

## Status of the zero-order levelling network of France and consequences for UELN

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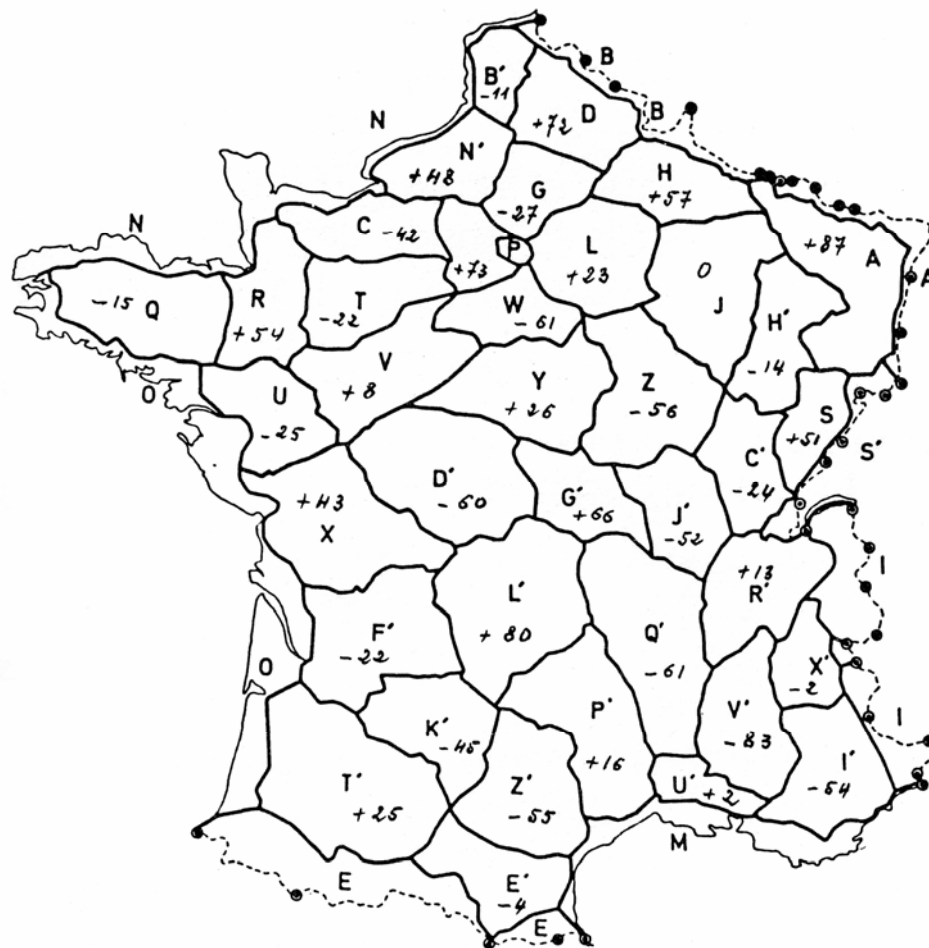
# Summary

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- **Status of the French data included in UELN95/98**
  - The IGN69 network
  - French data in UELN
- **The NIREF network**
  - Objectives
  - Measurements (methods, status)
- **Preliminary results: the Marseille-Dunkerque traverse**
  - Data processing
  - Comparisons with: IGN69, GPS+geoid, MSL
- **Inclusion of NIREF in UELN**
  - Strategies and consequences

# Status of the French data included in UELN95/98 (1/2)

- **The IGN69 network**
  - Measured: 1962-1969
  - Fundamental point: Marseille
  - 13 700 km
  - Instrument: Wild N3
  - Std. dev.:  $2,0 \text{ mm/km}^{1/2}$   
(from loops misclosures)
  - N-S bias suspected by J.J. Levallois, from comparison with tide gauges data, and by M. Kasser after new measurements in 1983.

