

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

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



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INTRODUCTION

COST-G: Website



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Welcome to COST-G

The International **C**ombination **S**ervice for **T**ime-variable **G**ravity Fields (**COST-G**) is a product center of the International Gravity Field Service (IGFS) and is dedicated to the combination of monthly global gravity field models. COST-G stems from the activities of the former H2020 project European Gravity Service for Improved Emergency Management (EGSIEM).

Please use the top menu to visit the various parts of our website!

The service started its work in 2019 and the website is still under construction. More features will be available soon! We apologize for any inconvenience. For any questions, please contact us.

Best regards,
Your COST-G Team.

<https://cost-g.org/>

Latest News

January 11th 2021

COST-G is having its annual start of the year meeting from 11th to 15th of January!

November 23rd 2020

COST-G GRACE-FO monthly models are now available!



EGU 2021
G4.2 - Satellite Gravimetry

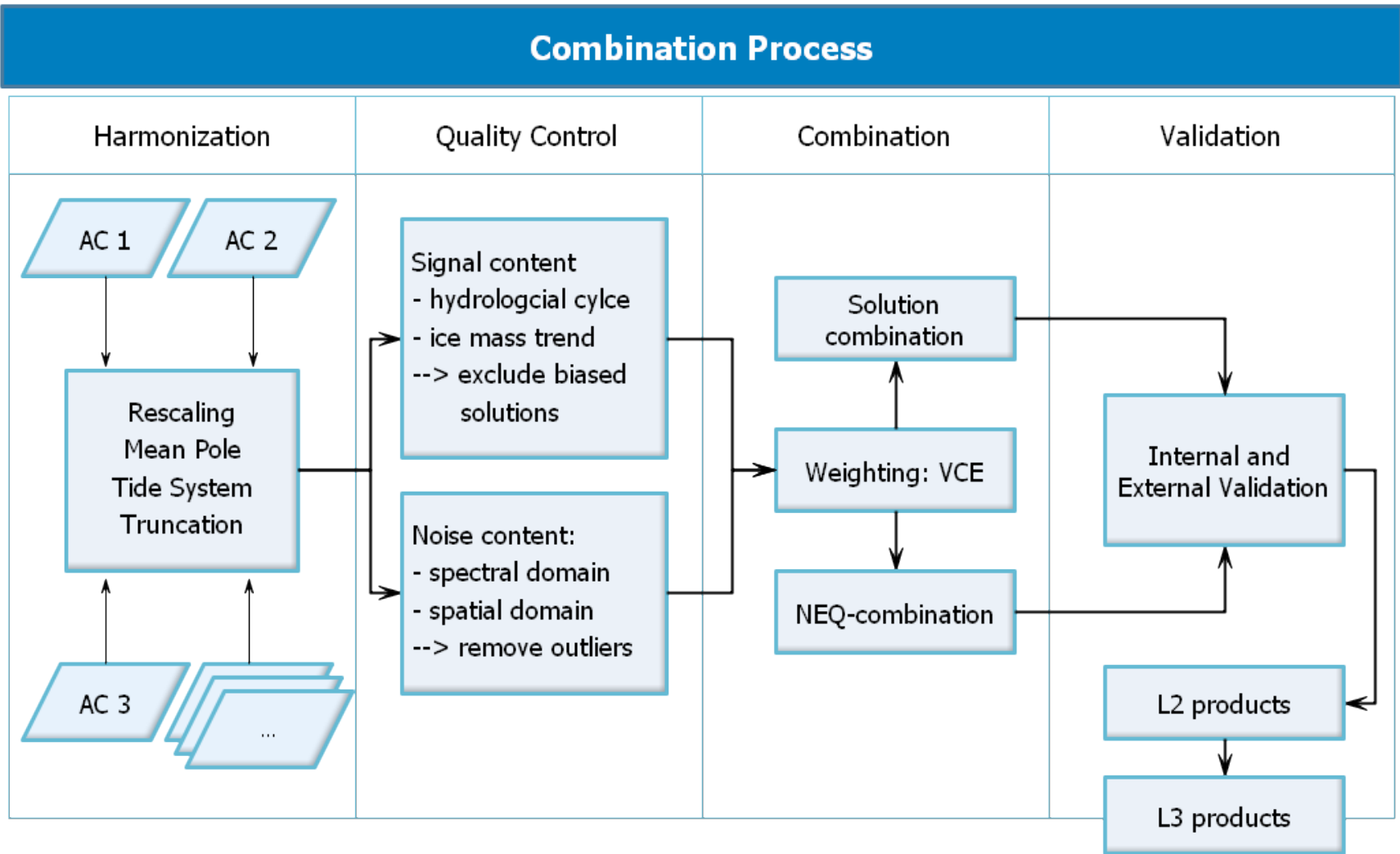
COST-G: Permanent Components

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

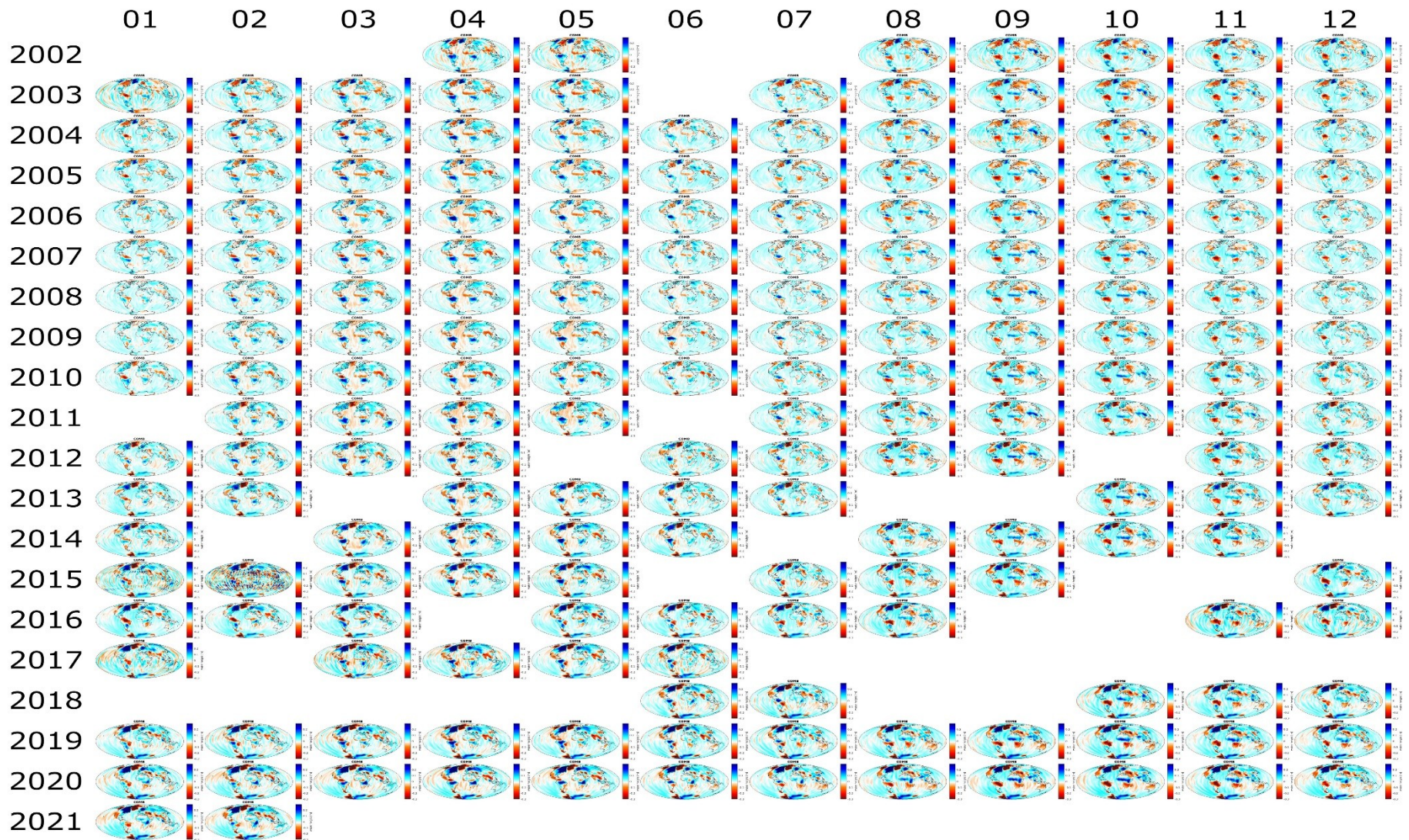
- **Central Bureau (CB) & Analysis Center Coordinator (ACC)**
 - AIUB
- **Analysis Centers (ACs)**
 - AIUB, CNES, GFZ, LUH, TUG
- **Level-3 Center (L3C)**
 - GFZ
- **Validation Centers (VCs)**
 - GRGS, GFZ
- **Product Evaluation Group (PEG)**
 - A. Eicker, A. Groh, B. Meyssignac
- **Partner ACs:** CSR,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



