Developing a Product Validation and Merged JPSS/GOES-R System Using Advanced Collocation Methods

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Decades of experience in applying vector algebra and analytic geometry to problems in satellite navigation at the University of Wisconsin's Space Science and Engineering Center has led to development of a variety of techniques for computationally practical collocation. This poster presents our current progress and future goals in support of the GOES -R program. As will be presented the collocation software library being developed provides powerful tools that facilitate AWG validation and algorithm development using multiple instruments on a diverse suite of observational platforms (LEO and GEO). Leveraging the computationally efficient methods, 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:

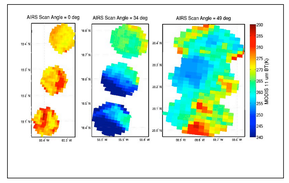
- Develop a maintainable C++ library based on over 30 years of SSEC collocation expertise capable of both LEO and GEO collocation and SNO calculations
- Support the collocation needs of the AWG algorithm teams and develop collocation tools as new instruments become available
- Develop a system for GEO/LEO inter-calibration in near realtime
- Develop merged products facilitating validation and combined use of LEO/GEO retrievals

Developing a Toolkit for Navigation and Collocation

Master \ Follower	AVHRR	CALIOP	CLOUDSAT	GOES	MODIS	POLDER	SEVIRI	VIIRS
AIRS		X		X	X		X	
AMSR-E					X			
CLOUDSAT		X						X
CrIS		X					X	X
GOES					X			
HIRS	X	X						
IASI					X		X	
MODIS		X						
SEVIRI		X						
VIIRS		X						

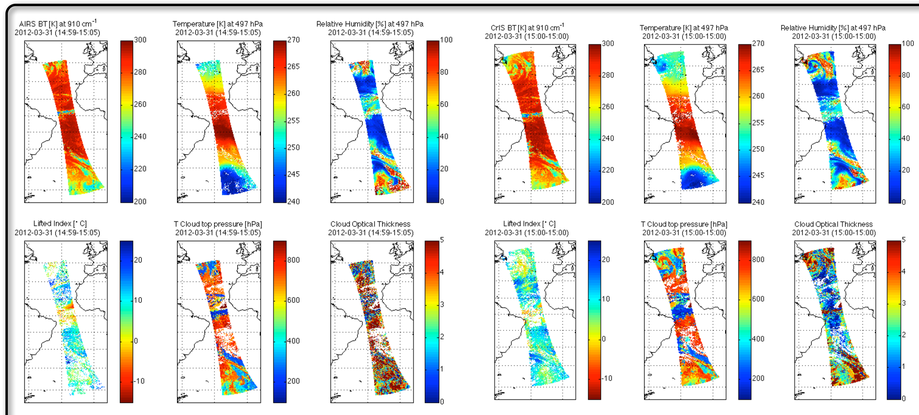
Collocation routines have been developed for a variety of sensor pairs (see table on left). Each collocation program takes as input two data files corresponding to its "master" and "slave" sensors. For each FOV of the master sensor the algorithm finds all slave pixels that fall within the master FOV's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

All sensor combinations indicated in the table have collocation implementations in Fortran 77 which are currently being ported into a C++ based toolkit with emphasis on ease-of-use and extensibility to new sensor combinations. The AIRS-MODIS, CrIS-VIIRS, HIRS-AVHRR, and MODIS-CALIOP combinations have been implemented within this new framework.



MODIS Collocated within AIRS FOV for three different scan angles.

Hyper-Spectral Atmospheric Profile Retrievals Applied to JPSS (CrIS) and EOS (AIRS) and Integrated with GOES-R

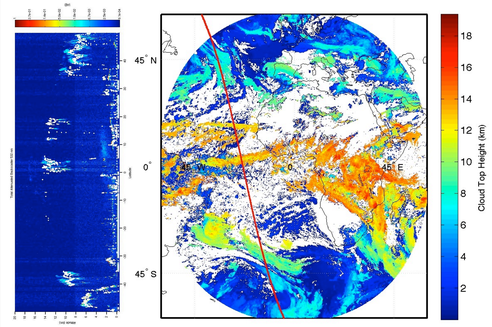


The UW dual regression retrieval is applied to both CrIS and AIRS observations at 15:15 UTC on March 31st. The collocation tools provide rapid integration of the GEO (GOES-R) and LEO (Hyperspectral) data allowing for near real time combined Polar and GEO algorithms. We are developing this system has part of the collocation project.

AWG Retrieval Validation and Near Real Time GOES-R/JPSS/EOS Merged Products

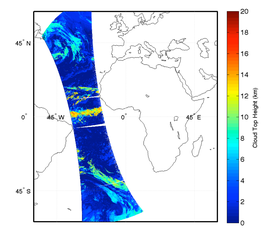
We are developing merged products that will include collocated POLAR and GEO Level 1B and Level 2 products in a single file. These products will provide AWG teams with rapid access to both validate GOES-R algorithms using LEO passive and active (ie AIRS,CALIOP, MODIS) atmospheric retrievals and develop combined retrievals leveraging POLAR observations. We present examples applying the collocation tools to evaluate the GOES-R proxy cloud products using SEVIRI and GEOCAT with a focus on AWG evaluation of cloud products. The VIIRS products are still preliminary and where obtained from the UW Atmospheric PEATE and generated from IDPS.

