International Laser Ranging Service

Agenda

1.	Opening Remarks	G. Appleby
2.	ILRS Stations/Action Items	M. Pearlman/C. Noll
3.	Data Issues	
	a. CRD format implementation	R. Ricklefs
	b. Disposition of full-rate data	R. Ricklefs
	c. Normal point formulation	M. Torrence
4.	IERS Report/ITRF Status	B. Schutz/Z. Altamimi
5.	Working Group Briefs and Recommendations	
	a. Working group responsibilities	G. Appleby
	b. Analysis	E. Pavlis/C. Luceri
	c. Missions	G. Appleby/S. Wetzel
	d. Data Formats and Procedures	W. Seemueller/R. Ricklefs
	e. Networks and Engineering	G. Kirchner
	f. Transponder	U. Schreiber
6.	Task Force Reports	
	a. Communications	M. Torrence
	b. Center-of-Mass Corrections	G. Appleby
7.	Network Reports	
	a. EUROLAS	G. Bianco
	b. NASA	S. Wetzel
	c. WPLTN	R. Govind
	d. LLR	J. Mueller
8.	ILRS Special Issue in Journal of Geodesy	E. Pavlis
9.	LRO-LR Update	M. Torrence
10.	GGOS Activities	M. Pearlman
11.	New Business	M. Pearlman/WG Chairs
12.	Other Business	M. Pearlman

ILRS Governing Board

Technical University of Vienna
Vienna, Austria

May 03, 2010
18:00-21:00

ILRS Governing Board 2010

Director of the Central Bureau	Mike Pearlman (appointed)
Secretary of the Central Bureau	Carey Noll (appointed)
President of IAG Commission 1	Zuheir Altamimi (appointed)
IERS Representative	Bob Schutz (appointed)
EUROLAS Network Representatives	Giuseppe Bianco, Francis Pierron
NASA Network Representatives	David Carter, Jan McGarry
WPLTN Network Representatives	Yang Fumin, Ramesh Govind
Data Center Representative	Wolfgang Seemueller
LLR Representatives	Juergen Mueller
Analysis Representatives	Cinzia Luceri, Erricos Pavlis
At-Large Representatives	Graham Appleby*, Georg Kirchner

* Chair for 2010

ILRS Working Groups

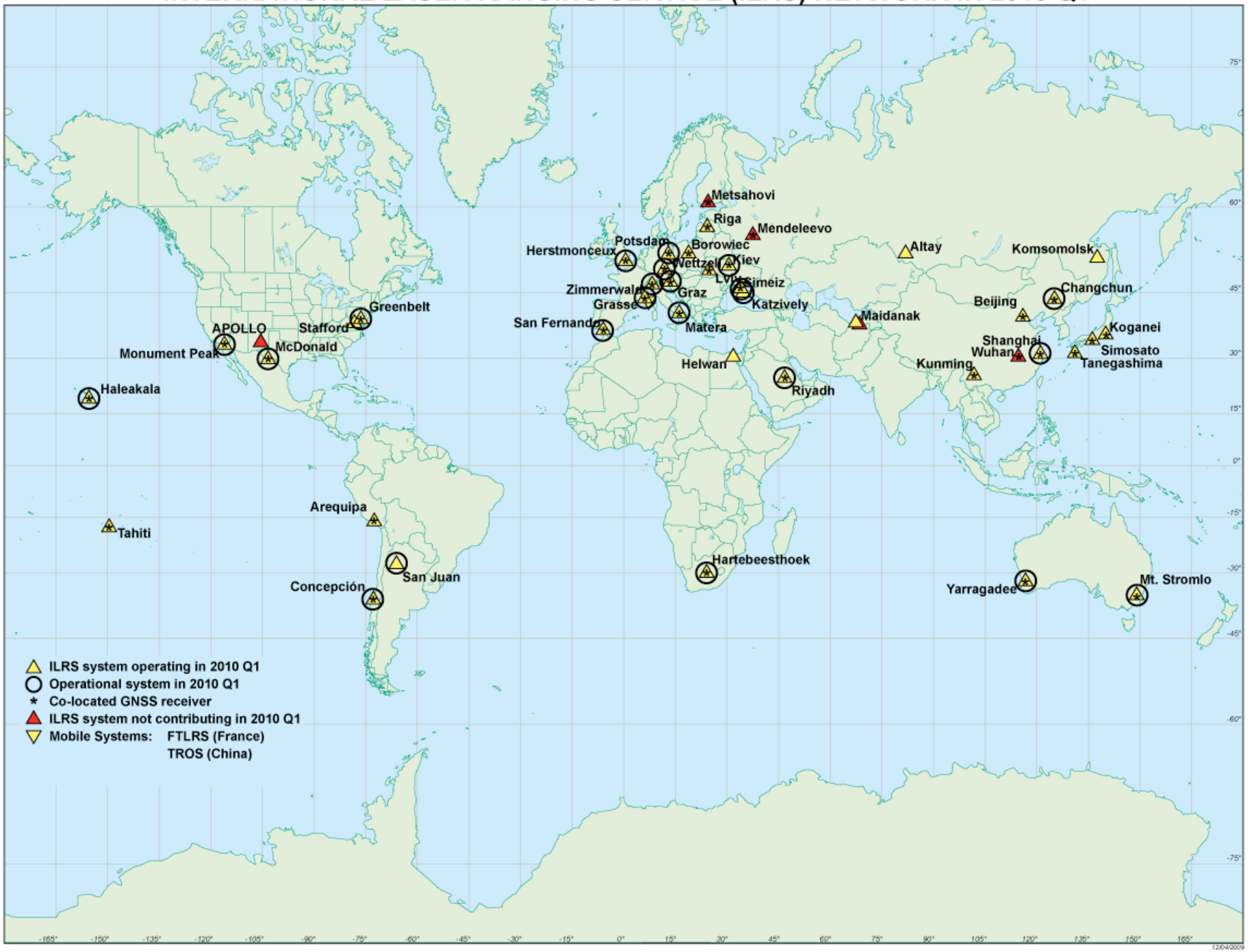
- Analysis
  - E. Pavlis/C. Luceri
- Missions
  - G. Appleby/S. Wetzel
- Data Formats and Procedures
  - W. Seemueller/R. Ricklefs
- Networks and Engineering
  - G. Kirchner/U. Schreiber
- Transponder
  - U. Schreiber/J. McGarry

Central Bureau Update

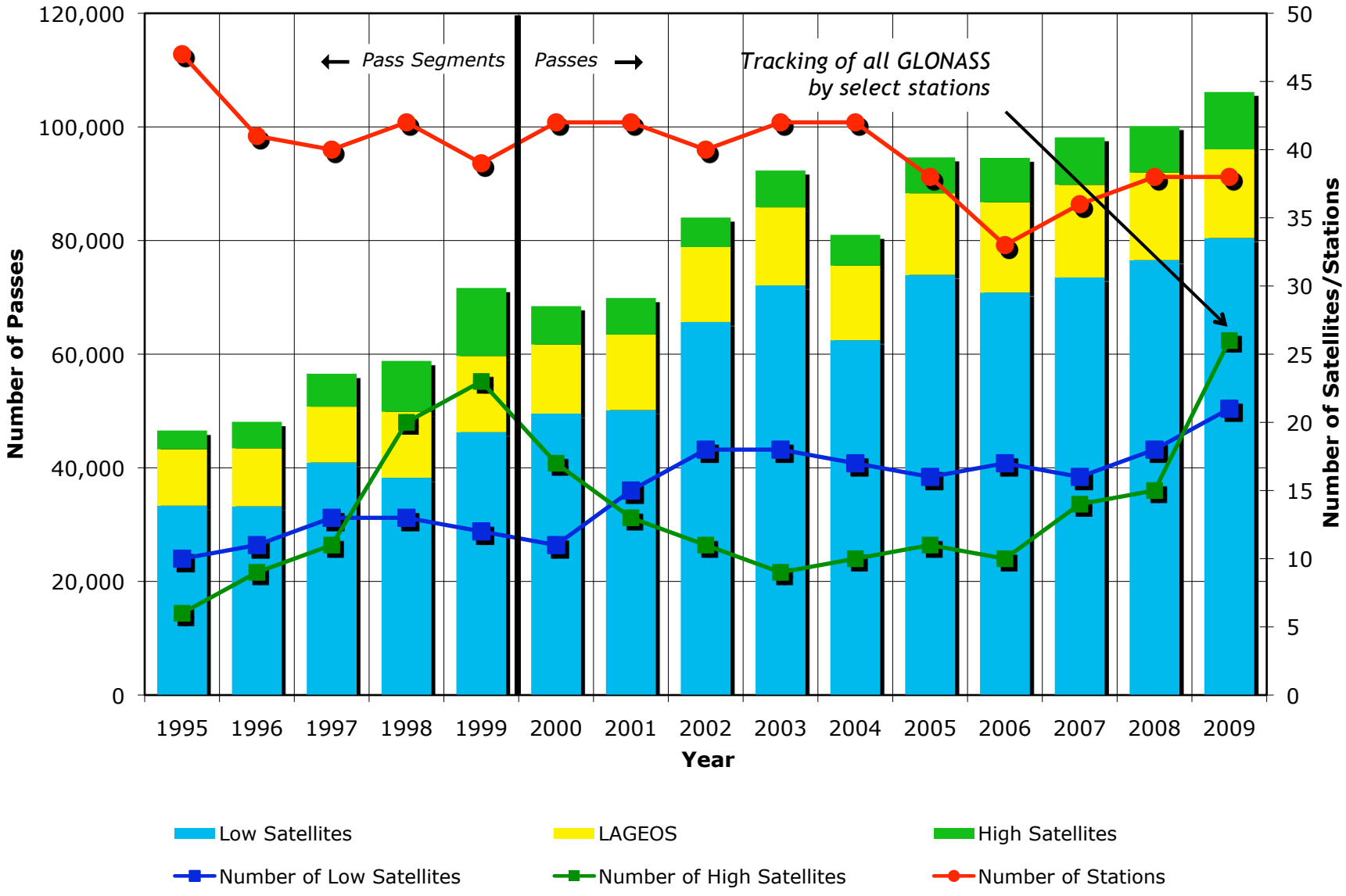
Network Status

- 29 stations providing tracking data in 2010 thus far (38 in 2009)
- Most productive stations are Yarragadee, Zimmerwald, Mt. Stromlo, Greenbelt, Changchun, Wettzell, San Juan, Graz, San Fernando, and Herstmonceux
- All MOBLAS systems (except Tahiti) and MLRS operating at 10Hz on low satellites
- Arequipa operational after MCP failure; data under evaluation
- Concepcion/TIGO under system testing after 02/2010 earthquake
- DORIS at Monument Peak shut down due to interference with U.S. emergency broadcast transmissions; beacon most likely to be moved to Goldstone
- Wettzell not operational due to mechanical issues with the telescope drive; staff hopes to bring new system (SOS-W) online shortly
- Simosato system testing after replacement of telescope
- APOLLO lunar system to participate in LRO-LR and two-way ranging experiments in 2010; data (in CRD format) available on CDDIS

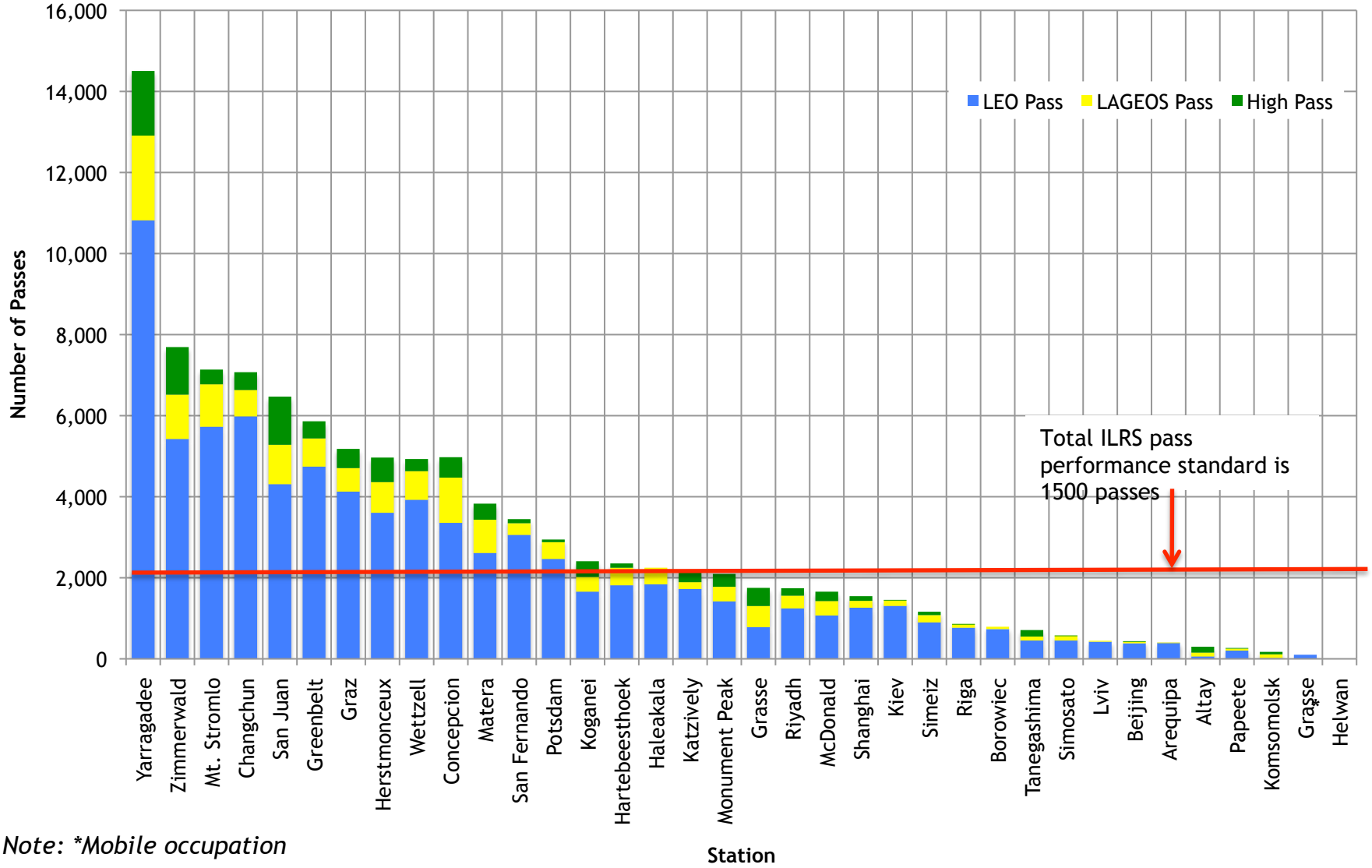
INTERNATIONAL LASER RANGING SERVICE (ILRS) NETWORK IN 2010 Q1



Annual Data Yield



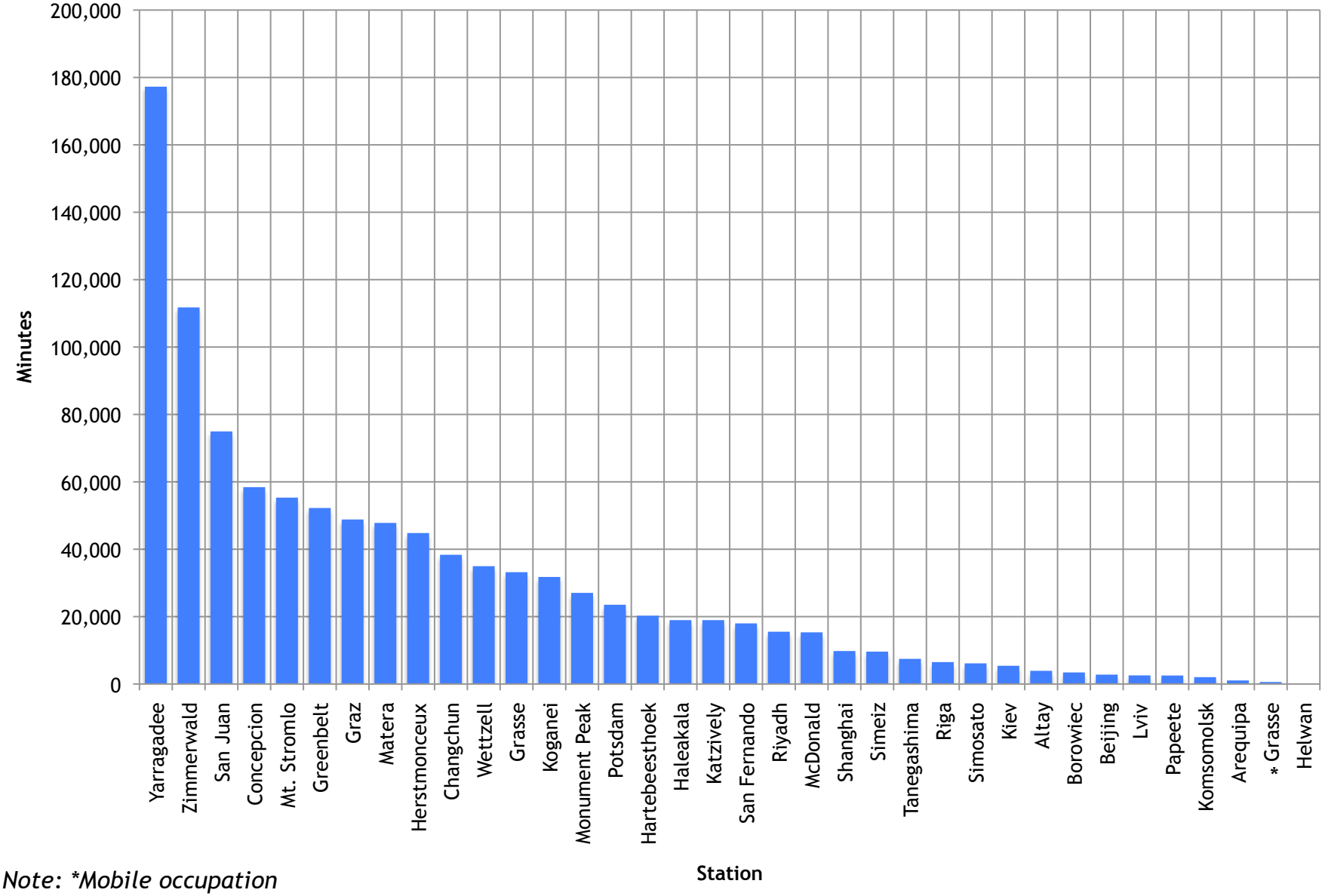
Station Performance
All Satellites (2010Q1)



*Note: *Mobile occupation*

Station Performance

Minutes of Data (2010Q1)

