# The contribution of EUREF to Inspire

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# SUMMARY

- ***About INSPIRE: principles, organization***

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- *From Florence2009 to Gävle2010*

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- About INSPIRE: principles, organization
- From Florence2009 to Gävle2010
- Implementing Rules: CRS

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- **Further contribution of EUREF**

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- Implementing Rules: CRS
- Further contribution of EUREF
- Conclusion

# INSPIRE

## *INfrastructure for SPatial InfoRmation in Europe*

- *Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing INSPIRE was published in the official Journal on the 25th April 2007*

- *The INSPIRE Directive entered into force on the 15th May 2007 (http://inspire.jrc.it/directive/l_10820070425en00010014.pdf)*

# About INSPIRE: principles and organization

- ***Community policy on the environment*** *must aim at a high level of protection taking into account the diversity of situations in the various regions of the Community.*

  *Moreover,* ***information, including spatial information, is needed for the formulation and implementation of this policy and other Community policies,*** *which must integrate environmental protection requirements in accordance with Article 6 of the Treaty.*

  *In order to bring about such integration, it is necessary to establish a measure of coordination between the users and providers of the information so that information and knowledge from different sectors can be combined.*

- ***The Infrastructure for Spatial Information in the European Community (Inspire) should assist policy-making in relation to policies and activities that may have a direct or indirect impact on the environment.***

# About INSPIRE: principles and organization

- *the infrastructures for spatial information in the Member States should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level*
- *it is possible to combine spatial data from different sources across the Community in a consistent way and share them between several users and applications*
- *it is possible for spatial data collected at one level of public authority to be shared between all the different levels of public authorities*
- *spatial data are made available under conditions that do not restrict their extensive use*
- *it is easy to discover available spatial data, to evaluate their fitness for purpose and to know the conditions applicable to their use*

## SPATIAL DATA THEMES

*The INSPIRE Directive addresses 34 spatial data themes needed for environmental applications. These themes are subdivided in the three annexes of the directive.*

http://inspire.jrc.ec.europa.eu/index.cfm/pageid/2/list/7

D2.3_Definition_of_Annex_Themes_and_scope_v3.0.pdf

## *ANNEX I*
## SPATIAL DATA THEMES ON CRS AND CGS

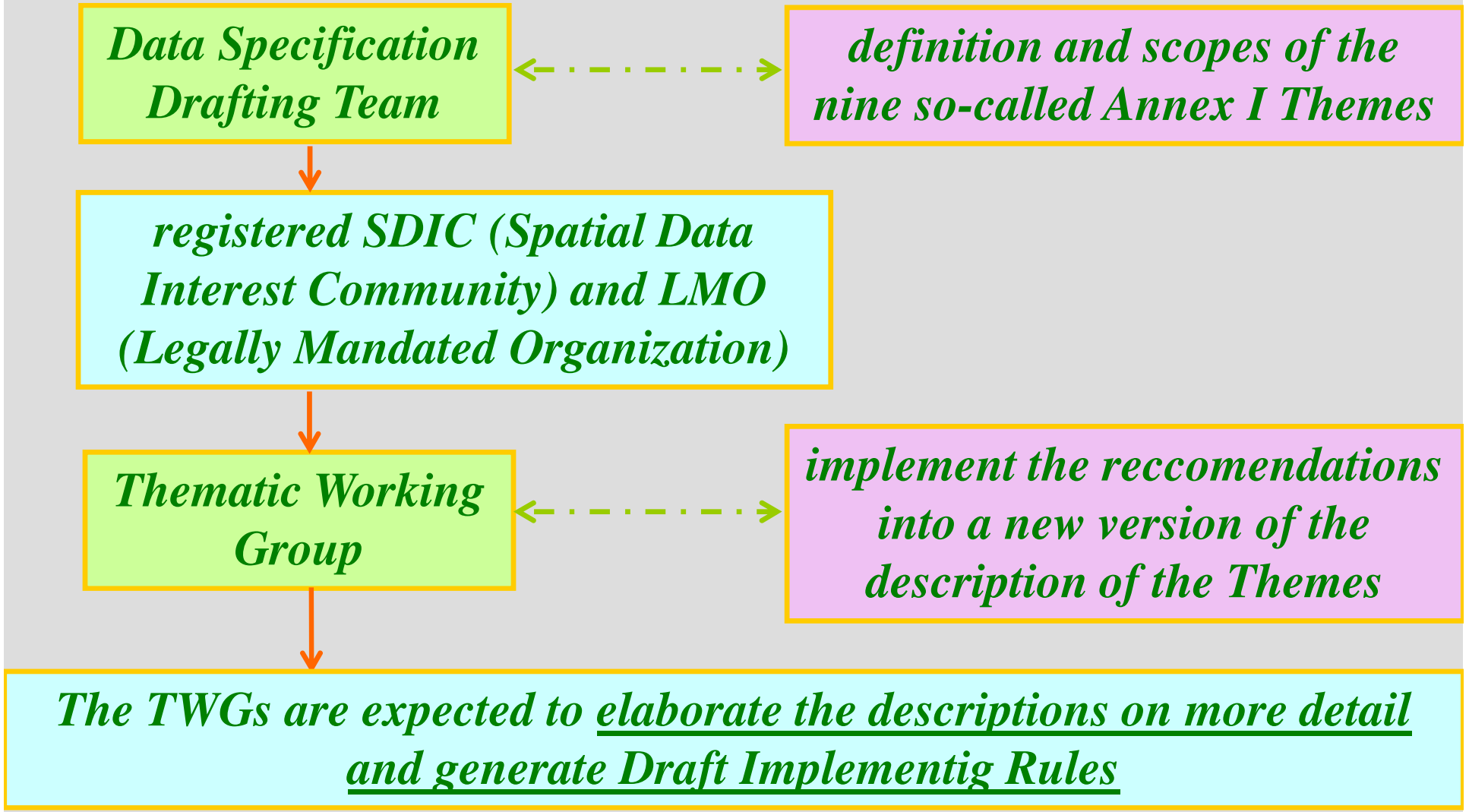
***1. Coordinate reference systems***

***Systems for uniquely referencing spatial information in space as a set of coordinates (x, y, z) and/or latitude and longitude and height, based on a geodetic horizontal and vertical datum.***

