

## Introduction

Cross satellite comparison analysis is an important step in land surface temperature (LST) development. This is particularly true for new satellite missions. In our LST development for the U.S. GOES-R and S-NPP missions, we applied the MODIS LST product as a reference for the comparison analysis. It is found that LSTs from two satellite measurements can differ significantly in some cases. Such differences do not necessarily imply that one of the LST products is better. Instead, it can be resulted from view angle and/or time differences between the two satellite observations. In particular, results of cross satellite LST comparison are very sensitive to the time difference at daytime. The compositing process may also introduce significant differences when comparing gridded LST maps from two satellite data sources, due to differences in compositing approaches. Caution must be paid if the gridded LST maps are used for diurnal variation analysis. In this study, we present our VIIRS LST and MODIS LST comparisons and reveal the issues observed.

## S-NPP/VIIRS LST Evaluation Using MODIS LSTs

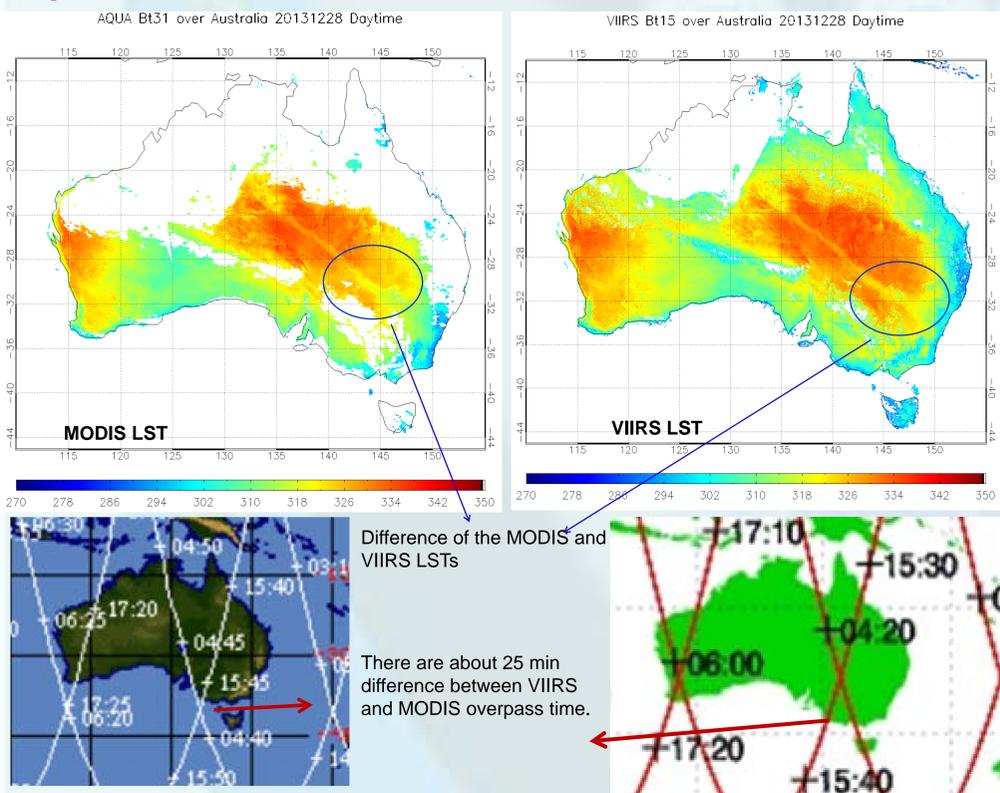
A Split-window Regression algorithm is running for the VIIRS land surface temperature,  $T_s$ , production:

$$T_s = a_{0,i} + a_{1,i} T_{11} + a_{2,i} (T_{11} - T_{12}) + a_{3,i} (\sec\theta - 1) + a_{4,i} (T_{11} - T_{12})^2$$

