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Geographic information — Referencing by coordinates

AMENDMENT 2

Information géographique — Système de références par coordonnées

AMENDEMENT 2

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Geographic information — Referencing by coordinates

AMENDMENT 2

3.1.16

Move the EXAMPLE to be before Note 1 to entry. At the end of the EXAMPLE, remove right parentheis after "...and G1762." The complete revised definition becomes:

3.1.16
datum ensemble
group of multiple realizations of the same terrestrial or vertical reference system that, for approximate spatial referencing purposes, are not significantly different

EXAMPLE "WGS 84" as an undifferentiated group of realizations including WGS 84 (TRANSIT), WGS 84 (G730), WGS 84 (G873), WGS 84 (G1150), WGS 84 (G1674) and WGS 84 (G1762). At the surface of the Earth these have changed on average by 0.7 m between the TRANSIT and G730 realizations, a further 0.2 m between G730 and G873, 0.06 m between G873 and G1150, 0.2 m between G1150 and G1674 and 0.02 m between G1674 and G1762.

Note 1 to entry: Datasets referenced to the different realizations within a datum ensemble may be merged without coordinate transformation.

Note 2 to entry: 'Approximate' is for users to define but typically is in the order of under 1 decimetre but may be up to 2 metres.

3.1.31

Replace definition with:

3.1.31
geodetic coordinate reference system
two- or three-dimensional coordinate reference system based on a geodetic reference frame and having either a three-dimensional Cartesian or an ellipsoidal or a spherical coordinate system

Note 1 to entry: In this document a coordinate reference system based on a geodetic reference frame and having an ellipsoidal coordinate system is geographic.

3.1.60

Replace definition with:

3.1.60
spherical coordinate system
two- or three-dimensional coordinate system in Euclidean space in which position is specified by two angular coordinates and (in the three-dimensional case) one distance coordinate

Note 1 to entry: Not to be confused with an ellipsoidal coordinate system based on an ellipsoid 'degenerated' into a sphere.

9.3.2

After 9.3.2 list item f), add:

g) Derived projected 2D + Vertical CRS.

h) Derived projected 2D + Engineering 1D (near vertical).

9.3.4

Replace whole subclause with the following:

A spatio-parametric coordinate reference system is a compound CRS in which one component is a geographic 2D, projected 2D, engineering 2D CRS or derived projected 2D CRS, supplemented by a parametric CRS to create a three-dimensional CRS: an example is included in E.3.3. More than one parametric coordinate reference system may be included if these represent independent parametric quantities.

9.4, fourth paragraph

Insert an additional new last sentence as follows:

Associations between coordinate reference systems and coordinate operations are summarized in the UML class diagram in Clause 12, Figure 17.

Figure 9

Replace Figure 9 with the following:

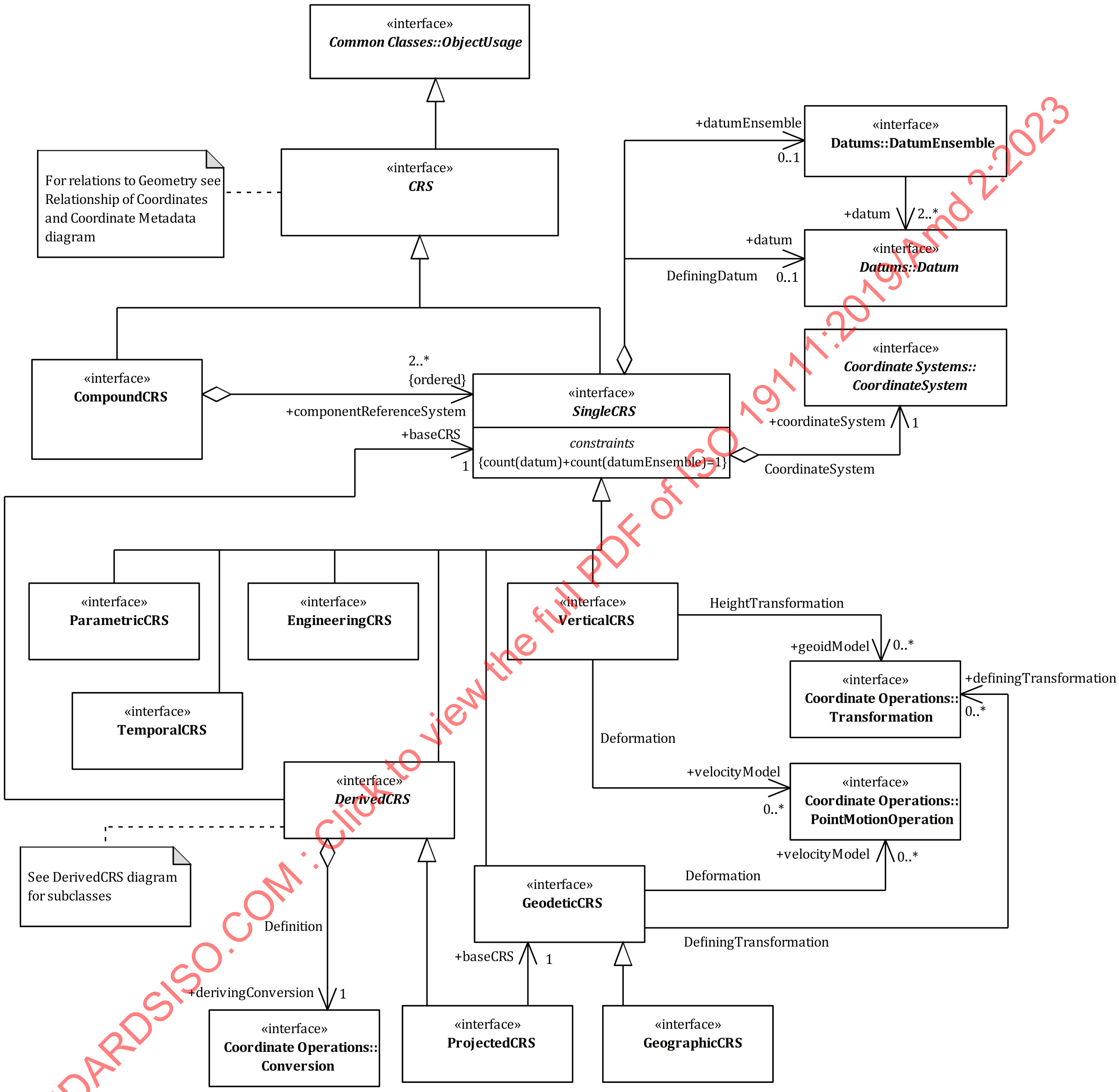

Figure 9 — UML diagram — Coordinate Reference Systems package

9.4, Table 10

Replace Table 10 with the following:

Table 10 — Defining elements of Coordinate Reference Systems::GeodeticCRS class

Definition:	coordinate reference system associated with a geodetic reference frame and a three-dimensional Cartesian or spherical coordinate system NOTE If the geodetic reference frame is dynamic then the geodetic CRS is dynamic, else it is static.				
Stereotype:	Interface				
Class attribute:	Concrete				
Inheritance from:	SingleCRS				
Generalization of:	GeographicCRS, DerivedGeodeticCRS				
Association roles:	associations inherited from SingleCRS, plus:				
Association name	UML identifier	Association with	Obligation	Maximum Occurrence	Association definition
Coordinate System	(aggregation) coordinateSystem	CoordinateSystems:: GeodeticCS	M	1	coordinate system that is a component of this geodetic coordinate reference system
Defining Datum	(aggregation) datum	Datums:: Geodetic ReferenceFrame	O	1	geodetic reference frame that is a component of this geodetic coordinate reference system
Defining Transformation	definingTransformation	CoordinateOperations:: Transformation	O	N	transformation that defines this geodetic coordinate reference system
Deformation	velocityModel	CoordinateOperations:: PointMotionOperation	O	N	velocity model(s) or deformation grid(s) that may be applied to this geodetic coordinate reference system
Constraints:	constraints inherited from SingleCRS, plus: {coordinateSystem.ocl As Type(EllipsoidalCS) implies count(datum.ellipsoid)=1}				
Remarks:	The constraint enforces the requirement on geographicCRS to be associated with an ellipsoid. It is made through the GeodeticCRS class because GeographicCRS is related to Datum and hence Ellipsoid only through its subtyping from the GeodeticCRS class. GeodeticCRSs should be associated with a Cartesian coordinate system or with a spherical coordinate system.				
Public attributes:	6 attributes (CRS name, CRS alias, CRS identifier, CRS scope, CRS validity and CRS remarks) inherited from Common Classes::IdentifiedObject and Common Classes::ObjectUsage.				

