



# GRACE Follow-On

## Science Data System Newsletter

Report: Apr – Sep 2021 (No. 18)

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## GRACE Follow-On Science Data System: Highlights & Updates

- The **2021 GRACE/GRACE-FO Science Team Meeting** took place Oct 13/14 & 20/21, 2021 as a fully-virtual online event. Over 220 registered participants presented and discussed 70+ papers, with extended small-group discussions in a virtual meeting space. [Abstract proceedings](#) are available, presentations will be available soon.
- As discussed during the STM, an orbit raise test maneuver was performed on Nov-03, 2021. Both GRACE-FO satellites were raised 500m, using approx. 220g of fuel on each satellite. During the 14-hour maneuver, no inter-satellite ranging measurements were taken. Both KBR and LRI links were quickly re-established after the successful maneuver completion, and science measurements have resumed.
- The following **Level1 & 2 SDS data products** are now available at NASA's Physical Oceanography Distributed Active Archive Center ([PO.DAAC](#)) and GFZ's Information System and Data Center ([ISDC](#)):
  - **Level-1** SDS data products through **Oct 2021**.
  - **Level-2** data products through **Sep 2021**.
- The following corresponding **Level-3 data** products (global, land, ocean, ice) are available:
  - JPL Tellus global mascon products:  
[https://grace.jpl.nasa.gov/data/get-data/jpl\\_global\\_mascons/](https://grace.jpl.nasa.gov/data/get-data/jpl_global_mascons/)
  - GFZ GravIS land, ocean and ice products:  
<http://gravis.gfz-potsdam.de/>
  - UT-CSR global mascon solutions:  
[http://www2.csr.utexas.edu/grace/RL06\\_mascons.html](http://www2.csr.utexas.edu/grace/RL06_mascons.html)
- Do you have exciting new GRACE-FO results, a conference presentation or paper publication you would like to share? Please send a copy of your GRACE and GRACE-FO related publications to [landerer@jpl.nasa.gov](mailto:landerer@jpl.nasa.gov) and [flechtne@gfz-potsdam.de](mailto:flechtne@gfz-potsdam.de) (please also consider a 1-slide highlight summary of the main findings).
- GRACE-FO Mission reference paper:



Landerer, F.W., Flechtner, F., et al., 2020, Extending the global mass change data record: GRACE Follow-On instrument and science data performance, *Geophys. Res. Lett.*, <https://doi.org/10.1029/2020GL088306>.

## Calendar & Upcoming Events:

- **GRACE / GRACE-FO Science Team Meeting 2022** will take place **Oct 17-21, 2022** at GFZ (Potsdam, Germany). We are planning for in-person meeting.
- **AGU Fall Meeting 2021 (13-17 Dec, 2021 – mixed in-person / online event)**
  - See <https://www.agu.org/Fall-Meeting> for [program and schedule](#) details

## GRACE Follow-On: Mission Status

### GRACE Follow-On: Orbit

The GRACE Follow-On orbital parameters on 20211122 (day 326) were as follows:

Sun Beta (deg)	-9
Absolute Distance (km)	212.1
Drift (km/d)	-0.06
Mean Altitude (>6378.1 km)	489.7
Decay Rate (GF1/GF2) (7d mean, m/d)	3.9 / 3.9

### Science-relevant Mission Events & Plans:

- Both accelerometers (ACCs) are operating and collecting observations in their nominal mode, Normal Range Mode (NRM). GF1 ACC data are used to generate an ACC transplant data product which is provided as the ACT1B product and should be used to substitute the GF2 ACC measurements (please check the ACT-Readme document for details at PO.DAAC).
- Center-of-Mass offset determinations are performed approx. every 6 months.
- Additional calibration periods, spacecraft activities and events are highlighted in the Level-1 v04 notes and event log below.



## Level-1, Level-2, Level-3 Data Products and Processing

### Level-1 Data Processing & Delivery

- [2020-07-10]: JPL SDS Level-1 has updated the v04 LRI data processing to (1) improve the removal of LRI phase jumps, and to (2) reduce the noise of the time-of-flight (TOF) correction for range-acceleration to the level of  $1 \text{ nm/s}^2$ ;

Please see Level-1 Release Notes for details.

- Level-1 data products (current version: v04), which are available at NASA's Physical Oceanography Distributed Active Archive Center (PO.DAAC) and GFZ's Information System and Data Center (ISDC), are continuously updated approximately every 7 days. The Level-1 data includes all data required for the generation of Level-2 gravity field products. Please refer to Level-1 release notes, documentation, as well as to the Sequence-of-Events (SOE) logfile for important updates, comments and detailed description of the data, file formats, and conventions (PO.DAAC / ISDC).

### KBR Performance Statistics

- [see Appendix 1A (p. 6)]

### Level-1 Data Product Availability

- [see Appendix 1B (p. 10) for GRACE-FO Level-1 data]
- [see Appendix 1C (p. 10) for de-aliasing AOD1B model data]

### Level-1 Release Notes & Sequence of Events

- [see Appendix 1D (p. 11)]

## Level-2 Data Processing & Delivery

### Level-2 Data availability

- Level-2 Release 06 data have been processed at JPL, GFZ and CSR and are archived at JPL PO.DAAC and GFZ ISDC. The Level-2 products include the monthly gravity fields from the three mission Science Data System centers (JPL, GFZ, CSR), as well as the corresponding atmosphere and ocean dealiasing (AOD) background model data.
- Please refer to the Level-2 Release Notes and documentation description of the data for file formats, updates, conventions, as well as important processing recommendations (PO.DAAC / ISDC).
- [see Appendix 2A (p. 11) for overview tables on data availability].

### Level-2 Ancillary Products and Comments

- TN-14 contains C20 & C30 estimates derived from SLR and using Level-2 RL06 standards, updated in synch with Level-2 monthly releases. It is recommended to replace the



native GRACE & GRACE-FO C20 & C30 coefficients with this product (Loomis et al., 2019).

- TN-13[a,b,c] contains geocenter estimates using the methods of Swenson et al. (2010) and Sun et al. (2016), and is updated in synch with Level-2 monthly releases. It is recommended to augment the GRACE / GRACE-FO geocenter with this product for surface mass change estimation.

