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Combination Service for Time-variable Gravity Field Models (COST-G) – current status

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1. Introduction to COST-G

The Combination Service for Time-variable Gravity Field Models (COST-G) is the new product center of IAG's International Gravity Field Service (IGFS). It will provide a combined time-series of gravity fields of the GRACE mission and operationally combined monthly solutions of GRACE-FO, once GRACE-FO L1B data will be released. Here we present the evaluation and combination of the most recent GRACE RL06 Level-2 products from CSR, JPL and GFZ and the alternative products ITSG-2018, GRGS-RL04 and AIUB-RL02. While COST-G will provide combinations on normal equation level, we here present a combination on solution level based on variance component estimation (VCE).

2. Quality control

Prior to combination all contributions undergo a quality control, taking into account:

- amplitude of mass variations in river basins (Figs. 1 and 2),
- mass trends in polar regions (Fig. 3), and
- noise content, evaluated by the RMS or STD of non-seasonal, non-secular variations either in the spectral domain (Fig. 4) or in the spatial domain over the oceans (Figs. 5, 6 and 7).

Time-series revealing significant signal attenuation (most often related to regularization) are rejected in order not to bias the combination (here we keep all time-series for illustration). Individual monthly solutions exceeding a noise threshold may also be rejected, if their effect on the combination cannot be taken into account by relative weights.

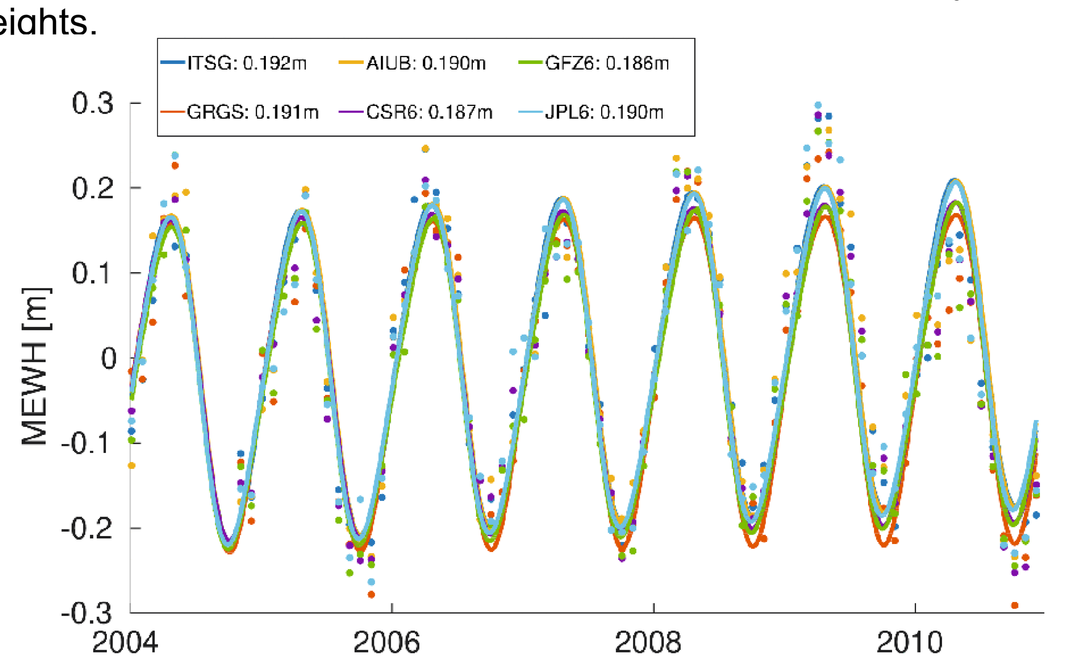

Figure 1: Mean equivalent water heights (MEWH) over the Amazon basin derived from the individual monthly solutions (dots) and from a posteriori fitting trends and seasonal signals (lines). Annual amplitudes, as given in the legend, agree well with ech other.

