

EGSIEM combination service: combination of GRACE monthly K-band solutions on normal equation level

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Vienna

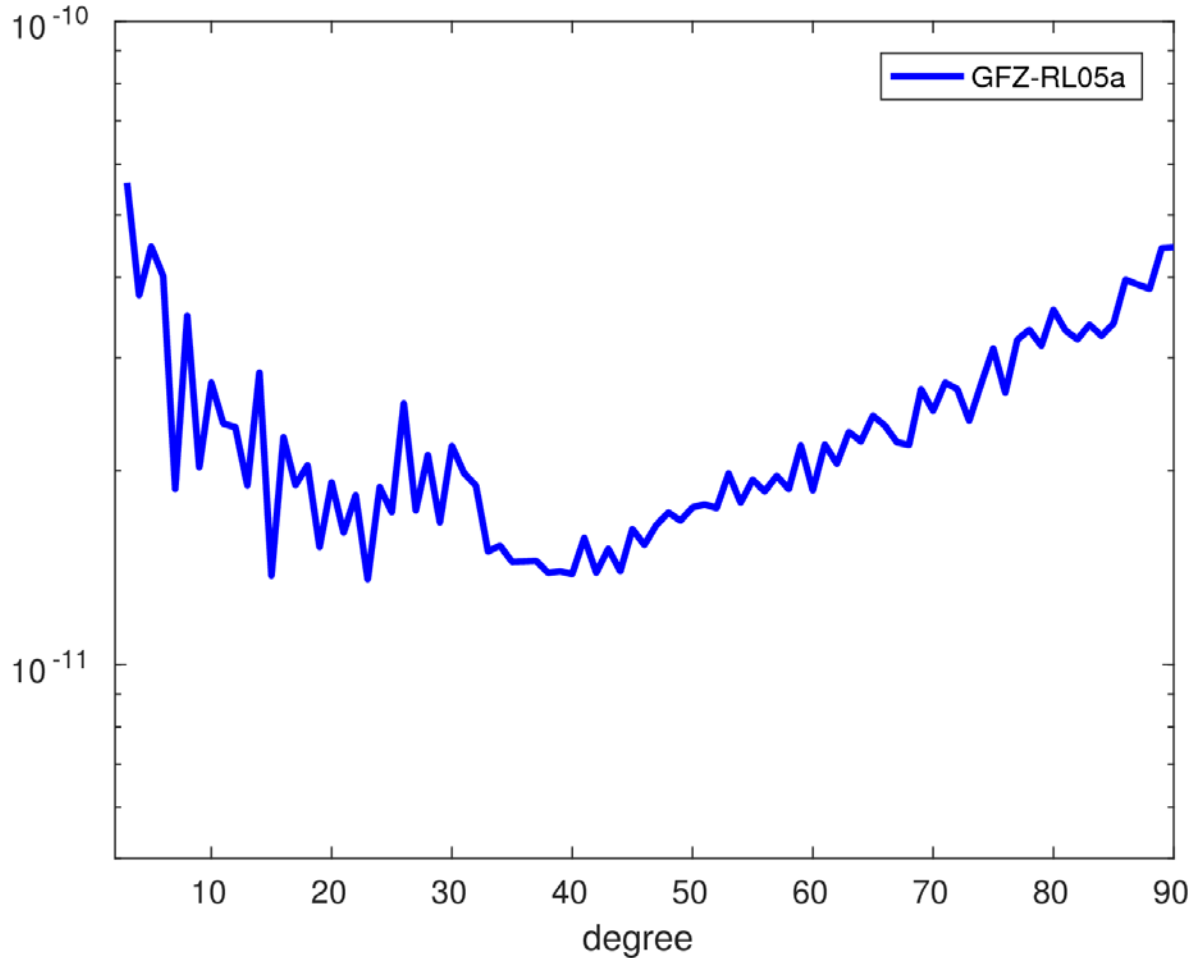
April 24-28, 2017

Contents

- Motivation
- Individual Contributions
- Noise Assessment
- Combination on Normal Equation Level
- Conclusions

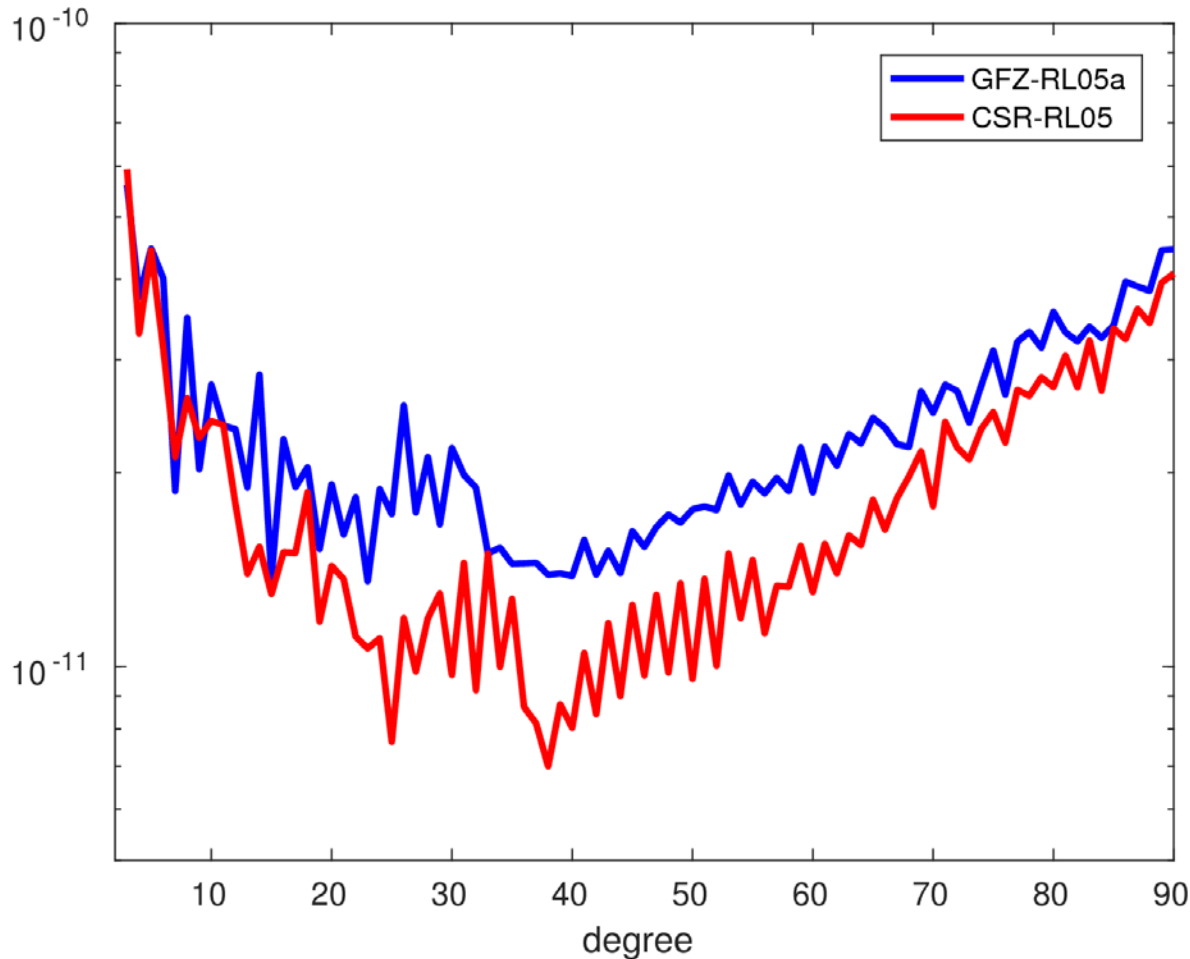
Motivation

Degree Amplitudes of Anomalies 01/2006: orders 0 - 29
SH coefficients – model fit of secular/seasonal variations



