

The role of a priori information in gravity field determination

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*G4.2: Satellite Gravimetry: GRACE, GOCE and Future Gravity
Missions*

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Contents

- Gravity field, Orbit, and the Celestial Mechanics Approach
- Signal and Noise in monthly fields (GRACE)
- Separation of Orbit and Gravity field estimation
- How does it work?
- Discussion

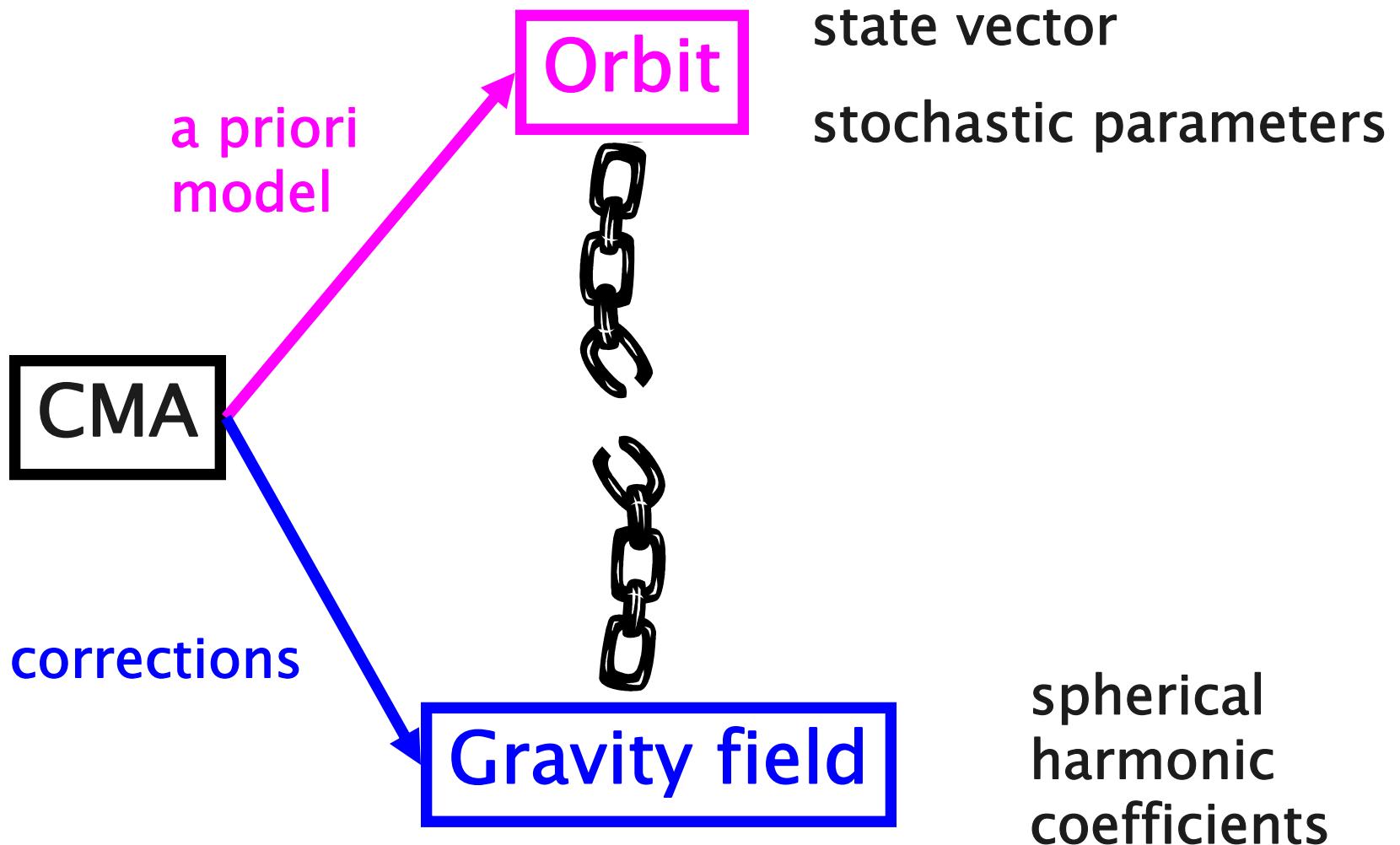
Gravity field and Orbit



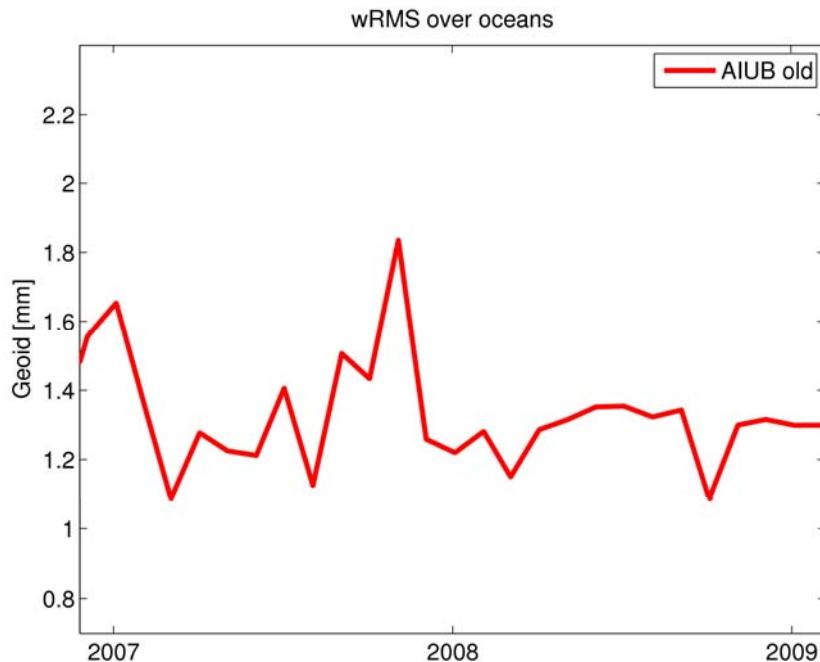
Non-linear parameter
estimation problem

- A priori model (linearization)
- Observations
- Regularization (a priori knowledge via pseudo-observations)

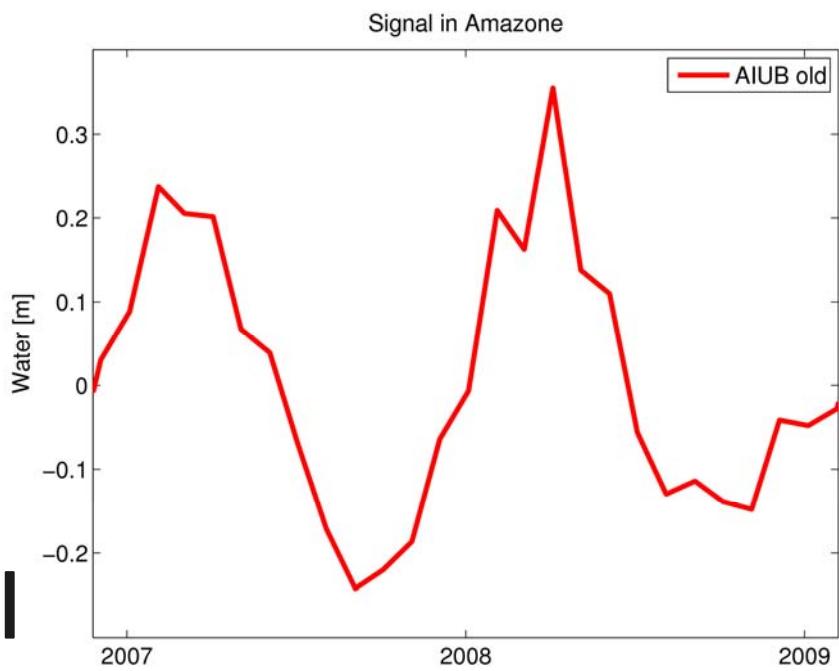
The Celestial Mechanics Approach (CMA)



Signal and Noise in monthly fields (GRACE)

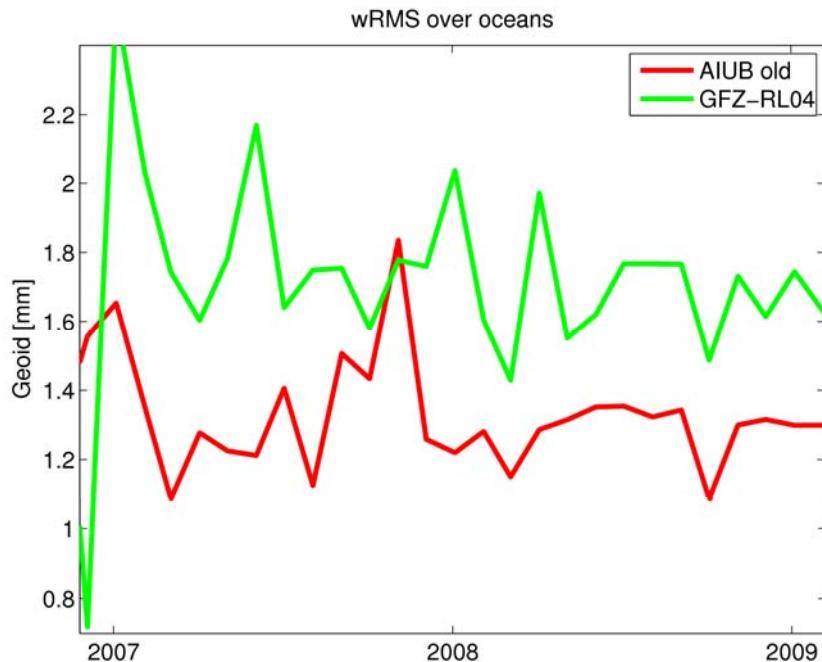


noise



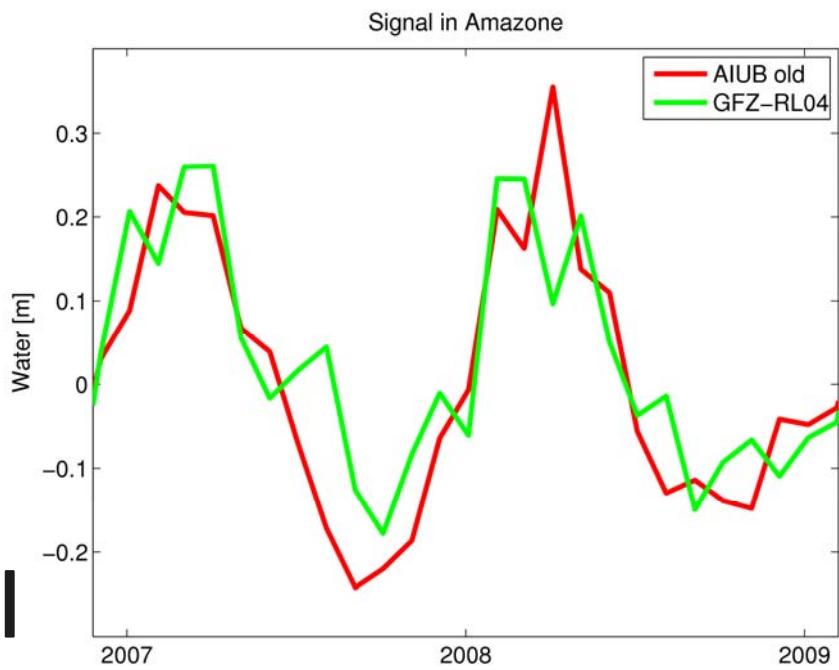
signal

Signal and Noise in monthly fields (GRACE)