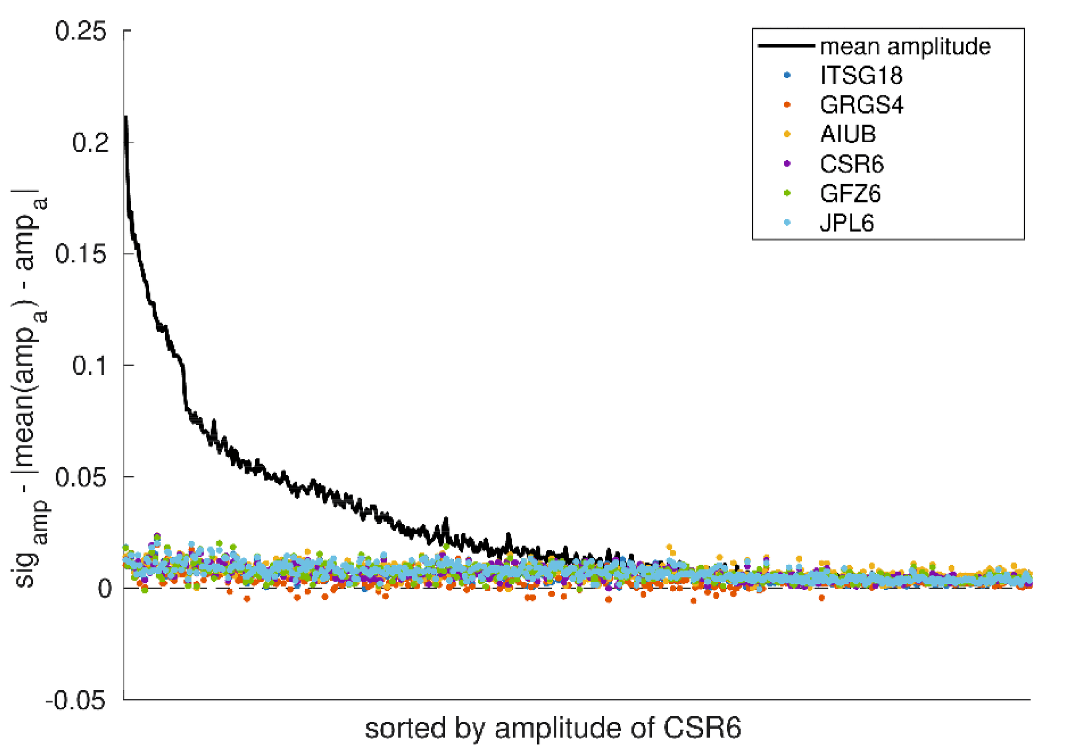

Figure 2: The comparison of the mean annual amplitudes of all basins covering at least 30 grid cells to the individual amplitudes and their formal errors indicates high consistency among the solutions.

Figure 3: Mass change over greenland. Only degrees 3 to 90 were taken into account and no Gaussian filter or corrections for leakage and GIA were applied. The attenuated trend visible in the GRGS-RL04 time-series may be related to the regularization by truncation of the eigenvalues in the inversion step.

