GRACE and GRACE-FO processing at IfE/LUH

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Gravity field recovery at IfE

- GRACE-SIGMA: new compact software package for gravity field recovery from GRACE and GRACE-FO sensor data
- All-MATLAB software implemented from scratch [Naeimi et al. 2018]
- Dynamic orbit and gravity field determination (variational equations approach)

Published LUH-GRACE2018 solutions

- First batch: 2003-2009 (available at ICGEM)
- Second batch: 2010-2016 (available at ICGEM)
- Solutions can also be accessed at the web site of our institute: https://www.ife.uni-hannover.de/en/services/luh-grace/
- Paper on processing accepted (IUGG Proceedings)


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2003
2005
2007
2009
2011
2013
2015

Parametrization - Pre-adjustment

Arc-length	3 hours
Numerical integrator	Modified Gauss-Jackson
Integration step size	5 s
Observations	GNV1B positions (5 s)
Weighting	Identity matrix
Local parameters	Initial states, acc. biases
Global parameters	No
Constraints	Not applied
Regularization	Not applied

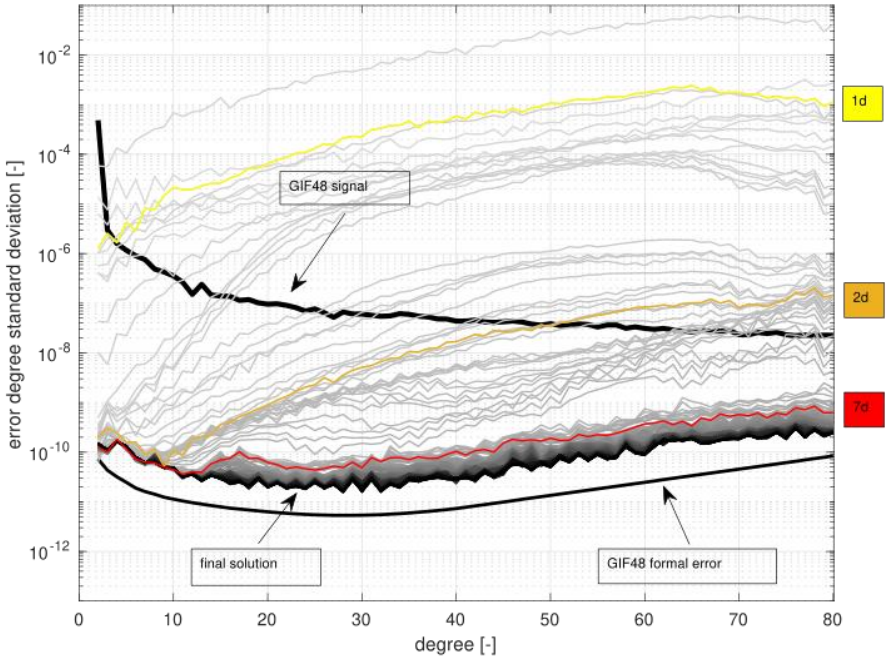
Parametrization - Main adjustment

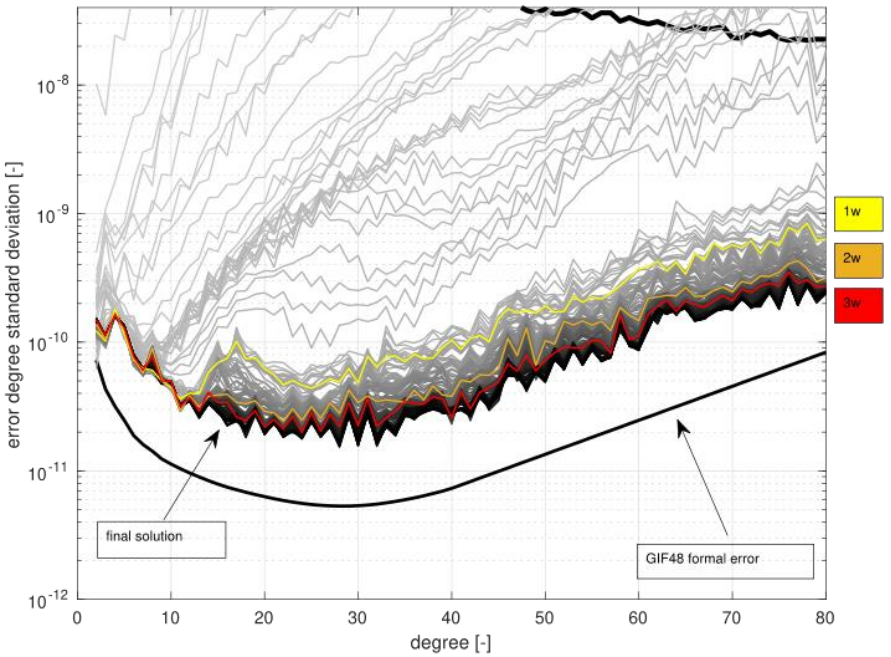
Arc-length	3 hours
Numerical integrator	Modified Gauss-Jackson
Integration step size	5 s
Observations	GNV1B positions (30 s), KBRR (5 s)
Weighting	GNV1B positions (0.02 m), KBRR (0.2E-6 m/s)
Local parameters	Initial states, acc. biases, empirical KBRR parameter; acc. scales (GRACE-FO)
Global parameters	Gravity potential up to degree/order 80/60; 96 (GRACE-FO)
Constraints	Not applied
Regularization	Not applied

