April 1st, 2022

ILRS QCB Meeting
February 14, 2022
Virtual Meeting
Next Meeting April 13, 2022
9:00 am EDT (14:00 UT)

Participants

Matt Wilkinson, Erricos Pavlis, Jason Laing, Claudia Carabajal, Van Husson, Tom Oldham, Peter Dunn, Randy Ricklefs, Stefan Riepl, Mike Pearlman, Toshi Otsubo, Frank Lemoine.

The charts from the meeting are available at
https://ilrs.cddis.eosdis.nasa.gov/science/qcb/qcbActivities/index.html

Agenda items to discuss:

- Erricos – ITRF update, History Logs (attached), etc.
- Van Husson - COM and SSEM Range Bias Analysis with inputs from Jose, 7839 Graz Data Analysis Update
- Peter Dunn - Rationalizing SSEM RB estimates. Calibration offsets at Yarragadee, Arequipa and Herstmonceux which were observed in the SSEM analysis can be explained by independent engineering measurements. (New slide set will replace an older set shared).
- Discussion

Erricos – History Logs (attached).

A table on History Log status is attached. Russian and Chinese stations are noticeably missing.

Matt commented that new pico second timing device at Shanghai was not recorded. Matt will follow up with them.

Peter Dunn - Rationalizing SSEM RB estimates. Calibration offsets

At Arequipa, a 2021 Minico measured 8mm difference in system delay between two targets. The change in target in 2006 was not accommodated in the calibration. This appears in the SSEM analysis as an RB of 8mm. When this is corrected, Arequipa data between 1998 and 2021 has an average bias of less than a millimeter. The station's behavior before 1998 will be studied and supported with information to be requested from station personnel.

For the next QCB meeting (April 13) Peter suggests that we discuss the following:

The TLRS-3 crew has supplied station log information for 1998, and this has been used to support analysis of unusual SSEM range bias behavior. Resulting advances in our knowledge of Arequipa station geodetics before the 2001 earthquake will be described.

At Herstmonceux, an observed SSEM range bias of 11 mm has been separated into a known, not applied, calibration error and a possible 2 mm CoM correction.

<u>Van - COM and SSEM Range Bias Analysis with inputs from Jose, 7839 Graz Data Analysis Update</u>

CoM and SSEM Range Bias Analysis

An analysis of LAGEOS and Etalon Center of Mass (CoM) corrections was performed on the best performing ILRS stations. The stations were broken into two groups, the MCP-PMT and the APD/SPAD/CSPAD stations in order to possibly identify any obvious errors solely based on the deviations from the mean CoM values.

From this analysis, it appears Monument Peak (7110, MOBLAS-4) CoM corrections appear to be an outlier based on other NASA MOBLAS systems (i.e. 7090, 7501, 7105, and 7124) with identical configurations (See Figures 1 and 2 below and slides 3 and 4 from presentation).
The Monument Peak CoM corrections were updated on 19-August-2001 when there was a detector change from an ITT MCP to a Photek MCP. This change resulted in a 19 mm REDUCTION in the 'apparent' Etalon CoM, but the same detector change in Greenbelt resulted in a 2 mm INCREASE in its Etalon CoM correction (See Figure 2). The SSEM analysis (see Figure 3 below and slide 5 from the presentation) indicates an ~20 mm REDUCTION in the 7110 Etalon bias immediately before and after the 7110-detector change. This confirms an issue in the 19 mm REDUCTION in the 7110 Etalon CoM.
In addition, based on Figure 1, it appears Monument Peak (7110) CoM corrections are more in family with the single photon APD/SPAD systems than the MCP systems, which raises the question. Can there be bug in the CoM generation software, where Monument Peak was treated as if it had a SPAD vs an MCP detector?

