ASI Analysis Center activities

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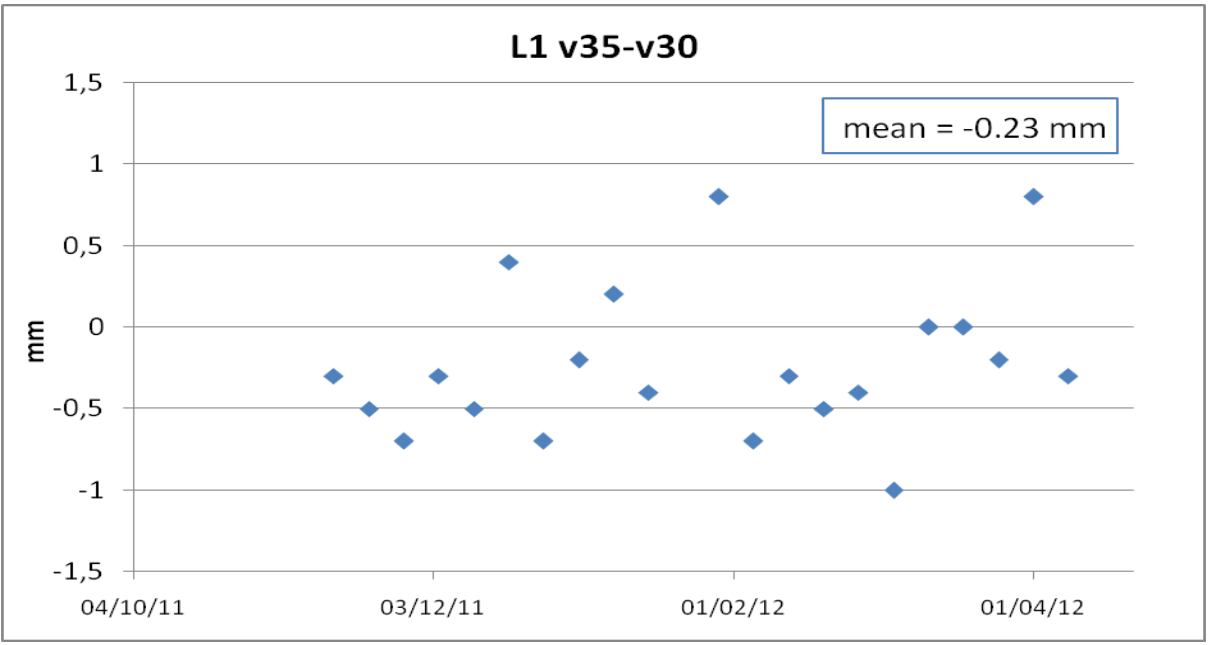
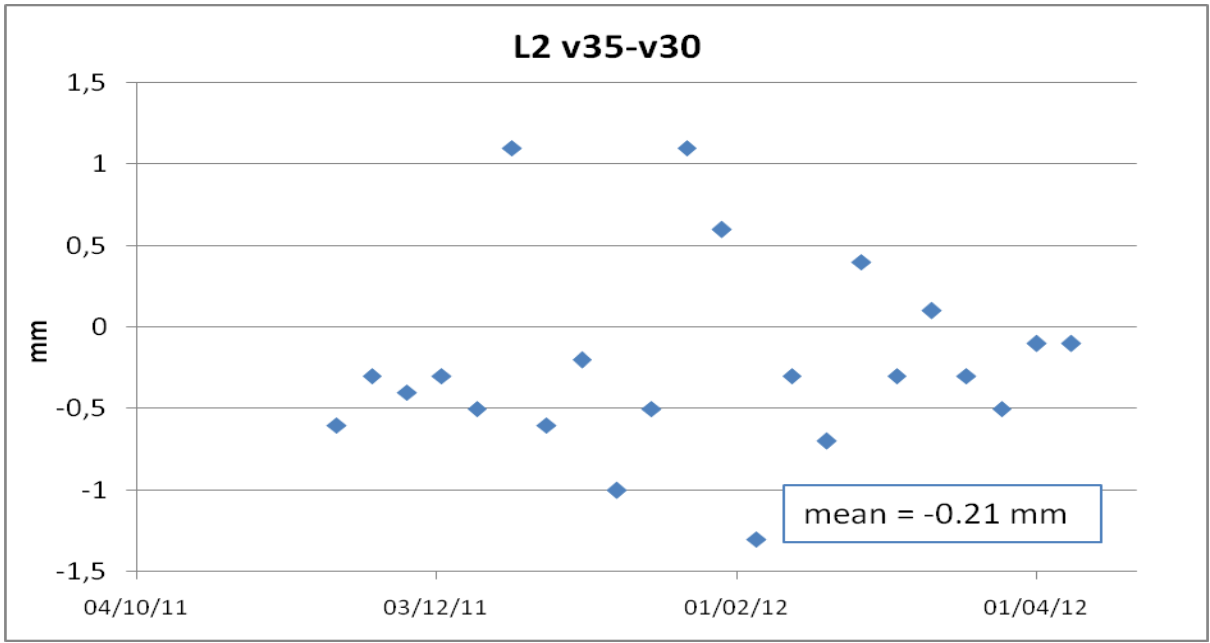
Main activities

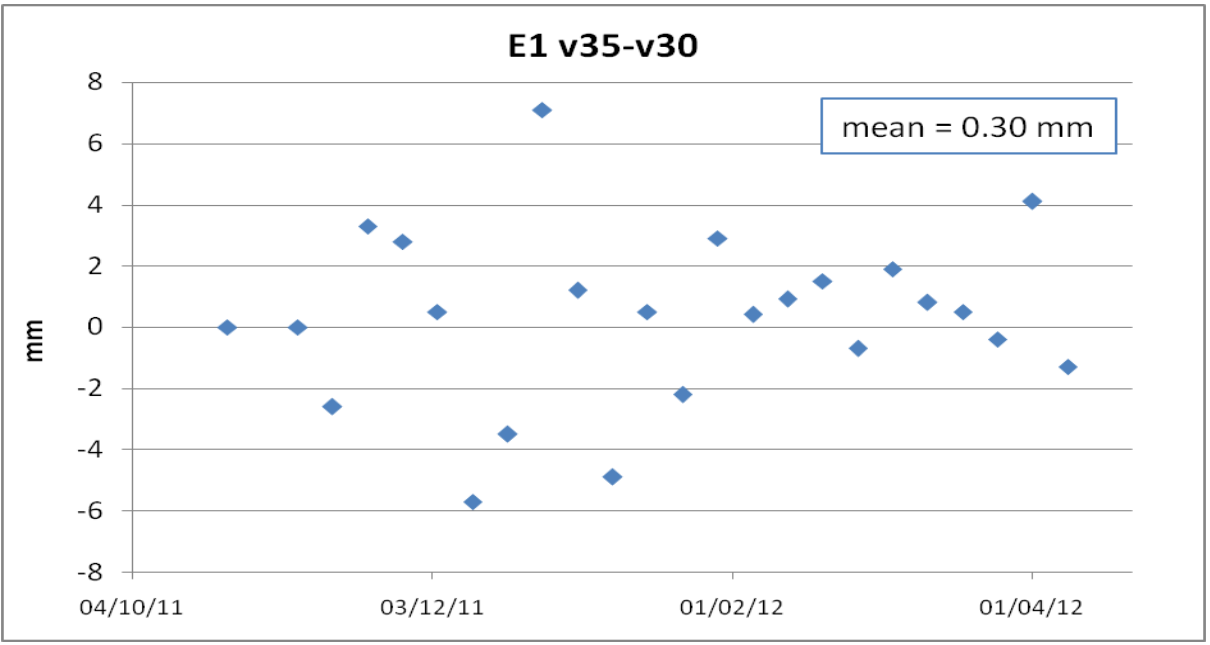
- Routine production of daily and weekly solutions
- V35 submitted
- CoM corrections from G. Appleby

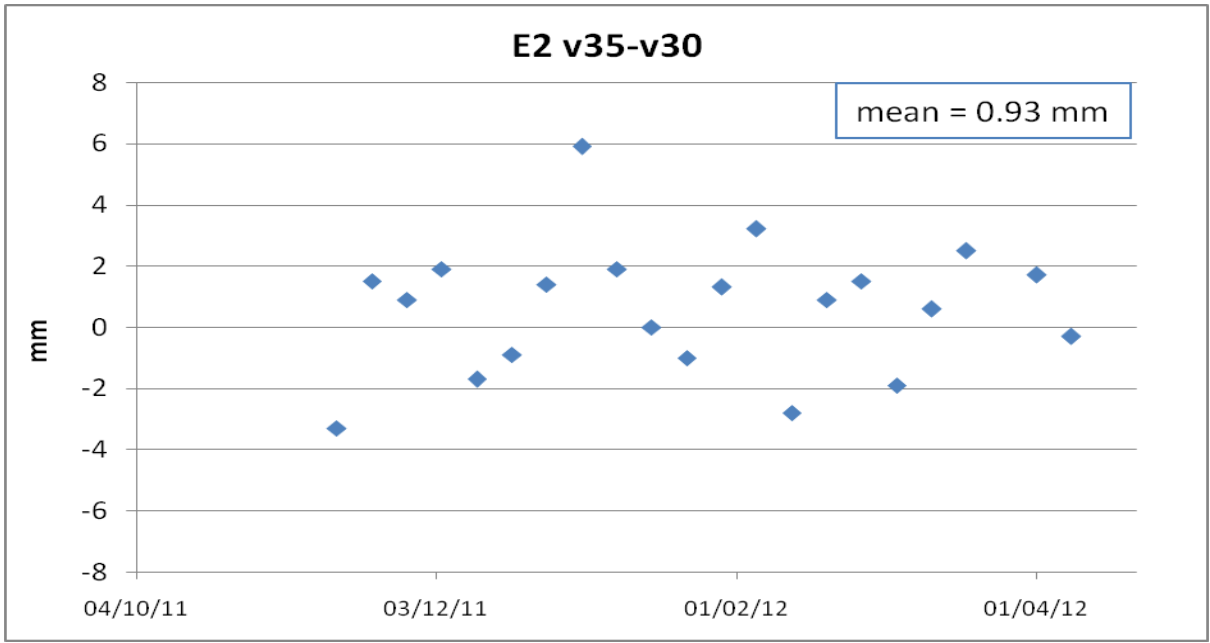
Arc wrms comparison for Lageos





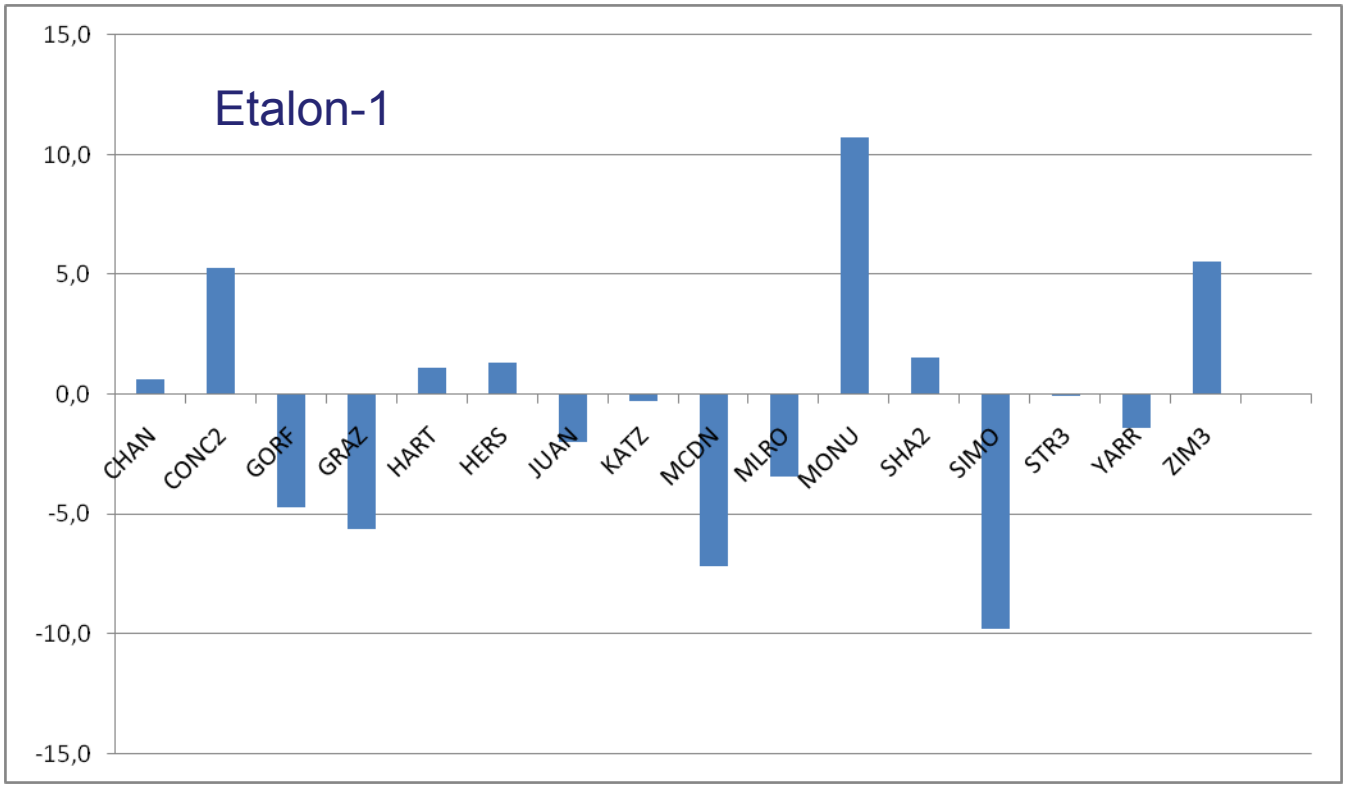
Arc wrms comparison for Etalon





Residual comparison

Lag1	mean	rms
CHAN	0,4	0,5
CONC2	0,2	0,2
HART	-0,3	3,6
POT3	0,6	0,6



ILRSA CC
v30/v35 solutions

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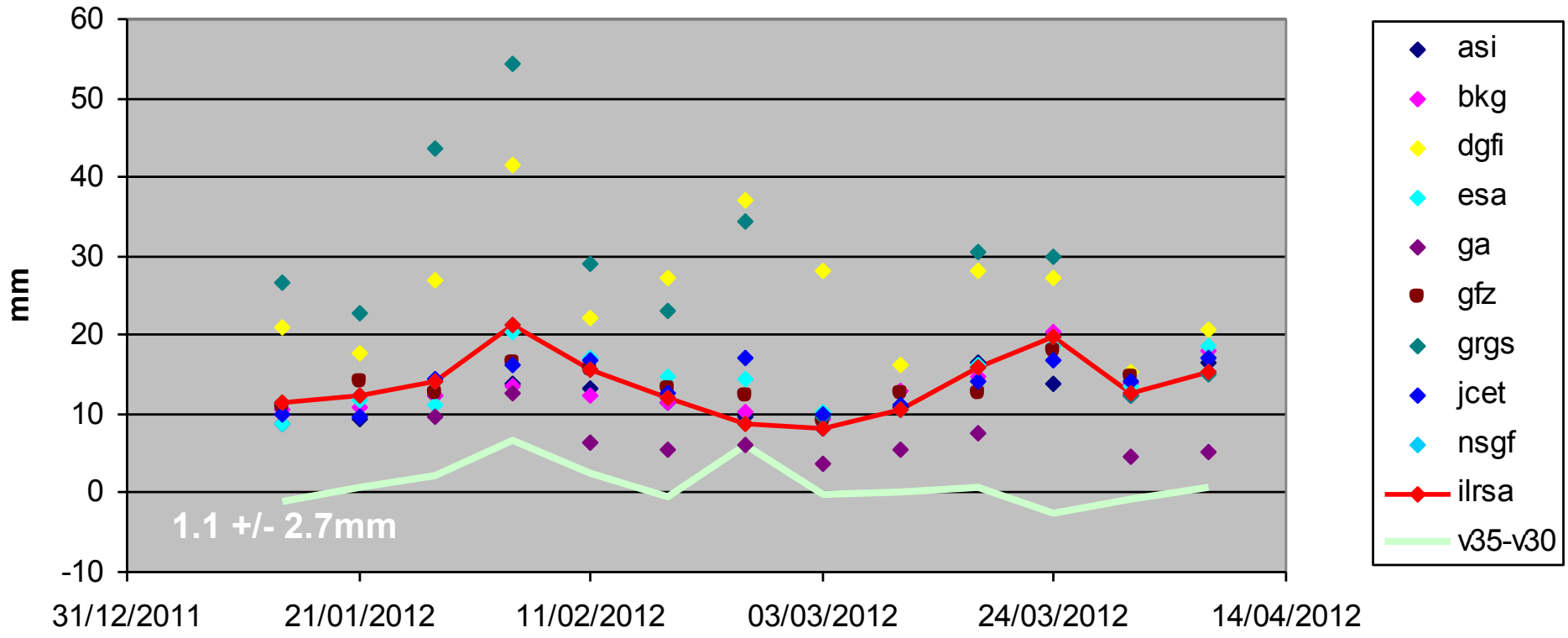
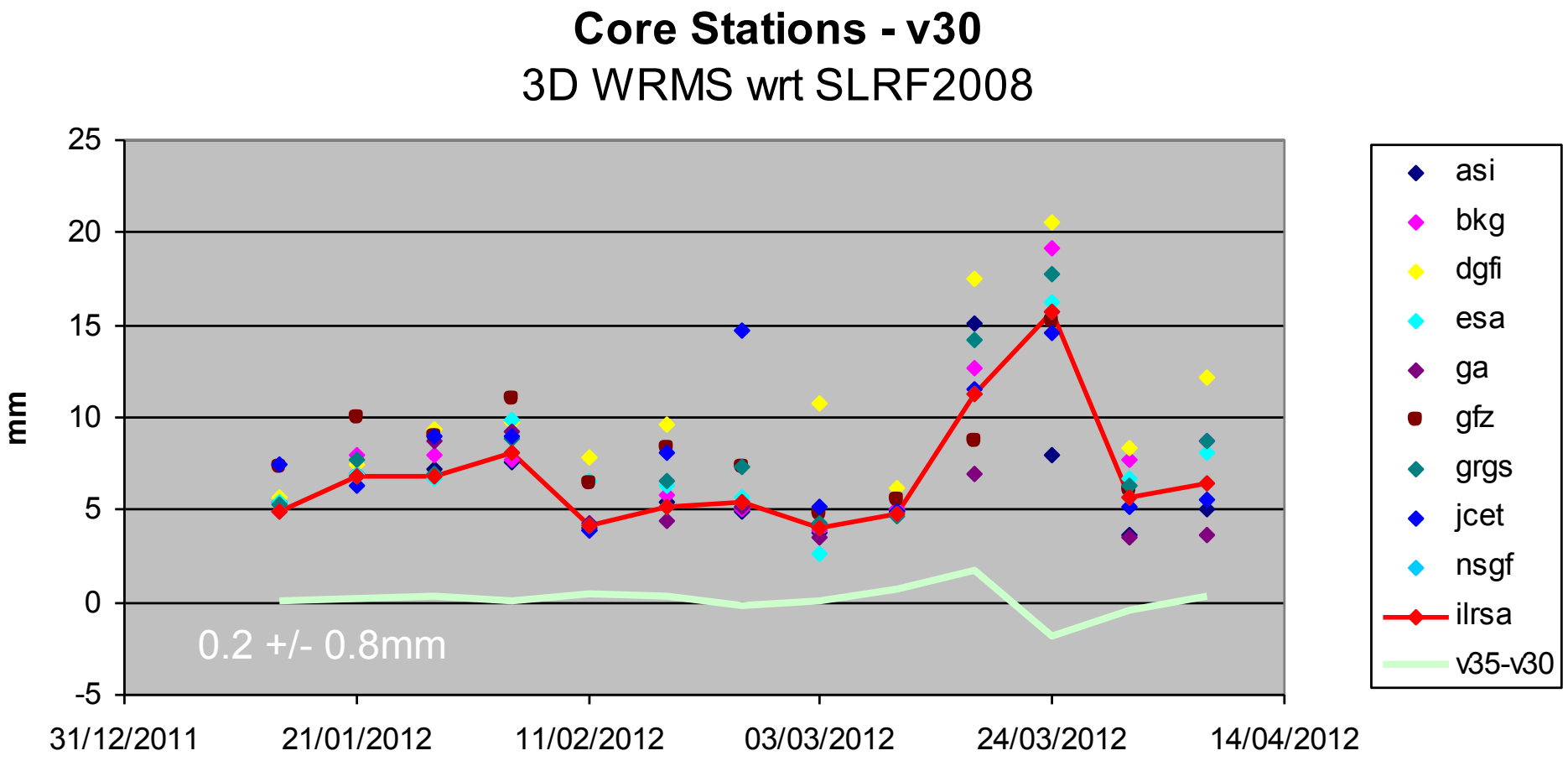
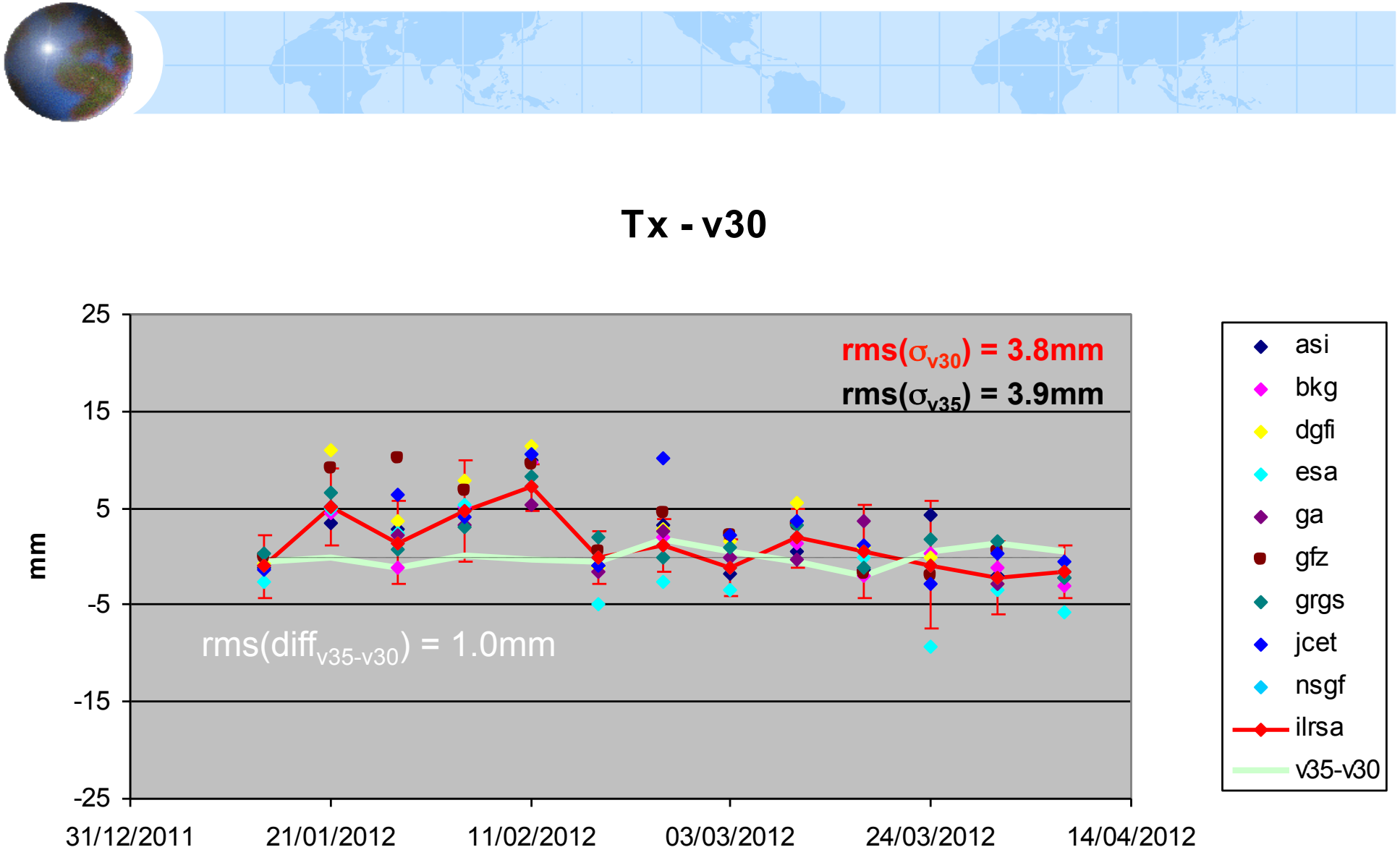
ILRS AWG Meeting, 21 April 2012, Wien

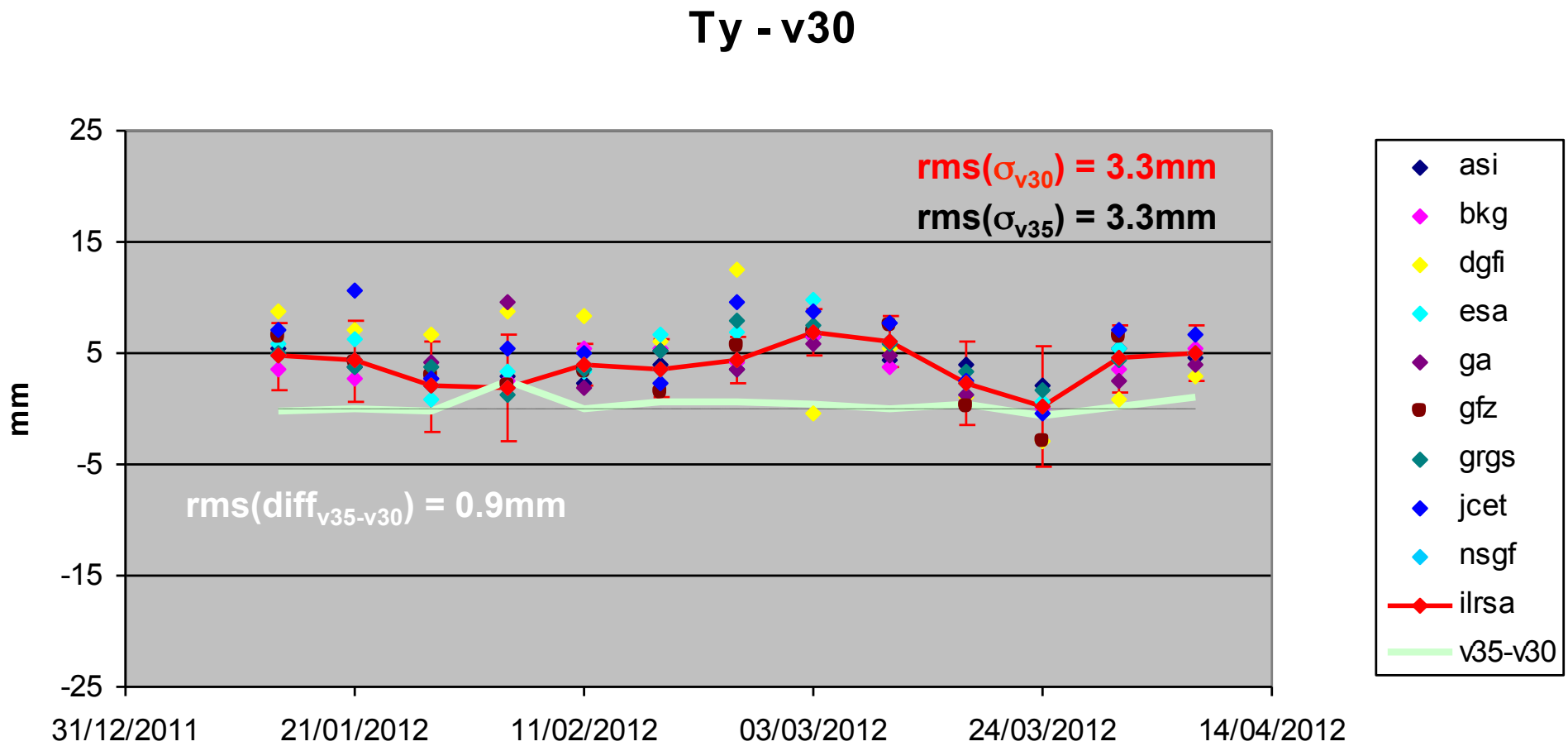
Contents

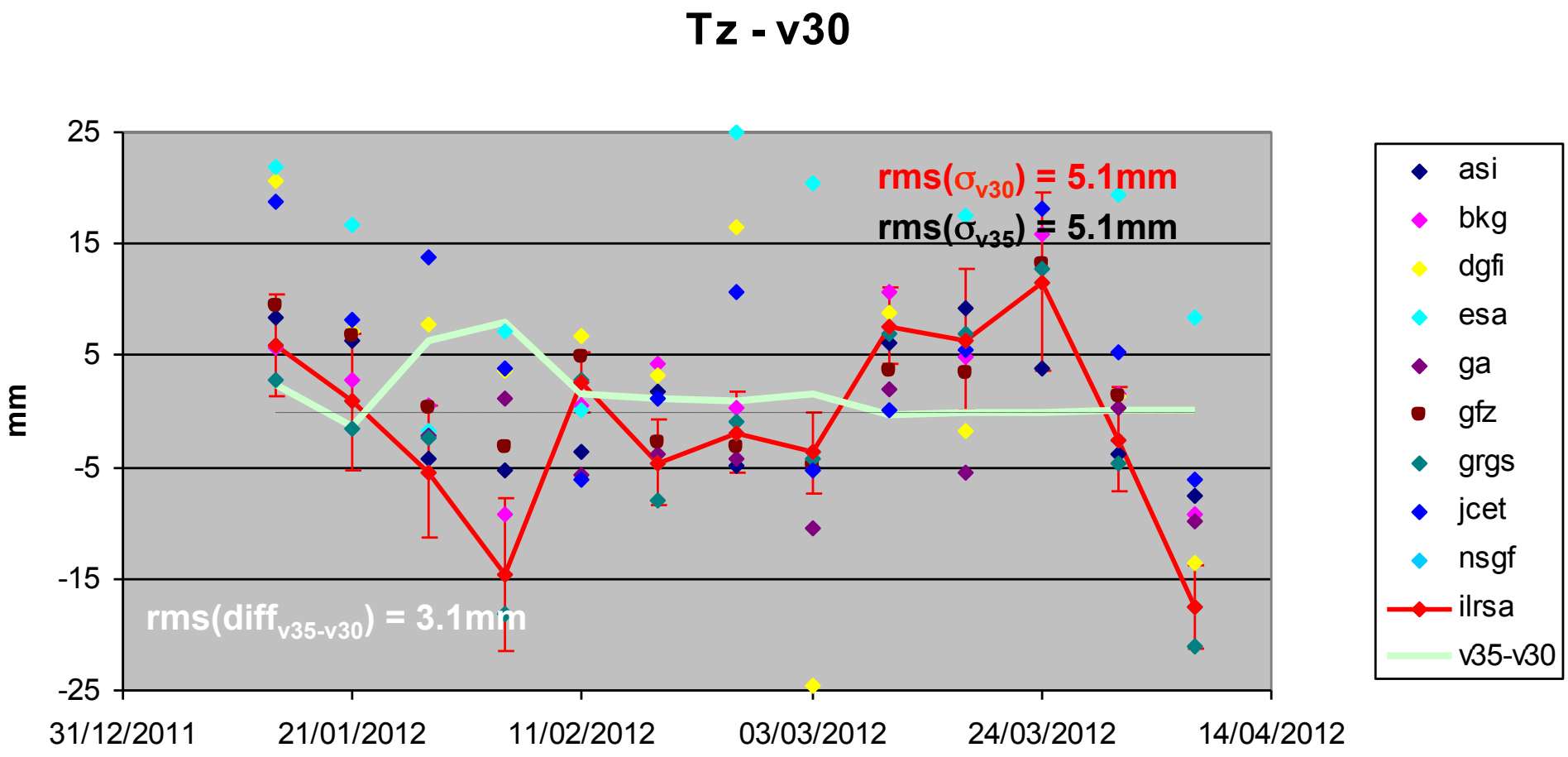
- Recent summary status of v30 solutions along with the v35 solutions assessment
- Measure the impact of the new CoM model on a 3-month test case with the usual quality parameters (positions vs SLRF2008, EOP vs usno values, translation/scale evaluation)
- V30/v35 shown are slightly revised to assure coherency (e.g. the same ACs contribute in the corresponding pair)

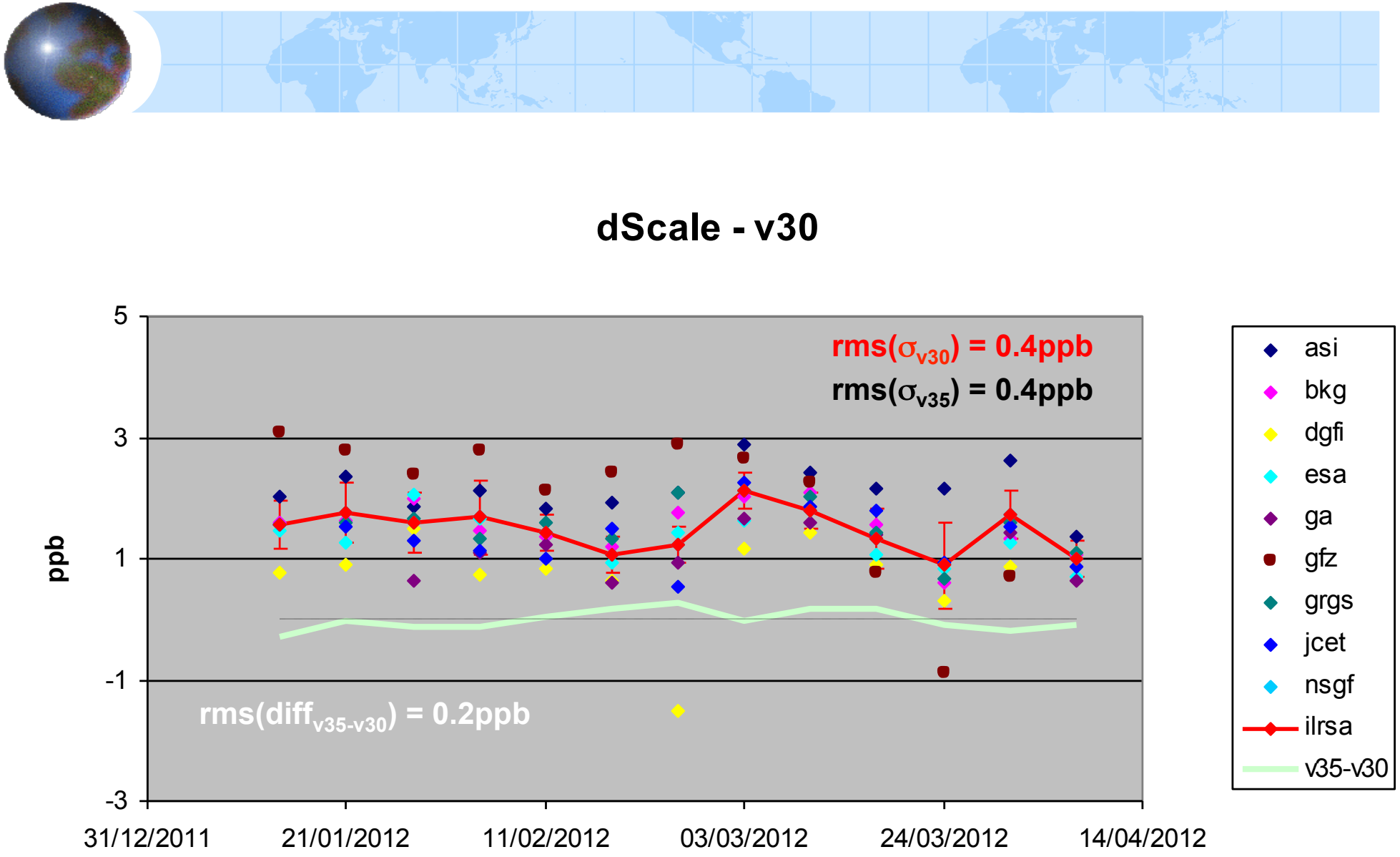

All Stations - v30
3D WRMS wrt SLRF2008
mm
60
50
40
30
20
10
0
-10
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012
1.1 +/- 2.7mm
asi
bkg
dgfi
esa
ga
gfz
grgs
jcet
nsgf
ilrsa
v35-v30

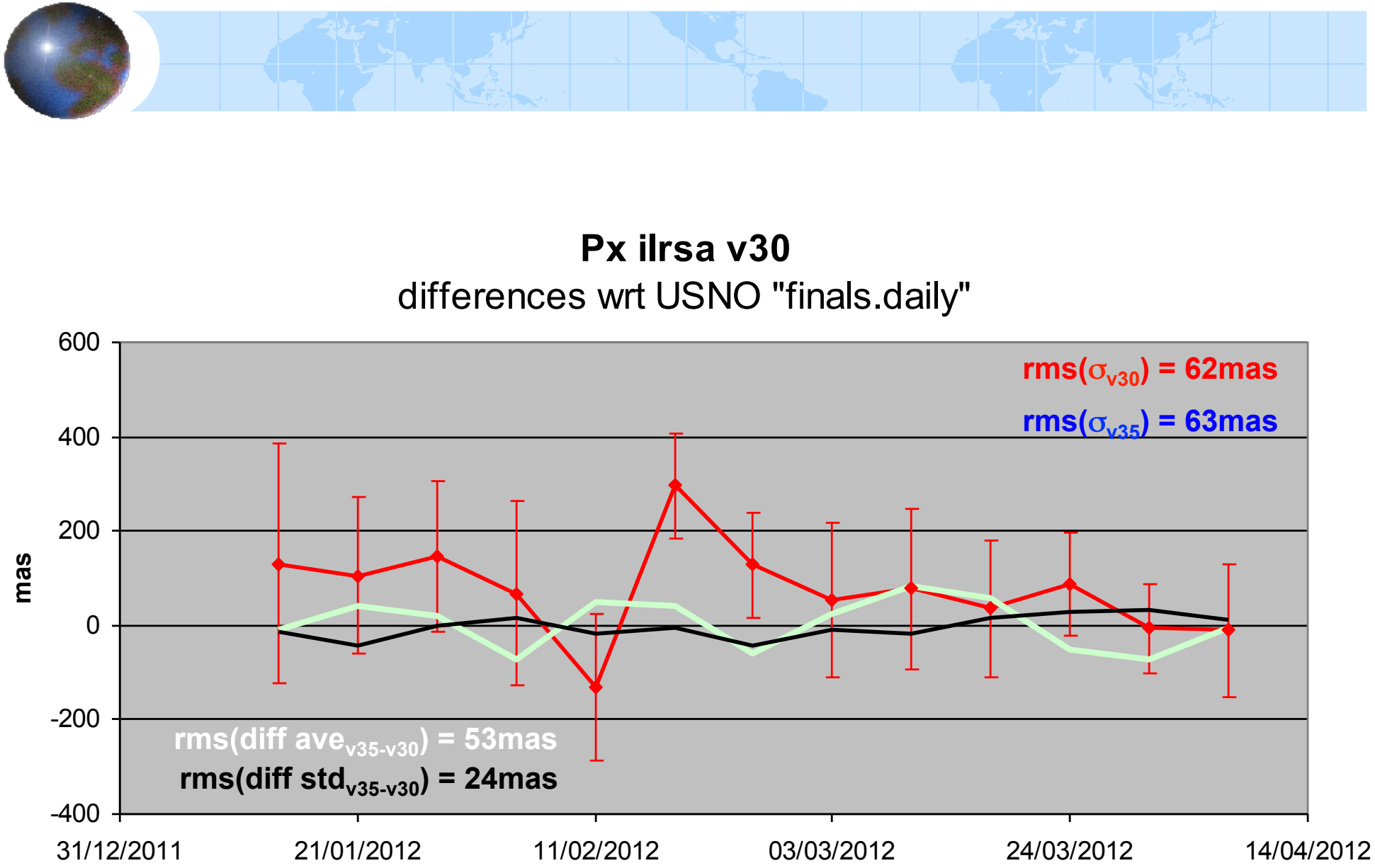

Core Stations - v30
3D WRMS wrt SLRF2008
mm
25
20
15
10
5
0
-5
0.2 +/- 0.8mm
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012
asi
bkg
dgfi
esa
ga
gfz
grgs
jcet
nsgf
ilrsa
v35-v30

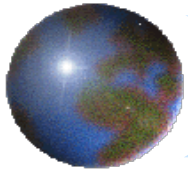

Tx - v30
rms(σv30) = 3.8mm
rms(σv35) = 3.9mm
rms(diffv35-v30) = 1.0mm
mm
25
15
5
-5
-15
-25
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012
asi
bkg
dgfi
esa
ga
gfz
grgs
jcet
nsgf
ilrsa
v35-v30


Ty - v30
rms(σv30) = 3.3mm
rms(σv35) = 3.3mm
rms(diffv35-v30) = 0.9mm
mm
25
15
5
-5
-15
-25
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012
asi
bkg
dgfi
esa
ga
gfz
grgs
jcet
nsgf
ilrsa
v35-v30


Tz - v30
rms(σv30) = 5.1mm
rms(σv35) = 5.1mm
rms(diffv35-v30) = 3.1mm
mm
25
15
5
-5
-15
-25
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012
asi
bkg
dgfi
esa
ga
gfz
grgs
jcet
nsgf
ilrsa
v35-v30

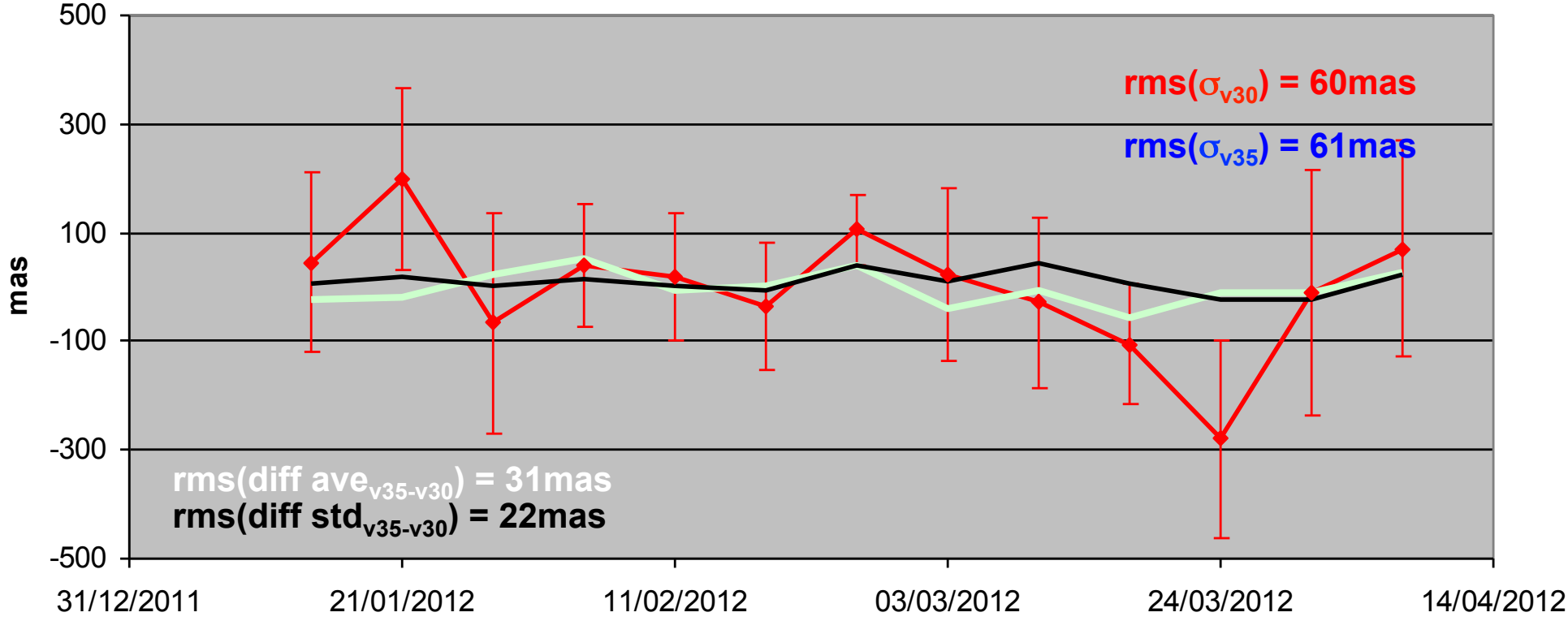

dScale - v30
rms(σv30) = 0.4ppb
rms(σv35) = 0.4ppb
rms(diffv35-v30) = 0.2ppb
ppb
5
3
1
-1
-3
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012
asi
bkg
dgfi
esa
ga
gfz
grgs
jcet
nsgf
ilrsa
v35-v30

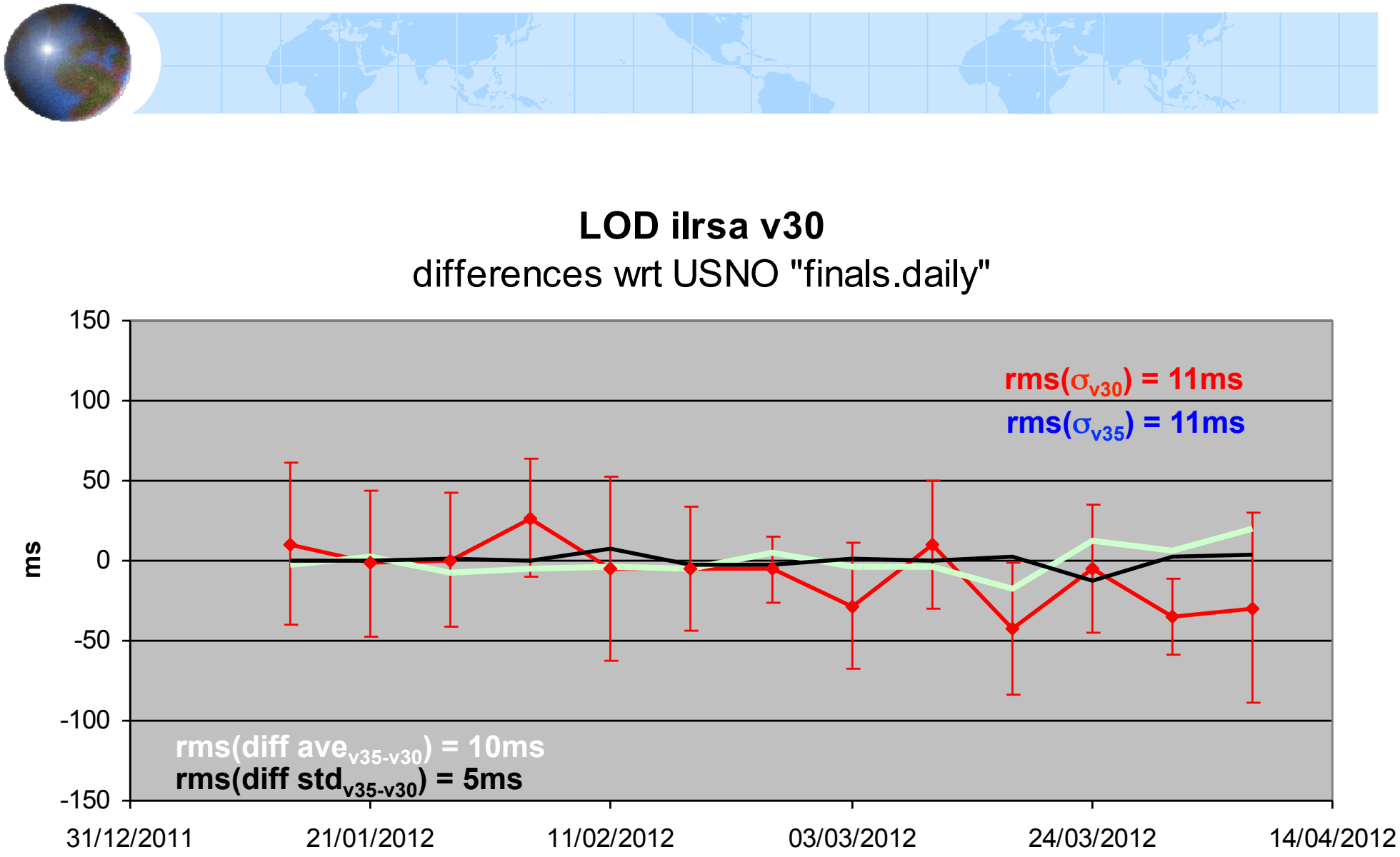

Px ilrsa v30
differences wrt USNO "finals.daily"
600
400
200
0
-200
-400
mas
rms(σv30) = 62mas
rms(σv35) = 63mas
rms(diff avev35-v30) = 53mas
rms(diff stdv35-v30) = 24mas
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012



Py ilrsa v30

differences wrt USNO "finals.daily"

