

GRACE Level-1 Processing Status

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Overview

- **Level-0/level-1 processing status**
- **GRACE alignment status**
- **V02 Level-1 reprocessing**
- **Summary**



Level-0/Level-1 Processing Status

- **Standard automatic Level-0/Level-1 processing is fully operational at PO.DAAC (JPL) since 2004-01-01. Only manual interventions during off-nominal operations of the GRACE spacecraft. SDS is responsible for final L1B product quality. Level-1 distribution by PO.DAAC to the level-2 centers. (latency ~12 days)**
- **Quick look Level-0/Level-1 processing is fully operational at JPL (section 335) since 2003-09-01 to monitor for non-nominal states of the science payload. Quick look Level-1 data distributed to CSR for early gravity field analysis since 2008-02-06 (latency ~24 hours).**

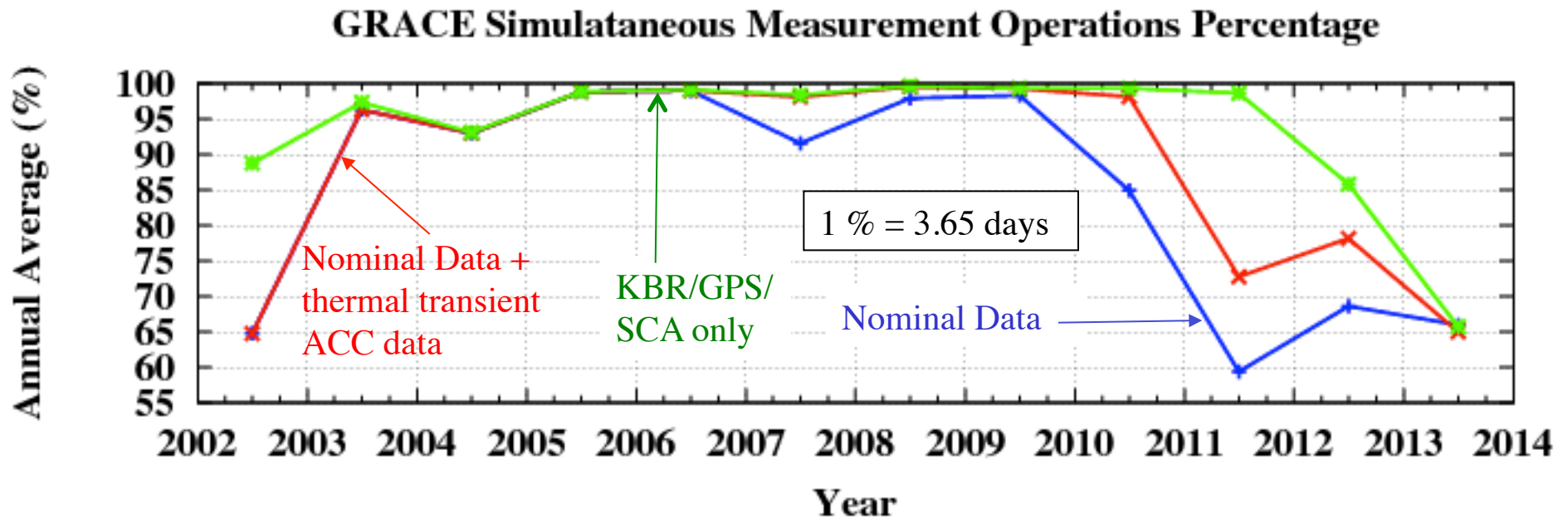


Data Flow Statistics as of 10 October 2013

- > **99.9** % of raw data has been retrieved successfully and reformatted by the Science Data System (data latency < 1.0 hour)
- **4210** days of Level-1B data have been distributed to the level-2 centers (CSR, GFZ ,JPL) (data latency < 12 days)
 - **4073** days pass KBR quality check, which serves as proxy for overall data quality
 - **3746** days all measurements simultaneously available, required for nominal level-2 processing
- Number of nominal level-2 days has dropped since 2011 due to powering off the ACC/MWA, to reduce the power load on the batteries during maximum eclipse season. (GPS and SCA data not affected)



GRACE Simultaneous Measurement Operations



Definition: Time percentage for which GPS, KBR, SCA and thermal stable ACC measurements exist **simultaneously** for **both** spacecraft and measurements are **valid**. (Data used in nominal Level-2 processing)

Definition: Time percentage for which GPS, KBR, SCA and ACC measurements data exist **simultaneously** for **both** spacecraft and measurements are **valid**. (thermal transient ACC data accommodated in Level-2 processing)

Definition: Time percentage for which GPS, KBR and SCA exist **simultaneously** for **both** spacecraft and measurements are **valid**.