***2. Geographical grid systems***

***Harmonised multi-resolution grid with a common point of origin and standardised location and size of grid cells.***

# About INSPIRE: principles and organization



# TYPES OF ORGANIZATIONS

***SDIC: Spatial Data Interest Community***
***LMO: Legally Mandated Organisation***

http://inspire.jrc.ec.europa.eu/index.cfm/pageid/42/list/1

# From Florence2009 to Gävle2010

| Document | Description | When | Who |
|---|---|---|---|
| *TWG-XX-nn* | *Evaluation of user requirements (for each Annex I theme)* | *2008-06* | *TWG, CT, EIONET* |
| *TWG-XX-nn* | *Development of use-cases / documentation for the development of specifications* | *2008-06* | *TWG* |
| *TWG-XX-nn* | *Analysis of possible "holes" in the documents* | *2008-08* | *TWG* |
| *DS-D2.8.I.n* | *Working document "Data Specifications" (technical annex for the IR – one for each Annex I theme)* | *2008-11* | *TWG* |
| *DS-D2.8.I.n b* | *Launch of the specifications for testing (based on use-cases that require data from different themes)* | *2008-11 2008-12* | *SDIC, LMO* |
| *DS-D2.8.I.n c* | *Launch of the consultation on "Data Specifications" to SDIC/LMO* | *2008-11 2008-12* | *SDIC. LMO* |
| *DS-D2.8.I.n d* | *Revised Draft Data specifications* | *2009-03 2009-06* | *TWG* |
| *DS-D2.8.I.n e* | *IR governing the interoperability of spatial datasets and services of Annex I themes submitted for opinion to the INSPIRE Committee* | *2009-05 2009-11* | *Comitology* |

# From Florence2009 to Gävle2010

***14 December 2009***

***Approval of IR by INSPIRE Committee***

http://inspire.jrc.ec.europa.eu/index.cfm/pageid/2

***Draft COMMISSION REGULATION implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services***

D00747402-en.doc

***(pp 18-20)***

## Datum for three-dimensional and two-dimensional coordinate reference systems

*For the three-dimensional and two-dimensional coordinate reference systems and the horizontal component of compound coordinate reference systems used for making spatial data sets available, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, or the datum of the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well documented relationship between both systems, according to EN ISO 19111.*

## Compound Coordinate Reference Systems

*For the horizontal component of the compound coordinate reference system, one of the coordinate reference systems specified in section 1.3.2 shall be used.*

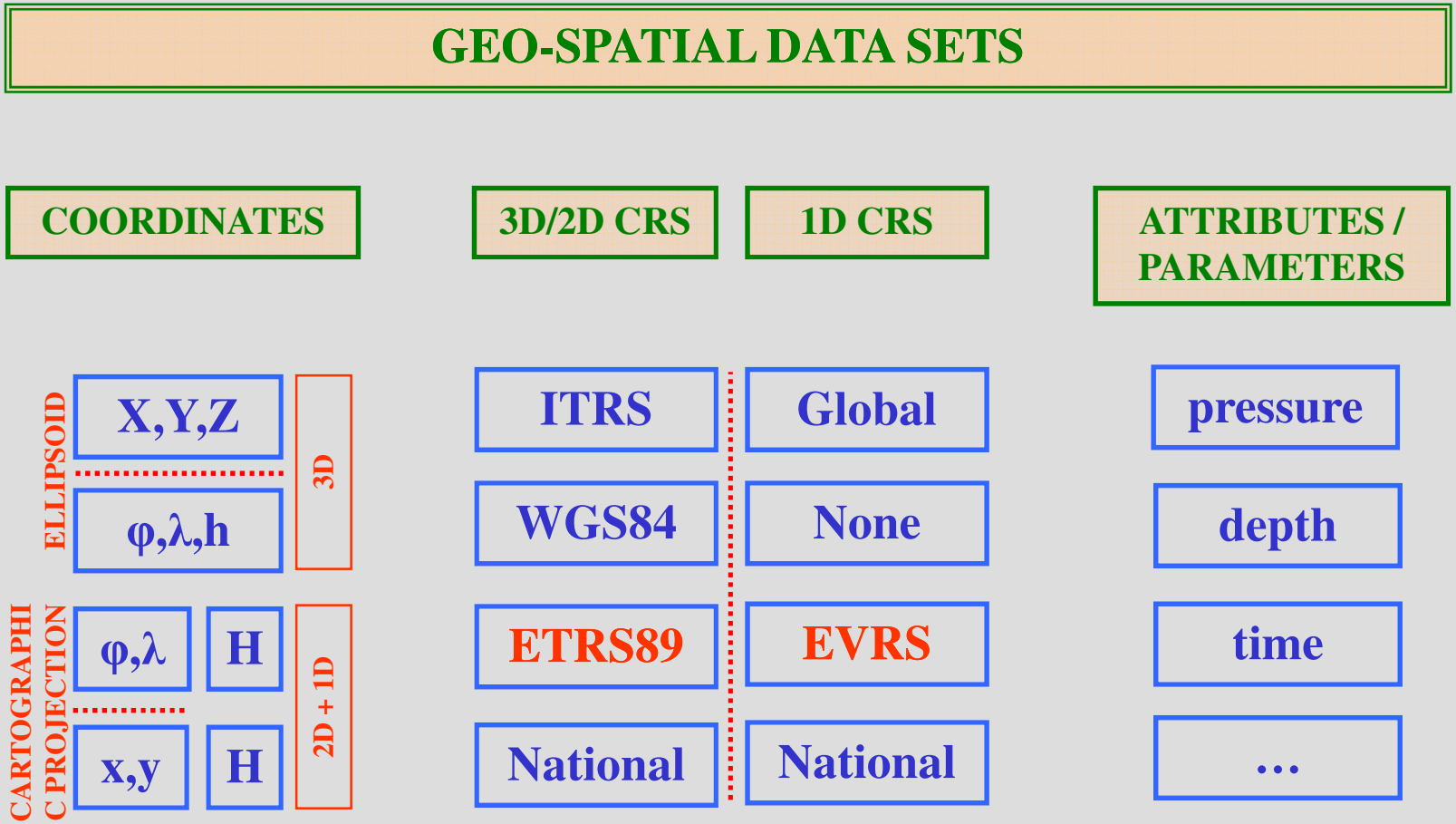
*For the vertical component, one of the following coordinate reference systems shall be used:*

