Practical implementation of the IHRF employing local gravity data and geoid models

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Methodology (1/2)

$$\delta g(P) = g(P) - \gamma(P)$$

gravity disturbance, P(φ,λ,h)

$\delta g_{GGM}(P)$

GOCE GGM (d/o=300)

REMOVE

$\delta g_{RTC}(P)$

Residual Terrain Effect

$$\hat{\zeta}_r(P) = Collocation[\delta g_r(P) = \delta g(P) - \delta g_{GGM}(P) - \delta g_{RTC}(P)]$$

$\zeta_{GGM}(P)$

GOCE GGM (d/o=300)

RESTORE

$\zeta_{RTC}(P)$

Residual Terrain Effect

$$\hat{\zeta}(P) = \hat{\zeta}_r(P) + \zeta_{GGM}(P) + \zeta_{RTC}(P) \qquad \hat{T}(P) = \gamma(P)\hat{\zeta}(P)$$

Methodology (2/2)

- In the remove-compute-restore

i) GGM model TIM-R6 to d/o 300

ii) RTC compute according to the spectral approach in two steps (361-2160) + (2161-96000)

- The normal potential computed according to the closed-form in Heiskanen&Moritz (GRS80 ellipsoid)

- Zero order term considered for the difference w.r.t. the new standard W_0

- Computation in TF and final W(P) values in MT

Data over Greece

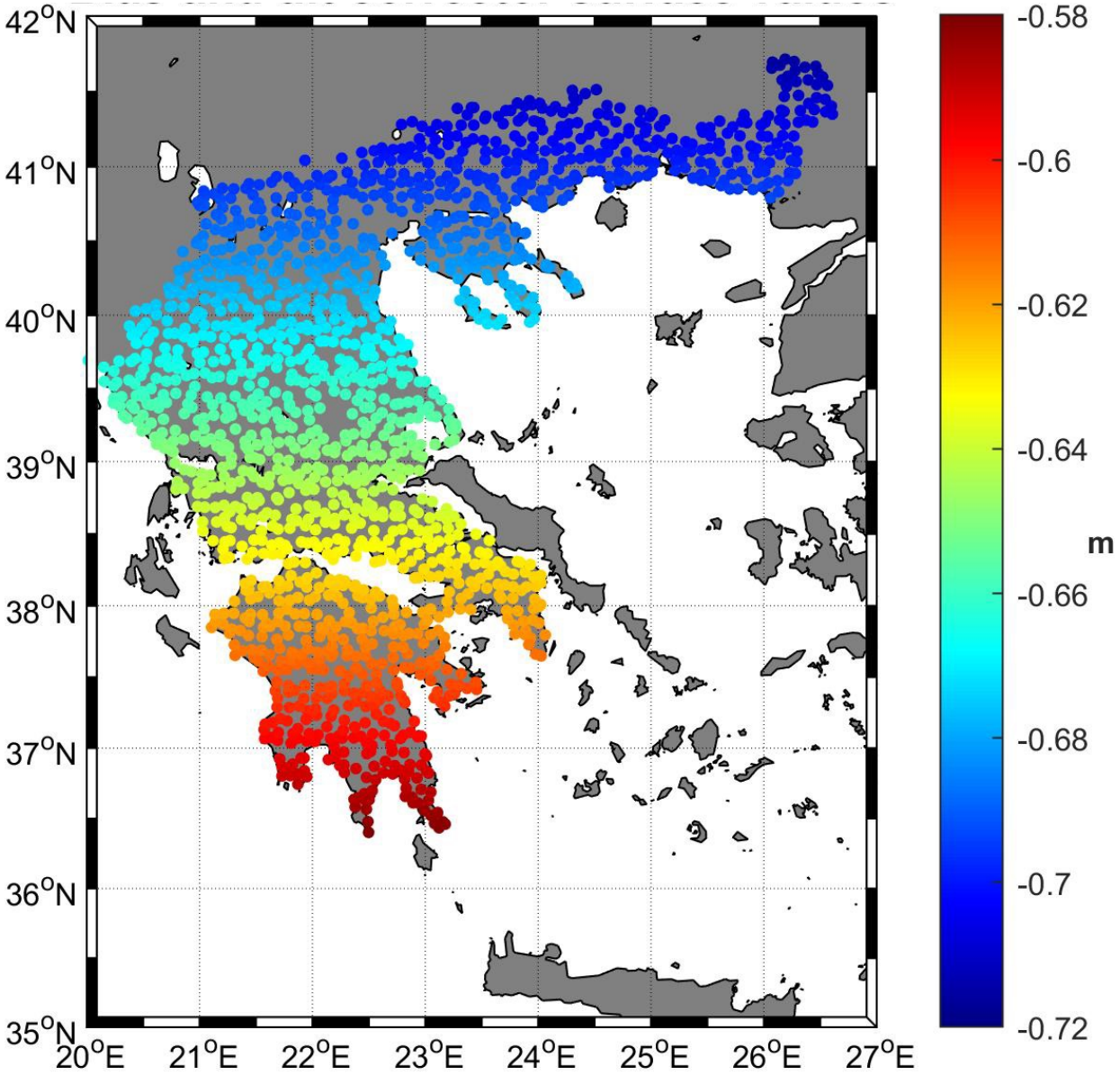
IHRF as a realization of IHRS at the AUT1 station