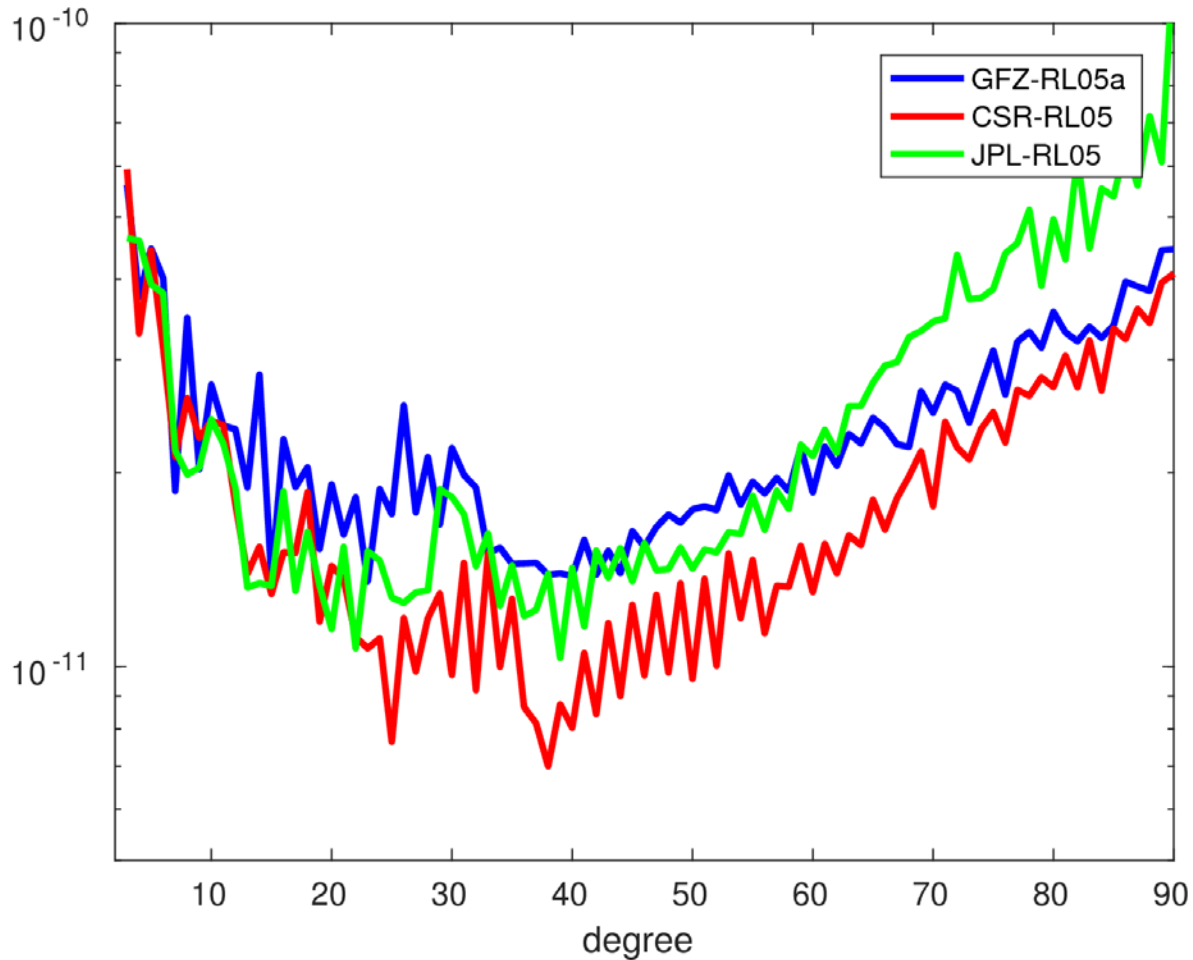
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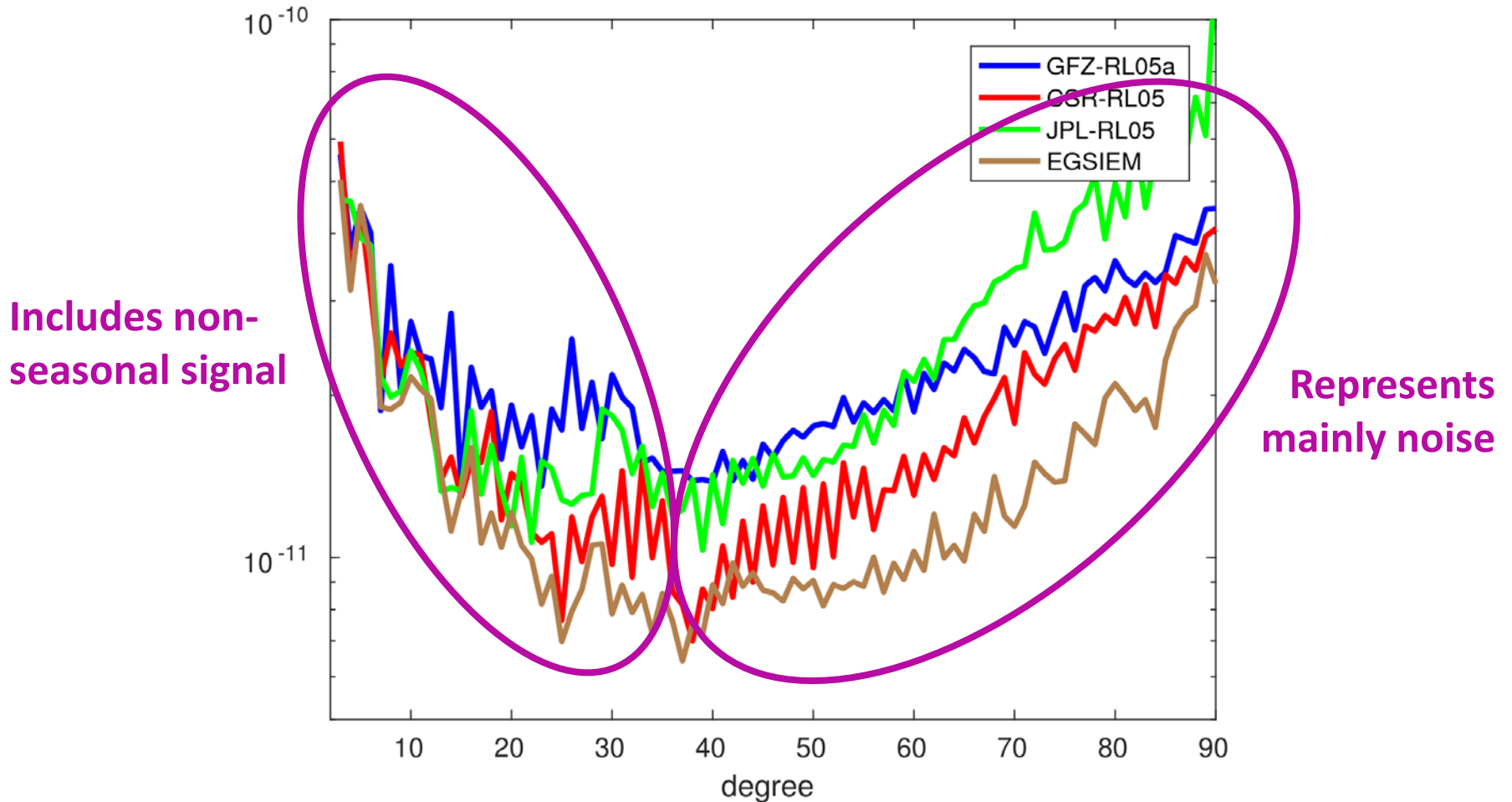
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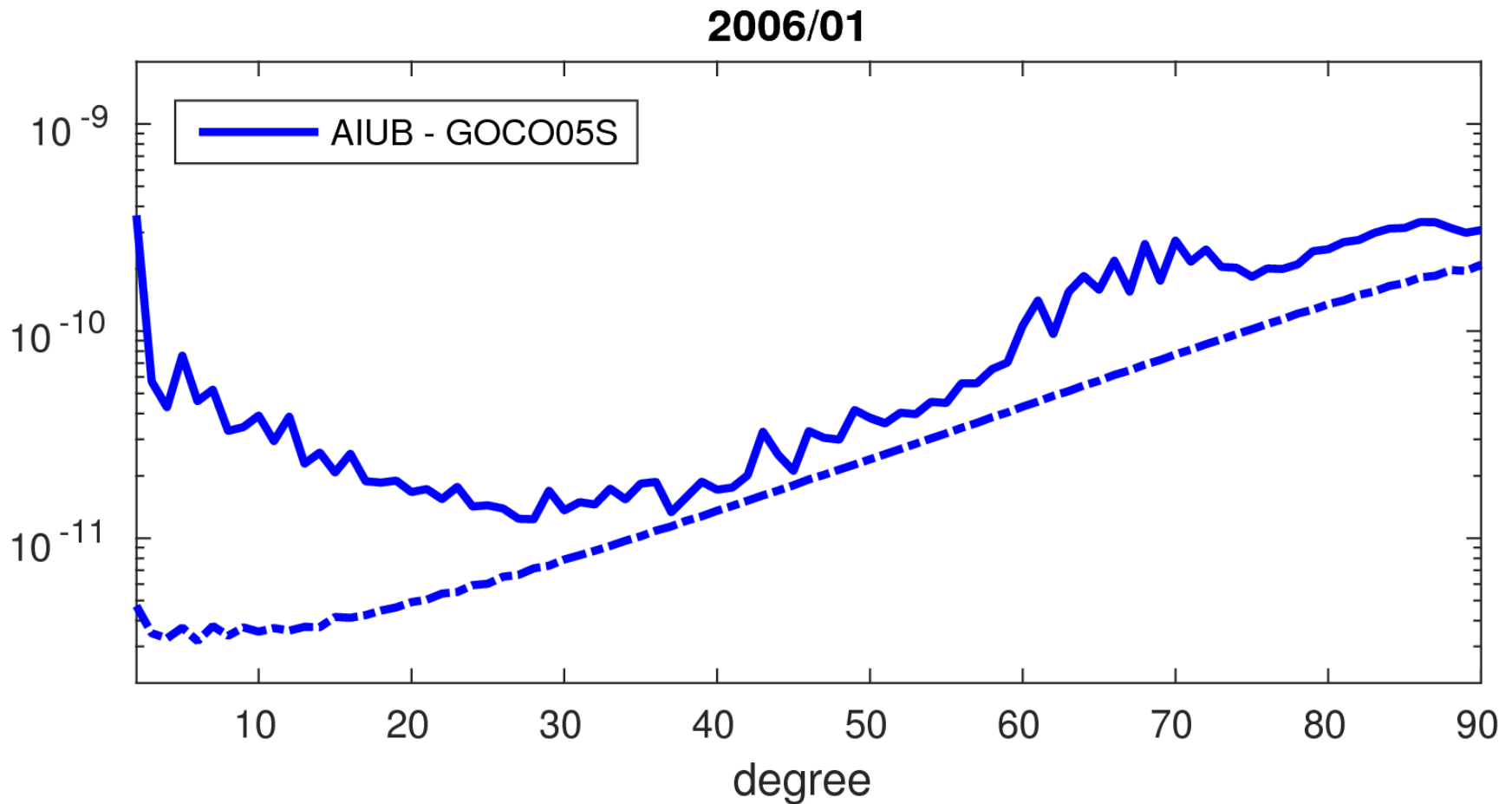


