ASI AC&CC report

V. Luceri, M. Pirri
e-GEOS S.p.A., CGS – Matera

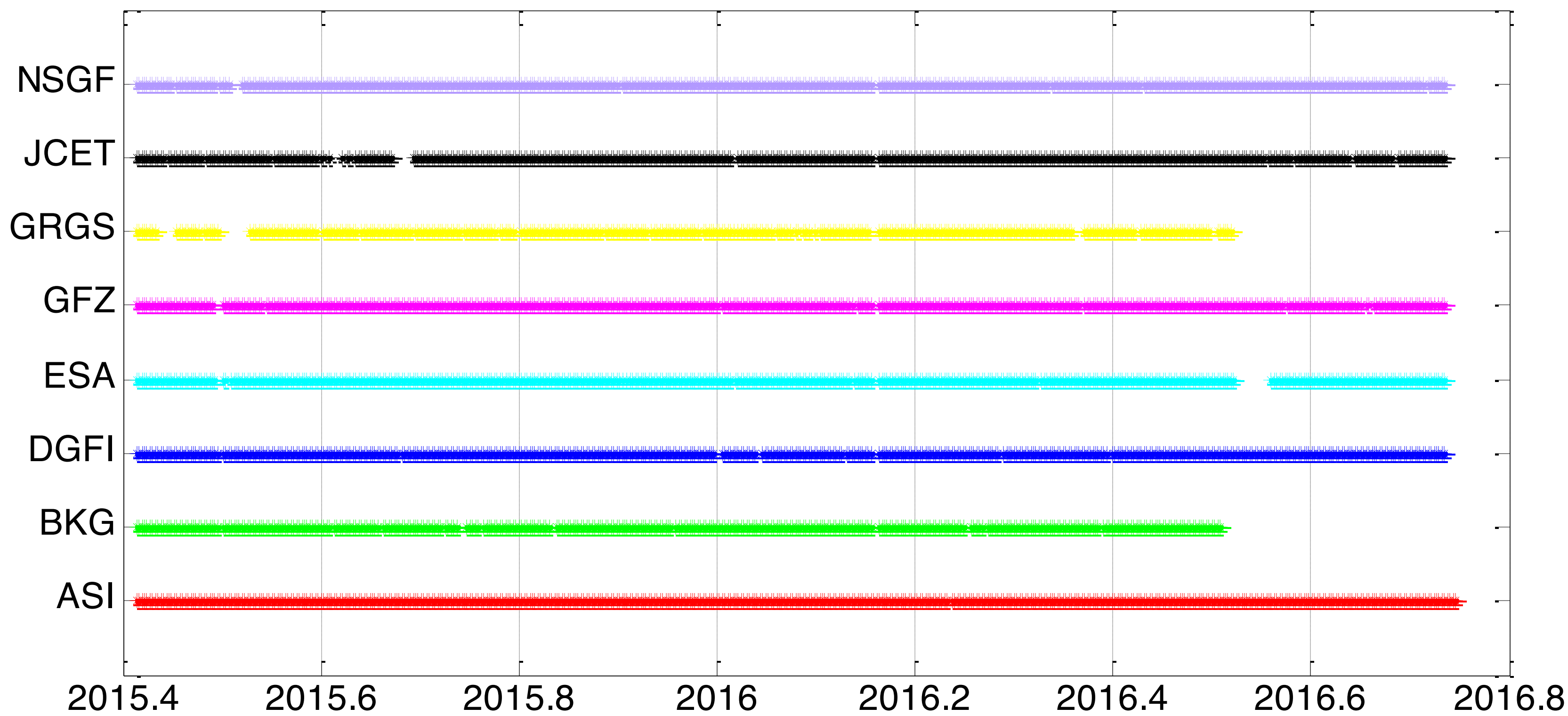
G. Bianco
Agenzia Spaziale Italiana, CGS - Matera

ILRS ASC Meeting, 8 October 2016, Potsdam

Main activities

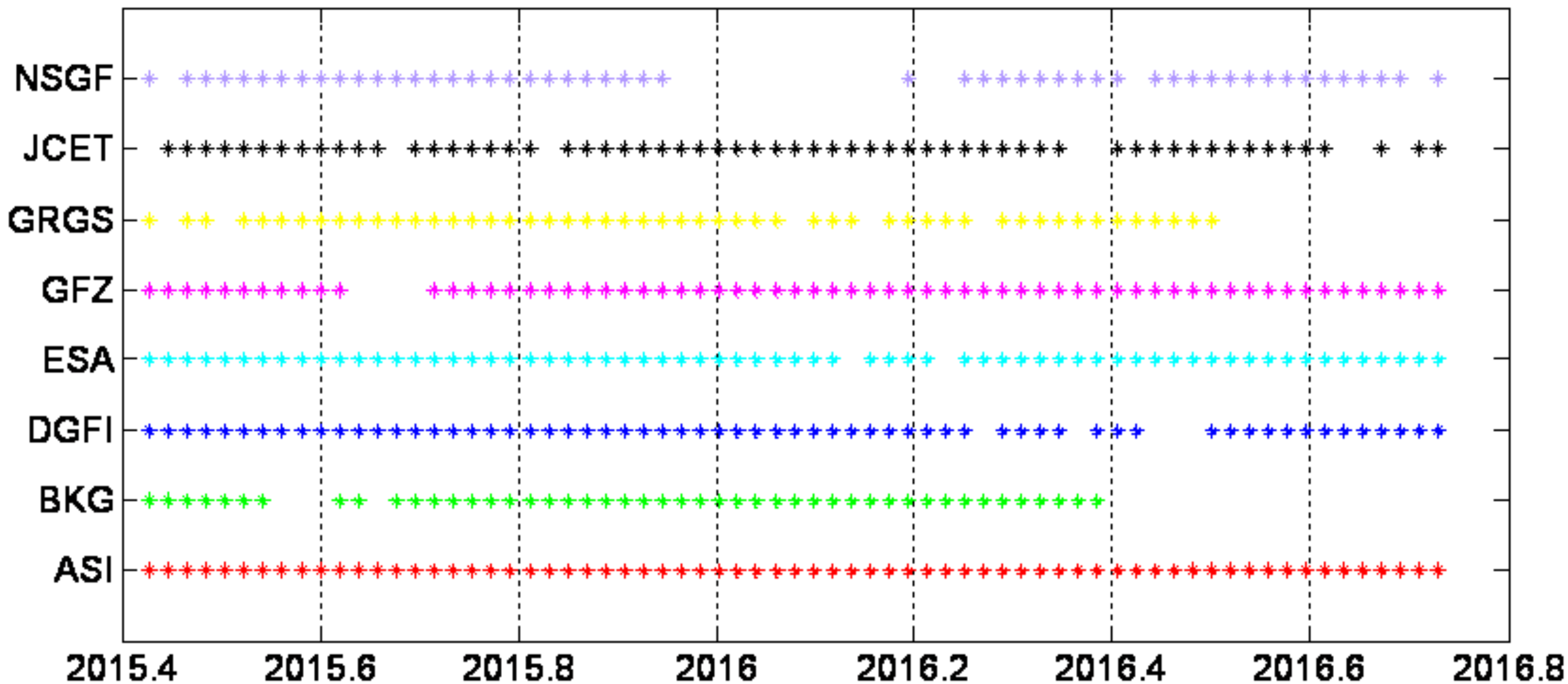
- AC performance
- ITRF2014 time series
- ASC Pilot Project on Systematic errors

