

# EUREF – The Continental ITRF and IGS Densification for Europe

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*Carine Bruyninx, Belgium, EPN Central Bureau*  
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Bangalore, India



# EUREF

- **Creation in 1987 at the IUGG General Assembly in Vancouver**
- **Sub-commission 1.3a of IAG, Secretary in Munich, Central Bureau of EPN in Brussels**
- **Permanent committee is the Technical Working Group (15 members, 3 meetings per year)**
- **Links to about 130 European organizations, agencies, universities (positioning and navigation)**



# Outline

- (1) Mission**
- (2) Definition and Realization of European Geodetic Reference Systems**
- (3) EUREF-IP Real-Time Activities**
- (4) Special Projects**
- (5) Contributions to ICG**





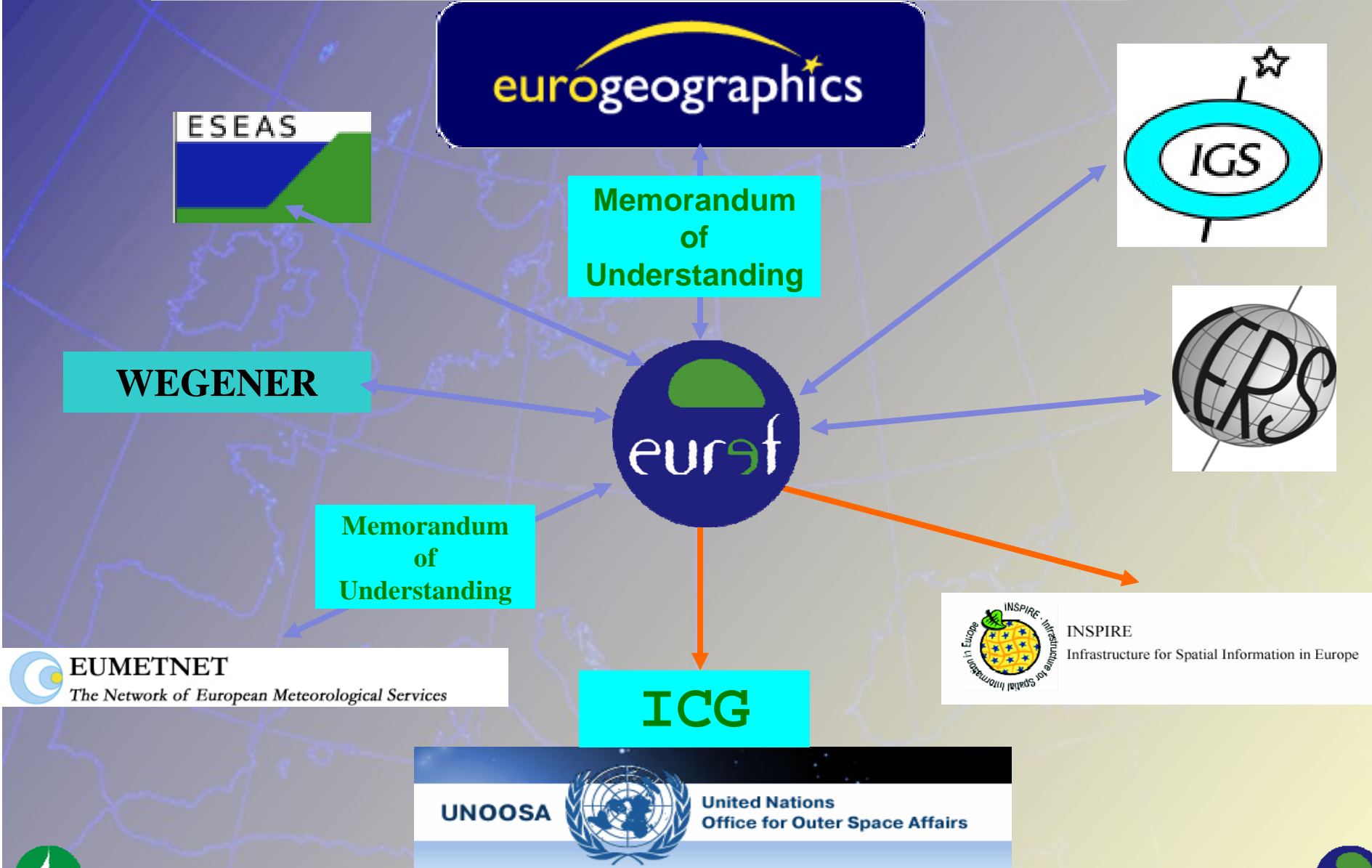
# (1) EUREF Mission

## Definition, realization and maintenance of the European Geodetic Reference Systems

- Promotion and assistance of the adoption and use of **European Terrestrial Reference System (ETRS89)** in Europe in alignment to ITRFxx
- The **EUREF GNSS Permanent Network (EPN)** is the ground based GNSS infrastructure for scientific and practical applications in positioning and navigation (GGOS, IGS-RT)
- The definition and realization of the **European Vertical Reference System** will arrive 2007 a new stage (**EVRS2007**)
- Provides all its products on the “**best effort**” basis and free of charge to the public



