Large scale time variability from high-low SST - filling the gap between GRACE and GFO

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GRACE und GRACE Follow-On (GFO)

Low-low

- K-Band (Laser)
- GPS
- Accelerometer

~ 5 year data gap

© CSR Texas
Other gravity field missions

High-low

GOCE

SWARM

© ESA

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Previous CHAMP studies

Difference degree RMS w.r.t. EGM08
CHAMP REPROCESSING
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)
CHAMP monthly gravity field solutions

Difference degree RMS w.r.t. EGM08

- EGM08
- CHAMP
- GRACE GFZ RL 04
- CHAMP reprocessed
CHAMP monthly gravity field solution

scaled by $10^{10}$
FILTERING
Example:

Time series for $S_{2,2}$ – scaled by $10^{10}$
Kalman filtering

Time series $K_{lm}$

Least squares: trend + mean annual signal

Prediction model

Kalman filtering

Process noise

Filtered time series
Filtered monthly gravity field solution

scaled by $10^{10}$
Filtered monthly gravity field solution
SOME VALIDATION
Time series

KOUR, Brazil

CUSV, Thailand

Equivalent water height [mm]

Blue: GRACE GFZ RL04
Red: CHAMP filtered
Time series:

Sermilik, Greenland

HYDE, India
SUMMARY
Summary

• Time variable gravity field from high-low SST
• Filtering (Kalman)
• Further improvements (e.g. considering correlations between coefficients)

• Expectations for SWARM:
  – better GPS receiver
  – three satellites
Thank you

GRACE GFZ Rel. 4
High-low SST

Equivalent water height: 01 January 2003
BACKUP
Macapá, Amazon

Chiang Mai, Thailand
CHAMP monthly gravity field solutions

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

$L_{Max} = 60$

GPS!

GPS!