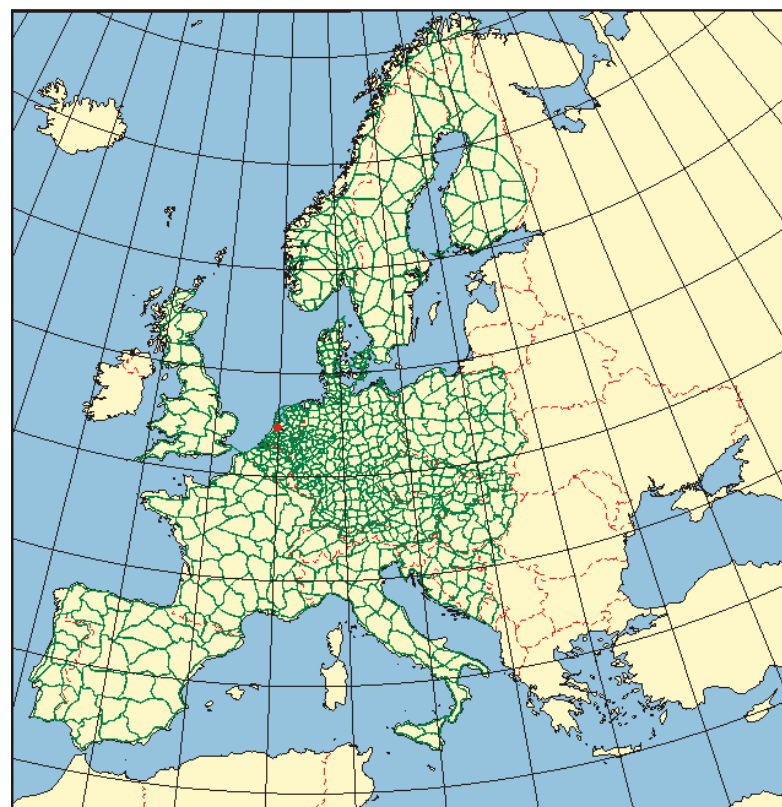


# Status of the French data included in UELN95/98 (2/2)

United European Levelling Network 1995

UELN 95/98

- **French data in UELN**
  - Same data set (IGN69) since 1973
  - Density similar to other countries
  - A posteriori std. dev.: 2,01 kgal×mm/km<sup>0,5</sup> (Compatible with the precision estimated by IGN)
  - The poorest precision of the national networks in UELN.



December 1998

• Reference point

# The NIREF network (1/3)

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- **Objectives**
  - Geodesy:
    - Research on vertical reference system
    - Unification of vertical reference systems
  - Geodynamics: crustal deformation
  - Oceanography: sea level temporal and spatial variations
  - Participation in UELN and EUVN
  - Not for common use: IGN69 will remain the official reference for a long time

# The NIREF network (2/3)

- **Main specifications:**

- Motorized levelling
- Instrument: ZEISS NI002
- double levelling, fore and back
- Max. line of sight: 50m
- Tolerances:
  - Misclosure at each station: 0,3 mm
  - Diff. back minus fore for each section:  $87\% < 0,83 \text{ mm/km}^{1/2}$
- Gravity not measured
- Rough topography avoided

