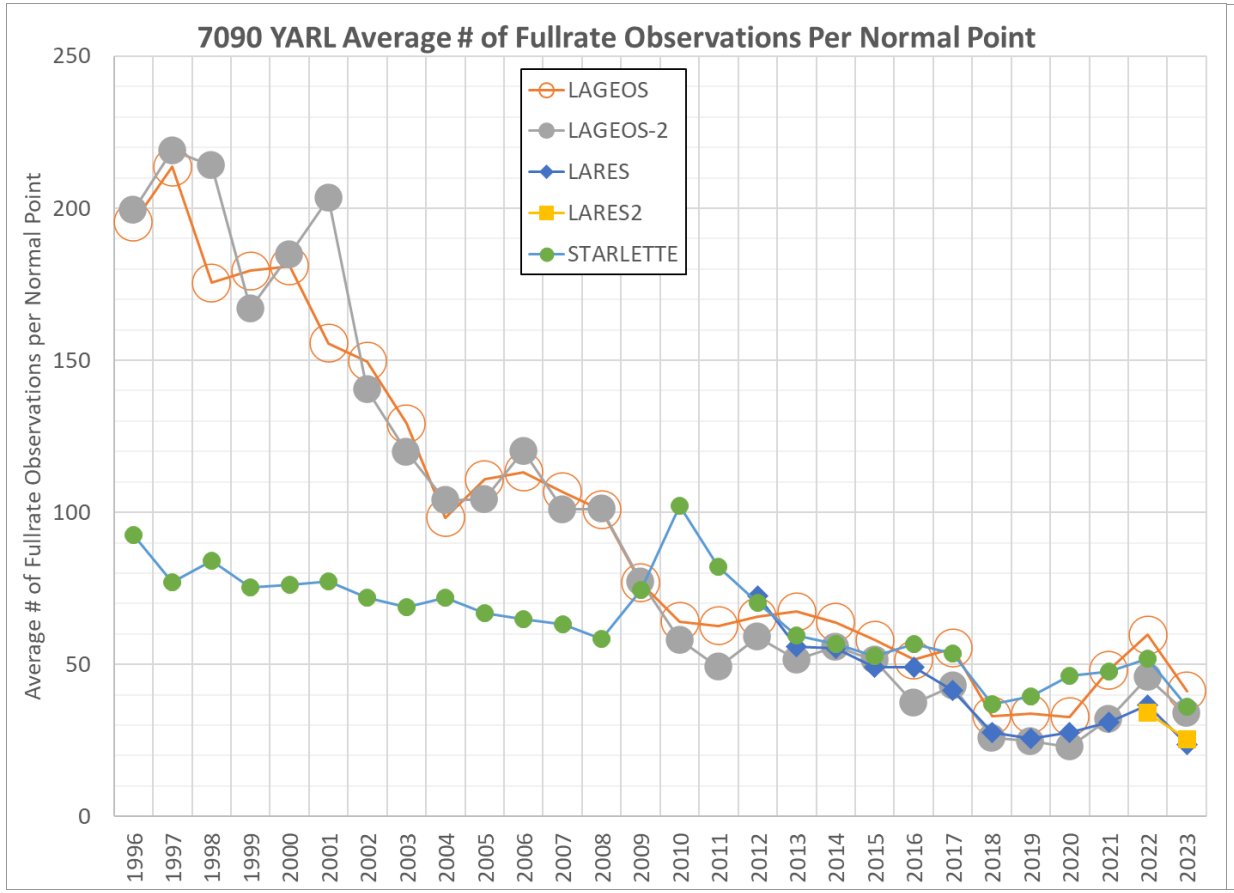
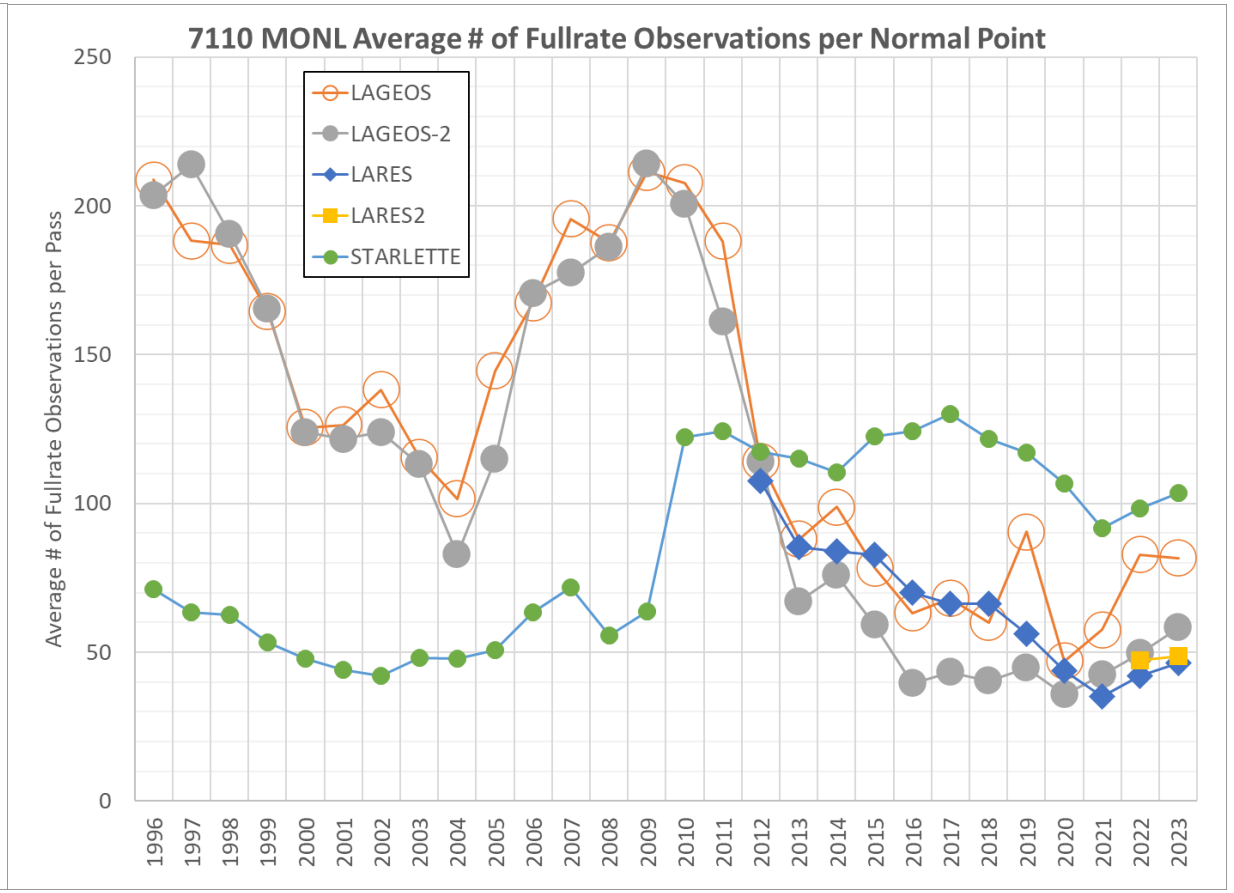
7090 YARL and 7110 MONL LAGEOS, LARES, & Starlette FR Obs per NP





- In 2009/2010 both 7090 YARL and 7110 MONL had a hardware upgrade that enabled ranging to LEOs at 10 Hz while LAGEOS ranging remained at 5 Hz until after the event timer upgrade

Greenbelt Surveys and 7105 Calibration Distances

Van S Husson
Troy Carpenter, retired

15-Jul-2024

ILRS QCB Meeting

NASA SLR Calibration Pier

Figure 1

Figure 2

Figure 3

Figure 4

- NASA SLR systems utilize concrete calibration piers, located within a few hundred meters, for operational calibrations and for system characterization tests
- Each NASA SLR calibration pier has a force-centering device which is designed to accept an adapter (Figure 1). For SLR operations a calibration prism is mounted on the adapter (Figures 2 and 3). During a survey, surveying instrumentation is mounted on the calibration pier adapter (Figure 4)
- NGS and IGN survey reports contain the calibration pier distances from the System Reference Point (SRP), but these distances require two mm level adjustments (prism height and depth) for use in NASA SLR data reduction
- *Photos from the May 2018 NGS Monument Peak Local Survey Report*

NASA SLR Calibration Pier Adapter

Disassembled

O-Ring

Prism

Assembled

- Pictured here are the components that make up the calibration pier adapter. Each adapter has a serial number and an associated prism depth. Prism depths can vary up to several mm. The prisms at some sites may accumulate moisture and must be removed and dried
- *Photos courtesy of MOBLAS-7*

7105 GODL Calibration Piers

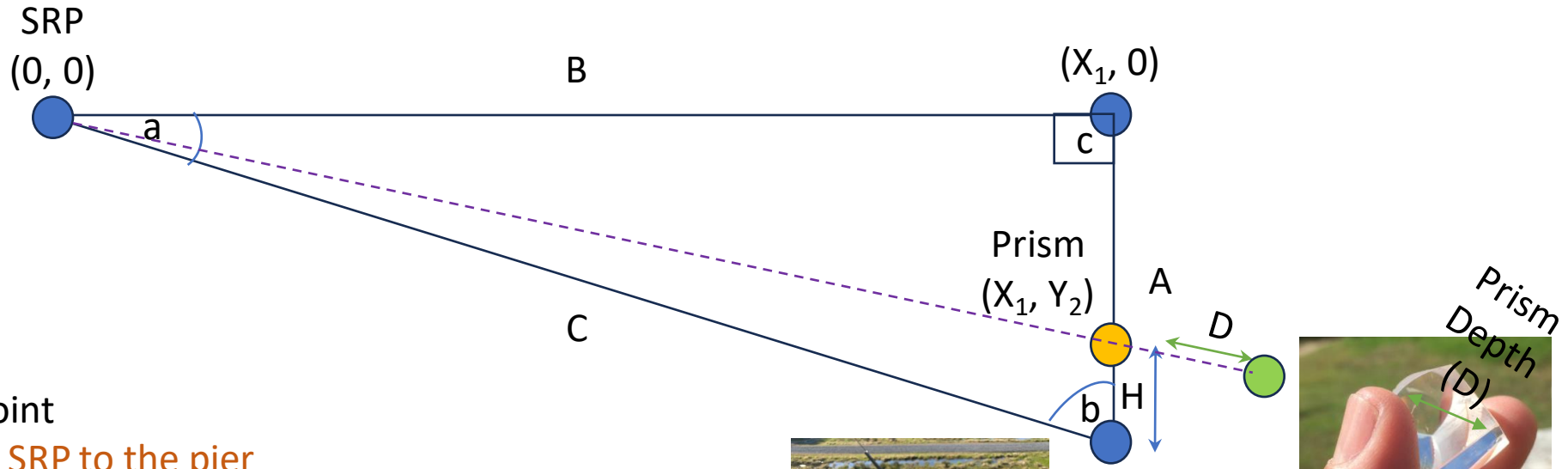
Pier A

Pier B

Pier C

Photos from NGS 2024 Greenbelt Local Survey

NASA SLR Calibration Distance Calculation



Legend

SRP: System Reference Point

a: vertical angle from the SRP to the pier

c: 90-degree angle

b: angle b (i.e. 90°) minus angle a

H: prism height (from prism spreadsheet + adapter height from survey))

A: pier height minus SRP height = Y_1 (*note: can be positive or negative*)

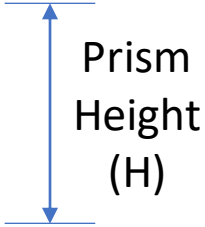
B: horizontal distance between the SRP and the pier = $\sqrt{(C)^2 - (A)^2} = X_1$

