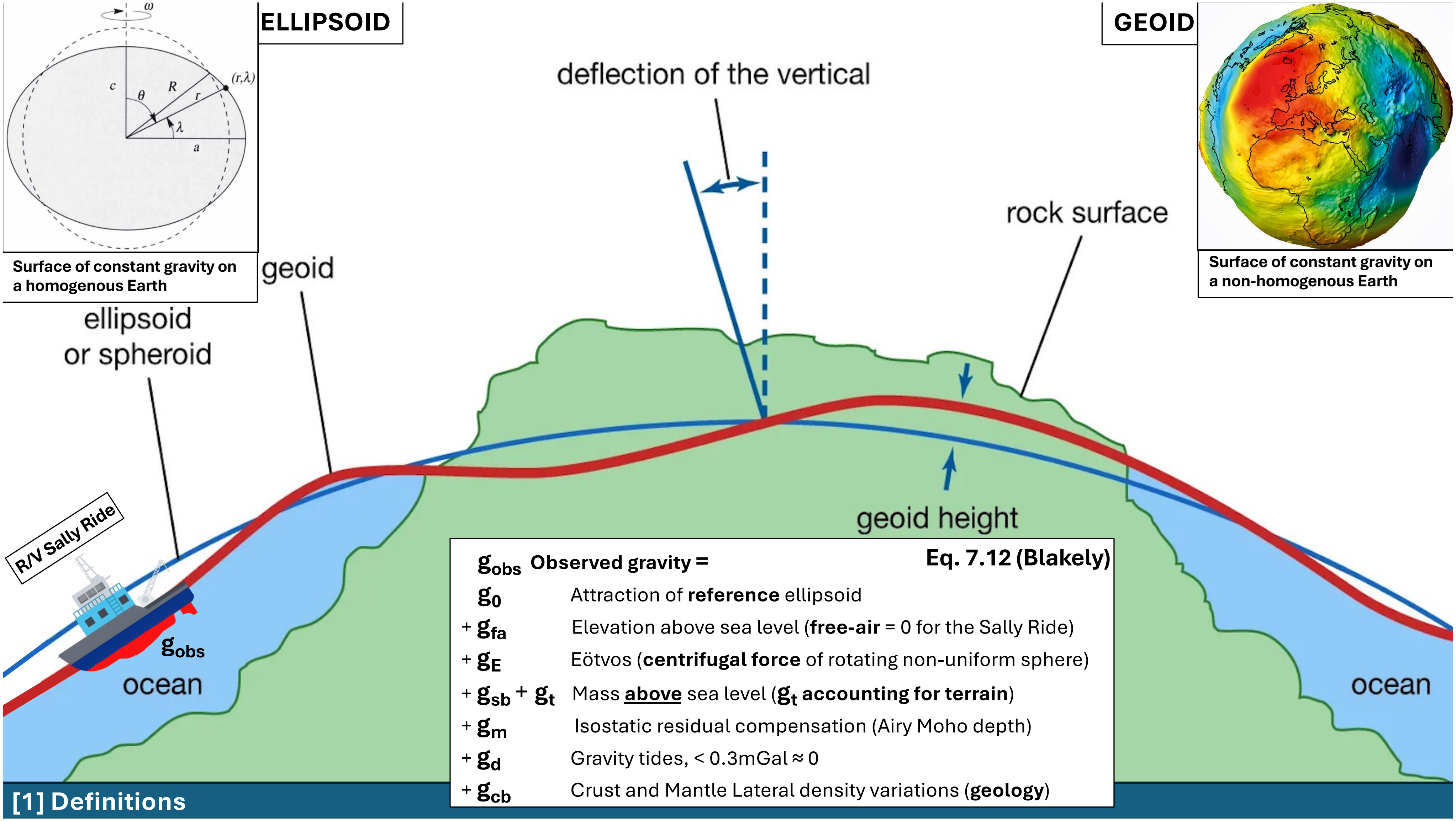
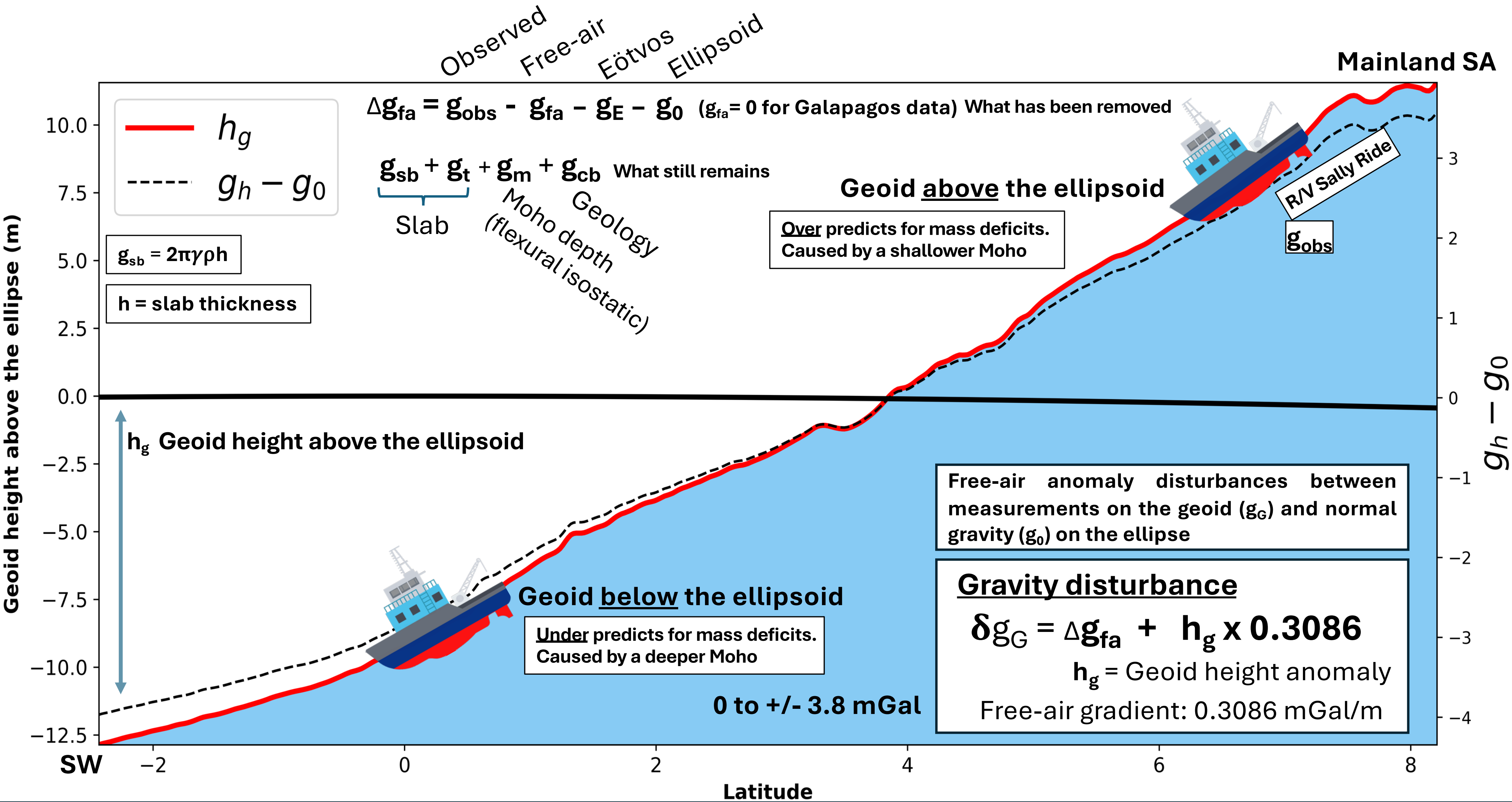
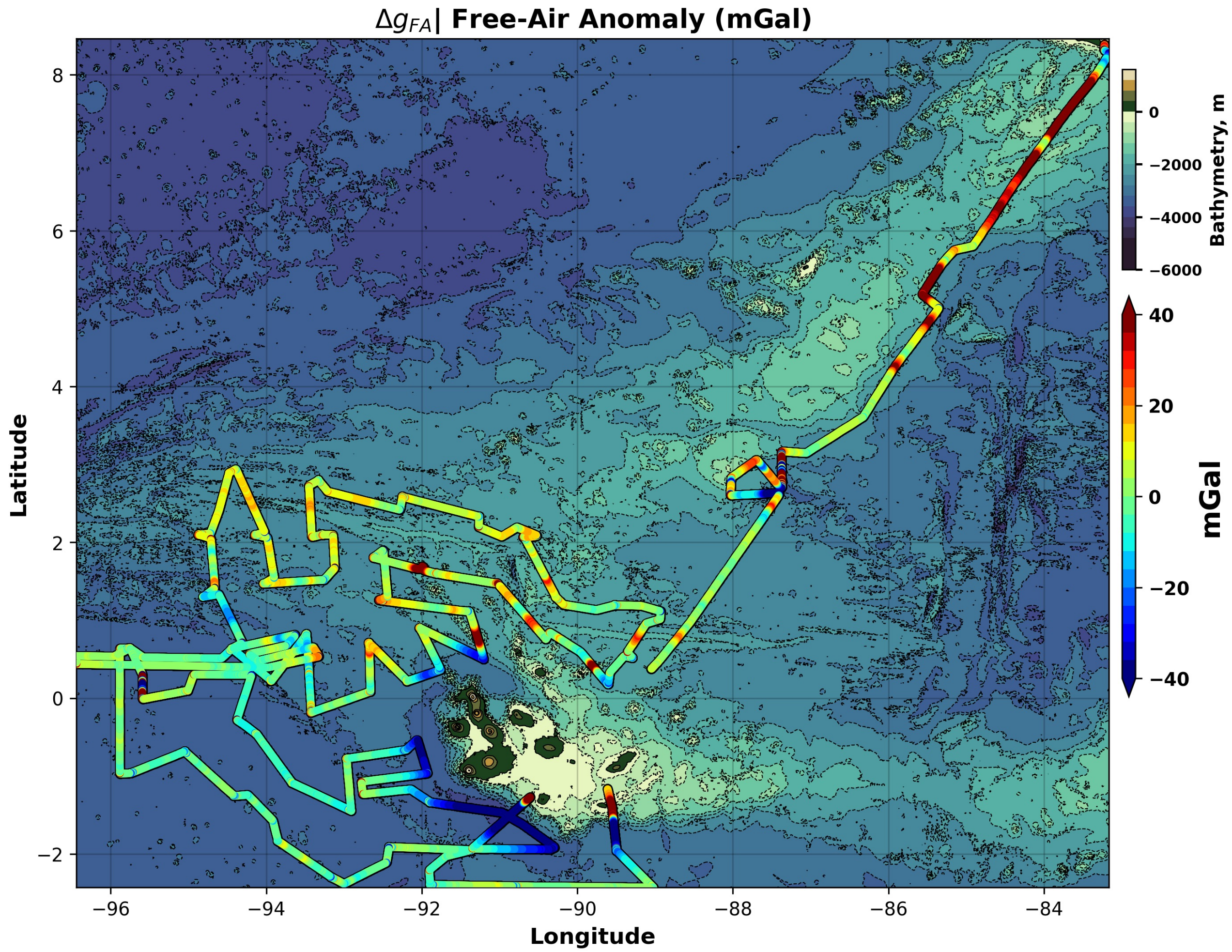

