Release Notes for GRACE-FO L-2 products - version UTCSR RL-06.3

Last Product List Update: 2025-11-20 - Products for September 2025

Note Date 2025-11-20

0) This note supersedes (replaces) all previous Release Notes pertaining to the UTCSR-RL06.3 GRACE-FO Level-2 products.

1) The list of GRACE-FO RL-06.3 product files being made available to the users as of the date of this Release Note is given at the top of this message.

2) For each calendar month, in general four product files are available. For example, for the month of June 2018, the available products are:

GAC-2_2018152-2018181_GRFO_UTCSR_BC01_0603

GAD-2_2018152-2018181_GRFO_UTCSR_BC01_0603

GSM-2_2018152-2018181_GRFO_UTCSR_BA01_0603

GSM-2_2018152-2018181_GRFO_UTCSR_BB01_0603

2.1) The product file GSM-2_2018152-2018181_GRFO_UTCSR_????_0603 contains the coefficients for the Earth gravity field for the indicated span.

* The monthly gravity field solutions are unconstrained where the unconstrained gravity parameters are estimated seperately from other orbit related parameters.

* Coefficients are supplied to degree and order 60 (BA01) and 96 (BB01). This is the highest degree that was solved from the data for each month.

* The use of a suitable truncation or smoothing technique is recommended. Examples are available in the literature. The selection of the smoothing technique and the highest degree are left to the user's discretion.

* ONLY the formal error standard deviations (sigmas) of the estimated geopotential harmonics are contained in the GSM-2* products.

* Users desirous of replacing the C20 values of the GSM file with improved estimates are offered the option of using SLR-determined C20 values given in GRACE Technical Note - 11. Please see the CSR-L2 Proc Stds Doc and TN-11 for further information.

2.2) The product file GAC-2_2018152-2018181_GRFO_UTCSR_BC01_0603 contains the average of the Release-06 AOD1B product for the same span as was used in creating the monthly solution to degree and order 180

* Although this file contains the degree 0 and degree 1 harmonics for completeness, these harmonics were NOT used in Level-2 data processing.

* The averaging is carried out over a whole number of days - regardless of whether full or partial day's data were used in creating the GRACE-FO monthly solution.

* GAD-2_2018152-2018181_GRFO_UTCSR_BC01_0603: This is an ancillary product that represents the mean ocean bottom pressure. Please review the AOD1B Product Description Document for its complete definition and usage guidelines. Over the oceans, maps of GAC and GAD products will look the same only if degree 0 and degree 1 terms are included while drawing both the maps. Note, however, that degree-0 and degree-1 of the AOD products (from which GAC is derived) were not used in Level-2 data processing. The GAD* products were not used in GRACE-FO data processing, and are provided only as a service to the user community.

3) Level-2 products starting from and higher than Release-06 are released with the new header. The new header is written in YAML syntax.

4) Note the change in the filename convention from the previous versions:

A product name is specified as PID-2_YYYYDOY-YYYYDOY_dddd_sssss_mmmm_rrvv

Where,

PID is 3-character product identification mnemonic

-2 denotes a GRACE-FO Level-2 product

YYYYDOY-YYYYDOY specifies the date range (in year and day-of-year format) of the data used in creating this product

dddd specifies the gravity mission (GRFO for GRACE-FO)

sssss is an institution specific string

mmmm is a 4-character mnemonic used to identify the characteristics of the gravity solution

rrvv is a 2-digit (leading-zero-padded) release number and 2-digit (leading zero-padded) version number

The Product Identifier mnemonic (PID) is made up of one of the following values for each of its 3 characters:

1st Character

= G: Geopotential coefficients

2nd Character

= S: Estimate made from only GRACE-FO data

= C: Combination estimate from GRACE-FO and terrestrial gravity information

= A: Average of any background model over a time period

3rd Character

= M: Estimate of the Static field.