### Level-3 Data Processing & Delivery & Availability

- SDS Level-3 monthly global grids of mass changes are generated by JPL and available at PO.DAAC.
- The following corresponding **Level-3 data** products (global, land, ocean, ice) are available:
  - JPL Tellus global mascon & SDS harmonic products:  
[https://grace.jpl.nasa.gov/data/get-data/jpl\\_global\\_mascons/](https://grace.jpl.nasa.gov/data/get-data/jpl_global_mascons/)
  - GFZ Gravis land, ocean and ice products:  
<http://gravis.gfz-potsdam.de/>
  - UT-CSR global mascon solutions:  
[http://www2.csr.utexas.edu/grace/RL06\\_mascons.html](http://www2.csr.utexas.edu/grace/RL06_mascons.html)
  - GSFC global mascon products:  
<https://earth.gsfc.nasa.gov/geo/data/grace-mascons>
- Interactive GRACE & GRACE-FO data browsers:
  - NASA/JPL: <https://grace.jpl.nasa.gov/data-analysis-tool>
  - GFZ: <http://gravis.gfz-potsdam.de/>

### Resources and Links:

#### SDS Data Archives (Level 1-3):

- JPL/NASA PO.DAAC (<http://podaac.jpl.nasa.gov>)
- GFZ ISDC (<https://isdc.gfz-potsdam.de/grace-fo-isdc>)

#### Miscellaneous Links:

- For GRACE Follow-On mission updates and news, please visit <https://gracefo.jpl.nasa.gov> and <http://gfz-potsdam.de/en/grace-fo>.
- The proceedings of previous GRACE / GRACE-FO Science Team Meetings are available at <https://www.gfz-potsdam.de/en/grace/>.
- **GRACE and GRACE-FO related publications** are available via searchable databases:
  - [http://www-app2.gfz-potsdam.de/pb1/op/grace/references/sort\\_date.html](http://www-app2.gfz-potsdam.de/pb1/op/grace/references/sort_date.html)
  - <https://grace.jpl.nasa.gov/publications/>



- If you are missing a publication, please send an e-mail to Frank Flechtner (flechtne@gfz-potsdam.de) and contact the JPL team via <https://grace.jpl.nasa.gov/about/feedback/>.



## Appendix

### 1.A - KBR Performance Statistics

#### KBR QUALITY ASSESSMENT

Key to columns in the table below

- 1) KBR1B product name
- 2) Total arc length with data (hours)
- 3) Number of observations used in KBR-GPS range residual calculation
- 4) KBR-GPS range residual RMS (mm)
- 5) Minimum KBR-GPS range residual (mm)
- 6) Maximum KBR-GPS range residual (mm)
- 7) Number of continuous segments in the KBR product

KBR1B_2021-05-01_Y_04.dat	24.0	17280	2.72	-12.6	12.1	1
KBR1B_2021-05-02_Y_04.dat	24.0	17280	2.62	-6.1	10.9	1
KBR1B_2021-05-03_Y_04.dat	24.0	17280	3.22	-14.3	10.4	1
KBR1B_2021-05-04_Y_04.dat	24.0	17280	3.95	-14.2	15.4	1
KBR1B_2021-05-05_Y_04.dat	24.0	17280	3.75	-11.6	14.4	1
KBR1B_2021-05-06_Y_04.dat	24.0	17193	3.07	-11.5	14.1	2
KBR1B_2021-05-07_Y_04.dat	24.0	17280	2.86	-10.9	10.9	1
KBR1B_2021-05-08_Y_04.dat	24.0	17280	3.34	-8.1	15.4	1
KBR1B_2021-05-09_Y_04.dat	24.0	17280	2.56	-8.8	8.3	1
KBR1B_2021-05-10_Y_04.dat	24.0	17280	2.73	-10.9	7.5	1
KBR1B_2021-05-11_Y_04.dat	24.0	17280	2.54	-10.7	11.4	1
KBR1B_2021-05-12_Y_04.dat	24.0	17280	3.56	-14.7	19.6	1
KBR1B_2021-05-13_Y_04.dat	24.0	17280	2.61	-15.3	9.5	1
KBR1B_2021-05-14_Y_04.dat	24.0	17280	2.86	-13.5	9.6	1
KBR1B_2021-05-15_Y_04.dat	24.0	17280	2.41	-7.5	10.3	1
KBR1B_2021-05-16_Y_04.dat	24.0	17280	2.43	-10.3	8.8	1
KBR1B_2021-05-17_Y_04.dat	24.0	17280	2.57	-6.3	10.7	1
KBR1B_2021-05-18_Y_04.dat	24.0	17280	2.52	-7.4	11.6	1
KBR1B_2021-05-19_Y_04.dat	24.0	17280	2.88	-12.9	9.7	1
KBR1B_2021-05-20_Y_04.dat	24.0	17280	2.89	-6.5	16.8	1
KBR1B_2021-05-21_Y_04.dat	24.0	17176	2.99	-10.6	11.5	2
KBR1B_2021-05-22_Y_04.dat	24.0	17280	2.96	-9.2	11.1	1
KBR1B_2021-05-23_Y_04.dat	24.0	17280	2.64	-8.1	8.9	1
KBR1B_2021-05-24_Y_04.dat	24.0	17280	2.45	-8.3	9.4	1
KBR1B_2021-05-25_Y_04.dat	24.0	17280	2.26	-8.9	7.0	1
KBR1B_2021-05-26_Y_04.dat	24.0	17192	2.92	-17.8	6.7	2
KBR1B_2021-05-27_Y_04.dat	24.0	17157	3.22	-16.9	9.1	2
KBR1B_2021-05-28_Y_04.dat	24.0	17103	3.22	-10.2	12.3	4
KBR1B_2021-05-29_Y_04.dat	24.0	17280	3.33	-16.4	11.5	1
KBR1B_2021-05-30_Y_04.dat	24.0	17280	2.48	-8.6	8.2	1
KBR1B_2021-05-31_Y_04.dat	24.0	16900	3.87	-17.4	8.4	3

