AWG2023: Status of DORIS Processing at GSFC

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IDS Analysis Working Group Meeting

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Summary of Recent SINEX Submissions Post ITRF2020

Series	Description	Comment
gscwd52	gscwd51 + Sentinel-3B starting 180610	Deliveries Started 2021-10-18 to NASA CDDIS.
gscwd53	gscwd52 + downweight SAA stations on HY2A by 3X; Remove Arequipa, Kourou, Cacheoira, Santiago, San Juan from HY-2A normal equation before combination. (Recommended after last IDS WS 2022)	Deliveries started 2023-04-25
gscwd54	gscwd53 + replace GOCO05s/SLR+DORIS 4x4 solutions with **CNES_GRGS.RL05MF_COMBINED_GRACE_SLR_DORIS** gravity model, and resubmit SINEX files from 20160101 for the preparation of the ITRF2020 extension.	Deliveries started 2023-11-08 (Delivered to 2023-DOY260).

Summary of POD Results: RMS of fit for gscwd54

(new satellite data for ITRF2020 and post-ITRF2020)

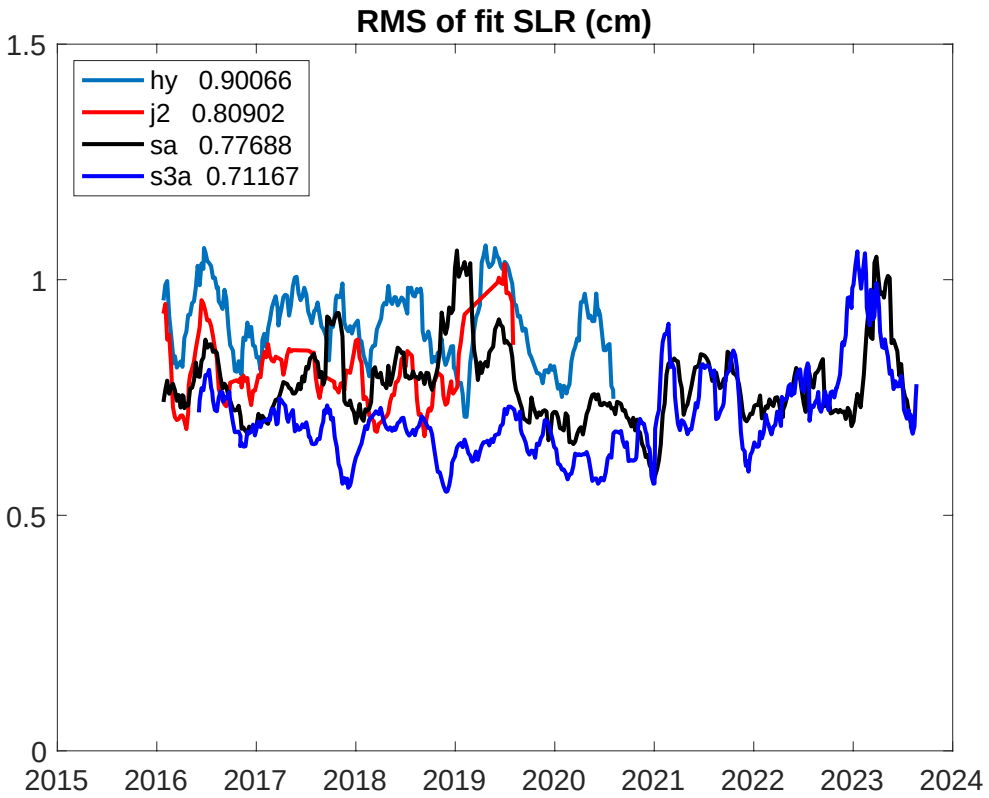
(using *CNES_GRGS.RL05MF_COMBINED_GRACE_SLR_DORIS gravity field)*

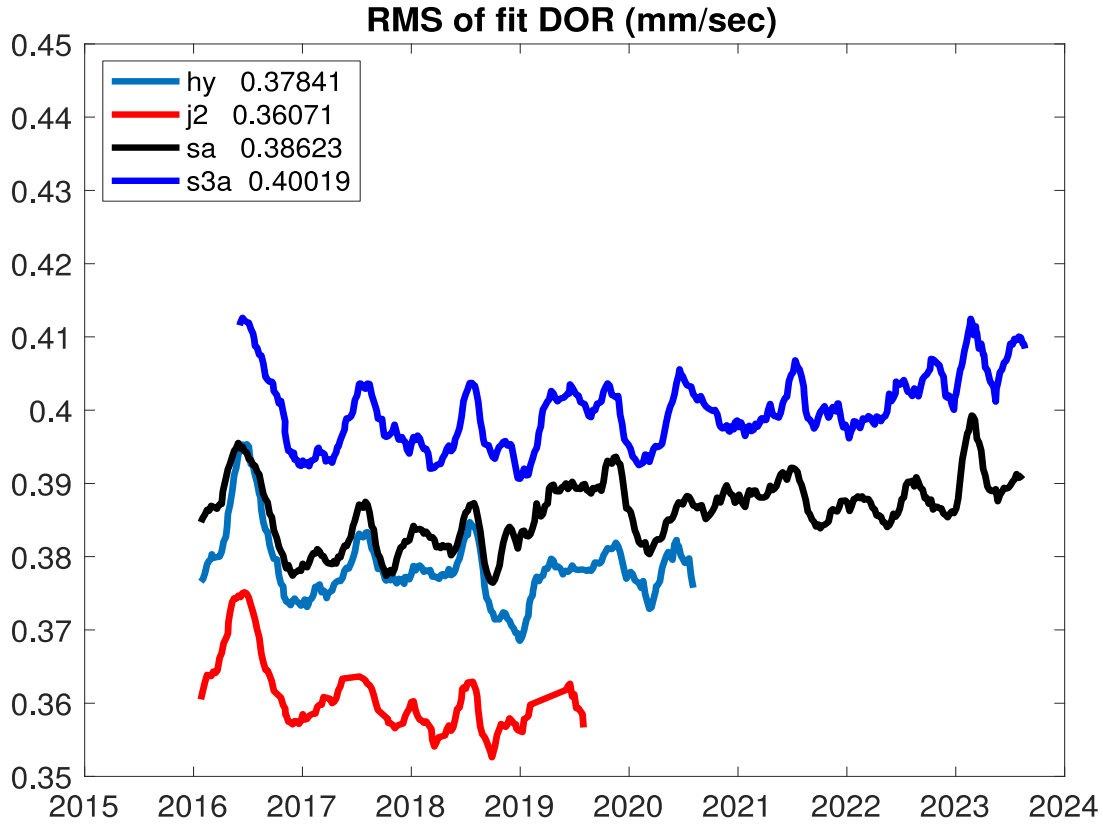
Satellite	First Arc	Last Arc	No of Arcs	Avg. No SLR obs	Avg. No DORIS obs	Avg. SLR fit (cm)	Avg DORIS fit (WRMS, mm/s)
Cryosat-2	160103	230917	492	964	61,996	0.894	0.4043
HY-2A	160103	200906	268	612	82,561	0.901	0.3784
Jason-2	160103	190908	164	2536	127,160	0.808	0.3607
Jason-3	160223	230917	426	2545	134,790	0.683	0.3887
Saral	160103	230917	409	1057	82,188	0.777	0.3862
Sentinel-3A (α)	160508	230917	458	929	76,334	0.712	0.4002
Sentinel-3B (β)	180606	230917	343	833	74,127	0.727	0.4121

(α) No SLR data for Sentinel-3A from 2016-0306 to week of 2016-0508. Sentinel-3A still included in SINEX solution gscwd51 starting on 160302.

(β) Sentinel-3B not included in the ITRF2020 submission, but is now part of the operational series, gscwd52.

