GSICS Meteosat-IASI Inter-calibration Validation Report for Meteosat-9 and -10

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# Introduction

## Purpose

This report presents the results of the validation of the GSICS GEO-LEO (Meteosat/SEVIRI-Metop-A/IASI) IR inter-calibration system for Meteosat-9 and -10. This system is installed on the EPS Calibration Validation Facility (CVF). The purpose of the validation is to confirm that the Near-Real-Time Correction can be applied to the operational MSG calibration data in near real-time to generate *alternative calibration coefficients*, so as to make their calibration consistent with that of the GSICS references (currently Metop-A/IASI). These should replace the current *alternative calibration coefficients* in the L1.5 header.

## Scope

The scope of this document is the validation of the GSICS GEO-LEO IR inter-calibration algorithm for Meteosat-9 and Meteosat-10.

## Applicable Documents

|  |  |  |
| --- | --- | --- |
| [AD-1] | ATBD for EUMETSAT Pre-Operational GSICS Inter-Calibration of Meteosat-IASI. | EUM/MET/TEN/11/0268 |

## 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 GSICS inter-calibration of Meteosat-IASI as implemented on the Cal/Val Facility

## Background

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 currently receives a routine feed of Meteosat data in HRIT format for Meteosat-9 and -10, as well as IASI data in native format for Metop-A and –B. The JMON-X suite subsets these datasets to select collocated observations, based a series of predefined criteria. These collocations are stored in temporary *DPX files,* which contain full spectral radiances. The GSICS software reads these collocations, filters and analyses them, according to the [[AD-1]](http://www.eumetsat.int/groups/ops/documents/document/pdf_gsics_msg_p-op_atbd.pdf) and generates Re-Analysis Corrections (RAC) and Near-Real-Time Corrections (NRTC), which are written in netCDF format, following the [GSICS Convention](https://gsics.nesdis.noaa.gov/wiki/Development/NetcdfConvention) and uploads these to EUMETSAT’s GSICS Data and Products Server: <http://gsics.eumetsat.int>.

These results have been reviewed following the [GSICS Procedure for Product Acceptance](https://gsics.nesdis.noaa.gov/wiki/Development/GppaWorkflow), and have been declared as *Pre-Operational GSICS Products*.

## File Naming Convention

The output file names are consistent with the GSICS File Naming Convention, as checked on 2013-05-15: <https://gsics.nesdis.noaa.gov/wiki/Development/FilenameConvention>.

This ensures that they are automatically moved to the products correct directory when they are uploaded to the EUMETSAT GSICS Data and Products Server (<http://gsics.eumetsat.int/>)

## File Content Syntax

The following tool was applied to the Pre-Operational RAC and NRTC files CF-Convention to check their compliance with the netCDF CF-Convention (v1.5):

<http://titania.badc.rl.ac.uk/cgi-bin/cf-checker.pl>

The tool is only capable of checking compliance with CF v1.5, whereas the GSICS Convention is based on CF v1.6.

The results showed only the following slight official non-compliances, which have been approved within the GSICS Convention:

* The attribute \_FillValue should have the same type as the variable it represents. However, the test samples used a fixed value of -999999, independent of type.
* The attribute ‘calendar’ is being used in a non-standard way in the variable ‘validity period’.

## Update Frequency

Both the NRTC and RAC files are each updated on the server daily, as required.

## Comparison of Pre-Operational and Demonstration GSICS Products

These biases evaluated here from the Pre-Operational GSICS Re-Analysis Correction are compared with those from the counterpart *Demonstration GSICS* product, which is generated from the prototype *ICESI* (Inter-Calibration at EUMETSAT of SEVIRI-IASI) code running on the TCE. This is based on an independent implementation in IDL of [[AD-1]](http://www.eumetsat.int/groups/sir/documents/document/pdf_gsics_atbd_intercalib_en.pdf), which is slightly different from the Pre-Operational version. The differences have some small impact on the results, which are discussed below.

### Meteosat-9/SEVIRI-Metop-A/IASI

Figure 1 compares time series of ~2 years of Demonstration and Pre-Operational Re-Analysis Corrections for Meteosat-9, based on inter-calibration with Metop-A/IASI. These are expressed as the brightness temperature bias for standard scene radiances (standard atmosphere over the sea) and include shaded bands representing the *k*=2 uncertainty limits calculated from the coefficients’ uncertainties specified in the netCDF files. The following conclusions can be drawn:

* Large jumps and outages found in previous Pre-Op versions have now been eradicated.
* Pre-Op results track Demo results well most of the time for most channels.
* IR3.9 has a systematic difference, expected to be 0.2K, due to Pre-Op version including gap-filling correction after May 2011, which was absent in Demo version.
* IR13.4 shows systematic difference increasing with time for no understood reason, but the Demo version 'jumps' later in time-series, which suggest rogue data was getting through.



Figure - Time Series of 2 years' Re-Analysis Corrections for Meteosat-9, based on inter-calibration with Metop-A/IASI.
Black line shows standard bias evaluated from Demonstration GSICS Product v3.4.1,
with grey shading representing k=2 uncertainty limits.
Red line shows standard bias evaluated from Pre-Operational GSICS Product v1.1.2,
with orange shading representing k=2 uncertainty limits.

