GRACE Level-1 Data Processing Status

Gerhard Kruizinga[*], Tamara Bandikova[*], Willy Bertiger[*], Carmen Boening[*], Sung Byun[*], Chris Finch[*], Nate Harvey[*], Da Kuang[*], Carly Sakumura[*], Dimitri Strekalov[*], Dah-Ning Yuan[*], Srinivas Bettadpur[**] and Furun Wang[**]

[*]Jet Propulsion Laboratory, California Institute of Technology
[**]Center for Space Research, University of Texas at Austin

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Overview

- **Level-0/level-1 processing status**
- **V03 Level-1 data reprocessing**
- **V03 SCA1B evaluation**
- **V04 Level-1 data reprocessing**
- **Summary**

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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).**

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Data Flow Statistics as of 22 September 2016

- **> 99.9 % of raw data has been retrieved successfully and reformatted by the Science Data System (data latency < 1.0 hour)**
- **5294 days of Level-1B data have been distributed to the level-2 centers (CSR, GFZ ,JPL) (data latency < 12 days)**
  - **4850 days pass KBR quality check, which serves as proxy for overall data quality**
  - **4523 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 during maximum eclipse season (GPS and SCA unaffected).**
- **Nominal day count includes partial L1-data days, for which MWA is power cycled every orbit in 2015 (Metric less applicable due to partial orbit operations)**

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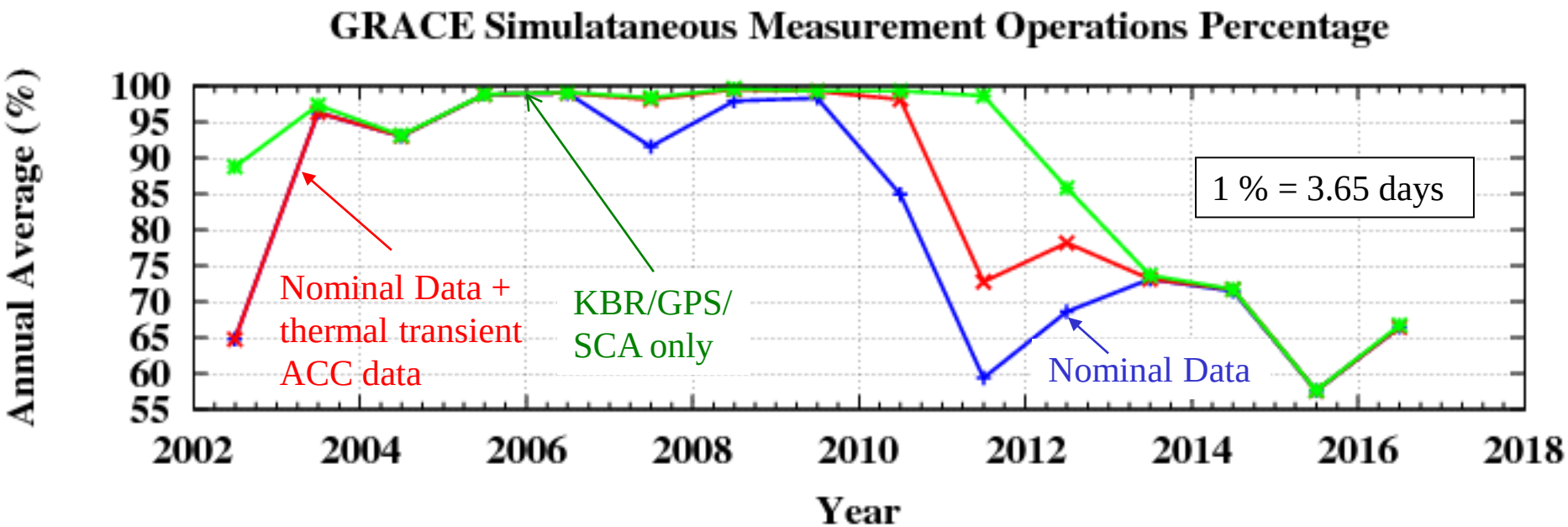
GRACE Simultaneous Measurement Operations



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.