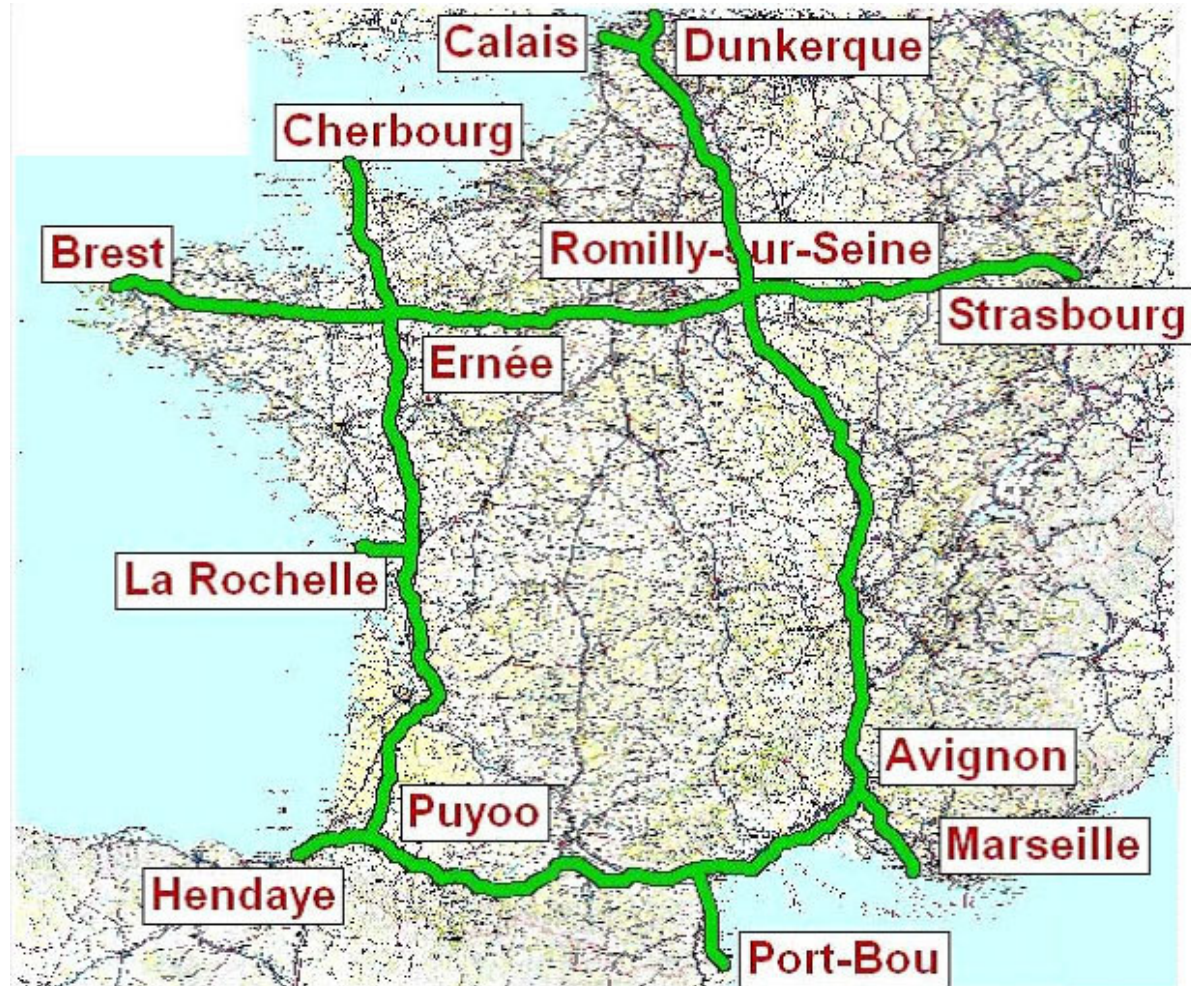




# The NIREF network (3/3)

- **Progress**

- Marseille-Dunkerque traverse measured in 1983
- The rest of the network measured between 2000 and 2006
- 4118 km



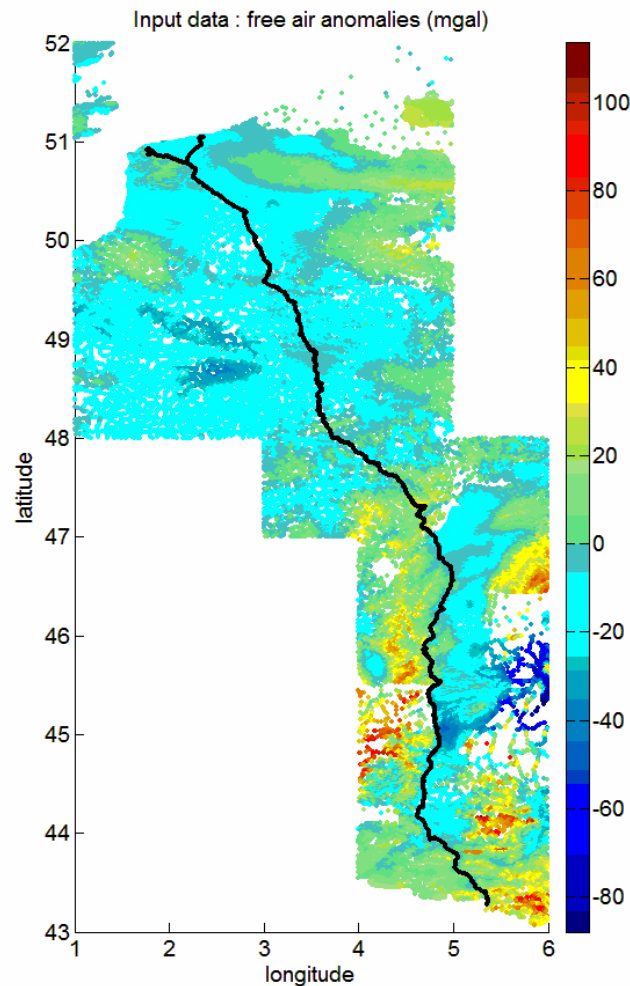
# The Marseille-Dunkerque traverse: data processing

