doi:10.7289/V5T151KT

GSICS Quarterly

V5 No. 2
2011

CMA • CNES • EUMETSAT • IMD • ISRO • JAXA • JMA • KMA • NASA • NIST • NOAA • ROSHYDROMET • USGS • WMO

http://gsics.wmo.int

Dr. Robert A. Iacovazzi, Jr., Editor

Overview of the GSICS Procedure for Product Acceptance

The success of GSICS is intimately linked to the quality and usefulness of GSICS inter-calibration products, and to the availability of these products to the GSICS community. Part of this success is gaining a detailed understanding of distribution-ready products before they achieve final acceptance into the GSICS product portfolio. This has motivated GSICS to establish a GSICS Procedure for Product Acceptance (GPPA), which provides the following:

1) A pathway for GSICS product developers to obtain a "Stamp of Approval" for a potential product;
2) A window for GSICS data users to judge product quality and "fitness for purpose"; and
3) Guiding standards for the GSICS governing body to judge GSICS product competence.

This article offers a summary of the GPPA. More information can be linked to from the GSICS Coordination Center (GCC) website[1].

Inspired by concepts developed within the Quality Assurance Framework for Earth Observations[2] - endorsed by the Committee on Earth Observation Satellites (CEOS) as a contribution to facilitate the Group on Earth Observations' (GEO) vision for a Global Earth Observation System of Systems (GEOSS) - the GPPA is put into place to determine whether a product is within the scope of GSICS, and whether its methods, uncertainties, reference traceability, and implementation have been properly documented. The GPPA is not developed to judge products as "good" and/or "bad", or even to discriminate them based on the type of method. This way, the GSICS data user can ultimately decide whether or not a given inter-calibration product will suit their needs.

A potential product is eligible for the GPPA when it is considered to be in a relatively mature state of development. The acceptance procedure commences when the provider fills out the required sections of the GSICS Product Acceptance Form (GPAF), found on the GSICS Wiki[3], and submits this form to the GCC. At this point, the product enters the Product Submission Phase. The full GPAF includes information about the product provider and the nature of the potential product. It also includes a checklist of required supporting documentation and materials that will be needed during the process. A high-level list of these supporting documents and materials can be found in detail in the GPPA workflow found at the GSICS Wiki.

The acceptance procedure process includes the Product Submission Phase, and the following three possible GSICS product distribution states:

1) **Demonstration Phase (DP)** – The product is determined to be within GSICS scope, its fundamental founding concepts are understood, and it meets GSICS data format/content guidelines. In this phase, the product is released solely for the purpose of evaluation within GSICS and by potential product users.
2) **Pre-operational Phase (PP)** – The product has been determined to be a valuable part of the GSICS product portfolio, and has developed and understood methodology, software, supporting models and measurements, uncertainty, quality indicator, and traceability to a community or SI standard. It has also been tested by product users outside of GSICS.
3) **Operational Phase (OP)** – In addition to its PP attributes, the product has developed and understood generation, distribution, version-control and archive strategies. It also has an available User's Guide. At this point, the product is fully accepted and maintained within GSICS.

An overview of the entire GPPA process is found in Figure 1.

In the GPPA, it is the role of the GSICS Product Acceptance Team (GPAT) – i.e., GSICS Processing and Research Center (GPRC) Representatives, GSICS Research Working Group (GRWG) and GSICS Data Working Group (GDWG) Chairs, and GCC Director - to review each GPAF submitted to them from product providers. During later steps of the process, they are responsible for reviewing documents and data submitted by product providers for fulfillment of GPPA requirements, and making recommendations to the GSICS Executive Panel regarding each product submitted to the GPPA. The GSICS Executive Panel is ultimately responsible for giving the "stamp of approval" for any product entering the GPPA.