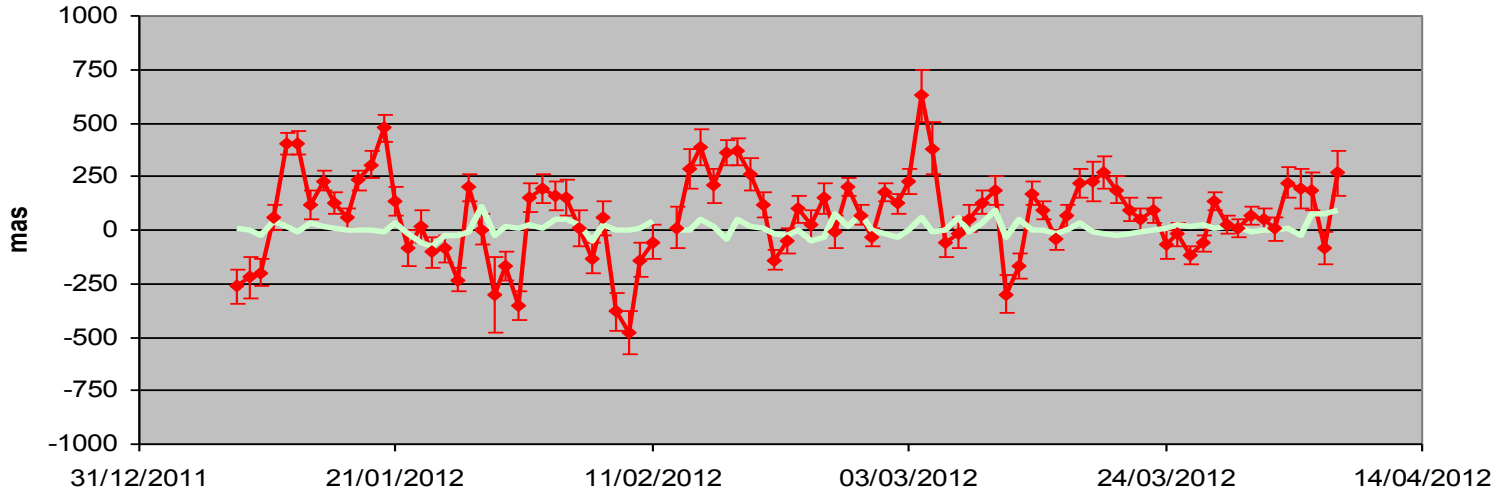


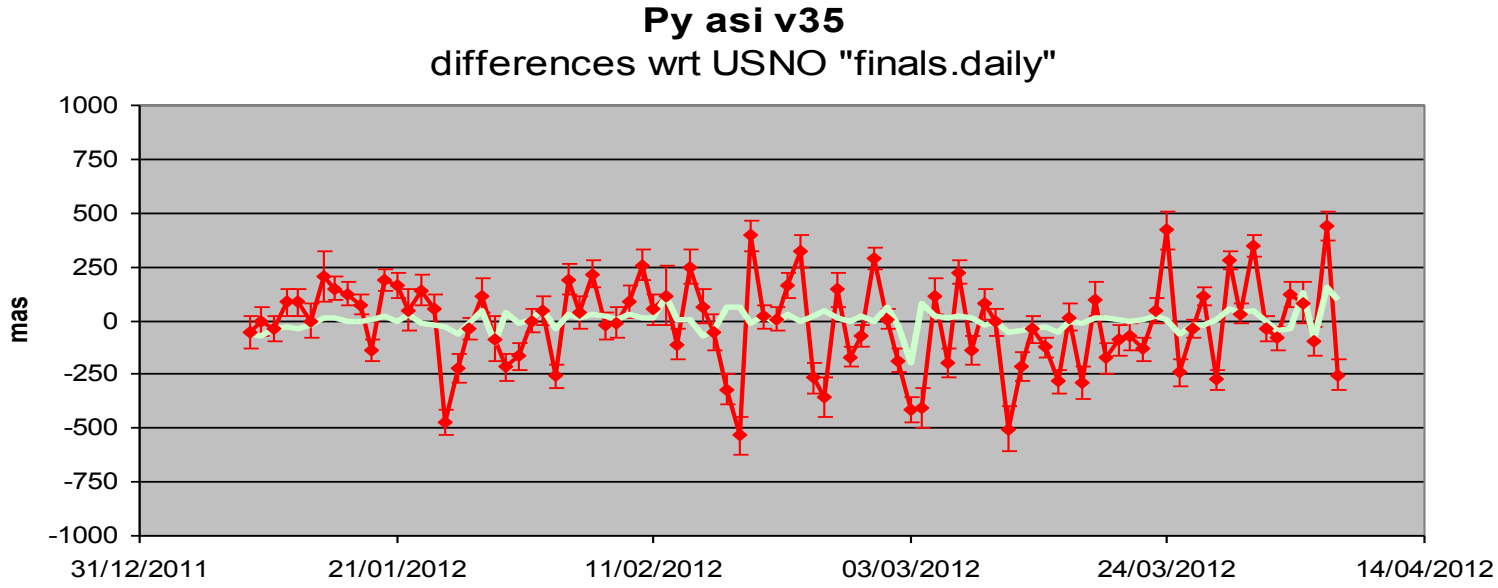

LOD ilrsa v30
differences wrt USNO "finals.daily"
150
100
50
0
-50
-100
-150
ms
rms(σv30) = 11ms
rms(σv35) = 11ms
rms(diff avev35-v30) = 10ms
rms(diff stdv35-v30) = 5ms
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

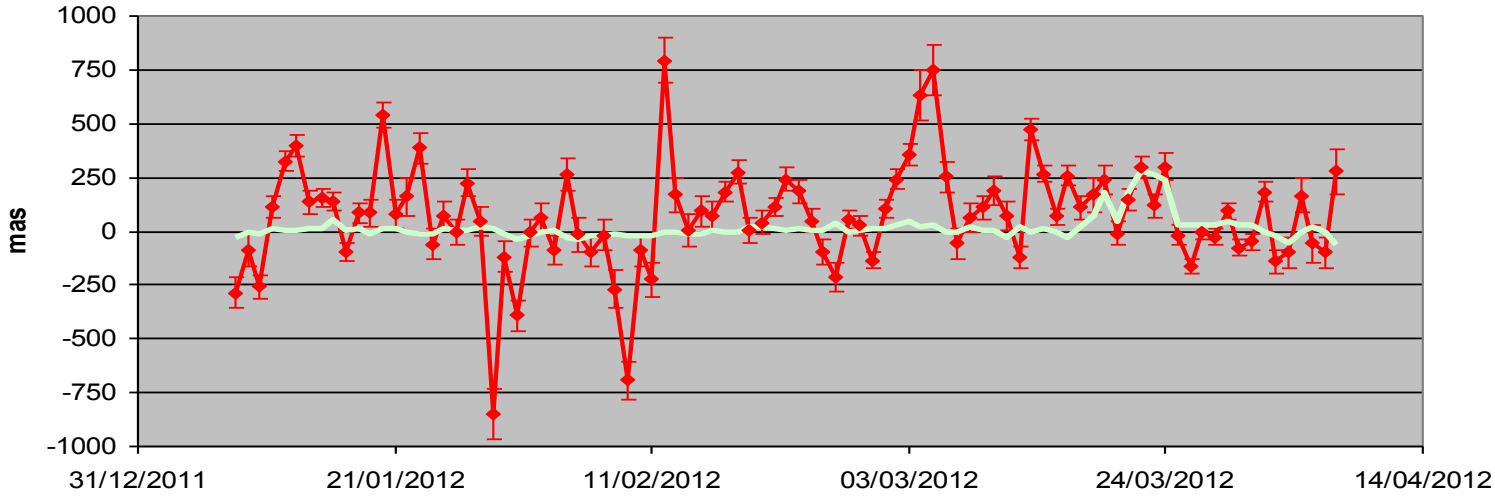
		V30 EOP vs USNO				V35 EOP vs USNO			
		average of diff	std of diff	rms of diff	rms of σ	average of diff	std of diff	rms of diff	rms of s
Px (mas)	asi	59	195	**204**	71	68	198	**209**	71
Py (mas)		-6	220	**220**	68	-15	206	**206**	70
LOD (ms)		-3	62	**62**	14	-10	53	**54**	14
	bkg	55	239	**246**	65	71	244	**254**	65
		-23	243	**244**	64	1	231	**231**	63
		-26	55	**61**	10	-26	47	**52**	10
	dgfi	46	269	**273**	49	40	269	**272**	48
		146	243	**284**	47	202	267	**335**	48
		16	73	**75**	9	21	77	**80**	9
	esa	88	164	**186**	75	40	165	**170**	74
		62	245	**253**	70	-8	230	**230**	69
		-21	54	**58**	14	-28	53	**60**	14
	ga	115	257	**282**	189	91	235	**252**	194
		79	245	**257**	128	65	259	**267**	136
		0	0	**0**	0	0	0	**0**	0
	gfz	15	332	**332**	102	20	334	**334**	102
		28	320	**321**	101	36	326	**328**	101
		87	157	**179**	39	86	159	**181**	39
	grgs	38	202	**206**	65	24	210	**212**	66
		24	243	**244**	63	25	248	**249**	63
		-10	59	**60**	14	-10	56	**57**	14
	jcet	88	171	**192**	60	61	283	**290**	156
		2	166	**166**	61	125	356	**377**	197
		-3	36	**36**	39	-18	59	**62**	38
	nsgf	-51	288	**292**	78	-75	253	**264**	75
		23	280	**281**	76	10	278	**278**	74
		24	97	**100**	33	145	87	**170**	32
	ilrsa	80	183	**200**	62	83	195	**212**	63
		5	181	**181**	60	0	192	**192**	61
		-10	45	**46**	11	-11	45	**47**	11

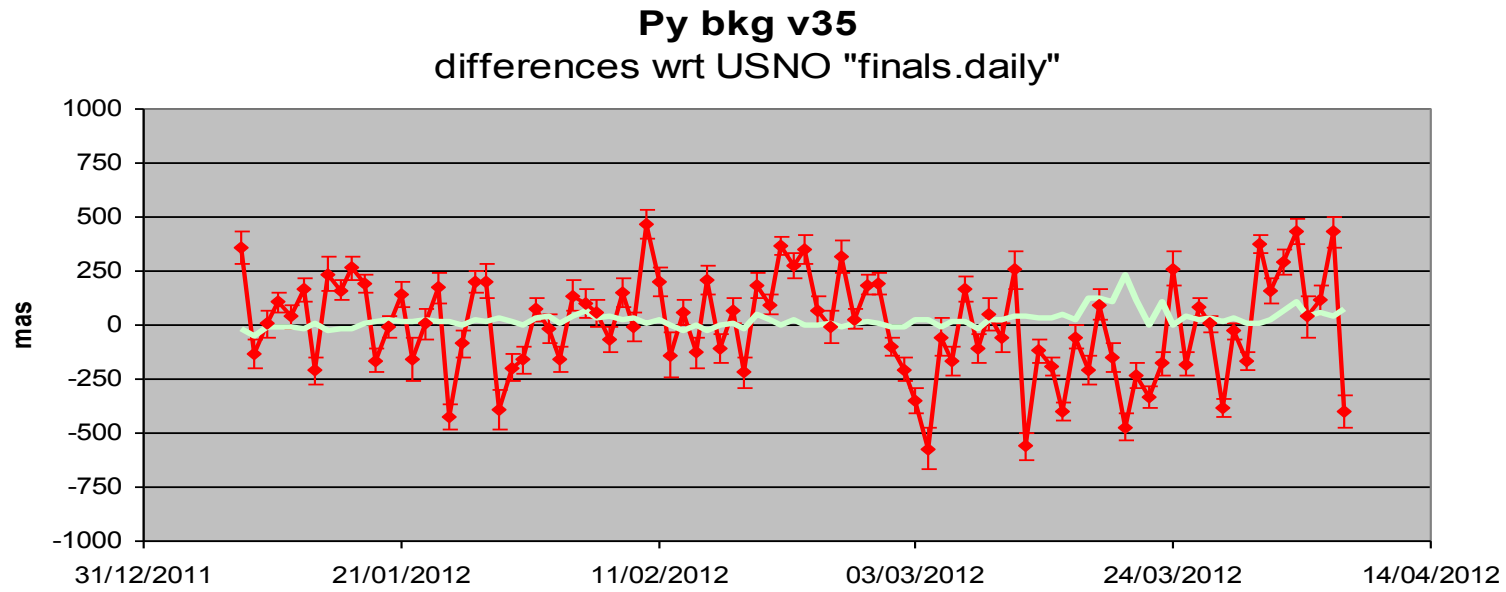
Final remarks

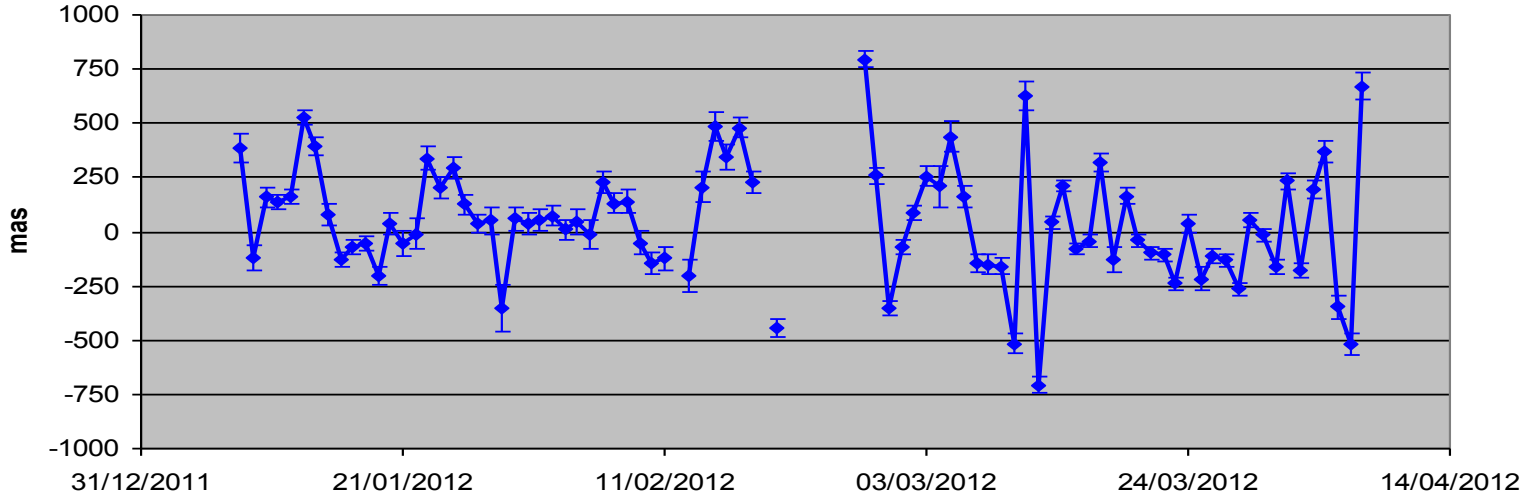
- New CoM: modest impact, difficult to measure on the combined solutions
- Single AC solution analysis maybe more effective

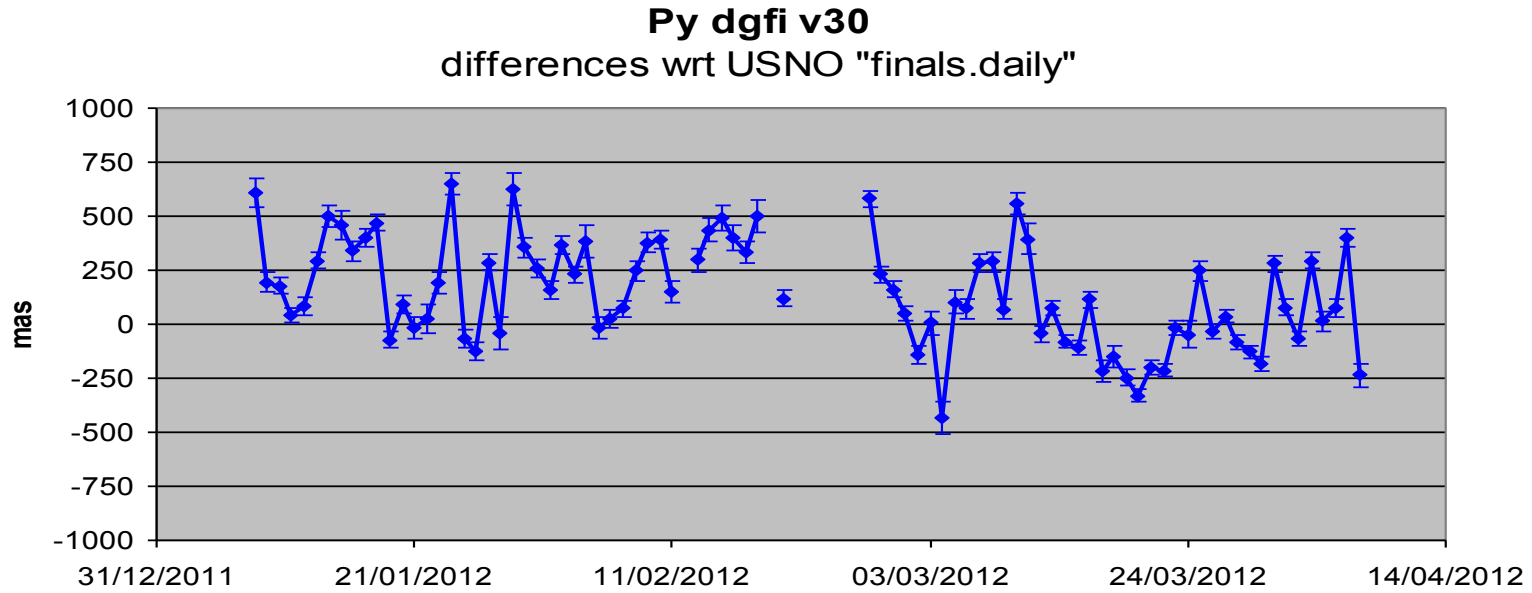

Px asi v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

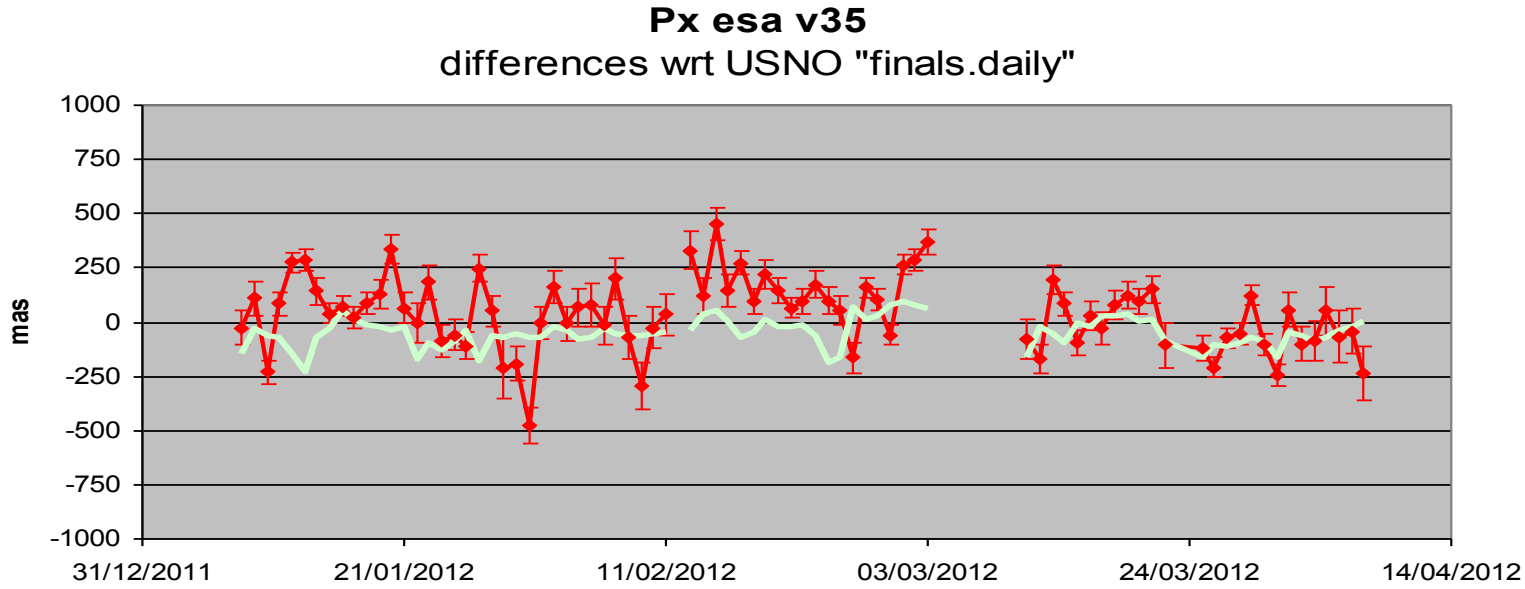

Py asi v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

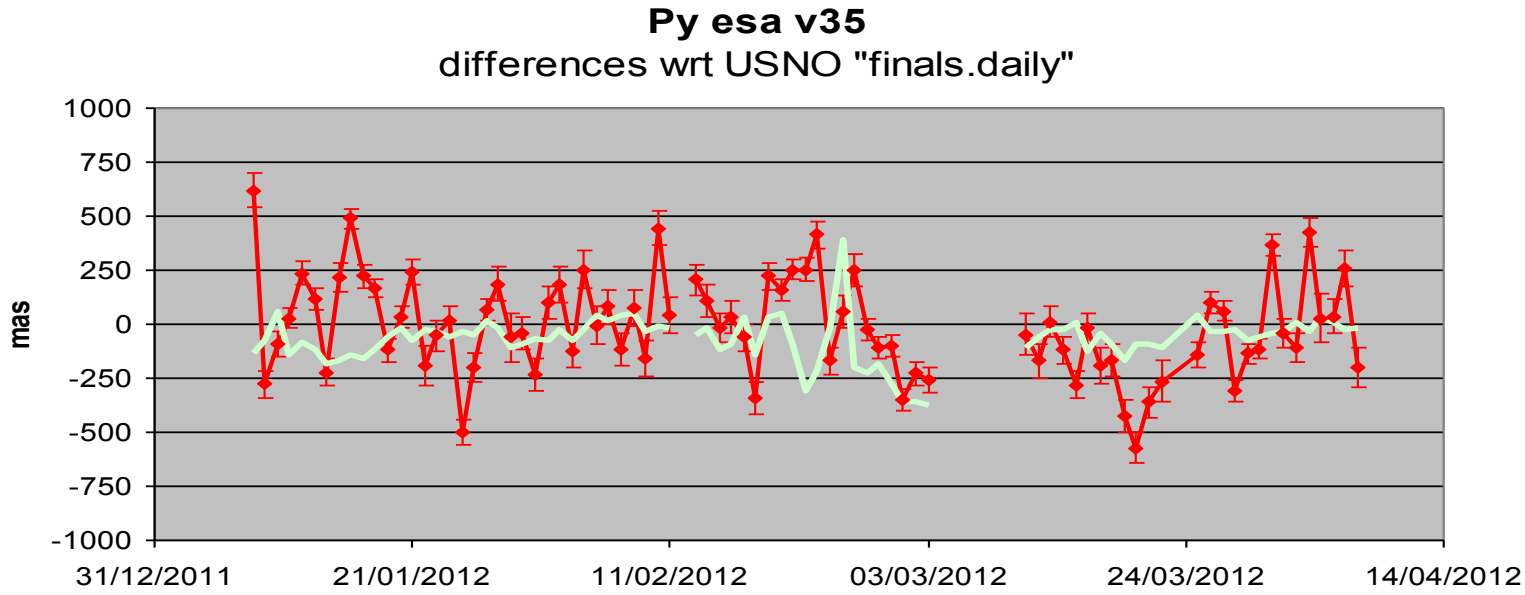

Px bkg v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

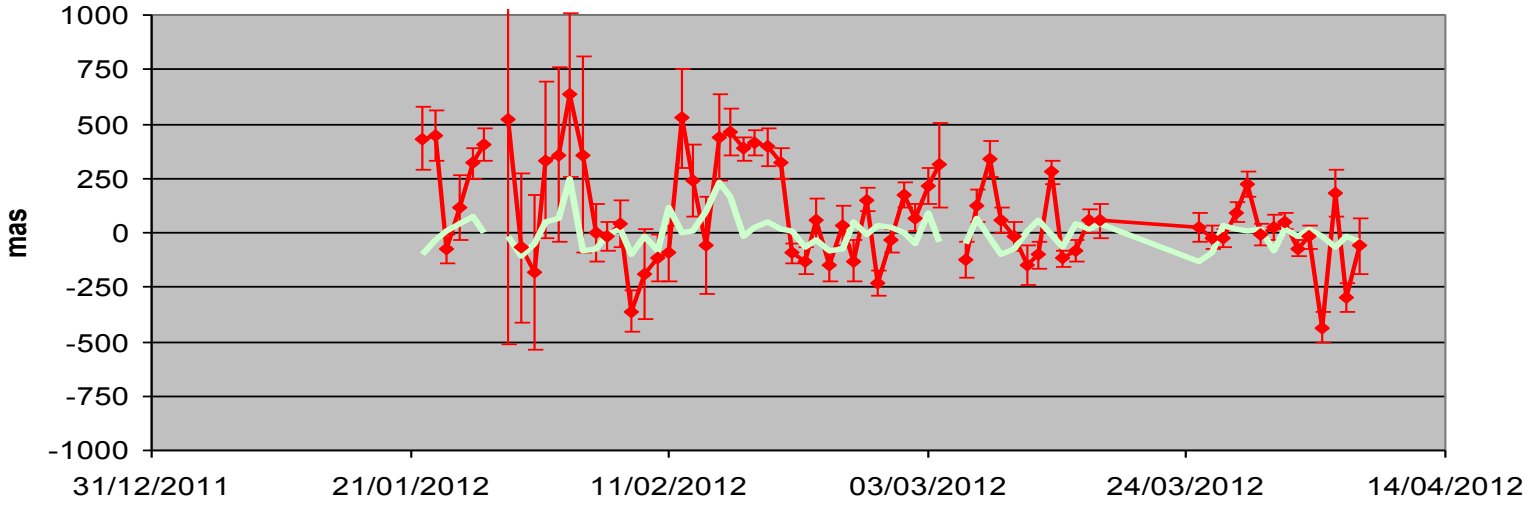

Py bkg v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

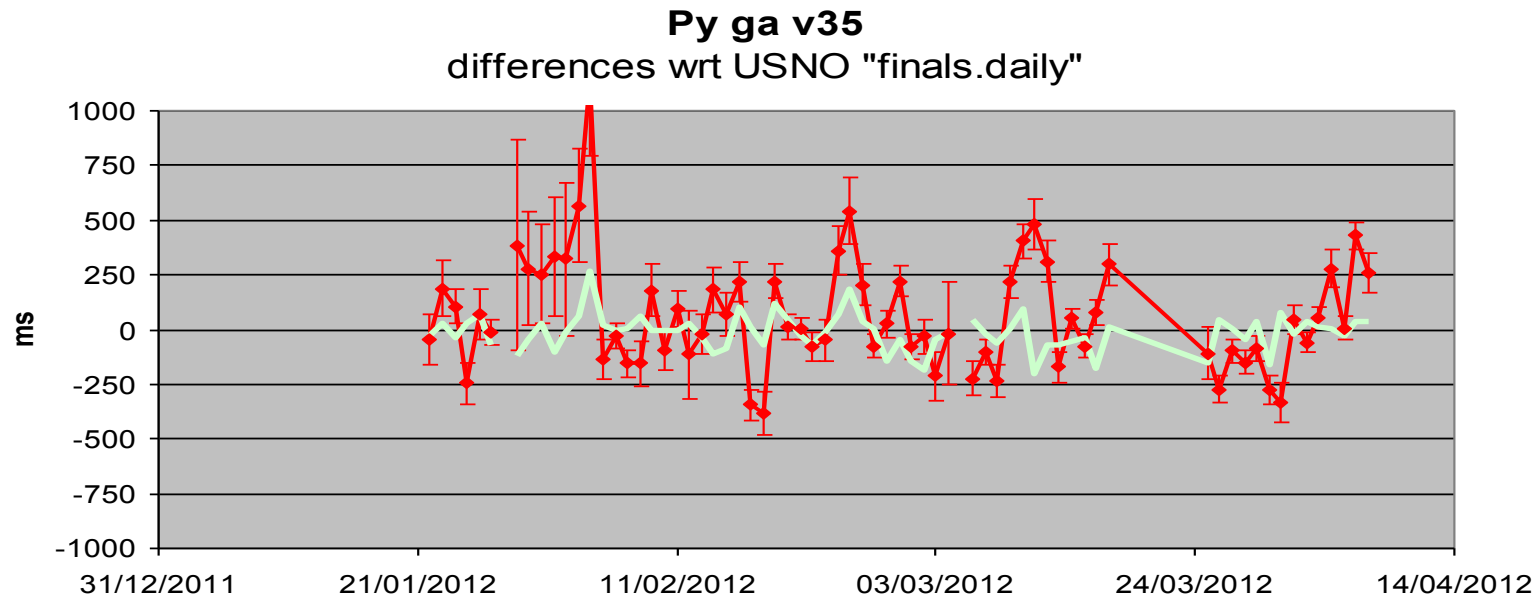

Px dgfi v30
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

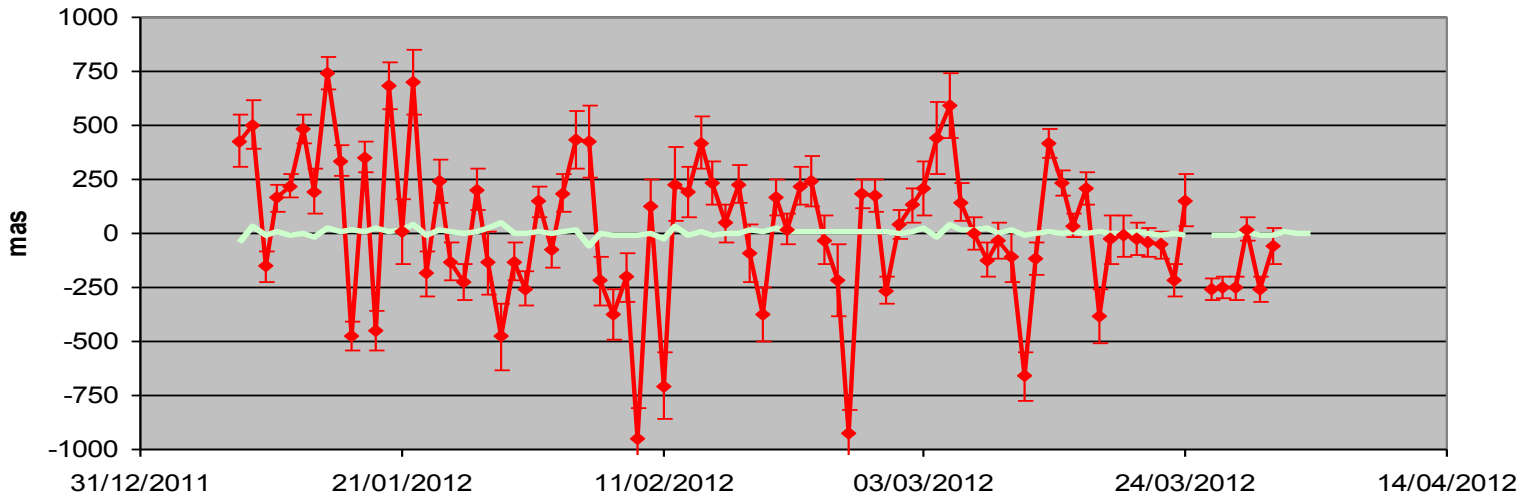

Py dgfi v30
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

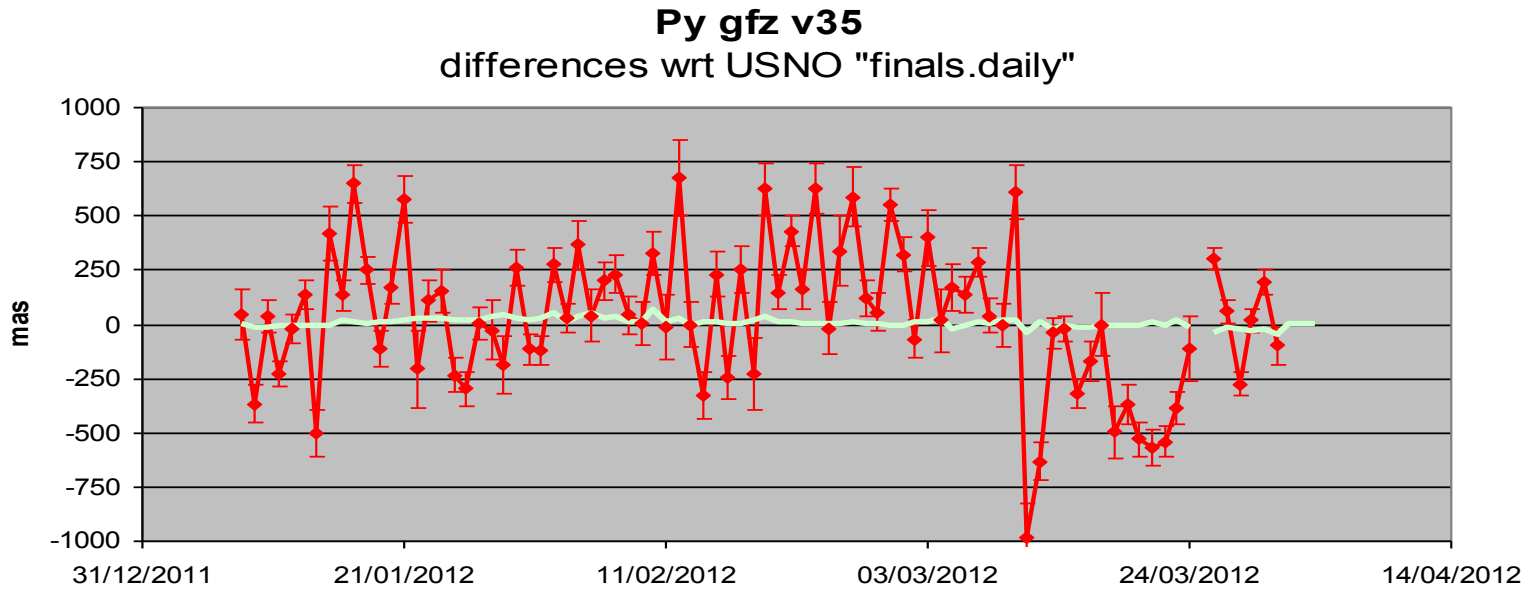

Px esa v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Py esa v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Px ga v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Py ga v35
differences wrt USNO "finals.daily"
ms
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Px gfz v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Py gfz v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
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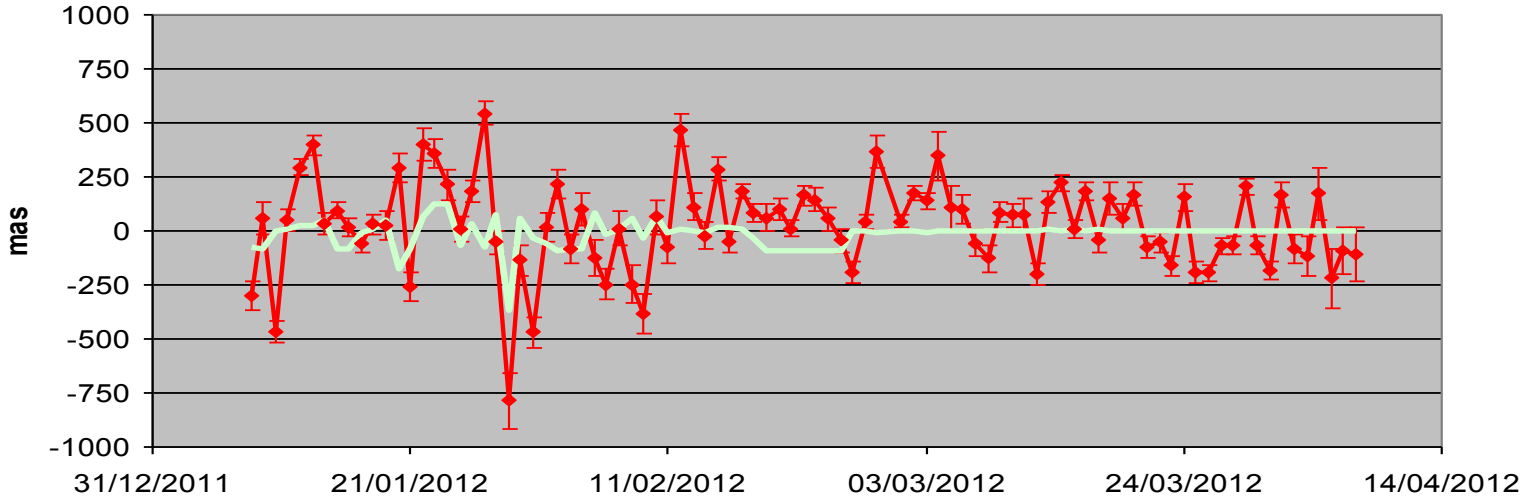
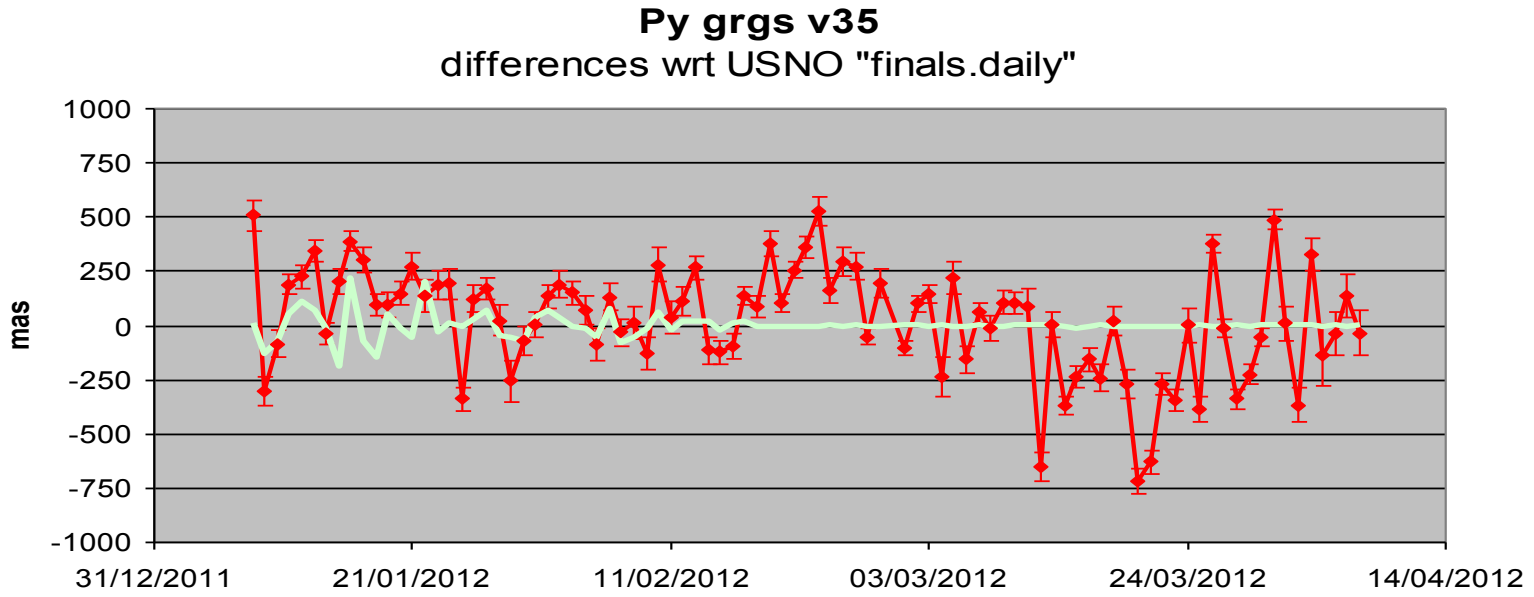
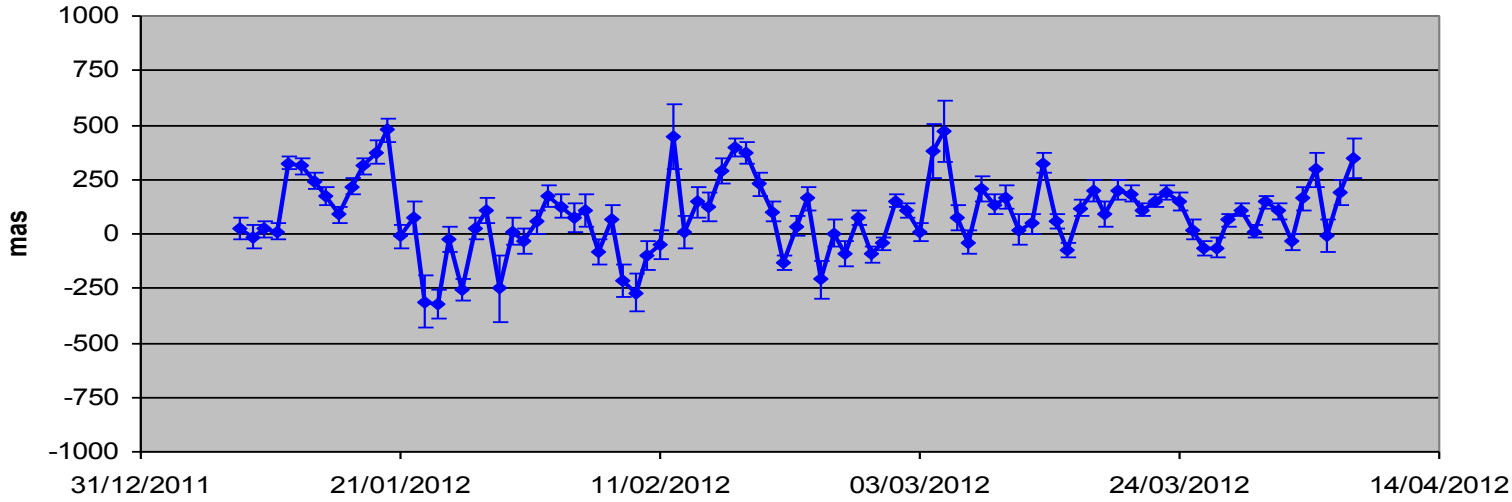
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Px grgs v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Py grgs v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


Px jcet v30
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
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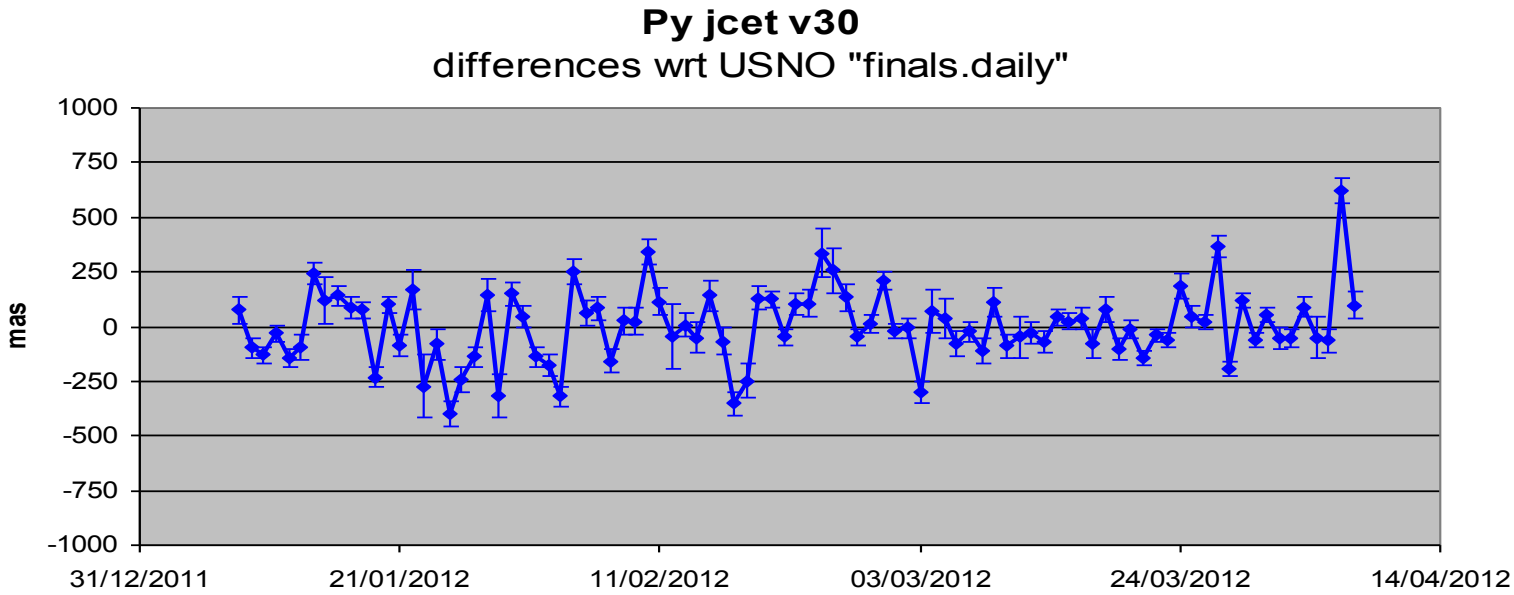
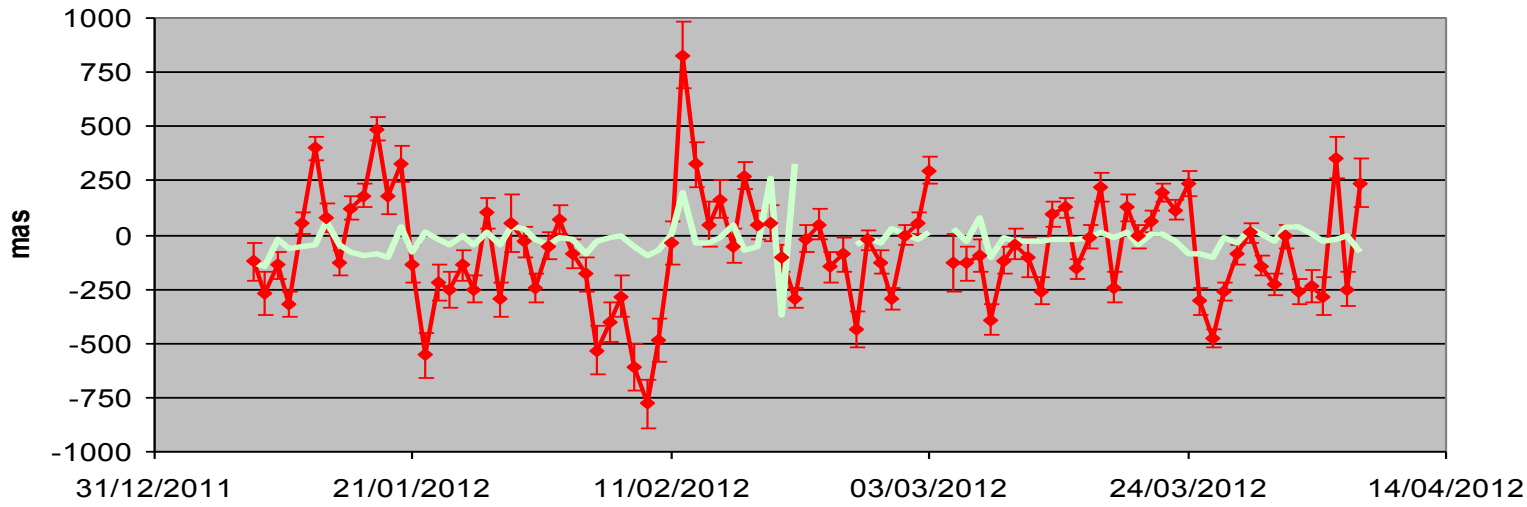
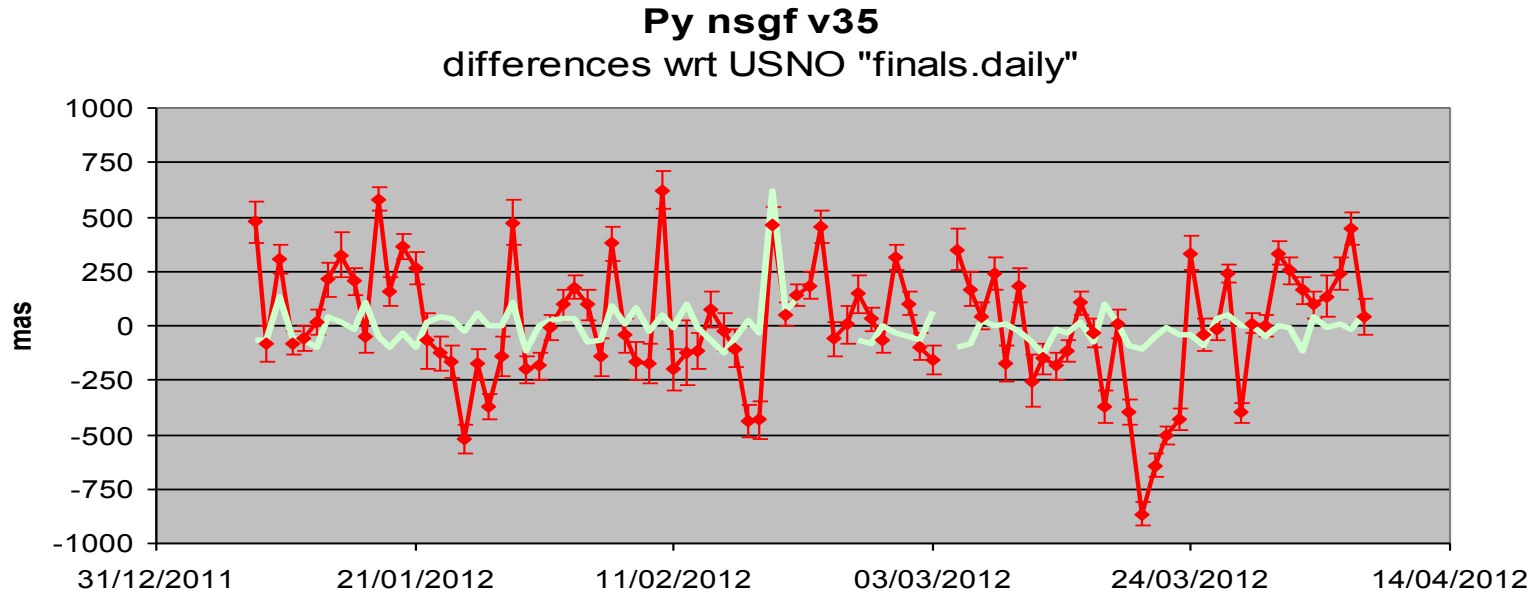
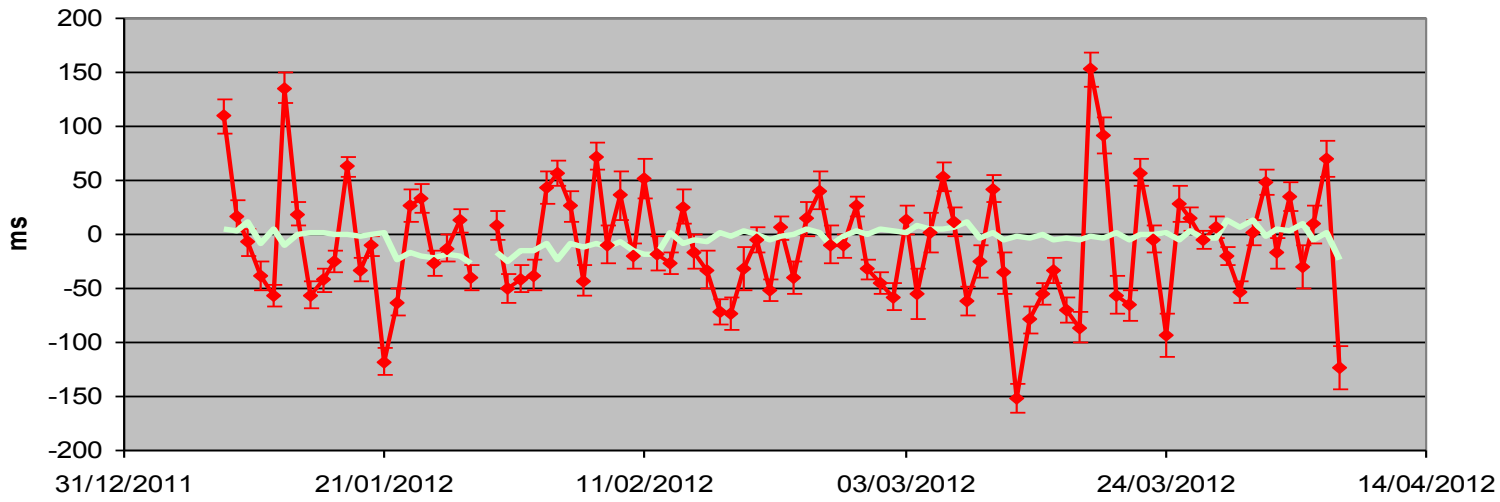
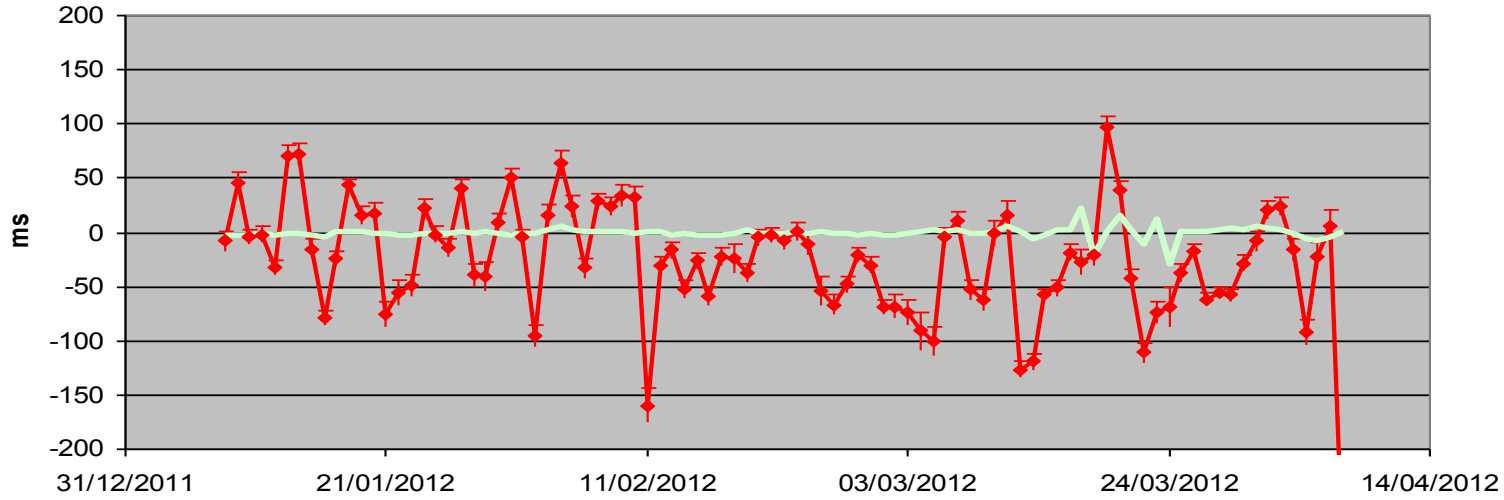
11/02/2012
03/03/2012
24/03/2012
14/04/2012

