Spatial Reference Workshop, Marne-la-Vallée, 29-30 November 1999

Short Proceedings Conclusions & Recommendations

Document information

Distribution: Public
File name: D:\Spatial Ref Workshop\proceedings\990067NT.doc
Reference: **990067NT**
History

Version	Author	Date	Notes
1.0a	CL	1/12/99	First draft for comments from participants
1.0	CL	15/12/99	Final for public dissemination

Contents :

1. Executive Summary

The Spatial Reference workshop was organised by MEGRIN following a request from the European Commission. Its objective, to be achieved by discussion amongst leading experts from the field of European geodesy and Geographic Information, was to examine the options and issues related to a European Reference System for spatial data. By its acceptance and support of the defined system the European Commission would promote widespread use of the de facto standard for future pan-European data products and services.

1.1 Summary of recommendations

The Workshop recommends that the European Commission:

European Geodetic Datum

- Adopts ETRS[1]89 as the geodetic datum for the geo-referenced co-ordinates of its own data;
- Promotes the wider use of ETRS89 within all member states.

Geographical co-ordinate system

- Normally expresses positions related to ETRS89 datum in ellipsoidal type co-ordinates.

European map projections

- Defines its various needs for map projection(s) / obtains further expert advice to determine the appropriate projections.

European Vertical Datum

- Adopts the results of the EUVN[2]/UELN[3] initiatives when available, as definitions of vertical datum and gravity-related heights;
- Promotes the wider use of the European vertical reference system within all member states.

Results dissemination

- Disseminates widely the results of the meeting and follow-up activities to the GIS industry, standards authorities, and potential users.

The Workshop recommends to the European National Mapping Agencies that:

Relationship with National Co-ordinate Reference Systems

- National transformation parameters and algorithms to and from ETRS89 providing co-ordinates of an accuracy at the 1~2m level should be placed in the public domain. The availability of more accurate transformations should also be indicated (with the achievable accuracies) and the official source of information.

The Workshop further recommends that the Technical Working Group of EUREF[4]:

- Manages the collection of the relevant transformation data, and its publication, in year 2000. Issues a progress report for the November 2000 meeting of the EUROSTAT working group on GIS, with NMA[5]s and NSI[6]s

[1] ITRS : IERS Terrestrial Reference System (IERS : International Earth Rotation Sevice)
[2] EUVN : EUropean Vertical reference Network
[3] UELN : United European Levelling Network
[4] EUREF : European Reference Frame
[5] NMA : National Mapping Agency
[6] NSI : National Statistical Institute

2. Agenda

2.1 Day 1 : presentations and discussions

Organisation	Person's Name	Topic or Presentation
Chair	Jean Meyer-Roux	Opening
Host/organiser	Claude Luzet	Format and objectives of the workshop
CEC / JRC / SAI	Alessandro Annoni	The EC requirements in terms of Spatial Reference Systems
CEC / DG InfoSociety	Martin Littlejohn	GI2000 and the political role of the Commission
CEC / EUROSTAT	Torbiörn Carlquist	The GISCO perspective
CEC / EEA	Chris Steenmans	Status of CLC2000 and other Environmental Projects
EUROCONTROL	Paul Dunkley	Civil Aviation requirements for data in a common reference system
OGC / GIPSIE	Martin Staudinger	Spatial Reference Systems, the OGC's efforts: issues, objectives, status, work-plan
MEGRIN	Bernard Farrell	Spatial Reference Systems and pan-European metadata services : issues for the LaClef project
EUREF	Claude Boucher	EUREF contributions to the knowledge of Spatial Reference Systems used in Europe, and the relations between them. The International Terrestrial Reference System and WGS84.
BKG	Georg Weber	The EUREF GPS permanent station network : description, availability of data and services, future evolution
CERCO WG8	Erich Gübler	Optimal use of the conventional European reference system ETRS
ISO-TC211	Johannes Ihde	Spatial reference by coordinates for GIS (concepts and status of relevant standards – ISO & CEN)"
BFL	Stefan Voser	MapRef : the Internet collection of Map Projections and Reference Systems for Europe
OGC/EPSG	Roger Lott	The perspective of the Oil Industry

2.2 Day 2 : Brain-storming, drafting of recommendations

3. Participants

3.1 Represented bodies and organisations

- **SAI: the Space Application Institute,**

Is one Institute of the Joint Research Centre of Ispra (JRC), depending of the Research Directorate-General (previously DGXII) of the European Commission.
"SAI's objective is deriving relevant timely and accurate, policy-relevant policy-sensitive information from earth observation data sets. In addition, the SAI's works responds to the information needs of DGs for non-framework programme ploicies."
The 'GI & GIS Project' of SAI, has the mission to facilitate "GI harmonisation and interoperability."