ELLIPSOID
ω
c
θ
R
r
(r,λ)
λ
a
Surface of constant gravity on a homogenous Earth
GEOID
Surface of constant gravity on a non-homogenous Earth
deflection of the vertical
rock surface
geoid
ellipsoid or spheroid
geoid height
R/V Sally Ride
gobs
ocean
ocean
gobs Observed gravity =
Eq. 7.12 (Blakely)
g0 Attraction of reference ellipsoid
+ gfa Elevation above sea level (free-air = 0 for the Sally Ride)
+ gE Eötvos (centrifugal force of rotating non-uniform sphere)
+ gsb + gt Mass above sea level (gt accounting for terrain)
+ gm Isostatic residual compensation (Airy Moho depth)
+ gd Gravity tides, < 0.3mGal ≈ 0
+ gcb Crust and Mantle Lateral density variations (geology)
[1] Definitions



[2] Crossing the Geoid Anomaly & Gravity Disturbances

$$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$$

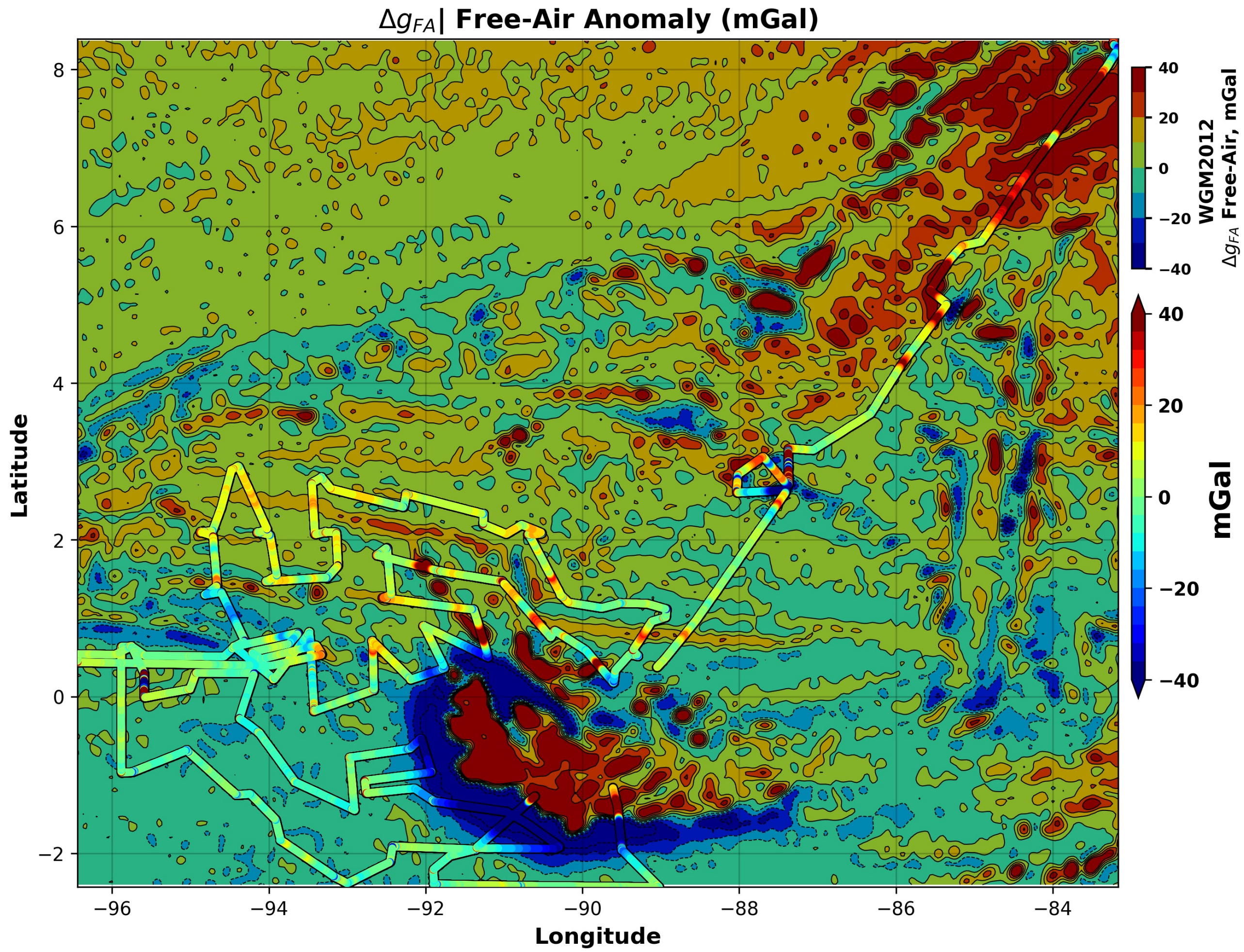
(g_{fa}= 0 for Galapagos survey)



