

Prepared by EUMETSAT
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Discussed in WGII

CGMS-45: WHITE PAPER SATELLITE INSTRUMENT EVENTS - STANDARDS AND NOMENCLATURE

In response to action CGMS-43: WGII/3 Action 43.01 “Calibration events logging task team to prepare a white paper outlining the set of parameters, the nomenclature, and the standards to be used for reporting on instrument calibration across space agencies.”.

This working paper summarizes the response of the CGMS Task Team on Calibration Events Logging to action CGMS-43: WGII/3 Action 43.01 “*Calibration events logging task team to prepare a white paper outlining the set of parameters, the nomenclature, and the standards to be used for reporting on instrument calibration across space agencies.*”

The Task Team was established further to a CGMS-42 action [CGMS-42: WGII/3 Action 42.0], and comprises representatives from the CGMS Satellite Operators and WMO. The Task Team contributed to the Global Space-based Inter-Calibration System (GSICS) action(s) asking these agencies to organise for each satellite their instrument calibration information on a single landing page. The WMO modified their WMO-OSCAR web-interface to allow linking to these landing pages. In preparation of CGMS-45, the Task Team prepared a white paper that proposes guidelines for reporting on instrument calibration events across the CGMS Satellite Operators, i.e., the set of parameters, the nomenclature, and the standards to be used for this reporting. Once the Task Team reaches consensus on the guidelines proposed in this white paper, they plan to recommend to CGMS to endorse the proposed guidelines and encourage the CGMS Satellite Operators to apply these guidelines for preparing their instrument landing pages in WMO-OSCAR and for their populating databases of calibration events for past, present (and future) satellite missions. This work shall be further discussed in the context of GSICS.

Action/Recommendation proposed: The CGMS plenary to endorse the guidelines for reporting on instrument calibration events across the CGMS Satellite Operators

RR: Note, this paper will be part of the GSICS reporting at CGMS WG-II.

CGMS-45: White Paper Satellite Instrument Events - Standards and Nomenclature

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2 INTRODUCTION

This white paper presents the response to action CGMS-43: WGII/3 Action 43.01 “*Calibration events logging task team to prepare a white paper outlining the set of parameters, the nomenclature, and the standards to be used for reporting on instrument calibration across space agencies.*”

The above action [CGMS-43: WGII/3 Action 43.01] originates from previous Coordination Topic for Meteorological Satellites (CGMS) actions related to logging calibration events. At the 39th meeting of CGMS it was recommended that “*CGMS Satellite Operators to provide regular information on satellite/instruments events affecting calibration and establish corresponding websites*” [Recommendation 39.12, CGMS MR 39]. At the 40th meeting of CGMS, EUMETSAT and NOAA were tasked “*EUMETSAT and NOAA to present a consensus concept and realisation of calibrations events logging system with emphasis on issues and lessons learnt*” [Action CGMS-40: WG II Action 40.15]. Similarly, the Global Space-based Inter-Calibration System (GSICS) working group recommended at their annual meeting in 2014 “*All Satellite Operators to provide satellite instrument specific links to calibration events to WMO-OSCAR*” [Action GRWG_14.22].

The CGMS Task Team on Calibration Events Logging was established after CGMS-42 [CGMS-42: WGII/3 Action 42.0], and tasked to coordinate among the CGMS Satellite Operators the presentation of instrument specifications, as well as instrument events, in particular calibration events and instrument monitoring. **Error! Reference source not found.** gives the names of the representatives of the CGMS Task Team on Calibration Events Logging.

| Name | CGMS Satellite Operator | Country |
|--|--|--------------|
| Dr. Li, Yuan | CMA | China |
| Mr. Miu, Peter | EUMETSAT | Germany |
| < ESA tbd > | ESA | Italy |
| Dr. A.K. Mitra | IMD | India |
| Mr. Takahashi, Masaya | Meteorological Satellite Center (MSC) Japan Meteorological Agency (JMA) | Japan |
| Ms. Woo, Jin | National Meteorological Satellite Center (KMA) | Korea |
| Mrs Yuhás, Cheryl | NASA | USA |
| Mr. Bali, Manik | NOAA | USA |
| Dr. Lafeuille, Jerome Dr. Bojinski, Stephan | WMO | Switzerland |