Daily AC submissions

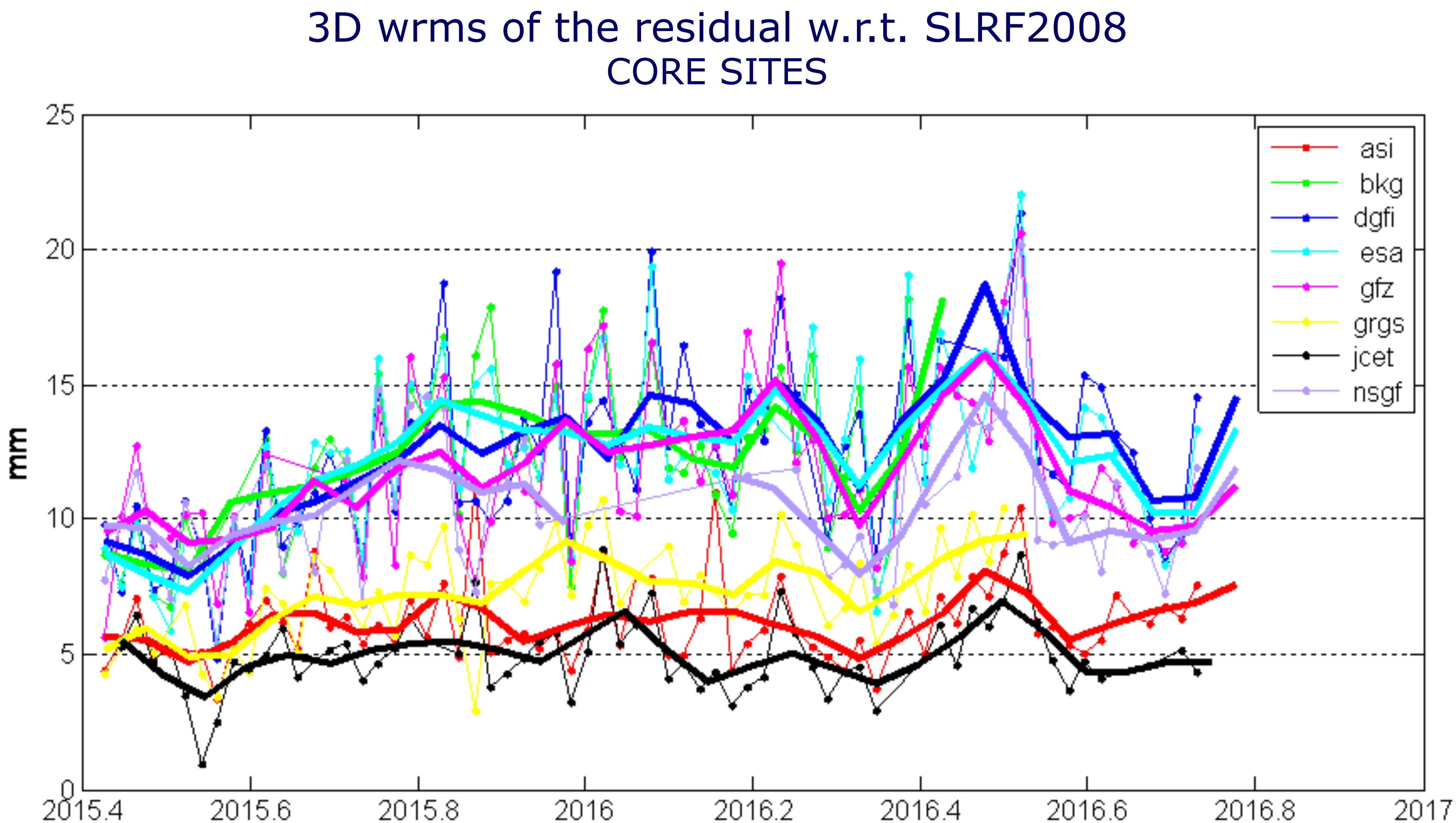


Weekly AC submissions

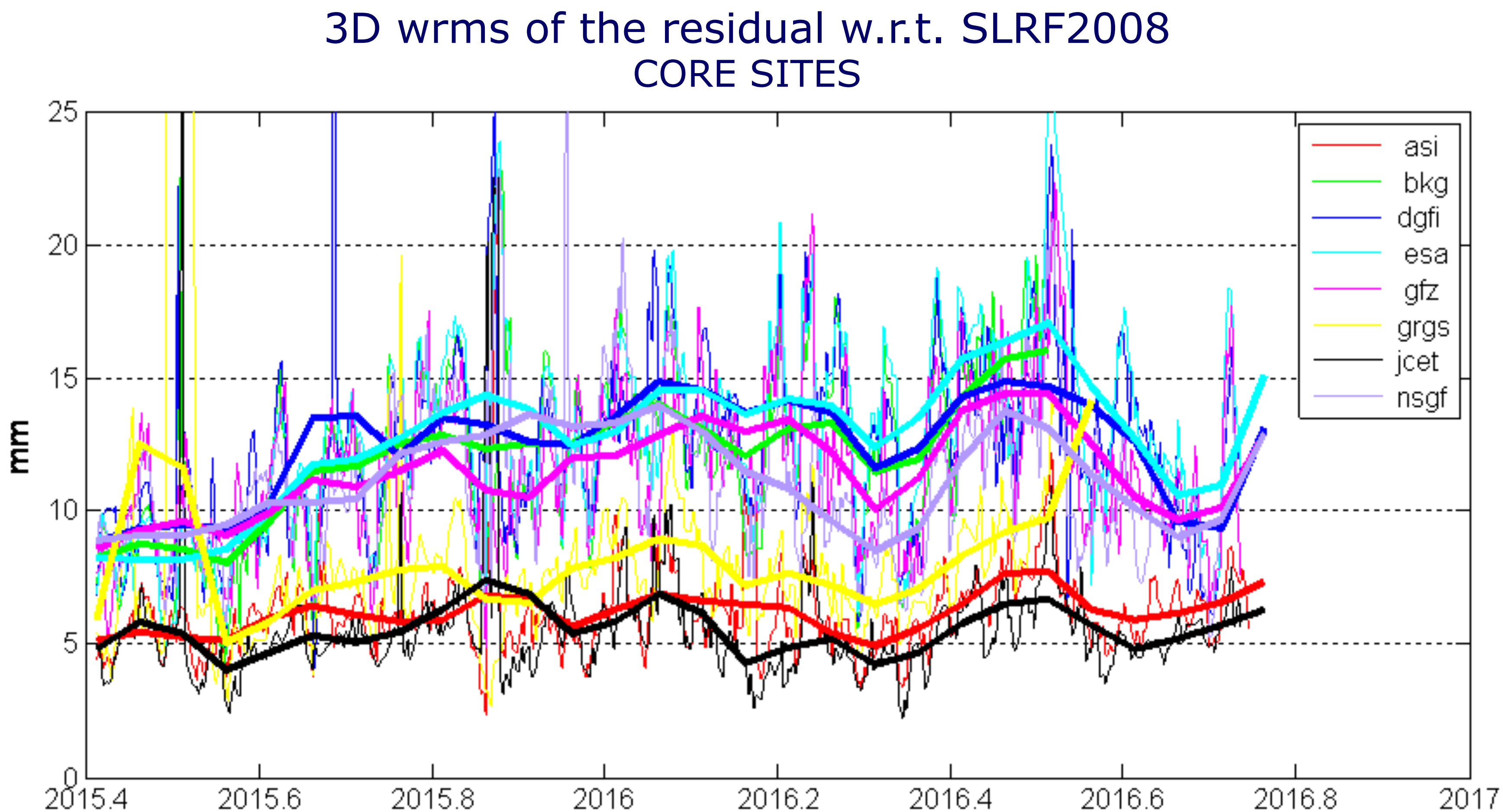
- Coordinate/EOP benchmark product with higher latency
- Estimated orbits