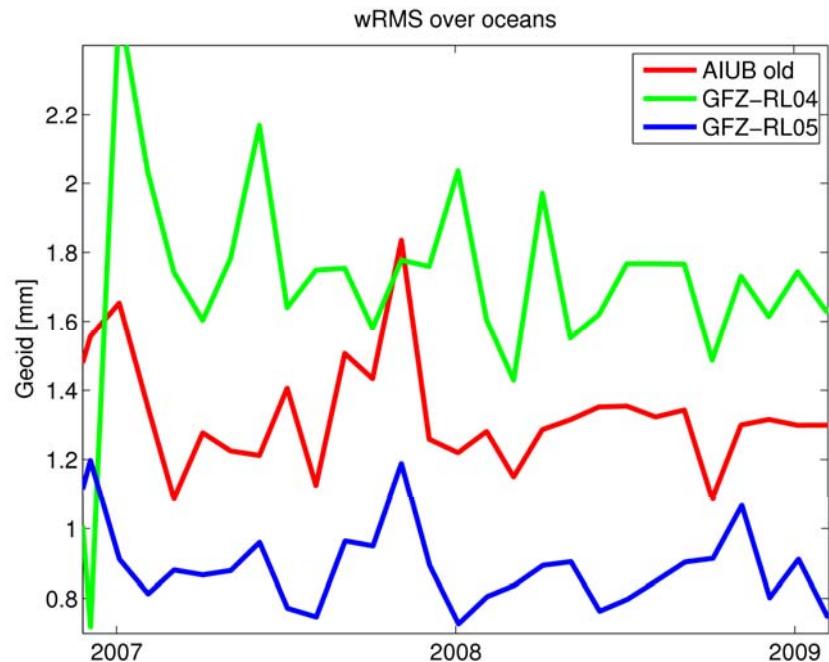


noise

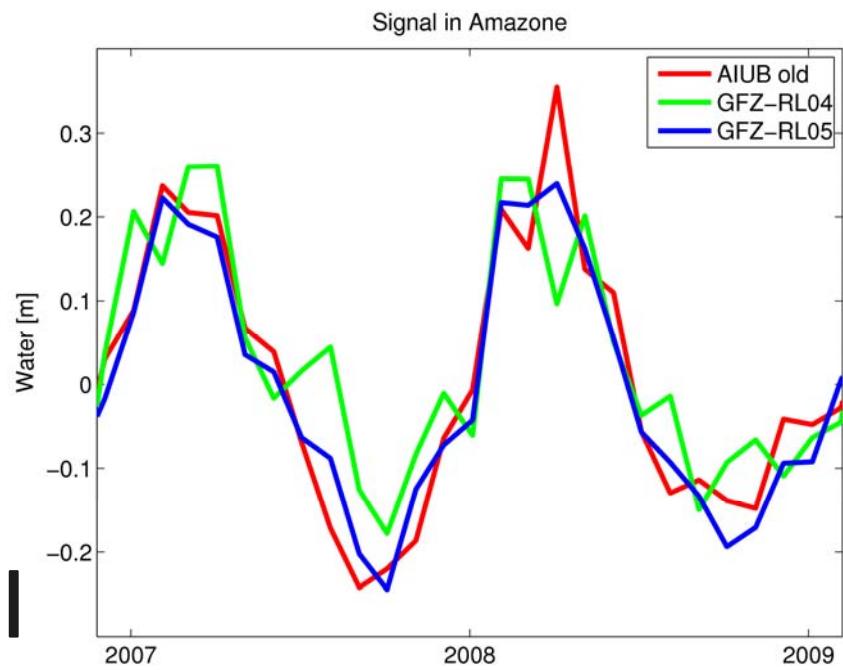
signal



Signal and Noise in monthly fields (GRACE)

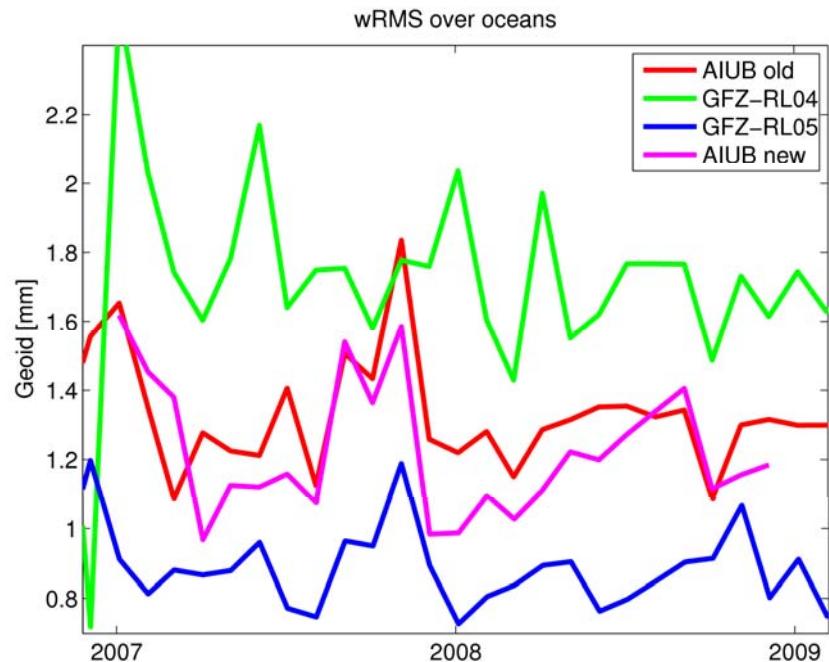


noise

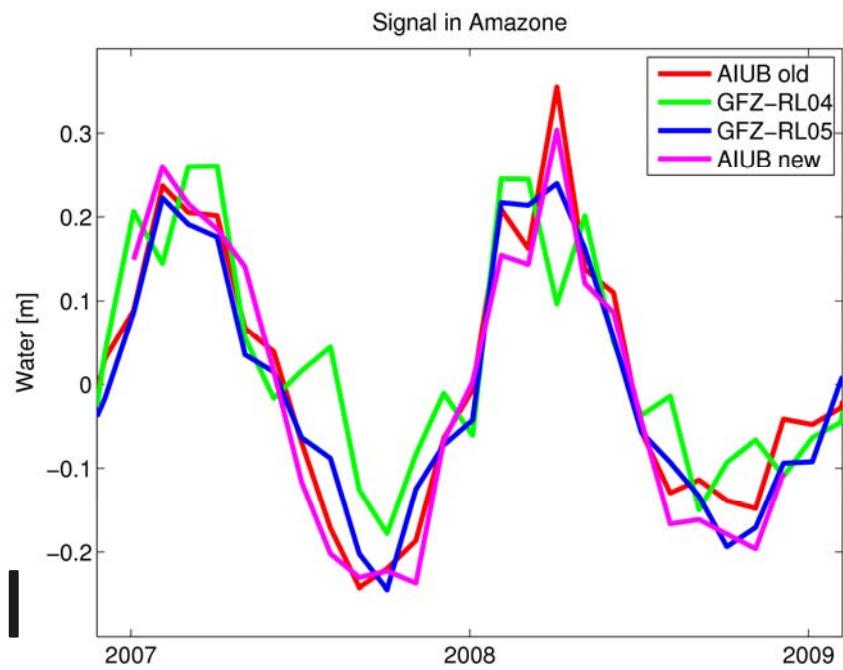


signal

Signal and Noise in monthly fields (GRACE)

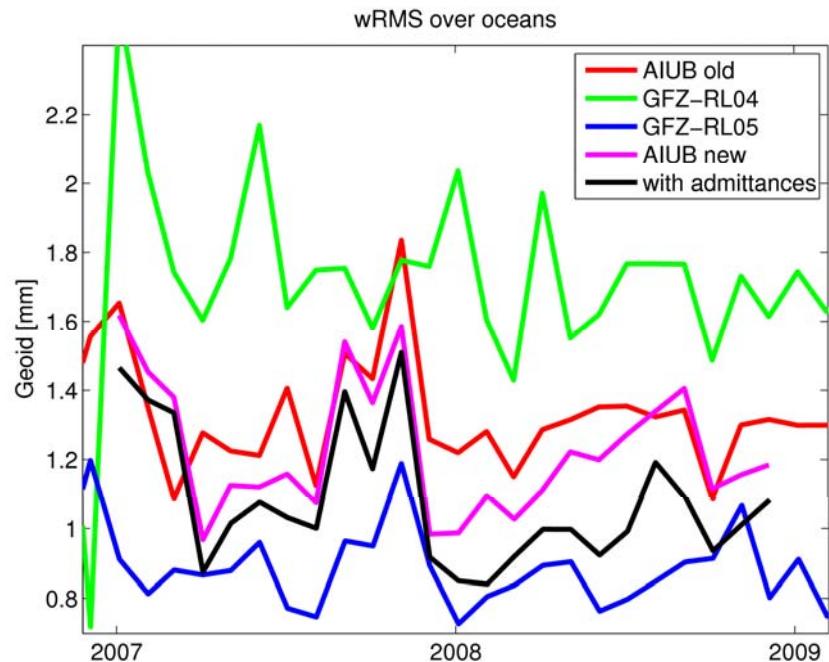


noise

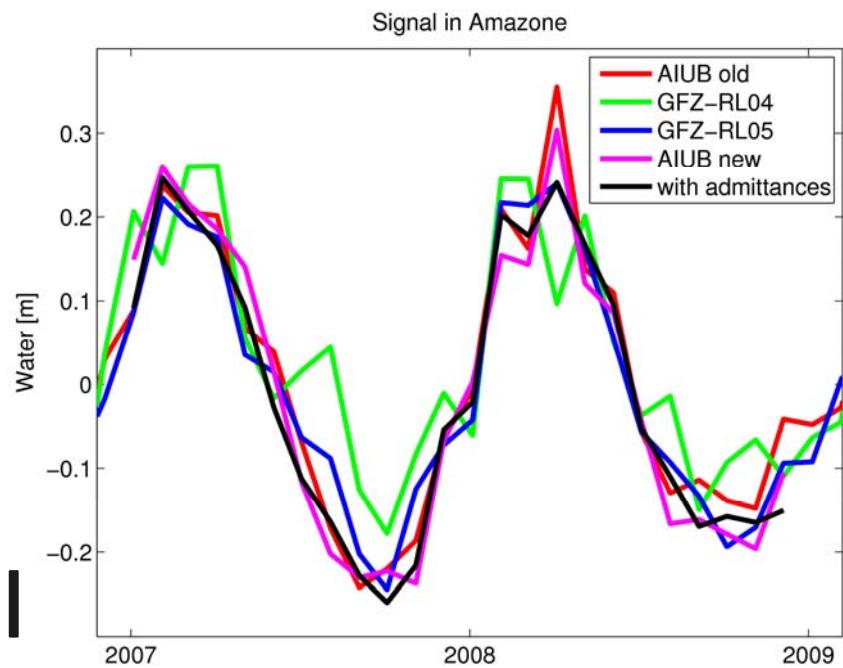


signal

Signal and Noise in monthly fields (GRACE)

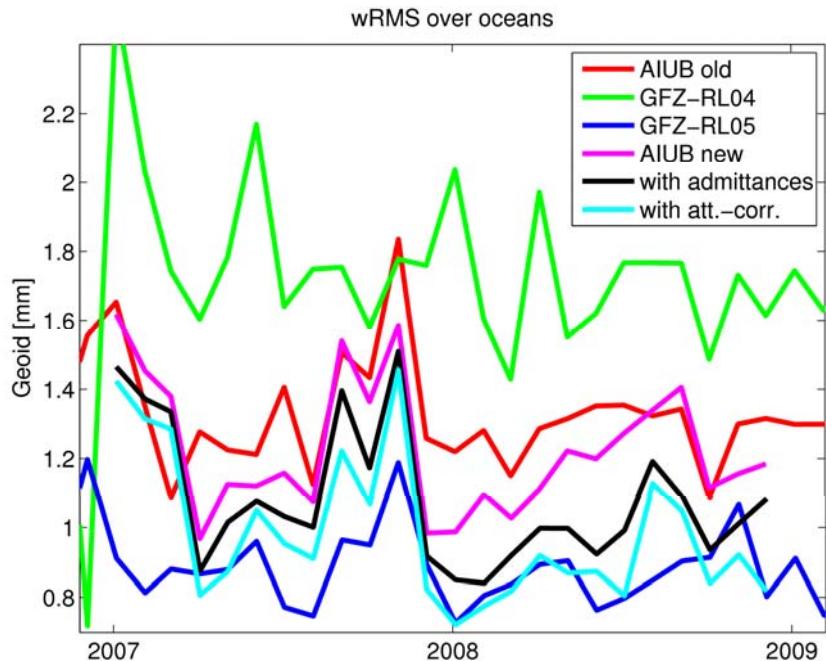


noise

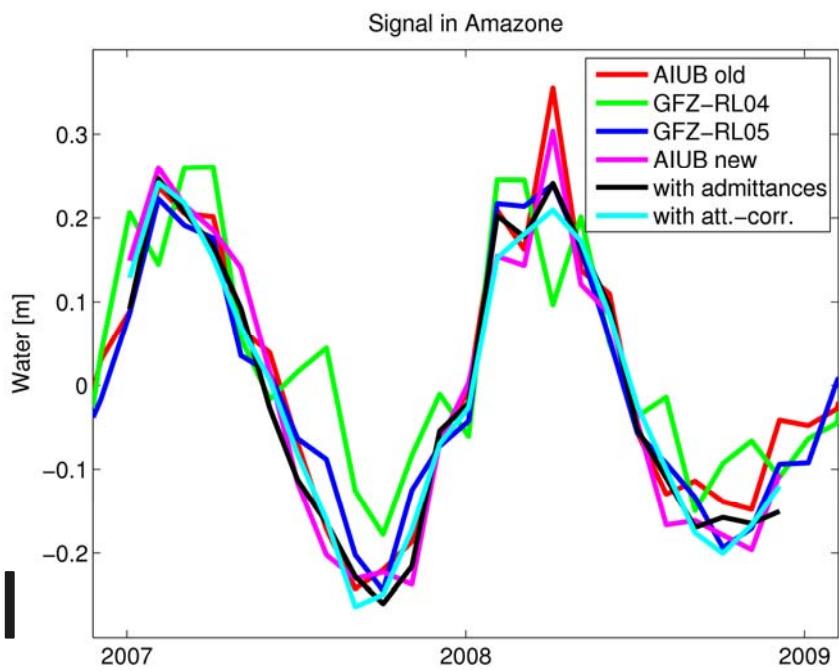


signal

Signal and Noise in monthly fields (GRACE)



