ILRS Governing Board Action Items

(December 2004)

1. CB will contact missions such as TOPEX, Envisat, GP-B etc. to remind them that we need recognition in their publications.
   - Messages sent on 4/8 to TOPEX, Envisat, ERS-2, Jason, GFO-1, GP-B, Champ, GRACE, GLONASS, and Meteor-3M
2. CB will contact the IAG Outreach to suggest that the IAG make its participants aware of the issue of service recognition issue in publications, papers, reports, and presentations.
   - IGS, IVS, ILRS, and IDS are working on a joint activity to:
     - Develop a common citation and post it with a notice on their web sites and on their data and product ftp sites
     - Jointly request that the IAG take positive action (website notice, messages to the community, etc) to activate its community
     - Consider contacting relevant journals and journal referees to help enforce this citation
3. CB will contact key TOPEX people to see if we can get an acknowledgement of this new role. (Done)
   - Acknowledgement received from Dr. Lee Fu/JPL on 3/18

ILRS Governing Board Action Items

(December 2004, continued)

4. CB will draft a term limits provision for WG Chairs for GB review. (Done)
   - Change drafted and approved on 3/22
5. If we do not hear anything by mid-January, the CB will send a note to Drs. Shargorodsky and Vasiliev.
   - Draft agreement received; to be reviewed at the GB meeting in Vienna
   - Satellites being designed and built now
6. Noll will contact the ACs, AACs, and stations requesting an email address for SLReport. (Done)
   - Noll contacted ACs and AACs
   - Seemueller added requested email addresses to SLReport mailing list
7. CB will check if the local ties have been measured for the Riyadh and Changchun SLR stations.
   - Noll contacted both stations; plans underway to perform survey in futur

ILRS Governing Board Action Items

(December 2004, continued)

8. Gurtner will look at the existing list of data problems (previously maintained by V. Husson) on the ILRS website and see if the webpage can be re-activated and updated on a regular basis.
9. CB will contact DGFI (backup combination center) and ask if they are willing to review problems identified by the individual AC solutions and do the follow-up with the stations.
   - Further discussion required at April AWG meeting to clarify task
10. CB will issue a message to the stations requesting that they try the prediction data sets generated by mission or mission specific providers. (Done)
    - Noll sent email to ILRS stations exploder on 3/18
11. CB will examine the idea of issuing a call for a volunteer on the dynamic priorities.
12. CB will bring to closure the recommendation on the Galileo request for tracking support. (Done)
    - GB approval sent 2/21 to Galileo mission contacts

ILRS Governing Board Action Items

(December 2004, continued)

13. CB will send a letter broaching the retroreflector issues with the GPS project. (Done)
    - Letter sent to Michael Shaw/DoT on 2/21, but no response yet
    - Some rumors that retro will be included; we need to get an update on the design
14. Appleby will provide web pages on the spacecraft center-of-mass characterizations to Noll for the ILRS website and prepare an SLRMail message to announce the new pages and request inputs for missing areas. (Done)
    - Appleby and Torrence provided additions to ILRS website
    - Noll installed pages and modifications on ILRS website and notified community, requesting review, update, additions
    - Fill in the holes (M. Torrence and G. Appleby)
15. Appleby will send an email to each of the ILRS WG chairs asking for hot topics for the fall 2005 workshop. (Done)
    - Inquiry sent out on 1/28

ILRS Governing Board Action Items

(December 2004, continued)

16. Resolution of OCTL/JPL application for ILRS network station. (Done)
    - Approved by the GB on 3/22
17. SLR Restricted Tracking (Randy Ricklefs)
    - Go-No Go Flag
      - Implemented at Zimmerwald and MLRS
      - In process at Graz and HTSI
      - New field to be added to the file for consitency with the new segment file format
    - Segment file
      - Implemented at Zimmerwald, Graz, and MLRS
      - In process at HTSI
    - Should be ready for discussions on ALOS at EGU.

Shenzhou 6 Spacecraft

- China's second manned space mission
- Launch in September-October, 2005
- **May** carry laser retroreflector
  - For spacecraft tracking
  - Developed by Shanghai Astronomical Observatory
  - May have also flown on Shenzhou 4 orbital module
  - 20 cm diameter, <1 kg
- Morris Jones (science writer in Sydney) has contacted several ILRS stations about supporting tracking the mission to verify presence of reflector
- Yang Fumin says retro-carrying Chinese spacecraft are in planning for sea and gravity research, navigation, etc. but nothing in the near future
- Web resources:
  - http://www.spacedaily.com/news/china-05zp.html
  - http://center.shao.ac.cn/Laser.htm

Status of the NASA SLR Network

David L. Carter

NASA Goddard Space Flight Center

Presented at the ILRS Governing Board Meeting

Vienna, Austria

April 26, 2004

NASA SLR Reductions (2004)

- FROM LASER WORKSHOP PRESENTATION:
  - Reduced SLR network infrastructure
  - Removed NASA provided operator trainer in Tahiti
  - Reduced MOBLAS-7 (Greenbelt) & MLRS (Texas) sites to single shift operations
  - Reduced MOBLAS-4 (Monument Peak) site to 3 shifts operations (5 days per week)
  - Closed TLRS-3 (Arequipa) in February 2004
  - Closed HOLLAS (Hawaii) site in June 2004

TLRS-3 - Arequipa

- Site currently closed
- Plan to re-open site in August 2005
- Agreement between NASA/UNSA signed
- Negotiating contract for SLR operations
- TLRS-3 will have two-shift operations

TLRS-4 - Greenbelt

- Hawaii site currently closed
- Plan to re-open site in November 2005
- Restoring TLRS-4 to operational status
- TLRS-4 will be shipped to Hawaii
- TLRS-4 will have two-shift operations

NASA SLR2000 STATUS

Upgraded receiver optics installed and aligned. Laser beam expander and receiver FOV hardware interface issues have been solved and will be implemented shortly. Original detector replaced – it appeared to have degraded.

Point-ahead software and Risley Prism control installed, checked out visually with camera and sunlit satellites, and now in regular operation.

Software to automate the rest of the transceiver optics is in development and will continue throughout the next several months.

A new optical alignment was developed to boresight the transmit with the receiver FOV using photon counting techniques on stars in the receiver. The detector quadrants are now receiving signal counts more uniformly.

Preliminary successes at closing the tracking loop using the quadrant detector on LEO satellites achieved. Some problems still to solve but dramatic increase in return signal strength seen when beam is centered on satellite.

LAGEOS and higher altitude satellite tracking remains to be demonstrated. Work in months ahead will be toward this goal as well as toward operational quality range data and achieving semi-automated operations.

Summary

- NASA committed to continue SLR operations
- Restoring operations in Hawaii & Peru
- Continuing SLR2000 Prototype development
- Developing plans for SLR2000 Prototype replication

ILRS/AWG “pos+eop” status

R. Noomen

operational product:

- since November 2003
- weekly analyses, providing weekly station coordinates and daily EOPs (x&y-pole, LOD)
- LAGEOS-1 & 2 plus Etalon-1 & 2
- 5 individual solutions (ASI, DGFI, GFZ, JCET, NSGF)
- 4 different software packages
- 2 combination solutions (ASI, DGFI)
- official ILRS product since June 2004
- available on Wednesday of each week

ILRS/AWG contribution to ITRF2004 (1)

- procedure identical to operational product
- October 25, 1992 – December 31, 2003 (+ operational)
- statistics:

  wrms x/y-pole ~ 0.25 mas LOD ~ 0.04 ms

  3D wrms station coordinates wrt ITRF2000 ~ 10 mm

  translation parameters ILRSA, ILRSB consistent at < 1 mm

  mean translation offset wrt ITRF2000 ~ 0 TY?

  annual amplitude and phase translation parameters consistent

  accuracy TX, TY ~ 2 mm accuracy TZ ~ 5 mm accuracy SC ~ 0.3 ppb
- problems:

  inconsistencies in point referencing

  editing/handling poor solutions individual stations

  systematics in historic data

  convergence individual arcs
- May 31 deadline

ILRS/AWG contribution to ITRF2004 (2)

- September 1983 – October 1992
- May 1976 (earlier?) – September 1983 ?
- ITRF2005 ?
- LAGEOS-1 only
- 28-day intervals, 4-day EOPs