*For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights within its geographical scope. Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS.*

*For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere shall be used.*

# Implementing Rules CRS

## Coordinate Reference Systems Concept



# INSPIRE Specification on Coordinate Reference Systems

| | |
|---|---|
| **Requirement 1** | For the three-dimensional and two-dimensional (horizontal component) coordinate reference systems, the European Terrestrial Reference System 1989 (ETRS89) shall be used for the areas within the geographical scope of ETRS89. |



| | |
|---|---|
| **Requirement 2** | The International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS shall be used in areas that are outside the geographical scope of ETRS89. |

| | |
|---|---|
| **Requirement 3** | For the computation of latitude, longitude and ellipsoidal height, and for the computation of plane coordinates using a suitable mapping projection, the parameters of the GRS80 ellipsoid shall be used. |

# INSPIRE Specification on Coordinate Reference Systems

## 5.3 One-dimensional coordinate reference systems

The European Vertical Reference System (EVRS) [EUREF] is the vertical reference system recommended for Europe on land to express gravity-related heights. The most recent realisation of the EVRS is labelled European Vertical Reference Frame 2007 (EVRF2007). The definition of EVRS is described in the EVRS Conventions 2007.

The vertical reference systems for land existing in the MS can be expressed in the EVRS in their continental territories through their own realisations that are linked to the EVRF2007 solution. Future solutions of the EVRF will constitute an improvement and are considered realisations of the EVRS. The European continental territories of the MS constitute the geographical scope of the EVRS.

Since not all the vertical datums in use can be connected to the European vertical datum, it is necessary that the rules concerning the vertical datum also take into account areas that are not in the European continental territories. In this case, a locally or globally defined vertical reference system related to the Earth gravity field will be used to express gravity-related heights.

| | |
|---|---|
| **Requirement 8** | For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights for the areas within the geographical scope of EVRS. |

| | |
|---|---|
| **Requirement 9** | Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS. |

# INSPIRE Specification on Coordinate Reference Systems

| Identifier | Type of coordinates |
|---|---|
| ETRS89-XYZ | Cartesian coordinates in ETRS89 in space (X,Y,Z) |
| ETRS89-GRS80h | Geodetic (geographic) coordinates and ellipsoidal height in ETRS89 on the GRS80 ellipsoid (Latitude, Longitude, Ellipsoidal height) |
| ETRS89-GRS80 | Geodetic (geographic) coordinates in ETRS89 on the GRS80 (Latitude, Longitude) |
| EVRS | Height in EVRS (H) |
| LAT | Depth of the sea floor, where there is an appreciable tidal range (D) |
| MSL | Depth of the sea floor, in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200m (D) |
| ISA | Pressure coordinate in the free atmosphere (P) |
| PFO | Pressure coordinate in the free ocean (P) |
| ETRS89-LAEA | ETRS89 coordinates projected into plane coordinates by the Lambert Azimuthal Equal Area projection (Y,X) |
| ETRS89-LCC | ETRS89 coordinates projected into plane coordinates by the Lambert Conformal Conic projection (N,E) |
| ETRS89-TMzn[18] | ETRS89 coordinates projected into plane coordinates by the Transverse Mercator projection (N,E) |

[18] »zn« denotes the projection zone

# Further contribution of EUREF

## Coordinate Reference System Identifiers

*Coordinate system parameters and identifiers shall be managed in one or several common registers for coordinate reference systems.*

*Only identifiers contained in a common register shall be used for referring to the coordinate reference systems listed in this Section.*

*Accept what comes from INSPIRE?*

*Accept the ESPG data base?*

*Is it possible for EUREF + EuroGeographics + ? to contribute for the register development and maintenance?*

# Further contribution of EUREF

## Annex I

1. Coordinate reference systems
2. Geographical grid systems
3. Geographical names
4. Administrative units
5. Addresses
6. Cadastral parcels
7. Transport networks
8. Hydrography
9. Protected sites

## Annex II

1. Elevation
2. Land cover
3. Orthoimagery
4. Geology

## Annex III

1. Statistical units
2. Buildings
3. Soil
4. Land use
5. Human health and safety
6. Utility and Government services
7. Environmental monitoring facilities
8. Production and industrial facilities
9. Agricultural and aquaculture facilities
10. Population distribution – demography
11. Area management / restriction / regulation zones & reporting units
12. Natural risk zones
13. Atmospheric conditions
14. Meteorological geographical features
15. Oceanographic geographical features
16. Sea regions
17. Bio-geographical regions
18. Habitats and biotopes
19. Species distribution
20. Energy resources
21. Mineral resources

