EGSIEM

European Gravity Service for Improved Emergency Management

EGSIEM - WP2
CNES/GRGS GRACE processing

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Summary

1. Report on 2006-2007 NEQs processing
2. Problems at the poles in our RL03-v1: solved in RL03-v2

HORIZON 2020

Report on 2006-2007 NEQs processing

- The years 2006-2007 have been processed and the NEQs computed.
- They will be uploaded on the ftp server at Bern very soon
- The unconstrained solutions will be provided at the same time as the NEQs
- We have also computed a 4-SLR-sat monthly time series of NEQs over 2002-2016 (Lageos-1, Lageos-2, Starlette and Stella). It is available to EGSIEM members

Report on 2006-2007 NEQs processing

- Processing standards:
  - A priori sigma for KBRR: 1.e-7 m/s
  - A priori sigma for GPS phase: 2.e-2 m
  - A priori sigma for GPS code: 1. m
  - GPS measurements density: 1 epoch every 30"
  - The GPS partial derivatives are computed only up to degree 40

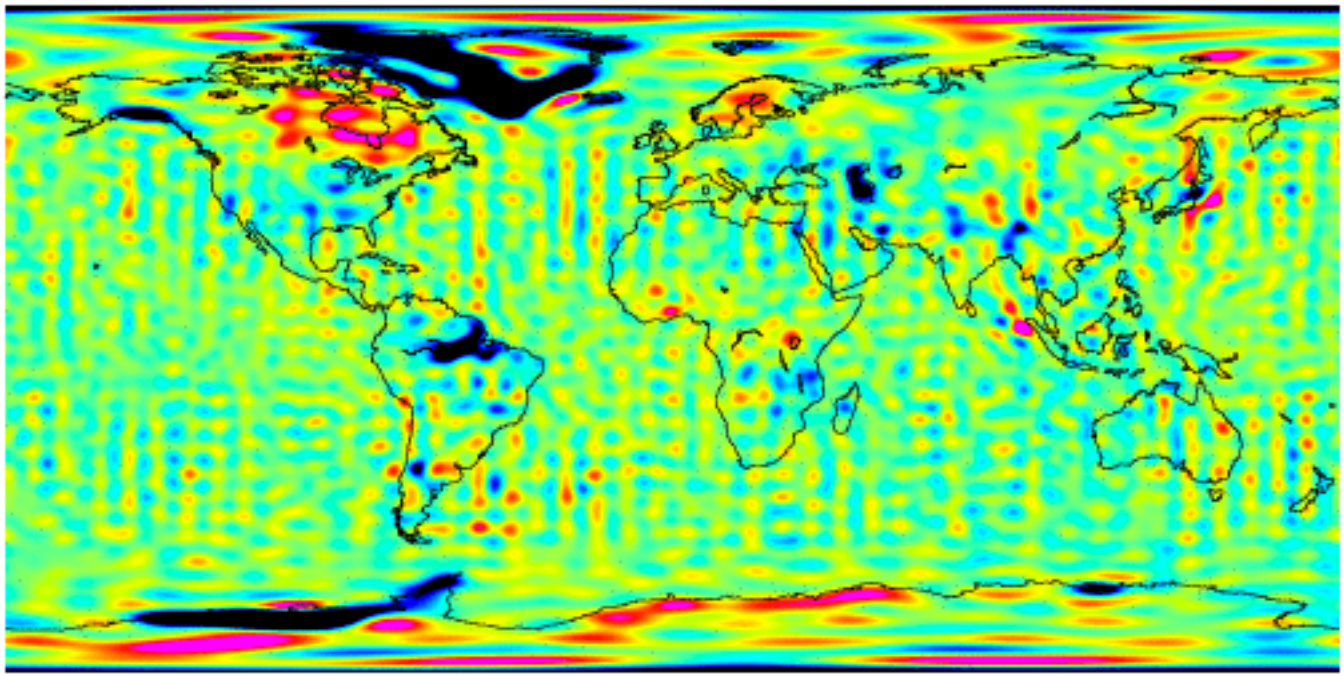
GPS KBR weighting

- **Effects of relative weighting**
  - **GPS weight too high: too much striping in the solution (resonances)**
  - **GPS weight too low: orbit errors, and low sectorial coefficients badly determined**

