COST-G

Combination Service for Time-variable Gravity Models

Products of the Combination Service for Time-variable Gravity fields for GNSS POD

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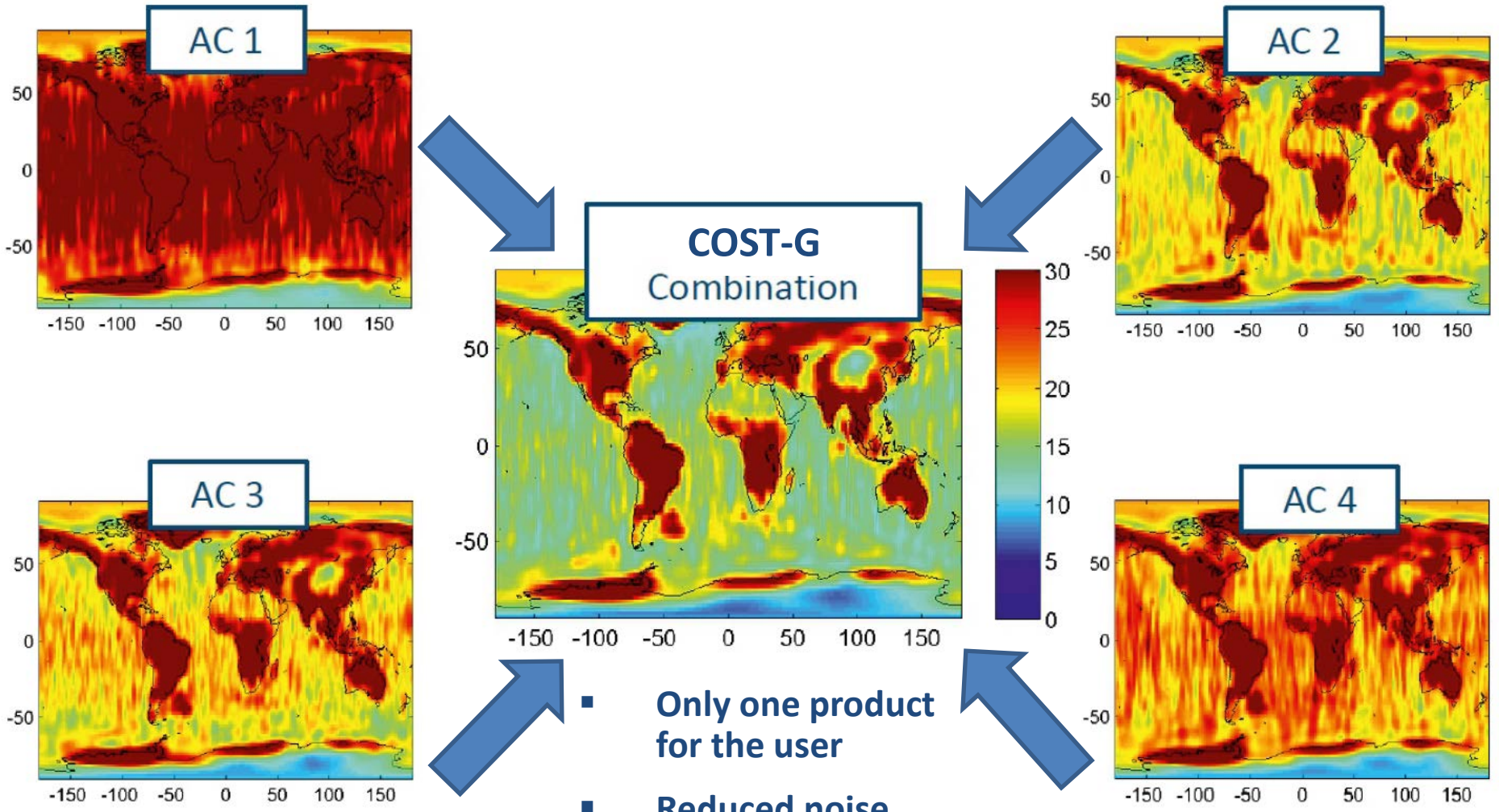
Session 5: GNSS-Enabled Applications