Force modeling

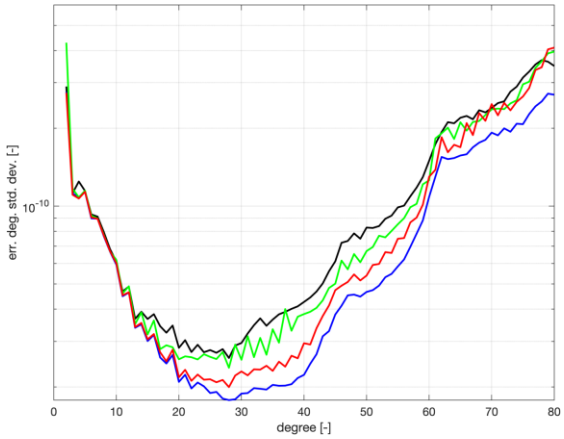
Effect	Model	Reference
Gravity field	GIF48 (d/o: 300)	Ries et al., 2011
Third bodies	Moon and Sun, Ephemerides: DE405	Standish, 1998
Solid Earth tides	IERS Conventions 2010	Petit a. Luzum, 2010
Ocean tides	EOT11a including minor waves (d/o: 80)	Rieser et al., 2012
Solid Earth pole tides	IERS Conventions 2010	Petit a. Luzum, 2010
Ocean pole tides	IERS Conventions 2010 (d/o: 60)	Petit a. Luzum, 2010
Relativistic	IERS Conventions 2010	Petit a. Luzum, 2010
Non-tidal	AOD1B RL05 (d/o: 100) (GRACE) AOD1B RL06 (d/o: 180) (GRACE-FO)	Dobslaw et al., 2015 Dobslaw et al., 2017
Atmospheric tides	N1, seasonal means (GRACE-FO)	Biancale a. Bode, 2006
Non-gravitational	Linear accelerometer measurements	

Arcwise NEQ stacking

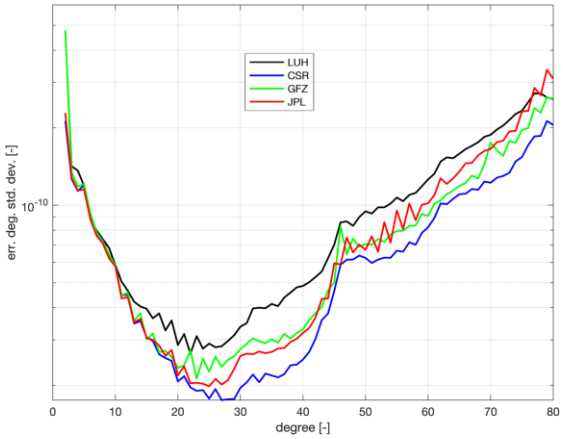




Error degree standard deviations

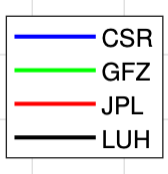


▪ GRACE 2002-2009



▪ GRACE 2010-2016

- Same monthly solutions are considered
- GOCO06s subtracted
- GRACE RL05, GRACE-FO RL06



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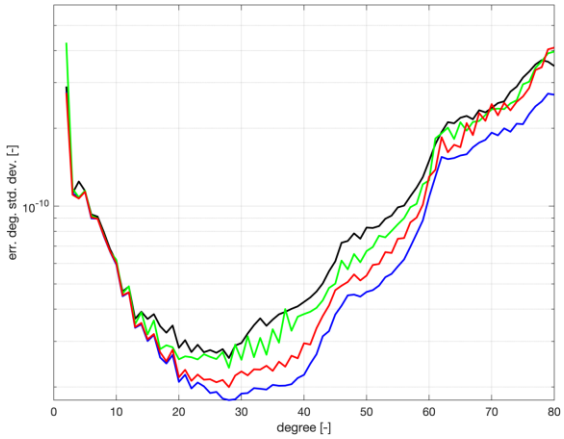
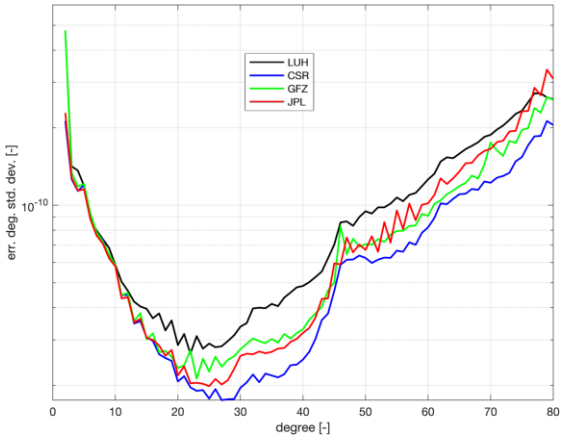
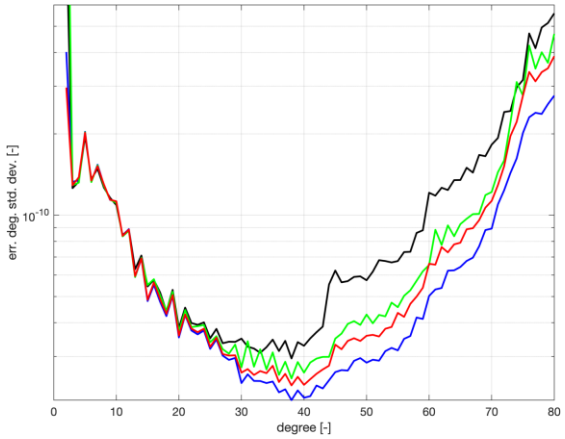


