

Time variability from high - low SST - filling the gap between GRACE and GFO



Matthias Weigelt



Adrian Jäggi, Lars Prange



Qiang Chen, Wolfgang Keller,



Nico Sneeuw

presented by
Tilo Reubelt

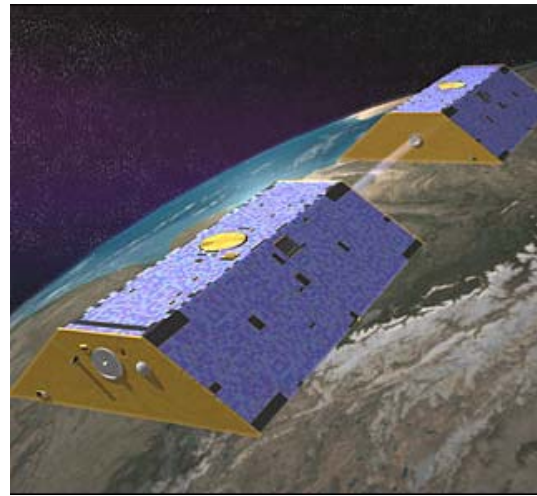
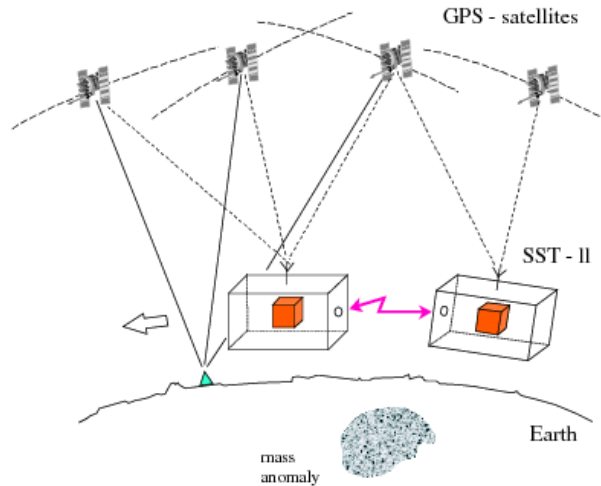
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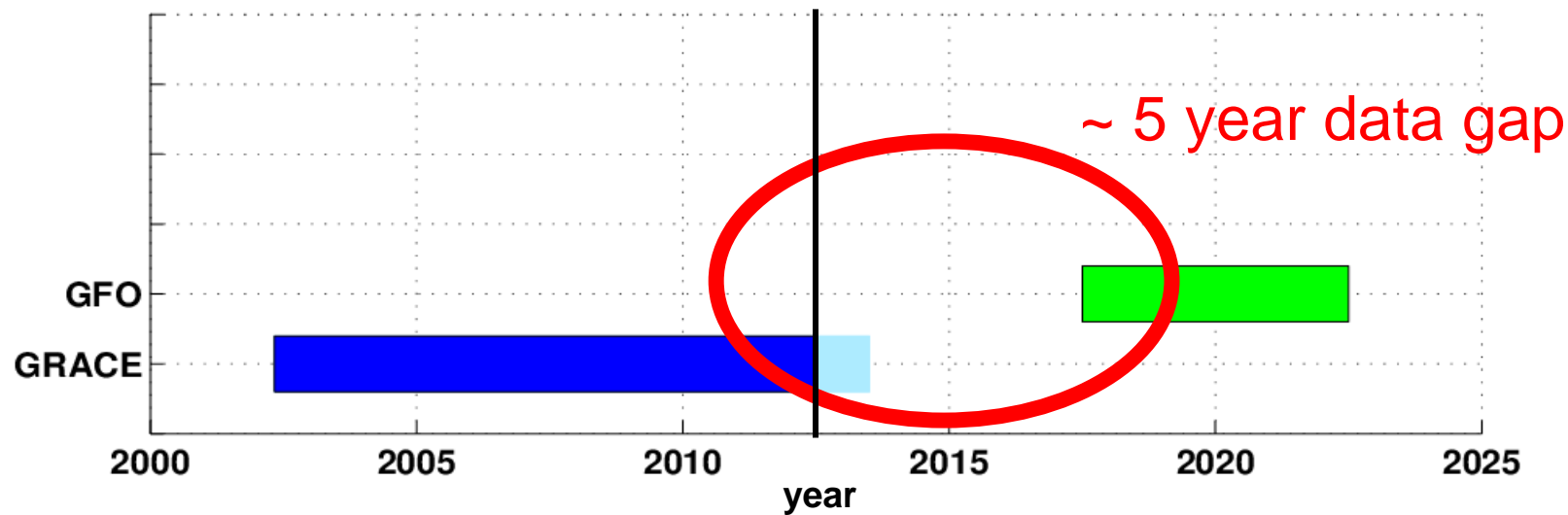
GRACE und GRACE Follow-On (GFO)

Low-low



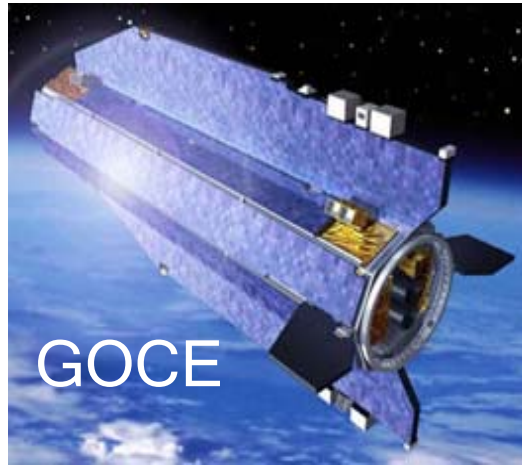
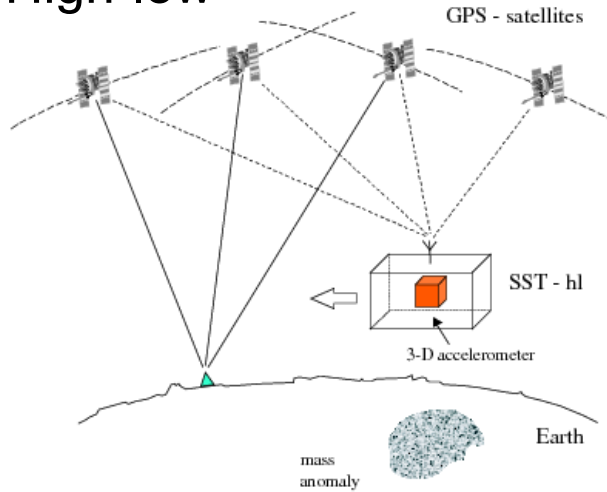
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- K-Band (Laser)
- GPS
- Accelerometer



