

The EGSIEM Plotter

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Géode & Cie

The EGSiEM Plotter



Summary of the
Progress Meeting Live Demo
And current status

June, 24th 2015



Summary



- Introduction and screen captures
- Evolutions since Kick-Off Meeting
- Conclusions

Introduction



- Extraction of GRACE time-series:
 - Data selection module
 - Geographical module
 - Plotting module
 - Numerical data module
 - Information module

Address



- Available at plot.egsiem.eu



The EGSiEM Plotter

👤 Stéphane Bourgogne 📅 17 March 2015

Welcome to the EGSiEM visualization page, provided by CNES and Géode & Cie.

On this page you will be able to see the results of our project, and to plot GRACE gravity time-series from the different groups. Choose your data center, your data version, choose the area on which on want to extract data and plot your graph!

🕒 Latest update 📅 21 June 2015

Plot GRACE time-series



HORIZON 2020

Data selection module

Plot GRACE time-series

Title	Gravity functional	Data set	Area	Latitude	Longitude	Address	Regression	Scale	Bias
Series 1	Water heights	CNES RL03-v1	Point	43.604652	1.444209	Toulouse	None	1	0
Series 2	Water heights	CNES RL03-v1	Rectangle	7.580440	-8.807438	Guinée, Région de N	None	1	0
				12.127292	9.513629	Nigeria, État de Jigav			
Series 3	Water heights	CNES RL03-v1	Nile	12.681132	32.345283	Nile basin	None	1	0
Caspian Sea	Water heights	CNES RL03-v1	7-Heptagon	46.981431	53.250068	Kazakhstan, District	None	1	0
				44.371645	51.182663	Kazakhstan, Mangui			
				42.046594	53.905958	Turkménistan			
				36.978462	53.661674	Iran			
				36.767533	49.586509	Iran, Gilan			
				40.794426	48.463319	Azerbaïdjan, Shamal			
				45.676125	46.879973	Russie, Kalmykia, Ch			