- EUREF Station (Class A Station)
- HNHS TG station in proximity (9.2 km)
- GravLab A10(#027) station in proximity (8 km)

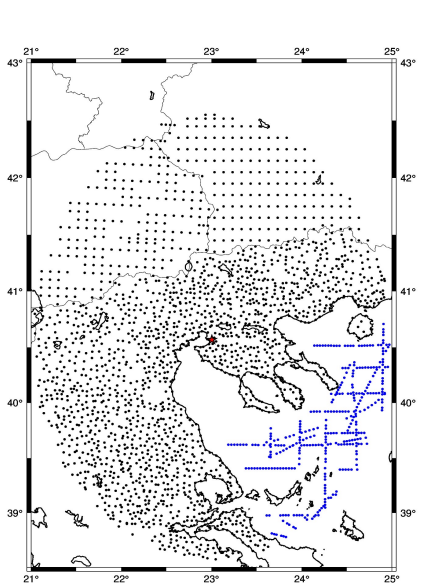
Simulate ellipsoidal heights based on a corrector surface of the Greek gravimetric geoid relative to GNSS/Levelling data

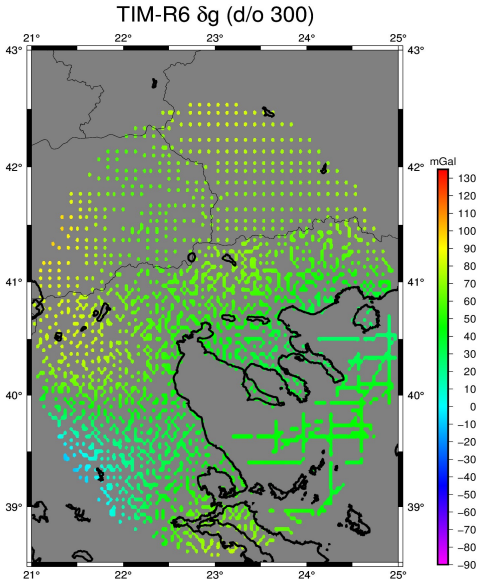
In collocation, we do not use the entire database, but point values selected close to 2 arcmin grid nodes

