Agenda for April 12 AWG meeting, TU Wien, 9:00 – 18:00

Agenda Items

- **Minutes of Grasse meeting: comments, corrections?**
- **ILRS News**
- **UAW Summary, Action Items and Recommendations** – **ECP**
  - **ILRS representatives present at UAW meeting:**
    - E. C. Pavlis, AWG overview on operations, products, future plans
    - V. Luceri, Analysis procedures review, bias estimation, etc.
    - C. Sciarretta, Combination procedures review, SLR_TRF, Orbits, etc.
    - G. Appleby, Range modeling improvements, CoM, calibrations, etc.
    - Horst Müller, Station performance monitoring, qualifying, feedback…
    - Jürgen Müller LLR overview, status, science, products, future…
      - Michael Pearlman, Werner Gurtner, Pippo Bianco

- **BRIEF AC and CC Reports with emphasis on the 2003 IERS Conventions implementation in their s/w and procedures**
  - ASI – AC & CC
  - BKG
  - DGFI – AC & CC
  - GA
  - GFZ
  - *GRGS/OCA*
  - JCET
  - NSGF
- **Recent data analysis issues – 1993 – present:**
  - Stanford corrections for additional sites ??? - **GA**
  - Station bias adjustment, revision of current list, implementation – **CL, ECP, ?**
  - Core site re-classification (update?) – **CL**
  - SLRF2005: proposal to adopt as JASON-2 POD standard - **JR**

- **Historical data analysis – 1983 – 1993:**
  - Status, AC contributions, CC combinations
  - Core-site selection for the historical network - **CL**
  - 1983 – present product:
    - Combination results? – **CS & RK**
    - **Final results by? …(ITRF2008+ needs input!!!)**
- **New/Returning station qualification:**
  - define and implement the activity and identify primary and back-up centers and procedures – **HM, ?**
- **Other products from Pilot Projects, Modeling issues, etc.:**
  - Daily "weekly" analysis & pos+eop report for station feedback – **ECP, ?**
  - SP3c Orbit files – **CL, HM, ECP**
  - Product improvements – **ECP**
    - New basic models: gravity (M & V), tides, loading, etc. – **ECP,?**
    - New data format testing (CRD) – **ECP**
    - Target-signature modeling specific to site and mode of operation – **GA, ECP**
    - Inclusion of atmospheric effects, (gravity, tides, loading) – **ECP,?**
    - Test files for ECMWF, 6- & 3-hour products (JPB)/**ECP**
- **Proposition for new procedure for acceptance of candidate ACs/CCs**– **ECP**
- **Other topics ???, next meeting? (16th ILW @ Poznan?)**

- **Project Status - a "living document" matrix** (*to be maintained under the ILRS pages*):

AC/CC	Weekly POS+EOP	Daily POS+EOP	Orbit Product SP3c	Reanalysis 1983 - 1993	Reanalysis 1993 - 2007	Reanalysis 1983 – 2007 (SET, biases, data editing)
ASI - AC	✔	✔	✔ (test)	✔	✔	✔
ASI - CC	✔	✔				
BKG	✔	✔		---		???
DGFI - AC	✔	?	✔ (test)	???	✔ (version w/SET)	???
DGFI - CC	✔	✔				
GA	✔	?		✔	✔	✔
GFZ	✔	✔		???	✔	✔
GRGS	✔	?			✔	✔
JCET	✔	✔	✔ (test)	✔	✔ (version w/SET)	???
NSGF	✔	✔		✔	✔ (version w/SET)	???

version w/SET: Solutions that used the initial, erroneous Stanford Event Timer corrections

- ## <u>Action items from past AWG meetings</u>

✔ = DONE

Pavlis, Luceri ✔	new ITRF for SLR analysis
Luceri ✔	new list of core sites from SLR2005 for daily EOP referencing
Luceri ✔	contact stations to rationalize biases seen in the data analysis
Müller (H) ✔	exchange and compare bias estimates with Luceri
Appleby ✔	send Luceri the Potsdam Stanford ET corrections to test
Appleby ✔	contact Francis Pierron to test their Stanford ET
Müller (H), Pavlis✔, Luceri✔	exchange and compare orbits in SP3c format
Pavlis ✔	check with GA/Mt. Stromlo the reason for delayed submissions of data
Pavlis ✔	check with Noll that ONLY latest SINEX versions are online
Pavlis ✔	check with Noll and Seemüller to generate archive for daily submissions
Müller (H), Pavlis✔, Luceri✔	validate the SLRF2005 (final version)
ACs ✔	verify that your SINEXs are formatted correctly for daily submissions!!!
AWG ✔	re-assess AWG core stations status + general ILRS classification
CCs ✔	prepare for combination of SP3c files
ACs	**prepare for new format (CRD) SLR data**
ACs	**include conversion of orbit solutions into SP3c format (step-size 2 minutes for LAGEOS; 15 minutes for Etalon)**
Mareyen	*develop 2-day analysts get-together in Frankfurt (???)*
Müller (H), König	**develop SLR discontinuities file further (1976-2007)**
Müller (H)	**develop validation plan for (new) SLR stations**
Müller (Jürgen)	**develop validation plan for (new) LLR stations**
Pavlis	get letter expressing general support for ILRS activities from IERS chairman **(is this really necessary by now???)**
Pavlis, Luceri, Pearlman, Gurtner	**organize JoG special issue**
Pavlis	**check IERS procedure for station documentation after earthquakes and such**
Pearlman	remind Simosato to become IGS station (done, no?)

- <u>**New action items**</u>

Pavlis	**datasets for the test on the models of atmospheric loading and gravity**
Pavlis, Luceri	**pilot project for the generation of a master bias list, etc.**
Müller (H) , Luceri	**Differences in CDDIS and EDC data file contents (examples)**
ACs and CCs	work on generating daily submission of weekly solutions
Task Force I	**homogenization of QC reports & development of a report with pos+eop use for stations and managers**
Task Force II	**develop a precise computation of the spacecraft CoM offset for given station-s/c configurations**

GGOS Unified Analysis Workshop Summary

Beach Resort Monterey, Monterey, CA 93940, USA, 05 - 07 December 2007

Workshop Scope   http://www.iers.org/MainDisp.csl?pid=66-1100205

An important goal of GGOS is to advance the combination and integration of the various space and insitu geodetic techniques. This goal can only be achieved with the help of all the IAG Services, and especially the IERS and IGFS.
Even if considerable progress has been made in the effort towards a rigorous combination of the various space geodetic techniques (e.g. the realization of ITRF2005, making use of a new approach based on time series of SINEX files), there are still many deficiencies (missing parameters), inconsistencies and systematic effects to be addressed.
Important topics are therefore:

- *Assessment of technique-specific systematic biases affecting the co-location on the ground and on satellites*
- *Step by step inclusion of all parameter types common to more than one observation technique*
- *Definition of common standards for all these parameters and their a priori values/models*
- *Improvements in combination strategies and rigorousness*
- *Development of new products based on a rigorous combination of the space geodetic techniques*
- *Setup of a common data portal for the products and data, and the definition of meta data and data flow*

The workshop was intended to be a forum to exchange information and results and thus increase the common understanding of all the technique representatives for each of the individual techniques as they contribute to GGOS.

The workshop was organized in the following six sessions:

- *Session 1: Details of Product Generation of the Services and Future*
- *Session 2: Technique-Specific Biases and Effects at Co-Location Sites/Satellites*
- *Session 3: Standardization/Extension of Common Parameterization*
- *Session 4: Combination Strategies and Aspects*
- *Session 5: New Products Based on Inter-technique Combinations*
- *Session 6: GGOS Portal and Meta Data Flow*

Spring 2008 ILRS AWG meeting – EGU08, Vienna, Austria, April 12, 2008

Erricos C. Pavlis

JCET/UMBC - NASA Goddard

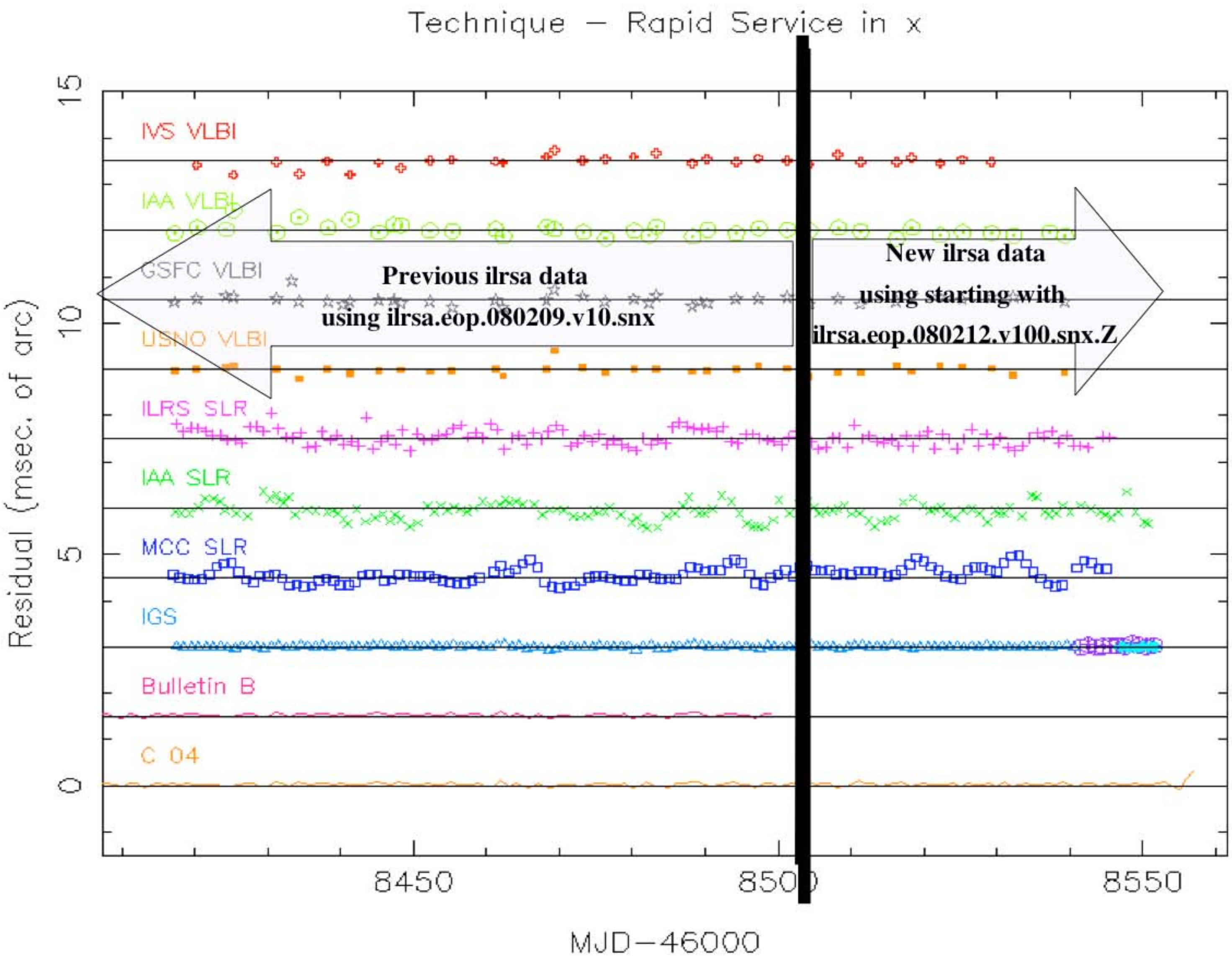
ILRS NEWS

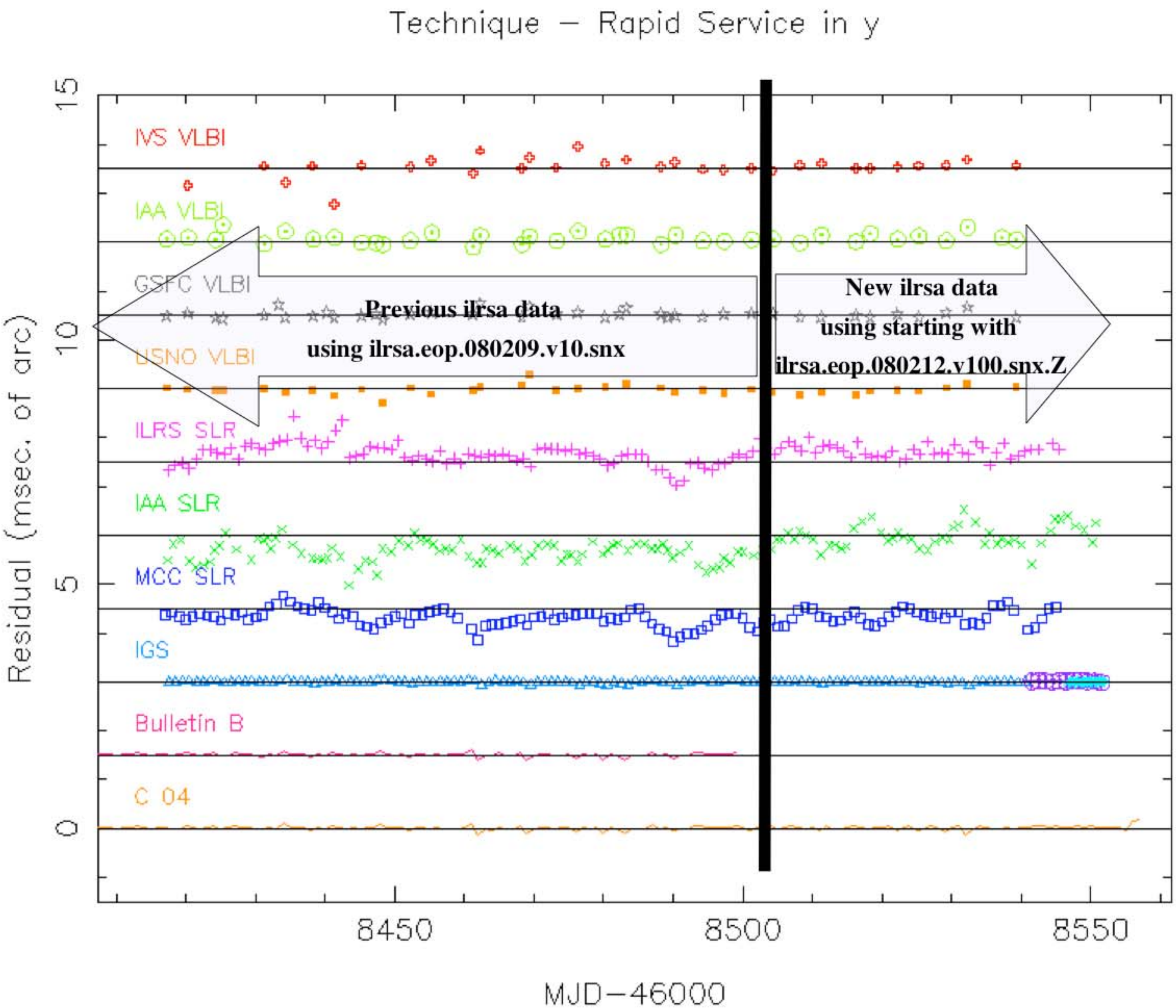
- GPS Campaign to track NEOL GPS-35 & -36 – *ongoing*
- Upcoming Launches:
  - **GIOVE-B** **April 27, 2008**
  - **OSTM/JASON-2** **June 2008**
  - **GOCE** **Summer/Fall 2008**
- LARES Mission approved by ASI (February 2008), launch 2009 (VEGA)
- SET Call for calibration issued – *first response for participation from Beijing*
- A "station status" service is nearly in place: http://aiuli3.unibe.ch:8000/slr/daystatus.y08
- Meetings of interest to the ILRS:
  - EGU meetings in Vienna – April 12 – 18:
    - **AWG (TUW,** April 12, 9 am - 6 pm**)**
    - **ILRS DF&P (TUW,** April 14, 3-5 pm**)**
    - **ILRS GB (TUW,** April 14, 5-8 pm**)**
    - **GGOS WG of GN&C (TUW,** April 16, 6-9 pm)
  - **IAG/FIGS Congress/Lisbon, Portugal – May 12 – 15, 2008**
  - **AOGS/Busan, S. Korea – June 16 – 20, 2008**
  - **GGEO2008/Chania, Crete, Greece – June 23 – 27, 2008**

DAILY EOP PRODUCT

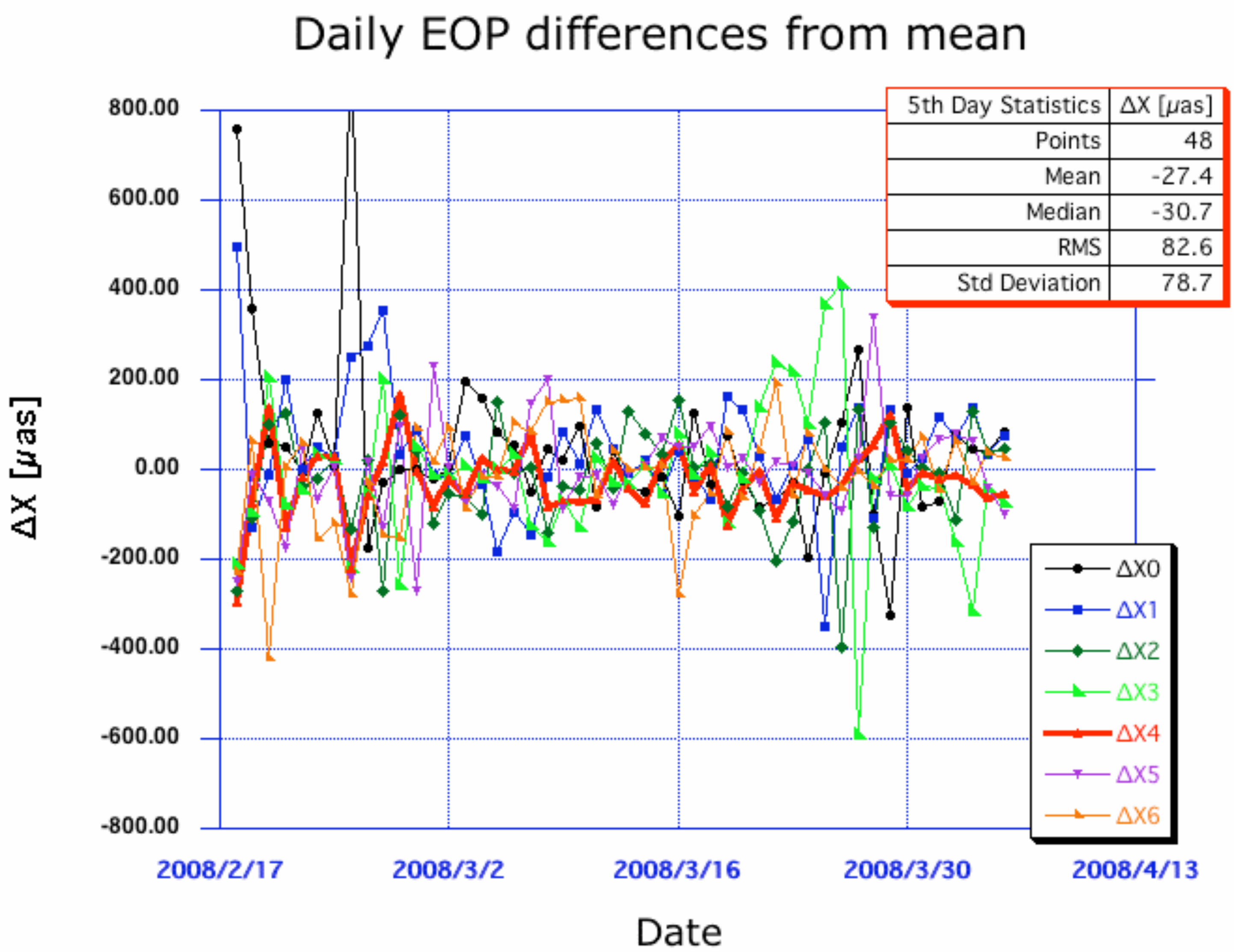
- ASI, BKG, GFZ, JCET and NSGF Contributing regularly since mid-February 2008
- NEOS has provided some preliminary evaluation results wrt to IERS EOP
- Internal precision (repeatability) analysis shows that we can deliver Polar motion to ~ 80-100 µas and LOD to ~ 45 µts
- We need more ACs to contribute and we also need to ensure that all of the contributing ACs use the correct standards and conventions (2003)

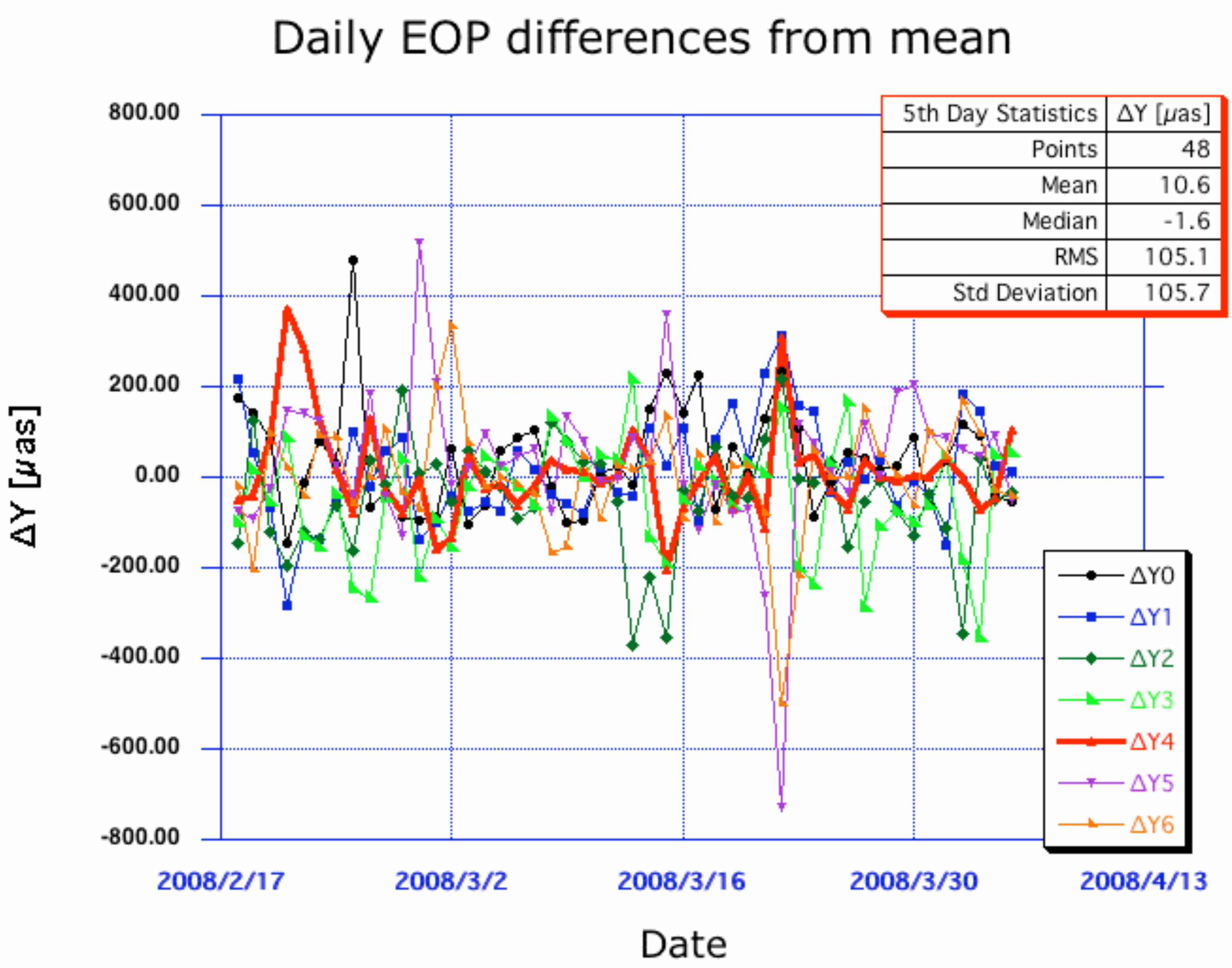
Shift of 3 in data

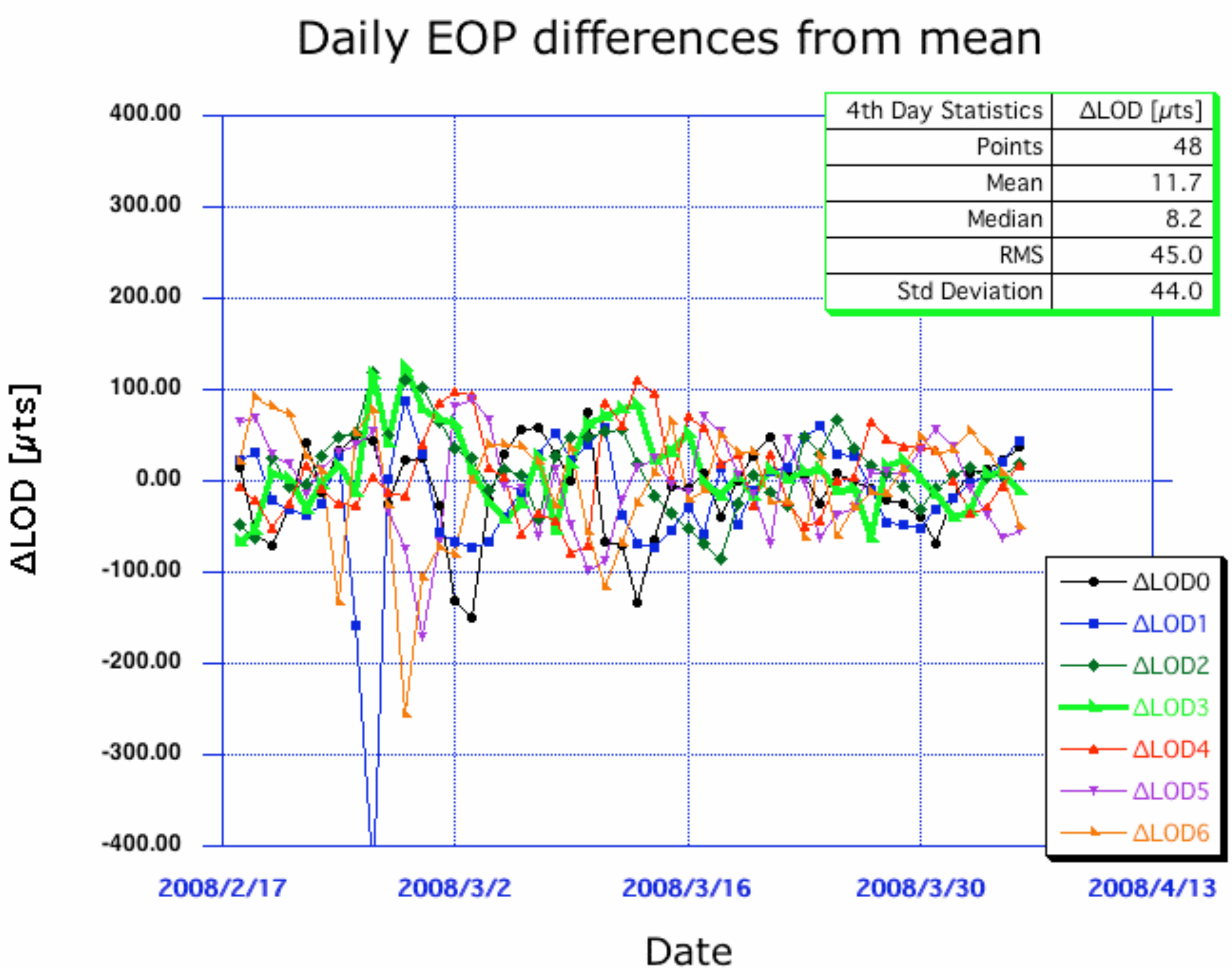




Technique – Rapid Service in y
Residual (msec. of arc)
MJD–46000
IVS VLBI
IAA VLBI
GSFC VLBI
USNO VLBI
ILRS SLR
IAA SLR
MCC SLR
IGS
Bulletin B
C 04
Previous ilrsa data
using ilrsa.eop.080209.v10.snx
New ilrsa data
using starting with
ilrsa.eop.080212.v100.snx.Z
15
10
5
0
8450
8500
8550


Daily EOP differences from mean
5th Day Statistics
ΔX [μas]
Points 48
Mean -27.4
Median -30.7
RMS 82.6
Std Deviation 78.7
800.00
600.00
400.00
200.00
0.00
-200.00
-400.00
-600.00
-800.00
ΔX [μas]
ΔX0
ΔX1
ΔX2
ΔX3
ΔX4
ΔX5
ΔX6
2008/2/17
2008/3/2
2008/3/16
2008/3/30
2008/4/13
Date


Daily EOP differences from mean
5th Day Statistics | ΔY [μas]
Points | 48
Mean | 10.6
Median | -1.6
RMS | 105.1
Std Deviation | 105.7
800.00
600.00
400.00
200.00
0.00
-200.00
-400.00
-600.00
-800.00
ΔY [μas]
2008/2/17
2008/3/2
2008/3/16
2008/3/30
2008/4/13
Date
ΔY0
ΔY1
ΔY2
ΔY3
ΔY4
ΔY5
ΔY6


Daily EOP differences from mean
4th Day Statistics | ΔLOD [μts]
Points | 48
Mean | 11.7
Median | 8.2
RMS | 45.0
Std Deviation | 44.0
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
-300.00
-400.00
ΔLOD [μts]
ΔLOD0
ΔLOD1
ΔLOD2
ΔLOD3
ΔLOD4
ΔLOD5
ΔLOD6
2008/2/17
2008/3/2
2008/3/16
2008/3/30
2008/4/13
Date

Unified Analysis Workshop 2007 Action Items

5 5a **5b** **5c** 5d	**SINEX Extension of Parameterization / Naming:** SINEX Proposal 2 will be distributed to all interested groups. The new version of SINEX should exclusively use new names. Old names are still supported for all older SINEX versions. **Feedback of groups until** **Distribution of final SINEX version description** Make a distinction between SINEX files for combination purposes and other purposes in the file name → convention. Proposal by Axel Nothnagel.	 IERS ACoo **All** IERS ACoo Nothnagel	 10-DEC-07 18-FEB-08 25-FEB-08 **NO NEWS** 10-DEC-07 **2 PROPOSALS**
6 **6a** **6b**	**Atmospheric Loading:** **Reference pressure for atmospheric loading:** Johannes Böhm checks the deviations of GPT and ISO standard from a correct mean pressure field. **Correction of atmospheric loading on the weekly, daily or on observation level? Check IERS WS 2007 recommendation.** **Böhm, Tesmer, van Dam, MacMillan, Pavlis to perform tests to assess the difference between application on the obs. and SINEX level (daily/weekly).**	 Böhm Van Dam	 31-JAN-08 31-MAR-08 **NO NEWS**
8 **8a** 8b 8c	**Generation of daily SINEX files:** Generation of daily SINEX files by VLBI (intensive sessions) and by GPS (rapid solutions). ACs are encouraged to submit daily SINEX files containing site coordinates, EOPs based on their rapid solutions. 24-hour data interval for GPS. **ILRS/IDS will discuss how they could contribute.** Intra-technique combination of daily SINEX files as a pilot phase Combination of daily SINEX files by interested groups as a pilot phase based on individual ACs	 IVS, IGS Ferland, Nothnagel GFZ, OP, (IGN), (IGGB)	 01-MAR-08 01-JUL-08 01-JUL-08
9	**Benchmarking of diverse models in the software packages**, that are common to all techniques. Which models should be checked? Put together a list with priorities. Technique-specific effects should be checked by technique services, common models should be checked on the IERS/GGOS level. Use UAW exploder.	Tim Springer	15-JAN-08 **NO NEWS**

10	**Work towards a representation of parameters by piece-wise linear offsets (instead of offsets and rates):**	**Services**, IERS	**NO NEWS**
10a	Generate SINEX files for the test period of CONT'05 with piece-wise linear ERPs (using the new SINEX format version) and, if possible, with the old representation (offsets and drifts)	ACs: CODE, ESA, DGFI, IGGB, …	01-JUL-08
10b	ITRF CCs and other combination groups test the combination based on the new representation	ITRF CC, others	01-OCT-08
10c	A priori representation of the ERPs: ACs should converge to a unique representation (interpolation) of the a priori ERP values as a linear function (linear interpolation) between the vertices. Further discussion by e-mail (UAW).	IERS ACoo, ACs	01-OCT-08
11	**Parameterization for ITRF20xx generation:**		For the next generation of SINEX time series for ITRF (ca. end 2008)
11a	1) Add quasar coordinates to the SINEX files	IVS	
11b	2) All techniques should include polar motion rates in the SINEX files	All Services	
11c	**3) Low-degree harmonics of the gravity field from SLR (degree/order 2)**	**ILRS**	
12	**Modeling standards for next ITRF generation:**	**Services**	See AI 11
12c	**1) FES2004 or GOT4.7b are recommended as ocean tide model for site displacements (Note: new values should be downloaded because of a model update of FES2004)**	All Services	
12d	**2) Atmospheric loading should be reconsidered after the tests by van Dam et al.**		
12e	3) Consistency with gravity (FES2004 etc.) should be considered as well.	IGS ACoo	
12f	Check consistency of the above options with the IGS reprocessing options.	IGS ACoo	
13	**Documentation of AC modeling and parameterization standards:**		
13a	Technique-specific forms (a template) are provided by IVS, IGS, **ILRS**, IDS. (ask Hermann Drewes about his activity here as GGOS WG Chair !!)	IVS, IGS, ILRS, IDS, CBs	20-DEC-07
13b	Generation of a unified form, if not already done by H. Drewes (check also standards sheet by GGOS-D for completeness) and distribution to all ACs	IERS CB	15-JAN-08
13c	Forms filled and returned by all ACs	**All ACs**	15-FEB-08

21	**Meteo data equipment/instrumentation coordinator, technique-independent → to be discuss a the next meeting of the GGOS Infrastructure WG**	**Pearlman**	12-DEC-07
	Recommendations		
24	**A clear distinction should be made between a solution (SINEX) as input for combination and an optimum solution of a specific technique: for the combination work the parameterization and time resolution of the most sensitive technique has to be used by ALL ACs. Therefore, it might be necessary to generate two types of solutions.**	**All Services**	
25a **25b**	**Investigate the reason for cut-off angle dependent effects and elevation-dependent weighting.** **ACs should freeze their selection of processing options and models between two reprocessing activities**	IVS, IGS, IDS, **ILRS** IVS, IGS, IDS, **ILRS**	
26	**Continuous monitoring of the range biases by ILRS**	**ILRS**	
30	**Further studies are required to understand the bias between SLR and microwave GPS orbits**	IGS, **ILRS**	
32	**Study the influence of the arc length and orbit constraints on geocenter estimates**	IGS, IDS, **ILRS**	

Proposal for a SINEX file name convention across techniques (small and capital letters are allowed)

Proposal 1

yyyy_doy_ntm_zz_aaaxxxxx.SNX

where
yyyy = year and
doy = date when observation data used starts
n = number of days included, 1 for 1 day, 7 full week, 9 for fraction of day
t = technique, P = GNSS, L = SLR, M = LLR, R = VLBI, D = DORIS,
C = combined, I = Integrated, Q = Satellite Co-location,
T = local ties
m = type of primary content, C = covariances, D = normal equations with datum fixed, F = normal equations with datum free
zz = Session name or other technique specific identifier
aaa = Analysis center code
xxxxx = "solution" identifier

examples:
2007_273_1DC_NN_JPL2007a.SNX
2005_199_9RF_XA_iaa2006b.SNX

Proposal 2
yydoy_ntm_zz_aaaxxxxx.SNX

where
yy = year and
doy = date when observation data used starts
n = number of days included, 1 for 1 day, 7 full week, 9 for fraction of day
t = technique, P = GNSS, L = SLR, M = LLR, R = VLBI, D = DORIS,
C = combined, I = Integrated, Q = Satellite Co-location,
T = local ties
m = type of primary content, C = covariances, D = normal equations
with datum fixed, F = normal equations with datum free
zz = Session name or other technique specific identifier
aaa = Analysis center code
xxxxx = "solution" identifier

examples:
07273_1DC_NN_JPL2007a.SNX
05199_9RF_XA_iaa2006b.SNX

Comment to both proposals:

Most of the ACs have 4-5-character long identifiers and we will try to artificially stuff these (as we do now too!) into 3 characters, which will make identification difficult and eventually ambiguous, especially for outsiders. On the other hand, a solution for a specific interval (1 day, 1 week, etc.) will easily be identified by a 2-digit year designator and a letter code, e.g. 08D, and I cannot think of anyone releasing more than 26 versions of such a file.

Why not swap the fields to:

aaaaa = Analysis center code
xxx = "solution" identifier

yyyy_doy_ntm_zz_aaaaaxxx.SNX

or

yy_doy_ntm_zz_aaaaaxxx.SNX

GPS 35 & 36 SLR Tracking Campaign 2008

The GPS-35 and -36 satellites will soon be decommissioned. They will continue to operate for a while, but they will not be used in the GPS navigation complex. These are the only GPS satellites that have retroreflectors and this may be our last chance to acquire a good set of GPS data for long-term studies, system comparisons, and reference frame support.

The ILRS Governing Board has approved an intensive tracking campaign on GPS-35 and -36 running from March 25 through May 31. The priority on GPS-35 and -36 will be raised to follow the Lageos Satellites. Pass segments should be 15 minutes (3 normal points) with 3 segments spread out over the pass to the extent possible.

Viewing schedules show that nighttime passes will be visible for GPS-35 in Europe, Saudi Arabia, South Africa, Eastern Australia, Tahiti and the Western US during this period.

Nighttime passes for GPS-36 should be visible from Asia, South America, Australia and Eastern US.

<u>**Courtesy Mark Davis**</u>

SLR Tracking of GPS

Misclosures to

IGS ULTRA RAPID

2007 - 07-APR-2008

Site	G35 and G36 # Obs.	MEAN (meters)	Std. Dev.
Beijing	15	0.0003	0.0667
Chang Chun	96	-0.0165	0.0524
Tanegashima (GUTS)	116	0.0162	0.0556
Koganei - Toyko	51	-0.0161	0.0392
Mt Stromlo	129	-0.0065	0.0292
Yarragadee	**672**	**-0.0273**	**0.0343**
GGAO	15	-0.0124	0.0363
Mon Pk	8	-0.0206	0.0423
San Juan	**729**	**0.0171**	**0.0235**
TIGO	52	-0.0169	0.0287
Graz	193	-0.0161	0.0256
NERC	98	0.0053	0.0374
Katsively	7	-0.0579	0.0656
Riyadh	87	0.0111	0.0133
Wettzell	44	0.0066	0.0218
G35 - whole network	**1034**	**-0.0102**	**0.0411**
G36 - whole network	**1264**	**0.0024**	**0.0346**

Author: Oscar Brogdon, HTSI / NASA SLR

GPS Weekly Tracking Report

Received **24-MAR-2008 - 07-APR-2008**

Sat	Station	PAD_ID	Wave	ALL Passes	**All Norm Points**	31-MAR-2008 07-APR-2008 Passes	31-MAR-2008 07-APR-2008 Norm Points
GPS-36	Yarragad	7090	5320	12	50	6	24
GPS-36	Greenbel	7105	5320	1	2		
GPS-35	Monument	7110	5320	1	3		
GPS-36	Beijing	7249	5320	1	3		
GPS-35	Tokyo	7308	5320	2	9	1	6
GPS-35	Tanegash	7358	5320	7	39	4	28
GPS-36	Tanegash	7358	5320	5	36	3	27
GPS-36	**San Juan**	**7406**	**5321**	**19**	**101**	**12**	**61**
GPS-36	Mt Strom	7825	5320	3	19	3	19
GPS-35	Riyadh	7832	5320	8	44	4	21
GPS-35	Graz	7839	5320	4	43	1	12
GPS-36	Graz	7839	5320	1	2		
GPS-35	Herstmon	7840	5320	4	12	2	8
				68	**363**	**36**	**206**

Over the last two weeks

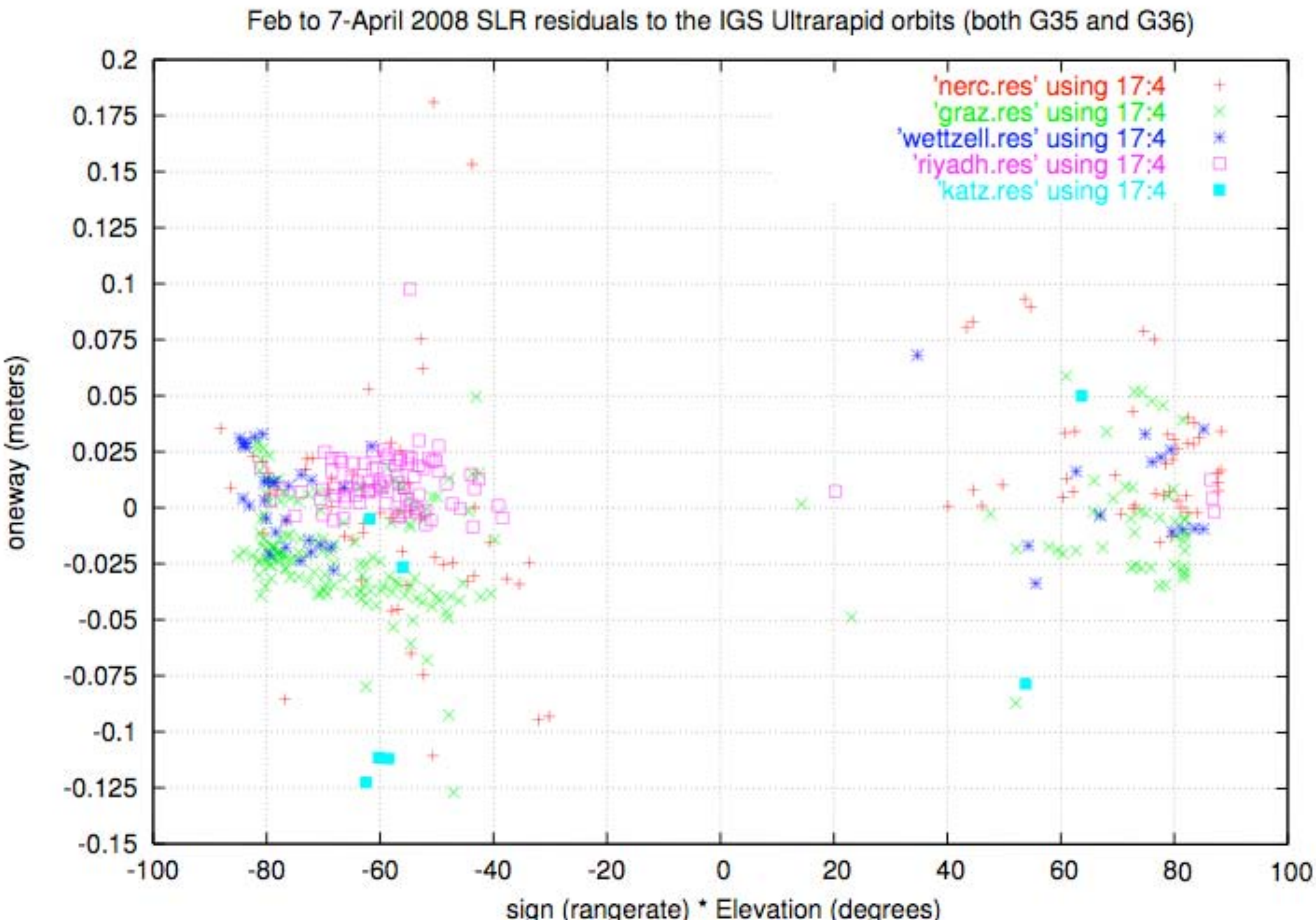
We have improved our yield on GPS 35 & 36 (combined)

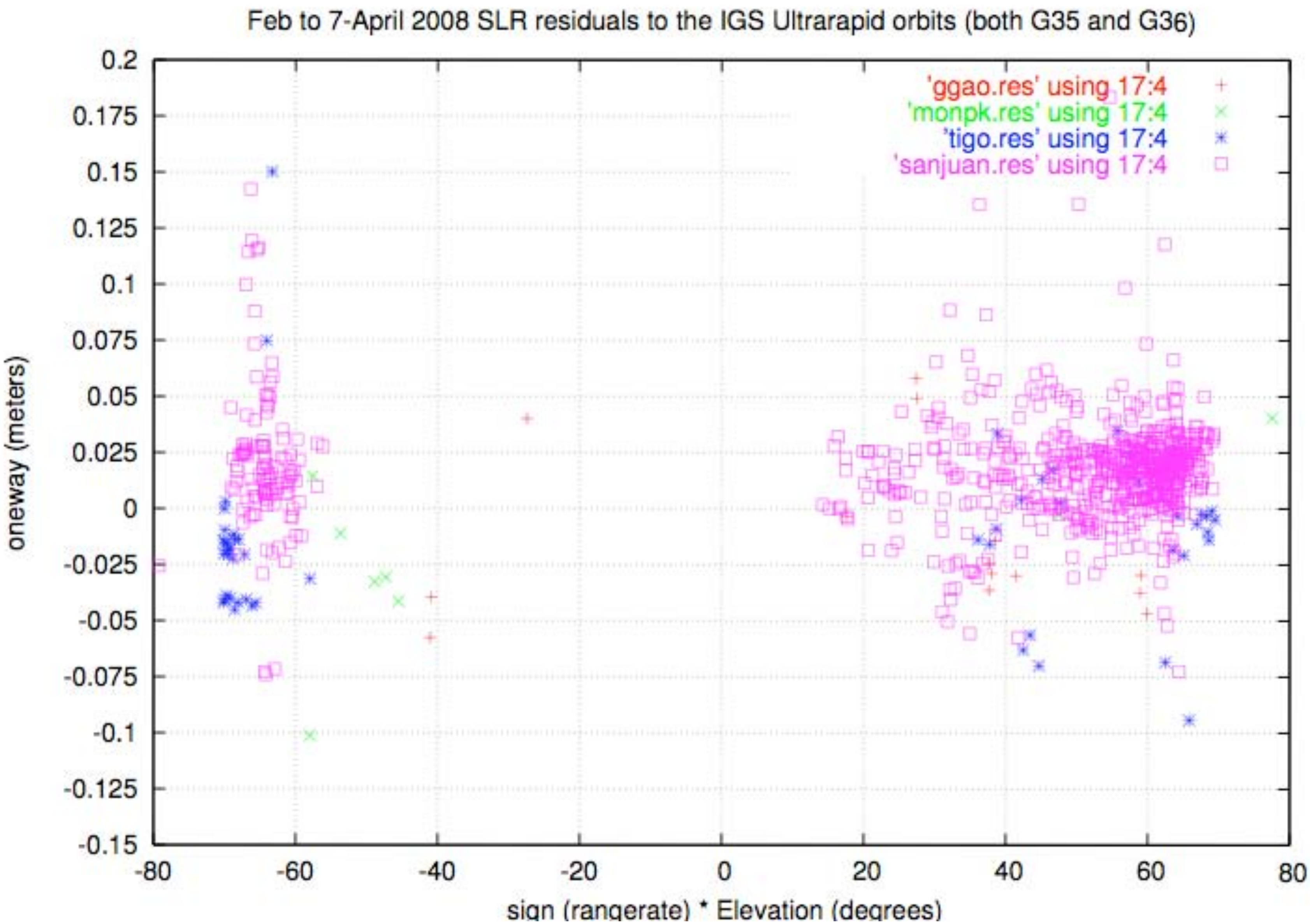
Going from

6 Ranges per day on average

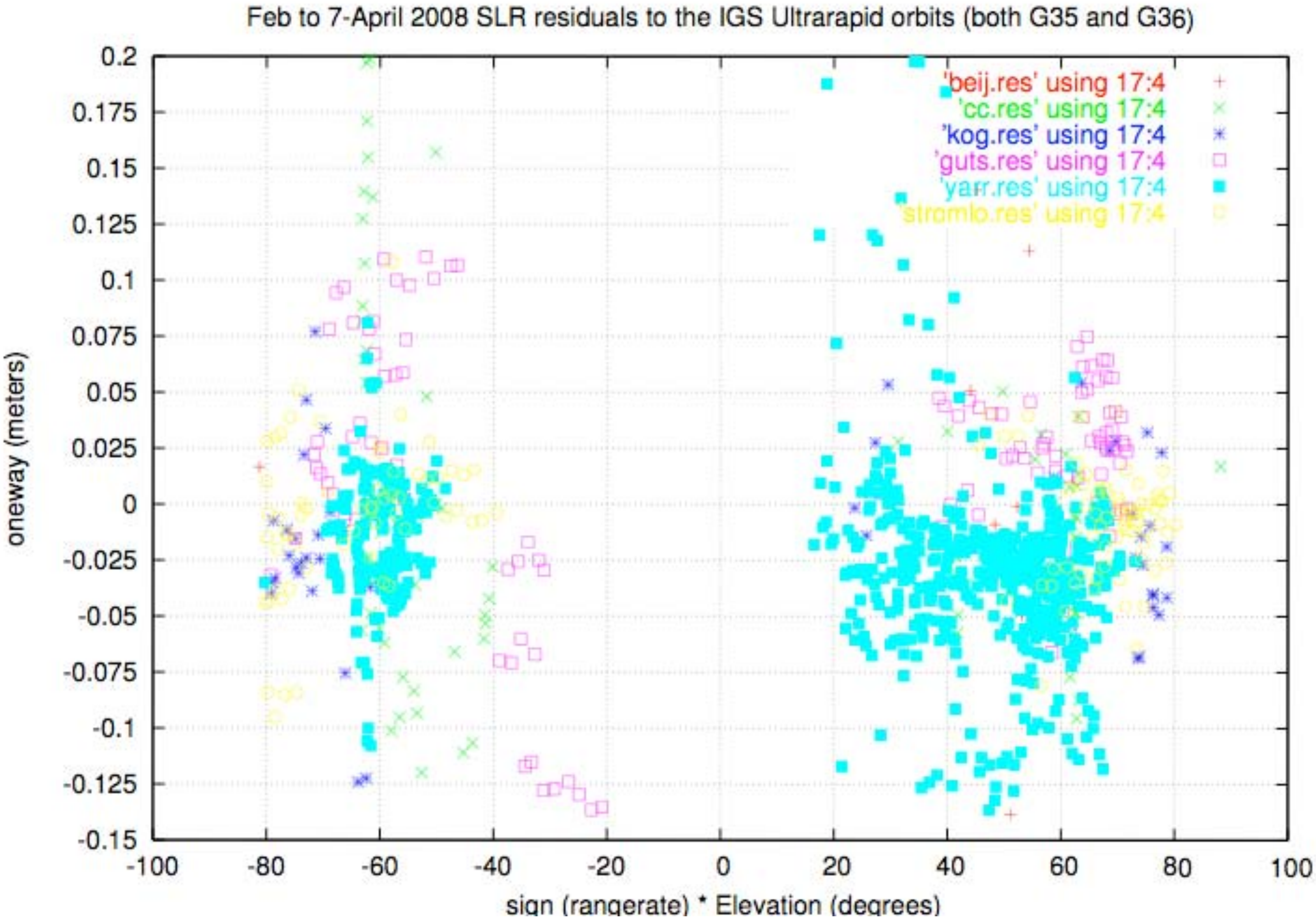
to

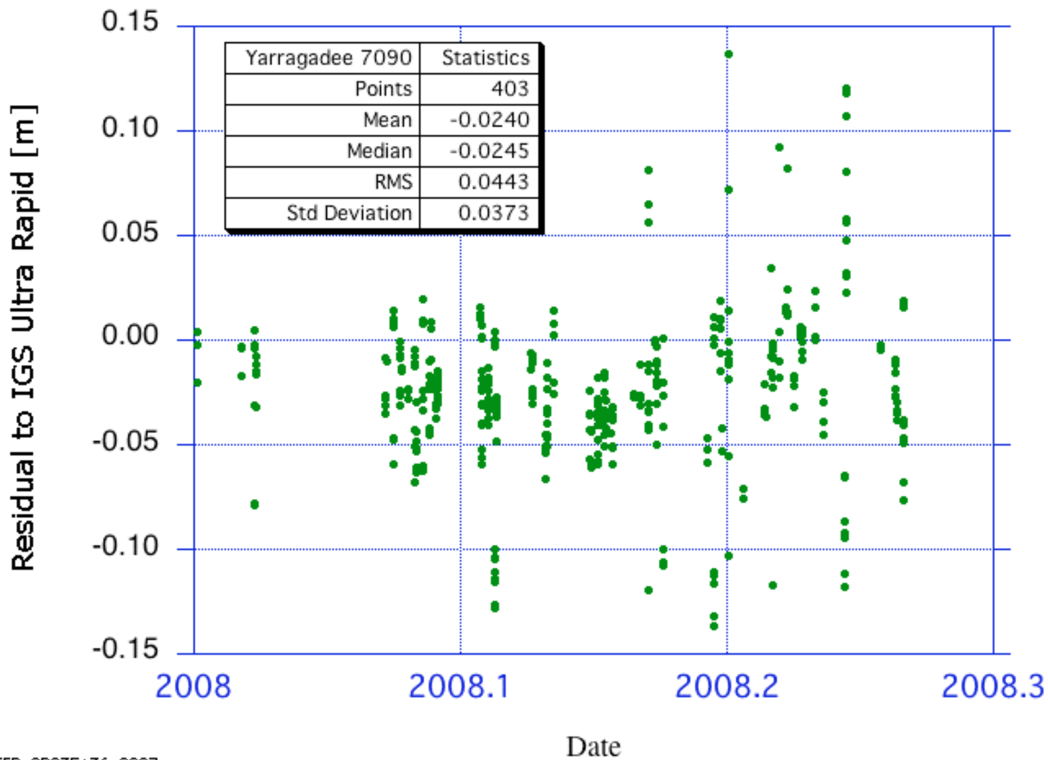
26 Ranges/day on average


Feb to 7-April 2008 SLR residuals to the IGS Ultrarapid orbits (both G35 and G36)
'nerc.res' using 17:4
'graz.res' using 17:4
'wettzell.res' using 17:4
'riyadh.res' using 17:4
'katz.res' using 17:4
oneway (meters)
0.2
0.175
0.15
0.125
0.1
0.075
0.05
0.025
0
-0.025
-0.05
-0.075
-0.1
-0.125
-0.15
-100
-80
-60
-40
-20
0
20
40
60
80
100
sign (rangerate) * Elevation (degrees)



Feb to 7-April 2008 SLR residuals to the IGS Ultrarapid orbits (both G35 and G36)
'ggao.res' using 17:4
'monpk.res' using 17:4
'tigo.res' using 17:4
'sanjuan.res' using 17:4
oneway (meters)
0.2
0.175
0.15
0.125
0.1
0.075
0.05
0.025
0
-0.025
-0.05
-0.075
-0.1
-0.125
-0.15
-80
-60
-40
-20
0
20
40
60
80
sign (rangerate) * Elevation (degrees)

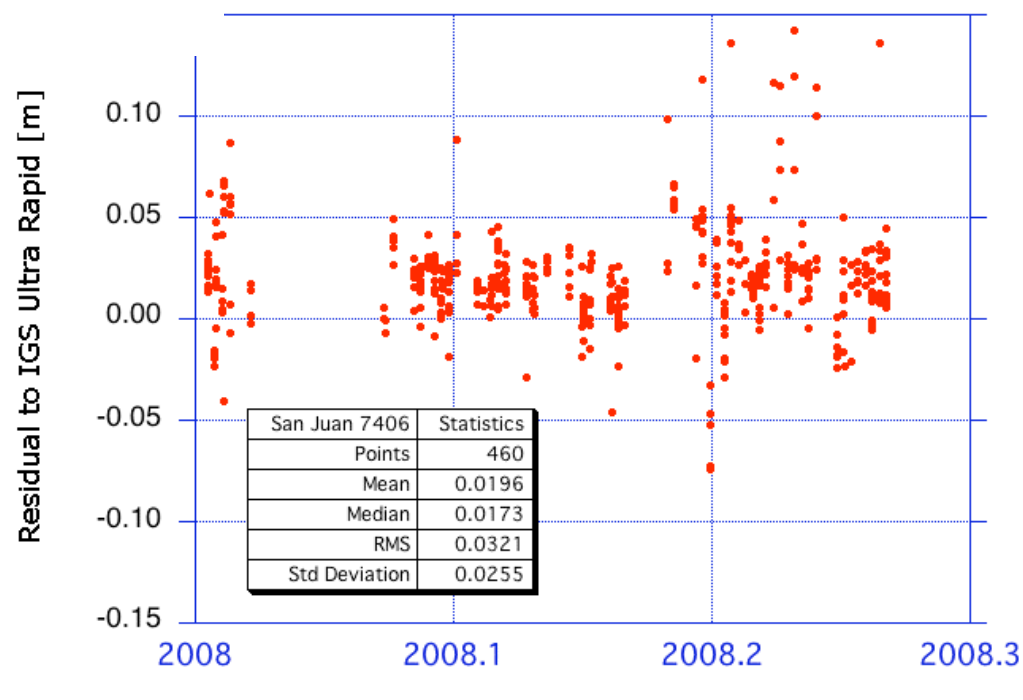

Feb to 7-April 2008 SLR residuals to the IGS Ultrarapid orbits (both G35 and G36)
'beij.res' using 17:4
'cc.res' using 17:4
'kog.res' using 17:4
'guts.res' using 17:4
'yarr.res' using 17:4
'stromlo.res' using 17:4
oneway (meters)
sign (rangerate) * Elevation (degrees)
0.2
0.175
0.15
0.125
0.1
0.075
0.05
0.025
0
-0.025
-0.05
-0.075
-0.1
-0.125
-0.15
-100
-80
-60
-40
-20
0
20
40
60
80
100



ASTER_GPS35+36_2007-now

Yarragadee 7090

San Juan 7406



CRD Data Format – The new ILRS Standard Format for **all** ILRS data

A draft timetable for CRD format implementation is as follows:

- **April '08** - We will request that all stations begin to make the conversion to the new format as soon as possible. We will also request that they send in both formats of the data for data validation. Once a system's data are validated by the **Analysis Working Group**, they will no longer be required to send in both formats.
- **Sept '08** - The Data Centers should be archiving data regularly. As of this date, the Operations Centers (EDC, HTSI) will convert all data that is NOT yet in the CRD format for a parallel delivery to the Data Centers. If a station's data has been validated, and they are only sending in CRD data, then the Operations Center will convert to normal point data for parallel delivery.
- **April '09** - By this date, we will expect that ALL ILRS systems will be sending in CRD data format.
- **January '10** - The Operations Centers will cease converting data to the old normal point format, and will only deliver CRD data to the Data Centers."

Note that the first item calls for the **AWG** to verify that the CRD data agrees with the old data for each station. We feel it is important that the network and analysts feel confident that the CRD data is not materially different from the old data, but is the **AWG** or a subset willing to take on this task?

MLRS CRD data at: http://cddis.gsfc.nasa.gov/pub/slr/data/npt_crd/.