Apply to all series    

Add series

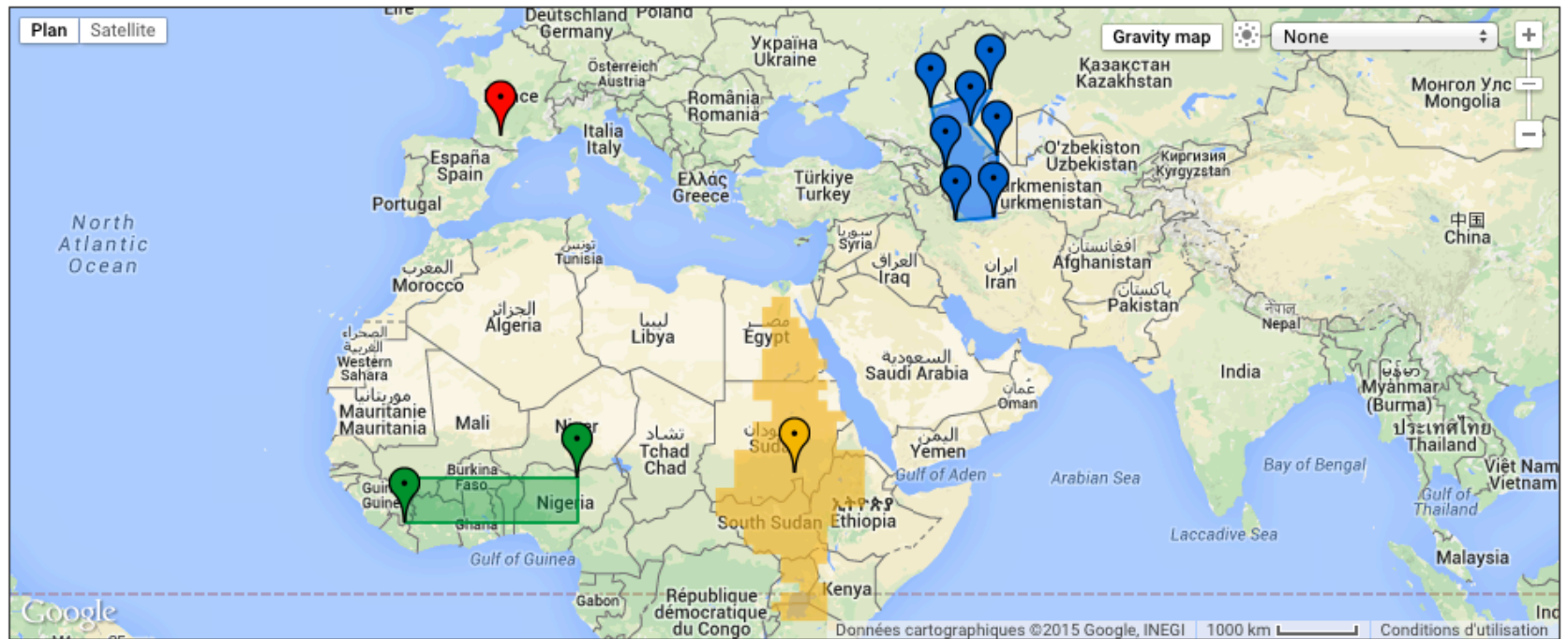
Remove

Plot graph

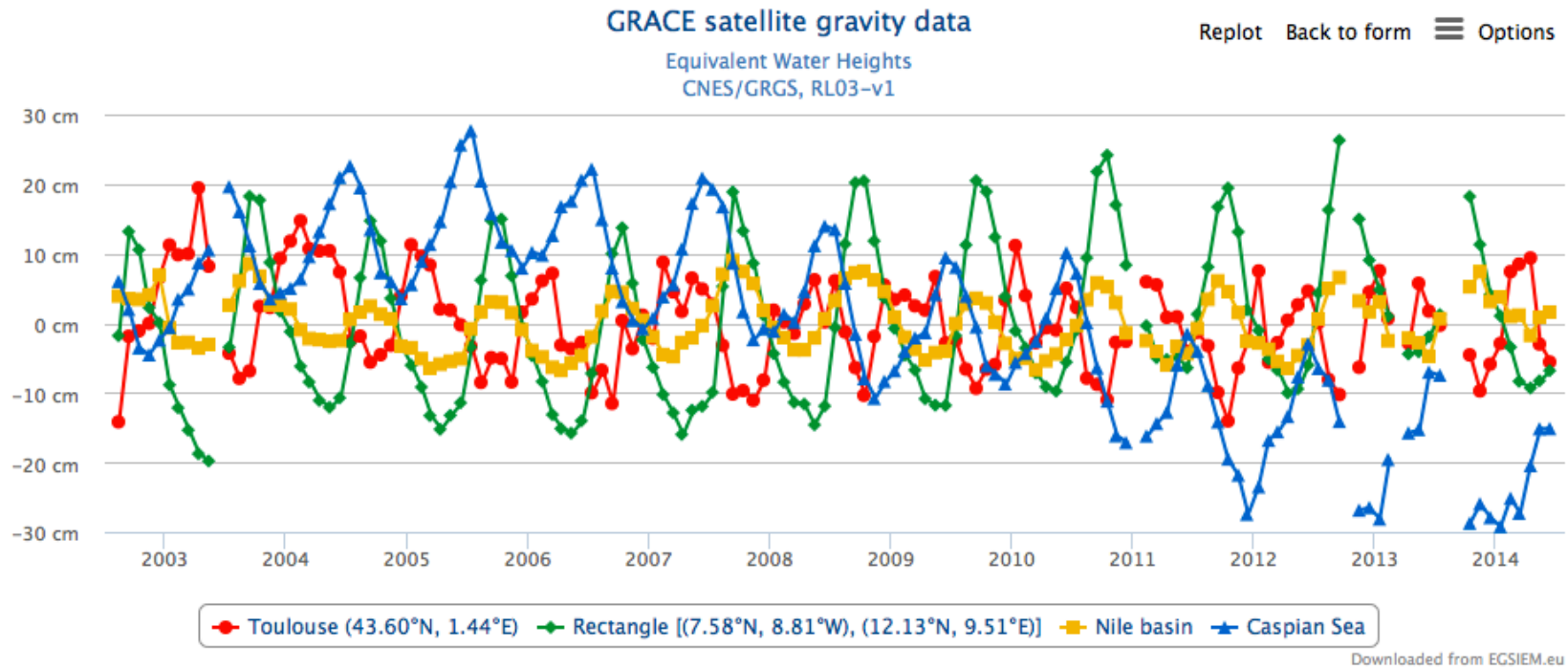
Map module

Apply to all series 

Add series **Remove** **Plot graph**



Graph module



Show data

Numerical data module

Hide data

```
### GRACE gravity data extraction ###
# Data: CNES/GRGS RL03-v1 monthly solutions
# Functional: Equivalent Water Heights
# Area type: Point
# (43.604652°N, 1.444209°E) Toulouse
# Grid points and weights used for computation: 4
# 1 (43.5°N, 0.5°E) 0.036234161910
# 2 (43.5°N, 1.5°E) 0.613228330427
# 3 (44.5°N, 0.5°E) 0.004164412411
# 4 (44.5°N, 1.5°E) 0.070478673594
# Surface area: 8953 km² or 1 deg² (mean latitude 43.605°N)
# Statistics:
# Number of dates: 137
# Min: -14.177 cm
# Max: 19.447 cm
# Mean: 0 cm
# Standard deviation: 6.582 cm
# Root mean square: 6.582 cm
# Linear model:
# Least square adjustment: y=A+B(t-t0)
# Reference date: 2008/01/01
# Bias at reference date: 0.171 cm
# Trend: -0.409 cm/year
# RMS of residuals (series-model): 6.435 cm
```

```
# Functional: Equivalent Water Heights
# Area type: Rectangle
# SW (7.580440°N, 8.807438°W) Guinée, Région de Nzérékoré
# NE (12.127292°N, 9.513629°E) Nigeria, État de Jigawa
# Grid points and weights used for computation: 76
# 1 (8.5°N, 8.5°W) 0.989015863362
# 2 (8.5°N, 7.5°W) 0.989015863362
# 3 (8.5°N, 6.5°W) 0.989015863362
# 4 (8.5°N, 5.5°W) 0.989015863362
# 5 (8.5°N, 4.5°W) 0.989015863362
# 6 (8.5°N, 3.5°W) 0.989015863362
# 7 (8.5°N, 2.5°W) 0.989015863362
# 8 (8.5°N, 1.5°W) 0.989015863362
# 9 (8.5°N, 0.5°W) 0.989015863362
# 10 (8.5°N, 0.5°E) 0.989015863362
# 11 (8.5°N, 1.5°E) 0.989015863362
# 12 (8.5°N, 2.5°E) 0.989015863362
# 13 (8.5°N, 3.5°E) 0.989015863362
# 14 (8.5°N, 4.5°E) 0.989015863362
# 15 (8.5°N, 5.5°E) 0.989015863362
# 16 (8.5°N, 6.5°E) 0.989015863362
# 17 (8.5°N, 7.5°E) 0.989015863362
# 18 (8.5°N, 8.5°E) 0.989015863362
# 19 (8.5°N, 9.5°E) 0.989015863362
# 20 (9.5°N, 8.5°W) 0.986285601537
```

