

GLOBAL SPACE-BASED INTERCALIBRATION SYSTEM

SUMMARY OUTCOME OF THE FIRST GSICS USERS' WORKSHOP

The Global Space-based Inter-Calibration System (GSICS) convened its first Users' Workshop on 22 September 2009 at Bath, United Kingdom, in conjunction with the 2009 European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) Meteorological Satellite Conference. The workshop attracted 67 participants from 37 national and international organizations and universities. A list of registered workshop participants is in Appendix A.

In the first two hours, participants were introduced to the GSICS, its first key product (GSICS Correction), the GSICS data and products servers, and the GSICS Coordination Center (GCC). A presentation was also given on the Committee on Earth Observation Satellites (CEOS) Quality Assurance Framework for Earth Observation (QA4EO) that proposes general principles and guidelines that were felt broadly in accordance with GSICS goals and practices. These were followed by two hours of discussions to receive feedback from a variety of users. Workshop agenda is in Appendix B, and workshop presentations are at: <https://cs.star.nesdis.noaa.gov/twiki/bin/view/GSICS/UsersWorkshop2009>.

1. Users Participation

Several users presented their results of and/or plans for calibration, inter-calibration, and re-calibration. GSICS should recognize that users tend to do their own calibration, or at least to validate the calibration given to them. This is especially true for those sophisticated applications that GSICS intends to serve. This is an opportunity to help achieving the goals of GSICS. GSICS needs a strategy to take advantage of users' calibration resources and expertise, to foster collaborations (for instance for redundancy and independent verification), in order to build GSICS as a centralized knowledge base. Since the main purpose of GSICS is to provide sustained intercalibration and corrections by satellite operators for the life of missions, GSICS needs to determine the sustainability of calibration efforts by users.

GSICS needs to define its interface with the users and how communications will be managed. A suggestion is to create an advisory body that includes users, which may provide a formal yet flexible channel for users to interact with GSICS members.

2. Reanalysis

Dick Dee (ECMWF) demonstrated the capability of reanalysis at the European Centre for Medium-range Weather Forecast (ECMWF) to identify instrument anomalies. John Eyre pointed out that the behaviour of O-B (difference between observations and background) in reanalysis is often indicative of the quality of that particular observation. These suggest that reanalysis may benefit from, *and* show the positive impact of, a partially improved calibration. Suppose we have improved GEO IR calibration since 2002 with GSICS, we then would expect the reanalysis to show that, compared to before 2002, O-B after 2002 becomes smaller or more uniform or otherwise more "predictable". This does not require recalibration of all sensors for all time before a reanalysis, nor "with/without" type of re-run after reanalysis. Reanalysis may become a powerful tool to evaluate the GSICS products.

However, GSICS should coordinate with the relevant centres to ensure that GSICS results are available in a time frame compatible with the planned reanalysis activities. Furthermore, it would be useful to define references for the heritage datasets collected before the availability of current reference instruments AIRS and IASI.

3. Climate trend detection

Bill Rossow (City College New York), in a presentation given on his behalf by Volker Gärtner, indicated that International Satellite Cloud Climatology Project (ISCCP) would use the GSICS Correction after evaluation, if it proves to be better than the ISCCP intercalibration scheme that has been applied for the past two decades. This represents another type of application, namely an application to a well-established climate research project on cloud properties.

GSICS needs to liaise with ISCCP to identify a way forward and define the specifications of the products required for such comparative evaluation.

4. Climate and seasonal forecast modelling

Roger Saunders indicated that an independent assessment of instrument bias would be useful to constrain and validate climate models and to initialize seasonal forecast models.

5. NWP bias monitoring

Roger Saunders (Met Office) reported good initial result from the Met Office NWP bias monitoring study and expressed an interest in extending it if funding can be found. He also pointed out that bias monitoring statistics from several other NWP centres should be available through the NWP Satellite Applications Facility ([NWPSAF website](#)).

Bias is monitored at several major NWP centres, often routinely, and may add to the instrument performance monitoring such as calibration. One requirement is to deduce the instrument bias from the NWP bias that is directly monitored. Double-differencing is a technique that removes the model bias but only yields the bias difference between two instruments.

