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

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presented by
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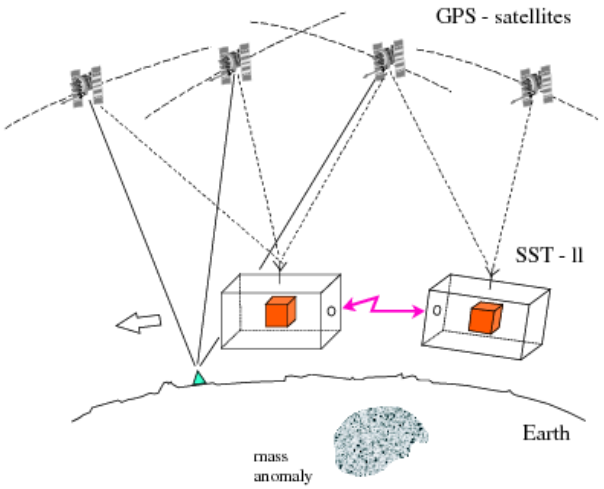
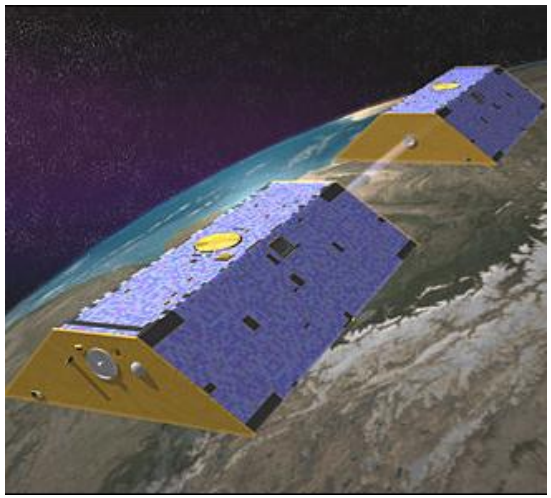
UNIVERSITÉ DU LUXEMBOURG

FACULTY OF SCIENCES, TECHNOLOGY AND COMMUNICATION

GRACE und GRACE Follow-On (GFO)

Low-low





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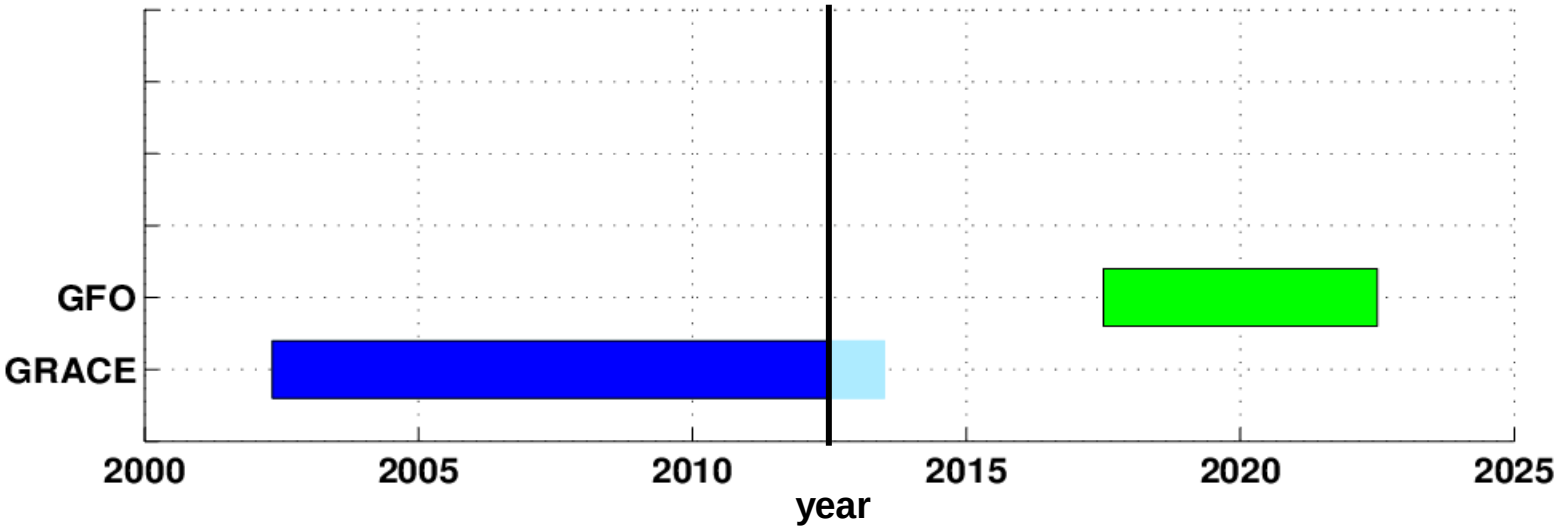
- K-Band (Laser)
- GPS
- Accelerometer



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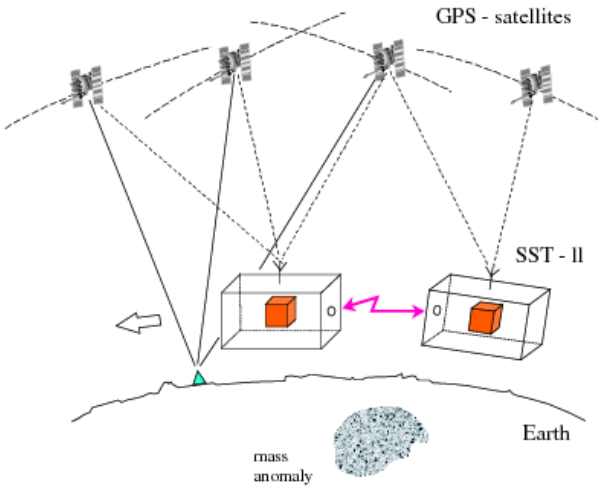