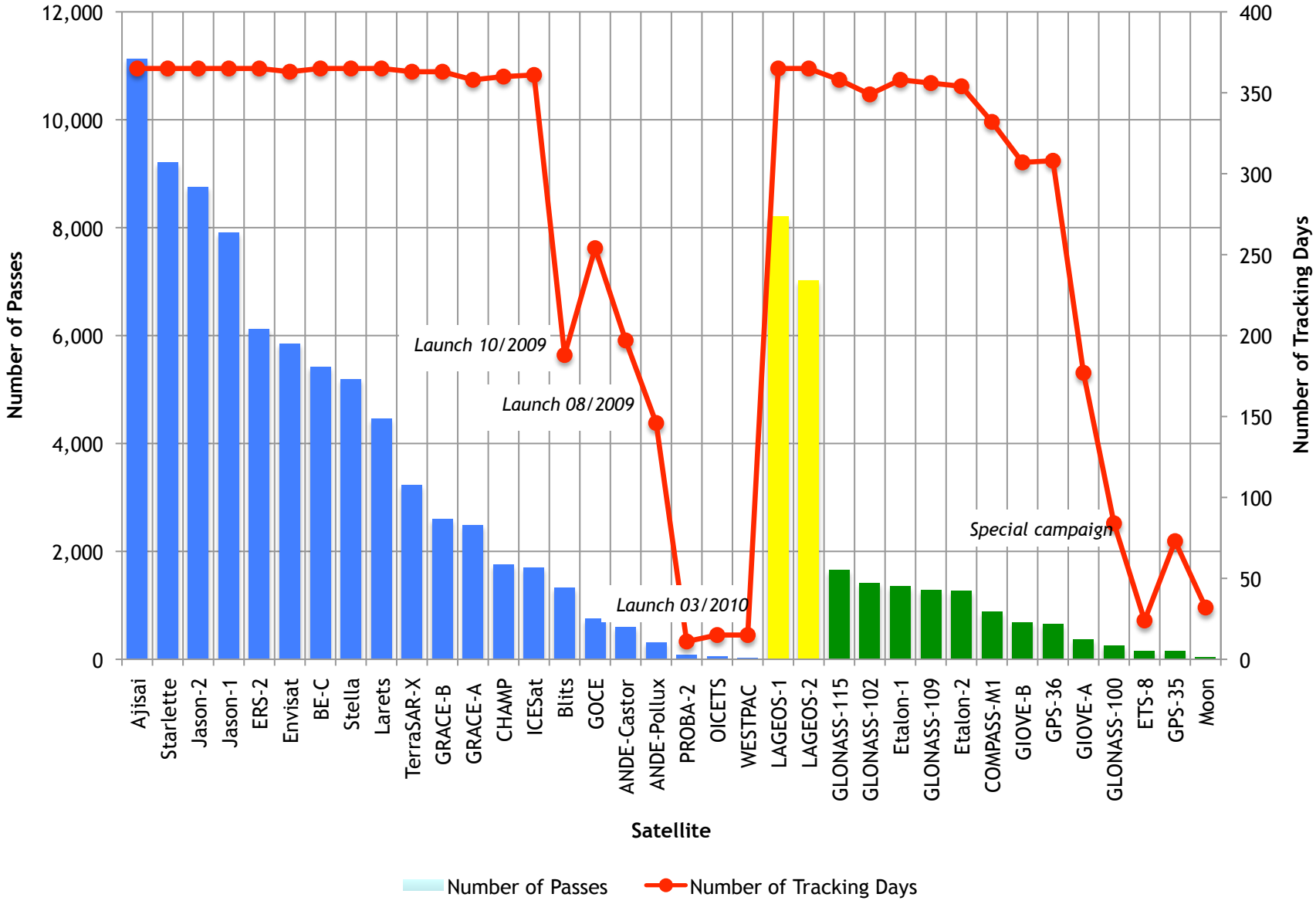


*Note: *Mobile occupation*

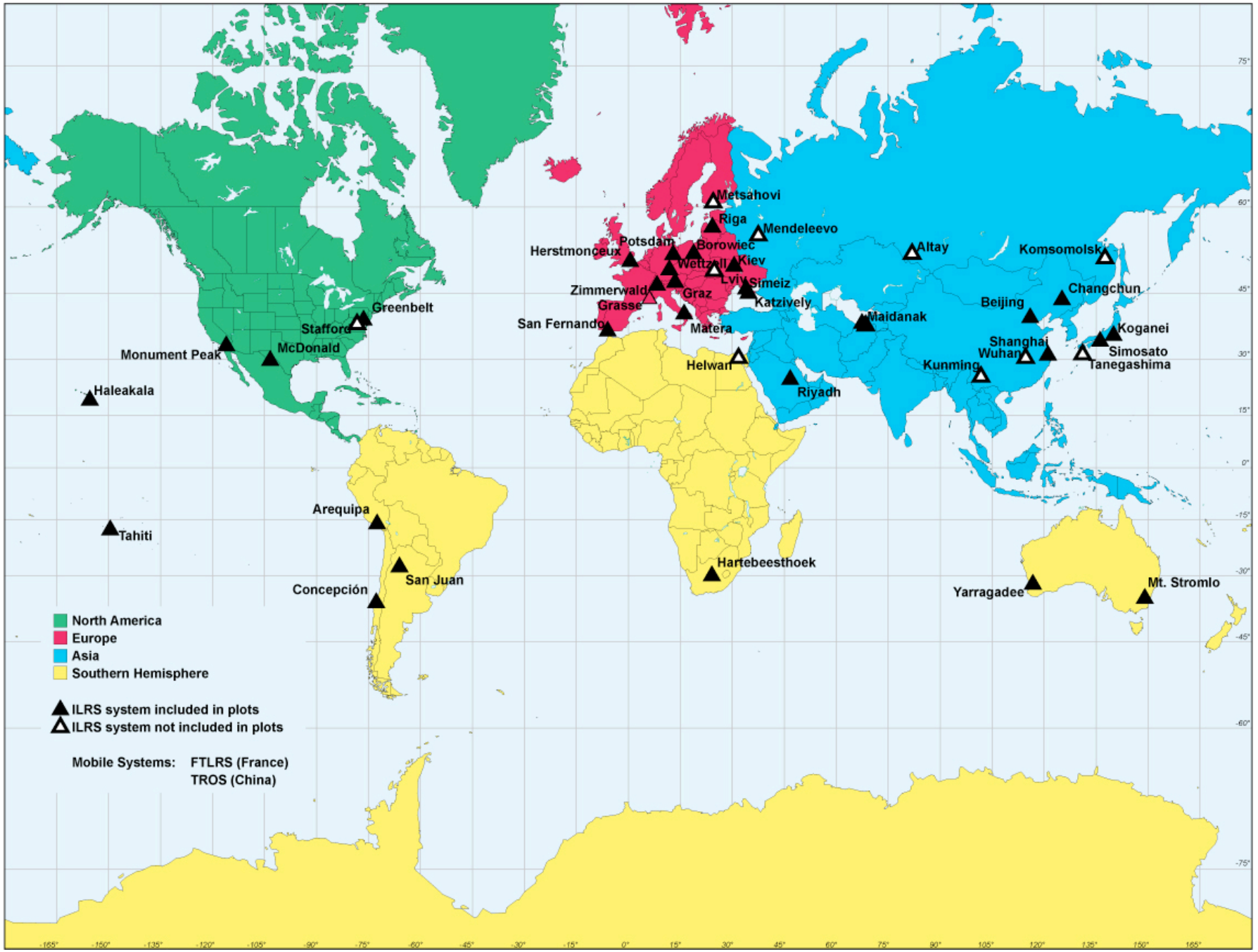
Mission Developments

- Currently supporting 32 missions and lunar tracking
- Recent launches:
  - Proba-2 (ESA): 02-Nov-2009 (tracking campaign Apr-2010)
  - CryoSat-2 (ESA): 08-Apr-2010 (first pass 20-Apr-2010)
  - GLONASS-119, -120, -121 launched 02-Mar-2010
- Upcoming launches of approved missions:
  - RadioAstron (Russia): 2010 (tracking by lunar-capable stations)
  - KOMPSAT-5 (KARI): 2010
  - STSAT-2B (KARI): May-2010
  - TanDEM-X (DLR, GFZ, others): 2010; tracking with TerraSAR-X in close formation
  - QZS-1 (JAXA): 2010?
- ANDE-Pollux re-entered atmosphere in April 2010
- GLONASS:
  - GLONASS-120 replaced -109
  - Herstmonceux tracking all operational satellites

Satellite Tracking (2010Q1)

