Towards combined global monthly gravity field solutions

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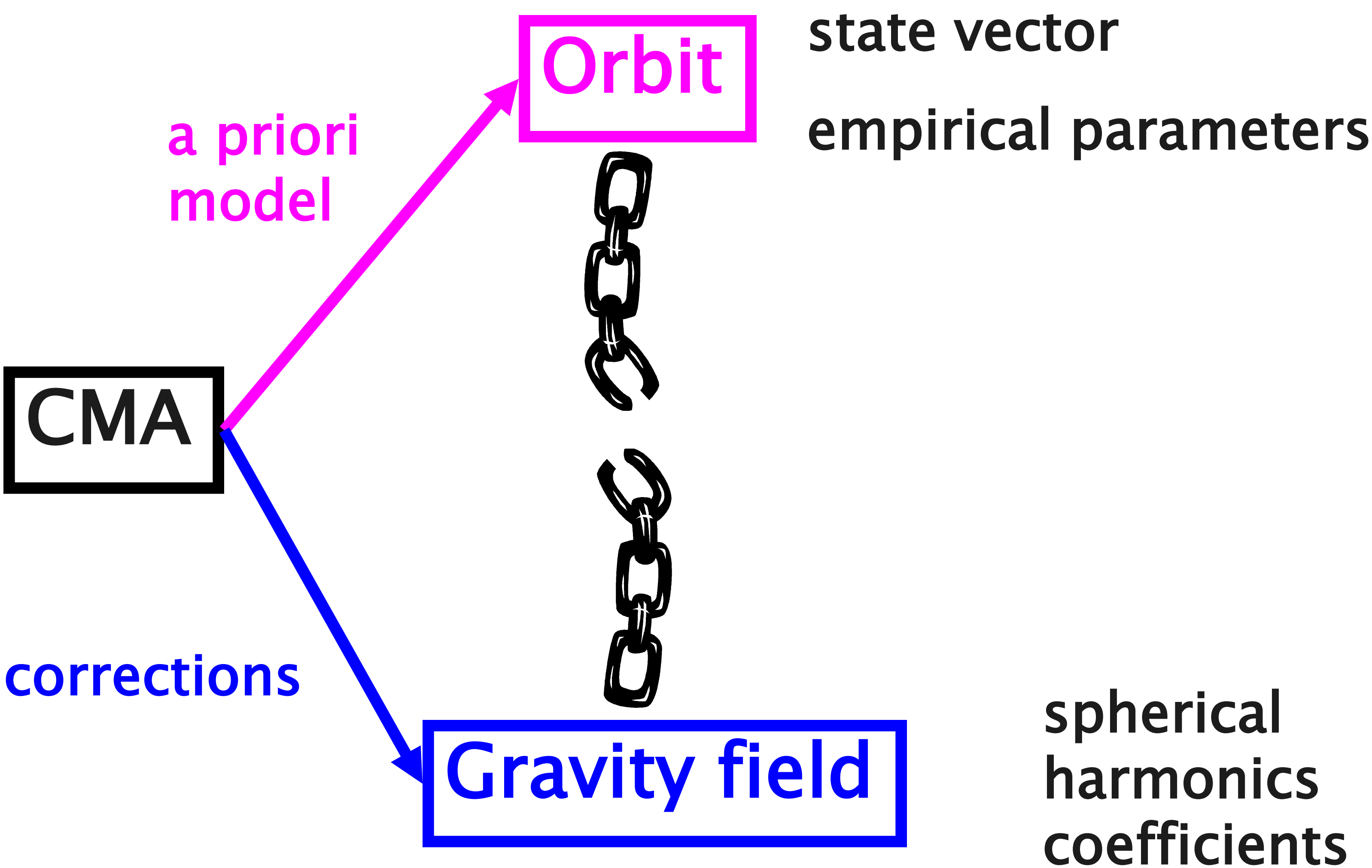
GRACE Science Team Meeting 2013, Austin, Texas

Motivation

A variety of time-variable GRACE solutions are today available from different groups:

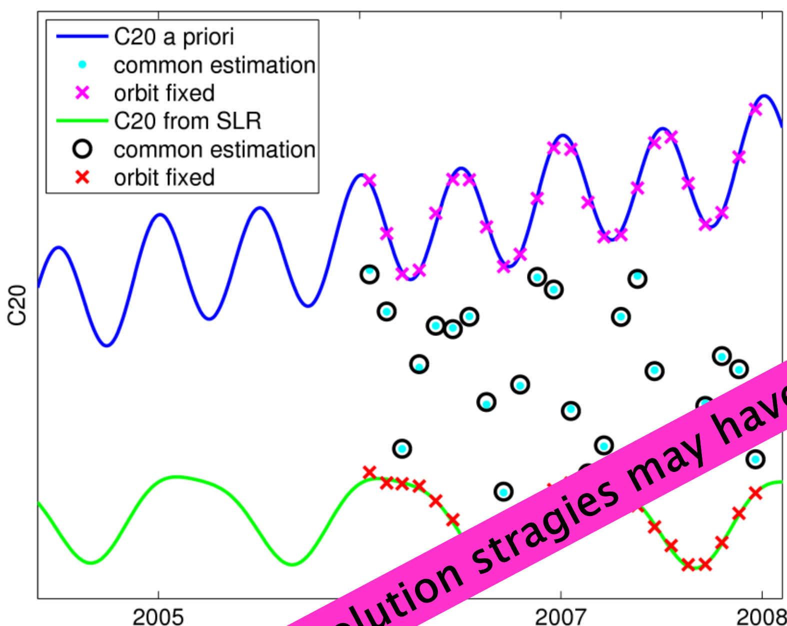
- They differ in terms of noise and (maybe) signal
- They may be based on different methodologies
- What can be done to make best possible use of all these solutions?
- Is it possible to establish a meaningful combination?