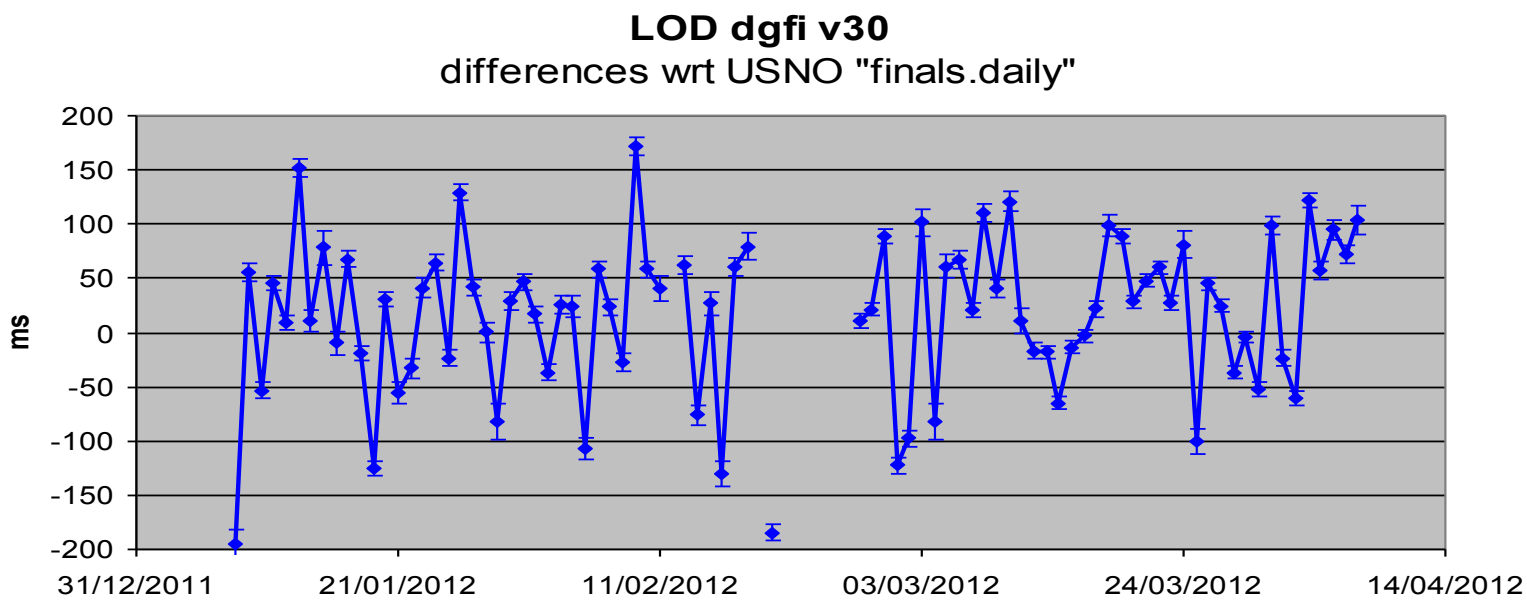

Py jcet v30
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

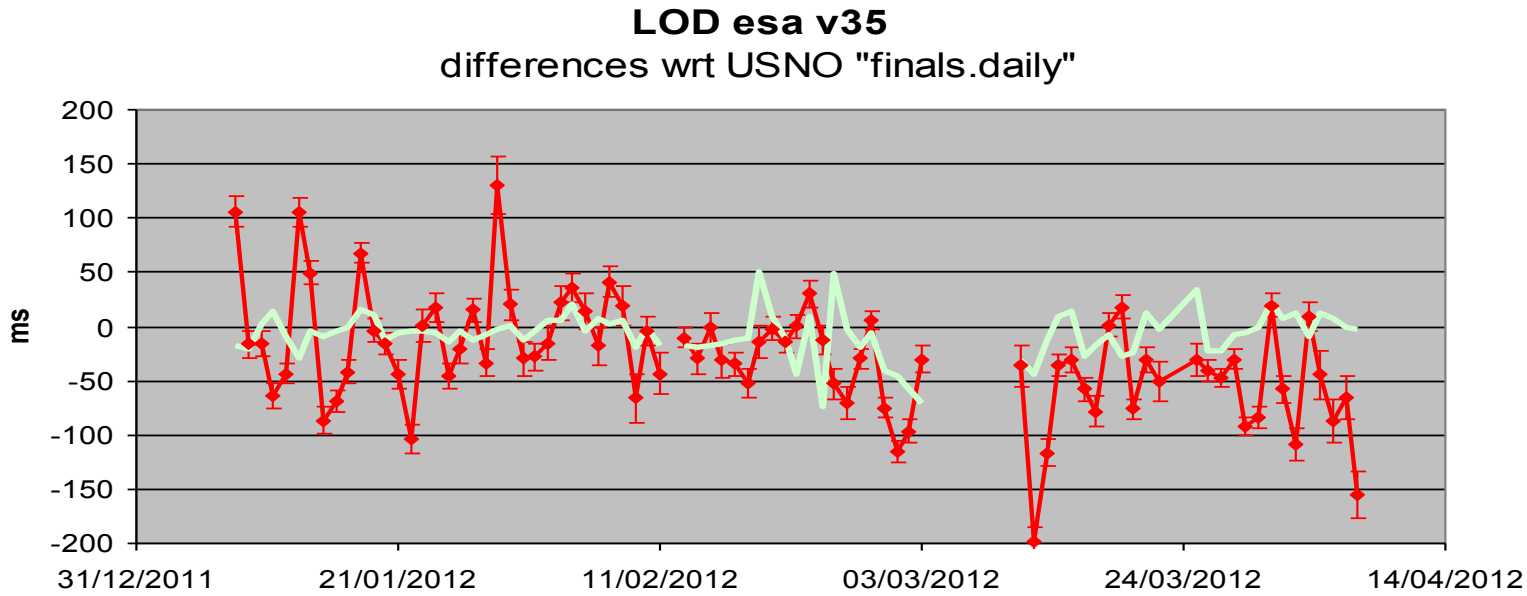

Px nsgf v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

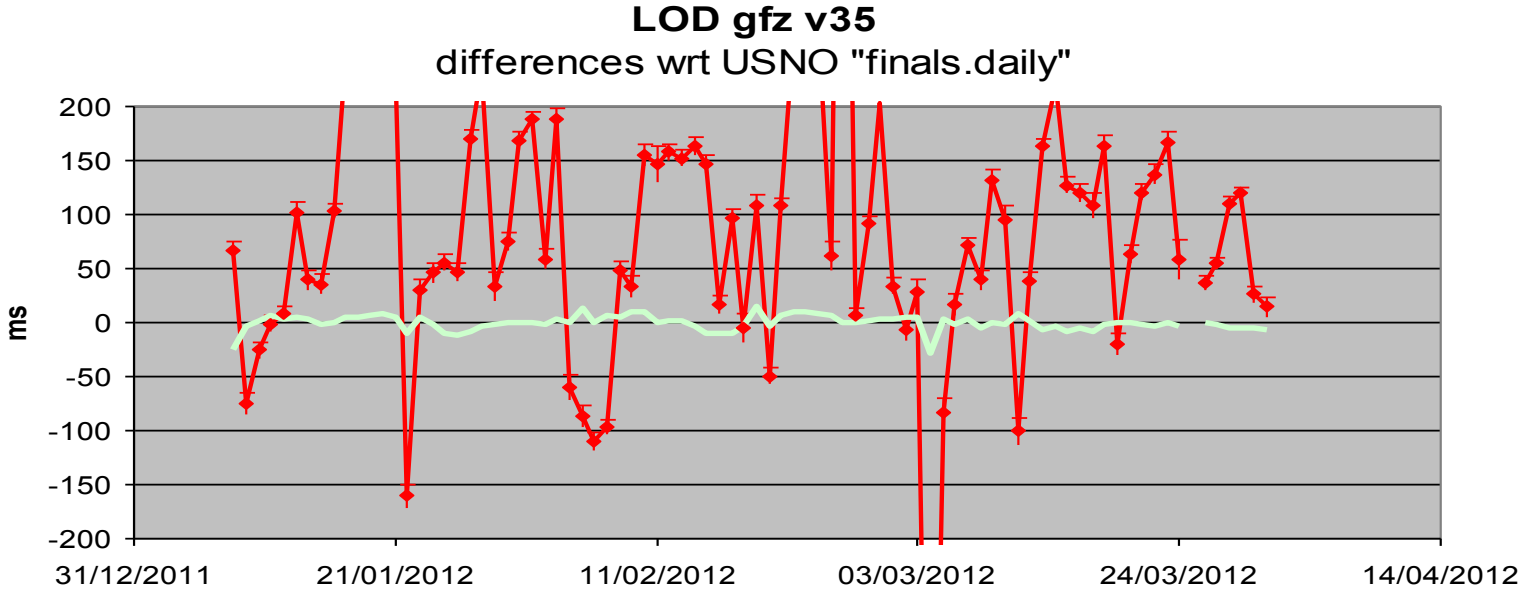

Py nsgf v35
differences wrt USNO "finals.daily"
mas
1000
750
500
250
0
-250
-500
-750
-1000
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

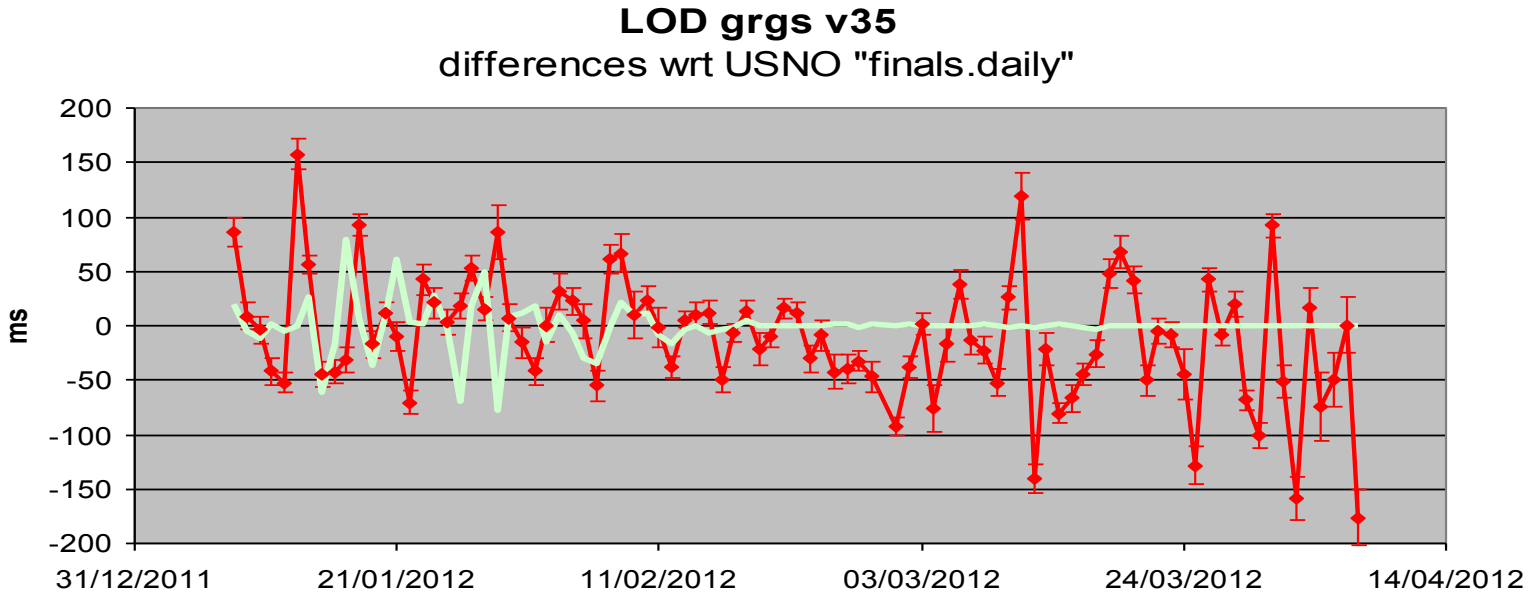

LOD asi v35
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

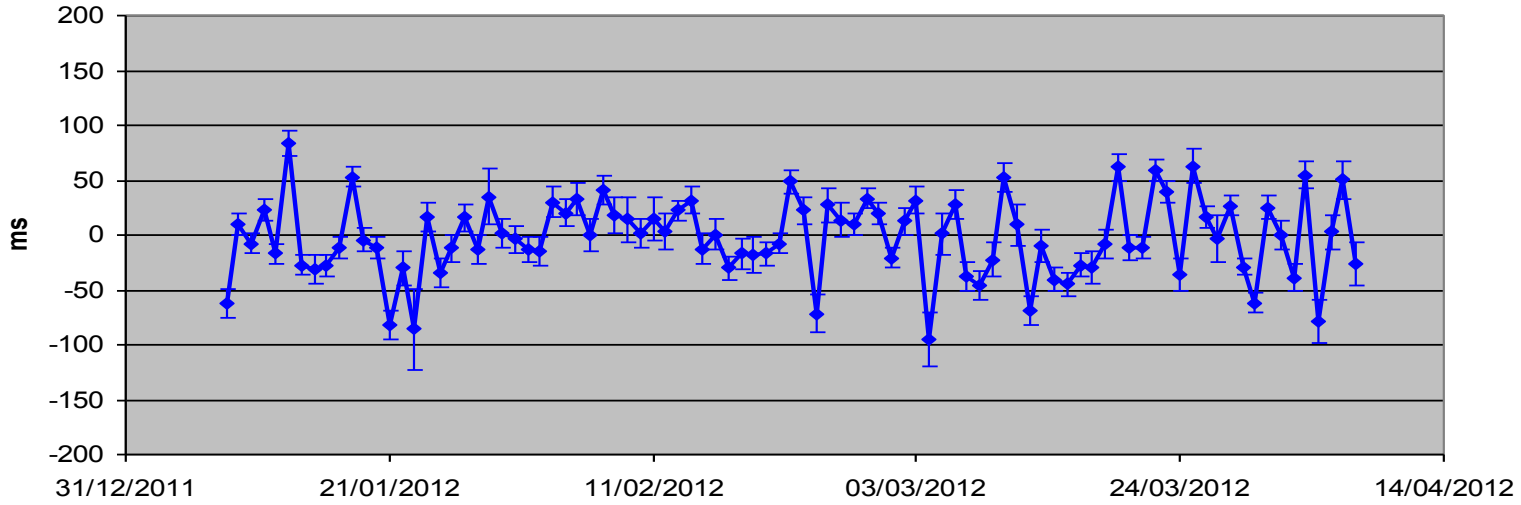

LOD bkg v35
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

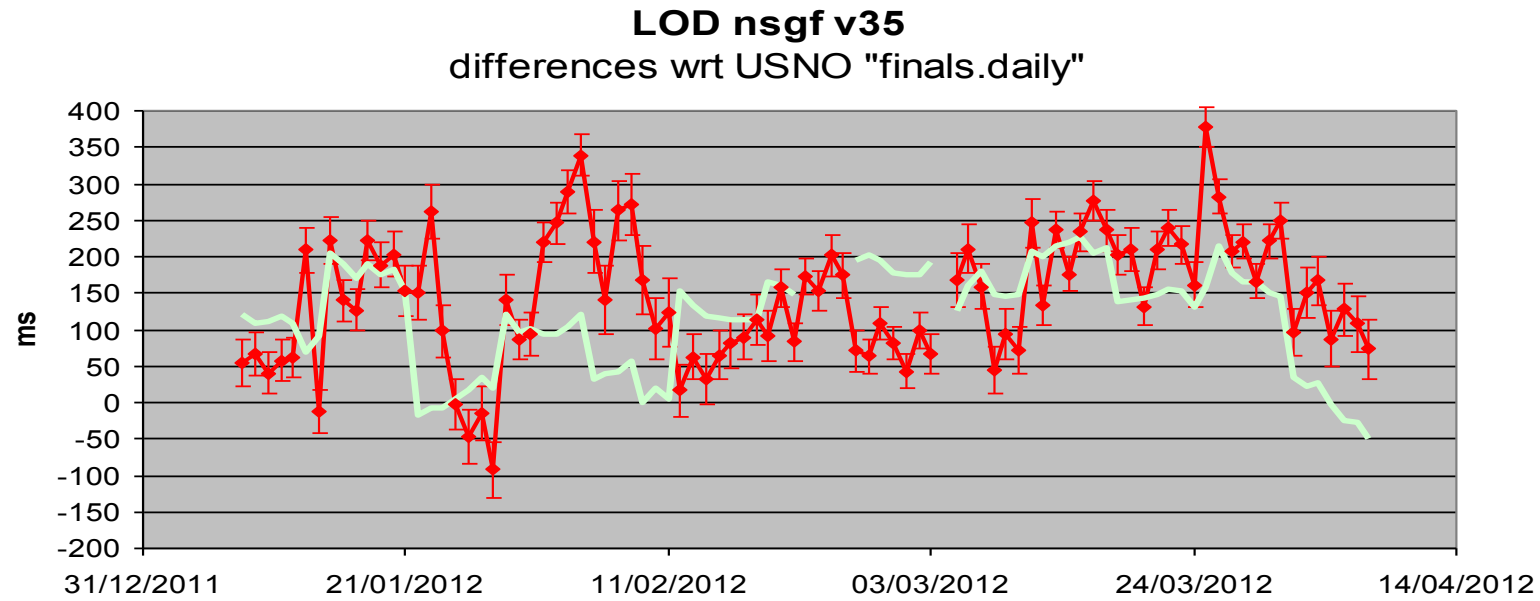

LOD dgfi v30
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


LOD esa v35
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


LOD gfz v35
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


LOD grgs v35
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


LOD jcet v30
differences wrt USNO "finals.daily"
ms
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012


LOD nsgf v35
differences wrt USNO "finals.daily"
ms
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
31/12/2011
21/01/2012
11/02/2012
03/03/2012
24/03/2012
14/04/2012

ILRS AWG April 2012

If DAILY is operational from now …

CRD OBS	**need: formal check of the data records by data centers** Problems 7825 in 2011 : 10^5 * rec „20“ , no Hh8/9 (?) 1887,… quarantine stations Data Center should take out corrupted passes H1-H8
	last minute start of calculations to catch observations „amap“ hence, no chance to have a look at solutions before uploads CRD_routine not prepared for extraordinary problems ->STOP
EDC=CDDIS	mirroring daily at 0.00 UTC (?) CRD daily, equivalent from…to UTC ? QLD ~ ~ ? **Repros:merge files necessary** ?
CoM value	if new stations get operational : LAGEOS 251 cm ?
Data Handling Data Discont.	automatic file update if remote file (DGFI) is newer new RELEASE Datum signalizes to make an update

ILRS intra-technique Combination – input for refined TRF combination strategies developing at IGN, DGFI

Kutterer, Krügel, Tesmer IAG134, 2009:

Intra-technique solutions are considered as independent despite they are derived from identical observations data.

There is an impact of the operators and of the SW packages at different analysis centers ACs on the combined results.

Impact of identical observation data and OSI : operator-software impact on the quality measures of intra-technique combinations

regarded in operationel products: IVS-CC (6 ACs)

ILRS: future AC and ilrsa solutions …..

SINEX with Normal Equation (no datum)

llrsa (combined with VLBI(„OSI“) for TRF solution) …..

*more realistic precision measures by refined weighting („identical observations“)

*reduce random impact of the ACs (*OSI*)

Report of DGFI/AC

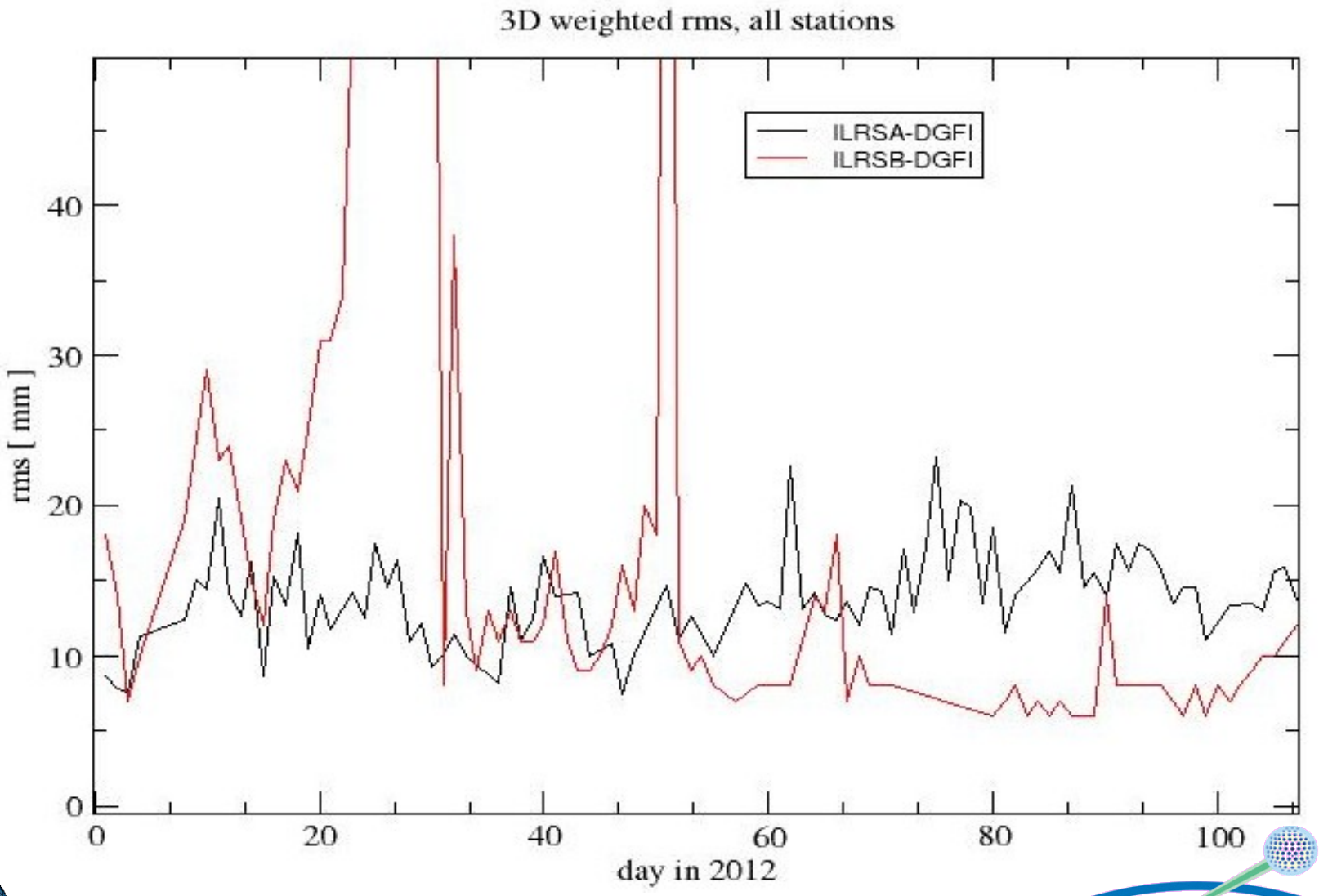
Horst Müller

Deutsches Geodätisches Forschungsinstitut, München
E-Mail: mueller@dgfi.badw.de

Routine POS+EOP Solution

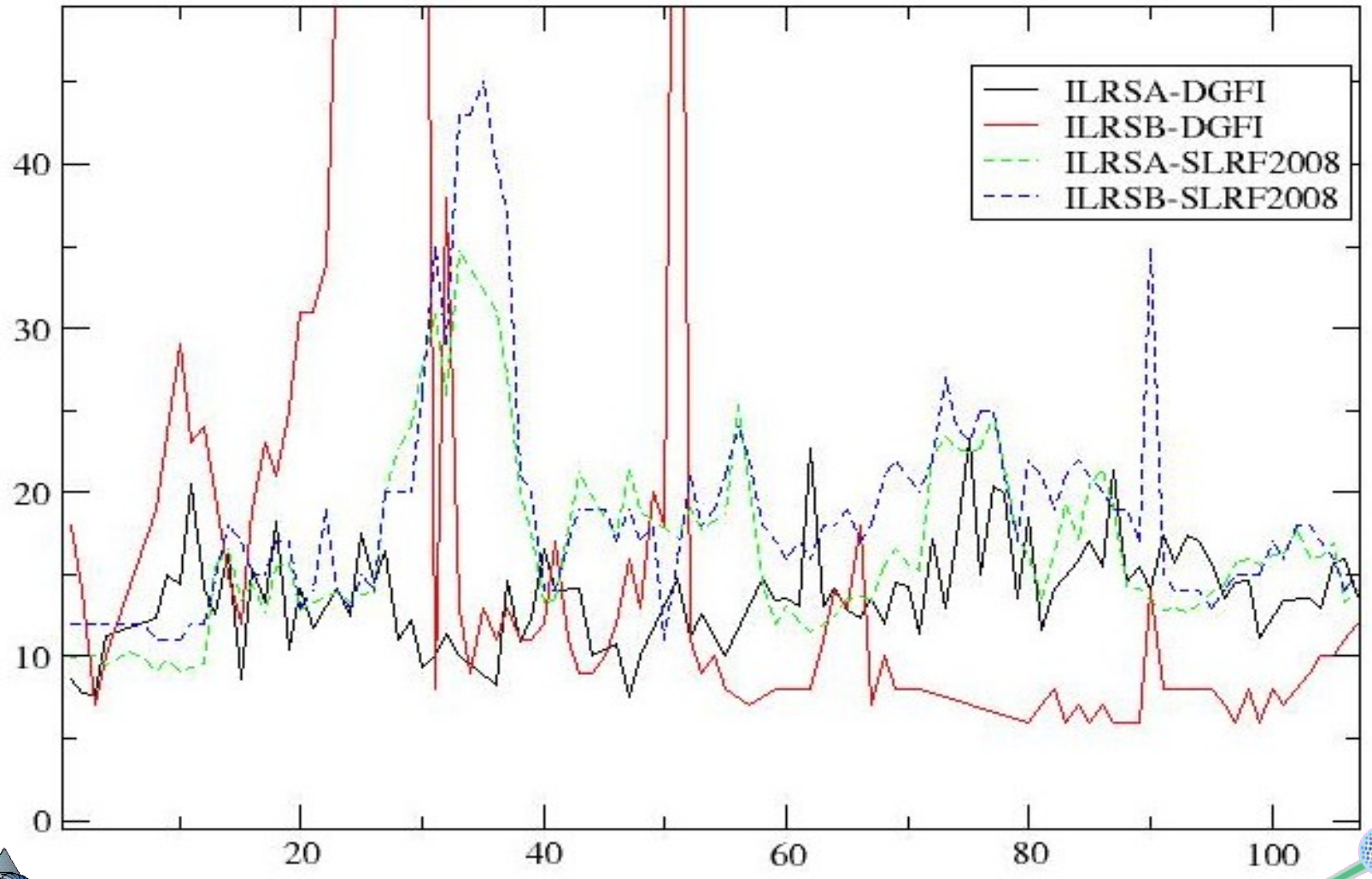
- Status
  - Solutions again submitted since Sep 19, 2011
  - Quality not very good, mainly for stations with biases
  - Difference between ILRSA and ILRSB
  - Still old eop interpolation scheme
  - Testing of new DOGS version 5.2 finished with marginal differences to version 5.0
- Future Plans
  - New Version DOGS5.2 will be used together with CRD format (can be read in directly in version 5.2), more new features
- Comments

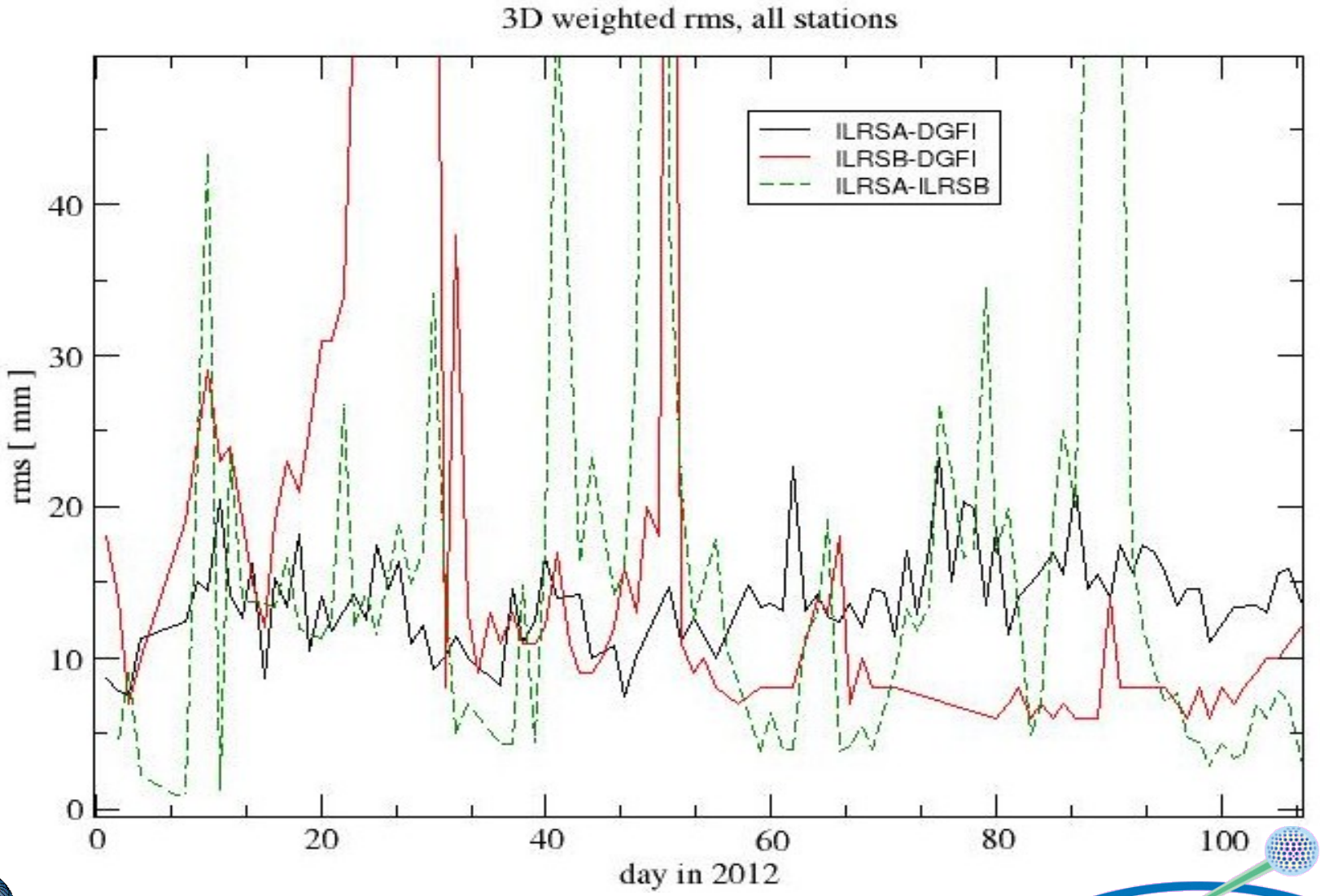
  Thanks to Cecilia, Keith and Erricos for testing new version



DGFI

International Laser Ranging Service


ILRSA-DGFI
ILRSB-DGFI
ILRSA-SLRF2008
ILRSB-SLRF2008
0
10
20
30
40
20
40
60
80
100



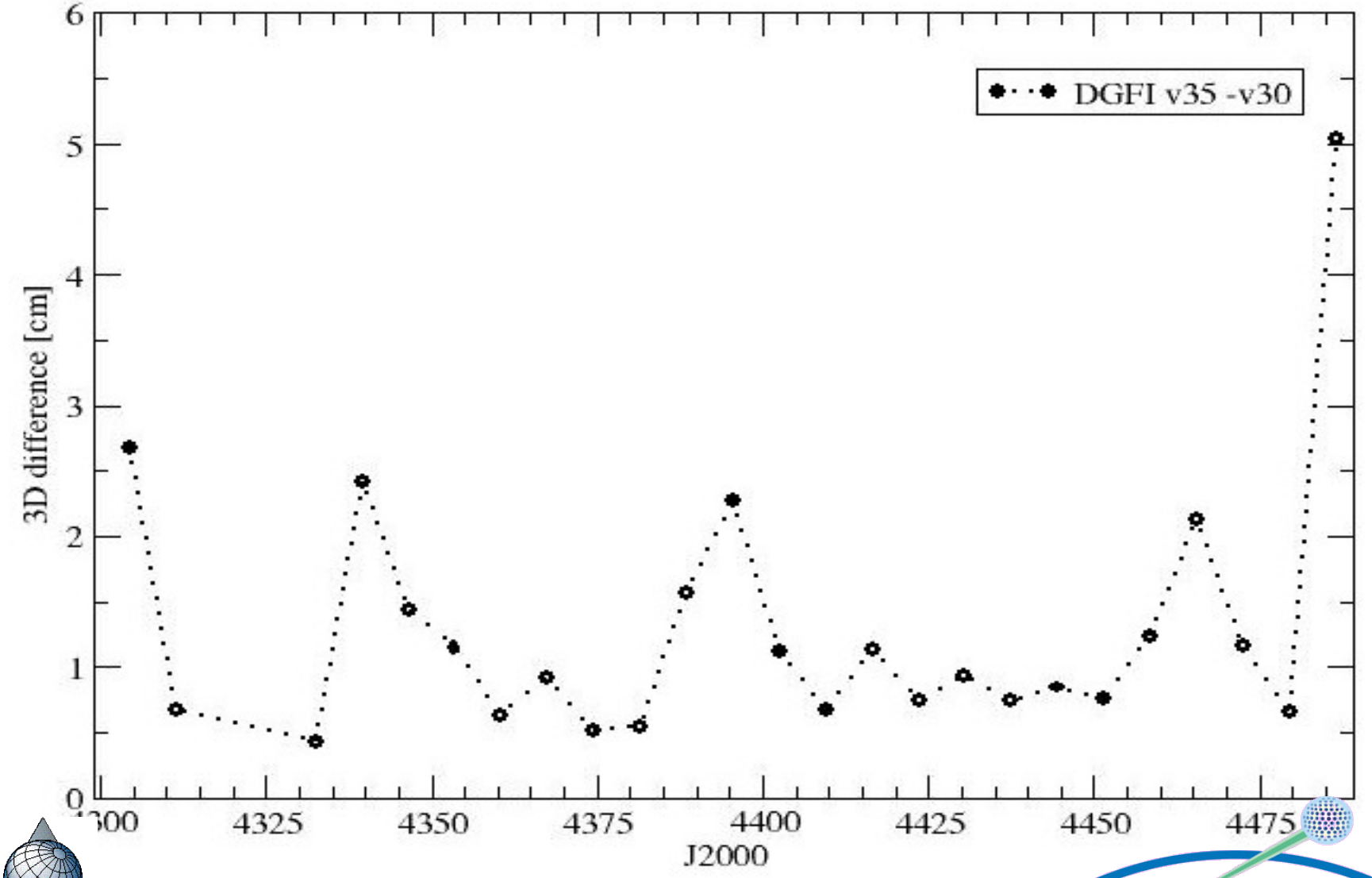
DGFI

International Laser Ranging Service

Version 35 new CoM

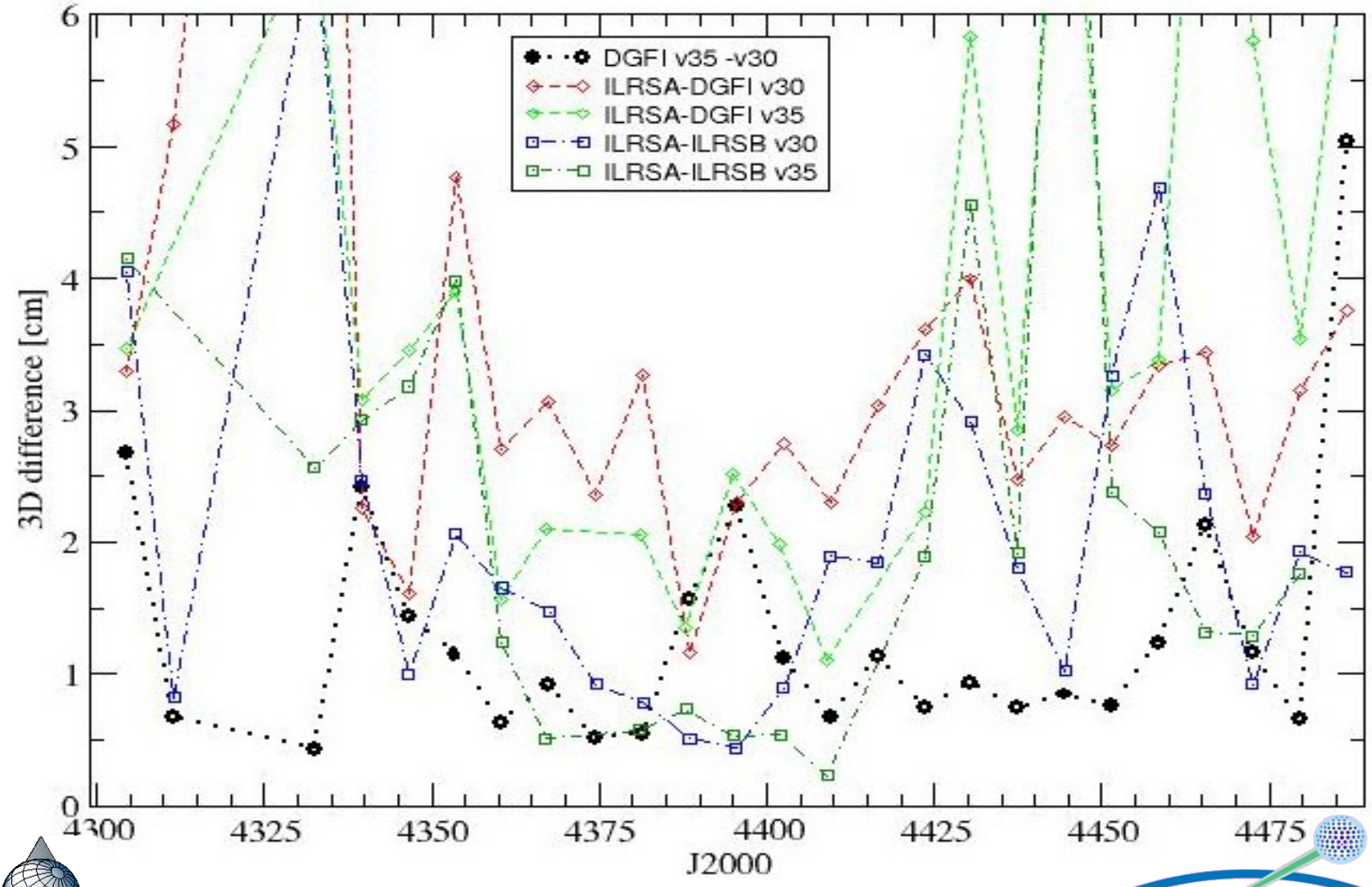
- Status
  - Delivered since Okt. 15. 2012
  - CoM not fully implemented, using station corrections
- Future Plans
  - New Version DOGS5.2, satellite, station and time dependent CoM implemented
- Comments

  3D difference between version 30 and 35 is little more than 1cm



DGFI

International Laser Ranging Service


DGFI v35 -v30
ILRSA-DGFI v30
ILRSA-DGFI v35
ILRSA-ILRSB v30
ILRSA-ILRSB v35
3D difference [cm]
J2000
0
1
2
3
4
5
6
4300
4325
4350
4375
4400
4425
4450
4475

SP3 Orbits

- Status
  - Solutions again submitted since Nov. 11, 2011
  - Fixed to SLRF2008 and C04 / finals daily
- Future Plans
  - New Version DOGS5.2 same
- Comments

  Orbits in loose constraint orbits not yet possible

CRD data

switch between QL NP and CRD data is possible
CRD data used only for testing and bias estimation

Only QL NP are delivered from
- Riga 1884
- San Juan 7406

Only CRD are delivered from Russian stations
- Svetloe 1888
- Zelenchukskya 1889
- Badary 1890

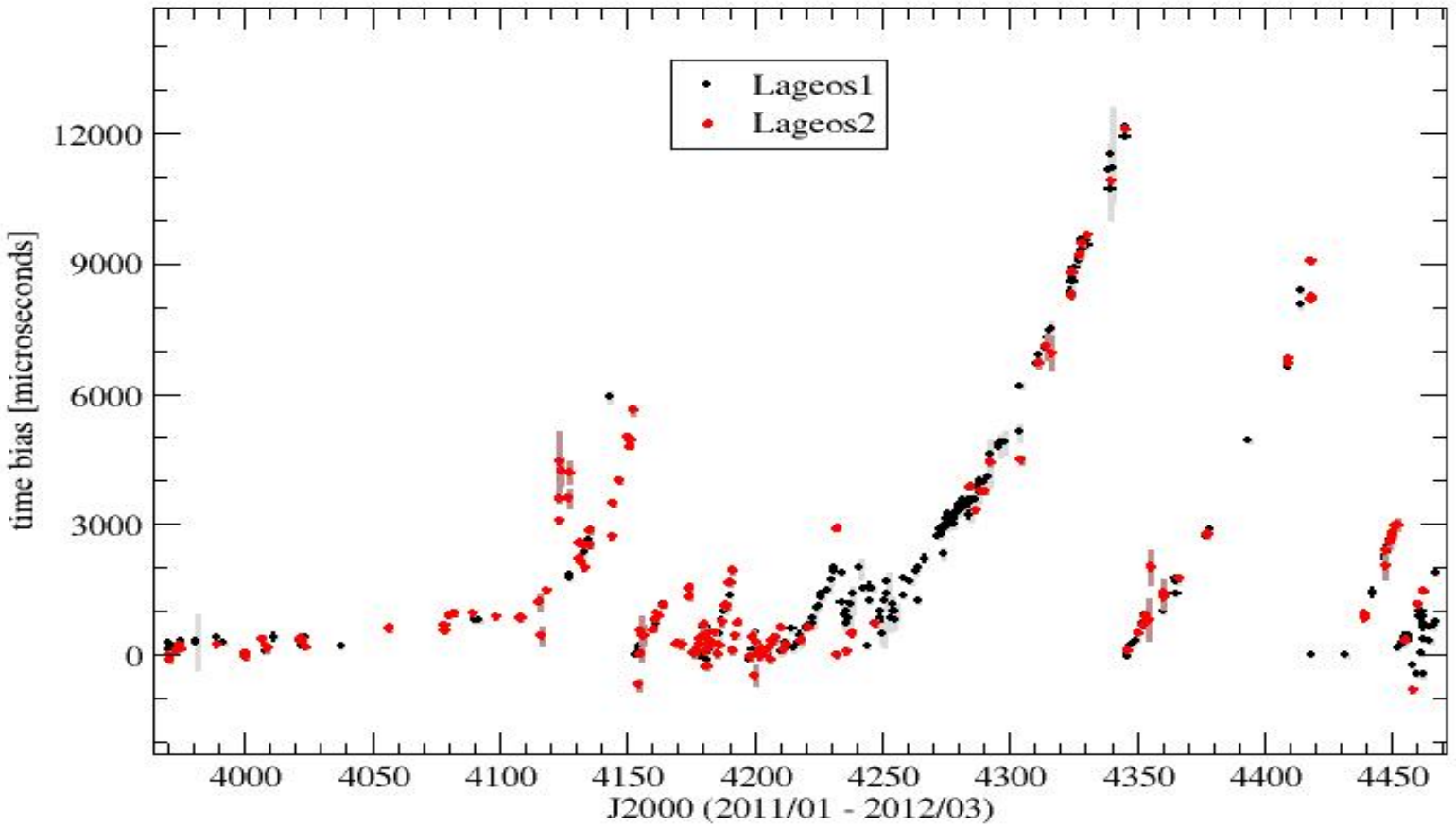
Data Handling File

- Status
  - Updated lately April 12, 2012, Arequipa, Monument Peak
  - Needs to be updated more often
- Candidates
  - Simeiz, time bias
  - Concepcion, station velocity
  - San Juan
  - …..
- Comments
  - More frequent update seems resonable
  - Who updates?
  - Biases?
  - Weighting of biases?

DGFI

GGE

Simeiz time bias



Rapid Service Mail

- Established after Bad Koetzing AWG-meeting
- Presently 22 messages to stations (HITU,DGFI,JCET,CSR)
- few responses from stations

Available from:
http://rapidservicemail.dgfi.badw.de/
and via mailing list maintained by DGFI (mailman)

Header:

```
*********************************************************************************
ILRS/AWG Rapid Service Mail  (HITU) 1873 up to 200 ms time bias Message No. 0006
*********************************************************************************
```

ILRS Analysis Working Group Meeting, Vienna, Apr. 21, 2012
New stations

Station	year	mm	dd	hh	mm		range-bias [cm]	sigma [cm]	prec.est. [cm]	no of observations	edit.	time-bias [microsec.]	sigma	
Arkhyz	2012	4	14	19	24	:	-0.97	0.43	1.78	10	0			1886
Svetloe	2012	4	9	19	21	:	-7.25	2.26	2.52	3	0			1888
Svetloe	2012	4	9	22	59	:	7.02	4.18	1.18	2	0	-107.00	28.18	1888
Svetloe	2012	4	15	18	13	:	1.43	5.23	0.72	2	0	97.30	25.24	1888
Badary	2012	4	9	15	24	:	-3.16	0.34	3.55	15	0	66.70	3.11	1890
Badary	2012	4	9	19	09	:	0.00	5.43	0.00	1	0	-239.00	45.21	1890
Badary	2012	4	11	16	15	:	5.28	0.36	4.14	15	0	67.00	2.87	1890
Badary	2012	4	14	15	38	:	2.25	0.39	3.76	12	0	67.70	3.19	1890
Badary	2012	4	15	14	15	:	-5.32	0.53	5.16	14	0	98.40	3.31	1890
Zelenchu	2012	4	8	20	39	:	4.64	0.70	2.78	5	0			1889
Zelenchu	2012	4	13	20	56	:	13.16	0.67	2.98	6	0	-24.00	7.73	1889

ILRS Analysis Working Group Meeting, Vienna, Apr. 21, 2012
Station Qualification

- Stations in quarantine and back to normal, lately
  - 7110 Monument Peak
  - 7403 Arequipa
  - 7119 Haleakala
  - 7249 Beijing
  - 7328 Koganai
  - 7358 Tanegashima
  - 7841 Potsdam
  - 7822 Tahiti
  - 1873 Simeiz, still in quarantine, can not be used
- New stations, not yet qualified
  - 1887 Baikonur, Kazakhstan
  - 1888 Svetloe, Russia
  - 1889 Zelenchukskya, Russia
  - 1890 Badary, Russia

- Information from ILRS page

  http://ilrs.gsfc.nasa.gov/stations/station_upgrades.html

This page needs to be machine readable, or an other page must informe the analysts on all stations under quarantine

DGFI

ILRS Analysis Working Group Meeting, Vienna, Apr. 21, 2012
Rapid Service Mail

Presently 24 Messages

- Delivering centers: HTSI,DGFI,JCET,CSR
- Partly response from stations

```
*************************************************************************
Rapid-Service-Mail Summary
*************************************************************************
  No# Date         From                                        Subject
    1 16/Jun/2011 |RapidServiceMail                          |ILRS/AWG Rapid Service Mail (HITU) 7249 -1 m
    2 21/Jun/2011 |RapidServiceMail                          |Wrong day for a Pass of Etalon2 11/06/14
    3 14/Jul/2011 |mueller@dgfi.badw.d                       |Wettzell 8834 degradation of SLR tracking data
    4 13/Jul/2011 |Toshimichi Otsubo                         |ILRS/AWG Rapid Service Mail (HITU) 8834 0.45 ms
    5 27/Jul/2011 |mueller@dgfi.badw.d                       |ILRS/AWG Rapid Service Mail (DGFI) 1873
    6 29/Jul/2011 |Horst Mueller                             |Rapid Service Mail (DGFI) 7080 1 sec time bias
    7 01/Aug/2011 |Toshimichi Otsubo                         |Rapid Service Mail (HITU) 1873 1 to 200 ms time
    8 01/Jun/0011 |Horst Mueller                             |Rapid Service Mail (DGFI) 7406 increasing time bias
    9 07/Sep/0011 |Toshimichi Otsubo                         |Rapid Service Mail (HITU) 7825 occasional range
   10 26/Sep/2011 |Horst Mueller                             |ILRS/AWG Rapid Service Mail (DGFI) 7941 time bias 0.5
   11 10/Nov/2011 |Toshimichi Otsubo                         |Rapid Service Mail (HITU) 1824 large range bias
   12 25/Nov/2011 |Horst Mueller                             |Simeiz Time Bias
   13 18/Dec/2011 |"Erricos C. Pavlis"                       |ILRS/AWG Rapid Service Mail (JCET) 7308
   14 18/Dec/2011 |"Erricos C. Pavlis"                       |Re: ILRS/AWG Rapid Service Mail (JCET)
   15 18/Dec/2011 |Toshimichi Otsubo                         |Re: ILRS/AWG Rapid Service Mail (JCET)
   16 19/Dec/2011 |Toshimichi Otsubo                         |Re: ILRS/AWG Rapid Service Mail (JCET)
   17 19/Dec/2011 |"Erricos C. Pavlis"                       |Re: ILRS/AWG Rapid Service Mail (JCET)
   18 12/Jan/2012 |Toshimichi Otsubo                         |ILRS/AWG Rapid Service Mail (HITU)
   19 13/Jan/2012 |Horst Mueller                             |[RapidServiceMail] No.19,
   20 01/Feb/2012 |Horst Mueller                             |ILRS/AWG Rapid Service Mail (DGFI) Large
   21 22/Feb/2012 |"John C. Ries"                            |Concepcion time bias
   22 09/Mar/2012 |Horst Mueller                             |Zimmerwald
   23 19/Mar/2012 |"Erricos C. Pavlis"                       |ILRS/AWG Rapid Service Mail (JCET) 7501
   24 18/Apr/2012 |Horst Mueller                             |1 Second time bias from McDonald
```

Status of ILRS Stations Engineering/Testing

(as of Wednesday, 11-Apr-2012 08:40:46 EDT)

This table summarizes the status of upgrades, repairs, and testing of stations in the ILRS network.

