

# ***EUPOS*<sup>®</sup> - a Joint Initiative of Central and East European Countries in Precise GNSS Real-Time Positioning: Status 2016**

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*EUPOS<sup>®</sup> Executive Board Members*

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Satellite Systems  
Sochi, Russian Federation, 06 – 11 November 2016

# OUTLINE

1. What is *EUPOS*<sup>®</sup>?
2. History
3. Structure and Membership
4. Observational Segment
5. Technical Issues
6. Outreach Activities
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8. Challenges
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# What is *EUPOS*<sup>®</sup> ?

- Consortium of European public institutions aiming at establishing and operating a uniform DGNSS infrastructure in **Central and Eastern Europe**
- Ground based European regional GNSS augmentation system
- Mosaic of national DGNSS segments operating according to common standards
- Provides DGNSS correction data for real-time positioning and for post-processing
- Supports precise positioning over entire accuracy scale (metre, sub-metre and centimetre in RT, centimetre and better in PP)
- *EUPOS*<sup>®</sup> is evolving in both intensive and extensive way by accepting new technical developments
- collaborates with other international organizations and scientific institutions acting in the field of GNSS technology

# *EUPOS*<sup>®</sup> - a History

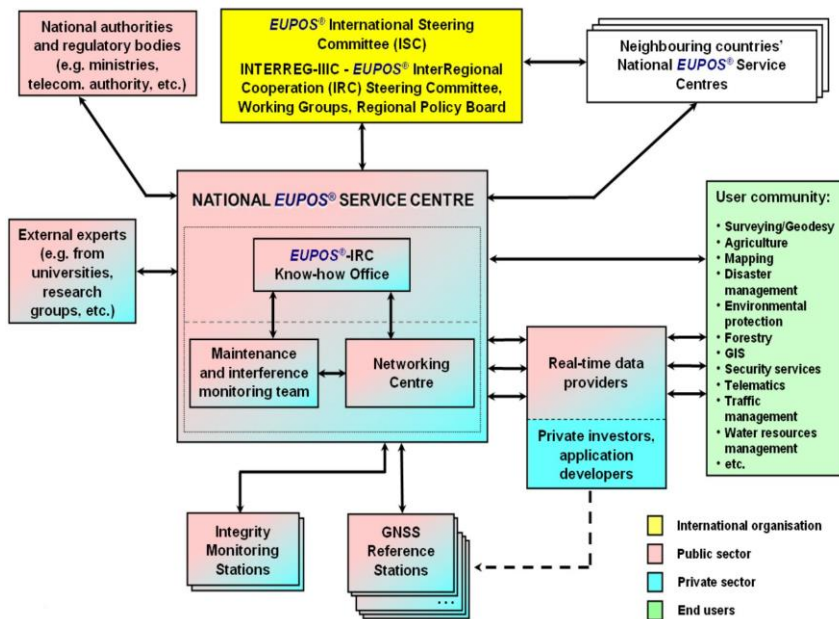
- Initiated by the Berlin Senate Department for Urban Development in March 2002
- Originally representatives of 16 countries
- ICG associated member since 2006
- 2014 – reorganization, new Terms of Reference
- Since 2014 member of Positioning Knowledge Exchange Network of EuroGeographics

# *EUPOS*<sup>®</sup> Structure (1)

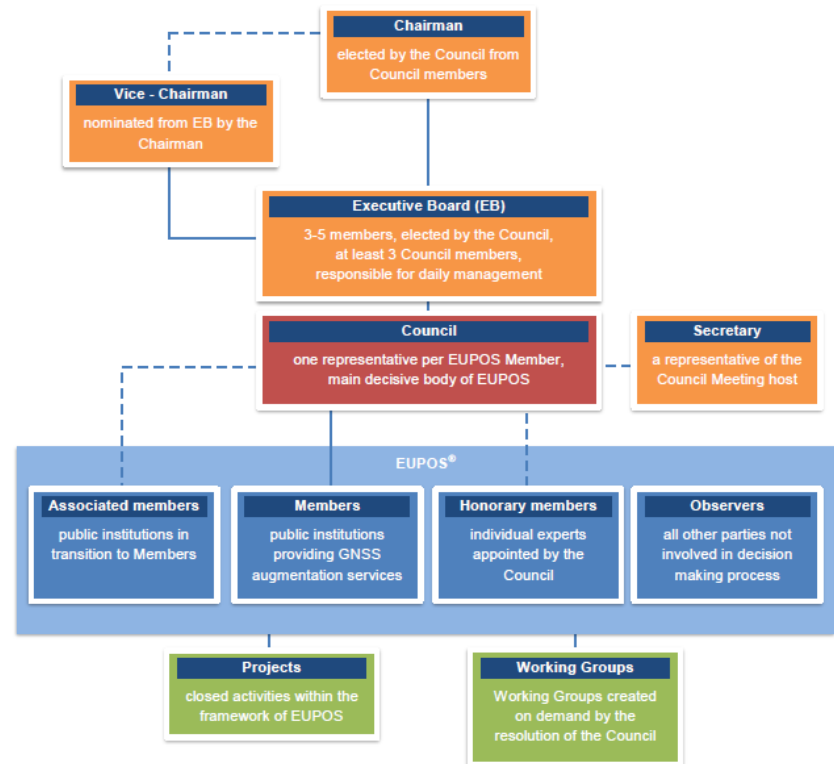
- *EUPOS*<sup>®</sup> Terms of Reference
- Council – one representative nominated by each Member
- Executive Board – manages activities on daily basis
- *EUPOS*<sup>®</sup> Office – coordination, organization, administration
- *EUPOS*<sup>®</sup> Working Groups (SQII, QM, ECC)
- National Service Centres – contacts with council delegates, contacts with national authorities and users, network operation, network integrity check, technical developments, personnel training, developing applications, public relations
- Authorized *EUPOS*<sup>®</sup> resellers
- Manufacturers of *EUPOS*<sup>®</sup> compatible hardware and software

# EUPOS<sup>®</sup> Structure (2)

## Functional structure 2002 -2014



## Membership and organisation since May 2014



# *EUPOS*<sup>®</sup> Membership (1)

- Membership is voluntary; members are obliged to observe the unified standards and *EUPOS*<sup>®</sup> ToR
- Membership status: full member, associated member, honorary member, observer
- Full membership is open to any public organization or institution that provides GNSS-based services
- Each member delegates a national representative to the Council
- Associated membership is intended to be transformed to the full membership

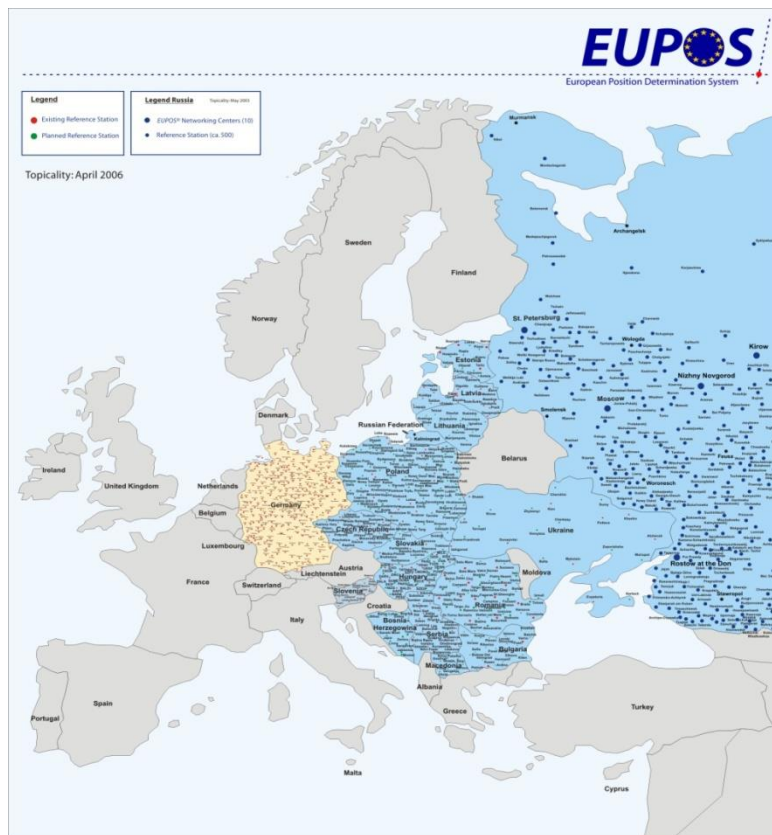
# *EUPOS*<sup>®</sup> Membership (2)

- Full members: Bosnia and Herzegovina, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, FYROM, Moldova, Montenegro, Poland, Romania, Serbia, Slovakia, FRG state Berlin
- Associated members: Slovenia, Georgia,
- Observers: Russian Federation, Kazakhstan, Ukraine, Uzbekistan

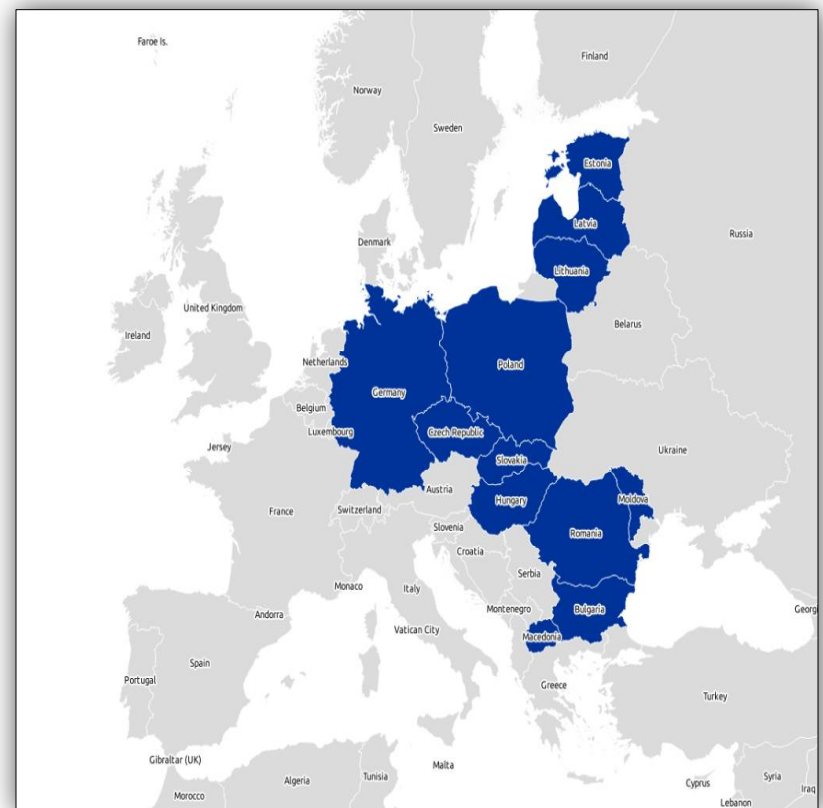


# EUPOS<sup>®</sup> Observational Segment

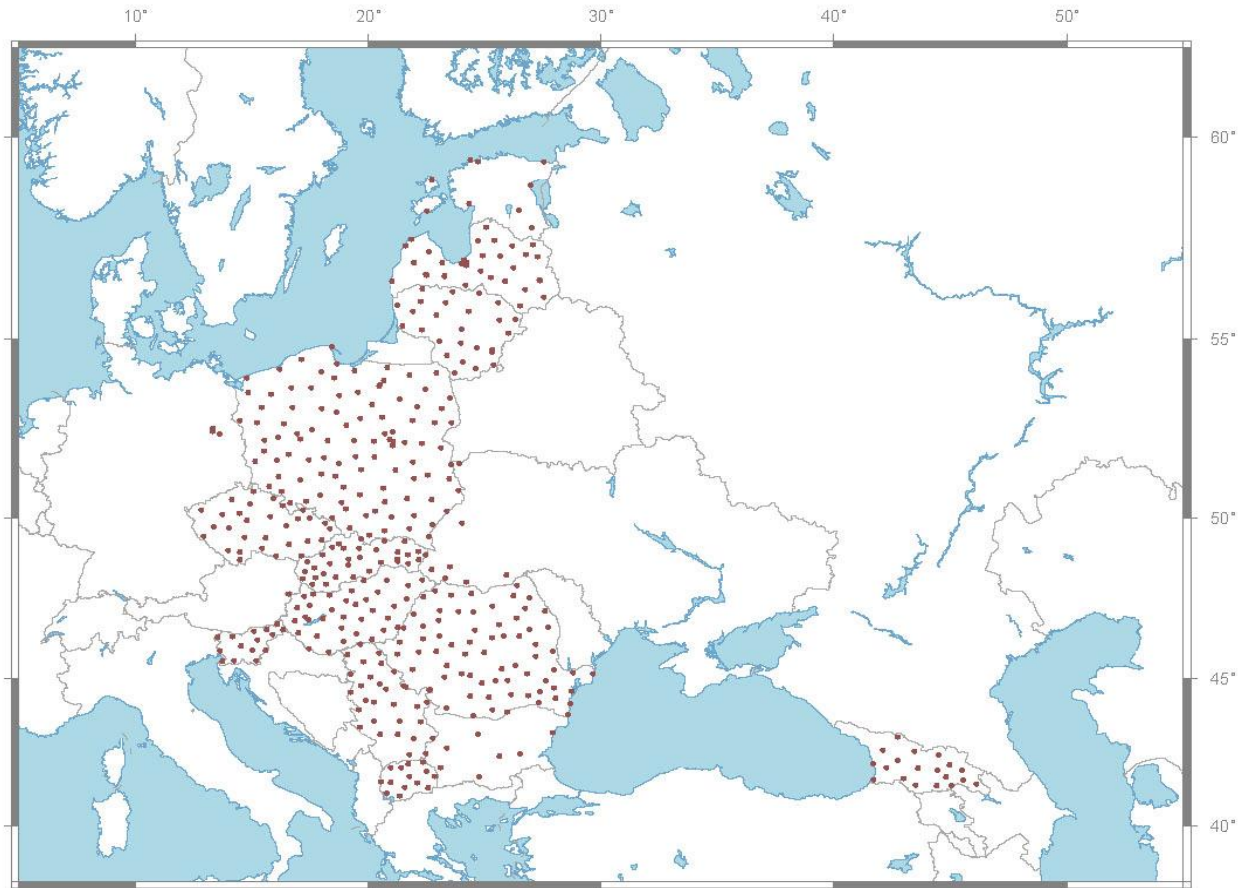
## Status 2002 - 2014



## Status 2016



# *EUPOS*<sup>®</sup> Stations contributing to ESDB Status 2016



# EUPOS® - a List of Operational Stations

EUPOS® member	Area [km <sup>2</sup> ]	Number of realized EUPOS® or compatible reference stations
Berlin, Germany (DE)		4
Bosnia and Hercegovina (BA)	51.000	36
Bulgaria (BG)	110.950	7
Czech Republic (CZ)	78.870	28
Estonia (EE)	45.220	9
Hungary (HU)	93.030	36
Kazakhstan (KZ)	2 717.300	30
Latvia (LV)	64.600	29 <sup>1)</sup>
Lithuania (LT)	65.300	26
Macedonia (MK)	25.330	14
Moldova (MD)	33.846	2
Montenegro (ME)	13.812	?
Poland (PL)	323.520	101
Romania (RO)	237.500	75
Russian Federation (RU)	17 075.000	31 <sup>2)</sup>
Serbia (RS)	88.360	32
Slovak Republic (SK)	49.035	29
Slovenia (SI) (observer)	20.270	15
Ukraine (UA)	603.700	13

# *EUPOS*<sup>®</sup> Technical Issues (1)

- *EUPOS*<sup>®</sup> Technical Standards, Rev. 3 (since 2013)
- DGNSS for RT positioning and navigation, accuracy 2m – 0.5m for moving objects and 0.2m for static
- Network RTK for precise RT positioning - 2 cm
- Geodetic, post-processing – 1 cm and better
- Data streams transmitted via Internet
- NTRIP technology, RTCM SC104 format
- Additionally radio or TV VHF broadcasting
- System availability on the level of at least 99%
- Availability upgrade up to 99.9% is realistic

# *EUPOS*<sup>®</sup> Technical Issues (2)

- *EUPOS*<sup>®</sup> deploys unified standards and communication lines to achieve full interoperability and compatibility
- Reference stations receive signals from GPS and GLONASS satellites, Galileo expected
- Guidelines for single site design
- Guidelines for cross-border data exchange
- Guidelines for reference frame fixing (in 2014 recommended to use current EUREF guidelines)

# *EUPOS*<sup>®</sup> Working Groups

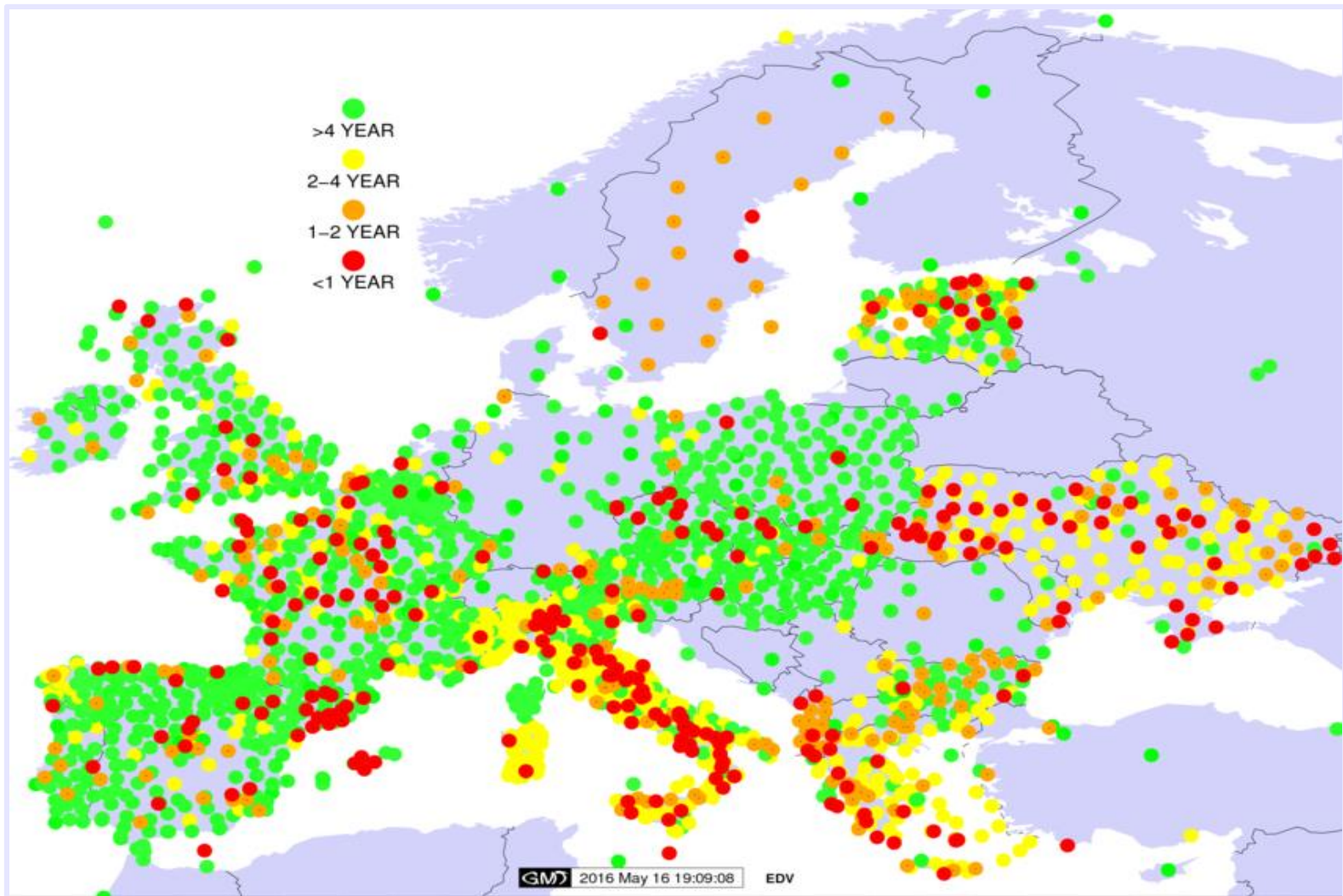
- WG on Technical Cooperation with Industry (TCI) (Chairman of *EUPOS*<sup>®</sup>)
- WG on Site Quality, Integrity and Interference Monitoring (SQII) (J. Zvirgzds, Latvia)
- WG on Service Quality Monitoring (SQM) (B. Droščák, Slovakia)
- WG on *EUPOS*<sup>®</sup> Combination Centre (ECC) (A. Kenyeres, Hungary)
- *EUPOS*<sup>®</sup> Station Database (ESDB) (A. Fabian, Hungary)

# *EUPOS*<sup>®</sup> Combination Centre

- Initiated in 2010
- Time series of coordinates + velocities from combination of weekly SINEX files based on EUREF standards
- Centre located at SGO Penc, Hungary
- Data from CORS of EUPOS and many other European countries
- Currently more than 2000 stations → EPN densification
- Significant contribution to the densification of velocity field in Europe and to detection of intraplate movements



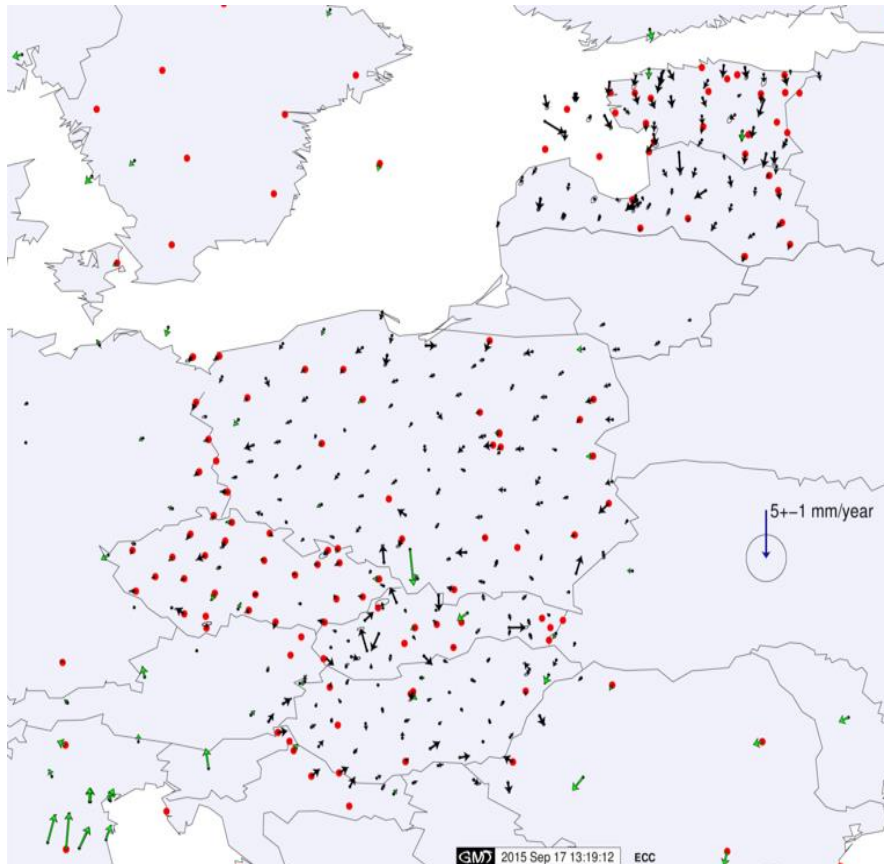
# ECC – SINEX Availability



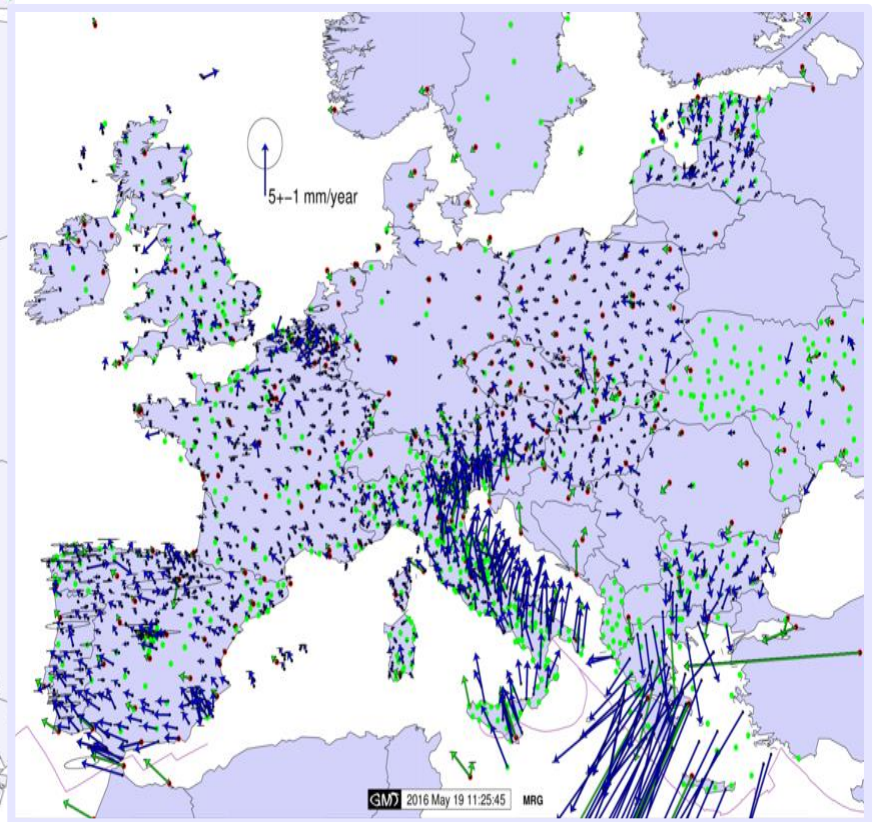


# ETRF 2000 Velocities $L > 3$ years

ECC solution – EUPOS area

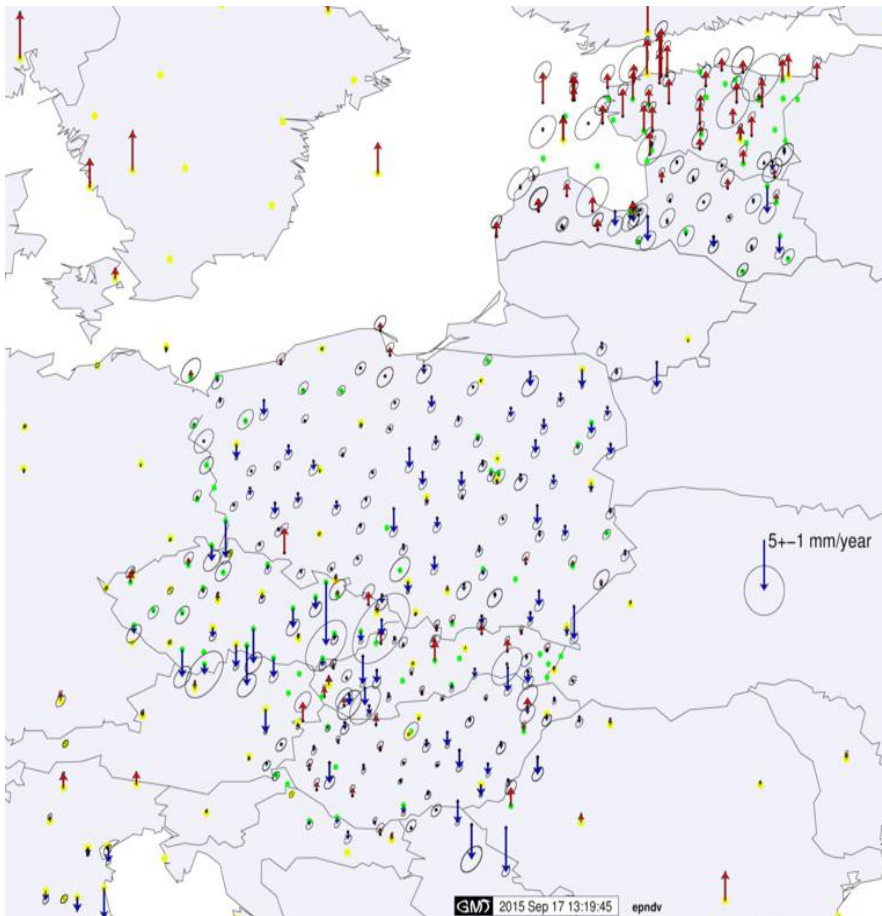


ECC solution - Europe

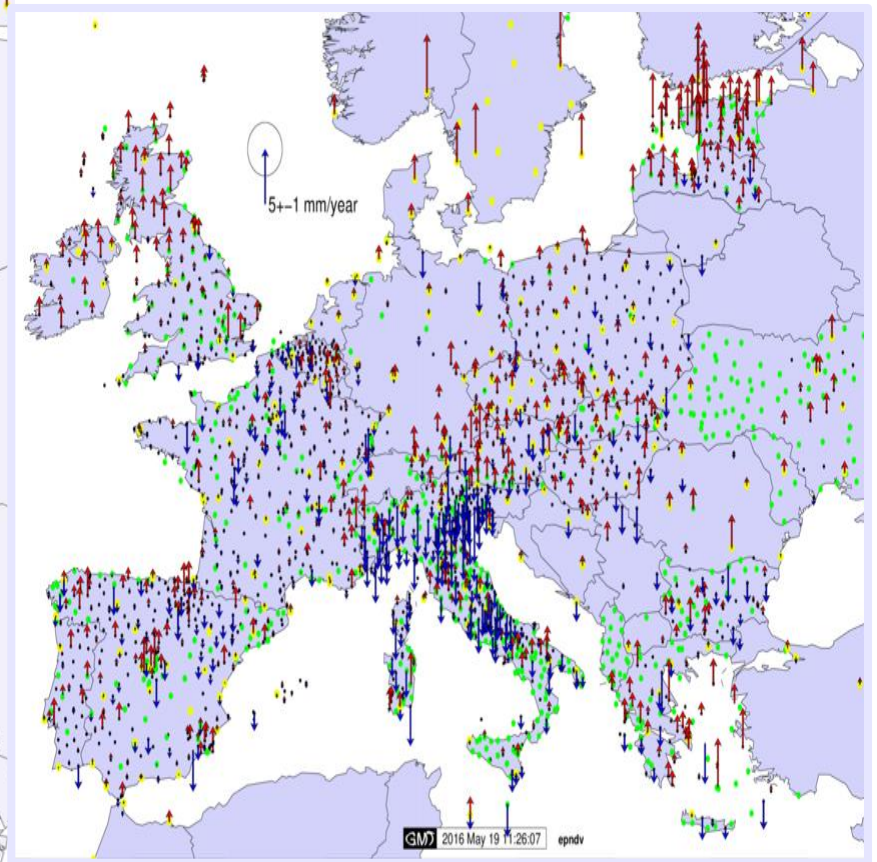


# Vertical velocities $L > 3$ years

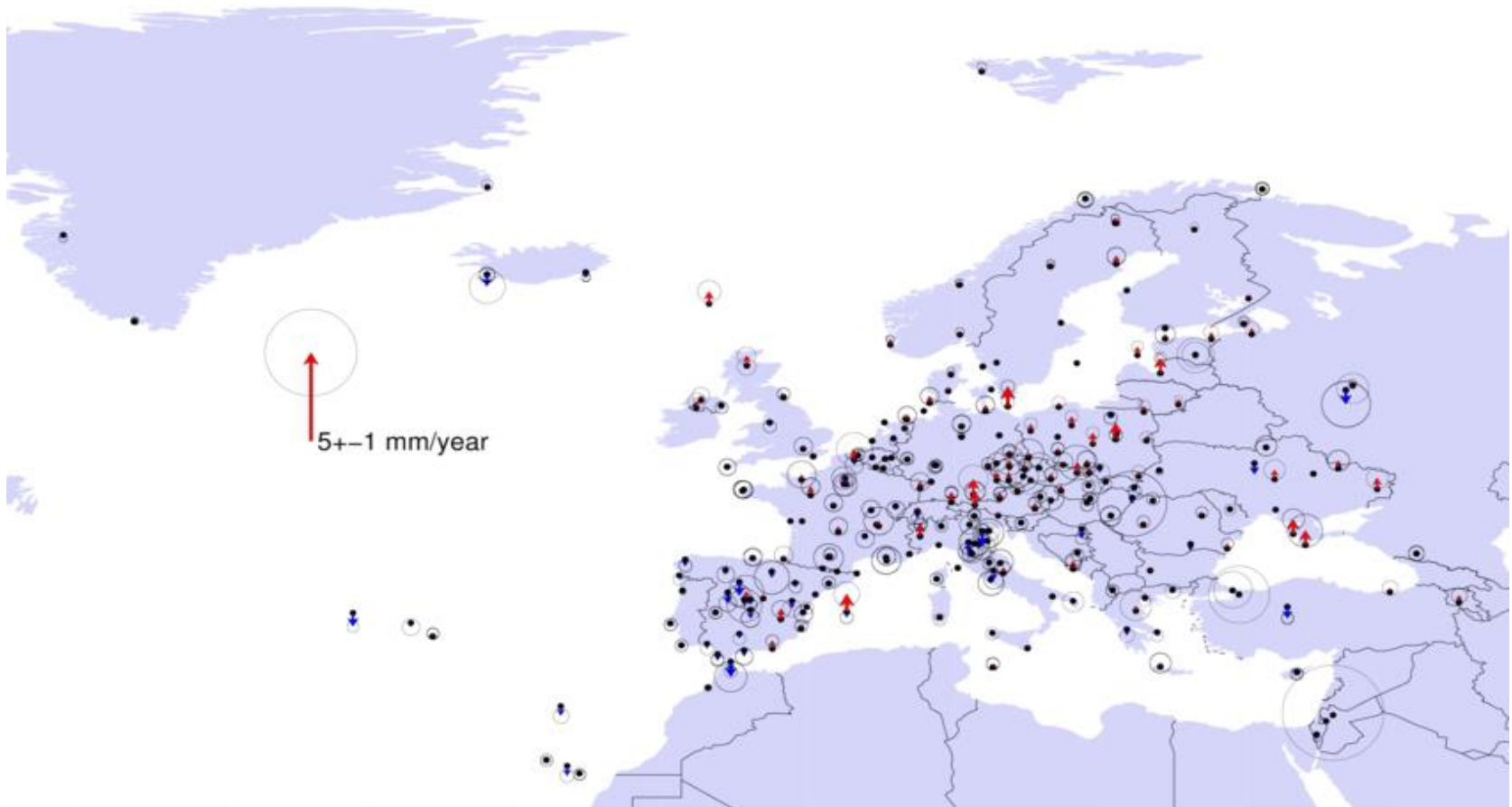
ECC solution – EUPOS area



ECC solution - Europe



# Comparison of ECC solution with official EPN velocities



# WG SQM - EUPOS<sup>®</sup> Positioning Services Quality Monitoring

## Objectives

- Develop a unified and independent process of positioning service quality monitoring based on a virtual approach
- Verification of the virtual approach
- Analysis, comparison and publishing of results
- Implementation into the EUPOS<sup>®</sup> Technical Standards



