

# GSICS Quarterly



Global Space-based Inter-Calibration System

CMA • CNES • EUMETSAT • JMA • KMA • NASA • NIST • NOAA • WMO

Vol. 2, No. 4, 2008

[www.star.nesdis.noaa.gov/smcd/spb/calibration/icvs/GSICS/index.php](http://www.star.nesdis.noaa.gov/smcd/spb/calibration/icvs/GSICS/index.php)

Dr. Robert A. Iacovazzi, Jr., Editor

## GSICS on the Net

### Roll Out of Updated Central GSICS Web Site

The web site hosted by the GSICS Coordination Center (GCC) has recently undergone a significant transformation using the NOAA/NESDIS Center for Satellite Applications and Research (StAR) web site

[www.star.nesdis.noaa.gov/smcd/spb/calibration/icvs/GSICS/index.php](http://www.star.nesdis.noaa.gov/smcd/spb/calibration/icvs/GSICS/index.php)



- STAR Home
- GSICS Community
- News
- **Products >>**
  - > GEO-LEO Intercalibration
    - > Imager Visible Channels
    - > Imager Infrared Channels
    - > Sounder Channels
  - > LEO-LEO Intercalibration
    - > Microwave Imagers
    - > Microwave Sounders
    - > Visible/Infrared Imagers
    - > Infrared Sounders
    - > Ultraviolet Instruments
  - > Vicarious Calibration
    - > GEO Vicarious Calibration
    - > LEO Vicarious Calibration
  - > Radiative Transfer Model Simulation
  - > GEO Instrument Performance
  - > LEO Instrument Performance
- Documentation
- Publications
- Links
- Opportunities

kit. This web site kit offers:

- Web page templates that do not require design work, and are edited with a simple text editor;
- Web pages without frames;
- Accessibility to persons with disabilities as dictated by Section 508 of the U.S. Rehabilitation Act;
- Instant approval for use on StAR web servers; and
- Improved searchability of the site via the USASearch.gov search facility and visibility of GSICS in Google.

The updated GSICS web site offers attractive, well-organized, and easily-navigable web pages. It includes expanded product pages and new pages dedicated solely to documentation of algorithms and processes. An example of the expanded product menu can be visualized in Figure 1 (left). This picture shows links to web pages that contain results of geostationary (GEO) to low-earth-orbiting (LEO), as well as LEO to LEO, inter-calibration; vicarious calibration; radiative transfer model simulations; and GEO and LEO

instrument performance monitoring. Many of the web links that have been established in the updated web site are not currently populated, but they have been designed to accommodate data and information produced as GSICS goals and milestones are met.

Although the GSICS web site update represents significant improvements to GSICS information technology, further

developments of the web site are currently in progress. In particular, a new infrastructure and design of web pages

that ultimately serve the plethora of GSICS data tables and graphs is currently being implemented. At GCC, new techniques are being implemented to serve GEO to LEO instrument inter-comparison products. These techniques feature menu-driven table and plot selection driven by java/php scripts that can parse filename strings. The strings then can be used to create information about the tables and plots that will help users to understand what they are seeing. These scripts are also capable of embedding metadata for chart images to assist persons with disabilities in navigating the site. In addition, the tables and plots are served in "inline Frames" or "iFrames." An iFrame is a HTML element which makes it possible to embed a HTML document inside another HTML document. This method is a very efficient way to dynamically serve information and data. In the future, we hope to apply this technology in serving LEO to LEO inter-calibration results and instrument performance monitoring plots and data tables.

As a coordination center, the GCC is responsible for maintaining pathways of information and data storage and transfer. At GCC, the continual development of the GSICS web site is taking place to meet current and future web demands of GSICS members and data users. In addition, an integrated communication system that includes collaborative servers also requires a fast and easy-to-use web interface, as the one being developed at the GCC.

(by Dr. R. Iacovazzi, Jr. and Lori Brown, [NOAA])

### GSICS Members Introduce New GSICS Web Pages

In this quarter, EUMETSAT and JMA launched new local GSICS web pages. The pages can be linked to through the

Figure 1: The left panel menu of the updated GSICS web site.

