Status of the **Sentinel-3 DORIS** processing at the **Copernicus POD Service**

IDS AWG meeting
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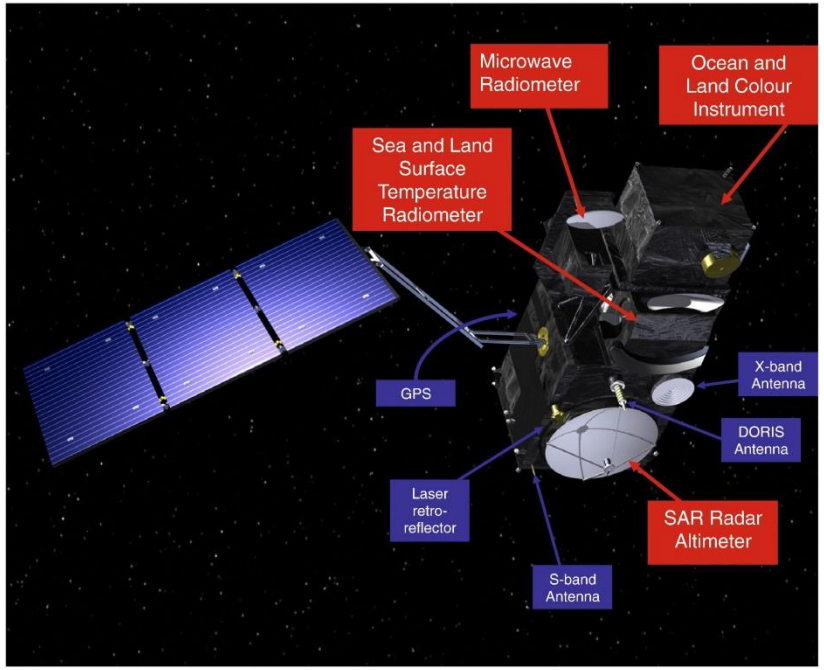
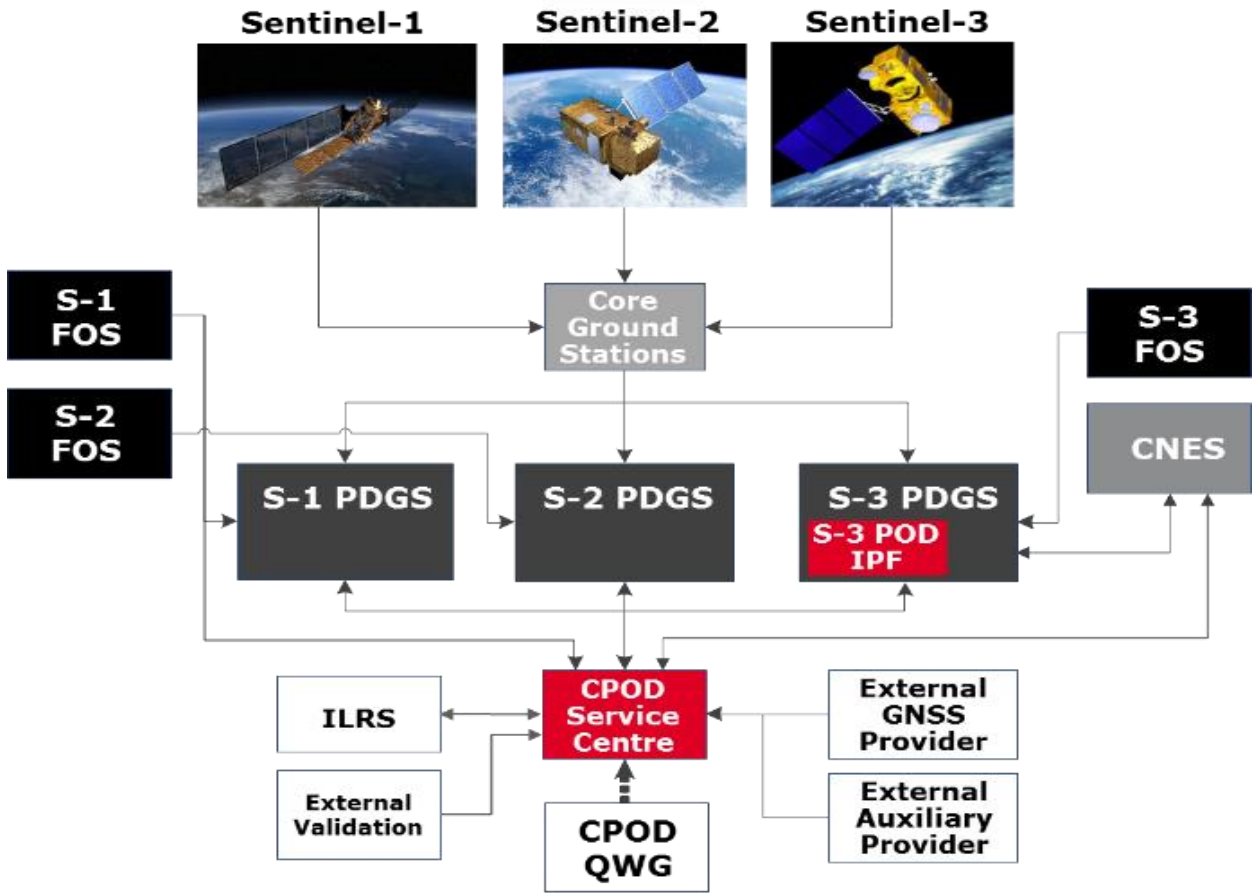


Overview of Copernicus POD Service

- **Payload Data Ground Segment (PDGS):**
  - Processing the scientific data
  - Provider of GPS and attitude data to the CPOD Service
  - User of the orbits and platform files from the CPOD Service
- **Sentinels Flight Operations Segment (FOS):**
  - Orbits, manoeuvre and satellite mass evolution
  - ESOC for S1 and S2; EUMETSAT for S3
- **Centre National d'Études Spatiales (CNES):**
  - S-3 orbital and attitude products, DORIS data
- **ILRS - SLR data provider:**
  - International Laser Ranging Service –ILRS- centres
- **External Validation:**
  - AIUB, CNES, DLR, ESOC, TU Delft, TUM, EUM, CLS, (JPL)
  - provision of independent orbital products
- **External GNSS data Provider (EGP):**
  - VERIPOS; provider of high accurate GPS orbits and clocks products
  - ***magicGNSS***: in-house back-up GPS provider
- **External Auxiliary providers:**
  - Atmospheric gravity models, EOPS and leap seconds, etc.
- **CPOD Quality Working Group (CPOD QWG):**
  - Monitoring the quality of CPOD products
  - Definition of enhancements (algorithms, standards, etc.)