Summary of POD Results for gscwd54: RMS of fit (2)





RMS of fit smoothed using a running ~9 week average

Elevation-dependent weighting was used for the DORIS data in SLR +DORIS POD run, so the final WRMS is rescaled by 1/0.65 for presentation to approximate the unscaled DORIS residuals.

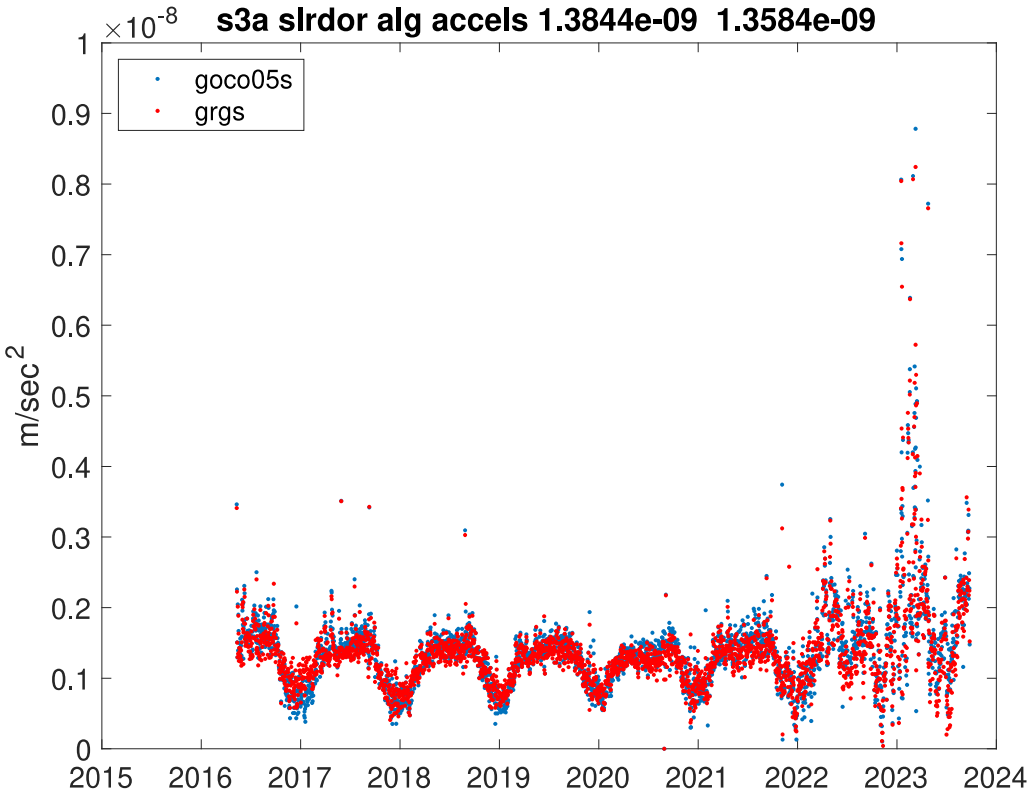
POD Results for gscwd54: Empirical Accelerations

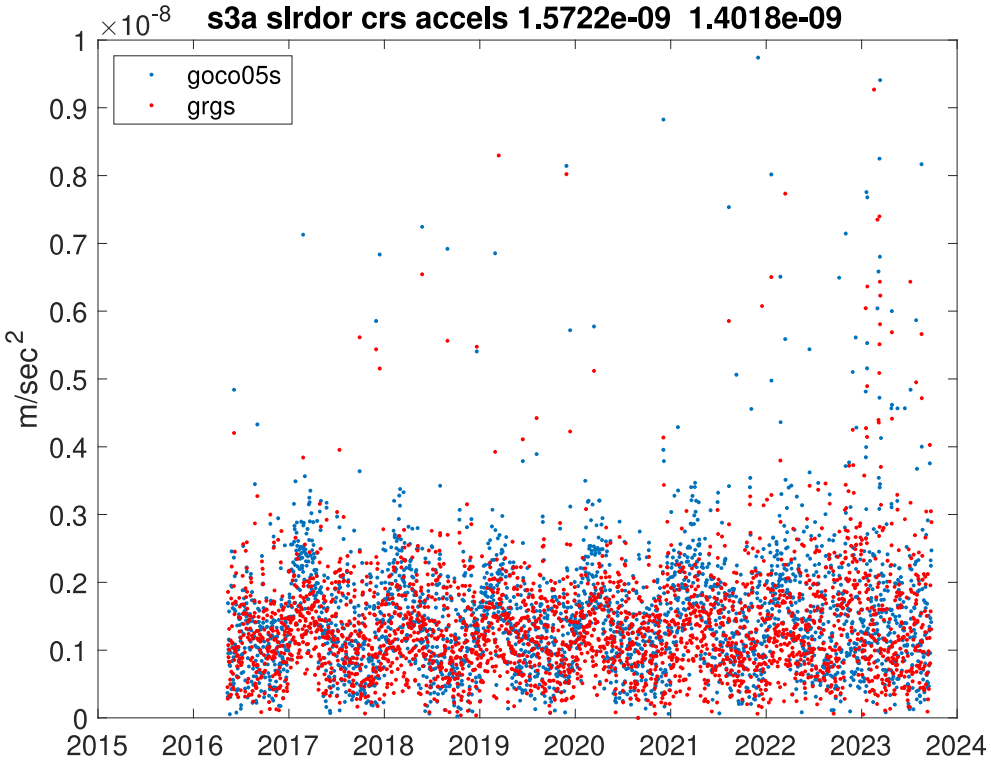
(using *CNES_GRGS.RL05MF_COMBINED_GRACE_SLR_DORIS gravity field)*

Satellite	First Arc	Last Arc	No of Values	Along-track Accels (nm/s^2)		Cross-track Accels (nm/s^2)	
				Average	RMS	Average	RMS
Cryosat-2	160103	230917	2835	2.415	2.593	2.004	2.825
HY-2A	160103	200906	1684	0.526	0.576	2.501	3.058
Jason-2 (α)	160103	190908	2140	0.734	1.063	2.544	2.803
Jason-3 (α)	160223	230917	2736	0.652	1.004	1.863	2.988
Saral	160103	230917	2806	1.419	1.705	1.506	1.956
Sentinel-3A	160508	230917	2759	1.358	1.488	1.402	1.794
Sentinel-3A (γ)	180603	230917	1989	1.393	1.549	1.442	1.905
Sentinel-3B (β)	180606	230917	1960	0.901	1.096	1.498	1.753
Sentinel-3A (δ)	180617	181014	121	1.444	1.409	1.224	1.449
Sentinel-3B (δ)	180617	181016	118	0.654	0.694	1.364	1.530