9.4, Table 12

Replace Table 12 with the following:

Table 12 — Defining elements of Coordinate Reference Systems::VerticalCRS class

Definition:	coordinate reference system having a vertical reference frame and a one-dimensional vertical coordinate system used for recording gravity-related heights or depths; vertical CRSs make use of the direction of gravity to define the concept of height or depth, but the relationship with gravity may not be straightforward. NOTE 1 If the vertical reference frame is dynamic then the vertical CRS is dynamic, else it is static. NOTE 2 Ellipsoidal heights cannot be captured in a vertical coordinate reference system. They exist only as an inseparable part of a 3D coordinate tuple defined in a geographic 3D coordinate reference system.				
Stereotype:	Interface				
Class attribute:	Concrete				
Inheritance from:	SingleCRS				
Generalization of:	DerivedVerticalCRS				
Association roles:	associations inherited from SingleCRS, plus:				
Association name	UML identifier	Association with	Obligation	Maximum Occurrence	Association definition
Coordinate System	(aggregation) coordinateSystem	CoordinateSystems:: VerticalCS	M	1	vertical coordinate system that is a component of this vertical coordinate reference system
Defining Datum	(aggregation) datum	Datums:: VerticalReferenceFrame	O	1	vertical reference frame that is a component of this vertical coordinate reference system
Height Transformation	geoidModel	CoordinateOperations:: Transformation	O	N	geoid model or height correction model that is associated with this vertical coordinate reference system
Deformation	velocityModel	CoordinateOperations:: PointMotionOperation	O	N	velocity model or deformation grid that is applied to this vertical coordinate reference system
Public attributes:	6 attributes (CRS name, CRS alias, CRS identifier, CRS scope, CRS validity and CRS remarks) inherited from Common Classes::IdentifiedObject and Common Classes::ObjectUsage..				

10.3, Table 26

In Table 26, replace the description of spherical CS with the following:

two- or three-dimensional coordinate system in Euclidean space with two angular coordinates and, in the three-dimensional case, one distance, measured from the origin.

NOTE Not to be confused with an ellipsoidal coordinate system based on an ellipsoid ‘degenerated’ into a sphere.

10.4, Table 27

Replace Table 27 with the following:

Table 27 — Naming constraints for coordinate system axis

CS type	When used in CRS type	Permitted coordinate system axis names
Cartesian	geodetic	geocentric X, geocentric Y, geocentric Z
Cartesian	projected	northing or southing, easting or westing, [ellipsoidal height (if 3D)]
ellipsoidal	geographic	geodetic latitude, geodetic longitude, [ellipsoidal height (if 3D)]
spherical	geodetic	spherical latitude, spherical longitude, [geocentric radius (if 3D)] or geocentric latitude, geodetic longitude, [geocentric radius (if 3D)] or geocentric co-latitude, geodetic longitude, [geocentric radius (if 3D)]
vertical	vertical	depth or gravity-related height

10.5, Table 28

Replace Table 28 with the following:

Table 28 — Defining elements of CoordinateSystems::CoordinateSystem class

<table>
<tr><td colspan="2">Definition:</td><td colspan="4">non-repeating sequence of coordinate system axes that spans a given coordinate space
A coordinate system is derived from a set of mathematical rules for specifying how coordinates in a given space are to be assigned to points. The coordinate values in a coordinate tuple shall be recorded in the order in which the coordinate system axes associations are recorded.</td></tr>
<tr><td colspan="2">Stereotype:</td><td colspan="4">Interface</td></tr>
<tr><td colspan="2">Class attribute:</td><td colspan="4">Abstract</td></tr>
<tr><td colspan="2">Inheritance from:</td><td colspan="4">Common Classes::IdentifiedObject</td></tr>
<tr><td colspan="2">Generalization of:</td><td colspan="4">AffineCS, CylindricalCS, EllipsoidalCS, LinearCS, OrdinalCS, ParametricCS, PolarCS, SphericalCS, TemporalCS, VerticalCS, DerivedProjectedCS, EngineeringCS, GeodeticCS</td></tr>
<tr><td colspan="6">Association roles:</td></tr>
<tr><td><u>Association name</u></td><td><u>UML identifier</u></td><td><u>Association with</u></td><td><u>Obligation</u></td><td><u>Maximum Occurrence</u></td><td><u>Association definition</u></td></tr>
<tr><td>(not named)</td><td>(aggregation) axis</td><td>CoordinateSystemAxis (ordered)</td><td>M</td><td>N</td><td>coordinate system axis that is a component of this coordinate system</td></tr>
<tr><td colspan="2">Constraints:
Remarks:</td><td colspan="4">{axis->forAll(count(axis.axisUnitID)=1)}
This constraint requires all axes to include unit information. The constraint is modified by the ordinalCS and dateTimeTemporalCS classes.</td></tr>
<tr><td colspan="2">Public attributes:</td><td colspan="4">4 attributes (CS name, CS alias, CS identifier and CS remarks) inherited from Common Classes::IdentifiedObject.</td></tr>
</table>

