Routine Validation of the GOES-R Multi-Satellite Processing System Framework

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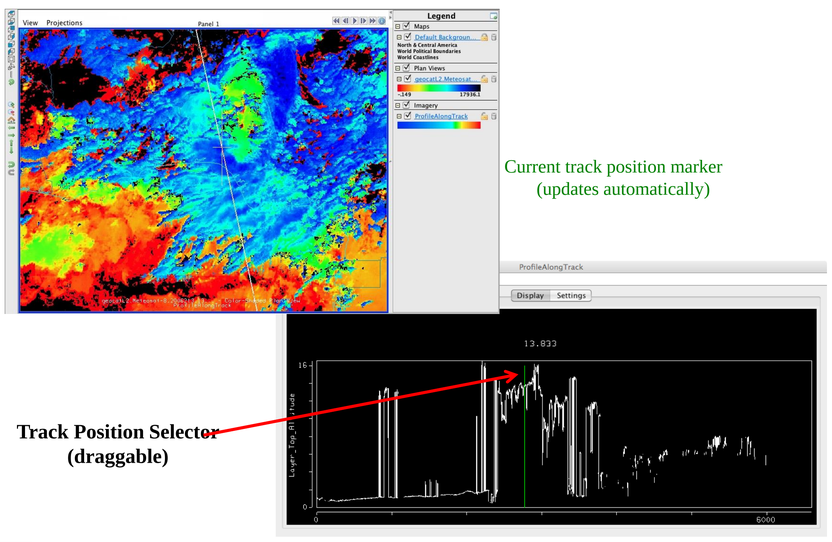
Introduction

The GOES-R Algorithm Working Group (AWG) was tasked to develop and test candidate (Level 2) product algorithms in a scalable, demonstration system, as well as to implement validation and verification tools. In conjunction with NOAA/NESDIS/STAR, the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin has helped develop, verify and validate algorithms in the GOES-R Algorithm Working Group (AWG) Product Processing System Framework. There are a variety of tools that are used for this purpose, including ones that visualize the output of the GOES-R AIT Framework, tools used to compare the output of the integrated algorithm versus test datasets, and validation tools to ensure both the accuracy and precision of the developed algorithms. This poster will discuss each of these tools.

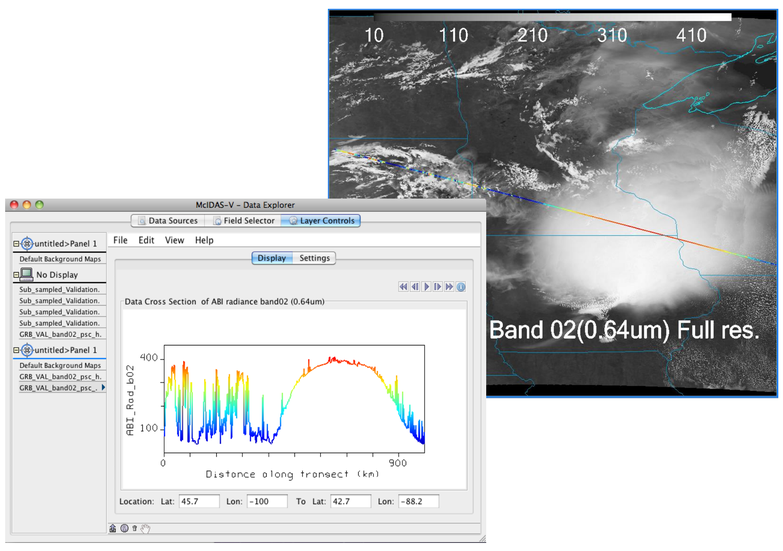
Interactive comparisons of outputs from various products and satellites, such as CALIOP cloud height and the ABI Cloud Height Algorithm can be useful in providing a first approximation of how an algorithm is performing. However, this does not account for any temporal collocation information.