▪ GRACE 2002-2009



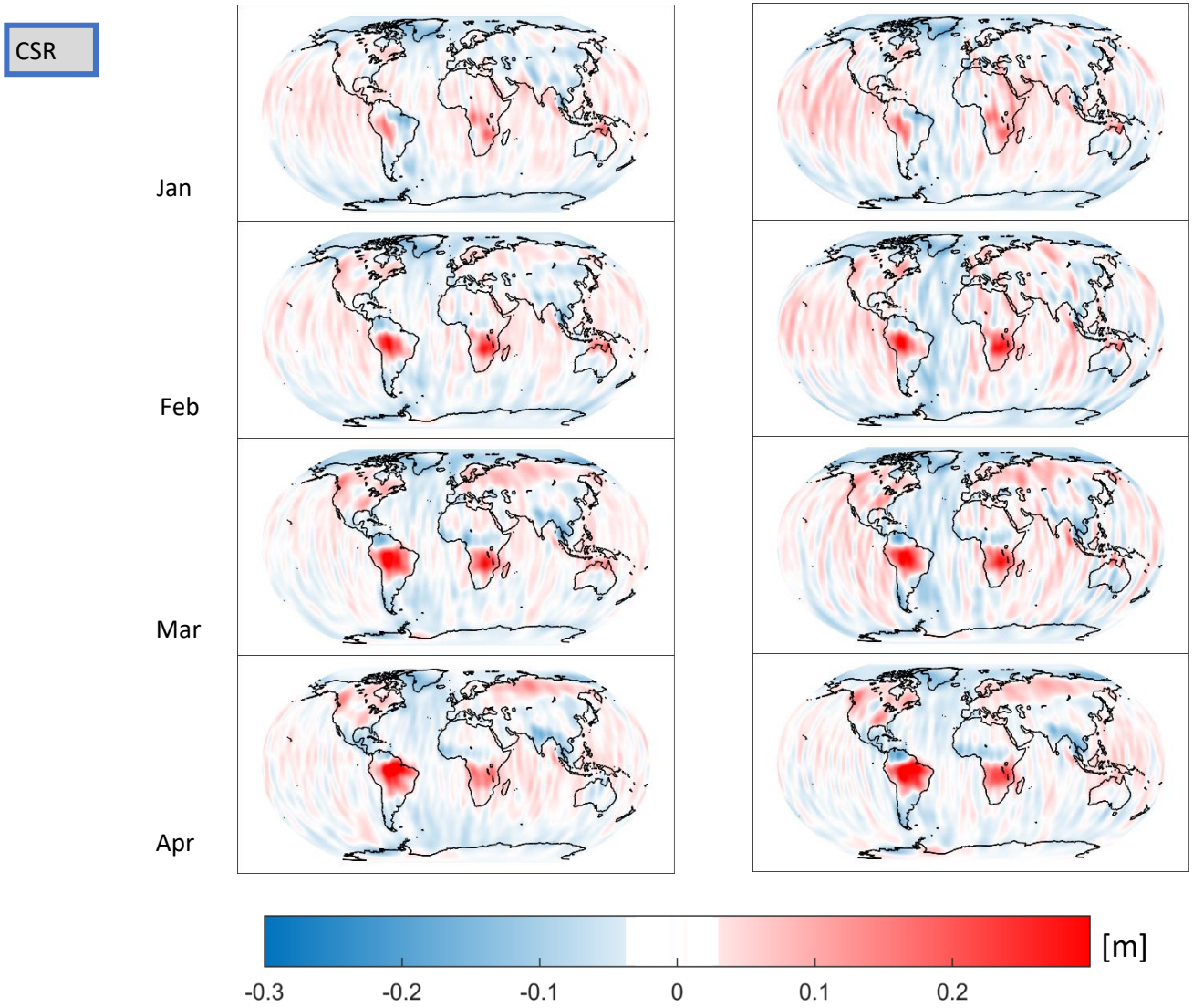
▪ GRACE 2010-2016



▪ GRACE FO mid 2018-mid 2019

- Same monthly solutions are considered
- GOCO06s subtracted
- GRACE RL05, GRACE-FO RL06

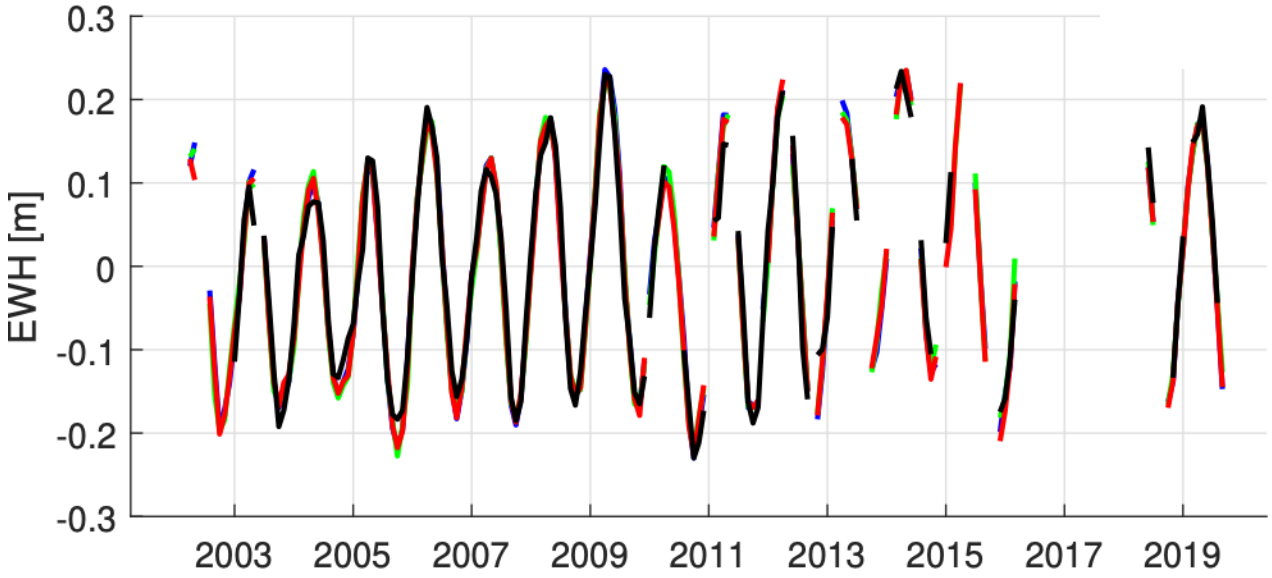
Exemplary EWHs (2008)



