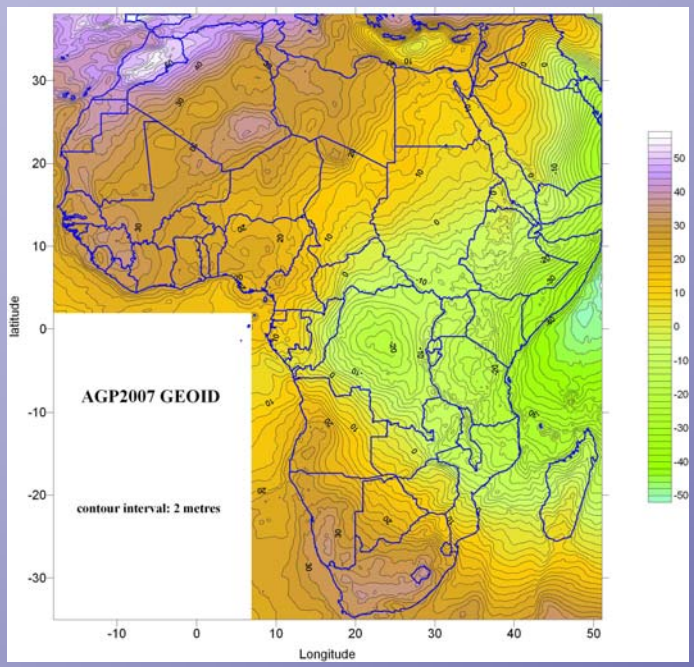
AN UPDATED GEOID MODEL FOR AFRICA



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❖ AFRICAN GEOID:

- Preliminary model developed in 2003 by African Geoid Working Group

- Update data sets:
  - EGM96 ➔ Eigen GL04C
  - GLOBE DEM ➔ SRTM DEM
  - Change model for $N - \zeta$ term

MATHEMATICAL MODELS:

- Geoid from Height anomaly: $N = \zeta + \frac{\bar{g} - \bar{\gamma}}{\bar{\gamma}} H$

- Height anomaly: $\zeta = \zeta_L + \zeta_S + \zeta_{G1} + \zeta_I$

ζ_L : long wavelength, from harmonic coefficients

ζ_S : short wavelength, from reduced anomalies

ζ_{G1} : G_1 contribution

ζ_I : inner zone contribution

2D CONVOLUTION:

- $$\zeta_S = \frac{R.\Delta\phi.\Delta\lambda}{4\pi\gamma}\left[S(\psi) * \Delta g_r \cos\phi\right]$$

- $$\zeta_{G1} = \frac{R.\Delta\phi.\Delta\lambda}{4\pi\gamma}\left[S(\psi) * G_1 \cos\phi\right]$$

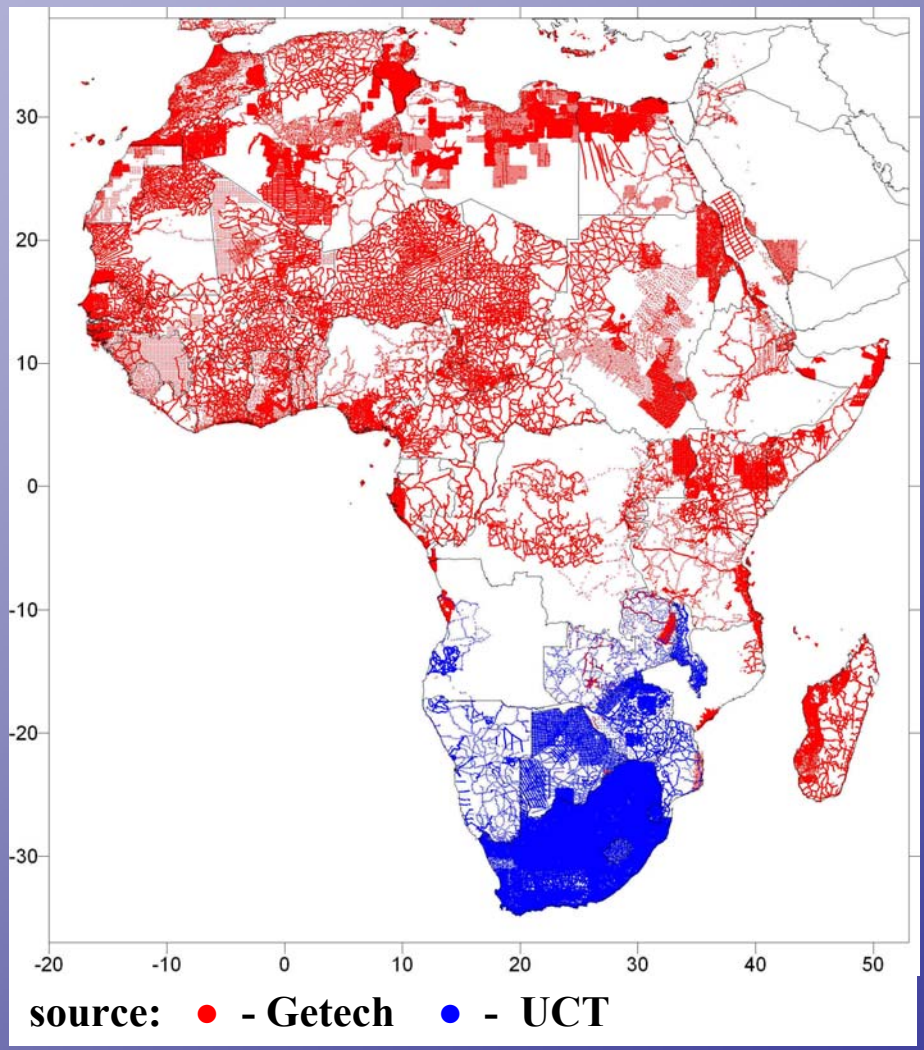
- $$G_1 = \frac{\Delta\phi.\Delta\lambda}{2\pi}\left[\left(h.\Delta g_f\right) * \frac{1}{\ell^3} - h.\left(\Delta g_f * \frac{1}{\ell^3}\right)\right]$$