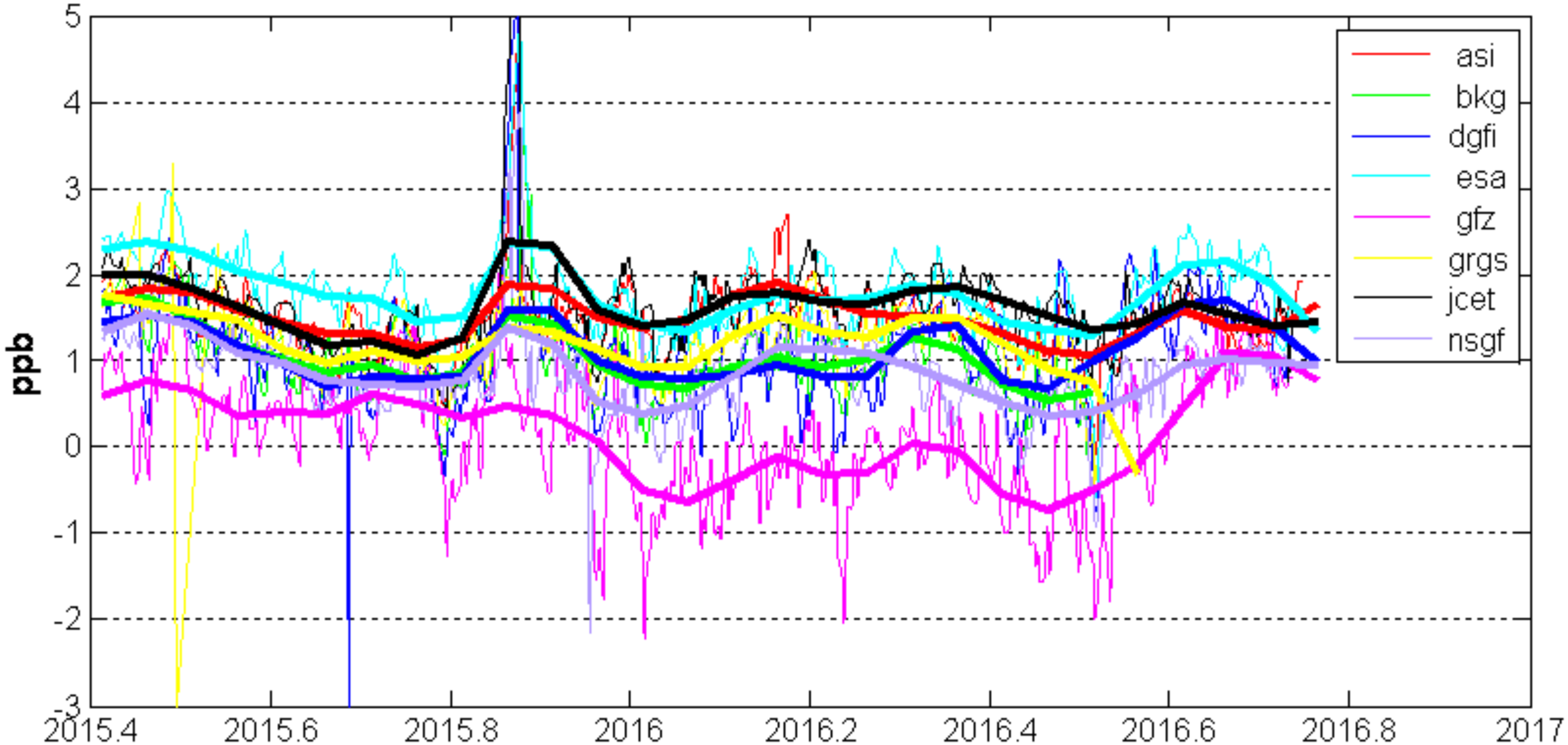
Weekly solutions



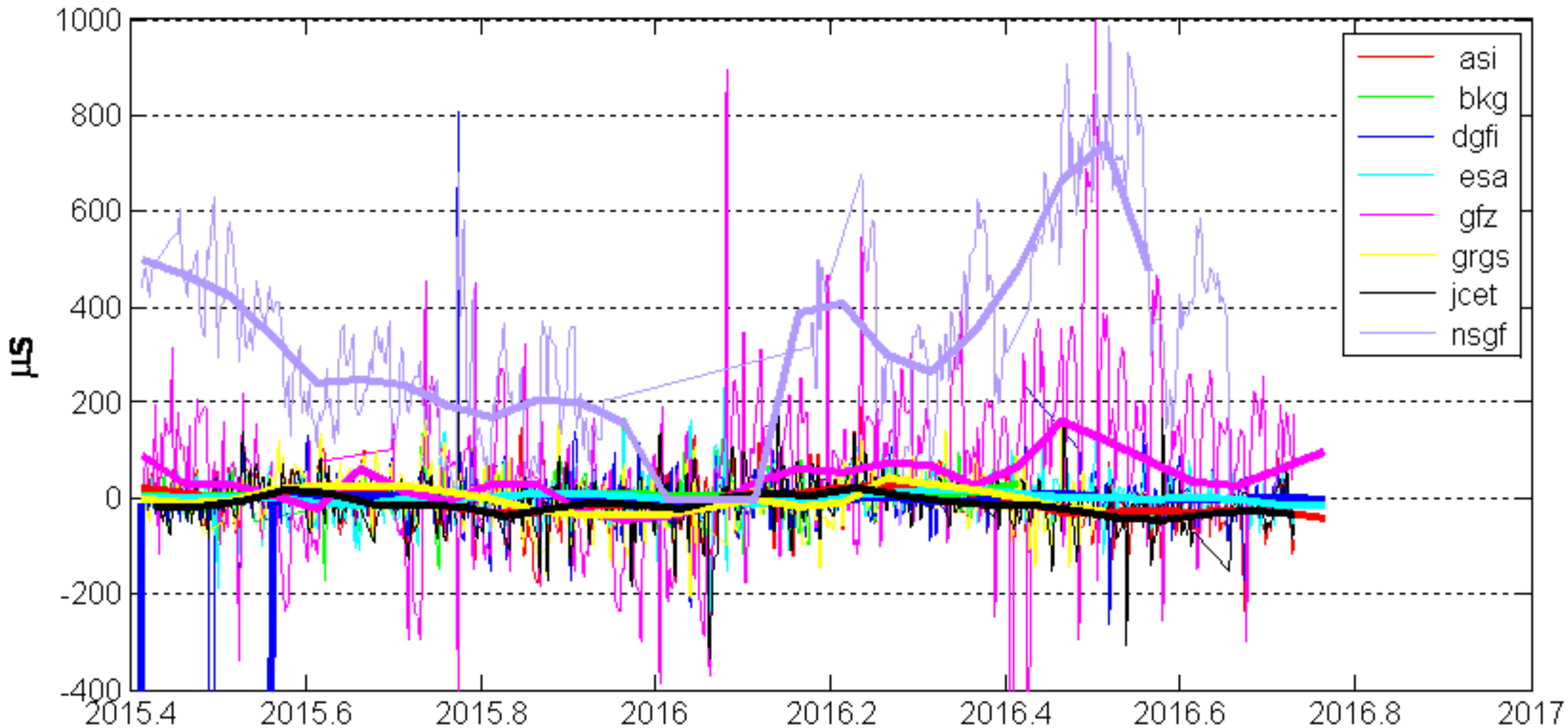
Daily solutions



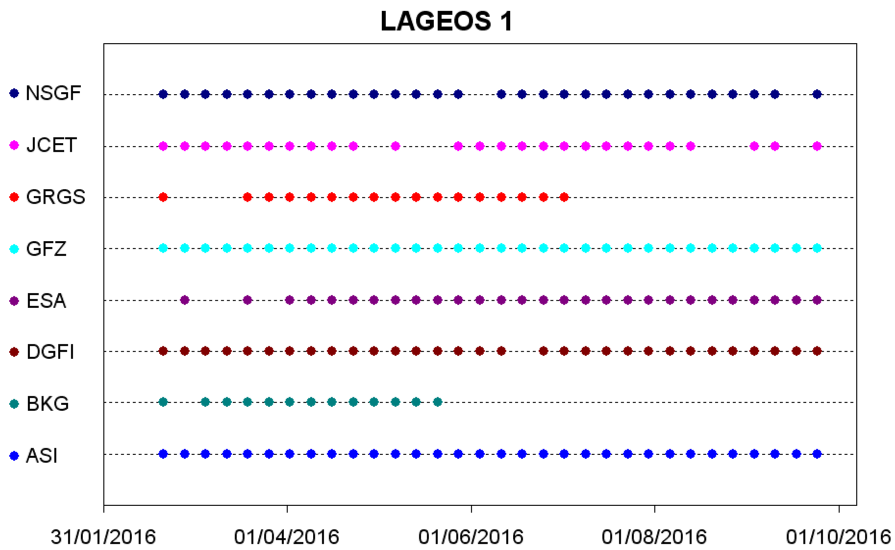
Scale from daily solutions

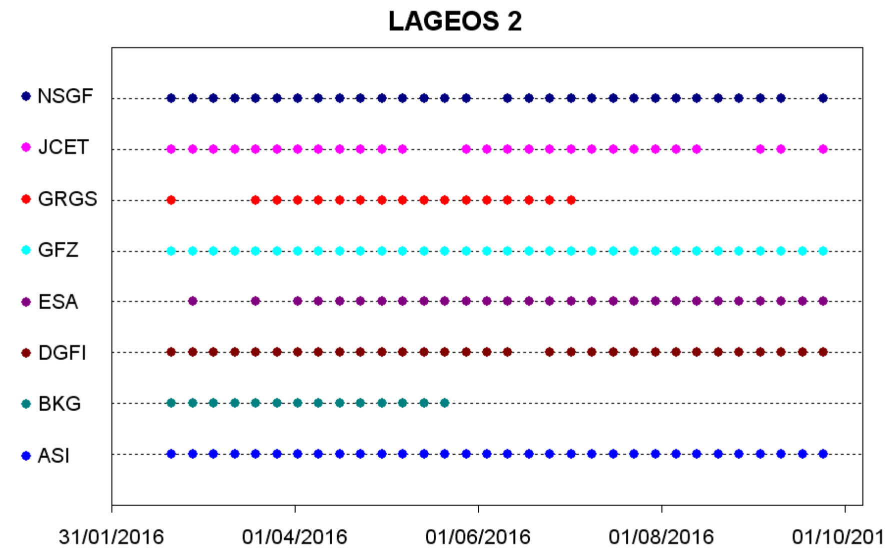


