

ILRS Governing Board Meeting

October 25, 2015

15:00-19:00

Casa Cava, Matera

Attendees:

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Welcome: G. Bianco opened the ILRS Governing Board (GB) meeting and welcomed the board and guests in attendance, noting that this week would be the third time that ASI has hosted an ILRS workshop in Matera: the 7th International Workshop on Laser Ranging in 1989 was the first; the 12th workshop was the second meeting and was held in 2000 in conjunction with the dedication of the Matera SLR station. He has also hosted a LAGEOS-2 science meeting here.

The workshop venue, Casa Cava, has had several uses over the years. It was formerly a limestone quarry, housing, and dump, and has been recently re-discovered and restored into an event venue. The ILRS workshop is probably the first scientific meeting held at Casa Cava. Matera has the honor of being named the European Capital of Culture in 2019.

CB Report: M. Pearlman reviewed the agenda for the GB meeting and presented the ILRS Central Bureau (CB) report (see slides).

- *Network status:* Several new stations are scheduled to come online in 2016. The Russian network plans to implement a new SLR at Hartebeethoek; the AGGO (Argentinean German Geodetic Observatory), formerly TIGO, has moved from Concepcion to La Plata; and two new stations are nearing readiness in India at Mount Abu and Ponmundi. Discussions with the Brasilia station manager while visiting the country stressed the importance of expanding SLR tracking on LEO and LAGEOS satellites. NASA continues its development of the SGSLR and is engaged with discussions with agencies in Brazil on options for a core site.
- *Pass performance standard:* The ILRS has used the same pass performance standard of 1500 passes to “rank” stations since 1996, before the service was established. The GB agreed that this should be updated in recognition of the greater number of targets available and the advances made in laser ranging systems, and as a means of giving stations an incentive to improve performance and to recognize stations that have done well.

ACTION: M Pearlman: Draft a revised pass performance standard for GB review. The proposed standard is attached to these minutes; this new standard will be posted on the ILRS website.

- *Mission tracking:* As the number of SLR targets increase, the ILRS needs to review priorities and consider tracking strategies that might time-share. Tracking of RadioAstron is very low; perhaps the array was not built properly. U. Schreiber pointed out that Wettzell saw a large time bias, which shows the importance of stations utilizing EUROSTAT to coordinate tracking of problem satellites.
- *Leap second:* Many stations and prediction providers had difficulty handling the leap second in June. Mike believes that the stations and providers had too many options to follow; the ILRS needs to specify one method for all stations to follow for future leap second events.
- *System Biases:* While we strive for greater accuracies, systems biases become more of a problem; a workshop session is devoted to this topic, but the CB needs to formulate a path forward to address this issue including improved on-site diagnostic tool and better feedback to the stations.

This topic was revisited later in the week (after the System Biases Session) and the following questions were formulated:

- Analysis Issues
 - Update the range bias model for the data to date (Pilot Project planned by the AWG)
 - Implement an improved diagnostic procedure (maybe based on the methods presented at the sessions)
- Station Issues

- Prepare and distribute to the stations the results that were presented at the Systems Biases Sessions with explanations and suggestions for inquiry (Appleby/Mueller/Otsubo with the CB)
- Provide the stations with a first set of improved diagnostic tools/procedures (Varghese and Kirchner with the CB)
- Communication Issues with the stations
 - Assess where we stand on the feedback, report, and responsiveness from each station
 - Define timely steps for better communication with the stations

ACTION CB/M. Pearlman: Develop plan to implement these actions

Working Group Reports:

AWG: E. Pavlis gave a summary of AWG meeting held on October 24 and reported on recent analysis developments (see slides).

- *Data quarantine:* Analysts need to review the list of stations in quarantine. Analysts require 90 days of data to determine initial positions for new stations.
- *ITRF2014 developments:* The AC's are in the process of evaluating the ITRF2014 solution. An SLR2014F file of station positions will be produced following the ILRS review of ITRF2014 and its official release.
- *New orbit product:* The pilot project on the new ILRS orbit product is nearly finished. Waiting on the GRGS submission and hope to have an official ILRS orbit product released soon.
- *LARES:* Working to include LARES in the official ILRS position and Earth orientation product.
- *New stations:* Several new and recently upgraded stations are being reviewed for operational status (Irkutsk, Wettzell SOS, Boroweic). We continue to remind stations to keep the ILRS informed of system changes and to keep site logs and history files current.
- *Station questionnaire:* The CB coordinated distribution of a questionnaire to all stations in the network to assess current and future capabilities. Responses received from all key stations and are now being collated.

MWG: T. Otsubo presented the MWG report; the WG will hold its meeting on Monday evening.

