ILRS
Governing Board Meeting

April 22, 2009
15:45 - 18:15

Vienna University of Technology
Seminar Room 124/CB0308, 3rd Floor
Gusshausstr. 27-29
Vienna, Austria

ILRS Governing Board

Technical University of Vienna
SEM124
Vienna, Austria

April 21, 2009

Agenda

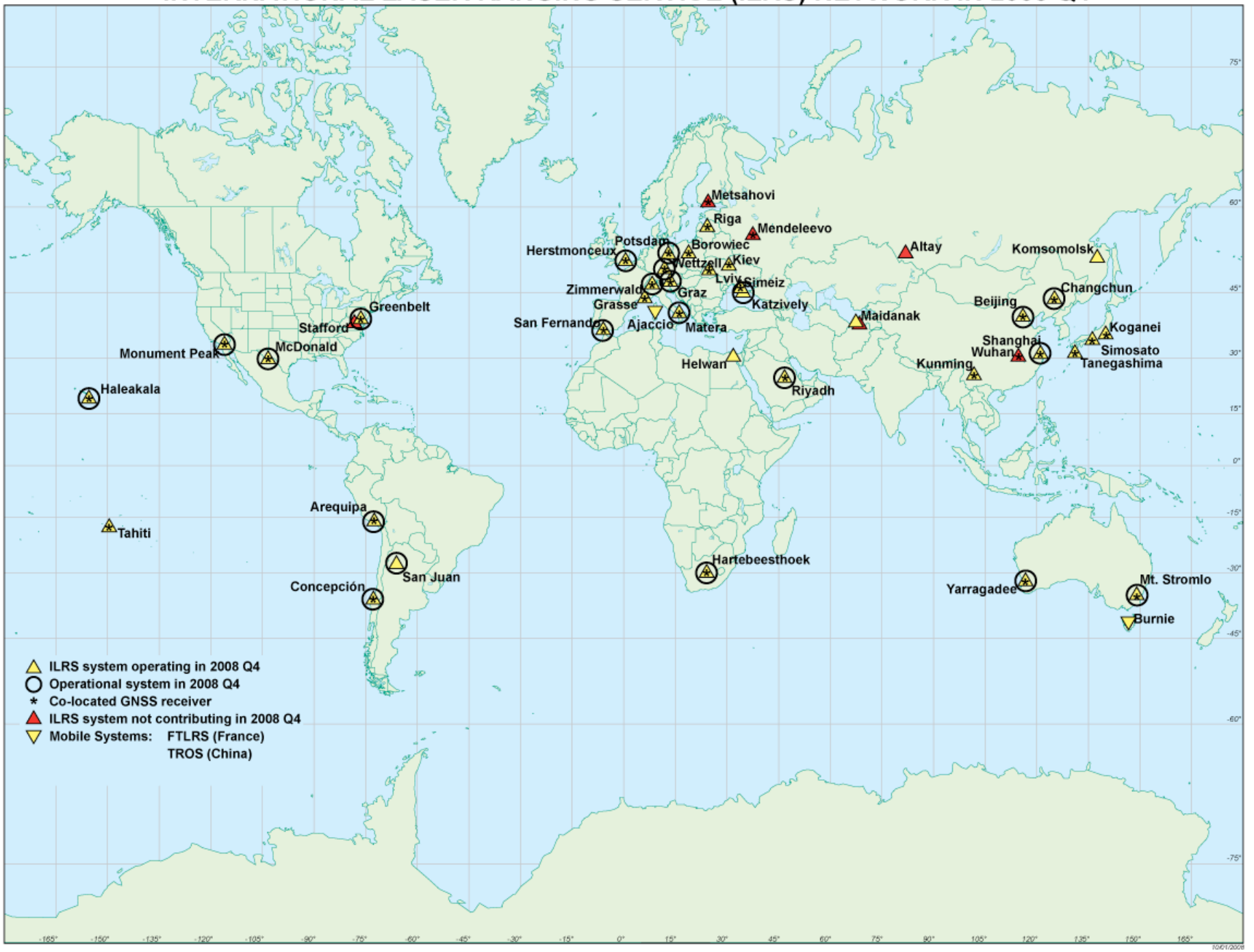
1. Opening Remarks (5 min.)	W. Gurtner
2. ILRS Status/Action Items (15 min.)	M. Pearlman
3. Working Group Briefs and Recommendations (5-10 min each)	WG Chairs
✦ Analysis	E. Pavlis/C. Luceri
✦ Missions	G. Appleby
✦ Data Formats and Procedures	W. Seemueller
✦ Networks and Engineering (including Stanford Counter tests)	W. Gurtner
✦ Transponders	M. Pearlman
4. Task Force Reports (5 min. each)	
✦ Communications	E. Pavlis
✦ Center-of-Mass Corrections	G. Appleby
5. Status of the next ITRF (5 min)	Z. Altamimi
6. ILRS Special Issue in Journal of Geodesy (5 min.)	E. Pavlis
7. GGOS Activities (5 min.)	M. Pearlman
8. Current Issues (10 min.)	
✦ Coping with Future Satellite Missions	W. Gurtner
9. New Business	W. Gurtner/WG Chairs
10. Other Business	W. Gurtner

Central Bureau Update

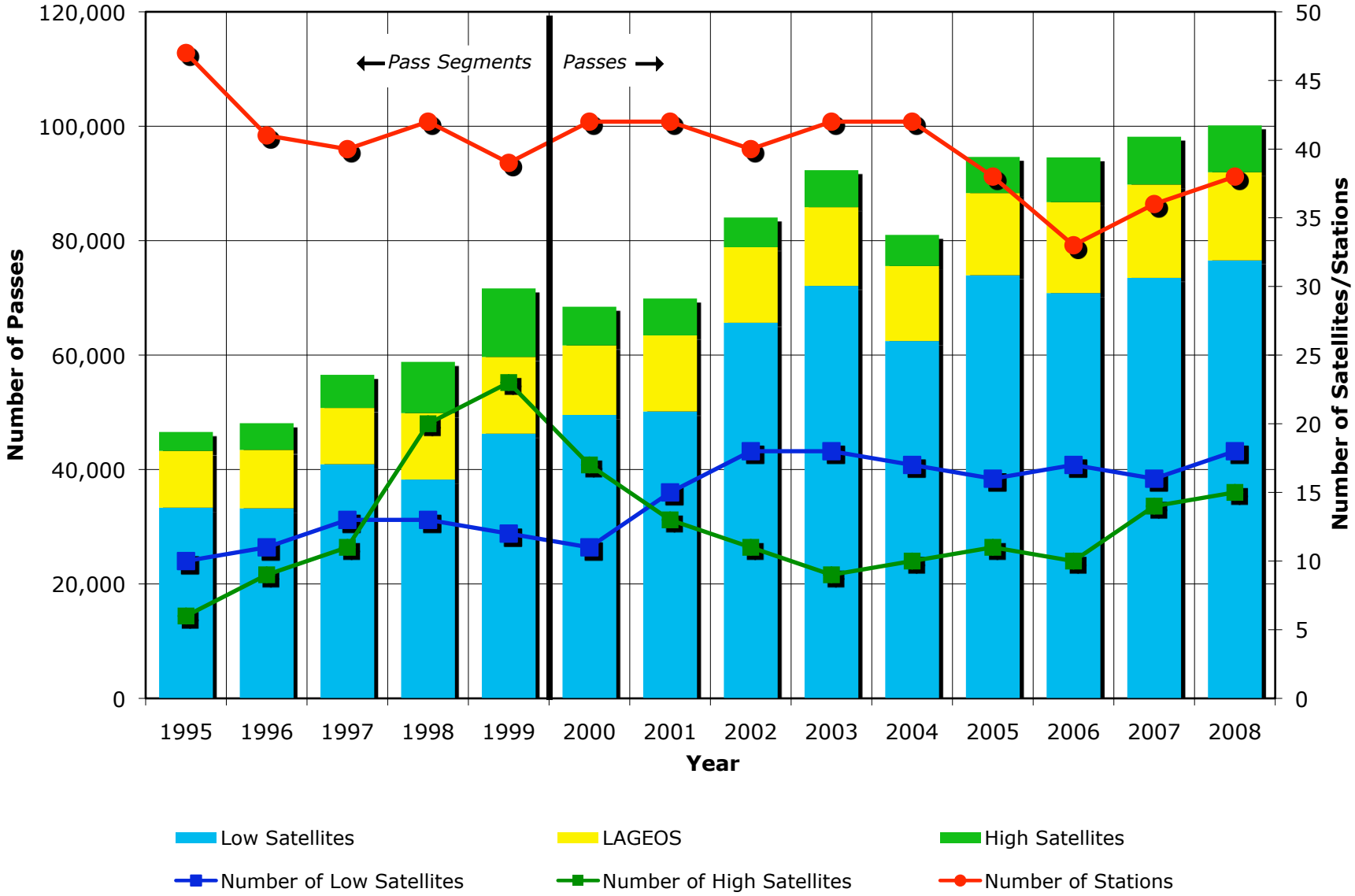
Network Status

- 33 stations providing tracking data thus far in 2009
- Most productive stations are Yarragadee, San Juan, Mt. Stromlo, Graz, Wettzell, Zimmerwald, Herstmonceux, Riyadh, and Changchun
- Newly refurbished Grasse MEO station on-line; dedication in April
- Tahiti now operational; meeting with NASA, CNES, and UFP held October 20-22, 2008
- Data from Altay Russia submitted and will be released soon
  - ACs still reviewing data to calculate site position
  - Site log complete
  - Co-located GNSS data may be released
- TROS campaigns in KASI, Korea in 2008 and 2009
- FTLRS occupation currently underway in Grasse