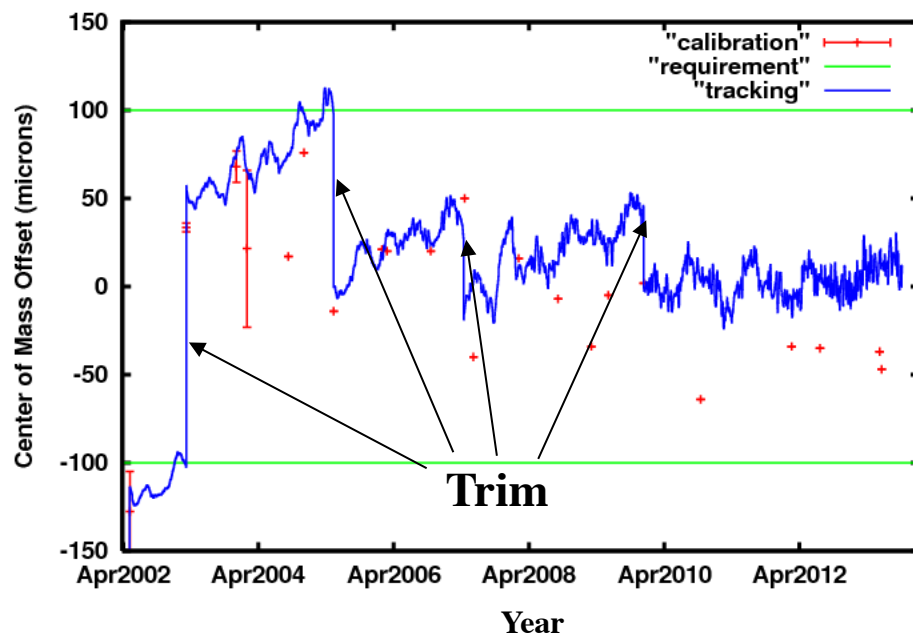
GRACE Alignment Status

- **20 simultaneous COM calibration maneuvers performed since July 2004**
 - **Center of Mass for both GRACE S/C are located within the required 100 microns of the ACC proof mass COM.**
 - **COM calibration analysis limited by ACC “twangs”**
 - **Last trim performed 8 December 2009 (X-component)**
 - **No trim planned**
- **X-component of COM tracking model diverging for GRACE-B from COM calibration results (cause under continued investigation)**
- **Star camera to accelerometer alignment (QSA) and KBR boresight vector (VKB) remain unchanged for V02 Level-1 processing**