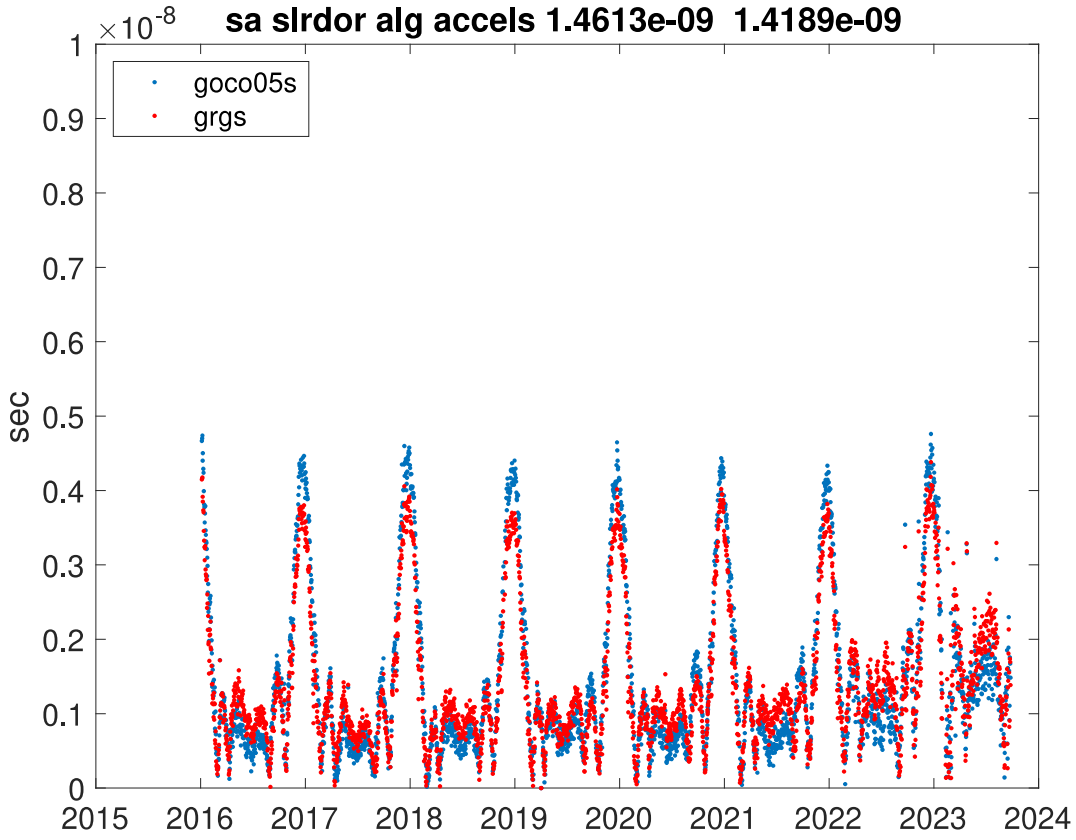
(α) For Jason-2 & Jason-3 Cr's were adjusted per arc in a separate POD step and then held fixed.
(β) Sentinel-3B was not included in ITRF2020, but is now part of the operational series, gscwd52.
(γ) Selecting Sentinel-3A arcs that are coincident with Sentinel-3B for comparison (180603 to 220911).
(δ) Sentinel-3A & Sentinel-3B comparison limited to S3A-S3B tandem mission period.

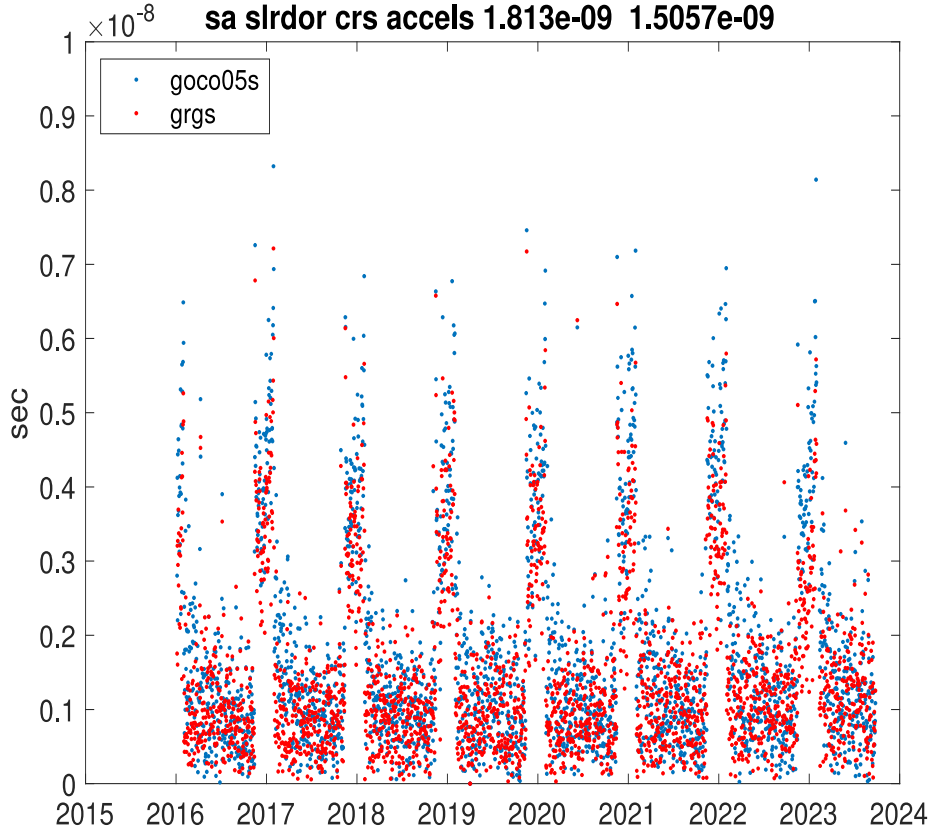
OPR Acceleration Amplitudes for Sentinel-3A (gscwd53 vs. gscwd54)



