POD splinter report
OSTST 2019, Chicago, IL

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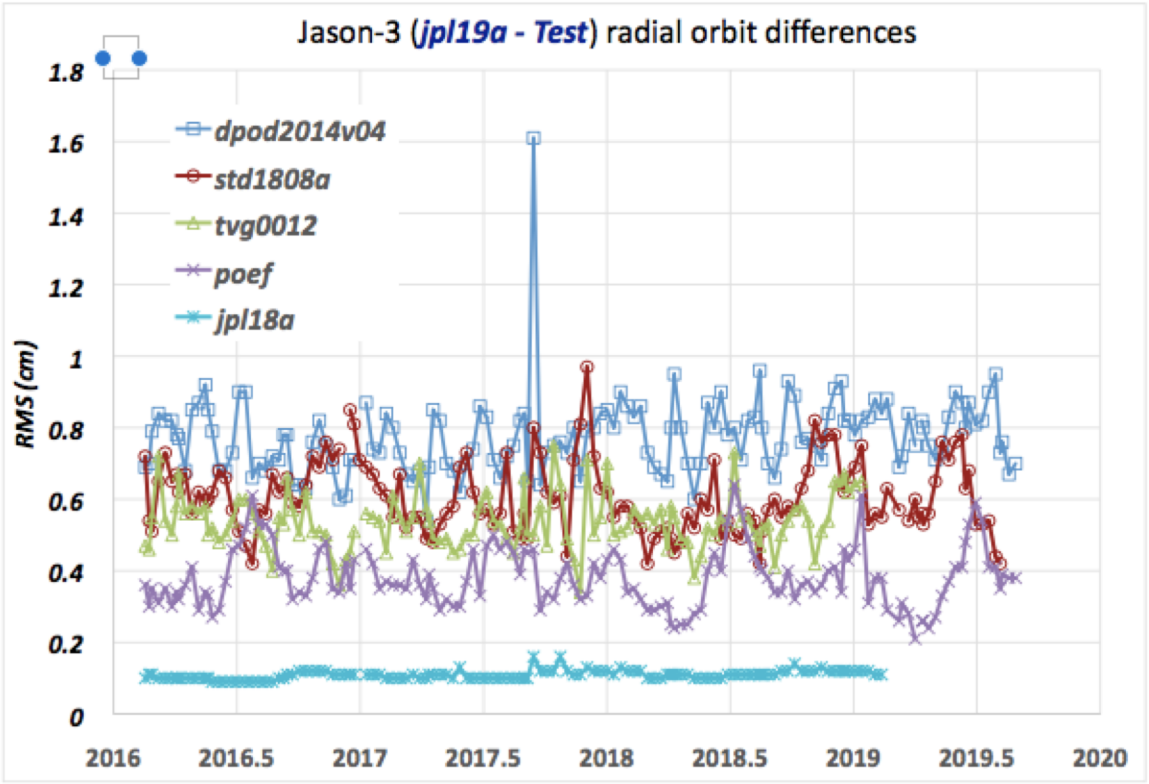
- Status of OSTST satellite POD
- Residual geocenter signals – continued
- Status of Sentinel3 POD
- Improvement of SLR station bias estimation
- PCO estimation dependence on yaw regime
- Summary and recommendations

Summary of Participation:
(13 papers; 10 oral 3 posters)

- Project Centers: CNES , GSFC, JPL.
- PosiTIM/GMV/ESA (Sentinel-3).
- GRGS, CLS (Toulouse).
- DGFI.
- AIUB (Switzerland).