- **Information Society Directorate-General**

Previously DGXIII, it focuses on "Telecommunication, Markets, Technology, Innovations and Expolitation of Research". DGXIII has be one key partner to the GI community, through its involvement in the GI2000 initiative, and programmes such as INFO2000.

- **EUROSTAT**

The statistical office of the Commission has for mission "to provide the European Union with a high-quality statistical information service. More specifically, this consists of:

- Providing the European institutions with statistical information for devising, managing and assessing common policies;
- Setting up a European statistical system using a common language linking the national statistical systems;
- Supplying the general public with statistical information, including the use ofnew electronic media;
- Offering technical cooperation with the rest of the world."

GISCO (GIS for the COmmission), is the unit of EUROSTAT responsible for maintaining a core GI database for the Commission, and supports its use within the Commission services.

- **EEA, the European Environment Agency**

The European Environment Agency (EEA) was launched by the European Union (EU) in 1993 with a mandate to orchestrate, cross-check and put to strategic use information of relevance to the protection and improvement of Europe's environment. Current membership includes all 15 EU states, as well as Iceland, Liechtenstein and Norway.
Mission statement: "The EEA aims to support sustainable development and to help achieve significant and measurable improvement in Europe's environment through the provision of timely, targeted, relevant and reliable information to policy making agents and the public."

- **EUROCONTROL**

EUROCONTROL, the European Organisation for the Safety of Air Navigation, has 28 Member States. Founded in 1960 for overseeing air traffic control in the upper airspace of Member States, EUROCONTROL today has as its most important goal the development of a coherent and coordinated air traffic control system in Europe. Its primary objectives are to:

- Manage the implementation of the European Air Traffic Management Programme (EATMP), on behalf of States belonging to the European Civil Aviation Conference (ECAC);
- Manage the development and implementation of the ATM 2000+ Strategy which will provide effective ATM in Europe up to the year 2015;
- Operate the Central Flow Management Unit (CFMU) so as to make optimum use of European airspace and to prevent air traffic congestion;
- Iplement short-term and medium-term action to improve the coordination of air traffic control systems throughout Europe;
- Carry out research and development work aimed at increasing air traffic control capacity in Europe.

- **EUREF**

EUREF (EUropean REference Frame) is the name of a network of geodetic stations as well as the name of the Sub-Commission for Europe (former EUREF and UELN/REUN) of the Commission X of IAG (International Association of Geodesy), created in 1987 as a successor of RETRIG.
The purpose of the IAG Commission X on Global and Regional Geodetic Networks (GRGN) is to focus on the variety of existing control networks (horizontal or vertical, national or continental, global from space techniques) as well as their connections and evolutions.
The Commission X has two types of subdivisions:

(1) Subcommissions for large geographical areas: such subcommissions will deal with all types of networks (horizontal, vertical and threedimensional) and all related projects which belong to the geographical area.
(2) Working Groups for specific technical topics

- **CERCO WG8**

CERCO (Comité Européen des Responsables de la Cartographie Officielle) is the group of 37 European National Mapping Agencies (NMAs) represented by their Heads. The mission of CERCO is to help all its members to meet both national and Europe-wide needs for their mapping and geospatial information.
CERCO's principal objective is to ensure that its members have a key role in developing the European geospatial information industry and, thereby, that investments by national governments in their country's mapping are used to the best advantage of the wider European Community. CERCO achieves this through the efforts of its Management Board, Secretariat, Work Groups, MEGRIN, and individual members.
Work Group 8 of CERCO deals with issues related with geodesy.