# EUPOS<sup>®</sup> Positioning Services Quality Monitoring



34 stations

32 stations

8 stations

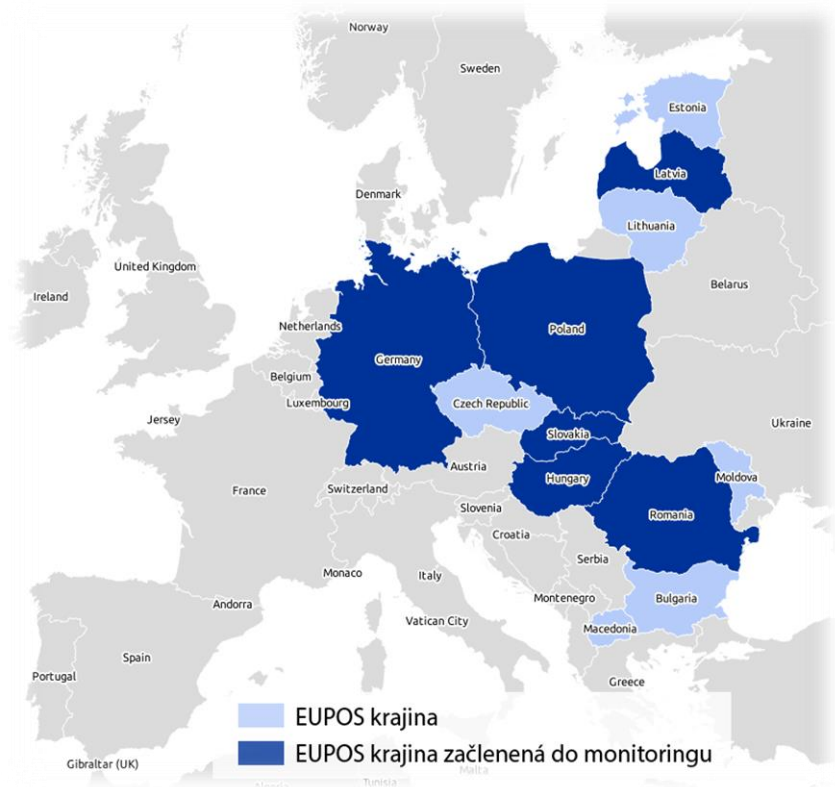
68 stations

4 stations

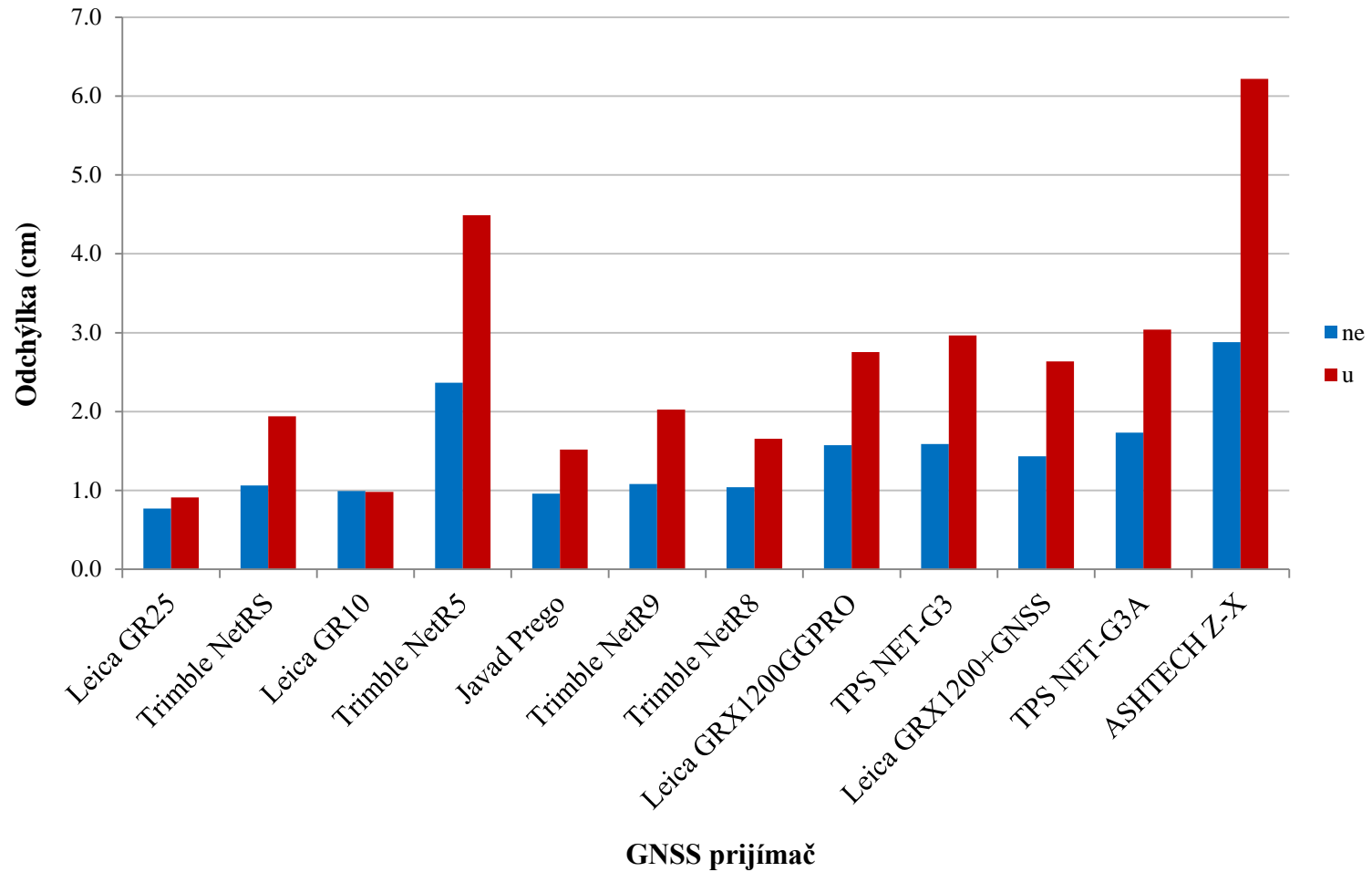
5 stations

**Total 151 stations**

Receivers: Trimble, Leica,  
Topcon, Javad, Ashtech



# EUPOS<sup>®</sup> Positioning Services Quality Monitoring: Comparison of Receivers



# *EUPOS*<sup>®</sup> Outreach Activities

- **EUREF** – MoU signed in June 2014
- **EUMETNET** – MoU signed in May 2013
- **EuroGeographics** – agreement of May 2014:  
Positioning Knowledge Exchange Network (PosKEN)  
→ EuroGeographics + EUREF + EUPOS + CLGE
- **International Committee on GNSS (ICG)** -  
associated member since 2006
- Technical Cooperation with Industry (TCI)
- RTCM Member – Special Committee 104 (since 2002; future ???)

# Achievements

- Incentive to building up CORS networks
- System of standards and guidelines
- Outreach activities
- *EUPOS*<sup>®</sup> symposia (impact on professionals from different fields of activities) – 2005, 2008, 2009 (Berlin), 2010 (Brussels), 2011 (Berlin), supported by UN OOSA
- *EUPOS*<sup>®</sup> in international programmes and projects (INTERREG, ESA)



# Challenges

- *EUPOS*<sup>®</sup> disposes of a large observation data and product volume which represents a potential that can benefit a number of activities, among others in science
- Reference frames, velocities
- Ground based meteorology
- Geodynamics, neotectonics ...
- Space weather, upper atmosphere studies
- Gravity field modelling, unification of height systems
- Mixed problems (ionosphere x earthquakes)

# Outlook

- Vitalize *EUPOS*<sup>®</sup> and its activities towards making full use of its potential
- Develop *EUPOS*<sup>®</sup> as a multi-GNSS facility
- Extend *EUPOS*<sup>®</sup> both geographically and in application sphere
- Continue keeping and developing all outreach links, WGs, projects, centres but also *EUPOS*<sup>®</sup> Symposia

# Nearest *EUPOS*<sup>®</sup> Related Events

- 3<sup>rd</sup> *EUPOS*<sup>®</sup> Council and Technical Meeting, Prague, Czech Republic, November 14 – 15, 2016
- EuroGeographics Positioning Knowledge Exchange Network Meeting (PosKEN), Prague, Czech Republic, November 15 – 16, 2016

Thank you for  
your attention

<http://www.eupos.org>