DATA:

- Eigen GL04C (degree 120)
- Δg_B ⇨ 5' grid
- gridded Δg_B + DEM

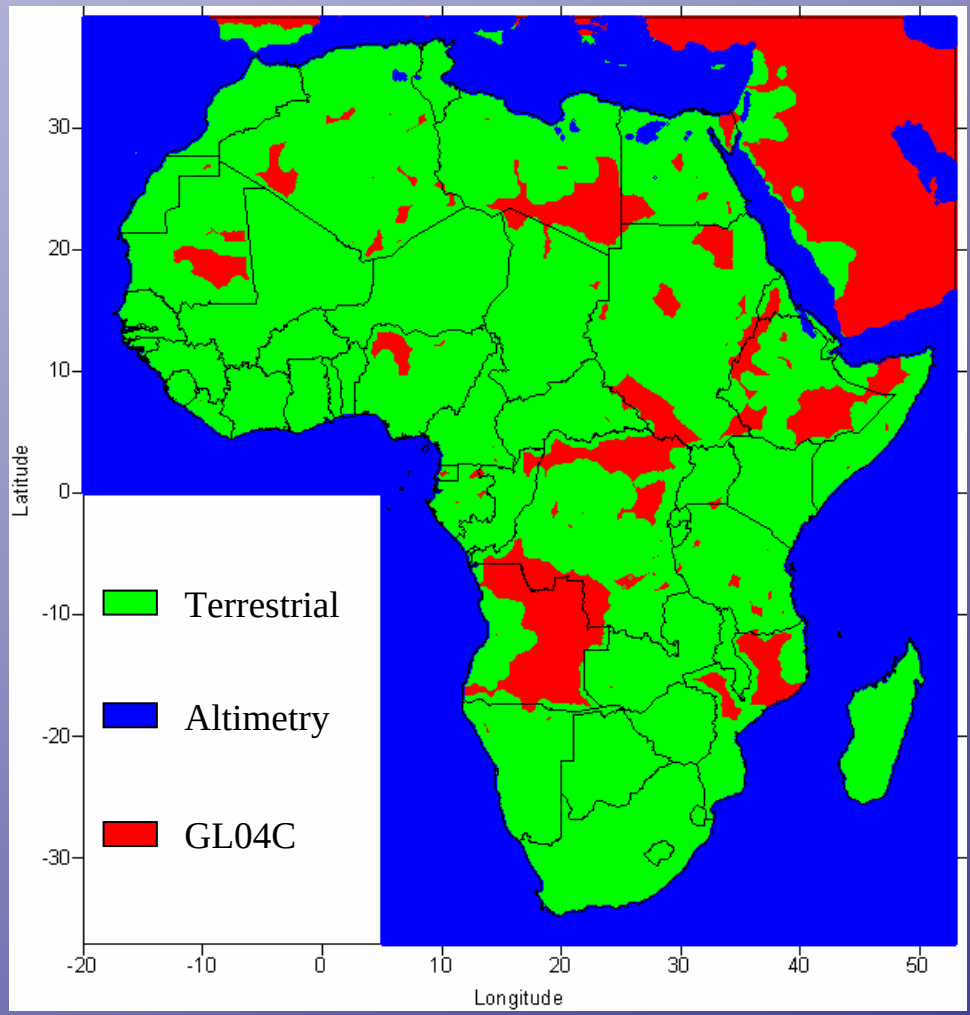
  ⇩

  Δg_f



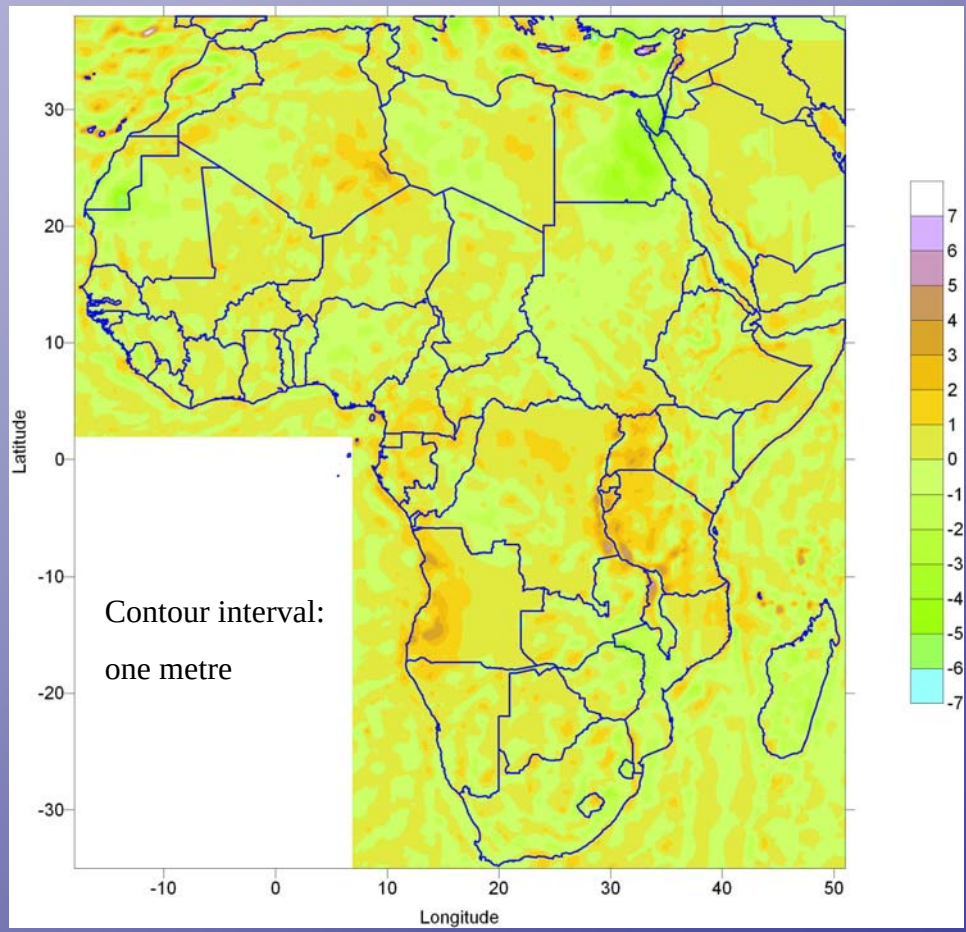
DATA (2):

