June 16th, 2023.

ILRS QCB Meeting May 15th, 2023 (version 1)
Virtual Meeting (9 AM – 11:00 AM EST – 13:00 UTC)
Next Meeting:
July 24th, 2023
9:00 am – 11:00 am EDT (13:00-15:00 UTC)

Participants:

Erricos Pavlis, Van Husson, Julie Horvath, Frank Lemoine, Matthew Wilkinson, Mike Pearlman, Peter Dunn, Mike Ferguson, Randy Ricklefs, José Carlos Rodríguez Pérez, David Sarrocco, Thomas Varghese, Tom Oldham, Stefan Riepl, Claudia Carabajal.

The charts from the meeting will be available at (when posted):
https://ilrs.gsfc.nasa.gov/science/qcb/qcbActivities/index.html

Agenda:

Erricos:

- ITRF update
- Stations recently qualified

Van:

- MLRO (7941 MATM) Data Analysis
- An Update on MOBLAS-4 (7110 MONL) MINICO analysis

Peter/Van:

- Any updates on Arequipa Range biases and other items (to be discuss further at the next ILRS QCB meeting)

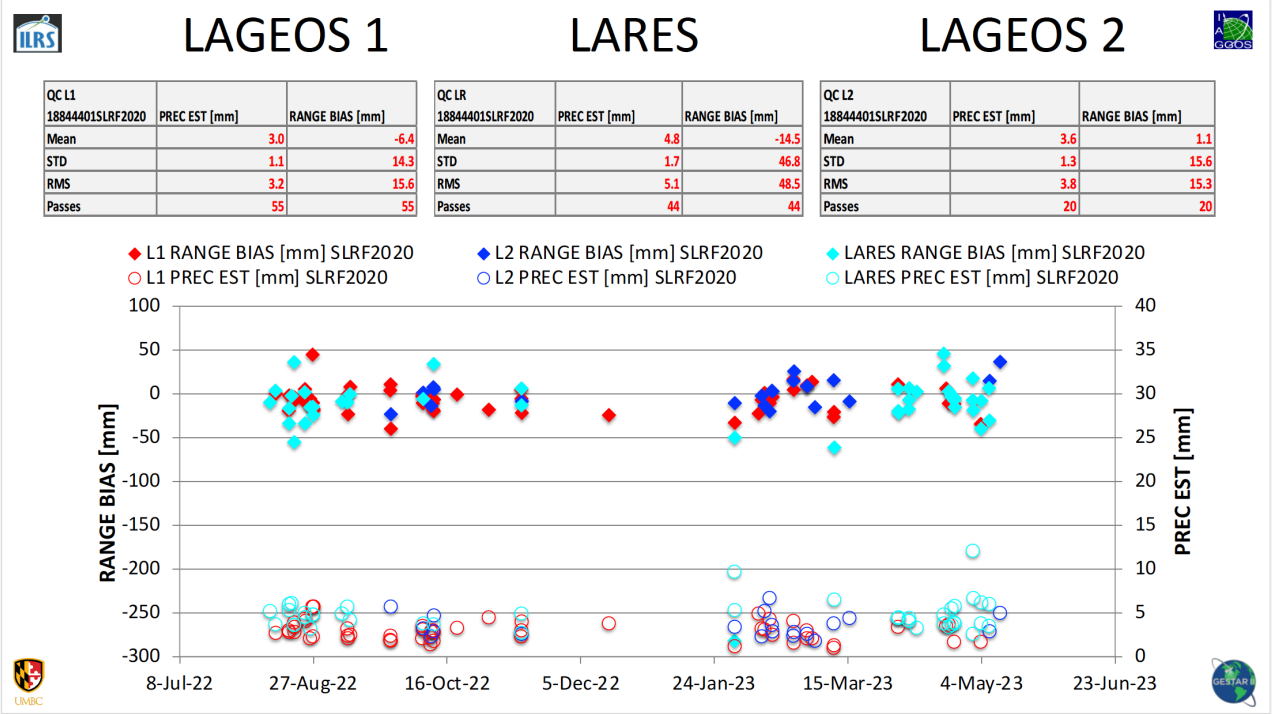
Erricos Pavlis:

ITRF is getting everyone to implement the frame, testing various combinations. All 2014 data will be 2020, and the new Data Handling File will be published.

