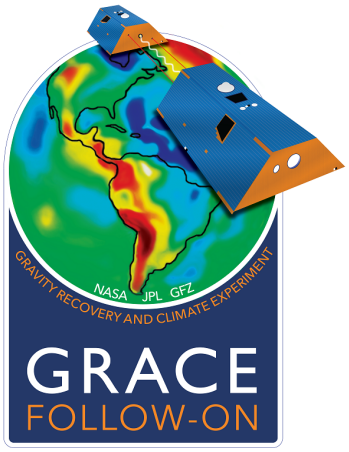

GRACE Follow-On

Science Data System Newsletter Report: September 2019 (No. 7)

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GRACE Follow-On Science Data System: News & Highlights

- **Level-2** SDS data products for **August-2019** are now available at NASA's Physical Oceanography Distributed Active Archive Center (PO.DAAC) and GFZ's Information System and Data Center (ISDC).
- The GRACE / GRACE-FO Science Team Meeting took place from Oct. 8-10, 2019 at JPL/Caltech in Pasadena. Over 100 participants contributed 60 talks and 20 posters, discussing and evaluating the first year of GRACE-FO data, data continuity from GRACE, and new science results from both missions. An abstract booklet and proceedings will be available over the next few weeks.
- **Mark your calendars:** the 2020 GRACE/GRACE-FO Science Team Meeting will take place at GFZ (Potsdam, Germany) from Oct 27-29, 2020.

Calendar & Upcoming Events:

- AGU Fall Meeting 2019:
  - Thursday, 12 December 2019; 16:00 - 18:00: 'Continuous Measurements of Earth System Mass Change: GRACE, GRACE-FO and Beyond' (talks)
  - Friday, 13 December 2019; 08:00 - 12:20: 'Continuous Measurements of Earth System Mass Change: GRACE, GRACE-FO and Beyond' (posters)
  - Wednesday, 11 December 2019: 12:30 - 13:30: Town Hall 'NASA and GFZ GRACE Follow-on Mission: Status, Science, Advances'
- GRACE/GRACE-FO Science Team Meeting 2020: GFZ, Potsdam, Germany, 27-29 October 2020

GRACE Follow-On: Mission Status

GRACE Follow-On: Orbit

The GRACE Follow-On orbital parameters on 2019-09-26 (day 269) were as follows:

Sun Beta (deg)	-9
Absolute Distance (km)	181.1
Drift (km/d)	0.00
Mean Altitude (>6378.1 km)	490.9
Decay Rate (GF1/GF2) (7d mean, m/d)	1.0 / 1.0

Science-relevant Mission Events & Plans:

- The mission is operating in science ranging mode and collecting nominal K/Ka-band ranging observations.
- Laser Ranging is enabled and collecting nominal ranging observations.
- Both accelerometers (ACCs) are operating and collecting observations. The GF1 ACC is operating in its nominal mode, Normal Range Mode (NRM), and the GF2 ACC is in Large-Range-Mode (LRM). 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

- 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), have been continuously expanded approximately every 7 days since the first data release on May-24, 2019. 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, updates, and conventions (PO.DAAC / ISDC).

KBR Performance Statistics

- [see Appendix 1A (p. 5)]

Level-1 Data Product Availability

- [see Appendix 1B (p. 5) for GRACE-FO Level-1 data]

- [see Appendix 1C (p. 6) for de-aliasing AOD1B model data]

Level-1 Release Notes & Sequence of Events

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

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. 7) for overview tables on data availability].

Level-2 Ancillary Products and Comments

- TN-11 containing C20 estimates derived from SLR and using Level-2 RL06 standards Cheng and Ries, 2013) is updated in synch with Level-2 monthly releases. It is recommended to replace the native GRACE-FO C20 coefficient with this product.
- TN-13[a,b,c] containing geocenter estimates using the methods of Swenson et al. (2010) and Sun et al. (2016) is updated in synch with Level-2 monthly releases. It is recommended to augment the GRACE / GRACE-FO geocenter with this product.
    - NOTE: A previous version from 04/2019 had an inconsistent epoch removed - please update all TN-13 data with the most recent version; this affected all monthly data points only by a constant offset value.
- TN-14 containing C30 estimates derived from SLR and using Level-2 RL06 standards (Loomis et al., 2019) is updated in synch with Level-2 monthly releases. SDS recommends to replace the native GRACE-FO C30 coefficient with this product.