GPS KBR weighting

- **A priori sigma GPS : 8 mm (high weight)**

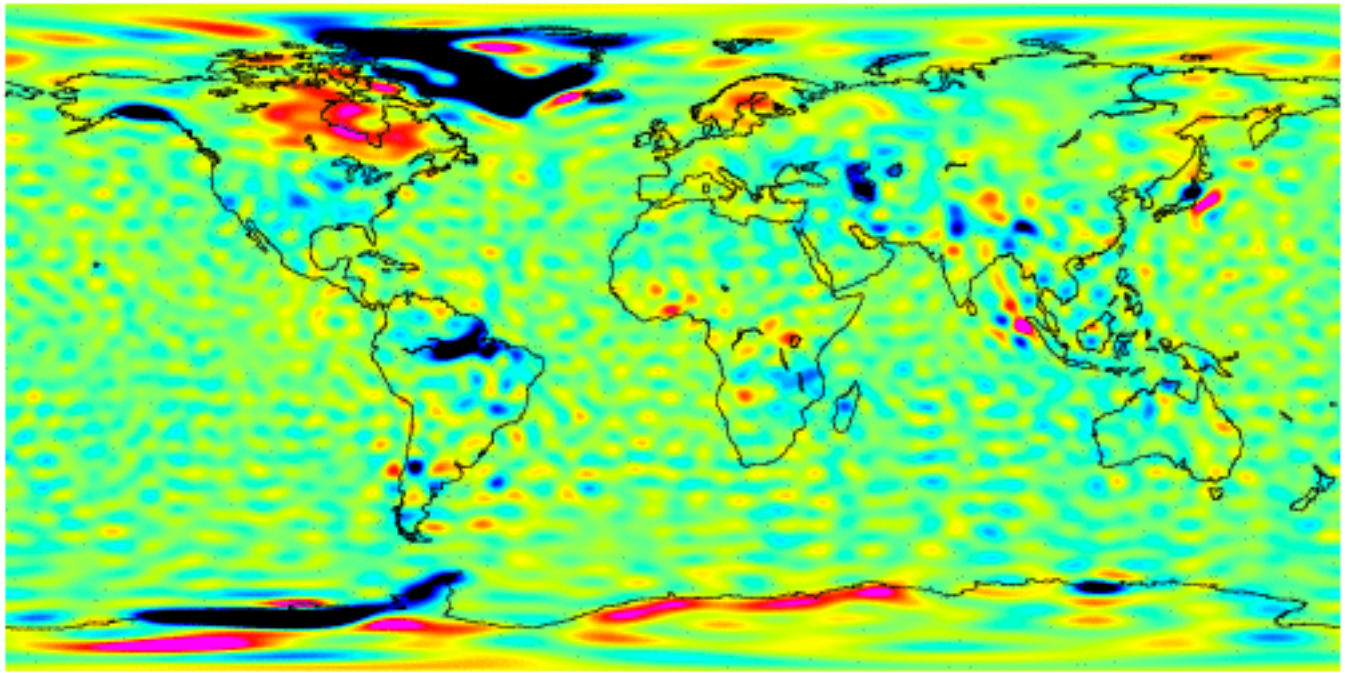
Typical monthly solution



GPS KBR weighting

- **A priori sigma GPS : 20 mm (low weight)**

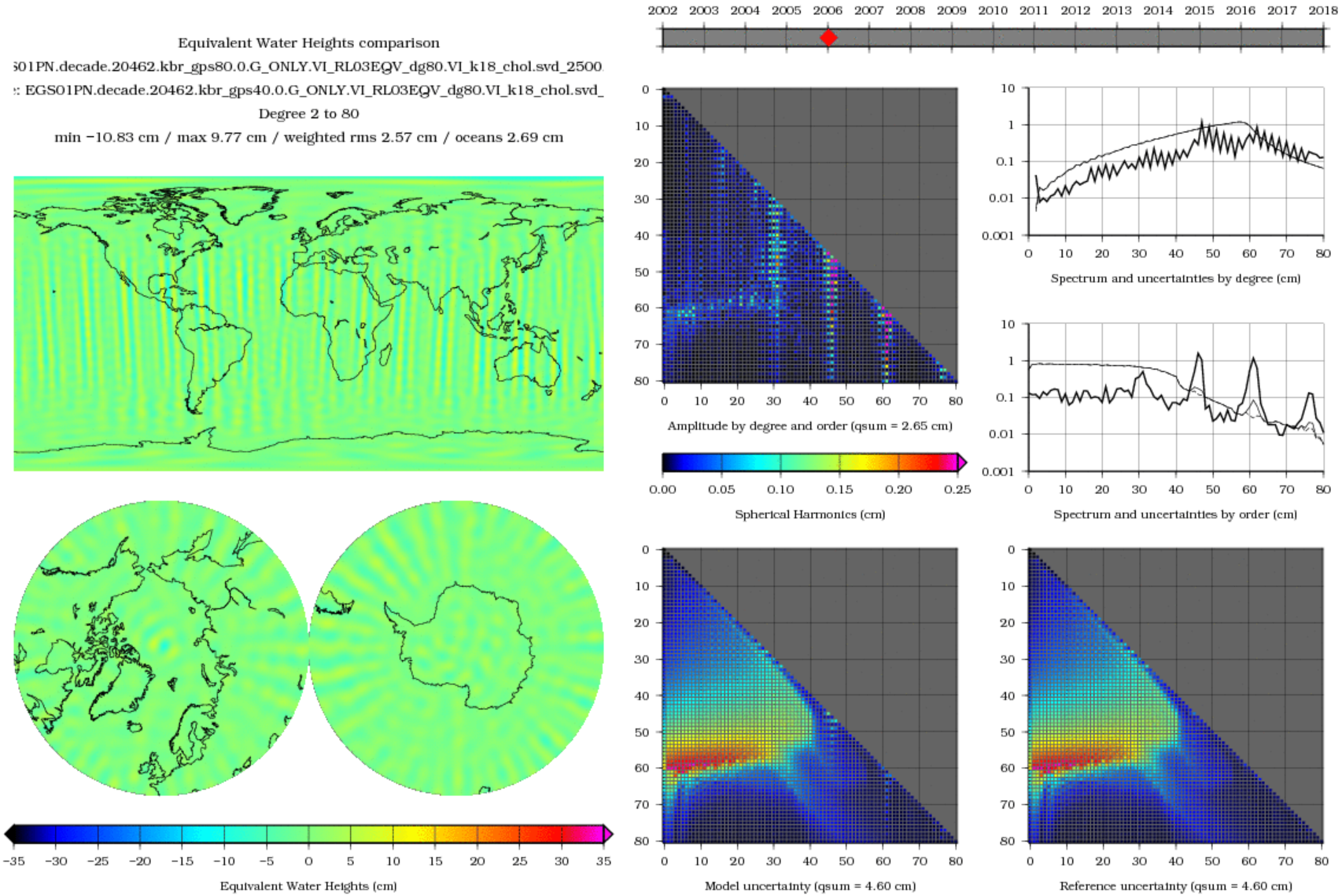
Typical monthly solution



GPS KBR weighting

- **Best solution:**
  - **high density, low weight, and cut GPS equation to degree 40**

