AS/NZS ISO 19170.1:2021
ISO 19170-1:2021

Australian/New Zealand Standard™

Geographic information — Discrete Global Grid Systems Specifications

Part 1: Core Reference System and Operations, and Equal Area Earth Reference System

AS/NZS ISO 19170.1:2021

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- ANZLIC — Spatial Information Council
- Australian Antarctic Division
- Australian Bureau of Meteorology
- Australian Maritime Safety Authority
- CSIRO
- Curtin University of Technology
- Department of Agriculture, Water and the Environment
- Department of Defence (Australian Government)
- Geoscience Australia
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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee IT-004, Geographical Information/Geomatics.

The objective of this document is to support the definition of:

(a) A Discrete Global Grid Systems (DGGS) core comprising:

   (i) an RS using zonal identifiers with structured geometry; and

   (ii) functions providing import, export and topological query;

(b) Common spatio-temporal classes for geometry, topology, RS using zonal identifiers, zonal identifiers and zones, based on AS/NZS ISO 19111 CRS. The spatio-temporal scope is constrained to:

   (i) spatial elements that are invariant through all time; and

   (ii) temporal elements that are invariant across all space.

(c) Equal-Area Earth Reference Systems (EAERSs) for Equal-Area Earth DGGS.

This document is identical with, and has been reproduced from, ISO 19170-1:2021, *Geographic information — Discrete Global Grid Systems Specifications — Part 1: Core Reference System and Operations, and Equal Area Earth Reference System.*

As this document has been reproduced from an International Standard, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

Contents

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 19170 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.

Introduction

DGGSs (Discrete Global Grid Systems) provide a new way to organize, store and analyse spatio-temporal data. This document contains a normative definition for DGGS and informative annexes. Annex B discusses the theoretical basis for Equal-Area Earth DGGS, and Annex C discusses DGGS's historical background. At the heart of DGGS is a new Reference System (RS). Spatial and temporal RSs described elsewhere by ISO/TC 211 and the OGC (Open Geospatial Consortium) fall into two types:

1) Referencing by coordinates (ISO 19111), and

2) Referencing by identifiers (geographic in ISO 19112 and ordinal era in ISO 19108).

In spatial referencing by identifiers, the only required geometry is an extent, which can be expressed as a simple bounding box. Formal geometry need not be defined and sometimes follows societal whim. Similarly, in ordinal temporal RSs, the topology of the ordinal eras are known, but the start and finish times are often only an estimation and are not required by the data model. DGGSs introduce a third type: referencing by identifiers with structured geometry, illustrated in Figure 1.