[3] Iguana Survey Free Air Anomaly

$$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$$
(g_{fa}= 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies



Bonvalot, S., Balmino, G., Briais, A., M. Kuhn, Peyrefitte, A., Vales N., Biancale, R., Gabalda, G., Reinquin, F., Sarrailh, M., 2012. World Gravity Map. Commission for the Geological Map of the World. Eds., Paris.

[4] Iguana Survey Free Air Anomaly compared with Global Gravity Models (WGM2012)

$$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$$

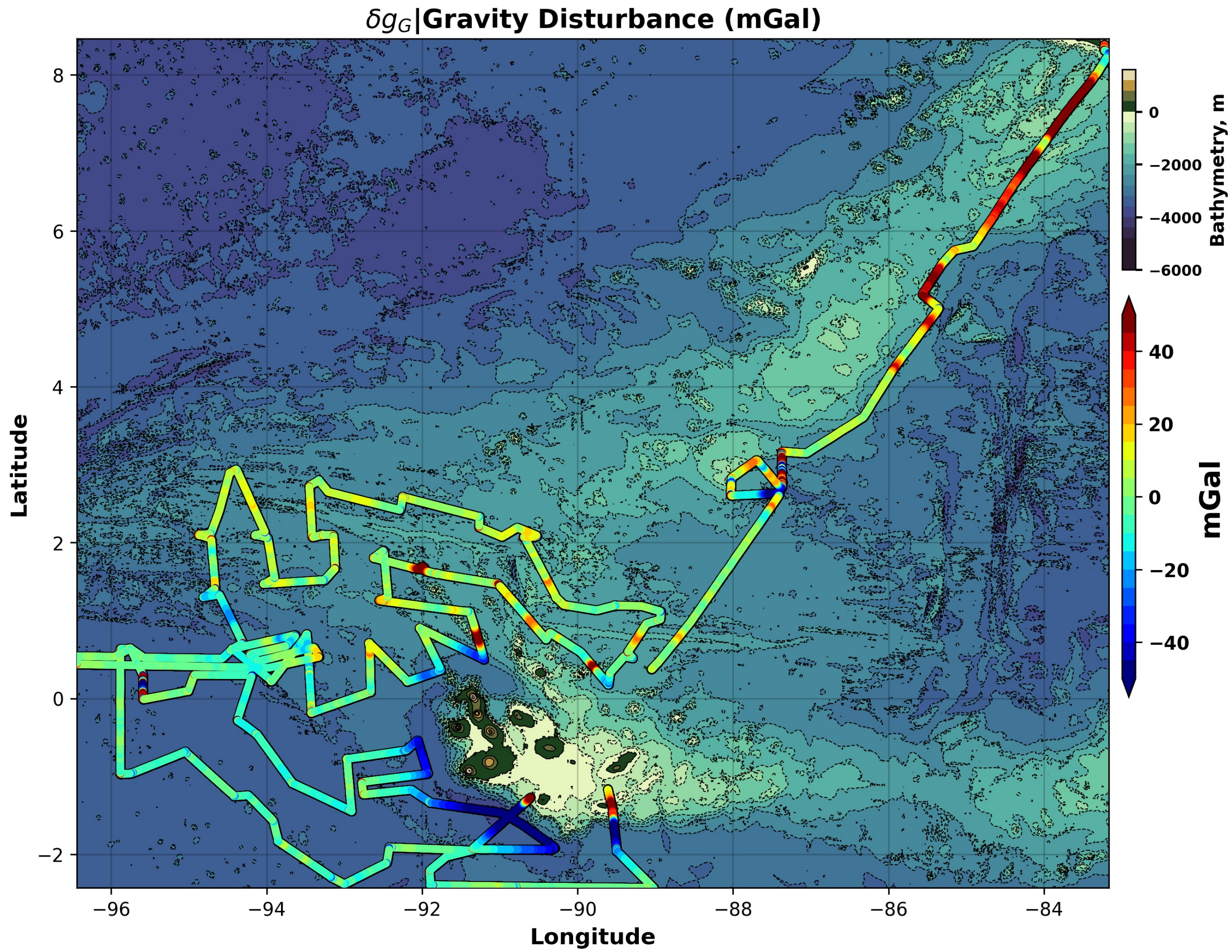
(g_{fa}= 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies

$$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$$

Gravity Anomalies: The (geodetic) gravity anomaly is defined as the difference between gravity on the geoid and normal gravity on the reference ellipsoid (Heiskanen & Moritz, 1967)

Gravity Disturbances: The gravity disturbance is defined as the difference of two fields at the same point on the reference ellipsoid (Hackney & Featherstone, 2003)



[5] Iguana Survey Geoid Gravity Disturbance, δg_P

$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$
(g_{fa}= 0 for Galapagos survey)

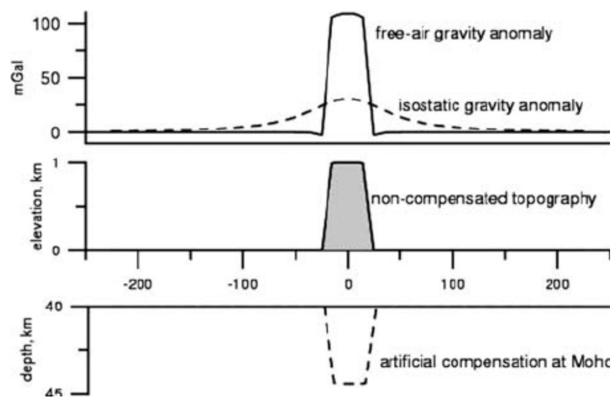
WGM2012 (Bonvalot, 2012) Free-Air Anomalies