STATION STATUS REPORT PAGE

http://aiuli3.unibe.ch:8000/slr/daystatus.y08

DOY	Date	BURF	CONL	HERL	MATM	POT3	SFEL	TEST	WETL	YARL	ZIML
071	11-Mar-2008	OUT	OUT	OPER		OPER	OPER		OPER	OPER	DOWN
072	12-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
073	13-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
074	14-Mar-2008	OPER	OUT	OUT	OPER	OPER	OPER		OUT	OPER	DOWN
075	15-Mar-2008	OPER	OPER	OUT		OUT	OPER		OPER	OPER	DOWN
076	16-Mar-2008	OPER	OPER	OUT		OPER	OPER		OPER	OPER	DOWN
077	17-Mar-2008	OPER	OPER	OUT	OPER	OPER	OPER	OUT	OUT	OPER	DOWN
078	18-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER	OUT	OPER	OPER	OPER
079	19-Mar-2008	OUT	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
080	20-Mar-2008	OPER	OPER	OPER	OPER	OPER	OUT		OPER	OPER	DOWN
081	21-Mar-2008	OPER	OPER	OPER	OPER	OUT			OPER	OPER	DOWN
082	22-Mar-2008	OPER	OPER	OPER	OUT	OUT			OPER	OPER	OPER
083	23-Mar-2008	OPER	OPER	OPER		OPER			OPER	OPER	OPER
084	24-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
085	25-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
086	26-Mar-2008	OPER	OPER	OPER		OPER	OPER		OPER	OPER	DOWN
087	27-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	OPER
088	28-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
089	29-Mar-2008	OPER	OPER	OPER		OPER	OPER		OPER	OPER	OPER
090	30-Mar-2008	OPER	OPER	OPER		OPER	OPER		OPER	OUT	DOWN
091	31-Mar-2008	OPER	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
092	01-Apr-2008	OUT	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
093	02-Apr-2008	OUT	OPER	OPER	OPER	OPER	OPER		OPER	OPER	DOWN
094	03-Apr-2008	OPER	OPER	OPER	OUT	OPER	OPER		OPER	OPER	DOWN
095	04-Apr-2008	OPER	OPER	OPER		OPER	OPER		OPER	OPER	OPER

Dubious Local Ties as results from the ITRF2005 computation (All techniques)

Dubious means disagreement between Local Survey and Space Geodesy Estimates
Sites listed where discrepancy is larger than ~10 mm

Site Name	Vector	Sigma used in ITRF2005 (mm)	Magnitude of Discrepancy (mm)	Comments (*)
REYKJAVIK	GPS-DORIS	20	20	
BOROWIEC	**GPS-SLR**	15	25	
YUZHNO-SAKHALINS	GPS-DORIS	15	20	
ZIMMERWALD	**GPS-SLR**	10	15	SLR Range Bias ?
HERSTMONCEUX	**GPS-SLR**	3.3	10	**Tie to be re-measured by IGN 2008**
SAN FERNANDO	**GPS-SLR**	3	50	SLR ?GPS ? Tie ?
MADRID	**GPS-VLBI**	10	30	GPS ?
SHANGHAI	**GPS-VLBI**	4	10	VLBI ?
BEIJING	GPS-SLR	10	20	SLR ?
WUHAN	GPS-SLR	10	20	SLR ?
LHASA	GPS-SLR	20	15	SLR ?
CIBINONG	GPS-DORIS	20	30	GPS ?
MAHE ISLAND	GPS-DORIS	22	70	
FAIRBANKS	DORIS-GPS	4	15	EQ ?
KAUAI	**GPS-VLBI**	9	10	GPS ?
KAUAI	GPS-DORIS	9	15	
WESTFORD	GPS-VLBI	20	20	GPS ?
MAUI-Haleakala	**GPS-SLR**	3	9	
PIETOWN	**GPS-VLBI**	9	10	
RIO GRANDE	GPS-DORIS	8	20	
FORTALEZA	**GPS-VLBI**	30	30	GPS ?
CACHOEIRA PAULIS	GPS-DORIS	15	20	
EASTER ISLAND	GPS-SLR	35	20	
CONCEPCION	GPS-SLR-VLBI	15	15	
THULE	GPS-DORIS	15	25	
YARAGADEE	**GPS-SLR**	7	10	
GUAM	GPS-DORIS	30	40	
SYOWA	GPS-VLBI-DORIS	30	40	
O'HIGGINS	**GPS-VLBI**	60	40	
TAHITI	**GPS-SLR**	3	10	**Tie Re-measured (IGN 2007)**

Missing Ties (All techniques)

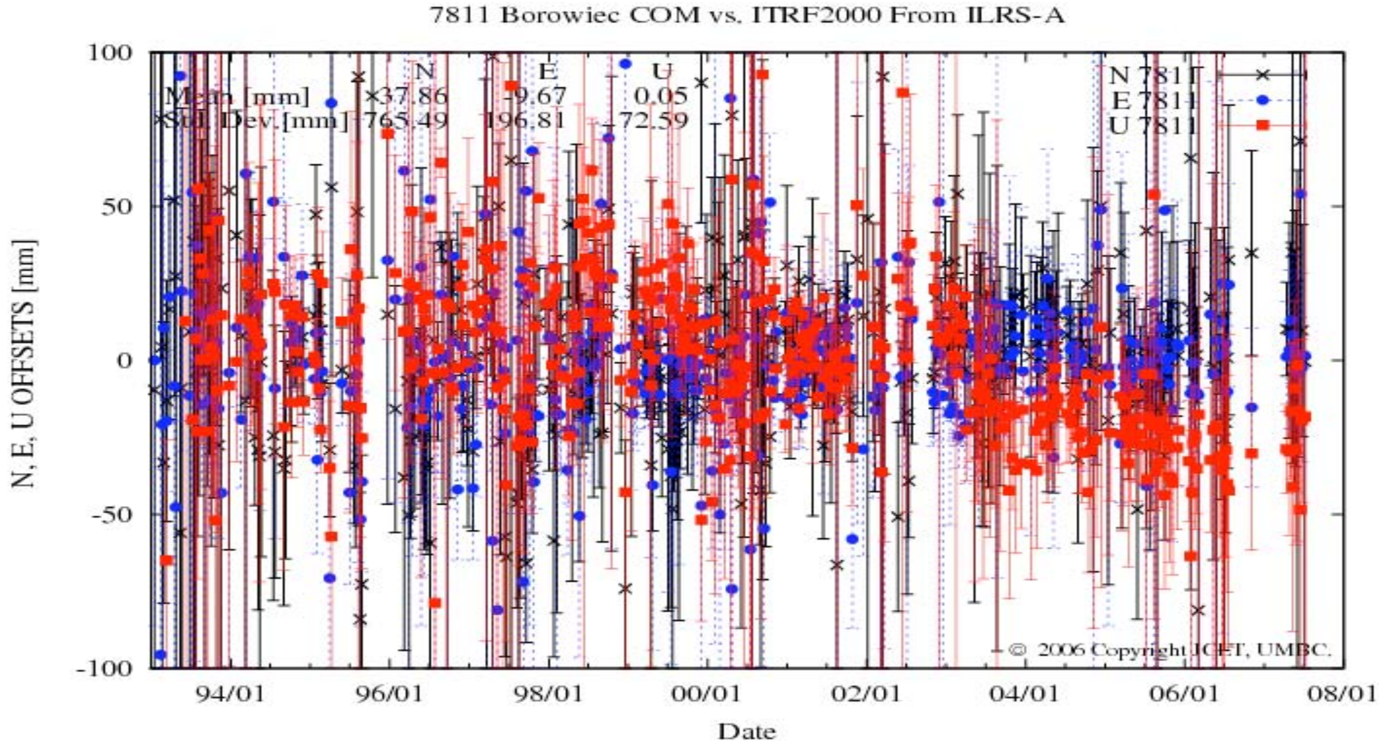
Site	Techniques	Comments
Ryiadh-Solar-Villlage	GPS-SLR	
URUMQI	GPS-VLBI-SLR	
SIMEIS-Katzively	SLR-VLBI	
KUNMING	SLR-GPS	SLR ?
MIZUSAWA	GPS-VLBI	
BREWSTER	GPS-VLBI	

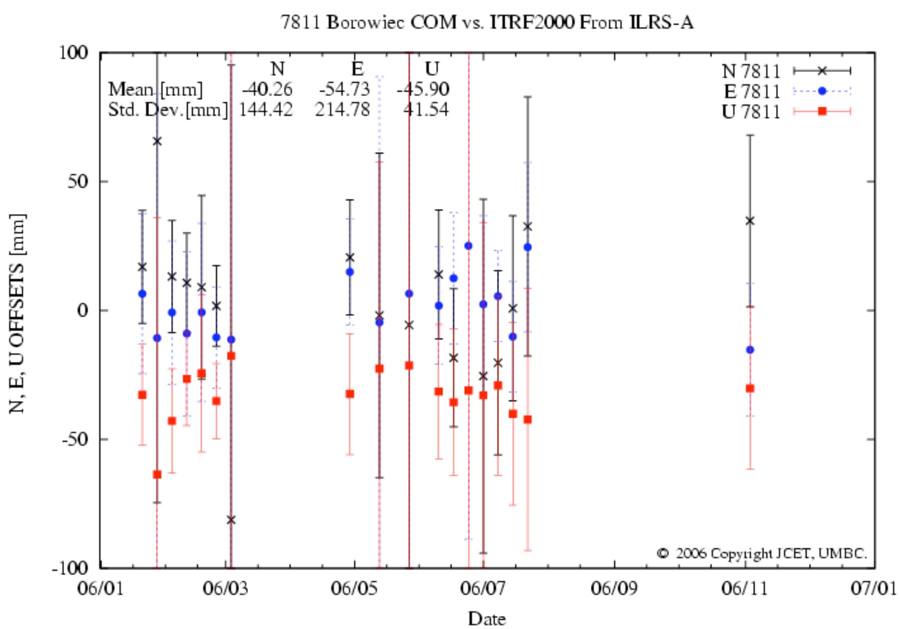
Dubious Local Ties as results from the ITRF2005 computation (SLR Cases)

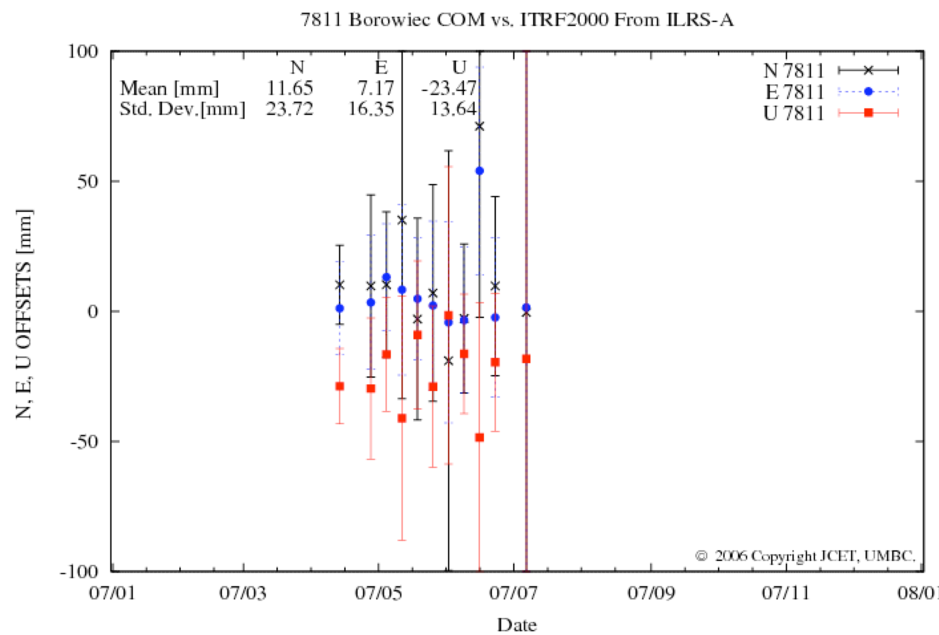
Site Name	Vector	Sigma used in ITRF2005 (mm)	Magnitude of Discrepancy (mm)	Comments (*)
BOROWIEC	GPS-SLR	15	25	NOISY SITE/REEVALUATE
ZIMMERWALD	GPS-SLR	10	15	SLR Range Bias ? REEVALUATE
HERSTMONCEUX	GPS-SLR	3.3	10	Tie to be re-measured by IGN 2008
SAN FERNANDO	GPS-SLR	3	50	SLR ? GPS ? Tie ? RIOA?
BEIJING	GPS-SLR	10	20	SLR ? REEVALUATE
WUHAN	GPS-SLR	10	20	SLR ? - Poor SLR site
LHASA	GPS-SLR	20	15	SLR ? - Poor SLR site
MAUI-Haleakala	GPS-SLR	3	9	OLD SLR SITE GONE
EASTER ISLAND	GPS-SLR	35	20	Old SLR site…
CONCEPCION	GPS-SLR-VLBI	15	15	BKG ?
YARAGADEE	GPS-SLR	7	10	GPS antenna pier uplift?
TAHITI	GPS-SLR	3	10	Tie Re-measured (IGN 2007) ∆X of -14 mm

Missing Ties Involving SLR

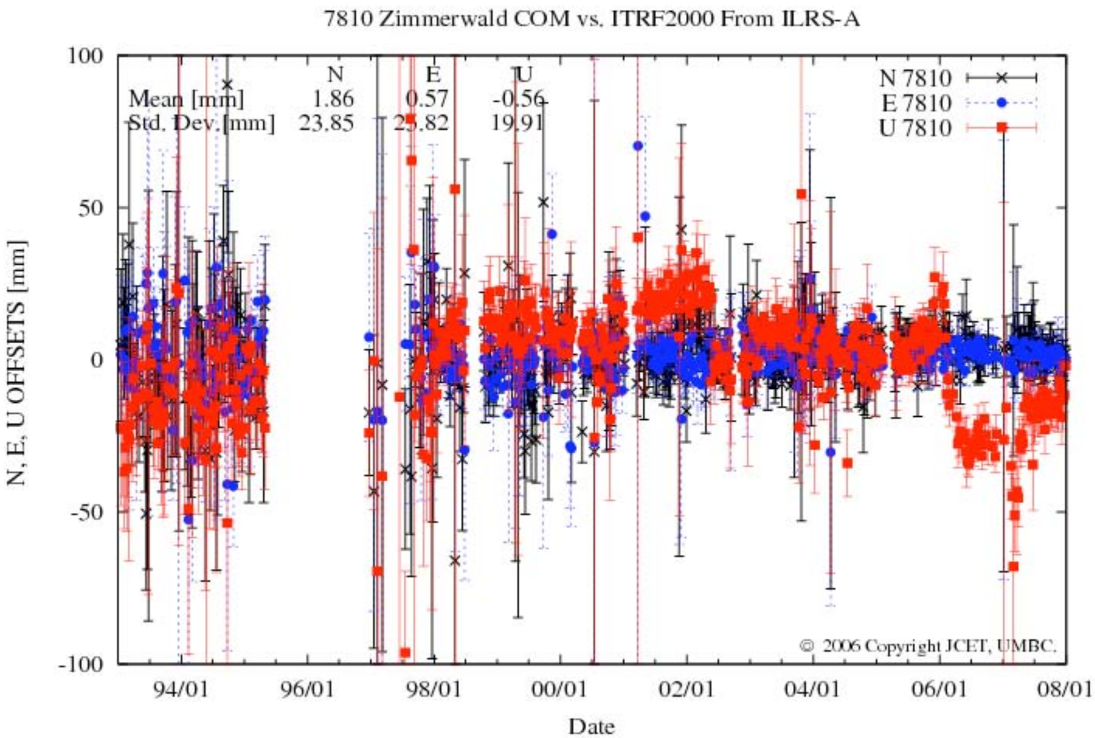
Site	Techniques	Comments
Ryiadh-Solar-Villlage	GPS-SLR	KACST?
URUMQI	GPS-VLBI-SLR	Poor SLR site
SIMEIS-Katzively	SLR-VLBI	Poor SLR site
KUNMING	SLR-GPS	SLR ? - Poor SLR site


7811 Borowiec COM vs. ITRF2000 From ILRS-A
N
E
U
Mean [mm] 37.86 9.67 0.05
Std. Dev.[mm] 765.49 196.81 72.59
N 7811
E 7811
U 7811
N, E, U OFFSETS [mm]
Date
94/01
96/01
98/01
00/01
02/01
04/01
06/01
08/01
© 2006 Copyright JCET, UMBC.


7811 Borowiec COM vs. ITRF2000 From ILRS-A
N
E
U
Mean [mm] -40.26 -54.73 -45.90
Std. Dev.[mm] 144.42 214.78 41.54
N 7811
E 7811
U 7811
N, E, U OFFSETS [mm]
Date
06/01
06/03
06/05
06/07
06/09
06/11
07/01
© 2006 Copyright JCET, UMBC.


7811 Borowiec COM vs. ITRF2000 From ILRS-A
N
E
U
Mean [mm] 11.65 7.17 -23.47
Std. Dev.[mm] 23.72 16.35 13.64
N 7811
E 7811
U 7811
N, E, U OFFSETS [mm]
Date
07/01
07/03
07/05
07/07
07/09
07/11
08/01
© 2006 Copyright JCET, UMBC.

07/12/07



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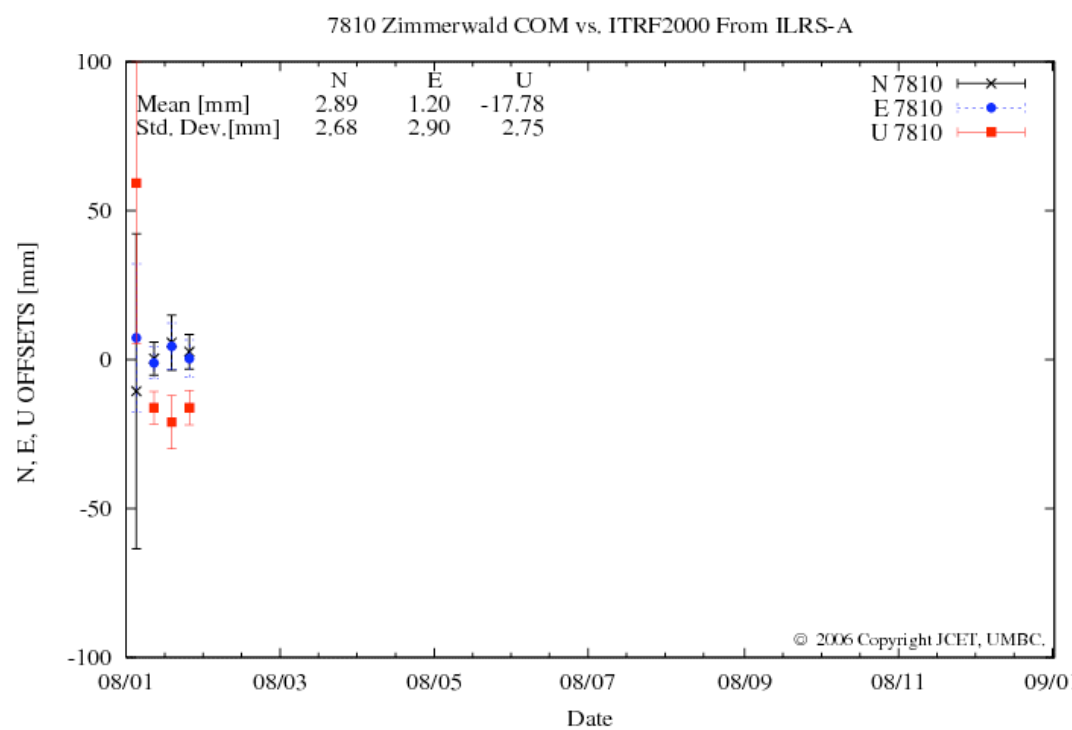
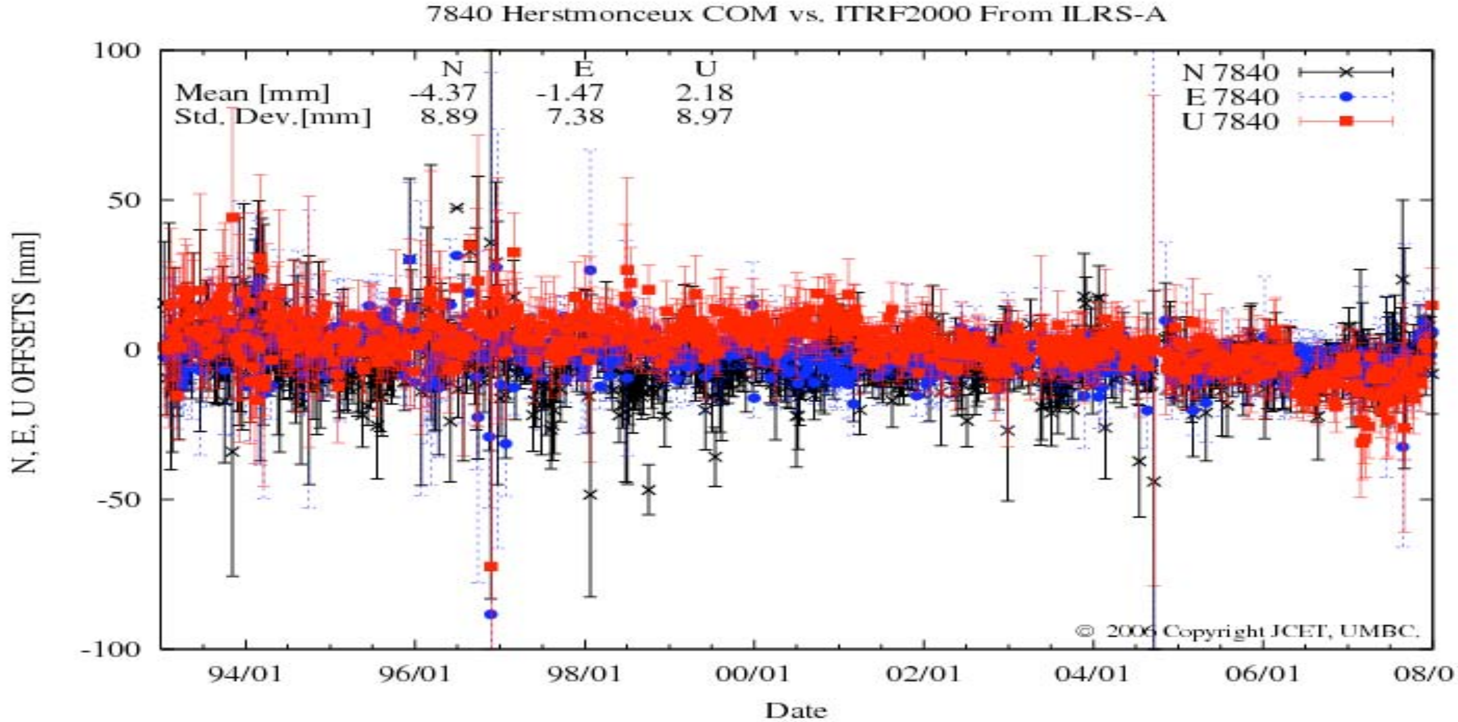


08/04/05



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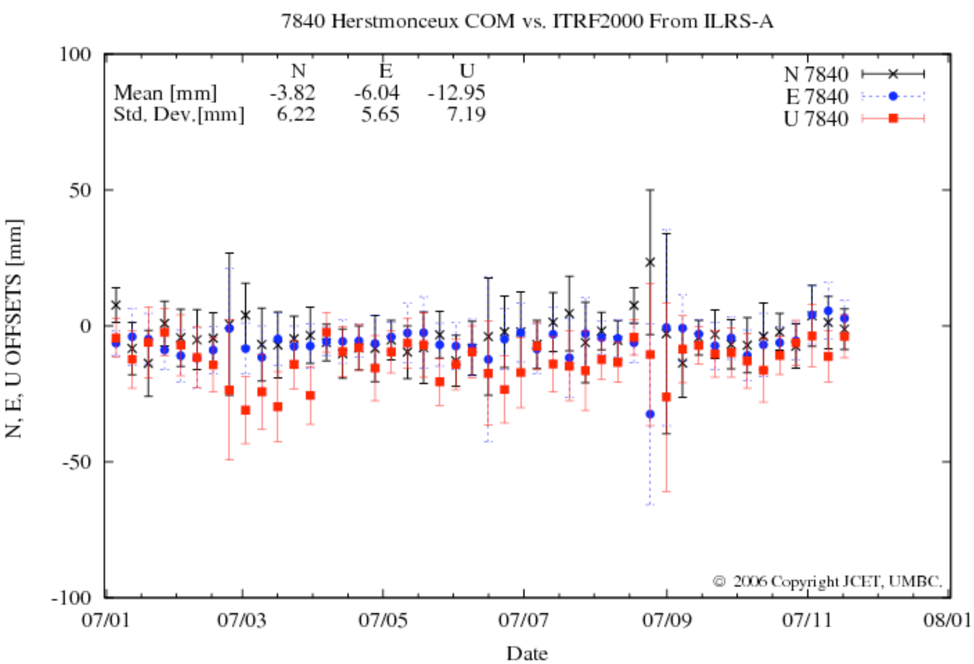

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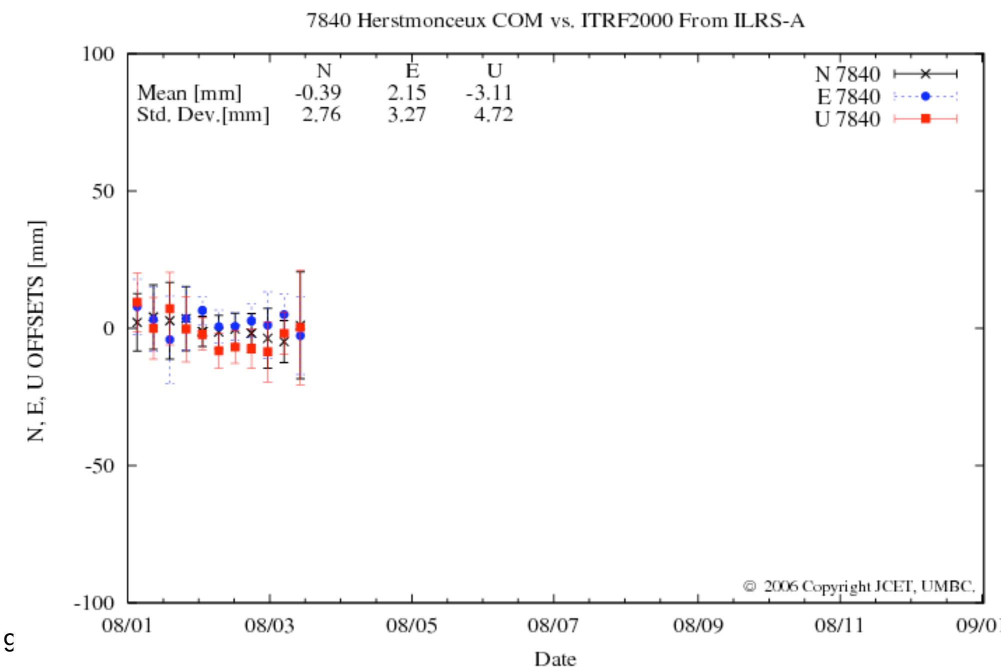

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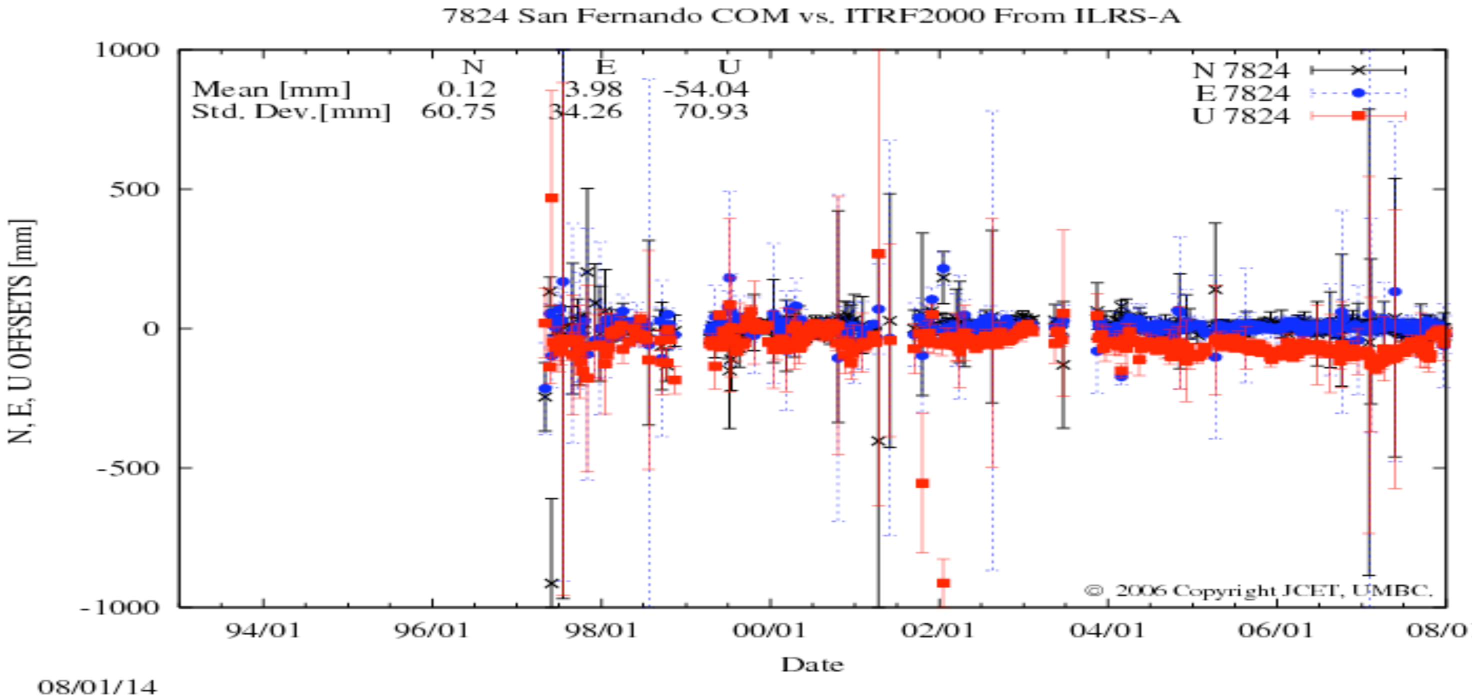
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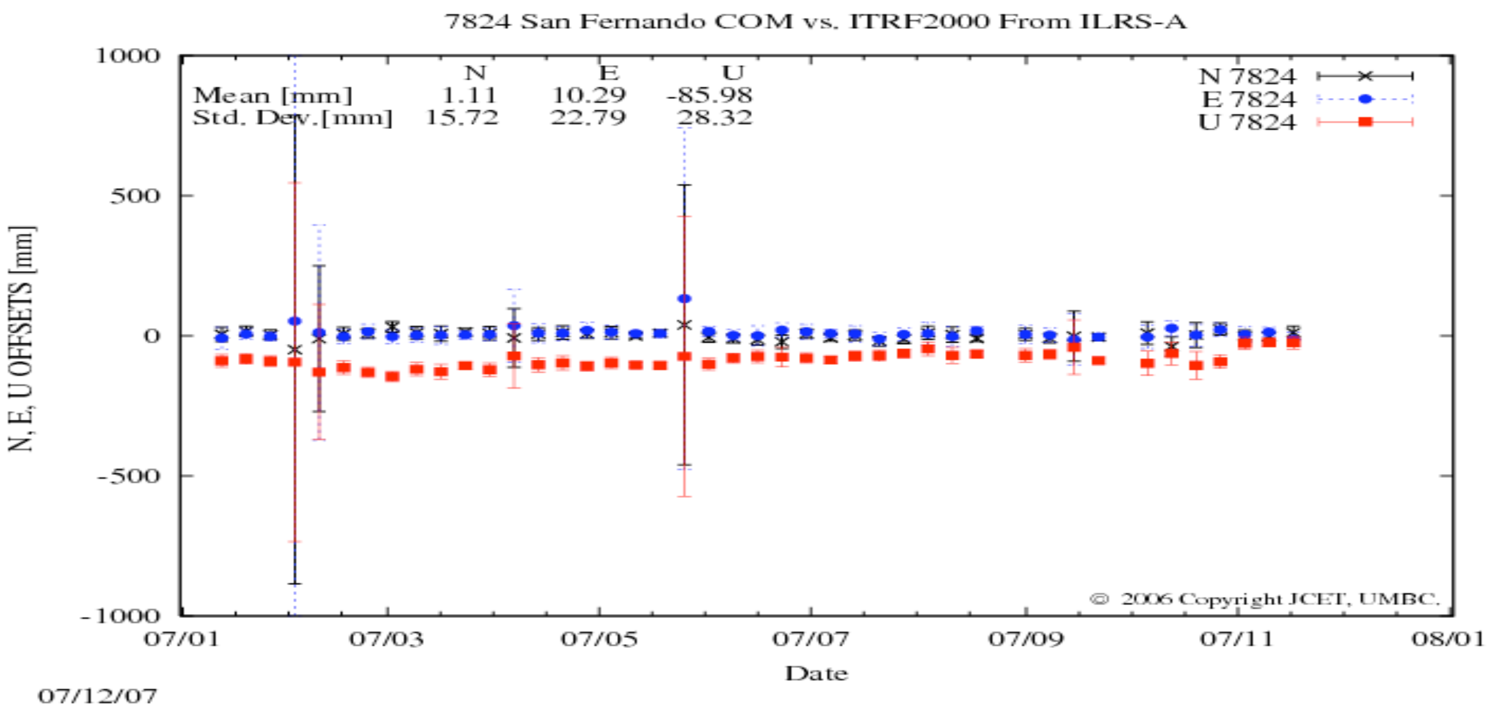
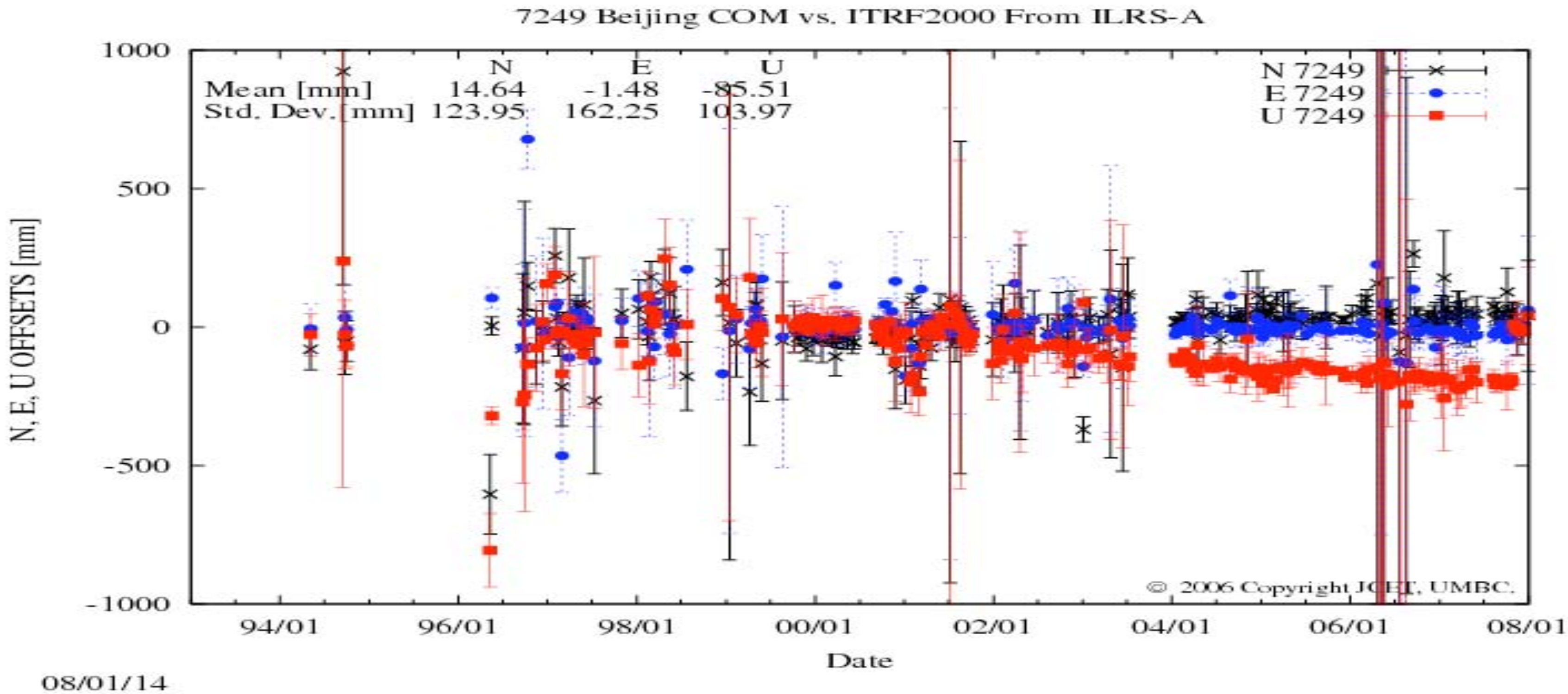
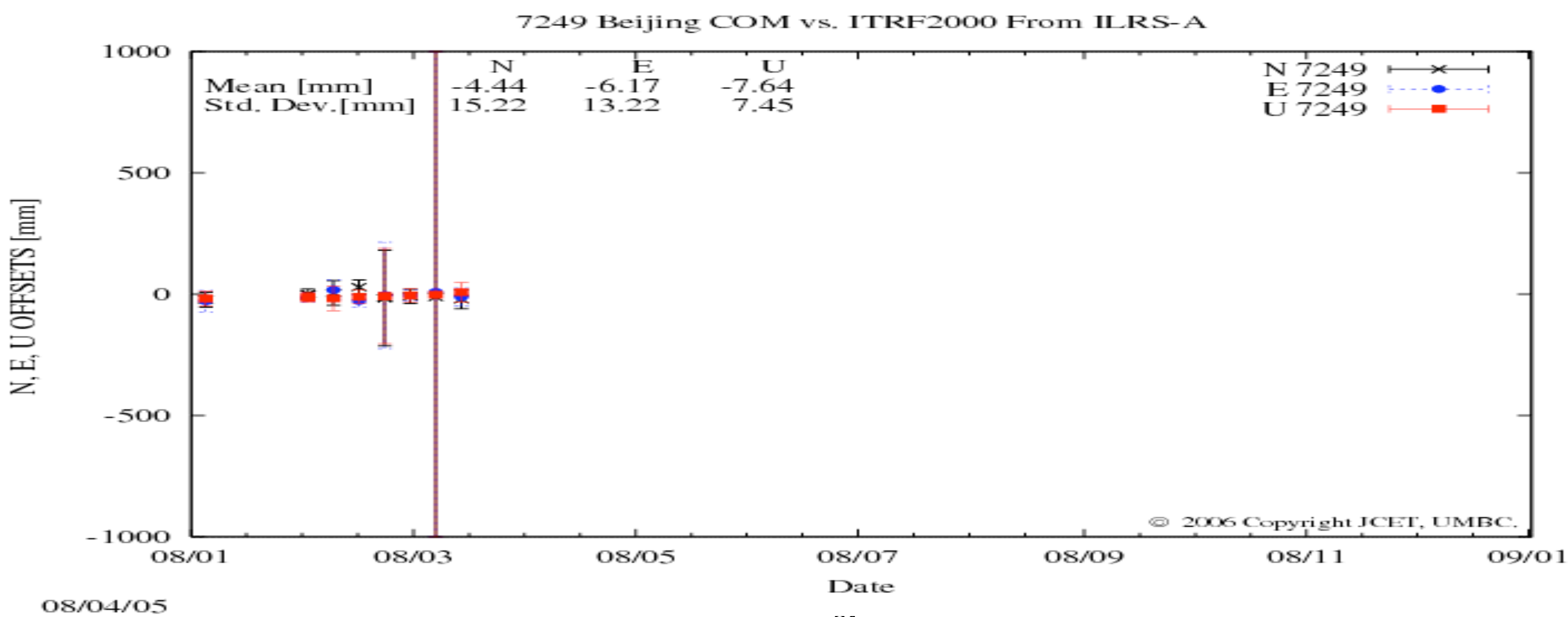
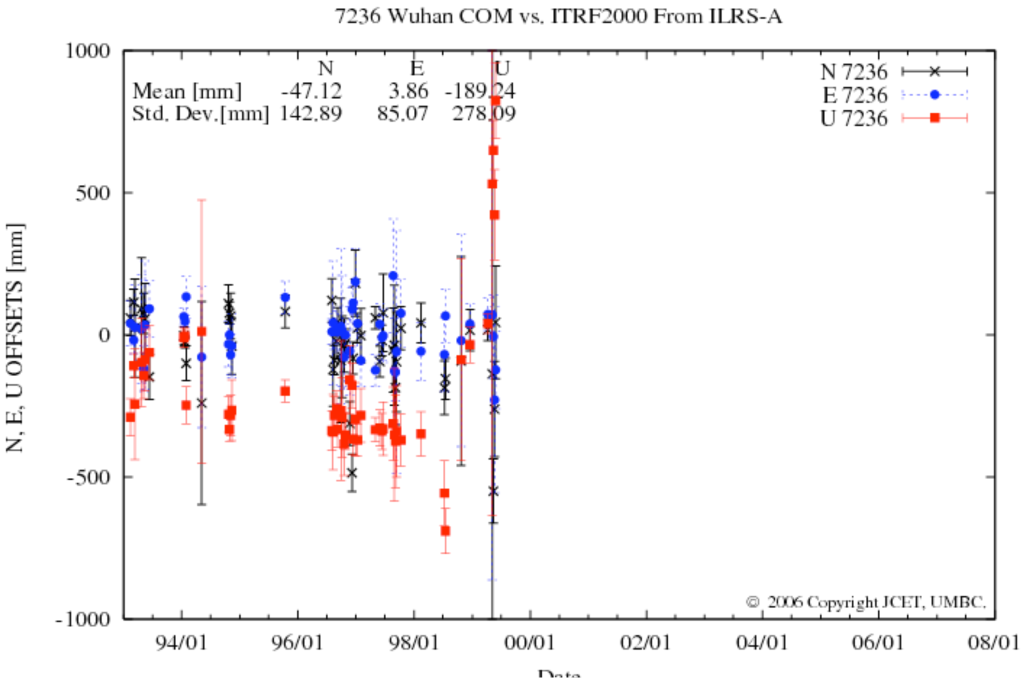
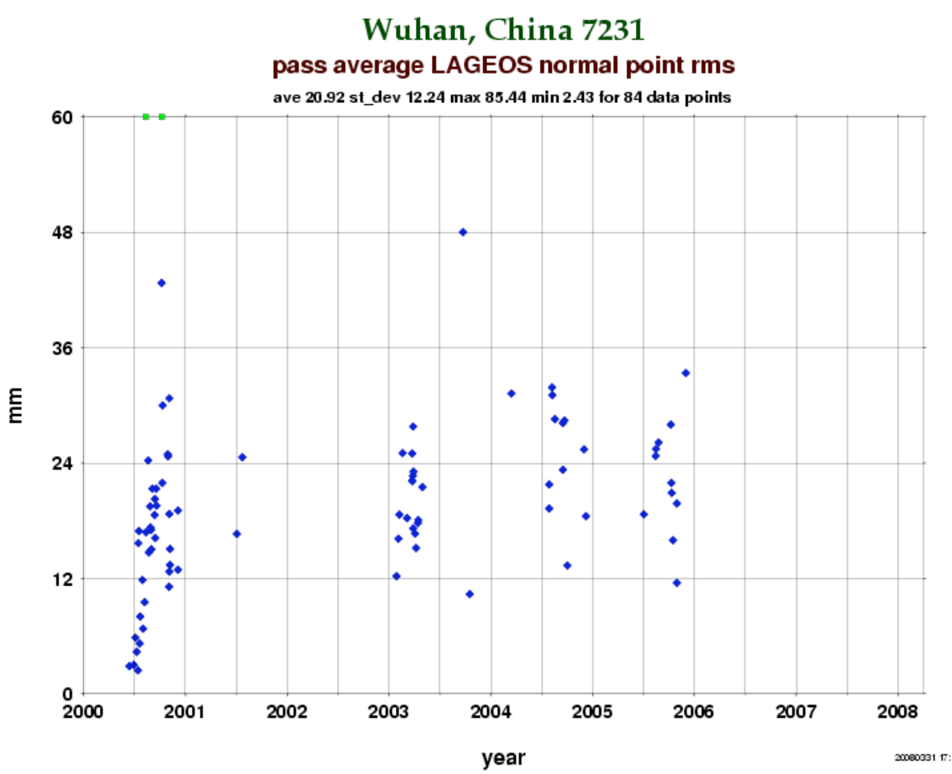
N E U
Mean [mm] 0.12 3.98 -54.04
Std. Dev.[mm] 60.75 34.26 70.93
N 7824
E 7824
U 7824
© 2006 Copyright JCET, UMBC.
N, E, U OFFSETS [mm]
Date
08/01/14

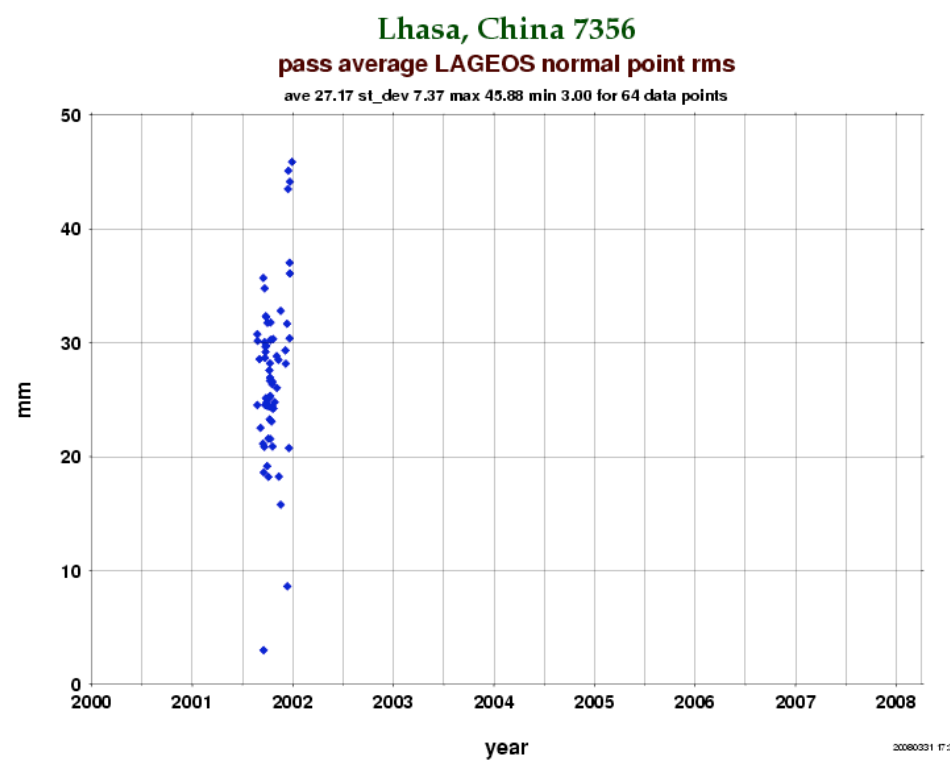

7824 San Fernando COM vs. ITRF2000 From ILRS-A
N E U
Mean [mm] 1.11 10.29 -85.98
Std. Dev.[mm] 15.72 22.79 28.32
N 7824
E 7824
U 7824
© 2006 Copyright JCET, UMBC.
N, E, U OFFSETS [mm]
Date
07/12/07

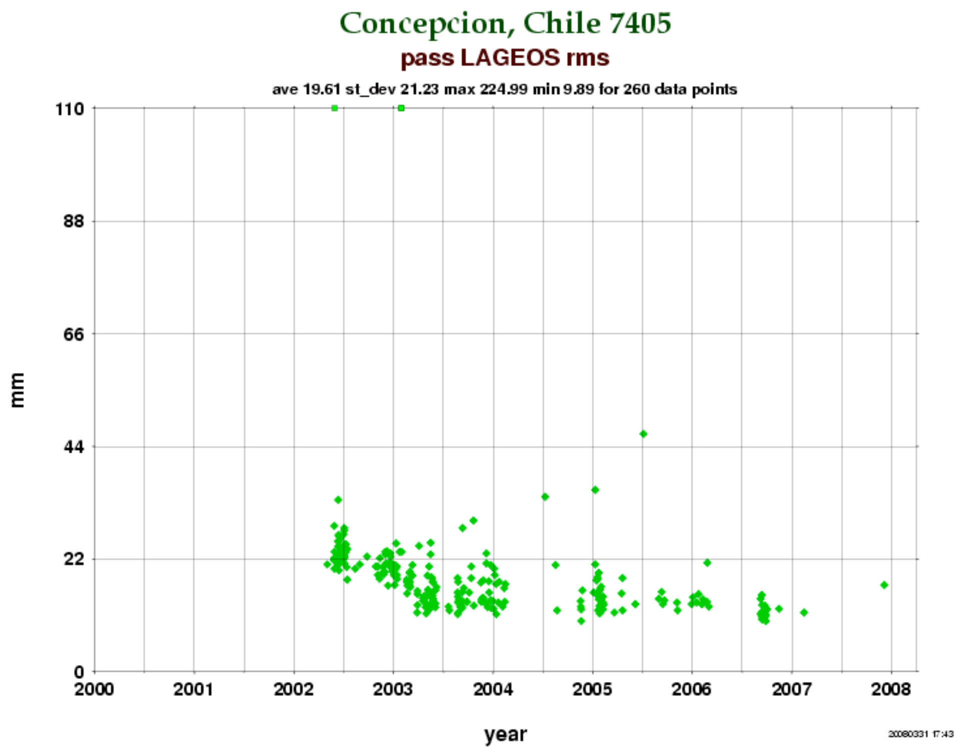

7249 Beijing COM vs. ITRF2000 From ILRS-A
N E U
Mean [mm] 14.64 -1.48 -85.51
Std. Dev. [mm] 123.95 162.25 103.97
N 7249
E 7249
U 7249
© 2006 Copyright JCET, UMBC.
N, E, U OFFSETS [mm]
Date
08/01/14

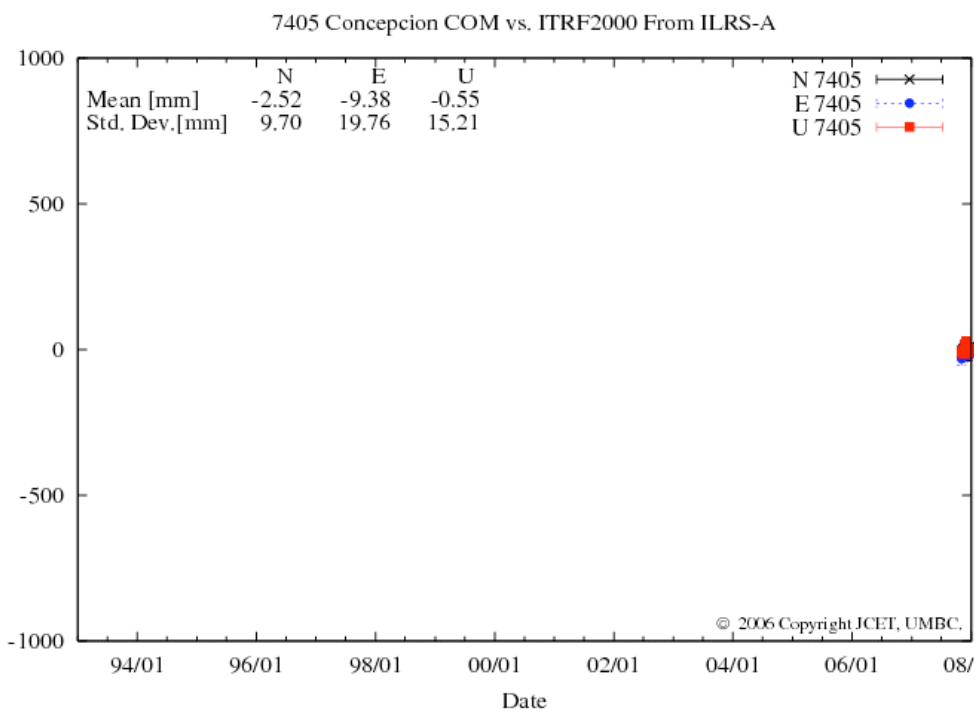

7249 Beijing COM vs. ITRF2000 From ILRS-A
N E U
Mean [mm] -4.44 -6.17 -7.64
Std. Dev.[mm] 15.22 13.22 7.45
N 7249
E 7249
U 7249
© 2006 Copyright JCET, UMBC.
N, E, U OFFSETS [mm]
Date
08/04/05


7236 Wuhan COM vs. ITRF2000 From ILRS-A
N E U
Mean [mm] -47.12 3.86 -189.24
Std. Dev.[mm] 142.89 85.07 278.09
N 7236
E 7236
U 7236
N, E, U OFFSETS [mm]
© 2006 Copyright JCET, UMBC.
94/01 96/01 98/01 00/01 02/01 04/01 06/01 08/01


Wuhan, China 7231
pass average LAGEOS normal point rms
ave 20.92 st_dev 12.24 max 85.44 min 2.43 for 84 data points
mm
year


Lhasa, China 7356
pass average LAGEOS normal point rms
ave 27.17 st_dev 7.37 max 45.88 min 3.00 for 64 data points
mm
year





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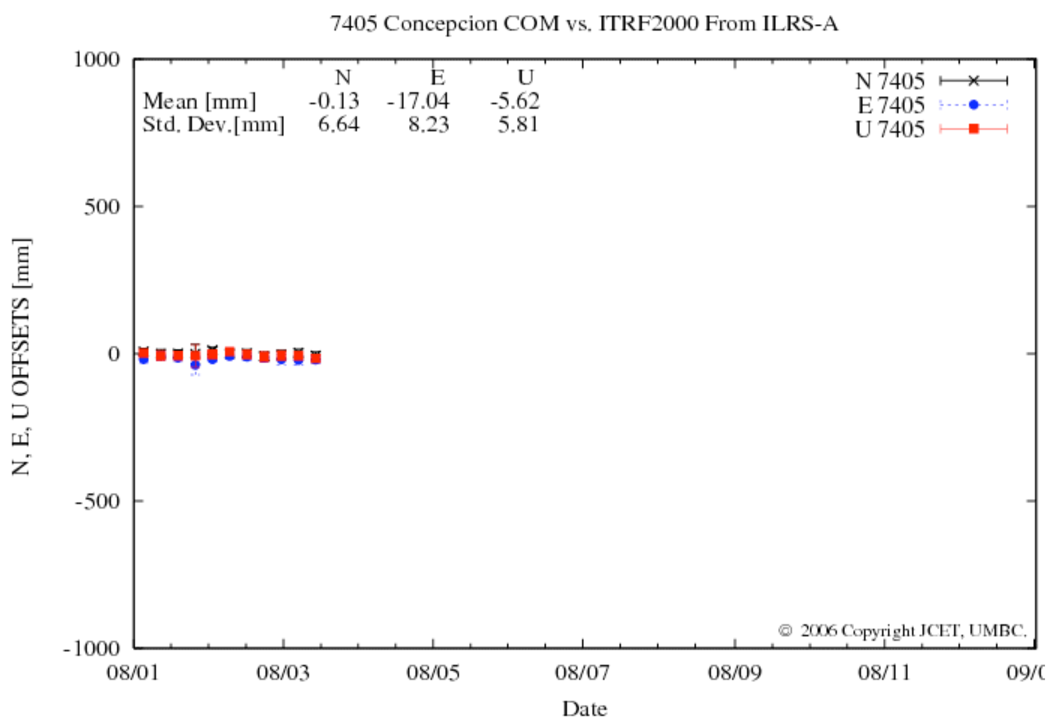
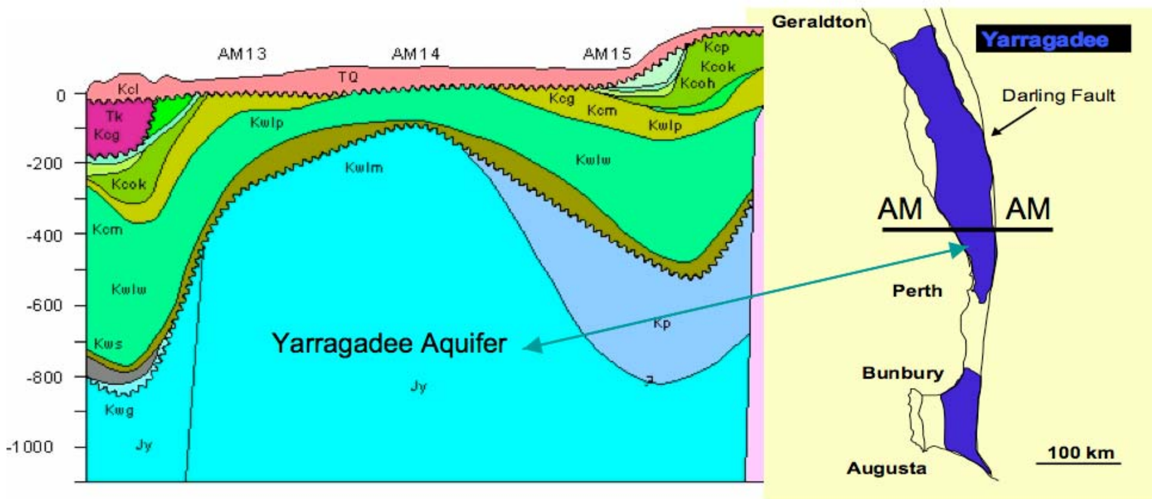
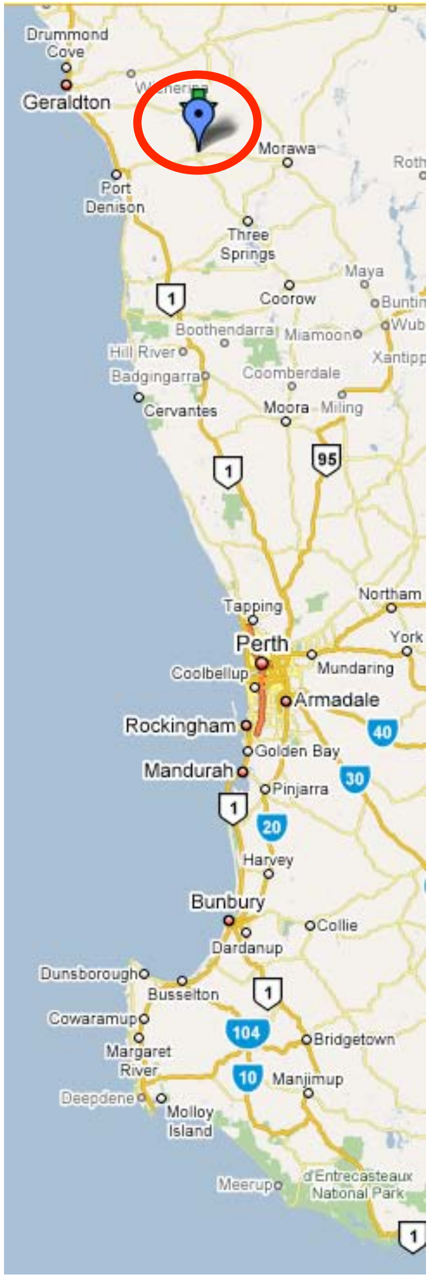


08/04/05

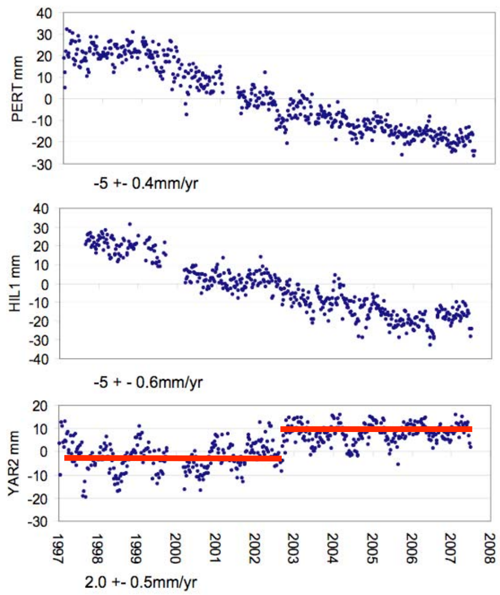
Yarragadee-Perth area investigation from GA and Water Dept. of Australia

Minghai Jia, Pauline English - Geoscience Australia
Philip Commander - Department of Water, Western Australia

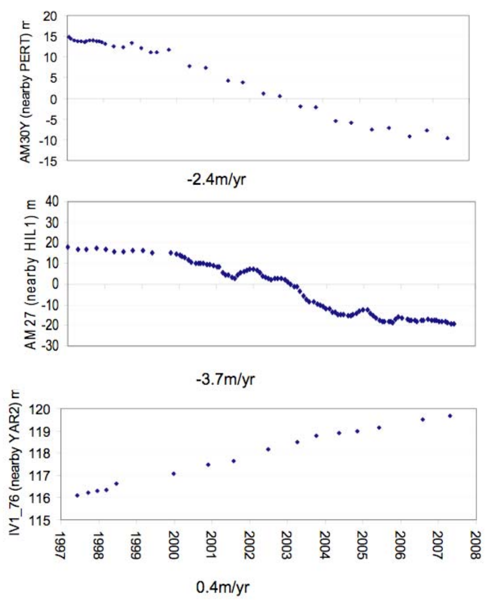


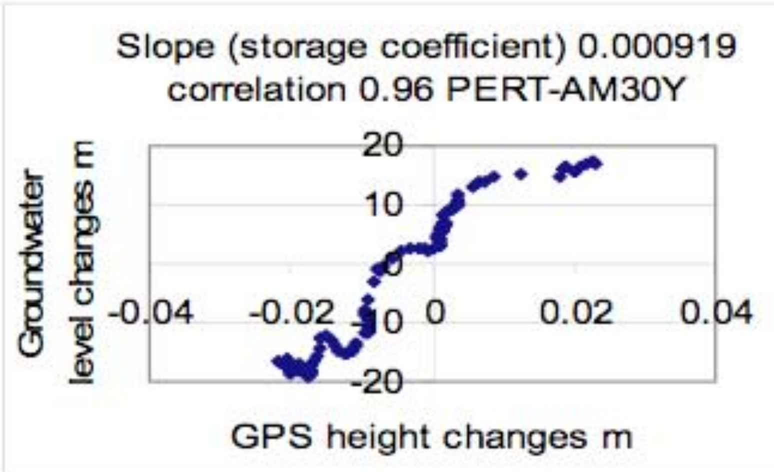


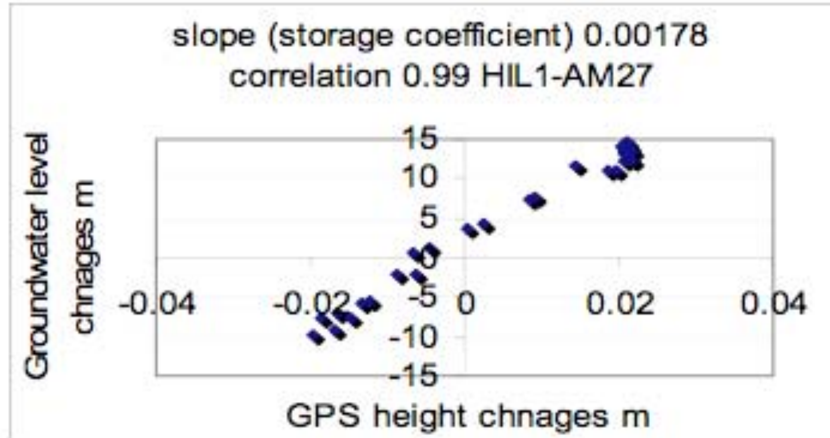
HEIGHT CHANGE

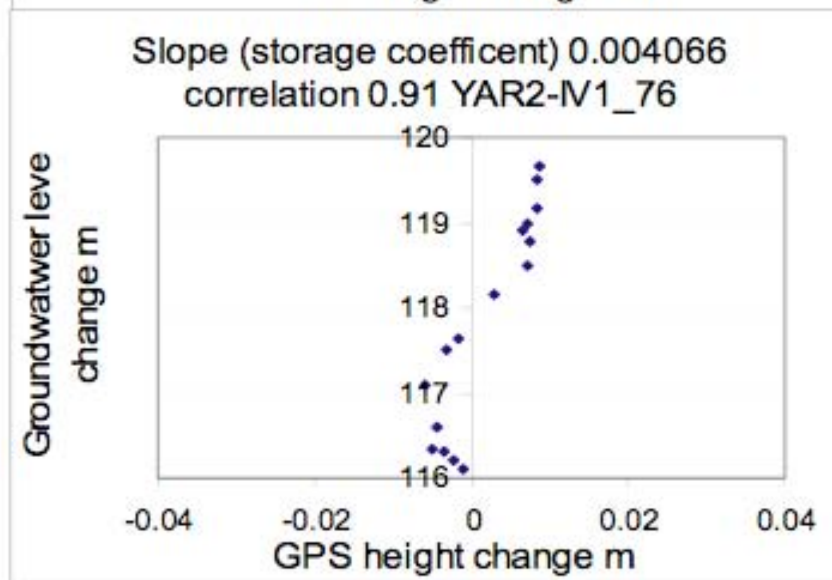


WATERTABLE CHANGE









The slopes (storage coefficients) estimated using the least squares method are 0.000919, 0.00178 and 0.004066 for pairs PERT-AM30Y, HIL1-AM27 and YAR2-IV1_76 respectively. The correlations are 0.96, 0.99 and 0.91 for the three pairs. The correlations are almost linear.