Impact of different processing strategies

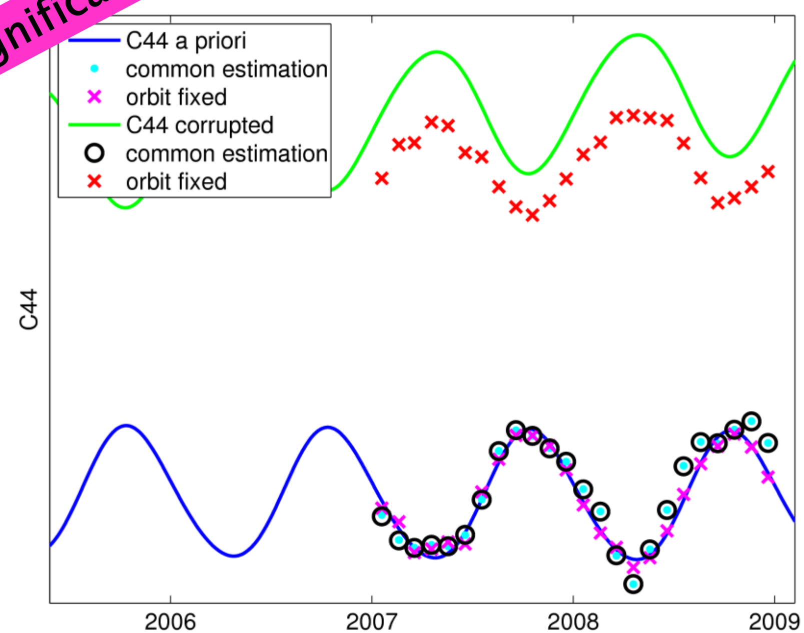


Impact of different processing strategies

C20



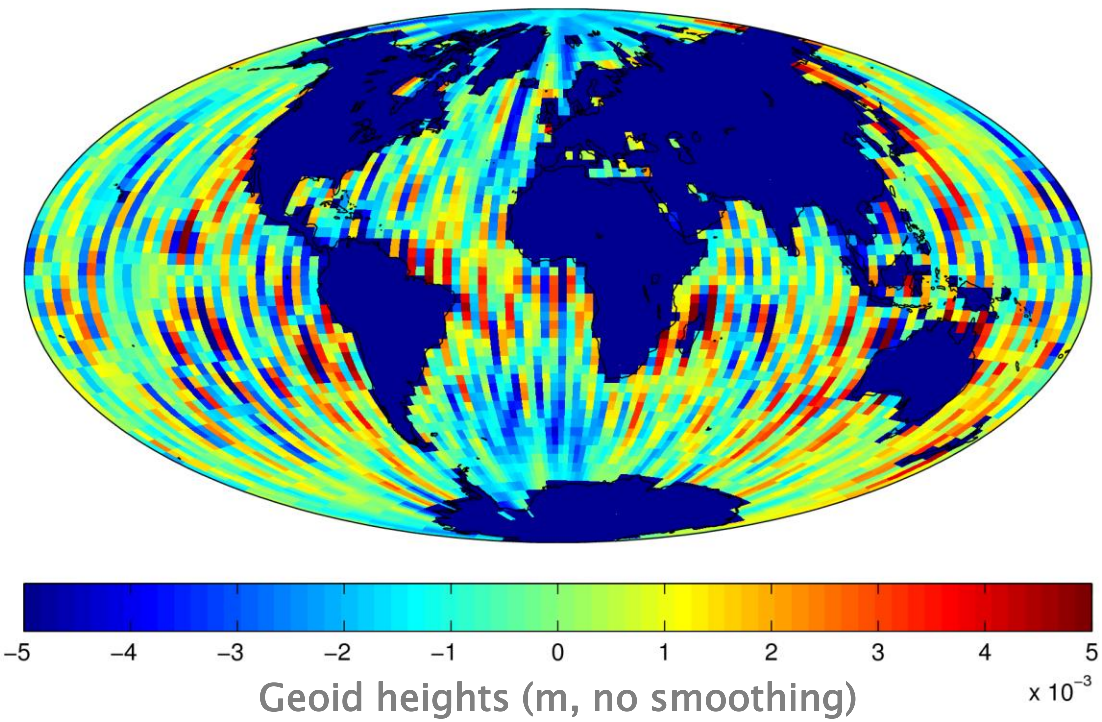
C44



Different solution stragies may have a significant impact on signal and noise

Noise assessment

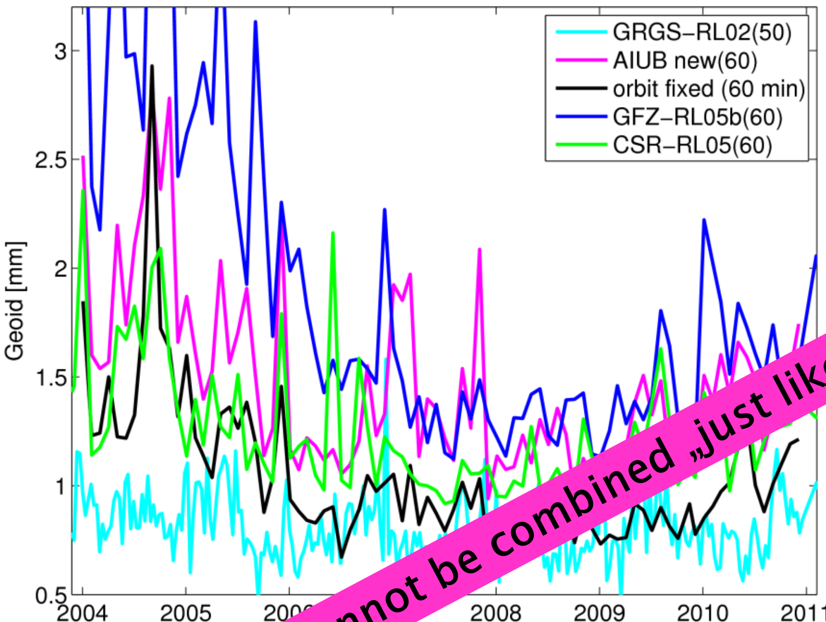
- weighted standard deviation (wSTD) over the oceans are computed to estimate the noise of the monthly solutions in a simple way



- an enlarged landmask is applied to compute the weighted RMS in order to avoid leakage from continental regions with strong hydrology