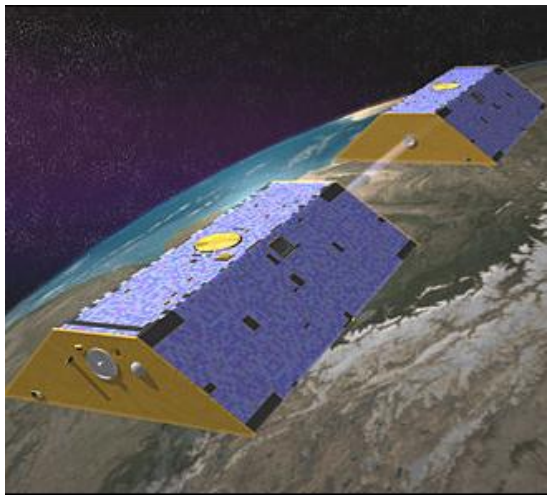

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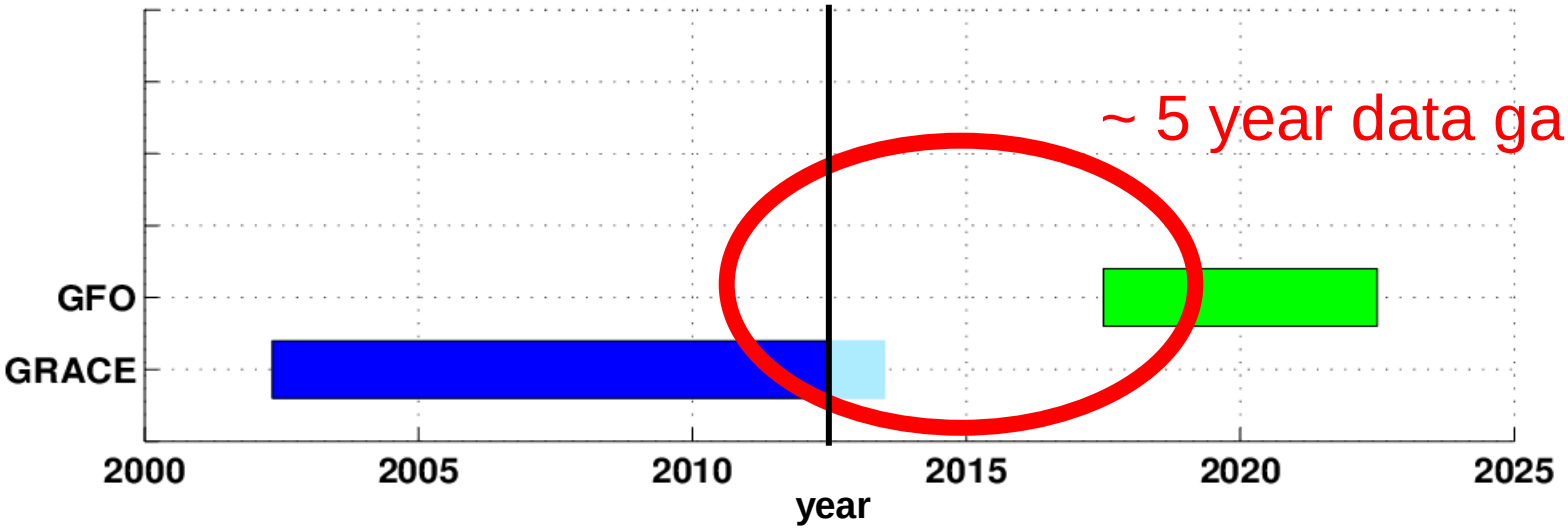
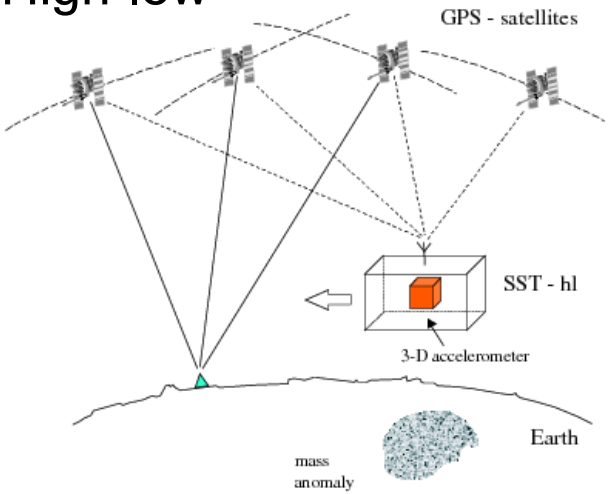
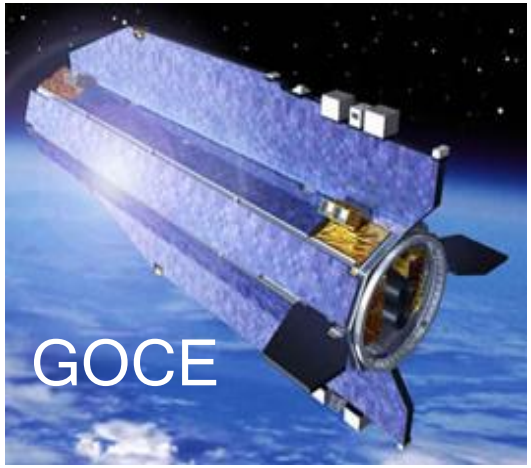


Other gravity field missions

High-low





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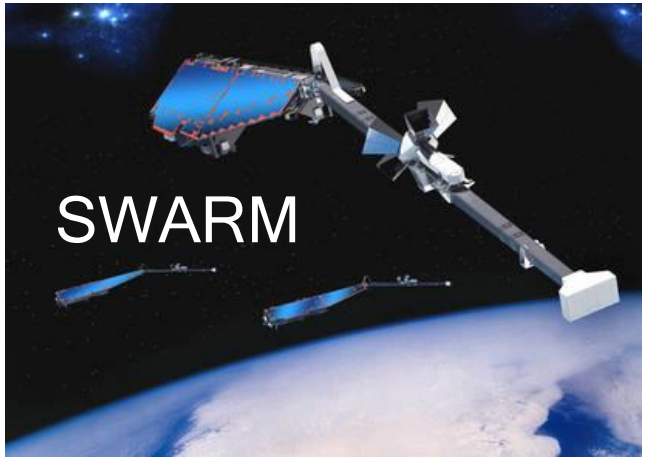

