

Reprocessing of GFZ Multi-GNSS product GBM

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Content

- Multi-GNSS status
- GFZ contributions to MGEX
- GBM reprocessing and validation
- GBU: GFZ MGEX Ultra-rapid products

Satellite Systems for Multi-GNSS

GNSS System	Number of Satellites	
	Operational system	Final system
GPS	31 MEO	31 MEO
GLONASS	25 MEO	24 MEO
Galileo	3(4) IOV+4(6) FOC MEO	30 MEO
BeiDou	5 GEO + 5 IGSO + 3(4) MEO	5 GEO + 3 IGSO + 27 MEO
QZSS	1 IGSO	4 IGSO
SUM:	77	124

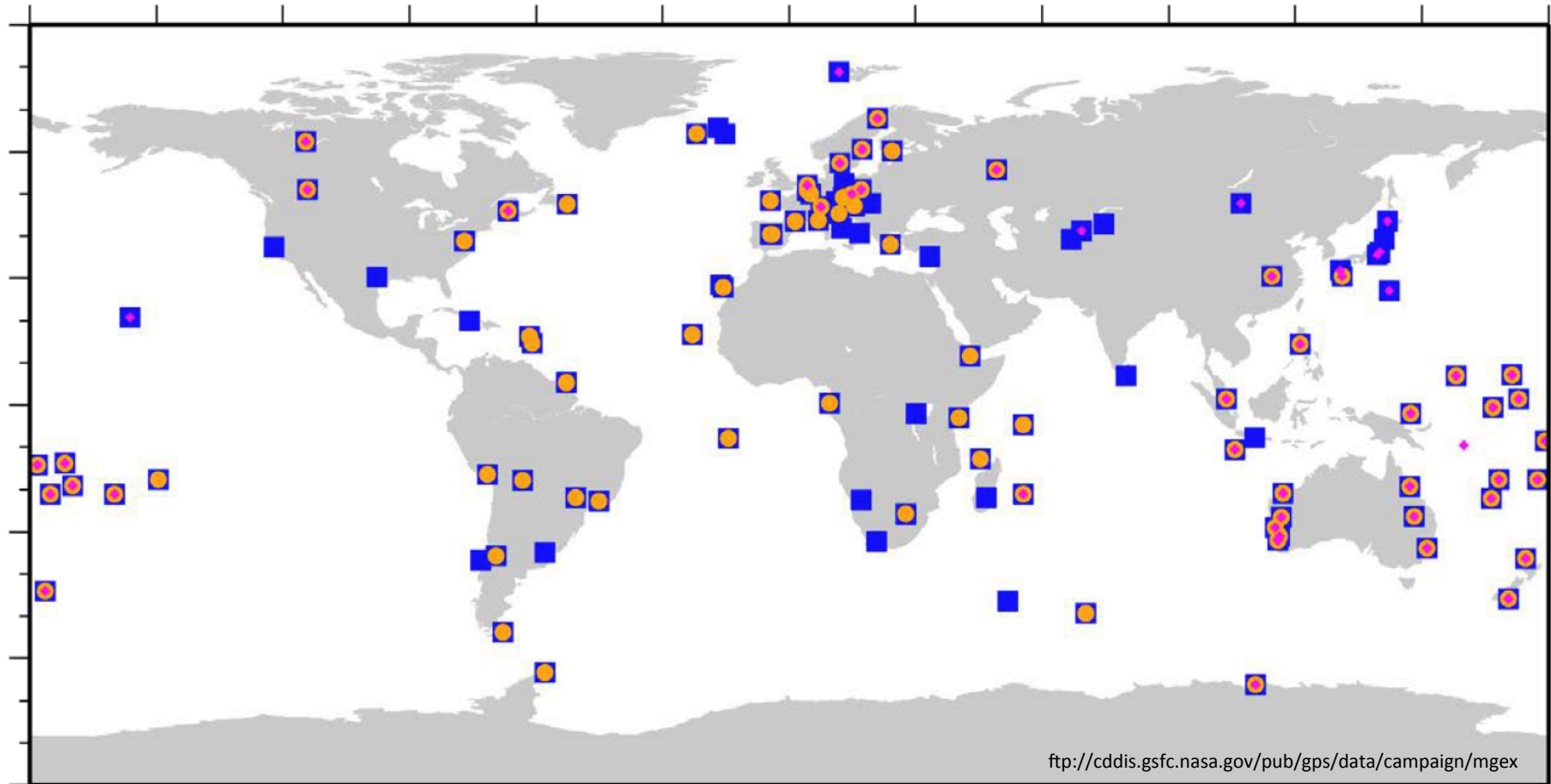
GEO: Geostationary orbit

IGSO: Inclined geostationary orbit

MEO: Medium Earth orbit

Status: Jan. 2016

Stations for Multi-GNSS



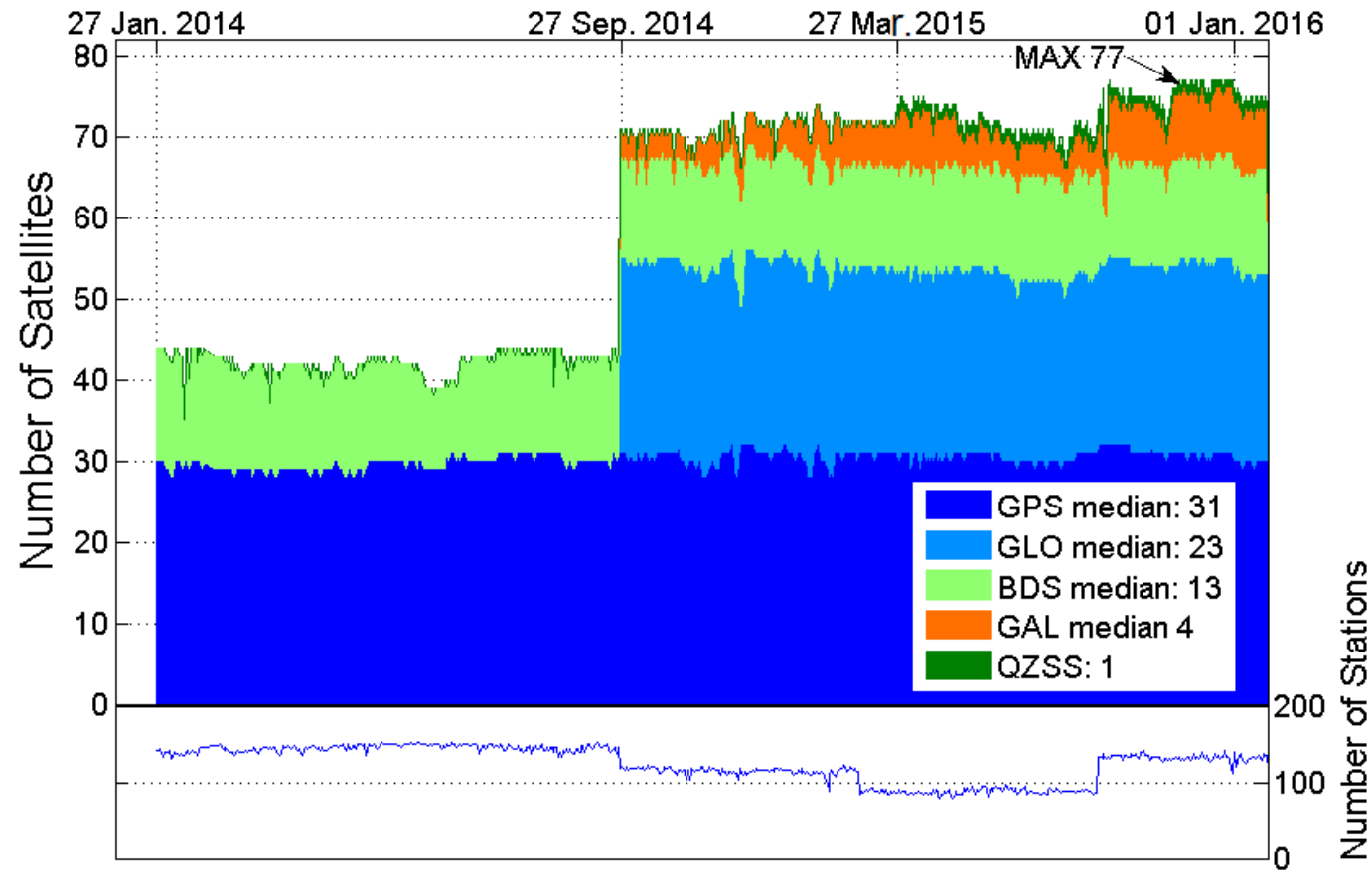
Status: November 2015

■ GAL (138)

● BDS (87)

◆ QZSS (59)

MGEX activity at GFZ



GBM Products:

- Multi-GNSS 5min. orbit and 30 sec. clock
- ERP parameter
- ISB for MGEX stations

Satellite system	Observation types
GPS	L1/L2
GLONASS	L1/L2
Galileo	E1/E5a
BeiDou	B1/B2
QZSS	L1/L2

GBM Reprocessing

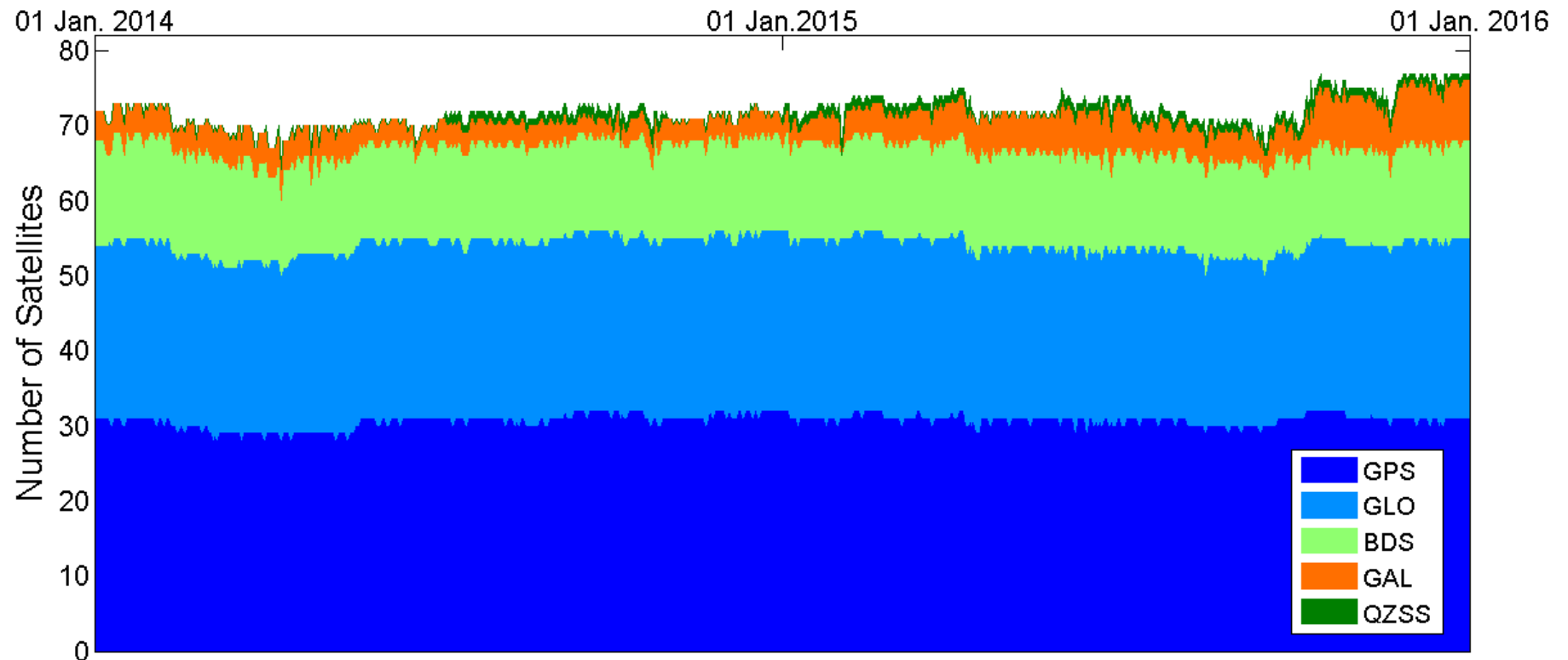
- Multi-GNSS data reprocessing.
- GNSS systems: GPS, GLONASS, Galileo, BeiDou, QZSS.
- IGS-Rapid like daily solutions with ~ 120 sites, IGS + MGEX data archives.