Table 1: CGMS Task Team on Calibration Events Logging (status 2 January 2017)

In this paper, the CGMS Task Team will present two aspects of the work to propose guidelines and methods for developing a uniform approach for presenting, logging, and monitoring (at a later stage) calibration information across CGMS Satellite Operators. Firstly, we will present the concept of using landing pages as a vehicle to open up the calibration information available at the CGMS Satellite Operators through the web portal of WMO-OSCAR. In Section 3, the WMO-OSCAR web portal is presented. In Section 4, the structure of the landing pages is presented.

Secondly, we will propose guidelines for reporting on instrument calibration events across the CGMS Satellite Operators, i.e., the set of parameters, the nomenclature, and the standards to be used for this reporting. In Section 5, the standards and nomenclature for instruments events are presented.

Figure 1 illustrates the pathway from the WMO-OSCAR web portal (Section 3), to the landing pages at the CGMS Satellite Operators (Section 4), and finally to Instrument Event databases that use common nomenclature and standards (Section 5).

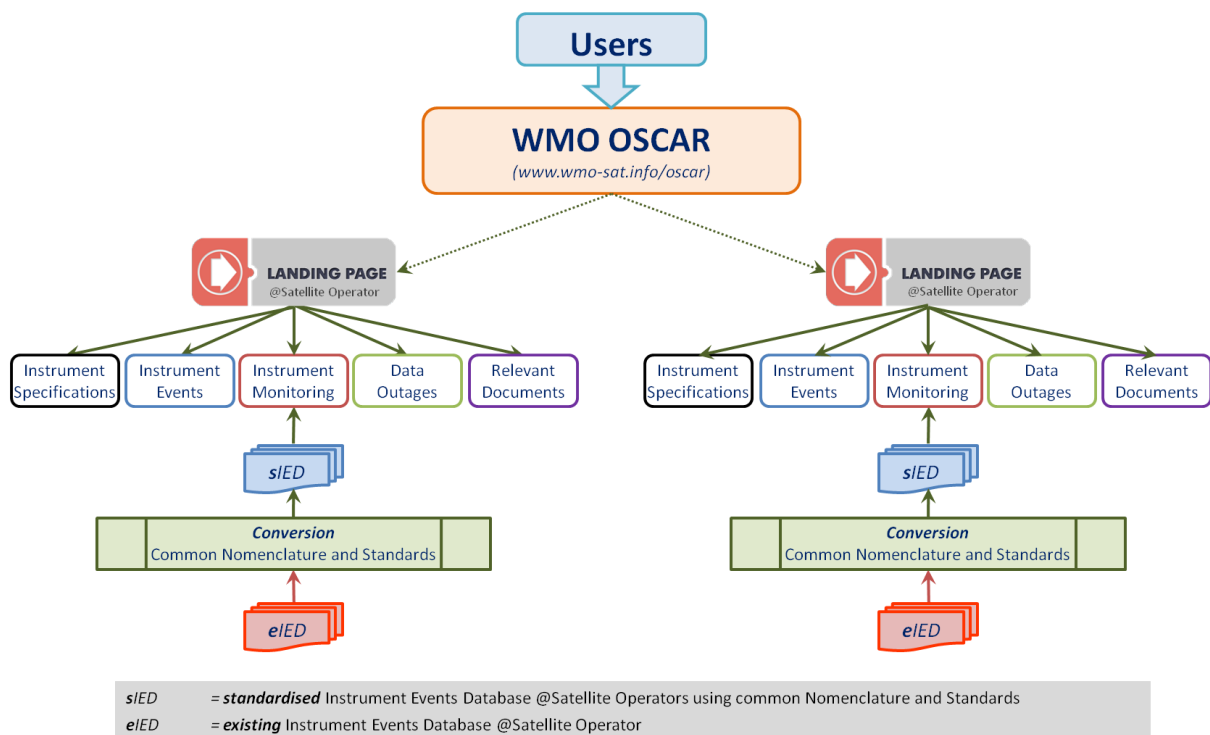


Figure 1: General concept of steps towards a standardizing the Mission and Calibration Event Databases and linking them to WMO OSCAR.

3 WMO-OSCAR

The Observing Systems Capability Analysis and Review Tool (OSCAR) web portal of the World Meteorological Organisation (WMO) provides information on the meteorological satellite of the CGMS Satellite Operators and of the capabilities of the instruments operated onboard of these satellites. In order to allow visitors of the WMO-OSCAR web portal to find more details on the Instrument Specifications, Instrument Events, Instrument Monitoring, and Instrument Data Outages, the WMO modified their OSCAR

web portal. This portal now offers per instrument per satellite a single link, where the CGMS Satellite Operators can provide the address of a landing page that presents the above mentioned instrument details.

4 WMO-OSCAR LANDING PAGES

4.1 Introduction

At CGMS-41 the action on developing a common approach outlining the procedure to log calibration events across space agencies was assigned to GSICS [Action: CGMS-41: WGII/3 Action 41.21 “GSICS to take on calibration event monitoring activities following the recent work on calibration event monitoring. Such information should be included in the next update of the WMO OSCAR database”].

Currently, most space agencies keep databases of calibration events for their operational missions. Users can query these databases to find events that occur at satellite and/or instrument level. These databases are often specific to a single mission and, in most cases, do not use standard naming and metadata conventions to report on calibration events. Moreover, these databases do not only include calibration and data outage events, but often also include events that are not (or not directly) related to instrument calibration.

4.2 Concept

