GSICS products and their Applications

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2014 CICS-MD Science Meeting

November 12, 2014

With Contributions from Tim Hewison (EUMETSAT), Xiuqing Hu Scott (CMA) , Minjin Choi (KMA) and Likun Wang (NOAA)

Outline

- Introduction
- GSICS Principals and Method
- GSICS Products
- Applications of GSICS Inter-Calibration Products
- GSICS Coordination Center
  - *GSICS Quarterly*
  - *GCC's and CICS connection*
  - *Opportunities at GSICS*
  - *Product promotion*
- *Conclusion*

GSICS Introduction

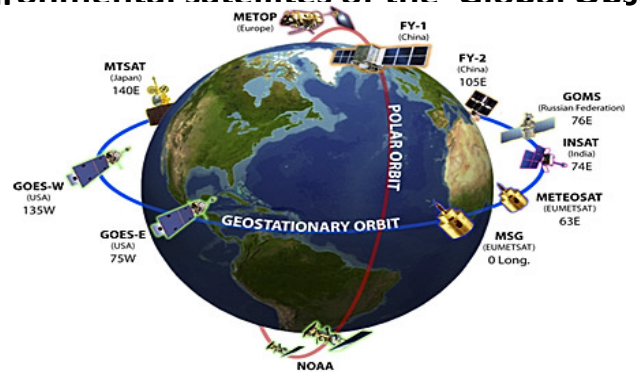
Satellite instruments are often unable to retain their stability and accuracy post launch (Ex. NOAA/AVHRR, AATSR ….)

Satellite measurements of TOA are used to produce key environmental variables

***There is a critical need to monitor the stability and accuracy of in-orbit instruments by comparing them with stable and accurate references*.**

GSICS Introduction

Global Space Based Inter-calibration System (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.**

- **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.**

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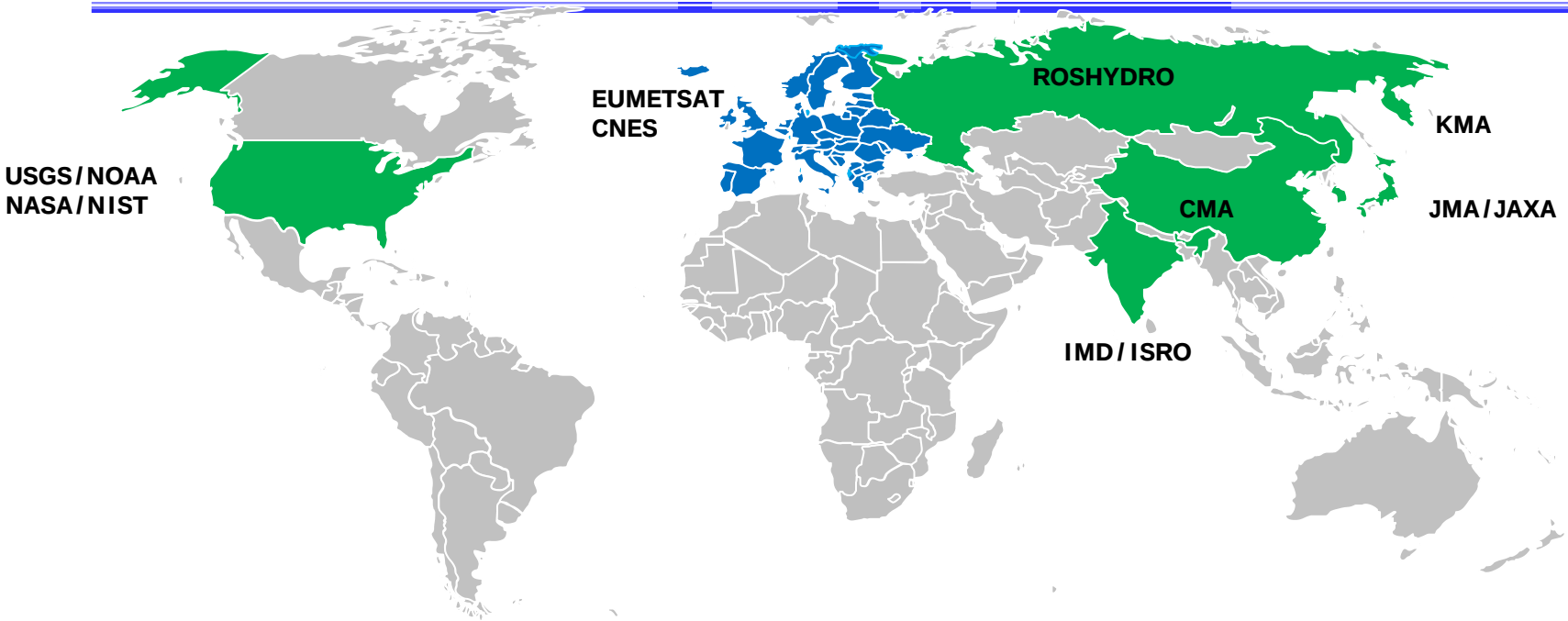


Obs. ESA + CEOS
ASSO. GPM X-CAL

GSICS Global Space-based Inter-Calibration System

GSICS Introduction

GSICS Principals

- Systematic **generation of** 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 on a routine operational basis**
  - **with specified uncertainties**
  - **through well-documented, peer-reviewed procedures**
  - **based on various techniques to ensure consistent and robust results**
- **Delivery to users**
  - **Free and open access**
  - **Adopting community standards**
- **To promote**
  - **Greater understanding of instruments' absolute calibration, by analysing the root causes of biases**
  - **More accurate and more globally consistent retrieved L2 products**
  - **Inter-operability for more accurate environmental, climate and weather forecasting products**