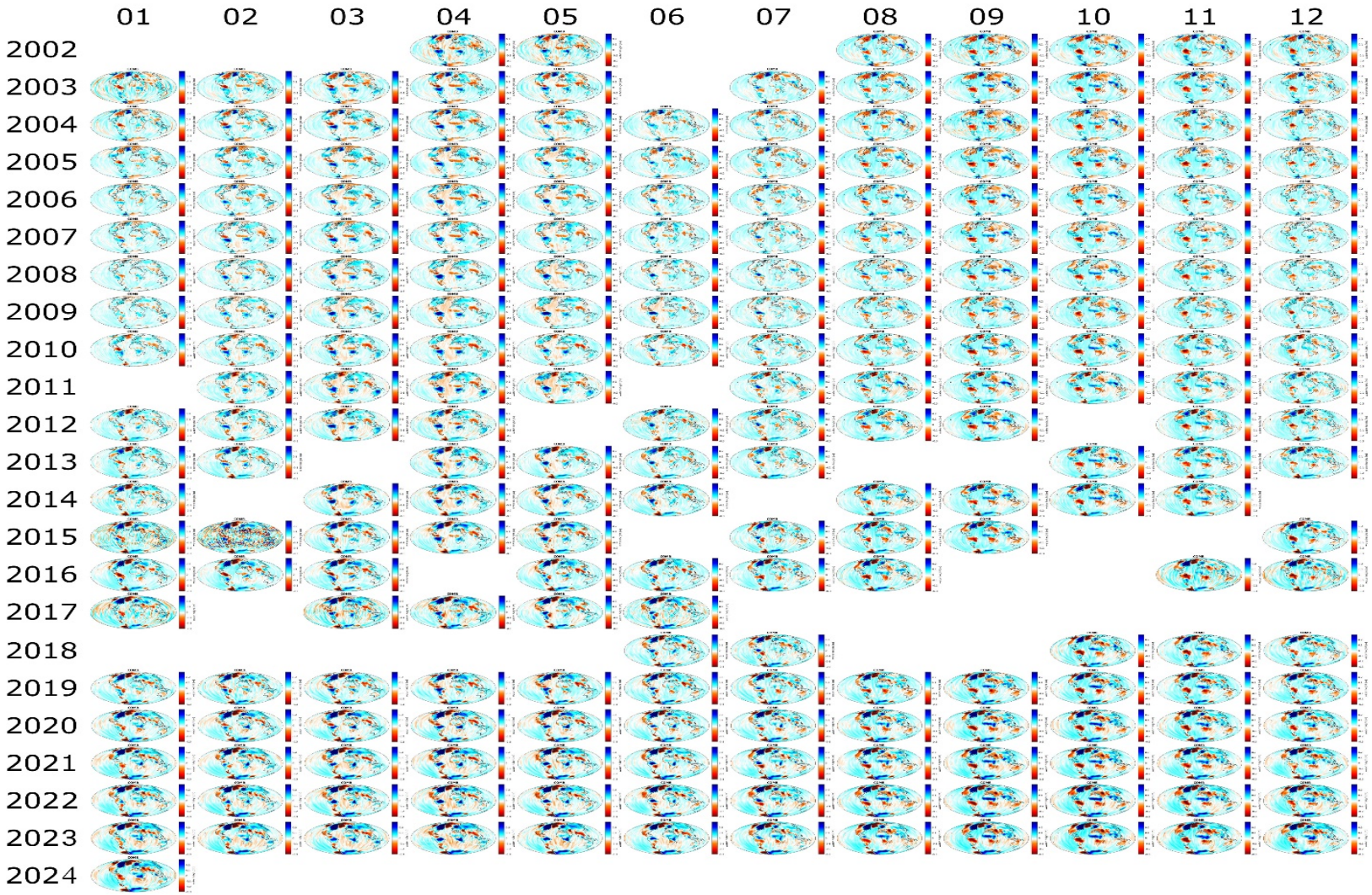
UNIVERSITÄT BERN

COST-G concept

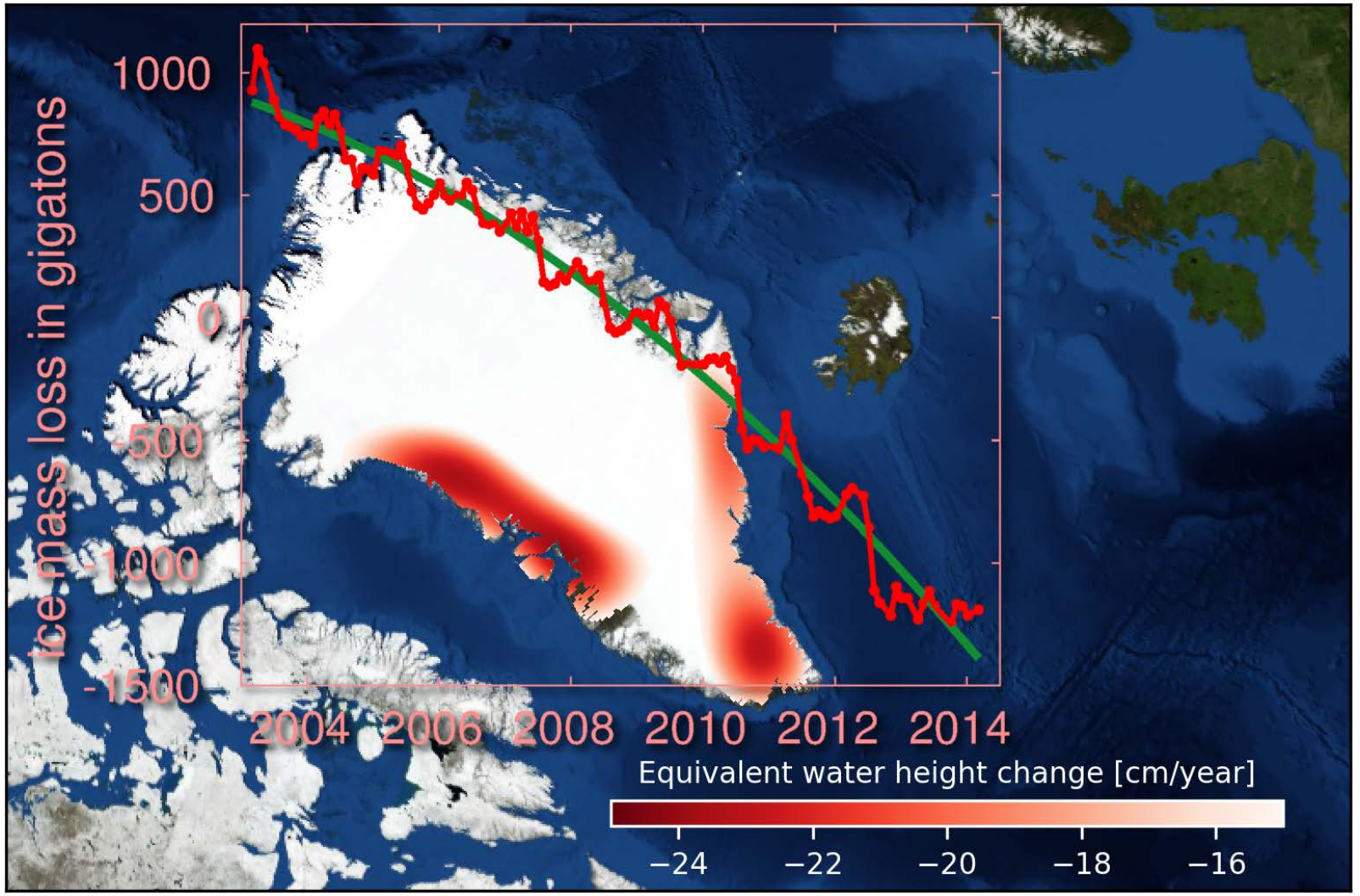


- **Only one product for the user**