“Links” web page of the central GSICS web site, or directly through the URLs of these GSICS Processing and Research Centers (GPRCs):

- EUMETSAT  
[http://www.eumetsat.int/Home/Main/What\\_We\\_Do/InternationalRelations/CGMS/SP\\_1214310159208?l=en](http://www.eumetsat.int/Home/Main/What_We_Do/InternationalRelations/CGMS/SP_1214310159208?l=en)
- JMA  
<http://mscweb.kishou.go.jp/monitoring/calibration.htm>

The EUMETSAT web pages describe the activities of EUMETSAT scientists and technical experts associated with the GSICS Research Working Group (GRWG) and the GSICS Data Working Group (GDWG). It also includes articles on inter-calibration studies performed at EUMETSAT and links to near real-time results for Meteosat-IASI comparisons ([http://www.eumetsat.int/Home/Main/Access\\_to\\_Data/InterCalibrationServices/index.htm?l=en](http://www.eumetsat.int/Home/Main/Access_to_Data/InterCalibrationServices/index.htm?l=en)). Meanwhile, the JMA web site includes results regarding the *MTSAT* infrared inter-calibration with high spectral resolution sounders, e.g., *Metop-A* Infrared Atmospheric Sounding Interferometer and Earth Observing System *Aqua* Atmospheric Infrared Sounder. It also includes *MTSAT* infrared inter-calibration with Advanced Very-High Resolution Radiometer.

(by Dr. R. Iacovazzi, Jr., [NOAA])

## News in this Quarter

### CALCON 2008

The 2008 calibration and characterization conference was held in Logan, Utah during 25-28 August 2008, with about 120 participants from government agencies/laboratories, universities, and industries in attendance. At the pre-conference tutorial dedicated to “Uncertainty analysis and budgeting for on-orbit radiometric calibration,” Drs. R. Iacovazzi and X. Wu presented a one-hour lecture titled “On-orbit components of radiance uncertainty analysis budget for operational satellite instruments.” Dr. Wu also co-chaired a session on “Intercalibration and validation of operational sensors,” and delivered an oral presentation titled “Investigation of GOES Imager 13  $\mu$ m Channel cold bias”.

Dr. C. Cao presented a poster on AVHRR lunar observations and calibration challenges. In addition, new progress was reported by university and industry scientists in the area of intersatellite calibration using the Simultaneous Nadir Overpass (SNO) method, in an effort to support climate change detection initiatives. For example, uncertainties below 0.1K in infrared sounding and imaging instruments have been achieved by these groups.

Dr. C.-Z. Zou presented a talk entitled “Intercalibration of Microwave Sounding Unit (MSU) for climate research—lessons learned.” The talk reviewed the NESDIS/STAR MSU intercalibration system and its capability in generating consistent atmospheric temperature time series for climate

trend monitoring. The talk also summarized the current issues in the MSU data processing and discussed future work.

(by Drs. X. Wu, C. Cao, and C.-Z. Zou, [NOAA])

## Hyperspectral Observations Looking Up

The 4<sup>th</sup> Annual Advanced High Spectral Resolution Infrared Observations Workshop was held at EUMETSAT in Darmstadt, Germany on 15-17 September 2008, hot on the heels of the EUMETSAT Satellite Conference. This was a welcome opportunity for experts from national meteorological agencies, satellite operations centers, space research agencies, academia and industry to report their latest results and exchange ideas in an informal forum. These discussions included instrument developments, cal/val campaigns, operational data processing, spectroscopy, and radiative transfer and retrievals of profiles and column amounts of atmospheric temperature, humidity, cloud and trace gases. Many of the presentations naturally concentrated on the recent successes of the Infrared Atmospheric Sounding Interferometer, which is proving to be a stable and reliable instrument, suitable for use as an inter-calibration reference.

Particularly exciting was the renewed optimism for the proposed hyperspectral missions, including geostationary and polar-orbiting sounders and CLARREO, which could provide an excellent inter-calibration reference, traceable to SI standards. The presentations from this workshop are available at <http://www.ssec.wisc.edu/hsr/meetings/2008/>.

(by Dr. T. Hewison, [EUMETSAT])

## NASA PMM Calibration Team Working Group Meeting

On 3 August 2008, the NASA Precipitation Measurement Mission (PMM) instrument calibration team held its working group meeting at the Atmospheric Science Department of Colorado State University (CSU). The meeting was chaired by Dr. T. Wilheit. The primary task of the working group is to develop algorithms for comparing the calibrations of similar, but not identical, radiometers. The Brazos Earth System Science, CSU, NOAA/NESDIS, University of Central Florida, and University of Michigan teams each presented progress on their respective algorithms. The Japan Aerospace Exploration Agency algorithm was presented by Dr. T. Iguchi, who substituted for Dr. K. Imaoka. These working group presentations revealed a convergence in the microwave radiometer calibration process. In the NOAA presentation, GCC Director Fuzhong Weng presented the latest Special Sensor Microwave/Imager inter-calibration from F10 to F15 using simultaneous conical overpasses, and the impacts of the improved calibration on climate data records. Dr. Y. Hong of Aerospace Corporation gave a presentation on the Microwave Imager/Sounder sensor being built for NPOESS by NRL. This radiometer is a key element of the Global Precipitation

Measurement concept and, although launch is not set until 2016, it is encouraging to see that it is in the plans again.