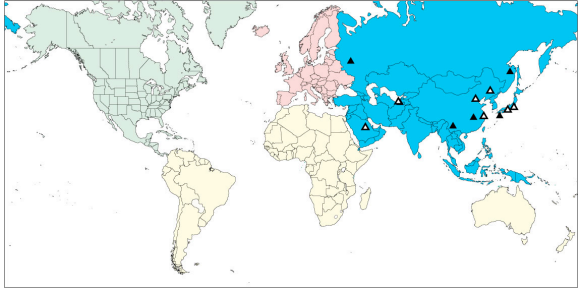


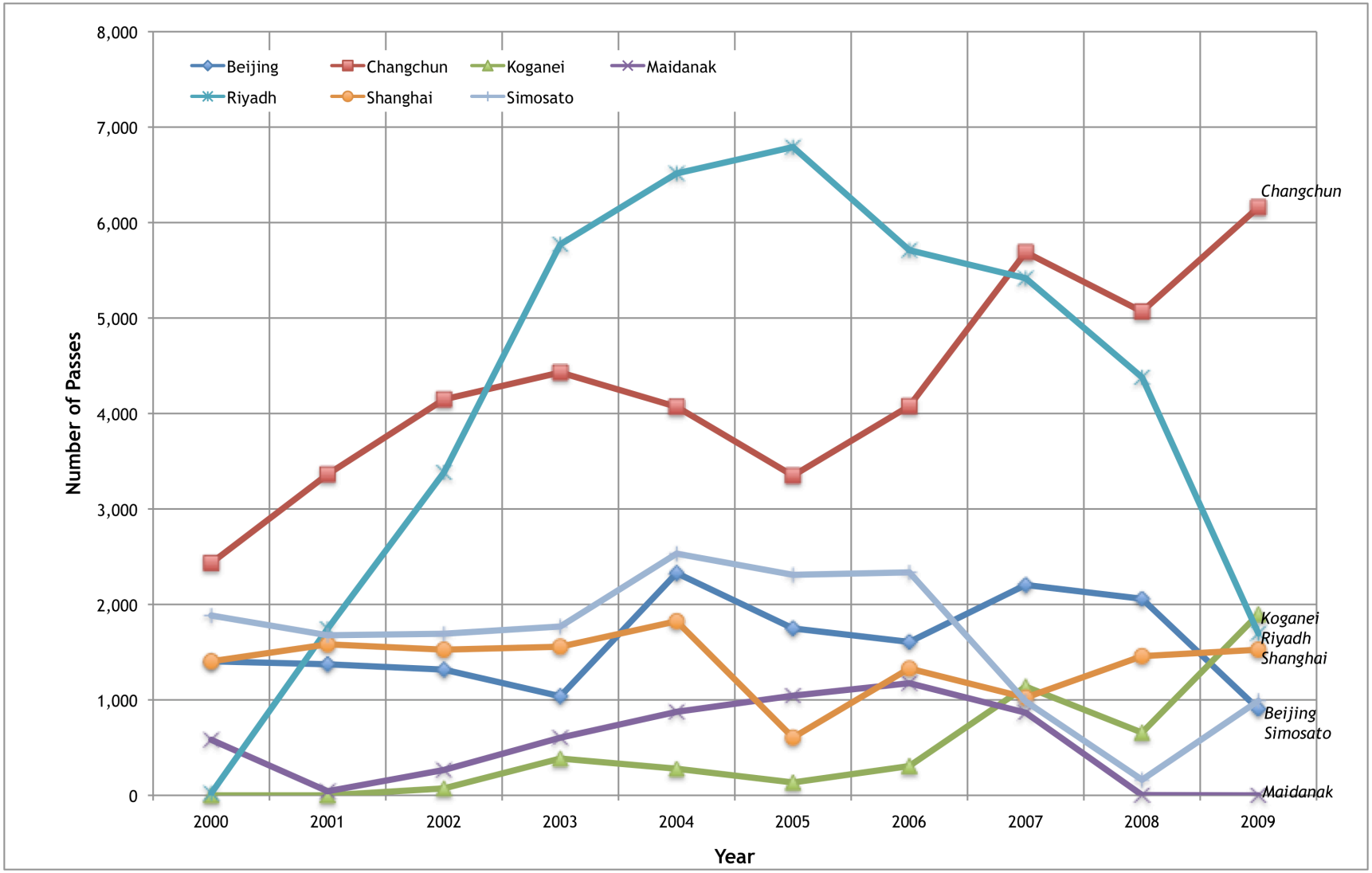
ILRS Network by Region



Yearly Pass Totals

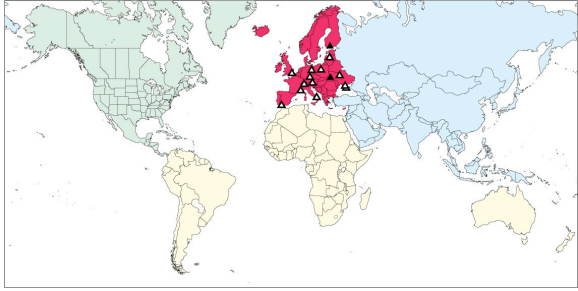
Asia

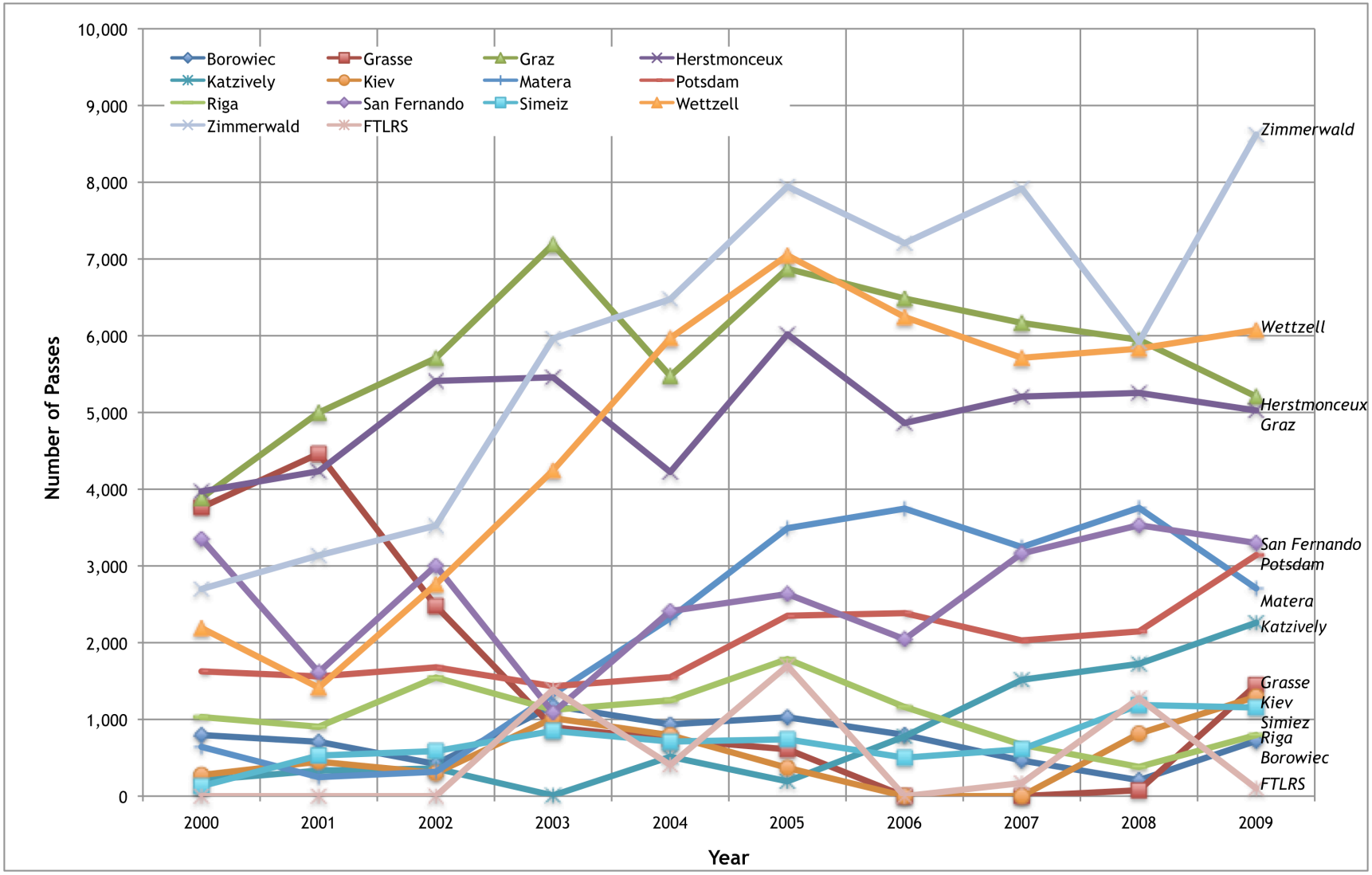




Yearly Pass Totals

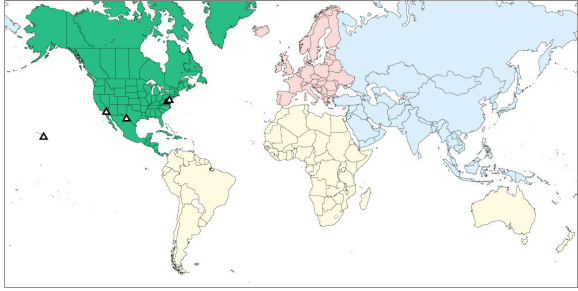
Europe

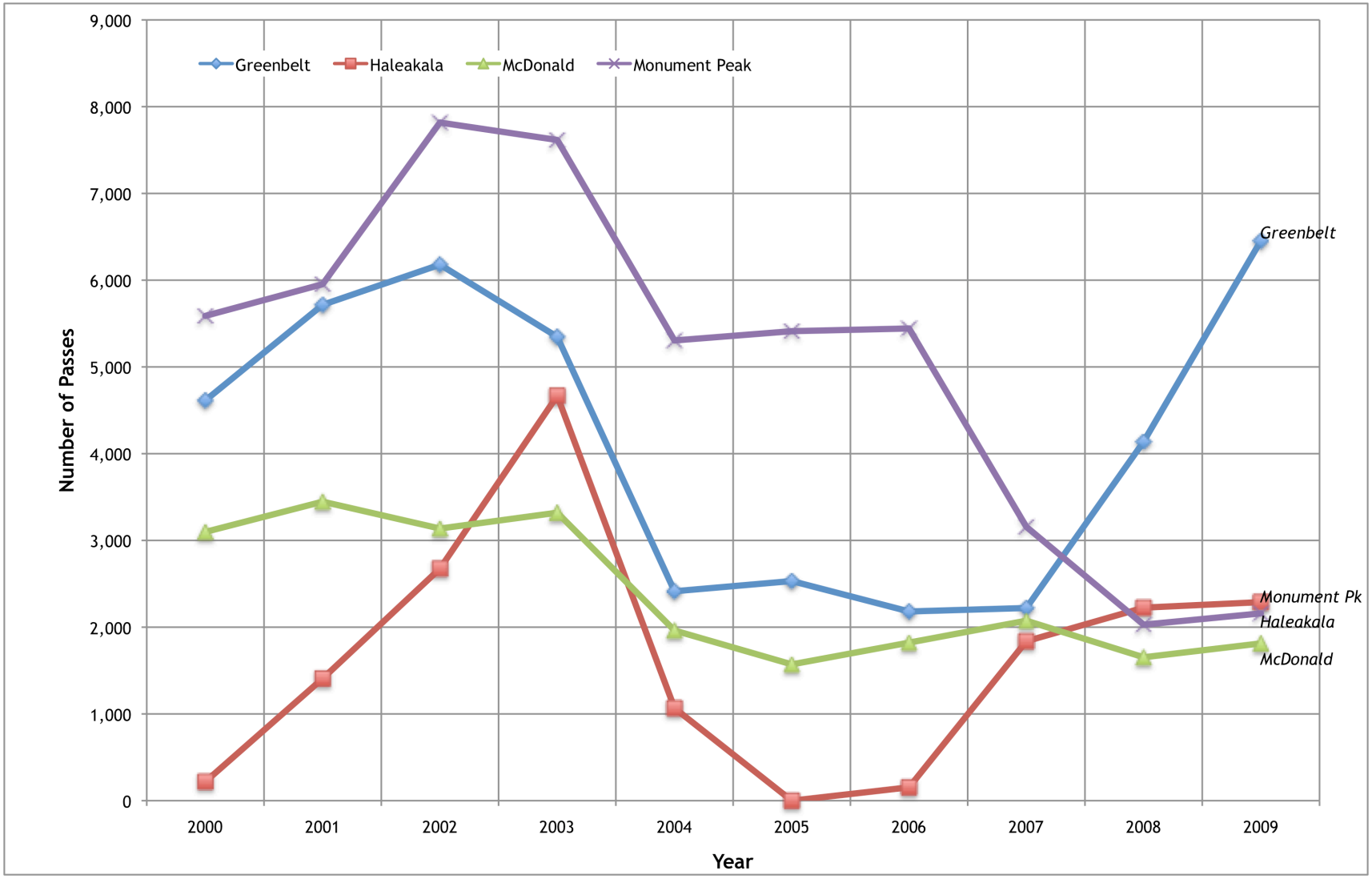




Yearly Pass Totals

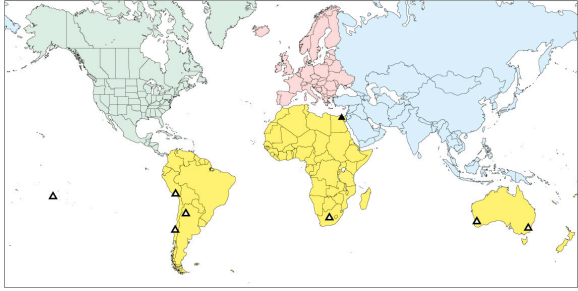
North America

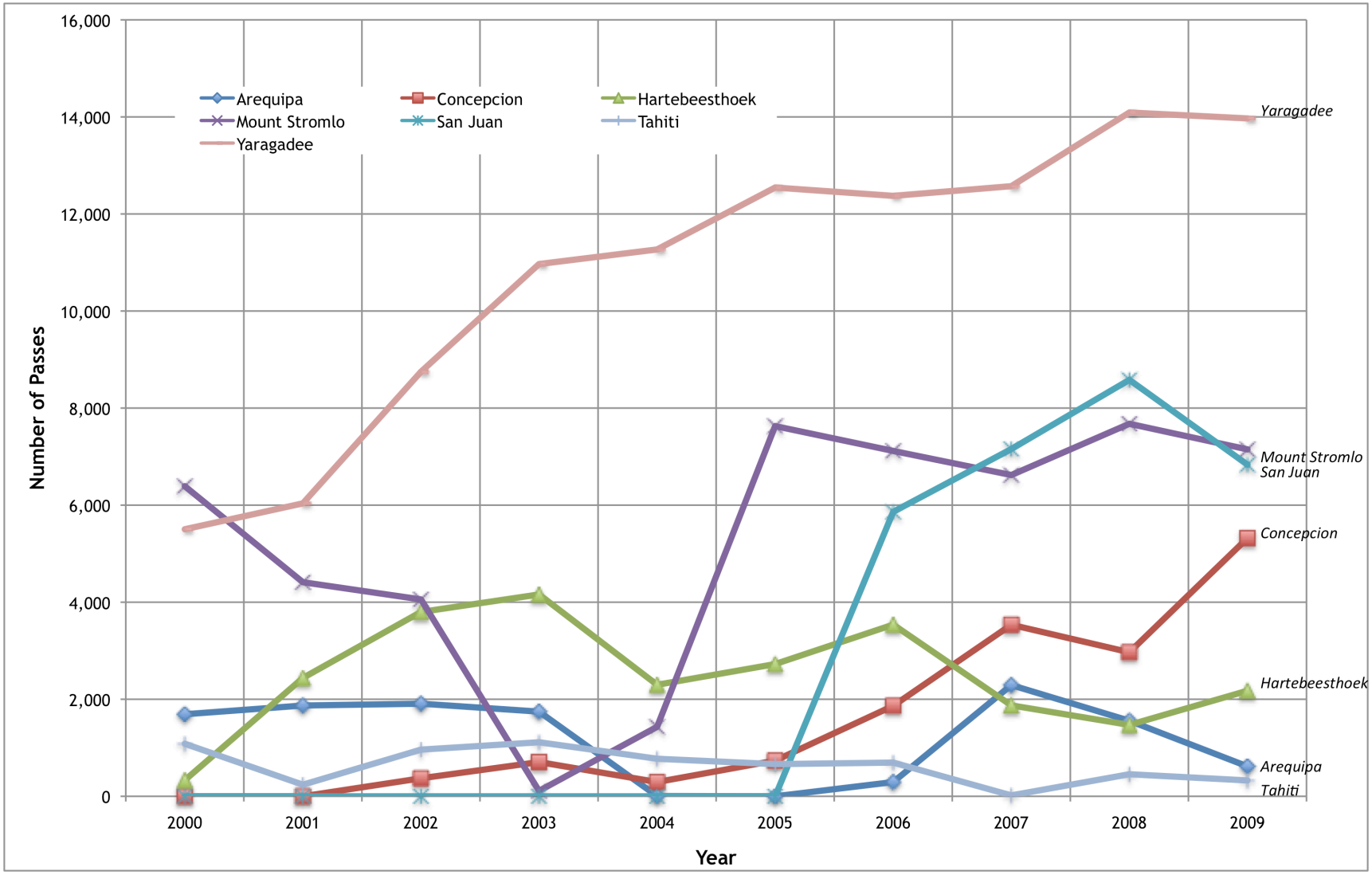




Yearly Pass Totals

Southern Hemisphere





CB Items

- CDDIS and EDC data center structures, Q/C, and quarantining procedures supporting CRD-formatted data are being harmonized
- Normal point population recipe under review to take advantage of the high repetition systems
- All stations encouraged to submit full-rate data (including kHz) to be archived by the Data Centers
- Trying to strengthen the timely feedback and response procedures from the stations on maintenance, modification, and upgrades
- Pulkovo Observatory accepted as ILRS Associate Analysis Center
- ILRS 2007-2008 Report distributed

Other CB Items

- ILRS 2007-2008 Report distributed
- Proceedings from 16th International Laser Ranging Workshop distributed
- Re-design of ILRS website underway to make it more responsive to user needs
- Deadline for CRD conversion has been pushed to June 30, but some stations have not been answered our continuous inquiries
- Criteria for certification of new stations and requalification of stations after upgrading or significant downtime still needs to be addressed
- Simplified algorithm to encourage stations to better distribute tracking efforts perhaps using the real-time web facility at AIUB needs to be developed

Meetings

- May 01-07, 2010: EGU, Vienna Austria
  - MWG, DF&PWG, and AWG meetings
  - GGOS Steering Committee, Data and Information Working Group, and Networks and Communications Bureau meetings
- July 18-25, 2010: 38th COSPAR Scientific Assembly, Bremen Germany
- August 08-13, 2010: Meeting of the Americas, Foz do Iguassu, Brazil
- September 20-22, 2010: Journees 2010, Paris France
- October 04-08, 2010: IAG Commission 1 Symposium 2010 “Reference Frames for Applications in Geosciences”, Marne-la Valee France
- October 25-28, 2010: GGOS/IAU Workshop “Observing and Understanding Earth Rotation”, Shanghai China
- December 13-17, 2010: Fall 2009 AGU, San Francisco CA
- January 2011: 17th International Workshop on Laser Ranging, Concepción Chile
- June 28-July 7, 2011: IUGG General Assembly, Melbourne Australia

NORMAL POINT CONSTRUCTION FOR OPTIMAL TRACKING

- Original Concept from Werner Gurtner AIUB
  Use satellite multiplexing capability at high repetition rate stations to improve tracking efficiency

- Response from ILRS CB
  Proposes a protocol to move to a new target after 100 returns
  see
  http://terra.sgt-inc.com/~pdunn/trackmore/NormalPointConstruction.doc

NORMAL POINT CONSTRUCTION FOR OPTIMAL TRACKING

(*To be reviewed and validated by the Analysis Working Group)*

ASSUMPTIONS

- The quality of a normal point depends only on the number of single shot contributors.
- The primary application of the SLR Network tracking LAGEOS I and II is station location.
- The primary applications of the SLR network tracking GNSS are (1) orbit definition and (2) reference frame definition (geocenter, scale and orientation) which has similar pass geometry requirements to orbit definition.
- Stations should strive for precision as close to one mm as possible for all applications of SLR data.
- Normal Point distribution during a satellite pass should be determined by the requirements of the most stringent application for that satellite.