C: 3D distance between the SRP and the pier based on local survey

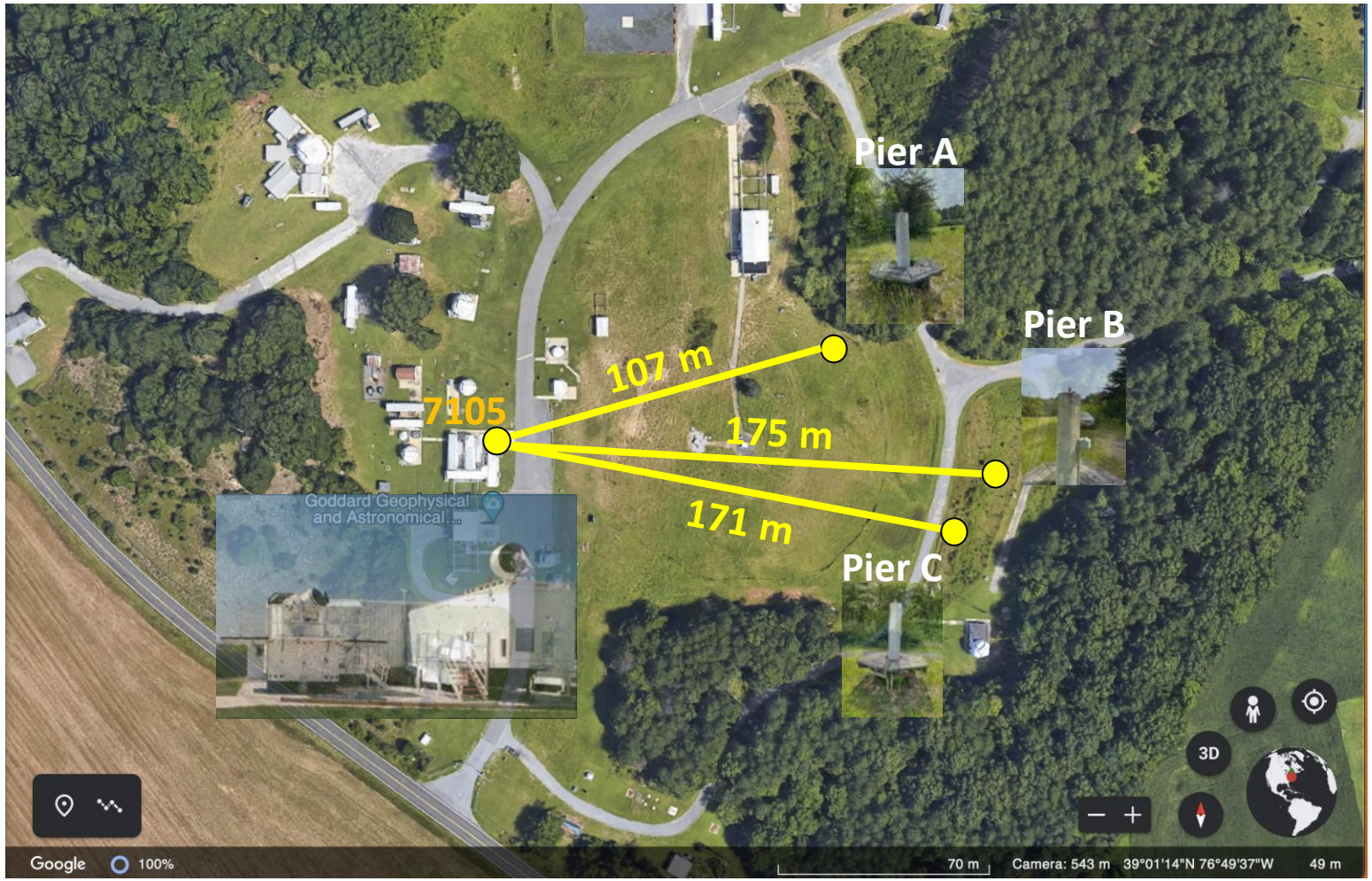
D: prism depth at 532 nm (from prism spreadsheet)

$Y_2 = Y_1 + H$

E: calibration distance (SRP to prism) = $\sqrt{(x_1)^2 + (y_2)^2}$ + D = $\sqrt{(C)^2 + (A - H)^2}$ + D

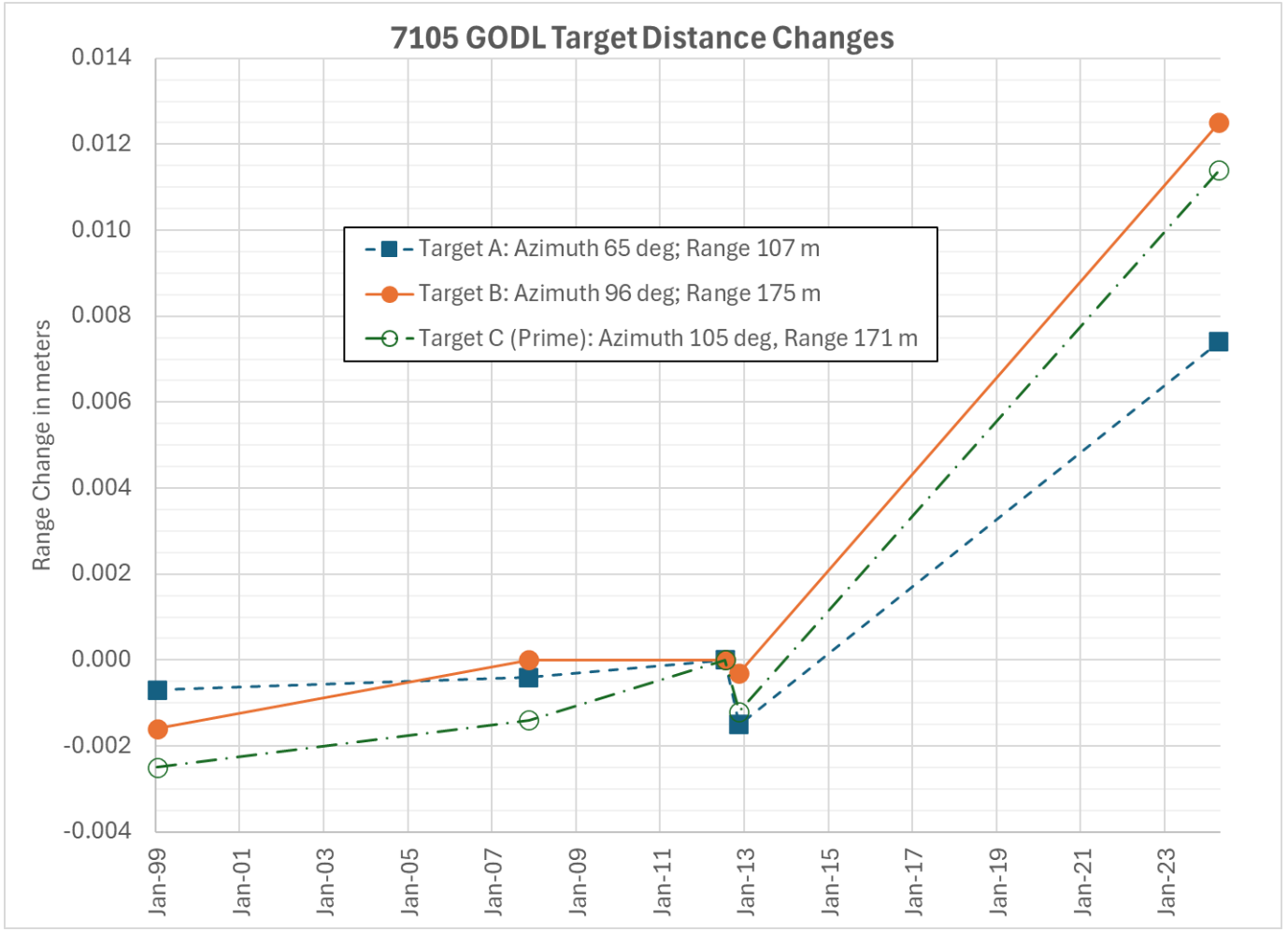


MOBLAS-7 at 7105 GODL (Greenbelt)



- MOBLAS-7 has three calibration targets, but not much separation in azimuth. Target C is prime
- Targets B and C have similar ranges and azimuth, not ideal to identify potential systematic errors in the local survey and/or ranging electronics

7105 GODL Calibration Target Distance Changes Normalized to July 2012 NGS Survey



- 7105 GODL Target Distance normalized based on the NGS July 2012 survey
- There were 1 to 2 mm changes in the 7105 GODL target distances between 1999 and November 2012 based on the local surveys.
- Have all the calibration piers moved or tilted eastward since 2012; is there a survey error; or a combination of the two

NGS Survey Tie Differences (2024 vs 2012)

5.7 Comparison with previous surveys

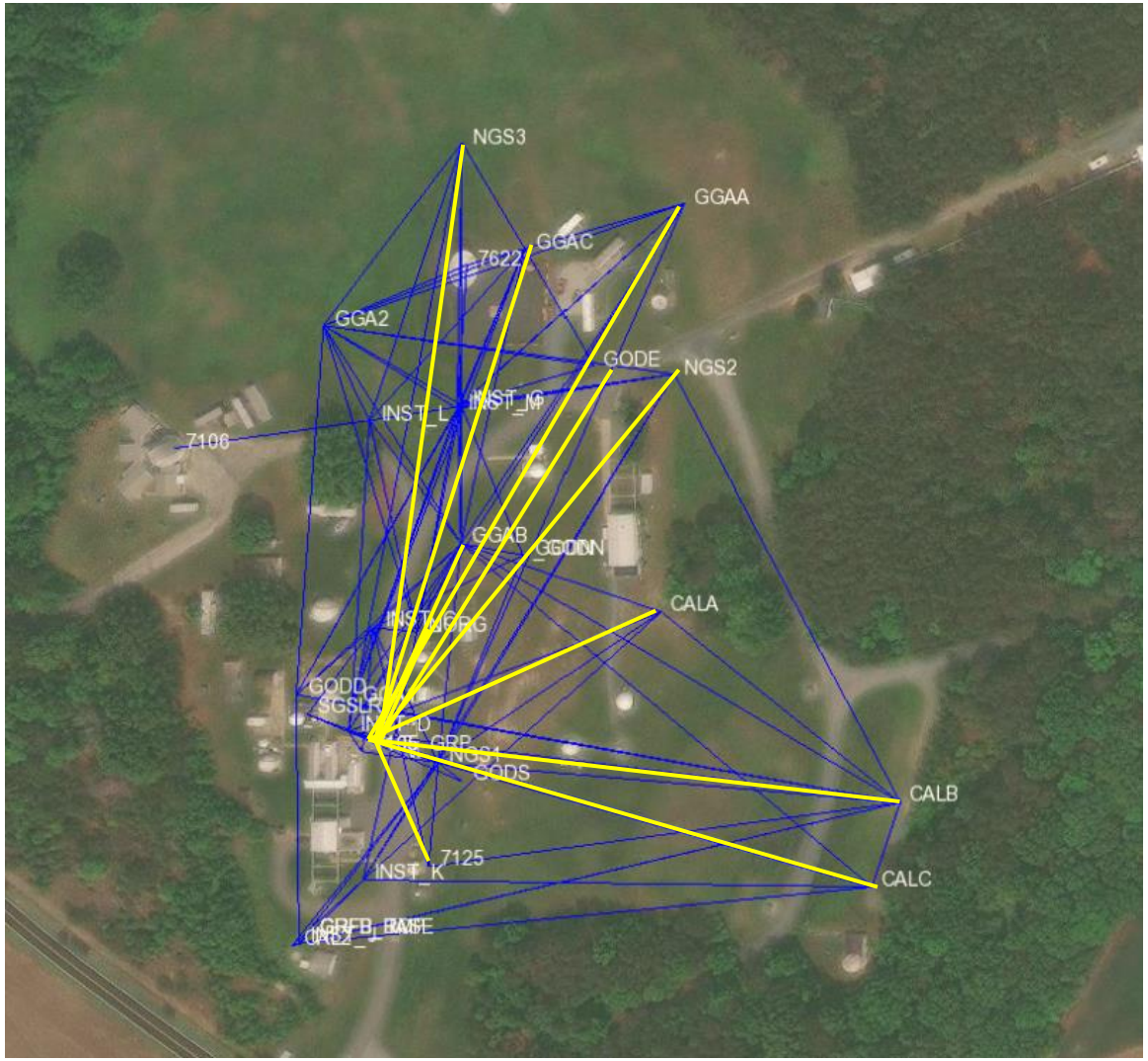
As a check on the results of the field survey, AXIS software was used to align the current survey to the NGS 2012 previous survey in ITRF2008 (epoch 2012/07/14). Topocentric tie vector comparisons are provided for all common surveyed stations. Complete coordinate information is available in the included data products.