- *COSMIC-2:* A mission support request form (MSR) for the COSMIC-2 constellation scheduled for launch in 2016. At a 24-degree inclination and 520 km altitude, only very low latitude stations will see the satellites. The satellites are configured with only single-cube arrays, further reducing ranging access and again emphasizing the need for missions to consult with the ILRS before designing arrays for future satellites. The original MSR was incomplete, requiring several iterations with the mission before the full impact of the request could be

understood. The question arose whether missions with so small a chance of success should be approved at all; but another scenario might be that we might try a short test period (a week or two) and discontinue support if we have poor success. We need to run a fast simulation using the mission parameters to estimate the length of visibility that the low latitude stations will have per month.

ACTION: Dave Arnold will verify the pertinent parameters with mission and estimate the potential periods of visibility for the satellites; we also suggested that Dave be added to the MWG.

There was an issue of whether the satellite data could be separated in the cluster, but the mission told us that the satellites would separate sufficiently fast to avoid confusion.

- *Sentinel-3:* There has been a great deal of communication with the mission regarding potential damage from the ILRS stations to onboard instruments. There also appear to be some issue of angular dependence. ILRS is awaiting more information and a clear statement of threshold vulnerability before approving the MSR. We may require some form of restricted tracking procedure. The satellite is scheduled for launch in December 2015. A presentation on the mission will be given during the week.
- *MSR:* The MSR form is under review to see if additional information should be added; a revision is being circulated for comment.

DFPWG: H. Mueller reviewed DFPWG activities (see slides); a WG meeting will be held during lunch on Tuesday October 27.

- *Dual-path data submission:* Efforts are underway to establish a “dual-path” data flow scheme, where stations submit data to both the NASA and EDC operations centers (OCs). Outages at one OC or the other have delayed data flow in the past, and now that some of our products are issued on a daily basis, data loss can be a problem. There was some discussion on whether this was worthwhile, since the main obstacle would probably be the dual submission from the stations. However, some were adamant that we do not want to lose any data. We agreed to bring each Operations Center up to point where they could receive data from any station, and then work on the stations over time.
- *Leap second:* Randy Ricklefs has prepared a report on the leap second experience in June. Many stations had difficulty following the available options as to when the leap second was applied. In addition some of the providers had some modeling issues. Fortunately some stations had the wisdom to switch providers when they had a problem; others reinitiated the tracking process at midnight. Still other stations were saved by the cloudy weather. The consensus is that between the providers and the stations, there were too many options for the application of the leap second. Next time we should adopt one scheme for everyone, and just reissue new predictions with the leap second applied starting at midnight.

NEWG: G. Kirchner reported on NEWG activities (see slides) for M. Wilkinson who could not come to the workshop (he and his wife were expecting their first child any day now); the WG meeting will be held Tuesday evening.

- *Beam divergence measurement proposal:* A procedure developed by NRL and NERC has been published on the ILRS website and tried at a few stations. The evaluation of the data has yet to be completed. The WG will select a representative mix of stations (older stations, kHz stations, etc.) to further test the procedure; Herstmonceux can help station personnel with their questions. This activity should be a first step before asking the entire network to make these measurements.
- *Wettzell:* Due to administrative procedures to address safety issues, Wettzell is currently prevented from doing any daylight ranging. This may become an issue at other stations.

TWG: U. Schreiber gave a TWG summary (see write-up in slide package); the WG meeting will be held on Monday evening.

- *WG Terms of Reference (ToR):* After the last workshop in Annapolis, the WG's ToR was updated and posted on the ILRS website.
- *Time transfer:* Preparations for ACES are underway; proposed launch to the International Space Station (ISS) is 02/2017. Work has been slowed due to laser safety questions from NASA and ESA. A working concept for tracking has been developed and is awaiting clearance from NASA and ESA. An MSR has been developed but is awaiting resolution of the safety issues. Wettzell and Graz have performed successful experiments using 2-way time transfer with space debris.
- *Other Comments:* As the number of satellites on the ILRS roster continues to grow, stations may have less time/funding for engineering activities. The network offers a valuable capability for other applications such as time transfer, laser communications, interplanetary ranging, tracking space debris, etc. some of which might provide financial benefit, but may take away from the ILRS support for geodesy and geophysics, our IAG mandated task.

SDSG: G. Kirchner provided a report on the Space Debris Study Group activities (see slides); the SG will meet Tuesday evening.

- *TOPEX:* Recent activity for the SG has been to set up an experiment to characterize the spinning of the TOPEX satellite. Several stations have volunteered to participate in the experiment, at whatever level is convenient for them (1 pass/day or 1 pass/week). The SDSG will run the experiment for a few months.