Site Name	Sta. No.	ILRS Code	Upgrade		SOD Update	Description	Quarantine Start	Data Released
			Start	End				
Lviv	1831	LVIV	Dec-2009			Laser repair		
Greenbelt	7105	GODL	Apr-2010	04-Dec-2010	No update	System down for operational issues	04-Dec-2010	20-Jan-2011
Haleakala, HI	7119	HA4T	19-Jun-2010	12-Jul-2010	No update	Laser upgrades	20-Jul-2010	07-Oct-2010
Haleakala, HI	7119	HA4T	01-Mar-2011	15-Mar-2011	71191402	Telescope repositioned	17-Jun-2011	04-Aug-2011
Beijing	7249	BEIL		15-Aug-2010	No update	Telescope servo and kHz laser upgrade; data taken from 09-Nov-2010 onward released	15-Aug-2010	02-Feb-2011
Koganei	7308	KOGC		15-May-2010	No update	Telescope repairs	15-May-2010	10-Aug-2010
Koganei	7328	KOGL	15-Jun-2010	31-Aug-2010	No update	Restart of operations	31-Aug-2010	20-Jan-2011

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International Laser Ranging Service

Tanegashima	7358	GMSL	02-Apr-2010	28-Jul-2010	No update	Telescope repairs	28-Jul-2010	20-Sep-2010
Arequipa	7403	AREL	05-Aug-2010	01-Oct-2010	74031306	Repair of mount tachometer	22-Sep-2010	12-Nov-2010
Borowiec	7811	BORL	25-Mar-2010			Laser repair		
Kunming	7820	KUNL		06-Apr-2010	No update	kHz laser upgrade	06-Apr-2010	
Tahiti (FTLRS)	7822	THTF	18-May-2011		78226901	Tahiti occupation	18-May-2011	16-Sep-2011
Potsdam	7841	POT3	24-Apr-2011	05-Sep-2011	No update	Laser repair/upgrade	05-Sep-2011	20-Oct-2011
Arequipa	7403	AREL	11-Oct-2011	24-Oct-2011	Yes	Laser upgrade, detector upgrade, MET 4 weather station, telescope refocusing	11-Oct-2011	10-Apr-2012
Riyadh	7832	RIYL	Jan-2010		No update	General system maintenance/repair	Oct-2011	

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International Laser Ranging Service

GRGS ILRS analysis center

Operational activities and research

AWG Meeting, Wien, EGU 2012

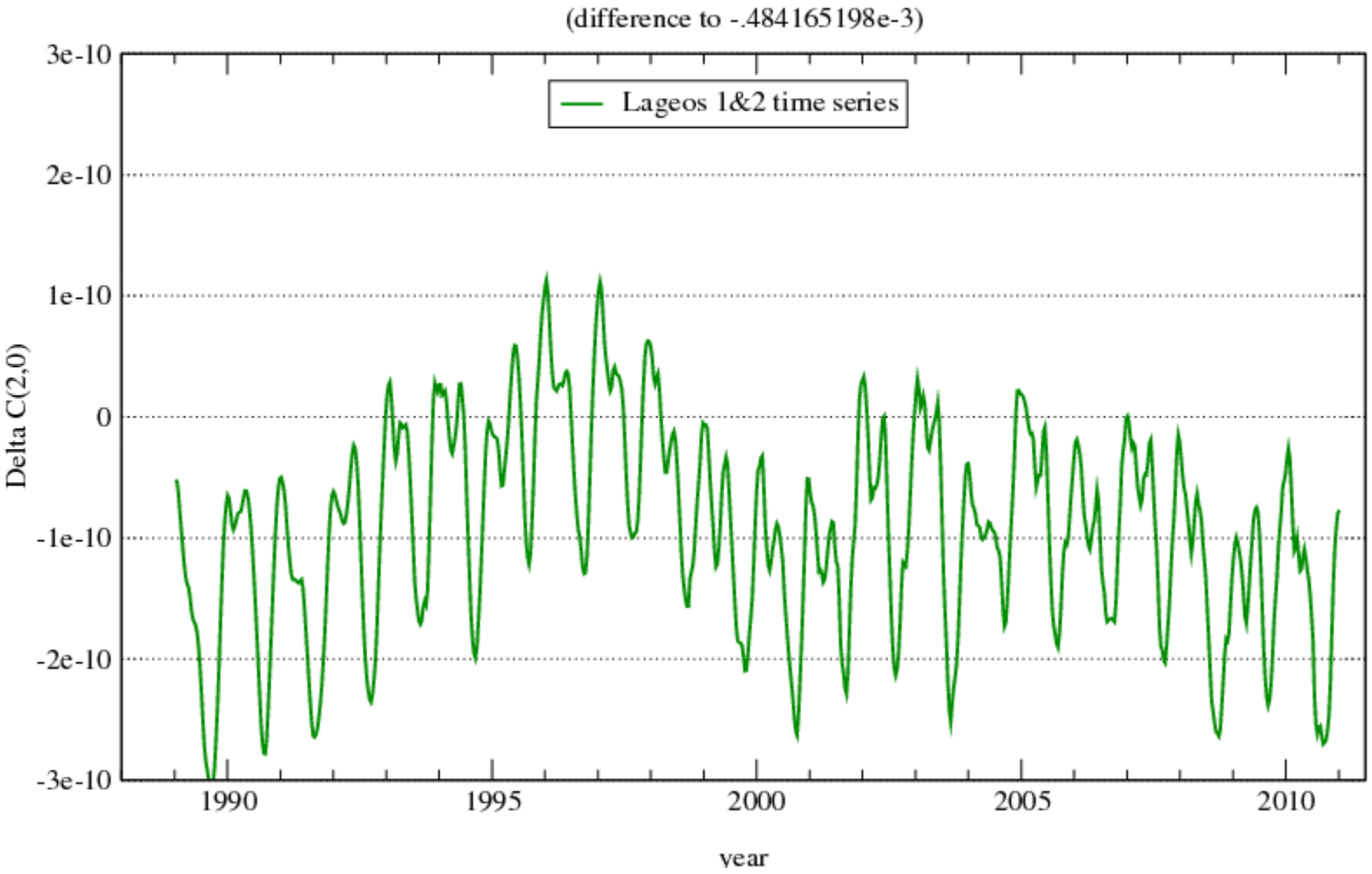
GRGS
GROUPE DE RECHERCHE DE GEODESIE SPATIALE

GRGS ILRS PROJECT STATUS

- Operational submissions:
  - Weekly « v30 »: ok
  - Daily « v130 »: ok
  - v35 now ok
- CRD implementation : ok
- Handling file . snx: now a input file in the operarional analysis scheme
- J2 time series : ok
- IERS 2010 conventions:
  - Ok in GINS
  - Not yet ok in the inversion s/w

GRGS
GROUPE DE RECHERCHE DE GEODESIE SPATIALE

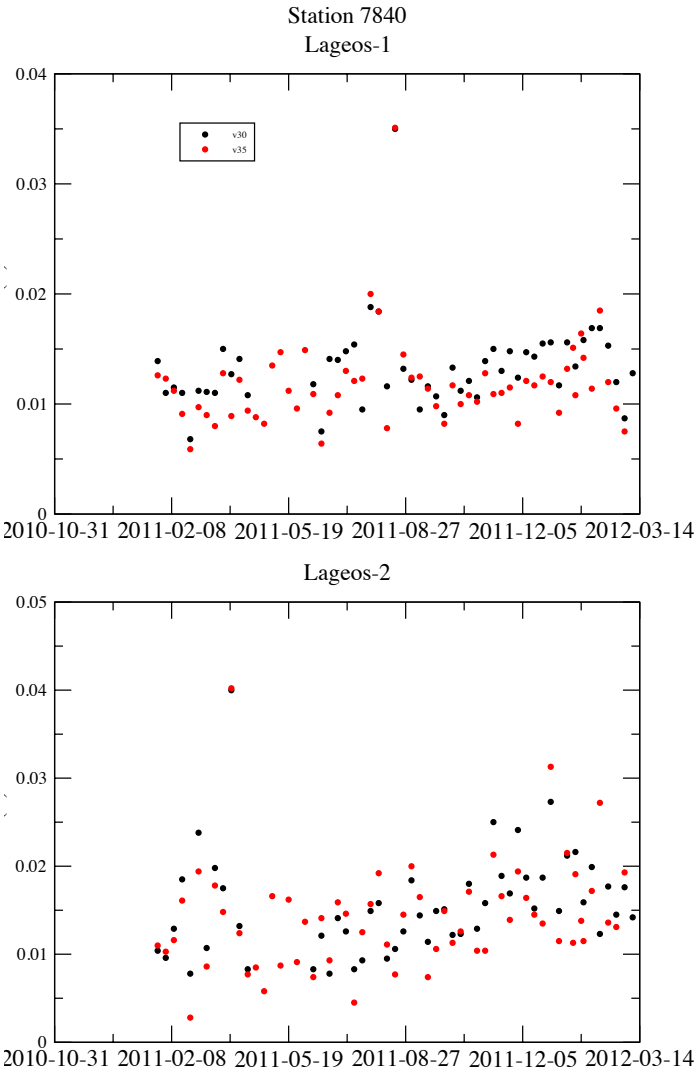
Gravity field



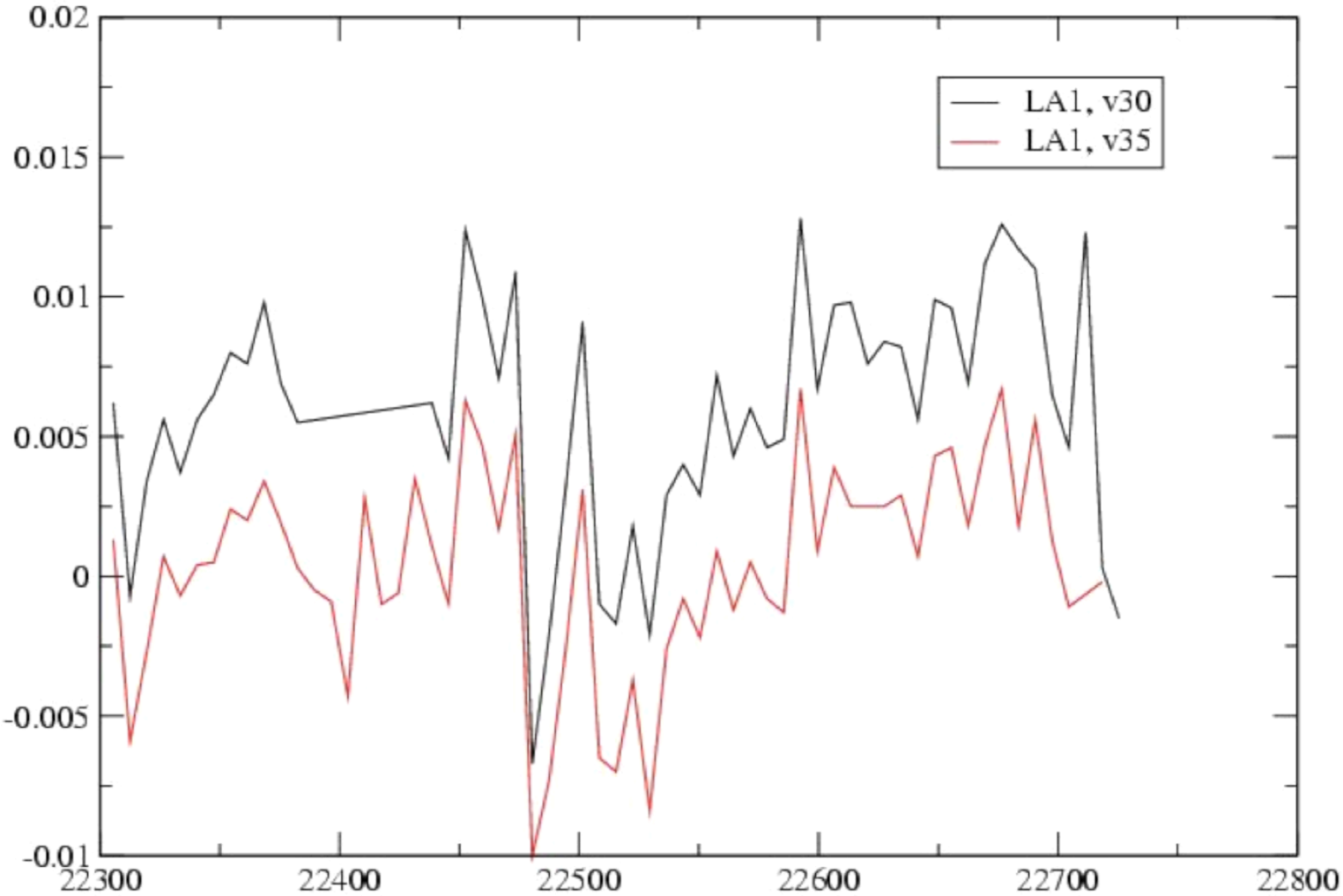
GRGS
GROUPE DE RECHERCHE DE GEODESIE SPATIALE

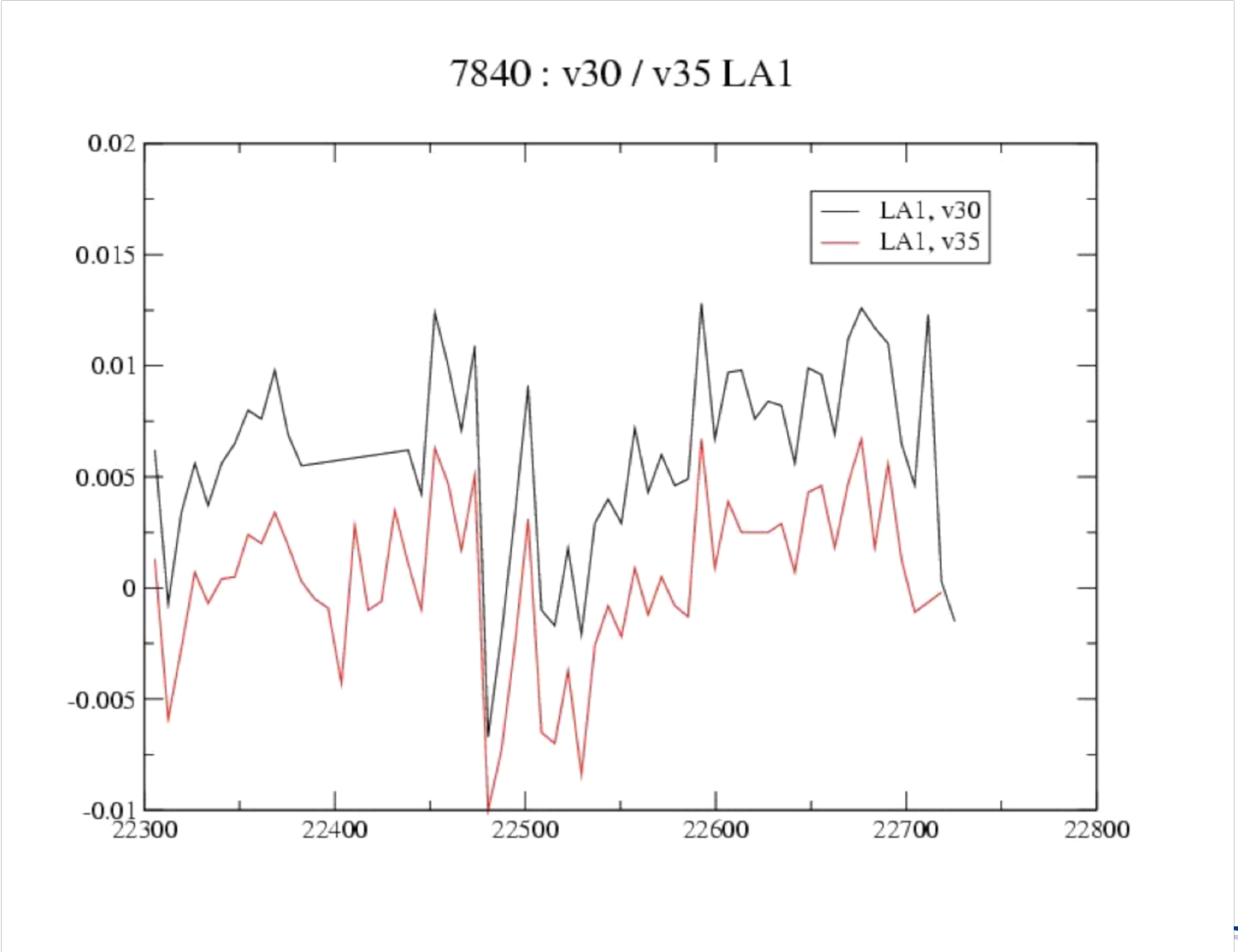
CoM corrections

1874	LAG1	18048	36889	0.249
1879	LAG1	19981	36889	0.254
1884	LAG1	13757	36889	0.252
1893	LAG1	11950	36889	0.248
7080	LAG1	13057	36889	0.250
7090	LAG1	10773	36889	0.250
7105	LAG1	11382	36889	0.250
7110	LAG1	12279	36889	0.250
7119	LAG1	20727	36889	0.250
7124	LAG1	17379	36889	0.250
7130	LAG1	17669	20513	0.250
7210	LAG1	8460	19846	0.250
7231	LAG1	18258	36889	0.257
7237	LAG1	12053	36889	0.250
7249	LAG1	14244	36889	0.255
7308	LAG1	13939	36525	0.257
7328	LAG1	17257	36525	0.257
7335	LAG1	17257	18659	0.257



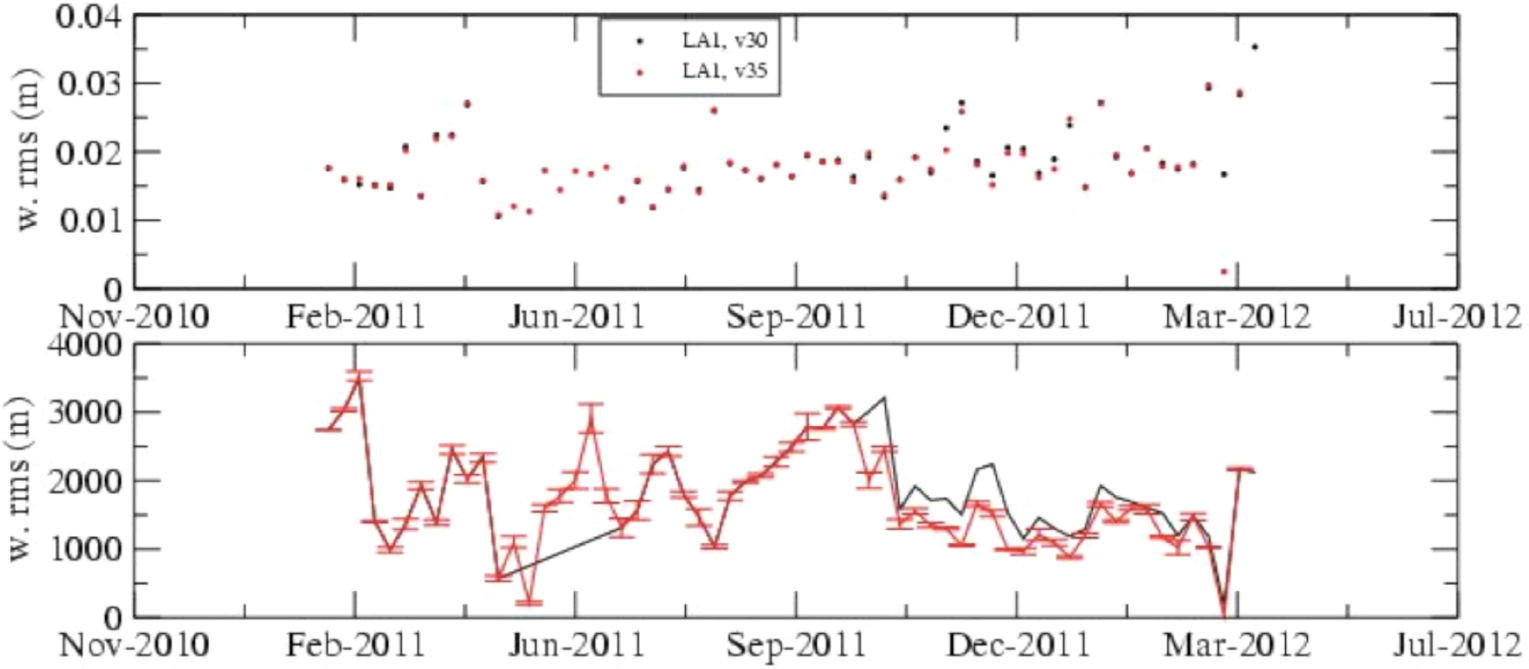
GROUPE DE RECHERCHE DE GEODESIE SPATIALE


7840 : v30 / v35 LA1
LA1, v30
LA1, v35
0.02
0.015
0.01
0.005
0
-0.005
-0.01
22300
22400
22500
22600
22700
22800



GRGS
GROUPE DE RECHERCHE DE GEODESIE SPATIALE

LAGEOS2 weekly post-fit residuals : v30 v35



GRGS
GROUPE DE RECHERCHE DE GEODESIE SPATIALE

To be discussed,
and possible inputs from our group…

- Stability of daily solution
- Gravity field time series: lumped coeff ?
- NP formula and rules…
- Impact of atmospheric effects and ECMWF files
- Weekly bias report ?
- Other satellites signatures

GRGS
GROUPE DE RECHERCHE DE GEODESIE SPATIALE

JCET AC/CC REPORTS

Erricos C. Pavlis
GEST/UMBC – NASA Goddard 698
M. Kuzmicz-Cieslak
GEST/UMBC

ILRS AWG, Vienna, Austria
April 21, 2012

Activities since last AWG

- Station validation for Arequipa, Monument Peak, Beijing and new Russian sites Badary, Baikonur and Zelenchuskaya in progress
- CRD validation for Russian stations (remaining: Riyadh, Borowiec, etc.)
- Site log compilation updates (Excel spreadsheets & SCH-SCI database)
- SLRF2008 updates: new Russian sites to be included (within May)
- Data flow investigation in view of CSTG to CRD switch on May 2
- Atmospheric de-aliasing application tests and test-files generated
- Graham's new model for L1&2 & E1&2 tested in multiyear TRF solutions
- SP3c file combination now for orbital products in DGFI's ILRS-B s/w (with Rainer Kelm's help switched to fixed TRF option)

EDC Daily SLR Data Flow Over Past 8d

Home | The EDC ... | Data & Products | Stations | Satellites | Statistics | Operation Center (OC) | Mailing Lists | ILRS-Website (Mirror)

Statistics -> Normal Points (cstg) — *Fri, 20 Apr 2012 09:13:01 GMT*

Number of Normal Points (CSTG) of the last 8 days for Lageos1/2 and Etalon1/2

As of 2012-04-19 12:30:04		2012-04-12	2012-04-13	2012-04-14	2012-04-15	2012-04-16	2012-04-17	2012-04-18	2012-04-19	Total
Komsomolsk-na-Amure	18685901						3			3
Riga	18844401			14			8			22
Arkhyz	18869601			10						10
Baikonur	18879701							23		23
Katzively	18931801	11	5		20	5				41
McDonald	70802419					30	38	15		83
Yarragadee	70900513	14	36	102	90	111	81	58	6	498
Greenbelt	71050725	83	65	6		53	59	19		285
Monument Peak	71100412					28	55	31	25	139
Haleakala	71191402	32	58	33	13	22	26	33	9	226
Tahiti	71240802								19	19
Changchun	72371901	20	5		0	13		3		41
Beijing	72496102	8	9	5		16				38
Koganei	73085001	5								5
Tanegashima	73588901						9			9
Arequipa	74031306	5		10		7		9	0	31
Concepcion	74057904	45		77	33	18	77	92	21	363
San Juan	74068801	62		16	13	37	6	44	36	214
Hartebeesthoek	75010602	112	92	56	12	49	53	52	33	459
Zimmerwald	78106801						21	16	4	41
San Fernando	78244502					5				5
Mt Stromlo	78259001	91	93	43	103	77			7	414
Simosato	78383603	81					52	17		150
Graz	78393402						15			15
Herstmonceux	78403501	11	33	9	22	49	42			166
Potsdam	78418701		16	17		19	22	16		90
Grasse	78457801	10				5	20	28	11	74
Matera	79417701	61		18	41		19	69		208
Wettzell	88341001		2	40			55	24		121
Total		651	414	456	347	544	661	549	171	3793

Number of Normal Points in old format and CRD are equal.
Number of Normal Points in old format and CRD are NOT equal.

CDDIS Table for SLR Data Flow for Past 8d

CDDIS

Number of LAGEOS AND Etalon Normal Points (CDDIS) for 120411 through 120418 AS of 18 Apr 2012 10:55:03 (old format)

Site	Sta.	120411	120412	120413	120414	120415	120416	120417	120418	Total
Riga	1884	0	0	0	14	0	0	0	0	14
Arkhyz	1886	0	0	0	10	0	0	0	0	10
Katzively	1893	0	11	5	0	20	0	0	0	36
McDonald	7080	0	0	0	0	0	30	38	0	68
Yarragadee	7090	87	14	36	102	90	111	14	0	454
Greenbelt	7105	33	83	65	6	0	53	41	0	281
Monument Peak	7110	0	0	0	0	0	28	37	0	65
Haleakala	7119	21	32	58	33	13	22	13	0	192
Tahiti	7124	54	0	0	0	0	0	0	0	54
Changchun	7237	7	20	5	0	0	13	0	0	45
Koganei	7308	0	5	0	0	0	0	0	0	5
Arequipa	7403	0	5	0	10	0	7	0	0	22
Concepcion	7405	66	45	0	77	25	11	47	0	271
San Juan	7406	30	62	0	16	13	37	6	0	164
Hartebeesthoek	7501	141	112	92	56	12	49	44	0	506
Zimmerwald	7810	8	0	0	0	0	0	0	0	8
San Fernando	7824	5	0	0	0	0	5	0	0	10
Mount Stromlo	7825	72	91	93	43	103	77	0	0	479
Simosato	7838	42	81	0	0	0	0	30	0	153
Graz	7839	14	0	0	0	0	0	0	0	14
Herstmonceux	7840	30	5	33	9	22	49	0	0	148
Potsdam	7841	0	0	16	17	0	19	0	0	52
Grasse	7845	45	10	0	0	0	5	0	0	60
Matera	7941	32	61	0	18	41	0	0	0	152
Wettzell	8834	3	0	2	40	0	0	39	0	84
Totals:	25	690	637	405	451	339	516	309	0	3347

EDC-CDDIS Data Flow Over Past 8d

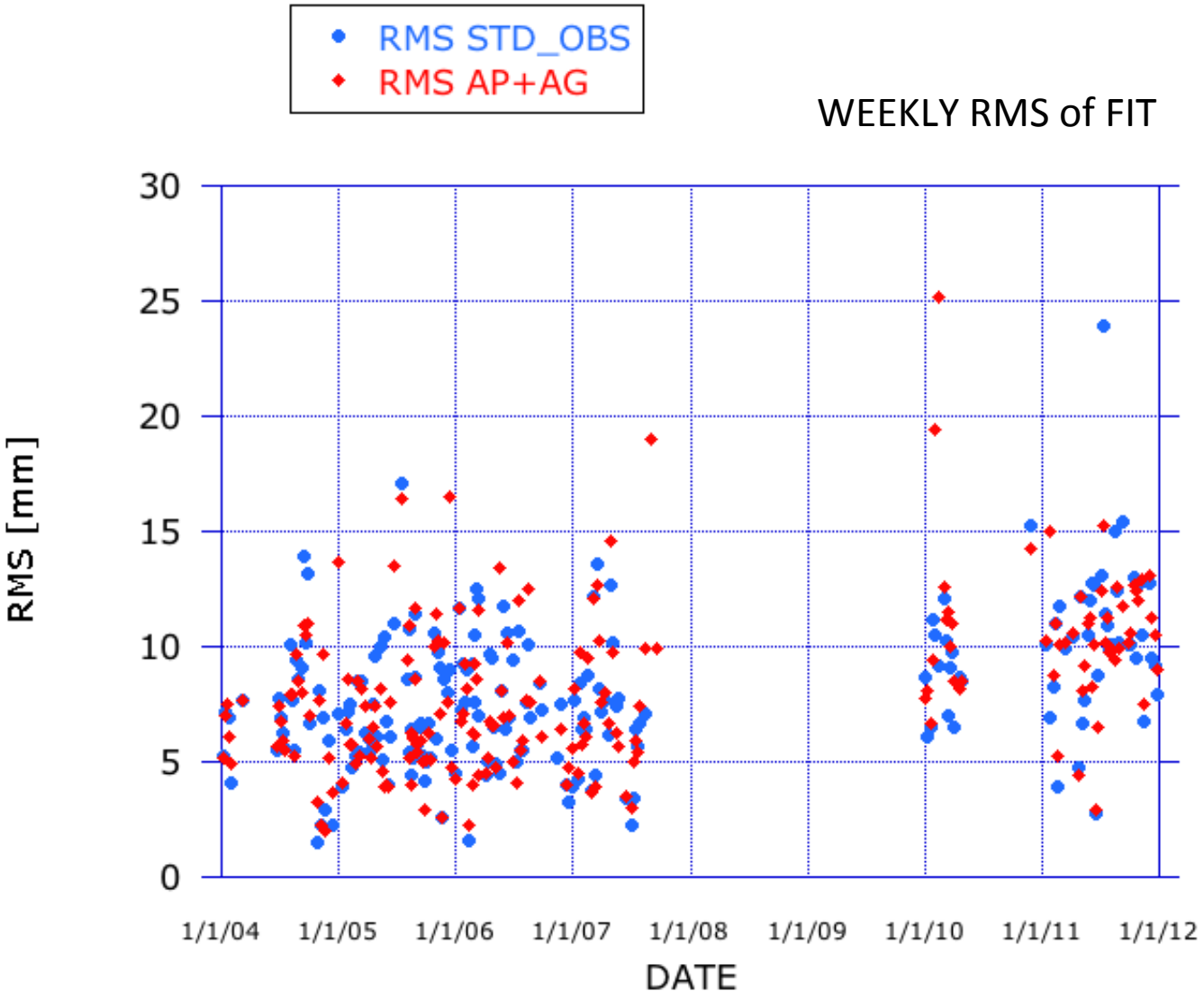
DATA DIFFERENCES: EDC-CDDIS

As of 2012-04-18 14:30:04	20120411	20120412	20120413	20120414	20120415	20120416	20120417	20120418	Total
Riga 18844401	0	0	0	0	0	0	8	0	8
Arkhyz 18869601	0	0	0	0	0	0	0	0	0
Katzively 18931801	0	0	0	0	0	5	0	0	5
McDonald 70802419	0	0	0	0	0	0	0	15	15
Yarragadee 70900513	0	0	0	0	0	0	67	13	80
Greenbelt 71050725	0	0	0	0	0	0	18	19	37
Monument_Peak 71100412	0	0	0	0	0	0	18	26	44
Haleakala 71191402	0	0	0	0	0	0	13	8	21
Tahiti 71240802	0	0	0	0	0	0	0	0	0
Changchun 72371901	0	0	0	0	0	0	0	0	0
Koganei 73085001	0	0	0	0	0	0	0	0	0
Arequipa 0	0	0	0	0	0	0	0	0	0
Concepcion 74057904	0	0	0	0	8	0	30	33	71
San_Juan 74068801	0	0	0	0	0	0	0	32	32
Hartebeesthoek 75010602	0	0	0	0	0	0	9	0	9
Zimmerwald 78106801	0	0	0	0	0	0	21	0	21
San_Fernando 78244502	0	0	0	0	0	0	0	0	0
Mount_Stromlo 78259001	0	0	0	0	0	0	0	0	0
Simosato 78383603	0	0	0	0	0	0	22	0	22
Graz 78393402	0	0	0	0	0	0	15	0	15
Herstmonceux 78403501	0	6	0	0	0	0	42	0	48
Potsdam 78418701	0	0	0	0	0	0	22	0	22
Grasse 78457801	0	0	0	0	0	0	20	0	20
Matera 79417701	0	0	0	0	0	0	19	46	65
Wettzell 88341001	0	0	0	0	0	0	16	16	32
NOT in CDDIS									
Komsomolsk-na-Amure 18685901	0	0	0	0	0	0	3	0	3
Tanegashima 73588901	0	0	0	0	0	0	9	0	9
Totals: 1	0	1	0	-10	8	-2	352	208	557

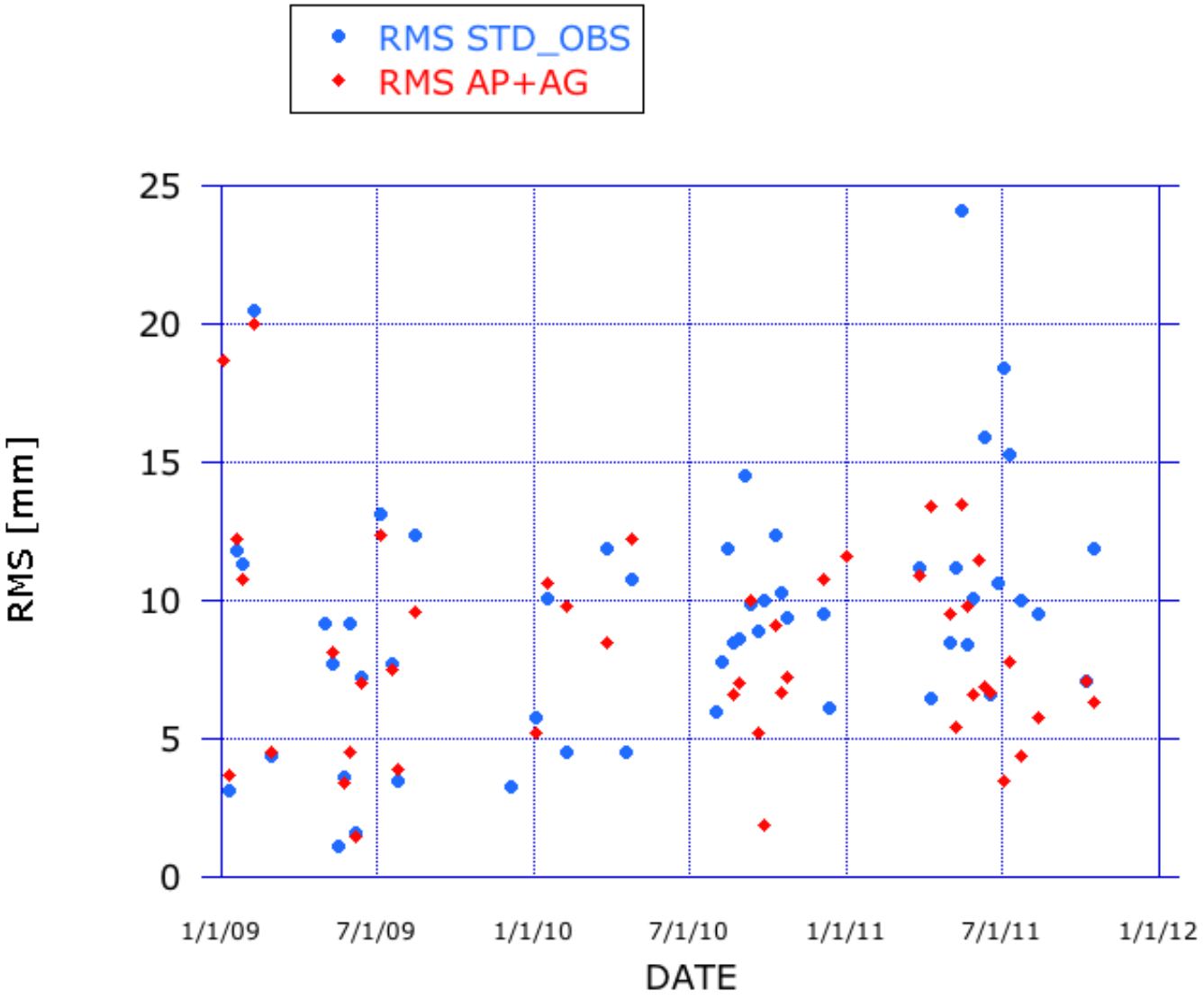
Loading & gravity models

- Data (atmospheric loading only) available from IERS GGFC web site:
  - http://geophy.uni.lu/ggfc_atmosphere/NCEP-loading.html
- GEODYN-compatible files (atmospheric loading and gravitational effect) available from JCET (ftp site TBD)
  - Eventually it can include compatible oceans and hydrology (from Jean-Paul Boy)
- GRACE project files (atmospheric AND oceanic!) available from GFZ's ISDC:
  - http://isdc.gfz-potsdam.de
- New service from TUW to provide eventually atmos. loading & gravity effect
- New sub-daily EOP model from VLBI+GPS (UniBonn & TUM)
- Need to have these tested and compared between a few ACs: ???
  - Preferably by ACs using a mix of s/w packages (DOGS, EPOS, GEODYN, etc.)

