ILRS Governing Board Agenda

Crown and Crab Room
October 26, 2014
14:30 – 16:30

• Opening Remarks	G. Bianco	10 min
• Workshop Overview	C. Noll	5 min
• ILRS CB Report/ILRS Status (20 min)	M. Pearlman/C. Noll	15 min
◦ Network Update		
◦ Status of Expanded GNSS/Synch. Sat.		
• Analysis Activities	E. Pavlis/C. Luceri	10 min
◦ Status of ILRS Submission to the ITRF		
◦ Update on the Combination Center		
◦ Plans for New ILRS Products		
• Report on REFAG2014 IERS WG on Site Survey and Co-location	E. Pavlis/C. Luceri	5 min
• Data Q/C	T. Otsubo	5 min
• Site Performance Validation	T. Varghese	5 min
• Data Center Updates	C. Noll/H. Mueller	10 min
• Working Group Reports (issues/plans for splinter meetings)		25 min
◦ Analysis	E. Pavlis/C. Luceri	
◦ Missions	T. Otsubo/S. Wetzel	
◦ Data Formats and Procedures	H. Mueller/R. Ricklefs	
◦ Networks and Engineering	G. Kirchner/M. Wilkinson	
◦ Transponder	U. Schreiber/J. Degnan/J. McGarry	
• Debris Laser Ranging (DLR) Working Group	G. Kirchner	5 min
• Report on the GPS III Plan	L. Thomas	5 min
• GGOS Activities/Role of the ILRS	M. Pearlman	5 min
• Clinic and Operational Issues that will be discussed at the Workshop	D. McCormick	10 min
• Future Workshop Proposals	M. Pearlman	5 min
• Other Business and Discussion	G. Bianco	

