COST-G

Combination Service for Time-variable Gravity Models

Combination Service for Time-variable Gravity Fields: operational GRACE-FO combination and validation of Chinese GRACE time-series

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G3P

G4.2 Satellite Gravimetry: Data Analysis, Results and Future Mission Concepts

UNIVERSITÄT BERN

GFZ Helmholtz Centre Potsdam

TU Graz Graz University of Technology

cnes

Leibniz Universität Hannover

TECHNISCHE UNIVERSITÄT DRESDEN

STELLAR SPACE STUDIES

HCU HafenCity Universität Hamburg

LEGOS

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INTRODUCTION

COST-G: Website

https://cost-g.org/

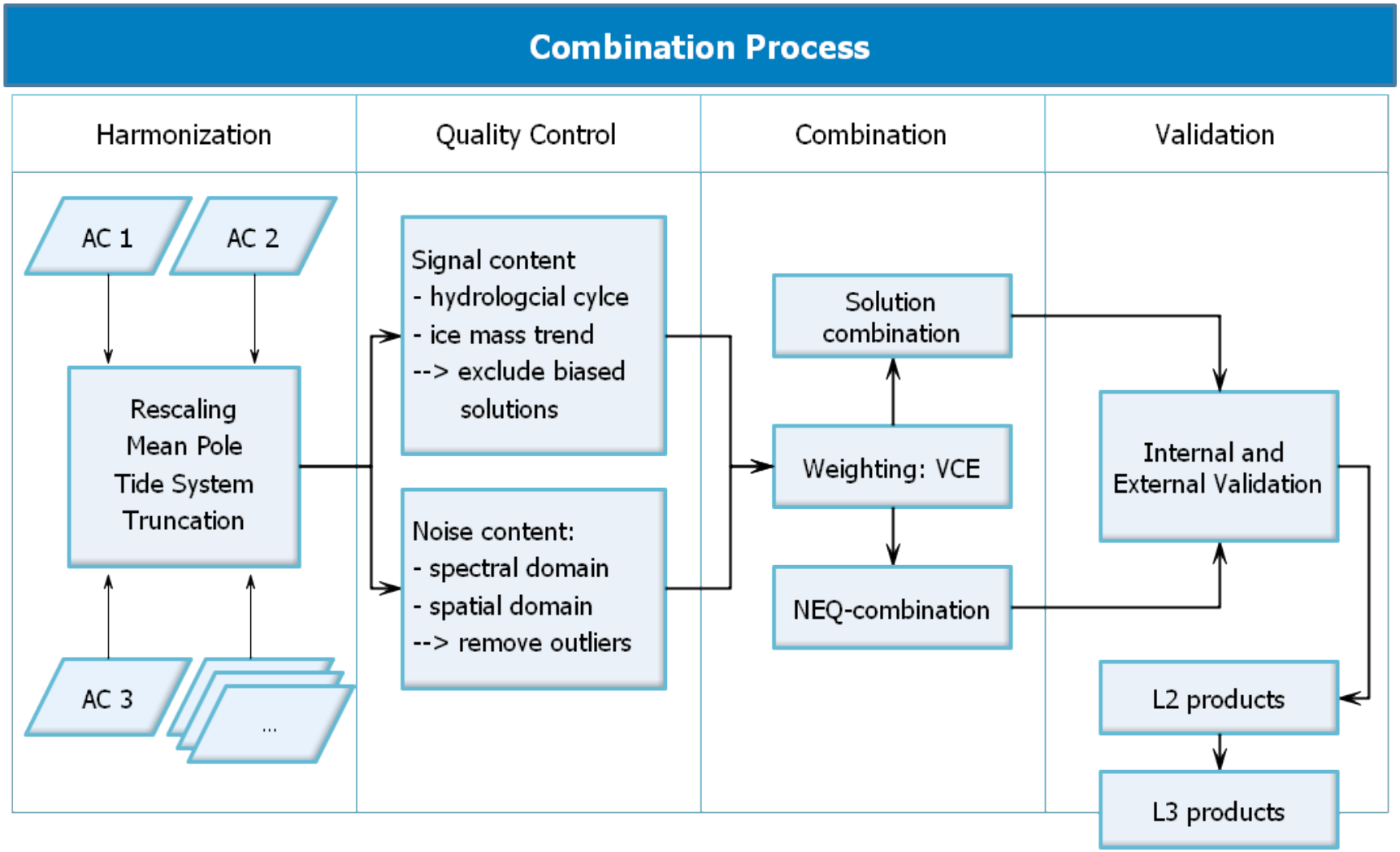
COST-G: Permanent Components

COST-G accomplishes its objectives through the following permanent components and roles:

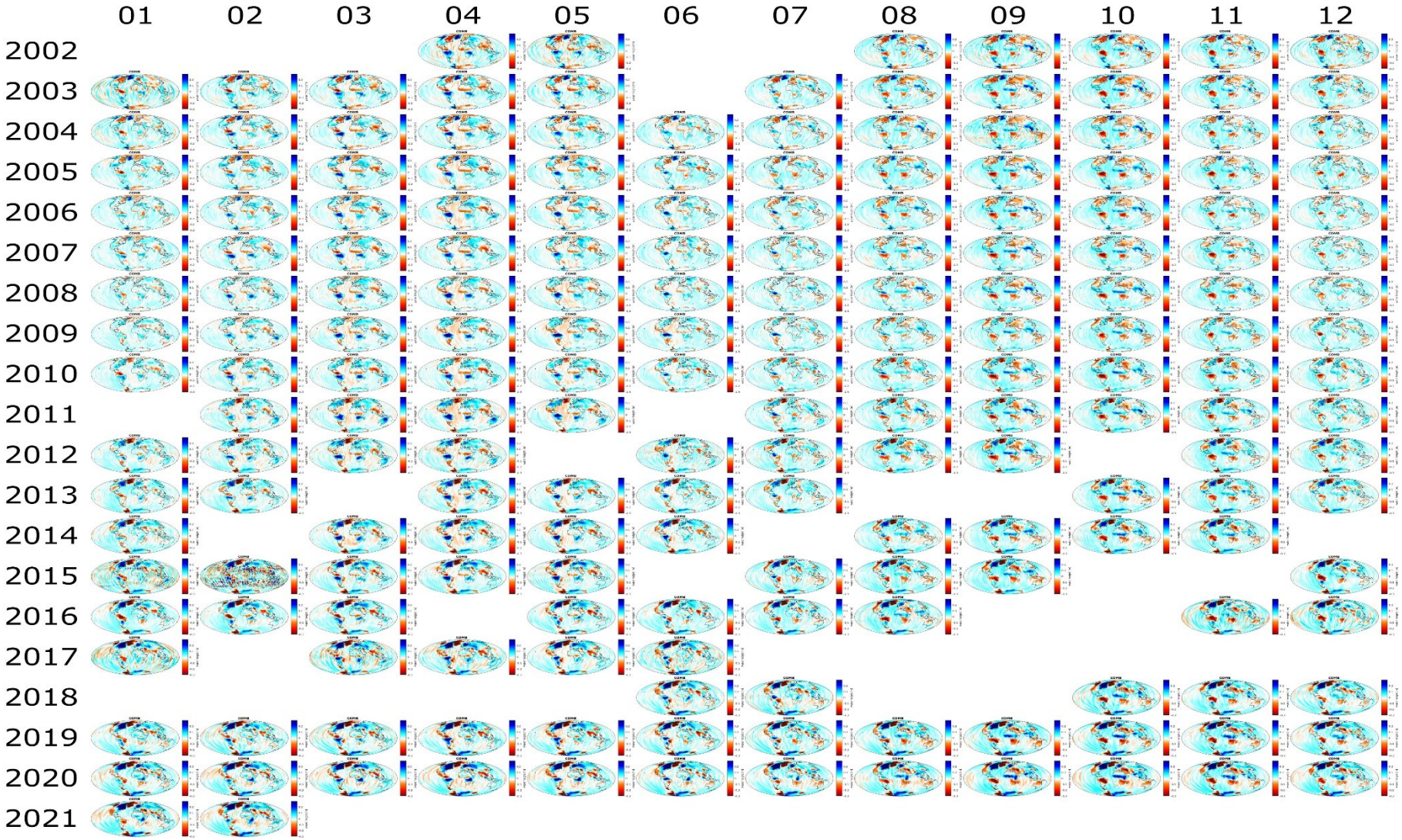
- **Central Bureau (CB) & Analysis Center Coordinator (ACC)**
  - AIUB
- **Analysis Centers (ACs)**
  - AIUB, CNES, GFZ, LUH, TUG
- **Level-3 Center (L3C)**
  - GFZ
- **Validation Centers (VCs)**
  - GRGS, GFZ
- **Product Evaluation Group (PEG)**
  - A. Eicker, A. Groh, B. Meyssignac

