ISO/TS 19124-1:####:2023(E)

ISO/TC 211/WG 6

Date: 2022-12-062023-02

Geographic information — Calibration and validation of remote sensing data and derived products — Part 1: Fundamentals

Style Definition ...
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Different first page header
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: zzCover, Left
Formatted ...
Formatted: Font: Not Bold, English (United Kingdom)
Formatted: zzCover, Left, Space After: 0 pt
Formatted: English (United Kingdom)
Formatted: Font: 11 pt
Formatted: zzCover, Line spacing: single

Publication stage

Formatted: Font color: Blue

Formatted: std_publisher, Font color: Blue

Formatted: Font color: Blue

Formatted: Font color: Blue

Formatted: Justified, Border: Box: (Single solid line, Blue, 0.5 pt Line width)

Formatted: Font: 11 pt, Font color: Blue

Formatted: Font: 11 pt, Font color: Blue, English (United Kingdom)

Formatted: Font: 11 pt, Font color: Blue, English (United Kingdom)

Contents

Formatted: Space Before: 48 pt, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

A list of all parts in the ISO 19124 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Formatted: English (United States)
Formatted: English (United States)
Formatted: English (United States)
Formatted: English (United States)
Formatted: English (United States)
Formatted: Font color: Auto, English (United States)
Formatted: English (United States)
Formatted: English (United States)
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: Font: Cambria
Formatted: English (United States)
Formatted: English (United States)

Introduction

~~Post~~The ISO 19124 series addresses post-launch calibration and validation (Cal/Val) of remotely sensed data and products derived from the data ~~are addressed by the ISO 19124 series of standards. The first standard of the series, this document.~~ This document, ISO 19124-1, provides the fundamentals and a common framework on Cal/Val of remote-sensing data and derived products~~, whereas~~. Subsequent parts of the ~~subsequent standards~~ISO 19124 series deal with sensor- or product-specific Cal/Val.

NOTE In contrast to the ISO 19124 series, the ISO 19159 series focuses on the pre-launch Cal/Val process of the sensor and hardware.

This document was ~~built upon materials~~drafted based on material provided by the major organizations that are active in this field such as CEOS (international), NASA (USA), ESA (Europe), JAXA (Japan), CSIRO (Australia~~),~~, and the Chinese space agency.

~~In contrast to the ISO 19124, the existing ISO 19159 series focuses on the pre-launch calibration/validation process of the sensor and hardware.~~

Formatted: No page break before, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

In accordance with the ISO/IEC Directives, Part 2, 2018, Rules for the structure and drafting of International Standards, in International Standards the decimal sign is a comma on the line. However, the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures) at its meeting in 2003 passed unanimously the following resolution:

"The decimal marker shall be either a point on the line or a comma on the line."

In practice, the choice between these alternatives depends on customary use in the language concerned. In the technical areas of geodesy and geographic information it is customary for the decimal point always to be used, for all languages. That practice is used throughout this document.

Geographic information — Calibration and validation of remote sensing data and derived products — Part 1: Fundamentals

1 Scope

The ISO 19124 series is focused on calibration and validation (Cal/Val) of remote sensing data, which are collected by a sensor on-board a platform in a mission, and products derived in part or whole from the data. The ISO 19124 series ~~will define~~defines the metadata related to the calibration and validation process that has not been defined in other ISO/TC 211 ~~standards.~~International Standards. The metadata allows the data providers to provide a standardized description of the Cal/Val process they have applied to the data and the data users to get the same forms of metadata from different data providers.

~~Part 1~~This document addresses the overall framework and common calibration and validation processes related to Earth observation data and derived products from different types of remote sensors.

Subsequent parts in the ISO 19124 series will target data from specific sensors, e.g~~.~~, infrared, ultraviolet/visible/near-infrared, microwave, or broadband, products derived from those data, and calibration and validation sites.

Calibration addresses a geometric, radiometric, or spectral correction of the data. Validation addresses an evaluation of the quality and the accuracy of the data and the derived products.

~~In this Technical Specification, derived products mean the products are not directly measured by sensors but derived from direct sensor measures by algorithms or models.~~

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19157~~:2013~~-1, *Geographic information - — Data quality — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— — ISO Online browsing platform: available at ~~https://www.iso.org/obp~~https://www.iso.org/obp

— — IEC Electropedia: available at https://www.electropedia.org/

3.1
accuracy
closeness of agreement between a test result or measurement result and the true value

[SOURCE: ISO 3534-2:2006, 3.1.1, modified — ~~The original notes~~— Notes to entry have been ~~deleted~~]removed.]