Processing settings

Orbit Model:	empirical CODE orbit model (5 parameter)
Ambiguity fixing:	GPS, GAL, BDS (no GEO)
Antenna PCO/PCV:	IGSwww.atx +BDS (IGSO, MEO from ESA)
Observation model:	undifferenced ionosphere-free linear combination
Intersystem-bias setup:	GLO per sta/sat-link, GAL/BDS/QZSS per station
Attitude Model:	nominal attitude; GEO: yaw-fixed mode; IGSO&MEO yaw-fixed mode ($\beta < 4^\circ$); QZSS yaw-fixed mode ($\beta < 20^\circ$)

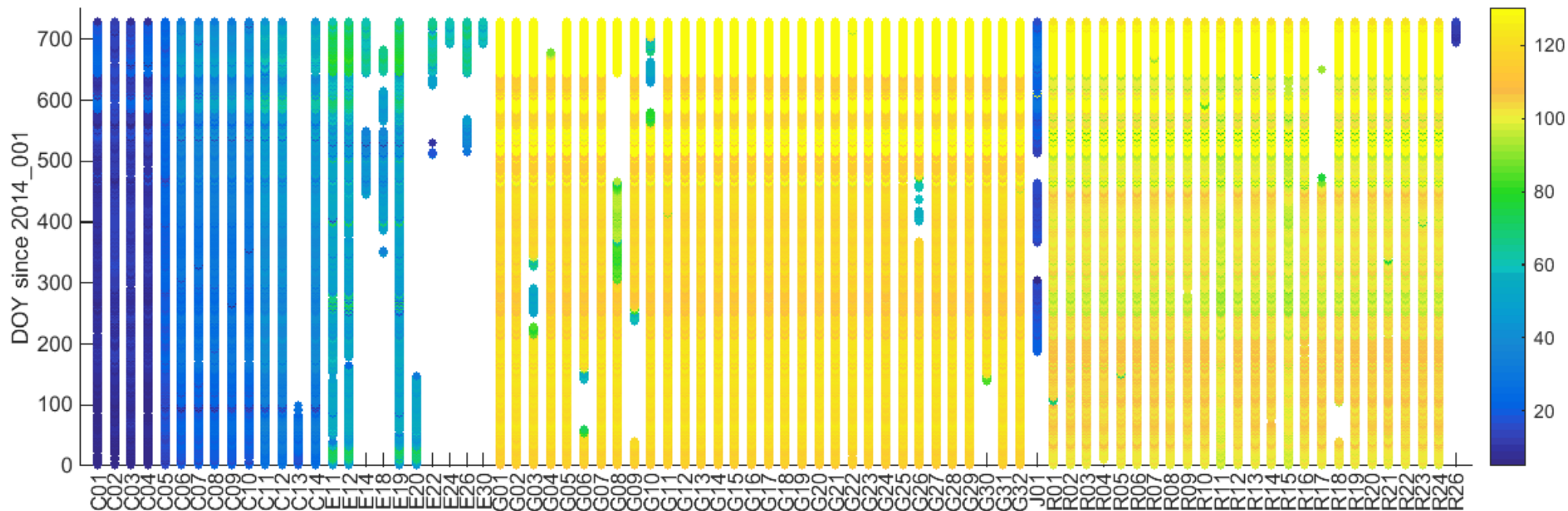
GBM Reprocessing

Two years Multi-GNSS data were reprocessed.
Including 5 systems.

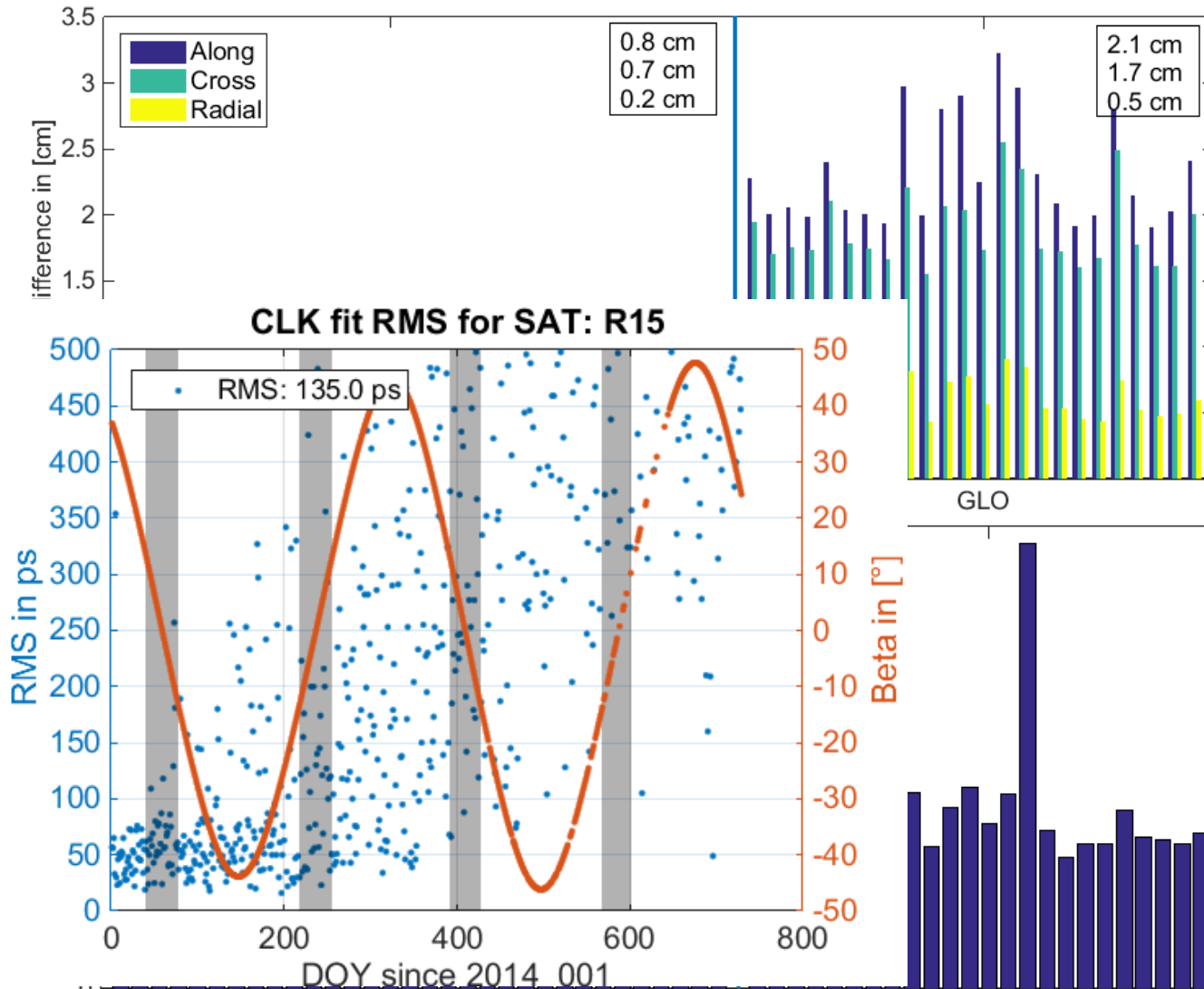


GBM Reprocessing

Number of stations used for each satellite varies from 10 to 130



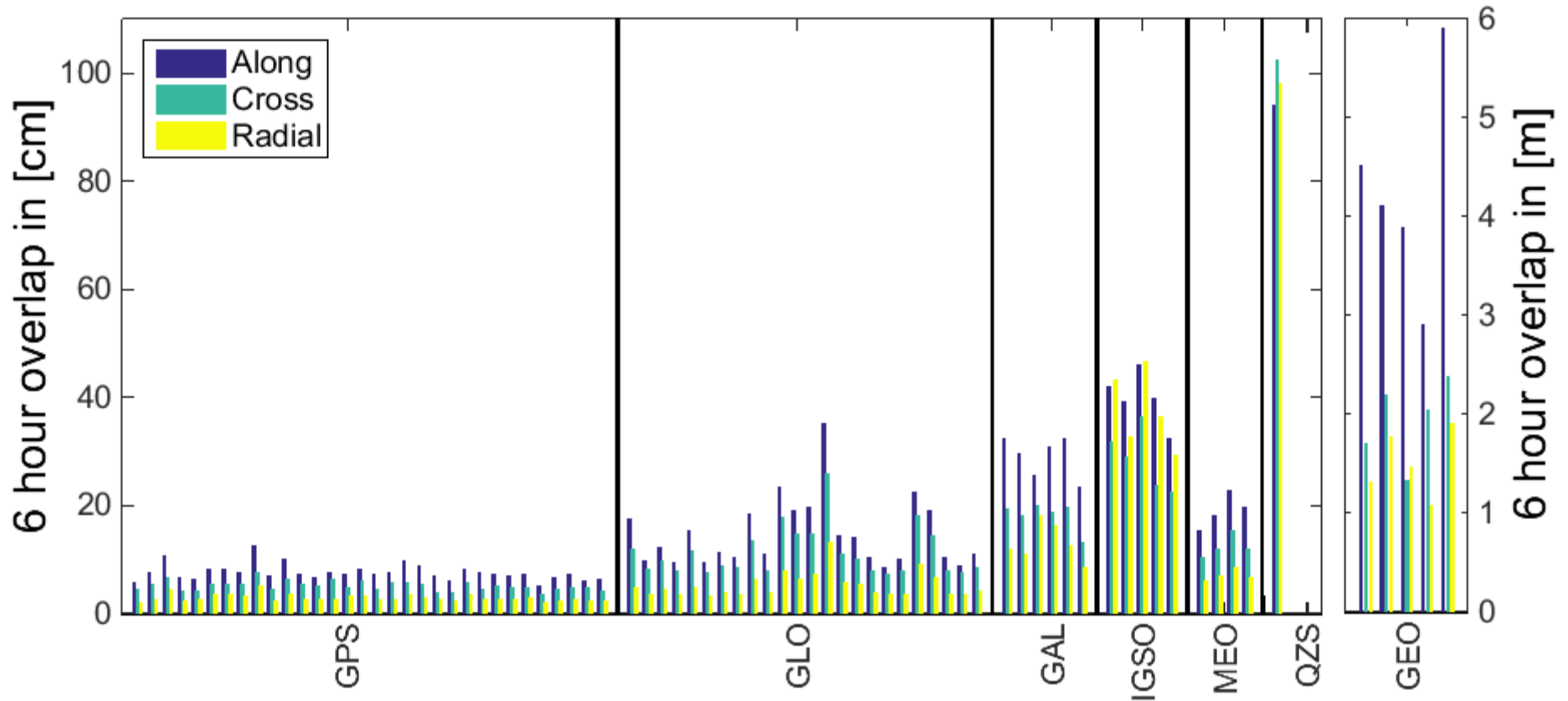
GBM Reprocessing Validation



Orbit and clock differences: GBM VS. GFZ official IGR

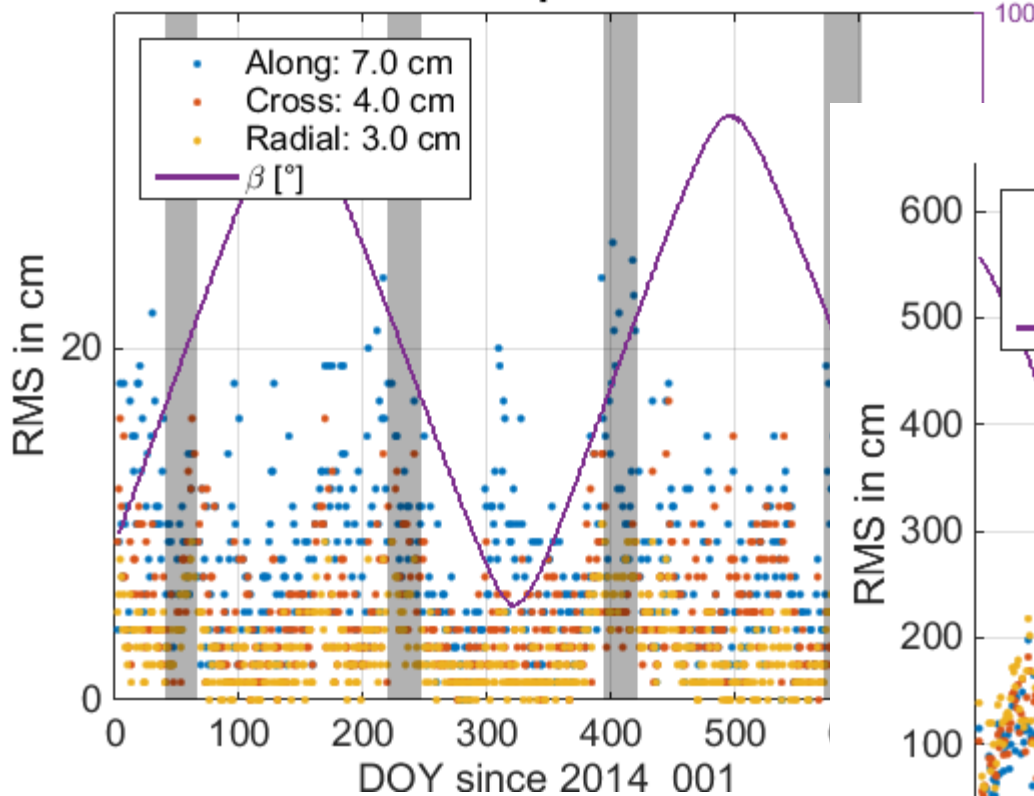
GBM Reprocessing Validation

Orbit overlap: difference between 6 hour predicted orbit with calculated orbit from next day.



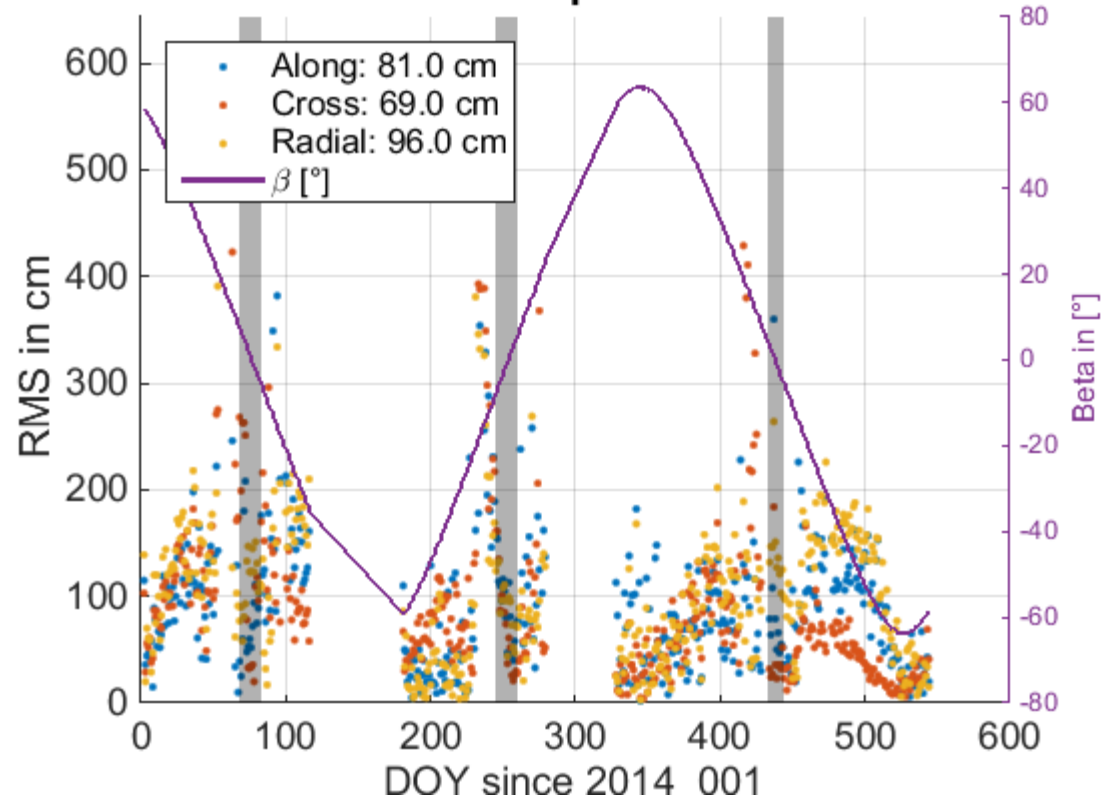
GBM Reprocessing Validation

6 hour Overlap for SAT: G04



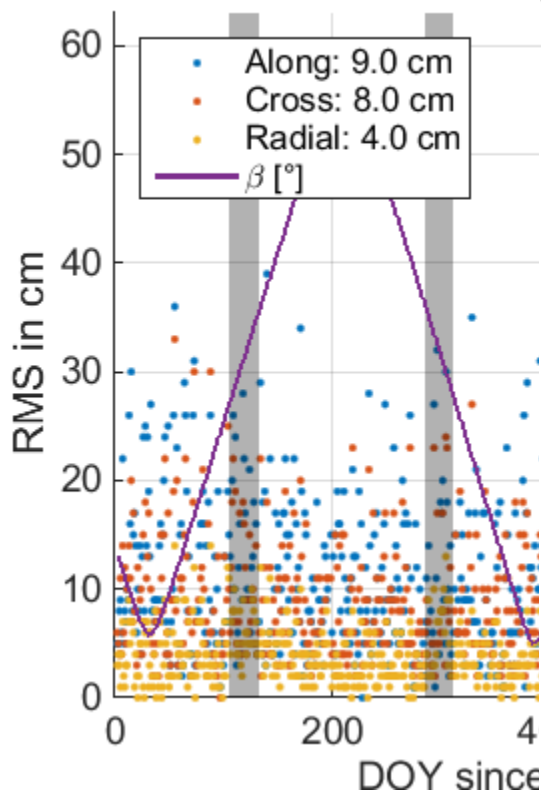
Transition from yaw-steering to yaw-fixed should be improved.

6 hour Overlap for SAT: J01



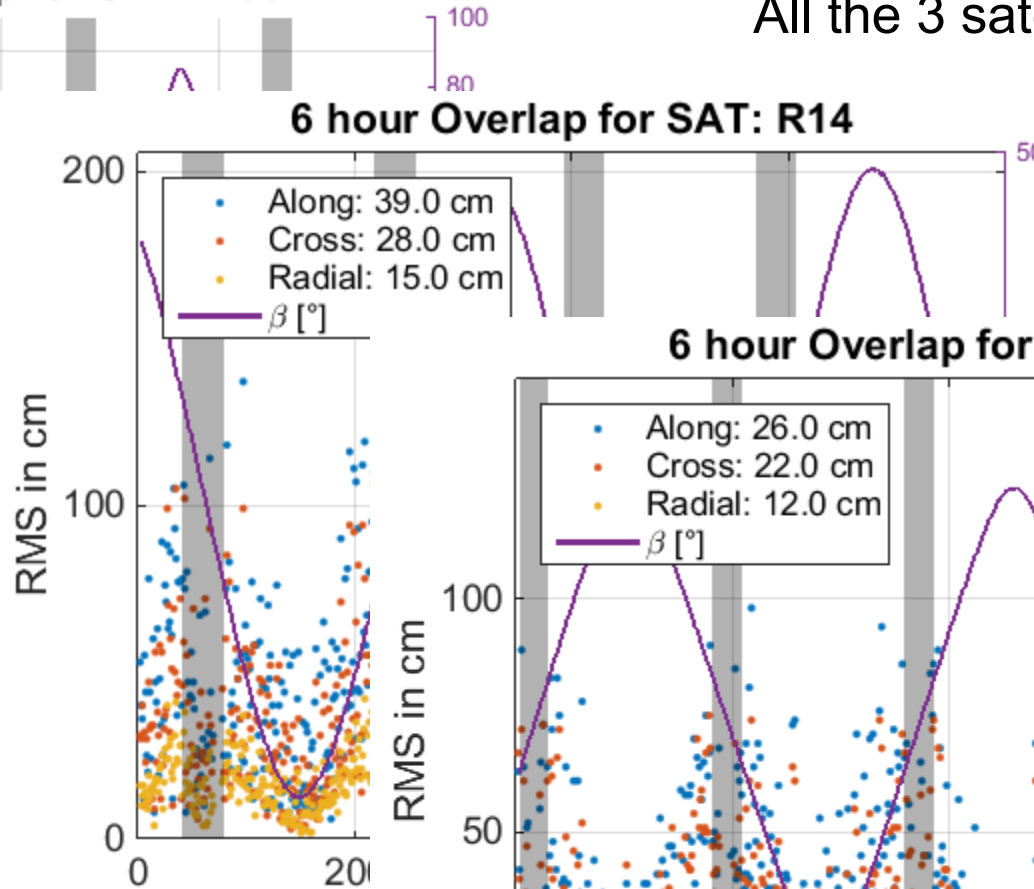
GBM Reprocessing Validation

6 hour Overlap for SAT: R06

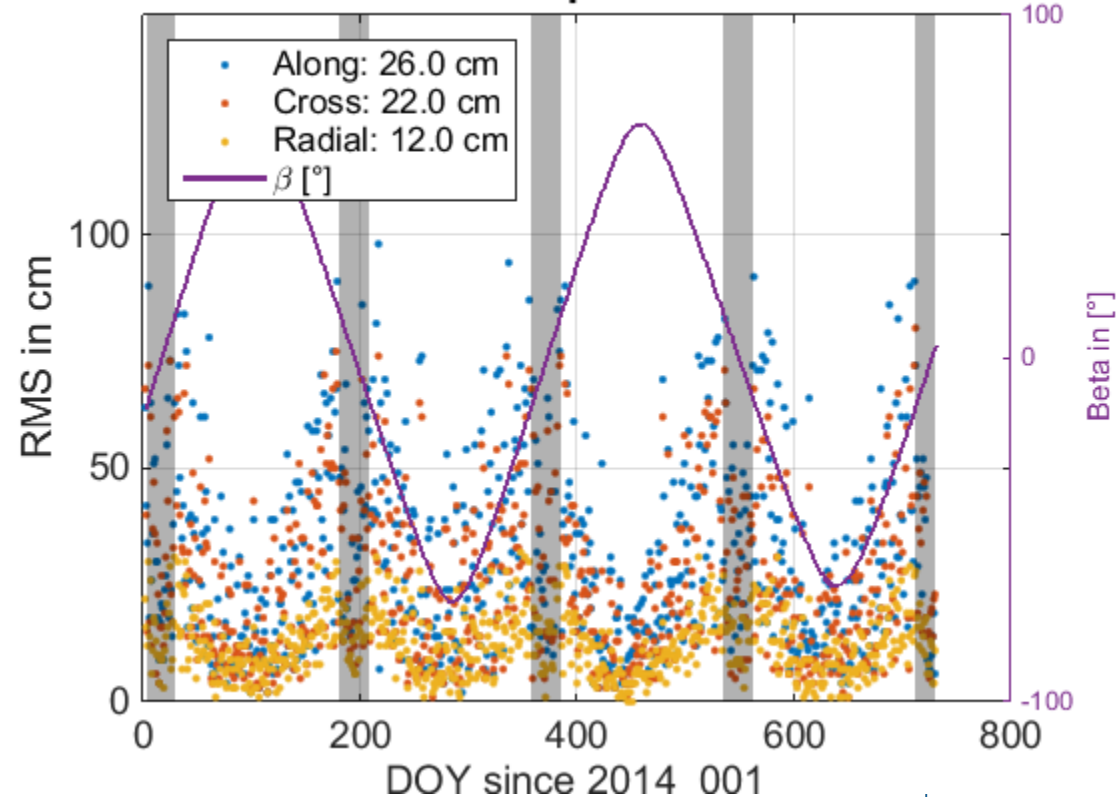


All the 3 satellites are type M.