Other gravity field missions

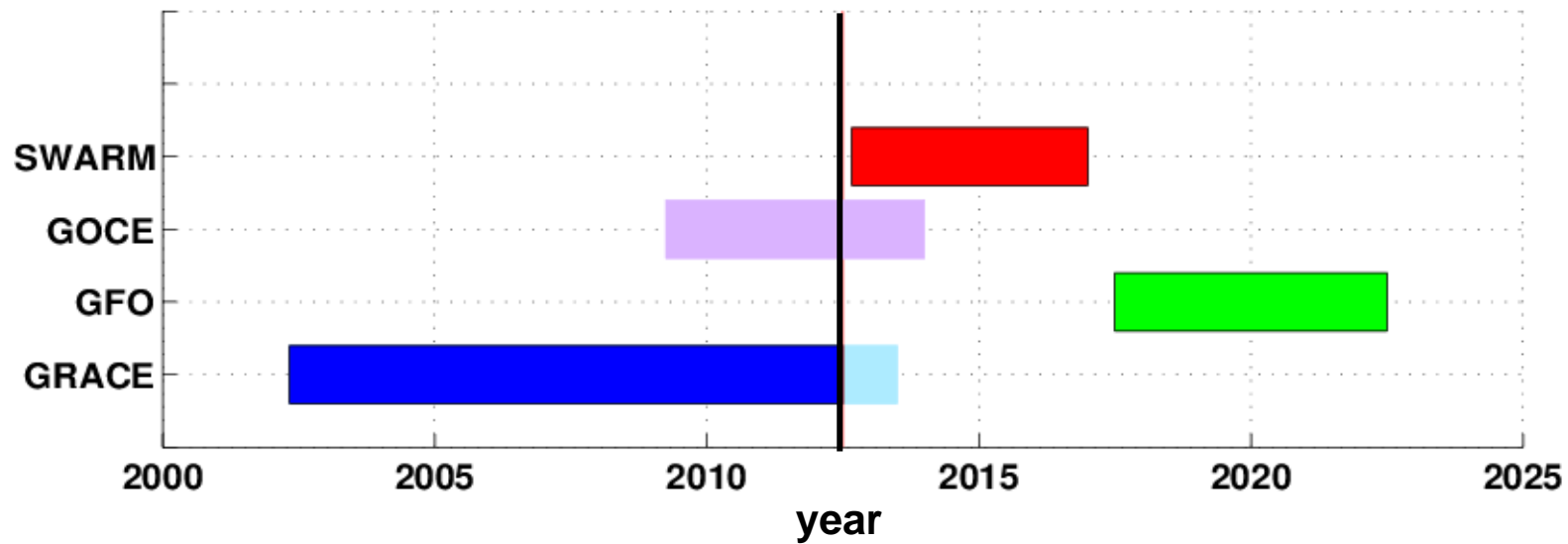
High-low



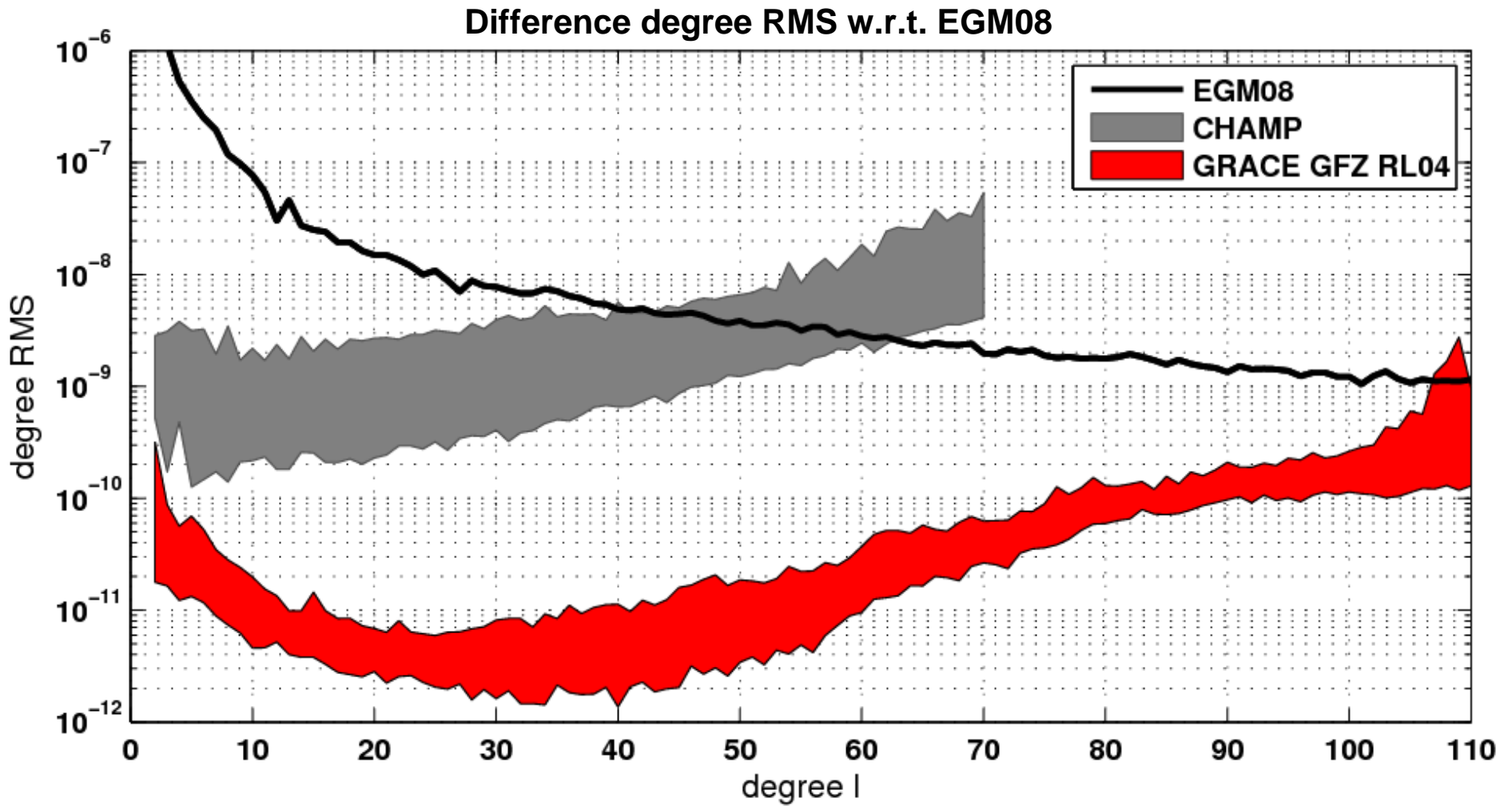
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Previous CHAMP studies



CHAMP REPROCESSING

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Data reprocessing

GPS positions:

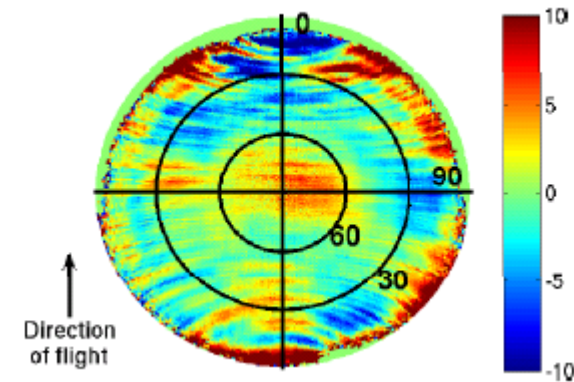
- 10 s sampling
- empirical absolute antenna phase center model
- ...