# Further contribution of EUREF

*Is there a need to include Geodetic Data as a theme?*

*Does INSPIRE accepts it?*

*Has that inclusion an added-value for EUREF + NMA + EuroGeographics ?*

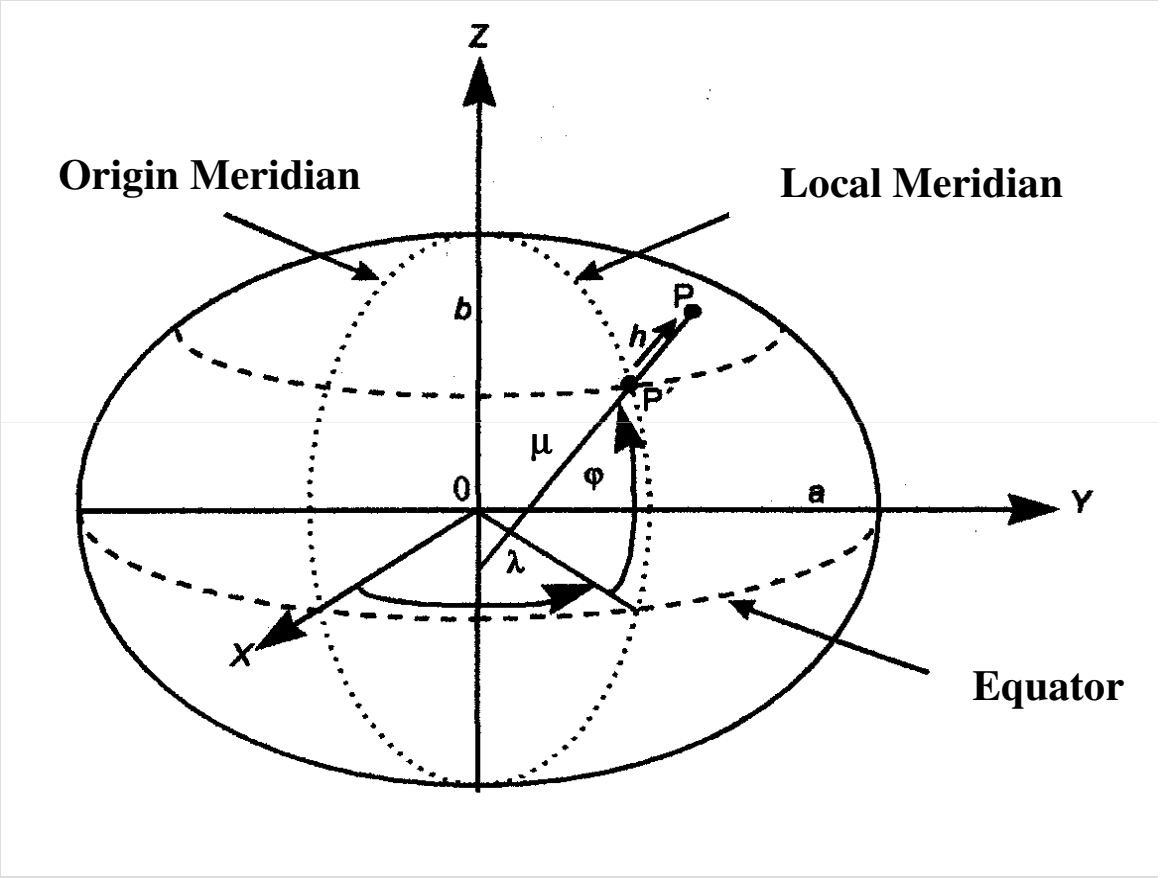

INSPIRE - Infrastructure for Spatial Information in Europe

# INTRODUCING THE REFERENCE ELLIPSOID

$$X = (\mu + h) \cos \varphi \cos \lambda$$

$$Y = (\mu + h) \cos \varphi \operatorname{sen} \lambda$$

$$Z = (\mu (1 - e^2) + h) \operatorname{sen} \varphi$$

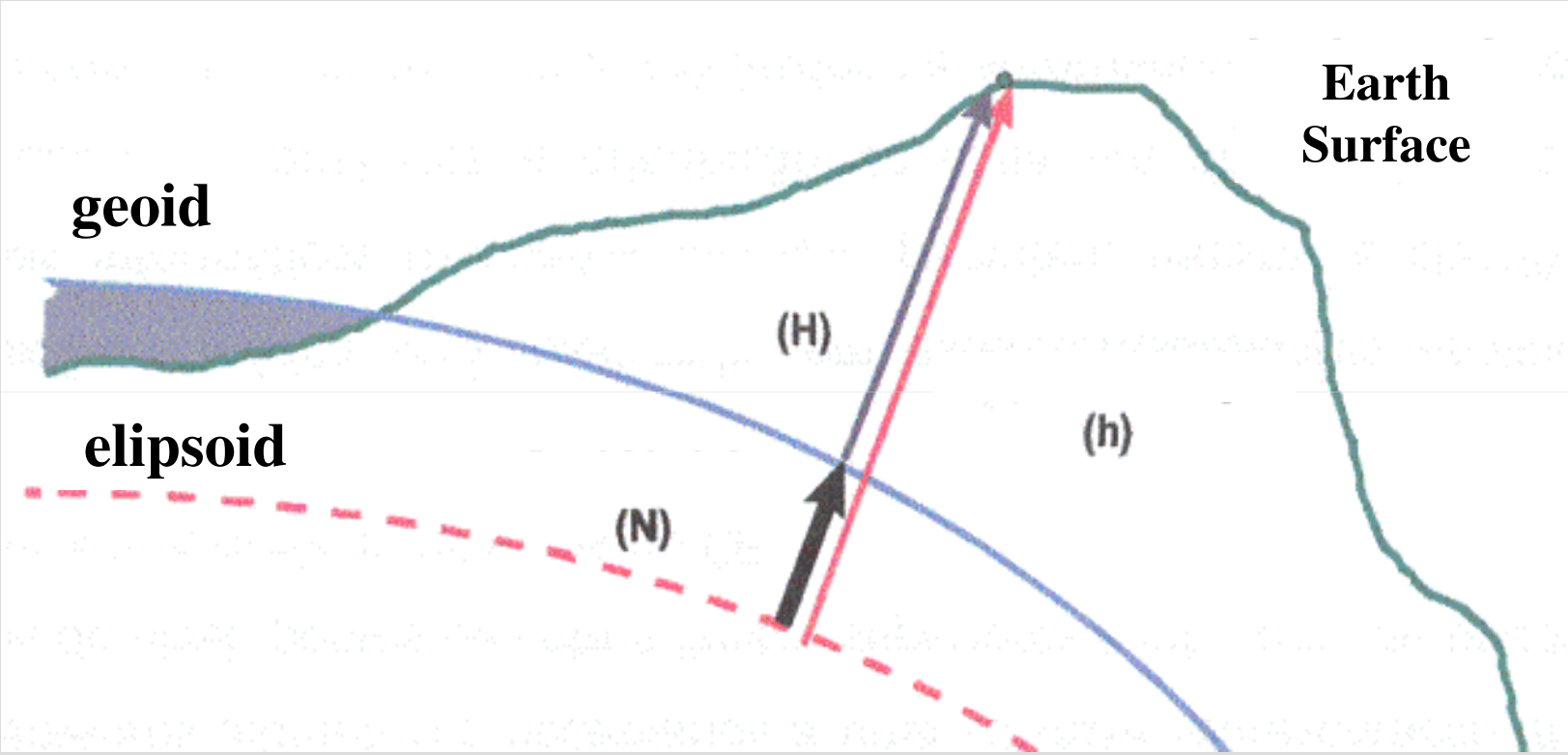



$$h = f(\varphi, \lambda)$$

$$\tan \lambda = Y / X$$

$$\tan \varphi = (Z / Y) ((\mu + h) \operatorname{sen} \lambda) / (\mu (1 - e^2) + h)$$

# VERTICAL REFERENCING




**H - orthometric height**
**h – elipsoidal height**

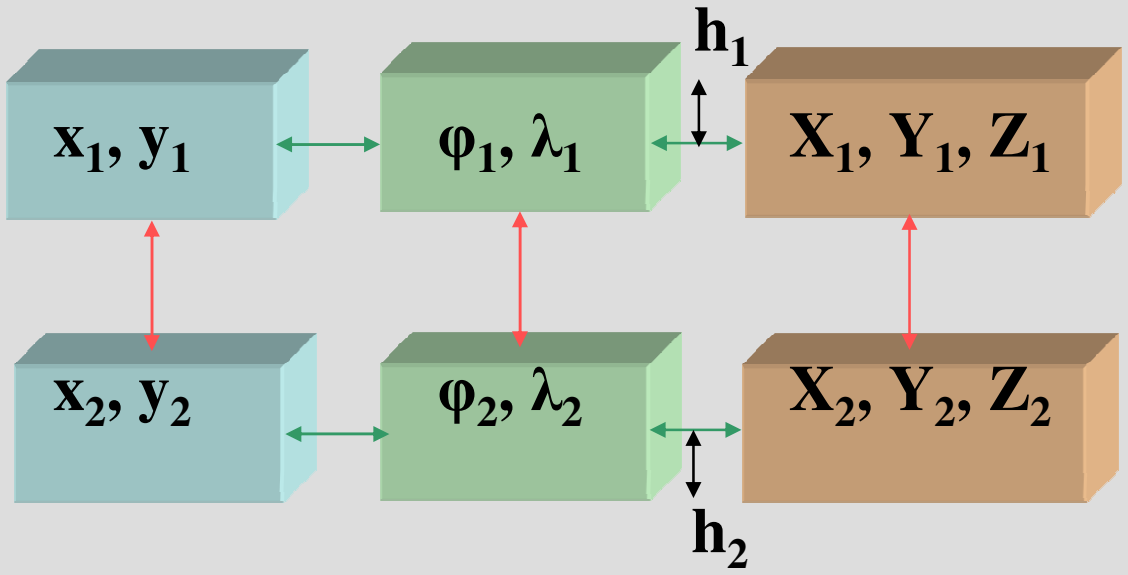
**N - geoid undulation**

# *Coordinate Reference Systems*

## *Relationship between the different types of coordinates and different reference systems*

**Geodetic system 1**

**Geodetic system 2**




| | |
|---|---|
| $x_i, y_i$ | *Plane cartesian coordinates* |
| $\varphi_i, \lambda_i, h_i$ | *Geographic coordinates and ellipsoidal height* |
| $X_i, Y_i, Z_i$ | *Spatial cartesian coordinates* |

# REFERENCE SYSTEMS: TERMINOLOGY

- **Ideal Reference System**

  *theoretical definition (not accessible to the users)*
- **Reference Frame**
  - *Set of physical objects with their coordinates*
  - *Realization of an Ideal Reference System*