The Riga Station (1884) qualified out of quarantine, and it is now operational. Based on the QC analysis, the system shows on average a ~3-4 mm precision on the two LAGEOS and LARES targets. The analysis also showed an insignificant bias on the order of a few mm but this could be due to changes in the system parameters that have not been yet incorporated in the calculation of the new CoG correction (the AC still use the old model value); they should wait for the new model release. (4 mm and unbiased).

Riga 1884 Validation, E. C. Pavlis & M. Kuzmicz-Cieslak, GESTAR II/UMBC

May 15, 2023



Other quarantined stations:

Quarantine Stations 2023.05.12

Station	Code	Site	DC	SOD	DOMES	First Data	Last Data	
1824	GLSL	Golosiiv, Ukraine	EDC	18248101	12356S001	2000-02-15	2023-05-12	today
1868	KOML	Komsomolsk-na-Amure, Russia	EDC	18685901	12341S001	1992-06-19	2021-04-22	750 day(s)
1879	ALTL	Altay, Russia	EDC	18799401	12372S001	2008-11-19	2021-04-23	749 day(s)
1884	RIGL	Riga, Latvia	EDC	18844401	12302S002	1987-09-21	2023-05-12	today
1886	ARKL	Arkhyz, Russia	EDC	18869601	12373S001	2010-12-03	2022-07-09	307 day(s)
1887	BAIL	Baikonur, Kazakhstan	EDC	18879701	25603S001	2011-10-17	2022-12-28	135 day(s)
7249	BEIL	Beijing, China	EDC	72496102	21601S004	2012-01-12	2023-05-09	3 day(s)
7306	TKBL	Tsukuba, Japan	EDC	73069301	21797S001	2022-10-19	2023-05-11	1 day(s)
7395	GEOL	Geochang, Republic of Korea	EDC	73956501	23910S001	n.a.	n.a.	n.a.
7407	BRAL	Brasilia, Brazil	EDC	74072701	48081S001	2014-05-12	2021-08-30	620 day(s)
7807	METN	Metsahovi, Finland	EDC	78077501	10503S018	n.a.	n.a.	n.a.
7810	ZIML	Zimmerwald, Switzerland	EDC	78106801	14001S007	1997-07-09	2022-02-14	452 day(s)
7816	SMIL	Stuttgart, Germany	EDC	78165202	10916S001	2023-02-07	2023-04-20	22 day(s)
7817	YEBL	Yebes, Spain	EDC	78176201	n.a.	n.a.	n.a.	n.a.
7865	STAL	Stafford, Virginia	NASA	78658601	49654M001	2019-09-11	2019-10-18	1302 day(s)
7941	MATM	Matera, Italy (MLRO)	EDC	79417701	12734S008	2001-08-28	2023-02-02	99 day(s)

History log voids Table from 06/06/2023 is included at the end of the Notes.

Van Husson (see slides):

Introduction

Before Van's started his presentation on MLRO (7941 MATM) Data Analysis, he recapped some issues raised from the previous QCB meeting in March 2023.

Izana (7701) and Tsukuba (7306) CRD fullrate data only contains data that is within their 2.2 sigma filter. For LAGEOS-1, LAGEOS-2 and Ajisai, both stations employ a more restrictive 2 cm leading-edge (LE) filter. However; the satellites returns that are excluded from the LE filter are not

flagged as excluded returns in their CRD fullrate data.

Jose Rodriguez recommends that stations add excluded returns that are within 5-Sigma with the filter flag properly set to their CRD fullrate data. This will assist in computing satellite center of mass corrections.

MLRO Data Analysis

MLRO LAGEOS single shot RMSs were monotonically increasing in 2022. The station attributes the increase in RMS due to laser instability. Data prior to August 1, 2022 was manually edited to try and mitigate the effect of the laser instability. The station change history did not indicate when the manual editing began or when it ended.

The laser instability appears to have caused a range bias change based on yearly aggregation of HITU's geodetic (LAGEOS, Ajisai, Stella/Starlette, LARES) range biases.

The onsite MLRO data reduction procedure automatically corrects for receive amplitude variations based on a peak amplitude detector calibration. Based on receive energy analysis of a robust LAGEOS-1 pass from January 2023, it appears the peak detector was not functioning properly since the satellite residuals exhibit a large dependency (~25 mm) with the signal strength. In addition, at least 20% of the receive energy measurements were frozen at a maximum value of 209.