As a first step towards making calibration information available through the WMO-OSCAR web portal, the members of the CGMS Task Team on Calibration Events Logging (see **Error! Reference source not found.**) are asked to create and maintain stable landing pages (a single landing page per instrument per satellite) where information (or links to information) is displayed on the following five topics:

- a) *Instrument Specification* (documents on instruments baseline physical basis)
- b) *Instrument Events* (database or documents of calibration related events)
- c) *Instrument Monitoring* (database or documents following state of the instrument)
- d) *Data Outages* (database or documents with instrument outage dates)
- e) *Relevant Documents* (documents on data usage and data calibration and validation)

Once the landing pages have been created, the Task Team members can send their addresses to the WMO-OSCAR representative, and make a request to add them to the WMO-OSCAR web portal.

a) Instrument Specifications

The topic “*Instrument Specifications*” provides general information on the platform and instruments operated in the mission that is relevant to all users of the satellite data. Even though this topic is not strictly-speaking related to events affecting the calibration quality, the provided information is often appreciated by users. It gives them a complete overview on a mission, and makes them aware of changes in the observing system, in particular when new satellites and instruments are positioned and set operational. Within this topic pieces of information on both the platform and the instrument are covered. The information foreseen includes documents that provide information on the launch and operational dates, on the satellite, on the instrument and sensor characteristics, and on the sensors spectral response functions. In addition, information on requirements,

expected performance, or actual performance could be included. However, the latter information should be labelled as such, and updated during the instruments' evolving lifetime. These specifications shall either be provided through the landing page, or through links referring to the relevant documents.

Note, it is recommended that instrument specifications are, when possible, made available through the landing pages about two to three years before the instrument becomes operational, and that these specifications are linked to the WMO Satellite User Readiness Navigator (SATURN) portal. This portal aims to provide a single point of access for all information on next generation meteorological satellites needed for user community preparations.

b) Instrument Events

The topic "*Instrument Events*" covers information on events that impact the radiometric or geometric quality of the observations. This can be events onboard the instrument, such as instruments calibrations, manoeuvres, ground segment anomalies or miscellaneous, or updates of the processing algorithms (either onboard or at the ground segment), or reprocessing (at the ground segment) events.