  - *Accessible to the users*
- **Coordinate System**

  *cartesian (X,Y,Z), geographic (λ, φ, h),...*

# TRS - TERRESTRIAL REFERENCE SYSTEM

- ***Spatial reference system co-rotating with the Earth in its diurnal motion in space***
- ***Mathematical model for a physical Earth in which point positions are expressed and have small temporal variations due to geophysical effects (Plate motion, Earth tides, etc.)***

  - **Mathematical and physical definition**
  - **Tridimensional system of axes defined by an origin, a unit of lenght and an orientation**
  - **Associated physical constants:**
    ***time, speed of light in vacuum, GM***

# TRF - TERRESTRIAL REFERENCE FRAME

- *Realization of the reference system*
- *Set of geodetic references (physical points)*
- *Coordinates estimation based on space geodetic techniques*
- *Each technique and data analysis realizes its own TRS*
- *Multitude of TRF exist*

## RESOLUTIONS ADOPTED BY THE COUNCIL at the XXIV IUGG GENERAL ASSEMBLY, PERUGIA, ITALY, JULY 2 – 13, 2007

### Resolution 2: Geocentric and International Terrestrial Reference Systems (GTRS and ITRS)

**The International Union of Geodesy and Geophysics,**

***Considering,***

**The increasing importance of geodetic reference systems in geosciences, and more generally in numerous scientific and technical activities, such as satellite navigation systems and geospatial information;**

