INTERNATIONAL STANDARD

ISO 19111-2

First edition
2009-08-15

Geographic information — Spatial referencing by coordinates —

Part 2: Extension for parametric values

Information géographique — Système de références spatiales par coordonnées —

Partie 2: Supplément pour valeurs paramétriques

Reference number
ISO 19111-2:2009(E)

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 19111-2 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

ISO 19111 consists of the following parts, under the general title *Geographic information — Spatial referencing by coordinates*:

— *Geographic information — Spatial referencing by coordinates*

— *Part 2: Extension for parametric values*

Introduction

ISO 19111 describes the elements necessary to fully define various types of reference systems used for spatial referencing by coordinates. In ISO 19111, a coordinate is one of n scalar values that define the position of a point. ISO 19111 allows for coordinates which are angular, such as latitude and longitude, or linear, such as easting and northing. It also describes the concept of a compound coordinate reference system, which uses at least two independent coordinate reference systems to describe a three-dimensional spatial position.

Scientific communities, especially those concerned with the environmental sciences, frequently express spatial position partially in terms of a parameter or function. Within these communities, this parameter or function is treated as a coordinate. Its relationship with a spatial dimension will usually be non-linear. Examples are widespread, but latitude, longitude and pressure is a commonly encountered example.

This part of ISO 19111 defines a parametric coordinate reference system using the concepts of ISO 19111. The provisions of ISO 19111 are then used to include a parametric coordinate reference system as part of a compound coordinate reference system. Optionally, time can also be included as an additional axis or as axes.

Geographic information — Spatial referencing by coordinates —

Part 2:
Extension for parametric values

1 Scope

This part of ISO 19111 specifies the conceptual schema for the description of spatial referencing using parametric values or functions. It applies the schema of ISO 19111 to combine a position referenced by coordinates with a parametric value to form a spatio-parametric coordinate reference system (CRS). The spatio-parametric CRS can optionally be extended to include time.

The intended users of this part of ISO 19111 are producers and users of environmental information.

Parameters which are attributes of spatial locations or features, but which are not involved in their spatial referencing, are not addressed by this part of ISO 19111.

2 Conformance requirements

Any CRS for which conformance to this part of ISO 19111 is claimed shall be in accordance with Annex A.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19111:2007, *Geographic information — Spatial referencing by coordinates*

4 Terms and definitions

For the purposes of this document the terms and definitions of ISO 19111 and the following apply.

4.1
parametric coordinate system
one-dimensional coordinate system where the axis units are parameter values which are not inherently spatial

4.2
parametric coordinate reference system
coordinate reference system based on a parametric datum

4.3
parametric datum
datum describing the relationship of a parametric coordinate system to an object

NOTE The object is normally the Earth.

4.4
spatio-parametric coordinate reference system
compound coordinate reference system in which one constituent coordinate reference system is a parametric coordinate reference system and one is a spatial coordinate reference system

NOTE Normally the spatial component is “horizontal” and the parametric component is “vertical”.

4.5
spatio-parametric-temporal coordinate reference system
compound coordinate reference system comprised of spatial, parametric and temporal coordinate reference systems

5 Conventions

5.1 Abbreviated terms

CCRS Compound Coordinate Reference System

CRS Coordinate Reference System

CS Coordinate System

GML Geography Markup Language

UML Unified Modelling Language

5.2 UML notation

In this part of ISO 19111, the conceptual schema for describing spatio-parametric referencing is modelled with the Unified Modelling Language (UML). The basic data types and UML diagram notations are defined in ISO/TS 19103 and ISO/IEC 19501.

5.3 Attribute status

In this part of ISO 19111, attributes are given an obligation status:

Obligation	Definition	Meaning
M	Mandatory	This attribute shall be supplied.
O	Optional	This attribute may be supplied.

In Tables 1 to 3, the “Maximum occurrence” column indicates the maximum number of occurrences of attribute values that are permissible, with “N” indicating no upper limit.