noise

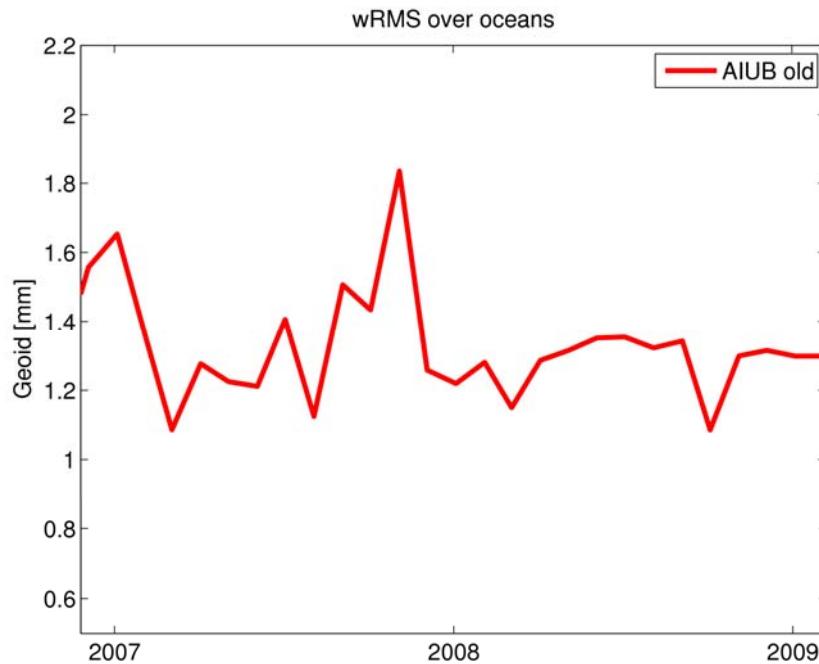


signal

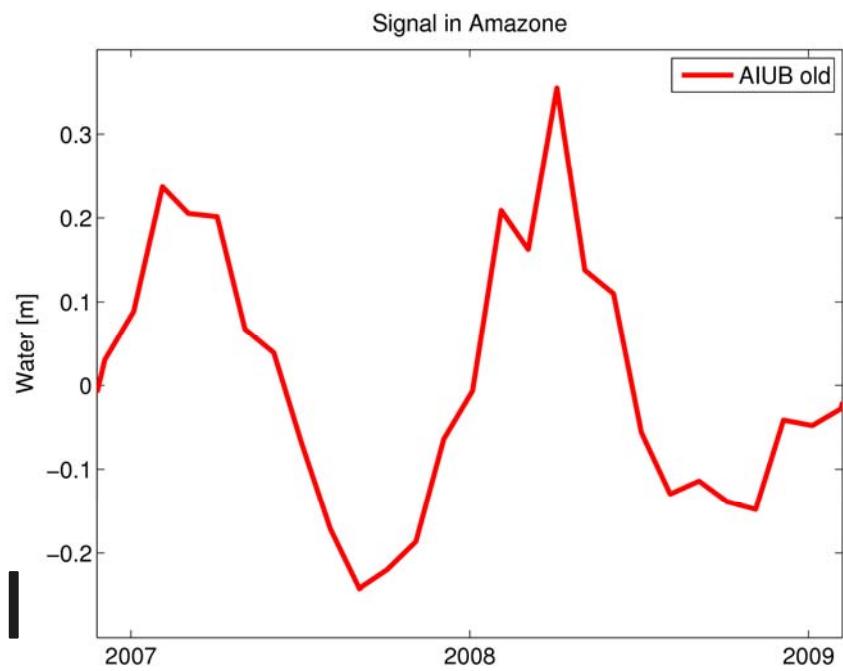
NEQ-modification tools

- Sampling / Binning of stochastic parameters.
- Absolute / Relative constraining of stochastic parameters.
- Pre-Elimination of arc-specific parameters (correlations with SH coefficients are kept).
- Deletion of arc specific parameters (correlations with SH coefficients are destroyed).

Separation of Orbit and Gravity field

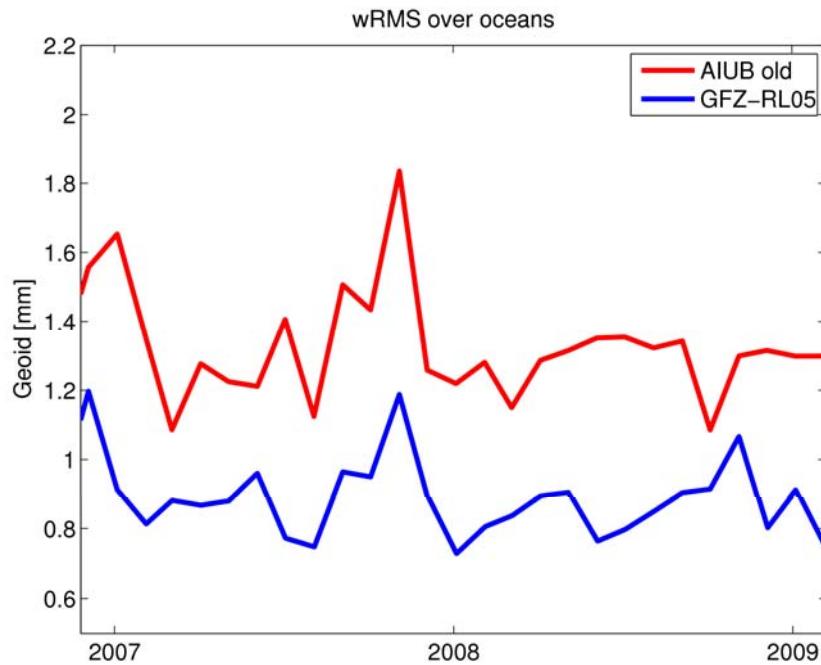


noise



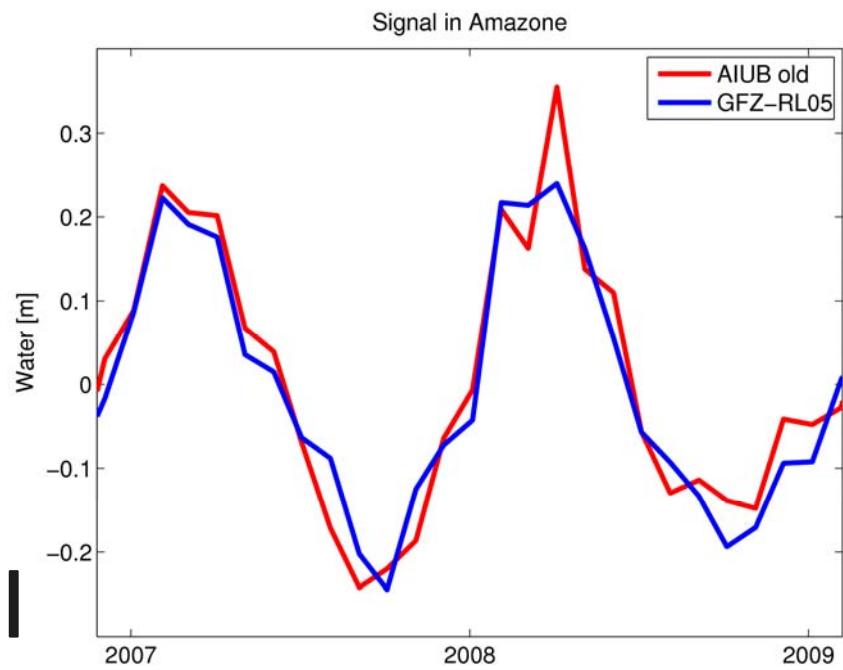
signal

Separation of Orbit and Gravity field

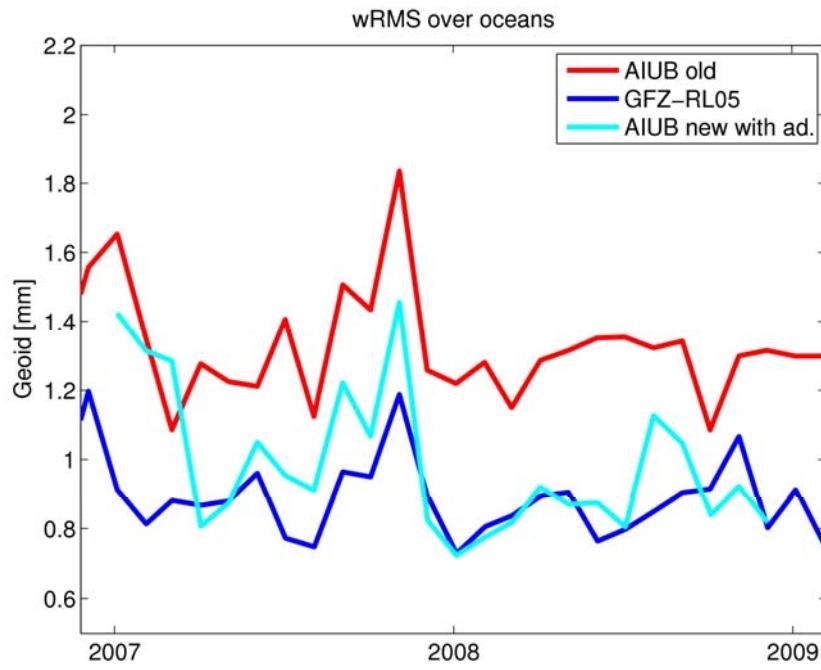


noise

signal

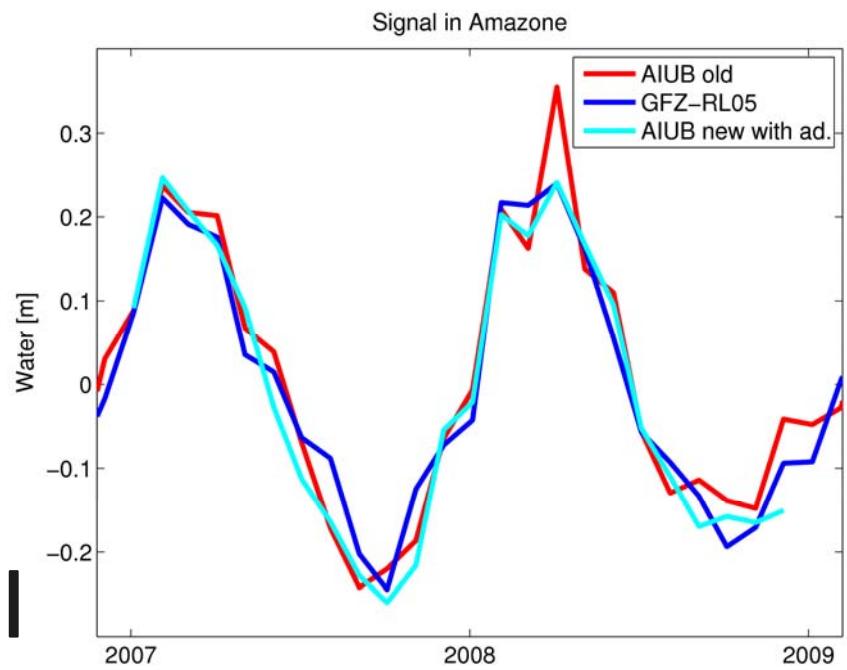


Separation of Orbit and Gravity field

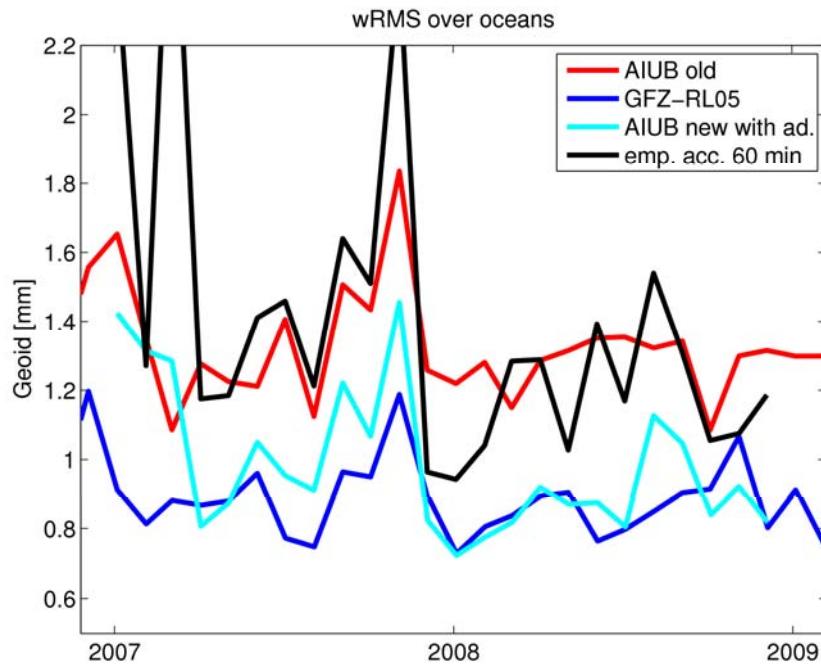


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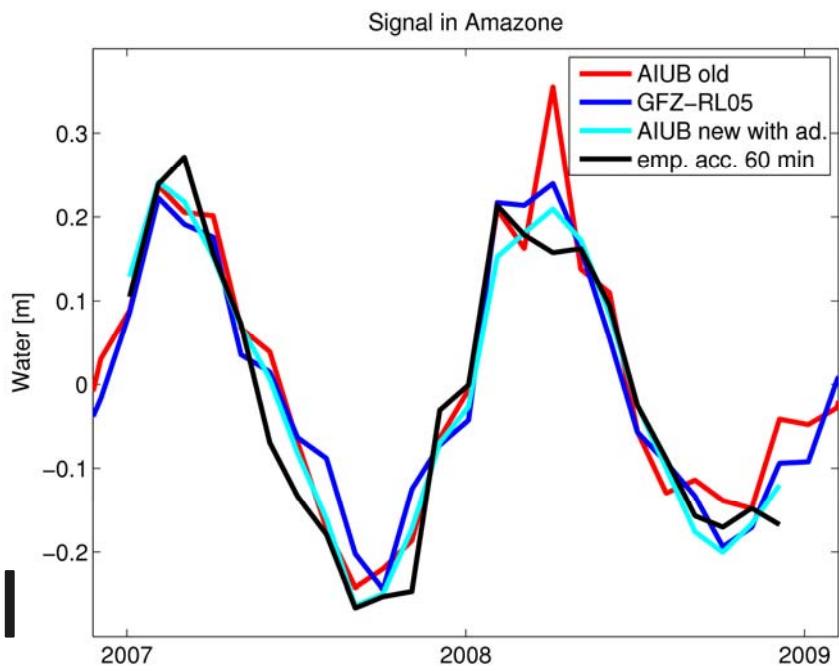
signal