10.5, Table 37

Replace Table 37 with the following:

Table 37 — Defining elements of CoordinateSystems::SphericalCS class

Definition:	two- or three-dimensional coordinate system in Euclidean space with two angular coordinates and (in the 3D case) one distance measured from the origin Not to be confused with an ellipsoidal coordinate system based on an ellipsoid "degenerated" into a sphere. A SphericalCS shall have two or three axis associations; the number of associations shall equal the dimension of the coordinate system.
Stereotype:	Interface
Class attribute	Concrete
Inheritance from:	CoordinateSystem
Used by:	DerivedProjectedCS EngineeringCS GeodeticCS
Public attributes:	4 attributes (CS name, CS alias, CS identifier and CS remarks) inherited from Common Classes::IdentifiedObject.

Figure 13

Replace Figure 13 with the following:

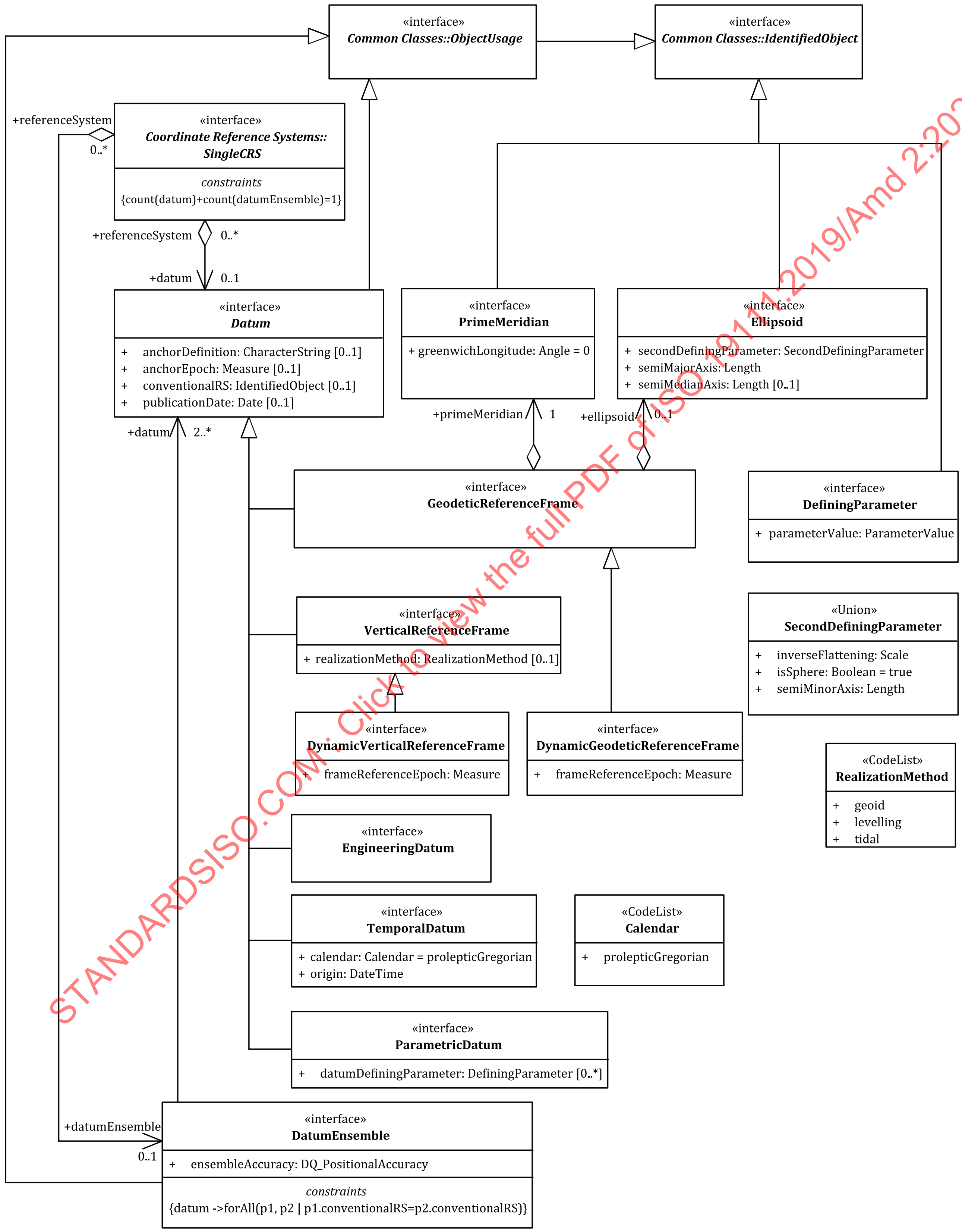

Figure 13 — UML diagram — Datums package

11.6, Table 50

Replace Table 50 with the following:

Table 50 — Defining elements of Datums::Datum class

Definition:	specification of the relationship of a coordinate system to an object, thus creating a coordinate reference system NOTE For geodetic and vertical coordinate reference systems, it relates a coordinate system to the Earth. With other types of coordinate reference systems, the datum can relate the coordinate system to another physical or virtual object. A datum uses a parameter or set of parameters that determine the location of the origin of the coordinate reference system. Each datum subtype can be associated with only specific types of coordinate reference systems.
Stereotype:	Interface
Class attribute:	Abstract
Inheritance from:	Common Classes::ObjectUsage
Generalization of:	EngineeringDatum GeodeticReferenceFrame ParametricDatum TemporalDatum VerticalReferenceFrame
Public attributes:	6 attributes (datum name, datum alias, datum identifier, datum scope, datum validity and datum remarks) inherited from Common Classes::IdentifiedObject and Common Classes::ObjectUsage, plus:

Attribute name	UML identifier	Data type	Obligation	Maximum Occurrence	Attribute Definition
Datum anchor definition	anchorDefinition	CharacterString	O	1	description, possibly including coordinates of an identified point or points, of the relationship used to anchor a coordinate system to the Earth or alternate object NOTE 1 For modern geodetic reference frames the anchor may be a set of station coordinates; if the reference frame is dynamic it will also include coordinate velocities. For a traditional geodetic datum, the anchor can be a point known as the fundamental point, which is traditionally the point where the relationship between geoid and ellipsoid is defined, together with a direction from that point. — For a vertical reference frame the anchor can be the zero level at one or more defined locations or a conventionally defined surface. — For an engineering datum, the anchor can be an identified physical point with the orientation defined relative to the object.
Datum anchor epoch	anchorEpoch	Measure	O	1	epoch at which a static reference frame matches a dynamic reference frame from which it has been derived. NOTE 2 Not to be confused with the *frame reference epoch* of dynamic geodetic and dynamic vertical reference frames. Nor with the epoch at which a reference frame is defined to be aligned with another reference frame; it is recommended that this information be included in the *datum anchor definition*.
Datum publication date	publicationDate	Date	O	1	date on which the datum definition was published
Conventional reference system	conventionalRS	CommonClasses::IdentifiedObject	O	1	name, identifier, alias and remarks for the terrestrial reference system or vertical reference system realized by this reference frame EXAMPLE "ITRS" for ITRF88 through ITRF2008 and ITRF2014, or "EVRS" for EVRF2000 and EVRF2007.

Table 50 *(continued)*

Remarks:	The constraint on the SingleCRS class *{count(datum) +count(datumEnsemble) = 1}* requires a single CRS to have either a datum or a datum ensemble. The constraint on the DatumEnsemble class *{datum ⟶ forAll(p1, p2 | p1.conventionalRS = p2.conventionalRS)}* requires that all reference frames that are members of a specified datum ensemble shall have the same terrestrial or vertical reference system.

11.6, Table 52

Replace Table 52 with the following:

Table 52 — Defining elements of Datums::DynamicGeodeticReferenceFrame class

Definition:	geodetic reference frame in which some of the parameters describe time evolution of defining station coordinates EXAMPLE Defining station coordinates having linear velocities to account for crustal motion.
Stereotype:	Interface
Class attribute:	Concrete
Inheritance from:	GeodeticReferenceFrame
Public attributes:	9 attributes (datum name, datum alias, datum identifier, datum remarks, datum scope, datum validity, datum anchorDefinition, datum publication date and conventionalRS) inherited from Common Classes::IdentifiedObject, Common Classes::ObjectUsage and Datum plus:

Attribute name	UML identifier	Data type	Obligation	Maximum Occurrence	Attribute Definition
Frame reference epoch	frameReferenceEpoch	Measure	M	1	epoch to which the coordinates of stations defining the dynamic geodetic reference frame are referenced, usually given as a decimal year EXAMPLE 2016.47.

12.2

Insert a new sentence (paragraph) after the EXAMPLE text "An example is given in C.5.1" and immediately before Figure 15:

Associations between coordinate operations and coordinate reference systems are summarized in the UML class diagram in Figure 17.

Figure 15

Replace Figure 15 with the following: