Seventh General Assembly of the ILRS
April 25, 2002
Nice, France

Presentation Material

ILRS Chairman's Report

John Degnan
ILRS Governing Board Chairperson
Nice, France
April 25, 2001

International Laser Ranging Service (ILRS)

- ***Governing Board*** **debates and sets policy for all aspects of SLR through its** ***Working Groups***
  - Current 16 member Governing Board (GB) was installed in November, 2000 at the 12th International Workshop on Laser Ranging in Matera, Italy.
  - New Coordinators and Deputy Coordinators were chosen from the new GB membership to head the various working groups
  - Next GB elections are scheduled for Summer, 2002, prior to the 13th International Workshop on Laser Ranging in Washington, DC, during the week of Oct. 7-11, 2002.
- ***Central Bureau*** **at NASA/GSFC oversees daily operations and communications, maintains databases, works to foster and implement GB policy, and produces annual reports.**
  - New Director: Dr. Michael Pearlman, Smithsonian Astrophysical Observatory (replaced John Bosworth who retired from NASA/GSFC on 1 June 2001)
  - New Secretary: Ms. Carey Noll, NASA/GSFC(replaces Dr. Michael Pearlman, SAO)
- ***2000 Annual Report*** **is being distributed.**

Current ILRS Governing Board (term ends October 2002)

Hermann Drewes	Ex-Officio, CSTG President	Germany
Michael Pearlman	Ex-Officio, Director ILRS Central Bureau	USA
Carey Noll	Ex-Officio, Secretary, ILRS Central Bureau	USA
Werner Gurtner	Appointed, EUROLAS , Networks & Eng. WG Coordinator	Switzerland
Wolfgang Schlueter	Appointed, EUROLAS, Networks & Eng. WG Deputy Coord.	Germany
David Carter	Appointed, NASA	USA
John Degnan	Appointed, NASA, Governing Board Chairperson	USA
Yang FuMin	Appointed, WPLTN	PRC
Hiroo Kunimori	Appointed, WPLTN, Missions WG Coordinator	Japan
Bob Schutz	Appointed, IERS Representative to ILRS	USA
Graham Appleby	Elected, Analysis Rep.	UK
Ron Noomen	Elected, Analysis Rep. , Analysis WG Coordinator	Netherlands
Wolfgang Seemueller	Elected, Data Centers Rep. , Data Formats & Procedures WG Deputy Coordinator	Germany
Peter Shelus	Elected, Lunar Rep., Analysis WG Deputy Coordinator	USA
Georg Kirchner	Elected, At-Large, Missions WG Deputy Coordinator	Austria
John Luck	Elected, At-Large, Data Formats & Procedures WG Coordinator	Australia

International Laser Ranging Service

ILRS Working Group (WG) Activities

- ***Missions WG*** has formalized procedures for approving new missions and establishing tracking priorities
- ***Analysis WG*** has pilot project underway to compare results from different analysis centers and to develop a formal ILRS solution
- ***Data Formats and Procedures WG*** is streamlining and modernizing data formats and procedures to better handle new mission requirements and technologies.
- ***Networks and Engineering WG*** is upgrading procedures to expedite data flow and developing engineering data bases to improve network performance
- ***Signal Processing Ad Hoc WG*** is working to reduce remaining systematic ranging errors (satellite signature, refraction, etc.)

Central Bureau

- **Actively providing new conveniences for communications such as targeted email exploders and enhanced search capabilities within the ILRS web site *http://ilrs.gsfc.nasa.gov***
- **Adding new material to the ILRS Web Site with following major topics:**
  - **ILRS structure, membership, and relationships to outside organizations**
  - **Current Events**
  - **Working Group membership and activities**
  - **Satellite missions and tracking plans with links to individual mission sites**
  - **ILRS stations with links to individual station sites**
  - **ILRS Data Products**
  - **Science and Analysis (including extensive bibliographies)**
  - **Engineering and Technology (including extensive bibliographies)**
  - **Reports and Meeting Minutes**
  - **Frequently Asked Questions (FAQ's)**
  - **Links to Related Web Sites**

SLR Network Improvements

- ***Improvements in Southern Hemisphere Coverage***
  - **Tahiti and South Africa NASA partnership SLR sites are operational**
  - **New German multi-technique (SLR, VLBI, GPS, gravimeter) station in Conception, Chile (TIGO)**
  - **New SLR sites in Argentina under consideration (NASA, China)**
- ***Other Network Updates***
  - **New state-of-the-art systems in**
    - **Italy (Matera) - includes two-color and lunar capability**
    - **Australia (Mt. Stromlo)**
  - **Several new stations under development**
    - **Russia (Moscow, Novosibirsk)**
    - **China (Kunming plus two mobile units)**
  - **Fully automated systems under development (NASA SLR2000, EOS Keystone)**

Current SLR Network

International Laser Ranging Service

ILRS Tracking Priorities (Jan 2002)

Priority	Mission	Sponsor	Altitude (km)	Inclination (degrees)	Comments
1	CHAMP	GFZ, Germany	429-474	87.27	Gravity research
2	Starshine 3	US Cooperative	470	67	Drag research / no other tracking technique available
3	GFO1	US Navy	790	108.0	Altimeter POD/calibration / no other tracking technique
4	ERS2	ESA	800	98.6	Altimeter calibration /PRARE backup
5	Jason	NASA/CNES	1,350	66.0	Altimeter / DORIS and GPS backup
6	TOPEX/Poseidon	NASA/CNES	1,350	66.0	Altimeter calibration / DORIS and GPS backup
7	Stella	CNES	815	98.6	Geodetic / / no other tracking technique available
8	Starlette	CNES	815-1,100	49.8	Geodetic / / no other tracking technique available
9	Meteor-3M	NASA/IPIE, Russia	1020	99.64	Retroreflector research / Tracking by 2 NASA sites only
10	REFLECTOR	IPIE, Russia	1,020	99.6	POD research for space debris detection
11	BeaconC	NASA	950-1300	41	Gravity Research / upgraded to ongoing mission (Jan 2002)
12	Ajisai	NASDA	1,485	50	Geodetic / / no other tracking technique available
13	LAGEOS2	NASA/ASI, Italy	5625	52.6	Geodetic / / no other tracking technique available
14	LAGEOS1	NASA	5850	109.8	Geodetic / / no other tracking technique available
15	Etalon1	Russia	19,100	65.3	Geodetic / / no other tracking technique available
16	Etalon2	Russia	19,100	65.2	Geodetic / / no other tracking technique available
17	GLONASS80	Russia	19,100	65	Positioning POD enhancement / replaced G70 as of 10/20/99
18	GLONASS78	Russia	19,100	65	Positioning POD enhancement / replaced G72 as of 6/29/00
19	GLONASS84	Russia	19,100	65	Positioning POD enhancement / replaced G79as of 2/22/01
20	GPS35	US DoD	20,100	54.2	Positioning POD enhancement
21	GPS36	US DoD	20,100	55.0	Positioning POD enhancement

International Laser Ranging Service

ILRS Tracking Campaigns

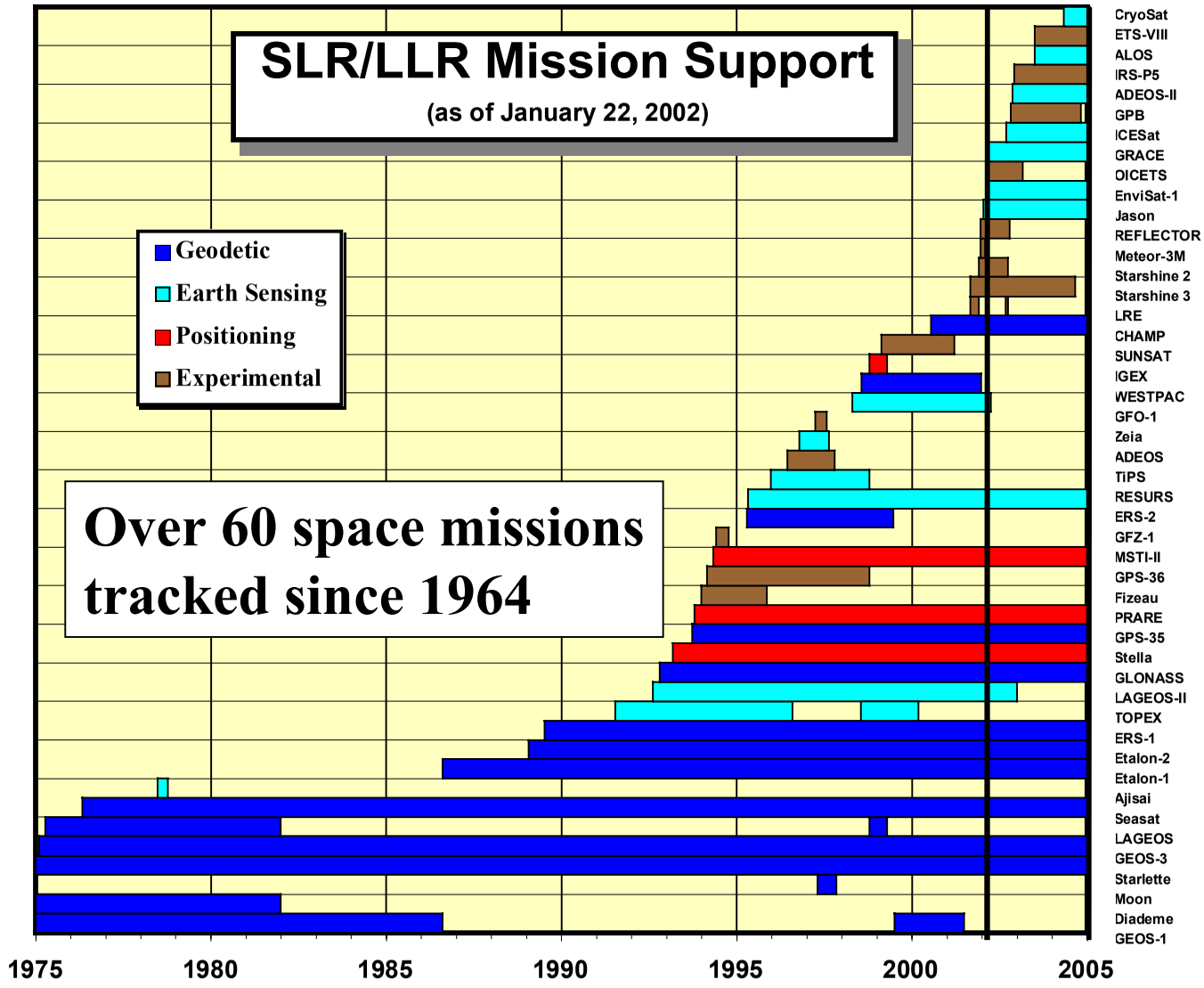
- **Recent Campaigns**
  - **Revived ERS-1 tracking to support tandem Synthetic Aperture Radar (SAR) measurements with ERS-2**
  - **GFO-1 was moved to full tracking status (now totally reliant on SLR due to failure of 4 redundant GPS receivers)**
  - **South African SUNSAT remote sensing mission (now terminated)**
  - **Japanese LRE mission (highly elliptical orbit)**
  - **Revived GEOS-3 and Beacon-C tracking for gravity field improvement in preparation for GRACE**
  - **Initiated intensified ETALON 1 & 2 campaign at the request of the ILRS Analysis Working Group to better understand usefulness of SLR in measuring Earth Orientation Parameters**
  - **Test new retroreflector designs on Russian Meteor-3M and Reflector satellites (SAGE Project has since requested regular SLR tracking due to failure of onboard GPS/GLONASS receiver).**

Upcoming ILRS Missions

(Status as of January 22, 2002)

Satellite	Owner	Mission Type	Planned Launch Date	Mission Duration	Received Mission Request Form	Received ILRS GB Approval
Starshine 2	NASA, NRL, etc	Atmospheric Drag , Education Outreach	End November 2001	Approximately 5 months	Yes	Conditionally for limited testing Have not started Tracking
Envisat-1	ESA	Altimeter POD/ calibration	February 28, 2002	5 years	Yes	Yes
OICETS	NASDA	Experimental	February 2002	1 year	No	No
Grace	NASA / GFZ	Gravity	March 5, 2002	5 years	Yes	Yes
IceSat (GLAS)	NASA	Ice/land topography Laser Altimeter POD/ calibration	September 8, 2002	3-5 years	Yes	Yes
Gravity Probe B	NASA	Relativity	October 30, 2002	1-2 years	Yes	Yes
ADEOS-II	NASDA	Altimeter POD/ calibration	November 2002	3 years	Yes	Yes
IRS-P5	ISRO	Experimental	Late 2002	5 years	No	No
ALOS	NASDA	Altimeter calibration	Jul/Aug. 2003	3 years	No	No
ETS-VIII	NASDA	Time transfer	Jul./Aug. 2003	3 years	No	No
CryoSat	ESA	Sea Ice/ Ice cap	Apr/May 2004	3.5 years	Yes	Awaiting MWG Recommendation
VCL	NASA	Laser Altimeter POD/calibration for Vegetation studies	Delayed Indefinitely	18 months	Yes	No

International Laser Ranging Service



International Laser Ranging Service

Next ILRS General Assembly

- **13th International Workshop on Laser Ranging and 8th ILRS General Assembly**
  - **October 7-11, 2002, Washington, DC**
  - **Hosted by NASA Goddard Space Flight Center and Smithsonian Astrophysical Observatory**
  - **Tour of Goddard Geophysical and Astronomical Observatory (GGAO)**
    - **SLR2000**
    - **MOBLAS-7**
    - **TLRS-4**
    - **1.2 Meter Experimental Ranging Facility**
  - **Banquet at the Smithsonian**

Certificate of Appreciation

This certificate is awarded to

Dr. Francois Barlier

in appreciation of his many contributions to Satellite Laser Ranging and his meritorious service as an elected At-Large Representative on the first ILRS Governing Board, 1998-2000

International Laser Ranging Service

John J. Degnan, Chairperson, ILRS Governing Board

Michael R. Pearlman, Director, ILRS Central Bureau

Carey E. Noll, ILRS Secretary

Central Bureau Report

NETWORK TRACKING PRIORITIES

Tracking priorities have been ordered as follows:

1. priorities decrease with:
   a. increasing orbital altitude; and
   b. increasing orbital inclination (at a given altitude).
2. priority of some satellites may then be increased to intensify support for:
   a. active missions (such as altimetry);
   b. special campaigns (such as IGEX 98); or
   c. post-launch intensive tracking phases; and
3. some slight reordering may be done to give slightly higher priority to missions with increased importance to the analysis community.

ILRS SATELLITE TRACKING PRIORITIES
April 2002

Priority	Mission	Sponsor	Altitude(km)	Comments
1.	GRACE	GFZ/JPL	485 - 500	Special Priority/Active Sat.
2.	CHAMP	GFZ	429 - 474	Special Priority/Active Sat.
3.	GFO-1	US Navy	790	Active Sat/no other tracking
4.	ENVISAT	ESA	796	Tandem with ERS-2
5.	ERS-2	ESA	800	
6.	JASON	CNES/NASA	1,350	Tandem with Topex
7.	TOPEX/Poseidon	NASA/CNES	1,350	
8.	Starlette	CNES	815 - 1,100	
9.	Stella	CNES	815	
10.	Beacon-C	NASDA	1,485	
11.	Reflector	IPIE	1,020	
12.	Ajisai	NASDA	1,485	
13.	LAGEOS-2	ASI/NASA	5,625	
14.	LAGEOS-1	NASA	5,625	
15.	Etalon-1	Russian Fed.	19,100	Campaign thru April 2002
16.	Etalon-2	Russian Fed.	19,100	Campaign thru April 2002
17.	GLONASS 86	Russian Fed.	19,100	Replaced GLONASS 80
18.	GLONASS 87	Russian Fed.	19,100	Replaced GLONASS 88
19.	GLONASS 84	Russian Fed.	19,100	Replaced GLONASS 79
20.	GPS-35	US DoD	20,100	
21.	GPS-36	US DoD	20,100	
LUNAR TARGETS				
	Apollo 11	NASA	356,400	
	Apollo 14	NASA	356,400	
	Apollo 15	NASA	356,400	
	Luna 17	Russian Fed.	356,400	
	Luna 21	Russian Fed.	356,400	

QUALIFICATION OF ILRS TRACKING STATIONS

Proposal

Assign all ILRS stations to one of three categories based on an annual performance review by the Analysis Working Group:

- **Core Stations: meet the "highest standards" of performance in terms of data quantity and quality;**

- **Contributing Stations: contribute significantly to the scientific and/or technical goals of the ILRS; and**

- **Associate Stations: presently provide intermittent, varying quality, less useful data.**

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CORE STATIONS

- **consistently provide a large quantity of accurate range data that can be used by the analyst with a high level of confidence;**
- **meet all of the Recommended Performance Criteria (RPC) as first presented at the Tenth Workshop on Laser Ranging in Shanghai in November 1996;**
- **can be added as stations achieve RPC performance level as verified by the Analysis Working Group; and**
- **can be deleted if stations fall below the RPC performance level**

CONTRIBUTING STATIONS

- **provide data of sufficient quantity and quality to have a positive impact on analysis results as determined through an annual review process by the Analysis Working Group; and**
- **produce data that is regularly and continuously analyzed by at least one ILRS Analysis Center or one mission specific Associate Analysis Center**

ASSOCIATE STATIONS

- **do not meet the performance criteria for a Contributing Station during the prior annual review;**
- **may be under development or protracted programs of upgrading; and**
- **would be encouraged to submit data so that analysis groups could provide scrutiny and advice as the station works toward a higher classification.**

Table 1. Recommended Performance Criteria (RPC)

Daytime and nighttime Ranging Capability	
Data Yield:	
LEO satellites 1000 passes	
LAGEOS 1/2 400 passes	
Data Quality:	
LAGEOS NP precision:	**1.0 cm**
Short term range bias stability:	**2.0 cm (STD of the pass by pass biases)**
Long term range bias stability:	**1.0 cm (STD of the monthly range 2.0 cm biases for 8 of the last 12 months)**
Data delivery	**within 24 hours**

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Table 2. Station Performance during the Period 1 July 2000 through 30 June 2001		
	Core Stations	Contributing Stations
Europe	Herstmonceux	Potsdam
	Graz	San Fernando
	Grasse (SLR +LLR)	Riga
	Zimmerwald	Borowiec
	Matera (MLRO)*	Wettzell
Africa	Hartebeesthoek*	
Asia	Changchun	Shanghai
		Beijing
		Kunming
		Simosato
		Keystone Systems
Australia/S. Pacific	Mt Stromlo	Tahiti
	Yarragadee	
North/South America	Monument Peak	Arequipa
	Greenbelt	Mt Haleakala
	McDonald	Concepcion (TIGO)*
* indicates high performance station recently moved to a new site or ready to move		

Table 3. Associate Stations		
Metsahovi Wuhan Helwan Golosiiv	Maidanak Simiez Katsively	Mendeleevo Komsomolsk Cagliari

Honeywell

ILRS Operational Issues & Network Performance

Van Husson

ILRS Central Bureau

International Laser Ranging Service

Operational Issues (Apr 2002)

Honeywell

PREDICTS

- Daily predicts, except sub-daily predicts for CHAMP and GRACE + drag functions

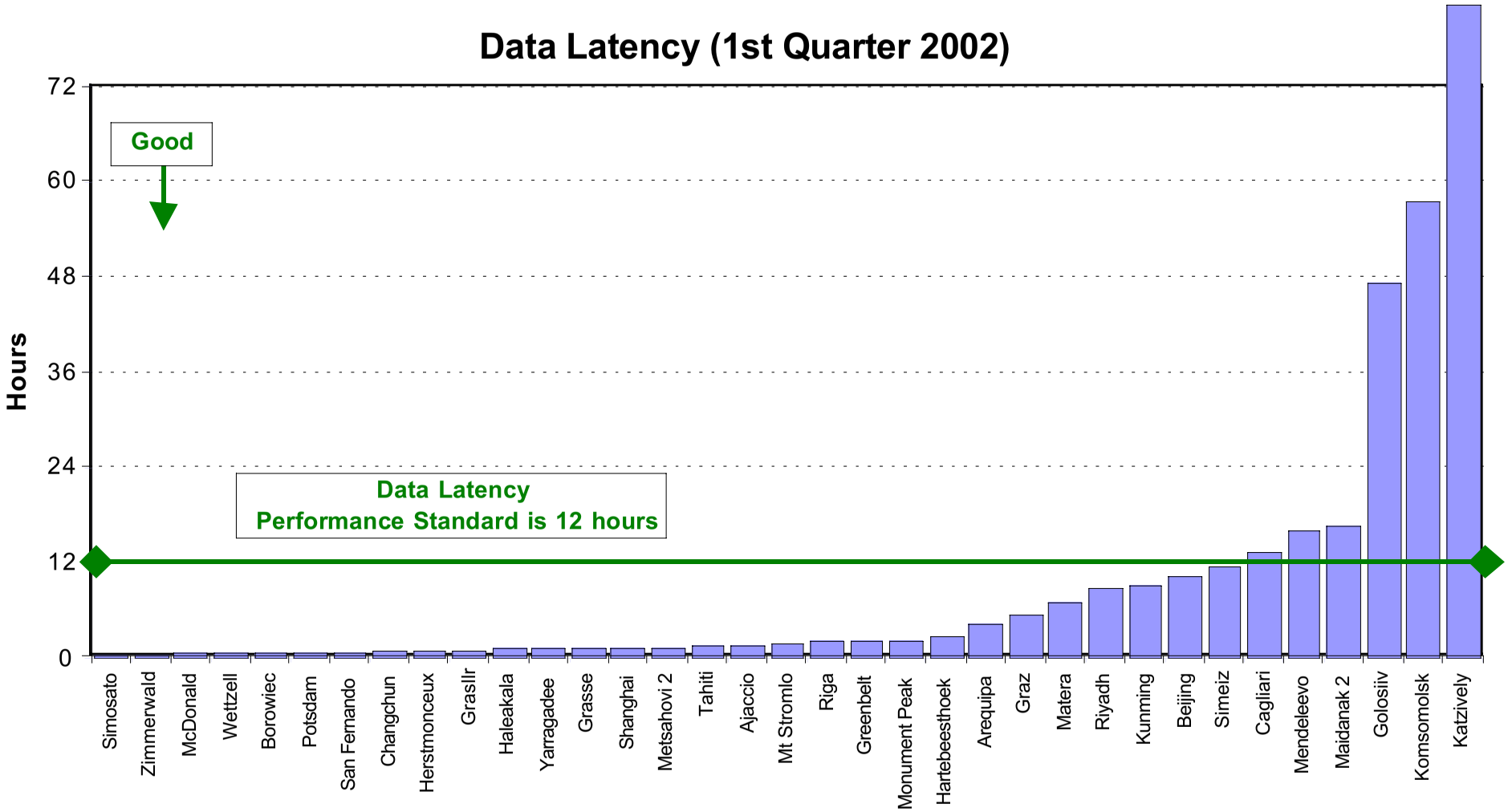
- Real time system status exchange (W. Gurtner)

DATA LATENCY – excellent

SITE LOGS – good progress, need to make logs current

LOCAL SITE TIES – need a lot of work, need to communicate importance

NEW ILRS WEB SITE – operational on April 18, 2002


Data Latency (1st Quarter 2002)
Hours
72
60
48
36
24
12
0
Good
Data Latency
Performance Standard is 12 hours
Simosato
Zimmerwald
McDonald
Wettzell
Borowiec
Potsdam
San Fernando
Changchun
Herstmonceux
GrasIIr
Haleakala
Yarragadee
Grasse
Shanghai
Metsahovi 2
Tahiti
Ajaccio
Mt Stromlo
Riga
Greenbelt
Monument Peak
Hartebeesthoek
Arequipa
Graz
Matera
Riyadh
Kunming
Beijing
Simeiz
Cagliari
Mendeleevo
Maidanak 2
Golosiiv
Komsomolsk
Katzively

Site Log Status

Honeywell

44 site logs received and on-line at:
ftp://cddisa.gsfc.nasa.gov/pub/reports/slrlog/

Outstanding Site Logs

- 1863 Maidanak-1
- 1864 Maidanak-2
- 1868 Komsomolsk

Master file has been created in MS EXCEL

- One Worksheet per section
- Auto Filter (i.e. search) enabled
- Initial QC of most sections complete (e.g. corrected numerous format/data integrity issues)
- Incorporated some manufacturer specifications

International Laser Ranging Service Home Page - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: http://ilrs.gsfc.nasa.gov/ What's Related

Instant Message Internet Lookup New&Cool Netcaster

International Laser Ranging Service Home Page

Satellite laser ranging (SLR brochure and cartoon) uses lasers to measure ranges from ground stations to satellite borne retro-reflectors to the millimeter level. The primary mission of the ILRS as stated in the organization's Terms of Reference is "*to support, through satellite and lunar laser tracking data and related products, geodetic and geophysical research activities.*"

If you have a suggestion or complaint about our service, please send an email to the ILRS CB Secretary.

ILRS Web Site Curator(s): ilrsweb@ilrs.gsfc.nasa.gov
Responsible Government Official: Carey Noll (noll@cddisa.gsfc.nasa.gov)
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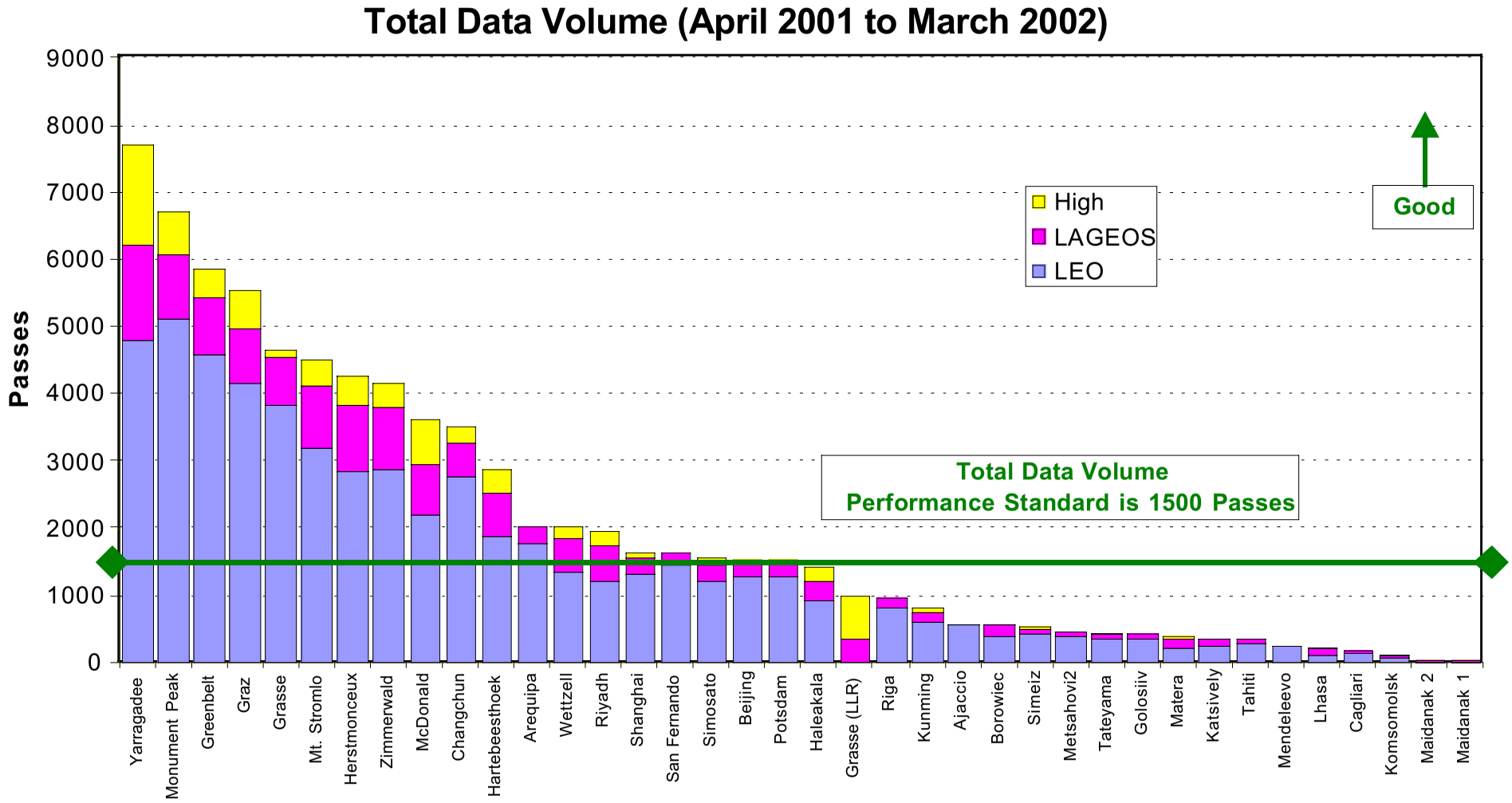
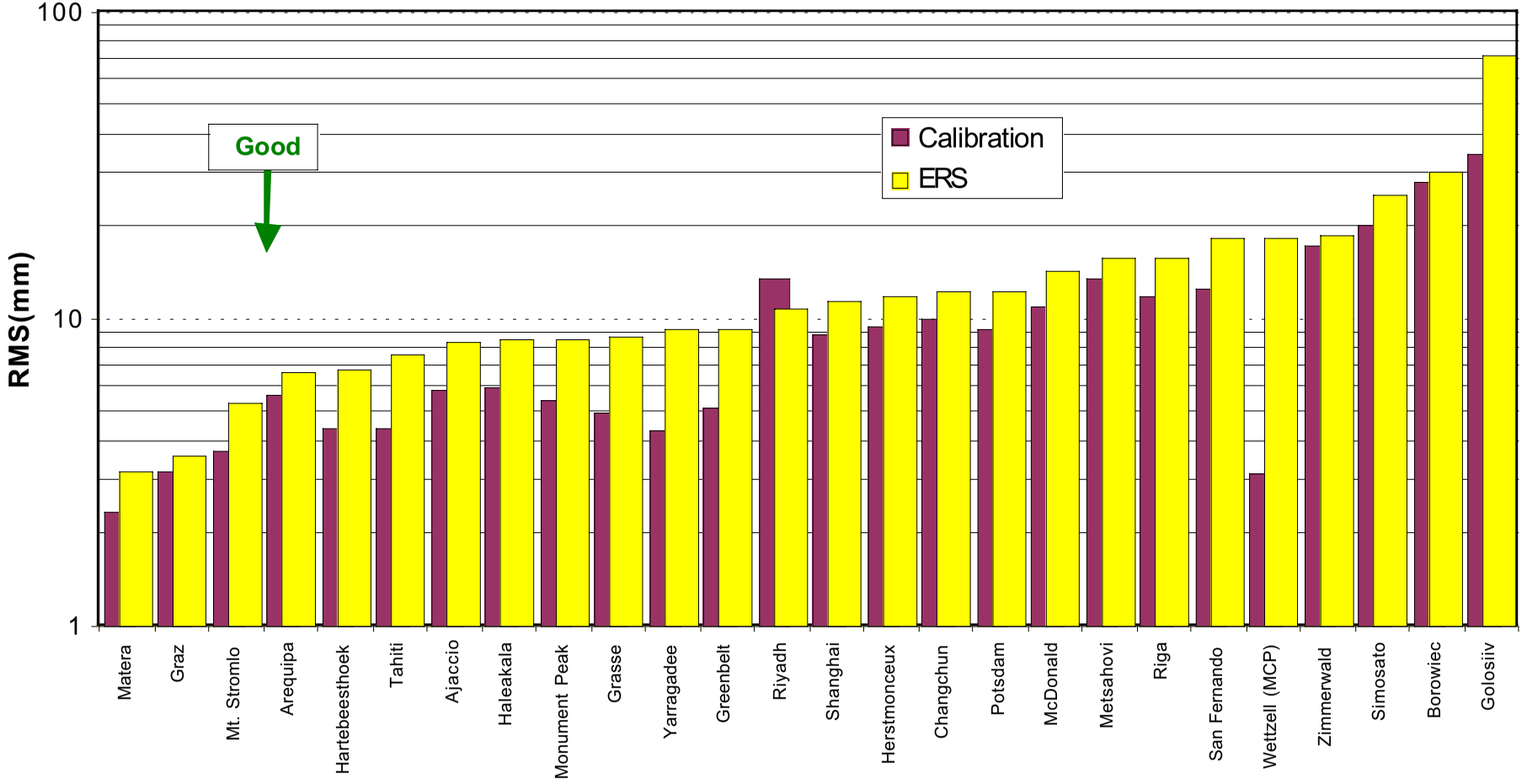
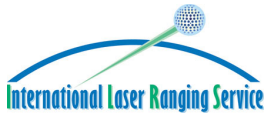
Document: Done