Data Centers (H. Mueller): DGFI is in process of moving to the Technical University of Munich. Offices have not been relocated, but emails have changed. The CDDIS will undergo a major systems upgrade in the next few months, providing more redundancy and reliability at both the hardware and network level. There will also be major changes to the way data/product suppliers provide their files for archive at the CDDIS. All the

changes will be communicated to the community, as we get closer to operations. The GGOS-sponsored technical meeting on metadata standardization in space geodesy was held in August in Boulder CO; the meeting summary and charts are in line at <ftp://cddis.gsfc.nasa.gov/misc/ggos/metadata1508/> and will soon be linked on the Bureau's section of the GGOS website. A plan for the path forward is underway and will be discussed at the GGOS Bureau for Networks and Observations meeting to be held in San Francisco on December 14, in conjunction with AGU.

ToR: It is time to review the ILRS Terms of Reference (ToR) and update certain areas, e.g., election scheduling, requirement for holding general assemblies, membership in GGOS, and working groups in the service.

ACTION M. Pearlman/C. Noll: Draft an update the ILRS TOR and circulate it to the GB for review and comment.

GB Elections (M. Pearlman): Elections to fill GB positions have been closely aligned with the International Workshop on Laser Ranging. This practice is rather artificial and we are now off-track since the last two workshops were held a year apart. Although the schedule is very tight, we plan to hold the next election by the end of this year; we will start the process shortly after returning from Matera. Since Geoff Blewitt is now the president of IAG Commission 1 (taking over from Tonie van Dam), he will become the Commission's Representative to the ILRS GB.

ACTION CB/GB: Send a message to G. Blewitt welcoming him to the ILRS GB.

GGOS Update (M. Pearlman): The IAG has reminded us that the ILRS is a member of the GGOS Affiliated Network and that ILRS products are also GGOS products. GGOS Days, held at BKG October 21-23, highlighted the need to identify a global gravity field product and then integrate it into a consolidated Global Geodetic Reference Frame including the components of the ITRF and the ICRF. The process needs to identify the gravity field product, the need, the users, and instrument required and the analyses required to perform the formulation.

GGIM Activities: P.E. Opseth, chair of the GGOS Inter-Agency Committee (GIAC), reviewed the importance of GGOS and the reference frame in the UN initiative on Global Geospatial Information Management (UN-GGIM), a roadmap for geodesy that recognizes the need for a Global Geodetic Reference Frame (GGRF) for geospatial data. A GGRF WG is chaired by Norway (Per Erik) and Australia (Gary Johnston). A geospatial resolution, the Global Geodetic Reference Frame for Sustainable Development (GGRF) was adopted by the UN General Assembly in early 2015. .

This is the first resolution on geodesy in the UN; it is important for the geodetic community, showing us that there is a mandate from the UN. Laila Lovhoiden from Norway emphasized that the UN has said that the reference frame is so important it needs to have sustained funding; we must create a roadmap to develop this funding by the August 2016 timeframe. We need to think about how to present this concept, perhaps by giving the services a list of questions that will help form the roadmap. For example, what are your service's products, who are your customers, what is unique

about your service, if you had additional funding, what activities would you put this towards, etc.

ACTION (M. Pearlman): Develop a list of questions that might help the WG structure its response.

Core Site in Ny Alesund: Per Erik showed photos of the work underway on core site construction in Ny Alesund (see slides). The pedestals for the twin VLBI telescopes are in place as is the pad for the future SLR station; NMA is in discussion with NASA on installing an SGSLR system as its SLR. The goal is for the site to be operational in 2019.

NASA SGP: S. Merkowitz presented the status of the Space Geodesy Project; in particular near term plans for the Space Geodesy SLR (SGSLR) deployment include systems in McDonald, Ny Alesund, and Haleakala.

Future Workshops: M. Pearlman reminded the group that the next workshop, the 20th International Workshop on Laser Ranging, will be hosted by GFZ and held in Potsdam Germany, October 9-14, 2016, following the GRACE Science Team Meeting, which also held in Potsdam; L. Grunwaldt will provide more information about their plans for the workshop on Friday. We have also received a proposal from a consortium of companies (put forward by Ben Greene) to hold the 21st workshop in Australia, either Canberra or the Gold Coast. Our colleagues in Kunming have offered to hold a future workshop in China.

The meeting was closed at 19:00.