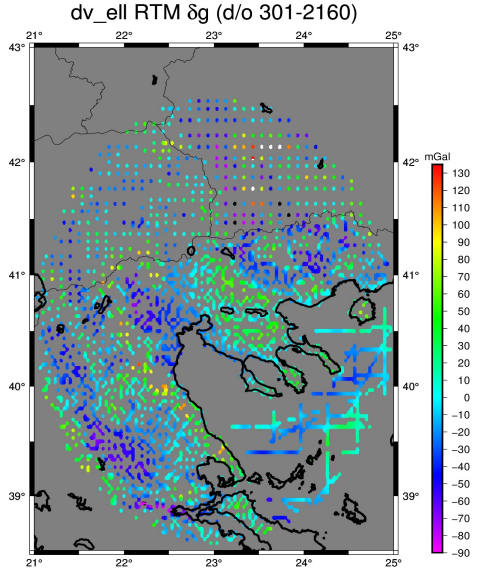
Bias and tilt corrector surface values

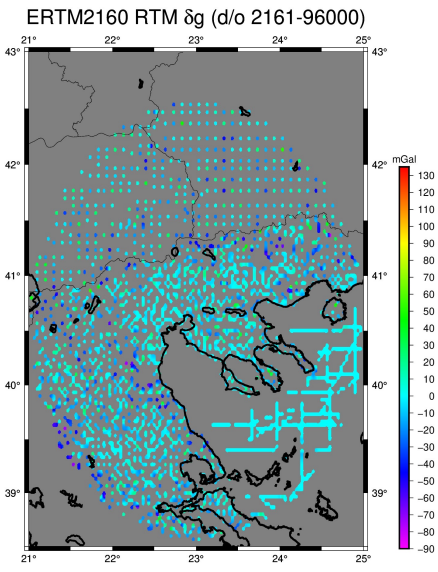


Data over Greece (~2500 pts @ 2arcmin nodes)