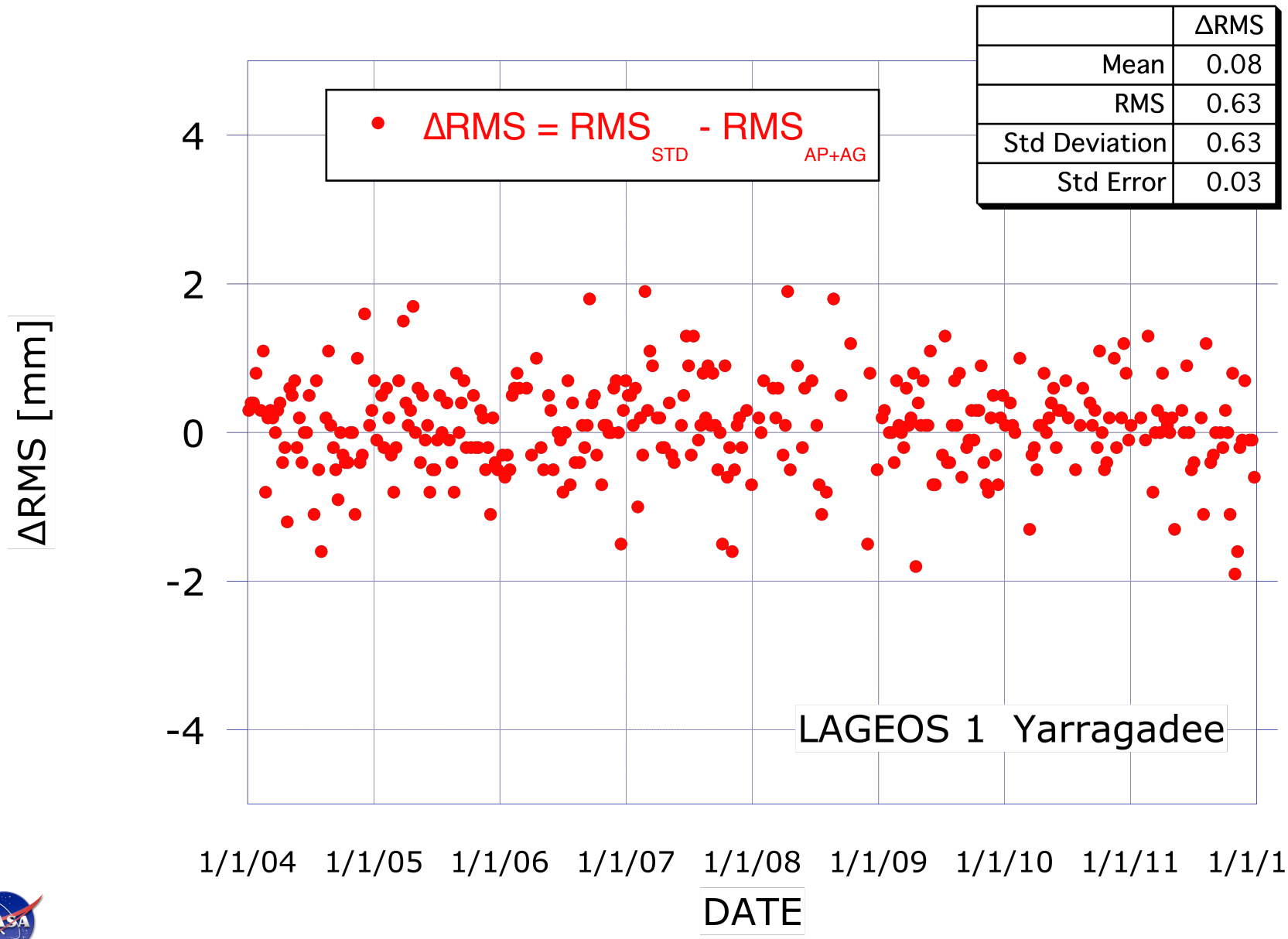
Greenbelt, MD LAGEOS 2



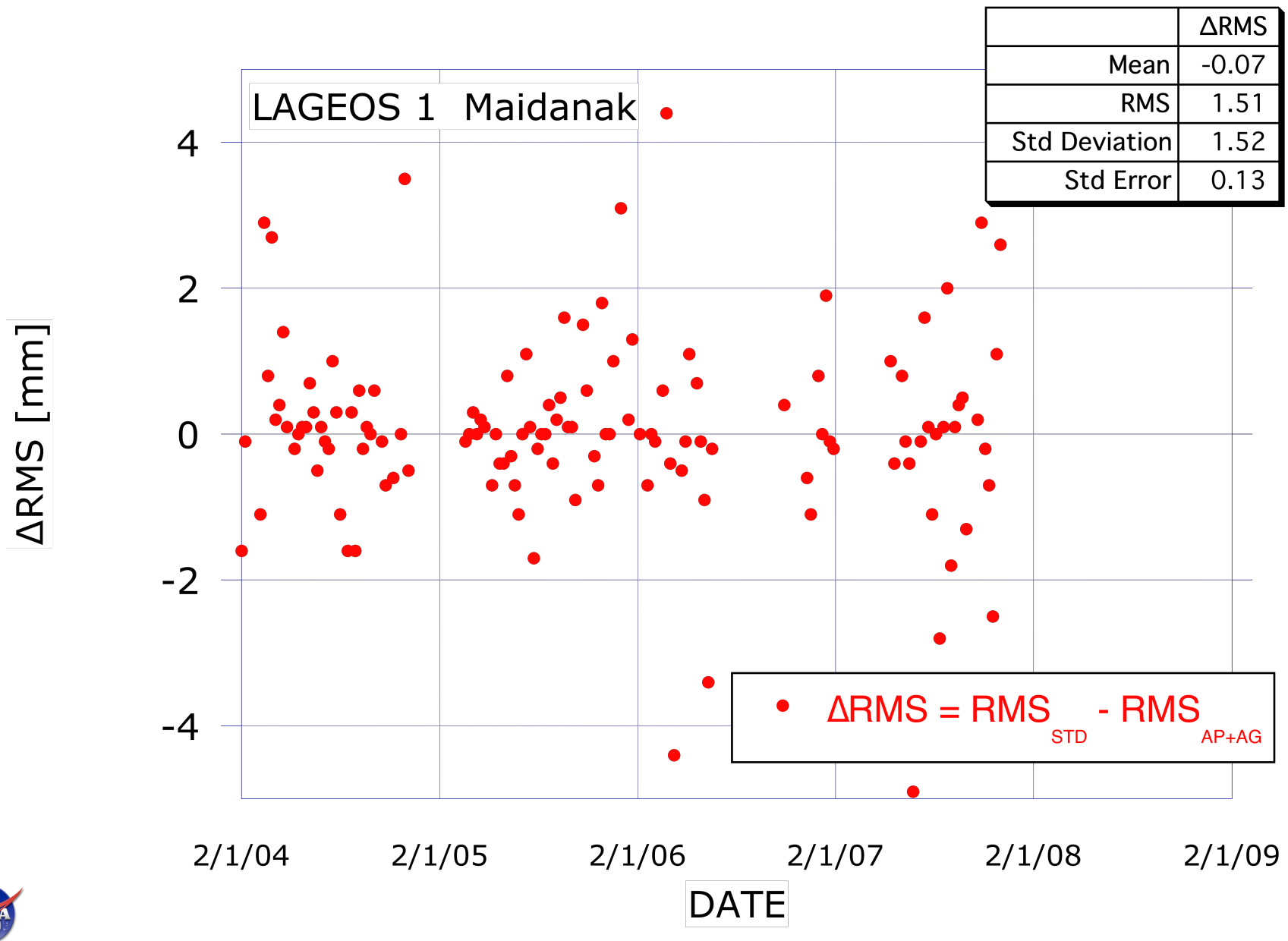
Altay, Russia, LAGEOS 2



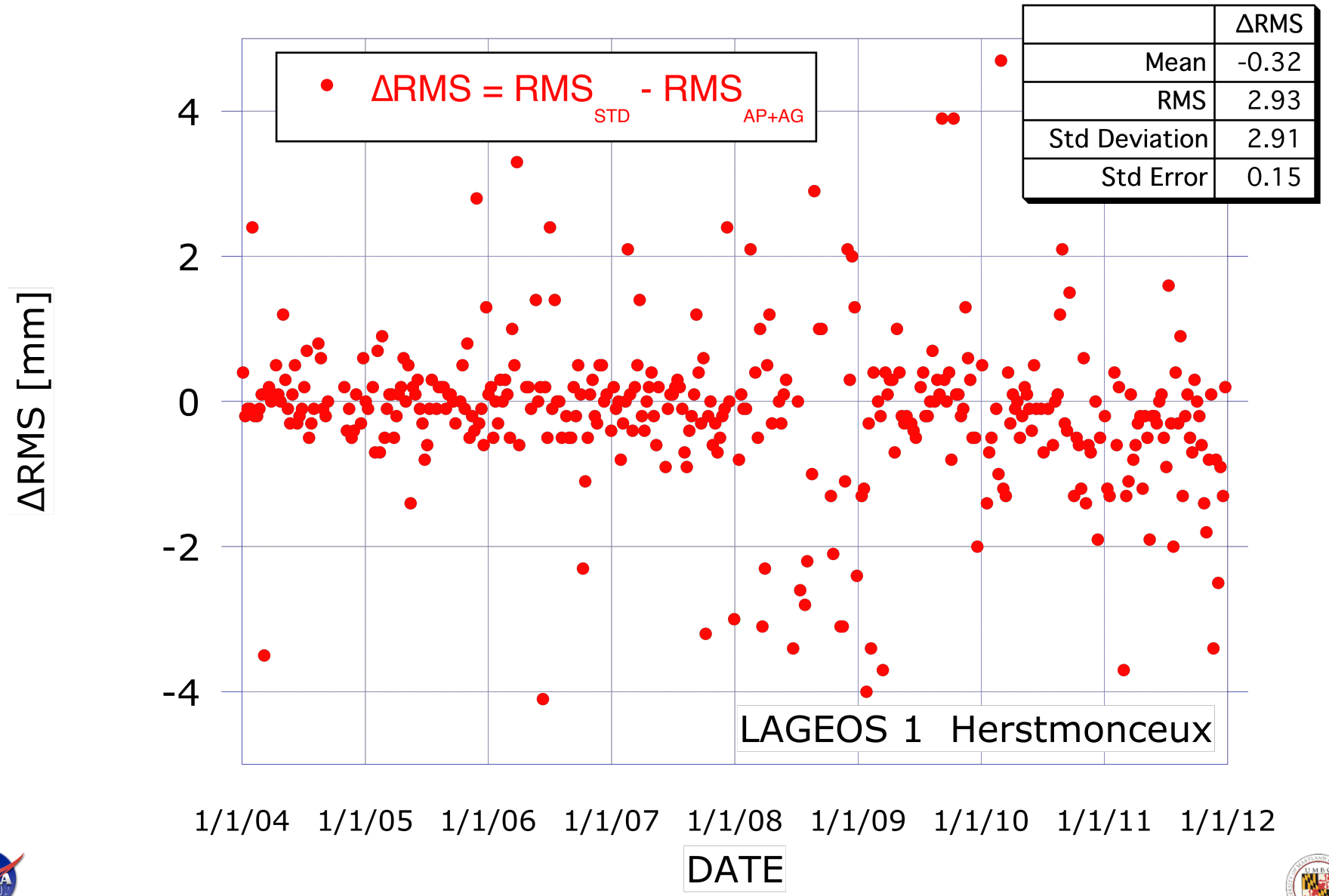
Yarragadee, Australia LAGEOS 1



Maidanak, Uzbekistan, LAGEOS 1

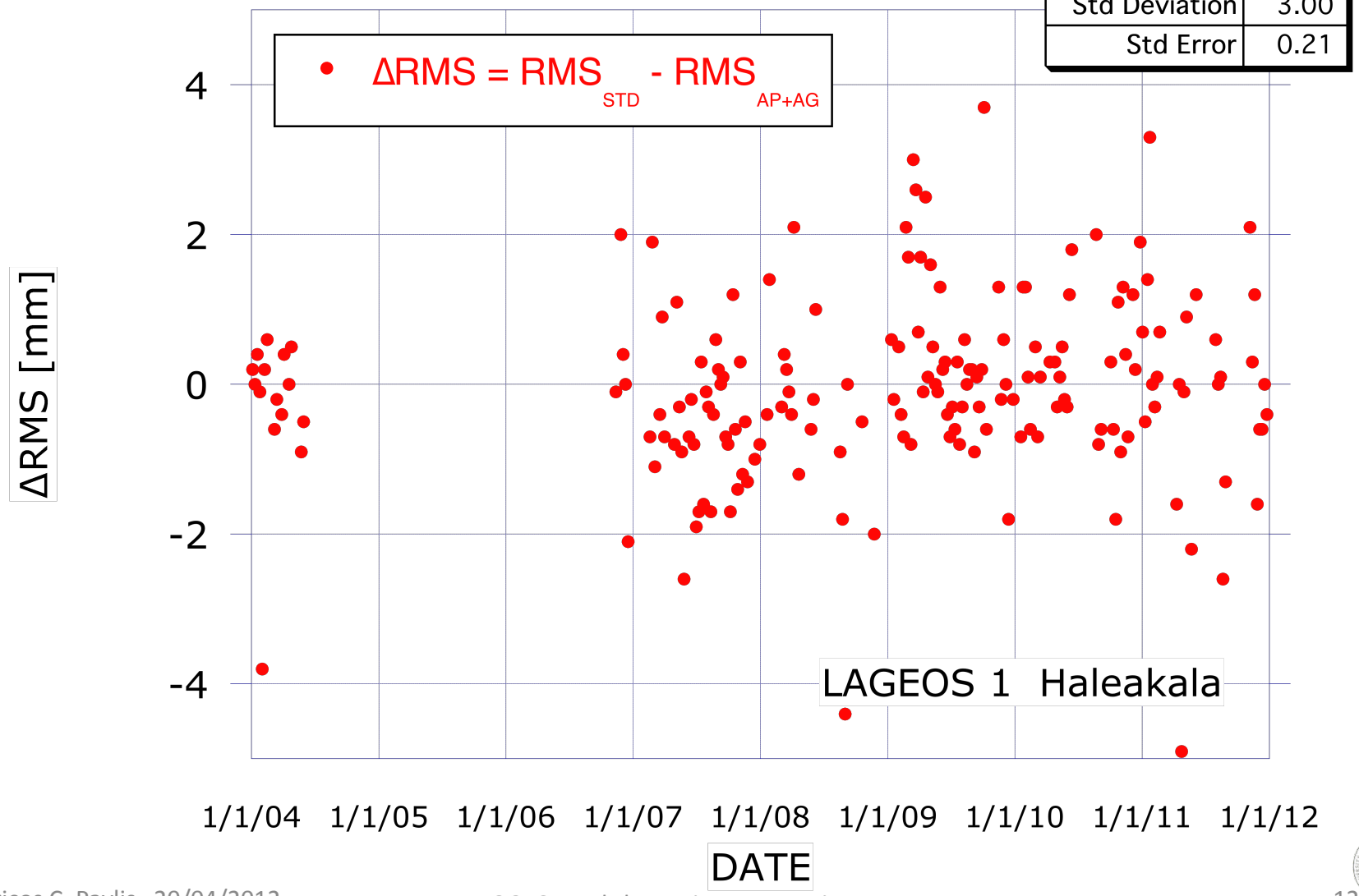


Herstmonceux, UK, LAGEOS 1

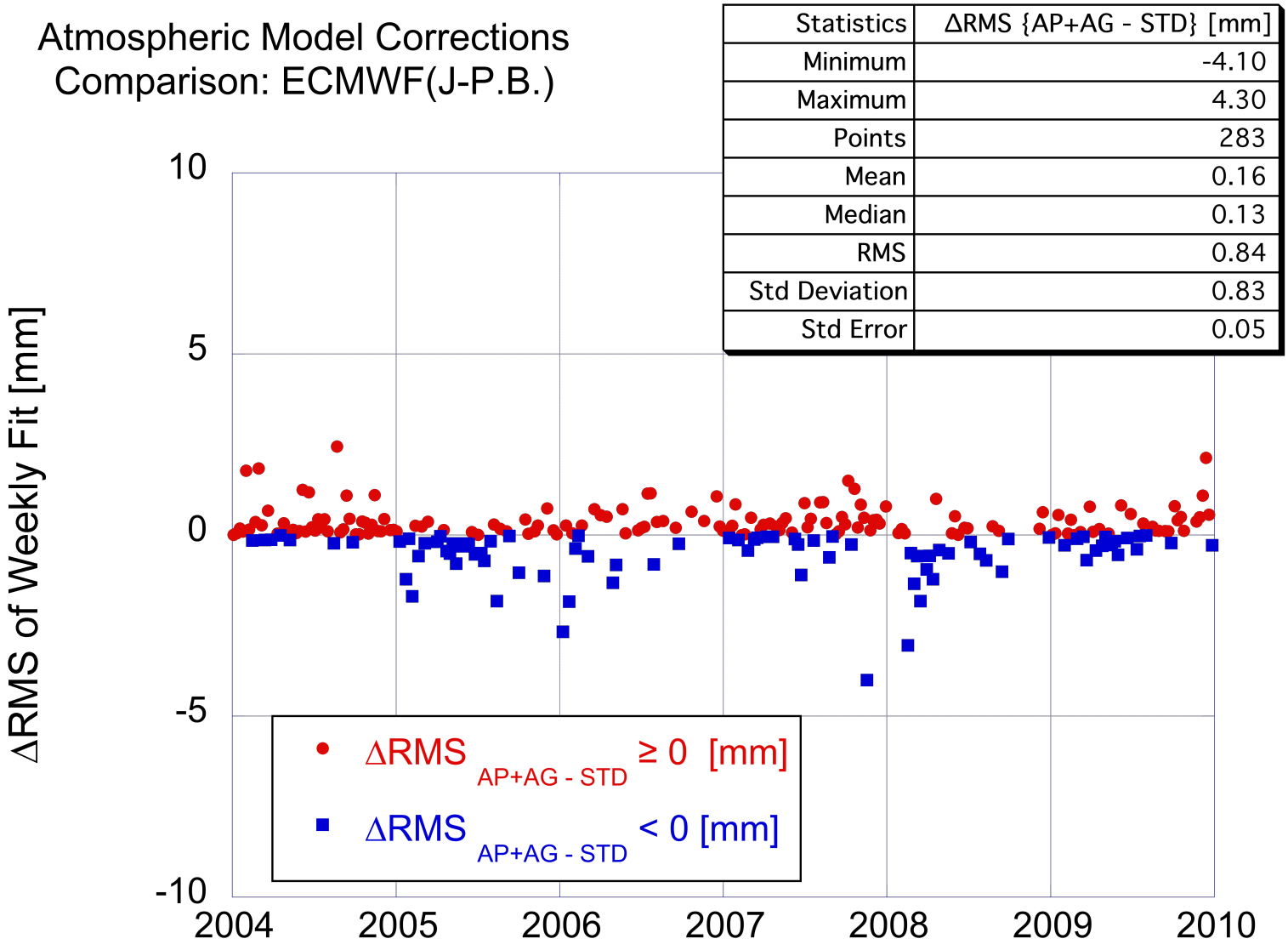


Haleakala, Hawaii, LAGEOS 1

	ΔRMS
Mean	-0.12
RMS	2.99
Std Deviation	3.00
Std Error	0.21

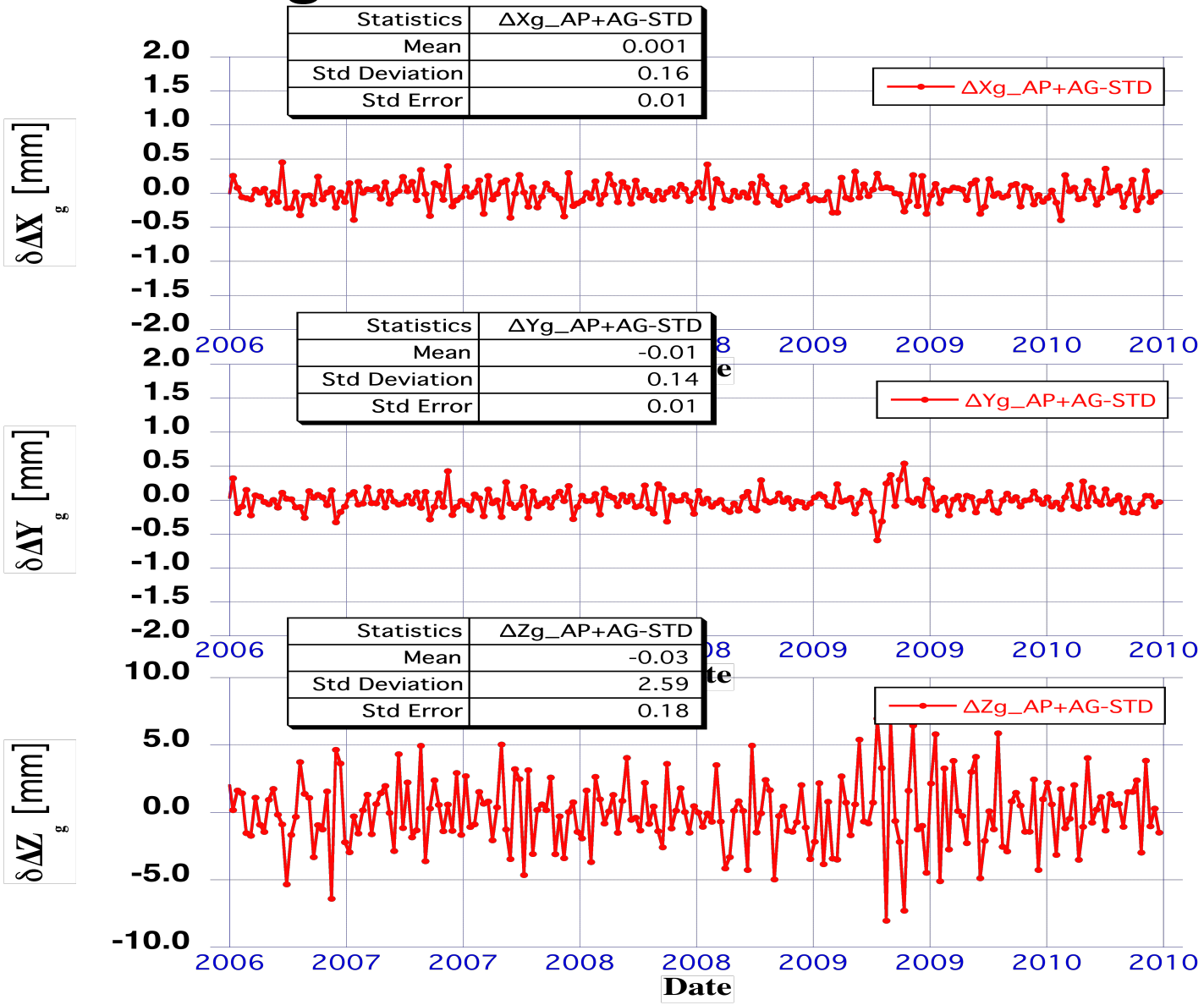


SLR TESTS over 2004 - 2010



Statistics	ΔRMS {AP+AG - STD} [mm]
Minimum	-4.10
Maximum	4.30
Points	283
Mean	0.16
Median	0.13
RMS	0.84
Std Deviation	0.83
Std Error	0.05

Change in "Geocenter" Series



AP Load & Gravity Summary

- Inclusion of atmospheric loading and gravity variations in the reduction of SLR data resulted in a small increase of the overall RMS of the weekly arcs for most of the 2004-2009 cases, although at the individual site level, there are several sites that show improvement
- The resulting "geocenter variations" series show little difference compared to the ones without the atmospheric corrections applied, especially the equatorial components
- Future reanalysis will use improved background TVG from GRACE RL05 and data from IERS GGFC
- Availability of GGFC data needs to be better understood

Atm. Loading & Gravity Data Sets

- JCET can provide GEODYN-compatible files (Year YYYY+ 2 months, December of YYYY-1 and January of YYYY+1)
- The GEODYN group is working on converting the official IERS GGFC data set to similar GEODYN-compatible files so that they can be tested/used in the near future
- Along with the GFZ AOD product, this will give us at least three different data sets to test, based on ECMWF
- Another version compatible with Bernese-based s/w is available from TUW
- We need AC commitments to test at least two of these, preferably more

CoG Model Tests

- Appleby model provided in terms of a routine and data base files
  - Covers only LAGEOS and ETALON, some old sites are still missing
- JCET processed all of the LAGEOS and ETALON arcs over 1993 to 2010 using GEODYN and site specific CoG corrections
- For sites not in the model we used the default CoG correction
- Sites which toggled between configurations over the same period of time, we used one CoG for now
  - In these cases we need to check the configuration flag on the data record to decide which correction is the correct to pick. This requires a significant additional effort in bookkeeping such info and it is postponed for the future, since these cases are rather limited and in the early years mostly, when data quality is lower than at present.
- Depending on other's input as well, we need to decide to adopt or not the new model as is or continue the evaluation after further changes (TBD)

ILRS-B Summary Report

Statistics of input solutions
****

AC	# stations	# obs.	var.factor
asi	21	3393	0.00015723
bkg	20	3406	1.56767
dgfi	22	3672	4.76165
ga	22	3288	9.14305e-05
gfz	21	2980	0.999723
grgs	19	2569	0.000126439
jcet	22	3389	6.91013e-05
nsgf	20	3446	0.0181519

1

First smallest eigen values of deconstrained normal equations
****

AC	eig val 1	eig val 2	eig val 3	eig val 4	eig val 5
asi	9.93218e-10	1.07768e-09	3.67683e-08	6.52131e-06	1.26773e-05
bkg	-1.20173e-16	-3.47992e-18	1.34399e-10	0.000118045	0.000173833
dgfi	9.69003e-09	1.15997e-08	3.93851e-07	2.89629e-06	0.000162761
ga	1.05684e-10	4.2457e-10	6.46948e-10	1.18917e-07	4.92065e-07
gfz	1.78731e-10	4.0526e-09	4.64555e-09	3.40792e-05	4.76276e-05
grgs	9.58058e-08	1.06456e-05	0.000128834	0.000142586	0.000160768
jcet	-1.75726e-08	6.2759e-10	7.51661e-10	2.46752e-09	3.0283e-07
nsgf	-1.64003e-16	2.58154e-17	4.14586e-08	0.000113086	0.000132809

Rank type analysis: ET*N_unc*E = 0? and Loose = (ET*(C_loose)^-1*E)^-1
****

Note: E being the Helmert transformation parameter coefficient
matrix. C_loose being the loose constraints covariance
matrix. The smaller the diagonal elements of E^T*N*E,
the more significant the rank deficiencies are numerically
identified.The larger the diagonal elements of the
Loose matrix, the more significant the rank deficiencies
are numerically identified.

E^T*N*E = 0?

AC	tx [m]	ty [m]	tz [m]	rx [m]	ry [m]	rz [m]	sc [ppb]
asi	4.31e+06	4.37e+06	6.01e+05	13.7	13.4	0.712	6.91e+06
bkg	4.56e+06	4.38e+06	6.47e+05	6.14e-07	6.54e-07	0.00288	6.95e+06
dgfi	7.63e+06	7.52e+06	1.06e+06	210	234	12.4	1.17e+07
ga	3.95e+06	3.94e+06	5.33e+05	10.2	10	3.35	7.15e+06
gfz	4.78e+06	4.36e+06	6.74e+05	71.2	69	0.00408	1.4e+06
grgs	5.14e+06	4.64e+06	8.06e+06	1.3e+05	6.46e+03	2.5e+06	9.34e+06
jcet	6.23e+06	5.86e+06	9.8e+05	20.2	18.9	-0.661	9.64e+06
nsgf	3.68e+06	3.89e+06	5.07e+05	1.26e-07	1.56e-07	0.637	5.09e+06

Standard deviations of Loose quatity

AC	tx [m]	ty [m]	tz [m]	rx [m]	ry [m]	rz [m]	sc [ppb]
asi	0.0005	0.0005	0.0013	0.1943	0.1926	0.3401	0.0004
bkg	0.0005	0.0005	0.0012	0.2716	0.2655	0.3614	0.0004
dgfi	0.0004	0.0004	0.0010	0.0693	0.0660	0.2783	0.0003
ga	0.0005	0.0005	0.0014	0.1815	0.1779	0.2374	0.0004
gfz	0.0005	0.0005	0.0012	0.1056	0.1058	0.2810	0.0009
grgs	0.0005	0.0005	0.0004	0.0061	0.0276	0.0006	0.0003
jcet	0.0004	0.0004	0.0011	0.1649	0.1668	0.3214	0.0003
nsgf	0.0005	0.0005	0.0014	0.0291	0.0287	0.0389	0.0004

Core stations applied for rotational constraints
****

Code
12734S008
13212S001
14001S007
14201S018
30302M003
40442M006
40451M105
50107M001
50119S003

Variance factors and their variances (VCE)
****

5

asi.pos+eop.120418:	0.81672	0.04445
bkg.pos+eop.120418:	2.02109	0.08077
dgfi.pos+eop.120418:	8.18594	0.22536
ga.pos+eop.120418:	33.67870	0.78736
gfz.pos+eop.120418:	5.58654	0.16066
grgs.pos+eop.120418:	7.26949	0.22145
jcet.pos+eop.120418:	9.24517	0.27795
nsgf.pos+eop.120418:	4.05097	0.12307

Helmert parameters w.r.t. SLRF2008
****

6

AC	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
asi	-0.003	-0.004	0.011	-1.806	0.012	0.018
bkg	-0.004	-0.005	0.011	-1.270	0.010	0.018
dgfi	-0.006	-0.005	0.006	-1.067	0.012	0.021
ga	-0.001	-0.003	0.019	-1.179	0.011	0.013
gfz	0.002	-0.010	0.004	-1.853	0.012	0.018
grgs	-0.002	-0.006	0.003	-1.621	0.010	0.013
jcet	0.004	-0.002	0.005	-1.101	0.007	0.010
nsgf	-0.001	-0.006	0.010	-1.248	0.010	0.019

Helmert parameters w.r.t. combined solution
****

7

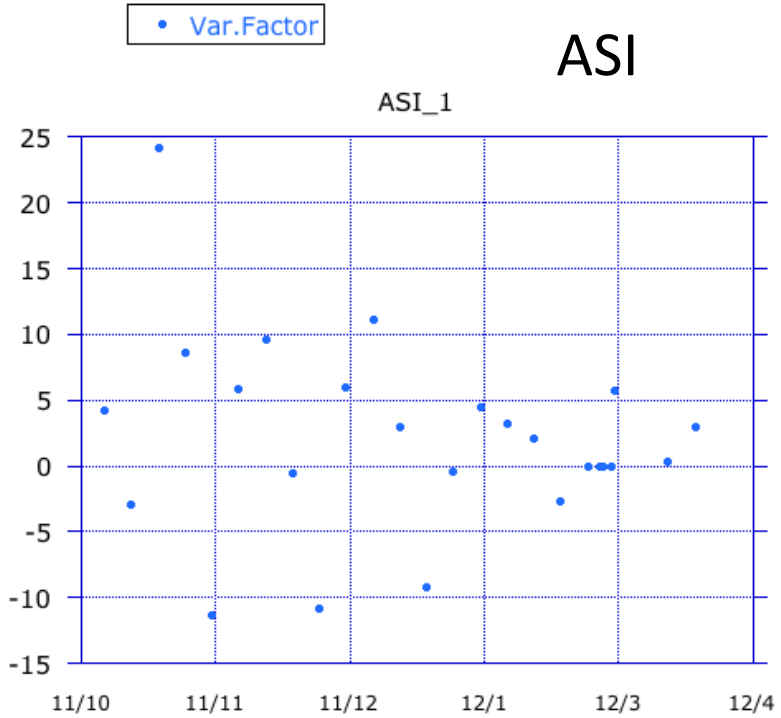
AC	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
asi	0.000	0.001	0.001	-0.249	0.002	0.003
bkg	-0.001	0.000	0.002	0.284	0.002	0.003
dgfi	-0.003	0.001	-0.003	0.478	0.007	0.009
ga	0.002	0.002	0.010	0.428	0.007	0.008
gfz	0.005	-0.005	-0.005	-1.031	0.006	0.006
grgs	0.001	-0.000	-0.003	-0.055	0.005	0.006
jcet	0.003	0.002	-0.000	0.201	0.004	0.007
nsgf	0.002	-0.001	0.000	0.285	0.005	0.006

Helmert parameters of combined solution w.r.t. SLRF2008
****

AC	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
comb	-0.003	-0.005	0.008	-1.543	0.010	0.015

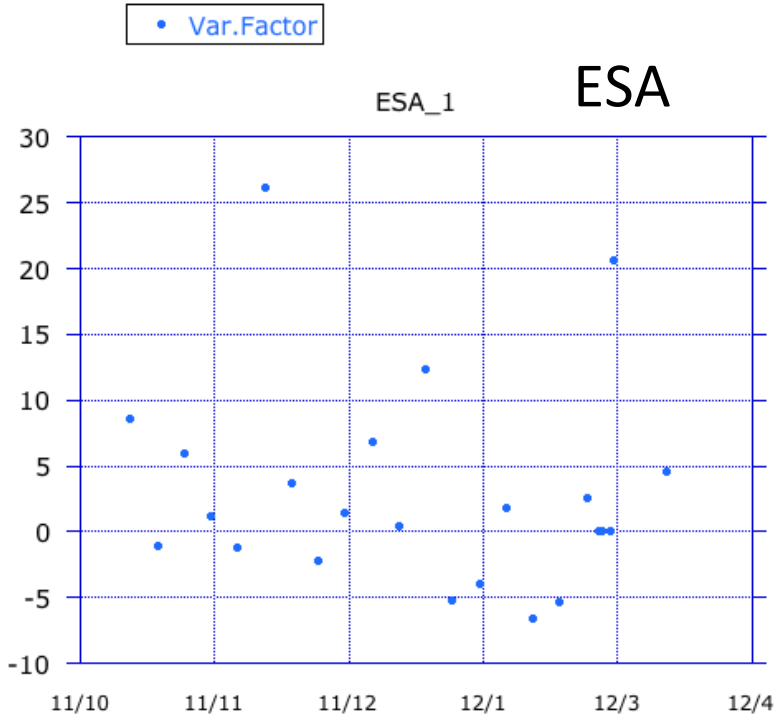
Variance Factor % Change (#1)

ASI



	Var.Factor
Points	25
Mean	2.133076
RMS	7.4797912
Std Deviation	7.3170223

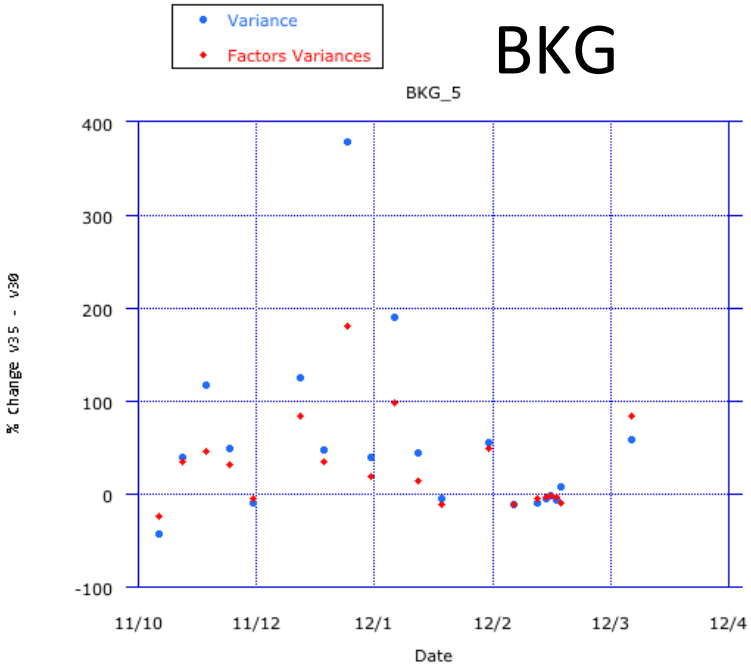
ESA



	Var.Factor
Points	23
Mean	18.148965
RMS	30.279309
Std Deviation	24.78213

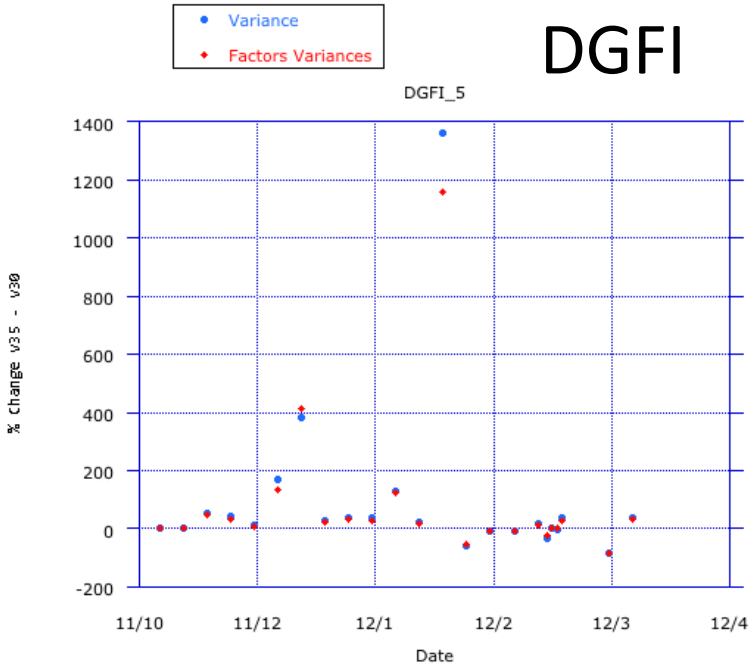
Variance Components % Change (#5)

BKG



	Variance	Factors Variances
Points	20	20
Mean	52.865169	29.64822
RMS	106.4779	57.094529
Std Deviation	94.828474	50.060682

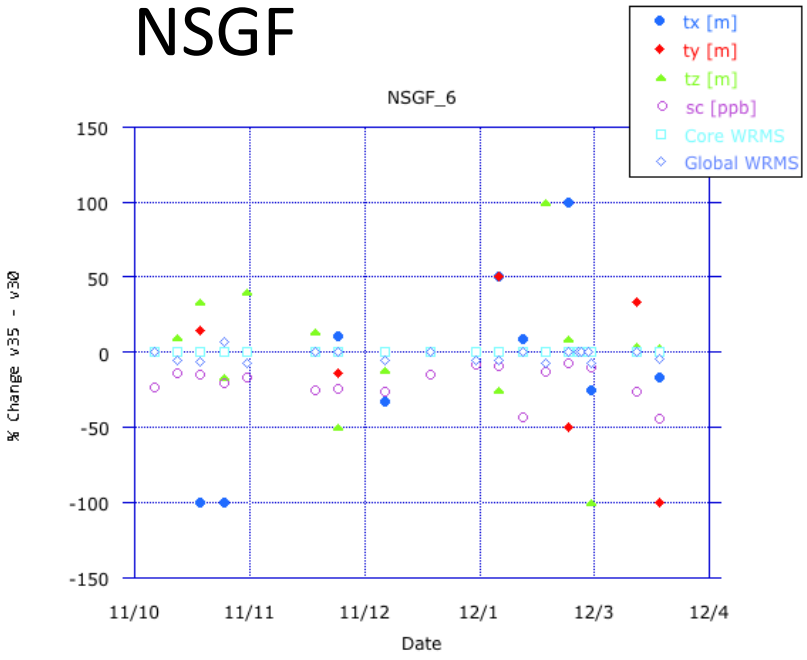
DGFI



	Variance	Factors Variances
Points	23	23
Mean	94.716614	84.159411
RMS	299.74721	261.29493
Std Deviation	290.78065	252.93023

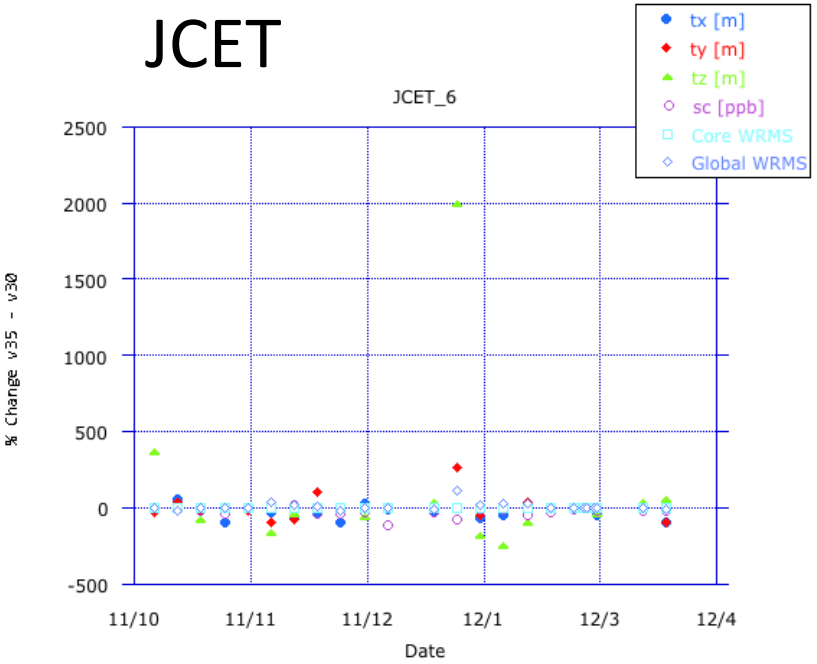
Helmert Parameters wrt SLRF2008

NSGF



	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
Points	20	20	20	20	20	20
Mean	-5.2777801	-3.3333349	0.40404005	-17.109995	0	-2.377245
RMS	41.657405	28.739582	36.503843	21.002673	0	4.3637701
Std Deviation	42.395189	29.287189	37.449858	12.49675	0	3.7544635

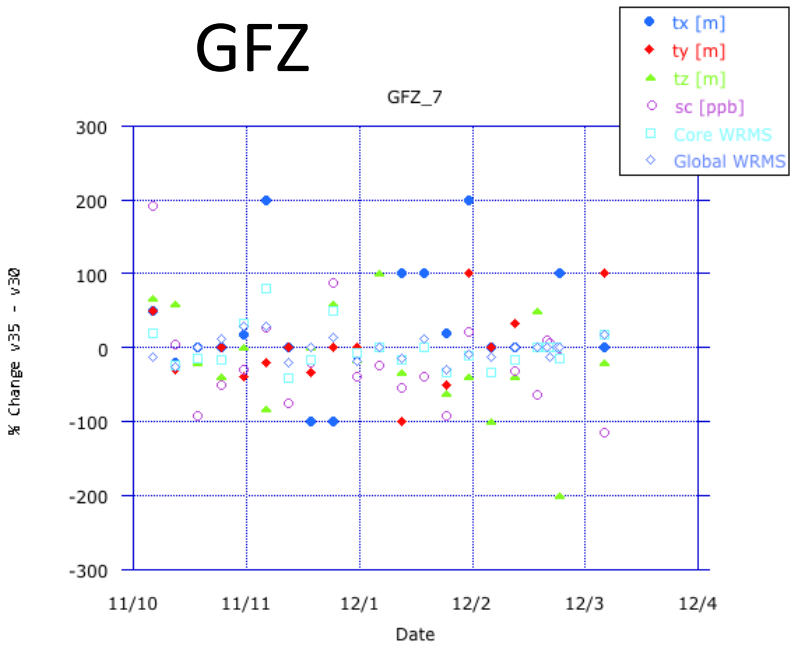
JCET



	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
Points	24	24	24	24	24	24
Mean	-23.438771	0.83333278	64.698821	-22.877054	0	7.4379166
RMS	45.722693	69.029317	422.50847	35.96968	0	26.551271
Std Deviation	40.10233	70.50885	426.50548	28.354126	0	26.036377

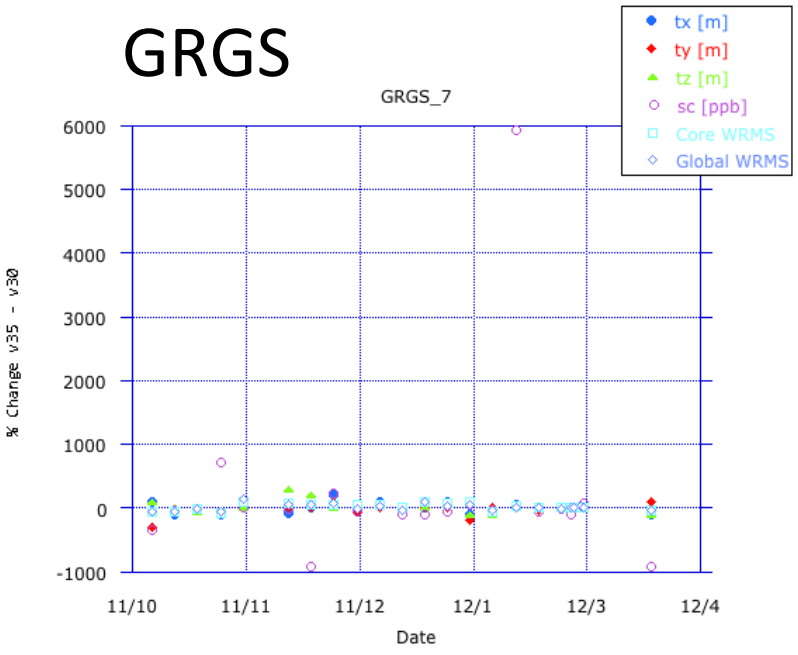
Helmert Parameters wrt Combination

GFZ



	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
Points	23	23	23	23	23	23
Mean	24.154591	0.46035651	-15.525826	-18.505626	-1.9957174	-1.8450957
RMS	76.24367	41.748352	63.717143	65.374418	27.133074	15.347407
Std Deviation	73.941628	42.684039	63.185488	64.109705	27.667736	15.578519

GRGS

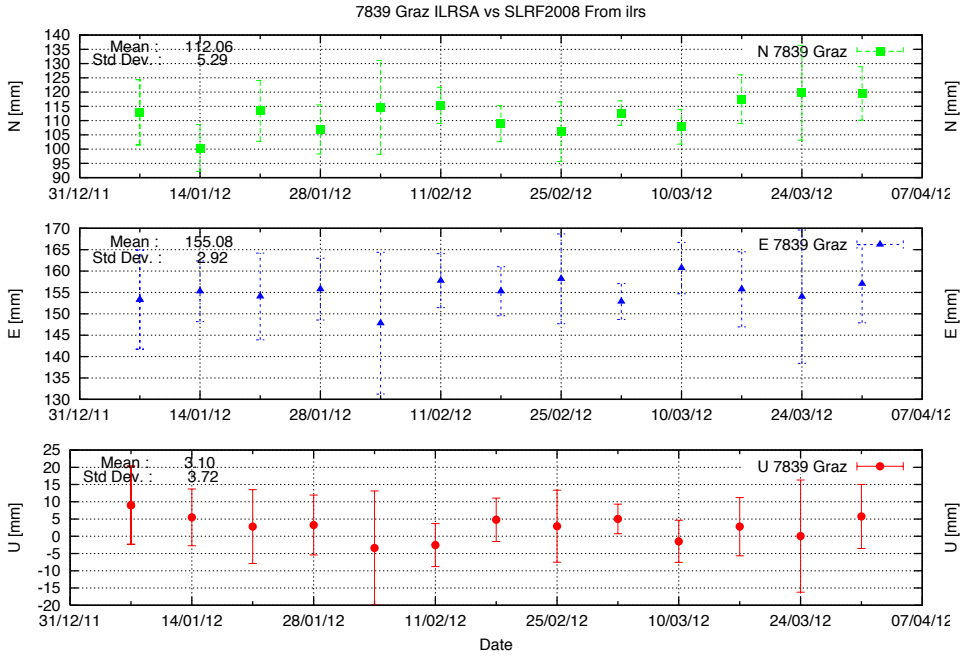


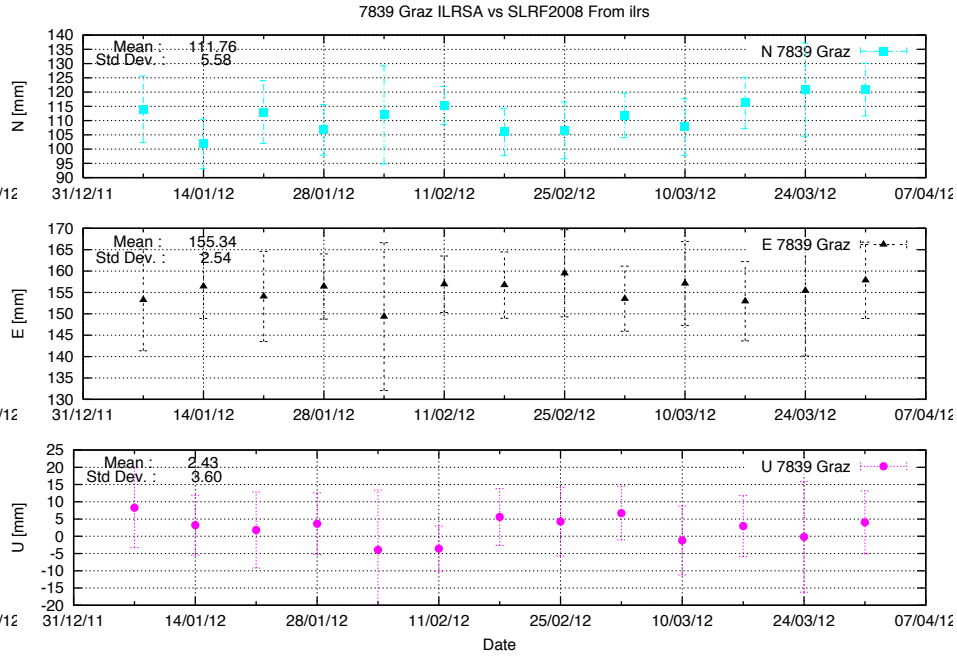
	tx [m]	ty [m]	tz [m]	sc [ppb]	Core WRMS	Global WRMS
Points	23	23	23	23	23	23
Mean	-0.53830429	-22.173913	11.286231	188.24554	15.658713	7.862487
RMS	73.529224	83.402869	89.568755	1278.794	54.600273	53.112936
Std Deviation	75.179757	82.208215	90.851829	1293.2902	53.482314	53.708303

N-E-U Comparison: GRAZ

STANDARD MODEL: v30*

NEW MODEL: v35*

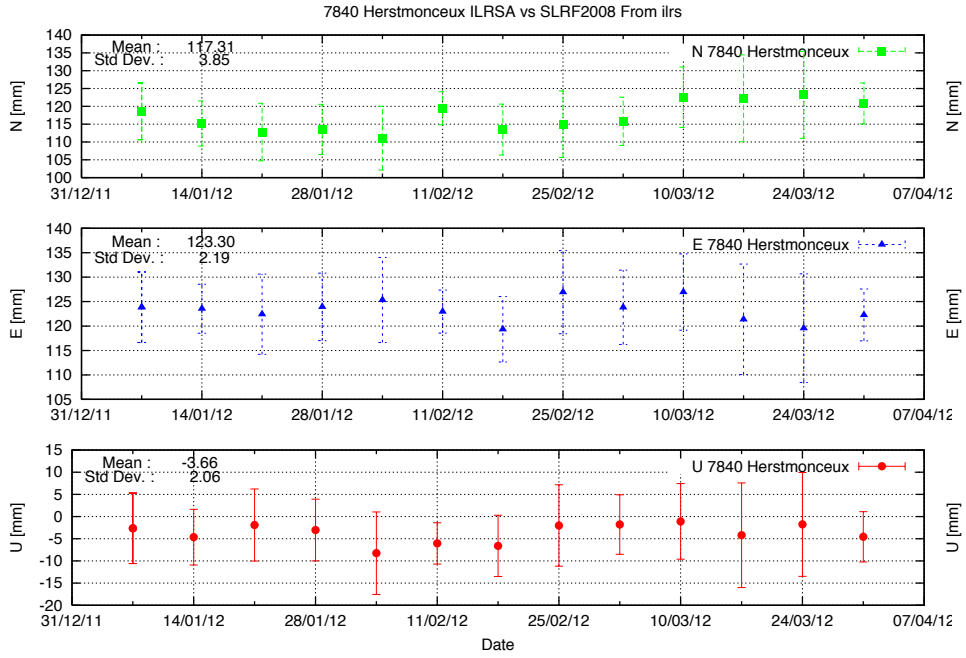




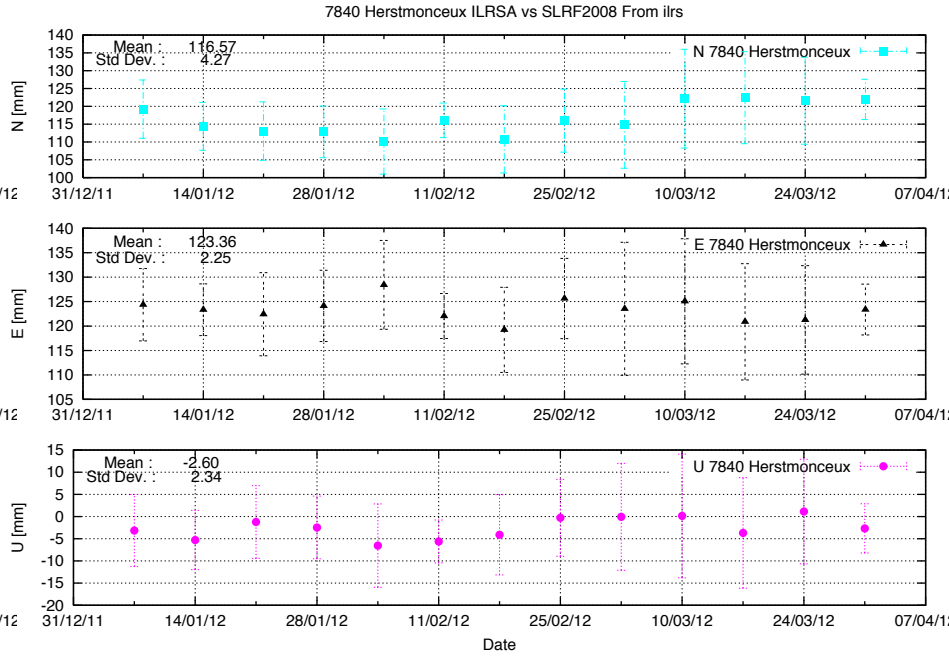
*ILRS-A (ASI) Combination from Cecilia Sciarretta