S-3 POD IPF
Marine Centre (EUMETSAT)
Land Centre (Svalbard/ESA)

General information (1)

- The Sentinel-3 orbits delivered to the PDGS (Payload Data Ground Segment) from the Copernicus POD Service are all GPS-only derived solutions
- S-3A & S-3B **DORIS-only** and GPS+DORIS orbit solutions are routinely generated but not routinely checked/controlled
- Most results shown in this presentation are from a post-processing at PosiTim

- Unfortunately, only few progress has been made since IDS Workshop last year
  - ⇒ BUT: a small bug in the ionosphere correction has been found, which had quite a large impact on the orbits
  - ⇒ Inconsistencies between ocean tide model (EOT11a) and ocean loading (FES2004) removed

- For S-3A the ARPs are adopted to CNES POE-F standards for all three observation techniques (GPS, DORIS, SLR)
- First tests with EIGEN-GRGS RL04 gravity field model and GFZ AOD Level 1B products

General information (2)

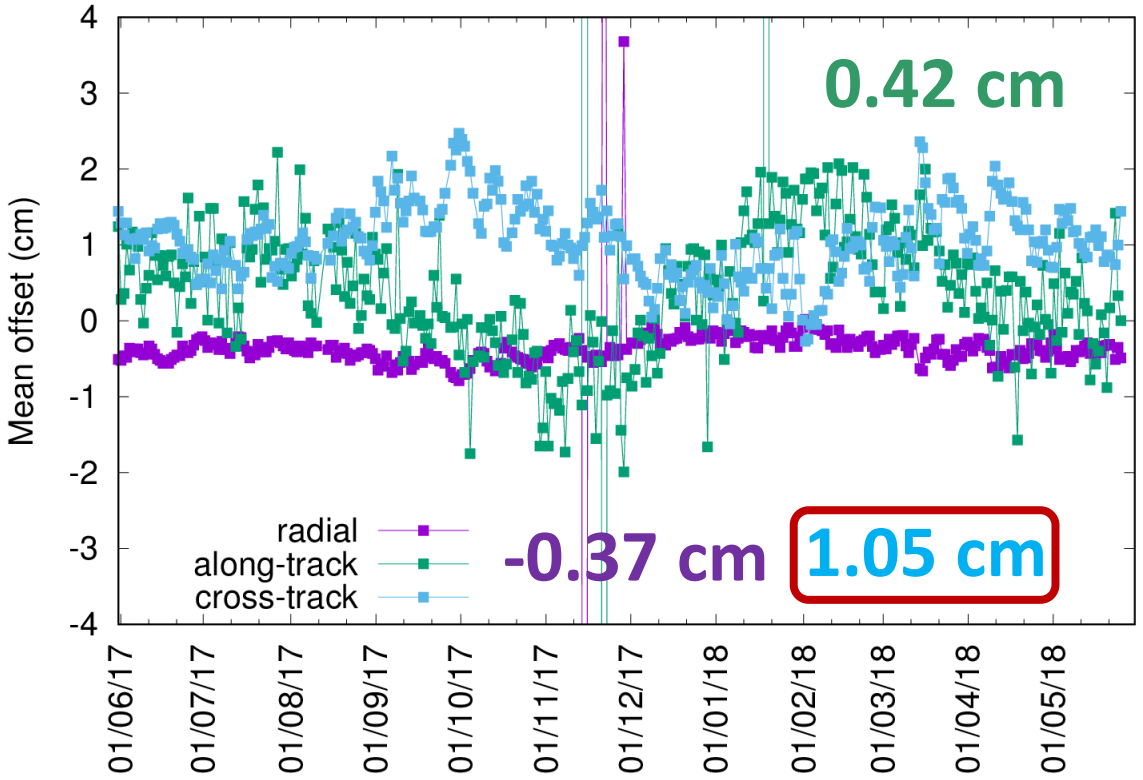
The key data of the DORIS processing are:

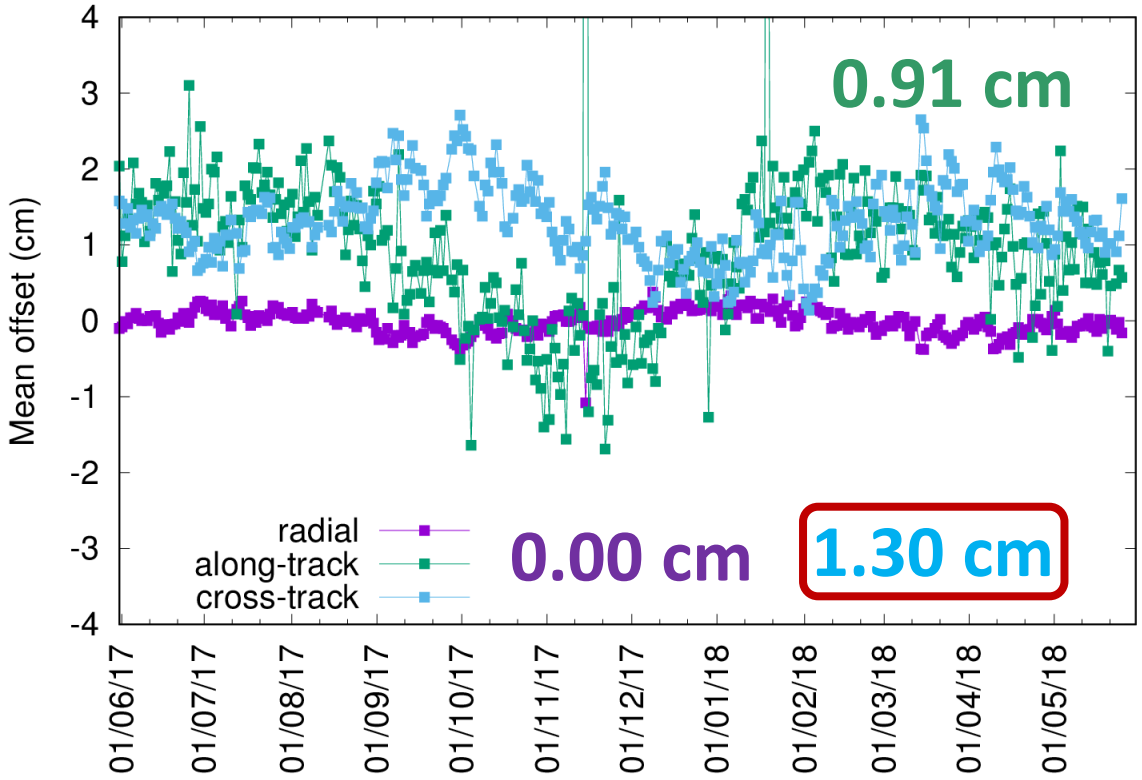
- DORIS Doppler observations (converted from the phase available in the DORIS RINEX)
- Three-day arc length (72 hours)
- Estimation of
  - 1 radiation pressure coefficient
  - 10/24h atmospheric drag scale factors
  - 2/24h sets of CPR along-track sine+cosine and cross-track sine+cosine parameters
- Elevation cut-off angle of 10^{o} for DORIS observations, no elevation-dependent weighting