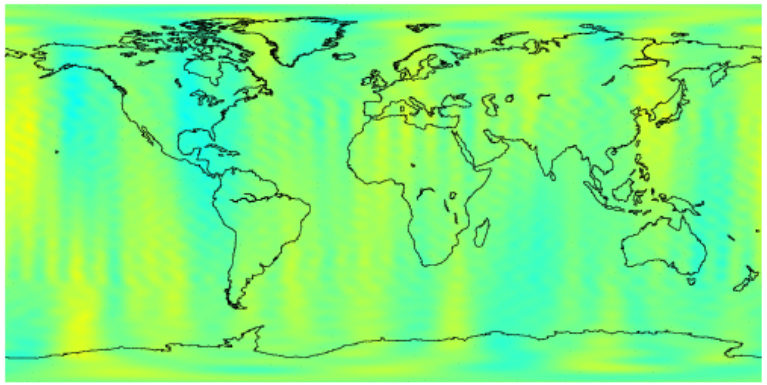
Truncation of GPS partials

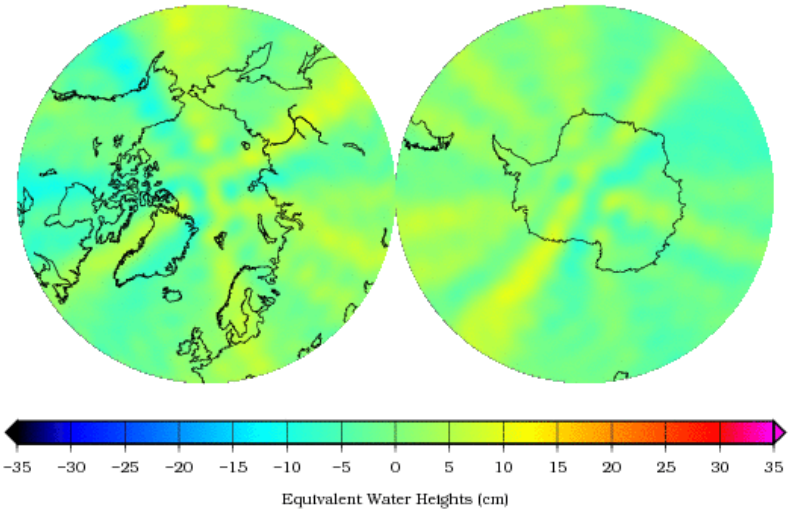


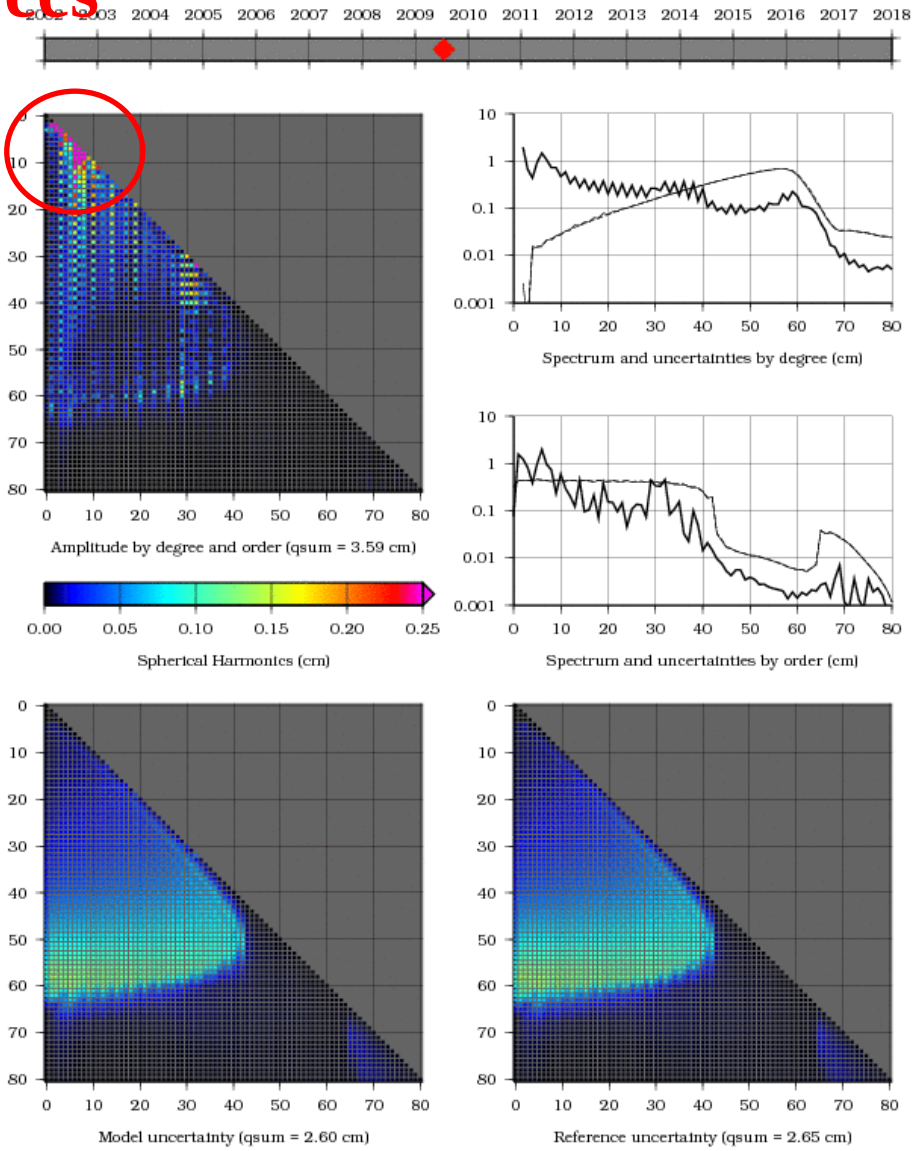
Truncation of GPS partials

Up to 40 improves low degrees

Gravity field solution:
High vs. Low GPS weight



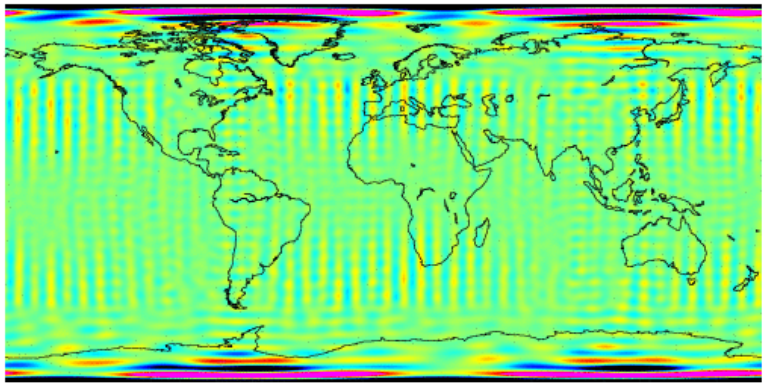


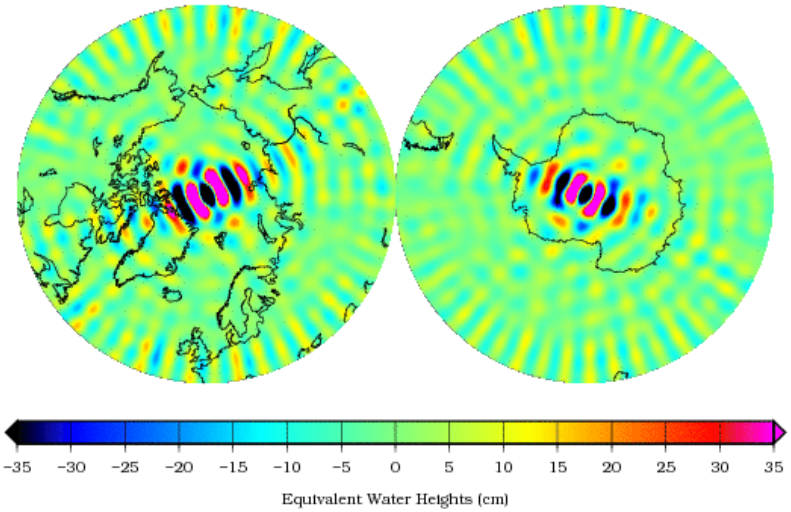


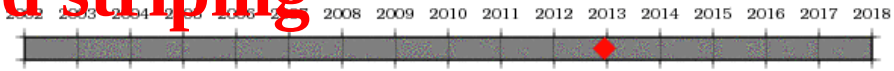
Truncation of GPS partials

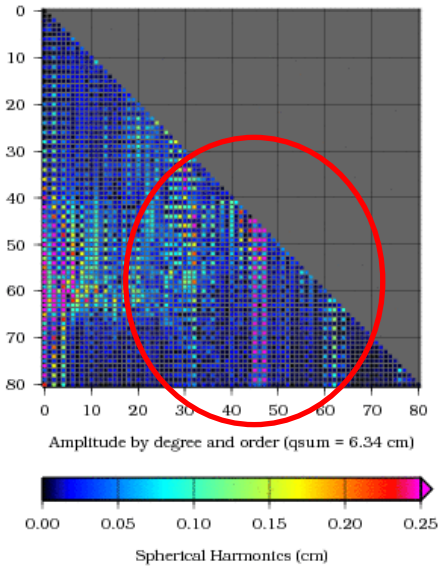
From 40 to 80 adds noise and striping

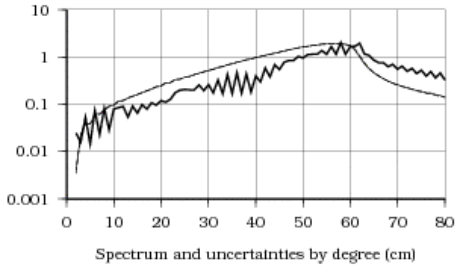
Gravity field solution:
High vs. Low GPS weight

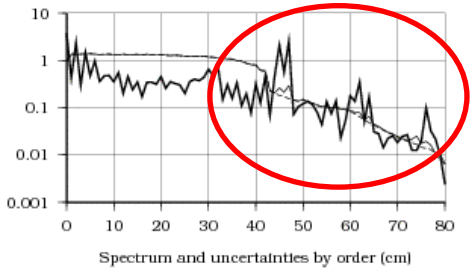


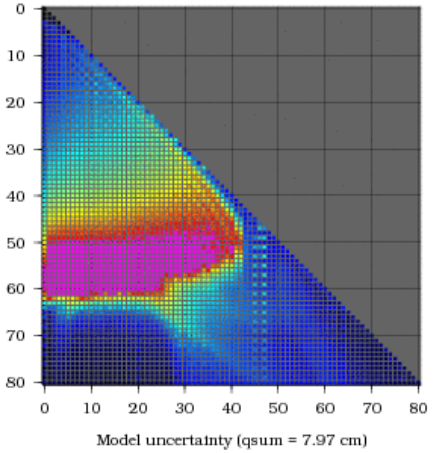


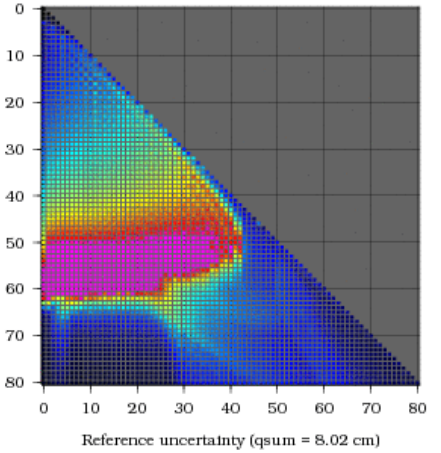












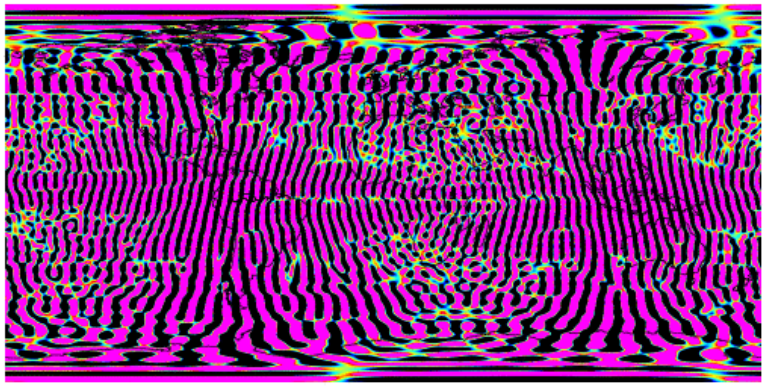
Problems at the poles

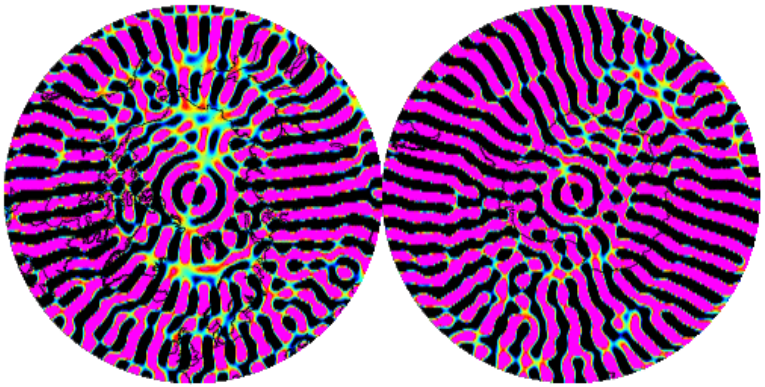
- **Problems at the poles**
  - **They are not immediately related to GPS**
  - **Appear when low sectorial coefficients are wrong (compensation on higher orders). This can be the case when those are fixed, or with SVD**