(by Dr. F. Weng, [NOAA])

## GSICS Executive Panel IV

On 10-11 July 2008, the GSICS Executive Panel (EP) held their fourth meeting at WMO Headquarters in Geneva, Switzerland. The highlights of this meeting included:

- Introductory remarks by GSICS EP Chair, Mitch Goldberg;
- Status reports from the GSICS Coordination Center (GCC) and most of the GSICS partners;
- A presentation from guest speaker John Nash of the UK Met Office entitled “Extracts from ‘Introduction to Training Workshop on Upper Air Observations and Monitoring of Upper-Air Observations;’ ” and
- Discussions regarding the drafts of the GSICS Information Services and Products Roster, the GSICS Procedure for Product Acceptance, and the GSICS role in the work to be performed by the Regional/Specialized Satellite Centres on Climate Monitoring.

The agenda and presentations from this meeting can be found at the WMO Space Programme meetings web page found at <http://www.wmo.int/pages/prog/sat/meetings/GSICS-ExecutivePanel-4.html>. The next meeting of the GSICS EP is scheduled for early November.

(by Dr. R. Iacovazzi, Jr., [NOAA])

## GRWG Achievements and Outlook

Since inception, the GSICS Research Working Group (GRWG) has been primarily focused on the development, implementation, and evaluation of an algorithm for the geostationary (GEO) to low-earth-orbit (LEO) instrument inter-calibration. Tapping on years of experience from an international community of experts, the GRWG proposed at its first meeting in January 2007 a strategy that emphasized the importance of instrument collocations for single pixels near and away from the satellite nadir, and foresaw the necessity of repeated re-analysis. At its second meeting in June 2007, the GRWG adopted a sophisticated gap-filling algorithm that significantly improved the utility of AIRS data for inter-calibration, and recognized IASI as the reference for inter-calibration. At its third meeting in February 2008, the GRWG reviewed the recent success of initial routine inter-calibrations and their impacts on correcting a cold bias in the 13  $\mu\text{m}$  channel of *GOES-13* and *METEOSAT-9*, and started the discussion on establishing an Algorithm Theoretical Basis Document (ATBD). Since then, a sophisticated hierarchical structure has been proposed and discussed for the GSICS ATBD, and several new results have been obtained, e.g., the midnight calibration anomaly for MTSAT Imager and the AIRS-IASI comparison using operational GOES Imagers. These laid a solid foundation for the success of GSICS in the past and future.

Currently, GSICS GEO to LEO inter-calibration is routinely performed at EUMETSAT between METEOSAT imagers and IASI, at JMA between MTSAT imagers and AIRS and IASI, and at NESDIS between GOES imagers and AIRS and IASI. Meanwhile, KMA has successfully implemented MTSAT-AIRS inter-calibration and produced some results. Great progress has been made, yet the infrastructure is not complete. Therefore, the short term goal for the remaining months of 2008 is to make inter-calibration operational at each GPRC for its GEO imagers with AIRS or IASI; and at NESDIS for all GEOs with both AIRS and IASI to compare, backup, or support the products at other GPRCs.

A major mid-term goal, perhaps for much of 2009, is to establish protocols for analyzing the GEO-LEO inter-comparison data and exchanging the results among the GPRCs. This is not merely a matter of format, but rather the content and purpose of what is being analyzed and disseminated. This goal is tied naturally to the “learning phase of GSICS products,” which is envisioned by the GSICS Executive Panel to be a period when we explore and demonstrate new utilities, and engage users that will benefit from the GSICS products. After all, we must deliver useful products in a portable and accessible format. Thus, a users’ workshop proposed by V. Gärtner is very appropriate. Another aspect of analyzing data and sharing results is to document the algorithm precisely and concisely. This connects well with the hierarchical ATBD initiative. A second mid-term goal is to develop inter-calibration for GEO visible and near infrared (VNIR) channels. The use of deep convective clouds (DCCs) as calibration targets for these instruments has emerged as a good candidate, although inter-calibration techniques based on DCCs vary and there are other options. One suggestion is for NASA Langley to implement a well-documented algorithm of its choice for all GEOs, and for GRWG members to improve or implement that algorithm. A third mid-term goal is to merge the GEO-LEO activities with inter-calibration involving other platforms (e.g., LEO-LEO or GEO-GEO) and instruments (e.g. microwave).