Total Data Volume (April 2001 to March 2002)
Passes
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
High
LAGEOS
LEO
Good
Total Data Volume
Performance Standard is 1500 Passes
Yarragadee
Monument Peak
Greenbelt
Graz
Grasse
Mt. Stromlo
Herstmonceux
Zimmerwald
McDonald
Changchun
Hartebeesthoek
Arequipa
Wettzell
Riyadh
Shanghai
San Fernando
Simosato
Beijing
Potsdam
Haleakala
Grasse (LLR)
Riga
Kunming
Ajaccio
Borowiec
Simeiz
Metsahovi2
Tateyama
Golosiiv
Matera
Katsively
Tahiti
Mendeleevo
Lhasa
Cagliari
Komsomolsk
Maidanak 2
Maidanak 1

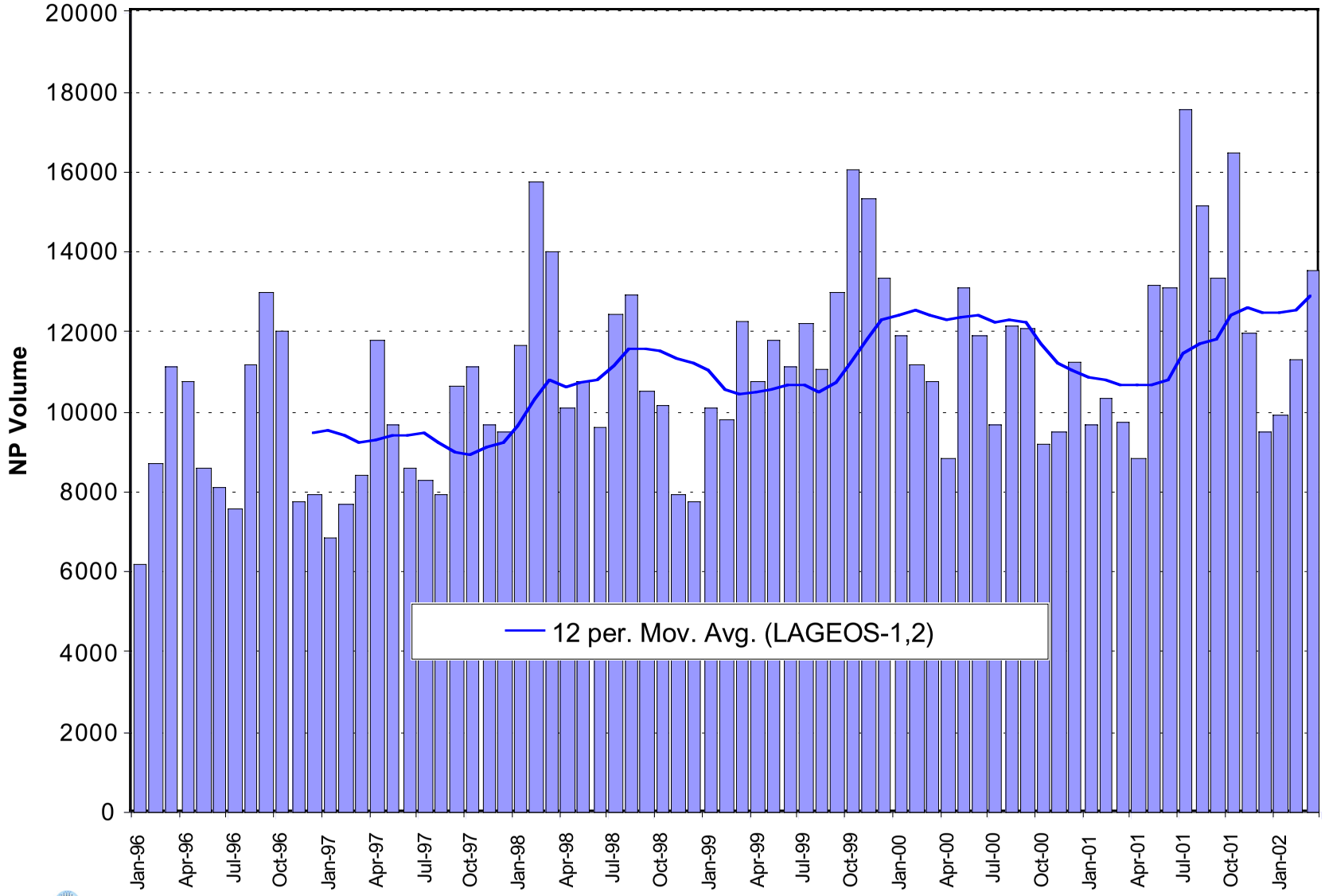
Honeywell

ERS Single Shot RMS (1st Quarter 2002)



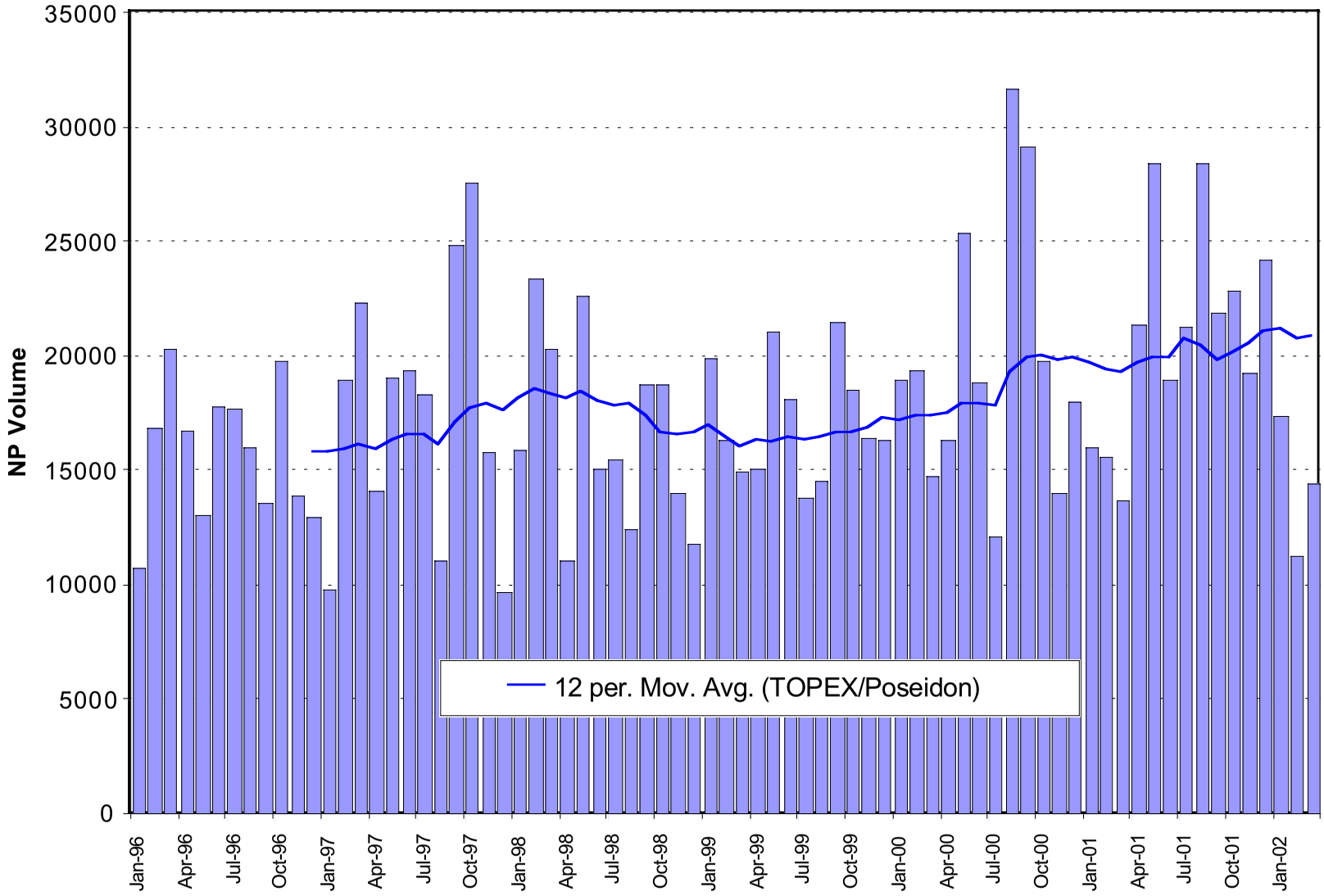


LAGEOS NP Volume



Honeywell

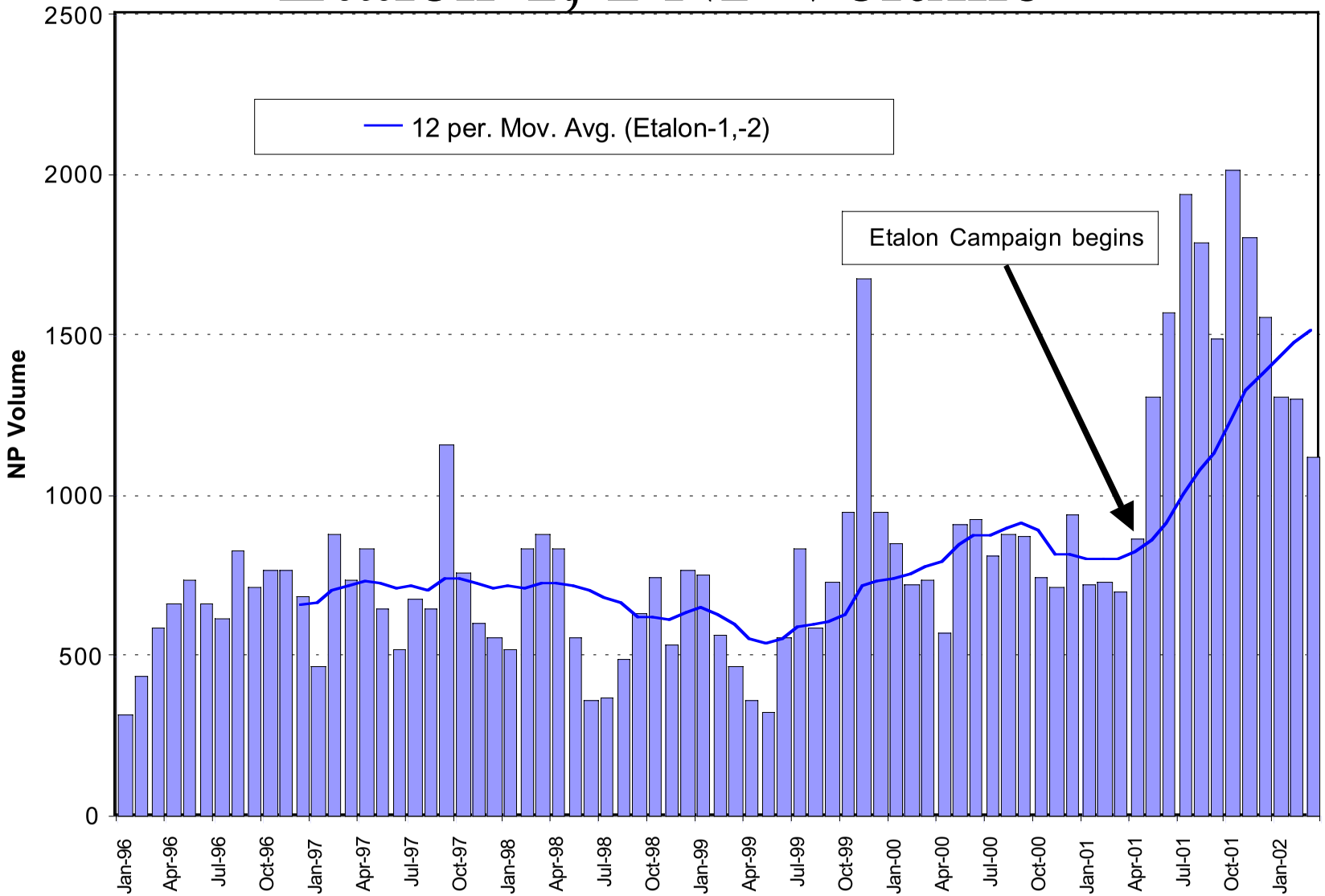
TOPEX/Poseidon NP Volume



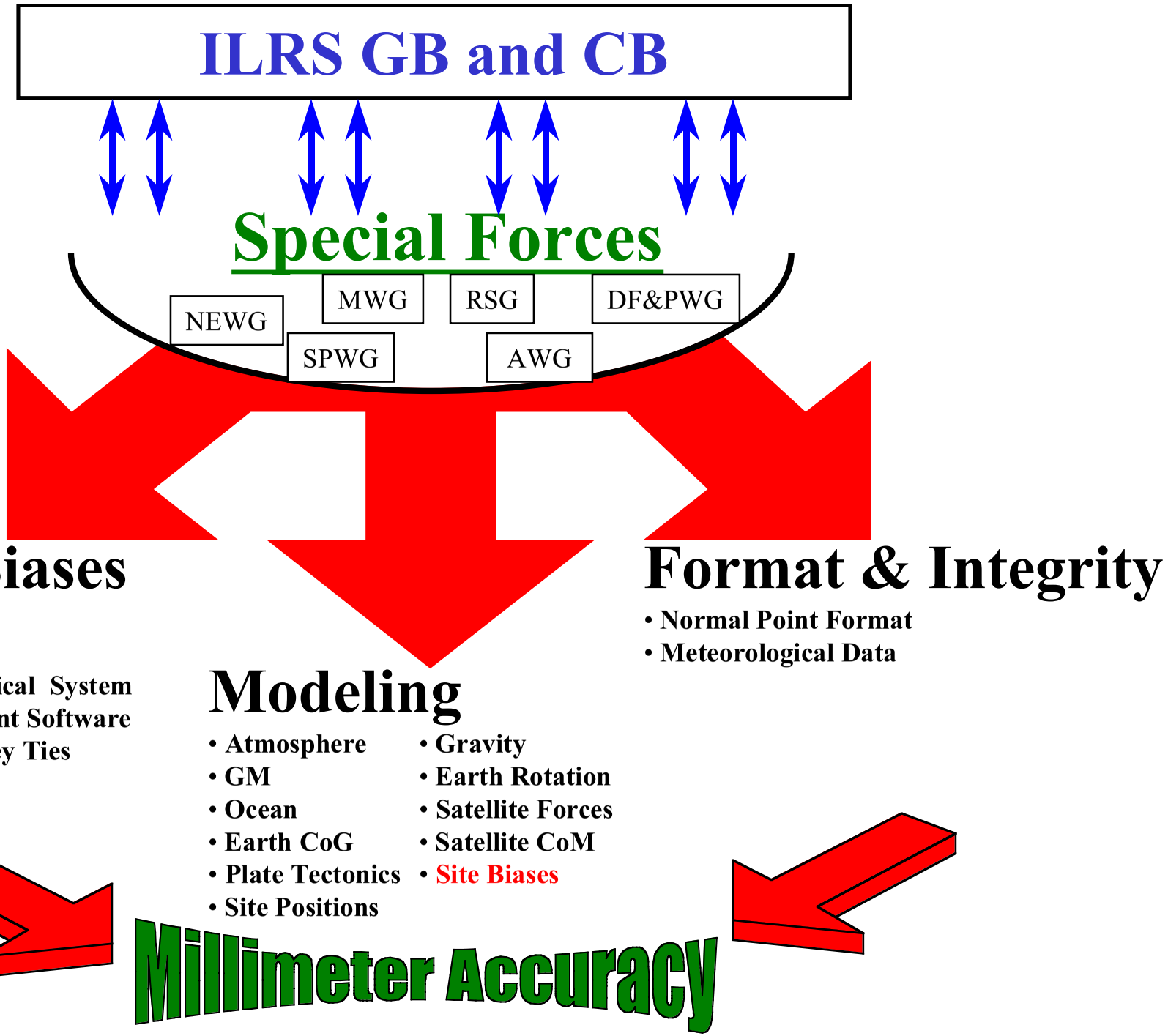
International Laser Ranging Service

Honeywell

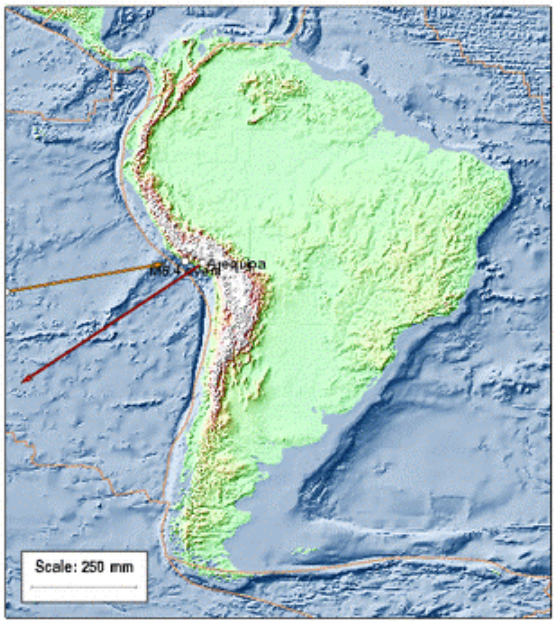
Etalon-1,-2 NP Volume



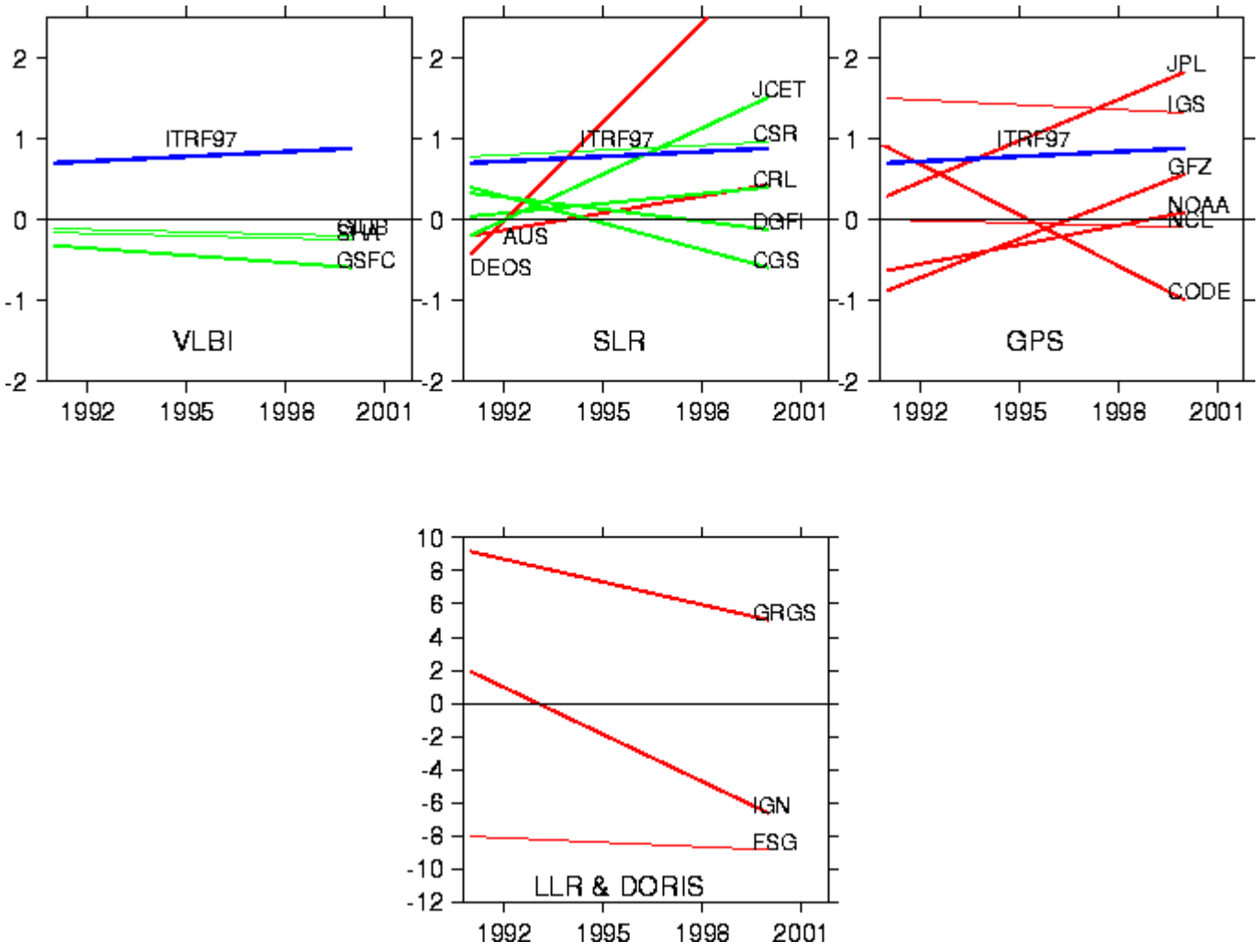
International Laser Ranging Service


ILRS GB and CB
Special Forces
NEWG
MWG
RSG
DF&PWG
SPWG
AWG
Site Biases
• Electronics
• Optics
• Meteorological System
• Normal Point Software
• Local Survey Ties
Format & Integrity
• Normal Point Format
• Meteorological Data
Modeling
• Atmosphere
• GM
• Ocean
• Earth CoG
• Plate Tectonics
• Site Positions
• Gravity
• Earth Rotation
• Satellite Forces
• Satellite CoM
• Site Biases
Millimeter Accuracy

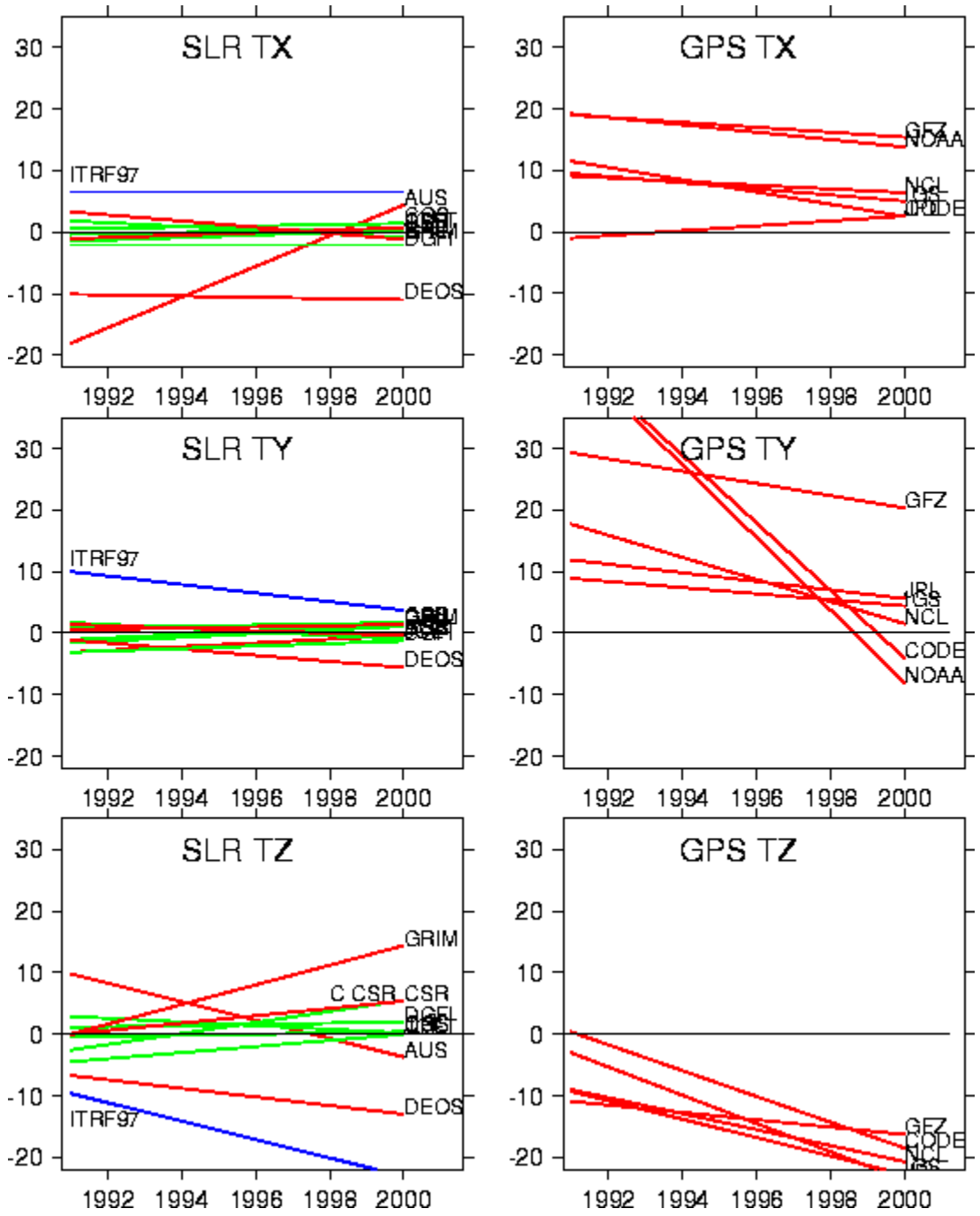
Displacement at Arequipa June 23 2001



NAZCA plate direction *58 cm. station shift*



ITRF2000 SCALE VARIATIONS



ITRF2000 TRANSLATION VARIATIONS

Network Reports

WLRS:

- **fully operational (SLR) since January 2002**
- **improvements:**
  - **Event Timer (French Development(Dassauld))**
  - **Improvement in Calibration**
- **extension to low orbiting satellites (Champ, ..)**
  - **second receiving telescope with detector**
  - **integration of the resp. calibration features**

TIGO-SLR

- **since January in Concepcion**
- **since mid of April operational**
- **first passes have been tracked**

MTLRS

- **still idle**
- **waiting for decisions to move on with the cooperation with the Urumqi Astronomical observatory**

EUROLAS: Station reports

- FTLRS
- Wettzell
- Graz
  - Range gate generator with < 0.5 ns resolution
  - Designed for multi-kHz Laser systems
- Zimmerwald
  - Very preliminary tests with infrared ranging (846 nm)
  - Hamamatsu PM
  - Better return rate, less day light noise, slightly higher single-shot RMS
- Matera

French Transportable Laser Station in operation

Colocation phase at Grasse observatory

Three stations (Fixed SLR, LLR and FTLRS)

eptember 2001 ->December 2001

Results:
-60 simultaneous passes on Lageos with three stations
-more than 120 LEOS satellites with two stations

