COST-G

Combination Service for Time-variable Gravity Models

COST-G: a note on uncertainty information

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Mass Variations derived from Satellite Gravimetry (GRACE/GRACE-FO)

Mass variations on Earth are not observed directly by dedicated instruments onboard the GRACE/GRACE-FO satellites. They are derived by the solution of inverse problems from satellite orbits, resp. orbit differences. Uncertainties are related to:

- Orbit determination
- Signal separation

Satellite Gravimetry: Observation Noise and Background Model Errors

GRACE/GRACE-FO observations (orbit determination):

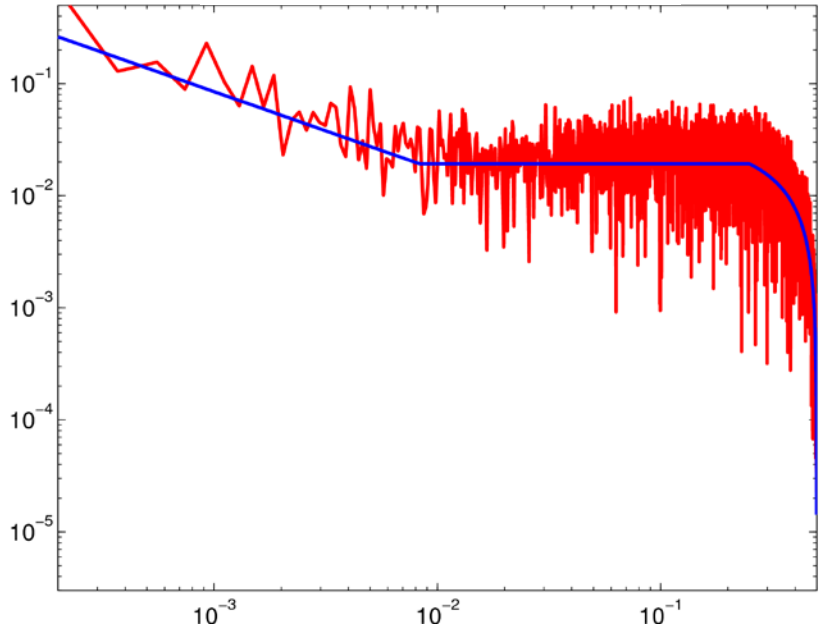
- Kinematic satellite positions (or GPS code and phase observations)
- Inter-satellite K-band ranges (differentiated to range-rates)
- Satellite attitude
- Non-gravitational accelerations (surface forces)

Gravitational background models (signal separation):

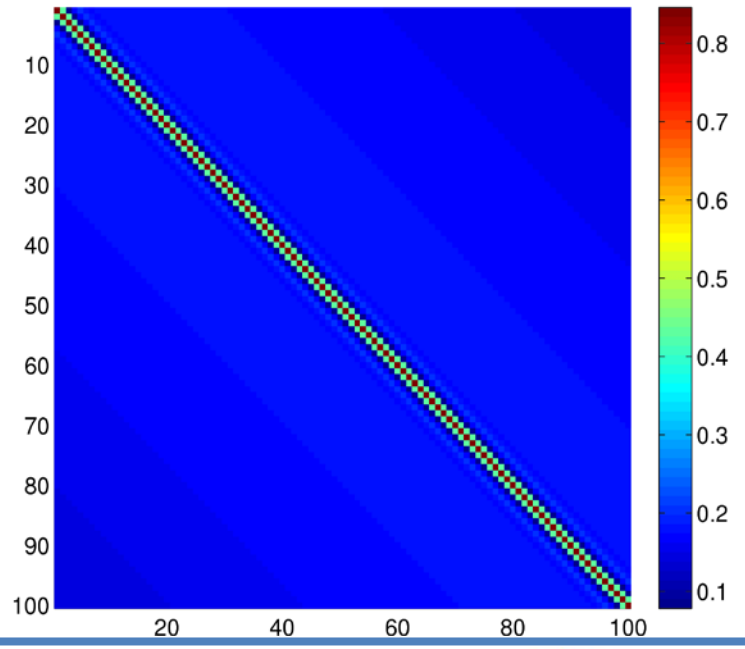
- Ocean tides
- Atmospheric tides
- Solid Earth tides
- Pole tides
- Non-tidal atmosphere and ocean mass variations (weather)

Observation Noise Model (based on Instrument Calibration)

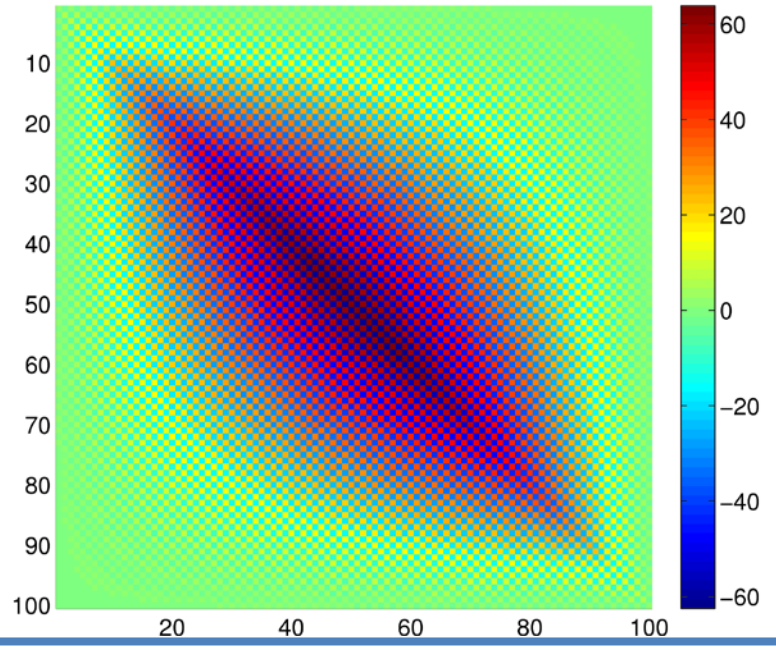
instrument noise PSD:



covariance matrix:

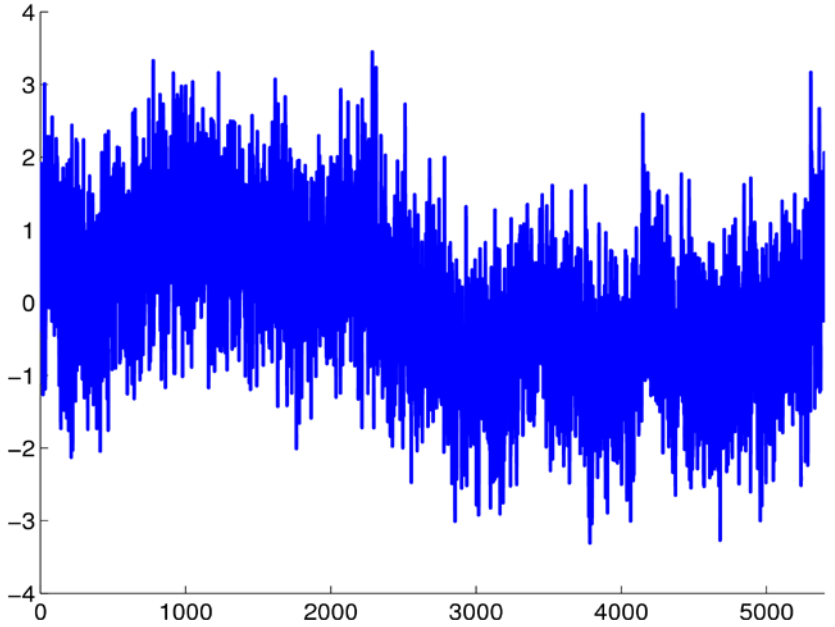


weight matrix:

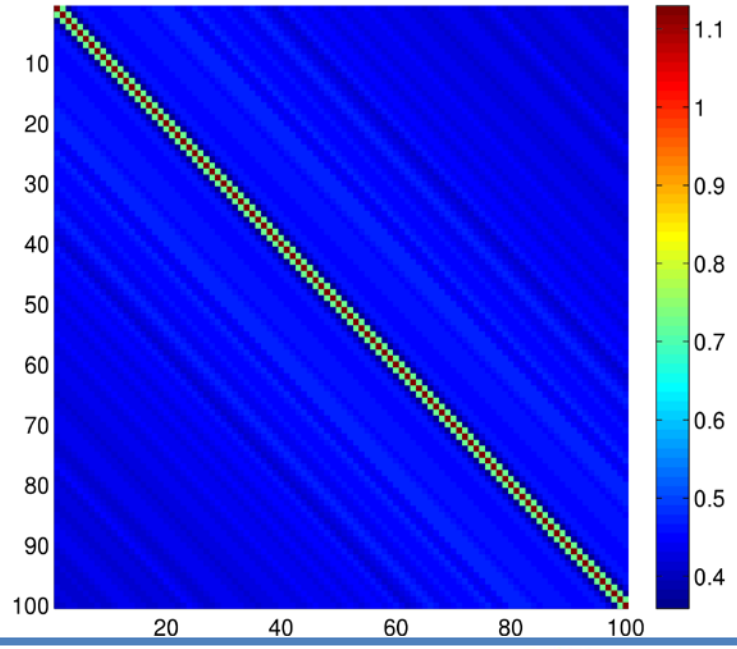


Empirical Noise Model (based on post-fit Residuals)

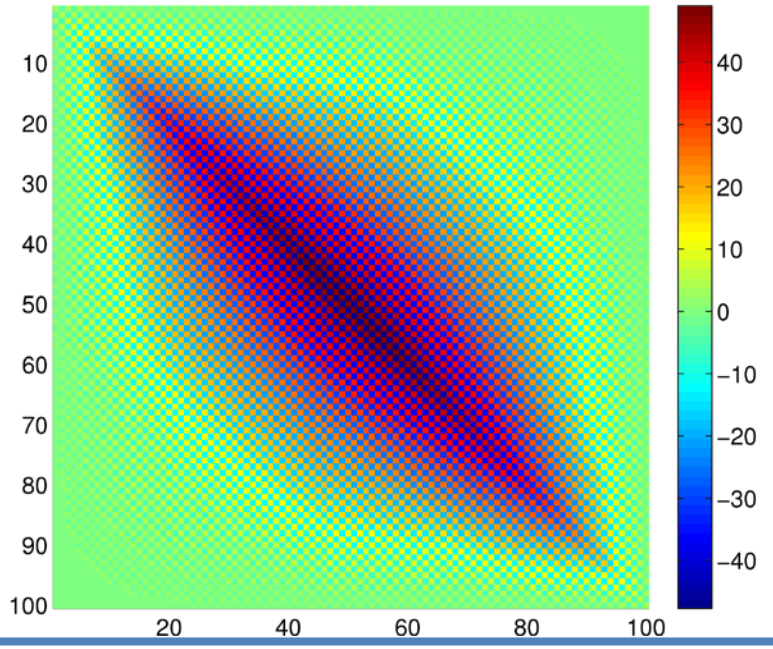
observation residuals:



covariance matrix:

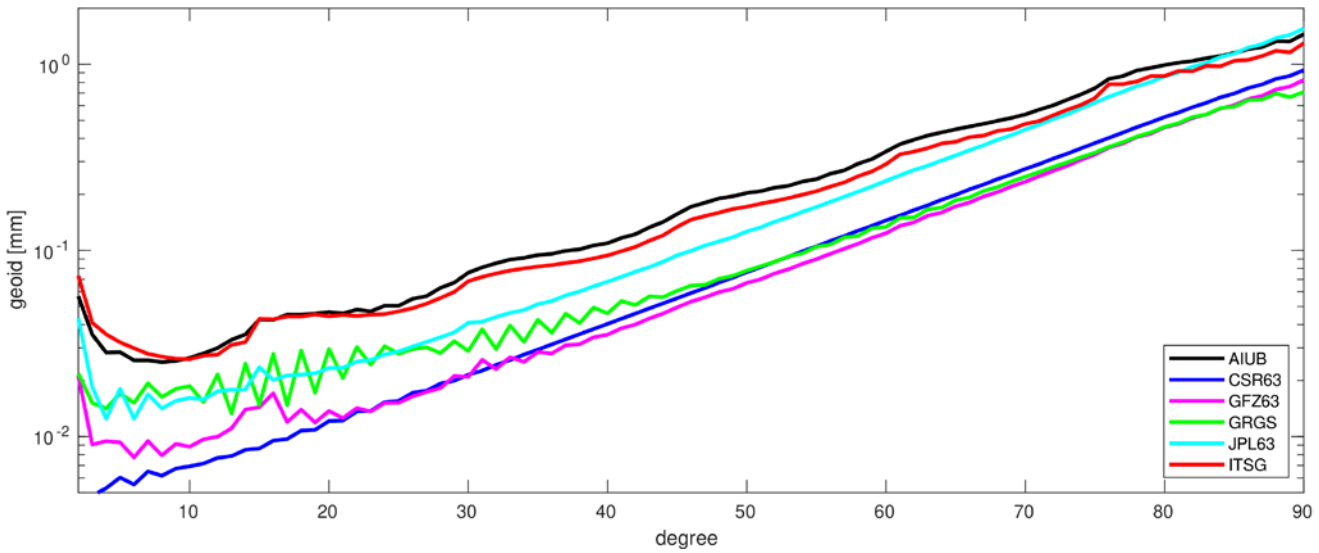


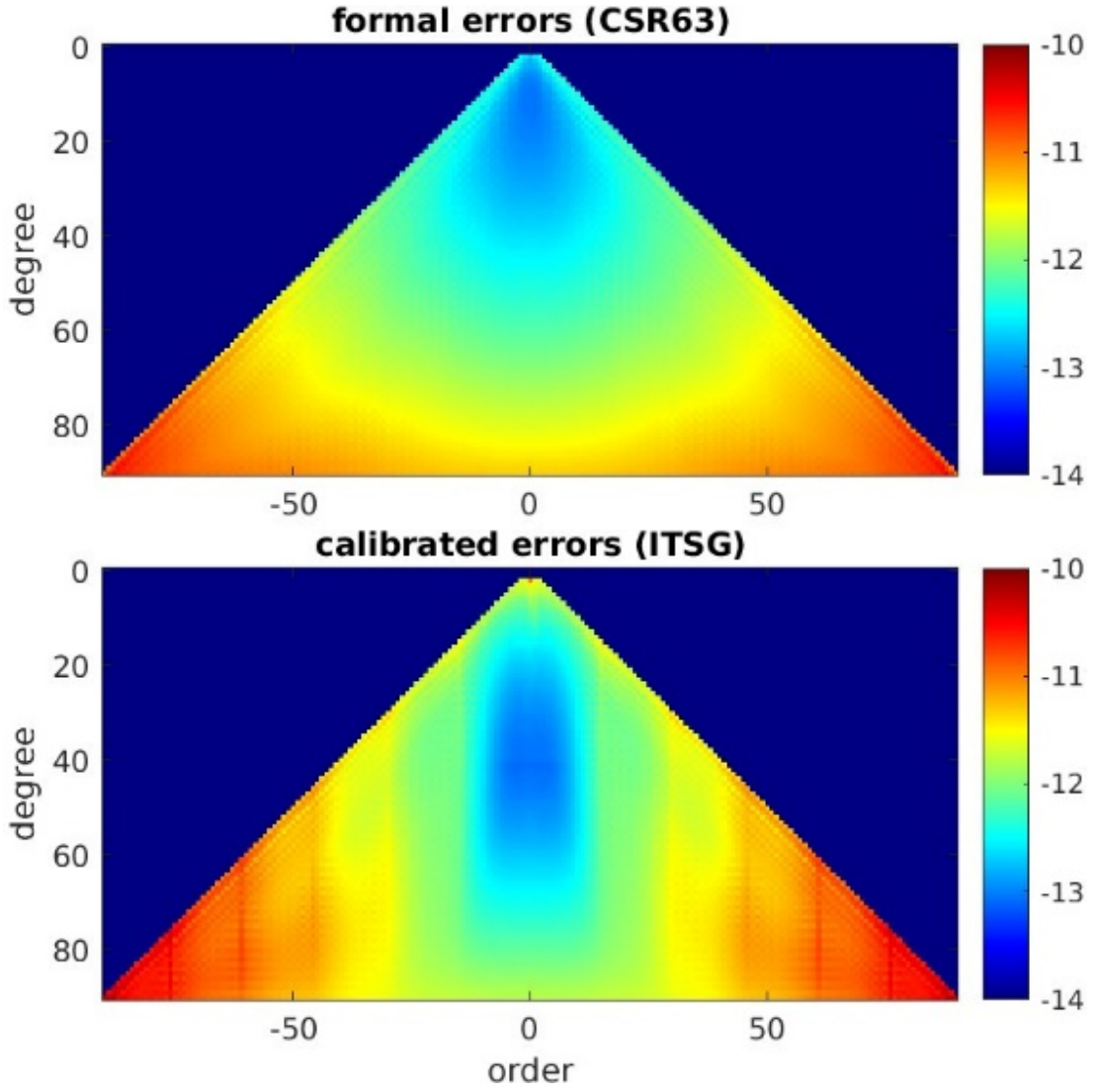
weight matrix:



GRACE-FO Level-2 (spherical harmonics) uncertainties

Mean degree amplitudes of L2-uncertainties

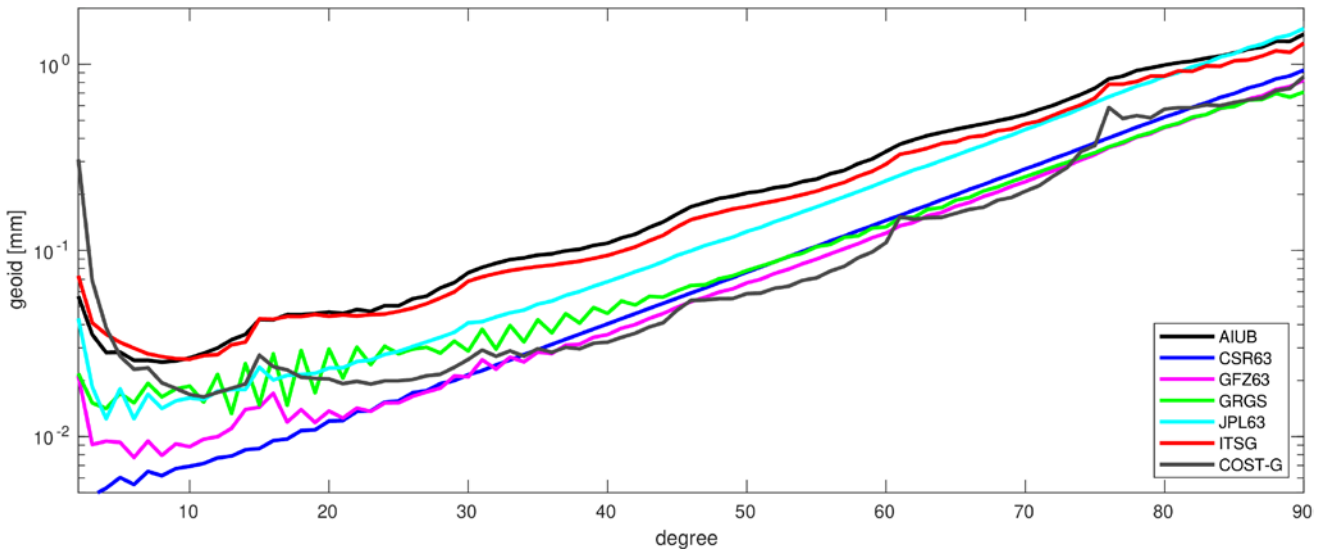


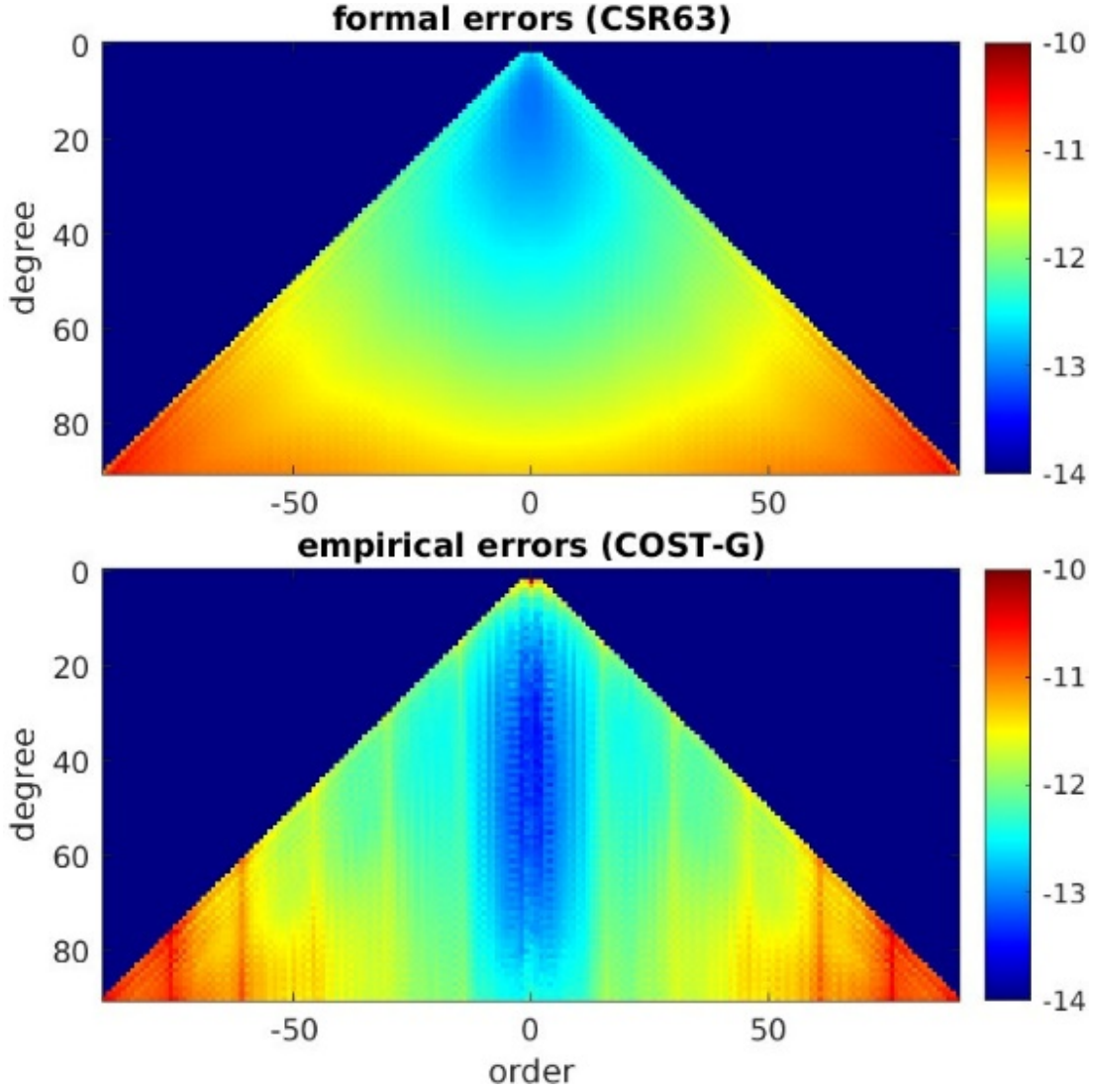


Formal uncertainties of the monthly gravity field solution from different