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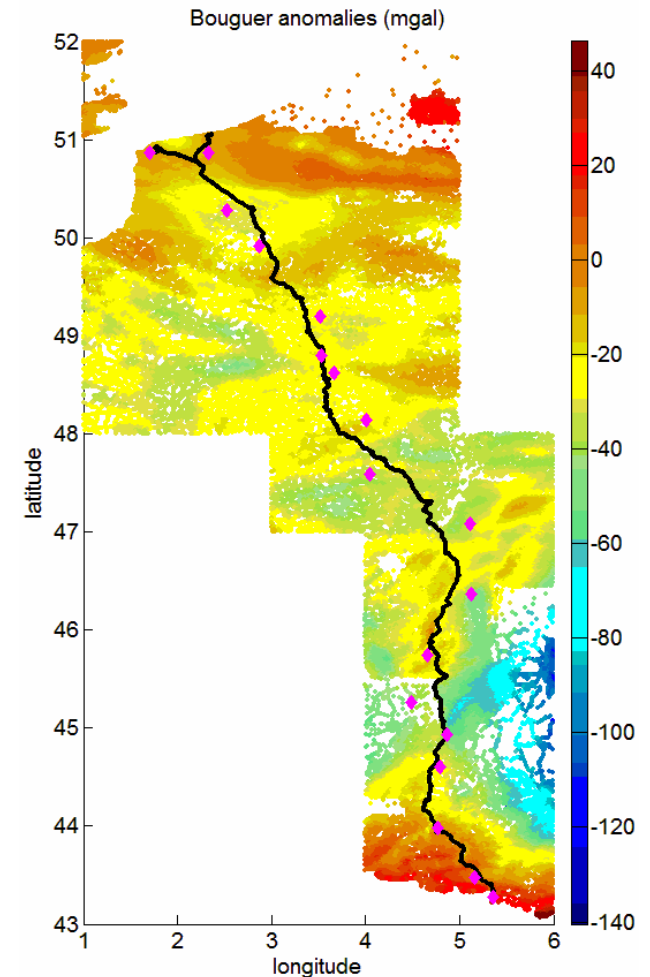
- **Main steps :**
  - Interpolation of gravity
  - Computation of potential differences
  - Computation of normal heights
  - Comparison with IGN69, GPS and geoid, MSL



# The Marseille-Dunkerque traverse: interpolation of gravity



- Gravity data from BRGM, BGI and IGN
- Complete Bouguer reduction (DTM resolution: 140 m)
- Interpolation by LS collocation
- Restoration of terrain effects and normal gravity
- MDT + 18 RBF control points
- Difference interpolated  $g$  / measured  $g$  : everywhere below 2 mgal except in Marseille (3.7 mgal)