Noise assessment

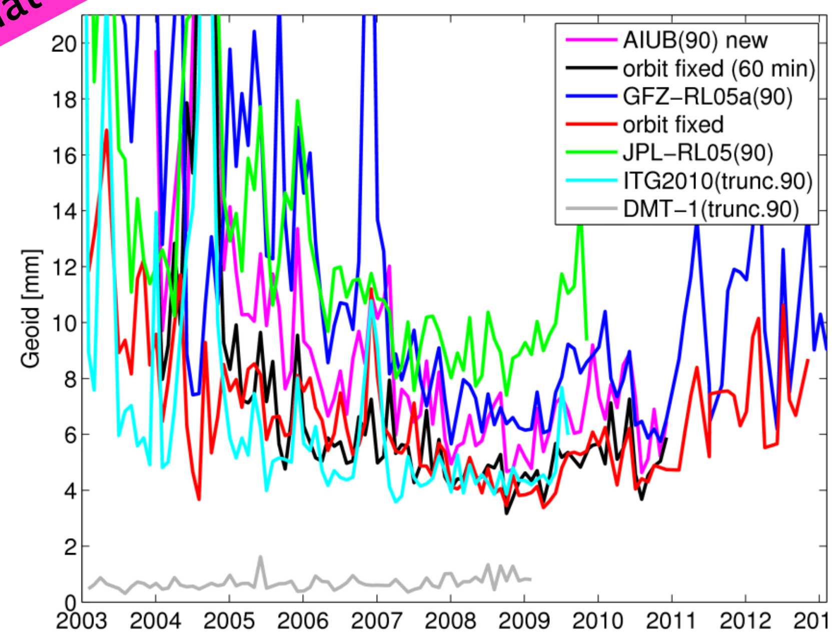
wSTD over oceans (60)



GRG[illegible] [illegible].9 mm
A[illegible]: 1.5 mm
fixed: 1.1 mm
GFZ5b: 1.8 mm
CSR: 1.3 mm

AIUB: 9.7 mm
fixed: 6.9 mm
GFZ5a: 1[illegible]m
fixed[illegible].1 mm
J[illegible] 11.8 mm
[illegible]G10: 6.2 mm
DMT1: 0.7 mm

wSTD over oceans (90)



Solutions cannot be combined „just like that“ due to different solution strategies

Adrian Jäggi et al.: Towards combined monthly gravity field solutions, GRACE Science Team Meeting, Austin, 23.–25. October 2013

Astronomical Institute University of Bern AIUB

Averaged monthly solutions
(input solutions based on similar strategies)

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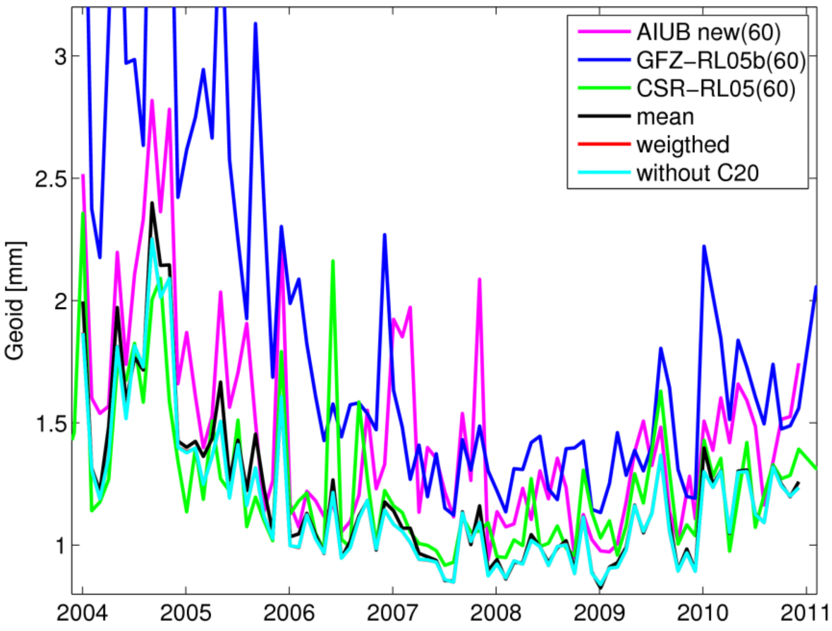
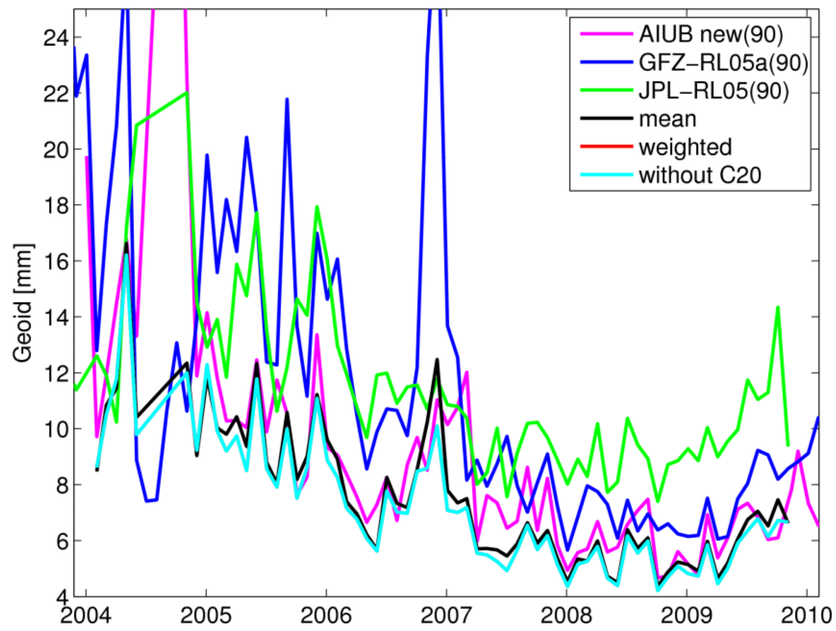
wSTD over oceans (60)