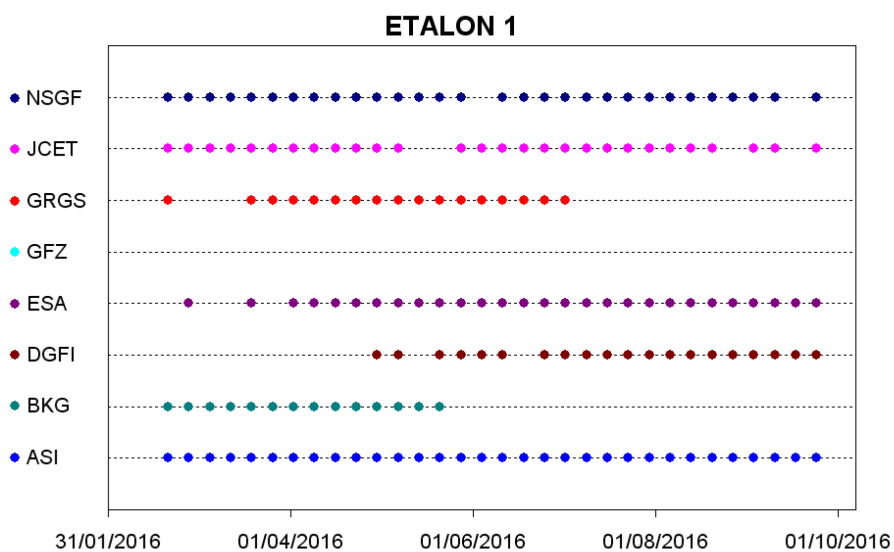
LOD from daily solutions

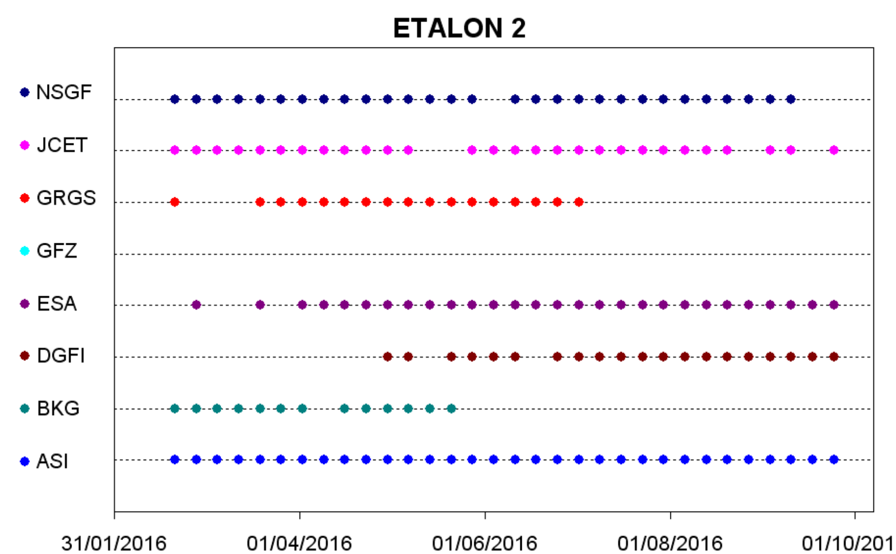


ILRS AC orbits



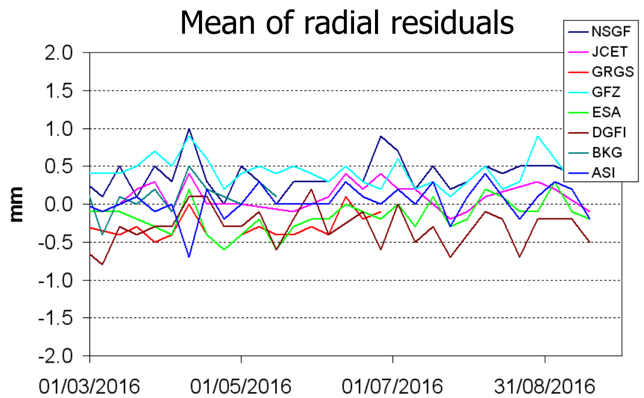


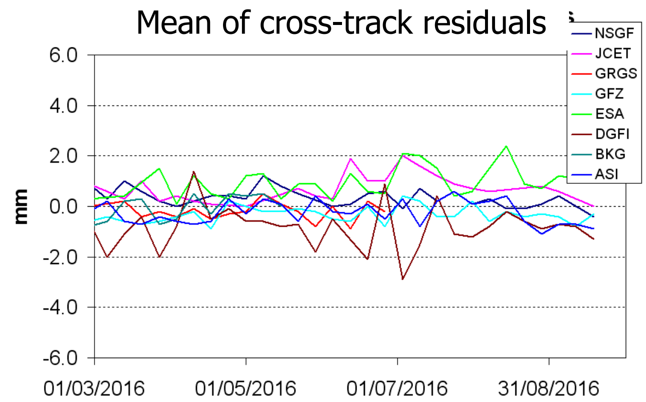