Approach:

- acceleration approach
- no accelerometer data used
- no regularization and no *a priori* model / information

Background models:

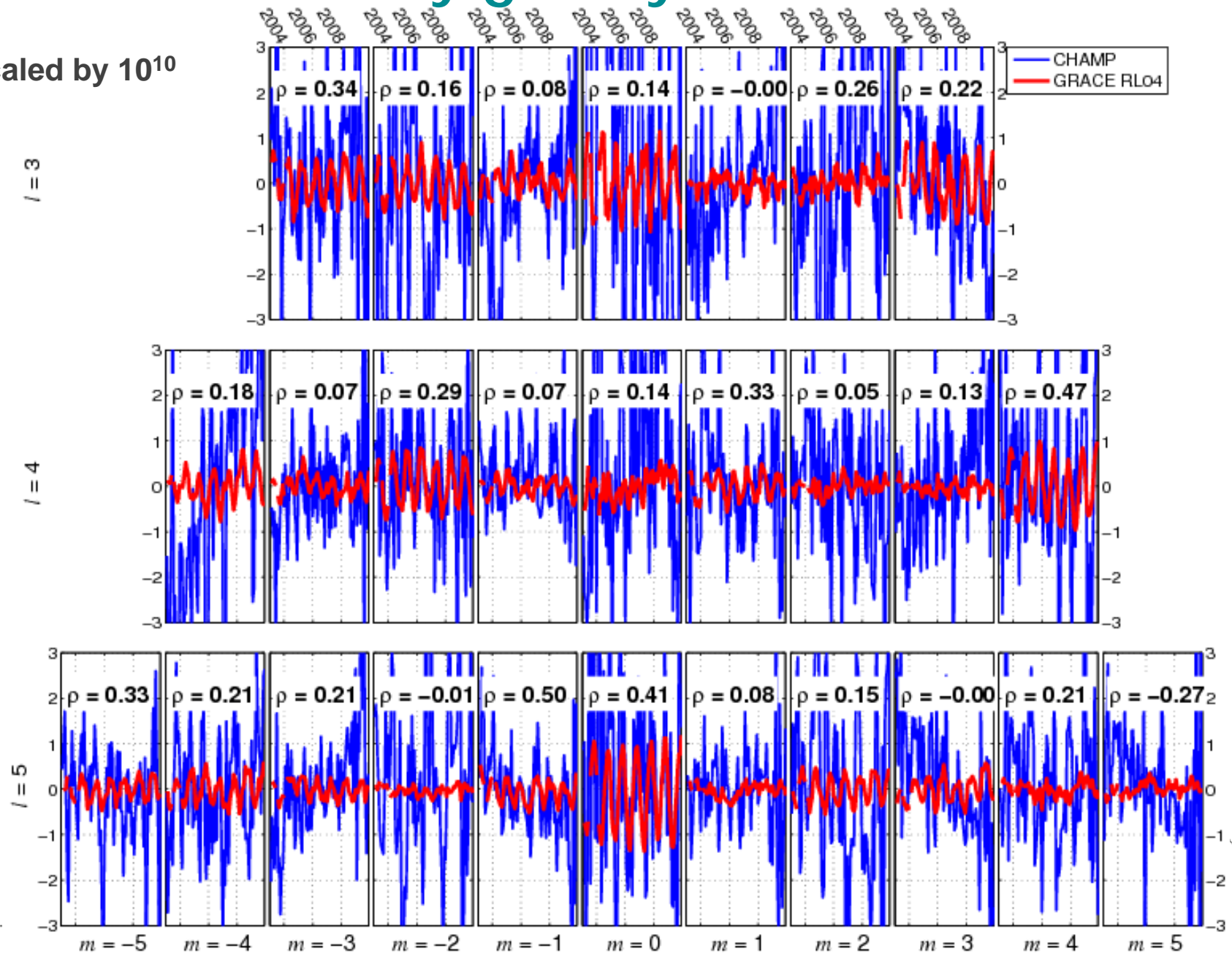
- JPL ephemeris DE405
- Solid Earth tides & solid Earth pole tides (IERS conventions)
- Ocean tides (FES 2004)
- Ocean pole tides (IERS conventions, Desai 2002)
- Atmospheric tides (N1-model, Biancale and Bode 2006)
- Relativistic corrections (IERS conventions)
- AOD1B-product (Flechtner 2008)



Prange 2010

CHAMP monthly gravity field solution

scaled by 10^{10}



FILTERING

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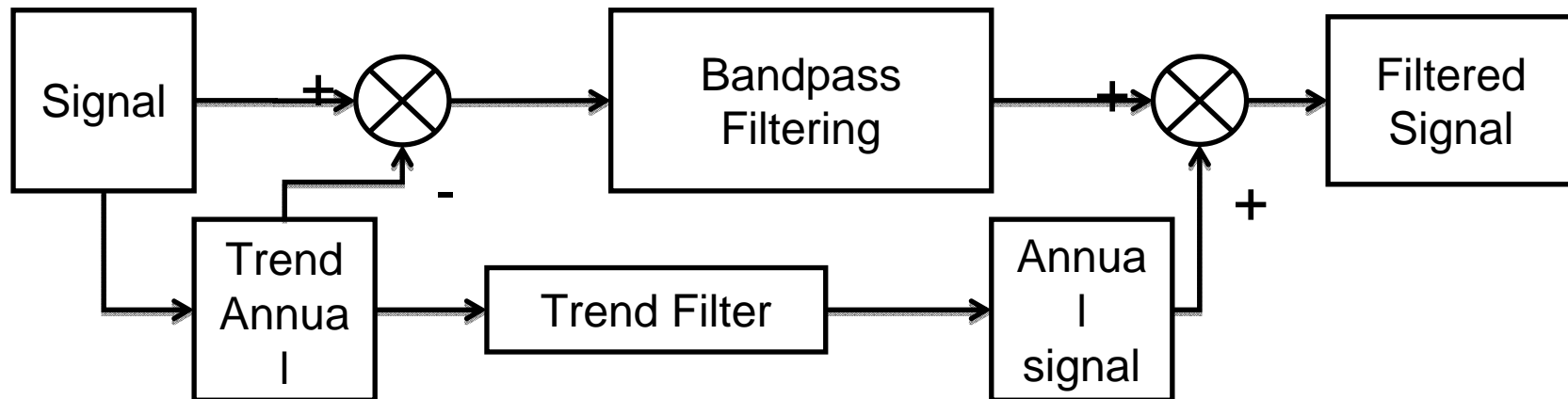