- **Reduced noise**

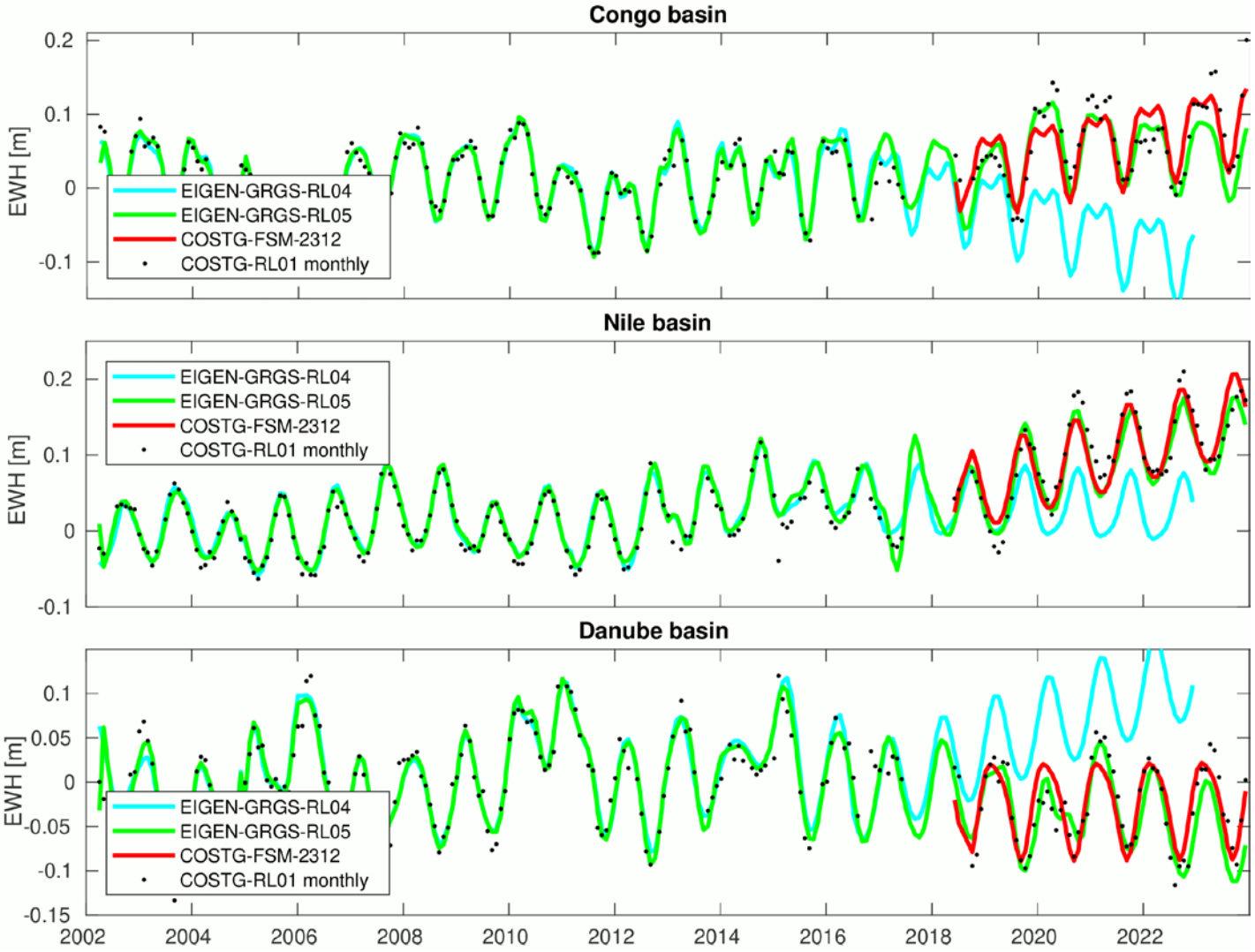
COST-G Products: monthly GRACE/GRACE-FO gravity field combinations



