# ECGN
## European Combined Geodetic Network

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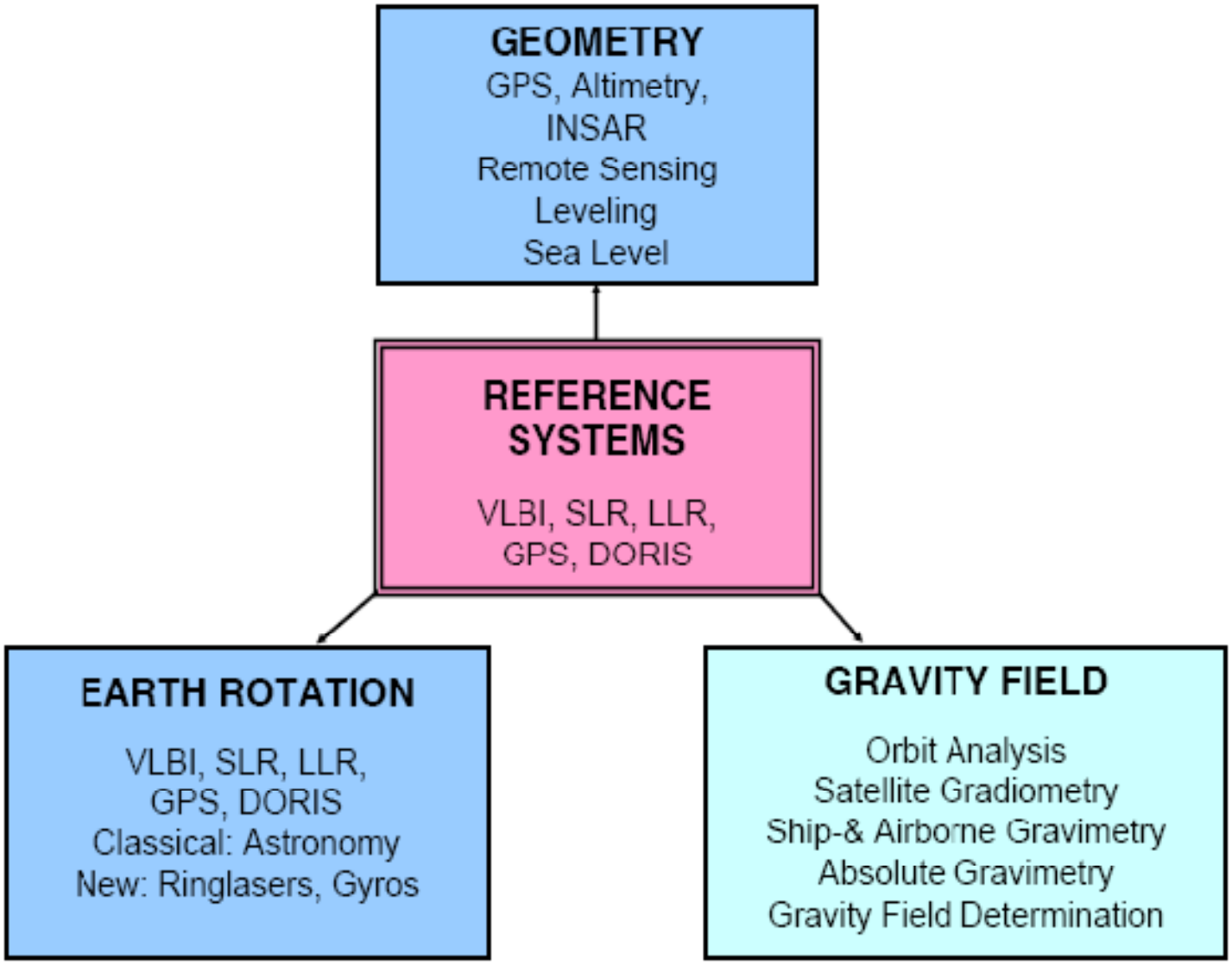
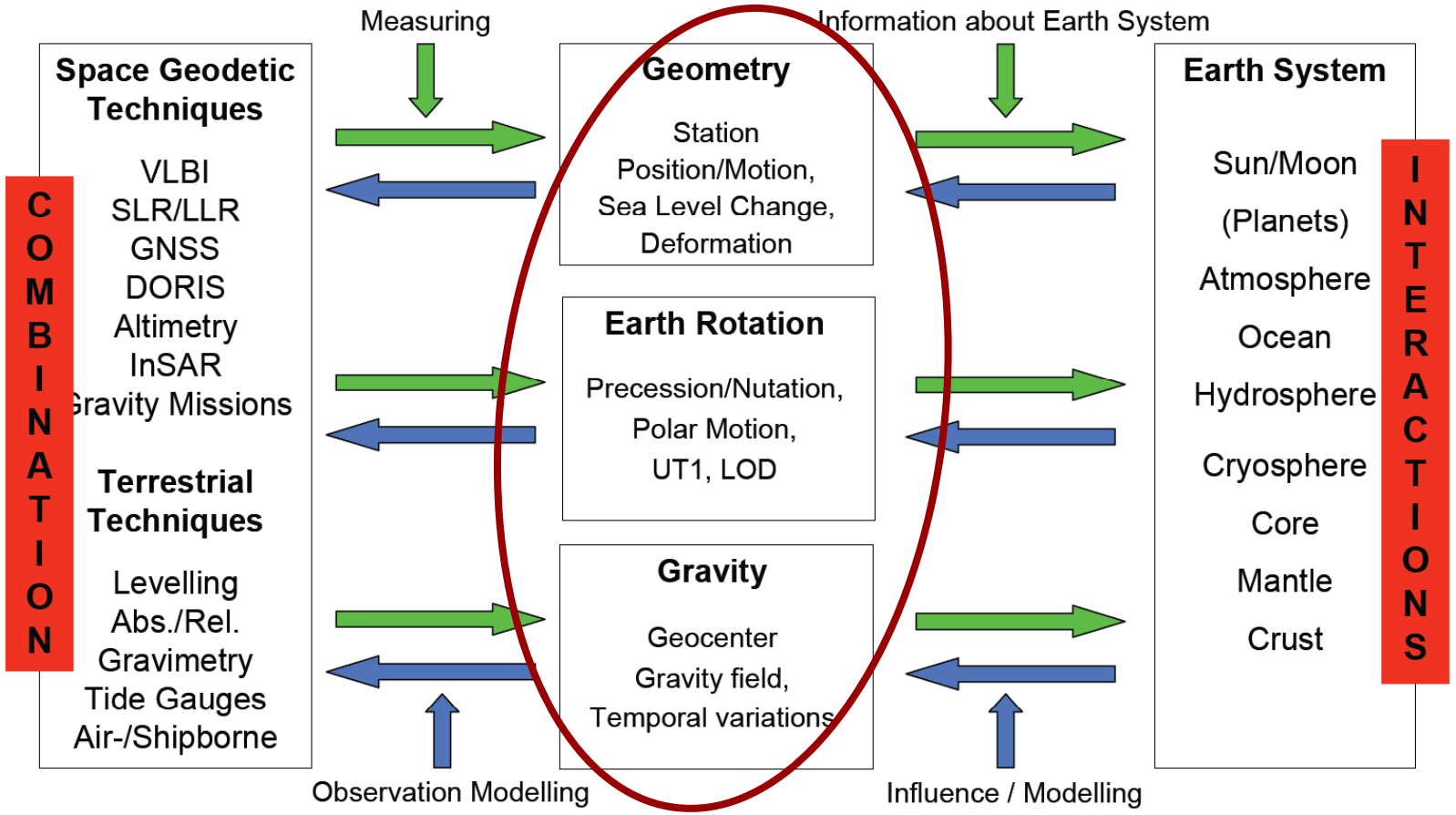
# Three pillars of geodesy