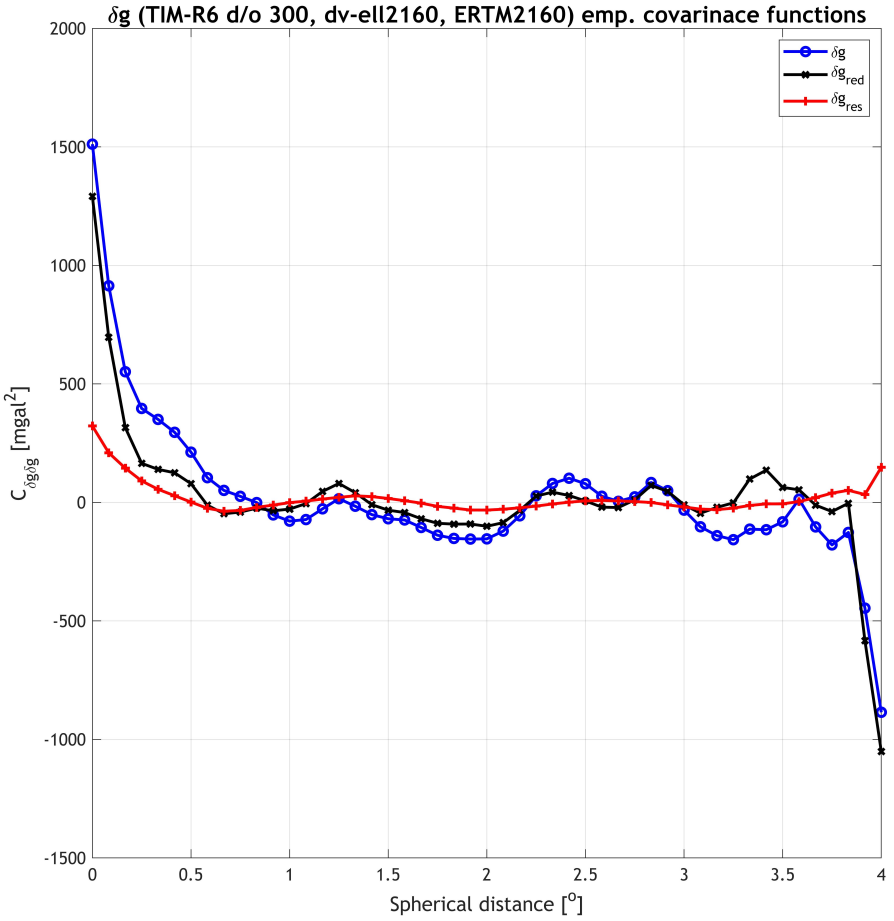


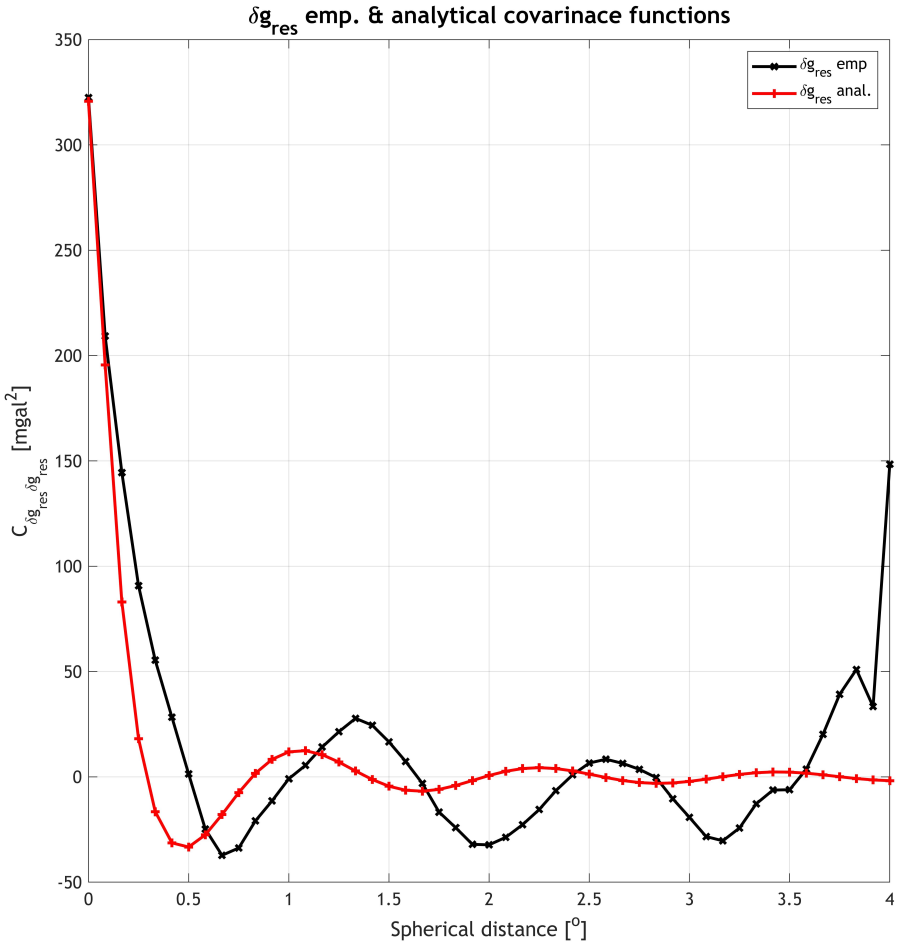
$$\mu_{\delta g} = 44.63\ mGal \qquad \sigma_{\delta g} = 39.22\ mGal$$

$$\mu_{\delta g_{red}} = -10.36\ mGal \qquad \sigma_{\delta g_{red}} = 35.80\ mGal$$

$$\mu_{\delta g_{res}} = -2.91\ mGal \qquad \sigma_{\delta g_{res}} = 19.01\ mGal$$

Covariance function over Greece





Potential at AUT1

The estimated value in WGS84 and TF

$$\zeta_{AUT1} = 42.455 \pm 0.0494\, m$$

$$W_{AUT1} = 62{,}635{,}796.6046 \pm 0.0050\ {}^{m^2}/_{s^2}$$

To GRS80 and MT

$$\zeta_{AUT1} = 41.489 \pm 0.0494\, m$$

$$W_{AUT1} = 62{,}635{,}787.8025 \pm 0.0050\ {}^{m^2}/_{s^2}$$

Compared to our previous (IAG2017) best estimate with ~25,000 pts.

