The tool for the VIIRS LST Product monitoring and validation

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Introduction

As one of the key products of VIIRS, land surface temperature (LST) is of fundamental importance to the net radiation budget at the Earth surface and to monitoring the state of crops and vegetation, as well as an important indicator of both the greenhouse effect and the energy flux between the atmosphere and the land. To better monitor the performance of the VIIRS LST product and evaluate different retrieval algorithms for potential algorithm improvement, a monitoring system has been developed and implemented for both the routine monitoring and the basic research.

It consists of two main components, the global cross-satellite comparison system and the one validating VIIRS LST against certain ground sites' LST observations. The third component for cross-satellite comparison at the granule level will be included in the near future. The global component generates daily global LST maps for both daytime and nighttime from VIIRS and MODIS-AQUA. Besides the satellite LST, additional variables such as the brightness temperature and the sensor zenith angle, etc, are included in the daily composite dataset, allowing not only the cross-satellite LST comparison, but also the cross-algorithm comparison. A series of subset datasets with respect to certain ground sites' locations are generated from this component. These will replace the subset data produced by LPEATE, which is currently being used by the satellite-ground validation component. The latter carries out the validation of VIIRS LST with observations from SURFRAD ground stations. It evaluates the satellite retrieval performance against the ground "truth" for the past week, the past month, and the past year. Warning messages will be generated and sent to the LST group if any of the prescribed criteria is met. A data table consisting of around 30 variables is generated with respect to each ground site. The data table is used to evaluate different retrieval algorithms and analyze the retrieval under different situations.

The monitoring system is automatically run at the background in a local Linux computer on a daily basis. The results are published via an FTP site and will be transitioned to a web site in the future. The tool currently includes two satellite sensors, VIIRS and AQUA, and will be extended to the monitoring of the LSTs from other satellites including the current GOES-13 and GOES-15 and the future GOES-R and Himawari/AHI.

Validation with ground sites

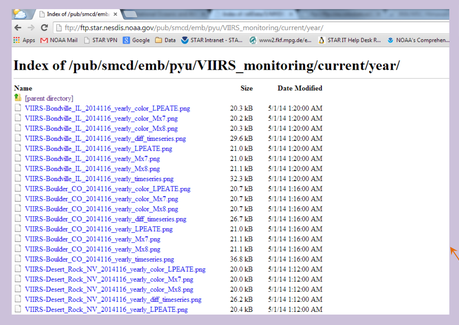
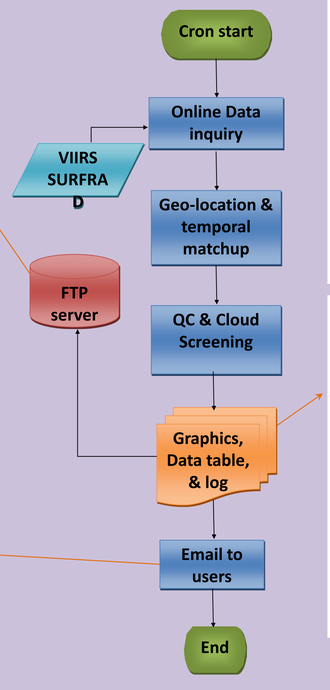


Fig. 1Validation results are published via FTP server.

Flowchart of the site validation tool.



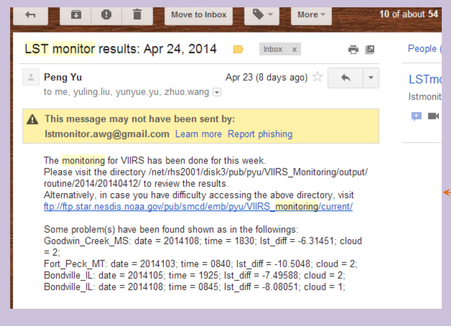
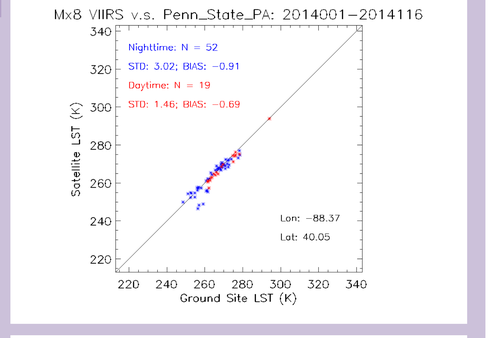


Figure. 2. A message with summary and/or warning will be sent to the users once the validation is done.



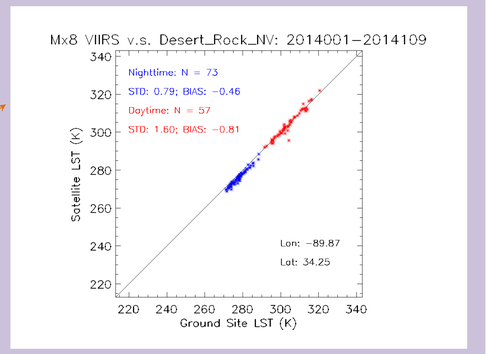


Figure. 3. VIIRS LST and LST calculated with other algorithm are validated with SURFRAD sites' observations.

