LST Validation Tool V1.0 Quick Guide

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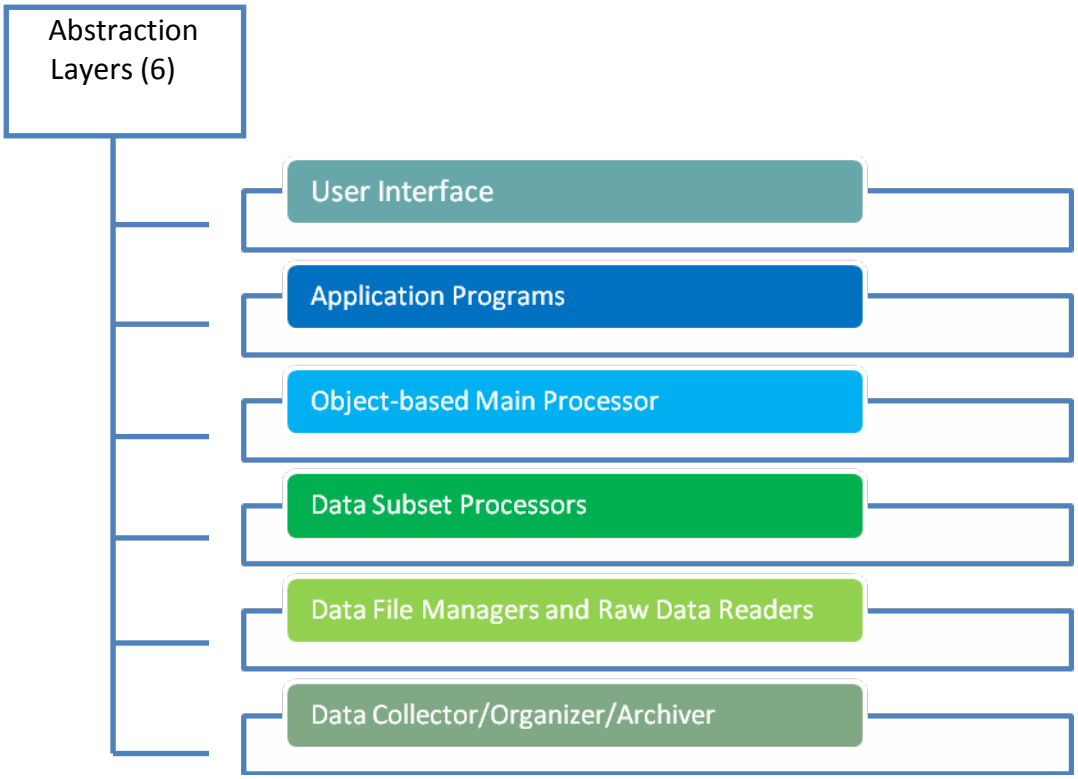
LST Validation Tool Conceptual Model



The main body of this conceptual model was implemented in the Interface Description Language.

The user interface was a simple command line driver in bash-shell scripting language.

1. Source Codes

The LST validation tool package was developed in the Interface Description Language (IDL V 6.4). Enclosed in this package are a set of user-defined IDL object classes, and several application programs in IDL. In addition, a bash-shell script file is enclosed in the package to facilitate the tool usage.

Each user-defined IDL class has in-line documentation to describe its member variables and member methods / functions. A short description of the package files is given in the following table.