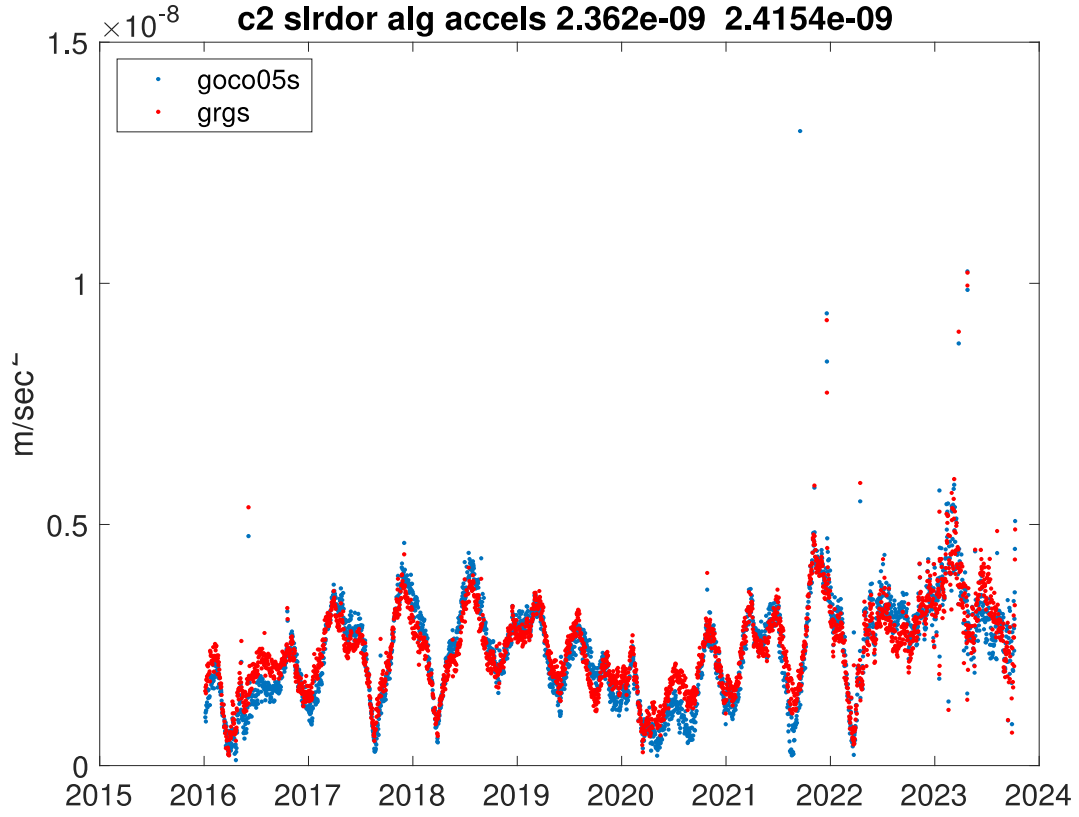


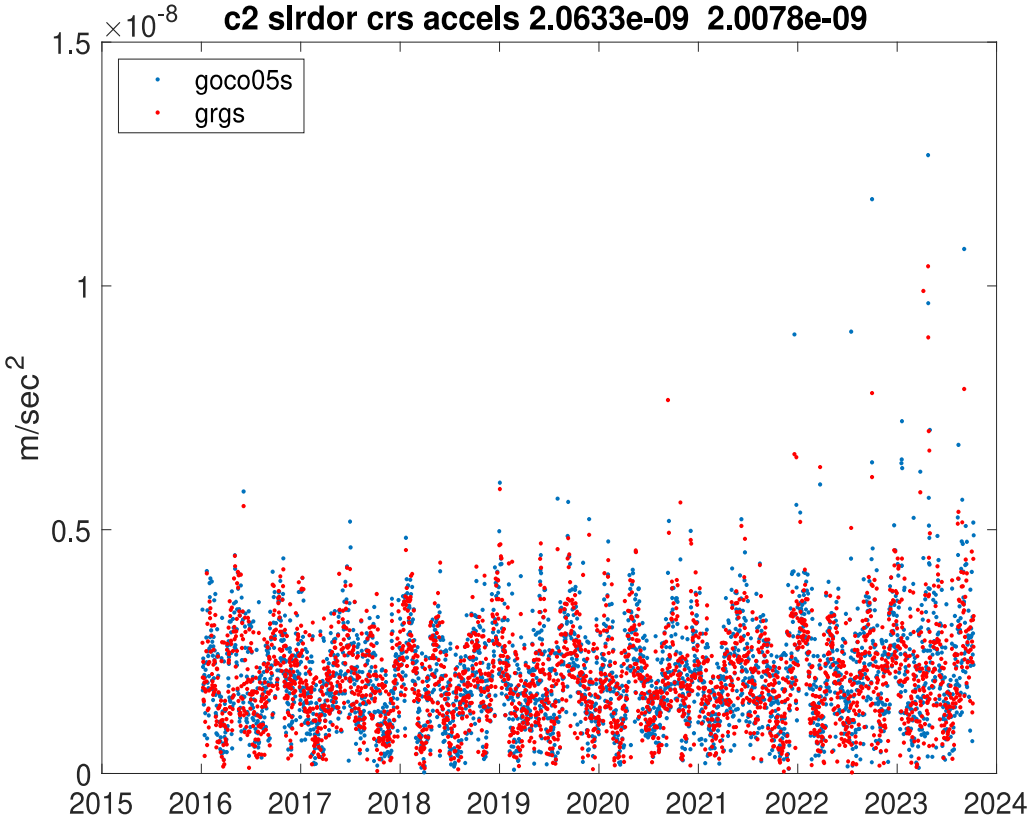
OPR Acceleration Amplitudes for Saral (gscwd53 vs. gscwd54)



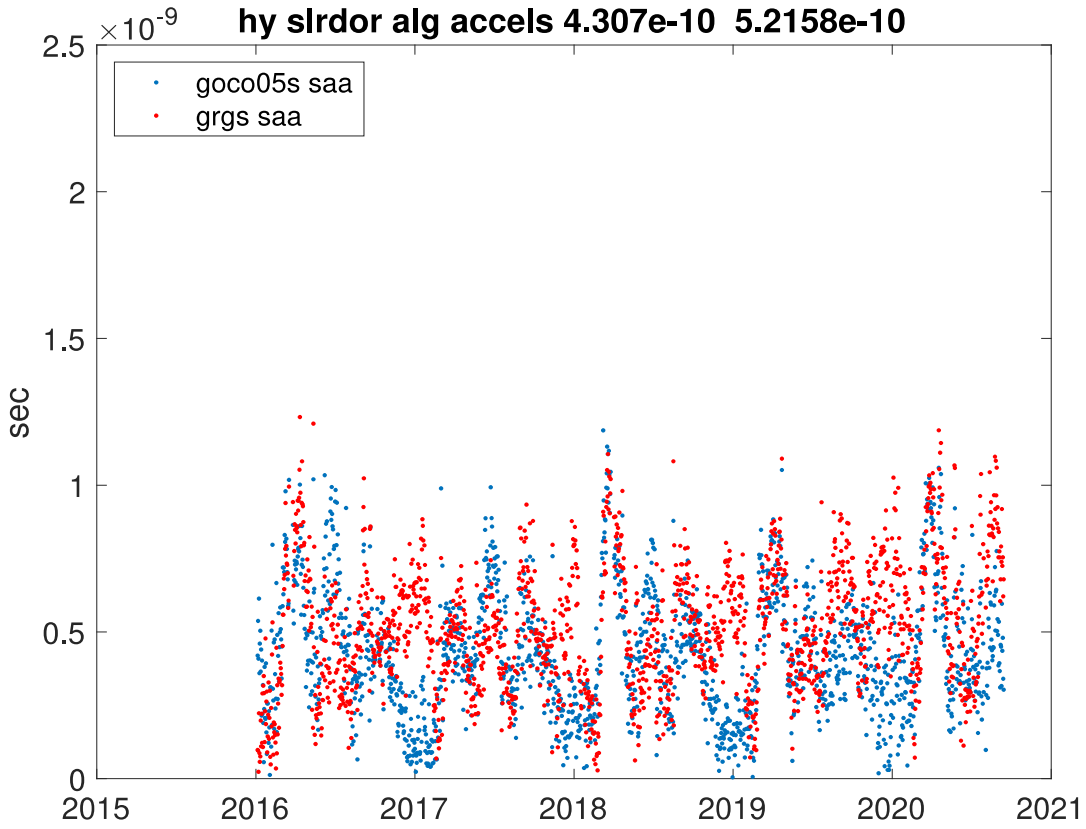


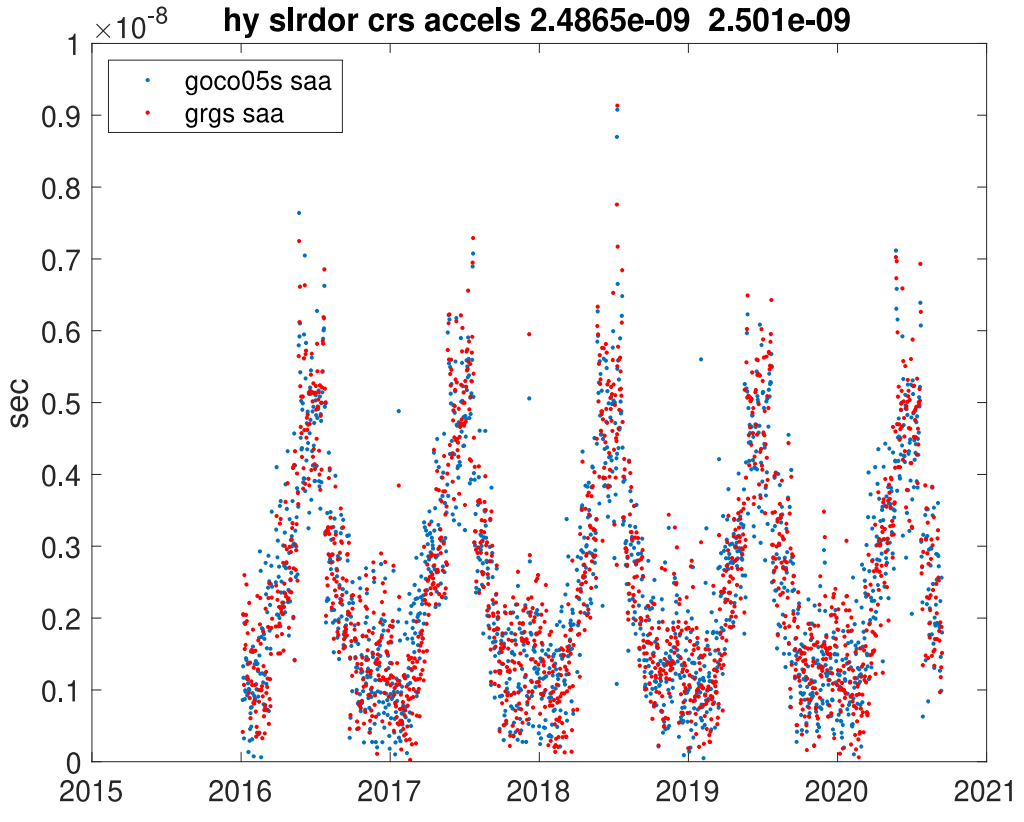
OPR Acceleration Amplitudes for Cryosat-2 (gscwd53 vs. gscwd54)