Separation of Orbit and Gravity field

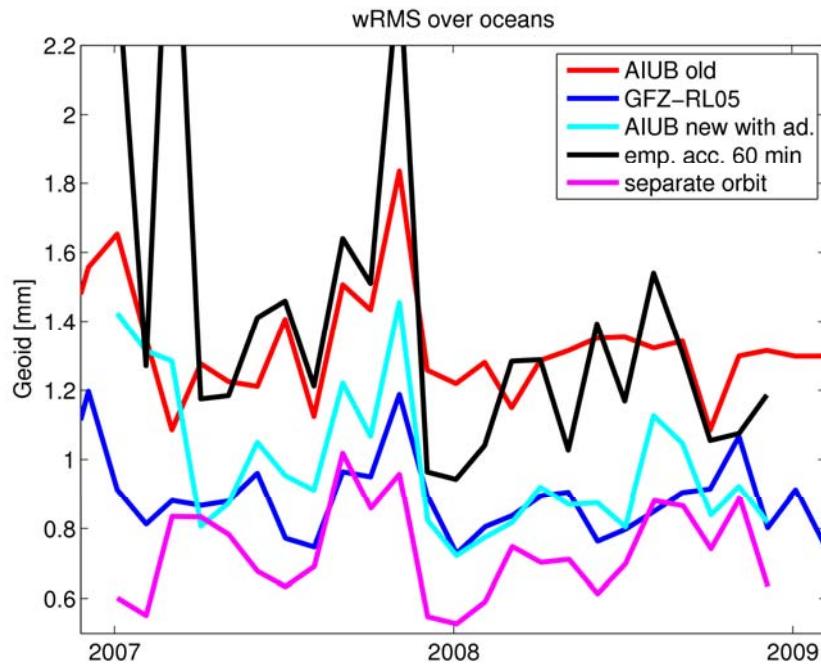


noise



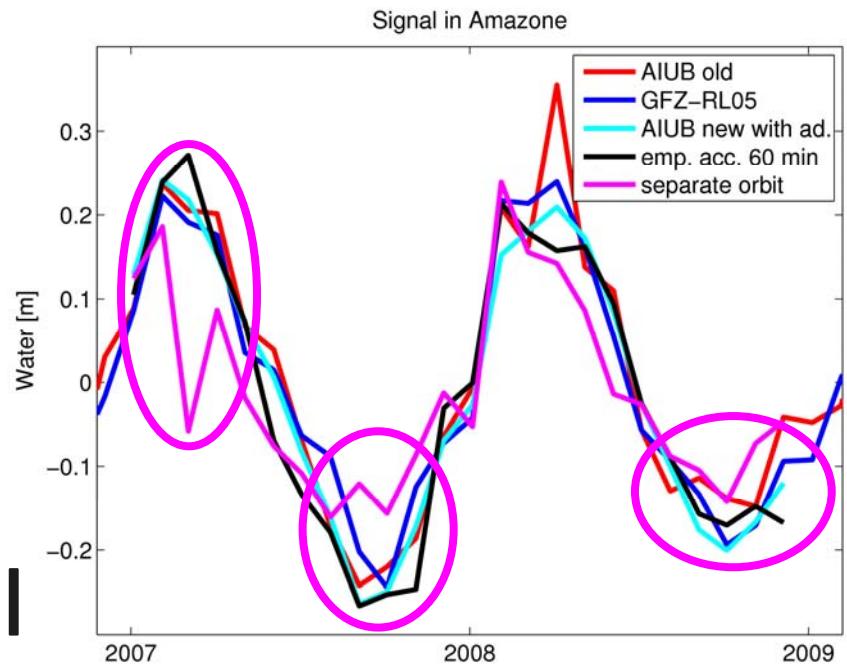
signal

Separation of Orbit and Gravity field



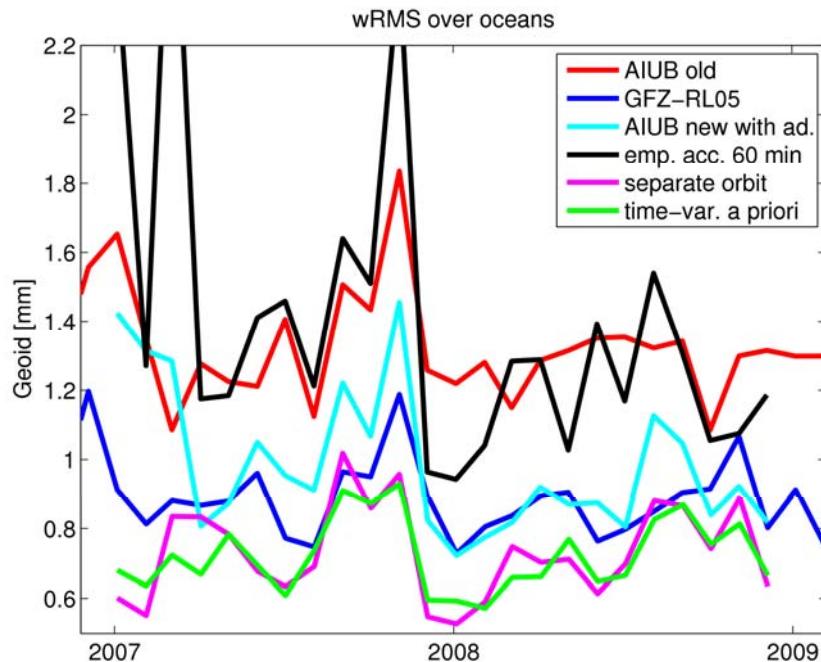
noise

signal loss

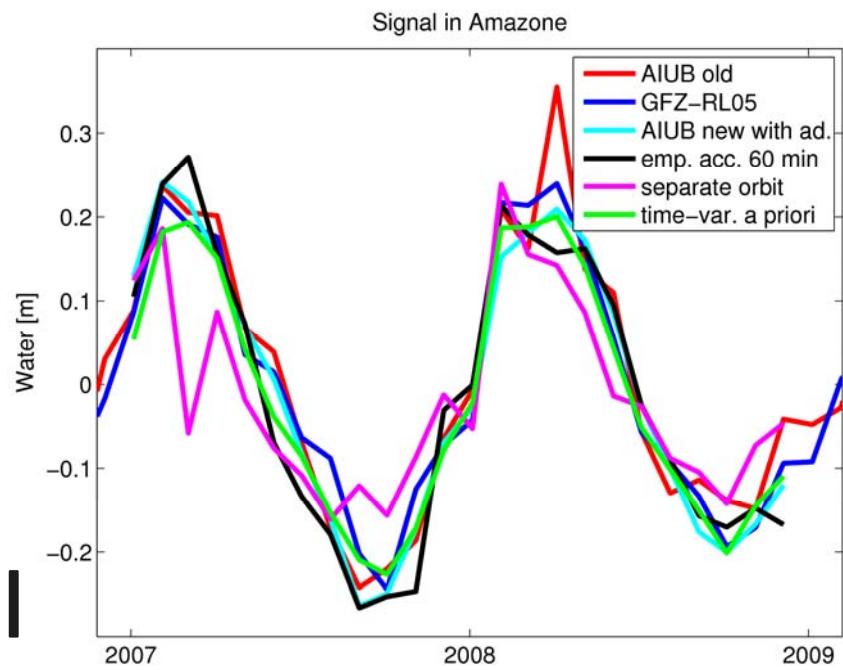


signal

Separation of Orbit and Gravity field

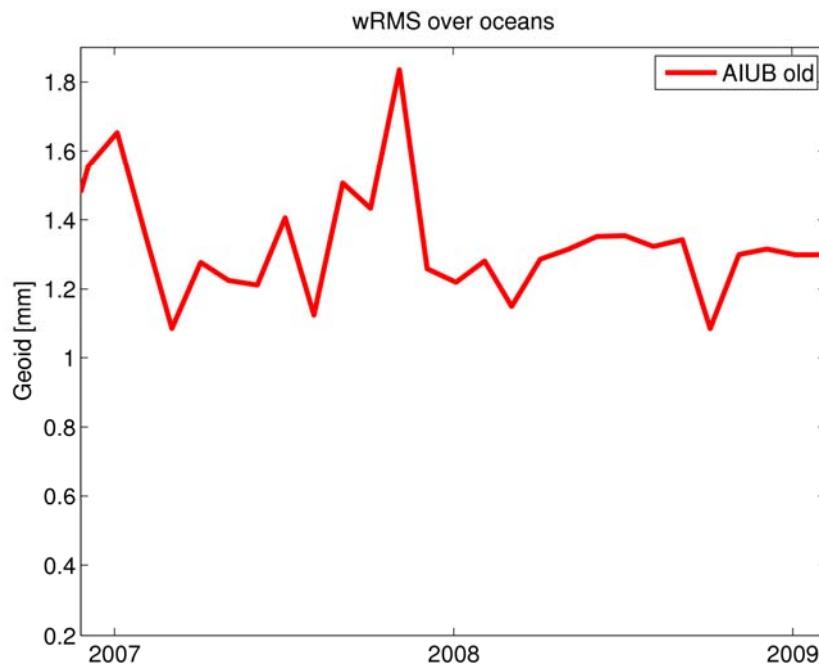


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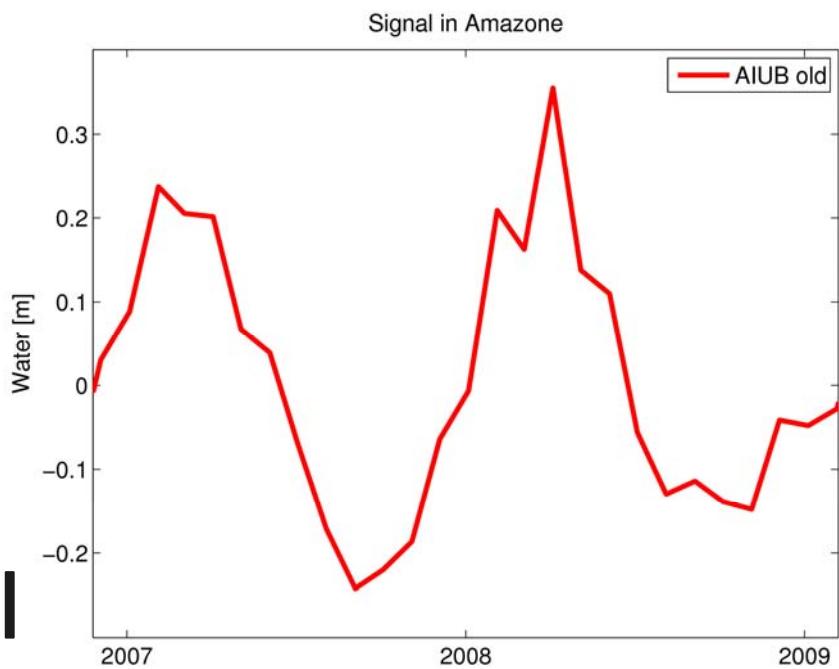