Jason-3 jpl19a-Test Radial RMS orbit differences (cm)

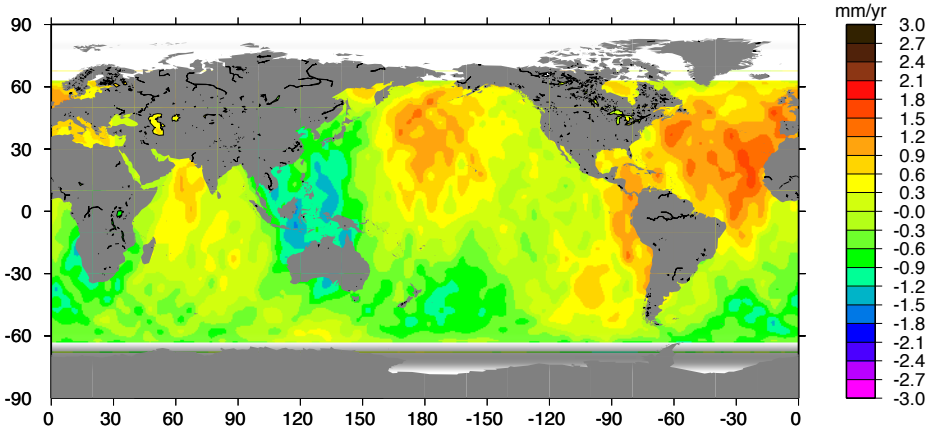


Lemoine et al., 2019. GSFC POD Status For J2 & J3. OSTST, October 22, 2019

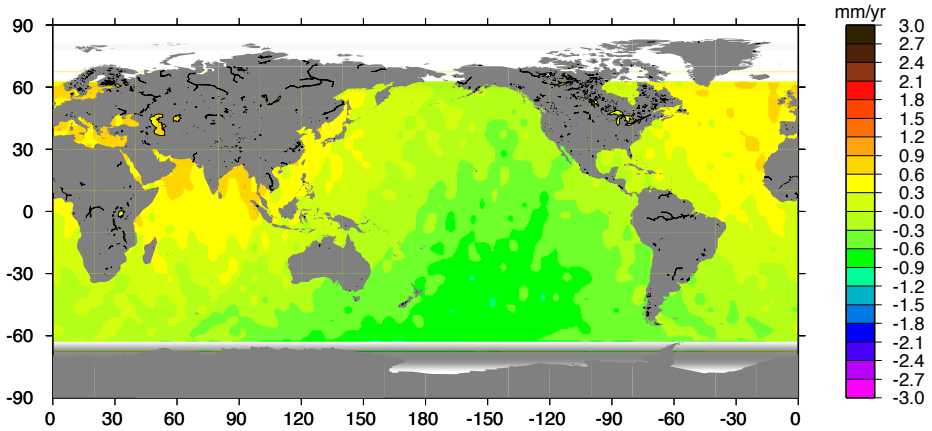
Radial orbit difference Rates for current Jason-3 orbits (mm/yr)