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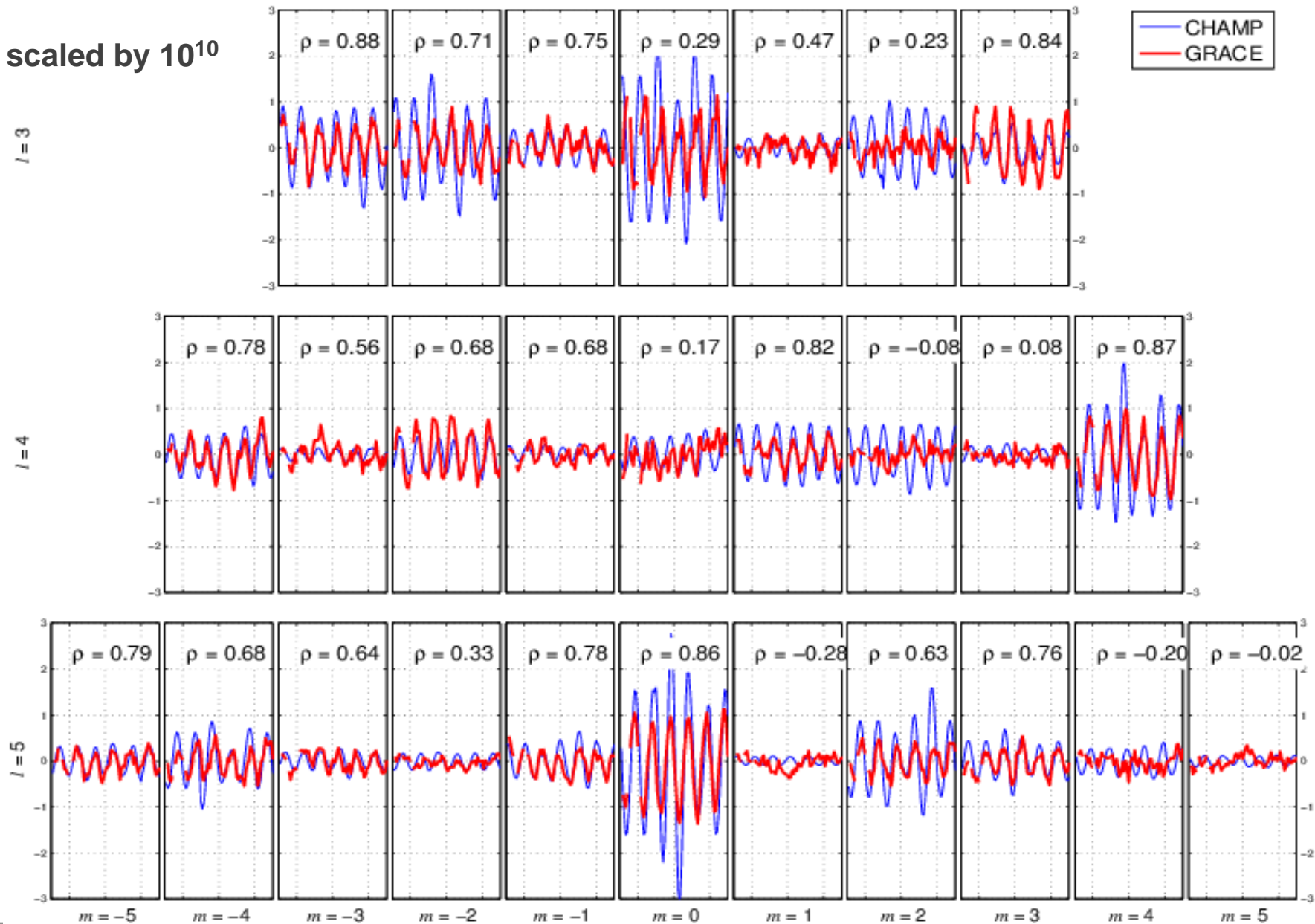
Band-pass filtering approach



- Pro:
 - variation of frequencies between coefficients possible (within passband)
 - applicable to all degrees and orders
 - filter design
- Con:
 - filter design
 - warmup
 - sophisticated outlier detection necessary
 - neglecting correlations between coefficients