-> Ftlrs qualification

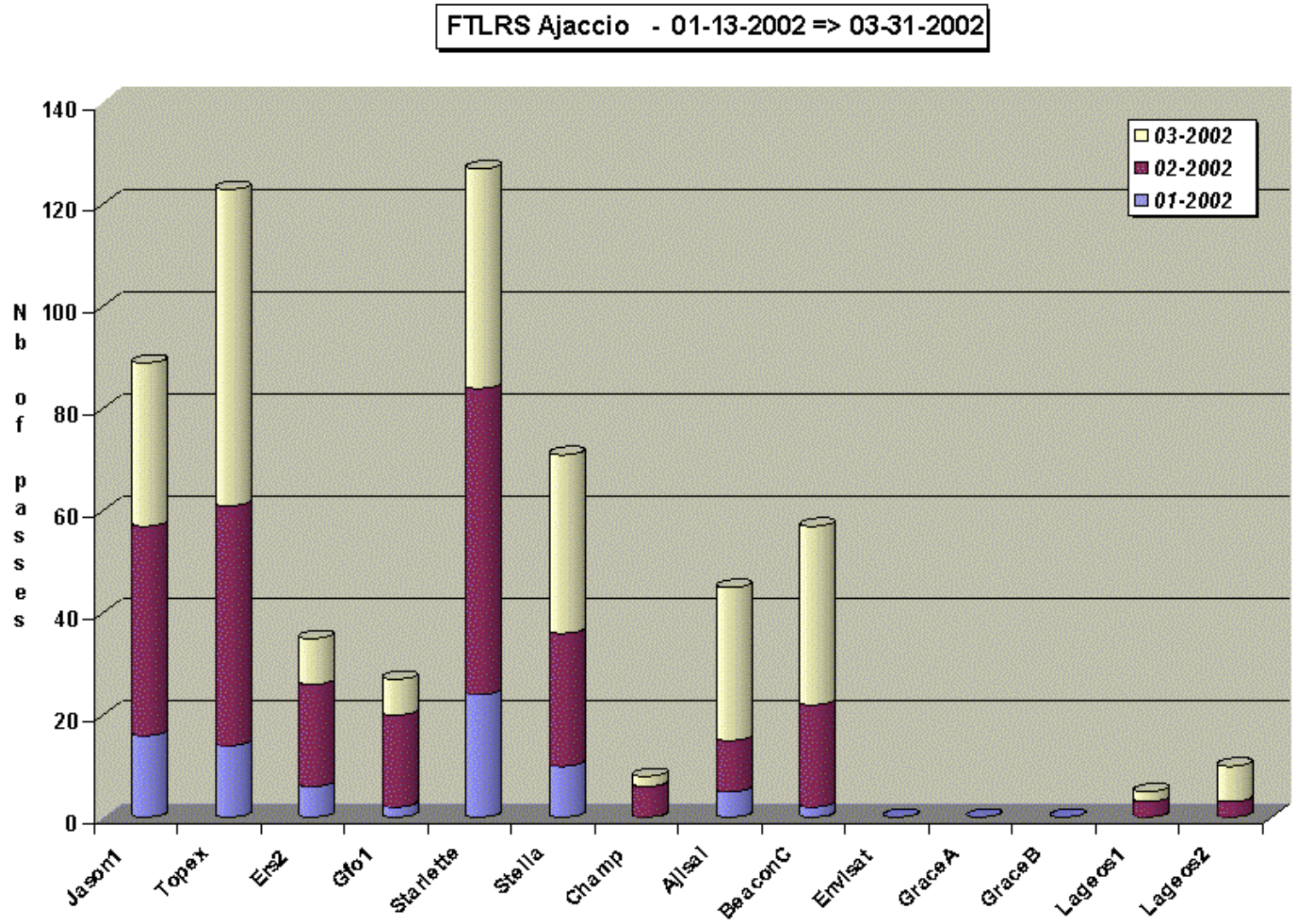
Jason1 calibration campaign

nstallation on january 15th 2002 in Corsica
t Ajaccio

ason1 calibration pass every ten days

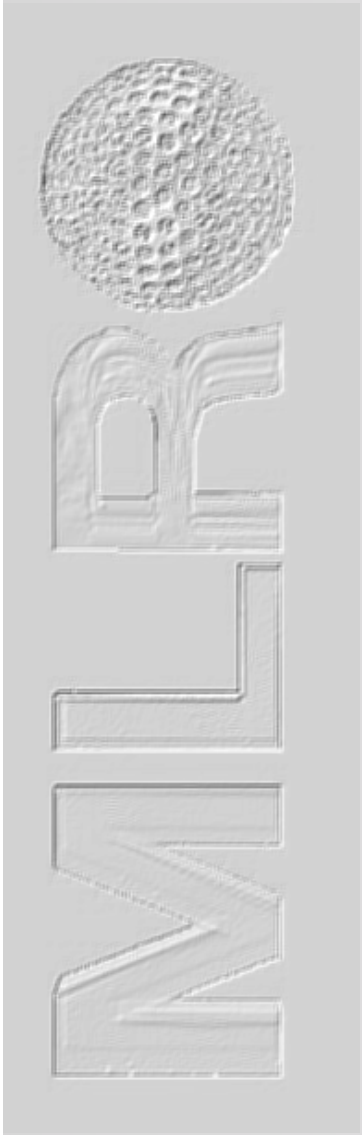
lore than 600 passes in three months

End of this campaign July 2002


FTLRS Ajaccio - 01-13-2002 => 03-31-2002
03-2002
02-2002
01-2002
Nb of passes
140
120
100
80
60
40
20
0
Jason1
Topex
Ers2
Gfo1
Starlette
Stella
Champ
Ajisai
BeaconC
Envisat
GraceA
GraceB
Lageos1
Lageos2

FTLRS at Ajaccio (Corsica)

Ajaccio-campagne d ’étalonnage Jason1 janvier/juin 2002



Status report

G. Bianco

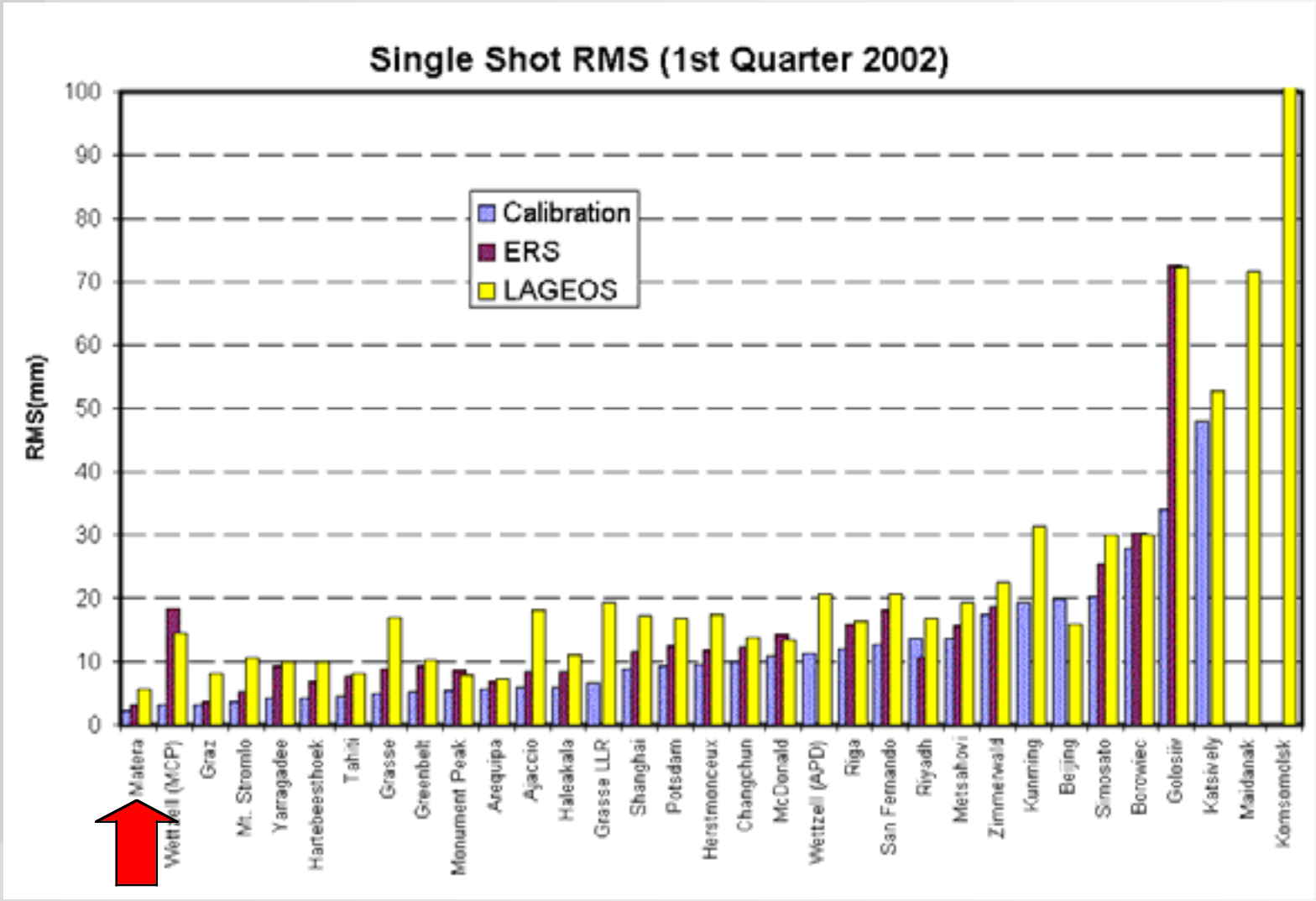
ASI/CGS, Matera, Italy

7th ILRS General Assembly
Nice, France, 25 April 2002

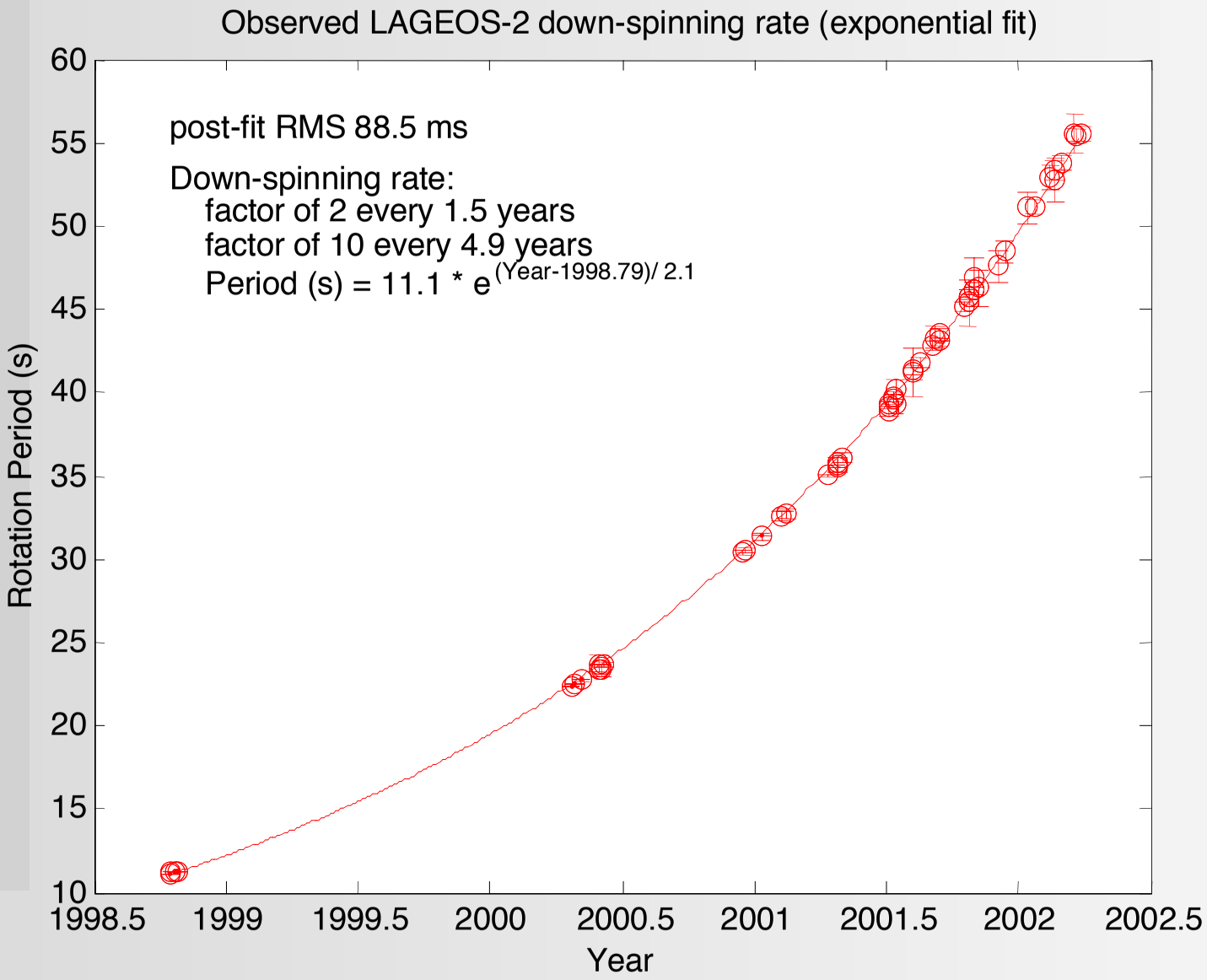
MLRO status report

- System is producing good quality data
- 2-color PMT configuration operational
- 2-color streak camera configuration operational (several passes tracked)
- LLR configuration operational (Moon tracked)
- Ready to go into final acceptance at any time now

In case you missed this, we're here…



LAGEOS II down-spinning rate



WPLTN Report
ILRS Seventh General Assembly

Nice, France
April 25, 2002

ABSTRACTS:

Australian Network

The Australian stations Stromlo (7849) and Yarragadee (7090) are performing well. Stromlo routinely operates autonomously and unattended for 80 hours every week, without problems.

The LIDAR system at Yarragadee is to be upgraded slightly to provide enhanced data to atmospheric physicists. The definitive report on the local ties at Stromlo, Yarragadee, Orroral, Hobart and Tidbinbilla has been published.

AUSLIG has been re-organised within the Australian Government administration, and is now called the National Mapping Division of Geoscience Australia. SLR funding faces an uncertain future in Australia.

Chinese Network

The performance of the Chinese stations has not been changed since last Laser Workshop. But many problems have happened recently. The Beijing station has laser problem, the Wuhan station has the problem with the new dome, the Kunming station has problem with their detectors. Each station is making effort to solve the problems.

The SLR system for Argentina is still under construction. It will be finished by the fall of this year, but not including the installation in San Juan, Argentina.

Japanese Network

The KSP(CRL) station at Miura was dismantled in January 2001 and the telescope was moved to the University of Kagoshima. Observation from other KSP stations are suspended, pending allocation of funds under the next budget.

JHD has submitted to CDDIS outstanding data obtained in by HTLRS during the 1990's occupation of a remote island in Japan.

Simosato station has been in trouble with mount motors [now replaced], while LEO productivity increased by increased efforts in satellite acquisition with lower minimum elevation angle and working shift optimisation.

NASDA new SLR station of GUTS project is under development in a southern island near launching site, and is now in CDR phase.

Russian Network

Komsomolsk [1868] will stop operation from June 2002 to the end of 2002, for modernization (telescope, tracking system, laser, distance measurement system). Maidanak [1863] will be operational in mid 2002. Maidanak [1864] and Mendeleevo [1870] are operational.

REFLECTOR and METEO were launched.

The new SLR station near Moscow is seeking permission for the publication of its station coordinates.

Saudi Arabia

SALRO has re-started observation and to send data to CDDIS in January 2001 with considerably high volume of passes from low satellites to high satellites including GPS. Effort to bring the station to a fully operational status continues.

SALRO symposium [to be held on 23-24 September 2001] was deferred indefinitely due to the events of September 11, 2001.

DETAILED NATIONAL REPORTS

1. Russia

1868, Komsomolsk:

It is planned to stop the station operation from June, 2002 till the end of 2002, for modernization (telescope, tracking system, laser, distance measurement system).

1863, Maidanak

The tracking system is under upgrading. Possibly the station will be operational in April, 2002.

1864, Maidanak, and 1870, Mendeleevo

Operational

SLR station near the Moscow

The station makes regular ranging measurements, but we still have no permission for the station's participation in the ILRS; we continue our efforts to obtain such a permission.

The MCC-M is regularly making estimations of the station's ranging precision (see below in Attachment 1).

Besides this, IPIE is currently conducting several experiments in space, to solve some SLR problems.

Spherical retroreflector on board of the METEOR-3M(1) satellite

Most of the passive SLR satellites have been launched during the years when the SLR station equipment provided an accuracy of several centimeters. But now, with the new equipment providing an accuracy of several millimeters, the systematic target errors caused by the retroreflector design and their distribution over the satellite surface are limiting the distance measurement precision.

On board of the METEOR-3M(1) satellite, a novel-type retroreflector is installed, having an unique design based on the spherical Luneberg lens principle. It has a spherical symmetry, and a constant CoM correction value with an accuracy of about ±0.02 mm. In contrary to currently used cube corner prism retroreflectors, this retroreflector has a practically zero target error.

Starting from December, 2001, a joint experiment is conducted by GSFC and IPIE on laser ranging of the "Optical Luneberg Lens" on board of the METEOR-3M(1)spacecraft. Two American SLR stations (Greenbelt and Monument Peak) and one Russian station near Moscow are taking part in the experiment. The limited number of stations participating in the experiment was caused by fear that laser light may cause interference during operation of the SAGE instrument installed by NASA on board of the METEOR-3M(1) spacecraft. Currently all the limitations have been lifted, and we are asking the ILRS for support of the METEOR-3M(1) mission with the spherical retroreflector on board.

From the measurement results obtained by the three SLR stations above (10 passes) it can be seen that the return signal strength is in accordance with the predicted values. Thus it is possible to initiate, during the ILRS meeting, a discussion on a future launching of an autonomous spherical satellite-retroreflector, and on a search for sponsors for such a launching. A satellite 22 cm in diameter (mass of about 15 kg) could be a good target with a

sufficient cross-section and a near-zero target error. The cost of such a satellite, with an account for the separation device and the launching, will be about 600,000 USD. The launching of such a satellite will not only serve for development of investigations in crustal dynamics, but will also stimulate further developments of more precise SLR equipment.

REFLECTOR microsatellite

December 10, 2001, as a piggyback load on the METEOR-3M(1) spacecraft, the REFLECTOR microsatellite has been put into orbit.

The REFLECTOR microsatellite is a passive test object comprising several groups of retroreflectors placed into specified points of the object. It is intended for investigations of resolving power of large-size ground-based telescopes with laser illumination of the target, used to obtain images of "space debris", as well as for determination of spatial attitude of spacecraft by precise ranging with use of multistop time interval counters.

IPIE asked ILRS for support of the REFLECTOR mission, and the CB of ILRS responded positively. The first SLR observations of the REFLECTOR satellite were made by the Yarragadee station. Currently we are using the FR data available from NASA stations, as well as FR data kindly provided by the Herstmonceau station team, to investigate the satellite orientation status and to determine its oscillation damping parameters.

2. China

The fixed stations at Changchun, Shanghai, Beijing and Kunming have been routinely operational. The window of the dome at Wuhan station was broken and had been rebuilt last year, and the station will start observation soon.

The system stability including both short term and long term stability for all stations has been paid more attention. Some data from these stations were still edited in the analysis reports published by the UTX/CSR due to the large range bias.

These stations would like to ask for assistance from the Network and Engineering Working Group and the Analysis Working Group to identify and eliminate system biases.

The Shanghai station has had a fixed bias –40 mm for some years and –80 mm since July 2001 in the UTX/CSR reports. In order to identify the biases, K.Hamal and I.Prochazka of the Czech Technical University brought a portable Pico Event Timer and the independent data acquisition and processing software package to Shanghai and carried out the calibration comparative experiment during August 16-22, 2001 [Results attached].

The joint team has measured 3 short distance targets and found the differences of the system delays from these targets only 2-3 mm. The P-PET calibration package was operated in parallel to the existing SLR system and has tracked 16 passes satellites. The comparison of ranging accuracy, time bias and range bias for each pass are listed in the following table. The range biases were derived from the point to point comparison with the full-rate data obtained by two systems.

No obvious biases were detected in the experiment. The conclusion we reach is that additional support from the Working Groups will be required to identify the system biases.

The mobile system TROS was moved to Urumqi, the biggest city in the northwest border and had tracked 44 passes of Lageos from April 23 to June 5, 2001. Afterwards, the TROS was moved to Lhasa, Tibet in June 2001, and left in January 2002. It had obtained 102 passes from Lageos and 129 passes from other satellites.

Chinese-Czech Joint Project, Satellite Laser Ranging

Summary of Satellite Laser Ranging

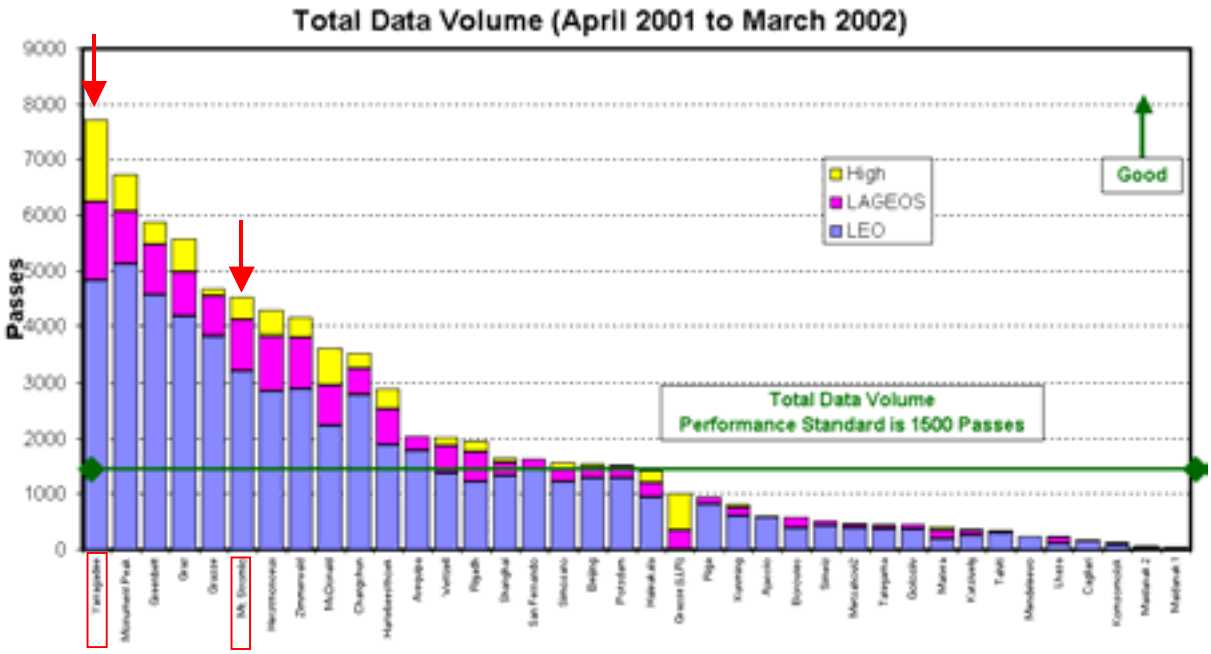
August 16-22, 2001

Satellite	**P-PET rms (mm)**	**SLR rms (mm)**	**Time bias (us)**	**Range bias (ns)**
Starlette	7.5	12.7	0.1	0.02
Beacon-C	9.3	13.8	0.1	0.00
Ajisai	10.9	15.9	0.1	0.00
Lageos 2	10.5	17.3	0.1	-0.01
Starlette	9.0	15.1	0.1	0.03
Lageos 1	8.5	14.2	0.1	0.01
Beacon C	19.2	19.7	0.1	0.02
Topex	22.4	35	0.1	0.00
Topex	4.9	10.8	0.1	0.00
Lageos 1	7.0	13.5	0.1	0.00
Stella	6.1	12.4	0.1	0.00
Beacon C	10.0	16.1	0.1	0.00
Starlette	8.4	12.9	0.1	0.01
Westpac	--	16.6	0.1	0.03
Lageos 2	8.5	16.1	0.1	0.00
ERS-2	4.0	10.5	0.1	0.01
mean			**0.1**	**0.01**

3. Australia

3.1 Station performance

Both Australian stations continue to perform to a high standard, as indicated by the graph below, extracted from the recent ILRS performance report (ilrs.gsfc.nasa.gov/perf_2002q1.html).



3.2 SLR Analysis

Geoscience Australia continues analysis as part of the ILRS Working Group pilot project. A 1994-2002 solution for EOP was submitted to IERS for EOP in the frame of ITRF2000.

3-day arc solutions for range and time bias continue to be provided on a regular basis and are available from www.auslig.gov.au/geodesy/sgc/product.htm.

3.3 Local Tie Surveys

Geoscience Australia has conducted a number of high accuracy local surveys at Stromlo and Yarragadee to connect the SLR invariant point (IVP) to the GPS, Glonass and Doris equipment at these sites. The results of these surveys were submitted to IERS for inclusion in ITRF2000.

Yarragadee was surveyed in August 1998 and again in May 2001 and the difference in the computed position of the IVP was of the order of 3 mm. A full description of these projects can be found in the Technical Reports (www.auslig.gov.au/geodesy/techrpts/pdf/techrep3.pdf & www.auslig.gov.au/geodesy/techrpts/pdf/techrep4.pdf).

Stromlo was surveyed in June 1999 and again in early 2002. Results of the first survey can be found in the Technical Report (www.auslig.gov.au/geodesy/techrpts/pdf/techrep3.pdf) and they compare very well (mm level) with the preliminary results of the latest survey, which are yet to be finalised.

3.4 Administrative Arrangements for Stromlo & Yarragadee

In late 2001 the Australian Surveying & Land Information Group (AUSLIG) was merged with the Australian Geological Survey Organisation (AGSO) to form Geoscience Australia. In December 2001, Dr John Luck retired from Geoscience Australia, although maintains an active interest in SLR. His experience and knowledge will not be readily replaced - at the moment he continues to provide assistance on a part time basis.

The contracts for the two Australian SLR stations continue to be managed by Geoscience Australia and its Space Geodesy Analysis Centre continues as an ILRS Associate Analysis Centre.

Contract arrangements for the Stromlo SLR station continue for at least another 18 months. The existing contract for the Yarragadee station finishes on 30 June 2002; although there is provision for an extension of the current contract, funding is a critical issue and is still subject to negotiation.

STATUS OF NASA NETWORK

- MOBLAS-4 & 7: Nominal Operations.
- MOBLAS-5 (Australia): Nominal Operations. Perform some single operator tracking which increased data volume.
- MOBLAS-6 (South Africa): Nominal Operations. Also perform some single operator tracking.
- MOBLAS-8 (Tahiti): Training/Tracking Status. In the process of training the two new crew members.

STATUS OF NASA NETWORK (Cont.)

- TLRS-3 (Arequipa): Nominal Operations.
- HOLLAS (Hawaii): Engineering Status. In the process of completing the telescope control system upgrade.
- MLRS (Texas): Nominal Operations.

Lunar Laser Ranging

- Routine LLR observations continue at OCA and MLRS
- New station at Matera, Italy is undergoing LLR "shake-down"
- LLR-related activity at Apache Point, NM is quite encouraging
- Significant new work on the lunar interior using LLR data
  - Two LLR-related papers at Lunar and Planetary Science XXXIII (2002)
    - Lunar Love Numbers and the Deep Lunar Interior (Jim Williams, Dale Boggs, Tom Ratcliff and Jean Dickey at JPL
    - The "Core" of the Moon: Iron or Titanium Rich? (Mark Wieczorek and Maria Zuber at MIT)
- General relativity, gravitational theory, solar system dynamics work continues
- Coordinated Transponder/LLR/SLR "predicts" under active development

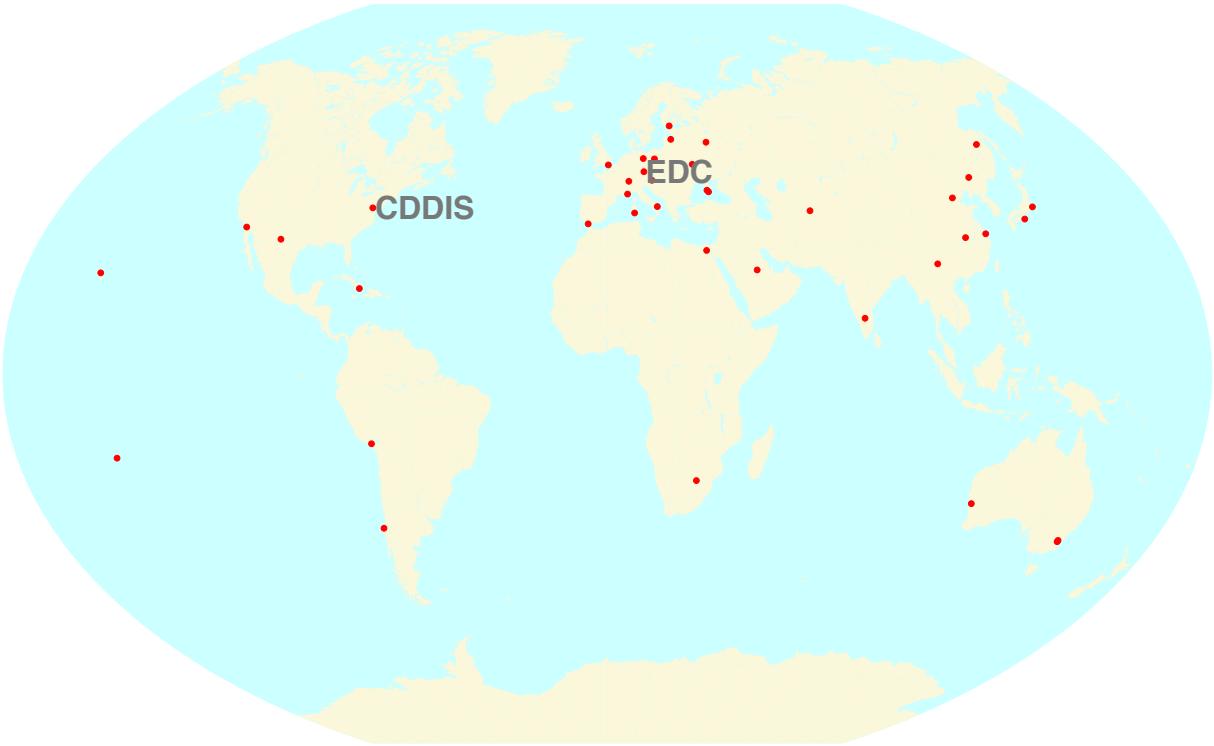
Apache Point Update

- Trip to MLRS in March. Good information exchange.
- Laser ordered. Optimistically looking forward to sending first photons skyward before the close of this year.
- Presently concentrating most intently on detector and timing electronics.
- Trip to MLRS reinforced their belief that that a 3.5-m telescope and 1 arcsec image quality, will produce a high photon-rate regime, able to achieve millimeter precision in a matter of minutes.
- Quoting Tom Murphy: "Exciting times, and I can't wait to get it all going".