Surveyed ties vs. Previous survey (NGS 2012) Topocentric tie discrepancies			
STATION	*DE (mm)*	*DN (mm)*	*DU (mm)*
GODE	0.0	0.0	0.0
7622	0.6	1.1	0.6
7125	-1.0	1.5	0.6
7105	-0.8	1.6	0.6
GODN	-0.1	1.4	0.5
GODS	-0.8	1.8	0.3
GRFB	-1.2	1.7	0.6
CAL2	-1.2	1.7	0.6
CALB	-0.9	0.3	0.5
GGA2	0.2	1.7	0.5
GGAA	0.8	0.6	0.2
NORG	-0.4	1.5	0.7

Table 8: Tie discrepancies between current survey and previous survey (current minus previous)

- ***Section 5.7 is from the NGS 2024 Greenbelt local survey***
- **CalB is Calibration Pier B and moved less than 1 mm in each component in 12 years**
- **While monument 7105 exhibited the same East and Up movement as Pier B, but slightly different North movement**
- **These topocentric (East, North, Up) tie differences contradict the geocentric (x, y, z) distance changes between the 2012 and 2024 NGS surveys**

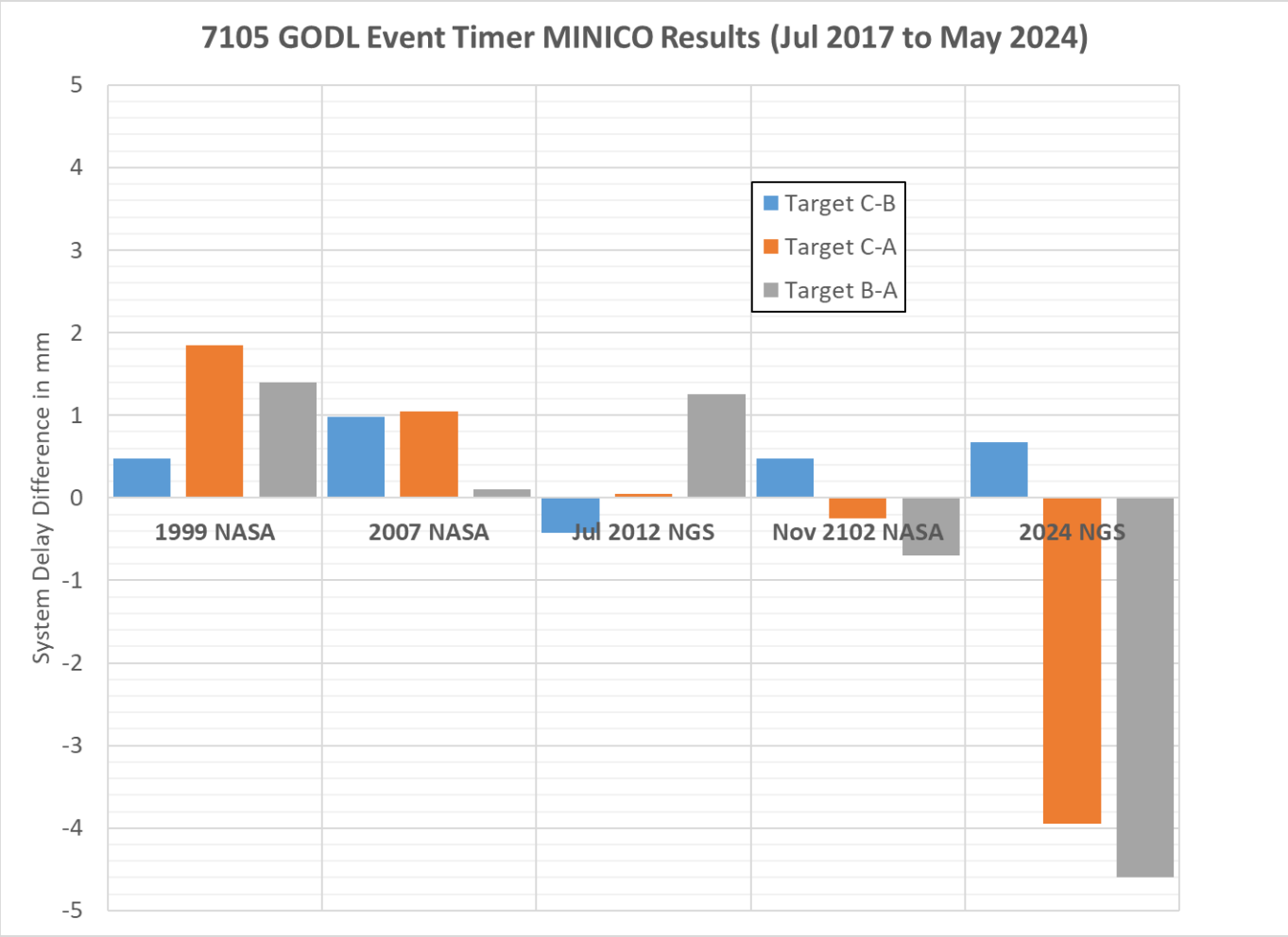
Distance Deltas from Monument 7105 between the NGS July 2012 and March 2024 Site Surveys



- **From Troy Carpenter: Mark to mark distance deltas between the NGS March 2024 and July 2012 Greenbelt site surveys using monument 7105. All the geocentric distances below increased in 2024**

Station	Delta(m)	Distance(m)	Scale
GODE	+0.0091	145.478	+0.000063
GGAA	+0.0180	205.581	+0.000088
GGAB	+0.0037	74.633	+0.000050
GGAC	+0.0109	171.088	+0.000064
NGS2	+0.0107	158.156	+0.000068
NGS3	+0.0102	199.664	+0.000051
NGEOS	+0.0029	46.622	+0.000062
7125	+0.0018	42.976	+0.000042
CALA	+0.0086	106.484	+0.000081
CALB	+0.0129	174.704	+0.000074
CALC	+0.0111	170.404	+0.000065
		Mean Scale	+0.000064

7105 GODL MINICO Results (July 2017 to May 2024) Applying Different Surveys



- In a 'Perfect' SLR system with a 'Perfect' local survey the mean system delay from any calibration target would be identical and therefore the system delay difference between any target pair would be zero
- The 7105 GODL MINICO results involving Target A indicate a 2024 survey error

Scale Factors in Surveying

- Since the earth is round, scale factors are used to convert ground to grid distances
- The 2012 and 2024 Greenbelt geocentric (x, y, z) coordinates appear to be based on different scale factors. Which ones are correct?

ILRS QCB Meeting

7/15/2024

Mike Pearlman & Claudia Carabajal

Agenda

- Stations updates:
  - ILRS Survey and Station Plan – Claudia/Mike
  - San Fernando station updates
- Missions updates: Mike/Claudia
  . Missions SLR Tracking Report Template
  . New Galileo Satellites
- Van inputs.
- Peter inputs:
  - Discontinuities
- Frank:
  - Station Quarantine Procedure Updates
  - Update on the COM models for the Geodetic Satellites
- Justine inputs from last meeting:
  - Do we want to maintain FR files; How do we keep track of FR - NP voids?
  - Notification of FR or NP voids?
- Graham and Andreja: Stanford historical problems (will report at a later date).

Agenda, Notes, and materials from the last QCB meeting on May13th, 2024 will be posted here:
https://ilrs.gsfc.nasa.gov/science/qcb/qcbActivities/index.html

ILRS Survey and Station Plan

- Reminder of the Survey was sent the first group of Stations: Irkusk, Mendelevo2, Metsahovi, Badari, Svetloe, Zelenchukskaya, Borowiec, MOBLAS-6 and MOBLAS-8 (and Graz).

[Stations contacted: Borowiec, Tahiti, Riga, Svetloe, Metsahovi, Simosato, Hartebeesthoek, Beijing, Mendeleevo, San Juan]

- Reviewers: Van Husson, Randall Carman, Alexandre Belli, Mathew Wilkinson, Clément Courde, You Zhao, and Mike Pearlman. Reports received sent to the committee for review.

San Fernando station updates

- San Fernando (SFEL, 7824) has a new mount/telescope and the system reference point will be different from their old mount/telescope. There was a question regarding the need for a new DOMES number. [Not sending data, currently in quarantine]
- The current SOD is 78244502 (change in mount). The DOMES number also changed from 13402S004 to 13402S007. System ID is 45. Do we need a new site occupation designator (SOD)?
- Van: Should the first four digits (7824), the Monument/Marker ID, be given a new number.? We can keep the system ID of 45. If we change the Monument ID, the last two digits can be 01. So a new SOD. Could be xxxx4501, where xxxx would be unique and assigned by the ILRS CB. Should the 4-character code (SFEL) be changed or be left alone? Any recommendations? The old mount/telescope has been removed and the new mount/telescope will be put back in a similar but not exact location.
- Erricos: This station does this routinely and it is NOT a simple "change" that we overlook. Look at the older event of San Fernando:

SITE/ID:
7824 A 13402S004 L San Fernan SPN. FIXED 353 47 40.8 36 27 54.9 98.6 78244501
7824 B 13402S007 L San Fernan SPN. FIXED 353 47 40.8 36 27 54.9 98.6 78244502

SOLUTION/EPOCH:
7824 A 1 C 97:119:25823 98:318:54560 98:036:40191
7824 B 1 C 99:102:74011 00:000:00000 09:337:29028

San Fernando station updates

- Erricos (cont.):

In 1999 they moved the laser again without a survey to connect the old and new location of the mount, so Zuheir was forced to introduce the trick of the “second” occupation “B” in order not to loose the continuity in estimating a common velocity with “A”. Without a new super survey to tie the new with the old location of the mount the use of aa new DOMES and the introduction of occupation “C”, Zuheir will be confused and probably upset.
Whatever you all did to handle the TWO occupations A & B for 7824, you will now need to expand to handle the new third occupation C. And it goes without saying that we need a new SOD too.

- Mathis:

This kind of trick is not necessary anymore... in all ITRS realizations nowadays, velocity contraints (even between the techniques) are introduced. And the IDS does DOMES number changes quite often, as I said, when a beacon is replaced. And, as we both cited the last SLRF2020 solution, even there a new DOMES is introduced but also the point code is changed from "A" to "B"...
I recommend, (in agreement with Erricos, but calling the TRF letter code “solution codes” instead of “occupations”)
1) increase the solution code to C,
2) change the DOMES number to sth. like 13402S010 (must be requested at (https://itrf.ign.fr/en/network/domes/request<https://itrf.ign.fr/en/network/domes/request>) and
3) increase the system ID to sth. like 78244503.
From the ITRS CC point of view, a station is uniquely identified by the 4c-ID, DOMES number and solution number (related to the number of discontinuities introduced). The latter one is usually checked by the ITRS CCs on their own since the interface between the techniques (e.g., SLR) and the ITRS CCs is not that strong...

San Fernando station updates

- Mathis (cont.):

In principle, if it is a larger change in the system, the DOMES number should be replaced as it is usually done for a beacon change by the IDS.

- Jake Griffiths:

FWIW: Having dealt with a large number of DOMES issues in my former life in the IGS, it is my understanding that a change to the SLR mount, and therefore the invariant point, would result in a new "S" type DOMES number.

The DOMES philosophy has evolved over the years and has lost its original intent. A symptom of this is the fact that the ITRF/catref tracks 4 ids (4-char CODE, PT ID, DOMES, SOLN) to uniquely define a point within the TRF. I still prefer the now so-called "M" type DOMES, which is assigned to a permanent (brass) marker. And the measurement system is incidental to that marker, and the measurements are tied to that marker through local metrology. IGS station operators are way too cavalier about their antennas, causing so many discontinuities that the induced velocity errors across the network will never get down to the stated GGOS levels. My 2 cents.

- Van: Someone should do a survey to measure the new local ties between the new mount/telescope to the other space geodetic techniques at their site (i.e. GNSS, DORIS). Maybe this survey should be done by IGN. Should we alert Zuheir now or once the dust settles on these issues?
- Station is aware that a survey will be needed. Will need to request a new DOMES number.
- CDDIS also needs to update their tables when the dust settles.

Missions SLR Tracking Report Template

- Template (version 1.6) was sent out to the active LEO satellites to start. Missions contacted: Cryosat-2, Geo-IK-2, GRACE-FO-1 and GRACE-FO-2, HY-2B, HY-2C, HY-2D, ICESat-2, Jason-3, PAZ, SARAL, Sentinel-3A, Sentinel-3B, Sentinel-6A/Jason-CSA, Swarm-A, Swarm-B, Swarm-C, SWOT, TanDEM-X, TerraSAR-X.
- Received from: Sentinel-3/-6, GFO, PAZ and HY-2. Sent reminder to Missions supported, extending the deadline to July 31st, 2024.
- Reviewers: Rob Sherwood, Nils Bartels, Alex Belli, Van Husson, Mike Pearlman and Graham Appleby.
- Reports sent to reviewers.