Filtered monthly gravity field solutions

scaled by 10^{10}



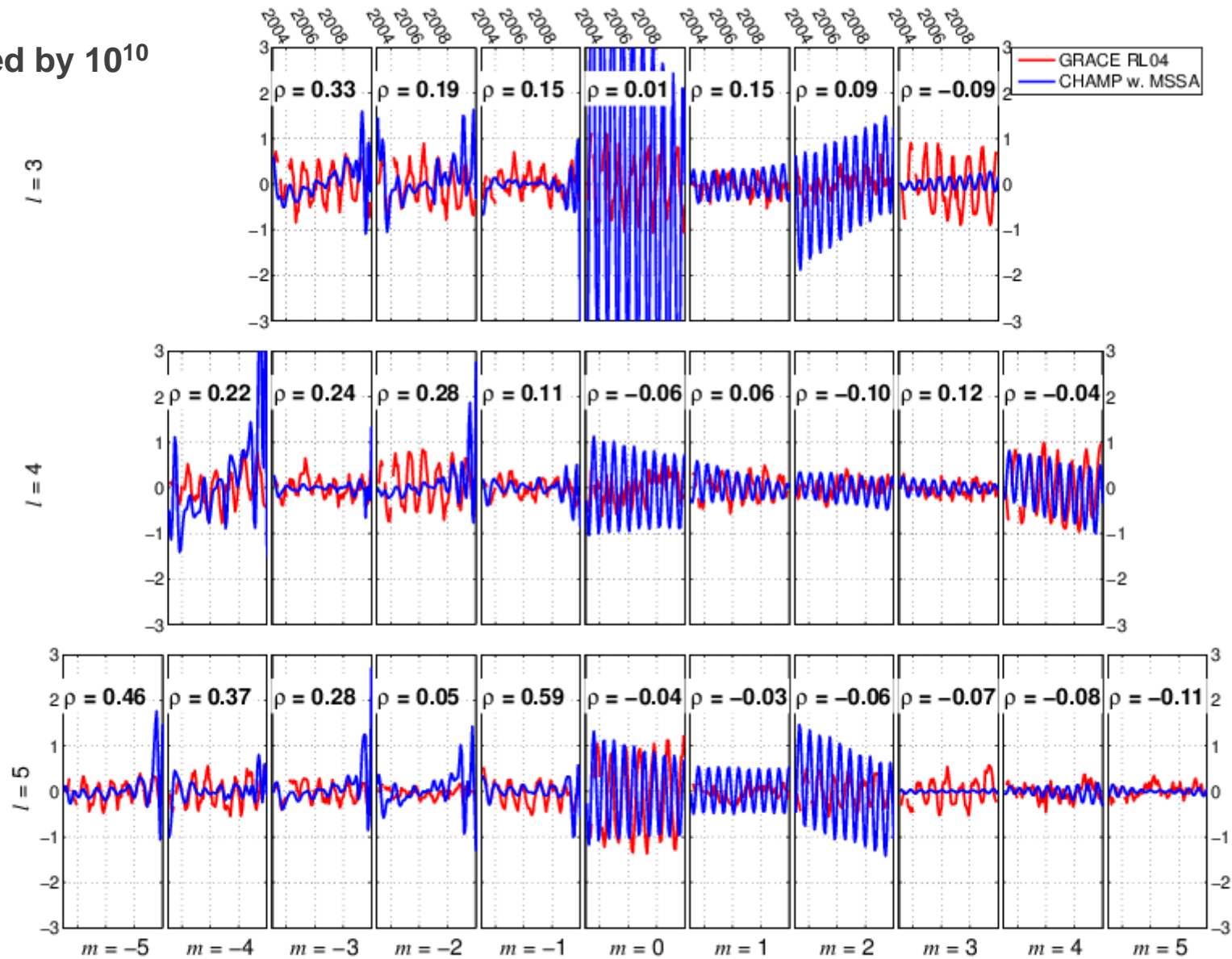
Filtering based on MSSA



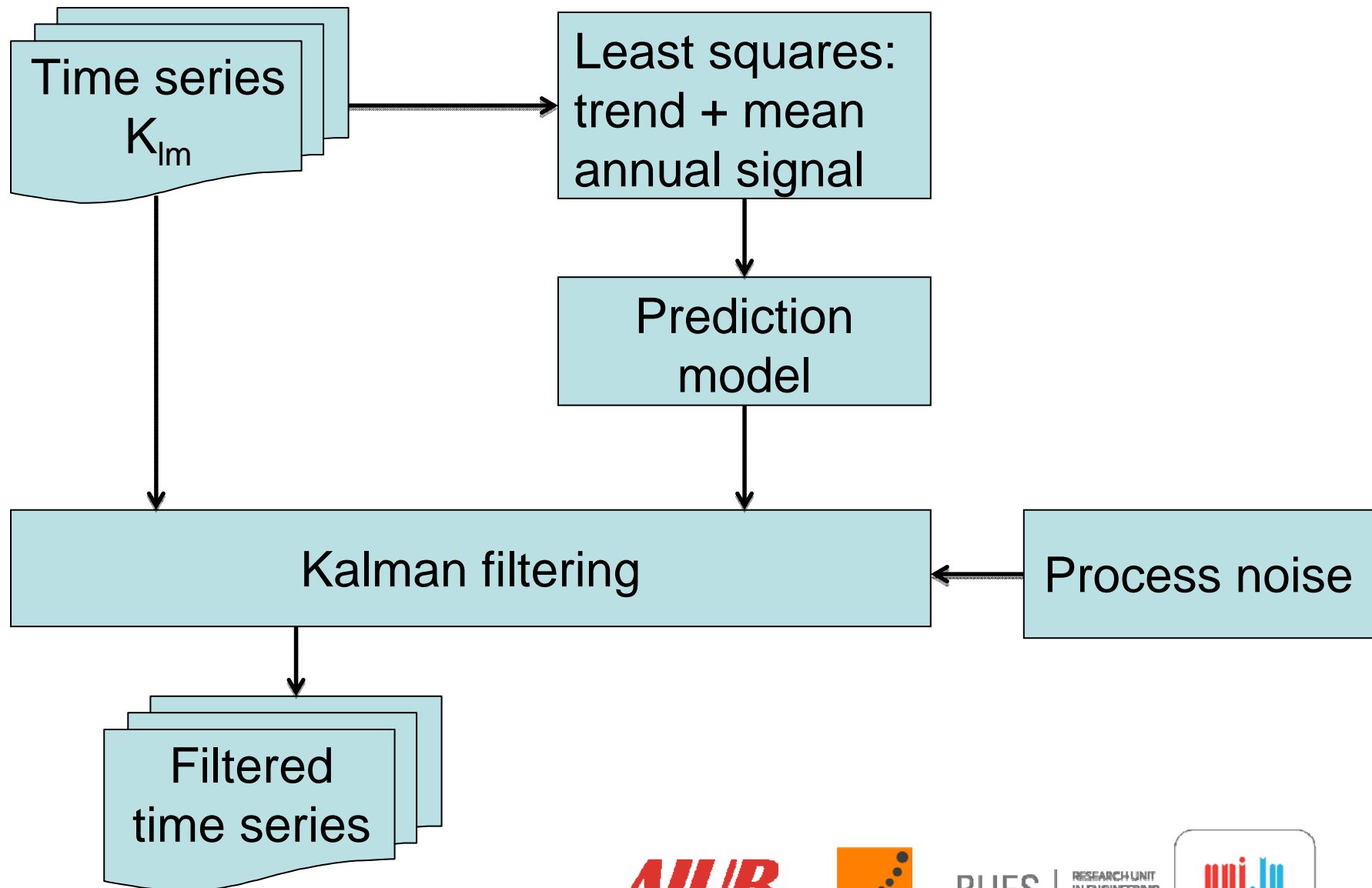
- Pro:
 - variation of frequencies between coefficients possible
 - considering correlations between coefficients
- Con:
 - filter design
 - prone to systematic noise with cyclic behavior
 - sophisticated outlier detection necessary

