September 9th, 2022

ILRS QCB Meeting
June 27 2022
Virtual Meeting
Next Meeting Sept 21, 2022
9:00 am EDT (14:00 UT)

Participants

Erricos Pavlis, Jason Laing, Matthew Wilkinson, Claudia Carabajal, Stefan Ripple, Van Husson, Peter Dunn, Randy Ricklefs, David Sarrocco, Mike Pearlman, Toshi Otsubo.

Agenda:
Erricos:

- ITRF update, History Logs, etc.

Van:

- 7821 Shanghai Analysis (~10 minutes)
- 7124 Tahiti -3 cm Range Bias Re-examination (~10 minutes)
- VMF3o System Characterization using SLR Barometric Comparisons to VMF3oEI data (~30 minutes)

Peter:

- Follow-up on my presentation at the last meeting on Recalibration of Herstmonceux

Stefan Riepl:

- Optimal Wiener filter for Multiphoton systems

Others items:

- Discussion

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

Erricos – ITRF update

The implementation of the ITRF is in process. A discussion is planned for 6/30 with the ACs on finalizing the ILRS product by the end of September. Not much progress has been made in the History logs; the major delinquents are the Russians and the Chinese.

Progress continues on the validation of the transition to CRD v2. Again, we have large voids in particular in the Russian Network. Now that the v1 – V2 conversion software is operational transition to v2 will commence on August 1; delinquent stations will be moved to station supplied v2 as they are they are ready.

Any progress on mechanism to move dormant stations into quarantine?

Van Husson:

CRD System Delay Applied Indicator Discussion

In CRD V1 a new data processing flag, the system delay applied indicator, was added to the H4 header record. This indicator did not exist in previous SLR legacy formats (MRT, CSTG). SLR data analysts have always assumed that all CRD data (normal points and full rate) has had the calibration applied.
Action: Randy and Van to notify the stations to always apply the calibration to both their CRD normal points and full rate data.

Shanghai Analysis

Shanghai's single shot LAGEOS RMSs had two noticeable reductions over the last several years. The first occurred on 17-Nov-2014, when a 30 mm Leading Edge (LE) clipping was applied. The second occurred on 22-Jul-2021 when an even tighter, but unspecified, LE clipping was applied. Based on a time series of Shanghai LARES and Starlette single shot RMS, no LE clipping was applied to these satellites.
The 17-Nov-2014 LAGEOS data editing change was not mentioned in the station change history nor their site log, but the LAGEOS Center of Mass (CoM) system configuration file had a footnote about this change and the Shanghai LAGEOS CoM was increased by 2.6 mm.
There were several Shanghai system configuration changes (i.e. two laser changes, an event timer change, detector change, data editing changes, and calibration target) in their station change history, but these changes were missing from their site log.

Shanghai has the action to update its site log to make system configuration changes consistent with their system change history. Jose will need to evaluate the detail of the system configuration changes and update the Shanghai LAGEOS CoM corrections accordingly.

Tahiti -3 cm LAGEOS Range Bias Re-examination

Erricos was the first to report an observed -3 cm LAGEOS range bias in Tahiti (station 7124) starting in mid-April 2018. Based on JCET and HITU range bias analysis, there was a negative drift in the range bias starting in late 2017, which coincided with a similar drift in system delay (not shown, but presented at a previous QCB meeting). Based on reviews of their monthly and weekly station reports, there did not appear to be any obvious reason for a bias of this magnitude on LAGEOS.

HITU analysis on other geodetic satellite, did not show range biases as large. A frequency error of -4.2E-09 appears to explain the bias changes on LAGEOS, LARES, Starlette and Ajisai. The root cause of the frequency error is still a mystery. Causes could be noise on the frequency provided to the time interval unit or an issue with the GPS-steered rubidium. The HP570B being on internal frequency was ruled out, based on event timer to HP5370B fullrate range comparisons in the period March to May 2019 (See Figure 1 below). *Note: The two cascading receive discriminators to the event timer in 2019 were mis-configured and may have contributed to the bias between the 2 timers.*

LAGEOS data in 2022 has been sparse, but post meeting, both John Ries and Erricos have observed a second significant Tahiti LAGEOS range bias of -20 to -35 to mm; receptively. Note: All data in 2022 is with the event timer.

Action: Peraton will try to address the cause of the 2022 range bias and, if possible, eliminate it.