6. Impact On Products

Several users are willing to evaluate the impact of GSICS on various products.

- a) Peter Francis (Met Office) is willing to apply the GSICS Correction to Meteosat-9 IR channels and to compare the resulting O-B biases with those from the uncorrected observations before they apply their internal bias correction. This is another way of evaluating the impact of GSICS on NWP, in addition to reanalysis.
- b) Elisabeth Good (Met Office) reported that the EUMETSAT SAF on Land Surface Analysis (LSA SAF) would be interested in evaluating the impact of GSICS Correction for Meteosat-9 IR data on the diurnal cycle of Land Surface Temperatures.
- c) Atsushi Higuchi (Chiba Univ.) reported positive impacts of GMS visible channel vicarious calibration on aerosols and other products. The algorithm was jointly developed with JMA.

- d) Jörg Schulz (CM SAF, DWD) offered to compare operational (non-corrected) radiance, GSICS Corrected radiance, and in-house corrected radiance (but non-GSICS) using reference RAOB. He is also interested in evaluating the impact of GSICS corrected Meteosat-9 radiance on the Upper Tropospheric Humidity products of the EUMETSAT SAF on Climate Monitoring (CM SAF).

7. Users Requests for New GSICS Products

Users have strong interest in the following future GSICS products:

a. Microwave

Many of the attendees expressed a strong desire for GSICS to include products for the inter-calibration of microwave images and sounders. There is a great heritage of work in this area, so it was suggested that we invite researchers who have conducted independent reviews of the existing algorithms to a meeting, aiming to recommend a consensus method for each class of microwave radiometer. One outstanding issue is the definition of an inter-calibration reference for microwave instruments, given the absence of any traceable or hyperspectral observations on-orbit. [Suggested Action: GRWG to identify microwave experts and invite them to next GRWG meeting.]

b. Solar

Throughout the conference we heard a lot of interest (e.g. CM SAF) in the calibration of the solar channels of GEO satellites – particularly MSG. Numerous different methods have been developed to inter-calibrate solar channels, many of which show evidence of biases in Meteosat and other GEO imagers. Within GSICS we need to define a consensus algorithm and inter-calibration reference for these channels. Potential references include MODIS, MERIS and GOME-2. [Suggested Actions: Invite experts on MERIS to next GRWG and focus the meeting on forming a consensus on solar inter-calibration method for GEO imagers.]

c. ATSR

There was considerable interest in extending the IR inter-calibrations to include (A)ATSR. This instrument has been widely used by the climate-monitoring community and is highly valued for providing a long time series of observations, which they regard as a benchmark for accuracy and stability. This would be best achieved by inviting experts from Rutherford Appleton Laboratory (RAL) to participate in GSICS. [Suggested Action for Exec: Invite (A)ATSR expert to join GSICS.]

d. AVHRR

Similarly, there was interest in including AVHRR. Although there are known deficiencies in its calibration, linearity and SRF definition, it is also widely used in the climate community because of its remarkably long data record. [Action: GRWG to review.]

e. GEO-GEO

The inter-calibration between different GEO imagers was also discussed. For IR channels this can be tackled by double-differencing using hyperspectral LEO sounders (or NWP models) as transfer radiometers, or by direct comparison of similar channels in overlapping areas. [Recommended Action: all GPRCs to pursue within GRWG.]

f. GPS Radio-occultation

It was suggested to investigate the use of GPS radio-occultation measurements in the future as an additional benchmark.

g. HEO missions

Should the current plans for Highly Elliptical Orbit missions be confirmed, it would be useful to develop intercalibration methods for these missions.

8. Other Users Requests and Recommendations

- a) GSICS should consider defining a single point of contact and creating a Google Group for GSICS Users’.
- b) Users stated a desire for the GCC website being a ‘One Stop Shop’ for all your GSICS needs. This is not currently the case. It does not link to all the prototype products, but provides link to many heritage products, which are neither GSICS approved or prototypes. [Suggested Action: to re-structure GCC website to make clear distinction between GSICS products and NOAA heritage products.]
- c) There is a need for more communication and outreach efforts and for collecting user feedback. In its present form, the GSICS Information, Services and Product Roster is not known by the users and is not sufficient to support interaction on planned product specification.
- d) It was requested that GSICS provide not only “best calibration results” but also best calibration algorithms to be used on one hand in reprocessing activities and, on the other hand, by direct readout users.