- Gaussian filter (400 km)
- C_{20}: TN SLR values

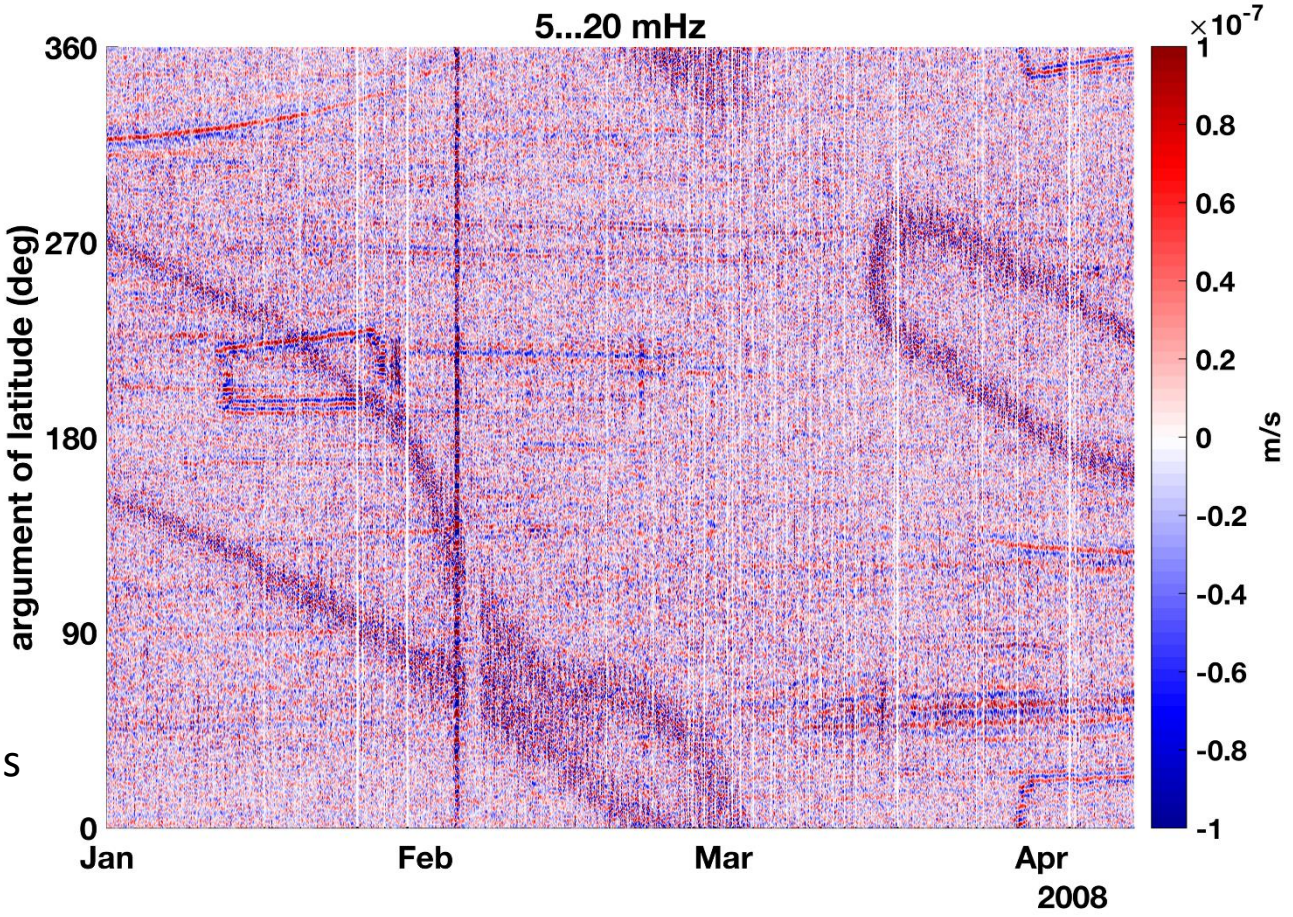
Equivalent water heights Greenland

Equivalent water heights Amazon



KBRR residuals GRACE

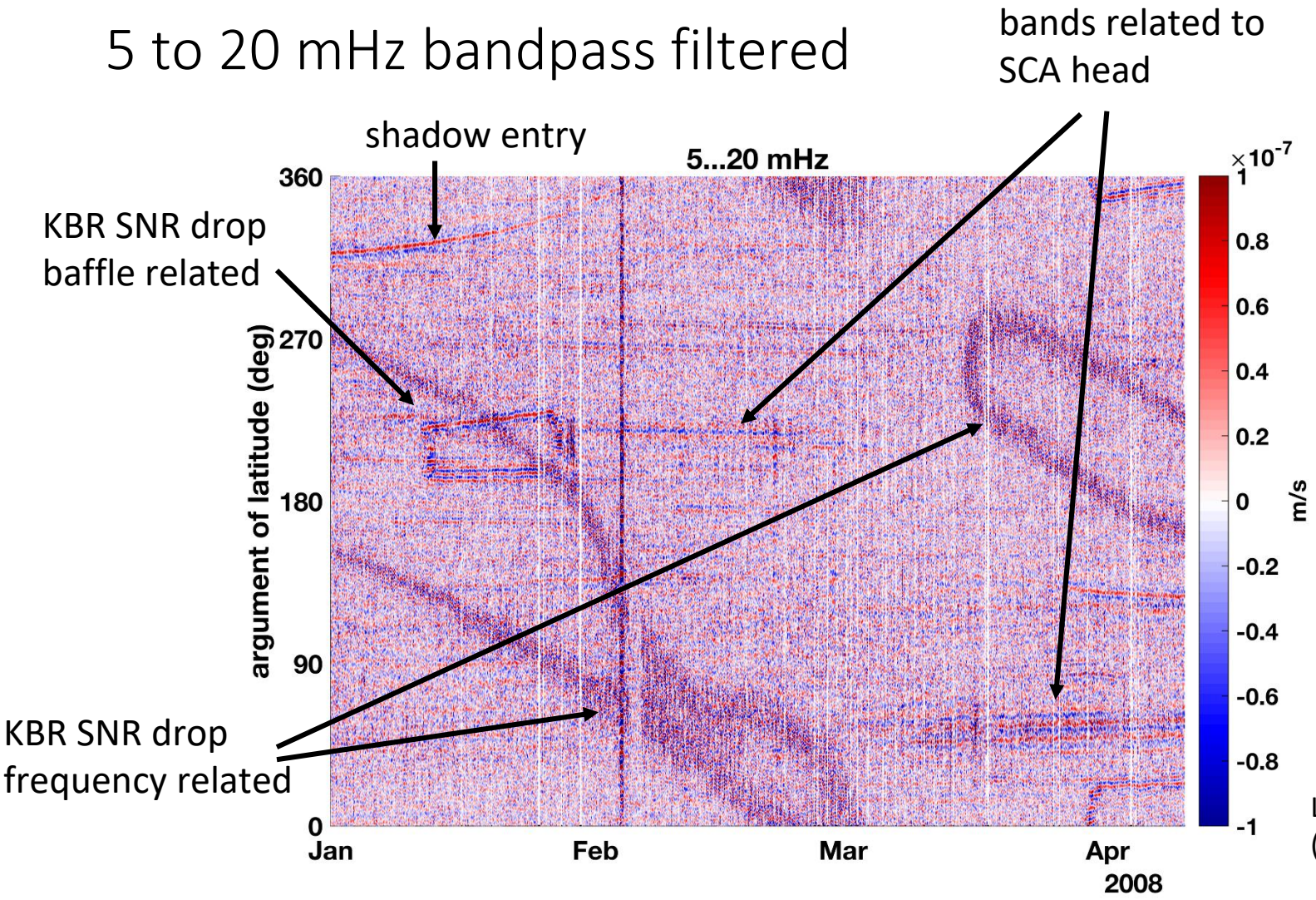