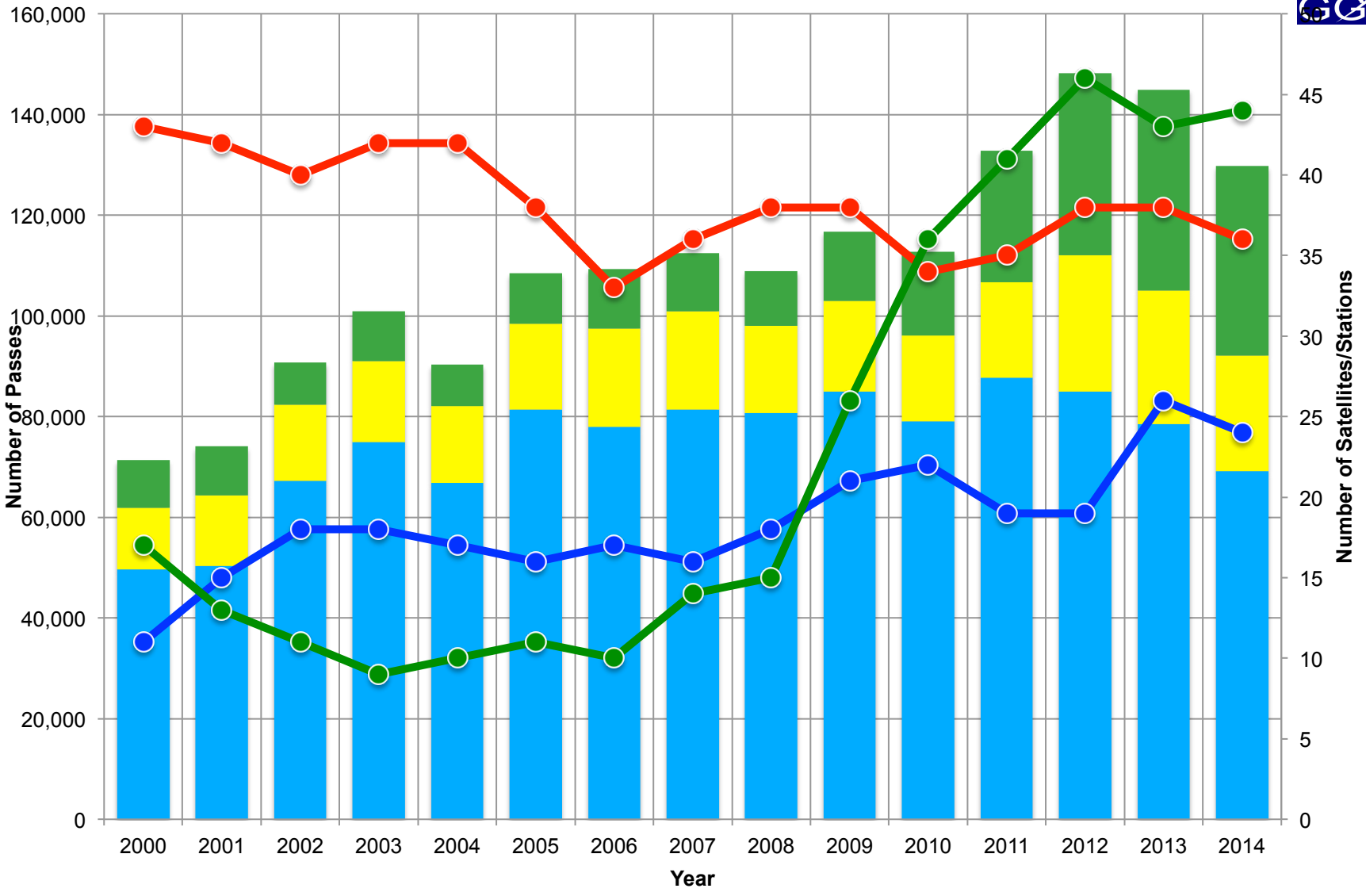
Opening remarks

G. Bianco, C. Noll, M. Pearlman

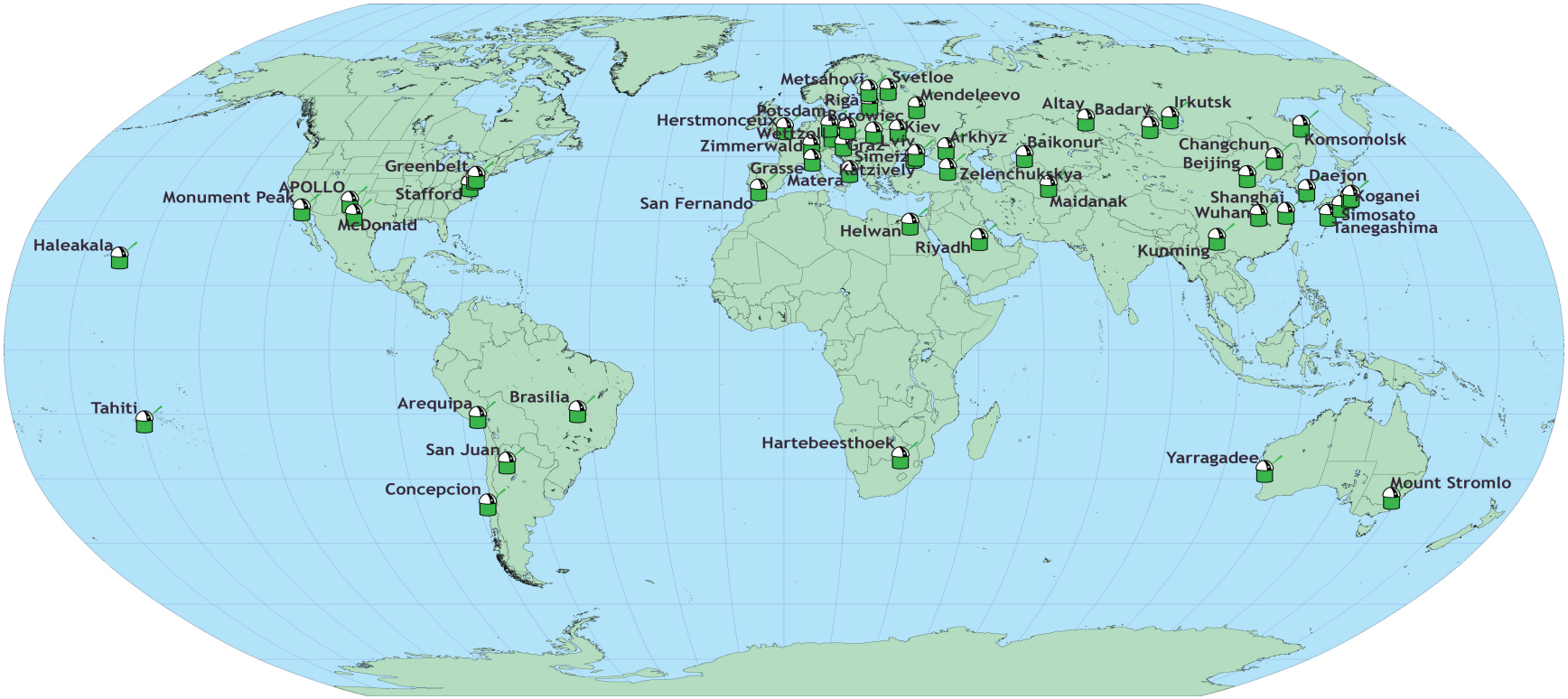
ILRS GB Meeting, October 26, 2014


50th
ANNIVERSARY

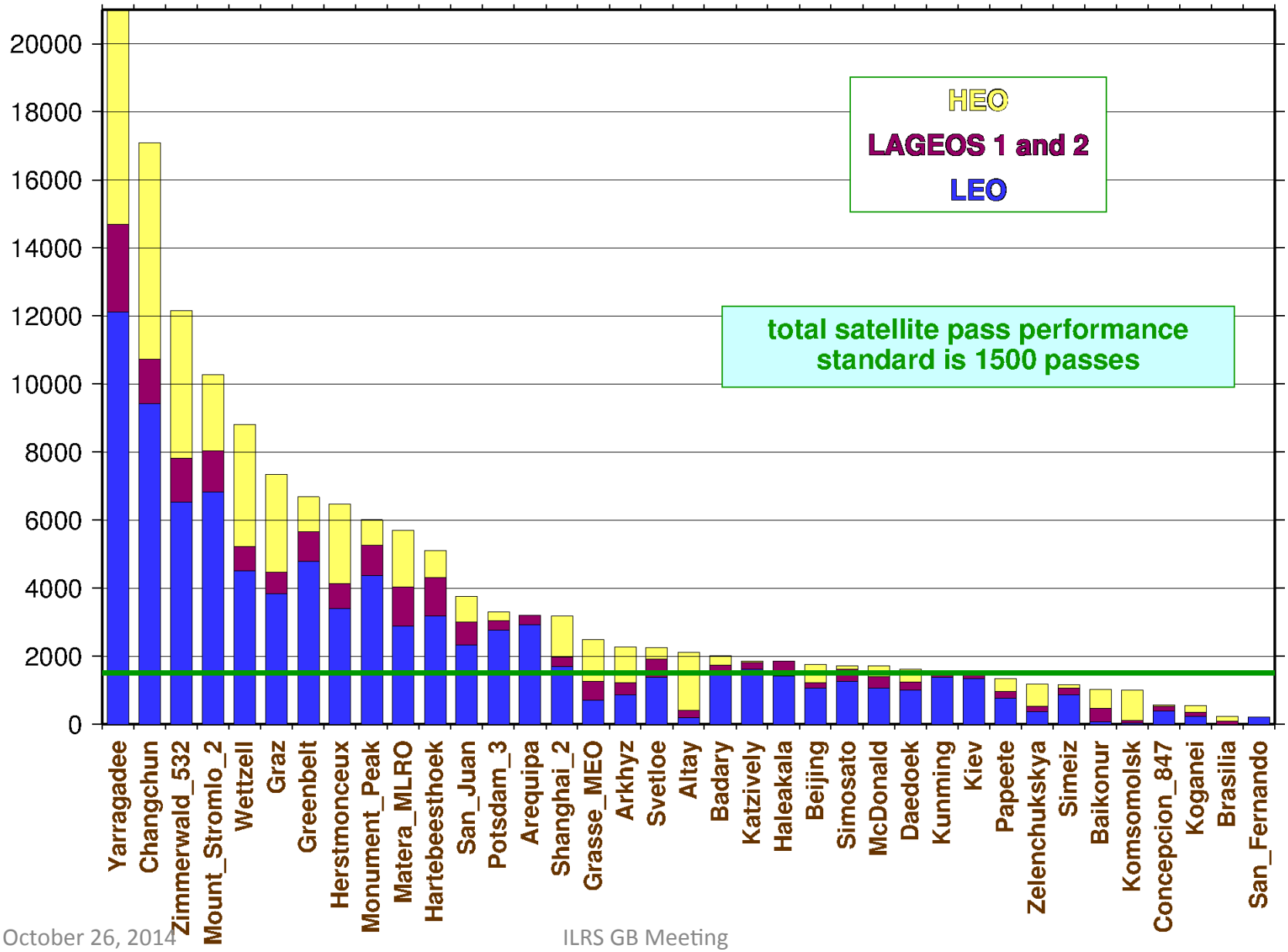
Annual Data Yield



ILRS Network Today

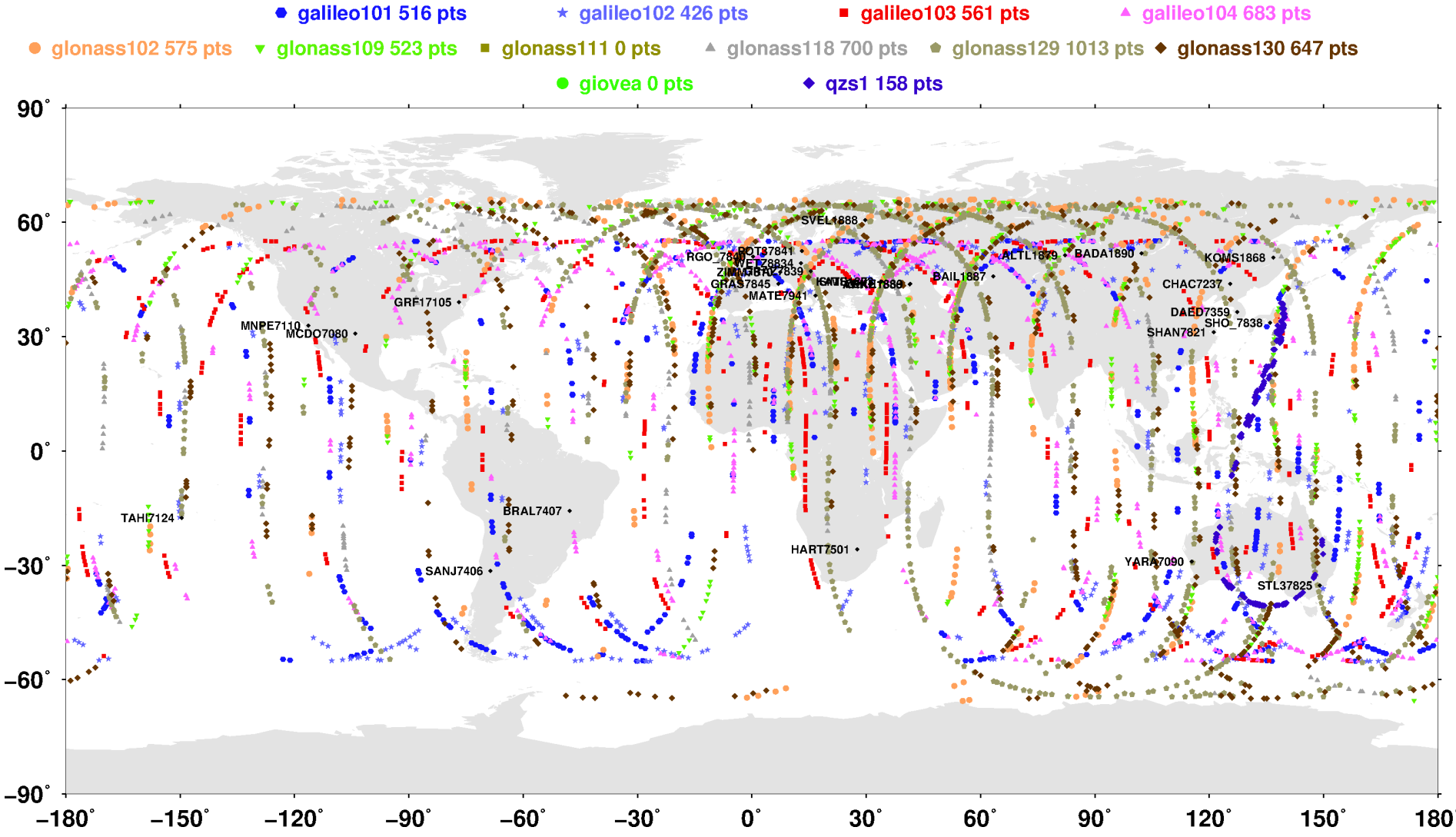


total passes
from October 1, 2013 through September 30, 2014



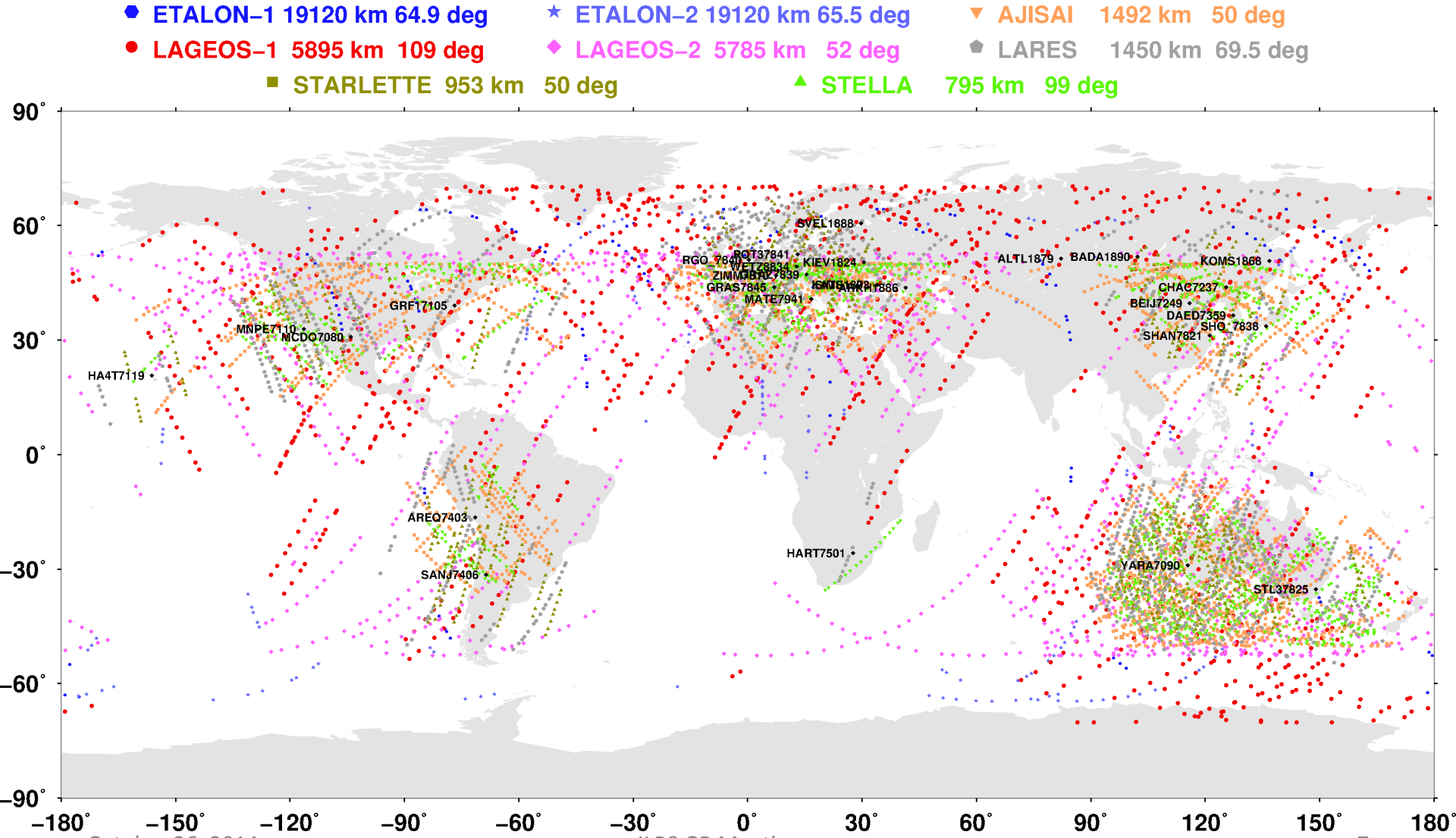
20141002

GNSS SLR data from 20140910 through 20141009 1200 UTC



International Laser Ranging Service

SLR data from 20141019 through 20141026 1200 UTC



Issues

- The lack of a “central design” for a “next generation SLR” system raises the cost, creates some compatibility issues (although minor) in data applications, and above all, makes the availability of any spare parts an almost unique issue per site or sub-network of sites;
- Mix of legacy and modern technologies and lack of standards in hardware will have an effect the data for a long time
- Filling the remaining geographic gaps will require many more partnerships and lots more resources;
- Co-locating SLR systems with VLBI; recognize that the two systems do not have the same site constraints – weather, RF problems, etc, so some compromises will be required if the total global network is to be realized;
- System biases still plague us at some stations; proper calibration and testing equipment and procedures need to be designed and implemented at all stations;
- Like the other techniques, we need standard procedures for site ties with proper modeling to instrument reference point.

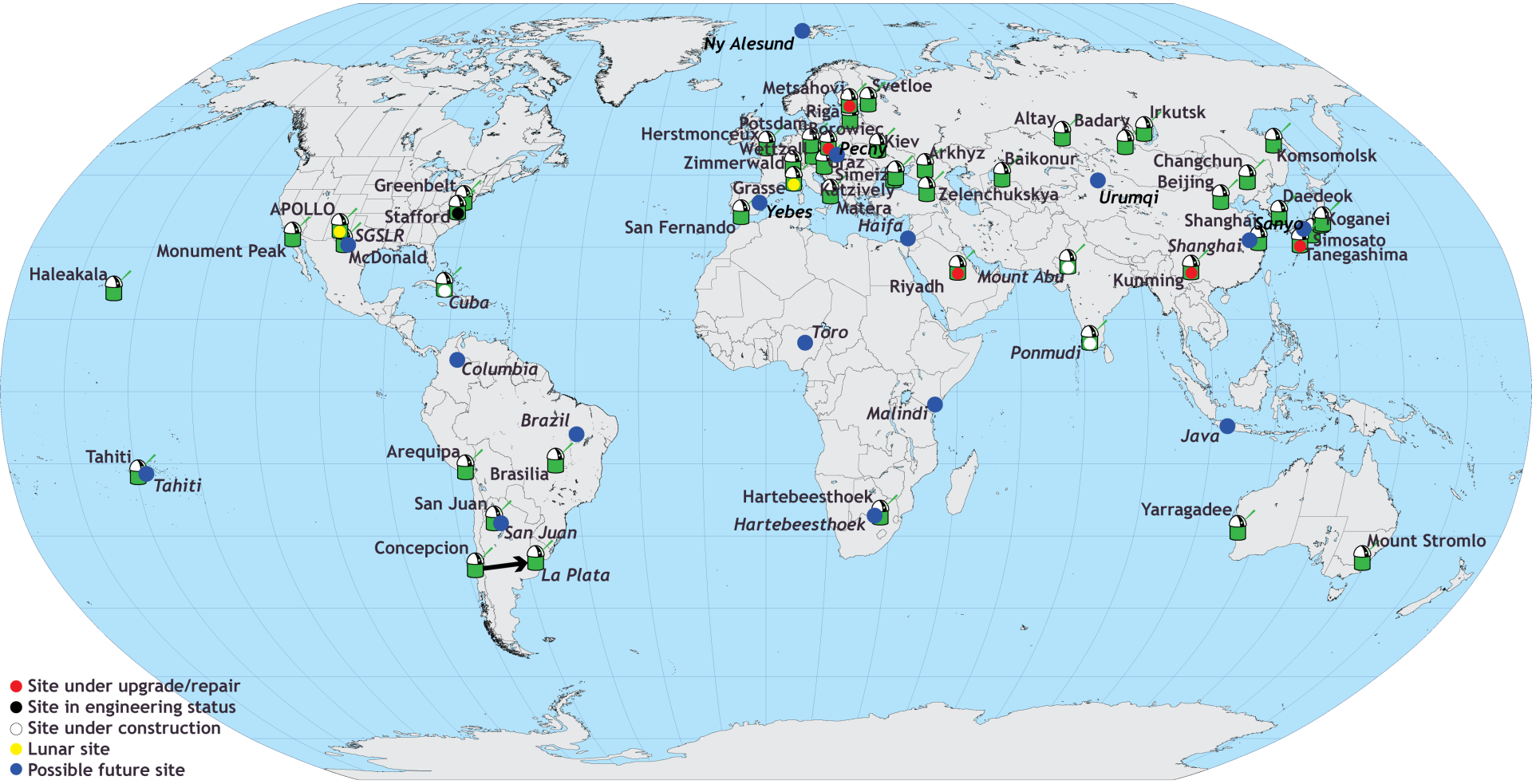
Path Forward

- Several initiatives under way to expand the Network; most notably Russia, China and the US that will help fill some of the the geographic gaps
- New individual stations in process: Ny Alesund, Metsahovi will help increase coverage at northern latitudes; talk being given in Japan regarding benefit of an SLR site in Antarctica;
- Expanded use of the newer technologies at the stations to move from legacy to new technology status
- Need more on-site tools for real-time performance assessment allowing systems to make real-time operational decisions
- Need more on-site tools to check for systematic errors and to apply diagnostic procedures to respond quickly
- More use of interactive communication on networks status to share experience and diagnostics

Path Forward (Continued)

- New applications using optical transponders for greater range;
  - Earth-to-MOLA laser transmission test was successfully conducted at a distance of 81 million km in September 2005);
  - LRO demonstrated one-way ranging to the Lunar Orbiter by the ILRS network over a period of 5 years with a total of X hours of tracking;
- Beyond ILRS Scope, some stations are also supporting tracking debris
  - Example ENVISAT
- Some stations are supporting Qcomm (MLRO, Graz,?)