## GRAVITY RECOVERY AND CLIMATE EXPERIMENT *Follow-On*



KBR1B_2021-06-01_Y_04.dat	24.0	17280	4.07	-13.2	13.0	1
KBR1B_2021-06-02_Y_04.dat	24.0	17280	4.23	-17.0	21.8	1
KBR1B_2021-06-03_Y_04.dat	24.0	17280	3.37	-13.7	8.9	1
KBR1B_2021-06-04_Y_04.dat	24.0	17280	3.49	-11.5	14.2	1
KBR1B_2021-06-05_Y_04.dat	24.0	17280	2.53	-11.3	8.3	1
KBR1B_2021-06-06_Y_04.dat	24.0	17280	2.97	-12.0	9.3	1
KBR1B_2021-06-07_Y_04.dat	24.0	17280	2.46	-9.9	10.2	1
KBR1B_2021-06-08_Y_04.dat	24.0	17280	2.48	-8.3	8.3	1
KBR1B_2021-06-09_Y_04.dat	24.0	17266	2.64	-10.2	10.7	2
KBR1B_2021-06-10_Y_04.dat	24.0	17206	2.43	-8.8	8.9	2
KBR1B_2021-06-11_Y_04.dat	24.0	17131	3.62	-14.1	9.8	2
KBR1B_2021-06-12_Y_04.dat	24.0	17280	2.75	-13.2	7.6	1
KBR1B_2021-06-13_Y_04.dat	24.0	17280	2.40	-11.6	6.4	1
KBR1B_2021-06-14_Y_04.dat	24.0	17280	2.64	-6.4	9.2	1
KBR1B_2021-06-15_Y_04.dat	24.0	17280	2.87	-10.6	9.3	1
KBR1B_2021-06-16_Y_04.dat	24.0	17280	3.23	-12.8	8.9	1
KBR1B_2021-06-17_Y_04.dat	24.0	17187	2.43	-9.2	10.3	2
KBR1B_2021-06-18_Y_04.dat	24.0	17280	2.36	-12.8	9.3	1
KBR1B_2021-06-19_Y_04.dat	24.0	17280	2.38	-11.0	6.8	1
KBR1B_2021-06-20_Y_04.dat	24.0	17280	2.16	-8.5	7.7	1
KBR1B_2021-06-21_Y_04.dat	24.0	17280	3.00	-10.7	12.1	1
KBR1B_2021-06-22_Y_04.dat	24.0	17280	2.81	-12.7	8.3	1
KBR1B_2021-06-23_Y_04.dat	24.0	17159	2.71	-9.0	12.0	2
KBR1B_2021-06-24_Y_04.dat	24.0	17280	3.12	-10.3	16.2	1
KBR1B_2021-06-25_Y_04.dat	24.0	17280	3.25	-14.4	11.1	1
KBR1B_2021-06-26_Y_04.dat	24.0	17280	2.36	-10.1	6.8	1
KBR1B_2021-06-27_Y_04.dat	24.0	17280	2.77	-8.2	10.1	1
KBR1B_2021-06-28_Y_04.dat	24.0	17280	2.27	-9.2	5.6	1
KBR1B_2021-06-29_Y_04.dat	24.0	17280	2.73	-9.9	15.5	1
KBR1B_2021-06-30_Y_04.dat	24.0	17280	3.23	-11.1	17.4	1
KBR1B_2021-07-01_Y_04.dat	24.0	17280	2.90	-8.7	14.4	1
KBR1B_2021-07-02_Y_04.dat	24.0	17280	2.72	-15.7	6.6	1
KBR1B_2021-07-03_Y_04.dat	24.0	17280	2.88	-10.2	12.0	1
KBR1B_2021-07-04_Y_04.dat	24.0	17280	2.65	-11.7	10.4	1
KBR1B_2021-07-05_Y_04.dat	24.0	17280	3.20	-11.1	16.5	1
KBR1B_2021-07-06_Y_04.dat	24.0	17167	3.86	-13.0	21.1	2
KBR1B_2021-07-07_Y_04.dat	24.0	17197	2.57	-8.3	8.3	2
KBR1B_2021-07-08_Y_04.dat	24.0	17027	2.52	-8.9	8.5	2
KBR1B_2021-07-09_Y_04.dat	24.0	16956	3.16	-15.5	14.0	3
KBR1B_2021-07-10_Y_04.dat	24.0	17280	3.29	-11.6	21.1	1
KBR1B_2021-07-11_Y_04.dat	24.0	17280	3.05	-11.5	11.2	1
KBR1B_2021-07-12_Y_04.dat	24.0	17167	2.93	-11.1	9.3	2
KBR1B_2021-07-13_Y_04.dat	24.0	17280	3.35	-17.1	15.5	1
KBR1B_2021-07-14_Y_04.dat	24.0	17183	3.31	-8.2	21.5	2
KBR1B_2021-07-15_Y_04.dat	24.0	17280	2.87	-8.9	12.5	1
KBR1B_2021-07-16_Y_04.dat	24.0	17086	4.13	-21.0	14.1	2
KBR1B_2021-07-17_Y_04.dat	24.0	17280	3.56	-18.9	11.6	1

