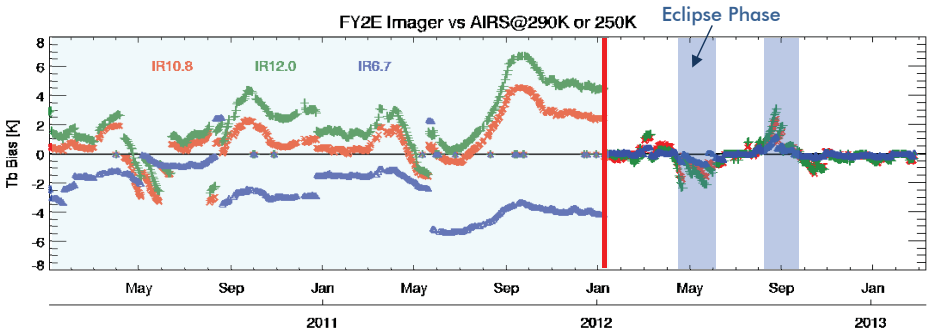
Application of GSICS Methodologies and Products

GSICS corrections and methodologies have played a key role in correcting radiances measured by GEO and LEO instruments.

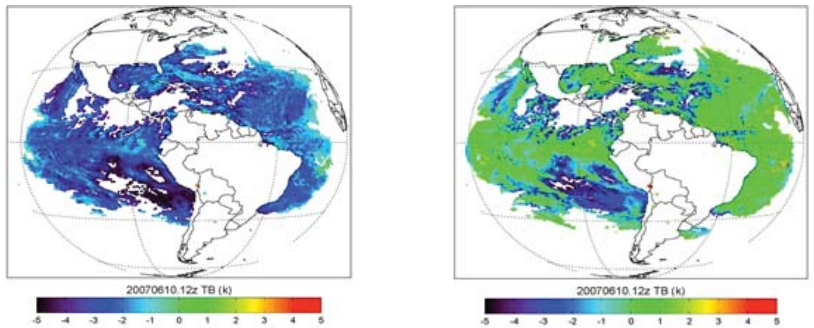
Example 1: GSICS methodologies played a key role in correcting FY2 biases



Operational calibration of FY-2E was upgraded using GSICS inter-calibration algorithm in 04/2012 and 01/2012 separately. Calibration biases are sharply reduced to about 0.5K-1K @290K.

Example 2: GSICS GOES-12 versus IASI correction removed GOES-12 bias

Before applying GSICS correction | **After applying GSICS correction**



The figures above show the difference between observed and calculated for GOES -12 13.3 Micron brightness temperatures (from NCEP analysis) before and after applying GSICS correction. Bias is reduced from 3°K to close to 0°K.

Find more information at the GSICS website at WMO: http://gsics.wmo.int

or, contact:

Manik Bali Manik.Bali@noaa.gov or

Tim Hewison Tim.Hewison@eumet.int

Layout & design for GCC by Lori K. Brown

Future Products

- Cross-calibration products for new CrIS and IASI-B sensors are being developed.
- A new product based on double differencing to transfer betweeen different references is being developed.
- The VIS group is developing a product that would use Deep Convective Clouds as a reference.

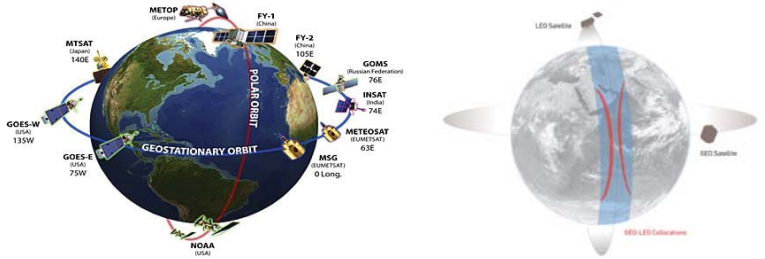
Global Space-based Inter-Calibration System Products

A WMO and CGMS Initiative

GSICS is an international collaborative effort initiated in 2005 by WMO and the CGMS to monitor, improve and harmonize the quality of observations from operational weather and environmental satellites of the Global Observing System (GOS).

This is achieved through a comprehensive calibration strategy which involves:

- Monitoring instrument performances.
- Operational inter-calibration of satellite instruments.
- Tying the measurements to absolute references and standards and recalibration of archived data.
- GSICS delivers calibration products corrections needed for accurately integrating data from multiple observing systems into products, applications and services.



The left image shows the set of operational Geostationary (GEO) and Low Earth Orbit (LEO) Polar, Earth Observation instruments operated by GSICS members for which cross comparison products are being made. The right image shows the overlapping tracks of two satellites (GEO and LEO). Pixels of the overlapped region are used for inter-comparison.

Basic Principle and Methodology

GSICS products are comparisons of radiances measured between a monitored and a reference instrument. GSICS systematically generates inter-calibration products for Level 1 data from satellite sensors to compare, monitor and correct the calibration of monitored instruments to community references by generating calibration corrections with specified uncertainties through well-documented, peer-reviewed procedures based on various techniques to ensure consistent and robust results. For example, the current GEO/LEO comparison method has three main steps.

Step 1.
Identification of collocated pixels that satisfy GSICS selection criteria

Geographical locations that are observed by the reference and the monitored instrument at close to the same time under similar viewing conditions are identified.