Network evolution



ILRS Governing Board Meeting

Annapolis MD
October 26, 2014

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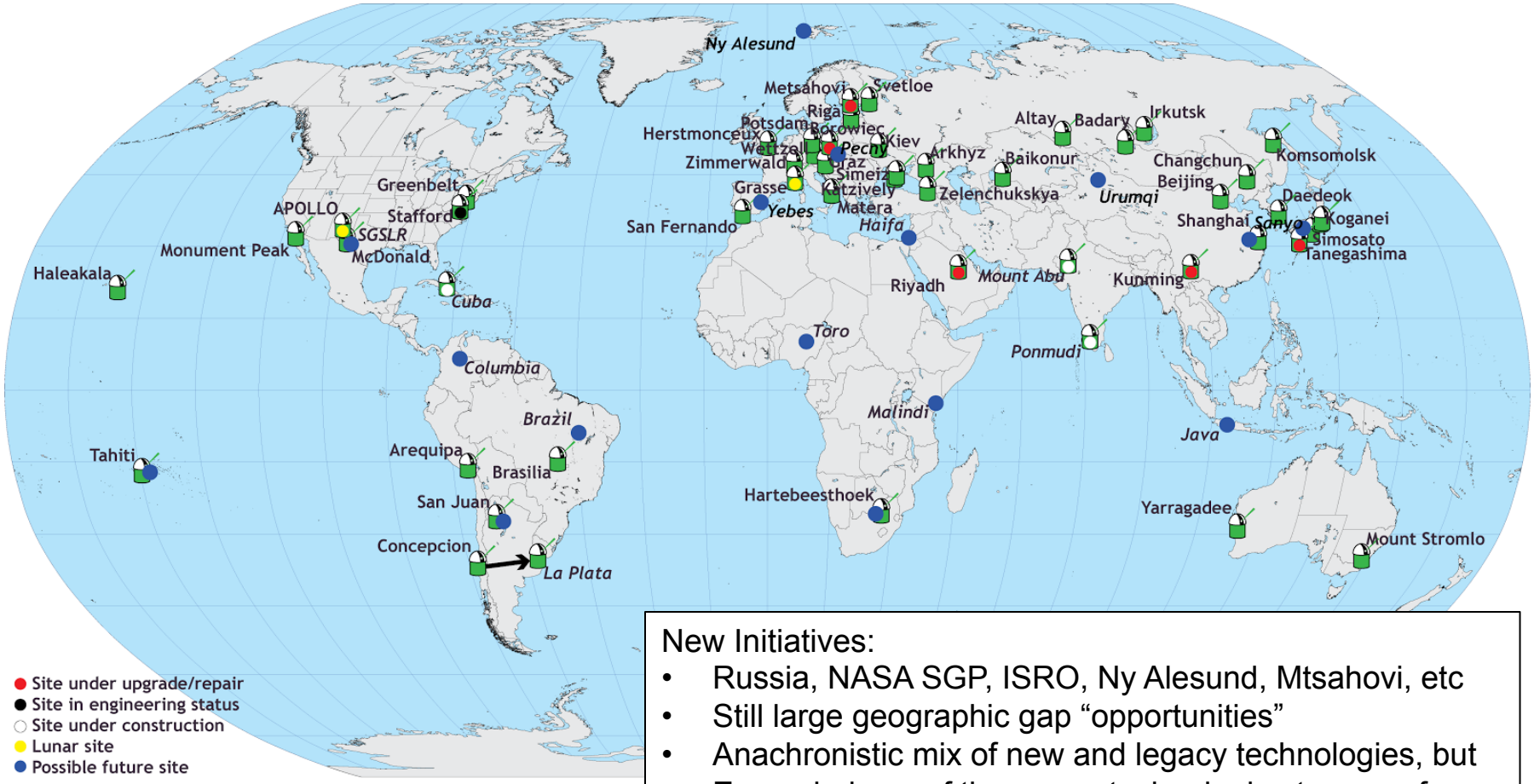
ILRS Governing Board 2013-2015

Director of the Central Bureau	Mike Pearlman (appointed)
Secretary of the Central Bureau	Carey Noll (appointed)
President of IAG Commission 1	Tonie Van Dam (appointed)
IERS Representative	Bob Schutz (appointed)
EUROLAS Network Representatives	Giuseppe Bianco, Georg Kirchner
NASA Network Representatives	David McCormick, Jan McGarry
WPLTN Network Representatives	Wu Bin, Toshi Otsubo
Data Center Representative	Horst Mueller
LLR Representatives	Juergen Mueller
Analysis Representatives	Cinzia Luceri, Erricos Pavlis
At-Large Representatives	Ulli Schreiber, Matt Wilkinson
Chair	Giuseppe Bianco

Current and Projected SLR Network



New Initiatives:

- Russia, NASA SGP, ISRO, Ny Alesund, Mtsahovi, etc
- Still large geographic gap “opportunities”
- Anachronistic mix of new and legacy technologies, but
- Expanded use of the newer technologies to move from legacy to new technology status

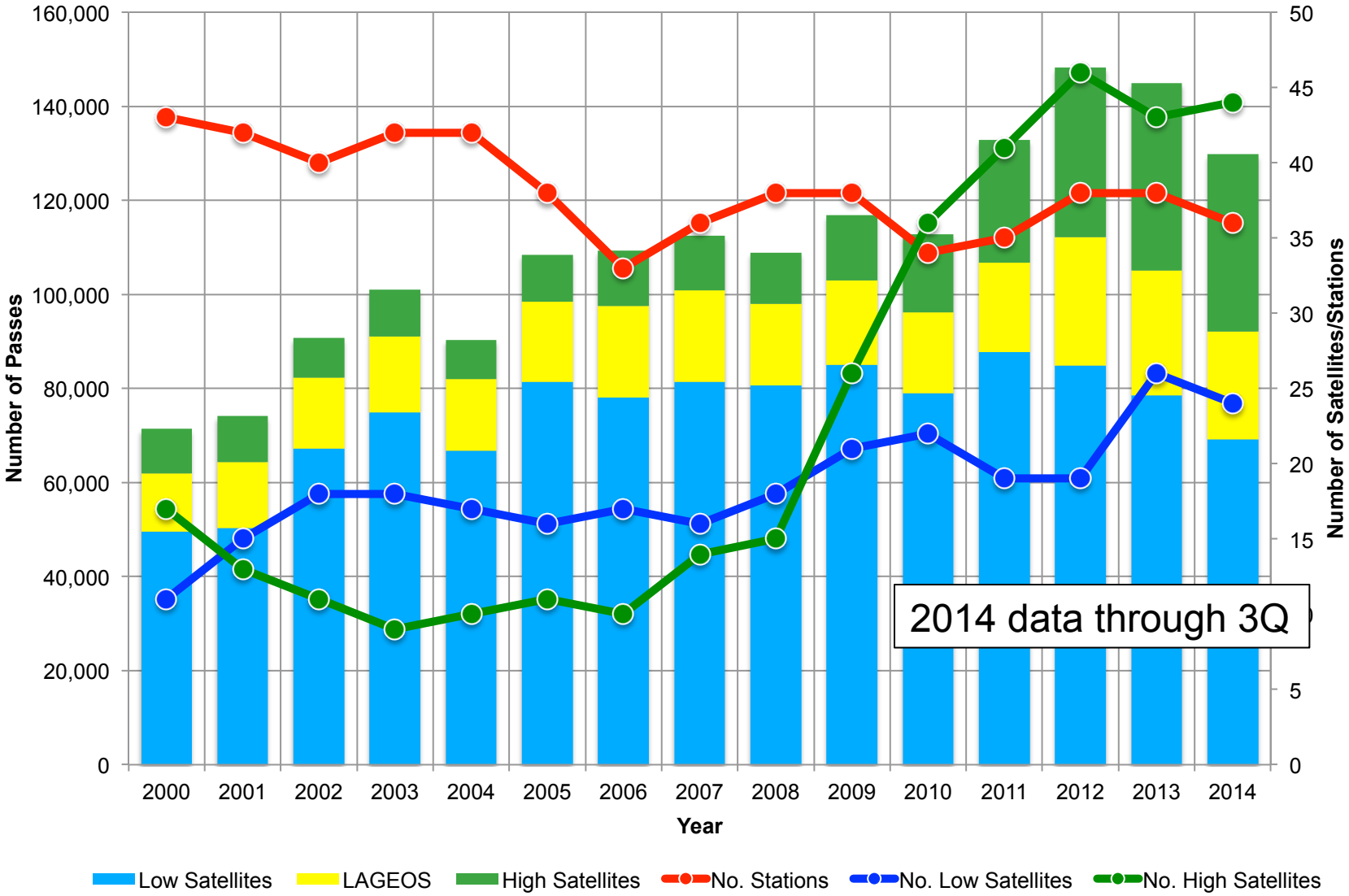
The development of the foreign segment of the Russian SLR network

In addition to existing stations Baikonur (Kazakhstan) and Brasilia (Brazil) the same SLR station will be installed in 2015 near Havana, Cuba (the station is ready). Four new-generation stations of submillimeter accuracy will be installed in future in 4 from 6 possible sites: San Juan (Argentina), HartRAO (South Africa), Haifa (Israel), the branch of the Shanghai Observatory (China), Java (Indonesia), Tahiti (French Polynesia).

