JPL Level-2 GRACE-FO Products - Release Notes
Version 6.0

Christopher M. McCullough, Eugene G. Fahnestock,
David N. Wiese, & Dah-Ning Yuan
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1 Overview

The following note accompanies the JPL GRACE-FO Level-2 products, version 6.0. It replaces any preceding release notes associated with the version 6.0 product release. For each month, there are typically 6 available products, as listed below where YYYY corresponds to a 4 digit year and DDD corresponds to a 3 digit day of year (for details see the Level-2 User Handbook [Yuan, 2019b]).

**GAA-2 YYYYDDD-YYYYDDD GRFO_JPLEM_BC01_0600**
The average of the ‘atm’ coefficients from the AOD1B RL06 product, for degree/order 180, over the same time span as the computed monthly solution. While the file contains values for degrees 0 and 1, these harmonic coefficients are not used in the JPL Level-2 data processing. Note that the averaging is computed over entire days, regardless of whether the full day (as opposed to a partial day) was included in the Level-2 data processing. For further details, see the RL06 AOD1B Product Description Document [Dobslaw et al., 2017].

**GAB-2 YYYYDDD-YYYYDDD GRFO_JPLEM_BC01_0600**
The average of the ‘ocn’ coefficients from the AOD1B RL06 product, for degree/order 180, over the same time span as the computed monthly solution. While the file contains values for degrees 0 and 1, these harmonic coefficients are not used in the JPL Level-2 data processing. Note that the averaging is computed over entire days, regardless of whether the full day (as opposed to a partial day) was included in the Level-2 data processing. For further details, see the RL06 AOD1B Product Description Document [Dobslaw et al., 2017].

**GAC-2 YYYYDDD-YYYYDDD GRFO_JPLEM_BC01_0600**
The average of the ‘glo’ coefficients from the AOD1B RL06 product, for degree/order 180, over the same time span as the computed monthly solution. These harmonic coefficients are modeled in the background during Level-2 data processing. While the file contains values for degrees 0 and 1, these harmonic coefficients are not used in the JPL Level-2 data processing. Note that the averaging is computed over entire days,
regardless of whether the full day (as opposed to a partial day) was included in the Level-2 data processing. For further details, see the RL06 AOD1B Product Description Document [Dobslaw et al., 2017].

**GAD-2 YYYYDDD-YYYYDDD_GRFO_JPLEM_BC01_0600**

The average of the ‘oba’ coefficients from the AOD1B RL06 product, for degree/order 180, over the same time span as the computed monthly solution. While the file contains values for degrees 0 and 1, these harmonic coefficients are not used in the JPL Level-2 data processing. Note that the averaging is computed over entire days, regardless of whether the full day (as opposed to a partial day) was included in the Level-2 data processing. For further details, see the RL06 AOD1B Product Description Document [Dobslaw et al., 2017].

**GSM-2 YYYYDDD-YYYYDDD_GRFO_JPLEM_BA01_0600**

The unconstrained monthly gravity field solution, computed out to degree/order 60.

**GSM-2 YYYYDDD-YYYYDDD_GRFO_JPLEM_BB01_0600**

The unconstrained monthly gravity field solution, computed out to degree/order 96. Note that due to satellite ground track coverage, this solution may not always be published.

## 2 General Usage Notes

For typical months, those where satellite ground track coverage is sufficient, 60x60 (BA01) and 96x96 (BB01) solutions are provided. It is left to the user’s discretion which solution best suits their particular application. Additionally, it is suggested that a suitable smoothing technique is applied, examples of which are available in the literature. The uncertainties provided with the gravity field solutions have NOT been calibrated and represent only the formal uncertainties.

### 2.1 Geocenter

Consistent with GRACE, GRACE-FO is not sensitive to degree 1 harmonics (geocenter). Candidate values for degree 1 coefficients are provided in TN-13, following the methods of Sun et al. [2016]. However, other techniques exist to derive and/or estimate degree 1 coefficients which users can take advantage of. Further details are available in the literature.

### 2.2 \( C_{2,0} \)

Consistent with the GRACE SDS recommendations, GRACE-FO SDS recommends the replacement of the native GRACE-FO \( C_{2,0} \) coefficient with that from SLR. Therefore, GRACE Technical Note TN-11 is being continued and contains a GRACE/GRACE-FO RL06-compatible SLR-\( C_{2,0} \) solution as was the case for GRACE [Cheng et al., 2013]; please note that a recent study by Loomis et al. [2019] provides an updated SLR-\( C_{2,0} \), which features some systematic differences from the SLR solution provided in TN-11. The Loomis et al. [2019] SLR-\( C_{2,0} \)
solution is provided in TN-14. Another GRACE/GRACE-FO RL06-compatible SLR-$C_{2,0}$
solution has recently been published by Konig et al. [2019].