- **MEGRIN**

MEGRIN was created in 1993 on the initiative of CERCO with the aim of helping the National Mapping Agencies (NMAs) of Europe to meet the increasing demand for cross-border products and services. Since November 1995 MEGRIN has had the legal statute of a GIE (Groupement d'Intérêt Economique, i.e. Economic Grouping of Interest) according to French law. MEGRIN's members, which are also CERCO members, have signed the GIE agreement and pay an annual membership fee to MEGRIN. There are today 20 MEGRIN members and other CERCO members also take part in the life of MEGRIN as observers.

MEGRIN is an acronym of "Multipurpose European Ground Related Information Network", it is a European network of geographical referenced information for use in many diverse applications. MEGRIN's budget is derived primarily from the financial contributions of its members, and from the incomes of its first commercial product SABE (Seamless Administrative Boundaries of Europe). MEGRIN also takes part in several projects partly funded by the European Commission.

- **OGC : Open GIS Consortium**

OpenGIS is defined as transparent access to heterogeneous geodata and geoprocessing resources in a networked environment. The goal of the OpenGIS Project is to provide a comprehensive suite of open interface specifications that enable developers to write interoperating components that provide these capabilities.
OGC (OpenGIS Consortium) is organized as a tax-exempt "membership corporation," as defined in section 501(c)(6) of the US tax code, whose mission is to promote the development and use of advanced open systems standards and techniques in the area of geoprocessing and related information technologies. OGC is supported by Consortium membership fees and, to a lesser extent, development partnerships and publicly funded cooperative programs.

- **GIPSIE**

The GIPSIE project is funded by the ESPRIT Programme of the European Commission (DG III) to help support the European GIS industry's development of products compliant with OpenGIS® specifications. Funding lasts for two years from June 1998 until May 2000.

Chair , SAI
European Commission, Joint Research Centre, Space Application Institute

Jean Meyer-Roux	SAI Deputy Director	jean.meyer-roux@jrc.it,
Alessandro Annoni	SAI, Head GI& GIS Project	alessandro.annoni@jrc.it,

3.2 Host & organiser : MEGRIN

Claude Luzet	MEGRIN Executive Director	Claude.Luzet@megrin.org
Bernard Farrell	Workshop organiser	Bernard.Farrell@megrin.org,
Marcus Wandinger	Workshop secretary	marcus.wandinger@megrin.org,

3.3 European Commission

Martin Littlejohn	CEC, DG Info Society	martin.littlejohn@lux.dg13.cec.be,
Chris Steenmans	European Environment Agency	Chris.Steenmans@EEA.eu.int,
Torbiorn Carlquist	CEC, EUROSTAT, GISCO project	torbioern.carlquist@cec.eu.int,

3.4 Experts

Claude Boucher	Ministry of Education & Research (FR)	boucher@ensg.ign.fr,
Christian Chenez	MELT/DRAST (FR)	chenez@drast.equipement.gouv.fr
Paul Dunkley	EUROCONTROL	paul.dunkley@eurocontrol.be,
Erich Gubler	CERCO Working Group 8 (geodesy)	erich.gubler@lt.admin.ch,
Dr. Johannes Ihde	ISO/TC211, WI 11	ihde@leipzig.ifag.de,
Roger Lott	BP-Amoco, (UK)	lottrj@bp.com,
Jean-Claude Lummaux	CNIG – Afigéo (FR)	lummaux@cnig.fr,
John Rowley	OGC-Europe	geobase@cix.compulink.co.uk,
Martin Staudinger	GIPSIE project	staudinger@geoinfo.tuwien.ac.at,
Stefan Voser	MapRef project	stefan.voser@lt.admin.ch
Dr.Georg Weber	EUREF	weber@ifag.de,
Anton Wolfkamp	EUROGI	eurogi@euronet.nl,