= U: Geopotential estimate relative to the background gravity model

= A: non-tidal atmosphere (see AOD1B Description Doc)

= B: non-tidal Oceans (see AOD1B Description Doc)

= C: combination of non-tidal atmosphere and ocean (see AOD1B Description Doc)

= D: bottom-pressure over oceans, zero over land (see AOD1B Description Doc)

The ‘dddd’ string specifies the gravity mission:

= GRAC: Gravity Recovery and Climate Experiment

= GRFO: GRACE Follow-On

The ‘sssss’ string specifies the institute where the data were processed:

= UTCSR: The University of Texas at Austin Center for Space Research

= JPLEM: NASA Jet Propulsion Laboratory

= GFZOP: GFZ German Research Centre for Geosciences

The ‘mmmm’ string is a 4-character mnemonic used to characterize the gravity solution. The first character is used to identify the primary observation type used in the gravity solution (Note: MWI = Micro Wave Instrument). The second character defines the size of the spherical harmonic expansion in the file. The third and fourth characters are used to represent other characteristics of the gravity solution, including the type of basis function used, whether it is an unconstrained or constrained solution, and the type of windowing function used. For any files that describe the average of a background model (where ‘A’ is the 2nd character in the PID), only the 2nd character in the ‘mmmm’ string is defined/applicable. The 1st, 3rd, and 4th characters are set to be equivalent to the corresponding gravity solution.

1st Character

= A: MWI range data

= B: MWI range-rate data

= C: MWI range-acceleration data

= D: LRI range data

= E: LRI range-rate data

= F: LRI range-acceleration data

2nd Character

= A: 60 x 60 spherical harmonic expansion

= B: 96 x 96 spherical harmonic expansion

= C: 180 x 180 spherical harmonic expansion

= D: 60 x 30 spherical harmonic expansion

3rd and 4th Characters

= 01: unconstrained spherical harmonic solution with a boxcar windowing function

5)

Geocenter:

Consistent with GRACE, GRACE-FO is not sensitive to degree 1 harmonics (geocenter). GRACE/GRACE-FO Technical Note TN-13[a,b,c] contains geocenter estimates using the methods of Swenson et al. [2008] and Sun et al. [2016], and is updated in synch with Level-2 monthly releases. These have been reprocessed for the entire GRACE and GRACE-FO time span to be consistent with the below-mentioned TN-14, so users need to replace the entire TN-13 time series. It is recommended to augment the GRACE and GRACE-FO geocenter

with this product for surface mass change estimation.

C20:

Consistent with the GRACE SDS recommendations, GRACE-FO SDS recommends the replacement of the native GRACE-FO C20 coefficient with that from SLR. Note that GRACE Technical Note TN-11 will no longer be updated; it is replaced by GRACE/GRACE-FO Technical Note TN-14. GRACE/GRACE-FO Technical Note TN-14 is now provided and contains both C20 and C30 estimates derived from SLR and using Level-2 RL06 standards, updated in synch with Level-2 monthly releases. It is recommended to replace/substitute the native GRACE and GRACE-FO C20 coefficients with this product [Loomis et al., 2019] for all months (04/2002 – current).

C30:

The GRACE-FO SDS has determined that the C30 coefficient in GRACE-FO shows comparatively more variability relative to the long-term climatology derived from the GRACE C30 coefficient. Therefore, SDS recommends that users assess the impact on regional mass budgets of substituting the GRACE-FO C3,0 coefficient with one derived from SLR (similar to the C20 approach).

GRACE/GRACE-FO Technical Note TN-14 is now provided and contains both C20 and C30 estimates derived from SLR and using Level-2 RL06 standards, updated in synch with Level-2 monthly releases.

It is recommended to replace/substitute the native GRACE and GRACE-FO C3,0 coefficients with this product [Loomis et al., 2020] from 08/2016 onwards (08/2016 – current).

Feedback is Requested:

The GRACE-FO project SDS is looking for feedback from the Science Team and wider community on the impact of C20 and C30 replacements, either from these or other candidate SLR time series, on regional mass balances to support the project in further improving the handling of low-degree harmonics in

GRACE and GRACE-FO data processing.

Differences between RL06.1 and RL06.2:

GPS handling for RL06.2 was re-assessed due to steady degradation in low degrees during late 2022 and 2023. Alterations in the processing of the GPS data were made to increase the volume of data available after editing. Additionally relative weighting between KBR and GPS was updated after June 2020 to use optimal weighting instead of capped weights for GPS used for RL06.1 solutions. The resulting RL06.2 time series shows improvement in the low degree coefficients after 2022.

Differences between RL06.2 and RL06.3:

Months that were in so-called 'wide deadband' mode were reprocessed using improved GF-2 Accelerometer data. Those months were Jan-Feb 2023 and July 2024 - present.
The solutions for all other months are the same as RL06.2 and have been renamed as RL06.3.