Formatted: Different first page header
Formatted: Font color: Blue
Formatted: Space Before: 20 pt, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: Font: Bold, Font color: Blue
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: std_publisher
Formatted: RefNorm, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers, Tab stops: 0.7 cm, Left + 1.4 cm, Left + 2.1 cm, Left + 2.8 cm, Left + 3.5 cm, Left + 4.2 cm, Left + 4.9 cm, Left + 5.6 cm, Left + 6.3 cm, Left + 7 cm, Left
Formatted: std_docNumber
Formatted: std_docTitle, Font: Not Italic
Formatted: std_docTitle, Font: Not Italic
Formatted ...
Formatted: English (United States)
Formatted ...
Formatted ...
Formatted: English (United States)
Formatted ...
Formatted: English (United States)
Formatted ...
Formatted ...
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_year
Formatted: std_section

3.2
bias
magnitude of the non-random or systematic errors of a result

Note 1 to entry: A bias can be positive or negative.

Note 2 to entry: This entry is adapted from Reference [9].

3.3
calibration
process of quantitatively defining a system's responses to the known, controlled signal inputs

[SOURCE: ISO/TS 19101-2:2008, 4.2018, 3.2]

3.4
calibration curve
depictionexpression of the relation between indication and corresponding measured quantity value

[SOURCE: ISO/IEC Guide 99:2007, 4.31, modified — Note 1 to entry has been removed.]

3.5
calibration equation
equation relating the primary measure and that of the radiometer, for example the brightness temperature, to subsidiary measurands, such as powers, and to calibration quantities, such as standard values

[SOURCE: ISO/PRF TS 19159-4:2022, 3.15]

3.6
calibration parameters
information generated (or that will be generated) during the course of a calibration that quantifies and/or describes the EOEarth observation (EO) sensor performance

Note 1 to entry: ThoseThese parameters may be laboratory measurement, thermal vacuum (TVAC) performance plots, or sheets (as allowed).

Note 2 to entry: This entry is adapted from Reference [12].

3.7
co-location
<coordinate> procedure to match the location of two or more spatial datasets

3.8
correction
compensation for an estimated systematic effect

Note 1 to entry: See ISO/IEC Guide 98-3:2008, 3.2.3, for an explanation of 'systematic effect'.

Note 2 to entry: The compensation can take different forms, such as an addend or a factor, or can be deduced from a table.

[SOURCE: ISO/IEC Guide 99:2007, 2.53]

3.9
cross-calibration
process of relating the measurements of one instrument to another instrument which is usually well-calibrated, serving as a reference

Note 1 to entry: Cross-calibration of instruments operating during the same period requires careful collocation wherein instrument outputs are compared when the instruments are viewing the same Earth scenes, at the same times, from the same viewing angles.

[SOURCE: ISO/~~PRF~~ TS 19159-4:2022, 3.18]

3.10
derived product
<earth observation> product that is not directly measured by sensors but derived from direct sensor measures by algorithms or models

~~Note 1 to entry: The definition is valid for this technical specification.~~

3.11
detector
<electro-optical> sensing element that generates an output signal in response to an energy input

[SOURCE: ISO 19130-1:2018, 3.18, modified — The domain <electro-optical> has been added to the entry and "device" has been replaced by "sensing element" at the beginning of the definition.]

3.12
emissivity
ratio of the energy radiated by an emissive surface relative to that of an ideal blackbody source at the same temperature

Note 1 to entry: It is generally related as a function of wavelength or frequency, emissivity values range from 0 to 1.

Note 2 to entry: This entry is adapted from Reference [12].

3.13
evaluation
<earth observation> systematic determination of the extent to which an entity meets its specified criteria

Note 1 to entry: The entity can be an item or activity.

[SOURCE: ISO/IEC 25001:2014, 4.1, modified — The domain <earth observation> and a new Note 1 to entry have been added.]

3.14
filter
<earth observation> optical device that is placed in the optical path of an Earth observation (EO) sensor to select, restrict, reject, limit, or adjust an EO sensor response

Formatted: Font: 12 pt, Bold
Formatted: Normal, Right, Space After: 36 pt, Line spacing: Exactly 12 pt
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers, Tab stops: 0.7 cm, Left + 1.4 cm, Left + 2.1 cm, Left + 2.8 cm, Left + 3.5 cm, Left + 4.2 cm, Left + 4.9 cm, Left + 5.6 cm, Left + 6.3 cm, Left + 7 cm, Left
Formatted: std_publisher
Formatted: std_documentType
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_section
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_year
Formatted: std_section
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers, Tab stops: 0.7 cm, Left + 1.4 cm, Left + 2.1 cm, Left + 2.8 cm, Left + 3.5 cm, Left + 4.2 cm, Left + 4.9 cm, Left + 5.6 cm, Left + 6.3 cm, Left + 7 cm, Left
Formatted: cite_bib
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted
Formatted
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_year
Formatted: std_section
Formatted: Font: 11 pt
Formatted: Space After: 0 pt, Line spacing: single

Note 1 to entry: ~~Bandpass:~~ The range of desired wavelengths/frequencies to be passed by an optical filter. ~~Generally~~ is called the "bandpass". This is generally defined by the cut-on and cut-off wavelengths/frequencies of the optical filter.