- Marine Δg_f : KMS02 satellite altimetry
- Data gaps: Eigen GL04C
- DEM: SRTM 30"



❖ RESULTS:

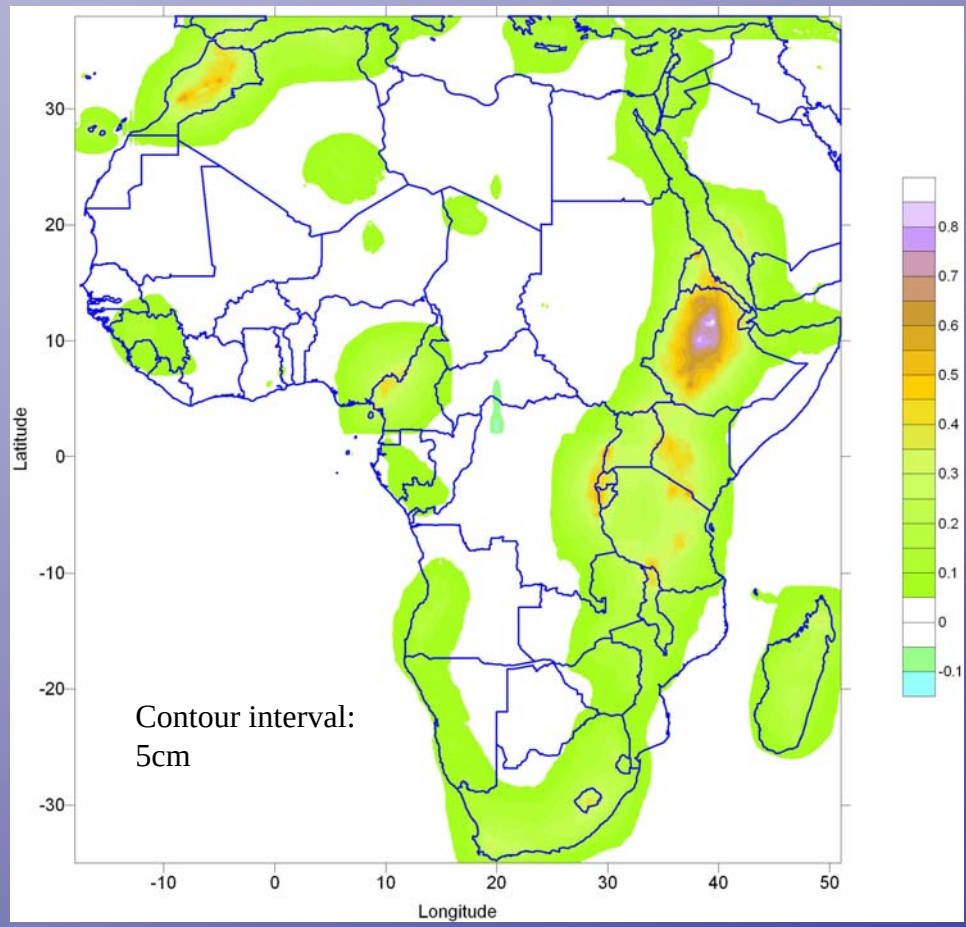
- Residual Quasi-Geoid (including inner zone)
- RMS: 88cm
  Max: +7.9m



❖ RESULTS (2):