Jean Meyer-Roux
CEC/JRC/SAI

Alessandro Annoni
CEC/JRC/SAI

Claude Luzet
MEGRIN

THE CHAIR

Erich Gübler
CERCO WG8 chair
Switzerland

Dr. Johannes Ihde
ISO, BKG Germany

Dr. Georg Weber
EUREF, BKG Germany

Torbiörn Carlquist
CEC/EUROSTAT/
GISCO project

Marcus Wandinger
Workshop secretary
MEGRIN

Claude Boucher
Ministry of Education &
Research; IGN France

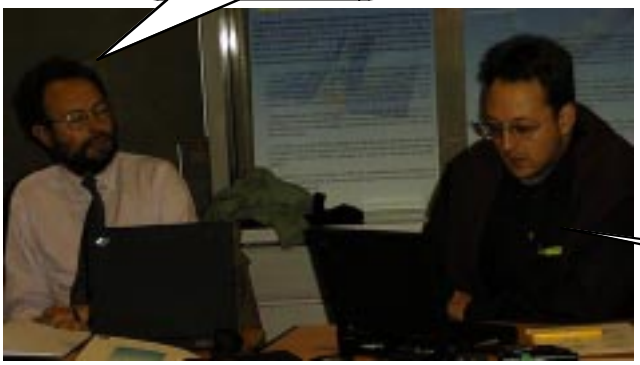
Martin Littlejohn
CEC/DG Info Society

Paul Dunkley
EUROCONTROL

Anton Wolfkamp
EUROGI Secretary General

John Rowley
OGC

Roger Lott
BP-Amoco, UK



Christian Chenez
MELT/DRAST France

Stefan Voser
MapRef project, Switzerland

Martin Staudinger
Vienna University
GIPSIE project

Jean-Claude Lummaux
CNIG-Afigéo, France

Chris Steenmans
EEA

Bernard Farrell
Workshop organiser
MEGRIN

4. Introduction

Exact knowledge, understanding, management and subsequent processing of the co-ordinates of any GI dataset is one of the central aspects of cross-border GI interoperability. The Joint Research Centre, on behalf of the European Commission, requested MEGRIN to organise a workshop with a panel of relevant experts, with the objectives:

1. To advise the European Commission on data specification related to spatial referencing systems;
2. To identify and assess, at the European level, the issues involved;
3. To identify the relevant actors for addressing them;
4. To eventually draft an initial action-plan.

Some of the topics that were proposed for further consideration were;

5. A common Spatial Reference System for Europe;
6. A survey/collection of the Spatial Reference Systems used in Europe;
7. Transformations from national co-ordinates to the common system, and reverse;
8. Specification, validation or certification of software embedded transformation modules.

The workshop was very successful due to the participation of a broad range of experts, including institutional cross-border GI users, as well geodesy and standardisation experts. Clear consensus was easily reached on recommendations to the European Commission, and the GI community at large, in regard to the choice and use of geodetic co-ordinates.

The scope of the workshop was restricted by the two following criteria:

- The workshop dealt only with geo-referencing by co-ordinates (direct referencing), and did not address the issues of indirect positioning (e.g. by postcodes, addresses, …);
- The workshop did not addressed point 8 (above) related to software specification and certification; however it is expected that software developers will take into consideration the recommendations of the workshop.

5. European co-ordinate reference system

5.1 European Geodetic Datum

ETRS[7]89 is recognised by the scientific community as the most appropriate European geodetic datum to be adopted. It is defined to 1cm accuracy, and is consistent with the global ITRS[8]. ETRS89 is now available due to the creation of the EUREF[9] permanent GPS station network and validated EUREF observations. It has been adopted by some European agencies, Civil Aviation, industry, etc. and is already part of the legal framework of some EU member states.

5.1.1 Recommendation:

The Workshop recommends that the European Commission:

- Adopts ETRS89 as the geodetic datum for the geo-referenced co-ordinates of its own data, and includes ETRS89 in the future specifications of the products to be delivered to the CEC[10], within projects, contracts, etc.
- Promotes the wider use of ETRS89 within all member states, by appropriate means (recommendations, official statement, …)

5.1.2 Actions :

Who	***What***	***By***
GISCO	Check implications for the GISCO database, at the 10m level	2nd quarter 2000
COGI	Check with relevant actors the implications for	2nd quarter 2000

[7] ETRS : European Terrestrial Reference System
[8] ITRS : IERS Terrestrial Reference System (IERS : International Earth Rotation Service)
[9] EUREF : European Reference Frame
[10] CEC : Commission for the European Community ; or the European Commission (EC)

	applications at the 1m level, and higher	
COGI	To formulate the recommendation statement, using the EUROCONTROL experience	2nd quarter 2000

5.2 Geographical co-ordinate system

5.2.1 Recommendation:

The Workshop recommends to the European Commission that:

- The co-ordinates for expressing positions related to ETRS89 datum will normally be ellipsoidal (geodetic latitude, geodetic longitude, and if appropriate ellipsoidal height).