6 Spatio-parametric referencing

6.1 Overview

ISO 19111 defines a *coordinate reference system* (CRS) as a coordinate system which is related to an object (such as the Earth) by a datum. A *coordinate system* (CS) is a set of mathematical rules for specifying how coordinates are to be assigned to points. A coordinate system will have one or more axes. A *datum* defines the position of the origin, the scale, and the orientation of a coordinate system. ISO 19111 describes several subtypes of coordinate reference system, coordinate system and datum. This part of ISO 19111 defines a further subtype of each to accommodate parametric referencing.

6.2 Parametric coordinate reference system

A parametric coordinate reference system shall be a subtype of a single CRS. Figure 1 shows the UML schema, which shall consist of one parametric coordinate system and one parametric datum, these elements being according to 6.3 and 6.4.

Table 1 specifies the attributes of a parametric coordinate reference system inherited from SC_SingleCRS.

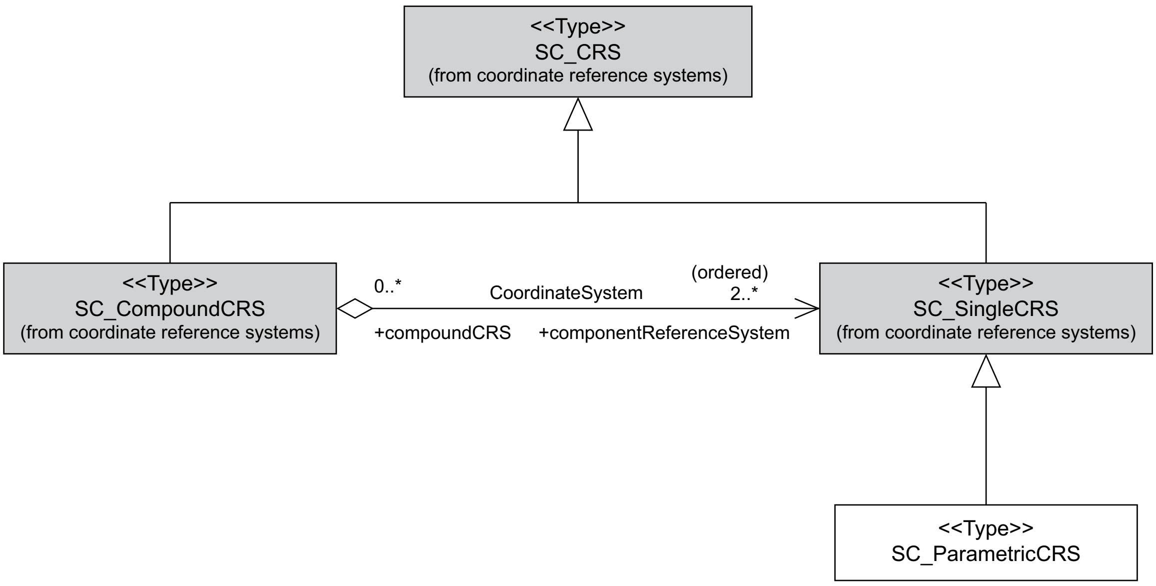

Figure 1 — UML schema for parametric CRS

Table 1 — Defining elements of SC_ParametricCRS class

Description:	One-dimensional coordinate reference system which uses parameter values or functions.				
Stereotype:	Type				
Class attribute:	Concrete				
Inherited from:	SC_SingleCRS				
Association roles:	(aggregation) datum to CD_ParametricDatum [1], association named *DefiningDatum* (aggregation) coordinateSystem to CS_ParametricCS [1], association named *CoordinateSystem* (associations inherited from SC_SingleCRS)				
Public attributes:	Six attributes inherited from SC_SingleCRS:				
Attribute name	**UML identifier**	**Data type**	**Obligation**	**Maximum occurrence**	**Attribute description**
CRS name	Name	RS_Identifier	M	1	This is the primary name for the CRS. Aliases and other identifiers may be given through the attributes alias and identifier.
CRS alias	Alias	GenericName	O	N	An alias by which this CRS is known.
CRS identifier	Identifier	RS_Identifier	O	N	An identifier which references elsewhere the CRS's defining information; alternatively, an identifier by which this CRS can be referenced.
CRS scope	Scope	CharacterString	M	N	Description of usage, or limitations of usage, for which this CRS is valid. If unknown, enter "not known".
CRS validity	domainOfValidity	EX_Extent	O	N	Area or region or timeframe in which this CRS is valid.
CRS remarks	Remarks	CharacterString	O	1	Comments or information on this CRS, including data source information.