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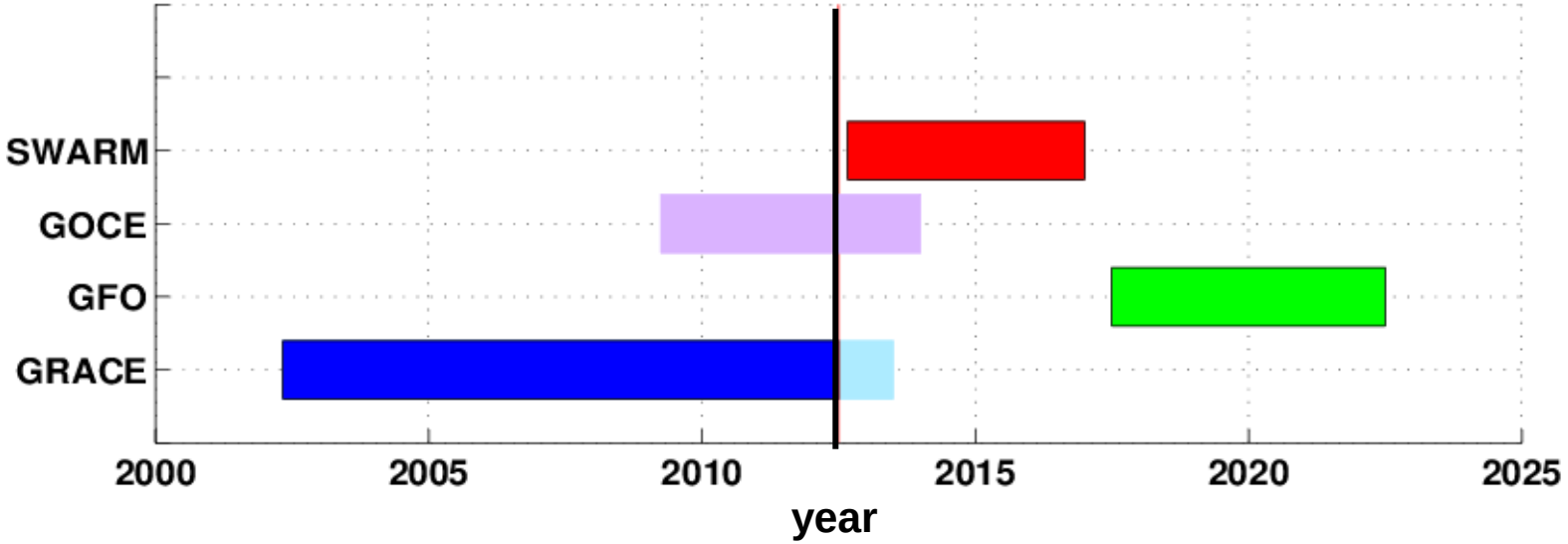
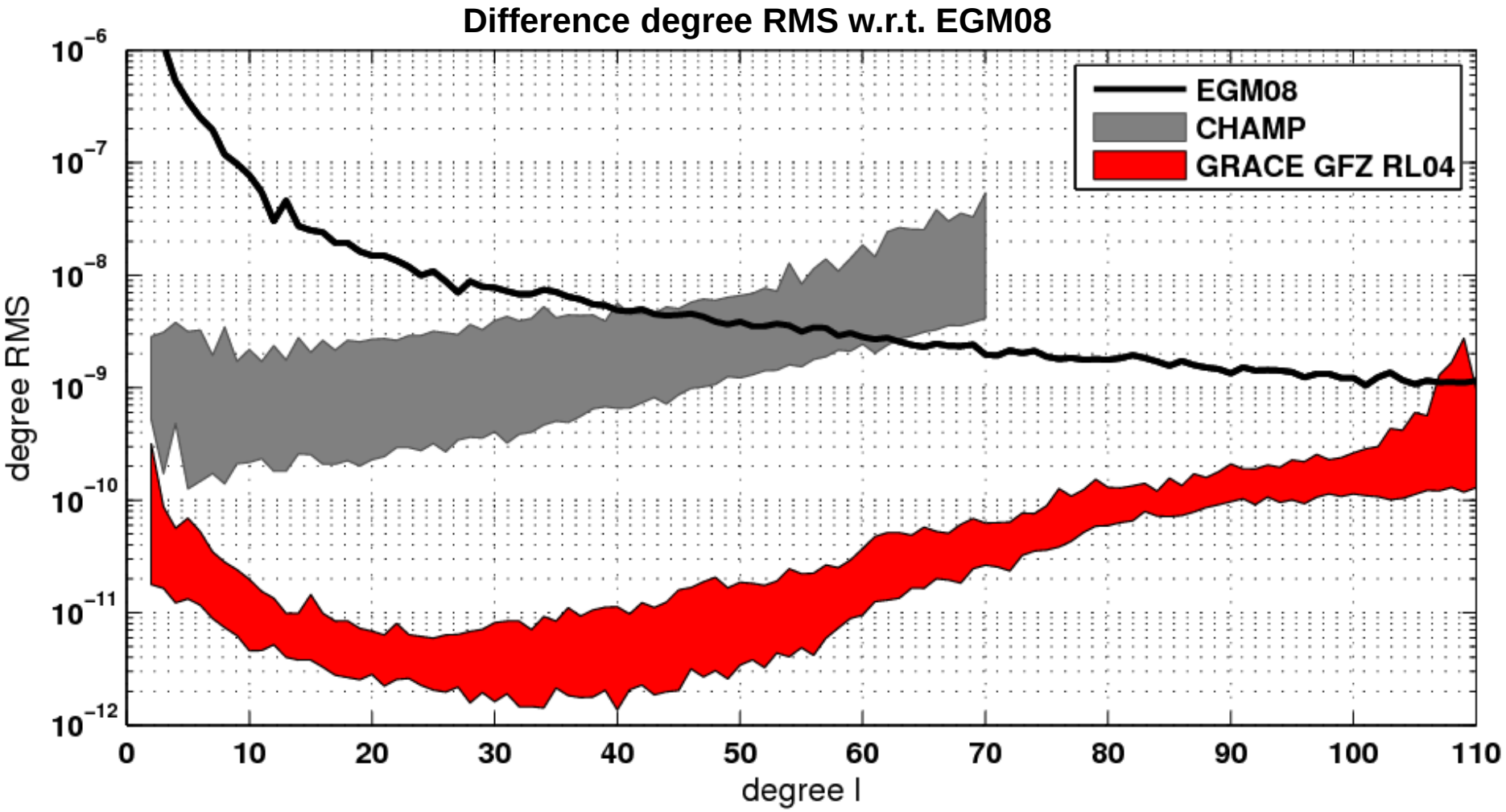


Previous CHAMP studies



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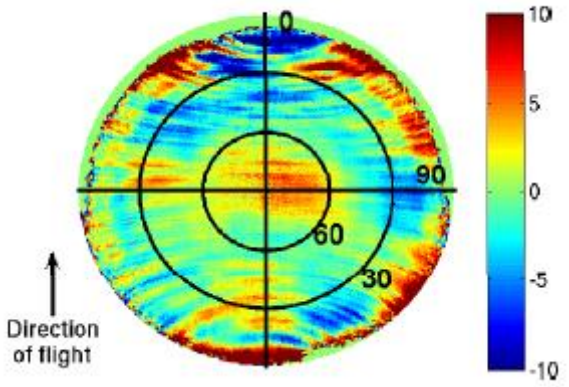
CHAMP REPROCESSING

Data reprocessing

GPS positions:

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



Prange 2010

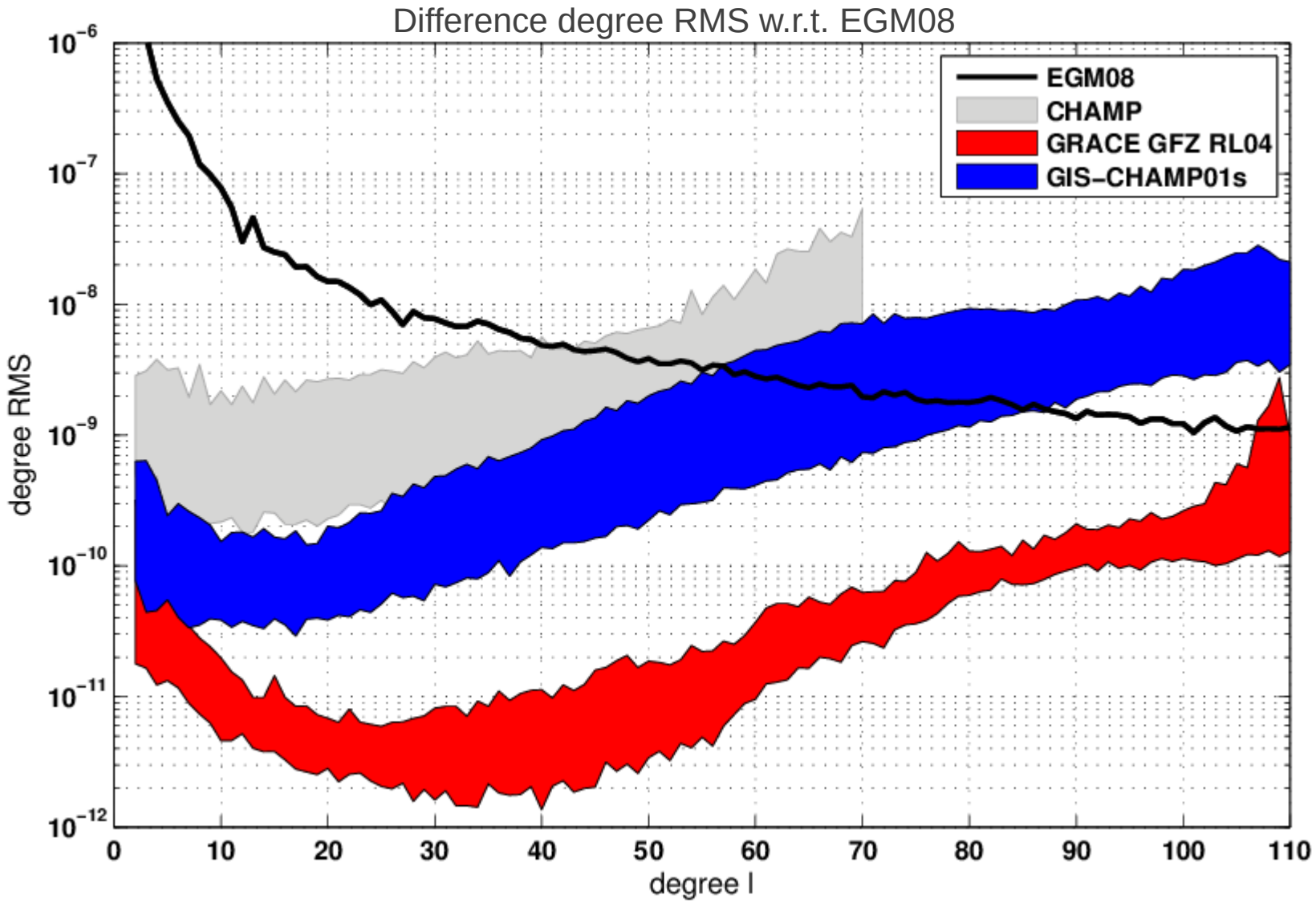
Approach:

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

Background models:

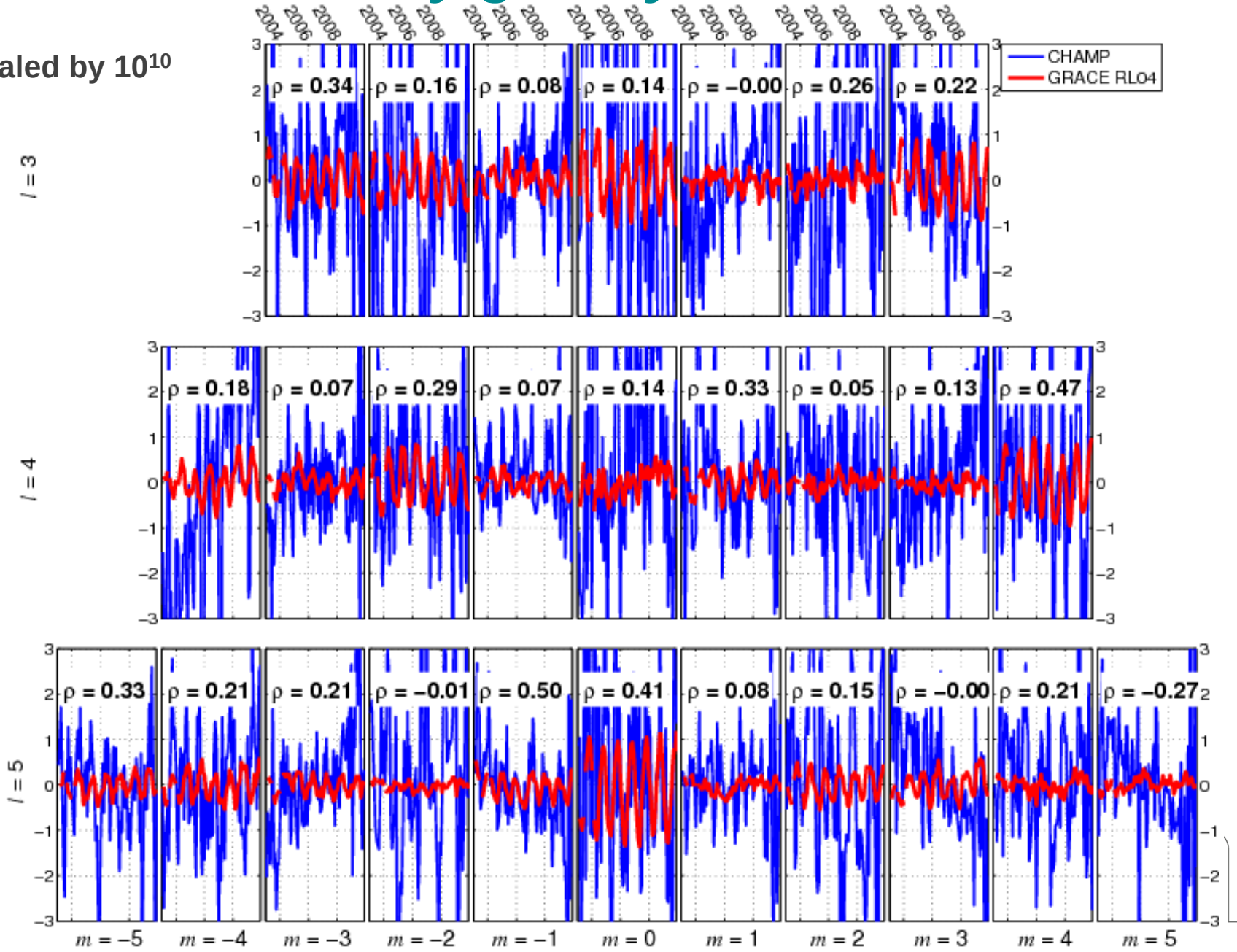
- JPL ephemeris DE405
- Solid Earth tides & solid Earth pole tides (IERS conventions)
- Ocean tides (FES 2004)
- Ocean pole tides (IERS conventions, Desai 2002)
- Atmospheric tides (N1-model, Biancale and Bode 2006)
- Relativistic corrections (IERS conventions)
- AOD1B-product (Flechtner 2008)