Looking towards the long term, a suggested emphasis has been, at least in part, on climate applications. The GSICS activities and impacts have so far been supporting satellite operations. This is good, necessary, and should continue. However, part of the GSICS future lies in climate detection, including the re-calibration of historical records, support for the Regional/Specialized Satellite Centres – Climate Monitoring (R/SSC-CM), and collaboration with the Committee on Earth Observation Satellites. The Executive Panel plans to make connections with those communities when the opportunity arises.

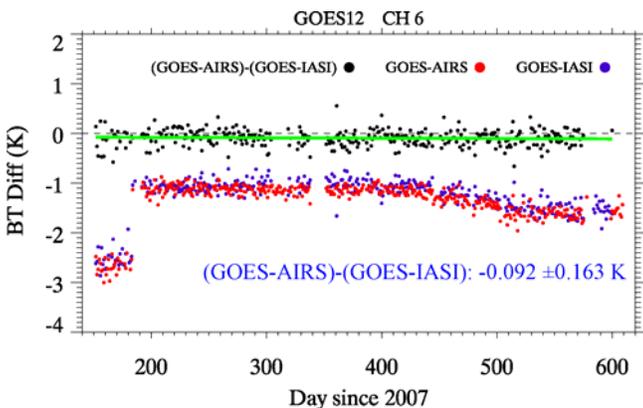
(by Dr. X. Wu, [NOAA])

## A Glimpse from GSICS Labs

### GSICS Tools Used to Compare IASI and AIRS

Quantifying the radiometric difference and creating a calibration link between *Aqua* Atmospheric Infrared Sounder (AIRS) and *Metop-A* Infrared Atmospheric Sounding Interferometer (IASI) are crucial for creating fundamental climate data records. The reason for this is that AIRS and IASI, combined with the future Cross-track Infrared Sounder, will provide us more than 20 years of hyperspectral measurements. In addition, other broad- or narrow-band instruments currently use AIRS and IASI data as an on-orbit radiometric standard to access their calibration accuracy. Recent efforts have been made to compare AIRS and IASI radiance measurements using 1) simultaneous nadir overpass (SNO) observations over relatively large wavelength intervals [Blumstein 2008; Iacovazzi and Cao 2008] or at the finest spectral scale [Tobin et al. 2008], and 2) double-differences of the radiances of these two sensors relative to a transfer target [Aumann and Pagano 2008; Strow et al. 2008].

Inter-calibrations of Geostationary Operational Environment Satellite (GOES) with both AIRS and IASI have been routinely performed at the Center for Satellite Applications and Research (STAR) in NOAA/NEDIS. In addition to assessing the calibration accuracy of GOES imagers, these inter-calibration results can also be used to compare AIRS and IASI with the double-differencing technique using GOES imagers as transfer radiometers. This indirect comparison complements the direct comparison of IASI and AIRS using the simultaneous nadir overpass (SNO) technique by extending the comparison beyond the Polar Regions to include different climate regimes. In Figure 1, a time series of differences between GOES-12 and AIRS and IASI for the



**Figure 1.** Time series of daytime differences between GOES-12 and AIRS (red) and IASI (blue), and their double difference (black) for the 13.3  $\mu\text{m}$  channel, expressed in terms of brightness temperature (BT), from June 2007 to August 2008. Note that only daytime observations are used in order to avoid the day-night calibration difference of the GOES-12 imager.

13.3 $\mu\text{m}$  channel is shown as an example application of the double-difference technique.

In Figure 1, the sudden change of bias after the July 2007 decontamination, as well as the gradual increase of the bias thereafter, is well characterized by both AIRS and IASI. The black dots are the double difference, or the difference between GOES-AIRS and GOES-IASI, which effectively is the difference between AIRS and IASI. These values are nearly invariant in time, despite the sudden and gradual change of their individual differences with GOES, indicating excellent calibration of AIRS and IASI. The green line is the linear regression line of the time series of double-difference values. This line indicates a trend of IASI and AIRS BT bias of  $-0.0269 \pm 0.0267$  K/year, but it is statistically not different from zero since the uncertainty of the estimate is  $\pm 0.0267$  K/year.