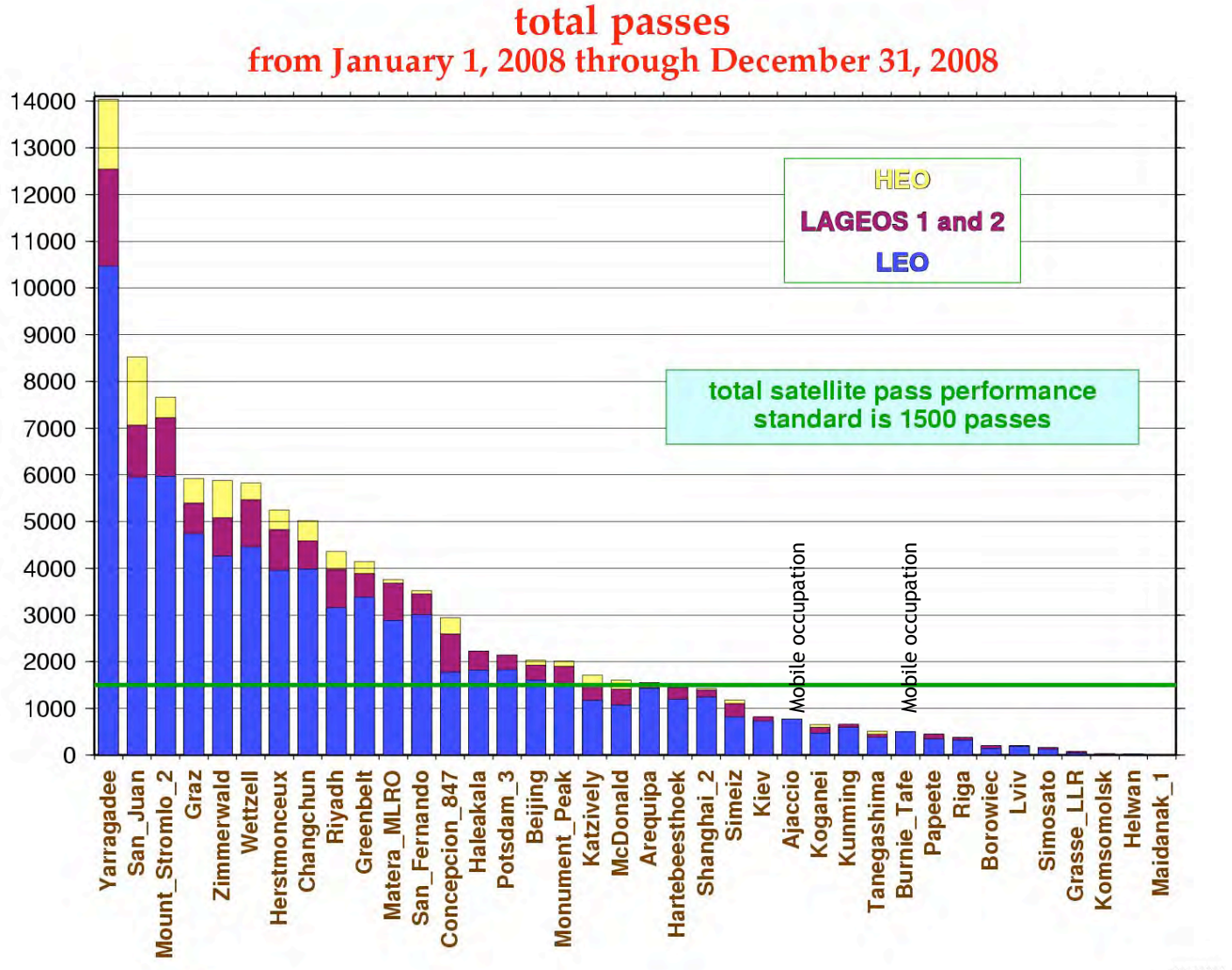
INTERNATIONAL LASER RANGING SERVICE (ILRS) NETWORK IN 2008 Q4



Annual Data Yield



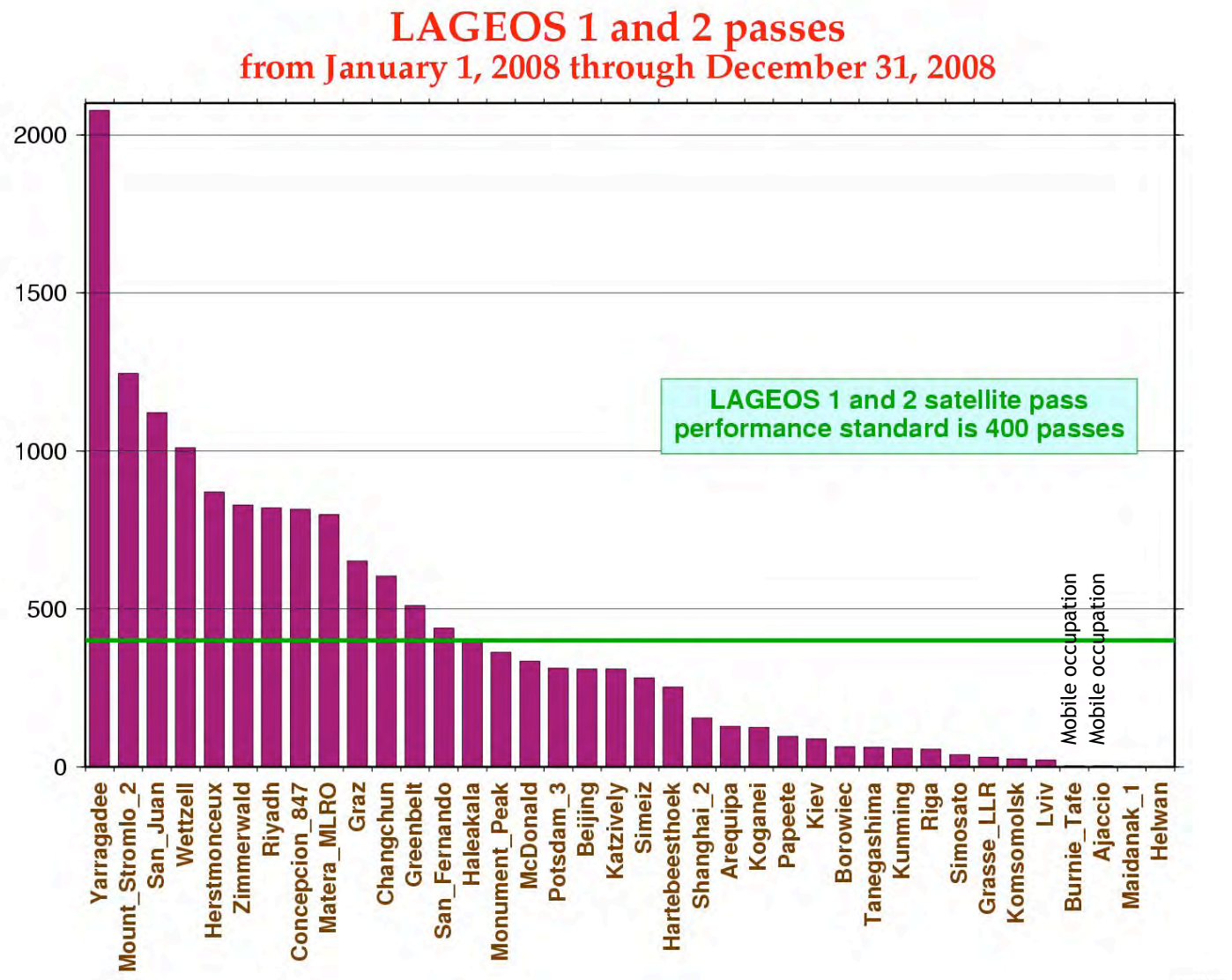
Station Performance
All Satellites (2008Q4)



Note: Over one third of the stations do not achieve 1500 passes per year

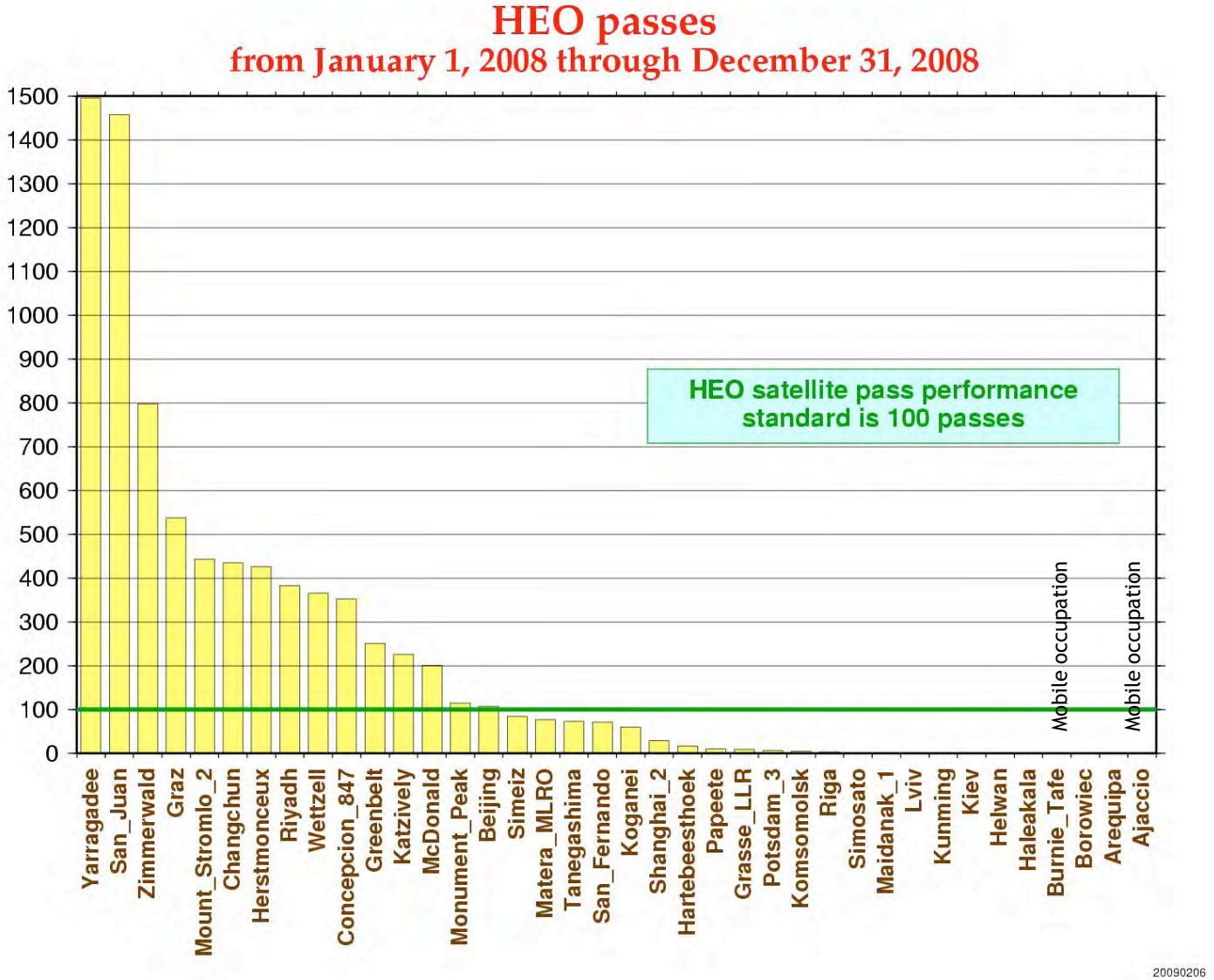
Station Performance

LAGEOS Satellites (2008Q4)