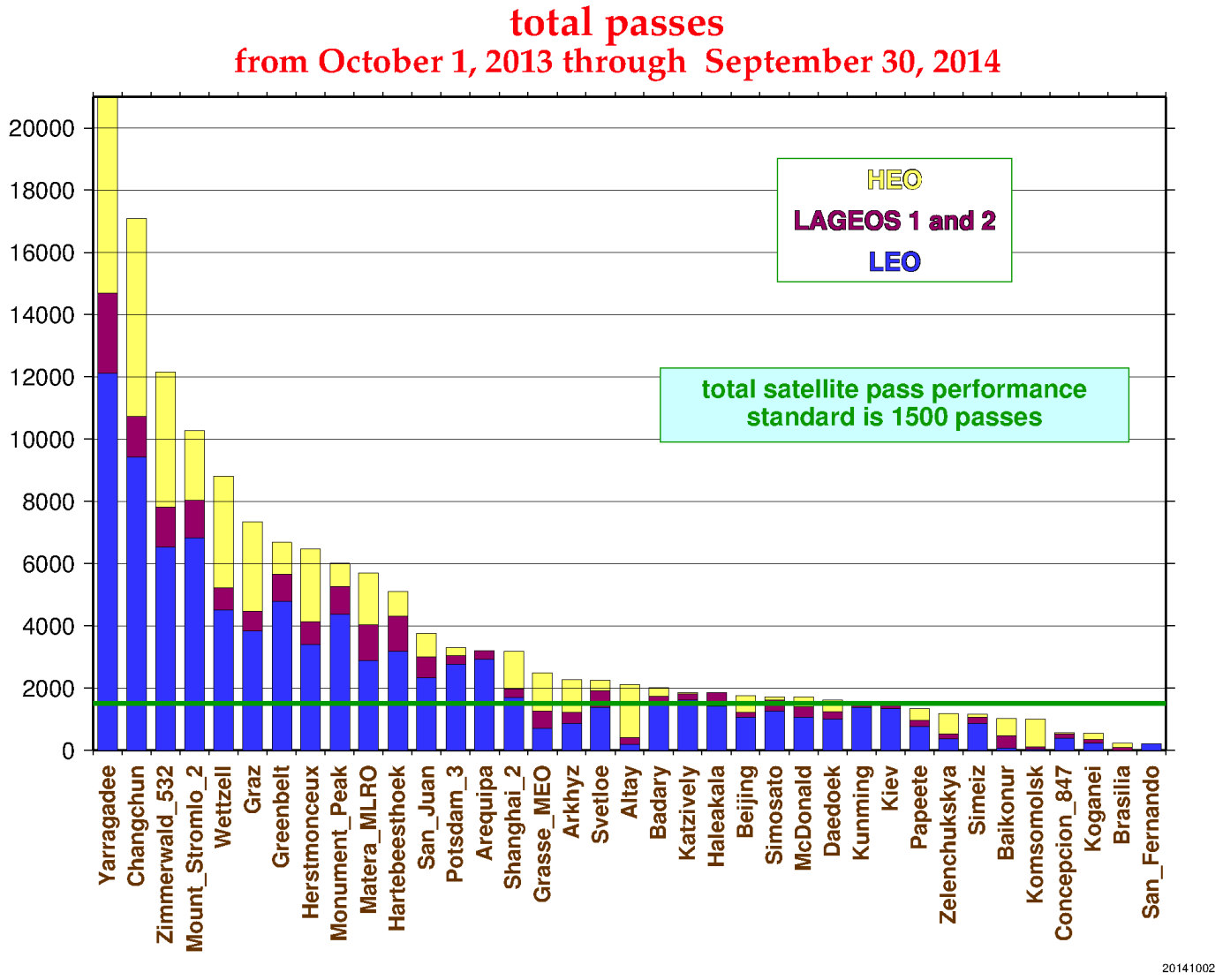
- staions is ready

- next generation stations

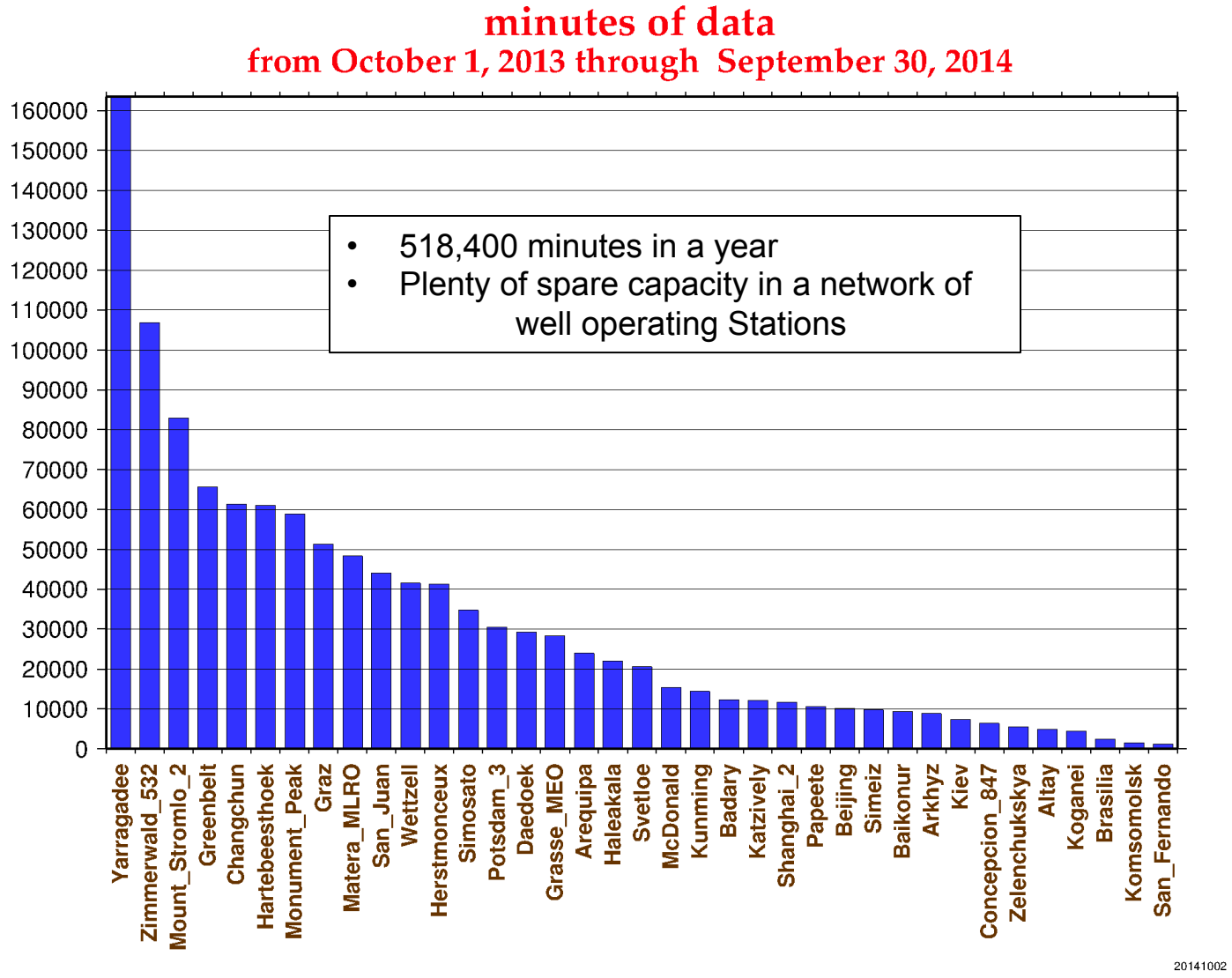
Annual Data Yield



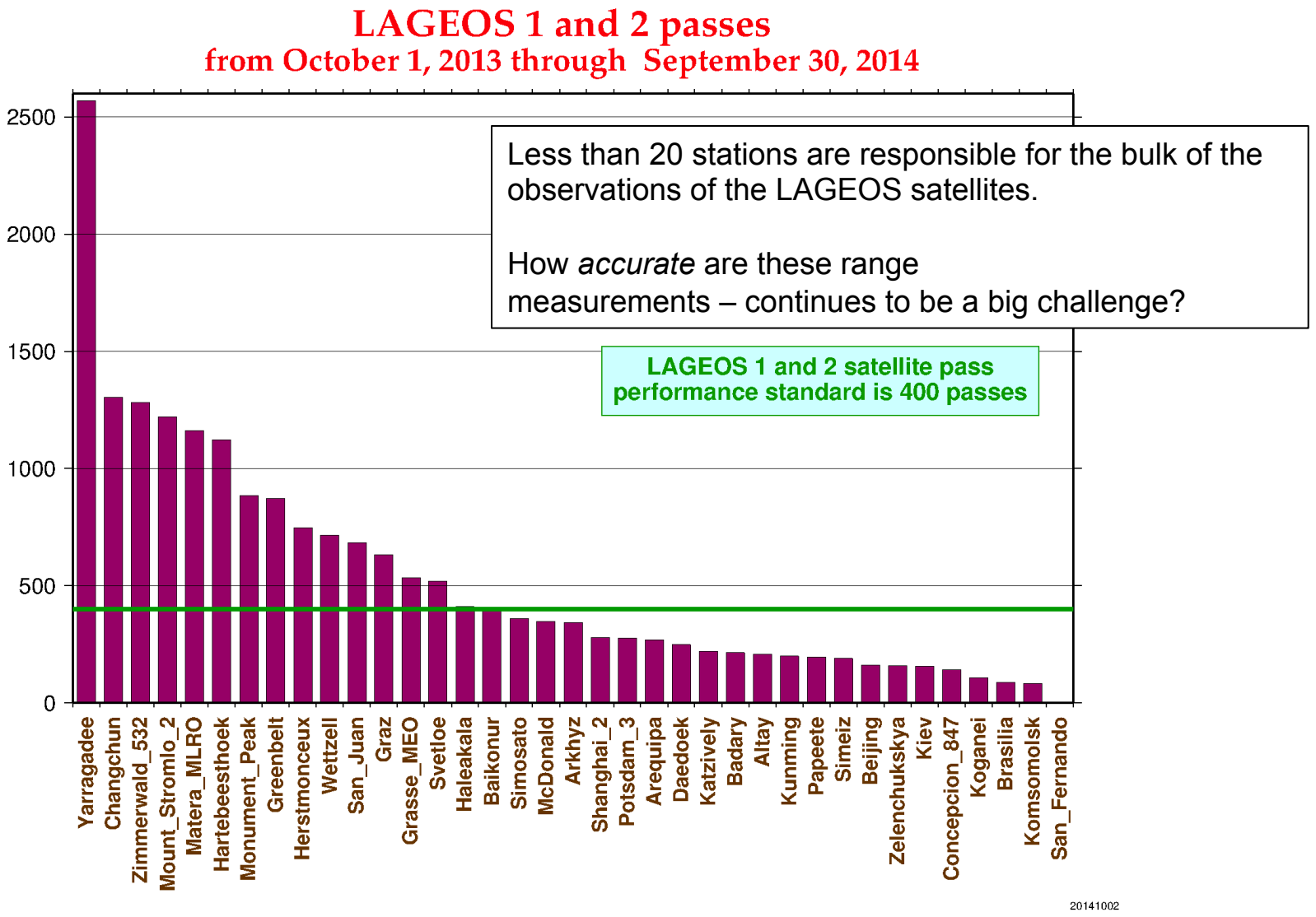
Station Performance (2014Q3)



Station Performance (2014Q3)



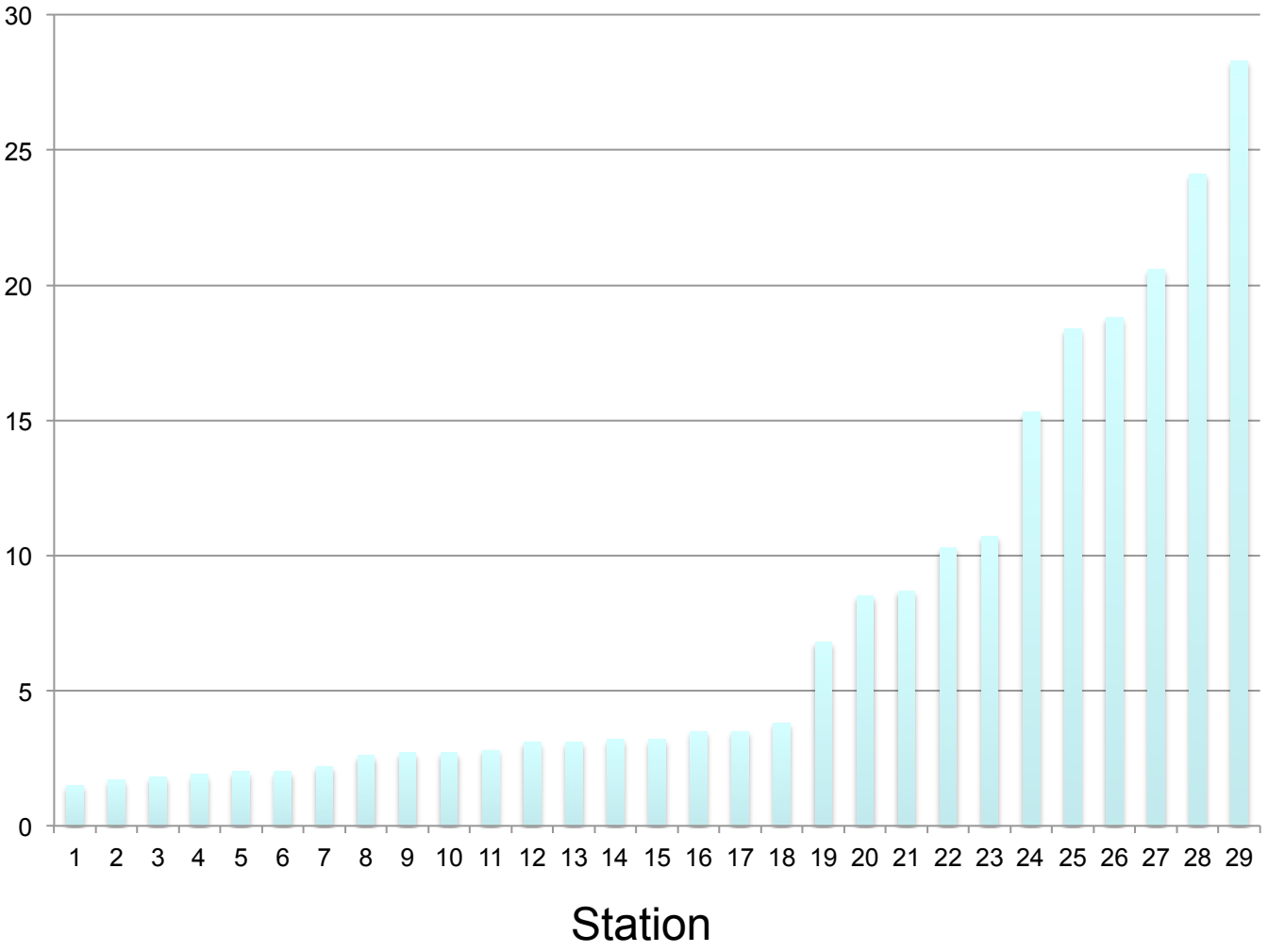
ILRS Network Productivity on LAGEOS-1 & -2 (Reference Frame)



Long-Term Stability estimates from the QC work by Toshi Otsubo at the Hitotsubashi University

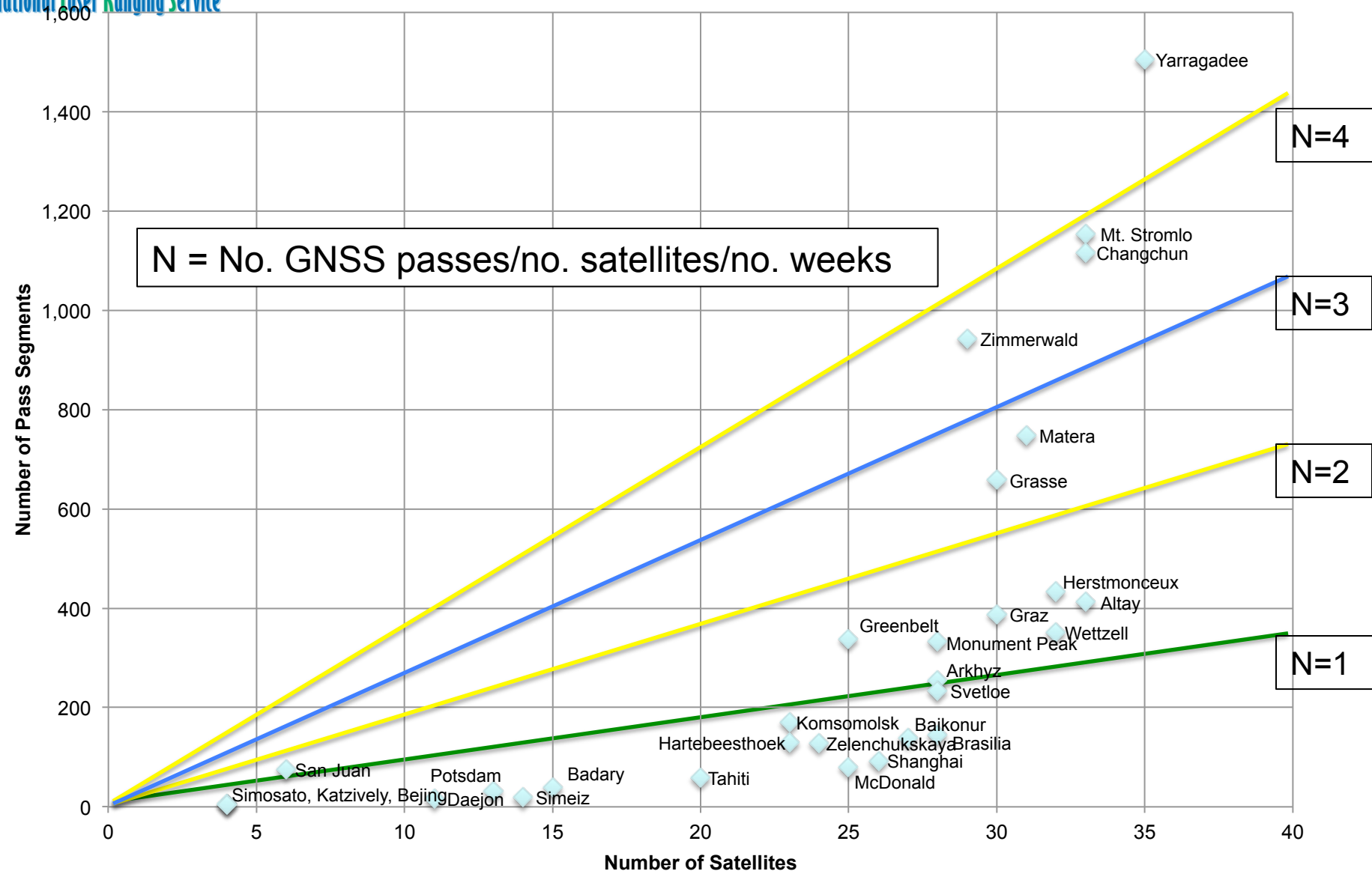
Long-term stability of RB (mm)