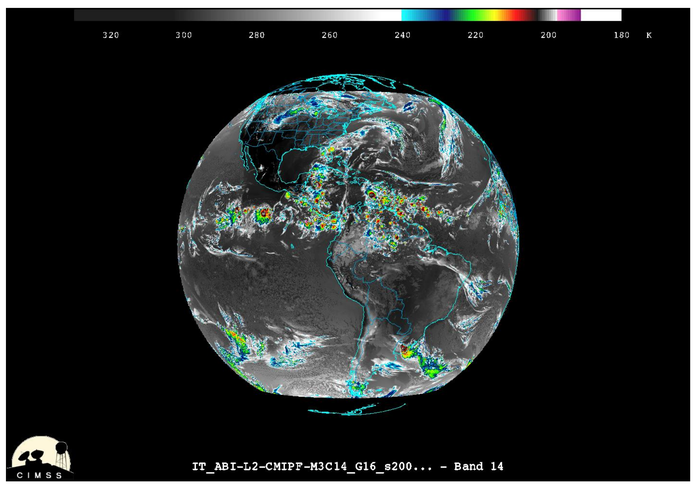


Product Visualization

McIDAS-V, which is an open source, freely available software package (latest release available: http://www.ssec.wisc.edu/mcidas/) can provide users with a quick way of easily display different images in the same projection.

Transects of two images along with some basic statistics can be displayed (right). These are simple statistics, so more in depth tools, such as "Glance" are required.





Example output from the GOES-R Ground System (available on the GOES-R website) can be read in and correctly displayed through easily using McIDAS-V (left). This demonstrates it can display output from the GOES-R Ground System on day 1. In addition, efforts are underway to ensure that McIDAS-V can read in data from the upcoming Himawari-8 satellite, which will be used as a proxy for ABI.

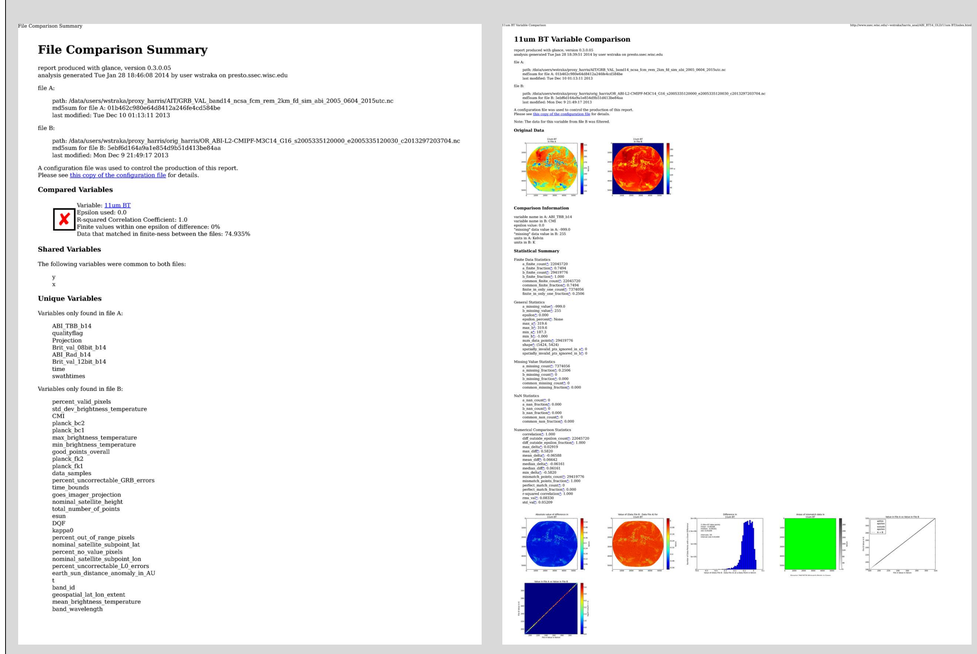
This means the various GOES-R Algorithm Working Groups (AWGs) to ensure that there are no issues with their algorithms prior to and after GOES-R becomes operational by using it to compare output from the GOES-R Multi-Satellite Processing System Framework. In addition, various AWGs can use McIDAS-V as a first order verification of output of their GOES-R algorithms on other sensors such as current GOES and VIIRS.