Data Center Report

ILRS Global Data Center Report/EDC

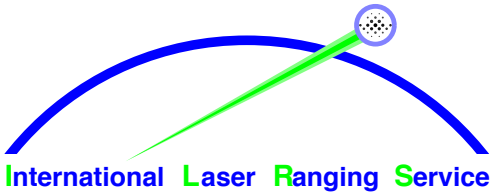
W. Seemüller



ILRS General Assembly, Nice, 25. April 2002

DGFI

International Laser Ranging Service



ILRS Global Data Center Report / EDC

Wolfgang Seemüller

- Check of successful hourly normal point data delivery between HTSI/CDDIS and EDC, and vice versa
- Backup procedures for ILRS prediction exploder are implemented at EDC
  - Backup procedures for IRVs of HTSI are implemented at EDC
  - Backup procedures for daily and subdaily IRVs, and Time Bias Functions of NERC are implemented at EDC
  - Backup procedures for IRVs of CHAMP and GRACE of D-PAF/GFZ are implemented at EDC
- Hourly update of all onp files and summary files

Structure of directory pub/laser (EDC ftp server)

pub / laser / qldata /

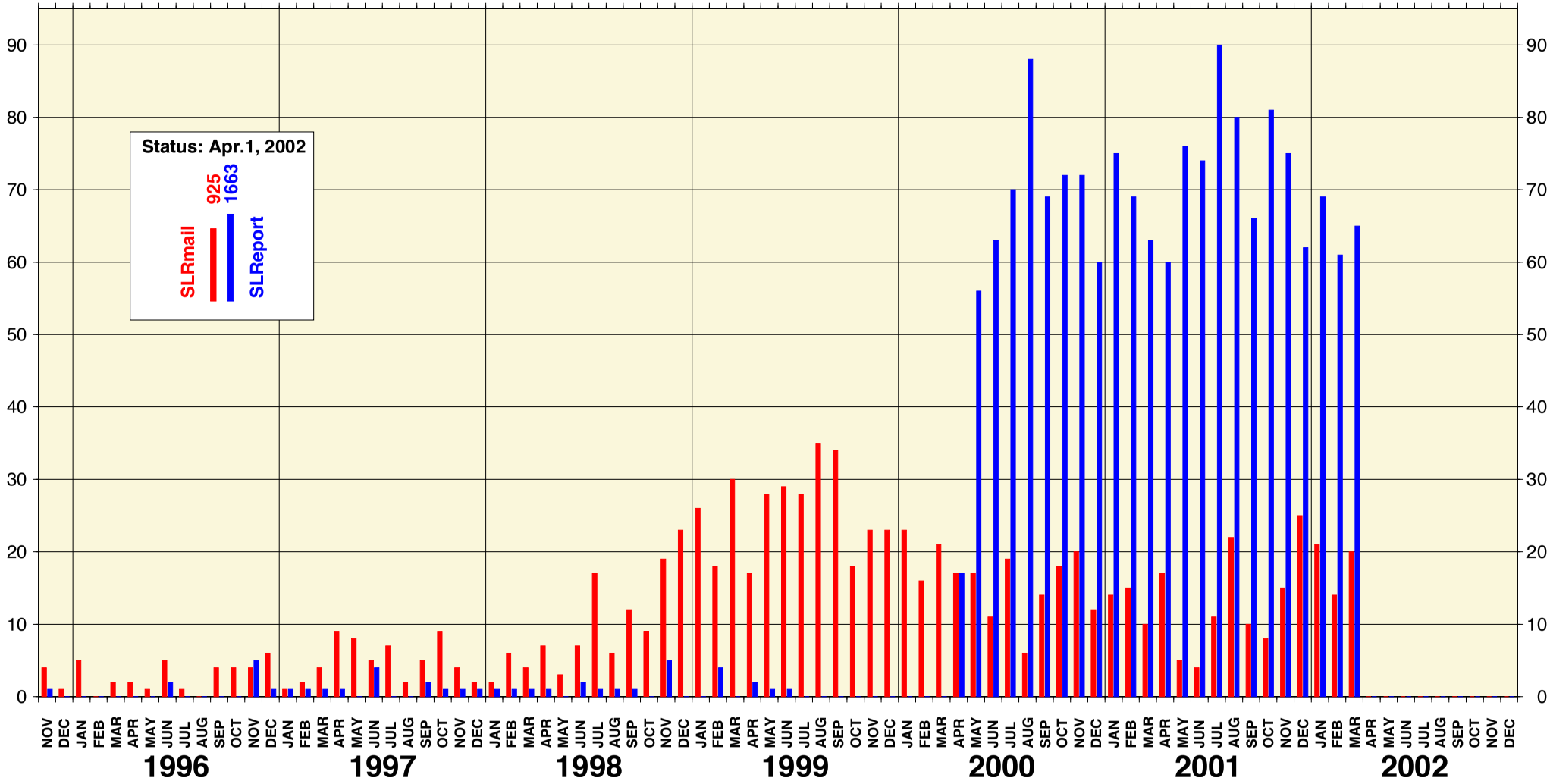
- hourly
- hourly_global
- hourly_htsi
- envisat
- gracea
- graceb
- .
- .
- satname
- .
- .

predictions /

- DPAF_PRED
- RGO_PRED
- CHAMP_PRED
- MCC_PRED
- NASDA_PRED
- GRACE_PRED
- ESOC_PRED

- timebias
- npdata
- frdata
- eccentricities
- calibrations
- occupations
- coordinates
- products
- solutions
- station / sch, sci, log
- messages / slrmail, slreport
- reports
- software
- formats
- cddis
- dpaf
- htsi
- ancillary
- summaries
- salro
- stromlo

SLRmails and SLReports per month since Nov. 1995



Working Group Reports

Missions Working Group Report

ILRS Missions Working Group

Nice, France

April 23, 2002

Agenda/Summary

- MWG membership
- Past and Current Activity Since Last Meeting (September 2001 - Toulouse)
  - Campaign/Mission status
    - New Launches - Starshine 3, 2, Envisat, Grace, Meteor-3M, Jason
    - New Campaigns -Etalon -1, -2, BEC, LRE, Reflector
  - Mission/Satellite Data Base for Satellite Signature Study
- Continuing and Future Actions
  - Satellite identification/misidentification issue (getting better?)
  - Develop/implement procedure to track SLR mission requirements
  - Work with known satellite organizations to get Mission Request Forms and Support Plans completed and put on Web - ongoing
- Upcoming Missions
  - Within 2002
    - IceSat - 1
    - ADEOS-II
    - Gravity Probe B
  - Beyond 2002
    - Cryosat
    - Starshine 4/5
- Other Mission News
- Other Issues
- Appendix: Satellite Tracking Priority List

MWG Membership

COORDINATOR(Re-elected)

Hiroo Kunimori	CRL	Japan

Deputy Coordinator

David Carter	NASA	USA

New membership includes:

David L. Carter	NASA	USA	Wolfgang Schluter*	BKG	Germany

Retained membership include:

John Degnan	NASA	USA	Giuseppe Bianco	ASI	Italy
Vladimir Vasiliev	IPIE	Russia	Urlich Schreiber	TUM	Germany
Scott Wetzel	HTSI	USA	Julie Horvath	HTSI	USA

Membership action

- More to be recruited for membership
- Change Mission Request Form to reflect satellite name in message Subject line
- New mailing list involving all working groups has been very successful. Current mailing list includes
  - Director of the Central Bureau
  - Secretary of Central Bureau,
  - Chairman of Governing Board
  - Coordinator of Each WG (AWG, NW&E, DF&P, and TIGER teams)

Past and Present Campaigns

Etalon-1, -2

- Campaign extended at Toulouse meeting until the end of March ‘02 - Extended until Nice for convenience
- Results provided by Ron Noomen showed that despite data volume increased by *2, EOP improvement was small
- Importance shifted to combined solution
- Action to Analysis Working Group to meet next week and give recommendations for continuation of campaign

LRE

- Official campaign was 1 month in September 2001 and very difficult target to acquire due to 3 hour launch delay caused satellite to loose most of the terminator conditions for 3 months
- Grasse LLR station finally caught it in December 2001, then Yarragadee, then CRL
- Kunimori proposes to keep LRE tracked on an “as available” basis
  - NASDA will provide TIRV routinely
  - LRE at bottom of priority list
- Lessons Learned
  - We were not ready for this campaign
  - We will work on better station pointing
  - We need cube specifications - Toshi

Past and Present Campaigns (2)

Reflector

- Reflector is a Russian satellite where SLR is used to support POD research for space debris detection
- Launched December 10, 2001
- Temporary emergency approval by the GB on December 20, 2001
- Campaign Duration was requested for 9 months
- SLR began on December 21, 2001
  - First operational Reflector pass received by Yarragadee
  - Tracking leaders are Yarragadee, Monument Peak and Graz
  - Currently 28 systems tracking Reflector
- Success of campaign needs to be reviewed by IPIE
- Justification for continuation of campaign to be provided at these meetings

Past and Present Campaigns (3)

Starshine 3

- Starshine satellites were to be tracked by NASA stations and others if desired to determine utility of the retroreflectors
- Starshine 3 launched on September 30, 2001
  - First Starshine-3 pass received by Yarragadee on October 3, 2001
  - Tracking limited to NASA stations and anyone who wanted to try tracking (9)
  - NRL provided high quality predictions to help support acquisition
  - Starshine-3 scheduled to de-orbit on approximately October 30, 2002

Starshine 2

- Starshine 2 deployed from STS-108 on December 16, 2001
  - No tracking attempted due to limitations of tracking Starshine 3
  - STARSHINE 2 2001-054B (#26996): is predicted to decay Apr 26, 2235Z
- Other Starshine(s) are being developed
- Starshine is important to drag research at NRL/NASA

Recent Launches / New Missions

Jason

- Jason was launched on Dec. 7, 2001 and placed in tandem orbit with TOPEX/ Poseidon (~1 minute separation, Jason leading)
- SLR attempted by several systems prior to operational commitment to confirm array performance
- SLR officially began on January 14, 2002
  - First operational Jason pass received by Yarragadee
  - Tracking leaders are Yarragadee, Graz….Good support from Monument Peak, Greenbelt, Zimmerwald & Wettzell
  - Currently 32 systems tracking Jason
- Tracking scenario as requested from Jason Team
  - Alternate successful full-pass tracking between Jason and TOPEX/Poseidon
  - Can pick up first minute of Jason pass when tracking TOPEX or last minute of TOPEX when tracking Jason
  - Several systems are experimenting with interleaving during each pass - being reviewed by Jason team
- Jason team to provide status at ILRS General Assembly

Envisat-1

- Envisat-1 launched on March 1, 2002 and placed in tandem orbit with ERS-2 (~30 minute separation)
- SLR scheduled to begin at ~launch + 40 days, began on April 10, 2002
  - First Envisat pass received by Metsahovi and Riga (same times)
  - Tracking leaders are Metsahovi, Monument Peak and Herstmonceux
  - Currently 11 systems tracking Envisat-1
- Envisat-1 team to provide status at ILRS General Assembly

Recent Launches / New Missions (2)

GRACE

- GRACE A&B were launched on March 17, 2002 and placed in tandem orbit with each other (~30 secs separation)
- SLR required ASAP from separation from S/C
- Tracking scenario as requested from GRACE Team
  - Alternate successful full-pass tracking between GRACE A & B unless systems are able to quickly alternate between satellites
  - Several systems are experimenting with interleaving during each pass - being reviewed by GRACE team
- Tracking Summary- GRACE A
  - First GRACE A pass received by Yarragadee
  - Tracking leaders are Yarragadee, Herstmonceux
- Tracking Summary- GRACE B
  - First GRACE B pass received by Yarragadee
  - Tracking leaders are Yarragadee, Herstmonceux, and Monument Peak
- Currently there are many more GRACE A passes than GRACE B…What is the impact on GRACE and why is this happening??
- GRACE team to provide status at ILRS General Assembly

Recent Launches / New Missions (3)

Meteor-3M

- Meteor-3M was launched on December 10, 2001 along with Reflector
- Meteor-3M is using an Optical Luneberg Lens for SLR tracking
- SLR originally limited by agreement to Greenbelt, Monument Peak, a Russian station near Moscow as a test only
  - the SAGE project was concerned about interference in their solar experiments
  - restricted tracking elevations
  - tracking in nighttime hours only
- At a meeting with the SAGE team in February it was disclosed that the GLONASS/GPS receiver on-board Meteor-3M was not function.
  - SLR had now become the only method for POD in support of SAGE - Radar tracking ends on April 30, 2002
- SAGE team requested to Meteor-3M group to support SLR -
  - No restrictions for elevation or daylight tracking
- On April 3rd a Mission Support Request Form was submitted for ILRS support of Meteor-3M
- Based on limited responses MWG endorses support Meteor-3M
  - new target testing
  - SLR only viable method for POD to support SAGE
- Governing Board Approval at ILRS GB meeting
- Tracking to begin ASAP

Upcoming Missions
(within 2002)

ADEOS-II (Advanced Earth Observing Satellite)

- ADEOS-II is an Earth Sensing mission hosted by NASDA
- ADEOS-II is currently scheduled to be launched in November 1-30, 2002
- SLR support required from L+39 days to support POD - GPS will be turned off during this period
- Issue with possible damage to GLI from SLR causing much problem with tracking
- Uchimura will provide specifications and analysis for safety concerns for the GLI

ICESat (Ice, Cloud, and Land Elevation Satellite)

- ICESat is a NASA mission to measure the ice sheet mass, balance, cloud and aerosol heights, optical densities, vegetation and land topography hosted by NASA / CSR.
- ICESat is currently scheduled to be launched in December 16, 2002
- Preparations for SLR support are ongoing at University of Texas, good coordination with ILRS
- HTSI to include GPS data in prediction generation
- Array confirmation only for L+30 days, then until L+6 months SLR is high priority

GPB (Gravity Probe B)

- GPB is a NASA / Stanford University relativity mission
- GPB is scheduled for launch in October 2002
- Coordination efforts for ILRS on-going

Upcoming Missions
(beyond 2002)

Starshine 4/5

- NASA has firmly manifested our Starshine 4/5 dual-satellite experiment on the STS-114 Shuttle mission to the International Space Station in January of 2003.
- Starshine 4/5 will have mounted 1000 mirrors and 31 laser retroreflectors on its external shell.
- Starshine 4/5 Mission Plan
  - Release from Starshine 4, a 4 inch (10 cm) hollow aluminum sphere, instead, which will be Starshine 5.
  - This small subsatellite will be released shortly after Starshine 4 is deployed from Space Shuttle Atlantis
  - Both Starshines 4 and 5 will carry 31 laser retroreflectors on their surfaces
  - Starshine 5 will have no mirrors and will thus not be naked-eye visible, so tracking will dependent totally on ILRS and Space Command tracking for orbit determination of this satellite.
  - By comparing the orbital decay rates of Starshine 4 and 5, it will possible for us to determine the density of the earth's atmosphere more precisely than we've been able to do on previous missions.

Other Mission News

Mission Status Changes

- BEC Mission Status Change
  - Campaign was revised to become a Mission (SLR Mail No. 0873 on January 3, 2002)
  - UTex/CSR requested Mission Status to strengthen long-term changes in gravity field
  - BEC retains same tracking priority level as during campaign
- WESTPAC SLR Support Suspended
  - SLR support was discontinued (SLR Mail No. 0877 on January 7, 2002)
  - ILRS community indicated WESTPAC was being used very little for research
  - Data set was very weak and difficult to acquire satellite
  - Satellite originators agreed to no immediate need for tracking data
- GLONASS satellite changes
  - At the request of the IGLOS-PP, the set of 3 GLONASS satellites to be tracked by SLR was changed to 84, 86 and 87. (SLR Mail No. 0900 on February 20, 2002)
  - Now all have the same type of (reduced sized) retroreflector arrays.
  - This limits some stations to night time tracking only resulting in loss of data

Missions to drop from list

- OICETS (NASDA) - Indefinitely postponed
- IRS-P5 (ISRO) - Lack of communication from ISRO
- SAC-C (CONAE) - No response from CONAE
- VCL (NASA) - Indefinitely postponed

Upcoming Missions

Satellite	Owner	Mission Type	Planned Launch Date	Mission Duration	Received Mission Request Form	Received ILRS GB Approval
Meteor-3M	ROSAVIACOSMOS	Solar Research / new array testing	December 10, 2001	3 years	Yes	Yes
IceSat (GLAS)	NASA	Ice sheet research	December 16, 2002	3-5 years	Yes	Yes
Gravity Probe B	NASA	Relativity research	October 30, 2002	1-2 years	Yes	Yes
ADEOS-II	NASDA	Altimeter calibration	November 2002	3 years	Yes	Yes
CryoSat	ESA	Earth Sensing	Apr/May 2004	3.5 years	Yes	Awaiting MWG Recommendation
ALOS	NASDA	Altimeter calibration	Jul/Aug. 2004	3 years	No	No
ETS-VIII	NASDA	Time transfer experiment	Jul./Aug. 2004	3 years	No	No

Other Issues

Open Forum

- Dynamic Tracking Priorities
  - Shelus recommended that we continuously monitor all tracking and adjust tracking priorities to pick up on weak satellites
  - The MWG is taking up this issue - Wetzel
- Weak initial tracking support of new satellite
  - First several weeks of tracking of new satellites usually have same few stations supporting with others following later
  - This should not be happening during critical phase of mission
  - Causes are being investigated
- More information about Mission Support planning and implementation status on web
  - Greater detail to the mission summaries with respect to mission support activities will be posted on the web
- Spacecraft COM
  - MWG responsible for providing Signal Processing Group S/C COM models from satellite host
  - This needs to be done in the early stages of mission planning

Next Meeting

- Next ILRS Missions Working Group Meeting:
  - Meeting to occur at the Laser Ranging Workshop
  - Washington, DC, Hyatt Hotel
  - October 7-11, 2002

Current Tracking priorities

Priority	Mission	Sponsor	Altitude (km)	Inclination (degrees)	Comments
1	GRACE A, B	GFZ/NASA	485-500	89	Gravity research (Two satellites tracked alternately)
2	CHAMP	GFZ	429-474	87.27	Gravity research
3	GFO-1	US Navy	790	108.0	Altimeter calibration / no other tracking technique available
4	Envisat-1	ESA	800	98.6	Altimeter calibration / DORIS backup
5	ERS-2	ESA	800	98.6	Altimeter calibration / PRARE backup
6	Jason	NASA/CNES	1,350	66.0	Altimeter / DORIS and GPS backup
7	TOPEX/Poseidon	NASA/CNES	1,350	66.0	Altimeter calibration / DORIS and GPS backup
8	Stella	CNES	815	98.6	Geodetic / no other tracking technique available
9	Starlette	CNES	815-1,100	49.8	Geodetic / no other tracking technique available
10	REFLECTOR	IPIE	1,020	99.6	POD research for space debris detection
11	BeaconC	NASA	950-1300	41	Gravity Research / upgraded to ongoing mission (Jan 2002)
12	Ajisai	NASDA	1,485	50	Geodetic / no other tracking technique available
13	LAGEOS2	ASI/NASA	5625	52.6	Geodetic / no other tracking technique available
14	LAGEOS1	NASA	5850	109.8	Geodetic / no other tracking technique available
15	Etalon1	Russian Federation	19,100	65.3	Geodetic / no other tracking technique available
16	Etalon2	Russian Federation	19,100	65.2	Geodetic / no other tracking technique available
17	GLONASS80	Russian Federation	19,100	65	Positioning POD enhancement / replaced G70 as of 10/20/99
18	GLONASS78	Russian Federation	19,100	65	Positioning POD enhancement / replaced G72 as of 6/29/00
19	GLONASS84	Russian Federation	19,100	65	Positioning POD enhancement / replaced G79as of 2/22/01
20	GPS35	US DoD	20,100	54.2	Positioning POD enhancement
21	GPS36	US DoD	20,100	55.0	Positioning POD enhancement

Other Targets of Opportunity:

Starshine 3	US Cooperative	470	67	Drag research / no other tracking technique available
Meteor-3M	IPIE	1020	99.64	Retroreflector research / No other tracking technique available
LRE	NASDA	250-36000	28.5	HEO Characterization / Spin evolution vs. BK7 degradation

April 23, 2002

ILRS Network & Engineering Working Group Meeting
Wednesday, April 24, 2002, 14:00-16:00
Nice Acropolis Congress Centre, Room M 11

Agenda

- EUROLAS calibration workshop 11-13 March 2002 in Herstmonceux (W. Gurtner, G. Appleby)
- Signal processing working group: Short progress report (G. Appleby)
- Station log files (V. Husson)
- Cloud detection (J. Degnan)
- Near-realtime computation and distribution of time biases (W. Gurtner)
- Any other business

!
! Time biases at 19-Apr-2002 14:21 UT
!
! Satellite Total IRVset LstObs Passes SIC Drag
!   TB[ms]   [hhh:mm] used   [ms]
!

Satellite	Total TB[ms]	IRVset	LstObs [hhh:mm]	Passes used	SIC	Drag [ms]
Ajisai	-1	HON108	4:16	38	1500	0
Ajisai	4	NSD032	4:16	68	1500	0
Ajisai	1	RGO096	4:16	113	1500	0
BeaconC	3	HON108	1:52	20	0317	0
BeaconC	-1670	RGO041	1:52	65	0317	0
Champ	**-89**	GFZ375	0:00	**0**	8002	-89
ERS2	-16	GFZ400	3:47	8	6178	0
Envisat	**100**	ESO108	6:26	**20**	6179	0
GFO1	0	HON108	4:02	19	8501	0
GFO1	103	RGO101	4:02	62	8501	0
GraceA	-70	GFZ060	6:54	1	8003	-52
GraceB	**-144**	GFZ061	5:57	**3**	8004	**-48**

Realtime Distribution of Time Biases

- NERC
  - Routine computation of time bias functions using recent SLR data
- Server program at Zimmerwald
  - collects the functions
  - distributes table of actual time biases (including drag function value) on request
- Client program at stations
  - requests, receives and displays/stores time bias table
  - EUROSTAT program or just TELNET
- Operator or user program at stations
  - Inserts current time bias into tracking program

Two-wavelength np data

```
ZIMMERWALD LASER STATION, SWITZERLAND 19-APR-02
QUICK LOOK DATA FILE

99999
930610202109781068014230000811310000000101571600150014 1
282153080562007101999297000012009165279306500770000066
282435080560006309370876000014609165279306500650000067
282764080561005648687931000011709165279306500210000071
283067080571005378514441000014609165279306500330000059

99999
930610202109781068018460000835940000000141071600160038 1
282150080559007111298748000013809165279306501740000070
282435080560006309369523000015709165279306501470000067
282756080560005660581151000014609165279306500730000061
283064080562005379376442000020809165279306500540000066
```

IRV files: Prediction center identification

First lines in each block:

```
IRVSHTSI    TUNED IRVS
GFZ_FITXYZ_950221_IRVS
GFZ_CONDOI_921001_IRVS
IRVS_ESOC_ENVISAT_ROUT
MCC_IRVS TUNED IRVS
IRV NSD Ajisai   0      1
GLO11630 GLO87          1
GLO11630 GLO87          4
COD11630 GPS35          1
COD11630 GPS35          4
NERCDY_LGA111           0
```

EUROLAS Workshop

Detecting and eliminating errors in the EUROLAS network

March 2002, 11-13
Herstmonceux

- Participants: 20 from 10 European stations
  1 from TU Prague
  2 from the ILRS CB

EUROLAS Workshop: General Principles

- Goal: 1 mm accuracy
  - Detection/reduction of systematic errors
  - Reduction of random errors
- Stations have primary responsibility for data integrity
  - Data screening/handling

EUROLAS Workshop: Detectors

- C-SPAD
  - Residual time walk could be determined if signal strength or return rate were known
  - Tune C-SPAD (pulse length dependent)
  - Check alignment
- PMT
  - Time walk determination (signal strength dependent)
  - Time walk omission (single photon level)

EUROLAS Workshop: Data reduction

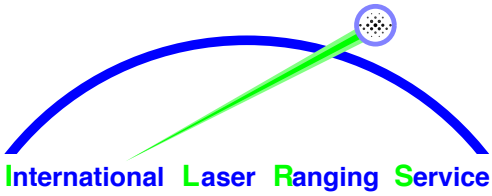
- Carefully check for noise
- Compute pass parameters: RMS, skew, kurtosis, compare with „standard“ values
- Compute return rates
- *Minimum number of returns for normal point*
  - Daytime: 6
  - At night: 3
- *Re-introduce full rate data archiving in MERIT II format*
- *Procedure for data withdrawal*
- Daily quality control by NERC

EUROLAS Workshop: Counters and timers

- Counter calibration/comparison relative to Herstmonceux counter.
- Measurements performed for some SR620 counters during the meeting
- Recommend to apply corrections to data
- NERC will analyse effect of corrections for test passes
- TU Prague: EU proposal for portable calibration standard (P-PET-based)

EUROLAS Workshop: Miscellaneous

- Encourage station personnel to visit each other
- Barometer calibration/comparison with Herstmonceux sensor on all European stations
- Recommendations for system monitoring
- Near-realtime status display: Encourage more stations to participate. Increase update rate
- Predictions: „Weak“ recommendation for sets to be used
- Instantaneous time bias computation by TCP/IP server program to be developed → Done



International Laser Ranging Service
Seventh General Assembly
Nice, France, April 25, 2002

Data Formats & Procedures Working Group Report

1. Review of CP Activities, Van Husson (only most important issues)
   - Backup for urgent mail exploder will be installed at EDC
   - Bias problems and occasional blunders:
     Procedure concerning archiving of retransmitted np data:
     The Data Centers archive retransmitted data additionally to the previous data
     (no data withdrawn, correct release number, creation of a file which gives information about these updated data)
   - Two colour data submission and management:
     submission of two files per pass for each wavelength
     (an e-mail will be sent by the CB about this procedure)
   - Archiving of full rate data:
     A request of the analysis working groups and the EUROLAS workshop in Herstmonceux to reinstall the archiving of FR data.
     A Study Group was built to define how to handle these data;
     members: Carey Noll, Werner Gurtner, Wolfgang Seemüller
     (no replacement of the np data, weekly/monthly files, file naming convention, etc.)

2. Future activity:
   Faster np data exchange between CDDIS/HTSI and EDC, i.e. every 15 min., for faster update of time bias functions of specific IRVs

3. Refraction Study Group Report, see report by Stefan Riepl

4. Prediction Format Study Group, see report by Randy Ricklefs

International Laser Ranging Service

ILRS Refraction Study Group Report

Stefan Riepl

(sent by e-mail from Concepcion)

1. **The new mapping function of E. Pavlis et. al. is derived for a laser wavelength of 532 nm only. According to the RSG charter it needs to be investigated for other wavelength.**

2. **A data set of the numerical weather prediction service (NWP) of Europe is under analysis for appliance in deriving horizontal refraction gradients. The results show pressure gradients of up to 0.08 mbar/km which need definitely to be considered for approaching mm accuracy at elevation angles > 15 degrees. The data set shows also a dependence of pressure gradients with respect to topography.**

3. **To generalize the application of horizontal gradients throughout the SLR network, each station manager should think about what can be done at the stations to improve the spatial resolution of meteorological data, either by using a meteorological network in the vicinity of the SLR station or a local GPS network.**

DGFI

Prediction Formats Study Group
"Lynx Team"

Commissioned by:
The ILRS Data Formats and Procedures Working Group
at Matera, November 2000

Presentation prepared by
R. Ricklefs
University of Texas at Austin
McDonald Observatory and Center for Space Research
(rlr@astro.as.utexas.edu)

Purpose

Recommend a single laser ranging prediction format to encompass

- Earth satellites
- Lunar laser retro-reflectors
- Laser transponders on or orbiting other solar system bodies
- Laser transponders in transit

Current Status

- Preliminary format is available
- Lunar feasibility study was successfully completed
- Transponder requirements are solidifying

Format Features

- Tabular (“grid”) format (interpolation, not integration)
- State vectors spaced as required (fixed or variable)
- True body-fixed coordinates
- Multiple header and ephemeris record types
- Special record types to handle features of particular target classes
- Records short enough for e-mail
- Allows for integration beyond last record of file
- Some free format records
- Removes need for drag messages

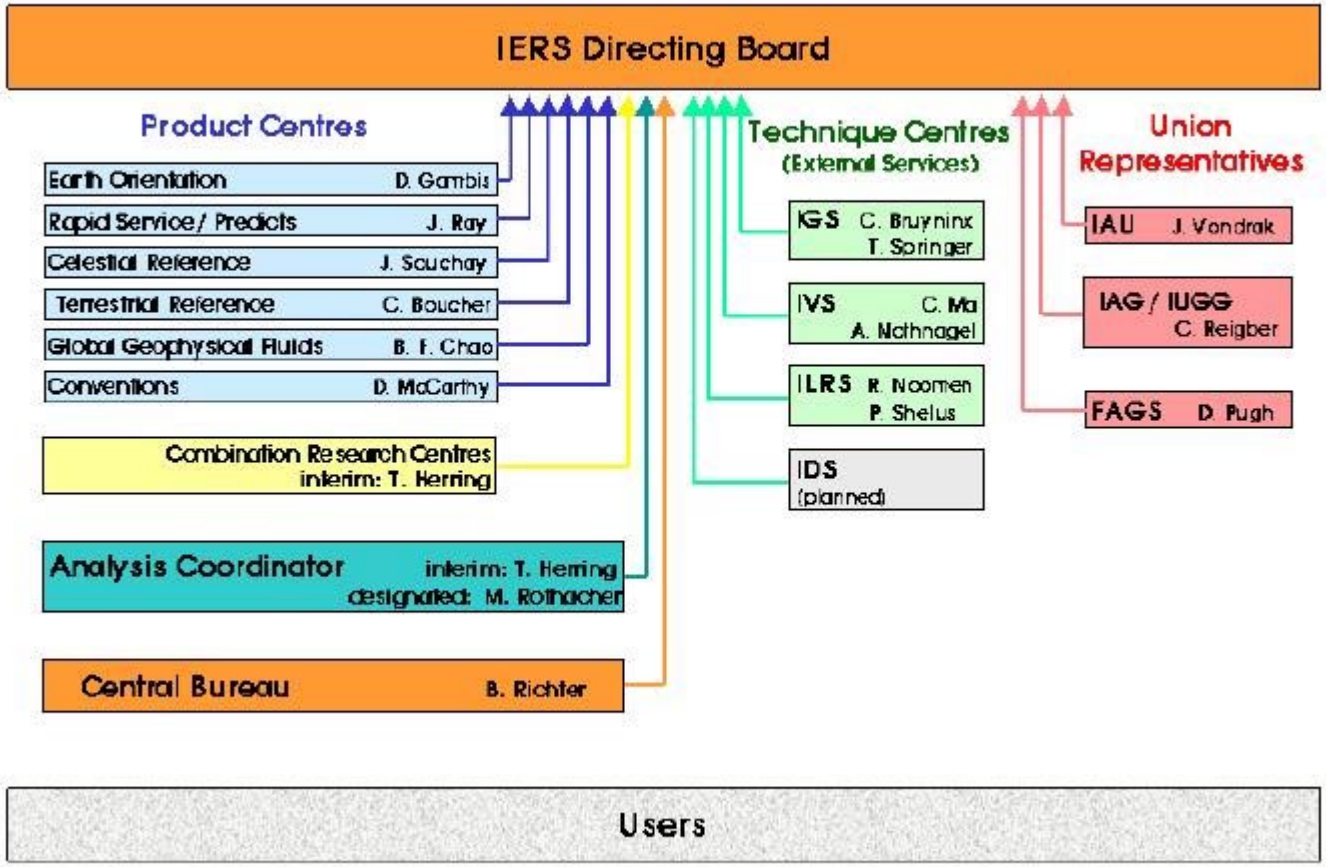
The Next Steps

- Perform simulations to finalize transponder prediction requirements
- Refine and document format
- Distribute format widely within laser community for comment
- Develop sample code, including interpolator
- Pilot projects to implement format at several stations
- Present results at Laser Workshop
- Further plans for implementation…