6.3 Parametric coordinate system

A coordinate system shall be of the parametric type if a physical or material property or function is used as the dimension. The parameter can be measured or could be a function defined in other contexts, but in parametric coordinate systems it forms the coordinate system axis.

EXAMPLE 1 Pressure in meteorological applications

EXAMPLE 2 Density (isopycnals) in oceanographic applications.

A parametric coordinate system shall be a subtype of a coordinate system and shall be used as a part of a parametric coordinate reference system. Figure 2 shows the UML schema and Table 2 describes the attributes, inherited from CS_CoordinateSystem, as defined in ISO 19111.

A parametric coordinate reference system shall be one-dimensional and shall have one axis. The defining elements are described in ISO 19111:2007, Tables 27 and 28.

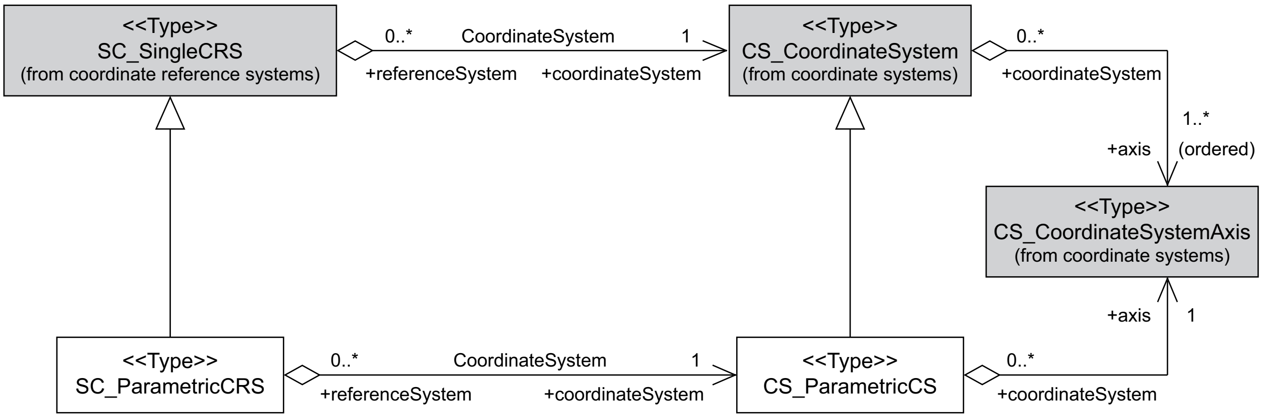

Figure 2 — UML schema for parametric coordinate system

Table 2 — Defining elements of CS_ParametricCoordinateSystem class

Description:	One-dimensional coordinate reference system which uses parameter values or functions. The values or functions can vary monotonically with height. A ParametricCS shall have one axis association.
Stereotype:	Type
Class attribute:	Concrete
Inherited from:	CS_CoordinateSystem
Association roles:	(aggregation) coordinateSystem from SC_ParametricCRS [1], association named *CoordinateSystem* (reverse: referenceSystem to SC_ParametricCRS [0..*] navigable only from SC_ParametricCRS — see Table 1) (associations inherited from CS_CoordinateSystem, including (aggregation) axis to CS_CoordinateSystemAxis [1])
Public attributes:	Four attributes inherited from CS_CoordinateSystem:

Attribute name	UML identifier	Data type	Obligation	Maximum occurrence	Attribute description
CS name	Name	RS_Identifier	M	1	This is the primary name for the coordinate system. Aliases and other identifiers may be given through the attributes alias and identifier.
CS alias	Alias	GenericName	O	N	An alias by which this coordinate system is known.
CS identifier	identifier	RS_Identifier	O	N	An identifier which references elsewhere the coordinate system's defining information; alternatively, an identifier by which this coordinate system can be referenced.
CS remarks	remarks	CharacterString	O	1	Comments or information on this coordinate system, including data source information.

6.4 Parametric datum

A parametric datum shall be a subtype of a datum. It shall be used as a part of a parametric coordinate reference system. Figure 3 shows the UML schema. Table 3 describes the attributes, inherited from CD_Datum, as defined in ISO 19111.