Product Verification

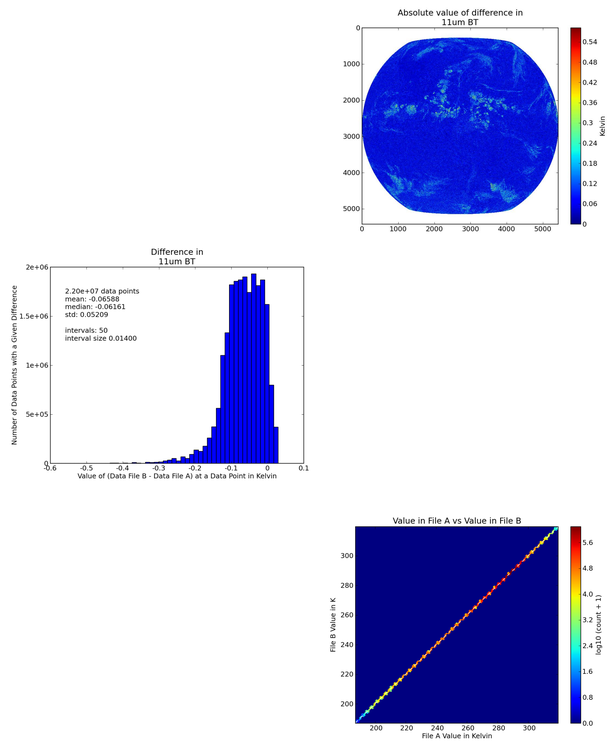
Algorithm developers from the various Algorithm Working Groups often work on algorithm development in in specialized test systems (ex. CLAVR-x and GEOCAT). In order to verify that the algorithms are integrated properly, a tool called "Glance" was developed to compare datasets between several applicable product generation systems, allowing for quick comparisons which ensure that the algorithm was successfully integrated correctly or identify where issues occur. In addition, it can be used to validate the output from the GOES-R GS in a quantitative way.

Glance can compare complex datasets stored in formats including HDF4, HDF5, and NetCDF, and it is readily adapted to other formats. It is a portable python application capable of providing a command-line report generation capability as well as an interactive GUI for exploratory use. It provides a suite of statistical and visual comparisons for earth-mapped product matrices as well as simple arrays, including settable tolerances and criteria as well as user-configurable data filters. It can be used for automatic verification of alternate algorithm implementations, trending and validation of new algorithm candidates, and general visual exploration of product data. An example of a *Glance* summary report and example inset comparison images are shown.

Example *Glance* output



Links can be selected to provide a more detailed report of a given variable, along with the various statistics, such as how many missing pixels were in each file, the correlation between the two datasets, the mean/max/min difference, etc., as well as plots of the area of difference, a histogram of the distribution of the differences and plot of the differences



Each image in the detailed report can be selected to show a larger image. In this case the mapped image of the absolute difference between the two datasets (top), a histogram of the differences (middle) and a density-scatter plot comparing the datasets (bottom) are shown.

Real time collocation and verification

Leveraging decades of experience in collocation and satellite navigation we are developing a near real time system that will provide merged operational GEO and POLAR (GOES-R/JPSS and SEVIRI/JPSS) products including hyperspectral temperature and water vapor retrievals from CrIS, IASI, and AIRS. Specific goals of this project are:

- Implement a centralized validation system for the GOES-R validation efforts
- Provide near real time monitoring and long term statistics of the GOES-R products
- Support the development of merged Polar and GEO (JPSS/GOES-R) products and retrievals
- Leverage over 30 years of SSEC collocation expertise capable of both LEO and GEO collocation and SNO calculations
- Provide a system for GEO/LEO inter-calibration in near real time

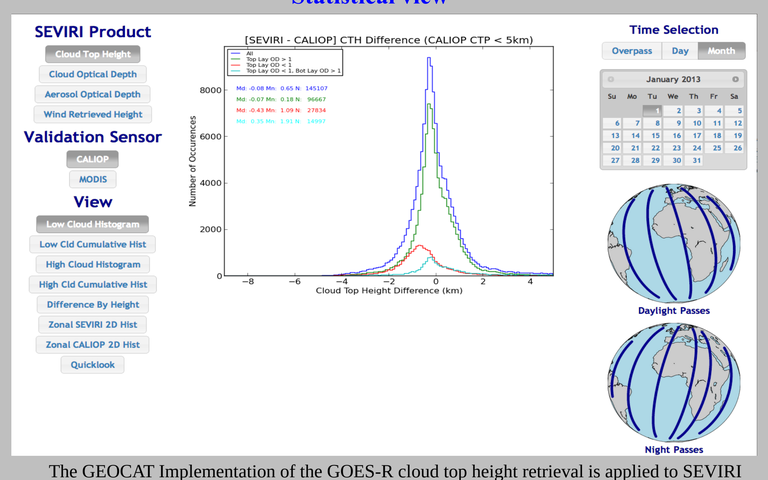
Master8 \ Follower8	AVHRR	CALIOP	CLOUDSAT	GOES	MODIS	POLDER	SEVIRI	VIIRS
AIRS		X	X	X	X		X	
AMSR1E					X			
CLOUDSAT		X			X			X
CrIS		X					X	X
GOES		X			X			
HIRS	X	X						
IASI					X		X	
MODIS		X				X		X
SEVIRI		X			X			X
VIIRS		X						