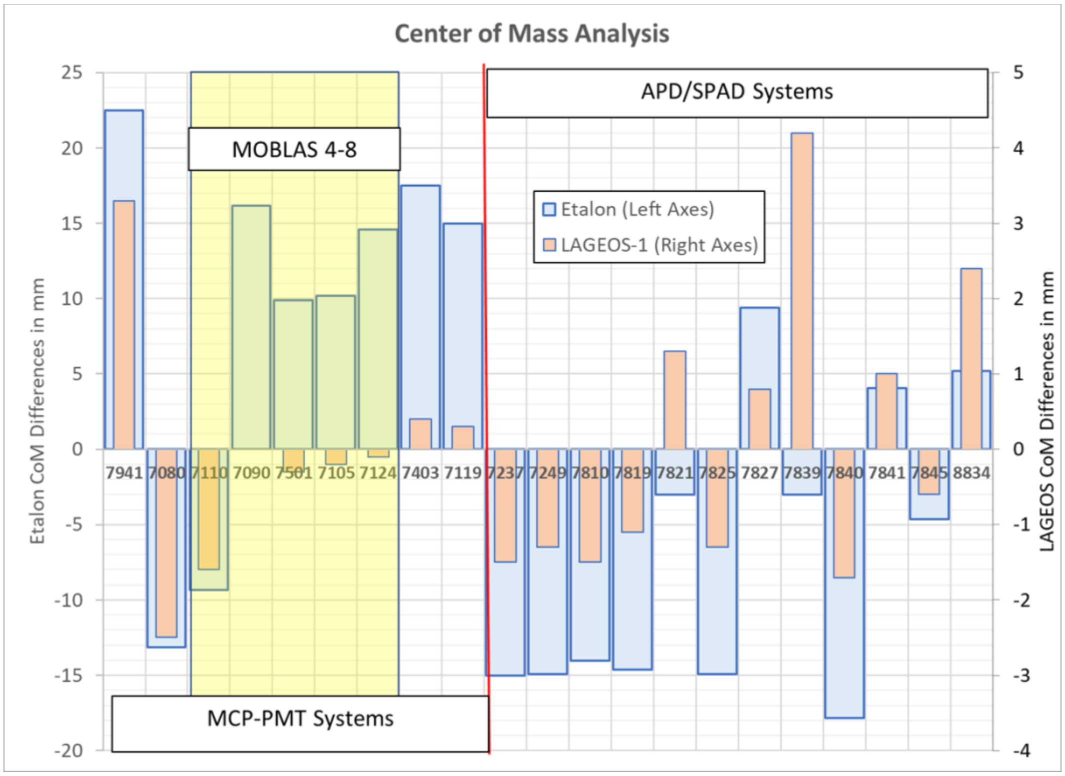

Figure 1: Etalon and LAGEOS Center of Mass Analysis (see Slide 3 of presentation)

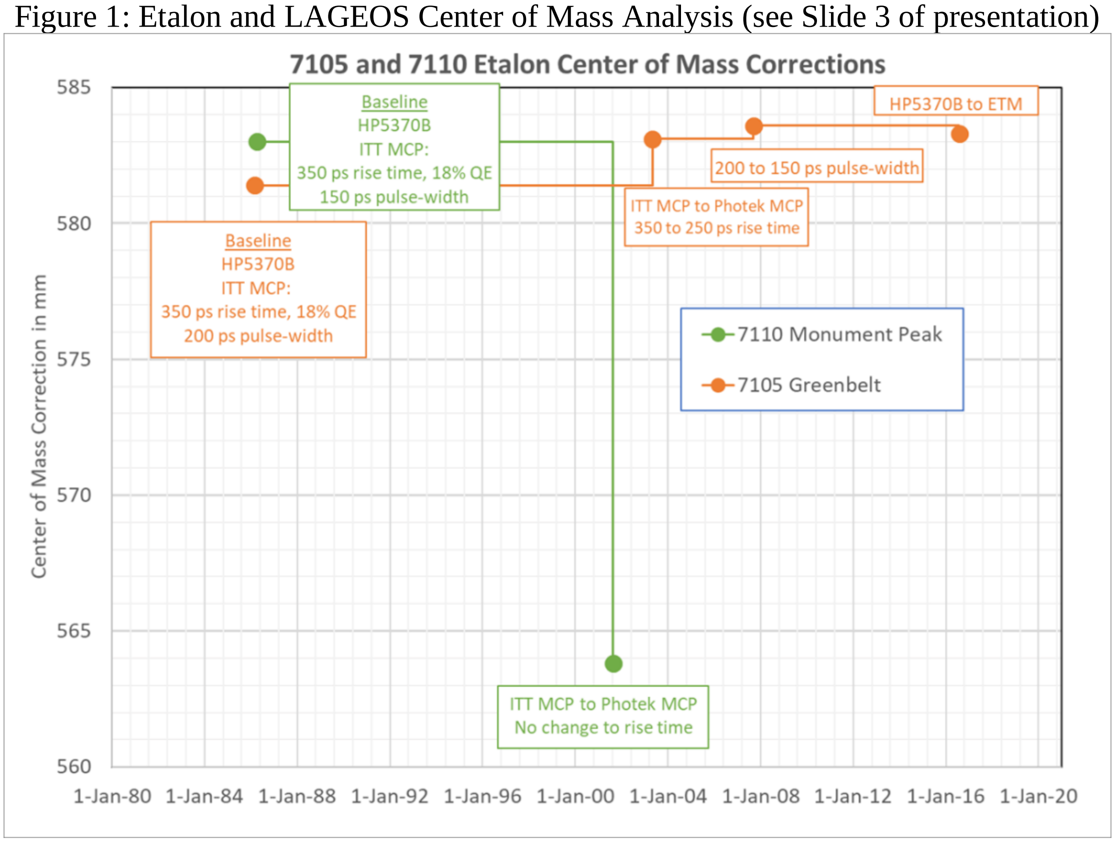

Figure 2: A time series of 7110 and 7105 Etalon CoM Corrections (See Slide 4 of presentation)

Figure 3: 7110 SSEM Etalon Range Biases (see Slide 5 of presentation)

The Etalon range biases on Matera (7941), Potsdam (7841), and Graz (7839) seem suspicious further supported by SSEM analysis (See slides 6 and 7 and slide 5 of the Graz Data Analysis presentation). Jose could not attend the meeting, but his comments were presented. His CoM correction models takes as inputs the average single shot RMS and return rates of the NPs collected which may explain why the CoM corrections are different between systems with the same configuration. Hopefully, Tom Varghese, Jose Rodriguez, and Georg Kirchner can all attend the next meeting to discuss these issues further.