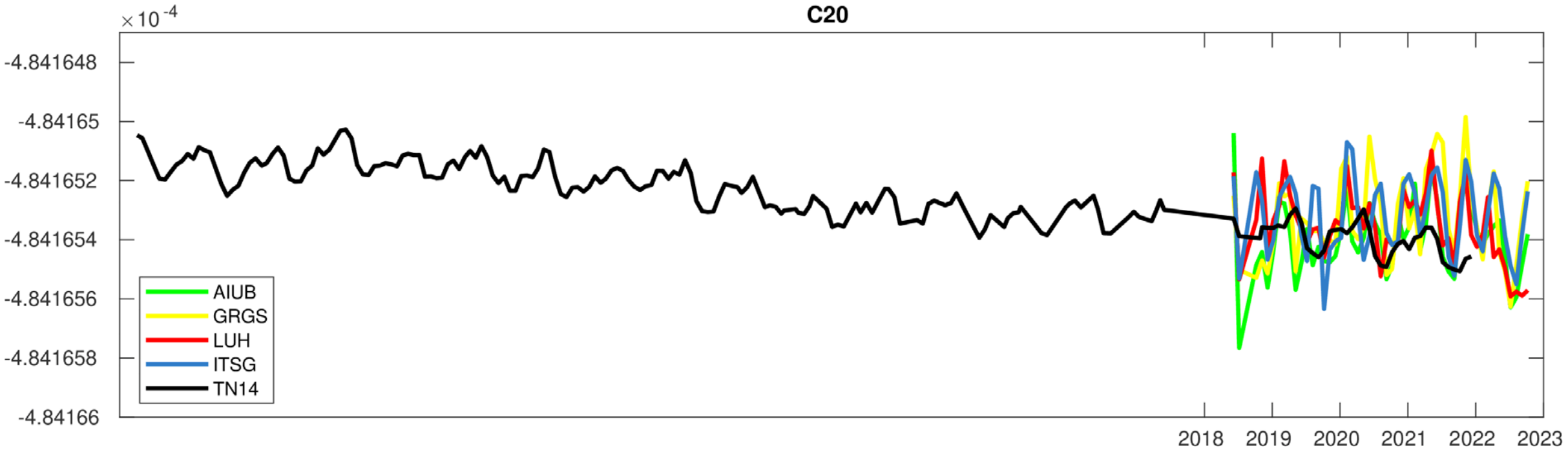
Temporal gravity variations



Fitted Signal Model: prediction of temporal variations



GRACE-FO C_{20} is corrupted -> replacement by SLR



Validation: LEO orbit fit

3D-RMS values [cm] of the orbit fit residuals (mean values from all involved arcs)
Parametrization: 6 orbital elements, accelerometer biases 1/arc (3 directions)