COST-G: Operations



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



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

IGEM

GFZ
Helmholtz Centre
POTSDAM

Gravity Field Solutions for dedicated Time Periods

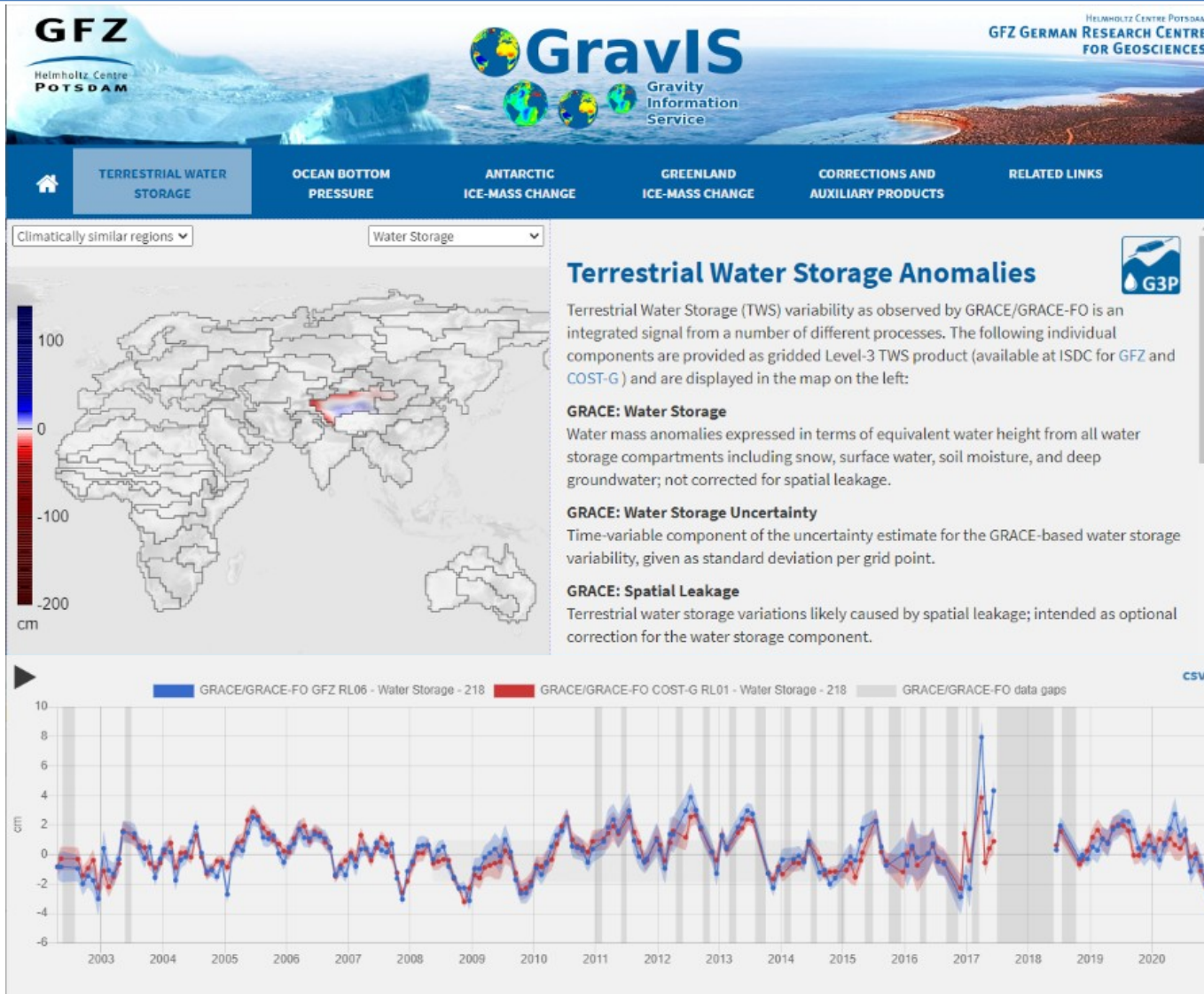
The following gravity field time series are presently available:

GRACE and Grace-FO solutions from the Science Data System centers CSR, GFZ and JPL				collapse all
- CSR	Center for Space Research at University of Texas, Austin			
- GFZ	Helmholtz Centre Potsdam German Research Centre for Geosciences			
GFZ Release 05	monthly	weekly	GFZ GRACE Level-2 Processing, Revised Edition, January 2013	
GFZ Release 06	DOI	monthly	GFZ GRACE Level-2 Processing Standards Document for Level-2 Products, Rev. 1.0, October 26, 2018	
GFZ Release 06 (GFO)	DOI	monthly	GFZ GRACE Level-2 Processing Standards Document for Level-2 Products, Rev. 1.0, June 3, 2019	
- JPL	Jet Propulsion Laboratory			

The processing standards to generate the GRACE Level-2 products of CSR, GFZ and JPL are also available in the Document Section of the GRACE archives at [GFZ ISDC](#) or [JPL PO.DAAC](#)

COST-G (International Combination Service for Time-variable Gravity Field)				collapse all
Grace	DOI	monthly		
Grace-FO	DOI	monthly		
Swarm	DOI	monthly		

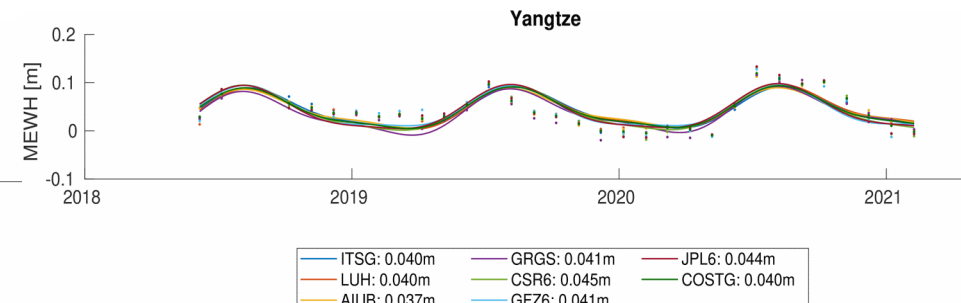
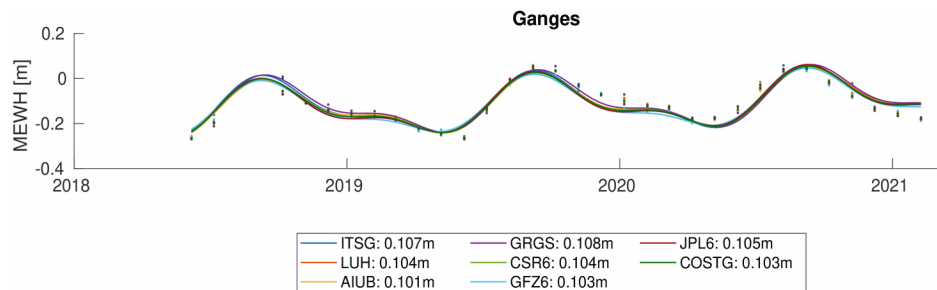
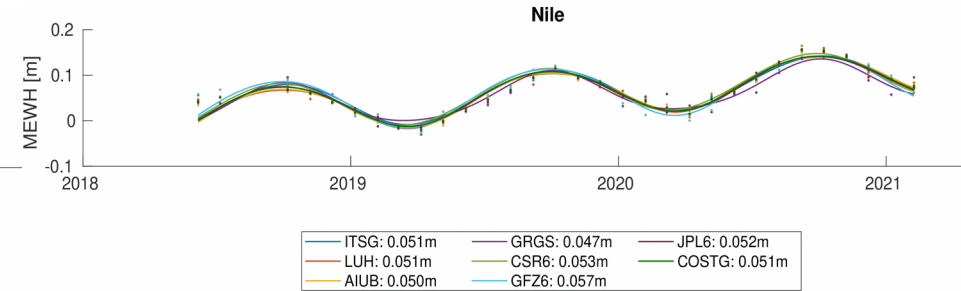
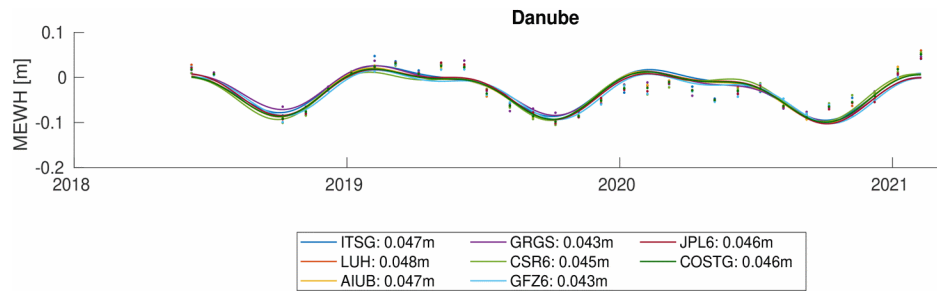
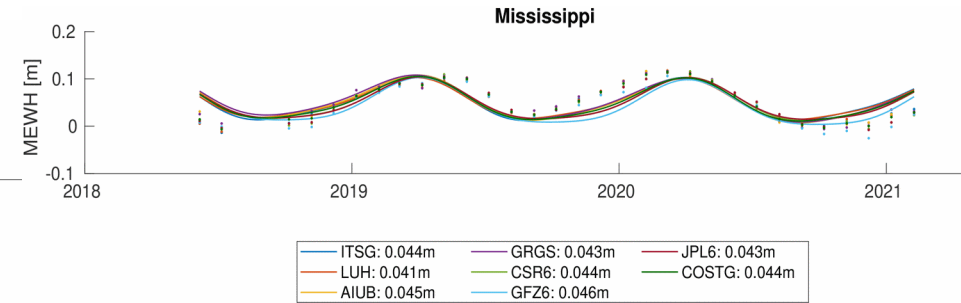
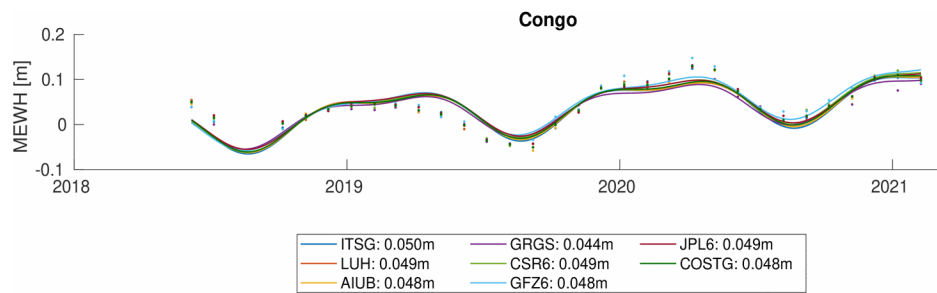
COST-G products: Level-3 (post-processed grids/time-series)