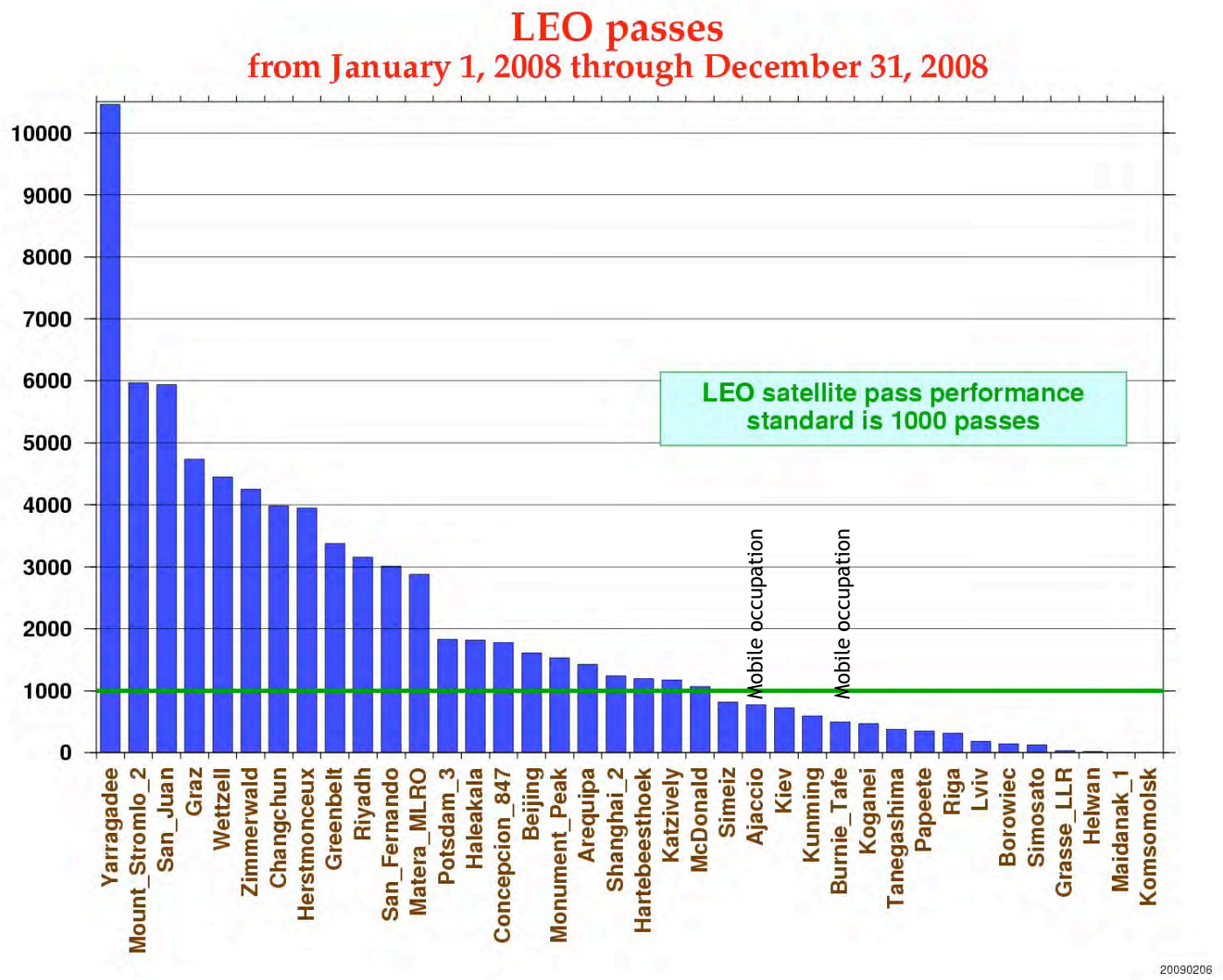


Note: More than half of the station do not achieve 400 LAGEOS passes per year

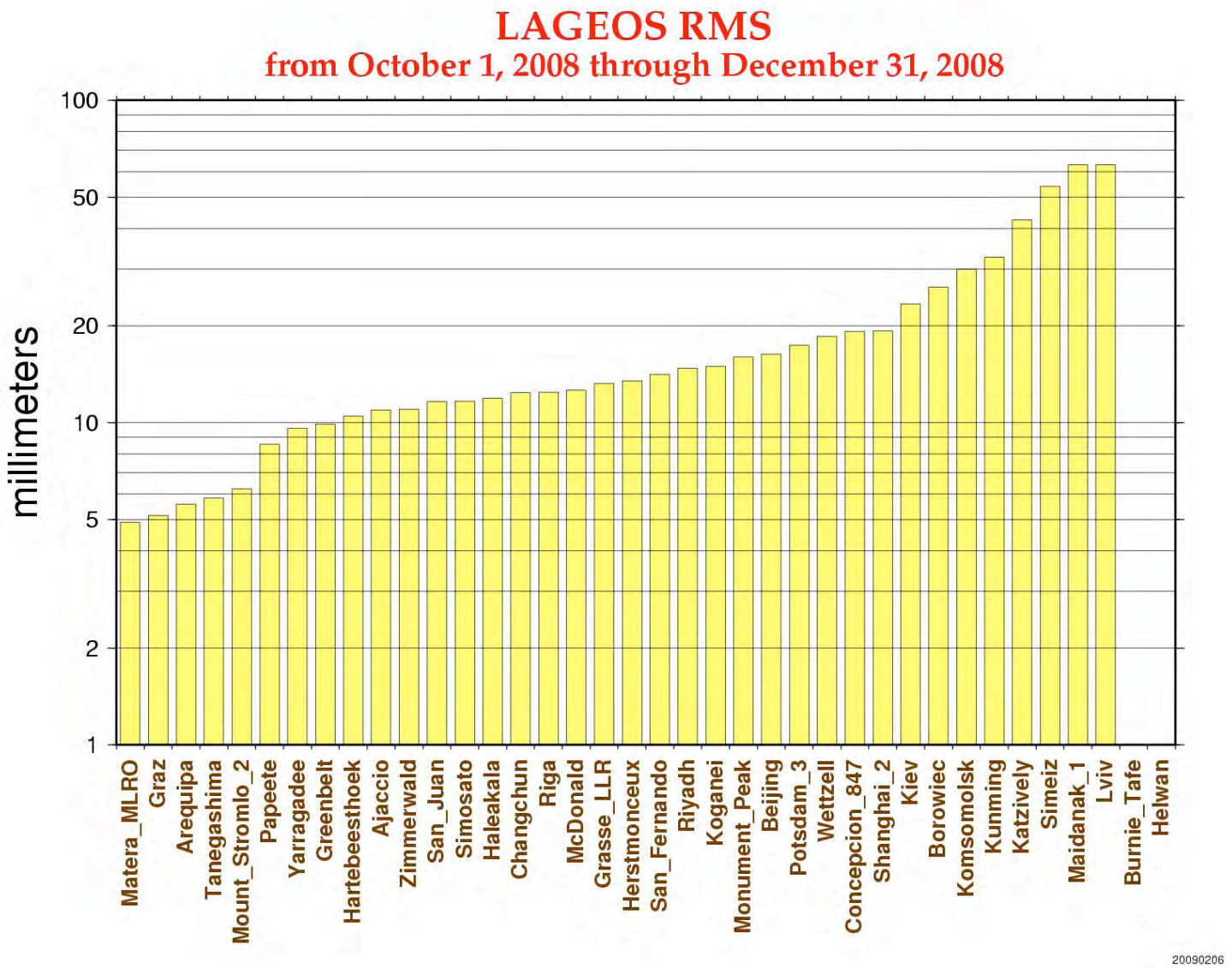
Station Performance
High Satellites (2008Q4)



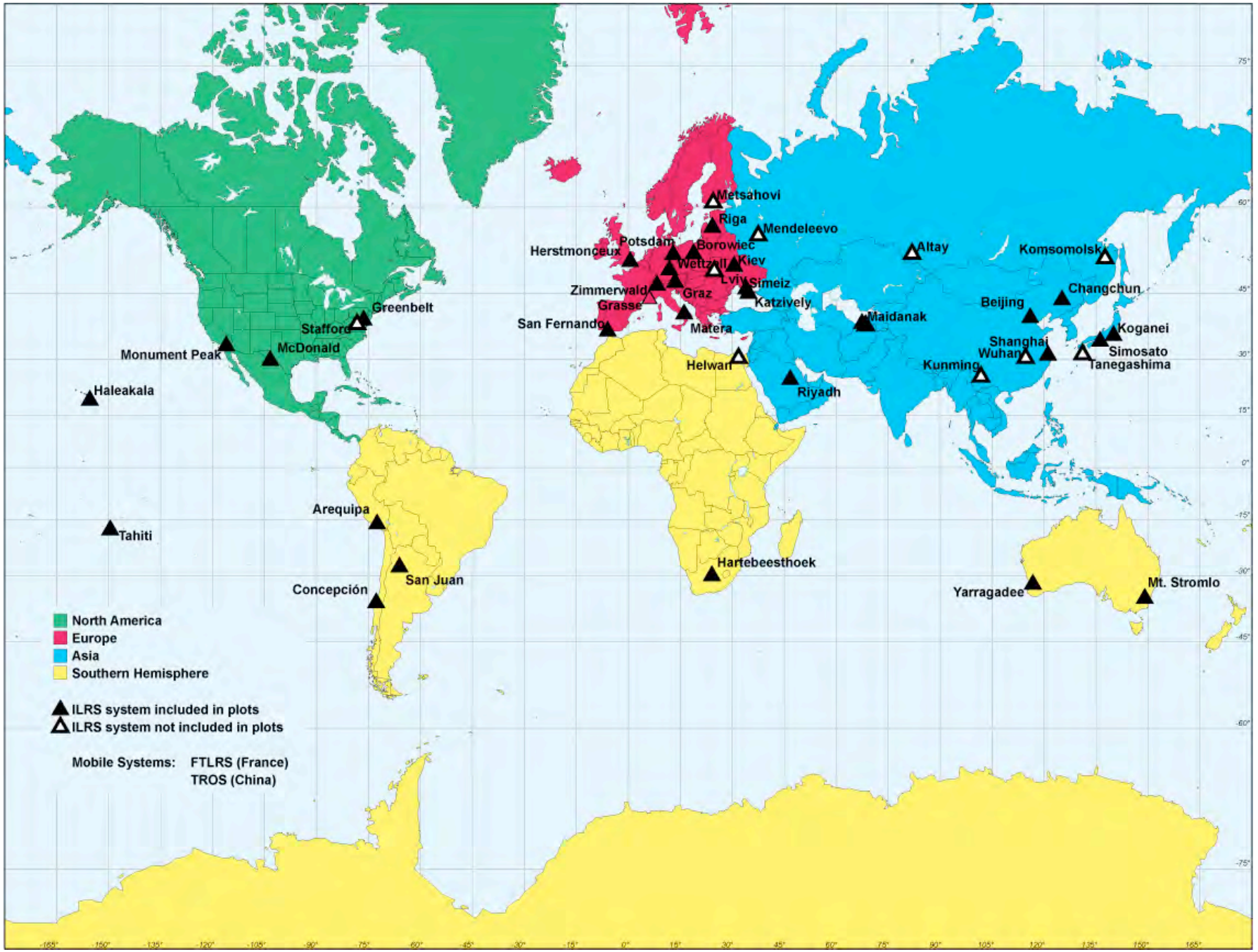
Station Performance
Low Satellites (2008Q4)



Station Performance
LAGEOS RMS (2008Q4)