- **Partner ACs:** CSR, JPL
- **Candidate ACs:** Chinese ACs

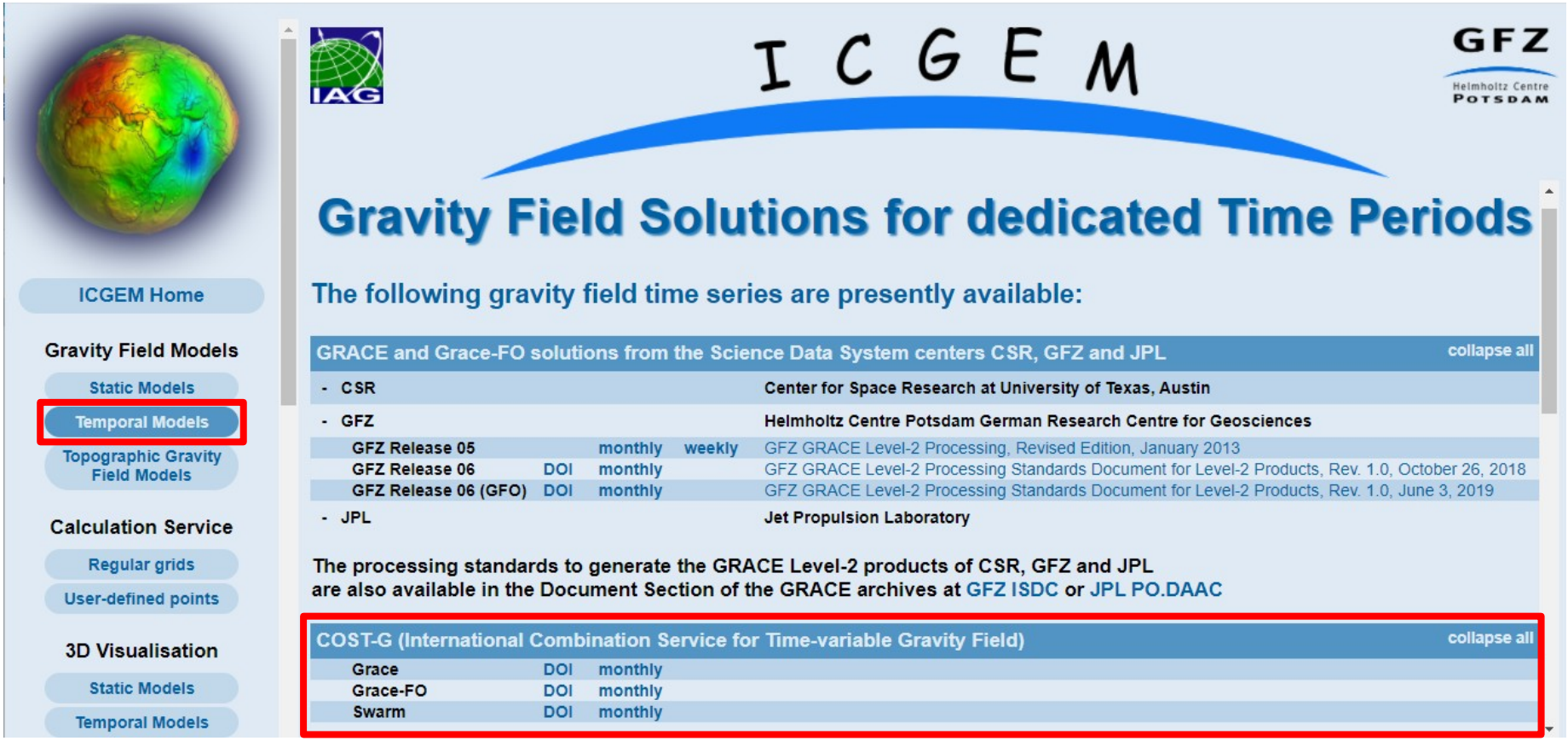
COST-G: Operations



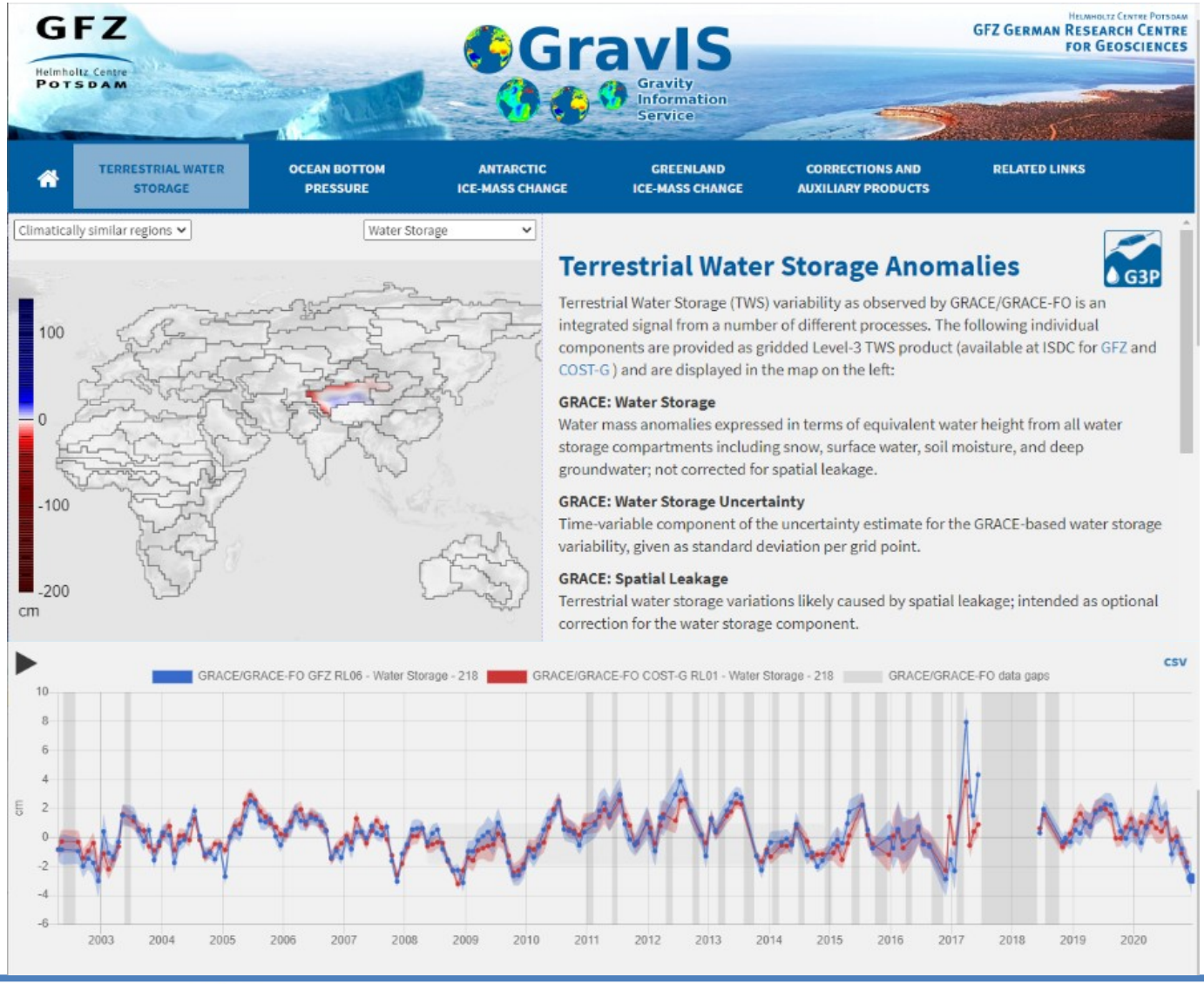
COST-G: Products (GRACE/GRACE-FO)



COST-G products: Level-2 (spherical harmonic)

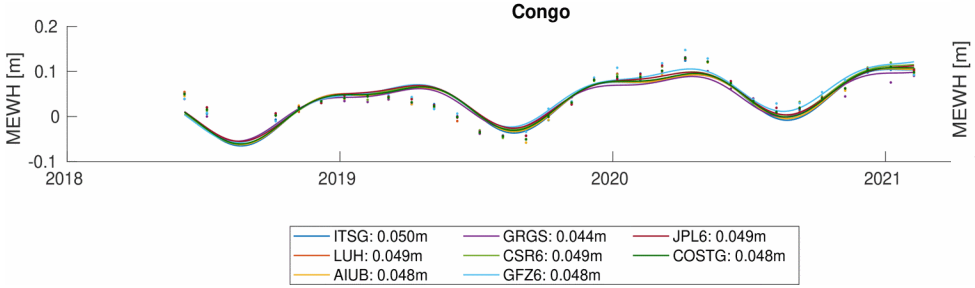


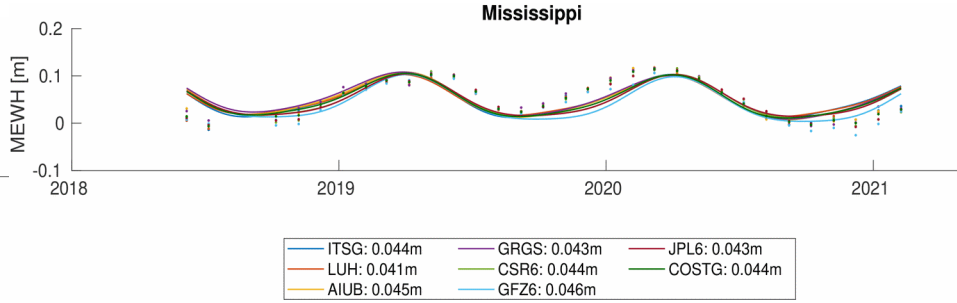
COST-G products: Level-3 (post-processed grids/time-series)