Global cross-satellite comparison

Daily data from SNPP-VIIRS and MODIS-AQUA are collected. Two global datasets based on different compositing procedure are generated for daytime/night and VIIRS/AQUA, allowing the cross-satellite comparison of the LST products. For dataset 1, satellite LST as well as data required for retrieval with other algorithm are stored. Different retrieval algorithms for VIIRS are tested for potential algorithm improvement.

Global LST maps for VIIRS and AQUA

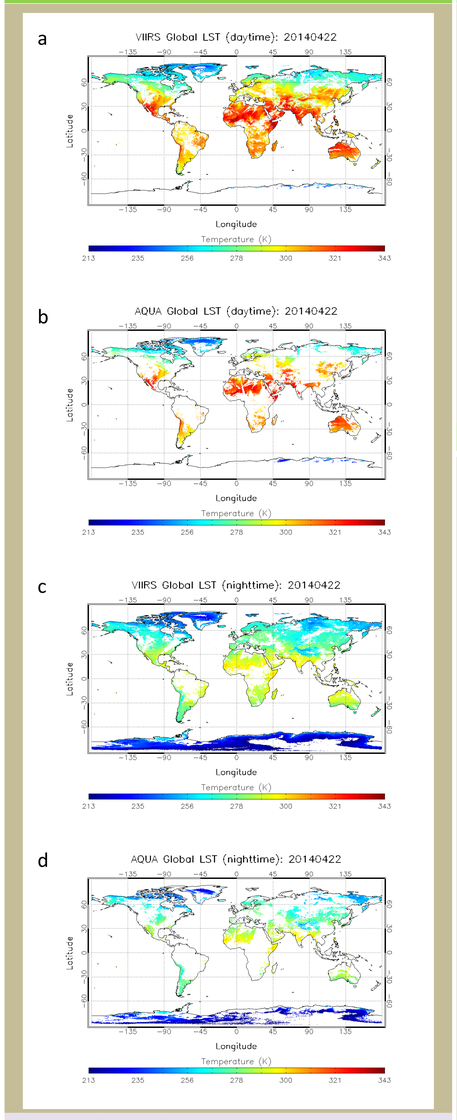


Figure. 4. Daily LST maps are generated for cross-satellite comparison. a) VIIRS daytime; b) AQUA daytime; c) VIIRS nighttime; and d) VIIRS daytime

Other variables of the global dataset

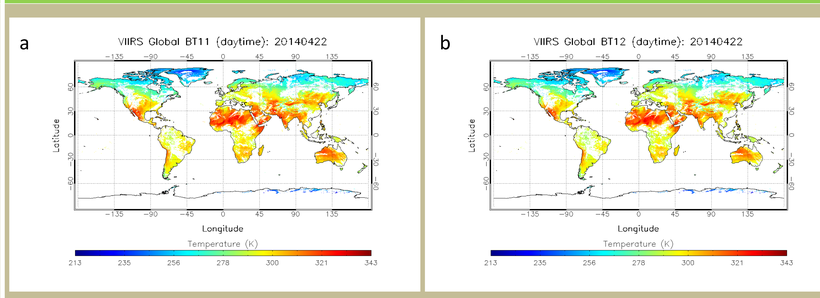


Figure. 5. Different variables required for common LST retrieval algorithms are stored for evaluation of the performance of different algorithm. Variables included are bright temperature at the two split window bands, multi-channel emissivity, surface types, product quality flags, satellite view angle, solar zenith angle, and observation time.

A case study: the LST difference between VIIRS and AQUA

Figure.6. a) The LST difference between VIIRS and AQUA is shown. The difference can be as large as 10K in some areas. b) The BT (11 micron meter) difference between the two satellitesis consistent with the LST difference. c) LST is calculated with MODIS BT data and VIIRS algorithm, its difference with AQUA LST is much smaller than that shown in a. This indicates the algorithm difference is not the main reason for the large LST difference. d) The scatter plot of the LST shown in c. Possible cause of the large LST difference: observation time, satellite view angle, which will be further studied.

Summary and future work

The routine satellite LST monitoring tool has been developed and implemented. Part of its functionalities has been automated for the goal of routine validation. The tool has been also utilized as a basic research tool to solve problems in the algorithm improvement and product validation.

The monitoring tool is still in development and testing mode. The global cross-satellite comparison component will be automated and the component to compare LST from different satellite LSTs at granule level is being developed. Further testing of the tool with different case studies will be needed. After the developmental phase, it will be also extended to other satellites such as GOES-R, etc.