SLR Discontinuities, Biases, Edits, etc. file

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*-------------------------------------------------------------------------------
+FILE/REFERENCE
 CONTACT            Horst Mueller <mueller@dgfi.badw.de>
 CONTACT            Rolf Koenig <koenigr@gfz-potsdam.de>
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+FILE/COMMENT
 This file sets up a SLR discontinuity file
 in parallel to those already available and subject to
 updates in the IGS and IVS community.
 SOLUTION/DISCONTINUITY
 ----------------------
 Confirmed and Probable
 Commonly used models for time series analysis are:
 "M" Models codes for coordinates time series analysis:
      P = Position
      V = Velocity
      A = Annual Periodicity
      S = Semi-Annual Periodicity
      E = Exponential Decay
  "A" Axis modeled:
      E,N,U = East, North, Up
      X,Y,Z = Geocentric XYZ
      -     = 3D
SOLUTION/DATAHANDLING
 ---------------------
 "M" Models codes:
      X = Exclude/delete data
      R = Estimation of range bias recommended
      C = Target signature bias, Center-of-mass correction different to standard
      S = Stanford ET bias, BIAS in millimeter to be added to all one-way ranges
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-FILE/COMMENT
*-------------------------------------------------------------------------------
+INPUT/ACKNOWLEDGMENTS
*AGY ______________FULL_DESCRIPTION____________________________________________
 DGF Deutsches Geodaetisches Forschungsinstitut (DGFI), Munich, Germany
 GFZ GeoForschungsZentrum Potsdam (GFZ), Potsdam, Germany
     + Several individuals.
-INPUT/ACKNOWLEDGMENTS
*-------------------------------------------------------------------------------
+SITE/ID
*Code Pt __Domes__ T _Station Description__ _Longitude_ _Latitude__ _Height
 1824  A 12356S001 L Kiev                    30 29 46.0  50 21 47.9   212.9
 1864  A 12340S002 L Maidanak                66 56 35.1  38 41 05.6  2713.6
 1868  A 12341S001 L Komsomolsk             136 44 37.7  50 41 40.6   269.4
 1884  A 12302S002 L Riga                    24 03 32.6  56 56 54.7    31.3
 1893  A 12341S001 L Katsively               33 58 32.5  44 23  3.8    43.9
 7210  A 40445M001 L Maui                   203 44 38.7  20 42 26.0   3068.
 7105  A 40451M105 L Greenbelt              283 10 20.3  39  1 14.2    19.2
 7231  A 21602S004 L Wuhan                  114 29 22.9  30 30 52.9    86.5
 7237  A 21611S001 L Changchun              125 26 36.4  43 47 25.8   274.2
 7249  A 21601S004 L Beijing, old Laser     115 53 31.3  39 36 24.9    81.7
 7343  A 21601m002 L Beijing (TROS)         115 53 31.6  39 36 27.4    75.2
 7403  A 42202M005 L Arequipa               288 10 32.0 -16 27 55.2  2488.9
 7406  A 41508S003 L San Juan, Argentina    291 22 36.5 -31 30 31.3   728.0
 7604  A 10004M002 L Brest                    4 30 13.8  48 24 28.3   104.8
 7810  B 14001S007 L Zimmerwald               7 27 54.7  46 52 38.0   951.3
 7811  A 12205S001 L Borowiec                17 04 28.5  52 16 37.1   122.7
 7820  A 21609S002 L Kunming                102 47 50.7  25  1 47.9  1993.0
 7824  B 13402S007 L San Fernando           353 47 40.8  36 27 54.9    98.3
 7830  A 12617M002 L Chania                  24  4 14.0  35 31 59.0   160.3
 7831  A 30101S001 L Helwan                  31 20 33.7  29 51 32.4   131.9
 7835  A 10002S001 L Grasse                   6 55 16.0  43 45 16.8  1322.8
 7836  A 14106S009 L Potsdam                 13  3 53.6  52 22 48.1   133.5
 7838  A 21726S001 L Simosato               135 56 13.3  33 34 39.6   101.6
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 7839  A 11001S002 L Graz                      15 29 36.0  47 04 01.6   539.4
 7840  A 13212S001 L Herstmonceux                 20 10.0  50 52 02.5    75.4
 7841  A 14106S011 L Potsdam                   13  3 41.2  52 22 58.8   127.3
 7848  A 10077M002 L Ajaccio                    8 45 45.7  41 55 38.6    96.8
 8834  A 14201S018 L Wettzell                  12 52 40.8  49 08 39.9   665.4
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 7210  A    2 L 94:020:00000 00:001:00000 P -
 7210  A    3 L 00:001:00000 00:000:00000 P -
 7403  A    1 L 00:000:00000 01:175:73994 P - Arequipa Earthquake
 7403  A    2 L 01:175:73994 01:219:00000 P - Post seismic
 7403  A    3 L 01:219:00000 01:255:00000 P - Post seismic
 7403  A    4 L 01:255:00000 02:237:00000 P - Post seismic
 7403  A    5 L 02:237:00000 00:000:00000 P -
 7811  A    1 L 00:000:00000 94:001:00000 P -
 7811  A    2 L 94:001:00000 00:000:00000 P -
 7835  A    1 L 00:000:00000 97:146:00000 P -
 7835  A    2 L 97:146:00000 97:293:00000 P -
 7835  A    3 L 97:293:00000 00:000:00000 P -
 7838  A    1 L 00:000:00000 04:249:00000 P -
 7838  A    2 L 04:249:00000 00:000:00000 P -
 7839  A    1 L 00:000:00000 96:274:00000 P -
 7839  A    2 L 96:274:00000 00:000:00000 P -
 8834  A    1 L 00:000:00000 97:001:00000 P -
 8834  A    2 L 97:001:00000 00:000:00000 P -
-SOLUTION/DISCONTINUITY
*-------------------------------------------------------------------------------
+SOLUTION/DATAHANDLING
*CODE PT SOLN T _DATA_START_ __DATA_END__ M ____BIAS ________COMMENTS___________
 1824  A    1 L 99:314:00000 00:000:00000 S     16.0 Add to all one-way ranges
 1864  A    1 L 93:001:00000 00:000:00000 R
```

```
 1868  A    1 L 93:001:00000 00:000:00000 R
 1884  A    1 L 93:001:00000 00:000:00000 R
 1893  A    1 L 98:171:00000 00:000:00000 S     10.0 Add to all one-way ranges
 7105  A    1 L 06:336:18000 06:342:10800 X          Time unit failure
 7210  A    1 L 93:001:00000 00:000:00000 R
 7231  A    1 L 99:001:00000 00:000:00000 S     10.0 Add to all one-way ranges
 7237  A    1 L 93:001:00000 00:000:00000 R
 7249  A    1 L 01:020:00000 00:000:00000 S     22.0 Add to all one-way ranges
 7343  A    1 L 00:032:00000 00:000:00000 S     10.0 Add to all one-way ranges
 7406  A    1 L 06:020:00000 00:000:00000 S     10.0 Add to all one-way ranges
 7810  B    1 L 97:001:00000 00:000:00000 S     11.0 Add to all one-way ranges
 7810  B    1 L 93:001:00000 00:000:00000 R          For infrared wavelngth only
 7811  A    1 L 93:001:00000 94:001:00000 R
 7811  A    1 L 02:127:00000 00:000:00000 S      9.0 Add to all one-way ranges
 7820  A    1 L 98:140:00000 00:000:00000 S     19.0 Add to all one-way ranges
 7824  A    1 L 01:222:00000 00:000:00000 S      8.0 Add to all one-way ranges
 7830  A    1 L 03:091:00000 03:274:00000 S      6.0 Add to all one-way ranges
 7831  A    1 L 99:135:00000 00:000:00000 S     10.0 Add to all one-way ranges
 7835  A    1 L 95:244:00000 05:213:00000 S      3.0 Add to all one-way ranges
 7835  A    1 L 93:001:00000 98:001:00000 R
 7836  A    1 L 92:129:00000 00:000:00000 S     10.0 Add to all one-way ranges
 7838  A    1 L 04:183:00000 00:000:00000 S      9.0 Add to all one-way ranges
 7839  A    1 L 93:001:00000 96:274:00000 R
 7840  A    1 L 93:001:00000 00:000:00000 C          245 mm CoM for LAGEOS1/-2
 7840  A    1 L 93:001:00000 94:274:00000 R          Stanford Counter problems
 7840  A    1 L 93:001:00000 02:032:00000 S     18.5 Add to all one-way ranges
 7840  A    1 L 02:032:00000 00:000:00000 S      8.5 Add to all one-way ranges
 7841  A    1 L 01:201:00000 04:050:00000 S     10.0 Add to all one-way ranges
 7848  A    1 L 02:091:00000 02:274:00000 S      8.0 Add to all one-way ranges
 8834  A    1 L 93:001:00000 97:001:00000 R
-SOLUTION/DATAHANDLING
*-----------------------------------------------------------------
%ENDSNX
```

```
+BIAS/EPOCHS     SLR DATA PROBLEM FILE PROPOSED by V. Husson in 2003
*
*   Last modified -  14 July 2003
*       by V. Husson/ILRS Central Bureau (back then :-)
*
* ILRS Point Codes are:
*
*   L1: LAGEOS-1
*   L2: LAGEOS-2
*   LC: LAGEOS Combined
*   E1: Etalon-1
*   E2: Etalon-2
*   EC: Etalon Combined
*   --: Wildcard (applies to all satellites, LEO, LAGEOS, and high)
*
*
* ILRS Observation Bias Codes are:
*
*   R: range bias
*   T: time bias
*   P: pressure bias
*   S: scale bias
*   X: blunder, please edit
*
*
* The Solution Number Code is used to reflect the release flag
* of the data (byte 48 of the normal point data record)
*
* Note: 1) The Mean Epoch field was intentionally left blank.
*       2) An entry with a Bias Code of 'X' will NOT have a corresponding
*          entry in the SOLUTION/APRIORI BLOCK, because this data is to
*          edited. Conversely, an entry with a bias code other than 'X'
*          will have a corresponding entry in the SOLUTION/APRIORI BLOCK.
```

```
*        1         2         3         4         5         6         7         8
*234567890123456789012345678901234567890123456789012345678901234567890123456789890
*-------------------------------------------------------------------------------
*SITE PT SOLN T _DATA_START_ __DATA_END__ _MEAN_EPOCH_
*
 1864 --    0 P 90:270:00000 00:359:00000
 1864 L1    0 X 99:170:58920 99:170:62520
 1864 --    0 X 02:070:00000 02:101:00000
 1868 L1    0 X 99:313:41160 99:313:44760
 1868 L2    0 X 99:313:47520 99:313:51120
 1868 L2    0 R 99:319:36120 99:319:39720
 1868 L1    0 R 99:319:61080 99:319:64680
 1868 L2    0 R 99:319:65460 99:319:69060
 1884 L2    0 X 99:128:71280 99:128:74880
 7105 L2    0 P 99:138:73380 99:138:76980
 7105 L2    0 X 99:141:68416 99:141:68418
 7105 L2    0 X 99:156:03150 99:156:03152
 7105 L2    0 X 99:158:03021 99:158:03023
 7105 L1    0 P 99:159:20580 99:159:24180
 7105 L1    0 P 99:191:15720 99:191:16444
 7105 L1    0 X 99:191:16805 99:191:16807
 7105 L2    0 P 99:192:51720 99:192:52927
 7105 L2    0 X 99:192:53055 99:192:53057
 7210 L1    0 T 99:183:31980 99:183:33200
 7210 L1    0 T 99:188:19860 99:188:20070
 7210 L2    0 T 99:189:07380 99:189:08330
 7210 L2    0 X 99:189:08584 99:189:08585
 7210 L1    0 T 99:189:27900 99:189:29300
```

```
-BIAS/EPOCHS
*
*
+SOLUTION/APRIORI
*
* SOLUTION/APRIORI entries will have a corresponding entry
* in the BIAS/EPOCHS Block. The Point Codes, Solution Number
* and start epoch should exactly match the corresponding entries
* in the SOLUTION/APRIORI Block.
*
*
* ILRS Parameters Types are:
*
*   RBIAS: range bias
*   TBIAS: time bias
*   SBIAS: scale bias
*   PBIAS: pressure bias
*   ZBIAS: tropospheric bias (zenith)
*
*
* ILRS Point Codes are:
*
*   L1: LAGEOS-1
*   L2: LAGEOS-2
*   LC: LAGEOS Combined
*   E1: Etalon-1
*   E2: Etalon-2
*   EC: Etalon Combined
*   --: Wildcard (apply to all satellites, LEO, LAGEOS, and high)
*
*
* The Solution Number Code is used to reflect the release flag
* of the data (byte 48 of the normal point data record)
*
```

```
*
* ILRS Parameter Units are:
*
*    m: meters
*   mb: millibars
*   ms: milliseconds
*   us: microseconds
*  mas: milli-arc-seconds
*  ppb: parts per billion
*
*
* Note: 1) Parameter Index is intentionally left blank
*       2) The Constraint Code has been set to "0", which implies a
*          fixed/tight constraint for the bias.
*       3) To apply the data correction subtract the correction field
*          (i.e. apriori bias) from the corresponding normal point
*          (NP) field
*
*             e.g. Corrected Range = NP Range - Range Bias
*                  Corrected Epoch = Epoch - Time Bias
*                  Corrected Pressure = NP Pressure - Pressure Bias
*
*       4) The uncertainity in the apriori bias value is in the column
*          Apriori Standard Deviation.
*
*
*        1         2         3         4         5         6         7         8
*234567890123456789012345678901234567890123456789012345678901234567890123456789O
*-------------------------------------------------------------------------------
*INDEX _TYPE_ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ __STD_DEV__
       PBIAS  1864 --    0 90:270:00000 mb   0 -.680000000000000E+01 .100000E+01
       RBIAS  1868 L2    0 99:319:36120 m    0 0.150000000000000E+01 .150000E-01
       TBIAS  7105 --    0 99:067:41720 ms   0 -.201500000000000E+00 .500000E-03
       PBIAS  7105 L2    0 99:138:73380 mb   0 0.560000000000000E+01 .100000E+01
```

DGFI/GFZ PROPOSAL:

```
+SOLUTION/DATAHANDLING
*CODE PT SOLN T _DATA_START_ __DATA_END__ M ____BIAS ________COMMENTS___________
 1824  A    1 L 99:314:00000 00:000:00000 S     16.0 Add to all one-way ranges
 1864  A    1 L 93:001:00000 00:000:00000 R
 7840  A    1 L 93:001:00000 00:000:00000 C          245 mm CoM for LAGEOS1/-2
 7105  A    1 L 06:336:18000 06:342:10800 X          Time unit failure
```

VH-modified PROPOSAL:

```
*INDEX _TYPE_ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ __STD_DEV__
       PBIAS  1864 --    0 90:270:00000 mb   0 -.680000000000000E+01 .100000E+01
       RBIAS  1868 L2    0 99:319:36120 m    0 0.150000000000000E+01 .150000E-01
       TBIAS  7105 --    0 99:067:41720 ms   0 -.201500000000000E+00 .500000E-03
       PBIAS  7105 L1    0 99:138:73380 mb   0 0.560000000000000E+01 .100000E+01
       SBIAS  7210 --    0 90:049:41720 ppb  0 -.809273589426100E+01 .500000E-03
```

FUSED VERSION PROPOSAL:

```
*        1         2         3         4         5         6         7         8
*234567890123456789012345678901234567890123456789012345678901234567890123456789O
+SOLUTION/DATAHANDLING
*CODE PT UNIT T _DATA_START_ __DATA_END__ M __E-VALUE___ STD_DEV_ ___COMMENTS___
 1864 -- mb   S 99:314:00000 00:000:00000 P -.680000E+01 .100E+01 Wrong Cal
 1868 L2 m    A 93:001:00000 00:000:00000 R 0.150000E+01 .150E-01 See 1993.12345
 7840 -- m    M 93:001:00000 00:000:00000 C 0.245000E+01 .200E-02 LAGEOS1/-2
 7105 L1 -    E 06:336:18000 06:342:10800 X 0.000000E+00 .000E+00 T-unit failed
 7210 -- ppb  A 90:049:41720 90:342:10800 S -.809274E+01 .500E-03 HOLLAS scale-b
 7105 -- ms   E 99:067:41720 99:097:41720 T -.201500E+00 .500E-03 Sec. time Unit
```

T-CODES:
- **S = Station-supplied/determined**
- **A = Analysis-supplied/determined** ***(1993.12345 refers to Rpt.)***
- **M = Model-supplied/determined**
- **E = Engineering-supplied/determined**

****

SLR Electronic Report   Wed Apr 9 15:15:07 CEST 2008   Message No. 9469

****

Author: Werner Gurtner

Subject: ILRS Combined Range Bias Report 09-Apr-2008

ILRS Combined Range Bias Report 1

****

2008-03-26 00:00 UT - 2008-04-09 00:00 UT

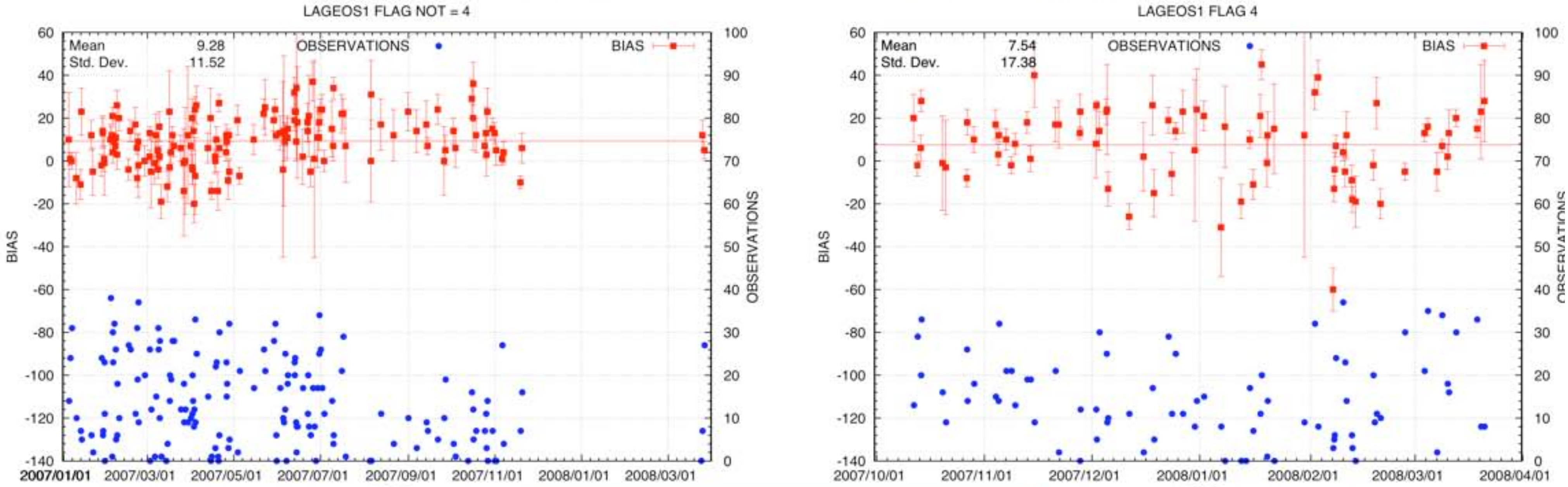
Compiled by: SLR Observatory Zimmerwald

Date   : 2008-04-09 12:30 UT

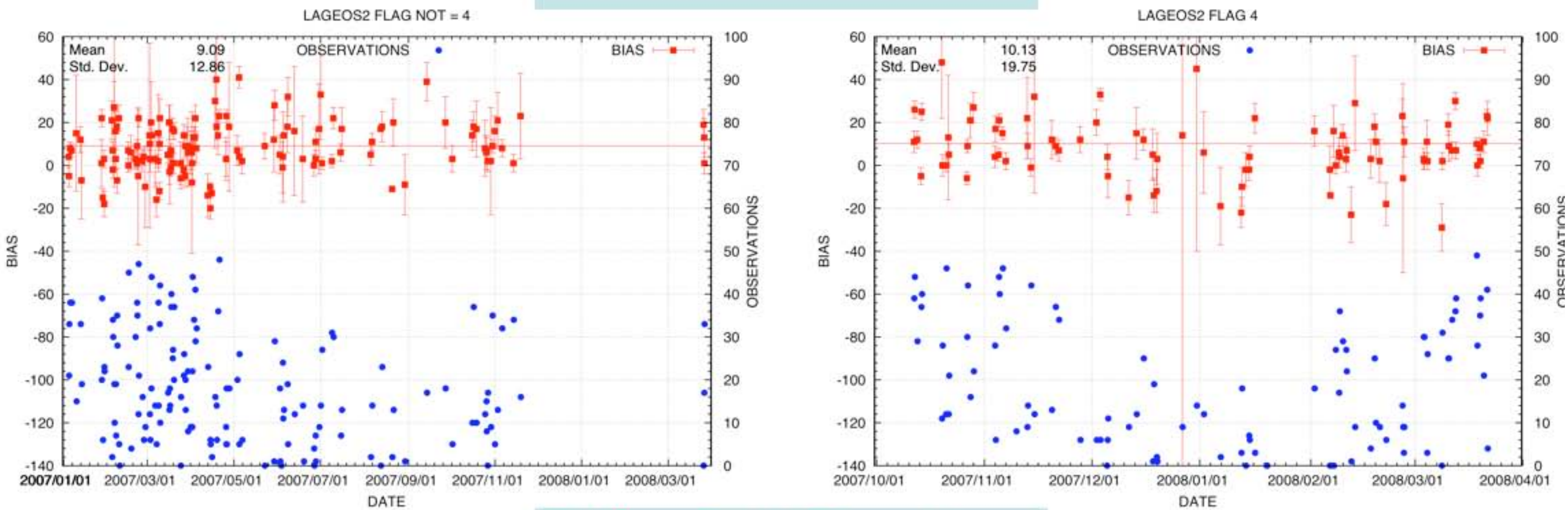
E-Mail   : Werner.Gurtner@aiub.unibe.ch

No.	Site Location		wl	DGFI rb	DGFI pr	MCC rb	MCC pr	HIT-U rb	HIT-U pr	SAO rb	SAO pr	JCET rb	JCET pr
1873	SIML	Simeiz	532	-51	13	38	70	-93	91	-13	49	93	8
1893	KTZL	Katzively	532	-21	10			-172	9			-177	8
7080	MDOL	McDonald	532	12	4	11	3	6	3	7	3	2	4
7090	YARL	Yarragadee	532	6	2	0	2	2	1	-6	1	7	3
7105	GODL	Greenbelt	532	2	4			2	2			0	3
7110	MONL	Monument Peak	532	-4	3	0	3	4	3	-4	3	-4	4
7119	HA4T	Haleakala	532	6	3	0	3	8	2	-5	3	8	4
7249	BEIL	Beijing	532	15	7	1	7	0	6	55	5	17	6
7308	KOGC	Koganei	532	33	2	62	2	26	2	31	1	14	3
7358	GMSL	Tanegashima	532	40	2			49	1	-79	6	41	4
7405	CONL	Concepcion	847	-4	4	-29	3	-55	2	-24	3	-35	4
7406	SANJ	San Juan	532	0	6	4	3	0	2	-3	3	8	4
7501	HARL	Hartebeesthoek	532	13	2	4	9	13	3	-34	2	3	8
7820	KUNL	Kunming	532	-519	7			117	8			125	8
7824	SFEL	San Fernando	532	-14	3	-42	4	-16	2	1	4	-15	3
7825	STL3	Mt Stromlo	532	3	3	-13	3	-2	2	-7	2	1	3
7832	RIYL	Riyadh	532	18	3	-21	3	16	2	-32	3	26	3
7839	GRZL	Graz	532	0	1	-6	1	-8	1	0	1	0	2
7840	HERL	Herstmonceux	532	12	1	7	2	13	1	13	2	9	2
7841	POT3	Potsdam	532	4	7	-3	5	-9	5			0	6
7941	MATM	Matera	532	-5	2	18	2	-4	2	18	1	5	3
8834	WETL	Wettzell	532	1	3	-2	3	3	3	-17	2	5	3

MLRS 7080 MCP Bias



Rb^{L1} wrt Old MCP ≈-1.7 mm



Rb^{L2} wrt Old MCP ≈+1.0 mm

Core sites and biases: an update

V. Luceri – e-GEOS S.p.A.

G. Bianco - Agenzia Spaziale Italiana

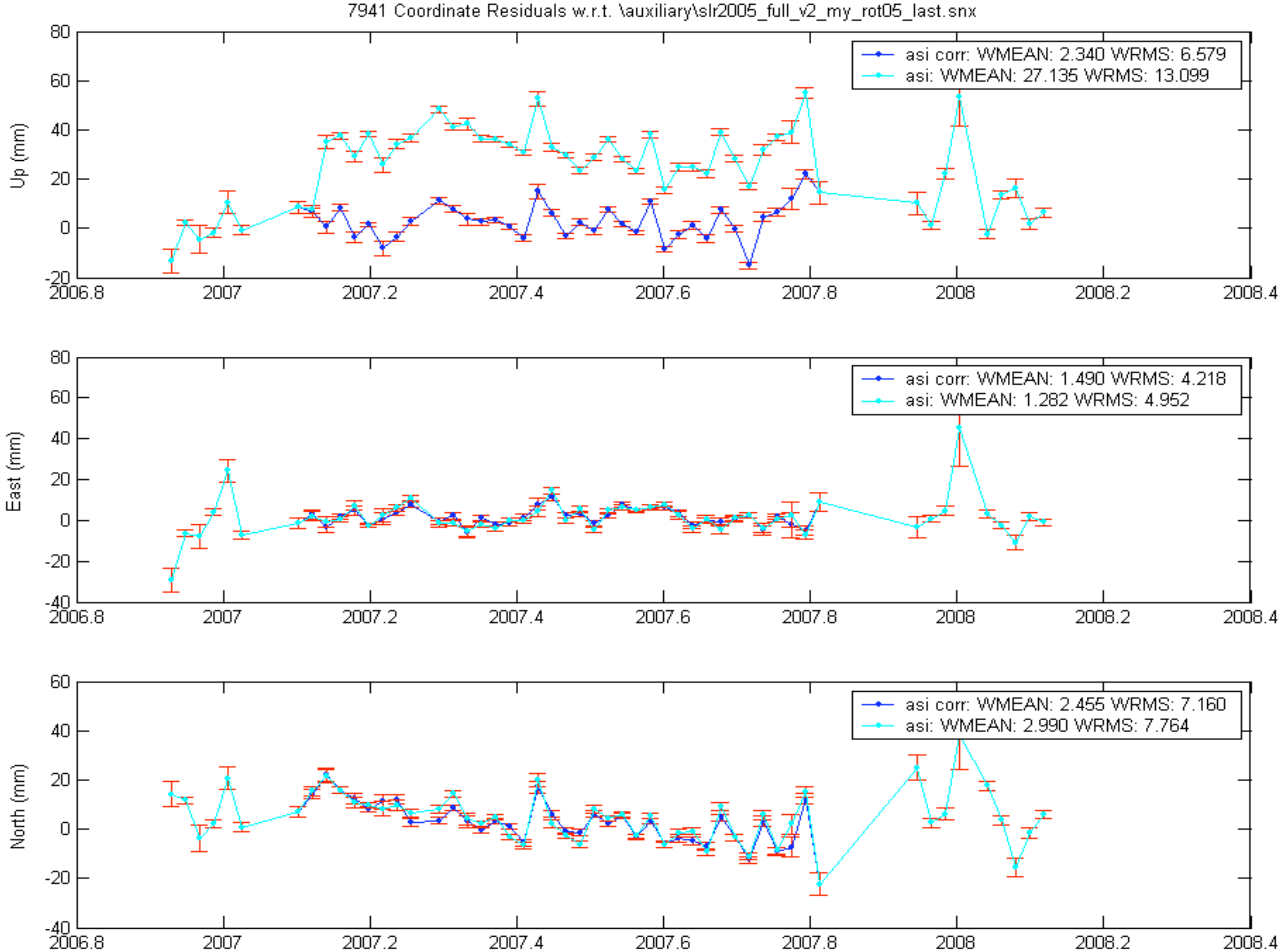
Core Sites residuals w.r.t SLRF2005

core	UP (mm)	EAST (mm)	NORTH (mm)
7080	WMEAN: 0.9 WRMS: 8.5	-0.1 4.6	1.4 7.8
7090	WMEAN: 1.1 WRMS: 4.4	-2.2 5.3	2.2 7.1
7105	WMEAN: 3.1 WRMS: 8.3	1.3 6.6	1.4 9.0
7109	WMEAN: -2.1 WRMS: 7.9	-0.4 7.0	-0.9 8.9
7110	WMEAN: 1.2 WRMS: 6.5	1.4 5.2	2.0 9.0
7210	WMEAN: -13.5 WRMS: 13.8	-0.9 10.3	2.0 13.7
7249	WMEAN: -9.2 WRMS: 31.7	1.8 20.2	-10.5 23.1
7403	WMEAN: -10.9 WRMS: 10.3	5.1 12.3	-0.2 12.2
7501	WMEAN: 1.2 WRMS: 7.6	3.7 7.3	5.8 12.0
7810	WMEAN: -21.9 WRMS: 7.4	0.2 3.5	0.8 6.4
7825	WMEAN: 1.2 WRMS: 6.0	-4.5 5.9	-4.2 7.0
7832	WMEAN: -5.1 WRMS: 9.2	-1.9 5.9	1.9 9.8
7834	Until 1991		
7835	WMEAN: 0.3 WRMS: 11.5	-0.2 8.3	2.2 12.9
7836	WMEAN: 0.4 WRMS: 12.4	-0.3 9.6	0.5 11.9
7837	WMEAN: -3.7 WRMS: 18.6	-1.5 15.8	6.4 14.4

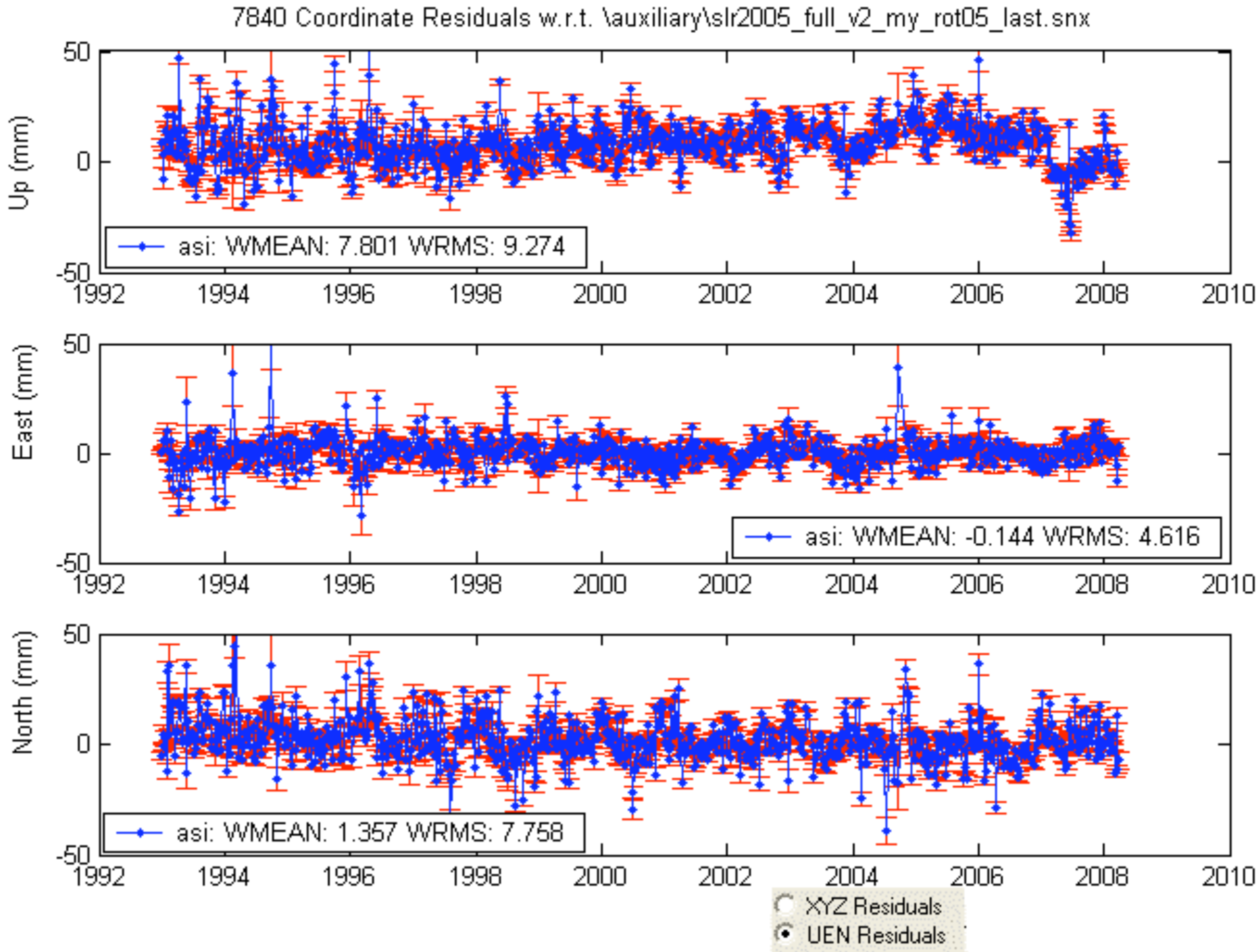
core	UP (mm)	EAST (mm)	NORTH (mm)
7837	WMEAN: -3.7 WRMS: 18.6	-1.5 15.8	6.4 14.4
7839	WMEAN: 3.8 WRMS: 10.4	0.0 4.4	1.3 7.1
7840	WMEAN: 7.8 WRMS: 9.3	-0.1 4.6	1.3 7.7
7849	WMEAN: 0.9 WRMS: 8.4	-8.1 8.0	4.0 11.2
7907	Until 1992		
7939	WMEAN: -2.1 WRMS: 13.6	2.0 14.6	2.2 18.3
7941	WMEAN: 12.7 WRMS: 15.6	1.4 4.8	1.5 7.9
8834	WMEAN: 2.9 WRMS: 12.4	0.4 6.4	0.3 8.5

- 7249 deleted from the core site list?
- Bias correction for 7941
- 7840 bias?

MLRO Time series before and after the bias correction



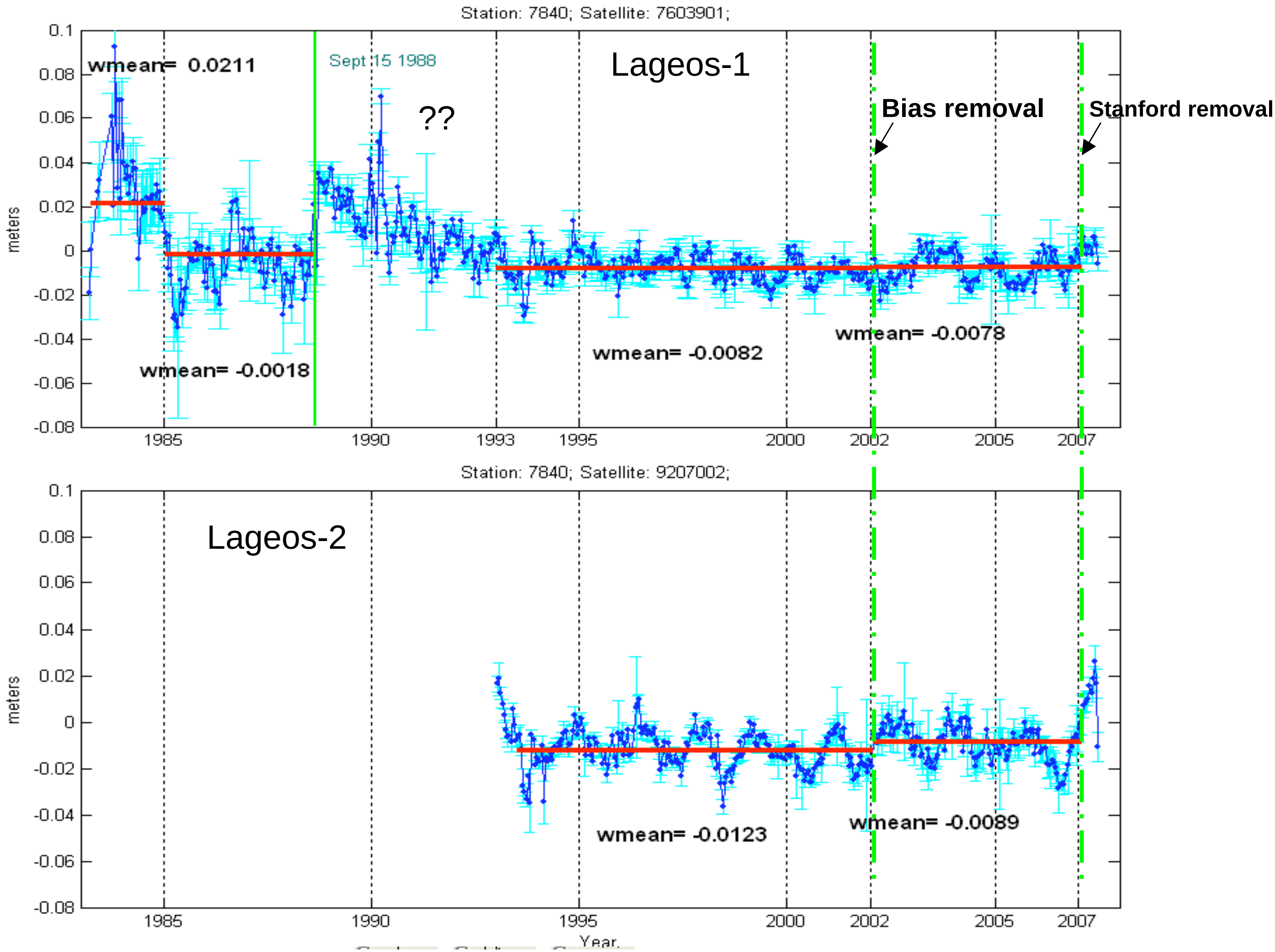
ASI v10 time series – 7840 residual coordinates w.r.t. SLRF2005



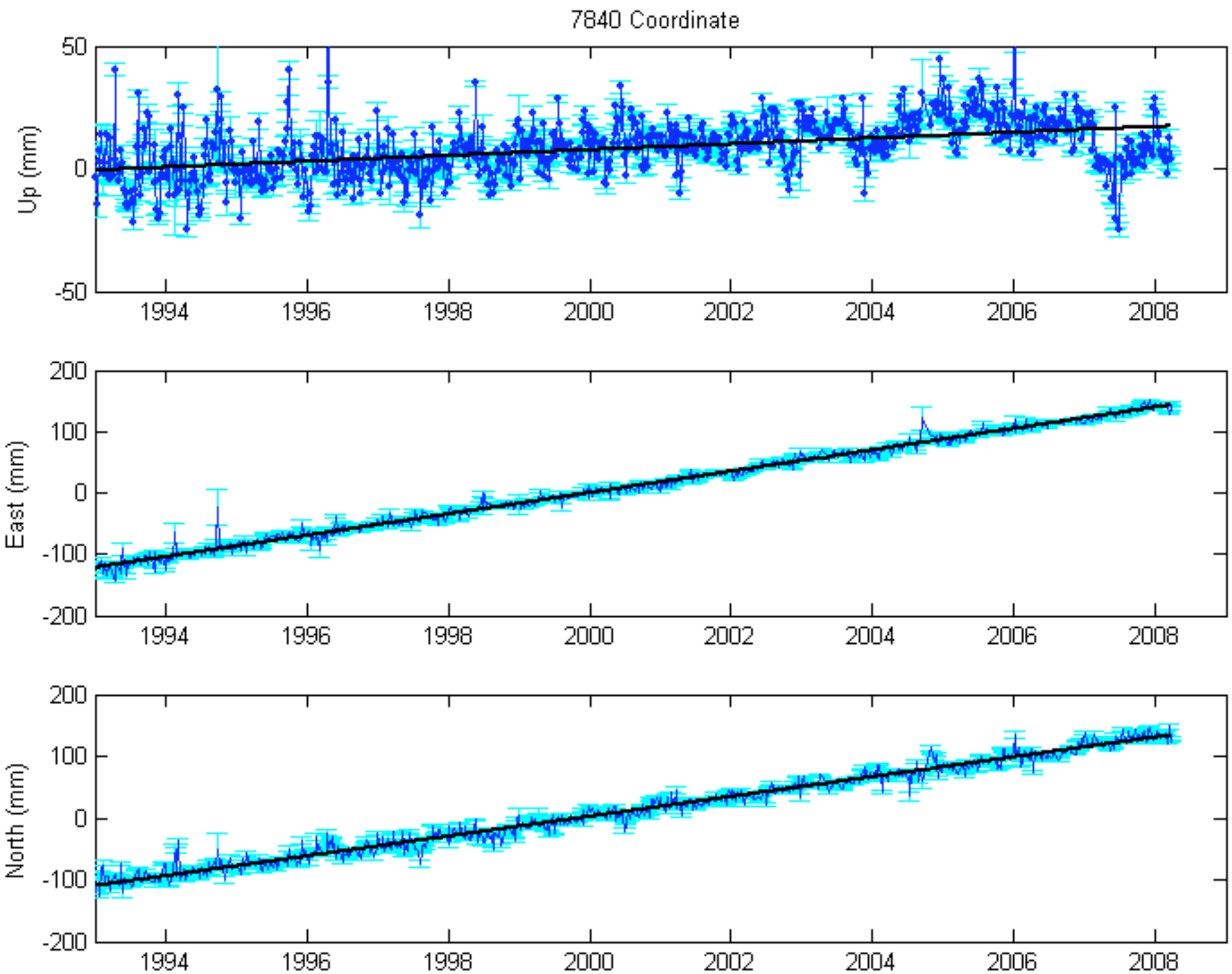
corrections

Start Date	End Date	Correction to be subtracted
october 1, 1994	february 1, 2002	-2.5 mm
february 1, 2002	february 10, 2007	5.5 mm

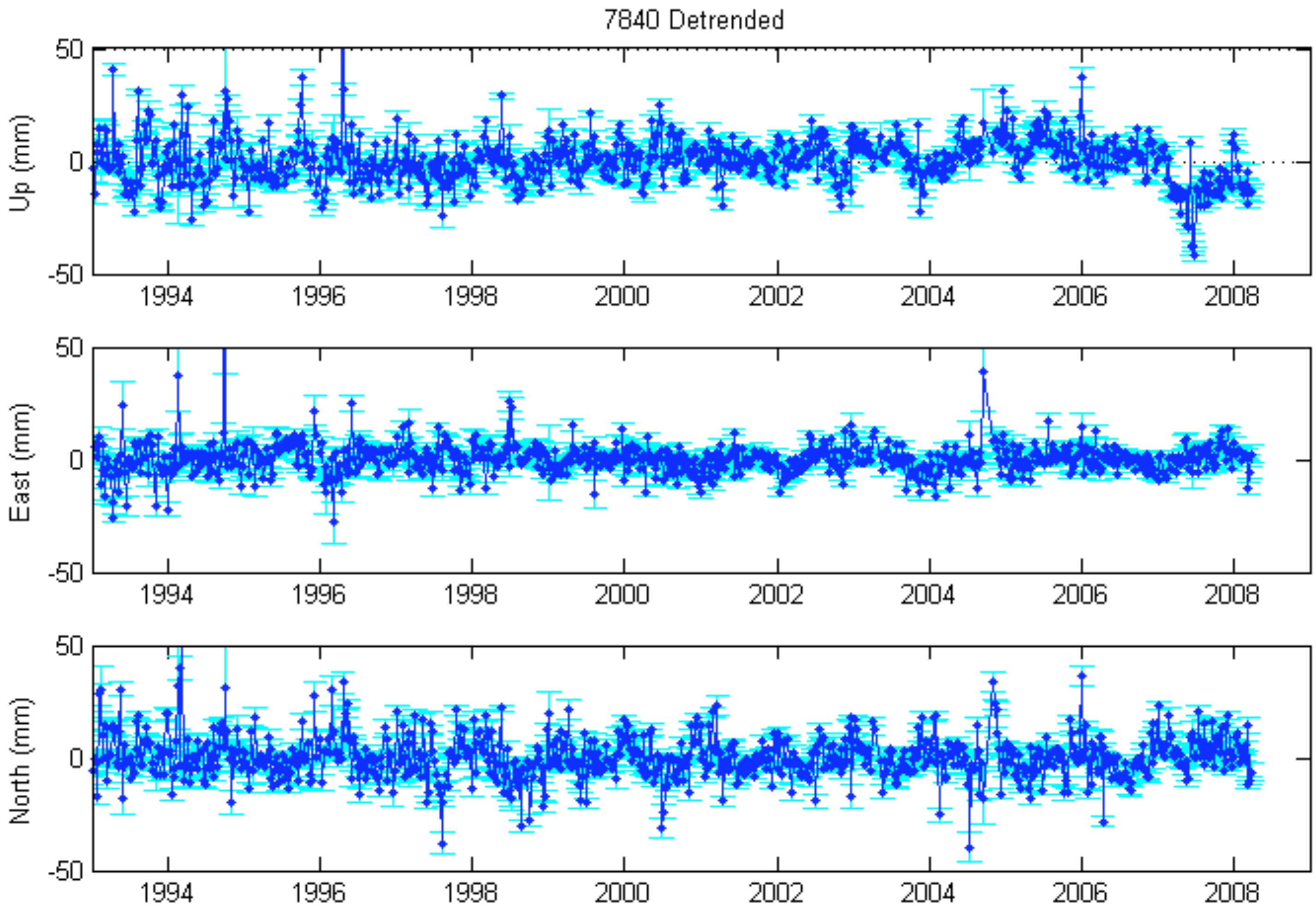
Herstmonceux: range biases from solution CGS2006_new



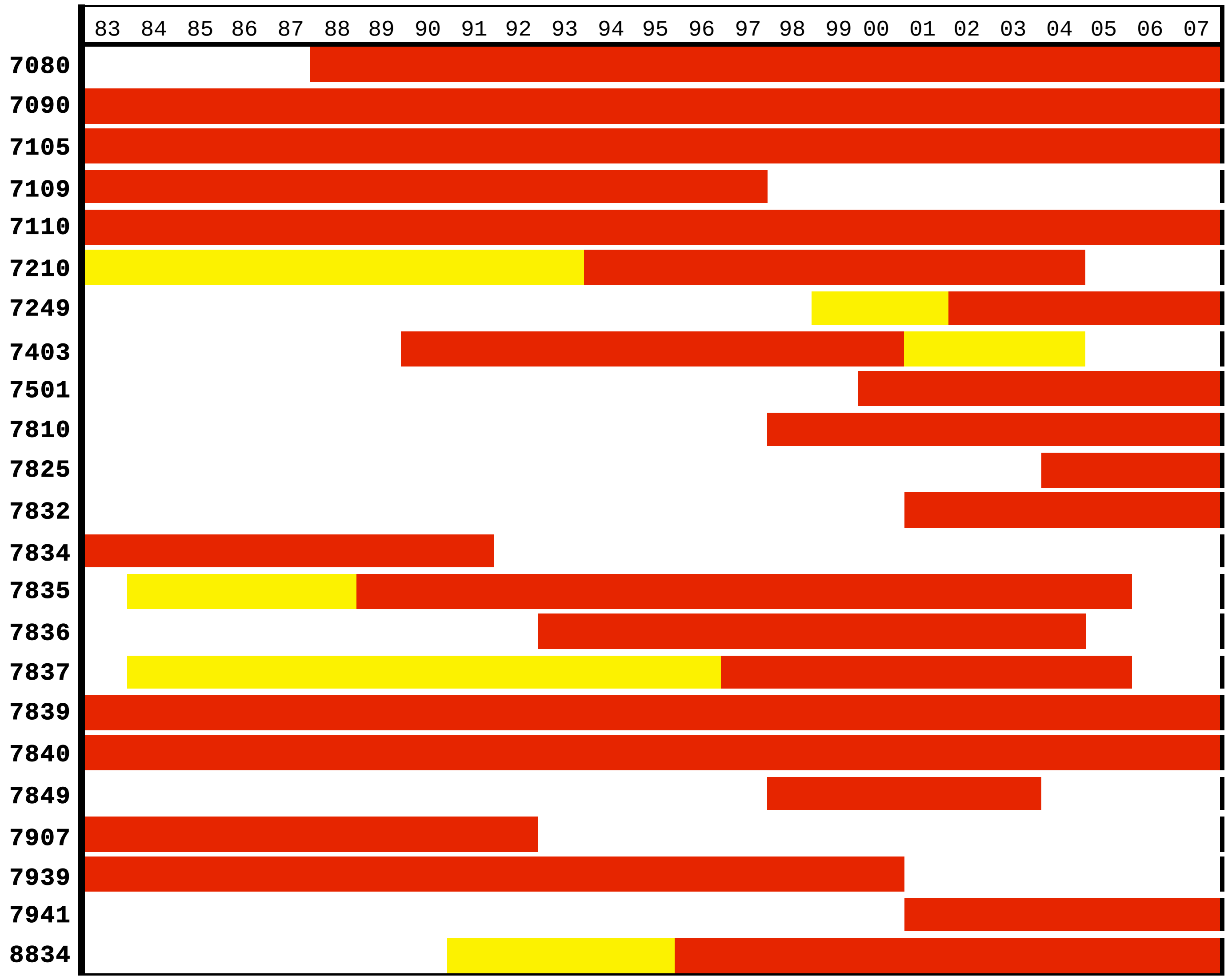
ASI v10 time series - Trended 7840 coordinates



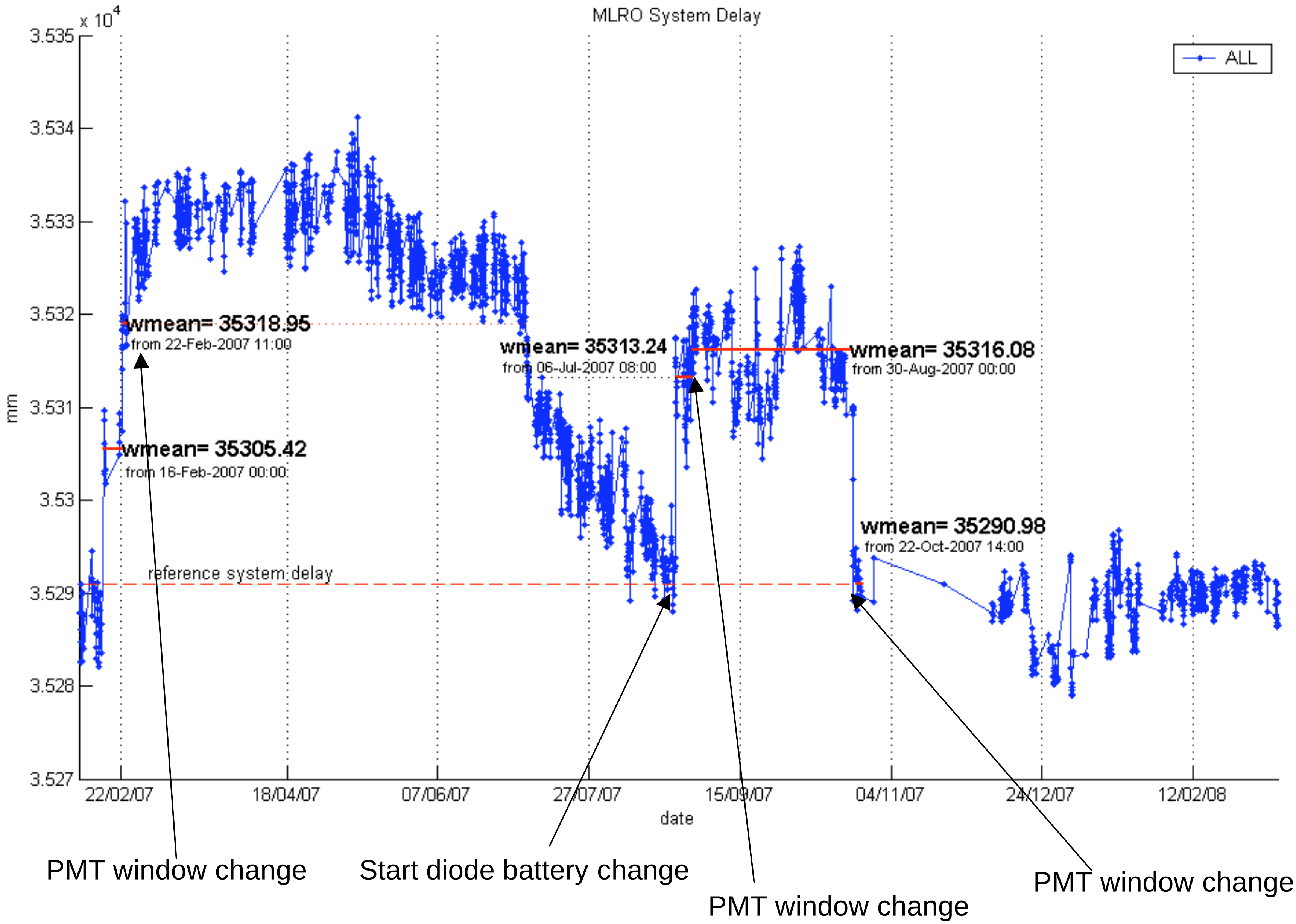
ASI v10 time series - Detrended 7840 coordinates



Core Sites Temporal Coverage



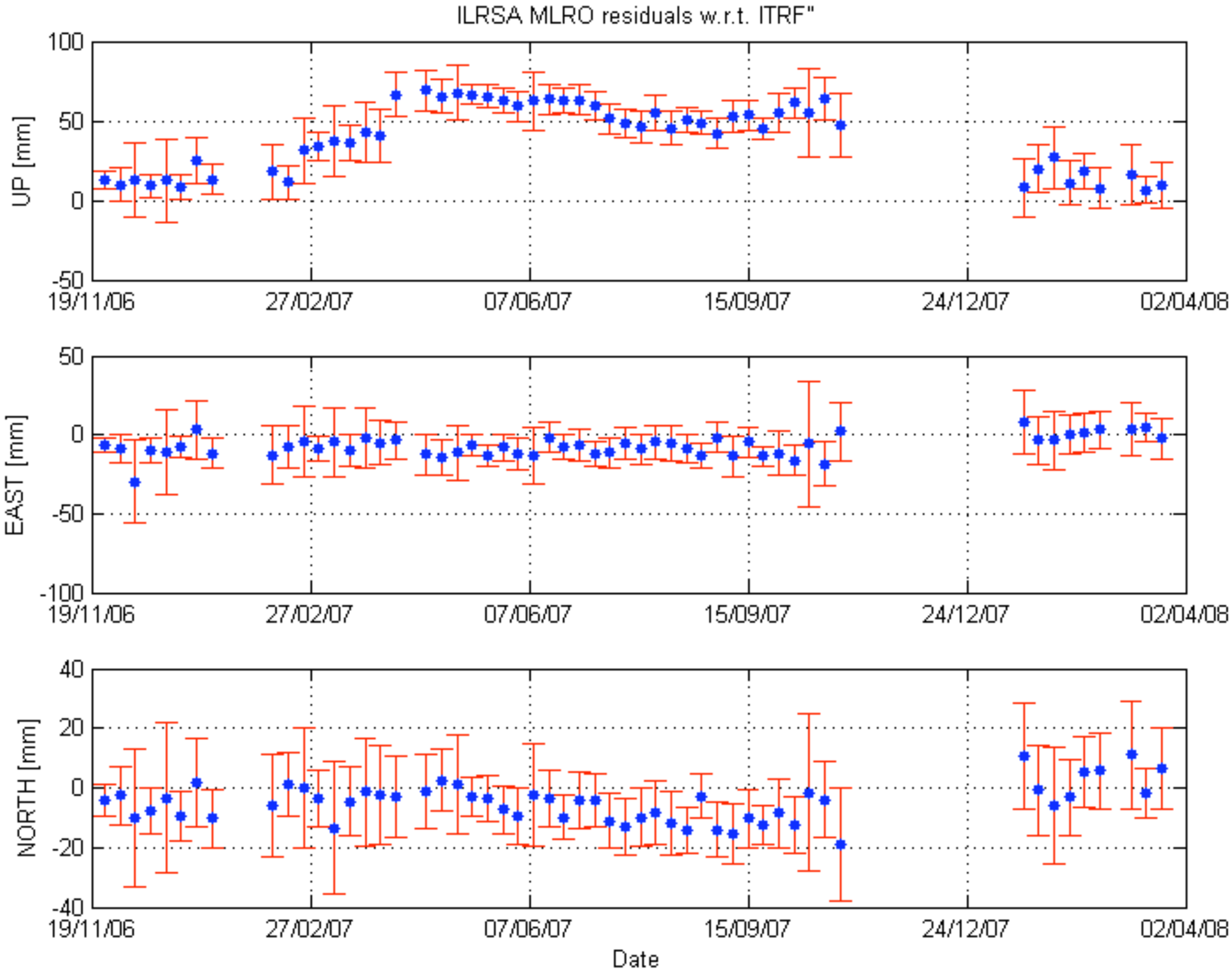
System delay mean



Corrections

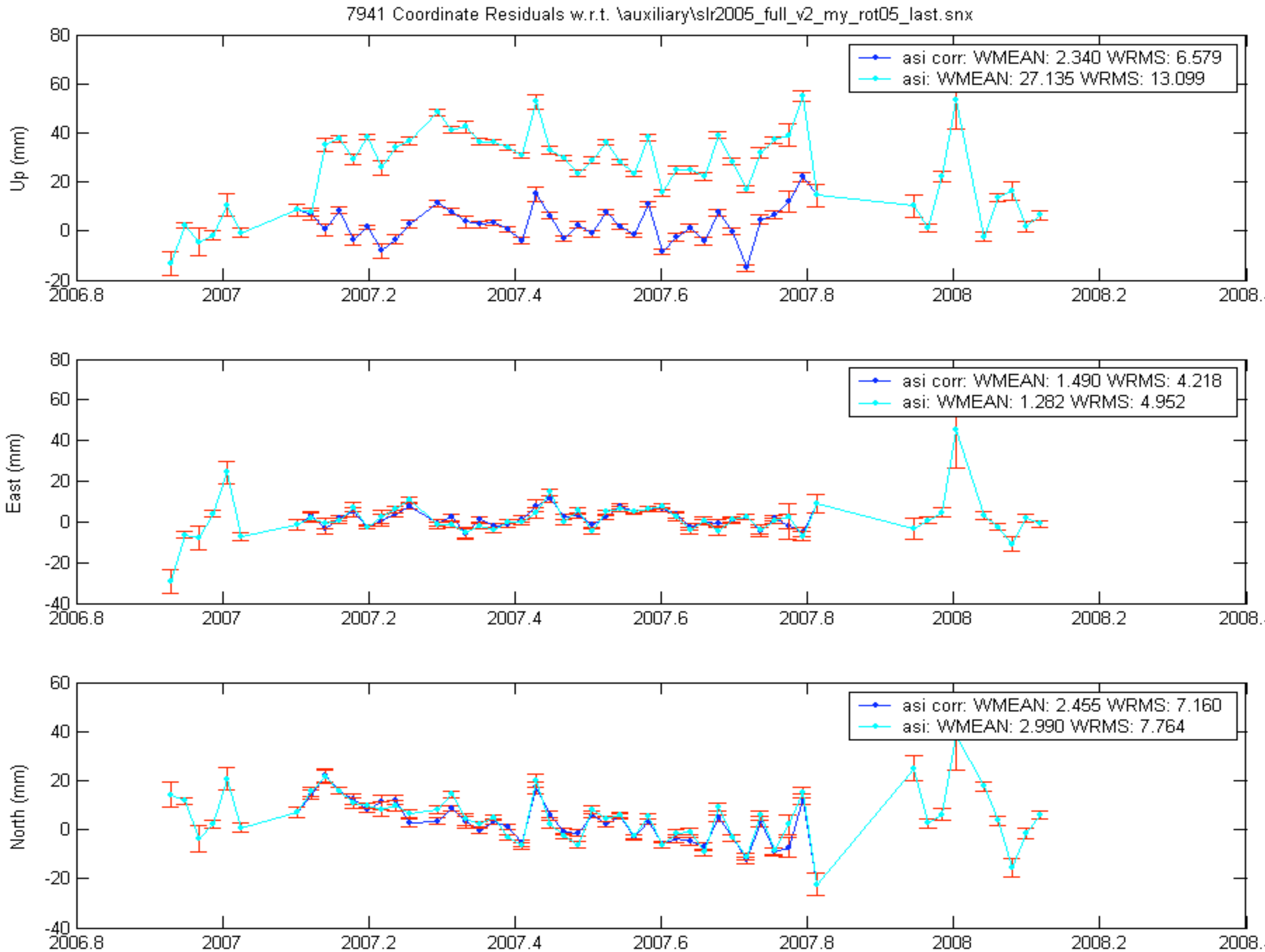
break ai cambi di gating.cfg (22/2/2007 30/8/2007 e 22/10/2007), il 6/7/2070 salto dedotto con uso del valore dopo il cambio pila del 24/8				
il valore di riferimento è la media subito dopo la correzione di ottobre, prima del break				
start	**stop**	value(mm)	ref value (mm)	**bias**
16/02/07 00:00	**22/02/07 11:00**	35305.42	35290.98	**14**
22/02/07 11:00	**06/07/07 08:00**	35318.95		**28**
06/07/07 08:00	**30/08/07 00:00**	35313.24		**22**
30/08/07 00:00	**22/10/07 14:00**	35316.08		**25**

MLRO Time series

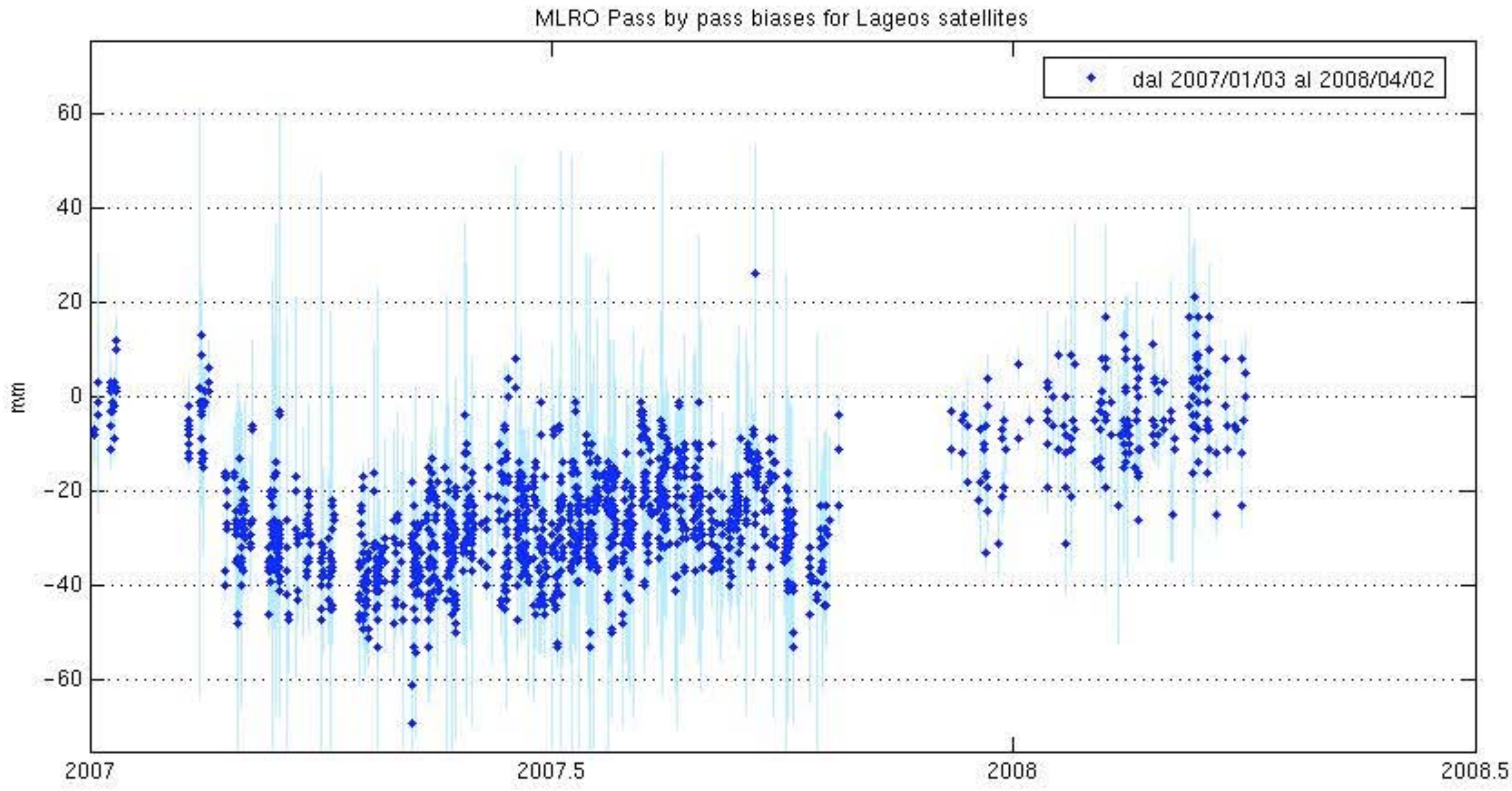


ASI/CGS, Matera, Italy

MLRO Time series before and after the bias correction



Bias stimati da Toshi

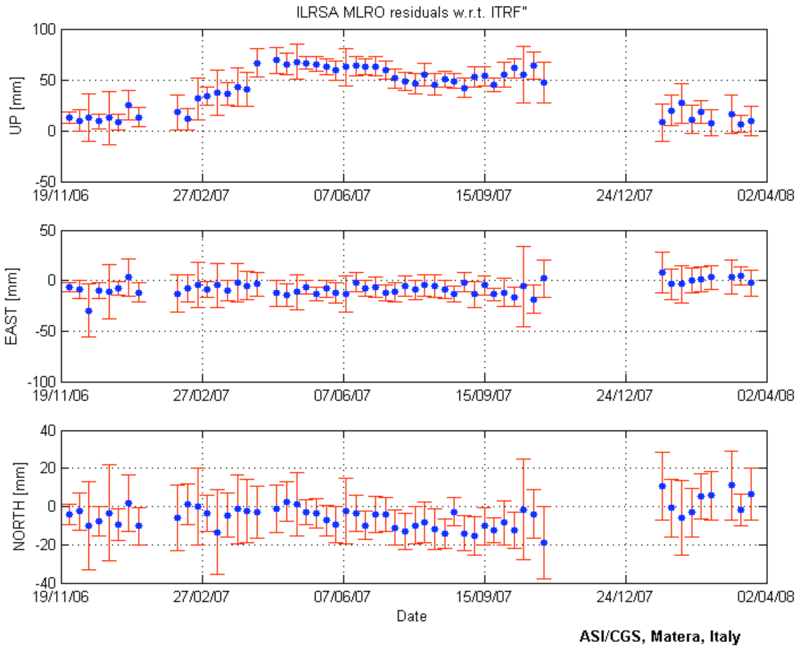


THE MLRO 2007 RANGE BIAS PROBLEM
ANALYSIS AND SOLUTION

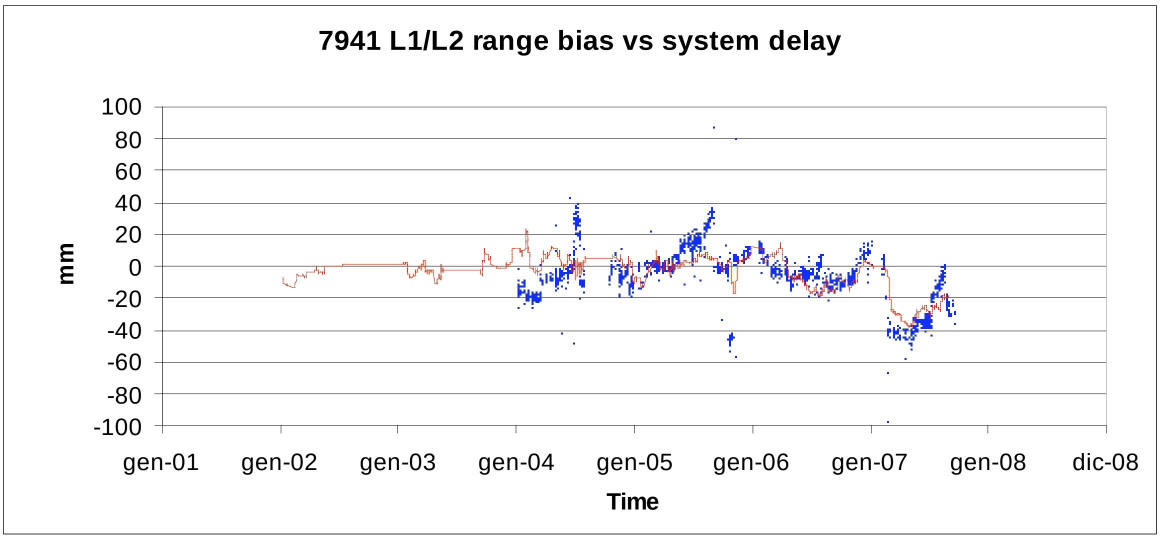
V. Luceri, G. Bianco

Introduction

Starting from the second half of February, 2007, SLR solutions from the ILRS analysis centers have been showing an anomalous behaviour in the MLRO data, as clearly illustrated in the graph below which shows MLRO Up, East and North residuals with respect to the ITRF as computed in the ILRSA combined solution.



The very significant misbehaviour in the "Up" component was clearly caused by a non zero range bias, non properly modelled in the system calibration. The graph below shows the MLRO range biases derived from Lageos-1 and Lageos-2 (thanks to T. Otsubo, Hitotsubashi University, hereafter Hit-U) as a red curve, while the blue dots represent the single system delay values plotted with an arbitrary zero point.



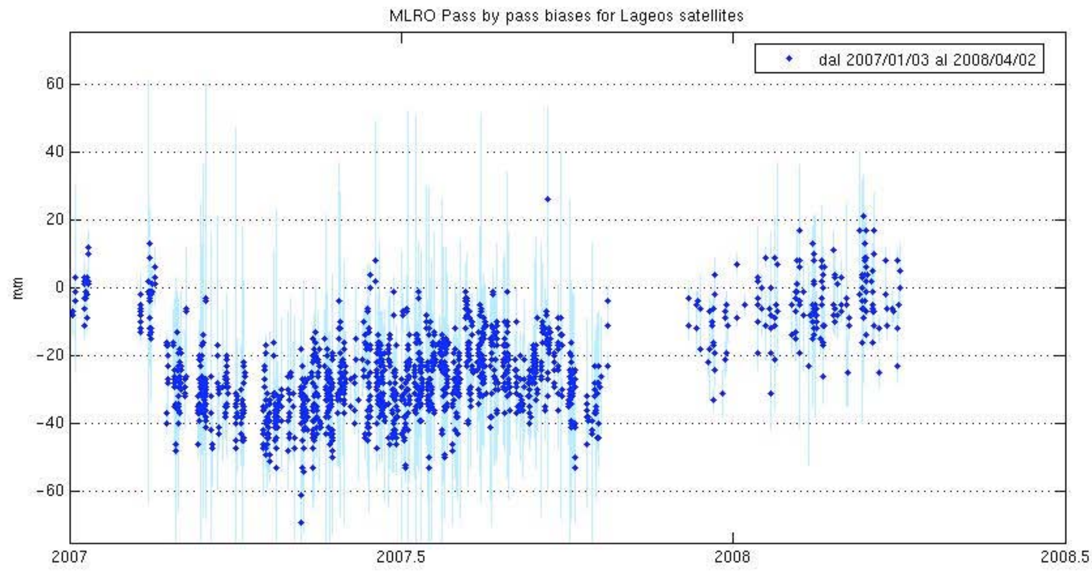
Calibration scheme screening

It is clear that, for some reason, at a certain point in time the system calibration routine became unable to properly compensate the system delay variations, which are clearly mapped into the solved-for bias values. At a first glance, nothing was changed in the MLRO calibration scheme, so this prompted us to thoroughly review the whole procedure.

The first finding has been a strong dependence of the System Delay from the received pulse energy.

The problem was finally traced in a wrong value of a few parameters, which had changed after the MCP/PMT replacement but had not been correctly written into the configuration files by the station operators. Those parameters are the PMT Gate Start Bias and, consequently, the CFD Gate Start Bias. The correct figures have been finally computed for the three operational MLRO configurations, i.e. Ground Target, Internal calibration and Satellite Ranging, and written into the relevant configuration files.

Once the parameters have been adjusted to the proper values, the MLRO range bias has returned to a zero value, as illustrated in the following graph in which MLRO Lageos' range bias computed by T. Otsubo (Hit-U) are plotted as a function of time.



Correction of 2007 data

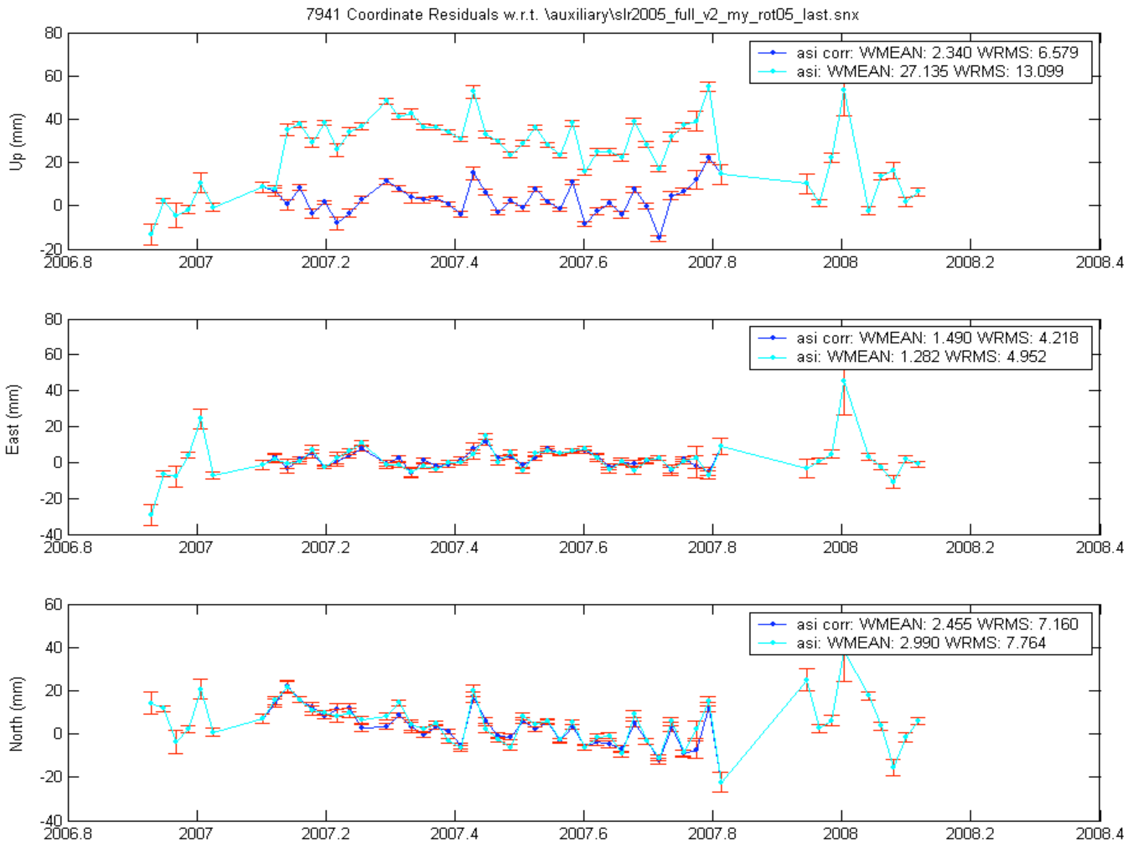
All MLRO observational data taken in the period between February 16th, 2007 and October 22nd, 2007 are affected by a negative range bias which we have quantified by crossing the time series of system delay measurements with all significant system change events. It's important to note that this process has been kept independent from SLR solutions.

The result is the following table which gives the computed MLRO range bias values for a few relevant time intervals.

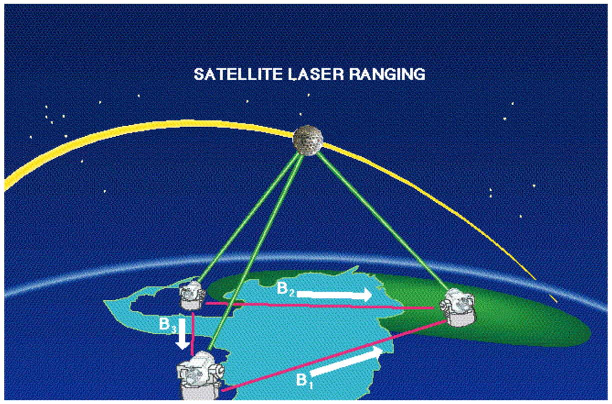
Start (UTC)	Stop (UTC)	MLRO range bias (mm)
16/02/07 00:00	22/02/07 11:00	-14
22/02/07 11:00	06/07/07 08:00	-28
06/07/07 08:00	30/08/07 00:00	-22
30/08/07 00:00	22/10/07 14:00	-25

NOTE: These biases must be subtracted from the ranges to obtain the correct value.

The following graph shows the MLRO coordinate residuals computed before (cyan) and after (blue) the corrections (ASI SLR solution). The improvement is readily apparent and brings the MLRO back to the ILRS core station quality standard.



SPOD2005: an SLR network for altimeter orbit reprocessing



John Ries

Center for Space Research
The University of Texas at Austin

ILRS Analysis Working Group Meeting
April 12, 2008

SPOD2005
(the SLR equivalent of DPOD2005)

- Need reference set of coordinates for POD for T/P and Jason-1 reprocessing, as well as for Jason-2
  - Must be good enough for high-precision orbit determination
  - Identify data that should not be used where possible
    - Example; Arequipa (do not use data between 6/23/01-3/24/02)
- Like DPOD2005, SPOD2005 based on ITRF2005
  - Propose to use SLRF2005 (ITRF2005+ITRF2000+new stations)
  - Propose alternative coordinates where tests reveal problems
  - Use Arequipa velocity from GPS for DORIS and SLR
- Q: will the users require a set of biases (or recommendation when to estimate biases) to use this or can they use this set of coordinates just combined with appropriate editing?
  - This is operational POD, not cutting edge SLR analysis...what is ‘good enough’?

ITRF2005 Performance for LAGEOS-1 / LAGEOS-2

SLR residual RMS for 1992-2005 using 60-day arcs*, GGM02C, Mendes/Pavlis refraction model, 17-station 'core' network

	ITRF2000	ITF2005	ITRF2005 (scaled -1.2 ppb)
SLR RMS (mm)	**13.3 / 12.5**	**12.6 /12.3**	**12.0 / 11.4**
Variance Decrease (mm^2)	**-**	**18 / 5**	**33 / 26**
SLR Mean (mm)	**1**	**3**	**<1**
YARAG Mean (mm)	**3**	**6**	**<1**

* 60-day arcs used for geocenter estimation

ITRF2005 performance (2006-2008)

(LAGEOS-1 7--day arcs)

Station	ITRF2000	ITRF2005	SPOD2005	delta	delta
7124 TAHITI	2.80	1.32	1.28	0.47	0.46
7308 CRL___	3.53	1.93	1.95	0.55	0.55
7824 SANFEB	3.41	2.32	2.94	0.68	0.86
1893 KATSIV	3.57	~~2.44~~	2.32	0.68	0.65
7237 CHACHU	3.88	2.66	2.74	0.69	0.71
7811 BOROWC	2.05	1.47	1.49	0.72	0.73
7825 STROML	1.54	1.11	1.05	0.72	0.68
7080 MCDON4	1.56	1.13	1.13	0.72	0.72
8834 WETZL2	1.68	1.24	1.19	0.74	0.71
7501 HARTEB	1.33	1.07	1.04	0.80	0.78
7406 SANJUA	2.21	~~1.79~~	1.84	0.81	0.83
6080 MCDON4	1.94	1.65	1.65	0.85	0.85
7105 GRF105	1.09	0.93	0.85	0.85	0.78
7841 PTSDM3	1.49	1.28	1.13	0.86	0.76
7838 SHO___	2.58	2.24	2.44	0.87	0.95
7130 GRF130	1.41	1.23	1.49	0.87	1.06
1831 _LVIV_	6.07	5.30	5.19	0.87	0.86
7249 BEIJNG	2.64	2.31	2.19	0.88	0.83
7820 KUNMNG	8.02	7.05	7.64	0.88	0.95
7840 RGO___	1.13	1.02	1.12	0.90	0.99
7941 _MLRO_	2.08	1.95	1.69	0.94	0.81
7110 MNPEAK	1.16	1.11	0.96	0.96	0.83
7119 HOLTL4	2.29	2.28	1.76	1.00	0.77
1873 SIMEIZ	5.47	5.48	5.37	1.00	0.98
8403 AREL2B	2.34	~~2.35~~	2.02	1.00	0.86
1884 RIGA__	2.22	2.23	2.17	1.00	0.98
1864 MAIDA2	4.33	~~4.39~~	4.30	1.01	0.99
7090 YARAG_	1.01	1.03	0.90	1.02	0.89
7821 SHANEW	3.13	3.43	2.66	1.10	0.85
7839 GRAZ__	0.93	1.08	0.82	1.16	0.88
7358 TANEGA	4.19	5.06	3.92	1.21	0.94
7832 RIYADH	1.10	1.47	1.15	1.34	1.05
6810 ZIMMWB	1.07	1.45	1.07	1.36	1.00
7405 CONCEP	1.10	1.55	0.88	1.41	0.80
7810 ZIMMEB	1.36	1.92	1.02	1.41	0.75
6405 CONCIR	1.09	1.90	1.06	1.74	0.97
				0.95	0.83

(—— not ITRF2005)

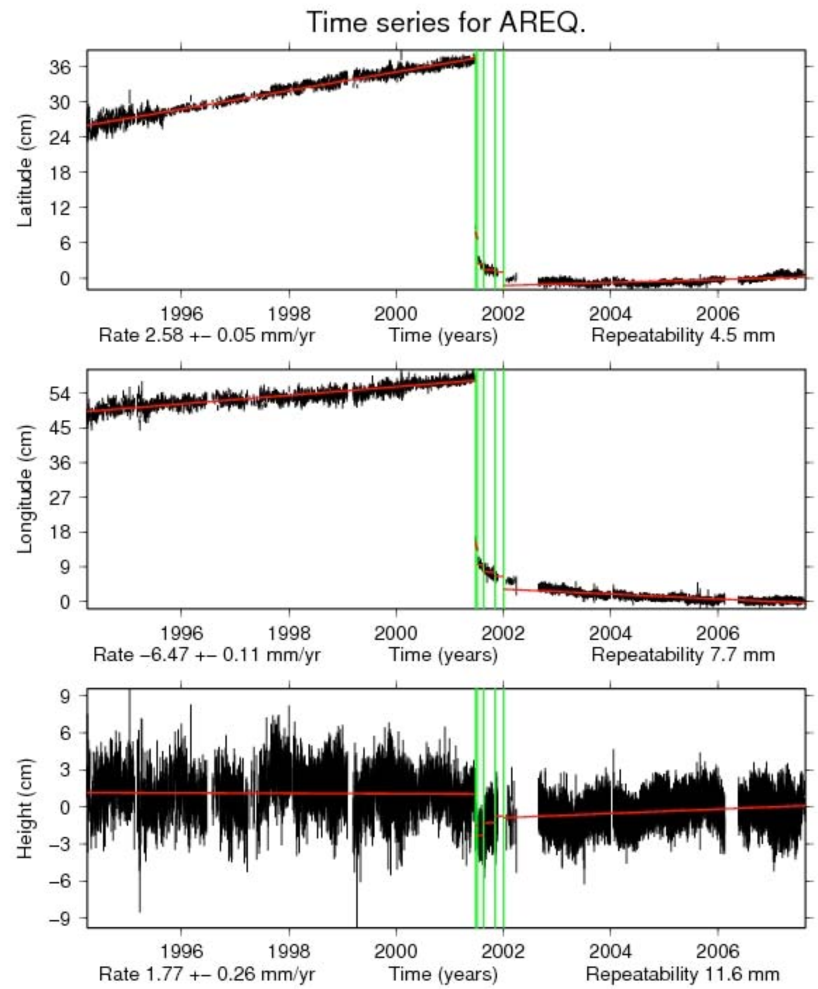
Arequipa (7403)

- Use GPS velocity after earthquake and post-seismic deformation
- Appears to stabilize to near-linear motion around March 2002
  - Data between July 21, 2001 and ~March 24, 2002 should not be used (downweight)
- Adopted -17.62, -7.26, -4.15 mm/y

  See http://www.ipgp.jussieu.fr/~willis/DPOD2005.htm

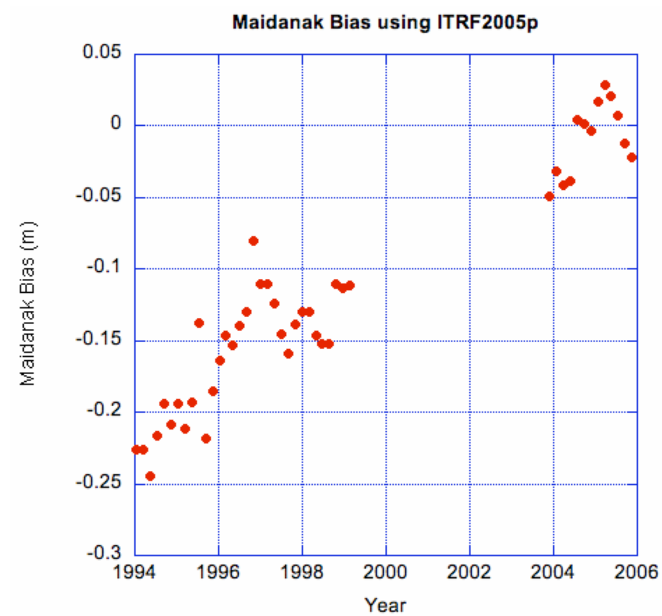
- Estimated position holding velocity fixed

http://sideshow.jpl.nasa.gov/mbh/all/AREQ.html



Others where ITRF2005 not used

- Maidanak (1863,1864)
  - Unreasonable change to velocity in ITRF2005
  - Probably due to ~15 cm bias prior to 1999



- Uruqii (7355)
  - Missing from ITRF2005 but should be possible to use if correct eccentricities used (error in eccentricity file at one point)

