

GSICS PILOT PROJECT FOR WIGOS

In response to CGMS Recommendation 36.05

CGMS-36 had recommended developing a Pilot Project for the WMO Integrated Global Observing Systems (WIGOS), based on the Global Space-based Inter-calibration System (GSICS). This recommendation has been fulfilled and GSICS is now recognized as one of the seven WIGOS Pilot Projects. The present document reports on the status of GSICS as a Pilot Project for WIGOS as of September 2009.

Important progress was made over the past year with respect to each planned deliverable:

- A common methodology was developed for the comparison GEO Infrared imagers and LEO hyperspectral sounders based on Simultaneous Nadir Overpasses;
- Data management and exchange procedures and tools were implemented;
- Routine production of inter-calibration results has started for geostationary and operational Polar-orbiting satellite infrared sensors;
- Results are made openly available through the GSICS web site;
- Changes in management procedures have been developed and harmonization is being pursued with the CEOS QA4EO initiative;
- Communication and outreach activities were carried out;
- The GSICS user workshop held on 22 September 2009 was an important milestone where a first direct interaction could take place with current and potential users, and representative users have agreed to serve as beta-testers of GSICS products.

Work is ongoing as the scope of GSICS is extending to visible and microwave radiometric sensors.

Participation of all CGMS satellite operators is strongly encouraged in order to ensure a world wide comparability and seamless integration of space-based observation data sets, which will ultimately benefit all.

Action/Recommendation proposed:

Participation of all CGMS satellite operators in GSICS is strongly encouraged in order to ensure a world wide comparability and seamless integration of space-based observation data sets.

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1 INTRODUCTION

The GSICS Pilot Project for WIGOS aims to identify and address key issues related to the integration of space-based observations from different satellite missions and instruments.

The Global Space-based Inter-calibration System (GSICS) is a joint initiative of WMO and the Coordination Group for Meteorological Satellites (CGMS), implemented along the GSICS Implementation Plan adopted in April 2006. Nine organizations are currently participating (CMA, CNES, EUMETSAT, JMA, KMA, NASA, NIST, NOAA, and WMO).

The project is overseen by the GSICS Executive Panel, supported by the WMO Space Programme Office. Scientific and technical activities are being performed by the GSICS participating organizations, in accordance with the agreed-upon Operations Plan, with coordination achieved by the GSICS Coordination Centre (GCC) for overall operational coordination and information aspects, the GSICS Research Working Group (for scientific aspects) and the GSICS Data Management Working Group (GDWG) for the data management aspects.

2 EXPECTED DELIVERABLES

The Pilot Project has the following deliverables:

- (i) Documents on best practices for pre-launch instrument characterization and SI traceability;
- (ii) Agreed-upon algorithms, data management practices, and deliverables for on-orbit satellite data intercomparison;
- (iii) Implementation of WIS-compatible data description and designation standards for satellite data intercomparison;
- (iv) Distributed operational infrastructure (software modules, data servers, web servers);
- (v) Routine availability of "GSICS Correction";
- (vi) Assessment of the consistency of data sets originated from different satellite systems, enabling their merging for the derivation of climate products or other applications.
- (vii) End-user evaluation of the benefit of GSICS results in 2 key applications.

3 PROGRESS AS OF END OF SEPTEMBER 2009

3.1 Best practices for pre-launch instrument characterization and SI traceability

A first issue of “Best Practice Guidelines for Pre-Launch Characterization and Calibration of Instruments for Passive Optical Remote Sensing (NISTIR 7602)” has been finalized by NIST on behalf of GSICS in September 2009.

3.2 Common algorithm development and documentation

A common hierarchical and modular structure for the Algorithm Theoretical Baseline Documents (ATBD) has been agreed by the GRWG. The hierarchical ATBD structure includes a layer of common principles, more specific layers for the detailed application to each satellite and sensor category (GEO/LEO, Infrared/Visible/Microwave) and more specific layers describing the implementation of the algorithm for each particular satellite instrument pair.

The ATBD has been completed by EUMETSAT, JMA, and NOAA for the comparison of Infrared imagery channels of their respective geostationary satellites with IASI and AIRS, based on (near) Simultaneous (near) Nadir Overpasses. This methodology was developed with the aim of setting common principles that would be applicable to other instruments as well.

Work needs to be pursued on the calibration of visible and microwave sensors.

3.3 Common data management procedures

The concept of a GSICS data and product server architecture proposed by EUMETSAT was adopted by the GDWG.

The following steps have been completed in terms of harmonization of data management procedures:

- A common file naming convention was adopted, in implementation of the general GTS file naming convention.
- The use of netCDF format was adopted for the comparison datasets and resulting products.
- The use of “.nc” extension for netCDF files was proposed to CBS, subsequently adopted and endorsed by the WMO Executive Council as part of an amendment to the Manual of Codes entering into force in November 2009.
- A proposal is being considered to define a new data category and related sub-categories for “Calibration dataset (satellite)” in the Common Code Table C-13.

3.4 Common data server infrastructure

EUMETSAT and NOAA have implemented operationally their respective GSICS Data and Products Servers, which mirror each other. The servers provide an upload

service for the GSICS partners to upload their comparable netCDF data sets identified in a unique way in accordance with WMO file naming convention. These data sets form a rolling archive accessible via HTTP or FTP download. Resulting products based on GSICS algorithms are also uploaded to the server for validation, publishing or archiving.

Similar servers may be added in the future by the other GSICS production centres.