Step 2.
Selection of pixels for intercomparison

Overlapping pixels from Step 1 need to satisfy GSICS selection criterion prior to proceeding the next step of Convolution and Comparison.

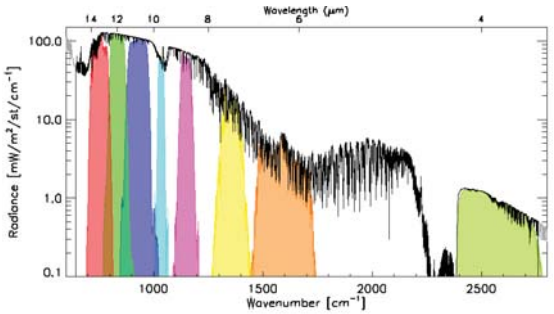
GSICS collocated pixel selection criterion

Time difference of observations ..... < 5 Min
Atmospheric path difference
Δsec (satellite zenith angle) ..... < 0.01
ΔLat ..... < 35°
ΔLon ..... < 35°

Spatial Averaging

Average GEO pixels in each LEO FoV

- Estimated uncertainty
- Due to spatial variability
- Use in weighted regression



Example radiance spectra measured by IASI (black) and modeled by LBLRTM (grey), convolved with the Spectral Response Functions of SEVIRI channels 3-11 from right to left (colored areas).

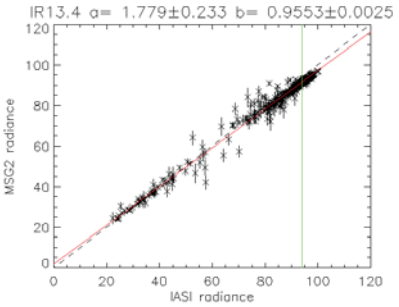


Figure above shows comparison of reference and monitored instrument from which regression coefficients are computed.

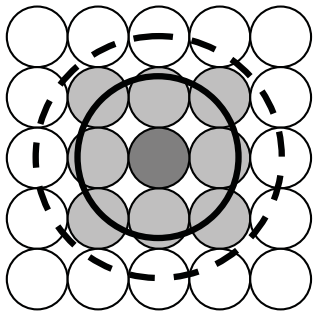


Illustration of spatial transformation. Small circles represent the GEO FoVs and the two large circles represent the LEO FoV for the extreme cases of FY2-IASI, where n x m=3x3 and SEVIRI-IASI, where n x m=5x5

Step 3.
Convolution and Comparison

Once collocated pixels are found, Radiances of the (reference) hyperspectral instrument are convolved with the monitored instrument Spectral Response Function to provide radiances representative of the reference instrument. These representative radiances are compared with the monitored instrument's measurements.

Regression coefficients computed from their comparison sample (approx. 1000 per day) are the main component in the GSICS product. The product also has uncertainty estimates of computed coefficients and instrument information.

$$L_i = \frac{\int_{\nu_1}^{\nu_2} R(\nu) S_i(\nu) d\nu}{\int_{\nu_1}^{\nu_2} S_i(\nu) d\nu}$$

R is the hyperspectral radiance
S is the spectral response function
L is the IASI convolved radiance
V is the wavenumber

GSICS Procedures for Product Acceptance

GSICS applies a stringent review process before accepting cross-comparisons as products and distributing them via its website. The GSICS Procedure for Product Acceptance (GPPA) assigns a maturity level to the cross calibration product. Products that follow GSICS guidelines of metadata file naming and have been reviewed by experts and users of the product are assigned high maturity. Once accepted, GPPA then assigns maturity of Demonstration, Pre-Operational or Operational to the product.

GSICS has 37 cross-comparison products spanning VIS and IR wavelengths.

Correction coefficients for Meteosat, GOES, JAMI and IM onboard MTSAT, and TIROS/AVHRR are available and those for FY-2 and COMS are under development.

Finished products are ready to download from the GSICS Product Catalog hosted at NOAA via the GSICS website.

Each member agency also maintains a GSICS Product Research Center (GPRC) where products are monitored in near real time.

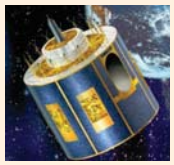
Currently Available GSICS Products

Agency	Monitored Instrument	Reference Instrument	GSICS Maturity Level
EUMETSAT	SEVIRI/Meteosat {7/8/9/10}	IASI	Pre-operational Demonstration
JMA	JAMI/MTSAT-1R Imager/MTSAT-2	IASI (+ AIRS)	Demonstration
NOAA	Imager/GOES-13/15	IASI (+ AIRS)	Pre-operational
	Imager/GOES-11/12		Demonstration
	TIROS/NOAA AVHRR 6-11	MODIS	Demonstration
CMA	FY2C FY2D FY2E	IASI (+ AIRS)	In development
KMA	COMS	IASI (+ AIRS)	In development

GSICS products are generated in accordance with the GSICS principles and practices. They are public and distributed via the product catalog:

http://www.star.nesdis.noaa.gov/smcd/GCC/ProductCatalog.php

GSICS Family of Monitored Instruments


SEVIRI


JAMI / IM

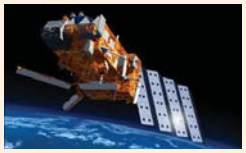

GOES


AVHRR

GSICS Reference Instruments


AIRS


MODIS


IASI