New Products: Orbits

- SP3 format
- test dataset:

  LAGEOS-1

  4 1-week periods

- coordinating committee: Gurtner, Ries, Luceri, Mueller, Koenig

Report on DF&P WG Meeting, Tuesday, April 26, 2005, 10:30-12:00

1. Review of CB Activities by Carey Noll (details will be included in minutes of the DF&P WG Meeting)

She reported about

- Network Items
  - EUROLAS
  - WPTLN
  - NASA

- Data Issues
  - Data reporting
  - CDDIS modified SLR data archive structure
  - (Additional remark by Wolfgang Seemüller: EDC installed the same structure (the old structure is still available, the new structure still not complete – SLRMAIL will follow when ready))

- Operations
  - Predictions
  - Low elevation tracking
  - Developing policy for restricted tracking missions
  - Dynamic priorities

- Site Surveys
- Mission Items
- Reports
- Meetings
- Other Items
  - INDIGO (see website indigo.nasa.gov)

2. Refraction Study Group by Stefan Riepl (not attending, sent his report by email)

Two papers were published in Geophysical Research Letters with the titles
"High-accuracy zenith delay prediction at optical wavelengths"
and
"Improved Mapping Functions for Atmospheric Refraction Correction in SLR"

Further work

- anomalous dispersion phenomena (group velocity concept for wavelength near absorption lines)
- modelling of horizontal refractivity gradients by use of numerical weather prediction data

3. Prediction Format Study Group by Randy Ricklefs, reported by Peter Shelus

Successful tests with the new format have been done by MLRS (40 passes to 12 satellites) and Zimmerwald, the tests to other satellites will follow. Still open is the content of velocities, and to include the time bias functions.

4. Restricted Tracking

A short report was given by Werner Gurtner (see also later on the agenda of GB meeting)

5. Draft Agenda for Herstmonceux 2005 Laser Workshop

Two issues are proposed:

- Refraction issues (especially on dispersion)
- The new prediction format (information of the SLR station people about the new format, application, etc.)

Mission Working Group Meeting Report To GB
Vienna , Austria 12:00-13:30 April 25, 2005
by H.Kunimori,

1 Participants:

Hiroo Kunimori	NICT
Mike Pearlman	CfA
Carey Noll	NASA GSFC
Wener Gurtner	AIUB
Scott Wetzel	NASA-GSFC HTSI
Julie Horvath	NASA-GSFC HTSI
David Carter	NASA-GSFC
Peter Shelus	UT/CSR
Ron Noomen	DEOS
Ulrich Schriber	FESG-TUM
Matt Wilkinson	NERC SGC
Graham Appleby	NERC SGC
David E Smith	NASA/GSFC
Martin Zwber	MIT
John C. Rie	UT/CSR
Ramesh Govind	Geoscience Australia

1 Events and Action items since San Fernando
June 2004
Cryosat mission support request reviewed and recommendation to GB and approved.
Correspondance about trasponder mission of LRO
Correspondance about GOCE mission
August -October 2004
Discussion about restricted laser tracking (Drafted)
New MWG coordinator: Hiroo Kunimori (NICT) and Deputy coordinator:
Peter Shelus (University of Texas) assigned by GB

January 2005
Galileo mission support request recommendation to GB and approved.
April 2005
Mission Request Form of ANDE arrived and
Mission Request Form of OICETS arrived.

2 Mission status updates
1) ALOS status was presented by Hiroo Kunimori.
Launch date between in September 2005.
Restricted laser tracking procedure of JAXA has been updated according to ILRS guildline. Detailed test procedure shall be published as soon as possible towards rehaearsal currently scheduled in June. The idea of qualification test such asusing saturated receiver to see just laser fire timing control and periodically check of GO/NOGO keys were given and the letter about liablity issues suggested in a session followed by MRG about restriced laser tracking.

2) ICESAT mission status was presented by Peter Shelus.
At present 7 dedicated stations are in operation with satifactory results.
Safe operation by Elevation cut-off and by GO/NOGO keys.
SLR data coincedent well to GPS determined orbit in a 1-2 cm level.

Medium term notification method was discussed when laser altimetry on board is off.

3) OICETS mission was presented by Hiroo Kunimori.
Optical Communication experimental satellite
Launch date is in Summer 2005.
Discussion on SLR role was made since requirement of POD is moderate.
and the maximum use of R&RR and visible optical tracking support is to be organized further.

4) LRO mission was updated by Dave Smith.
The system design with a sub-kg Laser Diode/FiberOptics package introduced.
The program is not approved yet.

N. & E. Working Group

Status

Why is there no N&E WG meeting at the EGU 2005?

... because there are no engineers left at this meeting!

... because there are no engineers left at this meeting!

(This is a statement essentially for all services!!!)

Possible Conclusions:

- There are no more projects within the reach of the observatories
- Everything is perfect at the observatories
- We are lacking longterm (technological) visions
- ... it may be well worthwhile to think about our position

Current N&E WG projects are:

- Engineering Data File (EDF)

- Progressive Automation (this has just as many aspects as participating stations -> no joint effort)
- Restricted Tracking (however this is more a project for a limited group rather than a full Working Group issue)
- High Rep.Rate tracking (Graz! not much else)
- Multicolor!? (Where are we on this really?)

SLR Engineering Data Files (EDF)

EDF Description
Documentation
Examples
Potsdam implementation
Notes
EDF utilities
Validate EDF
Validate pass EDF
Downloads
EDF creation support package
Koetzing presentation
Potsdam EDF scripts
Graz EDF implementation
External links
EDF proposal
EDF documents

News

November 9, 2004 Pass EDF XML schema and validator prototype implemented.

October 20, 2004 EDF database and hardware registry is designed using RDBMS Firebird 1.5 as a backend.

July 9, 2004 Graz EDF implementation is available in the download section

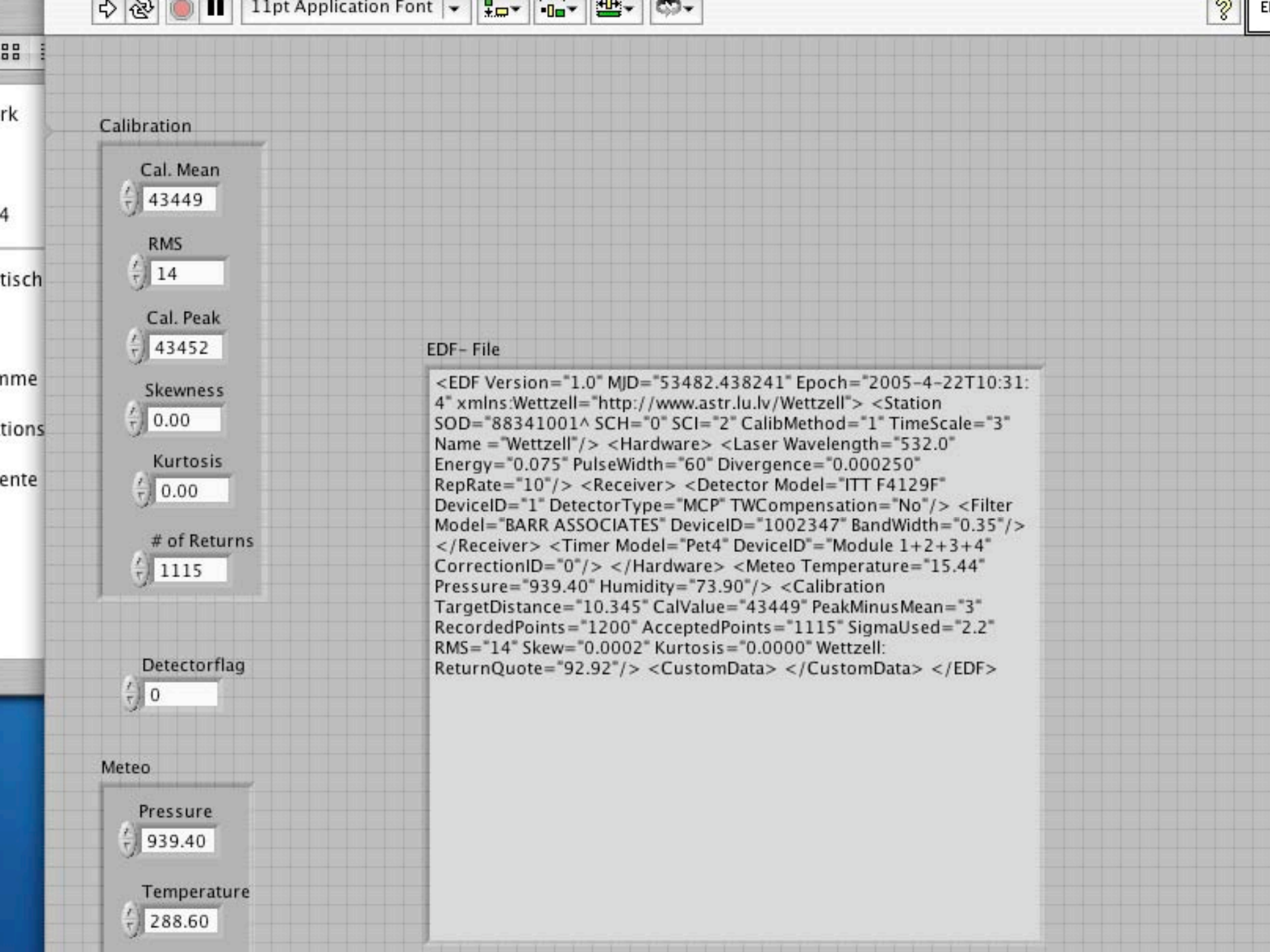
July 6, 2004 FTP site for the EDF is started.