$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$

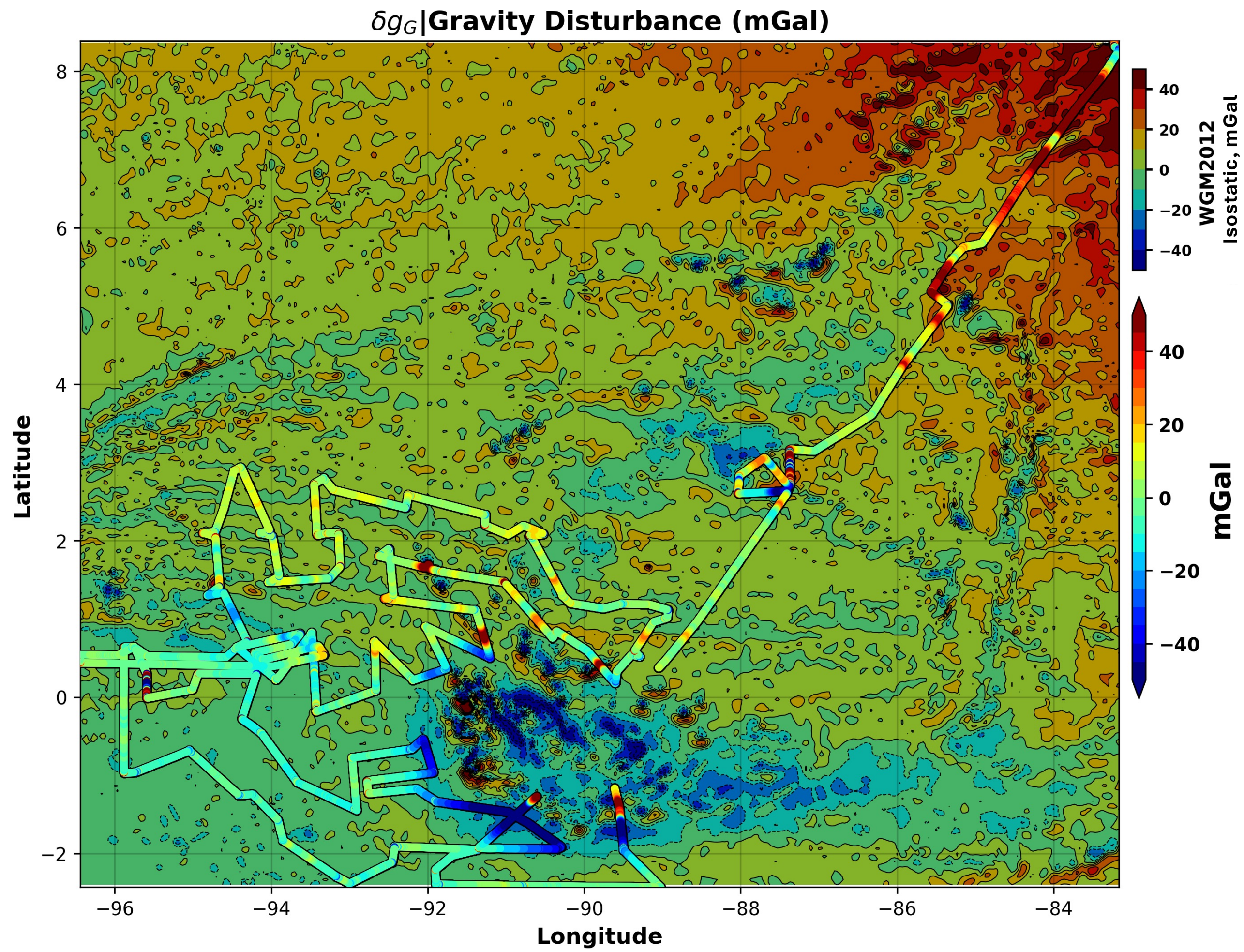
WGM2012, $\delta g_I = \Delta g_{fa} - A^T + A_C$

A_C :Isostatic compensation (ρ_c =2670 kg/m^3)

A^T :Topographic gravity



Kaban et al., 2004



Bonvalot, S., Balmino, G., Briais, A., M. Kuhn, Peyrefitte, A., Vales N., Biancale, R., Gabalda, G., Reinquin, F., Sarrailh, M., 2012. World Gravity Map. Commission for the Geological Map of the World. Eds., Paris.

[6] Comparing the δg_P with δg_I , the WGM Isostatic Gravity Disturbance

$$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$$

(g_{fa}= 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies

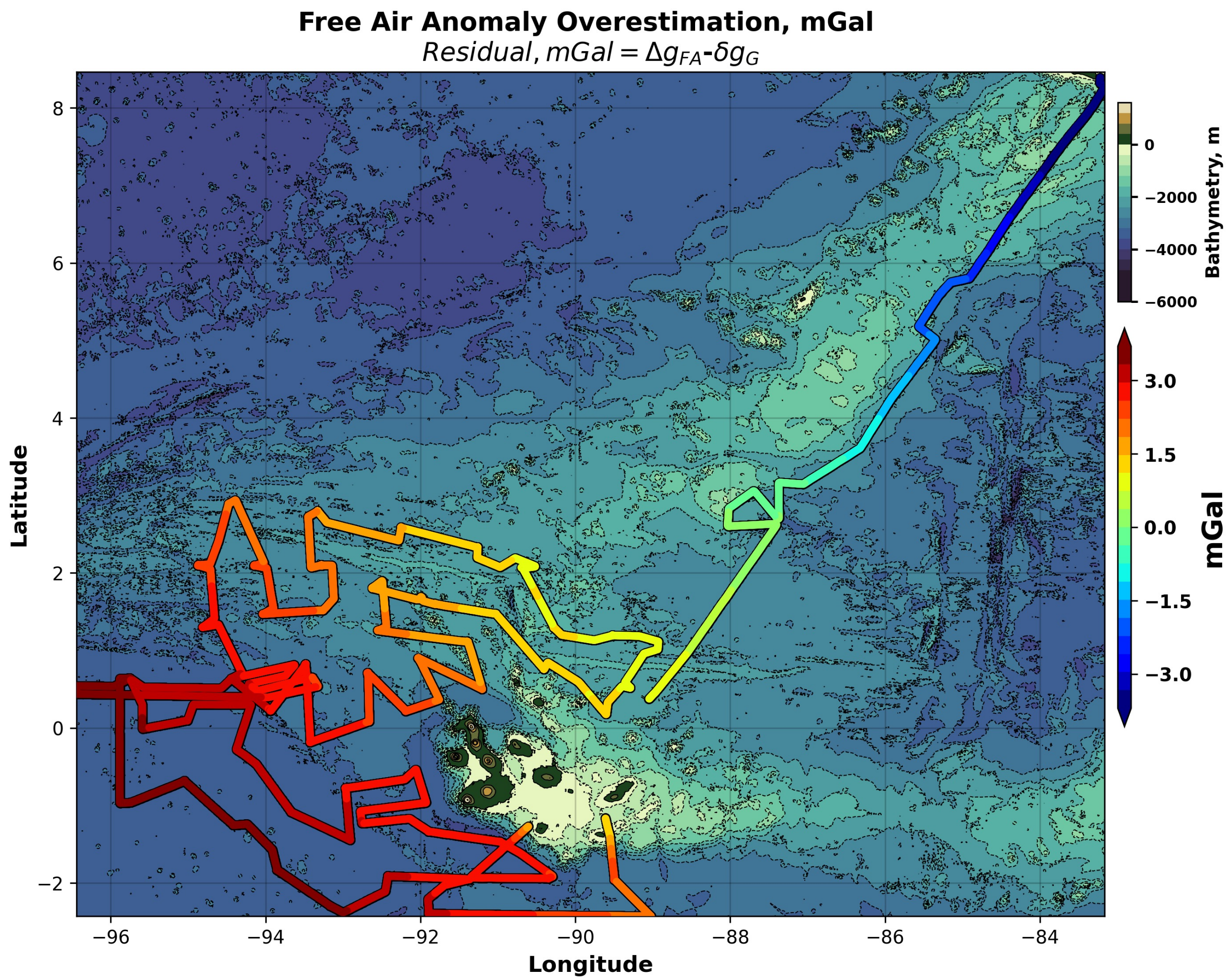
$$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$$