CHAMP monthly gravity field solutions



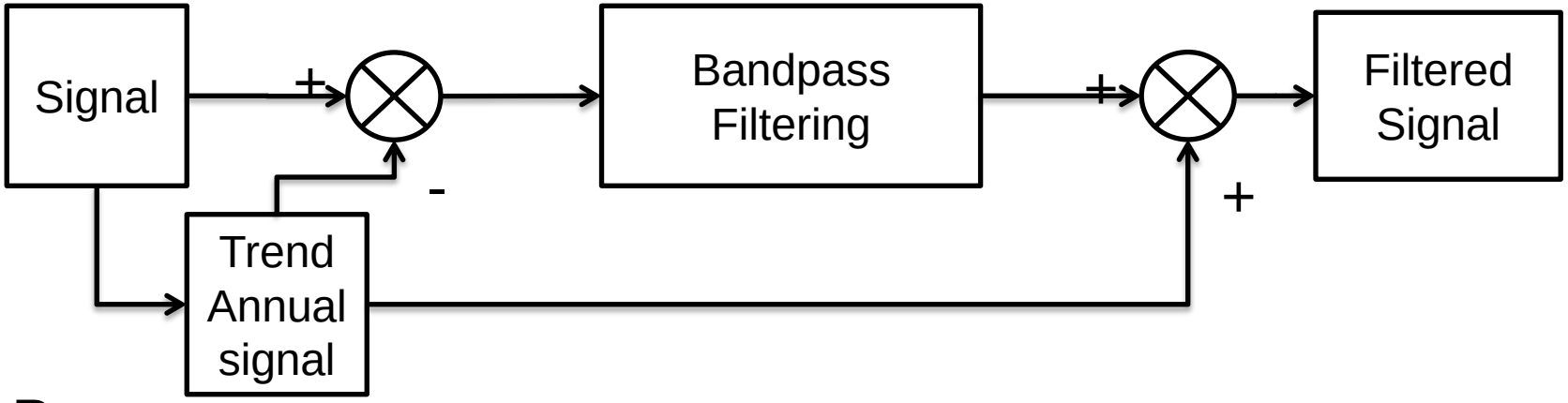
CHAMP monthly gravity field solution

scaled by 10^{10}



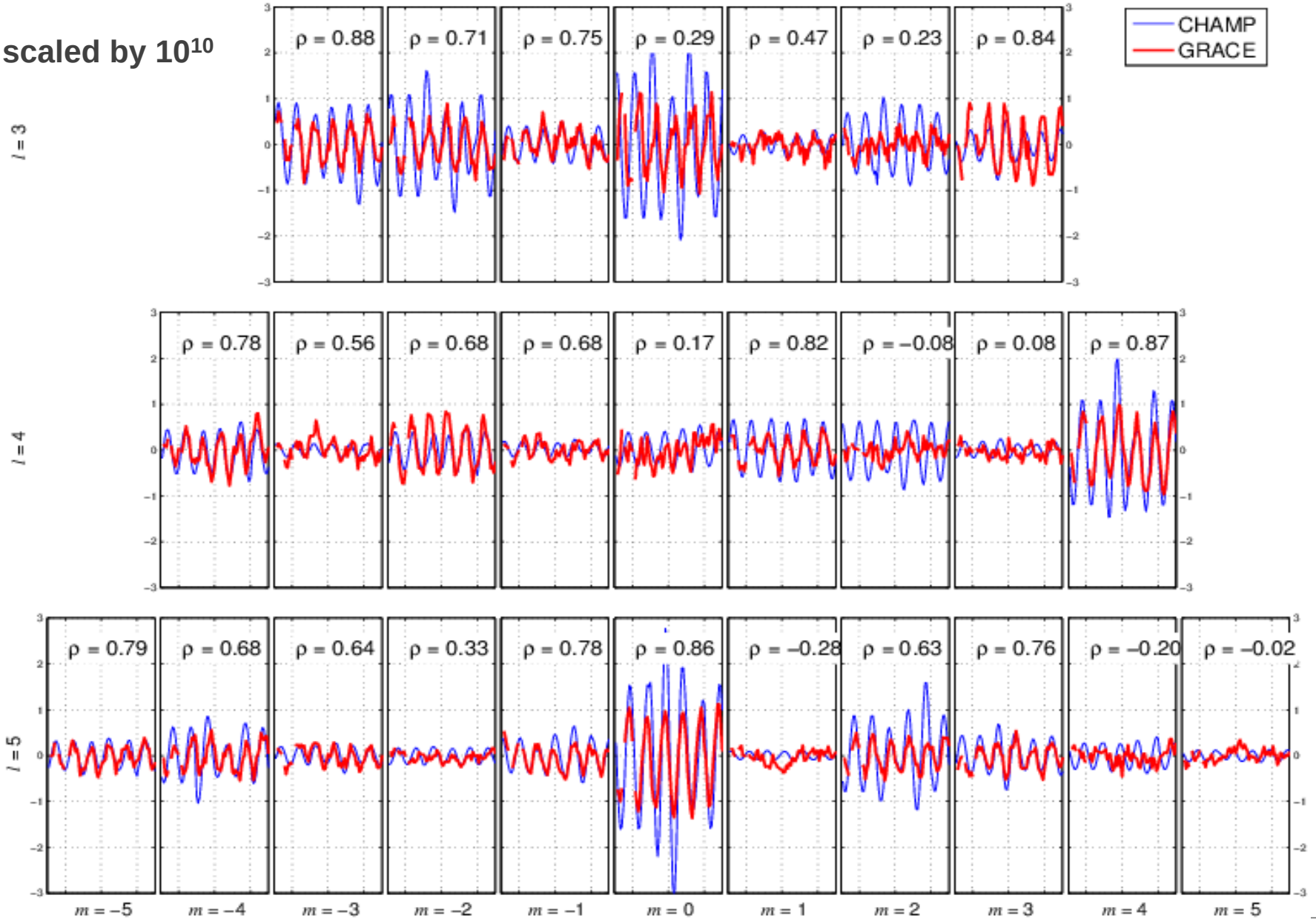
FILTERING

Band-pass filtering approach



- Pro:
  - variation of frequencies 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