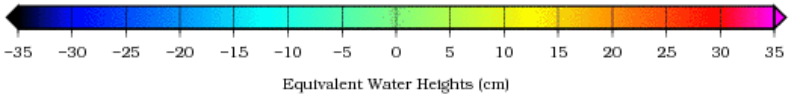
- **Example**
  - **Choleski inversion (no constraint), with degree 1 fixed or solved**

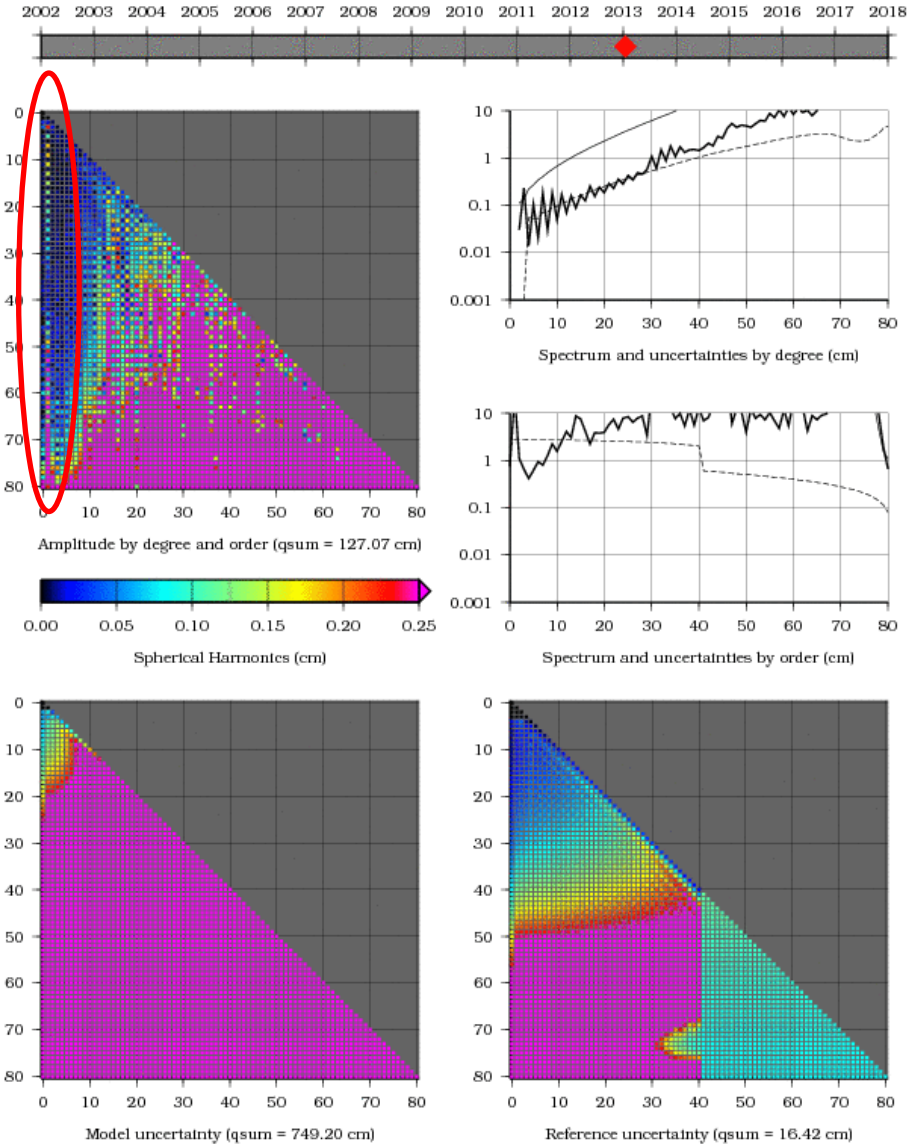
Degree 1 fixed

Unconstrained gravity field solution
Degree 1 FIXED (December 2012)



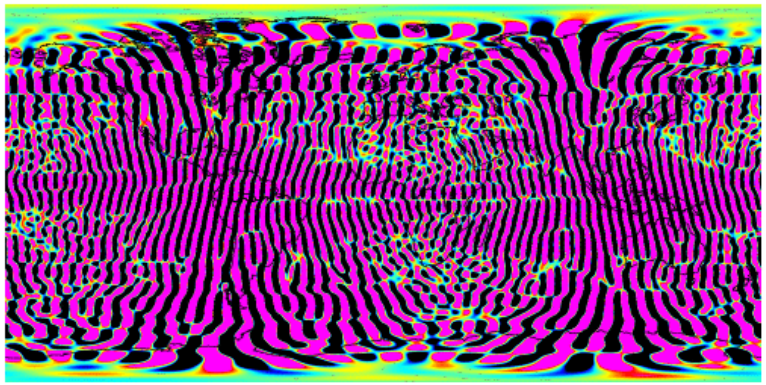


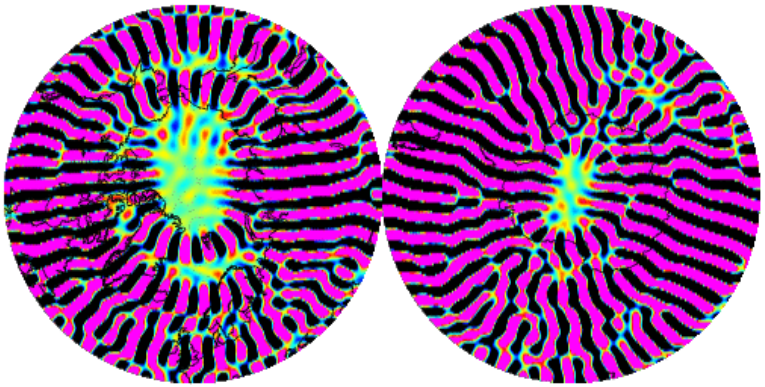


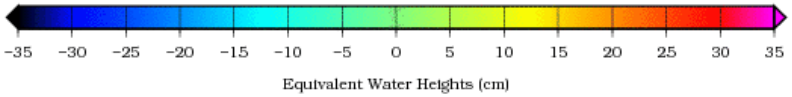


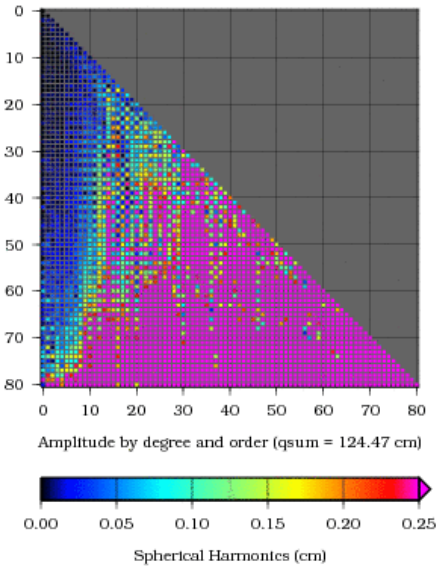
Degree 1 solved

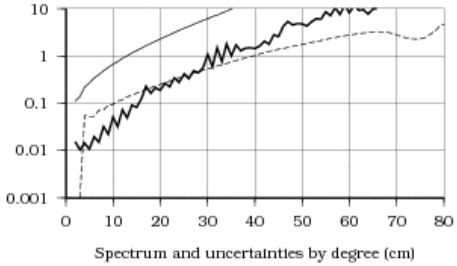
Unconstrained gravity field solution
Degree 1 FREE (December 2012)