New Galileo satellites

- Added the two recently launched Galileo (-225 and -227) to Active Missions.
- Contacted the mission to verify parameters and assigned SIC.
- CPFs started coming into CDDIS.
- Changes to the priority list were requested. Replaced Galileo 210 for Galileo-211 at #44. Galileo-210 will be decommissioned, CPFs are still going to be coming until then.
- Tracking reports from Van continue to be posted on the ILRS website: https://ilrs.gsfc.nasa.gov/science/SLR_science_campaigns/galileo_for_science.html

International Workshop on Laser Ranging – Kunming 2024

Celebrating 60 Years of SLR (1964-2024), Cooperation in the new era of ILRS

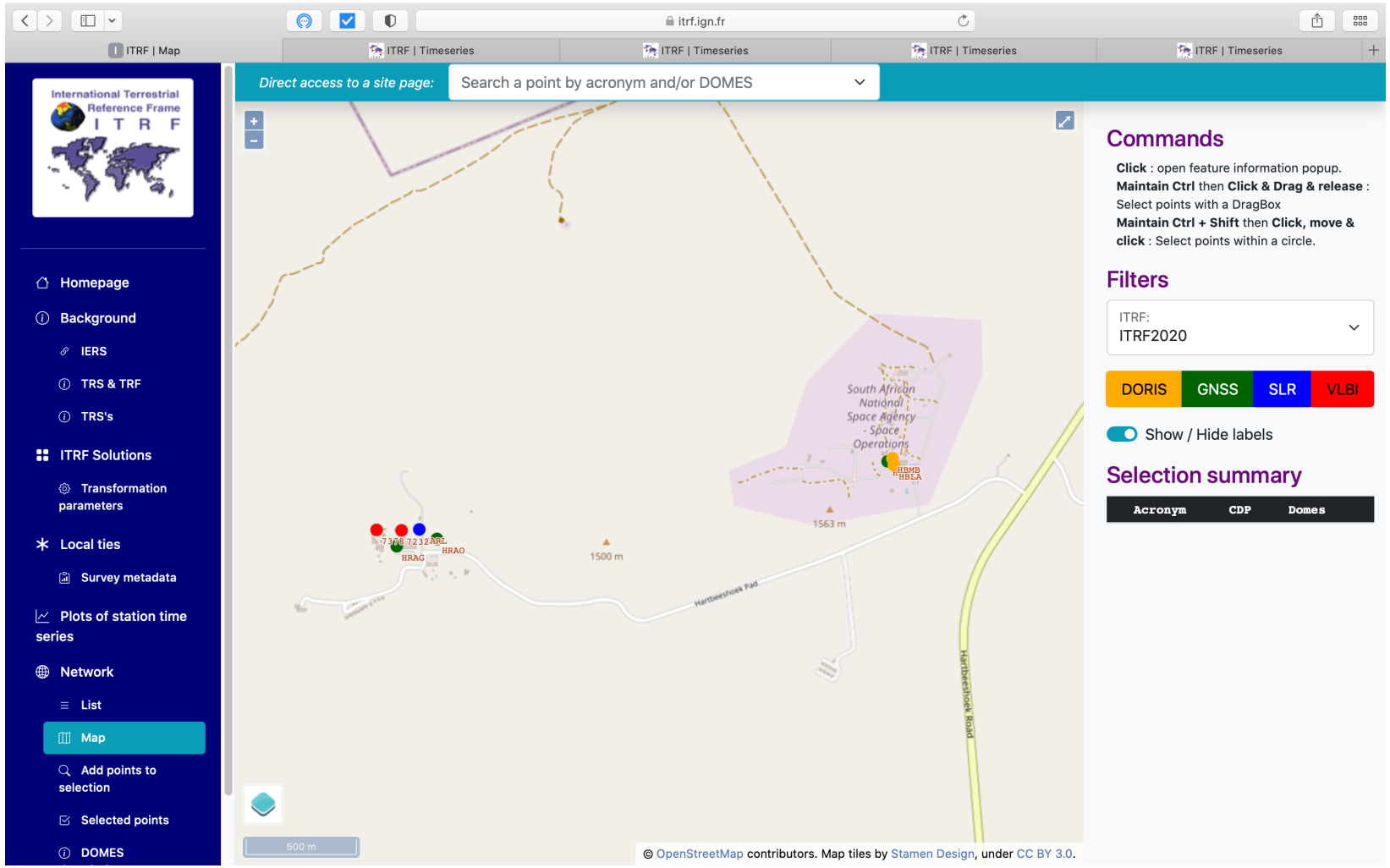
- The Yunnan Observatories and the International Laser Ranging Service (ILRS) are pleased to announce that the 23rd International Workshop on Laser Ranging will be held in Kunming, China during 20-26 October 2024.
- Second announcement sent with change in venue. Workshop website online with the link below (recently updated): https://23rdworkshop.casconf.cn/

  KunmingLOC@outlook.com
- LOC POC:

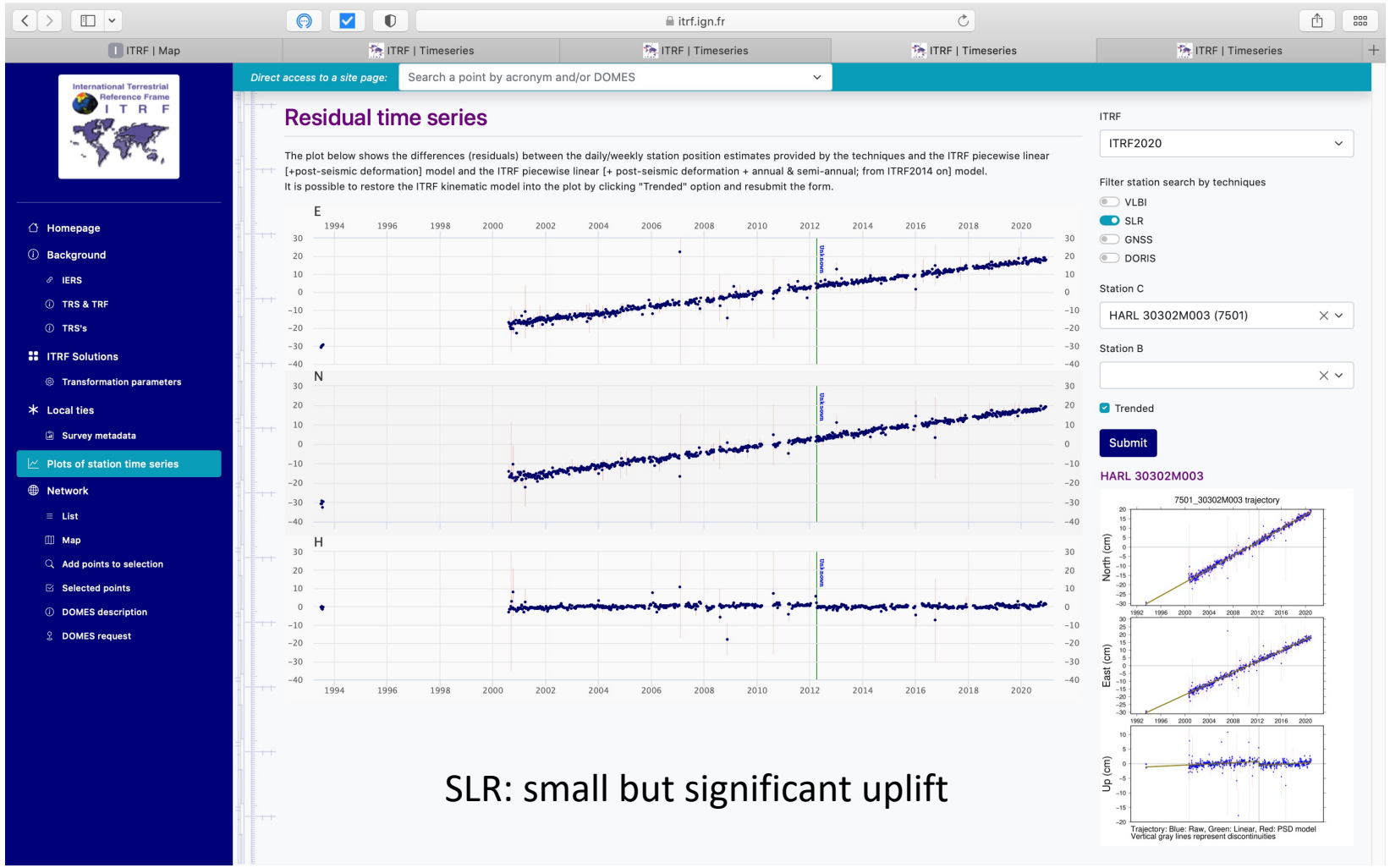
  Yongzhang Yang

- NASA approvals for participation may be difficult.

ITRF2020 HartRAO height rates from SLR, VLBI, GNSS and DORIS



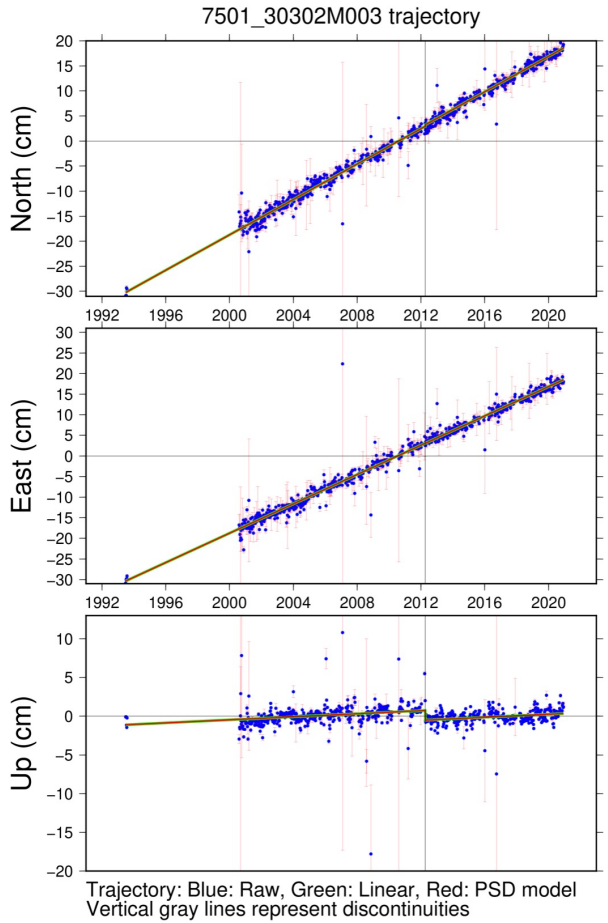
Hartebeesthoek Radio Astronomy Observatory