5 to 20 mHz bandpass filtered



Time-Arg.Lat.
(TAL) Diagrams

KBRR residuals GRACE

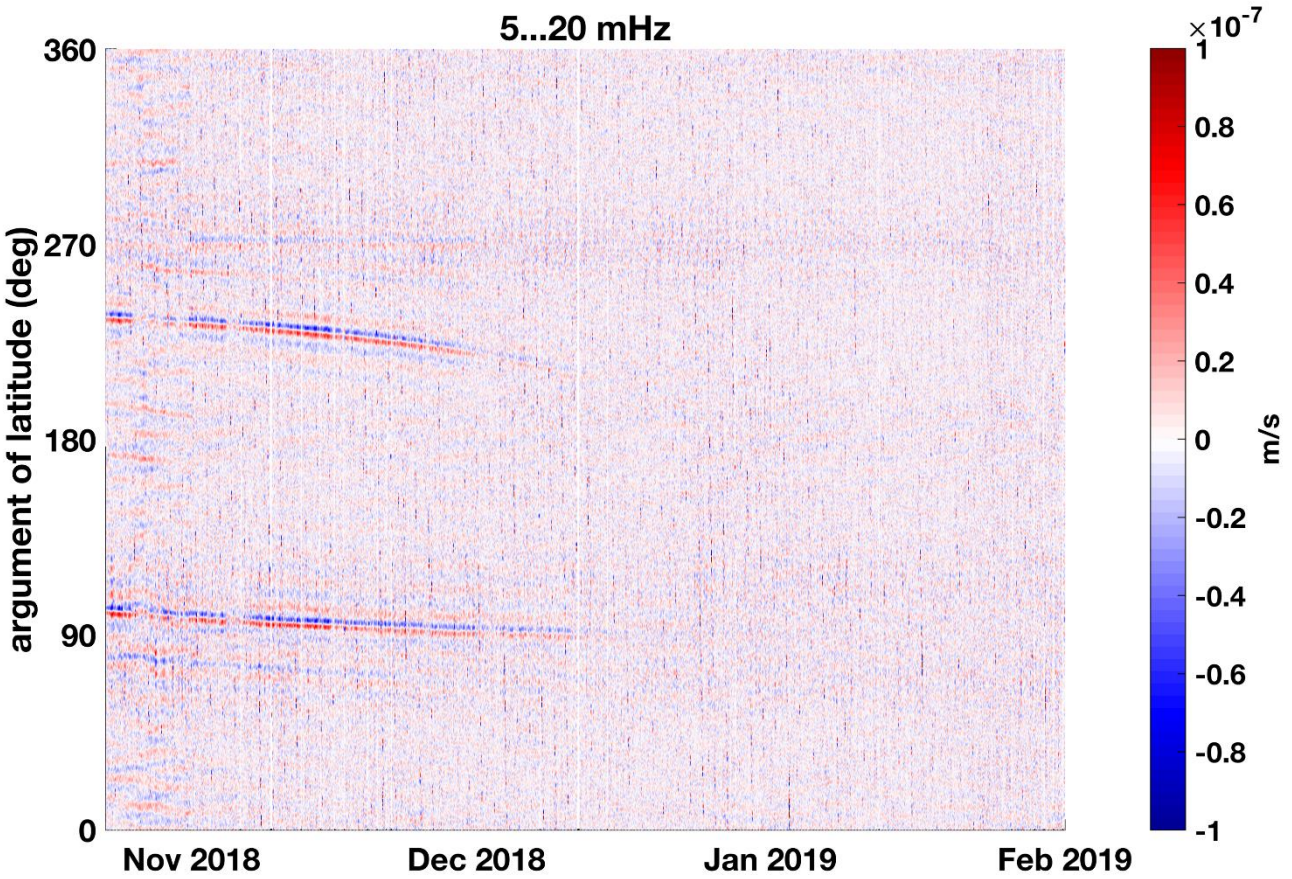
5 to 20 mHz bandpass filtered



LUH GRACE2018
(based on RL02 L1B)