signal

Separation of Orbit and Gravity field

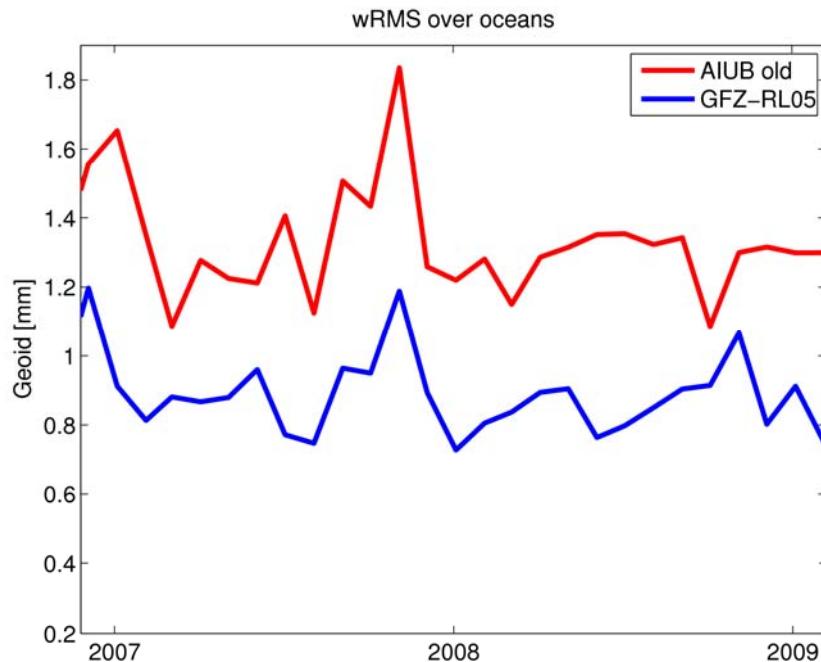


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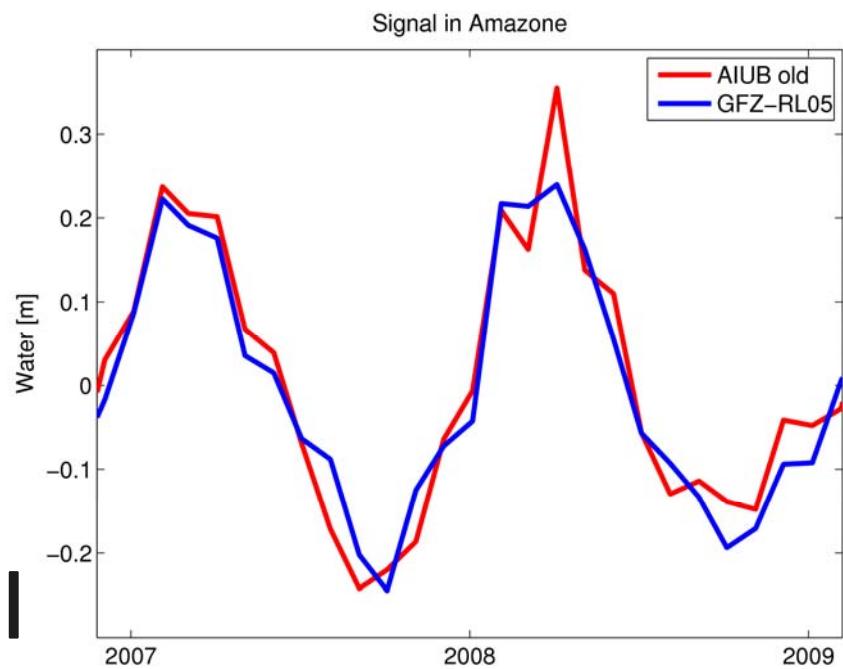
signal

Separation of Orbit and Gravity field

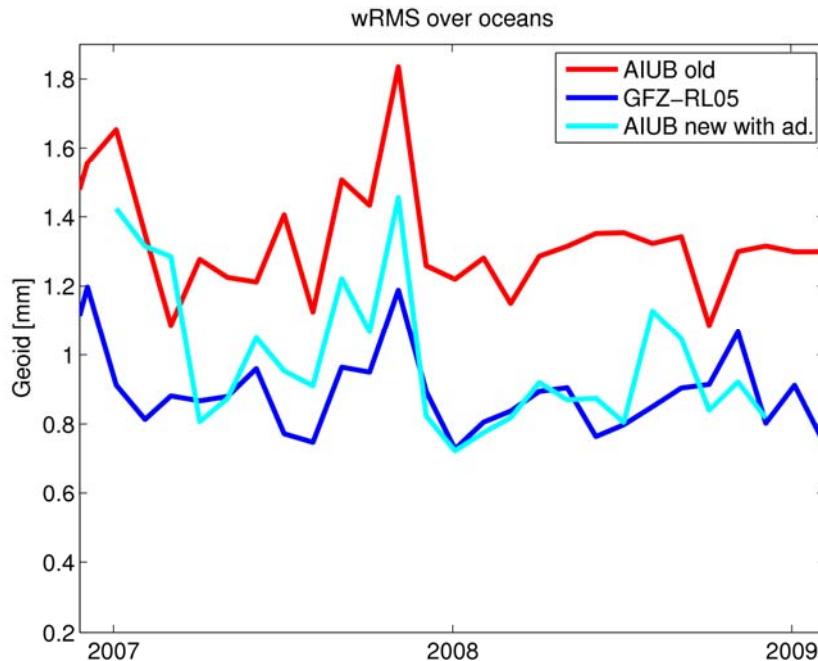


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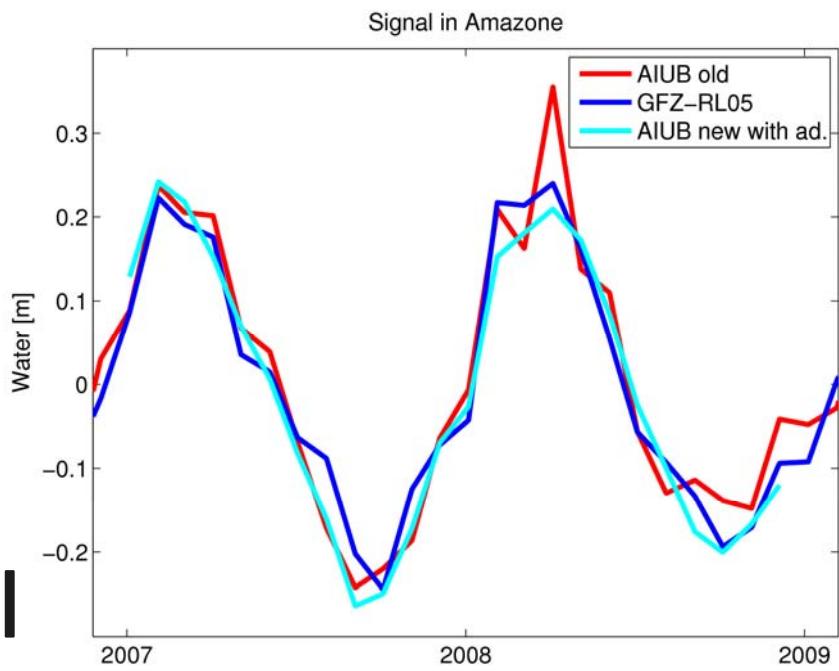
signal



Separation of Orbit and Gravity field

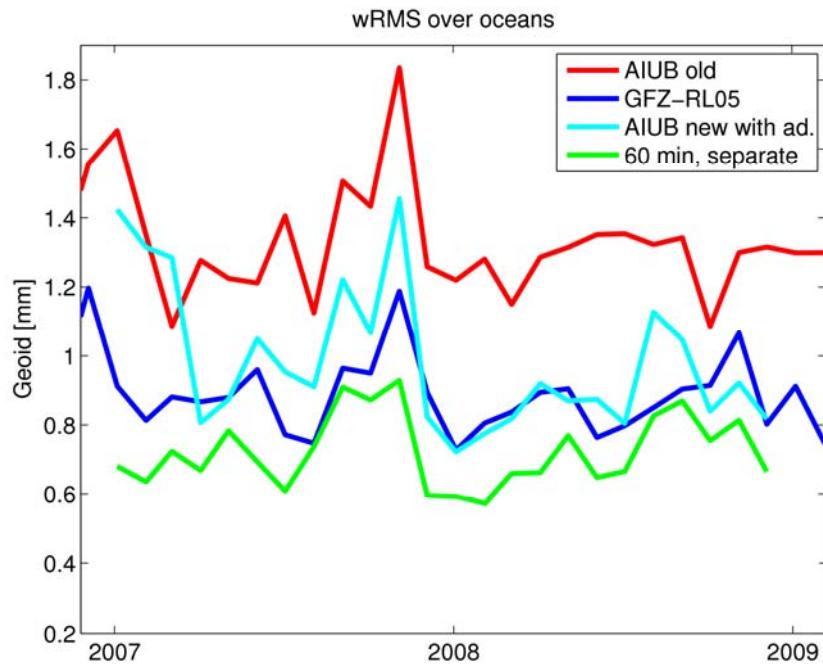


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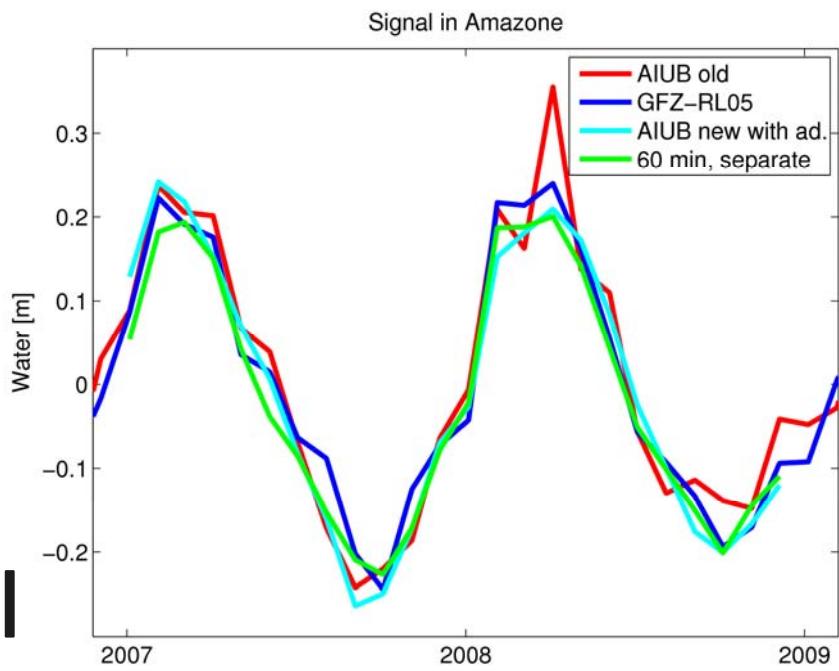