***Noting,***

**The IUGG Resolution 2 and International Association of Geodesy (IAG) Resolution 1, both adopted in 1991 at the Vienna IUGG General Assembly, which defined the Conventional Terrestrial Reference System (CTRS);**

***Recognizing,***

**The quality of the work done by several IAG services (IERS, IGS, ILRS, IVS, IDS) to realize these systems and provide access for numerous users within and beyond the geosciences community;**

## RESOLUTIONS ADOPTED BY THE COUNCIL at the XXIV IUGG GENERAL ASSEMBLY, PERUGIA, ITALY, JULY 2 – 13, 2007

***Endorses***

**The definition of a Geocentric Terrestrial Reference System (GTRS) in agreement with the 2003 IAU resolution B1.3;**

**The definition of the International Terrestrial Reference System (ITRS) as the specific GTRS for which the orientation is operationally maintained in continuity with past international agreements (BIH orientation); and**

***Adopts***

**The ITRS as the preferred GTRS for scientific and technical applications; and**

***Urges***

**Other communities, such as the geo-spatial information and navigation communities, to do the same.**

# EUROPEAN TERRESTRIAL REFERENCE SYSTEM 89 (ETRS89)

## Definition

***The IAG Subcommision for the European Reference Frame, following its Resolution 1 adopted in Firenze in 1990, recommends that the terrestrial reference system to be adopted by EUREF will be coincident with the ITRS at the epoch 1989.0 and fixed to the stable part of the Eurasian Plate.***

***It will be named European Terrestrial Reference System 89 (ETRS89).***

# EUROPEAN VERTICAL REFERENCE SYSTEM (EVRS)

***The IAG Reference Frame Sub-commission for Europe (EUREF)***

***recognising***

***the requirement of the European Commission for harmonisation of the vertical reference system for geo-information***

***noting***

***the availability of a new realisation of the European Vertical Reference System (EVRS) in agreement with the EVRS2007 conventions***

***recommends***

***to adopt this new realisation of the EVRS under the name EVRF2007 and to exchange the results between all participating countries and***

***proposes***

***to the European Commission that this solution is adopted as the vertical reference for pan-European geo-information.***

***(Resolution no. 3 of the EUREF Symposium in Brussels, 18 – 21 June 2008)***

## WGS84

- *Evolution from WGS72 (60…66), used with the TRANSIT satellite system, percussive of NAVSTAR GPS*
- *Collection of models including Earth Gravitational model, geoid, transformation formulae and set of coordinates of permanent DoD GPS monitor stations*
- *It's a geocentric conventional terrestrial system (Earth Centered Earth Fixed)*
- *The orientation is consistent with the BIH's at epoch 1984.0*
- *Associated with a reference ellipsoid, with the same name*
- *Associated with a reference frame*

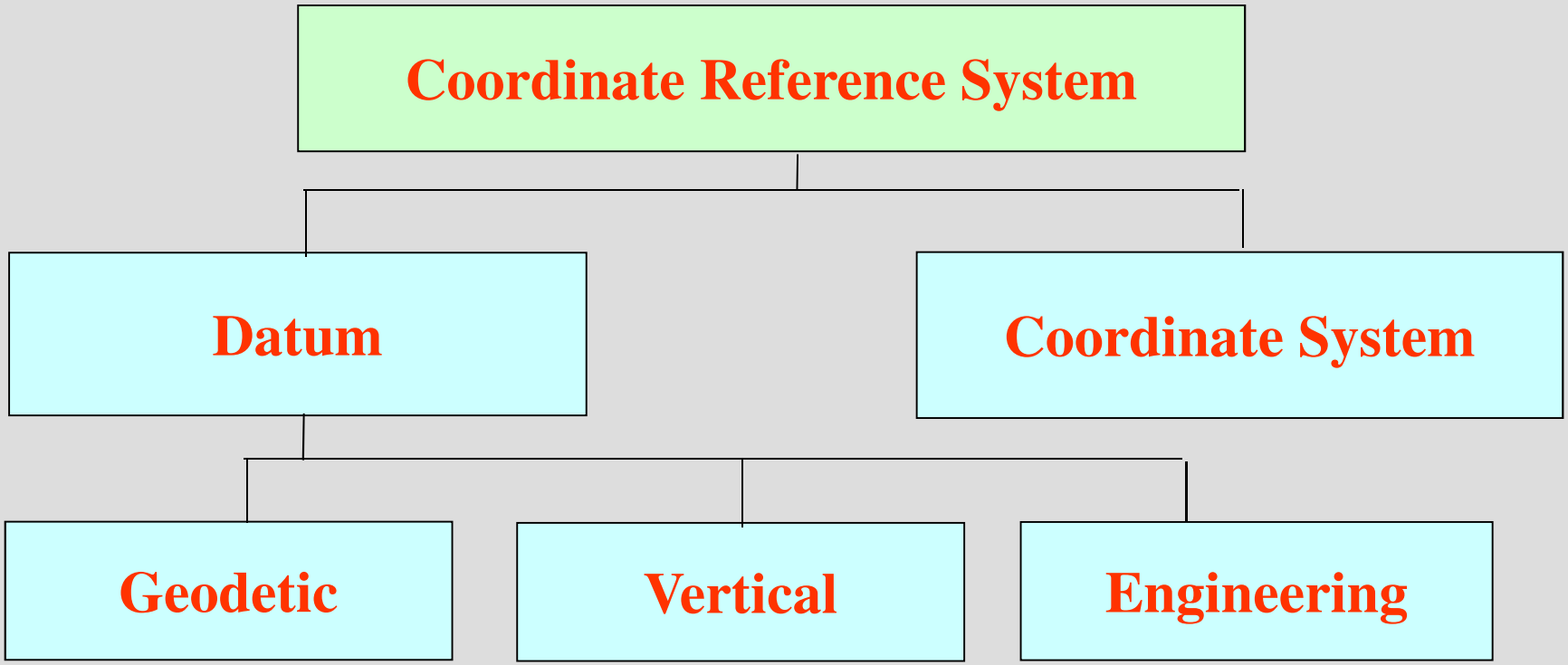
# GALILEO TERRESTRIAL REFERENCE FRAME (GTRF)