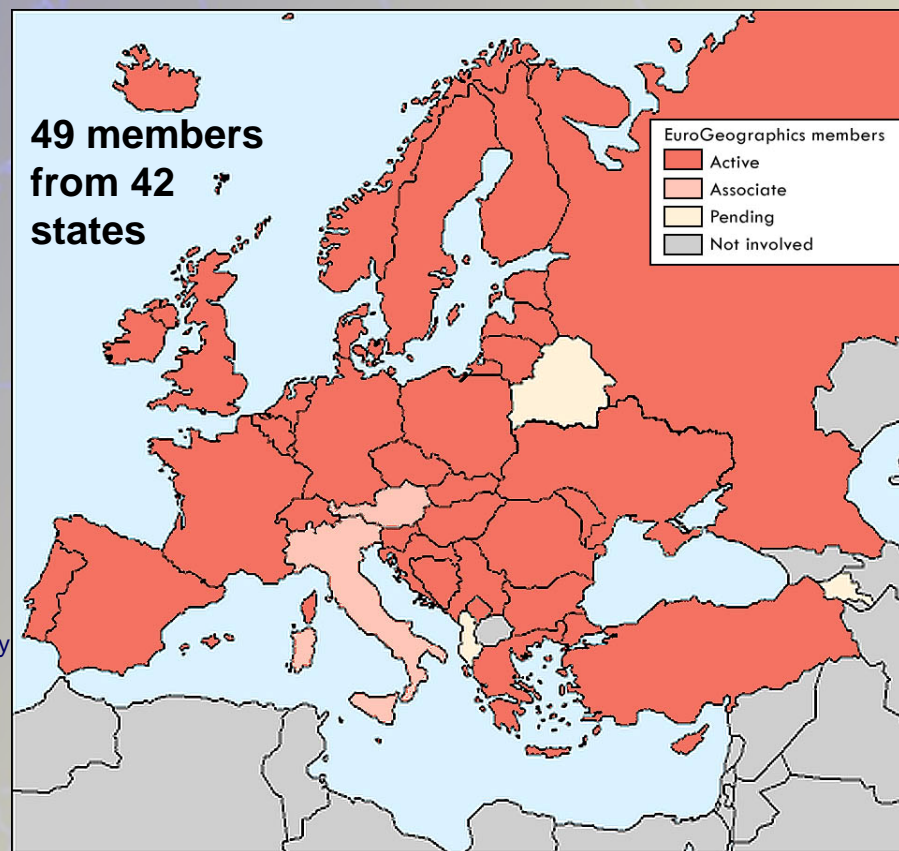
# Network of Cooperation



**EUMETNET**  
The Network of European Meteorological Services



1.	Albania	Institut Studimit Tokave	35.	Slovakia	Úrad geodézie, kartografie a katastra SR
2.	Armenia	State Committee of the Real Property Cadastre	36.	Slovenia	Geodetska uprava republike Slovenije
3.	Austria	BEV - Bundesamt für Eich- und Vermessungswesen	37.	Spain	- Instituto Geográfico Nacional - Dirección General del Catastro
4.	Belarus	State Committee for Land Resources, Geodesy and Cartography	38.	Sweden	Lantmäteriet
5.	Belgium	- Nationaal Geografisch Instituut / Institut Géographique National - Administration du Cadastre, de L'Enregistrement et des Domaines - Administratie van het Kadaster, de Registratie en de Domeinen	39.	Switzerland	Bundesamt für Landestopografie
6.	Bosnia & Herzegovina	Federal Administration for Geodetic and Real Property Affairs	40.	The Netherlands	Kadaster en Openbare Registers
7.	Bulgaria	Ministry of Regional Development and Public Works	41.	Turkey	Harita genel komutanligi, General Command of Mapping
8.	Croatia	Drzavna Geodetska Uprava	42.	Ukraine	State Service of Geodesy, Cartography and Cadastre
9.	Cyprus	Department of Lands and Surveys, Ministry of the Interior			
10.	Czech Republic	Cesky urad zememericky a katastralni			
11.	Denmark	Kort og Matrikelstyrelsen			
12.	Estonia	Maa-amet			
13.	Finland	- Maanmittauslaitos - Finnish Geodetic Institute			
14.	France	IGN – Institut Géographique National			
15.	Germany	BKG - Bundesamt für Kartographie und Geodäsie			
16.	Great Britain	Ordnance Survey of Great Britain			
17.	Greece	- Hellenic Military Geographical Service - Hellenic Mapping and Cadastral Organisation			
18.	Hungary	Földügyi és Térképészeti Főosztály			
19.	Iceland	- Landmælingar Islands - Fasteignamat Ríkisins			
20.	Ireland	Ordnance Survey of Ireland			
21.	Italy	Instituto Geografico Militare Italiano			
22.	Kosovo	Kosovo Cadastral Agency			
23.	Latvia	- LR Valsts zemes dienests - Latvijas Ģeotelpiskās Informācijas Aģentūra			
24.	Lithuania	- National Land Service - State Enterprise, Centre of Registers			
25.	Luxembourg	Administration du Cadastre et de la Topographie			
26.	Malta	Malta Environment and Planning Authority			
27.	Moldova	National Agency of Cadastre, Land Resources and Geodesy			
28.	Northern Ireland	Ordnance Survey of Northern Ireland			
29.	Norway	Statens kartverk			
30.	Poland	Główny Urząd Geodezji i Kartografii			
31.	Portugal	Instituto Geografico Português			
32.	Romania	Agentia Nationala de Cadastru si Publicitate Imobiliara			
33.	Russia	Federal Service of Geodesy and Cartography of Russia			
34.	Serbia & Montenegro	Republički Geodetski Zavod			





## **(2) Definition and Realization of European Geodetic Reference Systems**

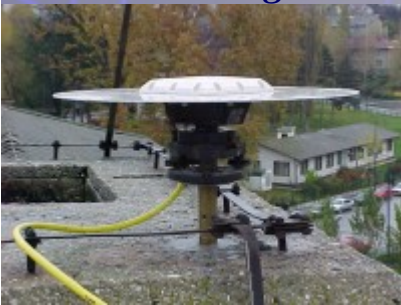
- **ETRS89 (European Terrestrial Reference System)**
  - The datum is fixed to the stable part of the European Plate at the epoch 1989.0 (ITRF89)
  - Realized by ETRFxx derived from ITRFxx by removing the velocity of the European plate (xx is currently 2005)
  - based on EUREF GNSS Permanent Network EPN
- **EVRS (European Vertical Reference System 2007)**
  - Related European Vertical Datum (NAP)
  - Realized by the United European Levelling Network (UELN)