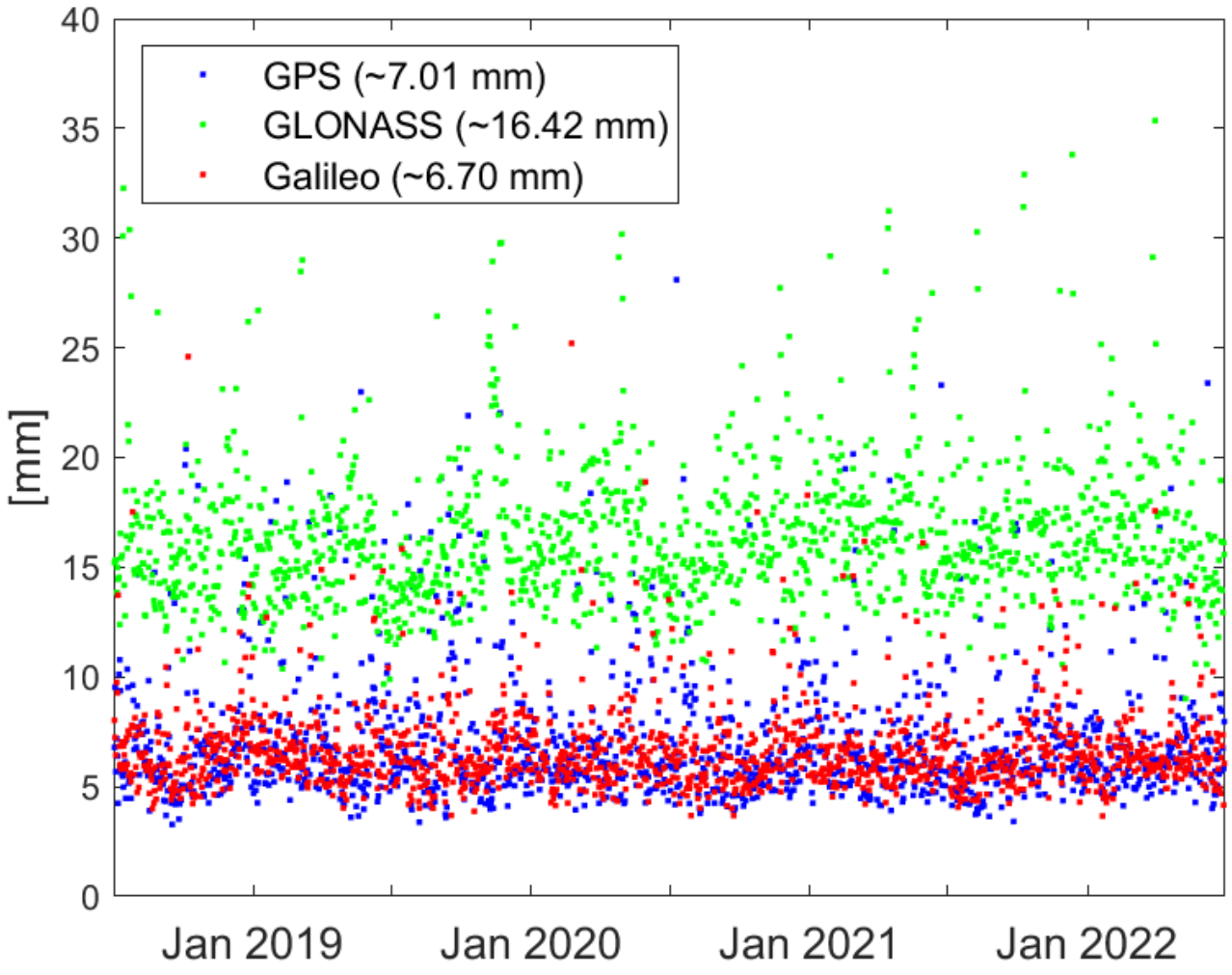
	March			April			June			December		
Model/Month	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
COST-G FSM	5,53	5,77	6,30	5,37	5,72	6,39	5,39	5,86	6,63	5,48	6,05	7,78
COST-G monthly	6,42	7,10	7,27	6,36	7,06	7,84	6,40	7,36	7,62	6,94	7,51	7,57

- COST-G fitted signal models (FSM), augmented by high-degree coefficients from a static field (GOCO06S), show significant improvement w.r.t. the monthly models of COST-G in almost all cases!
- The cause is most probably a reduction of noise in the high-d/o gravity field coefficients by the model fit (model error < noise reduction).

Setup of GNSS orbit validation

- solutions containing GPS, GLONASS and Galileo
- 4 years: 01.07.2018 - 30.06.2022
- background models and parameterization in agreement with the ITRF20 and CODE processing standards:
  - three-day arcs
  - ECOM2 (empirical force model) + orbit midnight pulses
  - DESAI2016 subdaily pole
- REF solution: EGM2008 + C_{20}, C_{30}, C_{40} bias and drift; C_{21}, S_{21} according to linear mean pole model
- COSTG: fitted signal model (FSM)