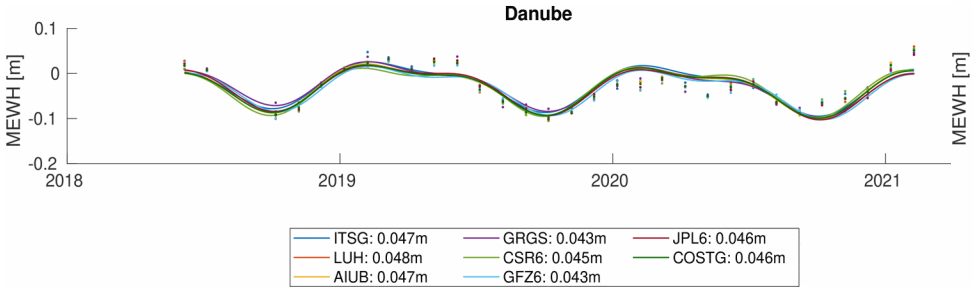


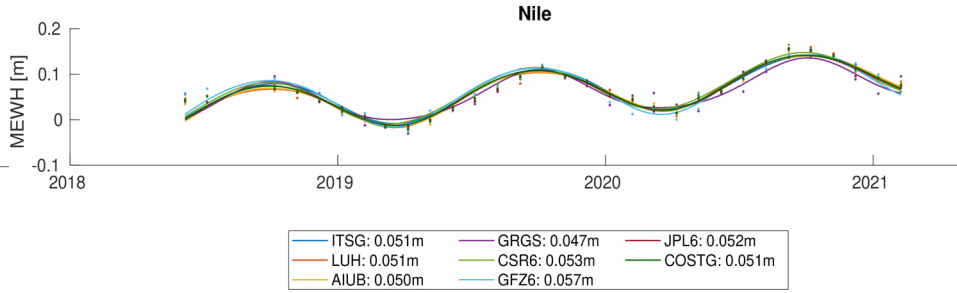
GRACE-FO: Operational combination

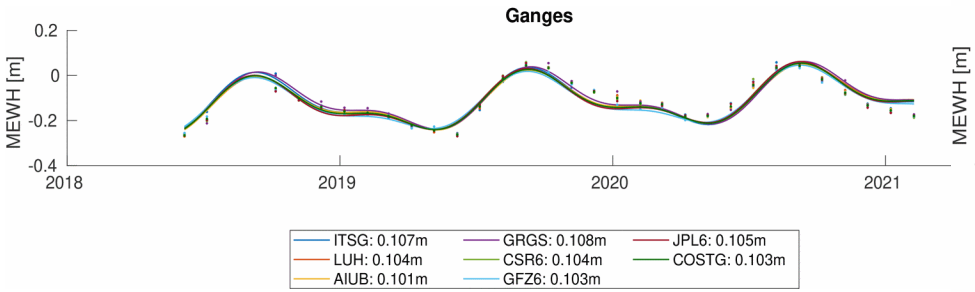
GRACE-FO: Assessment of hydrological signal content