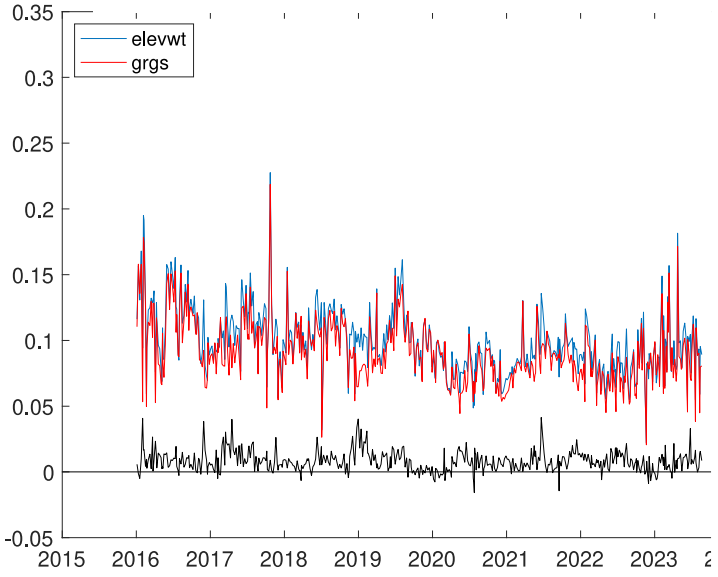
OPR Acceleration Amplitudes for HY-2A (gscwd53 vs. gscwd54)



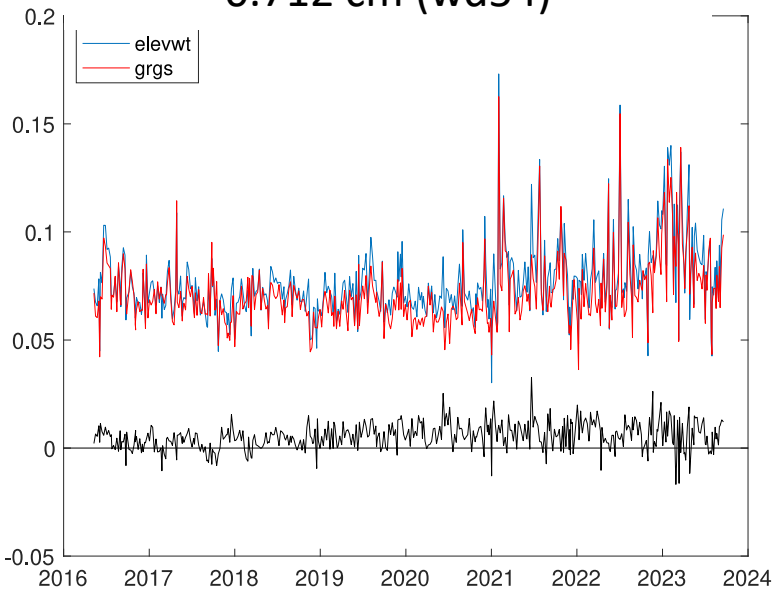


Impact on SLR RMS of fit (gscwd53 vs. gscwd54)

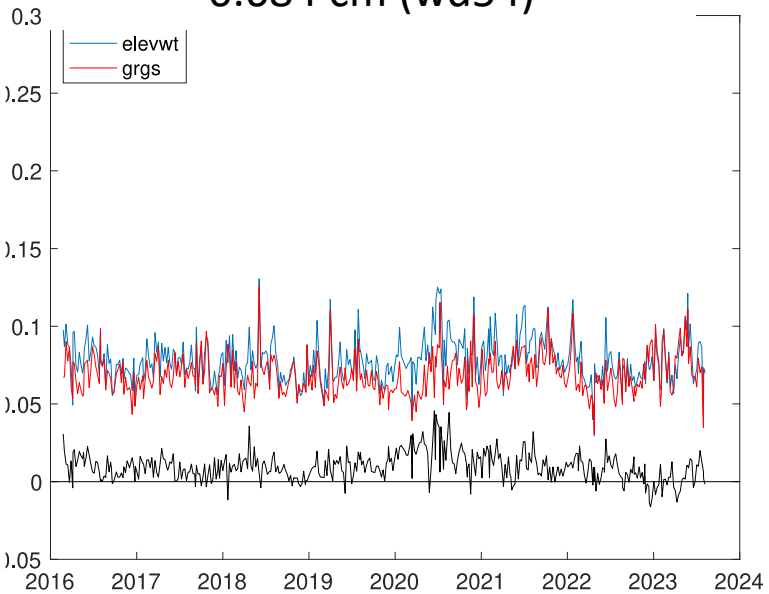
Cryosat-2: 0.979 cm (wd53);
0.0890 cm (wd54)



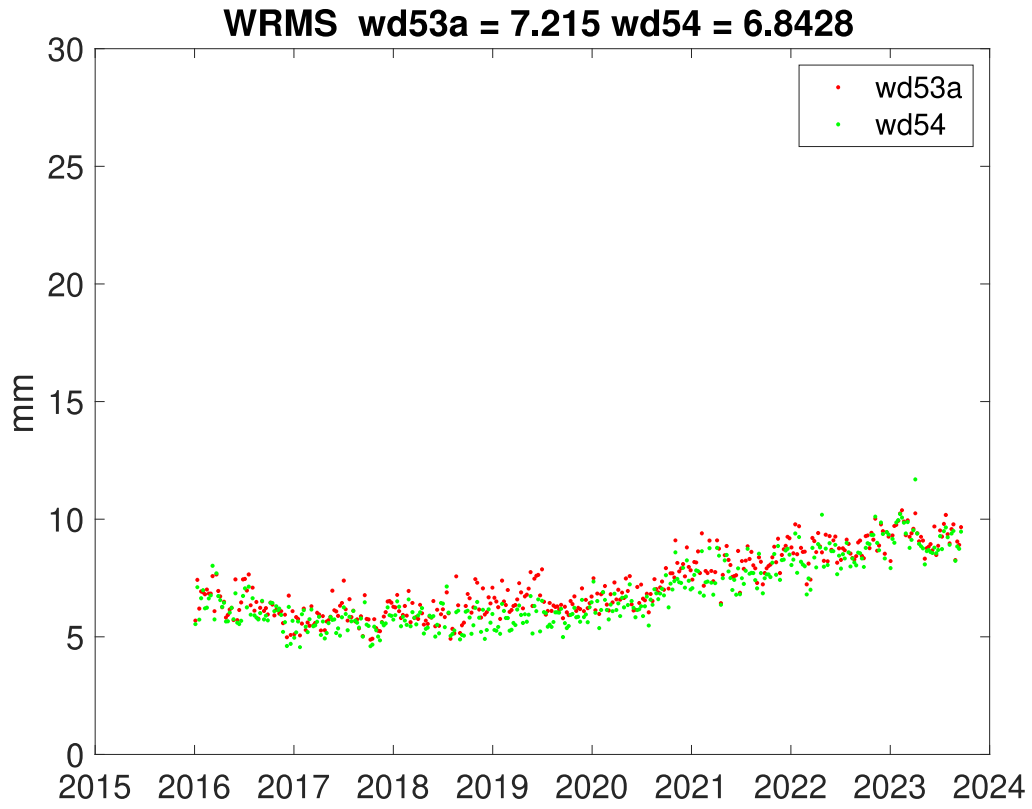
Sentinel-3A: 0.766 cm (wd53);
0.712 cm (wd54)