Motivation

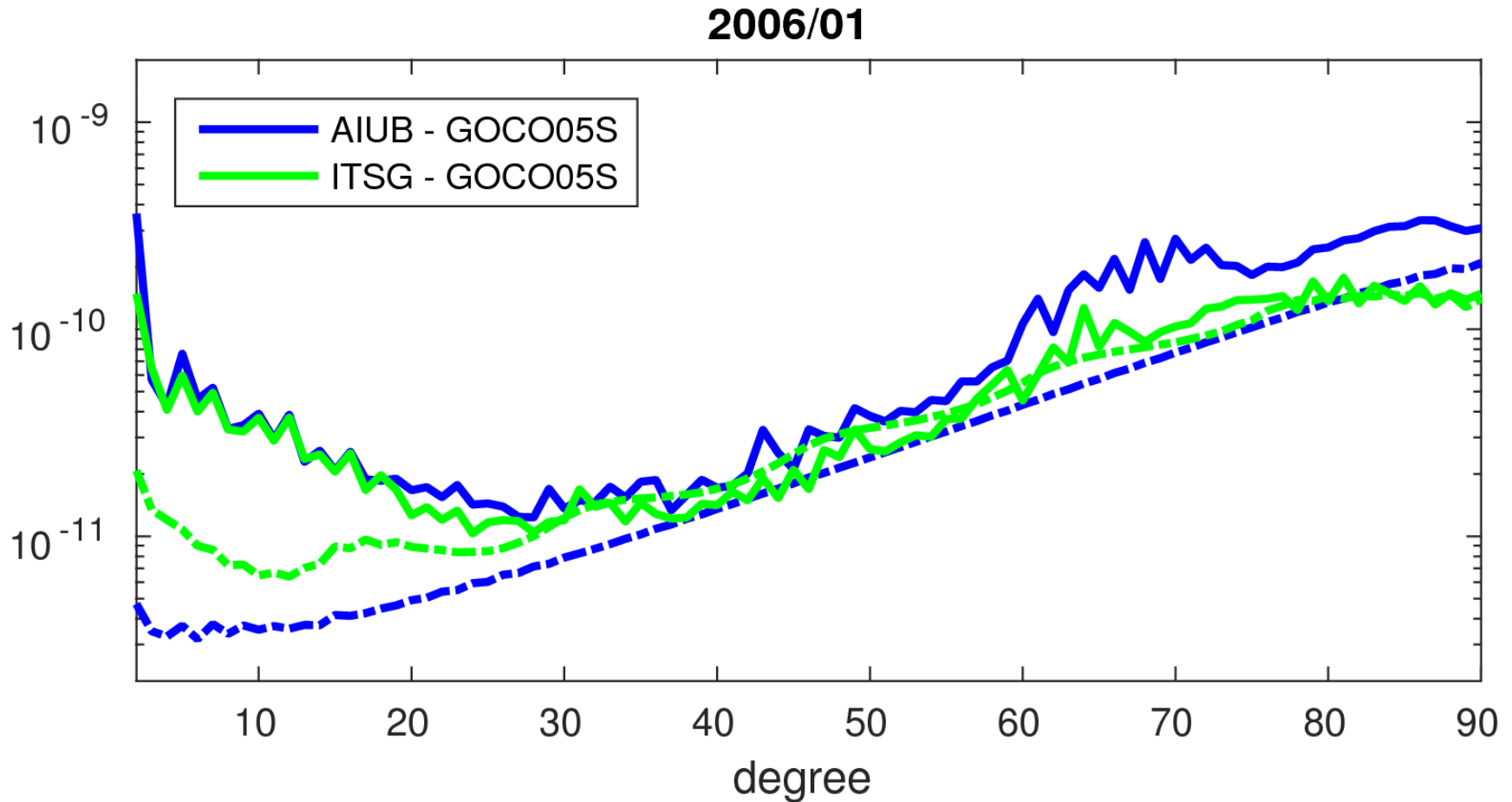
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SH coefficients – model fit of secular/seasonal variations