RECOMMENDATION:

- A normal point should be terminated when 100 full rate data points have been accumulated or the maximum normal point interval (i.e. 2 minutes for LAGEOS) is complete, whichever comes first.

Highlights of Feedback from High Rep Stations

- **Graham Appleby NERC**: Single-photon noise levels are higher than 10 mm and depend on the satellite. Engineering issues dictate single shot quota.

- **Philip Gibbs NERC:** Is normal point interval negotiable?

- **Georg Kirchner IWF/OEAW:** Useful only for HEO satellites 100 point minimum currently used at Graz.

- **Jan McGarry NASA:** Eyesafe system has higher single shot noise. NGSLR signal processing allows timely single shot quota assessment.

- **Adrian Jaeggi AIUB:** Burdensome on-line processing required

Highlights of Feedback from Analysis Community

John Ries CSR: Higher rate normal points may be useful for analysis off-line.

Erricos Pavlis JCET: Data yield could significantly increase with this recipe. We should ponder tracking choreography later (supported by Juergen Mueller IFE).

Analysis Working Group Report

ILRS Governing Board Meeting

2010 EGU, Vienna, Austria, Monday, May 3, 2010

Erricos C. Pavlis & Cinzia Luceri

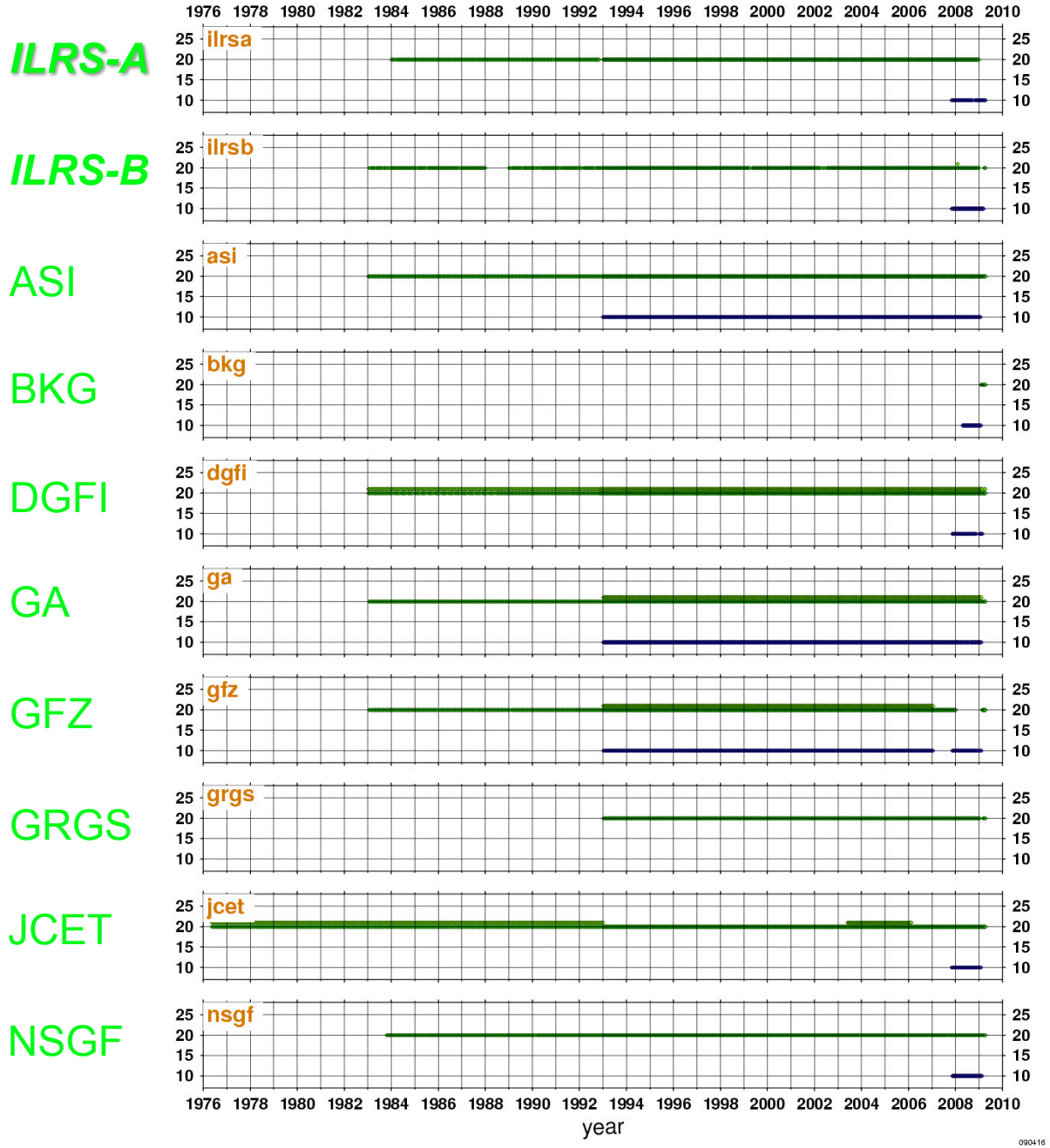
Analysis Coordinators

AWG News

- Eight AC/*CC*: ***ASI***, BKG, ***DGFI***, GA, GFZ, GRGS, JCET, and NSGF
- Candidate AC/AAC: **BKG*, ESOC, Pulkovo Obs.**, & MCC
- Operational weekly & daily products routinely delivered
- Re-analysis for 1993 to present by seven ACs:
  ASI, DGFI, GA, GFZ, GRGS, JCET, NSGF
- Historical data re-analysis 1983 to 1992 by six ACs:
  ASI, DGFI, GA, GFZ, JCET, NSGF
- Both CCs submitted combinations to ITRF2008
- **ITRF2008P** released and currently under AC/AAC evaluation

International Laser Ranging Service

current ILRS AC solutions: weekly reanalysis pos+eop versions



ITRF2008 CONTRIBUTIONS

AWG New Projects

- **Projects currently in progress:**
  - *Orbit products (SP3C) -- 6 AC in testing (ASI, BKG, DGFI, GA, GRGS, JCET)*
  - *Daily solutions of 7-day arcs for 1^{d} EOP for IERS RSP/USNO (5 ACs + DGFI soon!?)*
  - *CRD data format station validation active ACs:* ***ASI, DGFI, GFZ, GRGS*** *and* ***JCET***
- **New Potential projects:**
  - ***Testing the application of atmospheric effects in ILRS products***
  - ***Generation of a "low degree ~2 harmonics" series (for CPP/GGOS)***
  - ***3-4 ACs to study the possibility of a new definition of NP generation procedure***
  - *Use of Starlette and Ajisai initially for EOP and eventually for TRF products with improved modeling (e.g. atmospheric effects)*
  - *Near real-time analysis of SLR data for "station health"/bias Reports*

AWG Meetings, Past/Future

- The AWG met twice in 2009:
  - *EGU 2009, Vienna, Austria*
  - *ILRS Tech. Laser Workshop, Sept. 2009, Metsovo, Greece*
- **Next meetings:**
  - **EGU 2010, TUW, Saturday, May 8, 2010**
  - *REFAG (Near Paris, Oct. 4-8, 2010 ???)*
  - **17th ILRS Int. Workshop**, Conception, Chile, Jan. 2011(**???**)

International Technical Laser Workshop on SLR Tracking of GNSS Constellations

50 Years of Satellite Geodesy and Geodynamics
On the Occasion of Prof. George Veis 80th Birthday

September 14-19, 2009
Metsovon Conference Center
Metsovo, Greece

Presentations of the ILRS 2009 workshop are now available!

http://www.ntua.gr/MIRC/ILRS_W2009

National Technical University of Athens (NTUA)
Metsovion Interdisciplinary Research Center (MIRC) of the NTUA

ILRS 2009 Workshop Program

Program: **ILRS Workshop on SLR Tracking of GNSS Constellations**
50 years of Satellite Geodesy & Geodynamics

Sept. 14, Monday:	**Impact of SLR Tracking on GNSS Constellations: PP 1-5 on GPS, GLONASS, GALILEO, COMPASS, QZSS**
	Status of SLR and the ILRS
Sept. 15, Tuesday:	**Science from SLR and GNSS**
Sept. 17, Thursday:	**PP 06: Scientific impact of SLR tracking of GNSS Constellations**
	PP 08: Operational Issues
Sept. 18, Friday:	**PP 07: Technological Challenges**
	Panel discussion

ITRF2008P Tests

AC Contributions

- Four AC responded to the request to test the candidate models
- Only three have so far provided some input
- Tests are preliminary and will be followed by more in-depth evaluation of both ITRF solutions, with more AC contributions and the use of diverse s/w packages, with a target the REFAG Symposium in October

ITRF2008P Evaluation Summary

- The ITRF2008P combination improves the *a priori* fits of the two LAGEOS data sets in its entirety
- When we look at the fits over the period 2006 to 2010, when the collected data did not contribute to the ITRF2005, we see significant overall improvement
- If we focus on the last year 2009, data which are not contributing in either combination, then the improvement is even more significant

AWG Documentation

- All ACs and CCs have submitted online documentation (required by IAG/IERS/GGOS) describing the models and standards used in their routine analysis, only some AACs (*need to remind them often!*)

- On the occasion of the release of ITRF2008 a LR-dedicated special issue of the *Journal of Geodesy* to be compiled for better and wider documentation of ILRS products (ground segment, space segment, **data analysis and interpretation**).