- *Galileo Geodesy Service Provider (GGSP)*
  - *Define, realize & maintain the GTRF*
  - *GTRF is compatible with the ITRF*
  - *GTRF is fully aligned to ITRF*
- *GTRF is a realization of the ITRS*

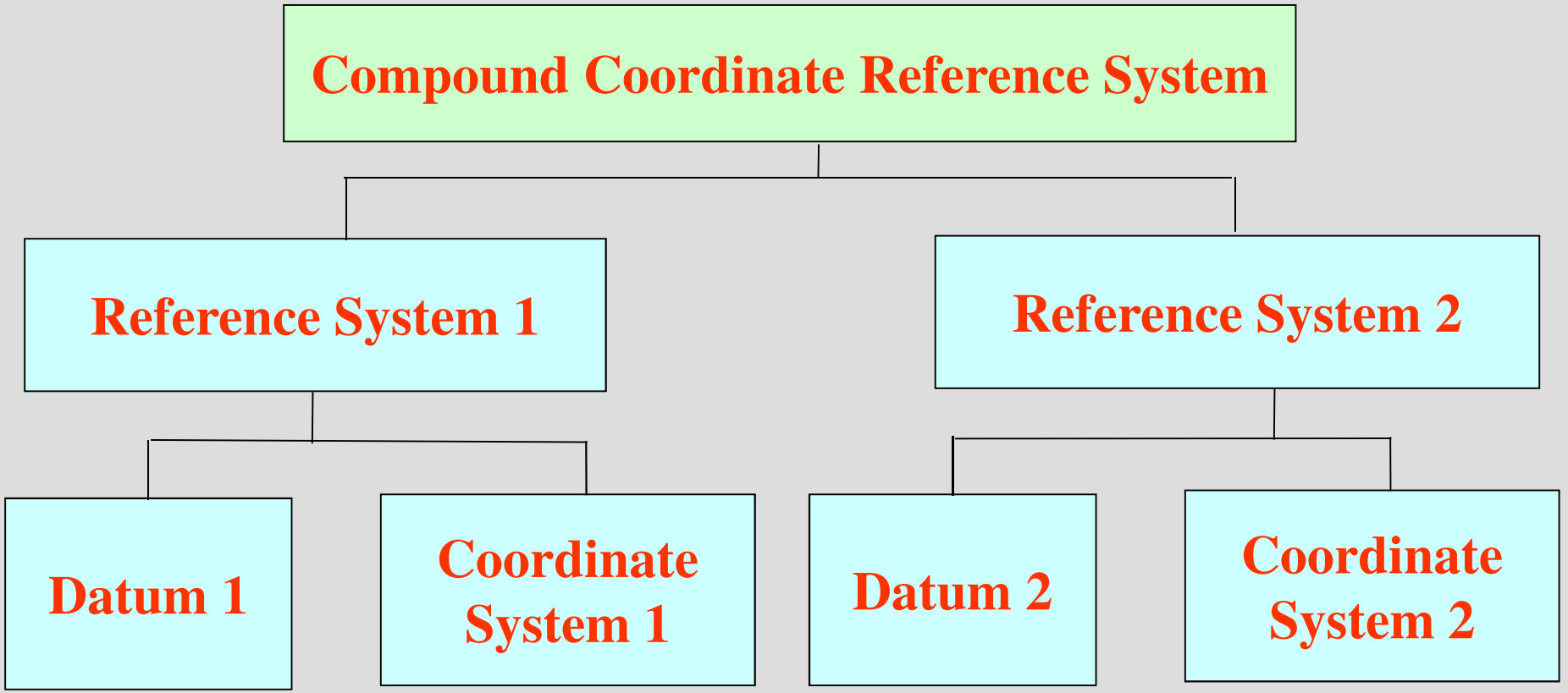
## *Coordinate Reference Systems*

- *The present geo-referencing systems are realized through an observing system based on geodetic space techniques*
- *There is a strong international effort and cooperation for the maintenance of the global and regional geodetic reference frames*
- *The description of geodetic reference systems is the aim of the ISO 19111 Geographic Information – Spatial referencing by coordinates*
- *WGS84, ETRS89, PZ90, GTRF are all connected to (compatible with) a Unique System: the ITRS*

# *Coordinate Reference Systems*



# *Coordinate Reference Systems*




***The horizontal and vertical components to describe a position come from different reference systems (it's the case of heights related to the mean sea level)***