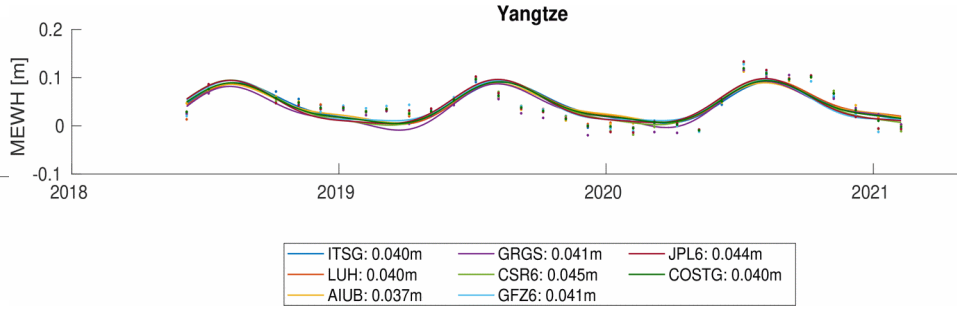




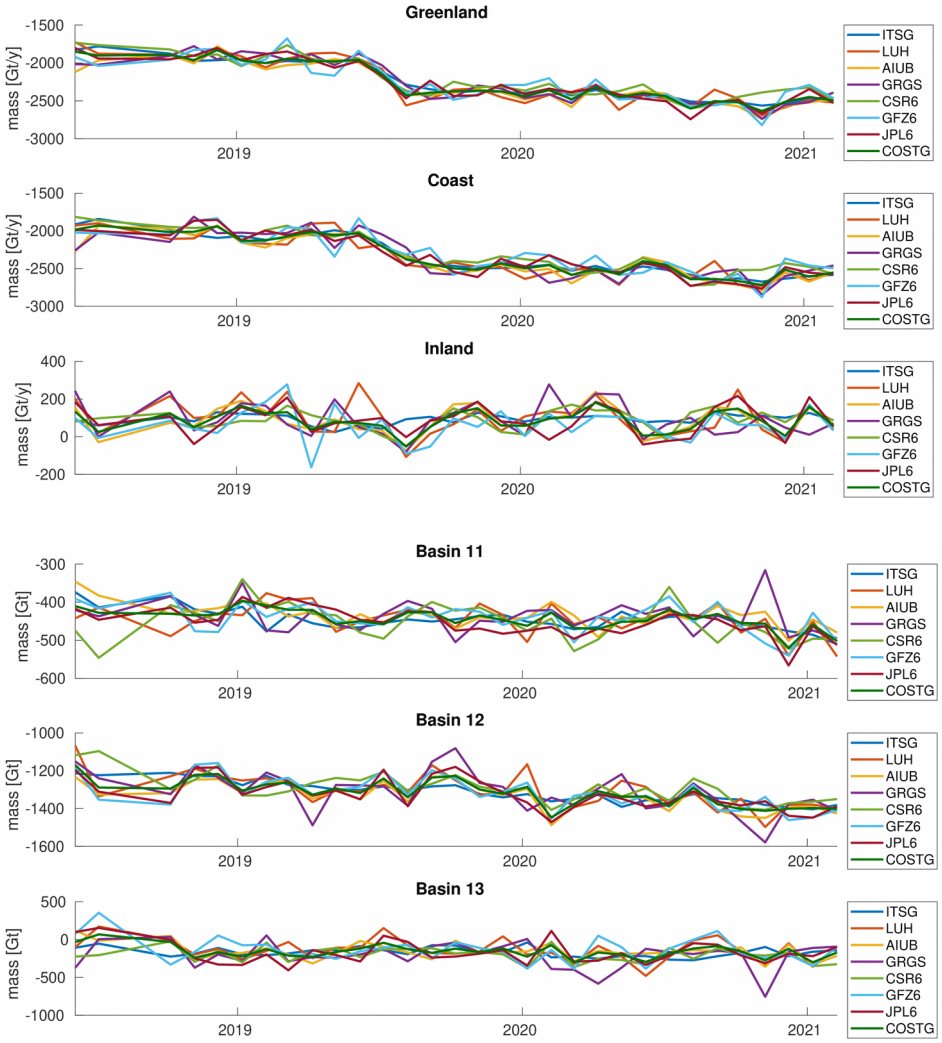


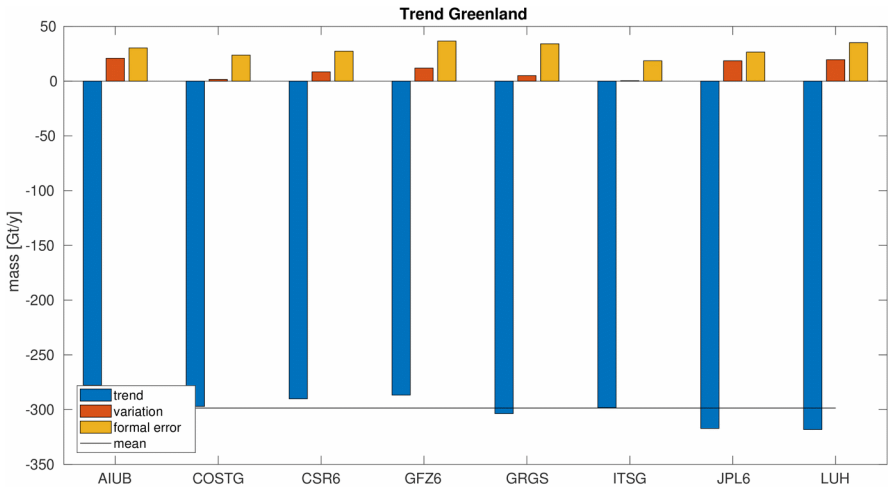


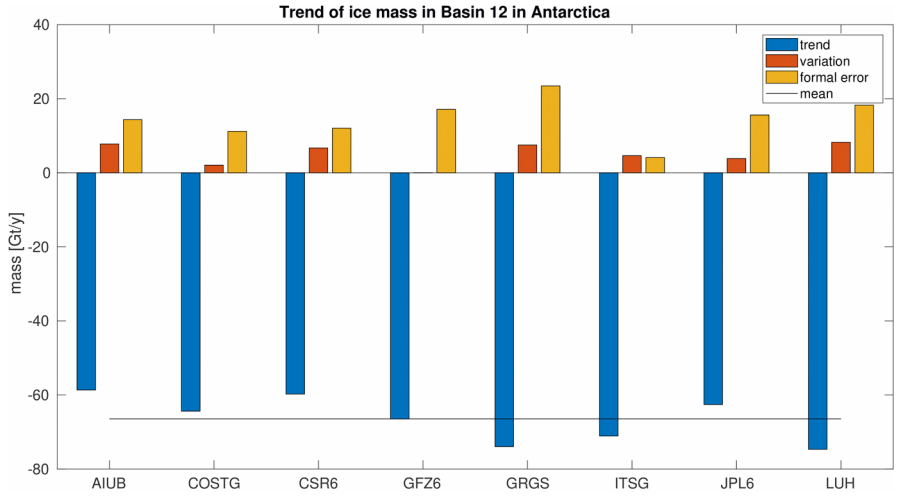




GRACE-FO: Assessment of polar mass change







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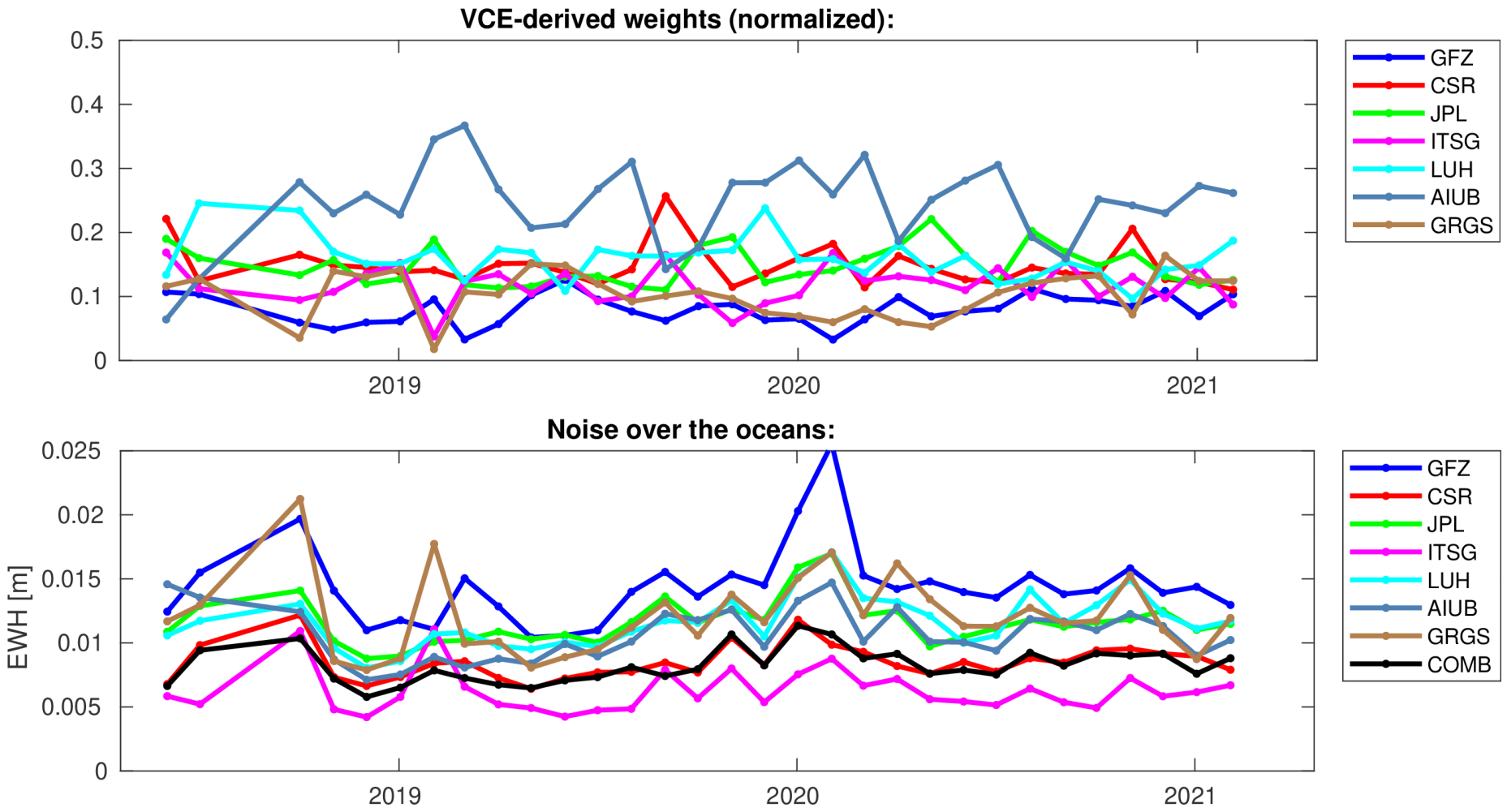
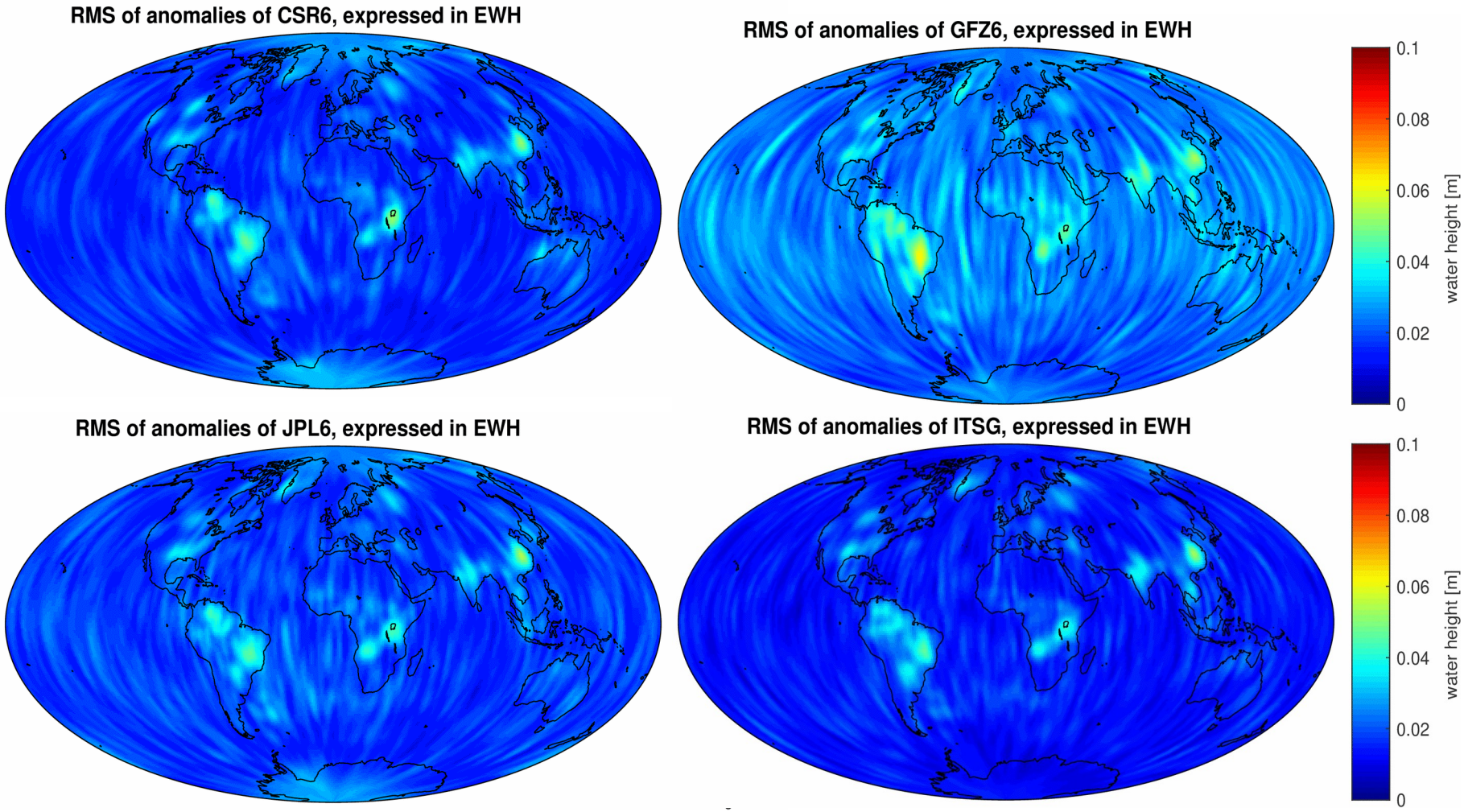
G4.2 – Satellite Gravimetry

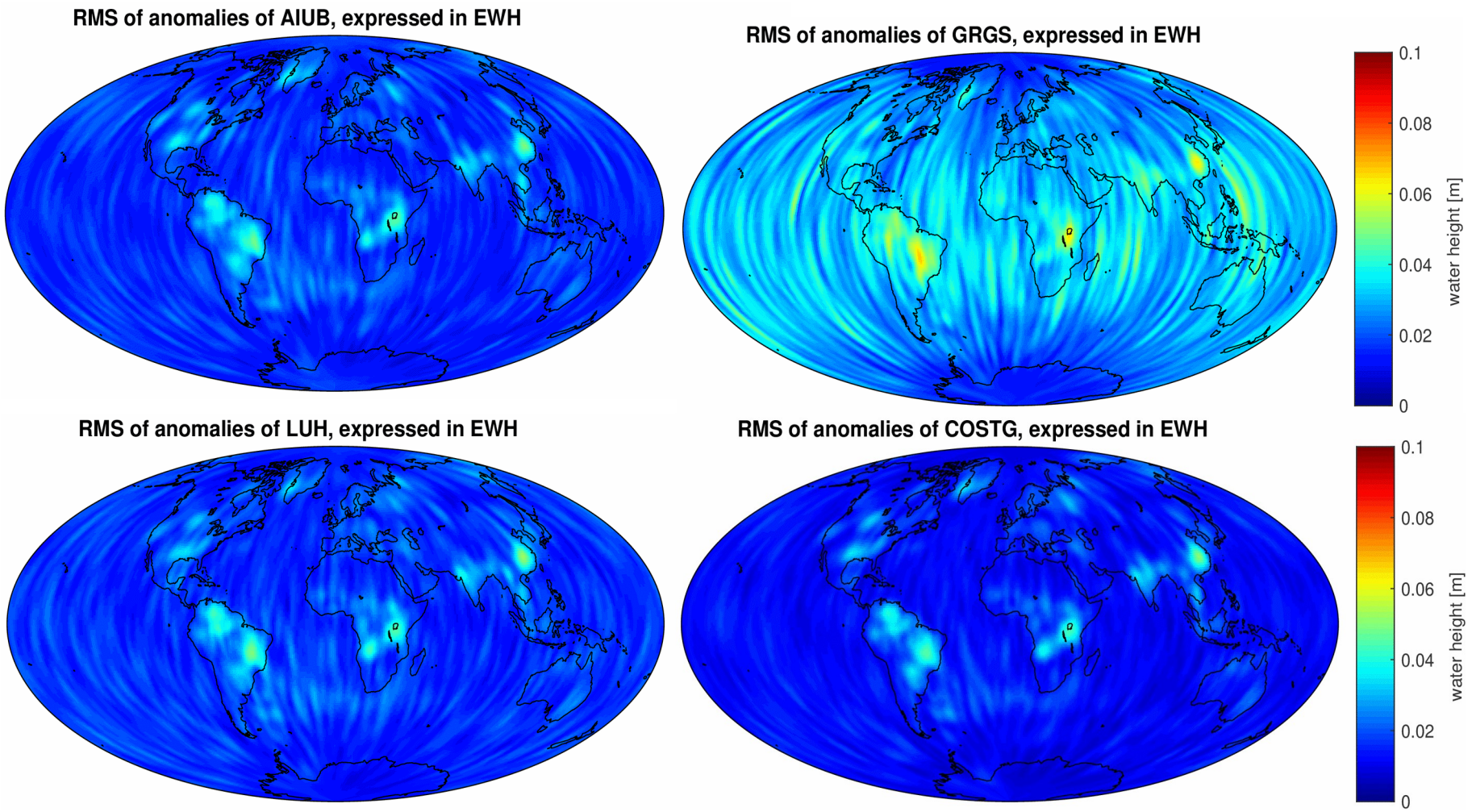
GRACE-FO: Weighted combination and noise asessment



GRACE-FO: Noise assessment



GRACE-FO: Noise assessment



Summary (Part 1)

- **COST-G combined Level-2 products for GRACE (repro), Swarm (operational), and GRACE-FO (operational) are available from ICGEM** (http://icgem.gfz-potsdam.de/series).
- **COST-G Level-3 products for GRACE and GRACE-FO are available via GFZ's GravIS portal** (http://gravis.gfz-potsdam.de).