3.5 Routine production of inter-calibration results

Operational GEO infrared imagers are now routinely compared to AIRS and IASI taken as reference instruments. The principle is to apply the spectral response function of each GEO imager channel to the radiance spectrum measured by IASI or AIRS, and to compare this simulation to the actual response of the GEO imager over the same scene.

The result of this comparison is described statistically in various ways including mean bias, linear regression, and graphical outputs. A correction formula, “the GSICS correction”, is then proposed to derive from actual measurements the best estimate of the “true” radiances.

Low-Earth orbit imagers and sounders are also compared on a routine basis by NOAA as a demonstration product.

All these products are calculated over a rolling time span, regularly updated and issued on the GSICS web pages of the relevant satellite operators. These pages are all accessible through the unique web page maintained by WMO: <http://gsics.wmo.int>.

3.6 Off-line production and assessments

CNES is providing regular assessments of the performance of the IASI instrument, which is a reference for all infrared GEO imager channels.

3.7 Harmonization of Quality Assurance aspects

A GSICS Procedure for Product Acceptance (GPPA) has been developed. The procedure should be implemented soon for the formal endorsement of the routine products that are currently in validation of demonstration stage (See 3.5 above).

Coordination was established with the Working Group on Calibration and Validation (WGCV) of the Committee on Earth Observation Satellites (CEOS) for the review of the Quality Assurance Framework for Earth Observation (QA4EO) developed by CEOS as part of a Task within the Group on Earth Observations (GEO) work plan.

3.8 Outreach activities

The GSICS Pilot Project for WIGOS was presented at TECO WIGOS and brought to the attention of CBS-XIV (Dubrovnik, Croatia, March 2009).

A GSICS newsletter is issued on a quarterly basis by the GSICS Coordination Centre (operated by NOAA), and distributed electronically to a regularly increasing list of recipients throughout the world. This GSICS Quarterly systematically contains reports on recent scientific work by GSICS partners as well as a summary outcome of the various GSICS working group meetings.

All reports and newsletters are made available online by the GCC web site, which can be accessed through the GSICS home page <http://gsics.wmo.int>.

3.9 User interaction

A GSICS Information, Product and Services Roster has been developed as a basis for informing potential users, and seeking their feedback, on the specification of current and planned GSICS deliverables. This roster was circulated to GCOS and SCOPE-CM participating organizations for comments. The specification of end-products is still provisional and shall be finalized once sufficient feedback will be collected from the beta-testers. It should also evolve with time in response to new users requirements.

A highlight of 2009 is the GSICS Users Workshop that was held on 22 September 2009 in Bath, United Kingdom, as a parallel session of the EUMETSAT Meteorological Satellite Conference. The main purpose of this session was to inform potential users, to seek preliminary feedback on the GSICS approach, and to identify applications and representative users willing to serve as beta-testers of the early GSICS products. The workshop was attended by around 60 people and its main outcome can be summarized as follows:

- Two major application areas confirmed their interest: climate monitoring for the detection of climate change and Numerical Weather Prediction.
- In addition, the importance of GSICS calibration information was mentioned for Land Surface applications.
- The climate monitoring area was represented at the workshop by the EUMETSAT SAF on Climate Monitoring and by a contribution from the International Satellite Cloud Climatology Project (ISCCP). GSICS should provide results comparable to ISCCP calibration data for evaluation and, if relevant, could replace the ISCCP inter-calibration approach that has been pursued for the past 26 years.
- NWP was represented at the workshop by CMC, ECMWF, JCSDA, JMA, and the Met Office. An independent bias assessment by GSICS would be useful for reanalysis, for the validation of climate models, for initiation of seasonal forecast models, and improvement of assimilation in NWP models. However, technical issues need to be investigated in order to (i) define a proper timescale for GSICS correction that is compatible with near-real time operations, and (ii) define references for heritage datasets collected before the AIRS and IASI instruments became available.

- It was agreed in principle that beta-testing evaluations would be performed by ECMWF, ISCCP, SAF-CM, and proposed to the SAF on Land Surface Analysis.
- A number of suggestions were made for future directions of work, which included: inter-calibration with heritage instruments, passive microwave calibration, visible calibration, use of GPS Radio-occultation as a benchmark, inter-calibration of future Highly Elliptical Orbit missions.
- As concerns the services to be delivered, the need was confirmed of a one-stop shop offering access to all GSICS products. It was suggested that GSICS provide best calibration algorithms for use either in reprocessing activities or by direct readout users.
- Continuing coordination was encouraged with the GEO-CEOS initiative to develop a Quality Assurance Framework for Earth Observation (QA4EO).
- The workshop stressed the need for more communication and outreach efforts.

3.10 Project coordination

The GSICS Executive Panel held its fifth meeting on 3 and 4 June 2009 in College Park, USA. The sixth meeting will be collocated with the 37th CGMS plenary meeting in Jeju, Republic of Korea, on 30 October 2009.

The GSICS working groups (GRWG and GDWG) have held a joint session in Tokyo in February 2009, and will hold their next joint session in Toulouse, France in February 2010. Virtual meetings are held by each group on a regular basis using a web conference system.

The WMO Secretariat is providing support to this overall coordination; however this support had to be reduced over the past year, as a result of the organization of work within the Secretariat and the resulting workload.

4 CONCLUSIONS

The project has completed the definition of common inter-calibration methods, and implemented data management and exchange procedures and tools. This has enabled starting routine production of inter-calibration results for geostationary and operational Polar-orbiting satellite infrared sensors, which are made openly available through the GSICS web site.

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