5.3 European Vertical Datum

The IAG[11] sub-commission for Europe (EUREF) is defining a European vertical datum based on the EUVN[12]/UELN[13] initiative. Results will be presented within the year 2000.

5.3.1 Recommendation:

The Workshop recommends that the European Commission:

- Adopts the results of the EUVN/UELN initiatives when available, as definitions of vertical datum and gravity-related heights,
- Includes the EUVN reference system so defined for the specifications of the products to be delivered to the CEC, within projects, contracts, etc.
- Further promotes the wider use of the European vertical reference system within all member states, by appropriate means (recommendations, official statement, …)

6. Relationship with National Co-ordinate Reference Systems

It is recognised that

- both the ETRS89 and the current national (and local) co-ordinate reference systems for spatial reference and
- both a European vertical datum and the current national height systems for height reference

will continue to co-exist for many years to come.
Numerous existing procedures allow transformations of co-ordinates from one system to the other. Some of these transformation programs are freely available, some are embedded in commercial software, yet many are reserved for internal use and not publicly distributed. There is a multitude of user-defined relationships in use. There is an urgent CEC business need to implement a single set of officially recognised transformations.

6.1.1 Recommendations:

The Workshop recommends to the NMA[14]s that:

- Transformation parameters and algorithms to and from ETRS89 providing co-ordinates of an accuracy at the 1~2m level should be placed in the public domain;
- The availability of more accurate transformations should also be indicated (with the achievable accuracies) and the official source of information.

The Workshop further recommends that the Technical Working Group of EUREF:

- Manages the collection of the relevant transformation data, and its publication, in year 2000;
- Issues a progress report for the November 2000 meeting of the EUROSTAT working group on GIS, with NMAs and NSI[15]s

[11] IAG : International Association of Geodesy
[12] EUVN : EUropean Vertical reference Network
[13] UELN : United European Levelling Network
[14] NMA : National Mapping Agency
[15] NSI : National Statistical Institute

7. European map projections

There are requirements to express the ETRS89 positions converted from ellipsoidal co-ordinates to projected co-ordinates. Different needs will require different types of map projections, capable of being used for both raster and vector data, and at various application scales. It is not therefore possible to adopt a single European map projection for all needs. Issues that have been identified include a Europe-wide projection for statistical data, a Europe-wide projection for raster imagery, and multiple projections for high resolution data.

7.1.1 Recommendation:

The Workshop recommends that the European Commission:

- Defines its various needs for map projection(s) (COGI, February 2000);
- Obtains further expert advice to determine the appropriate projections.

8. Results dissemination

8.1.1 Recommendation;

The Workshop recommends to the European Commission:

- That the results of the meeting and follow-up activities are widely communicated to the GIS industry, standards authorities, and potential users. It is also important to stimulate feedback in order to ensure that EC and other users needs are harmonised.

9. Notes : 'co-ordinate reference systems' for the layman

While the summary of the workshop proceedings will hopefully be clear to those working in the field of geodesy some of the concepts and terminology may be complex to those not familiar with the subject. The following notes, while far from comprehensive, are intended to fill some of the gaps and provide some background to help non-specialists to a better understanding of the discussion and results of the workshop.