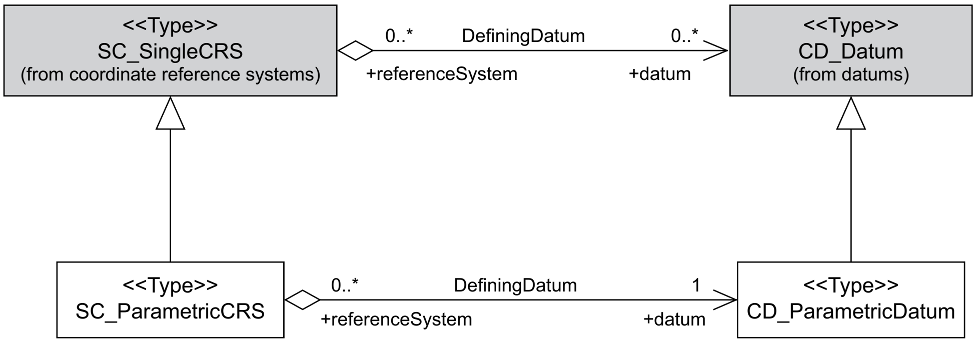

Figure 3 — UML schema for parametric datum

Table 3 — Defining elements of CD_ParametricDatum class

Description:	A textual description and/or a set of parameters identifying a particular reference surface used as the origin of a parametric coordinate system, including its position with respect to the Earth
Stereotype:	Type
Class attribute:	Concrete
Inherited from:	CD_Datum
Association roles:	(aggregation) datum to CD_ParametricDatum [1], association named *DefiningDatum* (reverse: referenceSystem to SC_ParametricCRS [0..*] navigable only from SC_ParametricCRS — see Table 1)
Public attributes:	Eight attributes inherited from CD_Datum:

Attribute name	UML identifier	Data type	Obligation	Maximum occurrence	Attribute description
Datum name	Name	RS_Identifier	M	1	This is the primary name for the datum. Aliases and other identifiers may be given through the attributes alias and identifier.
Datum alias	Alias	GenericName	O	N	An alias by which this datum is known.
Datum identifier	Identifier	RS_Identifier	O	N	An identifier which references elsewhere the datum's defining information; alternatively, an identifier by which this datum can be referenced.
Datum anchor	anchorDefinition	CharacterString	O	1	The datum definition: a description, possibly including coordinates of an identified point or points, of the relationship used to anchor the coordinate system to the Earth or alternative object. For a parametric datum, the anchor may be an identified physical surface with the orientation defined relative to the surface.
Datum realization epoch	realizationEpoch	Date	O	1	The time after which this datum definition is valid. This time may be given to any precision.
Datum scope	Scope	CharacterString	M	N	Description of usage, or limitations of usage, for which this datum is valid. If unknown, enter “not known”.
Datum validity	domainOfValidity	EX_Extent	O	1	Area or region or timeframe in which this datum is valid.
Datum remarks	Remarks	CharacterString	O	1	Comments or information on this datum, including data source information.

6.5 Spatio-parametric coordinate reference system

ISO 19111 describes the concept of, and UML schema for, a compound coordinate reference system (CCRS).

A spatio-parametric coordinate reference system shall be a compound CRS in which one component is a geodetic 2D, projected or engineering 2D CRS, supplemented by a parametric CRS to create a three-dimensional CRS. See Figure 4. An example is included in Annex B.

The geodetic 2D CRS may be the horizontal component of a geodetic 3D CRS.