# EUREF GNSS Permanent Network - EPN

- ▶ Science-driven GNSS network serving high precision users in Geodesy, Geophysics, Timing, Navigation
- ▶ Densification of the IGS (International GNSS Service) in Europe
- ▶ European contribution to global geodetic networks
- ▶ Operating under the IGS standards
  - GPS & GPS+GLONASS tracking stations
  - Data Centres providing free access to the observation data (daily & hourly RINEX)
  - Analysis Centres computing station coordinates and by-products

*Sajarevo,  
Bosnia/Hercegovina*



*Matera, Italy*



*Brest, France*



*Vaasa, Finland*





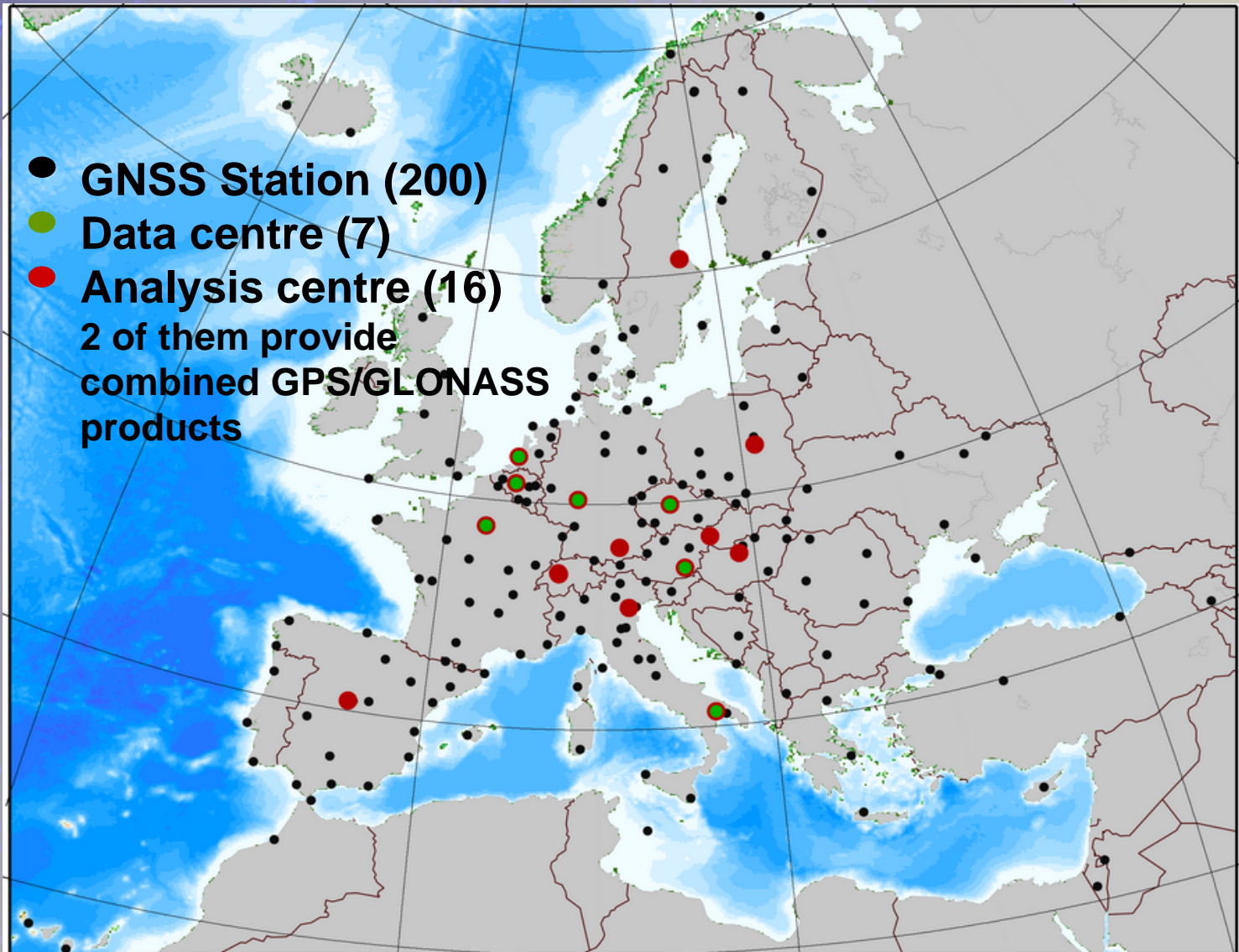
# EPN is the Densification of ITRF2005 and the Realization of ETRS89

▶ 200 permanent  
GNSS stations  
(40 GPS/  
GLONASS)

▶ 55 of them are  
IGS stations

▶ 30 European  
countries are  
covered

▶ 100  
contributing  
agencies



<http://www.epncb.oma.be/>



EUREF HOME

## EUREF Permanent Network



EPN CB HOME

### ORGANISATION

Creation, Management, Structure,  
Relation to IGS, Projects,  
Guidelines, FAQ

### TRACKING NETWORK

Maps, Stations, Equipment, Station  
coordinates

### DATA & PRODUCTS

Data centres, Analysis centres,  
Products, Time series, IGS  
products

### NEWS & MAILS

EUREF mail, LAC mail, News,  
Papers, Workshops, Web site  
history, Calendar

### FTP & WEB ACCESS

Anonymous FTP, Web site index,  
Related links

## WELCOME !

The [European Terrestrial Reference System 89](#) (ETRS89) is used as the standard precise GPS coordinate system throughout Europe. Supported by [EuroGeographics](#) and endorsed by the EU, this reference system forms the backbone for all geographic and geodynamic projects on the European territory both on a national as on an international level.



The ETRS89 is maintained by the IAG sub-commission [EUREF](#) and it is accessed through the EUREF Permanent Network (EPN), a science-driven network of continuously operating GPS reference stations with precisely know coordinates in the ETRS89.

All contributions to the EPN are voluntary, with more than 100 European agencies/universities involved, and the reliability of the network is based on redundancy and extensive guidelines guaranteeing the quality of the raw GPS data to the resulting station positons. Next to its key role in the maintenance of the ETRS89, the EPN data are also used for a wide range of scientific applications such as the monitoring of ground deformations, sea level, space weather and numerical weather prediction.