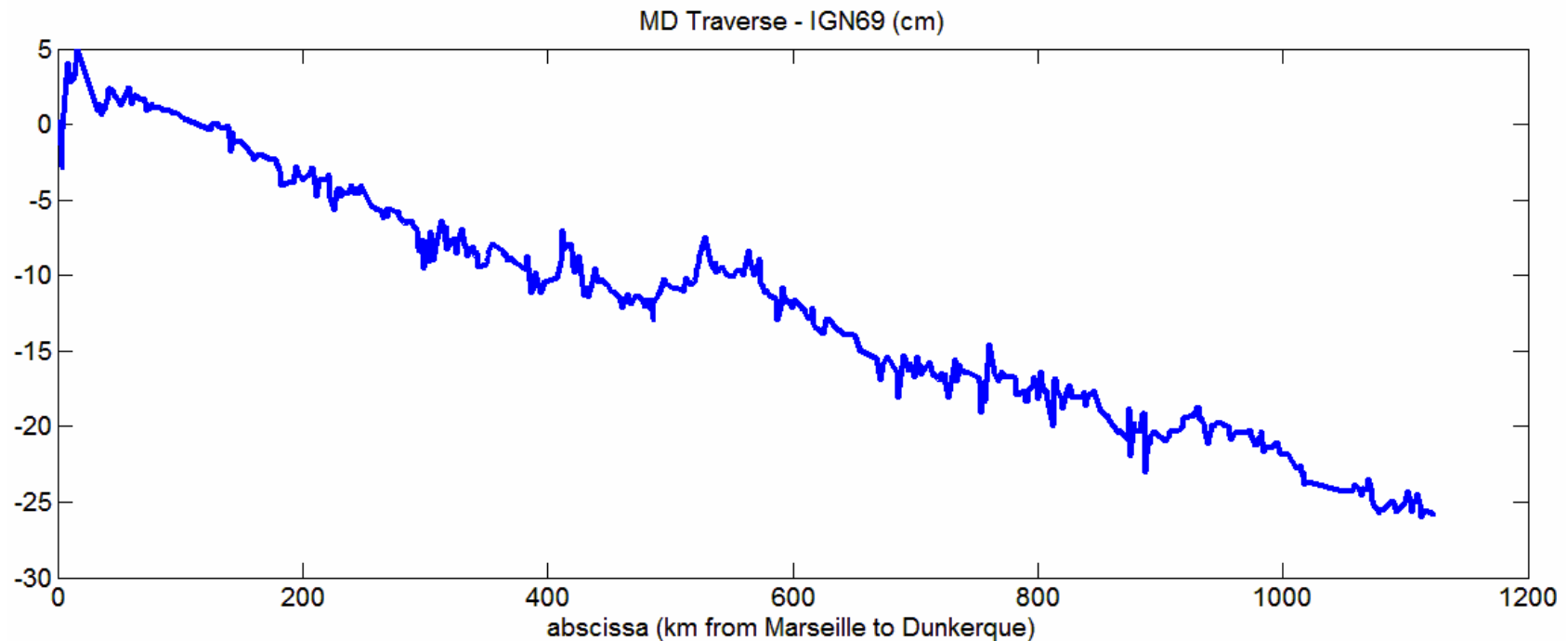


# The Marseille-Dunkerque traverse: computation of altitudes

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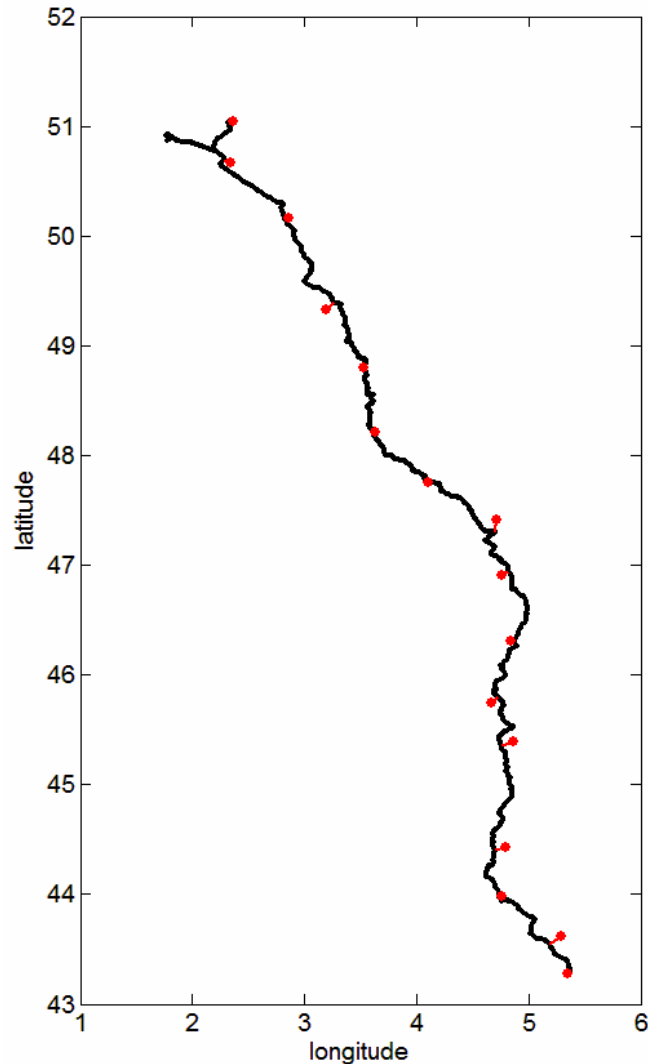
- **1st computation for comparison with IGN69 :**
  - Fixed point : Marseille tide gauge with IGN69 altitude
  - Computation of « IGN69 like » normal altitudes
  - $g$  referred to Potsdam31 system
  - Normal gravity: International 1930 formula
  
- **2nd computation for comparison with UELN :**
  - Fixed point : Dunkerque tide gauge with UELN95/98 altitude
  - Computation of « UELN like » normal altitudes
  - $g$  referred to IGSN71 system
  - Normal gravity: GRS80