IERS related issues

- IERS organization
- IAG reorganization
- SINEX 2.0
- IERS workshop on IAU 2000 Resolutions
- IERS projects/products
  - Bulletin A
  -SINEX project
  - IGGOS project

New IERS


IERS Directing Board
Product Centres
Earth Orientation D. Gambis
Rapid Service / Predicts J. Ray
Celestial Reference J. Souchay
Terrestrial Reference C. Boucher
Global Geophysical Fluids B. F. Chao
Conventions D. McCarthy
Combination Research Centres
interim: T. Herring
Analysis Coordinator interim: T. Herring
designated: M. Rothacher
Central Bureau B. Richter
Technique Centres
(External Services)
IGS C. Bruyninx
T. Springer
IVS C. Ma
A. Nothnagel
ILRS R. Noomen
P. Shelus
IDS
(planned)
Union
Representatives
IAU J. Vondrak
IAG / IUGG
C. Reigber
FAGS D. Pugh
Users

IAG reorganization

IUGG

|

|

V

IAG

with:

Commisions (4) (reference frame, gravity field, …)

Services: IGS, IVS, ILRS, IERS, PSMSL, …

Projects

Communication & Outreach

Inter-commision committees

- Overlap?
- New organization IAG approved by IERS DB

AWG activities

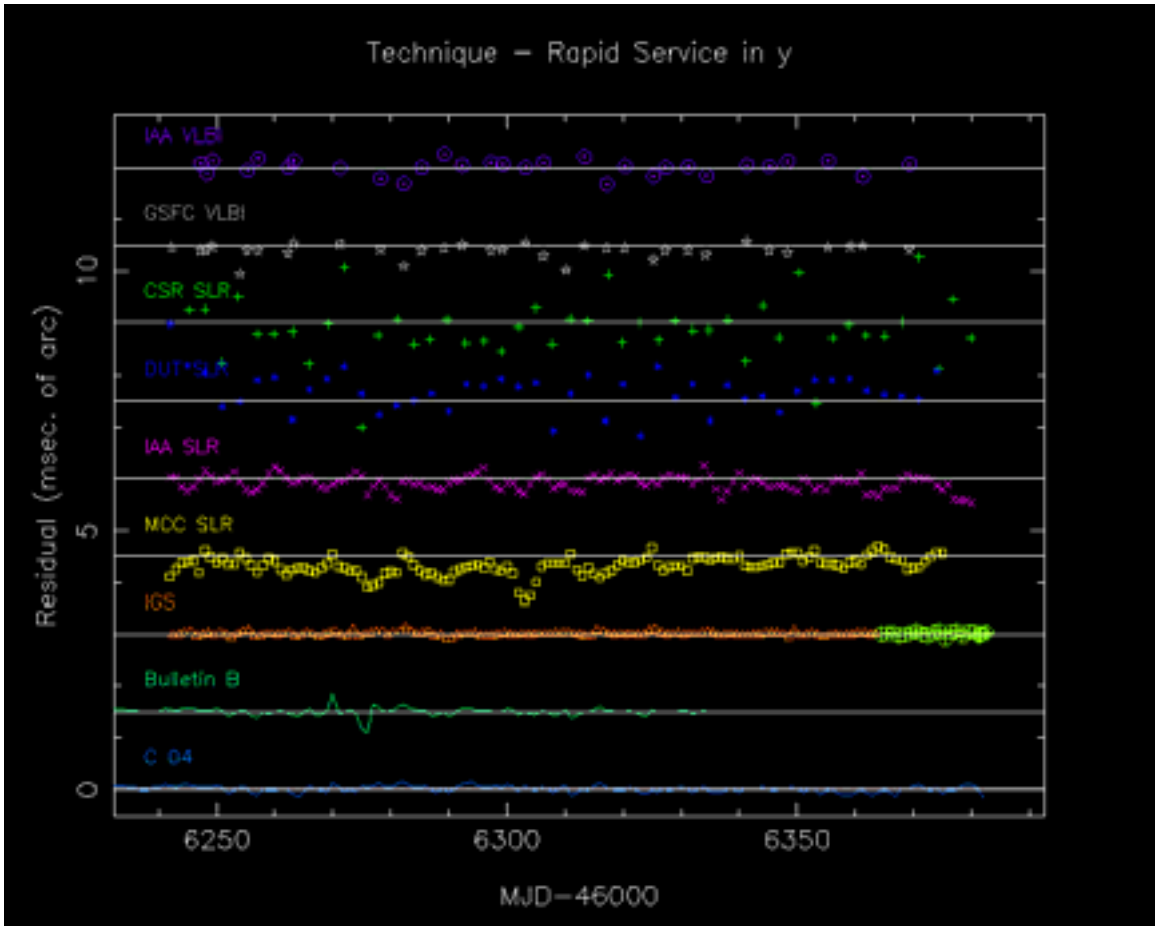
Pilot projects:

- Benchmarking
  Van Husson & Maria Mareyen
  Blunders, software inconsistencies
  Orbit comparisons

- Harmonization
  Van Husson
  Unify analysis results (i.e. biases)
  Continuous development

- Orbits
  Richard Eanes
  Product: satellite ephemerides
  Planning stage

- Positioning + earth orientation
  Ron Noomen


Technique – Rapid Service in y
IAA VLBI
GSFC VLBI
CSR SLR
DUT*SLR
IAA SLR
MCC SLR
IGS
Bulletin B
C 04
Residual (msec. of arc)
0
5
10
6250
6300
6350
MJD−46000

ILRS “public relations”

- “POD with SLR: setting the standard”
  Noomen
  Surveys in Geophysics, 22, p. 473-480, 2001

- ILRS contribution to IGGOS
  Noomen, Appleby and Shelus
  AGU Spring Meeting

ILRS General Assembly

April 25th 2002, Nice, France

Signal Processing Ad-hoc WG, G. Appleby and T. Otsubo.

Overview – what's been achieved:

GLONASS, GPS –

- We have acquired details of precise location and characteristics of each CCR, thanks to Missions WG;
- Attitude-dependent impulse functions computed for GLONASS and tested against single-photon range data;
- Demonstration that large (20-40mm) ambiguity exists in CoM correction for high-energy systems
- Through work of MWG, now have available accurate geometry of the 3 types of LRA on the GLONASS satellites and have concluded that:
    - The apparent radial bias in the GLONASS orbits was caused by a combination of incorrect information on location of LRA *plus* the 'large array' effect;
    - The radial bias (~50mm) of the GPS orbits persists - re-visit the current values of the locations of the GPS LRAs?

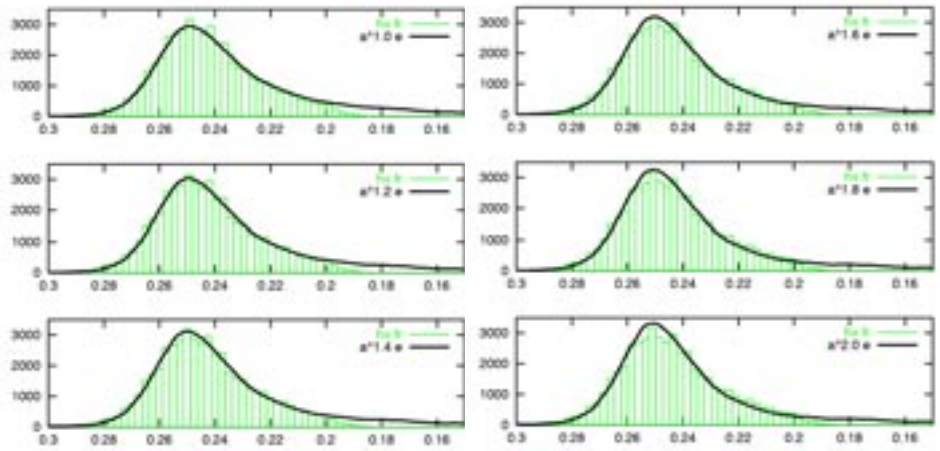
LAGEOS, ETALON and AJISAI –

- We know the precise location and characteristics of each CCR;
- Impulse response functions have been computed, where the reflection intensity is modelled as a function of effective reflection area, CCR reflectivity and diffraction effects;
- Tested against single-photon range data; crucial to this stage is to understand the particular power law applicable to each satellite. The fit of the models to Herstmonceux single photon data can be used as a powerful indicator of this, as shown in the results for LAGEOS over a range of power-law models:

Model vs Obs [1]

model: the (a priori) models convolved with the transmon system response
obs Single-photon (Herstmonceux) full-rate residuals
=> Fit: estimate x-shift and y-scale

LAGEOS



Further:

- We have demonstrated that the use of system-dependent CoM values are crucial for mm-level accuracy (e.g. the use of CSPAD at single- and multi-photon levels can influence appropriate CoM corrections by up to 5mm);

- Discussions are underway with Honeywell colleagues on details of the NASA systems' CFD/MCP combinations, with a view to deriving appropriate CoM values for this important group of systems.

- It is likely that estimates of CoM values, or ranges of values, for the broad classes of systems (Single-photon, multi-photon with C-SPAD, multi-photon with MCP/CFD) for LAGEOS, AJISAI and ETALON will be available by the next ILRS GA.

Campaigns and Missions

CHAMP

Status SLR-Tracking CHAMP Mission

R. Schmidt, R. König, Ch. Reigber

GeoForschungsZentrum Potsdam (GFZ)
Division I: Kinematics and Dynamics of the Earth
Telegrafenberg
14473 Potsdam

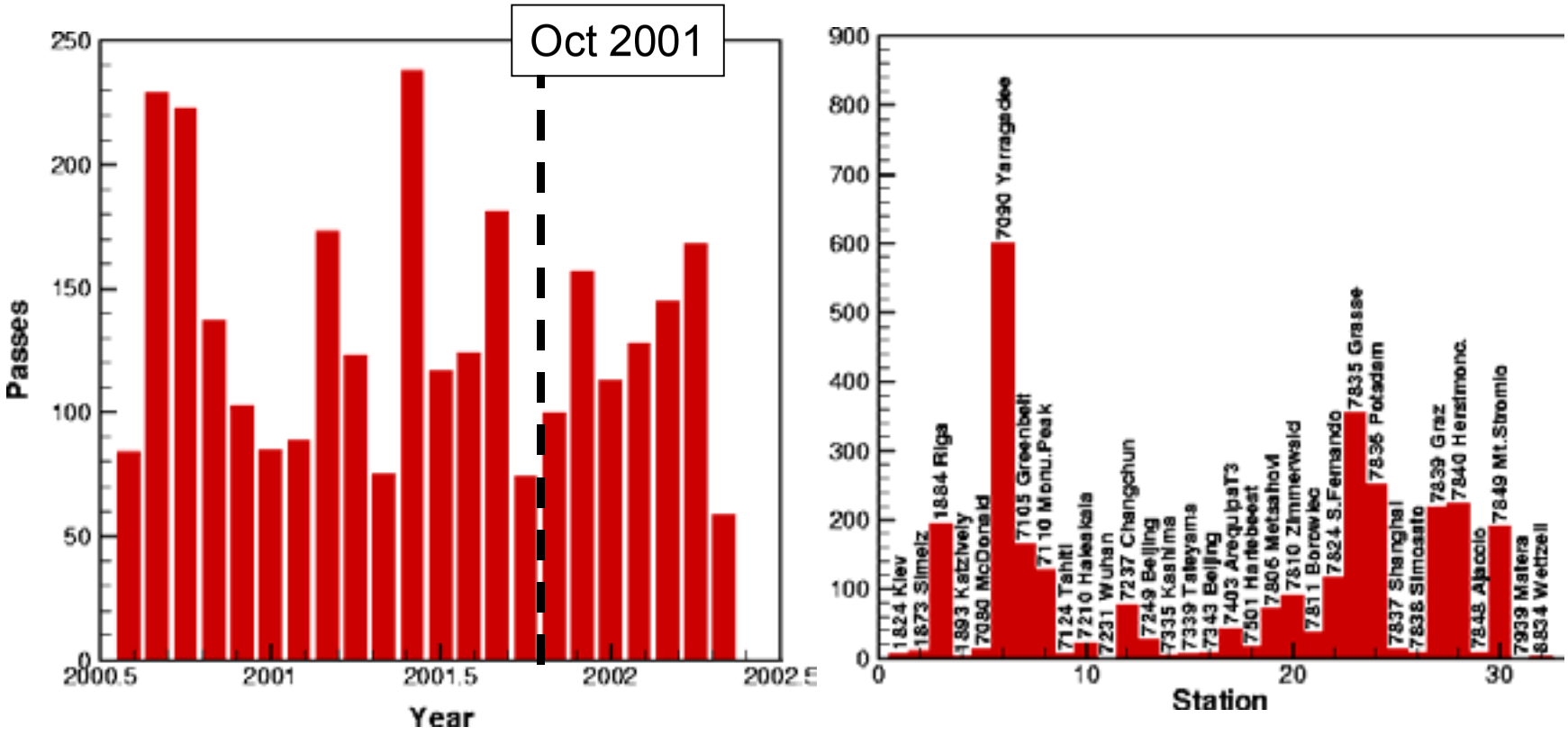
CHAMP

Status

- automated operations of orbit predictions based on GPS navigation solution and SLR data; as of October 10th, 2001 updating frequency has been set to 3 predicts/per day improving SLR statistics
- SLR data amount collected (Jul. 2000 - Apr. 2002)
  - 2929 passes (69721 NPs) at 32 ILRS stations
  - mean number of passes/day is 5
- good latency of SLR data (hourly updating ILRS data centers)
- spatial and temporal coverage reflect capability of ILRS network of tracking LEO satellites
- usage of SLR data at GFZ for the validation of orbit determination

CHAMP

SLR-Tracking Jul. 2000 - Apr. 2002

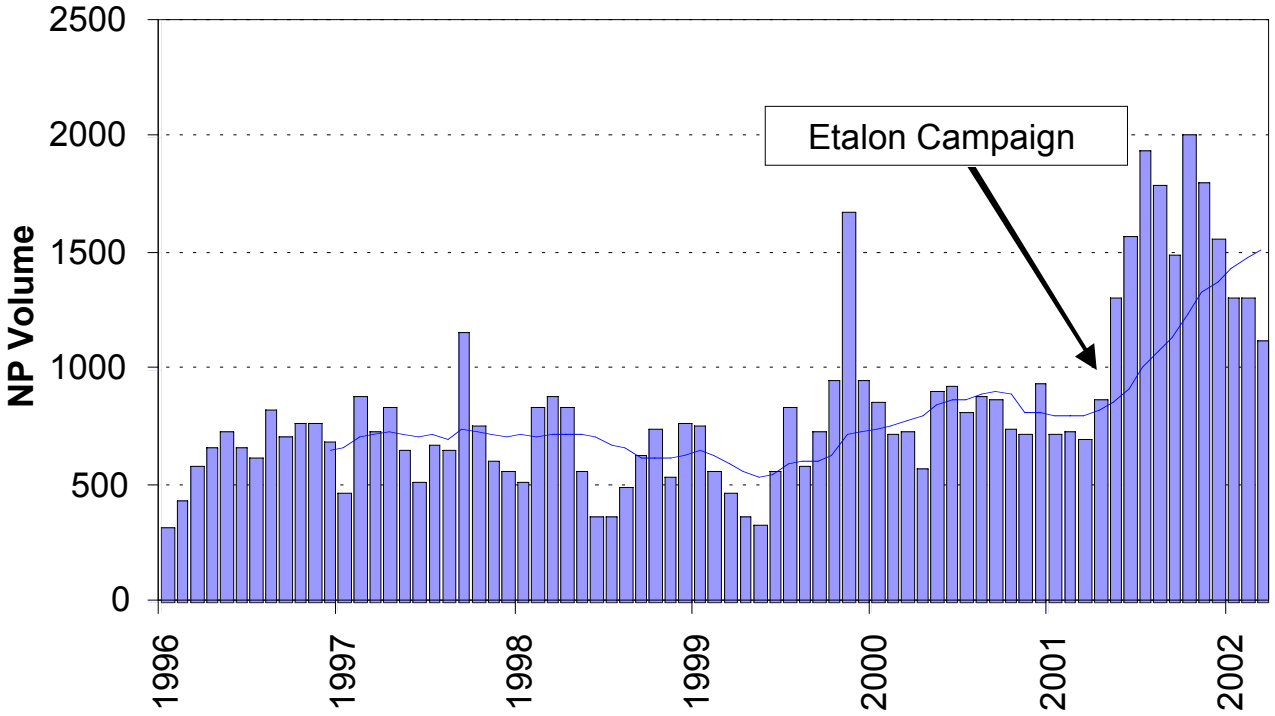


ETALON campaign

- Purposes:
  Improve EOPS
  GM
  Station data characterization

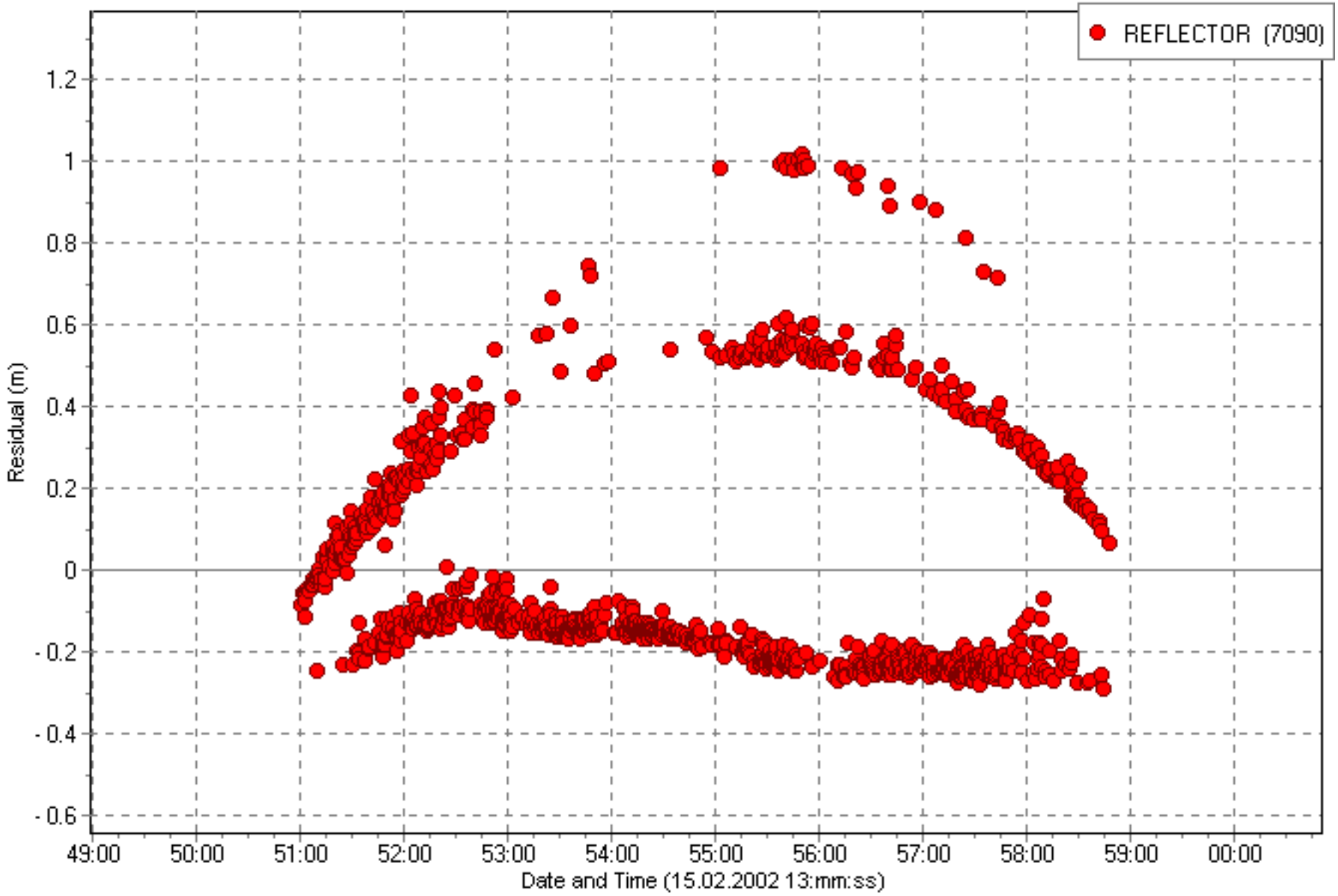
- At request of ILRS AWG

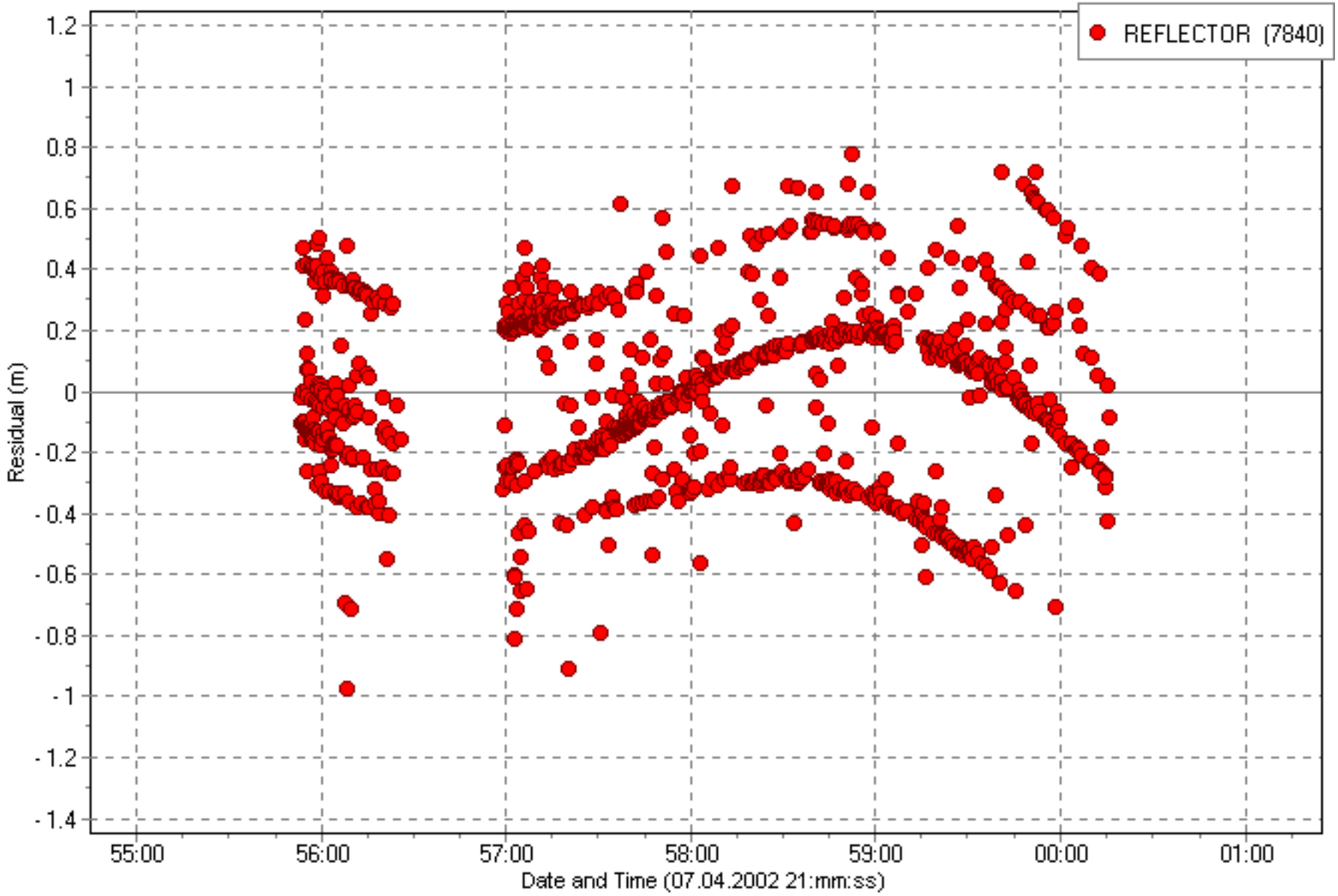
- April 2001 – April 2002

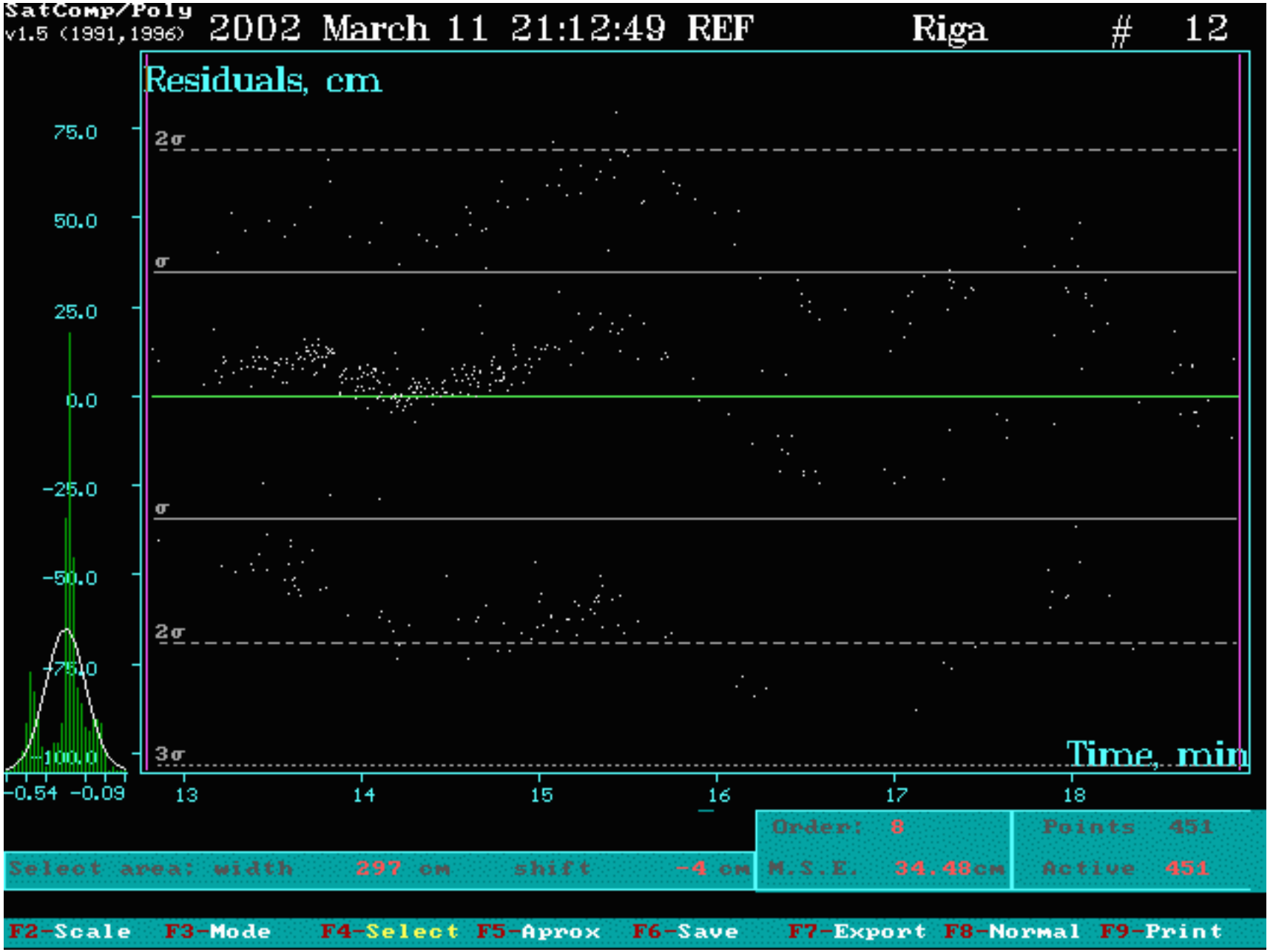

2500
2000
1500
1000
500
0
NP Volume
Etalon Campaign
1996
1997
1998
1999
2000
2001
2002

ETALON campaign: “conclusions”

- Improvement of EOPs marginal, but:
- Encouragement for improvement analysis
- Continue tracking at current level of intensity
- AWG -> development of official ILRS combination product


REFLECTOR (7090)
1.2
1
0.8
0.6
0.4
0.2
0
- 0.2
- 0.4
- 0.6
Residual (m)
49:00
50:00
51:00
52:00
53:00
54:00
55:00
56:00
57:00
58:00
59:00
00:00
Date and Time (15.02.2002 13:mm:ss)


REFLECTOR (7840)
1.2
1
0.8
0.6
0.4
0.2
0
- 0.2
- 0.4
- 0.6
- 0.8
- 1
- 1.2
- 1.4
Residual (m)
55:00
56:00
57:00
58:00
59:00
00:00
01:00
Date and Time (07.04.2002 21:mm:ss)


SatComp/Poly
v1.5 (1991,1996)
2002 March 11 21:12:49 REF
Riga
12
Residuals, cm
75.0
50.0
25.0
0.0
-25.0
-50.0
-75.0
-100.0
2σ
σ
σ
2σ
3σ
-0.54
-0.09
13
14
15
16
17
18
Time, min
Order: 8
Points 451
Select area: width 297 cm shift -4 cm
M.S.E. 34.48cm
Active 451
F2-Scale F3-Mode F4-Select F5-Aprox F6-Save F7-Export F8-Normal F9-Print

Report of LRE Launch Support

Maki MAEDA

Flight Dynamics Group
Office of Satellite Technology, Research and Applications
Satellite Mission Operations Department
National Space Development Agency of Japan

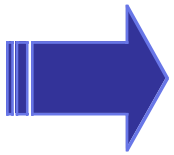
Launch Status

The launch of LRE/H-IIA was launched at 2001-08-29 07:00:00 (UTC)
from Tanegashima Island,Japan

07:39:47 [L+39m47s]
The LRE has separated
from Launch Viecle

The launch time had slipped
about 3 hours. (04:00 -->07:00)

