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A data set for testing geoid computation methods in the scope of the European gravity and geoid project

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Summary

- **Motivation and objectives**
- **Presentation of the test area**
- **Description of data**
  - DTM
  - Gravity
  - Leveled GPS points
- **A preliminary solution for the geoid**
- **Future developments**
- **How to get the data**

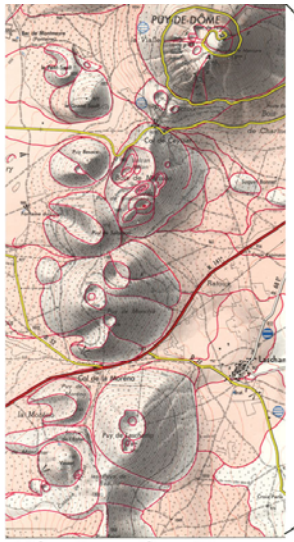
Motivation and objectives

- **Request of the steering committee of the European Gravity and Geoid Project EGGP for a data set to test geoid computation methods**
- **Increasing interest in evaluation of modeling methods of the geoid in the geodetic community**

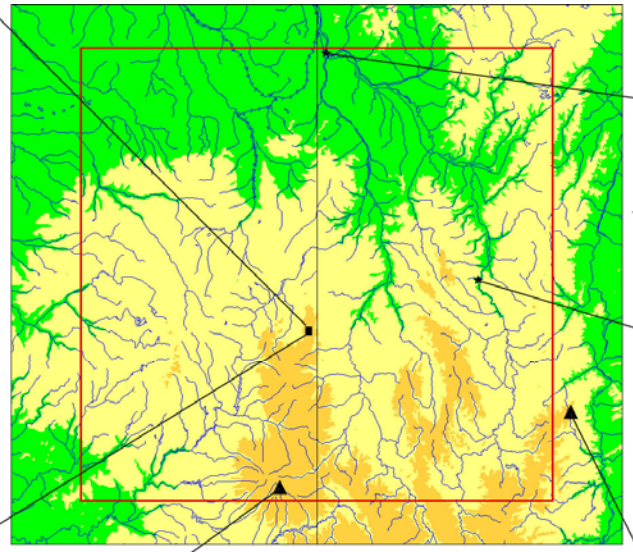
☞ **Elaboration of a data set available for interested geodesists**

Presentation of the area

- **Located in the Massif Central**
- **Various types of relief:**
  - Plateau with gaps
  - Medium mountain
  - Old volcanoes
  - Plain
- **Size: 200 km × 200 km**