This web site is part of the EPN Central Bureau Information System, providing both EPN member organizations and the public with information about the EPN organization, the EPN network of stations, and EPN data & products.

Whenever your use of EPN data or products results in a publication, please include a [citation](#).



# Results



**European Commission adopted ETRS89 as the geodetic datum for geo-referenced information of the EC and promote the use of ETRS89 within member states.**



eurogeographics

**Promotion of the adoption of ETRS89 by the National Mapping and Cadastral Agencies**



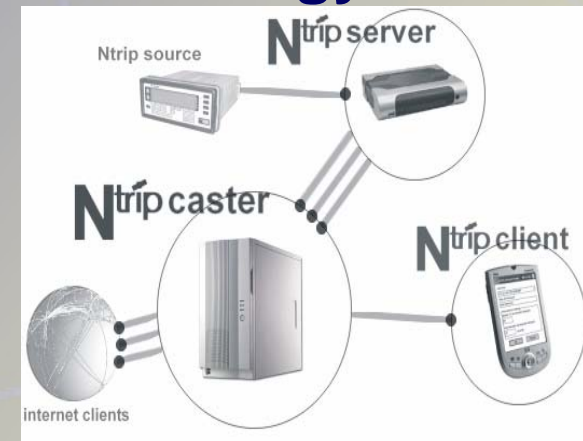
**Adoption of ETRS89 by Eurocontrol**





## (3) EUREF-IP Real-Time Activities (EUREF-IP)

- RTCM standard for transport of real-time GNSS data and information over Internet – NTRIP technology
- Guidelines developed for
  - Reference stations
  - NTRIP Broadcasters
  - High-rate RINEX Data Centers
- EUREF-IP Pilot Project turns into routine EPN service
- EPN data streams are received at central broadcaster which provides the users with access to the streams
- The RTCM/NTRIP standard is realized in most of GNSS receivers



# The server [www.euref-ip.net](http://www.euref-ip.net), running on Port 80 and 2101, operated by BKG

## Contributors to [www.euref-ip.net/home](http://www.euref-ip.net/home)

## Contributors to [www.igs-ip.net/home](http://www.igs-ip.net/home)

1. AGH University of Science and Technology - Poland (2)
2. Agricultural University of Wroclaw - Poland (1)
3. Agriculture Institute University of Milano - Italy (1)
4. Bucharest Technical University of Civil Engineering - Romania (1)
5. Budapest University of Technology and Economics - Hungary (2)
6. Bundesamt fuer Eich- und Vermessungswesen - Austria (2)
7. Czech Technical University CVUT - Czech Republic (1)
8. DIST Universita di Cagliari - Italy (1)
9. European Space Agency - Europe (1)
10. FOMI Satellite Geodetic Observatory - Hungary (1)
11. Fachhochschule Bochum - Germany (1)
12. Federal Agency for Cartography and Geodesy - Germany (17)
13. Finnish Geodetic Institute - Finland (3)
14. GOP Research Institute of Geodesy Topography and Cartographic - Czech Republic (1)
15. Geodetic Institute University Warszawa - Poland (1)
16. Geodetic and Cartographic Institute - Slovakia (1)
17. Institut Cartografic de Catalunya - Spain (2)
18. Institut Geographique National - France (1)
19. Institute of Geodesy and Geodetic Astronomy Warsaw University of Technology - Poland (1)
20. Instituto Geografico Nacional - Spain (15)
21. Instituto Geografico Portugues - Portugal (1)
22. Instytut Geodezji i Kartografii Warszawie - Poland (1)
23. Istituto Nazionale di Ricerca Metrologica I.N.R.I.M. - Italy (1)
24. KGSiN University of Warmia and Mazury - Poland (1)
25. Landesvermessung Bayern - Germany (1)
26. Landesvermessung Mecklenburg-Vorpommern - Germany (3)
27. Landesvermessung Saarland - Germany (1)
28. Landesvermessung Thueringen - Germany (1)
29. Leica Geosystems AG - Switzerland (1)
30. Leica Geosystems Sp.z.o.o - Poland (1)
31. Mairie de Cannes - France (1)
32. NERC Space Geodesy Facility - United Kingdom (1)
33. National Land Survey - Sweden (3)
34. Ordnance Survey - United Kingdom (2)
35. Politecnico di Torino - Italy (1)
36. Royal Observatory - Belgium (1)
37. SAPOS Berlin - Germany (1)
38. Satellite Observatory Lamkowko University of Warmia and Mazury - Poland (1)
39. Survey Sales and Hire - Ireland (2)
40. SwissTopo - Switzerland (1)
41. Technische Universitaet Wien - Austria (1)
42. Technical School of Rovereto - Italy (1)
43. Technical University Delft - The Netherlands (1)
44. Telespazio S.p.A. - Italy (2)
45. TopoBreda - Portugal (1)
46. Universitat die Perugia - Italy (2)
47. University Padova - Italy (2)
48. University Rome La Sapienza - Italy (1)
49. VUGTK Geodetic Observatory Pecny - Czech Republic (1)