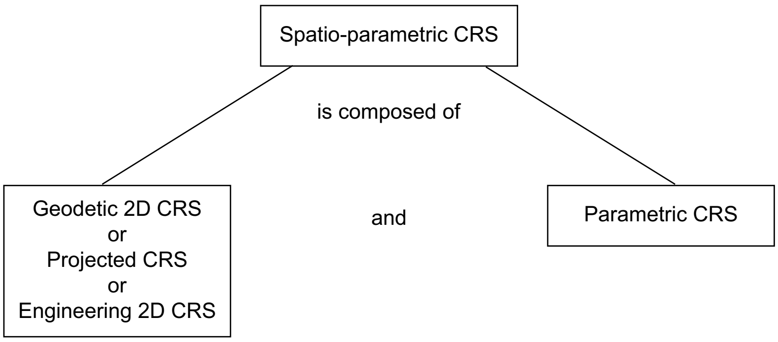

Figure 4 — Conceptual model of spatio-parametric CRS

6.6 Spatio-parametric coordinate reference system with time

Using the provisions of ISO 19111, any of the above-listed combinations forming a spatio-parametric CRS may be associated with a temporal CRS, as described in ISO 19108, to form a spatio-parametric-temporal CCRS. More than one temporal coordinate reference system may be included if these axes represent different time quantities. Nesting of CCRS shall not be permitted — the individual single systems shall be aggregated together. Figure 5 shows the possible composition of a spatial, a parametric and a temporal CRS in a spatio-parametric-temporal CCRS.

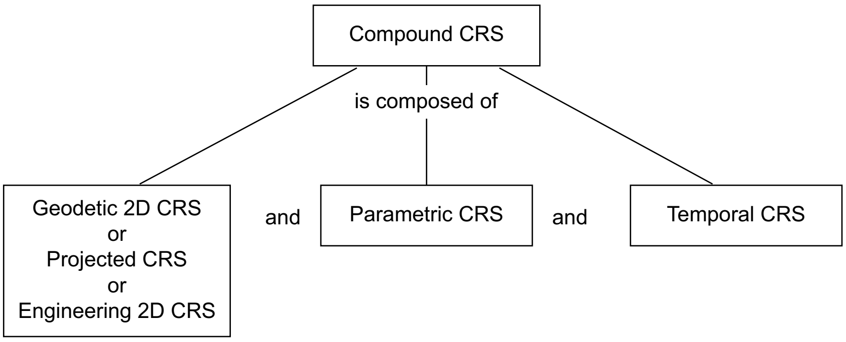

Figure 5 — Conceptual model of CCRS including spatial, parametric and temporal CRS

6.7 Transformation and conversion of parametric coordinate reference systems

ISO 19111 describes the schema for changing coordinates from one coordinate reference system to another. This schema may be applied to parametric, spatio-parametric and spatio-parametric-temporal CRS.

Annex A
(normative)

Conformance

A.1 Conformance of parametric CRS

A.1.1 Abstract test suite

To determine whether a coordinate reference system including parametric values is in conformance with this part of ISO 19111, check that it is in accordance with A.1.2 to A.1.4.

A.1.2 Conformance of a parametric CRS

a) Test purpose: to determine whether all of the relevant entities and elements specified as being mandatory or mandatory under the conditions specified have been provided in the description.

b) Test method: check the parametric coordinate reference system description to ensure that it includes as a minimum all of the elements indicated as mandatory in Tables 1 to 3.

c) Reference: 6.2 to 6.4.

d) Test type: capability.

A.1.3 Conformance of a spatio-parametric CRS

a) Test purpose: to determine whether all of the relevant entities and elements specified as being mandatory or mandatory under the conditions specified have been provided in the description.

b) Test method: check the spatio-parametric coordinate reference system description to ensure that it includes as a minimum all of the elements indicated.

c) Reference: see 6.5 and ISO 19111:2007, Clause 8.

d) Test type: capability.

A.1.4 Conformance of a spatio-parametric-temporal CRS

a) Test purpose: to determine whether all of the relevant entities and elements specified as being mandatory or mandatory under the conditions specified have been provided in the description.

b) Test method: check the spatio-parametric-temporal coordinate reference system description to ensure that it includes as a minimum all of the elements indicated.

c) Reference: 6.6 and ISO 19111:2007, Clause 8.

d) Test type: capability.

A.2 Conformance of coordinate operation

A.2.1 Abstract test suite

To determine whether a coordinate transformation or coordinate conversion operating on a parametric CRS is in conformance with this part of ISO 19111, check that it is in accordance with A.2.2.

A.2.2 Coordinate operation on a parametric CRS

a) Test purpose: to determine whether all of the relevant entities and elements specified as being mandatory or mandatory under the conditions specified have been provided in the description.

b) Test method: check the coordinate operation description to ensure that it includes as a minimum all of the elements indicated as mandatory.

c) Reference: 6.7 and ISO 19111:2007, Clause 11.

d) Test type: capability.