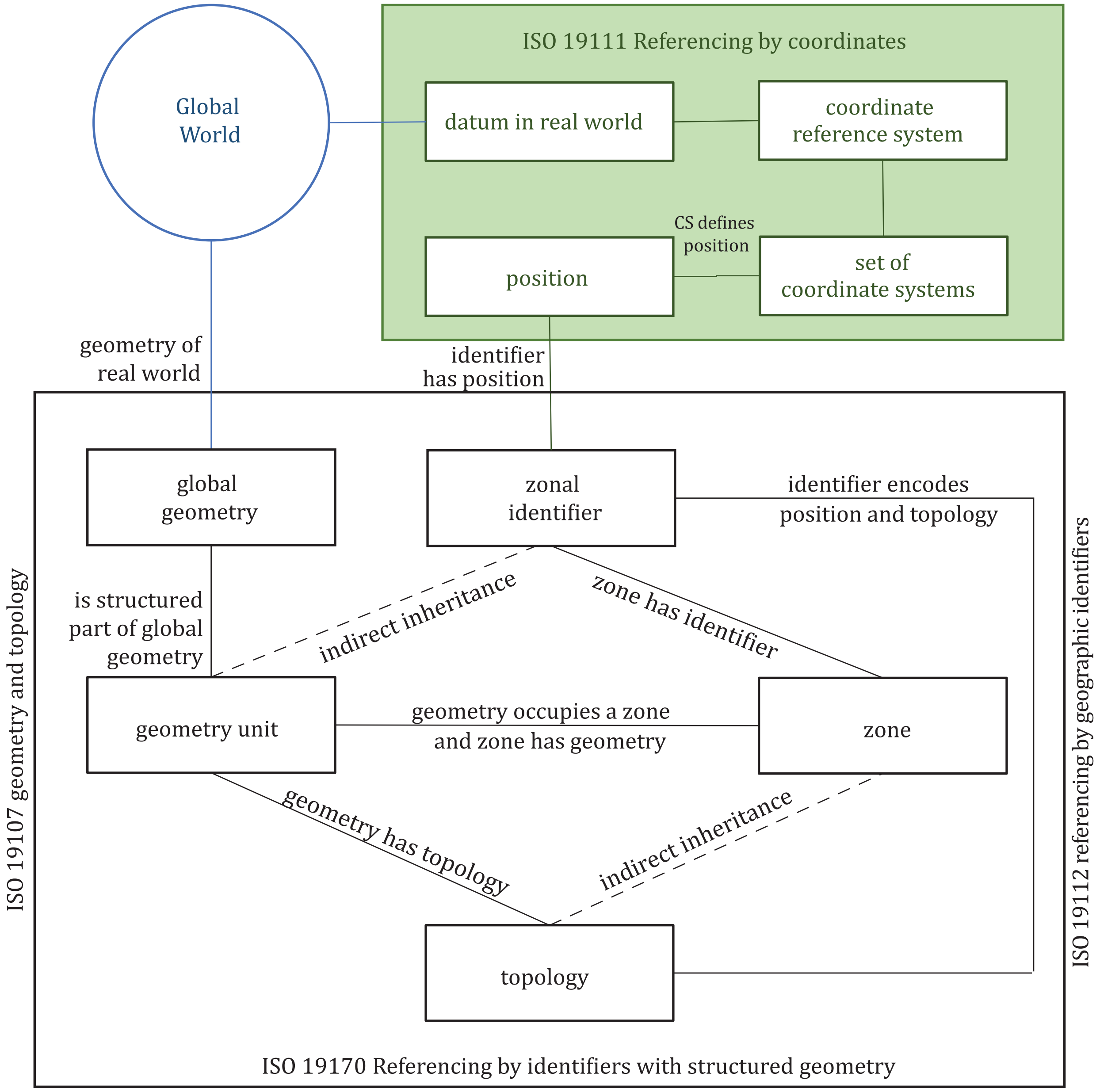

Figure 1 — Referencing by identifiers with structured geometry

A single parent global geometry is chosen to define the dimensionality and orientation of the region of space-time occupied by the DGGS: it's global world. The structure for the DGGS geometry is provided by a strictly controlled process of recursive tessellation of the parent geometry that creates the DGGS RS's units of geometry. The region occupied by each unit of geometry is called a zone. Each zone is given a unique name, called a zonal identifier. Each zonal identifier is associated with a representative spatio-temporal position in a base CRS (Coordinate Reference System) defined by a datum for the DGGS's global world. Best practice is for a zonal identifier to be an encoding of both its position and its topology. Referencing by identifiers with structured geometry gives rise to RSs using zonal identifiers with structured geometry. Geographic information is inherently four-dimensional and includes time. So, a unified spatio-temporal data model for coordinate systems, geometry, topology, identifiers and RSs using identifiers is a pre-requisite for spatio-temporal DGGSs.

The approach taken in this document to specifying spatio-temporal data classes is to apply the spatio-temporal data model pattern in ISO 19111 to spatial data classes in both ISO 19107 and ISO 19112 to produce their spatio-temporal equivalents. The set of common spatio-temporal classes for geometry, topology, identifiers and RSs using identifiers specified in this document are therefore consistent with spatio-temporal CRS and coordinate systems in ISO 19111. Like ISO 19111, the temporal data model in this document does not reference ISO 19108. The similarities and differences are described in Annex D.

In this document the spatio-temporal scope is constrained to spatial classes that are invariant through all time, and to temporal classes that are invariant throughout space. While this approach excludes certain spatio-temporal situations, it is flexible enough for a very large body of social and environmental modelling. Oceanic, climate and weather modelling often need geometries with a constant mass of gaseous fluid under changing pressure and temperature. These models can be run outside a DGGS. However, the results coming from these environmental models can be stored in a DGGS for efficient later use with other data.

This document specifies data models for a consistent set of common spatio-temporal classes, a DGGS core built on the common spatio-temporal classes, and a DGGS EAERS (Equal-Area Earth RS). The Common Spatio-temporal Classes, DGGS Core, and Equal-Area Earth DGGS packages each have their own conformance classes with their associated specifications and requirements.

The DGGS Core package comprises an RS and functions for quantization, topological query and interoperability.

The DGGS Core RS is an RS using zonal identifiers with structured geometry located in its real world by coordinates in a base CRS. The DGGS Core RS is designed to support:

— temporal, surface, volumetric and spatio-temporal DGGS,

— DGGSs with different grid constraints,

— DGGSs with different refinement strategies, and

— DGGSs referencing either the Earth or other celestial bodies.

The RS in Equal-Area Earth DGGSs is a specialization of the DGGS Core RS. It describes an RS, comprising:

— a base unit polyhedron,

— a discrete hierarchical sequence of global grids,

— global grids with equal-area zones each with a unique identifier, and

— located in a geodetic CRS, that is typically also a geographic CRS.

This document does not prescribe any specific Earth surface model, base polyhedron or class of polyhedra, but is intended to allow for a range of options that produce DGGSs with compatible and interoperable functional characteristics.

Future additions to the ISO 19170 series are intended to cover:

— Part 2: Three-dimensional and equal-volume Earth RS.

— Part 3: Spatio-temporal Earth RS.

— Part 4: Axis-aligned RS with all zone edges parallel to the base CRS's axes.

— Specification for a DGGS-API to formalize client-server, and server-server operations, both between DGGSs and between DGGSs and non-DGGS architectures.

— Creation of a register system for DGGS definitions analogous to the register for CRSs.

— Additions to other specifications, such as for OWS[52], [54] architectures, spatial features and data formats to support DGGS data structures.

This document was prepared in close collaboration with the Open Geospatial consortium (OGC).

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.

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1 Scope

This document supports the definition of:

- A Discrete Global Grid Systems (DGGS) core comprising:
  - an RS using zonal identifiers with structured geometry, and
  - functions providing import, export and topological query,
- Common spatio-temporal classes for geometry, topology, RS using zonal identifiers, zonal identifiers and zones, based on ISO 19111 CRS. The spatio-temporal scope is constrained to:
  - spatial elements that are invariant through all time, and
  - temporal elements that are invariant across all space.
- Equal-Area Earth Reference Systems (EAERSs) for Equal-Area Earth DGGS.

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 19107:2019, *Geographic information — Spatial schema*

ISO 19111:2019, *Geographic information — Referencing by coordinates*

ISO 19112:2019, *Geographic information — Spatial referencing by geographic identifiers*

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

ISO 19156:2011, *Geographic information — Observations and measurements*

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:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org

3.1
boundary
set that represents the limit of an entity

Note 1 to entry: Boundary is most commonly used in the context of geometry, where the set is a collection of points or a collection of objects that represent those points. In other arenas, the term is used metaphorically to describe the transition between an entity and the rest of its domain of discourse.

[SOURCE: ISO 19107:2019, 3.6]