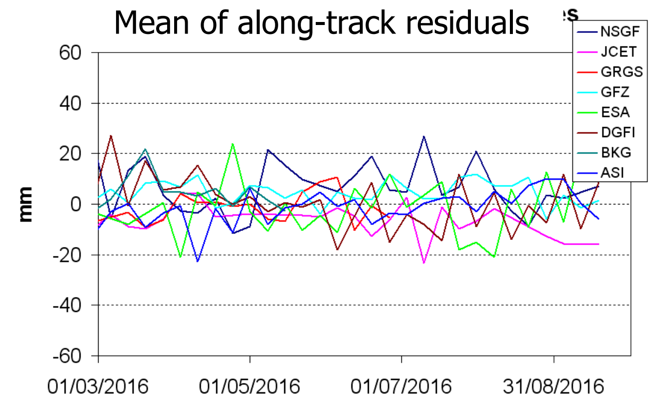


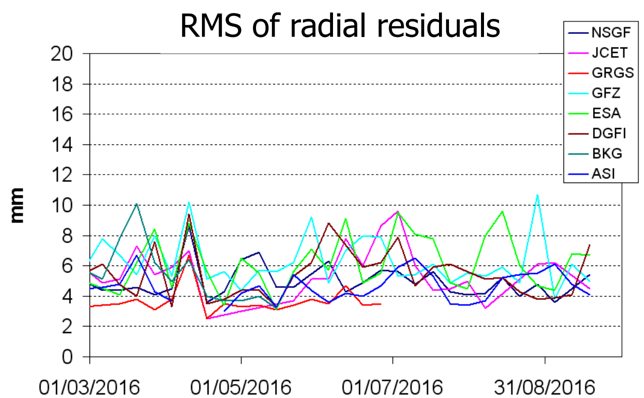
LAGEOS1 orbits

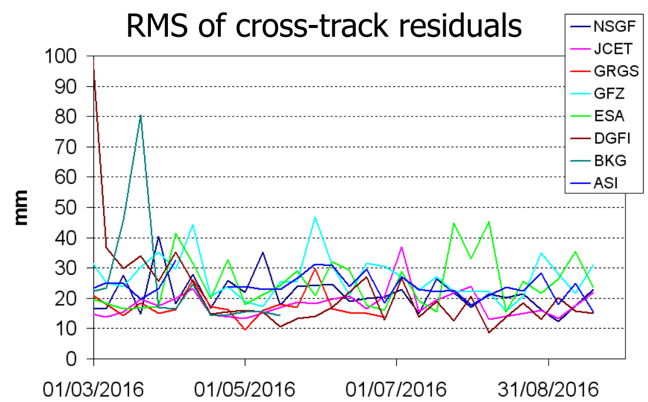
AC orbits compared with the combined one using weekly mean and rms of the residuals