$$\delta\zeta_{AUT1} = -0.0899\ \text{m} \qquad \delta W_{AUT1} = -0.8817\ {}^{m^2}/_{s^2}$$

Data over Italy

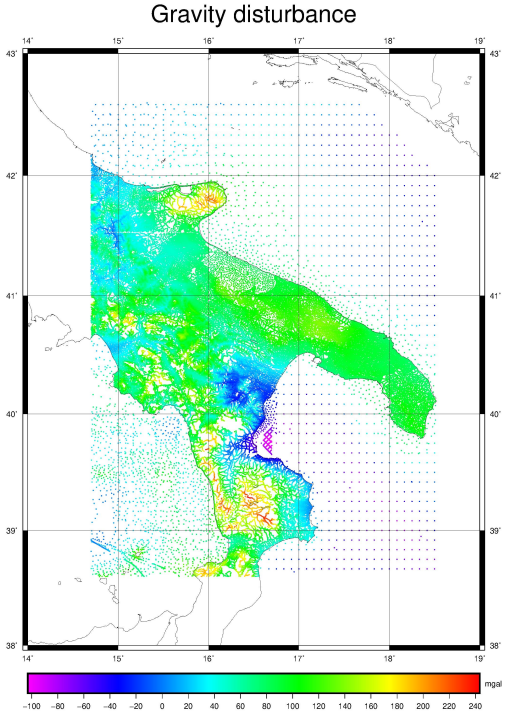
IHRF as a realization of IHRS at the Matera station

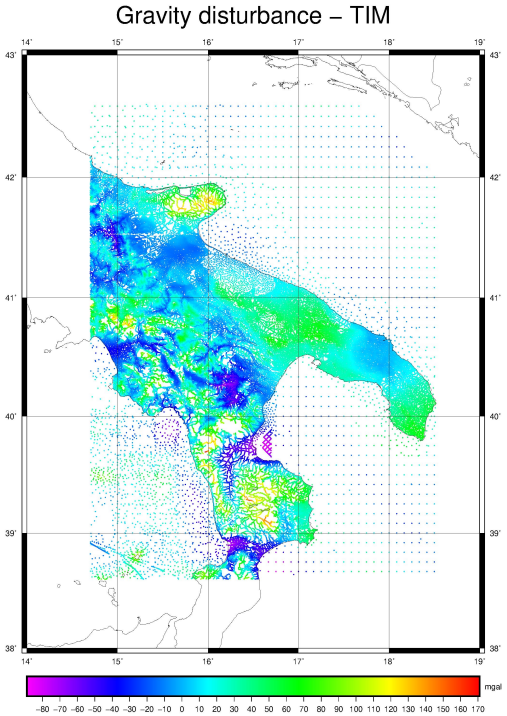
- EUREF Station (Class A Station)
- GGOS Core Site

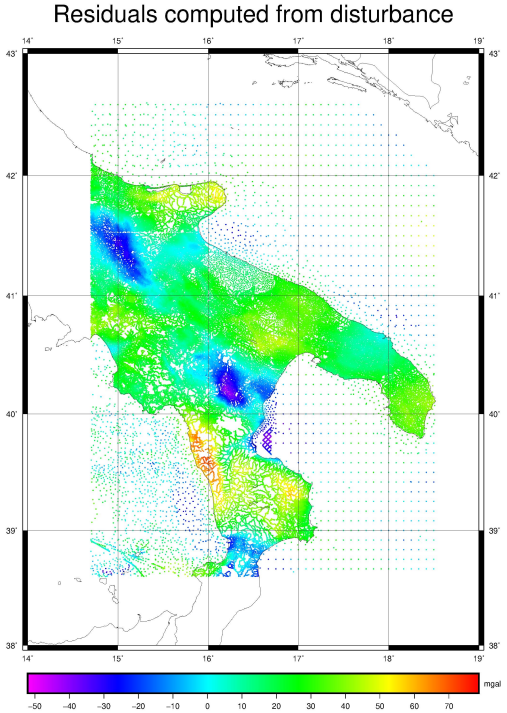
Simulate ellipsoidal heights based on a corrector surface (bias & tilt) of the Italian gravimetric geoid relative to GNSS/Levelling data

