INTERNATIONAL STANDARD

ISO 19101-2

First edition
2018-05

Geographic information — Reference model —

Part 2: **Imagery**

Information géographique — Modèle de réference —

Partie 2: Imagerie

Reference number
ISO 19101-2:2018(E)

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

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

This edition cancels and replaces the first edition (ISO/TS 19101-2:2008) which has been technically revised. In order to promote backward compatibility between different versions of standards, the changes that have been made between this document and the previous version are described in Annex D.

A list of all parts in the ISO 19101 series can be found on the ISO website.

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Introduction

This document provides a reference model for processing of geographic imagery which is frequently done in open distributed manners. The motivating themes addressed in this reference model are given below.

In terms of volume, imagery is the dominant form of geographic information.

— Stored geographic imagery volume will grow to the order of an exabyte.

— National imagery archives are multiple petabytes in size; ingesting a terabyte per day.

— Individual application data centers are archiving hundreds of terabytes of imagery.

— Tens of thousands of datasets have been catalogued and can be accessible online.

Large volumes of geographic imagery will not be portrayed directly by humans. Human attention is the scarce resource, and is insufficient to view petabytes of data. Semantic processing will be required: for example, automatic detection of features; data mining based on geographic concepts.

Information technology allows the sharing of geographic information products through processing of geographic imagery. Standards are needed to increase creation of products. A number of existing standards are used for the exchange of geographic imagery.

Examples of technical, legal, and administrative hurdles to moving imagery online include

— technical issues of accessibility – geocoding, geographic access standards,

— maintenance of intellectual property rights,

— maintenance of individual privacy rights as resolution increases, and

— technical issues of compatibility requiring standards.

Governments have been the predominant suppliers of remotely sensed data in the past. This is changing with the commercialization of remotely sensed data acquisition. Geographic imagery is a key input to decision support for policy makers.

The ultimate challenge is to enable the geographic imagery collected from different sources to become an integrated digital representation of the Earth widely accessible for humanity's critical decisions.

Currently a large number of standards exist that describe imagery data. The processing of imagery across multiple organizations and information technologies (IT) is hampered by the lack of a common abstract architecture. The establishment of a common framework will foster convergence at the framework level. In the future, multiple implementation standards are needed for data format and service interoperability to carry out the architecture defined in this document.

The objective of this document is the coordinated development of standards that allow the benefits of distributed geographic image processing to be realized in an environment of heterogeneous IT resources and multiple organizational domains. An underlying assumption is that uncoordinated standardization activities made without a plan cannot be united under the necessary framework.

This document provides a reference model for the processing of geographic imagery which is frequently done in open distributed manners. The basis for defining an information system in this document is the Reference Model for Open Distributed Processing (RM-ODP).[42] A brief description of RM-ODP can be referenced in Annex B. The basis for defining geographic information in this document is the ISO 19100 series of standards.

The RM-ODP[42] viewpoints are used in the following fashion.

— Typical users and their business activities, and policies to carry out those activities, are addressed in the Enterprise Viewpoint.

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— Data structures and the progressive addition of value to the resulting products are found in the schemas of the Information Viewpoint.

— Individual processing services and the chaining of services are addressed in the Computational Viewpoint.

Approaches to deploy the components of the Information and Computational viewpoints to distributed physical locations are addressed in the Engineering Viewpoint.

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Geographic information — Reference model —

Part 2: Imagery

1 Scope

This document defines a reference model for standardization in the field of geographic imagery processing. This reference model identifies the scope of the standardization activity being undertaken and the context in which it takes place. The reference model includes gridded data with an emphasis on imagery. Although structured in the context of information technology and information technology standards, this document is independent of any application development method or technology implementation approach.

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 19115-1:2014, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 19115-2:2009, *Geographic information — Metadata — Part 2: Extensions for imagery and gridded data*

ISO 19119:2016, *Geographic information — Services*

ISO 19123:2005, *Geographic information — Schema for coverage geometry and functions*

ISO 19130-1:—[1)], *Geographic information — Imagery sensor models for geopositioning*

3 Terms and definitions

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

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

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

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

3.1
band
range of wavelengths of electromagnetic radiation that produce a single response by a sensing device

3.2
calibration
process of quantitatively defining a system's responses to known, controlled signal inputs

[SOURCE: CEOS WGCV]

1) Under preparation. Stage at the time of publication: ISO/DIS 19130-1.