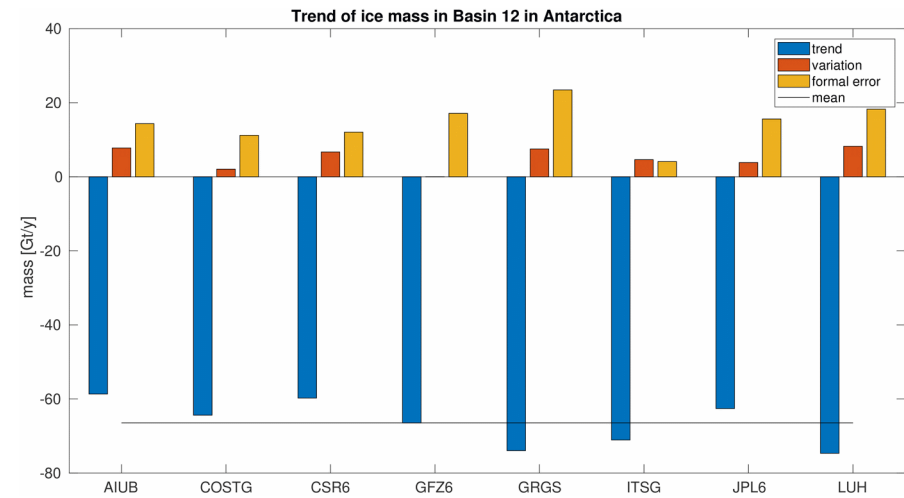
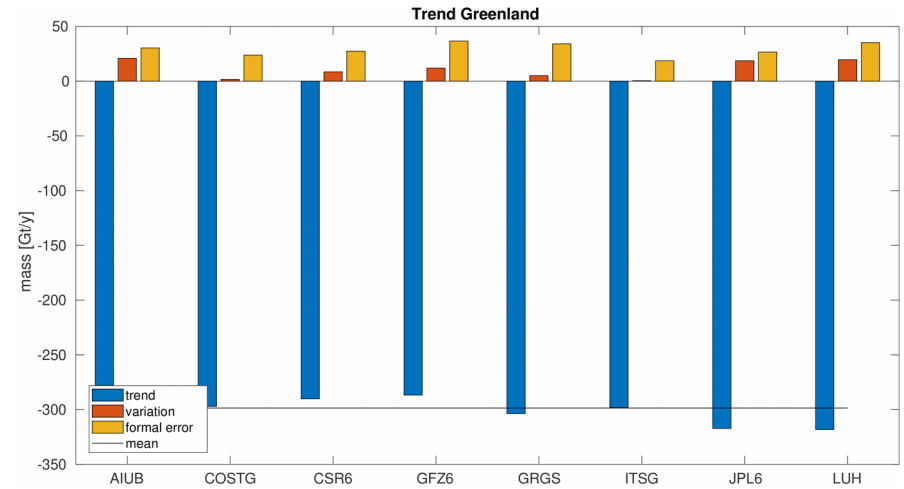
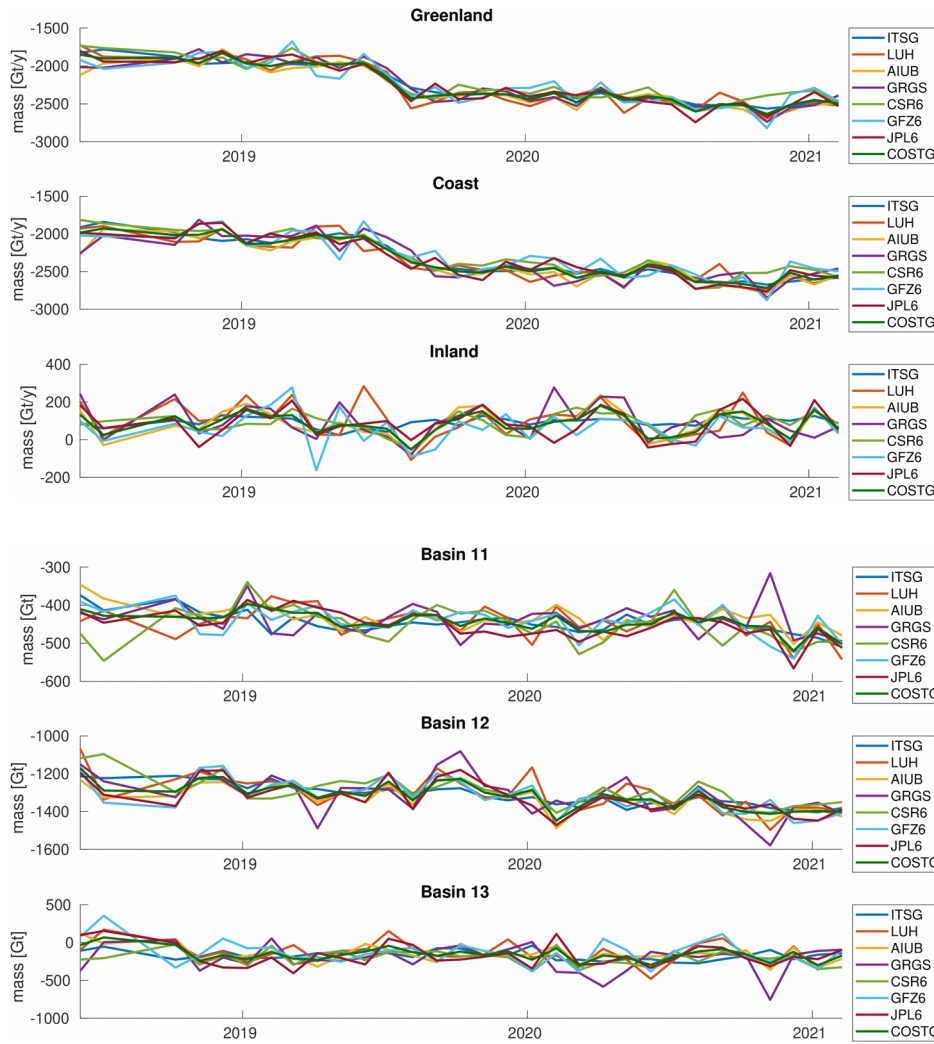
GRACE-FO: Operational combination



GRACE-FO: Assessment of hydrological signal content

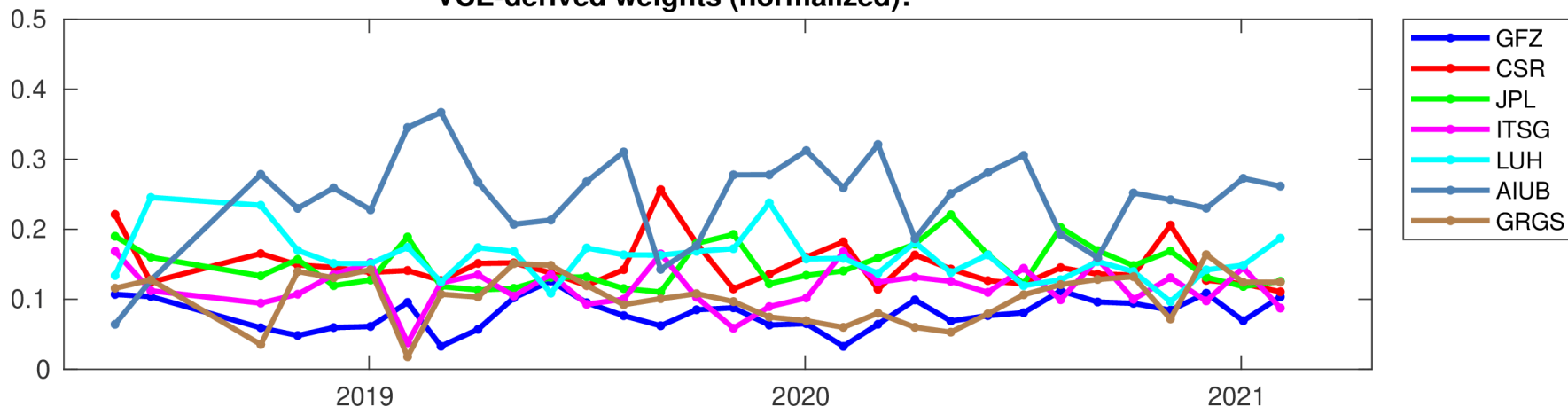


GRACE-FO: Assessment of polar mass change

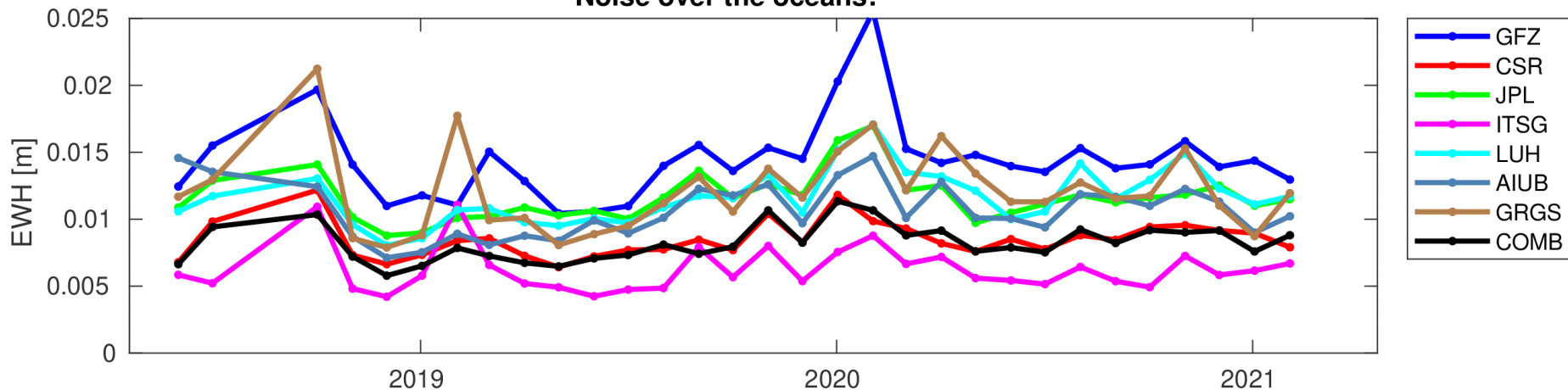


GRACE-FO: Weighted combination and noise assessment

VCE-derived weights (normalized):

