EUREF and EUPOS activities in a Knowledge Exchange Network for European GNSS users

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Contents

EUREF and EUPOS activities in a Knowledge Exchange Network for European GNSS users

(1) The Positioning Knowledge Exchange Network - PosKEN

(2) The PosKEN Partners

(3) Cooperation between EUREF and EUPOS

(4) Multi GNSS activities

(5) Reference Frames in Real-Time

(6) EUREF & EUPOS - How to proceed?

(1)The Positioning Knowledge Exchange Network - PosKEN

In 2014 the European organizations EuroGeographis, EUREF, EUPOS and Council of European Geodetic Surveyors (CLGE) agreed to install a Knowledge Exchange Network for GNSS positioning purposes.

A main goal is to act as an interface between GNSS providers and users.

EUREF and EUPOS as associated members of ICG are GNSS user and provider of regional and local services at the same time.

Goals of the Positioning Knowledge Exchange Network - PosKEN

1. Provide a networking platform for experts of GNSS positioning (as a social information space)
2. Coordinate GNSS service and policies developments
3. Create standards, guidelines and recommendations
4. Harmonize the position of GNSS network operators and users
5. Advertise the use of ITRS and ETRS89 (INSPIRE)
6. Establish an European Positioning System (?)
    - Select metadata concerning (public) reference stations and services in Europe in one place,
    - Establish a common access point to existing widespread services,
    - Propose, test, validate and run a common service.

- NMCA's, policy makers
- Scientific community, reference frames
- DGNSS service providers, dense networks
- Users of positioning services

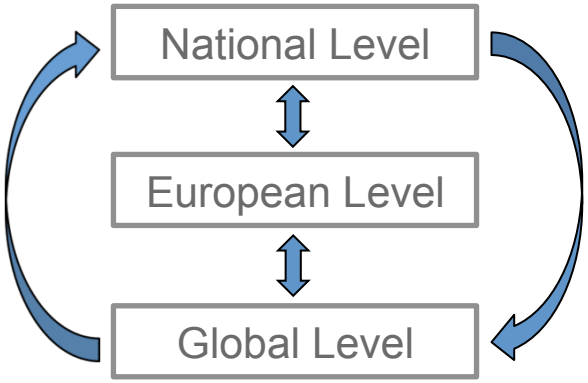
(2) The PosKEN Partners

- **EuroGeographic is the umbrella organization for more than 50 European National Mapping and Cadastral Organizations**
- **Organized several Knowledge Exchange Network (KEN) to different themes**
- **Support the KEN by finances**

- Sub-commission 1.3a of the International Association for Geodesy (IAG)
- Links to about 130 European organizations, agencies, universities from more than 30 countries – related to geo-referencing, positioning, and navigation (annual symposium)
- Mission of EUREF: Definition, realization and maintenance of the European Geodetic Reference Systems
- Development of the EUREF GNSS Permanent Network (EPN) - the ground-based GNSS infrastructure for scientific and practical applications in positioning and navigation
- EUREF is user and provider of GNSS
- Provides all of its products and services on the "best effort" basis and free of charge to the public