WGM2012, $\delta g_I = \Delta g_{fa} - A^T + A_C$

A_C :Isostatic compensation (ρ_c =2670 kg/m^3)

A^T :Topographic gravity

$$\Delta g_{fa} - \delta g_P = \Delta g_{fa} - \Delta g_{fa} + h_g \times 0.3086$$
$$= h_g \times 0.3086$$



[7] $\Delta g_{fa} - \delta g_P$ (The Geoid Gravity anomaly)

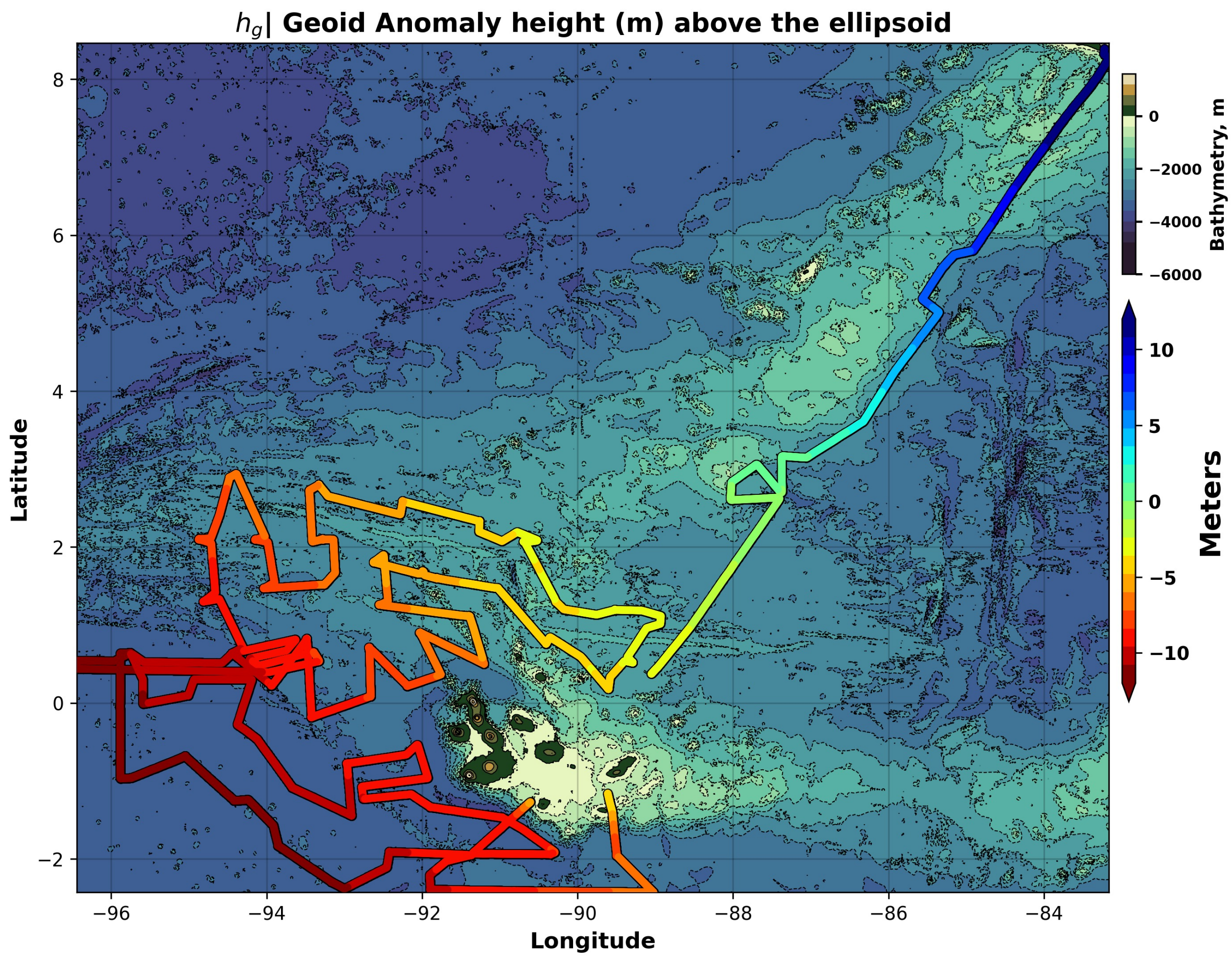
$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$
(g_{fa}= 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies

$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$

WGM2012, $\delta g_I = \Delta g_{fa} - A^T + A_C$
A_C :Isostatic compensation (ρ_c =2670 kg/m^3)
A^T :Topographic gravity

$\Delta g_{fa} - \delta g_P = \Delta g_{fa} - \Delta g_{fa} + h_g \times 0.3086$
$= h_g \times 0.3086$



[8] The Geoid Height anomaly

$$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$$
(g_{fa}= 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies

$$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$$

WGM2012, $\delta g_I = \Delta g_{fa} - A^T + A_C$

A_C :Isostatic compensation (ρ_c =2670 kg/m^3)