# Comparison: Marseille-Dunkerque traverse vs. IGN69



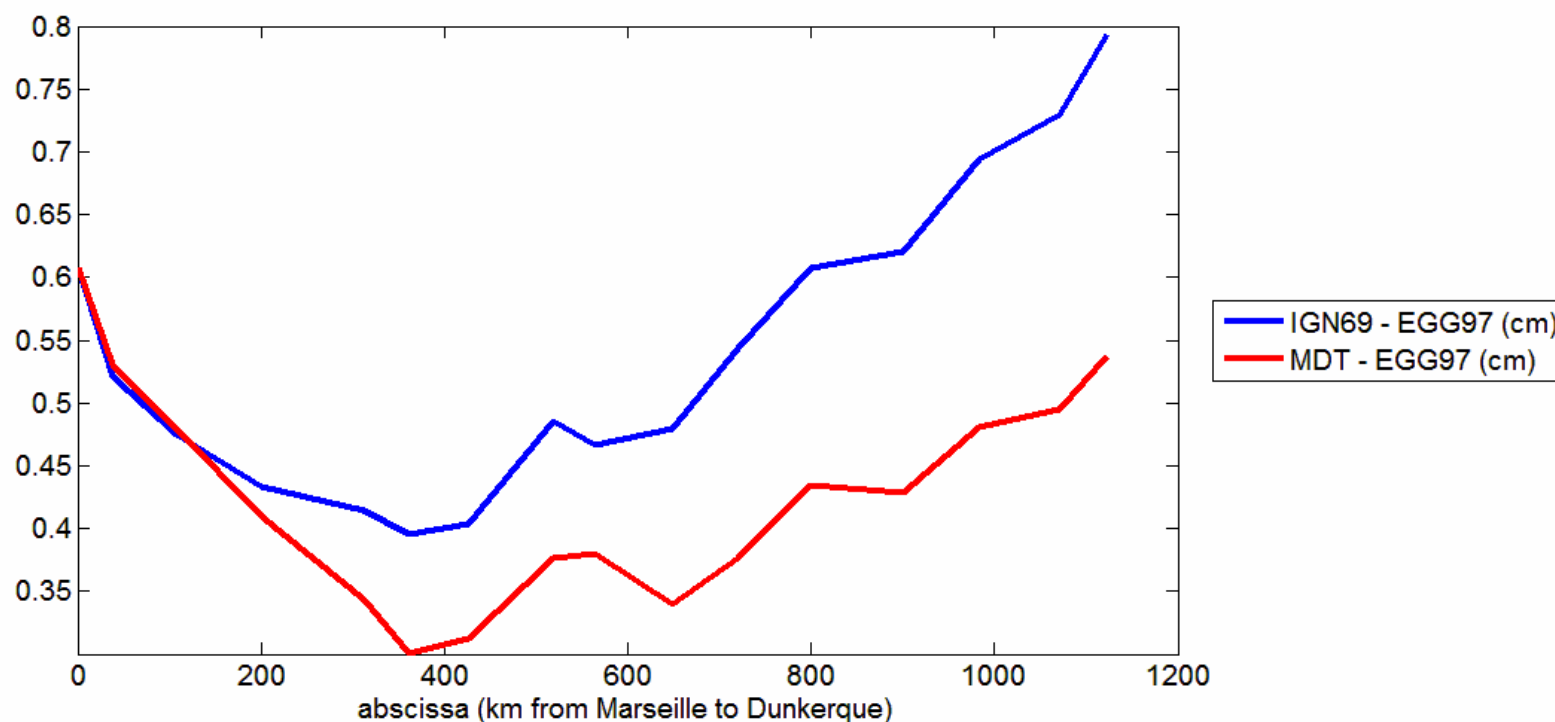
- Difference decreasing almost linearly from 0 cm in Marseille to **-25,8 cm** in Dunkerque
- Confirmation of the IGN69 network's South-North bias

# Comparison of levelling data vs. GPS - EGG97 (1/2)



- **Comparison points : 16 RBF benchmarks along the traverse**
- **Three altitudes for each point :**
  - IGN69 altitude
  - « IGN69 like » altitude computed using the M.-D. traverse
  - Ell. height (GPS) – EGG97 geoid height

## Comparison of levelling data vs. GPS - EGG97 (2/2)



- Large undulation probably due to uncorrected effects of the Alps on the global gravity field model (EGM96)
- According to GPS+MDT, the mean geoid N-S slope is quite 0 (only 5 cm / 1100 km)