J of G Guest EB

- *J of Geodesy Editor contacted*
- *Procedures of JoG provided (suggested list of topics)*
- *ILRS Special Issue Guest Editors:*
  - *Pavlis, Luceri, Pearlman*
- *Delayed due to higher priority for the development of the ILRS contribution to ITRF2008 (which will form the basis for this issue)*
- *Realistic time-table for soliciting papers: within less than a month*

Last LR Special Issue TOC

"Surveys in Geophysics", Vol. 22, No. 5, 2001

The Special Issue Of The Symposium ***Evolving Geodesy*** - ***Erricos C. Pavlis and Ulrich Schreiber***

Volume 22, Numbers 5-6 / September, 2001

DOI: 10.1023/A:1015658715005

Proposed TOC

TITLE	Lead Author(s)
Foreword	The Guest EB
The International Laser Ranging Service (ILRS): **the first decade** or **ten years of success**	The ILRS GB
ILRS Electronic Documentation Service: Mission Details, Data and Product Archives, Formats and Information for the Users	Noll, Torrence, Seemuller, Ricklefs
Past, Present and Future of the ILRS Global Tracking Network	Wetzel, Horvath, EUROLAS, WPLTN, ???
The Next Generation Satellite Laser Ranging Systems	McGarry, Degnan, Kirchner, Jäggi, Appleby, Fumin, ???
The Geodetic Sateliite Missions	Pearlman, Arnold, Barlier, Biancale, Vasiliev, (?)
Lunar and Planetary Laser Ranging	Shelus, Luck, Torre, McGarry, J. Müller, Murphy, Bianco, ???
Target Signature Systematic Errors for Geodetic Sateliites	Appleby, Otsubo, Arnold
Data Quality Control Service	Otsubo, H. Müller, Pavlis, Glotov
Systematics in SLR Data: Documentation and Discussion of Errors and their Sources	Luceri, Appleby, Pavlis and H. Müller
Weekly and Daily Products of the ILRS Analysis Working Group	Sciarretta, Kelm, Luceri and Pavlis
Monitoring Mass Redistribution in the Earth System with SLR	Pavlis
The ILRS Contribution to the International Terrestrial Reference Frame (ITRF)	The AWG ACs and CCs
Contributions from solicitation announcement	

BLITS Residuals [mm] (test)

Site	No._Obs.	Mean	RMS	No.-OBS_pass	Mean	WRMS
Yarragadee	81	0.1	7.3	81	0.1	7.3
Greenbelt	15	-0.1	3.5	15	-0.1	**3.5**
McDonald	4	-1.1	14.3	4	-1.1	14.3
Herstmonceux	27	0.2	4.9	27	0.2	**4.9**
Changchung	23	0.7	21.5	22	0.8	**4.6**
Monument Pk.	11	1	2.6	11	1	**2.6**
Hartebeesthook	5	0.1	11.6	5	0.1	11.6
Grasse	15	0.2	3.9	15	0.2	**3.9**
San Fernando	2	1.9	37.4	2	1.9	37.4
Zimmerwald	24	-24	52.4	18	-1.3	15.7
Graz	7	1.5	11	7	1.5	11.0
Mount Stromlo	8	0.7	2	8	0.7	**2.0**
Wettzell	4	2.1	2.8	4	2.1	**2.8**
TOTAL	226	-2.3	19.1	219	0.2	7.8
TOTAL (weighted)	**226**	**-2.3**	**11.5**	**219**	**0.2**	**9.4**

CRD Validation Status

CRD Implementation and Validation Schedule - 100503											
SITE	ID	Code	Coding	Testing	OC Validated	AC Validated					Operational
						ASI	DGFI	GFZ	GRGS	JCET	
Golosiiv	1824	GLSL									
Lviv	1831	LVIV	X	X	P						
Maidanak 1	1863	MAID									
Maidanak 2	1864	MAIL									
Komsomolsk	1868	KOML									
Mendeleevo	1870	MDVL									
Simeiz	1873	SIML	X	X	X				P	P	P
Riga	1884	RIGL	X	P							
Katsively	1893	KTZL	X	X	X				P	P	P
McDonald	7080	MDOL	X	X	X	X	X	X	X	X	X
Yarragadee	7090	YARL	X		X						P
Greenbelt	7105	GODL	X	X	X	X				X	X
Monument Peak	7110	MONL	X	X	X						P
Haleakala, HI	7119	HA46	X	X	X						P
Tahiti	7124	THTL	X	X	X						P
Wuhan	7231	WUHL									
Changchun	7237	CHAL	X	X	X	X			X	X	X
Beijing	7249	BEIL	X	P							
Koganei	7308	KOGC	X	X	X	X				X	X
Tanegashim	7358	GMSL	X	P							
Arequipa	7403	AREL	X	X	P						
Concepcion	7405	CONL	X	X	X	X	X		X	X	X
San Juan	7406	SJUL	P								
Hartebeesthoek	7501	HARL	X	X	X						P
Metsahovi2	7806	METL									
Zimmerwald	7810	ZIML	X	X	X	X	X			X	X
Borowiec	7811	BORL	X	X	X						P
Kunming	7820	KUNL	X	X	P						
Shanghai	7821	SHA2	X	X	X	X			P	P	P
San Fernando	7824	SFEL	X	X	X				P	P	P
Mt. Stromlo	7825	STL3	X	X	X	X	X		X	X	X
Helwan	7831	HLWL									
Riyadh	7832	RIYL									
Simosato	7838	SISL									
Graz	7839	GRZL	P	P							
Herstmonceux	7840	HERL	X	X	X	X	X		X	X	X
Potsdam	7841	POT3	X	X	X					X	X
Grasse (MeO)	7845	GRSM	X	X	X	X			X	X	X
Matera	7941	MATM	X	X	X		X	X	X	X	X
Wettzell	8834	WETL	X	X	X	X	X			X	X
FTLRS	--	--	X								
TROS	--	--									

ILRS Missions Working Group report to GB

Monday May 3rd 2010, Vienna

G Appleby, Scott Wetzel: MWG coordinators

ILRS Governing Board meeting 3 May 2010
Vienna, Austria

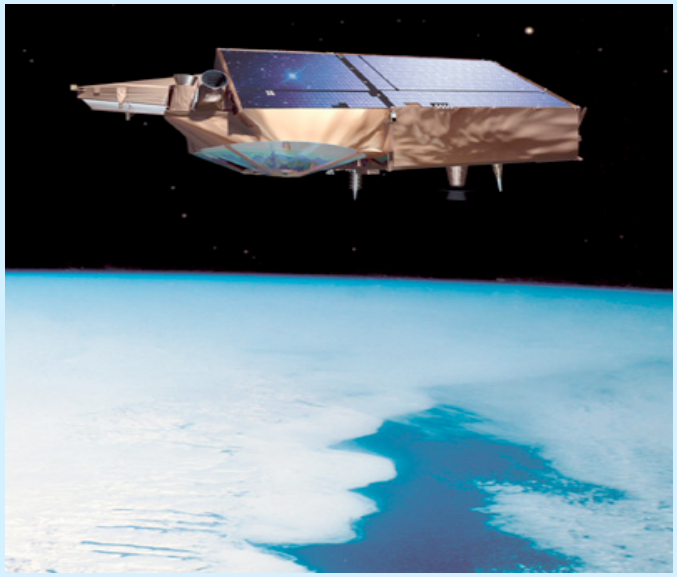
International Laser Ranging Service

Routine procedure for support recommendations

- As well as asking MWG members for comments:
- Use expertise in other Working Groups too:
  - Analysis WG regarding need for POD
  - Signal Processing for comments on LRA suitability
  - DFPWG and NEWG regarding operational issues (go-nogo flags, available CPFs, etc)
- Chairs of these WGs are ex-officio members of MWG

Missions recently approved for ILRS support

- CryoSat-2 – thickness of sea-ice and elevation of ice-sheets
- DORIS tracking with laser for altimeter calibration and additional POD support
- Launched 2010 April 8 into 750km polar orbit.
- No particular tracking issues – Yarragadee first station to track.



Missions recently approved for ILRS support (2)

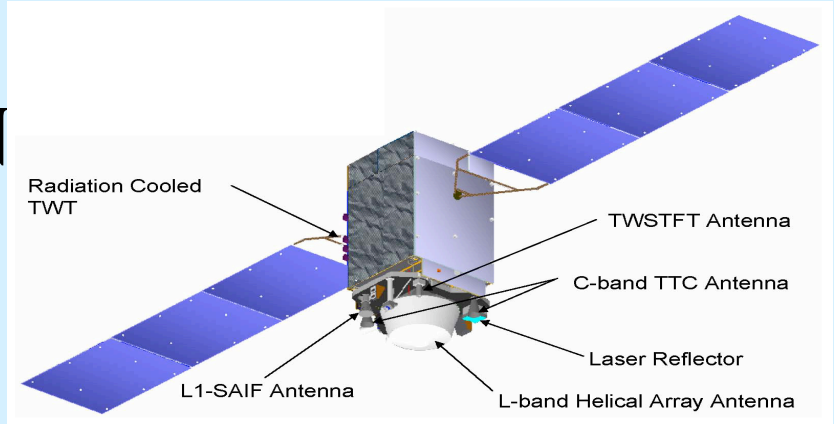
- RadioAstron – 10m VLBI dish in highly-elliptical orbit (0.96, 500-350,000km)
- Visibility of (100-cube) retro-arrays from Earth expected best at distances of 100-200 thousand km;
  - Realistic target only for LLR-capable systems
- MWG liaising – Matera, Wettzell expressed interest so far;
- Launch date unknown?

Missions recently approved for ILRS support (3)

- Quasi-Zenith-Satellite, QZS-1
- Japanese GNSS system, addition to existing GNSS
- To be launched late 2010 into 45º,

32,000-40,000km orbit

- Ranging from WPLTN



GLONASS

- Three new vehicles launched 2010 Mar 2
- CB worked with CODE to recommend:
  - One in each orbital plane
  - Only 1 GPS now (Apr 2010), so go for 4 GL?
- Also, discuss whether to attempt more of the GL constellation;
  - Issue is more satellites, less data or less satellites, more data on each
  - e.g. SGF Herstmonceux running a test now to attempt all GLONASS – data being submitted to CDDIS and EDC

CRD format status

- Conversion deadline is now June 30, 2010
- 25 stations are now submitting CRD-formatted normal points
  - 12 stations have been validated
  - 10 stations are awaiting analyst validation
  - 3 stations are awaiting OC validation
- 5 stations are known to be in coding/testing
- 10 stations are unaccounted for
- 6 AWG analysis centers are known to be able to handle CRD data, with 5 helping with the validation chores.
- ~7 stations are submitting CRD full rate data for T2L2
- 10 stations are submitting CRD full rate data for LRO, and the LROLR group are working to produce CRD normal points.

CRD format implementation

- All EDC OC's validated stations still need to provide normal points in CRD and old format. EDC is working on this.
- EDC is sending in CRD normal points 2-3 days later than the old normal points. EDC is work on this.
- Both OCs are now sending bad CRD normal points back to the stations for correction before distribution.
- Stations should not innovate data field values not already available in old format, e.g. 2 digits values in “Station Epoch Time Scales.” Some still are.

Full Rate Data

- How do we distribute full rate data, given the increase volume from kHz fire-rate stations?
- Largest kHz passes at Graz are about 1.7 Mb compressed, giving 690 Mb/month (based on average 406 passes/month). This would fit on a CD. (Thanks, Matt!)
- If Yarragadee were a kHz station, this could be 1.9 Gb/month (based on 1130 passes/month). This would fit on a DVD.
- Experience at Hersmonceaux and NASA stations show that daily uploads of full rate data are quite “do-able.” Media mails are a hassle.
- Internet transfer will be the recommended transfer method.