```
1997.0    URUMQI7355     184592.135    4606751.233    4393756.431                ITRF2000
SITE      STAVEL7355         -30.60          -5.50          -0.30                ITRF2000
          ECCEN 7355     2436934.5       -15.4235       -40.4854       -4.8704
# New station at Urumqi (7355, 21612M002)
          ECCEN 7355     2452760.5         0.6144         3.4911        0.9242
```

- Both sites probably of low value for altimeter POD (lots of bad data, 2-4 cm fits, 1-2 cm precision)

Others (cont.)

- Ajacio (7848)
  - Poor fits with ITRF2005 (5.5 cm vs 1.5) (also noted by N. Zelensky)
  - We ignore all data prior to 2002; not sure what the problem is
  - Velocity taken from previous ASI estimate; position re-estimated (< 1 cm)

- Katsively (1893)
  - Velocity change seems unreasonable; perhaps due to biases
  - Probably should be down-weighted for POD
- Ankara (7589)
  - ITRF2005 estimate probably affected by biased data (15 cm vs 2 cm fits)
  - Probably should be down-weighted for POD
- Helwan (7831)
  - Velocity seems wrong in ITRF2005
  - Marginal value for altimeter POD
- A few really old stations preserved from previous set-up
  - Included for completeness; no value for altimeter POD

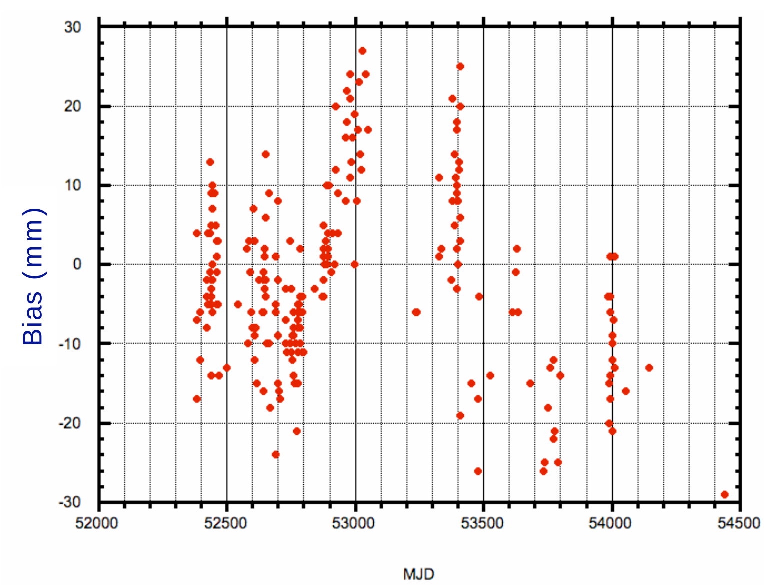
Others (cont.)

- Riyadh (7832)
  - Vertical velocity seems too large in ITRF2005/SLRF2005
  - Shows up more clearly extrapolated to recent data
  - Bias issues affecting velocity?
  - Used previous velocity (ASI) and updated position estimate
- Orroral (7843)
  - 2 cm bias seen across entire 1992-1998 span
  - Used SLR2005F velocity but ~3 cm update to height
- Beijng (7249)
  - We have seen a lot of bias issues with this site
  - Used SLR2005F velocity but ~2 cm update to position
  - Somewhat unreliable for POD (3 cm fits, 1 cm precision)
- Burnie (7370)
  - New; preliminary position from Starlette (plate velocity)

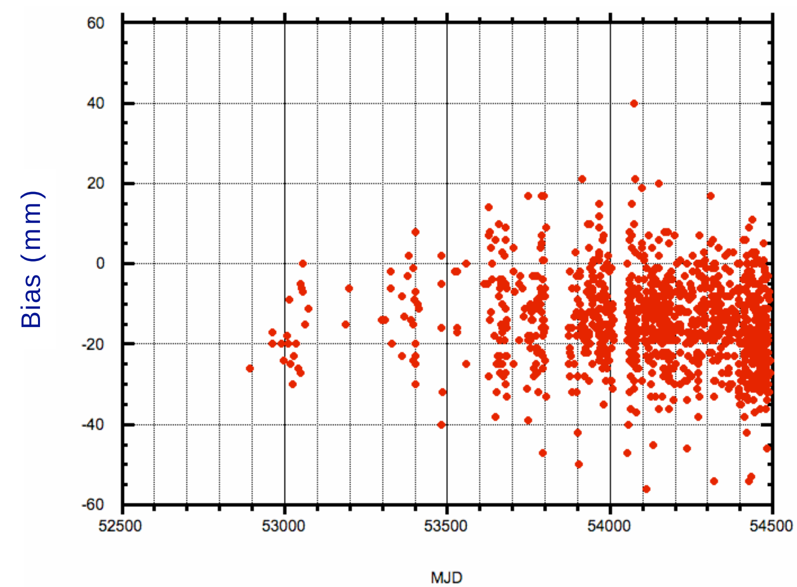
Others (cont.)

- Concepcion (7405) (?)
  - Bias problems affecting velocity estimate or just biased data?
  - Using earlier estimate works better

Concepcion (blue)



Concepcion (ir))



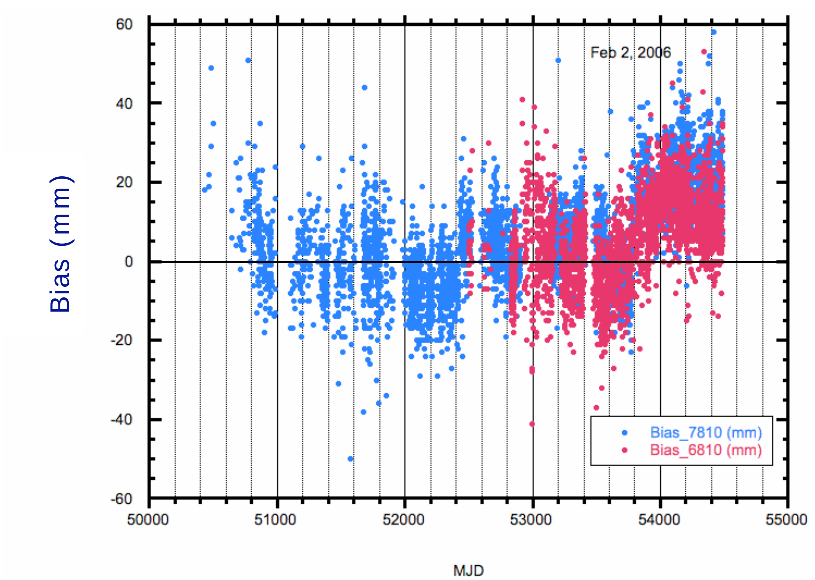
Some other bias issues

- Zimmerwald (7810) (?)
  - –Keep SLRF2005 but apply bias after ~Feb 2, 2006?

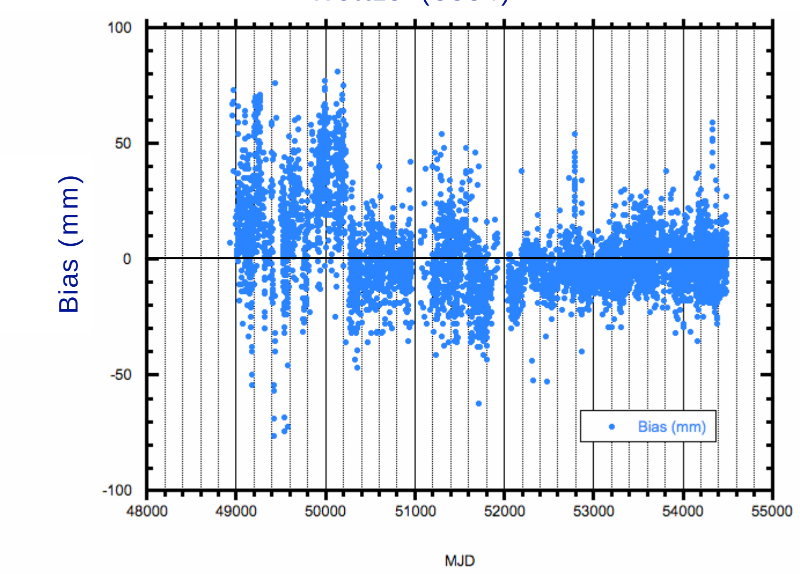
–Wetzell (8843) (?)

  - –Keep SLRF2005; beware of early data biases? model?

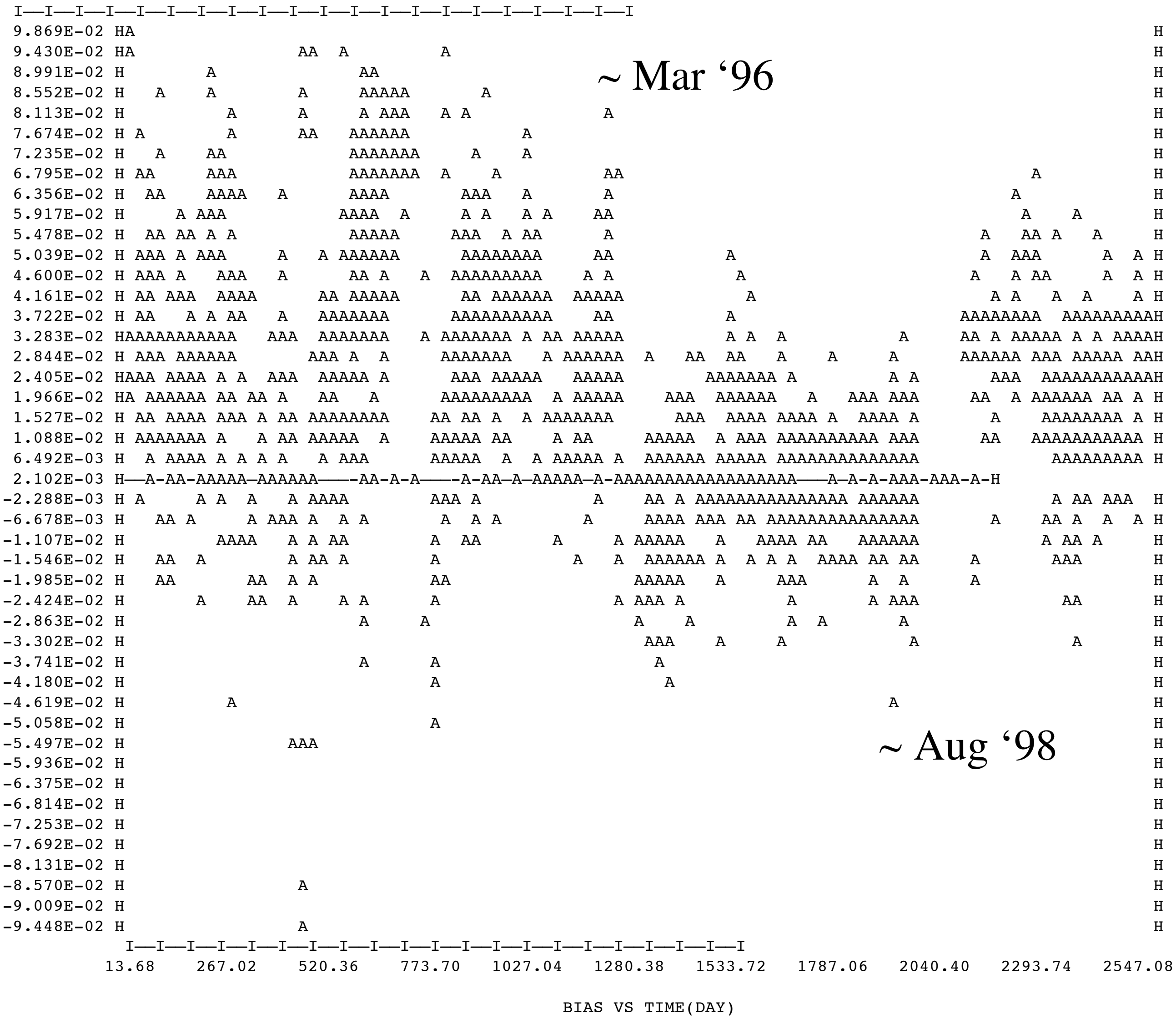
Zimmerwald (7810)



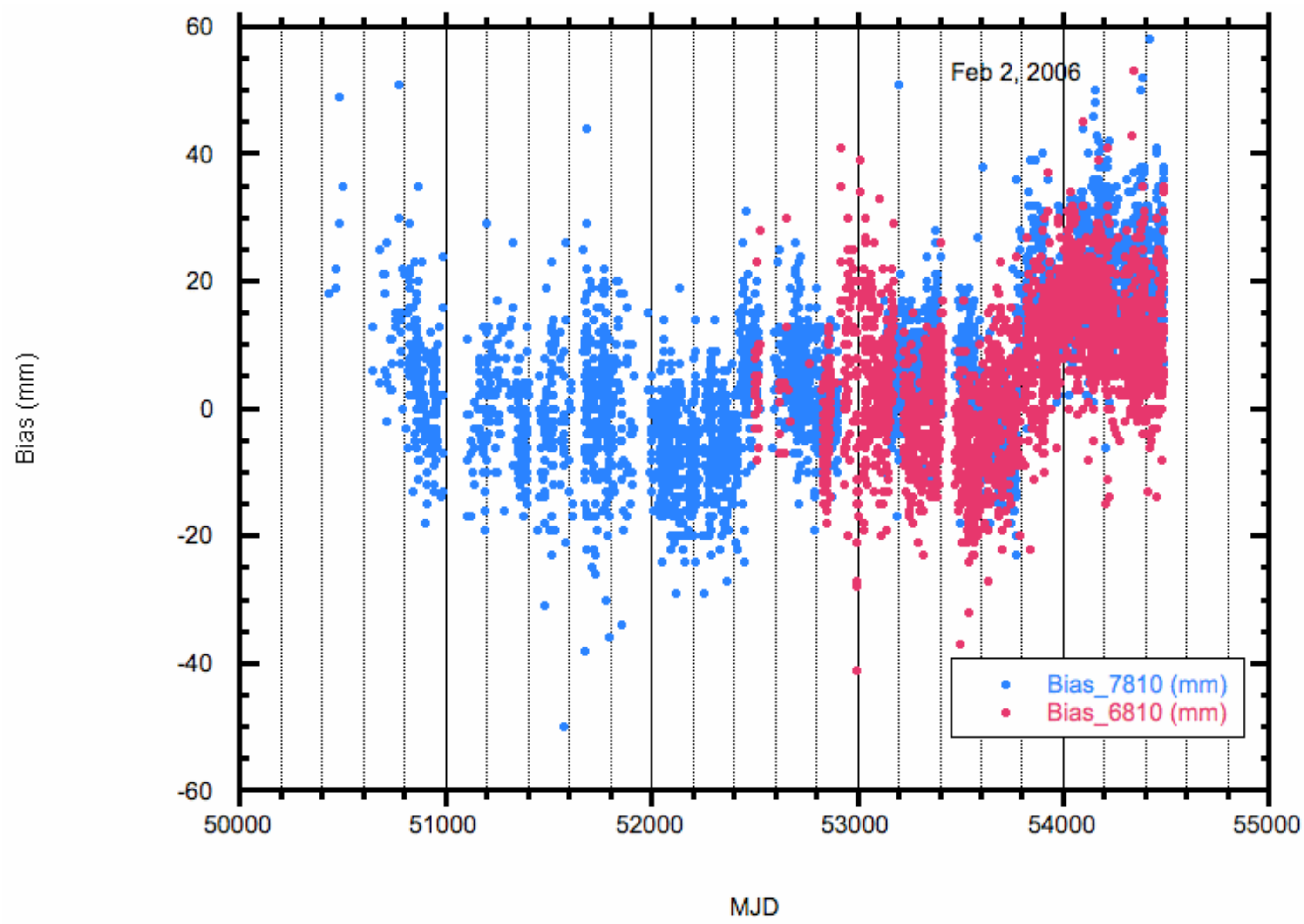
Wettzel (8834)



Wettzel Biases (Ajisai)



Zimmerwald bias



(using SLRF2005)

Status of the SLR processing at DGFI

Horst Müller

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E-Mail: mueller@dgfi.badw.de

- All software changed to version 5.0 (incl. new models)
- 1993-now: Processing with new ILRS/AWG standards finished
  - not yet delivered, because of LOD problem?
  - DGFI LOD solution not included in last ILRSA comb. sol.
- Daily processing is possible, though hardware must be more reliable for routine work. (HW failure in early 2008)
  - At present only the bias report is available from DGFI Home Page.
- Processing of all arcs 1981 – 1992 finished , final evaluation in progress
  - *DGFI normal points up to 1987*
- Weekly sp3c orbits are available from DGFI Home Page

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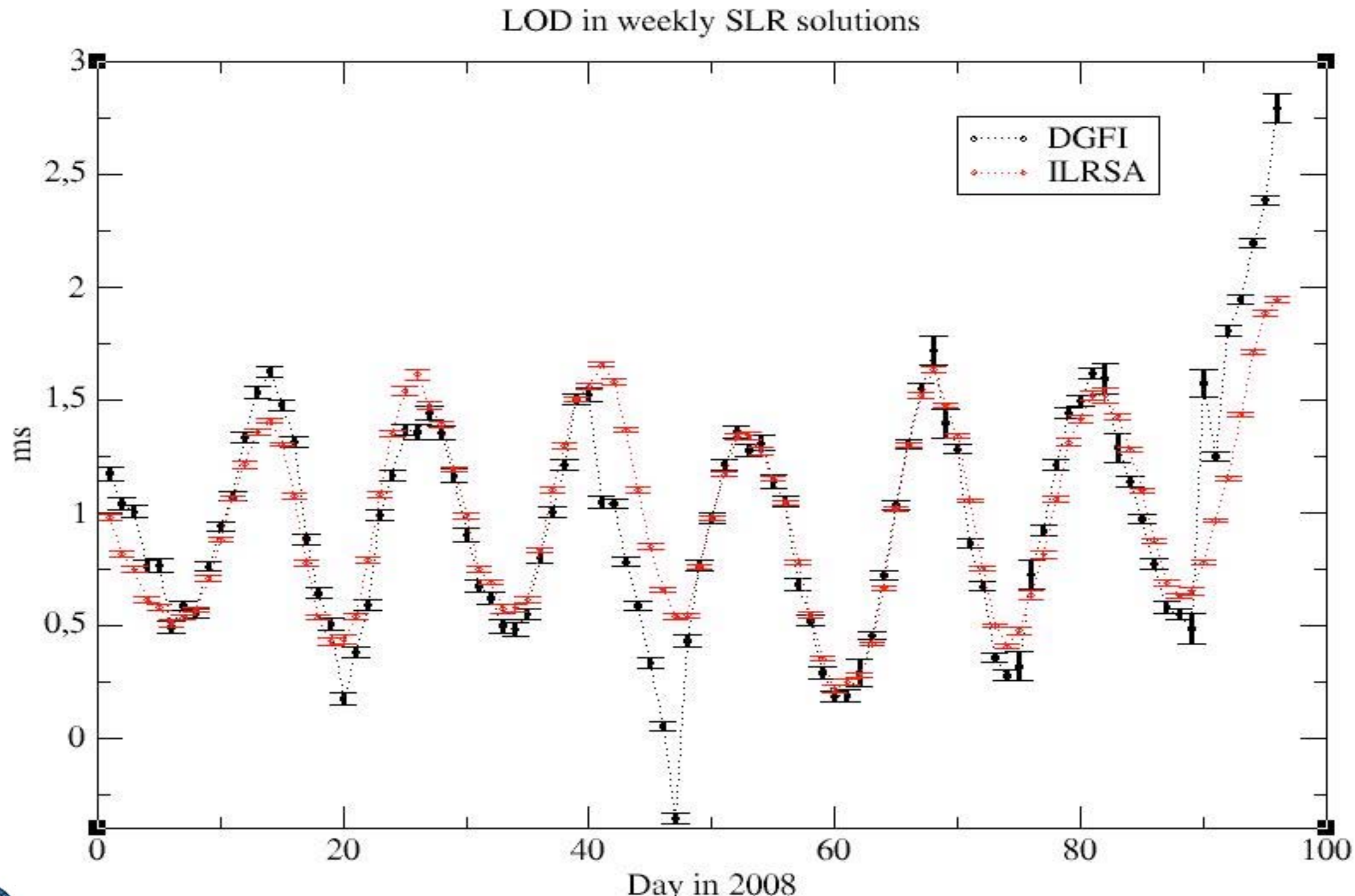
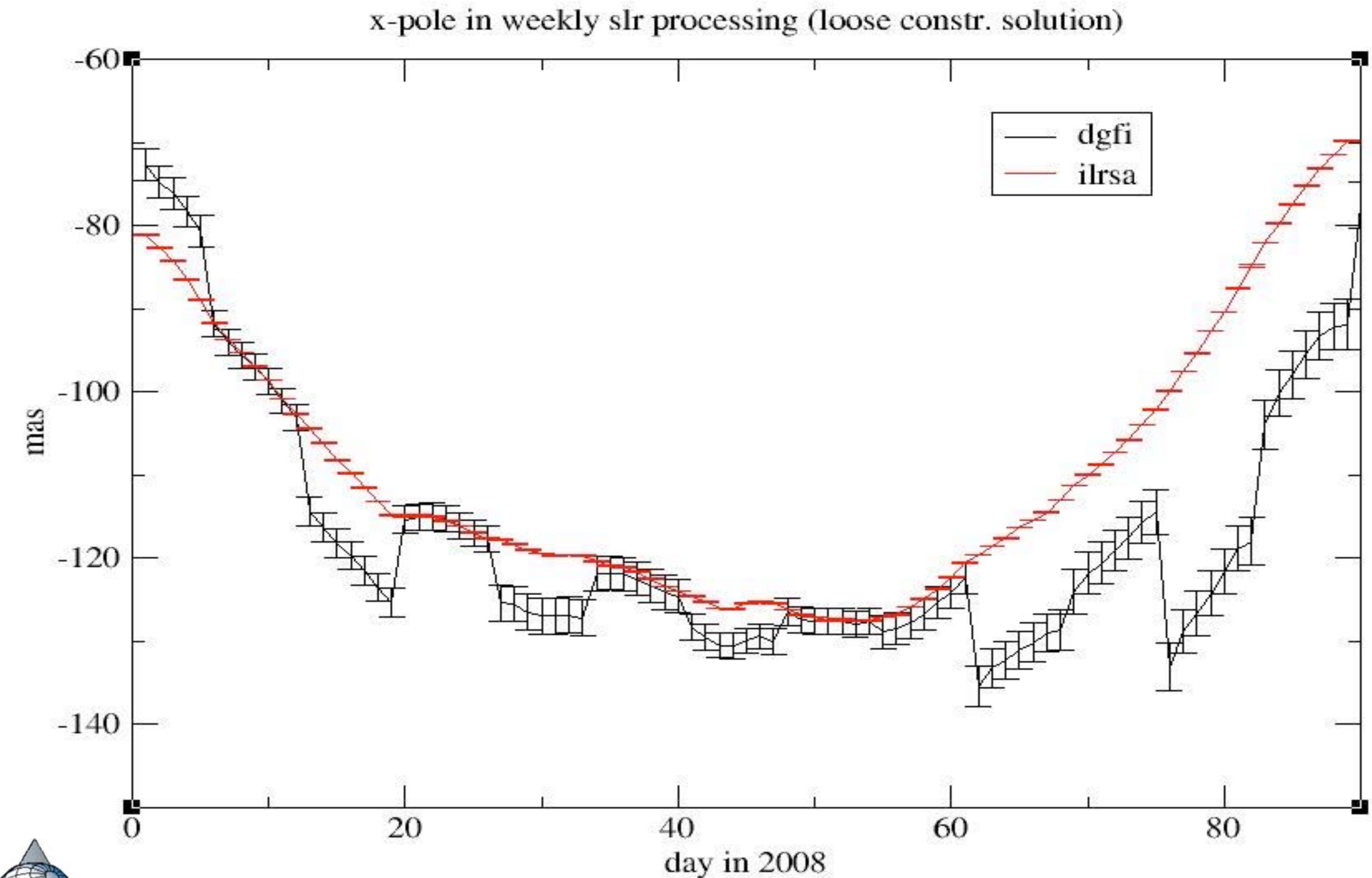


DGFI


x-pole in weekly slr processing (loose constr. solution)
dgfi
ilrsa
mas
-60
-80
-100
-120
-140
0
20
40
60
80
day in 2008

DGFI

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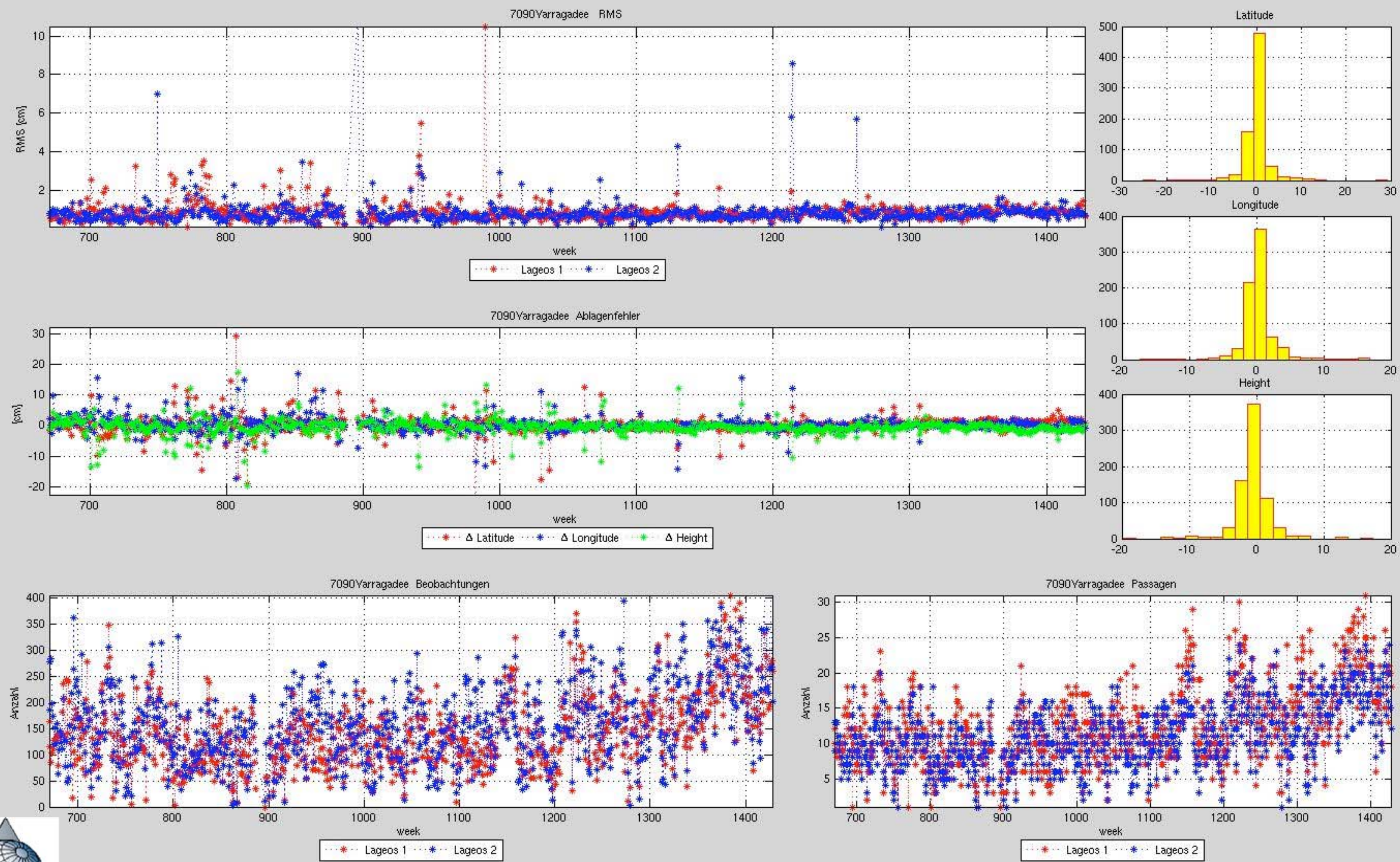

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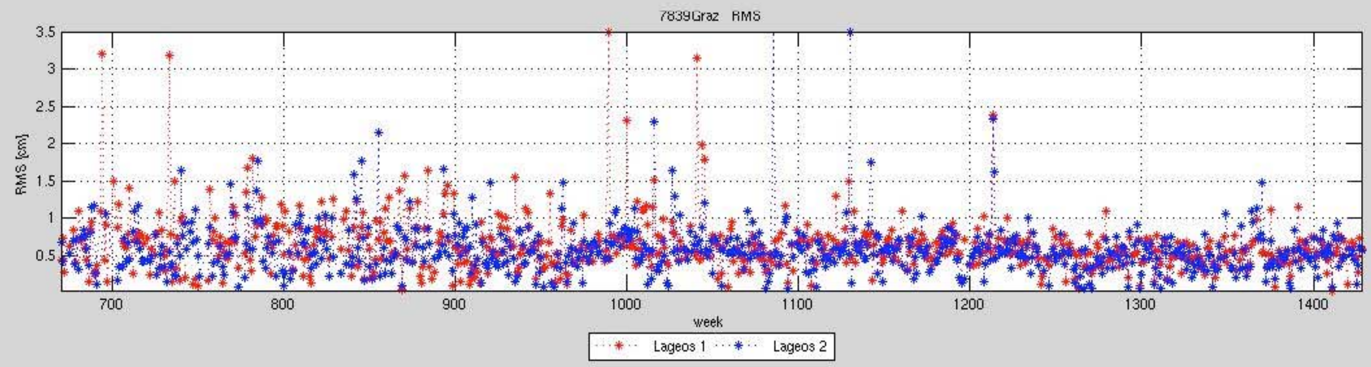

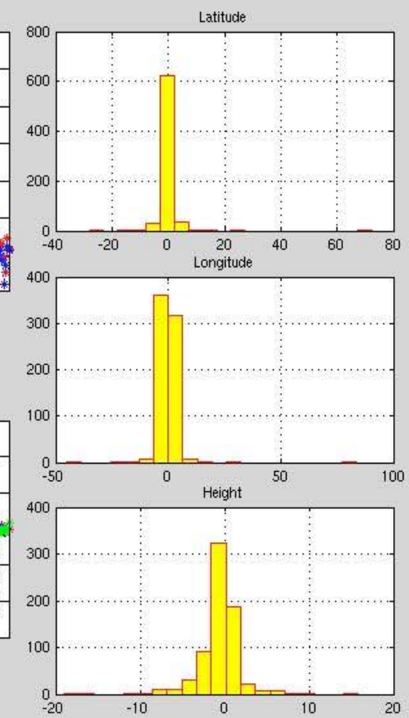

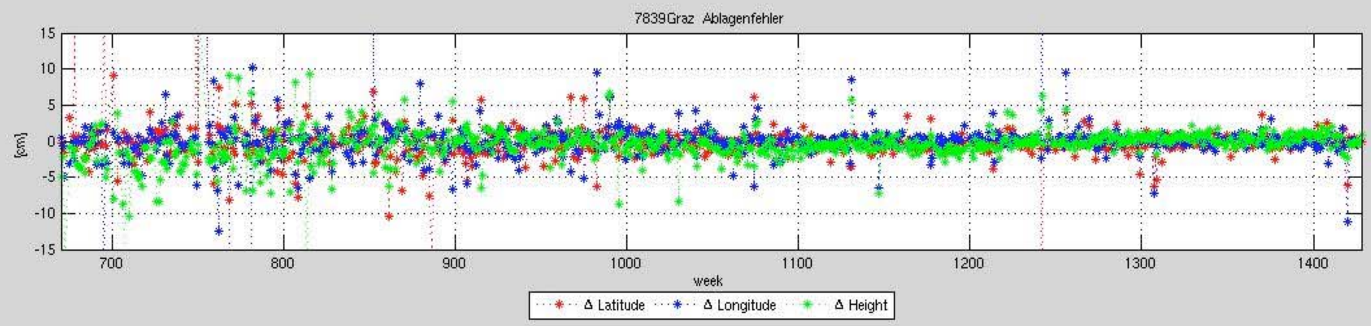

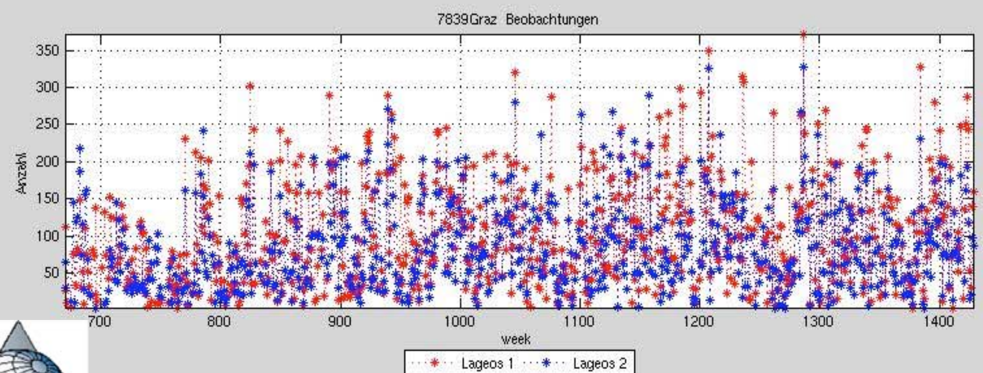

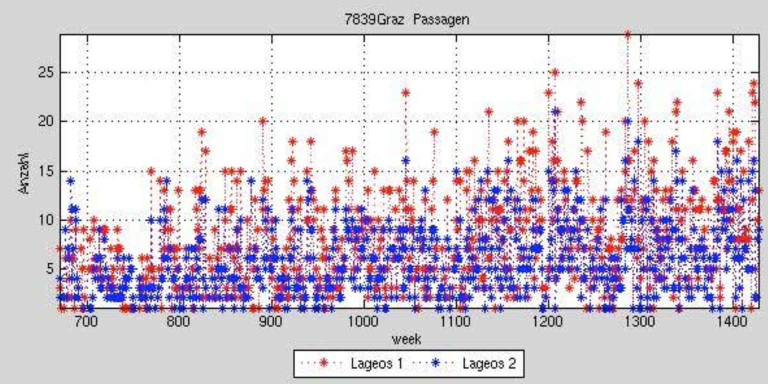

DGFI

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Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

http://www.dgfi.badw.de/dgfi/ILRS-AAC/quality/weekly_biases/lageos2/1473

SLR linux info extra Lycos MVV reise DGFI-Archive Ergebnisse PAYBACK - Startseite HappyDigit

6.3.3 Performance notes | http://aiuli3....ry_report.txt | http://ww...eos2/1473

Station	year	mm	dd	hh mm		range-bias [cm]	sigma [cm]	prec.est. [cm]	no of observations	edit.	time-bias [microsec.]	sigma
Graz____	2008	3	30	02:28	:	0.72	0.33	0.16	18	0		
Graz____	2008	3	30	20:36	:	-0.26	0.71	0.14	13	0		
Graz____	2008	3	31	00:32	:	0.39	0.22	0.11	20	0		
Graz____	2008	3	31	19:04	:	0.08	1.24	0.08	2	0		
Graz____	2008	4	2	22:48	:	1.29	0.24	0.12	21	0		
Graz____	2008	4	3	02:54	:	0.79	1.78	0.07	6	0		
Graz____	2008	4	3	07:12	:	2.59	0.75	0.23	12	0		
Graz____	2008	4	4	19:08	:	-0.46	0.81	0.26	13	0		
Graz____	2008	4	4	22:58	:	0.17	0.19	0.21	20	0		
Graz____	2008	4	5	03:08	:	1.04	0.23	0.24	15	0		
Graz____	2008	4	5	21:10	:	-0.50	0.41	0.21	19	0		
Graz____	2008	4	6	01:12	:	0.03	0.23	0.18	15	0		
Graz____	2008	4	9	07:48	:	1.00	0.86	0.13	14	0		
Graz____	2008	4	10	06:20	:	3.06	1.62	0.18	5	0		
Katsivel	2008	4	5	21:24	:	-1.65	0.49	0.99	8	0		
Herstmon	2008	3	31	04:38	:	1.08	0.22	0.12	13	0		
Herstmon	2008	4	1	20:54	:	3.02	0.99	0.21	11	0		
Herstmon	2008	4	3	07:06	:	2.77	1.79	0.16	2	0		
Herstmon	2008	4	4	23:06	:	1.22	0.41	0.17	21	0		
Herstmon	2008	4	5	03:07	:	1.33	0.18	0.13	17	0		
Herstmon	2008	4	5	21:15	:	0.33	0.66	0.21	18	0		
Herstmon	2008	4	6	01:10	:	1.18	0.18	0.13	16	0		
Herstmon	2008	4	6	05:40	:	2.39	0.70	0.19	3	0		
Herstmon	2008	4	6	23:18	:	-0.19	0.47	0.22	14	0		
Herstmon	2008	4	7	03:25	:	1.34	0.20	0.18	16	0		
Herstmon	2008	4	7	21:33	:	-0.09	0.84	0.16	15	0		
Herstmon	2008	4	8	05:48	:	1.69	0.53	0.12	10	0		
Herstmon	2008	4	8	19:50	:	0.50	1.12	0.12	6	0		
Herstmon	2008	4	8	23:32	:	0.10	0.30	0.30	17	0		
Herstmon	2008	4	9	03:38	:	1.14	0.20	0.15	15	0		
Herstmon	2008	4	9	07:52	:	1.20	0.73	0.20	10	0		
Herstmon	2008	4	9	21:42	:	0.54	0.83	0.17	15	0		
Herstmon	2008	4	10	01:42	:	0.21	0.23	0.29	10	0		
Herstmon	2008	4	10	20:02	:	0.91	2.19	0.18	12	0		
Herstmon	2008	4	10	23:44	:	0.03	0.36	0.13	24	0		

Suchen: Ku | Abwärts | Aufwärts | Hervorheben | Groß-/Kleinschreibung

DGFI

http://www.dgfi.badw.de/dgfi/ILRS-AC/results/weekly_orbits/lageos1/1473.sp3c