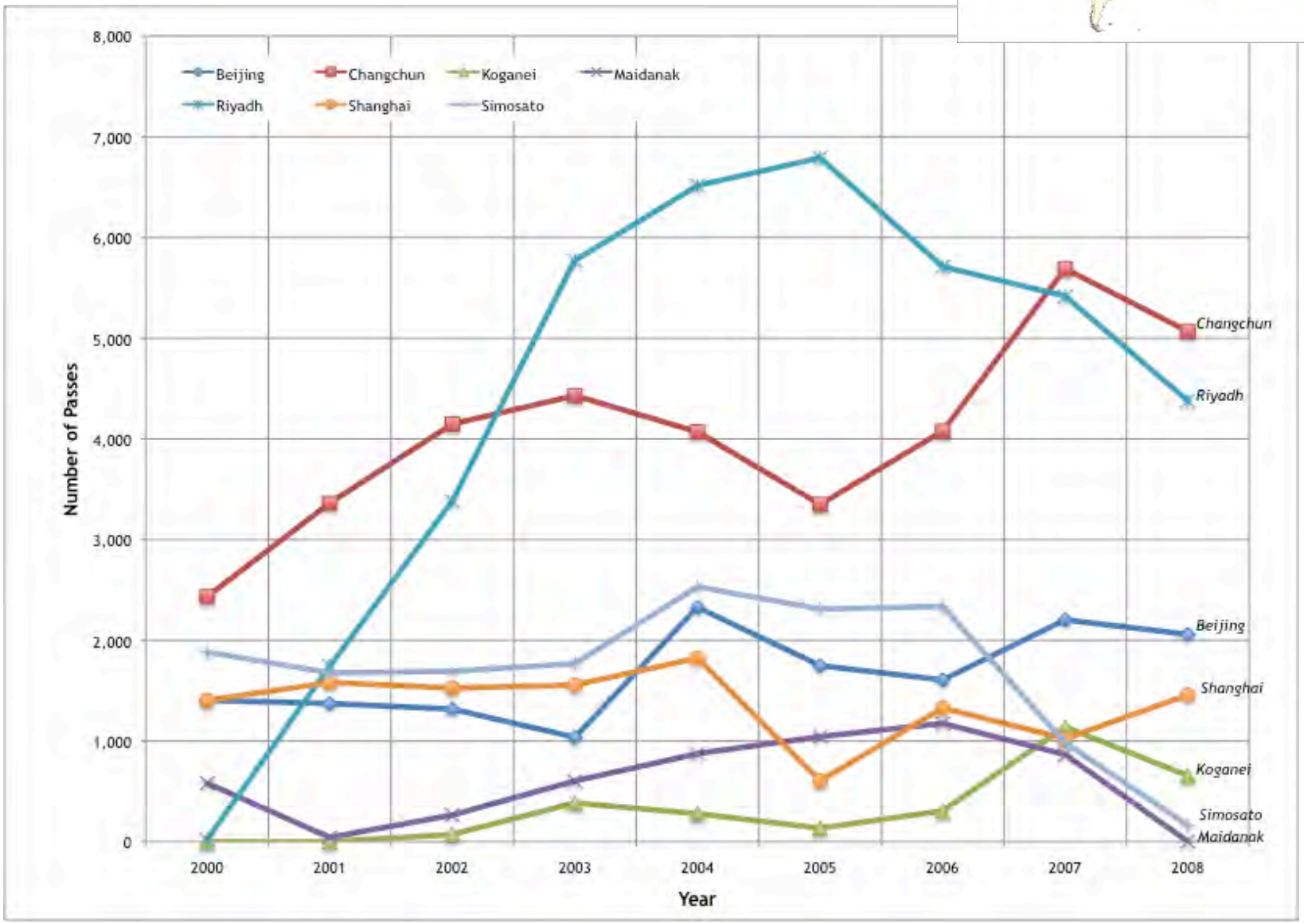


ILRS Network by Region

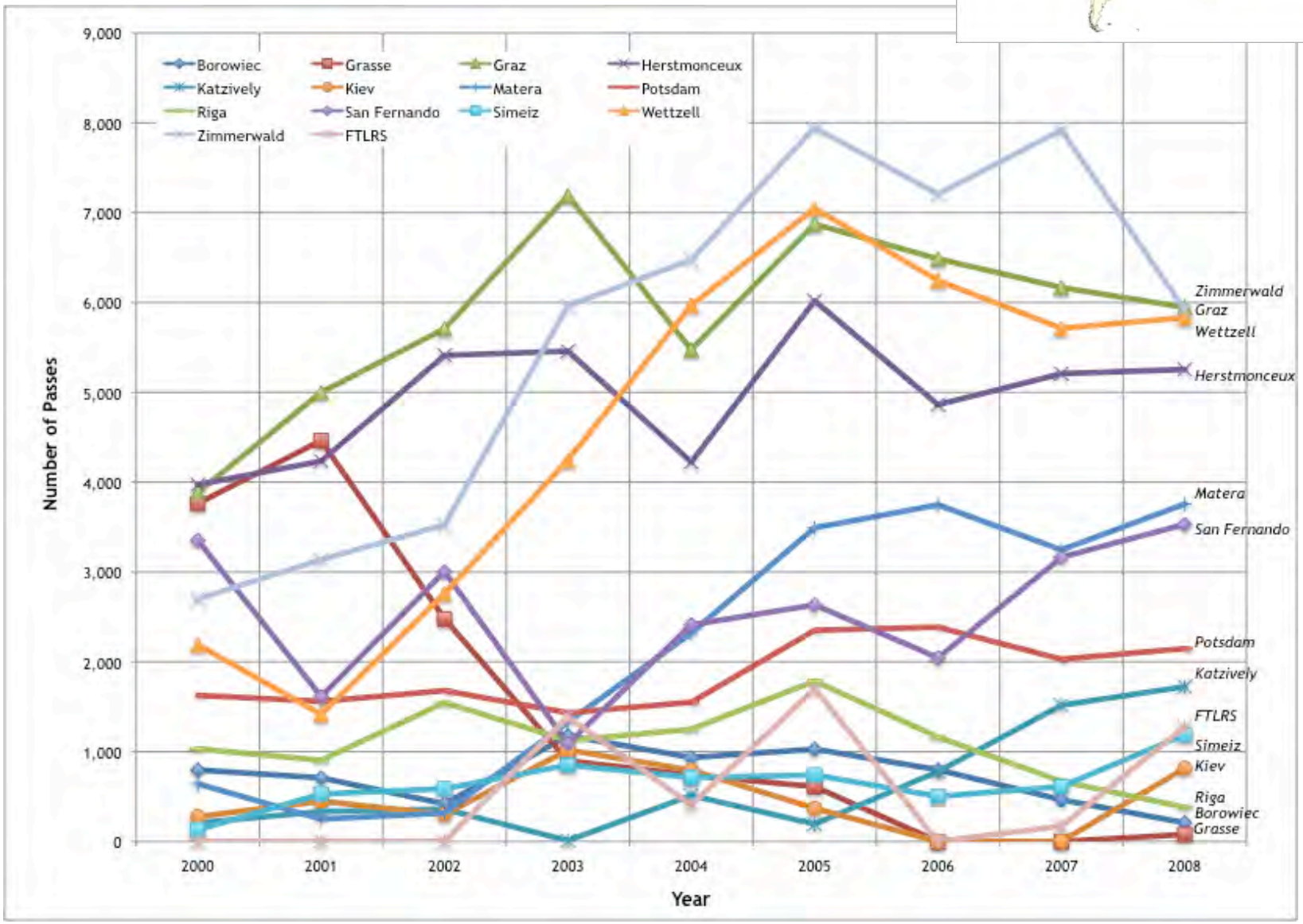


Yearly Pass Totals

Asia

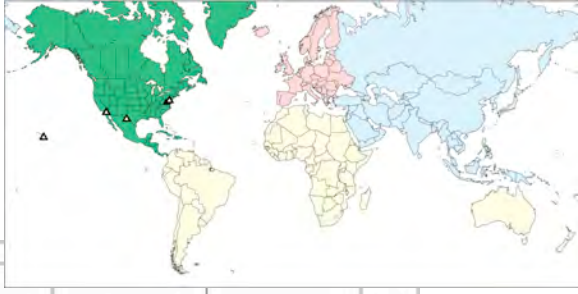


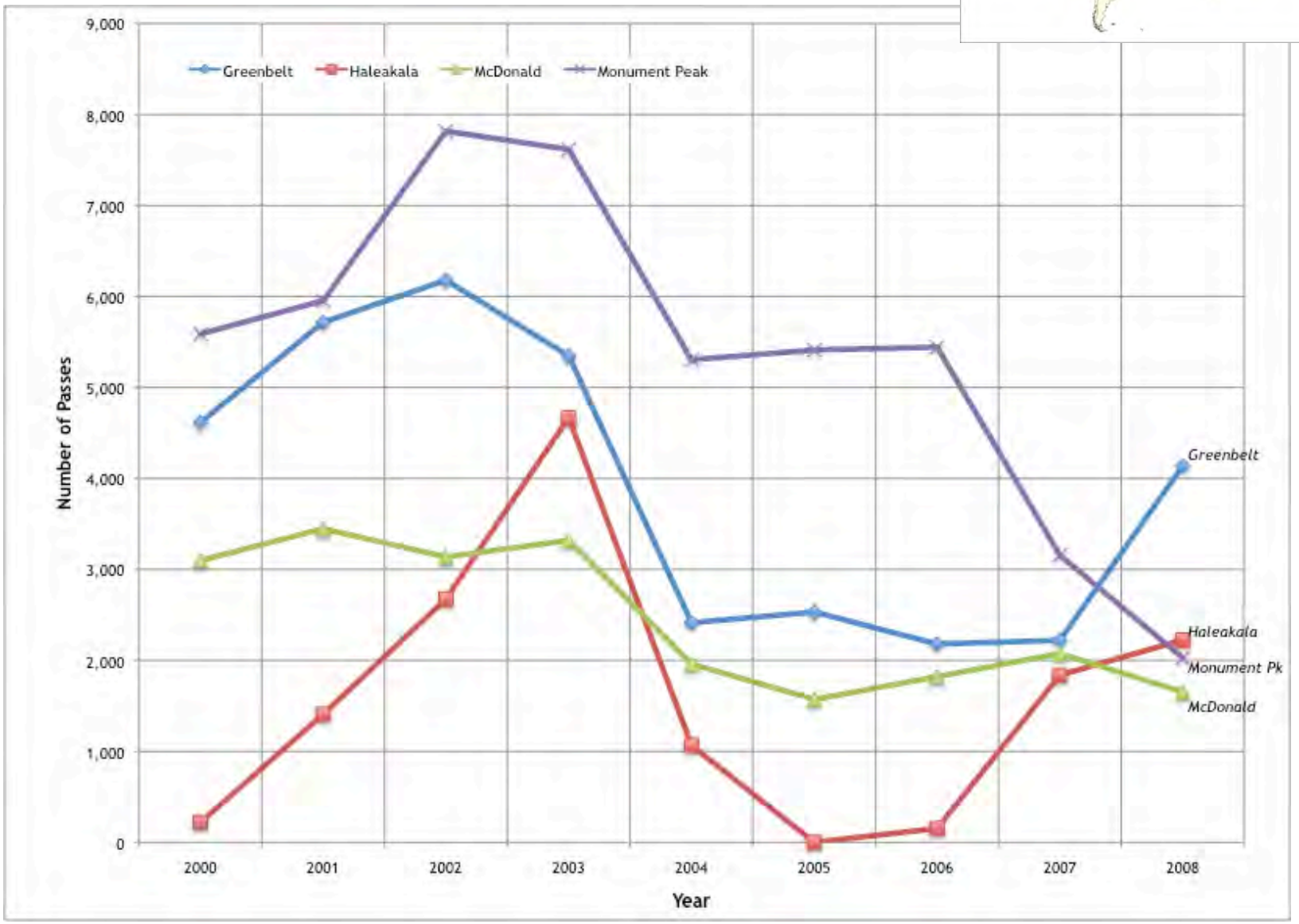
Yearly Pass Totals
Europe



Yearly Pass Totals

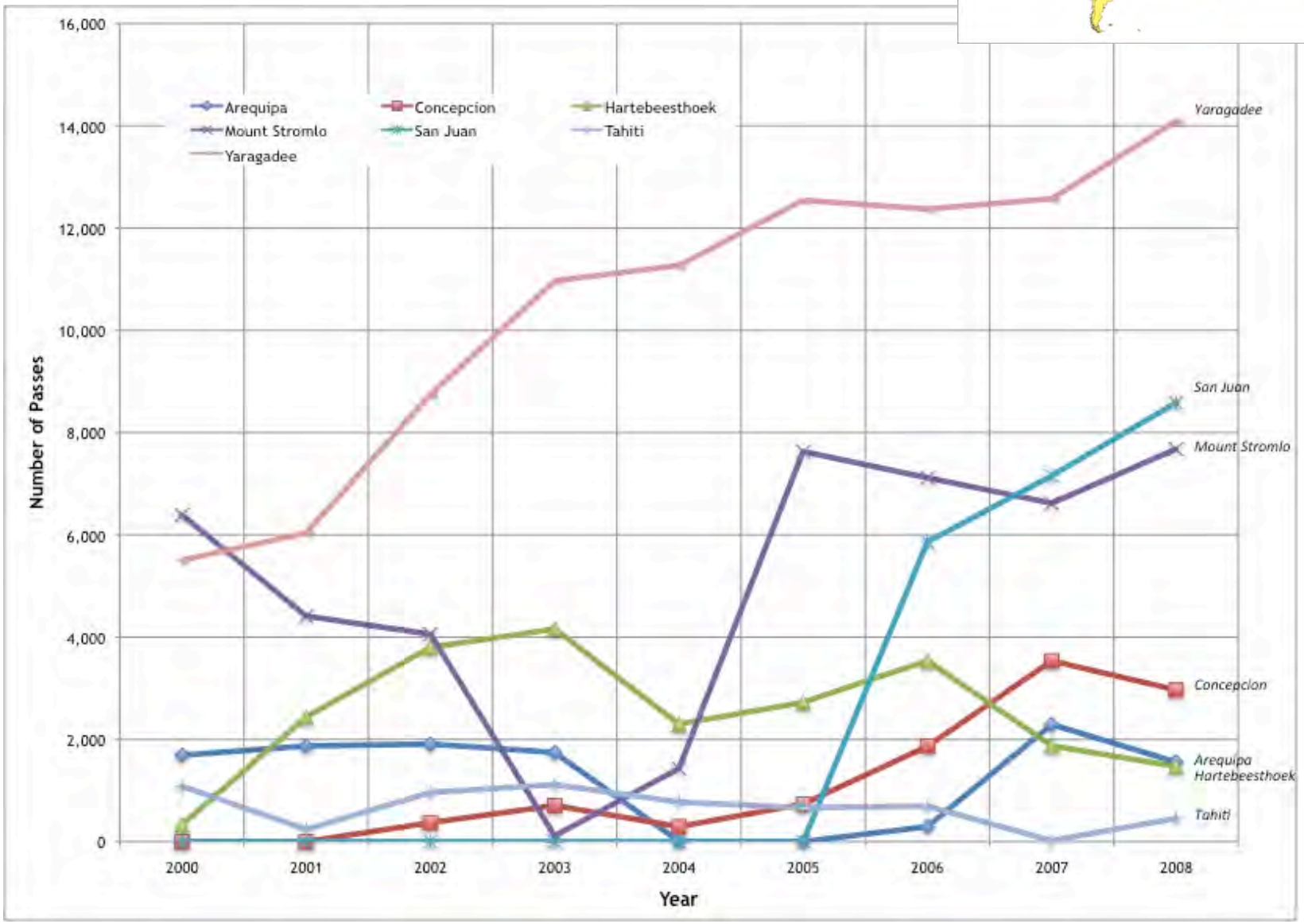
North America





Yearly Pass Totals

Southern Hemisphere



Operational Station Status

- Surveyed stations not currently qualifying for operational status to ask what measures are being taken to reach operational status
- Stations contacted were; *Kiev*, Koganei, Kumning, *Tanegashima*, *Riga*, *Metsahovi*, *Boroweic*, Lviv, Simosato, Komsomolsk, Maidanak, and *Wuhan*
- Responses:
  - Riga
    - Weather, atmospheric conditions, and funding are severe limitations
    - Some modifications planned for the systems including daylight ranging
    - Variations in accuracy assessment by the analysis centers is frustrating
  - Metsahovi
    - Upgrade underway with kHz laser, renovated mount and telescope
    - Major rework of the software is underway
    - Long term plan to replace the system, but funding very tight
    - Expect to be operational by 2010
  - Borowiec
    - Modernization program has been underway, new telescope optics, detector, gating system, software, etc.
    - Problems with many of the new systems including the software
    - Should be ready by year end
    - Weather is a severe problem
  - Tanegashima
    - Troubles with the equipment
    - Bad weather condition
    - Preparing a new backup power supply to avoid the past difficulties with the storm damage
    - Trying to get back to normal operation soon.
  - Wuhan
    - Upgrade underway with Khz laser, new servo and event timer
    - Expect to be operational later this year
  - Kiev
    - Personnel are trying; maybe 1-2 years

Mission Developments

- Supporting 31 missions and lunar tracking
- SOHLA-1 launched on January 2009; first campaign in March, second campaign in fall probable
- GOCE launched March 17, 2009; tracking began March 31 but some problem due to maneuvers until April 7
- GLONASS-115 replaced GLONASS-99 on March 31
- Currently tracking COMPASS-M1; issues with predictions, now cleared up
- Upcoming launches of approved missions:
  - STSAT-1: April 2009
  - ANDE: June 2009
  - BLITS: June 2009
  - LRO: June 2009
  - QZSS-1: 2009
- New Mission Support Request form developed and available on ILRS Web site

GNSS Retroreflector Arrays

- ILRS Standard for GNSS retroreflectors is posted and advertised
  - Some additional constraints on ground pattern have been suggested
- Talk given at the Third Meeting of the International Committee on GNSS in Pasadena on December 8 -12, 2008
- GPS
  - Meeting at Lockheed-Martin on February 18 to discuss placement options for arrays on GPS-3 series (2014 – 17 timeframe)
  - Talk invited at the UPS Users Partnership Council on May 14
  - Keep feeding NASA material to argue for the arrays
- Galileo
  - Met with the Director of ASI to discuss our needs and requirements on Galileo
  - Dialogue underway; they are focused on the ILRS Standard with uncoated cubes
  - Trying to get some cubes to INFN for testing
- COMPASS
  - Success with the uncoated cubes on COMPASS
- Signal link test underway on the GNSS satellites – Graham Appleby

Procedures for New Mission Support

- Prior to launch, the mission requestor should:
  - Complete an ILRS SLR Mission Support Request Form and submit to the ILRS Central Bureau
  - Keep the ILRS CB informed of anticipated mission launch schedules
  - Three months prior to launch, contact the ILRS CB to schedule tests of prediction (in CPF) and data transfer procedures ("quarantine" predictions during tests)
  - As soon as possible following launch, inform the CB of key tracking parameters (e.g., NORAD number and COSPAR ID). A sample CPF should be submitted for review to ensure usability by the ILRS stations. The mission should specify the timeframe for ILRS tracking to commence
  - Report at ILRS meetings on mission results and the contributions of SLR to these results
  - Keep the ILRS community (stations, CB) informed of changes to the mission status (e.g., maneuvers, system problems, etc.) that could affect SLR tracking
- Post launch, the ILRS CB will:
  - Inform the ILRS operations and data centers of the new mission, providing all necessary information (e.g., COSPAR ID, SIC number, normal point interval, prediction provider, special support instructions, start date) to begin data transfer and archive
  - Issue a notice to the ILRS stations and general community announcing the new mission and providing all necessary information to commence tracking
  - Issue new mission reports weekly detailing tracking statistics through SLReport with copies to mission contacts
  - Monitor tracking progress to ensure adequate support is provided

Restricted Tracking

- Survey of stations distributed; 25 responses received
- Summary of results:
  - 13 have elevation restrictions implemented
    - 9 plan to implement: from 1 month to end of 2009 or undefined
  - 14 have go/no-go implemented
    - 9 plan to implement: from 1 month to end of 2009
  - 12 have pass segments implemented
    - 9 plan to implement: from 1 month to end of 2009
  - 1 have power restrictions implemented in automation
    - 11 plan to implement: from 1 month to end of 2009, or TBD
  - 11 have some level of manual control of laser power or beam divergence
- Some have promised to implement certain restriction when it becomes necessary