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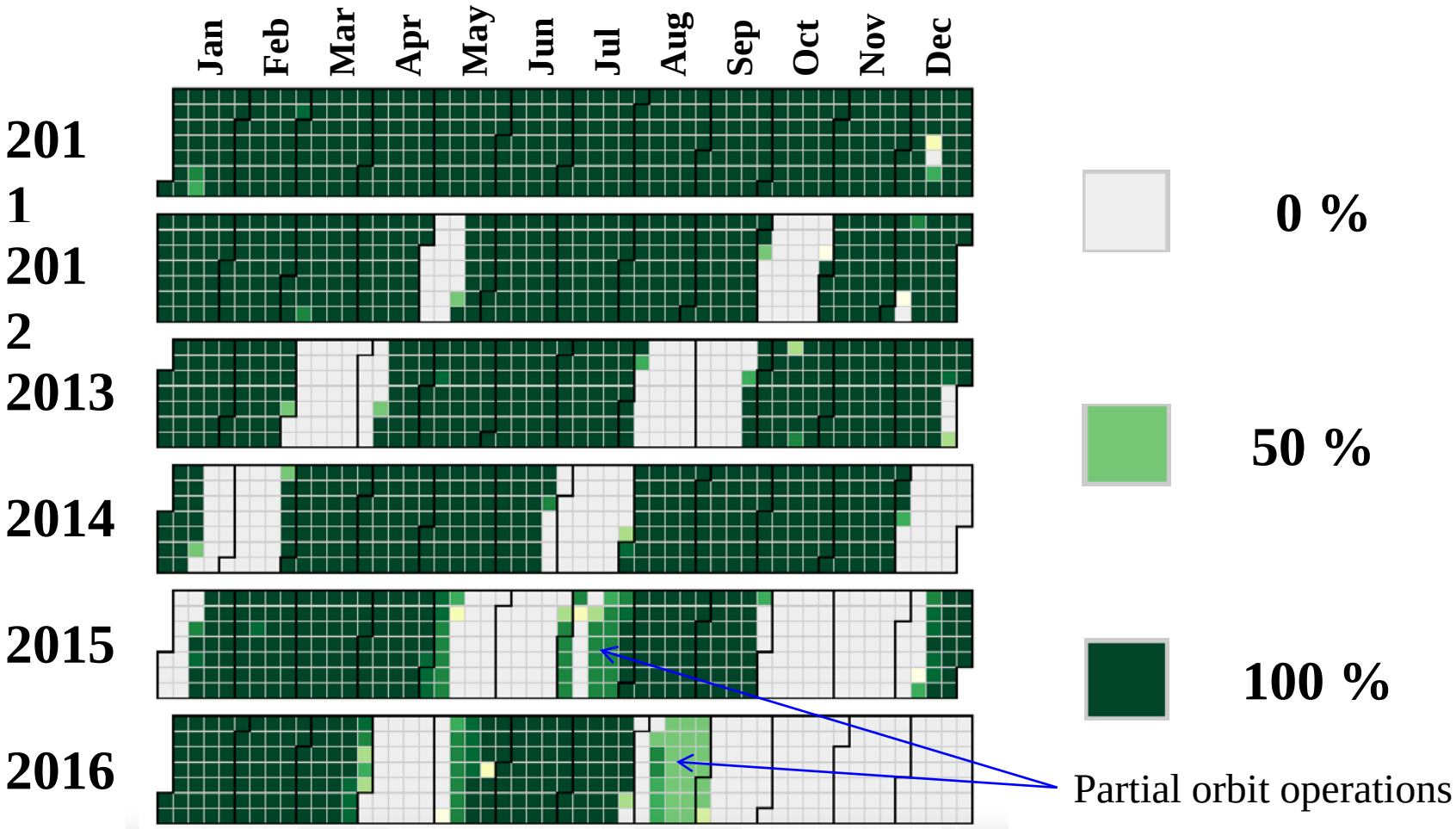
GRACE Daily Nominal KBR Ops Percentage



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V03 Level-1 Data Reprocessing