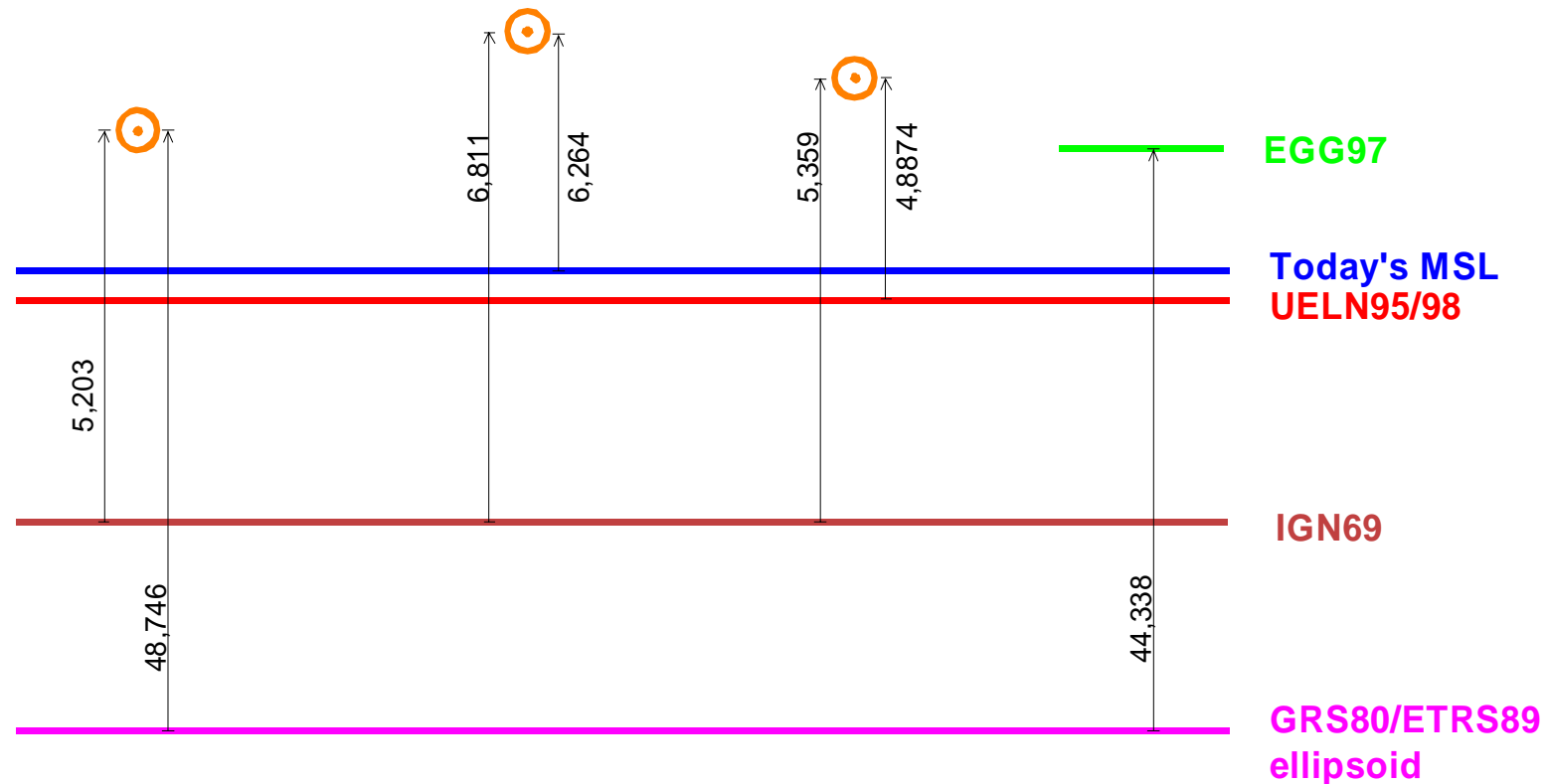


# Geodetic, levelling and TG data available at Dunkerque

## DUNKERQUE

Heights in m

RGF: 5918304A    IGN69: N.A.L3-7    IGN69: N.A.L3-7-I    EGG97  
 IGN69: N.A.L3-7-III    TG    UELN: 700351    *geoid model*