**Total: 94 Streams**

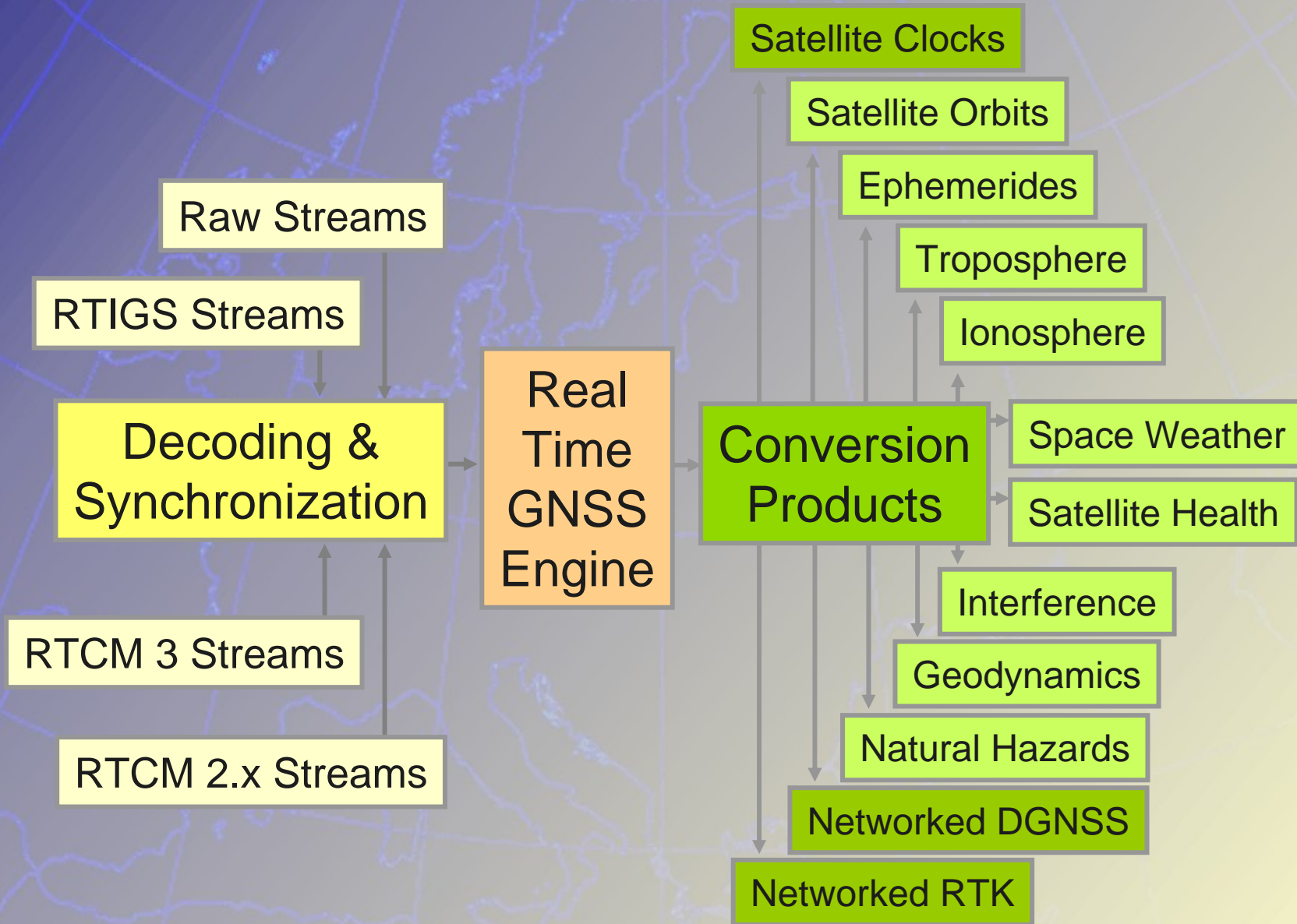
*EUREF – ITRF and IGS Densification*

1. Addis Abeba University - Ethiopia (2)
2. Agenzia Spaziale Italiana - Italy (1)
3. Agricultural University of Wroclaw - Poland (1)
4. Astronomy and Space Science Institute - Korea (2)
5. Brazilian Institute of Geography and Statistics - Brazil (1)
6. Bucharest Technical University of Civil Engineering - Romania (1)
7. Bundesamt fuer Eich- und Vermessungswesen - Austria (2)
8. Clark Fortune McDonald & Associates - New Zealand (2)
9. DIST Universita di Cagliari - Italy (1)
10. Department of Sustainability and Environment Victoria - Australia (1)
11. European Space Operations Centre - Germany (3)
12. FOMI Satellite Geodetic Observatory - Hungary (1)
13. Federal Agency for Cartography and Geodesy - Germany (20)
14. Finnish Geodetic Institute - Finland (2)
15. Florida International University Miami - U.S.A. (1)
16. GOP Research Institute of Geodesy Topography and Cartographic - Czech Republic (1)
17. GPS Solutions Inc. - U.S.A. (1)
18. Geodetic Institute University Warszawa - Poland (1)
19. Geoinformatics Center Asian Institute of Technology - Thailand (1)
20. Geoscience Australia - Australia (23)
21. Instytut Geodezji i Kartografii Warszawie - Poland (1)
22. Istituto Nazionale di Ricerca Metrologica I.N.R.I.M. - Italy (1)
23. L'equipe du reseau Banian - New Caledonia (2)
24. Lantmaeteriverket - Sweden (1)
25. Mecinca Topografia GPS - Venezuela (1)
26. NASA Stennis Space Center - U.S.A. (1)
27. NERC Space Geodesy Facility - United Kingdom (1)
28. National Geographic Information Institute - Korea (1)
29. National Land Survey - Sweden (3)
30. Natural Resources - Canada (9)
31. Naval Observatory - U.S.A. (1)
32. Point Inc. - Canada (2)
33. Puget Sound Reference Network - U.S.A. (1)
34. Regional Centre for Mapping of Resources for Development - Kenya (1)
35. Royal Observatory - Belgium (1)
36. Scripps Orbit and Permanent Array Center - U.S.A. (1)
37. Solucoes em Posicionamento Global SPG - Brazil (1)
38. Standard Instrument Corporation - Taiwan (1)
39. Survey Research Institute HARAM SRI - Egypt (1)
40. Surveys and Mapping - South Africa (2)
41. SwissTopo - Switzerland (1)
42. Technical University Prague - Czech Republic (4)
43. Universidade Estadual Paulista UNESP/FCT - Brazil (4)
44. Universidade da Baira Interior UBI/CGUL/IDL - Portugal (1)
45. University New South Wales - Australia (1)
46. University Padova - Italy (2)
47. University of New Brunswick - Canada (2)