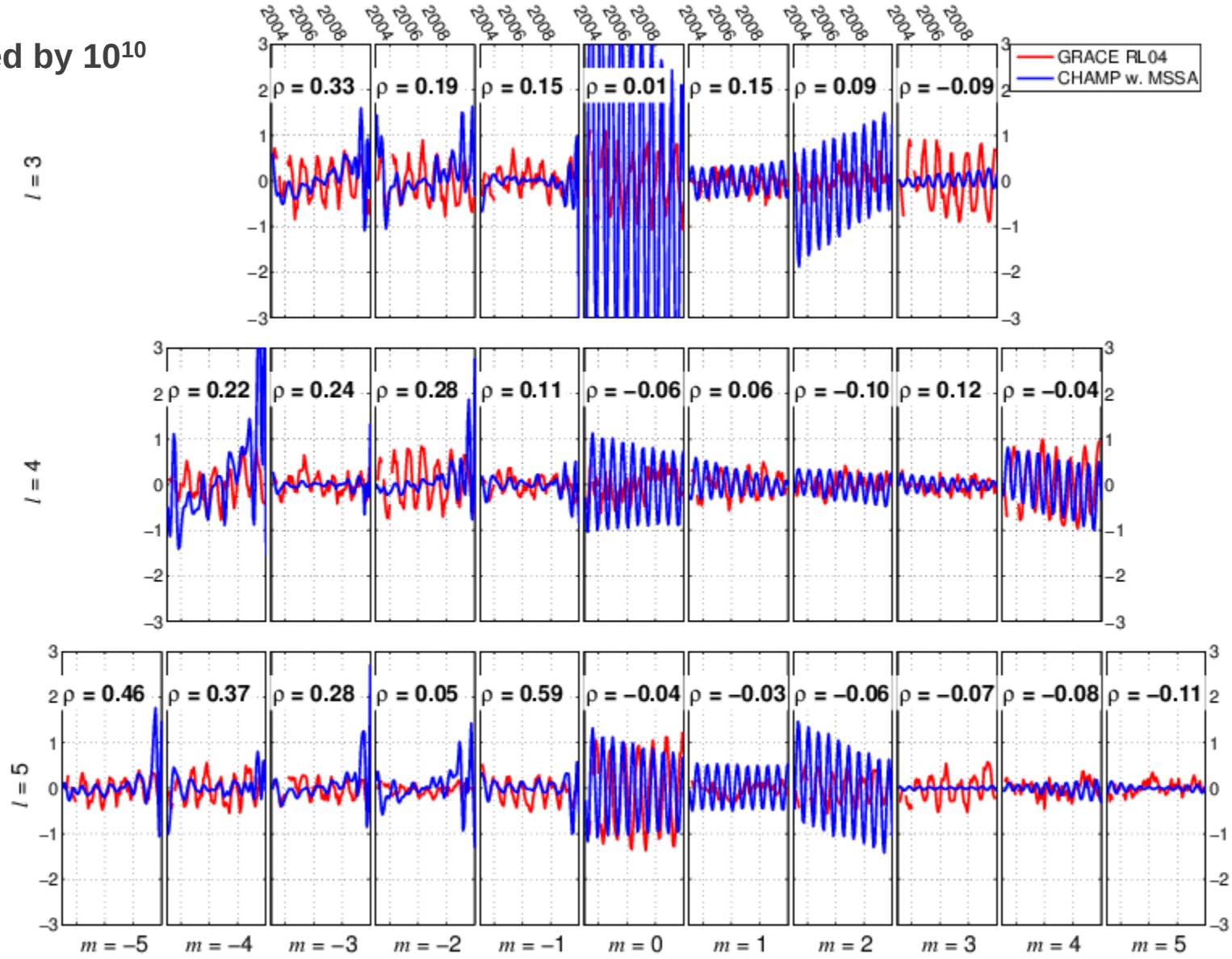


Filtering based on MSSA

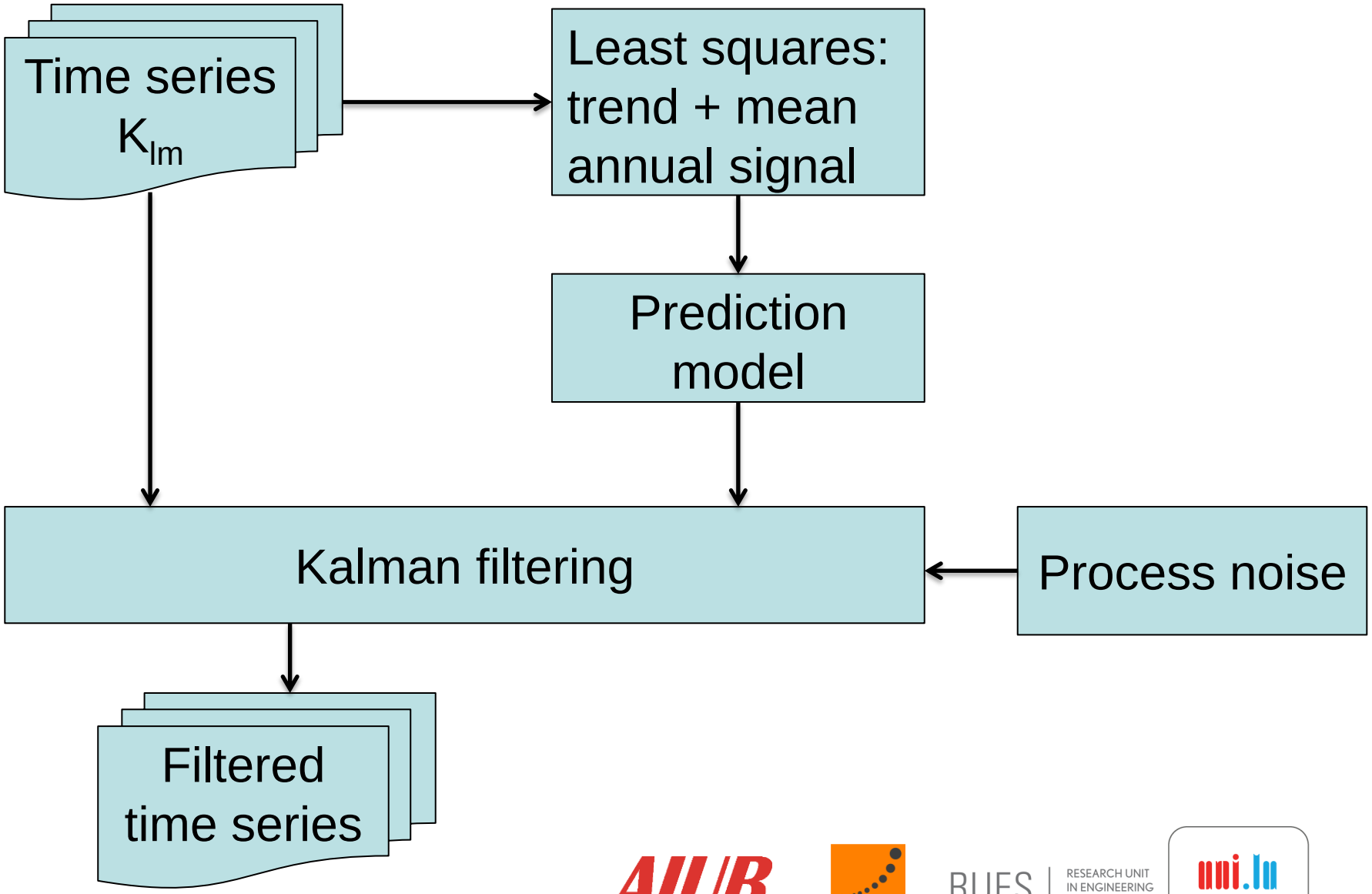
- Pro:
  - variation of frequencies between coefficients possible
  - considering correlations between coefficients
- Con:
  - filter design
  - prone to systematic noise with cyclic behavior
  - sophisticated outlier detection necessary