Because of the trouble of launch site

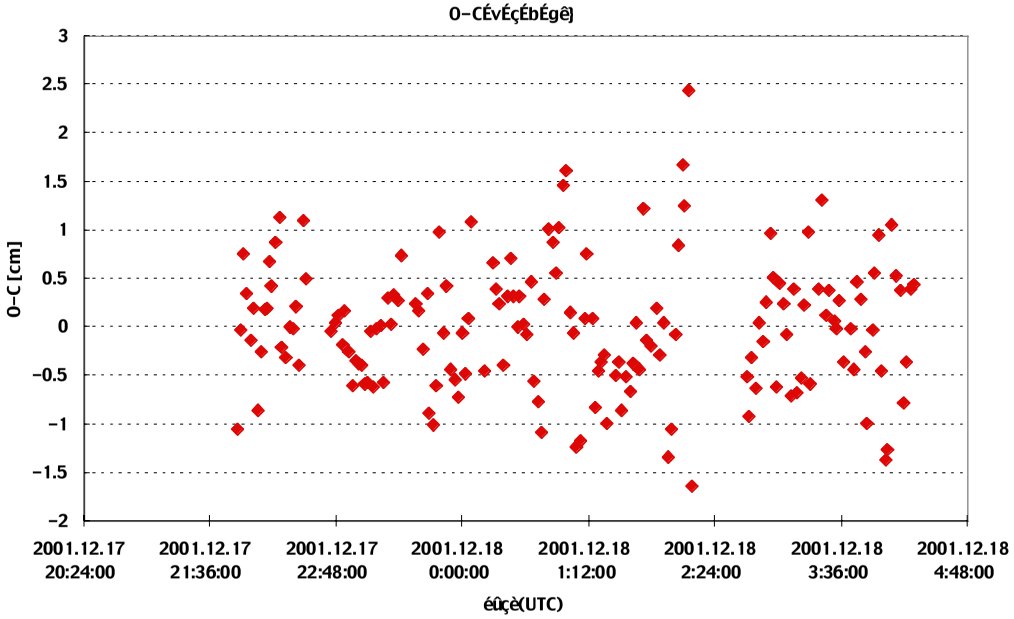


The relation between Sun and
LRE visibility has changed

FIRST laser return from LRE

Dec 17 GRASSE/LLR station succeed SLR

	Start	End	NPs
2001/12/17	**21:51:33**	**22:08:10**	**10**
	22:09:45	**23:04:10**	**23**
	23:05:48	**00:04:35**	**28**
2001/12/18	**00:11:51**	**00:58:50**	**23**
	01:01:34	**01:58:32**	**28**
	02:01:36	**03:06:48**	**20**
	03:09:11	**04:02:14**	**26**
	04:04:58	**04:18:42**	**8**



Following GRASSE,
Yaragadee station (Dec 22) and
CRL station(Jan 28) also succeed SLR

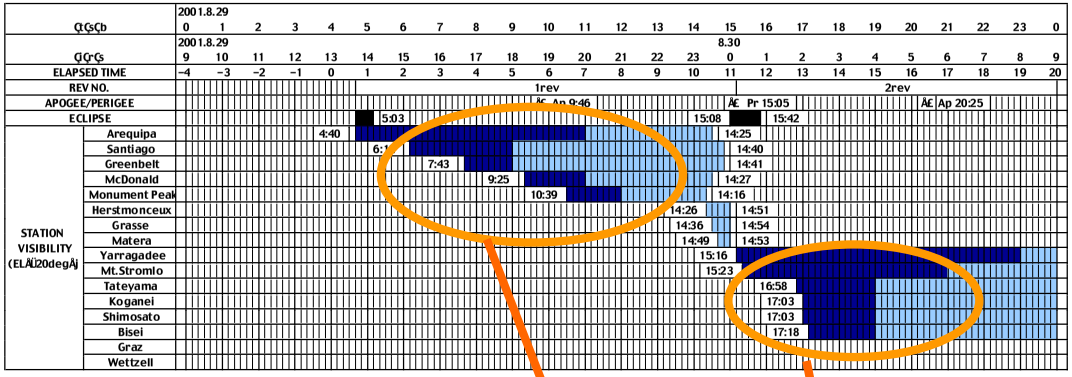
Difficulty of SLR to the transfer orbit

Interference with the SUN

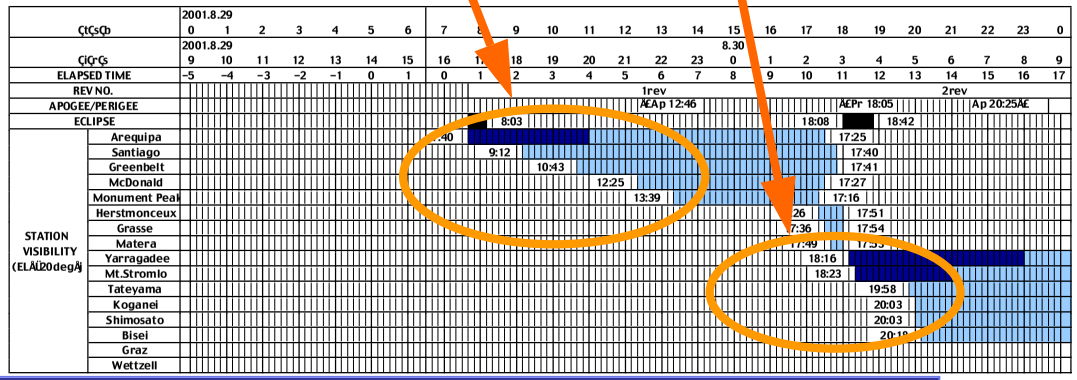
H-IIA launch was
Slipped about
3 hours

Day time

Night time



AFTER Launch Slip



The angle between sun and LRE had been small.
Difficult to target the telescope to LRE

Difficulty of SLR to the transfer orbit

Range Gate estimation

LRE flights eccentricity orbit
Slant range change during tracking pass

GRASSE station was modified software
to change range gate in short time.

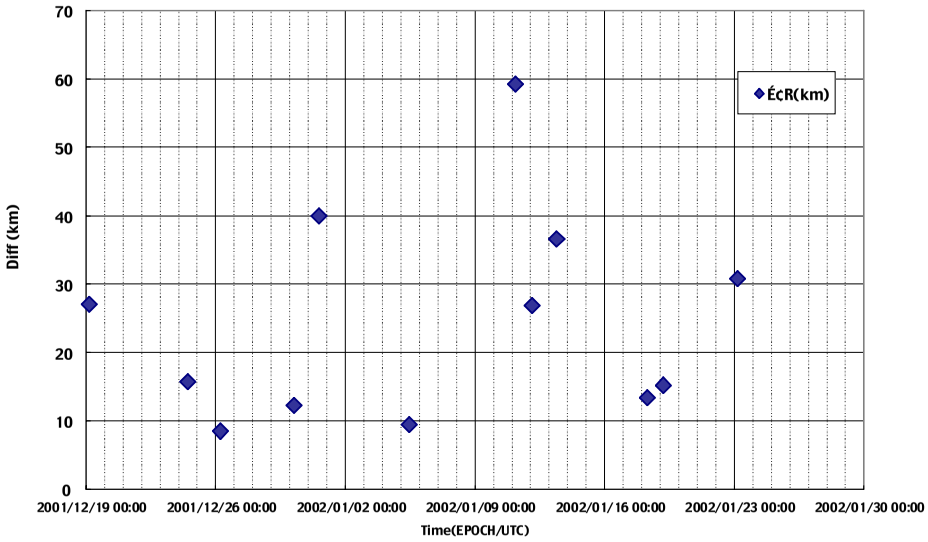
Very effective to success SLR of LRE

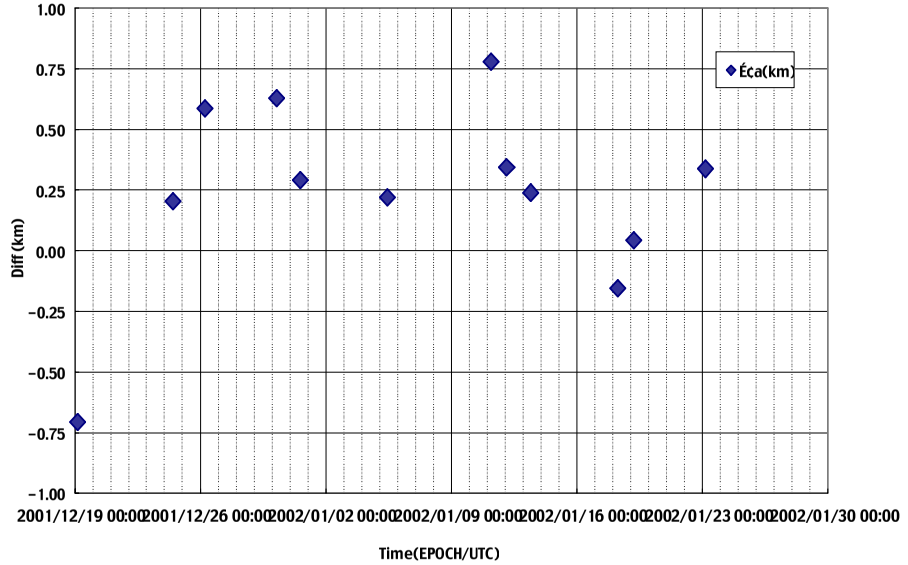
Difficulty of SLR to the transfer orbit

TIRV accuracy

Before the success of SLR, we delivered TIRVs based on NORAD TLE

only ONE information of LRE orbit





Compare with TLE and NASDA OD result

The accuracy of TLE was not enough for Laser ranging

Difficulty of SLR to the transfer orbit

Visibility in optical

Report from many station, It found that the visibility of LRE in optical was too bad condition.

WHY?

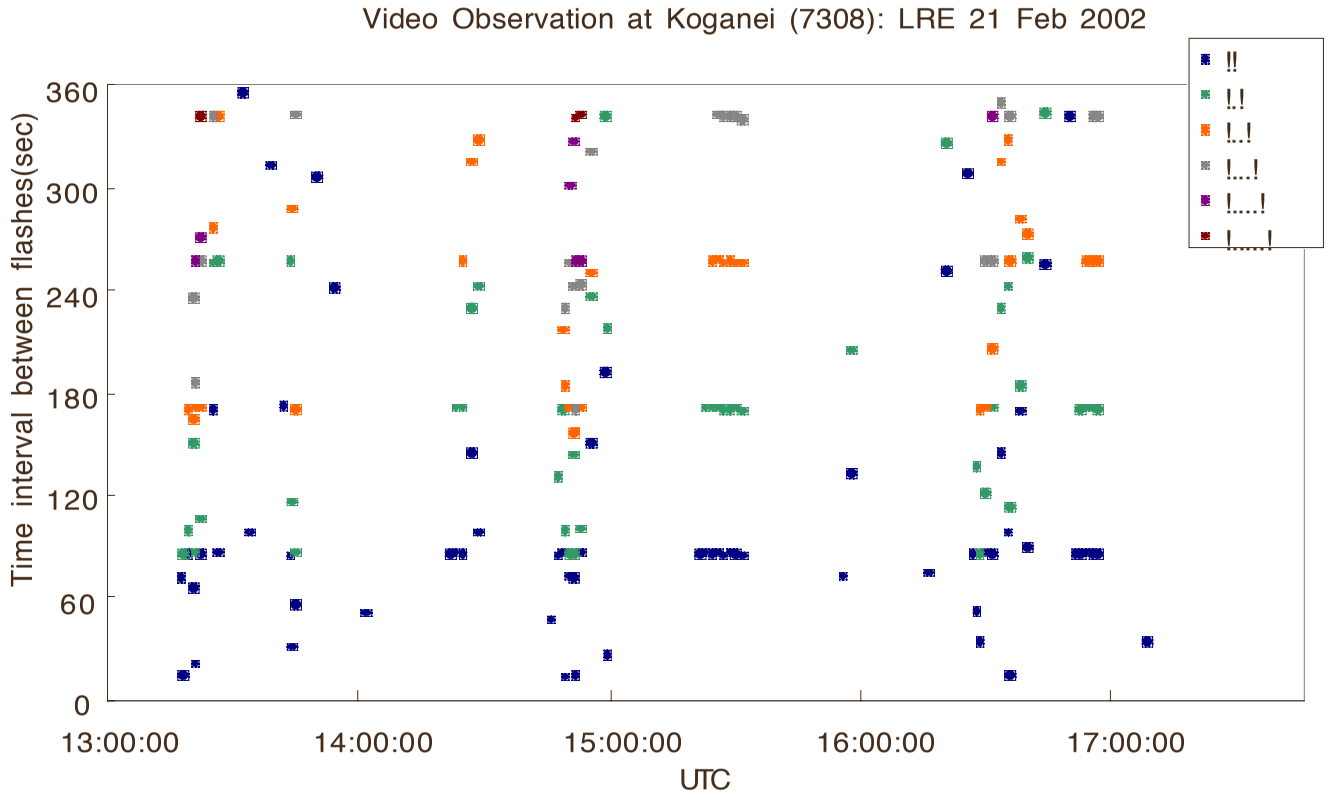
Estimated spin rate from the Video onboard
H-IIA rocket was about 3rpm (EGS is 32rpm)

LRE was too small and not so good mirror
Configuration to get enough optical sectional area

LRE: Video Observation at CRL

Probably reflected from mirrors. Many fall in 85±1 sec.

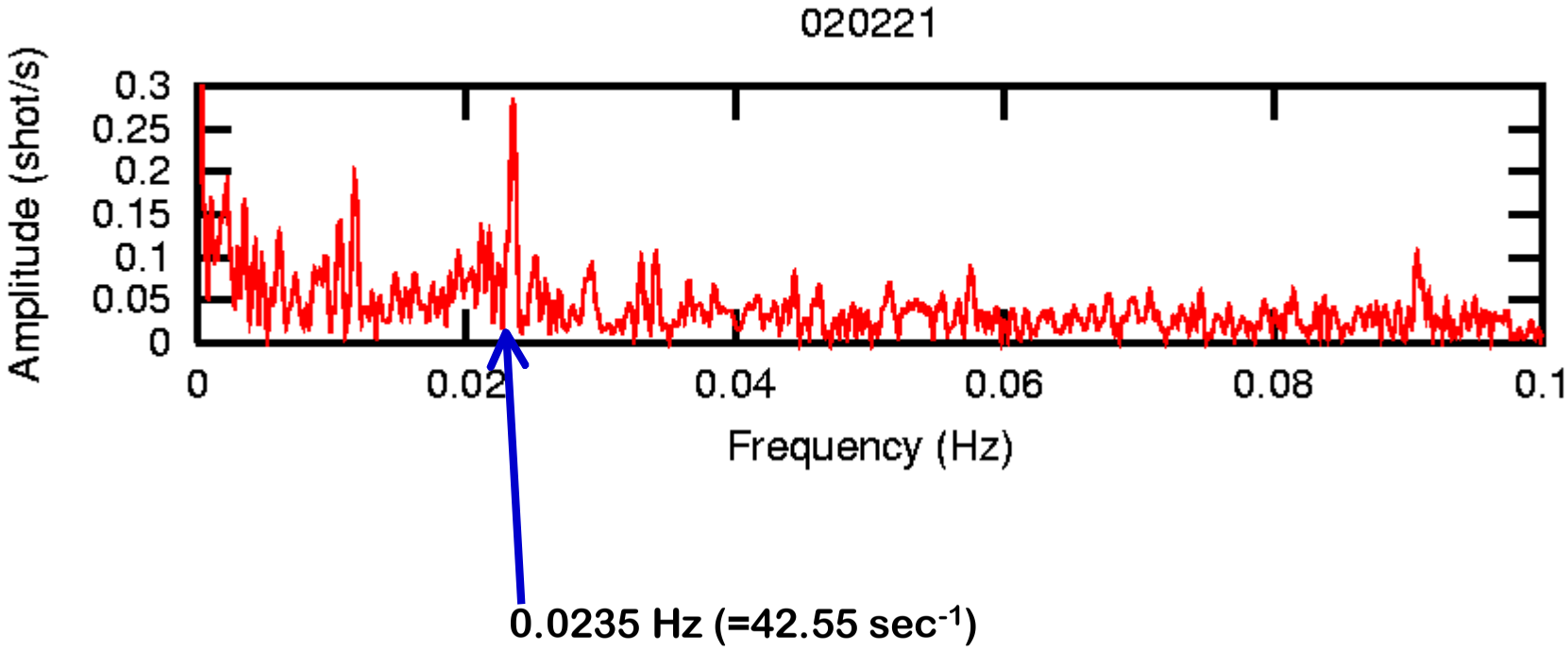
the spin period can be 85, 85x2, 85x3, 85x4 or 85x6 seconds



LRE: FR (Grasse) spectral analysis

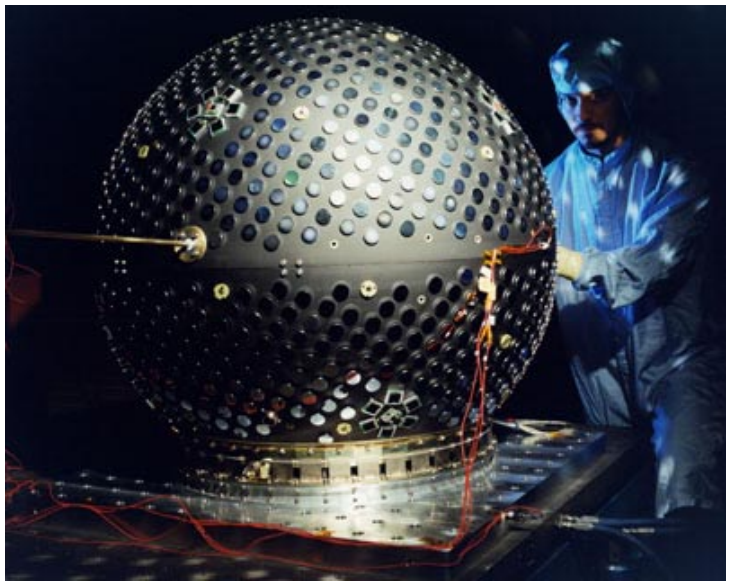
Spectral analysis of post-fit full-rate data from Grasse.

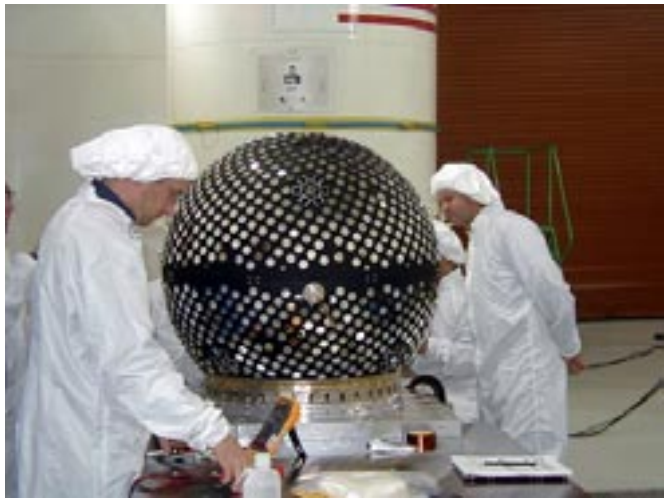
Time domain: number of returns per sec (not residuals!).

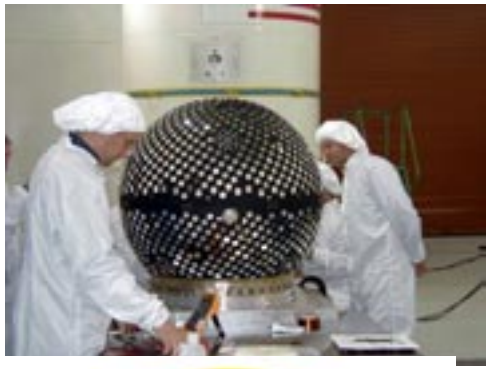


Starshine 3

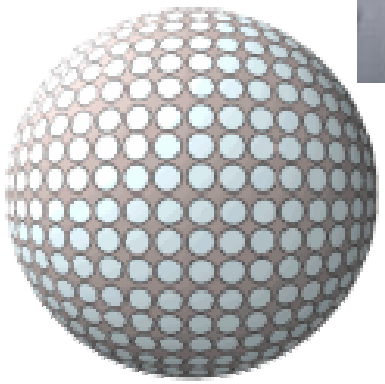
- **Official Name**
  - Starshine 3
- **Sponsor**
  - Cooperative international organization
- **Primary Mission**
  - Thermospheric research, student experiments
- **Launch (September 30, 2001)**
  - Athena ELV from Kodiak, Alaska
- **Orbital Parameters**
  - Altitude: 470 km (at start)
  - Inclination: 67.048°
  - Eccentricity: 0.000066
- **Mission Duration**
  - 1 year
- **Array Characteristics**
  - 36 inch sphere, approximately 250 total pounds
  - 31 one cm cubes spaced around the sphere
  - 1000 student ground and polished mirrors
- **Tracking History (Oct. 3, 2001 - April 16, 2002)**
  - 9 systems (4 NASA, 3 EUROLAS, 2 WPLTN)
  - 33 total passes, came in spurts

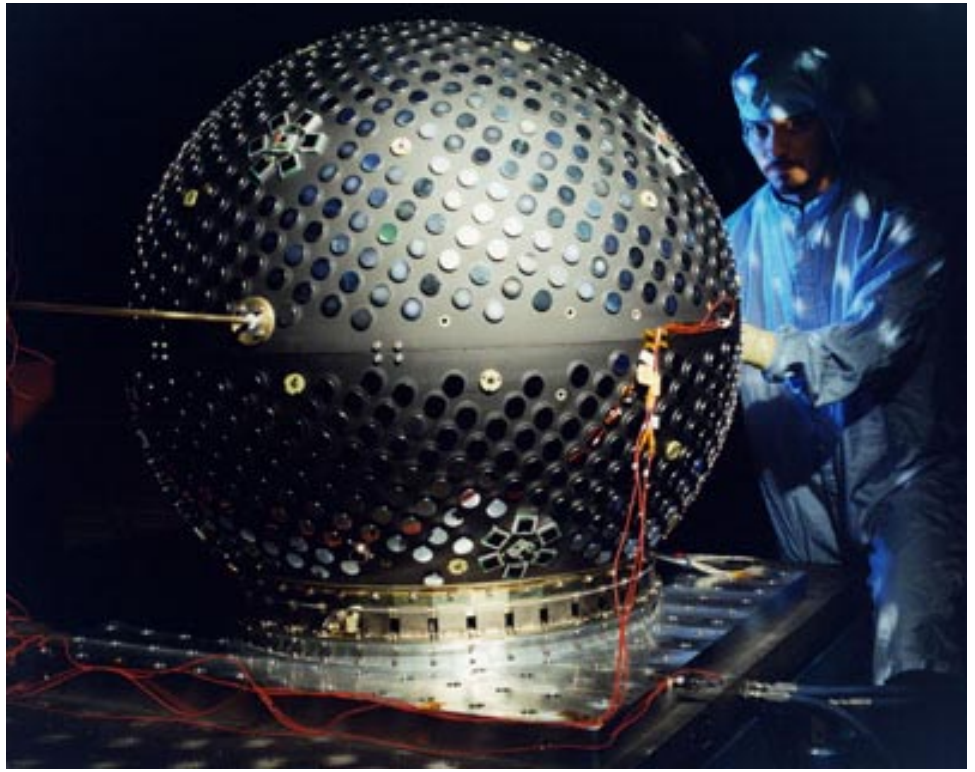






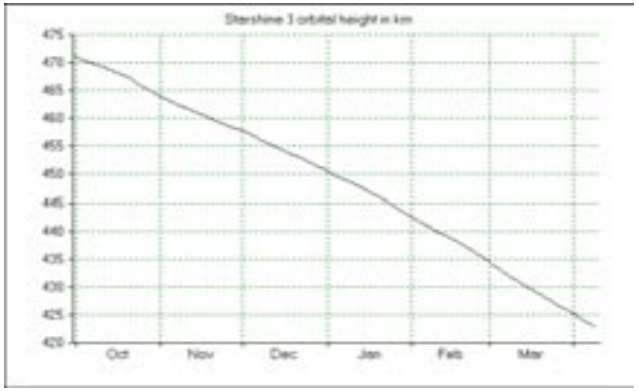

STUDENTS OF THE WORLD
STARSHINE 3
MASA·IAS·IAAN·USAF·SPACE GRANT·BATC·ADC·PSC·OAI·CC·SDSMT·PSL·CFPPR·DNV·CEC·RCEI





Starshine -2, -3

- Starshine 3
  - Starshine 3 launched on September 30, 2001 as part of first launch from Kodiak, Alaska
  - Starshine satellites were to be tracked by NASA stations and others if desired to determine utility of the retroreflectors - if viable then make a mission
    - First Starshine-3 pass received by Yarragadee on October 3, 2001
    - Tracking limited to NASA stations and anyone who wanted to try tracking (9 stations) - Sparse data
    - NRL provided high quality predictions to help support acquisition
- Starshine 2
  - Starshine 2 deployed from STS-108 on December 16, 2001
    - No tracking attempted attempting Starshine 3



The end of Starshine -2 & -3

- Starshine -2 will decay on or about April 26
- Starshine -3 will decay on or about October 30

- Starshine SLR data has significant impact on thermospheric research and applications impacted by variations in the thermosphere
- Currently, there are a limited number of thermospheric science missions
- Starshine satellites make excellent targets with the spherical shapes and SLR data

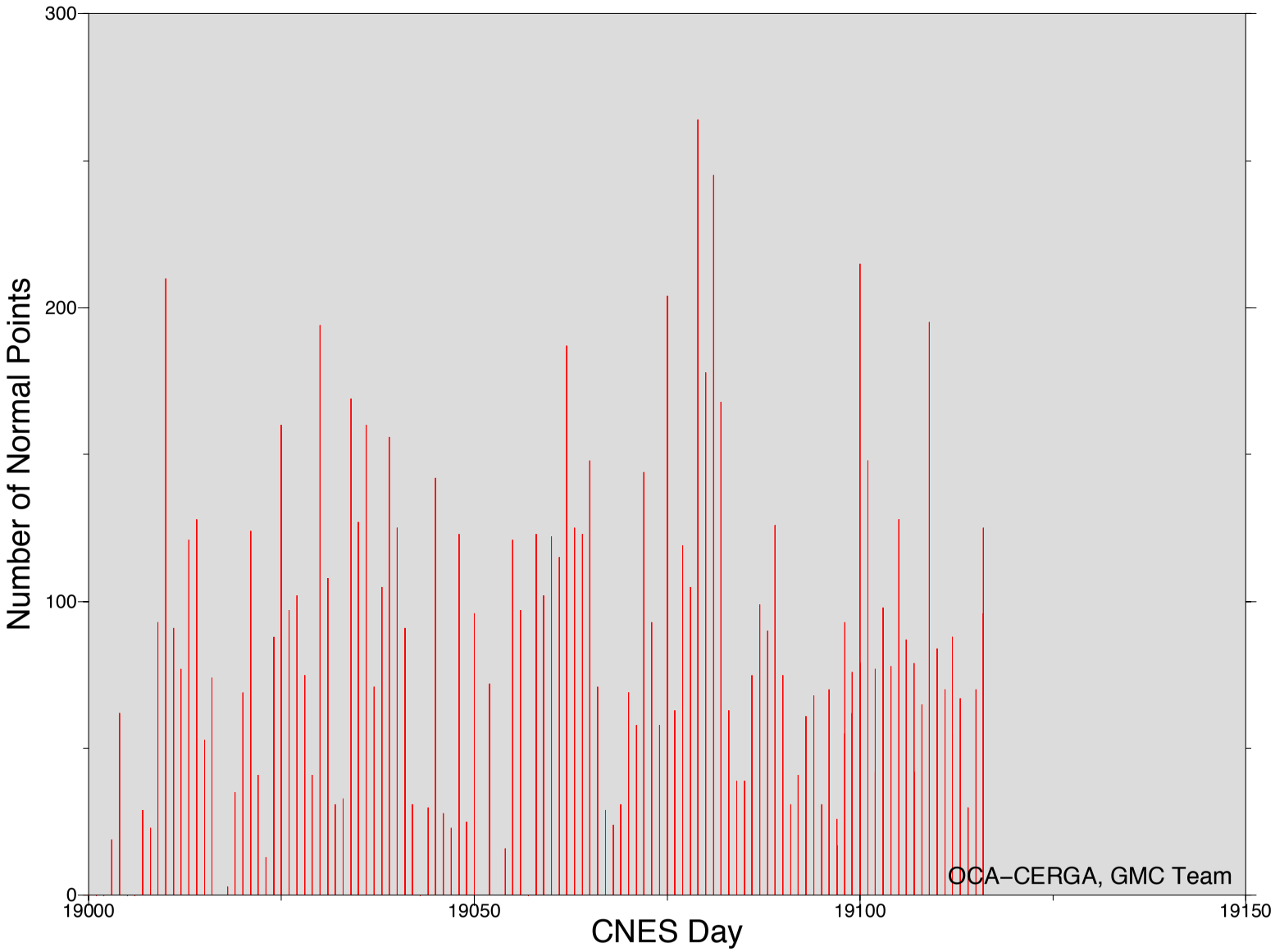
Starshine -4, -5 Underway

Starshine 4/5

- NASA has firmly manifested our Starshine 4/5 dual-satellite experiment on the STS-114 Shuttle mission to the International Space Station in January of 2003.
- Starshine 4/5 will have mounted 1000 mirrors and 31 laser retroreflectors on its external shell.
- Starshine 4/5 Mission Plan
  - Release from Starshine 4, a 4 inch (10 cm) hollow aluminum sphere, instead, which will be Starshine 5.
  - This small subsatellite will be released shortly after Starshine 4 is deployed from Space Shuttle Atlantis
  - Both Starshines 4 and 5 will carry 31 laser retroreflectors on their surfaces
  - Starshine 5 will have no mirrors and will thus not be naked-eye visible, so tracking will dependent totally on ILRS and Space Command tracking for orbit determination of this satellite.
  - By comparing the orbital decay rates of Starshine 4 and 5, it will possible for us to determine the density of the earth's atmosphere more precisely than we've been able to do on previous missions.