**Total: 116 Streams**



# EUREF Real-Time GNSS Product Area





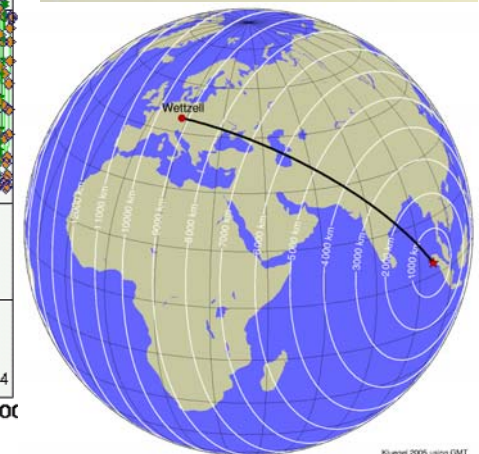
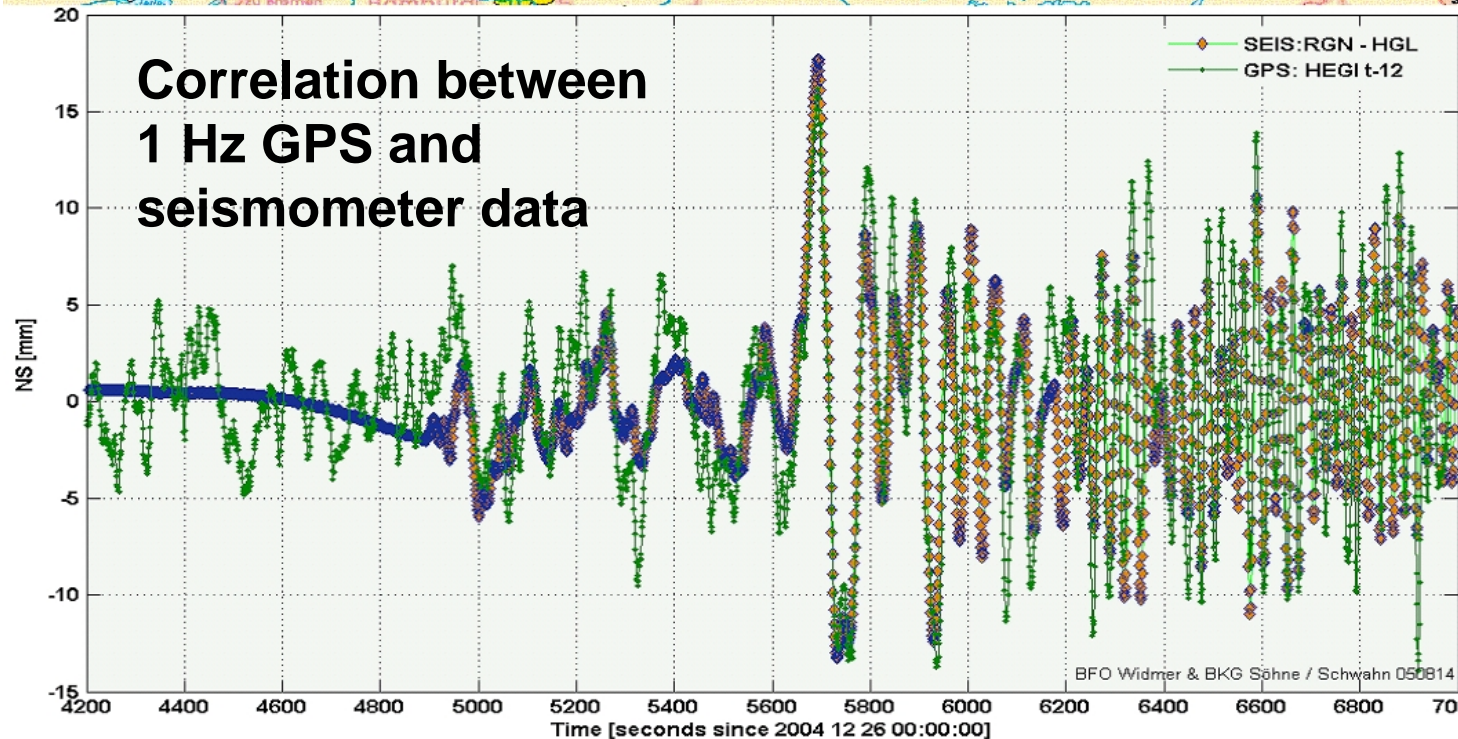
# Example: GNSS RT Application for Geohazard Monitoring

The Love wave caused by the Sumatra-Andaman earthquake has reached Germany approx. 5530 seconds since 00:00:00 UTC, Dec 26, 2004 from the East direction after a travel time of approx. 2000 seconds.

IGS station  
Helgoland



1 Hz GPS data,  
Bernese  
Software 5.0,  
kinematic mode



# (4) Special Projects

## European Combined Geodetic Network

### European Geodetic Network contribution to GGOS

- 21 countries
- 74 stations with
  - GNSS (EPN)
  - absolute gravity
  - levelling to EVRS
  - 6 super conducting grav.
  - 15 tide gauges
- ❖ 8 ECGN core
- ❖ 42 ECGN
- ❖ 7 candidate
- ❖ 15 proposed



Status and Techniques (Standard: GPS, absolute gravity, levelling)