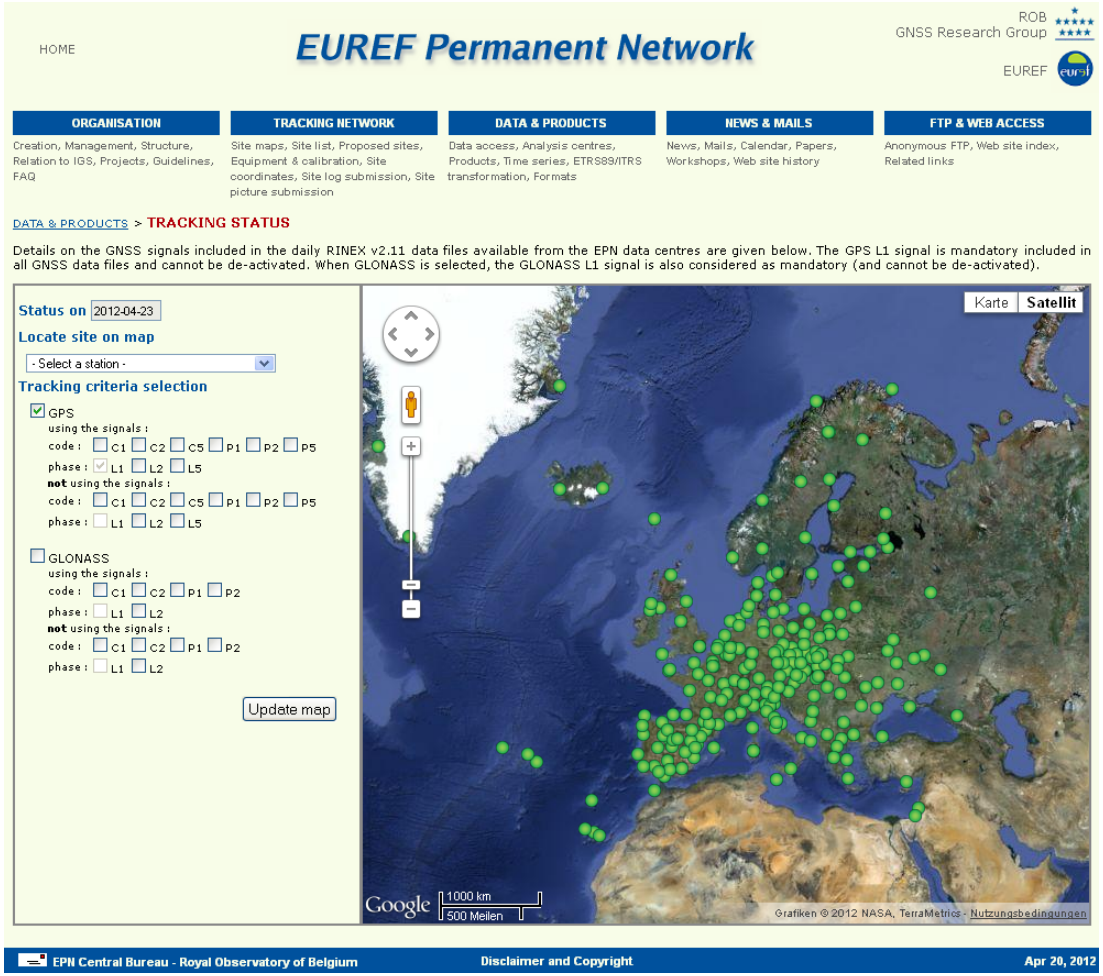
EUREF PERMANENT NETWORK (EPN)

EPN Regional Densification in Europe: Provide reference system data and information in ITRS and ETRS89 to European users by GNSS technologies



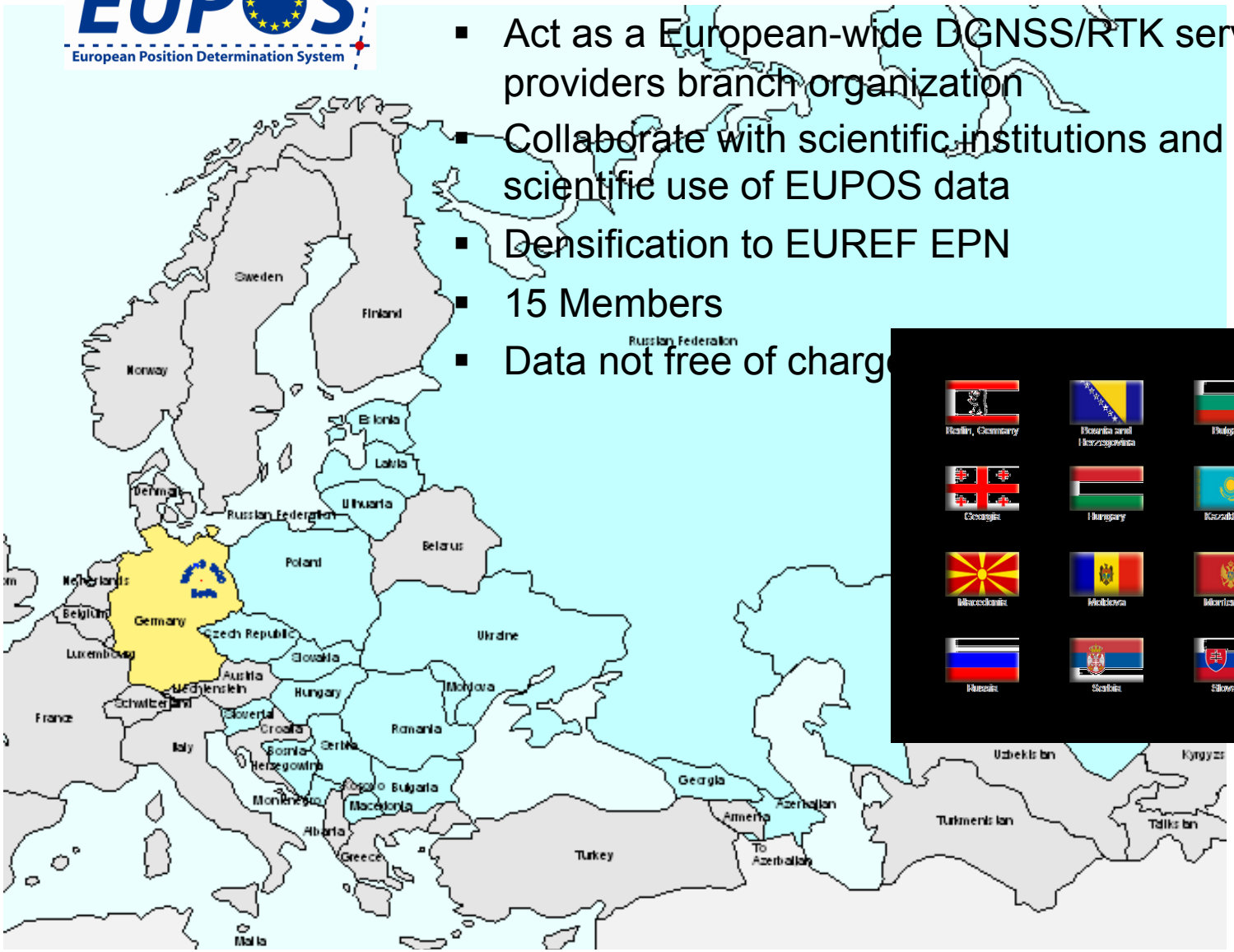
GNSS Permanent Network (EPN) with ~ 260 stations