## GRAVITY RECOVERY AND CLIMATE EXPERIMENT *Follow-On*



KBR1B_2021-07-18_Y_04.dat	24.0	17280	3.55	-15.4	16.8	1
KBR1B_2021-07-19_Y_04.dat	24.0	17179	2.53	-7.4	9.1	2
KBR1B_2021-07-20_Y_04.dat	24.0	17280	2.56	-9.8	14.1	1
KBR1B_2021-07-21_Y_04.dat	24.0	17173	2.40	-12.4	6.9	2
KBR1B_2021-07-22_Y_04.dat	24.0	17142	1.84	-8.0	6.9	2
KBR1B_2021-07-23_Y_04.dat	24.0	17179	1.65	-5.4	4.4	2
KBR1B_2021-07-24_Y_04.dat	24.0	17280	1.63	-8.2	4.1	1
KBR1B_2021-07-25_Y_04.dat	24.0	17280	1.58	-5.5	5.2	1
KBR1B_2021-07-26_Y_04.dat	24.0	17280	1.69	-4.1	6.7	1
KBR1B_2021-07-27_Y_04.dat	24.0	17280	1.53	-6.0	3.8	1
KBR1B_2021-07-28_Y_04.dat	24.0	17280	1.52	-4.4	4.9	1
KBR1B_2021-07-29_Y_04.dat	24.0	17280	1.75	-5.4	5.7	1
KBR1B_2021-07-30_Y_04.dat	24.0	17175	1.64	-5.0	5.5	2
KBR1B_2021-07-31_Y_04.dat	24.0	17280	1.58	-6.3	4.8	1
KBR1B_2021-08-01_Y_04.dat	24.0	17280	1.62	-5.0	5.8	1
KBR1B_2021-08-02_Y_04.dat	24.0	17280	1.51	-5.1	4.3	1
KBR1B_2021-08-03_Y_04.dat	24.0	17280	1.60	-5.4	5.8	1
KBR1B_2021-08-04_Y_04.dat	24.0	17280	1.52	-4.0	5.4	1
KBR1B_2021-08-05_Y_04.dat	24.0	17280	1.66	-6.4	5.5	1
KBR1B_2021-08-06_Y_04.dat	24.0	17141	1.80	-4.4	7.9	2
KBR1B_2021-08-07_Y_04.dat	24.0	17280	4.74	-7.6	39.5	1
KBR1B_2021-08-08_Y_04.dat	24.0	17280	1.58	-6.6	5.1	1
KBR1B_2021-08-09_Y_04.dat	24.0	17280	1.59	-5.4	7.4	1
KBR1B_2021-08-10_Y_04.dat	24.0	17280	1.50	-3.7	4.5	1
KBR1B_2021-08-11_Y_04.dat	24.0	17280	1.92	-5.1	6.6	1
KBR1B_2021-08-12_Y_04.dat	24.0	17280	1.65	-5.2	4.3	1
KBR1B_2021-08-13_Y_04.dat	24.0	17280	1.67	-4.4	6.9	1
KBR1B_2021-08-14_Y_04.dat	24.0	17280	1.57	-5.3	4.3	1
KBR1B_2021-08-15_Y_04.dat	24.0	17280	1.61	-4.2	4.1	1
KBR1B_2021-08-16_Y_04.dat	24.0	17147	1.75	-6.6	5.4	2
KBR1B_2021-08-17_Y_04.dat	24.0	17280	1.71	-5.6	5.2	1
KBR1B_2021-08-18_Y_04.dat	24.0	17280	1.65	-5.3	5.6	1
KBR1B_2021-08-19_Y_04.dat	24.0	17280	1.76	-5.1	6.5	1
KBR1B_2021-08-20_Y_04.dat	24.0	17280	1.60	-5.5	4.4	1
KBR1B_2021-08-21_Y_04.dat	24.0	17280	1.57	-5.5	6.5	1
KBR1B_2021-08-22_Y_04.dat	24.0	17280	1.50	-4.9	6.0	1
KBR1B_2021-08-23_Y_04.dat	24.0	17280	1.85	-5.3	6.5	1
KBR1B_2021-08-24_Y_04.dat	24.0	17280	1.83	-5.8	7.3	1
KBR1B_2021-08-25_Y_04.dat	24.0	17280	1.56	-5.0	4.3	1
KBR1B_2021-08-26_Y_04.dat	24.0	17280	1.76	-7.8	4.4	1
KBR1B_2021-08-27_Y_04.dat	24.0	17280	1.51	-5.4	5.4	1
KBR1B_2021-08-28_Y_04.dat	24.0	17280	2.02	-5.5	5.5	1
KBR1B_2021-08-29_Y_04.dat	24.0	17280	1.81	-7.5	8.0	1
KBR1B_2021-08-30_Y_04.dat	24.0	17280	1.40	-3.3	5.6	1
KBR1B_2021-08-31_Y_04.dat	24.0	17280	1.68	-5.9	4.9	1
KBR1B_2021-09-01_Y_04.dat	24.0	17280	1.58	-5.4	5.4	1
KBR1B_2021-09-02_Y_04.dat	24.0	17280	1.51	-4.9	5.1	1