#### References

Aumann, H. H., and T. S. Pagano, 2008: Using AIRS and IASI data to evaluate absolute radiometric accuracy and stability for climate applications, paper presented at Atmospheric and Environmental Remote Sensing Data Processing and Utilization IV: Readiness for GEOSS II, SPIE, San Diego, CA, USA.  
 Blumstein, D., 2008: *Metop-A* Level-1 Cal at IASI TEC. *GSICS Quarterly*, Vol. 2, No. 2, ([online](#)).  
 Iacovazzi, Jr., R., and C. Cao 2008: An AIRS-IASI Inter-comparison. *GSICS Quarterly*, Vol. 2, No. 2, ([online](#)).  
 Tobin, D., 2008: An SNO analysis of IASI and AIRS spectral radiance, *GSICS Quarterly*, Vol. 2, No. 3, ([online](#)).  
 Strow, L., et al. 2008: Inter-Calibration of the AIRS and IASI operational infrared sensors, paper presented at 17th annual CALCON Technical Conference, Logan, UT, USA.

(Drs. L. Wang and X. Wu, [NOAA])

### GSICS-Related Publications

Iacovazzi, Jr., R. A., C. Cao, 2008: Reducing uncertainties of SNO-estimated inter-satellite AMSU-A brightness temperature biases for surface-sensitive channels. *J. Atmos. and Oceanic Tech.*, **25**, 1048-1054.  
 Wang, L., and C. Cao, 2008: On-Orbit calibration assessment of AVHRR longwave channels on MetOp-A Using IASI. *IEEE Trans. on Geoscience and Remote Sensing*, **46**, No. 11, DOI:10.1109/TGRS.2008.2001062.

Please send bibliographic references of your recent GSICS-related publications to [Bob.Iacovazzi@noaa.gov](mailto:Bob.Iacovazzi@noaa.gov).

## Just Around the Bend ...

### GSICS-Related Meetings

- **GSICS Executive Panel V Meeting**, 7-8 November 2009, MasPalomas, Gran Canaria, Canary Islands (Spain).
- **16th Conference on Satellite Meteorology and Oceanography**, 11-15 January 2009, Phoenix, Arizona,

USA, <http://www.ametsoc.org/MEET/annual/index.html>.  
Held in conjunction with the 89<sup>th</sup> Annual Meeting of the AMS.

- **Joint GRWG-IV/GRDG-III Meeting, (Tentative)** 28-30 January 2009, Tokyo, Japan.
- **IGARSS**, 13-17 July 2009, Capetown, South Africa, Session on Radiometer Instruments and Calibration, <http://www.igarss09.org/>
- **CALCON Technical Conference**, 24-27 August 2009, Logan, UT, USA, <http://www.sdl.usu.edu/conferences/calcon/>.

## GSICS Classifieds

### HELP WANTED

**GSICS Quarterly Asian Correspondent:** Join the *GSICS Quarterly* Press Crew in providing up-to-date news about calibration/validation activities from around the globe. The Asian Correspondent for *GSICS Quarterly* would be responsible for acquiring articles about GSICS-related activities occurring in Asia, and coordinating their publication in the newsletter with the *GSICS Quarterly* Editor, Bob Iacovazzi, Jr.. If you are interested in this unique opportunity, please e-mail Bob at [Bob.Iacovazzi@noaa.gov](mailto:Bob.Iacovazzi@noaa.gov).

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Are you looking to establish a GSICS-related collaboration, or do you have GSICS-related internships, exchange programs, and/or available data and services to offer? *GSICS Quarterly* includes a classified advertisements section on an as-needed basis to enhance communication amongst GSICS members and partners. If you wish to place a classified advertisement in the newsletter, please send a two to four sentence advertisement that includes your contact information to [Bob.Iacovazzi@noaa.gov](mailto:Bob.Iacovazzi@noaa.gov).

### *With a Little Help from our Friends:*

The *GSICS Quarterly* Editor would like to thank those individuals who contributed articles and information to this newsletter. The Editor would also like to thank *GSICS Quarterly* European Correspondent, Dr. Tim Hewison of EUMETSAT, in helping to secure articles for publication, and Ms. Regina Bellina for her help in proofreading this newsletter.

The *GSICS Quarterly* Press Crew is looking for short articles (<1 page), especially related to cal/val capabilities and how they have been used to positively impact weather and climate products. Unsolicited articles are accepted anytime, and will be published in the next available newsletter issue after approval/editing. **Please send articles to [Bob.Iacovazzi@noaa.gov](mailto:Bob.Iacovazzi@noaa.gov), GSICS Quarterly Editor.**