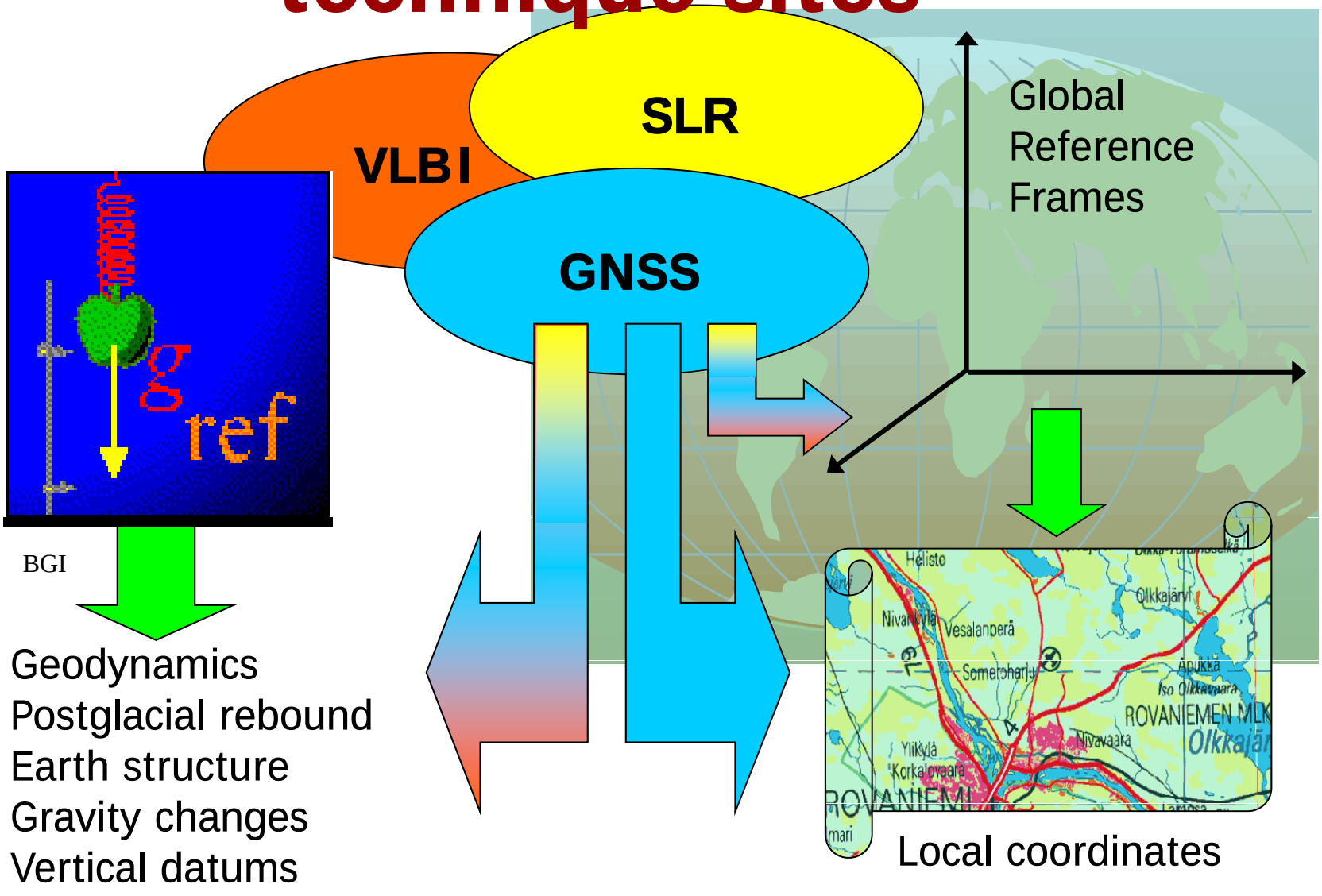


# Measuring and Modeling the Earth's System




*M. Rothacher/GGOS*

# Motivation for multi-technique sites



# Why?

- Geodetic networks of different techniques separated (reference frames, levelling, gravity)
- Connection of observations of different techniques
- Availability of data, access of data
- Quality control of data
- Continuation and stability of the infrastructure
- Response to political and societal needs
- Delivery of products to the end users
- Unawareness of geodetic methods; promoting

# European Combined Geodetic Network

Objectives of the ECGN as an integrated European Reference System for Spatial Reference and Gravity are:

- Realization of a terrestrial reference system and maintenance of long time stability with an accuracy $10^{-9}$ for Europe especially in the vertical component
- In-situ combination of space geodesy (GPS) with Earth gravity parameters (gravity, heights)
- Modelling of influences of time depended parameters to TRF (of the solid Earth of the Earth gravity field, the atmosphere, the oceans, the hydrosphere)
- Modelling of terrestrial gravity field components to validate satellite gravity missions
- Geodetic platform in Europe for geo-initiatives (GMES, INSPIRE, GEOSS, GGOS)

The ECGN is considered as a European contribution to the IAG's Global Geodetic Observation System (GGOS). At the business meeting of the IGGC at the Gravity and Geoid 2002 Symposium in Thessaloniki the ECGN project as a cross-commission project was approved. The primary concern of the project consists in connecting the height component with the gravity determination while allowing for measuring data that are acquired in the European coastal regions and above adjacent seas.