EDF

EDF's are intended as an additional SLR data product containing a snapshot of the SLR station parameters which currently are not recorded in the Normal Points or published otherwise. The purpose of the EDF are described in more the details at the ILRS website and discussed at the workshops, see ILRS documentation . EDF uses XML based format which is defined with the W3C XML Schema, available in the download section. The data required to form an EDF can be divided in the three groups: required parameters, optional parameters and station custom data. The brief overview of the data, necessary to create EDF, is presented in the table below. Optional parameters are defined in the schema, but their use is up to the station.

EDF content overview

Item	Required data	Optional data
EDF epoch	Calibration epoch	
Station data	Name, SOD, System change indicator (SCH), System Configuration Index (SCI), **calibration method, timescale used** (Name is just a station name, all other parameter values are defined by the ILRS)	
Laser	Wavelength (nm), pulse width (ps), energy (mJ)	Repetition rate (Hz), number of semitrain


11pt Application Font
Calibration
Cal. Mean
43449
RMS
14
Cal. Peak
43452
Skewness
0.00
Kurtosis
0.00
# of Returns
1115
EDF- File
<EDF Version="1.0" MJD="53482.438241" Epoch="2005-4-22T10:31:
4" xmlns:Wettzell="http://www.astr.lu.lv/Wettzell"> <Station
SOD="88341001^ SCH="0" SCI="2" CalibMethod="1" TimeScale="3"
Name ="Wettzell"/> <Hardware> <Laser Wavelength="532.0"
Energy="0.075" PulseWidth="60" Divergence="0.000250"
RepRate="10"/> <Receiver> <Detector Model="ITT F4129F"
DeviceID="1" DetectorType="MCP" TWCompensation="No"/> <Filter
Model="BARR ASSOCIATES" DeviceID="1002347" BandWidth="0.35"/>
</Receiver> <Timer Model="Pet4" DeviceID"="Module 1+2+3+4"
CorrectionID="0"/> </Hardware> <Meteo Temperature="15.44"
Pressure="939.40" Humidity="73.90"/> <Calibration
TargetDistance="10.345" CalValue="43449" PeakMinusMean="3"
RecordedPoints="1200" AcceptedPoints="1115" SigmaUsed="2.2"
RMS="14" Skew="0.0002" Kurtosis="0.0000" Wettzell:
ReturnQuote="92.92"/> <CustomData> </CustomData> </EDF>
Detectorflag
0
Meteo
Pressure
939.40
Temperature
288.60

Summary

Things are not quite as bad as it seems:

Great progress was achieved during the past meetings in: London, Florence, (Toulouse), Herstmonceux, Graz and Wettzell

Further meetings are in preparation: Eastbourne...

However, we need a viable future vision: **Where do we want to be 10 years from now?**

ILRS Governing Board Meeting
Tuesday 26th April 2005
Signal Processing ad-hoc WG

Graham Appleby/Toshi Otsubo

- Area of work:
  - Making available via ILRS website information to enable laser CoM corrections for all past, present and future missions.
- Current status:
  - Website operational, with vector information available for most missions (thanks to Carey Noll for implementation). Input from the community following ‘launch’ was very useful.
  - Need some more info, e.g. GRACE

Specifics

- Primary geodetic satellites:
  - LAGEOS. From work by Otsubo & Appleby (2003), CoM correction in range 244 – 256mm.
  - For single photon station, very accurate CoM value can be computed (e.g. 245mm for Herstmonceux)
  - For MCP systems, 251mm is a good approximation, but we have to be aware that variation of _4mm is possible depending on given station hardware.
  - For C-SPAD systems, varying return energy (no. of photons) directly influences appropriate value of CoM. Values in range 245-252.

LAGEOS CoM (cont)

- Primary MCP systems – 7080, 7090, 7105, 7110, 7501, 7836, 7941, 8834
- Single photon system – 7840
- Primary C-SPAD systems – 7237, 7810, 7825, 7832, 7837, 7839, 7841
- Further work using FR data (e.g. Wilkinson *et al)* may help discriminate the C-SPAD systems and tighten up the possible range of CoM values.

ETALON CoM

- In principle, CoM values in range 560 – 605mm, with single-photon (7840) at 565mm.
- However, low return energy for most stations, so standard value of 576 _ 4mm is a reasonable estimate.

Conclusion

- For primary stations, use a-priori CoM values for LAGEOS and ETALON as above, but also solve for constrained RB values (few mm);
- For other stations, use standard CoM values and solve for RB as at present.