Chaîne des Puys



Bec d'Allier

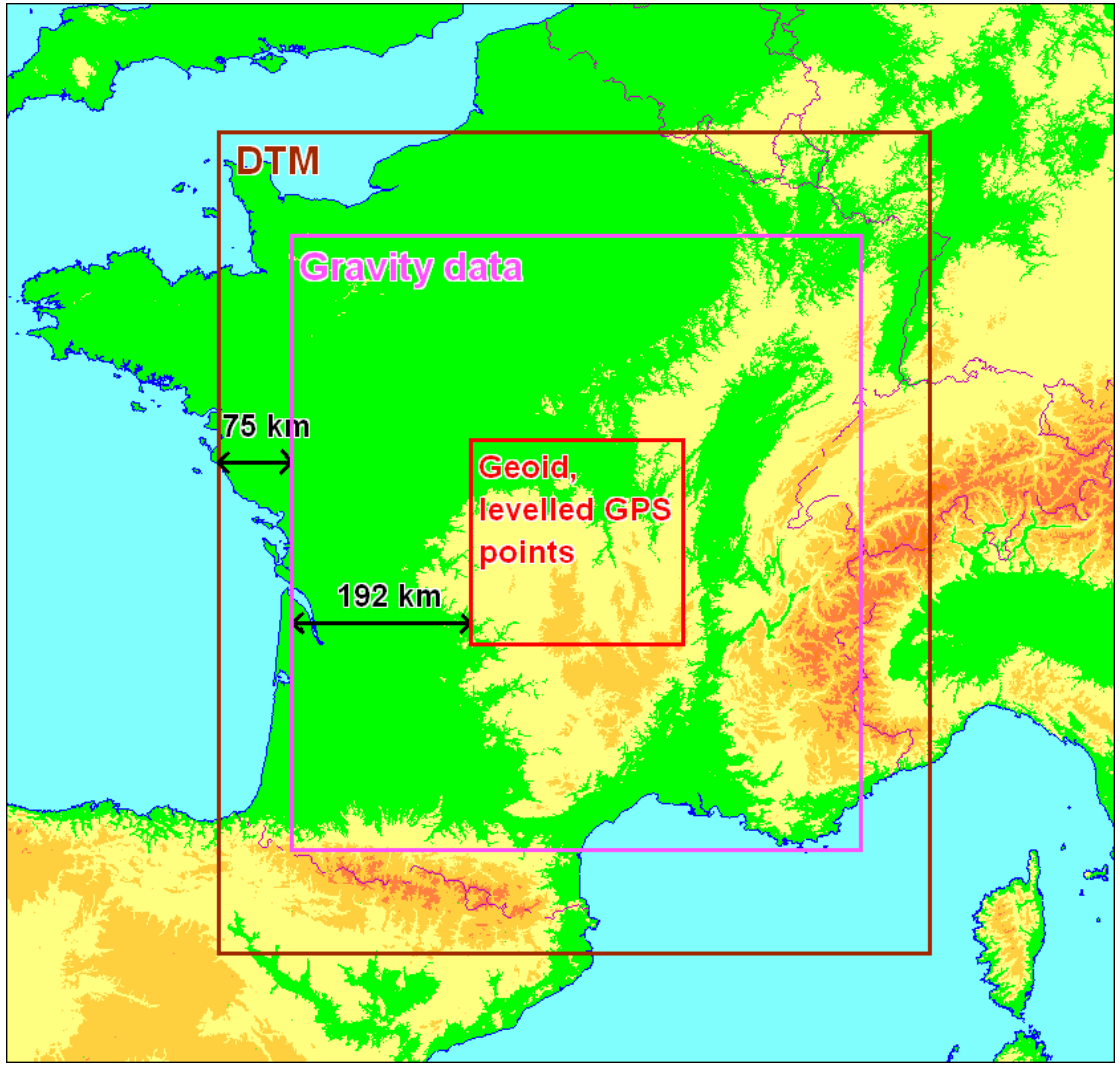
Gorges de la Loire

Plomb du Cantal, 1583 m

Mont Pilat, 1370 m

Content of the data set

- **Data types:**
  - Levelled GPS points
  - Gravity data
  - 2 DTMs



The DTMs

- **Types of data:**
  - DTM1: height of topography above sea level
  - DTM2: height of topography above ellipsoid
- **Data source : IGN's « BD-alti »**
- **Grids features:**