Jason-3: 0.779 cm (wd53);
0.684 cm (wd54)

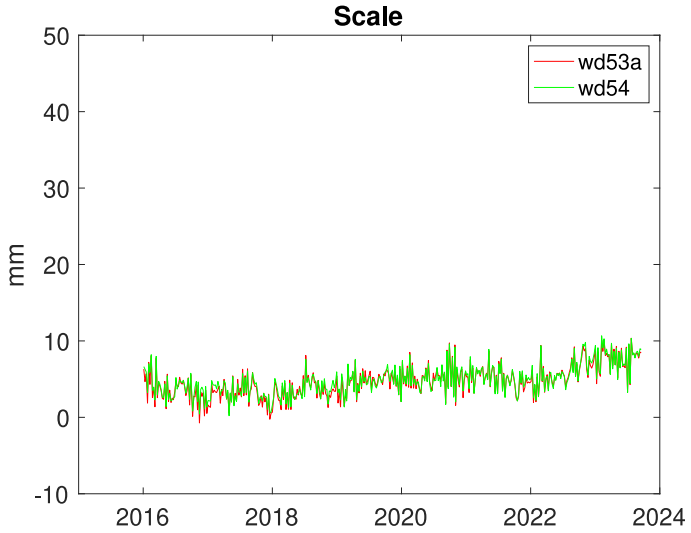


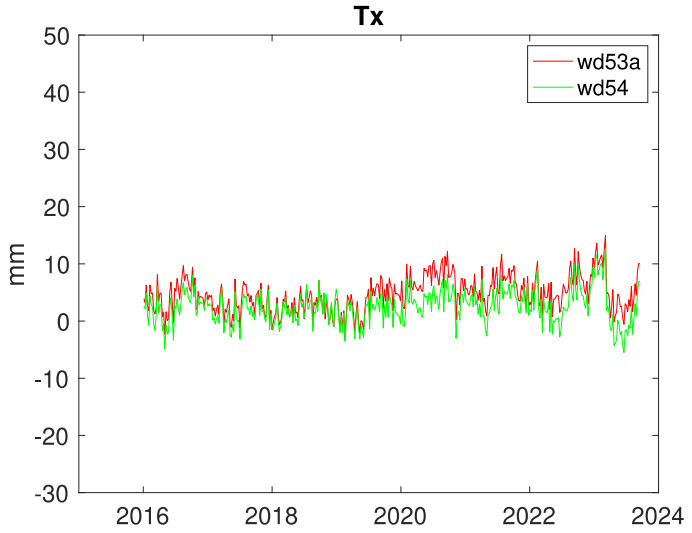
Impact on WRMS of weekly solutions w.r.t dpod2014_v5.5 (gscwd53 vs. gscwd54)

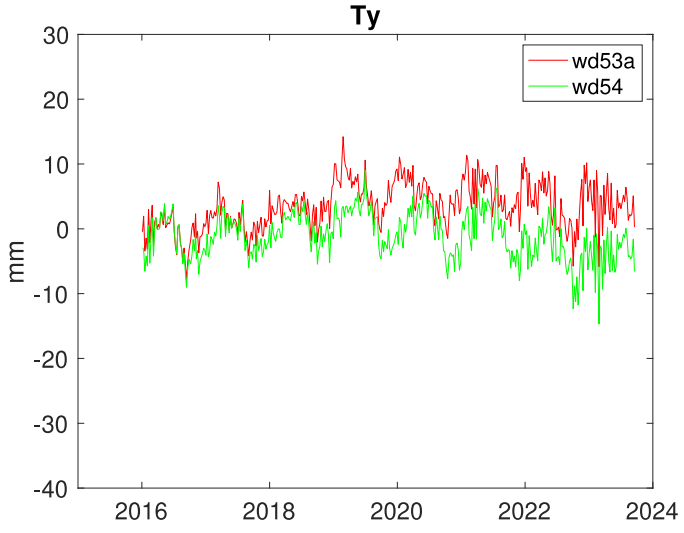


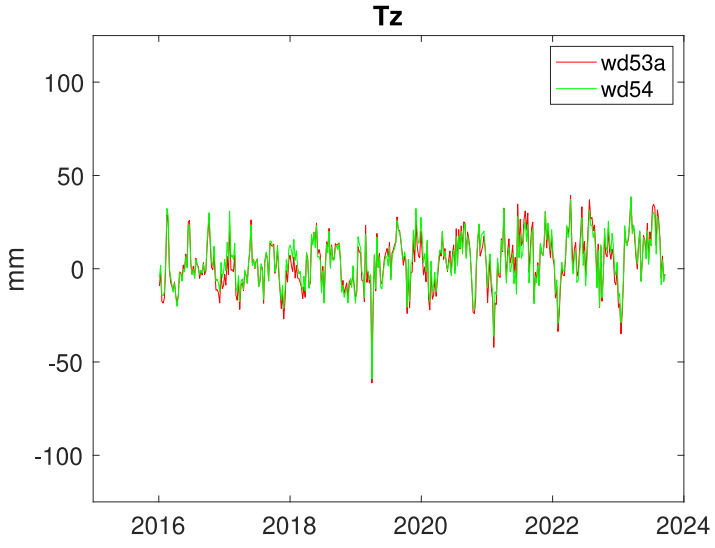
Satellite	Wd53 (goco5s + slr/dor 4x4) (mm)	Wd54 (grgs_rl05) (mm)
Cryosat-2	12.29	12.06
HY-2A_saa	10.86	9.84
Jason-2 (V2)	16.95	16.11
Jason-2 (RINEX)	16.15	16.03
Jason-3	16.84	16.54
Saral	10.81	10.28
Sentinel-3A	14.11	13.64
Sentinel-3B	15.74	15.26

Impact on Scale & Tx,y,z parameters of weekly solutions w.r.t dpod2014_v5.5 (gscwd53 vs. gscwd54)



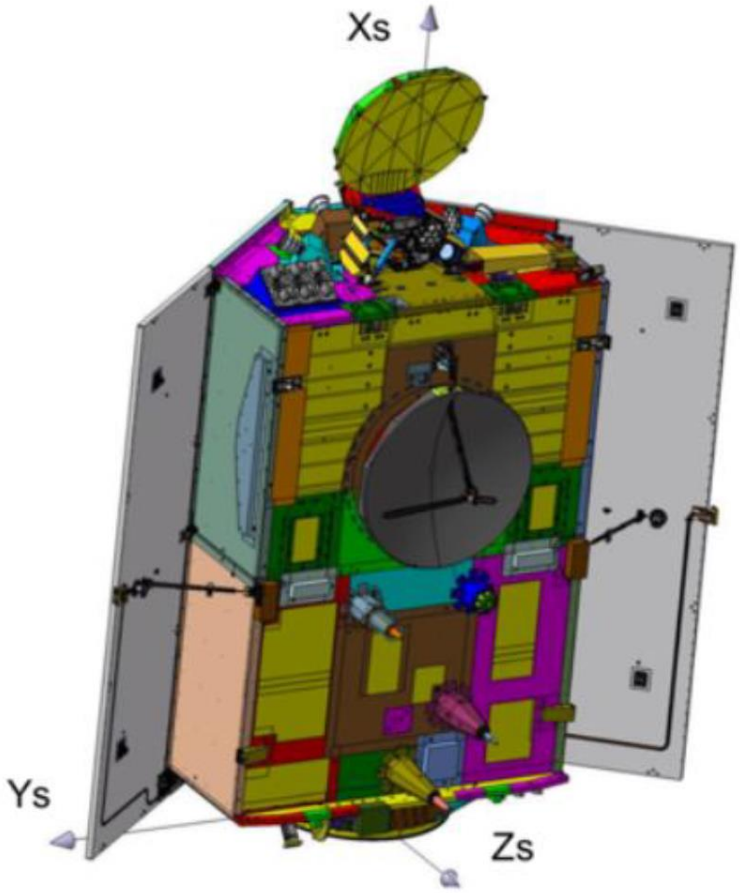






Tests on Sentinel-6A Macromodel

Macromodel tests on Sentinel-6A (1)