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3.3
computational viewpoint
viewpoint (3.42) on an ODP system and its environment that enables distribution through functional decomposition of the system into objects which interact at *interfaces* (3.16)

[SOURCE: ISO/IEC 10746-3:2009, 4.1.1.3]

3.4
coverage
feature (3.9) that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain

[SOURCE: ISO 19123:2005, 4.1.7]

3.5
digital elevation model
dataset of elevation values that are assigned algorithmically to 2-dimensional coordinates

3.6
digital number
DN
integer value representing a *measurement* (3.20) as detected by a *sensor* (3.36)

3.7
engineering viewpoint
viewpoint (3.42) on an ODP system and its environment that focuses on the mechanisms and functions required to support distributed interaction between objects in the system

[SOURCE: ISO/IEC 10746-3:2009, 4.1.1.4]

3.8
enterprise viewpoint
viewpoint (3.42) on an ODP system and its environment that focuses on the purpose, scope and policies for that system

[SOURCE: ISO/IEC 10746-3:2009, 4.1.1.1]

3.9
feature
abstraction of real world phenomena

[SOURCE: ISO 19101-1:2014, 4.1.11]

3.10
geographic feature
representation of real world phenomenon associated with a location relative to the Earth

[SOURCE: ISO 19125-2:2004, 4.2]

3.11
geographic imagery
imagery (3.14) associated with a location relative to the Earth

3.12
geographic imagery scene
geographic imagery (3.11) whose data consists of *measurements* (3.20) or simulated measurements of the natural world produced relative to a specified vantage point and at a specified time

Note 1 to entry: A geographic imagery scene is a representation of an environmental landscape; it may correspond to a remotely sensed view of the natural world or to a computer-generated virtual *scene* (3.35) simulating such a view.

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3.13
grid
network composed of two or more sets of curves in which the members of each set intersect the members of the other sets in an algorithmic way

[SOURCE: ISO 19123:2005, 4.1.23]

3.14
imagery
representation of phenomena as images produced by electronic and/or optical techniques

Note 1 to entry: In this document, it is assumed that the phenomena have been sensed or detected by one or more devices such as radar, cameras, photometers, and infrared and multispectral scanners.

3.15
information viewpoint
viewpoint (3.42) on an ODP system and its environment that focuses on the semantics of information and information processing

[SOURCE: ISO/IEC 10746-3:2009, 4.1.1.2]

3.16
interface
named set of *operations* (3.24) that characterize the behaviour of an entity

[SOURCE: ISO 19119:2016, 4.1.8]

3.17
interoperability
capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units

[SOURCE: ISO/IEC 2382:2015, 2121317]

3.18
knowledge base
data base of knowledge about a particular subject

Note 1 to entry: The database contains facts, inferences, and procedures needed for problem solution (Webster Computer).

3.19
measurable quantity
attribute of a phenomenon, body or substance that may be distinguished qualitatively and determined quantitatively

[SOURCE: VIM:1993, 1.1]

3.20
measurand
particular quantity subject to *measurement* (3.20)

EXAMPLE Vapour pressure of a given sample of water at 20 °C.

Note 1 to entry: The specification of a measurand may require statements about quantities such as time, temperature and pressure.

[SOURCE: VIM:1993, 2.6]

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3.21
measurement
set of *operations* (3.24) having the object of determining the value of a quantity

[SOURCE: VIM:1993, 2.1]

3.22
metadata
information about a resource

[SOURCE: ISO 19115-1:2014, 4.10]

3.23
metric traceability
property of the result of a *measurement* (3.20) or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties

[SOURCE: Derived from VIM]

3.24
operation
specification of a transformation or query that an object may be called to execute

Note 1 to entry: An operation has a name and a list of parameters.

[SOURCE: ISO 19119:2016, 4.1.10]

3.25
orthoimage
image in which by orthogonal projection to a reference surface, displacement of image points due to *sensor* (3.36) orientation and terrain relief has been removed

Note 1 to entry: The amount of displacement depends on the resolution and the level of detail of the elevation information and on the software implementation.