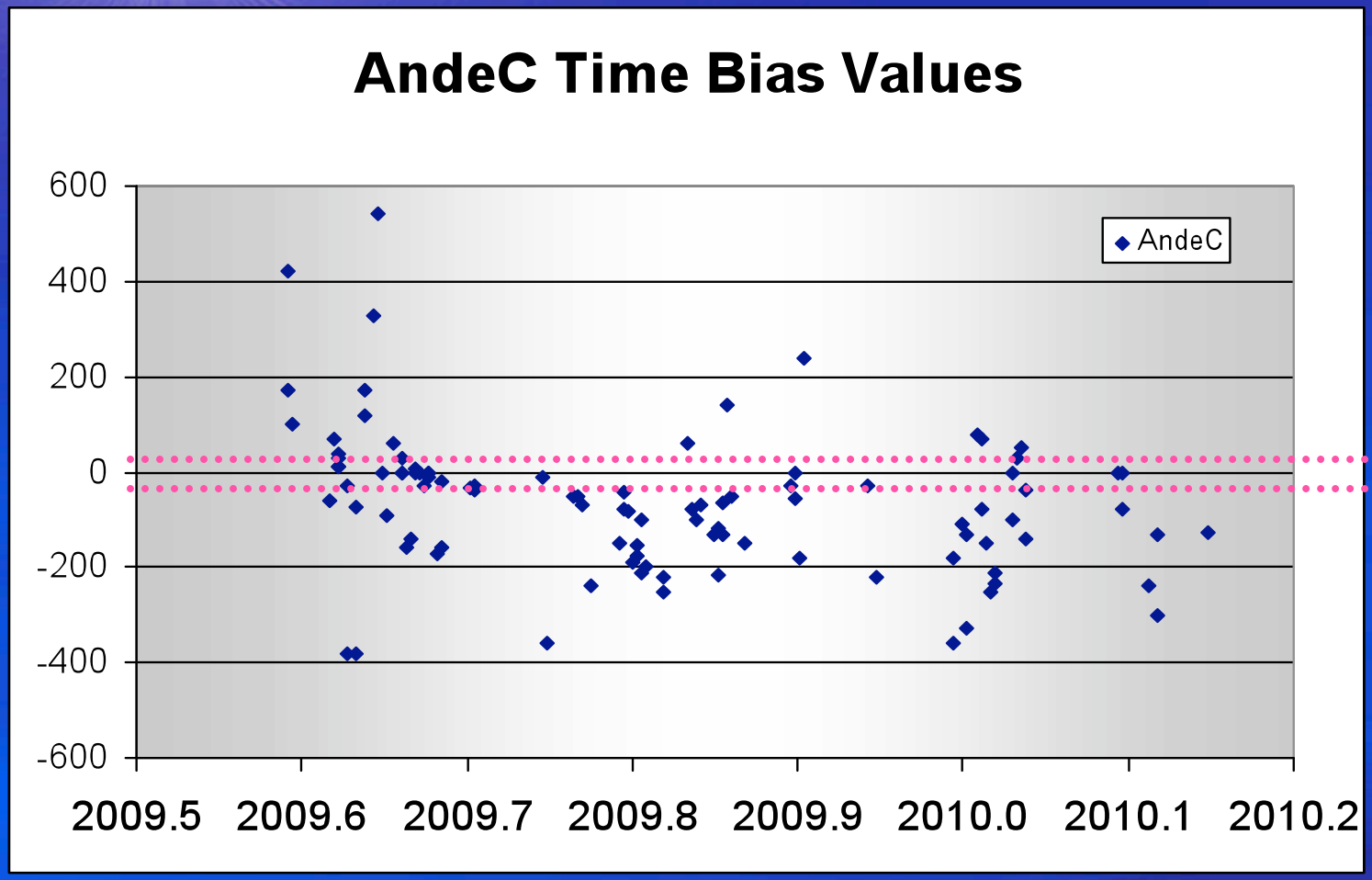
Harmonizing Full Rate Handling

- Can EDC and CDDIS handle the archive of kHz full-rate data?
- Automate the transfer of full-rate data (both formats if possible) from EDC to CDDIS on a daily basis

File System and Normal Point QC Harmonization

- Agreed in Metsovo to harmonize CRD directory structure at EDC and CDDIS: change EDC – done (normal points and full rate)
- Agreed that all daily files should contain only data from that day: change CDDIS handling – not done
- Harmonize QC checks at EDC/OC and NASA/OC: comparison shows that both perform the same checks as on the ILRS web site, but EDC does more format checks and may be missing one check NASA does.
- Be sure OCs send bad data back to station for correction. Both do, now.
- Be sure OCs quarantine data from stations after upgrade: to be discussed later in DFPWG meeting.

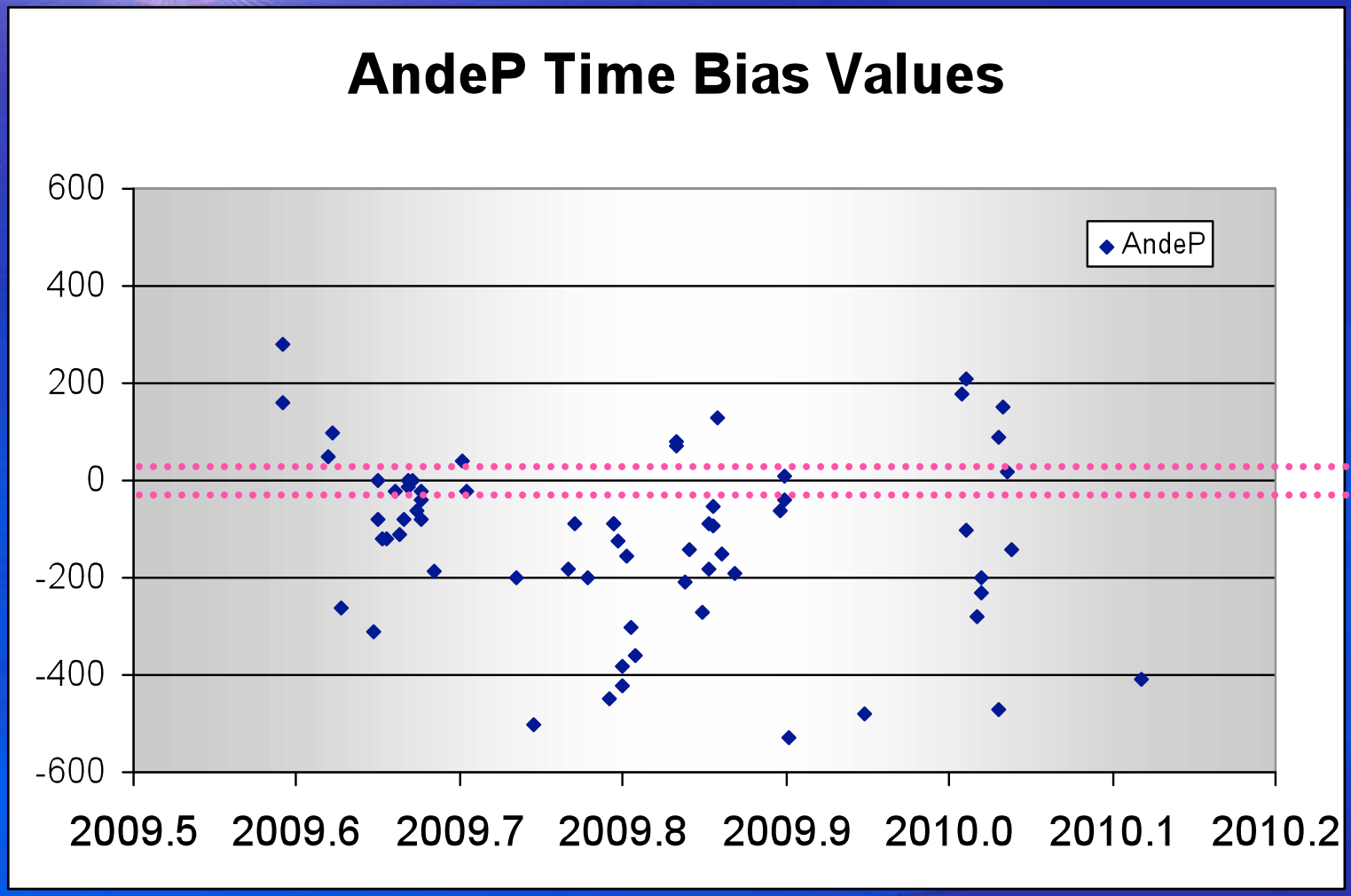
ANDE Predictions are not good enough ...



„GOOD“ pred.:

± 20 ms TB

ANDE Predictions are not good enough ...



„GOOD“ pred.:

± 20 ms TB

Due to bad predictions: Sparse data ...

		Passes	NPs
ANDEP	Simeiz	1	6
ANDEP	Riga	1	10
ANDEP	Katzivel	8	75
ANDEP	Yarragad	127	2918
ANDEP	Greenbel	47	1202
ANDEP	Monument	5	58
ANDEP	Mount Ha	3	29
ANDEP	Changchu	36	281
ANDEP	Tokyo	1	3
ANDEP	Hartebee	2	18
ANDEP	Zimmerwa	1	22
ANDEP	Borowiec	1	12
ANDEP	San Fern	4	31
ANDEP	Mt Strom	2	4
ANDEP	Graz	26	499
ANDEP	Herstmon	44	584
ANDEP	Potsdam	1	10
ANDEP	Matera	2	29
		905	18675

- Most ILRS stations tracked only few passes successfully
- Only 5 stations with > 10 passes in 230 days !!!
- Almost ZERO daylight passes
- But a lot of time / work invested at SLR stations ...

- **ARE THE RESULTS WORTH THIS EFFORT ???**

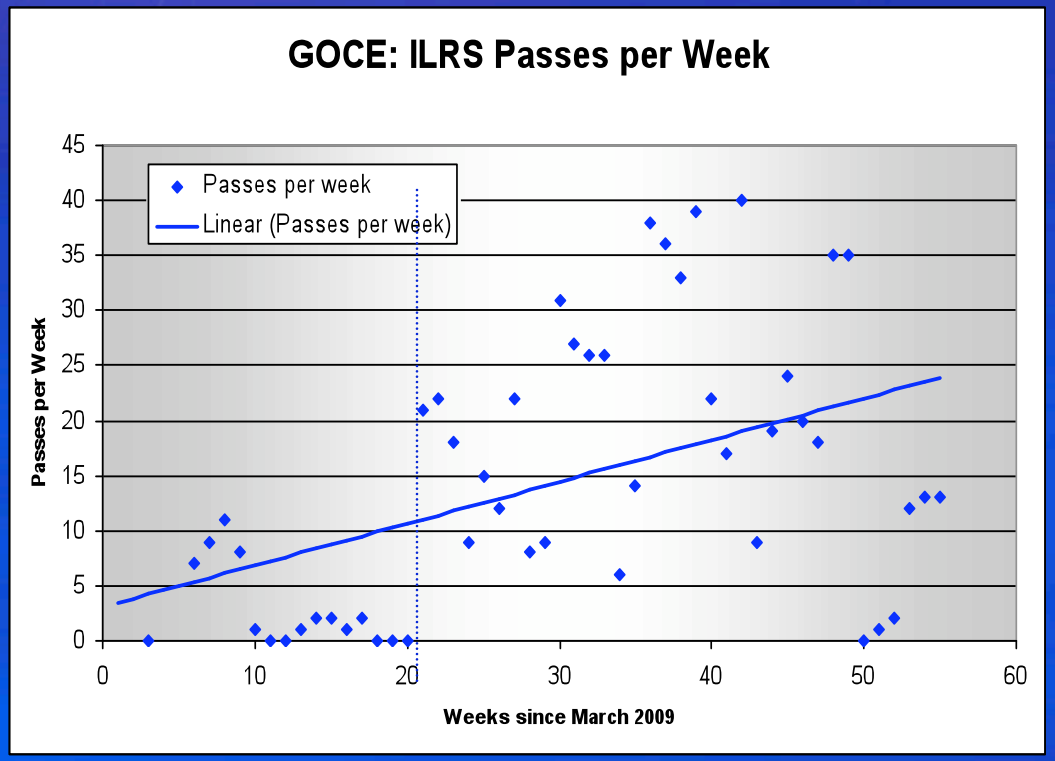
- Should we cancel such satellites ???
- Or ADD to mission requirements:

  - Good predictions required
  - If not: Satellite removed from tracking list

Goal: PUSH satellite operators to provide better predictions

(if possible ☺)

GOCE: Difficult target, but tracking has been improved ...