LIST OF AVAILABLE PRODUCTS: (see date of last update on Line-2 of this file)

GAC-2_2018152-2018181_GRFO_UTCSR_BC01_0603
GAC-2_2018182-2018199_GRFO_UTCSR_BC01_0603
GAC-2_2018295-2018313_GRFO_UTCSR_BC01_0603
GAC-2_2018305-2018334_GRFO_UTCSR_BC01_0603
GAC-2_2018335-2018365_GRFO_UTCSR_BC01_0603
GAC-2_2019001-2019031_GRFO_UTCSR_BC01_0603
GAC-2_2019026-2019066_GRFO_UTCSR_BC01_0603
GAC-2_2019060-2019090_GRFO_UTCSR_BC01_0603
GAC-2_2019091-2019120_GRFO_UTCSR_BC01_0603
GAC-2_2019121-2019151_GRFO_UTCSR_BC01_0603
GAC-2_2019152-2019181_GRFO_UTCSR_BC01_0603
GAC-2_2019182-2019212_GRFO_UTCSR_BC01_0603

GAC-2_2019213-2019243_GRFO_UTCSR_BC01_0603

GAC-2_2019244-2019273_GRFO_UTCSR_BC01_0603

GAC-2_2019274-2019304_GRFO_UTCSR_BC01_0603

GAC-2_2019305-2019334_GRFO_UTCSR_BC01_0603

GAC-2_2019335-2019365_GRFO_UTCSR_BC01_0603

GAC-2_2020001-2020031_GRFO_UTCSR_BC01_0603

GAC-2_2020032-2020060_GRFO_UTCSR_BC01_0603

GAC-2_2020061-2020091_GRFO_UTCSR_BC01_0603

GAC-2_2020092-2020121_GRFO_UTCSR_BC01_0603

GAC-2_2020122-2020152_GRFO_UTCSR_BC01_0603

GAC-2_2020153-2020182_GRFO_UTCSR_BC01_0603

GAC-2_2020183-2020213_GRFO_UTCSR_BC01_0603

GAC-2_2020214-2020244_GRFO_UTCSR_BC01_0603

GAC-2_2020245-2020274_GRFO_UTCSR_BC01_0603

GAC-2_2020275-2020305_GRFO_UTCSR_BC01_0603

GAC-2_2020306-2020335_GRFO_UTCSR_BC01_0603

GAC-2_2020336-2020366_GRFO_UTCSR_BC01_0603

GAC-2_2021001-2021031_GRFO_UTCSR_BC01_0603

GAC-2_2021032-2021059_GRFO_UTCSR_BC01_0603

GAC-2_2021060-2021090_GRFO_UTCSR_BC01_0603

GAC-2_2021091-2021120_GRFO_UTCSR_BC01_0603

GAC-2_2021121-2021151_GRFO_UTCSR_BC01_0603

GAC-2_2021152-2021181_GRFO_UTCSR_BC01_0603

GAC-2_2021182-2021212_GRFO_UTCSR_BC01_0603

GAC-2_2021213-2021243_GRFO_UTCSR_BC01_0603

GAC-2_2021244-2021273_GRFO_UTCSR_BC01_0603

GAC-2_2021274-2021304_GRFO_UTCSR_BC01_0603

GAC-2_2021305-2021334_GRFO_UTCSR_BC01_0603

GAC-2_2021335-2021365_GRFO_UTCSR_BC01_0603

GAC-2_2022001-2022031_GRFO_UTCSR_BC01_0603

GAC-2_2022032-2022059_GRFO_UTCSR_BC01_0603

GAC-2_2022060-2022090_GRFO_UTCSR_BC01_0603

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GAC-2_2022244-2022273_GRFO_UTCSR_BC01_0603

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GAC-2_2022305-2022334_GRFO_UTCSR_BC01_0603

GAC-2_2022335-2022365_GRFO_UTCSR_BC01_0603

GAC-2_2023001-2023031_GRFO_UTCSR_BC01_0603

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GSM-2_2019244-2019273_GRFO_UTCSR_BA01_0603

GSM-2_2019244-2019273_GRFO_UTCSR_BB01_0603

GSM-2_2019274-2019304_GRFO_UTCSR_BA01_0603

GSM-2_2019274-2019304_GRFO_UTCSR_BB01_0603

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GSM-2_2020032-2020060_GRFO_UTCSR_BB01_0603

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GSM-2_2020061-2020091_GRFO_UTCSR_BB01_0603

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