Download

Download

1066262400	19646.00	2003.78782	6.765	0.055	4.622
1068897600	19676.50	2003.87132	2.606	0.054	2.816
1071532800	19707.00	2003.95483	2.544	0.053	0.459
1074211200	19738.00	2004.03970	2.024	0.052	-1.643
1076803200	19768.00	2004.12183	-0.940	0.051	-3.152
1079395200	19798.00	2004.20397	-2.207	0.050	-4.233
1082030400	19828.50	2004.28747	-2.361	0.049	-4.795
1084665600	19859.00	2004.37098	-2.589	0.048	-4.358
1087300800	19889.50	2004.45448	-2.476	0.047	-2.531
1089936000	19920.00	2004.53799	0.559	0.046	0.399
1092614400	19951.00	2004.62286	1.596	0.045	3.377
1095249600	19981.50	2004.70637	2.464	0.044	4.998
1097884800	20012.00	2004.78987	1.289	0.043	4.691
1100520000	20042.50	2004.87337	0.653	0.042	2.857
1103155200	20073.00	2004.95688	-3.303	0.041	0.500
1105833600	20104.00	2005.04175	-3.532	0.040	-1.589
1108382400	20133.50	2005.12252	-5.091	0.039	-3.065
1110931200	20163.00	2005.20329	-6.467	0.038	-4.128

```
# Periodic model:
# Least square adjustment: y=A+B(t-t0)
# +Ccos(ω(t-t0))+Dsin(ω(t-t0))
# +Ecos(2ω(t-t0))+Fsin(2ω(t-t0))
# Reference date: 2008/01/01
# Bias at reference date: 1.445 cm
# Trend: -3.176 cm/year
# Annual cos/sin: -9.437 cm, 1.822 cm
# Annual amplitude: 9.612 cm
# Annual phase: 190.93° (max on Jun 20)
# Semiannual cos/sin: 2.066 cm, 0.758 cm
# Semiannual amplitude: 2.2 cm
# Semiannual phase: -20.153° (max on Jan 11/Jul 11)
# RMS of residuals (series-model): 5.464 cm
# Numerical data:
# Column 1: Time (seconds since 1970/01/01)
# Column 2: Time (days since 1950/01/01)
# Column 3: Time (years)
```

Information module

Information

Spherical harmonics

Time series are obtained from the gravity field models downloaded at ICGEM.
Except for CNES, models are filtered with the DDK5 filter (see Kusche et al, 2009).

Geoid heights or equivalent water heights

Spherical harmonic models are converted into $1^\circ \times 1^\circ$ grids after replacement of the C20 by the SLR series provided in GRACE Technical Note 07, and subtraction of the mean over the time span. Coefficients taken into account for the conversion to grid go from degree 2 to degree 89. The time-series are extracted from these grids through a geographical extraction algorithm (see item below).

CNES notice

CNES solutions are not a-posteriori filtered since they are regularized in the inversion process - either by a constraint or by truncated SVD. Coefficients go from degree 2 to degree 80 (RL03) or degree 50 (RL02). The C20 is not replaced in CNES solutions since they already contain SLR data (Lageos 1&2, Starlette, Stella).

Geographical extraction

For single point extraction, a barycentric computation is performed from the values at the 4 surrounding grid points. For rectangles and polygons, an average is performed over grid points situated inside the contour. For basins, an average is performed over grid points from a basin file. In every case, grid values are weighted by $\cos(\text{latitude})$, in order to obtain per surface unit values (cm/m^2). Complete area information, including list of grid points and weights, is provided in the numerical data box.

Background maps

GRACE gravity maps (trend, annual and semiannual amplitude of equivalent water heights) are obtained through a regression on the global series of harmonic coefficients. DDK5 filtered coefficients are used (except for CNES).

Regressions

Analytic models are adjusted on time series through a least squares process. "Periodic model" includes a linear component, an annual component and a semiannual component. The "Advanced model" has a polynomial component instead of linear, and polynomial-modulated annual and semiannual components. In both case, components can be displayed using "Periodic+" and "Advanced+".

Tips

Click on the legend of the series to activate/deactivate the series on the graph. Highlight an area on the graph to zoom in. Use bias and scale if you wish to visualize different quantities on the same graph (for example equivalent water heights and geoid heights). When requesting regressions, use Periodic+ and Advanced+ to show the components of the adjusted model.



News

- Many new features since first version
 - More available data: AIUB, CNES, CSR, GFZ, JPL, TUGRAZ

Plot GRACE time-series

Interface for plotting GRACE time-series data. The main form includes the following fields:

Title	Gravity functional	Area	Latitude	Longitude	Address	Regression	Scale	Bias
Series 1	Water heights	Point	43.604652	1.444209	Toulouse	None	1	0

Available data series in the dropdown menu:

- AIUB RL02 DDK5
- CNES RL03-v1**
- CNES RL02
- CSR RL05 DDK5
- GFZ RL05a DDK5
- JPL RL05 DDK5
- TUG ITSG14 DDK5

Buttons: Add series, Remove, Plot graph

Map controls: Plan, Satellite, Gravity map, Trend CNES, +, -

News

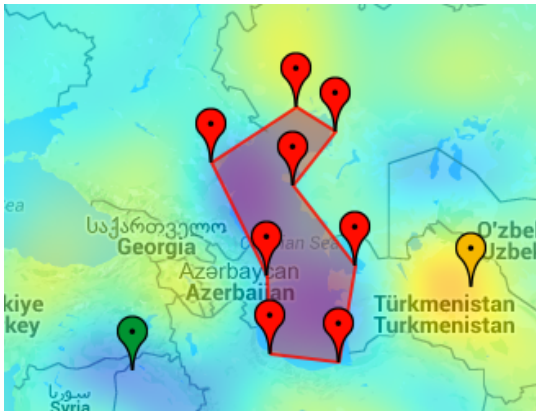
- Three gravity functionals
 - Equivalent Water Heights
 - Geoid Heights
 - Spherical harmonics, including C, S, and $\sqrt{C^2+S^2}$