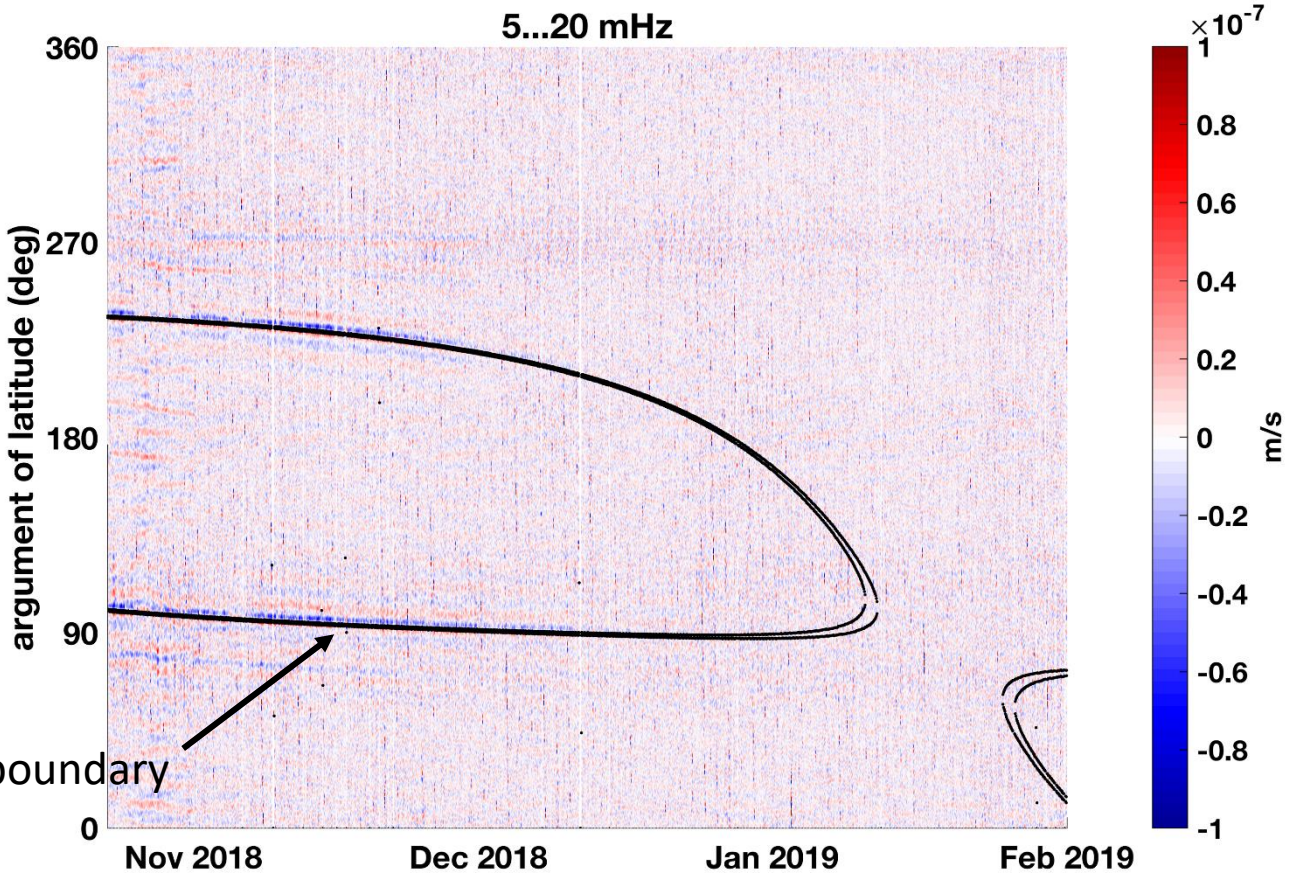
KBRR residuals GRACE FO

5 to 20 mHz bandpass filtered



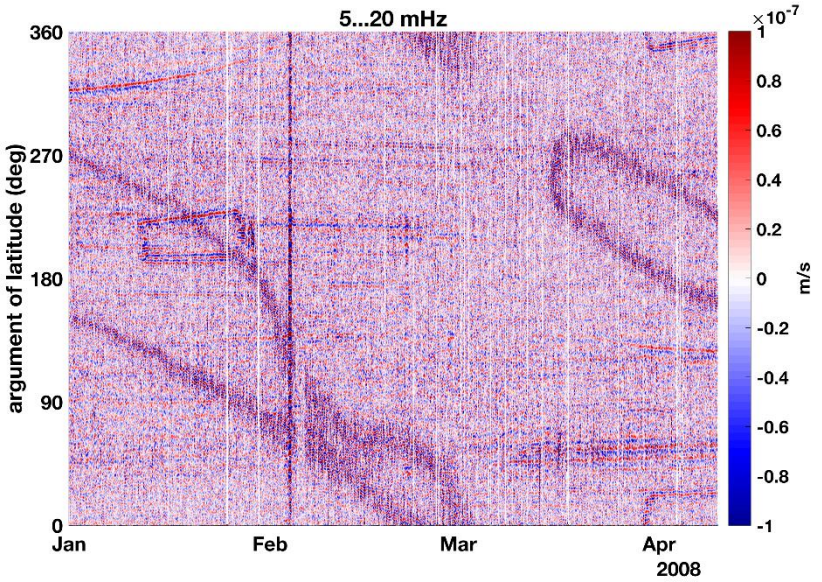
KBRR residuals GRACE FO

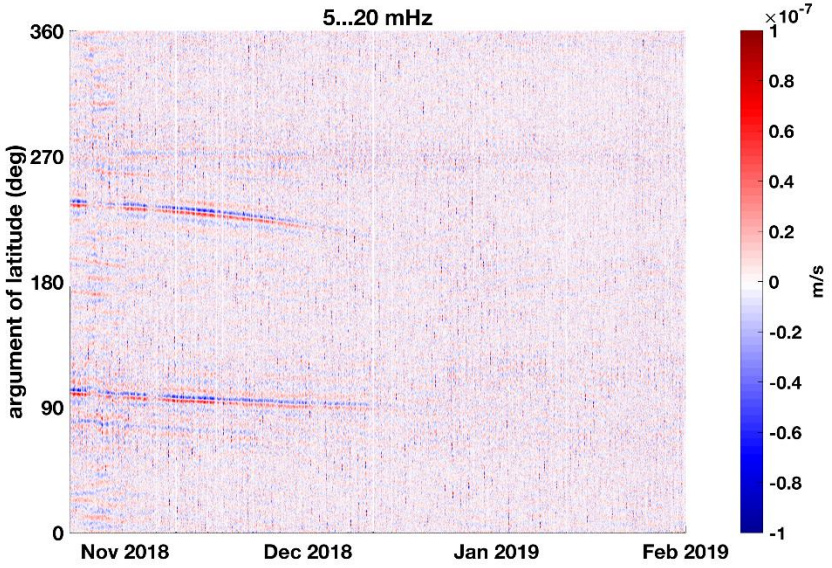
5 to 20 mHz bandpass filtered



GRACE vs GRACE FO

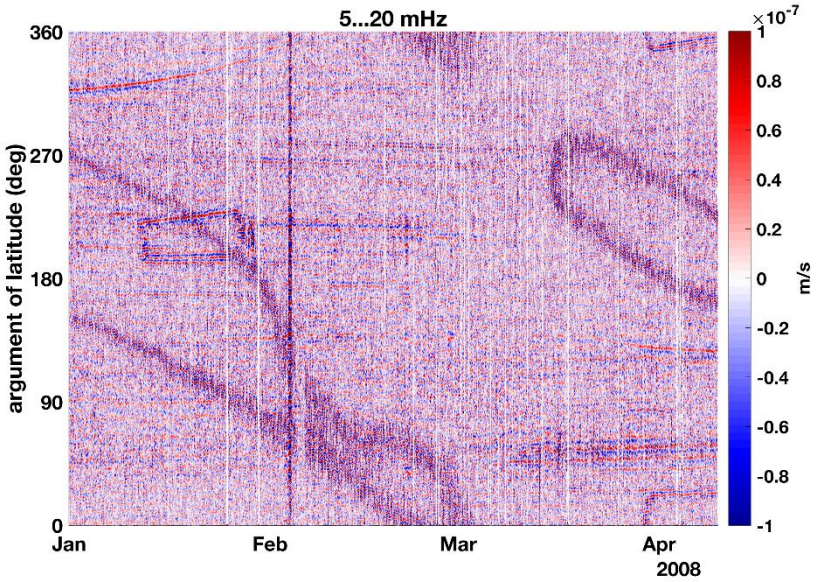
5 to 20 mHz bandpass filtered

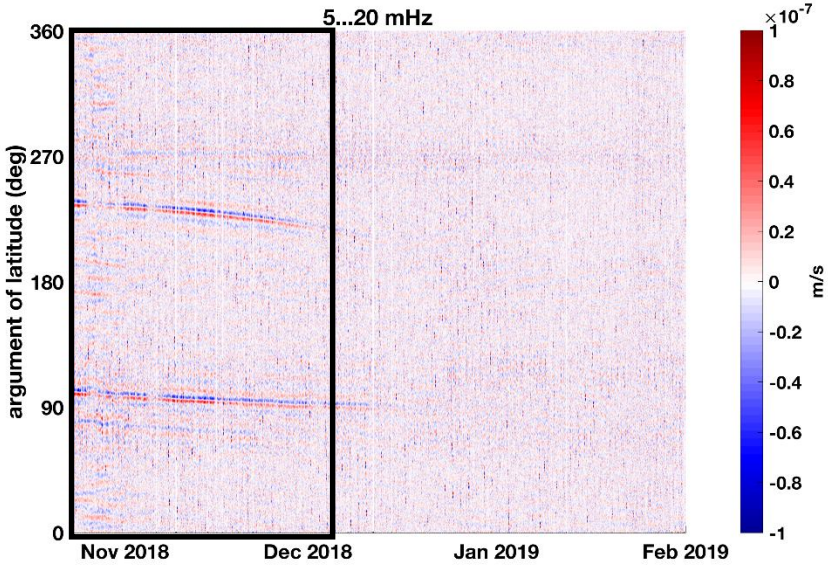




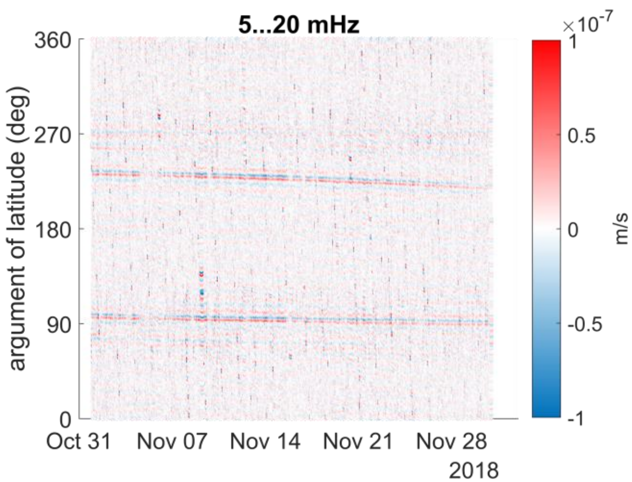