Filtered monthly gravity field solutions

scaled by 10^{10}

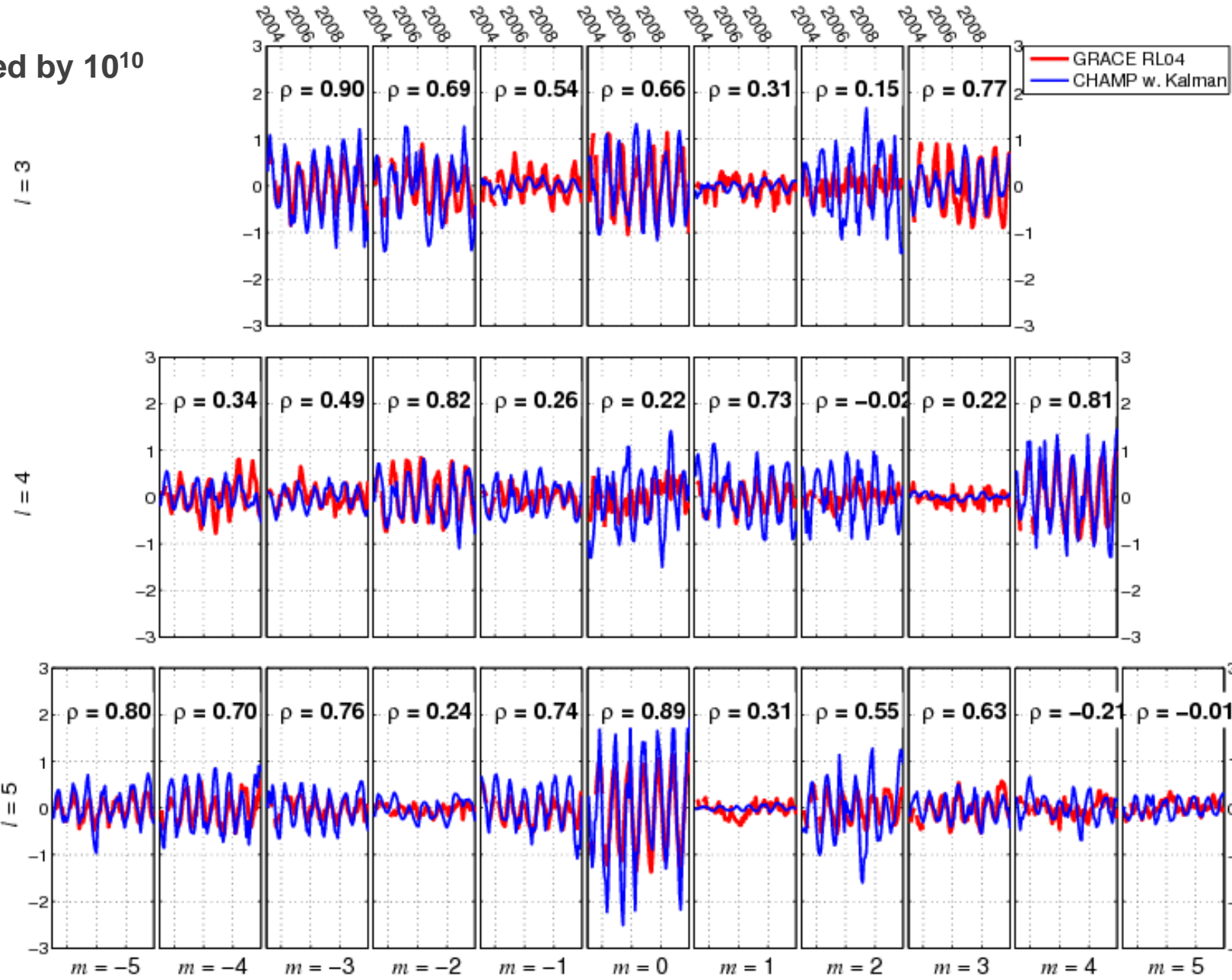


Kalman filtering



Filtered monthly gravity field solution

scaled by 10^{10}



SOME VALIDATION

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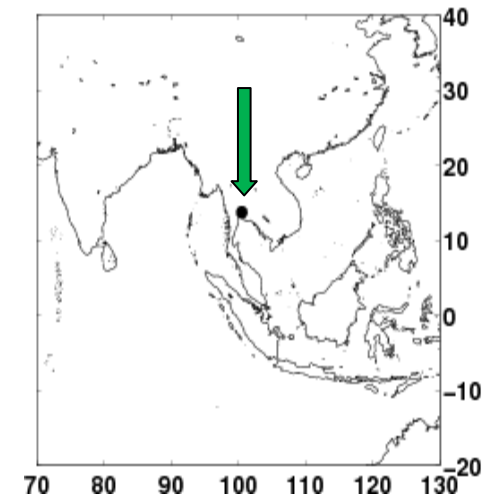
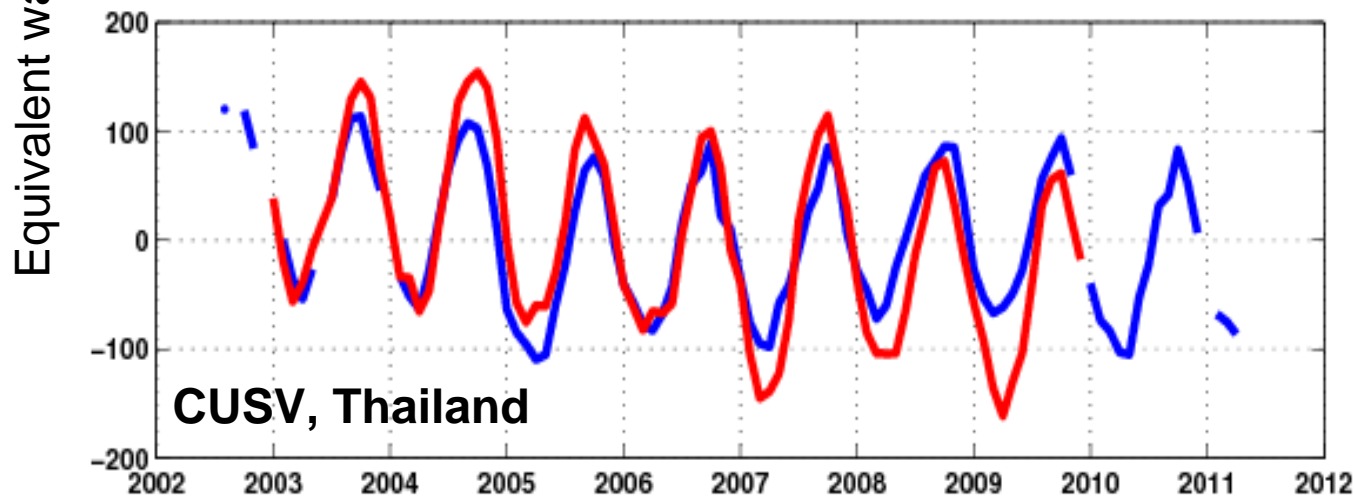
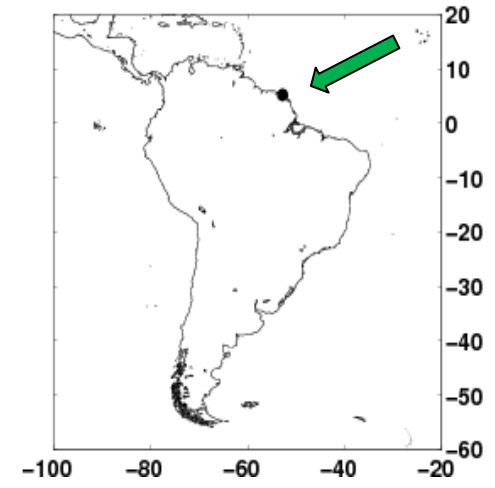
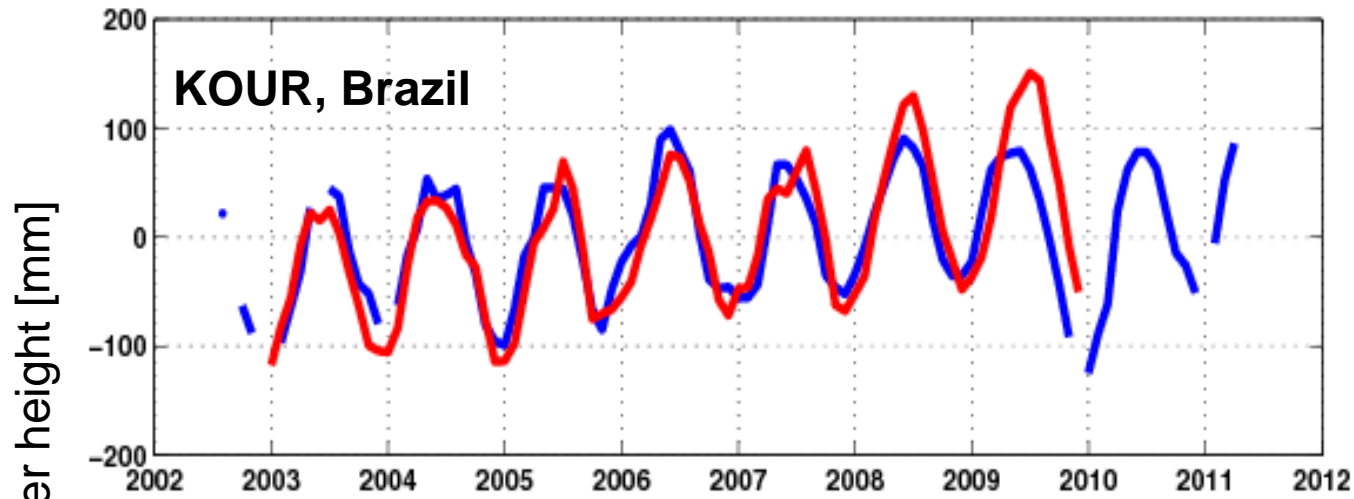