signal

Separation of Orbit and Gravity field

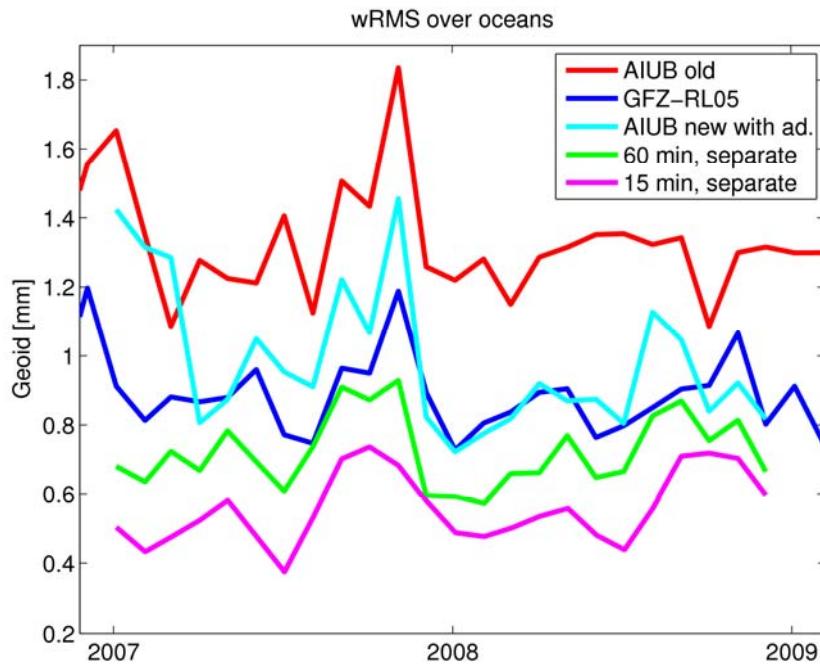


noise



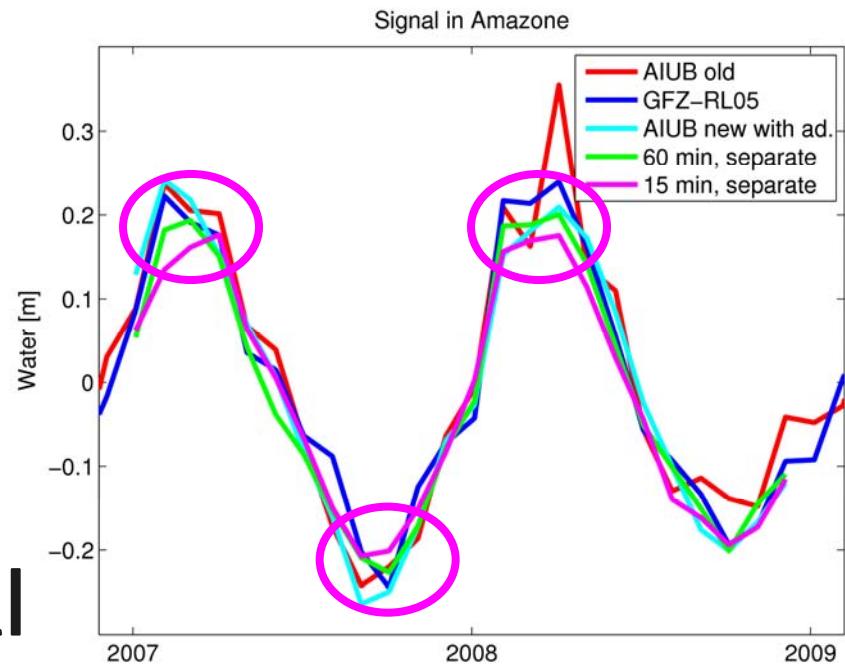
signal

Separation of Orbit and Gravity field



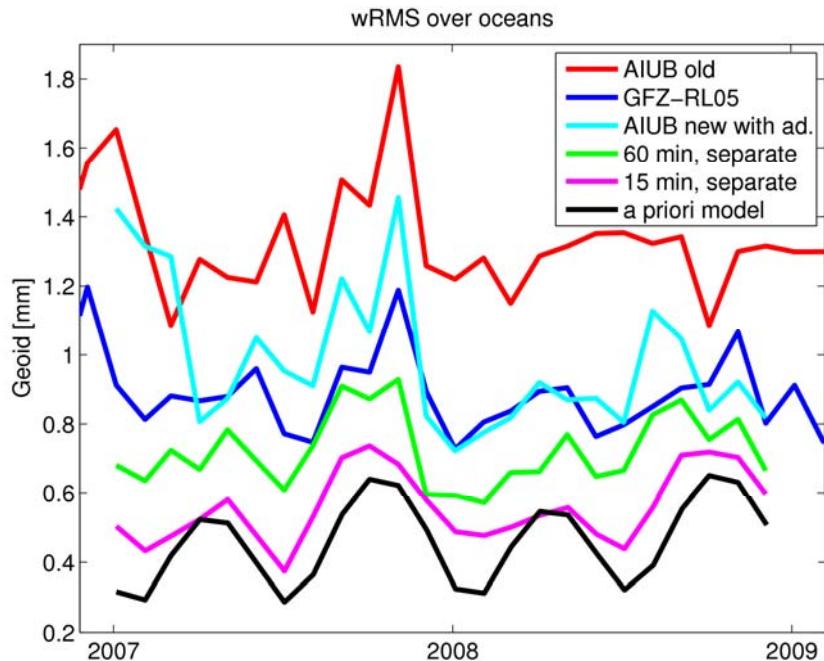
noise

signal loss

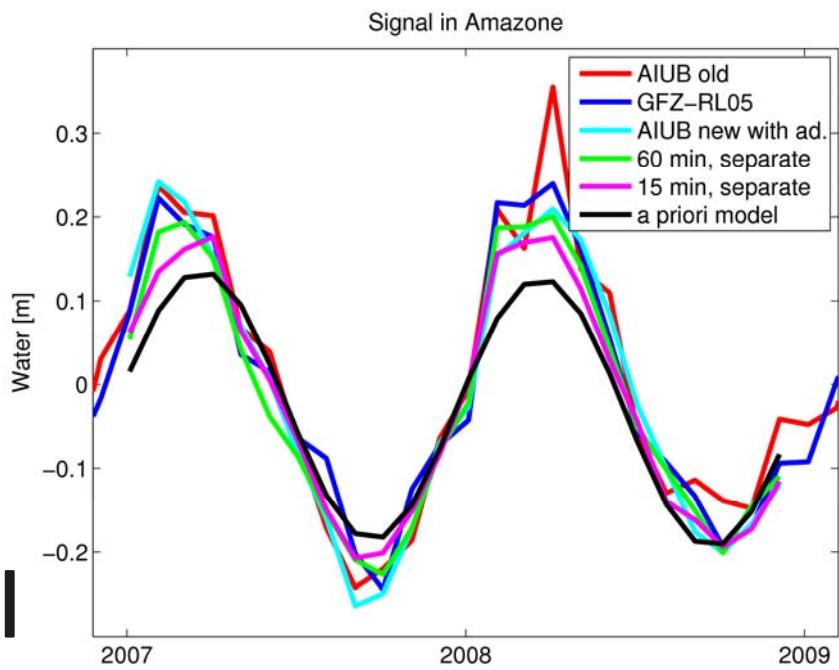


signal

Separation of Orbit and Gravity field



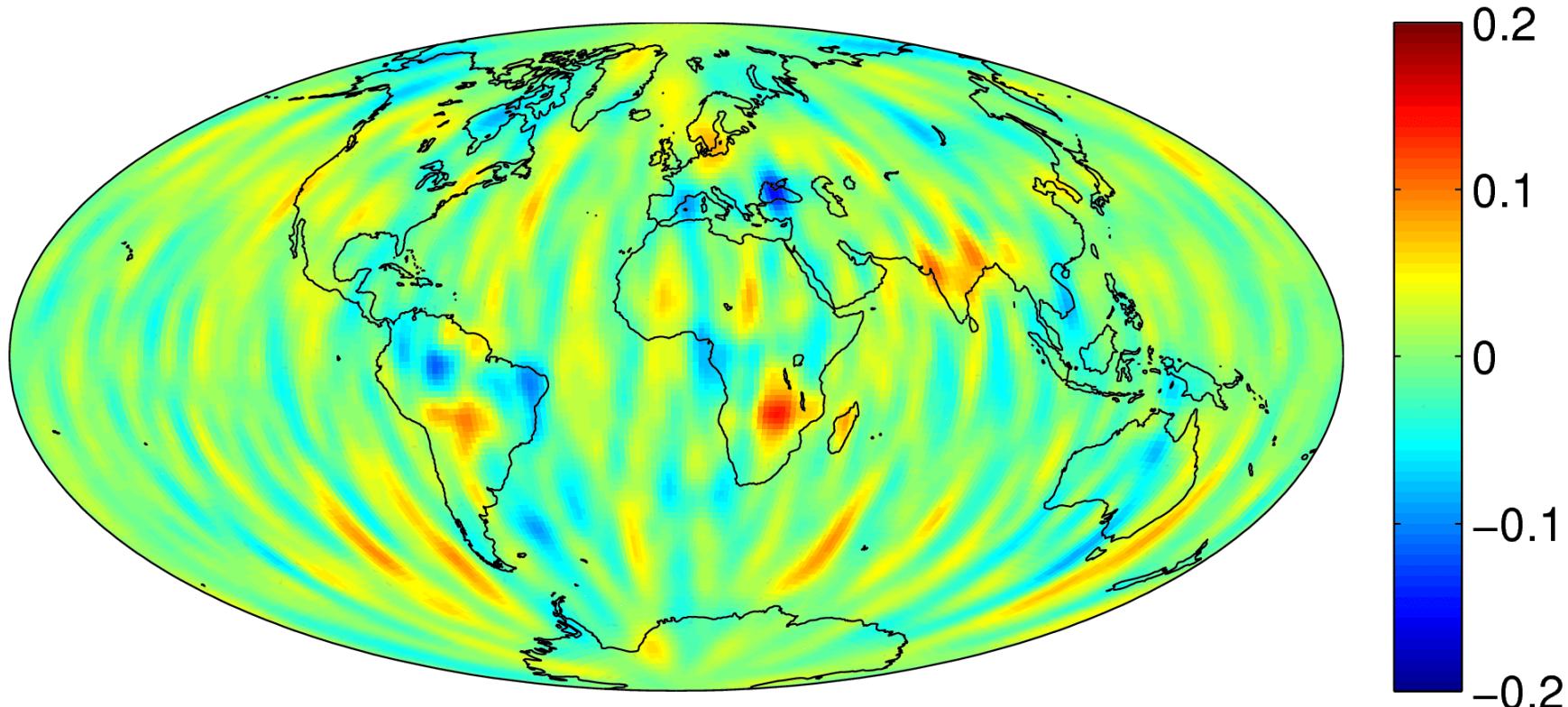
noise



signal

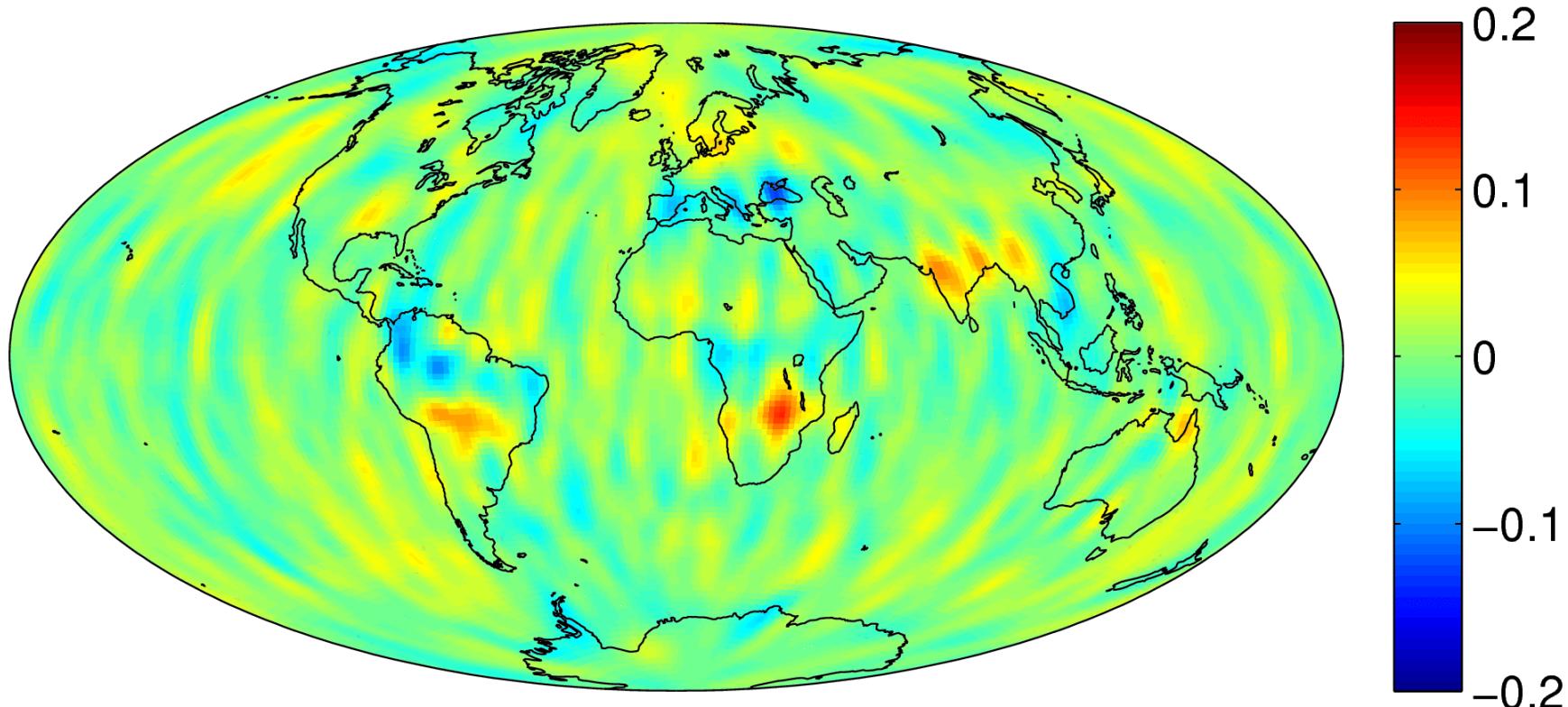
Monthly field – a priori model

Combined solution, 15 min



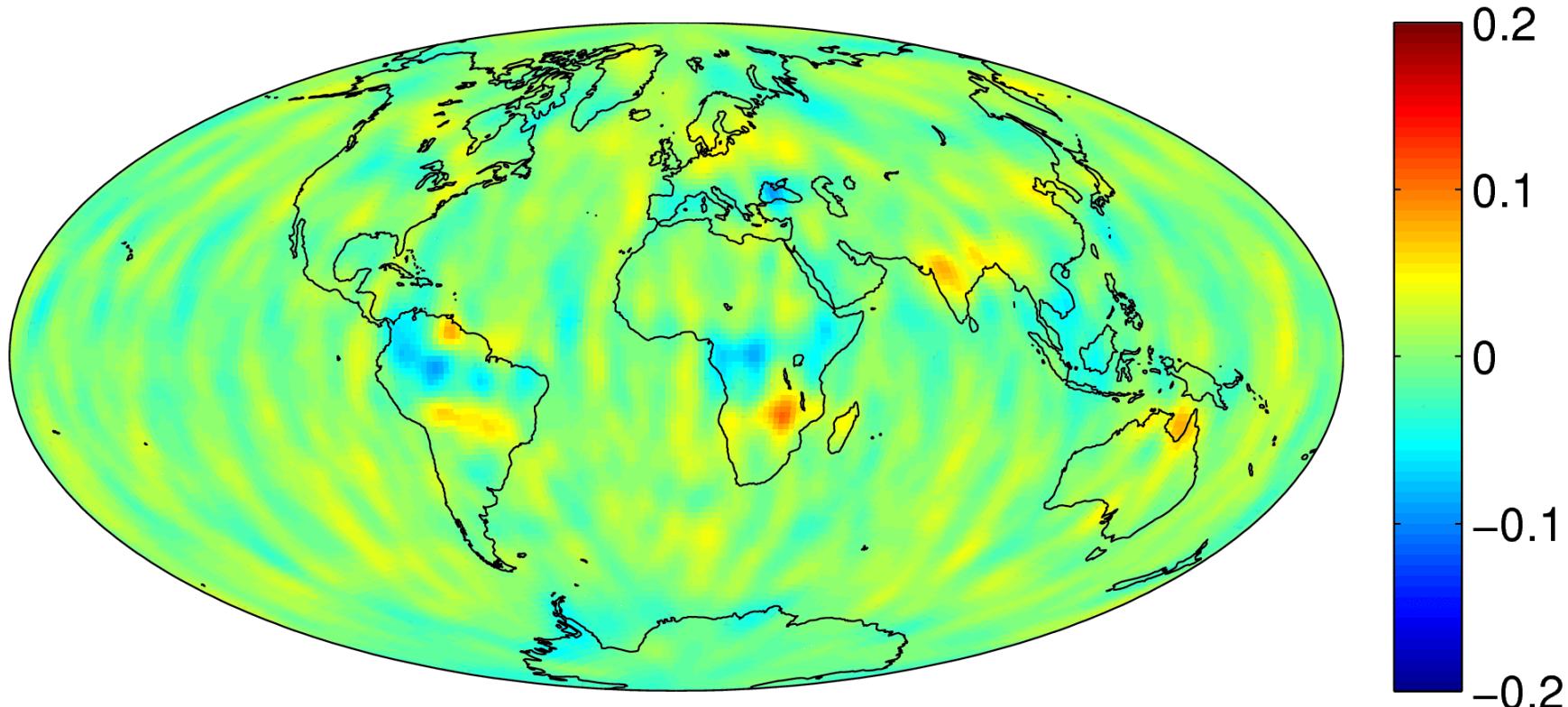
Monthly field – a priori model

Separate solution, 60 min



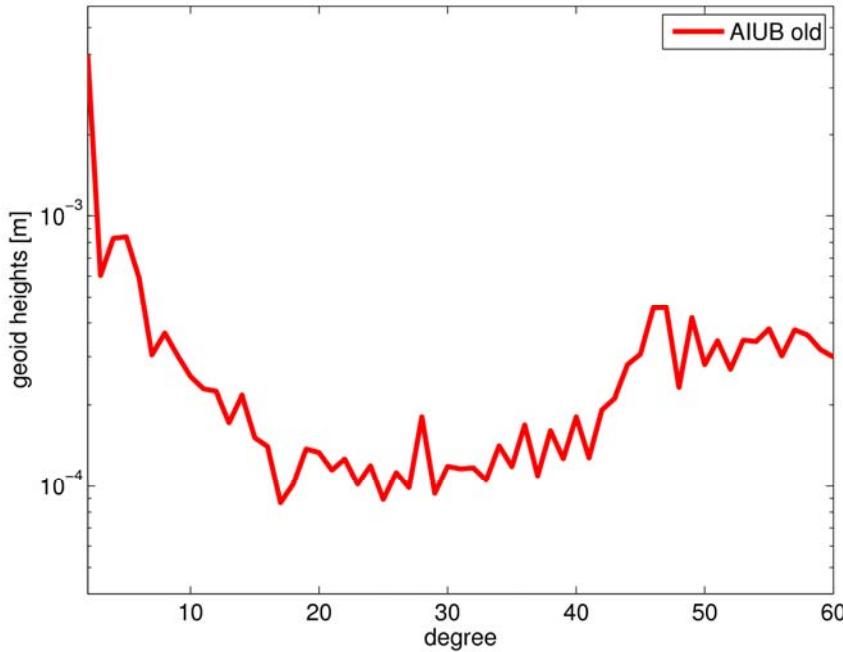
Monthly field – a priori model

Separate solution, 15 min