# Geodetic, levelling and TG data available at Marseille

## MARSEILLE

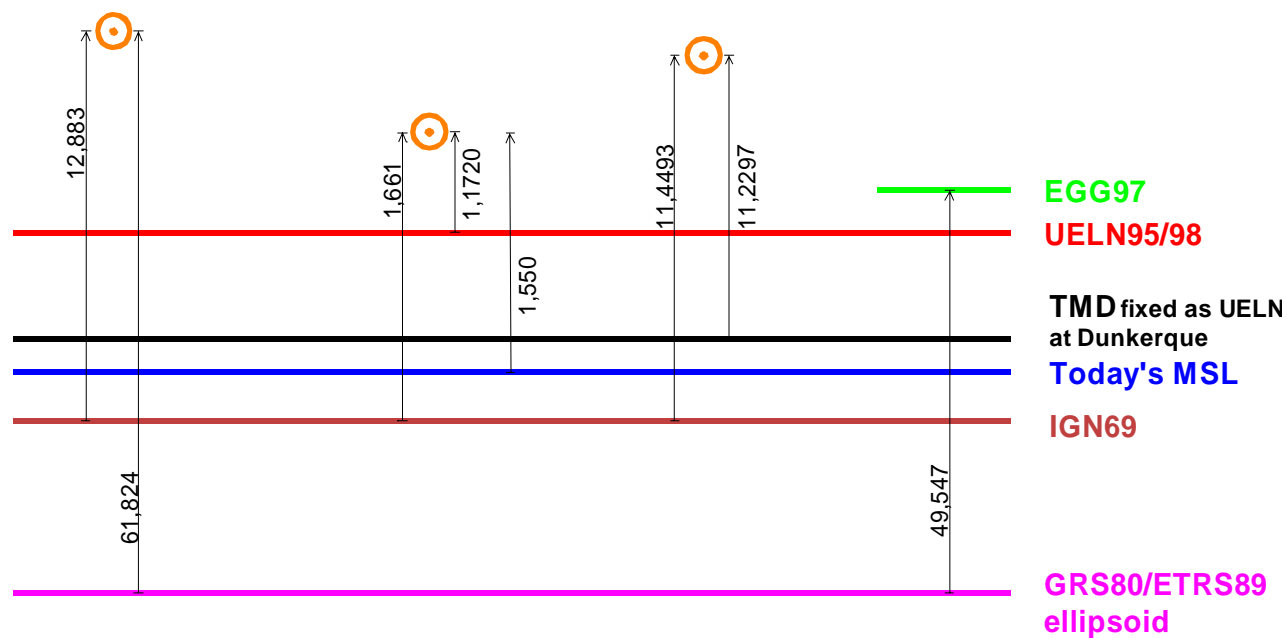
Heights in m

RGF: 1305535E  
IGN69: M.AC-0-XII

IGN69: M.AC-0-VIII  
UELN: 700359  
TG

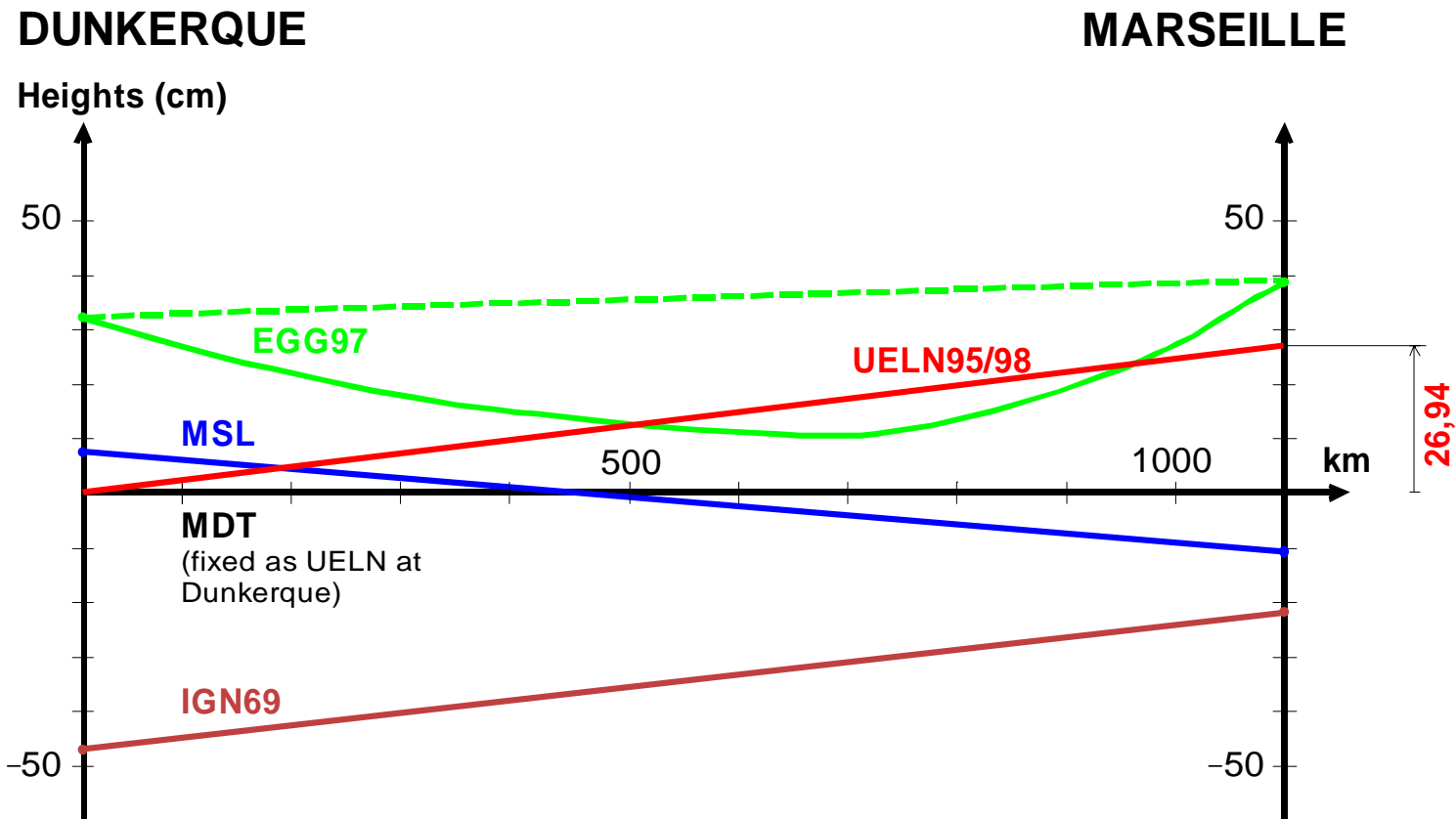
IGN69: M.ABC  
TMD

EGG97  
geoid model



# Summary of comparisons

Outline of the 0-height surfaces, the MSL and the EGG97 geoid model between Dunkerque and Marseille



# French data in future UELN realizations

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- **Scenarii**
  1. No change (IGN69 data)
  2. Replace IGN69 by NIREF conveniently completed
  3. Combination NIREF + IGN69 ??
- **The arguments for and against the scenario 2**
  - More accuracy (probably)
  - Less redundancy and reliability
  - Significant change of heights in France, Italy, Spain and Portugal
  - Transformation UELN ↔ IGN69 delicate
  - Complementation of NIREF is needed.

# Acknowledgements

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**For providing data**