POD2022-004

OSTST Science Team Meeting
31 October - 04 November 2022
Venice, Italy

COST-G Combination Service for Time-variable Gravity Fields

A. Jäggi[1], U. Meyer[1], J. Teixeira da Encarnacao[2], M. Lasser[1], F. Flechtner[3], C. Dahle[3], E. Boergens[3], C. Förste[3], T. Mayer-Gürr[4], A. Kvas[4], S.Behzadpour[4], J.-M. Lemoine[5], S. Bourgogne[6], I.Koch[7], M. Duwe[7], J. Flury[7], M. Weigelt[7],H. Peter[8], A. Groh[9], I. Sasgen[10], A. Eicker[11], A. Blazquez[12], B.Meyssignac[12]

(1) University of Bern, Switzerland
(2) TU Delft, The Netherlands
(3) GFZ Potsdam, Germany
(4) TU Graz, Austria
(5) CNES, France
(6) Stellar Space Studies, France
(7) University Hannover, Germany
(8) PosiTim UG, Germany
(9) TU Dresden, Germany
(10) Alfred-Wegener-Institut
(11) HafenCity University Hamburg
(12) LEGOS, France

Objectives

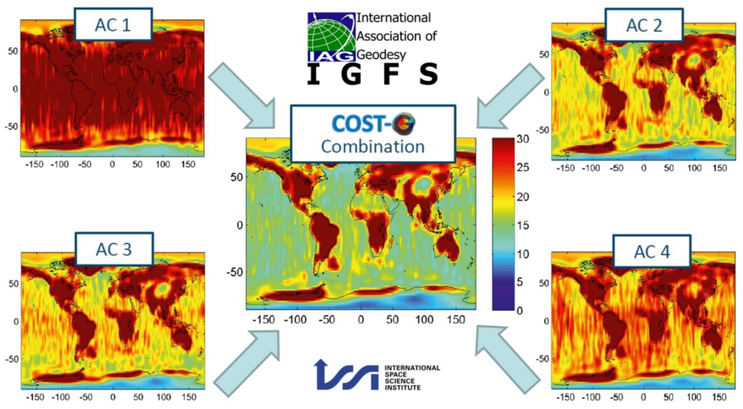
The International Combination Service for Time-variable Gravity Fields (COST-G) is the Product Center of the International Gravity Field Service (IGFS) for time-variable gravity fields. COST-G continues the activities of the H2020 project European Gravity Service for Improved Emergency Management (EGSIEM, 2015-2017) to realize a long-awaited standardization of gravity-derived mass transport products.

The products of COST-G are:

- **Combined gravity field solutions** in SH coefficients (Level-2 products) derived from a weighted combination of individual solutions generated by different Analysis Centers (ACs),
- **Spatial grids** (Level-3 products) of the combined solutions for hydrological, oceanic and polar ice sheets applications.

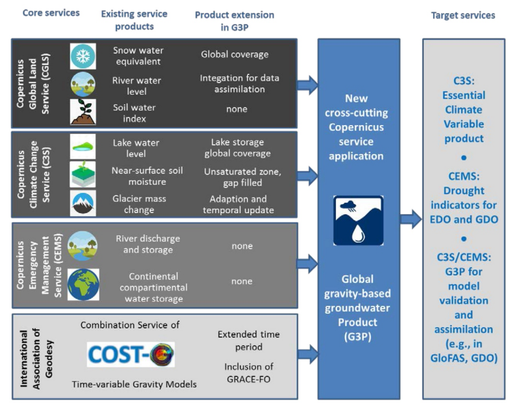
COST-G Team Members

COST-G Principle



COST-G provides consolidated monthly global gravity models in terms of spherical harmonic (SH) coefficients and thereof derived grids by combining solutions from individual ACs. The ACs adopt different analysis methods but apply agreed-upon consistent processing standards to deliver time-variable gravity field models, e.g. from GRACE-FO low-low satellite-to-satellite tracking (ll-SST).