TRACEABILITY / UNBROKEN CHAINS OF COMPARISONS

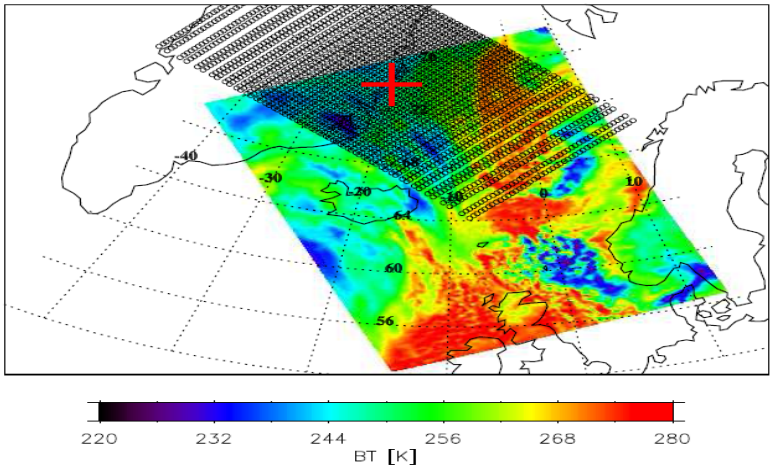
Courtesy Tim Hewison EUMETSAT

GSICS Global Space-based Inter-Calibration System

GSICS Comparison Method

Simultaneous Nadir Overpass

Step 1. Identification of Collocated Pixels that satisfy GSICS selection criterion.



Step 2. Selection of pixels for inter- comparison

.....Selection Criterion.....

GSICS collocated pixel selection criterion

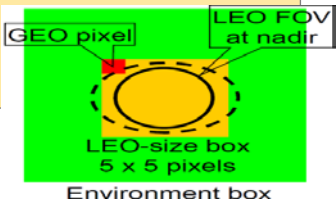
Time difference of observations < 5 Min

Atmospheric path diff Δsec(sat. zenith angle) < 0.01

Uniformity Constraint

STD (GEO pixels within LEO FOV) < 0.01 K (yellow in figure below).

STD (GEO pixels around the LEO pixel) < 1 K (Green in figure below). One reference (say IASI) instrument footprint is compare with the averaged value of the GOES pixels falling into that IASI footprint (see below).

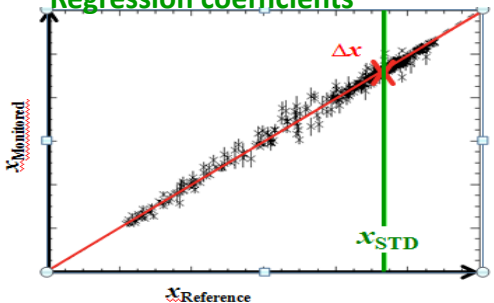


Step 3. Convolution and Comparison

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

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

GSICS Product Regression coefficients



Final Result

Correction Formula To be applied on Monitored Instrument

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GSICS Products

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

Future Products

Cross calibration products with new sensors CrIS and IASI-B being developed.

A new product based on double differencing to transfer between different references is being developed

VIS group developing products that would use Deep Convective Cloud as a reference.

Products span VIS and IR bands

[Product Catalog]

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Product Monitoring at NOAA

NOAA GPRC

A GSICS Processing and Research Center

GSICS Global Space-based Inter-Calibration System

Jump

GPRC

Log In or Register

NOAA GPRC Home
- Mission
- Organization
- Contact us

Products
- GEO vs LEO
- LEO vs LEO
- GEO vs GEO
- Satellite vs Model

Documents
- ATBDs
- Tools
- FAQ
- Publications

Links
- WMO GSICS
- GCC
- Development Wiki
- Other GPRC's
- Instrument Performance Monitoring(IPM)

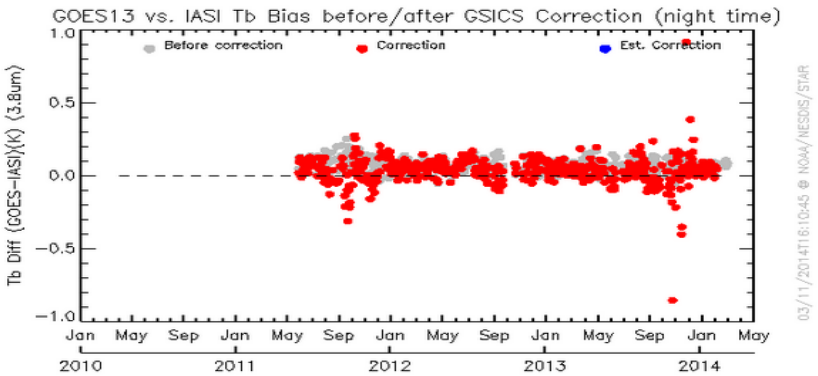
You are here: GSICS Wiki > GPRC Web > GeoLeo > GeoLeo13ImageIasi > GeoLeo13ImageIasiBias (11 Mar 2014, FangfangYu)

GOES-13 Imager vs. Metop-A IASI

Standard scene temperature for GOES-13 Imager is defined as [285.7K, 244.8K, 284.0K, 266.8K] for the four IR channels. In addition to the Tb bias at the standard scene temperature, daily mean Tb bias at the homogeneous scenes are also monitored and plotted.

