



Introducing GSICS

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(2)WMO – Secretariat of GSICS Executive Panel

Global Space-based Inter-Calibration System

- **What is GSICS?**

- Global Space-based Inter-Calibration System
- Effort to produce consistent, well-calibrated data from the international constellation of Earth Observing satellites

- **What are the basic strategies of GSICS?**

- Improve on-orbit calibration by developing an integrated inter-comparison system
 - Initially for GEO-LEO Inter-satellite calibration
 - Being extended to LEO-LEO
 - Using external references as necessary
- Best practices for prelaunch characterisation (with CEOS WGCV)

- **This will allow us to:**

- Analyze root causes of biases, improve understanding of instrument absolute calibration
- Improve consistency between instruments
- Reduce bias in Level 1 and 2 products
- Provide traceability of measurements
- Retrospectively re-calibrate archive data
- Better specify future instruments



EUMETSAT



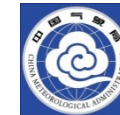
CNES



JMA



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ISRO



NASA



WMO



USGS



NIST



JAXA



ROSHYDROMET



IMD



ESA

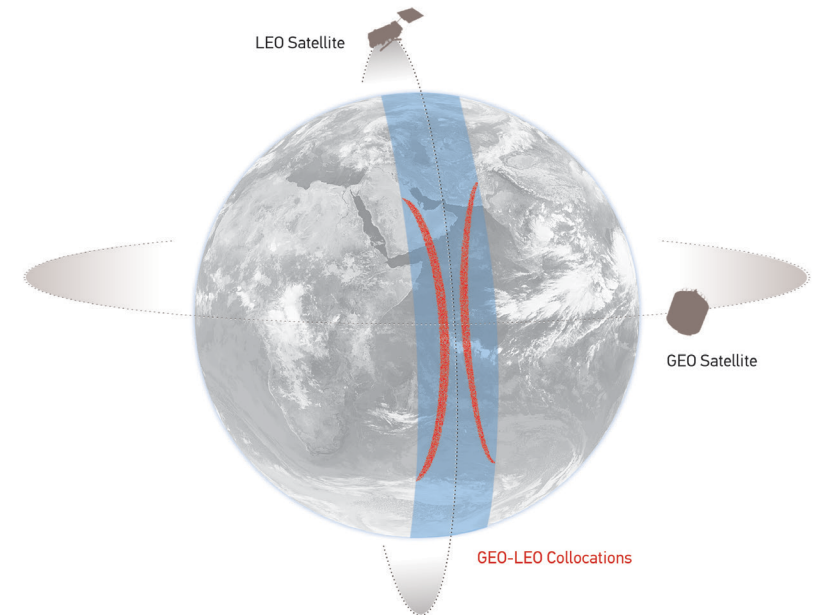
Interoperability

- Goal is to ensure consistency of measurement data sets acquired from different sources, and/or at different times
- Different issues
 - Sampling (time, space, pointing direction, orbit..)
 - Measurement specification (spectral band, energy level,..)
 - Sensor geometry
 - Spectral characteristics (SRF)
 - Radiometric calibration

Comparison of Collocated Radiances

Simultaneous near-Nadir Overpass of GEO imager and LEO sounder

- Collocation Criteria:
- $\Delta\text{Lat} < 35^\circ$ $\Delta\text{Lon} < 35^\circ$
- $\Delta t < 5$ mins
- $\Delta\text{sec}\theta < 0.01$
(Atmospheric path diff.)
- Concentrated in tropics
- ~ 1000 collocations/orbit
- ~ 1 orbit/night

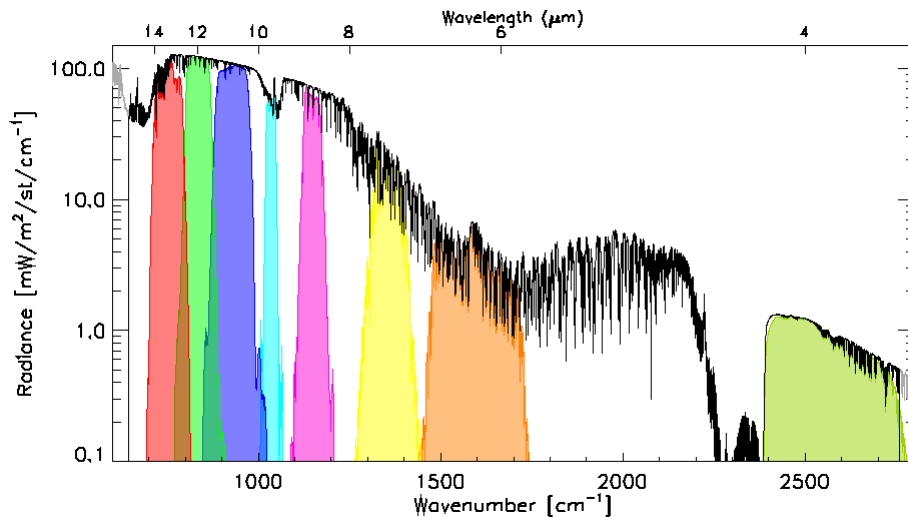


Schematic illustration of the geostationary orbit (GEO) and polar low Earth orbit (LEO) satellites and distribution of their collocated observations.