$$42° \le \varphi \le 50° \qquad -2° \le \lambda \le 8°$$

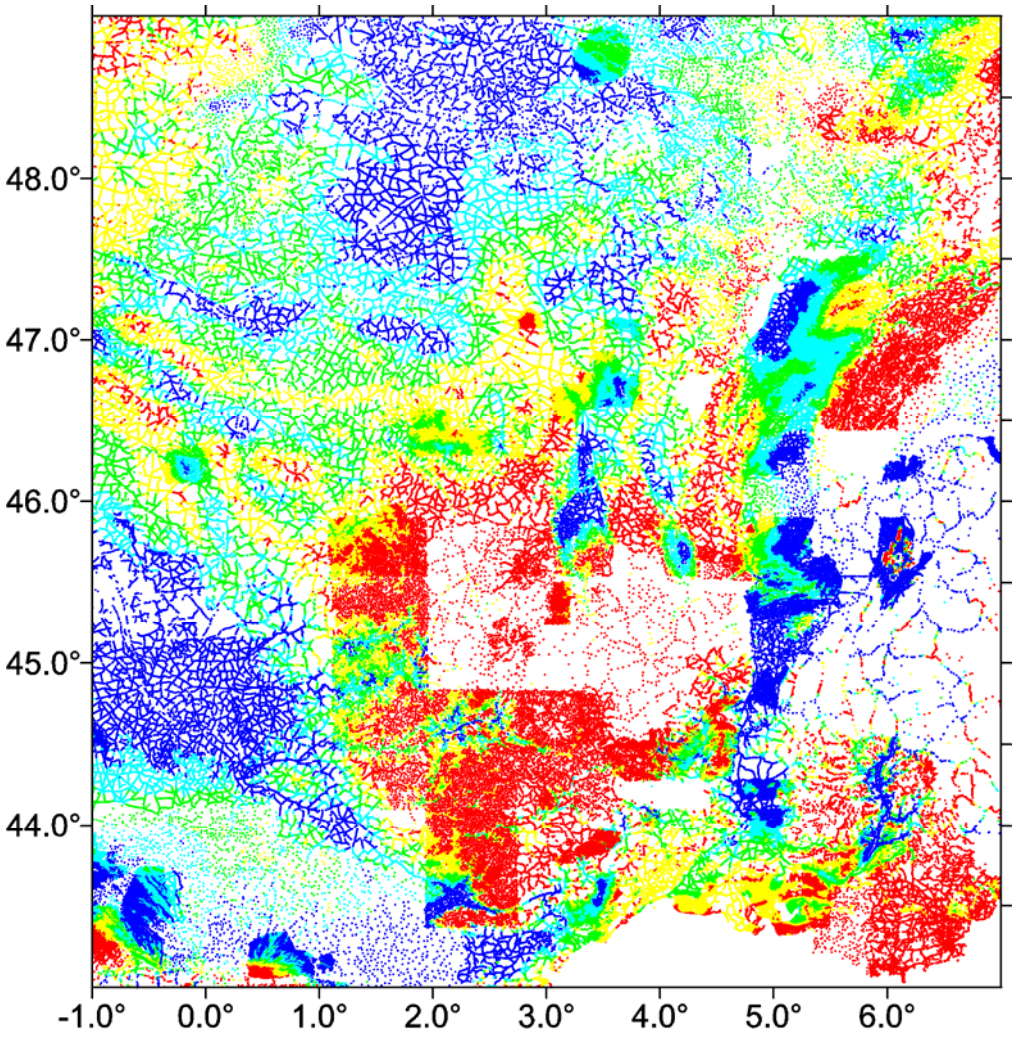
$$\Delta\varphi = 4{,}5'' \qquad \Delta\lambda = 6'' \qquad (\approx 140 \text{ m})$$

- **Geodetic Rererences**
  - DTM1: RGF93/ETRS89, IGN69
  - DTM2: RGF93/ETRS89
- **Accuracy: 2.5 m to 15 m**