# Three pillars of ECGN

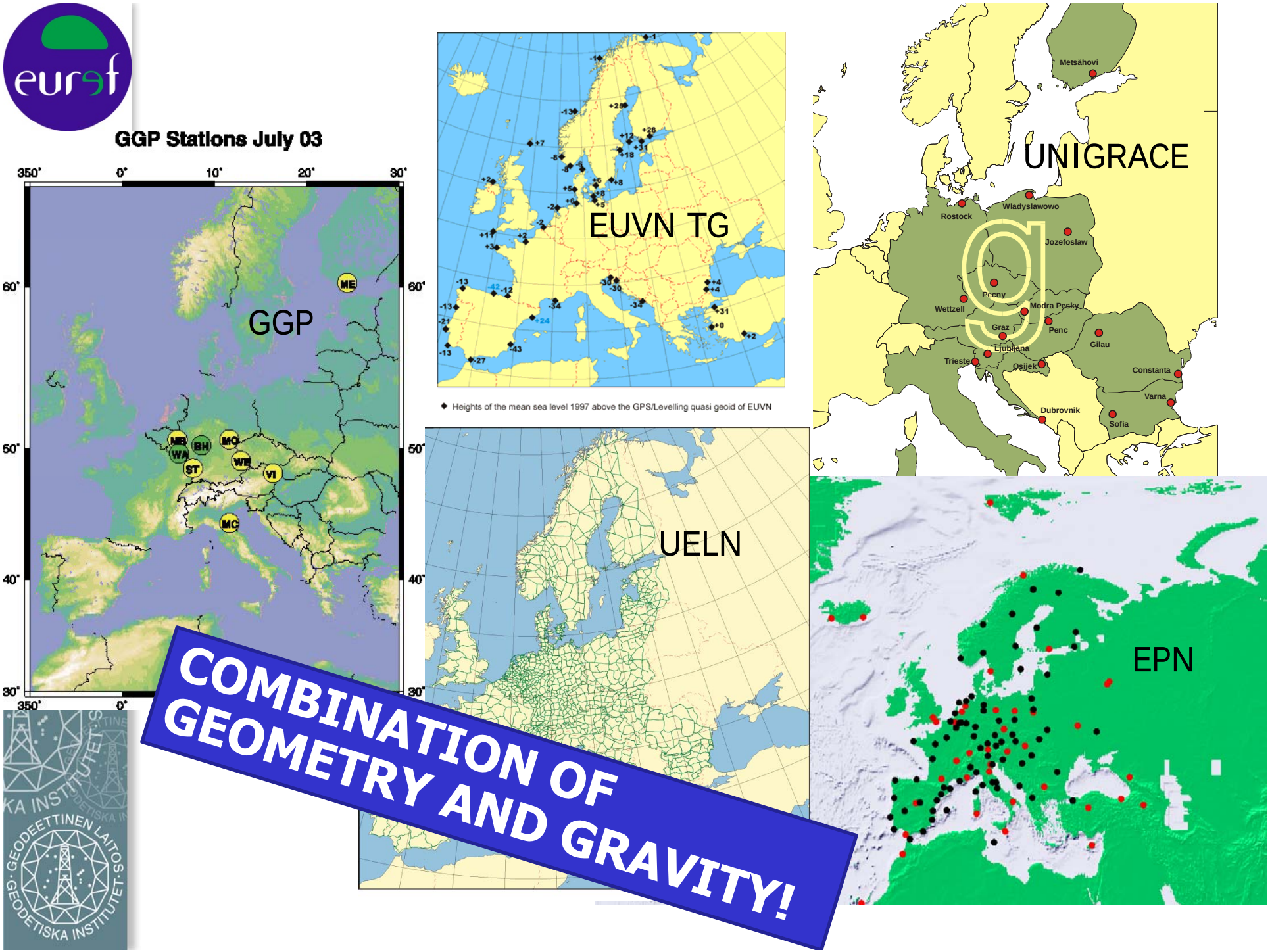
1. Stations
   - Criteria and guidelines for stations
   - Selection of stations based on guidelines
2. Data Banks
   - Most of data already in data banks
   - Update of the metadata bank needed
3. Combination/products
   - To be organized by the ECGN WG
   - Long-term stability

# Network Infrastructure

1st Call for Participation (April 2003):
Implementation of ECGN Stations
(to be revised in the near future)

Elaboration of the observation network of ECGN stations with the standard observation techniques:

- GNSS (GPS/GLONASS, GALILEO) – permanent
- Gravity (super conducting gravimeter and/or absolute gravimeter) – permanent or repeated
- Levelling connections to the of UELN/EVRS network
- Tide gauges – permanent
- Meteorological parameters – permanent.