A very significant step of the GPPA occurs during DP when the potential product is tested by GSICS product users. The information that is sought after here is product accessibility and availability, as well as its reliability and suitability for implementation. Of greatest interest during this testing is the end-to-end demonstration of impacts of the product to satellite imagery, weather nowcasting, numerical weather prediction, and climate monitoring. This step is critical to the GPPA, and beta-testers of GSICS Products are highly sought after to fulfill this purpose.

[1] http://www.star.nesdis.noaa.gov/smcd/GCC/qa-gppa.php
[2] http://qa4eo.org
[3] https://gsics.nesdis.noaa.gov/wiki/Development/GppaWorkflow

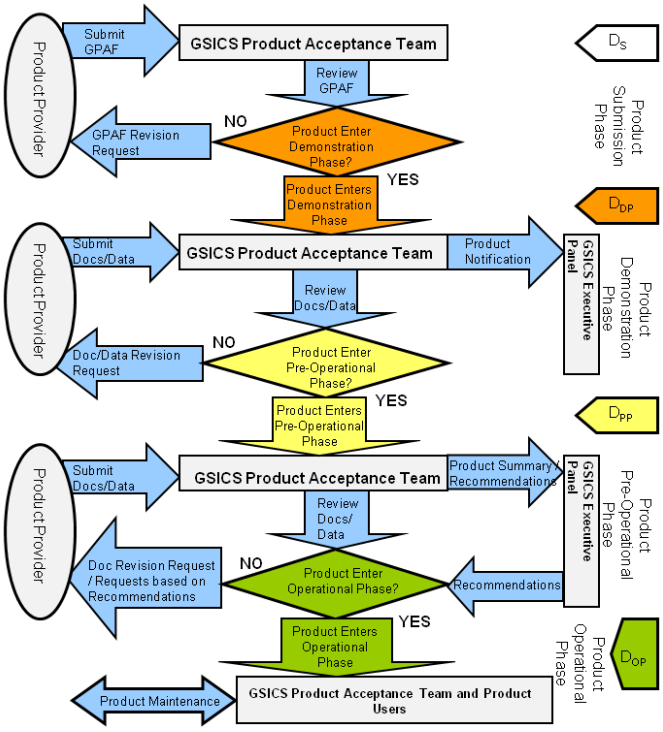

Figure 1. From top to bottom, the GPPA is described by four phases - Product Submission Phase, Demonstration Phase (DP), Pre-operational Phase (PP), and Operational Phase (OP) – and their review and revision cycles. The time markers at the far right, and their defined limits, are the date of submission (D_S) and the number of days from D_S to fulfill requirements to enter DP ($D_{DP} \leq D_S$+90days), PP ($D_{PP} \leq D_{DP}$+365days), and OP ($D_{OP} \leq D_{PP}$+180days).

Currently, there are four potential products in DP:

- GSICS Correction for -
  - Meteosat SEVIRI IR Channels based on IASI
  - MTSAT Imager IR Channels based on AIRS and IASI
  - GOES Imager IR Channels based on AIRS and IASI
- PATMOS-x POES/Metop-A AVHRR solar reflective channel corrections based on MODIS

In the next year, we hope to have all of these potential products available in PP. We also hope to have the following new submissions of potential products:

- GSICS Correction for -
  - FY-2 VISSR IR channels based on IASI
  - Meteosat SEVIRI, MTSAT Imager and GOES Imager solar reflective channels based on MODIS
  - POES/Metop-A MSU/AMSU-A based on the SNO method

Since the inception of the GPPA, it has been changed to add clarity and justification to its steps, and the order of completion of steps have been shifted within the GPPA timeline to make the procedure more attractive to those calibration product producers outside of GSICS that wish to seek a GPPA compliance designation for their calibration products. Regardless of the changes that the GPPA has undergone within GSICS, it remains a rewarding learning process for those that have been involved.