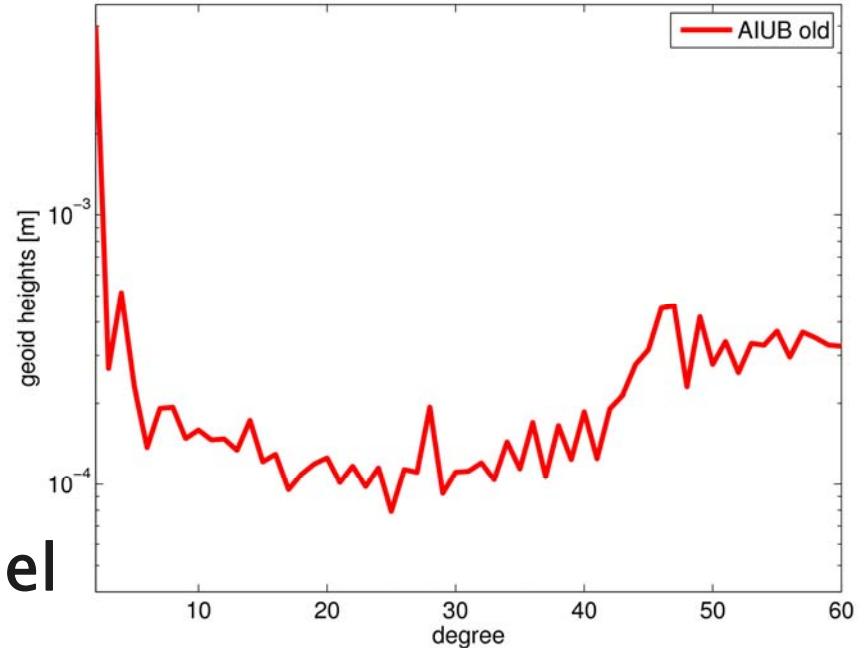
Degree Variances (monthly field)

Difference degree amplitudes monthly field – static field



monthly field – static field

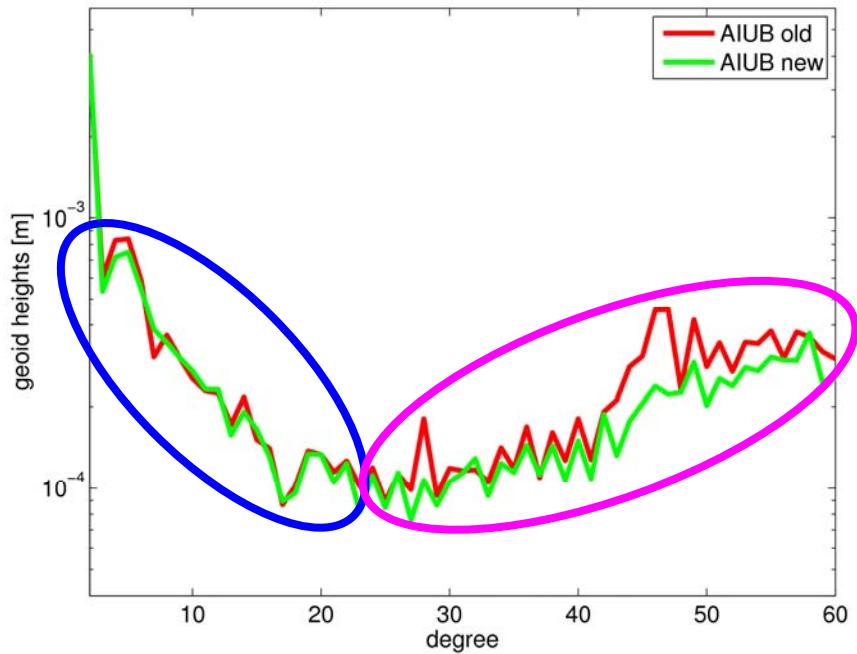
Difference degree amplitudes monthly field – a priori model



monthly field – timevar. model

Degree Variances (monthly field)

Difference degree amplitudes monthly field – static field



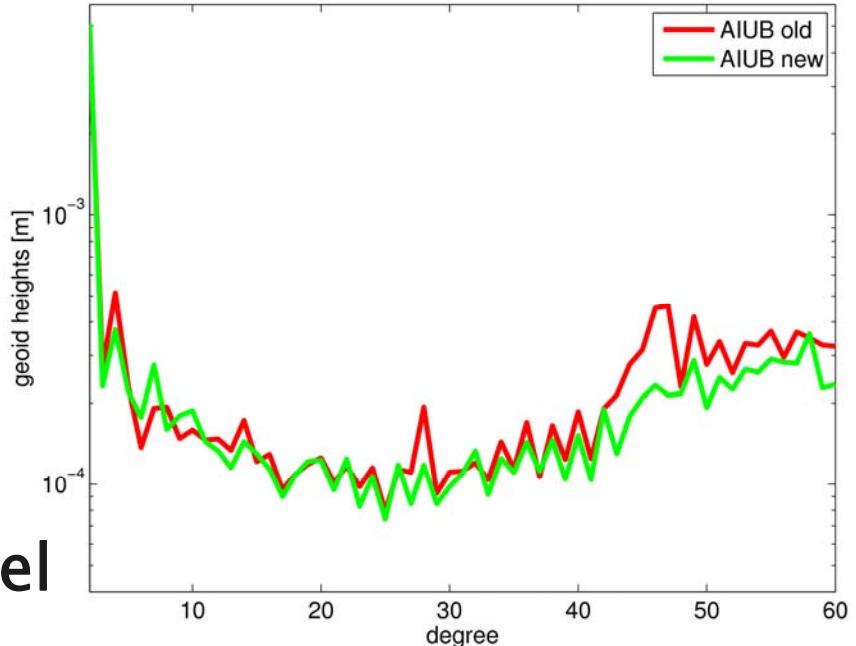
signal-dominated

noise-dominated

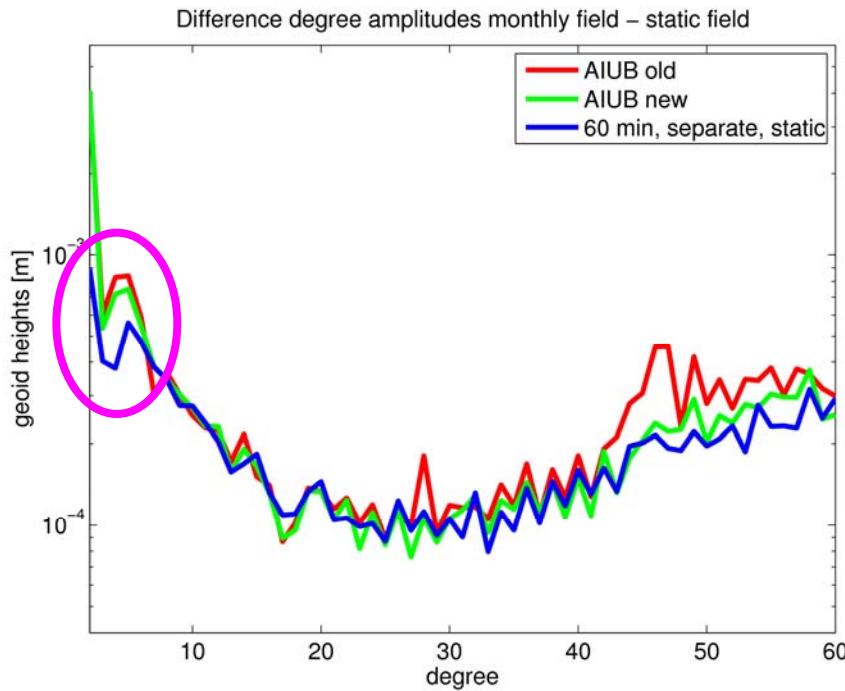
monthly field – timevar. model

monthly field – static field

Difference degree amplitudes monthly field – a priori model



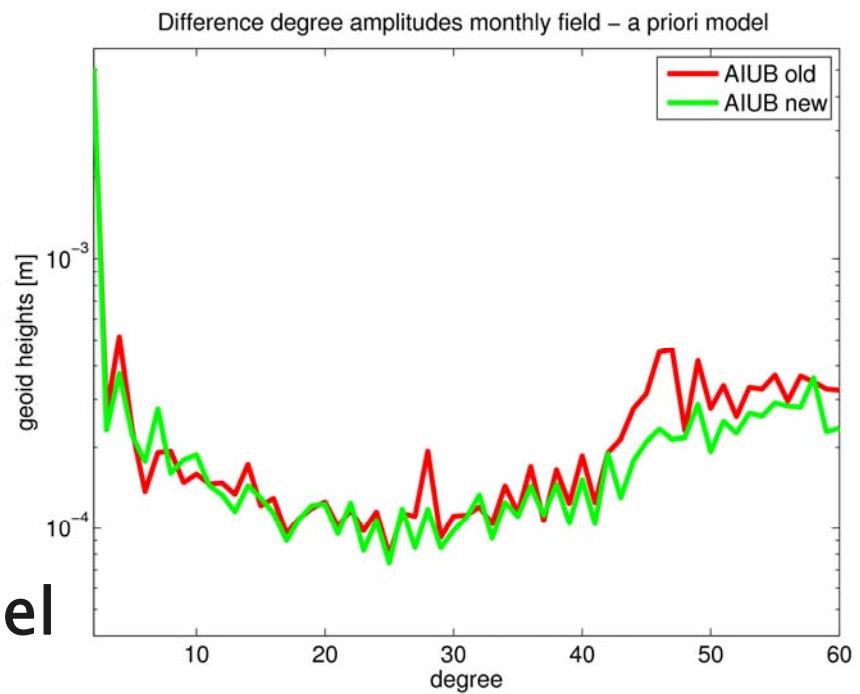
Degree Variances (monthly field)