GRACE vs GRACE FO

5 to 20 mHz bandpass filtered

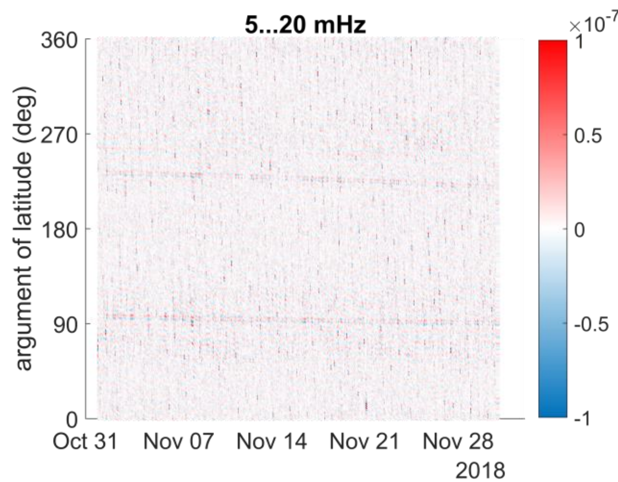




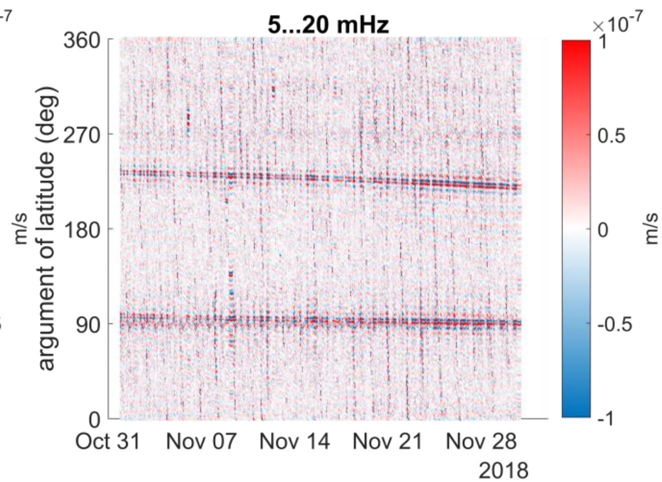
GRACE-FO
5 to 20 mHz bandpass filtered



Standard scenario:
- Initial state (3 h)
- Acc. bias+scale per arc (3 h)
- 8 KBRR empirical parameters per arc (3 h)



Scenario:
- Initial state (1.5 h)
- Acc. bias+scale per arc (1.5 h)
- 8 KBRR empirical parameters per arc (1.5 h)



Scenario:
- Initial state
- Acc. bias+scale per arc (3 h)
- Estimated for satellite C and then applied to C+D
- 8 KBRR empirical parameters per arc (3 h)

Perspectives

- continue GRACE-FO processing and analysis
- LRI etc.
- experiments with parameterization
- comparison of residuals
- …

References

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