The topic "*Instrument Events*" includes:

- Radiometric Events (that affect the radiometric quality of the data),
- Geometric Events (that affect the geometric quality of the data),
- Miscellaneous Events,
- Processing Update Events, and
- Reprocessing Events.

c) Instrument Monitoring

The topic "*Instrument Monitoring*" provides continuous information on the state of the instrument by providing graphical or text, output of temporal variations in the monitored variables.

Note, it is recommended to provide on the landing page information on the actual instrument status being either: *commissioning, stand-by, operational, or inactive*.

d) Data Outages

The topic "*Data Outages*" provides information on events that triggered the temporary or definitive end of the data collection. Keeping a log of periods that data were missing is valuable as it gives an overview of actual data availability. Reasons for data outages can be events at Platform, Instrument and Processing level.

e) Relevant Documents

The topic "*Relevant Documents*" is intended to provide links to documents with information on the use, the validation, or the calibration of the instrument product (level-1.x data). Examples of Relevant Documents for an instrument product are: the Release

Note, the Product User Guide, the Generation Specifications, the Format Specifications, and the Validation Report.

4.3 Recommendations: WMO-OSCAR Landing Pages

LPR-01: CGMS Space Operators shall provide WMO-OSCAR one address of the landing pages per instrument per satellite (satellite/instrument landing page);

LPR-02: The addresses of the satellite/instrument landing pages should preferably not be changed, but shall be kept unchanged for at least one year;

LPR-03: CGMS Satellite Operators shall inform WMO-OSCAR on changes of addresses of the satellite/instrument landing pages;

LPR-04: Satellite/instrument landing pages shall include five topics:

- Instrument Specification;
- Instrument Events;
- Instrument Monitoring;
- Data Outages;
- **Relevant Documents.**

5 NOMENCLATURE AND STANDARDS FOR INSTRUMENT EVENTS

5.1 Introduction

In this section guidelines are proposed to develop a uniform approach for nomenclature and standards to be used for logging of Instruments events. An inventory of existing instrument event databases revealed that Satellite Operators: *i*) do often report on similar types of events, but *ii*) do often use different nomenclature and standards in their events reports. To ensure better traceability and uniformity, Satellite Operators are encouraged to follow the proposed guidelines, and store their instrument events with the proposed nomenclature and standards, in so called standardised instrument event databases (sIEDs), as schematised in Figure 1.

5.2 Concept

5.2.1 Common Nomenclature

The existing instrument events databases, operated at different Satellite Operators, are the main source of information for defining common nomenclature for instrument events. The definition of common nomenclature for instrument events, as developed in this document, is based on an inventory of the existing instrument event databases.

The Task Team drafted a list of events that related to the instrument calibration, which are used in the databases of the different Satellite Operators. The most frequently used events in the list served as baseline for proposing a common nomenclature. To limit the list in length, it is restricted to high-level standard events names only. The philosophy is that detailed, Satellite Operator and satellite instrument specific, information shall be

provided in the event description. Each event shall be associated with at least one standard event name, but could be associated several standard event names.

The inventory of existing instrument events databases revealed that instrument events can be broken up into the following categories *i)* Calibration Events, *ii)* Processing Events, and *iii)* Data Outages (see ANNEX 3). Note an event may be tagged several times and appear with different standard event names and/or in different categories.