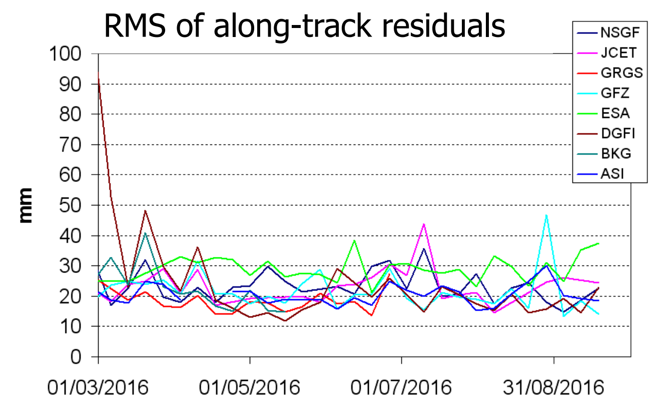








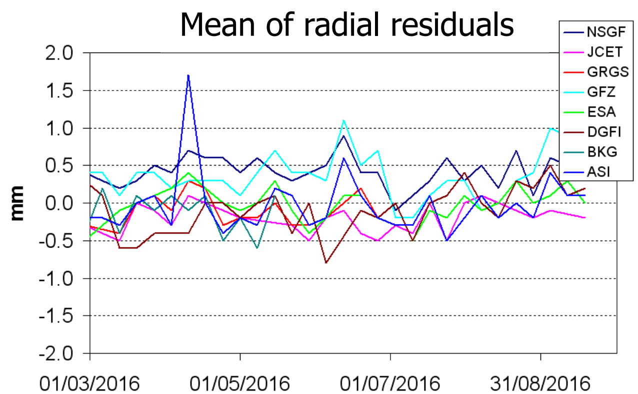


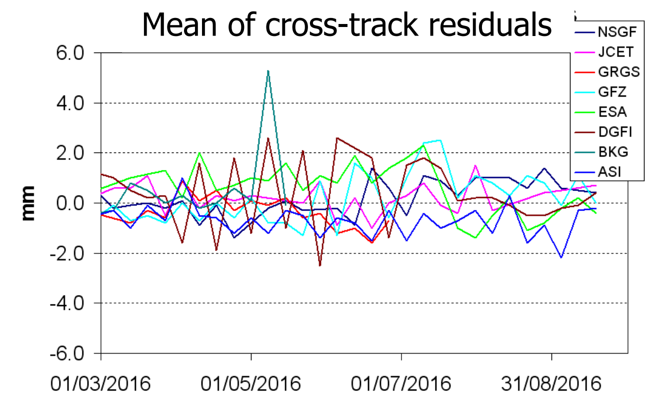


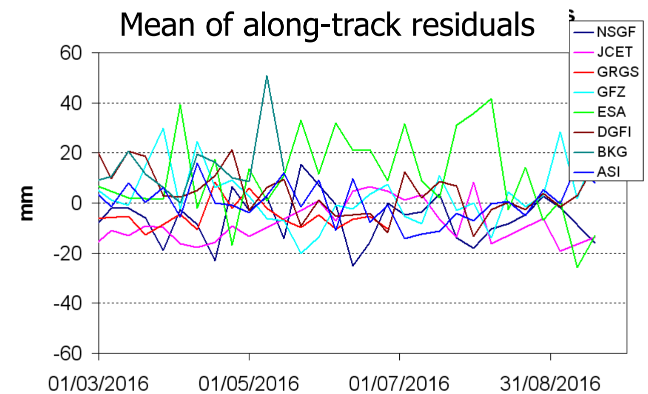
Mean R=5 C=25 A=25 mm

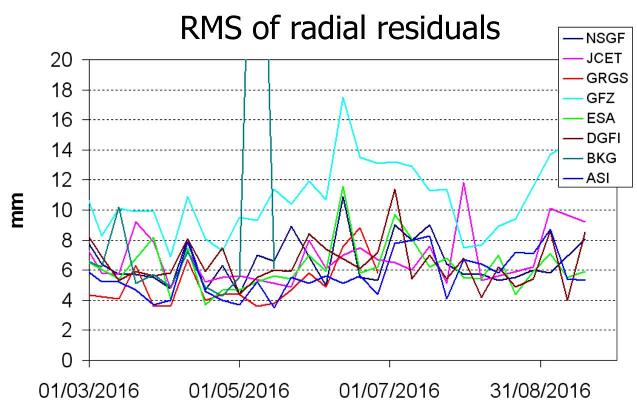
LAGEOS2 orbits

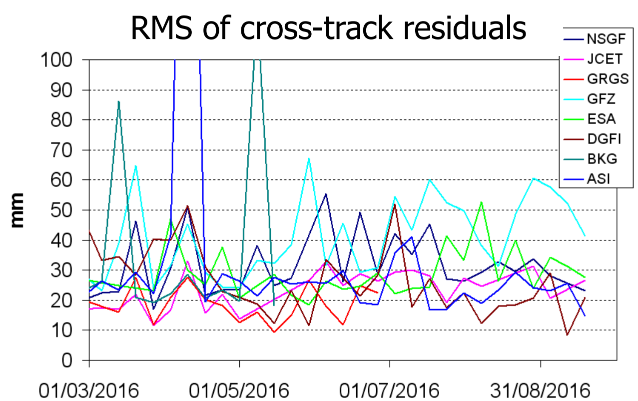
AC orbits compared with the combined one using weekly mean and rms of the residuals