CloudScreeningRefValueEvaluator__DEFINE.pro	To evaluate "clear-sky" reference value
compile_package.pro	To compile the package files
DataFileManager__DEFINE.pro	A bass class to manage ground sites info
EmissivityDataArchives__DEFINE.pro	To manage the default emissivity databases
GeoLocMatchupPreprocessor__DEFINE.pro	To perform geo-location match-up
GoesDataFileManager__DEFINE.pro	A derived class to manage GOES-8/10 data sets
GoesDataProcessor__DEFINE.pro	A derived class to buffer user defined GOES data for upper-level application programs
GoesDataReader__DEFINE.pro	To read GOES data from the raw data files
GoesLandSurfaceTemperatureRetriever__DEFINE.pro	To calculate LST from GOES BTs
GoesSurfCloudScreening__DEFINE.pro	To perform cloud-screening for GOES-8/10
GoesSurfradMatchupMainProcessor__DEFINE.pro	The main processor for GOES-SURFRAD matching up
MatchedDataAnalyzer__DEFINE.pro	To perform validation analysis
MatchedDataAnalyzerMainFrame.pro	The main program to drive validation analysis
MatchedDataFileManager__DEFINE.pro	A derived class to manage matched data
MatchedDataReader__DEFINE.pro	To read the matched data sets
MatchedDataWriter__DEFINE.pro	To write the matched data sets
MatchupMainFrame.pro	The main program to drive the matching up
ObsTimeMatchupPreprocessor__DEFINE.pro	To perform time match-up
run_lst_validation.sh	A bash-shell script file to run the package
set_package_paths.pro	To set various data file paths
surface_stations.txt	Ground site listing file
SurfradDataFileManager__DEFINE.pro	A derived class to manage SUFRAD data
SurfradDataProcessor__DEFINE.pro	A derived class to buffer user defined SURFRAD data for upper-level application

	programs
SurfradDataReader__DEFINE.pro	To read SURFRAD data files
SurfradLandSurfaceTemperatureCalculator__DEFINE.pro	To calculate LST from SURFRAD obs.
TargetAreaDataBuffer__DEFINE.pro	A base class to manage data buffers
TimeDateUtil__DEFINE.pro	A utility class to process IDL time variables

2. Input Data Sets

Before running the package, GOES data, SURFRAD data and the ancillary data, e.g., emissivity data, algorithm coefficient data, needed to be prepared and organized following the same structures as the test data sets described in this document.
For those who have access to GOES-R project computing environment at NOAA/NESDIS/STAR, the test data are archived at /net/orbit175l/disk2/pub/mchen/LSTValidationTool/DataSets.
You don't need extra efforts to copy the test data to your local machine, but just to copy the source codes to the machine you have IDL license.
For those who want to copy the test data to your local machine, you need copy the data sets as a whole. And if you want to add your own data, you need follow the same data organization structure as that described here.

- The test GOES-8/10 data were prepared by the GOES-R proxy team. The data files were named and organized by a hierarchical structure in time and space. For details, one may check the test data sets at /net/orbit175l/disk2/pub/mchen/LSTValidationTool/DataSets/Satellite/.

- The SURFRAD data was downloaded from ftp://ftp.srrb.noaa.gov/pub/data/surfrad. A simple naming and organizing is used for the SURFRAD data files. The test data is achived at: /net/orbit175l/disk2/pub/mchen/LSTValidationTool/DataSets/Ground/SURFRAD_Data

- The default emissivity data sets is organized at /net/orbit175l/disk2/pub/mchen/LSTValidationTool/DataSets/Emissivity_Data.

- The algorithm coefficient data is organized at /net/orbit175l/disk2/pub/mchen/LSTValidationTool/DataSets/Algorithm_Coeffs.

The ground site listing file, surface_stations.txt, should be in the same subdirectory as the source files.

3. Running the Tool Package

- Step 1:

To run the package, one needs to set up the root paths for various data sets. The path configuration file is

set_package_paths.pro.