GGP Stations July 03
GGP
EUVN TG
Heights of the mean sea level 1997 above the GPS/Levelling quasi geoid of EUVN
UNIGRACE
Metsähovi
Wladyslawowo
Rostock
Jozefoslaw
Pecny
Wettzell
Modra Pesky
Graz
Penc
Gilau
Ljubljana
Trieste
Osijek
Constanta
Varna
Dubrovnik
Sofia
UELN
EPN
COMBINATION OF GEOMETRY AND GRAVITY!

# Selection of stations

- Status after the 1st call

# Techniques

| Technique | Objective | Accuracy | Component(s) |
|---|---|---|---|
| GNSS | Point positioning relative to a satellite system | E: 1-2 cm *)<br>C: 1-2 mm | Surface displacement<br>Reference frame |
| Levelling | Height differences of points relative to the geoid | < 1 mm/km½ | Surface displacement<br>Reference frame |
| Tide gauges | Height of points relative to sea level | E: 10 cm<br>C: 1 cm | Surface displacement<br>Reference frame |
| Absolute gravimeters | Absolute gravimetric accelerations | 2-3 mGal | Surface displacement; Earth rotation, Gravity; Reference frame |
| Superconducting gravimeters | Relative gravimetric accelerations | 0.1 mGal<br>(< 1 nGal periods) | Surface displacement; Earth rotation, Gravity; Reference frame |
| Spring gravimeters | Relative gravimetric accelerations | 2-3 mGal | Gravity<br>Reference frame |
| VLBI | Point positioning relative to space | 0.001 ppb<br>0.1 mas | Surface displacement; Earth rotation; Reference frame |
| SLR | Point positioning relative to many satellites | < 1 cm (range)<br>1-2 cm | Surface displacement; Earth rotation; Reference frame |
| DORIS | Point positioning relative to satellites | 1-5 cm | Surface displacement<br>Reference frame |

*) *E means episodic and C continuous measurements*

# Topics / Techniques included

- GNSS = EPN (All ECGN stations should be included to the European Permanent GPS network (EPN). Therefore the stations have to fulfill the requirements of EPN)
- Gravity (absolute gravity, superconducting gravimeters (GGP), relative gravimeters (geoid computation data))
- Levelling = UELN (All ECGN stations should be connected to the United European Levelling Network - UELN)
- Tide gauge = PSMSL, ESEAS (For Tide Gauge measurement the data of Permanent Seal Level Observing System - PSMSL and the project European Sea Level Service - ESEAS should be used)

# Status / GNSS

- EPN up and running
- Fully organized
- Operational and analyzing centers exist
- Data base exist
- Easy access to data and results
- Standards for becoming a GNSS EPN Station
- Connections to GGOS (via IGS, IERS)

✓ **This component is ready and operational.**

✓ **Produces data and results for global and regional use**

✓ **In the viewpoint of the ECGN no further action is needed**

# Status / gravity

- ECGN Standards for Absolute Gravity measurements
- AG data bank exists, up and running in BKG Frankfurt and a mirror in BGI Toulouse

✓ **BKG support the AG database and will continue maintaining it**

- Standard for SCG observations (Global Geodynamic Project GGP)
- GGP data bank exists, but separate to the ECGN project as an IAG project.