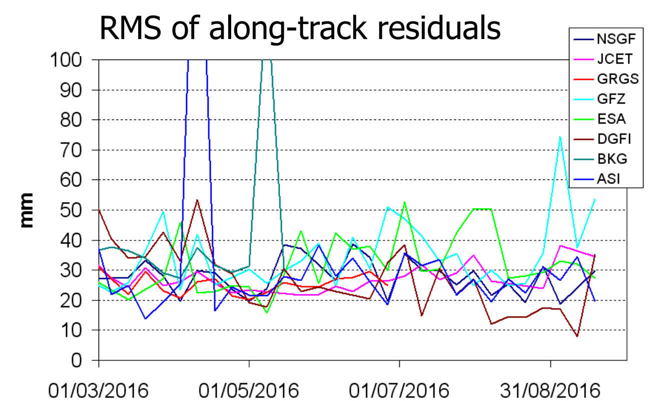








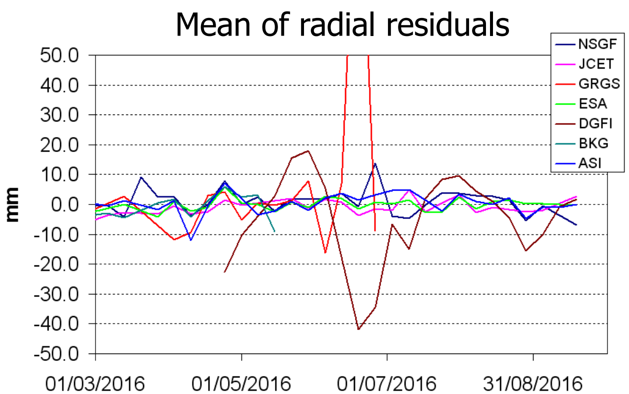


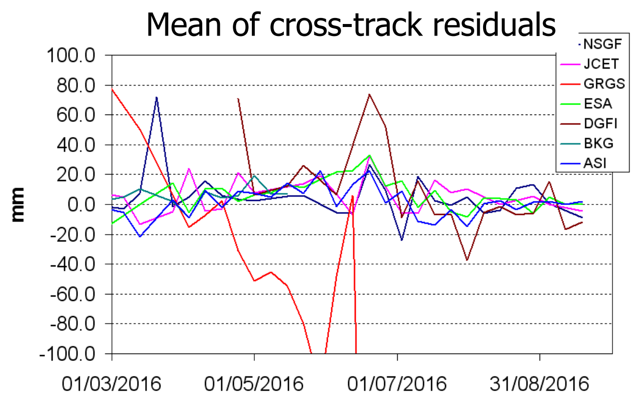


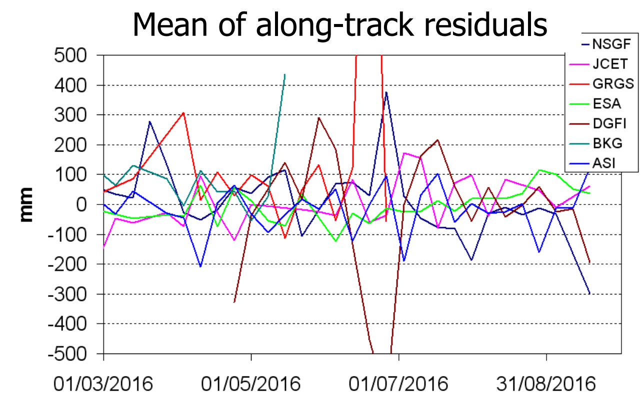
Mean R=7 C=30 A=31 mm

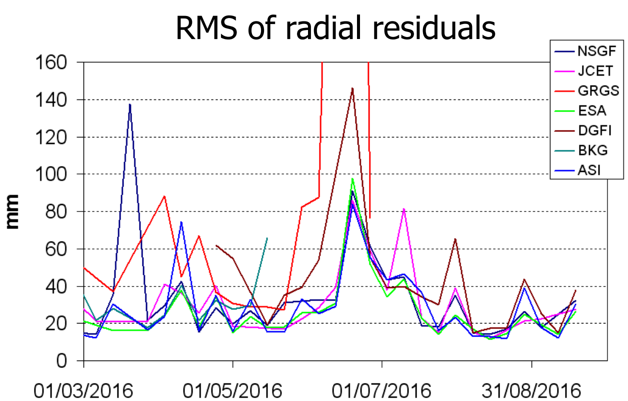
ETALON1 orbits

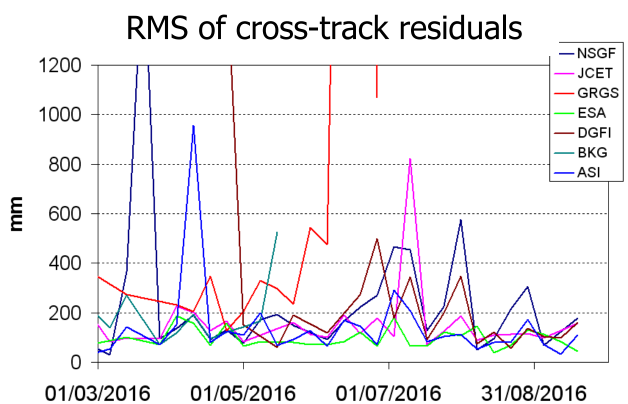
AC orbits compared with the combined one using weekly mean and rms of the residuals

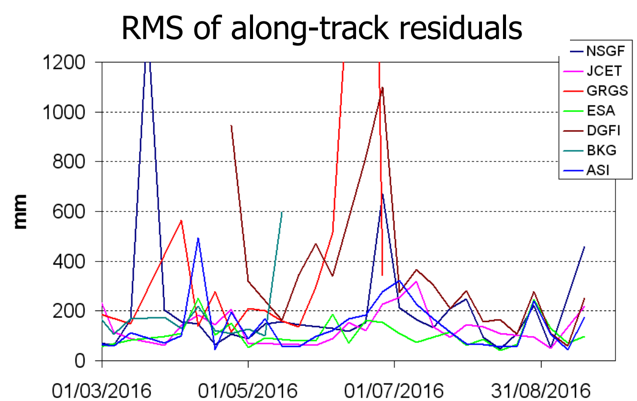








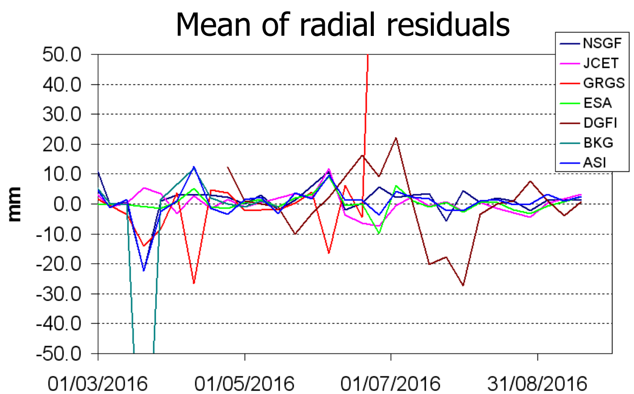


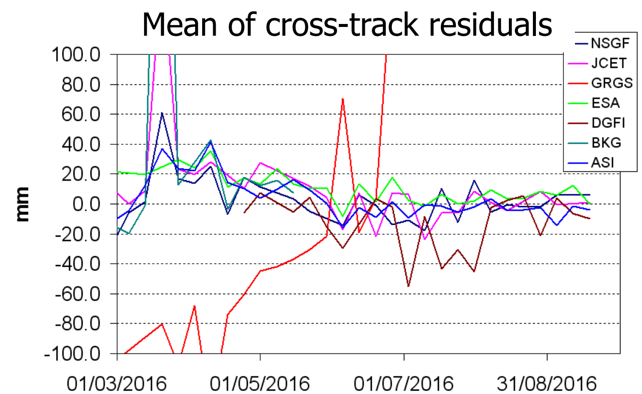


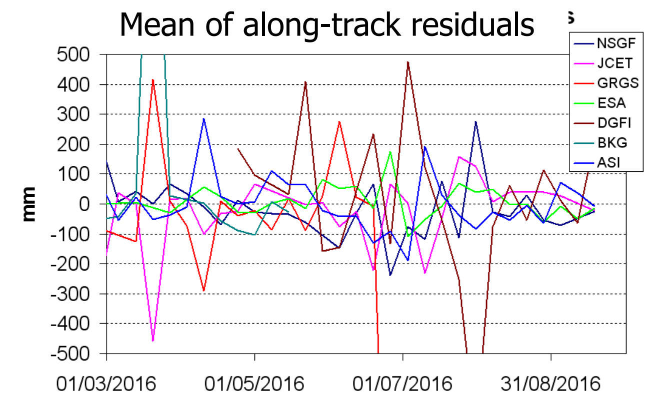
Mean R=28 C=148 A=140 mm

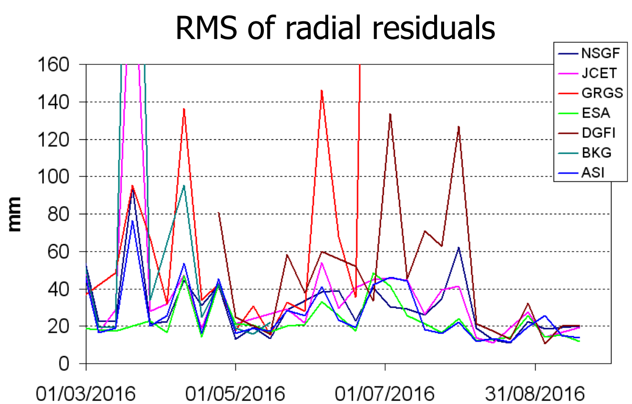
ETALON2 orbits

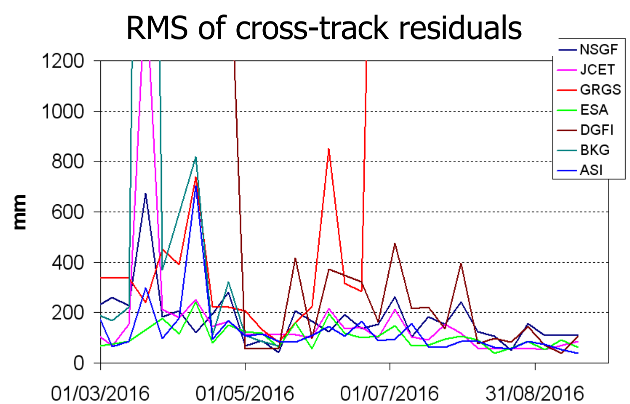
AC orbits compared with the combined one using weekly mean and rms of the residuals