GRACE: Validation of Chinese time-series

COST-G quality control and combination

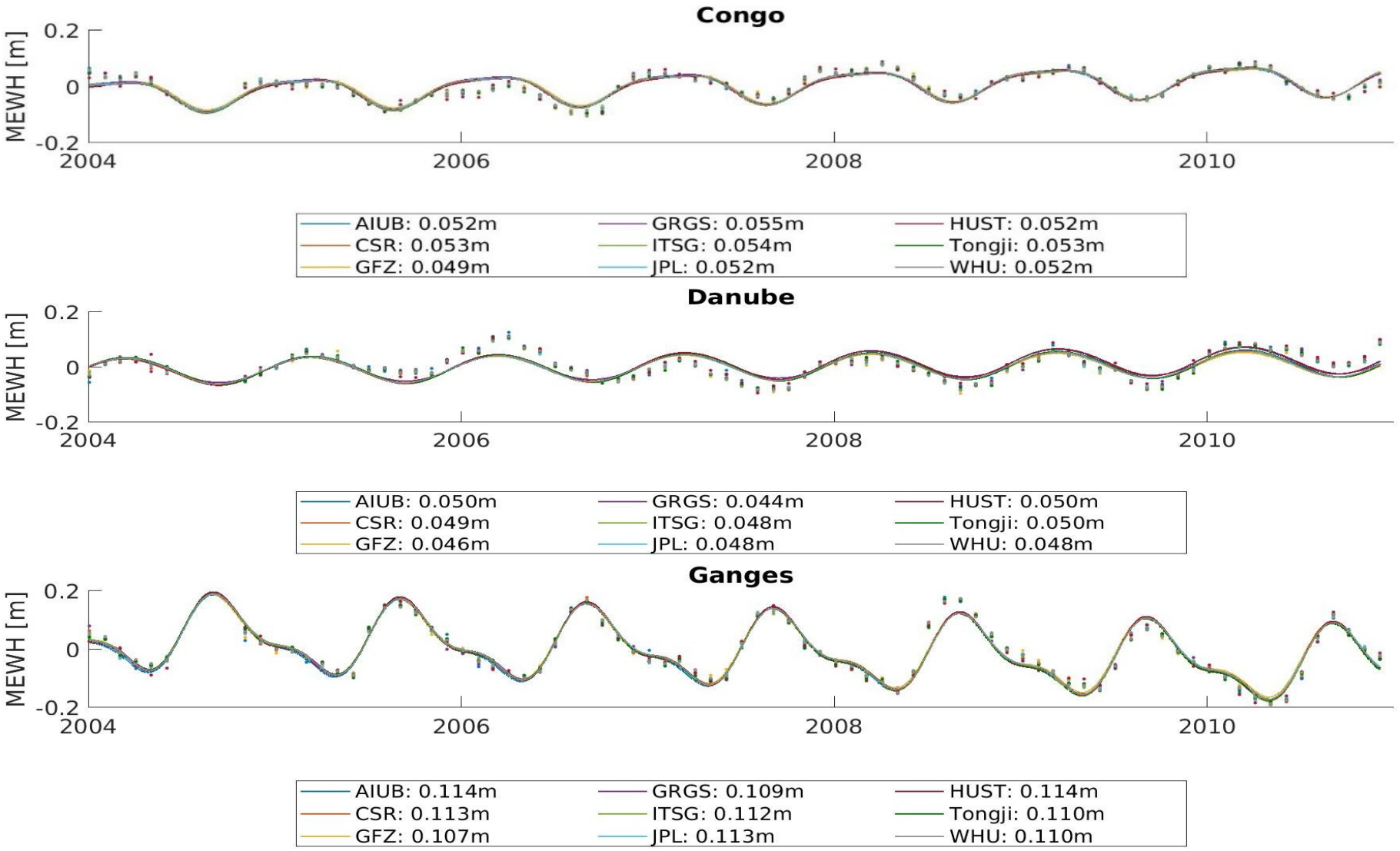
- COST-G quality control aims at the assessment of the signal content in the time-series of monthly gravity fields, which should be comparable in all time-series.
- Different noise levels are taken into account by relative weights in the combination.
- The combination of the monthly gravity fields is performed by Variance Component Estimation (VCE), low weights indicate either high noise content or systematic differences.
- We expect the combination to have full signal content but lower noise than the individual time-series.
- The noise level is validated independently by the variability of the monthly solutions in regions that are supposed not to show short term variability (oceans).
- Additional validations (e.g. orbit fits) are performed by the COST-G validation centers.

Data base

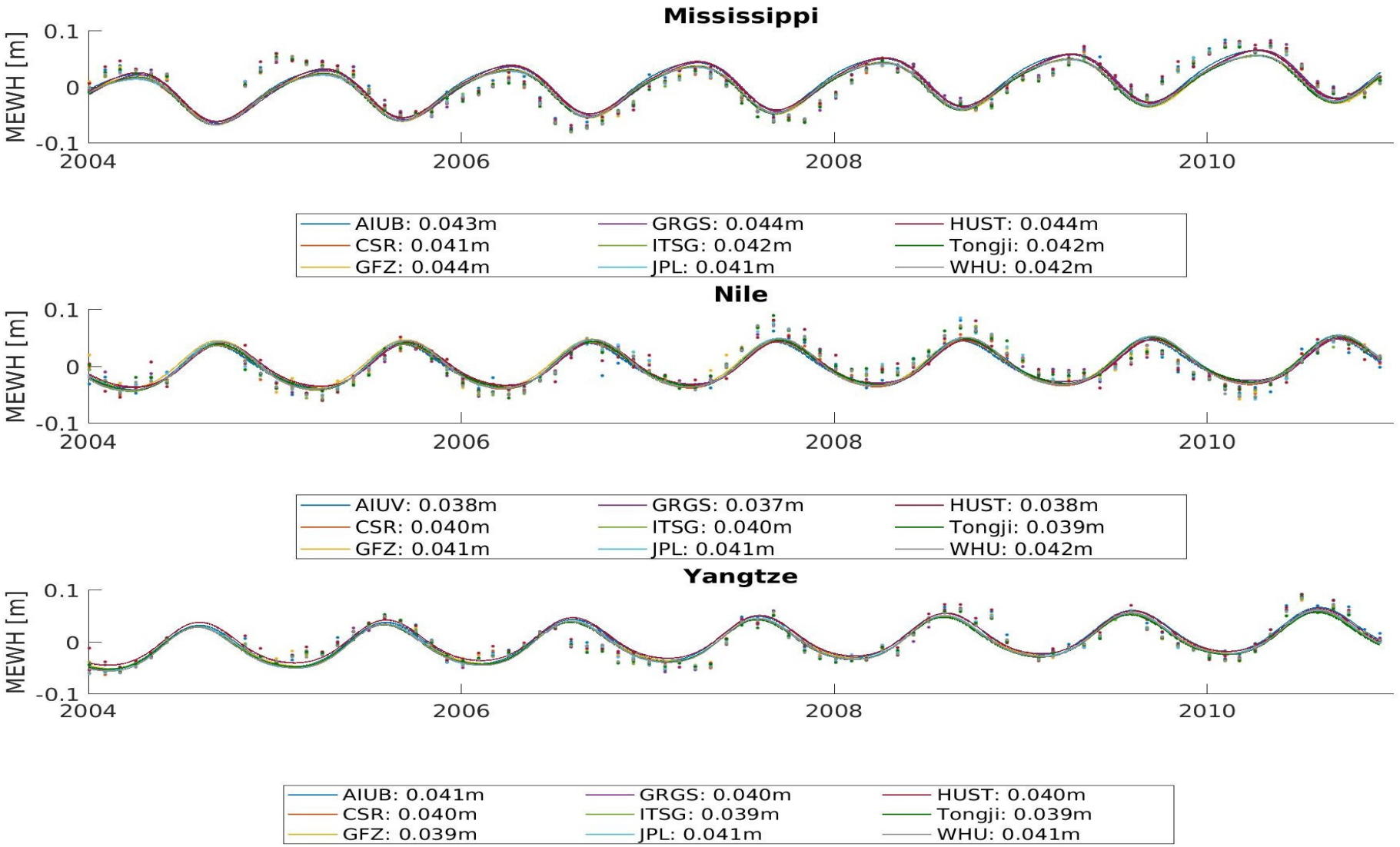
- **COST-G ACs:**
  - AIUB-RL02 (90, AOD-RL05, 01/2003-08/2016)
  - GFZ-RL06 (96, AOD-RL06, 04/2002-06/2017)
  - GRGS-RL04 (90, ERA-interim/TUGO, 08/2002-06/2017)
  - ITSG-Grace2018 (96, AOD-RL06, 04/2002-06/2017)
- **COST-G Partner ACs:**
  - CSR-RL06 (96, AOD-RL06, 04/2020-06/2017)
  - JPL-RL06 (96, AOD-RL06, 04/2002-06/2017)
- **COST-G candidate ACs:**
  - HUST-Grace2019 (90,AOD-RL05, 01/2004-12/2010)
  - IGG-RL01 (60, AOD-RL05, 04/2002-07/2016)
  - SUSTech-2018 (60, AOD-RL05, 01/2004-12/2010)
  - Tongji-Grace2018 (90, AOD-RL06, 04/2002-12/2016)
  - WHU-RL02 (90, AOD-RL06, 01/2004-12/2010)

Signal validation and ortib fits are limited to the degree 90/96 time-series.