## GRAVITY RECOVERY AND CLIMATE EXPERIMENT *Follow-On*



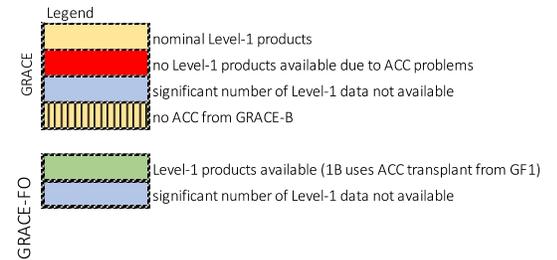
KBR1B_2021-09-03_Y_04.dat	24.0	17280	1.77	-4.4	6.1	1
KBR1B_2021-09-04_Y_04.dat	24.0	17280	1.77	-6.9	6.0	1
KBR1B_2021-09-05_Y_04.dat	24.0	17280	1.91	-6.1	6.9	1
KBR1B_2021-09-06_Y_04.dat	24.0	17280	1.52	-6.5	5.9	1
KBR1B_2021-09-07_Y_04.dat	24.0	17280	1.47	-3.7	5.1	1
KBR1B_2021-09-08_Y_04.dat	24.0	17280	1.63	-4.0	5.1	1
KBR1B_2021-09-09_Y_04.dat	24.0	17280	1.33	-5.0	3.2	1
KBR1B_2021-09-10_Y_04.dat	24.0	17280	1.52	-5.2	4.6	1
KBR1B_2021-09-11_Y_04.dat	24.0	17280	1.54	-4.7	5.7	1
KBR1B_2021-09-12_Y_04.dat	24.0	17280	1.46	-4.1	4.3	1
KBR1B_2021-09-13_Y_04.dat	24.0	17280	1.76	-6.2	4.9	1
KBR1B_2021-09-14_Y_04.dat	24.0	17280	1.68	-5.2	6.0	1
KBR1B_2021-09-15_Y_04.dat	24.0	17280	1.53	-4.2	4.5	1
KBR1B_2021-09-16_Y_04.dat	24.0	17280	1.72	-6.1	4.5	1
KBR1B_2021-09-17_Y_04.dat	24.0	17280	1.70	-6.7	5.3	1
KBR1B_2021-09-18_Y_04.dat	24.0	17280	1.49	-5.2	4.4	1
KBR1B_2021-09-19_Y_04.dat	24.0	17280	1.61	-4.2	5.3	1
KBR1B_2021-09-20_Y_04.dat	24.0	17280	1.49	-4.0	5.7	1
KBR1B_2021-09-21_Y_04.dat	24.0	17280	1.88	-6.0	6.7	1
KBR1B_2021-09-22_Y_04.dat	24.0	17280	1.82	-8.7	5.7	1
KBR1B_2021-09-23_Y_04.dat	24.0	17280	1.96	-8.2	5.0	1
KBR1B_2021-09-24_Y_04.dat	24.0	17051	1.87	-5.3	4.9	2
KBR1B_2021-09-25_Y_04.dat	24.0	17280	1.35	-4.8	3.9	1
KBR1B_2021-09-26_Y_04.dat	24.0	17280	1.96	-7.0	7.1	1
KBR1B_2021-09-27_Y_04.dat	24.0	17280	1.41	-4.9	5.3	1
KBR1B_2021-09-28_Y_04.dat	24.0	17280	1.87	-5.6	7.6	1
KBR1B_2021-09-29_Y_04.dat	24.0	17280	1.59	-3.9	3.8	1
KBR1B_2021-09-30_Y_04.dat	24.0	17280	1.91	-5.4	7.1	1
KBR1B_2021-10-01_Y_04.dat	24.0	17280	1.53	-5.6	4.5	1
KBR1B_2021-10-02_Y_04.dat	24.0	17280	1.57	-5.4	5.7	1
KBR1B_2021-10-03_Y_04.dat	24.0	17280	1.52	-4.9	4.4	1
KBR1B_2021-10-04_Y_04.dat	24.0	17280	1.65	-4.0	5.0	1
KBR1B_2021-10-05_Y_04.dat	24.0	17280	1.82	-4.8	6.0	1
KBR1B_2021-10-06_Y_04.dat	24.0	17280	1.68	-5.9	7.2	1
KBR1B_2021-10-07_Y_04.dat	24.0	17280	1.81	-6.5	6.6	1
KBR1B_2021-10-08_Y_04.dat	24.0	17280	1.39	-5.6	3.9	1
KBR1B_2021-10-09_Y_04.dat	24.0	17280	1.50	-4.4	3.9	1
KBR1B_2021-10-10_Y_04.dat	24.0	17280	1.82	-5.5	6.4	1
KBR1B_2021-10-11_Y_04.dat	24.0	17280	1.50	-4.2	6.0	1
KBR1B_2021-10-12_Y_04.dat	24.0	17280	1.48	-4.4	4.4	1
KBR1B_2021-10-13_Y_04.dat	24.0	17280	1.57	-4.8	5.0	1
KBR1B_2021-10-14_Y_04.dat	24.0	17280	1.73	-9.2	5.2	1
KBR1B_2021-10-15_Y_04.dat	24.0	17280	1.89	-6.1	7.6	1
KBR1B_2021-10-16_Y_04.dat	24.0	17280	1.56	-5.2	4.3	1
KBR1B_2021-10-17_Y_04.dat	24.0	17280	1.63	-4.2	8.8	1
KBR1B_2021-10-18_Y_04.dat	24.0	17280	1.48	-4.3	4.8	1
KBR1B_2021-10-19_Y_04.dat	24.0	17280	1.81	-6.5	6.2	1



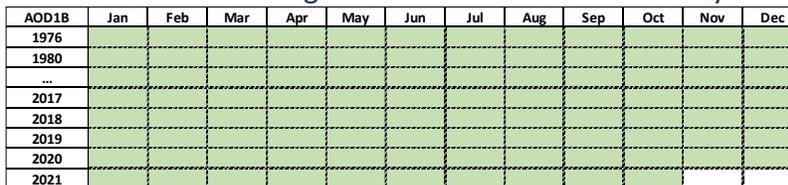
KBR1B_2021-10-20_Y_04.dat	24.0	17175	1.66	-5	5.2	2
KBR1B_2021-10-21_Y_04.dat	24.0	17280	1.46	-4.2	4.1	1
KBR1B_2021-10-22_Y_04.dat	24.0	17280	1.57	-7.2	4.9	1
KBR1B_2021-10-23_Y_04.dat	24.0	17280	1.69	-5.6	5.4	1
KBR1B_2021-10-24_Y_04.dat	24.0	17280	1.46	-6.9	4.9	1
KBR1B_2021-10-25_Y_04.dat	24.0	17280	1.84	-6.4	5.9	1
KBR1B_2021-10-26_Y_04.dat	24.0	17280	1.73	-5.9	8.0	1
KBR1B_2021-10-27_Y_04.dat	24.0	17280	1.70	-6.7	5.4	1
KBR1B_2021-10-28_Y_04.dat	24.0	17280	1.77	-4.5	7.6	1
KBR1B_2021-10-29_Y_04.dat	24.0	17280	1.82	-4.3	8.6	1
KBR1B_2021-10-30_Y_04.dat	24.0	17280	1.93	-5.7	5.9	1
KBR1B_2021-10-31_Y_04.dat	24.0	17280	2.16	-5.5	8.4	1

### 1.B – Level-1 GRACE-FO Data Availability

Table 1: Current version: Level-1 v04.



### 1.C – Level-1 De-aliasing Model AOD1B Data Availability



- For more information on the AOD de-aliasing AOD1B model please visit <https://www.gfz-potsdam.de/en/aod1b/>.