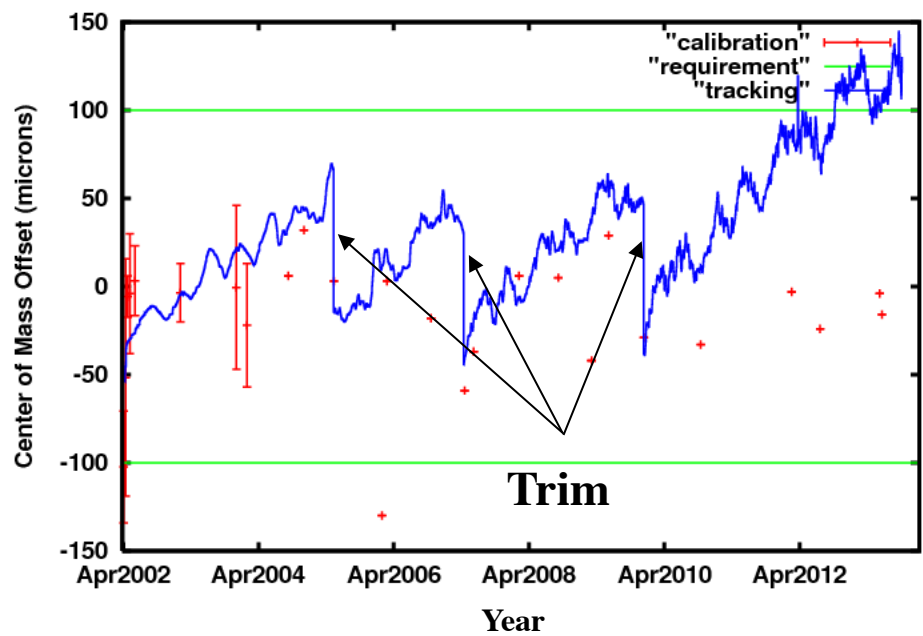


Center of Mass X-Alignment; Calibration & Tracking

GRACE-A

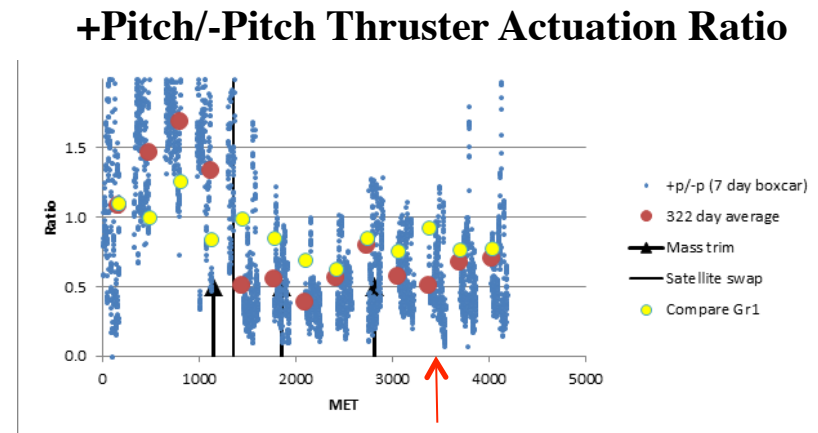


GRACE-B



GRACE-B COM X-component Discrepancy

- X-component of COM tracking model diverging for GRACE-B from COM calibration results
- GRACE-A X-component COM model is consistent with calibration result
- Divergence occurred early 2011
- Operations team investigating possible thruster leak (evidence inconclusive)

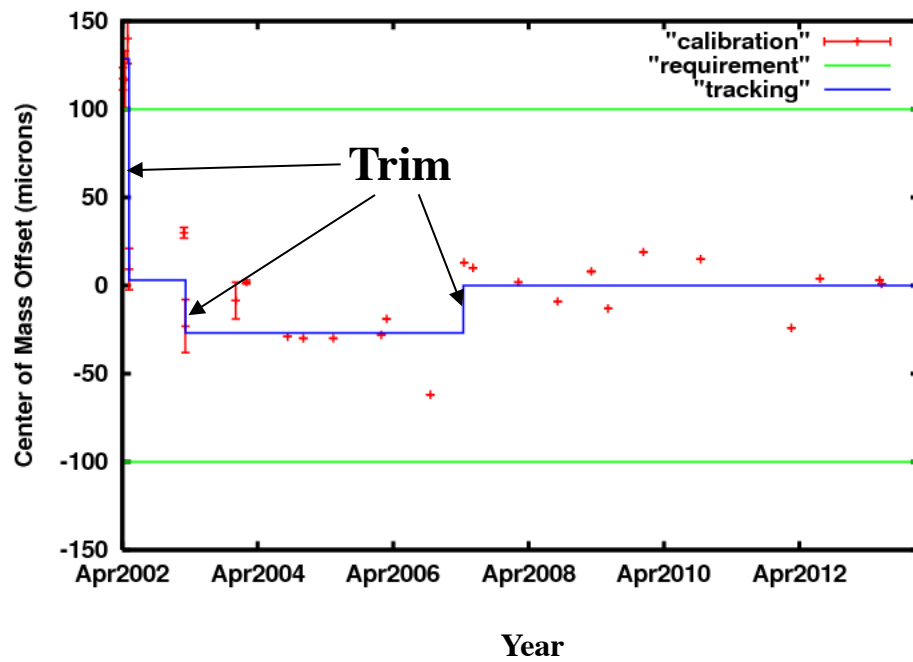


- COM calibration repeated twice in June 2013. (results consistent)
- GRACE project for now relies on COM calibration result