Orbit overlaps (midnight misclosures): REF

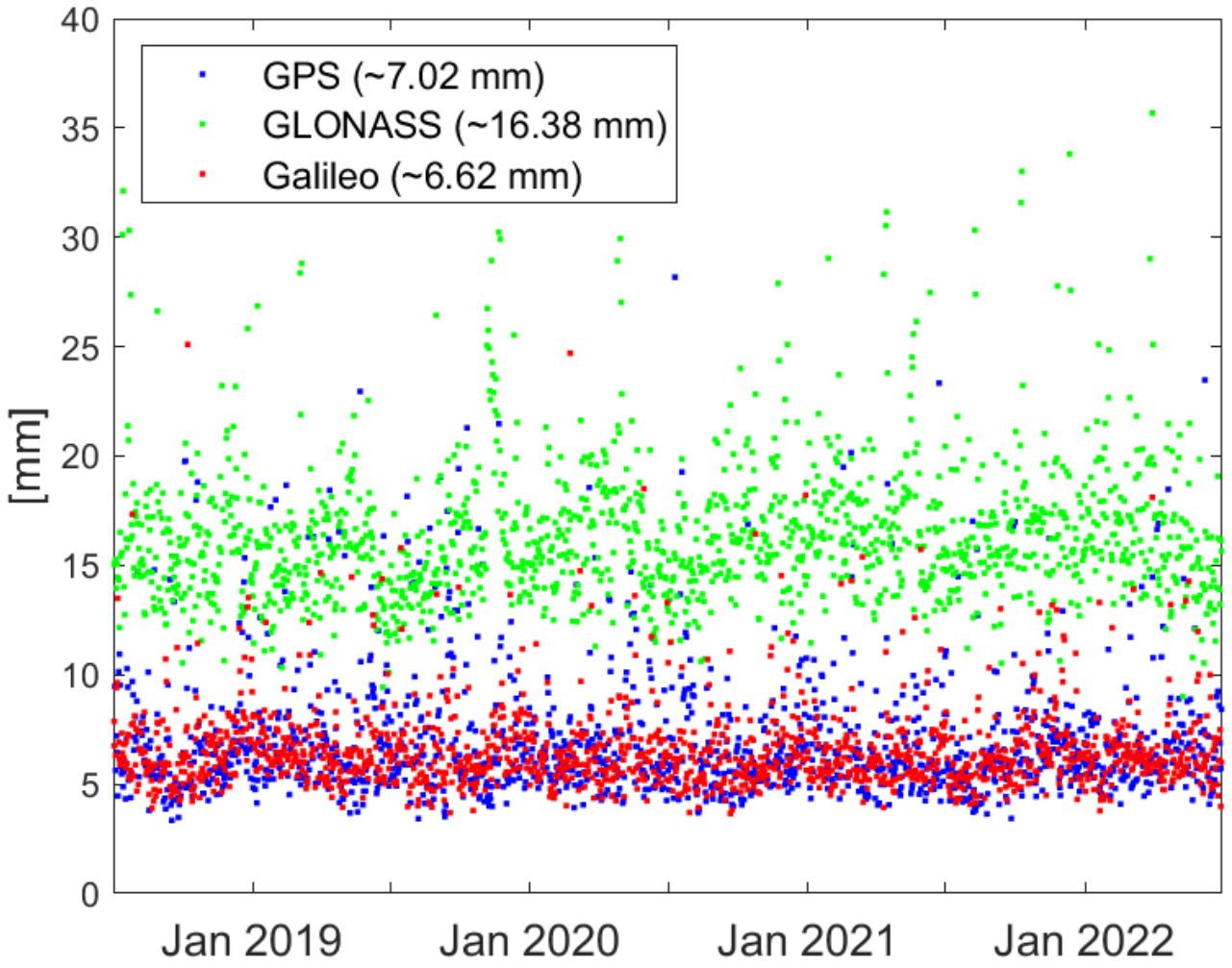


From subsequent 3 day arcs the middle days are extracted which overlap at exactly one epoch :

- end of first orbit at midnight
- = start of second orbit

The averaged midnight misclosures per satellite system are provided in the legend.

Orbit overlaps (midnight misclosures): COSTG



From subsequent 3 day arcs the middle days are extracted which overlap at exactly one epoch :