Title	Gravity functional	Data set	Area	Latitude	Longitude	Address	Regression	Scale Bias
Series 1	<input checked="" type="checkbox"/> Water heights Geoid heights Spherical Harmonics	AIUB RL02 DDK5	Point	43.604652	1.444209	Toulouse	None	1 0

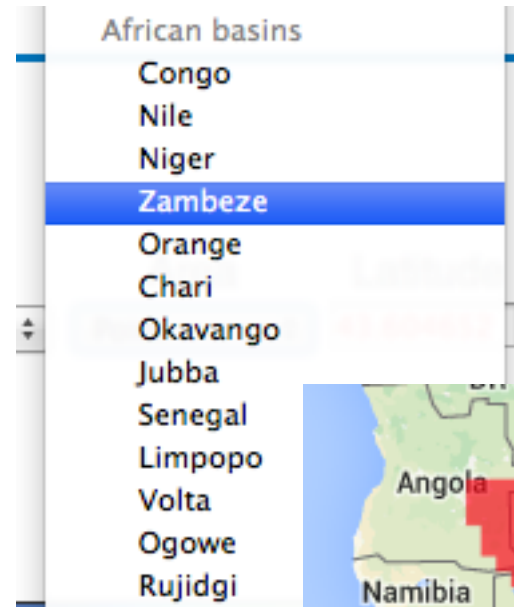
Title	Gravity functional	Data set	Coefficient	Degree	Order	Unused	Regression	Scale Bias
Series 1	Spherical Harmonics	CNES RL03-v1	<input checked="" type="checkbox"/> C S $\sqrt{C^2+S^2}$	2	0	-	None	1 0

News

- Areas: still custom geometrical shapes + now over 200 basins



Area	Latitude	Longitude	Address
8-Octogon ▾	47.070940	51.102412	Kazakhstan, Atyraou
	46.175034	53.143805	Kazakhstan, Mangui
	44.174711	50.916865	Kazakhstan, Mangui
	41.004237	54.198493	Turkménistan
	36.937395	53.387568	Iran
	37.325921	49.676253	Iran, Gilan
	40.606021	49.442256	Azerbaidjan, Khizi
	45.006521	46.512191	359231, Russie



News

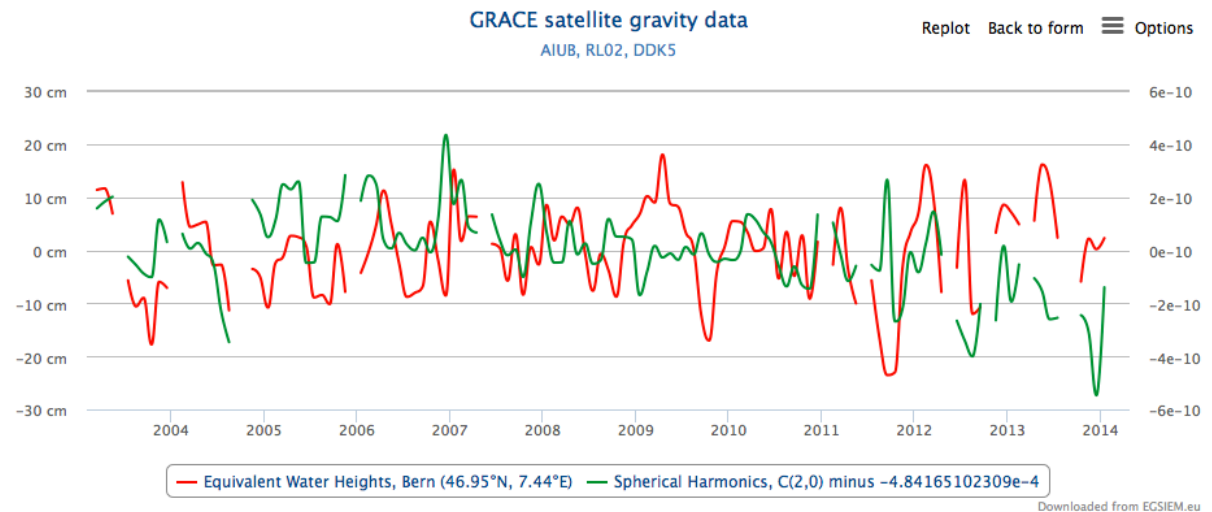
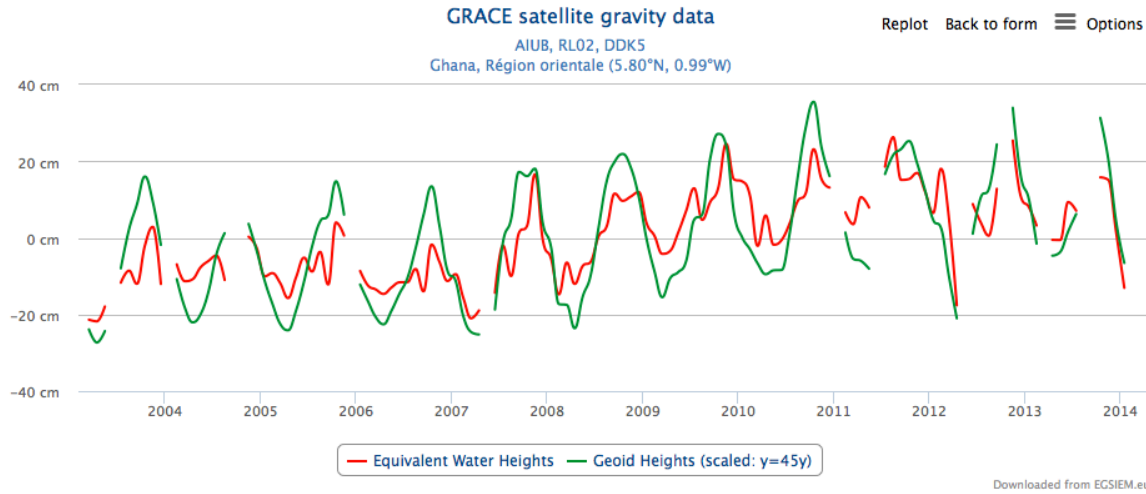
- Plot different quantities on the same graph:
 - No common characteristics imposed: fully flexible
 - Saves space and keeps the page light
 - Allows more comparisons (geoid vs water heights)
 - Two-scaled y-axis
 - Possible bias and scale