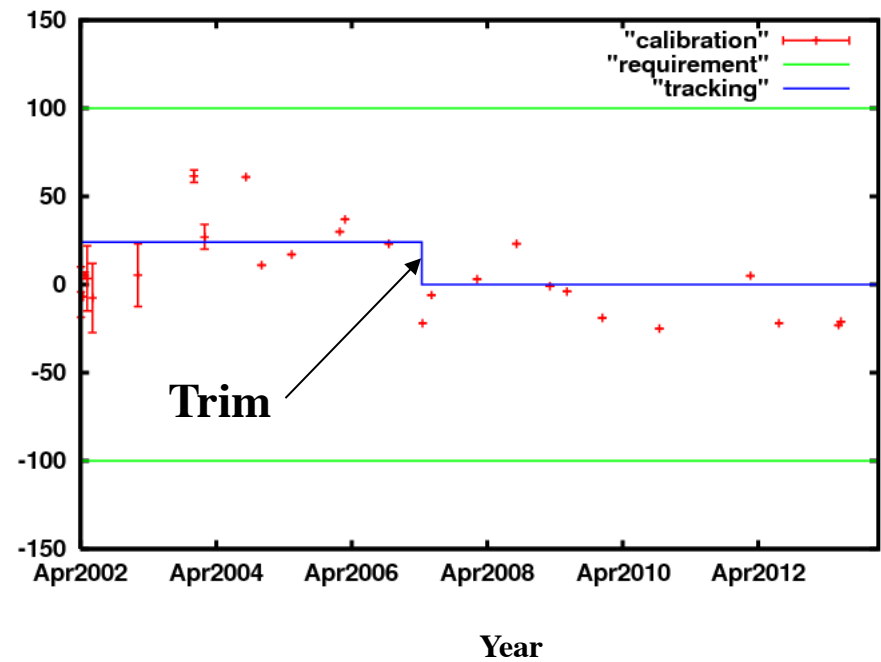


Center of Mass Y-Alignment; Calibration & Tracking

GRACE-A

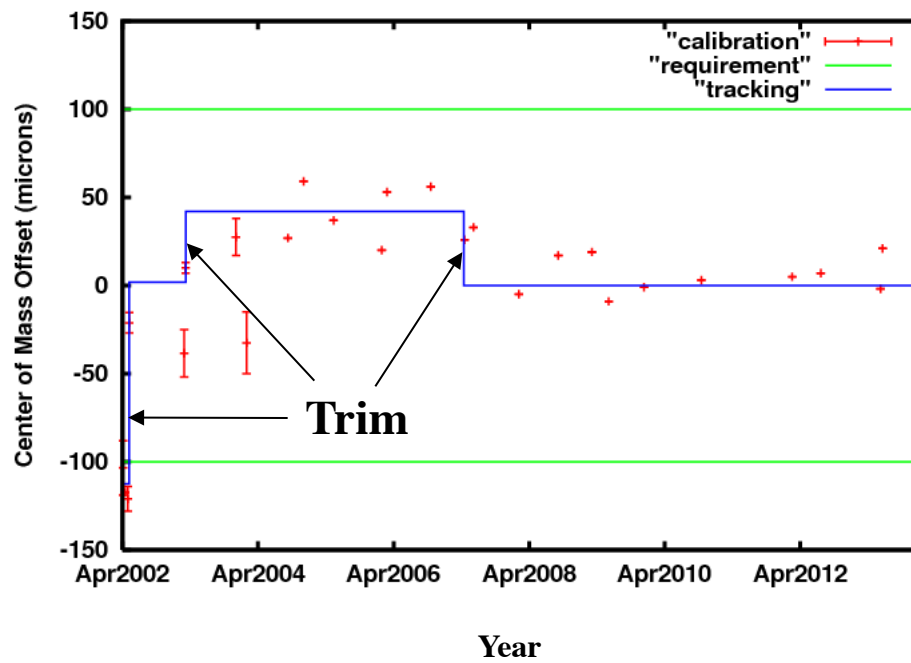


GRACE-B

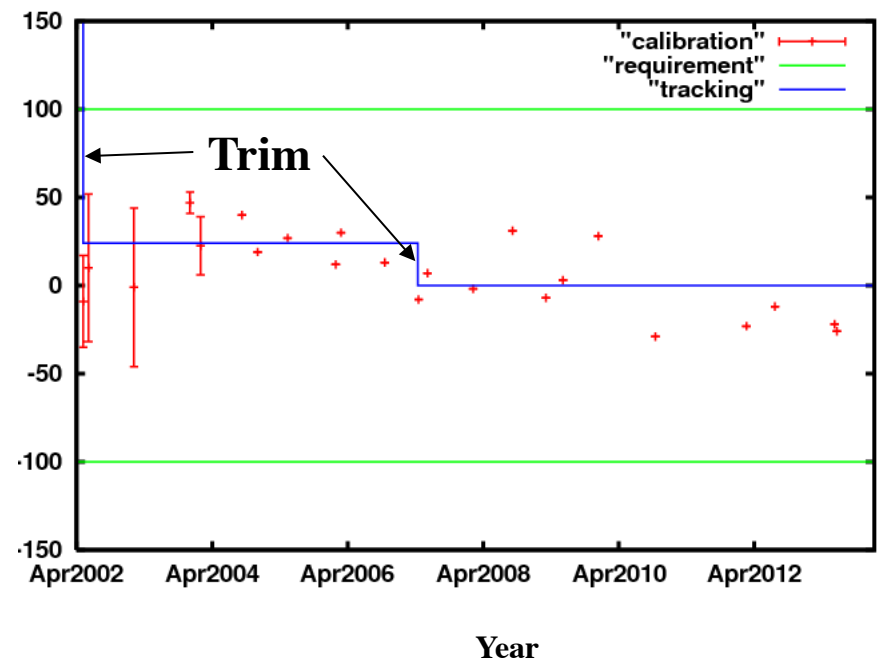


Center of Mass Z-Alignment; Calibration & Tracking

GRACE-A



GRACE-B



V02 Level-1 Reprocessing (1/2)

- **SDS has completed V02 Level-1 processing for 2002 – current**
- **2002 completed and delivered to Level-2 centers late August 2013**
 - **Precision Attitude Determination (PAD) required for 2002 (single camera operations) complicated by regular off-nominal operations of the GRACE spacecraft.**
 - **PAD specialist retirement introduced a learning curve for current GRACE L1 personnel**
 - **Corrections for KBR Missed Interrupt improved with new KBR analysis tool**
 - **Incorporated lessons learned from GRAIL KBR processing**



V02 Level-1 Reprocessing (2/2)

- **Level-1 V02 uses two Precision Orbit Determination strategies:**
 - **Using GPS data only for POD (KBR data used as independent check)**
 - **2002 - 2003 and 2012 – current (high solar activity)**
 - **L1 orbit quality degraded (using GPS data only for POD)**
 - **2004 – 2011 (low solar activity)**
 - **“Yellow Sticky” days:**
 - **About 30 days were incomplete or skipped during V02 processing caused by significant spacecraft anomalies on those days.**
 - **Labor intensive. Expected completion late 2013.**
 - **Users need to download from PO.DAAC/ISDC these days again.**
- Release will be announced in SDS news letter**



Star Camera Data Combination Software Bug

- Investigation was started after review of a presentation by Tamara Bandikova (Univ of Hannover) at GSTM in September 2012, Potsdam
- Presentation by Bandikova found that the standard Level-1B SCA1B product had higher levels of noise compared to the implementation by Bandikova as described in the star camera data combination GRACE document .
- Software inspection found that correct parameterization was commented out and never restored to the proper value.
- UTCSR implemented the correct algorithm and found that SCA1B data noise was reduced but no significant improvement was found in the monthly gravity solution.
- SDS decided not to reprocess the SCA1B. (Correction will be made for V03)



Summary

- Number of “nominal” Level-1 days has been dropping in 2012 and 2013 due to a new power down strategy during the beta-zero (maximum eclipse) season.
 - KBR instrument is now the first to be powered off and the last to be powered on
- COM X-component discrepancy between COM tracking model and COM calibration results is currently unresolved. Relying on COM calibration results for now
- SDS completed V02 processing.
 - Yellow sticky days completion anticipated late 2013
 - SDS will not reprocess SCA1B because increased noise due to a software bug does not significantly affect the monthly gravity field solutions