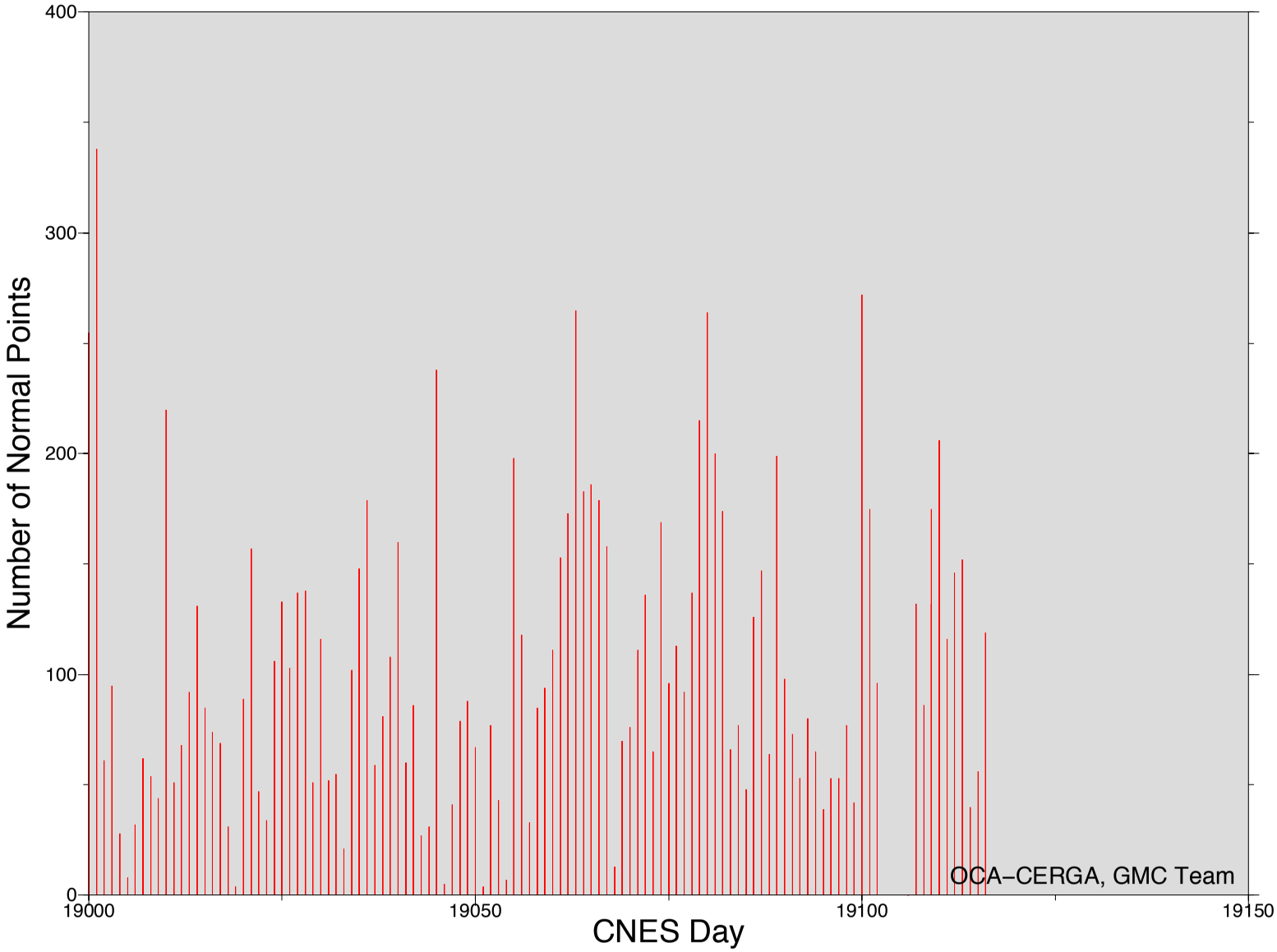
Number of SLR Residuals for T/P and JASON–1: all stations

Mediterranean Area / Input Orbits from JASON–1 (MOE): global residuals



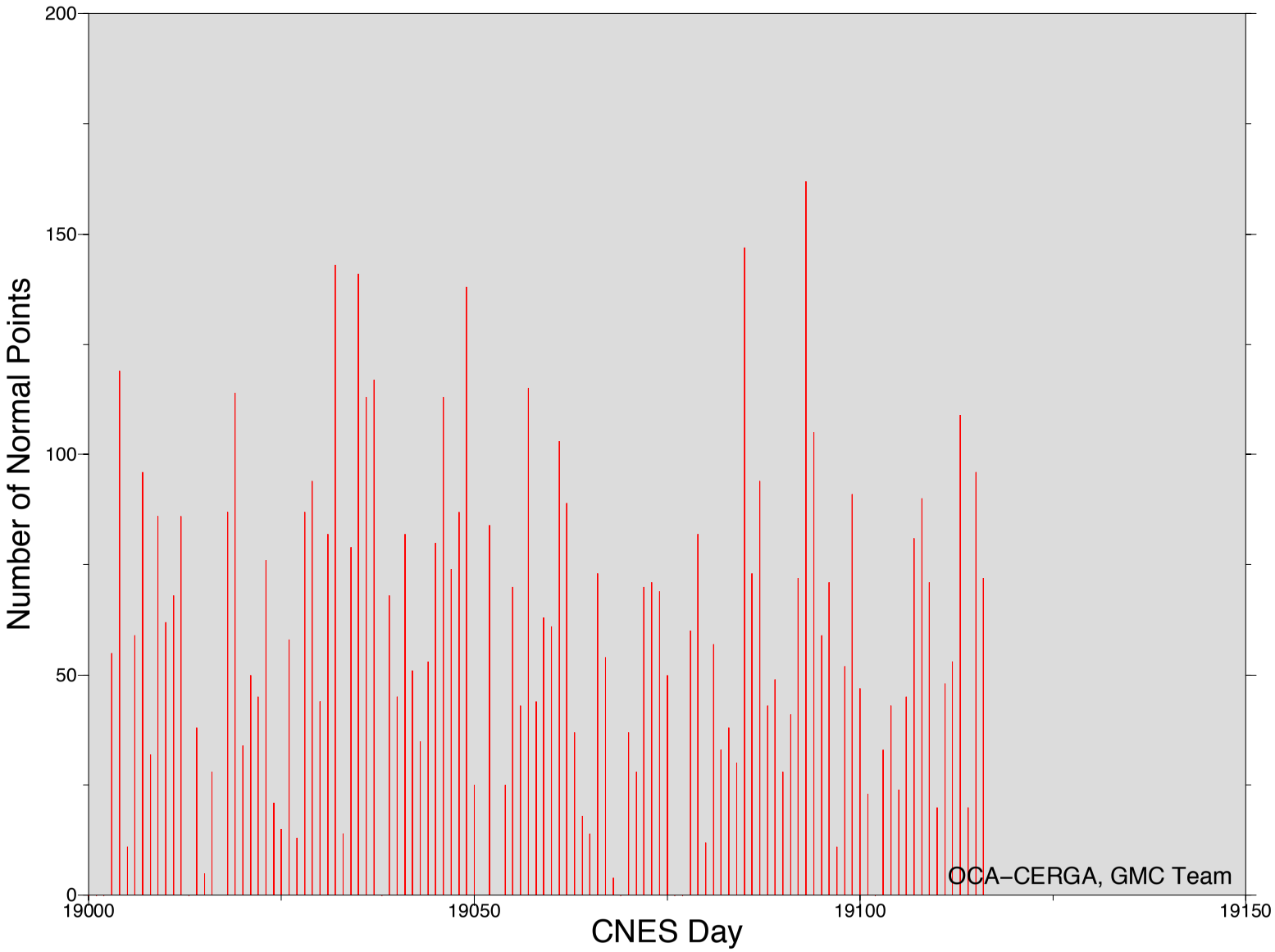
Number of SLR Residuals for T/P and JASON–1: all stations

Mediterranean Area / Input Orbits from TOPEX/POSEIDON (MOE): global residuals



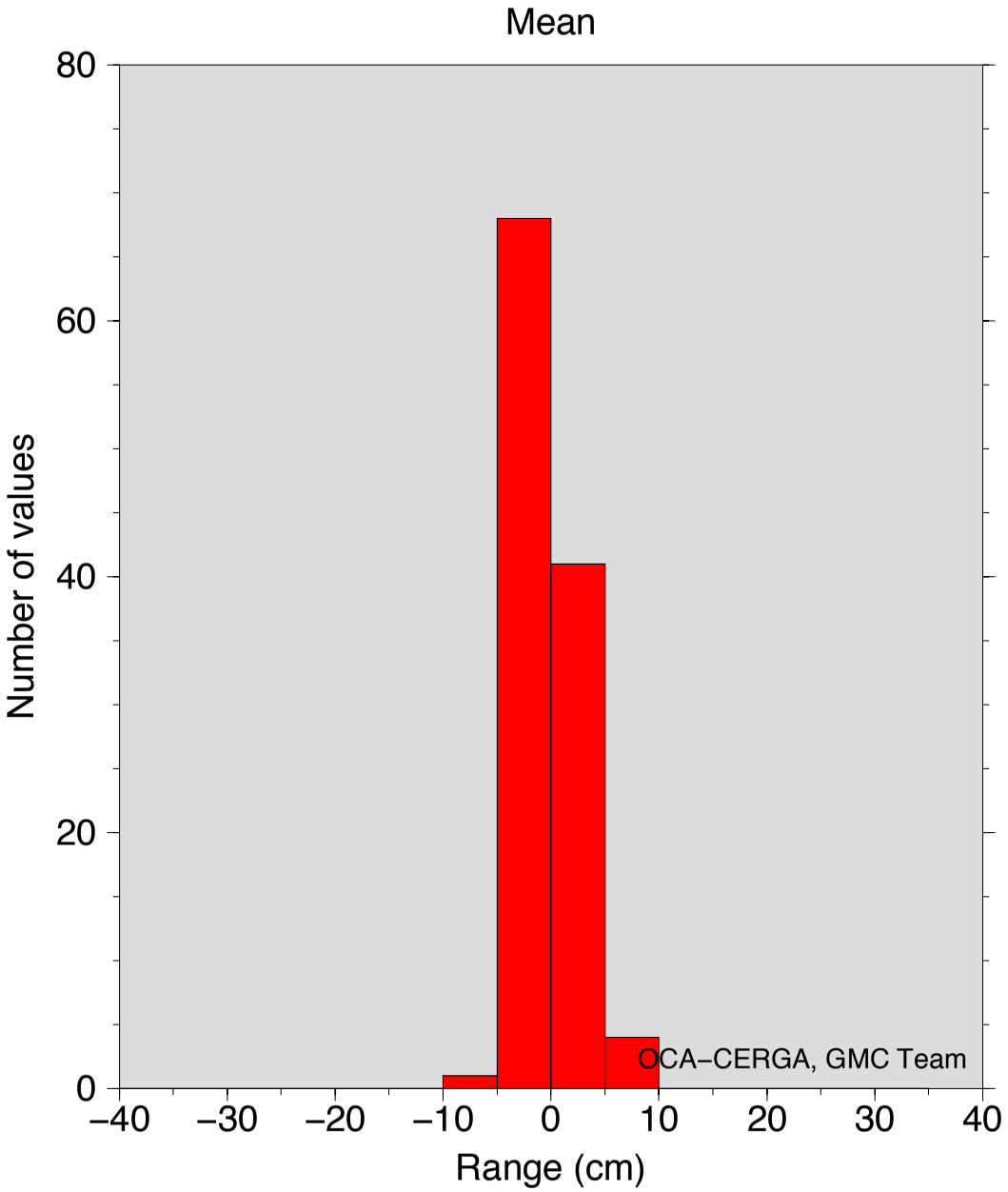
Number of SLR Residuals for T/P and JASON–1: all stations

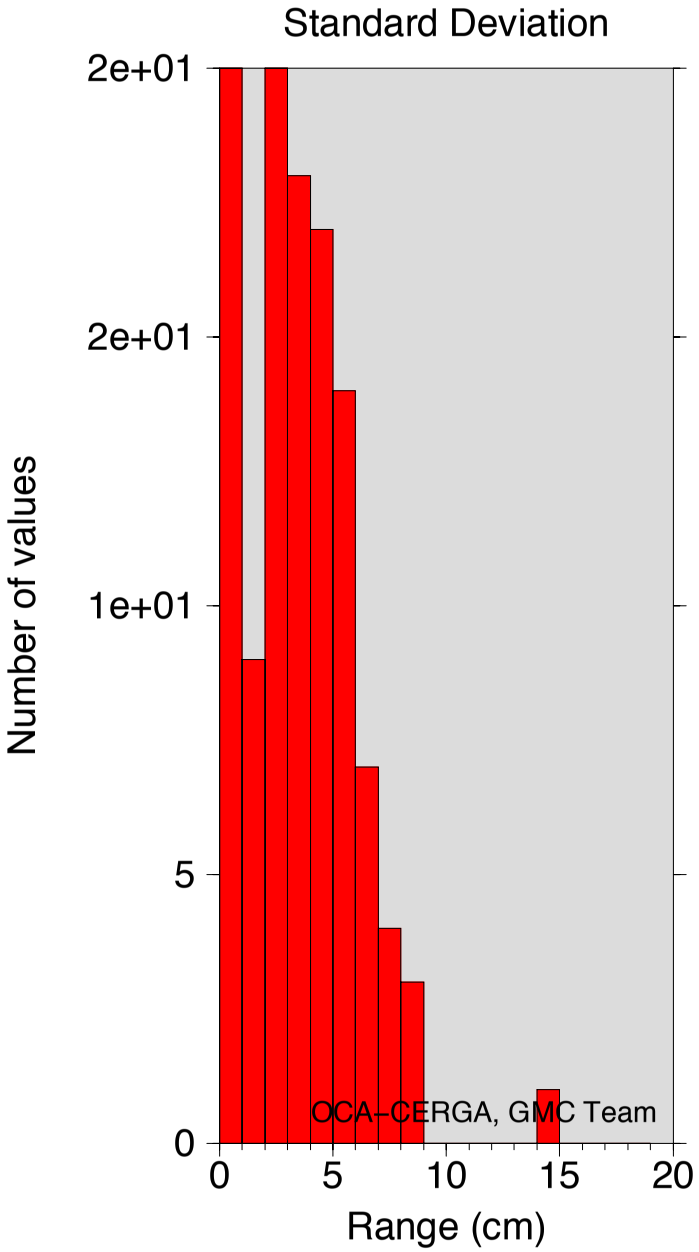
USA Area / Input Orbits from JASON–1 (MOE): global residuals



Histogram of SLR Residuals for T/P and JASON–1: all stations

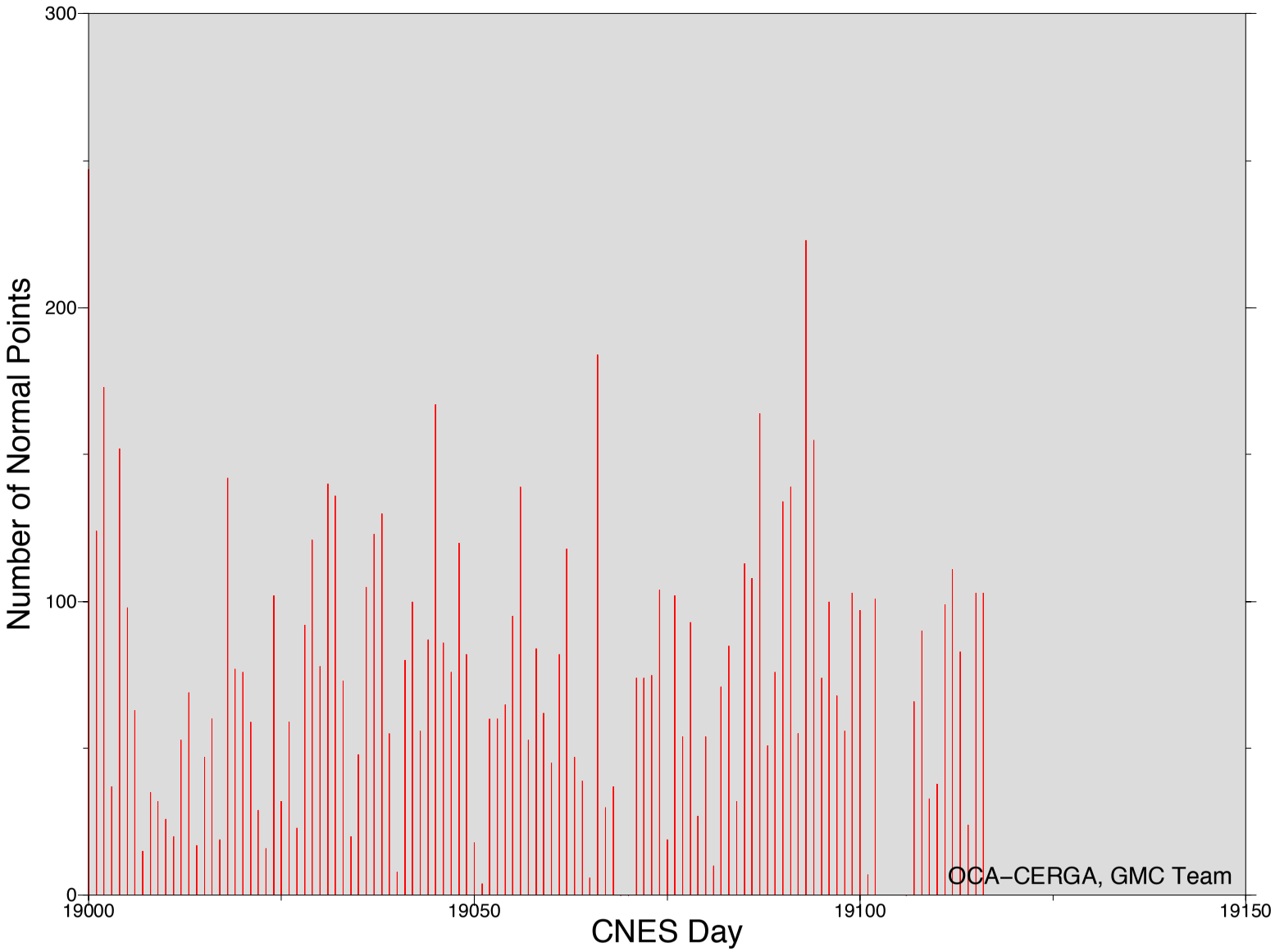
USA Area / Input Orbits from JASON–1 (MOE): global residuals





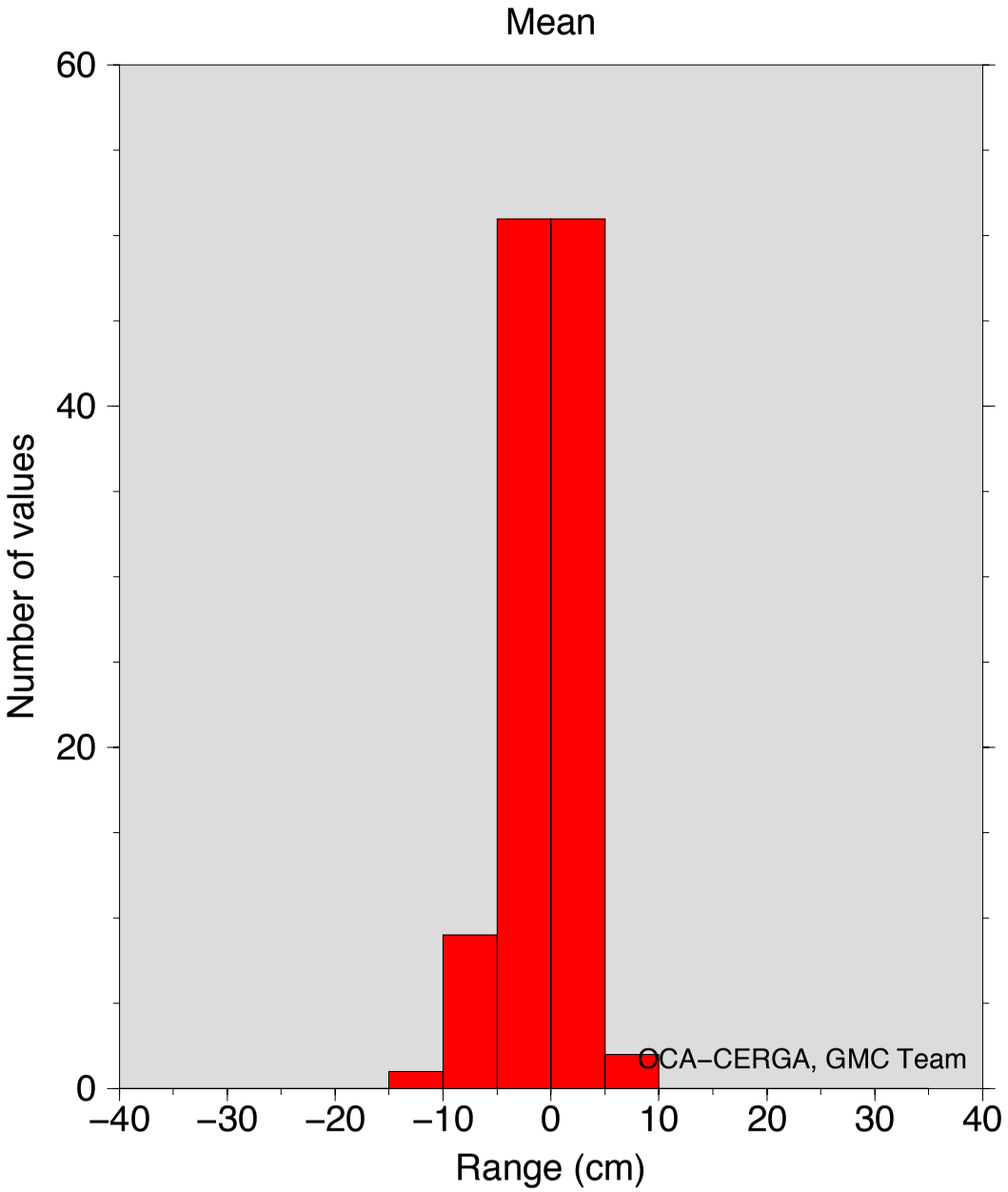
Number of SLR Residuals for T/P and JASON–1: all stations

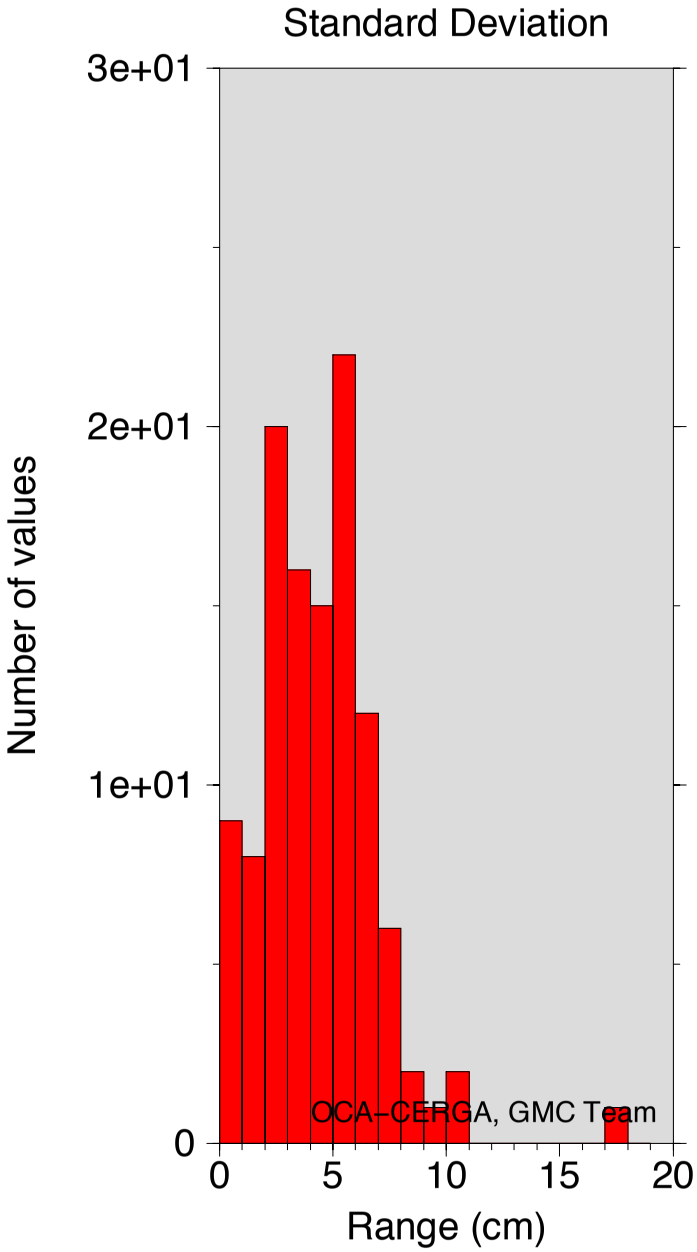
USA Area / Input Orbits from TOPEX/POSEIDON (MOE): global residuals



Histogram of SLR Residuals for T/P and JASON–1: all stations

USA Area / Input Orbits from TOPEX/POSEIDON (MOE): global residuals



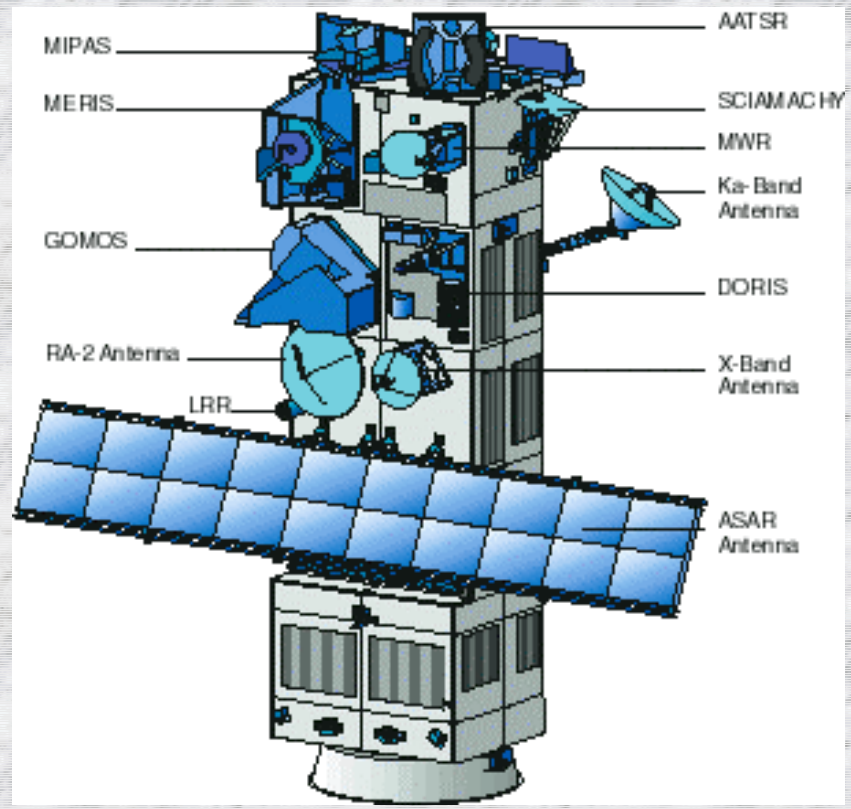


ENVISAT STATUS

Mission Status

SATELLITE SUCCESSFULLY LAUNCHED ON 1 MAR 2002 (CET)

ENVISAT STATUS/Instruments



Satellite Status

NOMINAL LEOP

Switch-on and Initial Verification: complete (except AATSR and SCIA that require a longer stabilisation)

Altimeter switch-on: successful
DORIS Switch-on: successful
MWR switch-on:successful
All other instruments:successful

ENVISAT STATUS/Orbit

ENVISAT ORBIT: SSO, 10 am solar time at descending node
ERS ORBIT: SSO, 10:30 am solar time at descending node

TANDEM : ENVISAT AND ERS on the same track at 30 mins

Reaching of the Tandem Configuration required a drift phase for several weeks

FINAL ORBIT REACHED ON 4 APRIL 2002

ENVISAT Next Steps

Cal-Val for Altimeter, MWR and DORIS, incl. POD

Successful tracking by 17 stations

Intense Laser tracking will be needed until the end of the Commissioning (Sep 2002).