- Comparisons to other solutions:
  - GRGS/CLS orbits
  - Combined QWG orbits (weighted average of several orbit solutions)
  - Operational CPOD GPS orbits
  - CNES DORIS-only orbits

S-3A DORIS orbits: Com

IDS Workshop 2018



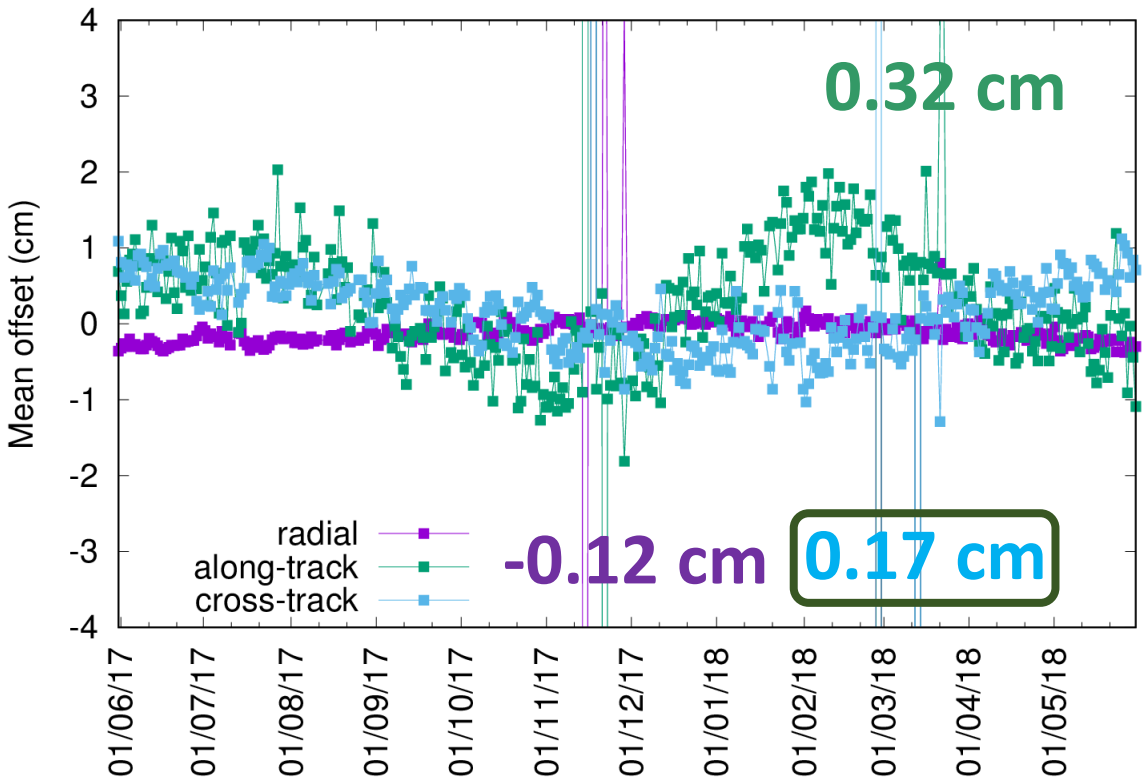


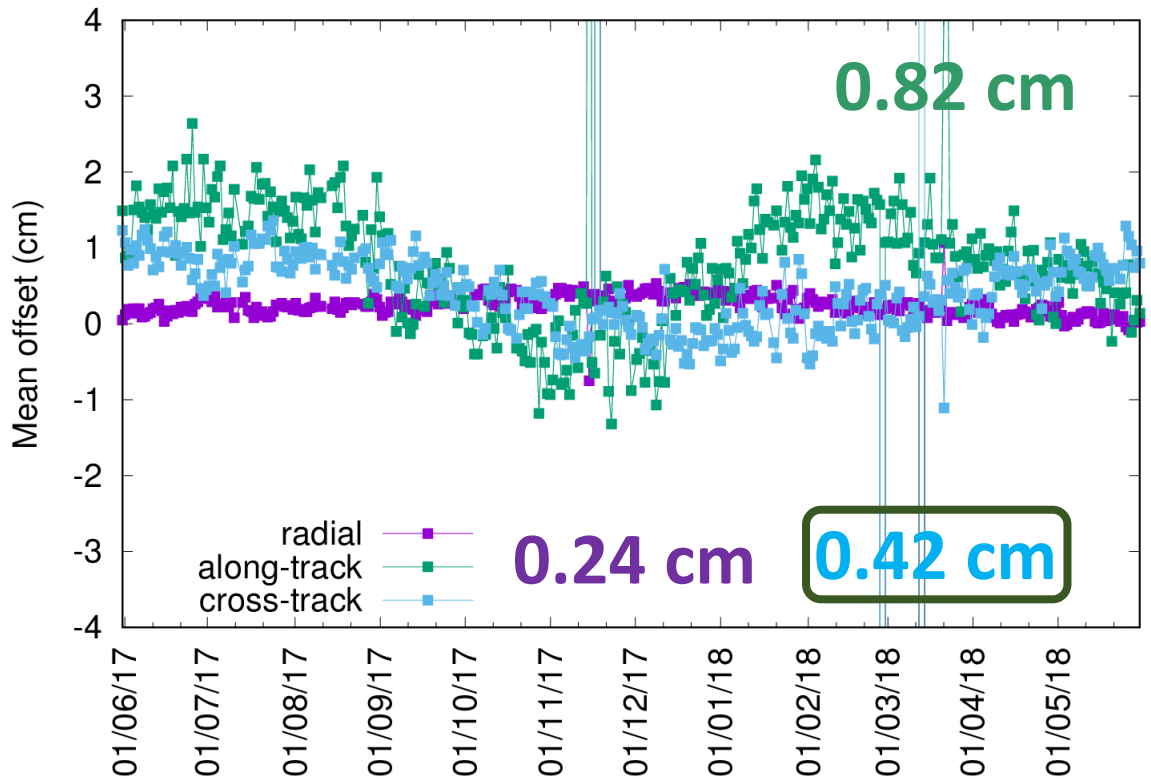
Daily mean offsets (m) between S-3A DORIS orbits and CLS/GRGS orbits (left) and QWG combined orbits (right)