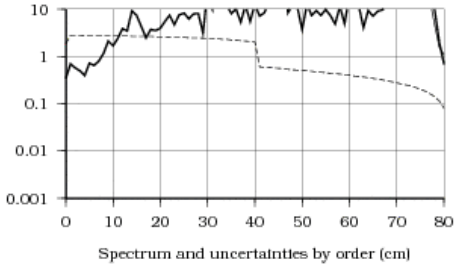


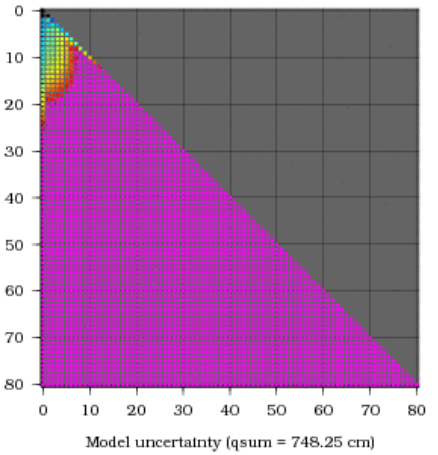


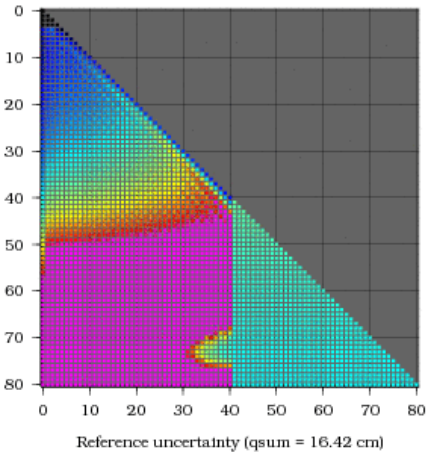




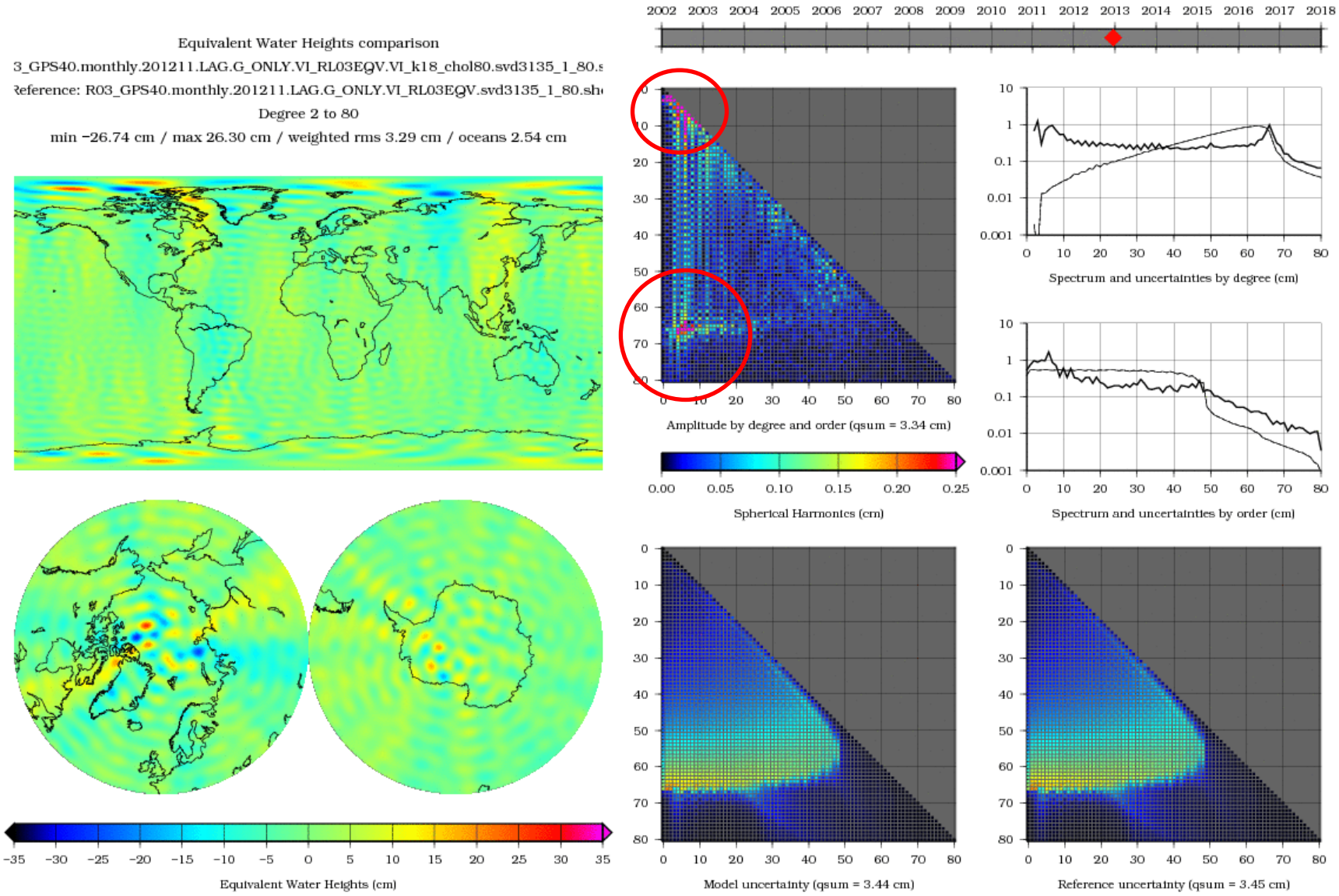




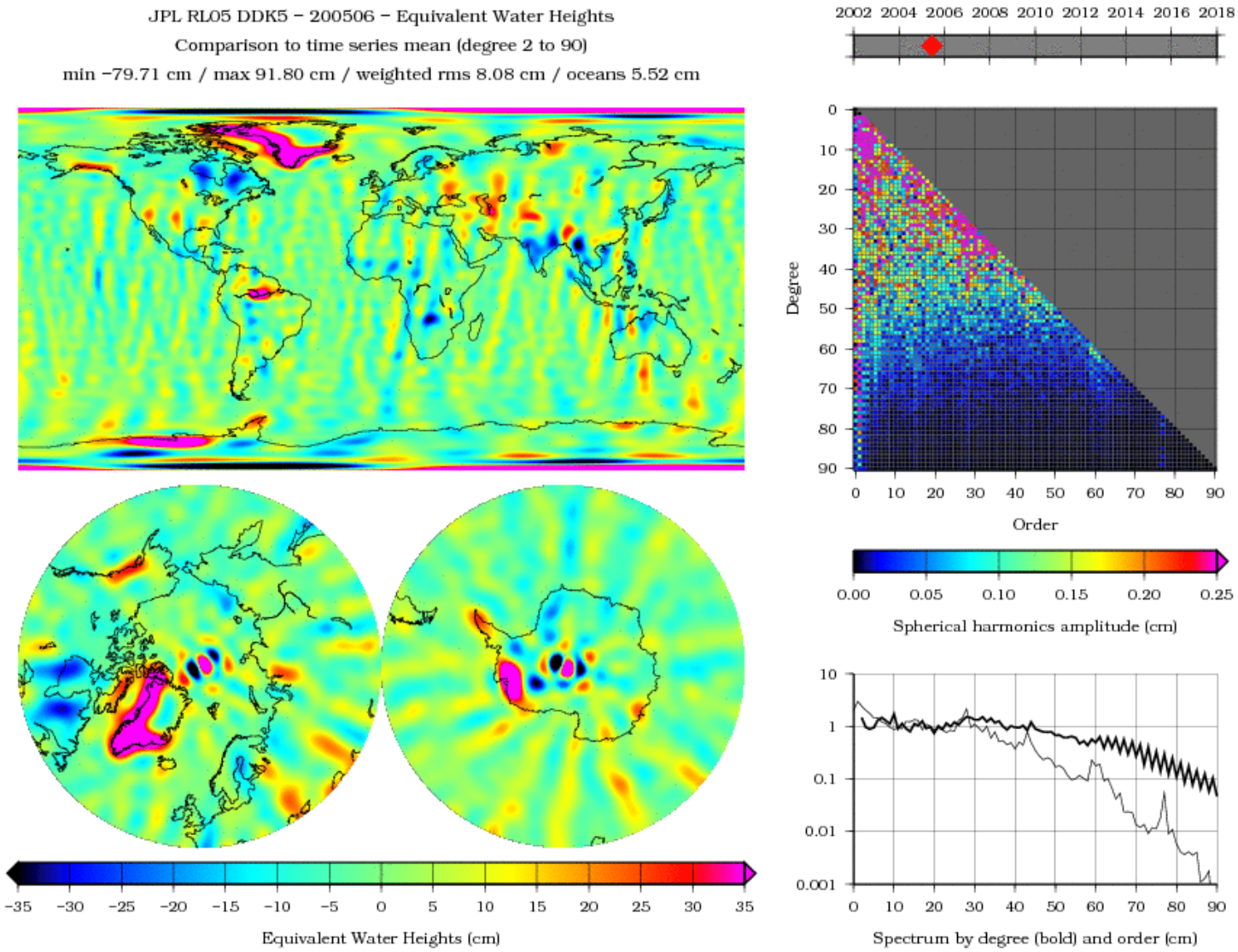




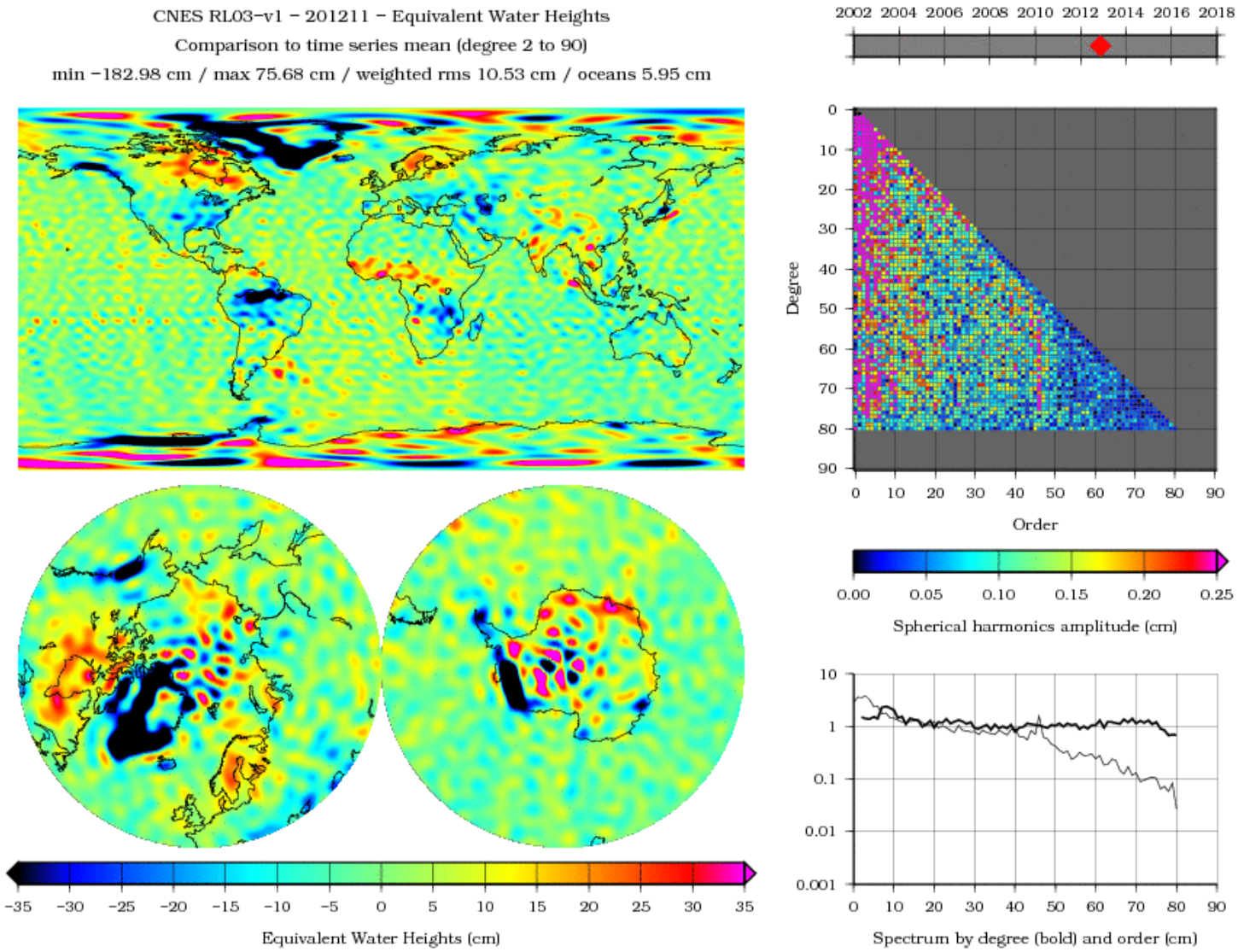
Impact of wrong low-degree sectorials



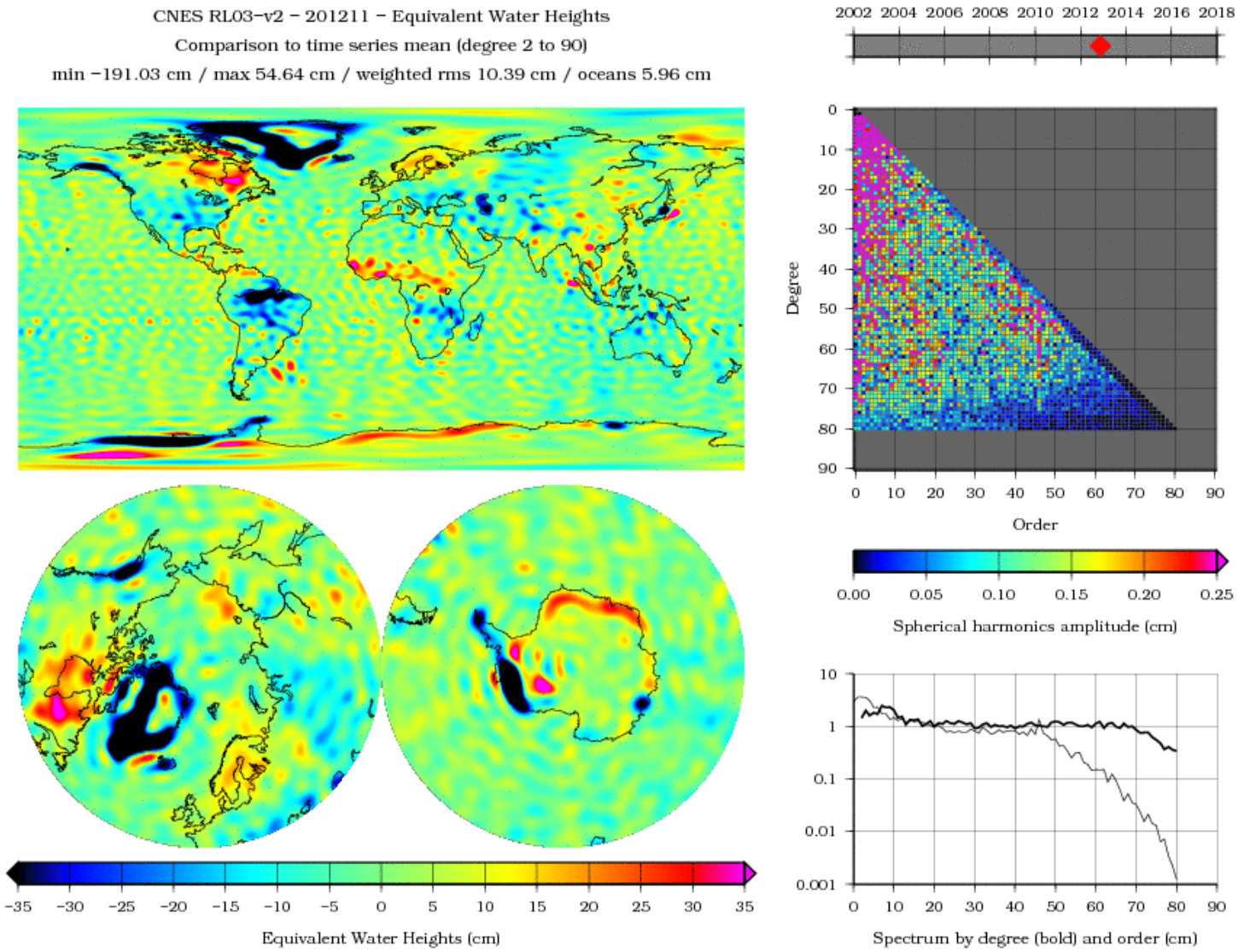
JPL solution

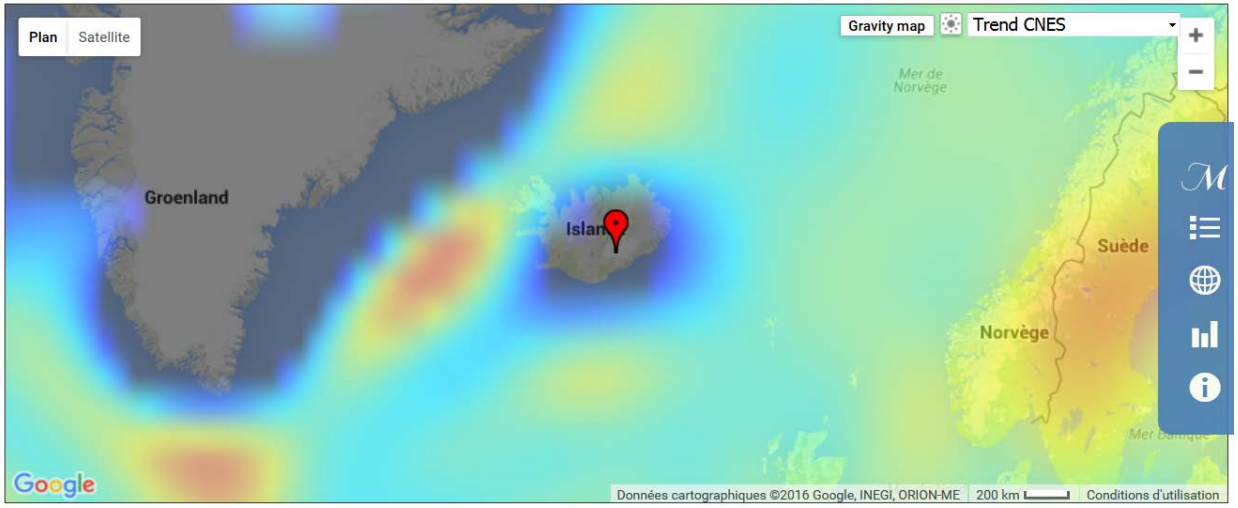


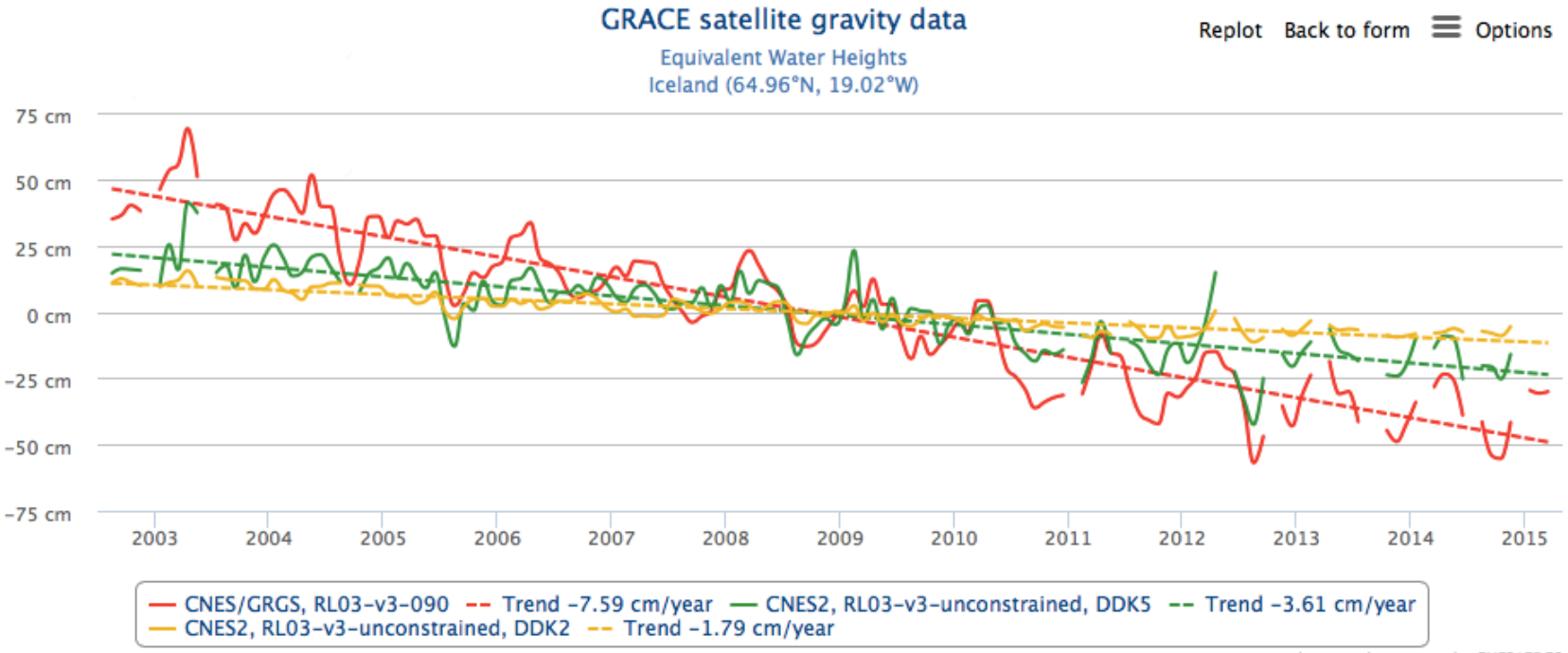
RL03-v1

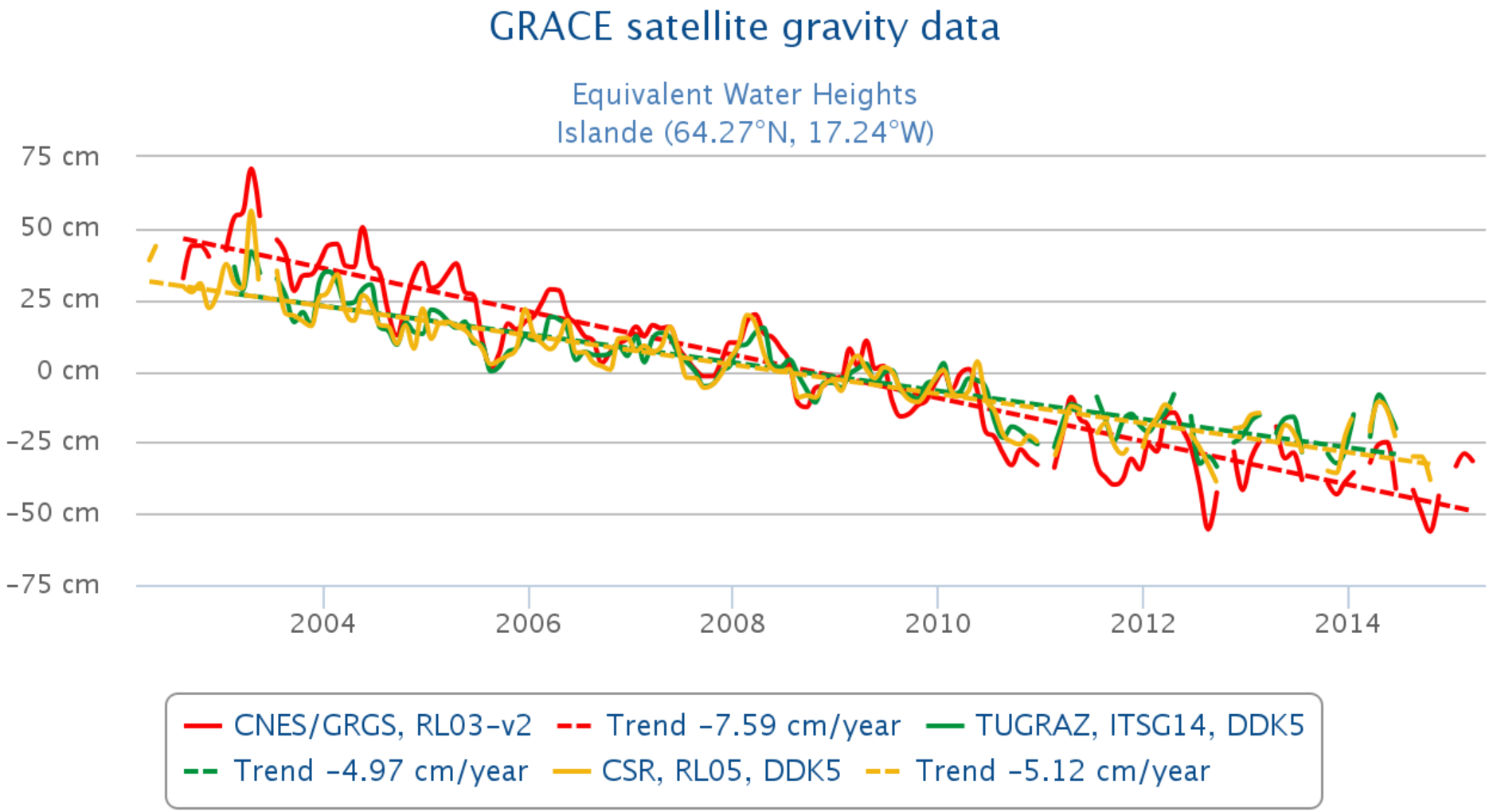

CNES RL03-v1 – 201211 – Equivalent Water Heights
Comparison to time series mean (degree 2 to 90)