Calibration Events

The category "*Calibration Events*" comprises scheduled and non-scheduled events that impact the radiometric and/or geometric quality of the observations due to instruments calibrations, manoeuvres, ground segment anomalies, or miscellaneous. The Radiometric Events refer to events that affect the radiometric quality of the data. The Geometric Events refer to events that affect the geometric quality of the data. The Satellite Operators need to develop rules to decide if a "*Calibration Event*" is significant, i.e., the radiometric/geometric calibration is altered above a certain threshold, or non-significant, i.e., the radiometric/geometric calibration is not affected or remains below a certain threshold. The common nomenclature proposed for "*Calibration Events*" are presented in Table Radiometric Events in ANNEX 4-1 and the Table for Geometric Events in ANNEX 4-2 of ANNEX 4.

Processing Events

The category "*Processing Events*" comprises events related updates of the processing algorithms (either onboard or at the ground segment) or reprocessing (at the ground segment) that affected the radiometric or geometric quality of the observations. The Satellite Operators need to develop rules to decide if a "*Processing Event*" is significant, i.e., the radiometric/geometric calibration is altered above a certain threshold, or non-significant, i.e., the radiometric/geometric calibration is not affected or remains below a certain threshold. The common nomenclature proposed for "*Processing Events*" is presented Table ANNEX 4-3 of ANNEX 4.

Data Outages

The category "*Data Outages*" comprises events that triggered the temporary or definitive end of the data collection. Keeping a log of periods that data were missing is valuable as it gives an overview of actual data availability. Reasons for missing data can be at Platform, Instrument and Processing level. The category "*Data Outages*" includes events such as Instrument Outages and Ground Segment Outages. Instrument Outages refers to events where data are missing due to outages at the instrument level. Ground Segment Outages refers to events where data are missing due to outages at the ground segment. The common nomenclature proposed for Data Outages is presented in Table ANNEX 4-4 of ANNEX 4.

5.2.2 Common Standards

Satellite Operators are encouraged to use, as much as possible, common standards (metadata) for reporting on instrument events, to ensure traceability, uniformity, and interoperability across these Operators. The metadata used to describe an Instrument Event shall use commonly used conventions (standards), such as the Climate and Forecast (CF) conventions and the GSICS conventions. ANNEX 5 lists the proposed minimal set of mandatory metadata attributes for Instrument Events.

5.3 Recommendations: Common Nomenclature and Standards

CSR-01: The instrument events shall be classified with the common nomenclature as suggested in ANNEX 4.

CSR-02: Each instrument events shall be logged with a minimum set of attributes as suggested in ANNEX 5.

CSR-03: The Attribute Names and Attribute Values suggested in ANNEX 5 shall follow standards that are compliant with CF conventions and GSICS conventions.

CSR-04: The GSICS Data Working Group (GDWG) of GSICS shall review the proposed standards for nomenclature and mandatory metadata attributes for Instrument Events.

6 NEXT STEPS

- To endorse the guidelines to provide calibration information on stable landing pages that follow a standard layout across Satellite Operators;
- To endorse the guidelines to use common nomenclature and reporting standards for instrument events across Satellite Operators;
- To start preparing landing pages for WMO-OSCAR, following the guidelines proposed in this White Paper;
- To start populating instrument events databases for past and present satellites, following the guidelines proposed in this White Paper.

REFERENCES

CGMS-40 EUM-WP-09 Calibration Event Working Group: Working Paper to CGMS 40

CGMS-41 EUM-WP-06 Calibration Event Working Group: Working Paper to CGMS 41

CGMS-42 EUM-WP-06 Calibration Event Working Group: Working Paper to CGMS 42

CGMS-43 EUM-WP-10 Calibration Event Working Group: Working Paper to CGMS 43

ANNEX 1: ACRONYMS

| Acronym | Meaning |
|----------------|---|
| CGMS | Coordination Group for Meteorological Satellites |
| CF | Climate and Forecast |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| EUMETSAT | European Organisation for the Exploitation of Meteorological Satellites |
| GDWG | GSICS Data Working Group |
| GRWG | GSICS Research Working Group |
| GSICS | Global Space-based Inter-Calibration System |
| IR | Infrared |
| OSCAR | Observing Systems Capability Analysis and Review Tool |
| WMO | World Meteorological Organisation |
| WV | Water Vapour |
| VIS | Visible |