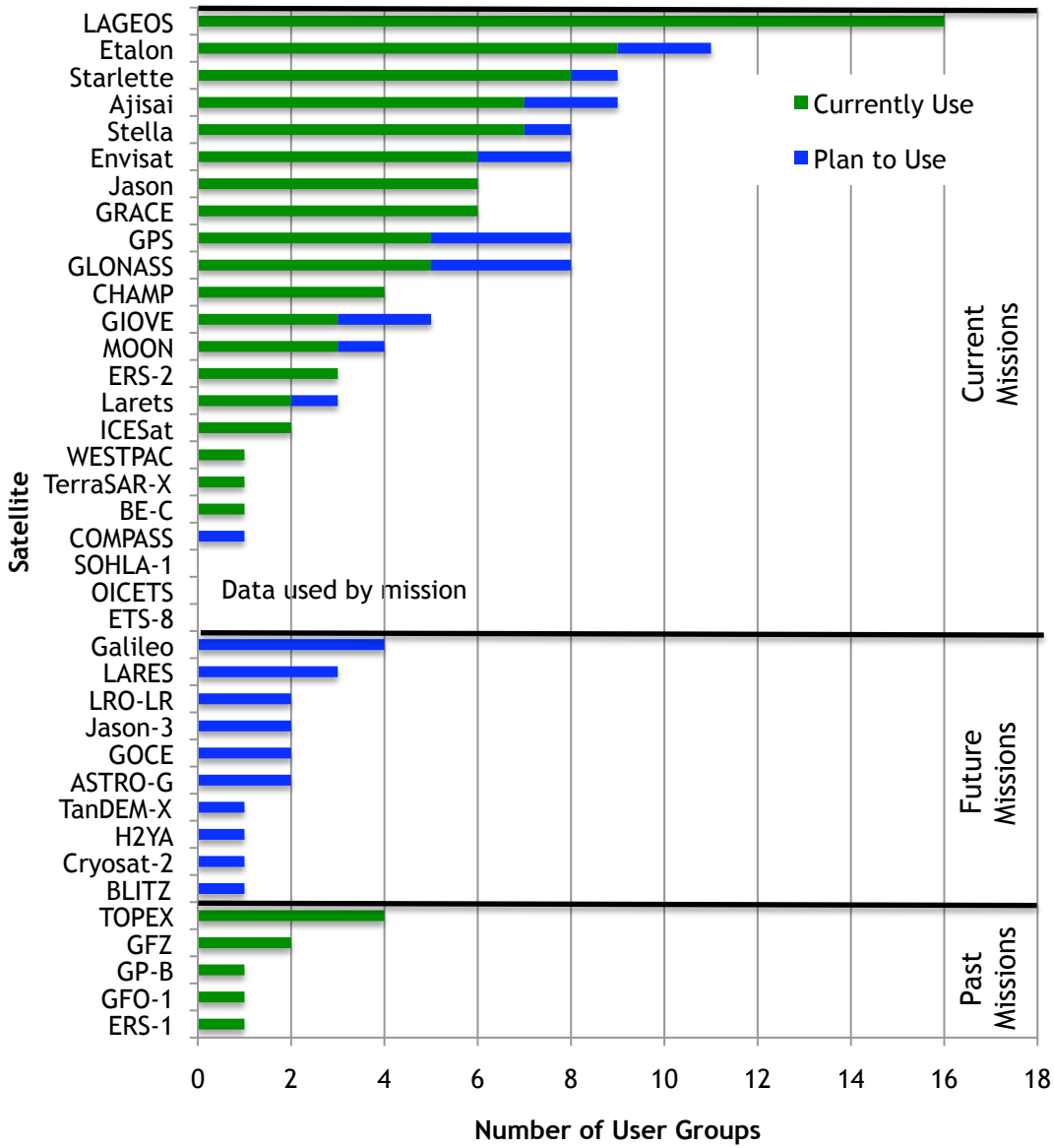
CRD Format Development

- CRD testing performed in phases:
  - Station submits CRD to OCs (HTSI and EDC)
  - OCs perform format validation and new/old normal point comparison and verification
  - HTSI to perform test orbit validation with prediction orbit
  - ACs perform precise orbit validation
  - Station submits only CRD after validation (OCs convert to ILRS NPT format until completion)
- MLRS passed first phase of OC validation at HTSI; awaiting review by ACs
- NASA network software in testing; expect phased deployment into second half of 2009
- Six stations (Matera, Herstmonceux, Zimmerwald, Mt. Stromlo, Changchun, Wettzell) submitting CRD; awaiting OC (EDC) validation
- EDC processing scheduled for mid-April
- Several stations submitting full-rate data in CRD format (with limited validation) for T2L2 and LRO-LR simulations
- Goal for all stations submitting CRD is mid-April 2009
- Data flow only in CRD by January 2010

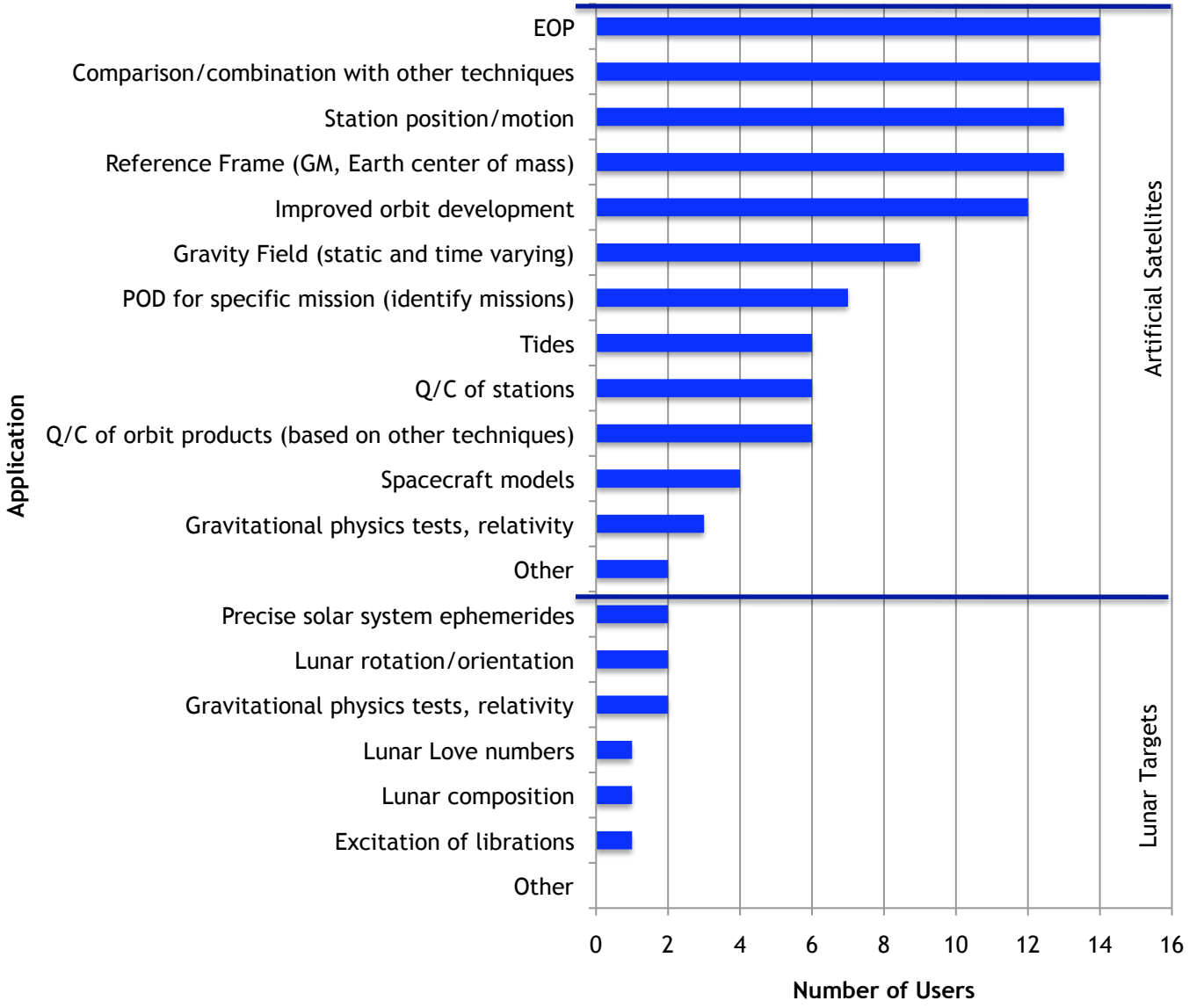
SLR Data User Survey

- Survey analysis community (ACs and AACs) to determine:
  - Targets used
  - Analysis topics
  - ILRS performance
- Sent January 2009 with several reminders
- Response from 16 ACs/AACs (all 8 ACs)
- Summary of comments:
  - All satellites have at least one customer
  - Global station distribution insufficient; additional data from southern hemisphere needed
  - “Core” station accuracy sufficient; non-“core” station accuracy insufficient
  - Stations have cm level bias problems
  - Mm-level accuracy
  - Unified scheme for calibration and accuracy assessment of stations
  - Need improved tables for station corrections
  - Insufficient tracking data from high satellites (Etalon and GNSS); better temporal coverage of entire orbit
  - Sporadic data from CHAMP and GRACE
  - Additional lunar data required
  - More scientific papers written
- Next step: survey mission contacts to:
  - Verify continued ILRS tracking support is required
  - Ensure ILRS is providing adequate support

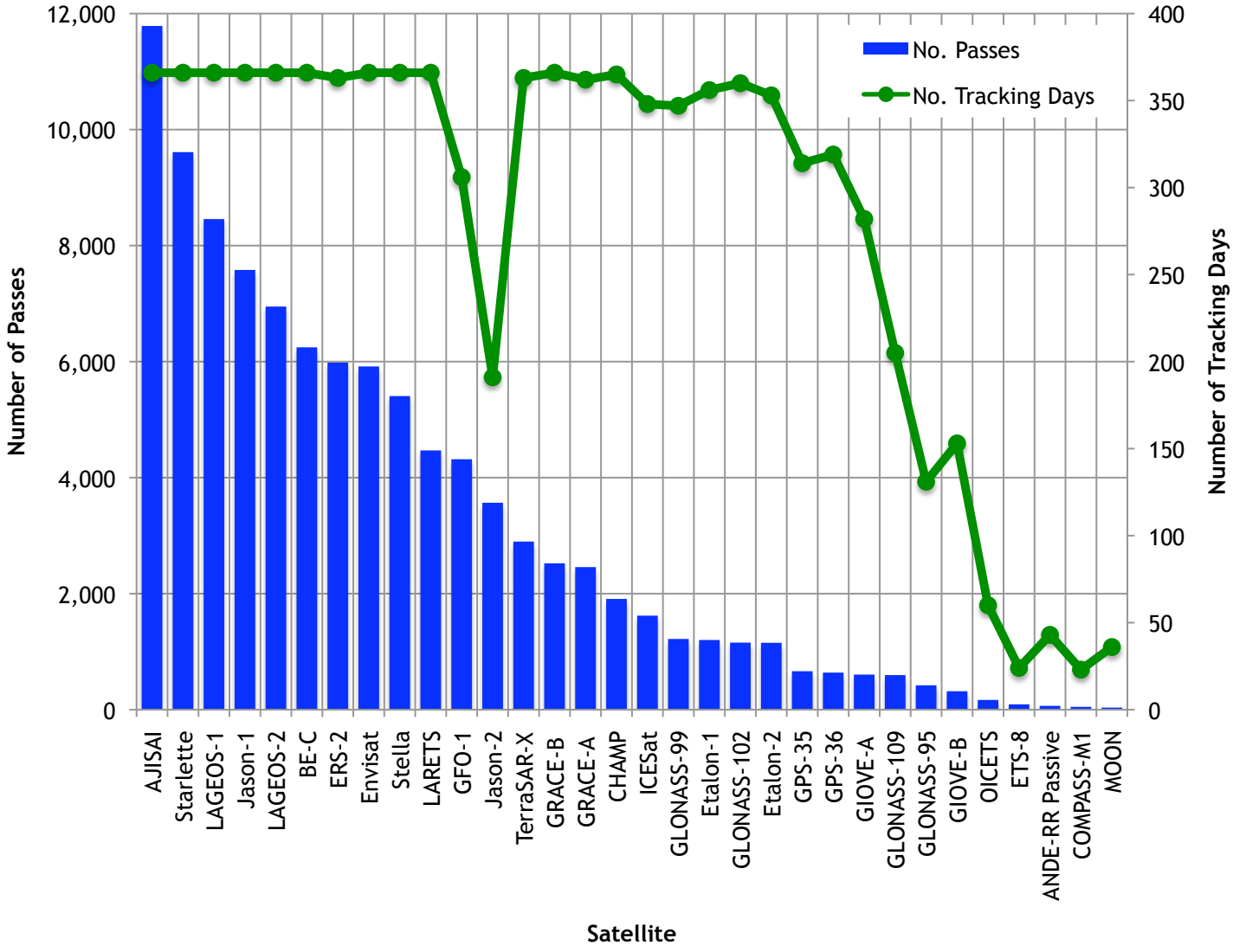
Targets Used by Analysis Community



Applications of Analysis Community



Satellite Tracking (2008)