- **Small radial offset between CLS/GRGS and CPOD DORIS orbits, variable along-track offsets, significant cross-track offsets**

S-3A DORIS orbits: Com

Corrected iono corr



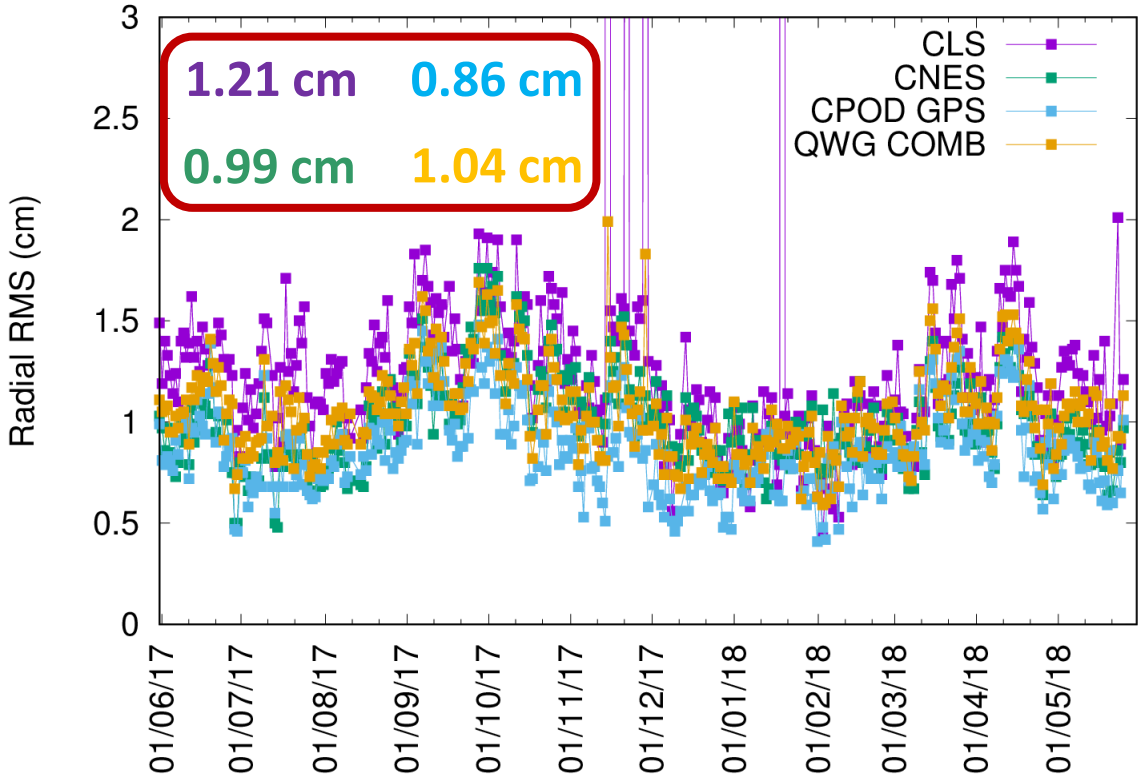


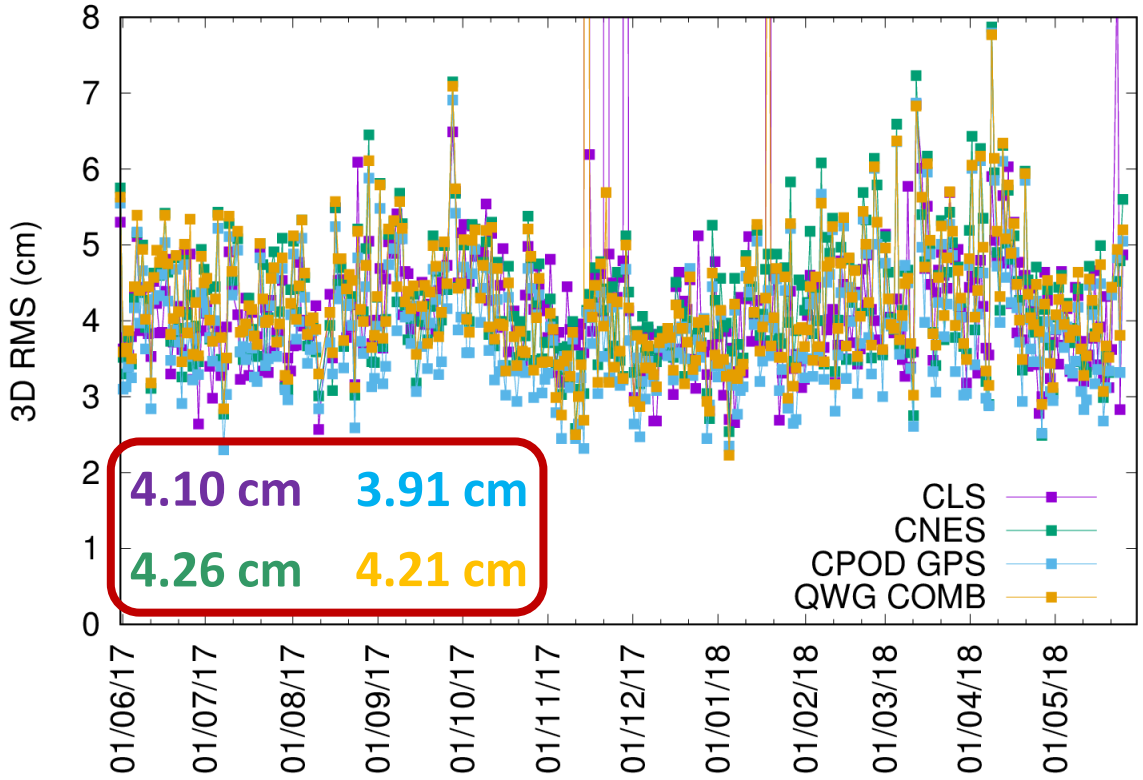
Daily mean offsets (m) between S-3A DORIS orbits and CLS/GRGS orbits (left) and QWG combined orbits (right)