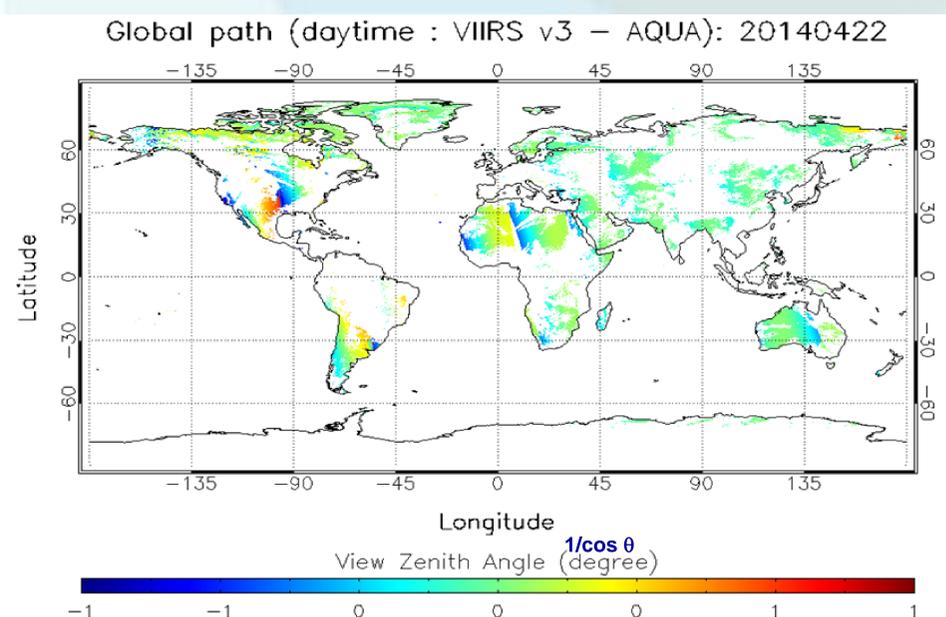
where  $a_{k,i}$  are algorithm coefficients;  $i$  indicates 17 IGBP surface types;  $\theta$  is view zenith angle,  $\phi$  is solar zenith angle. T11 and T12 represent the VIIRS sensed brightness temperatures at 11 and 12 micron channels (the split-window).

MODIS LST is used as reference in evaluation of the VIIRS LST product. Caution must be taken in comparing the both LSTs.

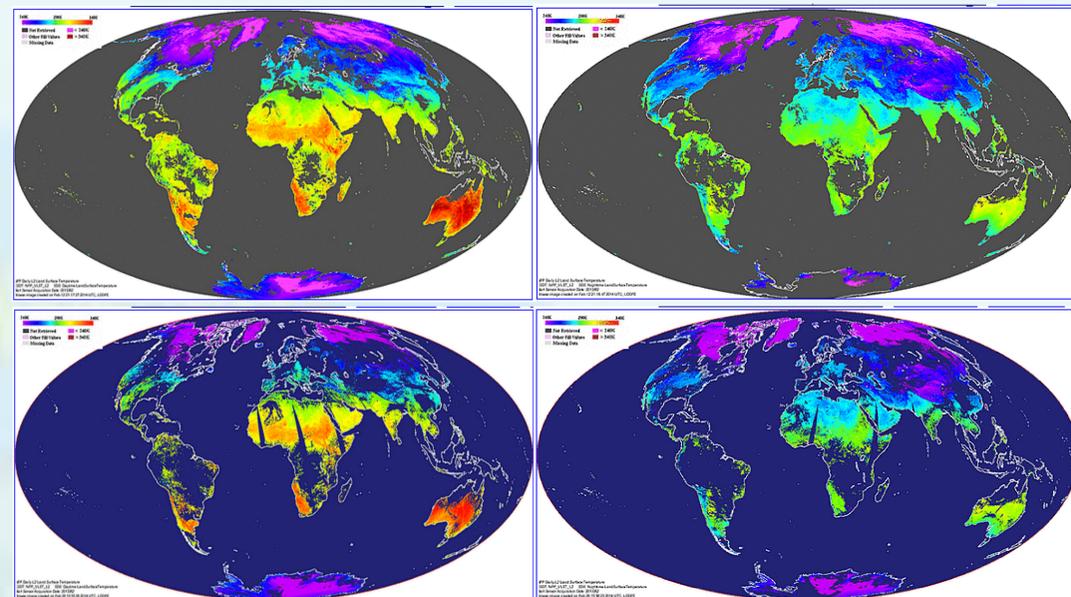
## Impact of Time Difference



## Impact of Atmospheric Path (1/cos θ) Difference



View zenith angle difference between the two satellite shows orbit-track dependent pattern, which impacts the LST difference pattern as well.