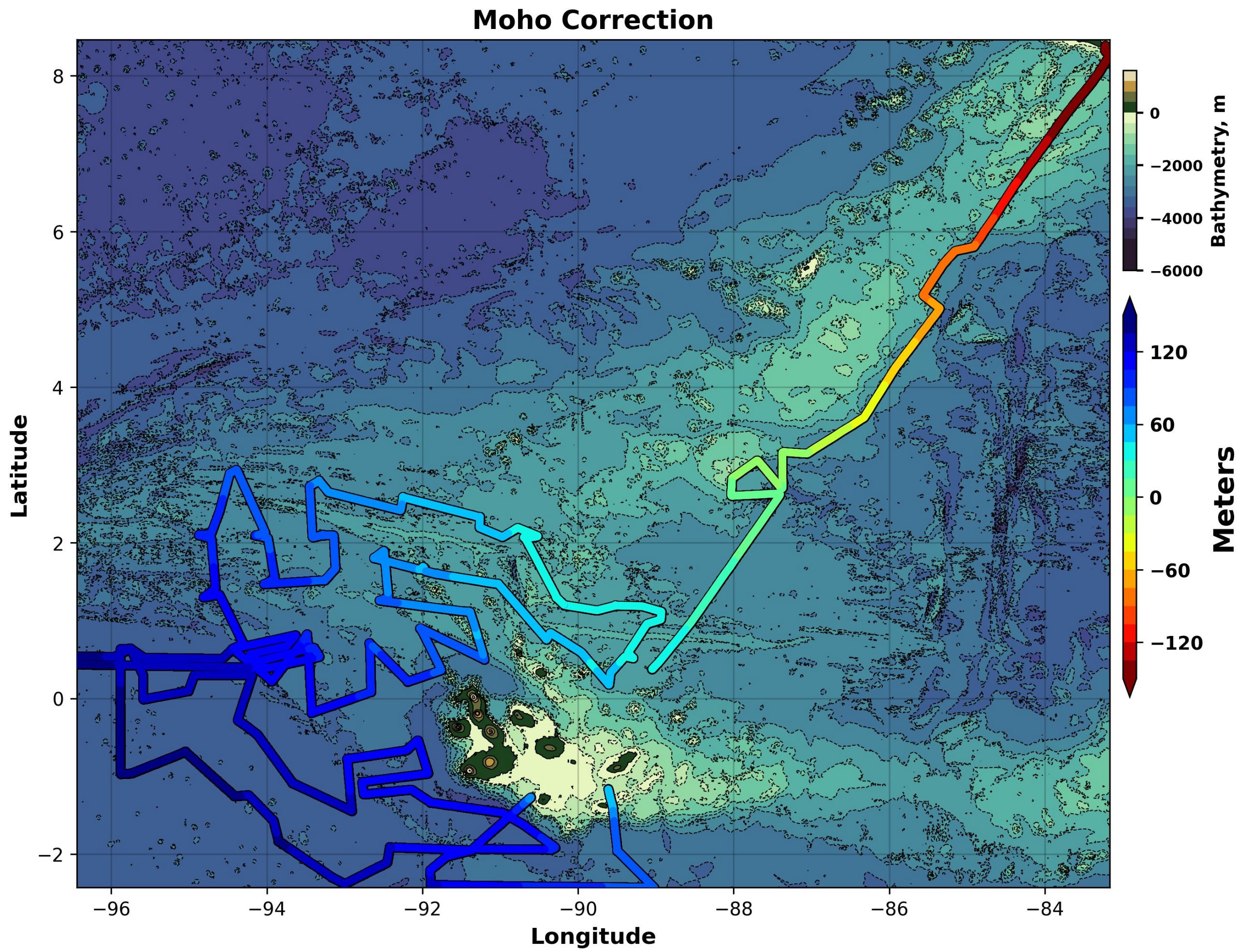
A^T :Topographic gravity

$$\Delta g_{fa} - \delta g_P = \Delta g_{fa} - \Delta g_{fa} + h_g \times 0.3086 = h_g \times 0.3086$$

$$\Delta g_{fa} - \delta g_P = h_g \times 0.3086$$

$\Delta\rho$ =600 kg/m^3

$$\delta h_m = (\Delta g_{fa} - \delta g_P) / 2\pi\gamma\Delta\rho$$



[9] Moho depth corrections caused by the Geoid

$$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$$
(g_{fa} = 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies

$$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$$

WGM2012, $\delta g_I = \Delta g_{fa} - A^T + A_C$

A_C :Isostatic compensation (ρ_c =2670 kg/m^3)

A^T :Topographic gravity

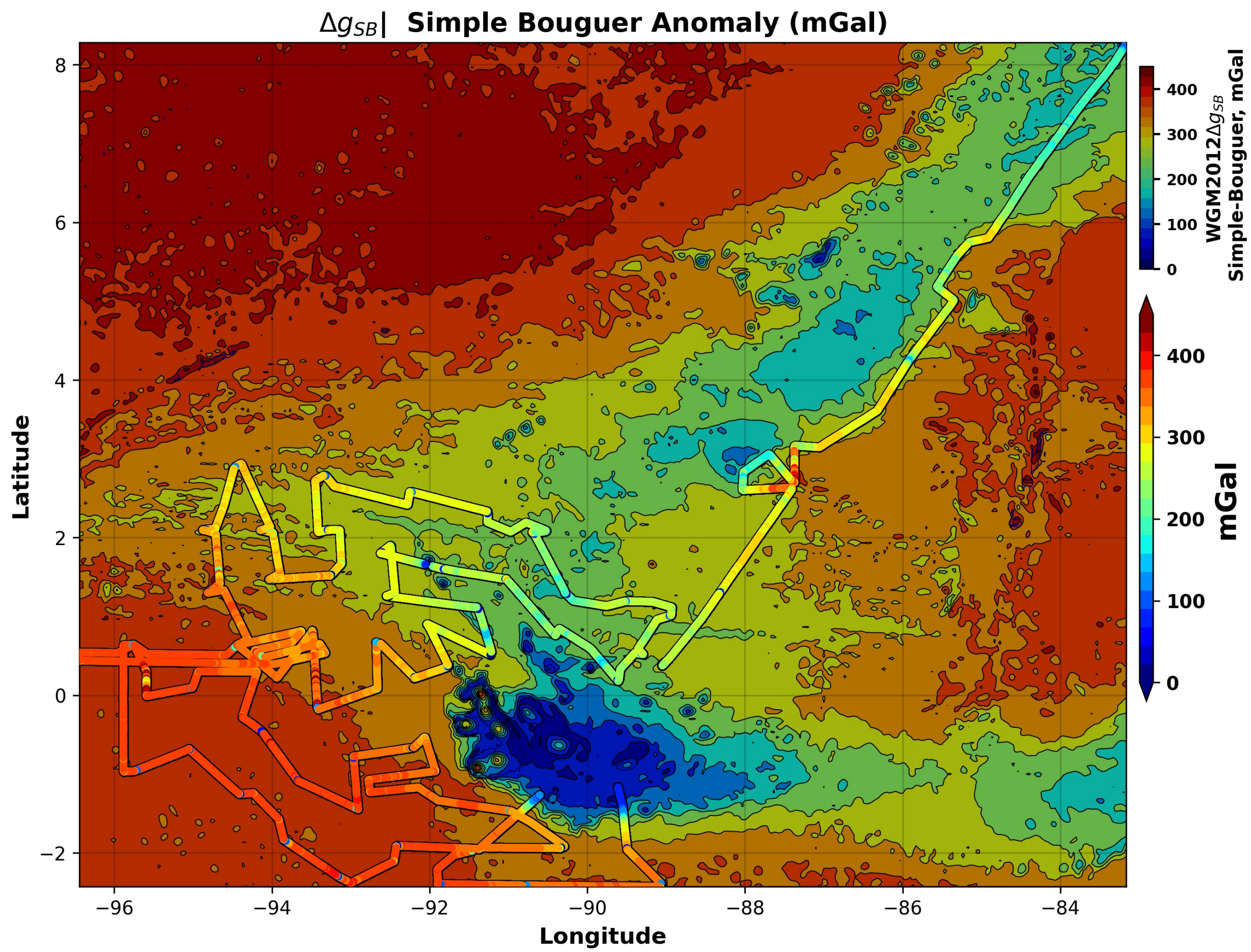
$$\Delta g_{fa} - \delta g_P = \Delta g_{fa} - \Delta g_{fa} + h_g \times 0.3086 = h_g \times 0.3086$$

$$\Delta g_{fa} - \delta g_P = h_g \times 0.3086$$
$\Delta\rho$ =600 kg/m^3
$$\delta h_m = (\Delta g_{fa} - \delta g_P) / 2\pi\gamma\Delta\rho$$

$$\Delta g_{SB} = \Delta g_{fa} - 2\pi\gamma\rho_c h$$
h = Slab Thickness
(ρ_c = 2670 kg/m^3)

$$\Delta g_{CB} = g_{obs} - g_{fa} - g_{sb} - g_t - g_0 = \Delta g_{SB} - g_t$$
z = Depth
($\Delta\rho = \rho_c - \rho_w$ = 1670 kg/m^3)

$$g_t = \Delta\rho 2\pi\gamma[R - \sqrt{(R^2+z^2)}+z]$$ (LaFehr, 1991)



R = Average spacing (1,000m)

LaFehr, T. R. "Standardization in gravity reduction." Geophysics 56.8 (1991): 1170-1178.