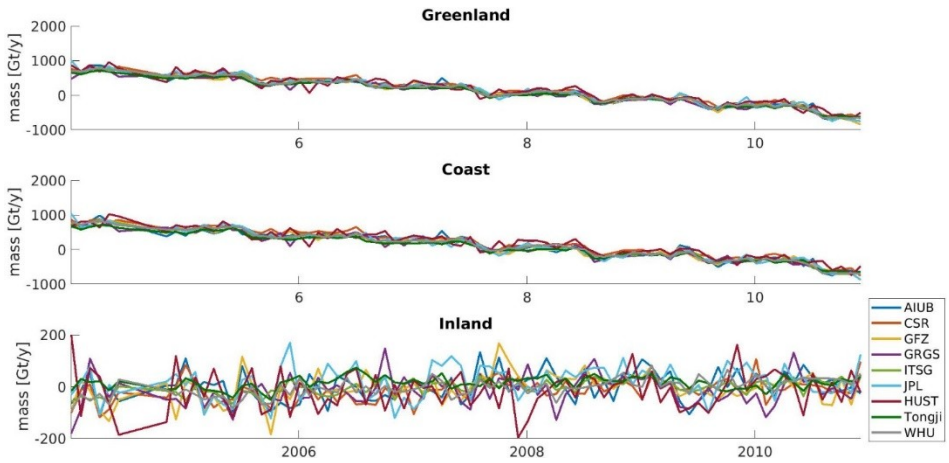
GRACE: Assessment of hydrological signal content (90)

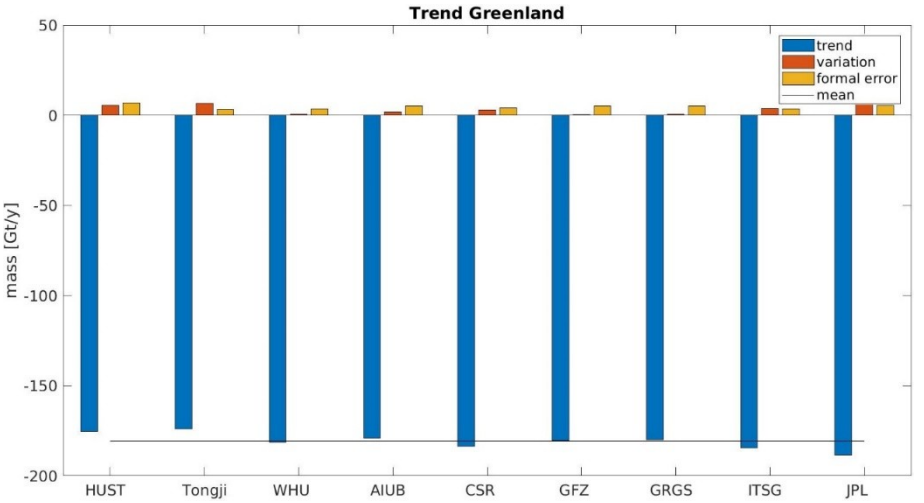


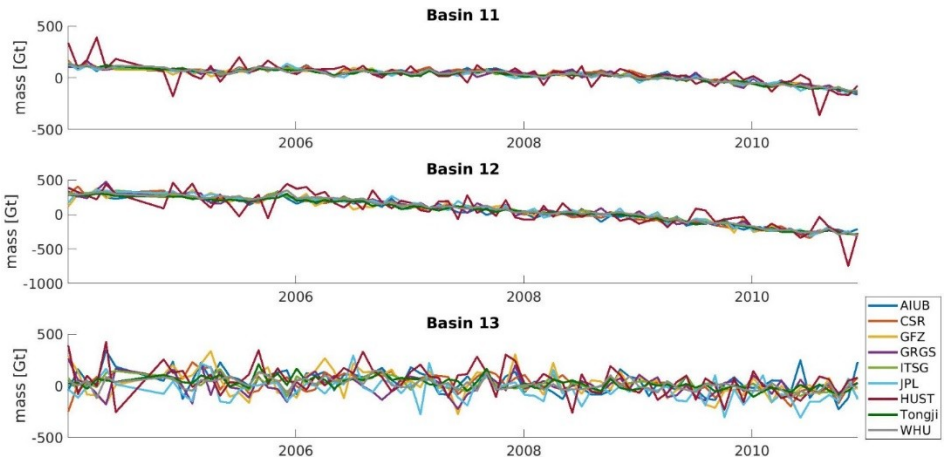
GRACE: Assessment of hydrological signal content (90)

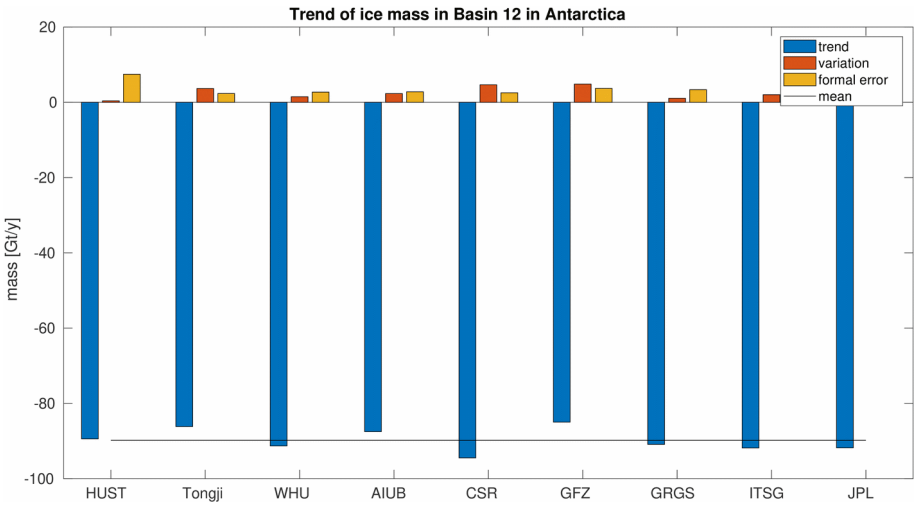


GRACE: Assessment of polar mass change (90)