Bias Monitoring

TB Corr validate Ch2 (3.9μm)



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Application of Cross Calibration Products

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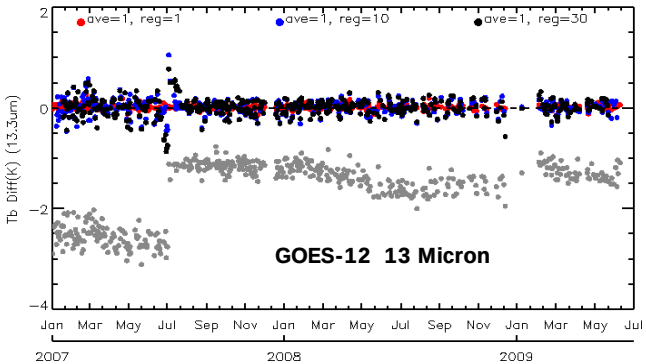
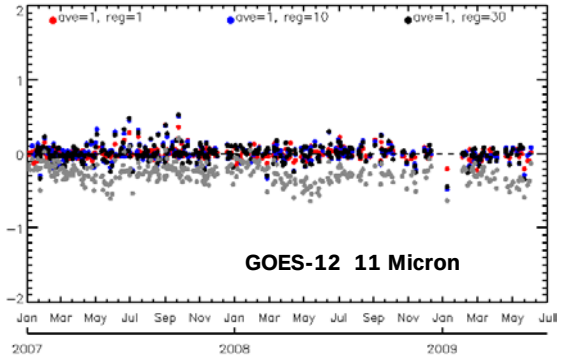
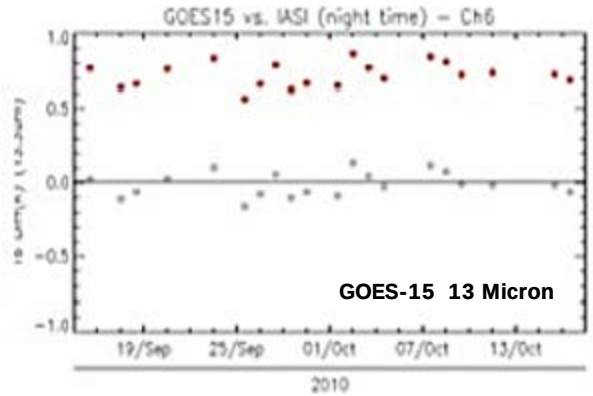
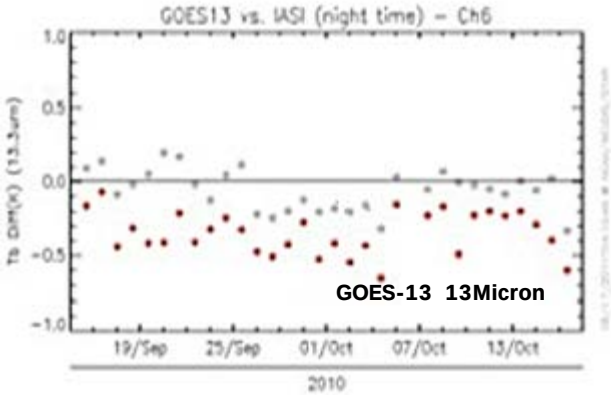
1 GSICS GOES Products









Cross Calibration can correct temporal biases

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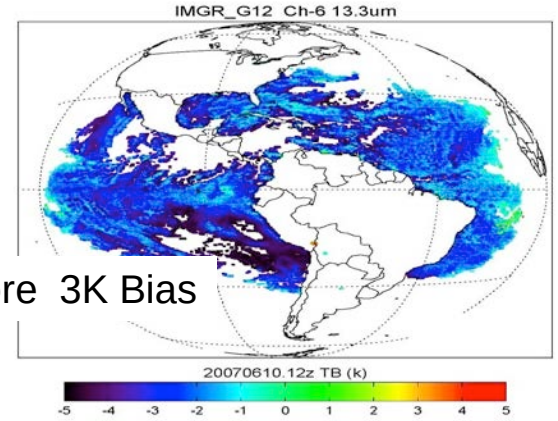
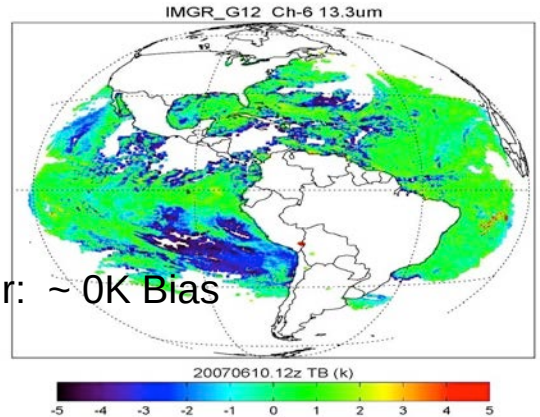
2 GSICS Correction Algorithm for Geostationary Infrared Imagers



Before 3K Bias



After: ~ 0K Bias

12 N

The first major deliverable to the user community is the GSICS correction algorithm for geostationary satellites.