## 1.D - Level-1 Release Notes & Sequence of Events

See table below for current release period. All times in UTC:

2021-05-05	GRACE-D Due to incorrect GPS solution satellite attitude was unstable for 20 sec at 22:07. Due to attitude anomaly on GF2, LRI dropped to re-acquisition mode for ca. 2min at 22:07.
2021-05-06	GPS PRN#26 was disabled in the IPU's (01:10 through 14:41) due to an announced period of unavailability. GRACE-D IPU reboot (commanded) at 14:45:40 GRACE-C IPU reboot (commanded) at 14:50:00
2021-05-20	GPS PRN#28 was disabled in the IPU's at 11:03 due to an announced period of unavailability.
2021-05-21	GRACE-C A new TC to clear GPS Almanac (NMWI_6399) was at 00:34. RI-1742 was executed following the new flight rule to Clear Predict Almanac instead of a command soft restart on GF1 after the schedule PRN 28 outage, but unfortunately, GF1 IPU still was not able to reacquire PRN 28. GRACE-D IPU reboot (spontaneous) at 03:05:40, GPS PRN#28 was enabled in the IPU
2021-05-26	GRACE-C IPU reboot (commanded) at 21:04:50, reboot was commanded because PRN#28 never reacquired after 2021-05-21 reboot
2021-05-27	GRACE-D IPU reboot (spontaneous) at 18:40:30 GPS PRN #22 was disabled at 2021-05-27 23:15 due to an announced period of unavailability
2021-05-28	GRACE-D IPU reboot (commanded) at 12:50:40 to enable GPS PRN #22 GRACE-C IPU reboot (commanded) at 17:34:30 to enable GPS PRN #22 K/Ka band trackers restarted autonomously by the onboard MI monitor at approximately 18:13 GRACE-D The IPU DSP channels 21, 22 and 23 have not been outputting data since around 15:44 UTC
2021-05-31	GRACE-C K/Ka band trackers restarted autonomously by the onboard MI monitor at approximately 04:38 GRACE-D IPU reboot (commanded) at 17:35:30 GRACE-D IPU reboot (spontaneous) at 17:49:40 The channels 21, 22, and 23 were recovered around 17:55 UTC
2021-06-01	The satellites were transitioned from relative pointing to nadir pointing at 152/00:00. They will continue nadir pointing for the next two days in order to help characterize the difference in drag between GF1 and GF2. These nadir pointing characterizations will occur two days per week over the next month or so. LRI mirror scanning is disabled during the two day characterization.
2021-06-03	The satellites were transitioned back to relative pointing at 154/00:00. Mirror scanning was re-enabled in the LRIs five minutes later and a warm restart was commanded. The LRIs failed to reacquire and enter science mode. They remain in reacquisition mode.
2021-06-04	LRI switched to Diagnostic Mode at 00:17 after being in Re-Acquisition Mode for 24 hours.
2021-06-06	LRIs were restarted at 23:57, but remain in diagnostic mode.
2021-06-07	Satellites were transitioned from relative pointing to nadir pointing at 00:00
2021-06-09	The satellites were transitioned back to relative pointing at 00:00

## GRAVITY RECOVERY AND CLIMATE EXPERIMENT *Follow-On*



The LRIs were both restarted at 00:15, and entered science mode at 00:19  
New LRI parameter file and frequency updated at 16:10, then restarted at 16:24  
LRI reacquired at 16:28 after the parameter update  
GRACE-D KBR Missed Interrupt occurred at 21:20

2021-06-10 GRACE-D KBR restart tracker command was sent at 04:15  
GPS PRN #31 will be disabled from 18:15 to 07:46

2021-06-11 GRACE-D IPU reboot (commanded) at 07:50:40 to re-enable PRN #31  
GRACE-C IPU reboot (commanded) at 07:55:40 to re-enable PRN #31

2021-06-13 The LRIs on both satellites were restarted to Diagnostic Mode at 23:57.  
GRACE-D Possible micrometeoroid impact at 19:09:10 (delta-v of approximately -0.116 microns/sec).

2021-06-14 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-06-16 The satellites were transitioned back to relative pointing at 00:00. The LRIs on both satellites were restarted at 00:15 and entered Science Mode.

2021-06-17 GRACE-D IPU reboot (commanded) at 17:03:50

2021-06-20 GRACE-C GPS PRN #28 disabled at 13:23  
The LRIs were both restarted to diagnostic mode at 23:57

2021-06-21 The satellites were transitioned from relative pointing to nadir pointing at 00:00  
GRACE-D LRI was changed to master to check the status of the LRI cavity  
GRACE-D GPS PRN #28 disabled at 01:47  
GRACE-D autonomous KBR Missed Interrupt Handling was enabled at 14:35

2021-06-23 The satellites were transitioned from nadir pointing to relative pointing at 00:00  
GRACE-D LRI ws changed to transponder role at 00:15 and restarted  
LRI mirror scanning was not enabled as expected at 00:05, and wasn't enabled until 13:53  
LRI entered Science Mode at 13:54  
GRACE-D IPU reboot (spontaneous) at 15:41:10

2021-06-26 GRACE-C Possible micrometeoroid impact at 11:57:29 (delta-v of approximately 0.095 microns/sec).  
GRACE-D Possible micrometeoroid impact at 06:33:35 (delta-v of approximately 0.112 microns/sec).  
Possible micrometeoroid impact at 14:47:39 (delta-v of approximately -0.403 microns/sec).

2021-06-27 GRACE-D The LRI was set to master role and restarted at 23:55  
The LRI was commanded to Diagnostic Mode at 23:59:30

2021-06-28 The satellites were transitioned from relative pointing to nadir pointing at 00:00.  
LRI diagnostic tests were performed on both satellites:  
- cavity scan was performed at 01:00 and the LRI was restarted at 01:38.  
- PMH temperature scan was performed at 03:00 and the LRI was restarted at 08:13.  
LRI remains in Diagnostic Mode.

2021-06-30 GRACE-C The LRI was commanded to Reacquisition Mode at 00:06.  
GRACE-D The LRI was set to Transponder role at 00:15 and restarted to Reacquisition Mode.  
GRACE-D: DSP channels 36, 37, and 38 stopped outputting data at approximately 2021-06-30 13:30  
The satellites were transitioned back to relative pointing at 00:00. LRI entered Science Mode at 00:19.



2021-07-01 GRACE-C Possible micrometeoroid impact at 11:36:30 (delta-v of approximately -0.307 microns/sec).

2021-07-04 The LRIs were restarted to Diagnostic Mode at 23:57

2021-07-05 Both satellites were transitioned from relative pointing to nadir pointing at 00:00

2021-07-06 GRACE-D IPU reboot (commanded) at 09:39:00 to re-enable DSP channels 36, 37, and 38

2021-07-07 The satellites were transitioned back to relative pointing at 00:00. LRIs entered Science Mode at 00:08.  
GRACE-D IPU reboot (spontaneous) at 16:33:50

2021-07-08 GRACE-D IPU reboot (spontaneous) at 03:23:30  
GRACE-D IPU autonomous MI event detected and trackers restarted at 03:37:52

2021-07-09 GPS PRN #06 is disabled in the IPU's from 04:15 to 17:46  
GRACE-D IPU reboot (commanded) at 17:50:40 to re-enable PRN #06  
GRACE-C IPU reboot (commanded) at 17:56:10 to re-enable PRN #06

2021-07-11 The LRIs on both satellites were restarted to Diagnostic Mode at 23:57.