Note 2 to entry: ~~In-Band Response:~~The EO sensor response to the optical wavelengths/frequencies within the desired optical filter bandpass. is called the "in-band response".

Note 3 to entry~~: Out-of-Band (OOB) Blocking~~: The ability of an optical filter (or optical system) to reject optical energy outside the desired wavelengths/frequencies. ~~May~~ is referred to as "out-of-band (OOB) blocking". This can also refer to filter design specifications regarding the ability to reject optical energy outside the desired filter bandpass.

Note 4 to entry: ~~OOB Leakage:~~ Undesired optical energy that passes through an optical filter (or optical system) that has a spectral location outside the desired spectral bandpass. is called " OOB leakage".

Note 5 to entry: ~~OOB Response:~~ An EO sensor's response to OOB leakage. is called the "OOB response".

Note 6 to entry: ~~Transmittance: Ratio~~The ratio of the open-path throughput of an optical path with and without the filter. is called "transmittance". Generally expressed as a function of wavelength or optical frequency, transmittance values range from 0 to 1, or 0 % to 100 % if expressed in percent transmittance.

Note 7 to entry: This entry is adapted from Reference [12].

3.15
irradiance
electro-magnetic radiation energy per unit area per unit time

[SOURCE: ISO/TS 19159-1:2014, 4.13, modified — ~~The original~~ Note 1 to entry has been ~~deleted~~removed.]

3.16
measure
<GML> value described using a numeric amount with a scale or using a scalar reference system

Note 1 to entry: When used as a noun, measure is a synonym for physical quantity.

[SOURCE: ISO 19136-1:2020, 3.1.41]

3.17
measurement
set of operations having the object of determining the value of a quantity

[SOURCE: ISO 19101-2:2018, 3.21]

3.18
measurement error
error of measurement
error
measured quantity value minus a reference quantity value

[SOURCE: ISO/TS 19159-1:2014, 4.18, modified — ~~The~~ Notes to entry have been ~~deleted~~removed.]

3.19

Formatted: Font: 12 pt, Bold
Formatted: Normal, Space After: 36 pt, Line spacing: Exactly 12 pt
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers, Tab stops: 0.7 cm, Left + 1.4 cm, Left + 2.1 cm, Left + 2.8 cm, Left + 3.5 cm, Left + 4.2 cm, Left + 4.9 cm, Left + 5.6 cm, Left + 6.3 cm, Left + 7 cm, Left
Formatted: cite_bib
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted ...
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_year
Formatted: std_section
Formatted ...
Formatted ...
Formatted ...
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_year
Formatted: std_section
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_year
Formatted: std_section
Formatted: std_publisher
Formatted: std_documentType
Formatted: std_docNumber
Formatted: std_docPartNumber
Formatted: std_year
Formatted: std_section
Formatted: Font: 11 pt
Formatted: Space After: 0 pt, Line spacing: single

noise
unwanted signal which can corrupt the measurement

Note 1 to entry: In most measurement scenarios, measurement noise limitations challenge measurement objectives and are a major contributor to overall measurement uncertainty.

Note 2 to entry: Noise ~~Noise Equivalent Radiance~~equivalent radiance (NER) is the entity of radiance that is most appropriate for the description of radiant flux from an extended area source. The NER is the amount of radiant flux that produces a signal equal to the system's noise when viewing an extended source.

[SOURCE: ISO/TS 19159-1:2014, 4.22, modified — The original Note 1 to entry has been ~~deleted~~removed and two new Notes to entry have been added.]

3.20
point source
source of electromagnetic radiation that is resolved in the ideal case to a single point or direction in space

Note 1 to entry: A natural star is an ideal point source. In the laboratory on the ground, a point source is simulated using an optical collimator.

Note 2 to entry: This entry is adapted from Reference [12].

3.21
post-launch calibration
all calibration activities that occur after a satellite-based Earth observation (EO) sensor is on-orbit

Note 1 to entry: The post-launch calibration may also be referred to as on-orbit calibration.

Note 2 to entry: The scope of the post-launch calibration varies from program-to-program and sensor-to-sensor, and includes considerations such as mission objectives, measurement requirements, mission operations capabilities, sensor data collection capabilities, and the ability to downlink low-level sensor response data to the ground.

Note 3 to entry: Post-launch calibration activities are included in the calibration plan and are executed according to the post-launch calibration procedures.

Note 4 to entry: This entry is adapted from Reference [12].

3.22
precision
measurement precision
closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same or similar objects under specified conditions

[SOURCE: ISO/TS 19159-2:2016, 4.23, modified — ~~The notes~~Notes to entry have been removed and the original preferred term and admitted terms have been inversed.]

3.23
pre-launch calibration
sequence of measurement and characterization that takes place during and after instrument assembly and integration, prior to launch