ANNEX 2: GLOSSARY

| Term | Definition |
|----------------------------|--|
| <i>Mission Information</i> | Refers to general information on the platform and instruments operated in the mission that is relevant to all users of the satellite data. In addition it provides links to detailed information on both the platform and the instrument. |
| <i>Calibration Event</i> | Refers to events affecting the radiometric and/or geometric calibration quality of the sensor. These can be scheduled and non-scheduled events that impact the radiometric or geometric quality of the observations due to instruments calibrations, manoeuvres, ground segment anomalies, or miscellaneous. Such events can be either radiometric events (for instance ice decontamination) or geometric events (for instance platform manoeuvres). |
| <i>Processing Events</i> | Refers to events involving updates of the processing algorithms (either onboard or at the ground segment) or reprocessing (at the ground segment) events that affected the radiometric or geometric quality of the observations. Processing changes include software updates and reprocessing activities. |
| <i>Data Outages</i> | Refers to events that provide information on events that triggered the temporary or definitive end of the data collection. Reasons for missing data can be at Platform, Instrument and Processing level. |

ANNEX 3: INSTRUMENT EVENT CATEGORIES

ANNEX 3-1: Main Categories of Instrument Events

Main Categories

- I. CALIBRATION EVENTS**
 - *Radiometric Calibration Events (ANNEX 4-1)*
 - *Geometric Calibration Events (ANNEX 4-2)*
- II. PROCESSING EVENTS**
 - *Processing Updates (ANNEX 4-3)*
 - *Reprocessing Events (ANNEX 4-3)*
- III. DATA OUTAGES**
 - *Instrument Outages (ANNEX 4-4)*
 - *Ground Segment Outages (ANNEX 4-4)*

ANNEX 4: COMMON NOMENCLATURE FOR INSTRUMENT EVENTS

ANNEX 4-1: Standard names Category Radiometric Calibration Event

Category: Radiometric Calibration Events

- general announcement
- spacecraft maintenance
- spacecraft anomaly
- radiometric calibration drift
- radiometric calibration anomaly
- radiometric calibration correction

ANNEX 4-2: Standard names Category Geometric Calibration Events

Category: Geometric Events

- general announcement
- spacecraft maintenance
- spacecraft anomaly
- geometric calibration drift
- geometric calibration anomaly
- geometric calibration correction
- co-registration error

ANNEX 4-3: Standard names Category Processing Events

Category: Processing Events

- general announcement
- ground-segment maintenance
- ground-segment anomaly
- ground-segment processor update
- on-board processor update
- auxiliary data update

ANNEX 4-4: Standard names Category Data Outages

Category: Data Outages

- general announcement
- spacecraft maintenance
- spacecraft anomaly
- instrument maintenance
- instrument anomaly
- ground-segment maintenance
- ground-segment anomaly
- in-plane-manoevre
- out-of-plane-manoevre
- eclipse-season
- lunar-eclipse

ANNEX 5: COMMON STANDARDS FOR INSTRUMENT EVENTS

ANNEX 5-1: Common Database Attributes

| Attributes name | Attributes value |
|----------------------------------|---|
| Mission type | LEO or GEO |
| Satellite | [satellite name] |
| Satellite details | Link to satellite details |
| Instrument | [instrument name] |
| Instrument details | Link to instrument details |
| Prelaunch characteristics | Link to mission specifications document |
| Start date | [<yyyy-mm-dd>T<hh:mm>Z] |
| End date | [<yyyy-mm-dd>T<hh:mm>Z] |
| Product type | |
| Product description | |
| Main Category | [from list of categories, see ANNEX 3] |
| Event type | [from lists of standard names, see ANNEX 4] |
| Event description | [short description of the event] |
| Event report | Link to the full event report |