Link to Copernicus

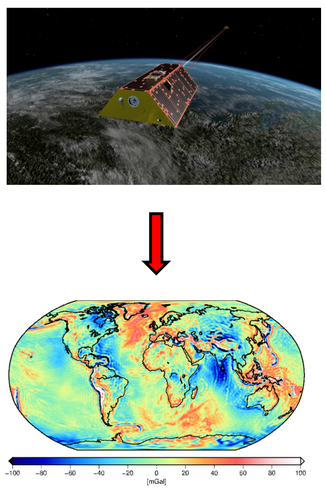


The H2020 project Global Gravity-based Gorundwater Product (G3P, 2020-2022) is developing a product of groundwater storage variations with global coverage and monthly resolution by a cross-cutting combination of GRACE/GRACE-FO data with water storage data based on the existing portfolio of the Copernicus services for a later operational implementation of the Essential Climate Variable (ECV) Groundwater into the Copernicus Climate Change Service (C3S).

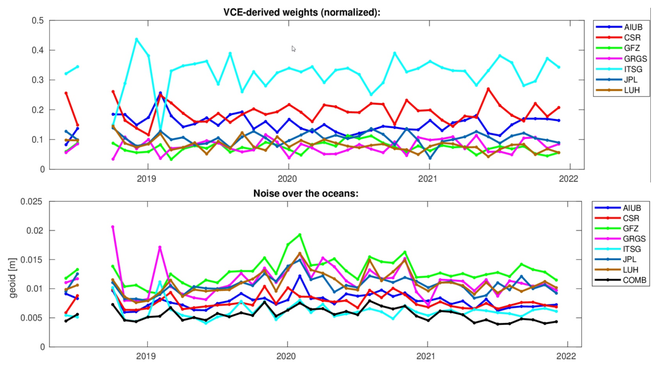
Level-2 Products

In the frame of COST-G different groups generate gravity field solutions based on independent software packages:

GFZ
EPOS software
CNES
GINS software
AIUB
Bernese software
ITSG
GROOPS software
LUH
GRACE-SIGMA software
and Partner Analysis Centers



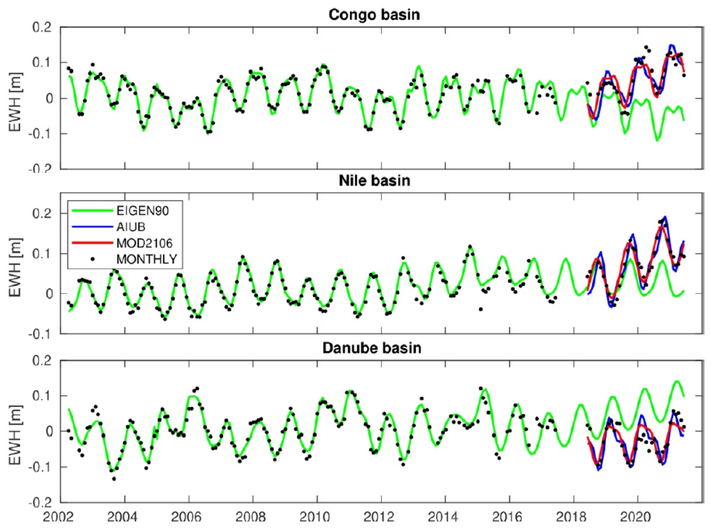
Adopting rigorous and independent processing approaches, each analysis center delivers unregularized and consistent gravity field solutions. This enables a meaningful combination of gravity field solutions.



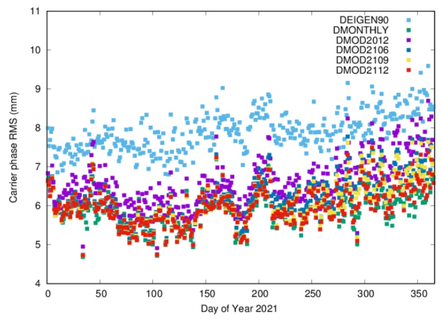
Top: Weights of the combination of monthly GRACE-FO solutions that will be adopted for a first reprocessing of COST-G solutions.
Bottom: Noise over the oceans of the monthly GRACE-FO solutions and the combined COST-G solution (labelled COMB).