- **Cross-track offsets could significantly be reduced**

S-3A DORIS orbits: Com

IDS Workshop 2018



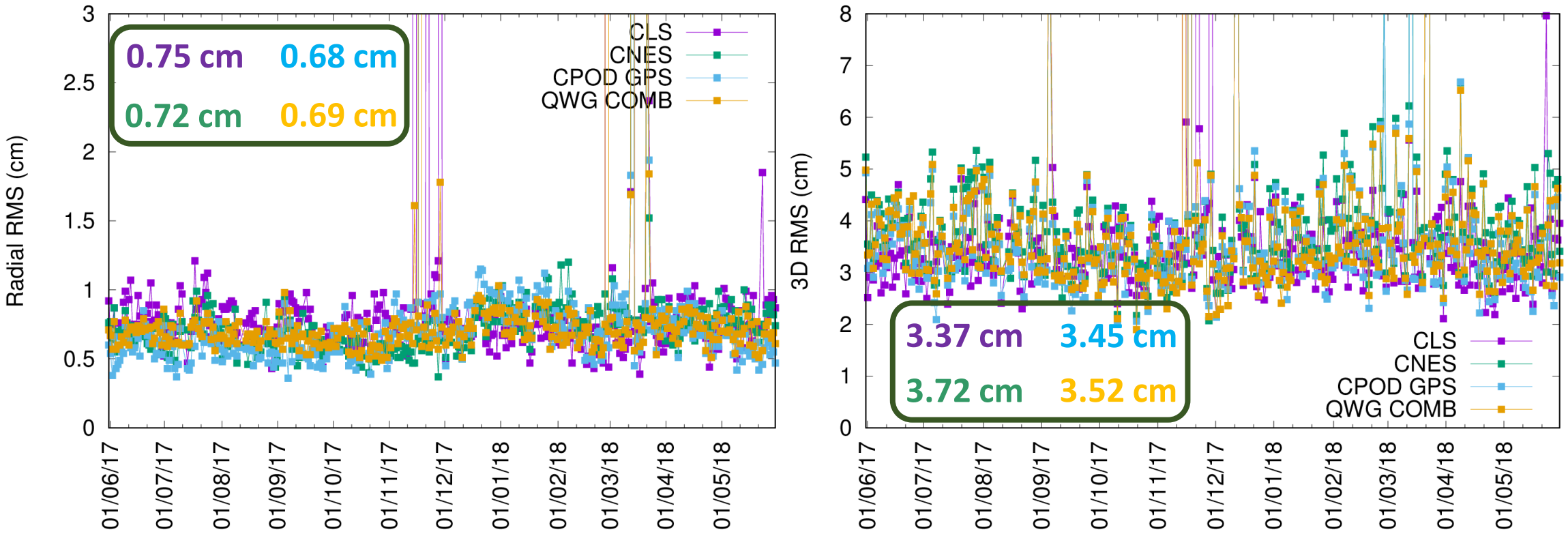


Daily radial and 3D RMS (cm) of S-3A DORIS orbits w.r.t different orbit solutions