(Drs. R. Iacovazzi, Jr. and F. Weng [GCC])

News in this Quarter

GSICS Joint Research and Data Working Group Meeting

The Fifth GSICS Data Working Group (GDWG) and Sixth GSICS Research Working Group (GRWG) meetings, held jointly 22-25 March 2011 in Daejeon, Republic of Korea, were generously hosted by the Korea Meteorological Administration (KMA) and the National Meteorological Satellite Center (NMSC). Dr. Ae-Sook Suh of KMA warmly welcomed the group at the beginning of the first plenary session on behalf of her agency.

During the initial plenary session, reports from the GSICS Executive Panel (EP), GSICS Coordination Center (GCC), GRWG and GDWG, and the GSICS Processing and Research Centers (GPRCs) were given. Highlights of these presentations included the recent expansion of the GSICS memberships to include the Indian Space Research Organization (ISRO), India Meteorological Department (IMD), Japan Aerospace Exploration Agency (JAXA), United States Geological Survey (USGS), and Russia's Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET). GSICS also welcomed the European Space Agency (ESA) as a GSICS observer. The EP reported that it endorsed the GSICS Procedure for Product Acceptance (GPPA), which is design to assess the theoretical basis, traceability to standards, quality and operational readiness of potential GSICS products.

The GCC reported that there are four potential GSICS products that are on the road to GPPA Pre-operational Phase – GSICS Corrections to relate GOES, Meteosat, and MTSAT imager infrared data to those of the Atmospheric InfraRed Sounder (AIRS) and/or Infrared Atmospheric Sounding Interferometer (IASI) instruments, as well as the PATMOS-x correction to transfer the calibration of AVHRR to that of MODIS. The GCC also reported the success of the Second GSICS Users' Workshop, which yielded input from beta-testers regarding the impact of using GSICS inter-calibration products on their products created from satellite radiance data. Their input helps to guide future GSICS activities, and the EP continued to encourage the GRWG to take appropriate actions based on users' feedback.

The GRWG and GDWG reports provided the audience with an update on the actions of these working groups. In addition, the GDWG reported that the GSICS Collaboration Servers are in operations, and that source data and demonstration products are available on the servers. Meanwhile, reports from the GPRCs revealed a great deal of progress within GSICS over the past year:

KMA:

- Successfully launched the COMS satellite on 26 June 2010.

NOAA:

- Processed calibration transfer corrections for 1) GOES-11/12/13, Meteosat-7/9, MTSAT-1R/2, and FY-2C/2D with respect to AIRS and/or IASI; 2) AVHRR solar bands with respect to MODIS; and 3) MSU/AMSU (no independent reference).
- Developed new capabilities, including GEO-LEO Sounder and GEO-GEO inter-calibration.
- Resolved GOES instrument anomalies with the aid of GSICS developments.

JMA:

- Revealed a renewed inter-calibration homepage in July 2010, which led to the development of a prototype web page for all GPRCs.
- Established routine visible calibration monitoring for MTSAT-2 in September 2010.

EUMETSAT:

- Improved the GSICS pages of the EUMETSAT web site to include a summary of the GSICS product status for easier navigation.

CMA:

- Established routine processing of GEO-LEO infrared GSICS correction, providing near real-time results between FY-2C/2D/2E versus IASI and AIRS, as well as corrections for some historical instruments.
- Created initial comparisons of polar orbiter FY-3A' MERSI with respect to AIRS and IASI.

At the end of the first Joint Session, M. Bouvet from ESA gave a presentation on the Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison (DIMITRI) remotely via Skype. It is one of the tools used by ESA to investigate the radiometric stability and radiometric performance of MERIS and AATSR, and to inter-compare them to other sensors. The database is currently being further populated to include data from AATSR-2, AATSR, MERIS, Aqua-MODIS, POLDER-3 and VEGETATION over 8 terrestrial sites for the period 2002 to 2010. A first delivery is expected in summer 2011.