```
#cV2008  3 30  0  0  0.00000000    5040  SLR  FITDGF
## 1473       0.00000000   120.00000000 54555 0.0000000000000
+    1   L51  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
+          0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
+          0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
+          0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
+          0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
++        10  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
++         0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
++         0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
++         0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
++         0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
%c L  cc UTC ccc cccc cccc cccc cccc ccccc ccccc ccccc ccccc
%c cc cc ccc ccc cccc cccc cccc cccc ccccc ccccc ccccc ccccc
%f  0.0000000  0.000000000  0.00000000000  0.000000000000000
%f  0.0000000  0.000000000  0.00000000000  0.000000000000000
%i    0    0    0    0      0      0      0      0         0
%i    0    0    0    0      0      0      0      0         0
/* CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
/*               DGFI SP3c orbit, testversion only
/*                   SLR2005 reference frame
/* CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
* 2008  3 30  0  0  0.00000000
PL51  -7979.395286  -6324.825392   6876.064143
VL51   3537.357178  42044.956180  43145.612722
* 2008  3 30  0  2  0.00000000
PL51  -7920.469739  -5811.469212   7382.903003
VL51   6285.059718  43484.701903  41305.952281
* 2008  3 30  0  4  0.00000000
PL51  -7828.540803  -5281.913622   7866.901060
VL51   9036.022726  44744.203848  39339.819889
* 2008  3 30  0  6  0.00000000
```

New/Returning Station Qualification

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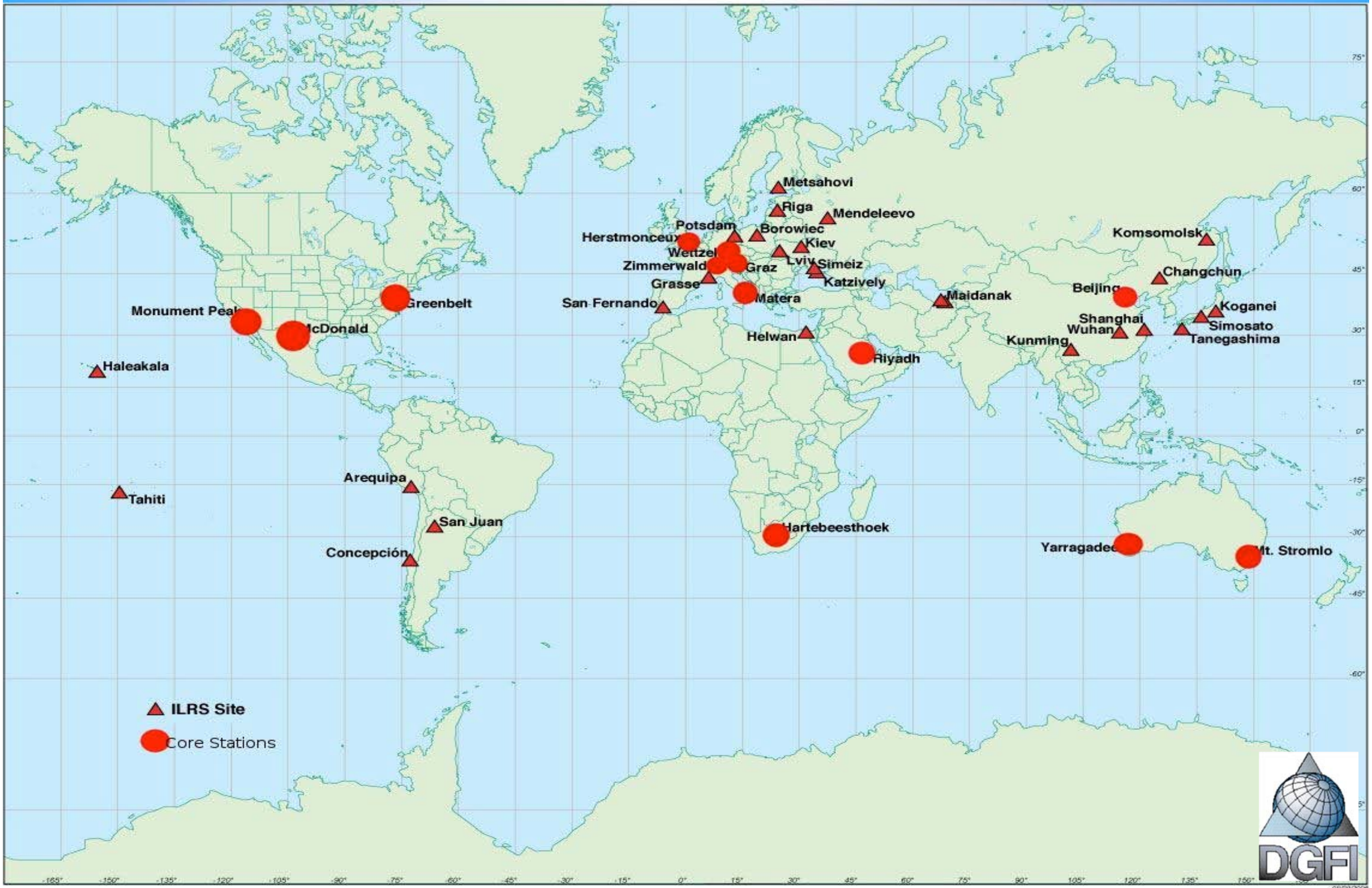
ILRS Analysis Working Group Meeting, Vienna, April 12 2008
Current SLR Network



Status of new stations:

Station	Lageos1	Lageos2
	passes in 2008	
Arequipa	1	-
Haleakala	52	72
San Juan	213	141

Site Information		DGFI Orbital Analysis				Hitotsubashi Univ. Orbital Analysis				JCET Orbital Analysis				MCC Orbital Analysis				SHAO Orbital Analysis			
Station Location	Station Number	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP
Baseline		10.0	20.0	20.0	95	10.0	20.0	20.0	95	10.0	20.0	20.0	95	10.0	20.0	20.0	95	10.0	20.0	20.0	95
Yarragadee	7090	2.5	21.1	3.5	100.0	1.7	8.4	2.3	100.0	2.8	13.3		99.7	2.1	10.2	1.8	99.2	2.0	15.2	1.3	95.8
San_Juan	7406	4.3	32.8	5.7	100.0	3.0	15.7	11.7	99.6	4.2	15.5		97.2	4.5	22.7	8.4	99.4	3.4	28.2	3.8	94.3
Haleakala	7119	3.3	31.5	5.2	100.0	2.5	9.7	2.3	99.6	3.7	17.8		97.8	4.1	20.2		99.4	3.0	22.0	11.9	95.6

DGFI

validation for new stations

- Station reports to ILRS
- specific analysis centres cooperates with the station
  - centre and backup centre to be appointed from the AWG
  - local surveys are desirable at that point, prel. Coordinates
- If no problem happens in a period of about 8(?) weeks and sufficent passes are availble the station can be used as non core station in weekly analysis
  - better coordinates

- Core station qualification
  - fulfil ILRS station qualification
  - proofs to be stable (no sig. biases)
  - common decision from AWG

DGFI

French Analysis Center of SLR data

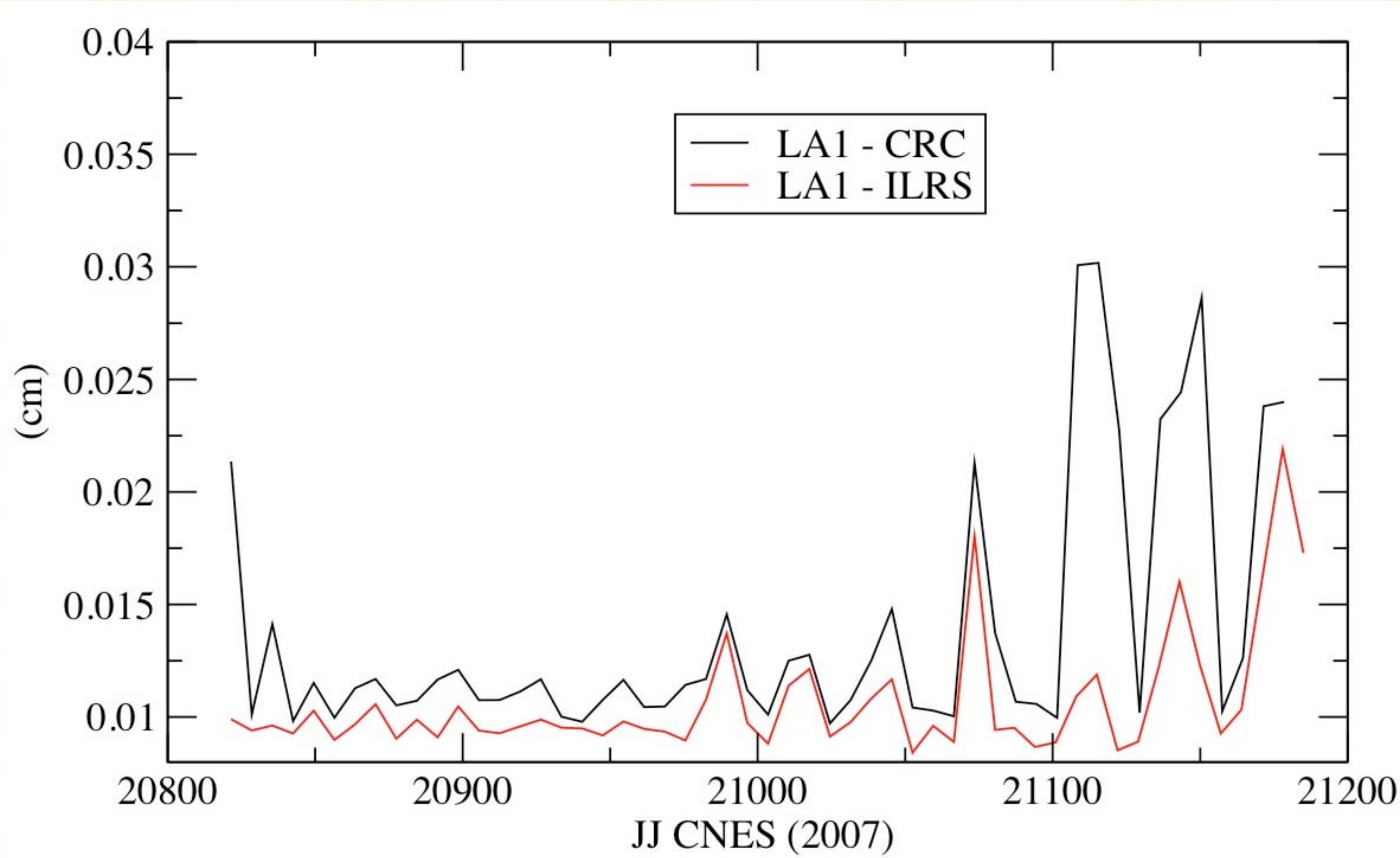
-

Activities 2008 : ILRS, and research

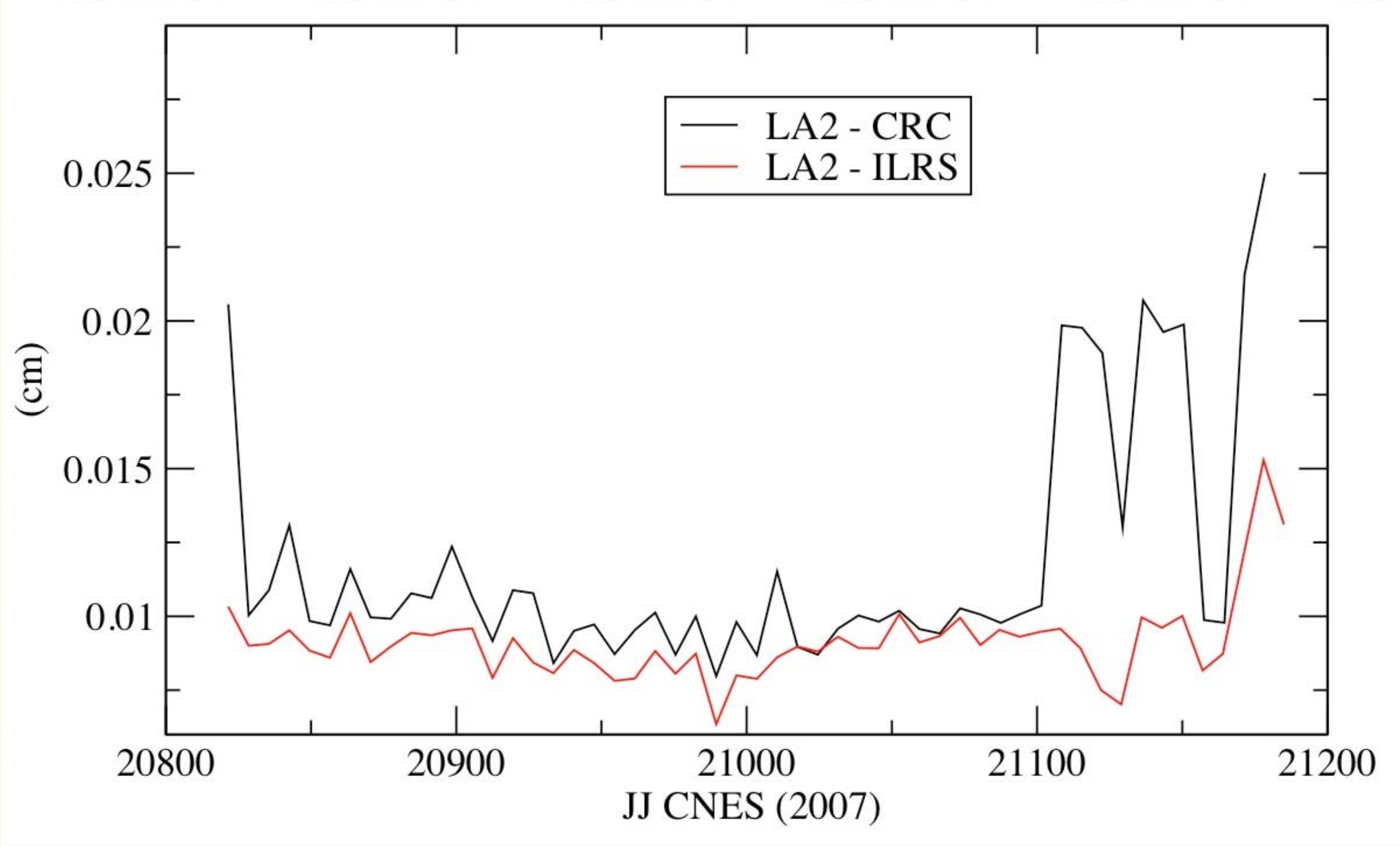
Philippe Berio, Pascal Bonnefond, David Coulot, Florent Deleflie, Pierre Exertier, Dominique Feraudy, Bachir Gourine, Olivier Laurain

Version 12 avril 2008

LAGEOS-1: weekly *post-fit residuals*



LAGEOS-2: weekly *post-fit residuals*

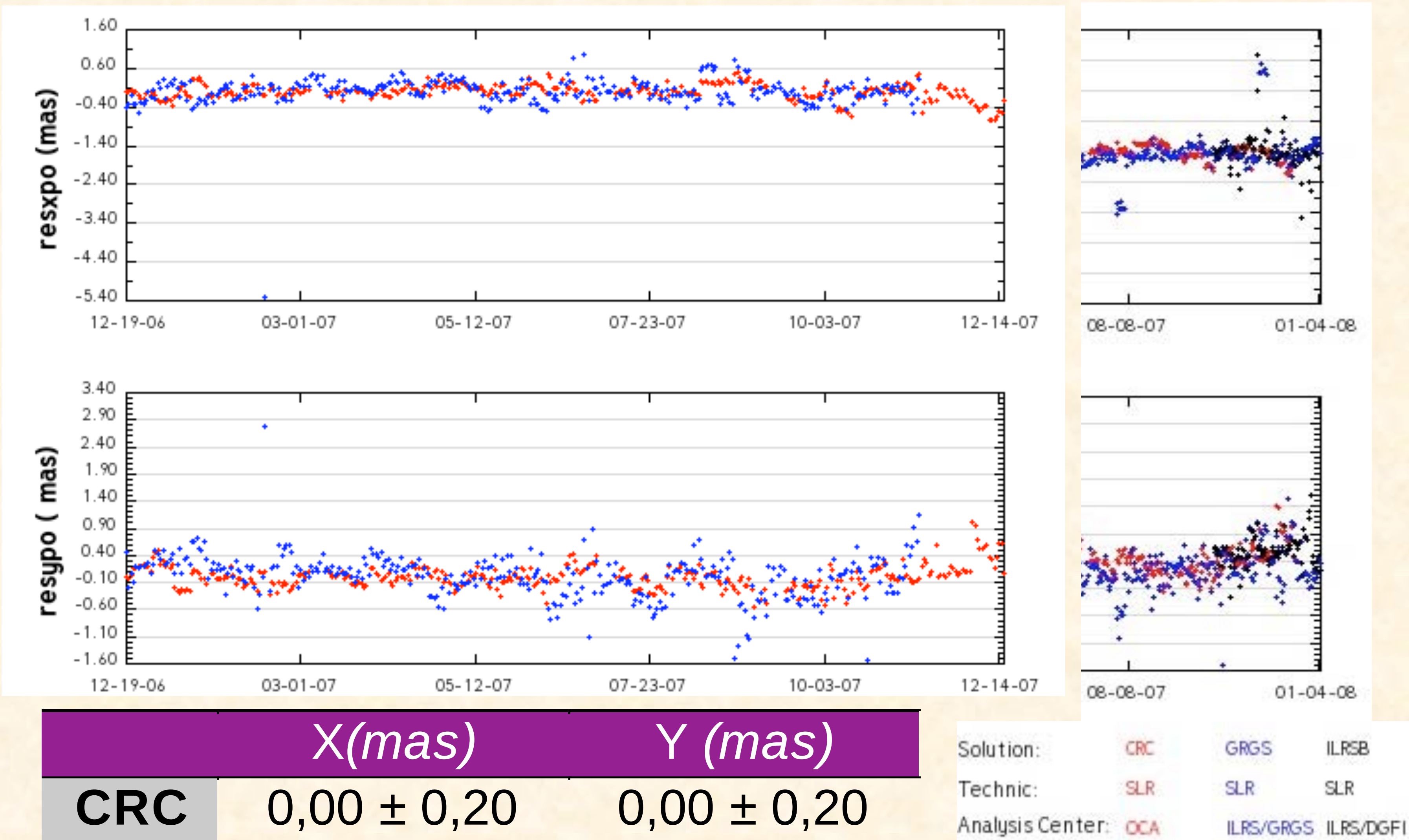


LAGEOS-1, -2: *Orbital modelling*

- ILRS
  - Week n-1
  - Albedo: Stephens model
  - No atmospheric loading for the gravity field (DEPSTA = 0)
  - No atmospheric loading for the stations (fes2002 = 0)
  - Daily polar motion a priori
  - 12 empirical coefficients

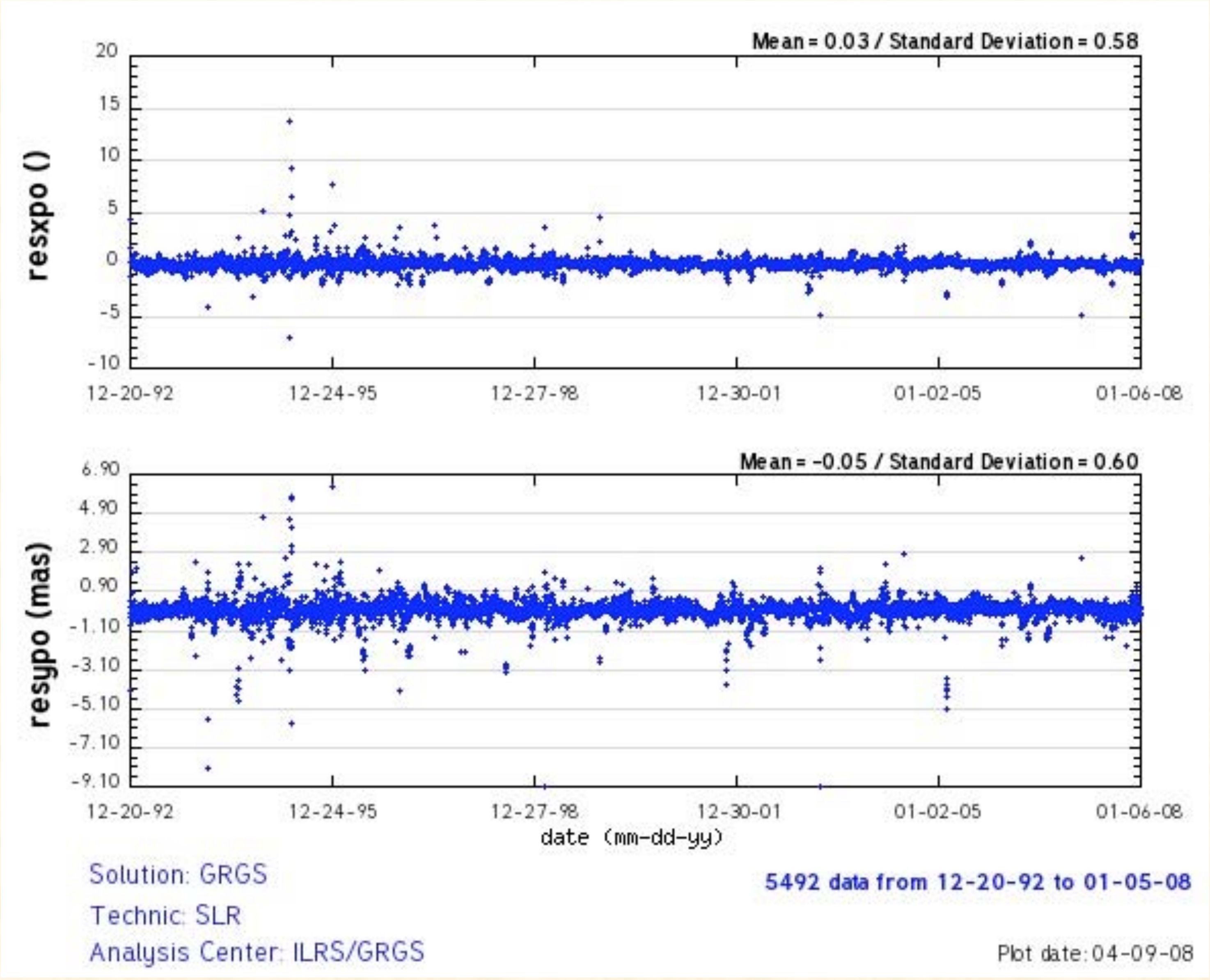
- CRC
  - Week n-3
  - Polar motion a priori: C04
  - DEPSTA = 1, fes2002 = 1
  - Albedo : Grids
  - Empirical coefficients: BT, BTC, BTS, BNC, BNS

ILRS operational products
EOP: Res wrt c04 (2006-2008)

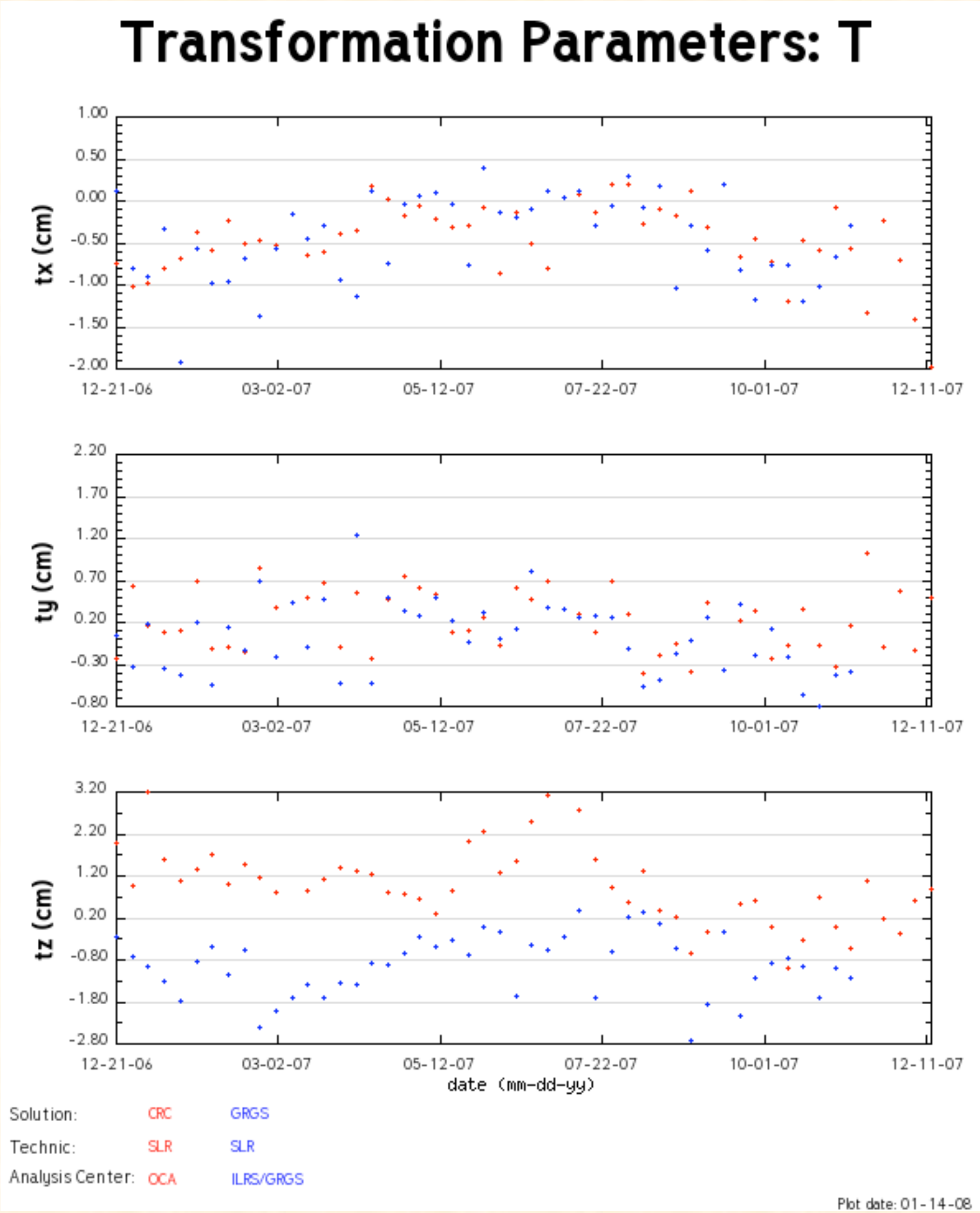


	X*(mas)*	Y *(mas)*
CRC	0,00 ± 0,20	0,00 ± 0,20
ILRS	0,01 ± 0,39	0,02 ± 0,40

ILRS operational products
EOP: Res wrt c04 (1993-2008)

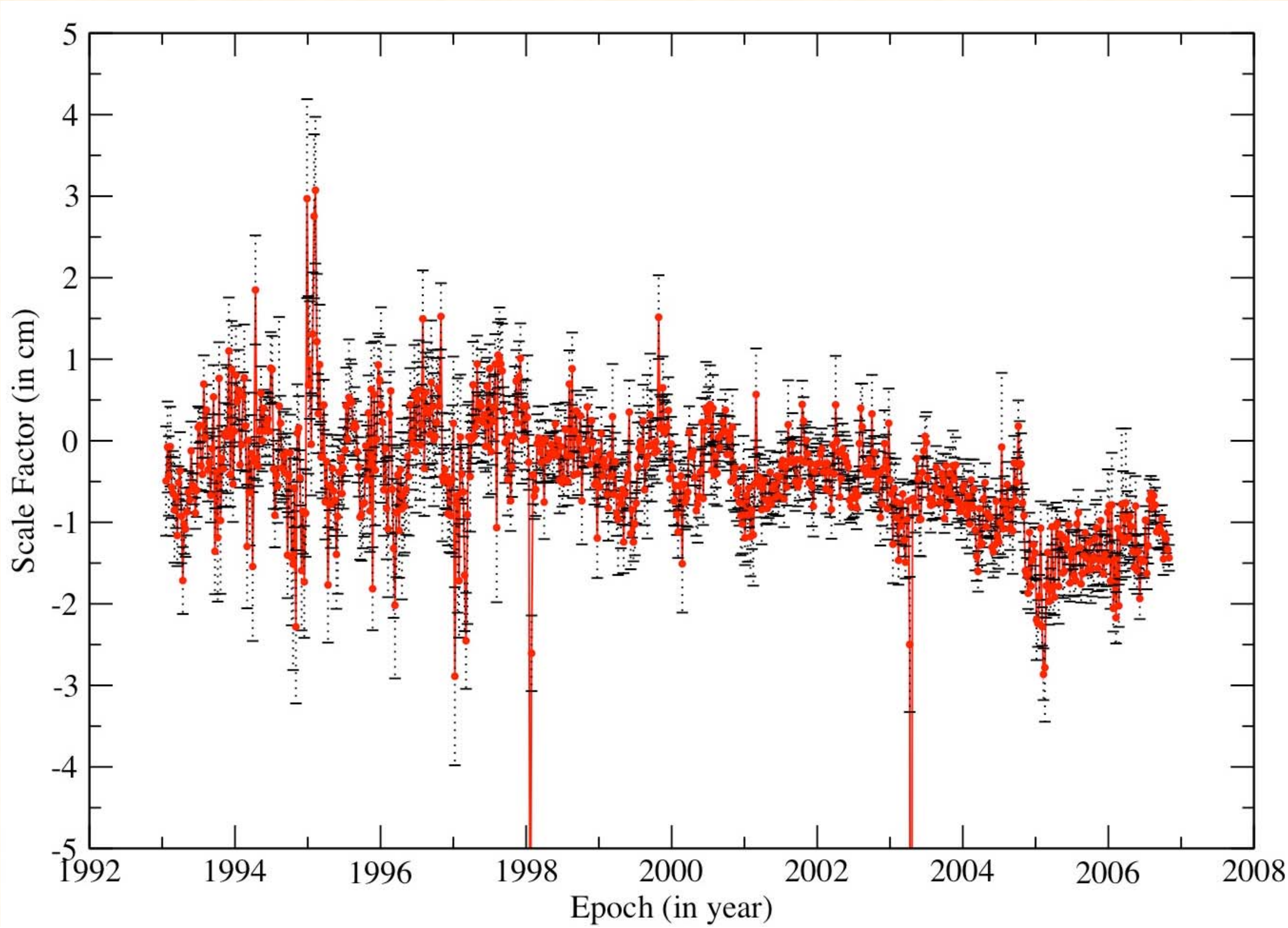


Reference frame

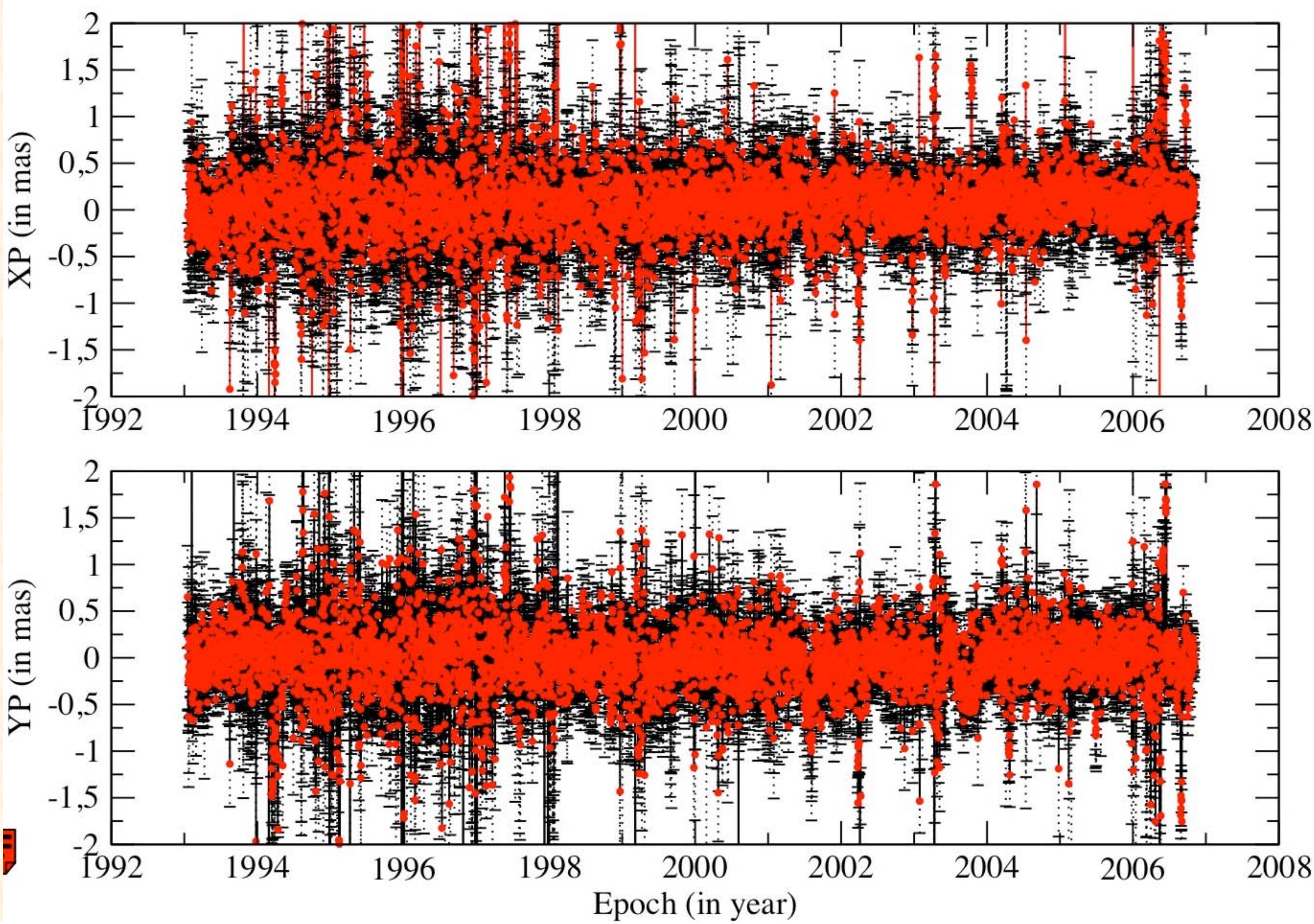


	CRC	ILRS
Tx (cm)	-0,47 ± 0,44	-0,46 ± 0,52
Ty (cm)	0,23 ± 0,36	0,09 ± 0,42
Tz (cm)	0,98 ± 0,90	-0,93 ± 0,73

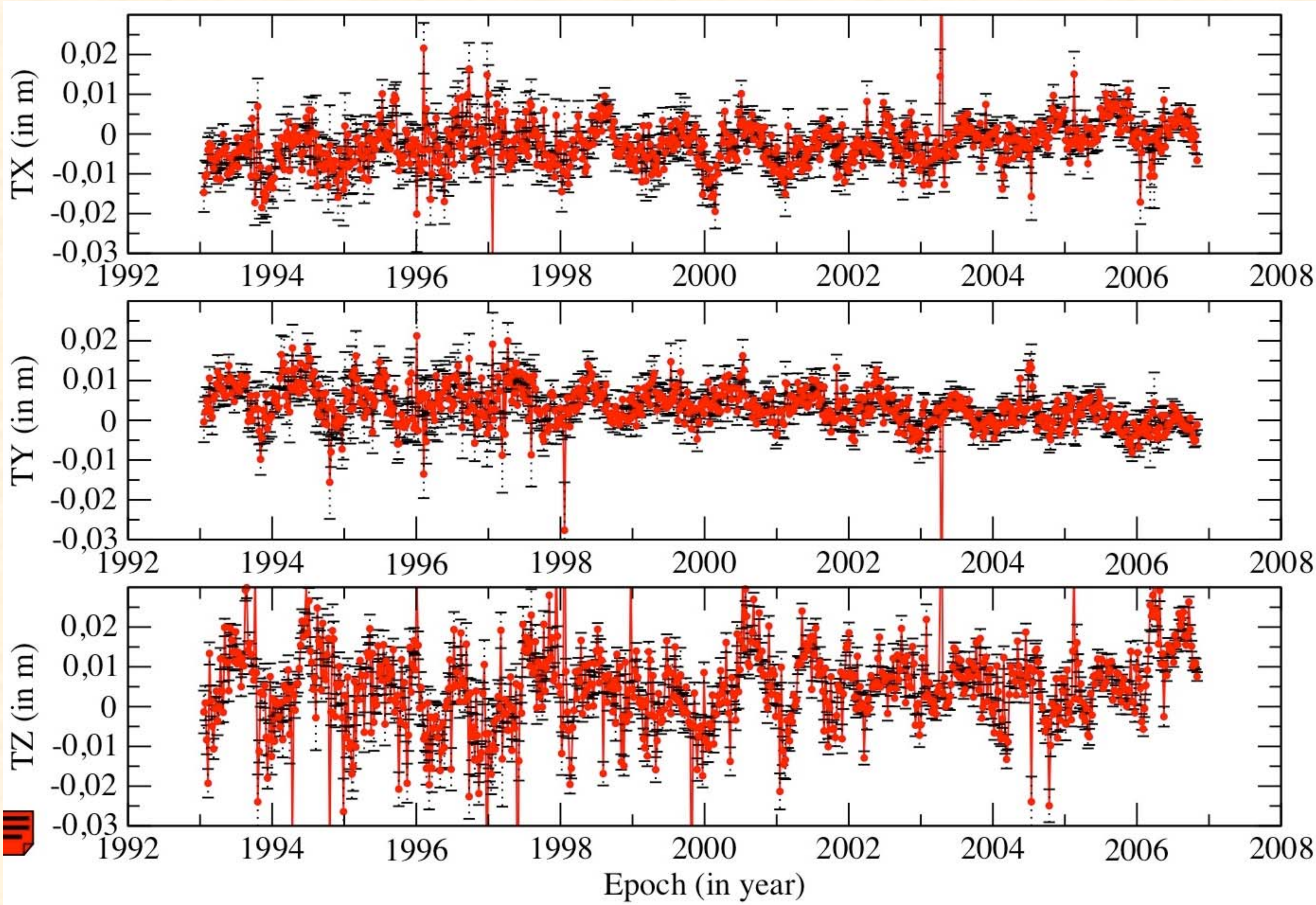
Post-fit reference frame: 1993-2007
scale factor



Post-fit reference frame: 1993-2007
polar motion (res wrt C04)



Post-fit reference frame: 1993-2007
transformation parameters



Post-fit reference frame: 1993-2007 *results*

	mean	rms
Xp (mas)	0,053	0,287
Yp (mas)	-0,028	0,288

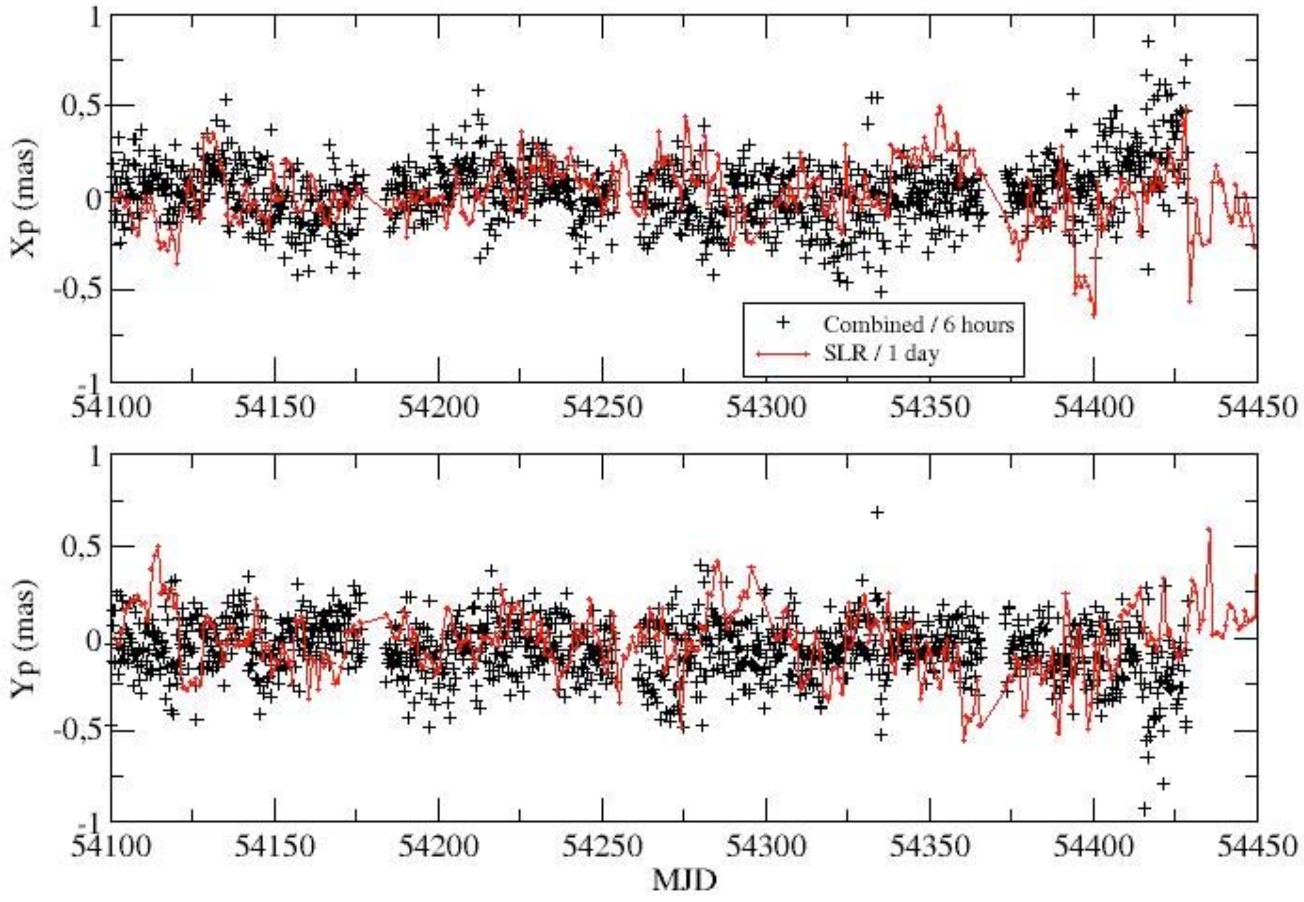
	mean	rms
D (mm)	-3,8	4,16

	mean	rms
Tx (mm)	-1,99	4,96
Ty (mm)	2,97	4,5
Tz (mm)	6,55	8,77

Inversion LA1 - LA2

- CRC
  - Empirical Orbital parameters
    Re-estimated under constraint
  - Stacking LA1-LA2
  - Contraints:
    pole : ± 1m
    stations à ± 1m
  - Deriving SINEX file + projection ITRF 05
- ILRS
  - MATLO : dynamical strategy (same parameters as orbit modelling)
  - Bias : ILRS strategy :
    No estimated bias, except for 4 stations, other bias only applied (ASI list)

Comparaison sol. SLR, sol. combinée / C04

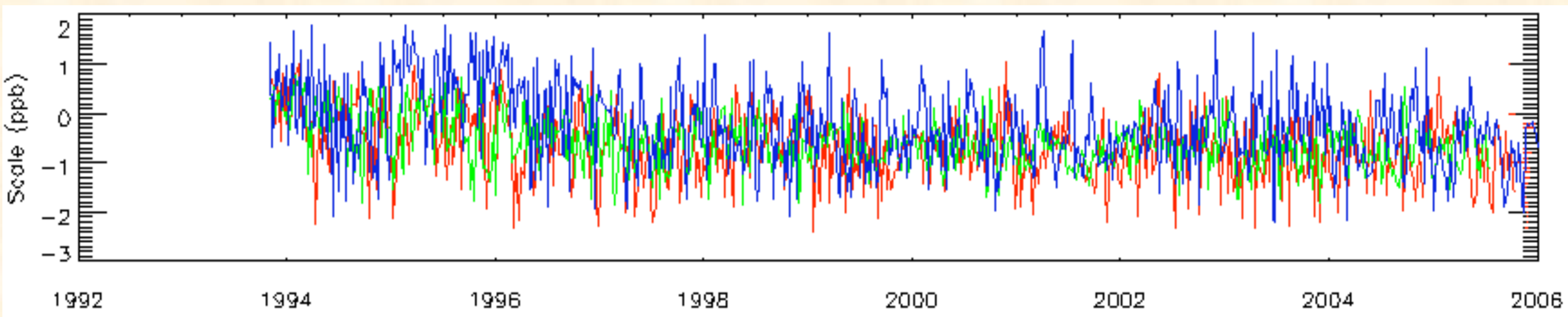


Use of STARLETTE : results

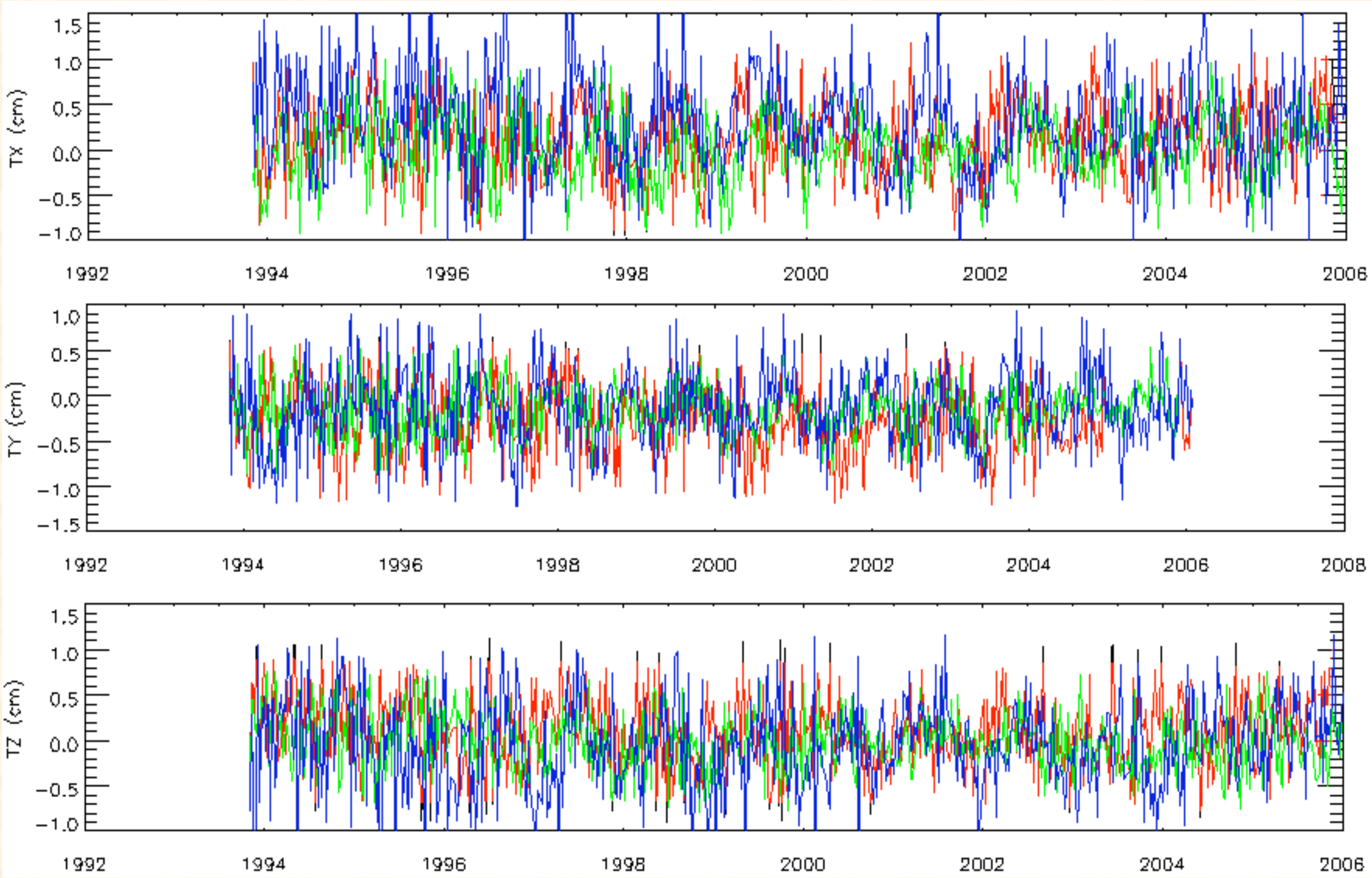
	TX (cm)	TY (cm)	TZ (cm)	D (ppb)
LA-1	-0.93 1.19 0.12 ±0.43 610	-1.19 1.19 -0.27 ±0.39 619	-0.90 1.12 0.11 ±0.41 609	-2.40 1.03 -0.66 ±0.70 604
LA-1&LA-2	-0.92 1.00 0.03 ±0.39 654	-0.85 1.00 -0.15 ±0.29 625	-0.79 0.78 0.00 ±0.32 640	-1.87 0.76 -0.59 ±0.54 607
LA-1&STAR (a)	-1.04 1.65 0.30 ±0.54 642	-1.22 1.65 -0.15 ±0.43 629	-1.22 1.17 -0.04 ±0.48 640	-2.18 1.80 -0.26 ±0.84 630
LA-1&STAR (b)	-0.85 1.68 0.39 ±0.52 644	-1.39 1.68 -0.10 ±0.52 650	-1.08 1.51 0.23 ±0.53 646	-5.10 1.09 -2.03 ±1.26 659

Use of STARLETTE : scale factor

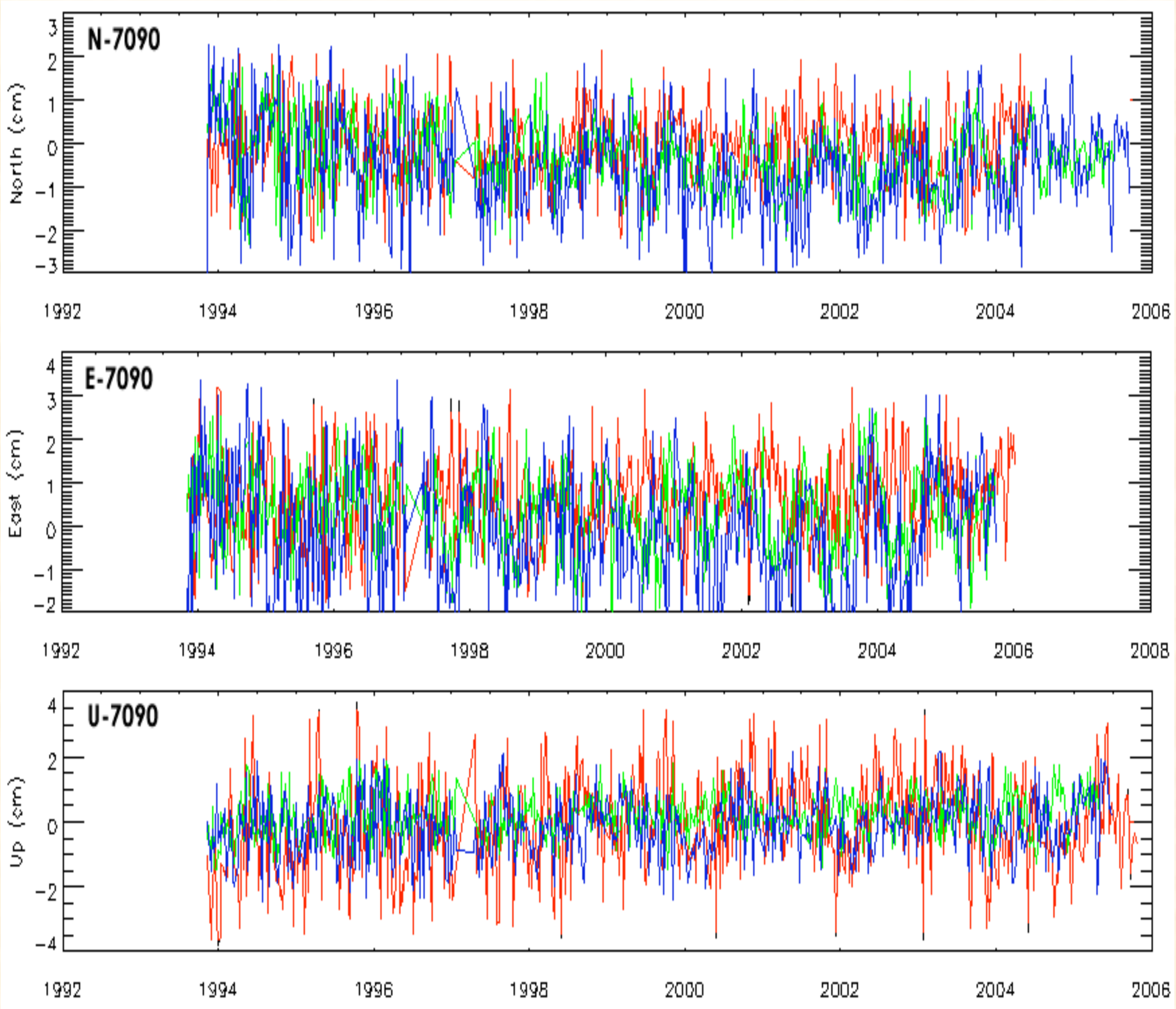
- LA1
- LA1+LA2
- LA1+STA



Use of STARLETTE: *translations*



Use of STARLETTE: *stations*



Conclusion

- On that study: interest of using STARLETTE not clear

- CRC - ILRS :
  - Solution CRC less noisy

    CRC : 4 points per day for the pole, interpolation to get 1point/d

    ILRS : 1 point / d

Further work on LAGEOS CoM Issues

Graham Appleby

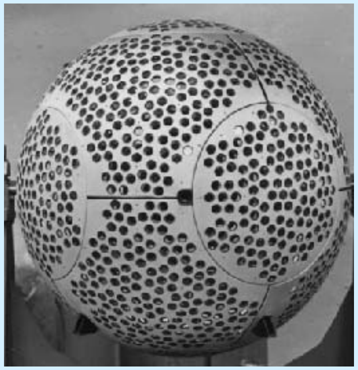
Space Geodesy Facility, Herstmonceux, UK

Acknowledgements:
ILRS Task Force #2

NATURAL ENVIRONMENT RESEARCH COUNCIL

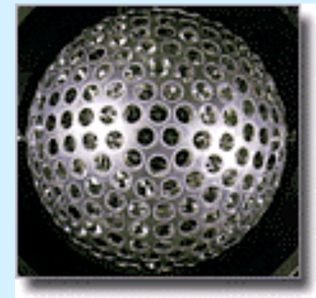
ILRS Analysis WG, Vienna Saturday 12th April 2008

International Laser Ranging Service

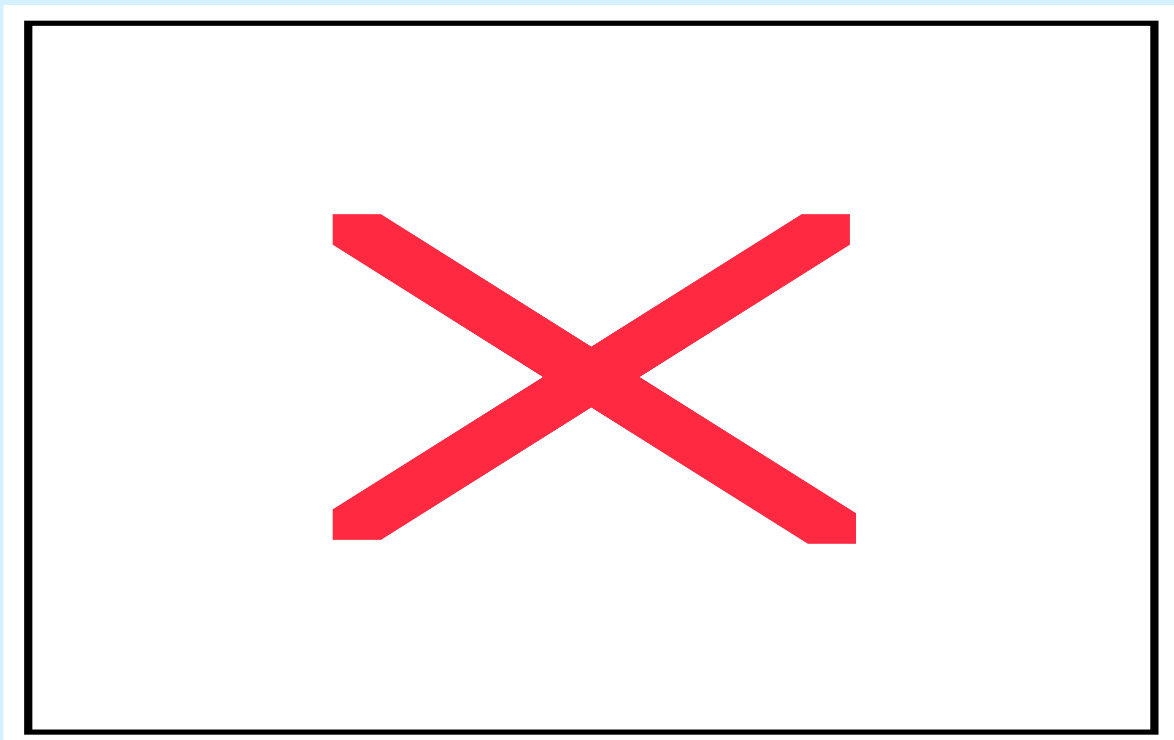


ETALON

Centre of Mass corrections: Satellite ‘signature’ contribution



LAGEOS



On average, over many shots, returning pulse-shape can be modelled as a convolution of laser pulse-shape with the satellite response function.

Magnitude of effect

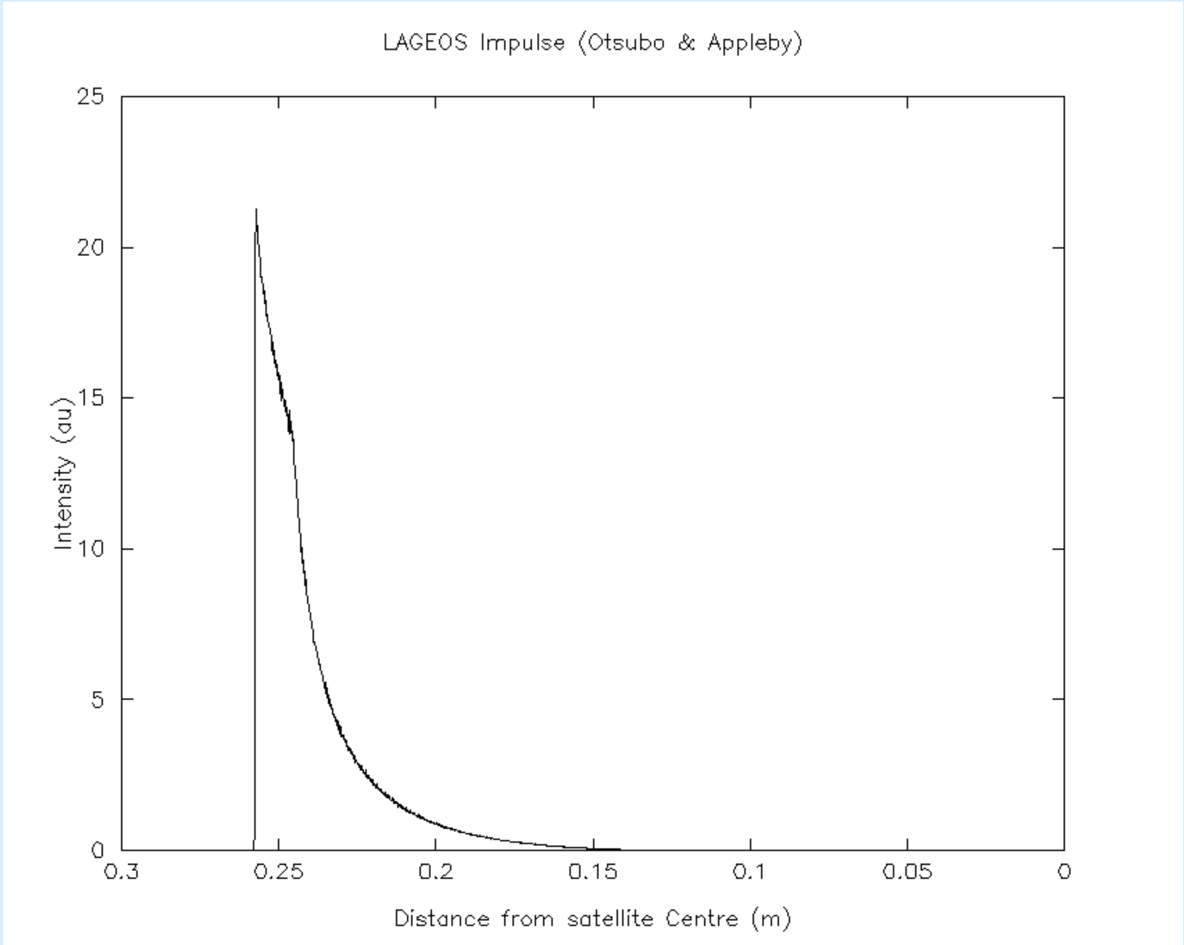
- Depending upon the stations' technology:

  - there is a range of appropriate CoM values;
  - for LAGEOS the total range is ~6mm (Minott *et al*, 1993, Otsubo & Appleby, 2003)

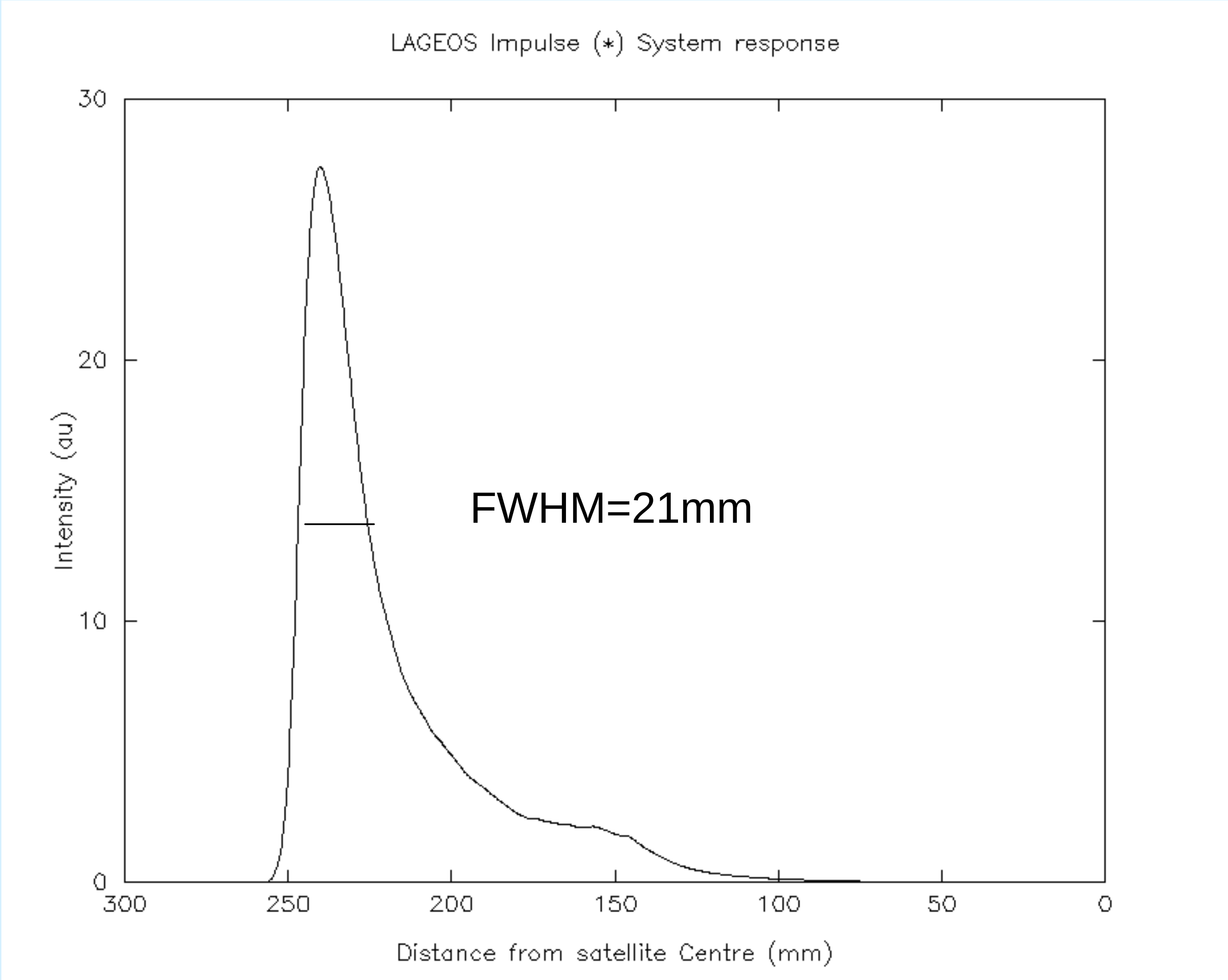
- Station technology:
  - multi-photon returns:
    - photomultiplier or first-photon detection
  - single photon return

- Development of a model, illustrated using a low return-energy system (single photons):

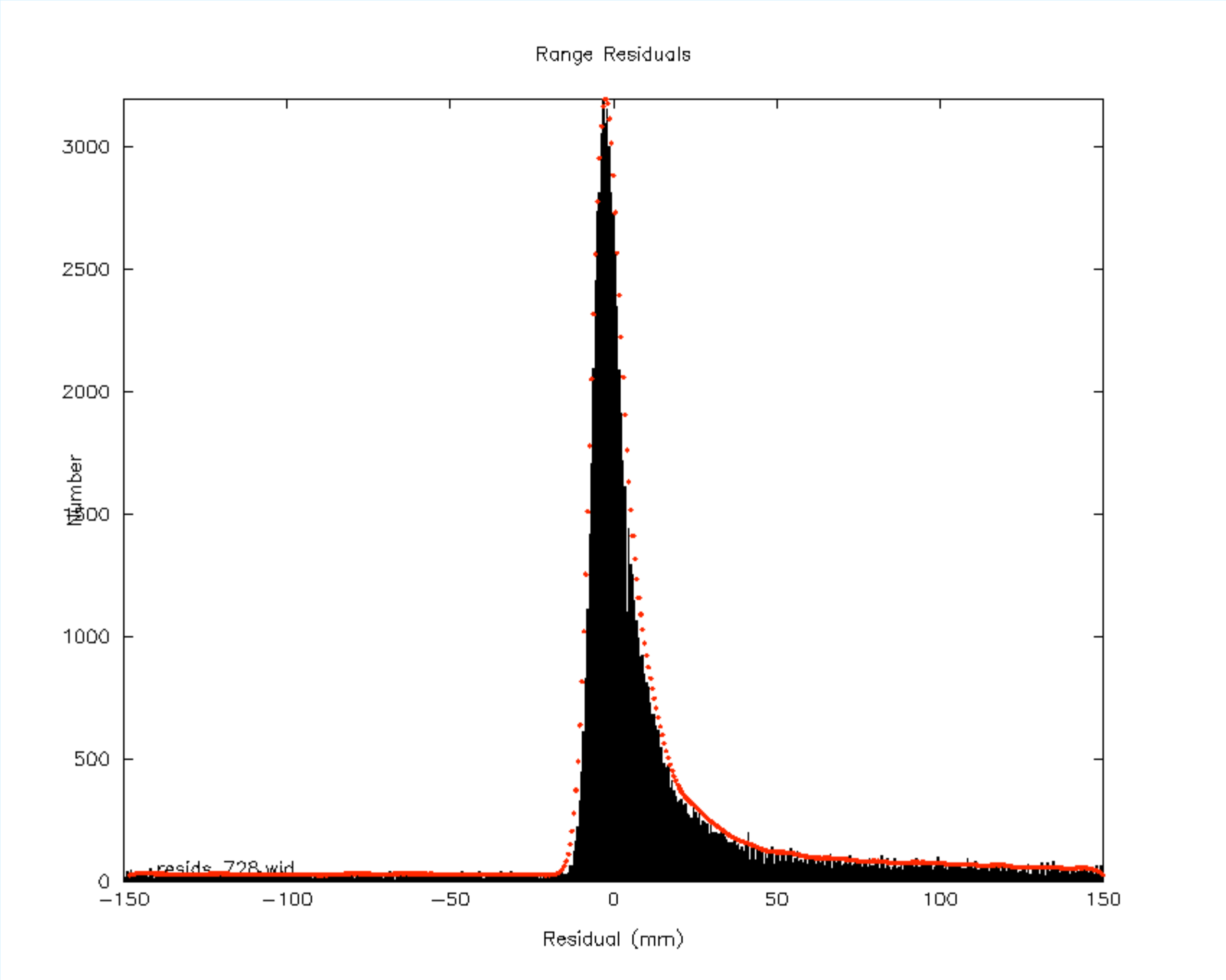
LAGEOS impulse (Otsubo & Appleby, 2003)



System ($_*$) LAGEOS



Real data from a pass at << **single photons**.
σ = 8.5mm: (data will be rejected at −12 and +25mm

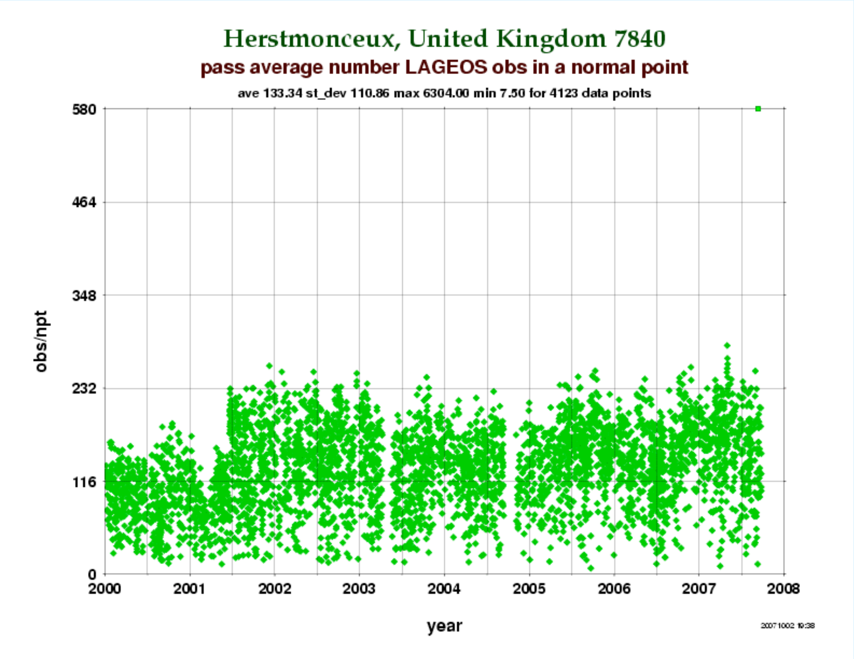


For this case, possible to compute **from the model** an **average** CoM value accurate to ~1mm (=245mm)

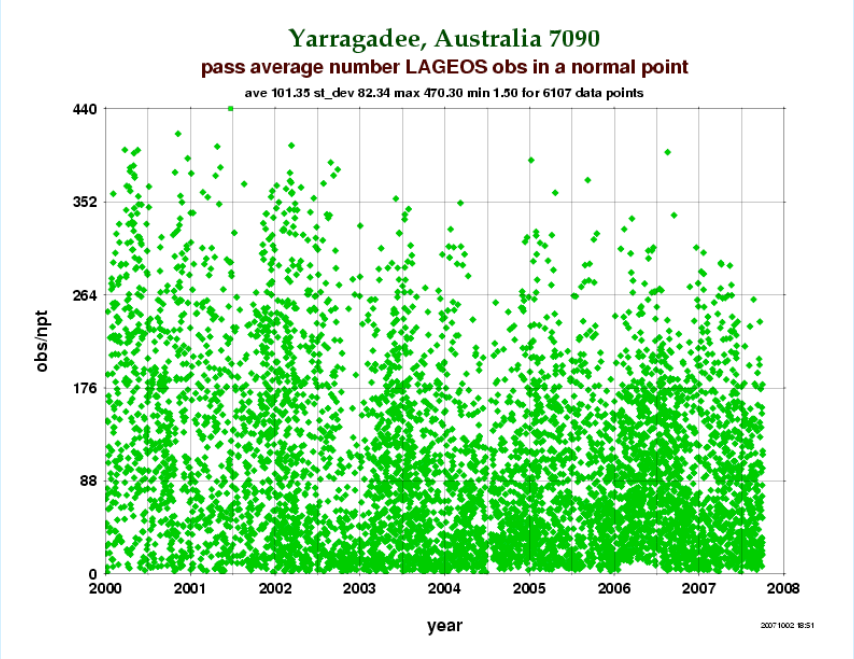
Centre of mass corrections >> single photons

- For NASA systems, for example, returns peak at several hundreds of photons (est. from link models, e.g. Degnan, 1993)
- Models for CoM depend upon characteristics of electronic discriminators;
- Cannot use statistical method for CoM as for single-photon systems
  - But can **estimate** from the model distributions (leading edge), to give CoM 248 ±2 mm
  - This compares with ground tests on LAGEOS-2 giving 249 mm (Minott, 1993)

Single-photon vs multi-photon yield



Single-photon, consistent



Multi-photon, variable

In summary:

There exist different CoM values dependent on the stations’ technology.

- Single photon systems have smallest uncertainty: **±1mm**

- Com for high-energy systems have an estimated uncertainty of ± 2mm
    - take account of unknown effect of discriminators at different stations;
    - effect is to increase effective pulse-length

- A table of values has been produced:

- CoM for typical single photon station 245mm

- Com for typical, majority, high-energy station 248mm
    - or use 249mm as measured for MCP on LAGEOS-2 in lab.

ILRS stations - System configuration and CoM corrections for LAGEOS

Stn pad ID	*Name*	*Pulselength*	*Detector*	*Regime*	*Processing*	*Calib.*	*LAGEOS*	*LAGEOS*
		(ps)		*(single, few, multi)*	*level*	*St. error (mm)*	*St. error (mm)*	*CoM (mm)*
1873	Simeiz	350	PMT	No Control	2.0 sigma	60	70	248-244
1884	Riga	130	PMT	Controlled s->m	2.0 sigma	10	15	252-248
7080	Mc Donald	200	MCP	Controlled s->m	3.0 sigma	8.5	13	250-248
7090	Yaragadee	200	MCP	Controlled f->m	3.0 sigma	4.5	10	250-248
7105	Greenbelt	200	MCP	Controlled f->m	3.0 sigma	5	10	250-248
7110	Monument Peak	200	MCP	Controlled f->m	3.0 sigma	5	10	250-248
7124	Tahiti	200	MCP	Controlled f->m	3.0 sigma	6	10	250-248
7237	Changchung	200	CSPAD	Controlled s->m	2.5 sigma	10	15	250-245
7249	Beijing	200	CSPAD	No Control, m	2.5 sigma	8	15	255-247
7355	Urumqui	30	CSPAD	No Control	2.5 sigma	15	30	255-247
7405	Conception	200	CSPAD	Controlled s	2.5 sigma	15	20	246-245
7501	Harteb.	200	PMT	Controlled f->m	3.0 sigma	5	10	250-244
7806	Metsahovi	50	PMT	?	2.5 sigma	15	17	254-248
7810	Zimmerwald	300	CSPAD	Controlled s->f	2.5 sigma	20	23	246-244
7811	Borowiec	40	PMT	No Control f	2.5 sigma	16	23	256-250
7824	San Fernando	100	CSPAD	No Control s->m	2.5 sigma	30	25	252-246
7825	Stromlo	10	CSPAD	Controlled s->m	2.5 sigma	4	10	257-247
7832	Riyadh	100	CSPAD	Controlled s->m	2.5 sigma	10	15	252-246
7835	Grasse	50	CSPAD	Controlled s->m	2.5 sigma	6	15	255-246
7836	Potsdam	35	PMT	Controlled s->m	2.5 sigma	10	20	256-252
7838	Simosato	100	MCP	Controlled s->m	3.0 sigma	20	40	252-248
				No Control				

Progress with Stanford Counter assessments

Philip Gibbs and Graham Appleby

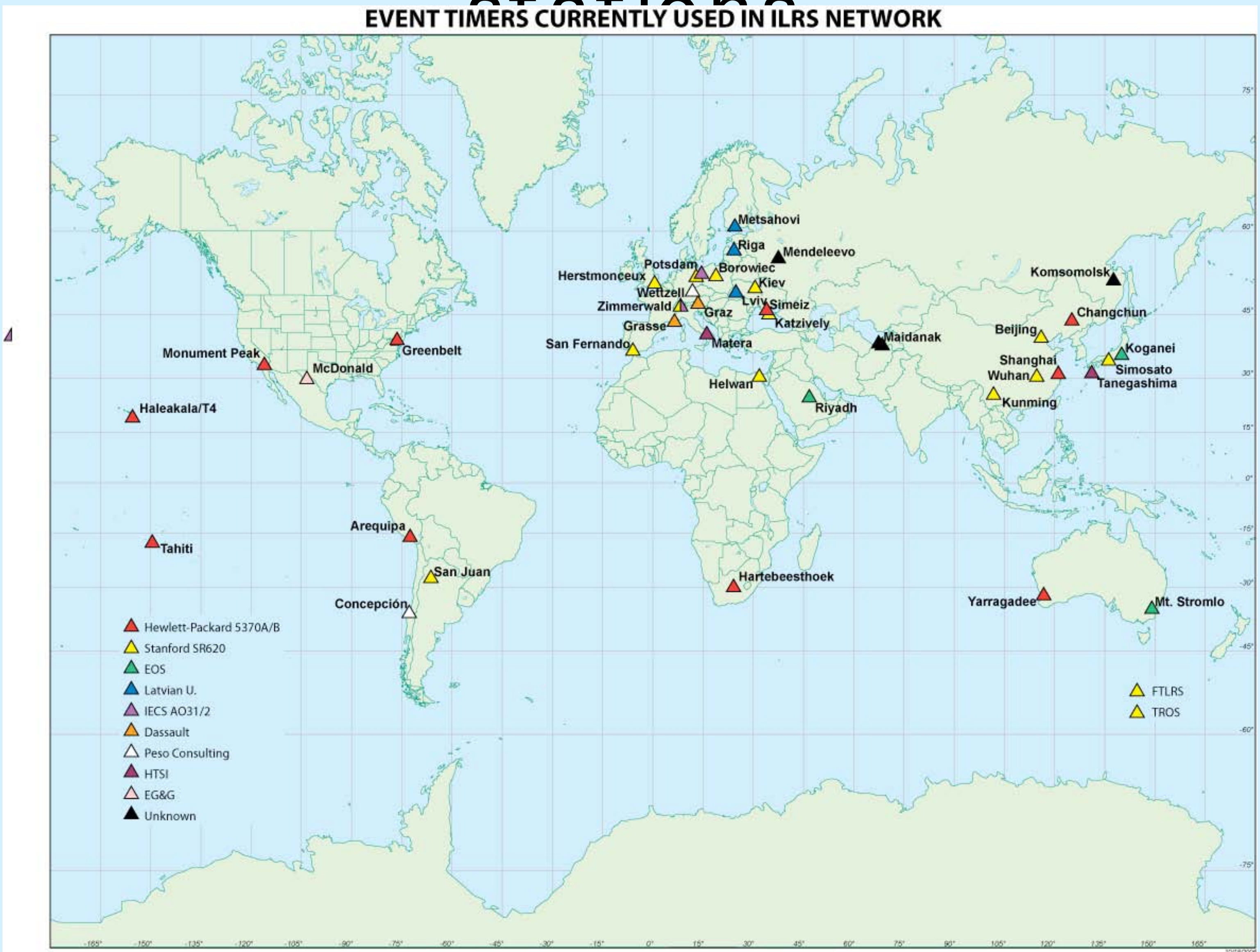
Space Geodesy Facility, Herstmonceux, UK

ILRS Analysis WG Vienna Saturday 12th April 2008

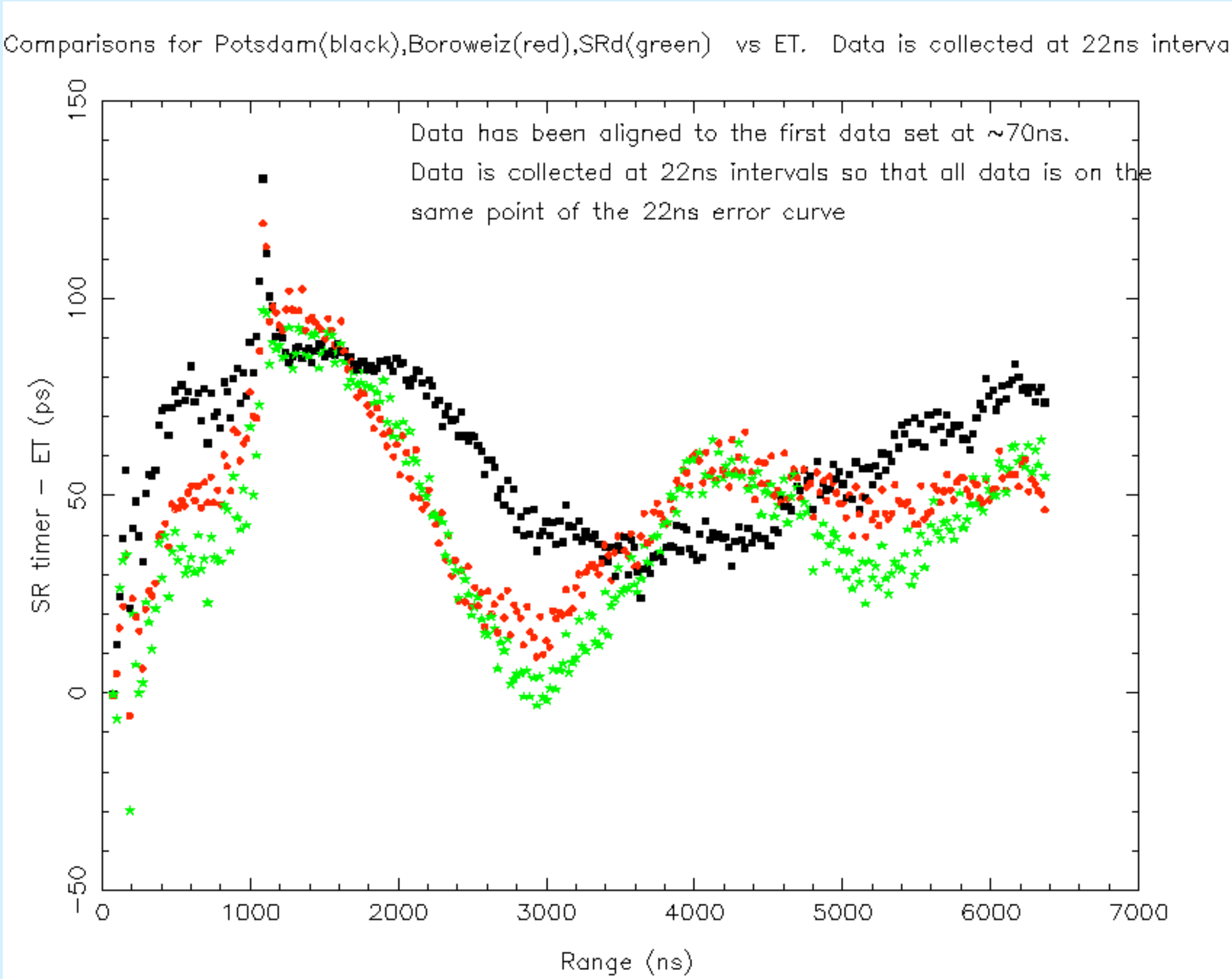
Tests on (Stanford) counter linearity

- Relative to a 'perfect' time-of-flight counter, what are the characteristics of the counters in common use over the last 15+ years?
- Work has been carried out on ***Stanford*** counters in use at Herstmonceux, relative to a high-spec, ps-level event timer.
- Counters from Potsdam and Boroweic also tested at Herstmonceux.
- Studied effects at LAGEOS and at local calibration target distances.

Counters in use in ILRS stations



Tests at Hx with Potsdam (7836) and Borowiec counters - at calibration ranges



Tests and estimates

- From tests or estimates, following table constructed
- Computed for LEO-MEO
- Test results in **bold**
- Re-iterate the uncertainty in this approach
  - High-frequency several mm variations present
  - Not possible to do an exact 'calibration'
  - Uncertainty may by 3mm

STATION NAME		PAD ID	Calib error	LEO error	LAGEOS error	GPS error
BEIL	Beijing	7249	-12	- 2	- 2	- 3
BORL	**Borowiec**	**7811**	**- 9**	**- 9**	**- 9**	**0**
BREF	Brest	7604	-10	0	0	- 1
GLSV	Kiev	1824	- 6	+ 4	+ 4	+ 3
HELW	Helwan	7831	0	+10	+10	+ 9
HERL	**Herstmon.**	**7840**	**- 7**	**- 7**	**- 7**	**- 7**
KTZL	Katzively, Ukraine	1893	0	+10	+10	+ 9
KUNL	Kunming, China	7820	- 9	+ 1	+ 1	0
POT3	**Potsdam**	**7841**	**0**	**+ 5**	**+ 5**	**+ 5**
POTL	Potsdam	7836	0	+ 3	+ 3	+ 3
SFEL	**San Fernando**	**7824**	**0**	**+ 8**	**+ 8**	**+ 8**
SISL	Simosato, Japan	7838	+ 1	+11	+11	+10
SJUL	San Juan	7406	0	+10	+10	+ 9
WUHL	Wuhan	7231	0	+10	+10	+ 9
ZIML	**Zimmerwald**	**7810**	**- 3**	**- 3**	**- 3**	**- 3**
GRSL	Grasse	7835	- 1	+ 9	+ 9	+ 8

Summary where specific dates known

Station	Dates	Range Correction (mm)
7840 HERL	1994/10/01 – 2002/01/31	+2.5
7840 HERL	2002/02/01- 2007/02/10	-7.0
7836 POTS	1992/05/01 ->	+3.0
7841 POTS	2001/07/01 – 2004/02/28	+5
7811 BORL	2002/05/01 ->	-9

Estimates for other stations

- In collaboration with ILRS CB
- Have invited four major stations to send their counters to SGF Herstmonceux for comparison with event timer
- One positive response (only?)
  - Working with that group to exchange a counter.

Worse-case error estimates (mm)

Station		ID	Calibration error	LAGEOS error	Total error
BEIL	Beijing	7249	-12	+10	- 2
BORL	Borowiec	7811	- 9	+ 0 meas	- 9
BREF	Brest	7604	-10	+10	0
GLSV	Kiev	1824	- 6	+10	+ 4
HELW	Helwan	7831	0	+10	+10
KTZL	Katzively, Ukraine	1893	0	+10	+10
KUNL	Kunming, China	7820	- 9	+10	+ 1
POT3	Potsdam	7841	0	+ 5	+ 5
POTL	Potsdam	7836	0	+ 3 meas	+ 3
SFEL	San Fernando	7824	0	+ 8 meas	+ 8
SISL	Simosato, Japan	7838	+1	+10	+11
SJUL	San Juan	7406	0	+10	+10
WUHL	Wuhan	7231	0	+10	+10
ZIML	Zimmerwald	7810	-3	+ 8 appl	- 3
Closed sites					
GRSL	Grasse	7835	- 1	10	+9

meas = measured on particular Stanford counters; **appl** = applied at station

Comments

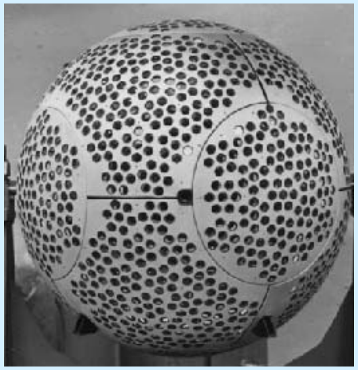
- We emphasise the **estimated** nature of this table;

  e.g. the 3 Herstmonceux Stanford counters show large inter-counter differences;

- Difficult to test other counters;
  - Either no longer available or still vital to operations
  - Unlikely to make significant further progress
- Several of the stations have already **upgraded** to higher-quality counters.

Summary/outlook

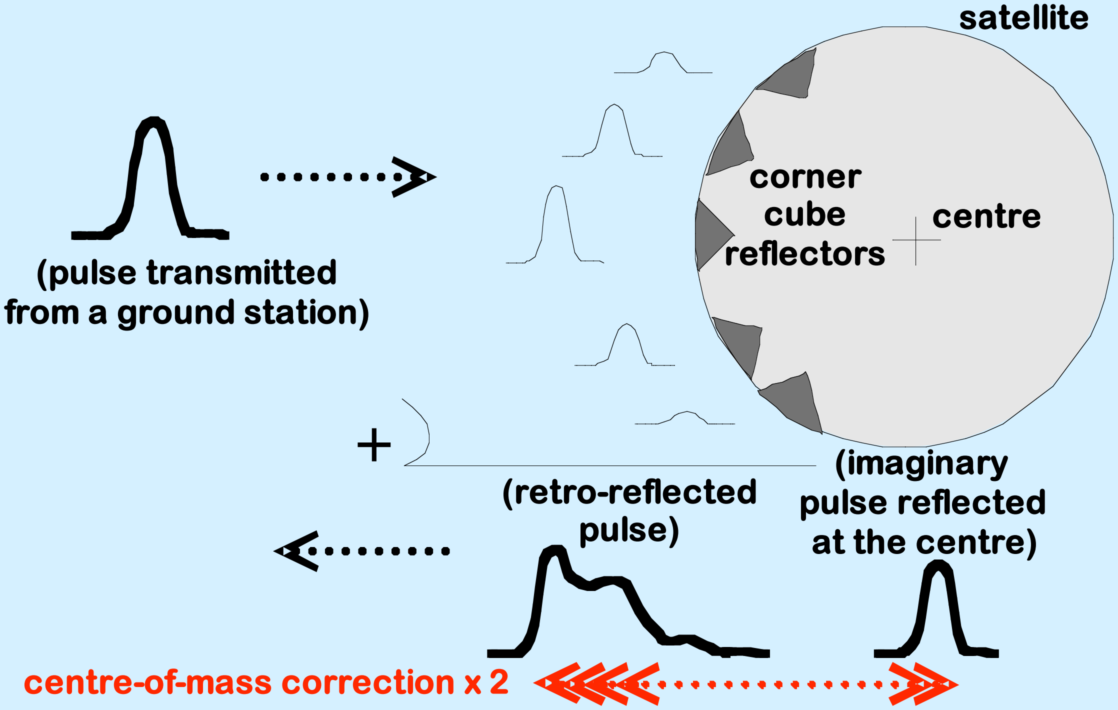
- We also note that:
- The stations are a subset of the full ILRS network, but do contain some core sites;
- It is also estimated (Zhong, 1998) that the **HP** counters in common use have non-linearity effects at ~3mm level
  - Needs further investigation



ETALON

Centre of Mass corrections: Satellite 'signature' contribution

LAGEOS



On average, over many shots, returning pulse-shape can be modelled as a convolution of laser pulse-shape with the satellite response function.

Magnitude of effect

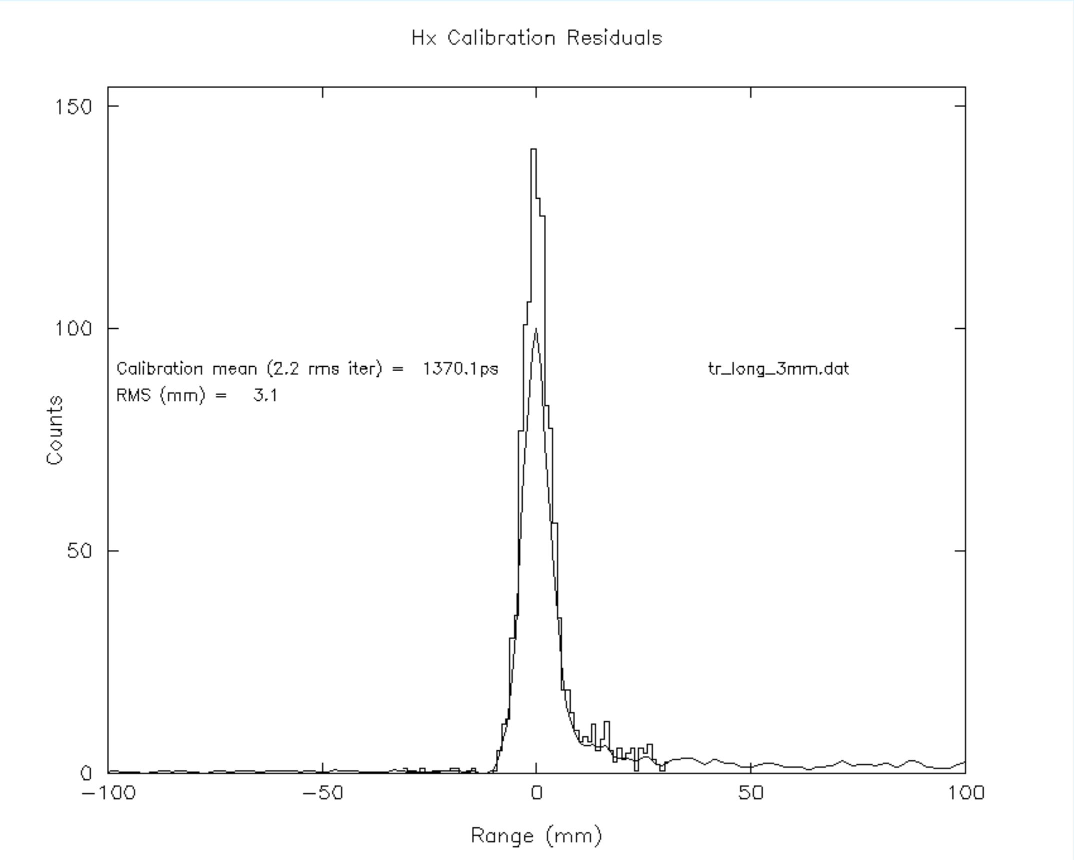
- Depending upon the stations' technology:

  - there is a range of appropriate CoM values;
  - for LAGEOS the total range is ~6mm (Minott *et al*, 1993, Otsubo & Appleby, 2003)

- Station technology:
  - multi-photon returns:
    - photomultiplier or first-photon detection
  - single photon return

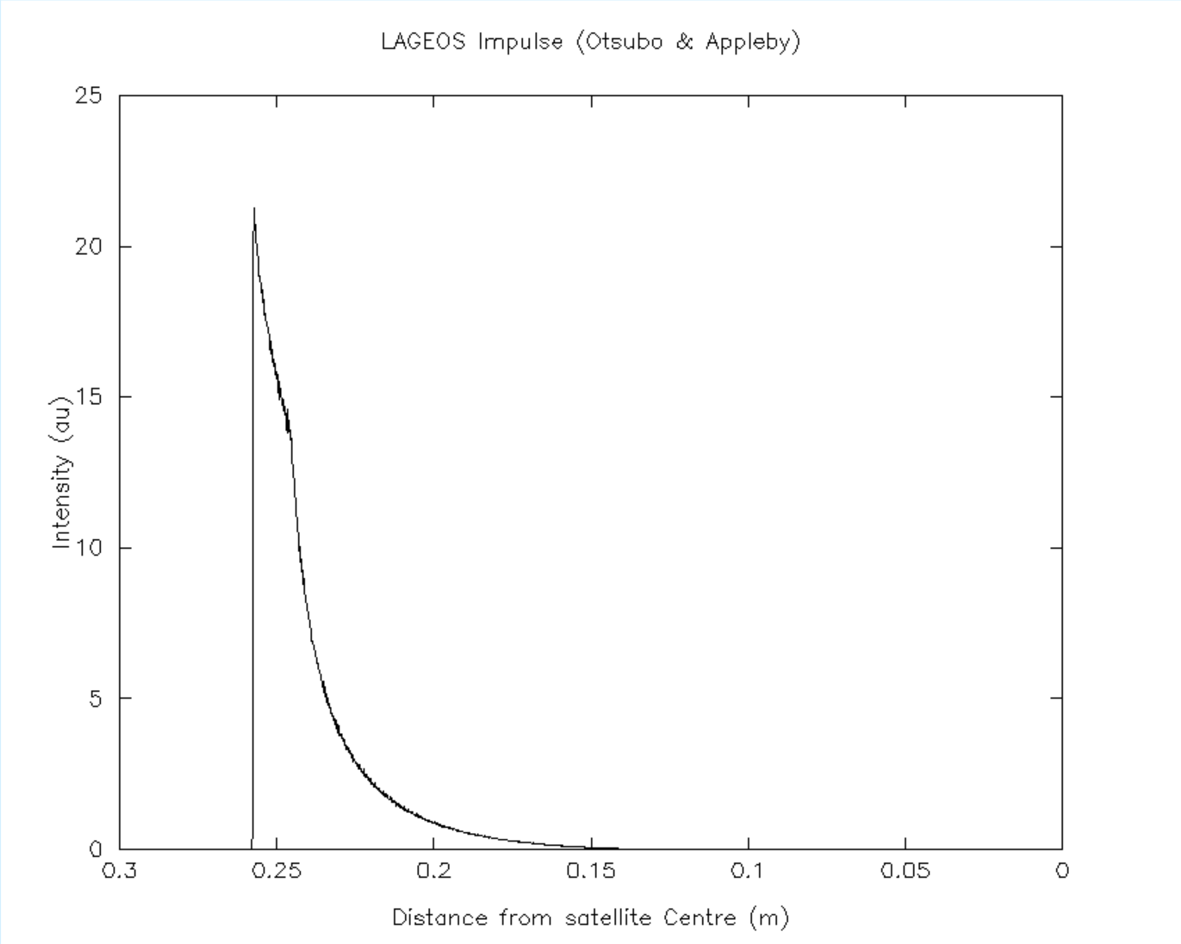
• Development of a model, illustrated using a low return-energy system (single photons):

At **single-photon**, expect distribution of range residuals to be convolution of whole-system response with LAGEOS impulse

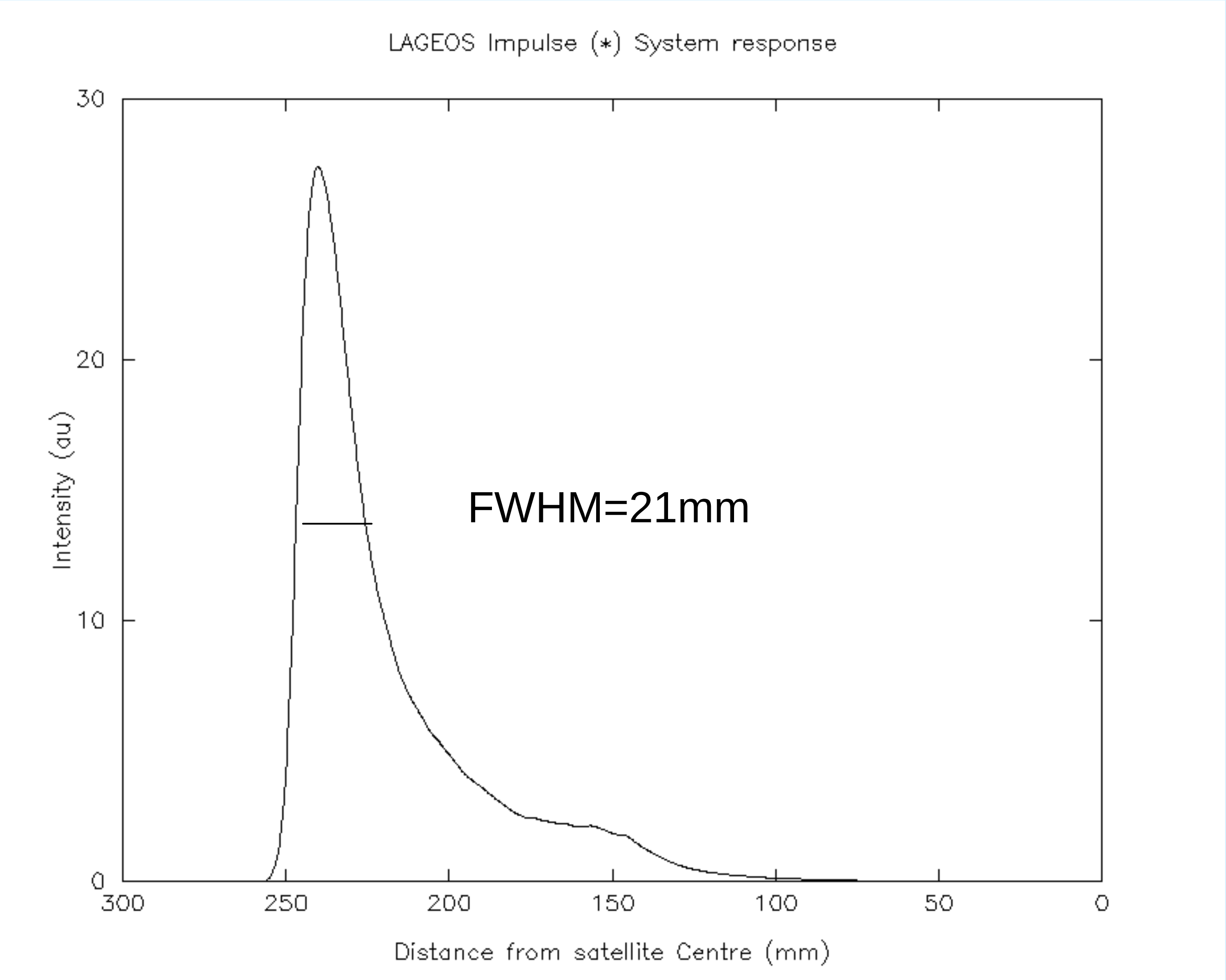


System response obtained from target-board ranging at << single photons

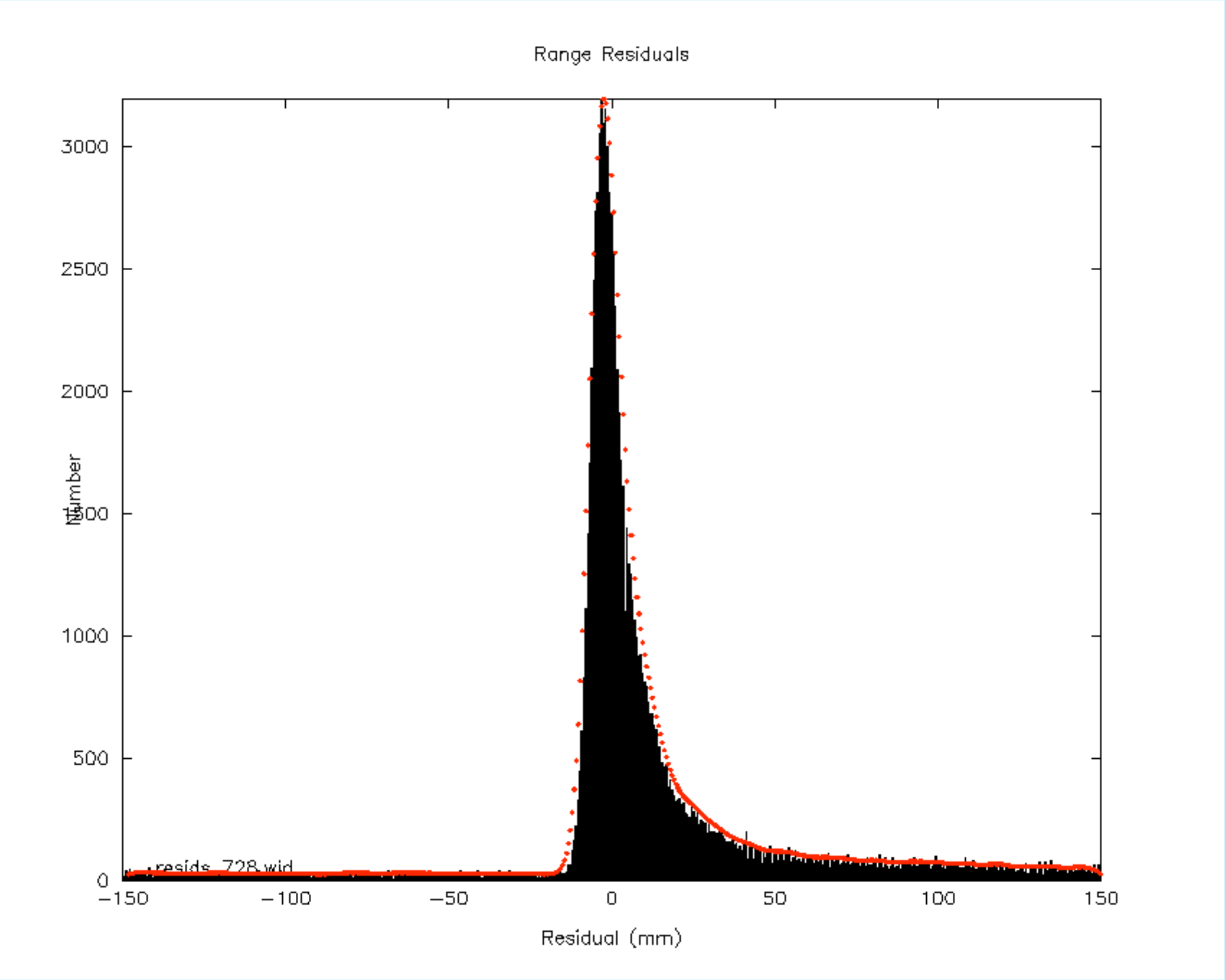
LAGEOS impulse (Otsubo & Appleby, 2003)



System (*) LAGEOS



Real data from a pass at << **single photons**.
σ = 8.5mm: (data will be rejected at −12 and +25mm



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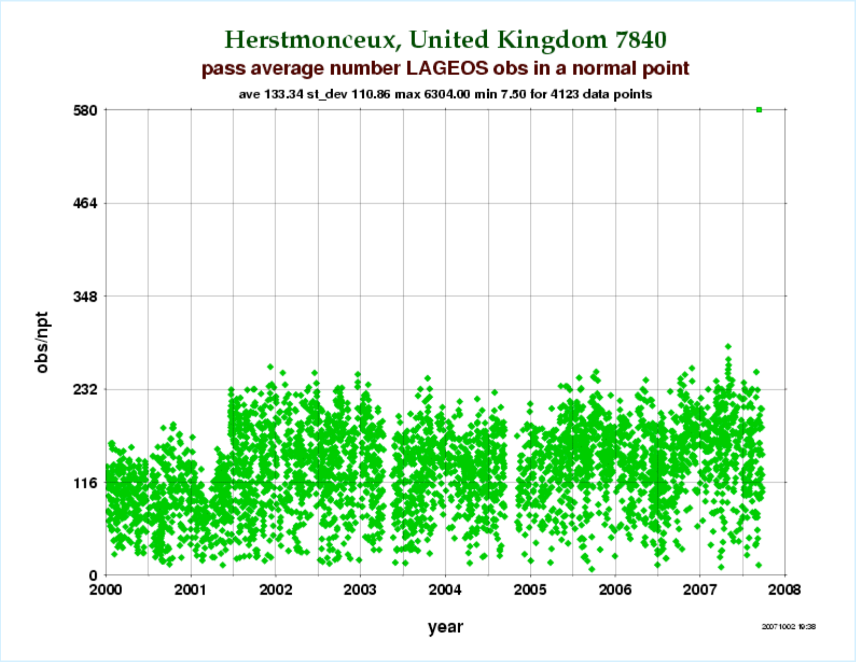
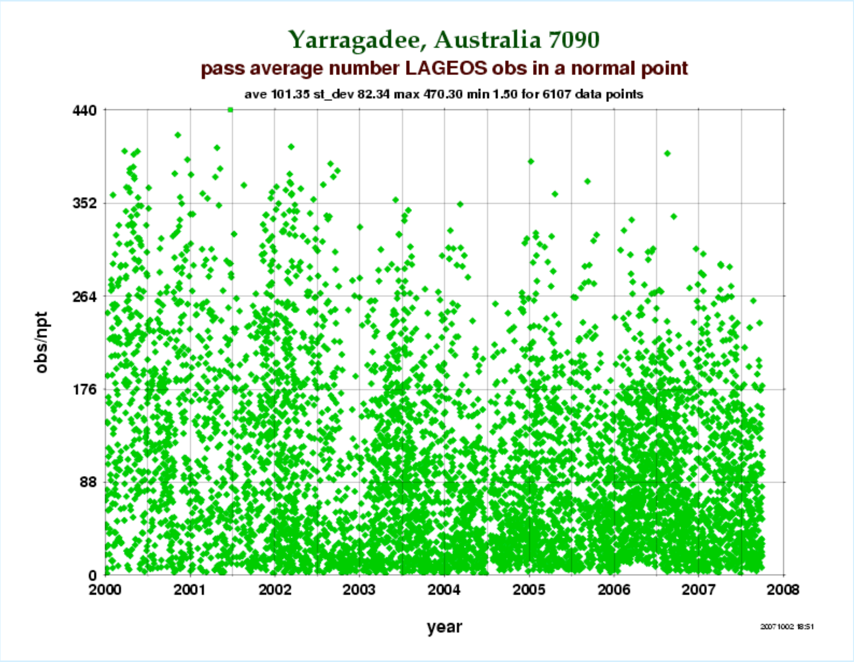
Single-photon vs multi-photon yield



Single-photon, consistent



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- CoM for typical single photon station 245mm
- Com for typical, majority, high-energy station 248mm

- Relative to 'standard' 251mm, change of ~0.3ppb.

Conclusion

- With improved
  - estimates of counters’ effects in the sub-network;
  - knowledge of band of appropriate CoM values throughout the network:
    - LAGEOS is not a mm-level target for >single photons
- Should include these effects in future re-analyses efforts towards:
  - TRF;
  - GM: a change of CoM from 251 to 248 is 0.5ppb
  - Constrained RB for stations based on informed CoM band and counter characteristics.
- **NB** New technology (event timer, kHz) systems fulfil ‘best practice’ requirements.

Perspectives of Processing SLR Data Using the Bernese GPS Software

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ILRS: Analysis working group meeting

Vienna, Austria. 12–April–2008

Bernese GPS Software:

- Name has been wrong for many years because of the GLONASS capability
- Implementation of the Galileo (MW) capability is under way

- Processing of SLR data for validation of GNSS orbits

Bernese GPS Software:

- Name has been wrong for many years because of the GLONASS capability
- Implementation of the Galileo (MW) capability is under way
- Processing of SLR data for validation of GNSS orbits
- Now: Extension to an analysis tool with full SLR capability
  (Definition of a joint project between AIUB and BKG in the frame work of CODE)
  - Fully consistent processing of data from different space–geodetic techniques
  - Introduce a new software package to the benefit of SLR processing community
  - Improvement of the GNSS part due to reviewing the analyis models

Perspectives of Processing SLR Data Using the Bernese GPS Software

- What can we do today with SLR observations?
- What common parameters do we have with MW processing?
- What needs to be developed?
- What can the ILRS expect from this development?

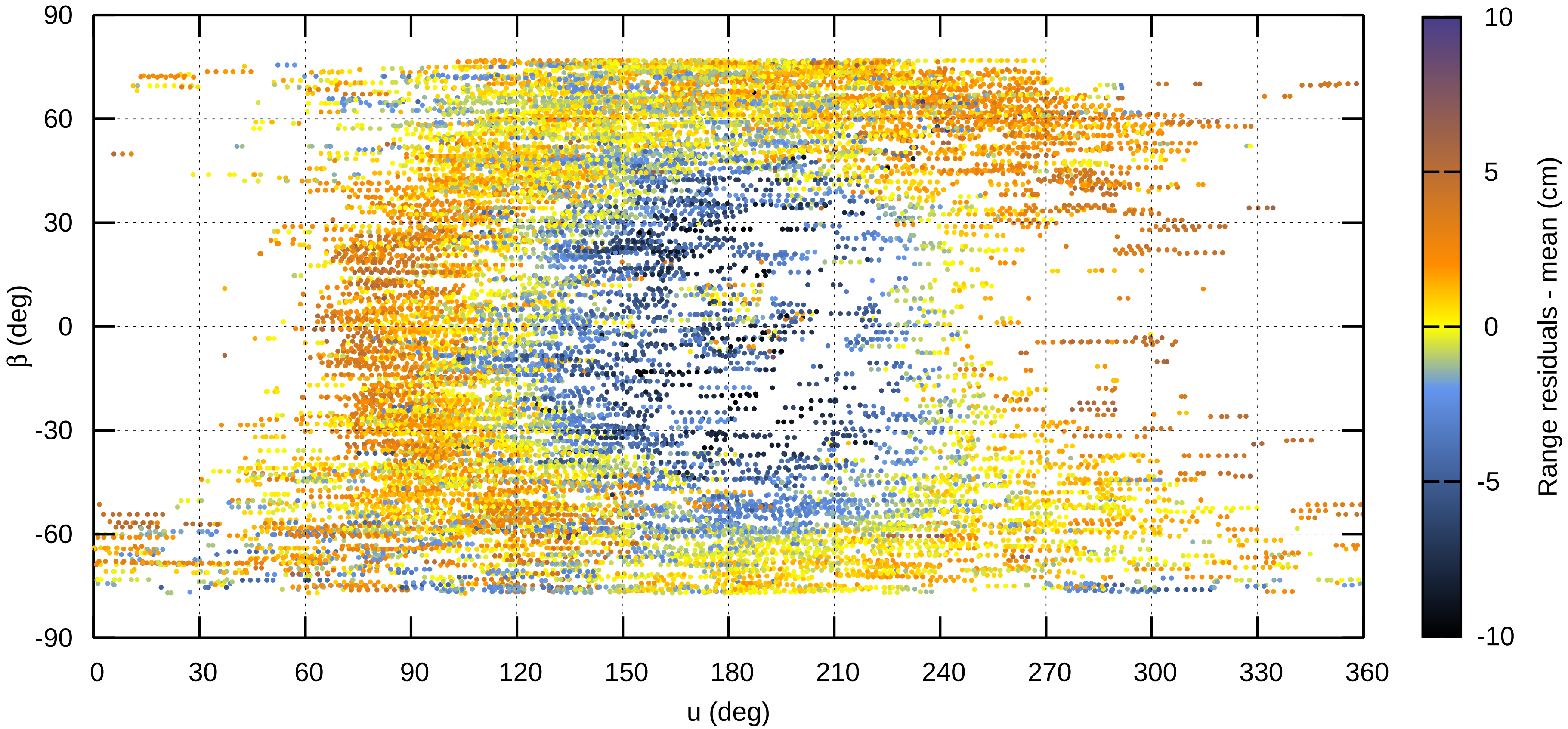
The current status

What can we do today with SLR observations?

1. Start with SLR normal point files
2. Conversion to "RINEX"-style observation and meteo files
3. Import from RINEX files as it is done for GNSS data
4. Computing SLR residuals with respect to existing orbits
   - processed as one–way data in the same manner as MW data
   - troposphere modelling is still Marini-Murray, 1973
5. Compiling the residuals in the Quicklook summary or for other systematic analysis

Analysis of SLR residuals

SLR residuals in cm w.r.t. CODE final orbits (G05 and G06)



Urschl et al., 2007

$\beta \ldots$ elevation of Sun over orbital plane

$u \ldots$ argument of latitude w.r.t. Sun

Developing the "Bernese SLR Software"

What existing parameters are useful for SLR processing?

- station coordinates
- geocenter position
- Earth orientation parameter
- reflector offsets

Developing the "Bernese SLR Software"

What existing parameters are useful for SLR processing?

- station coordinates
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What needs to be adapted/developed?