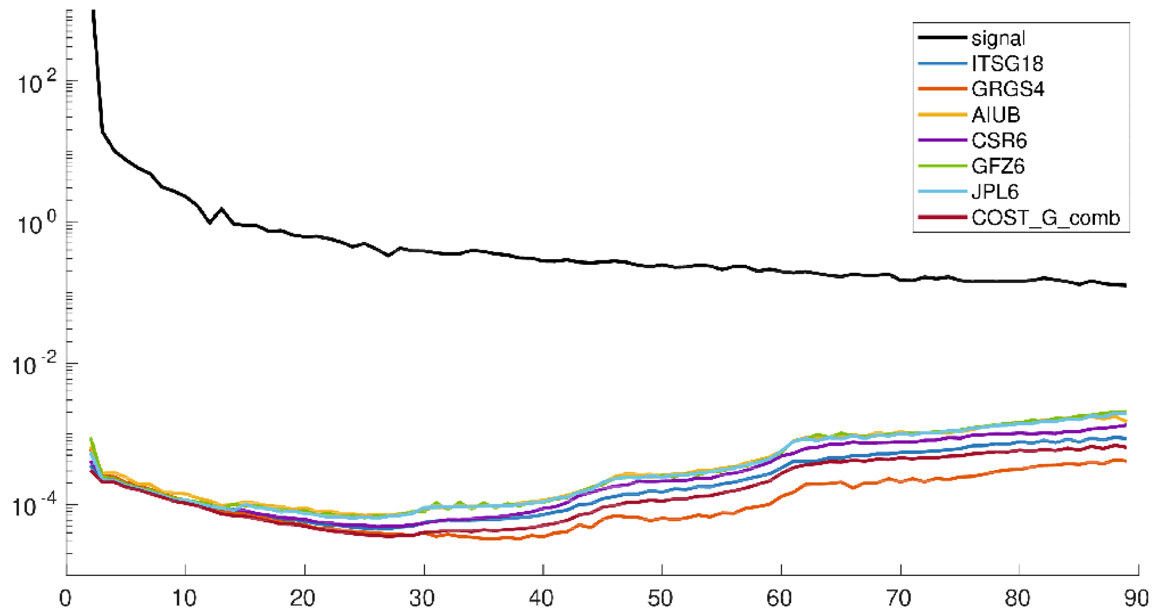

Figure 4: Mean degree variances to a mean model for degrees 2 to 90 including the combination based on VCE on solution level (COST_G_comb). The GRGS-RL04 time-series stands out by its low noise level, related to the regularization applied.

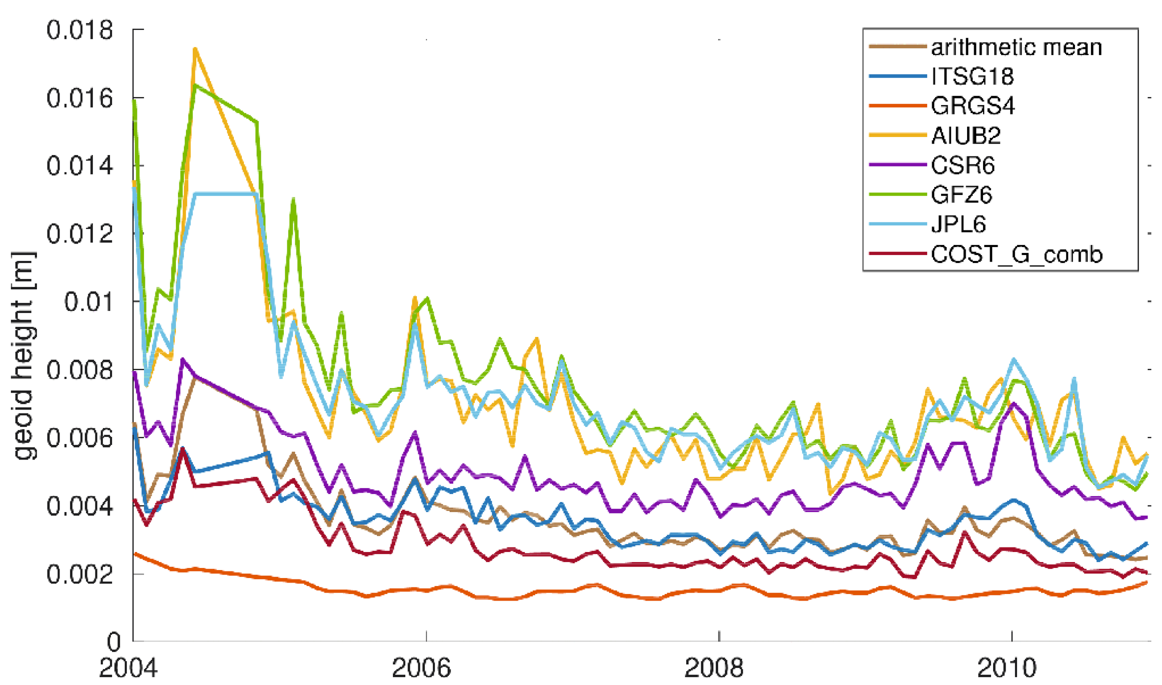

Figure 5: Weighted standard deviation (wSTD) to mean model over the oceans. Degrees 3 to 90 were taken into account and no Gaussian filter was used. The noise level of the combination by VCE (COST_G_comb) is superior to all individual time-series but the regularized GRGS-RL04.