CNES 6-panel (only optical properties used)

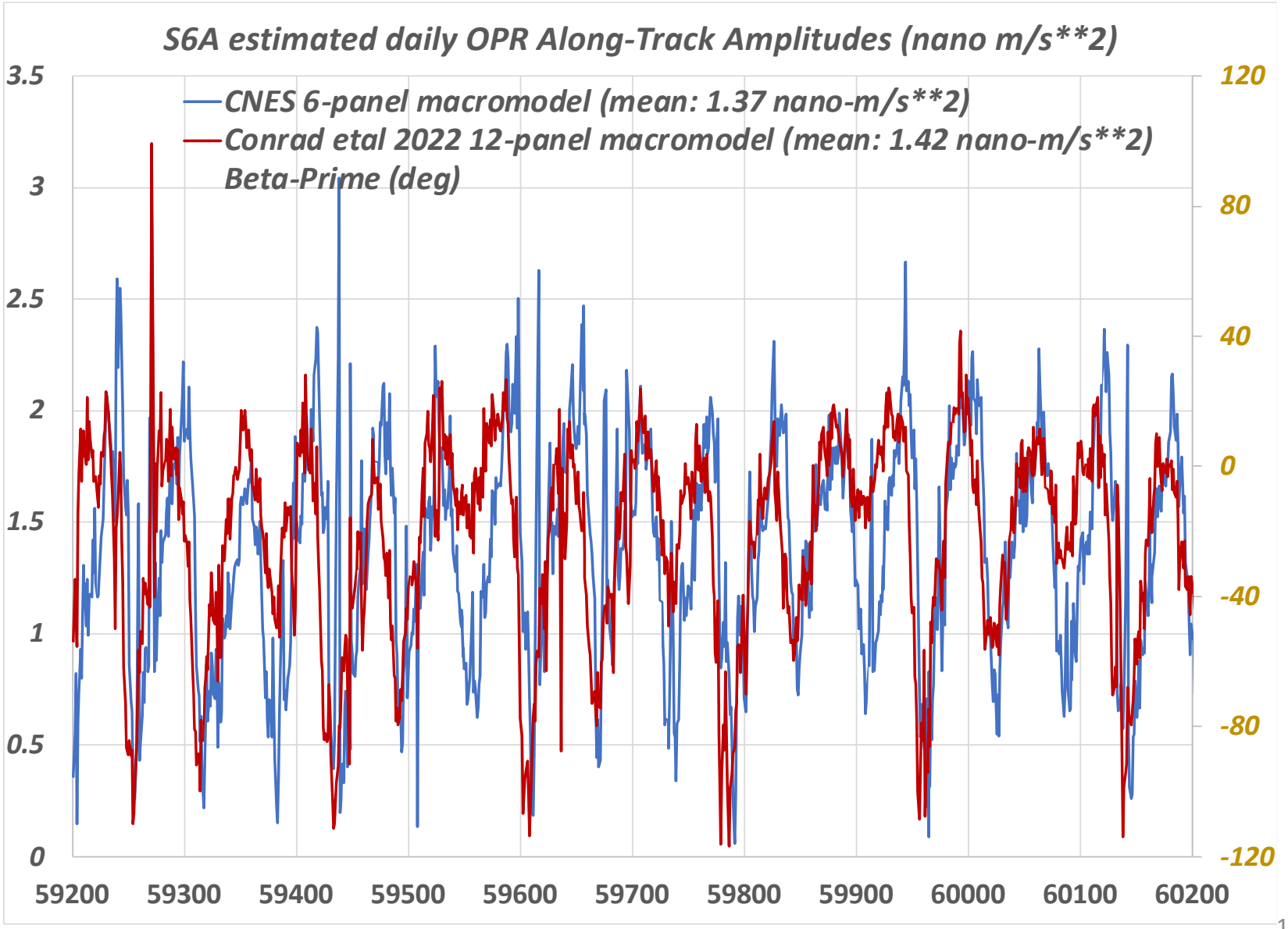
				// Optical properties			// Infrared properties		
// Surf(m²)	// Normal in sat ref frame			// spec	// diff	// abs	// spec	// diff	// abs
3.600	-1.	0.	0.	0.4500	0.1200	0.4300	0.1800	0.0400	0.7800
3.370	1.	0.	0.	0.4590	0.5410	0.0000	0.1920	0.8080	0.0000
8.660	0.	-0.6157	-0.7880	0.0000	0.3370	0.6630	0.0000	0.6150	0.3850
8.660	0.	0.6157	-0.7880	0.0000	0.3370	0.6630	0.0000	0.6150	0.3850
2.990	0.	0.	-1.	0.4550	0.5110	0.0340	0.1140	0.6270	0.2590
15.350	0.	0.	1.	0.3420	0.6300	0.0280	0.0660	0.7240	0.2100

Conrad 12-panel

Surface	Surface normal [x,y,z]	Area (m^2)	Diffusivity	Specularity
Body +X	[1.000, 0.000, 0.000]	4.149	0.041	0.349
Body -X	[−1.000, 0.000, 0.000]	3.941	0.042	0.546
Body +Y	[0.000, 1.000, 0.000]	1.329	0.040	0.506
Body -Y	[0.000, −1.000, 0.000]	1.329	0.040	0.506
Body +Z	[0.000, 0.000, 1.000]	11.830	0.016	0.571
Body -Z	[0.000, 0.000, −1.000]	2.072	0.030	0.660
Left SP	[0.000, −0.616, −0.788]	8.65	0.316	0.139
Right SP	[0.000, 0.616, −0.788]	8.65	0.316	0.139
AMR-C (top)	[0.469, 0.000, −0.883]	0.92	0.080	0.000
AMR-C (bottom)	[0.000, 0.000, 1.000]	0.8123	0.563	0.188
Left SP (bottom)	[0.000, −0.616, 0.788]	3.760	0.164	0.013
Right SP (bottom)	[0.000, 0.616, 0.788]	3.760	0.164	0.013