Other CB Items

- Revised ILRS Mission Support Request form on Web site
  - *http://ilrs.gsfc.nasa.gov/docs/ilrsmsr_0901.pdf*
- Organized GNSS comparison test campaign in March; Appleby, Arnold, Kirchner, Fumin analyzing results
- Contacted Phil Woodworth about FAGS membership
  - FAGS disbanded to be replaced by WDS
  - New members not accepted in the interim
  - Procedures to join WDS TBD
- Call for input to ILRS 2007-2008 Report issued
  - Input due April 15
  - Minimal responses received thus far
- Papers due for proceedings from 16th Laser Ranging Workshop by March 31; printing planned for June 2009
- New ILRS exploders implemented in April

Remaining Action Items

- **Vienna, Austria (April 14, 2008)**
  - The CB will contact the other two stations to ascertain their interest in participating in Stanford Counter testing. *(assigned 04/2008; completed)*
  - The editorial board will develop a table of contents for the ILRS special issue for the Journal of Geodesy. *(assigned 04/2008)*
- **Poznan, Poland (October 15, 2008)**
  - The CB will request a plan and a schedule from each of the non-performing stations to reaching Operational status. Stations not furnishing a plan or not able to reach Operational Status may remain in the ILRS but will be deleted from the ILRS map until they do qualify. *(assigned 10/2008; in process)*
  - The CB will conduct a survey of the Analysis Centers/Associate Analysis Centers on current data needs and report back. *(assigned 10/2008; in process)*
  - The CB should query the stations on plans to use a dynamic priority tool and work with the Working Groups to formulate some simple algorithms to encourage stations to better distribute their tracking efforts. *(assigned 10/2008)*
  - The CB should draft an improved version of the Mission Support Request Form which will also require a signature of an authorized official for the Mission. *(assigned 10/2008; completed)*

Multiple GNSS Tracking Strategies

- Assumptions:
  - Satellites carry the enhanced array (factor of 5 increase in effective cross section)
  - Precise Center of Mass information including the change with fuel consumption required for all spacecraft
  - Many network stations will be using enhanced systems (e.g. KHz ranging, improved detection, etc.) in the 2013 timeframe for improved performance on weak targets
  - Increased automation and data interleaving procedures at the field stations will increase ranging efficiency
- Concepts for an Operational HEO Plan:
  - Support GPS, Galileo, and GLONASS; possibly COMPASS
  - Pointing predictions based on on-board GPS data and SLR data for improved pointing particularly in daylight using real-time analysis
  - Decrease Normal Point intervals (from 5 minutes) as data volume increases, thereby increasing tracking capacity
  - Three segments per pass (ascending, middle, descending)
  - Data available for analysis immediately after each pass
  - Network tracking roster organized for at least 16 GNSS satellites at a time (at least one satellite per orbital plane per system)
  - Tracking cycles set for 30 – 60 days (to cover all satellites within a 12 month period)
  - Greater stress on daylight tracking
  - If data yield is sufficient, divide the stations into subnetworks with different tracking agendas to increase coverage
  - Flexible tracking strategies; organized in cooperation with the agencies involved and the requirements for the ITRF

NGSLR Developments

- Return rate dependent bias has been identified and problem resolved. We now get good agreement with MOBLAS-7 over varying rates without having to model the return rate.
- Have now tracked GLONASS-95, GLONASS-99 and GLONASS-102 at NGSLR with eyesafe laser. Still haven't been able to get returns from GPS-35 or 36.
- System tracking is now very robust. Can track with week old star calibrations.
- Current configuration is laser divergence of 4 arcseconds, receive field of view at 11 arcseconds for daytime and 16 arcseconds for nightime operations. All numbers are FWHM.
- Q-Peak laser energy is decreasing with time. Now only outputting less than 80 microJoules of energy out of the laser (which implies < 40 microJoules out of the telescope). But have been able to track GLONASS-102 recently with this low energy level.
- New GSFC in-house developed laser is at NGSLR for some preliminary testing before going back to be completed and packaged for operations. We expect to have this laser permanently at NGSLR in the next couple of months. This laser will allow us to output ~ 1 milliJoule at 2khz frequency but has the option to reduce the energy and track at eyesafe levels. In addition, the laser has the capability to switch from 1 Hz to 2kHz fire rates and from 100 microJoules to 1+ milliJoule of energy out, and any combination of these. Laser is being developed by Donald B. Coyle and his team at GSFC. It can be made commercially available if there is any interest in the ILRS community.
- After testing with new laser, we will put the Q-Peak laser back into the system and begin co-location with MOBLAS-7. This data will be given to the AWG to checkout so that NGSLR can join ILRS (still need to get those logs to Carey!).
- Following co-location we will go back to working on completing the automated satellite tracking by closing the tracking loop with the four quadrant detector. Note that our one high QE (32%) Hammamatsu MCP failed and our second one is having problems with one of the four quadrants. Trying to find out the expected lifetime of these high QE tubes.
- SLR operations with eyesafe laser will occur during the 2 shift LRO operations (between LR passes). This should give us on average about 25 hours per week of SLR tracking opportunities from NGSLR. The weather will take away at least half of that.

LRO-LR Developments

- NGSLR has just successfully gone through the LRO Flight Operations Review. The system is ready for laser ranging to LRO.
- Launch is now expected to be early June, 2009. Operational ranging will begin about a month after launch.
- There are now four ILRS partner stations participating in LR: MLRS, Zimmerwald, Herstmonceux and Wettzell. We are still working the Agreement for Wettzell but that should be completed shortly. All other stations are finished with this administrative process.
- We are testing a modification to the MOBLAS systems at MOBLAS-7 to allow MOBLAS-5 and MOBLAS-6 to participate in LRO-LR. This modification does not affect SLR operations and uses a completely separate computer and timing card. We expect to have this testing completed in the next few weeks.
- Data flow testing for ILRS stations participating in LRO-LR has begun. First test was on March 25, 2009 worked well.

Meetings

- April 19-24, 2009: EGU General Assembly, Vienna Austria
  - ILRS DF&PWG, MWG, AWG meetings
  - GGOS SC, Networks and Communications Bureau meetings
- August 31-September 04, 2009: IAG Scientific Assembly, Buenos Aires Argentina
- September, 2009: ILRS Workshop (Tracking GNSS), Metsovo Greece
- December 2009: 2nd GGOS Unified Analysis Workshop
- December 14-18, 2009: Fall 2009 AGU
  - GGOS SC, Networks and Communications Bureau meetings
- January 2011: 17th International Workshop on Laser Ranging, Concepción Chile
- 2011: IUGG General Assembly, Melbourne Australia

2009 ILRS Data User Survey

Question	AC: ASI/CGS/Cinzia Luceri	AC: BKG/Maria Mareyen	AC: DGFI/Horst Mueller
1. What general areas of study at your center rely on laser ranging data and products?	- Reference frame - Earth Orientation - Orbit determination - Gravity field - Station bias - Solution combination	Geodesy, reference frames , SLR-analysis support for observatorium Wettzell, Conception	Reference frame (ITRF processing)
2. Which targets are you currently using in your analysis work?	LAGEOS-1,-2, Etalon-1,-2, Starlette, Stella, Ajisai	LAGEOS, Etalon for ILRS products	LAGEOS-1/-2 and Etalon-1/-2
3. What are your applications for each target?			
Artificial Satellites			
Earth Orientation (EOP)	LAGEOS-1,-2, Etalon-1,-2	Yes	Yes
Reference Frame (GM, Earth center of mass)	LAGEOS-1,-2, Etalon-1,-2	Yes	Yes
Gravity Field (static and time varying)	LAGEOS-1,-2, Etalon-1,-2 Starlette, Stella, Ajisai		Yes
Tides			
Comparison/combination with other techniques	LAGEOS-1,-2, Etalon-1,-2 for solution combination with VLBI and GPS	Yes	Yes
Improved orbit development		Yes	Yes
Station position/motion	LAGEOS-1,-2, Etalon-1,-2	Yes	Yes
POD for specific mission (identify missions)	LAGEOS-1,-2, Etalon-1,-2		
O/C of stations	LAGEOS-1,-2		Yes
O/C of orbit products (based on other techniques)			
Spacecraft models			
Gravitational physics tests, relativity			
Other (explain briefly)			
Lunar Reflectors			
Lunar rotation/orientation			
Lunar composition			
Lunar Love numbers			
Excitation of librations			
Gravitational physics tests, relativity			
Precise solar system ephemerides			
Other (explain briefly)			
4. Are you receiving sufficient data volume?	Yes	No, see "New Year", weekend, last day of ILRS-daily-product (ask Erricos). Etalon often only a few observations per week	Yes
5. Are you receiving sufficient spatial and temporal data coverage?	The spatial coverage is still a problem: the North/South balance is better than in the past but the longitudinal data distribution is worse, i.e. more data in the eastern than in the western emisphere	No, global stations' distribution not sufficient (south hemisphere etc.), and see answer to 4.	Yes
6. Are the data of sufficient accuracy for your applications?	Yes	Core stations are OK. The long list of corrections edited by Horst Mueller, DGFI, gives the answer on sufficient accuracy …	Mostly
7. What other satellites do you plan to use in the future?	Low satellites for gravity field recovery	Depends on ILRS instructions (Erricos).	Ajisai, Starlette
8. What other products or data would you like to see from ILRS?	Within the AWG we are already working on: discontinuities, orbits, geocenter	An excellent SLR-IRTF (coord., vel.), updated very soon if a new station begins to work.	Atmospheric loading data, models and measured values
9. How do you access the data (CDDIS, EDC, etc)? Any problems to report?	Mainly ftp	Standard CDDIS, if this server is closed switching to EDC. No 1:1 data-filenaming (different sorting) doubles the programmer's work.	Via Internet, resp. EDC direct disk connection, minor problems
10. What other comments or suggestions do you have regarding the ILRS data and products?			The Web-interface of EDC could be better. On CDDIS pages it is sometimes not so easy to find the information required. Search utility could be helpful. Station information (log file) is often not up to date.