- **All comparisons are similar**

S-3A DORIS orbits: Com

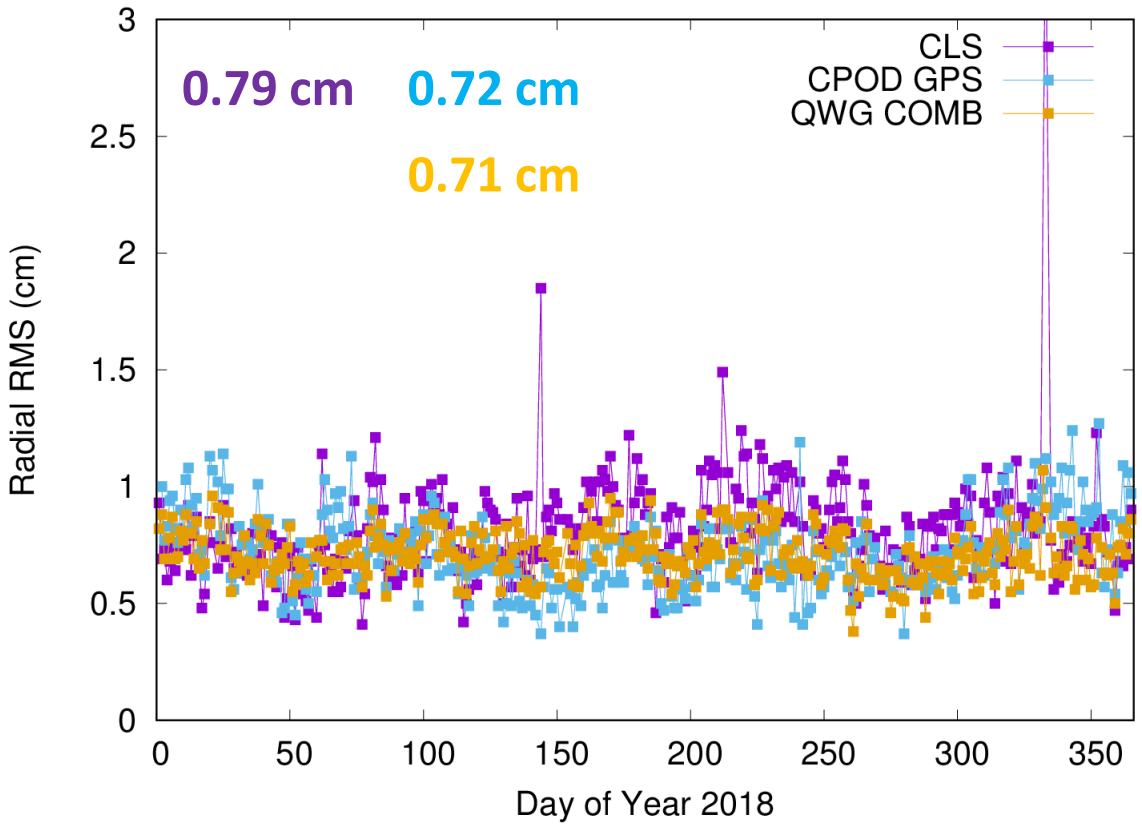
Corrected iono corr

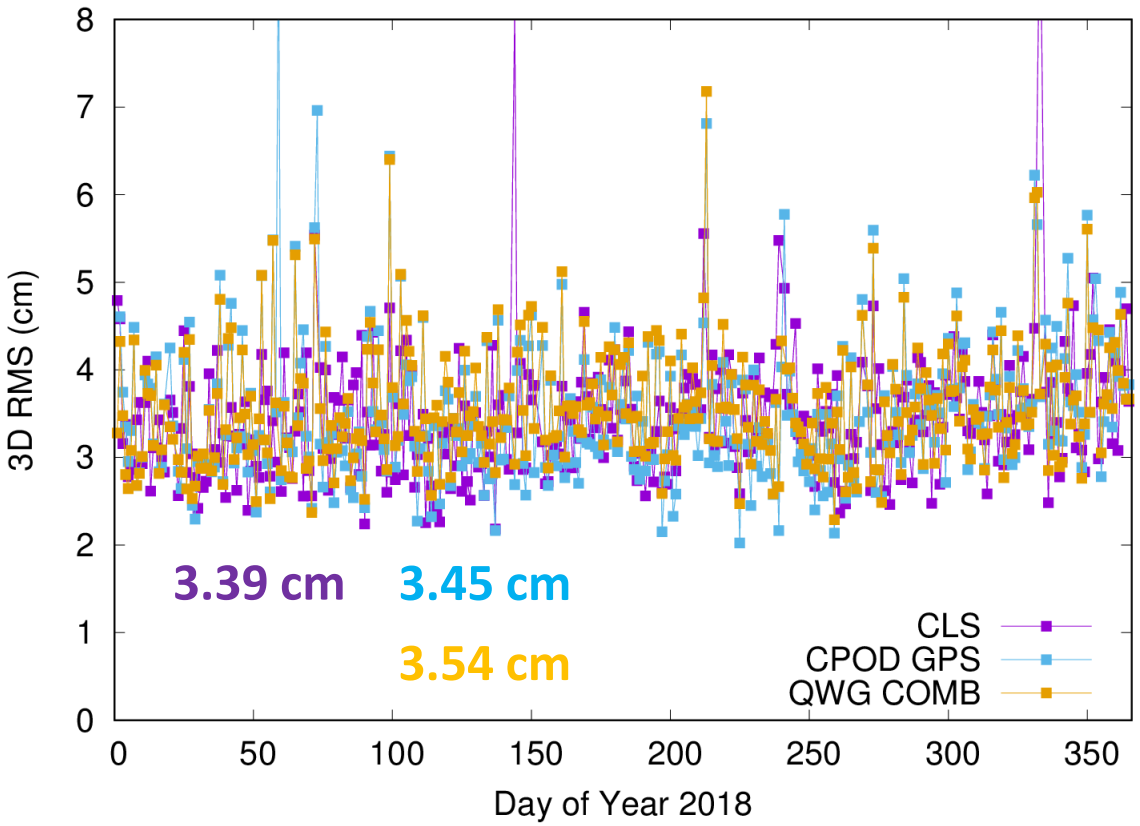


Daily radial and 3D RMS (cm) of S-3A DORIS orbits w.r.t different orbit solutions

- **All comparisons are similar**
- **Radial and 3D RMS are significantly reduced**