The user applies the correction to the original data using GSICS provided software and coefficients.

The correction adjusts the GOES data to be consistent with IASI and AIRS.

The figures to the left show the difference between observed and calculated brightness temperatures (from NCEP analysis) before and after correction

The bias is reduced from 3 K to nearly zero.

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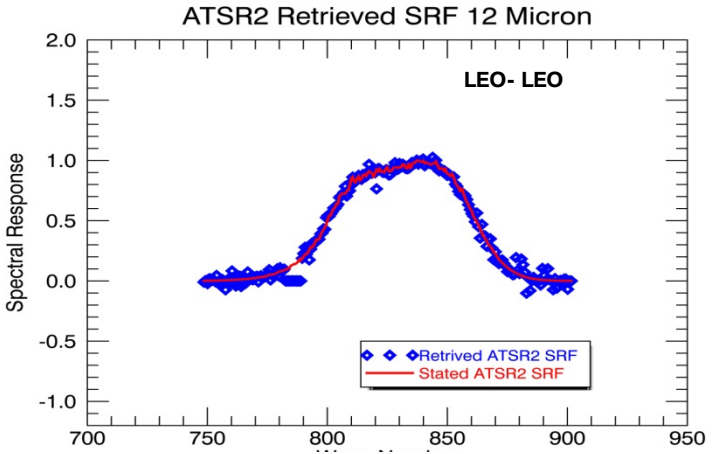
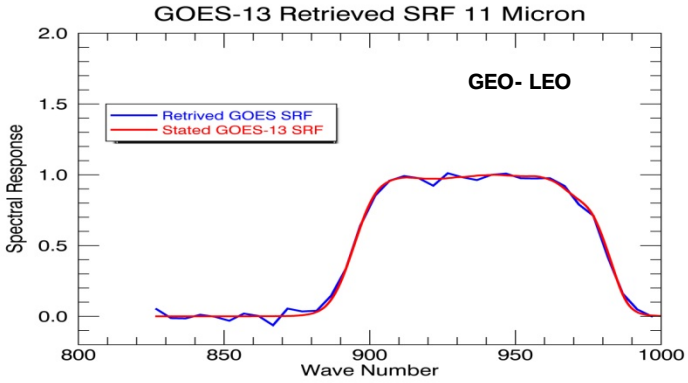
3 Validation of In-orbit status of Spectral Response Function

Rep Rad = $\dfrac{\sum RADVAL * SRFVAL}{\sum SRVAL}$

$$\begin{bmatrix} a_{1,1} & \cdots & a_{1,n} \\ \vdots & \ddots & \vdots \\ a_{n,1} & \cdots & a_{n,n} \end{bmatrix} \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix}$$

SRF = A^{-1} B





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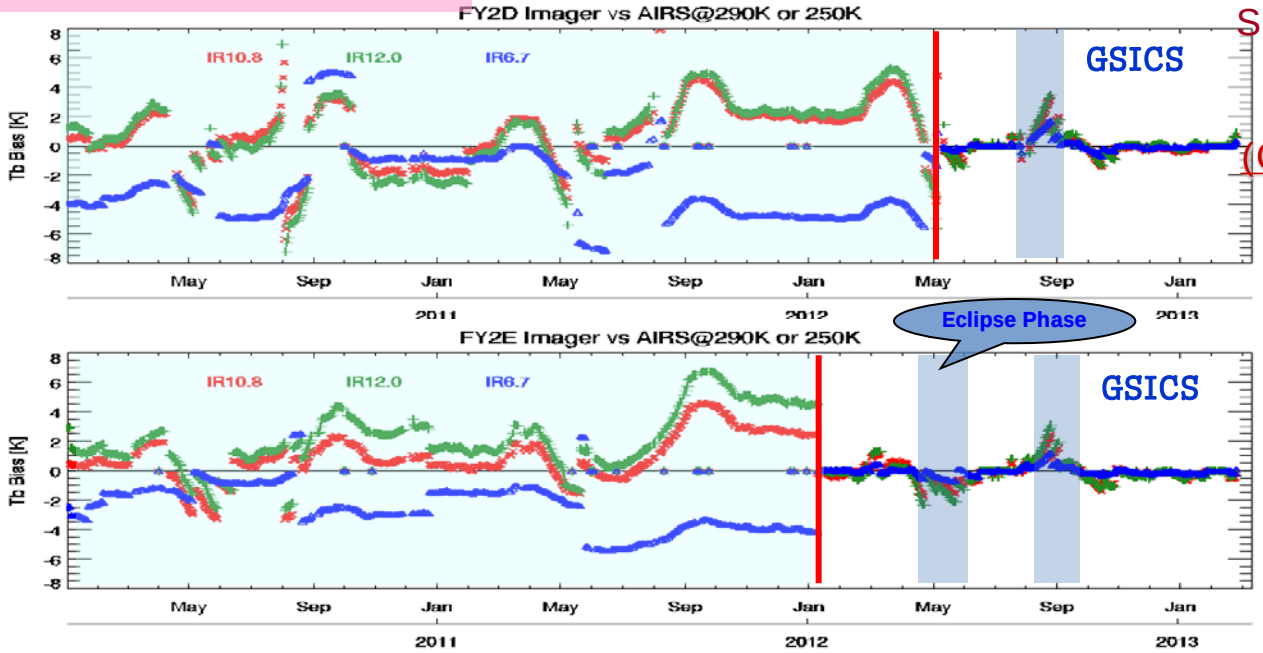
IR Calibration Bias of FY-2 VISSR

FY-2 vs IASI+AIRS



Time series of TBB biases for IR1~3 channels vs AQUA/AIRS reference scenes (290 K for IR1 and IR2, 250 K for IR3).