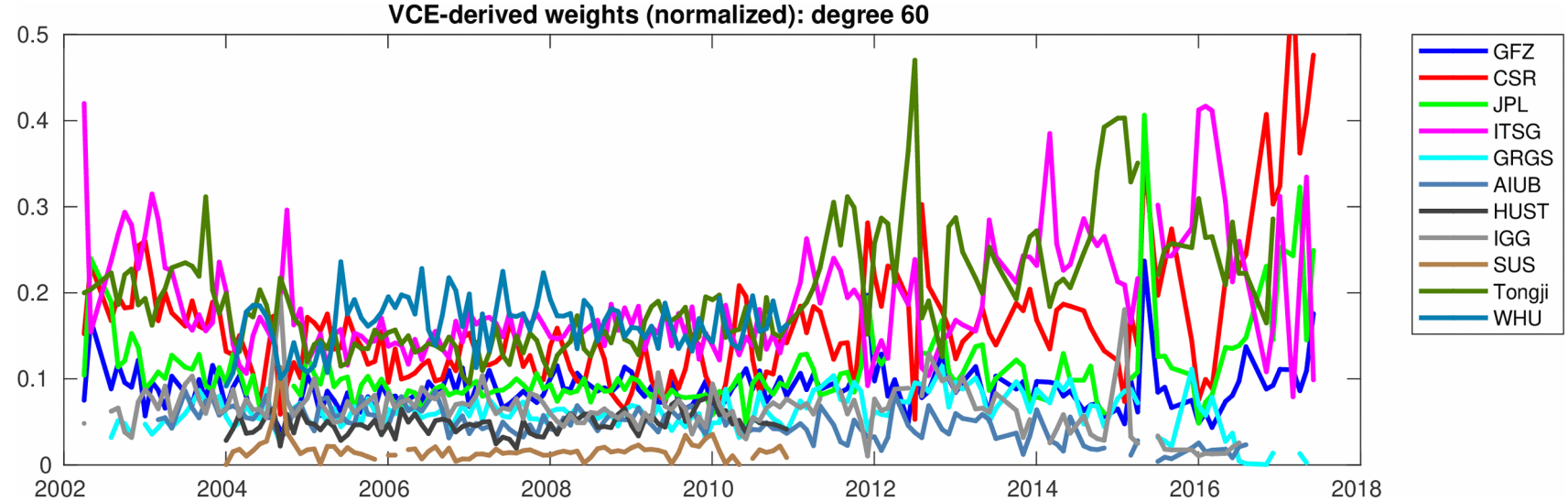


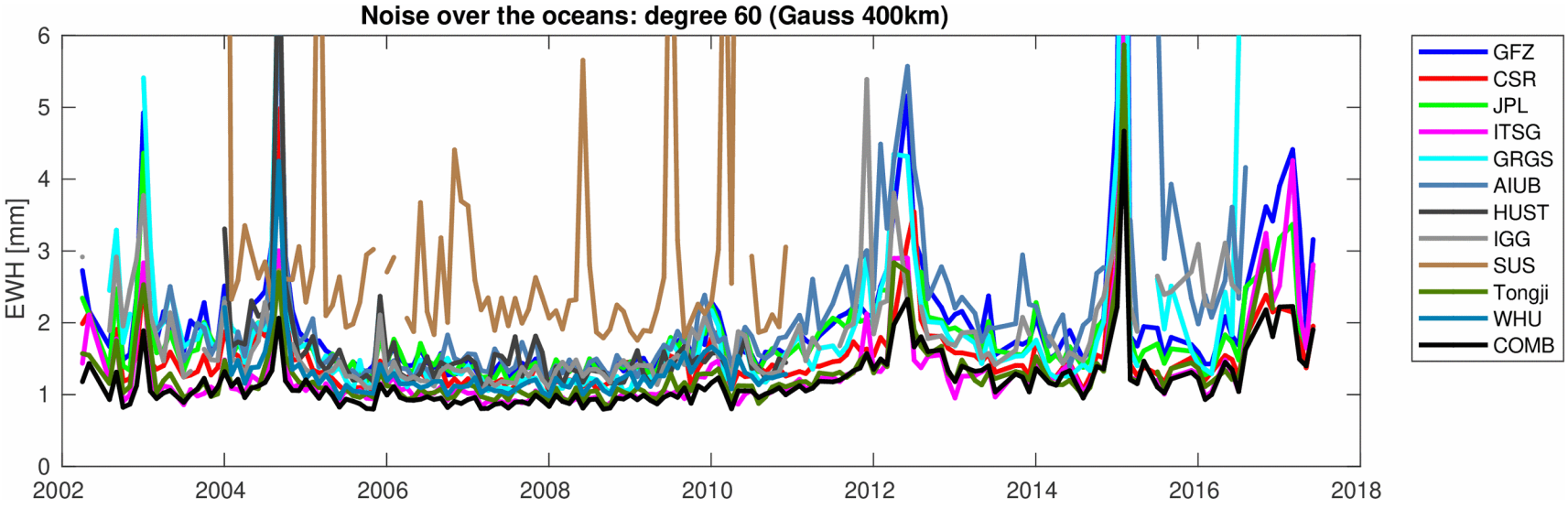




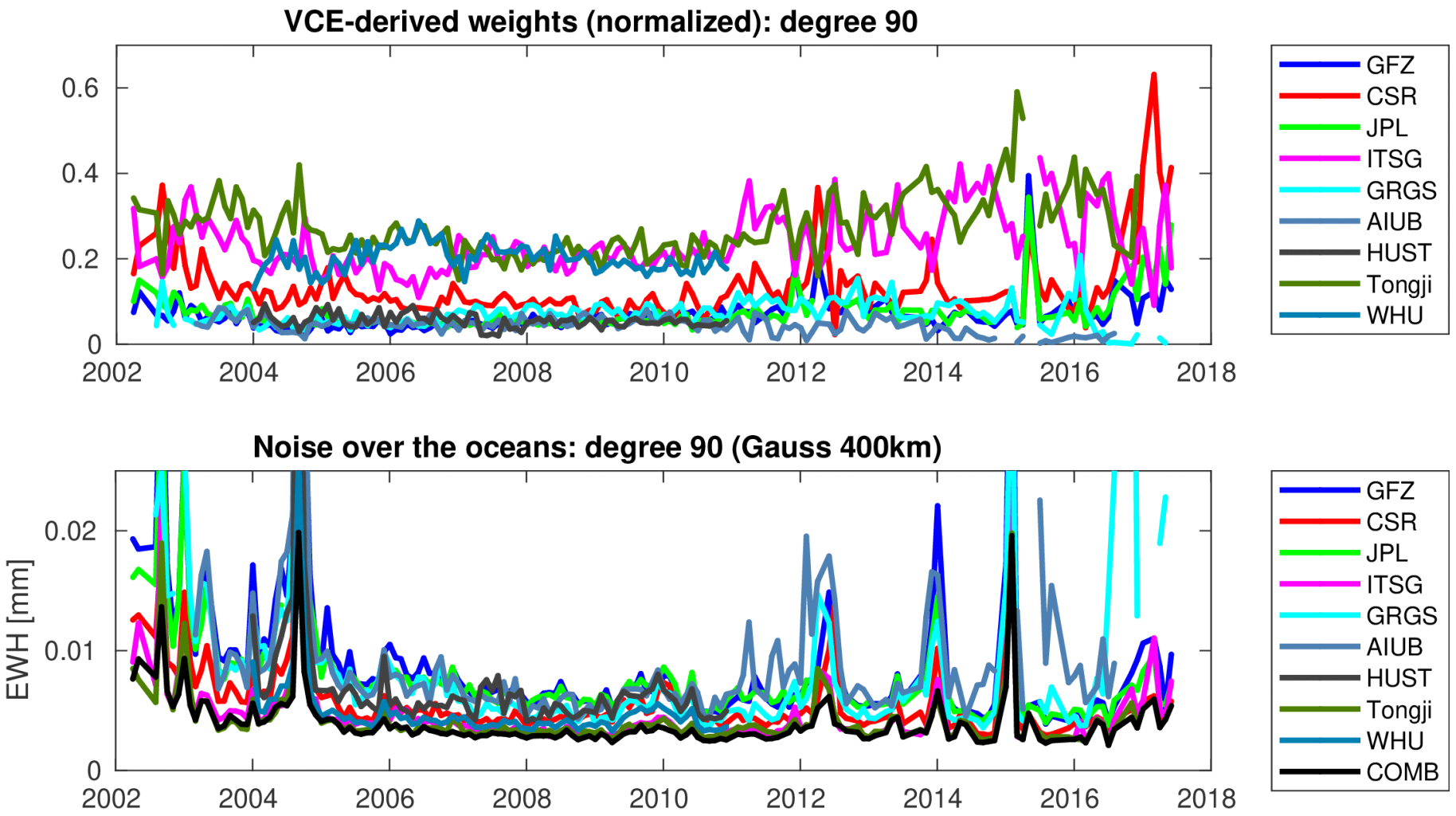


GRACE: Weighted combination and noise assessment (60)