Collocation routines have been developed for a variety of sensor pairs (see table on left). Each collocation program takes as input two data files corresponding to its "master" and "follower" sensors. For each FOV of the master sensor the algorithm finds all follower pixels that fall within the master FOV's spatial extent.

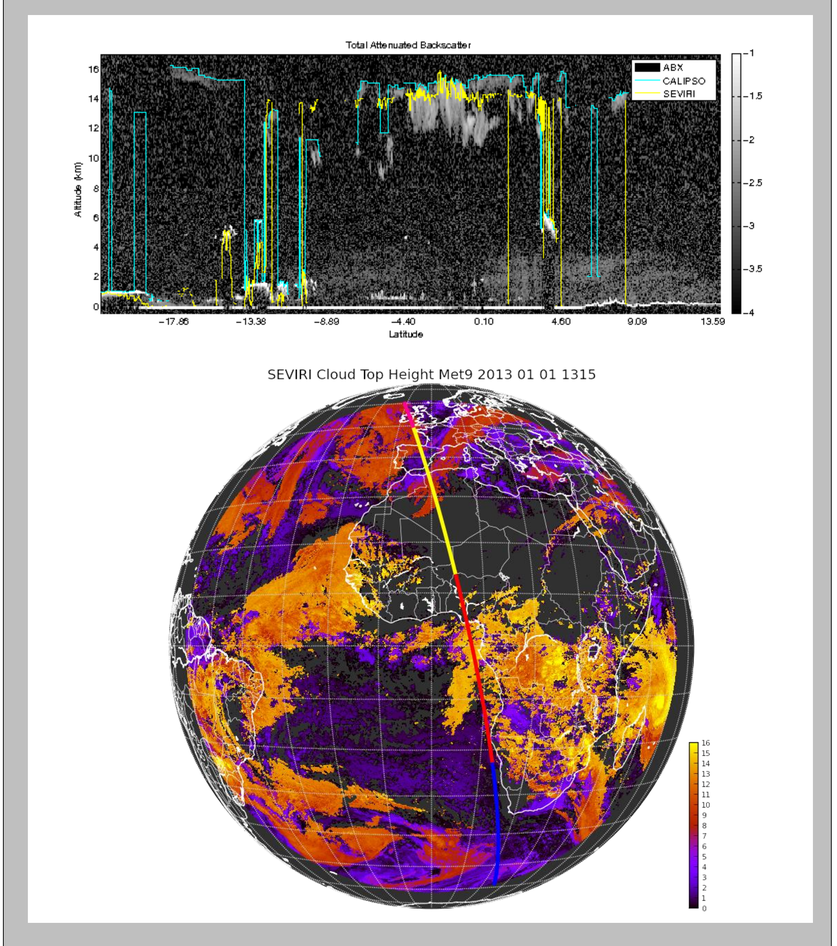
GOES-R Validation Web Interface
http://kepler.ssec.wisc.edu

We are developing a GOES-R validation web interface that will provide both quick look images of comparisons between the GOES-R retrievals and the validation products as well as physically collocated quantitative performance information searchable by day or month averages. We currently have a prototype interface with screen shots of the interface and capabilities presented in this section of this poster.

SEVIRI CTH vs CALIPSO "Statistical view"



The GEOCAT Implementation of the GOES-R cloud top height retrieval is applied to SEVIRI observations. Histograms of cloud top height differences between CALIOP and SEVIRI are presented above for a month of SEVIRI observations. A negative difference occurs if SEVIRI detected the cloud top height under CALIOP. The above figure is for low clouds only, i.e. CALIOP CTH < 5 km.

SEVIRI CTH vs CALIPSO "Granule view"

The CALIOP track (blue, red, yellow, magenta lines) is presented on the SEVIRI/GEOCAT CTH image (bottom) with the corresponding attenuated backscatter curtain file (top), overlay line plots show the collocated CTH from both instruments.