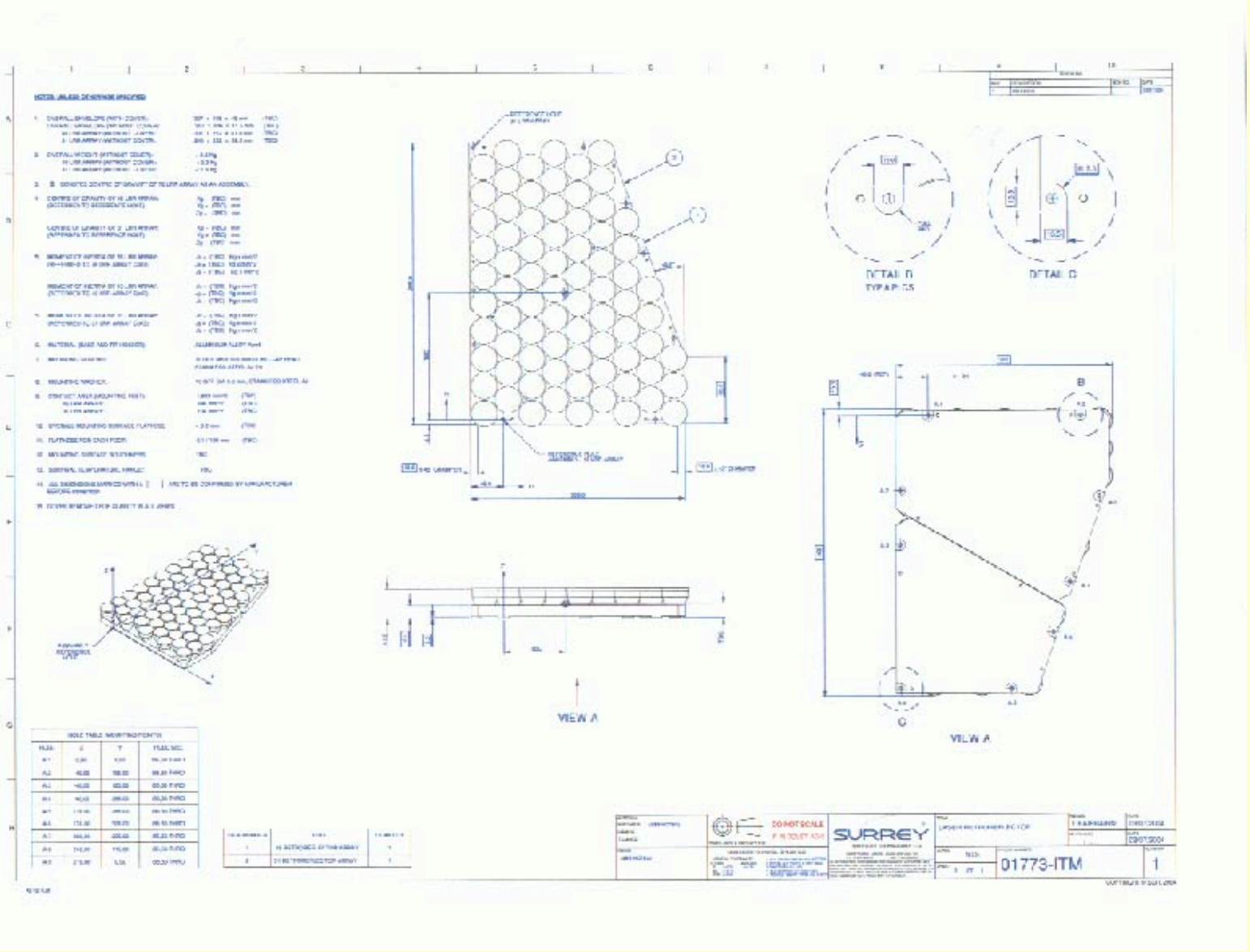
GALILEO Arrays

- Received from ESA information on the two Galileo System Test Bed missions, (at least one) due for launch in late 2005:
- **GSTB V2/A** (SSTL, UK). 76 coated cubes, 27mm face diameter, in array 30x40 cm. We have xyz wrt a marker on the array base, but nothing wrt S/C CoM.

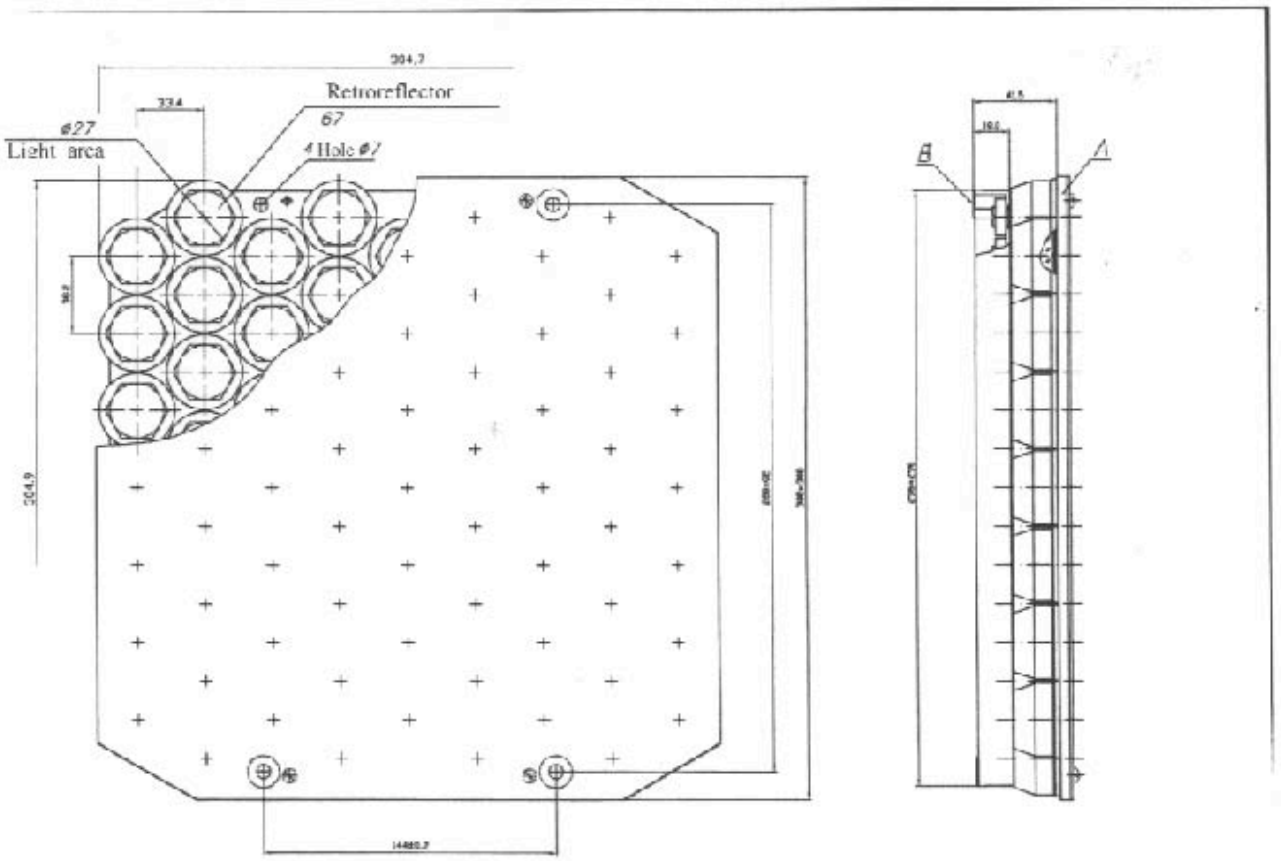
- **GSTB V2/B** (GAIN). 67 coated cubes in array 30x30 cm. No xyz info yet.

- **GALILEO.** 27 vehicles, maybe including one of above. Probably >100 cubes: ESA want cubes surface area >660 cm^2.

GSTBV2/A (SSTL) array



GSTBV2/B (GAIN) array



GSTBV2-1F-GAIN-0508 Draft 23-2-04

Transponder Working Group?

Motivation

- Significant Link Budget Improvement: $1/R^4$ -> $1/R^2$
- Missions become more and more specialized:
  Lunar Orbiter, T2L2, Transponder on the Moon?
- Corner Cubes are heavy and some satellites do not provide the Real Estate for CCR panels with comfortable link margins (Galileo).
- Testbed activities (as a spin-off from altimeter studies)
- New Prediction Format
- Interplanetary Ranging activities

Goals

- Design of Transponder application scenarios
- Develop a concept (or more) that optimizes requirements on both ends: Spacecraft + Observatories
- Questions to be answered among others are:

  What type of Lasers (wavelength, rep. rates)?
  Telemetry Issues (downloading data, uploading missions)?
  Predictions (using the new format)?
  Asynchron, Synchron, One-way, Two-way, ...
  Satellite Clock Requirements, Delay stability, ...

Eventually fly a transponder on Galileo

Proposal:

Ad hoc Tranponder Working Group:

Jan McGarry	Interplanetary Mission
John Degnan	Interplanetary Mission
Ivan Prochazka	Altimetry
Yang Fumin	T2L2
Etienne Samain	T2L2
Dave Smith	LRO
Georg Kirchner	Hi Rep.Rate Lasers
Ulrich Schreiber	BELA (Selene II)
Randy Ricklefs	Predictions
Werner Gurtner	

The group would be open: However members are expected to contribute...

Russian Proposal on Novel Satellites (The Lunenberg Lens Revisited)

- We were approached at EGU in Nice in April 2004 by Drs. Shargorodsky and Vasiliev regarding IPIE interest in building and launching “novel” SLR satellites;
- The ILRS sent FSA a letter expressing interest and outlining the importance of these new satellites;
- The FSA is interested and has sent the ILRS a draft agreement that covers their commitment to build such satellites and our commitment to track them and provide access to the data;
- The agreement makes no more of a commitment from us than a normally make with any new mission;
- The agreement has to be cleaned up a bit and signed;
- Design of the satellite(s) is already underway to be ready of a early launch.

SCIENCE-TECHNICAL AGREEMENT
between
the Federal Space Agency of Russia
and
the International Laser Ranging Service

The Federal Space Agency of Russia (referred below as ROSKOSMOS), and the International Laser Ranging Service (referred below as ILRS) being a part of the of the International Association for Geodesy (IAG), referred together as Parties, following the will to develop cooperation in space research and of its use for peaceful purposes, within the area of high-precision satellite laser ranging, and

taking into account the importance of further increase of the measurement precision and limitations in the existing approaches, and therefore the need for a new conception to achieve this goal;

taking into account the appreciation by the international satellite laser ranging community of the minimum-target-error satellite conception proposed by IPIE, which may provide a breakthrough towards new frontiers of precision;

taking into account the extreme importance of millimeter- and submillimeter- accuracy satellite laser ranging for solving of fundamental and applied problems, including prediction of earthquakes;

agreed to cooperate in development of terrestrial and space-based means of satellite laser ranging, in the following directions.