All the gravity points of the Italian gravity database in a range of 4° from the Matera station have been considered in collocation (~54000 pts)

Data over Italy





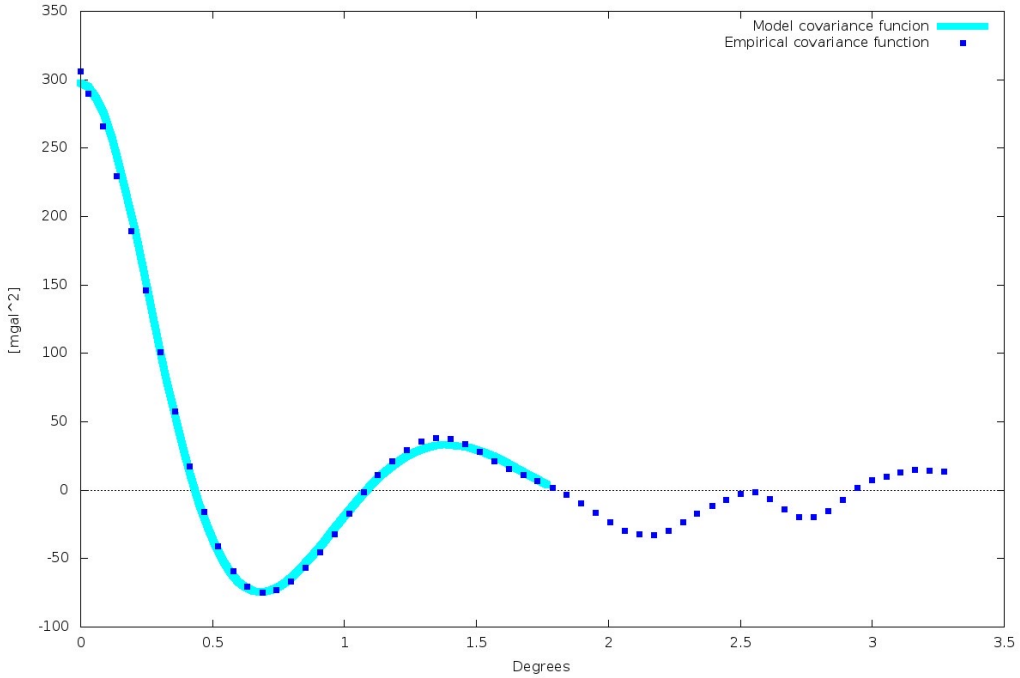


$$\mu_{\delta g} = 73.98\, mGal \qquad \sigma_{\delta g} = 41.08\, mGal$$

$$\mu_{\delta g_{red}} = 15.08 mGal \qquad \sigma_{\delta g_{red}} = 30.47 mGal$$

$$\mu_{\delta g_{res}} = 16.84\, mGal \qquad \sigma_{\delta g_{res}} = 17.50\, mGal$$

Covariance function over Italy



GRS80 and MT

$$\zeta_{MATE} = 46.571\, m$$

$$W_{MATE} = 62{,}632{,}059.7326\, {}^{m^2}/_{s^2}$$

Remarks and conclusions

- Refinements in the estimation of the ellipsoidal heights will be considered (e.g. local bias estimate)

- Computations of ζ in the two sites will be repeated using different methods and different satellite only GGMs

- Estimation error computed also in the Matera station

- Comparison with W(P) values based on high resolution GGM