The remainder of the GSICS Joint GDWG-V and GRWG-VI Meeting focused on development of new GSICS products and capabilities. This effort was carried out in a series of separate GRWG and GDWG breakout sessions, as well as joint plenary sessions. The GRWG breakout sessions focused on different solar calibration techniques. It also included presentations regarding calibration transfer references, e.g., their traceability to international standards, establishing common reference channels, handling multiple references, and strategy for migrating to new references. The sessions also focused on the use of the GCOS Reference Upper Air Network (GRUAN), strategy for reanalysis and LEO-LEO inter-calibration products, NWP bias monitoring, and product uncertainty analysis.

The GDWG sessions delved into GSICS data file issues, including clarification and improvement of GSICS netCDF file content and descriptions, additions and modifications to the netCDF and file naming conventions, and development of the metadata for GSICS products based on the WMO Core Metadata Profile System. The GDWG also discussed future developments of the GSICS data servers, requirements for GSICS data user registration tools for effective communication with registered GSICS data users, as well as helpdesk functionality and GPPA automation requirements.

The final plenary session concentrated on establishing instrument event logs and their requirements, as well as plans for the upcoming 2011 GSICS Users' Workshop to be held in Oslo, Norway in conjunction with the EUMETSAT Satellite Conference. Also, on the final day of the meeting, Dr. G. Chander of SGT/USGS gave a presentation on the cross-calibration of Landsat-7 and Terra MODIS to the Joint Session.

The agenda and minutes of the meeting can be accessed by following the "Meeting reports" link at the GSICS website[4]. Due to time constraints, some agenda items were postponed to a series of web meetings, which will continue the dialogue within GSICS.

The participants (see photo below) were particularly appreciative of KMA for the professional organization of the meeting, their generous hospitality in Daejeon, the tour of the new Korea Meteorological Satellite Center, and their support in arranging logistics. The next GSICS Joint Research and Data Working Group meeting is to be held in March 2012 at a location to be decided. The working groups are pleased with the progress of this four day meeting in Korea. They also look forward to another year of collaboration that will focus on the GSICS goals established during this meeting.

Photograph courtesy of KMA.

(Dr. R. Iacovazzi, Jr. [GCC])

NOAA Workshop on Climate Data Records from Satellite Passive Microwave Sounders – AMSU/MHS/SSMT2

As part of NOAA's Climate Data Record (CDR) program[5], two related projects - one lead by a NESDIS/Center for Satellite Applications and Research (STAR) team and one lead by the City College of New York (CCNY) – held a joint

[4] http://gsics.wmo.int
[5] http://www.ncdc.noaa.gov/cdr/index.html

workshop between 2-3 March 2011 in College Park, Maryland, USA with the following objectives:

- To allow NOAA's CDR Product Development Teams to interact with Advance Microwave Sounding Unit (AMSU), Microwave Humidity Sounder (MHS) and Special Sensor Microwave Temperature-2 (SSM/T2) data/product users and other CDR developers on relevant aspects of sensor characteristics and inter-calibration that will lead to mature CDRs.
- To provide a formal mechanism for technical input by external parties with expertise on the subject matter, in particular, sensor scientists and engineers.
- To move towards a community consensus approach for NOAA microwave sounder CDRs.

Over 40 passive microwave instrument experts were in attendance to discuss the various aspects of the AMSU, MHS and SSMT/2 sensors, as well as their applications to hydrological products and upper tropospheric humidity. NOAA's CDR program and its relevance to the broader international scientific community were described by B. Nelson (NCDC) and M. Goldberg (STAR). It has its origins from the National Research Council (NRC) study "*Climate Data Records from Environments Satellites*[6]", where "Fundamental" CDRs (FCDRs) are defined as calibrated radiances from a family of sensors whereas "Thematic" CDRs (TCDRs) are geophysical variables derived from the FCDRs.