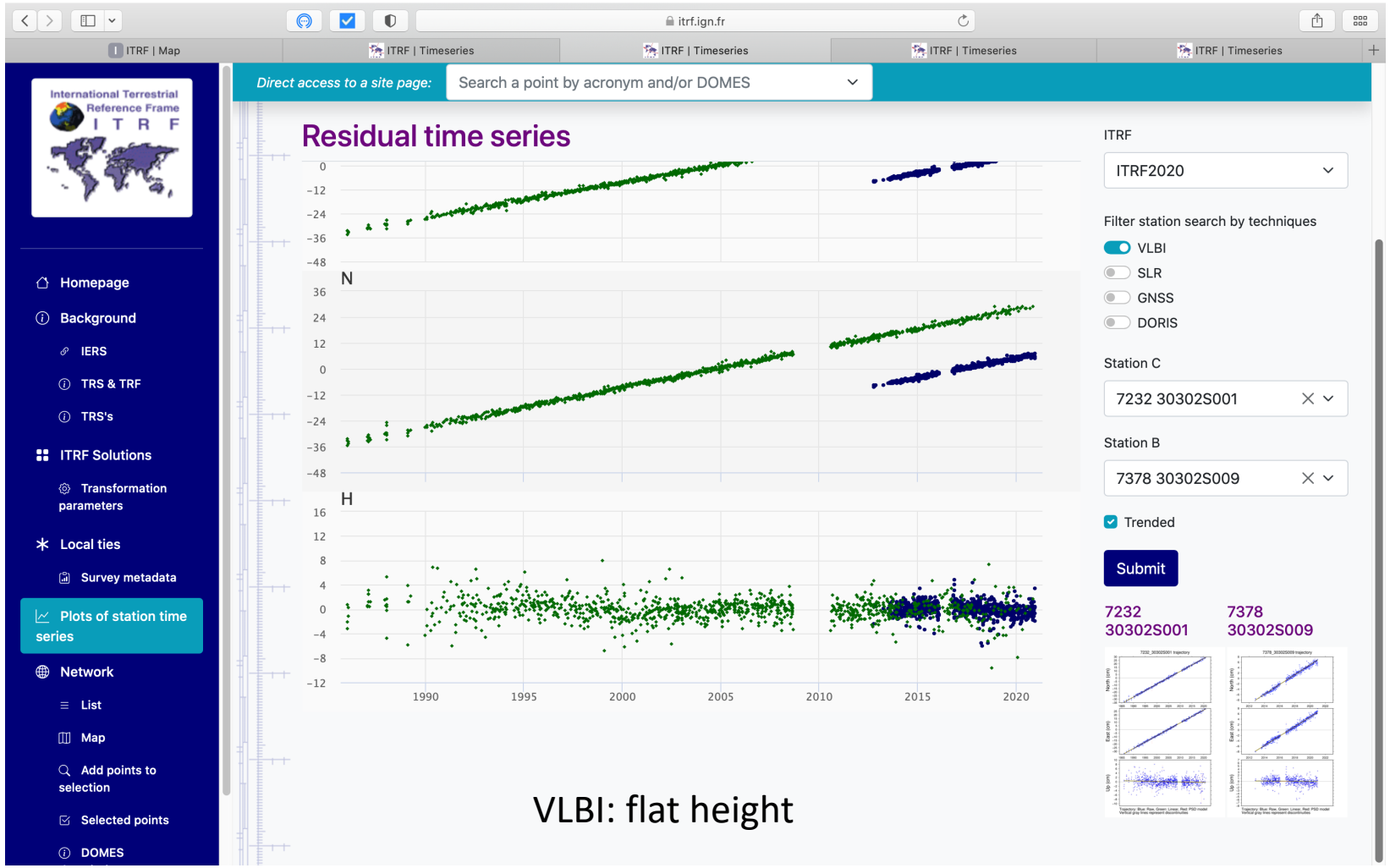


SLR: small but significant uplift

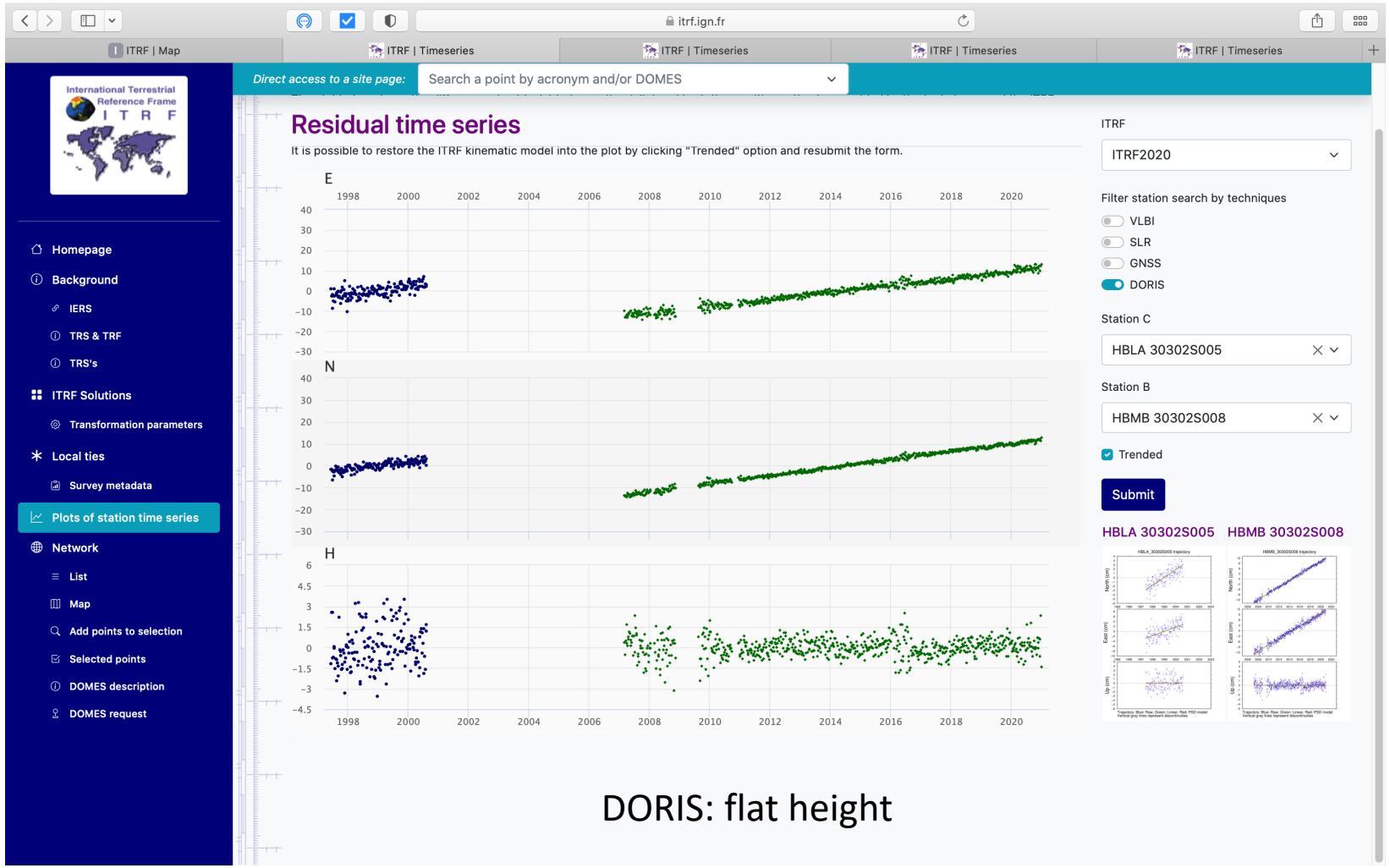
itrf.ign.fr

ITRF | Map | ITRF | Timeseries | ITRF | Timeseries | ITRF | Timeseries | T7501_30302M003.png 2... | ITRF | Timeseries | Station History Log | Hart...

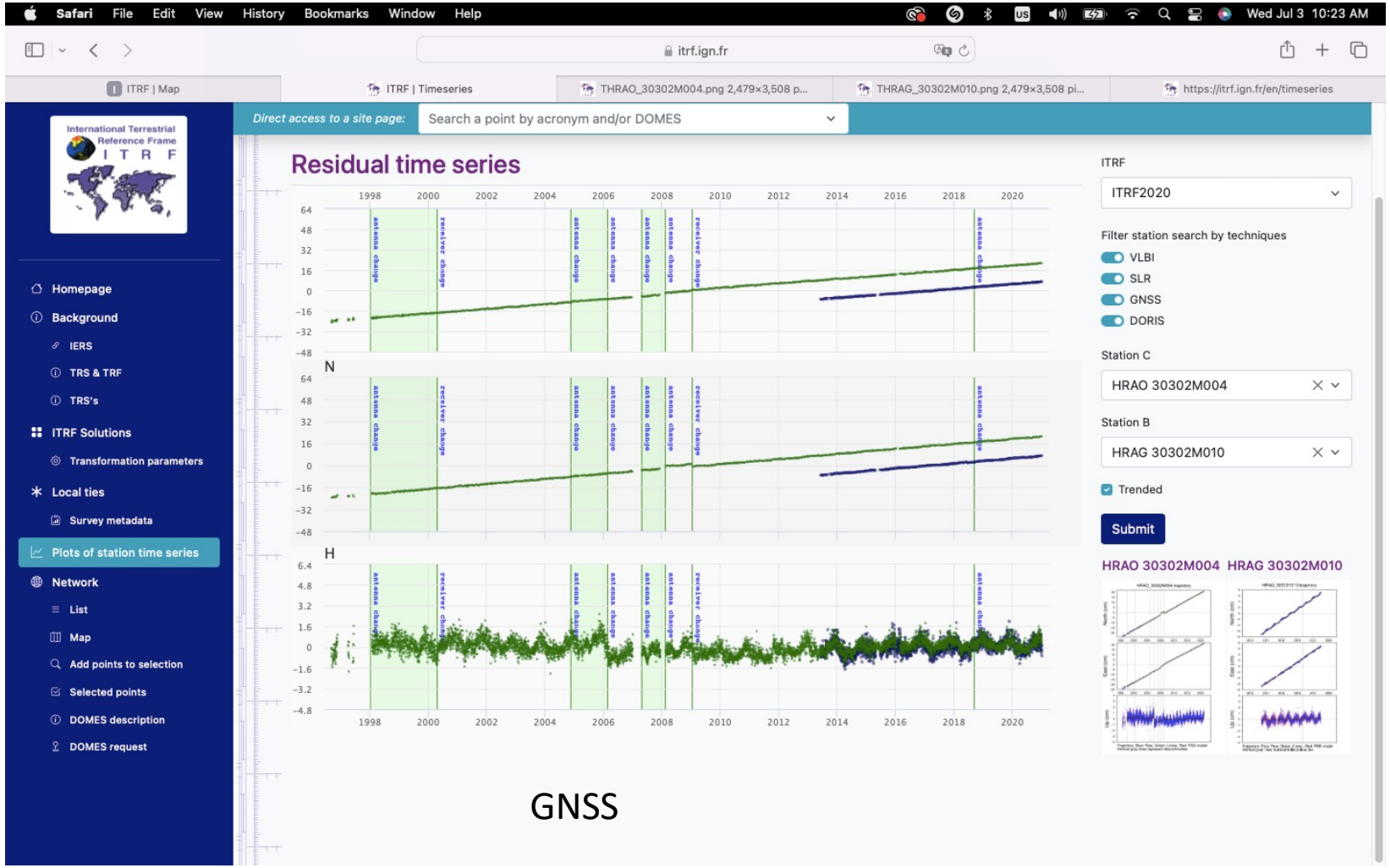




VLBI: flat height



DORIS: flat height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International Terrestrial Reference Frame ITRF
Direct access to a site page:
Search a point by acronym and/or DOMES
Homepage
Background
IERS
TRS & TRF
TRS's
ITRF Solutions
Transformation parameters
Local ties
Survey metadata
Plots of station time series
Network
List
Map
Add points to selection
Selected points
DOMES description
DOMES request
Residual time series
N
H
ITRF
ITRF2020
Filter station search by techniques
VLBI
SLR
GNSS
DORIS
Station C
HRAO 30302M004
Station B
HRAG 30302M010
Trended
Submit
HRAO 30302M004 HRAG 30302M010

GNSS

Ideally, any “signal” being detected is seen in all three* major geodetic systems,
and they have sufficiently different sensitives to systematic errors
that a common signal is likely to be real.
Tom Herring (p.c. EGU2024)

IGS station operators are way too cavalier about their antennas, causing so many discontinuities that the induced velocity errors across the network will never get down to the stated GGOS levels.
Jake Griffiths (p.c 2024)

The VLBI and DORIS systems show flat long-term height for HRAO in ITRF2020

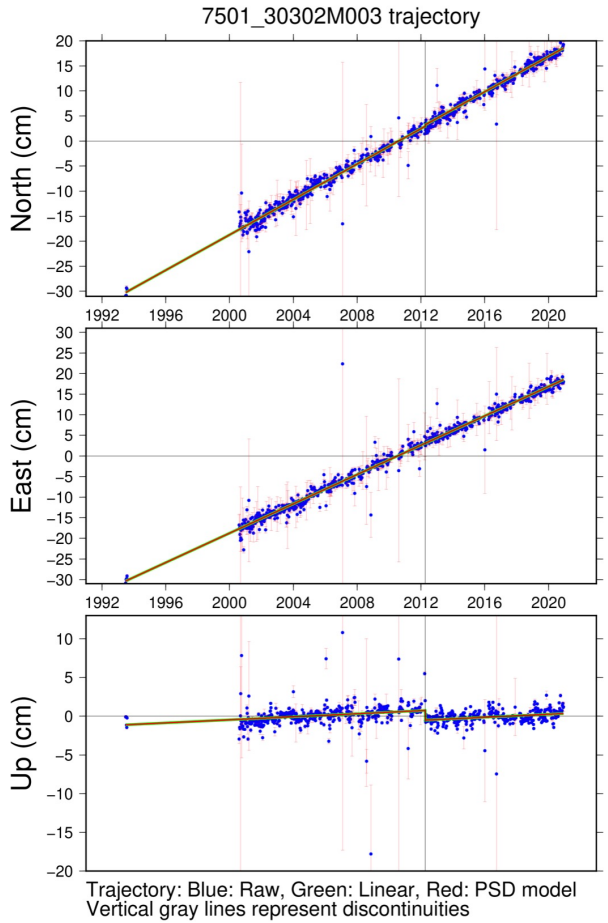
HARL exhibits small but significant (and questionable) uplift in ITRF2020

GNSS? Don’t Ask

Was Zuheir Cavalier?

itrf.ign.fr

ITRF | Map | ITRF | Timeseries | ITRF | Timeseries | ITRF | Timeseries | T7501_30302M003.png 2... | ITRF | Timeseries | Station History Log | Hart...