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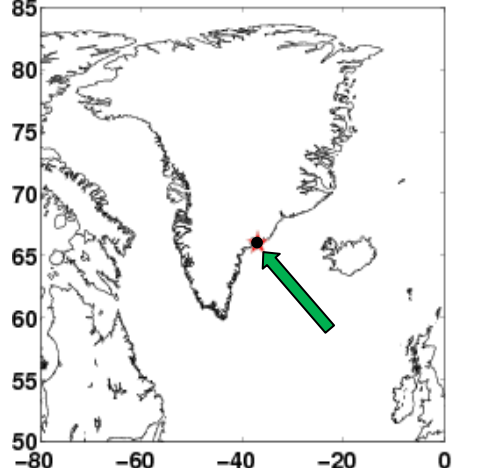
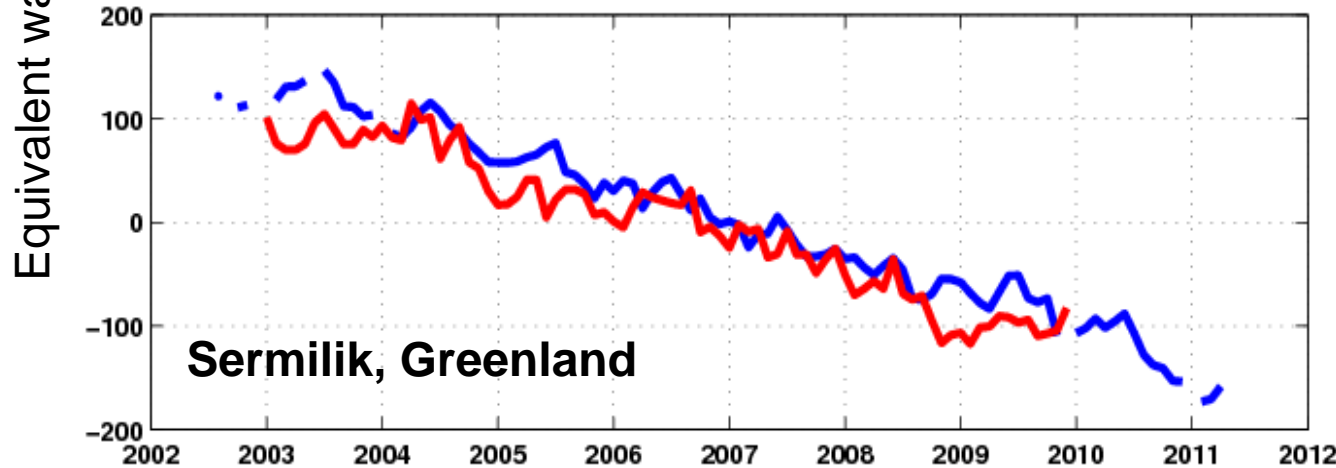
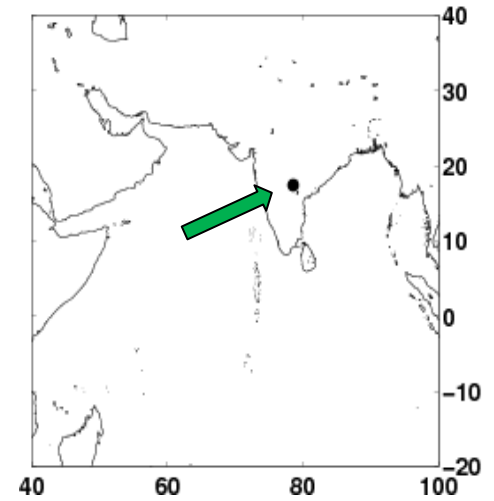
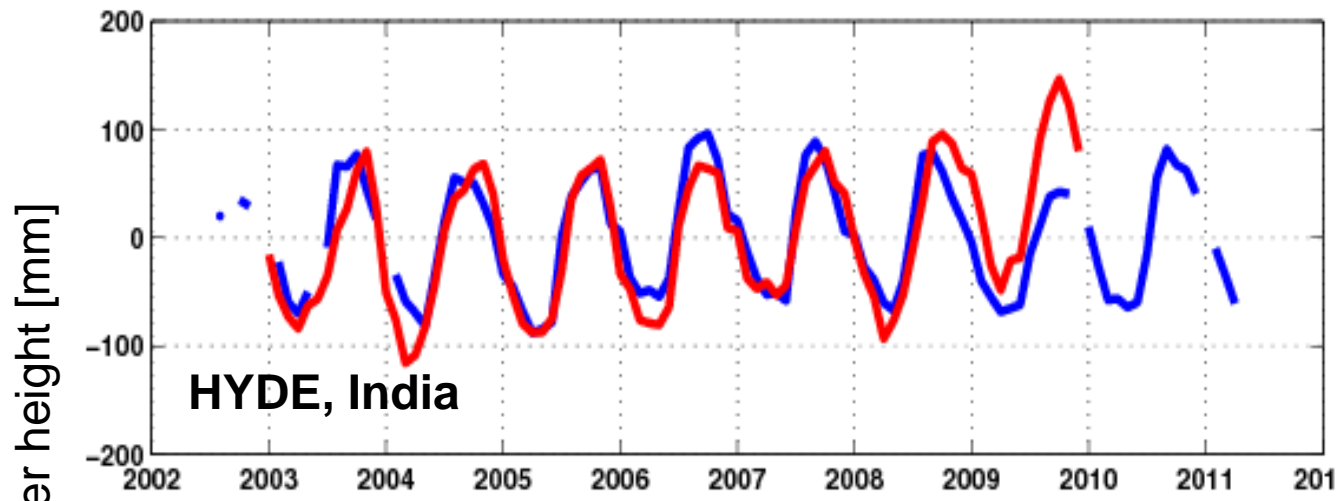


Time series



— GRACE GFZ RL04
— CHAMP filtered

Time series:



SUMMARY

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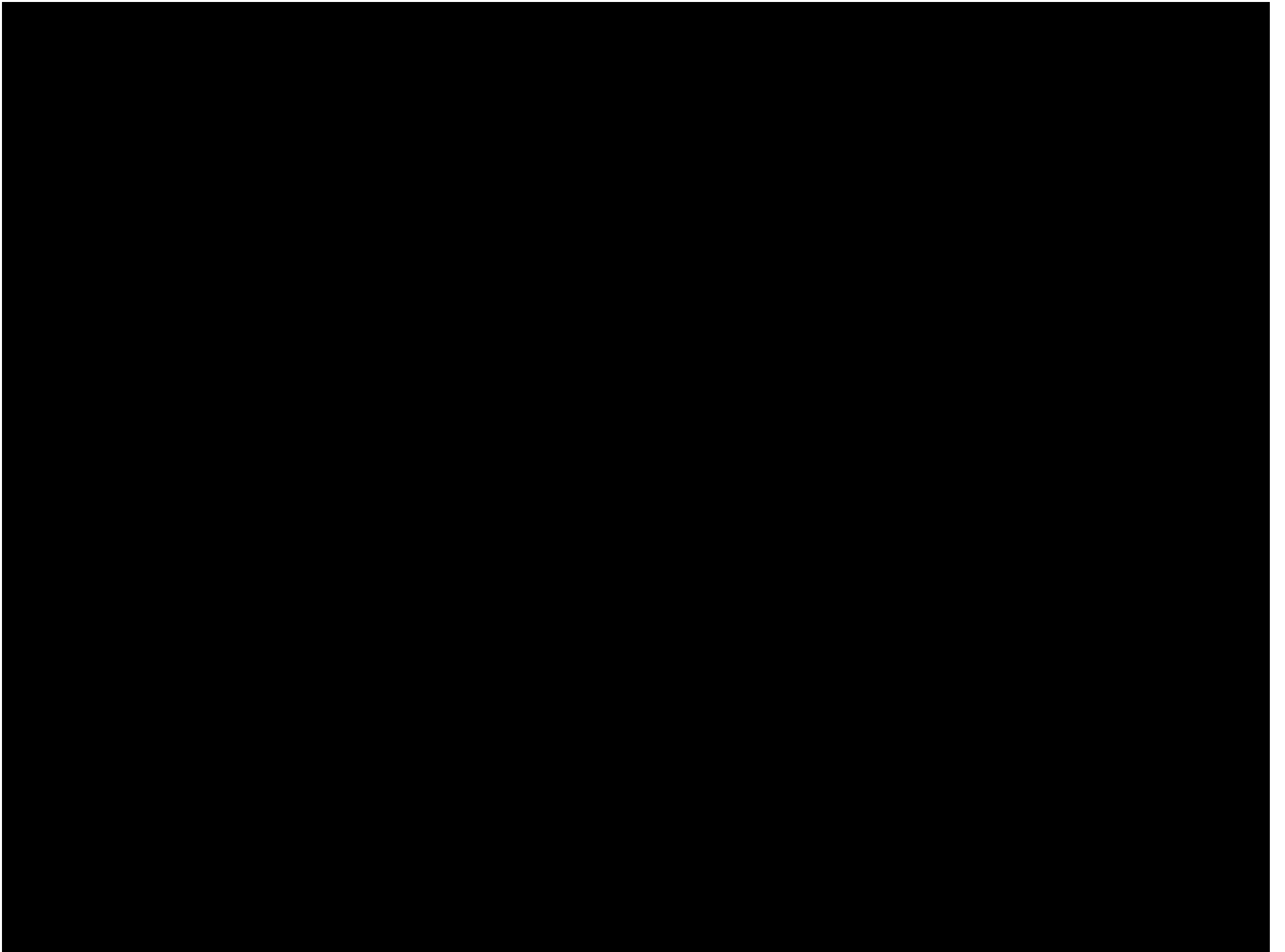
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Summary