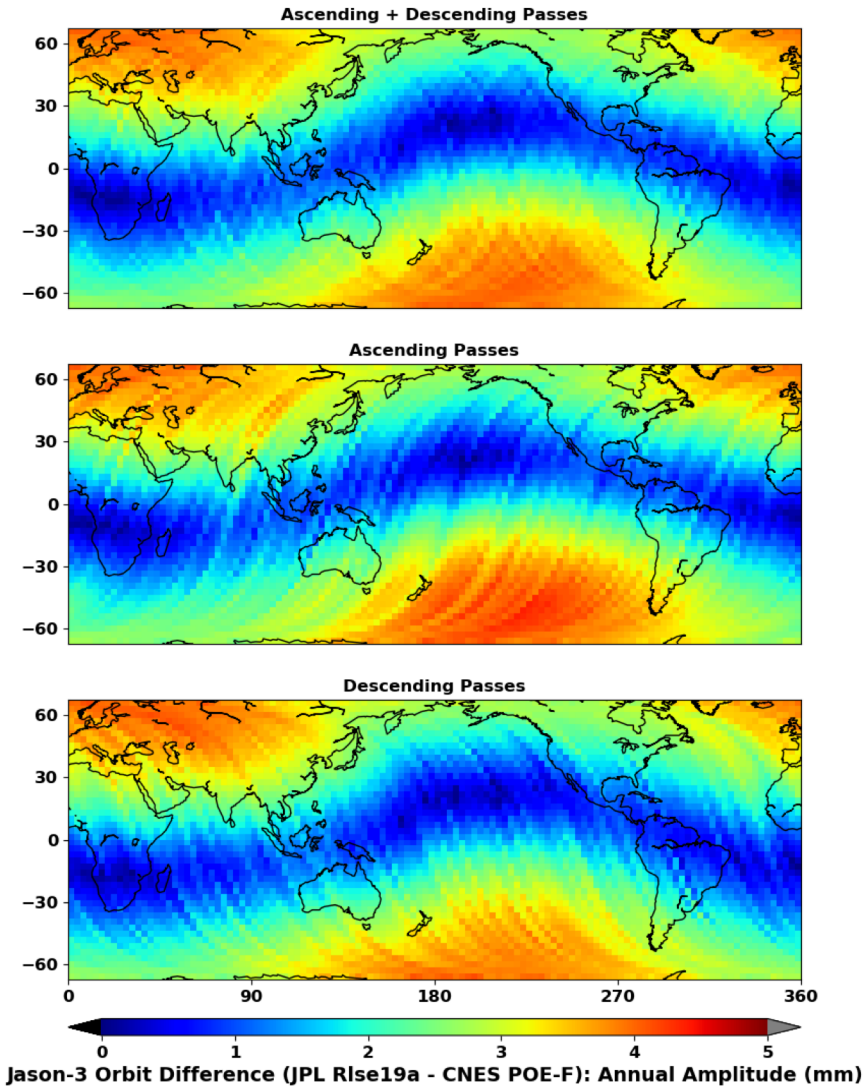
(*160217 – 190123; cycles 1-108*)

jpl19a – NASA GSFC newer (tvg0012)



jpl19a – CNES poef





Geographically Correlated Orbit Differences: JPL Release 19a vs. CNES POE-F (Annual)

At annual period, similar patterns as observed between JPL's IGS14 and IGS14+Annual orbit solutions, but with larger amplitude.

Performance of DORIS-only POE-F reduced dynamic orbits

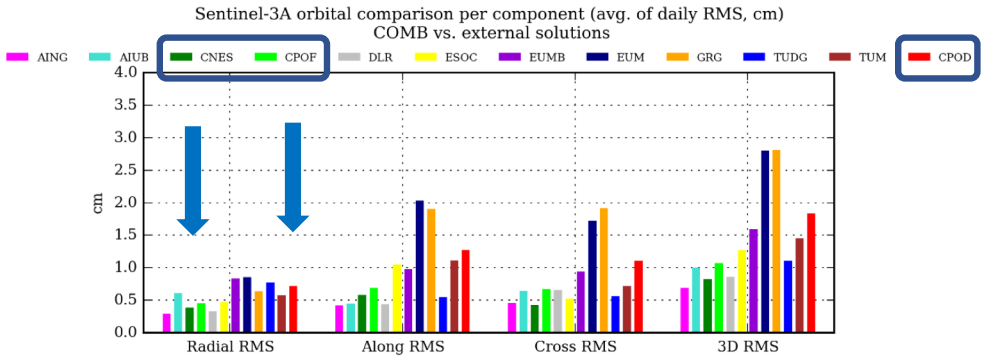
High Elevation (> 70 deg) SLR Residuals

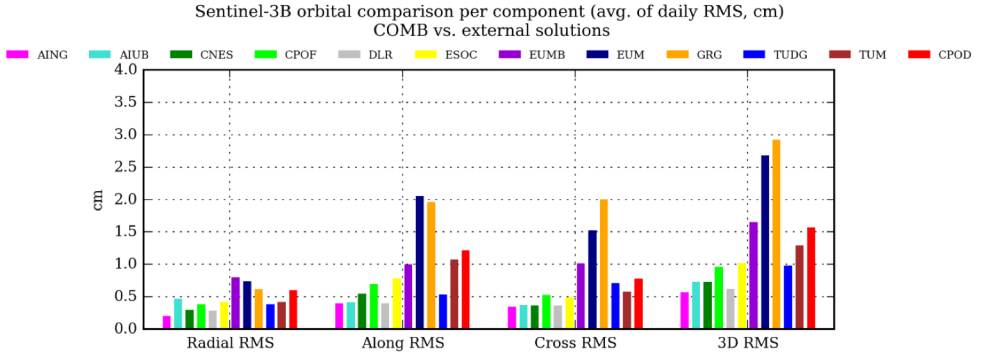
RMS over 2017 (cm)