- 130 EPN stations are part of ITRF2008
- About 110 stations provide RT, about 200 stations GPS +GLONASS data
- Station movements monitored
- Data free of charge



EUPOS
European Position Determination System

- Act as a European-wide DGNSS/RTK service providers branch organization
- Collaborate with scientific institutions and promote scientific use of EUPOS data
- Densification to EUREF EPN
- 15 Members
- Data not free of charg



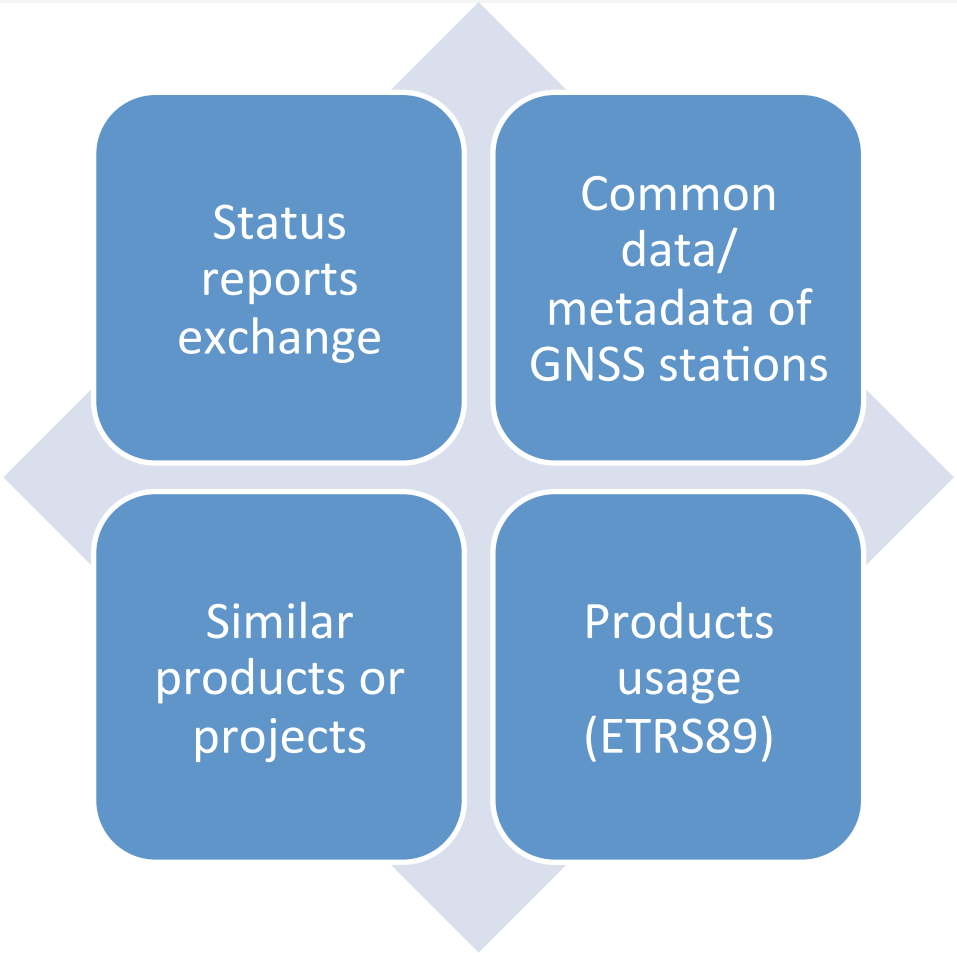
The Council of European Geodetic Surveyors