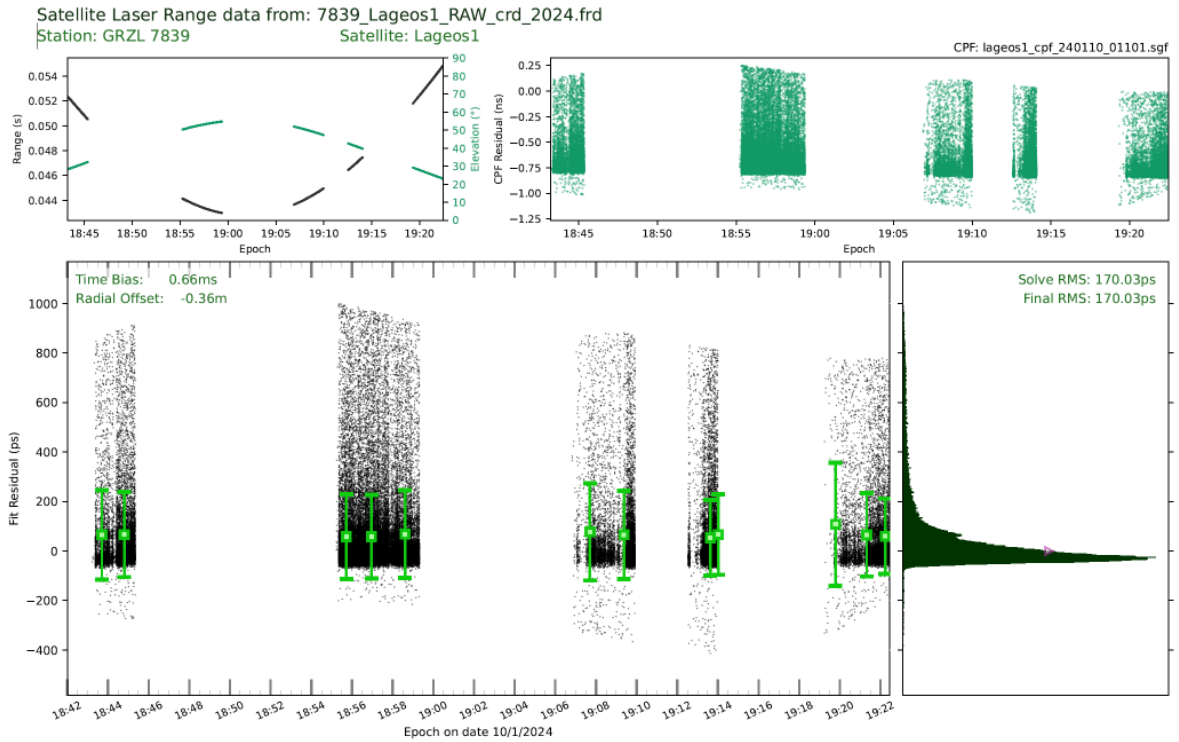


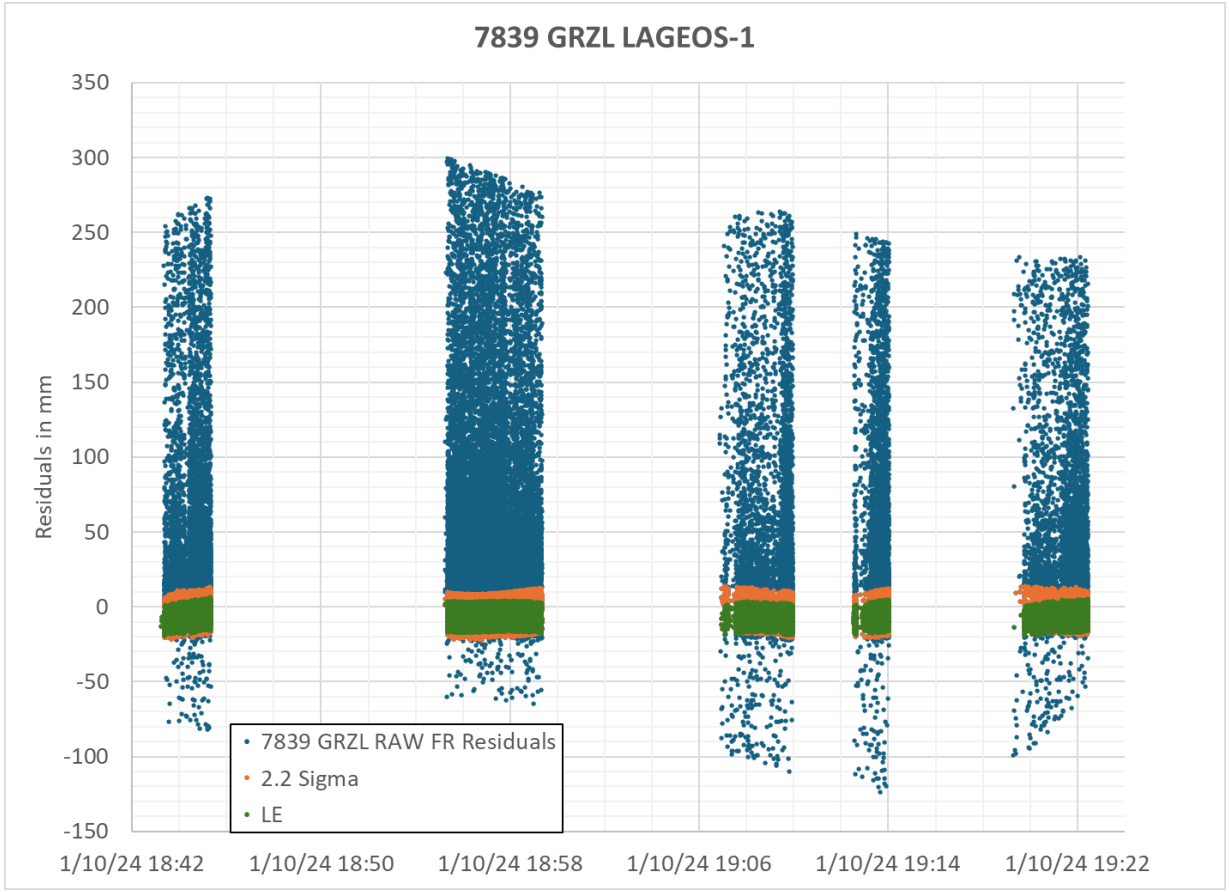
Comments from Graz on the Leading Edge (LE) Filter

15-July-2024 ILRS QCB

Van Husson

7839 GRZL Raw LAGEOS-1 Fullrate Residuals from OrbitNP





- ❑ **Left Chart: OrbitNP Analysis of 7839 GRZL Raw LAGEOS-1 Fullrate data**
- ❑ **Right Chart: OrbitNP 7839 GRZL Fullrate residuals with the observations from the 2.2σ and a LE filter, respectively**

Response from Graz

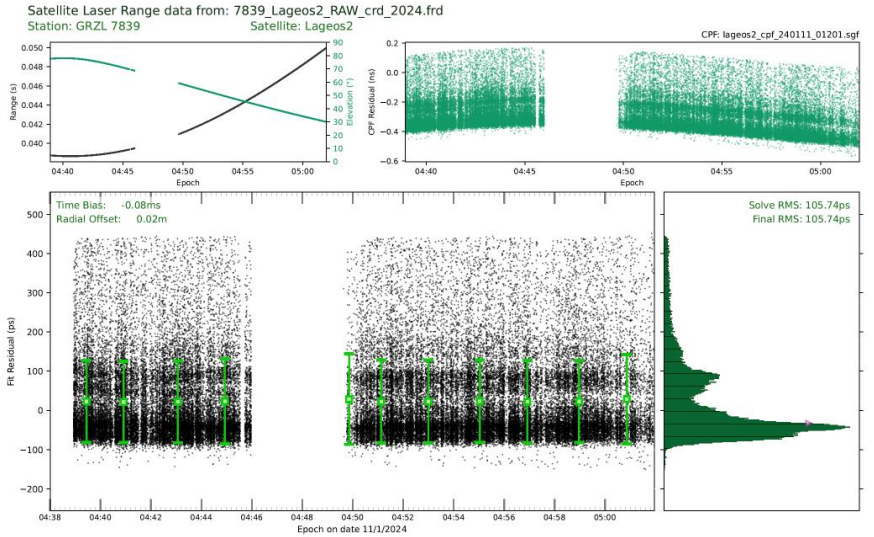
Is some of the long residual tail due to 'ringing' of the CSPAD?

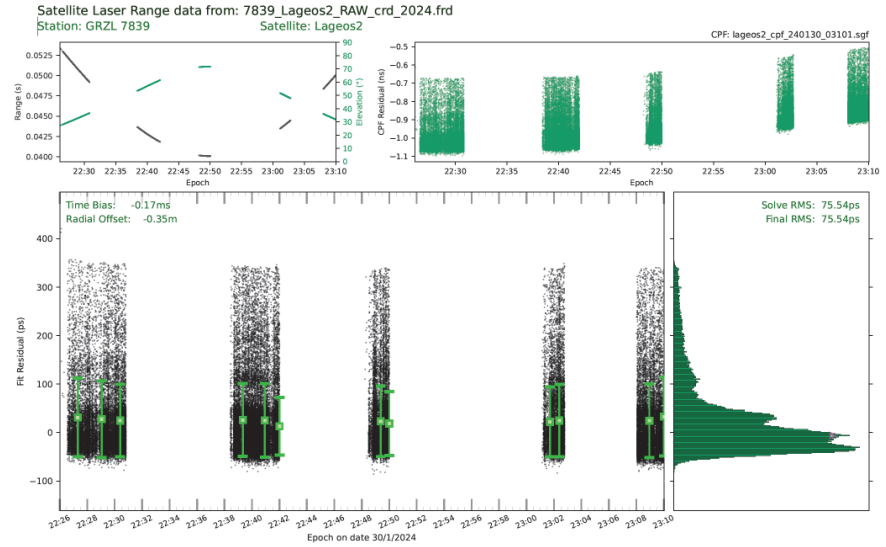
We believe this early ambient background noise and long tail come from the impulse response of the C-SPAD. Then this is related to true signal photons but not the corresponding to the true range. I've also just learned from one paper, and its "chapter 2" explains the same issue.

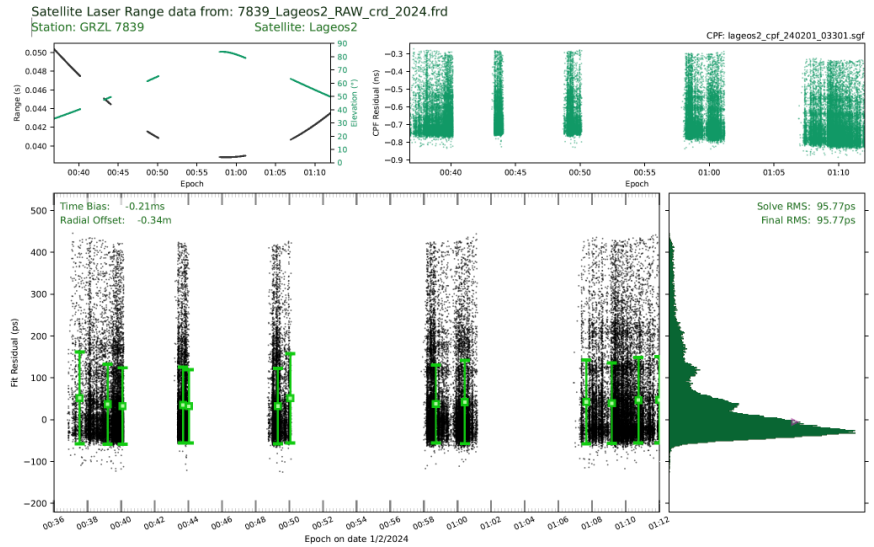
https://opg.optica.org/oe/fulltext.cfm?uri=oe-19-11-10735&id=214120