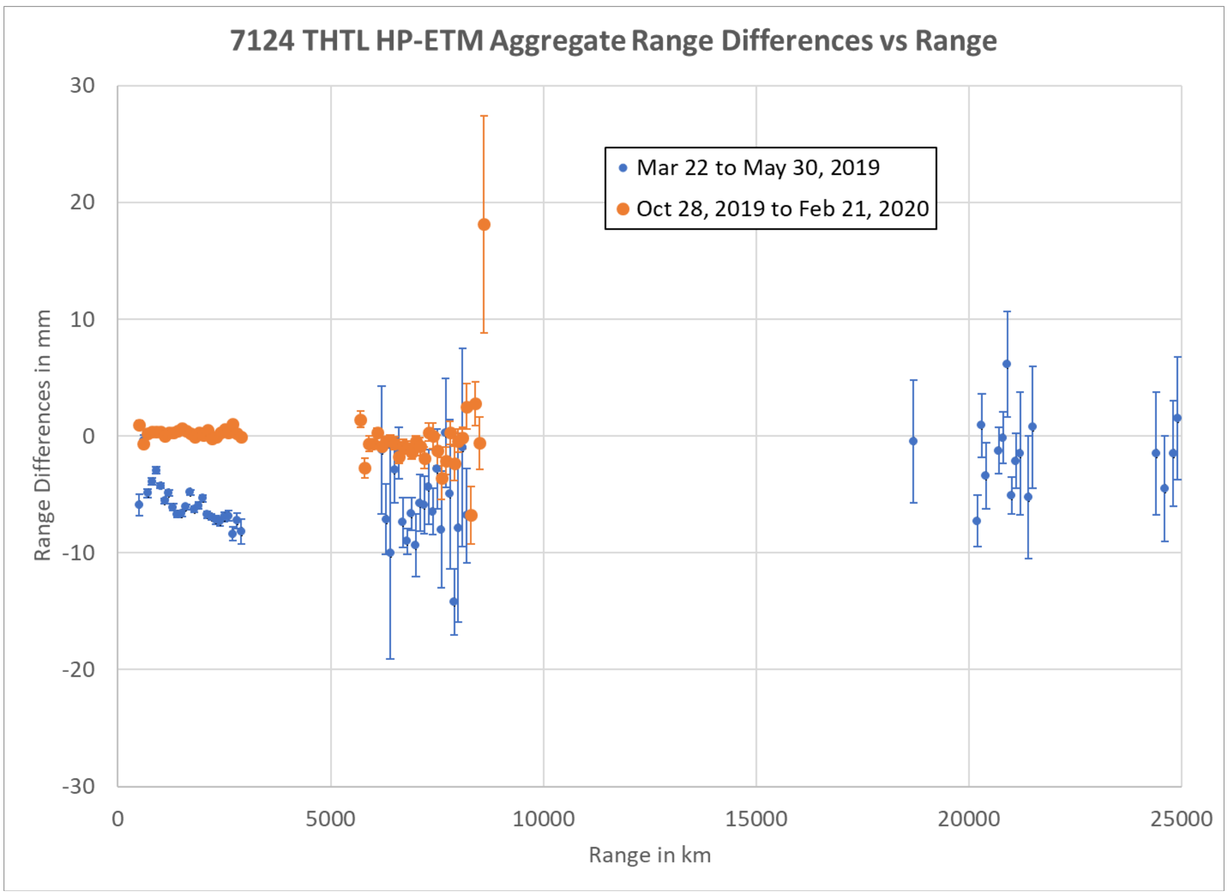

Figure 1: HP5370B vs Event Timer Comparisons vs Range

VMF3o System Characterization using SLR Barometric Comparisons to VMF3oEI data

There are 3-flavors of Vienna Mapping Functions for optical wavelengths (VMF3o) data based on ray tracing techniques. Van compared two of the flavors, the climate reanalysis (VMFeoEI) and the operational (VMF3oOP) data, showing average station dependent barometric differences of up to 0.4 millibars. The climate reanalysis is considered more accurate than the operational data.

Van then showed station barometric differences (6-hour and monthly) vs the VMF3oEI for some of the higher performance systems since 1992. There are average seasonal variations in these differences of up to +/- 0.2 millibars (0.4 millibars peak-to-peak). For some stations, there are mean offsets between the station's sensor and the VMF of up to 0.6 millibars after any VMF System Reference Point (SRP) height errors were modeled. Erricos noted that the absolute accuracy of the ray tracing technique is reduced for stations that are close to large bodies of water (Hawaii, Arequipa, Tahiti, Yarragadee, etc.). Despite these VMF shortcomings, the VMF data was valuable in identify discontinuities and drifts in the station's barometric data.
As stations upgraded their barometric sensors starting in the early to late 1990's, the barometric differences have stabilized. Unmodelled station barometric errors prior to 1997 could be one potential.

Presentations:
7821 Shanghai Analysis
Van S. Husson

7124 Tahiti minus 3 cm Range Bias Re-examination
Van S. Husson

VMF3o System Characterization using SLR Barometric Comparisons to VMF3oEI data
Van S. Husson

Stefan Reipl

Comments on AWC charts presented on Oct. 5 2021 regarding the objective to process MCP multi photon data with a Wiener filter.