- **At last GSTM in Austin it was decided not to wait until the end of GRACE mission to reprocess Level-1 data.**
  - **Decision driven by desire to use corrected SCA1B and KBR1B data in RL06 gravity products**
  - **Due to limited resources, it is was decided to only regenerate (using GRACE-FO software) the reconstructed attitude SCA1B and the derived KBR range corrections in KBR1B (V03).**
  - **V03 SCA1B and KBR1B will be distributed in ASCII format (compliant with GRACE-FO distribution plan) via JPL and GFZ archives at the time when the RL06 gravity products are released.**
  - **V03 data delivery to UTSR and GFZ will start 01 December 2016**
- **RL06 Level-2 reprocessing (harmonizing GRACE and GRACE-FO time series) will start spring 2017, using V02/V03 Level-1B data**

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V03 SCA1B Reprocessing

- **What is new?**
  - **SCA1B is reconstructed using star tracker and accelerometer data**
  - **Star tracker and accelerometer data are processed using Kalman Filtering**
  - **Correct implementation of stellar aberration**
  - **Correct weighting for strong and weak axes of the star tracker**
  - **Detailed modeling of star tracker and accelerometer noise**
  - **SCA1B output at 1 Hz instead of 0.2 Hz (V02)**
- **Details in posters:**
  - **SCA1B V03: Data processing and improved features (Bandikova et al.)**
  - **GRACE Level 1 V03: Parameterization, alignment and gravity field results (Sakumura et al.)**

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V03 SCA1B Evaluation

- **GRACE Science Data System is currently evaluating the V03 SCA1B and derived KBR1B range corrections.**
- **Evaluation consist of:**
  - **Comparison between V02 and V03 SCA1B and KBR1B**
  - **V02 and V03 derived monthly gravity solution comparisons**
  - **See Bandikova and Sakumura posters for details**
- **Initial assessment:**
  - **High frequency V03 SCA1B noise significantly reduced**
  - **Improved attitude reconstruction for single camera operations**
  - **Improved KBR1B range rate residuals for gravity solution**
  - **Gravity V02/V03 comparisons show modest improvement in V03 field for degree and order > 30. No significant change degree and order < 30**

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V04 Level-1 Data Reprocessing

- **Final Level-1 Reprocessing (V04) is planned to start after GRACE mission completes**
  - **GRACE-FO Level-1 processing software will be used to generate GRACE Level-1 B data products**
    - **Provide consistent processing between GRACE-FO and GRACE**
    - **All Level-1B products are generated**
  - **Known problems in the level-1 V02/V03 data products will be fixed. For example:**
    - **Star tracker data (L1 software bug, stellar aberration)**
    - **ACC time tag error**
- **Level-1 Reprocessing expected to be finalized about 1 year after completion of the GRACE mission**
- **V04 Level-1 data will be distributed in ASCII**

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Summary

- **Number of "nominal" Level-1 days has been nearly level since 2013**
  - **Degraded GRACE-B battery performance for remainder of the mission will reduce nominal level-1 days and fewer complete nominal days expected**

- **V03 Level-1 processing in evaluation stage**
  - **Only SCA1B and KBR1B products will be generated**
  - **Initial assessment SCA1B quality assessment indicates high frequency noise reduction, improved single camera attitude reconstruction and modest improved in gravity field solution for degree and order > 30**
  - **V03 SCA1B and KBR1B will be released with the RL06 gravity solution**

- **V04 Level-1 data will be generated after the completion of the GRACE mission**
  - **All Level-1B data products will be regenerated with GRACE-FO software and distributed in ASCII, approximately one year after completion of the GRACE mission**

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Backup

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GRACE Alignments Status

- **Center of Mass**
  - **Final COM trims executed on 22 June 2015**
    - **+50 µm GRACE-A X-axis**
    - **- 50 µm GRACE-B X-axis**
  - **Final COM trims were chosen such that +/- 100 µm COM offset requirement is met for the remainder of the mission**
  - **No COM maneuvers planned for the remainder of the mission to preserve propellant**

- **Star camera to accelerometer alignment (QSA) and KBR boresight vector (VKB) remain unchanged for V02 Level-1 processing. Last update in 2011 (Wang, Strekalov 2011)**

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