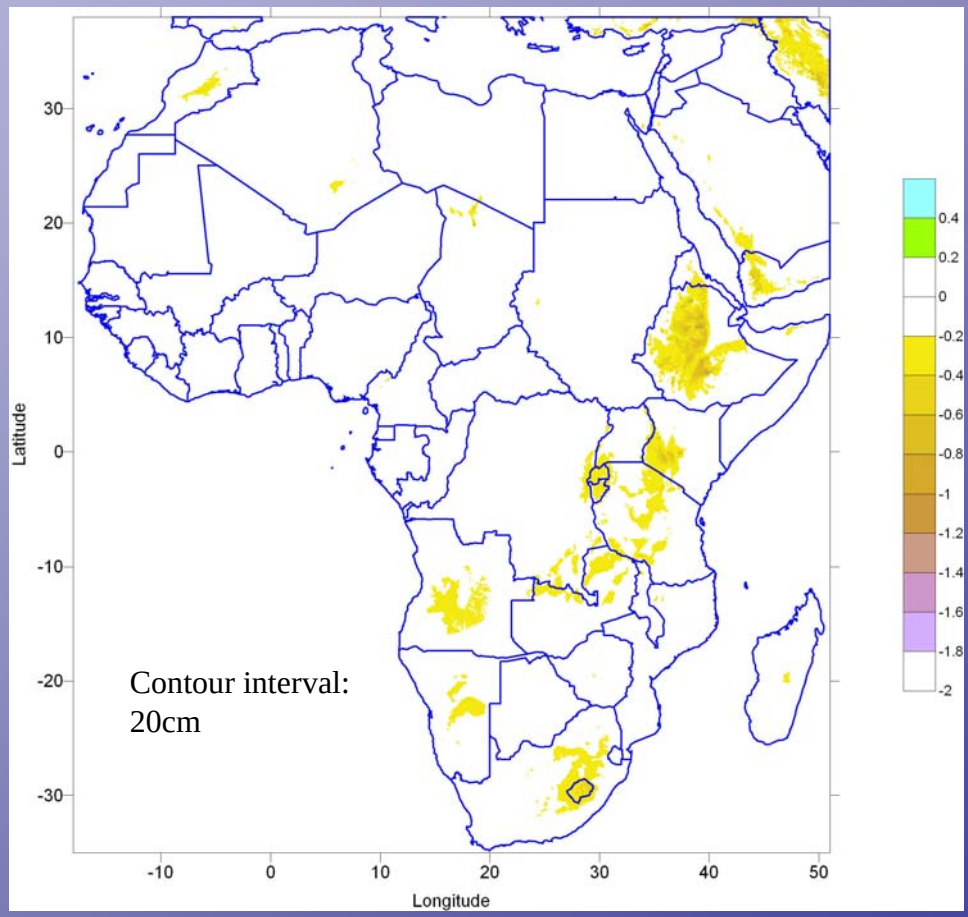
- G_1 Contribution

- RMS: 12cm
  Max: +87cm

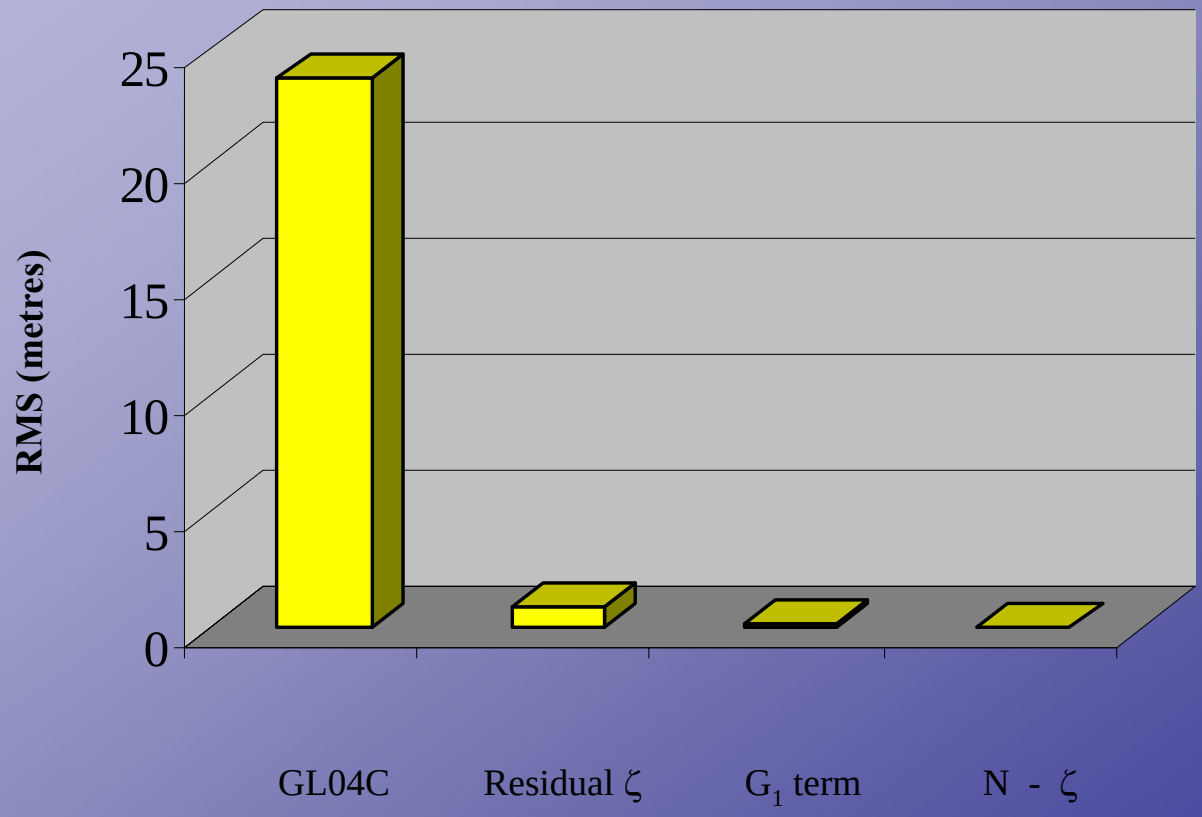


RESULTS (3):