N-E-U Comparison: HERSTMONSEUX

STANDARD MODEL: v30

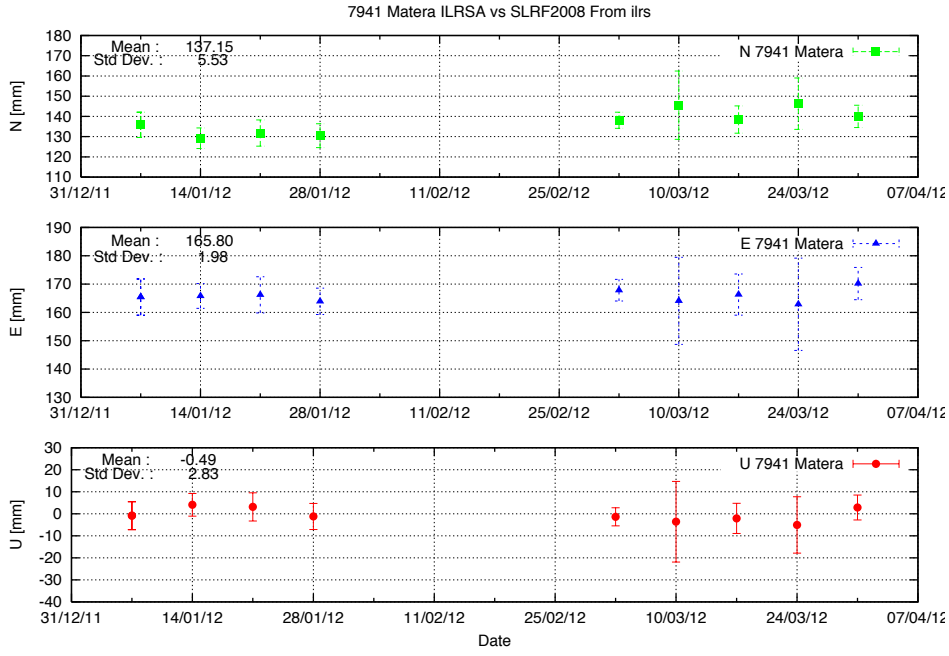


NEW MODEL: v35

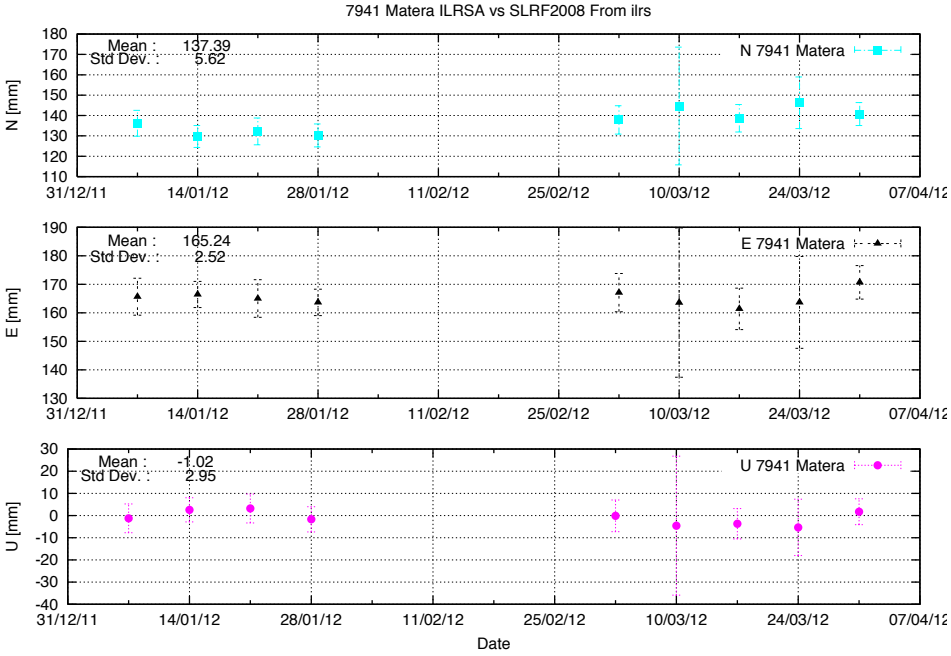


N-E-U Comparison: MATERA

STANDARD MODEL: v30

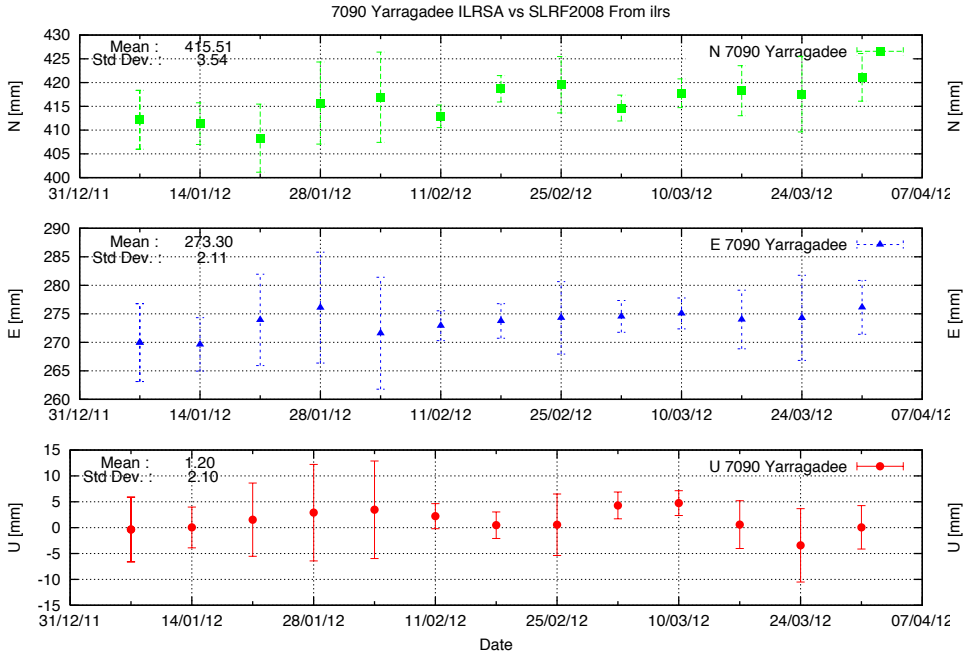


NEW MODEL: v35

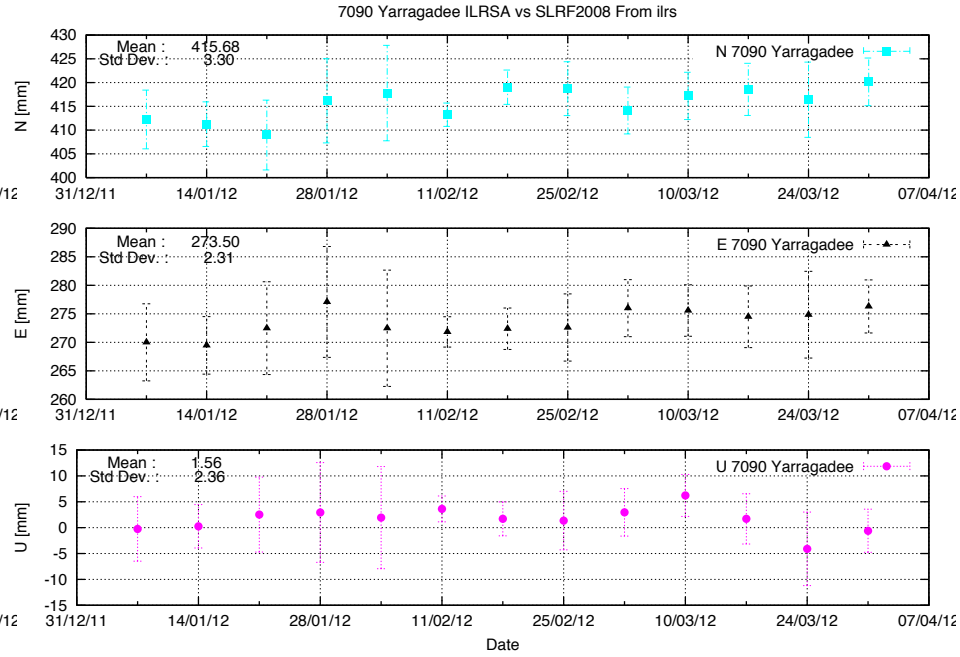


N-E-U Comparison: YARRAGADEE

STANDARD MODEL: v30

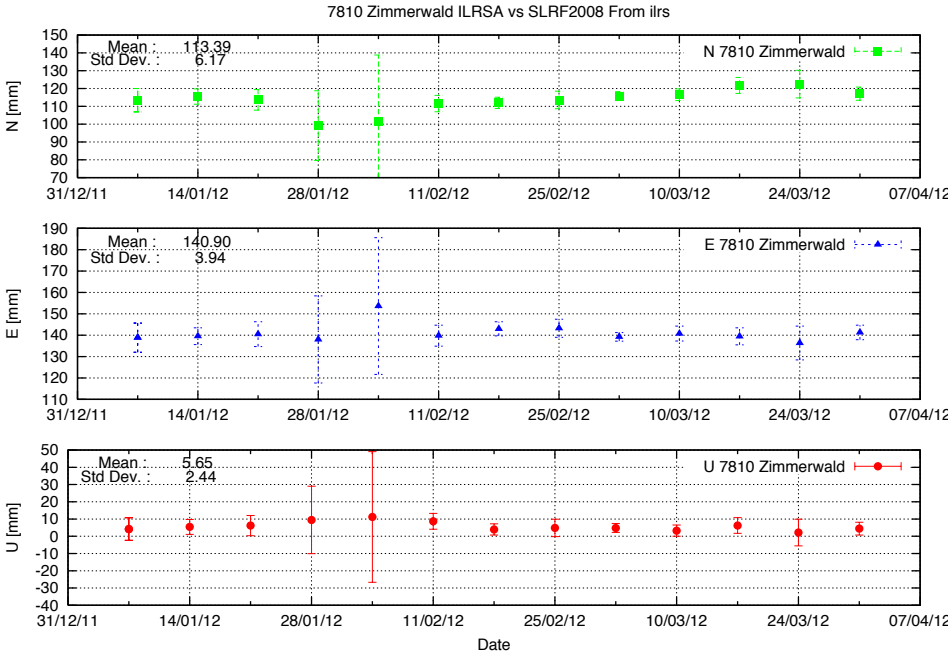


NEW MODEL: v35

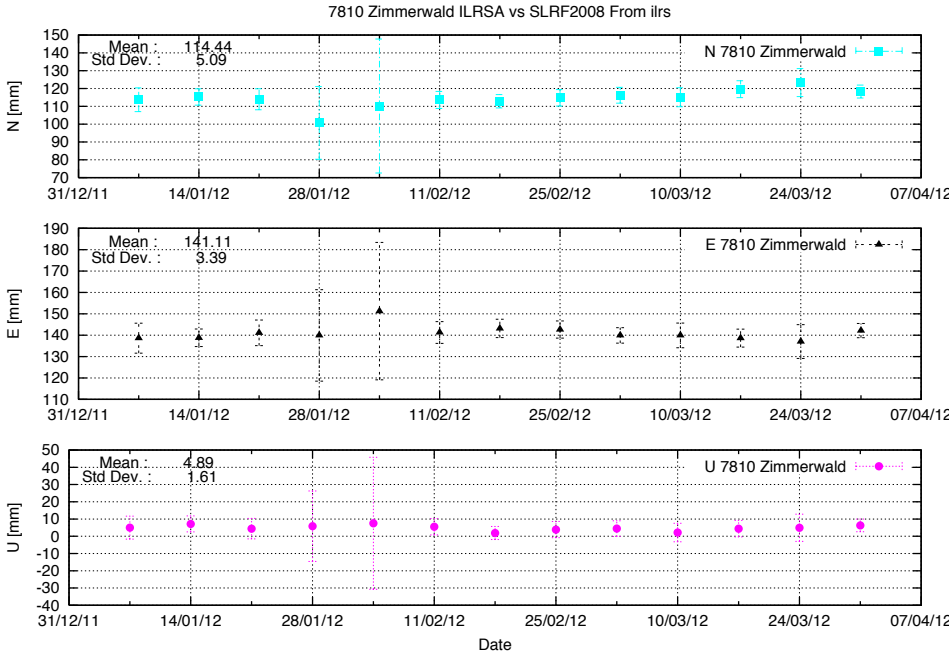


N-E-U Comparison: ZIMMERWALD

STANDARD MODEL: v30

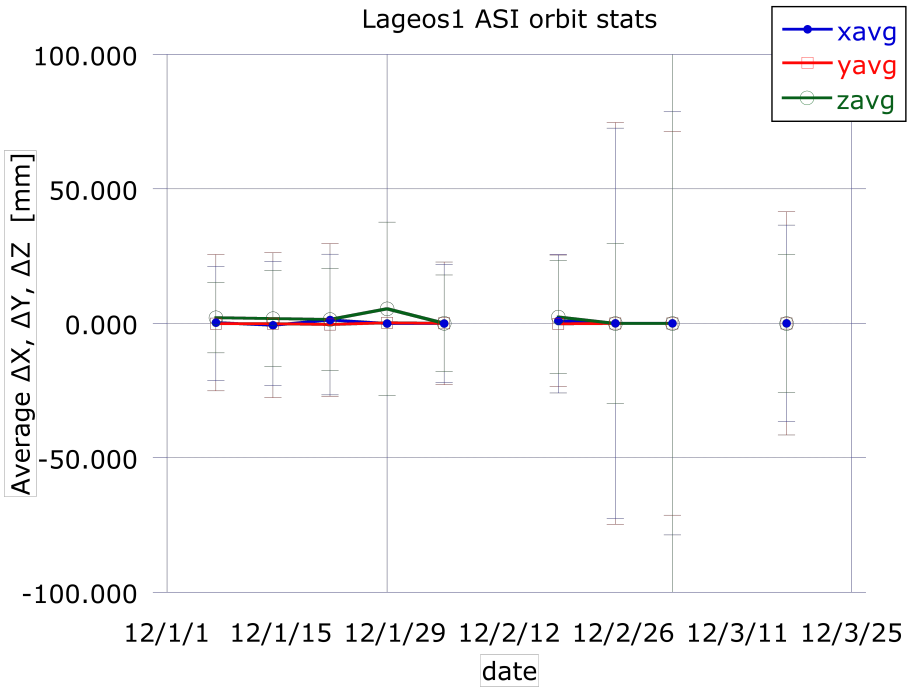


NEW MODEL: v35

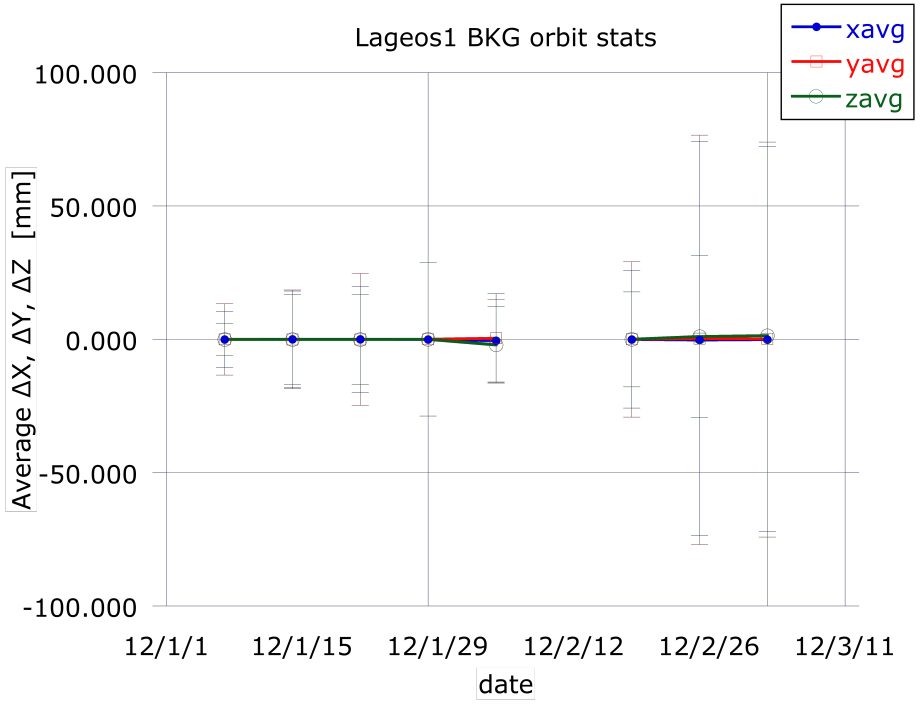


SP3c Comparison for ILRS-B Combination

ASI

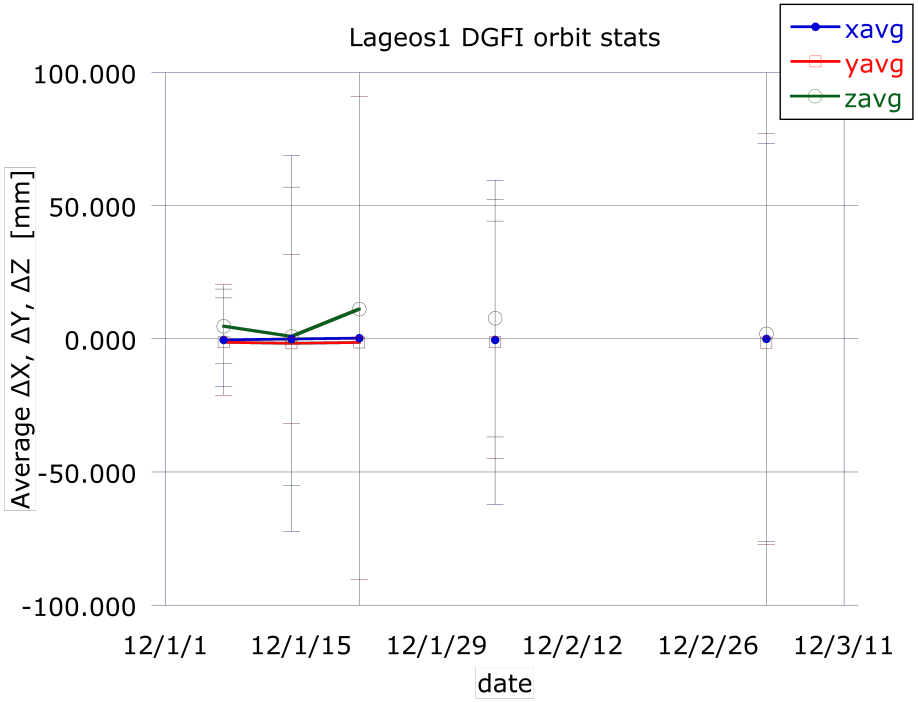


BKG

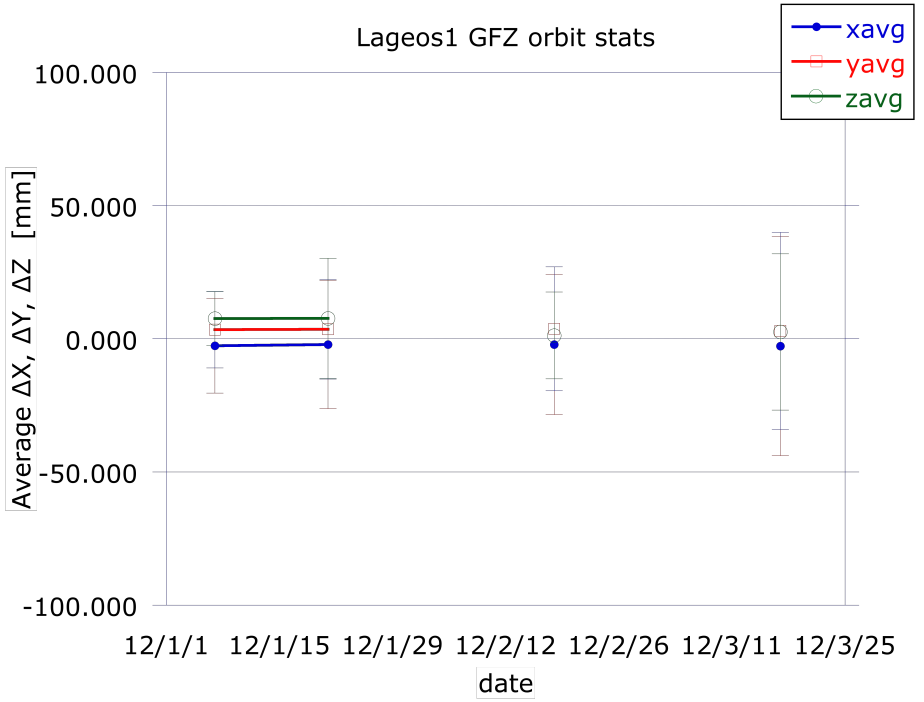


SP3c Comparison for ILRS-B Combination

DGFI

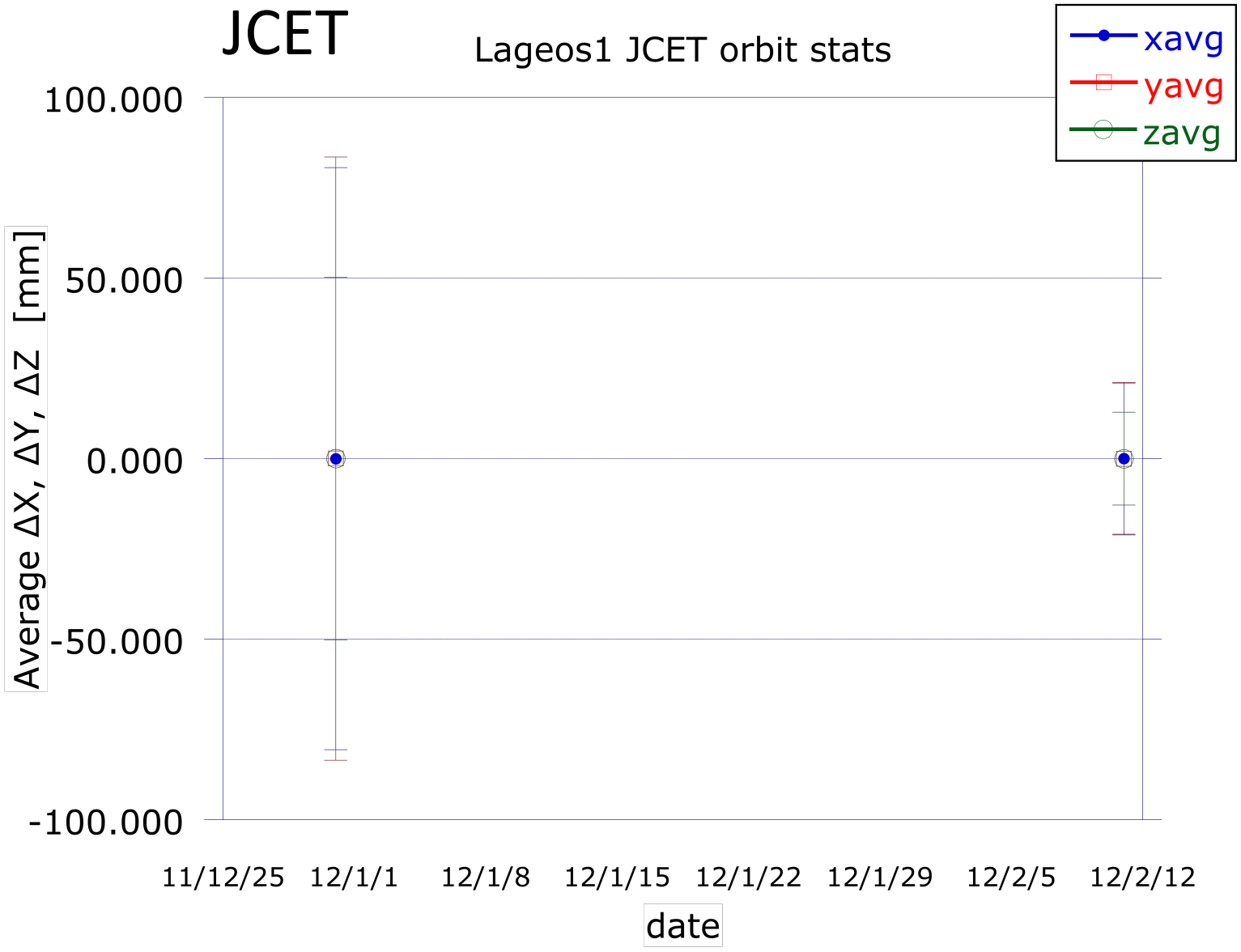


GFZ



SP3c Comparison for ILRS-B Combination

JCET



Proposed plan for ILRS product evolution

a) We need to decide on the CoG model adoption and then the switch of the operational product from the WEEKLY series to the DAILY, with enough lead time to allow USNO NEOS to handle the switch

b) Complete AC certification of IERS 2010 Conventions implementation (how?)

c) Verify AC ability to estimate low-degree gravity terms (PP)

d) Verify AC ability to implement environmental loading from external data (PP)

e) Pilot projects to verify compatibility of all AC's products with (c) and (d)

f) Apply new product to the weekly series with appropriate latency

g) Daily product will remain the same as is now (no forward modeling of Geo-fluids and no additional parameters estimated for now)

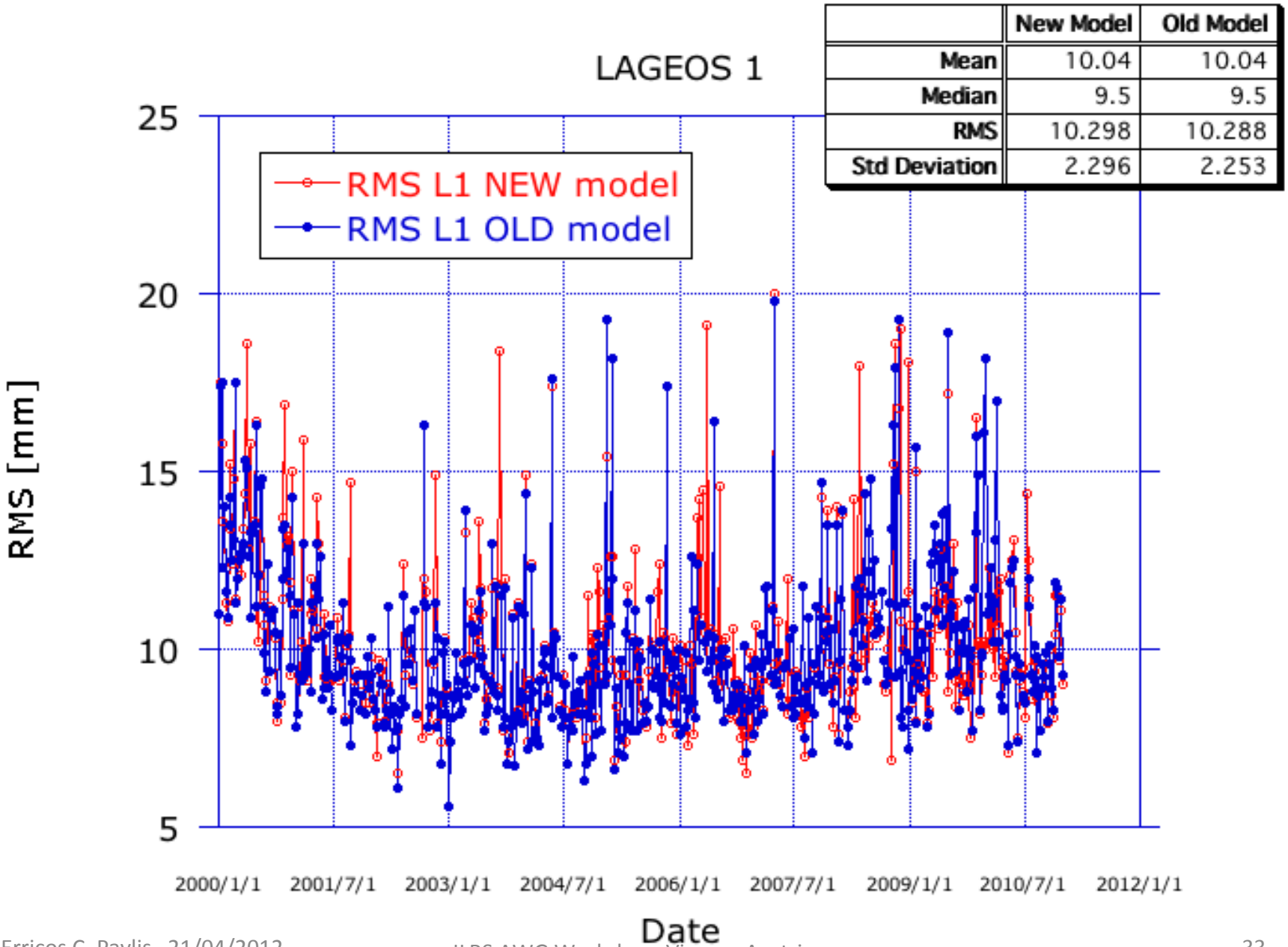
JoG SI Table of Contents – Status 2012.04.21

#	TITLE	Lead Author(s)
0	Foreword	The Guest EB
1	The International Laser Ranging Service (ILRS): The First Decade and Beyond	Pearlman, Appleby, Noll, Pavlis, Torrence
2	Information Resources Supporting Scientific Research for the International Laser Ranging Service	Noll, Horvath, Ricklefs, Schwatke, Torrence
3	*Past, Present and Future of the ILRS Global Tracking Network*	*Wetzel, Horvath, Carter, Pierron, Bianco, Govind, ???*
4	Next Generation Satellite Laser Ranging Systems	Degnan, McGarry, Kirchner, Appleby, Prochazka, Jäggi, Moore, Artyukh, Samain, Schreiber
5	Geodetic satellites: a high accuracy positioning tool	Pearlman, Arnold, Davis, Barlier, Biancale, Vasiliev, Paolozzi. Ciufolini, Pavlis
6	Satellite Laser Ranging to Global Navigation Satellite Systems	Thaller, Dell'Agnello, Fumin, Govind, Nakamura, Noda, Springer
7	Lunar Laser Ranging – A Tool for General Relativity, Lunar Geophysics and Earth Science	J. Müller, Murphy, Schreiber, Shelus, Torre, Williams, Boggs
8	Interplanetary Ranging	Degnan, Schreiber, McGarry, Sun, Zagwodzki, Murphy, Samain, Turyshev
9	Target Signature Systematic Errors for Geodetic Satellites and Novel LR Array Design	Appleby, Otsubo, Arnold, Kirchner, Neubert, Grunwaldt, Vasilliev
10	Data Quality Control Service for the ILRS Tracking Network	Otsubo, H. Müller, Pavlis, Torrence, Thaller, Glotov, Xiaoya, Appleby
11	Systematic errors in SLR Data: Documentation and Discussion of their Sources	Luceri, H. Müller, Vei, Appleby and Pavlis
12	Operational and Definitive Products of the ILRS Analysis Working Group	Sciarretta, Luceri, Pavlis and Kelm
13	*Monitoring Mass Redistribution in the Earth System with SLR*	*Pavlis, König, Ries, Deleflie, Cheng, H. Müller, ???*
14	*The ILRS Contribution to the International Terrestrial Reference Frame (ITRF)*	*Pavlis and the AWG ACs and CCs*

Peter Dunn to lead

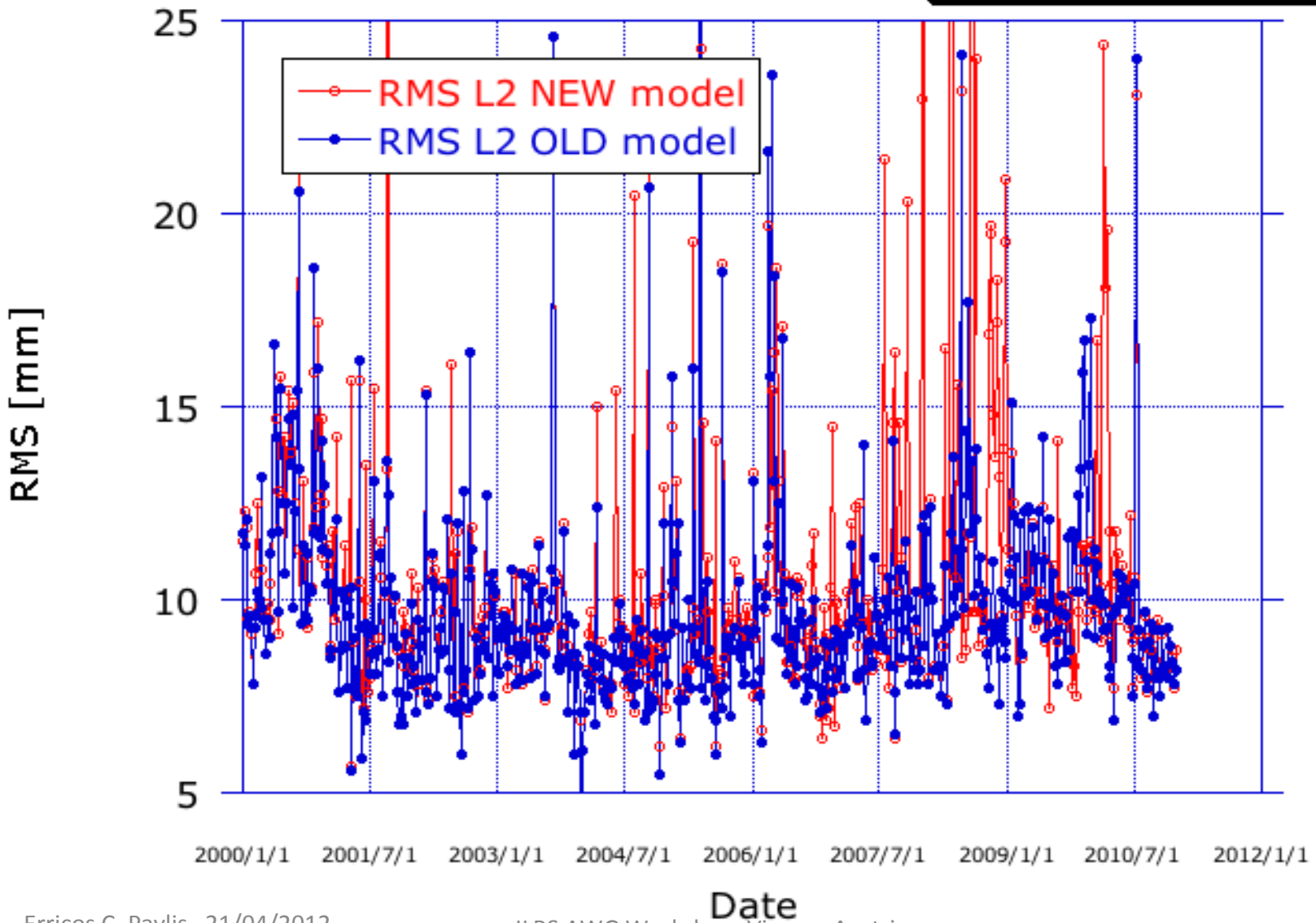
We also have EIGHT (8) "un-solicited" abstracts so far

1) **BOLD** indicates working title from author(s) for a submitted abstract
2) **RED** indicates lead author
3) *Non-bold entries in italics are still pending!!!*



	New Model	Old Model
Mean	10.04	10.04
Median	9.5	9.5
RMS	10.298	10.288
Std Deviation	2.296	2.253

	New Model	Old Model
Mean	10.38	9.75
Median	9.5	9.2
RMS	10.952	10.103
Std Deviation	3.511	2.645



Report from SGF Herstmonceux Analysis Centre

Graham Appleby

SGF Herstmonceux, UK

NATURAL ENVIRONMENT RESEARCH COUNCIL

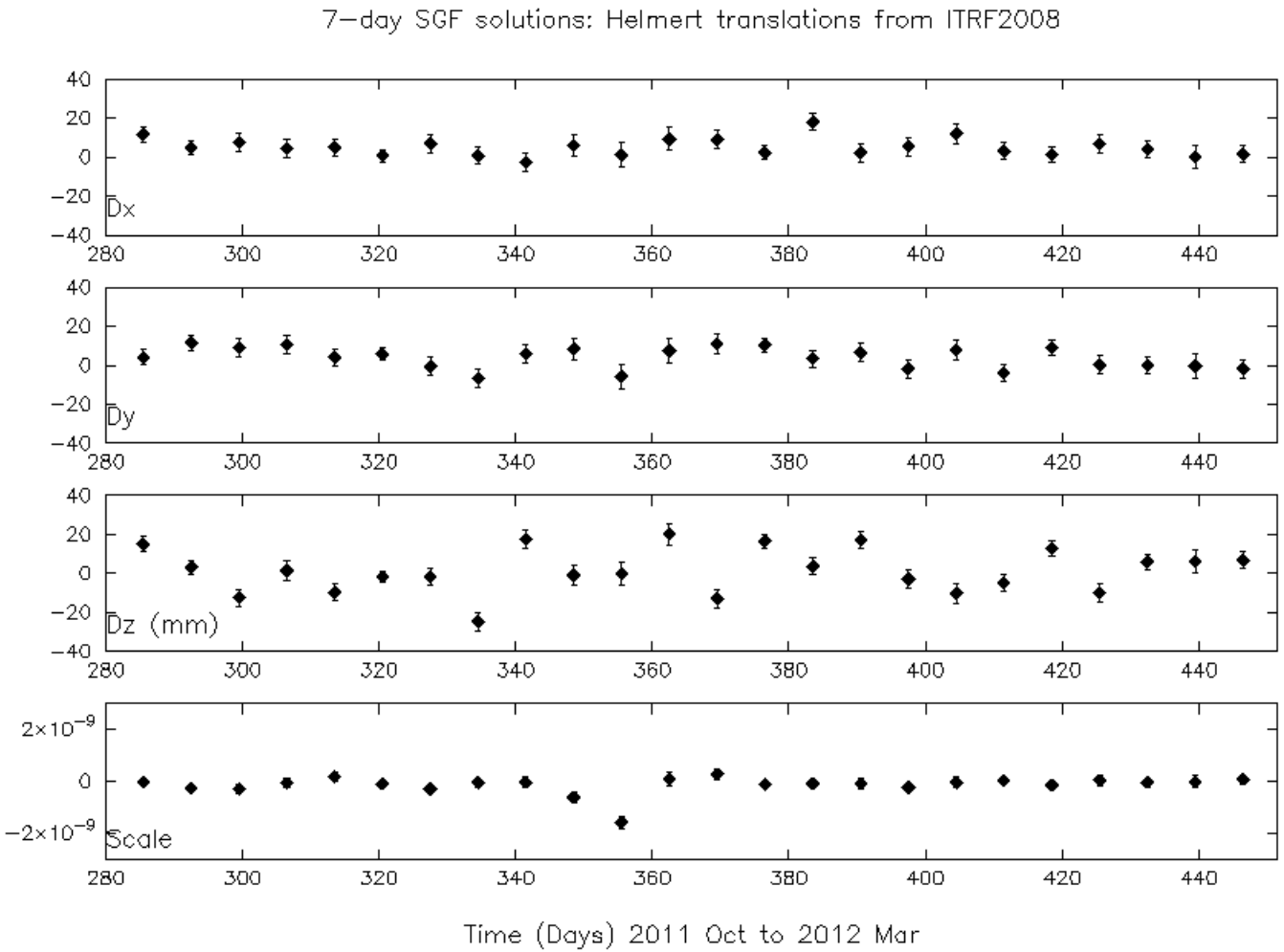
Detail from CoM table for LAGEOS

Station	Time-span		detector info	CoM min, max, adopted (mm)
7838	01 04 2008	31 12 2050	20 MCP CSM	3.0 6 15 252 248 **250**
7838	01 07 1990	01 04 2008	100 MCP CSM	3.0 20 40 252 248 **250**
7839	01 01 1983	31 12 2000	300 PMT NC	3.0 120 150 245 241 **243**
7839	01 11 1981	08 10 2003	35 CSP NCM	2.2 3 9 255 250 **252**
7839	09 10 2003	31 12 2050	10 CSP NSF	2.2 3 9 255 250 **252**
7840	01 02 2007	31 12 2050	10 CSP CS	2.5 3 9 245 245 **245**
7840	31 03 1983	31 03 1992	100 PMT NCF	3.0 35 45 252 244 **248**
7840	31 03 1992	31 12 2050	100 CSP CS	3.0 6 15 246 244 **245**
7841	20 07 2001	31 12 2050	50 PMT CSF	2.5 10 18 254 248 **251**

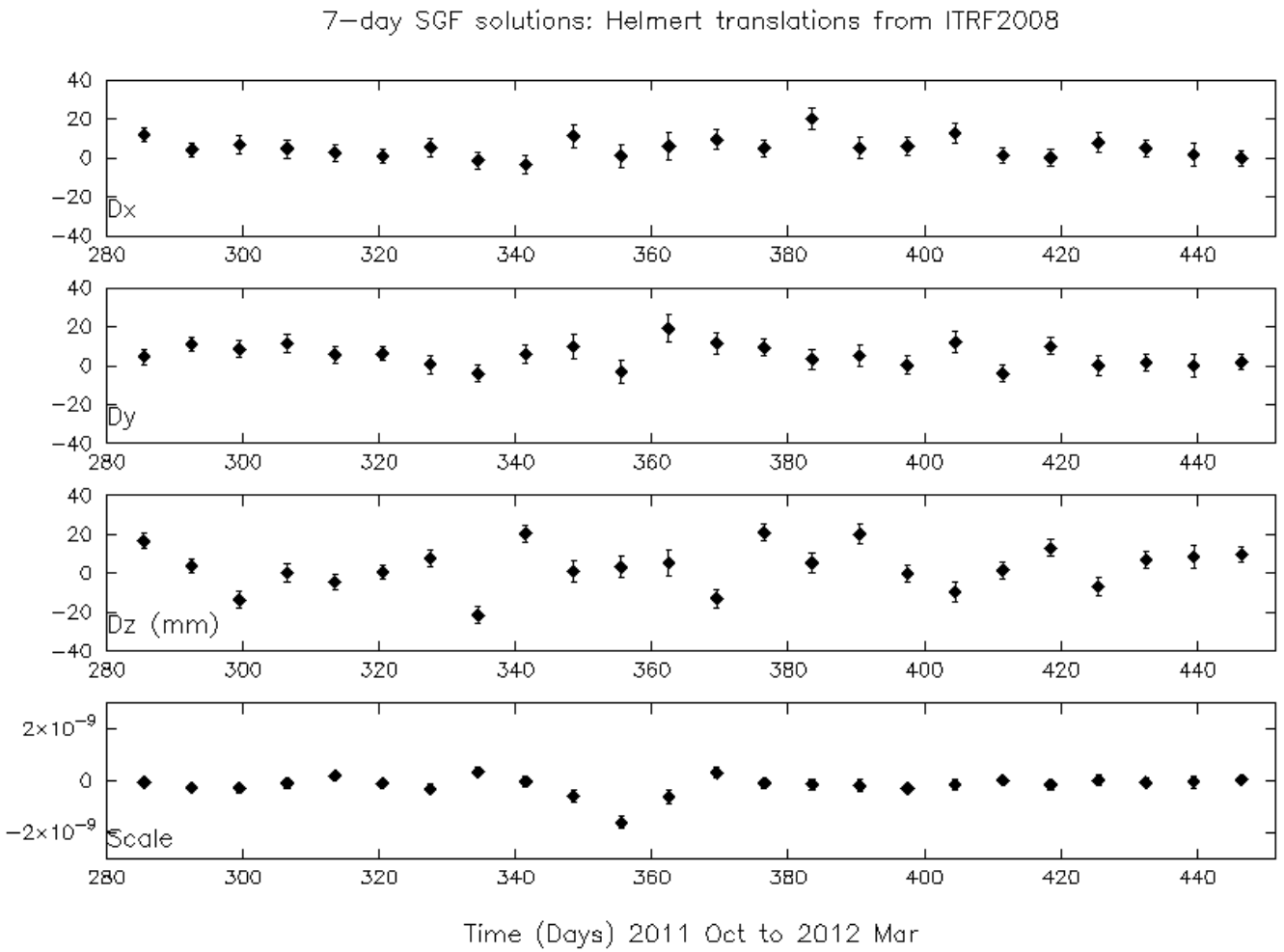
AWG Pilot Study CoM

- In common with all ACs, SGF carried out two weekly solutions, from October 2011:
- One (v30) the standard pos+eop
- Two (v35) using the new CoM correction tables, epoch and station-dependent
- Then Helmert (7-parameter) mapping of each weekly solution onto SLRF2008

‘Standard’ v30 solutions



New-CoM v35 solutions



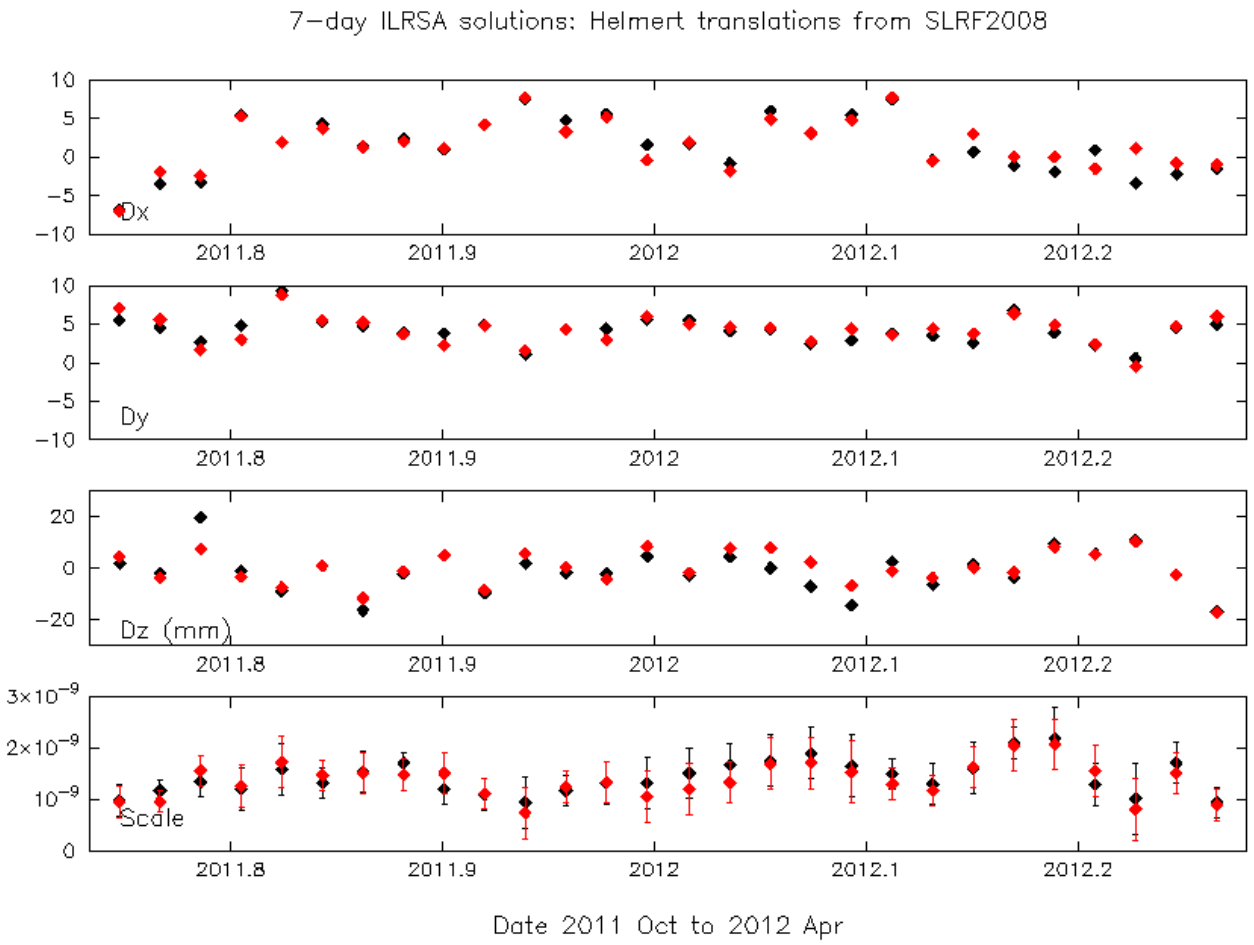
Summary of v30-v35 differences

- V30 mean scale difference from SLRF2008:
  - -0.13±0.05ppb
- V35 mean scale difference from SLRF2008:
  - -0.16±0.05ppb
- Difference in scale driven by more careful use of CoM values is only 0.03ppb

AWG Pilot Study CoM

- Also took weekly Helmert parameters from ILRSA summaries
- Primary CC maps ILRSA weekly combined v30 and combined v35 solutions each onto SLRF2008
- V30 average scale is 1.44ppb
- V35 average scale is 1.38ppb
  - Difference of 0.06ppb
- But of course GM is not a free parameter

Differences between ILRSA v30 and v35 combined solutions



CoM conclusions

- Not major issue?
- But important to model as well as possible
- Must consider CoM effects in context with those of poor site-ties and range measurement error issues
- Can we really say that some sites are range-error free?

Progress with updates to SATAN

- Some tests done on APL, as part of standard weekly solutions;
- Very little change in post-fit residual WRMS;
- Implementation working, needs full test

- No orbit SP3 files available yet – a priority
  - New team member at SGF getting involved

Progress with updates to SATAN

- Using ITRF2008 coordinates and IERS08_c04 as a-priori for daily and weekly ILRS coordinate and EOP solutions;
  - No progress with LoD problem
- Daily LAGEOS and Etalon QC web-based solutions also use ITRF2008.
- Atmospheric loading at observation level:
- Scheme devised to use Vienna APL V2 data:
- Interpolation in 6-hourly data to NP epochs during a data pre-processing stage

International Laser Ranging Service

LLR Status Report
- ILRS 2012 -

Jürgen Müller

Institut für Erdmessung (Institute of Geodesy) and

Center of Excellence QUEST
(Quantum Engineering and Space-Time Research)

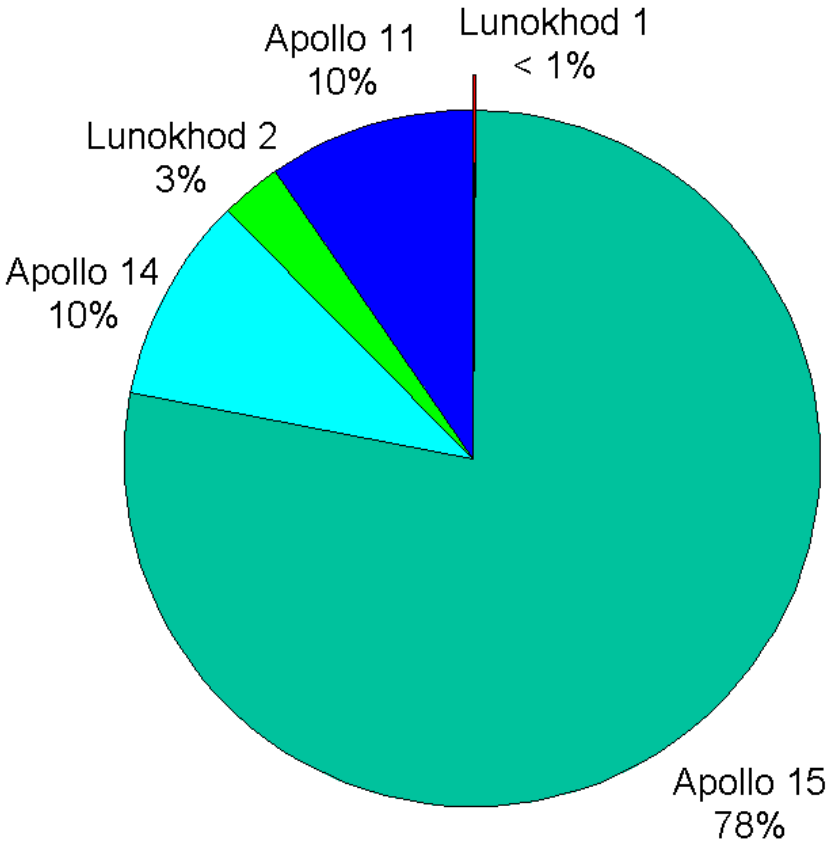
Leibniz Universität Hannover (University of Hannover)

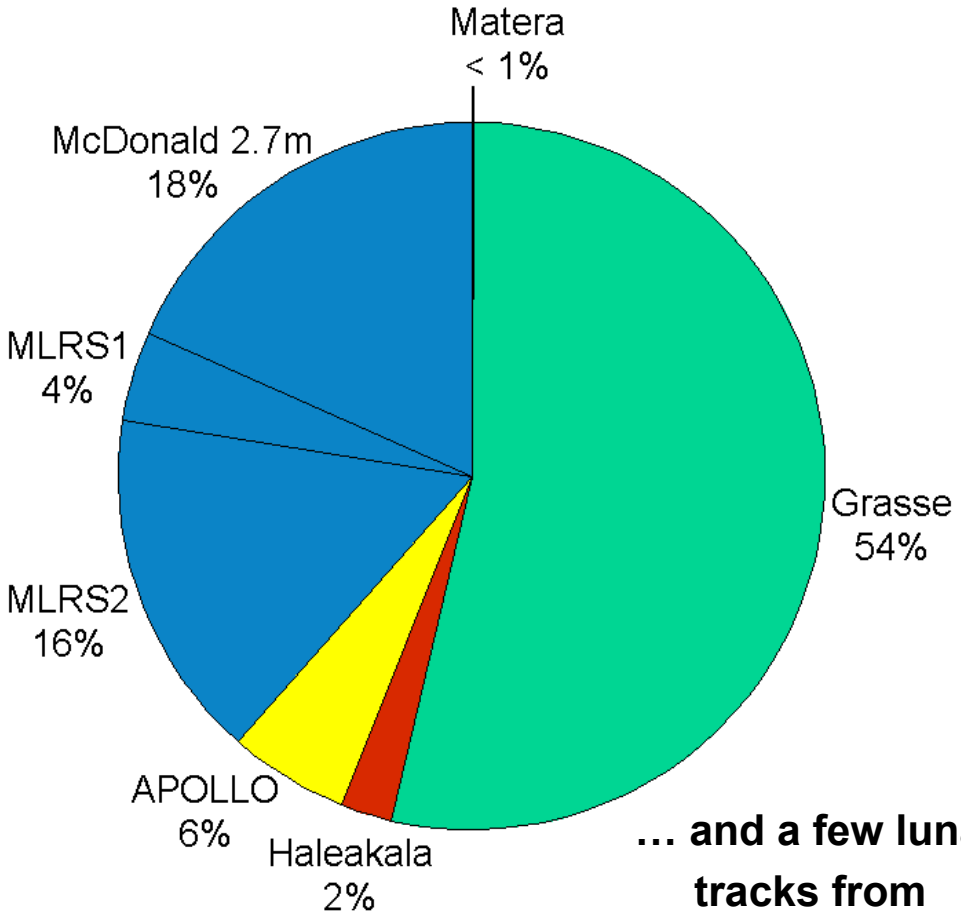
ife

Leibniz Universität Hannover

Statistics – retro-reflectors and observatories

Time span **1970-2011**



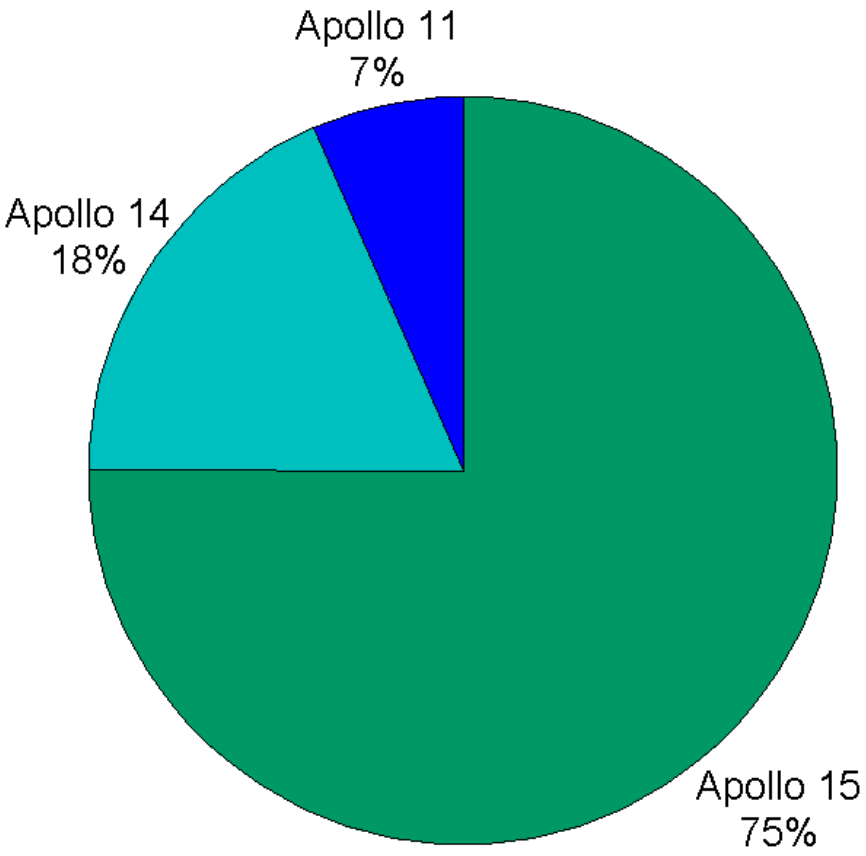


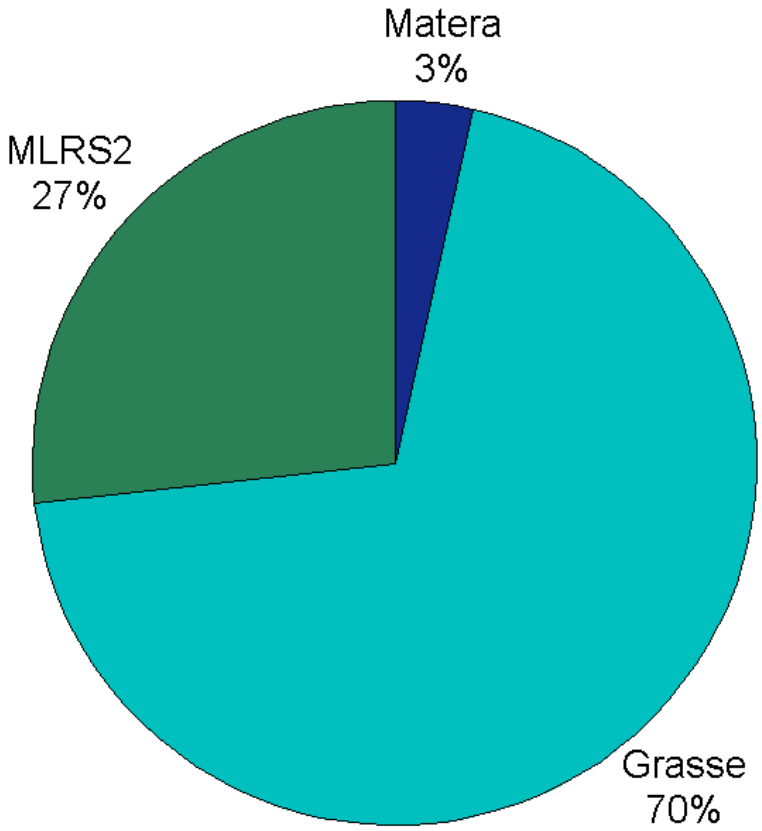
… and a few lunar tracks from

- **Orroral**
- **Wettzell**

Statistics – retro-reflectors and observatories

Only **2011**

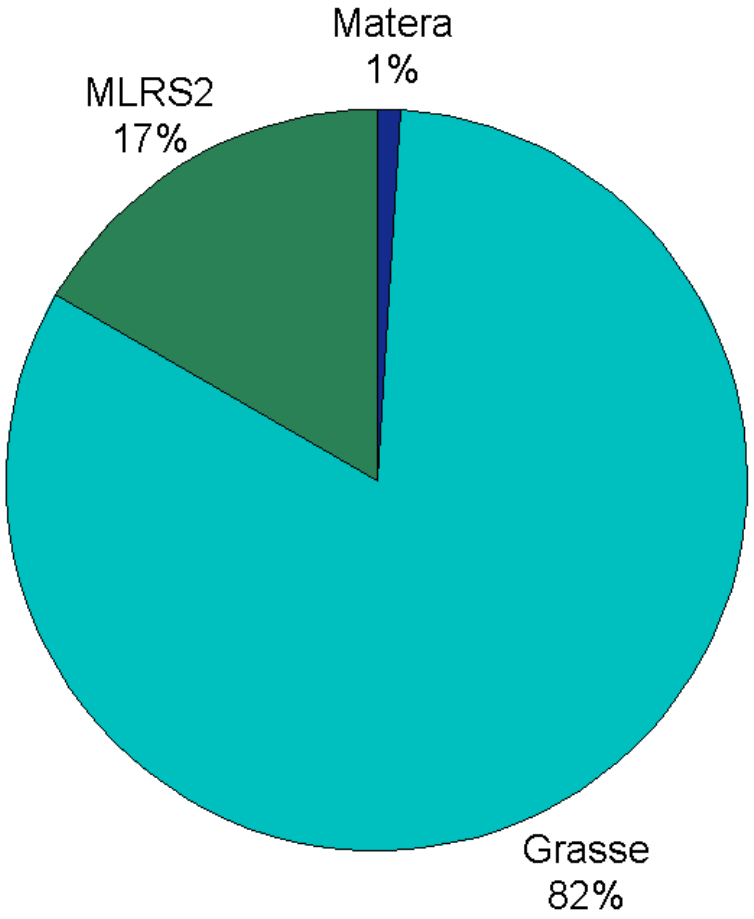




No APOLLO tracks and
no tracks to Lunokhod 1 and 2
in the archive for 2011

Statistics – observatories 2012

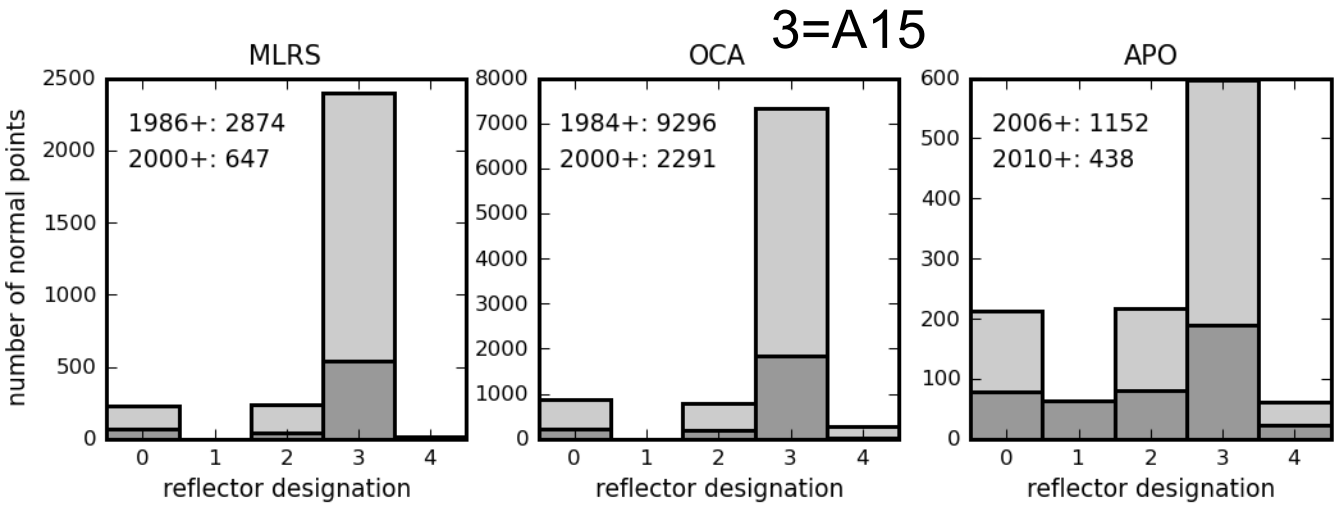
Only **2012** (until April)

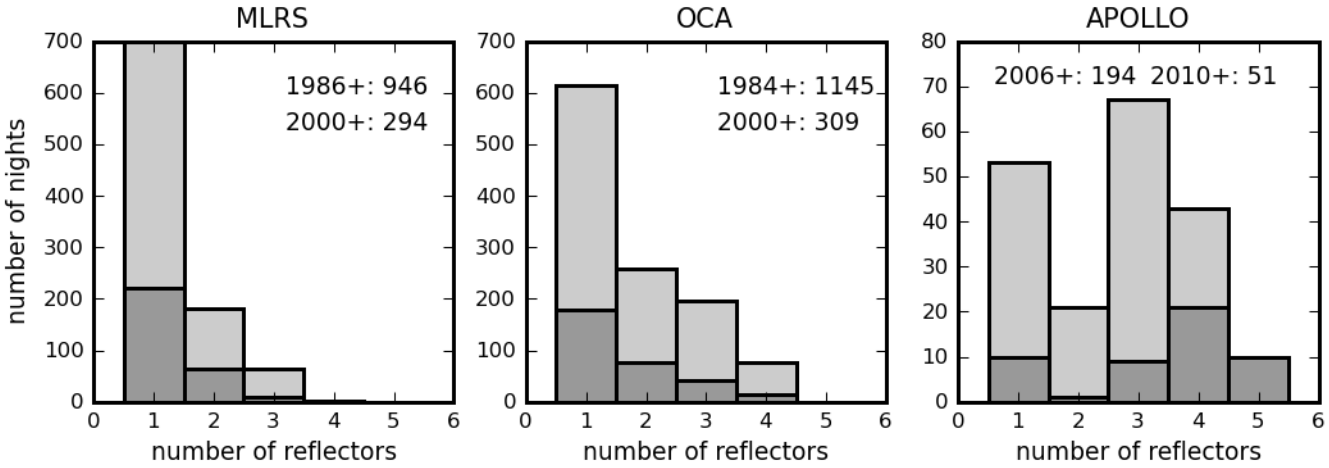


Statistics – retro-reflector acquisition

Number of normal point measurements per reflector for the major LLR sites

dark shade is only “recent years”





Number of reflectors acquired per night of observation

dark shade is only “recent years”

Status, perspective at the LLR sites

- McDonald continued lunar tracking (at low level?)
- APOLLO - good LLR data, but no “official archiving”
- Grasse re-started lunar tracking by end of 2009, less returns in 2010, good performance since end of 2011
- Matera re-started lunar tracking in spring 2010, now routine operation (?)
- Wettzell will soon resume – first attempts have been made

Perspective for the LLR retro-reflectors

- Future lunar missions, e.g., pushed by Google Lunar X Prize (http://en.wikipedia.org/wiki/Google_Lunar_X_Prize) may damage the retro-reflectors on the moon in the *worst case* (casting of dust onto, shift of retro-reflectors, etc.).
  In the *best case*, those missions could also be helpful for us (visual inspection or even “cleaning” of retro-reflectors, …).