You may modify the paths accordingly. Note that the paths are the root paths to the input data sets. From each root path down to the data files, the current file naming and organizing needs to be used.

```
;
; set the data file paths
;

Data_DISK = '/net/orbit175l/disk2/'
ROOT_DIR = Data_DISK+'pub/mchen/LSTValidationTool/DataSets/'

SatDataPath = ROOT_DIR + 'Satellite'
SurfDataPath = ROOT_DIR + 'Ground/SURFRAD_Data'

EmissPath = ROOT_DIR +'Emissivity_Data'
CoeffPath = ROOT_DIR +'Algorithm_Coeffs'

OutputDataPath = ROOT_DIR + 'MatchupData’
MatchedDataPath  = OutputDataPath
```

- Step 2:

After the setting of the data file paths, one needs to specify the satellite and the ground site parameters (satellite ID and site ID) for the matching-up system. These parameters may be modified from the bash-shell script file:

run_lst_validation.sh

```
;
;set the time, satellite and ground site
;
YEAR=2001 & SATID='G10'& SiteID='site01'
```

One needs to modify the running modes if they just want to run either the matching-up system or the validation analysis system, separately.

```
;
;set running mode
;
RUN_MATCHUP = 0   ; 1: run the matchup system    0: no running
RUN_ANALYSIS = 1    ;  1:  run the analysis system     0: no running
```

- Step 3:

To run the package, enter the command:

source_run_lst_validation.sh

4. Match-up Output

The output of match-up system is a text files with 32 field columns. These 32 record fields includes the matched satellite LST and Ground LST, as well as the data used for satellite LST retrieval, ground LST "truth" value calculation, and cloud mask, etc.

Table-Record Fields of Match-up Output file

1	year
2	day of the year
3	satellite hour of time matched
4	satellite minute of time matched
5	ground hour of time matched
6	ground minute of time matched
7	day/night flag 0: day 1:night
8	dry/moist flag 0: dry 1:moist
9	cloud mask 0:clear 1:cloudy
10	satellite LST matched
11	ground LST matched
12	air temperature at 10m
13	solar zenith
14	satellite view angle
15	satellite azimuth angle with respect to solar zenith
16	Channel-1 BT
17	Channel-2 BT
18	Channel-3 BT
19	Channel-4 BT

20	Channel-5 BT
21	surface upward thermal radiance
22	surface downward thermal radiance
23	surface direct solar radiance
24	BT difference bt2_bt4
25	BT difference bt4_bt5
26	BT difference between the maximum BT-4 of the last 10 days and the current BT-4
27	BT difference between the maximum BT-4 of the collocated 3X3 BT-4 matrix and the center BT-4
28	channel-1 BT*100
29	difference between ground LST and BT-4
30	standard deviation of downward thermal radiance over the past 15 minutes
31	TPW in mm
32	surface broadband emissivity

5. Match-up Data Processing – Validation Analysis

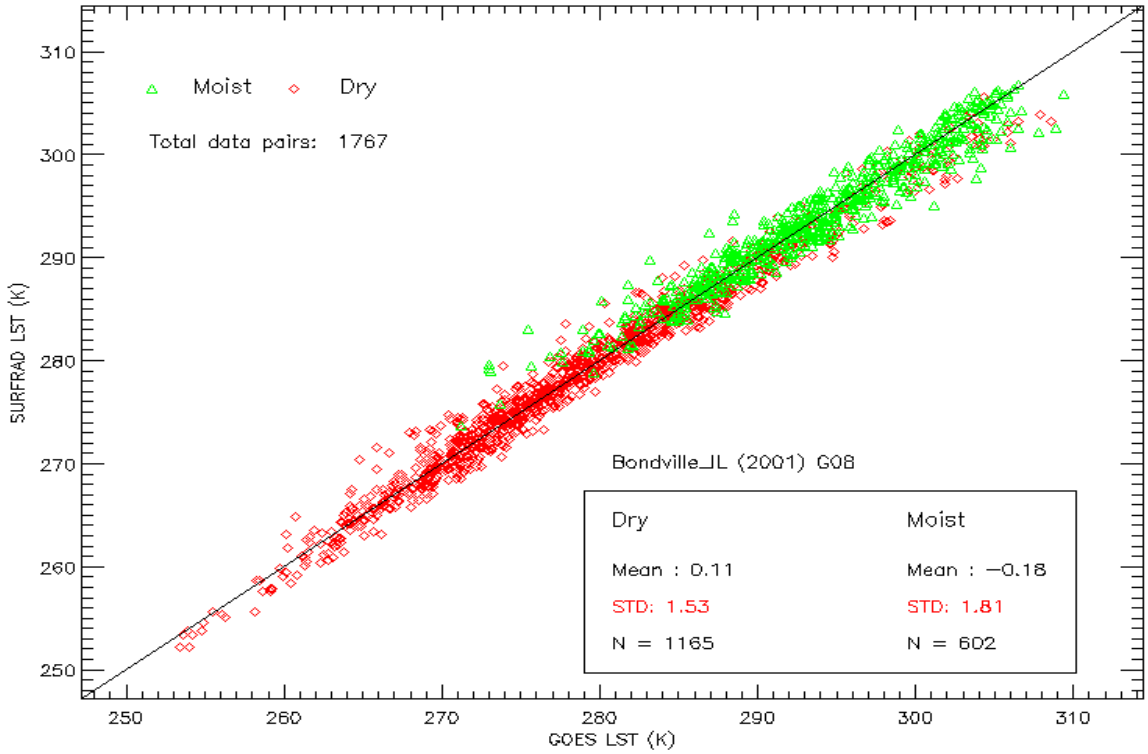
The current version encloses a dedicated IDL object class to handle the analysis of the match-up output. Two member methods are provided for rendering the validation analysis results: 1) text output of the statistics and 2) scatter plots.
These two methods are based on direct comparison of the satellite LST with the ground "truth".