- N - ζ
- RMS: 9cm
  Min: -182cm

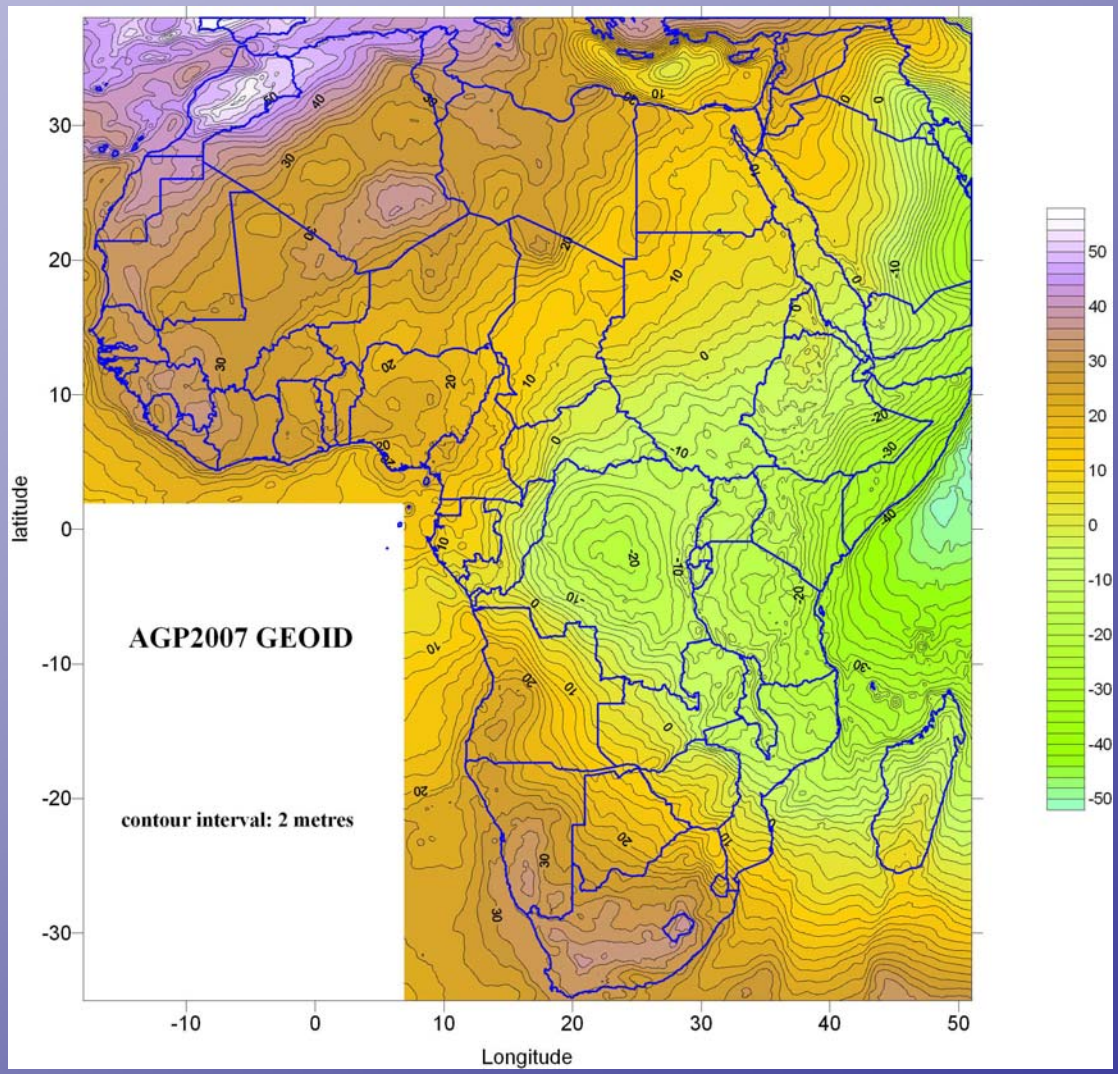


❖ RMS CONTRIBUTIONS:



- **RESULT:**

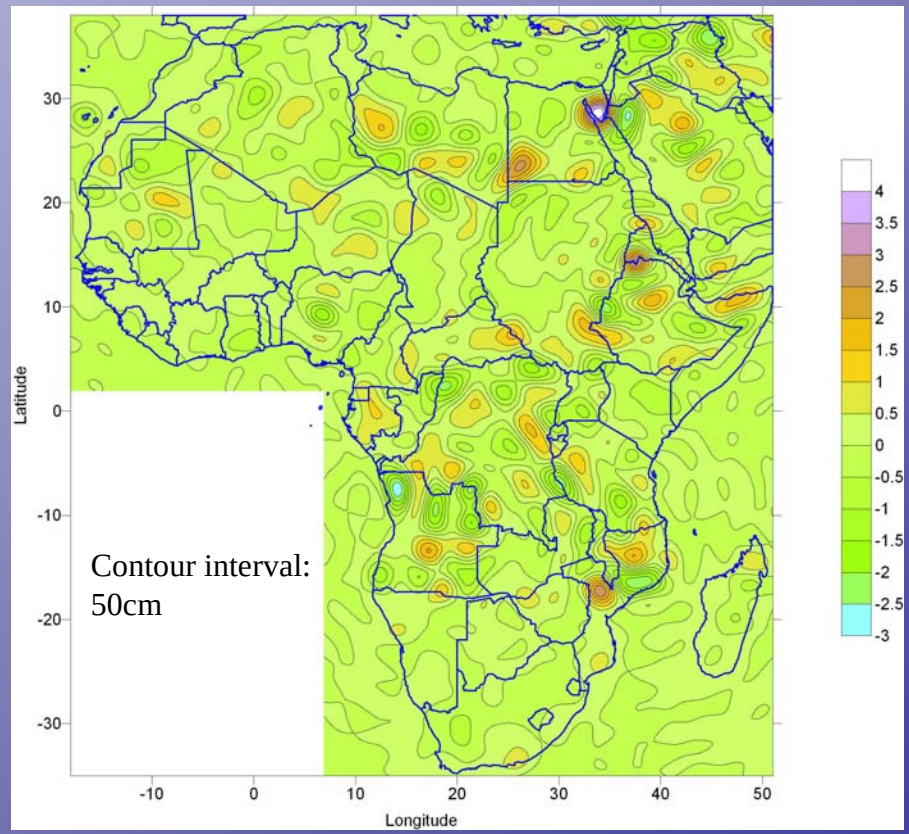
Updated African Geoid



❖ COMPARISONS: AGP2007 – AGP2003

- Underlying geopotential model: GL04C – EGM96 (to degree 120)