In 2018, the MLRO LAGEOS single shot RMSs were at their all-time low, slightly below 3 mm. Analysis of December 2018 LAGEOS fullrate data indicated only a few mm of signal strength dependency with the strongest signals being biased toward the LE of the retroreflector array. The peak energy measurements during this time also exhibited the issue with at least 20% of the measurements being frozen at a maximum value of 209.

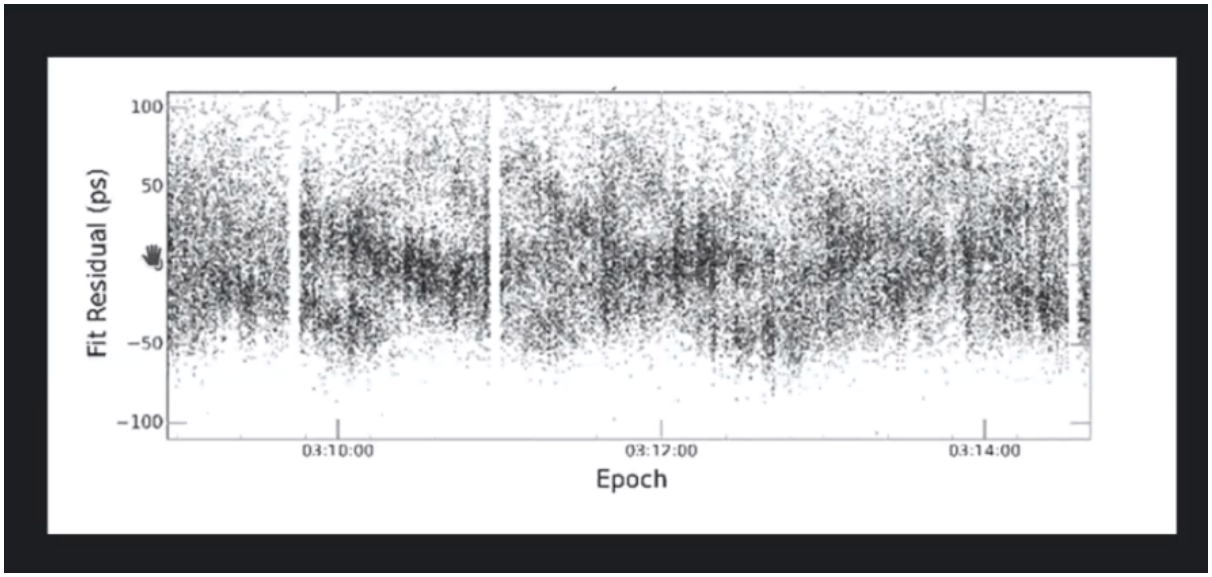
David Sarrocco commented that at Matera they are completing an upgrade for the station, and they are working on checking the performance between the old system and the new one. They are also checking the porting of all S/W scripts from old machine and new one, to make sure they produce the "same" quality output. At the moment, they are at a good point. Almost all is aligned. There was a question about the change in the cesium oscillator, and he consulted with the operators.

- The Cesium oscillator was installed in 05/09/2005 (as it is reported at ILRS webpage).
- Then there was the change to the passive maser at 17/07/2022.
- The change is reported on site logs (at EDC and ILRS website).

Station History Log - Matera, Italy (MLRO) (7941)

SOD	Year	Day of Year	Time of Day	Data Impact	System	Description
79417701	2023	040	14:00	0	6.013	PMT and CFD board replacement
79417701	2023	011	08:00	0	99	Replaced computer controller platform, now operating under linux Operative System, SW ported accordly
79417707	2022	213	09:00	0	99	lageos qc RMS treshold increase (from 8 to 10 mm)
79417701	2022	199	14:00	0	09.01.03	cesium oscillator replacement

It was noted that the fullrate residuals, including a Starlette pass, from December 2018 had some interesting trends. Matt said that the Herstmonceux station sees individual retro reflectors for certain satellites, particularly the spherical geodetic satellites and he showed a Stella fullrate residual plot, in which you could see the range change of cubes as the satellite orientation changed. Matera is a high energy system and therefore sees the front of the satellite and perhaps can also see the range change of the nearest retro (see figure below).