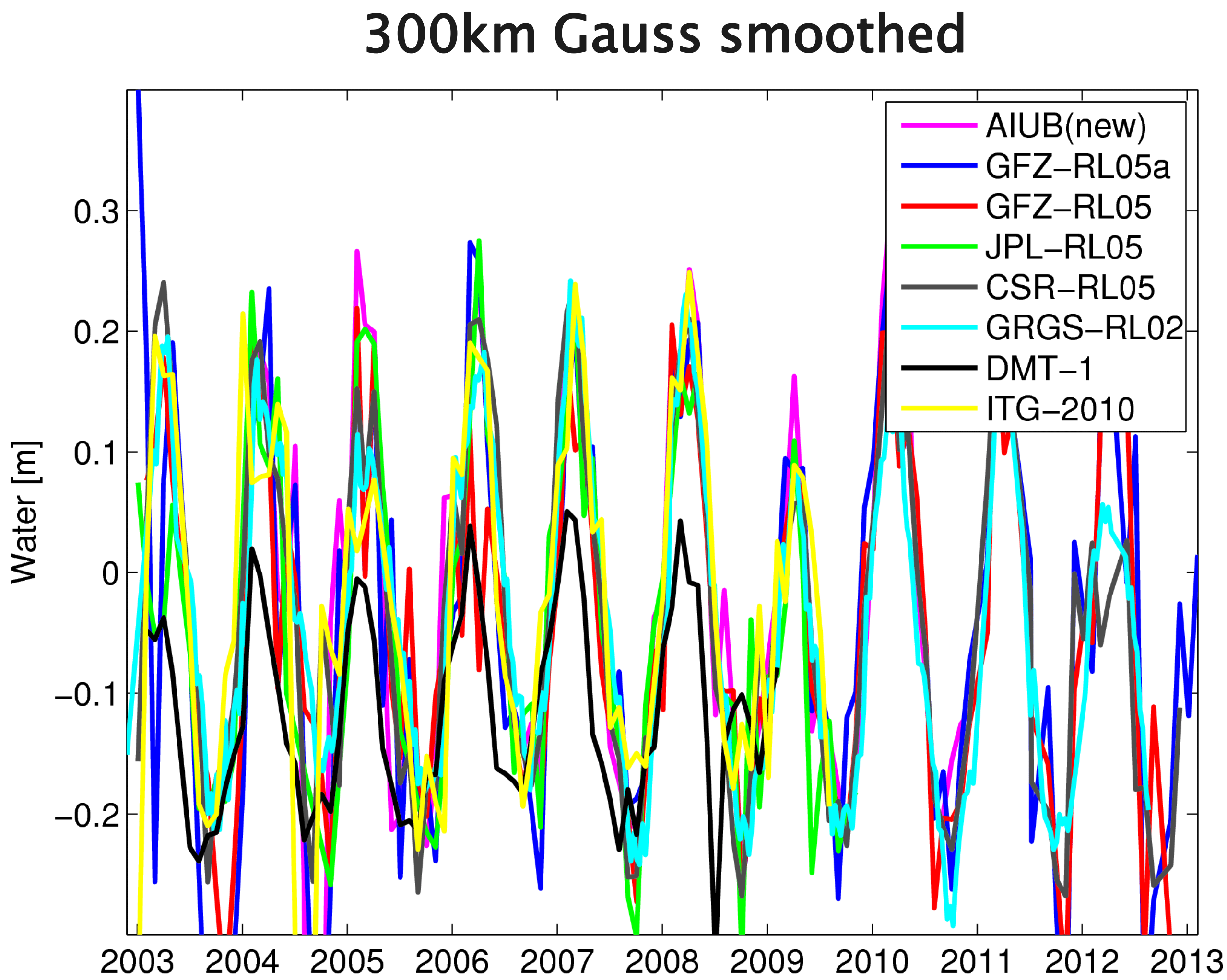
AIUB: 1.5 mm
GFZ5b: 1.8mm
CSR: 1.3 mm
mean: 1.2 mm

AIUB: 9.7 mm
GFZ5a: 11.3 mm
JPL: 11.8 mm
mean: 7.8 mm
wmean: 7.5 mm

wSTD over oceans (90)

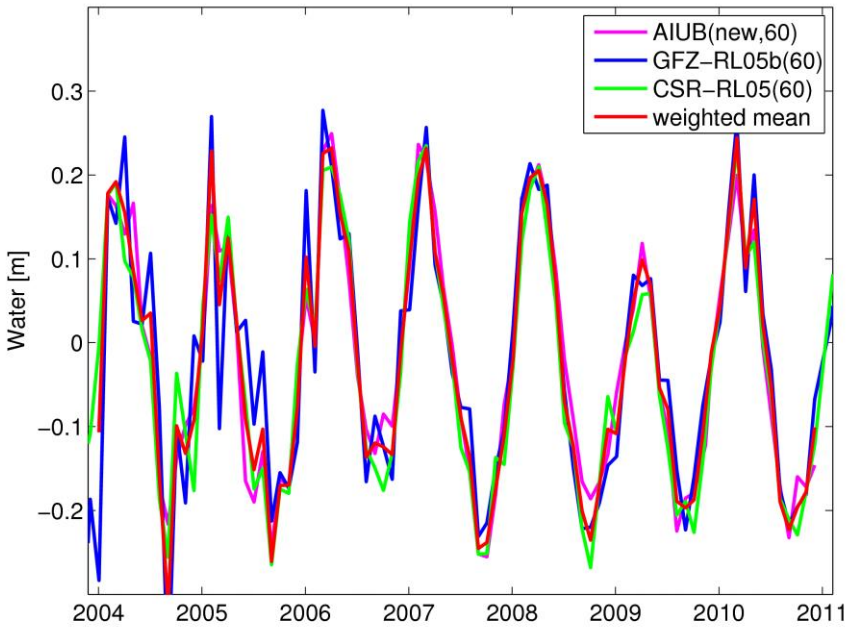


Signal (hydrology in South America)

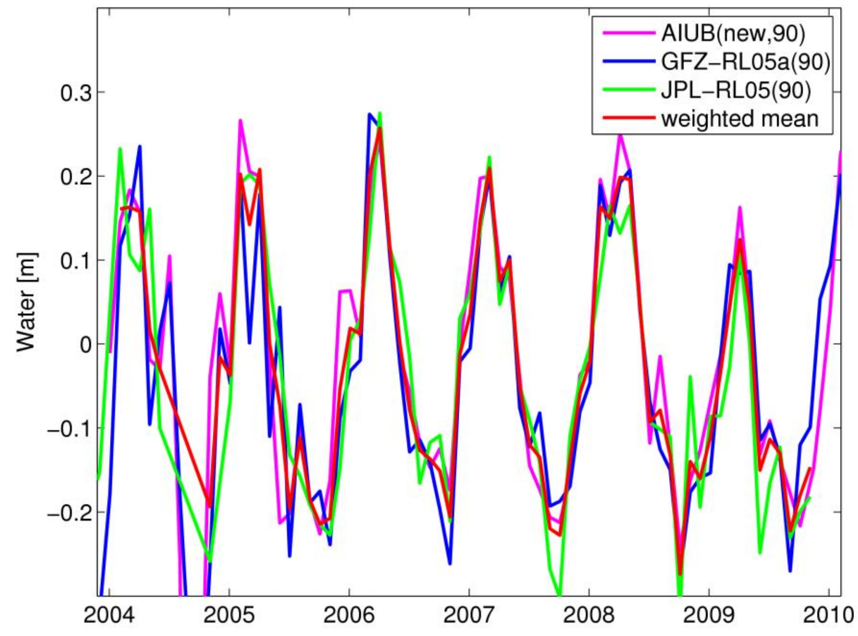


Averaged monthly solutions
(input solutions based on similar strategies)