- Time variable gravity field from high-low SST
- Filtering (Kalman with best performance)
- Further improvements possible
(e.g. considering correlations between coefficients)
- Expectations for SWARM:
 - better GPS receiver
 - three satellites



BACKUP

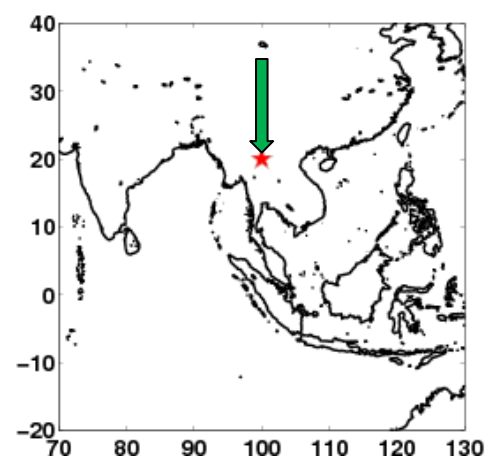
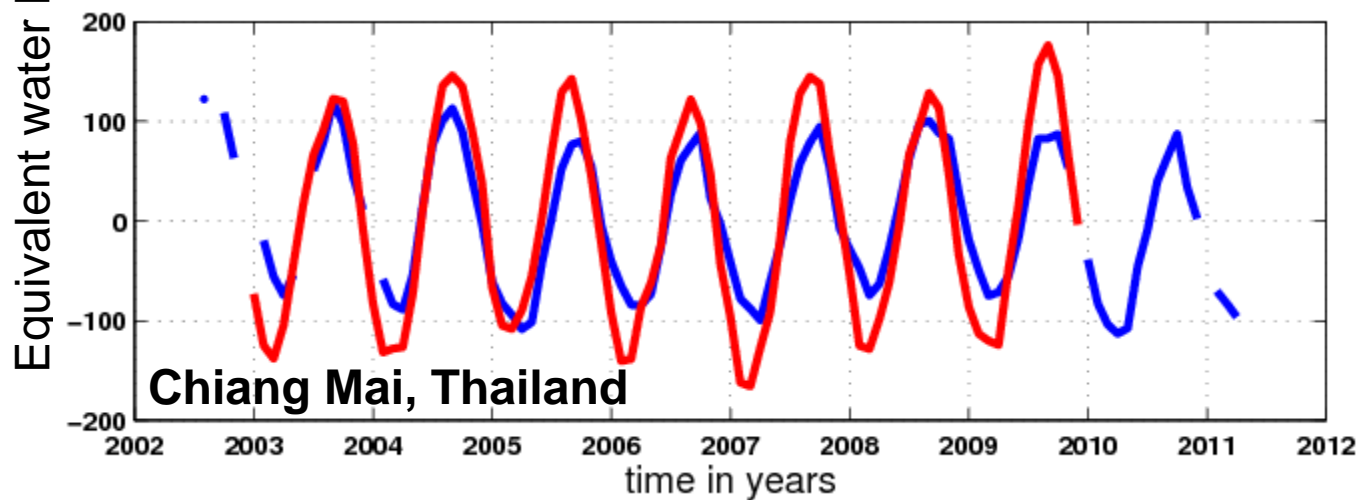
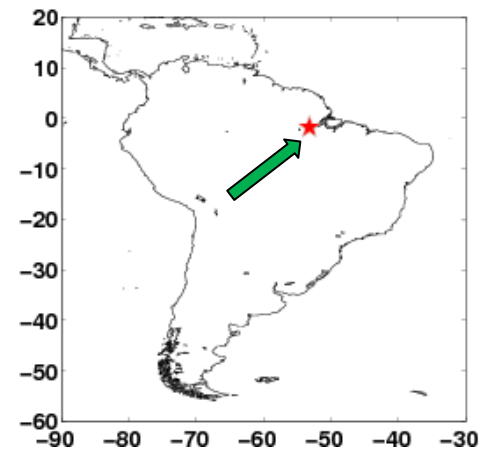
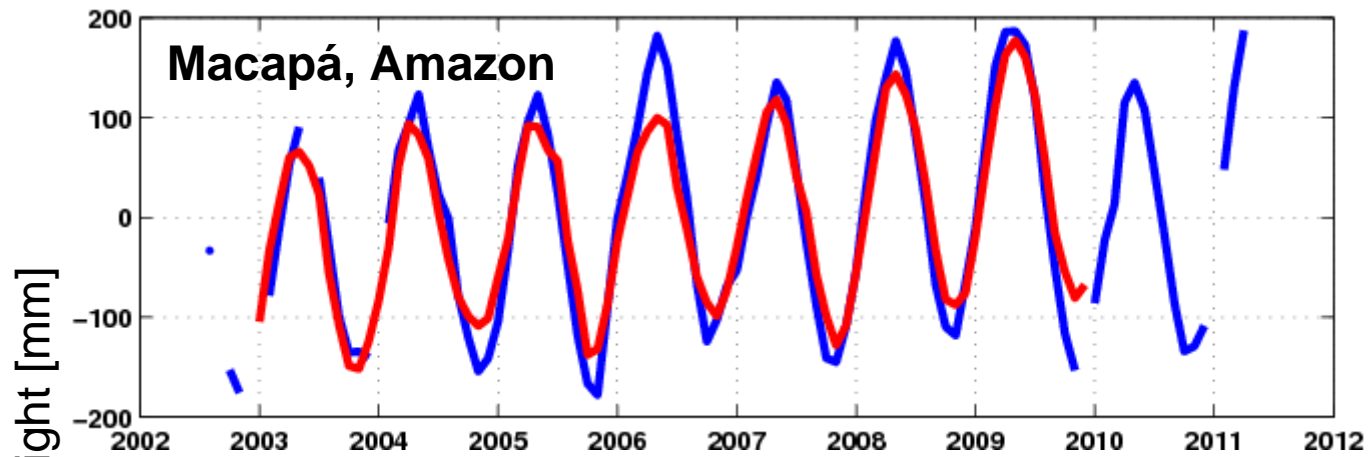
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CHAMP monthly gravity field solutions

Area-weighted spatial RMS w.r.t. EGM08

