Geodetic Reference System 2015
- the Approach in North-Rhine Westphalia
subtitle: Do we still need reference point fields?

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Germany
16 federal states
– 82 Mill. people

North-Rhine Westphalia
– 18 Mill. people
– 5 administrative districts
– Centrality in Europe with borders to Belgium and the Netherlands
Surveying and Mapping responsibility: North-Rhine Westphalia Cologne District Government, dep. 7 = GEObasis.nrw

- service provider for the whole of North-Rhine Westphalia (280 staff members)
- offers geobasis data (reference data) for citizens, public administration, trade and industry
- products and services
  - Satellite Positioning Service (SAPOS®) / coordinate reference
  - topographic maps / data
  - aerial views / orthophotos
  - terrain- and landscape-models
  - thematic maps / data
  - house-coordinates / addresses …

Employees responsible for the geodetic reference frame (NRW, Germany):
1980: ca. 115
today: ca. 45

Developments in the Surveying and Mapping Administration

analogue digital services
ca. 1800 ca. 1980 2010

Cadaster
- Cadastral maps
- ALK
- AAA®

Top. Mapping
- Topographic maps
- ATKIS®
- SAPOS®
- Pfiff

Geodetic Reference
- Trigonometric points
- + SDI
210 Years Surveying and Mapping
- innovations over two centuries -

surveying and mapping law in NRW
Vermessungs- und Katastergesetz NRW

§ 1 tasks
(1) ... The collection, maintenance and provision of the surveying and mapping data ... have to be continuously adjusted to the development of science and technique.
Definition of kernel tasks and personal resources

- reorganization of the surveying and mapping administration
- guarantee of services in the surveying and mapping administration
- review of necessary tasks -> reduction of administrative / state activities with respect to kernel tasks / definition of the spatial information infrastructure

Kernel tasks = data maintenance and data provision

perspective: in close relation to INSPIRE

---|---|---|---
Trigonometry | Geodetic Reference | Geodetic Reference | Geodetic Reference
Topography | Topography and Cartography | Topographic Information Management | Topographic Information Management
Cartography | Software development technical support | Reproduction (maps) | Geo Data Center, SDI
geodetic software development | | | Satellite positioning service (SAPOS)

standardization and harmonization of reference data
standardization of AAA-GIS (AFIS, ALKIS, ATKIS)
reference point field

FIG Working Week 2011
Bridging the Gap between Cultures
Marrakech, Morocco, 18-22 May 2011
3 Measurement Campaigns:
- a) 1st order leveling campaign „DHHN 2006-2011“
- b) GNSS-campaign 2008
- c) absolute gravity campaign 2008

Integrated Reference Frame:
physical heights (a), 3D-coordinates (b) and gravity (c).

Vision:
new (harmonized European) Vertical Reference Frame + DE-Undulation (quasi geoid) ?
GNSS for 2D-coordinates and height (NHN / Molodensky).

GNSS permanent stations:
The connection of
- 3D- coordinates (x,y,z)
- height (NHN)
- gravity

absolute gravimetric measurements
 → 10 AGRAV-points

DHHN in NRW
The accuracy of GNSS-satellite technique to determine NHN-heights in the official geodetic reference frame is dependent (restricted) on the accuracy of the ellipsoidal height of the (CORS GNSS) SAPOS-stations and the accuracy of the geoid (undulation model).

\[
\text{ellipsoidal height} + \text{(quasi) geoid undulation} = \text{NHN height}
\]

**Conclusions (I)**

⇒ CORS GNSS (SAPOS®) is the fundamental measurement technique to determine 3- or 2D-coordinates. In the future this technique will be available to determine heights (dynamic information)

⇒ other measurement techniques will loose importance

⇒ the determination of the (accurate) 1 cm-geoid is an important goal
**Geodetic reference**

- European Terrestrial Reference System (ETRS89)
- Universal Transversal Mercator projection (UTM)

as a common base for Germany (cadastre and surveying & mapping)
Do we still need reference point fields?

- Classical point field (ca. 37000 TP 1-4. order)
- NRW-geodetic reference 2015 (part of the German geodetic reference frame)
- Classical leveling points (NIVP 2.+3. order)
- 3D-Reference points ca. 170 GGP (129 TP (C,D,E-Network) + 27 RSP + 10 SFP (AGRAV))
- Leveling points DHHN-NRW (4000 HFP)
- Gravity points SFP (10 AGRAV + x RGRAV)

How to deal with the topic of (vertical) ground movement?

Absolute ground movements in the Ruhr area ca. 1900 - 2010

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- Classical leveling points (NIVP 2.+3. order)
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Areas with ground movements

TODAY

conclusions

Mining activities cause ground movements

Legal mandate (§4 DVOzVermKatG):
The reference point field has to be kept up to date. To detect changes the spatial information system also includes historical data.

Periodic re-leveling campaigns under management of the Surveying and Mapping Administration (Geobasis NRW):
The state surveying authorities use classical precise leveling and rely on collaboration with many institution (mining companies, local authorities, …).
From leveling points to ground moving areas

Result of re-leveling:
new height values
for leveling points

Determination of
ground moving area
(because of mining)

Grey: ground movement area (old)
Red: ground movement area (new) 3mm/a

The future of reference point fields

NRW- geodetic reference 2015
(part of the German geodetic reference frame)

3D-Reference points
ca. 170 GGP
(129 TP (C,D,E-
Network) + 27 RSP +
10 SFP (AGRAV))

Leveling points
DHHN-NRW
(4000 HFP) + points in areas of
ground movements

Gravity points
SFP
(10 AGRAV + x RGRAV)
Conclusions (II) - a view behind 2015...

→ CORS GNSS (SAPOS®) is the fundamental measurement technique to determine 3- or 2D- coordinates and heights.
→ An accurate 1 cm-geoid is usable.*

→ New measurement techniques might gain importance, if they are a) inexpensive (less man power), b) fast in the field and in general, c) contact-free. This might be:
   → Radar interferometry (to detect changes in height)
   → UAV, Unmanned Aircraft Vehicles (to determine high-resolution orthophotos and digital terrain models)
→ Classical point fields have less (no) importance.

Conclusions (II) → virtual geodesy 2020!

* Thank you very much for your attention!