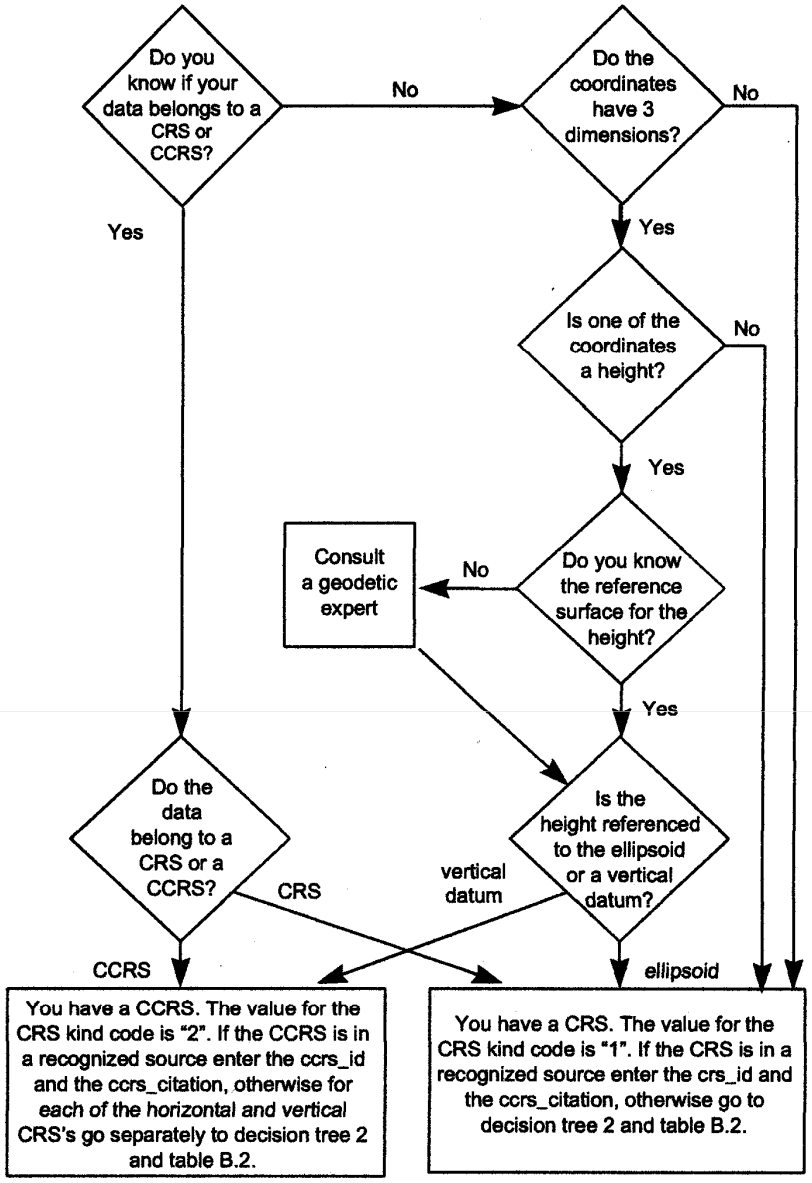



**Figure C.1 — Decision tree 1 – kind of coordinate reference system**

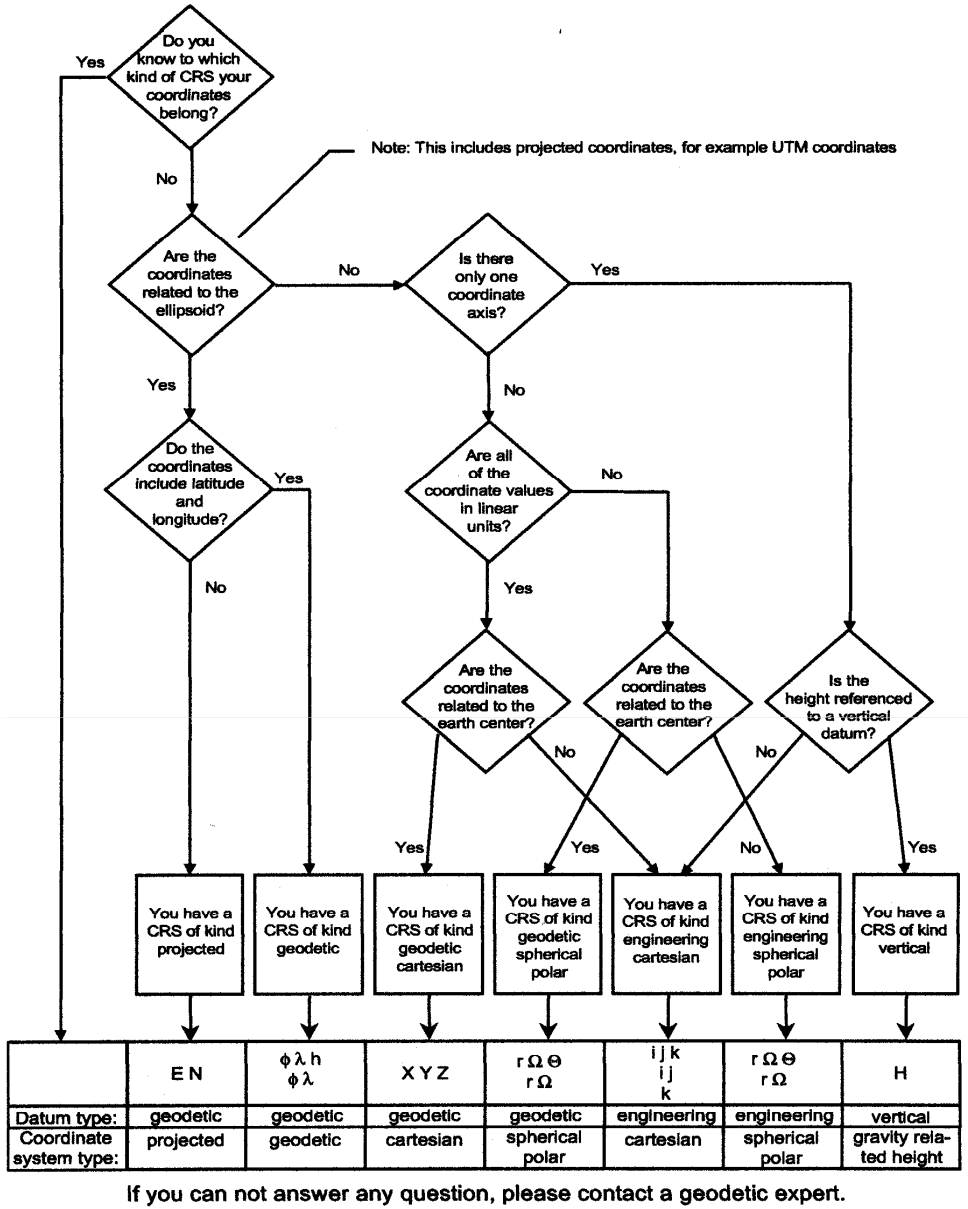



**Figure C.2 — Decision tree 2 – type of coordinate reference system**