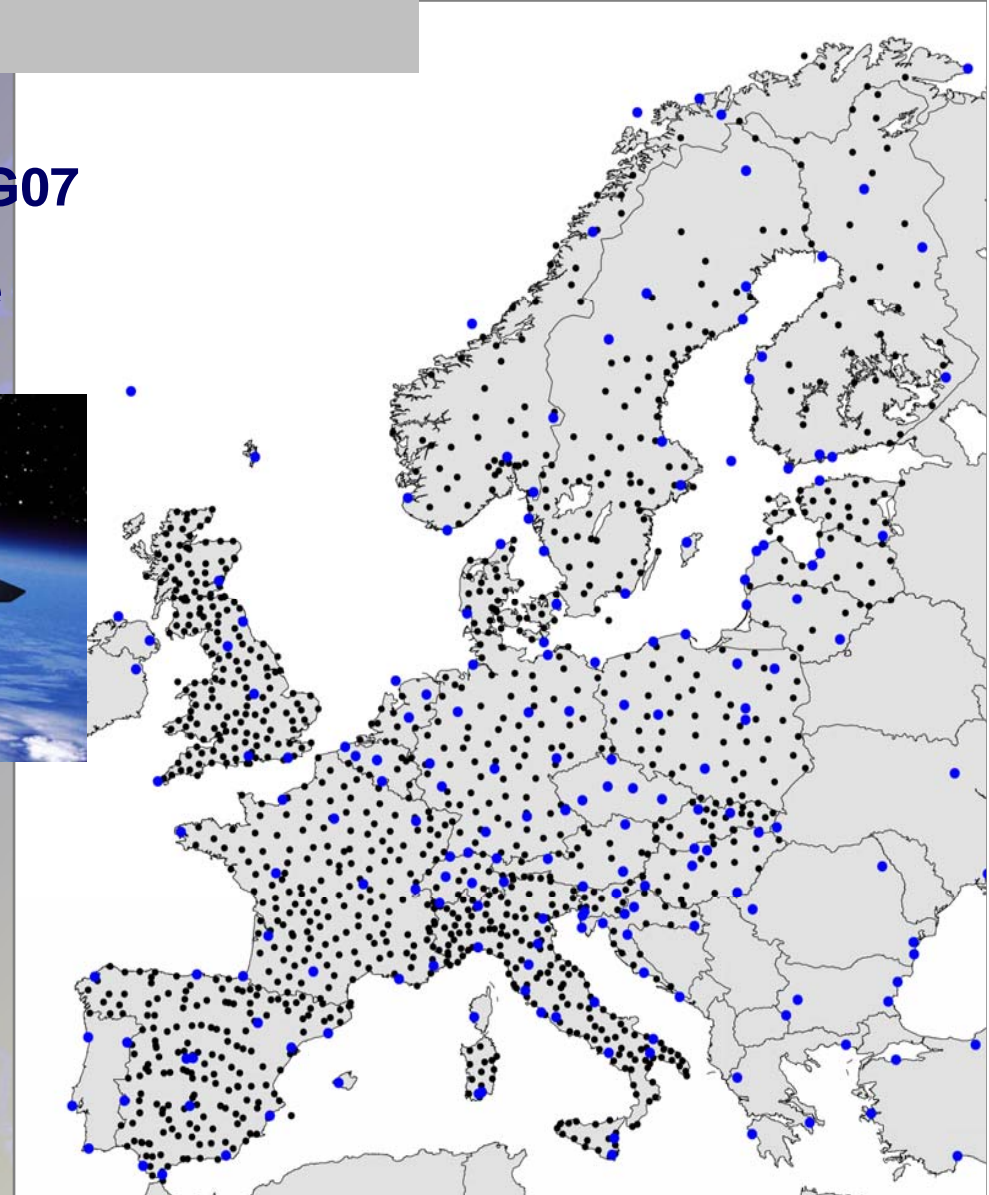
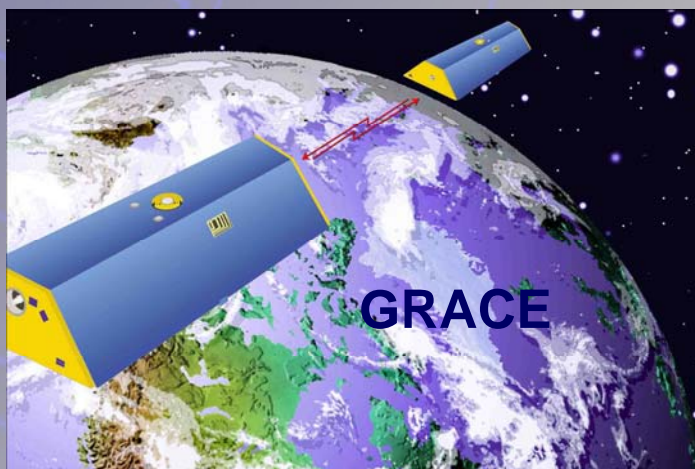
core station	●	super conducting gravimeter	○
station	●	tide gauge	△
candidate station	■		
proposed station	+		



# EUVN Densification Action (EUVN\_DA)

## 1200 GNSS/levelling points

- GPS/levelling control data for European geoid determination EGG07
- Disturbance potential values of the Earth gravity field for validation of





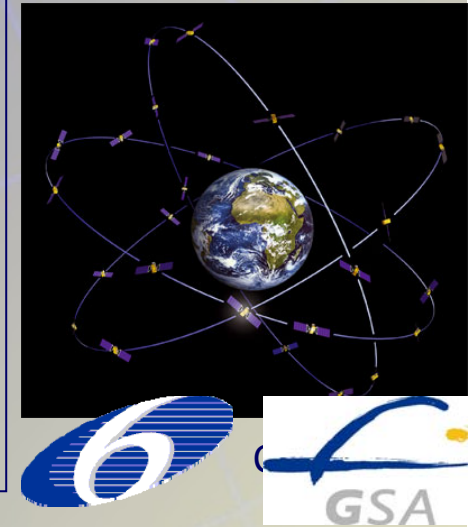
# GLONASS & GALILEO

EPN is extending  
combined GPS/  
GLONASS stations

IGS orbit  
determination

Development of the  
GALILEO Terrestrial  
Reference Frame (GTRF)  
in alignment to ITRF 3cm