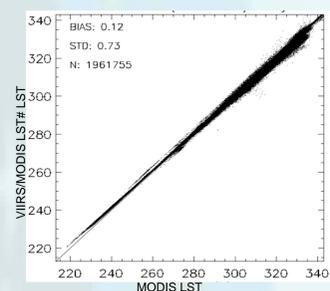
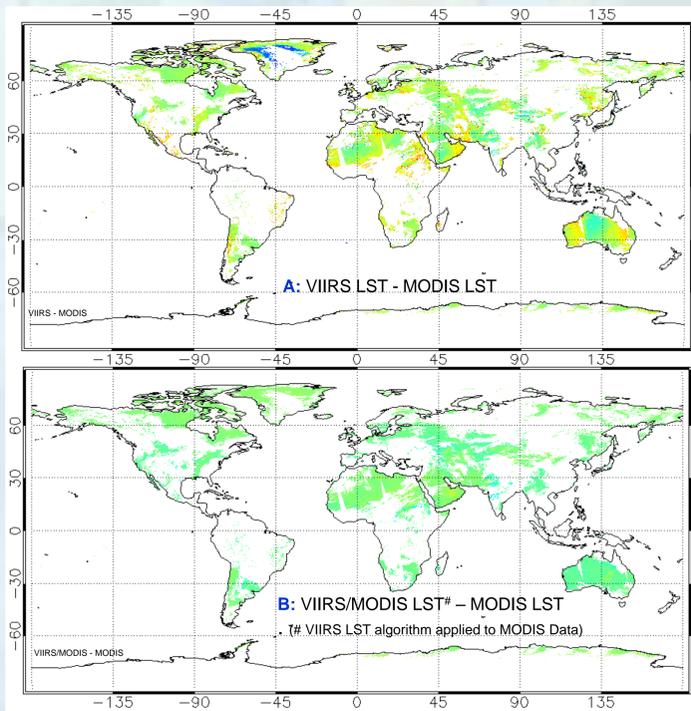


Global comparisons of VIIRS (top) and MODIS (bottom) LST maps for daytime (left) and night time (right) cases, courtesy by NASA Land PEATE.

## Impact of Composition Algorithm Difference

The global or regional LST maps from VIIRS and MODIS are usually composited from granule datasets. The composition algorithms can be different from one another, such as averaging, maximum, weighting of quality flags, etc, which may result significant difference in some areas.

## Impact of LST retrieval Algorithm Difference



The LST derivation algorithm difference does not show significant LST difference in the cross-satellite LST comparison analysis; the major difference is from the platform difference (i.e., time difference and view angle difference). For instance, VIIRS LST is an emissivity implicit (surface type dependent) algorithm, while MODIS LST is an emissivity explicit (emissivity is applied as input) algorithm. The LST value difference between the two products is observed clearly (top-left). However, if the VIIRS LST derivation algorithm is applied to MODIS data (i.e. uses MODIS data as VIIRS data proxy), the LSTs between the two algorithm (but the same dataset) does not show significant difference (top, and bottom-left).

## Impact to Application Users

Since different LST products may provide different LST values, caution must be taken to LST users in their applications. For instance, the LST diurnal range obtained from different satellite LST dataset should be compared for more accurate range. To LST developers, time and view angle difference must be considered in evaluating one satellite LST data using the other dataset as a reference.

## Summary

- ✓ LST products derived from different satellite missions may appear significant difference, particularly for daytime LST observations; such difference **does not** imply one of the LST products is better.
- ✓ The difference can be impacted from orbit overpass difference of, sensor view zenith angle, etc.
- ✓ The difference of LST derivation algorithms for the two satellites is less important.
- ✓ A consistent LST product is needed for applications that are sensitive to LST diurnal range.