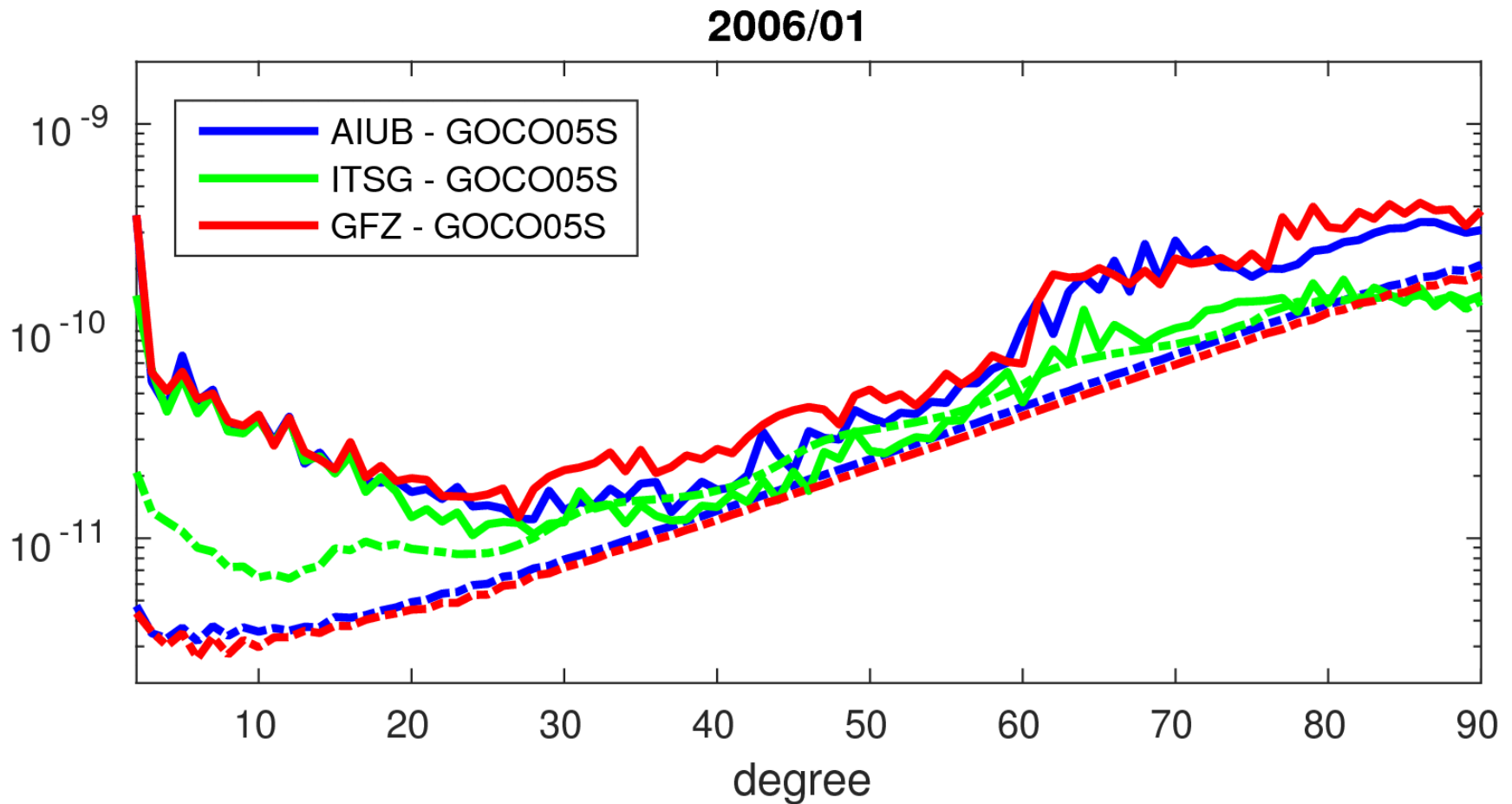
Individual Contributions



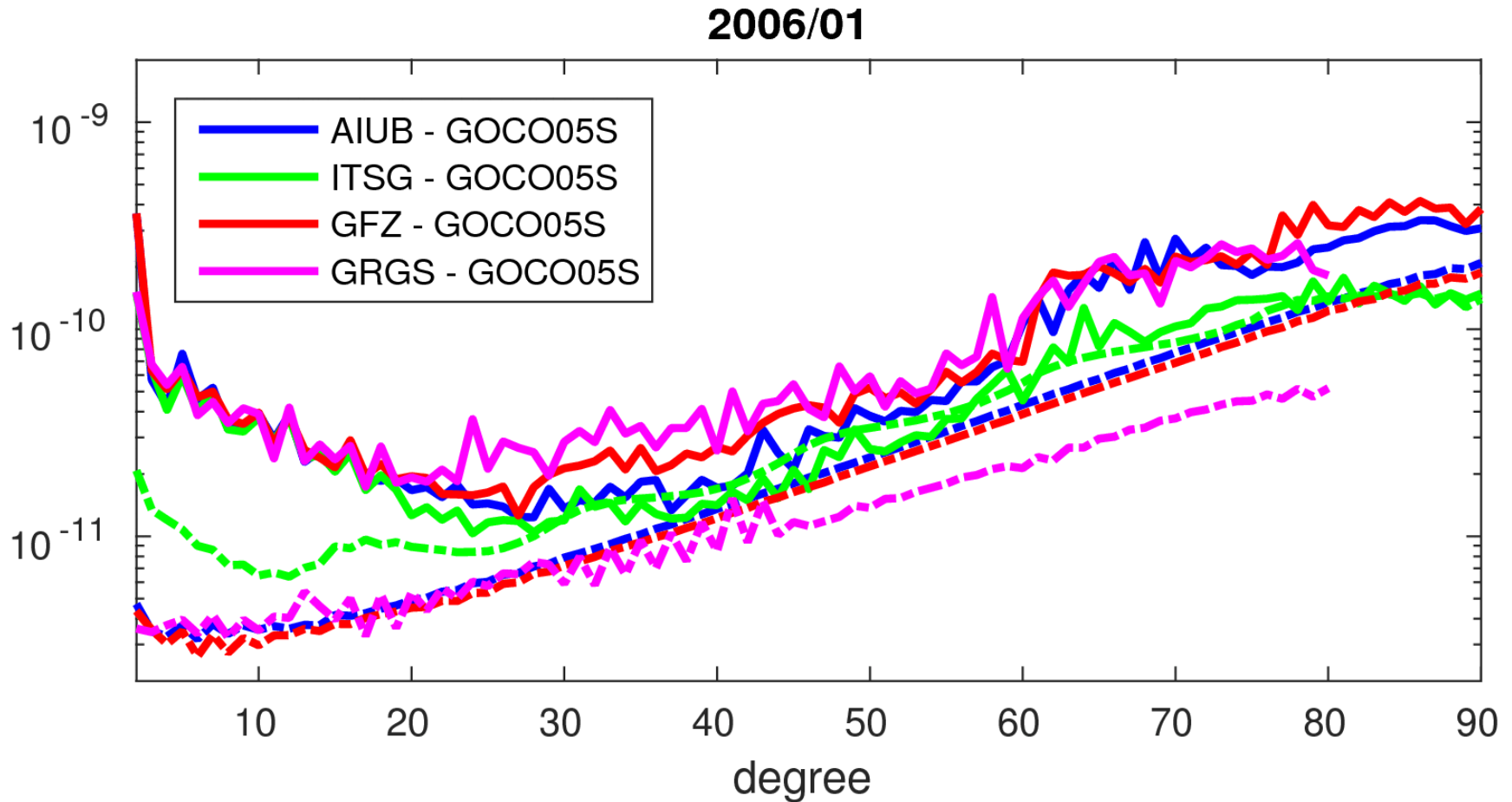
Individual Contributions



Individual Contributions



Individual Contributions



Individual Contributions

Why are formal errors so different?

Formal errors depend on the noise model applied!

Error propagation of kinematic orbits and K-band observations



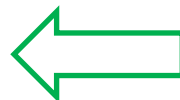
Optimistic

Realistic (empirical)

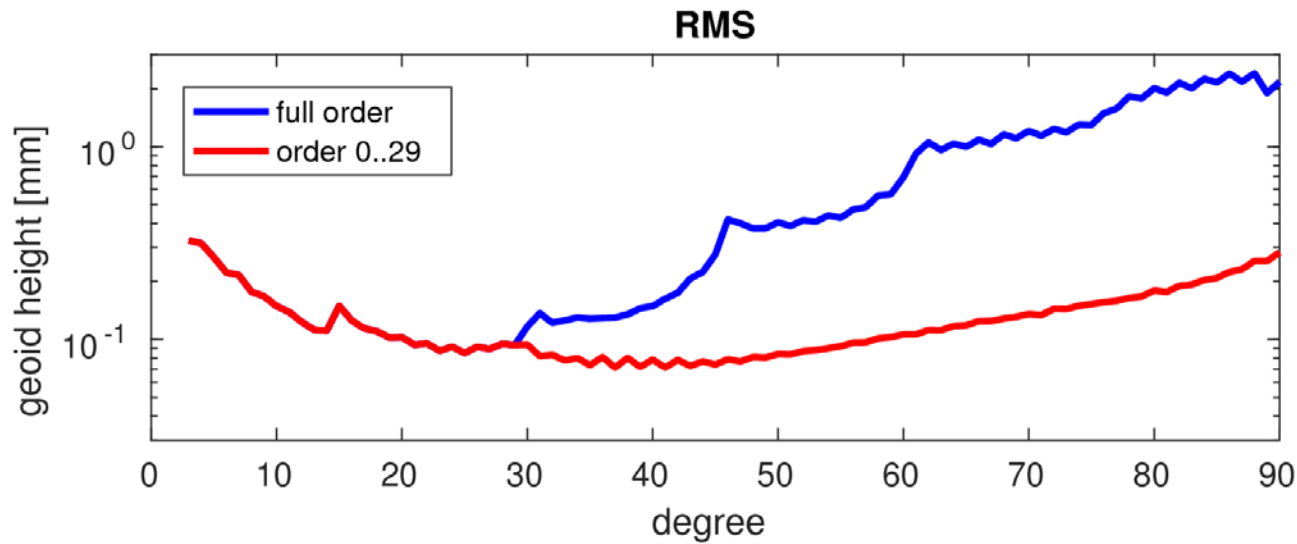
Errors of observations: GPS, K-band, accelerometers, star cameras



Errors of background models and de-aliasing: ocean tides, short periodic atmosphere and ocean variations (AOD)