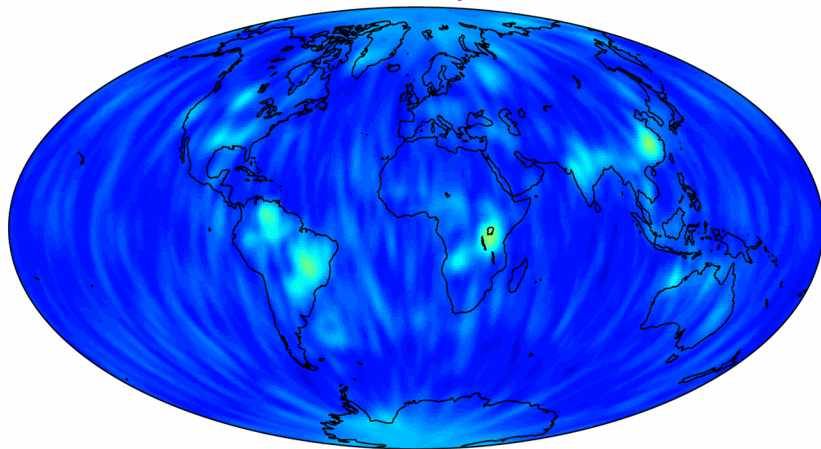


Noise over the oceans:

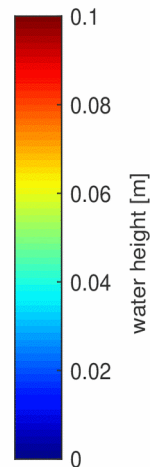
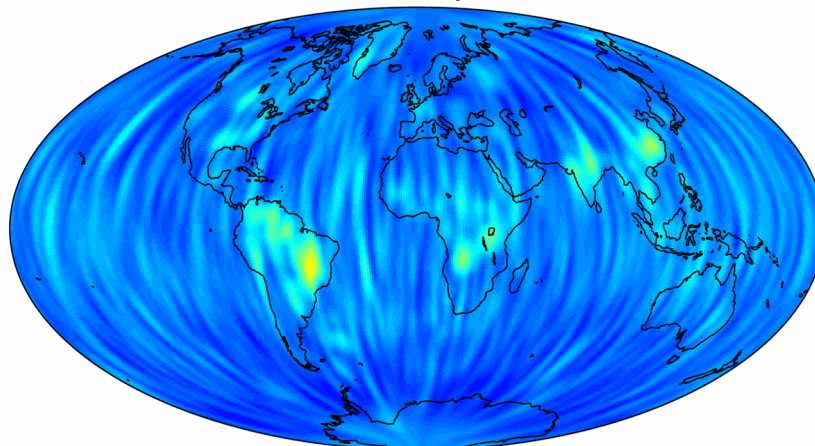


GRACE-FO: Noise assessment

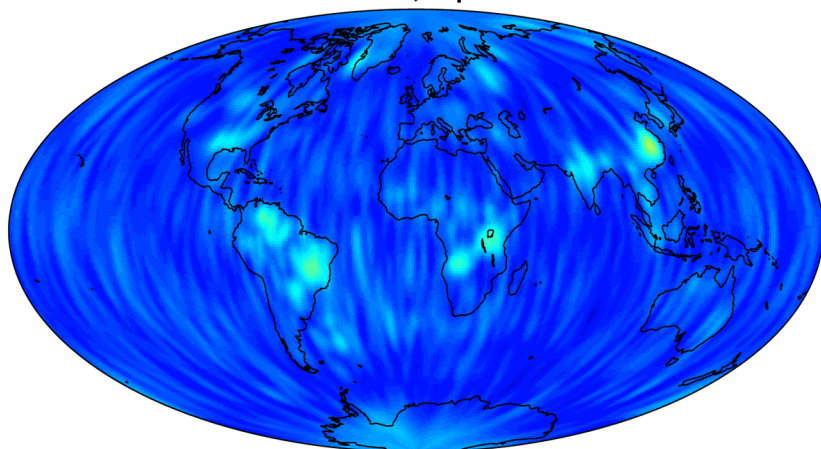
RMS of anomalies of CSR6, expressed in EWH



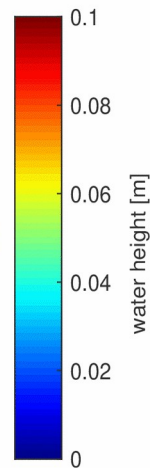
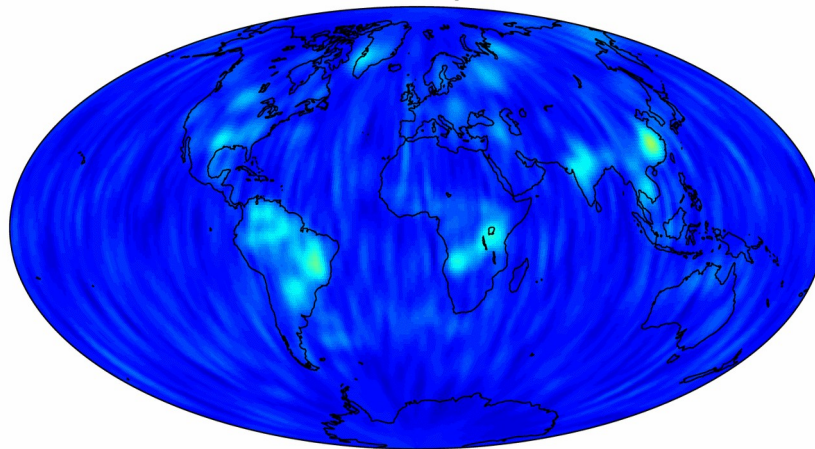
RMS of anomalies of GFZ6, expressed in EWH



RMS of anomalies of JPL6, expressed in EWH

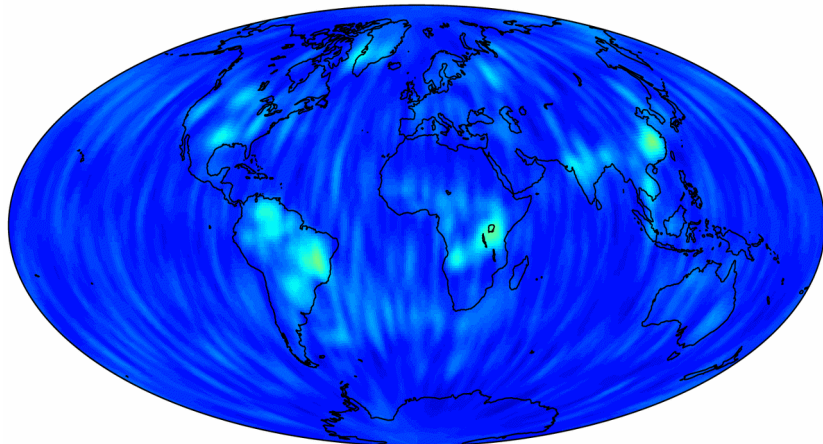


RMS of anomalies of ITSG, expressed in EWH

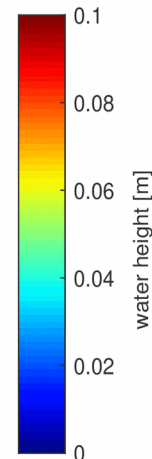
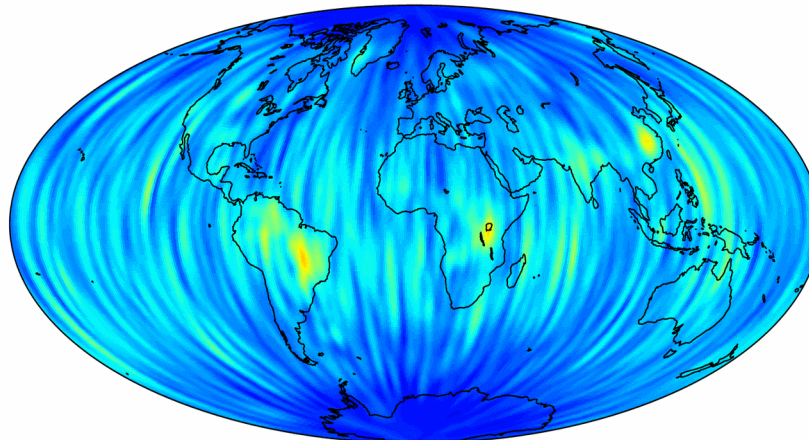


GRACE-FO: Noise assessment

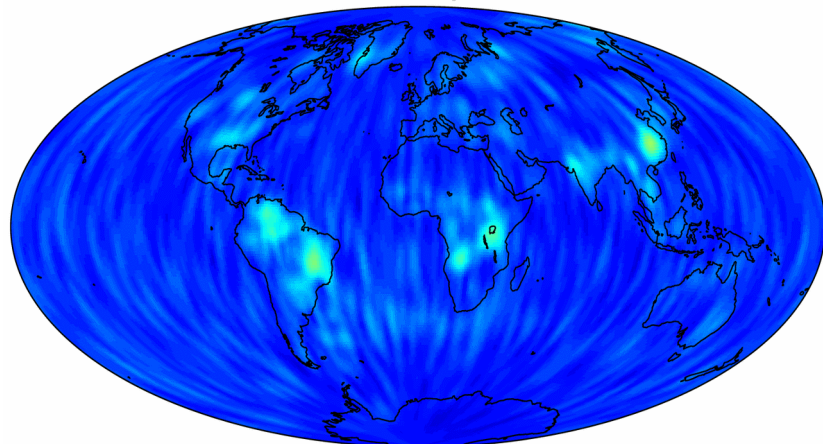
RMS of anomalies of AIUB, expressed in EWH