[11] Simple Bouguer with Topo

$\Delta g_{fa} = g_{obs} - g_{fa} - g_E - g_0$

(g_{fa}= 0 for Galapagos survey)

WGM2012 (Bonvalot, 2012) Free-Air Anomalies

$\delta g_G = \Delta g_{fa} + h_g \times 0.3086$

WGM2012, $\delta g_I = \Delta g_{fa} - A^T + A_C$

A_C :Isostatic compensation (ρ_c =2670 kg/m^3)

A^T :Topographic gravity

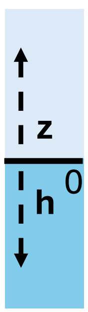
$\Delta g_{fa} - \delta g_P = \Delta g_{fa} - \Delta g_{fa} + h_g \times 0.3086$

$= h_g \times 0.3086$

$\Delta g_{fa} - \delta g_P = h_g \times 0.3086$

$\Delta\rho$ =600 kg/m^3

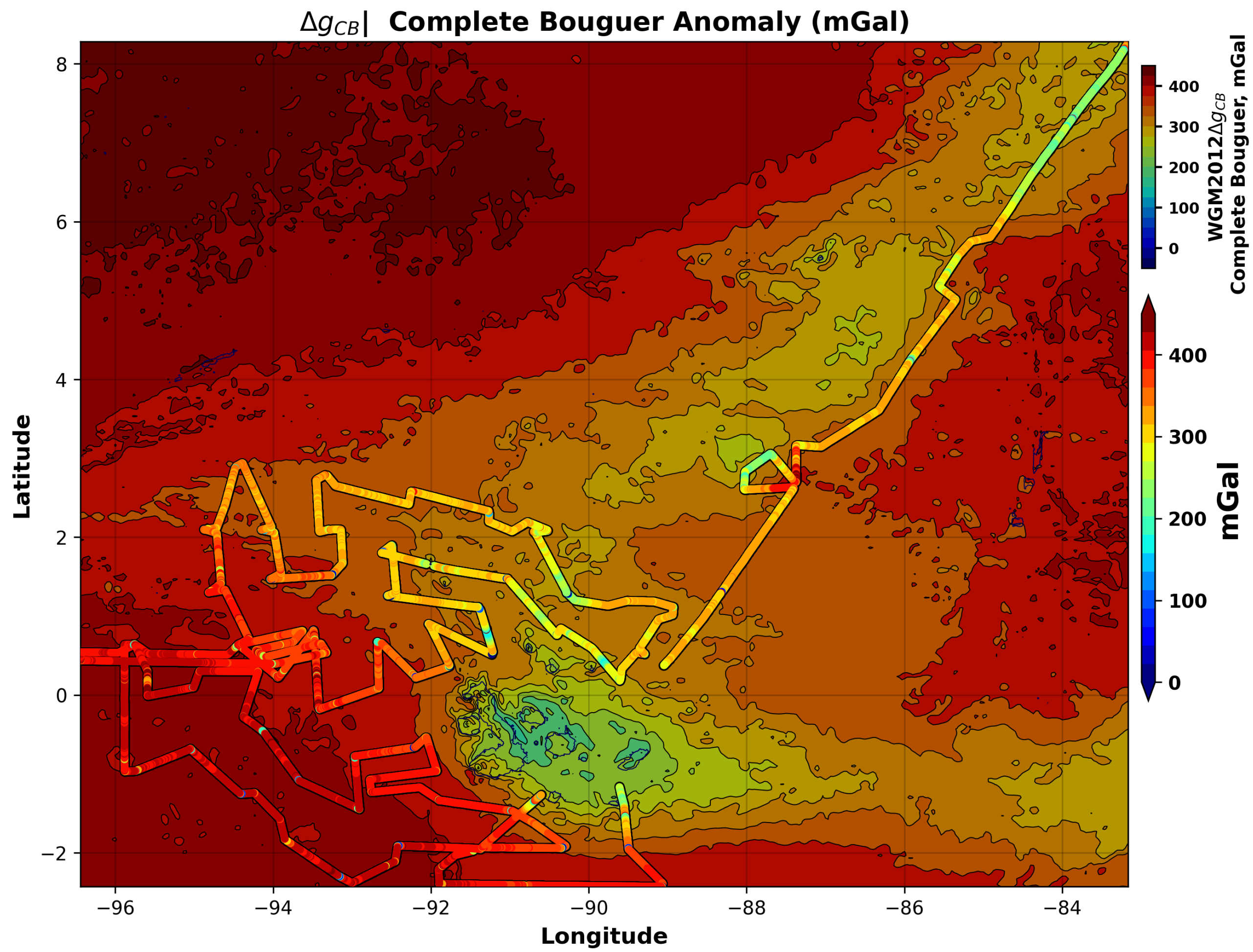
$\delta h_m = (\Delta g_{fa} - \delta g_P) / 2\pi\gamma\Delta\rho$



$\Delta g_{SB} = \Delta g_{fa} - 2\pi\gamma\rho_c h$

h = Slab Thickness

(ρ_c = 2670 kg/m^3)