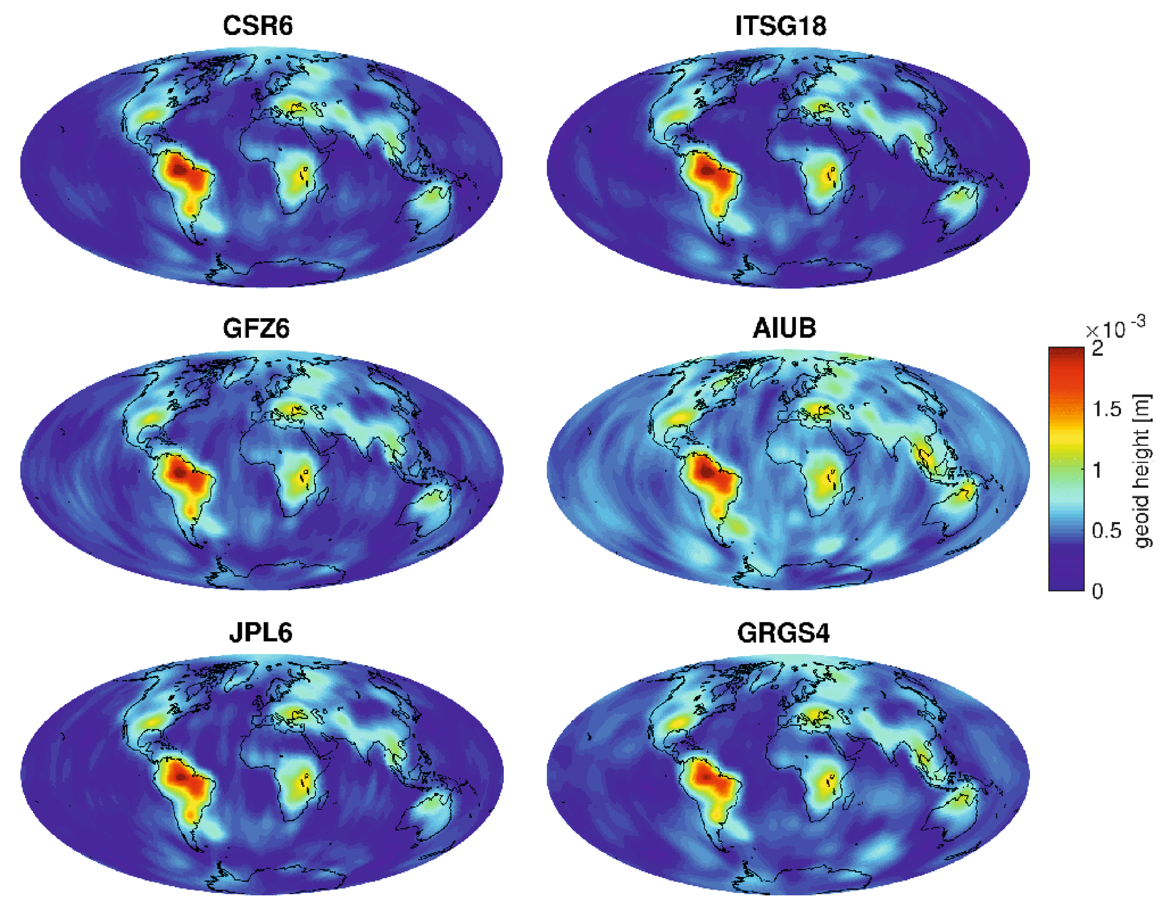

Figure 6: RMS of anomalies in the spatial domain, expressed in geoid heights and filtered with a 400km Gaussian filter. Stripes over the oceans indicate noise, bumpy features are mostly related to modeling issues. Note that AIUB-RL02 is the only time-series still based on L1B-RL02 data and partly outdated background models.