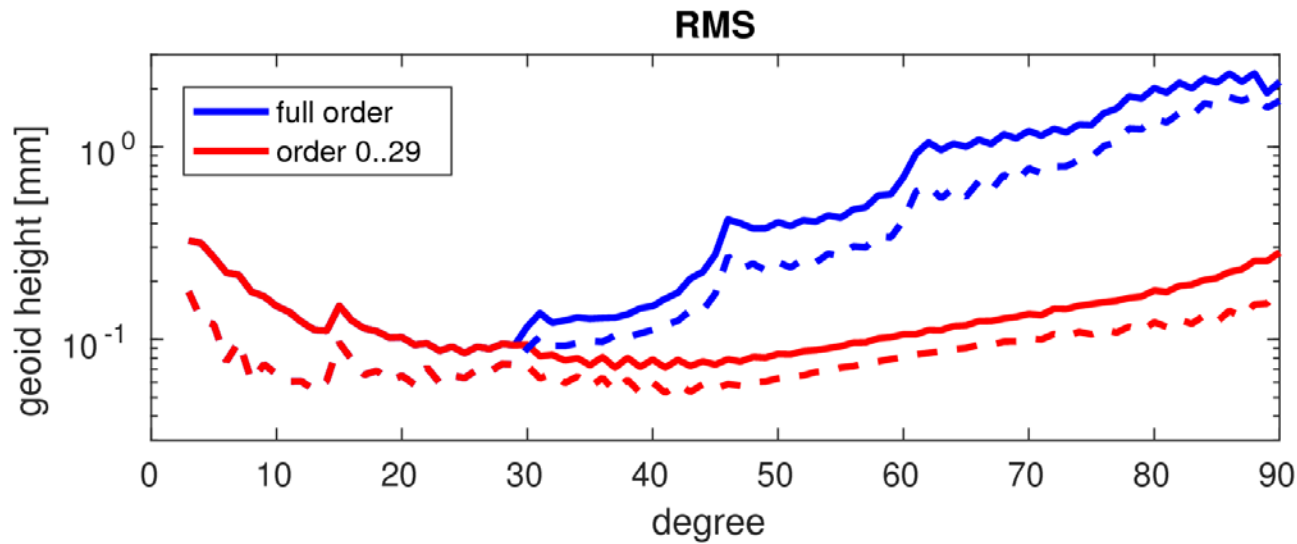


Noise Assessment



Anomalies:  
differences to model

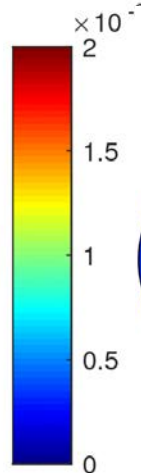
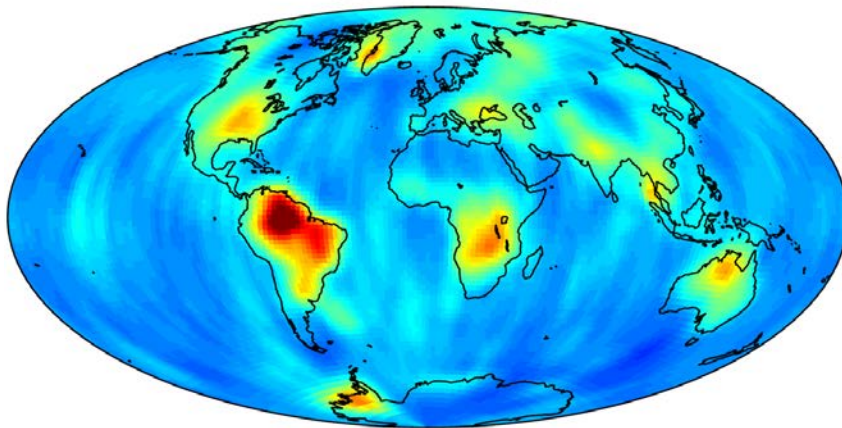
Noise Assessment



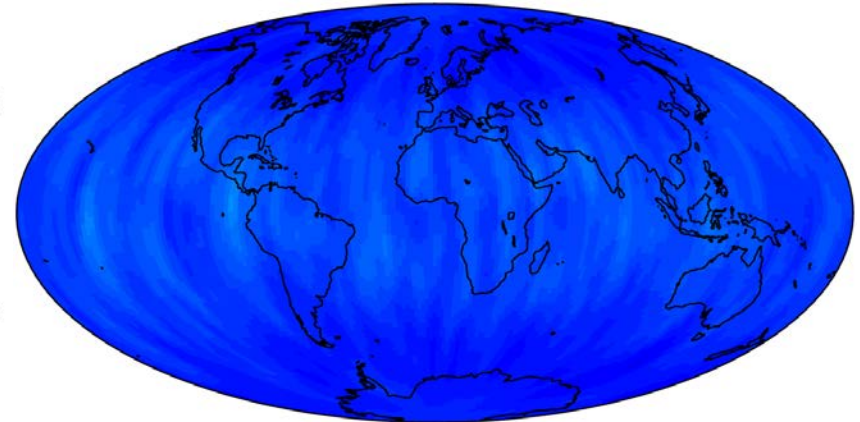
Anomalies: — (solid blue), — (solid red)
differences to model

Differences: - - (dashed blue), - - (dashed red)
differences to mean

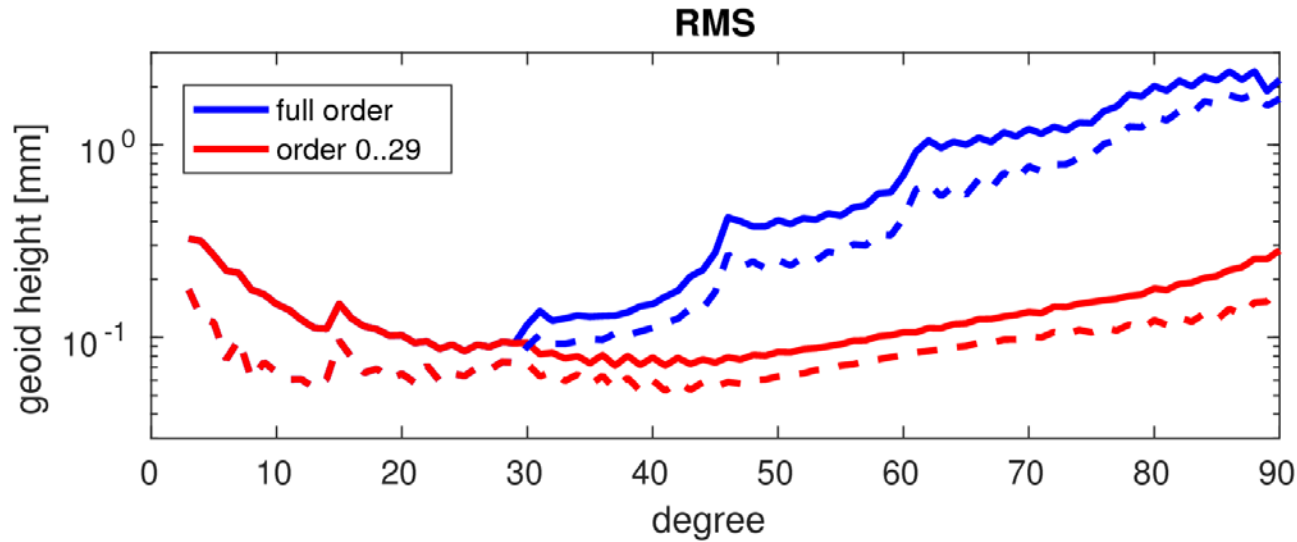
RMS of anomalies





RMS of differences to mean



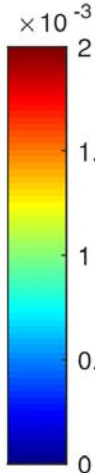
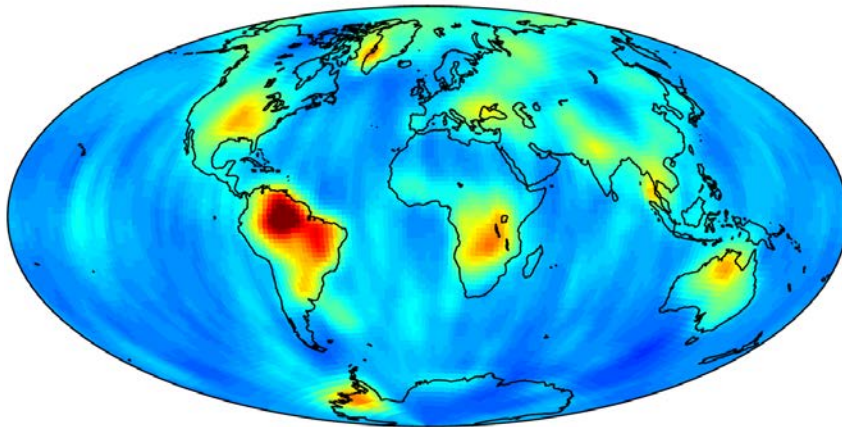
Noise Assessment



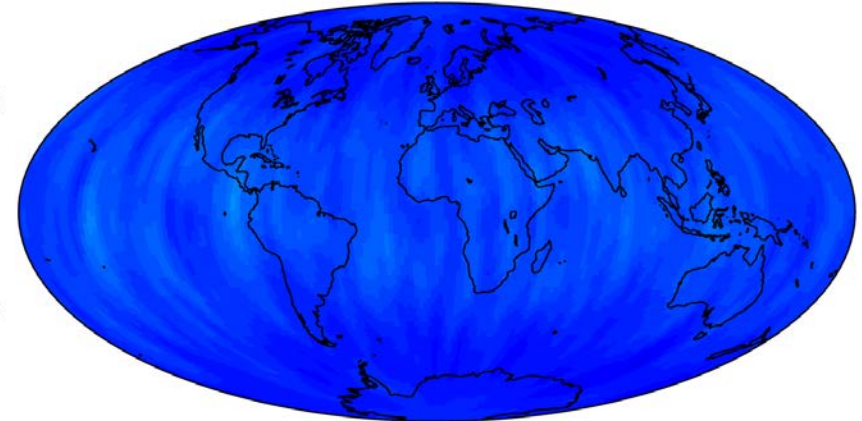
Differences to mean
to derive relative
weights.  

Anomalies over quite
regions to indepently
assess quality.  