2.3 $C_{3,0}$

The GRACE-FO SDS has determined that the $C_{3,0}$ coefficient in GRACE-FO shows com-
paratively more variability relative to the long-term climatology derived from the GRACE
$C_{3,0}$ coefficient. Therefore, SDS provisionally recommends that users assess the impact on
regional mass budgets by substituting the GRACE-FO $C_{3,0}$ coefficient with one derived
from SLR (similar to the $C_{2,0}$ approach). A candidate $C_{3,0}$ replacement value is provided in
Technical Note TN-14 [Loomis et al., 2019].

2.4 Feedback is Requested

The GRACE-FO project SDS is looking for feedback from the Science Team and wider
community on the impact of $C_{2,0}$ and $C_{3,0}$ 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.

3 Gravity Field Solutions

Gravity field solutions are outlined in Table 1. Each solution gives a general GSM filename
(with a Linux glob string inserted for the solution mnemonic), the first date included in the
solution, the last date included in the solution, the total number of days included in the
solution (accounting for any days that were skipped), the spherical harmonic solution sizes
available, and comments associated with each solution (for solution specific annotations).
Additionally, further details on filenames, formats, and further details and a more complete
overview of the processing see the Level-2 User Handbook [Yuan, 2019b] and Processing
Standards Document [Yuan, 2019a].
Table 1: Overview of gravity field solutions (GSM file-names are given using Linux glob strings).

<table>
<thead>
<tr>
<th>Gravity Field Solution</th>
<th>Span Start</th>
<th>Span End</th>
<th>Number of Days</th>
<th>Degree/Order</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM-2.2018152-2018181.GRFO_JPLEM_????_0600</td>
<td>2018-06-01</td>
<td>2018-06-30</td>
<td>29</td>
<td>60x60, 96x96</td>
<td>(1)</td>
</tr>
<tr>
<td>GSM-2.2018182-2018199.GRFO_JPLEM_????_0600</td>
<td>2018-07-01</td>
<td>2018-07-18</td>
<td>18</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2018295-2018313.GRFO_JPLEM_????_0600</td>
<td>2018-10-22</td>
<td>2018-11-09</td>
<td>19</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2018305-2018334.GRFO_JPLEM_????_0600</td>
<td>2018-11-01</td>
<td>2018-11-30</td>
<td>30</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2018335-2018365.GRFO_JPLEM_????_0600</td>
<td>2018-12-01</td>
<td>2018-12-31</td>
<td>31</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2019001-2019031.GRFO_JPLEM_????_0600</td>
<td>2019-01-01</td>
<td>2019-01-31</td>
<td>31</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2019026-2019063.GRFO_JPLEM_????_0600</td>
<td>2019-01-26</td>
<td>2019-03-04</td>
<td>25</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2019060-2019090.GRFO_JPLEM_????_0600</td>
<td>2019-03-01</td>
<td>2019-03-31</td>
<td>31</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2019091-2019120.GRFO_JPLEM_????_0600</td>
<td>2019-04-01</td>
<td>2019-04-30</td>
<td>30</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
<tr>
<td>GSM-2.2019121-2019151.GRFO_JPLEM_????_0600</td>
<td>2019-05-01</td>
<td>2019-05-31</td>
<td>31</td>
<td>60x60, 96x96</td>
<td>(2), (3)</td>
</tr>
</tbody>
</table>
4 Solution Comments

(1) The solution is parameterized using nominally 5 second KBR range-rate data and nominally 30 second GRACE-FO GPS data. The solved for local/common parameters include the satellite initial states (solved per arc - nominally 1 day), accelerometer biases/rates in the GRACE-FO SRF XYZ directions (solved per arc in the XZ directions and every 3 hours in the Y direction), a full accelerometer scale matrix (9 parameters solved per arc), GPS phase biases (solved per GPS satellite pass), and empirical biases/drifts/once per revolution sinusoids for the KBR range-rate data (solved every 90 minutes). The solved for global parameters include the spherical harmonic coefficients.

(2) The solution is parameterized using nominally 5 second KBR range-rate data and nominally 30 second GRACE-FO GPS data. The solved for local/common parameters include the satellite initial states (solved per arc - nominally 1 day), accelerometer biases/rates in the GRACE-FO SRF XYZ directions (solved per arc in the XZ directions and every 3 hours in the Y direction), GPS phase biases (solved per GPS satellite pass), and empirical biases/drifts/once per revolution sinusoids for the KBR range-rate data (solved every 90 minutes). The solved for global parameters include a full accelerometer scale matrix (9 parameters) and the spherical harmonic coefficients.

(3) Accelerometer data for GRACE-D is derived using the accelerometer data from GRACE-C (accelerometer transplant).

References