Laser Tracking will also be required during the Routine Phase, planned from Sep 2002

CONCLUSION

ESA ACKNOWLEDGES THE LONG-STANDING EFFORTS OF LASER STATIONS TO CONTRIBUTE TO THE SUCCESS OF ERS AND ENVISAT AND EXPECTS THAT TO CONTINUE WITH THE UPCOMING MISSIONS CRYOSAT (2004) AND GOCE (2006)

Status SLR Tracking GRACE Mission

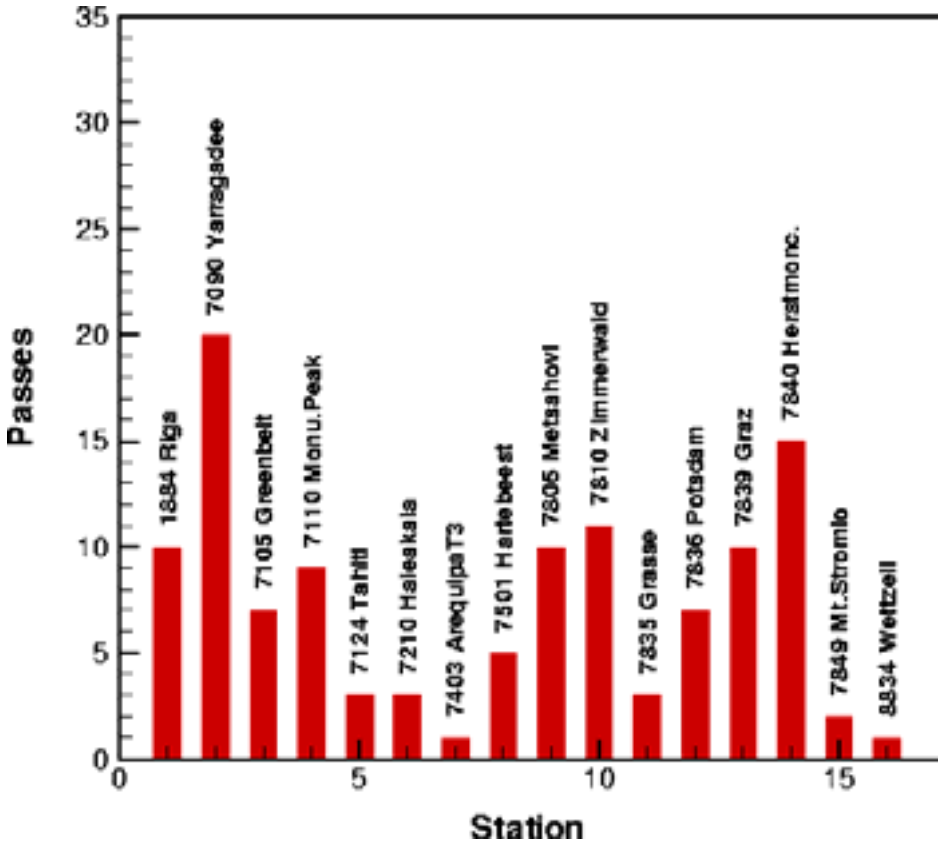
R. Schmidt, R. König, Ch. Reigber

GeoForschungsZentrum Potsdam (GFZ)
Division I: Kinematics and Dynamics of the Earth
Telegrafenberg
14473 Potsdam

Development/Status

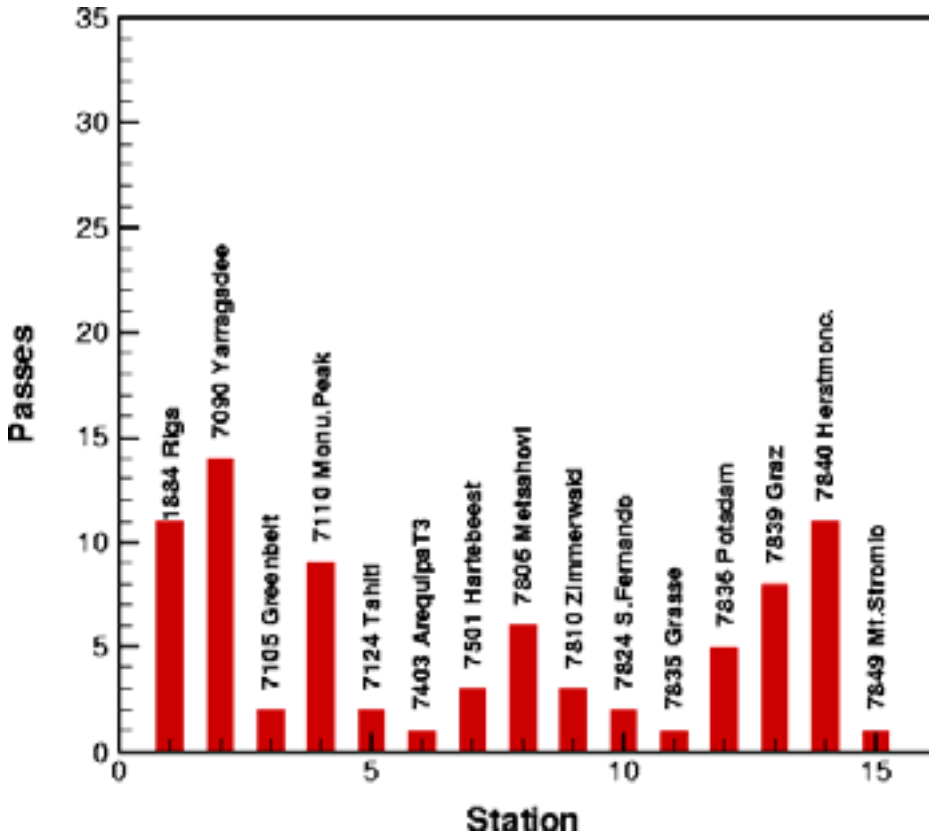
- successfull launch on March 17th, 2002, 09:21 UTC; nominal separation on March 17th, 2002, 10:46 UTC
- initial orbit determination and orbit predictions based on angle- and RADAR-tracking; after the switch-on of onboard GPS receivers standard orbit predictions derived from GPS navigation solution initiated (March 18th, 2002)
- first NPs for GRACE-A/B observed by Yarragadee on March 18th, 15:55 UTC in one pass
- generation of standard GRACE orbit predictions based on GPS navigation solution and SLR data turned to automatic mode
- prediction cycle at the moment set to 2 preditcs/day
- good quality of the GPS navigation solution data; rms in orbit determination 6 - 8 [m]

GRACE-A SLR-Tracking Mar./Apr. 2002



- 117 passes (Mar. 46 passes, Apr. 71 passes)
- 16 ILRS stations
- mean number of passes per day is 3 - 4; max. 9 passes on Apr. 4th
- in March two days of zero tracking due to orbit manoeuvres (calibration and stop/drift manoeuvres)
- tracking statistics in April shows stronger tracking of GRACE-A than of GRACE-B

GRACE-B SLR-Tracking Mar./Apr. 2002



- 79 passes (Mar. 27 passes, Apr. 52 passes)
- 15 ILRS stations
- mean number of passes per day is 2 - 3; max. 5 passes on several days in Apr.
- in March several days of zero tracking due to orbit manoeuvres (calibration and stop/drift manoeuvres)
- tracking statistics in April shows weaker tracking of GRACE-B than tracking of GRACE-A

Summary

- successfull SLR tracking initiated early in the beginning of the GRACE mission; rather quick transistion to automated operations
- tracking statistics reflect in general good quality of the standard GRACE orbit predictions based on GPS navigation solution and SLR data
- improvements of the orbit predictions are expected from a reduced latency of GPS navigation solution data and improved gravity field modelling from GRACE data
- unbalanced tracking statistics for GRACE-A and GRACE-B
- calibration/validation of the GPS tracking system using SLR data is ongoing

In case of questions/suggestions/comments feel free to contact us under:
rschmidt@gfz-potdam.de

GLONASS –Satellite System
(IGS and ILRS Tracking Status in 2002)

Between January 1 and May 31, 2002, there have been 7-8 healthy, operational GLONASS satellites. They are all in planes 1 and 3 of the constellation. The first new GLONASS-M satellite, GLONASS No. 711 in Plane 1/Slot 5, has not yet been designated as operational. It is not clear what if any problems may have been encountered after launch.

Microwave Technique / Tracking Status

The number of "permanent" IGLOS microwave tracking stations has grown slightly since December 2001. There are now 50 stations in the network, continuously tracking the GLONASS satellites and transmitting their data to the IGS Data Centers. Forty-five or more of these stations have been sending data to the data centers each week. Most of the receivers are Ashtech Z18 or JPS Legacy models. New stations that came on-line during the last three months include Frankfurt, Germany (FFMJ), Kourou, French Guyana (KOU1), and Zimmerwald, Switzerland (ZIMZ).

Satellite Laser Ranging / Tracking Status

The ILRS has agreed to continue to track three GLONASS satellites as part of their standard tracking protocol. In February 2002, the IGLOS Project Committee requested the ILRS to track two of the satellites in orbit plane 1 and one satellite in plane 3: Plane 1/Slot 1, Plane 1/Slot 3, Plane 3/Slot 24. A few weeks later Slot 1 has been set unhealthy, so this satellite was replaced by Plane 1/Slot 6.

Orbit Determination

BKG, ESA and the Russian Mission Control Center (MCC) continue to compute and make available GLONASS orbits on a routine basis. The MCC orbits are based on SLR data. A combination orbit is produced by Robert Weber, the IGS Analysis Center Coordinator, from the orbits of these three centers. Figure 1 below demonstrates the daily coordinate rms. of the center submissions with respect to the combined orbit (1998.8-2002.2). The consistency among all contributed orbit submissions is at the 20cm level, regardless of the basic observable. MCC orbit rms. numbers are of course somewhat noisier, caused by the low number of satellites tracked by ILRS. The visible bump in figure1 in summer 2001 is related to a mis-modelling of radiation pressure for satellite slot 8 by ESA. Just after fixing that problem the rms. numbers went down below the 20cm level.

Outlook

In May 2002 the IGS-CB integrated all combined GPS/GLONASS tracking sites within their official data site pool, which was a long lasting request of the IGLOS-Pilot Project. This step should encourage all IGS Analysis Centers to make increased use of the GLONASS data in their processing schemes and come up with a number of new or improved products. In the first place precise GLONASS orbits with an increased orbit accuracy of 1-3 cm in the radial direction should be sufficient to study in detail the reason of the remaining bias of a few centimetres between microwave and laser tracking observations. Moreover, in case of a new GLONASS launch to plane II (elevation of sun above the orbital plane up to 88 degree) we are looking forward to learn more about

reliable radiation pressure models for the GLONASS satellites Thus, the ILRS is kindly asked to continue the tracking of GLONASS satellites and to provide laser based precise orbits.

James A. Slater (IGLOS-PP Chair)
Robert Weber (IGS Analysis Coordinator)

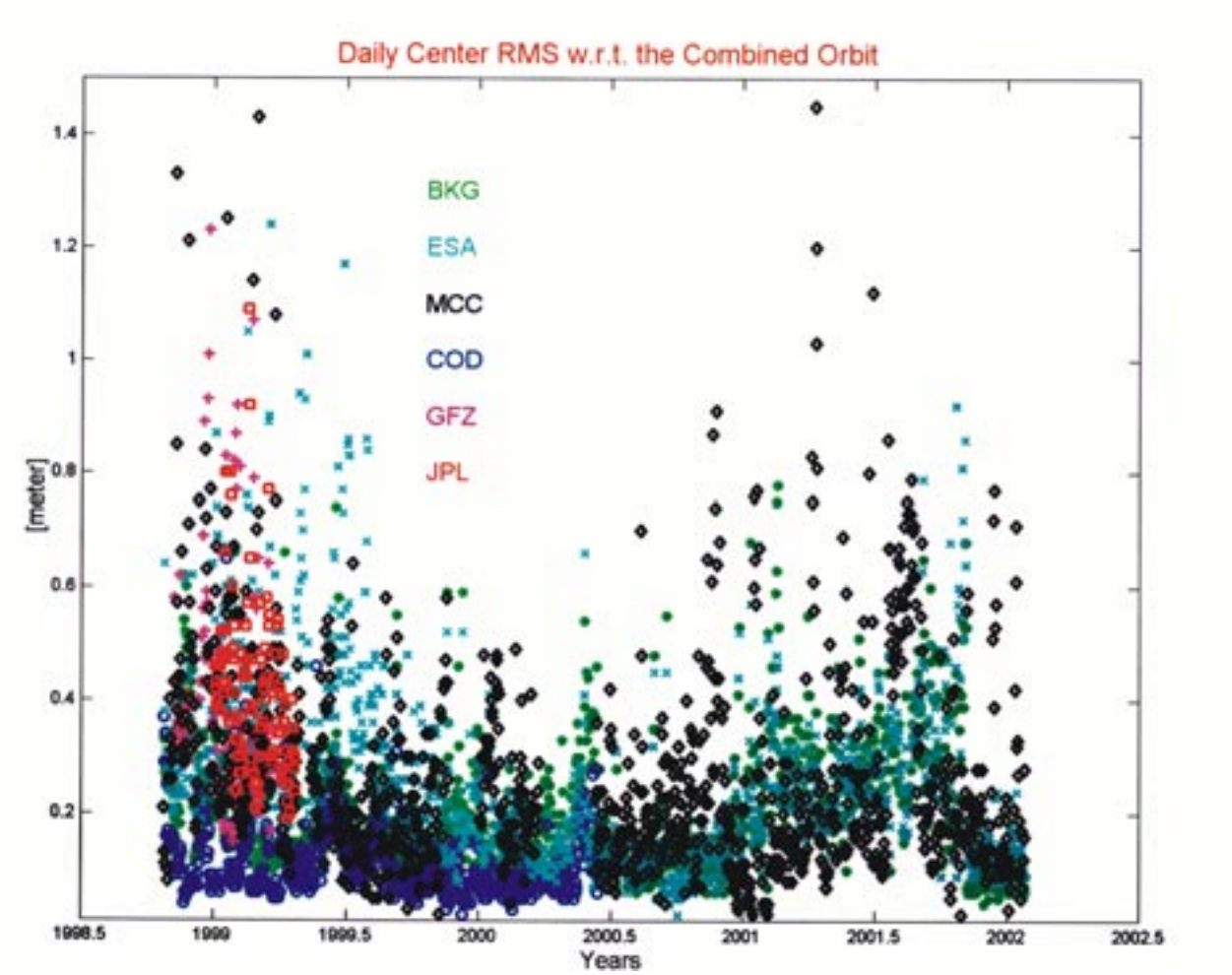


Figure 1

Upcoming Missions

ADEOS-II Mission status report

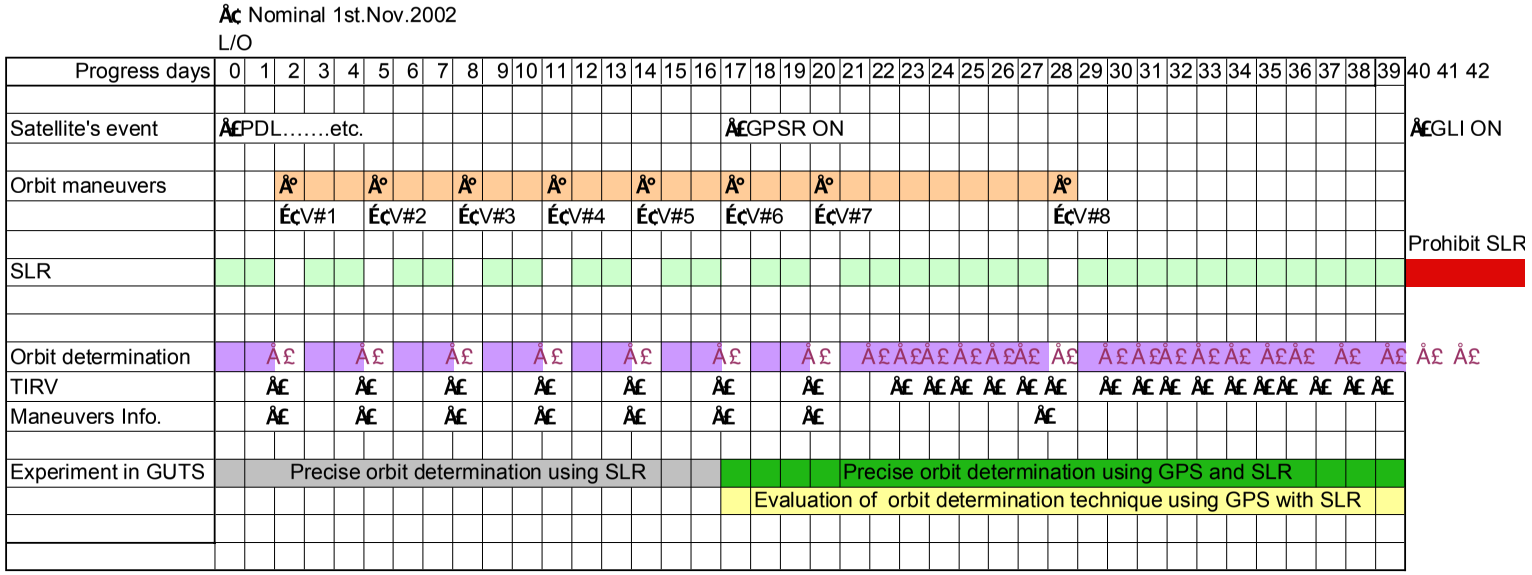
Takashi Uchimura

Flight Dynamics Group
Office of Satellite Technology,Research and Applications
Satellite Mission Operations Department
National Space Development Agency of Japan

ILRS, General Assembly, 25rd April / Nice
NASDA-ILRS-0006

The Latest Information of ADEOS-II

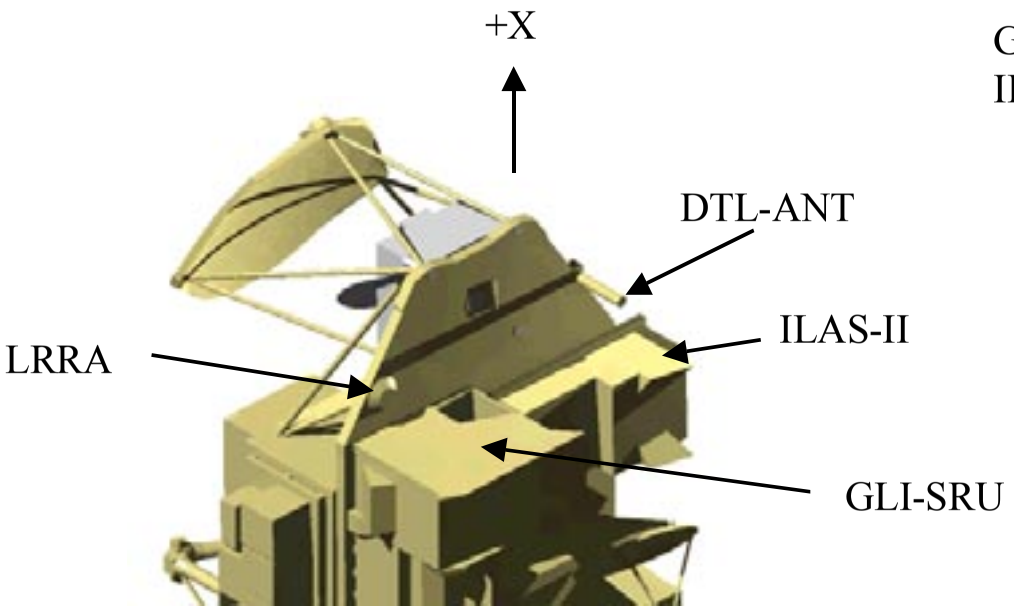
- *Launch vehicle : H-IIA*
- *Launch site : Tanegashima (Southern Island of Japan)*
- *Launch Window (Plan) : 1st Nov. 2002 to 30th Nov.2002*
  Launch time : 01h30m+/-15min(UT)
- *Preliminary orbit maneuvers (Plan) :*

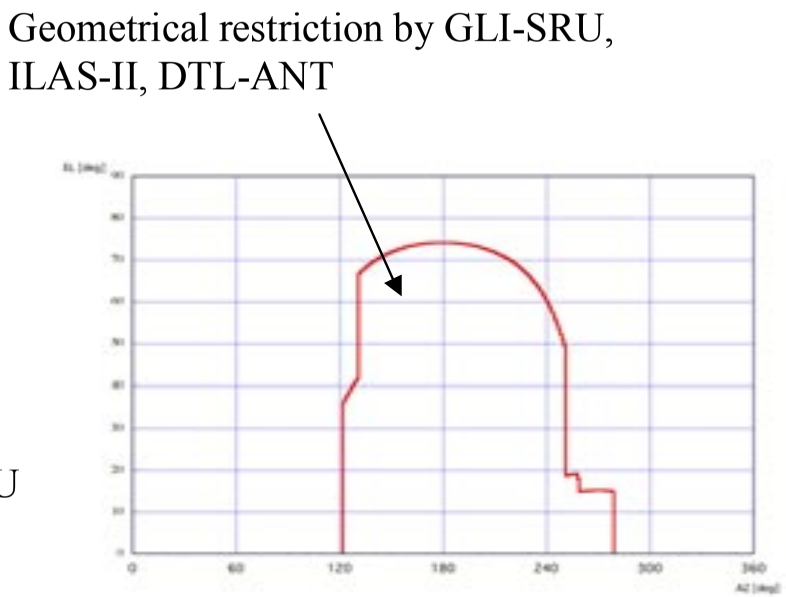


Background

As a result of detail analysis by ADEOS-II satellite side, it turned out that there were some constrain area caused by GLI (Global Imager: Optical sensor) in ADEOS-II SLR operation.

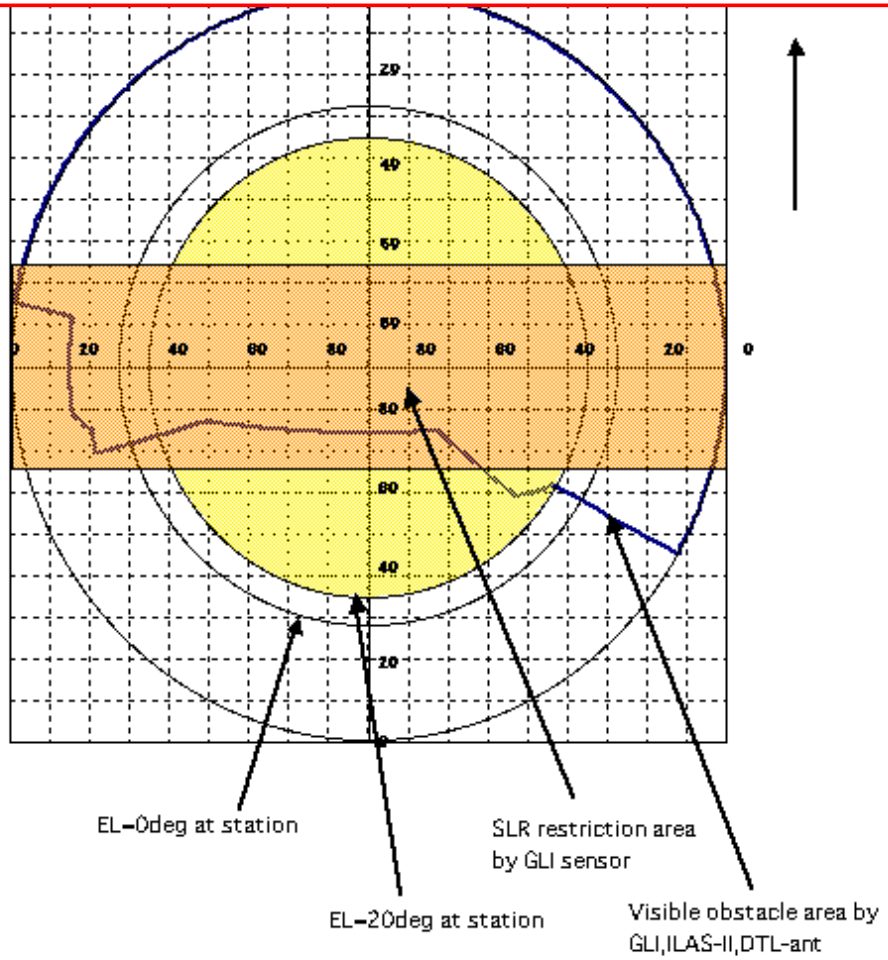
Below figure shows the restriction area that I have reported at Matera meeting(Nov.2000).

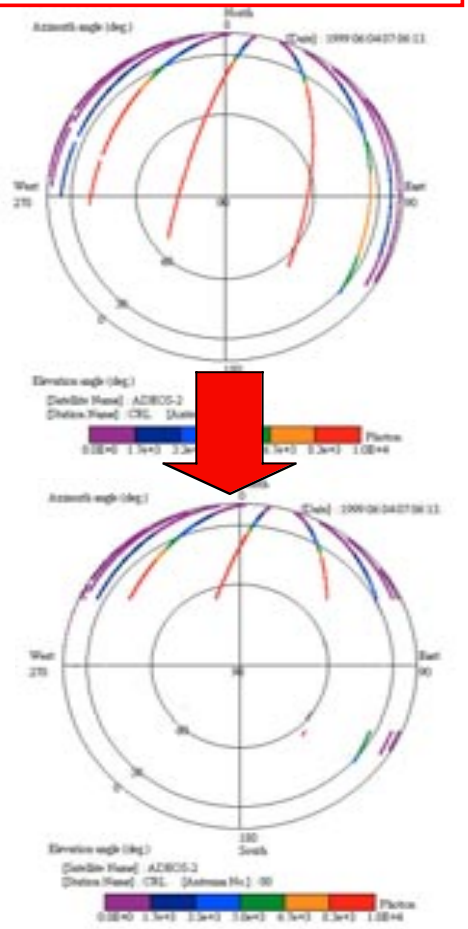




The Latest Information of restriction area in the ADEOS-II tracking

If SLR laser beam enter GLI optics, there is the possibility that SLR beam damage GLI optics.
Considering GLI restriction, ADEOS-II SLR restriction area is shown below.

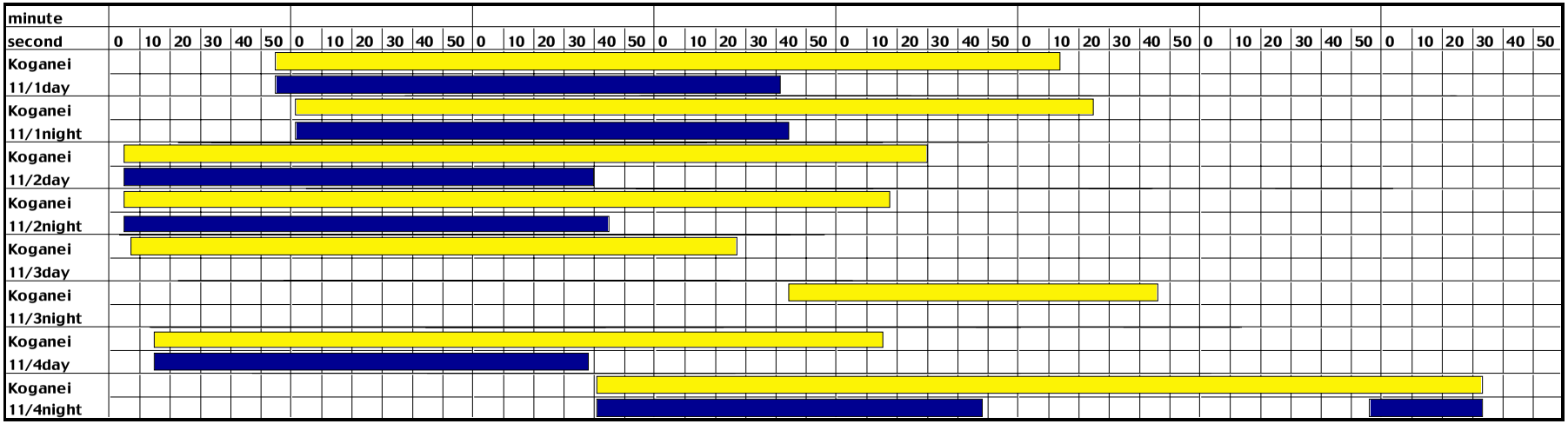




Analysis result of satellite visibility analysis

Variation of satellite(LRRA) visibility

Station visibility becomes short or extinct



ADEOS-II SLR tracking plan

NASDA would like to propose the following operation plan

- *Launch Phase:*

40 days tracking campaign after launch
(GLI is under safety mode avoiding any signal through its aperture.)

- *Routine Phase:*

After launch phase, GLI will starts its observation and switch over to the routine operation through the mission check out.
All station must be suspended laser ranging to the ADEOS-II from this phase, and also NASDA will interrupt deliver IRV set to the station at once.

If we need more SLR data in routine phase, we request to the specified station as an partial campaign. We under examine a method for concrete operation.

ICESat Status

- Laser altimetry to detect changes in polar ice sheets; land mapping and atmospheric science
- Geoscience Laser Altimeter (GLAS) testing at Goddard:
  - Acoustic complete (early April)
  - Vibration complete (mid-April)
  - Thermal/vacuum (May)
  - Ship to Ball Aerospace (June)
  - Laser/telescope boresight shifts have been concern (backup alignment mechanism being considered for inclusion)
- At Ball Aerospace, GLAS will be mounted to spacecraft bus, with additional testing of the observatory (GLAS + bus)
- Launch from Vandenberg on Delta-2 in December, 2002

ICESat Operations

- Two BlackJack GPS receivers
- GFO-like LRA
- First 6 months after launch
  - First month: spacecraft commissioning
  - Second month: GLAS commissioning
  - 120 days+ for verification, calibration and validation
  - Intense SLR tracking essential to validate the orbit determination accuracy
- After initial 6 months, normal SLR tracking
- Ground track repeat requires approximately weekly maneuvers
- CSR in collaboration with HTSI will provide tracking predicts

PLAN FOR THE
2001 ILRS ANNUAL REPORT

- **Be Concise**
- **One Version for Paper and Web Reports**
- **Liberal use of Web Site Links and References**
- **Fast Turnaround**
- **Focus on Progress during the Year and Future Plans**
- **Contributions due May 31, 2002**

2001 ILRS Annual Report
Table of Contents

Section 7 – Analysis Center Reports (R. Noomen)

7.1 Satellite Laser Ranging (Peter Dunn)
- 7.1.1 Analysis Centers
  - 7.1.1.1 Center for Space Research (Richard Eanes) — 2 pages
  - 7.1.1.2 Delft Analysis Center (Ron Noomen) — 2 pages
  - 7.1.1.3 Mission Control Center (Vladimir Glotov) — 2 pages
- 7.1.3 Associate Analysis Center (as submitted) — 1 pages each

7.2 Lunar Laser Ranging (Peter Shelus)
- 7.2.1 Analysis Centers
- 7.2.1.1 Paris Observatory (Jean Chapront) — 2 pages
- 7.2.1.2 FESG/TUM (Jurgen Muller) — 2 pages
- 7.2.1.3 Jet Propulsion Lab (James Williams) — 2 pages
- 7.2.1.4 University of Texas (Judit Ries) — 2 pages

Data Products Provided, Current Activities, Future Plans

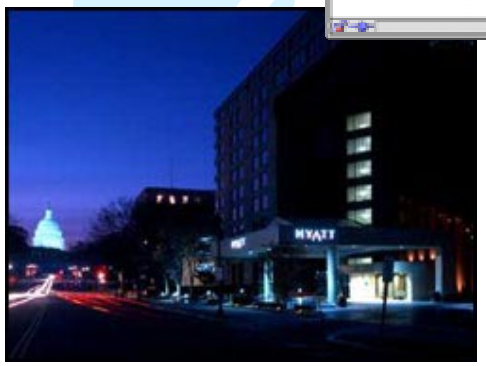
Section 8 – ILRS Information (Van Husson and Carey Noll)

ILRS Terms of Reference
ILRS Website Reference Card
ILRS Components
ILRS Participating Institutions
ILRS Associates
List of Acronyms
Use links to existing web pages

13th Workshop on Laser Ranging

"Toward Millimeter Accuracy"

- Hyatt Regency Capital Hill, Washington, D.C.
- October 07-11, 2002
- http://cddisa.gsfc.nasa.gov/lw13
- Program Committee:
  - Giuseppe Bianco, ASI
  - John Degnan, NASA GSFC
  - Yang Fumin, Shanghai Observatory/Academia Sinica
  - Ben Greene, EOS Pty. Ltd
  - Werner Gurtner, AIUB
  - Hiroo Kunimori, CRL
  - Ron Noomen, TU Delft
  - Michael Pearlman, Harvard-Smithsonian
  - Ulrich Schreiber, TU Munich
  - Peter Shelus, U. of Texas
  - Suriya Tatevian, RSA
- Local Organizers:
  - John Degnan
  - Mike Pearlman
  - Carey Noll



Program Topics

- Overview of Space Geodesy Techniques
- Scientific Achievements, Applications, and Future Requirements
- Lunar Laser Ranging
- Improved or Upgraded Systems
- Station Performance Evaluation
- Station Operational Issues
- Target Design, Signatures, and Biases
- Timing Devices (G. Kirchner and V. Vassiliev)
- Calibration
- Atmospheric Correction and Multiwavelength Ranging
- Detectors and Optical Chain Components
- Laser Technology Development
- Automation and Control Systems
- Advanced Systems and Techniques
- New Ranging Systems Applications