Comité de Liaison des Géomètres Européens

- **CLGE gathers 36 with as many National Liaison Groups or National Associations**
- **CLGE represents about 100.000 or more surveyors ranging from civil servants to liberal surveyors, via publicly appointed or licensed surveyors**
- **It would be interesting that CLGE provides a platform via which this tremendous user group could voice its needs and remarks about existing or lacking services**

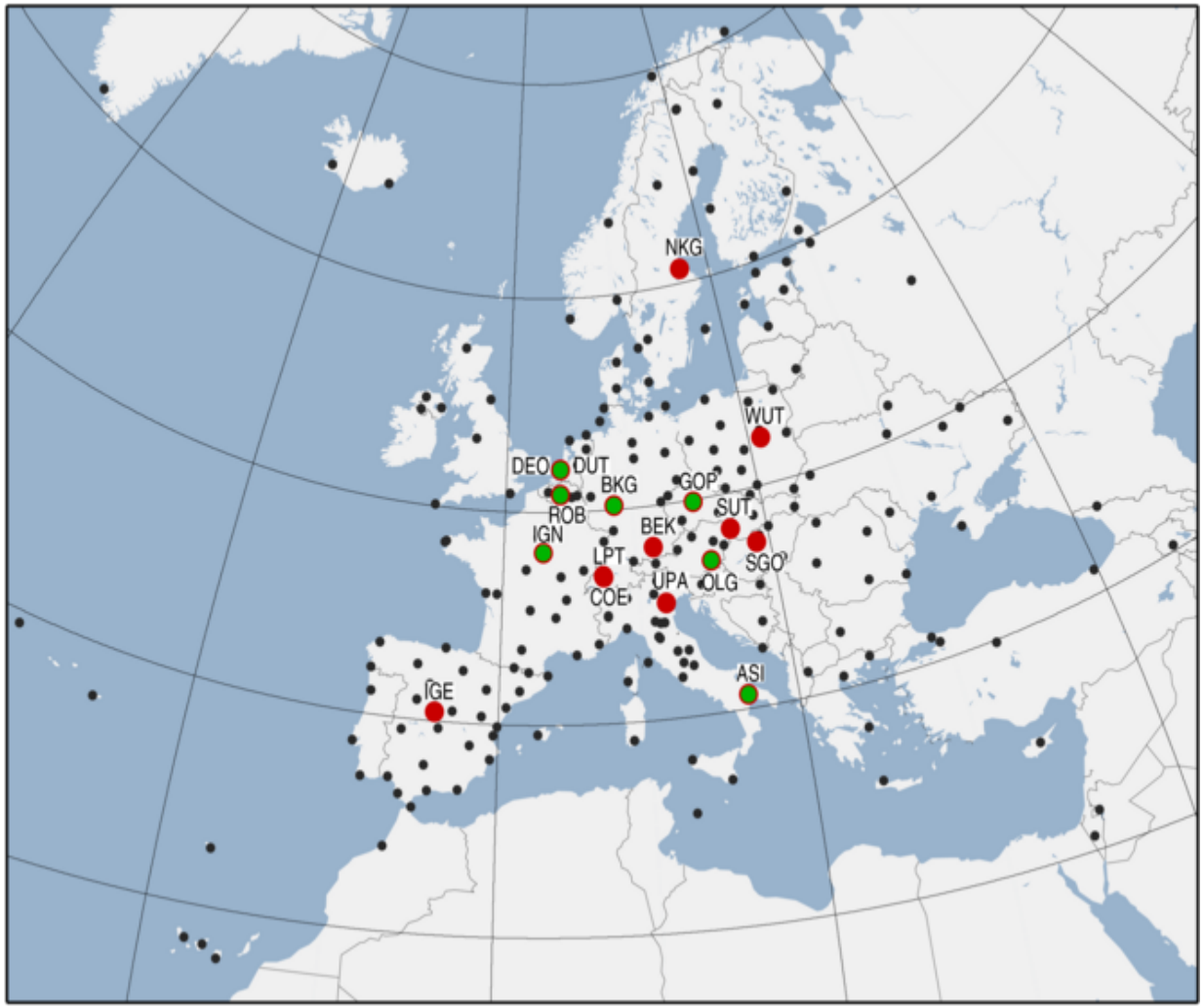
- NMCA's, policy makers
- Scientific community, reference frames
- DGNSS service providers, dense networks
- Users of positioning services

(3) Cooperation between EUREF and EUPOS agreed in a MoU



EUREF GNSS Permanent Network (EPN)

EPN stations providing GNSS data are the key infrastructure



EPN runs GNSS stations in a well organized environment and serves as the backbone of the realization and for access to the ETRS89.