- range and time bias parameters
- adapt orbit–related parameters
- update the SLR-specific models (e.g., troposphere)
- review the observation handling
- develop an outlier detection/rejection algoithm
- capability to simulate SLR data

Developing the "Bernese SLR Software"

What are our objectives?

- a fully operational and highly automated analysis of SLR data
  (as it is running for the IGS at CODE in Bern)
- full capability as a processing software for an ILRS analysis center

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- comparison with the results generated with UTOPIA at BKG
- ILRS benchmark test
- . . .

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- . . .

What satellites do we plan to handle?

- at a first stage: processing of data from geodetic satellites
- perspective: inclusion of other LEOs
  (in particular satellites equipped with GNSS receivers and retro–reflectors)

Summary

- We have started to extend the SLR-option of the "Bernese GPS Software" to a fully operational SLR analysis tool.
- We expect a benefit for both, the ILRS and the IGS.
- A new, independent software package shall become available to the SLR community (allowing for, e.g., inter–software comparisons).
- Due to the consistent analysis of GNSS–MW and SLR measurements in one and the same software package the combination of different space–geodetic techniques on observationlevel is improved.

ILRSA combination products: status&issues

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G. Bianco
Agenzia Spaziale Italiana, CGS - Matera

ILRS AWG Meeting, 12 April 2008, Wien (A)

A new ILRS product: Daily Solution

The consolidated ILRS weekly product has generated the concept of a ‘rolling’ weekly product to be issued daily to provide the minimum latency SLR contribution to the IERS EOP estimation.

At day **N**, within midnight UTC, each contributing AC makes available its weekly solution “***acx***.**pos+eop.*yymmdd*.v100.snx**” spanning the period **[N-7, N-1]**; at day **N+1**, CCs generate the combined solution, “***ccx***.**eop.*yymmdd*.v100.snx**”.

ILRSA strategy

- ASI-CGS CC adapted the ILRSA combination strategy to its daily product; only a slight tuning has been performed to allow the proper handling of the USNO “finals.daily” as reference values (necessity of computing a reference value for the last LOD estimate).

- A careful revision of the combination procedure has been performed, in order to allow the **fully automated** generation of the solutions, including the reporting, to avoid (or minimize) the daily intervention of the analyst.

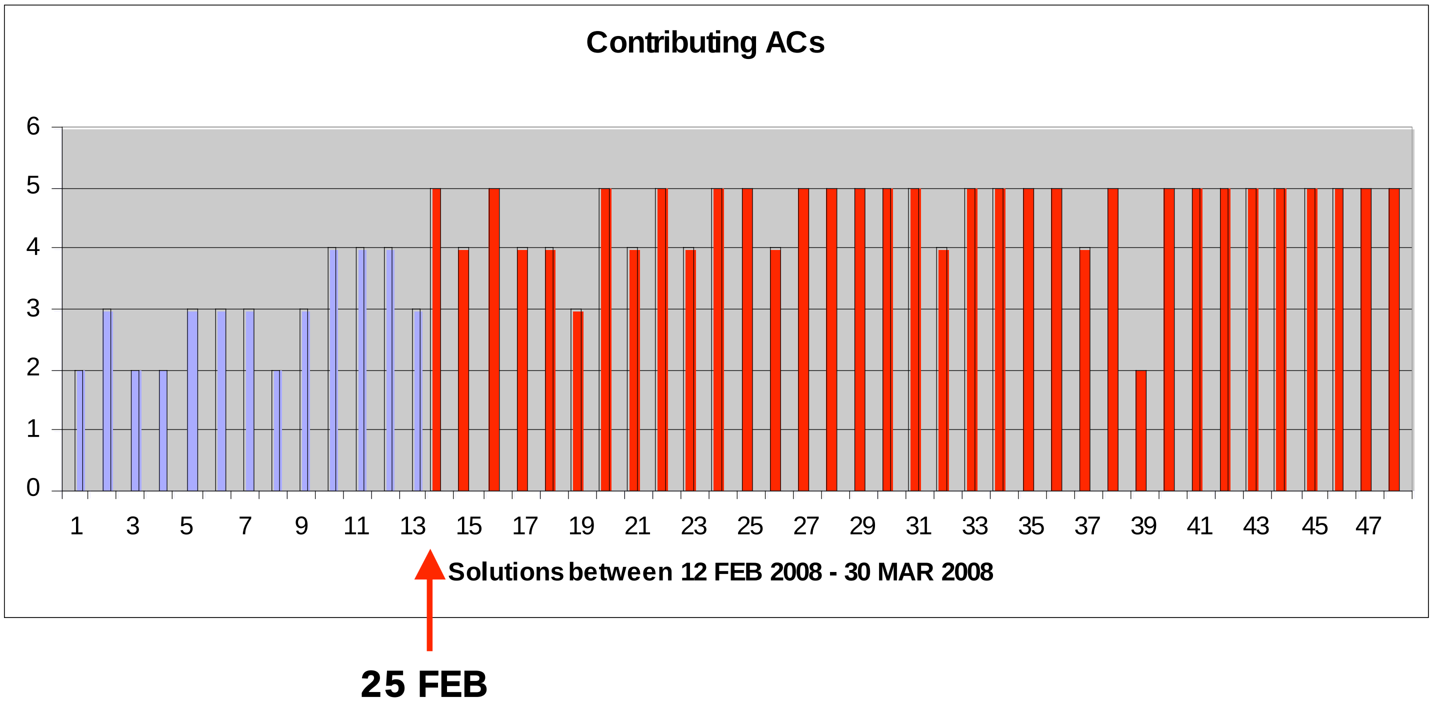
- Even if not necessary, the SSC/EOP combined, loose SINEX files (“pos+eop”) have been kept available at the archives.

- Automated ILRSA combination procedure, at present, starts every day at 3:30 AM Italy Local Time (1:30 AM UTC); the starting time may be modified according to AWG recommendations.

A new ILRS product: Daily Solution

At present, **5 ACs** contribute to the daily ILRS combined solution:

ASI BKG GFZ JCET NSGF

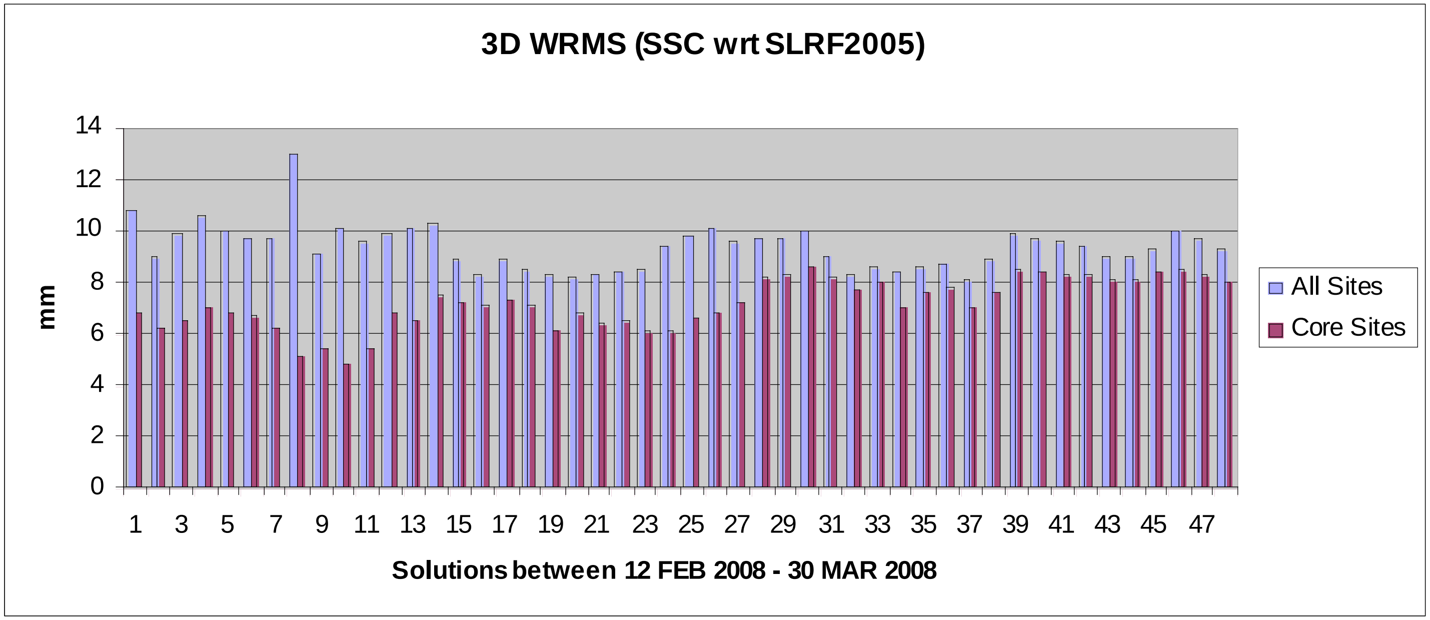


25 Feb solution may be assumed as the true start of the pre-operational phase of the daily ILRSA product: it is the first date when all the 5 ACs submitted fully operational solution (i.e. several small problems were fixed); after then, only few sporadic cases of missing solutions occurred. If late solutions were submitted, they were not analysed to stress the ILRSA combination procedure under realistic operational conditions.

Since **29 Mar**, the ILRSA reporting becomes automated.

Quality assessment of the Daily Solution

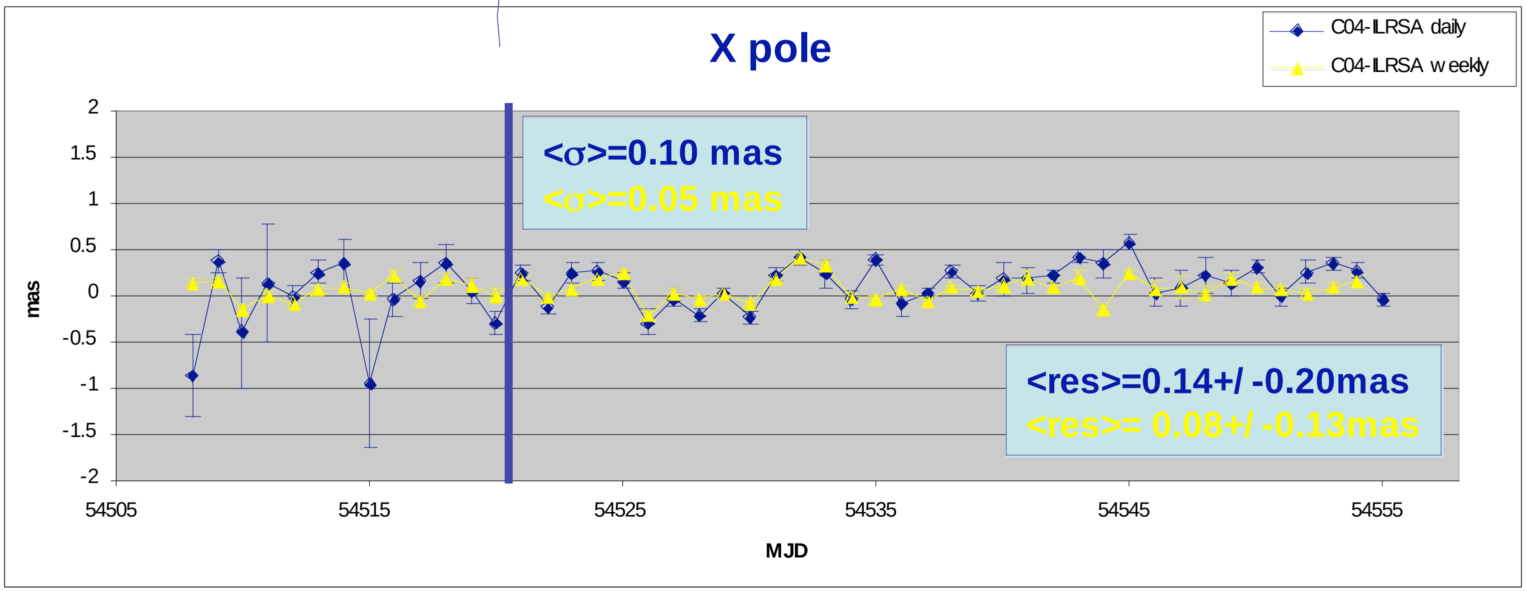
The Core station list as agreed after Grasse AWG (09/07) has been used in the ILRSA dai product. As for the consolidated weekly product, 3d WRMS for all sites is below 10mm, whi for the Core sites is slightly above 7mm. *It can be seen a moderate growth of the 3d wrms for t core sites….*

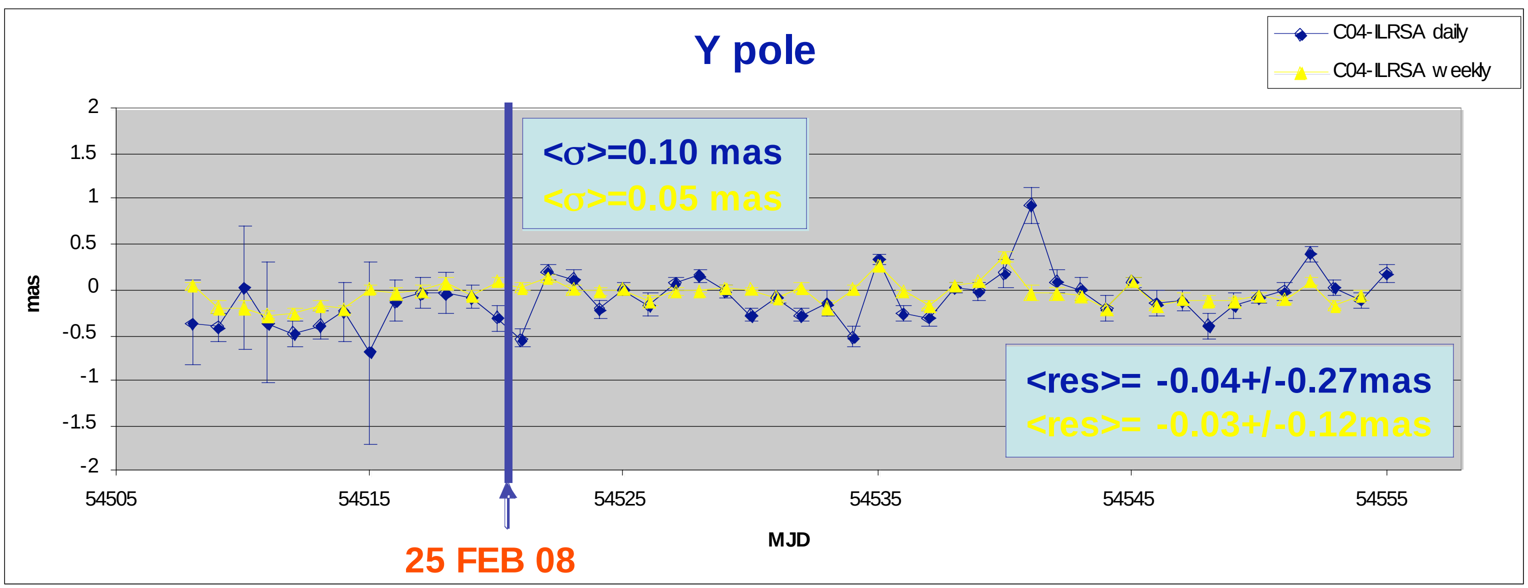


A preliminary quality evaluation of the daily solution results is made through the cross compariso with eop C04 and with ILRSA weekly solutions. The evaluation is performed on the last da EOP estimate of each daily solution.

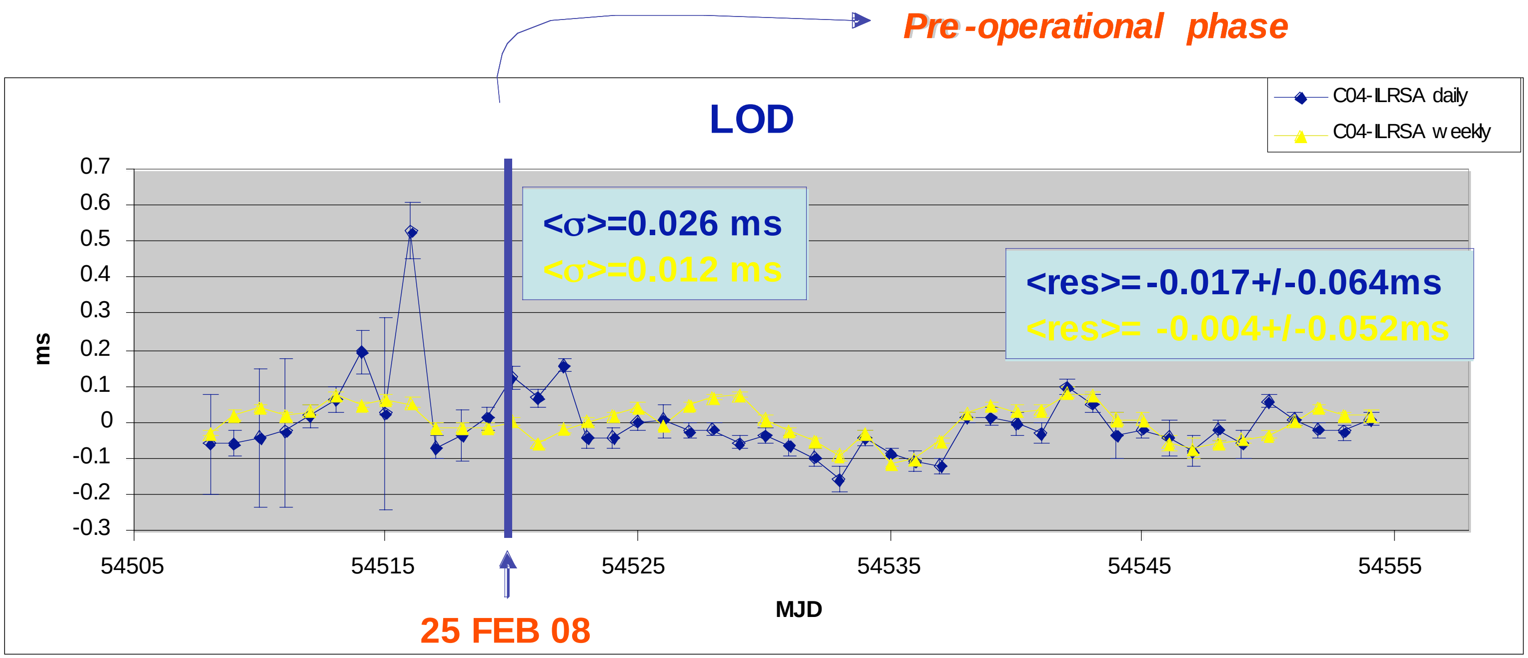
Quality assessment of the Daily Solution

Pre-operational phase





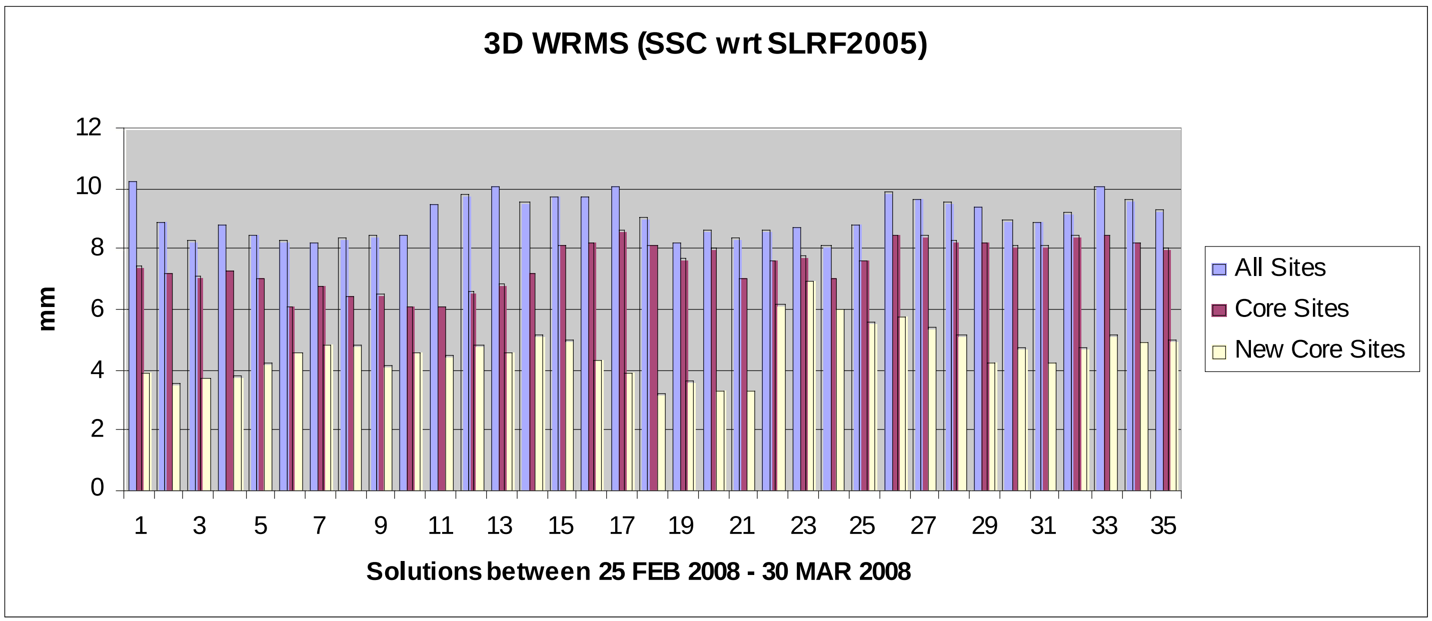
Quality assessment of the Daily Solution



Daily Solution issues: Core sites vs EOPs

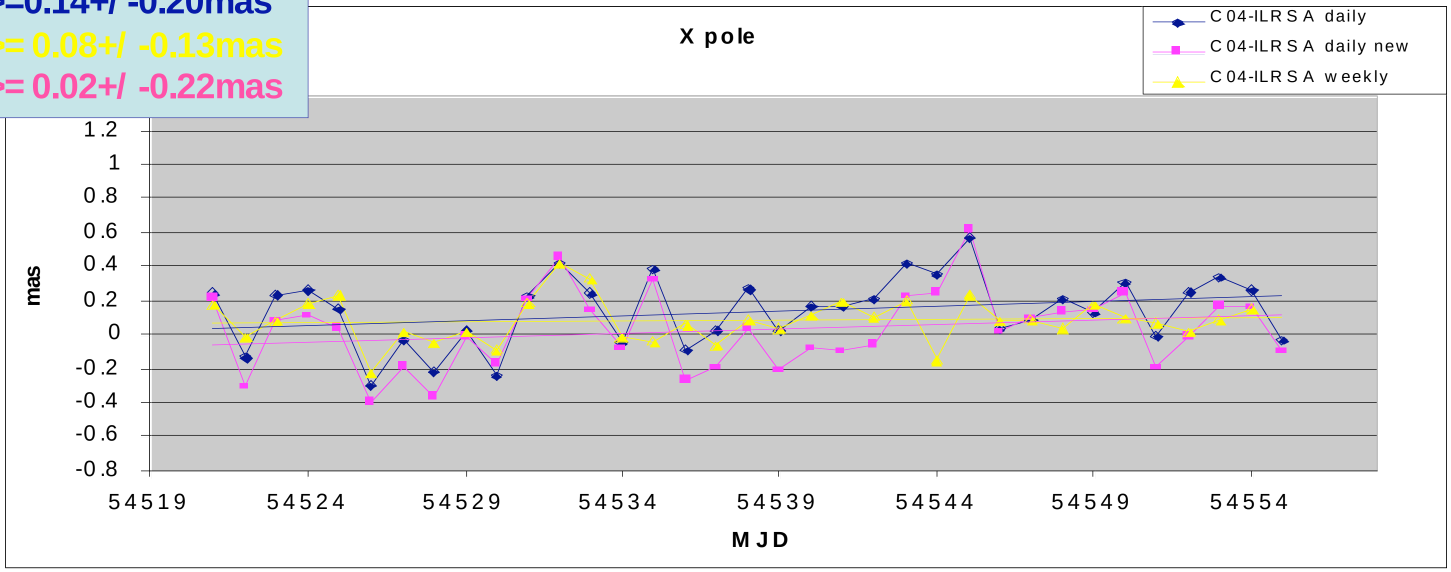
The Core station list as agreed after Grasse AWG (09/07) has been used in the ILRSA dai product. As for the consolidated weekly product, the <3d WRMS> for all sites is below 10mr while for the Core sites it is slightly above 7mm.

Re-analysing part of the daily solution pre-operational period with a different set of Core Sites (i. eliminating the newest ones: mainly 7941 and 7825), the <3d WRMS> is 4.6mm

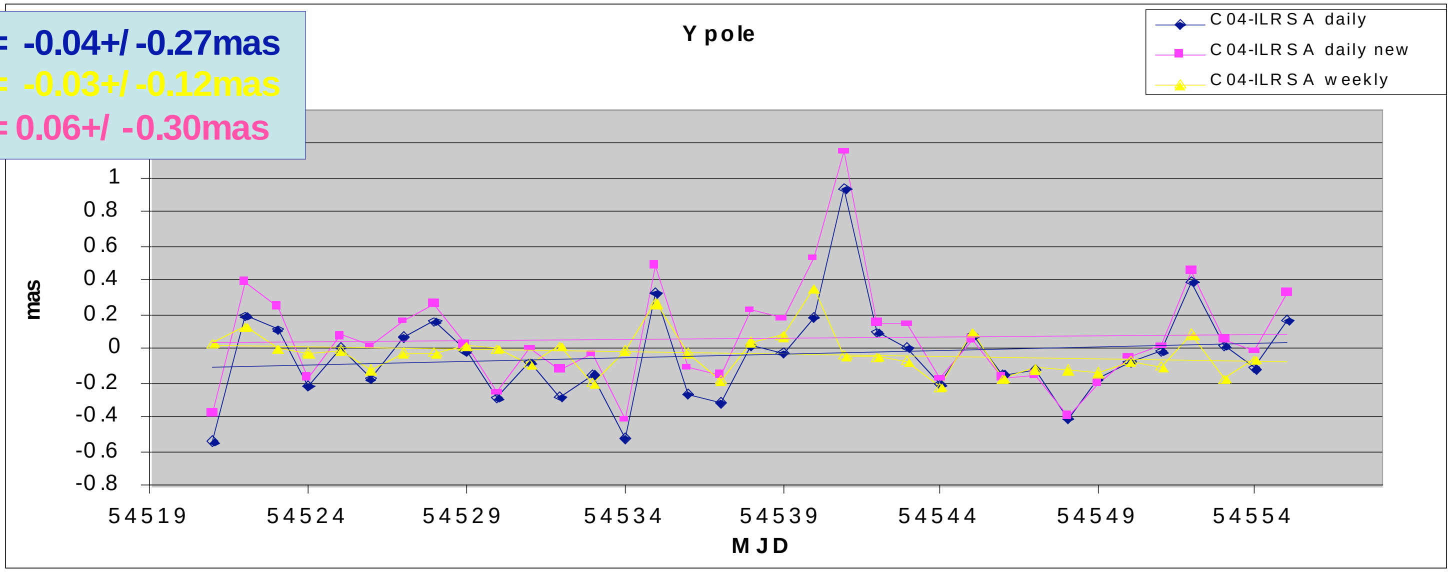


Daily Solution issues: Core sites vs EOPs

<res>=0.14+/ -0.20mas
<res>= 0.08+/ -0.13mas
<res>= 0.02+/ -0.22mas



<res>= -0.04+/ -0.27mas
<res>= -0.03+/ -0.12mas
<res>= 0.06+/ -0.30mas



Daily Solution issues: Core sites vs EOPs

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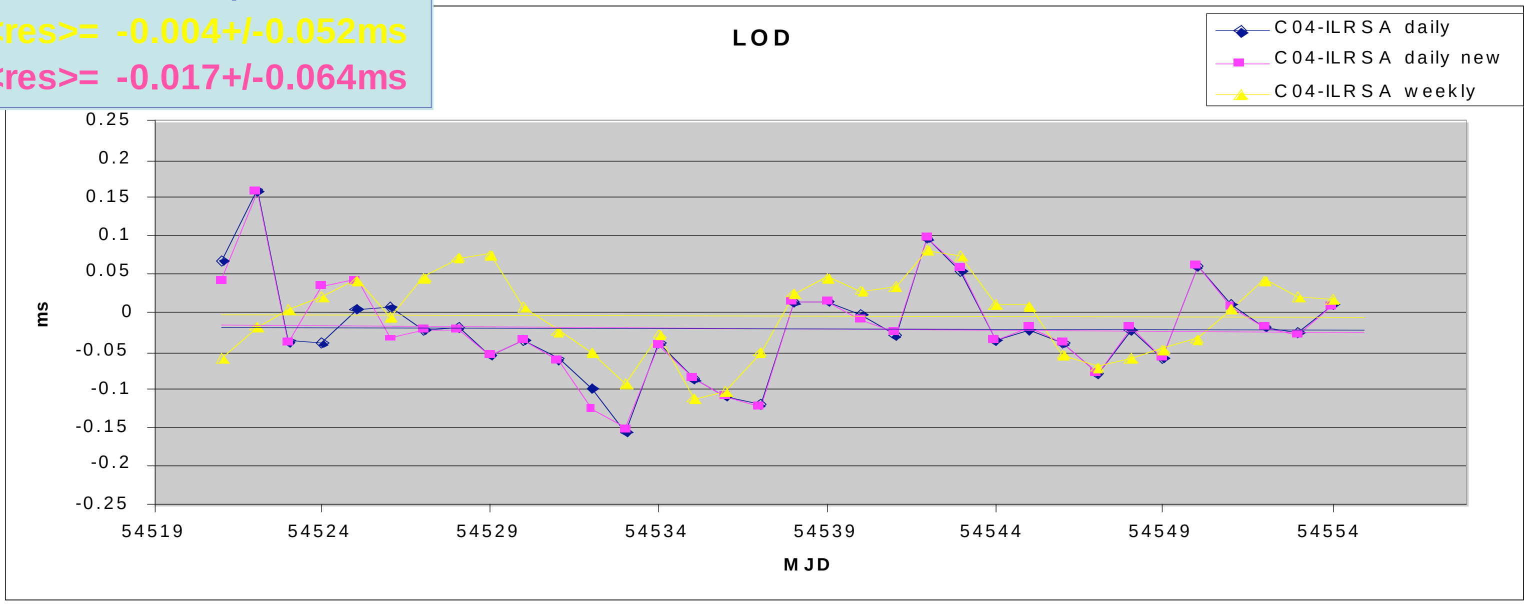
<res>= -0.004+/-0.052ms
<res>= -0.017+/-0.064ms



Daily Solution issues: ILRSA vs ILRSB

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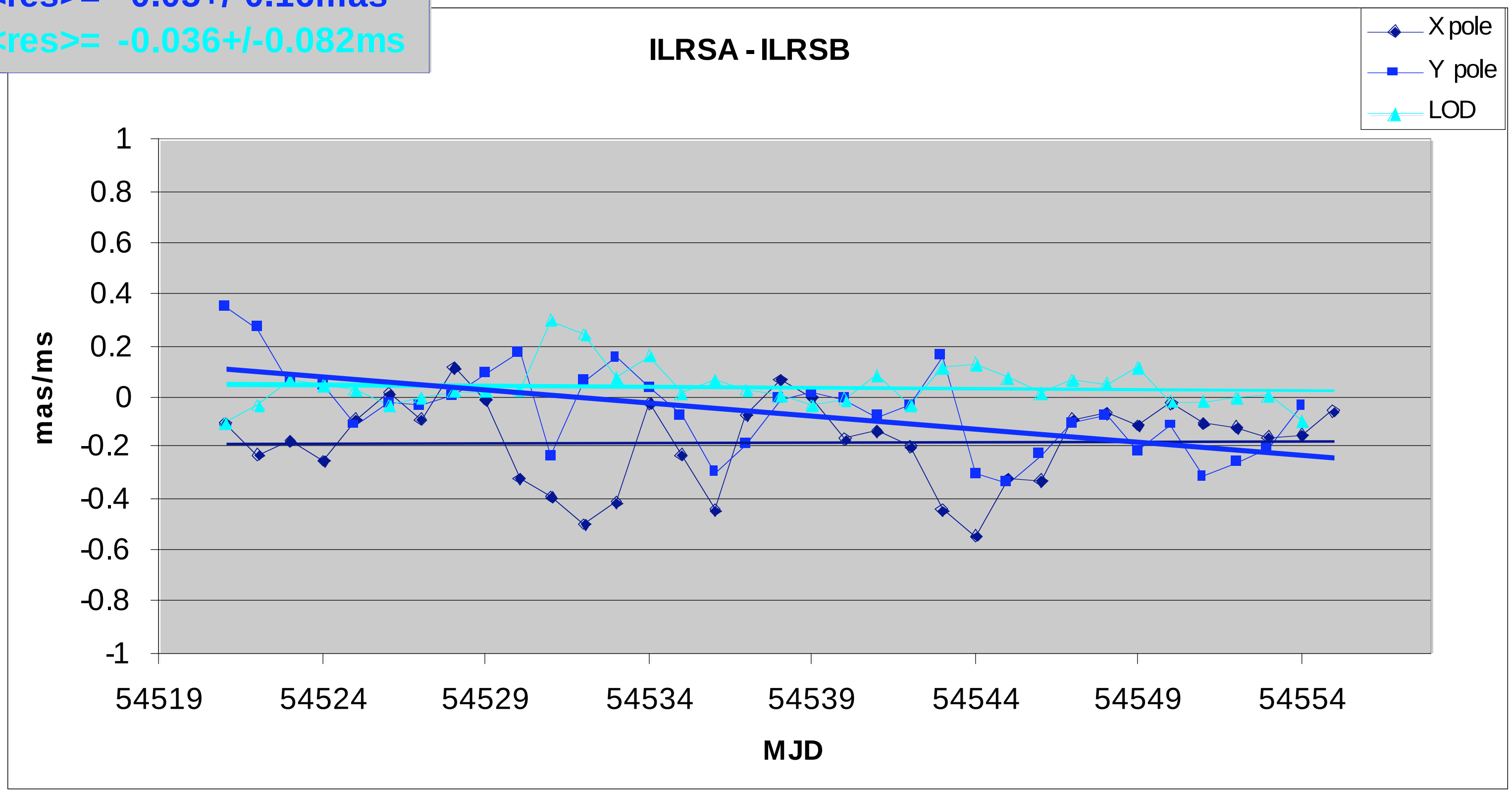
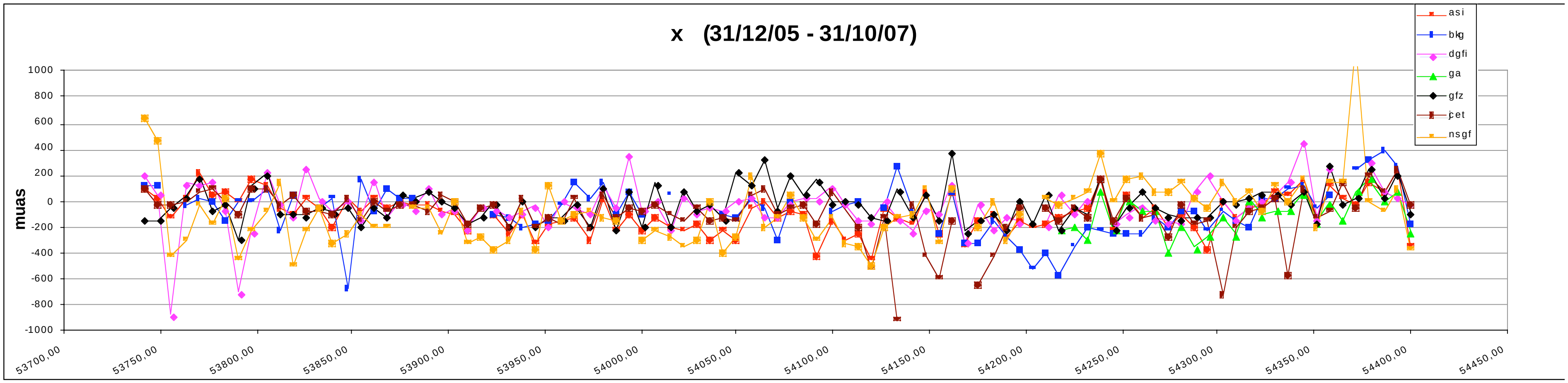
<res>= -0.05+/-0.16mas

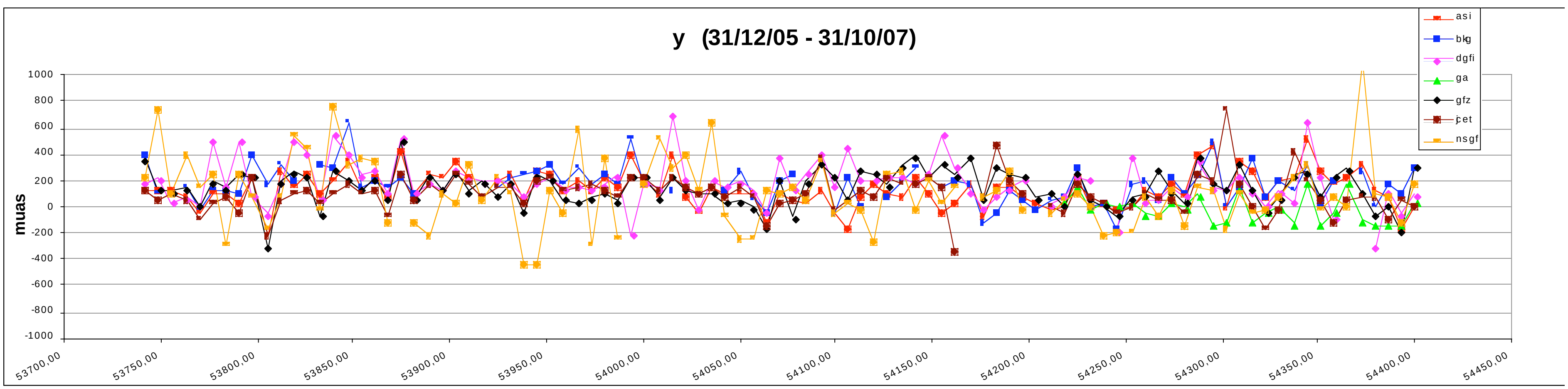
<res>= -0.036+/-0.082ms



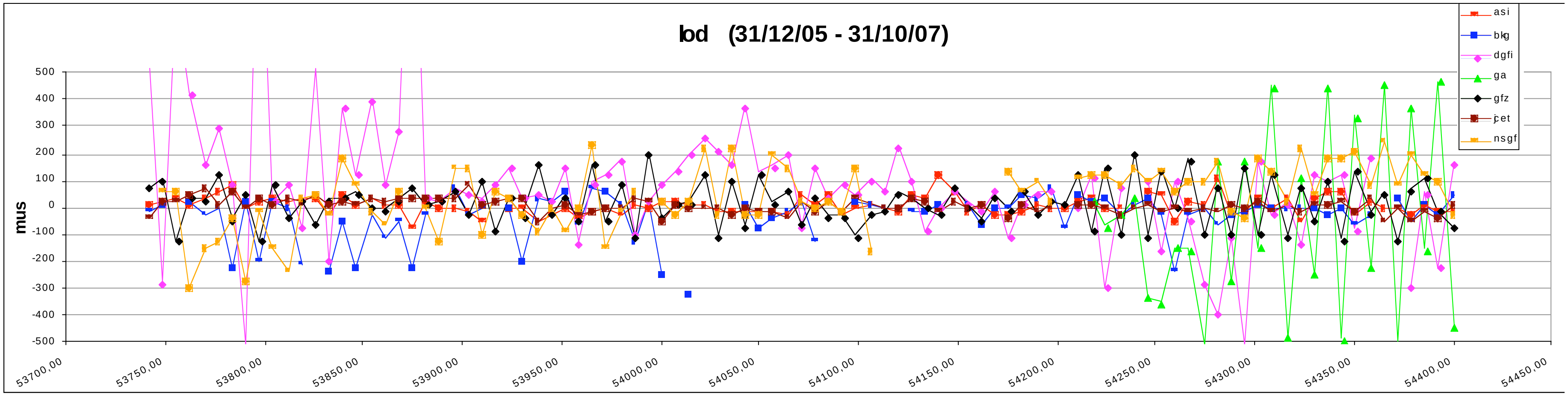
Weekly solution: LOD issue

The plots below show the averaged weekly residuals of the AC EOP estimates w.r.t. ITRF2005 framed reference values, re-analysed exactly under the same conditions, for the period 2006 2007. The estimates show an overall coherence.



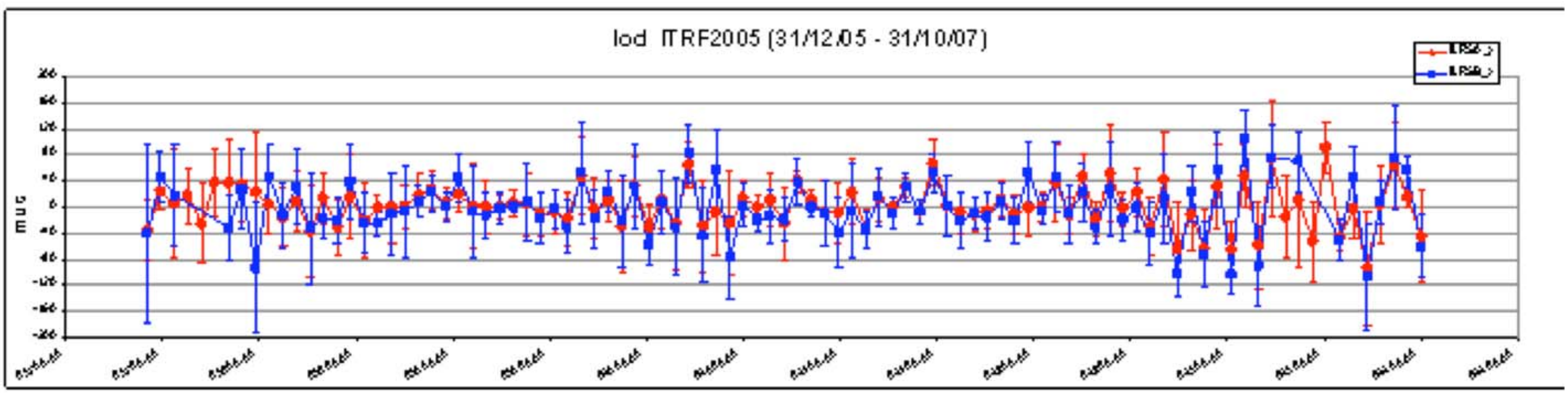


Weekly solution: LOD issue



Due to highly discrepant behavior, several specific contributions (e.g. GA, DGFI in some periods) are removed the weekly combination; others give odd residual values (GFZ, NSGF) even if smaller: they usually are incluc in the combination but they may have an impact on the combined solutions, as shown in the plot below.

The similar affection on ILRSA and ILRSB, using different way of combination (ILRSB removes the loc constraints, ILRSA doesn't), force to think to hidden constraints (maybe on UT1) not removable or to so 'special' LOD provided, maybe with some periodic effect removed.



ITRF2005 alignement

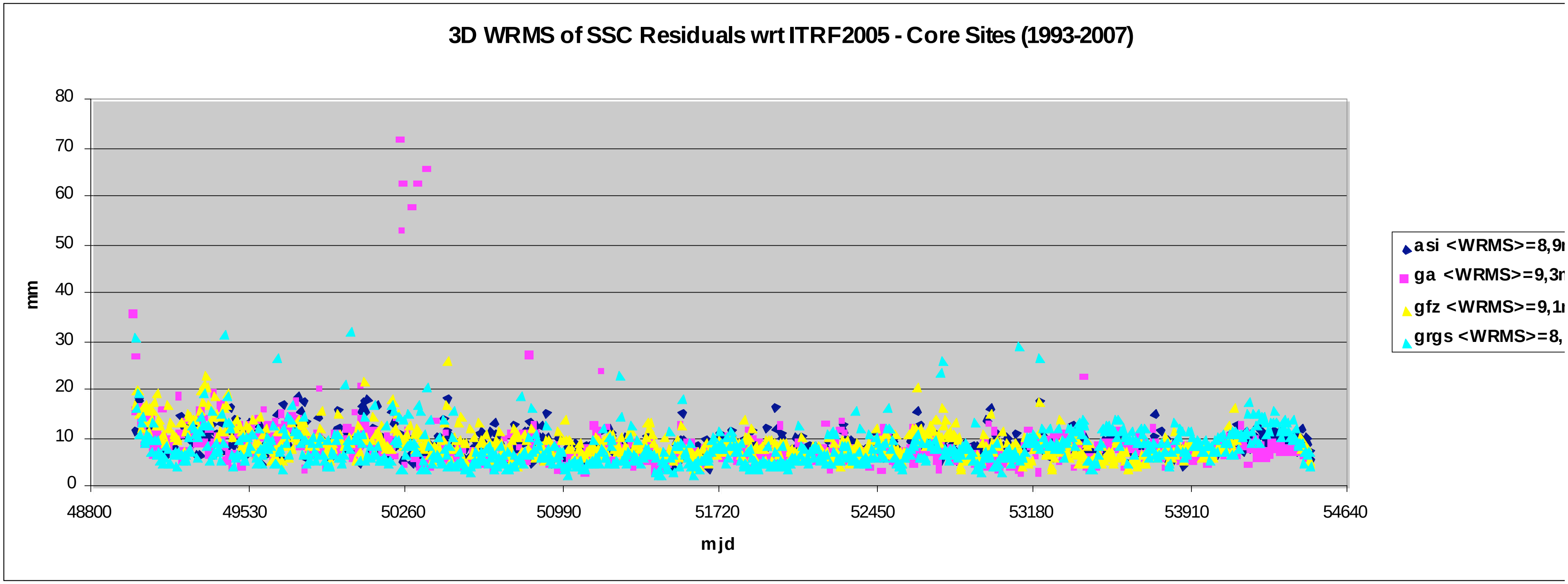
The quality assessment in the **ITRF2005** frame has been included since **November 200**
(071103), according to the new apriori standard adopted by the ACs in their solution preparatior

It uses, as reference values, the **SLRF2005**, with the core stations agreed at the Grasse AW
meeting and the **USNO daily.finals**, ITRF2005-framed since 14 June 2007.

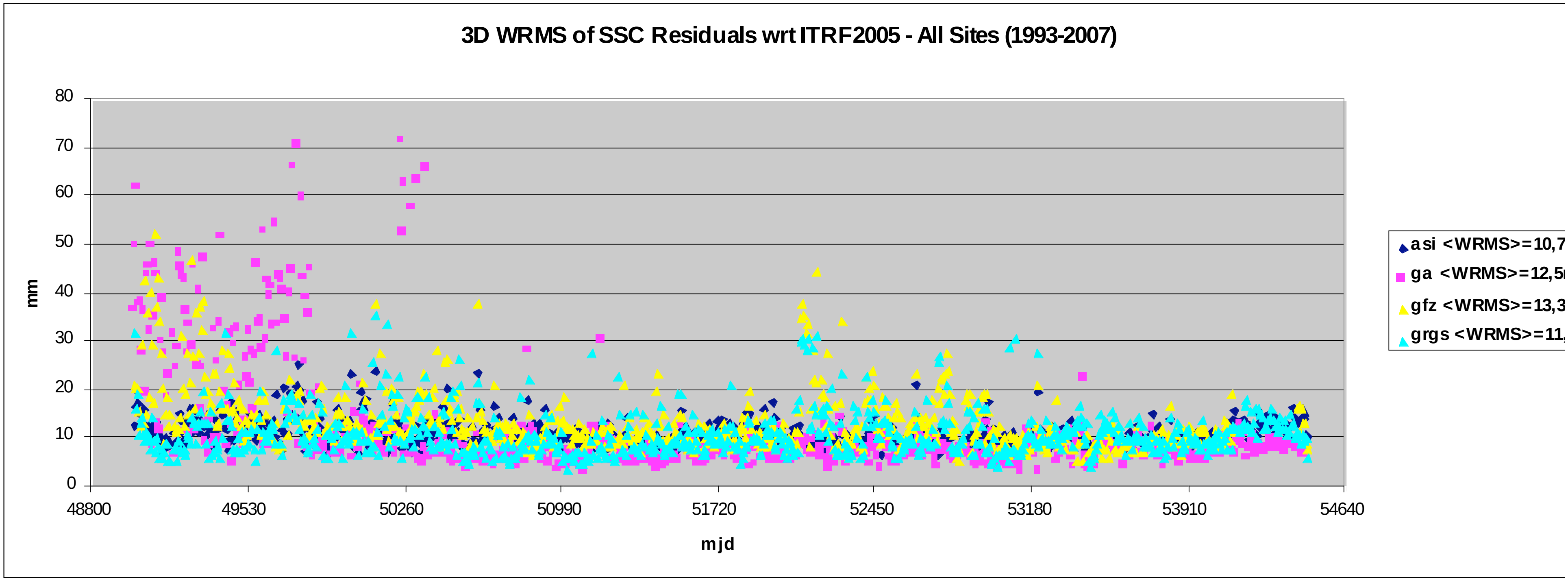
1993-2007 Reanalysis

Presently, 4 contributing solutions are available: asi, ga, gfz, grgs

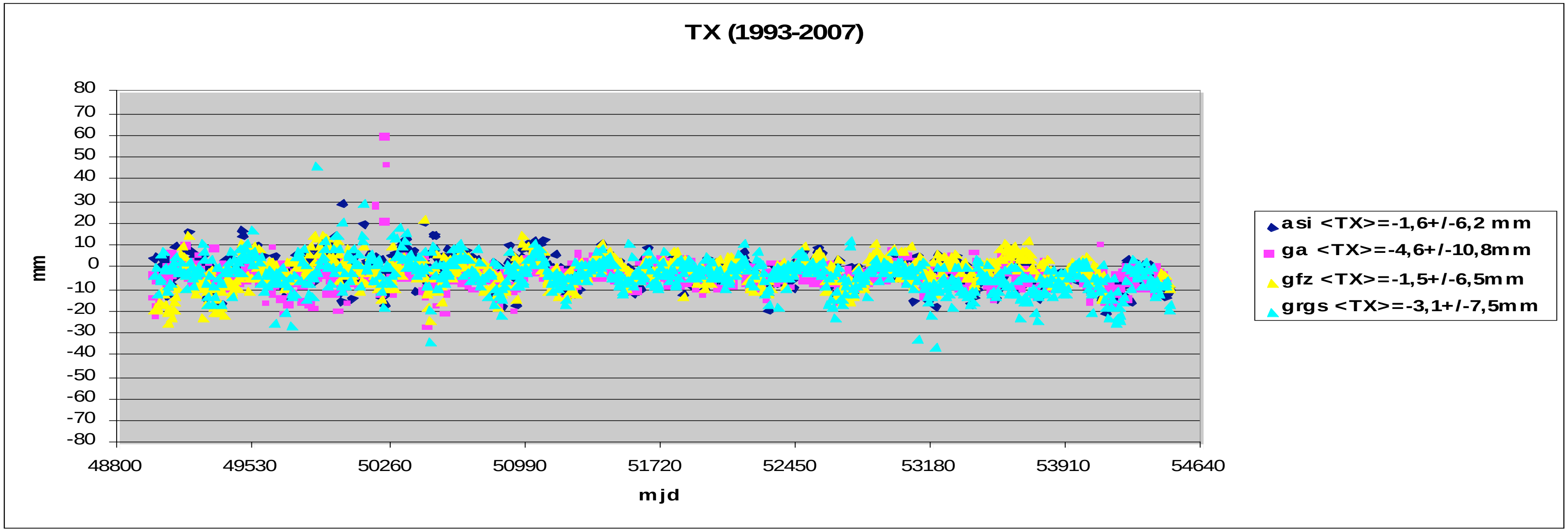
A preliminary quality assessment may be performed on the submitted time series

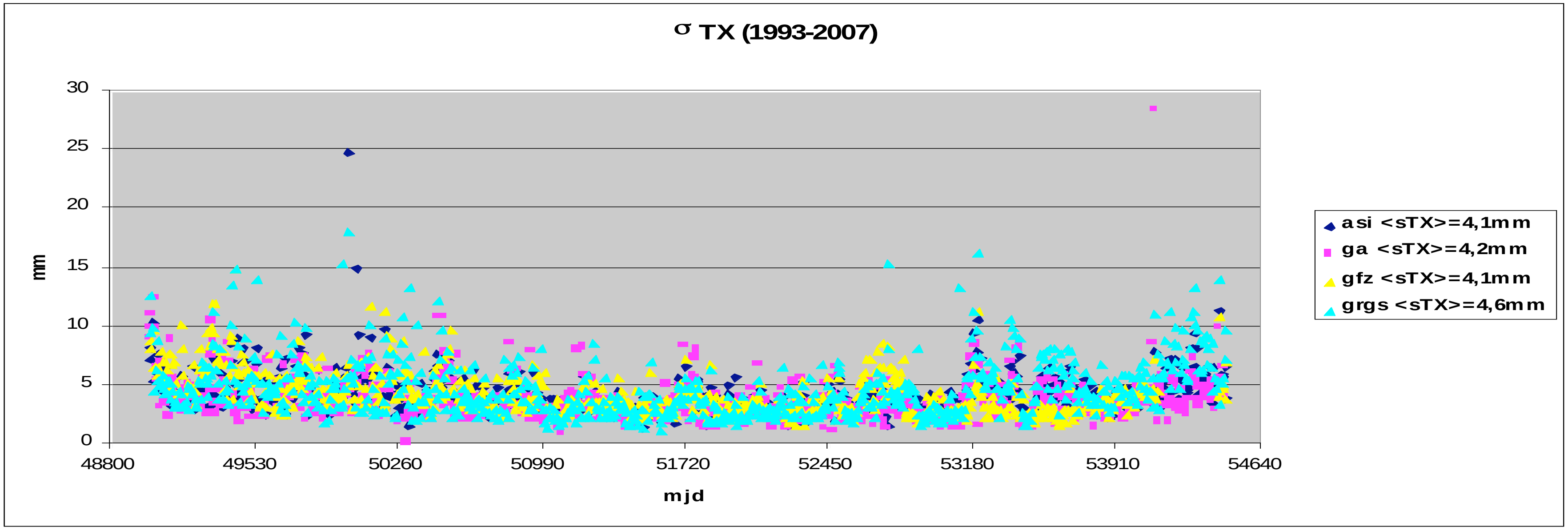


1993-2007 Reanalysis

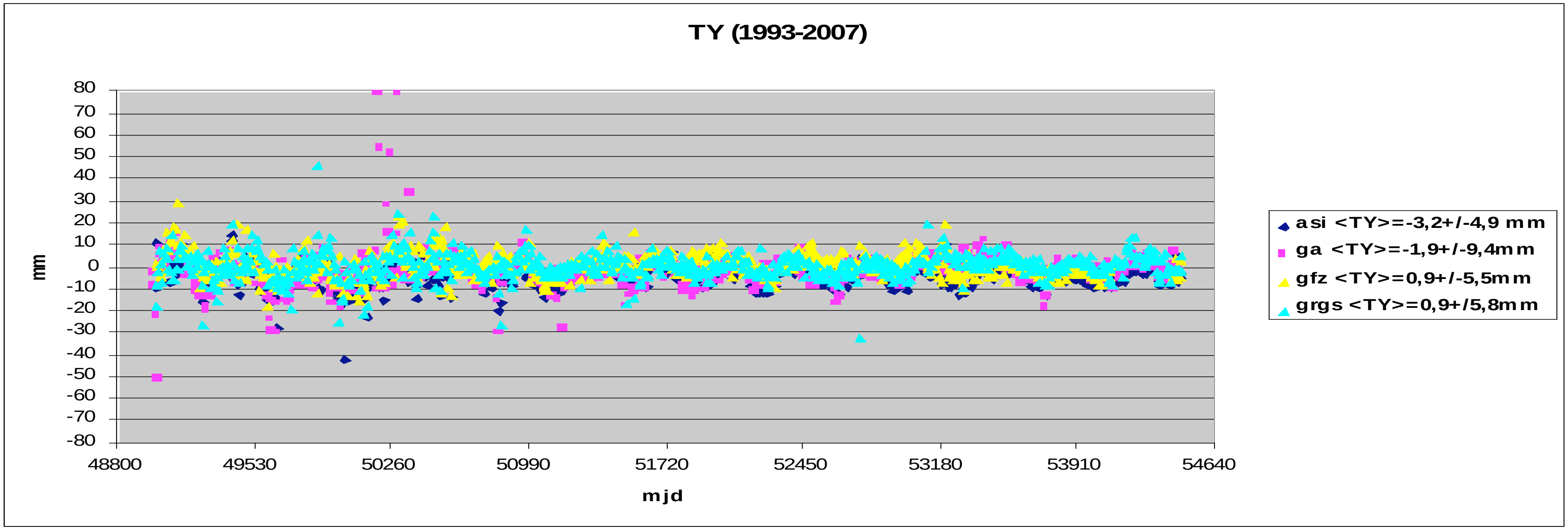


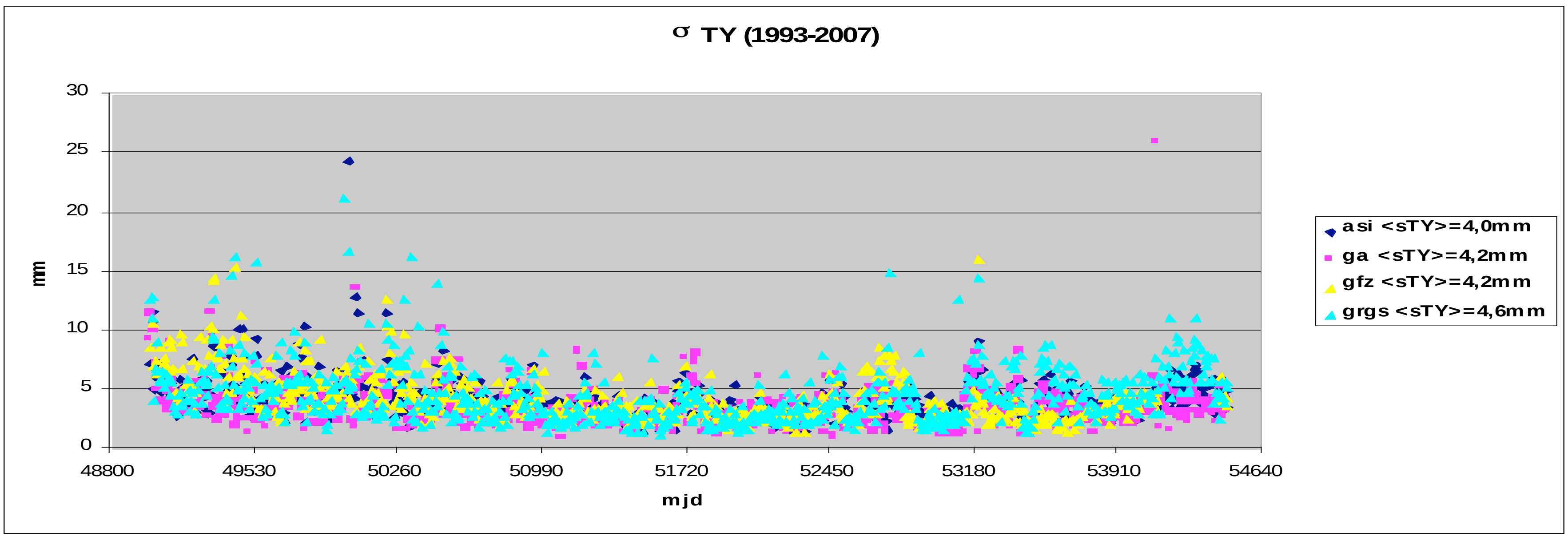
1993-2007 Reanalysis



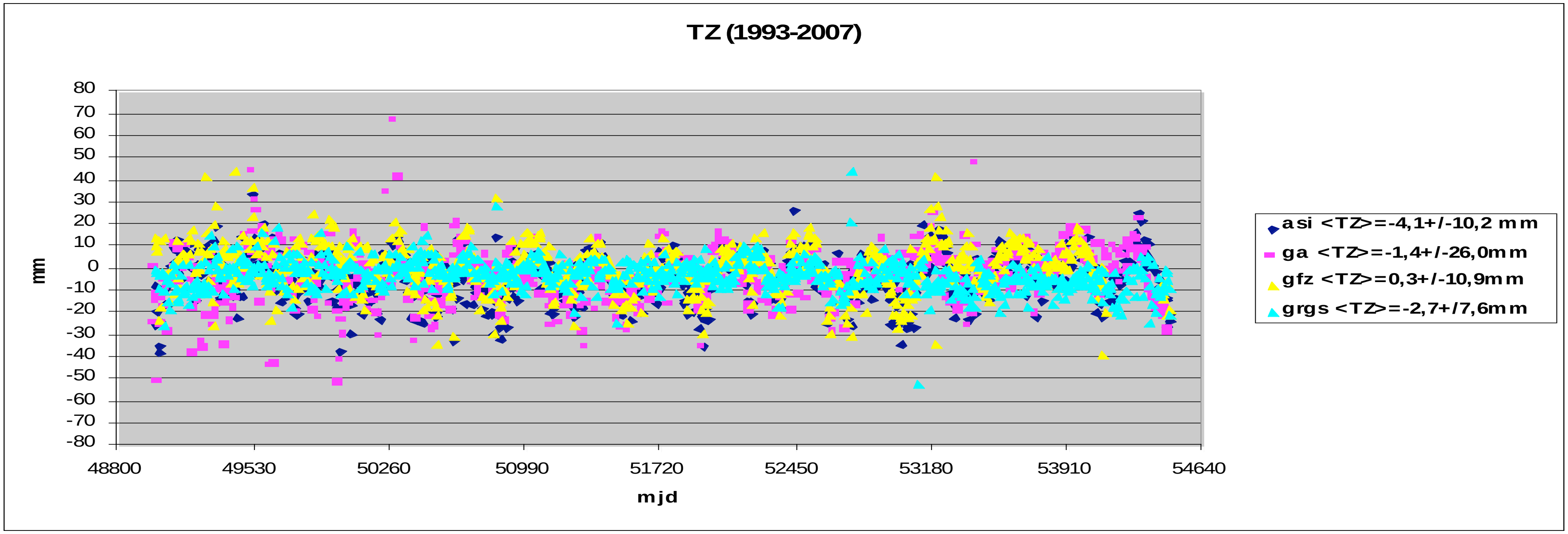


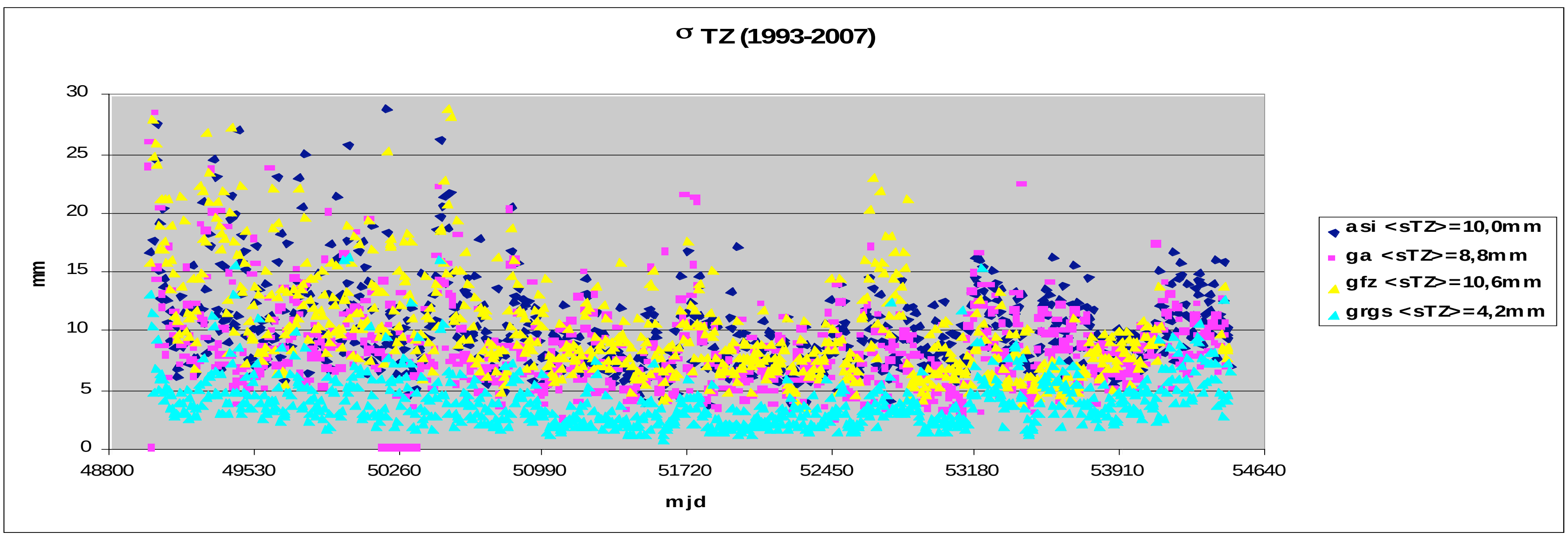
1993-2007 Reanalysis



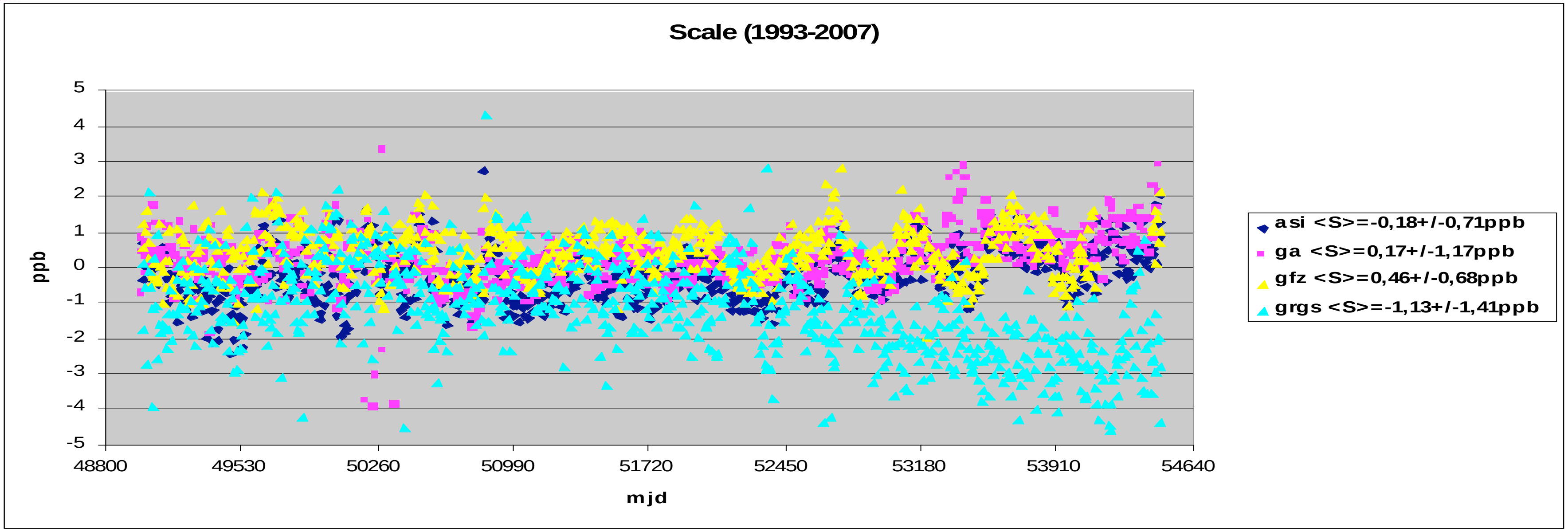


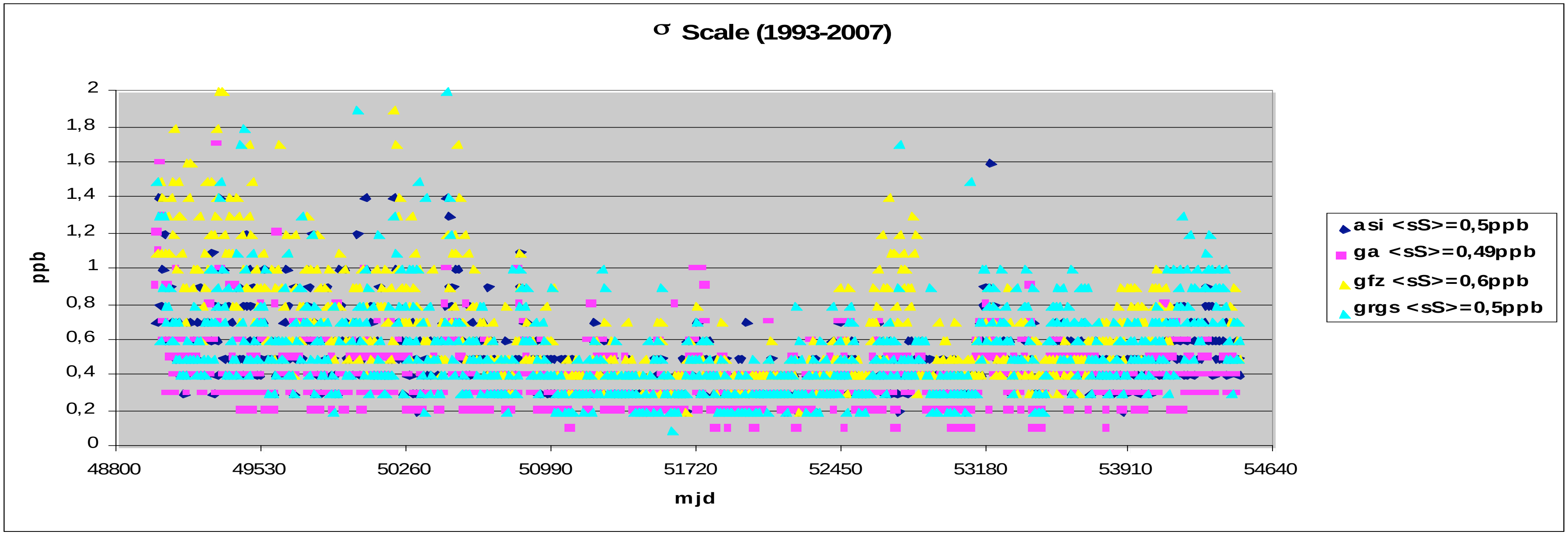
1993-2007 Reanalysis





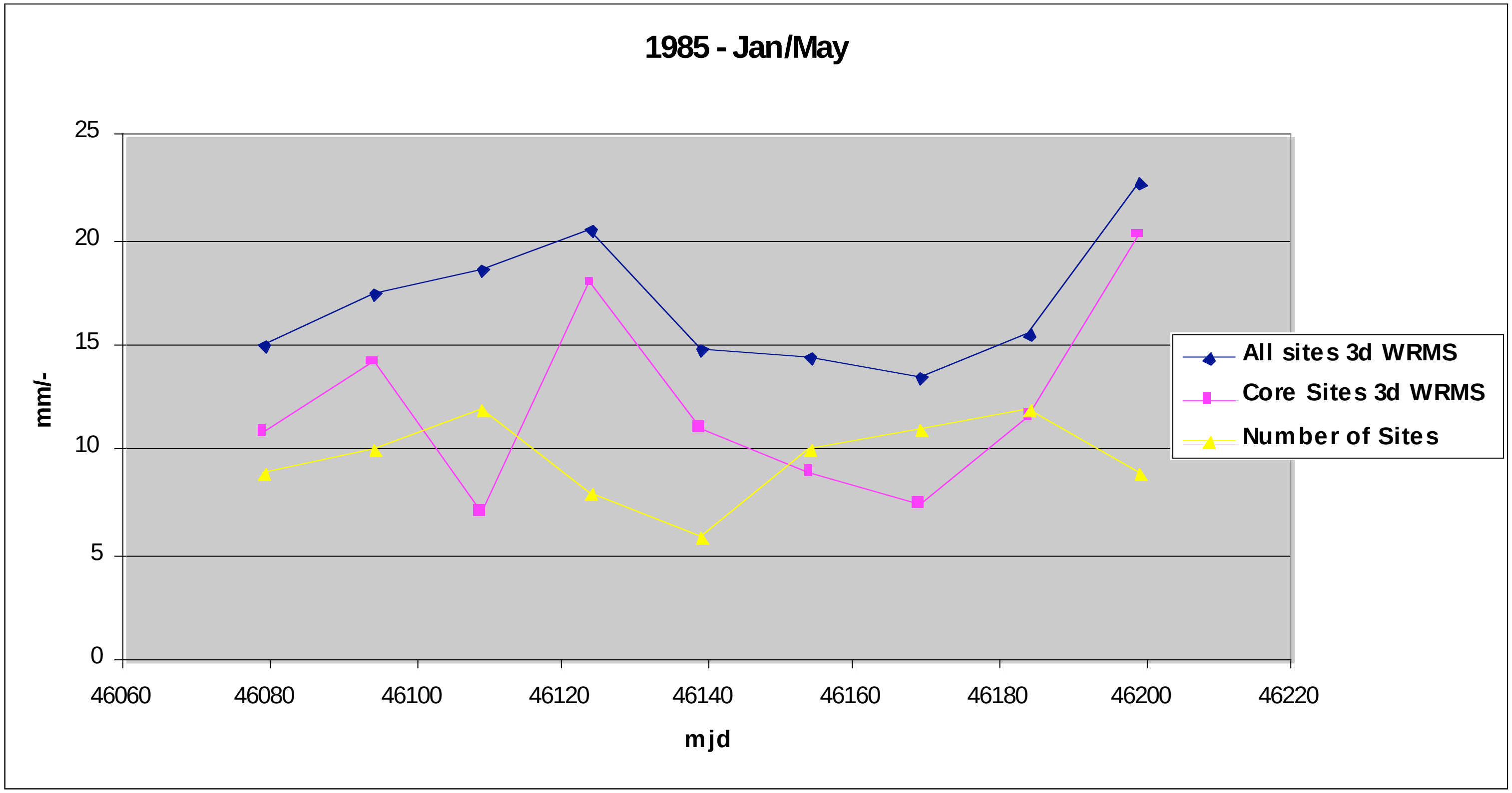
1993-2007 Reanalysis





1983-1992 Reanalysis

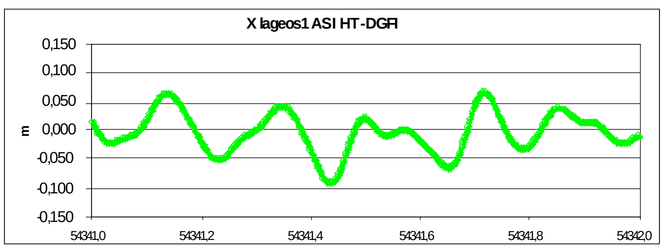
Presently, 4 contributing solutions are available: asi, ga, jcet, nsgf

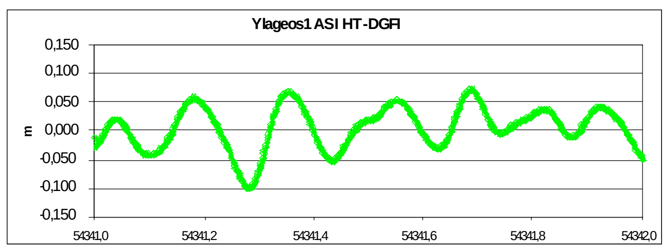


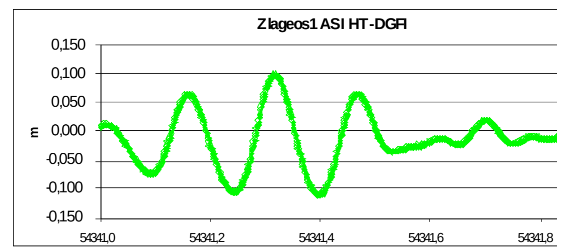
ILRS combined Orbit product

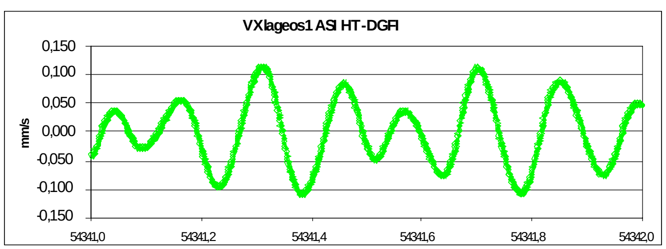
At present, only ASI and DGFI SP3 test files are available; comparison tests go and show a **5-cm level** position agreement (see table and plots) in the Lage orbit after the proper similarity transformation.

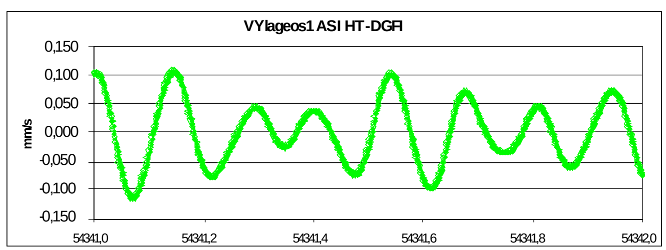
SAT	X mean std	Y mean std	Z mean std	VX mean std	VY mean std	VZ mean std
LAGEOS 1	**m**	**m**	**m**	**mm/s**	**mm/s**	**mm/s**
6 days	**0,001**	**0,004**	**-0,010**	**-0,001**	**0,001**	**0,001**
	0,053	**0,060**	**0,055**	**0,062**	**0,061**	**0,034**
1 day	**-0,003**	**0,006**	**-0,012**	**0,001**	**0,001**	**-0,001**
	0,035	**0,037**	**0,044**	**0,058**	**0,054**	**0,026**

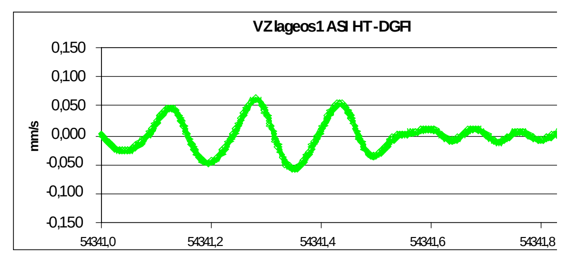












Status of ILRSB

Rainer Kelm
Deutsches Geodätisches Forschungsinstitut

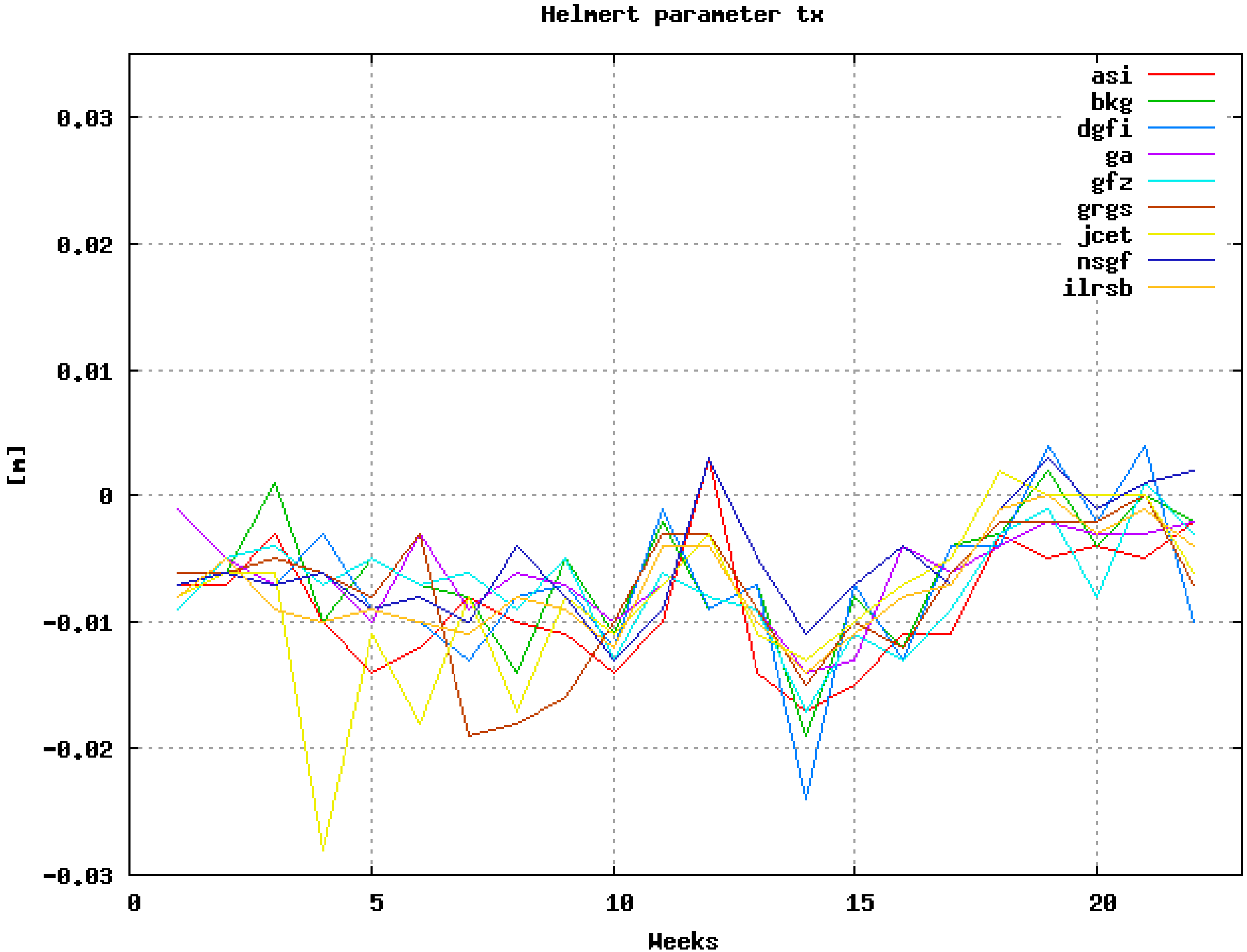
Weekly combination v10

Daily combination v100

Orbit combination SP3C

Weekly combination v10 (1)

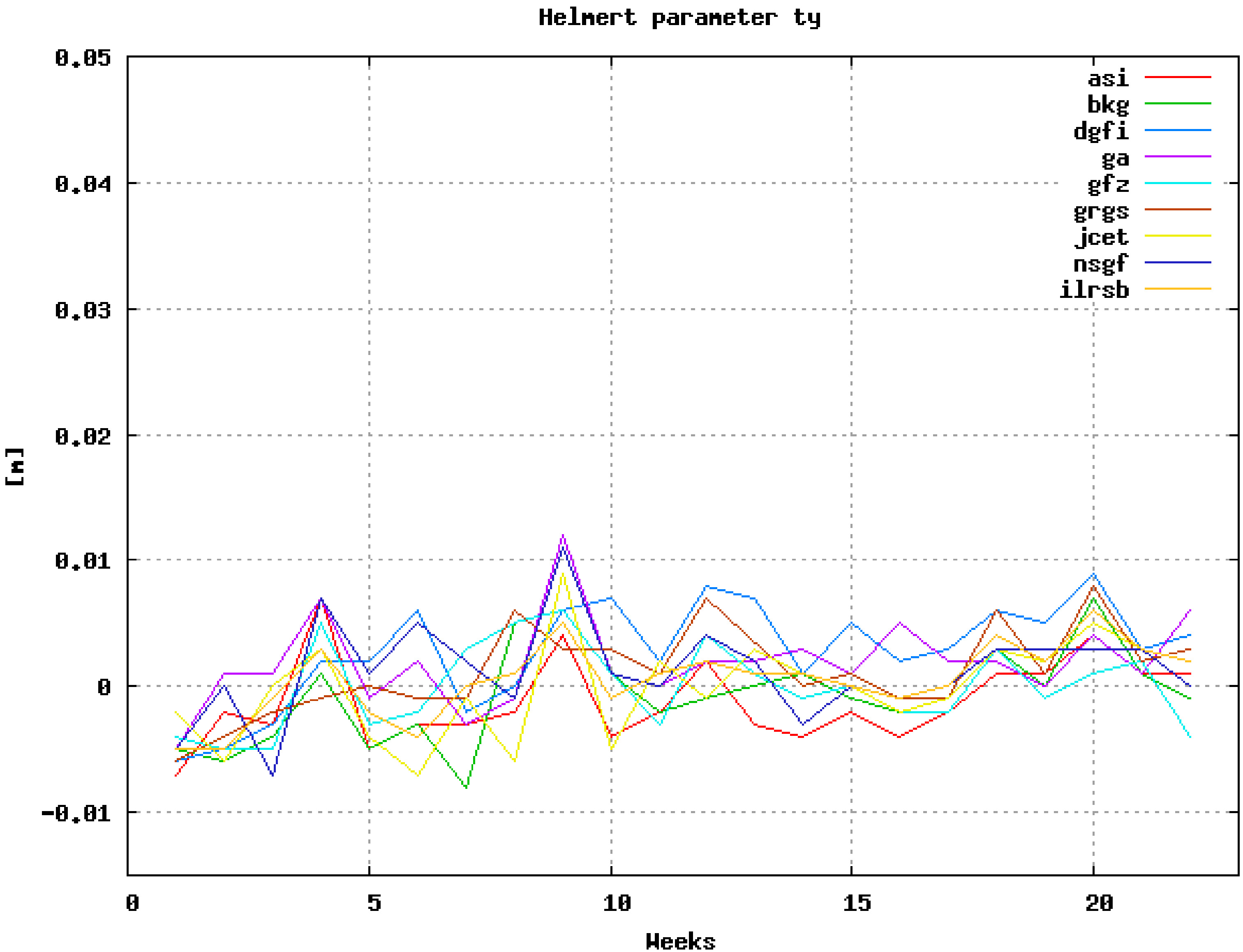
071110 - 080329



ILRS AWG Meeting Vienna, April 12, 2008

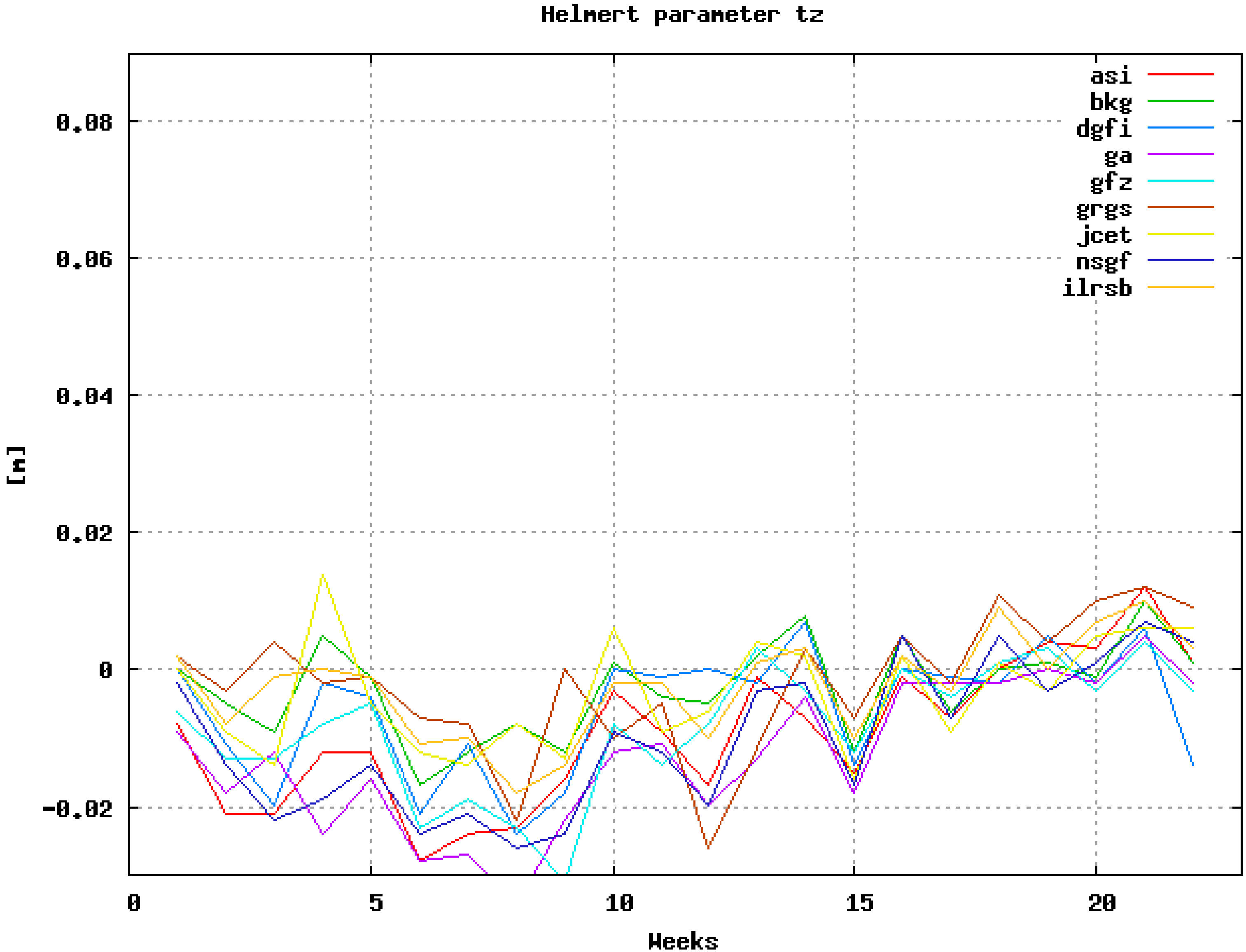
Weekly combination v10 (2)

071110 - 080329



Weekly combination v10 (3)

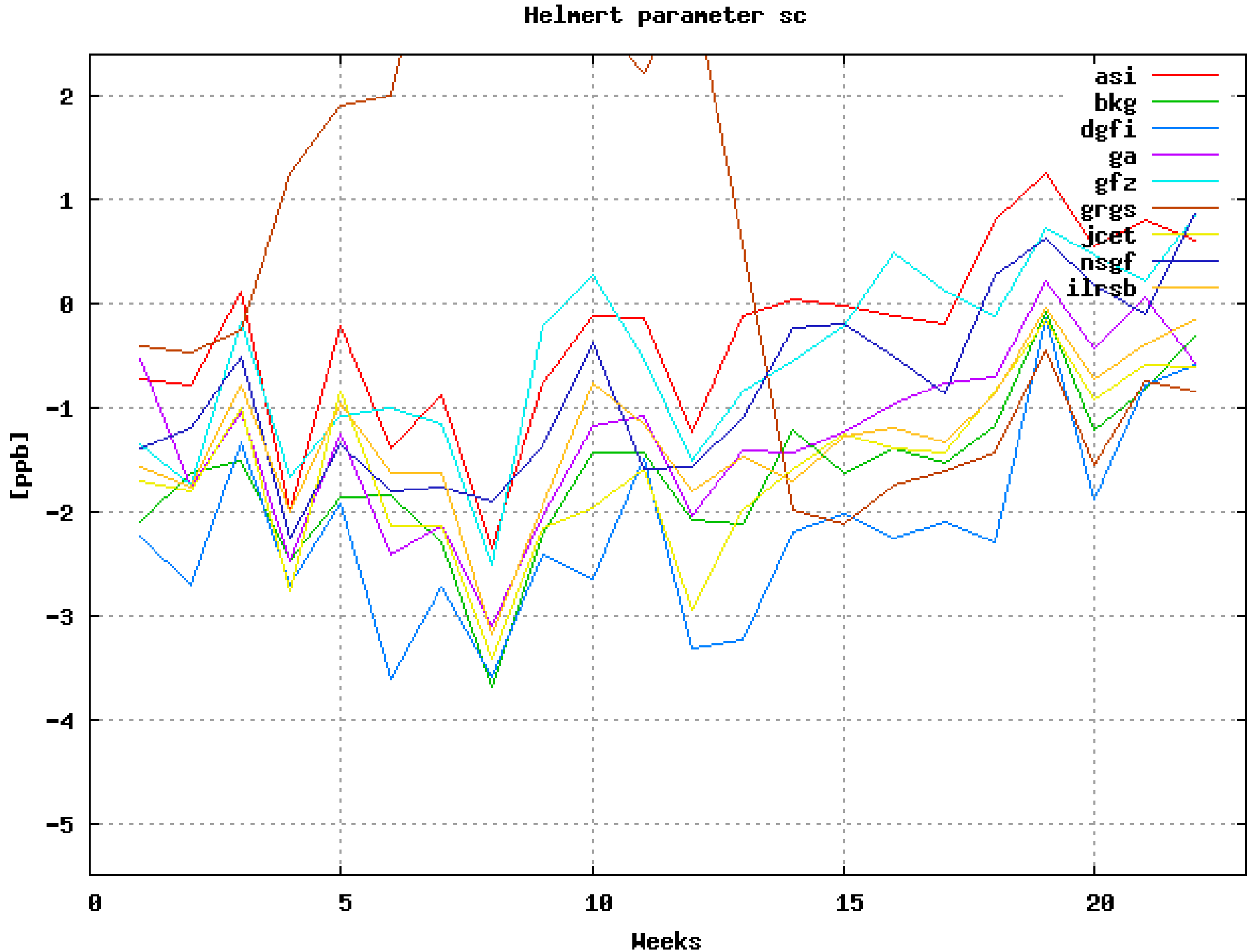
071110 - 080329



ILRS AWG Meeting Vienna, April 12, 2008

Weekly combination v10 (4)

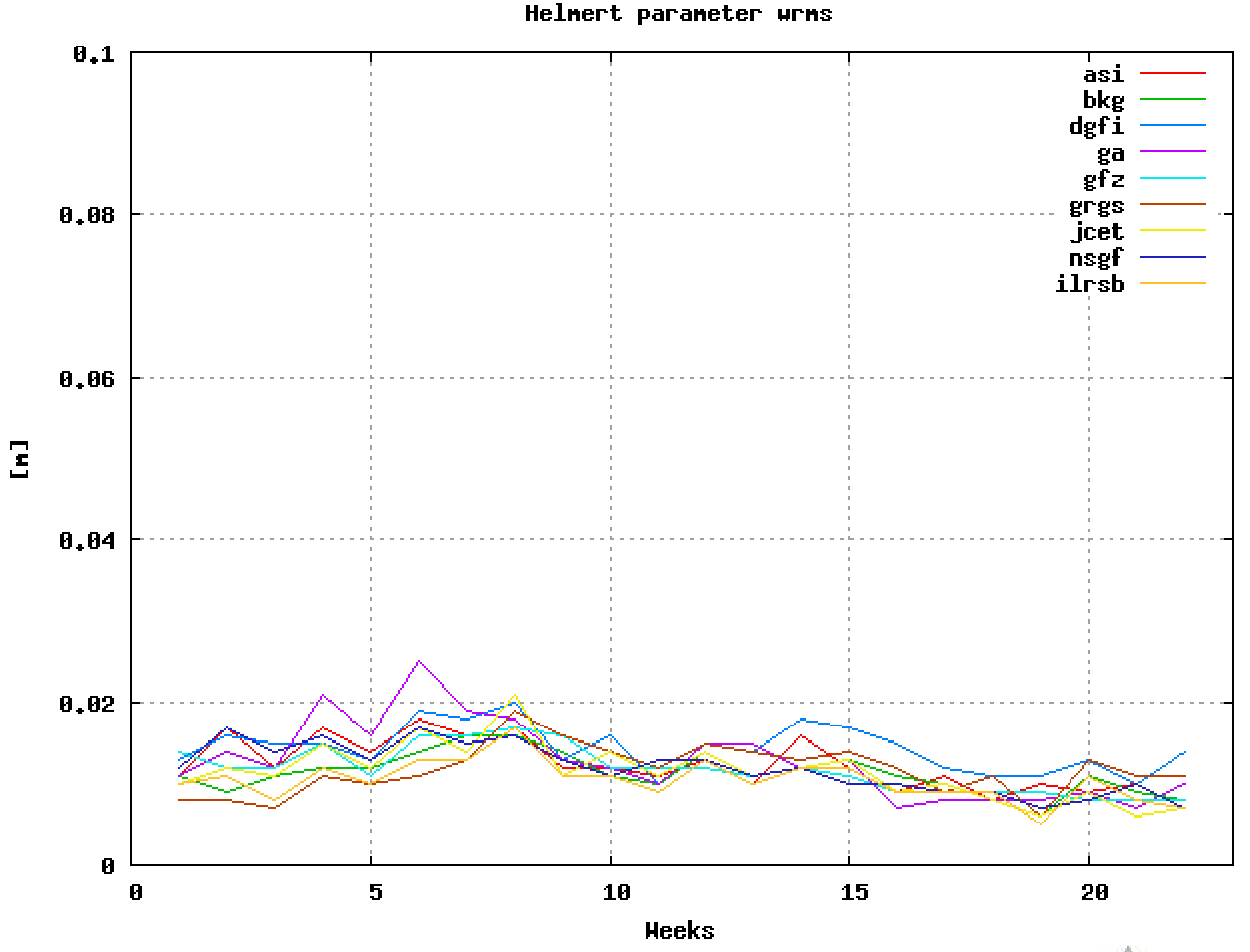
071110 - 080329



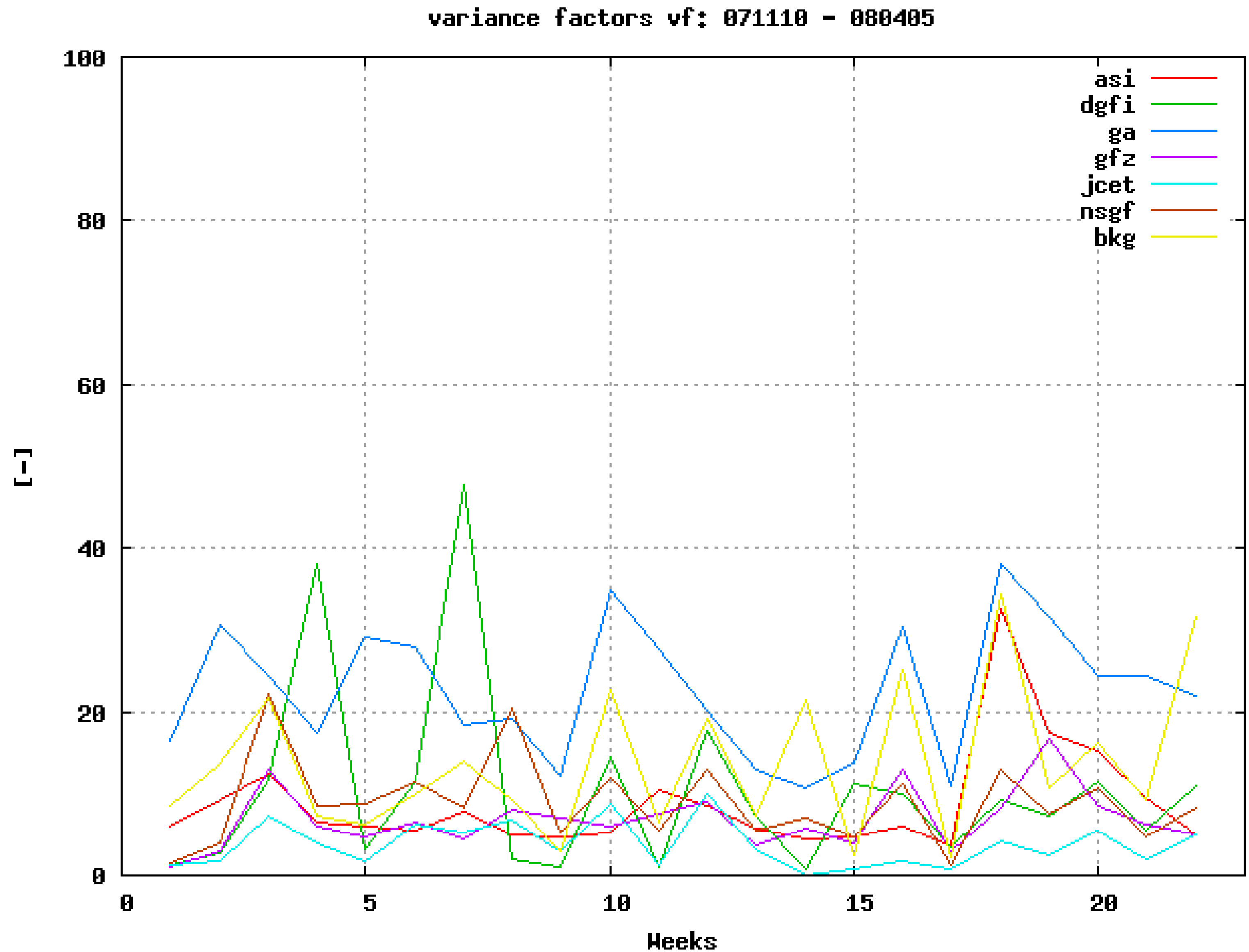
ILRS AWG Meeting Vienna, April 12, 2008

Weekly combination v10 (5)

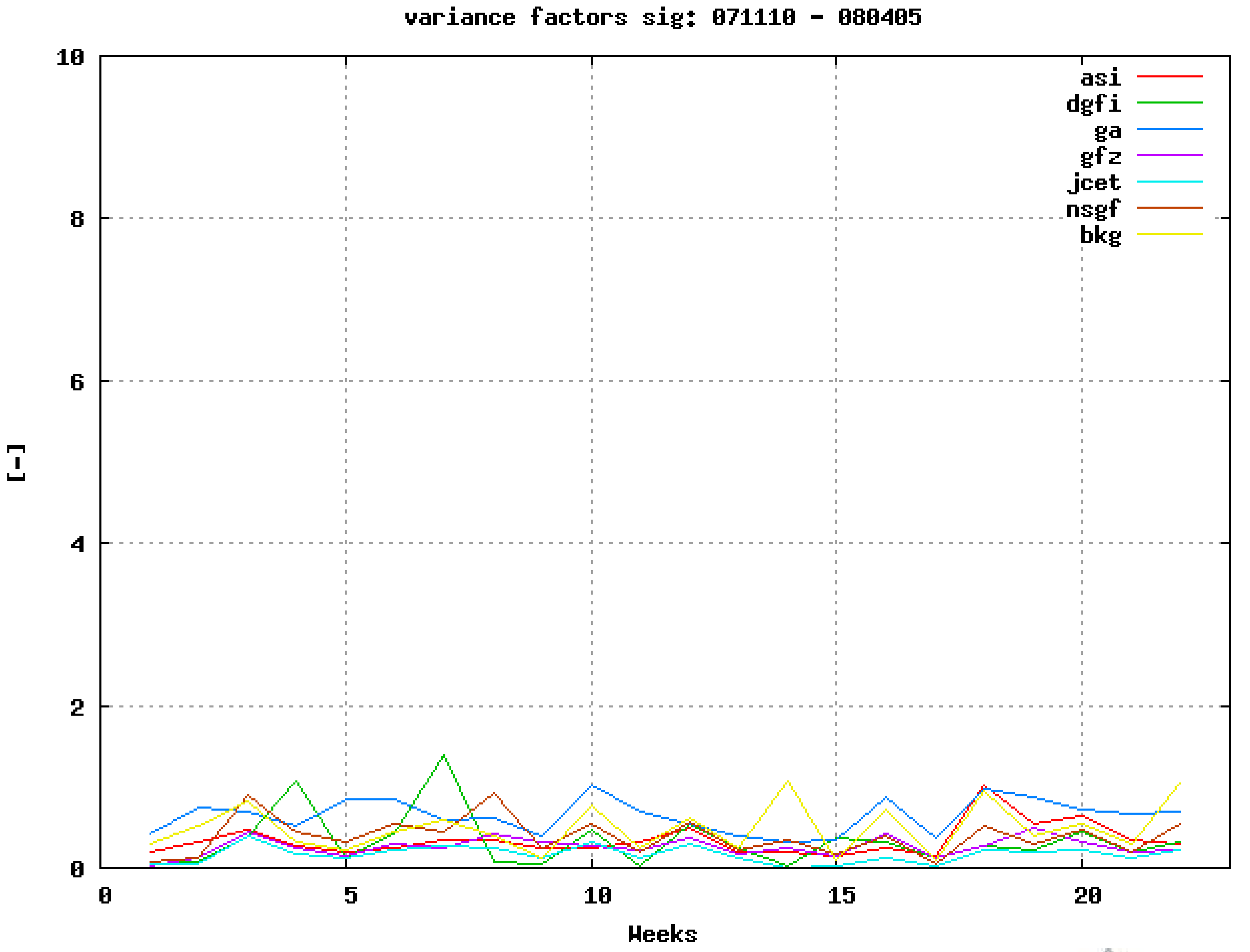
071110 - 080329



Weekly combination v10 (6)

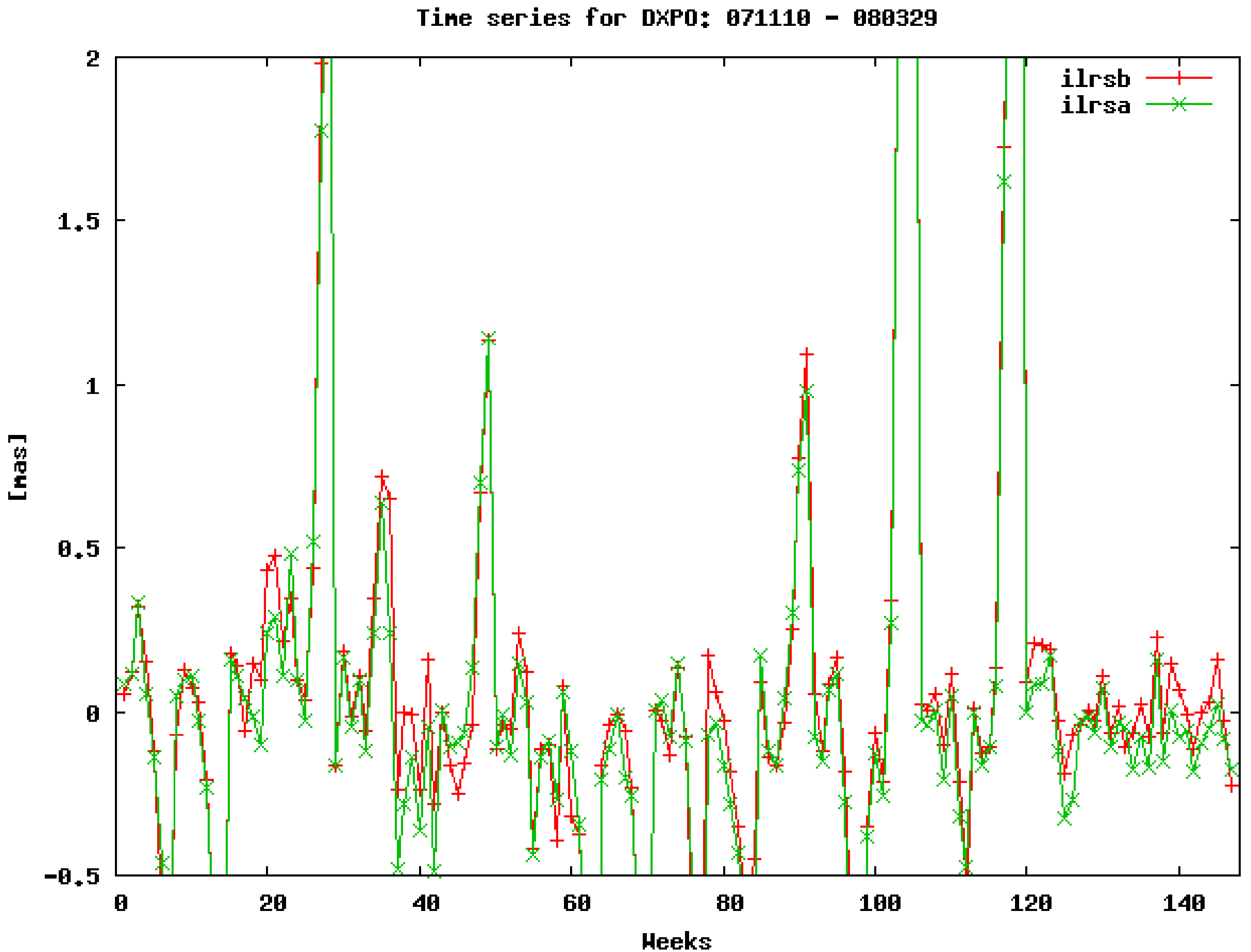


Weekly combination v10 (7)

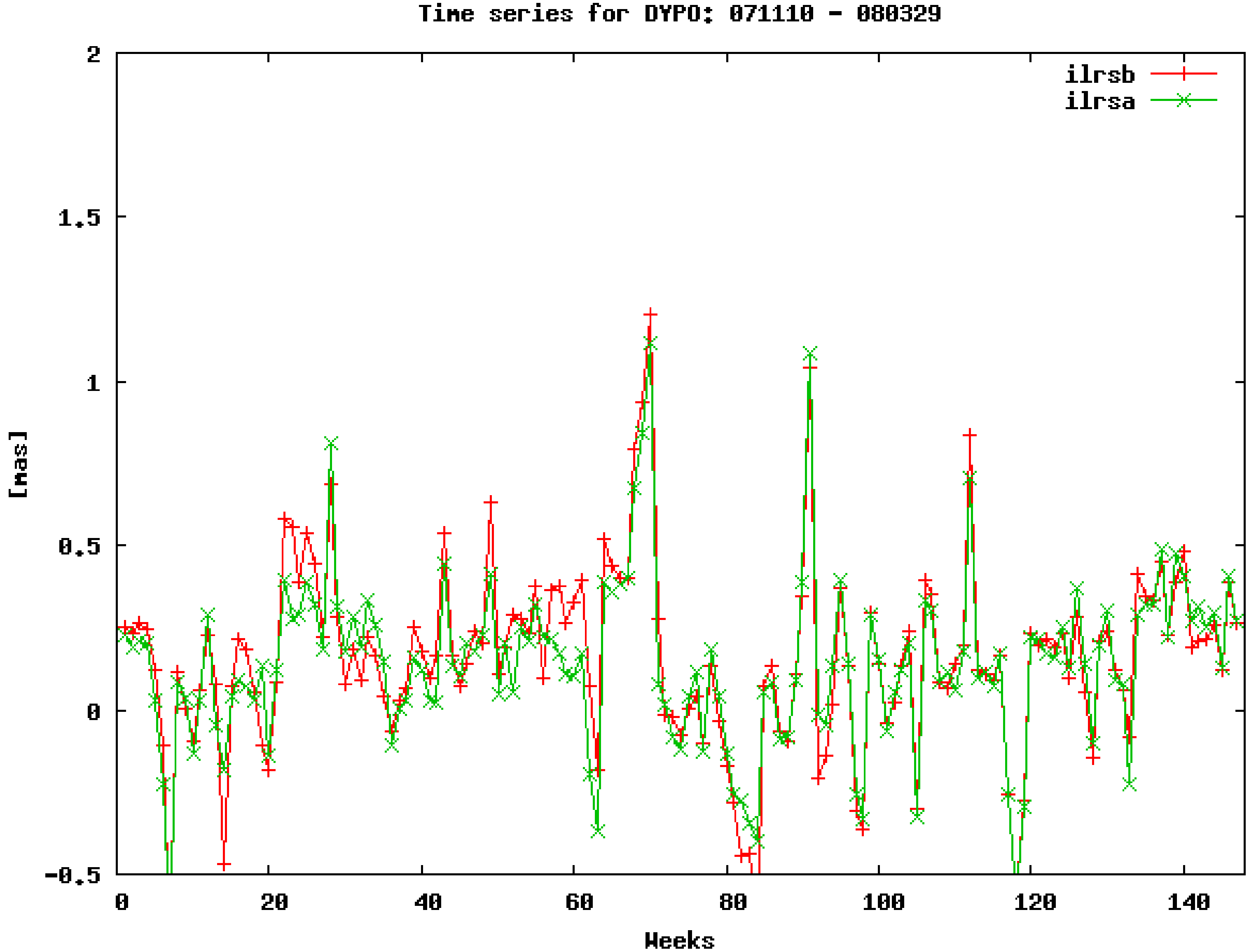


DGFI Forschungsgruppe Satellitengeodäsie

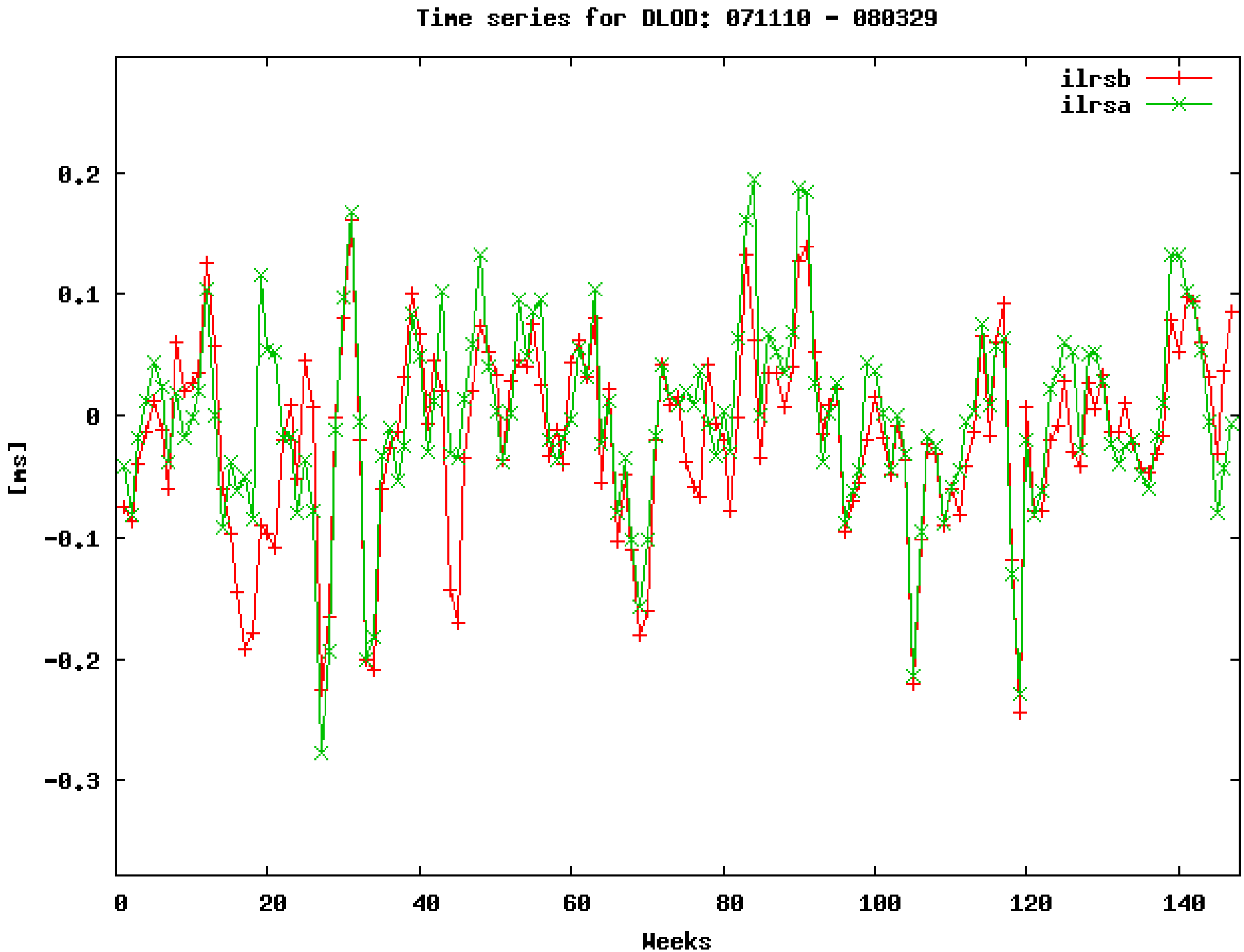
Weekly combination v10 (8)



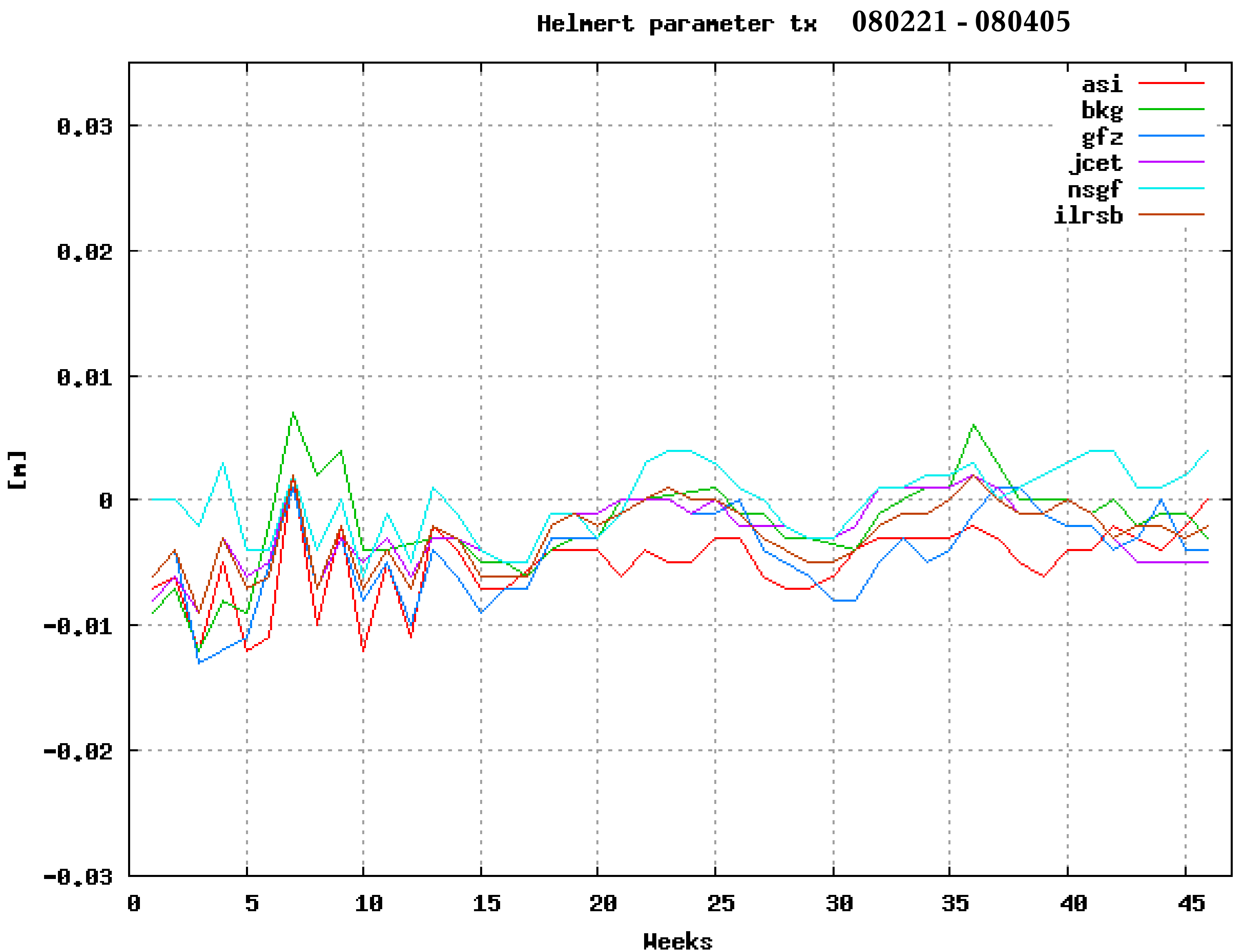
Weekly combination v10 (9)



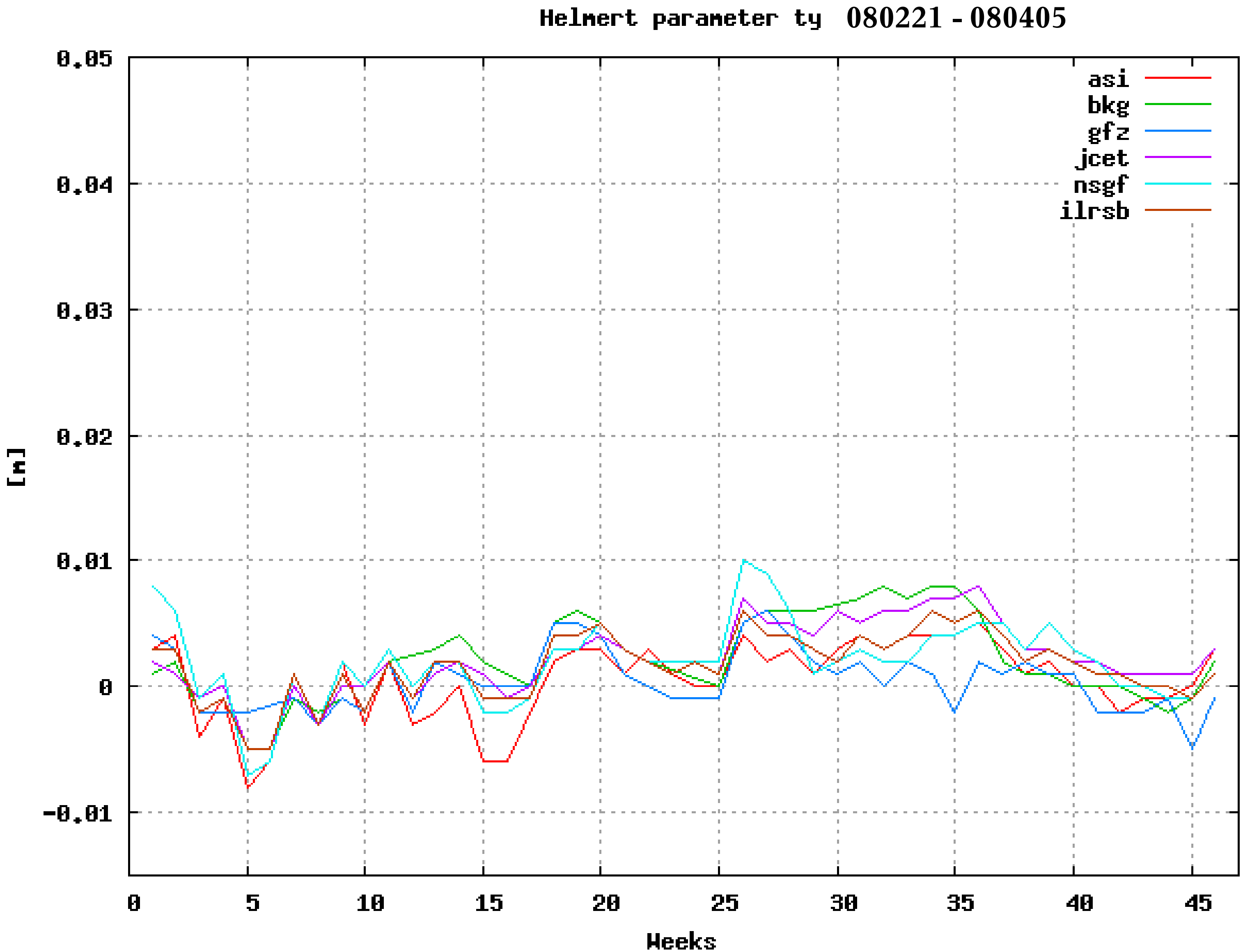
Weekly combination v10 (10)



Daily combination v100 (1)

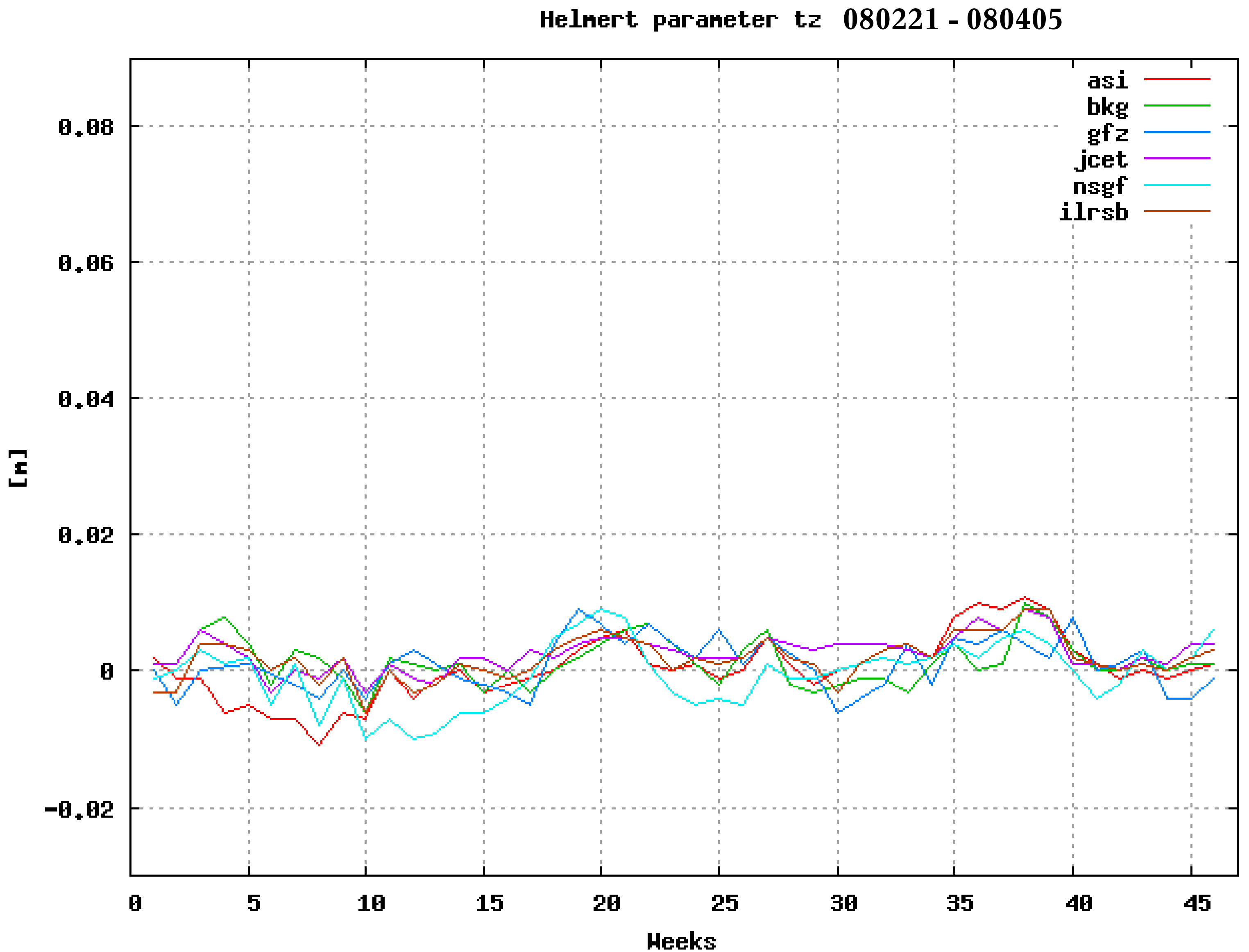


Daily combination v100 (2)

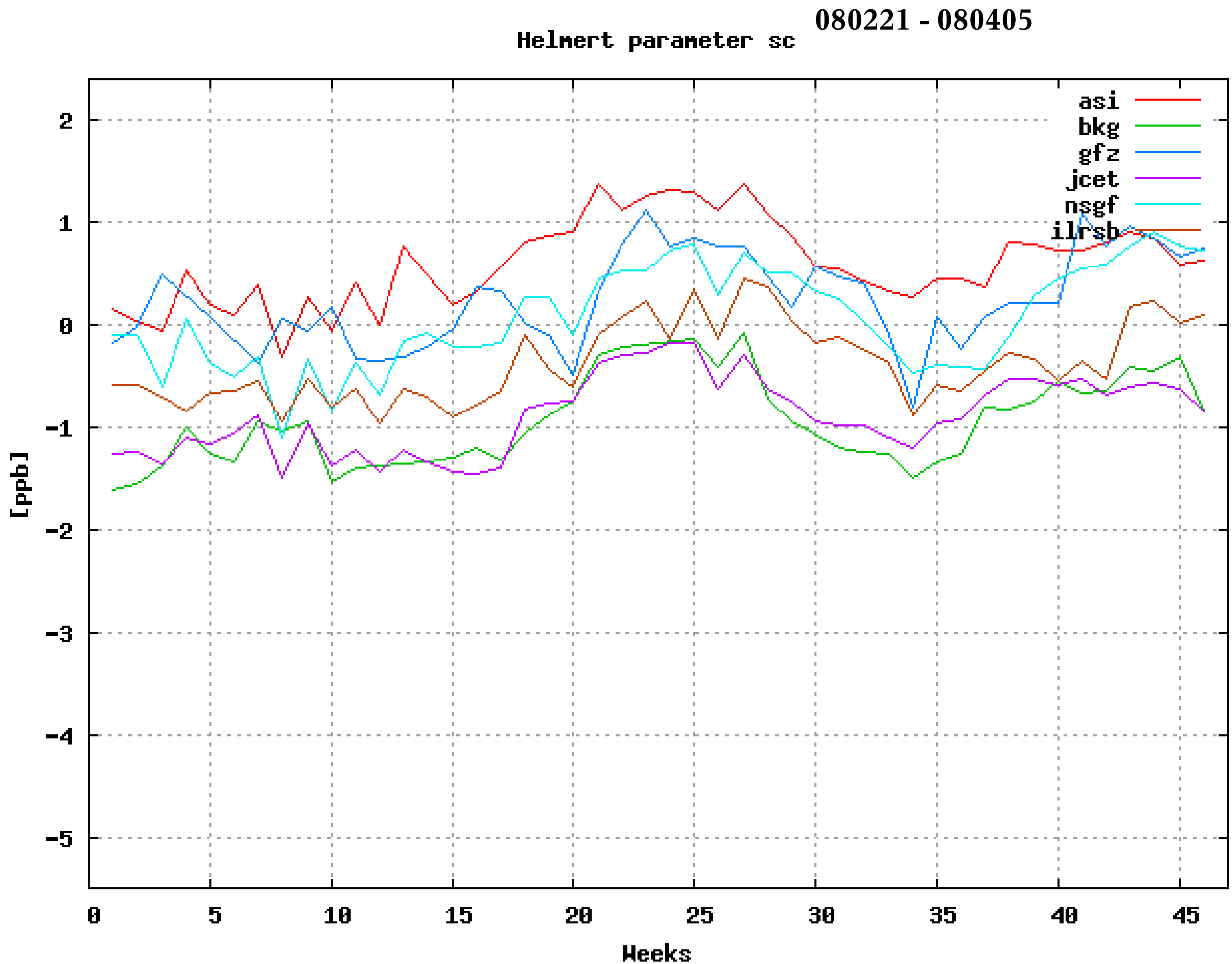


DGFI Forschungsgruppe Satellitengeodäsie

Daily combination v100 (3)



Daily combination v100 (4)



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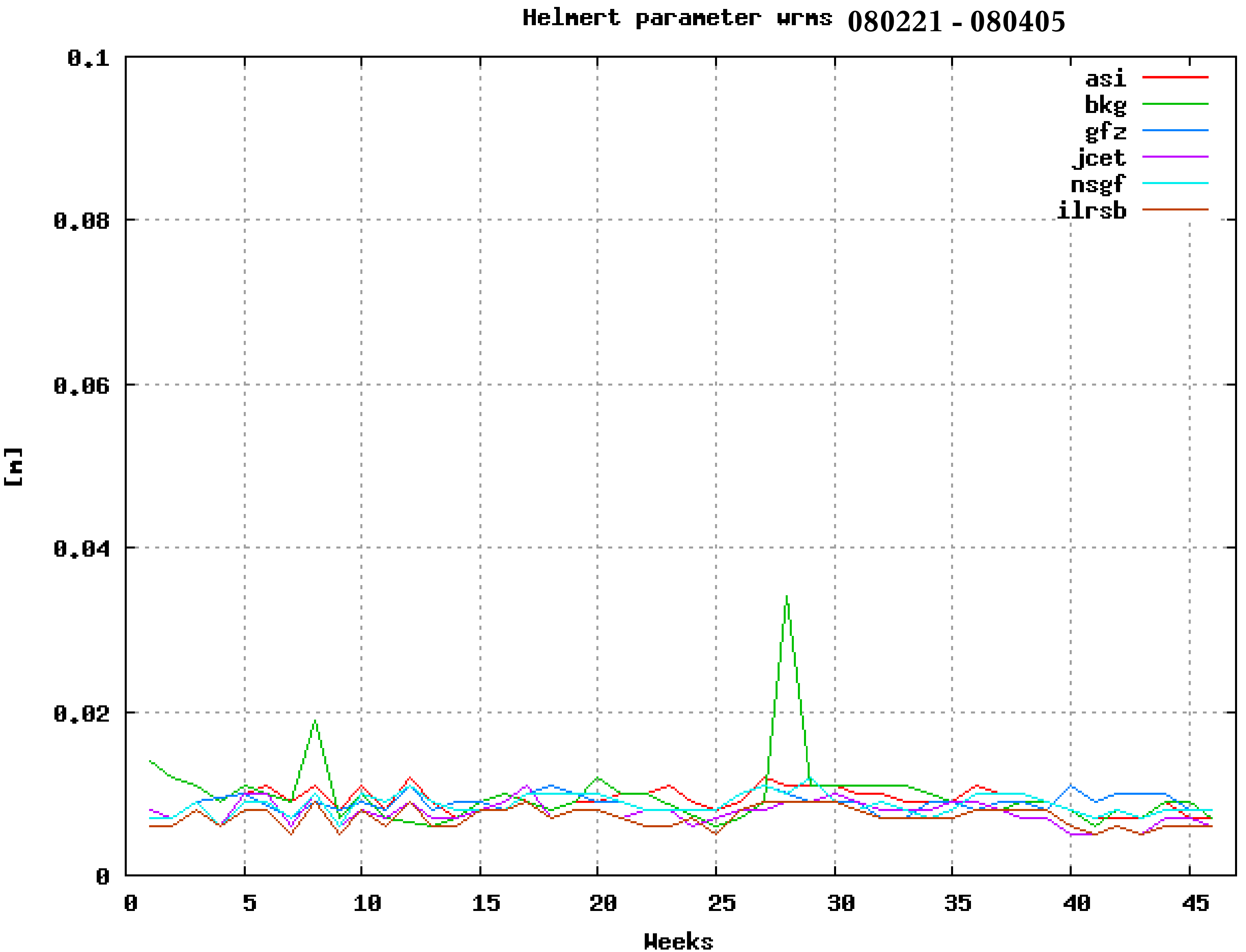
Daily combination v100 (5)



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Orbit combination SP3C (1)

Processing flow

Reference orbit (DGFI): pos+vel
SP3C

orbit (ASI): pos+vel
SP3C

orbit (...): pos+vel
SP3C

Reference orbit (DGFI): pos+vel
Internal

orbit ASI): pos+vel
Internal

orbit ASI): pos+vel
Internal

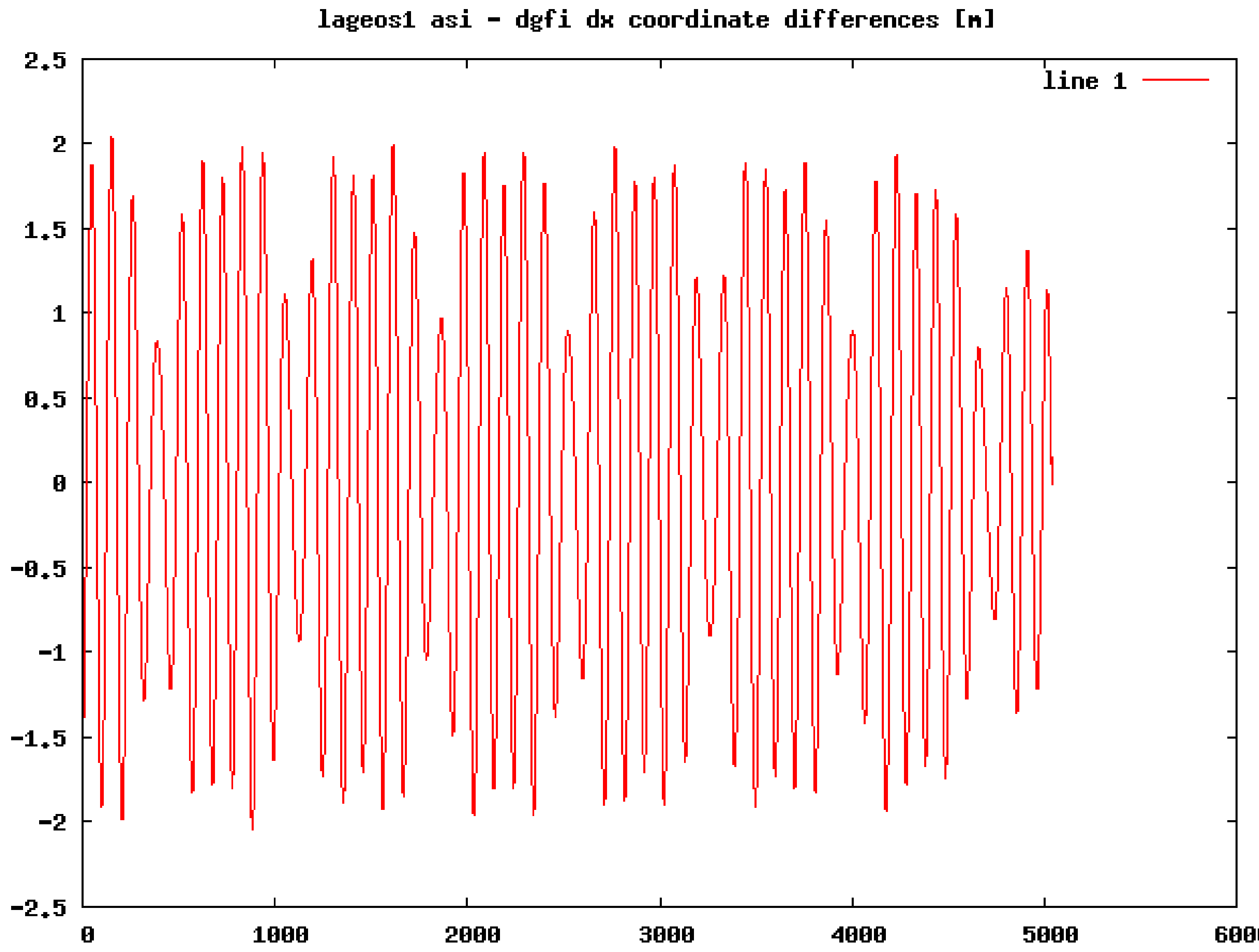
Helmert transformation parameter (T) estimation of orbits w.r.t. reference orbit for pos

combination of transformed orbits and reference orbit for pos and vel

Combined orbit : pos+vel
Internal

Combined orbit : pos+vel
SP3C

Orbit combination SP3C (2)



Orbit combination SP3C (3)

Test computation: 1 day orbit

Helmert parameters dt:

tx: 0.00104336379424856
ty: -0.00623915422595959
tz: 0.025565165862839
rx: -0.0723469400000462
ry: -0.024252471310669
rz: -0.0214411640204961
sc: -1.07006034191655e-05

sd_t:
tx: 0.0373069503591284
ty1: 0.037334130826632
tz2: 0.0373205108097731
rx: 0.000741780405495154
ry: 0.000738115944099478
rz: 0.000834557772619003
sc: 0.00303938926677166

rms_total: 0.0555640171783795
rms_x: 0.0702765623525939
rms_y: 0.0544170253416045
rms_z: 0.0369062616891886

DGFI FGS Forschungsgruppe Satellitengeodäsie

Consolidated Laser Ranging Data (CRD) Format
Notes for Analysts

Advantages for Analysts

While the CRD manual contains a list of advantages of the CRD over previous format,s what follows is a list of advantages the analysts will be most interested in.

- Skew, Kurtosis, peak-mean are data fields that have been requested over the years but have not been available in the data set. This should allow analysis of over-filtering and anomalous data distributions.
- The CRD format is capable of handling multi-channel, multi-stop, multi-color systems. Although the old formats could handle multiple color data, they could not be integrated into one normal point file. Multi-channel and multi-stop data is not explicitly recognized in the old formats.
- Standard satellite, transponder, and lunar data can be fully represented in one format.
- The free format data records mean the number of significant digits can be increased to the accuracy required by some missions without requiring all targets to carry additional digits.
- Most station configuration information can now be embedded with the data. This can help with keeping track of station configurations at a finer granularity than the current SCF and SCH values. This will only help if stations use the new configuration section and if values are current. This is an area that many analysts will not be interested in, but the data is readily available for those who are.
- The all-in-one, building-block nature of the format should make processing full-rate and other special formats easier, if they are needed. Also, full-rate files will be smaller than with the Merit II format.
- Future enhancements to the format should not require starting over again.

Record-by-record Information

Headers

H1 – format header

- Date of file production (as distinct from release number in H4) tells when the current file was created (by merge, split, etc.). This could help verify that the latest file is available.

H2 – station header

- Nothing new

H3 – Target header

- All 3 commonly used satellite IDs and name are included.
- Spacecraft epoch time scale is available for transponders
- Target type (passive satellite, passive lunar, transponder, mixed, etc.) will allow sending data to the right processing steps for the target

H4 – session header

- A flag tells whether this is full rate, normal point, or sampled engineering data.
- Provides many of the fields in the Merit II formats – but watch the sense of the flags.
- Indicates whether this is 1 or 2 way ranging, etc. needed for processing decisions.
- Data quality alert will give some sense as to whether the data should be used in critical applications.

H8/H9 – end of pass or file

Configuration

C0 – system configuration

- Provides wavelength and pointers to related configuration information for this color.

C1 – laser configuration

- Various info including fire rate, pulse width, divergence, number of pulses.
- These could all be of interest in analysis.
- For example, does the pulse width match the rms of the calibrations and data?

C2 – detector configuration

- Contains detector information, such as detector type, quantum efficiency, spectral and spatial filters.
- The data biases and corrections may depend on whether this is a cspad or mcp, etc.
- Is the change of signal processing algorithm the reason for changes to this station's biases?

C3 – timing system configuration

- Is a new station bias correlated with changes to any of these pieces of equipment?

C4 – transponder/clock configuration

- This record is needed for transponder analysis where the spacecraft and ground station need to be merged, and each is running on a separate clock timescale.

Data

10 – range record

- Variable precision in seconds of day and the return field allow for increased precision for transponders.
- Epoch event will tell how to interpret time of flight/ receive time field, and allows for transponder data.
- Detector channel and stop number show where the data comes from. Each channel could have a separate bias.

11 - normal point

- Again, epoch event will tell how to interpret time of flight/ receive time field, and allows for transponder data.
- Normal point window length gives the length in seconds, for those targets that require variable normal point lengths (e.g., lunar and satellites with highly elliptical orbits).
- Skew, kurtosis and peak-mean can show anomalies in the data distribution that would indicate hardware or processing problems. Since lasers do not produce Gaussian distributions, a skew that is unusually symmetrical could indicate over-filtering.
- Return rate could give some sense of system performance, tempered by sky conditions.

12 - range supplement

- Nothing new except time bias.

20 – meteorological record

- Origin of values specifies where the values came from (sample or interpolated value).

21 - meteorological supplement record

- This contains various ancillary data that could correlate with return rate.

40 – Calibration record

- Can include target system delays (transponder).

- Number of fires and points used could indicate quality of calibration results.
- Skew, kurtosis, and peak-mean are also included here.

50 – Session (pass) statistics record

- Provides skew, kurtosis, and peak-mean for the entire pass or session.

60 – Compatibility record

- Includes old system change indicator (SCH) and system configuration indicator (SCF) for those stations not including c1-c3 configuration records.

9x – user defined records

- Not applicable.

00 – comment record

- If the station considers data suspect, or if there is anything unusual that is not covered in the configuration records, this record type can provide an explanation. These should be kept with the data.

Record inclusion by data type

As a way of keeping track of what you will be seeing, here are the types of data and data records.

Record	**Full Rate**	**Sampled Engineering (Rarely used)**	**Normal Point**
Header Section			
H1 - Format	√	√	√
H2 - Station	√	√	√
H3 - Target	√	√	√
H4 -Session (Pass)	√	√	√
H8 - EOS	√	√	√
H9 - EOF	√	√	√
Configuration Section			
C0 – System Configuration	√	√	√
C1 – Laser Configuration	recommended	recommended	recommended
C2 – Detector Configuration	recommended	recommended	recommended
C3 – Timing Configuration	recommended	recommended	recommended
C4 - Transponder Config	√ transponders; n/a for other targets	√ transponders; n/a for other targets	√ transponders; n/a for other targets
Data Section			
10 - Range	√	√	not allowed

11 – Normal point	not allowed	not allowed	√
12 – Range Supplement	as available	as available	as available
20 - Meteorological	√	√	√
21 – Meteorological Supp	as available	as available	as available
30 – Pointing angles	√	√	n/a (usually)
40 – Calibration Statistics	n/r	n/r	√
50 – Session Statistics	n/r	n/r	√
60 - Compatibility	√ if no C1-C3; n/r otherwise	√ if no C1-C3; n/r otherwise	√ if no C1-C3; n/r otherwise
9x – User defined	Usually not transmitted	Usually not transmitted	Usually not transmitted
00 - Comments	as needed	as needed	as needed

n/a = not applicable or not appropriate
n/r = not required
√ = required

Sample Data

There is quite a bit of sample data in the manual, but here is more, and it includes all record types. Note that the 2 sample files have been merged into one file, as shown by the missing 'h9' record after the first 'h8' record.