2009 ILRS Data User Survey

Question	AC: GA/Ramesh Govind	AC: GFZ/Rolf Koenig	AC: GRGS/Florent Deleflie
1. What general areas of study at your center rely on laser ranging data and products?	As one of the Global Analysis Centre of the ILRS contributing to AWG products; TRF, EOP. Studying EOP, Geocentre and GM (Scale). Calibration DORIS determined orbits for TOPEX/Jason/Envisat.	- Precise Orbit Determination (POD) - Gravity Field - Reference frame - Relativity - Validation of space-borne GPS tracking	- Earth rotation, and its gravity field - station coordinates, range bias, terrestrial reference frame - fundamental physics - orbit determination and validation - Moon motion
2. Which targets are you currently using in your analysis work?	LAGEOS-1/-2, Etalon-1/-2Lageos-1, Lageos-2, Etalon-1, Etalon-2 Stella, Starlette GLONASS, GIOVE-A/-B TOPEX, Jason-1/-2, Envisat The SLR data for these satellites have been processed.	CHAMP, GRACE-A/-B, TerraSAR-X, GPS-35/-36, ERS-1/-2, TOPEX, LAGEOS-1/-2	- routinely (ILRS AC) : LAGEOS-1/-2, Etalon-1/-2 - other geodetic targets (gravity field and terrestrial reference frame): Starlette, Stella, Ajisai, CHAMP, GRACE - fundamental physics: Jason-2 - orbit determination and validation: Jason-1, Jason-2, GPS-35, GPS-36, GIOVE-A, GIOVE-B - the Moon !
3. What are your applications for each target?			
Artificial Satellites			
Earth Orientation (EOP)	LAGEOS-1/-2, Etalon-1/-2, GLONASS	LAGEOS-1/-2, GPS, CHAMP, GRACE	Yes
Reference Frame (GM, Earth center of mass)	LAGEOS-1/-2, Stella, Starlette	LAGEOS-1/-2, GPS, CHAMP, GRACE	Yes
Gravity Field (static and time varying)		LAGEOS-1/-2, GPS, CHAMP, GRACE	Yes
Tides		LAGEOS-1/-2, GPS, CHAMP, GRACE	Yes
Comparison/combination with other techniques	TOPEX, Jason-1/-2, Envisat, GLONASS, GIOVE-A/-B	LAGEOS-1/-2, GPS, CHAMP, GRACE	Yes
Improved orbit development		GNSS, CHAMP, GRACE	Yes
Station position/motion	LAGEOS-1/-2	LAGEOS-1/-2, ERS-1/-2, TOPEX	Yes
POD for specific mission (identify missions)		CHAMP, GRACE-A/-B, TerraSAR-X, ERS-1/-2, TOPEX, LAGEOS-1/-2	Yes (LAGEOS-1/-2, Etalon-1/-2, Starlette, Jason-2
O/C of stations	LAGEOS-1/-2		
O/C of orbit products (based on other techniques)	TOPEX, Jason-1/-2, Envisat	CHAMP, GRACE-A/-B, TerraSAR-X, GPS-35/-36	
Spacecraft models			
Gravitational physics tests, relativity		LAGEOS-1/-2	Yes
Other (explain briefly)			Yes: SLR for T2L2 activities
Lunar Reflectors			
Lunar rotation/orientation			Yes
Lunar composition			
Lunar Love numbers			
Excitation of librations			
Gravitational physics tests, relativity			Yes
Precise solar system ephemerides			Yes
Other (explain briefly)			
4. Are you receiving sufficient data volume?	Adequate – within reason for some spacecraft	This is a really difficult question, depending on your attitude you could answer YES or NO. Inbetween, here some answers of my colleagues: More data would be desirable in the first day(s) after manoeuvres, in November-December and during Christmas and New Year periods for ERS-2. There could always be more for CHAMP, GRACE-A, and GRACE-B. Rather yes, could be more	No for the Moon, Yes for satellites, except for T2L2, regarding the theoretical number of stations which should have a good time&frequency equipment, but cannot use it for different reasons !
5. Are you receiving sufficient spatial and temporal data coverage?	As best that can be done. Some core stations outperform others in data volume; non-core stations need some improvement in there data volume and regularity. The spatial data coverage is a major concern and limitation to the work.	As above: Sufficient, but could be more. It makes no sense to speak of spatial and temporal data coverage for CHAMP and GRACE as the data are very sporadic. More SLR stations in the southern hemisphere would be desirable.	Temporal coverage ok Lack of data above Southern hemisphere, due to the shape of the network, of course. For T2L2 : no, concerning the east part of Europe and US.
6. Are the data of sufficient accuracy for your applications?	Yes, from the core stations. Some non-core stations need improvement.	Answers of most of my colleagues was: YES. One had a distinct opinion: What is the accuracy of SLR normal points? It would be good, if finally there will be a unified scheme for calibration and accuracy assessment for all laser stations even if they come from different manufacturers. This could also help to get a clear idea of the biases and systematic errors of each SLR system. Currently it is hard to find any quality information on the ILRS website. It is hidden somewhere. As far as I know the accuracy information is based on the fits of Lageos solutions. But this does not help very muchif there is data from only a few stations available. Then, it has to be precisely clear how to treat their data.	A millimeter of accuracy, which is a next challenge of laser ranging, would provide new exciting scientific challenges. T2L2 : it depends on the time&frequency equipment available at each site and it depends also on the used format for full rate SLR (merit or CRD).
7. What other satellites do you plan to use in the future?	All the proposed LEO satellites (due for launch in the coming 5 years that will be equipped with multiple tracking systems (GPS, DORIS and retro-reflectors).	ENVISAT, CRYOSAT-2, GOCE, TanDEM-X, GALILEO, GLONASS, LARES	GOCE, Galileo constellation. LRO. COMPASS ?
8. What other products or data would you like to see from ILRS?	Nil at this time.		More scientific papers written all together, on the basis of our operational products built through the AWG for example. It is very important, from French authorities, to have more opportunities for scientists as we are, to participate to international scientific papers ; from these point of view, the AWG should be more active and should deploy actions in 2009, to have at least a special issues for SLR-LLR activities in a Journal. We are fully ready to help Erricos, Cinzia, and the others, to initiate this task, and ever ready to be in charge of this project, if everyone agrees to participate.
9. How do you access the data (CDDIS, EDC, etc)? Any problems to report?	CDDIS and EDC through ftp.	Via both, CDDIS and EDC. No major problems, the DCs are doing a great job.	Both DC for most of applications. For T2L2: Full rate SLR data comes directly from CDDIS (Merit fmt) and from EDC (CRD fmt). Except for Graz station which provided us data with local format and files just for examples.
10. What other comments or suggestions do you have regarding the ILRS data and products?		-ILRS is a good working service. Thank you! tes. -C.f. point 6. Moreover, it would be nice, if certain information is spread to the community as a whole like ceasing the distribution of IRVS. Another suggestion is to introduce fully automized reliably working SLR stations that are capable to deliver even more normal points for LEOs like CHAMP and GRACE without reducing the data for other priority missions. This could be a very useful action to be taken in order to support the economic development in the current situation of financial desaster.	Regarding SLR full rate data: it could be very usefull for T2L2 activities to have at our disposal every date of laser pulses which have been emitted by SLR stations, even if no return were detected ; in fact in this case, some pulses should have been detected on board Jason-2 by T2L2 , and so having the start dates of the corresponding stations should permit us to improve the monitoring of DORIS !... We hope that these answers will help ILRS to continue to provide scientific results based on satellite and lunar ranging !!!.

2009 ILRS Data User Survey

Question	AC: JCET/Erricos Pavlis	AC: NSGF/Graham Appleby	AAC: AIUB/Daniela Thaller
1. What general areas of study at your center rely on laser ranging data and products?	Reference Frames, POD, network performance, global and regional tectonics, gravitational (static & temporally varying) modeling, altimeter calibration, fundamental physics tests, combination of techniques studies and cross-calibration, atmospheric modeling validation studies.	Reference frame realisation via contribution to daily ILRS efforts, research into local site motion	- Quicklook analysis of SLR observations to GNSS satellites (GPS, GLONASS, GIOVE): range residuals w.r.t. GNSS orbits derived at CODE IGS analysis center; the results for GPS and GLONASS are provided daily to the ILRS - orbit determination for GIOVE-A/-B - orbit determination for CHAMP and GRACE - weekly solutions of station coordinates, ERPs and orbital parameters based on Lageos data
2. Which targets are you currently using in your analysis work?	LAGEOS-1 & -2, Etalon-1 & -2, Starlette, Ajisai	LAGEOS-1/-2, Etalon-1/-2	GPS, GLONASS, GIOVE, LAGEOS CHAMP, GRACE
3. What are your applications for each target?			
Artificial Satellites			
Earth Orientation (EOP)	Yes	Yes, daily X-pole, Y-pole, LoD	Yes
Reference Frame (GM, Earth center of mass)	Yes	Earth CoM	Yes
Gravity Field (static and time varying)	Yes		
Tides	Yes		
Comparison/combination with other techniques	Yes	Comparison with GNSS and local absolute gravity	Yes
Improved orbit development	Yes	Yes	Yes
Station position/motion	Yes	Yes, for the global ILRS stations	Yes
POD for specific mission (identify missions)	Yes	Some work on Envisat, ERS-2	
O/C of stations	Yes		Yes
O/C of orbit products (based on other techniques)	Yes		Yes
Spacecraft models	Yes		
Gravitational physics tests, relativity	Yes		
Other (explain briefly)		Test of IGS GNSS orbital quality and systematic effects using laser range data	
Lunar Reflectors			
Lunar rotation/orientation			
Lunar composition			
Lunar Love numbers			
Excitation of librations			
Gravitational physics tests, relativity			
Precise solar system ephemerides			
Other (explain briefly)			
4. Are you receiving sufficient data volume?	VERY LOW for Etalon-1 & -2	Yes for LAGEOS No for Etalon	see question 5.
5. Are you receiving sufficient spatial and temporal data coverage?	In all cases we are NOT getting a complete longitudinal coverage with any combination of targets on a daily basis (as required for reliable EOP estimates)	Yes for LAGEOS No for Etalon	Especially for the high satellites (GNSS), the passes are not fully covered by SLR observations, and the gaps can be even very long. It would be nice to have a better temporal coverage for the entire satellite orbit. In addition, a parallel tracking of several stations would give some redundancy in the orbit determination. However, we are aware of the fact that there are several limitations for SLR to reach this goal (not all stations are able to track high satellites, actual global coverage of stations, huge effort in general, etc.).
6. Are the data of sufficient accuracy for your applications?	Only about a dozen stations meet the accuracy level required by most applications	Yes, mostly but with some poor quality stations	for some stations not (large biases)
7. What other satellites do you plan to use in the future?	Stella, Larets, BLITS, the Moon	All the laser-tracked GNSS vehicles	Etalon
8. What other products or data would you like to see from ILRS?	Near real-time reduction of data collected from the stations that supply hourly data	Would be interested in precise orbits of the geodetic satellites for comparison purposes.	
9. How do you access the data (CDDIS, EDC, etc)? Any problems to report?	Automatically from CDDIS and manually from EDC if CDDIS unavailable. Need to harmonize the file structure of the two to avoid manual work. If EDC does not want to physically change things, they can at least provide a "ghost" structure using links with the same naming conventions as on CDDIS, so that to an outsider their data base looks the same as CDDIS even if it is physically organized in a different manner.	Both EDC and CDDIS via automatic ftp scripts. NO problems to report	CDDIS (probably EDC in future, because of collecting the observations of one day in one file)
10. What other comments or suggestions do you have regarding the ILRS data and products?	We need a faster communication of changes at stations in order to keep the analysis products at the same quality despite those changes. Perhaps a "heads up" message to the AWG/AC/AAC lists, sufficiently earlier than the event would alert them to upcoming changes so that they can anticipate them prepared. It is usually much more difficult and not as effective if these are communicated days and sometimes months after the fact.	Clearer route on ILRS web to current data corrections would be valuable.	We are very glad that the ILRS supported our request for tracking the GNSS satellites during eclipsing period and manoevers. Unfortunately, the amount of data during the last eclipsing period (September/October 2008) was not very big due to a disadvantageous position of the satellite during the entry in the eclipsing phase and the exit out of the eclipsing phase (only a very few stations could have seen the satellite, and only at very low elevations). Nevertheless, such experiments are very interesting, so that we hope, that the ILRS will again support a similar request in future.

2009 ILRS Data User Survey

Question	AAC: CSR/John Ries	Other: GSFC/Frank Lemoine	AAC: Hitotsubashi U/Toshi Otsubo
1. What general areas of study at your center rely on laser ranging data and products?	Geodesy, geodynamics, relativity, orbital dynamics, aeronomy	A. Precision Orbit Determination for Altimetry Satellites. B. Precision Orbit Determination for Gravity Field studies. C. ITRF Development. D. Intertechnique comparisons (DORIS/GPS) E. POD to the Lunar Reconnaissance Orbiter (after launch) F. Validation of atmospheric density models.	Precise orbit determination, TRF
2. Which targets are you currently using in your analysis work?	LAGEOS-1, LAGEOS-2, Starlette, Stella, Ajisai, BE-C, Etalon-1, Etalon-2, Topex/Poseidon, Jason-1, GRACE-A, GRACE-B, ICESat, GFZ-1, GP-B	TOPEX/Poseidon, Jason-1, Jason-2, Envisat, Starlette, Stella, Ajisai, LAGEOS-1/-2, GFO-1, Larets, GFZ-1, Westpac, GRACE-A/-B	Extracting highest accuracy from SLR technology
3. What are your applications for each target?			
Artificial Satellites			
Earth Orientation (EOP)	For LAGEOS-1, LAGEOS-2, Starlette, Stella, Ajisai, BE-C, Etalon-1, Etalon-2:	LAGEOS-1/-2, GFO-1, Larets, GFZ-1, Westpac, GRACE-A/-B	
Reference Frame (GM, Earth center of mass)	Time variable gravity, terrestrial reference frame (station motion, Earth orientation, geocenter motion), fundamental constants such as GM of the Earth, atmospheric drag, relativity, precise orbit determination,satellite altimeter calibration, laser range quality control (bias, time-bias, precision), station position corrections (tides, loading), satellite surface force modeling (solar and terrestrial radiation pressure, thermal re-radiation effects).	LAGEOS-1/-2, GFO-1, Larets, GFZ-1, Westpac, GRACE-A/-B	
Gravity Field (static and time varying)	For GRACE-A, GRACE-B, ICESat: precise orbit validation	LAGEOS-1/-2, GFO-1, Larets, GFZ-1, Westpac, GRACE-A/-B	
Tides	For Topex/Poseidon, Jason-1: precision orbit determination for ocean altimetry	LAGEOS-1/-2, GFO-1, Larets, GFZ-1, Westpac, GRACE-A/-B	
Comparison/combination with other techniques	For GFZ-1, GP-B: gravity model evaluation	TOPEX/Poseidon, Jason-1, Jason-2, Envisat	
Improved orbit development	No significant work with LLR data	T/P, Jason-1, Jason-2, Starlette, Stella	Yes
Station position/motion		LAGEOS-1/-2/Starlette/Stella/Envisat	Yes
POD for specific mission (identify missions)		Altimeter missions (Jason-1, Jason-2, TOPEX, Envisat, ICESAT, LRO)	Yes (GPS, GLONASS, Etalon, LAGEOS, Ajisai, Starlette, Stella, ERS-2, Jason-1,2, Envisat, etc)
O/C of stations			Yes
O/C of orbit products (based on other techniques)		Jason-1, Jason-2, TOPEX, Envisat, GRACE-A/-B	
Spacecraft models		Envisat, GFO, Jason-1, Jason-2, TOPEX, LRO	
Gravitational physics tests, relativity			
Other (explain briefly)			
Lunar Reflectors			
Lunar rotation/orientation			
Lunar composition			
Lunar Love numbers			
Excitation of librations			
Gravitational physics tests, relativity			
Precise solar system ephemerides			
Other (explain briefly)			
4. Are you receiving sufficient data volume?	Data volume for high satellites (Etalon, GPS) is poor, and coverage of complete passes rare. Tracking of very low satellites (ICESat, GRACE) is sparse, which somewhat limits the SLR data for validating orbit accuracy. Tracking of geodetic satellites in the 800-1500 km altitude range is generally good in total volume.	More southern hemisphere data would be nice. The yield of some stations could be improved	Yes
5. Are you receiving sufficient spatial and temporal data coverage?	The spatial coverage is very poor. Much of the hemisphere containing the Pacific ocean is essentially not covered, due to poor data yield at Hawaii and Tahiti. This has implications for orbit determination (and monitoring) for ocean altimeter satellites, and for the terrestrial reference frame.	Generally yes.	Yes, but more uniform global coverage is preferable.
6. Are the data of sufficient accuracy for your applications?	Biases at the cm level remain a problem, and target/detector interaction needs to be better understood. The data is probably precise to a few mm, but the accuracy may be closer to 1 cm.	Generally yes.	Precision-wise yes, accracy-wise we don't know.
7. What other satellites do you plan to use in the future?	GNSS targets with reflector arrays, LARES.	Jason-3, H2YA, LRO, LARES, GPS	GALILEO, more low orbiters and ASTRO-G.
8. What other products or data would you like to see from ILRS?	The list of bias, time-bias, frequency bias and meteorological data problems is documented to some degre, but the implementation of corrections for the known problems to the data is extremely difficult. New users are seriously intimidated when faced with the list of issues, with no available mechanism for actually applying the corrections to the data. Even long-time users are hard-pressed to track down and apply all the known corrections, and each user implements this independently as best he/she can. Either a corrected data set, or a common code-based correction model that all users can implement is strongly suggested. Better models for the target/detector interaction, so that the center of mass correction is more accurate, is necessary to improve the precision as well as the absolute accuracy of the data. There is some research in this area, but much more work is needed. This would seem to be one of the 'tall poles' limiting the data accuracy.	N/A	No
9. How do you access the data (CDDIS, EDC, etc)? Any problems to report?	CDDIS. No significant problems to report. Data is generally posted in a timely manner. However, see Item 10.	CDDIS. No problems, - except on the rare occasions the network cuts off GSFC from the universe	No, we are greatly obliged to data centers. We would be glad if the CRD storage structure (directory/file names for daily/hourly? data etc) is announced soon.
10. What other comments or suggestions do you have regarding the ILRS data and products?	The updating of the data when a problem is discovered is somewhat ad hoc. It's not clear what the criteria are for updating the data vs leaving it alone and adopting a model. It can also take quite a while to get the data updated when a problem is found and data re-issued.		