- Few passes only at begin; bad predictions
  - Average: 4 passes / week only
  - 2 stations only

- Predictions: Improved by Swiss group
  - Average now: 20 passes / week
  - > 17 NPs per pass
  - 10 active stations (> 10 passes)

- TB exchange via mail (Yarragadee, Graz):
  - effective, fast, public

- Still place for improvement ☺

CRYOSAT: Predictions had a problem ...

- First prediciton set: Sent with
    - wrong satellite numbers (just placeholder values: 12345 ...)
    - ***** ****** fields in header line

- After publishing (ILRS stations) that: Second prediction set:
    - Numbers corrected; but still the same ******* fields problem

- Conclusions / Consequences
    - Nobody did check the predictions before sending ...
    - WE did not know WHOM to address for that ???

- For future missions: Name (and publish ?) a responsible person + mail address
    - Also: Carey can handle that (as a central person ...)

Station / AC communication / „Shanghai Problem ☺“

- **Case A**: If ANY AC detects some problem in the data:

  - AC informs station immediately by direkt mail;
  - Station can react fast: Problem can be identified / eliminated;
  - Works fast, efficient, no unresolved / open cases known (?)

- **Case B**: Station is changing some setup / devices / procedures: Station SHOULD:

  - Send updated Station Log Sheet (Shanghai did it); BUT:
    - This is for reference only, no action triggered, no AC informed automatically ...
  - Update SCH (System CHange) flag (Shanghai did not)
    - Should be automatically checked by AC programs (I guess so ?)
    - But there is no information about significance ....
    - Any warning included for ACs ???

Station to AC communication: Problem if stations forget ...

- Stations CAN forget to update Station Log Sheet and System CHange flags
  - It did happen – and it will happen again (forgetting is an **advantage** of human brain ☺)
  - Designing new procedures: Be careful – they might suffer the same fate ....
  - However: It **IS** the stations duty to communicate such changes to ILRS !!!

- Suggestions / Ideas how to cope with that:

  - Send a mail reminder to all stations: UPDATE SCH / LOG => Carey already did that
  - Repeat it 2 times per year ? (maybe just before summer holidays / Christmas time or so ...)
  - Remind stations that this is THEIR duty (our SLR product quality depends on that !!!)
  - Propose some consequences in case they do not (data is deleted, station downgraded ...)

  - With EVERY SCH flag change, and with EVERY Station Log Sheet update:
    - Station MUST send a 1-line-mail WHAT has been changed; to all stations? ACs? CB?
    - Allows everybody at least to estimate possible impacts on data integrity / quality

NASA Network Status

ILRS Governing Board Meeting
Vienna, Austria
May 3, 2010
Scott Wetzel

Network Summary

- On April 28, 2010, a hardware issue was discovered within a NASA SLR station that may potentially impact other NASA SLR station operations. This issue has resulted in the cessation of ranging operations by the MOBLAS, NGSLR and the MLRS systems. We are continuing to troubleshoot this issue and hope to return to operations in the very near future.
- Further investigation has determined that this is a human factor issue and is not an inherent hardware issue.

International Laser Ranging Service

NASA

Network Summary

- Ongoing LR-LRO support:
  - NGSLR, MOBLAS 4 ,-5, -6, -7,MLRS
- Completed major Controller and Processor computer upgrades at all MOBLAS, TLRS, and MLRS.
- New CRD format is now generated at every NASA Site
  - MLRS first station to be verified by ILRS AWG last year
  - MOBLAS-7 was verified by ILRS AWG in Mar 2010
  - MOBLAS-4,-5,-6,-8, and TLRS-4 is in ILRS AWG approval stage
  - TLRS-3 will go to ILRS AWG stage very soon
- Implemented 10 Hz tracking on LEO satellites at the MOBLAS systems
- Continuing efforts to gain satellite retroreflectors on the next group of GPS satellites.

International Laser Ranging Service

NASA

NASA Network Station Status

- Moblas 4 (Monument Peak, California, 7110)
  - Still only operating 1 shift, no radar
- Moblas 5 (Yarragadee, Western Australia, 7090)
  - 24X7 Operations
  - MOBLAS-5 is one of the highest LR-LRO contributors and LOLA team interested in a better timing frequency
  - Begin using the nearby VLBI maser for LRO operations
- Moblas 6 ((Hartebeesthoek, South Africa, 7501)
  - Currently off-line, Time Interval Failure
  - Johan Bernhardt left MOBLAS-6 for Riyadh in January.
  - Ludwig Combrink is Acting Station Manager until a replacement has been found.
  - Major loss in technical expertise in the daily operations at the station

International Laser Ranging Service

NASA

NASA Network Station Status

- Moblas 7 (Greenbelt, Maryland, 7105)
  - Increased shift operations due to LRO support
  - Lost 1 operator due to retirement, looking for replacement
  - Continue to be used as the Network testbed (both hardware and software testing)
- Moblas 8 (Tahiti, French Polynesia, 7124)
  - Continue to have radar issues, difficulties with scheduling trip to station
  - Currently off-line, Time Interval Failure
- TLRS-3 (Arequipa, Peru, 7403)
  - Back on-line following issues with Tachometer, (Aug.2009) and MCP (Sept.2009)
- TLRS-4 (Haleakala, Hawaii, 7119)
  - Continue to make progress at High Orbital tracking
- MLRS (Ft. Davis, Texas, 7080)
  - Continue support Lunar Operations
  - New Normal Point software installed at the site this month

NGSLR Status: May 2010

- Current focus is on passing an intercomparison with MOBLAS-7

- Final NGSLR work consists of completion of the automation, ranging to GNSS satellites during the day, and passing a collocation with MOBLAS-7.

- Continue to work toward completion of the automation of the transceiver bench (filters, IRIS, beam expander). Risley control (for point-ahead) is complete and fully working. Automated ND wheel is being developed. New I/O chassis which will give the software knowledge and control of radar and lasers.

- New in-house built 2kHz laser is being tested in the lab. Puts out variable transmit energy from eye-safe to 1 milliJoule and fits in the same space on the bench as the current Q-Peak. This laser was developed to allow us to range to GNSS satellites during the day.

- Work that has been done to improve the system performance is shown on next slide. This work is a precursor to the MOBLAS-7 intercomparison with the Q-Peak, and eventually to the collocation with the new laser.

International Laser Ranging Service

NASA

NGSLR: System Performance & Stability Issues

The following issues have been addressed and resolved:

- System crosstalk and back scatter have been eliminated by relocating ND filters from the transceiver bench to a newly fabricated light tight PMT enclosure. Eliminated multipath sources of noise.
- Transmit and 4 ch receive discriminators have been optimized and now perform at the sub-centimeter level.
- Procured and installed a new higher gain 4 ch receive.
- Relocated the start diode to a position preceding the Risley prisms to eliminate start pulse amplitude fluctuations.
- Installed an internal calibration fiber optic delay in the system and used to monitor stability. A simulated electronic delay is also available now.
- Installed delay cables and fiber optic bundles in thermal enclosures with probes to monitor temperature.
- Installed a dust curtain over the transceiver table to keep it clean and to minimize air turbulence.

International Laser Ranging Service

NASA

LRO-LR Status for ILRS GB: May 2010

Jan McGarry and Mark Torrence

-Nine ILRS stations have now successfully performed 1-way ranging to LRO:
NGSLR, MLRS, Greenbelt (MOB-7), Herstmonceux, Zimmerwald, Wettzell, Hartebeesthoek (MOB-6), Yarragadee (MOB-5) and Monument Peak (MOB-4).

- We have accumulated over 300 hours of successful laser ranging to LRO.

- Grasse has been accepted for participation and is in testing.

- We are working with the University of Tasmania to get the maser in earlier at the new VLBI station near Yarragadee so that the timing can be used by MOB-5 for LRO.

- Current information on LRO-LR can be found at: http://lrolr.gsfc.nasa.gov/

- LR has significantly contributed to knowledge and understanding of time on LRO

Summary of successful LRO-LR data through 2 May 2010

LR weekly summaries Units are minutes	DOY	GO1L NGSLR	GODL MOB-7	MDOL MLRS	HERL Herst.	ZIML Zimmer.	WETL Wettzell	HARL MOB-6	YARL MOB-5	MONL MOB-4	GRSM Grasse	TOTAL minutes	YEAR
Commissioning orbit												2628	
Mission Mapping Orbit	**Start of week**												**2009**
Week 1	263	45	0	0	0	0	0	0	0	0	0	45	
Week 2	270	714	35	0	0	0	0	0	0	0	0	749	
Week 3	277	616	0	0	33	0	0	0	0	0	0	649	
Week 4	284	211	0	0	49	0	0	0	0	0	0	260	
Week 5	291	83	0	47	0	0	0	0	0	0	0	130	
Week 6	298	120	0	0	34	0	16	0	0	0	0	170	
Week 7	305	980	0	79	0	0	20	0	0	0	0	1079	
Week 8	312	141	0	0	0	0	0	0	0	0	0	141	
Week 9	319	158	0	0	0	0	0	0	0	0	0	158	
Week 10	326	433	0	72	0	41	0	0	0	0	0	546	
Week 11	333	865	0	0	1	0	0	0	0	0	0	866	
Week 12	340	762	0	0	0	0	0	55	0	0	0	817	
Week 13	347	96	0	0	0	0	0	0	0	0	0	96	
Week 14	354	65	0	26	0	0	0	0	0	0	0	91	
Week 15	360	813	0	33	0	0	0	0	0	0	0	846	
Week 16	3	166	0	12	0	0	0	0	0	0	0	178	**2010**
Week 17	10	152	0	0	0	0	0	0	0	0	0	152	
Week 18	17	709	0	0	0	0	0	0	0	0	0	709	
Week 19	24	575	0	0	50	0	0	0	465	0	0	1090	
Week 20	31	379	0	104	0	0	0	0	617	21	0	1121	
Week 21	38	0	0	24	0	0	0	0	54	20	0	98	
Week 22	45	114	0	113	71	0	0	0	0	0	0	298	
Week 23	52	183	0	81	12	0	0	0	90	0	0	366	
Week 24	59	287	0	94	0	0	0	0	325	31	0	737	
Week 25	66	176	0	7	0	0	0	0	24	19	0	226	
Week 26	73	525	180	50	0	0	0	0	70	0	0	825	
Week 27	80	503	0	182	23	0	0	0	153	0	0	861	
Week 28	87	149	0	60	0	0	0	0	495	4	0	708	
Week 29	94	295	0	80	1	0	0	0	18	19	0	413	
Week 30	101	334	0	0	15	0	0	2	122	0	0	473	
Week 31	108	793	0	123	136	0	0	0	137	0	0	1189	
Week 32	115	153	0	135	31	0	0	0	413	0	0	732	
Week 33	122											0	
Week 34	129											0	
Week 35	135											0	
TOTAL minutes		11595	215	1322	456	41	36	57	2983	114	0	16819	
Fraction of data		0.6894	0.0128	0.0786	0.0271	0.0024	0.0021	0.0034	0.1774	0.0068	0.0000	1.0000	

	Hours
MMO only	280.3
w/comm	324.1