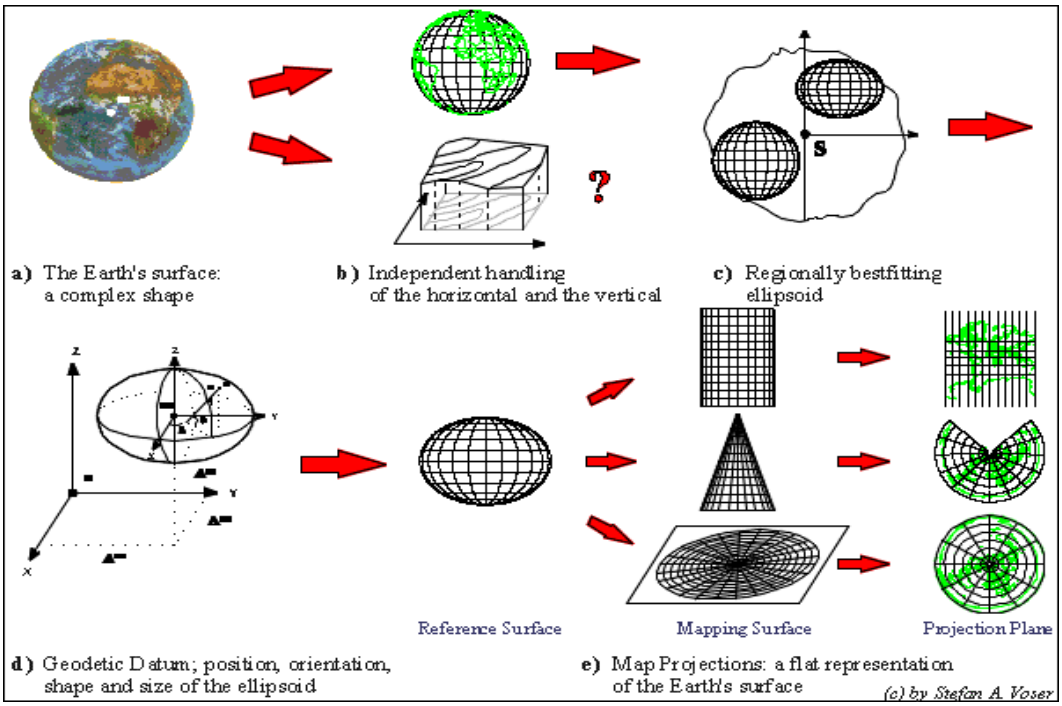
Co-ordinate reference system definition:
"Location or position on or near the Earth's surface may be described using co-ordinates. Co-ordinates are unambiguous only when the co-ordinate reference system to which those co-ordinates refer has been fully defined. Each position shall be described by a set of co-ordinates that shall be related to a co-ordinate reference system. A co-ordinate reference system consists of one datum and one co-ordinate system" (ISO 19111)

There exist various co-ordinate reference systems in which a geographic location may be described mathematically by co-ordinates. In each system, the position gets its own co-ordinate values. To understand any set of co-ordinate values, one needs to know without any ambiguity to which 'system' it belongs. We further need to have a complete mathematical description of that 'system'. And finally, particularly if we want to share data belonging to different co-ordinates systems, we need to know the parameters and algorithms that relate that specific 'system' to the others, or preferably to an agreed common co-ordinate reference system.

It is therefore strongly recommended that all co-ordinates must be accompanied by unambiguous identification of the system in which they are expressed.

Defining co-ordinates is a specialist issue that has its own specific terminology. For the layman, there are three main types of co-ordinates.

- Elevation, or height : it expresses (or is related to) the 'vertical distance' between a location and a 'horizontal' surface defined as the reference (generally in meters, feet)
- Geographical co-ordinates : expresses in terms of longitude and latitude the position of a location on a sphere or an ellipsoid (generally in degrees, minutes, seconds)

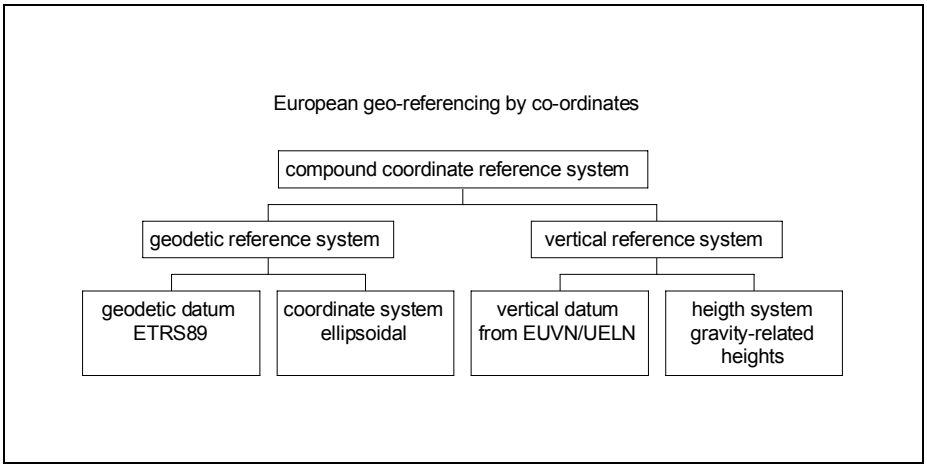


- Cartesian co-ordinates, or map projection: expresses the position of a location in terms of Easting and Northing on a plane on which the Earth's surface has been projected (generally in kilometres/meters or miles/feet)