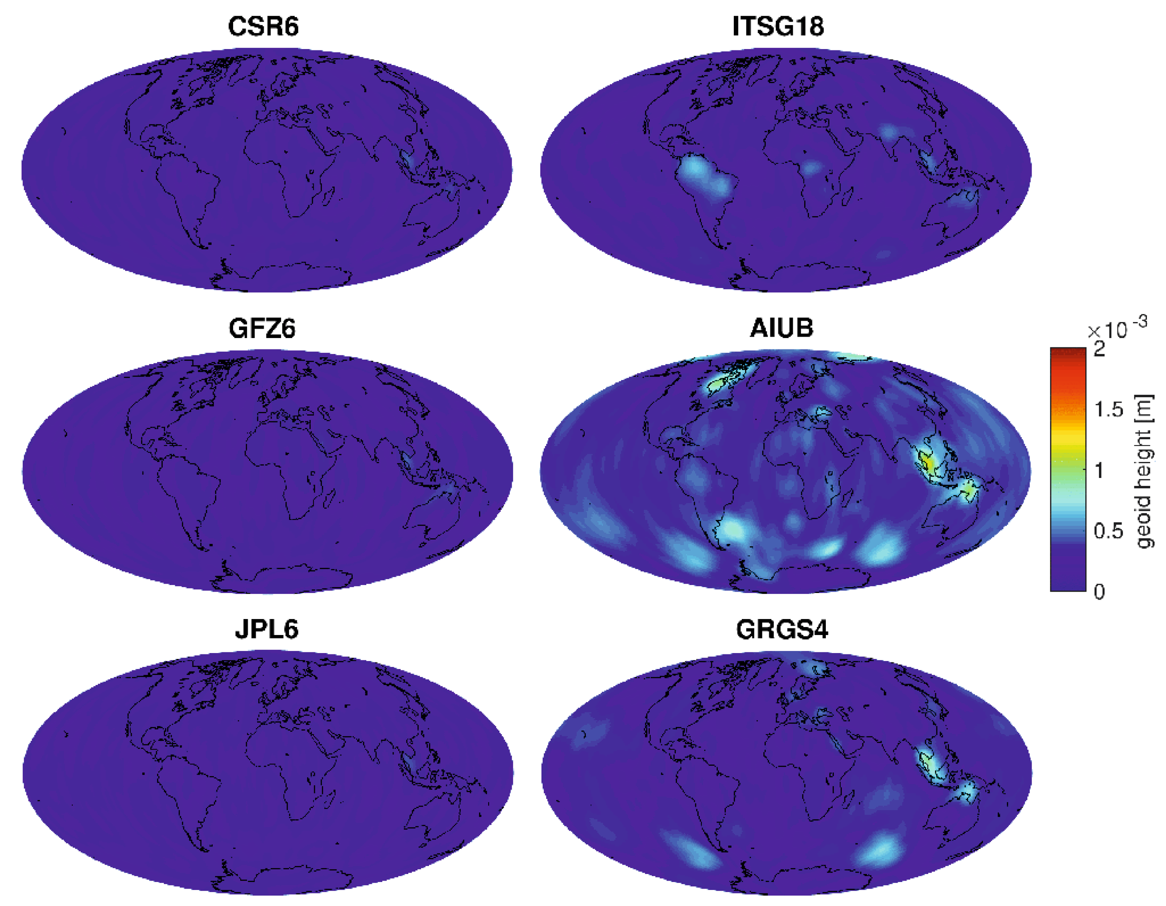

Figure 7: RMS of differences to the mean in the spatial domain, expressed in geoid heights and filtered with a 400km Gaussian filter. The features visible in the right column are mainly due to differences in the background modeling adopted by the individual ACs.

3. VCE on solution level

The final COST-G combination will be performed on Normal Equation (NEQ) level to correctly take into account all correlations between gravity field, orbit and instrument parameters. But the determination of relative weights on NEQ-level is not possible due to the different noise modeling approaches applied by the individual Analysis Centers (ACs). Therefore, relative weights are first determined by VCE on solution level. The weights represent the noise levels of the individual monthly gravity fields as derived by iterative comparison to the weighted mean of all contributions (Fig. 8) as explained in detail by Yean et al. (2018).