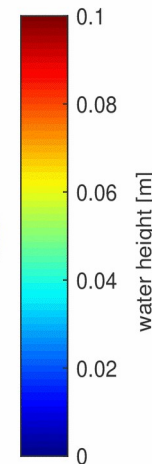
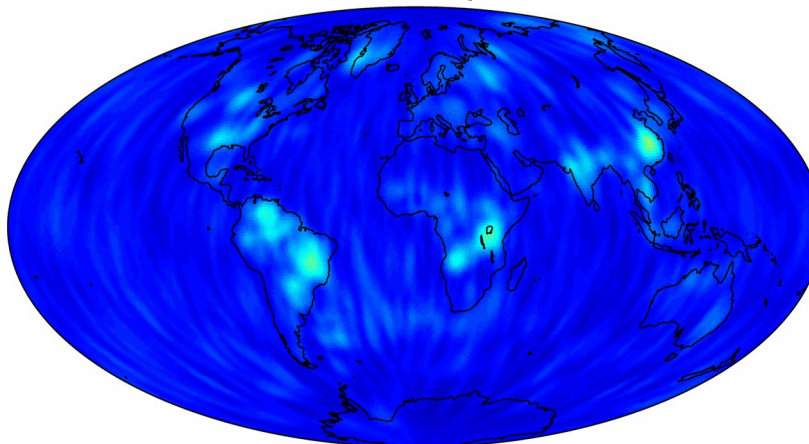
RMS of anomalies of GRGS, expressed in EWH



RMS of anomalies of LUH, expressed in EWH



RMS of anomalies of COSTG, expressed in EWH



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)

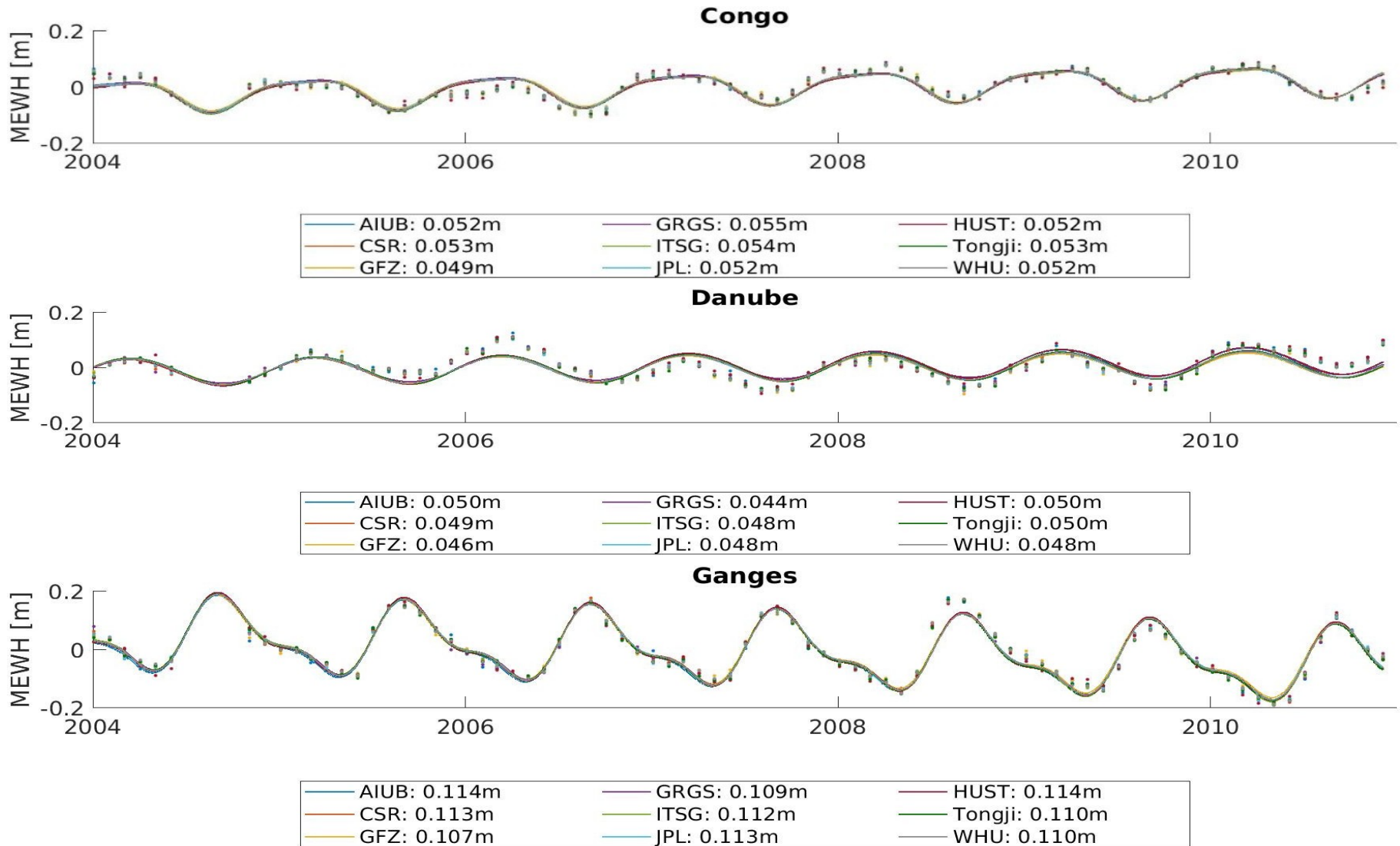
- **COST-G candidate ACs:**

- 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)

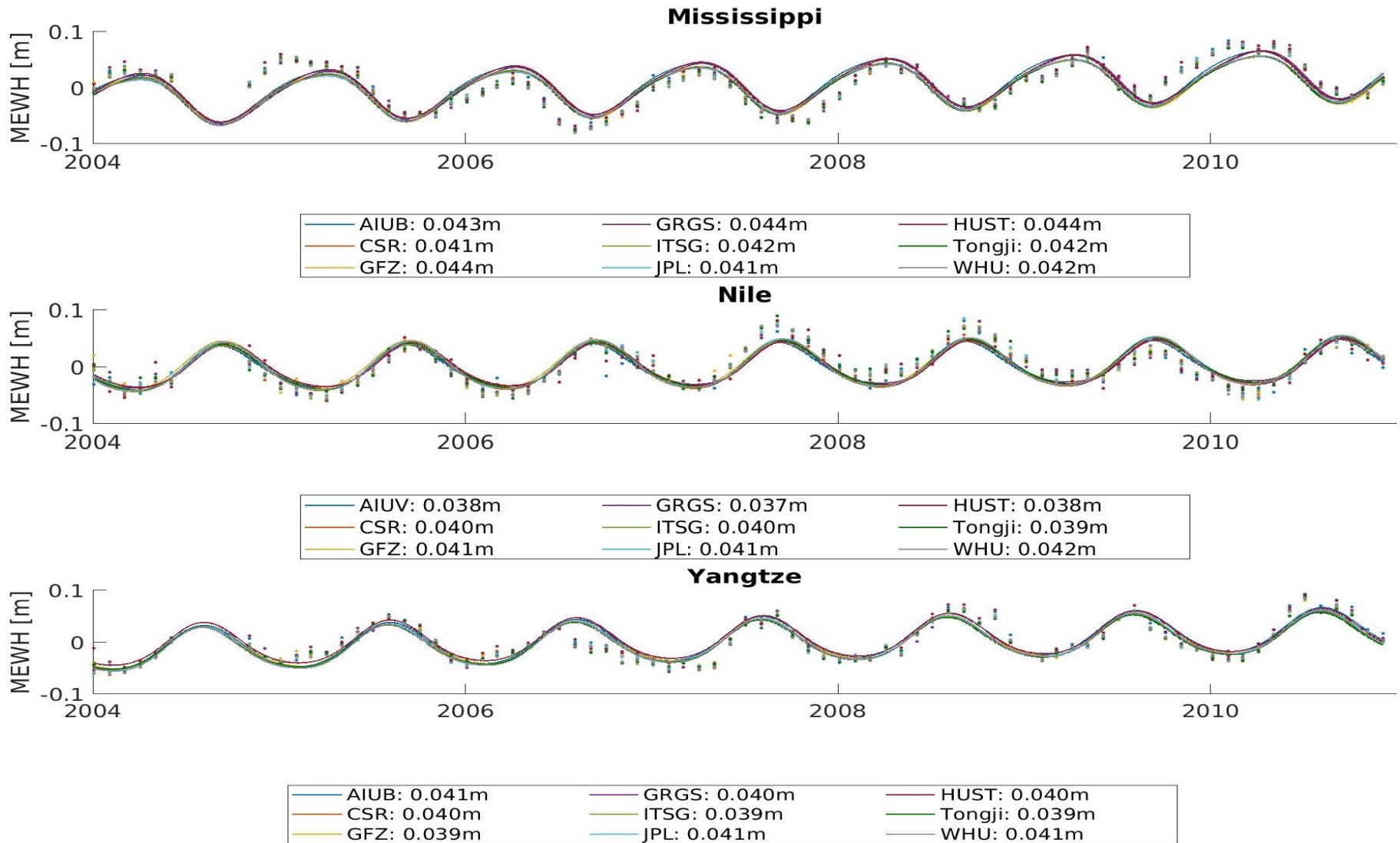
Signal validation and orbit fits are limited to the degree 90/96 time-series.