SLR Core Network	CRYOSAT-2	SARAL	JASON-3		SENTINEL-3A	
	DORIS	DORIS	DORIS	GPS	DORIS	GPS
3D	1.18	1.14	1.59	1.06	1.25	0.85
High Elevation (radial)	0.68	0.66	0.89	0.70	0.63	0.54

The POE-F DORIS-only orbit radial performance approaches the GPS-based orbits, especially for satellites with smaller Surface/Mass ratio

Regular Service Reviews – RSR#14 Feb – May 2019





- The Copernicus POD Service is responsible for Sentinel-1, -2, and -3 POD processing.
- POD setup has to be regularly reviewed to stay up-to-date.
- Step-wise validation of several model updates has successfully been performed for all three missions.
- Copernicus POD QWG has to approve the new POD setup for all three Sentinel missions before the switch can be done.

SLR station issues - bias

Estimated Corrections wrt SLRF2014

Corrections from 1-year of dynamic, ambiguity-fixed Swarm-A/B/C, Sentintel-3A/B and GRACE-FO-C/D orbits.

Station	SOD	E [mm]	N [mm]	U [mm]	B [mm]
Badary	18900901	8.0 ± 0.6	-0.2 ± 0.6	6.0 ± 2.2	8.4 ± 1.4
Yarragadee	70900513	4.8 ± 0.1	-0.3 ± 0.1	-2.5 ± 0.4	0.6 ± 0.2
Greenbelt	71050725	3.4 ± 0.2	6.1 ± 0.2	-12.7 ± 0.6	-6.3 ± 0.3
Monument Peak	71100412	-2.7 ± 0.2	-7.6 ± 0.2	-10.8 ± 0.9	0.3 ± 0.5
Haleakala	71191402	4.5 ± 0.4	-4.5 ± 0.4	1.2 ± 1.3	11.0 ± 0.8
Papeete	71240802	12.1 ± 0.6	4.5 ± 0.6	-5.1 ± 2.1	-12.7 ± 1.2
Arequipa	74031306	0.2 ± 0.4	3.5 ± 0.4	-4.2 ± 1.4	8.1 ± 0.8
Hartebeesthoek	75010602	-2.7 ± 0.3	6.4 ± 0.3	-6.6 ± 1.0	4.2 ± 0.6
Zimmerwald	78106801	0.6 ± 0.2	2.0 ± 0.2	9.4 ± 0.6	7.5 ± 0.3
Mount Stromlo	78259001	5.8 ± 0.3	2.3 ± 0.2	5.5 ± 0.9	1.6 ± 0.5
Wettzell (SOSW)	78272201	-1.3 ± 0.5	-9.6 ± 0.5	-6.7 ± 1.7	5.6 ± 1.0
Graz	78393402	2.7 ± 0.2	3.2 ± 0.2	8.7 ± 0.7	11.9 ± 0.4
Herstmonceux	78403501	3.1 ± 0.3	1.5 ± 0.3	-4.1 ± 1.0	-2.5 ± 0.6
Potsdam	78418701	0.9 ± 0.3	3.7 ± 0.3	17.1 ± 0.9	-0.6 ± 0.6
Matera	79417701	1.7 ± 0.4	4.8 ± 0.4	4.2 ± 2.0	-5.3 ± 1.0

Some larger corrections ask for further investigations, e.g. comparisons to LAGEOS-based coordinate solutions. But that's only the first step …

Dynamic ambiguity-fixed LEO orbits have reached a quality level that is interesting to validate the SLR station network.