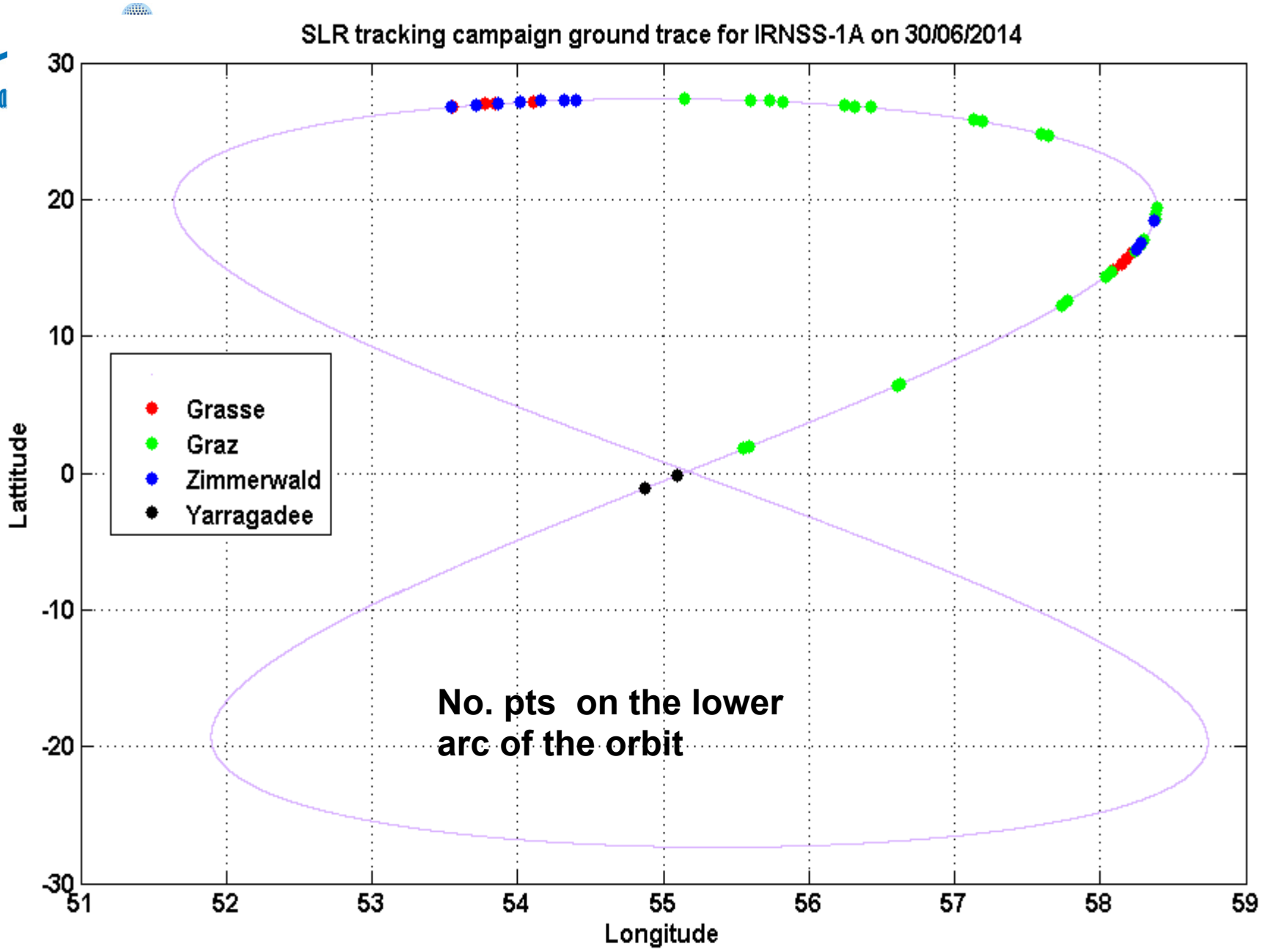
2013 Q3, HitU

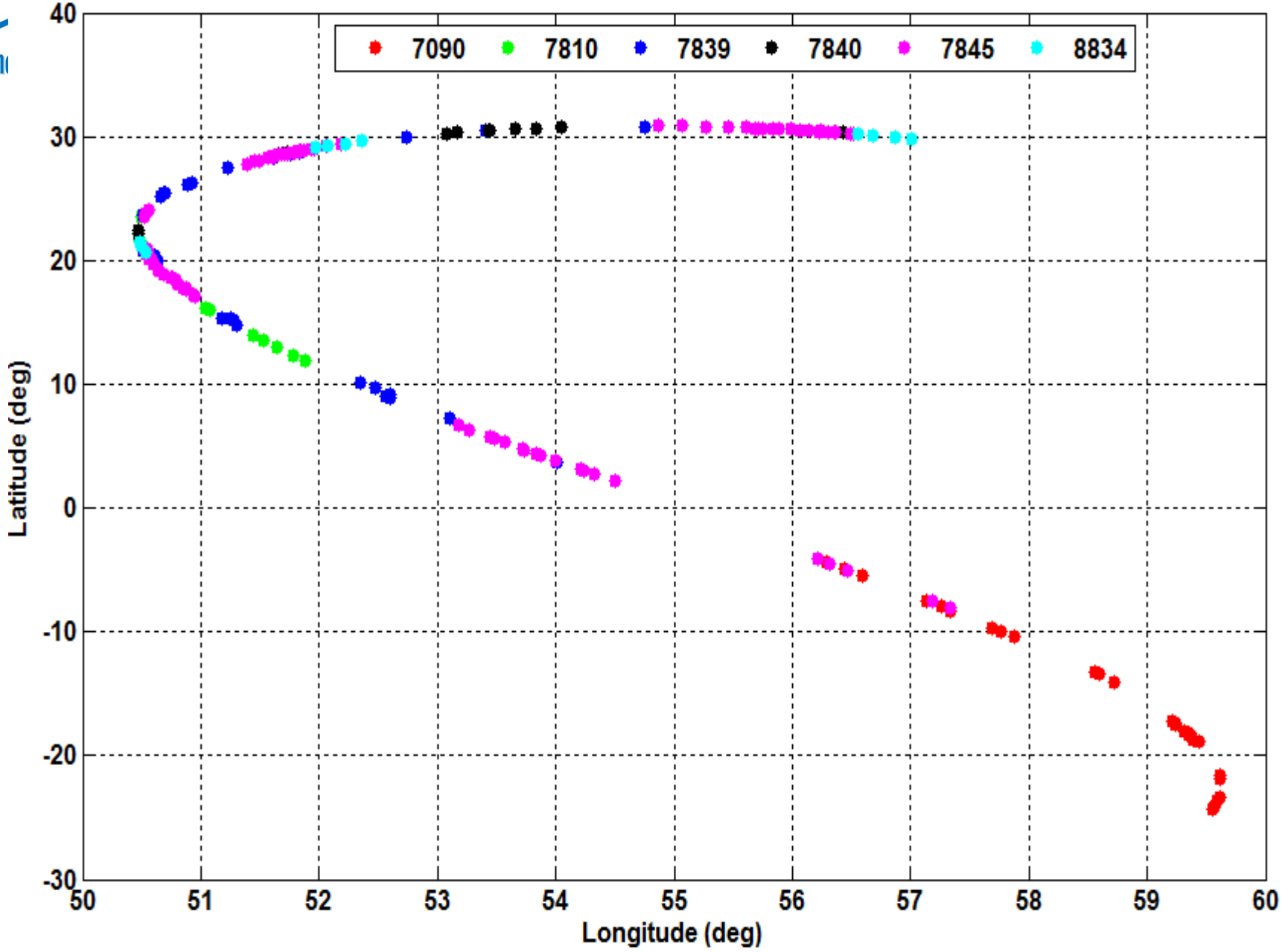


GNSS Campaign Results

August 1 – September 30, 2014

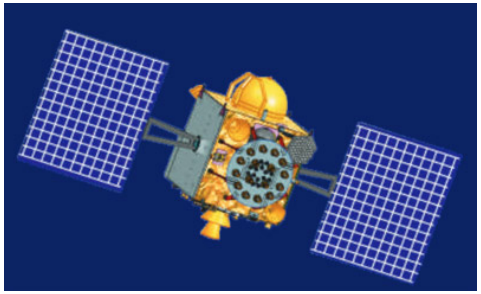
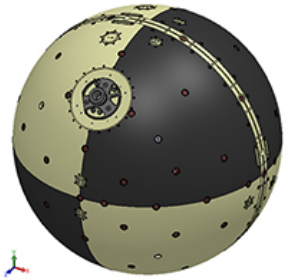
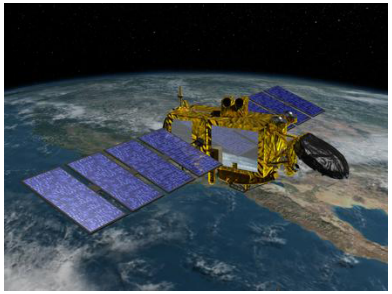
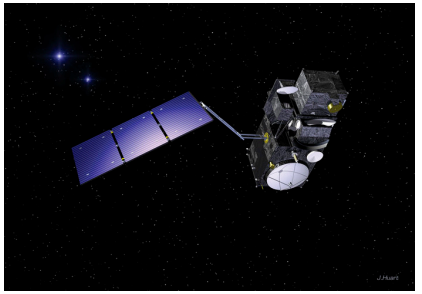



SLR tracking campaign ground trace for IRNSS-1A on 30/06/2014
Grasse
Graz
Zimmerwald
Yarragadee
No. pts on the lower arc of the orbit
Lattitude
Longitude
30
20
10
0
-10
-20
-30
51
52
53
54
55
56
57
58
59


SLR tracking campaign for IRNSS-1B from 10th to 18th Aug-2014
7090
7810
7839
7840
7845
8834
Latitude (deg)
Longitude (deg)
40
30
20
10
0
-10
-20
-30
50
51
52
53
54
55
56
57
58
59
60

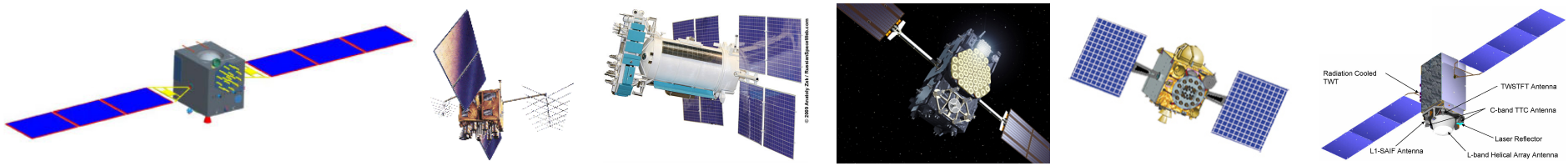
Missions

- Currently supporting 68 missions (includes 26 GLONASS satellites) and lunar tracking (5 reflectors)
- LRO-LR 5,153 hours of data since launch; activity now ended
- Recent additions
  - IRNSS-1B (geosynchronous, launch 04-Apr-2014)
  - IRNSS-1C (ISRO); 15-Oct-2014; tracking not yet started
- Upcoming missions
  - Sentinel (ESA); 2 satellites; 2015
  - Jason-3 (CNES); April 2015
  - SpinSat (NRL); Nov-2014

Central Bureau Items

- New normal point population recipe devised and approved to take advantage of the high repetition systems
- New log files implemented for tracking station configuration changes; stations have started to respond
- Strengthen ILRS policies regarding station updates and quarantine of data following these updates; in process
- Strengthen the timely feedback and response procedures from the stations on maintenance, modification, and upgrades; initiated
- Adherence to processes for certification of new stations and requalification required for stations after upgrading or significant downtime
- Coordinated campaign for expanded GNSS tracking



Issues

- Filling the remaining geographic gaps will require many more partnerships and lots more resources;
- System biases still plague us at some stations; proper calibration and testing equipment and procedures need to be designed and implemented at all stations;
- Need more on-site tools for diagnostics and real-time performance assessment allowing systems to make real-time operational decisions
- Need more use of interactive communication on networks status to share experience and diagnostics
- The lack of a “central design” for a “next generation SLR” system raises the cost, creates some compatibility issues (although minor) in data applications, and above all, makes the availability of any spare parts an almost unique issue per site or sub-network of sites;
- Mix of legacy and modern technologies and lack of standards in hardware will have an effect the data for a long time

Meetings

- 19th International Workshop on Laser Ranging, Annapolis, MD, USA, October 27-31
  - AWG meeting: October 26, 09:00-14:00 (in Maryland Inn, Crown and Crab Room)
  - MWG meeting:, October 28, 17:00-18:30 (in Governor Calvert House, Abram Claude)
  - NEWG meeting: October 28, 18:30-20:00 (in Governor Calvert House, Abram Claude)
  - DFPWG meeting: October 30, 17:00-18:30 (in Governor Calvert House, Abram Claude)
  - TWG meeting: October 30, 17:00-18:30 (in Governor Calvert House, Rebecca Grand)
- 2014 Ocean Surface Topography Science Team (OSTST) meeting, Lake Constance, Germany, October 28-31
- NIRP Symposium on Polar Science, Tokyo, Japan, December 2 – 5, 2014
- AGU Fall Meeting, San Francisco CA, December 15-19
  - GGOS Bureau for Networks and Observations, December 17

Working Group on Site Survey and Co-location Report on

Splinter Meeting at the IAG Commission 1 Symposium:
Reference Frames for Applications in Geodetic Science,

REFAG2014

13-17 October, 2014, Luxembourg

ILRS Governing Board Meeting

Annapolis, MD, USA,

October 26, 2014

Erricos C. Pavlis and Cinzia Luceri

Analysis Coordinators

Participants

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Xavier Collilieux	IGN-France	xavier.callilieux@ign.fr
Jim Ray	Retired	jimr.ray@gmail.com

Site Ties Splinter - 1

- Introduction and formalities, WG overview – Sten **~4:00 pm**
- Open WG, but Services have a single POC for Sten:
  - **IDS** **Jerome Saunier**
  - **IGS** **(Ruth Nielan or Urs Hugentobler ?)**
  - **ILRS** **Erricos Pavlis & Cinzia Luceri**
  - **IVS** **Rüdiger Hass (Onsala)**
  - **FhF** **Michael Lösler**
  - **GA** **John Dawson**
  - **IGN** **Xavier Collilieux**
  - **NGS** **Kendall Fancher**
  - **SP** **Sten Bergstrand**
  - **UBonn** **Axel Nothnagel**
  - **NASA SGP** **Jim Long**
- Other Teams need to be invited from Russia, China, and Japan.
- Sten is creating a SharePoint website for the WG (soon)

Goals & Objectives

- Sten reviewed the goals & objectives in the current WG charter:
  - Revise existing local tie procedures
  - Revise existing tie vector estimation process
  - Develop and define new methods.