Graz Data Analysis Update

Starting in 2015, the Graz prime barometer, a Paroscientific MET3, began slowly drifting at a rate of minus 0.13 millibar per year, inducing a slowly drifting positive range bias. Toward the end of 2020, the Graz LAGEOS range bias had drifted by ~+5mm. On 10-Dec-2020, the Graz MET3 was replaced with a Vaisala PTU300 barometer, eliminating a -0.8 mBar error. Replacing the MET3 should have reduced the LAGEOS range bias by ~5 mm. Based on both HITU and JCET range bias analysis, the Graz range bias on multiple satellites during 2021 were only lowered by a few mm. There must more to this change. Did changing the laser polarization from linear back to circular in March 2021 or some other system change counteract the Dec 2020 barometric change at the few mm level?

The Graz Etalon range bias changed abruptly in May 2017, when a new staff member changed the Etalon data rejection criteria from 2.2 sigma to Leading Edge (LE). Etalon data taken between 18-May-2017 and 20-April-2018, intermittently, had the LE filter applied and unfortunately there is no record of which Etalon passes had the LE filter applied. Post our QCB meeting, Graz has reprocessed most of the Etalon data between 18-May-2017 and 20-April-2018 with a 2.2 sigma filter and resupplied the Etalon data to the EDC. Below is a chart, Figure 1, of the pass-by-pass differences in single shot RMS vs Peak minus Mean (P-M) variations. Notice the linear relationship with a slope of -0.8 (P-M/RMS).

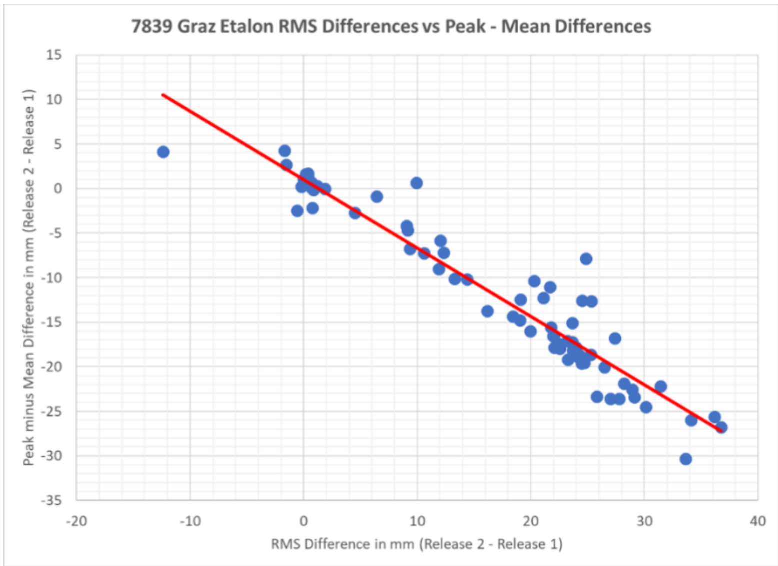

Figure 4: Graz Etalon Mean RMS Differences vs. Peak

Table 1. History Log Voids by Station

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					220228
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					220322
Greenbelt	7105					220120
Monument_Peak	7110					210802
Haleakala	7119					220201
Tahiti	7124	020825-080414	130321-191022			210415
Changchun	7237	950101-970802	020714-051002	180410-210106		211215
Beijing	7249	881101-940301	940301-981116			981116
Tanegashima	7358	NO DATA				CLOSED
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				220311
Hartebeesthoek_HRTL	7503	NO DATA				
Izana	7701					
Zimmerwald_532	7810	030905-060203	080715-100901			211207
Borowiec	7811	030329-071227	080205-131218			211005
Kunming	7819	NO DATA				
Shanghai_2	7821	140222-170315	170720-190811			210922
San_Fernando	7824	900703-930222	971216-010124	090302-110601	180801-210518	220224
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				210326
Herstmonceux	7840					220210
Potsdam_3	7841	040906-081026	081026-110501	170303-200303		211229
Grasse_MEO	7845	010601-200818				220203
Matera_MLRO	7941	140902-171204	171206-210629			220315
Wettzell	8834	980720-001012	001012-090324	090324-131021	170407-190604	210115

* Assuming at least 2 year data gap

Status 2022.03.25