✓ **Further discussion needed for arrangements of SCG**

- Relative g-data access?
- Geoid models

✓ BUT: all g-data are not in the data banks

# Status / levelling

- UELN network exists
- ECGN Standards Levelling Connection of the ECGN Station
- ECGN Levelling Form

✓ **UELN adjustments exist and in use**

✓ **EVRS -> EVRF 2000, 2007**

- **Levelling to the ECGN Stations?**

# Status / Tide gauges

- For Tide Gauge measurement the data of Permanent Seal Level Observing System - PSMSL and the project European Sea Level Service - ESEAS should be used.
- ECGN Standards for Tide Gauge measurements
- many tide gauges are maintained and owned by non-geodetic organizations, not a full control over physical existence of stations or data availability

✓ **Data banks exist and most of data are there (sometimes with a delay)**

# Status of ECGN Metadata

**To be updated**

**Status: 2007-02-09**

yes = available

| | Site Name | Station Code (GPS) | GPS Status (EPN) | Metadata Form | | | | | Additional Forms | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | [..] code not available, temporary defined code | (p) = planned | Form | GPS | Lev | Grav | Ties | GPS Form | ECGN Levelling Form | Gravity | Local ties | Miscellaneous |
| AT | | | | | | | | | | | | | |
| AT | Graz | GRAZ | EPN | - | - | - | - | - | yes | yes | yes | yes | |
| AT | Innsbruck / Hafelekar | HFLK | EPN | | | | | | | | | | |
| AT | Bregenz, Pfaender, Moos | PFAN | EPN | - | - | - | - | - | yes | yes | no | yes | |
| AT | Pernitz / Trafelberg | TRFB | EPN | - | - | - | - | - | yes | yes | yes | yes | |
| BG | | | | | | | | | | | | | |
| BG | Rozhen | [ROZH] | perm | | | | | | | | | | |
| BG | Sofia | SOFI | EPN | | | | | | | | | | |
| BG | Varna | [VARN] | perm (p) | | | | | | | | | | |
| CH | | | | | | | | | | | | | |
| CH | Zimmerwald | ZIMM | EPN | yes | yes | yes | yes | yes | | | yes (Report) | | |
| CZ | | | | | | | | | | | | | |
| CZ | Ondrejov, Pecny, Geodetic Observatory | GOPE | EPN | | | | | | | | | | |
| DE | | | | | | | | | | | | | |
| DE | Bad Homburg | BADH | EPN | yes | yes | national height | yes | *yes* | yes | at present not possible | | | |
| DE | Helgoland Island | HELG | EPN | yes | yes | | yes | yes | yes | not possible (Island) | | | |
| DE | Moxa | MOX2 | perm | yes | yes | yes | yes | yes | yes | yes | yes | yes | |
| DE | Sassnitz | SASS | EPN | yes | yes | national height | yes | yes | yes | | yes | yes | |
| DE | Bad Kötzting / Wettzell | WTZR | EPN | yes | yes | yes | yes | yes | yes | yes | yes | yes | |
| DK | | | | | | | | | | | | | |
| DK | Smidstrup, Velje | SMID | EPN | | | | | | | yes (2x) | | | |
| DK | Suldrup | SULD | EPN | | | | | | | yes (2x) | | | |
| DK | Qaqortoq, Julianehaab (Greenland) | QAQ1 | EPN | | | | | | | | | | |
| EE | | | | | | | | | | | | | |
| EE | Suurupi | [SUUR] | perm (problems) | | | | | | | | | | |
| ES | | | | | | | | | | | | | |
| ES | A Coruna | ACOR | EPN | | | | | | | | | | |
| ES | Albacete | ALBA | perm | | | | | | | | | | |
| ES | Alicante | ALAC | EPN | | | | | | | | | | |

# ECGN Working group

- Markku Poutanen (Chair)
- ✓ Olivier Francis
- ✓ Steve Shipman
- ✓ Jaroslav Simek
- ✓ Herbert Wilmes
- ✓ Simon Williams
- Carine Bruyninx (Euref TWG)
- Johannes Ihde (Euref TWG)
- Ambrus Kenyeres (Euref TWG)
- Jaakko Mäkinen (Euref TWG)

+ 3-4 additional members

# Recommendations, schedule and the future

- ✓ Renewal of the ECGN Working Group
- ➢ Renewal of the guidelines and recommendations
- Inventory of current ECGN-related activities
- Update the 1st call
- Update the (meta)data bases
- Demonstration of combination techniques

Further aspects:

- New techniques to be included in the ECGN (InSAR, laser scanning)
- Organizational aspects, status of ECGN, relations to e.g. GGOS
- Funding? EU FP7, COST, ... ?
- KEY ISSUE: How to keep on the activity to guarantee the long-term monitoring? Where to get resources?