analysis centers (ACs) are very diverse, dependent on the noise modelling/ mitigation strategies of the individual ACs.

GRACE-FO Level-2 (spherical harmonics) uncertainties

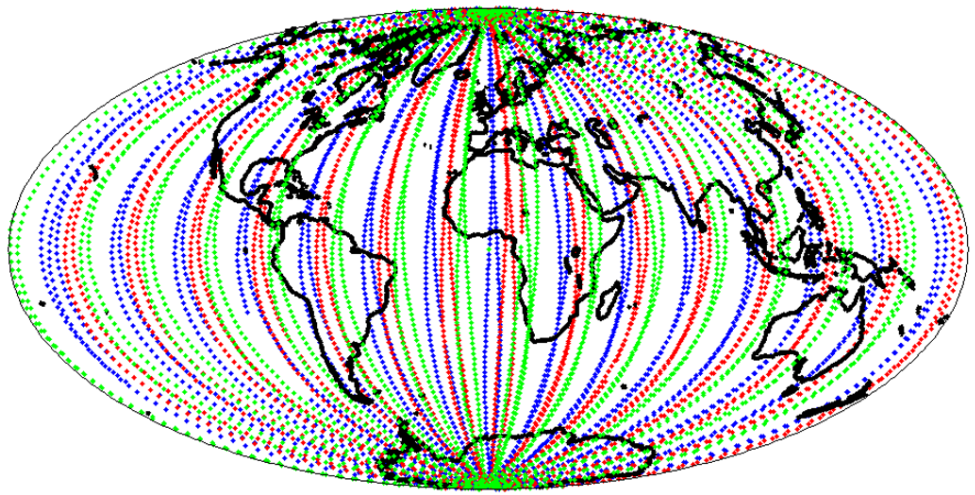
Mean degree amplitudes of L2-uncertainties