Fitted Signal Models

COST-G monthly solutions are fitted by a simple parametric model (offset, trend, seasonal signal) to provide fitted signal models (FSM) that may be used in operational Precise Orbit Determination (POD) activities:



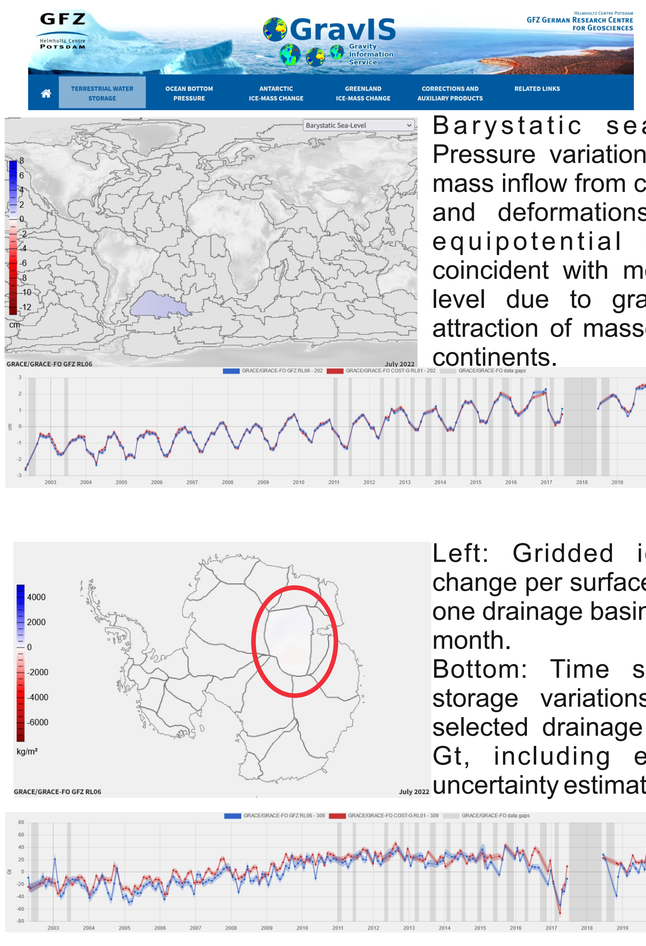
Especially in larger river basins the COST-G FSM agrees much better than the predicitions of the standard EIGEN-GRGS-RL04 model (labelled EIGEN90) that is widely used for POD activities.



The carrier phase RMS of dynamic Sentinel-3B satellite orbits based on monthly GRACE-FO gravity fields (green) or different FSMs reveals the benefit of up-to-date models. All models were truncated at a max. d/o 90.

Level-3 Products

Terrestrial Water Storage (TWS) variability, ocean bottom pressure (OBP) variability, mass changes of the Antarctic and Greenland Ice Sheets are provided in terms of different Level-3 products at the portals GravIS and ISDC:

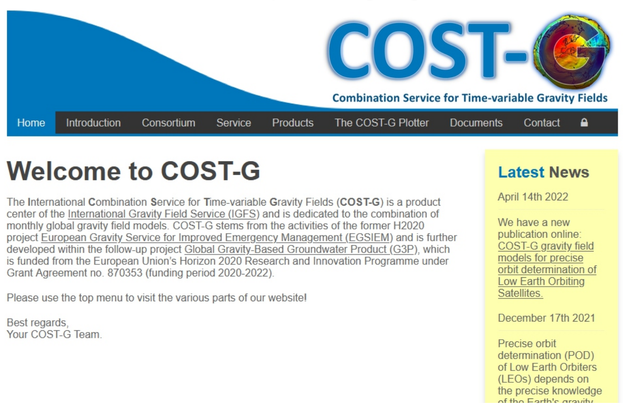


Barystatic sea-level: Pressure variations due to mass inflow from continents and deformations of the equipotential surface coincident with mean sea-level due to gravitational attraction of masses at the continents.