3.26
picture original
representation of a two-dimensional hardcopy or softcopy input image in terms of the colour-space coordinates (or an approximation thereof)

Note 1 to entry: Picture originals could be obtained from printed maps, printed pictures of a *geographic imagery scene* (3.12), or drawings of geographic information, etc.

3.27
picture portrayal
representations of image data in terms of the colour-space coordinates that are appropriate for, and tightly coupled to, the characteristics of a specified real or virtual output device and viewing

Note 1 to entry: Picture portrayals are geared for visual display whether in hardcopy or softcopy.

3.28
pixel
smallest element of a digital image to which attributes are assigned

Note 1 to entry: This term originated as a contraction of “picture element”.

Note 2 to entry: Related to the concept of a *grid* (3.13) cell.

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3.29
policy
set of rules related to a particular purpose

[SOURCE: ISO/IEC 10746-2]

3.30
radiance
at a point on a surface and in a given direction, the radiant intensity of an element of the surface, divided by the area of the orthogonal projection of this element on a plane perpendicular to the given direction

[SOURCE: ISO 80000-7:2008, 7-15]

3.31
radiant energy
energy emitted, transferred or received as radiation

[SOURCE: ISO 80000-7:2008, 7-6]

3.32
record
finite, named collection of related items (objects or values)

[SOURCE: ISO 19107:2003, 4.62]

3.33
remote sensing
collection and interpretation of information about an object without being in physical contact with the object

3.34
resolution (of a sensor)
smallest difference between indications of a *sensor* (3.36) that can be meaningfully distinguished

Note 1 to entry: For *imagery* (3.14), resolution refers to radiometric, spectral, spatial and temporal resolutions.

3.35
scene
spectral *radiances* (3.30) of a view of the natural world as measured from a specified vantage point in space and at a specified time

Note 1 to entry: A scene may correspond to a remotely sensed view of the natural world or to a computer-generated virtual scene simulating such a view.

[SOURCE: ISO 22028-1:2016, 3.35]

3.36
sensor
element of a measuring system that is directly affected by a phenomenon, body, or substance carrying a quantity to be measured

[SOURCE: ISO/IEC GUIDE 99:2007, 3.8]

3.37
sensor model
description of the radiometric and geometric characteristics of a *sensor* (3.36)

3.38
service
distinct part of the functionality that is provided by an entity through *interfaces* (3.16)

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3.39
technology viewpoint
viewpoint (3.42) on an ODP system and its environment that focuses on the choice of technology in that system

[SOURCE: ISO/IEC 10746-3:2009, 4.1.1.5]

3.40
uncertainty
parameter, associated with the result of *measurement* (3.20), that characterizes the dispersion of values that could reasonably be attributed to the *measurand* (3.21)

Note 1 to entry: The parameter may be, for example, a standard deviation (or a given multiple of it), or the half-width of an interval having a stated level of confidence.

Note 2 to entry: Uncertainty of measurement comprises, in general, many components. Some of these components may be evaluated from the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information.

Note 3 to entry: It is understood that the result of the measurement is the best estimate of the value of the measurand, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to the dispersion.

[SOURCE: ISO 19116:2004, 4.26, modified — Notes 1-3 to entry have been added.]

3.41
validation
process of assessing, by independent means, the quality of the data products derived from the system outputs

[SOURCE: CEOS WGCV]

3.42
viewpoint (on a system)
form of abstraction achieved using a selected set of architectural concepts and structuring rules, in order to focus on particular concerns within a system

[SOURCE: ISO/IEC 10746-2:2009, 3.2.7]

4 Abbreviated terms and symbols

4.1 Abbreviated terms

BeiDou	China BeiDou Navigation Satellite System
BIIF	Basic Image Interchange Format
CEOS	Committee on Earth Observation Satellites
CIE	International Commission on Illumination
CMYK	Nonlinear Cyan, Magenta, Yellow, Black
CRS	Coordinate Reference System
CRT	Cathode Ray Tube
CW	Continuous Wavelength

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