2009 ILRS Data User Survey

Question	AAC: IFE/Juergen Mueller	AAC: MCC/Vladimir Glotov	AAC: Newcastle/Philip Moore
1. What general areas of study at your center rely on laser ranging data and products?	We analyse all LLR data and generate standard and special solutions, especially related to Earth rotation and Gravitational Physics. But we also use all kinds of reference frame data and EOP series where major contributions are provided by SLR.	- Terrestrial Reference Frame and System; - Precise orbit determination (different satellites, now more important - the Global Navigation Satellites Systems GLONASS and GPS); - Models and software validation.	Gravity field studies including the temporal variation, geocentre studies
2. Which targets are you currently using in your analysis work?	All retro-reflector arrays on the Moon	LAGEOS, GLONASS, LARETS	LAGEOS-1,-2, Starlette, Stella
3. What are your applications for each target?			
Artificial Satellites			
Earth Orientation (EOP)		LAGEOS	Yes
Reference Frame (GM, Earth center of mass)		LAGEOS	Yes
Gravity Field (static and time varying)			Yes
Tides			
Comparison/combination with other techniques		GLONASS	Yes
Improved orbit development		GLONASS, LARETS	
Station position/motion		LAGEOS	Yes
POD for specific mission (identify missions)			
O/C of stations			
O/C of orbit products (based on other techniques)		GLONASS	
Spacecraft models		LAGEOS, GLONASS, LARETS	
Gravitational physics tests, relativity			
Other (explain briefly)			
Lunar Reflectors	All, with main emphasis on General Relativity. This year we will more concentrate on the lunar interior.		
Lunar rotation/orientation			
Lunar composition			
Lunar Love numbers			
Excitation of librations			
Gravitational physics tests, relativity			
Precise solar system ephemerides			
Other (explain briefly)			
4. Are you receiving sufficient data volume?	More Lunar Ranging data were very welcome, especially from more sites regulary tracking the Moon.	Insufficient volume of the data for GLONASSes (often)	Yes - but can always use more of course
5. Are you receiving sufficient spatial and temporal data coverage?	No, both spatial and temporal coverage is poor at this time.	Insufficient spatial and temporal data coverage for GLONASSes (often)	No - the laser network is too sparse for proper analysis of temporal varaiability from station displacements.
6. Are the data of sufficient accuracy for your applications?	The data quality is quite good.	Sufficient mainly	On the whole - yes
7. What other satellites do you plan to use in the future?	May be, data from lunar orbiters, if there are any. Or data from luanr transponders, beacons …	Etalon, Low satellites	Ajisai, Envisat
8. What other products or data would you like to see from ILRS?	If better predictions of the lunar reflectors were available, may be, more (SLR) sites would track the Moon.		Better tables for station corrections
9. How do you access the data (CDDIS, EDC, etc)? Any problems to report?	We use bot and have no problems.	CDDIS, EDC (no problems mainly)	CDDIS - no problems
10. What other comments or suggestions do you have regarding the ILRS data and products?	It would be helpful if the ILRS could push lunar tracking.	To continue the work as effective as possible … Very interesting will be the information concerning precise spacecrafts models for the different missions (if possible).	ILRS might consider coordinating the piggy back launch of further spherical geodetic satellites to add to Lageos, stella and starlette to permit greater decoupling between gravity field harmonics for long-term temporal variability studies.

2009 ILRS Data User Survey

Question	AAC: NICT/Tadahiro Gotoh	AAC: IAA/Georgy Krasinsky
1. What general areas of study at your center rely on laser ranging data and products?	Studies of non-gravitational force model, especially SRP. Validation of LEO orbits solved by GPS H-L SST.	Dynamical applications of SLR and a multi-disciplinary issue of LLR.
2. Which targets are you currently using in your analysis work?	Ajisai, LAGEOS, Jason, GRACE, CHAMP, GLONASS, GPS	LAGEOS-1/-2
3. What are your applications for each target?		
Artificial Satellites		
Earth Orientation (EOP)		Yes
Reference Frame (GM, Earth center of mass)		
Gravity Field (static and time varying)		Yes
Tides		Yes
Comparison/combination with other techniques	Yes	
Improved orbit development	Yes	
Station position/motion		
POD for specific mission (identify missions)		
O/C of stations		
O/C of orbit products (based on other techniques)		
Spacecraft models	Yes	
Gravitational physics tests, relativity		
Other (explain briefly)		
Lunar Reflectors		
Lunar rotation/orientation		
Lunar composition		
Lunar Love numbers		
Excitation of librations		
Gravitational physics tests, relativity		
Precise solar system ephemerides		
Other (explain briefly)		
4. Are you receiving sufficient data volume?	Yes	This is no the case of LLR data. The data from the new laser station Apache have to be taken not from the same database CDDIS as all the others but from the site
5. Are you receiving sufficient spatial and temporal data coverage?	Yes	
6. Are the data of sufficient accuracy for your applications?	Yes	About 10 percent of SLR data are to be ignored due to poor quality
7. What other satellites do you plan to use in the future?	ASTRO-G	
8. What other products or data would you like to see from ILRS?	Nothing special	
9. How do you access the data (CDDIS, EDC, etc)? Any problems to report?	FTP from CDDIS	
10. What other comments or suggestions do you have regarding the ILRS data and products?		

SLR Tracking Restriction Summary by Station

			Type of restriction											
			Elevation				Go/Nogo Flag				Pass Segment			
Site	ID	Code	Y/N	Tests	Missions	Plans?	Y/N*	Tests	Missions	Plans?	Y/N*	Tests	Missions	Plans?
Golosiiv	1824	GLSL	Y				N			Y: months	N			Y: months
Lviv	1831	LVIV	N			Y: 2-3 mon	N			Y: 6 mon	N			Y: 2-3 mon
Maidanak 1	1863	MAID												
Maidanak 2	1864	MAIL												
Komsomolsk	1868	KOML												
Mendeleevo	1870	MDVL												
Simeiz	1873	SIML	N			Y: 1 mon	N			Y: 1 mon	N			Y: 1 mon
Riga	1884	RIGL	N			N	Y	ALOS	ALOS	-	Y	ALOS	ALOS	-
Katsively	1893	KTZL												
McDonald	7080	MDOL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat	-	Y	simulation	none	-
Yarragadee	7090	YARL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Greenbelt	7105	GODL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Monument Peak	7110	MONL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Haleakala, HI	7119	HA46	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Tahiti	7124	THTL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Wuhan	7231	WUHL												
Changchun	7237	CHAL												
Beijing	7249	BEIL												
Koganei	7308	KOGC	N				M	Ajisai	ALOS		M	Ajisai	ALOS	
Tanegashim	7358	GMSL	M			Y	Y	ALOS tests	ALOS	-	M			Y
Arequipa	7403	AREL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Concepcion	7405	CONL	Y	Visual test of shutter	all		N			Y: 3-6 mon	N			Y: 3-6 mon
San Juan	7406	SJUL												
Hartebeesthoek	7501	HARL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Metsahovi2	7806	METL												
Zimmerwald	7810	ZIML	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Borowiec	7811	BORL	N			Y end 2009	N			Y end 2009	N			Y end 2009
Kunming	7820	KUNL												
Shanghai	7821	SHA2												
San Fernando	7824	SFEL												
Mt. Stromlo	7825	STL3	N			Y; undefined	Y	1)JAXA demo; 2)formal tests	1)ALOS; 2)Debris tracking	-	Y	1)JAXA demo; 2)formal tests	1)ALOS; 2)Debris tracking	-
Helwan	7831	HLWL												
Riyadh	7832	RIYL												
Simosato	7838	SISL	N			Y-week	N			Y – week	Y	Ajisai	ALOS	-
Graz	7839	GRZL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat	-	N			N
Herstmonceux	7840	HERL	Y	Ajisai	ICESat	-	Y	Ajisai	ICESat/ALOS	-	Y	Ajisai	ALOS	-
Potsdam	7841	POT3	N			tbd	N			tbd	N			tbs
Grasse	7845	GRSM	N			Y	N			Y	N			Y
Matera	7941	MATM	N			Y – 043009	N			Y – 043009	N			Y – 053109
Wettzell	8834	WETL												
FTLRS	--	--	N			Y	N			Y	N			Y
TROS	--	--												
Stafford			Y	Day-long detailed tests		-	N			unknown	N			unknowm

*: Y(es), N(o), or (M)anual

SLR Tracking Restriction Summary by Station

			Type of restriction						
			Maximum Power						
Site	ID	Code	Y/N*	Tests	Missions	Plans?	S/W control of laser power?	S/w control of Divergence?	Comments
Golosiiv	1824	GLSL	N			N: >year	N	N	
Lviv	1831	LVIV	N			N	N	N	Power restrictions “impossible”
Maidanak 1	1863	MAID							
Maidanak 2	1864	MAIL							
Komsomolsk	1868	KOML							
Mendeleevo	1870	MDVL							
Simeiz	1873	SIML	N			N	N	N	03/18/09
Riga	1884	RIGL	N			N			Elevation and Power restrictions possible to add
Katsively	1893	KTZL							
McDonald	7080	MDOL	M	simulation	LRO	Y	Soon	Y	
Yarragadee	7090	YARL	N			N	N	N	Manual control over power and divergence
Greenbelt	7105	GODL	N			N	N	N	Manual control over power and divergence
Monument Peak	7110	MONL	N			N	N	N	Manual control over power and divergence
Haleakala, HI	7119	HA46	N			N	N	N	Manual control over power and divergence
Tahiti	7124	THTL	N			N	N	N	Manual control over power and divergence
Wuhan	7231	WUHL							
Changchun	7237	CHAL							
Beijing	7249	BEIL							
Koganei	7308	KOGC	N			N	N – Manual	N	Restriction implemented for ALOS only; no automated restrictions
Tanegashim	7358	GMSL	M			Y	Y	Y	Manual control over power and divergence
Arequipa	7403	AREL	N			N	N	N	two manual power settings; no plans for other implementation
Concepcion	7405	CONL	N			Y: 1-2 mon	Y (control of Nds)	Y	
San Juan	7406	SJUL							
Hartebeesthoek	7501	HARL	N			N	N	N	Manual control over power and divergence
Metsahovi2	7806	METL							
Zimmerwald	7810	ZIML	Y	simulation	LRO		Y	Y	Software-controller attenuator in laser beam
Borowiec	7811	BORL	N			Y end 2009	N	N	Manual control currently; station undergoing modernization
Kunming	7820	KUNL							
Shanghai	7821	SHA2							
San Fernando	7824	SFEL							
Mt. Stromlo	7825	STL3	N			not planned	manual; preconfigured	Y; needs study	
Helwan	7831	HLWL							
Riyadh	7832	RIYL							
Simosato	7838	SISL	N	beam div on		Y – soon	N	Y	resources are available
Graz	7839	GRZL	N			Y,when needed	For cal; automation	yes;automation possible	
Herstmonceux	7840	HERL	N				20mj@ 10Hz;40mJ@ 1kHz	yes	Power controlled by choice of laser and beam divergence
Potsdam	7841	POT3	N			tbd	yes, now	yes	Will consider implementation after major station upgrade starting mid-2009
Grasse	7845	GRSM	N			Y	Y	Y	To implement in “some months”
Matera	7941	MATM	N			Y - TDB	N	Y	
Wettzell	8834	WETL							
FTLRS	--	--	N			Y	Y	N	To implement in “some months”
TROS	--	--							
Stafford			N				Y (control of Nds; laser manual)	Manual (lengthy setup)	DoD clearinghouse certification; manual go/no-go possible;

*: Y(es), N(o), or (M)anual