Clause 1

ROSKOSMOS, within the Federal Space Program:

- will provide development, manufacturing and launching as a piggyback load of an IPIE-proposed spherical glass satellite based on the Luneberg lens concept;
- will provide, through the leading information collection and processing center MCC-M, quick delivery of ephemeris for tracking of the spherical glass satellite;
- will equip at least one of the Russian laser tracking stations in operation with upgraded measurement equipment;
- will take efforts to establish contacts between ILRS and other Russian SLR stations within this work.

Clause 2

ILRS, on request from the Russian Party, will provide tracking by its global SLR network, collection and exchange of data, and cooperation in their analysis and investigation; ILRS will also cooperate in evaluation of the satellite parameters during its spaceflight. The ILRS analysis centers will, together with the Russian analysis centers, work on data evaluation and on use of the data for scientific purposes.

Clause 3

Contact persons from Federal Space Agency of Russia are:

- V.V. Simonov, Head of Department, FSA
- Prof. V.D. Shargorodsky and Prof. V.P. Vasiliev, IPIE

Contact persons from ILRS are:

- Dr. Michael Perlman, Director of the ILRS Central Bureau
- Dr. Werner Gurtner, Chairman of the ILRS Governing Board

Clause 4

The Agreement is made in Russia and English. Both texts have equal force.

The Agreement takes force from the moment of its signing, and will remain in force till December 31, 2010, with automatic prolongation for subsequent 5-year-long periods, if any of the Parties does not notify the other Party on its intention to stop its action 6 months before the end of the corresponding period.

From ILRS

From FSA

From IPIE

International Laser Ranging Service

Orbits as ILRS Products

Werner Gurtner

ILRS Governing Board Meeting,
Vienna, April 26, 2005

Rational

- SLR-only precise orbits are generated for many satellites:
  - Lageos, Etalon, Stella/Starlette/Larets/…, Beacon/Topex/ERS-2/…, Glonass
  - Only Glonass orbits (MCC) publicly available in SP3 format (IGS project)
- Orbits can be used for
  - Comparison of analysis results between ACs
  - Calibration of other techniques (e.g., optical tracking)
  - Combination with other techniques
  - Long-term studies of physical parameters or phenomenae

Proposal

- Adopt SP3 as orbit exchange format
- Define necessary parameters for SP3 for the different satellites (codes, rates, …)
- Start with Lageos and Etalon from weekly analysis
- Encourage ACs to convert and publish all SLR-only orbits according to ILRS guidelines

International Laser Ranging Service

Data Quality Checks

Werner Gurtner

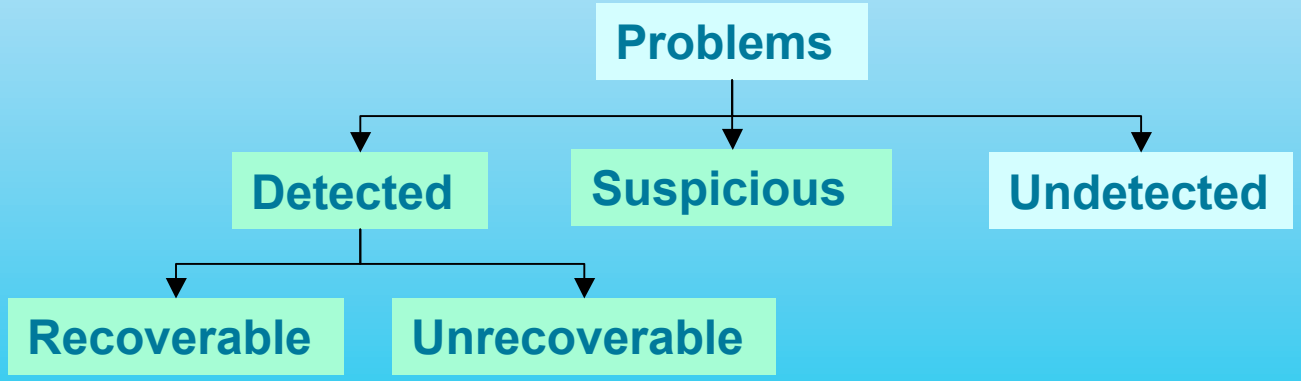
ILRS Governing Board Meeting,
Vienna, April 26, 2005

Goals

- Detect problems in ranging or auxiliary data as soon and as sensitively as possible
- Feedback to the stations for proper action
- Inform analysis centers of detected problems for proper action
- Combination products should be based on consistently-cleaned data
- Data problems should be archived for future use

Data Problems

- Range biases, time biases
- Noise as data, Normal points polluted with noise
- Wrong formats
- Uncalibrated or malfunctioning met sensors
- Wrong epochs, satellite identifiers
- …



Hierarchical Structure

- Central Bureau: Monitoring of parameters (2)
- Combination centers
  - Cross-comparison between individual analyses (eliminated stations, differences between stations)
- Analysis Centers
  - Weekly routine analysis
  - Special bias analysis (hourly, daily, weekly)
- Central Bureau: Monitoring of parameters (1)
- Data centers: Plausibility tests, format checks
- Station level: Plausibility tests, calibration, system monitoring

Current Status (1)

- Checks by stations: Inhomogeneous
- Checks by Data Centers: OK
- Checks by Central Bureau (VH): Stopped
- Hourly analysis by NERC: Done, feedback to stations
- Daily checks for GPS+Glonass by CODE
- Weekly bias analysis: 5 centers (one: daily), inhomogenous procedures, formats, and feedbacks
  → Weekly Combined Range Bias Report

Current Status (2)

- Weekly routine procedures: Problem detection and handling unclear
- Combination centers: Problem detection and handling unclear
- Monitoring by Central Bureau (VH): Stopped or reduced (quarterly charts stopped, one table added, no long-term monitoring)
- Archive: `slr_data_corrections.snx` stopped
- Compilation of station SLRMails continued

Problem Areas

- Most reported bias analyses are for Lageos 1 and 2 only
- Detected problems are not necessarily available to all interested parties
  Especially true for special missions (earth observing satellites, gravity field missions, …)
- No systematic and coordinated compilation of data problems
- Error detection becomes more difficult (and more important) with reduced number of stations