end of first orbit at midnight

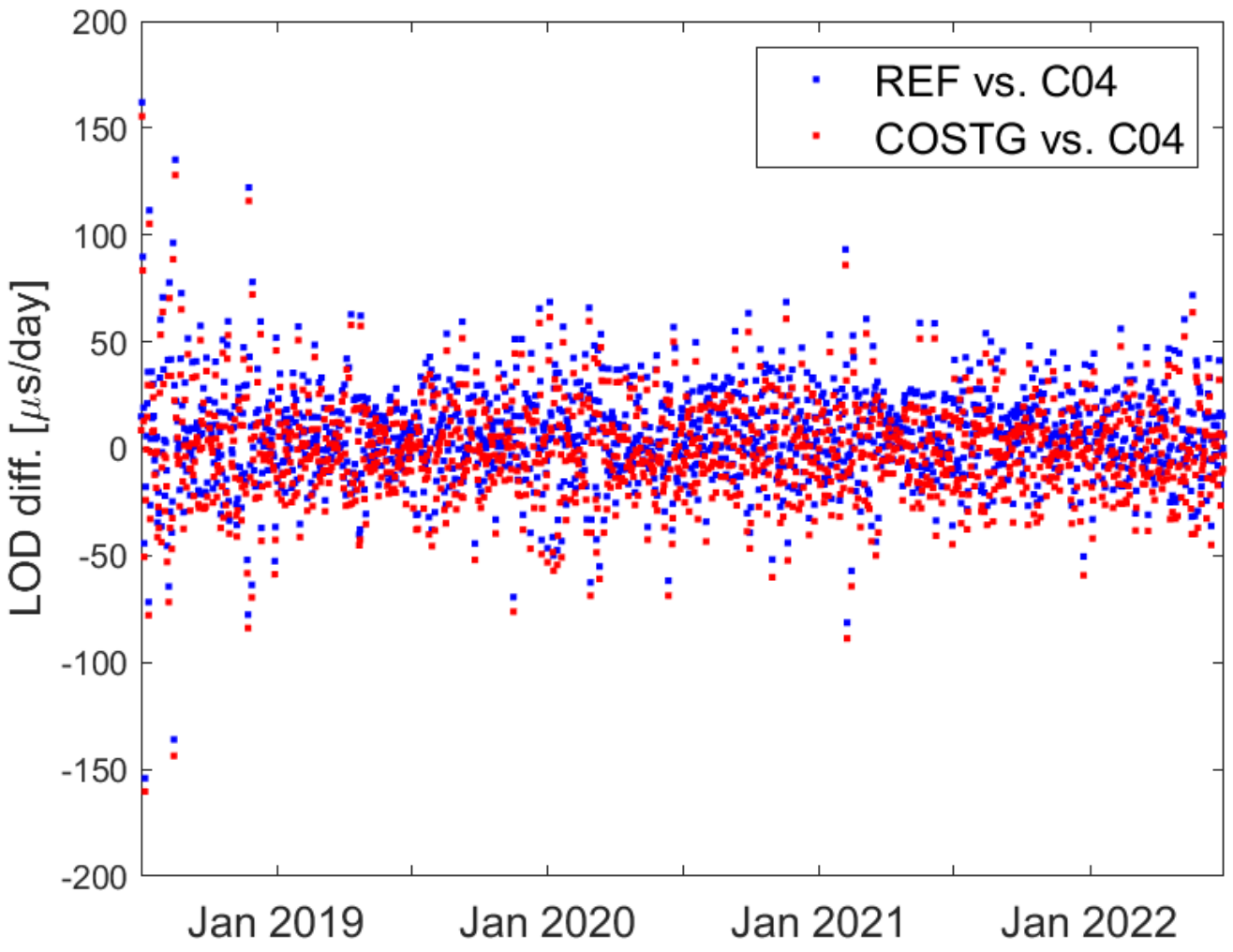
= start of second orbit

The averaged midnight misclosures per satellite system are provided in the legend.

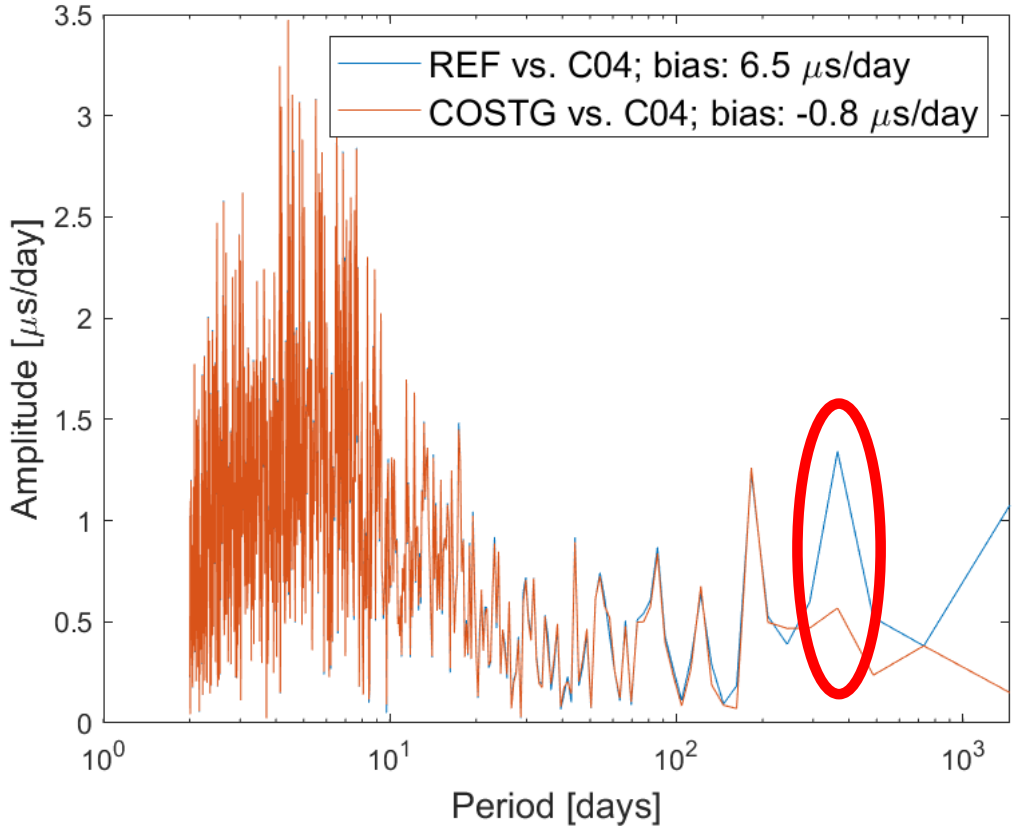
SLR-validation:

	GLONASS	Galileo
REF	0.70+-3.44 cm	0.39+-2.11 cm
COSTG	0.70+-3.44 cm	0.34+-2.11 cm