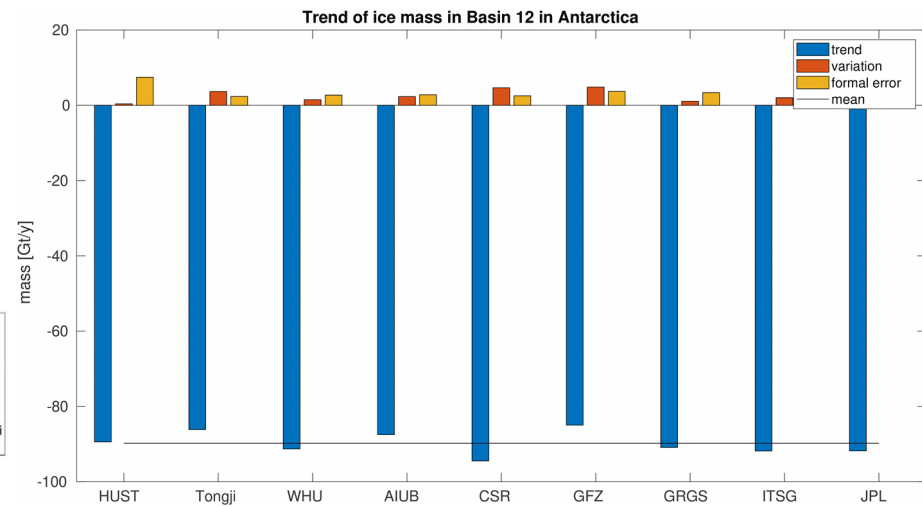
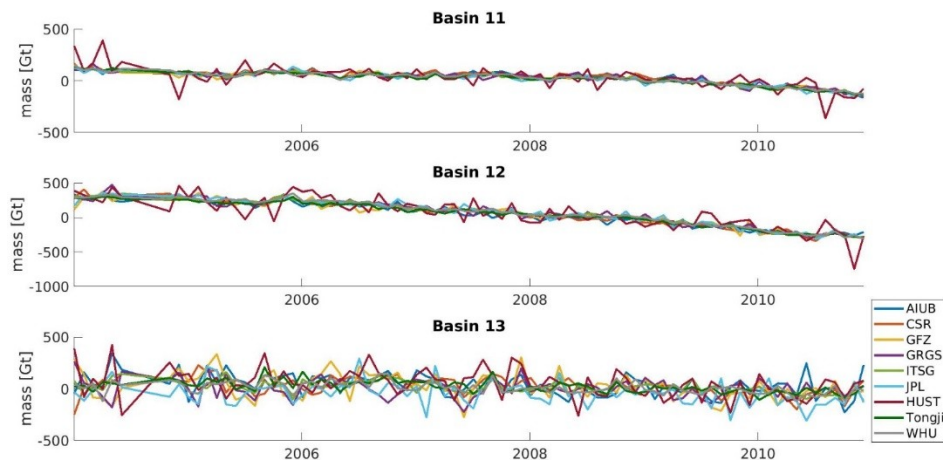
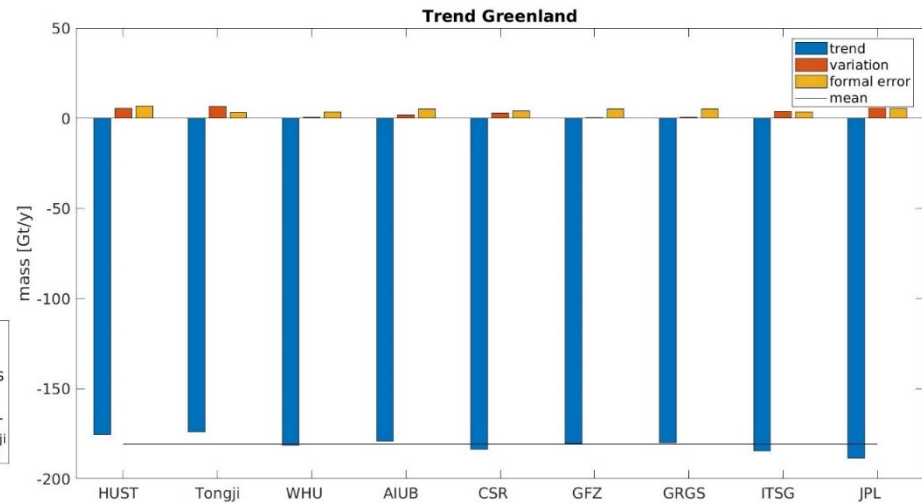
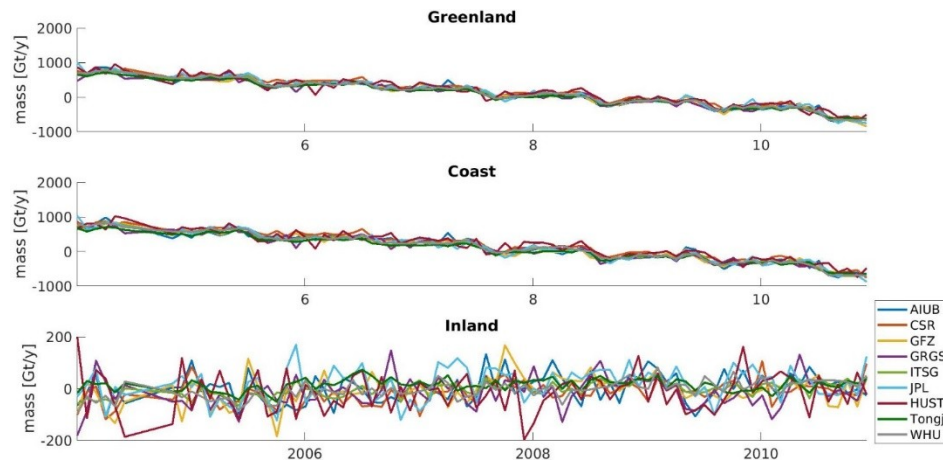
GRACE: Assessment of hydrological signal content (90)



GRACE: Assessment of hydrological signal content (90)

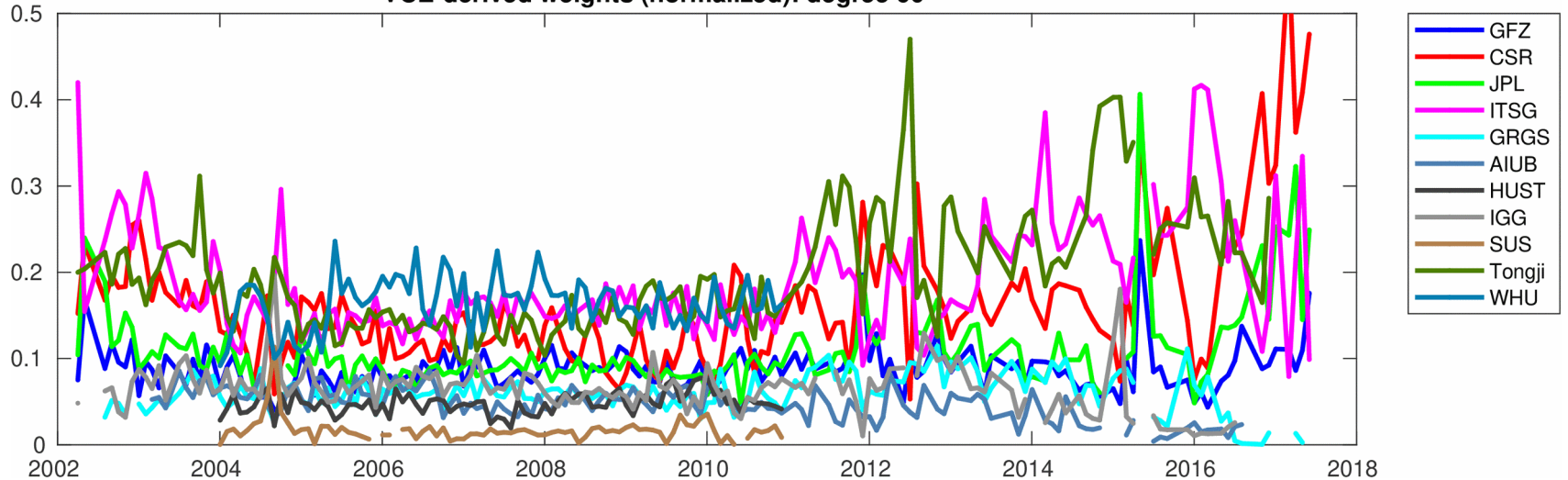


GRACE: Assessment of polar mass change (90)

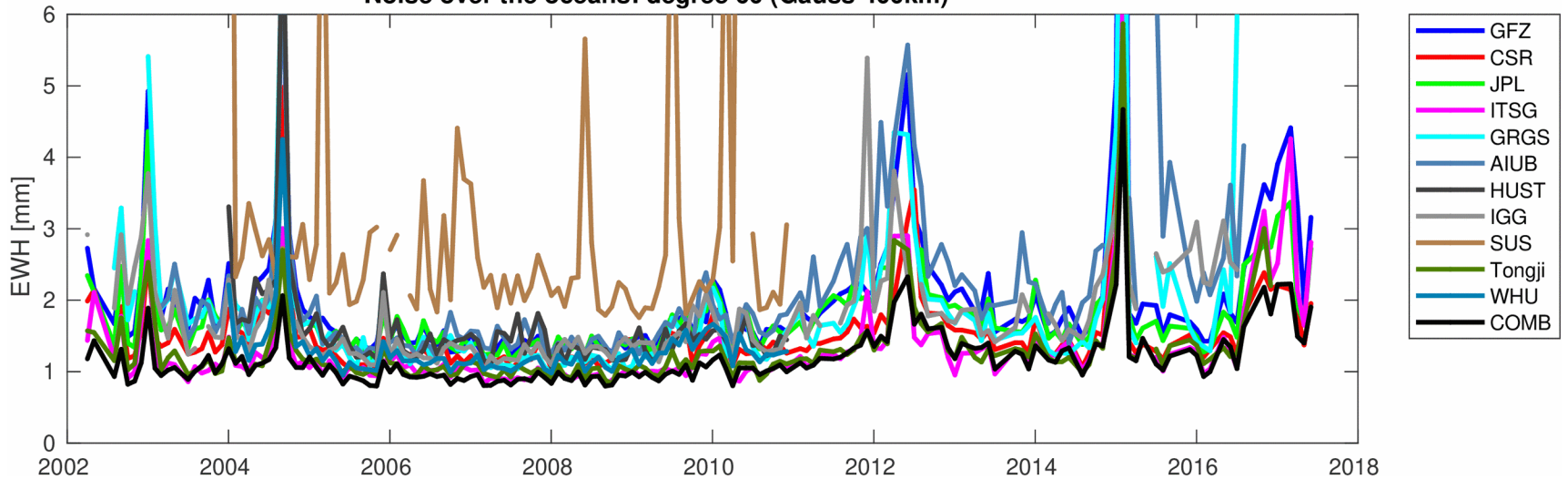


GRACE: Weighted combination and noise assessment (60)