max. degree 60

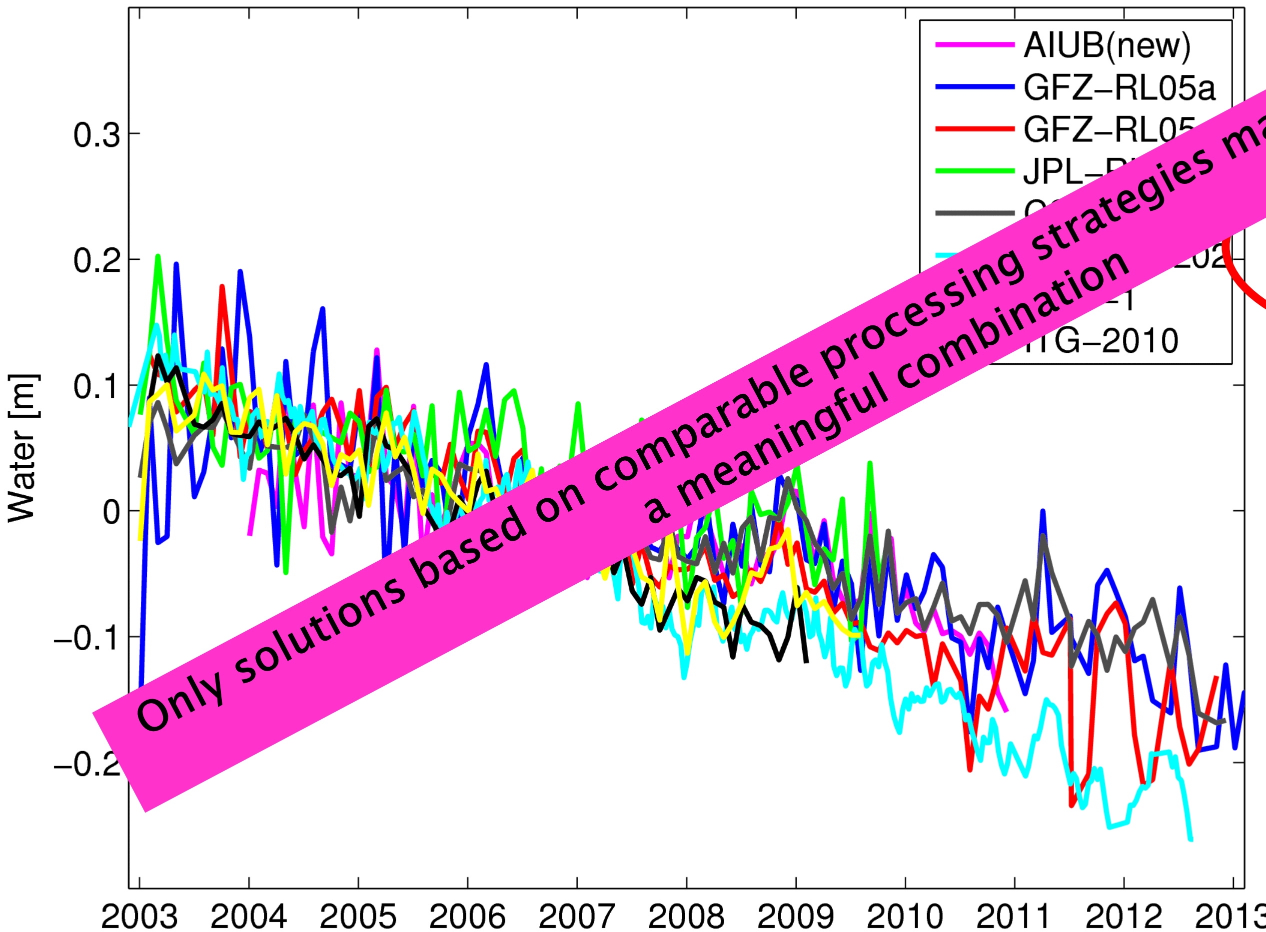


max. degree 90



Signal (ice mass change in Greenland)

300km Gauss smoothed



Only solutions based on comparable processing strategies may be used for a meaningful combination