Level-3 Data Processing & Delivery

- SDS Level-3 monthly global grids of mass changes are generated by JPL and available at PO.DAAC.

Resources and Links:

Data Archives (Level 1-3):

- 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/.
- Searchable databases of **GRACE and GRACE-FO related publications** are available at
    - 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

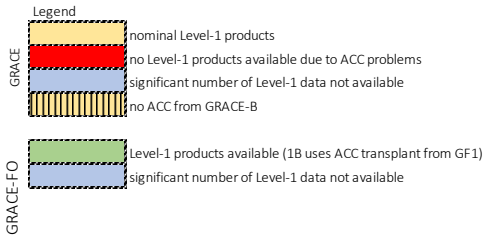
KBR QUALITY ASSESSMENT
Key to columns in the table below
1) KBR1B product name
2) Total arc length with data (hours)
3) Number of observations used in KBR-GPS range residual calculation
4) KBR-GPS range residual RMS (mm)
5) Minimum KBR-GPS range residual (mm)
6) Maximum KBR-GPS range residual (mm)
7)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

KBR1B_2019-08-01_Y_04.dat	24.0	17280	1.38	-4.2	5.0	1
KBR1B_2019-08-02_Y_04.dat	24.0	17280	1.58	-4.5	6.3	1
KBR1B_2019-08-03_Y_04.dat	24.0	17125	1.33	-4.7	5.1	2
KBR1B_2019-08-04_Y_04.dat	24.0	17280	1.38	-4.8	4.5	1
KBR1B_2019-08-05_Y_04.dat	24.0	17280	1.34	-3.7	3.7	1
KBR1B_2019-08-06_Y_04.dat	24.0	17280	1.30	-5.2	4.7	1
KBR1B_2019-08-07_Y_04.dat	24.0	17280	1.42	-6.1	4.3	1
KBR1B_2019-08-08_Y_04.dat	24.0	17280	1.33	-3.7	5.8	1
KBR1B_2019-08-09_Y_04.dat	24.0	17167	1.31	-5.5	4.0	2
KBR1B_2019-08-10_Y_04.dat	24.0	17280	1.53	-6.0	5.0	1
KBR1B_2019-08-11_Y_04.dat	24.0	17280	1.45	-6.1	8.1	1
KBR1B_2019-08-12_Y_04.dat	24.0	17280	1.29	-4.1	5.6	1
KBR1B_2019-08-13_Y_04.dat	24.0	17280	1.29	-5.2	4.1	1
KBR1B_2019-08-14_Y_04.dat	24.0	17280	1.45	-3.5	5.8	1
KBR1B_2019-08-15_Y_04.dat	24.0	17280	1.45	-4.1	4.6	1
KBR1B_2019-08-16_Y_04.dat	24.0	17280	1.37	-3.8	4.0	1
KBR1B_2019-08-17_Y_04.dat	24.0	17280	1.16	-3.9	4.3	1
KBR1B_2019-08-18_Y_04.dat	24.0	17280	1.45	-4.0	4.4	1
KBR1B_2019-08-19_Y_04.dat	24.0	17280	1.45	-5.4	3.7	1
KBR1B_2019-08-20_Y_04.dat	24.0	17280	1.23	-3.4	4.1	1
KBR1B_2019-08-21_Y_04.dat	24.0	17280	1.32	-3.5	4.8	1
KBR1B_2019-08-22_Y_04.dat	24.0	17280	1.12	-4.8	3.5	1
KBR1B_2019-08-23_Y_04.dat	24.0	17280	1.41	-7.2	3.7	1
KBR1B_2019-08-24_Y_04.dat	24.0	17280	1.37	-4.6	6.3	1
KBR1B_2019-08-25_Y_04.dat	24.0	17280	1.34	-4.0	4.5	1
KBR1B_2019-08-26_Y_04.dat	24.0	17280	1.59	-4.1	6.3	1
KBR1B_2019-08-27_Y_04.dat	24.0	17280	1.18	-3.5	3.7	1
KBR1B_2019-08-28_Y_04.dat	24.0	17280	1.34	-3.7	3.4	1
KBR1B_2019-08-29_Y_04.dat	24.0	17280	1.74	-6.5	6.4	1
KBR1B_2019-08-30_Y_04.dat	24.0	17101	1.55	-4.7	4.7	2
KBR1B_2019-08-31_Y_04.dat	24.0	17280	1.45	-5.2	4.4	1

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

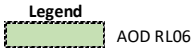
Table 1: Current version: Level-1 v04.