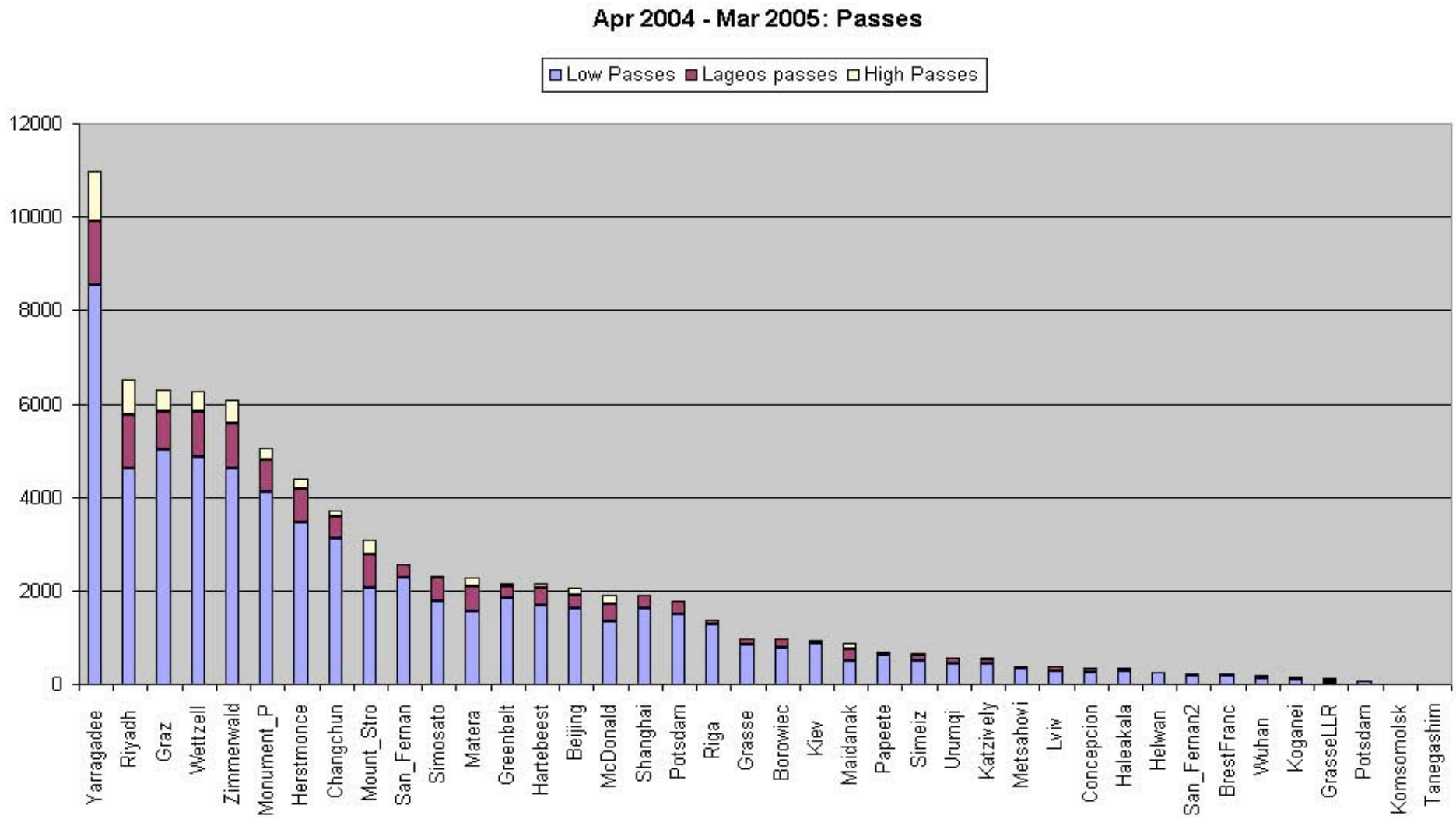
Proposal

- Look for an institution to
  - Collect reported/identified problems in range data and auxiliary data
  - Coordinate between analysis centers to flag data with error type (e.g., range bias, time bias) and level (“suspicious” or “bad”) or size
  - Organize feed back to stations
  - Compile data problem archive
- Candidates: Combination centers
  - Do analysis themselves
  - Get all analyses from the other ACs
  - Are responsible to generate the best possible ILRS product → Motivation

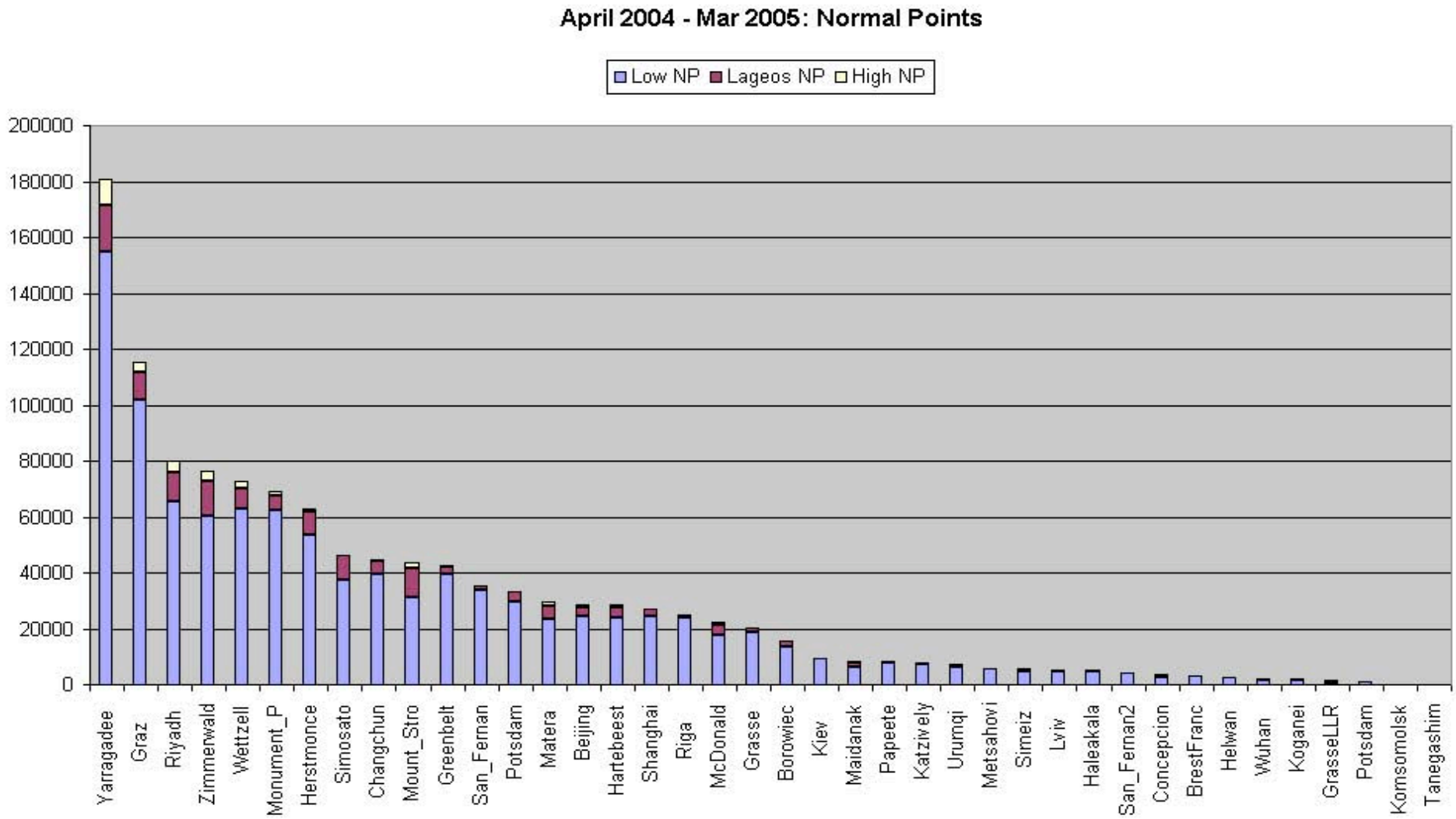
Performance Charts

- Quarterly performance charts should again be generated, based on the existing performance tables

International Laser Ranging Service



International Laser Ranging Service



International Laser Ranging Service

Restricted Tracking

Werner Gurtner

ILRS Governing Board Meeting,
Vienna, April 26, 2005

Restricted Tracking

- Vulnerable satellites
  - Sensitive sensors, damage by laser light possible
  - ICESat, ALOS
- Limited visibility of corner cubes
  - GP-B

Main Elements

- Maximum Elevation
  - Fixed nadir pointing
- Pass segment list
  - Start and stop times of pass segments
  - More than one per pass possible
  - Must be processed automatically
- Go-nogo flag
  - File residing at sponsor's server
  - Mainly contains flag "go" or "nogo"
  - Checked by station immediately prior to tracking and repeatedly during tracking if requested
  - "nogo" or no connection: No tracking