- Sten suggested that these must be left to the surveyors and switch to a new set:
  - Prioritize which sites to be surveyed next
  - Define all terms used in the site survey process
  - Understand user requirements (needs WG member input!).

Discussion

- Zuheir suggested a goal of “1 mm surveys”, with a reasonable repeat cycle,
- Fran Webb pointed out the monument instability issues that necessitate repeat surveys anyway.
- Axel pointed out the multiple techniques used, differing from site to site, ECP pointed out that they may differ even at the same site depending on the space technique surveyed
- Jim Ray suggested the revision of the Best Practices manual that Pierguido and Dawson worked on, to avoid such mistakes as removing GNSS antennae when surveying a site (*work needed to revive this!*).

Discussion, cont.

- Axel mentioned that they plan to get a “camera” to do the detailed job and Cinzia reported that at Matera they plan to use drone photography and reduce it photogrammetically
- Jim Ray pressed John Dawson on the BP manual stalemate and he eventually admitted that practices vary from group to group and site to site, so a BP is very hard to compile. In the end it was agreed to complete it.
- Axel’s idea for a “Measurement Exchange” format didn’t go too far ;-)

~5:00 pm

Presentations

- Next we had presentations by a few groups on various topics:
  - Cornella Eshelbach and Michael Lösler gave a two-part presentation on:

    "Cartesian based Network Adjustment including Uncertainty Handling"

    - First some theory of LS and modeling, followed by,
    - An example case that they demonstrated for us using a Windows GUI
  - Jerome Saunier gave a DORIS site tie survey review ~5:30
- Axel's idea for a "Measurement Exchange" format didn't go too far ;-)

Presentations, *cont.*

- Sten presented Axel's resolution on the nomenclature of space-geodetic reference points, first given in Paris
  - Axel pointed out that it has not been accepted, **only presented**
  - The ensuing discussion wasted quite some time only to reach the point that no one around the table disagreed with the obvious statement that Axel wanted to be "approved" or "accepted" as a "law"
- Agreement on nomenclature reached (I think…) and a note that very soon a new document (~60 pages) from IGN will present their experiences with many recent surveys (Xavier Collilieux is in charge of this).
- AGU is too soon, so EGU is the next time we meet. **~6:00 pm**

Data QC Issues

@ ILRS GB Meeting

26 Oct 2014

Toshimichi Otsubo

Hitotsubashi University

Maryland Inn, Crown and Crab Room, Annapolis, 1630-, 26 Oct 2014

```
 AJI1 7090 2014/10/13 03:50   8      -0 (     5 )       0.1 (    3.1 )     4   0 /  1
#
#  7105 = WASHINGTON
# sat site       date  time dur   rb mm   error        tb us    error    prec bad tota
 JAS2 7105 2014/09/30 17:20   3     -42 (     5 )       12.0 (    2.4 )     1   0 /  1
 LAG2 7105 2014/09/30 17:25   6     -20 (     4 )   -------.- ( ----.- )     1   0 /
 STRL 7105 2014/09/30 17:35  11     -23 (     4 )        2.7 (    0.9 )     3   0 /  2
 STEL 7105 2014/09/30 18:29   6       3 (     5 )        6.4 (    1.2 )     2   0 /  1
 LARS 7105 2014/09/30 18:36  11     -14 (     4 )       -1.5 (    1.4 )     3   0 /  2
 LAG1 7105 2014/10/01 00:03  23      -7 (     2 )       -0.3 (    3.2 )     3   0 /
 GL29 7105 2014/10/01 00:38   2      12 (     9 )   -------.- ( ----.- )     2   0 /
 LAG2 7105 2014/10/01 23:18  16       5 (     3 )       -8.7 (    5.9 )     1   0 /
 GL09 7105 2014/10/02 01:33   3     -20 (     8 )   -------.- ( ----.- )     3   0 /
 LAG1 7105 2014/10/02 02:09  40      -6 (     1 )        3.0 (    0.8 )     2   0 /  2
 AJI1 7105 2014/10/02 02:38   1      12 (    14 )   -------.- ( ----.- )     8   0 /
 ETA1 7105 2014/10/02 03:19  52     -12 (     9 )   -------.- ( ----.- )     6   0 /
 AJI1 7105 2014/10/02 04:33   9      23 (     4 )        1.3 (    1.2 )     1   0 /  2
 LAG1 7105 2014/10/02 05:40  34      -1 (     2 )       -1.2 (    1.1 )     1   0 /  1
 JAS2 7105 2014/10/02 06:16  11       3 (     3 )        1.4 (    0.7 )     2   0 /  4
 STEL 7105 2014/10/02 06:19   0     -25 (    14 )   -------.- ( ----.- )     5   0 /
 LARS 7105 2014/10/02 06:28   6      -8 (     6 )       -1.8 (    2.8 )     3   0 /  1
 AJI1 7105 2014/10/02 06:35  14       7 (     3 )        2.1 (    0.9 )     2   0 /  3
 STEL 7105 2014/10/02 07:57   4       1 (     4 )        5.8 (    1.2 )     1   0 /  1
 AJI1 7105 2014/10/02 08:46   6     -25 (    11 )        9.4 (    3.2 )     1   0 /  1
```

Quick QC

Quick feedback to the stations

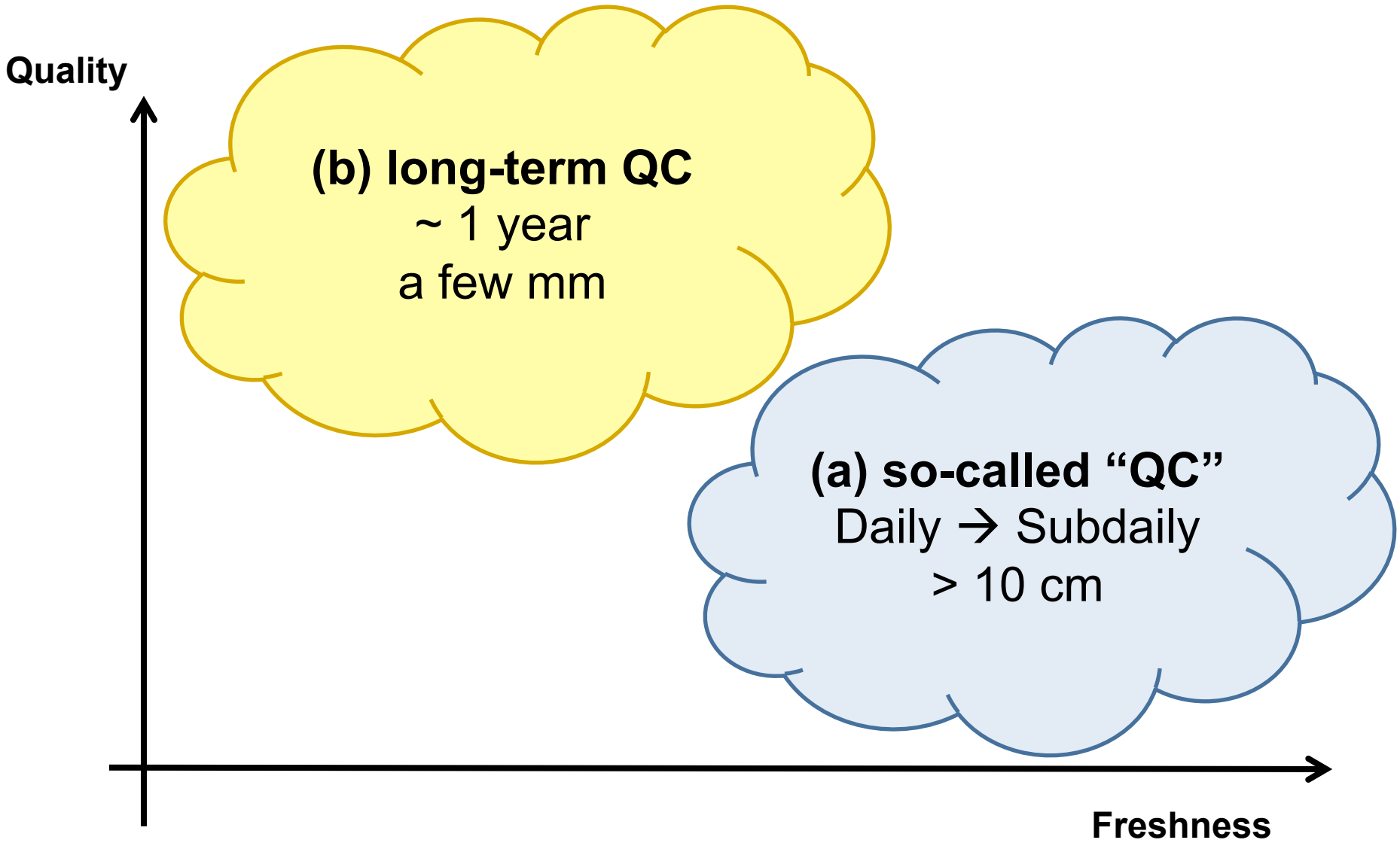
- 16 incidents reported via RapidServiceMail (operated at DGFI) in the last 1 year. 15 from HITU & 1 from DGFI.
- Improved responses & quick recovery.
- Obsolete contact info remaining on the ILRS Website.

Visualization & Combination/Comparison

- NERC, JCET: Web Tools
- AIUB: Combined RB Report
- ILRS CB: Global Performance Card

More on Friday.
Clinics Session.

Two-fold QC


Quality
(b) long-term QC
~ 1 year
a few mm
(a) so-called "QC"
Daily → Subdaily
> 10 cm
Freshness

“Slow” QC (@ HIT-U): Sorting parameters

Test #1:
Single-shot returns per NP bin

Test #2:
Single-shot RMS in a NP bin

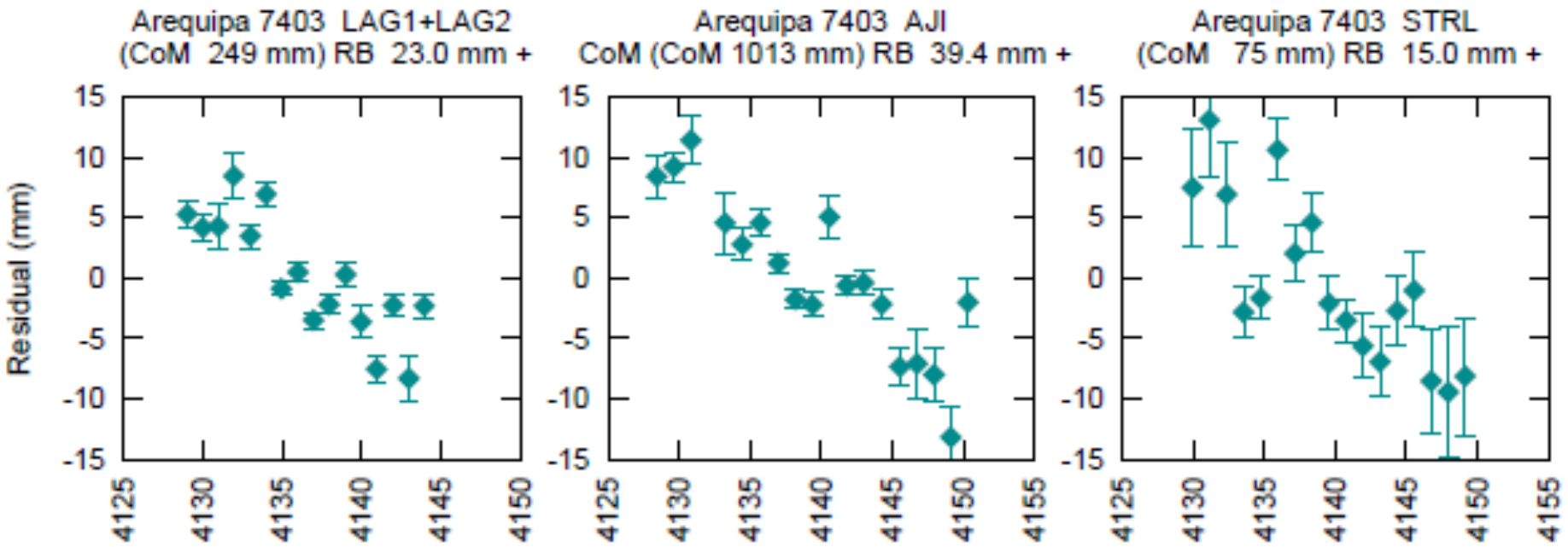
Test #3:
System delay (calibration)

