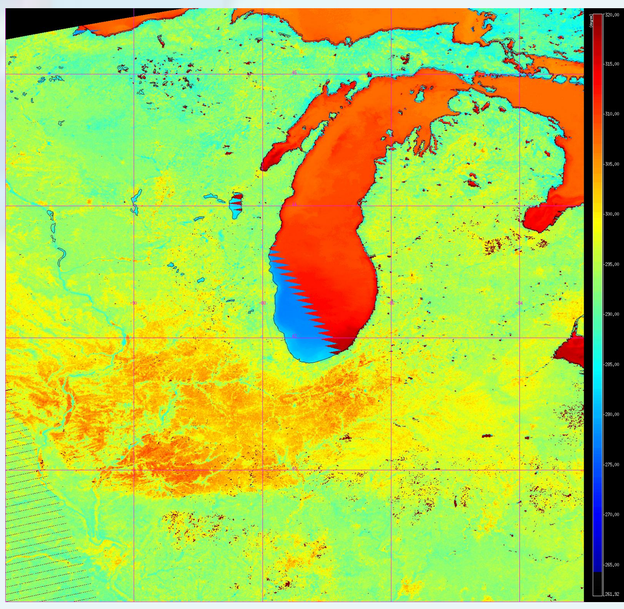
Above pictures (upper panel) show the MODIS LST product (left) and ABI LST product using the MODIS as proxy (right). Difference and histogram of the difference are showed in the lower panel.

## Capability of processing MSG/SEVIRI data as ABI proxy



The visualization tool can provide detailed view of the European and the Africa continents with LST data field readings. This is a valuable data source for our ABI LST algorithm validation and improvement.

## Capability of processing Suomi NPP VIIRS LST data



Similarly, preliminary image view of VIIRS LST product with the validation tool.