$\Delta g_{CB} = g_{obs} - g_{fa} - g_{sb} - g_t - g_0 = \Delta g_{SB} - g_t$

z = Depth

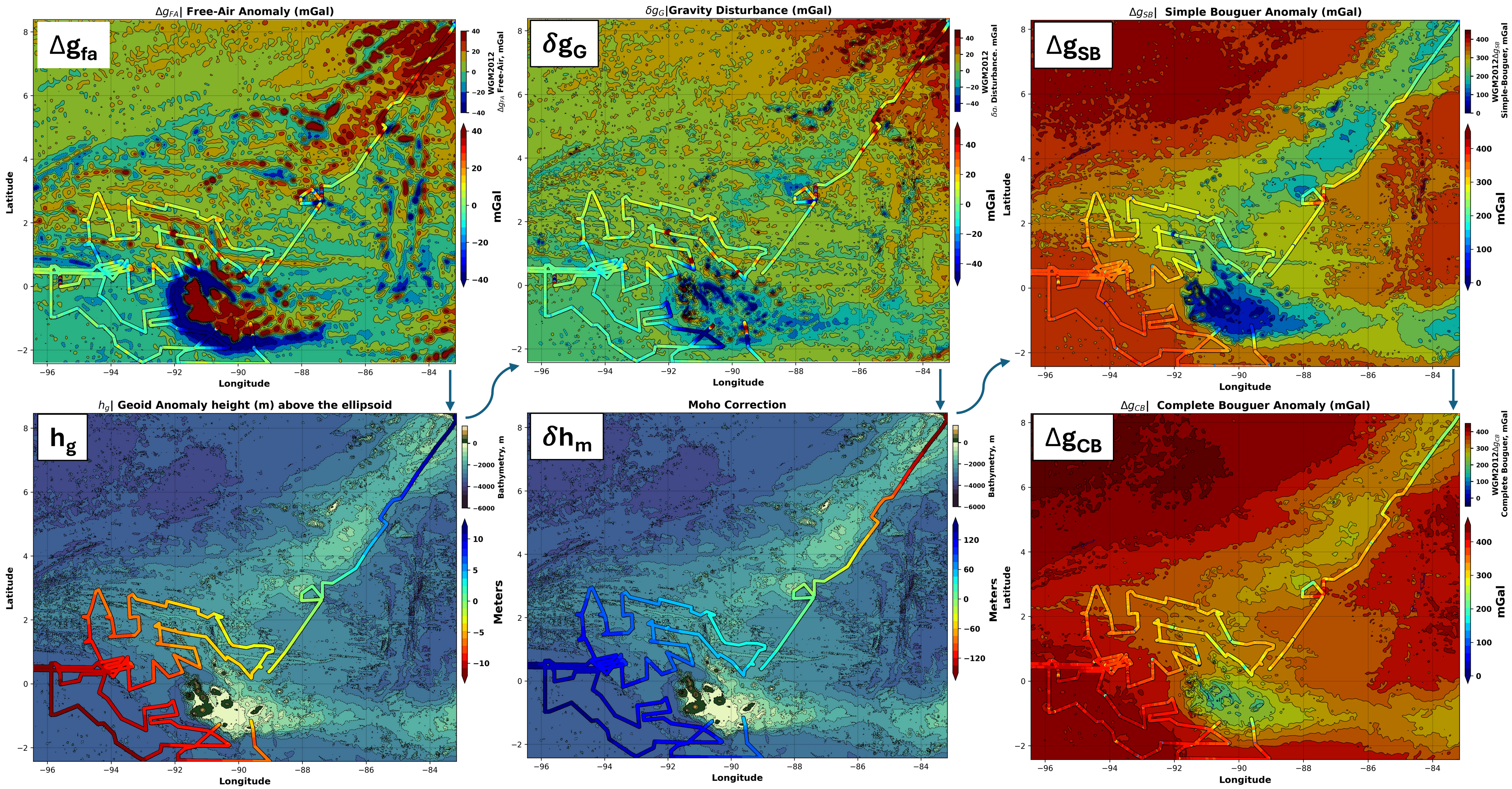
($\Delta\rho = \rho_c - \rho_w$ = 1670 kg/m^3)

$g_t = \Delta\rho 2\pi\gamma[R - \sqrt{(R^2+z^2)}+z]$ (LaFehr, 1991)

R = Average spacing (1,000m)

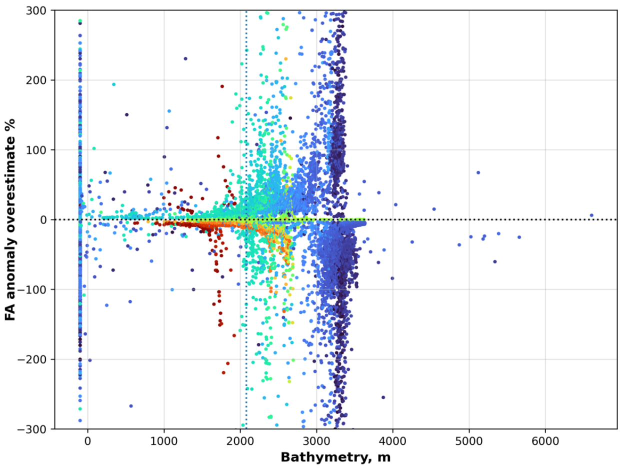
LaFehr, T. R. "Standardization in gravity reduction." Geophysics 56.8 (1991): 1170-1178.

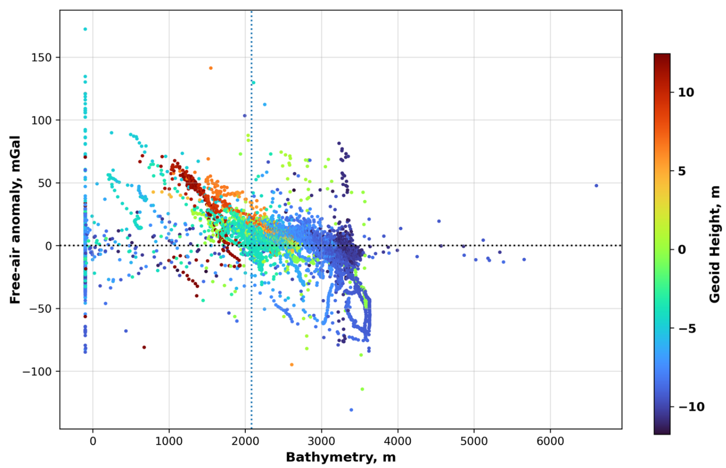
[12] Complete Bouguer



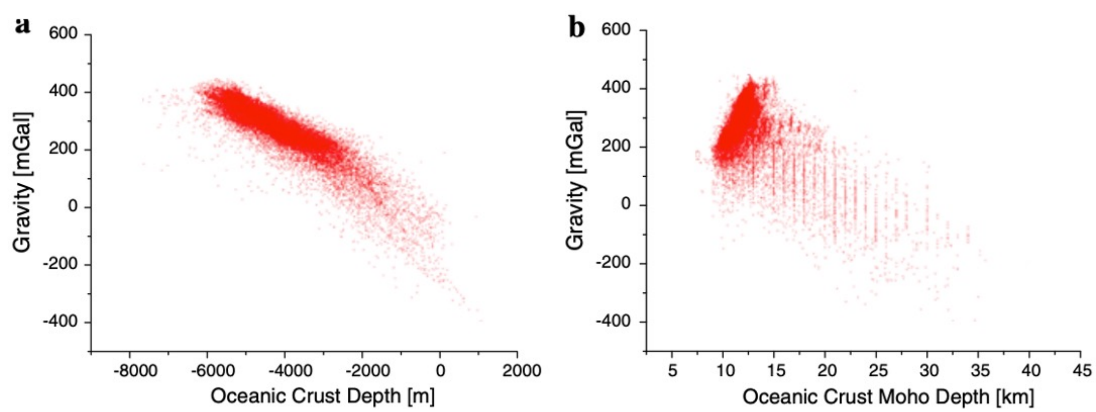
Δg_{FA}| Free-Air Anomaly (mGal)
Δg_{fa}
WGM2012 Δg_{FA} Free-Air, mGal
mGal
Latitude
Longitude
δg_G|Gravity Disturbance (mGal)
δg_G
WGM2012 δ_{Gi} Disturbance, mGal
Δg_{SB}| Simple Bouguer Anomaly (mGal)
Δg_{SB}
WGM2012Δg_{SB} Simple-Bouguer, mGal
h_g| Geoid Anomaly height (m) above the ellipsoid
h_g
Bathymetry, m
Meters
Moho Correction
δh_m
Δg_{CB}| Complete Bouguer Anomaly (mGal)
Δg_{CB}
WGM2012Δg_{CB} Complete Bouguer, mGal

[13] End





Gravity disturbances	Correlation with	
	Solid topography	Moho geometry
δg	−0.01	−0.09
δg^{T}	−0.55	−0.68
δg^{TB}	−0.89	−0.95
δg^{TBI}	−0.92	−0.97
δg^{TBIS}	−0.94	−0.97
δg^{cs}	−0.95	−0.98



[Supplement] Moho depth controls