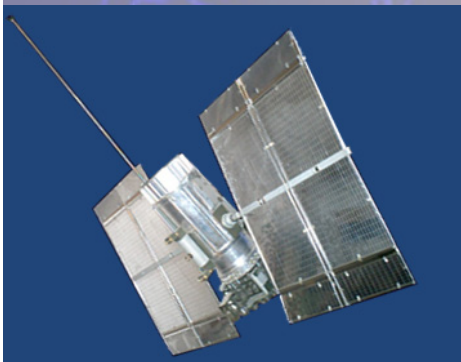
GGSP Consortium:  
GALILEO Geodetic Service  
Provider Prototype



CODE (AIUB,  
swisstopo, BKG)

ESOC

BKG



## **(5) EUREF Contributions to ICG**

- **Assistance in developing standards for monitoring GNSS networks (NTRIP, EUREF-IP)**
- **Development of GNSS real-time applications in geodynamics**
- **Support for Site Quality, Integrity and Interference Monitoring in real time and post-processing mode**
- **Adding knowledge how to support AFREF**
- **Organization of communication between ICG and the linked institutions of the EUREF community**





# Summary

**EUREF is the key organization for the support of the geodetic GNSS ground based infra-structure in Europe**  
**- GNSS, Height and Gravity reference frames -**

- **EUREF supports the IAG (IGS, GGOS, ...) items in EUROPE**
- **EUREF takes over geodetic tasks of EuroGeographics – the European legal entity of 49 European NMCA's in 42 states**
- **EUREF will certainly be an important partner in the implementation of INSPIRE (EC), GGOS (IAG), GEOSS (GEO)**

[www.euref-iag.net](http://www.euref-iag.net)

[www.euref.eu](http://www.euref.eu)



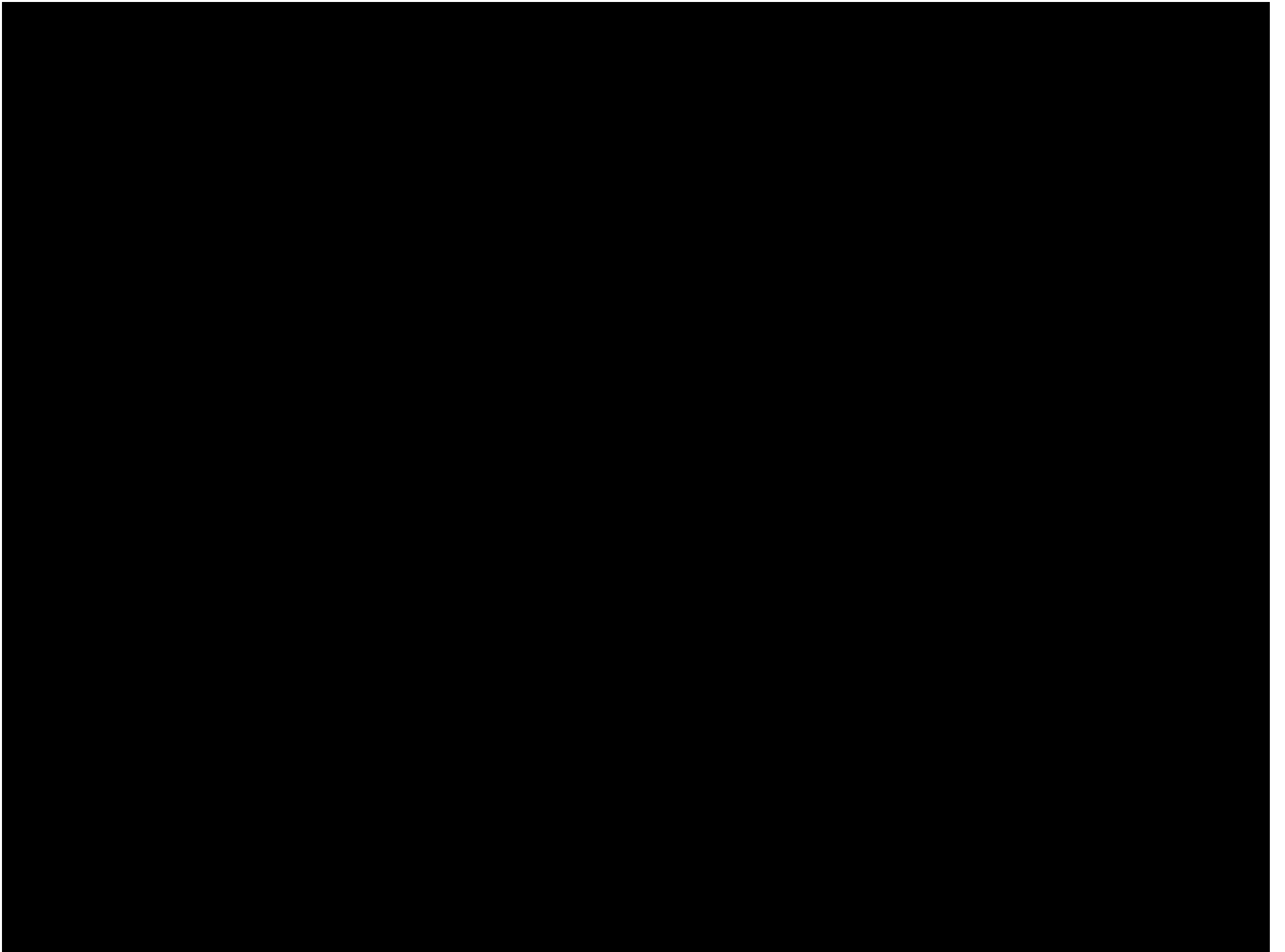


**Thank you for your attention!**



eur9f 2007 London





# Addendum

Is there a need for the creation of a legal basis for International Geodetic Reference Systems?

Through an International Treaty prepared by ICG?

Foundation of IAG is the creation of the “Mitteleuropäische Gradmessung” 1862, changed in “Internationale Erdmessung” in 1889,

on the basis of an International Treaty between Prussia and German and Non-German member states.

Closed 1917

Continued 1932 through foundation of IAG as non-gouvernemental organisation