2021-07-12 The satellites were transitioned from relative pointing to nadir pointing at 00:00.  
GRACE-D IPU reboot (spontaneous) at 02:41:40

2021-07-14 The satellites were transitioned back to relative pointing at 00:00.  
LRI low CNR test started on both satellites.  
- At 00:10 a low CNR parameter file was installed  
- At 00:13 LRI was restarted and re-acquired the link at 00:17  
GRACE-D IPU reboot (spontaneous) at 13:02:20

2021-07-15 Ongoing LRI low CNR test.

2021-07-16 GRACE-D IPU reboot (commanded) at 03:20:40  
GRACE-C IPU reboot (commanded) at 03:30:50  
GPS PRN#06 was enabled in the IPU's at 03:16 due to an announced period of unavailability.  
The LRI low CNR test was completed at 04:00: the nominal parameter files were restored and the LRIs restarted to Science Mode.

2021-07-18 GRACE-D Possible micrometeoroid impact at 04:40:38 (delta-v of approximately 0.419 microns/sec).

2021-07-19 GRACE-D undergoing IPU S/W upload starting at 08:20  
GRACE-D IPU reboot (commanded) at 08:20:40

2021-07-20 GRACE-D Possible micrometeoroid impact at 05:30:58 (delta-v of approximately 0.149 microns/sec).

2021-07-21 GRACE-D IPU reboot (commanded) at 12:58 to enable new IPU software  
GSOC has completed V4.4/V4.3 software upload to GF2 IPU, so we now have the same flight software running on both GF1 and GF2.  
GRACE-D max number of GPS satellites set to 11 at 13:01

2021-07-22 GRACE-D IPU reboot (spontaneous) at 13:03:00 ,  
GPS PRN #05 disabled from 15:00 to 2021-07-23 04:31 due to an announced period of unavailability

2021-07-23 GRACE-C IPU reboot (commanded) at 04:39:10 to re-enable GPS PRN #05 ,  
GRACE-D IPU reboot (commanded) at 04:39:10 to re-enable GPS PRN #05 ,  
Possible micrometeoroid impact at 04:24:57 (delta-v of approximately -0.185 microns/sec).

2021-07-25 The LRIs on both satellites were restarted to Diagnostic Mode at 23:57.

2021-07-26 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-07-28 The satellites were transitioned back to relative pointing at 00:00.



LRIs on both were commanded to Reacquisition Mode at 00:06 and entered Science Mode at 00:08.

2021-07-30 GRACE-D IPU reboot (commanded) at 18:24:30  
GRACE-C IPU reboot (commanded) at 18:25:10

2021-07-31 GPS PRN#14 was disabled in the IPU's (04:45 - 18:16) due to an announced period of unavailability.

2021-08-01 LRIs were restarted to Diagnostic mode at 23:59

2021-08-02 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-08-04 The satellites were transitioned back to relative pointing at 00:00.  
LRIs on both were commanded to Reacquisition Mode at 00:05 and entered Science Mode at 00:08.

2021-08-06 GPS PRN#03 was disabled in the IPU's (00:15 - 13:46) due to an announced period of unavailability.  
GRACE-D: IPU reboot (commanded) at 13:59:30  
GRACE C: IPU reboot (commanded) at 13:59:40

2021-08-08 The LRIs on both satellites were restarted to Diagnostic Mode at 23:59.

2021-08-09 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-08-11 The satellites were transitioned back to relative pointing at 00:00.  
LRIs on both satellites were commanded to Reacquisition Mode at 00:05 and entered Science Mode shortly thereafter.  
GRACE-C Possible micrometeoroid impact at 16:23:58 (delta-v of approximately 0.057 microns/sec in LOS).

2021-08-15 The LRIs on both satellites were restarted to Diagnostic Mode at 23:59.

2021-08-16 The satellites were transitioned from relative pointing to nadir pointing at 00:00.  
GRACE D: IPU reboot (spontaneous) at 03:48:20

2021-08-18 The satellites were transitioned back to relative pointing at 00:00.  
LRIs on both satellites were commanded to Reacquisition Mode at 00:05 and entered Science Mode shortly thereafter.

2021-08-20 GRACE-D At 07:28 an autonomous STRE switch-over A to B occurred.  
At 11:31 the first recovery steps were executed from ground:  
all MTL SSIDs except 7\* was enabled  
aberration correction for STRE-B was enabled

2021-08-23 GRACE-D MTL SSID (Mission Timeline Sub-Schedule ID) 7 was enabled at 17:35.

2021-08-26 GRACE-D STRE was successfully switched back from branch B to A at 13:15.

2021-08-29 The LRIs on both satellites were restarted to Diagnostic Mode at 23:59.

2021-08-30 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-09-01 The satellites were transitioned back to relative pointing at 00:00.  
LRIs on both satellites were commanded to Reacquisition Mode at 00:05 and entered Science Mode shortly thereafter.  
L2C Radio Occultations enabled for PRN 13 and 23 at 21:05

2021-09-05 Center-of-Mass Calibrations (CMCal) were performed on both satellites in NOM-AH.  
Due to sun blinding on each satellite one Star Tracker head was disabled in the AOCS processing for the CMCal maneuvers.  
GRACE-C The satellite was in NOM-AH mode from 20:36 2021-09-05 to 11:20 2021-09-06.  
At 20:45 STR3 was disabled in the AOCS processing.

## GRAVITY RECOVERY AND CLIMATE EXPERIMENT *Follow-On*



CMCal maneuvers were executed from 2021-09-05 to 2021-09-06:  
Pitch: 20:54, 05:55, 07:33  
Roll: 02:46, 04:20  
Yaw: 09:30, 11:05  
At 11:15 STR3 was enabled in the AOCS processing.  
GRACE-D The satellite was in NOM-AH mode from 21:31 2021-09-05 to 11:05 2021-09-06.  
At 21:40 2021-09-05 STR2 was disabled in the AOCS processing.  
CMCal maneuvers were executed from 2021-09-05 to 2021-09-06:  
Pitch: 06:07, 07:42, 08:51  
Roll: 02:57, 04:33,  
Yaw: 21:49, 23:24  
At 09:00 STR2 was enabled in the AOCS processing.