260 GNSS tracking stations

50 station are Galileo ready

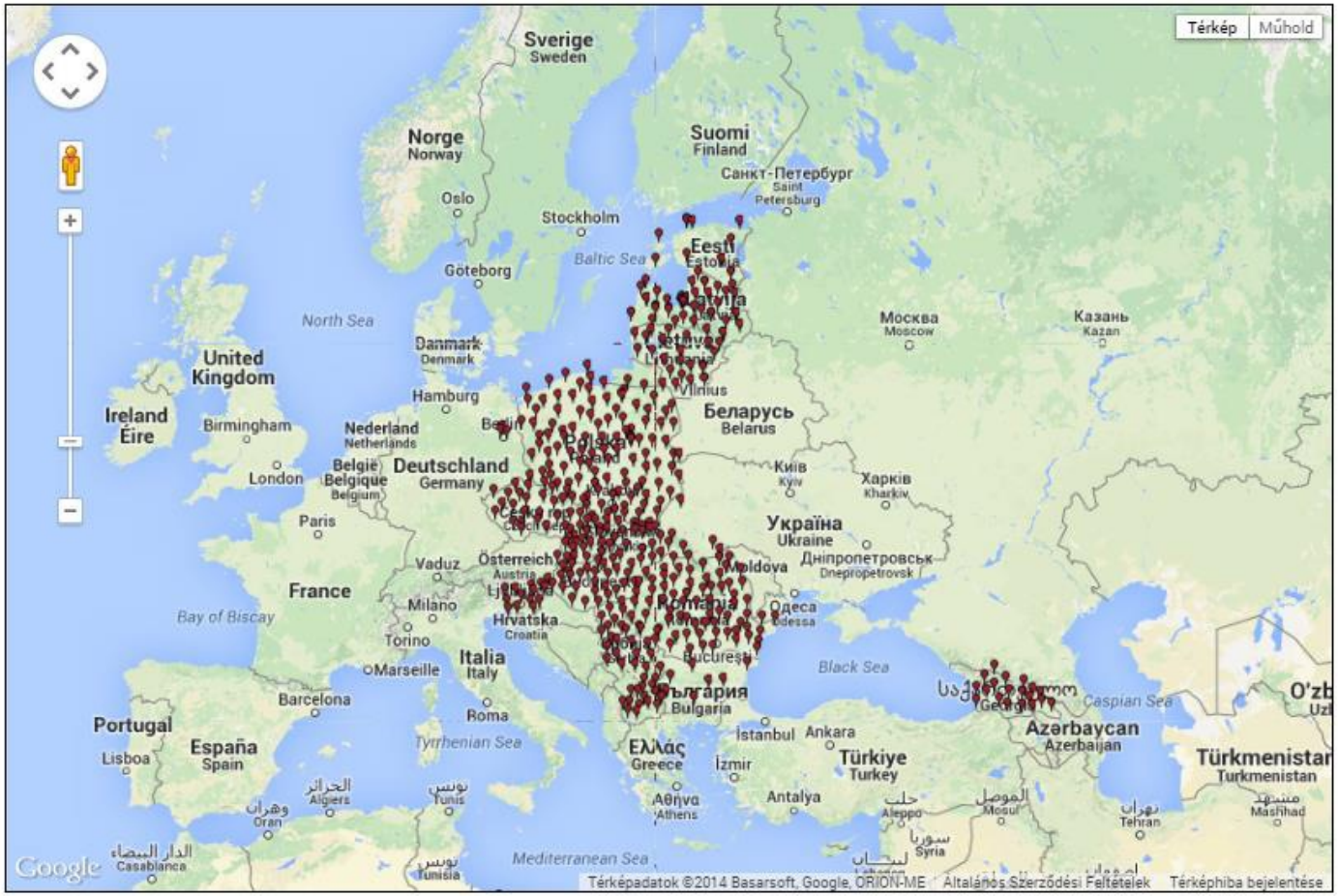
7 Data Centres

17 Analysis Centers

Since 2013 MUT/ WUT are analysis coordinator

EUPOS RTK Stations Network

Map of EUPOS Reference Stations



435 Stations

(4) Multi-GNSS activities

In 2012 a Multi-GNSS Working Group established in the EUREF Technical Working Group (TWG). Main goals of the WG are:

- **Handling data formats RINEX3.0x and/or RINEX2.1x and compatibility to RTCM 'High Precision Multiple Signal Messages' (HP MSM) and procedure for implementation in the EPN**
- **Enhancing the EPN infrastructure by Multi-GNSS-ready receivers and antennas**
- **Developing of software (post-processing and real-time) capable to handle multi-GNSS signals**
- **Setting up a time schedule in order to plan the operational switch to RINEX3 which also is in line with IGS**

IGS Multi-GNSS Experiment (M-GEX)

MGEX stations in Europe as taken from the MGEX web page (igs.org/mgex)

(5) Reference Frames in Real-Time

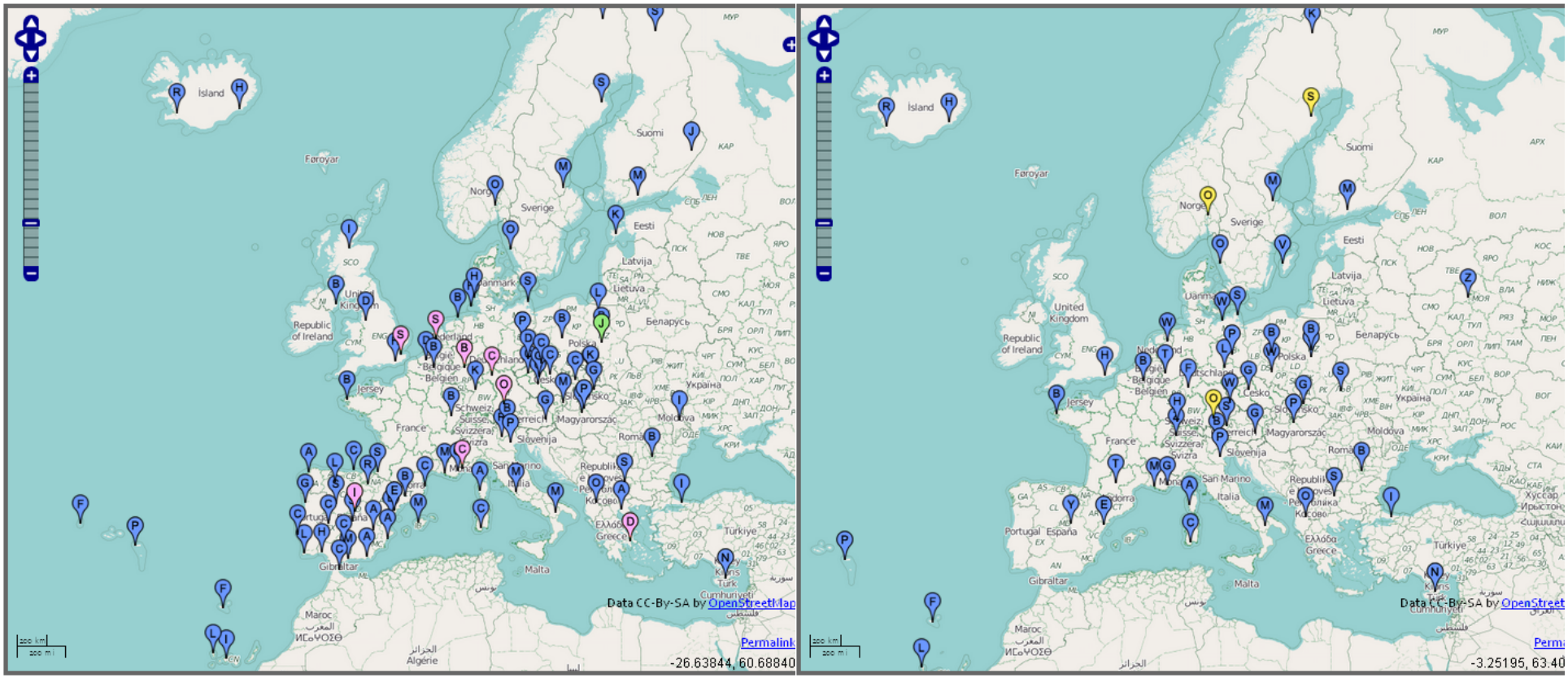
- **Local RTK networks**
  - stabile realization of (access to) ETRS89 in all countries
  - long term maintenance of ETRS89 also in tectonically affected areas
    - a few cm accuracy within a few observation epochs
    - local reference stations and reference frames realization
    - no daily activity from EUREF in this domain
- **PPP-RTK**
  - PPP is global approach
  - concept doesn't request local reference stations
  - global reference frame realization; if needed transformed to regional or local reference frames
- **Added value: basic input for science and safety (e.g., tectonic risk assessment)**