Level-1 A/B	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014												
2015												
2016												
2017												
2018												
2019												



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

AOD1B	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976												
1980												
…												
2017												
2018												
2019												



- 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

- Starting from the rl04 2019-08-10 LRI1B and LLK1B products, the Level-1 treatment of the LRI datation time offset has been updated. Previously, the jumps in datation bias that occurred at each IPU reset were not taken into account in the initial correction of LRI time-tags; this jump was left for the downstream time offset estimation to handle. The software has been updated so that these datation bias jumps – which can be determined from daily telemetry datation packets – are used in the initial time-tag correction. As a result, the time offset that is estimated is much smaller than before, and the LRI-KBR range differences are reduced for most days compared to the range differences from the previous method.
- Starting from the 2019-09-07 products, the following updates were made to the SDS Level-1 processing software. These software updates were verified by Level-2 reprocessing of the July 2019 (and GRACE June 2016) gravity field; the resulting changes in the gravity field were minor:

- In GPS1B processing, a phase break is now marked only at gaps > 100 seconds; previously, a phase break was marked at all gaps. This affects the GPS filtering window, since the filtering window is not allowed to include phase breaks.
- CLK1B now contains additional qualflg bits to indicate if a clock correction value was extrapolated from POD (Precision Orbit Determination) clock estimates, and such extrapolated values will not be used to correct K-band and GPS data. CLK1B values are extrapolated at, for example, IPU resets when there is no GPS data to allow estimation of clock corrections.

Date	Events
2019-08-03	IPU reboot (commanded) at 03:17:10
2019-08-09	IPU reboot (commanded) at 02:44:40
2019-08-03	IPU reboot (commanded) at 03:17:40
2019-08-09	IPU reboot (commanded) at 02:45:10
2019-08-05	GPS PRN#3 disabled in the IPUs from 15:30 till 24:00 due to an announced period of unavailability.
2019-08-06	GPS PRN#3 disabled in the IPUs from 0:00 till 05:05 due to an announced period of unavailability.
2019-08-07	GPS PRN#09 disabled in the IPUs from 11:30 till 24:00 due to an announced period of unavailability.
2019-08-08	GPS PRN#09 disabled in the IPUs from 0:00 till 01:00 due to an announced period of unavailability.
2019-08-08	GPS PRN#17 disabled in the IPUs from 12:45 till 24:00 due to an announced period of unavailability.
2019-08-09	GPS PRN#17 disabled in the IPUs from 0:00 till 02:15 due to an announced period of unavailability.
2019-08-15	Another thruster plateau test was performed from 06:00 through 12:00. For the test the satellite was in Attitude Hold Mode (NOM-AH). LRI was in re-acquisition mode for about 1 hour (starting around 10 UTC).
2019-08-16	GPS PRN#8 was disabled in the IPUs (06:45 - 20:15) due to an announced period of unavailability.
2019-08-29	GPS PRN#2 was disabled in the IPUs (13:15 - next day 02:45) due to an announced period of unavailability.
2019-08-30	An IPU S/W restart was commanded on each satellite at 03:06 (North Atlantic Ocean/West of Cape Verde).
2019-08-26	GRACE-C: The CMCal started at 03:55 and will end at 19:10. CMCal maneuvers: Yaw: 17:04, 18:39. Pitch: 04:28, 07:22, 10:33. Roll: 12:06,
2019-08-27	GRACE-D: The CMCal started at 03:30 and will end at 18:50. CMCal maneuvers: Pitch: 04:07, 07:01, 10:11. Roll: 11:45, 14:55. Yaw: 16:43,

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+				

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 cal-months

2.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:
  - https://tinyurl.com/tellus-level3-grids

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			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+				

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