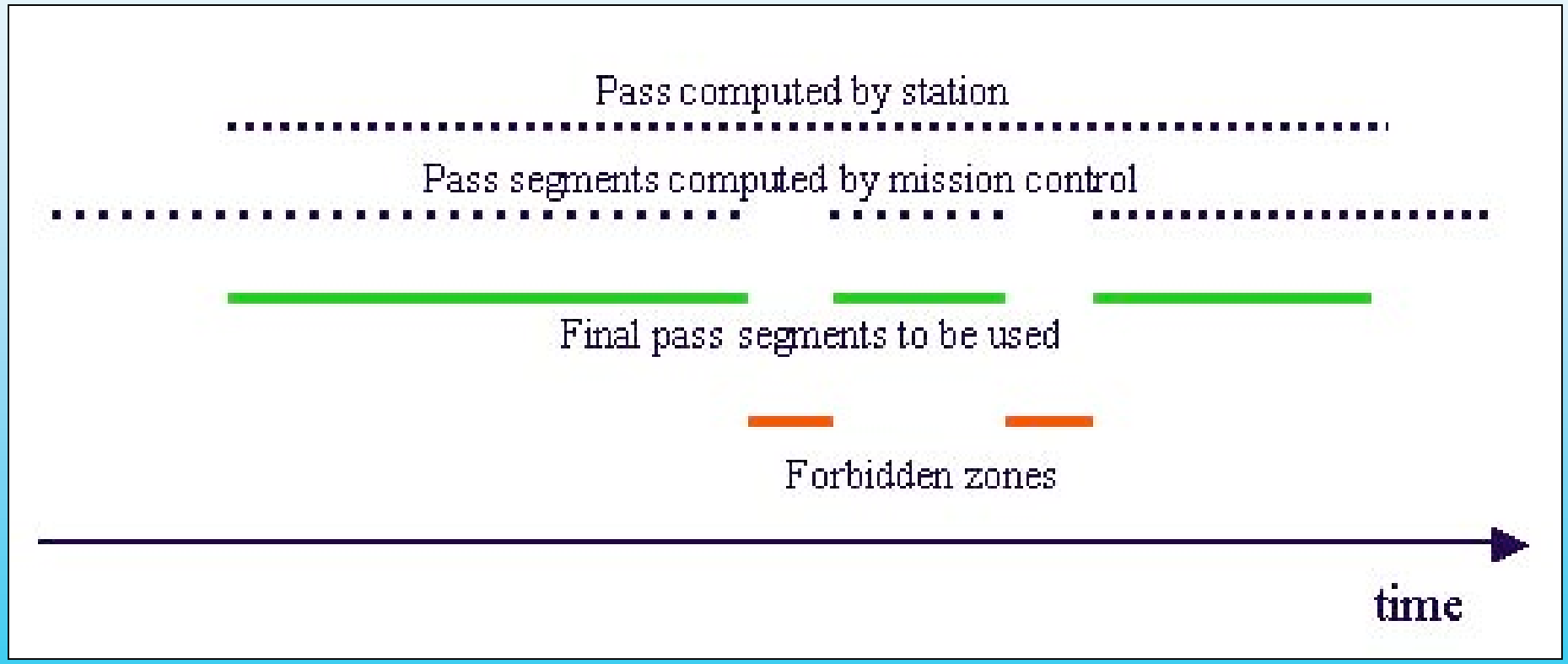
Pass Segment List

Proposal (new):

```
-------------------------------------------------------------------------
                                Start Date/Time      End Date/Time  MaxEl Dur
ID      SAT      COSPAR  SIC         [UTC]               [UTC]       [deg][min]
---- ---------- ------- ---- ------------------- ------------------- -- -----
1824 GP-B       0401401 8603 2005-03-12 08:02:24 2005-03-12 08:08:00 15   5.6
1824 GP-B       0401401 8603 2005-03-12 09:40:29 2005-03-12 09:47:21 71   6.9

                                    ...
```

Pass Computation



Go-Nogo File

Proposal (new):

Satellite	Cospar	SIC	Interv	Flag
ICESAT	0300201	8201	5	go

Other elements of agreement

- Use prediction set of mission sponsor, only
- Acceptance Tests
  - Description of procedures used to assure proper tracking
  - Test campaign with substitute satellite
  - Dry runs on “hot” satellite
  - Verification using full-rate data

Liability: Agreement

- Station
  - Best effort tracking
  - Start of tracking after acceptance only
  - Termination: Six months notice or “as funding constraints dictate”
- Mission sponsor
  - No claims against stations etc for damages
  - Insurances by sponsor if necessary at no costs for stations etc
- Disputes are resolved “jointly”

International Laser Ranging Service

Galileo Geodesy Service Provider GGSP

Werner Gurtner

ILRS Governing Board Meeting,
Vienna, April 26, 2005

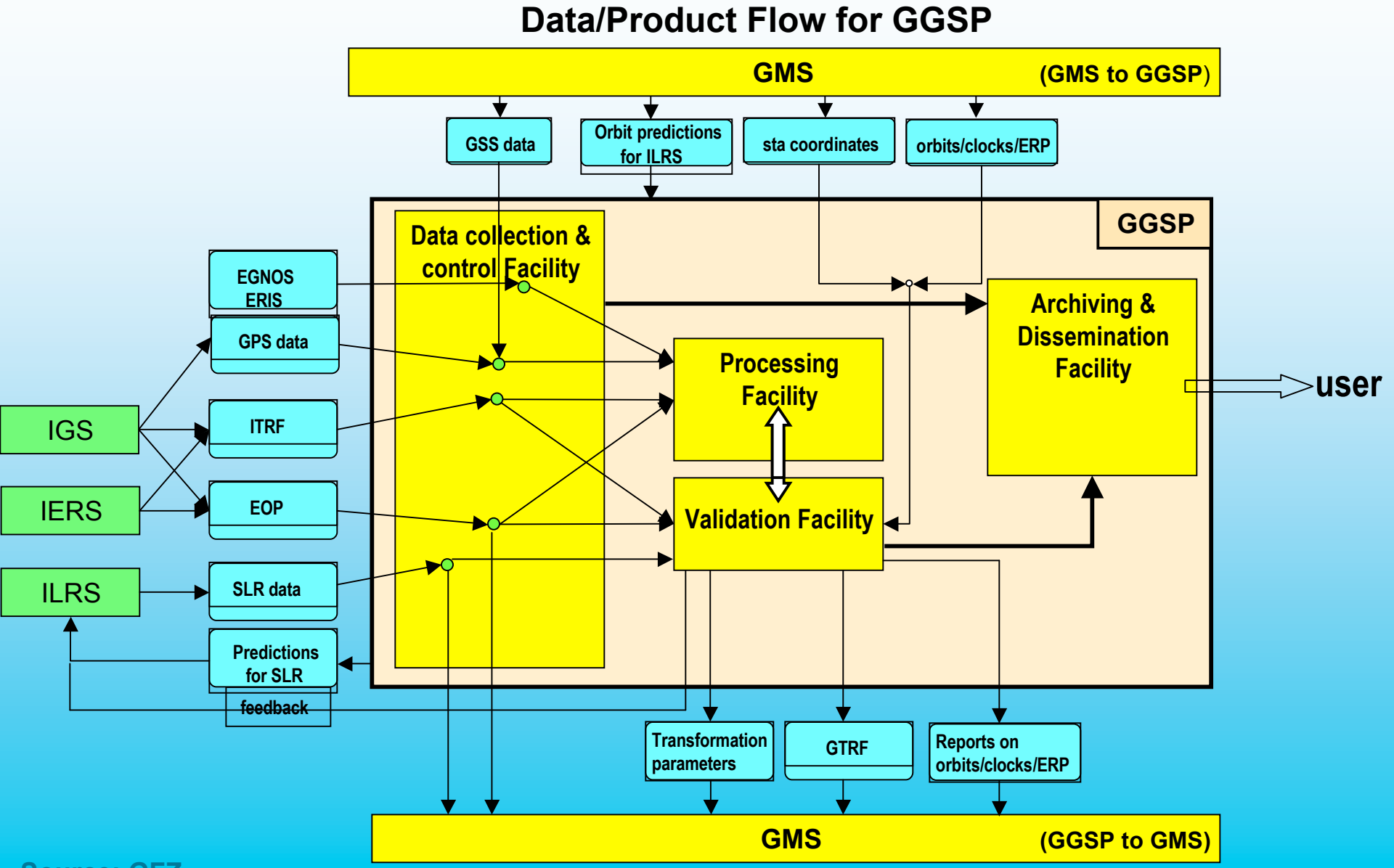
GGSP: Contributors

GFZ	(Germany)
AIUB	(Switzerland)
ESOC	(ESA)
IGN	(France)
BKG	(Germany)
Univ. Wuhan	(China)
NRCan	(Canada)

GGSP Tasks

- Provides the Galileo Terrestrial Reference Frame to the Galileo Mission Segment (GMS)
- Provides the necessary links between GMS and the Geodetic Services (IGS, ILRS, IERS)
- Generates products for the advanced geodetic user community
- Promotion, outreach, standardization

GGSP Architecture



Source: GFZ

Tasks related to ILRS

- Forward satellite predictions to ILRS
  GMS → GGSP → ILRS

- Forward SLR NP data to GMS
  ILRS → GGSP → GMS

GMS obviously will not have direct links to public Internet

Global Geodetic Observing System (GGOS)

Mission

- Ensure the collection, archiving and accessibility of all geodetic observations and models as well as the robustness of the estimated parameters in the three fields of geodesy (1) geometry and kinematics, (2) orientation and rotation, and (3) gravity field of the Earth.