Scale Bias

1	0
45	0

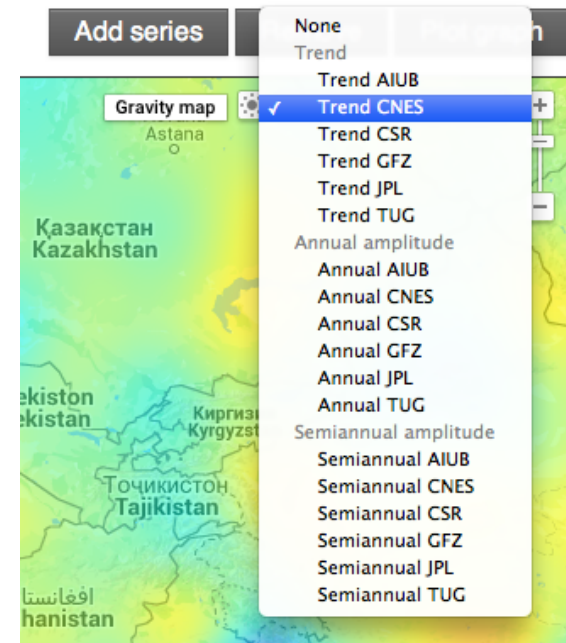
- Smart automatic titles:
 - Common characteristics appear in the title
 - Different characteristics appear in the legend
 - Fully customizable titles if desired

News



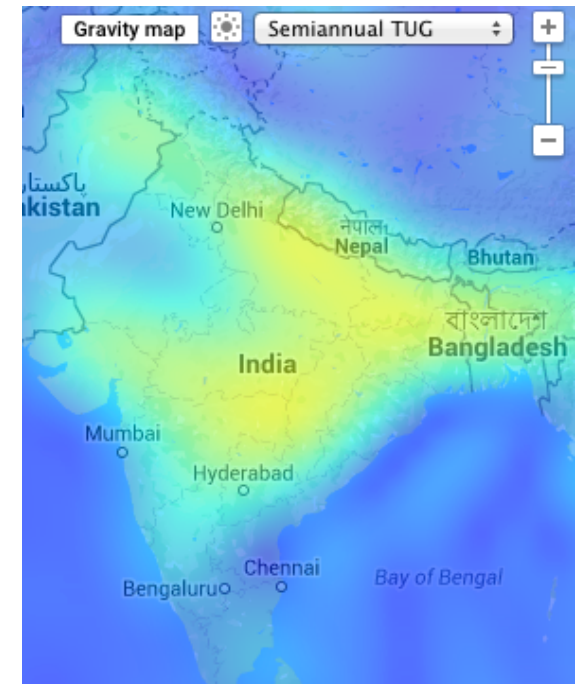
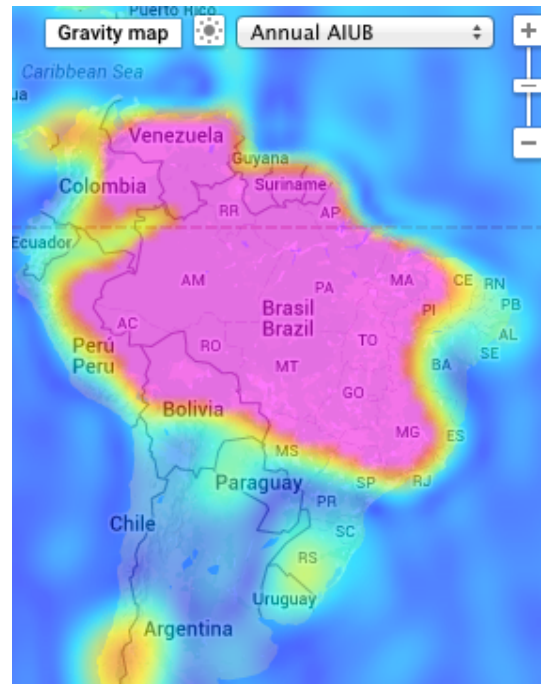
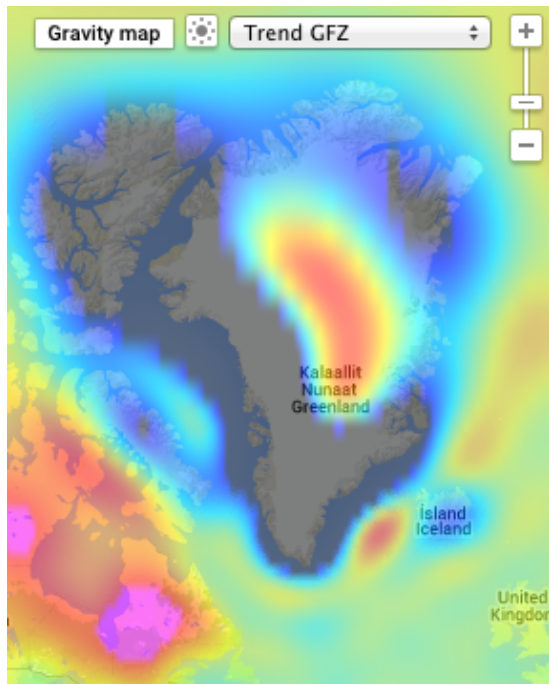
News

- GRACE gravity background maps
 - Trend, annual amplitude and semiannual amplitude for every group
 - Computation from periodic regression over the ICGEM coefficients
 - Tunable opacity level over Google satellite or road map