Table 1 shows the summary statistics of the data plotted in Figure 1. This shows:

* The *Mean Bias* is only significantly different for IR3.9, because Demo version omitted gap-filling, and for IR13.4, the reason for which is not fully understood.
* Standard Deviations (*SD*) of time series are similar for other channels, showing stable results.
* The *median unc*ertainties derived from the specified uncertainties in the GSICS Correction are very similar.
* Their *rolling standard deviations* (over 29d windows) are also very similar, confirming the stability of Meteosat-9 as well as the inter-calibration algorithms.



Table – Statistics of 2 years' Re-Analysis Corrections for Meteosat-9, based on inter-calibration with Metop-A/IASI.

### Meteosat-10/SEVIRI-Metop-A/IASI

Figure 2 compares time series of ~4 months’ of Demonstration and Pre-Operational Re-Analysis Corrections for Meteosat-10, based on inter-calibration with Metop-A/IASI. These are expressed as the brightness temperature bias for standard scene radiances (standard atmosphere over the sea) and include shaded bands representing the *k*=2 uncertainty limits calculated from the coefficients’ uncertainties specified in the netCDF files. The following conclusions can be drawn:

* Pre-Op results track Demo results well most of the time for most channels.
* IR3.9 has a systematic difference, expected to be 0.2K, due to Pre-Op version including gap-filling correction, which was absent in Demo version.
* IR13.4 shows systematic difference decreasing with time for no understood reason.



Figure - Time Series of 4 months' Re-Analysis Corrections for Meteosat-10, based on inter-calibration with Metop-A/IASI.
Black line shows standard bias evaluated from Demonstration GSICS Product v3.4.1,
with grey shading representing k=2 uncertainty limits.
Red line shows standard bias evaluated from Pre-Operational GSICS Product v1.1.2,
with orange shading representing k=2 uncertainty limits.

Table 2 shows the summary statistics of the data plotted in Figure 2. This shows:

* The *Mean Bias* is only significantly different for IR3.9, because Demo version omitted gap-filling, and for IR13.4, the reason for which is not fully understood.
* Standard Deviations (*SD*) of time series are similar for all channels, showing stable results.
* The *median unc*ertainties derived from the specified uncertainties in the GSICS Correction are very similar.
* Their *rolling standard deviations* (over 29d windows) are also very similar, confirming the stability of Meteosat-9 as well as the inter-calibration algorithms.



Table – Statistics of 4 months' Re-Analysis Corrections for Meteosat-10, based on inter-calibration with Metop-A/IASI.

## Comparison of Demonstration GSICS Near-Real-Time and Re-Analysis Correction

Figure 3 compares time series of ~3 months of Demonstration GSICS Near-Real-Time and Re-Analysis Correction for Meteosat-9, based on inter-calibration with Metop-A/IASI. It shows:

* NRTC lags RAC changes and is more erratic, as expected.
* Both show a clear discontinuity introduced by decontamination in mid February 2013.



Figure - Time Series of 3 months’ GSICS Corrections for Meteosat-9, based on inter-calibration with Metop-A/IASI.
Red diamonds shows standard bias evaluated from Demonstration Near-Real-Time Correction v3.2.1.
Black line shows standard bias evaluated from Demonstration Re-Analysis Correction v3.4.1,
with grey shading representing k=2 uncertainty limits.

## Comparison of Pre-Operational GSICS Near-Real-Time and Re-Analysis Correction

Figure 4 compares time series of ~3 months of Pre-Operational GSICS Near-Real-Time and Re-Analysis Correction for Meteosat-9, based on inter-calibration with Metop-A/IASI. It shows:

* NRTC lags RAC changes and is more erratic, as expected.
* No data after decontamination of 20 Feb 2013, as data feed lost!



Figure - Time Series of 3 months’ GSICS Corrections for Meteosat-9, based on inter-calibration with Metop-A/IASI.
Red diamonds shows standard bias evaluated from Pre-Operational Near-Real-Time Correction v1.1.2.
Black line shows standard bias evaluated from Pre-Operational Re-Analysis Correction v3.1.2,
with grey shading representing k=2 uncertainty limits.

# Conclusions

This report shows the GSICS inter-calibration of Meteosat-IASI implemented on Cal/Val Facility, which generates the *Pre-Operational GSICS Corrections*, is correctly configured, stable and generates good results consistent with those of the prototype code on the TCE, which generates the *Demonstration* GSICS Corrections.

It is recommended that the Near-Real-Time Correction is applied to the operational MSG calibration data in near real-time to generate *alternative calibration coefficients*, to make their calibration consistent with that of the GSICS references (currently Metop-A/IASI), as described in the [*ReadMe*](http://www.eumetsat.int/groups/ops/documents/document/PDF_GSICS_MSG_P-OP_NRTC_README.pdf) files for the GSICS Corrections. These should replace the current *alternative calibration coefficients* in the L1.5 header.