signal damaged

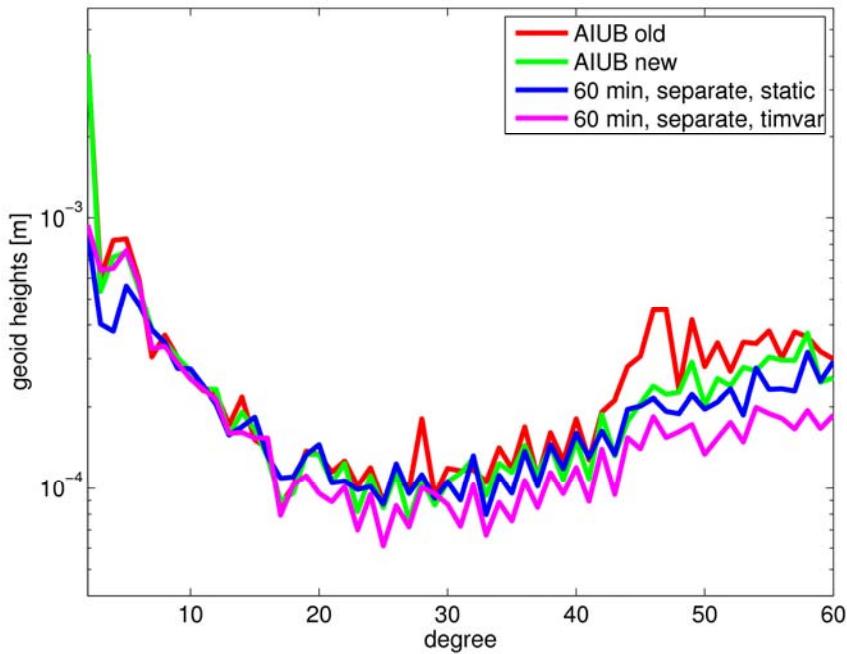
monthly field – timevar. model

monthly field – static field



Degree Variances (monthly field)

Difference degree amplitudes monthly field – static field

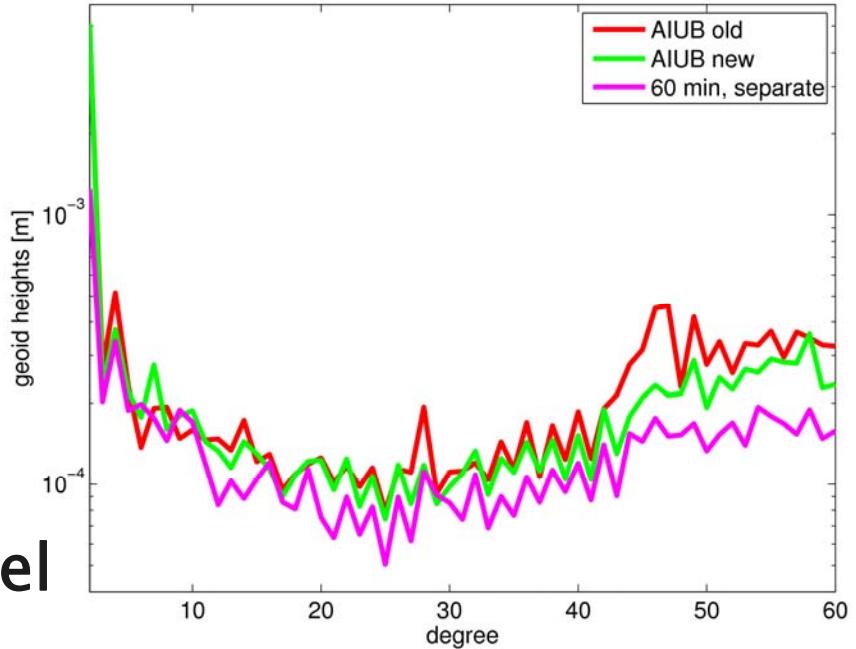


monthly field – static field

all degrees influenced

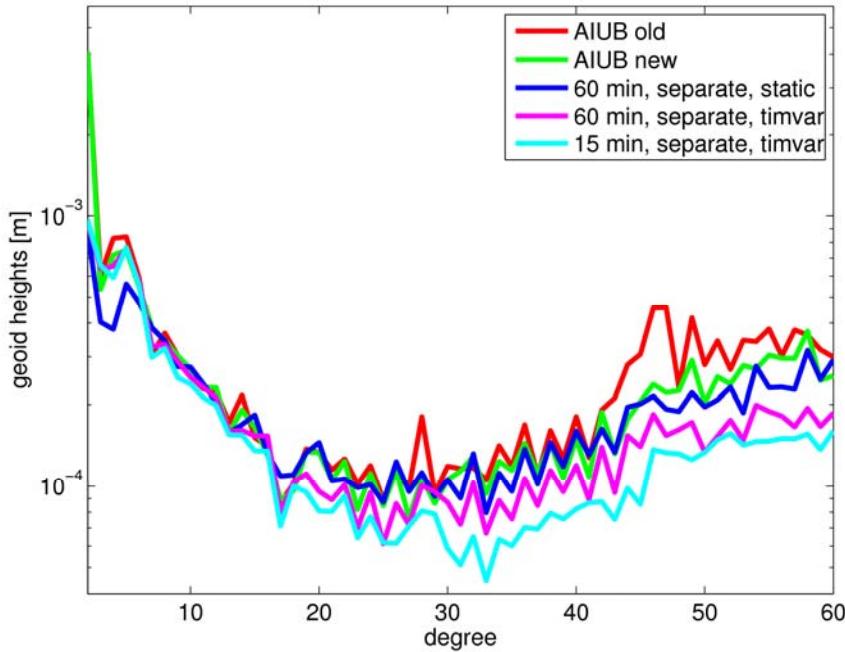
monthly field – timevar. model

Difference degree amplitudes monthly field – a priori model



Degree Variances (monthly field)

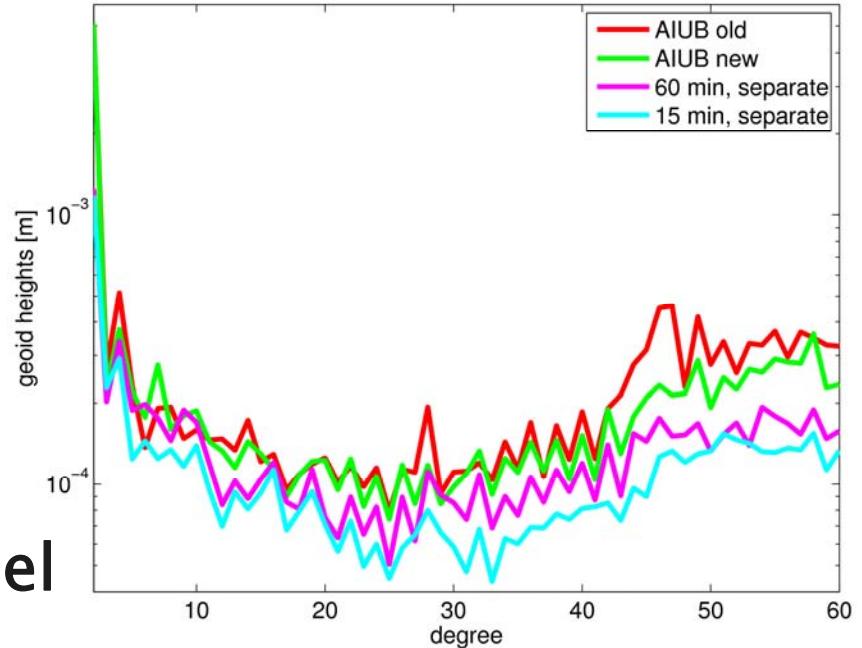
Difference degree amplitudes monthly field – static field



signal is damped

monthly field – static field

Difference degree amplitudes monthly field – a priori model



monthly field – timevar. model

How does it work?

How do we influence spherical harmonics of all degrees by only a few low frequent stochastic parameters?

High pass filter of Lumped Coefficients of orbit perturbations.

What happens if we estimate arc specific orbit parameters and gravity field coefficients separately?

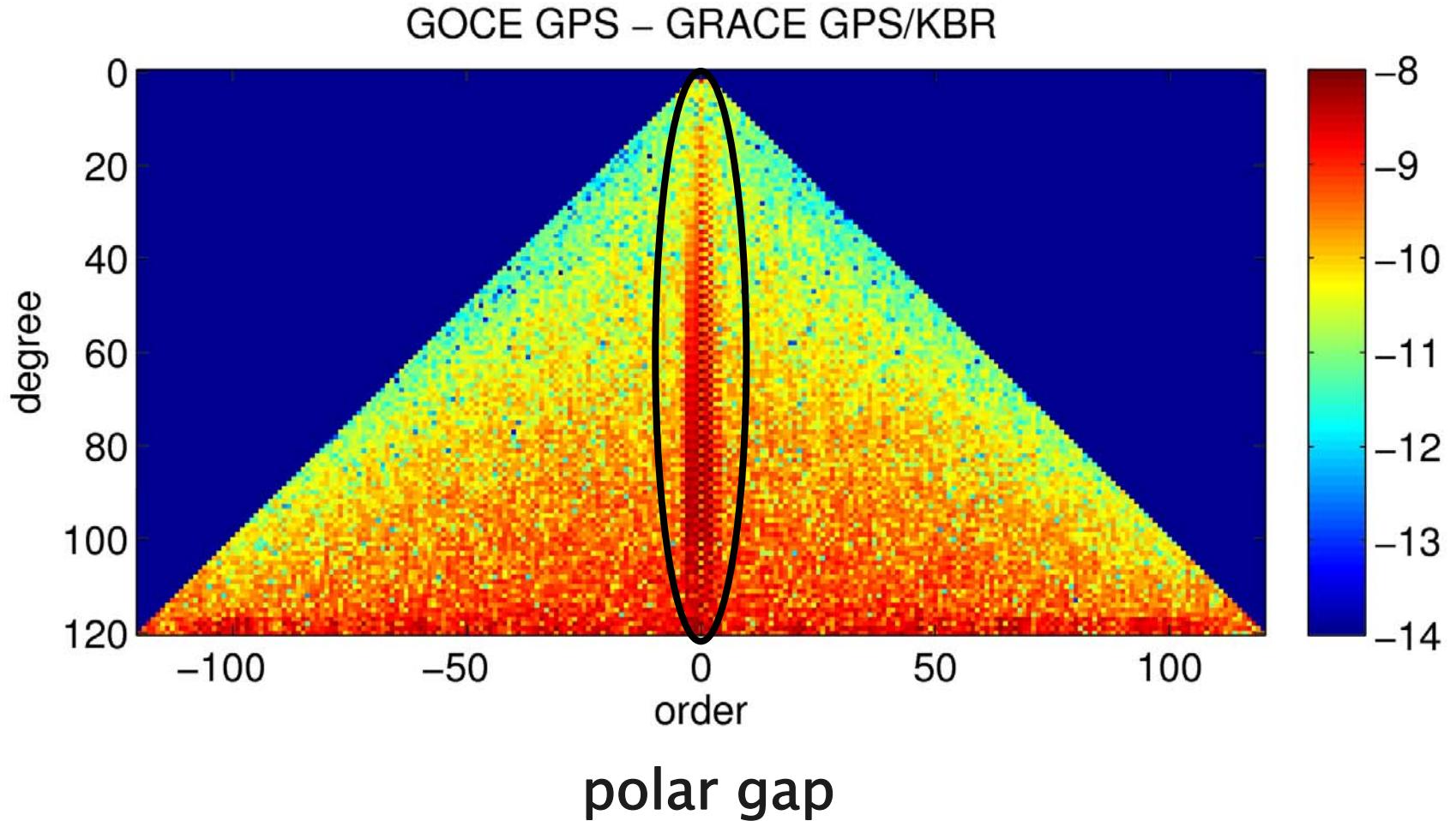
Correlations are destroyed, signal in stochastic parameters is lost for gravity field coefficients.

Discussion

Is it good or bad?

- Is it correct?
 - Not really
- Is it helpful?
 - Yes
- Is it dangerous?
 - Yes

GOCE polar gap



GOCE polar gap