2021-09-11 Flex power was on globally from 9-11 to 9-15. Before we saw some changes in POD stats (minor effects), probably will again. - willy,

2021-09-12 The LRIs on both satellites were restarted to Diagnostic Mode at 23:59.

2021-09-13 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-09-15 The satellites were transitioned back to relative pointing at 00:00.  
LRIs on both satellites were commanded to Reacquisition Mode at 00:05 and entered Science Mode shortly thereafter.

2021-09-24 GPS PRN#25 was disabled in the IPU's (01:45 - 15:16) due to an announced period of unavailability.  
GRACE-C IPU reboot (commanded) at 15:22:40.0000  
GRACE-D IPU reboot (commanded) at 15:23:30.0000

2021-09-26 The LRIs on both satellites were restarted to Diagnostic Mode at 23:59.

2021-09-27 The satellites were transitioned from relative pointing to nadir pointing at 00:00.

2021-09-29 The satellites were transitioned back to relative pointing at 00:00.  
LRIs on both satellites were commanded to Reacquisition Mode at 00:05 and entered Science Mode shortly thereafter.

2021-10-19 GRACE-C Possible micrometeoroid impact at 19:27:36 (delta-v of approximately 0.127 microns/sec).

2021-10-20 GRACE-C IPU reboot (spontaneous) at 14:29:50  
GRACE-D At 15:10 the settings of radio occultation measurements were modified to:  
azimuth: 55 deg  
start altitude: 125 km  
OL to EL transition: -15 km  
end altitude: -180 km

2021-10-23 GRACE-D Possible micrometeoroid impact at 18:17:53 (delta-v of approximately -0.131 microns/sec).

2021-10-26 GRACE-D Possible micrometeoroid impact at 12:24:26 (delta-v of approximately -0.209 microns/sec).

2021-10-27 GPS PRN#03 was disabled in the IPU's at 13:30 due to an announced period of unavailability. It will be enabled again on 10-Nov. -cvolk

2021-10-30 LRIs were restarted to Diagnostic Mode at 23:59.

2021-10-31 The satellites were in nadir-pointing from 31-Oct 00:00 through 02-Nov 00:00.



For the period in relative pointing the LRIs on both satellites were commanded to Diagnostic Mode.

2.A – Level-2 Product and Data Availability

JPL, GFZ & CSR

- Current Level-2 version: RL06
- All centers provide GSM solutions
  - Please check the Level-2 Release Notes for further details
- JPL and GFZ provide corresponding monthly de-aliasing models [GAA, GAB, GAC, GAD]; CSR provides [GAC, GAD].

Table 2: GRACE and GRACE-FO Level-2 product availability.

Level-2 (JPL)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002				1	2			3	4	5	6	7
2003	8	9	10	11	12		13	14	15	16	17	18
2004	19	20	21	22	23	24	25	26	27	28	29	30
2005	31	32	33	34	35	36	37	38	39	40	41	42
2006	43	44	45	46	47	48	49	50	51	52	53	54
2007	55	56	57	58	59	60	61	62	63	64	65	66
2008	67	68	69	70	71	72	73	74	75	76	77	78
2009	79	80	81	82	83	84	85	86	87	88	89	90
2010	91	92	93	94	95	96	97	98	99	100	101	102
2011		103	104	105	106		107	108	109	110	111	112
2012	113	114	115	116		117	118	119	120		121	122
2013	123	124		125	126	127	128			129	130	131
2014	132		133	134	135	136		137	138	139	140	
2015	141	142	143	144	145		146	147	148			149
2016	150	151	152		153	154	155	156			157+	158+
2017	159+		160+	161+	162*	163+						
2018						1*	2*			3*	4+	5+
2019	6+	7*	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
2020	18+*	19+*	20+	21+	22+	23+	24+	25+	26+	27+	28+	29+
2021	30+	31+	32+	33+	34+	35+	36+	36+	37+			

GRACE

Level-2 products

no Level-2 products available

GRACE-FO

Level-2 products available

Current Level-2 Release: RL06

+ Level-2 products (with ACC transplant)

\* partial / overlapping calendar-months

3.A – Level-3 Product and Data Availability

JPL, GFZ & CSR

- JPL provides Land (LND) and Ocean (OCN) global data grids for all three SDS centers (JPL, GFZ, CSR) via PO.DAAC.

# GRAVITY RECOVERY AND CLIMATE EXPERIMENT *Follow-On*



Table 3: GRACE and GRACE-FO Level-3 product availability

Level-2 (JPL)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002				1	2							
2003	8	9	10	11	12		13	14	15	16	17	18
2004	19	20	21	22	23	24	25	26	27	28	29	30
2005	31	32	33	34	35	36	37	38	39	40	41	42
2006	43	44	45	46	47	48	49	50	51	52	53	54
2007	55	56	57	58	59	60	61	62	63	64	65	66
2008	67	68	69	70	71	72	73	74	75	76	77	78
2009	79	80	81	82	83	84	85	86	87	88	89	90
2010	91	92	93	94	95	96	97	98	99	100	101	102
2011		103	104	105	106		107	108	109	110	111	112
2012	113	114	115	116		117	118	119	120		121	122
2013	123	124		125	126	127	128			129	130	131
2014	132		133	134	135	136		137	138	139	140	
2015	141	142	143	144	145		146	147	148			149
2016	150	151	152		153	154	155	156			157+	158+
2017	159*		160*	161*	162*	163*						
2018						1*	2*			3*	4*	5*
2019	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
2020	18+	19+	20+	21+	22+	23+	24+	25+	26+	27+	28+	29+
2021	30+	31+	32+	33+	34+	35+	36+	36+	37+			

- GRACE  
 Level-3 products  
 no Level-3 products available
- GRACE-FO  
 Level-3 products available
- Current Level-2 Release: RL06
- + Level-3 products (with ACC transplant)  
 \* partial / overlapping cal-months