Annex B
(informative)

Examples

B.1 Introduction

Several examples are given below to illustrate how to apply this part of ISO 19111 when defining a parametric coordinate reference system (CRS). The examples give both UML identifier and attribute name. For digital data processing purposes, the UML identifier should be used. When presenting CRS metadata to human beings, the attribute name should be given.

Three examples are given below: a parametric coordinate reference system using a parameter (pressure), a parametric CRS using a function (potential vorticity), and a spatio-parametric CRS.

B.2 Parametric CRS using parameter (pressure)

Barometric pressure is the basic measure of height used in aviation and meteorology, but the exact translation to a height depends on current conditions in the local atmospheric profile. In 1951, the International Civil Aviation Organisation (ICAO) incorporated the international standard atmosphere (ISA) into international law[1]. There have been a number of extensions since, up to 80 km. With the publication of ISO 2533 in 1975, a standard atmosphere in the range 2 000 m to 5 000 m was established[2]. See References [1] and [5].

Height in the atmosphere is measured by barometric pressure which is monotonically decreasing in height. Although the ISA is calibrated in both thousands of feet and in metres, it does not measure true height, but approximate geopotential height. This is because the datum ignores the variation of the atmospheric temperature and pressure near the bottom of the atmosphere. Heights are named as flight levels (e.g. FL320 is nominally 32 000 ft). Even if a true height measure is available in an aircraft, for example, through radar or GPS (global positioning system), the readings must be converted to ISA flight levels — unless the pilot is flying under visual flying rules (VFR) near the ground.

The datum is set at mean sea level pressure in the standard atmosphere at 1 013,25 hectopascals (hPA) [also expressed in the non-SI unit of millibars (mb)][3].

NOTE When aircraft fly at low level over topography, air traffic control (ATC) regulations set a transitional flight level or altitude below which the ISA does not apply, but at which the reference atmosphere does. This involves the pilot resetting the datum to ensure the aircraft is above all topography. The new datum (known as QNH) is transmitted by radio from ATC, and is the lowest pressure (reduced to mean sea level) forecast for the next 3 h in the low-flying zone, or the current aerodrome pressure (QFE) if the aircraft is about to land.

1) Convention on International Civil Aviation (the Chicago Convention 1947), Annex 8.

2) The US, ICAO and WMO (World Meteorological Organization) standard atmospheres are the same as the ISO standard atmosphere for altitudes up to 32 km.

3) For aviation in North America, by practice and by law, the datum is expressed as 29.92 in and hundredths of mercury.

UML identifier	Attribute	Entry	Comment
SC_ParametricCRS			
name:	Parametric CRS name	ICAO international standard atmosphere (ISA)	
alias:	CRS alias	WMO standard atmosphere	This is an optional attribute.
scope:	CRS scope	Aviation, meteorology	
domainOfValidity	CRS validity	2 km to 80 km in the free atmosphere (above topography)	
remarks:	CRS remarks	From 2 km to 32 km, equivalent to ISO 2533:1975	This is an optional attribute.
CS_ParametricCS			
name:	Parametric coordinate system name	Aviation flight levels	
remarks:	CS remarks	Flight level FL320 is 32 000 ft (as geopotential height)	This is an optional attribute.
CS_CoordinateSystemAxis (attributes are given in 19111:2007, Table 27)			
name:	Coordinate system axis name	Flight level	
axisAbbrev	Coordinate system axis abbreviation	FL	
axisDirection	Coordinate system axis direction	Up	
axisUnitID	Coordinate system axis unit identifier	Geopotential metres	
minimumValue	Coordinate system axis minimum value	2 000	This is an optional attribute.
maximumValue	Coordinate system axis maximum value	80 000	This is an optional attribute.
rangeMeaning	Coordinate system axis range meaning	Exact	This is a conditional attribute.
remarks:	CS axis remarks	Used only above legal transitional altitude in regions with topography	This is an optional attribute.
CD_ParametricDatum			
name:	Parametric datum name	Standard atmospheric pressure	
alias:	Datum alias	Mean sea level pressure (MSLP)	This is an optional attribute.
scope:	Datum scope	Aviation, meteorology	
anchorDefinition:	Datum anchor	Mean sea level	This is an optional attribute.
remarks:	Datum remarks	1 013,25 hPa	This is an optional attribute.