VCE-derived weights (normalized): degree 60

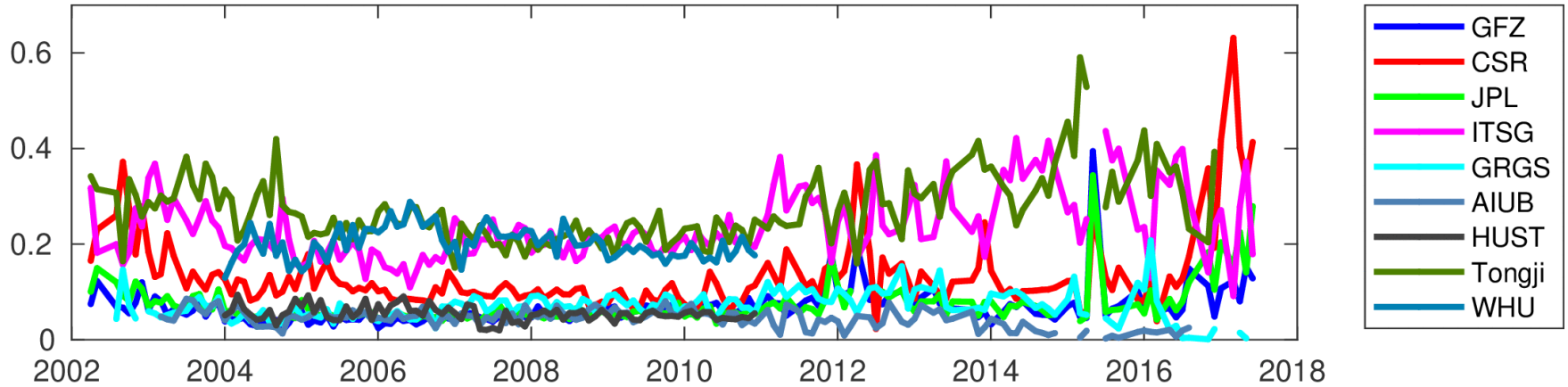


Noise over the oceans: degree 60 (Gauss 400km)

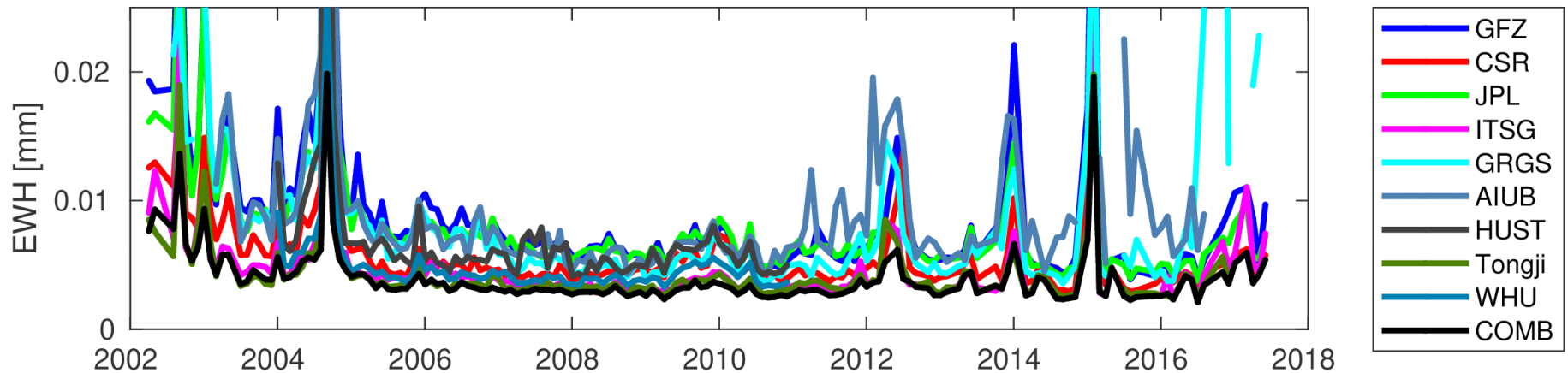


GRACE: Weighted combination and noise assessment (90)

VCE-derived weights (normalized): degree 90

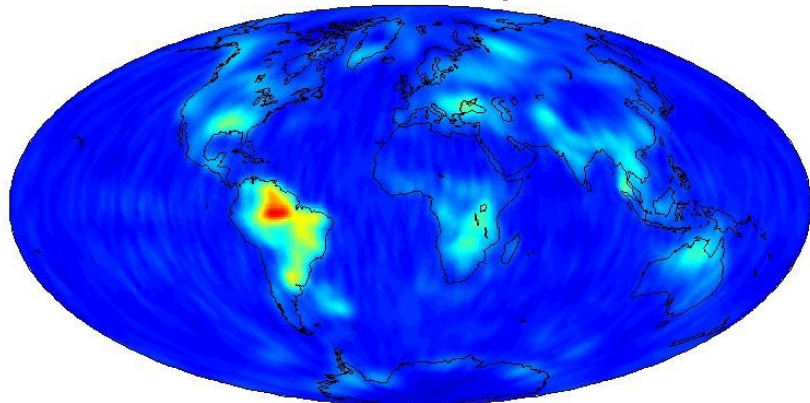


Noise over the oceans: degree 90 (Gauss 400km)

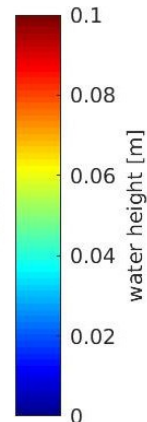
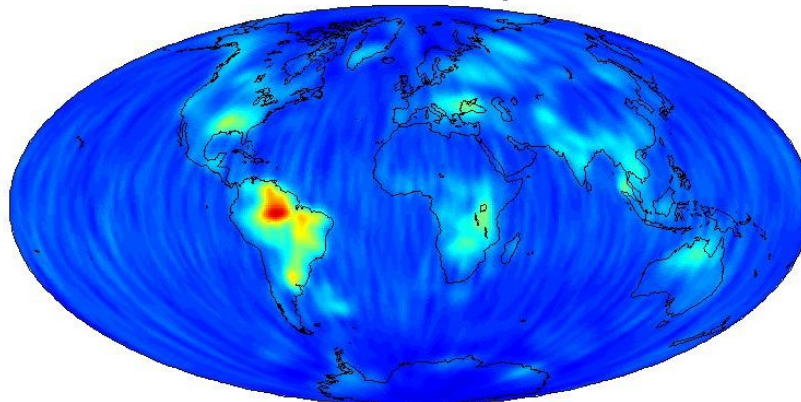


GRACE-FO: Noise assessment

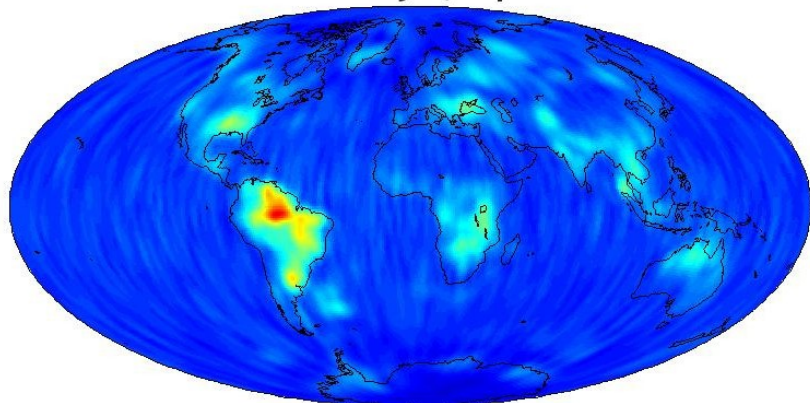
RMS of anomalies of CSR, expressed in EWH



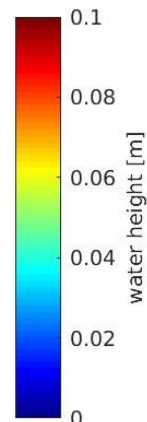
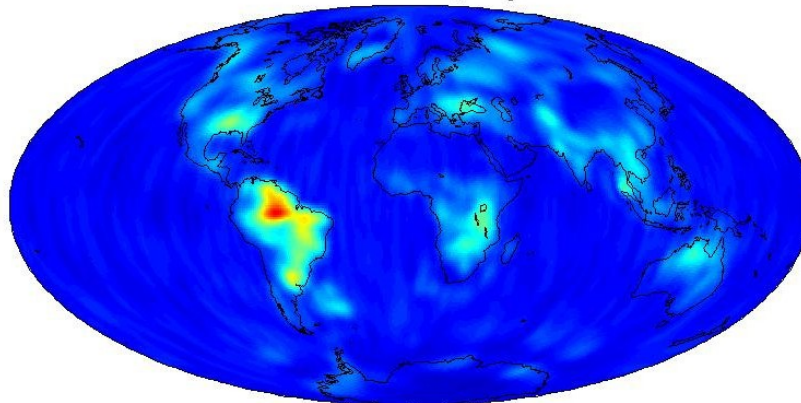
RMS of anomalies of GFZ, expressed in EWH