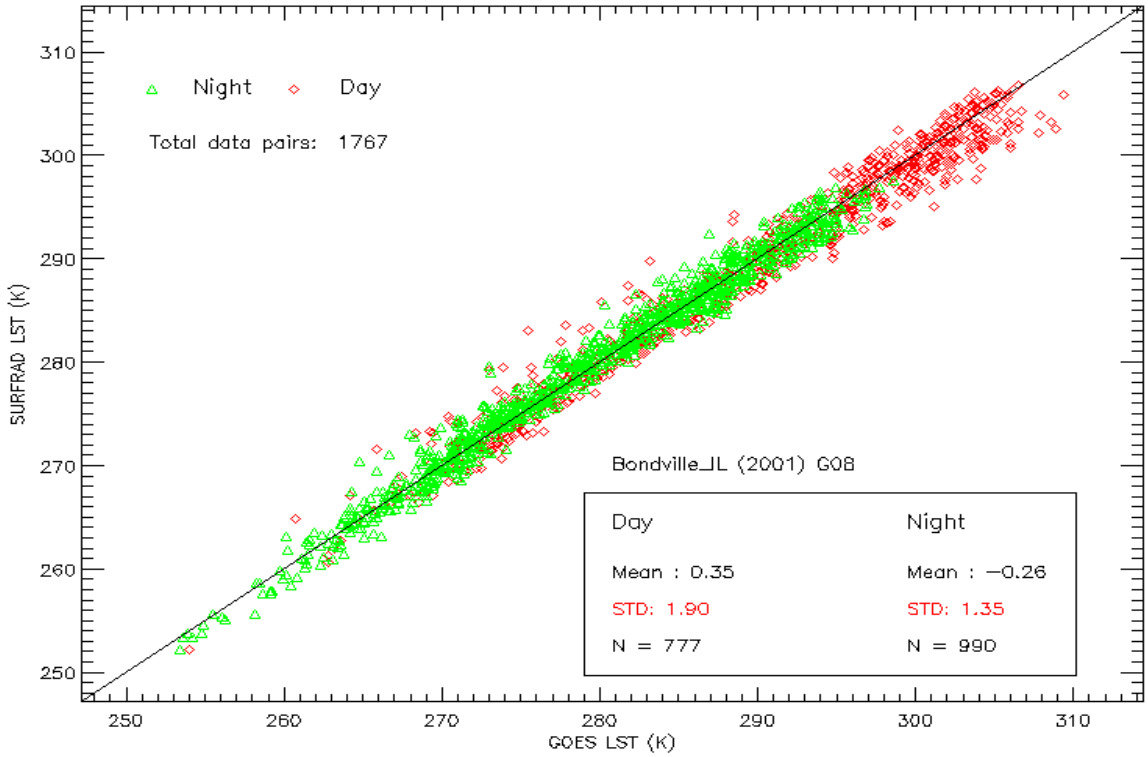
Sample statistics output:

```
    Year: 2001
Satellite: G08
  Ground: Desert_Rock_NV

    Type      Mean    StdDev    DataPairs
     day |    -1.68 |    1.00 |      17
   night|    -1.85 |    1.42 |       3
     dry |    -1.71 |    1.03 |      20
   moist|     0.00 |    0.00 |       0
   total |    -1.71 |    1.03 |      20
```