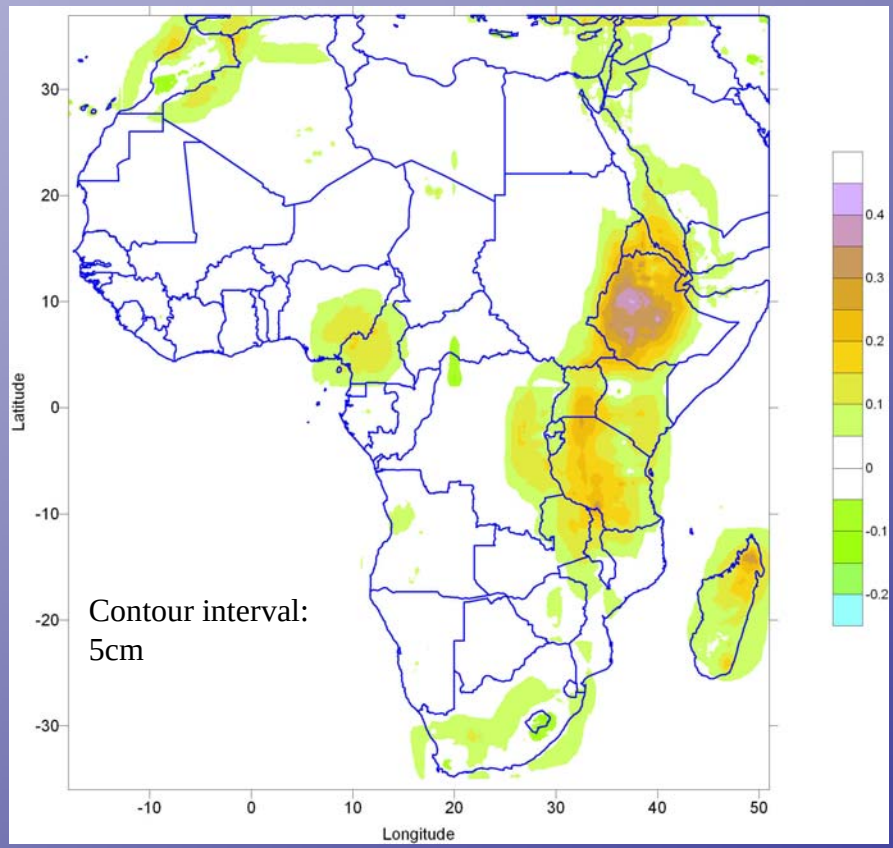
- RMS: 49cm
  Max: + 4.4m



❖ COMPARISONS: AGP2007 – AGP2003

- Difference in G_1 Contribution

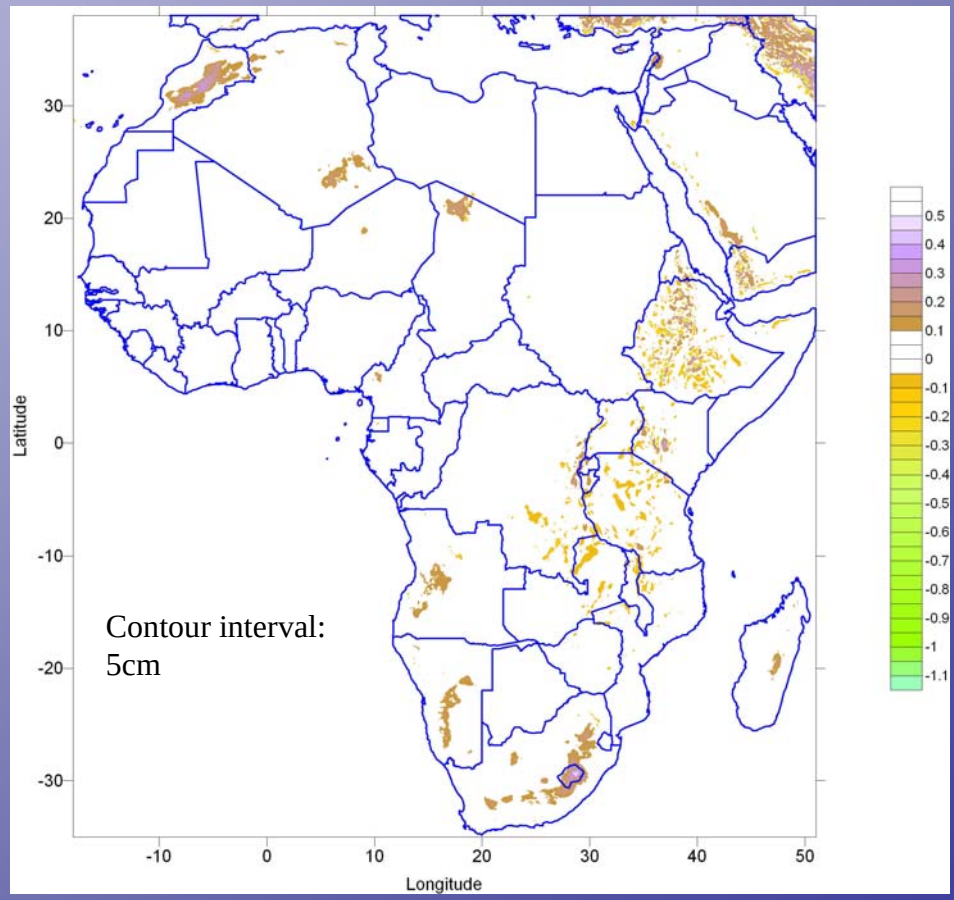
- RMS: 6cm
  Max: + 46cm



❖ COMPARISONS: AGP2007 – AGP2003

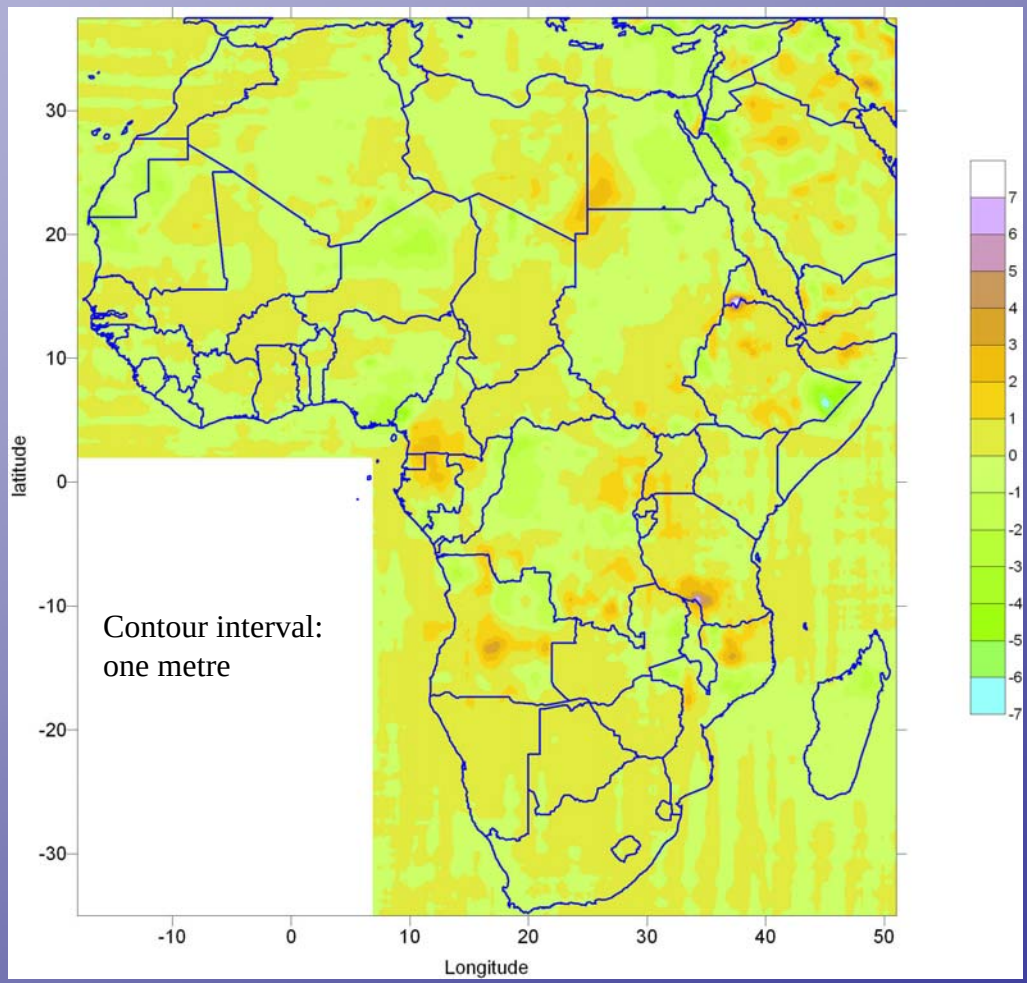
- Difference in N - ζ

- RMS: 4cm
  Min: - 112cm



COMPARISON: AGP2007 – AGP2003 Geoid Model