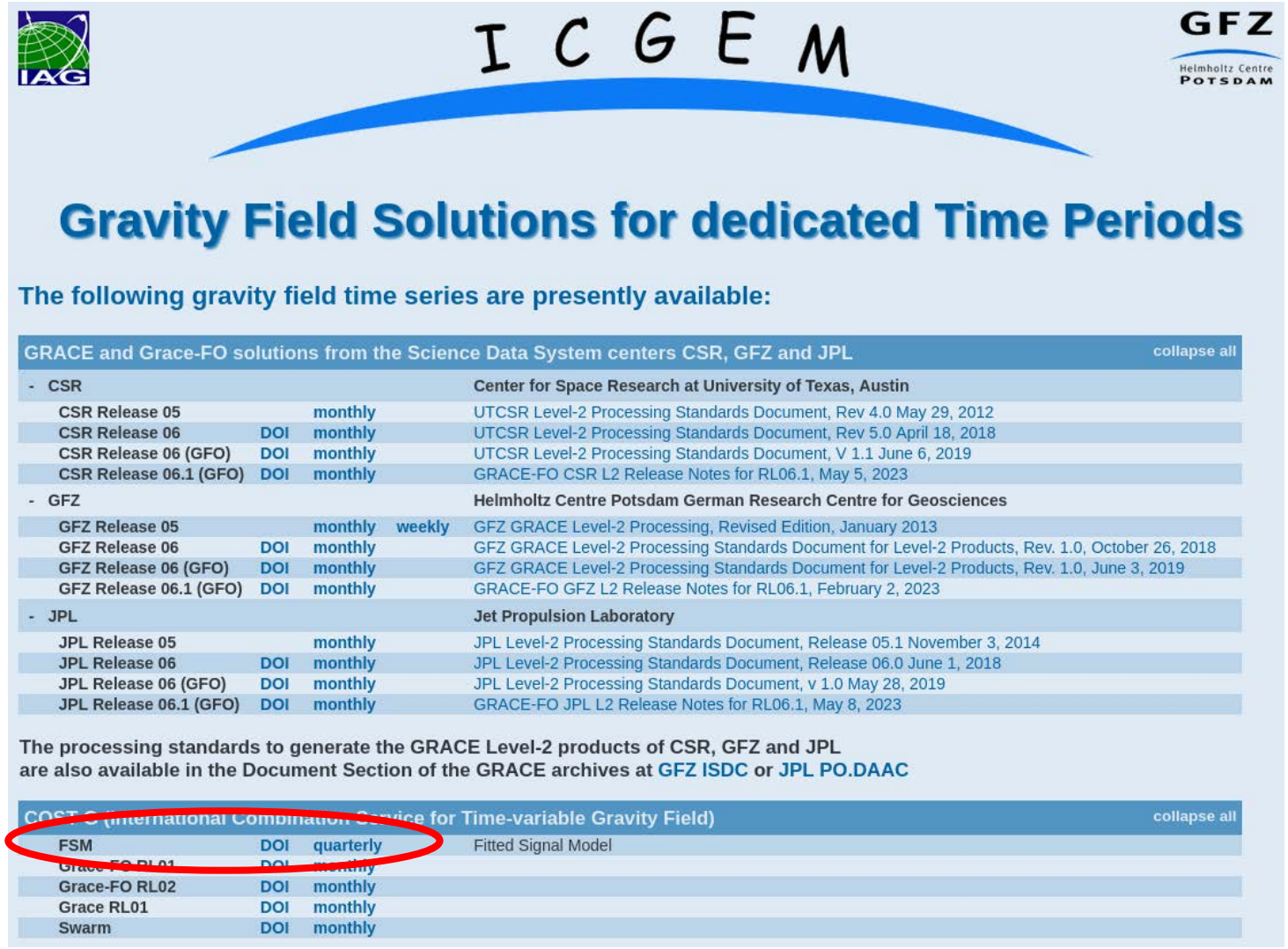
Length Of Day (LOD) estimates



The bias and the amplitude of the annual variations of LOD with respect to C04 are significantly reduced!



https://icgem.gfz-potsdam.de/sl/temporal



ICGEM

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
CSR Release 05		monthly		UTCSR Level-2 Processing Standards Document, Rev 4.0 May 29, 2012
CSR Release 06	DOI	monthly		UTCSR Level-2 Processing Standards Document, Rev 5.0 April 18, 2018
CSR Release 06 (GFO)	DOI	monthly		UTCSR Level-2 Processing Standards Document, V 1.1 June 6, 2019
CSR Release 06.1 (GFO)	DOI	monthly		GRACE-FO CSR L2 Release Notes for RL06.1, May 5, 2023
- 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
GFZ Release 06.1 (GFO)	DOI	monthly		GRACE-FO GFZ L2 Release Notes for RL06.1, February 2, 2023
- JPL				Jet Propulsion Laboratory
JPL Release 05		monthly		JPL Level-2 Processing Standards Document, Release 05.1 November 3, 2014
JPL Release 06	DOI	monthly		JPL Level-2 Processing Standards Document, Release 06.0 June 1, 2018
JPL Release 06 (GFO)	DOI	monthly		JPL Level-2 Processing Standards Document, v 1.0 May 28, 2019
JPL Release 06.1 (GFO)	DOI	monthly		GRACE-FO JPL L2 Release Notes for RL06.1, May 8, 2023

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
FSM	DOI	quarterly	Fitted Signal Model
Grace-FO RL01	DOI	monthly	
Grace-FO RL02	DOI	monthly	
Grace RL01	DOI	monthly	
Swarm	DOI	monthly	

Conclusions

- COST-G provides monthly gravity field combinations derived from GRACE/GRACE-FO observations, augmented by SLR-C_{20}.
- For operational satellite POD, COST-G provides a quarterly updated fitted signal model.
- LEO-POD clearly profits from a time-variable gravity model; the lower, the more.
- In case of GNSS the main impact is on LOD, where artifacts with annual period are significantly reduced.