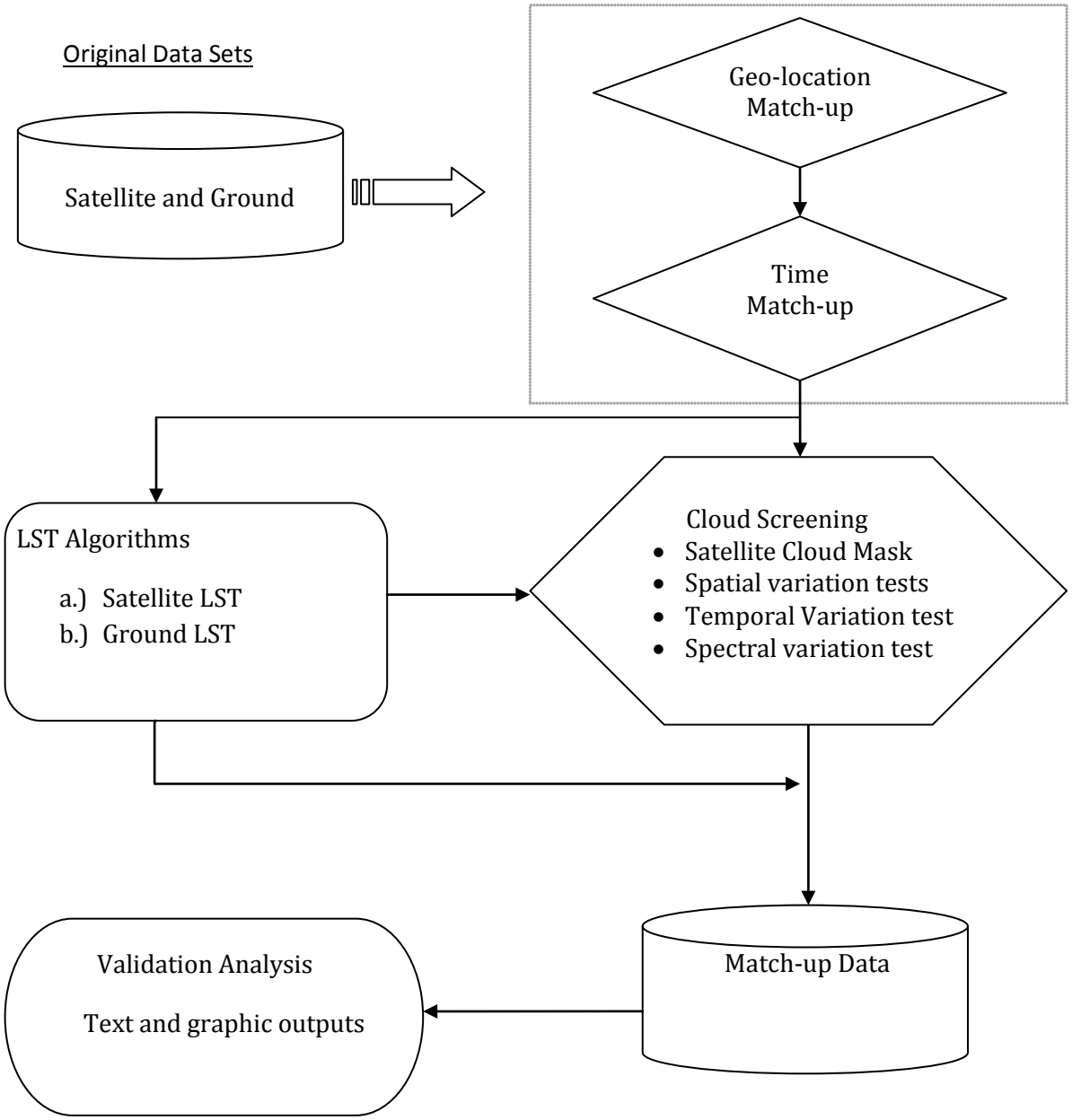
Sample Scatter Plots:


Moist
Dry
Total data pairs: 1767
Bondville_IL (2001) G08
Dry
Mean : 0.11
STD: 1.53
N = 1165
Moist
Mean : −0.18
STD: 1.81
N = 602
SURFRAD LST (K)
GOES LST (K)
250
260
270
280
290
300
310


Night
Day
Total data pairs: 1767
Bondville_IL (2001) G08
Day
Mean : 0.35
STD: 1.90
N = 777
Night
Mean : −0.26
STD: 1.35
N = 990
SURFRAD LST (K)
GOES LST (K)
250
260
270
280
290
300
310

6. Appendix:

A. Data Flows of the Tool Running



B. Validation Tool Version 1 Requirements

GOES-R AWG Leads,

As you may know, the deadline for the first delivery of the offline validation tools is approaching for the Baseline products. The delivery due date is Wednesday, December 15 by COB. I know this guidance is late, so if you need more time to put the validation tool together, please let me know. The AIT will be scheduling meetings in early 2011 with the various teams to go over their validation tools. This is part of the AWG task to develop validation tools that may be delivered to operations.

Requirements for Delivery:

1. The validation tools, including information that is needed to run these tools. The tool to be delivered is the software that was written to do the collocationn as well as the visualization. We do not require the IDL, Matlab, McIDAS-V, etc packages, just the home grown software.
2. As best as possible, documentation as to how to run these tools. We do not expect the software to be cleaned up, commented and/or documented. It is an "as is" delivery.
3. A single test case, including algorithm inputs, outputs and truth dataset outputs. If possible, please include an example output of the validation. For the v1 delivery, utilizing the offline output from your algorithm is acceptable.

NOTE: If you rely on visual inspection (example, Fires), please send instructions of how to perform the visual validation with an example truth dataset and test file to compare to

Instructions for delivery:

Please gather the tools in a single, compressed tarball for delivery. These are the tools that you already use for your offline and online validation. In addition, please include a README documenting what is inside of the tarball.

Due to the large number of expected tools, AIT-MidWest will be assisting AIT-East in gathering the validation tools. We are dividing the Baseline products as follows:

AIT-Midwest - Volcanic Ash, Winds, HIE, Clouds, Soundings, Ozone, Fires, Imagery

AIT-East - Radiation Budget, RainRate, Aerosols, Snow Cover, Land

(except Fires), SST

Note: Aerosol optical depth and RB-SRB have already delivered their tools. In addition a preliminary version of the ACHA and ACM tools have also been delivered. Finally, Rain Rate is due on 2/24/2011 and will follow a similar delivery instructions.

If your team is listed under AIT-Midwest, please contact William Straka III (william.straka@ssec.wisc.edu) and Ray Garcia (rayg@ssec.wisc.edu) with the location of your code. If your team is listed under AIT-East, please contact Xingpin Liu (Xingpin.Liu@noaa.gov) and Shanna Sampson (Shanna.Sampson@noaa.gov). Also, make sure you CC the Product Team Lead when you deliver your code to their appropriate contacts.

If you have any questions, please feel free to contact Walter Wolf, Xingpin, Shanna or William with any questions you may have.

Thank you in advance for your assistance in this effort.

The entire AIT team

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