Significant progresses were made in FY-2 operational calibration (Changed to GSICS in 2012)

Operational calibration of FY-2D/2E was upgraded using GSICS inter-calibration algorithm in 2012-04 and 2012-01 separately.

The calibration biases were sharply decreased, and reduced to about 0.5~1K@290K (@250K） without eclipse period.

Courtesy: Xiuqing (Scott) Hu(CMA)

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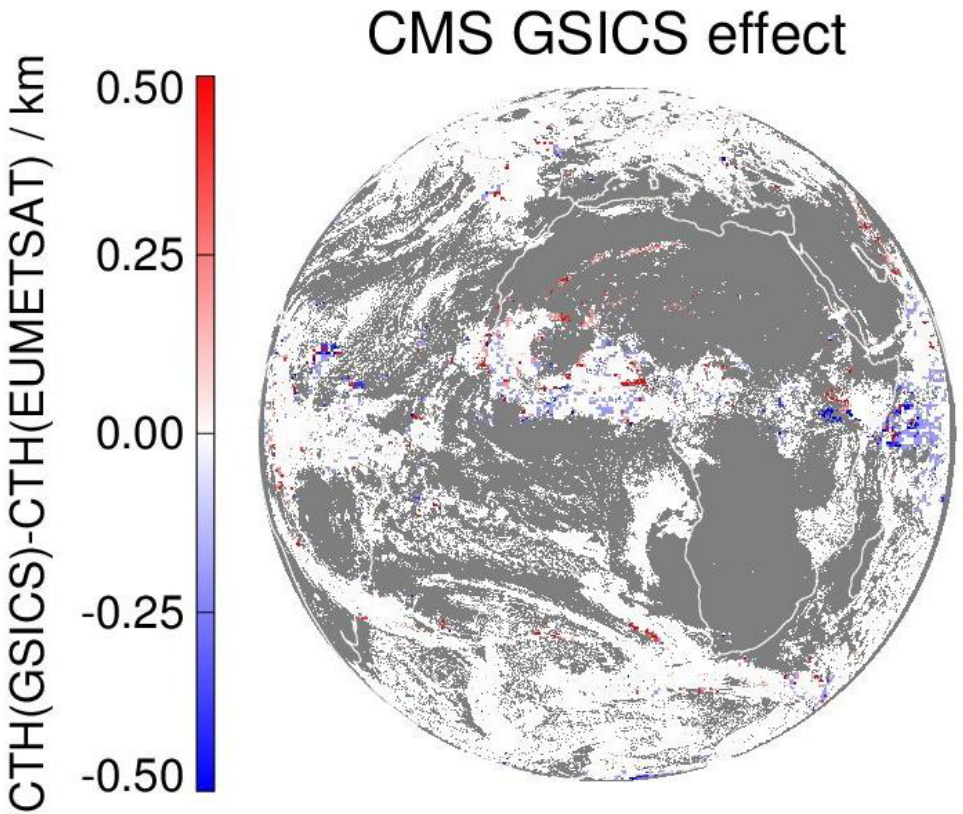
GSICS –SEVIRI: Impact on Cloud Height



In the most extreme case, the CTH was changed by 12km.

Hamann.et.al

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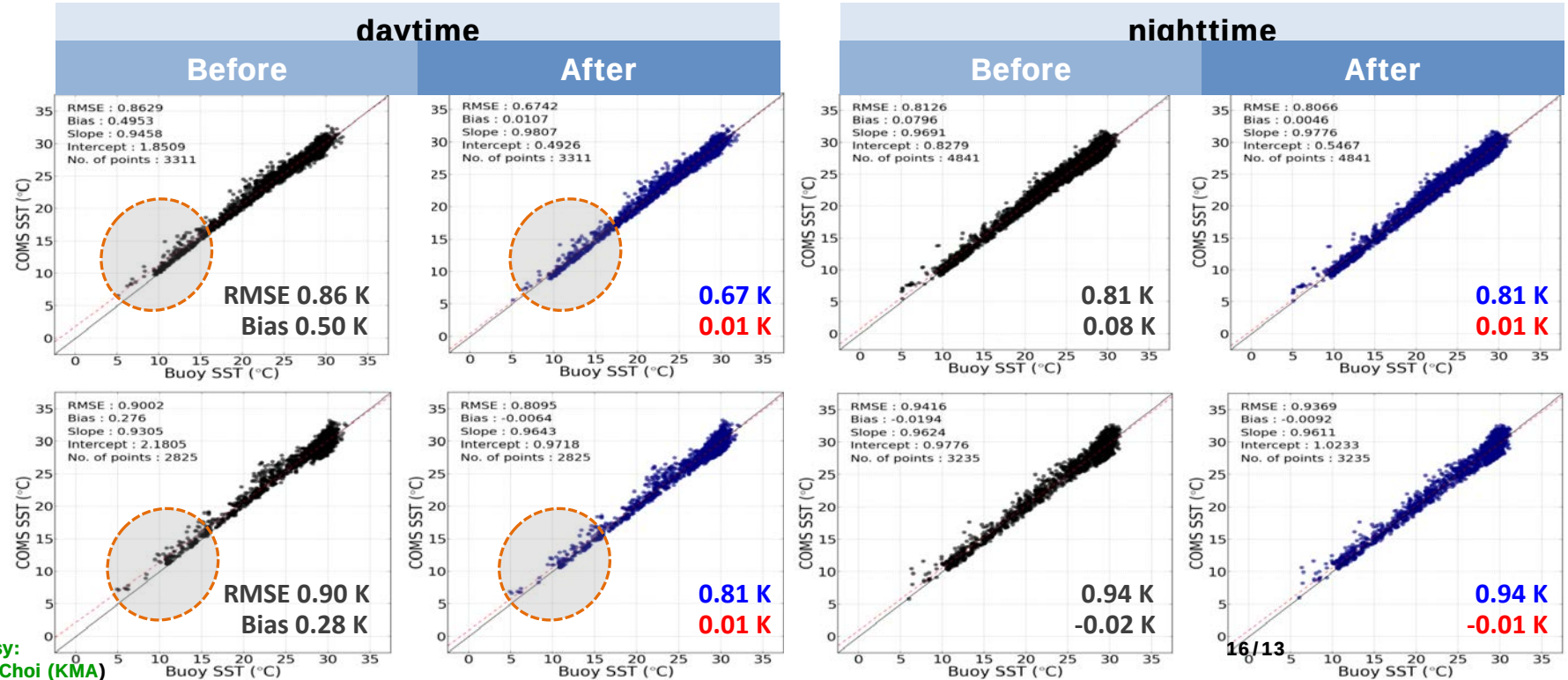
Comparison of recalibrated SST with observed buoy SST