9. Conclusions

The workshop was well attended and the general feedback is that users have strong expectations. Several representative users expressed readiness to contribute to the evaluation of GSICS products.

The following suggestions will be considered by the GSICS Executive Panel for follow-up actions:

- 1. To establish an advisory body providing a formal yet flexible channel for interaction with users.
- 2. To coordinate with NWP centres to ensure that relevant GSICS results can be made available in a time frame compatible with the planned reanalysis activities.
- 3. To define references for the heritage datasets collected before the availability of current reference instruments AIRS and IASI.
- 4. To work with ISCCP to define the specifications of GSICS products, based on GSICS correction, to be used in ISCCP for comparative evaluation with the current ISCCP intercalibration schemes, and to define practical modalities for such a test
- 5. To invite the EUMETSAT LSA SAF to evaluate the impact of GSICS correction on Land Surface Temperature or other LSA SAF products.

6. To invite the EUMETSAT CM SAF to evaluate the impact of GSICS correction on the CM SAF Upper Tropospheric Humidity products
7. GRWG to identify and invite microwave experts to next GRWG meeting.
8. To invite RAL to send a representative of the AATSR community to the next GRWG meeting.
9. GRWG to consider plans for AVHRR intercalibration
10. GRWG to refine the definition of GEO-GEO intercalibration products
11. GSICS representatives at CGMS to encourage participation of ISRO and/or IMD in GSICS.
12. To consider the definition of a GSICS single point of contact for users, and the establishment of a GSICS users Google group,
13. GCC to review its website with a view to distinguish GSICS products from other NOAA activities,
14. To review the GSICS Roster taking into account the suggestions for new products and services, and the need for improved readability by users.

Generally speaking, GSICS needs to enhance its communication towards, and interaction with users. It should maintain the momentum and develop a strategy that uses the available resources and expertise to meet users' needs in an optimal way.

It was further agreed that a summary of the outcome of this First GSICS Users' Workshop would be circulated to all attendees and published on the WMO GSICS website; a summary would also be published in the GSICS Quarterly.

APPENDIX A: GSICS USERS' WORKSHOP ATTENDEES

Alfheim, Arne (Environment Canada)
Andersson, Axel (ZMAW, Hamburg)
Blumstein, Denis (CNES, France)
Brindley, Helen (Imperial College, UK)
Clerbaux, Nicolas (RMI, Belgium)
Dee, Dick (ECMWF)
Dewitte, Steven (RMI, Belgium)
Eyre, John (Met Office, UK)
Frédéric Gasiglia (EUMETSAT)
Garand, Louis (Environment Canada)
Gärtner, Volker (EUMETSAT)
Goldberg, Mitch (NOAA)
Good, Elizabeth (Met Office, UK)
Harris, Andy (NOAA)
Hautecoeur, Olivier (MeteoFrance)
Heidinger, Andrew (NOAA)
Hewison, Tim (EUMETSAT)
Higuchi, Atsushi (Chiba Uni., Japan)
Holmlund, Kenneth (EUMETSAT)
Huang, Allen (SSEC Uni Wisconsin)
Iacovazzi, Robert (NOAA)
Illingworth, Samuel (Uni. Leeds)
John, Viju (Met Office, UK)
Jolivet, Dominique (HQ GCOS)
Kachi, Misako (JAXA, Japan)
Kilcoyne, Heather (NOAA)
Koenig, Marianne (EUMETSAT)
Lafeuille, Jerome (WMO)
Larar, Allen (NASA)
Lecomte, Pascal (ESA)
Lindfors, Anders (Uni. Edinburgh)
Majewski, Leon (BOM, Australia)
Martinez, Miguel A. (INM, Spain)
Mittaz, Jonathan (NOAA)
Nicolas, Jean-Marc (Uni. Lille, France)