ILRS Pass Performance Standard (PROPOSED) Revision 2015

In 1996, at the International Workshop on Laser Ranging in Shanghai, the SLR community established a Satellite Pass Performance Standard of 1500 passes which was adopted by the ILRS at the 1998 Workshop in Deggendorf, Germany. The standard was broken down into LEO (1000 passes), LAGEOS (400 passes) and the newly introduced HEO satellites (100 passes). At the time, the ILRS had far fewer satellites on its tracking roster.

We recognized that stations had difference cloud cover conditions, different levels of technology and operational readiness, and different staffing levels. The standard was set conservatively to give stations a target for improved performance on one hand and to recognize high achieving stations on the other.

Since that time our technologies have evolved, our procedures have improved, and we have considerably more ranging experience. We are more successful with daylight tracking and our retroreflector designs are more efficient. Above all, however, the number of targets has increased dramatically. As a result, it is now time to set a greater expectation.

As of late 2015, the network is tracking 23 LEO satellites, 3 LAGEOS–class satellites (including LARES), and 30–50 HEO (including GNSS and GEO) satellites.

In redefining the ILRS Pass Performance Standard we considered the following target as a basis:

- 2 passes per week on each LEO satellite (2300 LEO passes per year)
- 4 passes per week on each LAGEOS satellite (600 LAGEOS passes per year)
- 2 passes per week on each HEO satellite (>3000 HEO passes per year)

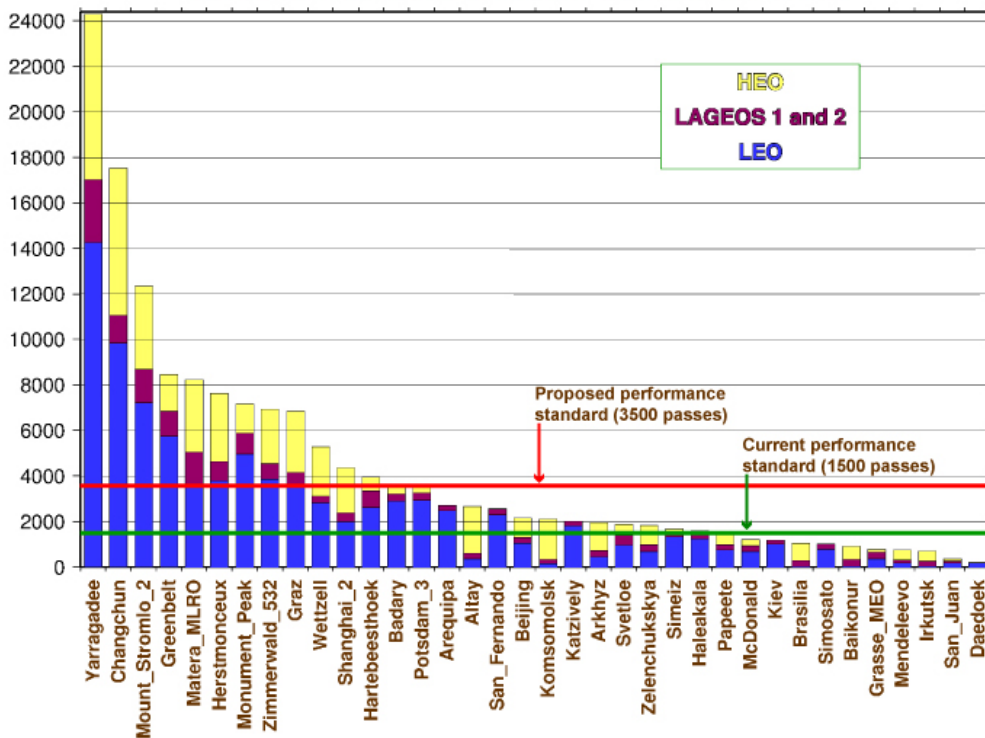
The Governing Board has set the new ILRS Pass Performance Standard at 3500 passes per year.

Stations exceeding this level will be deemed High Performance Stations.

We realize that some stations have disadvantages and may have a difficult time meeting this standard; your data remain very important and we urge you to expand your station's capability in any way possible. We also urge stations to recognize that the current trend is toward kilohertz lasers and event timers so that normal points can be taken much more quickly, providing much more efficient pass interleaving. This capability will be critical to meet our future needs. New stations not achieving a full year of data at the time of the report card will be flagged as such on the chart.

ILRS stations should be able to track GNSS satellites. Our tracking load in GNSS will increase and we will need as much coverage as possible to meet our users' requirements. Station upgrades and procedures should include a GNSS ranging capability.

total passes
from October 1, 2014 through September 30, 2015



20151003

Total passes for current report card period (October 01, 2014 through September 30, 2015) showing current Pass Performance Standard (green line, 1500 passes) and proposed Pass Performance Standard (red line, 3500 passes).