$$MCSST = C_0 + C_1 \cdot IR_{11\mu m} + C_2 \cdot (IR_{11\mu m} - IR_{12\mu m}) + C_3 \cdot (IR_{11\mu m} - IR_{12\mu m}) \cdot (\sec(\theta) - 1)$$



Courtesy:
Minjin Choi (KMA)

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Ralph Ferraro
Chair GSICS MW Subgroup

Ralph Ferraro
Chair MW Subgroup
Web Support- Lori Brown
Data Support : Weiguo Han

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Quarterly Newsletter

- **GSICS Quarterly Newsletter**
  - **Brand new format .**
  - **Newsletter has doi.**
  - **Article critically reviewed.**
  - **Accepts articles on topics related to calibration (Pre and Post launch).**
  - **Rate and Comment section readers and authors can interact.**
  - **Register at Messaging Service to get Newsletter**

Articles of 700-800 word length with 2 Figures and 1 Table acceptable . Contact Manik Bali for more info.

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GSICS and CICS Connection

Progress in past 1 Year and plans for the future

Critical contributions from CICS members to GSICS have been in

- **GSICS Product review process, awarded WMO backed certificates.**
- **Lead MW Special Issue of GSICS Newsletter and also contributed**
- **Lead GSICS Subgroups, Ralph Ferraro is Chair of MW Subgroup**
    - MW products (MSA/AMSU SSM/I) to be included into GSICS.
    - Tying with international groups GPM-XCAL , JAXA (AMSER-E), also tying with CEOS MW group.

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Opportunities

- **Use GSICS products and participate in an international publication as a co-author**
- **Contribute to GSICS Newsletter.**
  - Author (Research, News)
  - Reviewer
  - Member of Editorial Team
- **Letter of support for your projects**
- **WMO appreciation letters.**

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Conclusions

- **GSICS distributes 37 Inter-calibration products in VIS and IR bands online, via product catalog**
- **Cross calibration products have wide applications**
    - Bias Correction
    - SRF retrieval
    - Improving Cloud height and SST determination.
- **GCC publishes Newsletter brand new format , with a doi number**
- **GCC awards certificate of appreciation backed by WMO.**

You are welcome to contribute to a joint publication

[Use of GSICS cross calibration products]