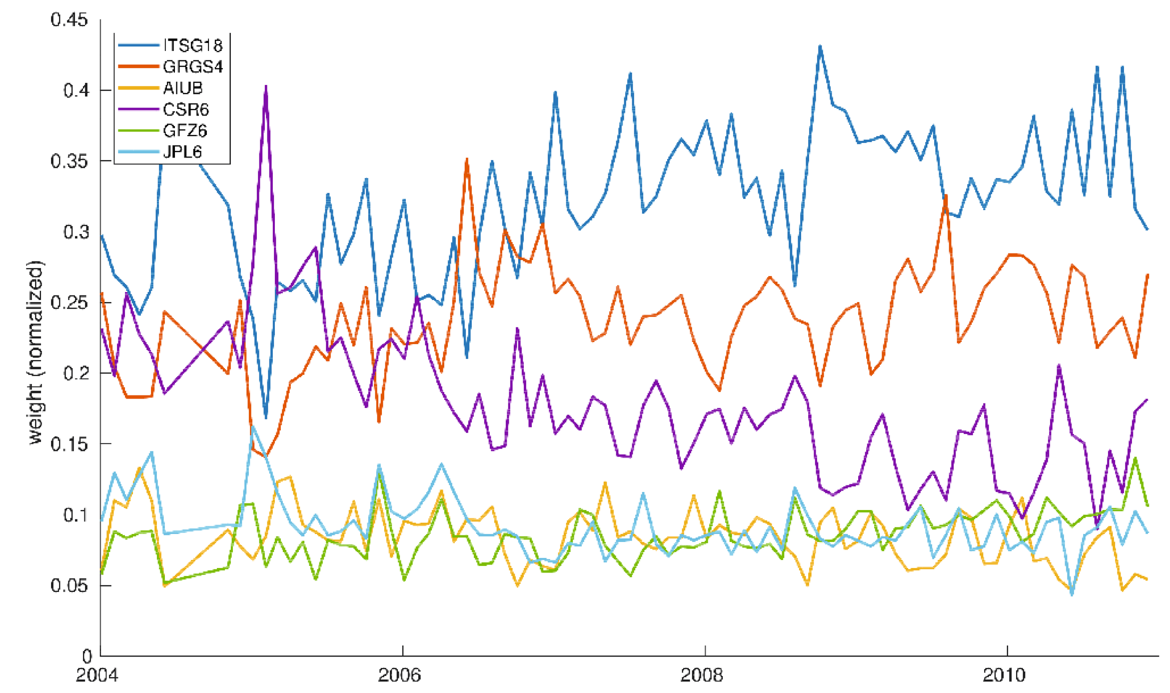

Figure 8: Normalized weights derived with VCE on solution level. These weights are representative for the individual noise levels under the assumption that differences between monthly solutions are dominated by noise, not background model issues.

4. Combination on solution level

To date, not all of the COST-G ACs provided NEQs of their monthly gravity fields. Therefore, the combination presented here is performed on solution level. In Figs. 4, 5 and 9 the noise assessment of the combined time-series is evaluated in the spectral and the spatial domain. With exception of the regularized GRGS-RL04 time-series the combined gravity fields are less noisy than all individual contributions.

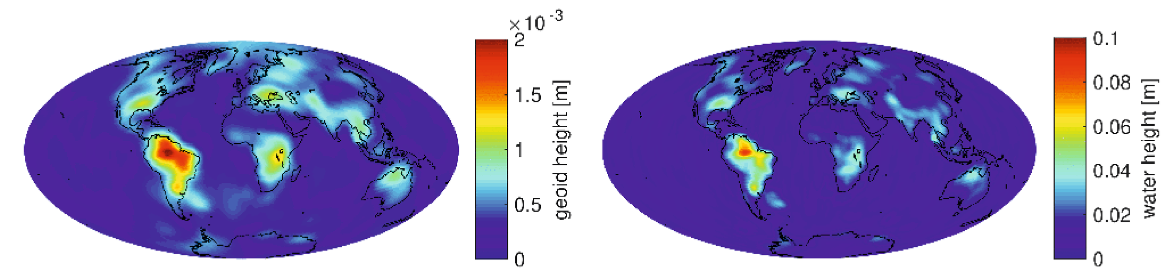

Figure 9: RMS of anomalies in the spatial domain for the combinatin on solution level expressed in geoid heights (left) and equivalent water heights (rigtht).

5. Discussion

We could demonstrate a significant reduction of the noise level of the individual time-series by performing a weighted combination on solution level. But our quality control also revealed problems in the individual time-series, like a regularization in GRGS-RL04 resulting in an attenuated mass trend over greenland (Fig. 3). Note that the final COST-G combination will be based on normal equations and the regularization in GRGS-RL04 that only takes place in their solution step, will not pose a problem.

Studying the spatial RMS of differences to the mean (Fig. 7) reveals further peculiarities of the individual contributions. While among all time-series studied AIUB-RL02 is the only one still based on L1B-RL02 and old processing standards, differences in the ocean model applied for de-aliasing are also visible for GRGS-RL04. Differences in large river basins in the case of ITSG2018 are related to filtering of the 1/161d-frequency by ITSG. Note the high consistency among the three RL06 time-series.

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References

Jean Y, Meyer U, Jäggi A (2018) Combination of GRACE monthly gravity field solutions from different processing strategies. Journal of Geodesy, Volume 92, Issue 11, pp 1313–1328

Meyer U, Jean Y, Kvas A, Dahle Ch, Lemoine JM, Jäggi A (2018) Combination of GRACE monthly gravity fields on the normal equation level. Submitted to Journal of Geodesy.

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