min −182.98 cm / max 75.68 cm / weighted rms 10.53 cm / oceans 5.95 cm
2002 2004 2006 2008 2010 2012 2014 2016 2018
Degree
Order
0.00 0.05 0.10 0.15 0.20 0.25
Spherical harmonics amplitude (cm)
−35 −30 −25 −20 −15 −10 −5 0 5 10 15 20 25 30 35
Equivalent Water Heights (cm)
Spectrum by degree (bold) and order (cm)

RL03-v2

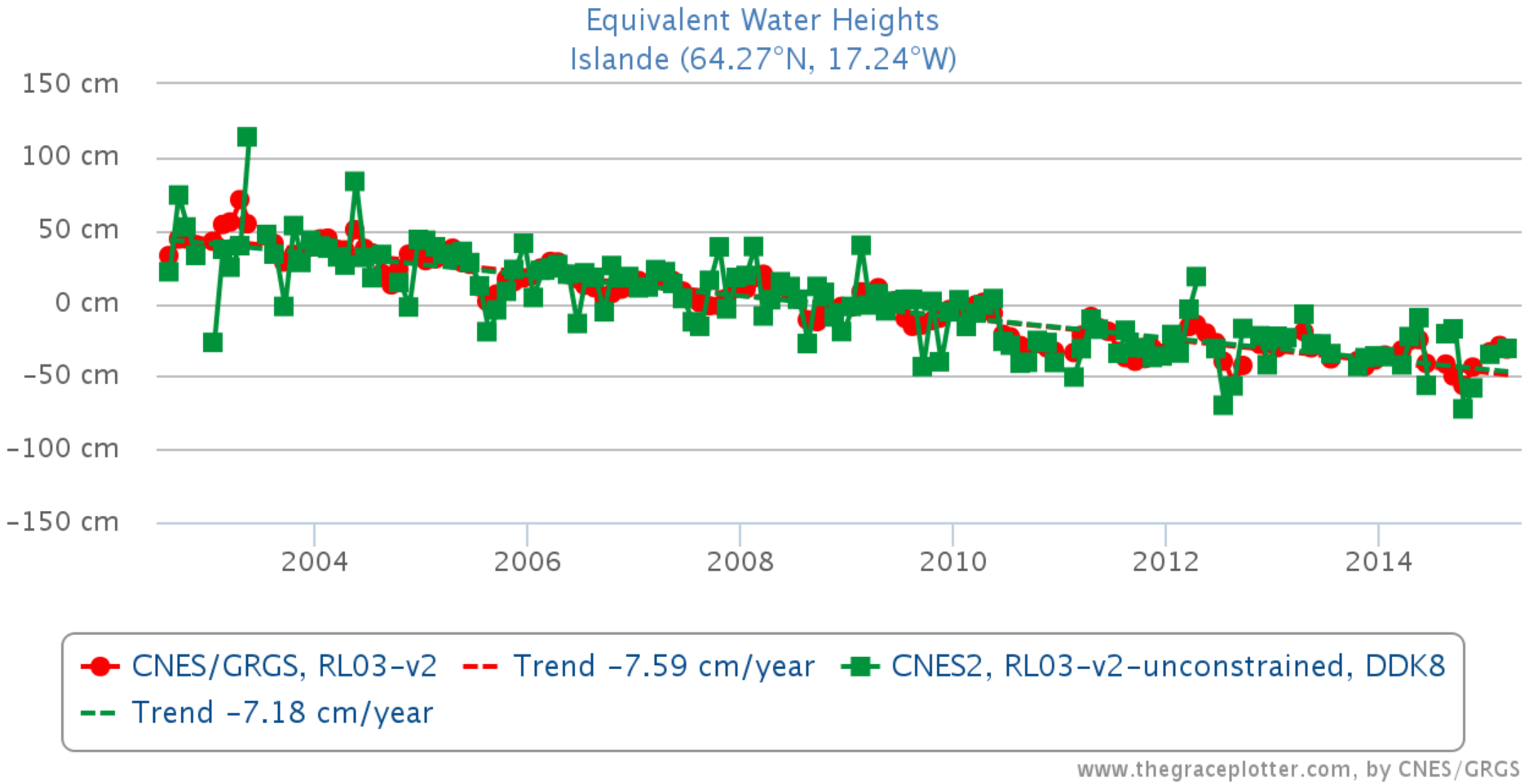

CNES RL03-v2 - 201211 - Equivalent Water Heights
Comparison to time series mean (degree 2 to 90)
min -191.03 cm / max 54.64 cm / weighted rms 10.39 cm / oceans 5.96 cm
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35
Equivalent Water Heights (cm)