GSICS Users Workshop to be held in Shanghai Nov 19-21 ,2014

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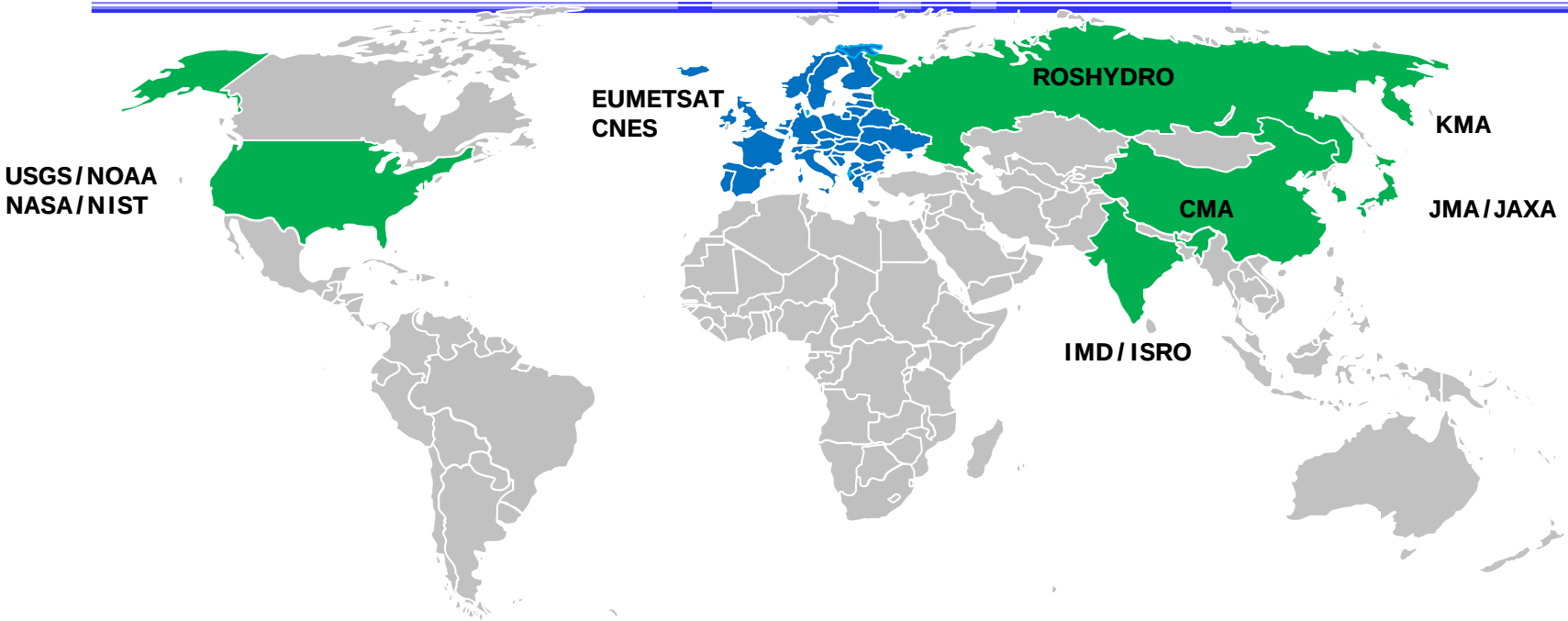
THANK YOU

GSICS Introduction

GSICS Members



Obs. ESA + CEOS
ASSO. GPM X-CAL

14 Members Worldwide

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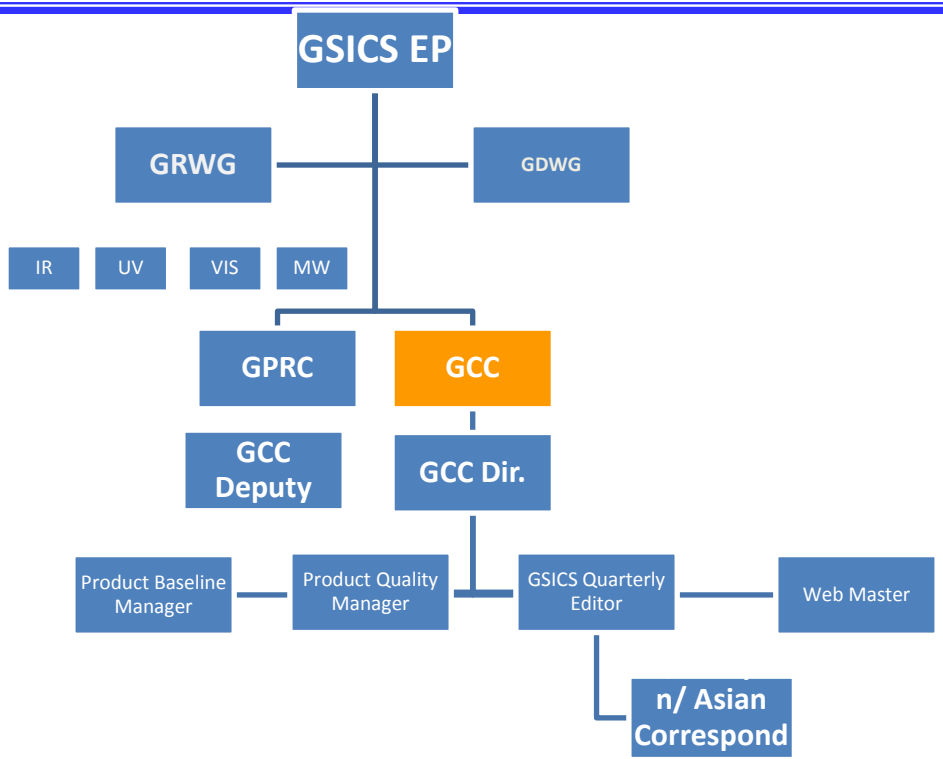
GSICS Introduction