IGS Real-time GNSS Service

IGS Real-time GNSS Service

- Real-time IGS Working Group since 2001
- Real-time Pilot Project since 2007
- RT Analysis Centers:
  BKG/CTU, CNES, DLR, ESA, Geo++, GMV, GFZ, NRCan, Wuhan Univ.
- IGS permanent RT service started in 2012 and is changed to an official service

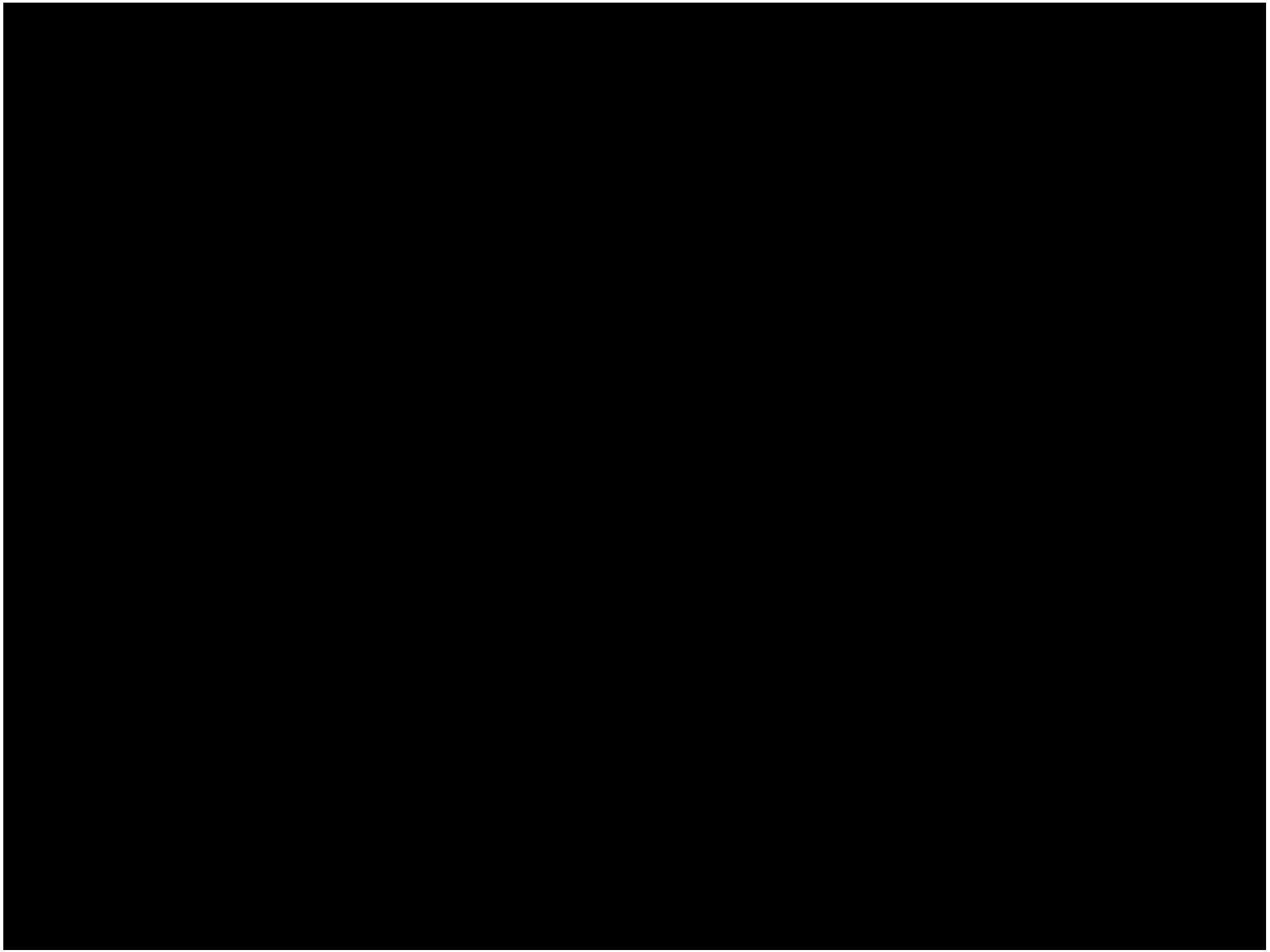
EUREF Real-Time Data Streams



EUREF (left) and IGS real-time stations in Europe as taken from the monitoring web page of BKG (bkgmonitor.dgpsonline.eu)