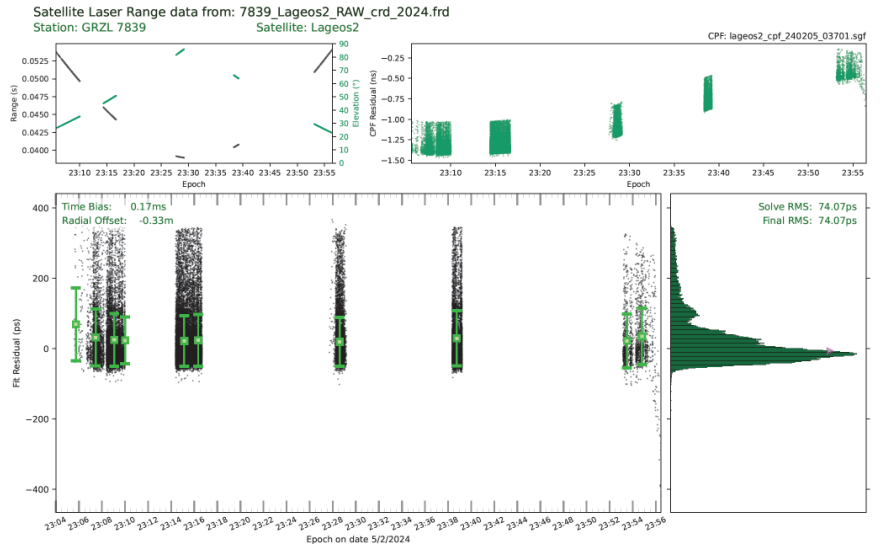
- **Abstract:** In many time-domain single-photon measurements, wide dynamic range (more than 5 orders of magnitude) is required in short acquisition time (few seconds). We report on the results of a novel technique based on a time-gated Single-Photon Avalanche Diode (SPAD) able to increase the dynamic range of optical investigations. The optical signal is acquired only in well-defined time intervals. Very fast 200-ps gate-ON transition is used to avoid the undesired strong signal, which can saturate the detector, hide the fainter useful signal and reduce the dynamic range. In experimental measurements, we obtained a dynamic range approaching 8 decades in few minutes of acquisition.

7839 GRZL OrbitNP LAGEOS-2 Raw Residuals







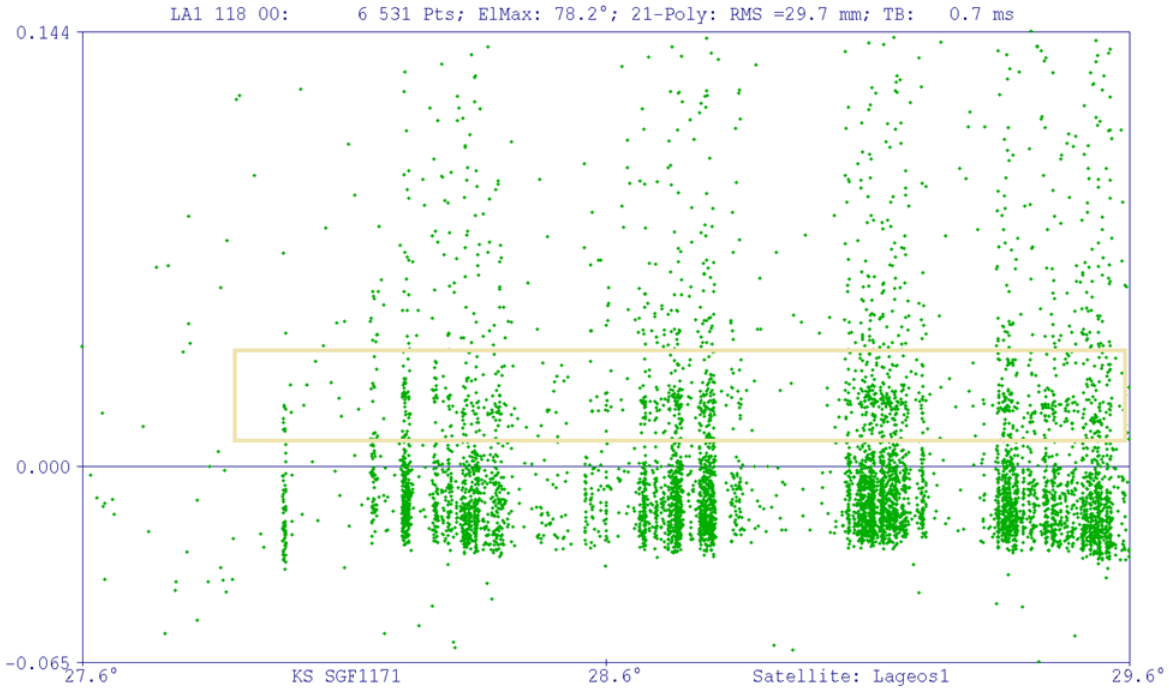


- There are multiple peaks in the LAGEOS-2 passes
- Could these multi peaks explain why the range biases between LAGEOS-1 and -2 are different by a few mm?

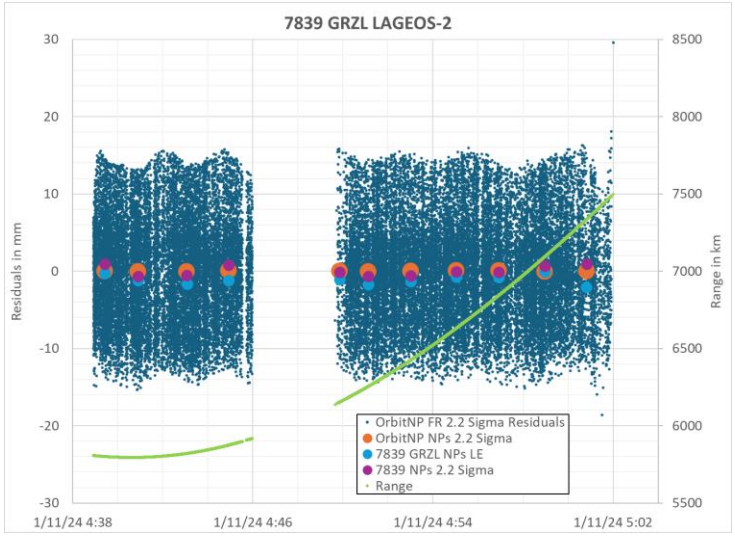
Response from Graz

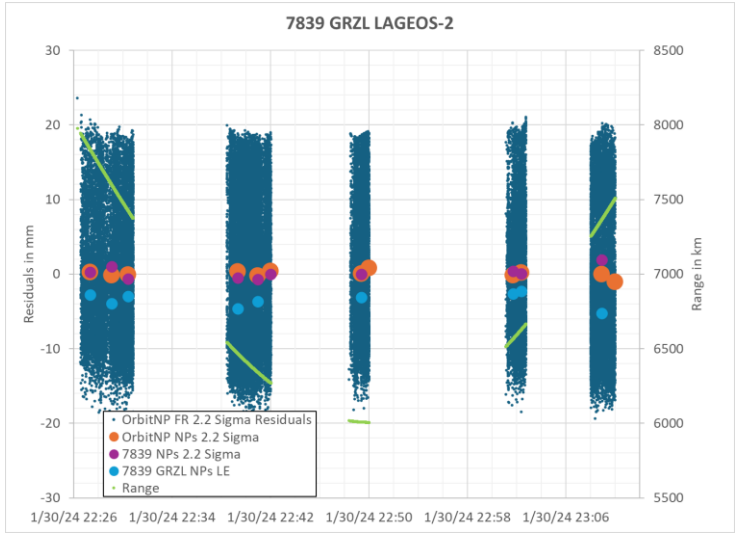
The LAGEOS-2 residual histograms exhibited some additional smaller peaks after the LE.

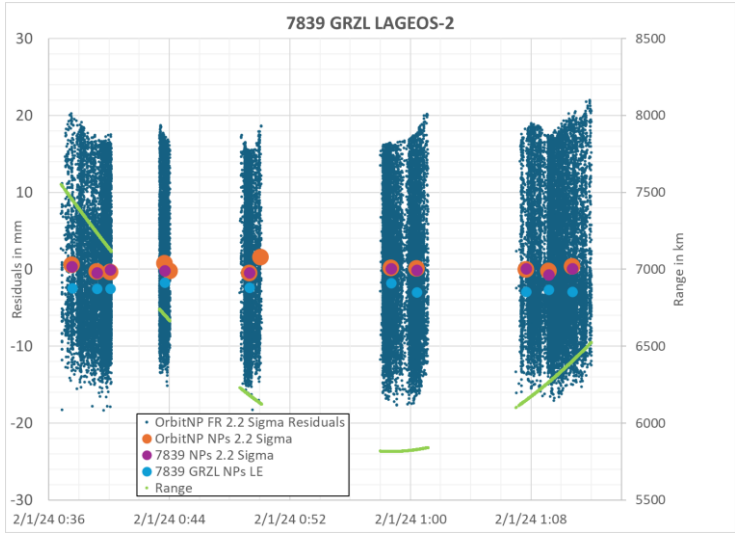
Regarding the small peaks of La2, first it comes very likely from the satellite signature. Although with the same CCRs distribution, why we do not see that from La1? We guess when choosing 5+5 Lageos passes, I was more in favourite to higher return rate – more in multi-photon mode. From different people we hear that La1 normally has higher return rate than La2 – if that is true (??) – The more in multi-photon mode, the more returns from the further CCRs (small peak) are "swallowed" by the closer CCRs. Below I show you a low return rate pass from La1, and you see the small peak is also appearing there.

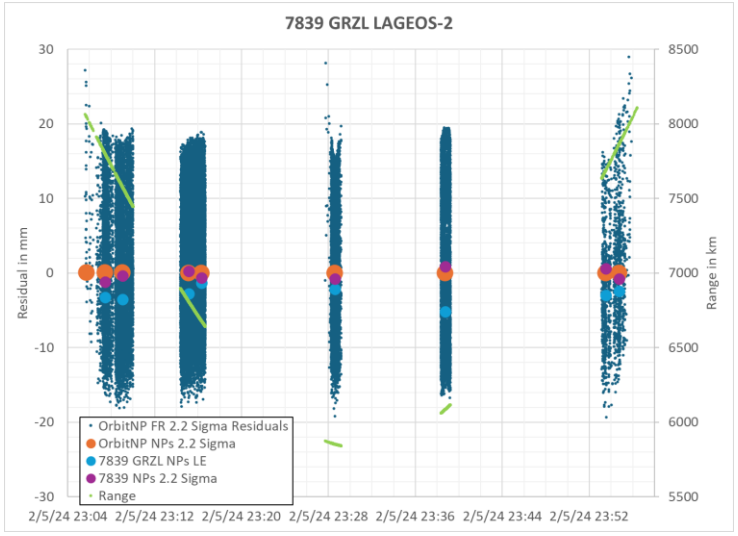


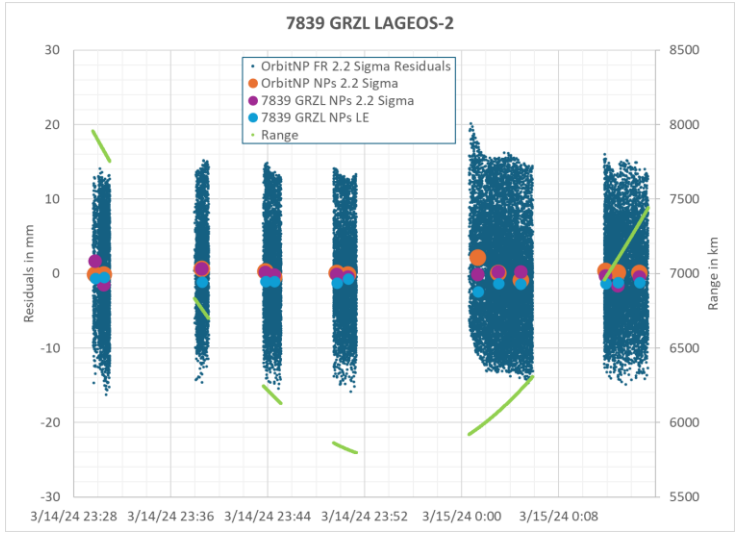
7839 GRZL LAGEOS-2 NP Analysis Using the 2.2σ Filtered Data