RMS of anomalies of JPL, expressed in EWH

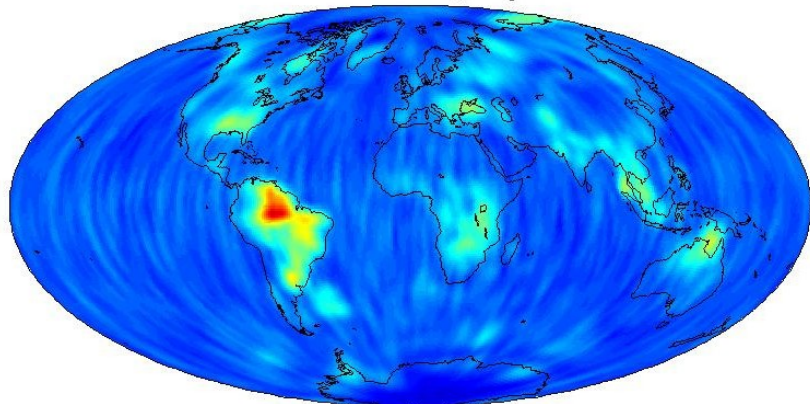


RMS of anomalies of ITSG, expressed in EWH

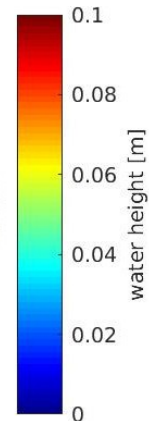
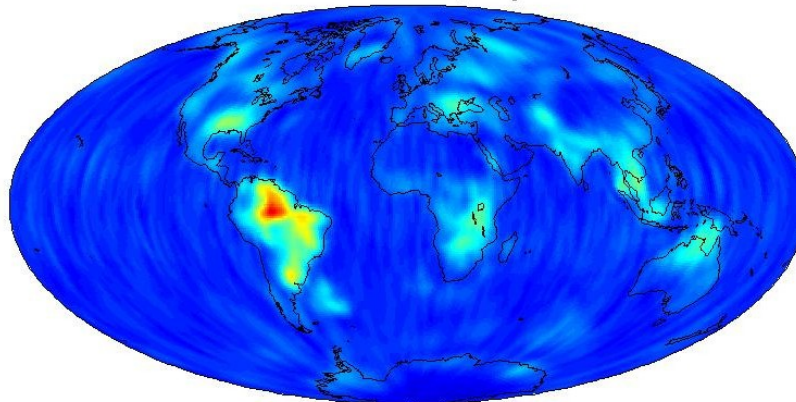


GRACE-FO: Noise assessment

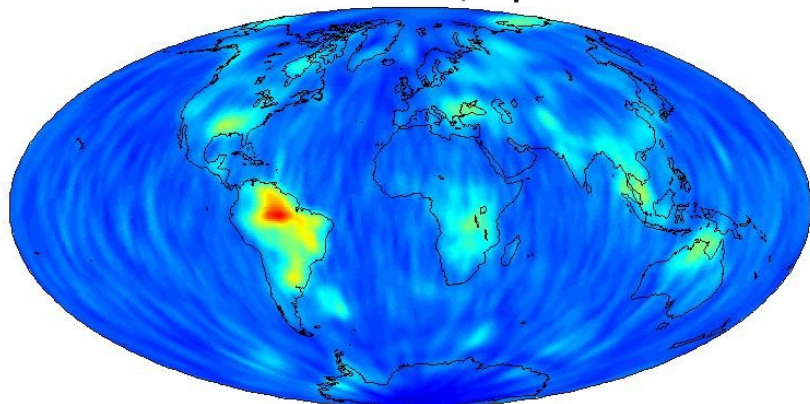
RMS of anomalies of AIUB, expressed in EWH



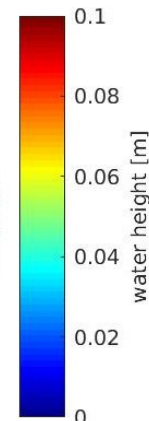
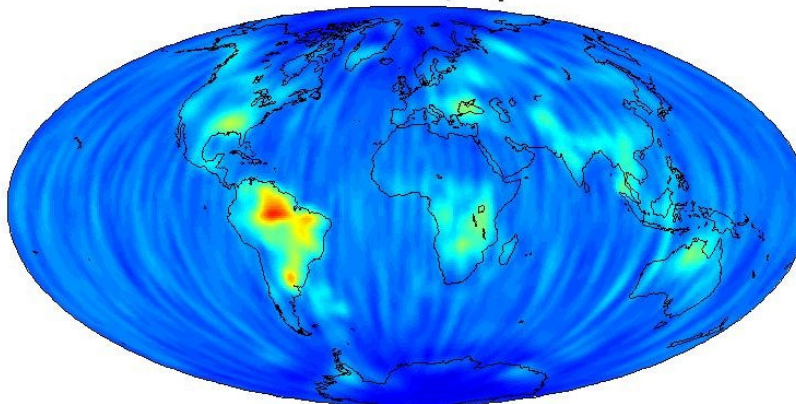
RMS of anomalies of GRGS, expressed in EWH



RMS of anomalies of HUST, expressed in EWH

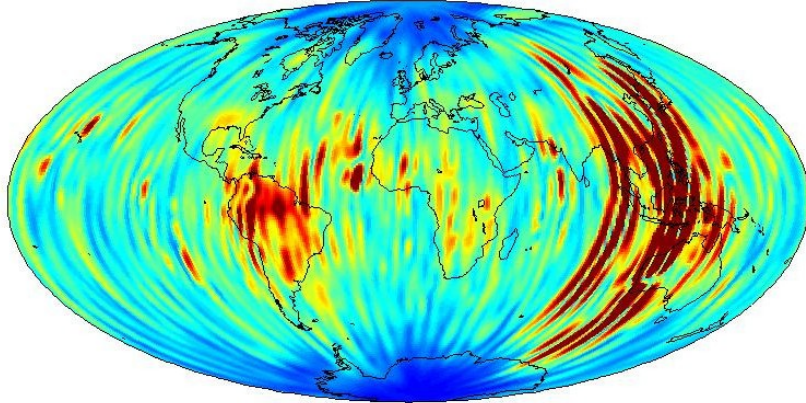


RMS of anomalies of IGG, expressed in EWH

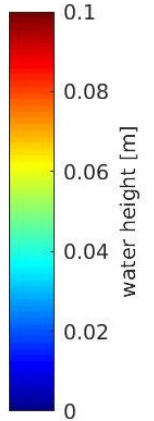
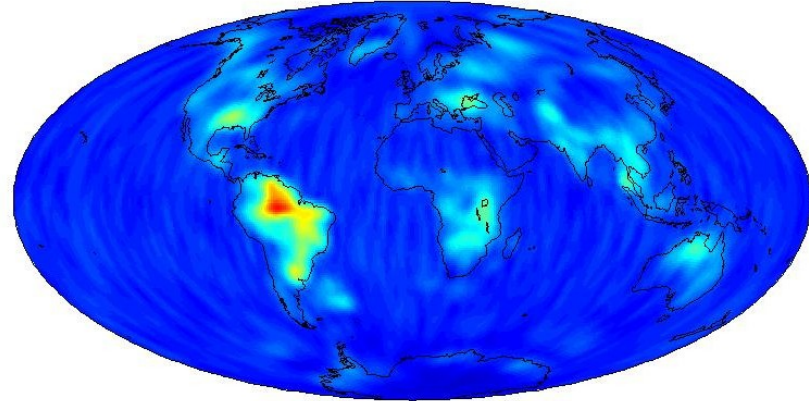


GRACE-FO: Noise assessment

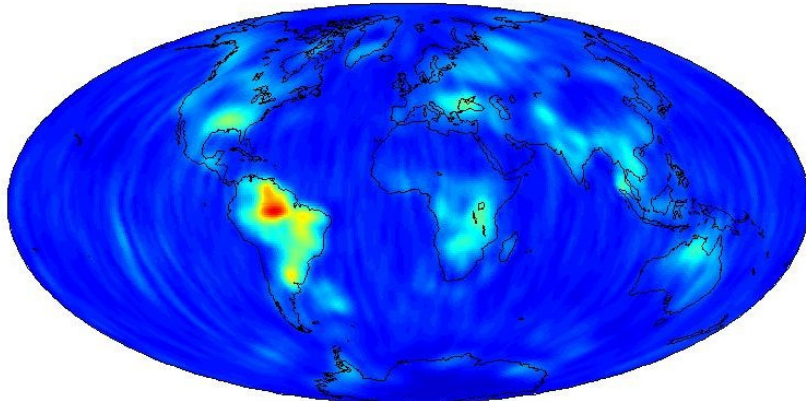
RMS of anomalies of SUS, expressed in EWH



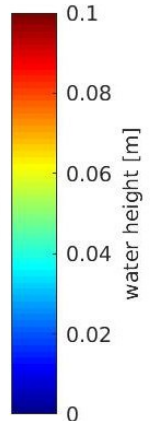
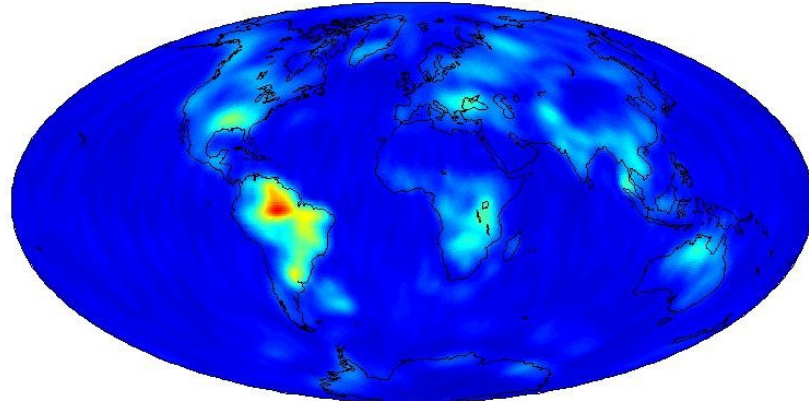
RMS of anomalies of Tongji, expressed in EWH



RMS of anomalies of WHU, expressed in EWH



RMS of anomalies of COMB90, expressed in EWH



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.**