Nilsson, Stefan (SHMI, Sweden)
Okuyama, Arata (JMA, Japan)
Ou, Mi-Lim (Korean Met Admin)
Phillips, Pepe (EUMETSAT)
Phulpin, Thierry (CNES, France)
Pougatchev, Nikita (SDL, Utah State)
Puschell, Jeffery (Raytheon, USA)
Randriamampianina, Roger (met.no)
Reed, Bonnie (NOAA)
Renaut, Didier (CNES, France)
Revercomb, Hank (SSEC Uni Wisconsin)
Riishojgaard, Lars-Peter (NASA)
Rothfuss, Harald (EUMETSAT)
Ryan, Barbara (WMO)
Saunders, Roger (Met Office, UK)
Schmetz, Johannes (EUMETSAT)
Schröder, Marc (DWD, Germany)
Schulz, Jörg (DWD, Germany)
Seiz, Gabriela (MeteoSwiss)
Sembhi, Harjinder (Uni. Leeds)
Shin, Hae-Yong (SeaSpace Corp, USA)
Sohn, B.J. (Seoul National University)
Stuhlmann, Rolf (EUMETSAT)
Takenaka, Hideaki (Chiba Uni, Japan)
de la Taille, Lionel (EUMETSAT)
Taylor, Jonathan (Met Office, UK)
Thepaut, Jean-Noel (ECMWF)
Wagneur, Nicolas (Environment Canada)
Wang, Likun (NOAA)
Weng, Fuzhong (NOAA)
Werscheck, Martin (DWD, Germany)
Wollenweber, Fritz G. (EUMETSAT)
Won, Jae Gwang (Korean Met Admin)
Wu, Xiangqian (NOAA)

APPENDIX B: GSICS USERS' WORKSHOP AGENDA

Timing Guideline	Topic	Speaker/Chair
13:30-13:40	Welcome	Barbara Ryan (WMO) Jo Schmetz (EUMETSAT) for GSICS Executive Panel
13:40-14:00	Introduction to GSICS	Mitch Goldberg (NOAA) for GSICS Executive Panel
14:00-14:35	Introducing the <i>GSICS Correction</i>	Fred Wu (NOAA) & Tim Hewison (EUMETSAT) for GSICS Research Working Group
14:35-14:55	GSICS Data and Products Servers	Volker Gärtner (EUMETSAT) for GSICS Data Working Group
14:55-15:15	Operational Aspects of GSICS	Fuzhong Weng/Bob Iacovazzi (NOAA) for GSICS Coordination Centre
15:15-15:30	Quality Assurance Framework for Earth Observation data (QA4EO)	Pascal Lecomte (ESA) – TBC for CEOS WGCV
15:30-16:00	Coffee break	
16:00-16:30	Users' Expectations of GSICS	Jörg Schulz (DWD for CM-SAF) Dick Dee (ECMWF) Roger Saunders (Met Office) Louis Garand (Environment Canada) Nicolas Clerbaux (RMIB) Jan Fokke Meirink (KNMI) Atsushi Higuchi (CEReS, Chiba U.) Lars Riishojgaard/F.Weng (JCSDA) Viju John (Met Office) Others – TBC
16:30-17:45	Discussion of potential Beta Testing of GSICS Products	Jérôme Lafeuille (WMO) Tim Hewison (EUMETSAT)
	<ul style="list-style-type: none"> • Identifying possible applications for GSICS Products • Identifying users for each application • Defining requirements for each application/product • Defining priorities for future products • GSICS Correction for GEO IR Imagers <ul style="list-style-type: none"> – Form of GSICS Correction – Applicability of GSICS Correction – Possible generation of global composite GEO imagery • Beta Testing Action Plan <ul style="list-style-type: none"> – Identifying Beta test users/products – Validation – e.g. ISCCP – Time frame – Way of Reporting – Workshop? 	
17:45-18:00	Conclusions	Mitch Goldberg (NOAA) Jo Schmetz (EUMETSAT)