2002 2004 2006 2008 2010 2012 2014 2016 2018
Degree
Order
0.00 0.05 0.10 0.15 0.20 0.25
Spherical harmonics amplitude (cm)
Spectrum by degree (bold) and order (cm)


Plan
Satellite
Gravity map
Trend CNES
Groenland
Islan
Suède
Norvège
Mer de Norvège
Google
Données cartographiques ©2016 Google, INEGI, ORION-ME
200 km
Conditions d'utilisation


GRACE satellite gravity data
Equivalent Water Heights
Iceland (64.96°N, 19.02°W)
Replot
Back to form
Options
75 cm
50 cm
25 cm
0 cm
-25 cm
-50 cm
-75 cm
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
CNES/GRGS, RL03-v3-090 -- Trend -7.59 cm/year
CNES2, RL03-v3-unconstrained, DDK5 -- Trend -3.61 cm/year
CNES2, RL03-v3-unconstrained, DDK2 -- Trend -1.79 cm/year
www.thegraceplotter.com, by CNES/GRGS


GRACE satellite gravity data
Equivalent Water Heights
Islande (64.27°N, 17.24°W)
75 cm
50 cm
25 cm
0 cm
-25 cm
-50 cm
-75 cm
2004
2006
2008
2010
2012
2014
CNES/GRGS, RL03-v2
Trend -7.59 cm/year
TUGRAZ, ITSG14, DDK5
Trend -4.97 cm/year
CSR, RL05, DDK5
Trend -5.12 cm/year
www.thegraceplotter.com, by CNES/GRGS

GRACE satellite gravity data



CONCLUSION

The choice of the inversion method for producing the combined solution is <u>VERY VERY</u> important