Presentation: Optimal Wiener filter for Multiphoton system and Summary
Stefan Reipl

Wiener Filter for multiphoton systems
Summary

In a previous report the Wiener filter has been applied to normal point processing of single photon data mitigating the slope and dispersion in the normal point rms vs. normal point residual statistics.

In order to extend the application to multiphoton SLR systems using solely a unique transfer function as reference for center of mass corrections, the analogue signal processing chain of these kind of systems is modeled for the retrieval of a so called empricial system specific transfer function (ESSTF).

Monthly averages of these ESSTF’s have been retrieved and are compared between the systems 7090,7105 and 7110 on the basis of statistical moments. It turns out that even systems with identical hardware show different ESSTF’s. A reason for this could be how the hardware is set up at each individual SLR system.

In turn the monthly averaged ESSTF’s are used to calculate normal points, which mitigates the dispersion in the normal point rms vs normal point residual statistics and confines the resulting normal points to rms values obtained in calibration measurements.

The next QCB meeting will be held on September 21, 2022 at 9 am EDT.

Please forward suggested agenda items for the meeting to Claudia.

Table 2. Latest status on CRD v2

In testing or Done	Close to submission	No Response	Monument	Code	Location Name, Country	JCET testruns NOV.2021-JUN.2022	Insufficient Passes 6/16/22
			1824	GLSL	Golosiiv, Ukraine	1824	
			1868	KOML	Komsomolsk-na-Amure, Russia		
			1873	SIML	Simeiz, Ukraine	1873	
			1874	MDVS	Mendeleevo 2, Russia	1874	
			1879	ALTL	Altay, Russia		
			1884	RIGL	Riga, Latvia		
			1886	ARKL	Arkhyz, Russia	1886	
			1887	BAIL	Baikonur, Kazakhstan		
			1888	SVEL	Svetloe, Russia	1888	
			1889	ZELL	Zelenchukskya, Russia	1889	
			1890	BADL	Badary, Russia	1890	
			1891	IRKL	Irkutsk, Russia	1891	
			1893	KTZL	Katzively, Ukraine	1893	
	no data for L1/L2/LRS		7045	APOL	Apache Point, NM	7045	
			7090	YARL	Yarragadee, Australia	7090	
			7105	GODL	Greenbelt, Maryland	7105	
			7110	MONL	Monument Peak, California	7110	
			7119	HA4T	Haleakala, Hawaii	7119	
			7124	THTL	Tahiti, French Polynesia		7124
			7237	CHAL	Changchun, China	7237	
			7249	BEIL	Beijing, China	7249	
CLOSED	CLOSED	CLOSED	7358	GMSL	Tanegashima, Japan		
	February 2022 target date		7394	SEJL	Sejong City, Republic of Korea		7394
			7395	GEOL	Geochang, Republic of Korea		
			7396	JFNL	Wuhan, China	7396	
			7403	AREL	Arequipa, Peru	7403	
			7406	SJUL	San Juan, Argentina		
			7407	BRAL	Brasilia, Brazil		
			7501	HARL	Hartebeesthoek, South Africa	7501	
			7503	HRTL	Hartebeesthoek, South Africa	7503	
			7701	IZ1L	Tenrife, Spain	7701	
			7810	ZIML	Zimmerwald, Switzerland	7810	
			7811	BORL	Borowiec, Poland	7811	
			7819	KUN2	Kunming, China	7819	
			7821	SHA2	Shanghai, China	7821	
			7824	SFEL	San Fernando, Spain	7824	
			7825	STL3	Mt Stromlo, Australia	7825	
	OUT OF COMMISSION INDEFINITELY		7827	SOSW	Wettzell, Germany		
			7838	SISL	Simosato, Japan	7838	
			7839	GRZL	Graz, Austria	7839	
			7840	HERL	Herstmonceux, United Kingdom	7840	
			7841	POT3	Potsdam, Germany	7841	
			7845	GRSM	Grasse, France (LLR)	7845	
			7941	MATM	Matera, Italy (MLRO)	7941	
			8834	WETL	Wettzell, Germany (WLRS)	8834	
36	2	6	45			33 + 1	2

Release 2022.06.16

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					220414
Greenbelt	7105					220521
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	981116-211013		211220
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			220222
Borowiec	7811	030329-071227	080205-131218			211005
Kunming	7819	NO DATA until 220329				220329
Shanghai_2	7821	140222-170315	170720-190811			210922
San_Fernando	7824	900703-930222	971216-010124	090302-110601	180801-210518	220421
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				220701
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			220629
Wettzell	8834	980720-001012	001012-090324	090324-131021	170407-190604	210115

* Assuming at least 2 year data gap

Status 2022.07.01