Data Transformations (Spectral and Spatial)

•Spectral Convolution:

- Convolve LEO Radiance Spectra with GEO Spectral Response Functions
- to synthesise radiance in GEO channels

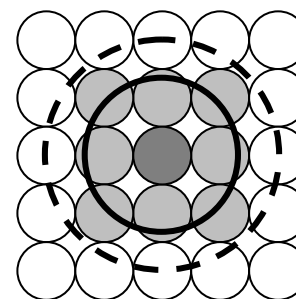


Example radiance spectra measured by IASI (black) and modeled by LBLRTM (grey), convolved with the Spectral Response Functions of SEVIRI channels 3-11 from right to left (colored shaded areas).

n.b. The IASI observations ($645 - 2760 \text{ cm}^{-1}$) do not quite cover the full spectrum observed by SEVIRI.

•Spatial Averaging:

- Average GEO pixels in each LEO FoV
- Estimate uncertainty
 - due to spatial variability
 - as Standard Deviation of GEO pixels
- Use in weighted regression



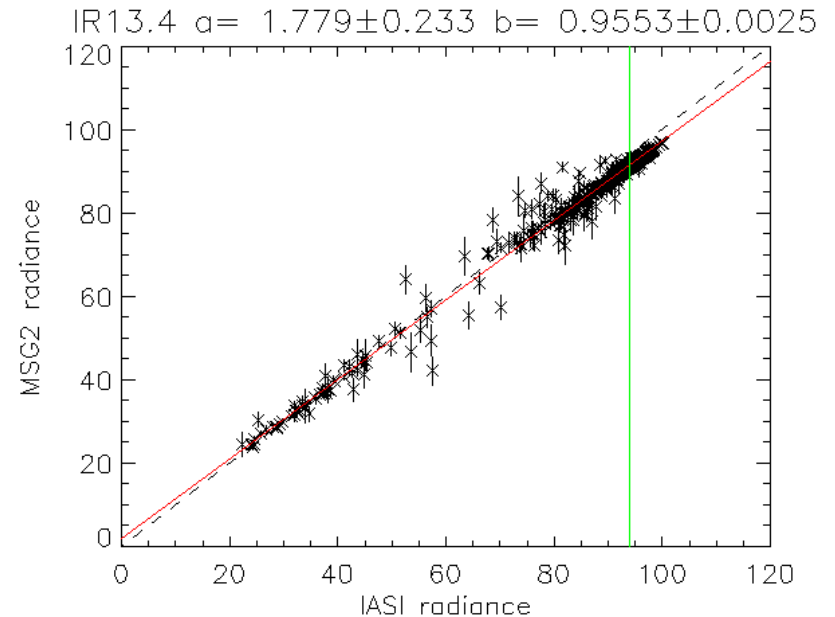
LEO FoV $\sim 10\text{km}$

$\sim 3 \times 3$ GEO pixels

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 $n \times m = 3 \times 3$ and SEVIRI-IASI, where $n \times m = 5 \times 5$.

Comparison by Regression

- Compare collocated obs:
- GEO radiance
 - Spatially averaged
- Regressed against
- LEO radiance spectra,
 - convolved with GEO SRF
- Using Variance of GEO radiances + Noise
 - to estimate uncertainty on each collocation



Weighted linear regression of $L_{GEO|REF}$ and $\langle L_{GEO} \rangle$ for Meteosat-9 13.4 μ m channel based on single overpass of IASI

Where to get the data?

- **GSICS Bias Monitoring (prototype)**

- Hosted on websites of GSICS Processing & Research Centres (GPRCs)

- **GSICS Corrections**

- GSICS Data & Products Servers
- THREDDS-based system
- NetCDF format
- WMO GTS standard file names
- Unidata & CF conventions

- See gsics.wmo.int for links

- **Recommendations for:**

- Instrument performance monitoring
- Event log

GTS = Global Telecommunication System
CF = Climate and Forecast



An international collaboration to monitor, improve and harmonize data quality from operational environmental satellites for climate monitoring and weather forecasting.

GSICS Portal

Provided by WMO Space Programme

- Home
- Objectives
- Membership
- Structure
- Contacts
- Meeting Reports
- GSICS Glossary

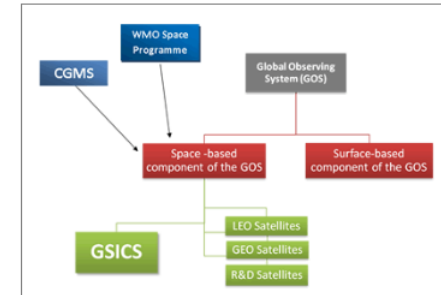
GSICS Home

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).

GSICS aims at ensuring consistent accuracy among space-based observations worldwide for climate monitoring, weather forecasting, and environmental applications.