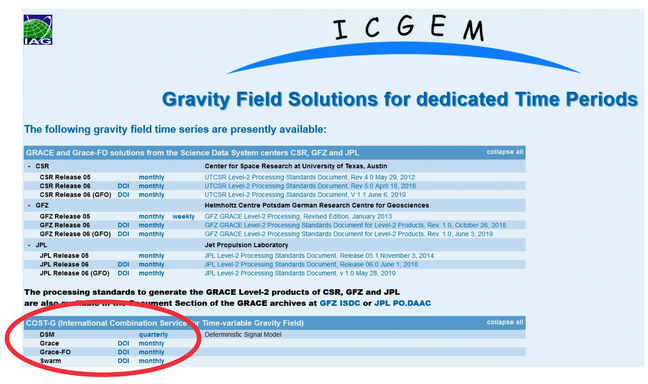
Left: Gridded ice-mass change per surface area for one drainage basin and one month.
Bottom: Time series of storage variations of the selected drainage basin in Gt, including empirical uncertainty estimates.

Dissemination

Information about COST-G:http://cost-g.org



Level-2 products: http://icgem.gfz-potsdam.de

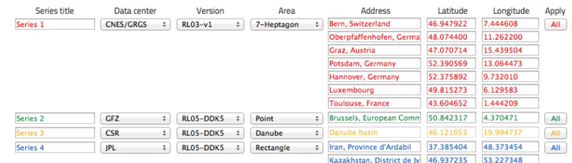


Public Outreach

COST-G plotter: http://plot.cost-g.org

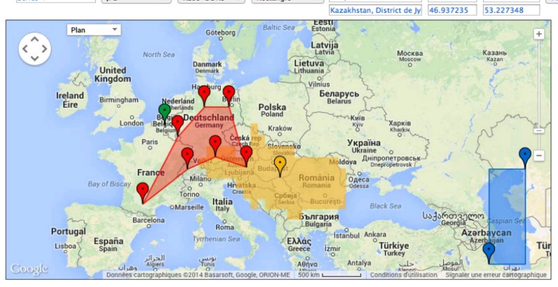
Data selection

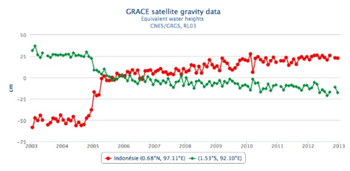
center, type, version ...

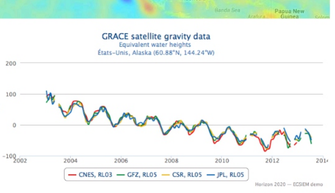


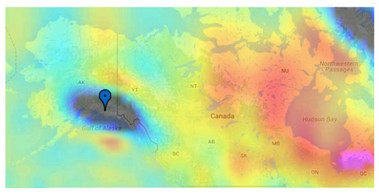
Multiple possibilities for extraction areas, custom or predefined

Interactive plots









Summary

- COST-G was established at the IUGG 2019.
- COST-G operates under the umbrella of the International Gravity Field Service (IGFS) of the International Association of Geodesy (IAG).
- COST-G operationally provides monthly gravity field solutions from GRACE-FO data and from Swarm data with a latency of about 3 months.
- COST-G operationally provides fitted signal models with quarterly updates.
- COST-G provides reprocessed monthly gravity field solutions in irregular batches.
- COST-G is planning to include several GRACE/GRACE-FO ACs from China in the near future.

In collaboration with and supported by

Acknowledgement

The international COST-G team is receiving support from the International Space Science Institute (ISSI) in Bern, Switzerland, and from the ISSI-Beijing, China. G3P is funded by the European Union's Horizon 2020 Research and Innovation Programme, Grant Agreement no. 870353.

Contact address

Adrian Jäggi
Astronomical Institute, University of Bern
Sidlerstrasse 5
3012 Bern (Switzerland)
adrian.jaeggi@aiub.unibe.ch

Poster compiled by Adrian Jäggi, October 2022
Astronomical Institute, University of Bern, Bern
adrian.jaeggi@aiub.unibe.ch