Matt also posted the links for the last NEWG meeting:
http://sgf.rgo.ac.uk/msteams.html
https://ilrs.gsfc.nasa.gov/network/newg/newg_activities.html

MOBLAS-4 (7110 MONL) MINCO Results
Between the November 2011 and May 2018 surveys, the distances to calibration Piers A and C from the MONL System Reference Point (SRP) changed in opposite directions by +6 and -3 mm; respectively, resulting in a net change of 9 mm.

Both calibration piers and the SRP moved horizontally by a few mm between these two surveys. No one knows if these horizontal movements were gradual; sudden or episodic, but the monthly MINICO results may perhaps shed some light when the calibration distances stabilized.
The NASA SLR legacy time of flight measurement devices, the HP5370B time interval units, had inherent mm level non-linearities in their 200 MHz verniers. When ranging to fixed ground targets this non-linearities would be exposed inducing few mm errors in historical MINICO results. Before the Event Timer Modules (ETMs) replaced the obsolete HP5370Bs, data was taken in parallel including MINICO tests. Using simultaneous MOBLAS-4 MINICO results between the ETM and HP5370B, the HP5370B non-linearities could be calibrated. Each HPS370B has its own non-linearities, so any MOBLAS-4 MINICO results prior to the last HP5370B swap on July 8, 2015, can't be modelled.

The MOBLAS-4 MINICO results were analyzed using both the November 2011 and the May 2018 calibration distances. Based on these results, the calibration distance changes have remained stable since the last HP5370B swap in July 2015. HP5370B non-linearities impact on MINICO results prior to July 2015 are unknown. This analysis implies the May 2018 survey results (i.e. system eccentricities and calibration distance changes) can be retroactively applied to at least July 8, 2015. The distance to the prime calibration target A changed by 5.7 mm between the 2011 and 2018 surveys. The May 2018 Target A calibration distance was never updated in the onsite MOBLAS-4 data processing and why a +5.7 mm range bias correction was added to the ILRS Data Handling file with a start date of May 17, 2018. Based on this updated MOBLAS-4 MINICO analysis, the current MOBLAS-4 eccentricities and the +5.7 mm range bias correction can be back dated to July 8, 2015.

There was also a discussion on how and when target distances changes, based on local surveys, have been handled within the NASA SLR Network. In the case of MOBLAS-4, the consensus was not to update their calibration distances since the error was documented in the ILRS Data Handling file with an open-ended end date.

Peter Dunn:
Early Arequipa data used to be good. Drifting bias (TLRS systems have it), started November of 1994, 10 mm, corrected in 1998. Improvements in the station are not obvious from the documentation. The question is what to do with the data between 1994-1998. Peraton and the Station are looking for any possible sources for what is seen in the data, and need to update the Station History Log. There have been no surveys since 2014.
All biases reported by Van are included in the DHF, and factored into the ITRF2020, carried into the future. Wrong calibrations will also affect the satellite data.

Peter will be discussing Arequipa data in the next ILRS QCB meeting.

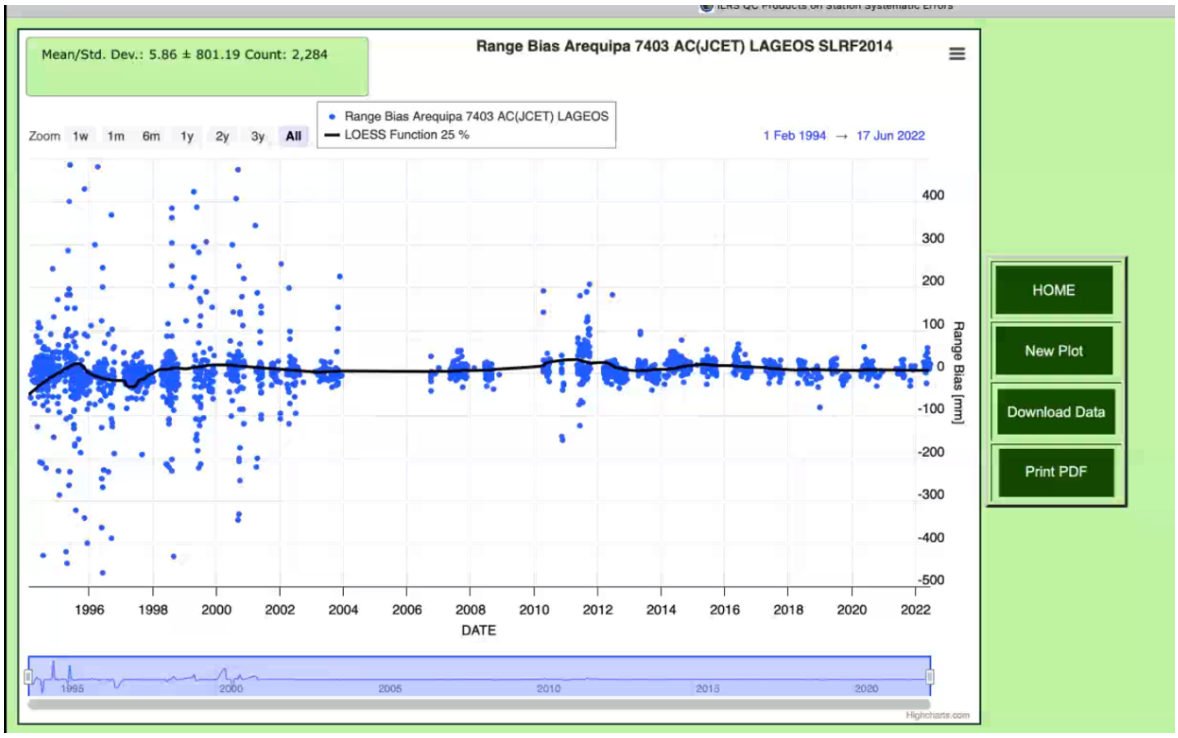
The next QCB meeting will be held on July 24th, 2023 at 9 am EDT (13:00 UTC).