Several talks focused on the AMSU-A sensor. Huan Meng (STAR) provided an overview of the project to develop AMSU and MHS CDRs that are used for hydrological applications. Progress after the first year of the project includes the characterization of the scan bias of AMSU-A, AMSU-B/MHS, as well as its geolocation error. An eleven-year CDR is expected by the projects' completion. Other scientists focused on various methods to inter-calibrate AMSU-A: T. Mo (STAR), W. Yang, (University of Maryland/ Cooperative Institute for Climate and Satellites – CICS), R. Iacovazzi, Jr. (STAR), and C. Zou (STAR). Cheng-Zhi Zou is leading the CDR project focused on the AMSU-A "sounding" channels for a long term MSU/AMSU/SSU FCDR and upper air temperature TCDR. Two presenters discussed AMSU-B and MHS: C. Devaraj (CICS) and J. Ackermann (EUMETSAT). It was obvious that synergy between the NOAA and EUMETSAT CDR programs should be pursued.

Zhengzhao Luo (CCNY) discussed their ongoing work to recover Defense Meteorological Satellite Program (DMSP) SSM/T2 data and to use temperature/moisture measurements from on-board commercial aircraft to calibrate SSM/T2 water vapor radiances (near 183 GHz). This is being undertaken in a separate NOAA CDR project. A 15-year CDR record from SSM/T2 is expected by projects completion and will be instrumental for monitoring upper level humidity. Eric Fetzer, (JPL) spoke about NASA's equivalent water vapor CDR using AIRS/AMSU while C. Liang (UCLA), presented a climate variability study using multi-sensor products from the A-Train to study upper tropospheric moisture.

Other speakers on various topical areas related to CDRs included F. Weng (STAR) - Empirical Model Decomposition; Isaac Moradi, (CICS) – Geolocation; W. Blackwell, (MIT/Lincoln Labs) – ATMS CDR (ATMS is the AMSU follow on instrument that will be first flown in October 2011); and R. Chen (STAR/I.M. Systems Group, Inc.) - Jason radiometer cross-calibration.

There are several key issues identified at the workshop that need to be addressed by the NOAA CDR projects. These include: satellite and sensor attitude; high quality "metadata" on the sensors; antenna sidelobe effects; sensor RFI; sensor nonlinear calibration error; orbital drift and decay; and asymmetry in environmental conditions. It is recognized that not all biases can be resolved within a three year project. Therefore, those issues that have proven solutions and cause the greatest uncertainties in the FCDRs should be addressed first. Over time, this approach reduces the overall uncertainty in both the FCDRs and TCDRs, and subsequent improvements can be addressed in follow-on efforts and through continued synergy with other similar programs at organizations like NASA and EUMETSAT. The project PIs (Ferraro, Meng, Luo) and their teams received valuable feedback on their ongoing efforts from the experts in the field that will greatly benefit their projects over the next two years. A complete workshop report is available at the NESDIS/STAR website[7].

(by Drs. R. Ferraro and H. Meng [STAR]; Z. Luo [CCNY]; and W. Yang, C. Devaraj, I. Moradi [CICS])

Special issue of the Canadian Journal of Remote Sensing (CJRS): Terrestrial Reference Standard Test Sites for Post-Launch Calibration

In an era when the number of Earth-observing satellites is rapidly growing and measurements from these sensors are used to answer increasingly urgent global issues, often through synergistic and operational combinations of data from multiple sources, it is imperative that scientists and decision-makers be able to rely on the accuracy of Earth observation data products. The characterization of sensor relative measurement biases, and the subsequent sensor inter-calibration to resolve those biases, is vital to achieving the development of the integrated Global Earth Observation System of Systems (GEOSS) for coordinated and sustained observations of the Earth. Currently, this can only be reliably achieved in the post-launch environment through the careful use of observations by multiple sensor systems over common and well-characterized terrestrial targets.

Earth surfaces with suitable characteristics have long served as benchmark or reference standard test sites to verify the post-launch performance of satellite sensors. Reference standard

[6] http://dels.nas.edu/Report/Climate-Data-Records-from-Environmental-Satellites/10944

[7] http://www.star.nesdis.noaa.gov/star/meeting_CDR2011.php

test sites are a key operational component of the newly established Quality Assurance Framework for Earth Observation (QA4EO). At present, test sites in their broadest sense are the only practical means of deriving knowledge on biases between sensors in all technical domains, and provide a convenient means of obtaining information to verify sensor performance. Accordingly, this special journal issue focuses on how reference standard test sites provide important and convenient post-launch means of obtaining information to verify the performance of sensors. For this edition, the domain of interest is limited to infrared, visible, and optical sensors.