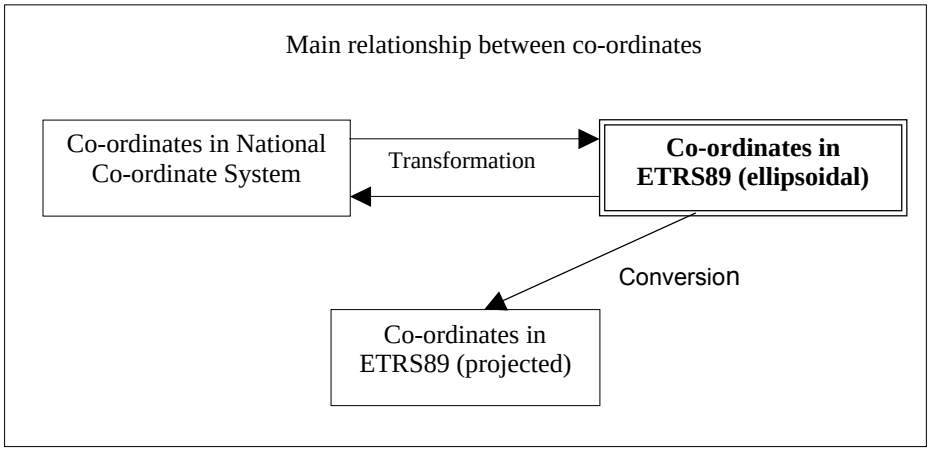
The definition of a geodetic datum will generally include the dimension of an ellipsoid, and its position and orientation relative to 'the Earth'. There is traditionally at least one main datum per country, but often many more. Each country has also its own map projection (Lambert, Mercator, Azimuthal,…) that is basically chosen to minimise the distortions on the national territory.
Conversion, within the same datum, from one type of map projection to the other, or to latitude and longitude is a simple matter of applying the predefined mathematical formulas, and can be as accurate as one desires. However, transformation from one datum to the other is always an approximation, and is based on empirical formulas and algorithms, deducted from measurements. Typical accuracies vary from 10 centimetres to 100 metres.

Definition of a vertical datum is more delicate, and will not be approached here. Let's say that there is also generally at least one vertical datum per country, and two main families of height. Ellipsoidal height is the third dimension of the location related to an ellipsoid, and is a length. Geoidal height is related to a physical model of the Earth's surface (the geoid), and is a physical component of a location, related to gravity.

The diagram below illustrates the components of an unambiguous European geo-reference system:



This second diagram indicates the relationship between co-ordinates in a European geo-reference system, a National system, and a European projection.