- NASA report (NASA-USG_lunar_historic_sites.pdf) shows awareness of the ongoing LLR effort and the importance of the LLR sites on the moon.

Major LLR-related activities

- ISSI workshop series on LLR modelling and analysis (start 2009), final meeting in spring 2012
- Boston workshop 2010 on comparison of LLR software packages
- ILRS initiative on LLR data qualification
- Joint LLR paper in ILRS JoG special issue (subm., 2012)
- In Germany: New DFG Research unit “Reference systems” (speaker A. Nothnagel, Bonn) with **2 LLR related projects**
  - Moon-related systems
  - Barycentric ephemeris

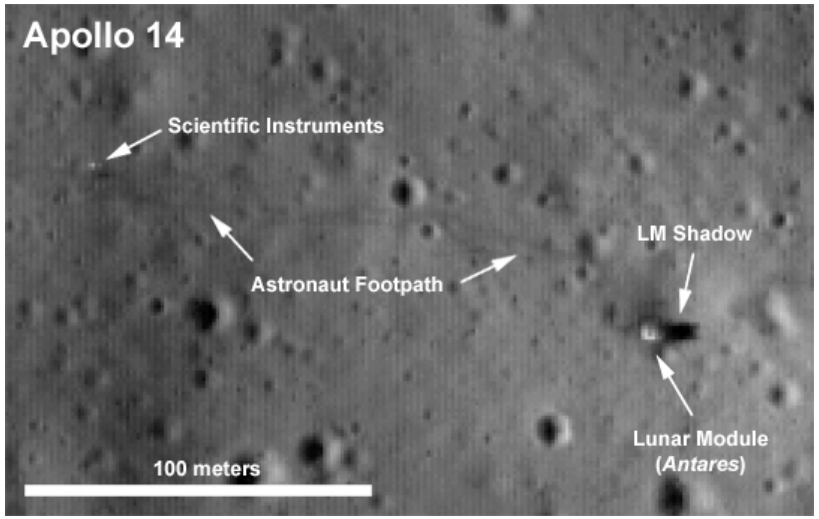
  has begun on 1 March 2012.

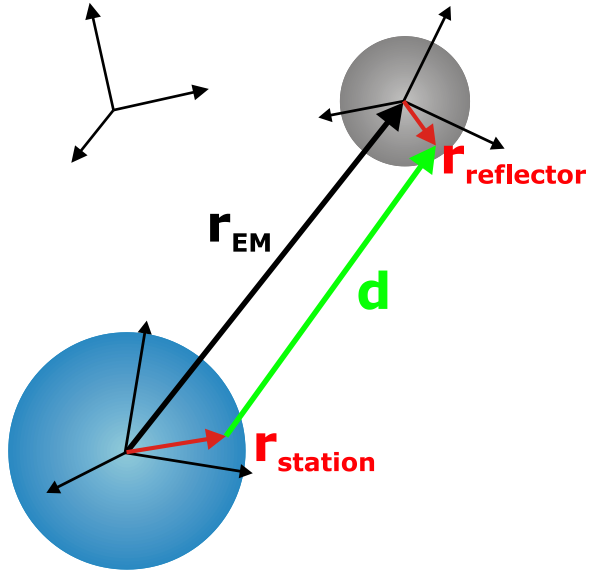
Project „Moon-related systems“

Moon-related reference systems are indispensable

- to link terrestrial and celestial reference systems and
- to advance lunar science and space exploration

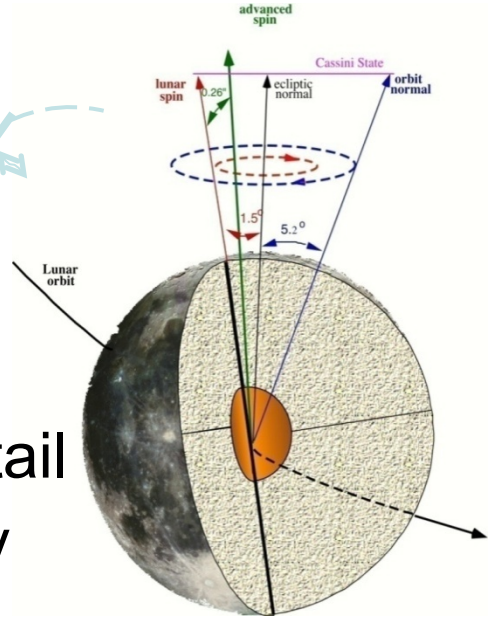
This project prepares the application of established methods for mapping and surveying the Earth to extra-terrestrial bodies.





Objectives

Provide next-generation lunar reference systems for geodesy, astronomy, and exploration.

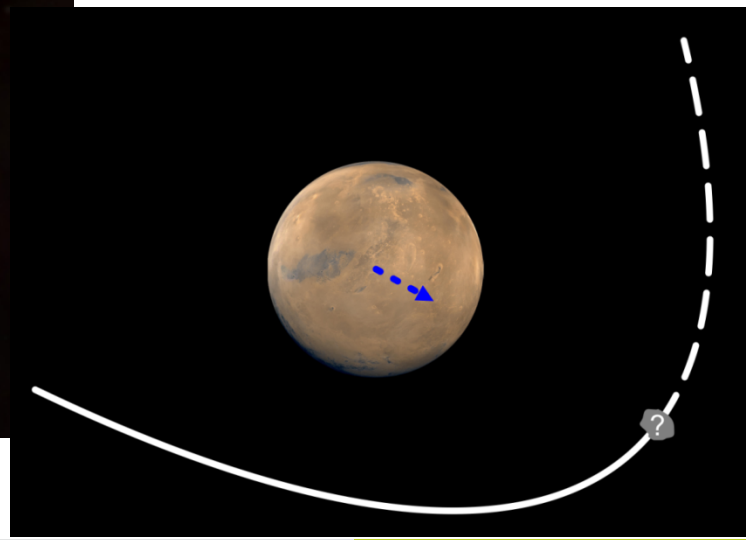


To achieve this:

- improve lunar models (lunar rotation, interior)
- integrate novel data sets in available s/w
- determine (new) parameters (e.g., tidal)
- realize the Moon-fixed coordinate system in detail
- deliver control point networks and geometrically accurate base maps
- carry out sensitivity studies and simulations of future geodetic experiments
- tie the stable Moon orbit into the inertial and terrestrial reference systems (realized by space geodetic techniques)

Project „Barycentric ephemeris“

Special aspects of an improved solar system ephemeris (additional forces and torques, lunar librations, asteroid perturbations, different timescale, solar mass loss, etc.)



Objectives

- Extension of existing LLR code to a full solar-system ephemeris
- Improvements of the force/torque model
  - additional figure-figure and relativistic interactions in the Earth-Moon system
  - librations: considering the full internal structure of the Moon (solid inner core)
  - considering effects from (unseen) asteroids
- work towards an independent fit to observational data

Beyond the first 3 years → high precision ephemeris by

- better data combination strategy
- long-term stability, e.g. for palaeo-climate studies, by means of
  - new integrators (symplectic, ...),
  - optimization w.r.t. computing time (parallelization, ...)

Links to other projects

INPOP: J. Laskar, A. Fienga (Paris, Besancon)
DE: W. Folkner (JPL)
EPM: E. Pitjeva (St. Petersburg)

The GAIA community (S. Klioner …)

Main research at lunar analysis centers

- Jet Propulsion Laboratory (JPL)
  - lunar interior, lunar core
  - relativity
- Paris Observatory Lunar Analysis Center (POLAC)
  - libration theory
  - reference frames
- Institute of Geodesy (IfE)
  - relativity
  - Earth orientation
  - lunar interior
- Others: special topics ...

LLR tests of general relativity

Equivalence Principle

$$\eta = (3.0 \pm 3.6) \times 10^{-4}$$

$$\left[\frac{M_G}{M_I}\right]_{SEP} - 1 = (-1.4 \pm 1.6) \times 10^{-13}$$

Müller et al., CQG 2012

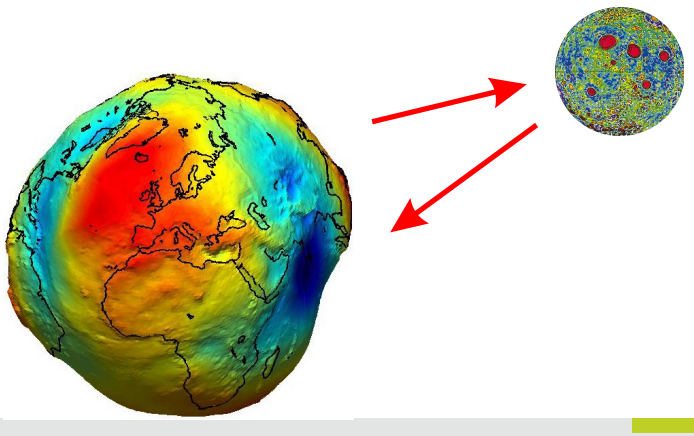
EP test with LLR is a combination of weak and strong EP test
(different compositions and additional gravitational self energy)

Temporal variation of the gravitational constant

$$G = G_0\left(1 + \frac{\dot{G}}{G}\Delta t + \ldots\right)$$

$$\frac{\dot{G}}{G} = (1 \pm 2.5) \times 10^{-13}\,\mathrm{yr}^{-1}$$

Müller et al., IAG Springer 2012



ILRSA CC
Status of the orbit files combination

C. Sciarretta, V. Luceri
eGEOS S.p.A., CGS – Matera

G. Bianco
Agenzia Spaziale Italiana, CGS - Matera

ILRS AWG Meeting, 21 April 2012, Wien

Contents

- Updated combination strategy outline
- Present data availability
- Preliminary orbit files evaluation
  - format and ILRS reqs adherence
  - consistency
- Recommendations for the next steps

Previous test: remarks

- Previous test on 1 month data -> 1 week is representative as well
- Only gfz and bkg were coherent ~5cm C-A L51/L52
- Big problems in C-A for all the other solutions

Overall statistics (previous test)

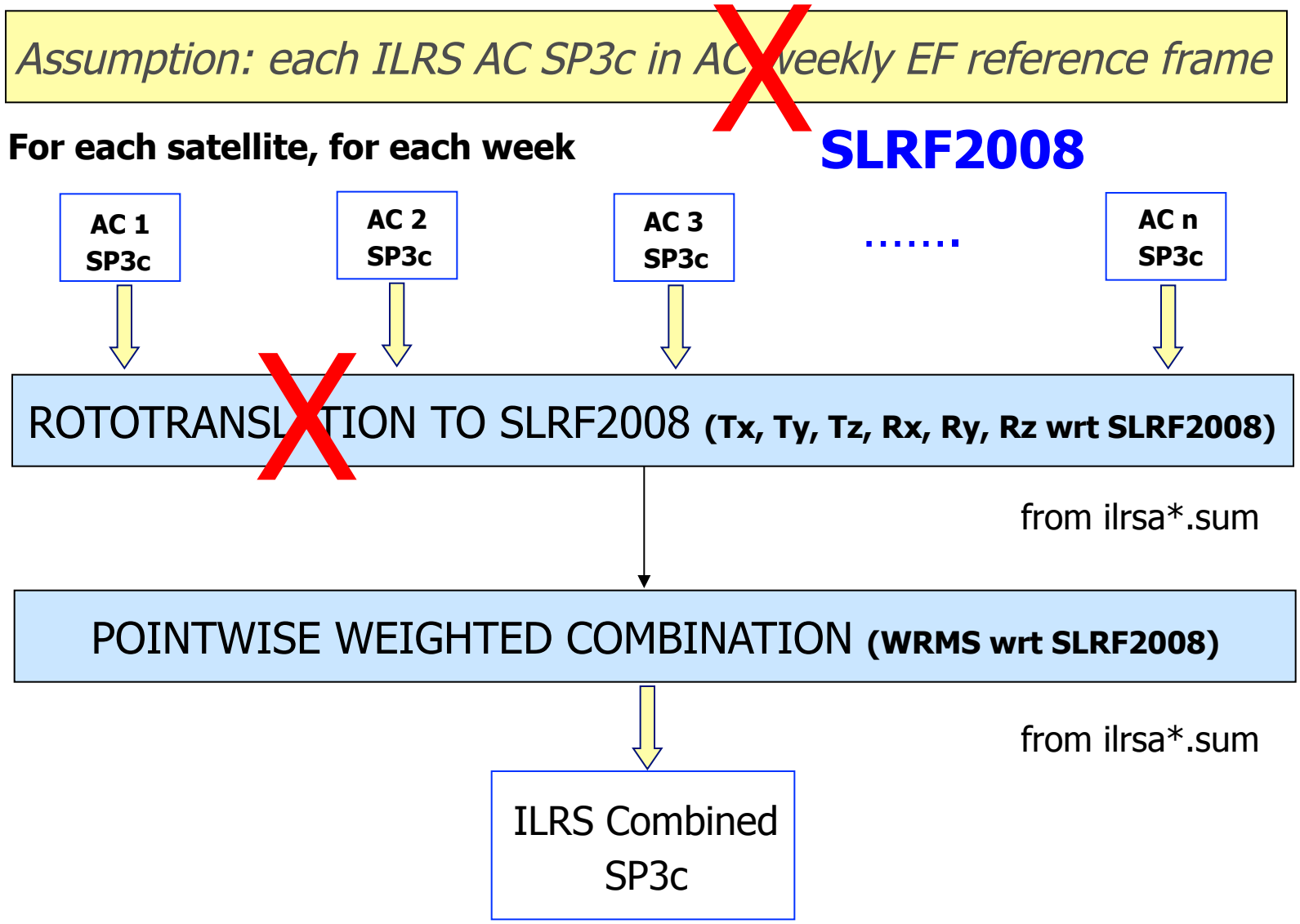
L51 Position differences (cm)		ASI	BKG	GA
BKG -	R	+0.06 ± 0.60		
	C	+0.09 ± 6.83		
	A	-0.73 ± 31.11		
GA -	R	+0.01 ± 1.20	-0.05 ± 1.14	
	C	-0.03 ± 13.65	-0.12 ± 14.89	
	A	-5.76 ± 23.54	-5.03 ± 17.52	
GFZ -	R	+0.08 ± 0.82	+0.02 ± 0.97	+0.09 ± 1.15
	C	+0.11 ± 6.21	+0.03 ± 4.10	+0.15 ± 13.38
	A	-0.28 ± 30.35	+0.46 ± 5.60	+2.45 ± 21.28

L52 Position differences (cm)		ASI	BKG	GA
BKG -	R	+0.03 ± 0.78		
	C	+0.27 ± 7.41		
	A	-3.55 ± 50.61		
GA -	R	-0.06 ± 1.13	-0.08 ± 1.07	
	C	-0.21 ± 13.27	-0.48 ± 14.98	
	A	+11.01 ± 18.24	+14.56 ± 33.87	
GFZ -	R	-0.03 ± 1.37	-0.06 ± 1.19	+0.03 ± 1.60
	C	+0.08 ± 8.09	-0.19 ± 4.39	+0.26 ± 13.72
	A	-2.94 ± 50.82	+0.62 ± 5.43	-14.59 ± 35.03

L53 Position differences (m)		ASI	BKG
BKG -	R	-0.01 ± 0.14	
	C	-0.13 ± 0.59	
	A	-0.13 ± 0.57	
GA -	R	-0.58 ± 0.48	-0.57 ± 0.51
	C	+0.40 ± 13.78	+0.51 ± 13.65
	A	+26.45 ± 26.23	+26.50 ± 25.90

L54 Position differences (m)		ASI	BKG
BKG -	R	-0.01 ± 0.02	
	C	+0.01 ± 0.17	
	A	+0.09 ± 0.24	
GA -	R	+0.25 ± 0.65	+0.26 ± 0.65
	C	-0.13 ± 11.65	-0.11 ± 11.57
	A	-11.73 ± 29.20	-11.78 ± 29.12

New combination strategy outline



SP3 test data set and strategy

- L51/L52/L53/L54 SP3c files 120310 week available at CDDIS and EDC
- cross-evaluate their consistency in R-C-A

Assumptions

- EF frame tied to SLRF2008 (C04)
- UTC
- SP3c format
- 2’ POS/VEL L51/L52
- 15’ POS/VEL L53/L54

SP3 availability and format adherence

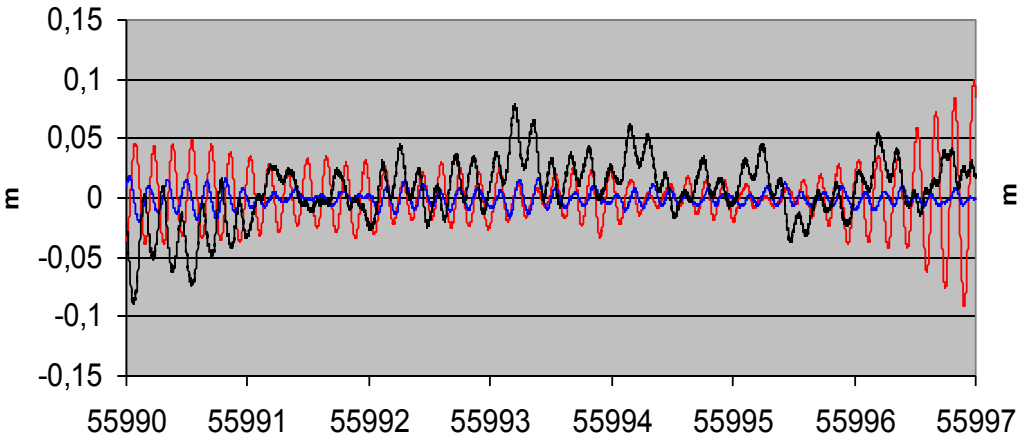
			Comments/notes
ASI	L51	X	OK
	L52	X	
	L53	X	
	L54	X	
BKG	L51	x	OK
	L52	X	
	L53	X	
	L54	X	
DGFI	L51	x	OK
	L52	X	
	L53	X	
	L54	X	
ESA	L51	X	On edc only (v36) P only
	L52	X	
	L53	X	
	L54	X	

			Comments/notes
GA	L51	X	OK
	L52	X	
	L53	X	
	L54	X	
GFZ	L51	X	OK
	L52	X	
	L53	-	
	L54	-	
GRGS	L51	X	TAI -> not usable
	L52	X	
	L53	-	
	L54	-	
JCET	L51	X	Small error in the sp3 header lines
	L52	X	
	L53	X	
	L54	X	

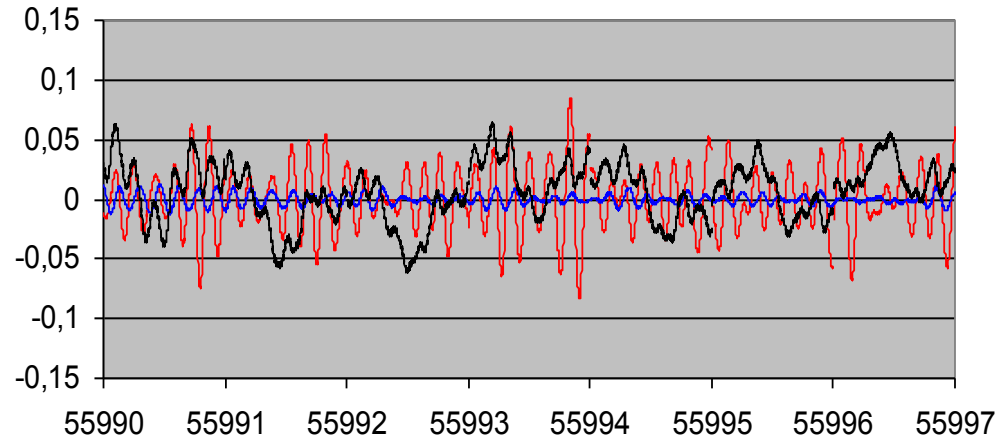
NSGF not available up to now

L51 ASI-BKG-GFZ

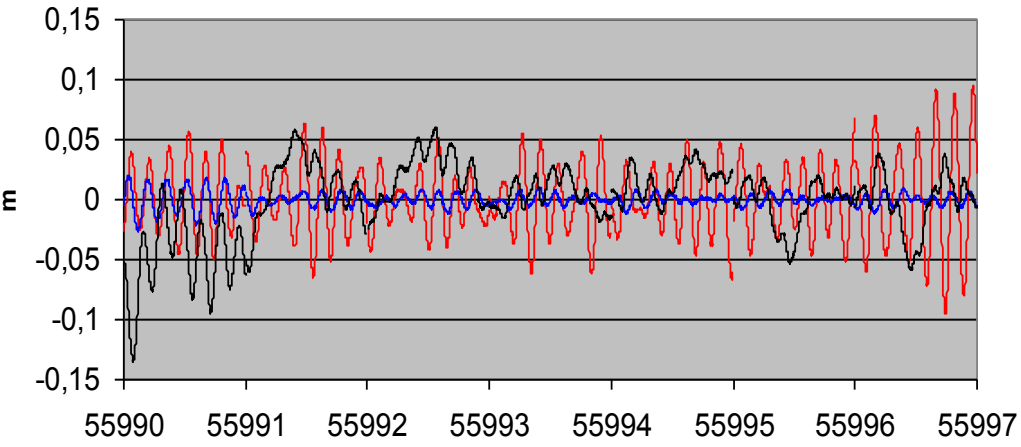
GFZ-BKG



ASI-BKG

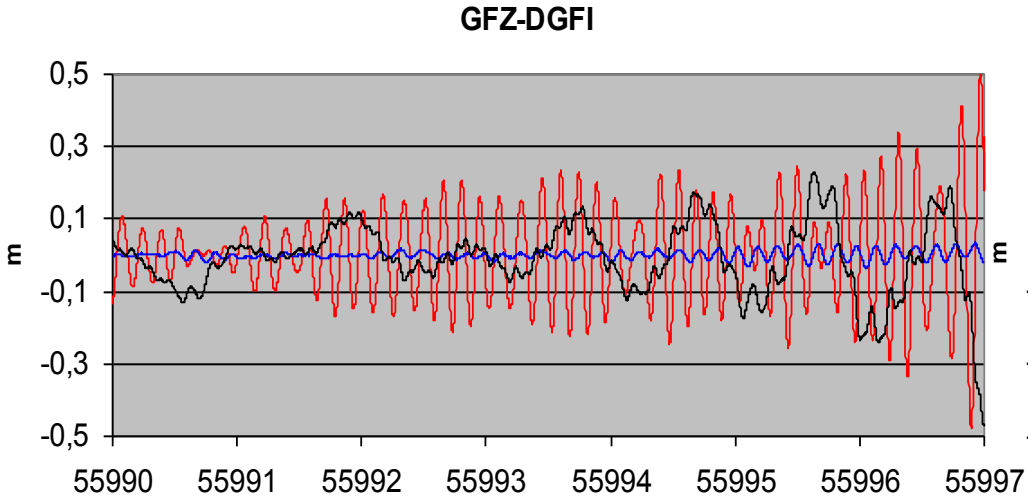


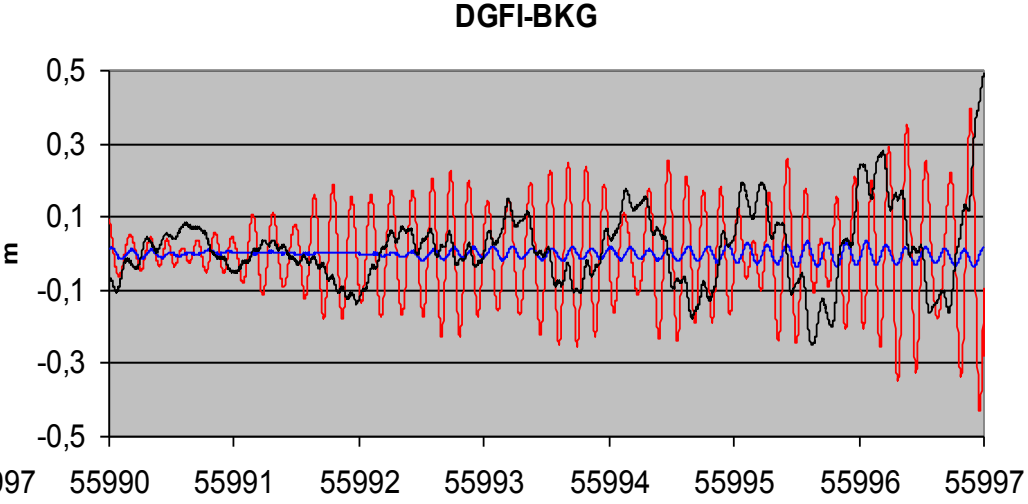
GFZ-ASI

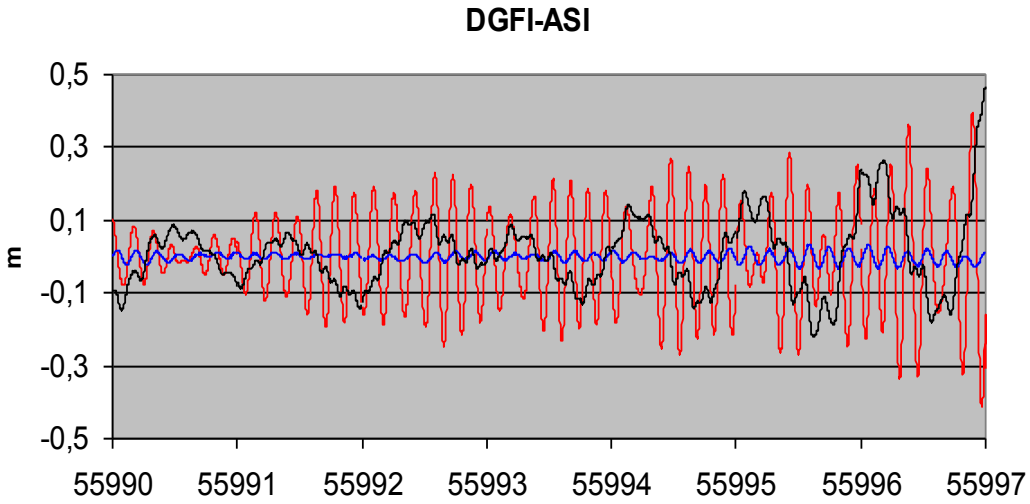


GFZ – BKG cm	R	-0.04 ± 0.66
	C	+0.05 ± 2.38
	A	+0.58 ± 2.57
GFZ – ASI cm	R	-0.02 ± 0.63
	C	+0.02 ± 3.17
	A	-0.01 ± 3.08
ASI-BKG cm	R	-0.02 ± 0.47
	C	+0.02 ± 2.72
	A	+0.60 ± 2.50

L51 DGFI vs ASI-BKG-GFZ

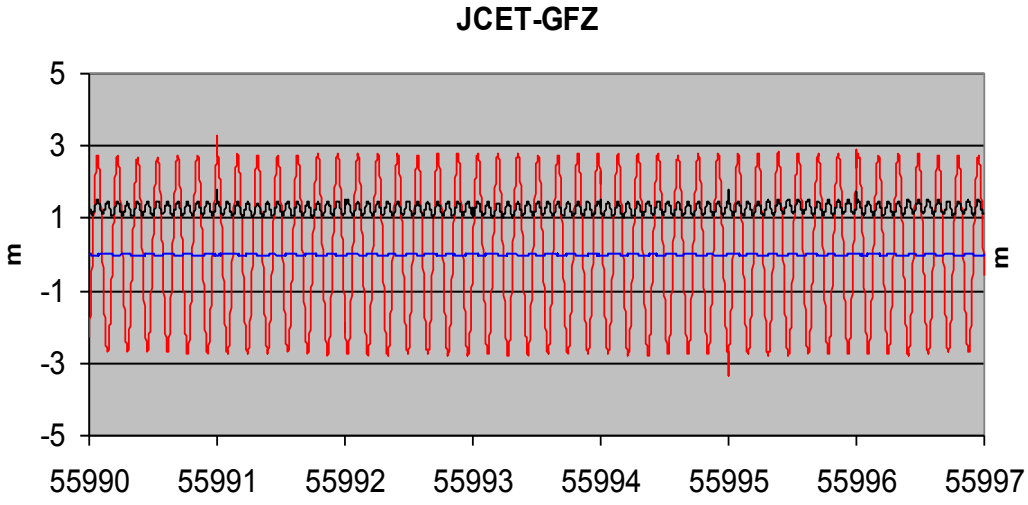


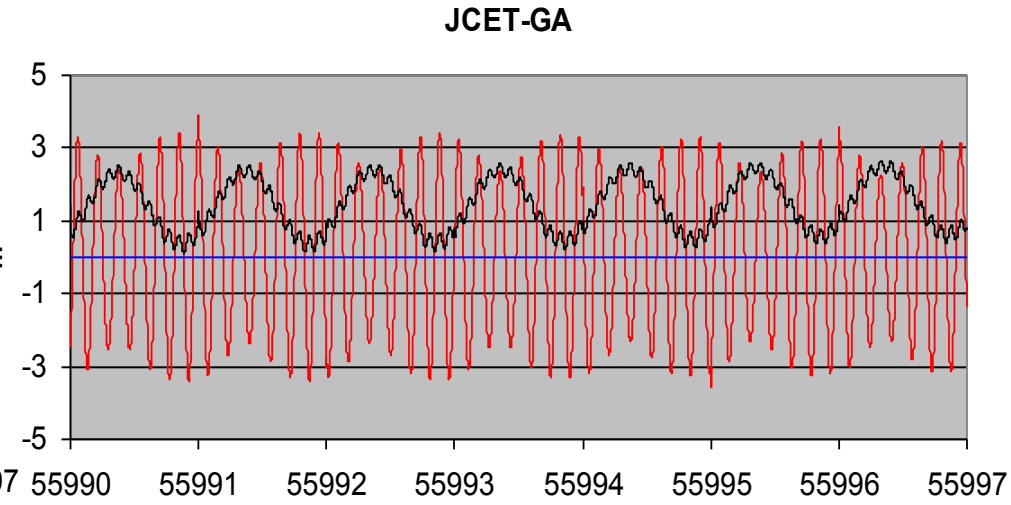


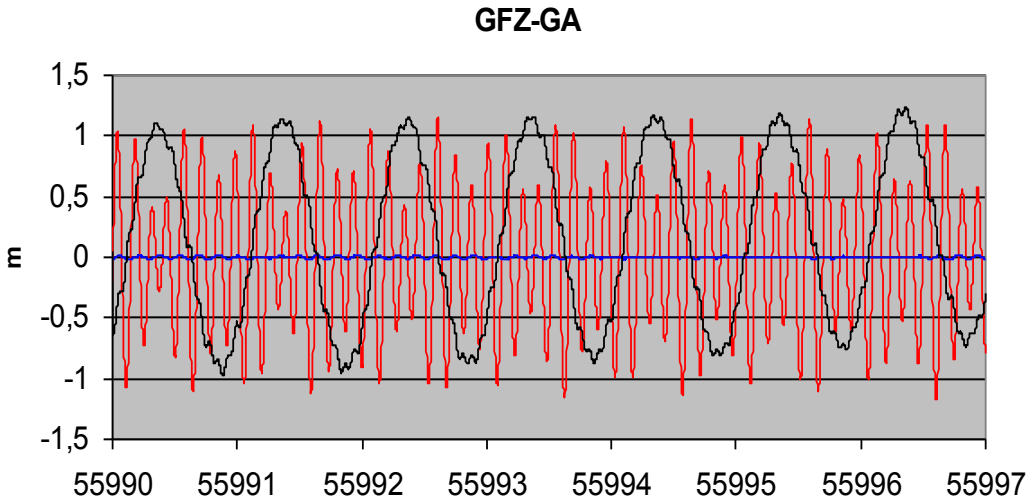


GFZ – DGFI cm	R	+0.07 ± 1.17
	C	+0.33 ± 13.46
	A	-0.86 ± 9.68
DGFI – ASI cm	R	-0.09 ± 1.23
	C	-0.31 ± 13.64
	A	+0.85 ± 9.94
DGFI-BKG cm	R	-0.11 ± 1.35
	C	-0.28 ± 13.38
	A	+1.45 ± 10.39

L51 JCET, GA vs GFZ

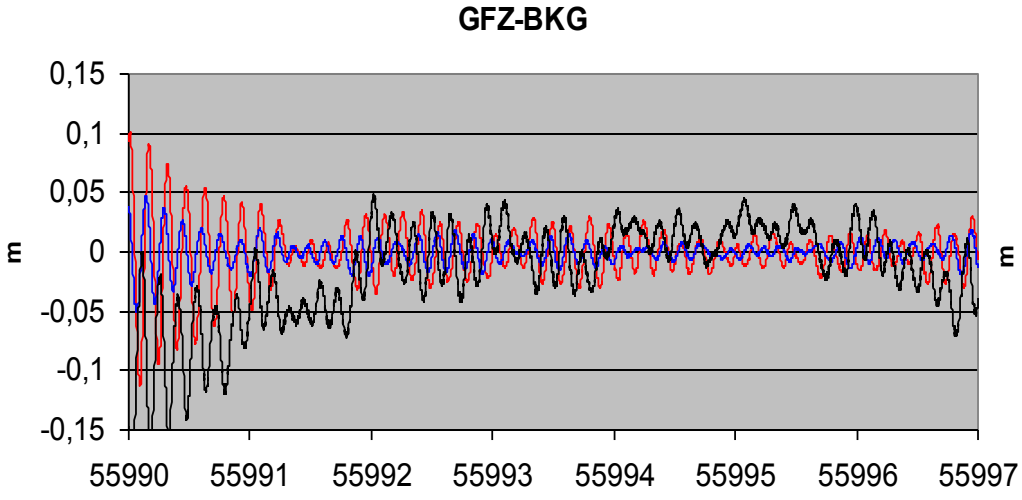


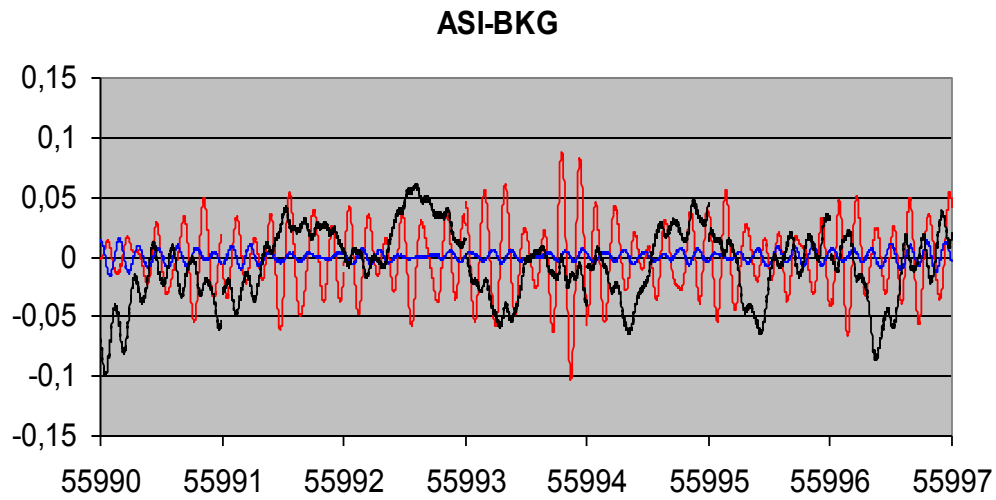


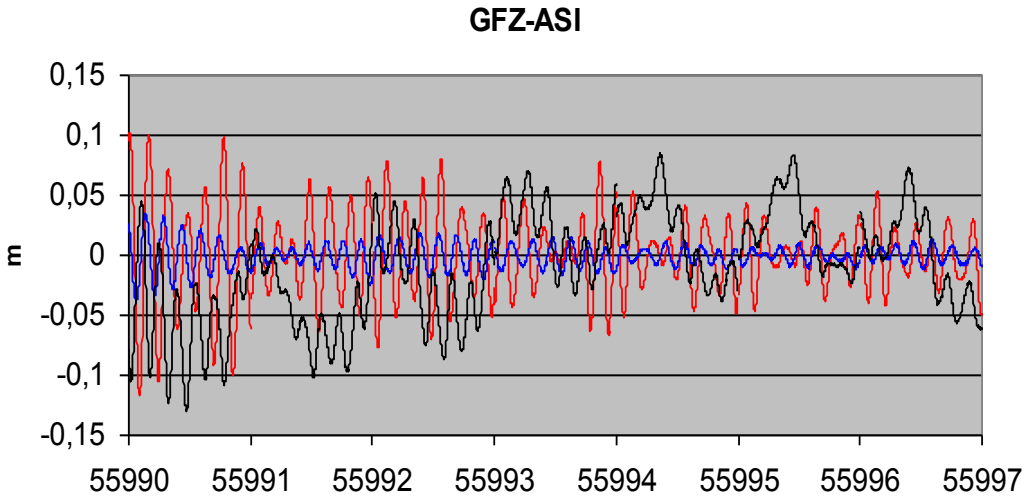


JCET - GFZ cm	R	+0.00 ± 0.57
	C	+3.19 ± 194.98
	A	-127.70 ± 14.26
GFZ – GA cm	R	-0.07 ± 0.83
	C	+0.30 ± 60.57
	A	+15.35 ± 69.81
JCET - GA cm	R	-0.07 ± 0.52
	C	+3.48 ± 208.98
	A	+143.05 ± 71.09

L52 ASI-BKG-GFZ

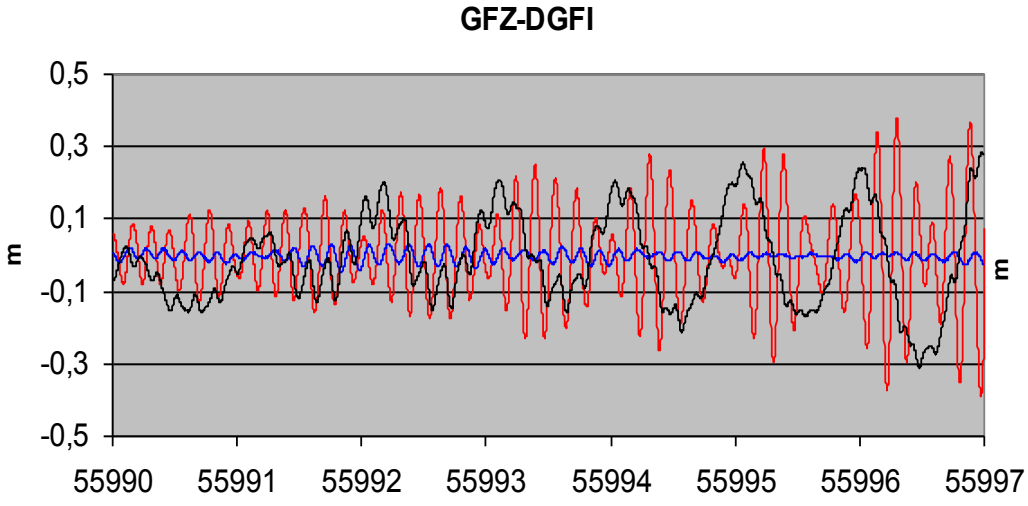


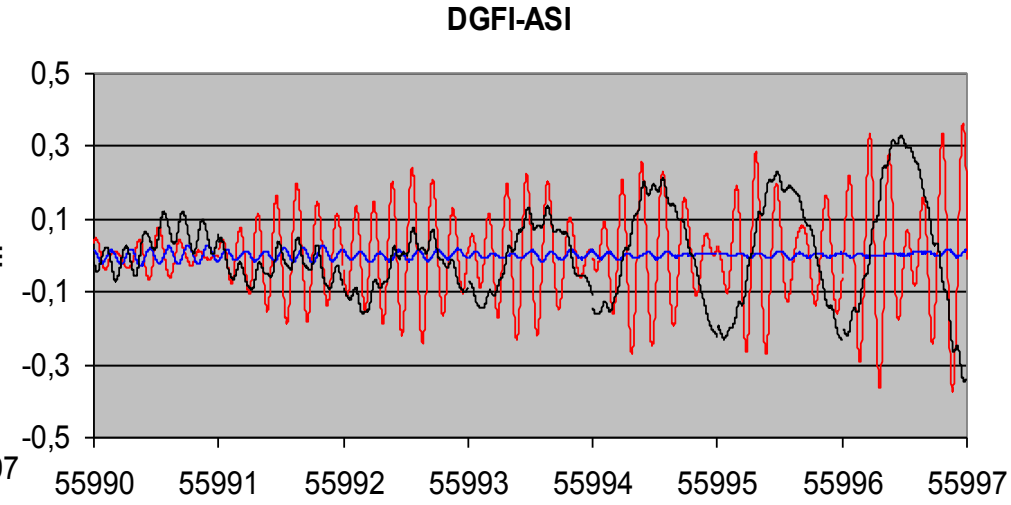


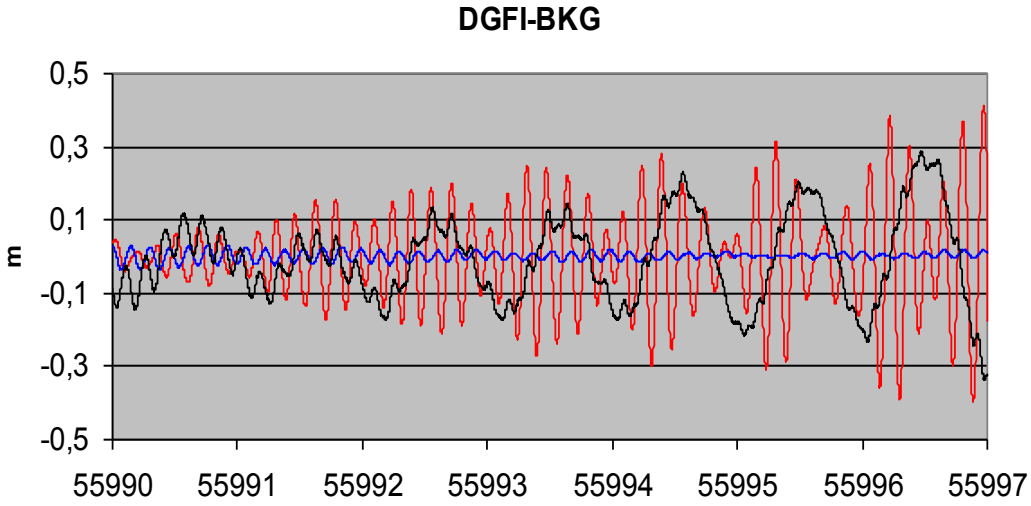


GFZ – BKG cm	R	-0.03 ± 1.10
	C	-0.11 ± 2.47
	A	-1.57 ± 4.09
GFZ – ASI cm	R	-0.08 ± 1.02
	C	+0.06 ± 3.55
	A	-0.90 ± 4.42
ASI-BKG cm	R	+0.04 ± 0.48
	C	-0.17 ± 2.92
	A	-0.67 ± 3.04