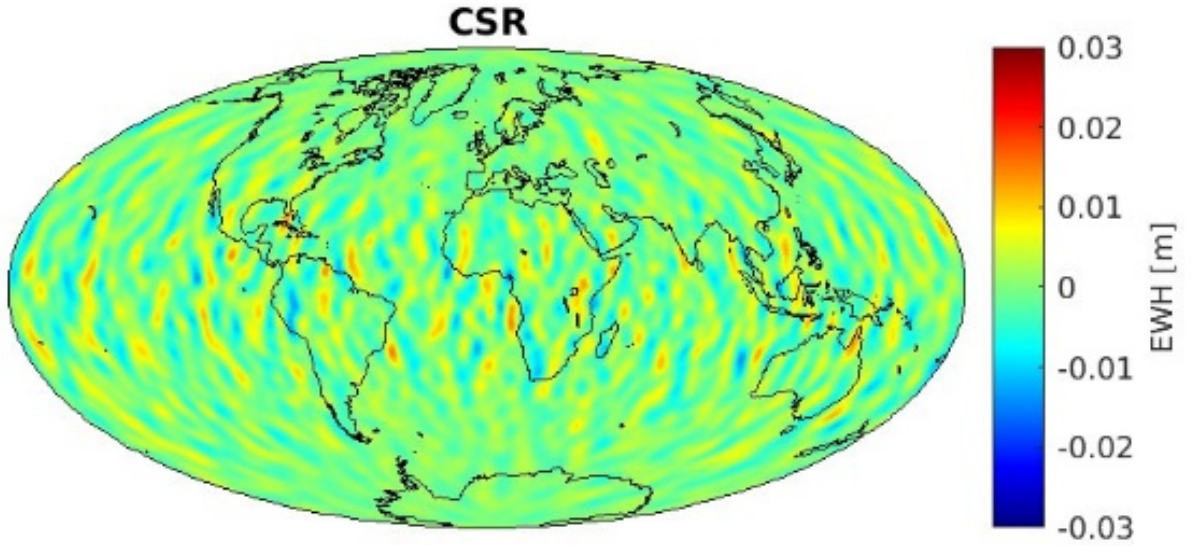


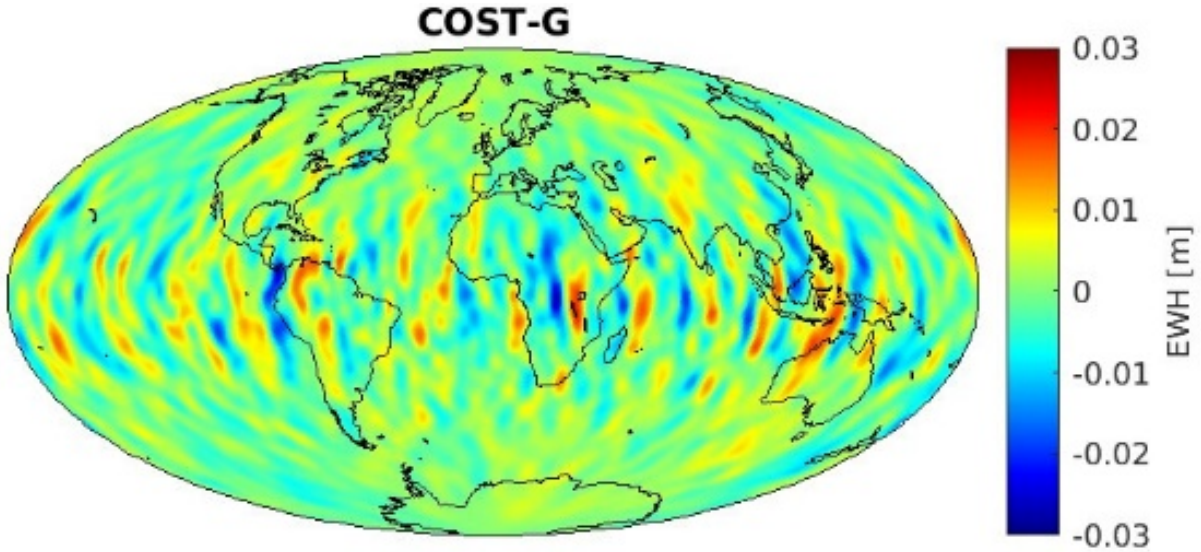


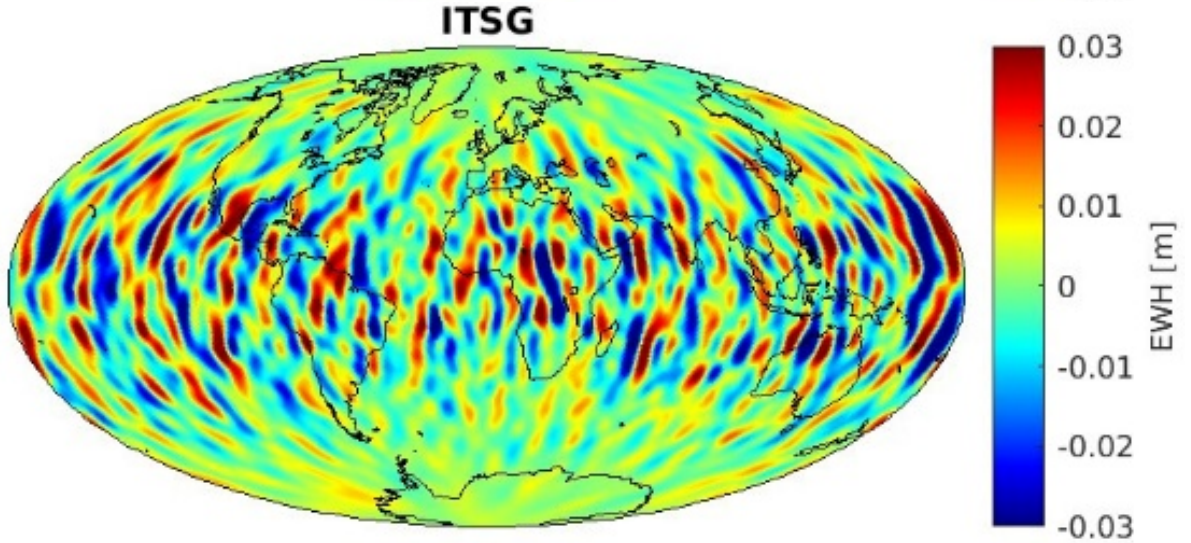
Empirical uncertainties of the combined monthly gravity fields are derived from the spread of the individual solutions. They are still rather optimistic due to common error sources.

