MPEF Alternative Calibration Coefficients from GSICS - Validation Report

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# Introduction

## Purpose

This report presents the results of the validation of the *Alternative Calibration Coefficients* generated from the GSICS Near-Real-Time Corrections for Meteosat-10. This system is currently implemented on one validation chain of the MPEF to demonstrate the functionality of the system and allow validation prior to operational roll-out.

## Scope

The scope of this document is the validation of the MPEF processing of the GSICS NRTC to generate alternative calibration coefficients for Meteosat-10.

## Applicable Documents

|  |  |  |
| --- | --- | --- |
| [AD-1] | [ATBD for EUMETSAT Pre-Operational GSICS Inter-Calibration of Meteosat-IASI](https://dmtool.eumetsat.int/cs/idcplg?IdcService=EUM_GET_FILE&dRevLabel=1A&dDocName=382222) | EUM/MET/TEN/11/0268 |
| [AD-2] | [GSICS Meteosat-IASI Inter-calibration Validation Report for Meteosat-9 and -10](https://dmtool.eumetsat.int/cs/idcplg?IdcService=EUM_GET_FILE&dRevLabel=1&dDocName=710237&allowInterrupt=1) | EUM/TSS/REP/13/710237 |
| [AD-3] | [ReadMe for GSICS Pre-Operational NRT Correction of SEVIRI-IASI](https://dmtool.eumetsat.int/cs/idcplg?IdcService=EUM_GET_FILE&dRevLabel=1&dDocName=685681) | EUM/RSP/TEN/13/685681 |

## Reference Documents

N/A.

## Document Structure

Section 1 Is the introduction (this section).

Section 2 Describes the results of the validation.

Section 3 Presents the conclusions.

# validation of the Alternative Calibration Coefficients generated from the GSICS Near-Real-Time Corrections

## Background

This report presents the results of the validation of the *Alternative Calibration Coefficients* generated from the GSICS Near-Real-Time Corrections for Meteosat-10.

### What?

The pre-operational inter-calibration of the IR channels of Meteosat/SEVIRI against Metop/IASI generates coefficients of the GSICS Near-Real-Time Correction (NRTC), which allow users to correct the operational calibration of the IR channels of SEVIRI to be radiometrically consistent with the GSICS reference (Metop-A/IASI). These are available from the EUMETSAT GSICS Data and Products Server (<http://gsics.eumetsat.int/>).

An option in the MPEF (“Cross-Cal Mode”) allows these NRTC coefficients to be read in from the server and converted to derive alternative calibration coefficients (both slope and offset), which are written to the L1.5 header and linked forward to the IMPF.

### Where?

The GSICS GEO-LEO IR inter-calibration algorithm for Meteosat/SEVIRI based on Hyperspectral Simultaneous Nadir Overpasses has been implemented for routine operational off-line processing and is currently installed on a dedicated platform in the Cal/Val facility.

This implementation was previously validated against the prototype version in [AD-2].

### Why?

The motivation for this change is four-fold:

1. To provide a backup calibration in case of failure of the on-board system;
2. To allow users to correct for known radiometric biases in the operational calibration, where these may affect their products (e.g. the effect of ice contamination on IR13.4);
3. To allow users concerned with consistent calibration of different geostationary imagers to apply the GSICS inter-calibration algorithm to bring them to a common scale;
4. The previous vicarious calibration system has become non-functional.

### When?

A new NRTC file is generated every day, based on the comparison of all collocated SEVIRI-IASI radiances over the past 14d period. These provide the best estimate of the current state of the instrument’s calibration. Although they have a nominal validity period of 14d, new coefficients are generated every day. In this way, the alternative calibration coefficients change slightly every day, but should not jump. But in event that no new NRTC being available, previous values will still be valid for a period of up to 14d.

### Who?

The NRTC is generated based on the inter-calibration algorithm [AD-1], developed within the GSICS Research Working Group and reviewed following the [GSICS Procedure for Product Acceptance](https://gsics.nesdis.noaa.gov/wiki/Development/GppaWorkflow). They have been declared as *Pre-Operational GSICS Products*.

The INRC section will ultimately have responsibility for the operational generation of the GSICS Corrections and is currently in the process of porting it to the MPSTAR environment.