L52 DGFI vs ASI-BKG-GFZ

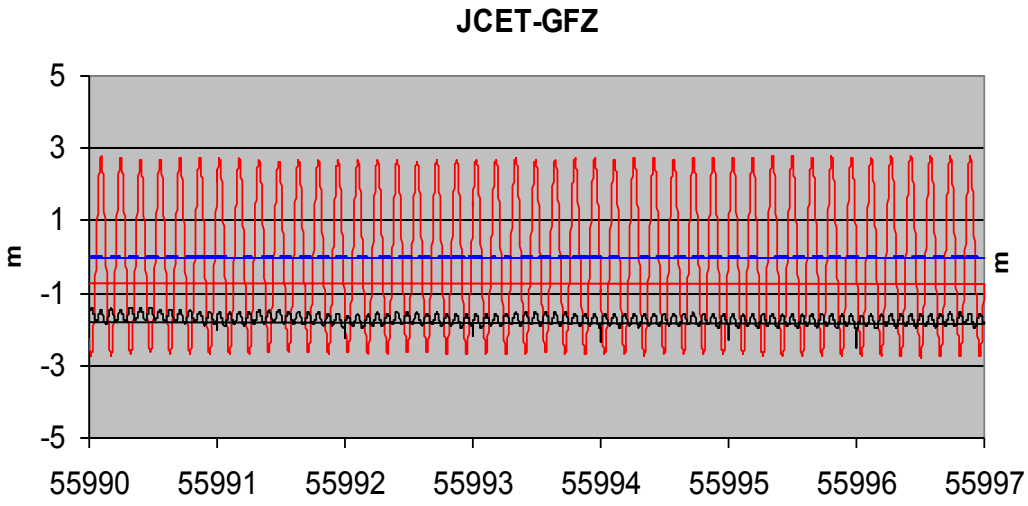


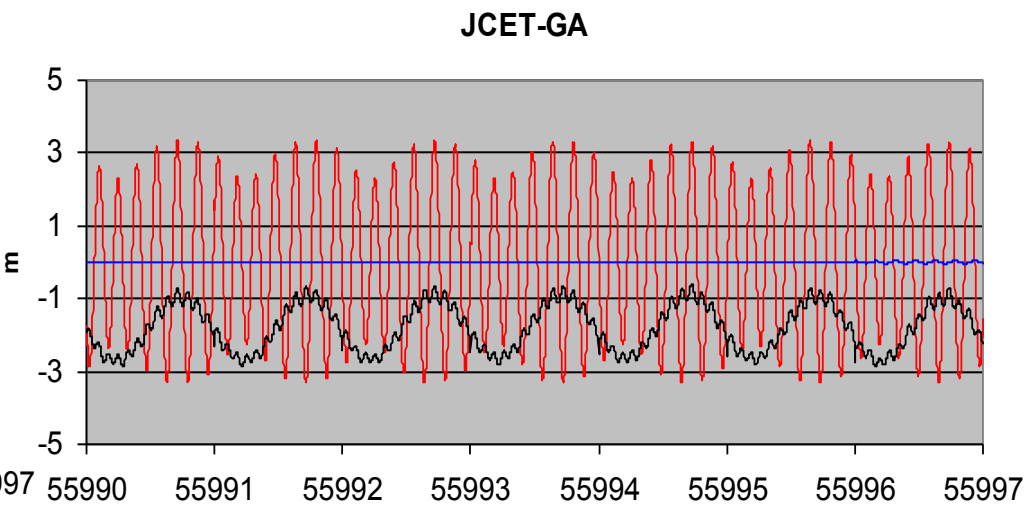


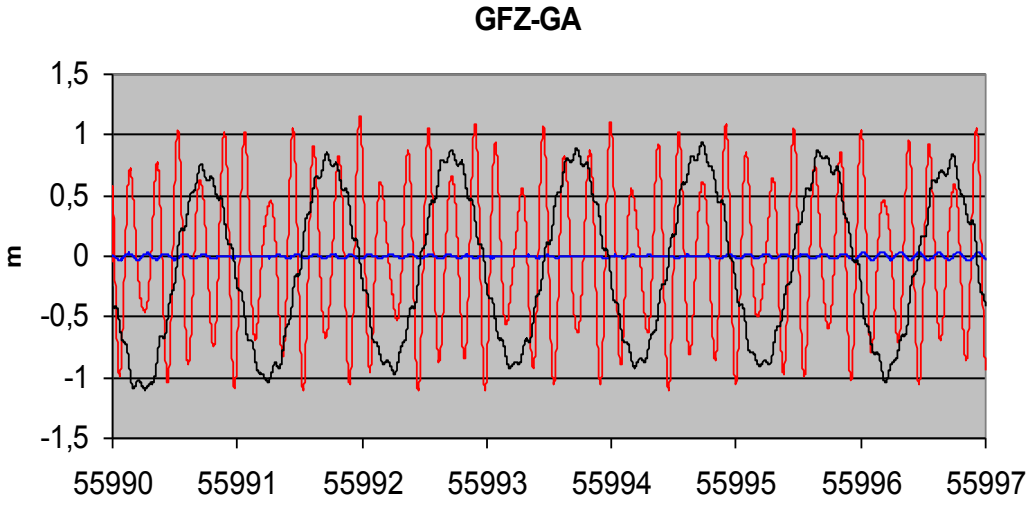


GFZ – DGFI cm	R	-0.23 ± 1.36
	C	+0.07 ± 13.04
	A	-1.07 ± 12.60
DGFI – ASI cm	R	+0.15 ± 1.00
	C	-0.01 ± 12.68
	A	+0.18 ± 12.45
DGFI-BKG cm	R	+0.20 ± 1.21
	C	-0.18 ± 13.62
	A	-0.50 ± 11.89

L52 JCET, GA vs GFZ





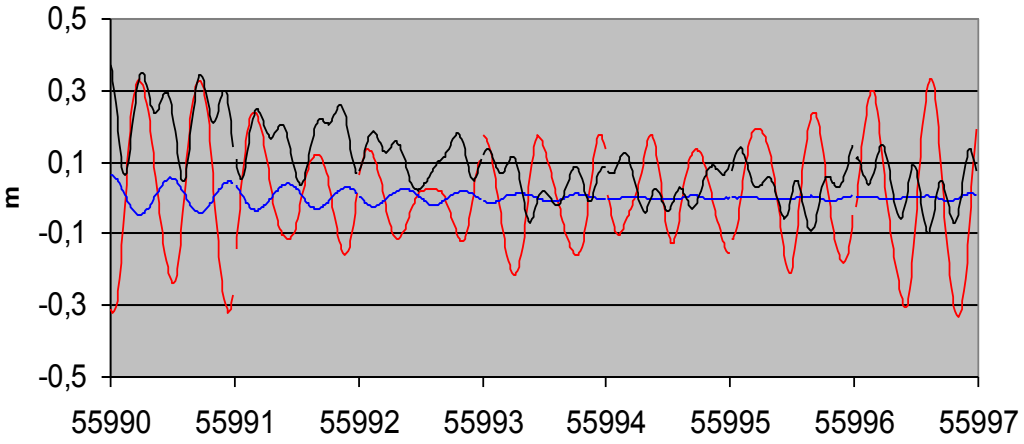


JCET - GFZ cm	R	+0.09 ± 0.64
	C	+0.76 ± 191.88
	A	+171.50 ± 13.57
GFZ – GA cm	R	-0.07 ± 1.34
	C	-0.17 ± 60.74
	A	-7.05 ± 62.47
JCET - GA cm	R	+0.07 ± 1.19
	C	+0.58 ± 207.26
	A	+178.56 ± 63.73

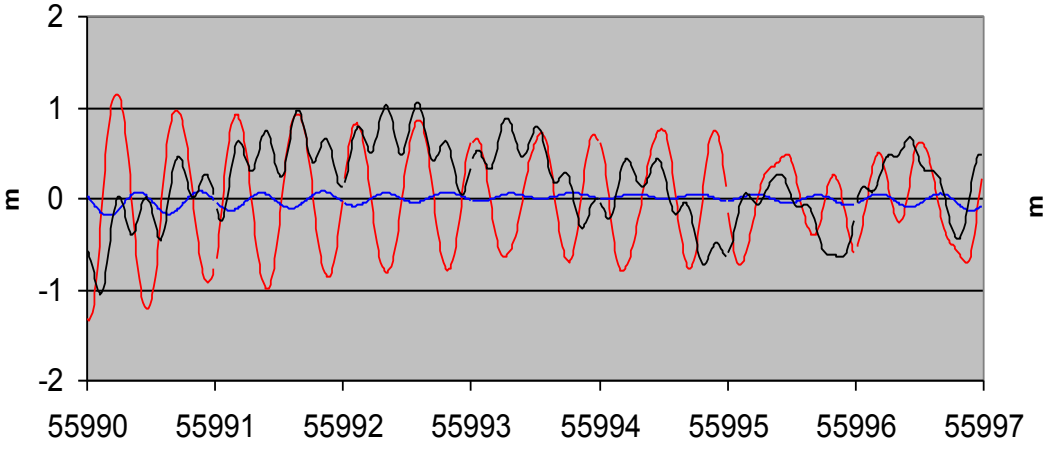
L53 ASI-BKG vs DGFI

ASI - BKG m	R	+0.00 ± 0.02
	C	+0.01 ± 0.15
	A	+0.09 ± 0.10
DGFI - ASI m	R	-0.01 ± 0.06
	C	-0.01 ± 0.58
	A	+0.18 ± 0.44
DGFI - BKG m	R	-0.01 ± 0.07
	C	-0.01 ± 0.68
	A	+0.27 ± 0.46

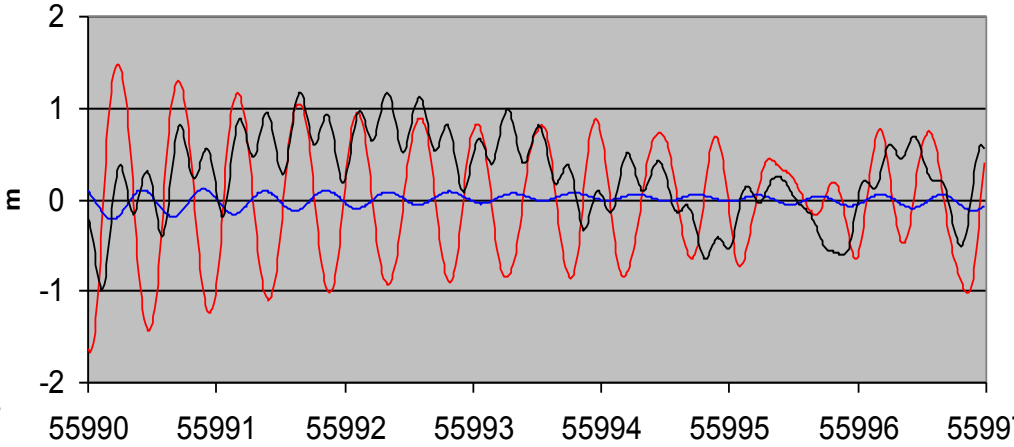
ASI-BKG



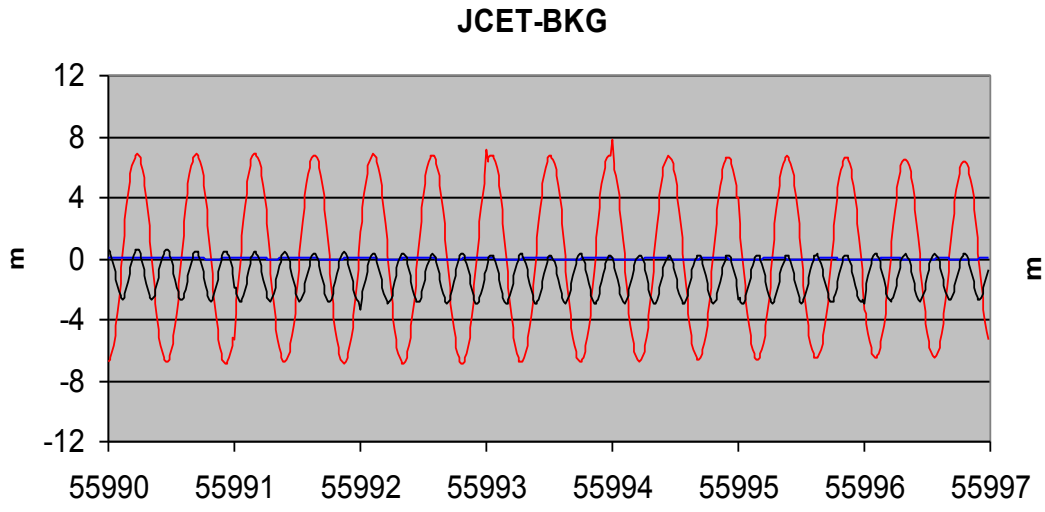
DGFI-ASI

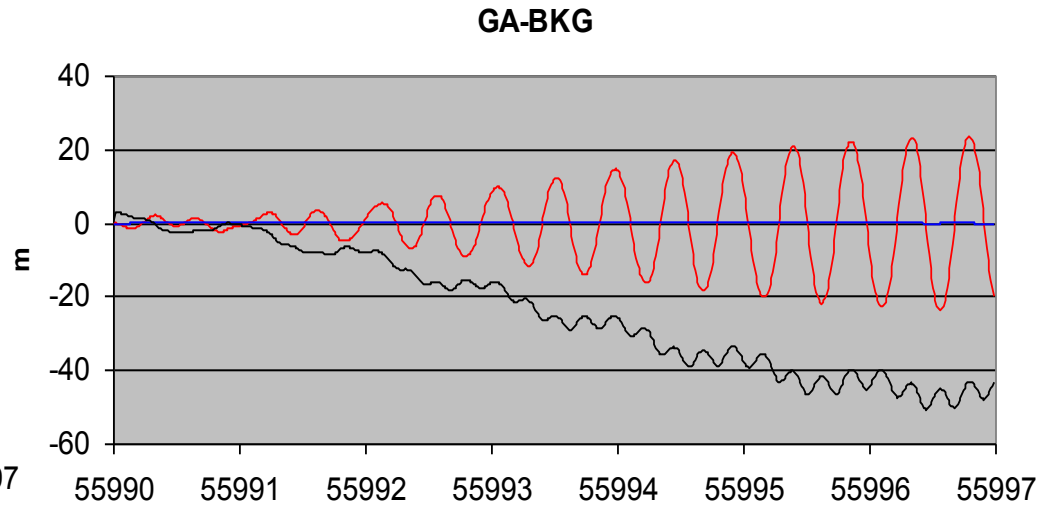


DGFI-BKG



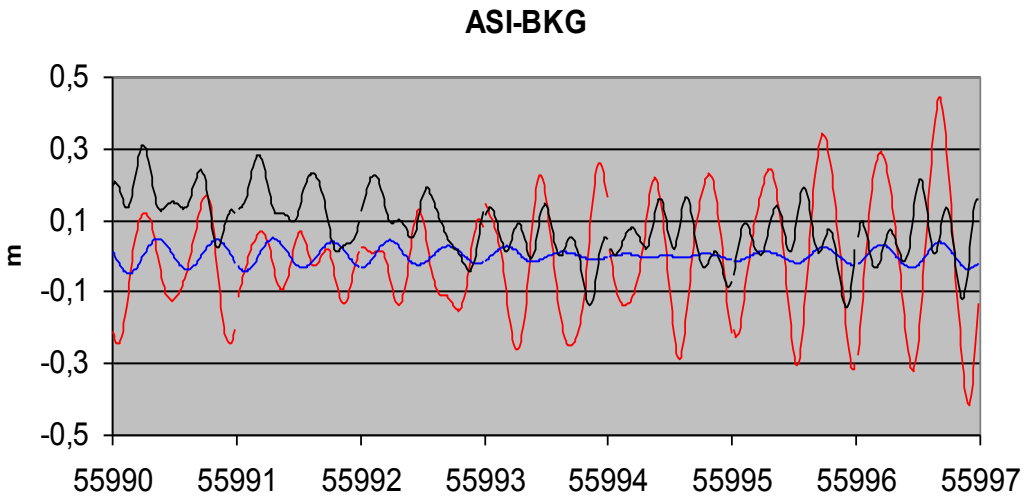
L53 JCET, GA vs BKG



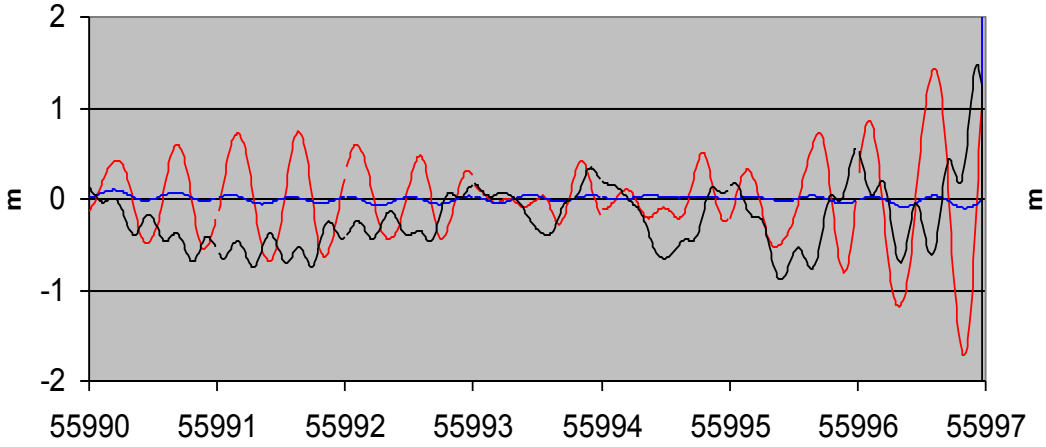


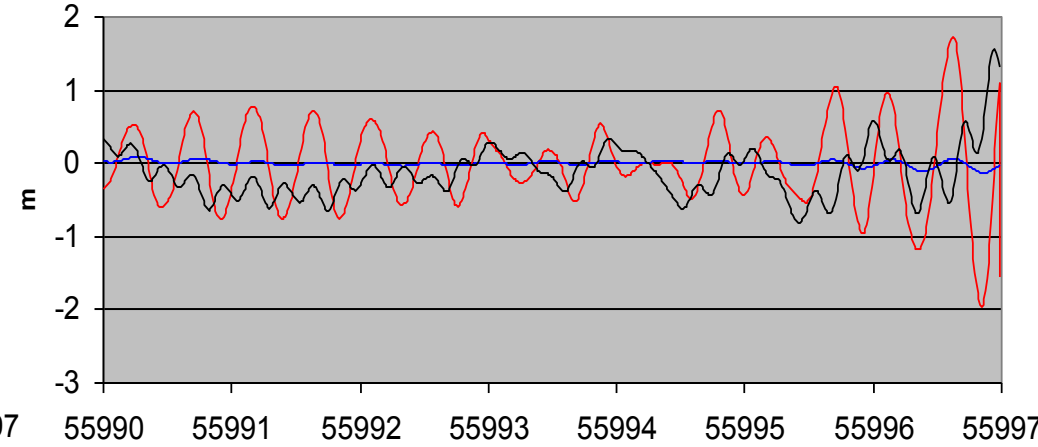
JCET - BKG m	R	+0.00 ± 0.01
	C	+0.05 ± 4.90
	A	-1.22 ± 1.14
GA - BKG m	R	+0.34 ± 0.17
	C	+0.10 ±10.70
	A	+23.50 ± 16.60

L54 ASI-BKG vs DGFI

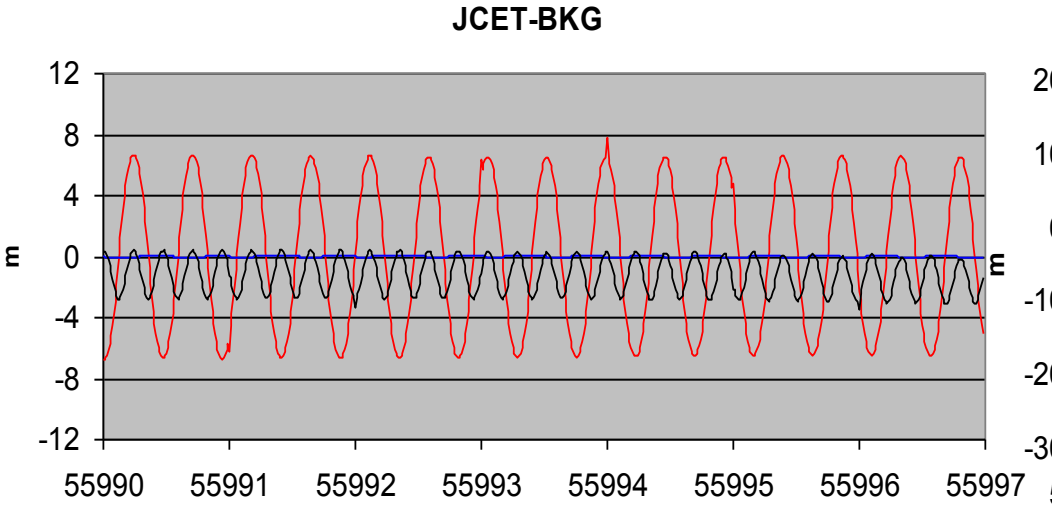


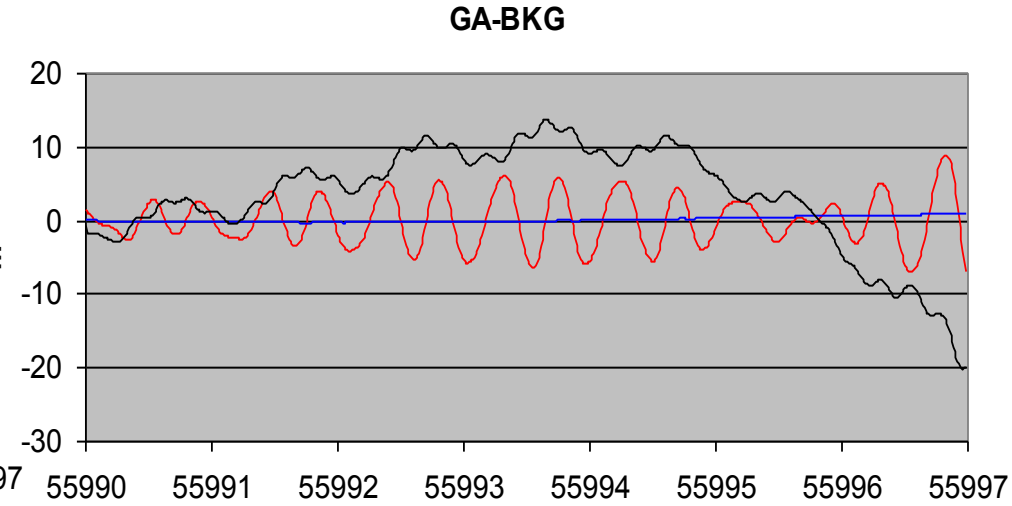
ASI - BKG m	R	+0.00 ± 0.02
	C	-0.01 ± 0.16
	A	+0.08 ± 0.09
DGFI - ASI m	R	+0.00 ± 0.04
	C	+0.00 ± 0.49
	A	-0.21 ± 0.37
DGFI - BKG m	R	+0.00 ± 0.04
	C	-0.02 ± 0.56
	A	-0.13 ± 0.34





L54 JCET, GA vs BKG





JCET - BKG m	R	+0.00 ± 0.02
	C	+0.03 ± 4.80
	A	-1.24 ± 1.12
GA - BKG m	R	+0.15 ± 0.38
	C	+0.08 ±3.39
	A	+3.35 ± 7.13

Towards next steps: remarks

- asi, bkg, dgfi, ga, gfz, grgs, jcet (esa) L51/L52
- asi, bkg, ga, jcet (esa) L53/L54
- Format check
  - grgs: TAI
  - Jcet: two additional comment lines in the sp3c header
- bkg, gfz, asi highly coherent (~3cm C-A L51/L52; asi vs bkg <15cm C-A L53/L54)
- dfgi <15cm C-A L51/L52 vs bkg, gfz, asi; ~50cm C-A L53/L54 vs bkg, asi

Call for space geodetic solutions corrected for non-tidal atmospheric loading (NT-ATML) at the observation level

IGN INSTITUT NATIONAL DE L'INFORMATION GÉOGRAPHIQUE ET FORESTIÈRE

UNIVERSITÉ DU LUXEMBOURG

Xavier Collilieux, Tonie van Dam, Zuheir Altamimi

Global Geophysical Fluid Center

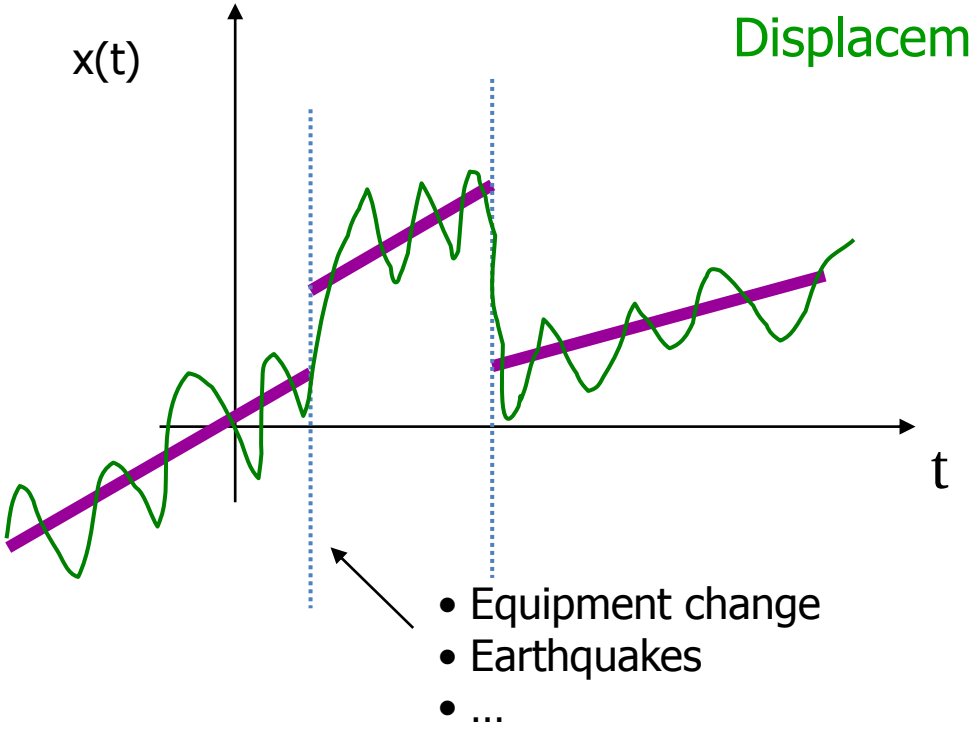
Outline:

- Context
- Why correcting for non-tidal atmospheric loading?
- Call of participation: your help is needed
- Discussion

Context (1/3)

Instantaneous pos. $\Big|_{\text{theoretical}}$ (t) = Ref. coordinate (t) + Modeled displacements (t)

Ref. coordinate (t) = $X(t_0) + V\,(t-t_0) + \Sigma_i\, dX(t-t_i) + \Sigma_i\, dV(t-t_i)$



Displacement models include:

- Solid Earth tides
- Pole tides
- Tidal ocean loading
- Atmospheric tides

http://www.iers.org/TN36/

Context (2/3)

http://www.iers.org/TN36/

IERS[1] conventions 2010 (Petit et Luzum (eds.), 2010)

- Accuracy < 1 mm
- Independant from space geod. If possible

Tidal Loading models

Class 1

Recommended to be used a priori

Non-tidal Loading models

Class 2

conventional

Class 3

Useful but not recommended

[1] IERS: International Earth Rotation and Reference Systems Service

Context (3/3)

How non-tidal ATM loading effects are accounted for up to now by the technique service Analysis Centers?

IVS applies non-tidal atmospheric loading corrections at the obs. level

IDS uses gravity potential model of the atmospheric effect (+ associated deformation effect k_n') but does not use position corrections.

ILRS and IGS do not use any NT-ATML model for operational products

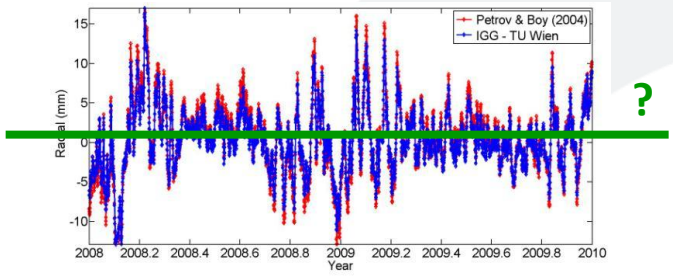
NB: for GRACE observation analysis, atmospheric models are widely used

Why correcting for non-tidal atmospheric loading a priori? (1/3)

1) Magnitude of the displacements

Up to a few centimeters peak-to-peak

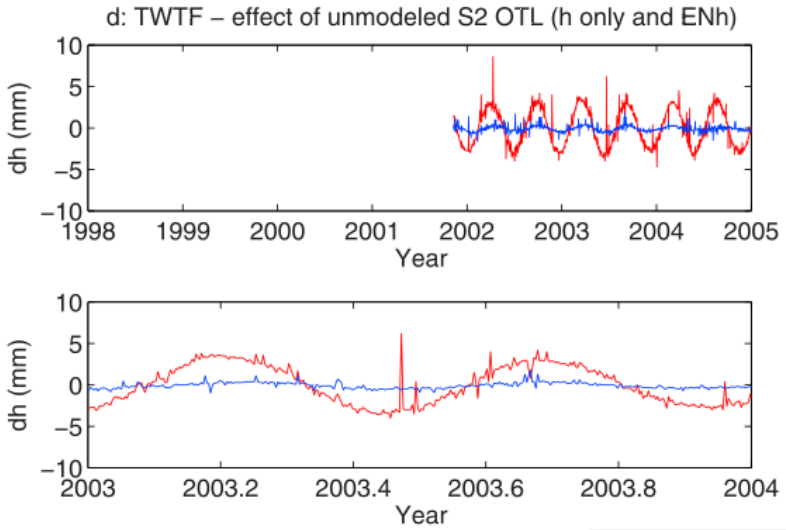
- Biased station positions if few data available



Problem solved if corrections applied at the observation level or a posteriori

2) If not corrected, high frequency ground displacements may leak into low frequency signals in the estimated position time series

Fig. by Penna et al. (2007)
Error in the height if semi-diurnal tidal ocean loading are not corrected



Problem solved if corrections applied at the observation level only.
BUT NT-ATM loading should be accurate for frequency higher than 1/14 cpd

Why correcting for non-tidal atmospheric loading a priori? (2/3)

3) Some part of the loading displacement may leak into estimated parameters other than station positions if NT-ATML loading corrections not included

Problem solved if corrections applied at the observation level only

Note:
Correlations reported for
• Troposphere parameters if station positions are fixed (Boëhm et al., 2009)
• GPS satellite 1/rev orbital parameters can absorb loading signals if not constrained enough (Dach et al., 2011) but 1/rev should be constrained enough in current processing (at least for CODE group).
=> No clear evidence of this effect yet.

Why correcting for non-tidal atmospheric loading a priori? (3/3)

Benefit for the IERS conventions

Current IERS conventions

$$\text{Instantaneous pos.}\Big|_{CM}(t) = \text{Ref. coordinate ITRF}\Big|_{\text{Time-averaged CM}}(t) + \text{Tidal-ATM loading}\Big|_{CM}(t) + \text{NT-ATM loading}\Big|_{CM}(t)$$

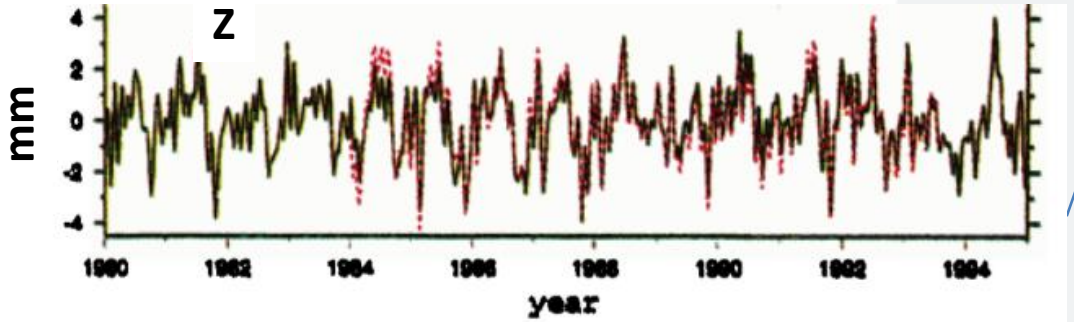


Figure 1: Geocenter variation from ECMWF (solid line) and NCEP (dashed line) series. ECMWF land-ocean mask was used in the inverted barometer (IB) model. Both series passed band-pass filtering with the cutoff period from 30 day to 10 year.

Include geocenter motion contribution

(Fig. Dong et al., 1997)

It looks very attractive to use a NT-ATM model. But do the available models reach the required accuracy? IERS conventions (2010) request 1mm or better (Ray et al., 2007)

Call for participation (1/5)

Motivation:

• Several studies using VLBI and GPS have shown that station position repeatability decreases significantly when NT-ATML corrections are applied (Petrov and Boy, 2004; Tregoning and Watson, 2009; Dach et al. 2011 etc…)

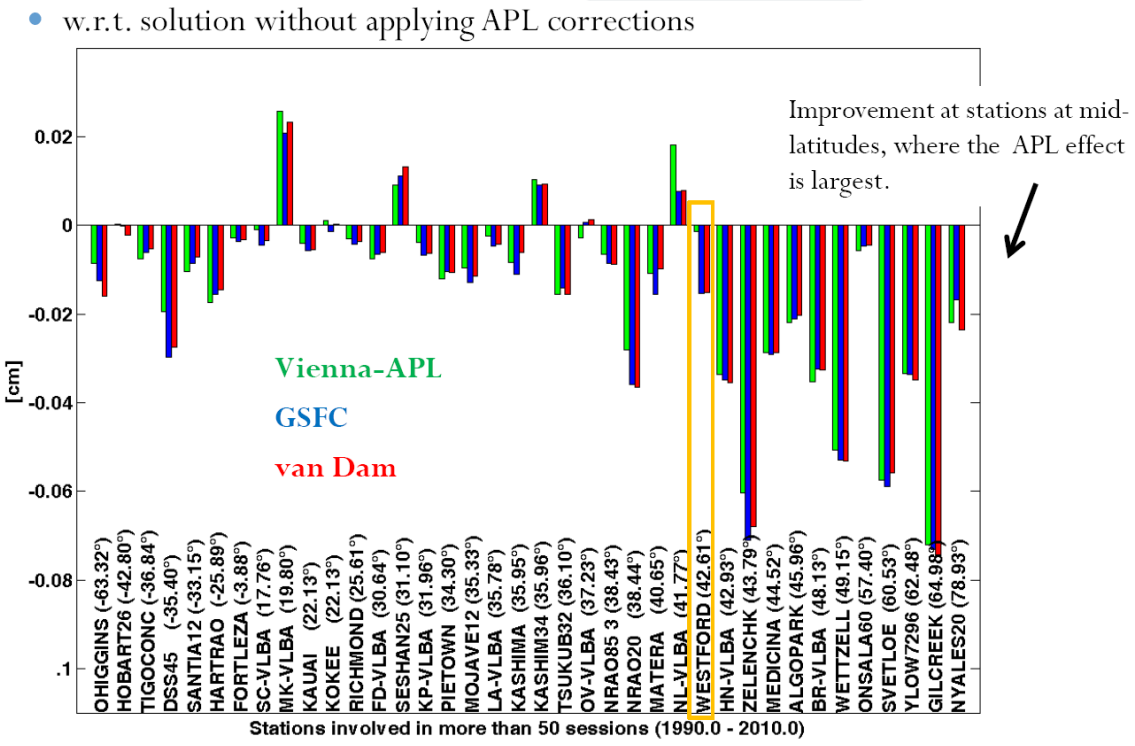


Fig. Height WRMS of **VLBI stations**

Spicakova et al. (2011)

• Few studies made for SLR and DORIS (see E. Pavlis's talk) -> Can previous results with GPS and VLBI be generalized to all the techniques?

•Recommendation by attendees of the GGOS Unified Analysis Workshop: test NT-ATML model in the data processing for 5 years of data

Call for participation (2/5)

- Would we expect any improvement of the ITRF?

  Example of analysis

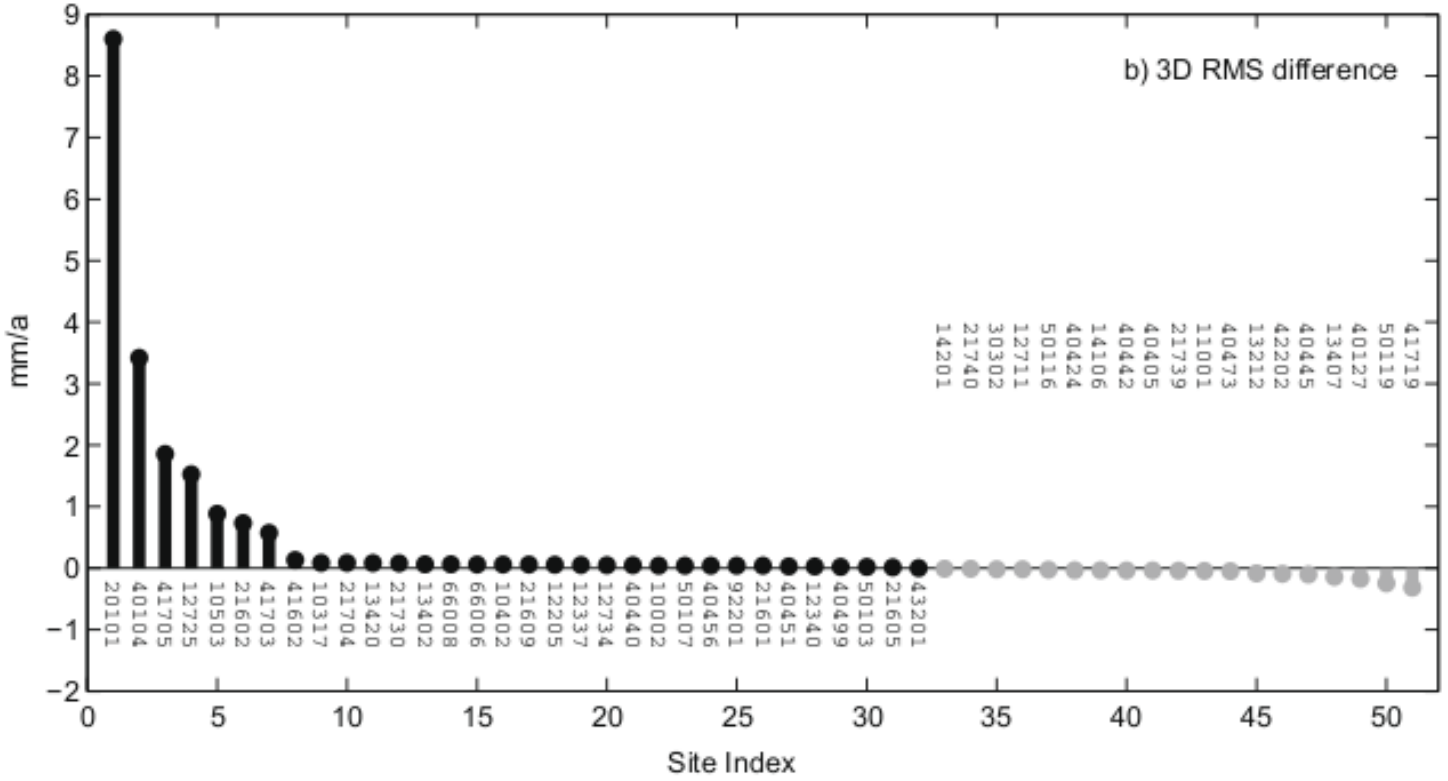


Fig. Improvement of the agreement between GPS, SLR and VLBI velocities at co-location sites when NT-ocean, NT-ATML and water loading models have been applied (Collilieux et al., ASR, 2010)

Call for participation (2/5)

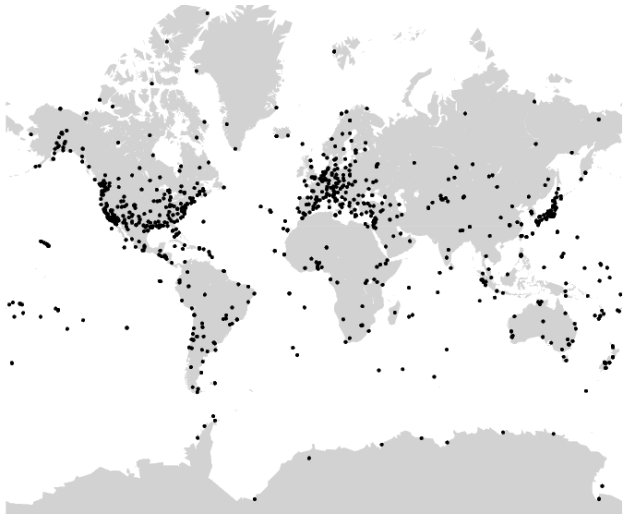
Loading model to be tested:

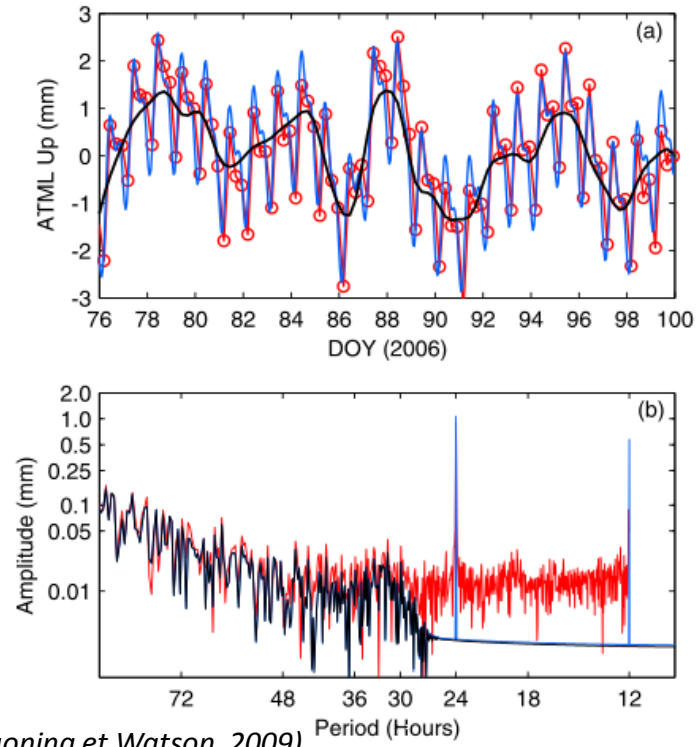
- Based on NCEP (6h) surface pressure data provided at 2.5 x 2.5 degree spacing over the Earth.

- Station displacements in the CM frame

- Sub-daily atmospheric tides have been filtered (Tregoning and Watson, 2009)

- Spherical coefficients of the potential changes up to degree and order 50





(Tregoning et Watson, 2009)

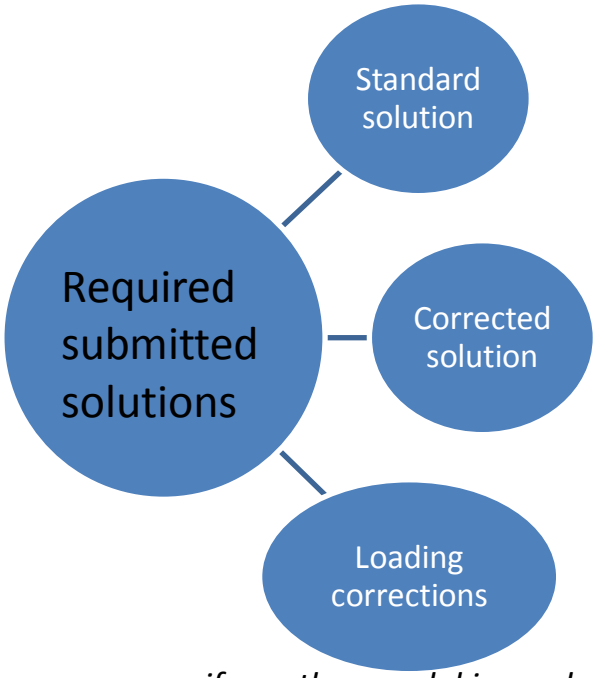
Figure 2. (a) Example time series of atmospheric loading deformation in the up component at Bahrain for the partial model used by *Tregoning and van Dam* [2005a] (red), our nontidal model (black) and our nontidal plus S1+S2 model (blue). (b) Power spectra of partial (red), nontidal (black) and nontidal plus S1+S2 (blue).

Call for participation (4/5)

Details on the requested solutions (1/2)

Time period: 2006.0 – 2011.0

Sampling interval: daily or weekly. Daily GPS are preferred



if an other model is used

Individual homogeneously reprocessed solutions: DORIS, GNSS, SLR or VLBI

Include Station positions, EOPs and if possible satellite antenna PCO, ZTD

Global network (for GNSS) with co-location sites included

Gravitational effect for satellite techniques:

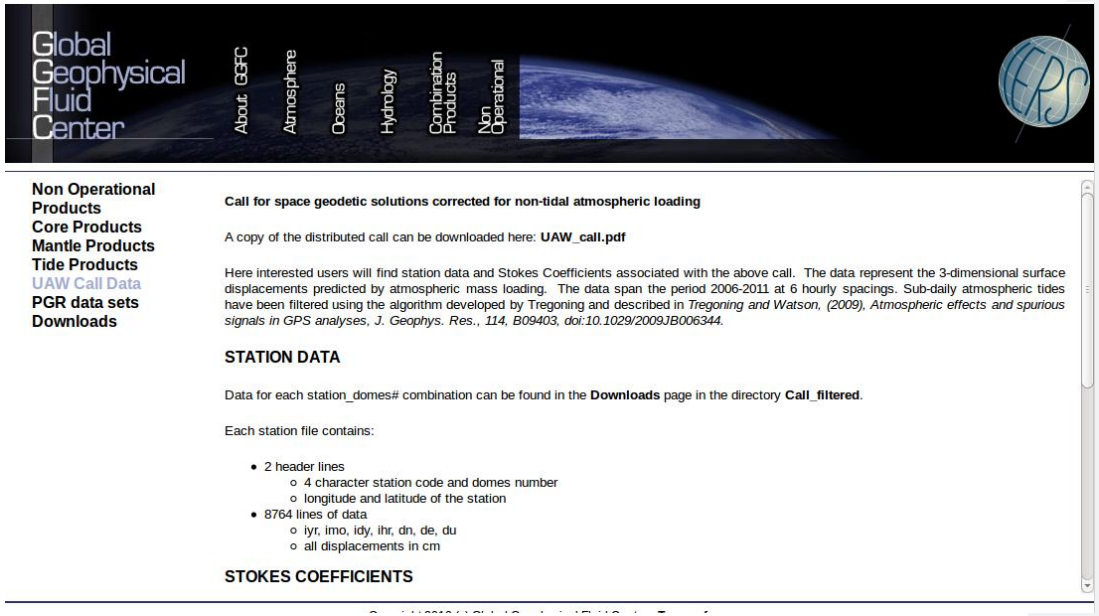
Spherical coefficients of the potential changes related to atmospheric mass fluctuations may be also used in the standard solution. This is recommended for LEO (Lemoine et al., 2010)

Tidal loading applied for the 2 solutions according to the IERS conventions

Call for participation (5/5)

Details on the requested solutions (2/2)

More details on the call at http://geophy.uni.lu/ggfc-nonoperational/uwa-call-data.html



Deadline: 1st of July 2012

To submit time series, contact itrf@ign.fr and central_bureau@iers.org

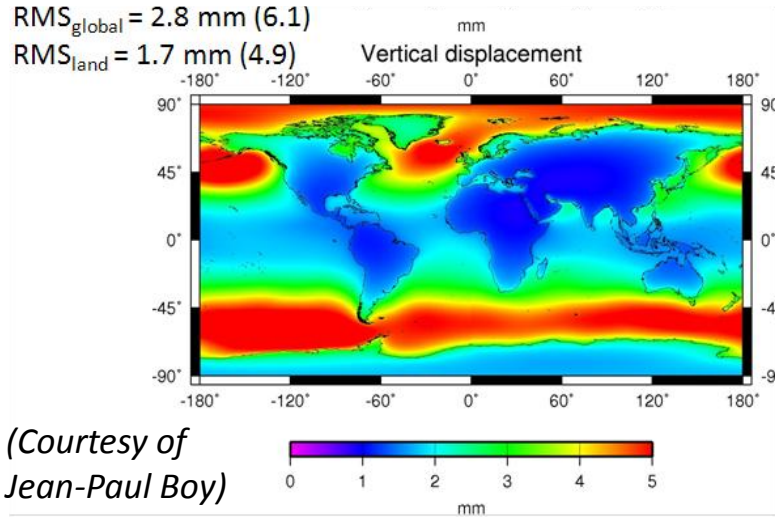
Submissions will be analyzed by the IAG Working Group on “Modeling environment loading effects for Reference Frame“, GGFC and the ITRF Product Center

Discussion (1/2)

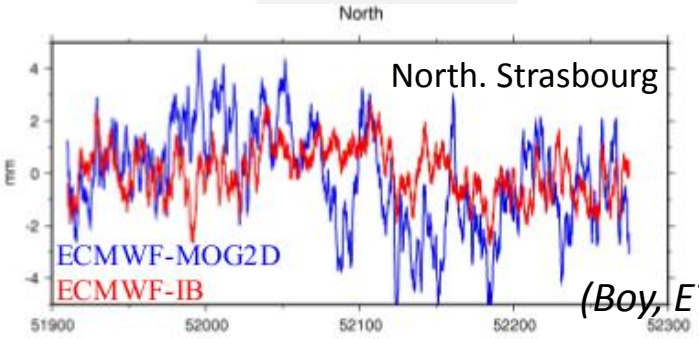
Accuracy of the models?

- IB hypothesis is not valid in the sub-weekly frequency band *(Petrov and Boy, 2004)* BUT this is exactly the frequency band where accuracy is needed to avoid aliasing

Effect of the modeling of the ocean response to changes in the atmospheric pressure forcing



(Courtesy of Jean-Paul Boy)



(Boy, ETS 2009)

Fig. Left) RMS of the differences between the IB assumption and MOG2D ocean model (CM)

- Is there other error budget of NT-ATML loading model than the one by *Petrov and Boy (2004)?* Evaluated at the level of 15% (Earth's model; ocean mask; pressure field; ocean response).

- Fritsche et al. (2011) have discussed the effect of the variation of total atmospheric mass. Should it be included? Max: ~ 0.5 mm in radial

Discussion (2/2)

How to evaluate the accuracy of available models?

- What is the consistency between various models? Too few studies available

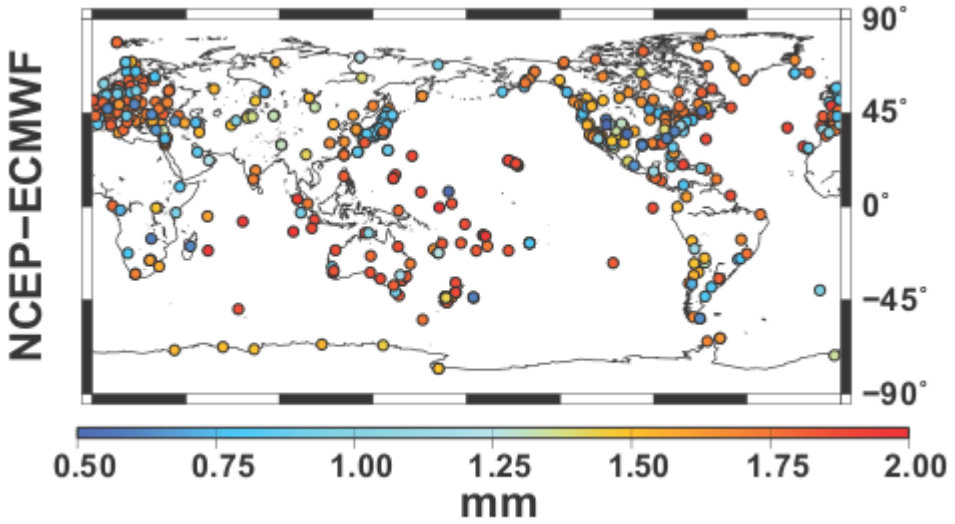


Fig. RMS in modeled height (2005-2010) from two different pressure fields: NCEP and ECMWF . Preliminary results

- How can we know that a model is accurate at the sub-millimeter level?

Already published criteria:

- Error budget of the model (Petrov et Boy, 2004)
- Station position RMS changes
- Estimation of admittance factor α: $\hat{X}=X_0+\hat{\alpha}\cdot\Delta X^0_{atm}+\hat{\Delta X}$
- Residual of the observations adjustment decrease

What is the threshold for each of those criteria?

Conclusions

What the call will help to answer:

- Will all technique frames benefit from NT-ATML corrections?
- Does any parameter other than station positions absorb loading displacements?
- Impact of the non-tidal atmospheric loading corrections on the combined TRF
- Does the TRF benefit from non-tidal atmospheric loading corrections?
- a priori vs. a posteriori corrections revisited for all techniques

What the call won't answer:

- Accuracy of the used model. Research effort is mandatory before any recommendation