20 mm/y

GFZa: −22 mm/y

GFZ: −31 mm/y

JPL: −20 mm/y

CSR: −19 mm/y

GRGS: −36 mm/y

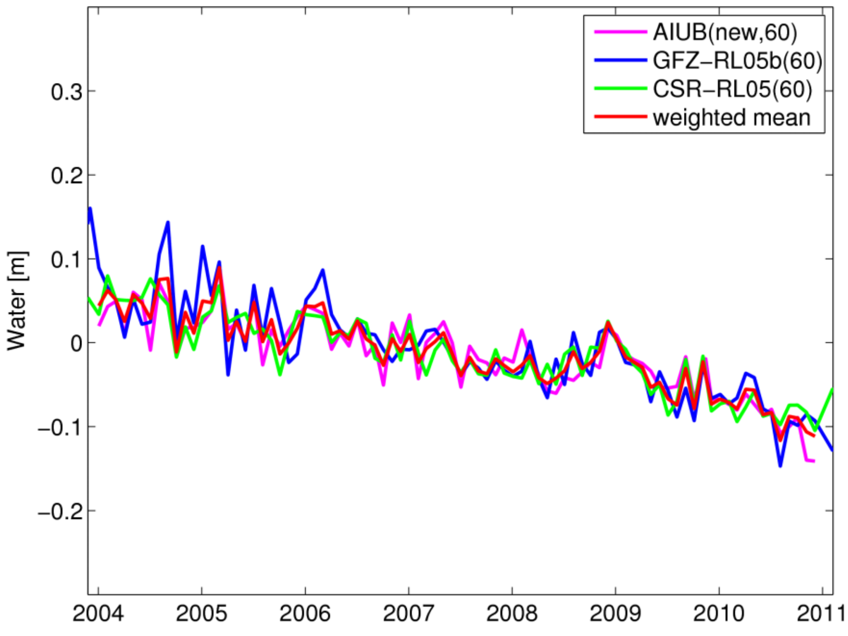
DMT: −34 mm/y

ITG: −28 mm/y

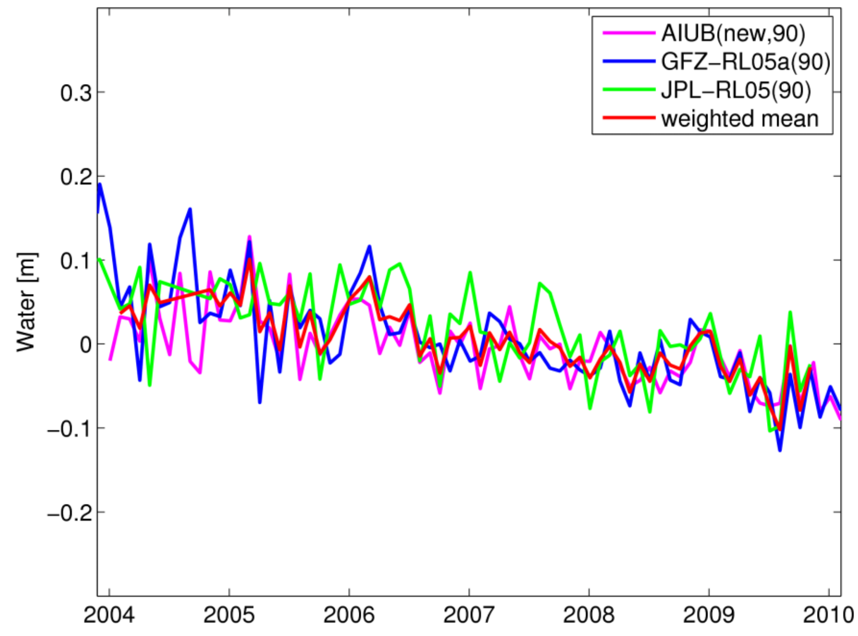
Averaged monthly solutions

(input solutions based on similar strategies)