S-3A DORIS orbits with updated ARPs: Comparisons



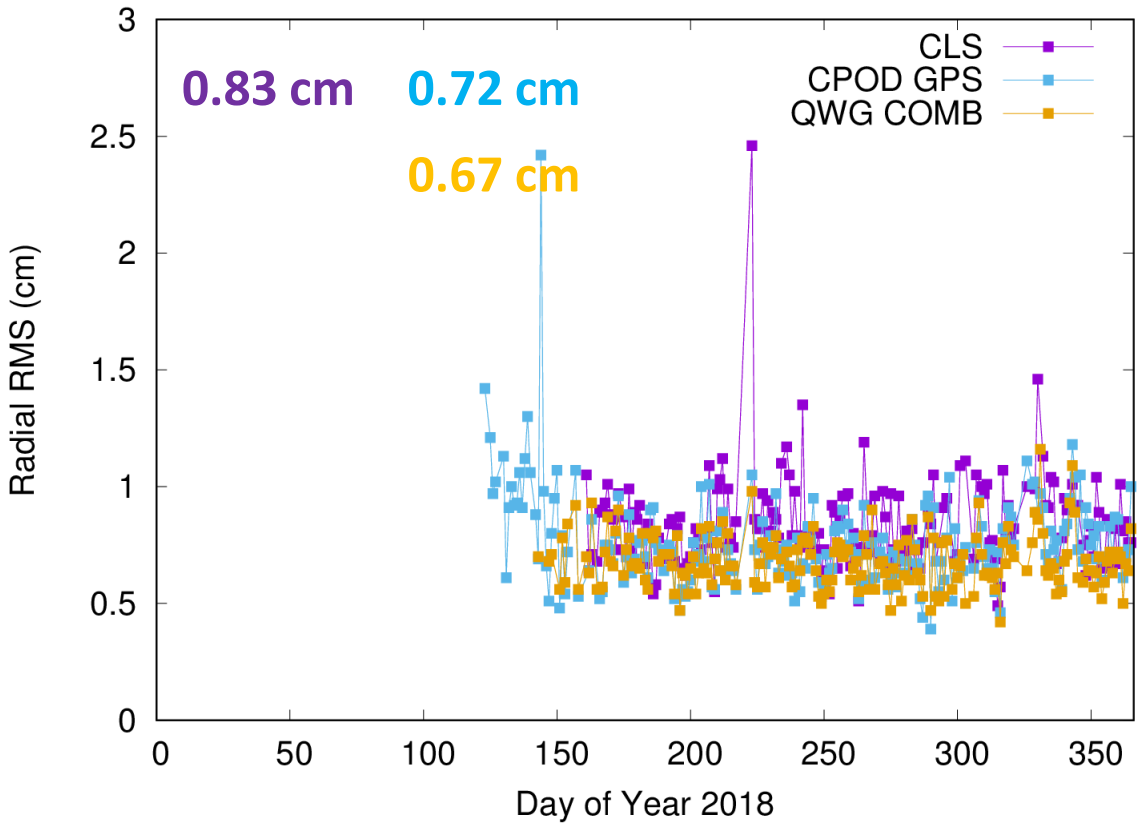


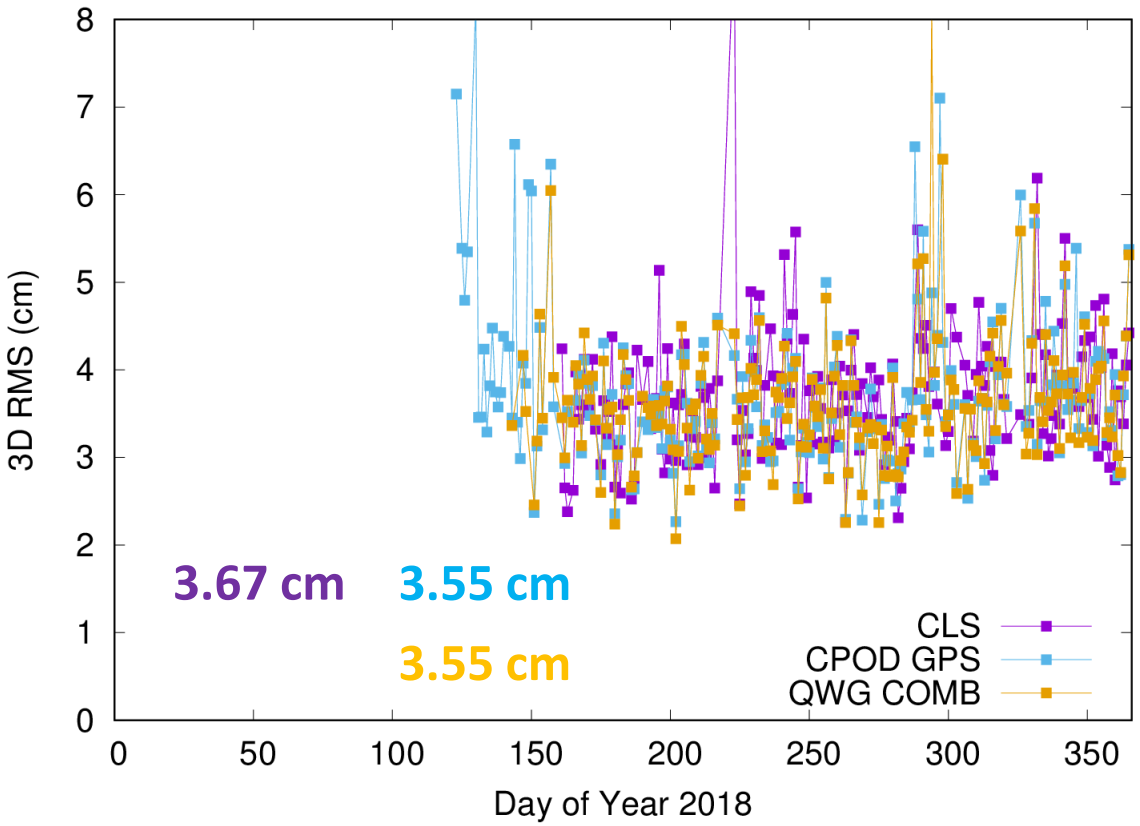
Daily radial and 3D RMS (cm) of S-3A DORIS orbits w.r.t different orbit solutions

- **Updated ARPs for DORIS**
- **Consistent ocean tide model and ocean loading values**

=> No changes in the comparisons, results are equivalent to before

S-3B DORIS orbits: Comparisons

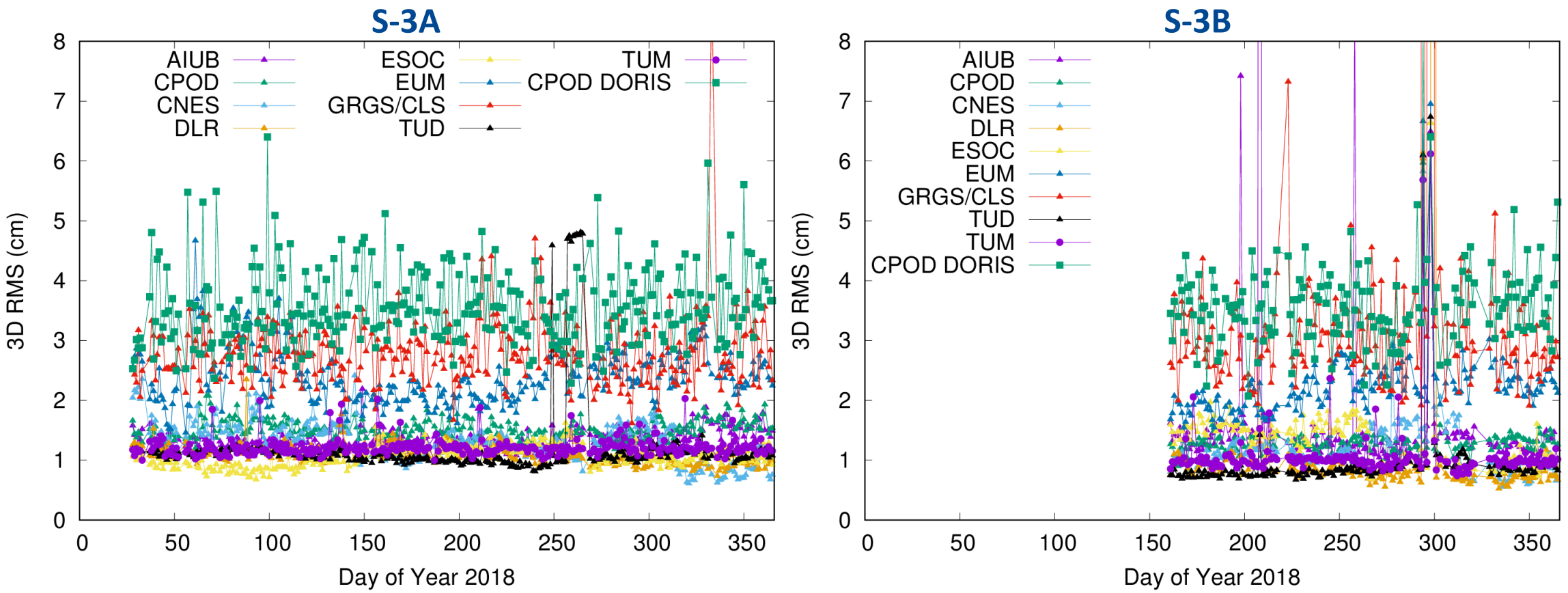




Daily radial and 3D RMS (cm) of S-3B DORIS orbits w.r.t different orbit solutions