- Emphasize the consistency between the different geodetic standards, models and products, and the maintenance of stable geometric and gravimetric reference frames.

- SLR is a key element for these objectives because it contributes to all three fields. Due to the very long observation and derived parameter series it guarantees the long-term stability more than any other geodetic technique.

Global Geodetic Observing System (GGOS) Structure (Status: 02 March 2005)

GGOS Highlights

- Activities underway to get GGOS integrated with several international science and political activities

- Meeting in Potsdam on March 1 & 2
- Slight reorganization of Working Groups
- GGOS website at: http://www.ggos.org/
- GGOS Session at IAG in Cairns in August 22 – 26
- GGOS definition phase to be completed by Cairns
- GGOS review by IAG at Cairns

Networks, Communications, and Infrastructure Working Group

- Task: “working with the IAG Measurement Services to develop a strategy for building, integrating, and maintaining the fundamental network of instrument and supporting infrastructure in a sustainable way to satisfy the long-term (10 – 20 years) requirements identified by the GGOS Science Council.”

- Early stops in this process:
  - quantify the “quality” of what the current networks are producing
  - settle on a strategy to design the geodetic network using our understanding of where we are, where the techniques are going, and what future scientific requirements we will be asked to support.

Members of the Working Group

- IVS: Chopo Ma, Zinovy Malkin
- IGS: Angie Moore, Norman Beck
- ILRS: Mike Pearlman, Werner Gurtner
- IDS: Pascal Willis
- IGFS: Rene Forsberg, Steve Kenyon
- Data Centers: Carey Noll
- ITRF and Local Survey: Zuheir Altamimi, Jinling Li
- Analysis: Erricos Pavlis, Marcus Rothacher
- Oceanography: Steve Nerem

How do we optimize the networks?

(Initial thoughts from a small meeting on March 29

- **In the absence of any definitive guidance yet from the GGOS Science Council we will look toward mm accuracies for relatively short time periods.**
- **No matter how well blessed we are in future budgets, we will be strapped for funds and must rely heavily on international cooperation and existing instruments, facilities, and infrastructure;**
- **Long time series of data is critical to the stability of the reference frames; stations that are well established and producing high quantity and high quality data should be maintained;**
- **Degradation of the reference frames may be slow as networks degrade; the "memory factor" may be strong;**
- **The best results will be achieved with collocation of techniques; ground surveys of collocated instruments must be well maintained;**
- **Using the most recent International Terrestrial and Celestial Reference Frames (ITRF, ICRF), examine the degradation of the reference frames and their products without each of the measurement techniques (one at a time); what contribution does each technique make?**

How do we optimize the networks?

(Initial thoughts from a small meeting on March 29

- **Instead of optimizing as a single network of all of the techniques; it may be more realistic to optimize each of the networks based on its strongest or unique contributions to the reference frames and the other required geodetic products.**

- **We need to decide what these critical contributions are from each network;**
  - **VLBI : Nutation, UT1, Polar Motion**
  - **SLR : Earth Center of Mass, Scale, POD on passive satellites, etc**
  - **GPS : Station position and motion; POD for LEO satellites, Navigation**
  - **DORIS – POD for DORIS satellites, ??**

- **Some and probably all of the networks are below their optimum number of stations, performance and optimum geographic distributions. Using real data, examine how the key products for each technique degrade as (1) the number of stations is decreased, particularly in regions that are already sparsely covered and (2) data yield per station is decreased (cut in half?). Are we near the "knee of the curve"?**

- **Develop simulations for each technique to study how the key products would improve as we add stations, move stations around, and improve capability. See if we can find the "knee of curve". We will need to model the errors and the data yield.**

Anticipated Technique Improvements

- **SLR**
  - **Better global distribution;**
  - **Kilohertz ranging**
  - **Autonomous operations**
  - **Improvements in control systems for better interleaving of satellites**
  - **Interstation scheduling to enhance satellite coverage**
  - **More compact retroreflector arrays to improve accuracy**
  - **Continuous data flow and more rapid availability of products**
  - **Transponder operations for terrestrial and extraterrestrial applications**
  - **Communications applications**
- **GPS**
  - **New satellites with GNSS signal**
  - **GLONAS and Galileo**
  - **Improved processing (to provide near real time orbits?)**
- **VLBI**
  - **Improve automation to overcome observation gaps**
  - **Improvements in the recorders**
  - **e-VLBI**
  - **Smaller antenna and fully digitized back-ends**
- **DORIS**
  - **G3 Beacons**
  - **Launch of additional satellites with DORIS tracking (eg Cryosat);**
  - **Dual channel tracking capability allowing a densification of the network**

ILRS Governing Board Meeting
Tuesday 26th April 2005
ILRS Fall 2005 Workshop

- Dates: Monday – Friday 3rd – 8th October 2005;
- Venue: Eastbourne, East Sussex, UK;
  - T&G Conference centre
  - Accommodation and full board ‘under one roof”
  - 10 miles from SGF Herstmonceux
- Website linked from front page of ILRS site

Outline Programme

- 5 days available;
  - Monday, WG meetings, in series
  - Tuesday – Thursday, full sessions;
    - Evening visit(s) to Herstmonceux
  - Friday, GB and ILRS GA.
- Draft programme for full sessions, to include:
  - Models and analysis
  - Hardware capabilities and limitations;
  - Calibration uncertainties;
  - Software applications
  - New procedures (e.g. prediction system)
- Working groups making suggestions for topics.
- SGF will produce discussion draft for comments by CB and GB by end July 2005.

NERC Space Geodesy Facility, Herstmonceux

NSGF Website

ILRS Fall 2005 Workshop

How to find us

Mainpage
Program
Instructions
Venue/Hotel Registration
Location: Eastbourne
Contact Us

Welcome to the ILRS Fall 2005 Workshop Website

Mainpage

Observations toward mm ACCURACY

For several years the ILRS has strived towards mm-level ranging systems. In truth we may obtain 1mm precision in our normal points, but we are well off the mark when it comes to 1 mm accuracy. The aim of the ILRS Fall 2005 Workshop is to encourage all stations to examine seriously their own systems, understand what happens for satellites and local targets for different energy levels and to help all stations develop software that produces a standard, user independent data set. The Workshop will also be an opportunity for further discussion on the level of accuracy of models to take account of satellite signature and atmospheric refraction delay.

The Workshop will take place in Eastbourne during the week beginning Monday 3rd October 2005. Eastbourne is situated on the coast of South East England and is about 10 kilometres from the Herstmonceux Facility. The Workshop venue is the T&G conference centre situated on the Eastbourne seafront, which will provide conference facilities and accommodation for delegates.

The Workshop theme is 'mm Accuracy' and will focus on the challenges facing Laser Ranging that limit the achievable accuracy in single-shot range measurements. The current draft program is availiable here. It is expected to include sessions on:

- Hardware capabilities;
- Satellite signatures;
- Calibration uncertainties;
- Software applications

as well as providing the opportunity for meetings of all the ILRS Working Groups and the Governing Board. An ILRS General Assembly will be held at the end of the Workshop.

Currently the ILRS Working Groups are discussing topics for inclusion in the sessions. It is likely that delegates will be asked to perform specific experiments in advance to contribute to some sessions. This will include performing High/Low return rate tests and supplying current reduction software for comparison. Descriptions of experiments requested for some sessions are to be found here.

The Workshop is open as a forum for all subjects that need to be discussed. To contribute to a session or to request an additional session topic click here.

The Workshop will incide a trip to visit the Space Geodesy Facility at Herstmonceux, which is situated in the grounds of Herstmonceux castle. Besides the laser ranging system, which is being upgraded to perform KHz ranging, the Facility hosts two IGS GPS/GLONASS receivers and will be in the early stages of running an FG5 absolute gravimeter which is to be permanently installed in a basement at the Facility.