Gravity data

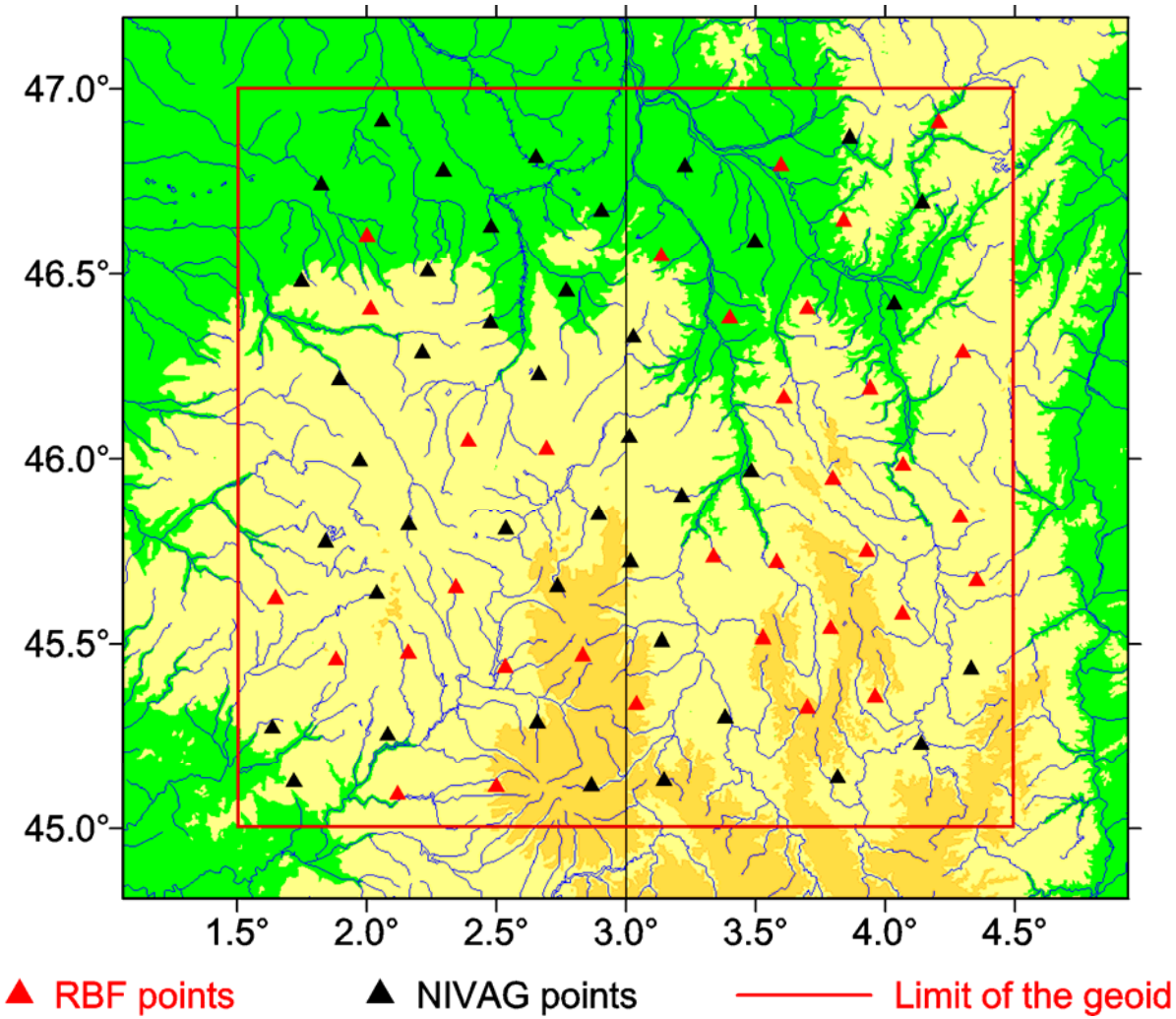
- **Data sources: BRGM, BGI**
- **Available data:**

  #, φ, λ, *H*, *h*, *g*, Δg
- **References: IGSN71, ETRS89, GRS80, IGN69**
- **Number of points: 244009**
- **Less density in montainous areas**
- **Validations**
  - Δg: re-interpolation of (BGI, Diva software)
  - φ, λ, H: comparison with DTM (IGN)
- **Accuracy: 1-2 mgals on Bouguer or residual anomalies**



Levelled GPS points

- **Data origin**
  - The RBF network
  - The « NIVAG » data set
- **References**
  - RGF93/ETRS89, NGF-IGN69
- **Total point number: 75**
- **Validation:** by comparison with models of the geoid