### How?

The schematic diagram in Figure 1 explains the relationship between SEVIRI L1.5 counts and radiance before and after application of the GSICS Correction.

*bc*

Counts, C

Radiance, L

GSICS

MPEF

*ac*

*SCc*

*bg*

*ag*

*SCg*

**Figure 1: Relationship between SEVIRI L1.5 counts and radiance before (MPEF, blue) and after (green) application of GSICS Correction.**

The “before” case refers to the operational MPEF calibration, based on views of space and the onboard black body, which provides the slope, *bc*, and space counts, *SCc* to convert counts, *C*, to L1.5 radiance, *Lc*:

**Equation 1: (MPEF):** 

Applying the GSICS Correction modifies these to generate the alternative calibration coefficients, *bg* and *SCg* to provide a radiance consistent with the GSICS reference, *Lg*:

**Equation 2: (GSICS):** 

n.b. *SCg* is equivalent to the calibration offset derived from the GSICS inter-calibration, converted to L1.5 counts. The sign convention is so that *SCg* is equal to the NEGATIVE value of the L1.5 count corresponding to zero radiance.

The coefficients of the GSICS Correction (*ar*, *br*) are defined in terms of the regression of collocated radiances from SEVIRI and IASI. These regression coefficients are inverted to apply the GSICS Correction to the operational calibration, as explained in [AD-3].

**Equation 3:** 

Combining Equations 3 and 2 yields:

**Equation 4:** 

Thus the alternative calibration coefficients become:

**Equation 5:** 

**Equation 6:** 

The GSICS Corrections include uncertainties for both *ar* and *br*, as well as their covariance. But, unfortunately there is only space in the L1.5 header to provide a single value for the uncertainty of the alternative calibration coefficients. So only the uncertainty on the calibration slope term is included by propagating it from *br* to *bg*, thus:

**Equation 7:** 

## Validation Results

The coefficients *ar*, *br*, *σ*(*br*), of the GSICS correction were extracted from the variables *offset*, *slope* and *slope\_se*, respectively from the following NRTC file, valid for 2013-09-30:

[W\_XX-EUMETSAT-Darmstadt,SATCAL+NRTC+GEOLEOIR,MSG3+SEVIRI-MetOpA+IASI\_C\_EUMG\_20130930000000\_preop\_01.nc](http://gsics.eumetsat.int/thredds/dodsC/msg3-seviri-metopa-iasi-preop-nrtc/W_XX-EUMETSAT-Darmstadt%2CSATCAL%2BNRTC%2BGEOLEOIR%2CMSG3%2BSEVIRI-MetOpA%2BIASI_C_EUMG_20130930000000_preop_01.nc%5D%5B0%3A1%3A7%5D)

These were manipulated in an Excel spreadsheet to calculate the alternative calibration coefficients – terms *SCg*, *bg* and *σ*(*bg*) in Table 1:

Table – Alternative calibration coefficients derived from GSICS NRTC for 2013-09-30



These values can be compared directly with the alternative calibration coefficients, *NewOffset*, and *NewCoeff*, from the L1.5 header generated by the Validation MPEF chain, as given in Table 2.

Table – Alternative calibration for 2013-09-30 from L1.5 header on Validation MPEF



These alternative calibration coefficients, *NewOffset*, and *NewCoeff*, from the L1.5 header generated by the Validation MPEF chain in Table 2 exactly match their counterparts *SCg* and *bg* calculated from the GSICS Near-Real-Time Correction in Table 1. Thus validating the implementation of the MPEF code that generates the alternative calibration coefficients.

**Post-validation note:**

Although this version of the code in the Validation MPEF did not correctly generate the uncertainty of the *NewCoeff*, this has now been corrected. It has now been modified to use **Equation 7** to evaluate the uncertainty on the alternative calibration coefficient, σ(*bg*).

# Conclusions

This report has demonstrated the validity of the implementation of the MPEF code that generates the alternative calibration coefficients from the GSICS Near-Real-Time Correction.

It is thus recommended that:

1. These changes should be rolled out to the operational chain of the MPEF for Meteosat-10 as soon as possible, and a user announcement made.
2. These changes should be extended to the processing of data from Meteosat-8 and -9 once validated pre-operational or operational GSICS Corrections can be generated for these instruments.