Table 1. History Log Voids by Station (2023.06.06)

Station Location	CDP #	Time Gap(s)*				Last entry
Kiev	1824	000120-080302	080402-110515			141410
Komsomolsk	1868	NO DATA				
Simeiz	1873	NO DATA				
Mendeleevo	1874	NO DATA				
Altay	1879	NO DATA				
Riga	1884					230605
Arkhyz	1886	NO DATA				
Baikonur	1887	NO DATA				
Svetloe	1888	NO DATA				
Zelenchukskaya	1889	NO DATA				
Badary	1890	NO DATA				
Irkutsk	1891	NO DATA				
Katzively	1893	NO DATA				
Yarragadee	7090					230519
Greenbelt	7105					230426
Monument_Peak	7110					220328
Haleakala	7119					230330
Tahiti	7124	020825-080414	130321-191022			230520
Changchun	7237	950101-970802	020714-051002	180410-210106		211215
Beijing	7249	881101-940301	940301-981116	981116-211013		230425
Tsukuba	7306					230404
Sejong	7394	NO DATA				
Wuhan	7396	NO DATA				
Arequipa	7403	920718-951023	951023-981130	981130-010523		200629
San Juan, Argentina	7406	NO DATA				
Brasilia	7407	NO DATA				
Hartebeesthoek_HARL	7501	020409-081105				230226
Hartebeesthoek_HRTL	7503	NO DATA				
Izana	7701					230406
Zimmerwald_532	7810	030905-060203	080715-100901			230425
Borowiec	7811	030329-071227	080205-131218			211005
Kunming	7819					221212
Shanghai_2	7821	140222-170315	170720-190811			210922
San_Fernando	7824	900703-930222	971216-010124	090302-110601	180801-210518	220830
Mount_Stromlo_2	7825					210901
Wettzell_SOSW	7827	140501-160511	160511-190528			200424
Simosato	7838	900701-950810	950810-991007	991019-040701	080401-181212	211209
Graz	7839	150504-190311				220629
Herstmonceux	7840					230427
Potsdam_3	7841	040906-081026	081026-110501	170303-200303		211229
Grasse_MEO	7845	010601-200818				230215
Matera_MLRO	7941	140902-171204	171206-210629			230209
Wettzell	8834	980720-001012	001012-090324	090324-131021	170407-190604	210115

* Assuming at least 2 year data gap

Status 2023.06.06


Mean/Std. Dev.: 5.86 ± 801.19 Count: 2,284
Range Bias Arequipa 7403 AC(JCET) LAGEOS SLRF2014
Range Bias Arequipa 7403 AC(JCET) LAGEOS
LOESS Function 25 %
Zoom 1w 1m 6m 1y 2y 3y All
1 Feb 1994 → 17 Jun 2022
400
300
200
100
0
-100
-200
-300
-400
-500
Range Bias [mm]
1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
DATE
1995 2000 2005 2010 2015 2020
HOME
New Plot
Download Data
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