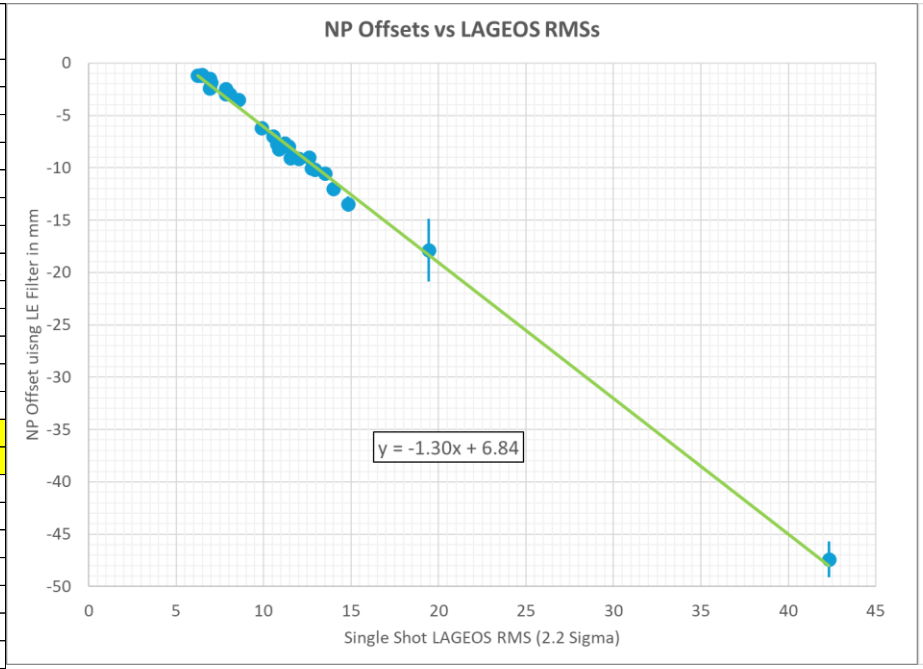


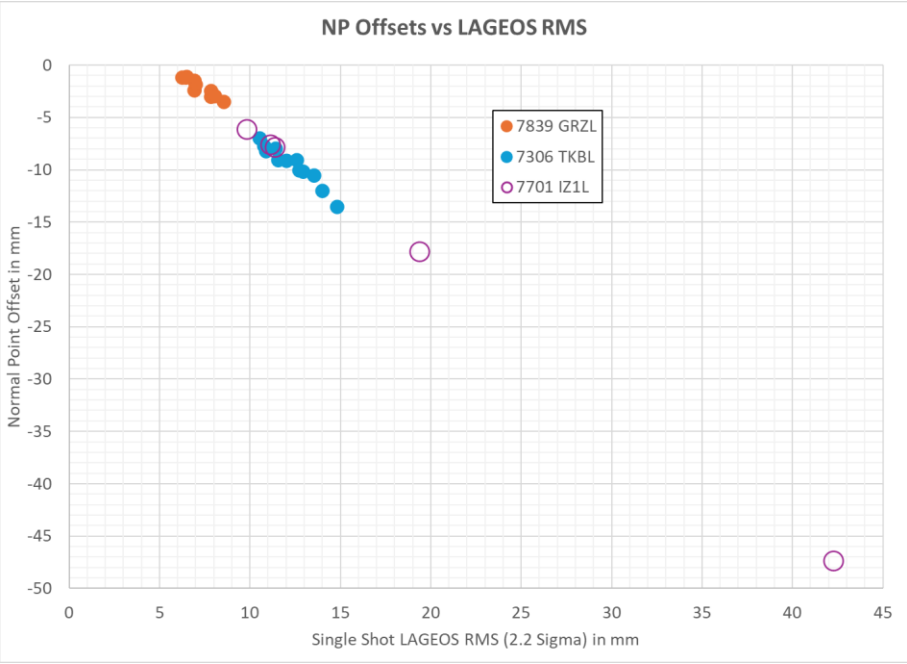




LE NP Offset from 2.2σ Fit versus 2.2σ Single Shot RMS

Pad	Satellite	Date and Time	Wave (nm)	2.2 Sigma RMS (mm)	NP offset in mm	Std Error in mm
7306	LAGEOS-1	1/21/2023 13:51	532	10.86	-8.20	0.73
7306	LAGEOS-1	2/14/2023 11:34	532	11.42	-7.98	0.88
7306	LAGEOS-2	2/21/2023 10:42	532	10.76	-7.70	1.07
7306	LAGEOS-2	1/29/2024 21:47	1064	14.81	-13.49	1.81
7306	LAGEOS-2	2/4/2024 13:34	532	10.53	-6.98	0.59
7306	LAGEOS-1	2/9/2024 12:50	532	13.52	-10.53	1.58
7306	LAGEOS-2	2/9/2024 16:03	532	12.92	-10.17	0.21
7306	LAGEOS-2	2/12/2024 14:34	532	12.01	-9.11	1.24
7306	LAGEOS-2	2/15/2024 9:00	1064	14.00	-12.00	0.99
7306	LAGEOS-1	2/15/2024 11:52	532	12.58	-9.03	1.58
7306	LAGEOS-1	2/16/2024 10:06	532	11.54	-9.04	1.41
7306	LAGEOS-2	2/16/2024 10:50	532	12.73	-10.02	0.96
7701	LAGEOS-1	1/8/2023 13:46	1064	11.44	-7.94	1.58
7701	LAGEOS-1	2/13/2023 10:44	532	42.32	-47.41	3.40
7701	LAGEOS-1	2/13/2023 20:54	1064	19.43	-17.88	8.50
7701	LAGEOS-2	2/14/2023 21:50	1064	11.20	-7.68	1.01
7701	LAGEOS-2	2/13/2024 23:57	1064	9.87	-6.20	1.19
7839	LAGEOS-1	1/10/2024 18:42	532	6.91	-2.41	0.40
7839	LAGEOS-1	1/25/2024 7:16	532	6.23	-1.19	0.38
7839	LAGEOS-1	1/25/2024 19:32	532	7.00	-1.82	0.26
7839	LAGEOS-1	2/2/2024 22:32	532	7.84	-2.97	0.43
7839	LAGEOS-1	2/5/2024 18:30	532	6.93	-1.45	0.36
7839	LAGEOS-2	1/11/2024 4:38	532	6.48	-1.10	0.23
7839	LAGEOS-2	1/30/2024 22:26	532	8.56	-3.48	0.37
7839	LAGEOS-2	2/1/2024 0:36	532	7.84	-2.47	0.17
7839	LAGEOS-2	2/5/2024 23:04	532	8.05	-2.94	0.43
7839	LAGEOS-2	3/14/2024 23:28	532	6.45	-1.18	0.18





- There is a linear relationship between the 2.2 sigma RMS and the LE NP Offsets. As the 2.2 Single Shot RMS increases the LE NPs will be biased more negative. Does the CoM corrections account for these offsets?

LE NP Offset from 2.2σ Fit and CoM Differences between a LE and 2.2σ Filter

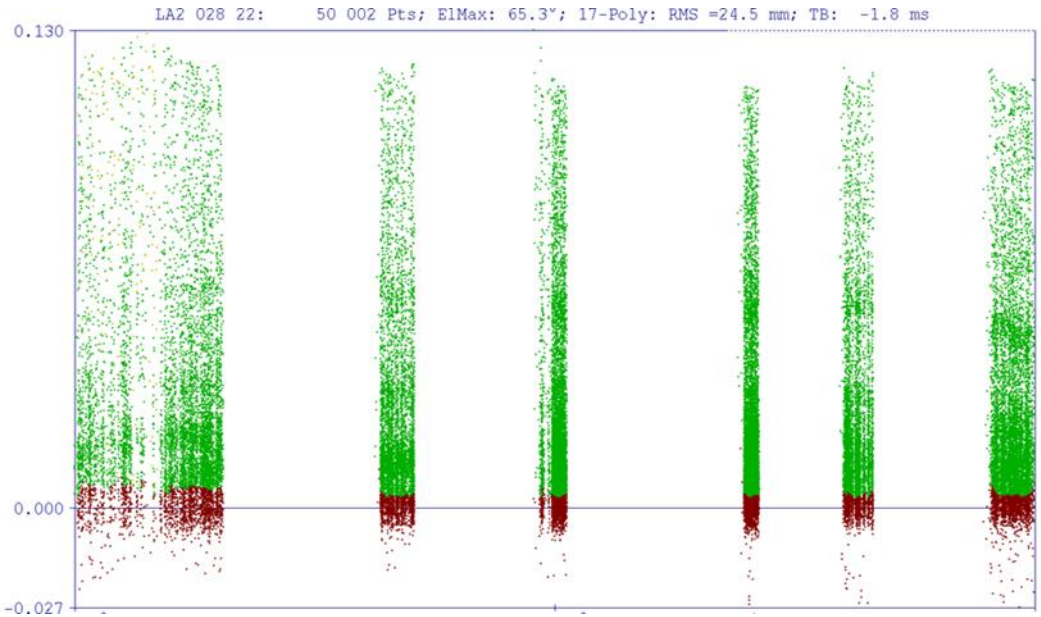
Station	LAGEOS-1			LAGEOS-2		
	Avg Offset (mm)	Std Dev (mm)	CoM Diff (LE-2.2σ in mm)	Avg Offset (mm)	Std Dev (mm)	CoM Diff (LE-2.2σ in mm)
7306 TKBL	-9.0	1.0	TBD	-9.9	2.3	TBD
7839 GRZL	-2.0	0.7	-3.1	-2.2	1.1	-3.4

- **Above is a comparison of the CoM Differences versus comparing the LE NP offsets from the 2.2σ edited fullrate data**

Response from Graz

If a station switches from a sigma edit criteria to a LE filter, can this technique be used to estimate the CoMs differences between the different NP formation techniques?

Don’t know exactly how TKBL and IZ1L find their LE, we mark the leading 20% of all points of each NP bin (red dots in the picture), then keep (-3/+17 mm). 20 mm LE defines a rather stable offset from CoM, however in case of using 2.2σ clipping, the bigger RMS (the broader distribution) the bigger offset to CoM. Therefore, we see that as the 2.2σ RMS increases the LE NPs will be biased more negative.



Response from Graz

If the inherent single shot RMSs based on a 2.2σ edit criterion change, does applying a 20 mm LE filter induce a systematic error?

We believe that is a good point in favour of LE. During real-time tracking, either stay always in single photon mode (not very simple: pointing offset, adjust divergence, switch filters….train observers accordingly, then loose the benefits of kHz), or only keep maximum return rate – like us, much less affords. The only thing is our observation might switch back and forth between single and multi-mode -- RMSs based on a 2.2σ changes also. LE is an efficient way to kick-out this trouble, because our "results" always from leading-edge to 20 (-3/+17) mm without introducing any systematic error – independent on mode.

Response from Graz

Are LAGEOS single shot RMS variations from pass-to-pass due to the retroflector array? Wilkerson's comment "The pass-to-pass variations of LAGEOS single shot RMS are due to both the retro-reflector array response and the signal to noise level. More noise means a larger sigma, which means wider N*sigma clipping, which results in a larger single shot RMS."

He is somehow right. The retroflector array/the satellite signature can vary from pass-to-pass (bin-to-bin of NP) and depends on rotation/attitude/incidence angle….. The return rate, relating to single/multi-mode, decides the data distribution. Both will influence the final RMS.

Response from Graz

Since applying a 20 mm filter, LAGEOS RMSs are constrained to a narrow band of 4 to 6mm. Does any degradation in the inherent station performance over the long-term induce a systematic error?

Yes or no. It depends on the station performance, to be more specific, the RMS after 2.2σ must be good enough (like Graz 😊). Otherwise if a station has Lageos 2.2σ RMS > 30 mm but applying 20mm LE filter, a systematic error is inevitable. In this case increasing LE filter width might be a solution to get a stable value – anyway RMS issue should be fixed first.

Subject: [ilrs-qcb] 7090 and 7110 fullrate observations per NP
Date: Wednesday, May 15, 2024 at 8:52:56 AM Eastern Daylight Time
From: Husson, Van (PERATON) via ilrs-qcb
To: ILRS QCB QCB
Attachments: image001.png, 7090 and 7110 LAGEOS, LARES, and Starlette Obs per NP.pptx

Fyi… Matt mentioned yesterday during our QCB meeting that Randall Carman (from Yarragadee) mentioned during a Networks and Engineering Standing Committee meeting that LARES-2 signals had gotten weaker since its launch in July 2022 and recommended that I add LARES-2 data to my charts. I also added Starlette and LARES to my charts for 7090 YARL and 7110 MONL. See attached. It s interesting that LARES data yield has also dropped off relative to Starlette for both stations. Not sure if there is more interleaving on LARES vs Starlette since its altitude is higher by a few hundred km.

Regards, Van

Van Husson
NASA SLR Operations Center
NASA Space Exploration Network Services and Evolution (SENSE)

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