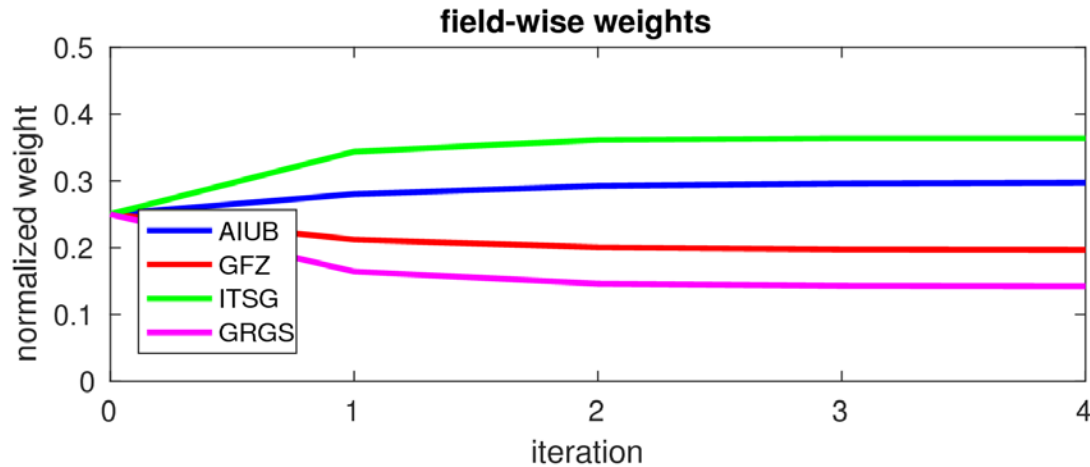
RMS of anomalies



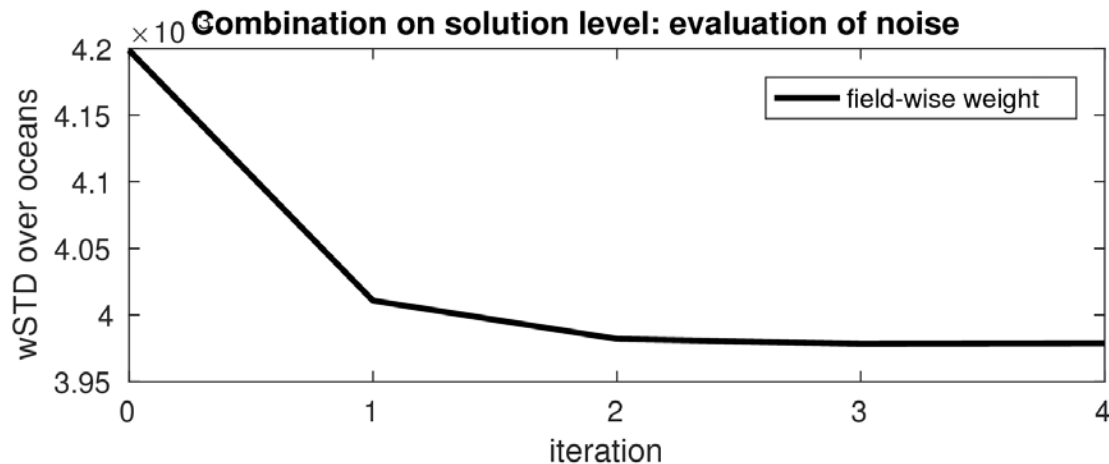
RMS of differences to mean



Variance component estimation on solution level



Variance component estimation on solution level taking into account all SH coefficients up to degree and order 80 with equal weight.



RMS of anomalies restricted to ocean areas as quality criterion.

Combination on Normal Equation Level

Achieve equal impact of individual contributions on pairwise combinations:

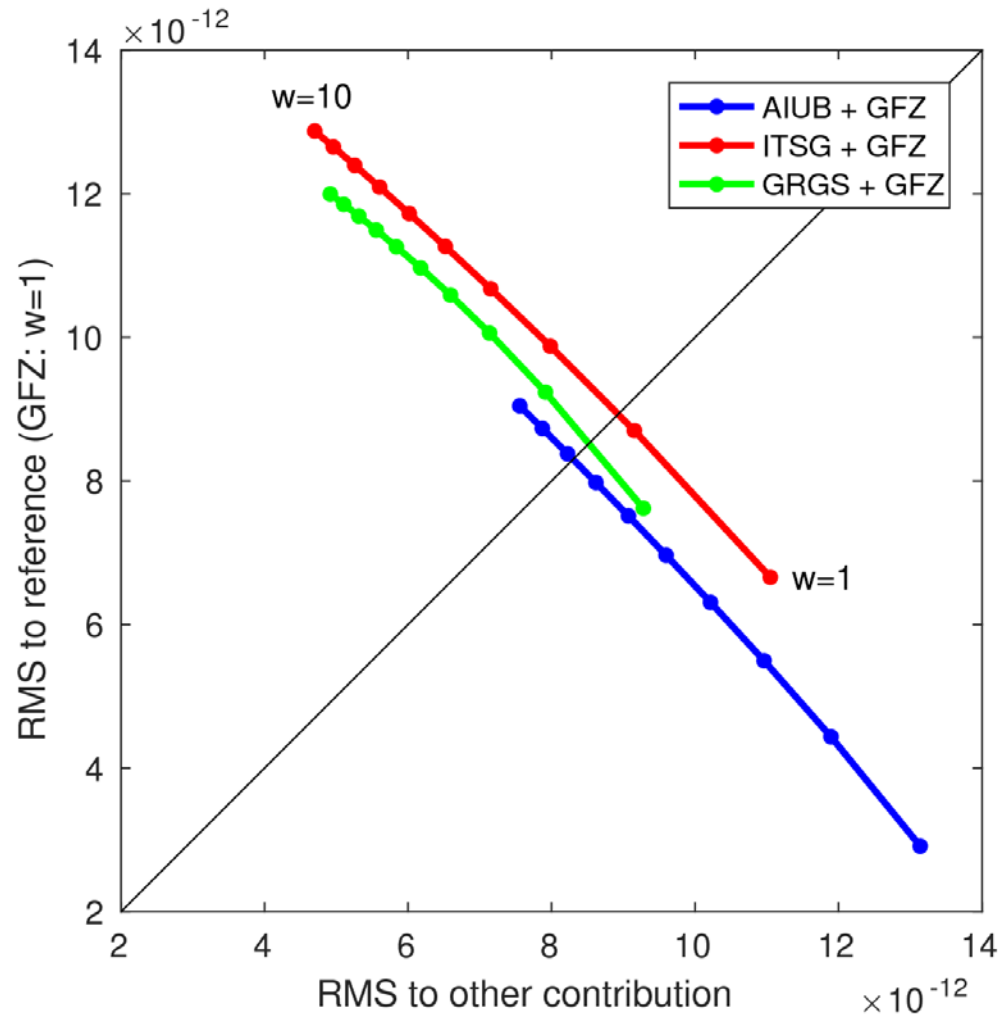
$$(\mathbf{N}_{\text{ref}} + w_i \mathbf{N}_i) d\mathbf{x} = \mathbf{b}_{\text{ref}} + w_i \mathbf{b}_i$$

The impact is measured by:

$$\text{RMS}_i = \sqrt{\frac{\sum_{l,m} (K_{l,m}^{\text{comb}} - K_{l,m}^i)^2}{n_{\text{coef}}}}$$

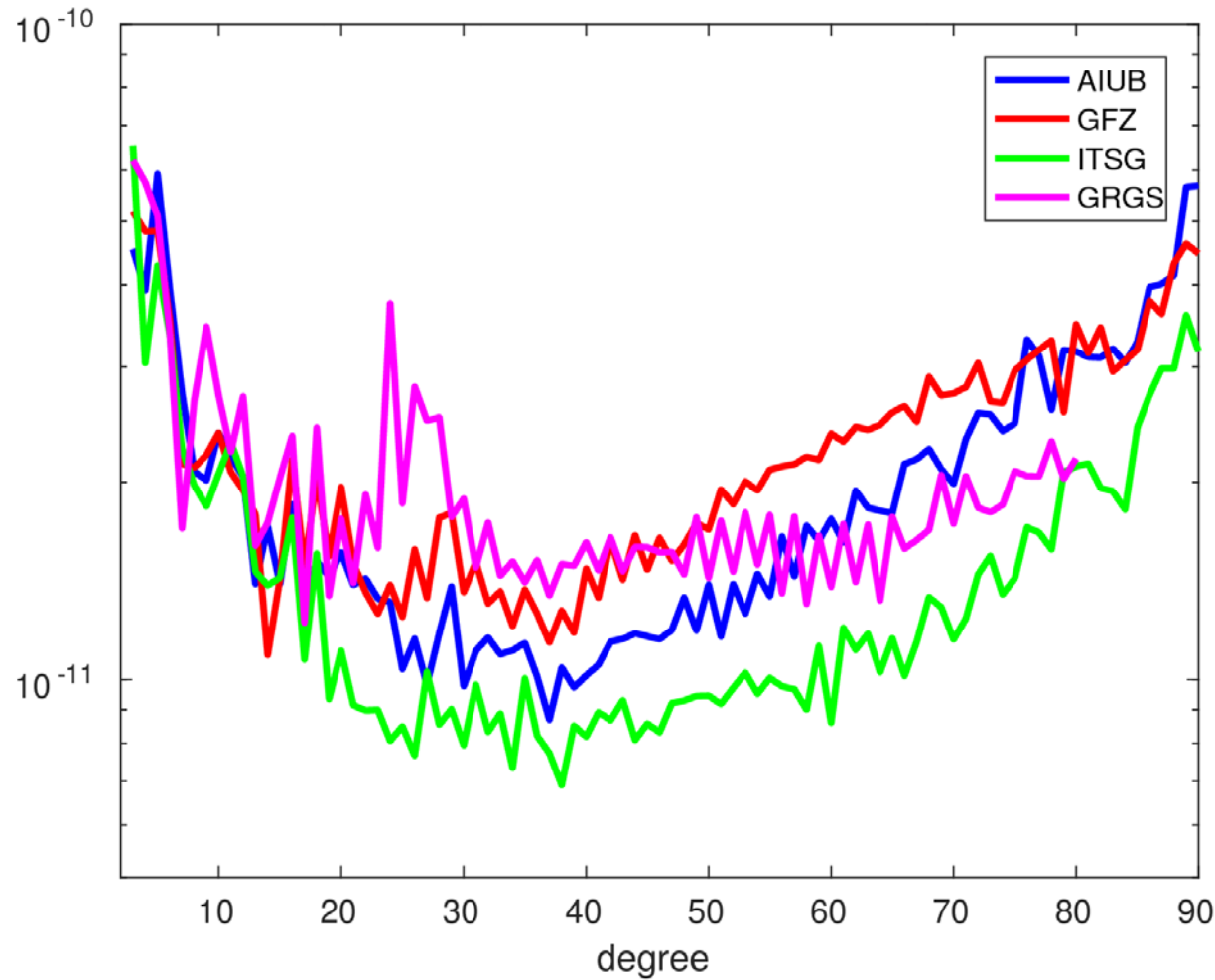
Equal impact is achieved for: $\frac{\text{RMS}_i}{\text{RMS}_{\text{ref}}} = 1$