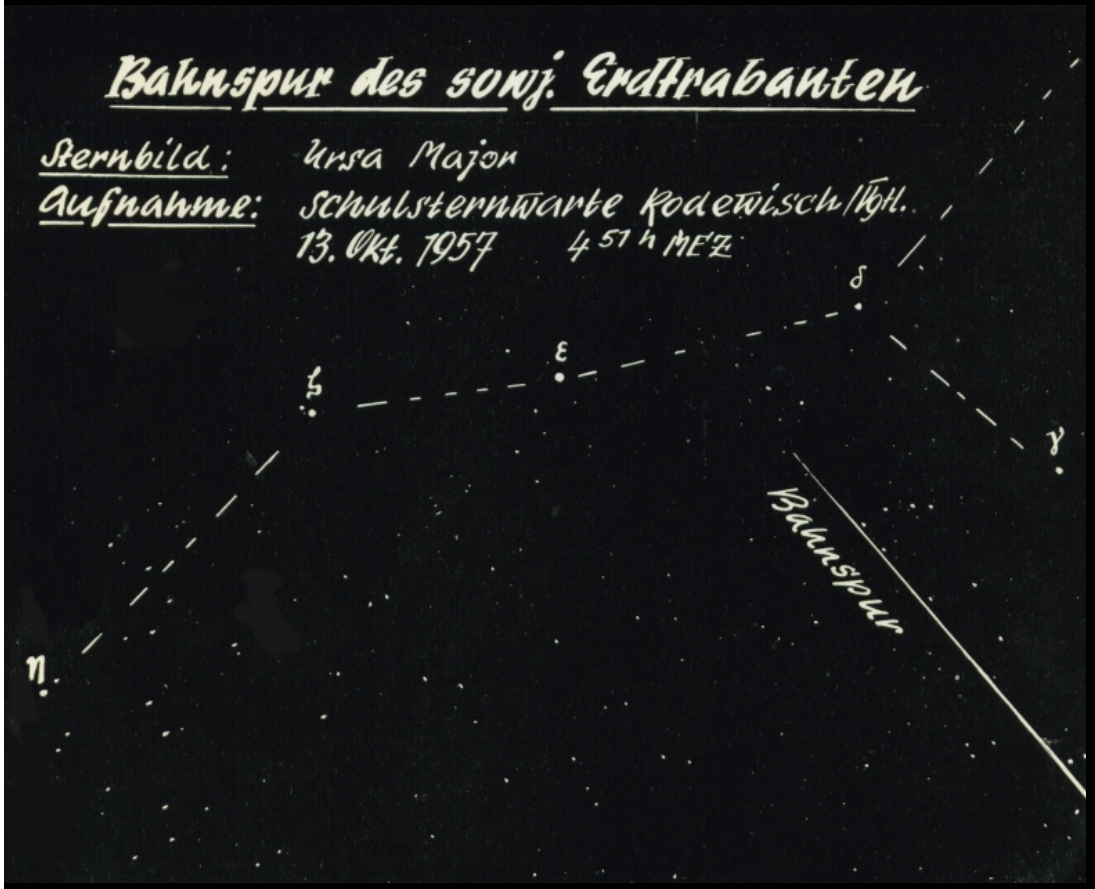
(6) EUREF & EUPOS - How to proceed?

- **EUREF supports all satellite navigation systems: especially GLONASS and Galileo recommended from data collection to analysis**
- **EUREF and EUPOS established real-time services in cooperation with NMAs: data and product streams, permanent PPP monitoring, development of tools, e.g., Anubis, BNC**
- **Introduction of the upcoming European GNSS Galileo will be a big challenge for EUREF and EUPOS by upgrading the station EUREF and EUPOS prepares a Multi-GNSS-RT-Service**
- **Today's Network RTK resources will not become obsolete, combination of PPP-RTK just develops towards an alternative**
- **Test & validate EUREF´s PPP in their countries, Open Source software available through, e.g. BNC and RTKLIB**



Stellar triangulation

Sputnik 1



Earth ellipsoid parameter

Earth ellipsoid	flattening
Int. (1930)	1:297 terr. triang.
Emil Buchar Prague 1958	1:297,90 Sputnik 2
John O´Keefe GSFC 1958	1:298,38 Sputnik 2 Vanguard 1
GRS 67	1:298,247
GRS 80	1:298.2572221