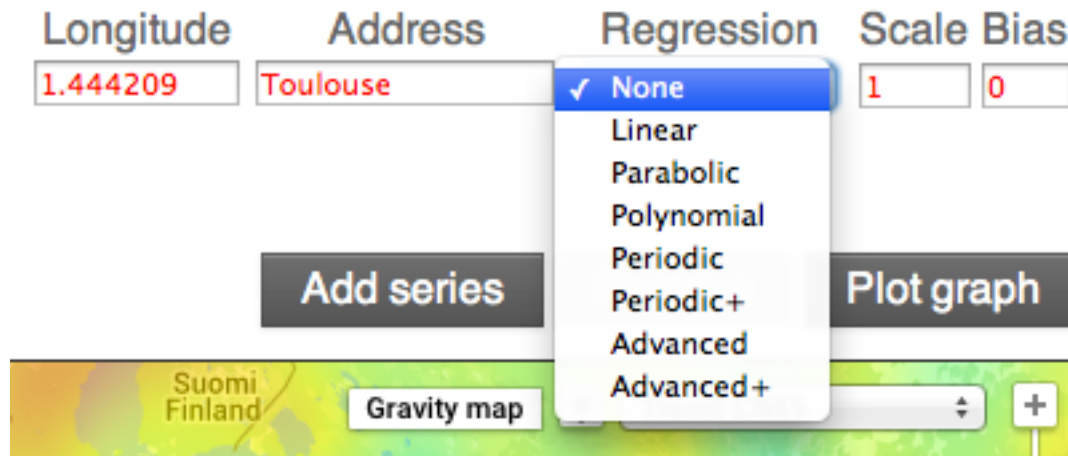
News

- GRACE gravity background maps



News

- Regressions on time series:
 - Standard to sophisticated regressions

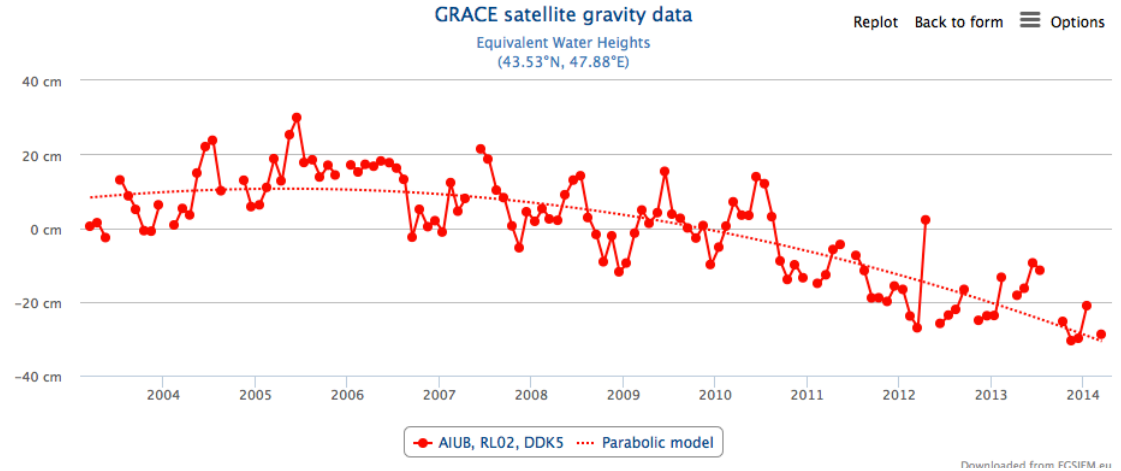


News

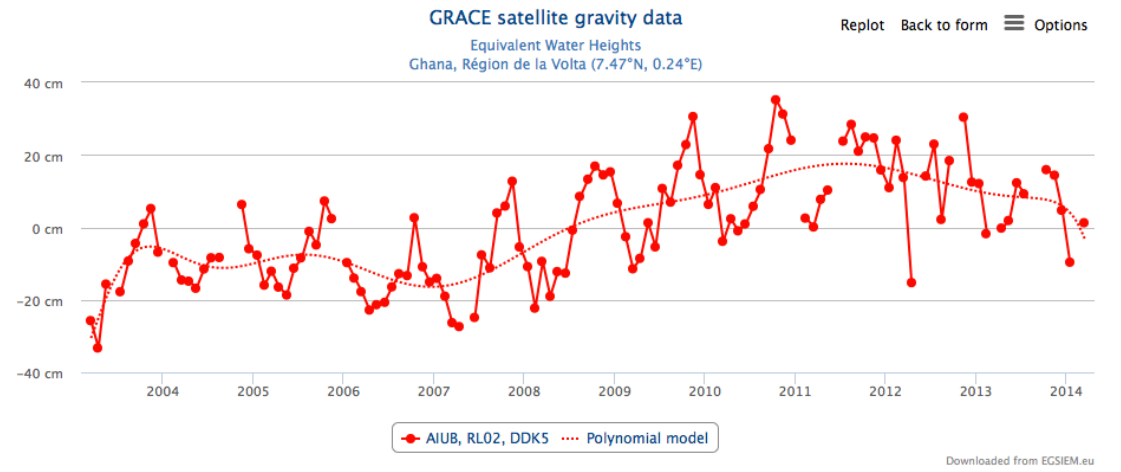
- Available regressions:
 - Linear
 - Parabolic
 - Polynomial
 - Periodic: linear component + annual sine/cosine + semiannual sine/cosine
 - Advanced: polynomial component + modulated annual + modulated semiannual