```
00 This is a recent MLRS normal point file.
00 Plausible '21' records have been added
00 Part of the full rate file has been added, so keep reading.
h1 CRD  0 2008  3 25  1
h2 MDOL       7080 24 19 4
h3 jason1       105501 4378    26997 0 1
h4  1 2008  3 25  0 45 17 2008  3 25  0 55  9  0 0 0 0 1 0 2 0
c0 0 532.000 std ml1 mcp mt1
c1 0 ml1 Nd-Yag 1064.00 10.00 100.00 200.0 -1.00 1
c2 0 mcp mcp 532.000 -1.00 3800.0 0.0 unknown -1.0 0.00 -1.0 0.0 none
c3 0 mt1 TAC TAC MLRS_CMOS_TMRB_TD811 na 445900000.0
60 std 5 2
40 2716.0000000 0 std 67 58 -1.000 -883.3 0.0 96.4 0.718 -0.126 364.4 3 3
20  2716.000  801.73 286.76  35. 0
21 2716.000 3.1 45 none 20 -1 3 10
11  2726.697640514675     0.013737698432 std  2   15     1   72.7   1.494  -0.536  -32.4   0.67
11  2804.507921286791     0.011496837034 std  2   15     1   72.7   1.494  -0.536  -32.4   0.67
```