Combination on Normal Equation Level

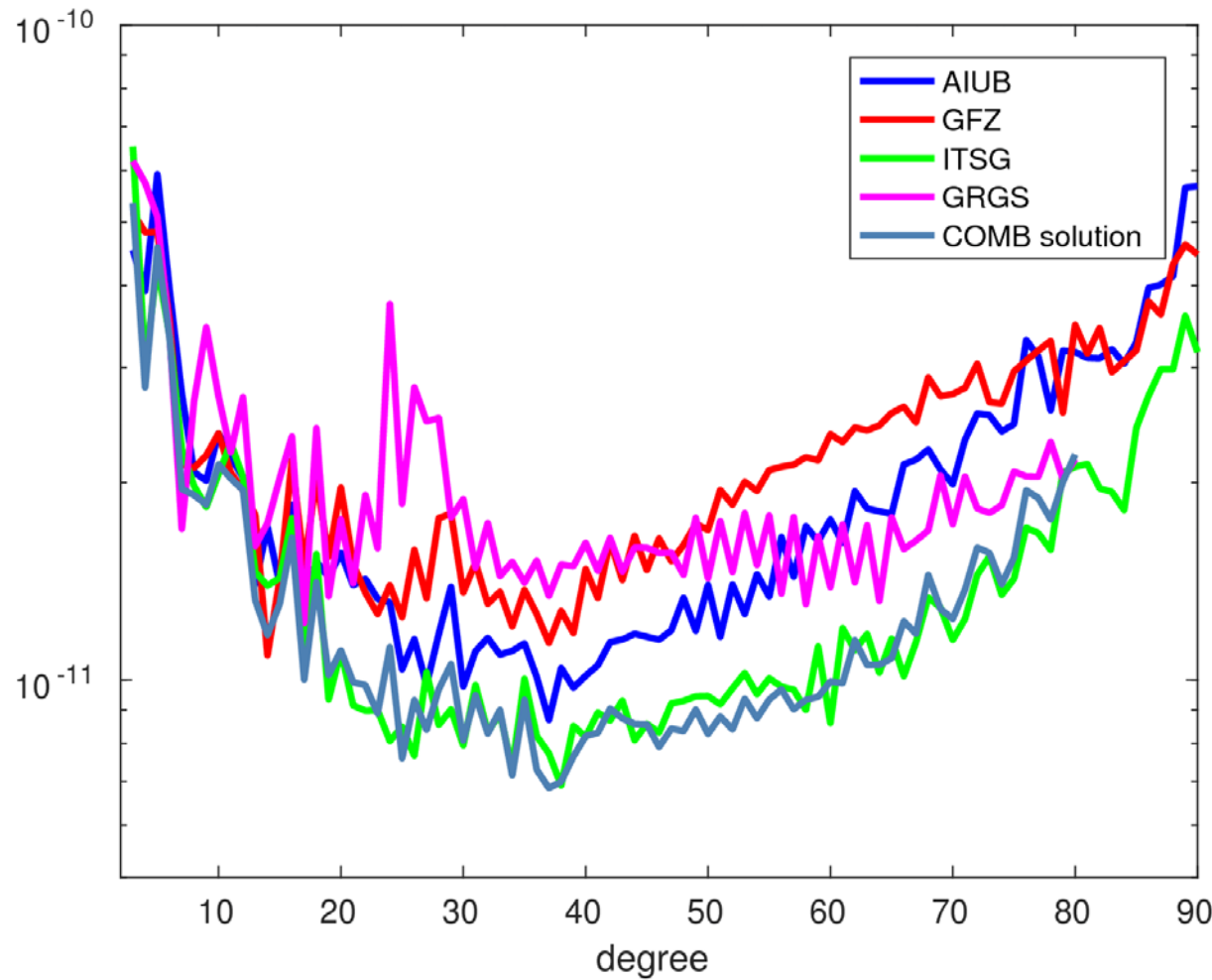


equalizing weight	
GRGS	1.60
GFZ	1.00
AIUB	7.81
ITSG	2.21

Combination: 2006/01

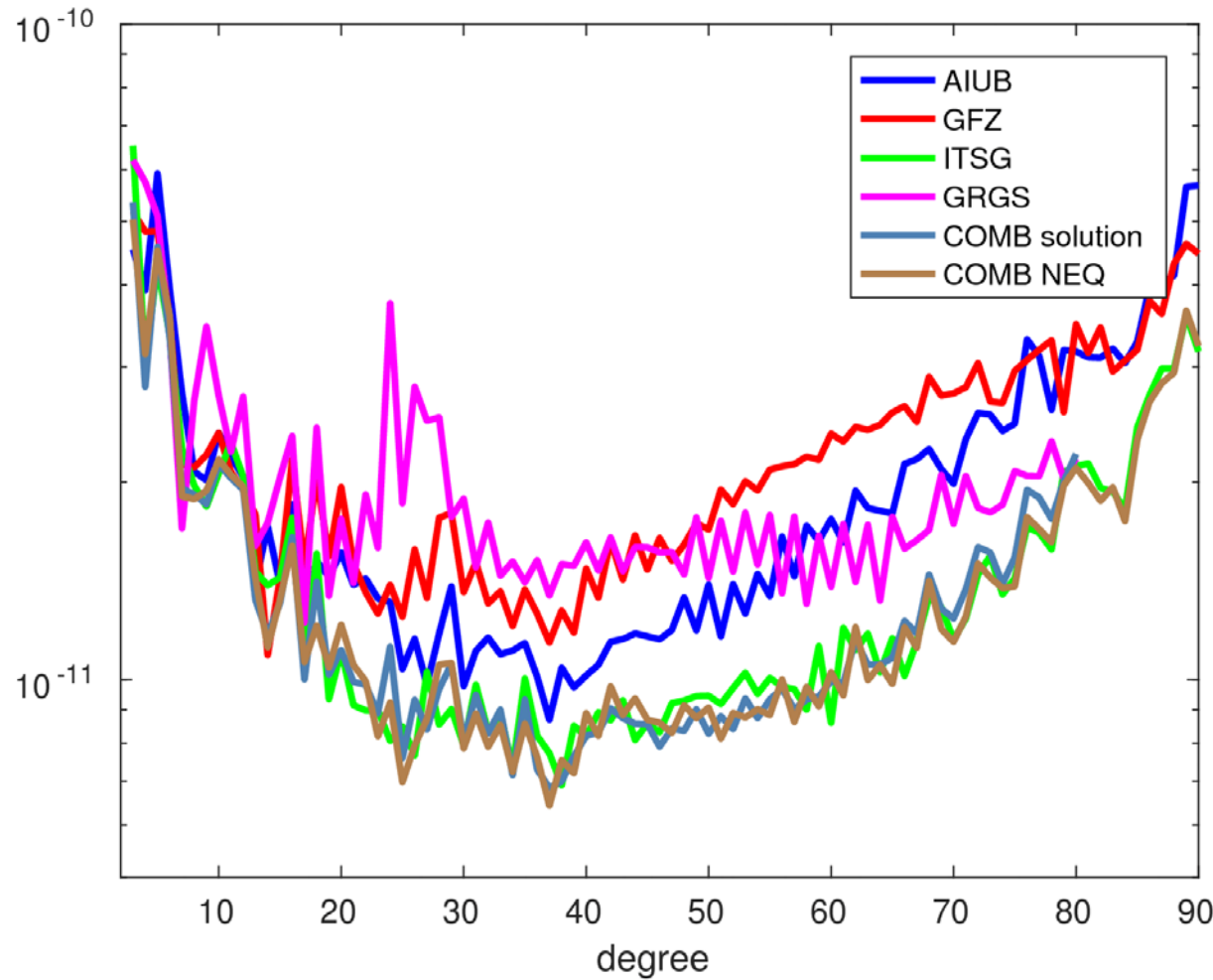


Combination: 2006/01



Solution:	weight
GRGS	0.14
GFZ	0.19
AIUB	0.29
ITSG	0.38

Combination: 2006/01



equalizing weight	
GRGS	1.60
GFZ	1.00
AIUB	7.81
ITSG	2.21

Solution:	weight
GRGS	0.14
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L3-Products: www.egsiem.eu -> Data -> EGSIEM-Plotter