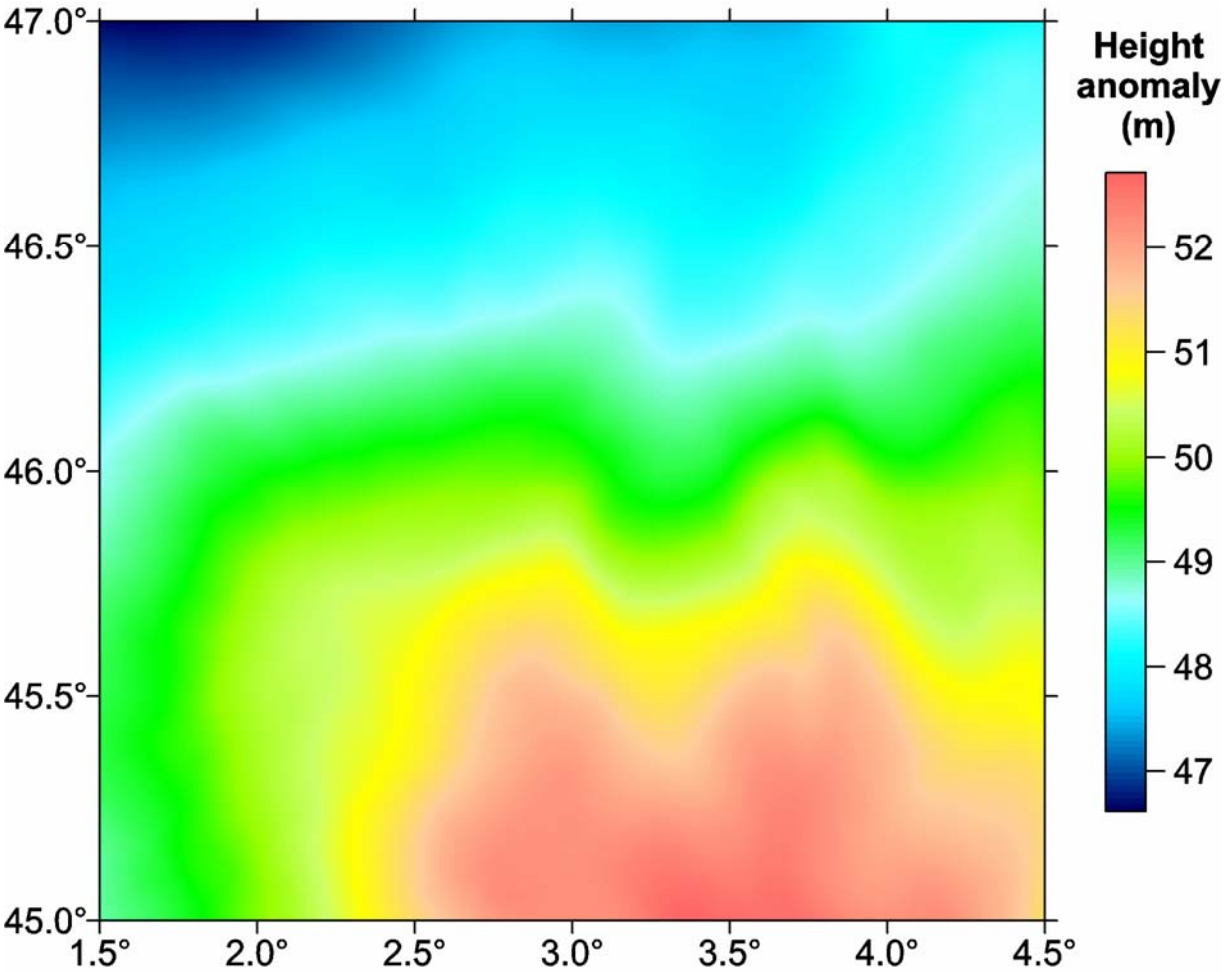


A preliminary solution for the geoid

- **Method:**
  Stokes'integration, remove-restore and residual terrain methods, giving height anomalies (quasigeoid)

- **Global gravity field model:**
  GGM02S ($0 \leq n \leq 100$) + EGM96 ($101 \leq n \leq 360$)

- **Software:**
  Gravsoft (R. Forsberg, C.C. Tscherning), author's software



Comparison: Geoid vs. Levelled GPS points

- **Linear regression:**

$$N_{GPS-Lev,i} - N_{Grv,i} = a + b(\varphi_i - \varphi_0) + c(\lambda_i - \lambda_0)\cos\varphi_0 + v_i$$

(75 equations, 3 unknowns)

- **Results:**

$a = -0.160$ m

$b = -0.0185$ m/° $\quad (-0.168\times10^{-6})$

$c = -0.0256$ m/° $\quad (-0.233\times10^{-6})$

$\min(v_i) = -0.085$ m

$\max(v_i) = +0.095$ m

$\sigma = 0.046$ m

- **Question: how to distinguish errors in the data from errors of the computation methods ?**

Future developments

- **Preparation of a set of synthetic data**
  - Coherent
  - Realistic
  - Errorless
- **Extension of the area**
  - International cooperation needed
- **Organisation of tests**
  - By IGeS or EGGP

Practical considerations

- **Status of the data**
  - Gravity data in the public domain
  - GPS-levelling data in the public domain
  - DTM : limited use
- **How to get the data**
  - Send an e-mail to henri.duquenne@ensg.ign.fr
  - Fill the form, sign the agreement which gives permission to use the DTM
  - Wait some days for the CD