```
11  2810.908760187949     0.011334723870 std  2   15     16   65.4   1.229  -1.235  -33.5  10.67
20  2822.000  801.73 286.56  35. 0
11  2828.611102554046     0.010908518342 std  2   15      1   72.7   1.494  -0.536  -32.4   0.67
11  2850.814029348448     0.010424908601 std  2   15      3  116.6   0.649  -2.333  -86.7   2.00
11  3104.347543373788     0.010760099652 std  2   15      2  108.7   0.354  -2.750  -73.5   1.33
11  3113.248715491056     0.010963708963 std  2   15     11   78.5   1.345  -0.730  -45.8   7.33
11  3124.950255557618     0.011244819341 std  2   15     14   65.2   1.635   0.207    4.5   9.33
11  3142.652594816107     0.011696747487 std  2   15     12   74.2   1.369  -0.535 -161.6   8.00
11  3150.653650787761     0.011910674436 std  2   15      2  123.0   0.354  -2.750  -83.7   1.33
20  3151.000  801.73 286.16  35. 0
21 3152.000 2 80 fog 20 -1 3 10
11  3169.356124039857     0.012431881802 std  2   15      1   72.7   1.494  -0.536  -32.4   0.67
50 std    72.7   1.494  -0.536  -32.4 0
h8
00 Note that there was no h9 "end of file" record after the "h8",
00 so this is a different part of the same file.
00
00 The following is part of the full-rate file from the same pass.
00 '21' records have been added to this example.
00 Even though this is not transponder data, a c4 record has been dummied.
00 The 'mc1' clock field id for the c4 record was added to the c0 record.
00 The file also contains 91, 92, and 93 records, which are user-defined.
00 Station-defined records will normally be stripped off by the station before transmittal.
00 Just bypass them as you do not know the format.
00 The analysts can also add their own 9x records if they wish.
h1 CRD  0 2008  3 25  1
h2 MDOL       7080 24 19 4
h3 jason1       105501 4378    26997 0 1
h4  0 2008  3 25  0 45 17 2008  3 25  0 55  9  0 0 0 0 1 0 2 0
c0 0 532.000 std ml1 mcp mt1 mc1
c1 0 ml1 Nd-Yag 1064.00 10.00 100.00 200.0 -1.00 1
c2 0 mcp mcp_varamp 532.000 -1.00 3800.0 0.0 unknown -1.0 0.00 -1.0 0.0 none
c3 0 mt1 TAC TAC MLRS_CMOS_TMRB_TD811 na 445900000.0
c4 0 mc1 0.000 0.00 1234567890123456.789 0.00 0.000000000000 0 0 0
60 std 5 2
91  8  85  2640 -2438728.97 -4909741.31  5429800.07  1474.0965 -5367.5721 -4187.1144 2
20 2716.000  801.73 286.76   35 0
21 2716.000 3.1 45 none 20 -1 3 10
40 2716.0000000 0 std 67 58 -1.000 -883.3 0.0 96.4 0.718 -0.126 364.4 3 3
30 2717.996 326.8923 32.9177 0 1 1
12 2717.9964890 std 0.0 0.0000 0.00 0.0000
30 2725.897 326.6035 33.9991 0 1 1
10 2726.697640514675 0.013737698432 std 2 2 0 0 0
30 2734.998 326.2469 35.2830 0 1 1
10 2738.899248614531 0.013359440021 std 2 1 0 0 0
```

30 2742.799 325.9195 36.4168 0 1 1

30 2752.100 325.4955 37.8239 0 1 1

10 2752.100991800282 0.012962363200 std 2 1 0 0 0

30 2762.002 324.9939 39.3585 0 1 1

...

21 3309.000 2 80 fog 20 -1 3 10

30 3309.224 164.3231 22.4342 0 1 1

10 3309.224609210523 0.016974823000 std 2 1 0 0 0

93 3309.224609210523 std   0.000 16.660 -20.265   0.97511 -0.00099   -2416.305   35267.021

92 3309.000 -0.0003 0.0003

h8

h9

Note:

1) Version 0.27 of the format document has an error in the suggested format for the sky clarity in record 21. This should be a floating point field, such as f4.2.
2) Version 0.27 of the format document does not include detector channel in the '40' calibration record. This will have to be included. It may be wise to include it on the normal point record, too, for flexibility.
3) Version 0.27 of the sample code allows strings (character) fields in the configuration and data sections to be shorter but not longer than the suggested field size. In other words an A10 field must be at least one character long but not longer than 10. Version 1.0 may allow longer fields (up to 256 characters) or may just state these limitations.

R. Ricklefs / 3 April 2008