6 hour Overlap for SAT: R14

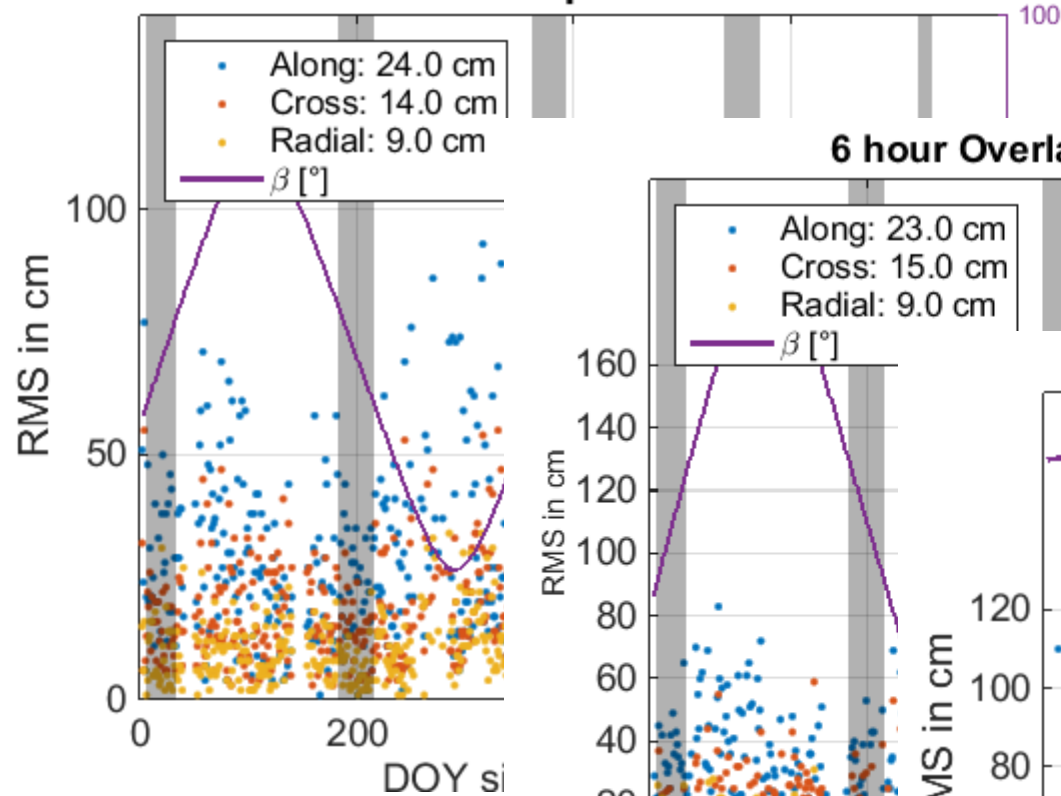


6 hour Overlap for SAT: R20

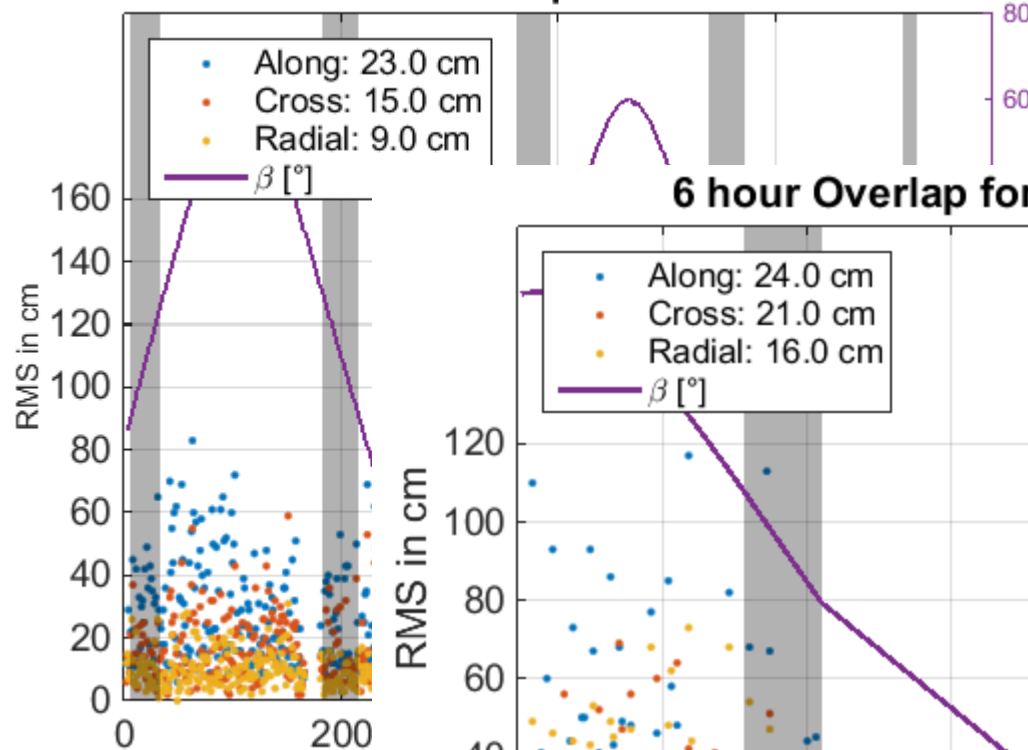


GBM Reprocessing Validation

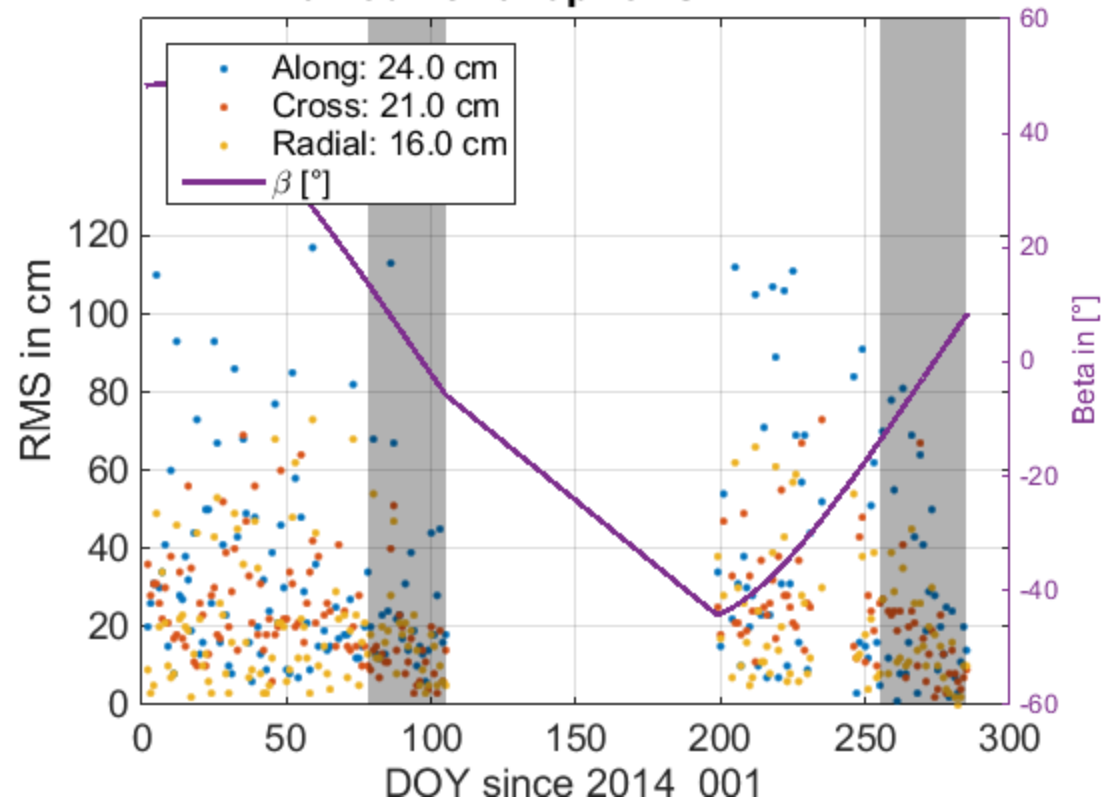
6 hour Overlap for SAT: E11



6 hour Overlap for SAT: E12

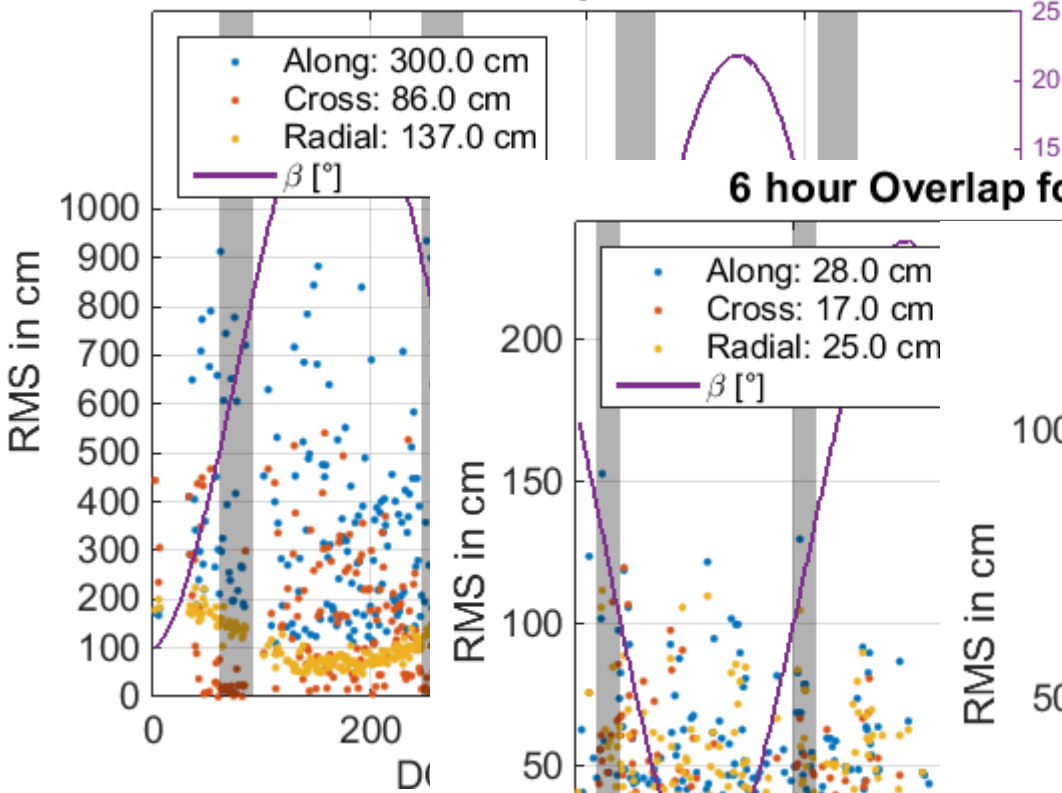


6 hour Overlap for SAT: E14

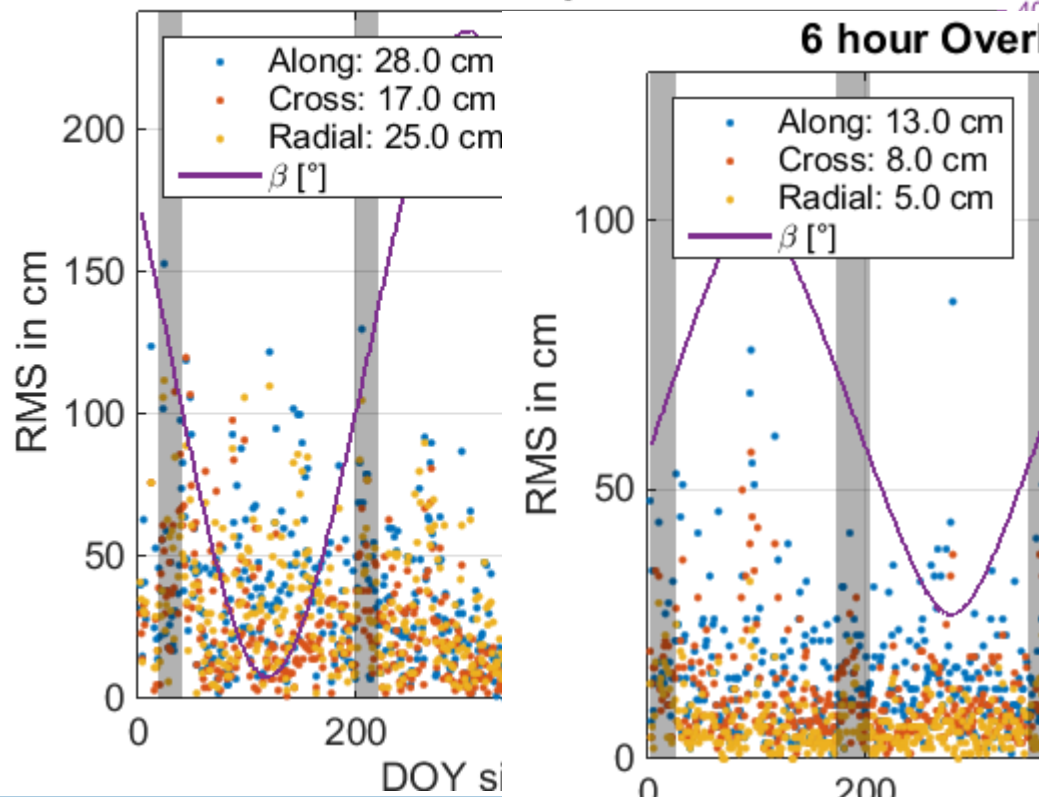


GBM Reprocessing Validation

6 hour Overlap for SAT: C01

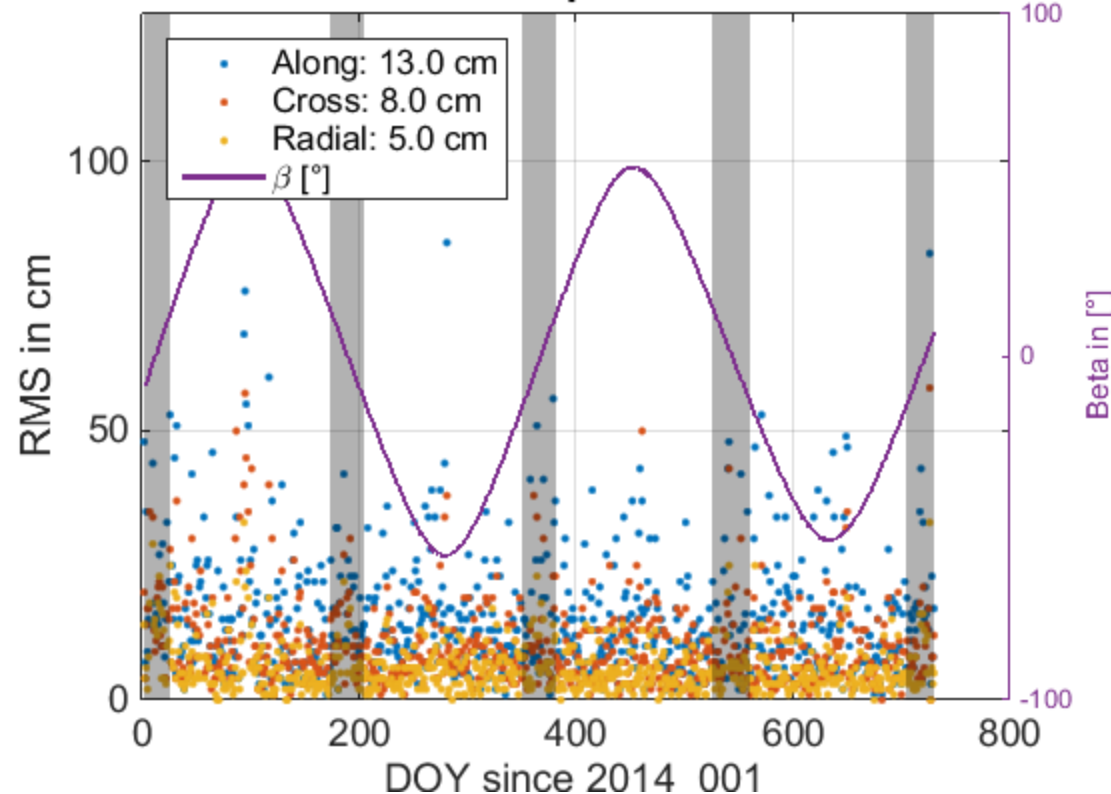


6 hour Overlap for SAT: C10



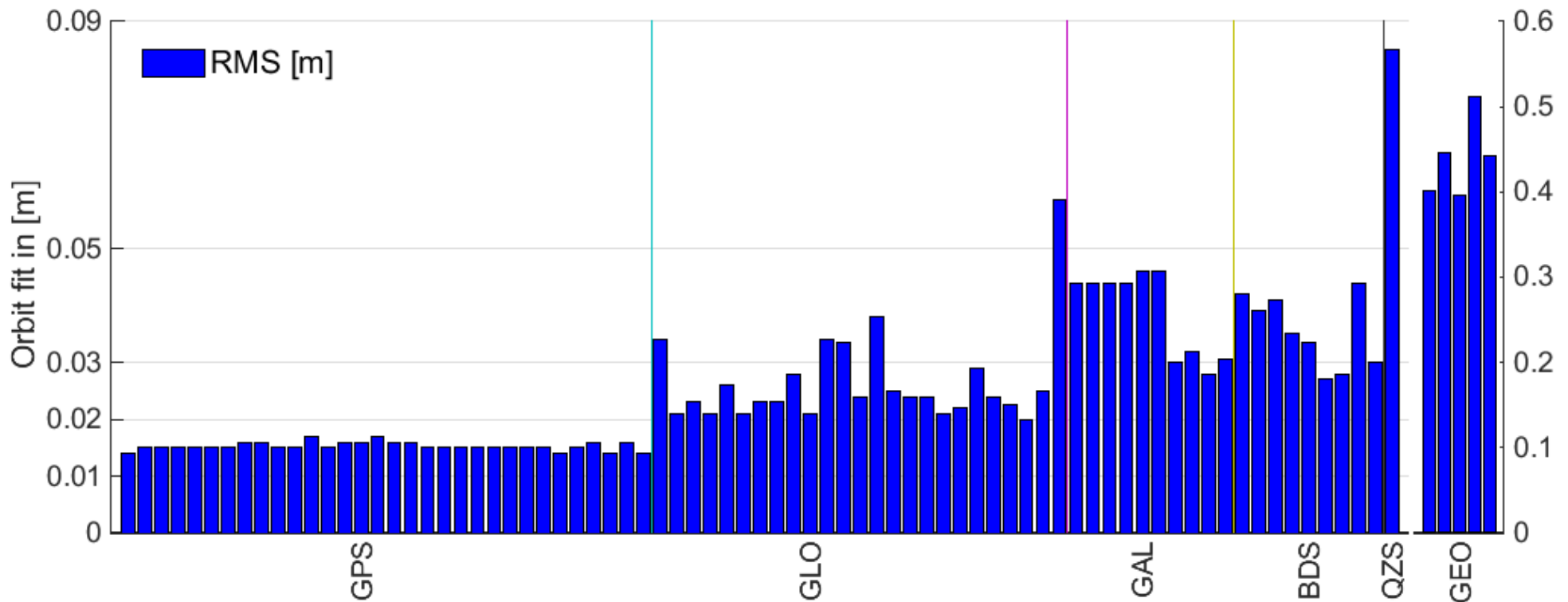
Issue for GEO satellites.
Range correction should be applied.

6 hour Overlap for SAT: C11



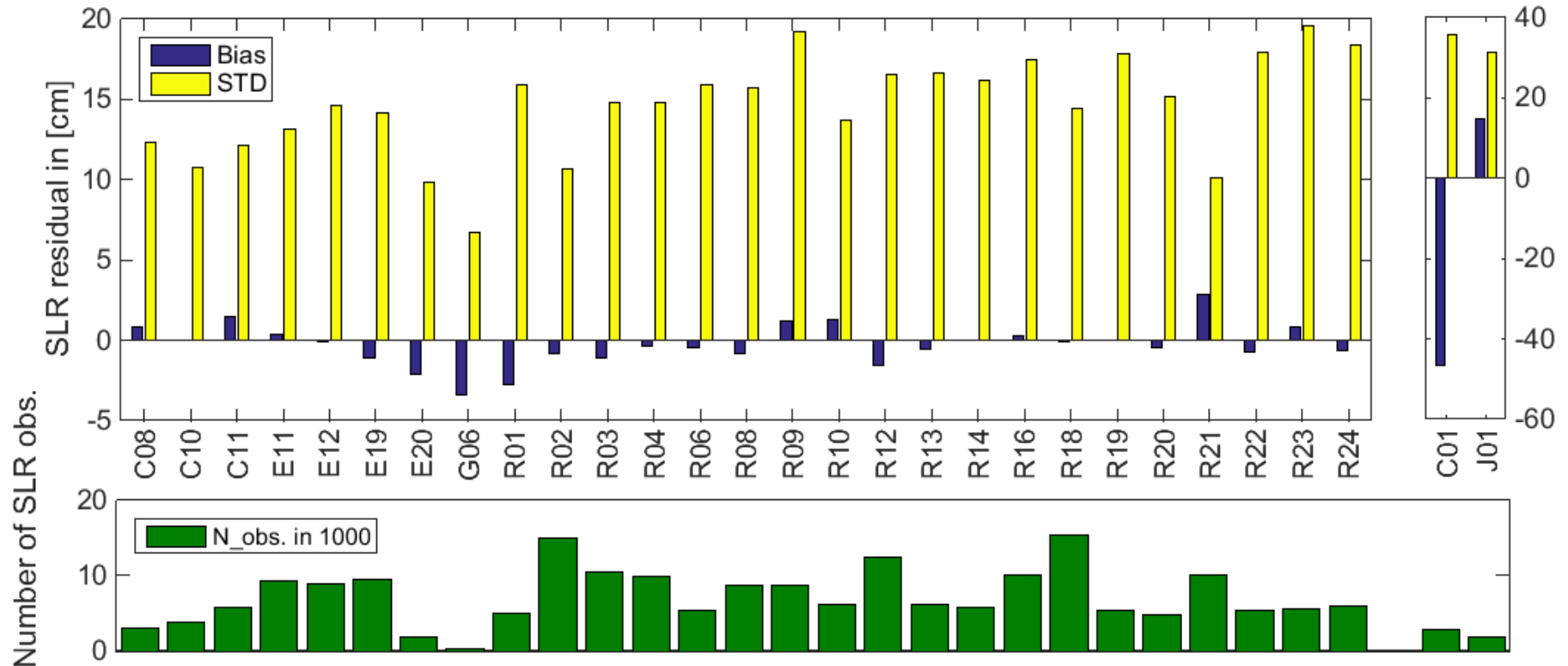
GBM Reprocessing Validation

Orbit is fitted through positions of 2 consecutive days, RMS of 2-day arc w.r.t. original orbits

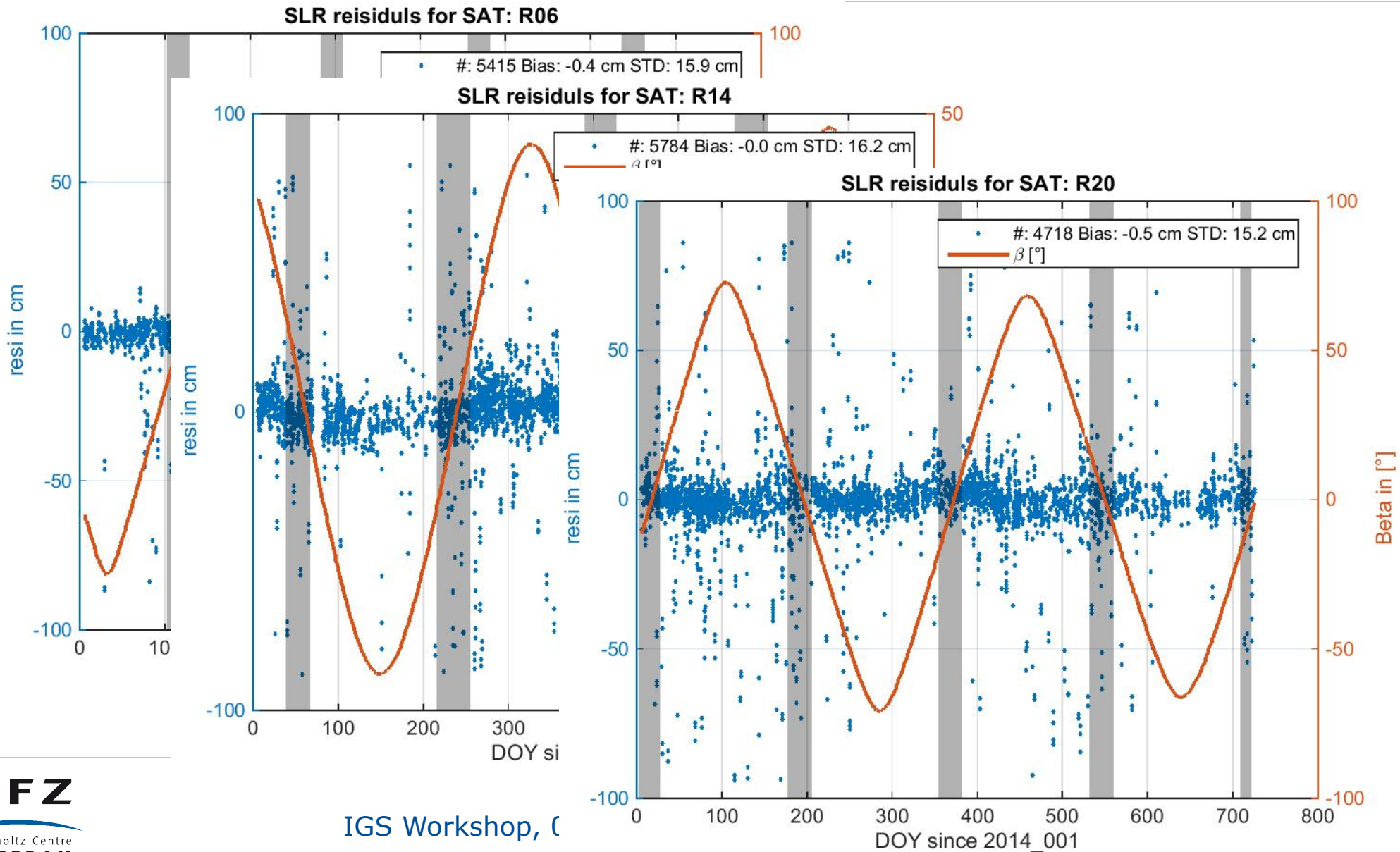


GBM Reprocessing Validation

Satellite Laser Ranging residuals: Independent optic technique

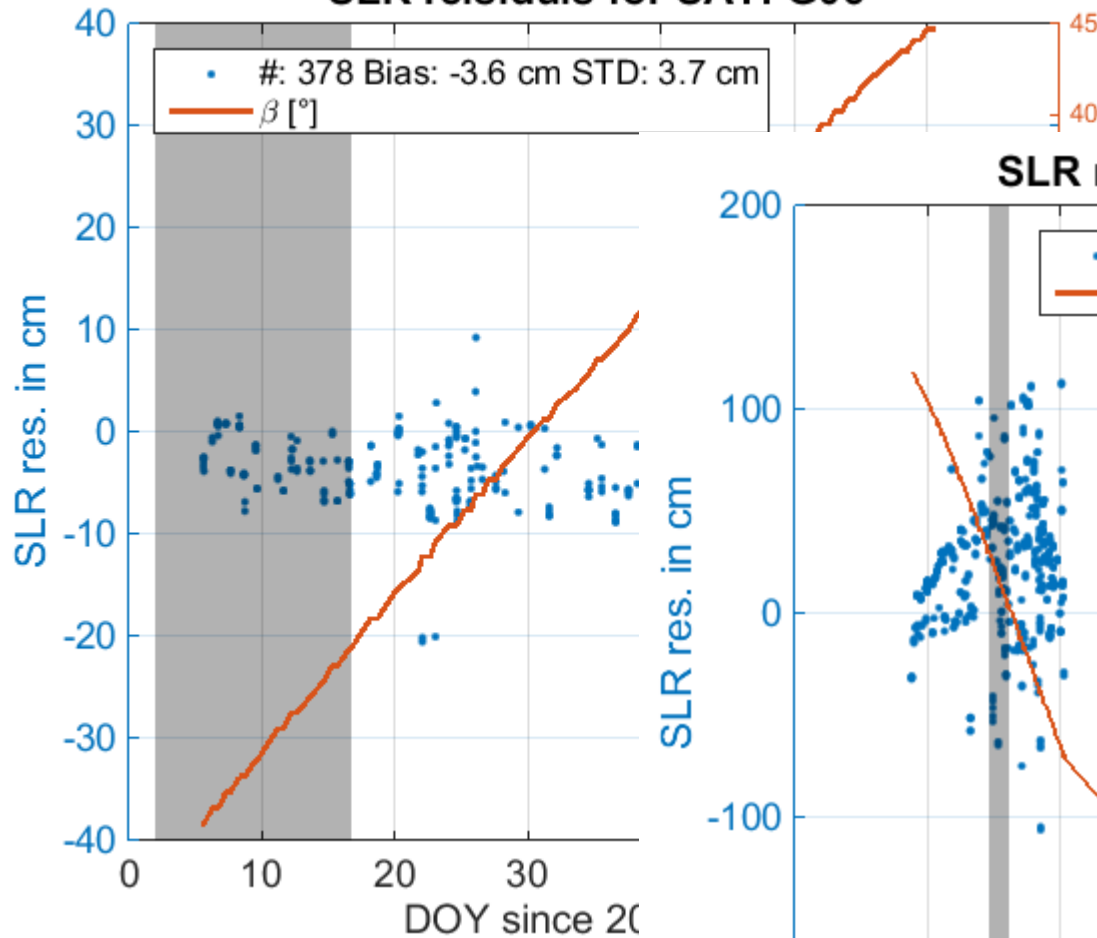


GBM Reprocessing Validation

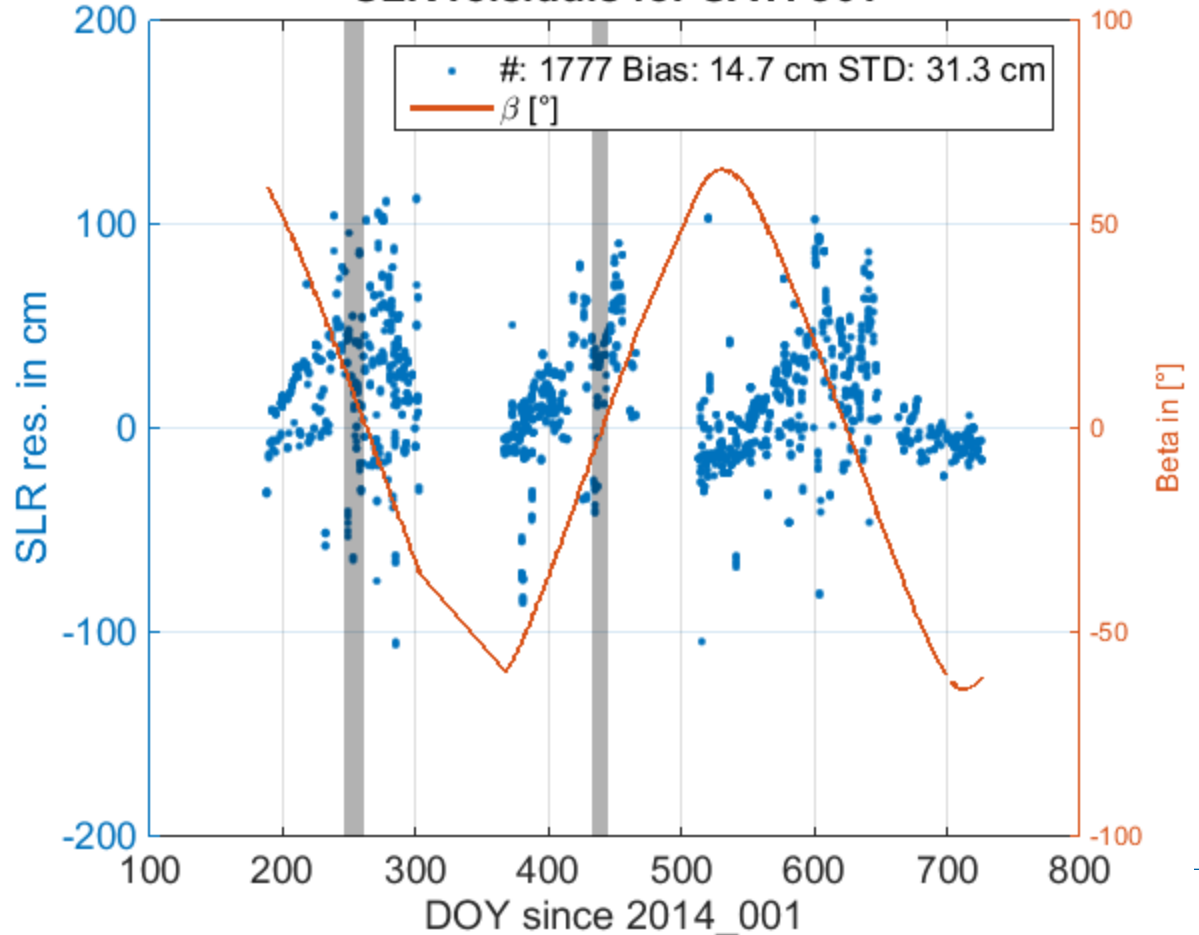


GBM Reprocessing Validation

SLR residuals for SAT: G06

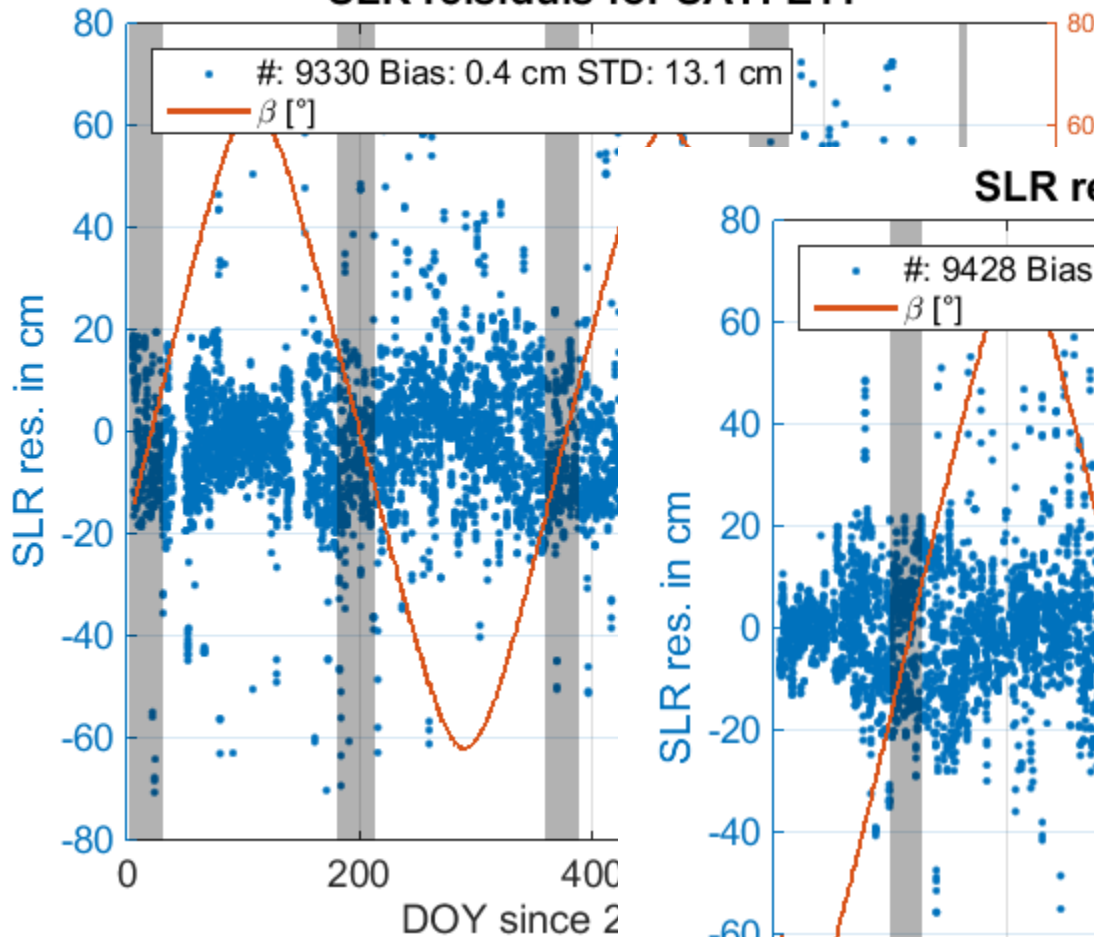


SLR residuals for SAT: J01



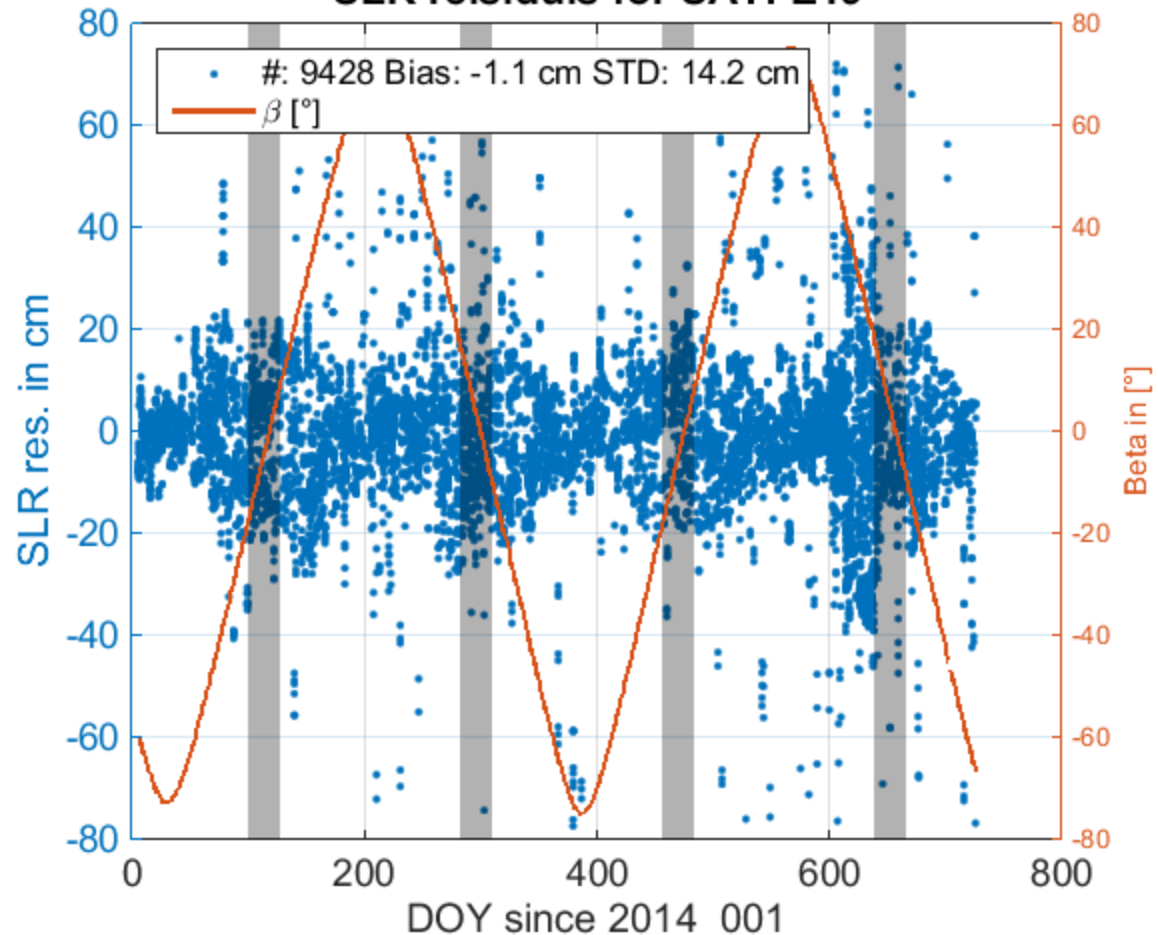
GBM Reprocessing Validation

SLR residuals for SAT: E11



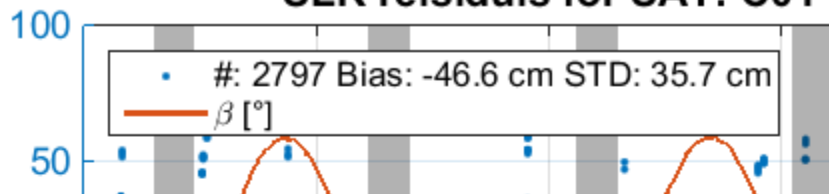
Need to switch to ECOM2 orbit parameterisation and A priori cuboid box model.

SLR residuals for SAT: E19

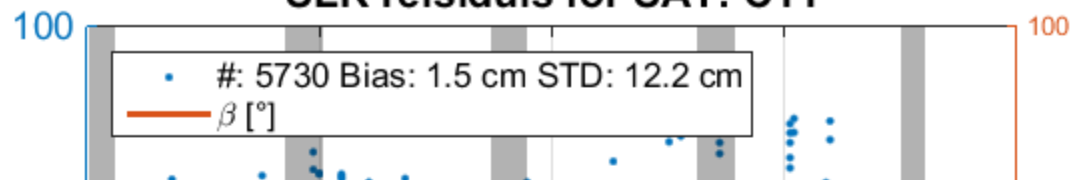


GBM Reprocessing Validation

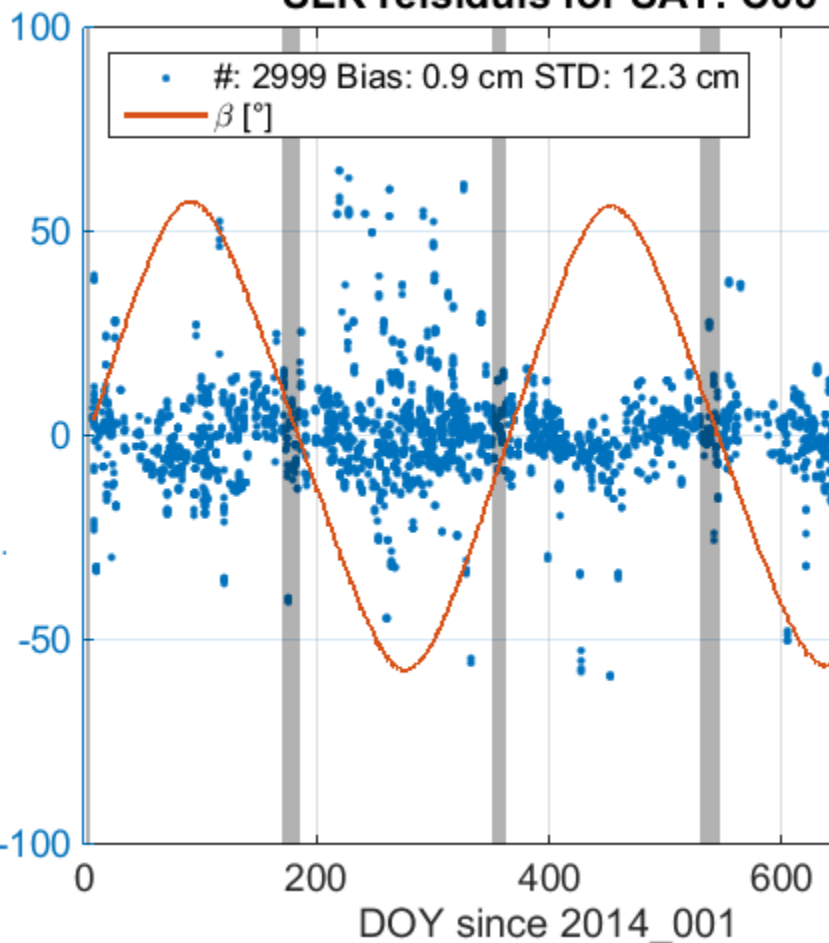
SLR residuals for SAT: C01



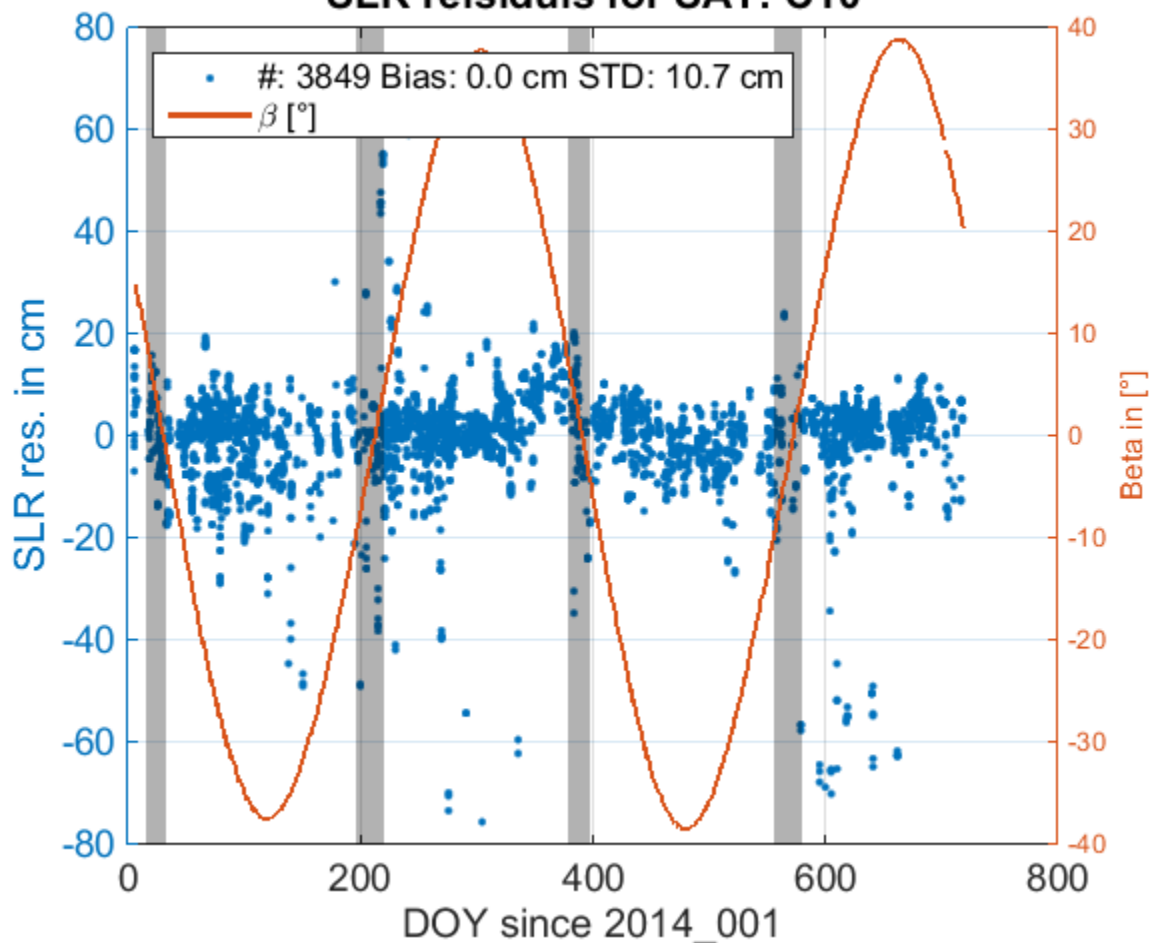
SLR residuals for SAT: C11



SLR residuals for SAT: C08



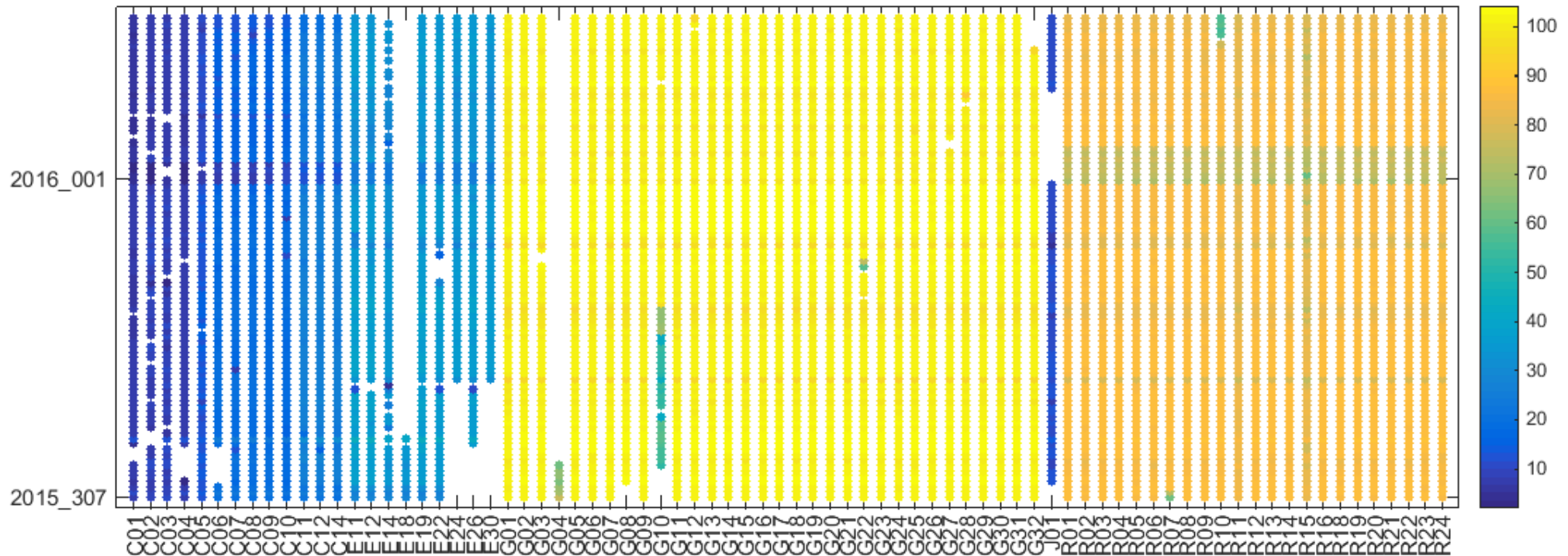
SLR residuals for SAT: C10



GBU product

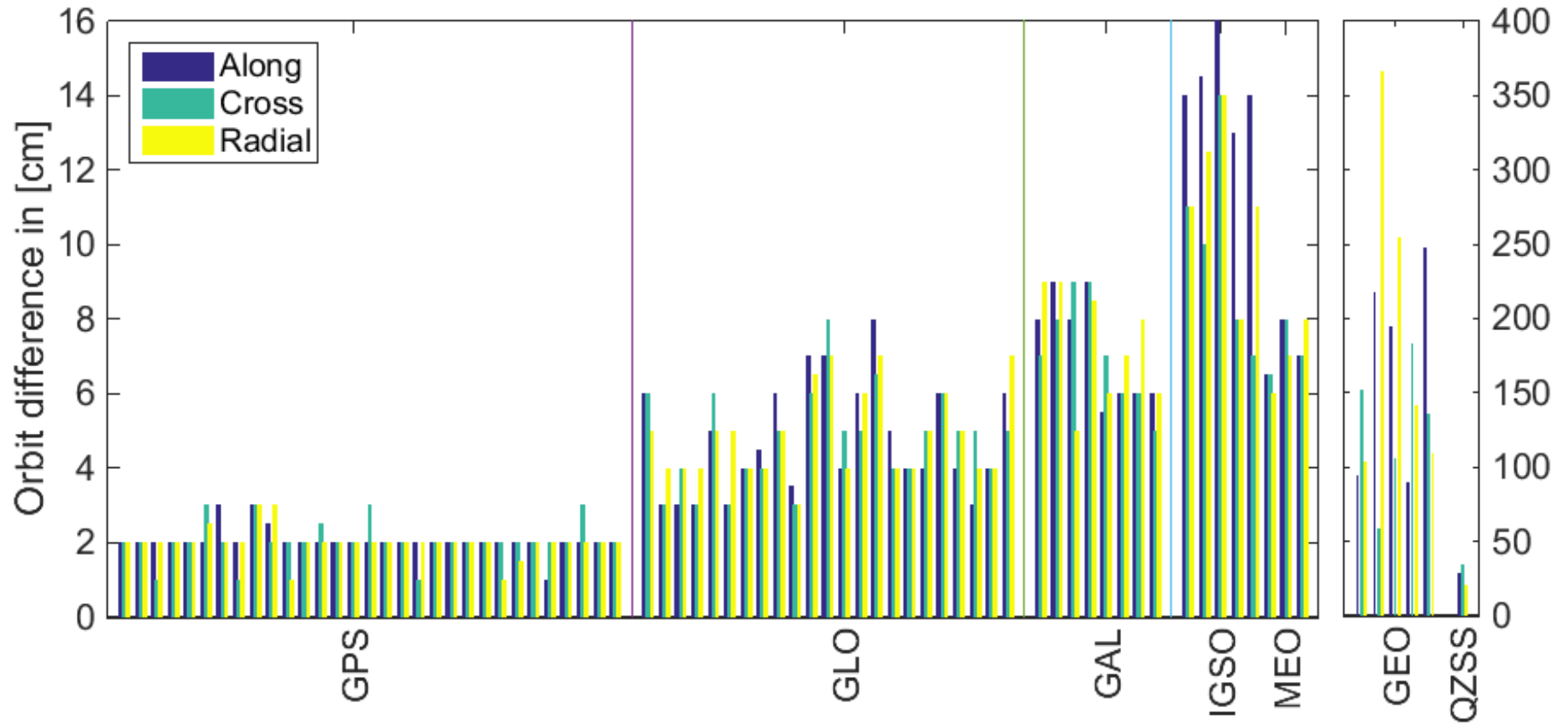
GBU: GFZ MGEX Ultra-rapid products

Number of used stations for each satellite varies from 3 to 100.



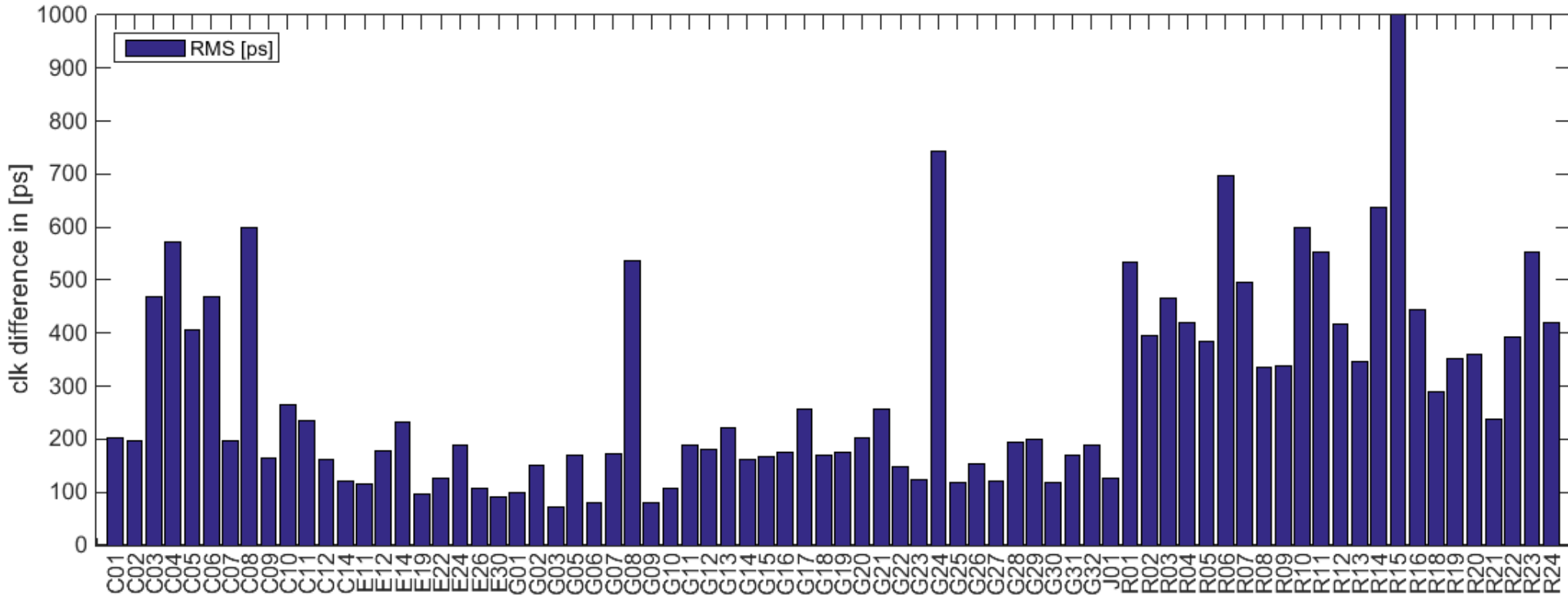
GBU product

Orbit differences: GBU (00:00 job, 6 hours prediction part) VS. GBM



GBU product

Clock differences: GBU (00:00 job, 6 hours prediction part) VS. GBM



Conclusions and outlooks

- GFZ provides operational Multi-GNSS rapid/ultra-rapid product including 5 GNSS systems.
- The validation studies show, in GBM product the GPS and GLO satellites have same accuracy as GFZ official rapid product.
- For improvement further investigation and implementation of individual attitude modes and solar pressure models are necessary.
- For comparison the multi-GNSS capable orbit and clock combination software is required (See Poster by Mathias Fritsche).

Thank you for your attention