B.3 Parametric CRS using function (potential vorticity)

Potential vorticity (PV) is a function which varies strongly with height. One common application of PV levels is to show values of fields on a single level of 2 PV units (1 PV unit = 10^{-6} m^{-2} s^{-1} K kg^{-1}), as this is a PV value often taken to denote the mid-latitude tropopause.

The PV is the absolute circulation of an air parcel that is enclosed between two isentropic surfaces. In the following equation, the PV is the product of absolute vorticity on an isentropic surface and the static stability. Thus, PV consists of two factors: a dynamical element and a thermodynamical element.

$$\mathrm{PV} = -g\left(\zeta_{\Theta} + f\right)\frac{\partial \Theta}{\partial p}$$

where

f is the Coriolis parameter;

g is the gravitational acceleration;

p is the pressure;

Θ is the potential temperature;

ζ_{Θ} is the relative isentropic vorticity.

Within the troposphere, the values of PV are usually low. However, the potential vorticity increases rapidly from the troposphere to the stratosphere due to the significant change in the static stability. Typical changes of the potential vorticity within the area of the tropopause are from 1 (tropospheric air) to 4 (stratospheric air) PV units. Typically, the 2 PV unit anomaly, which separates tropospheric from stratospheric air, is referred to as *dynamical tropopause*. The traditional way of describing the tropopause is to use the potential temperature or static stability. This is only a thermodynamical way of characterizing the tropopause. The benefit of using PV is that the tropopause can be understood in both thermodynamic and dynamic terms. An abrupt folding or lowering of the dynamical tropopause can also be called an upper PV anomaly. When this occurs, stratospheric air penetrates into the troposphere, resulting in high values of PV with respect to the surroundings, creating a positive PV anomaly. In the lower levels of the troposphere, strong baroclinic zones often occur which can be regarded as low level PV anomalies. Due to the conservation of PV, significant features that are related to synoptic-scale weather systems can be identified and followed in space as well as in time.

UML identifier	Attribute	Entry	Comment
SC_ParametricCRS			
name:	Parametric CRS name	Potential vorticity functional CRS	
scope:	CRS scope	Meteorology	
domainOfValidity	CRS validity	The whole atmosphere	This is an optional attribute.
CS_ParametricCS			
name:	Parametric coordinate system name	Potential vorticity functional CS	
CS_CoordinateSystemAxis (attributes are given in 19111:2007, Table 27)			
name:	Coordinate system axis name	Potential vorticity	
axisAbbrev	Coordinate system axis abbreviation	PV	
axisDirection	Coordinate system axis direction	Upward	
axisUnitID	Coordinate system axis unit identifier	PVU	

UML identifier	Attribute	Entry	Comment
remarks:	CS axis remarks	The potential vorticity unit is scaled to give values in the order of (10^{-6} K kg^{-1} m^{-2} s^{-1})	This is an optional attribute.
CD_ParametricDatum			
name:	Parametric datum name	Zero of the computed PV function	
scope:	Datum scope	The whole atmosphere	

B.4 Spatio-parametric coordinate reference system

Presented here is the construction of a spatio-parametric coordinate reference system using ISO 19111:2007, Example D.3, for the horizontal component and an oceanographic example where the parameter is density for the vertical component.

The Miami isopycnal coordinate model (MICOM) is an oceanographic numerical integration model which has horizontal latitude/longitude coordinates and a vertical coordinate which uses a parametric form based on potential density. One model version has MICOM configured for the Atlantic Ocean at 1/12th degree resolution providing fields of temperature and salinity for the MICOM domain for periods within a 20 year MICOM integration.

The MICOM grid in the deep oceans is in steps of potential density (density corrected for compressibility effects), rather than depth. The density of water varies with salinity and temperature as well as depth, and the isopycnal surfaces (constant potential density) are not level under the actions of wind and currents. Numerical ocean or weather forecasting models require complex grids in the vertical (and often the horizontal) to properly represent the physical processes involved. Using natural physical scales helps interpretation and most importantly keeps the model numerically stable. Computing the grid on density coordinates greatly reduces the numerically induced diabatic dispersion of water mass properties and preserves conservation laws, particularly on long model runs.