High elevation observed biases

The station biases are common to all satellites

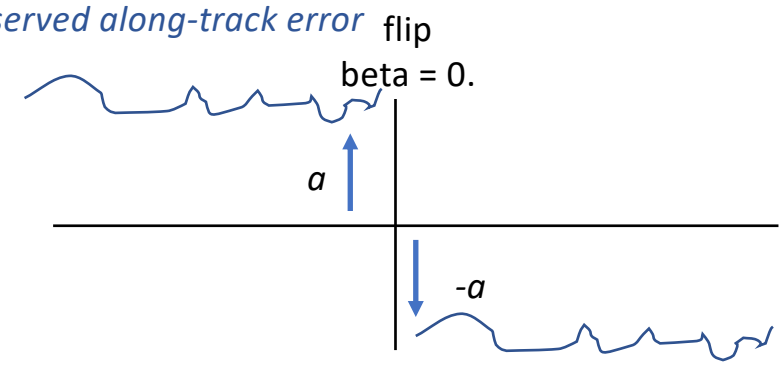
may include : station height modelling errors

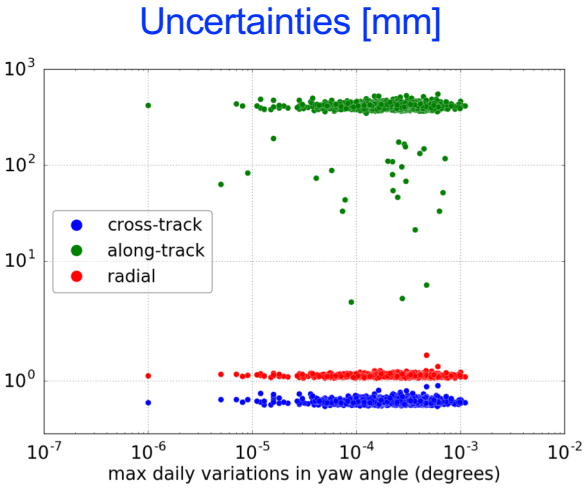
Values for the high elevation processing biases
(* : core network)
using Jason3, Cryosat2, Sentinel3A :

	bias (mm)	
L7090	2.0	*
L7105	3.0	*
L7110	13.0	
L7119	12.0	*
L7237	-34.0	
L7403	-2.0	
L7501	5.0	*
L7810	-6.0	*
L7825	-1.0	
L7839	0.0	*
L7840	0.0	*
L7841	-14.0	
L7941	-7.0	*
L8834	-20.0	

Systematic measurement error identification from attitude regime

- SLR validation of along-track biases during fixed yaw periods
- Effect of an error '*a*' in the distance between SLR and GPS along the X satellite axis (± along-track)





Challenges associated with poor observability of PCO vector in satellite's direction of motion when flying in fixed-yaw can be mitigated in 2 ways (*Along-track component poorly determined*):

- use **prelaunch** antenna calibration,
- **constrain along-track component of PCO** to prelaunch calibration value when estimating correction to a priori antenna calibration

Summary and recommendations

- **Jason-3 radial orbit error: 6-8 mm RMS**
- **DORIS-only POE is presently comparable with GPS**
- **Sentinel POD standards update is under way**
- **Radial orbit difference rates still display considerable regional signal**
- **SLR station bias estimation can be made more robust by using mulitple LEO satellites including those tracked by GNSS**

- **We need to continue to investigate cause of large radial orbit rate differences between different sets of orbits; Strong candidates are differences in TVG parameterization and sensitivity, and how the different techniques respond to the geocenter.**
- **We need to remember that the ability to discern systematic errors in the orbits of altimeter satellites (e.g. CRISTAL) relies on having three independent tracking techniques of comparable quality in tracking precision.**
- **POD group needs to reflect on improved SLR and X-over validation procedure.**
- **We need to have GNSS Rinex files for all satellites made publically available.**