The Austrian GEOID 2008

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TOPICS

• Project GEOonAUT

• Data

• Computation

• Evaluation
Project GEOOnAUT

- **Objective:** Improved Austrian Geoid solution

- **Sponsor:** Austrian Research Promotion Agency (FFG)

- **Partner of the Project:**
  - Institute of Navigation and Satellite Geodesy (INAS)/TU Graz
  - Institute of Numerical Mathematics/TU Graz
  - Federal Office of Metrology and Surveying
Gravity Field Data

- Gravity anomalies: 14,001 selected stations (out of >60,000); average distance 4 x 4 km
- Deflections of the vertical: 670 stations
- Highly precise GPS/levelling observations: 170 stations
- Global gravity field model EIGEN-GL04S (complete to degree/order 70)
Digital Terrain Model (DTM)

Differences [m] of the DTM at the gravity anomaly stations

New combined DTM with resolution 44 x 49 m was assembled:
• highly accurate regional DTM of Austria (BEV)
• highly accurate regional DTM of Switzerland (swisstopo)
• SRTM in neighbouring countries (corrected by Corine Land Cover CLC90 model)
Geoid computation (1)

Free-air anomalies, reduced by:
- global model EIGEN-GL04S (GRACE)
- topography & isostasy

Method:
Least Squares Collocation
Empirical and model covariance function
Degree variance model (*Tscherning-Rapp*)

- Variance: $396 \text{ mgal}^2$
- Correlation length: $42.6 \text{ km}$
Geoid computation (2)

- Estimation of relative weighting from residuals in GPS/levelling stations
- Final solution with individual weighting of GPS/levelling observations

170 GPS/Levelling stations
Final solution of Austrian Geoid

Austrian Geoid
Resolution: 2.5' long. x 1.5' lat.

Beside the Geoid solution a Quasi-Geoid solution was computed
Evaluation of the Austrian Geoid

- GPS/Levelling points
- Comparision with Swiss Geoid
- Comparision with European Geoid/Quasi-Geoid
GPS / levelling data

170 stations with highly precise ellipsoidal heights and orthometric heights
+ … these stations are included in the geoid solution

Deviations of GPS / levelling stations (+) from Geoid

Maximum = 69 mm
Minimum = -92 mm
SD = 22 mm
Comparison to Geoid of Switzerland

Difference of Geoids: Austria - Switzerland

Along the border Austria - Switzerland there is a step of appr. 15 mm

Explanation:
Austrian and Swiss Geoid are both adjusted to GPS / levelling stations in their countries
A special Austrian solution of the European Quasigeoid was calculated by IAG/Denker (IfE)

- EGG-AU was adjusted to the 170 GPS / levelling stations like in the Geoid solution
- 5 solutions: one purely gravimetric and 4 weighted solutions:
  - Sol. A is the best adjusted to GPS/lev.,
  - Sol. B, C and D less adjusted to GPS / lev. stations
European-Austrian Quasigeoid: purely gravimetric solution
Comparison with 170 GPS / levelling stations

Gravimetric sol.
Max = 103 mm
Min = -80 mm
SD = 38 mm
EQG-AU Solution- Evaluation (2)

European-Austrian Quasigeoid: solution A – best fitted to GPS/Levelling points +

Solution A
Maximum = 47 mm
Minimum = - 58 mm
SD = 15 mm
EQG-AU solution - Evaluation (3)

European-Austrian Quasigeoid solution – Compared to Austrian solution

Federal Office of Metrology and Surveying (BEV)
Statistics of GPS / levelling data

For non-mountainous areas (elevation < 1000m) the Austrian geoid solution seems to be much better than 20 mm!

Additional error source: GPS and levelling data were not measured at the same epoch! Difference in time up to 50 years.
Difference Quasigeoid - Geoid

The difference between Quasigeoid and Geoid mirrors the topography
Conclusion

- Successful Cooperation between the project partners
- Improvement of “power of ten“ compared to the solution from 1987
- In good accordance with the international solution by IAG
- Full advantage of this new Geoid/Quasigeoid Solution is only in combination with explicit defined heights available:

  Orthometric or Normal Heights

•Thank you for your Attention
Austrian Geoid: error estimates

Formal errors, rescaled using the standard deviation of the residuals at selected GPS/levelling control points → realistic estimate for the total error: 2 – 3 cm

Degraded accuracy in the Austrian boundary regions due to input data distribution.