The papers contained in this special issue include one overview article, five papers that pertain to specific reference standard sites, four papers that address specific sensor systems in the context of ground-look calibration methodologies, and four papers that are concerned with other types of sites that address the special issue topics. The issue can be found on the CJRS website[8].

(by Drs. G. Chander [SGT/USGS] and P. M. Teillet [University of Lethbridge])

Just Around the Bend …

New GSICS Mail and News Subscriptions

In August 2011, GSICS plans to launch a mail and news subscription service through the cloud-based provider MailChimp. The service will provide information about GSICS inter-calibration activities, product beta-testing opportunities, product updates, workshops and meetings, and access to the *GSICS Quarterly* newsletter. We at the GCC plan to send you an e-mail in the coming weeks about how you can sign up for this new subscription service.

GSICS-Related Meetings

- **GPM X-Cal Meeting, 13-14 July 2011, Fort Collins, CO, USA**
- **SPIE Optics and Photonics, 21-25 August 2011, San Diego, CA, USA. GSICS-relevant sessions:**
  - CERES
  - Sensor intercomparison
  - AIRS performance
  - MODIS on-orbit calibration and uncertainty analysis
  - Vicarious calibration
  - VIIRS
  - Data products and processing
  - Image processing
- **CALCON Technical Conference, 29 August to 1 September 2011, Logan, UT. High-level Agenda:**
  - Pre-launch testing and post-launch performance
  - Inter-calibration and validation of operational sensors
  - Radiometric sensor calibration uncertainty and error analysis
  - Calibration methods using celestial objects
  - Calibration of microwave radiometers and other microwave instruments
  - Calibration data analysis methods and software
  - Calibration methods for climate change measurements and modeling
- **Third GSICS Users' Workshop, 6 September 2011, Oslo, Norway (held in conjunction with the 2011 EUMETSAT Satellite Conference). High-level Agenda:**
  - GSICS status on activities and existing products
  - GSICS strategy for inter-calibration of solar channels
  - GSICS strategy for LEO to LEO products, especially µwave inter-calibration - an outreach to possible beta-testers
  - MODIS Product Uncertainty Index
  - Need for common reference channels
  - GSICS Work on the Chinese instrument MERSI
  - GSICS relation to GRUAN

GSICS Publications

Datla, R. et al., 2011: Best Practice Guidelines for Pre-Launch Characterization and Calibration of Instruments for Passive Optical Remote Sensing. *J. Res. NIST*, **116**, No. 2, 621-646.

Kerr, Y. et al., 2011: A multisensor appraoch to Remote sensing and related intercalibration techniques. *EGU General Assembly*

Ladstädter, A. et al., 2011: An assessment of differences in lower stratospheric temperature records from (A)MSU, radiosondes, and GPS radio occultation. *Atm. Measurement Techniques Discussions*. **4**, 2127-2159.

Radhadevi, P. et al., 2011: In-flight Geometric Calibration and Orientation of ALOS/PRISM Imagery with a Generic Sensor Model. *Photogrammetric Engineering Rem. Sens.*, **77**, No. 5, 531-538.

Please send bibliographic references of your recent GSICS-related publications to Bob.Iacovazzi@noaa.gov.

With 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* Associate Editor, Gordana Sindic-Rancic of GCC, European Correspondent, Dr. Tim Hewison of EUMETSAT, and Asian Correspondent, Dr. Yuan Li of CMA, in helping to secure and edit articles for publication.

Submitting Articles to GSICS Quarterly: 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, *GSICS Quarterly* Editor.**

[8] http://pubs.casi.ca/toc/cjrs/36/5