GSICS Structure



THANK YOU

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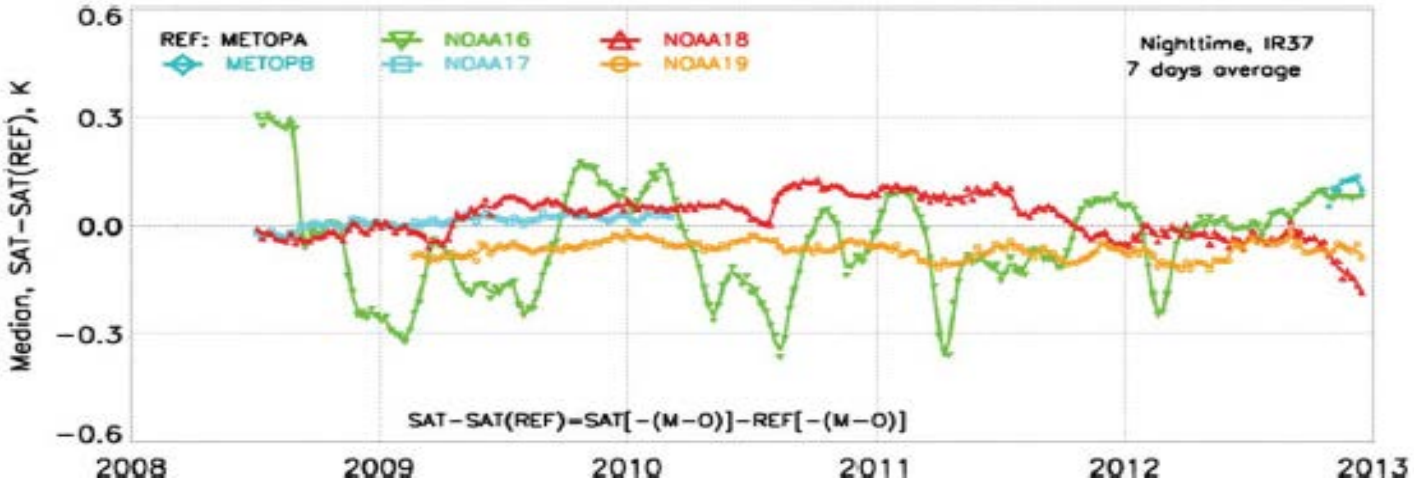

AVHRR, MODIS, and VIIRS radiometric stability and consistency in SST bands
XingMing Liang1,2 and Alexander Ignatov1
Received 29 January 2013; revised 16 April 2013; accepted 17 April 2013;

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In order to meet Near Term Goals GCC needs approvals from EP…

- FCDRs as GSICS Product.
- Awards (will be discussed separate presentation …)
- GCC Newsletter Article Review Process
  - Next two slides give an overview of the process that we follow.
- Relaxation of GPPA guidelines for new products and operationalization of existing products.
  - Or do we create a new category of GSICS endorsed but not GSICS approved products or housed products?
  - Correct, category exists and the terminology that is normally used in GSICS is ‘GSICS Products’ and Third Party products.
  - We need EP’s approval to deviate/apply relaxation in GPPA in the case of third party products (for example filenaming meta data).

- GCC to coordinate with WMO to add GSICS products catalogue to WMO OSCAR database.
- GCC will discuss with GPRCs to prepare for the GSICS user conference 2014 to promote the GSICS products.
- GCC shall take a look at WMO/CGMS documents to prepare templates for GSICS documents and provide these to the GDWG for discussion.
- GCC shall provide a Document Management Plan (for example NOAAs) to the GDWG so that GSICS has a framework to publish documents.
- GCC and Tim Hewison to follow up on the support to CEOS WGCV regarding the GPPA as an example for best practises for QA4EO - after reviewing at web meeting in Summer 2014.

Operations Plan Updates: Unfulfilled Actions

- GRWG06_19: Update GPPA to reflect delta correction due to migrating reference Status: Open, need update file not make a new product
- GRWG06_23: ER2 underflights June 2011 Status: Old action item (Fang Fang to explain why it is closed)
- GWG_13.12: GEO to GEO differences (for NOAA and EUMETSAT Status: Will be discussed in the IR Subgroup
- Joint07_3R GRWG for LEO IR and GEO IR Status: Xingming Liang will present status of this action item in the meeting
- GWG_13.31: Transfer of GCC responsibilities to WMO. Status: Answer is no, Completed/Closed.

Summary of 2013 GSICS Users' Workshop

- Hosted by NOAA/NESDIS/STAR in College Park, Maryland, the United States on 8 April 2013, in conjunction with the first NOAA Satellite Conference
- More than 50 people from 15 agencies, universities and private companies attended
- A total of 14 oral talks, together with 10 posters presented during the workshop.
- Workshop included four sections: Introduction and Updates on GSICS, insights of current and future instrument inter-calibrations, Users' feedback and requests, and Questions and discussion on the future potential products.
- All the oral presentations and the workshop minutes are available at: https://gsics.nesdis.noaa.gov/wiki/Development/UsersWorkshop2013

Outcomes of 2013 GSICS Users' Workshop

- **Success of GSICS products displayed by the Users**
  - Successful applications of the GSICS spectral response function corrections to improve the GOES imager data quality
  - Some examples of GSICS correction products to improve some GOES Sounder MTSAT products
- **Users plan to continue the investigation of the GSICS correction product impact on the L2 and L3 products**
- **GSICS Inter-calibration is expected to play an important role in the GOES-R on-orbit cal/val project**
- **Users' Requests**
  - Satellite operational anomaly alerting system for the GOES-R series
  - New GSICS sub-groups, ultraviolet (UV) and synthetic observation sub-groups, for a better understanding of UV instrument calibrations and radiative simulation performance
  - Intermediate data-sets requested during the off-line discussion

Backup for Action items as a topic

Proposed GCC/GDWG discussion on a better solution to tracking GSICS Actions:

- Suggested improvements:
- Add date closed – or replace due date
- Allow actions raised in web meetings to be entered
- With consistent numbering of actions
- Identify responsible person for each action
- Automatic reminders
- Allow outcomes to be recorded
- inline/links
- Allow items to be filtered by actionee, status, date, ...
- would allow customised views