News

- Parabolic model

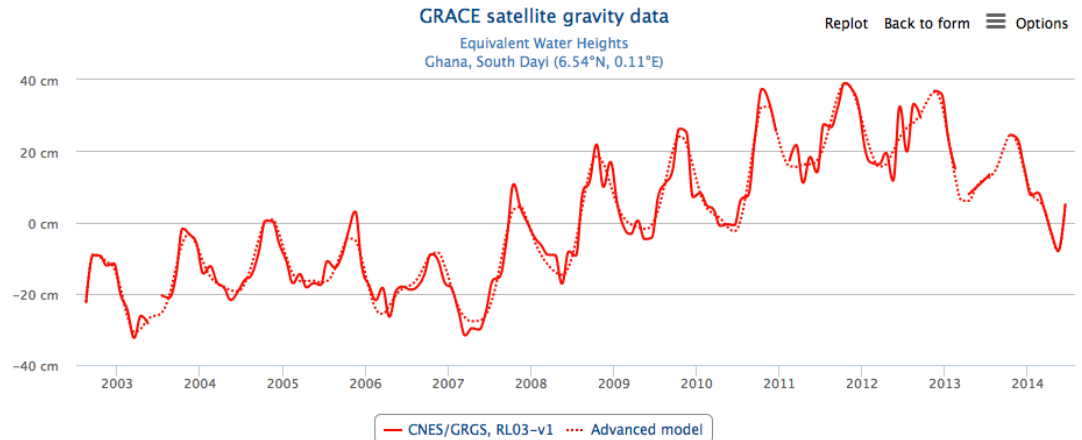
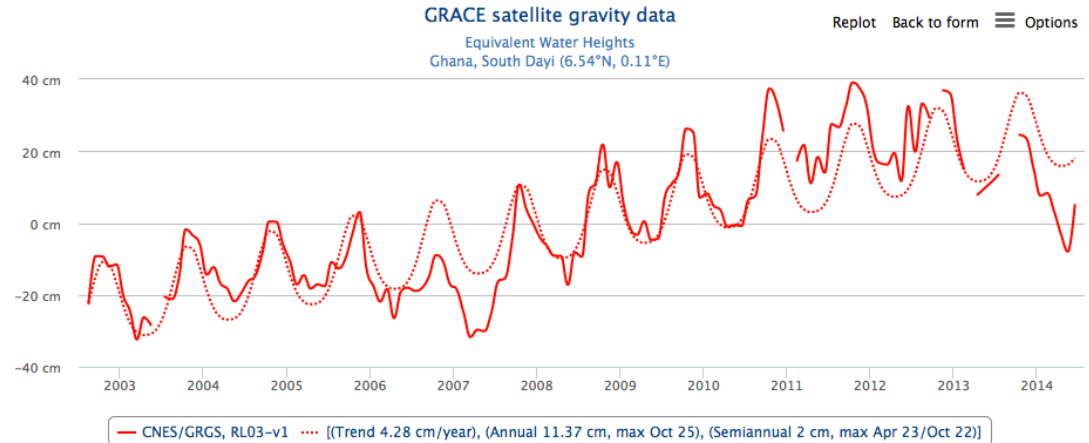


- Polynomial model



News

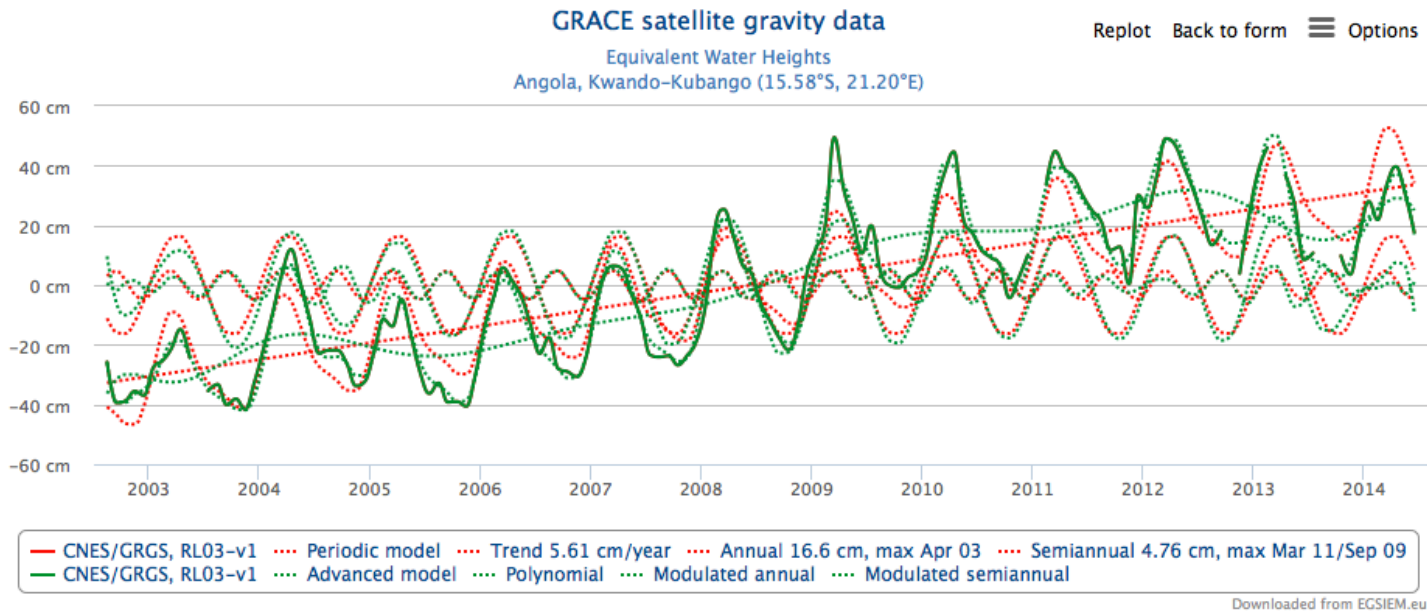
- Periodic model (trend + annual + semiannual)
- Advanced (same series)