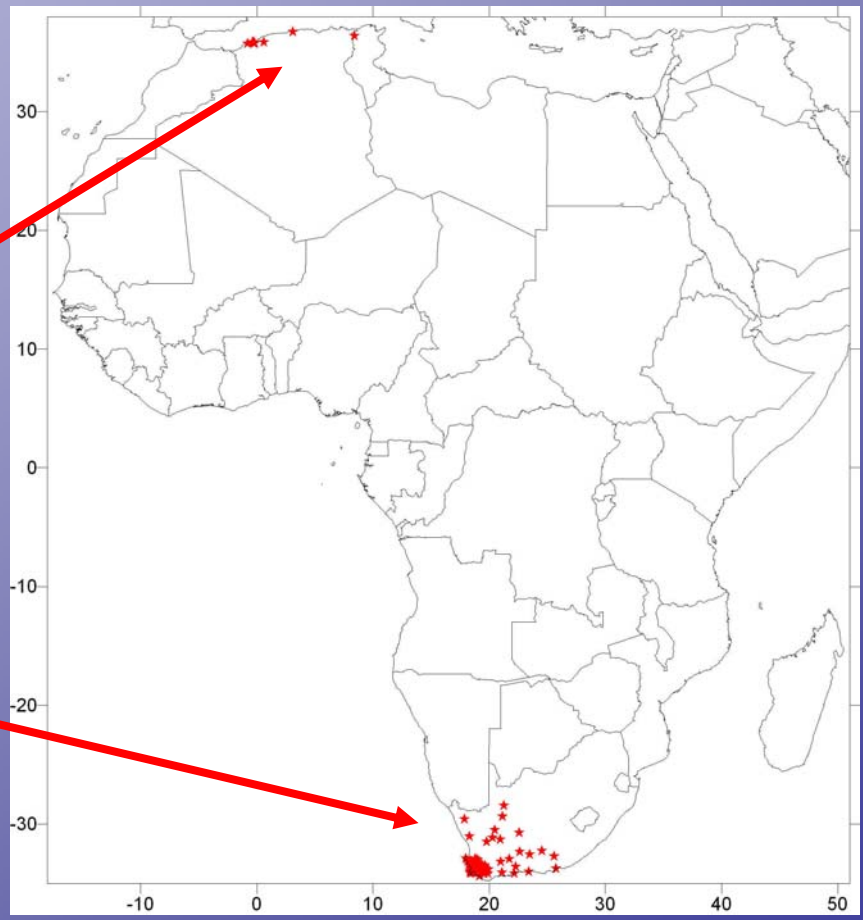
- RMS: 67cm
- Max: + 7.6m



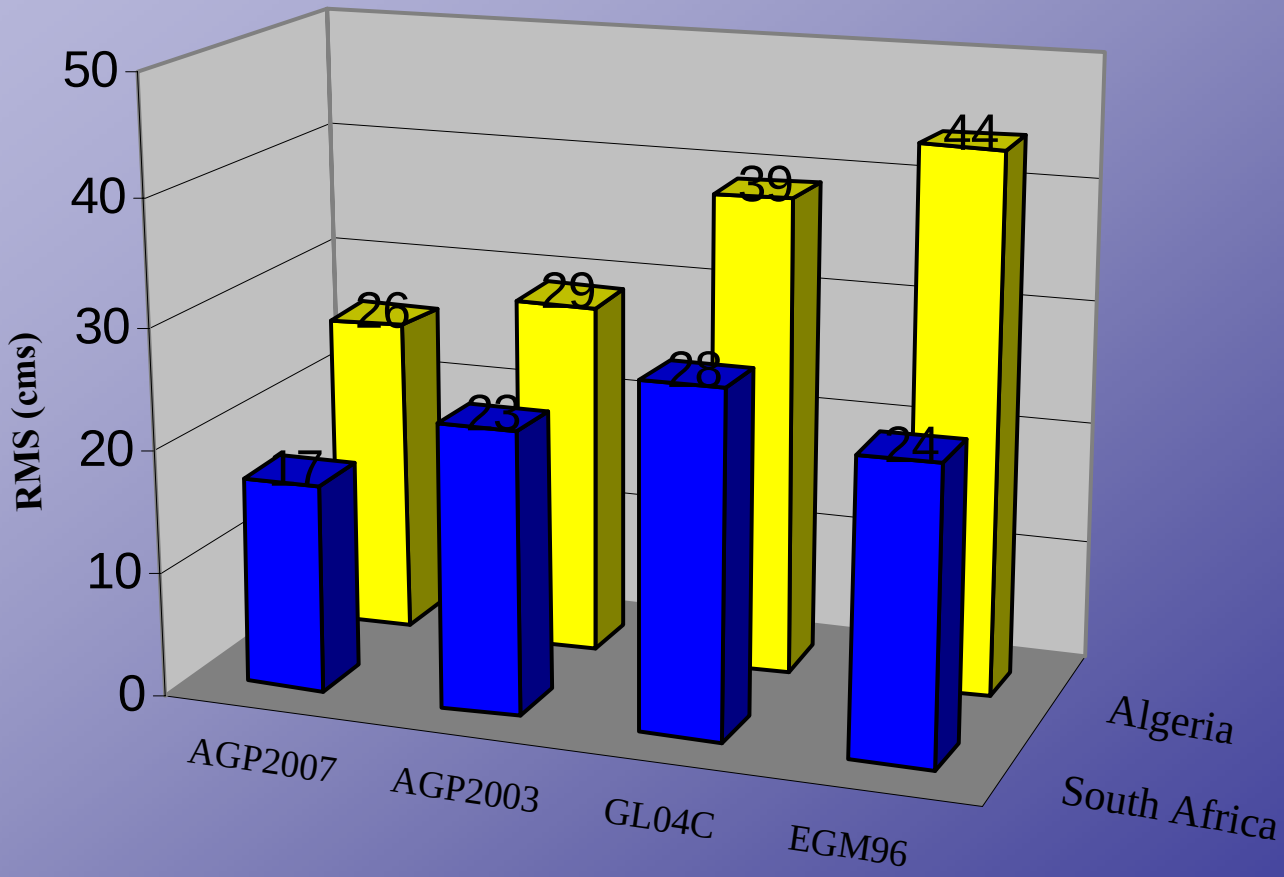
❖ COMPARISON WITH GPS/LEVELLING:

- Northern Algeria:
  AGP2007 σ : 26cm
  GL04C(360) σ : 39cm

- Western South Africa:
  AGP2007 σ : 17cm
  GL04C(360) σ : 28cm



❖ RMS FIT TO GPS/LEVELLING (mean removed) :



CONCLUSIONS:

- Successful combination of Eigen GL04C and local Δg to determine new model of the African geoid – AGP2007, using 2D convolution, and including G_1 term
- Refinements include new geopotential model, new DEM and new calculation of $N - \zeta$
- Comparison with GPS/levelling shows improvement over AGP2003 in western South Africa and northern Algeria
- Greatest weakness is lack of gravity data in large parts of Africa (also insufficient GPS/levelling data for validation)