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WP5: Status daily gravity field solutions for historical events and in NRT for operational service run

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EGSIEM General Assembly, DLR Oberpfaffenhofen

June 8-9, 2017

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Project Schedule

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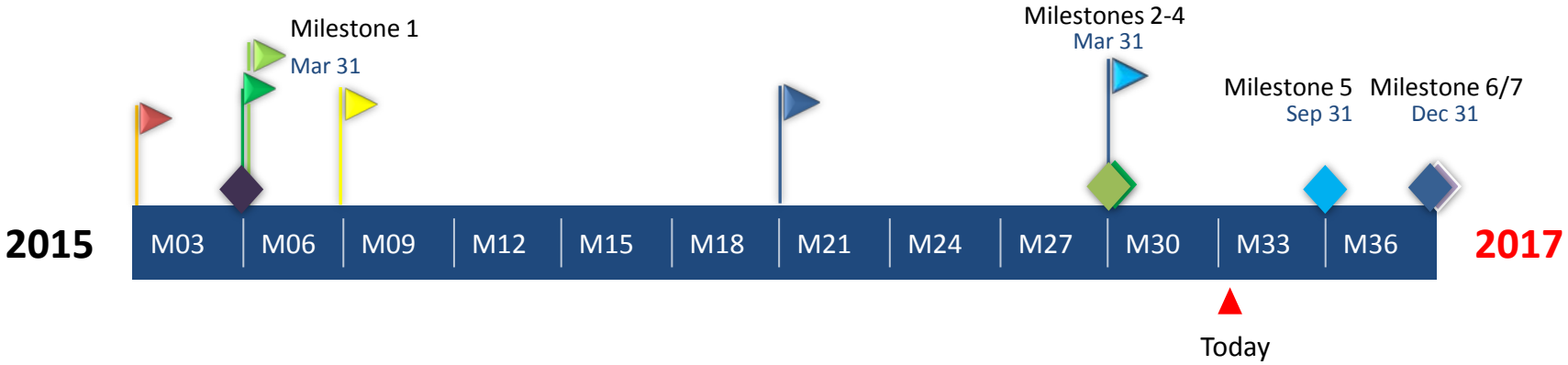

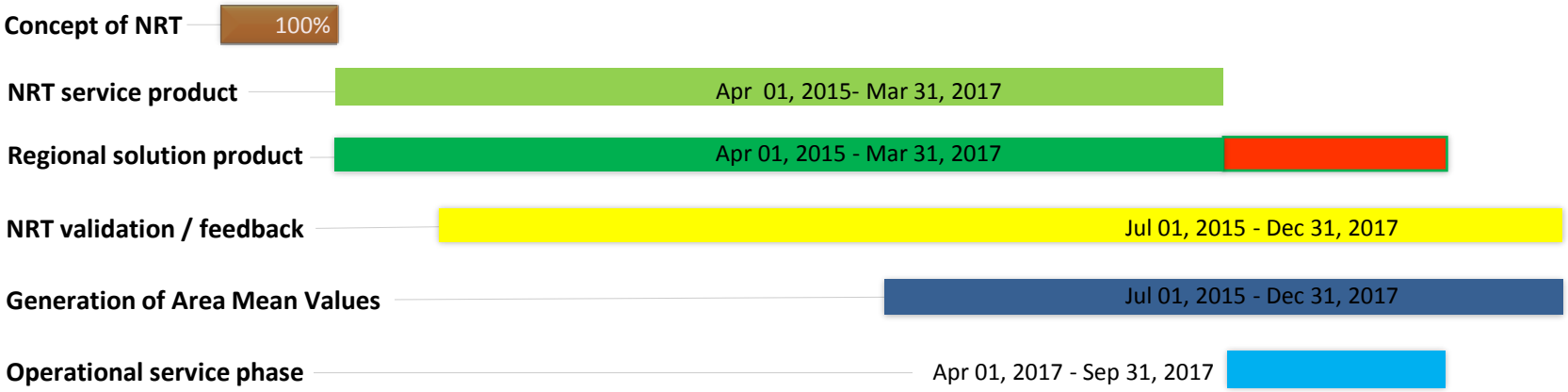

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RBF Status

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- First time daily **continuous** RBF GRACE solutions for *2002-2016* (for historical hydrological investigations and improved GNSS validation) have been computed (v221).
- Latest modifications are:
  - Instrument noise **de-correlation length shortened** from [0.1-100mHz] to [0.5-100mHz]
  - accelerometer **pre-processing** (bias/scale) in all 3 axis (high-pass)
  - minor **modifications** to process model (more weight for AOD)
- **Automatization** for operational NRT service run has been optimized and is running
  - *ftp download*, *shell/perl scripting*, data *conversion*, *formating*, *program execution* and time-outs.
- Historical data look good. Unfortunately, the results of the operational service service run are not satisfactory (see later)

Overview: Linear Equation System Steps

- Calculation of surface integrals for 2x2 deg. equal area grids: 10540 surface tiles
- Conversion between area/geographic grid representations
- Assembly of normal equation systems: Radial basis functions assembly in observation points
- Covariance estimation from monthly stacked hydrological and AOD1B RL5 data
  - Instrument noise de-correlation based on auto-covariance
  - External auto/cross covariances for stochastic prediction
- Least squares prediction
- Daily Kalman measurement updates

Comparison (monthly) basin AMVs with WGHM for 2002-2013

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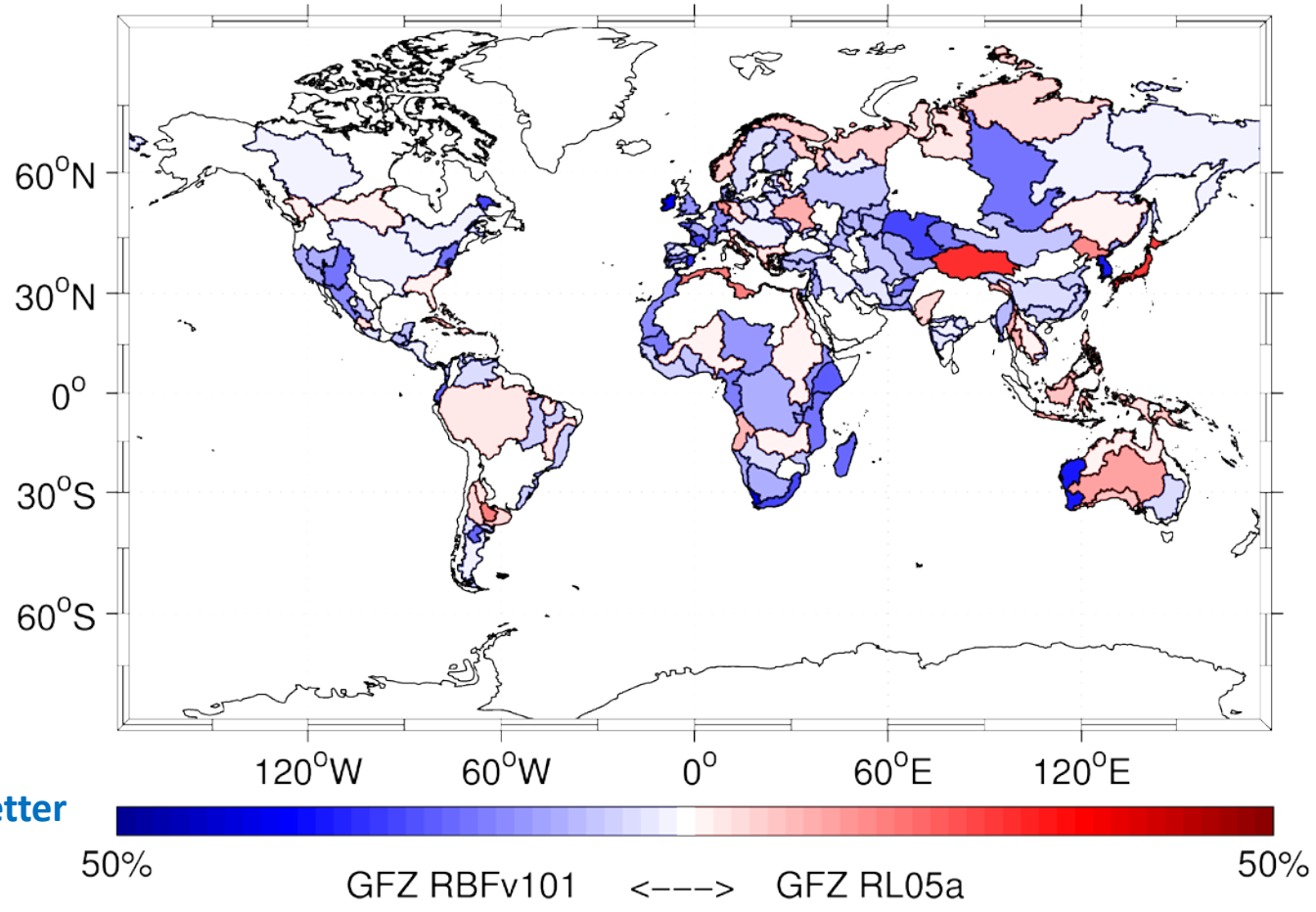

Blue: RBF performs better

Red: RL05a performs better

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Comparison (monthly) basin AMVs with WGHM for 2002-2013

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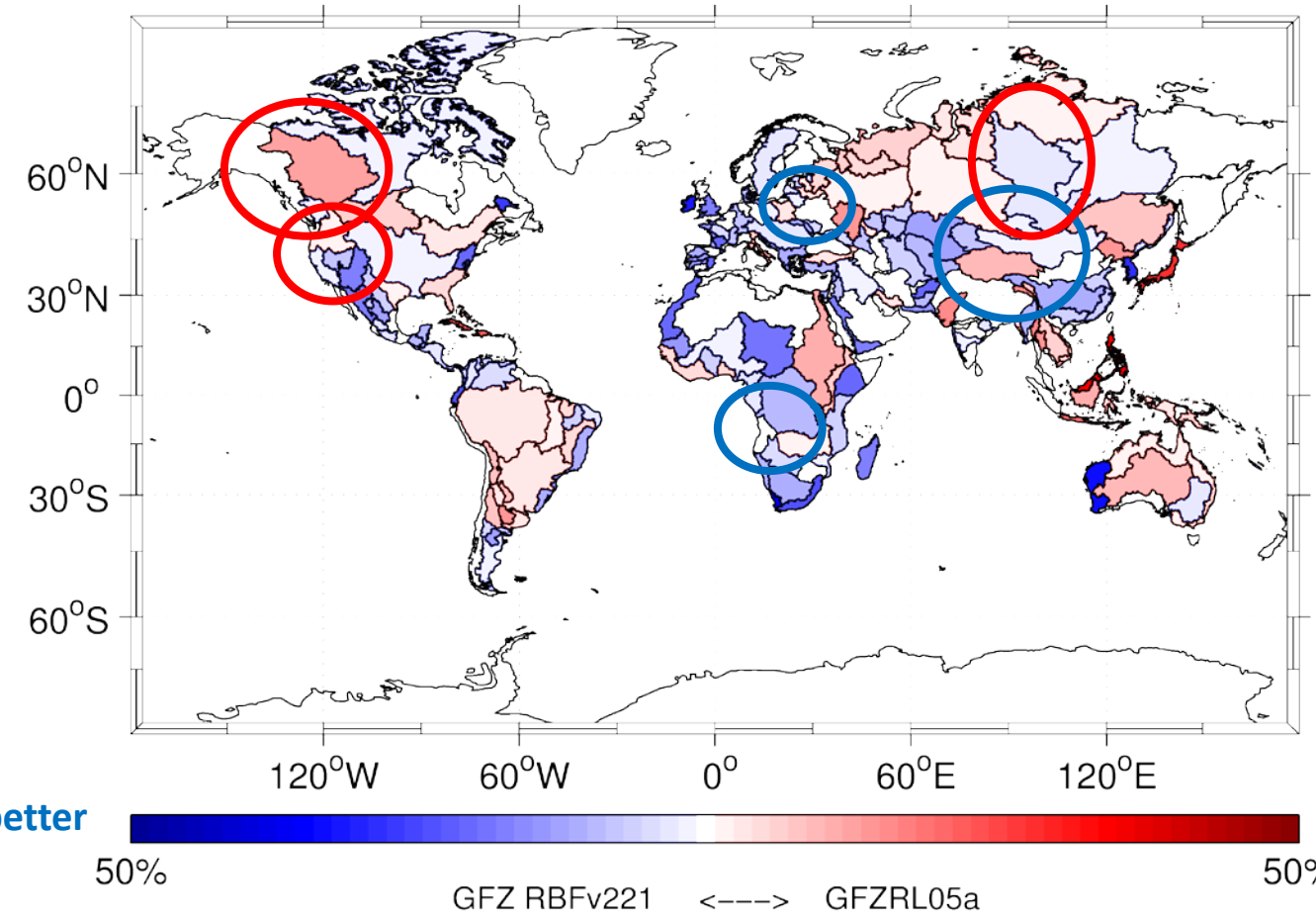

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Comparison (monthly) basin AMVs with WGHM for 2002-2013

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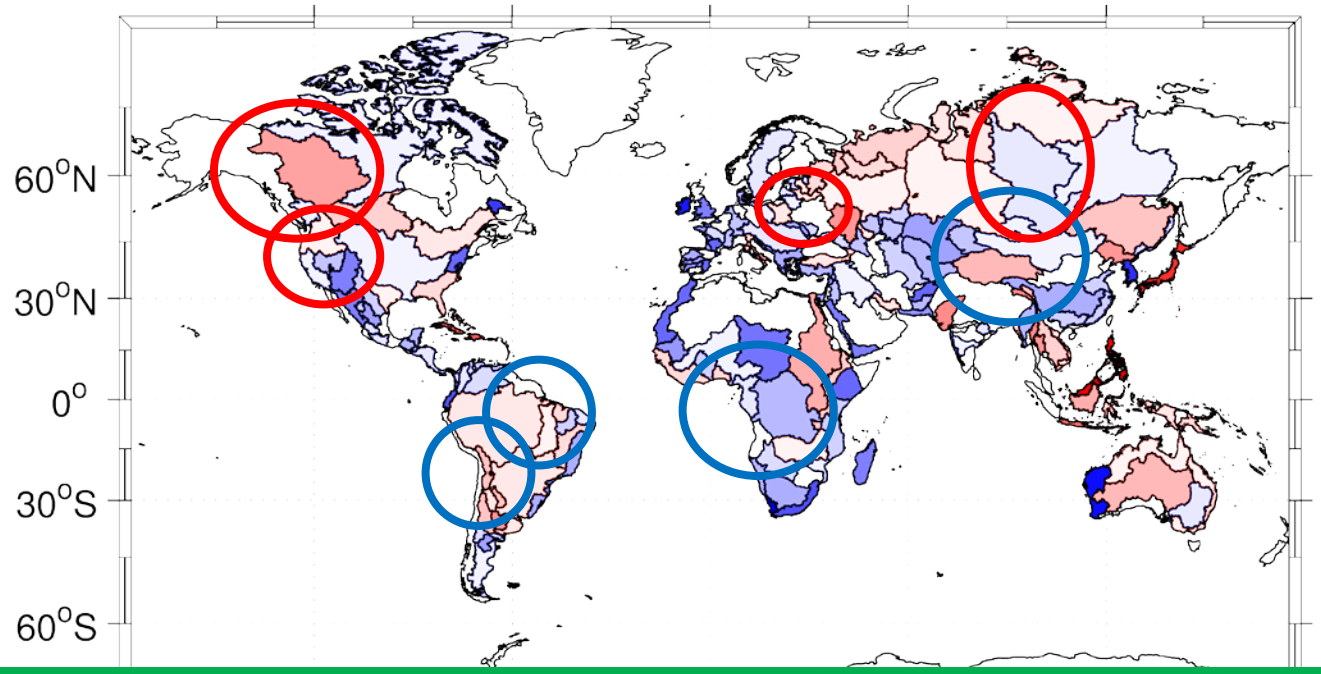

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This test of (historical) daily NRT not convincing as
- Monthly mean values used
- WGHM is not „the truth“
- RL05a is not perfect

=> Need validation from Hydrological Service, GNSS and OBP!

Data & Latencies

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Product	Source	Current Latency	Required Latency
EOP	IERS/UBERN	IERS: 1-3 days, UBERN: 14 days	IERS: 1-3days, UBERN: **17 hours**
GPS Orbits/Clocks	UBERN (T3.4)	14 days	**17 hours**
GRACE L1B Data	JPL, Backup: GFZ	11 days	**18 hours (*nominal*)**
Dealiasing Product (AOD1B)	GFZ	7 days	**1-2 days**
gravity field (global)	GFZ/ TU Graz	~ 2 month	**2-5 days (Daily products)**

Operational test run experience shows that NRTs can be provided almost (95%) within 2 days!

GFZ Processing Timeline

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Day of event 24:00

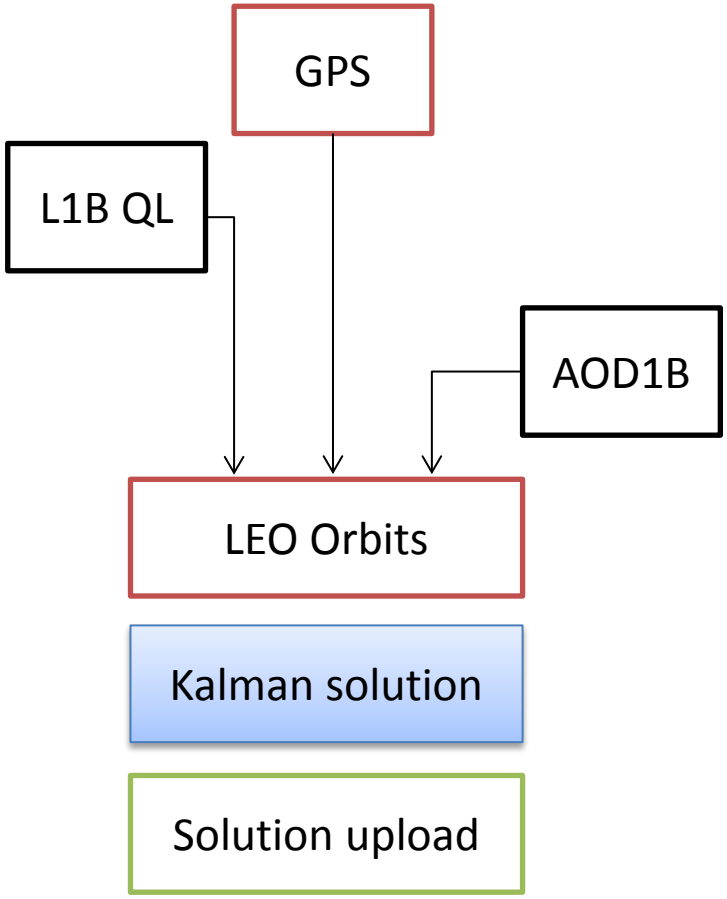
- **UB: CODE constellations, EOPs** +17:00
- **L1B QL data (KBR, SCA, ACC)** +18:00

1 day 24:00

- **Stochastic prediction** **1d**+18:00

1-2 day 24:00

- **3-hourly AOD1B RL06** **2d**+08:00
- **Dynamic orbit (iterated)** **2d**+12:00
- **Kalman update** **2d**+12:00
- **Plausibility test/ Evaluation** **2d**+12:00
- **Grid release /coefficients upload** **2d**+12:00



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Output products

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- Global daily solutions on 2x2 deg grid (water equivalent, center of figure added)
- Global daily solutions on 2x2 deg grid (water equivalent, center of figure added, GIA correction added ("L3 grid"))
- Global daily 2x2 deg grid operational average seasonal background model
- Global daily averaged AOD1B on 2x2 deg grid
- SHC deg/ord 50 (center of figure added, static field EIGEN6C restored)
- 1x1 deg regional product for defined areas of interest (*under construction, see separate presentation*)
- error estimates in the grid values

Measurement update de-gradation (Kalman) drops significantly on March 30

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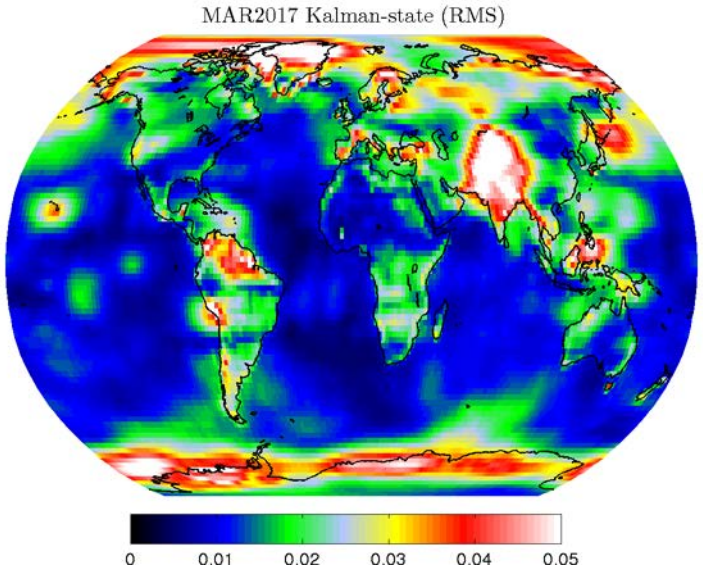
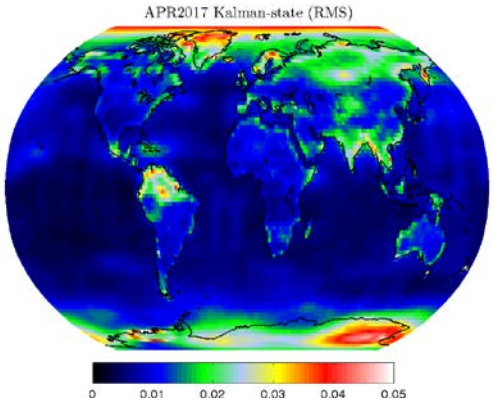
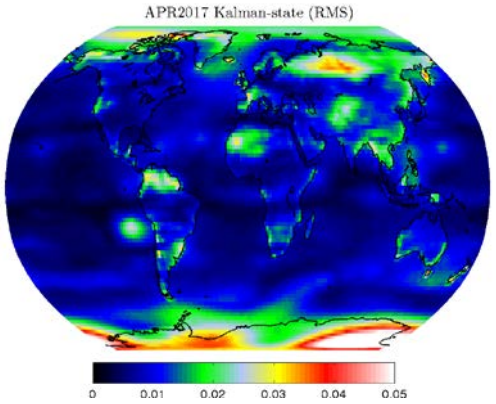
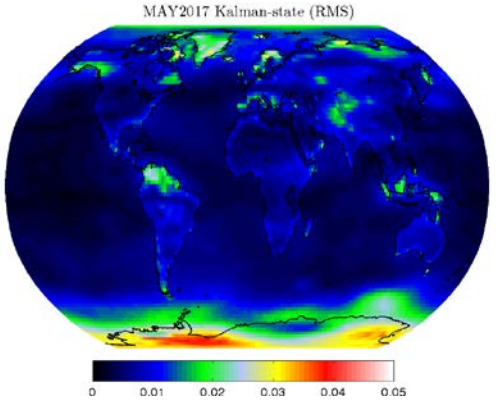


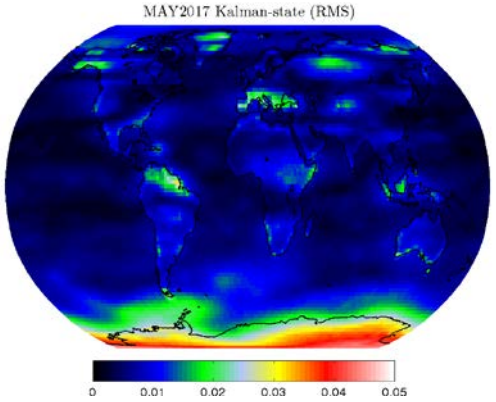


L1B KBR Antenna phase center corrections



L1B KBR Antenna phase center corrections **OFF**





Normal SD (σ_0) for GRACE orbits

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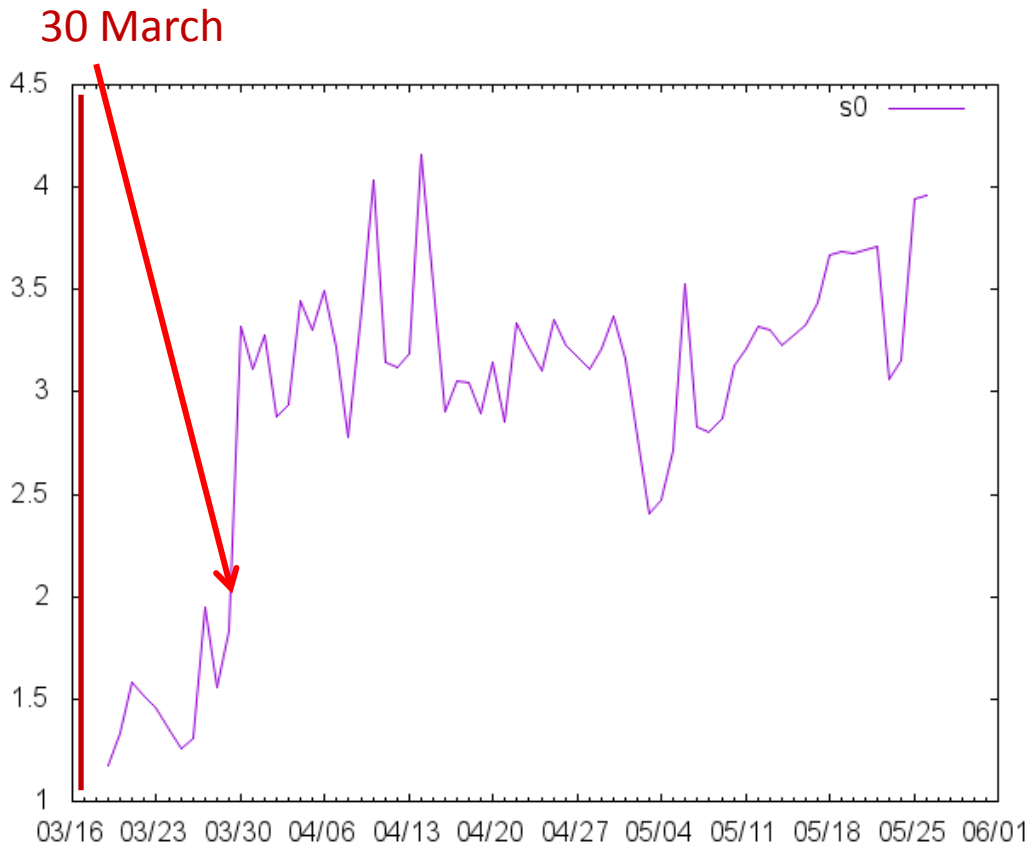
Usual values are close to 1 after iteration, but have increased significantly since begin of the service



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Pitch Angles

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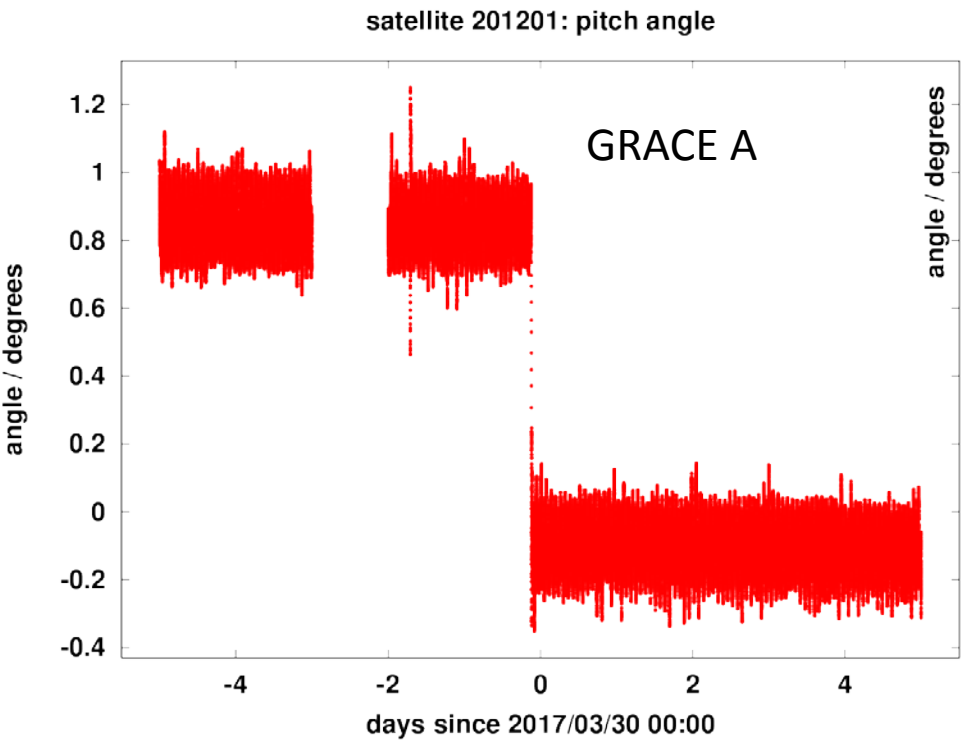

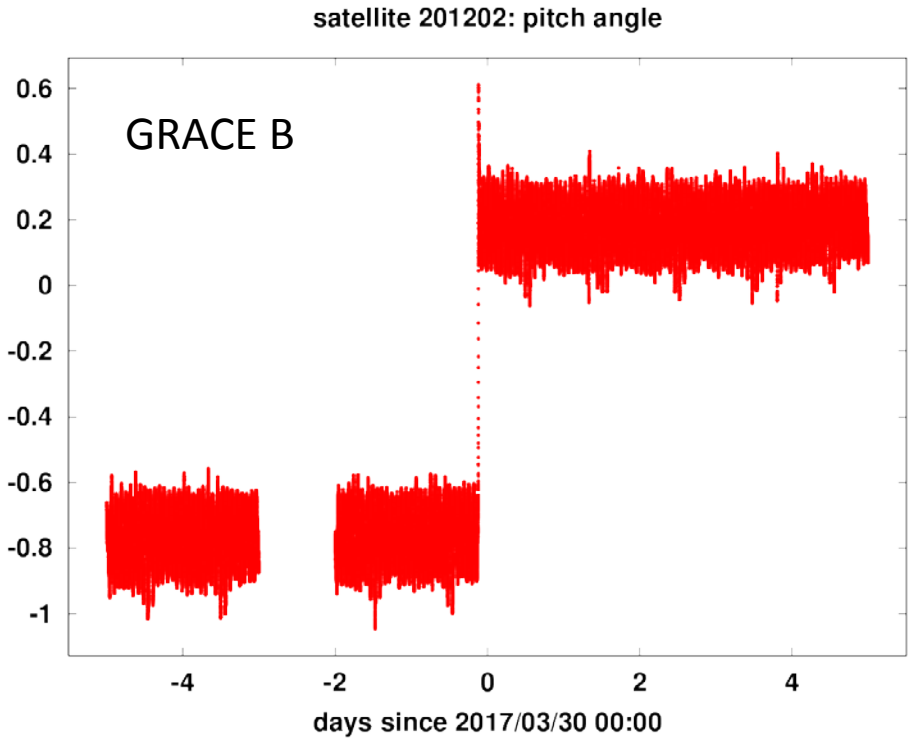

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KBR Phase Center Correction

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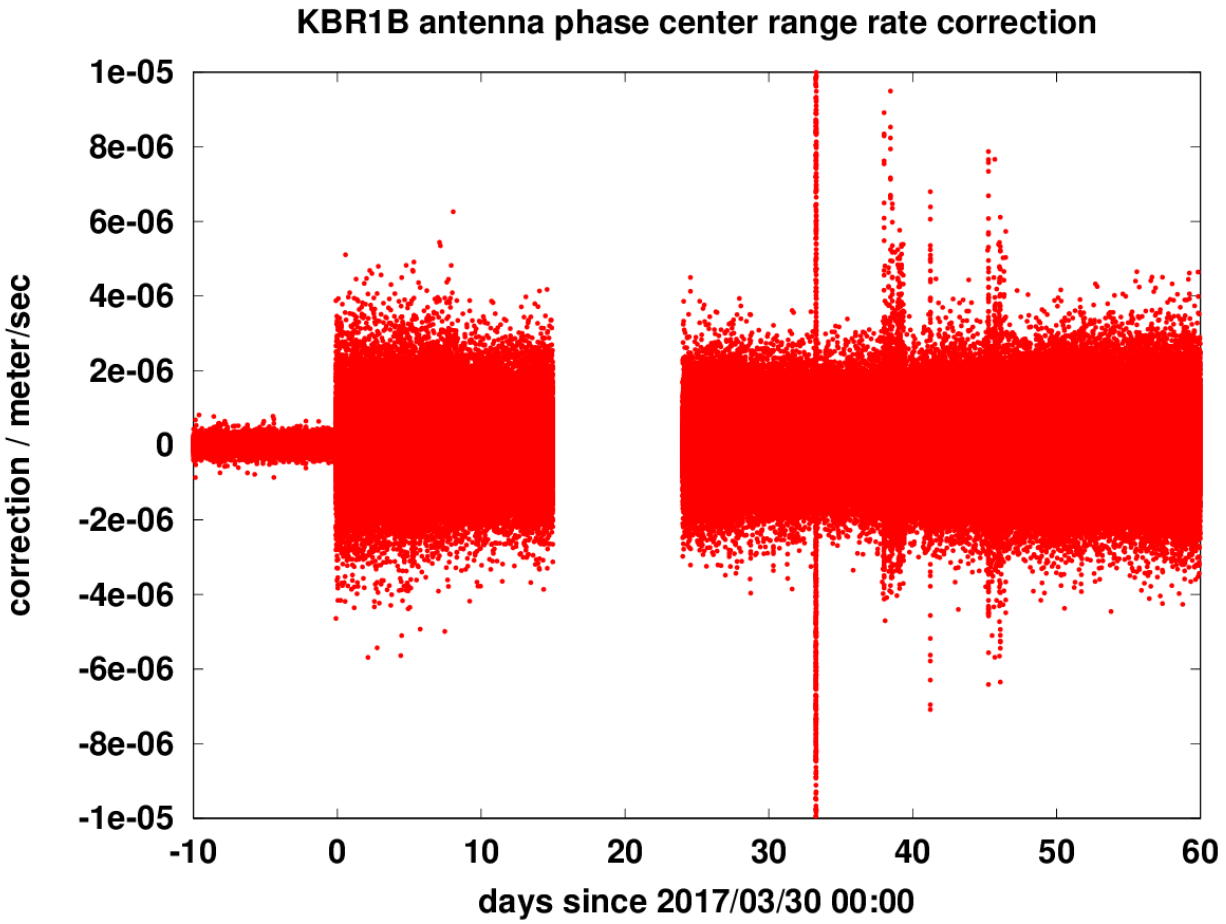

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Kalman mean square errors (RMS^2, averaged per month)

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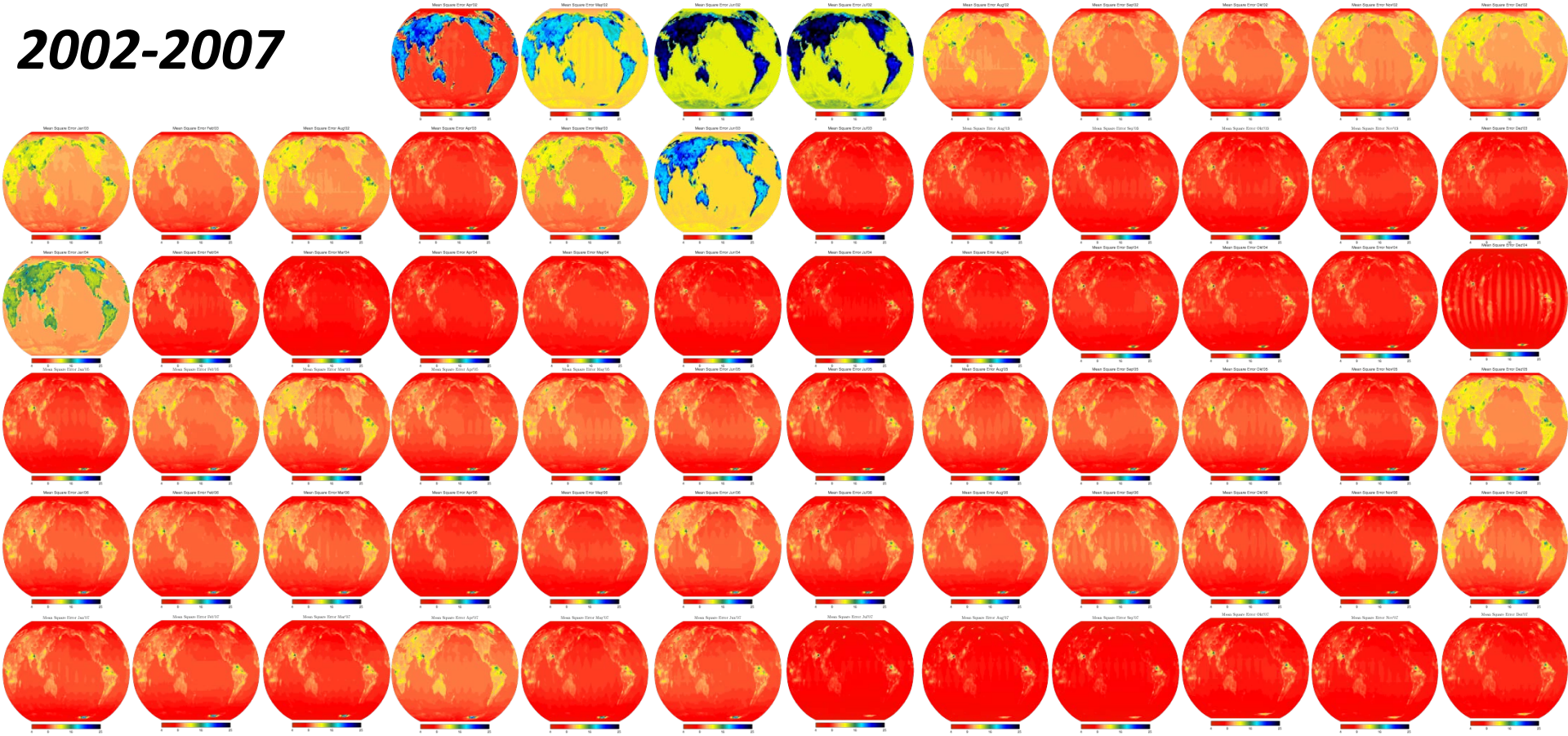
2002-2007



[cm^2]

4 9 16 25

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Kalman mean square errors (RMS^2, averaged per month)

2008-2013

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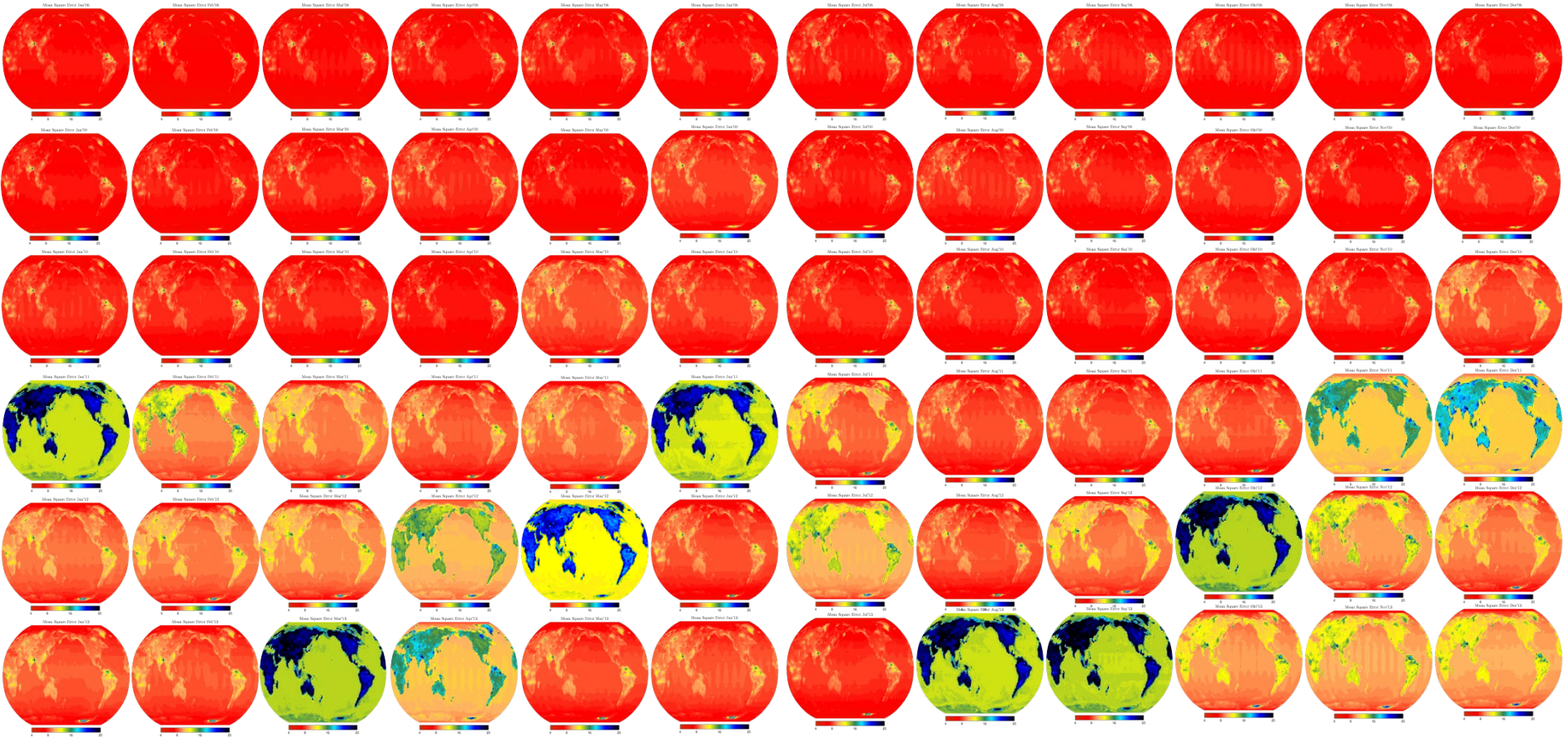

Kalman mean square errors (RMS^2, averaged per month)

2014-2016

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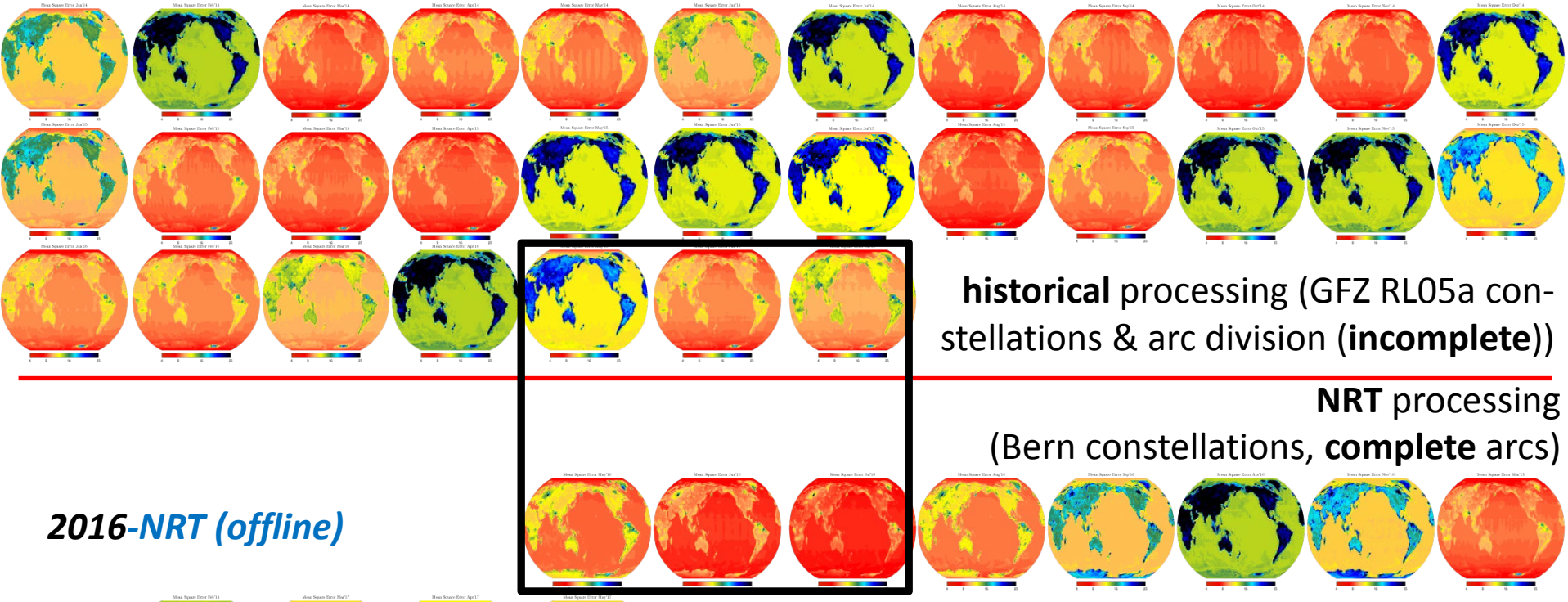


historical processing (GFZ RL05a constellations & arc division (**incomplete**))

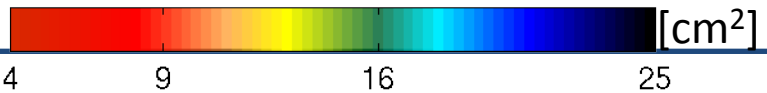
NRT processing (Bern constellations, **complete** arcs)

2016-NRT (offline)

2017-NRT

-> Transplant ACC, few KBR

17.3: eclipse end



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Outlook

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Until end of operational service phase (M33):

- Investigate phase center correction (PCC) problems:
  - Apply TUG PCC (based on L1B RL02) for March-May 2017 and 1 month out of 2008/2014
  - Compare with JPL L1B RL03 (test data available for 2008/2014)
- Reprocessing of NRT test period (if PCC problem can be improved)
- Compute the regional refinements (1 x 1 deg) in selected basins (see separate talk)

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