Functional

Water heights ▾

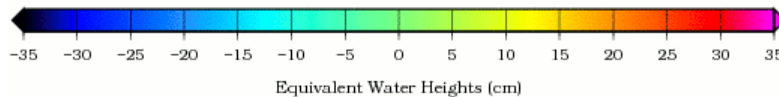
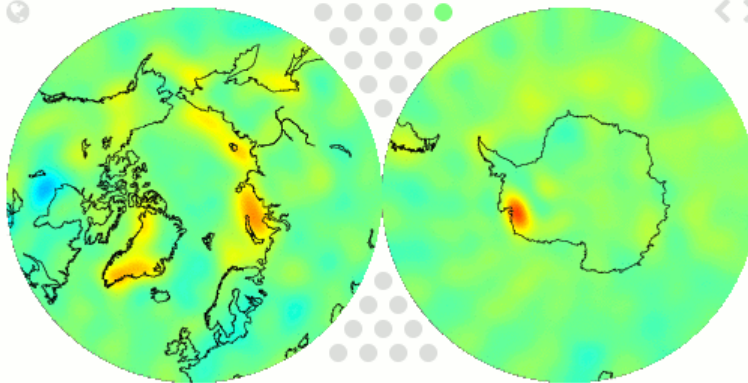
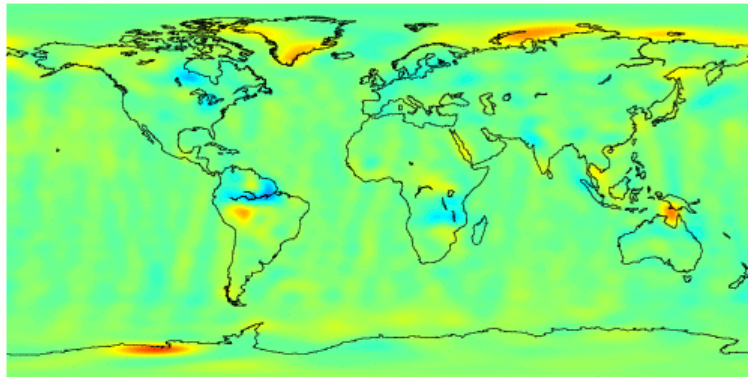
Data center and version

EGSIEM GRACE oceanography DDK3 ▾

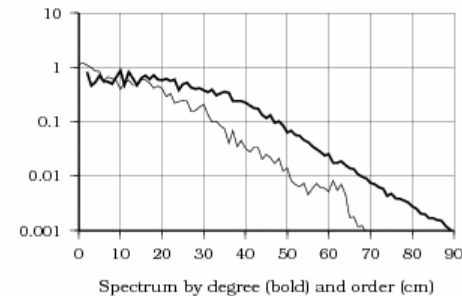
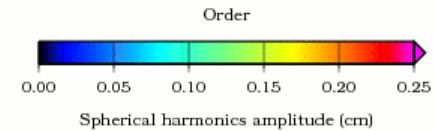
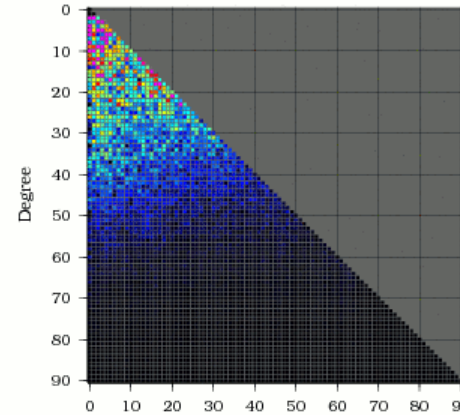
Date

2006 January ▾

EGSIEM graceOceanography monthly DDK3 - 2006/01/01 - 2006/01/31
Equivalent Water Heights comparison to time series mean (degree 2 to 90)
min -20.25 cm / max 24.79 cm / weighted rms 3.31 cm / oceans 2.34 cm



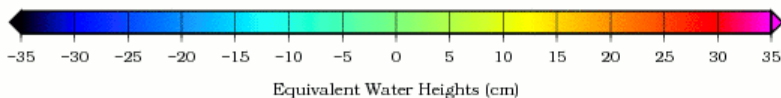
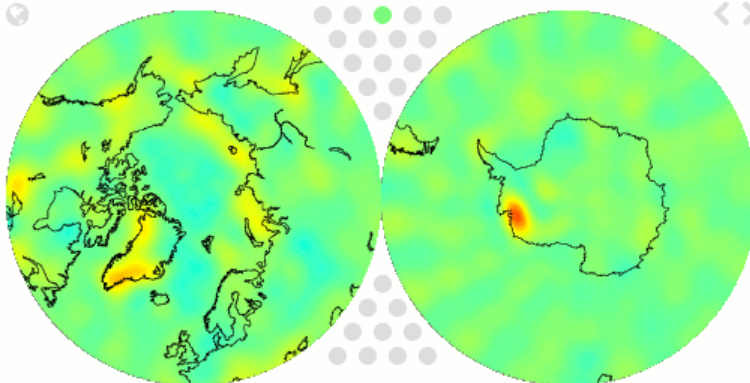
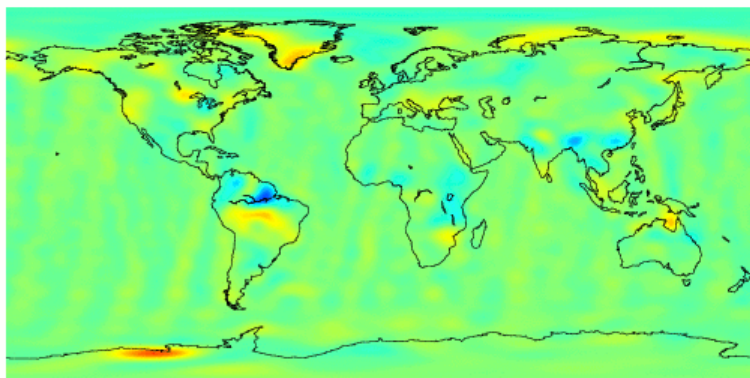
2002 2004 2006 2008 2010 2012 2014 2016 2018



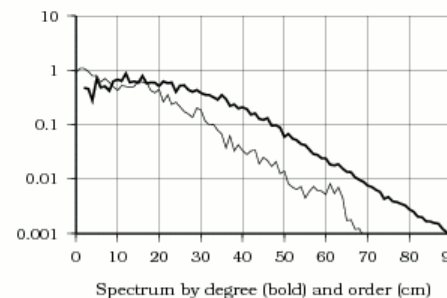
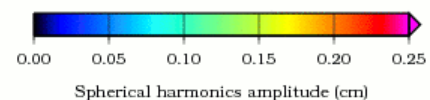
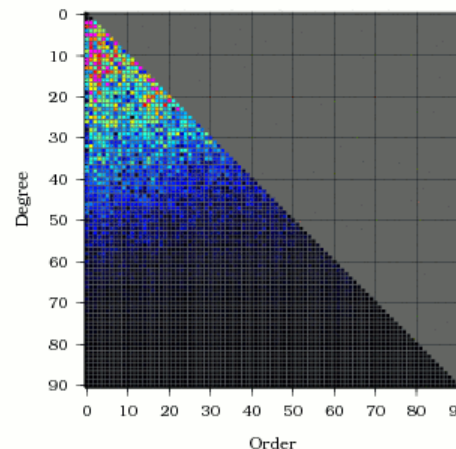
L3-Products: www.egsiem.eu -> Data -> EGSIEM-Plotter

Functional: Water heights
Data center and version: EGSIEM GRACE hydrology DDK3
Date: 2006 January

EGSIEM graceHydrology monthly DDK3 - 2006/01/01 - 2006/01/31
Equivalent Water Heights comparison to time series mean (degree 2 to 90)
min -24.86 cm / max 23.89 cm / weighted rms 3.16 cm / oceans 1.91 cm



2002 2004 2006 2008 2010 2012 2014 2016 2018



Conclusions

- EGSiem monthly gravity field combination on NEQ-level is operational.
- Noise assessment by variance component estimation on solution level.
- Relative weights based on noise levels.
- The EGSiem combination service provides two test years (2006 + 2007):
 - SH-coefficients (Level-2): www.icgem.de
 - grids and de-aliasing (Level-3): www.egsiem.eu