Corresponding Level-3 (EWH grids) errors

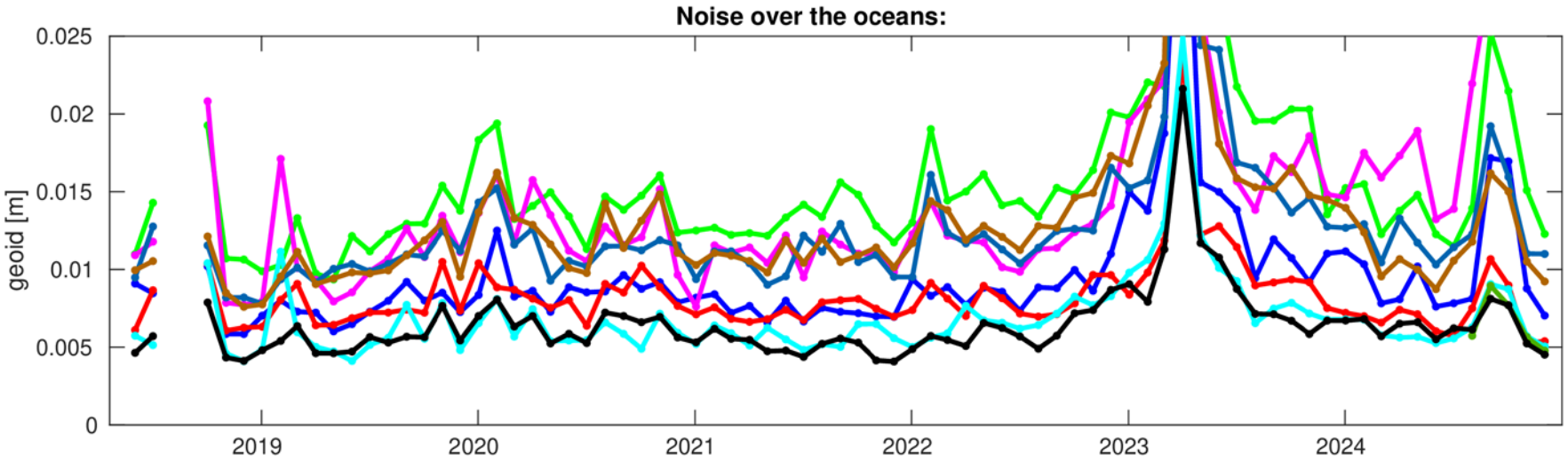




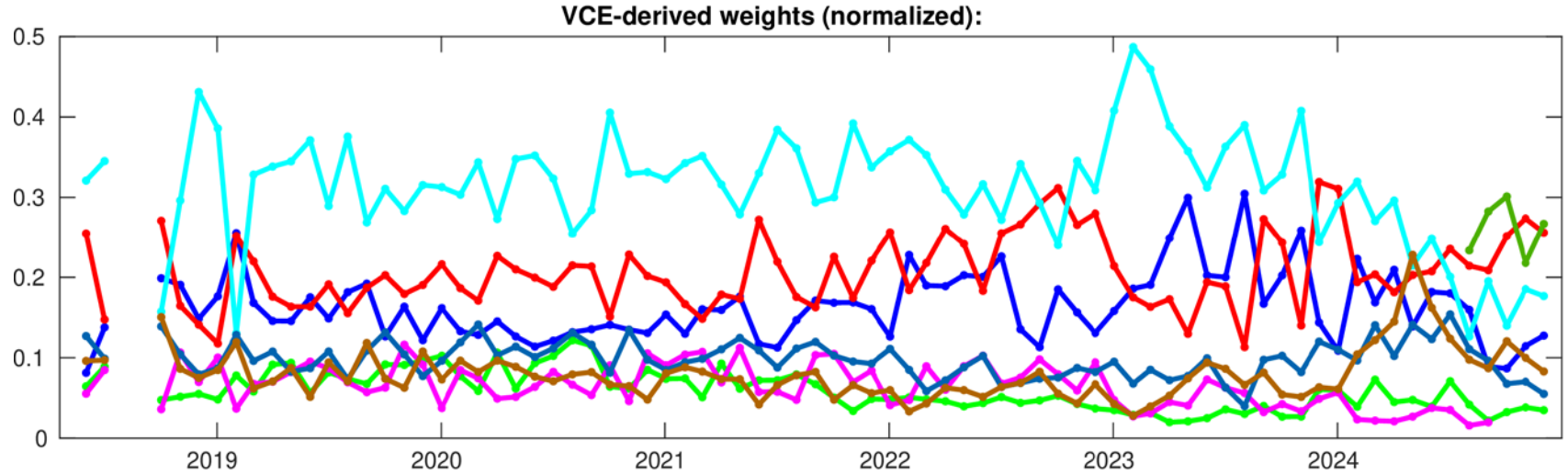




Alternative noise assessment

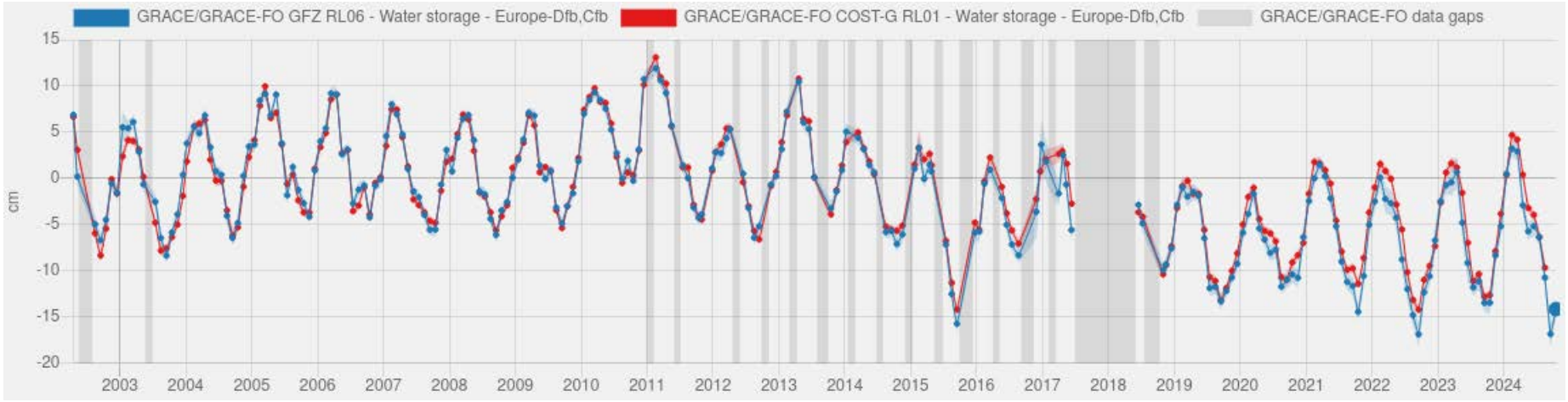


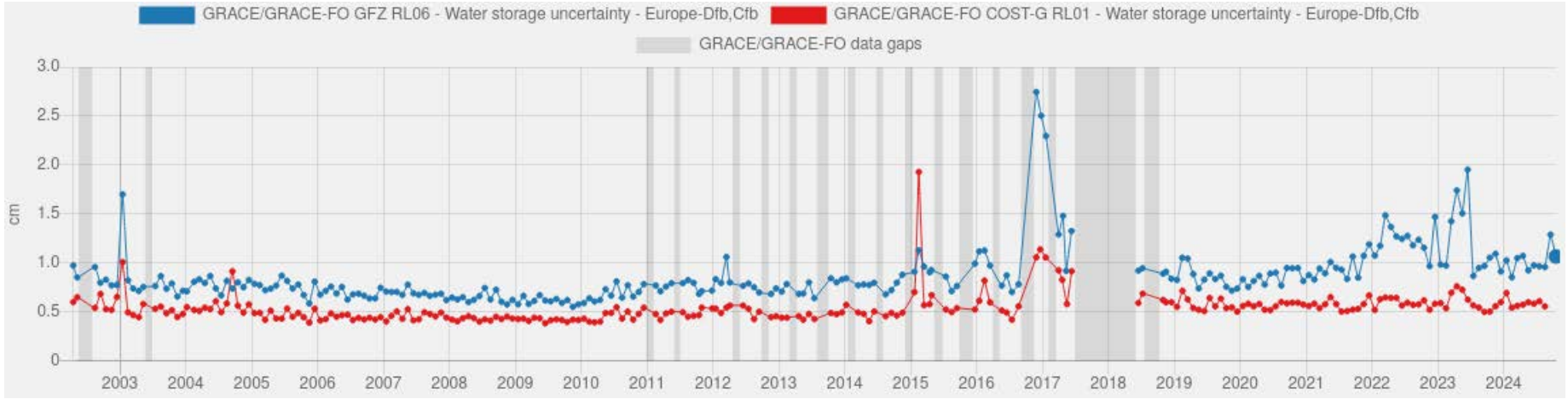
The noise may be assessed by the non-secular, non-seasonal variability over quiet ocean areas or deserts. In the time-series, orbit resonance periods stand out.



The relative weights of the combination are derived by Variance Component Estimation and are in rather good agreement with the noise assessment.

GravIS Level-3 products: global EWH grids/EWH variations in river basins





Realistic uncertainties are provided for river basins up to 70° latitude, based on an empirical co-variance model (Boergens et al, 2020 and 2022).