Different oceanographic models can have grids which differ greatly in detail. Many have hybrid coordinates which can be specified according to location. For example, the grid can be modified at the ocean bottom, in shallow seas and in unstratified water to allow a better representation of the specific physical processes involved there. For this example, all such complexity is ignored.

When the sea surface is used as a datum, the ocean model is subject to diurnal heating. For some ocean models, the datum is taken as 10 m to remove these fast variations; otherwise, a relevant mean sea level is used.

UML identifier	Attribute	Entry	Comment
SC_CompoundCRS			
name:	Compound CRS name	MICOM grid	
domainOfValidity:	CRS validity	Surface to ocean bottom	This is an optional attribute.
scope:	CRS scope	Oceanography	The individual CRS forming the compound CRS are next described. The sequence is significant, implying the order in which coordinates are given. In this example it is latitude, longitude, pressure.
SC_GeodeticCRS			
name:	Geodetic CRS name	WGS 84	
domainOfValidity:	CRS validity	World	
scope:	CRS scope	Global positioning	

UML identifier	Attribute	Entry	Comment
remarks:	CRS remarks	Horizontal component of 3D system.	This attribute is optional.
CS_EllipsoidalCS			
name:	Ellipsoidal coordinate sytem name	Latitude/longitude in degrees	
CS_CoordinateSystemAxis			
name:	Coordinate system axis name	Geodetic latitude	
axisAbbrev:	Coordinate system axis abbreviation	φ	
axisDirection:	Coordinate system axis direction	North	
axisUnitID:	Coordinate system axis unit identifier	Degree	
CS_CoordinateSystemAxis			
name:	Coordinate system axis name	Geodetic longitude	
axisAbbrev:	Coordinate system axis abbreviation	λ	
axisDirection:	Coordinate system axis direction	East	
axisUnitID:	Coordinate system axis unit identifier	Degree	
CD_GeodeticDatum			
name:	Geodetic datum name	World geodetic system of 1984	
CD_Ellipsoid			
name:	Ellipsoid name	WGS 84	
semiMajorAxis:	Length of semi-major axis	6 378 137,0 m	
secondDefiningParameter:	Second defining parameter	inverseFlattening	
inverseFlattening:	Inverse flattening	298,257 223 563	
SC_ParametricCRS			
name:	Parametric CRS name	MICOM potential density CRS	
scope:	CRS scope	Oceanography	
domainOfValidity	CRS validity	Global, oceans and seas	This is an optional attribute.
CS_ParametricCS			
name:	Parametric coordinate system name	Potential density in kg m^{-3}	
CS_CoordinateSystemAxis			
name:	Coordinate system axis name	Potential density	
axisAbbrev	Coordinate system axis abbreviation	PD	
axisDirection	Coordinate system axis direction	Down	
axisUnitID	Coordinate system axis unit identifier	kg m^{-3}	
CD_ParametricDatum			
name:	Parametric datum name	Sea surface	
alias:	Datum alias	Mean sea level	This is an optional attribute.
scope:	Datum scope	Oceanography	
anchorDefinition:	Datum anchor	Mean sea level	This is an optional attribute.

Bibliography

[1] ISO 2533:1975, *Standard Atmosphere*, amended by ISO 2533:1975/Add 1:1985, *Addendum 1: Hypsometrical tables* and ISO 2533:1975/Add 2:1997, Addendum 2: *Extension to − 5000 m and standard atmosphere as a function of altitude in feet*

[2] ISO/TS 19103, *Geographic information — Conceptual schema language*

[3] ISO 19108, *Geographic information — Temporal schema*

[4] ISO/IEC 19501, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

[5] Doc 7488, *Manual of the ICAO Standard Atmosphere: extended to 80 kilometres (262 500 feet).* International Civil Aviation Organisation (ICAO), Third Edition, 1993

[6] *The Miami Isopycnal Coordinate Model*, 2000, available at http://oceanmodeling.rsmas.miami.edu/micom/

ICS 35.240.70

Price based on 16 pages