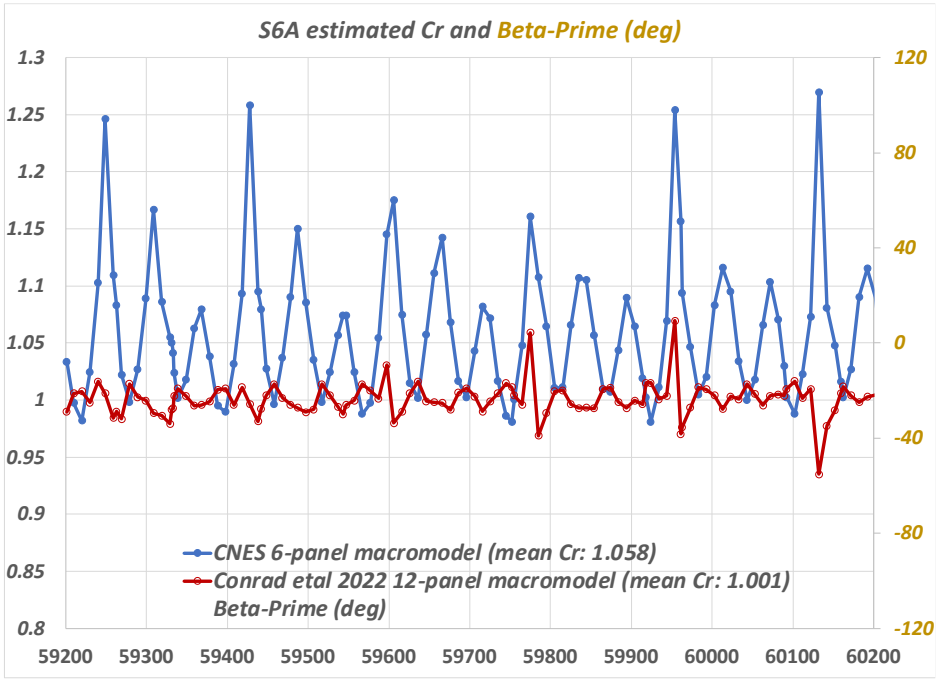
Conrad, Alex et al. (2023), J. Geodesy, Table 2, https://doi.org/10.1007/s00190-023-01718-0

Macromodel tests on Sentinel-6A (2)



Macromodel tests on Sentinel-6A (3)

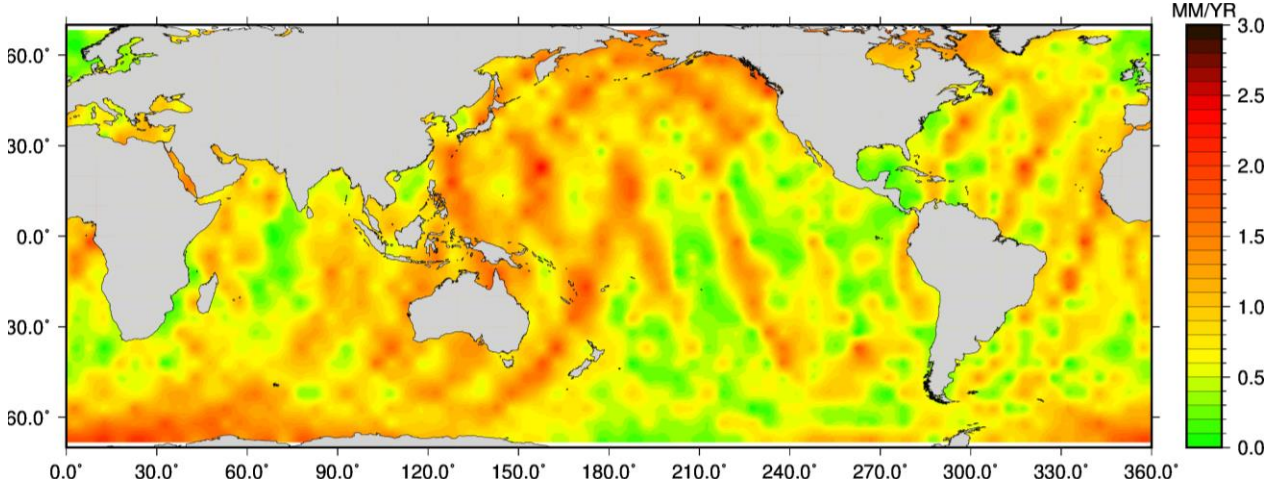
S6A tests (201218-231004)	POD residuals		Radial orbit RMS differences (mm)		
	DORIS (mm/s)	SLR (mm)	poef	jpl to 230419	std2300
std2300	0.3847	6.19	6.7	5.7	----
std2300 Conrad 12-panel model	0.3866	5.99	6.5	5.8	2.5



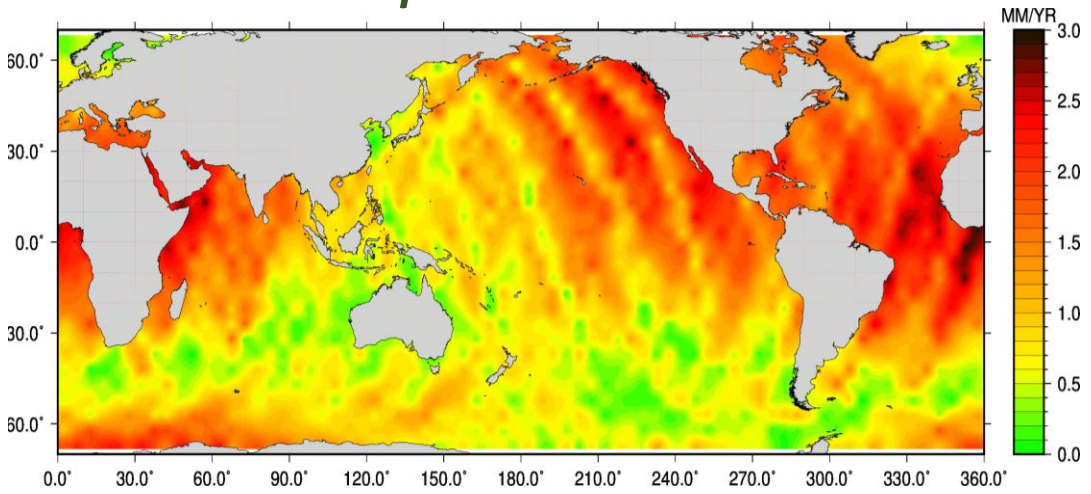
Macromodel tests on Sentinel-6A (4)

Sentinel-6a JPL-Test geographically-binned radial orbit 59-day signal (mm)

Sentine-6A JPL-std2300_conrad orbit 59-day signal Conrad 12-panel macromodel



Sentine-6A JPL-std2300 orbits 59-day signal CNES 6-panel macromodel



Reduction of the 59-day signal suggests that the Conrad 12-panel macromodel improves surface force modeling over the CNES 6-panel model.

Summary

- **For the GSC DORIS contribution to the ITRF2020-extension, we have reconverged all DORIS satellite orbits starting on 160101 with the CNES_GRGS.RL05MF_COMBINED_GRACE_SLR_DORIS (grgs_rl05) gravity model.**
- **We see small improvements in the SLR RMS of fit on DORIS satellites.**

- **The single-satellite solutions show a consistent reduction in the WRMS of the weekly solutions w.r.t. dpod2014_v5.5. There is no impact on the scale; There is a minor impact in the Helmert parameters, Tx, Ty, Tz.**

- **Therefore our contribution for the IDS combination for the ITRF2020-extension will be the gscwd54 solution which has two improvements w.r.t. ITRF2020**

(a) downweighting of SAA stations in POD, and removal of 5 SAA stations in the HY-2A contribution to the combination.

(b) consistent use of the grgs-rl05 gravity model (2016 – 2023).

- **We have worked to improve orbit determination for Sentinel-6A; Tests indicate the Conrad et al. (2023) 12-panel micromodel may be an improvement for Sentinel-6A POD.**

- **[Not showed at the IDS-AWG in the interests of time]** We showed at the OSTST 2023 (Puerto Rico) meeting, that the COSTG/FSM model (available since 2018-01-01, provides a further improvement for Sentinel-6A to the grgs_rl05 gravity model for Sentinel-6A. [COST-G FSM for time-variable gravity; GOCO06s for static gravity, and GRACE project SLR solutions for C20 & C30]. Please see the OSTST presentation for details.