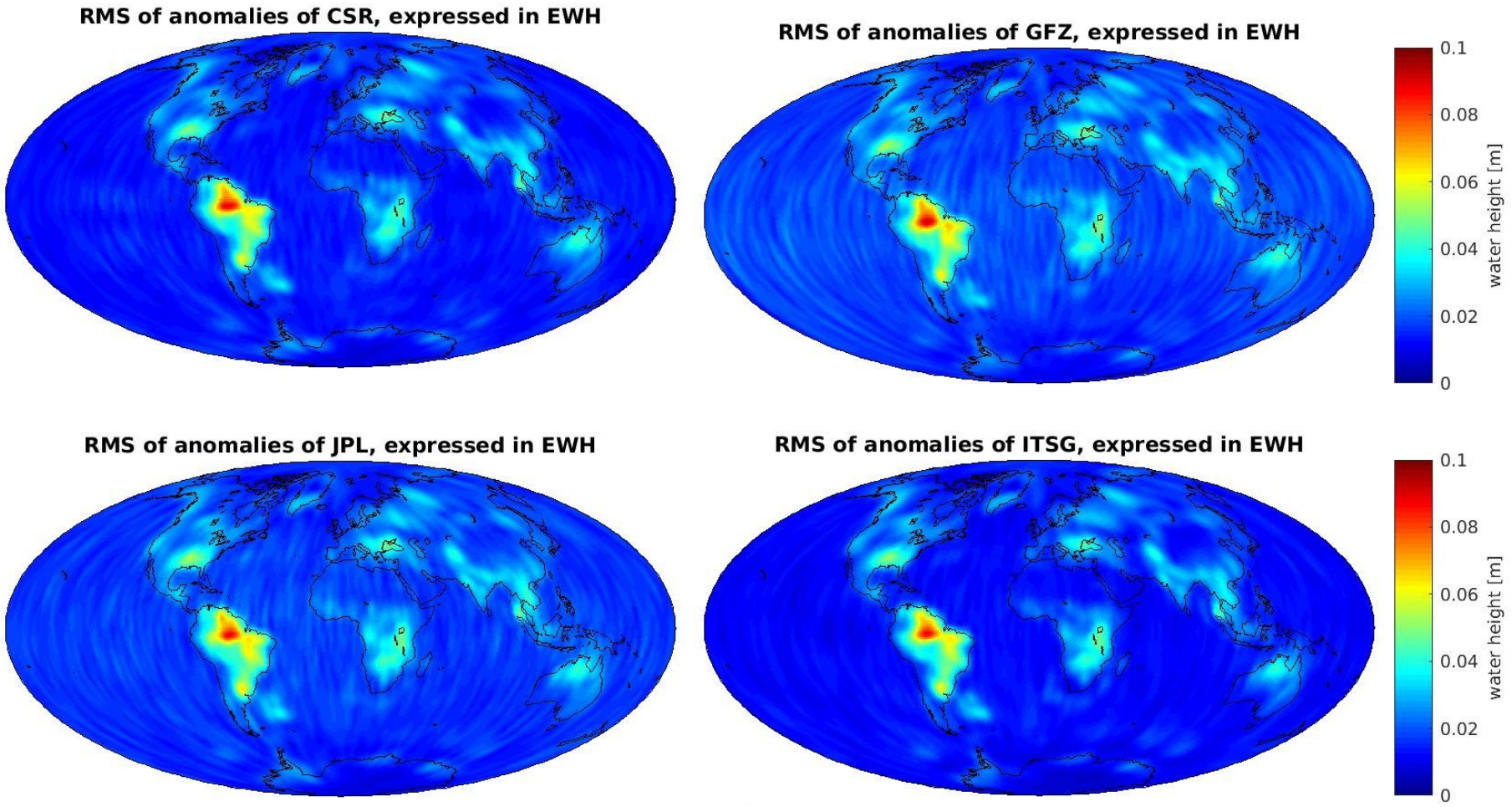




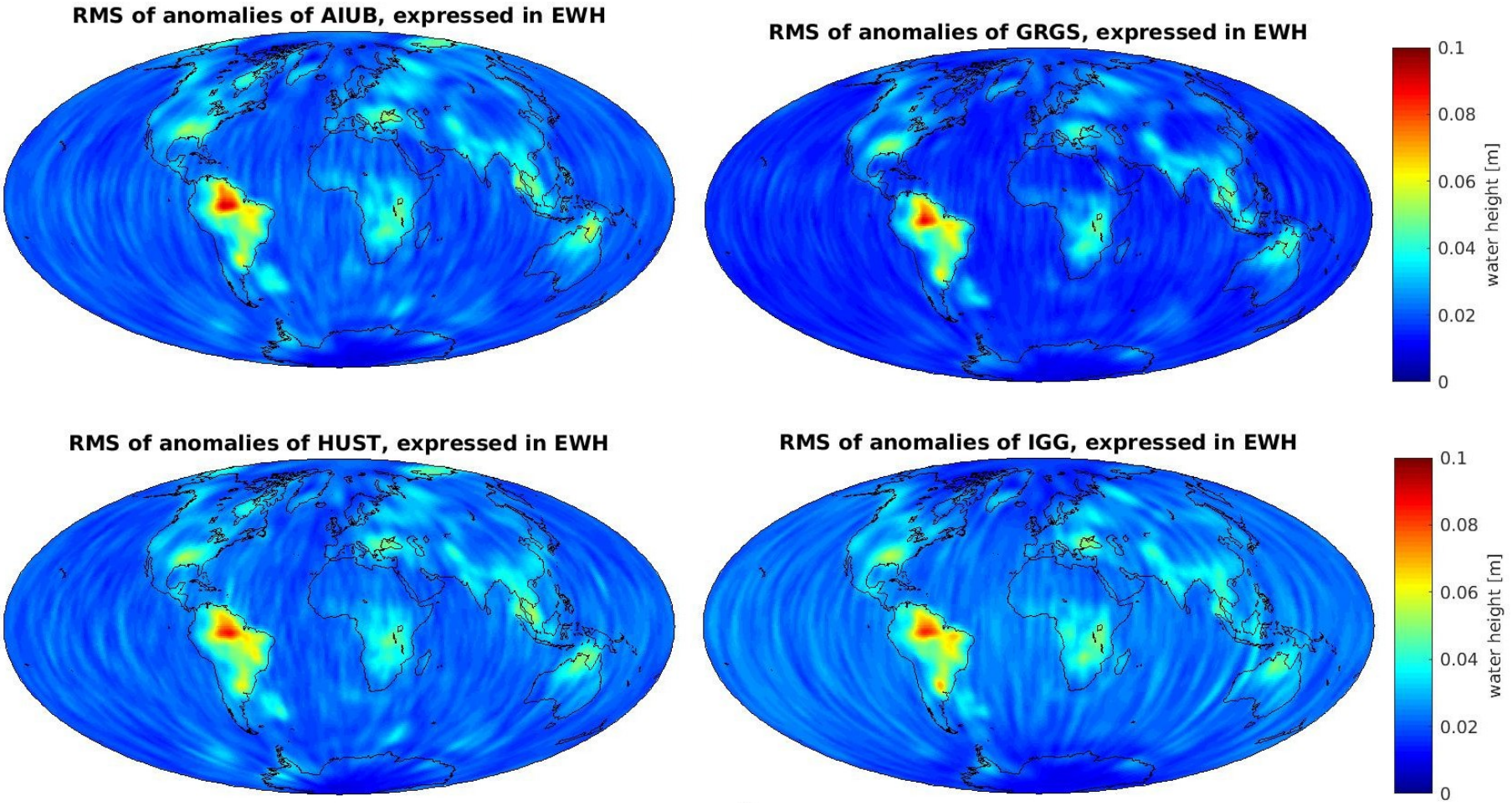
GRACE: Weighted combination and noise assessment (90)



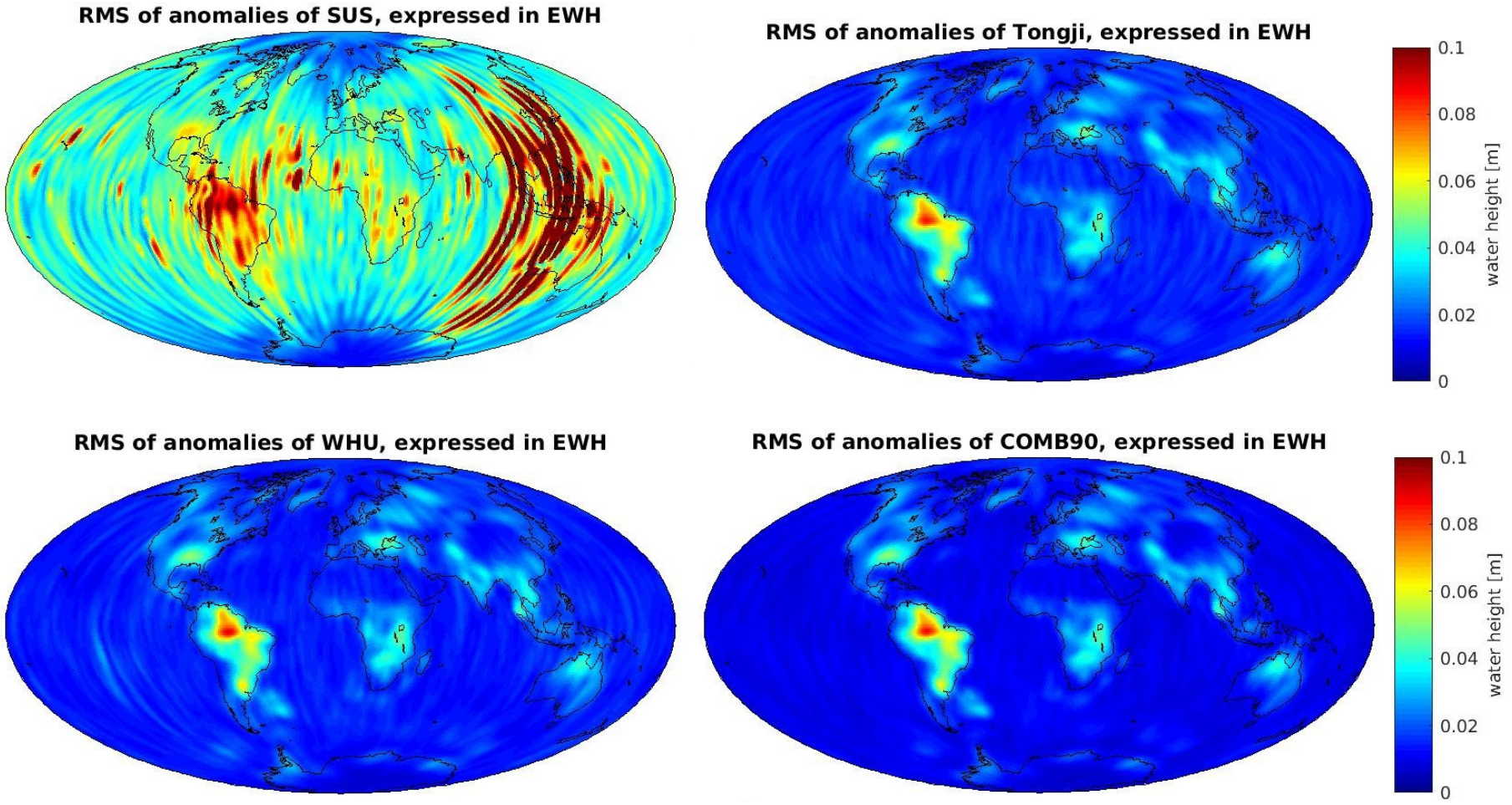
GRACE-FO: Noise assessment



GRACE-FO: Noise assessment



GRACE-FO: Noise assessment



Validation: GOCE orbit fit

- GRACE solutions up to d/o 90 filled up with GOCE-DIR-6 up to d/o 240:
- The table shows RMS of orbit fits (cm) for the different test cases (3D residuals. mean values from the 30 individual arcs in question)

Gravity model	Month			
	2009/11	2009/12	2010/10	2010/11
GFZ_RL06	**7.41**	**6.86**	**6.21**	**6.16**
AIUB_RL02	**8.71**	**8.56**	**7.39**	**7.21**
CSR_RL06	**6.89**	**9.10**	**6.65**	**6.20**
GRGS_RL04	**5.89**	**7.30**	**5.48**	**5.83**
ITSG_2018_tide_free	**5.53**	**5.13**	**4.19**	**4.54**
HUST-Grace2019	**7.93**	**7.92**	**6.98**	**7.59**
Tongji-Grace2018	**5.15**	**5.51**	**4.33**	**4.37**
WHU_RL02	**6.90**	**7.58**	**4.81**	**5.03**
COSTG_RL01	**5.03**	**5.54**	**4.52**	**4.72**
COSTG incl. Chinese	**5.08**	**5.33**	**4.37**	**4.55**

Best cases are highlighted

Original COSTG-RL01 for comparison

Summary and Outlook (Part 2)

- COST-G quality control confirms the high quality of the Chinese GRACE time-series.
- Chinese candidate ACs are currently updating their time-series with latest background models.
- Inclusion of Chinese candidate Analysis Centers is planned for next COST-G GRACE release.