Filtered monthly gravity field solutions

scaled by 10^{10}



Kalman filtering



Filtered monthly gravity field solution

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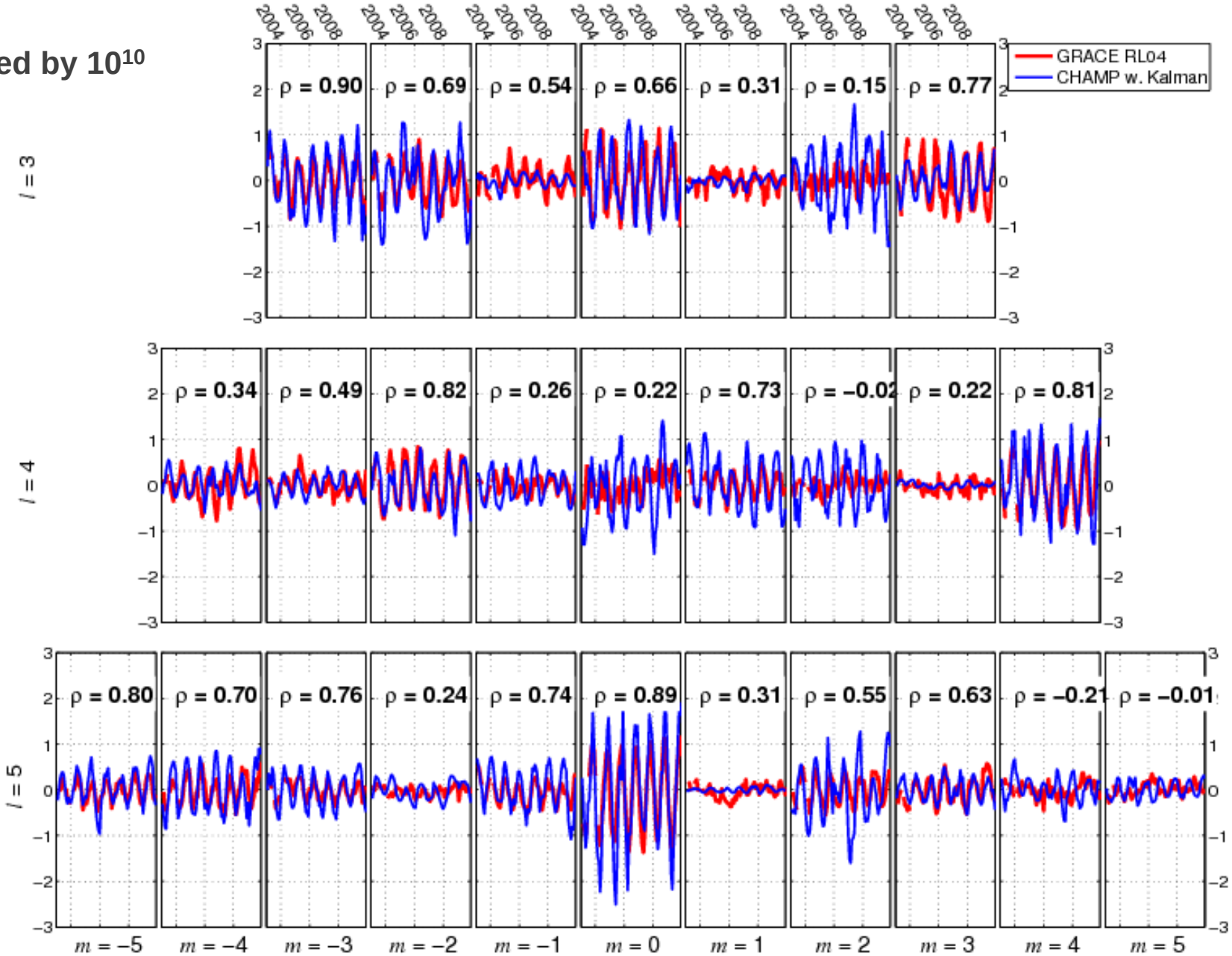
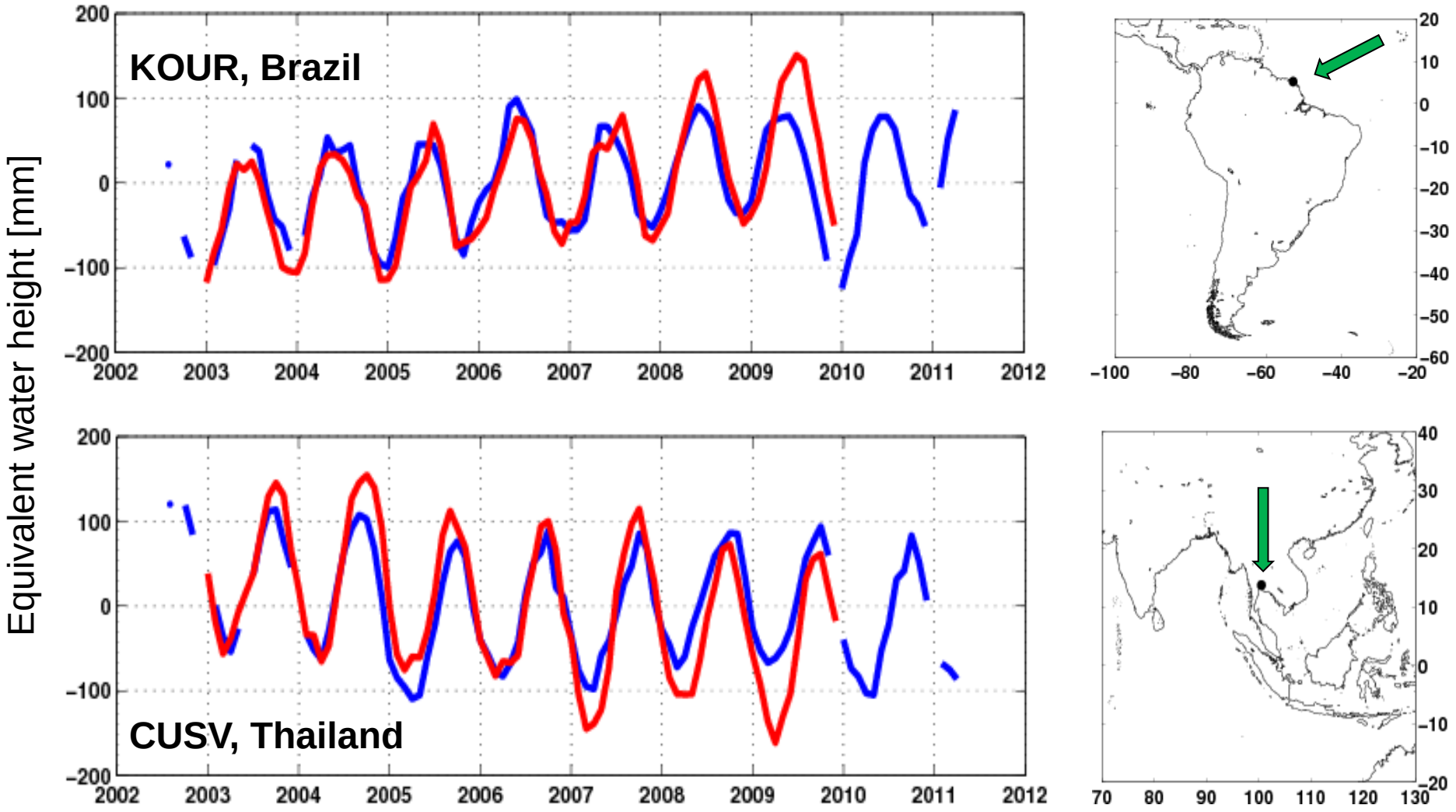