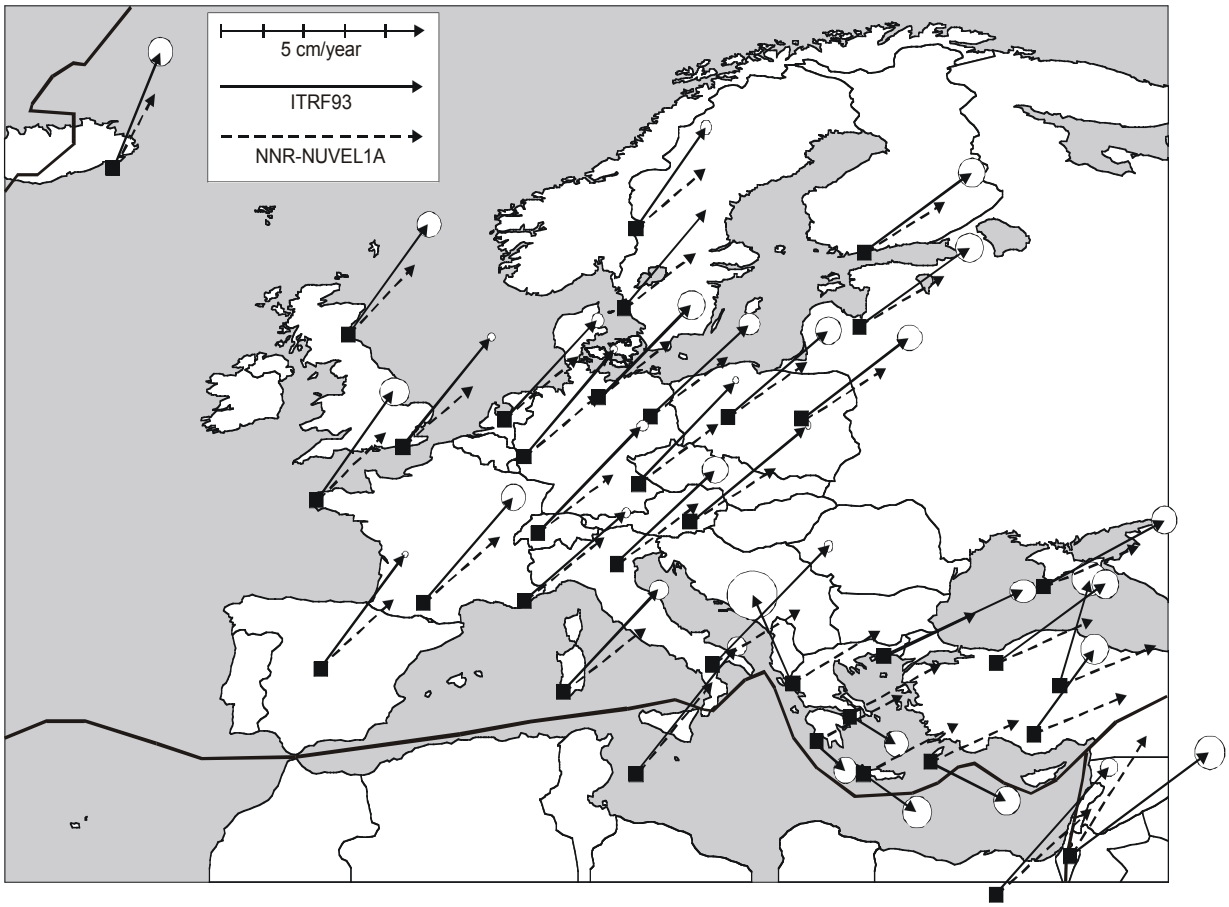


10. What is ETRS89?

The International Earth Rotation Service (IERS) has been established since 1988 jointly by the International Astronomical Union (IAU) and the International Union of Geodesy and Geophysics (IUGG). The IERS mission is to provide to the worldwide scientific and technical community reference values for Earth orientation parameters and reference realisations of internationally accepted celestial and terrestrial reference systems.

The IERS is in charge to realise, use and promote the International Terrestrial Reference System (ITRS) as defined by the IUGG resolution No 2 adopted in Vienna, 1991. In the geodetic terminology, a reference frame is a set of points with their co-ordinates (in the broad sense) which realise an ideal reference system. The frames produced by IERS as realisations of ITRS are named International Terrestrial Reference Frames (ITRF). Such frames are all (or a part of) the tracking stations and the related monuments which constitute the IERS Network, together with co-ordinates and their time variations.

From the time-series of the IERS results, it has been noted that the European Continental Plate is moving quite



uniformly of some 3 cm per year, relatively to the ITRS, at the exception of the south-eastern extreme of Europe (Greece, Turkey). For that reason, in order to have reasonably stable co-ordinates for Europe, the EUREF Sub-commission decided to define a System tied to the European plate. This System (datum) is named ETRS, or ETRS89, as was identical to the ITRS in the year 1989. Since 1989, ETRS89 co-ordinates, fixed in relation to the European Plate, have regularly shifted from their values expressed in ITRS. However, this shift is well known, monitored by IERS and EUREF, and transformations from one to the other are possible for most part in a 1 cm accuracy.