Test #4:
Time to the nearest calibration

Test #5:
Range rate

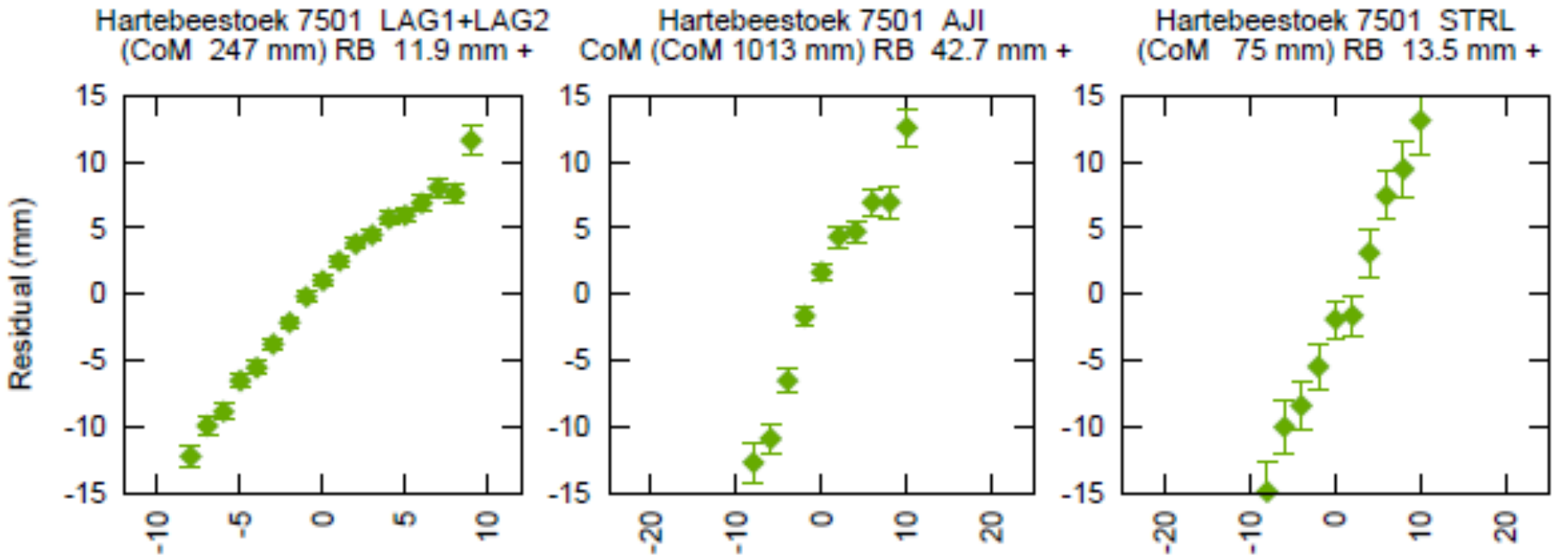
Test #6:
Time of day

Test #3:
System delay (calibration)



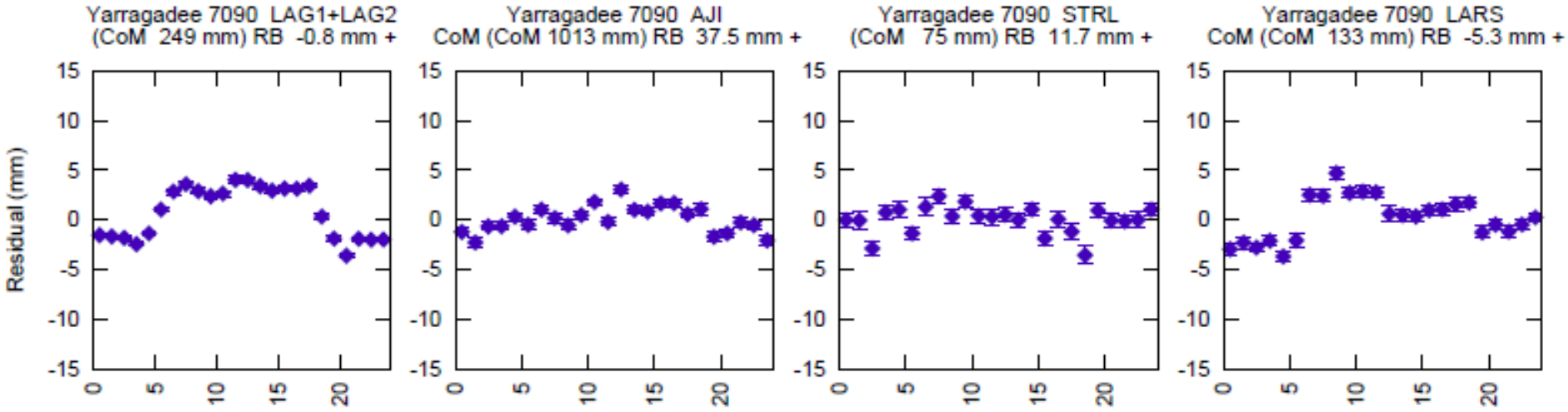
Calibration not working properly

Test #5:
Range rate



Time bias (> a few μs) suspected.
Time tag to be re-investigated for all?

Test #6:
Time of day



Day/Night range difference?

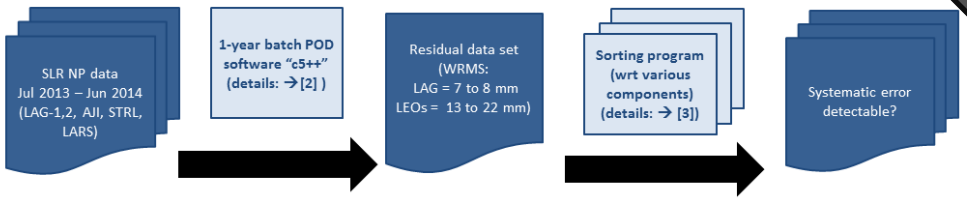
3141

HITOTSUBASHI UNIVERSITY

Systematic Range Error 2013-2014

Toshimichi Otsubo Hitotsubashi University, Japan (Email: t.otsubo@r.hit-u.ac.jp)

[1] Residual Analysis: Procedure Overview



[2] POD Analysis Settings

Software "c5++"

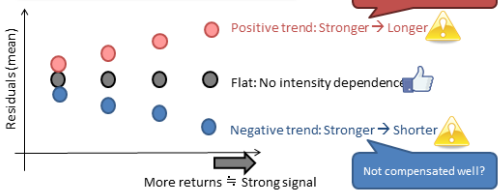
- 5 satellites (LA
- 5-da
- Ac
- para
- Station
- Range bias

Different from the 6-hourly QC analysis

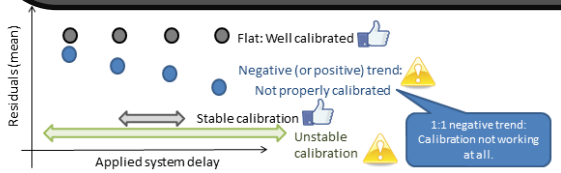
> 1000 graphs in a poster!

[3] Sorting Procedures and Checklist

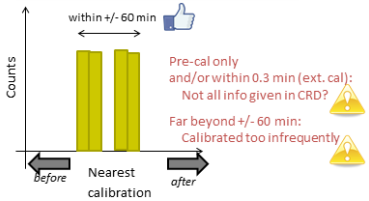
Test #1: Single-shot returns per NP bin



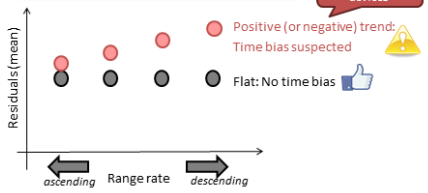
Test #2: Single-shot RMS in a NP bin

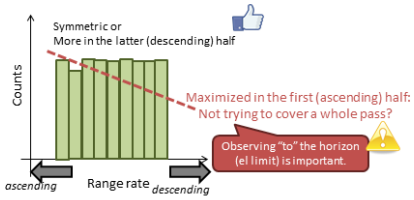


Test #4: Time to the nearest calibration

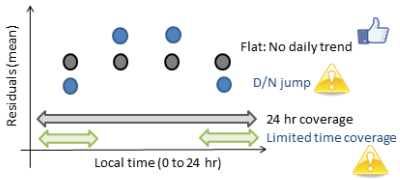


Test #5: Range rate





Test #6: Time of day



[4] Station-by-station diagnosis (more than 1000 charts!)

Please do not take them way until the end of Friday's clinic session.

Find your station's charts below!

- We recommend the representatives of each station to review the observation procedure or hardware especially if a comment tag is attached.
- Note that the post-fit residuals are the mixture of the measurement error at a station and the model error in our orbit computation. **There is a risk of false alarm.**

World Top 12 in data yield (total passes > 3500)

(after SLR Global Performance Report Card; see Torrence's poster in this workshop)

Yarragadee (7090), Changchun (7237), Zimmerwald (7810), Wettzell (8834), Graz (7839),

#13 to #25 (total passes > 1600)

San Juan (7406), Potsdam (7841), Arequipa (7403), Grasse (7845), Haleakala (7119),

Data Flow

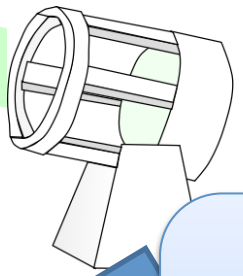
Operational Centers/Data Centers
(CDDIS and EDC)

Re-format

Observation Data

(within 1 hr)

Laser Ranging Station



Quick feedback

→ Shortening anomalous periods.

Feedback

Observation Data

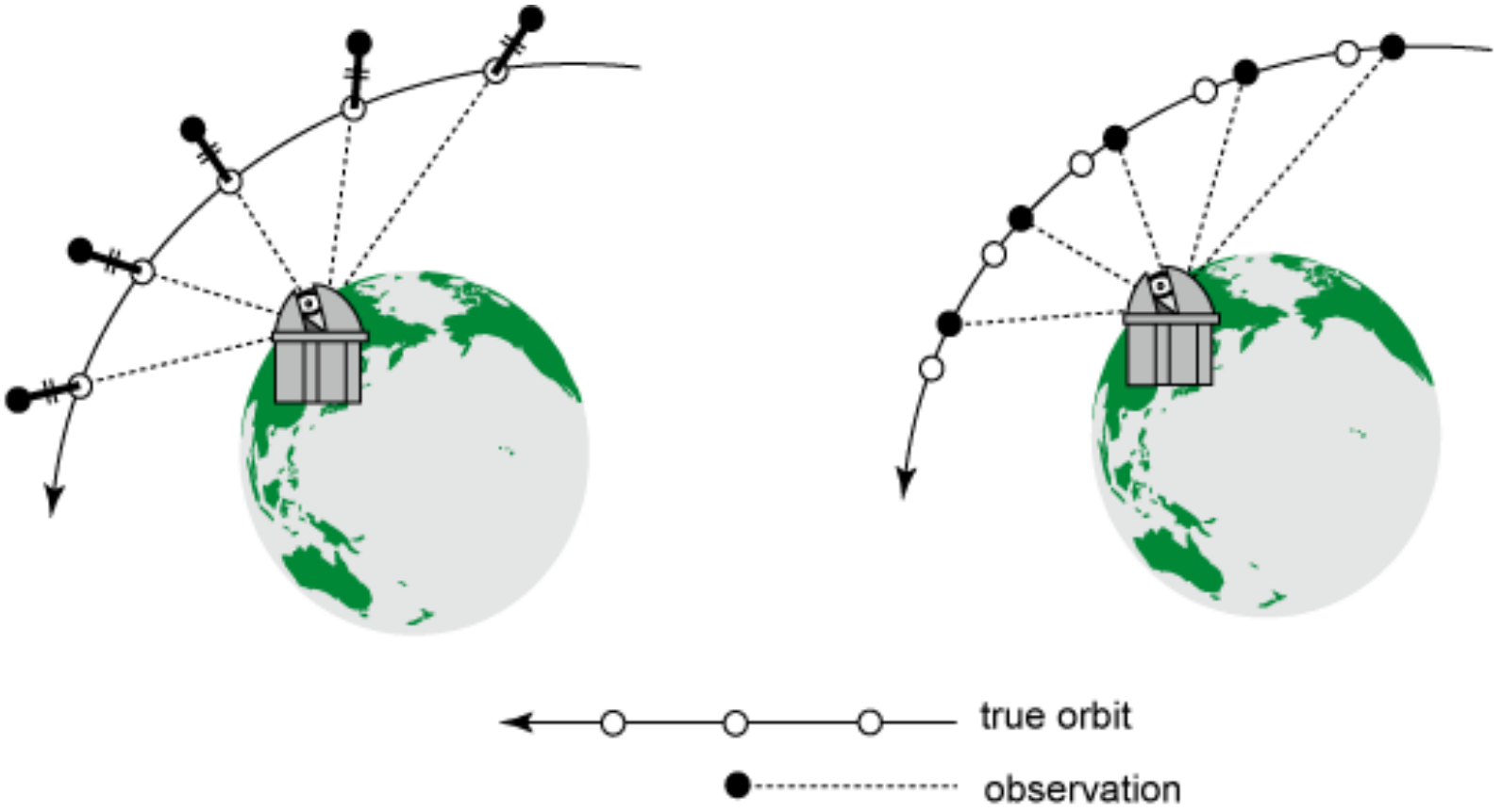
Quality check

Obse

Observation Data

Hitotsubashi University
(& Other QC-ACs/AACs)

Range Bias and Time Bias




```
# 7838 = SIMOSATO
# sat site date       time dur rb mm err tb us err prec bad total
AJI1 7838 2013/10/09 15:40 11 11 ( 6 )  -5.1 ( 1.6 ) 3 0 / 24
LAG2 7838 2013/10/09 16:03 40 19 ( 7 ) -17.1 ( 5.9 ) 5 0 / 22
:
:
```

ILRS Analysis Working Group Report

ILRS Governing Board Meeting

Annapolis, MD, USA,

October 26, 2014

Erricos C. Pavlis and Cinzia Luceri

Analysis Coordinators

ILRS AWG Activities

- Operational products (**daily** & weekly) delivered routinely and on time from the eight ACs:
  - **ASI** (AC & CC), BKG, DGFI, ESA, GFZ, GRGS, **JCET**(AC & CC), & NSGF
- The reanalysis for the ITRF2013 submission has been completed (with only minor details to be resolved) as of early October, for **1983 – 2013**
- The complete ILRS Series of SINEX files for ITRF2013 were delivered to DCs as of October 24
- Discussions with ITRS/Zuheir on the possibility to extend the submission by one year and develop "ITRF2014", with longer "shelf-life" by more than 1 yr