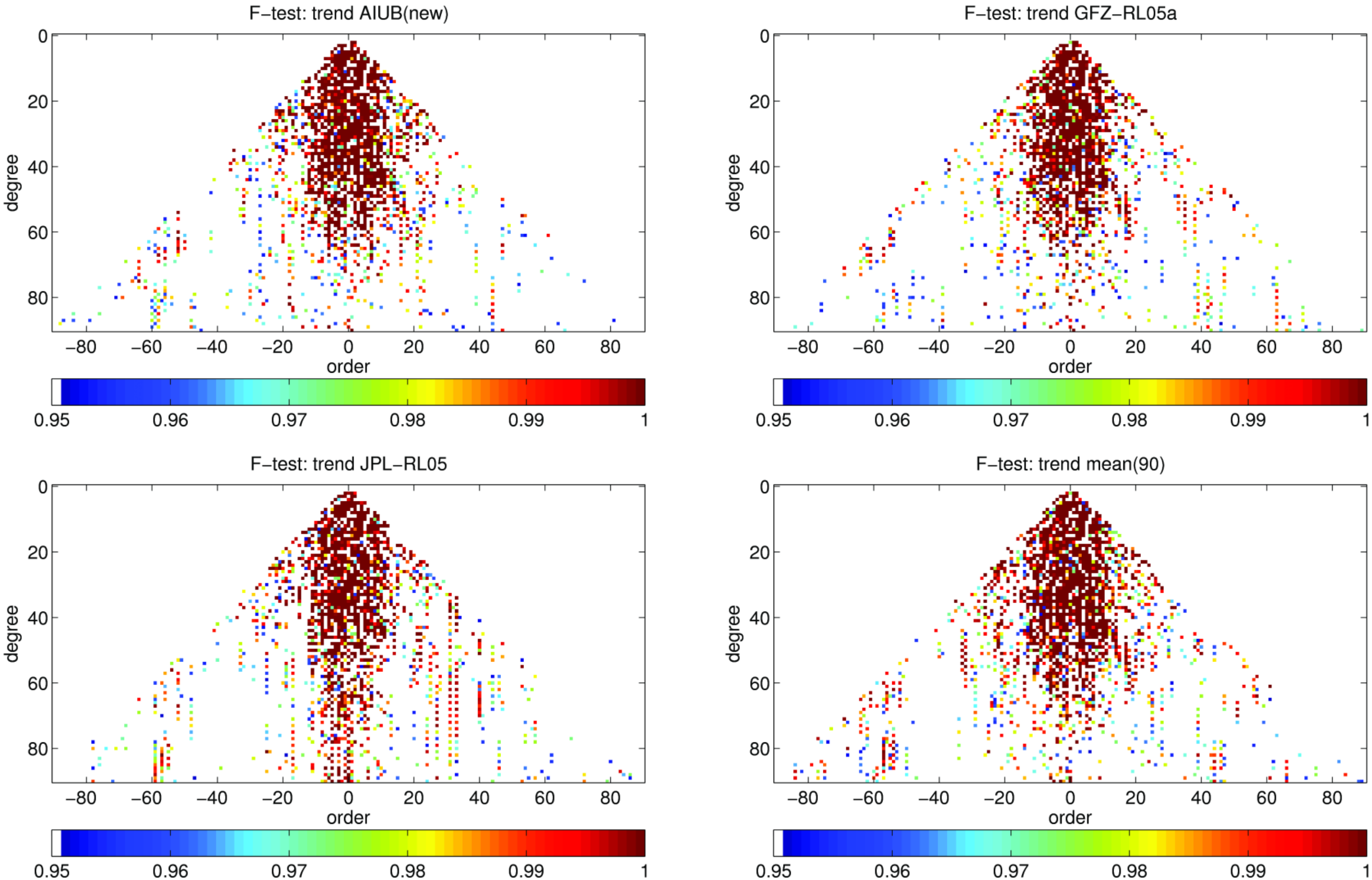
max. degree 60



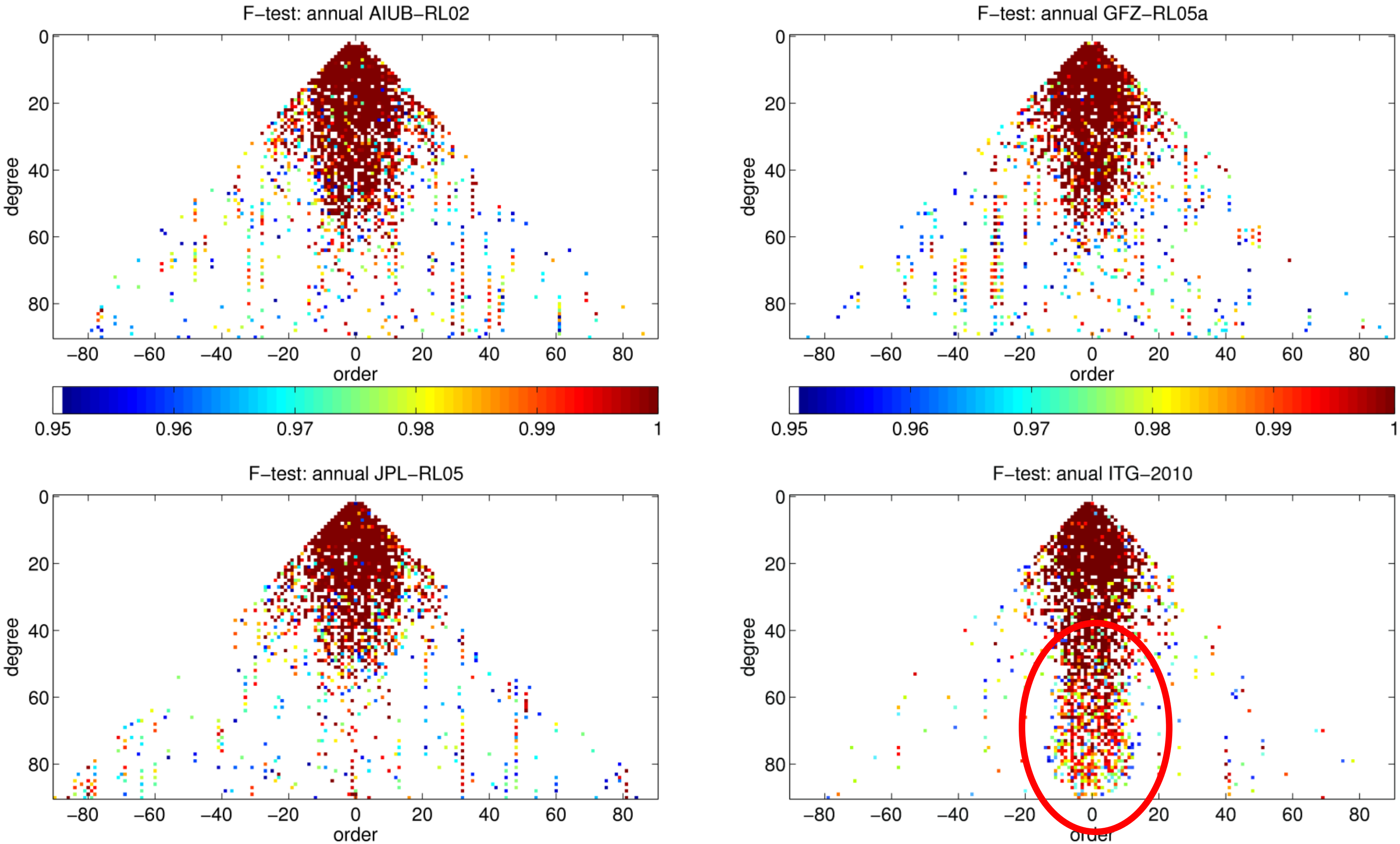
max. degree 90



Coefficient wise significance of trends



Coefficient wise significance of annual variations



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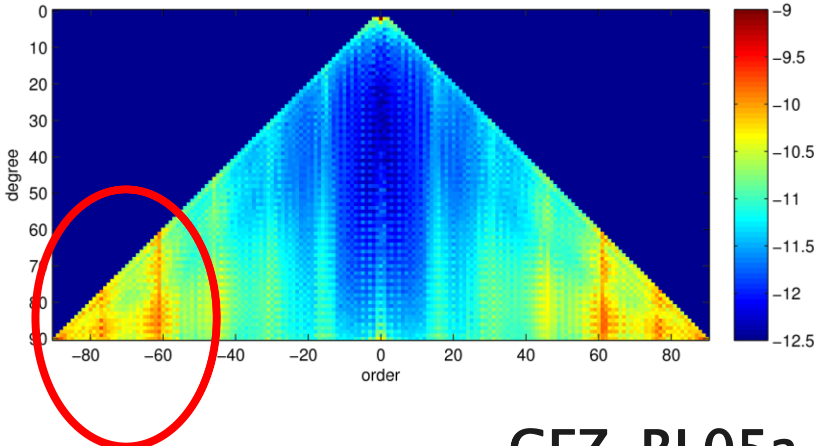
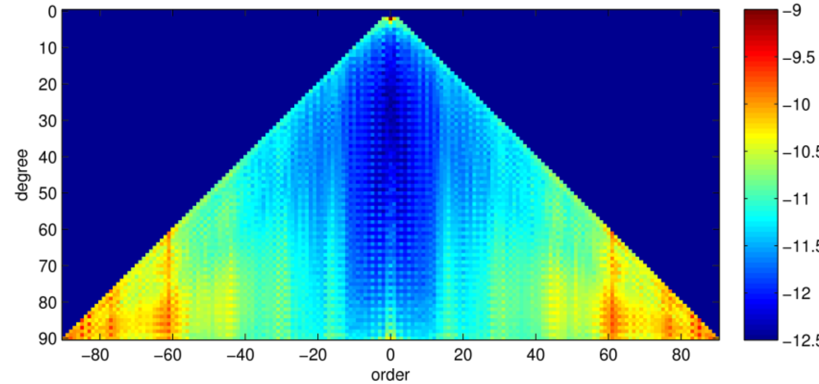
RMS of monthly differences per coefficient