Downloaded from EGSIEM.eu

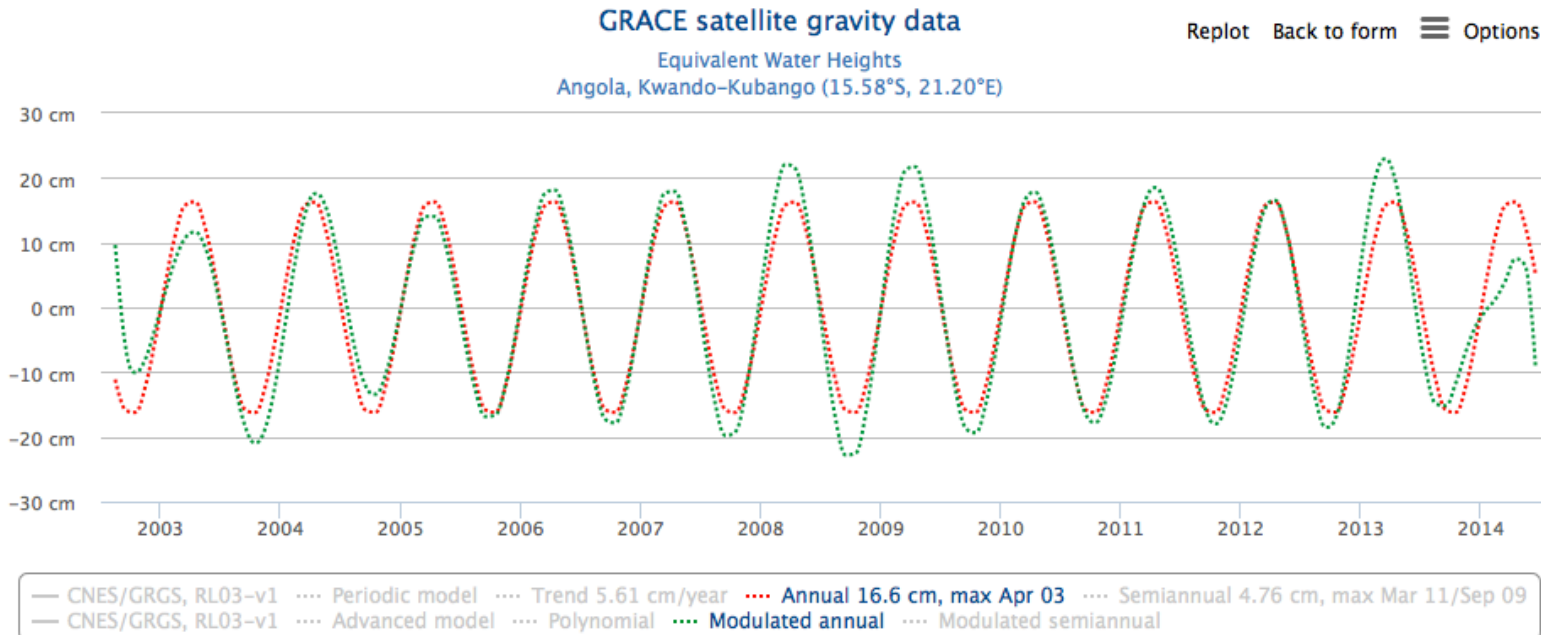
News

- Display components with Periodic+ and Advanced+



News

- Periodic vs advanced: modulation of amplitude and phase renders subtle differences between years



Downloaded from EGSIEM.eu



HORIZON 2020

News

- Numerical data
 - Detailed information about extraction area: grid points, weights, surface area...
 - Statistics (min, max, mean, standard deviation)
 - Regression information
 - One-click downloadable data and graph
 - EGSIEM watermark on data and graph

```
# Semiannual cos/sin: -3.567 cm, 3.144 cm
# Semiannual amplitude: 4.755 cm
# Semiannual phase: 221.393° (max on Mar 11/Sep 09)
# RMS of residuals (series-model): 8.769 cm
# Numerical data:
# Column 1: Time (seconds since 1970/01/01)
# Column 2: Time (days since 1950/01/01)
# Column 3: Time (years)
# Column 4: Equivalent Water Heights (cm)
# Column 5: Linear model (cm)
# Column 6: Periodic model (cm)
# From EWH cm to gigatons: multiply by area/100000 = 0.119102
1029456000 19220.00 2002.62149 -25.763 -33.923 -40.798
1032091200 19250.50 2002.70500 -39.413 -33.434 -43.355
1034726400 19281.00 2002.78850 -38.739 -32.945 -46.361
1037361600 19311.50 2002.87201 -35.539 -32.457 -46.628
1039996800 19342.00 2002.95551 -36.949 -31.968 -40.513
1042675200 19373.00 2003.04038 -27.591 -31.471 -28.131
1045224000 19402.50 2003.12115 -25.410 -30.998 -15.744
1047772800 19432.00 2003.20192 -21.410 -30.525 -9.023
```



Download

News

- Information and help
 - Full information at the bottom of the page
 - Help bubbles on cursor hover

Title	Gravity functional	Data set	Area	Latitude
Series 1	Water heights	CNES RL03-v1	Point	-15.5751
Series 2	Water heights	CNES RL03-v1	Point	-15.5751

Apply characteristics to all series, except data center and version

Apply to all series  



Multiply series by a scale factor

ess	Regression	Scale	Bias
ando-Ku	Periodic+	1	0
ando-Ku	Advanced+	1	0

News



- Design
 - Powerful but user-friendly, fast, and easy to use
 - Attractive modern design
 - Seamlessly designed in the style of the EGSIEM website, though externally designed and hosted. Integrated at plot.egsiem.eu

Conclusions



- Conclusions
 - A smart and useful tool much appreciated by users
 - Allows instant and valuable scientific analysis
- Further developments
 - Further improvement of ergonomics and functionalities
 - Increase of available data
 - Specific focus on the results of the project

Thank you