- **Comparisons are equivalent to the results from S-3A**

S-3A & S-3B DORIS orbits in RSR comparisons



- Regular Service Review (RSR) comparisons within the Copernicus POD Service
- Comparisons of all available orbit solutions to combined orbit (weighted average from all orbit solutions, except CPOD DORIS)
- CPOD DORIS orbits are slightly worse than other DORIS-only GRGS/CLS orbits

S-3A & S-3B DORIS orbits in RSR comparisons

Comparison to QWG combined orbit

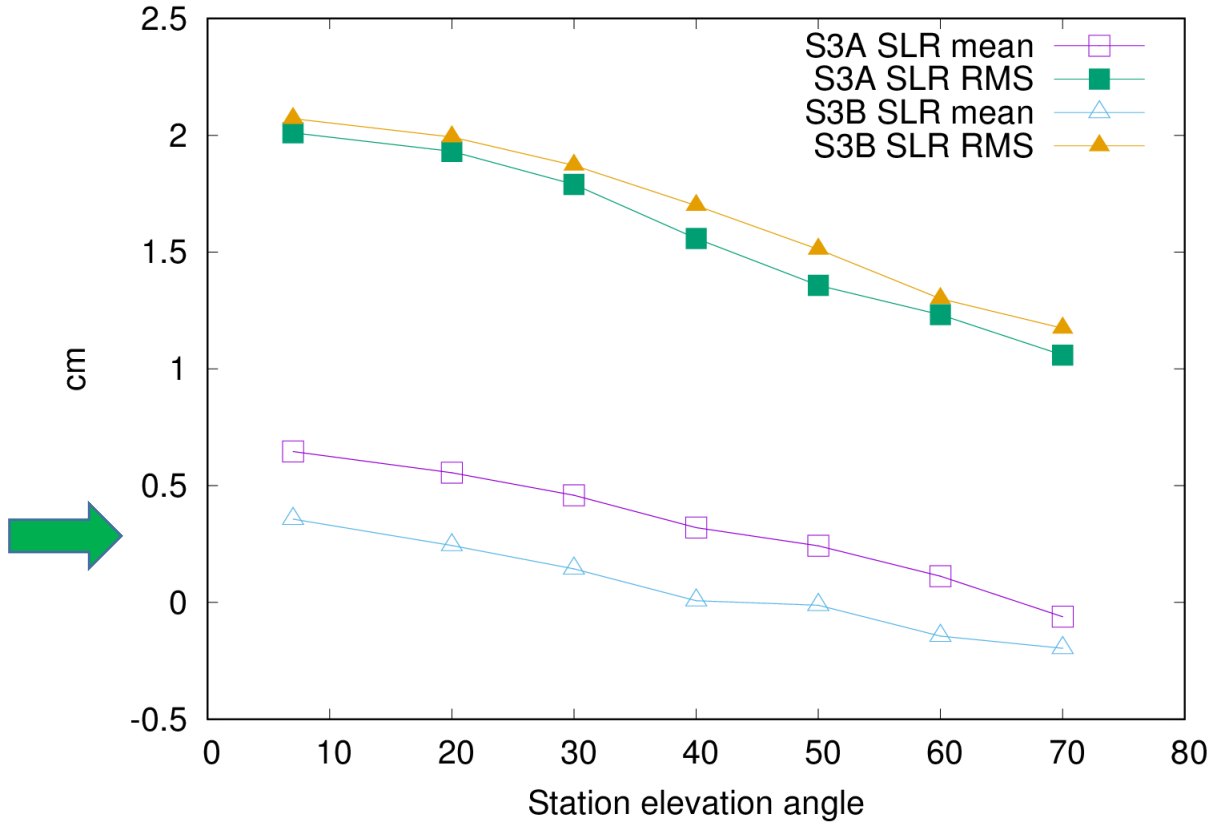
		CPOD DORIS	CLS/GRGS		
		Year 2018	RSR11 (Feb –May 18)	RSR12 (Jun-Sep 18)	RSR13 (Oct 18-Jan 19)
Radial RMS (cm)	S-3A	**0.71**	0.71	0.72	0.62
	S-3B	**0.67**	-	0.70	0.66
3D RMS (cm)	S-3A	**3.54**	2.75	2.87	2.74
	S-3B	**3.55**	-	2.99	3.03

- **Radial component is very similar to CLS/GRGS**
- **In 3D the CPOD DORIS orbits are still inferior, but we are working on it …**

S-3A & S-3B DORIS orbits: SLR validation

- **Nine SLR stations: 7090, 7105, 7119, 7501, 7839, 7840, 7841, 7941, 8834**

	Mean (cm)	RMS (cm)
S-3A	0.71	2.14
S-3B	0.40	2.19
S-3A	**0.65**	**2.01**
S-3B	**0.36**	**2.07**



- **Second listed solutions are obtained with**
  - **updated gravity field model (EIGEN.GRGS RL03 => RL04)**
  - **GFZ AOD L1B instead of atmosphere gravity products from massloading.net**

- **SLR observations above 70° are only 2.3 % (S-3A) and 2.2 % (S-3B) of the available observations!!**

Summary

- S-3A & S-3B POD based on DORIS observations is set up at the Copernicus POD Service and runs automatically in parallel to the operational POD processing
- Recent small software corrections and consistency updates in the processing led to improved orbit quality
- The results from S-3A & S-3B are equivalent
- Background model updates are ongoing (for all CPOD processing chains)

Some future work:

- Inclusion into RSR comparisons to better monitor the performance
- Detailed look at “problematic” days
- …

Thank you for your attention!

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