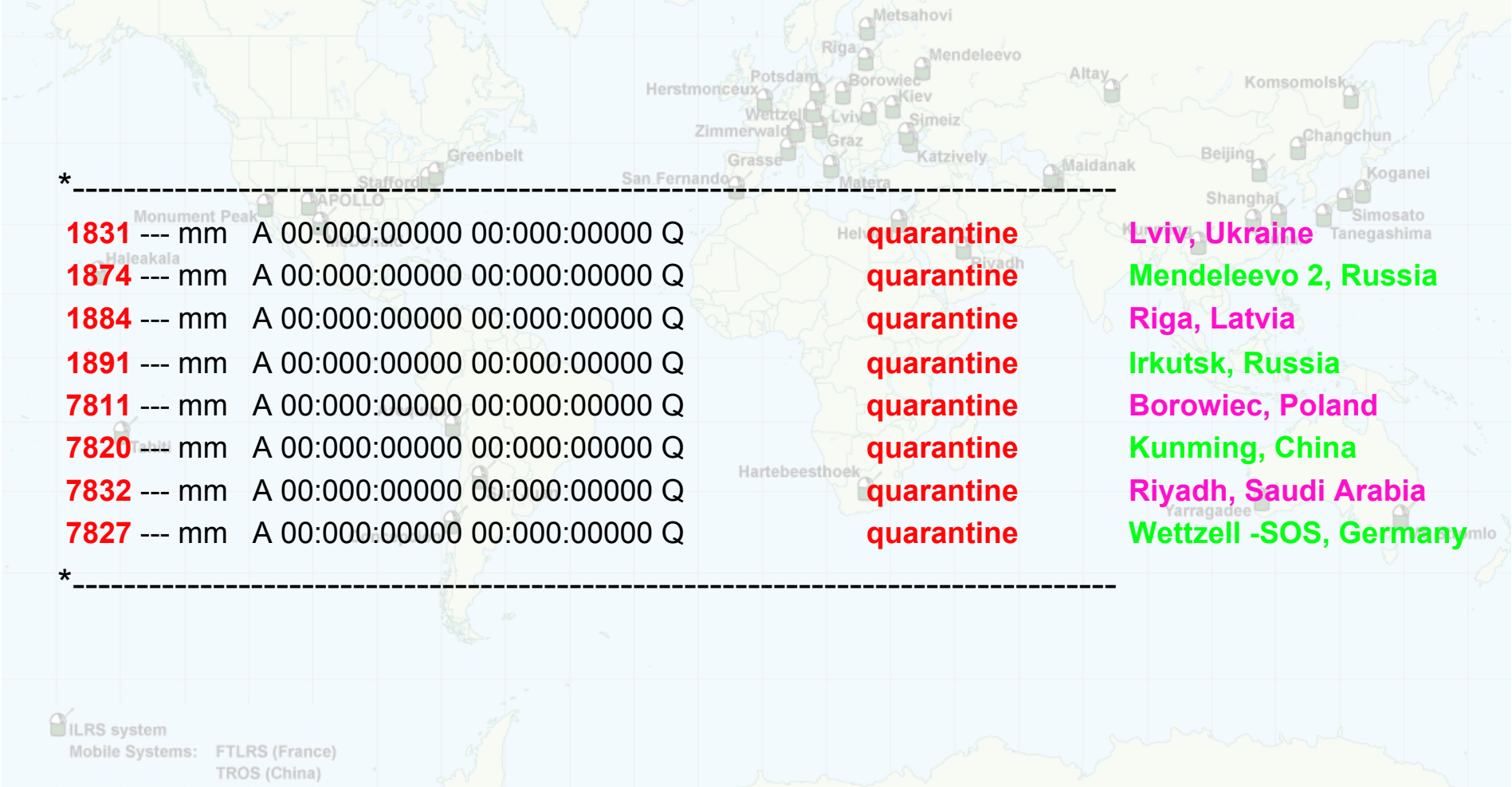
ILRS AWG Future Activities

- Pilot Project for low-degree harmonic estimation
- Next will be the incorporation of LARES in the operational data group
- Pilot Project for observational-level modeling of loading corrections for stations and corresponding gravitational corrections in orbit (operational product)
- Finalization of the orbital product for the currently used targets
- Benchmarking of new ACs

Network

- New Russian stations validated and accepted in 2014
  - Brasilia - OK,
  - Irkutsk - under quarantine
- New station SOS at Wettzell in quarantine
- Working with San Fernando to recover some of their data with erroneous calibrations
- Some stations undergoing repairs/upgrades are still not reporting these in time for the correct handling (quarantine) of their data and assignment of new SODs

Stations in Quarantine



*----------

1831	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Lviv, Ukraine
1874	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Mendeleevo 2, Russia
1884	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Riga, Latvia
1891	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Irkutsk, Russia
7811	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Borowiec, Poland
7820	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Kunming, China
7832	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Riyadh, Saudi Arabia
7827	--- mm	A 00:000:00000 00:000:00000 Q	quarantine	Wettzell -SOS, Germany

*----------

Publications & Meetings

- **IERS Annual Reports 2013:**
  - Will be submitted by next week
- **ILRS Special Issue in the Journal of Geodesy:**
- Progressing now, awaiting three more abstracts before sending them to the editor for approval
  - Over 24 submissions, 3 abstracts pending finalization
  - Planning for a completed review process by early 2015
- **Future Meetings:**
  - The next Spring meeting of the AWG will take place in Vienna, prior to the EGU 2015

ILRS SI @ JofG

#	TITLE	Lead Author(s)
0	Foreword	The Guest EB
1	The International Laser Ranging Service (ILRS): The First Decade and Beyond	Pearlman, Appleby, Noll, Pavlis, Torrence
2	Information Resources Supporting Scientific Research for the International Laser Ranging Service	Noll, Horvath, Ricklefs, Schwatke, Torrence
3	*Past, Present and Future of the ILRS Global Tracking Network*	*Dunn, Torrence, Pearlman, Varghese and McCormick ???*
4	Next Generation Satellite Laser Ranging Systems	Degnan, McGarry, Kirchner, Appleby, Prochazka, Jäggi, Moore, Artyukh, Samain, Schreiber
5	Geodetic satellites: a high accuracy positioning tool	Pearlman, Arnold, Davis, Barlier, Biancale, Vasiliev, Paolozzi. Ciufolini, Pavlis
6	Satellite Laser Ranging to Global Navigation Satellite Systems	Thaller, Dell'Agnello, Fumin, Govind, Nakamura, Noda, Springer
7	Lunar Laser Ranging – A Tool for General Relativity, Lunar Geophysics and Earth Science	J. Müller, Murphy, Schreiber, Shelus, Torre, Williams, Boggs
8	Interplanetary Ranging	Degnan, Schreiber, McGarry, Sun, Zagwodzki, Murphy, Samain, Turyshev
9	Target Signature Systematic Errors for Geodetic Satellites and Novel LR Array Design	Appleby, Otsubo, Arnold, Kirchner, Neubert, Grunwaldt, Vasilliev
10	Data Quality Control Service for the ILRS Tracking Network	Otsubo, H. Müller, Pavlis, Torrence, Thaller, Glotov, Xiaoya, Appleby
11	Systematic errors in SLR Data: Documentation and Discussion of their Sources	Luceri, H. Müller, Vei, Appleby and Pavlis
12	Operational and Definitive Products of the ILRS Analysis Working Group	Sciarretta, Luceri, Pavlis and Kelm
13	*Monitoring Mass Redistribution in the Earth System with SLR*	*Pavlis, König, Ries, Deleflie, Cheng, H. Müller, ???*
14	*The ILRS Contribution to the International Terrestrial Reference Frame (ITRF)*	*Pavlis and the AWG ACs and CCs*

We also have EIGHT (9) "un-solicited" abstracts so far

1) **BOLD** indicates working title from author(s) for a submitted abstract
2) RED indicates lead author
3) *Non-bold entries in italics are still pending!!!*

ILRS Missions WG Report

@ ILRS GB Meeting
26 Oct 2014

Toshimichi Otsubo

and

Scott Wetzel

Maryland Inn, Crown and Crab Room, Annapolis, 1630-, 26 Oct 2014

MWG 2013-2014

New chair appointed

Chair: G M Appleby → T Otsubo (appointed at the ILRS GB Meeting in Fujiyoshida)

Co-chair: S L Wetzel

Newly approved missions ← MSR Form Submission

Based on Email communications

Approved 3 missions: SpinSat, Galileo 201&202, IRNSS-1B

First meeting on Tue

Question: Does the mission support request include (precise) orbit analysis?

If yes, we probably need more info in the MSR form.

Agenda (for 28 Oct 2014)

International Laser Ranging Service

(1) Opening/Welcome

(2) Recently approved missions, (3) Future missions (5 min max each)

- **SpinSat (J Griffiths)**
- **Galileo 201 and 202 (ESA; read by T Otsubo)**
- **IRNSS (V Jayaraman ; read by T Otsubo)**
- **HY-2 series (Zhang Z ; read by T Otsubo?)**
- **GPS-III (L Thomas)**
- **ELT (U Schreiber)**
- **ICESAT-2 (B Schutz; read by S Wetzel)**
- **JASON-3 (J-P Berthias; read by S L Wetzel)**
- **Sentinel-3 (P Féménias; read by G M Appleby)**

(4) Mission Support Request (MSR) Form

(5) Others?

(6) Closure

Data Formats and Procedures Working Group Report to ILRS GB

Horst Mueller

R. L. Ricklefs

Station Change Tracking

- Stations have not been keeping their configuration files current with the ILRS. This makes life difficult for analysts and can lead to down-weighting of a station's data.
- One response was to simplify the SCH/SCI (System Change and System Configuration files), creating a single Station Change History Log that included more information, one line per change, to serve as a reference the station personnel could use to pull out more information if an analyst had questions.

Station Change Tracking (cont.)

- Another response was to clarify the ILRS web site, emphasizing the 3 methods needed to track changes:
  - CRD configuration records
  - New Change History Log
  - Site Logs

  And the possible need to quarantine data after a significant change
- Finally, education and reminders: email was sent to the stations to keep files up to date. There will be a presentation Friday morning on this issue that will be reinforced during the station clinic
- So far, 16 stations have provided the Change History Log

Two Path Data Distribution

- Currently, each SLR station sends data to only one operations center.
- When one of the operations or data centers is offline for an extended period of time, data is delayed, and rapid turnaround data products suffer.
- A procedure is being working out in which stations will send data to each operations center instead of just one.
- To be worked out is also insuring data is harmonized between both operations and data centers, including common data error checking procedures

CPF and CRD format issues

- The following issues are not critical, but should be dealt with as maintenance. They will be discussed at DF&P WG meeting.
- CPF:
  - Some options (e.g. inertial vectors) may not be implemented at the stations
  - Manual emphasizes transition from TIV to CPF. Could be re-written.
  - Make sure we are ready for a leap second
- CRD:
  - Extension for more configuration information (software versions; met setup)
  - Some lunar issues (mainly involving APOLLO station)
  - T2L2/ELT questions?
  - Reformatting of old CSTG format to CRD

Software Library

- The EUROSTAT station monitoring software and mount model fitting program have been added to the ILRS web site software page
- A normal point program and tracking restrictions software should be added in a few months
- A source of delay for NASA software are the legal issues involved in turning code into open source (which NASA does support)
- Study Group will meet this week and discuss how much more can reasonably be added to the library

Networks & Engineering Working Group

Tuesday 28th October 18:30 – 20:00

ILRS 19th Workshop, Annapolis, USA

Agenda

- How should a station respond to range bias errors?
- Beam divergence measurement procedure

- Stations Changes Log
- Tracking all GNSS
- In-sky safety
- AOB

Proposal to establish a new ILRS WG:

Debris Laser Ranging WG

Or: Debris WG ?

Or: DLR WG ?

Georg Kirchner

Annapolis, October 2014

Some arguments for a Debris Working Group

- Several SLR stations already have successfully tracked debris:
  - Graz, Grasse, Stromlo, Shanghai, Changchun, Yunnan, Russian …
  - More stations intend to join (using also their standard laser at IR?):
    Wettzell, NASA, Riga, San Fernando, Chinese …

- Increasing interest of organisations in debris LR: ESA, NASA, WPLTN …
  - ESA: Plans for an expert centre for federated SLR observations;
    - a good chance for ILRS to get involved in these activities;
      e.g. SLR Graz is now involved in 3 ESA debris LR projects
  - NASA: Designing a debris laser ranging facility

- These organisations need / would appreciate a proper interface to ILRS

Tasks for this WG

- Interface between ILRS and other organisations (ESA, NASA)
  e.g. ESA: Would appriciate it as a contact point / interface

- Coordination of Debris activities: Target selection, schedules, data quality control, data exchange etc.;
  - e.g. Graz / Shanghai / Changchun will start common DLR
  - e.g. Graz / Wettzell / DLR Stuttgart will start common DLR
  - e.g. Graz / Zimmerwald will start special DLR experiments
  - e.g. Multi-Static DLR within European SLR stations planned for 2015

- Calibration issues (1-way in case of multi-static debris ranging)

- Hardware / Software support & exchange (ETs, TLE calcs, etc.)

- Promotion of Debris Laser Ranging within ILRS:
  It should also strengthen the position of ILRS for DLR …

Chances and Opportunities for ILRS

Such a Debris WG might be a big opportunity for

ILRS *and* for stations:

- Extending ILRS competence into new applications
- Consolidating the role of ILRS concerning space debris issues

- Encouraging to / assisting in participation of SLR stations:
  - Can strengthen the position of SLR stations, e.g. within national funding scenarios…
  - It is more promising to apply for money for such *NEW* projects, than for continuous LAGEOS tracking (our Graz experience …)