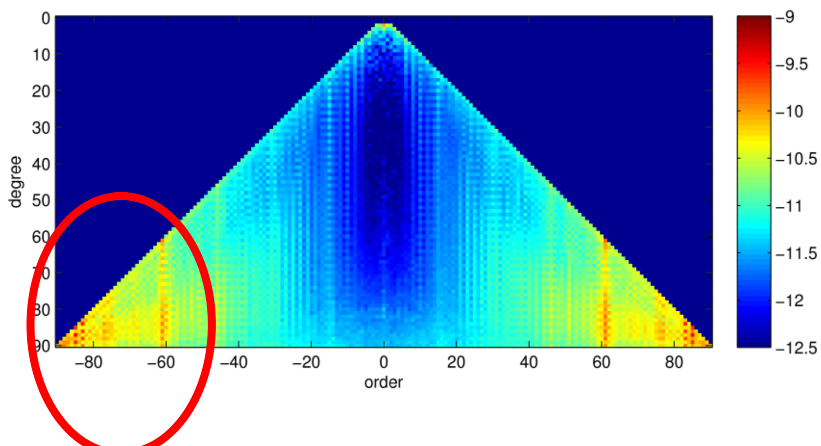
JPL-RL05 – AIUB (new)



JPL-RL05 – GFZ-RL05a

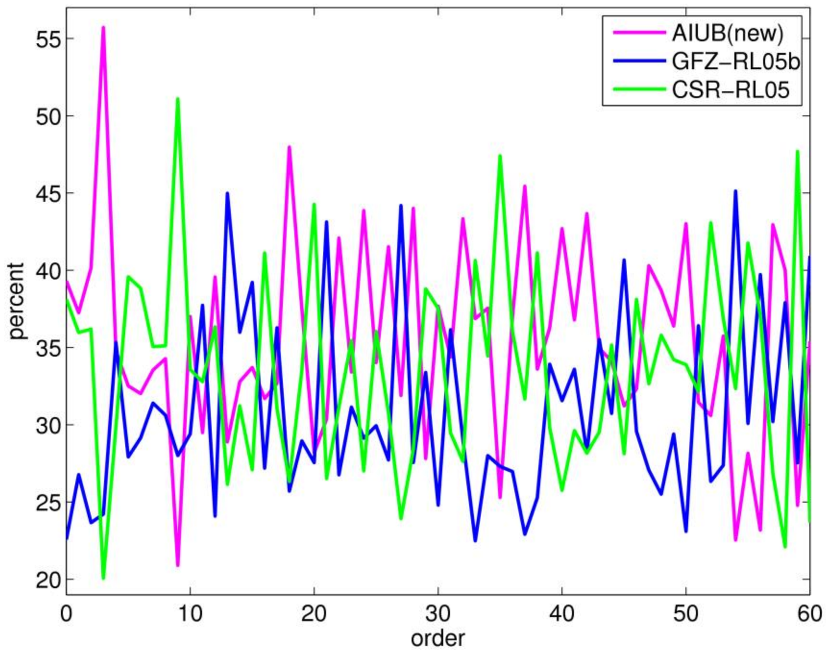


GFZ-RL05a – AIUB (new)



Monthly relative weights (example 03/2008)

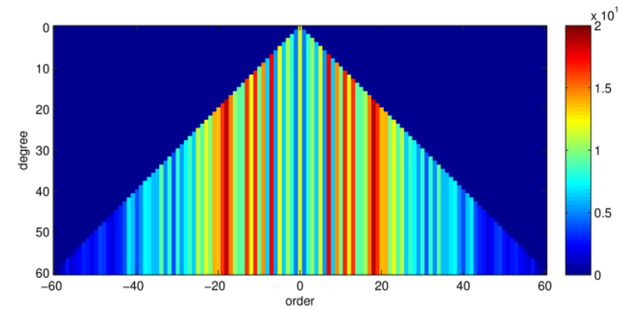
Contribution per order



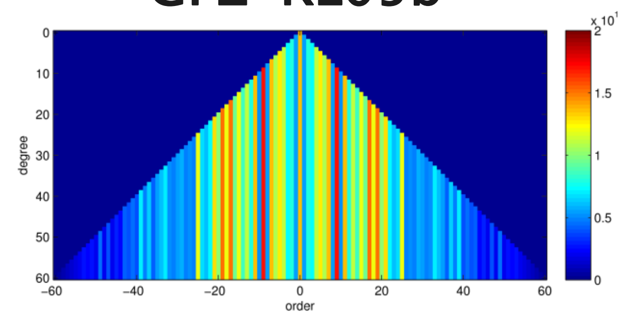
Percent: $100\% * w_i/(w_1+w_2+w_3)$

Weight matrix: 1/RMS per order

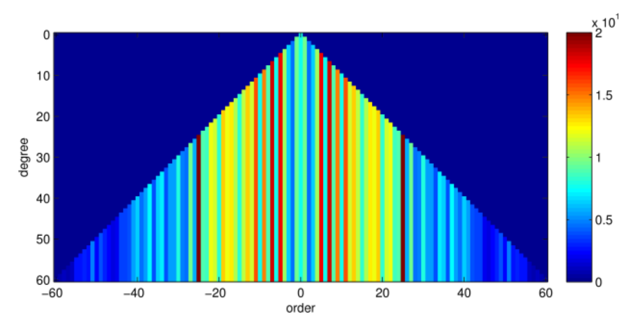
AIUB (new)



GFZ−RL05b



CSR−RL05



Summary in view of GRACE-FO

- A service should be established consisting of:
  - A larger number of Analysis Centers (ACs) providing time-variable gravity field solutions on a regular basis
  - Analysis Center Coordinator (ACC)
- Comparable processing strategies are mandatory to ensure meaningful results of the ACC work:
  - Comparison of the AC solutions (gravity field solutions, orbits, residuals), identification of problematic solutions
  - Pairwise comparison of solutions to derive approximate empirical weights for the individual ACs
  - Combination of all AC gravity fields, either by:
    - Calculating a weighted average of the gravity field parameters based on the previously derived weights
    - Combining the solutions based on normal equations generated by the individual ACs