SEVIRI AWG Evaluation of Cloud Top Height

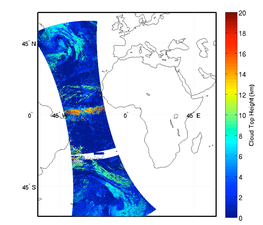


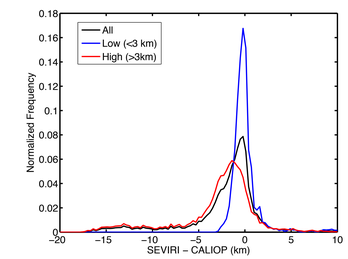
The GEOCAT Implementation of the GOES-R cloud top height retrieval is applied to SEVIRI observations (March 31st 1st 2012 at 15:15 UTC). Using the collocation tools, CALIOP, MODIS,AIRS, and CrIS are spatially matched to the individual SEVIRI FOVs. The CALIOP track (red) is presented on the image with the corresponding attenuated backscatter profile and collocated SEVIRI CTH (white dots) presented to the left of the SEVIRI image.

MODIS CTH



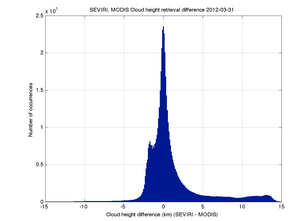
VIIRS CTH



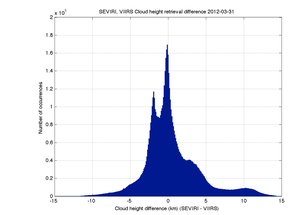


Histograms of cloud top height differences between CALIOP and SEVIRI are presented above for a day of SEVIRI observations. A negative difference occurs if SEVIRI detected the cloud top height under CALIOP. The distributions are separated by high (>3 km) and low (<3 km) clouds.

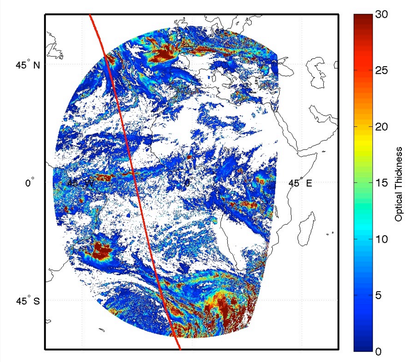
SEVIRI-MODIS



SEVIRI-VIIRS

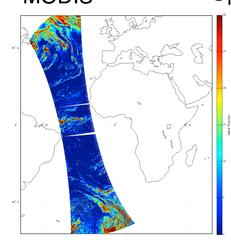


SEVIRI Cloud OD and Effective Radius Evaluation

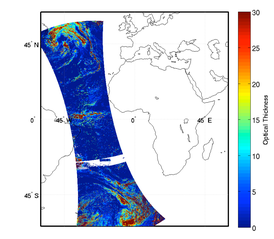


The GEOCAT Implementation of the GOES-R cloud optical depth retrieval is applied to SEVIRI observations (March 31st 1st 2012 at 15:15 UTC).

MODIS

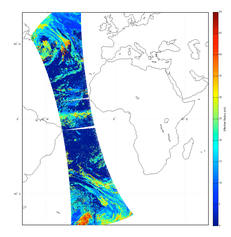


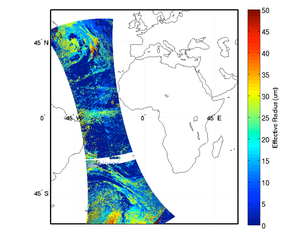
Optical



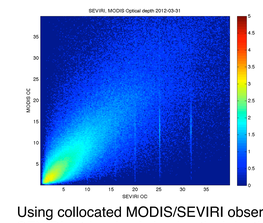
VIIRS

Effective Radius

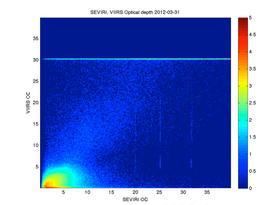




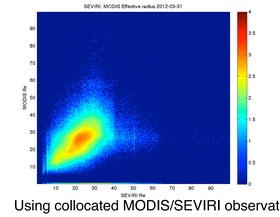
SEVIRI-MODIS

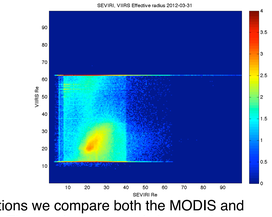


SEVIRI-VIIRS



Using collocated MODIS/SEVIRI observations we compare both the MODIS and SEVIRI retrievals of cloud optical depth and effective radius. The results are for cases when both the SEVIRI and the Polar retrievals detected ice.





Using collocated MODIS/SEVIRI observations we compare both the MODIS and SEVIRI retrievals of cloud effective radius The results are for only ice clouds