SOME VALIDATION

Time series



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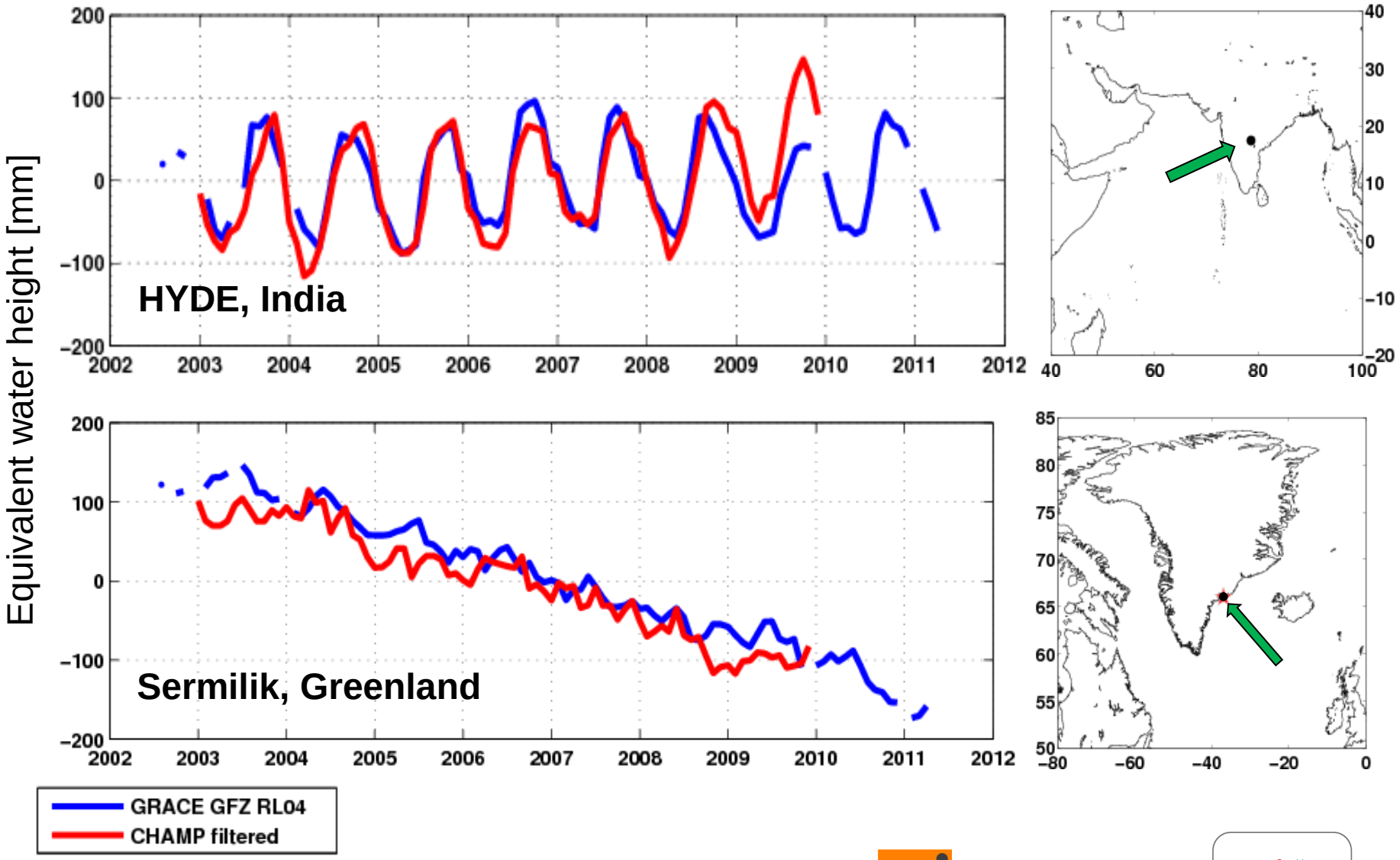
Time series:


Equivalent water height [mm]
HYDE, India
Sermilik, Greenland
GRACE GFZ RL04
CHAMP filtered

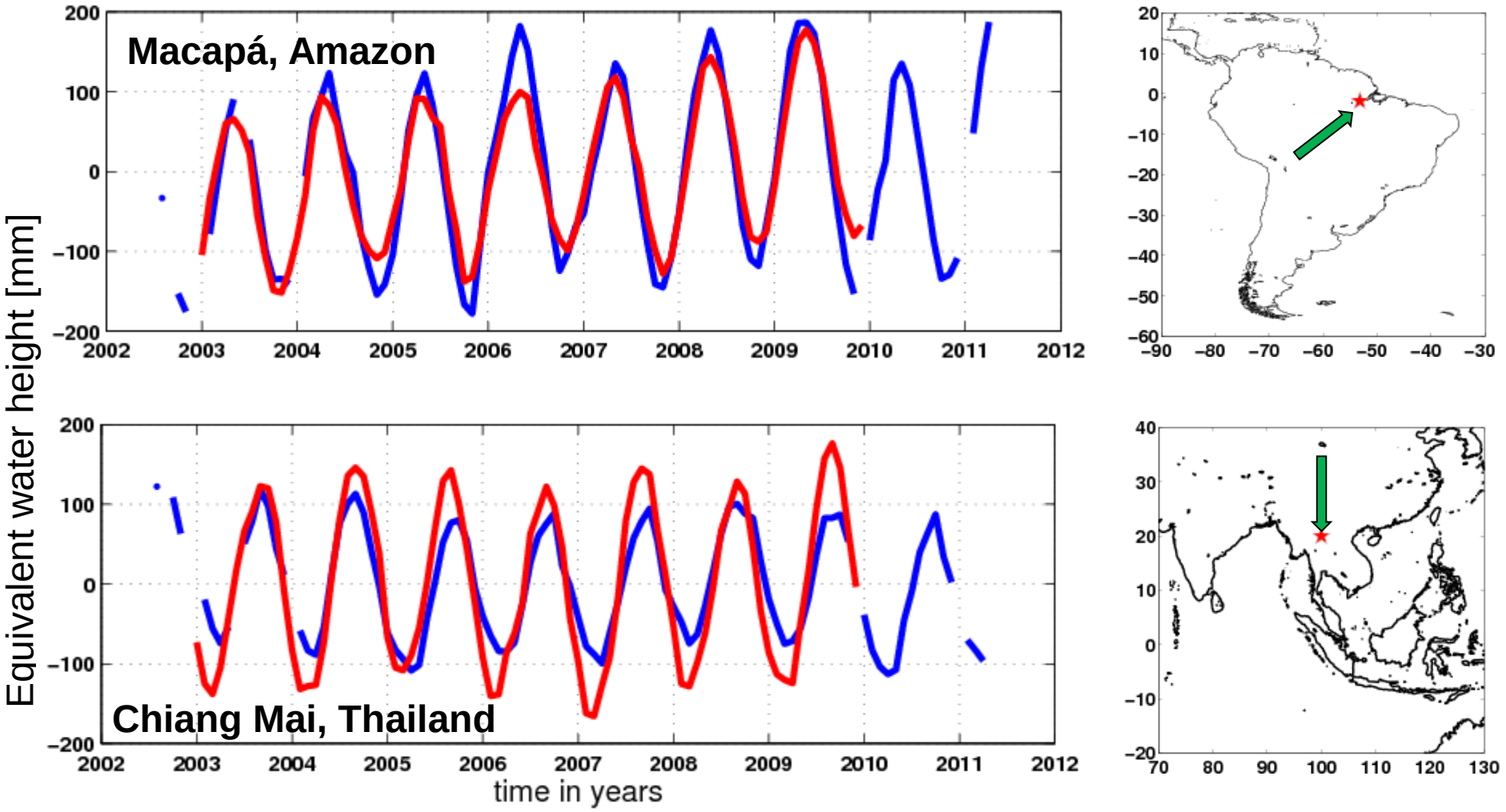
SUMMARY

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


Macapá, Amazon
Chiang Mai, Thailand
Equivalent water height [mm]
time in years
200
100
0
−100
−200
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
20
10
0
−10
−20
−30
−40
−50
−60
−90
−80
−70
−60
−50
−40
−30
40
30
20
10
0
−10
−20
70
80
90
100
110
120
130

CHAMP monthly gravity field solutions