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 corrections needed for accurately integrating data from multiple observing



Product, Services and Technical Information

Central Resources

GSICS Coordination Centre

GSICS WIKI

Datasever EUMETSAT

Datasever NOAA

GSICS Processing and Research Centres (GPRCs)

GPRC NOAA/NESDIS

GPRC CMA/NSMC

GPRC EUMETSAT

GPRC JMA

The image shows two overlapping browser windows. The background window is titled 'Catalog /thredds/catalog.html' and displays a directory listing of datasets. The foreground window is titled 'OPeNDAP Dataset Query Form' and shows a form for accessing data. The form includes fields for 'Data URL' and 'Global Attributes', and buttons for 'Action' (Get ASCII, Get Binary, Show Help).

Dataset	Size	Last Modified
GSICS Source Data		
EUMETSAT/		
CNES/		
JMA/		
GSICS Intermediate Data		
EUMETSAT/		
JMA/		
GSICS Products		
EUMETSAT/		
JMA/		

OPeNDAP Dataset Access Form

Tested on Netscape 4.61 and Internet Explorer 5.00.

Action:

Data URL:

Global Attributes:

Conventions: "CF-1.4"
Metadata_Conventions: "Unidata Dataset Discovery v1.0"
title: "MSG15 channel data in NetCDF."
summary: "MSG15 channel pixel counts with calibration coefficients and geo-location values."

Variables: ch4: Array of 16 bit Integers [yc = 0..2344][xc = 0..2355]

yc: xc:

standard name: "satellite geo meteosat ir 3.9 pixel count"

First GSICS Guideline document

Best Practice Guidelines for Pre-Launch Characterization and Calibration of Instruments for Passive Optical Remote Sensing

Report to GSICS Executive Panel

R.U. Datla, J.P. Rice, K. Lykke and
B.C. Johnson (NIST)

J.J. Butler and X. Xiong (NASA)

September 2009

NISTIR 7637

Best Practice Guidelines for Pre-Launch Characterization and Calibration of Instruments for Passive Optical Remote Sensing

(Report to Global Space-based Inter-Calibration System (GSICS)
Executive Panel, NOAA/NESDIS, World Weather Building,
Camp Springs, Maryland 20746)

R. U. Datla, J. P. Rice, K. Lykke and B. C. Johnson
NIST Optical technology Division

J.J. Butler and X. Xiong
NASA Goddard Space Flight Center

September 2009



U.S. DEPARTMENT OF COMMERCE
Gary Locke, Secretary

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
Patrick D. Gallagher, Director

Special Issue on Satellite Inter-Calibration

- IEEE Transactions on Geoscience and Remote Sensing
- On inter-calibration of satellite instruments
- 5 Guest GSICS/IVOS Editors
- 40 papers – incl. 13 Open Access
 - From CAS, CMA, CNES, ESA, EUMETSAT, ISRO, JAXA, KMA, JMA, MIT, NASA, NOAA, SDSU, USGS, etc.
 - Covering AVHRR, AMSU, (A)ATSR, CLARREO, ETM+, FY-2 & -3B, GOES, HIRS, Hyperion, IASI, Jason-2/OSTM, MODIS, PROBA, SCAIMACHY, Sentinel-2, etc.
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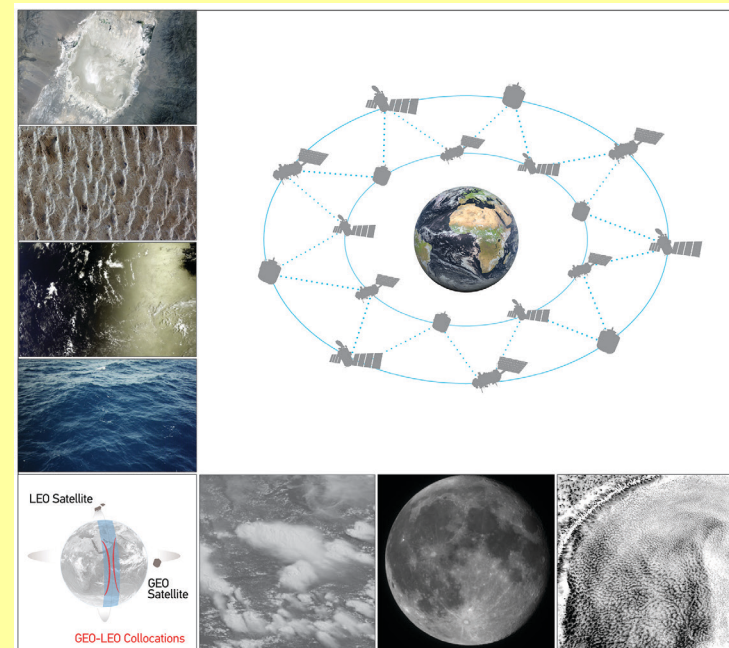
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PART I OF TWO PARTS

SPECIAL ISSUE ON INTERCALIBRATION OF SATELLITE INSTRUMENTS



(Top and bottom corner) Symbolic global network of Earth observing satellites connected by intercalibration and schematic illustration of the GEO and polar LEO satellites and distribution of their collocated observations. (Left column and bottom row) Examples of natural targets used as calibration references.