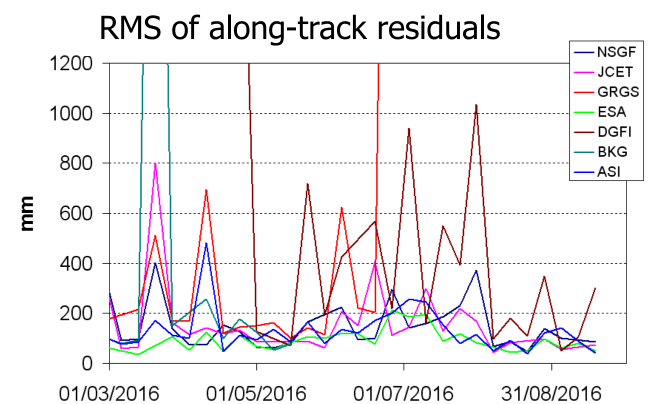












Mean R=31 C=193 A=166 mm

Summary on ILRS orbits

- Official ILRS orbits available since March 2016
- 6 ACs contributing to LAGEOS orbits
- 5 ACs contributing to ETALON
- The ACs orbits agreement, in terms of rms of the residuals w.r.t. the combination, is in the table below

	Radial (mm)	**Cross-track (mm)**	**Along-track (mm)**
LAGEOS1	5	25	25
LAGEOS2	7	30	31
ETALON1*	28	148	140
ETALON2*	31	193	166

*GRGS and DGFI not included

ITRF2014 in the ILRS products

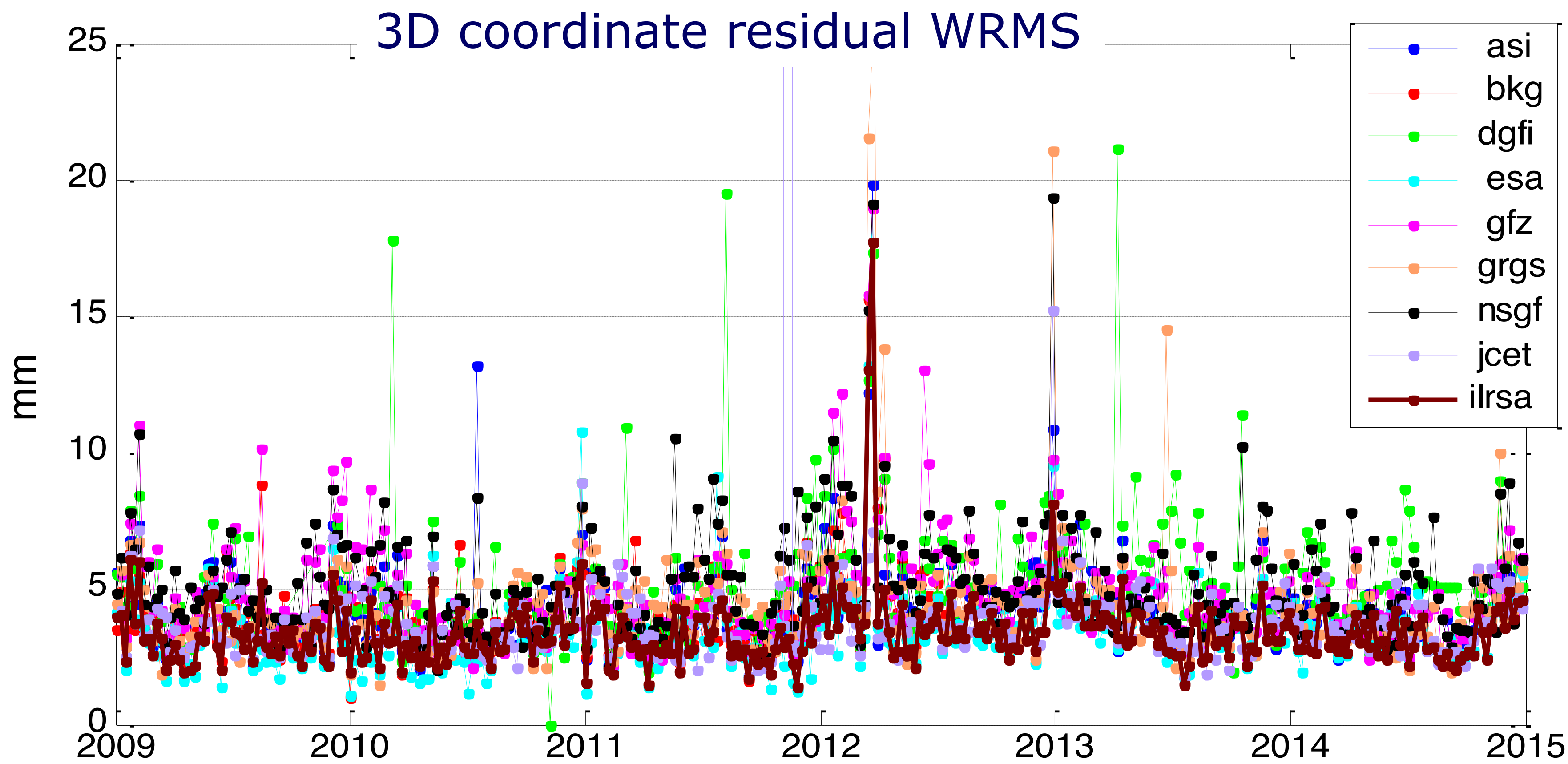
ITRF2014 test

AC time series were made using ITRF2014P as *a priori*

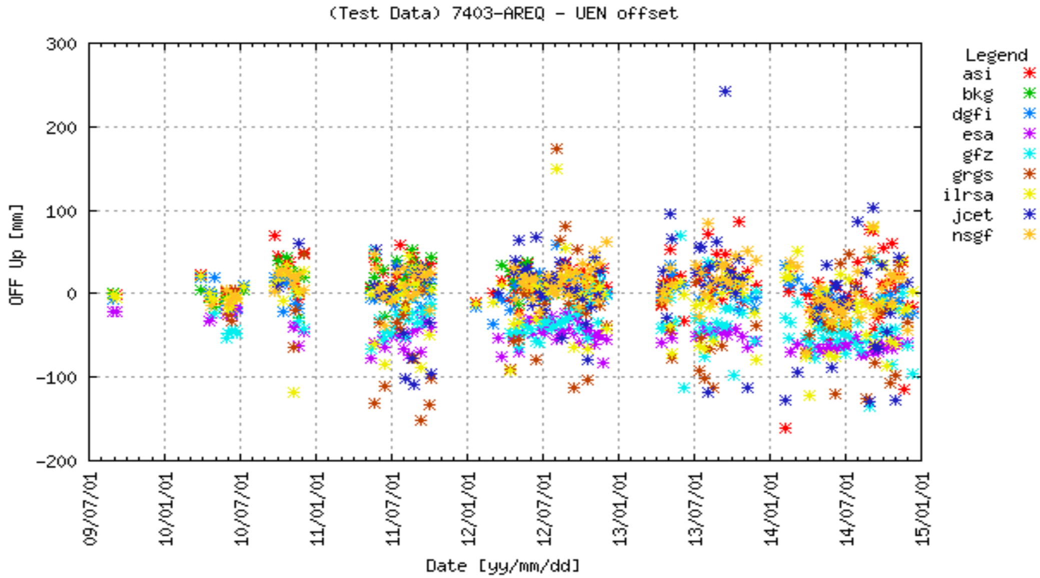
Agency	Time series	Note
ASI	2009-2014	
BKG	2009-2012	
DGFI	2009-2014	
ESA	1993-2014	
GRGS	2009-2014	Without PSD model
GFZ	2009-2014	
JCET	2009-2014	
NSGF	2009-2014	

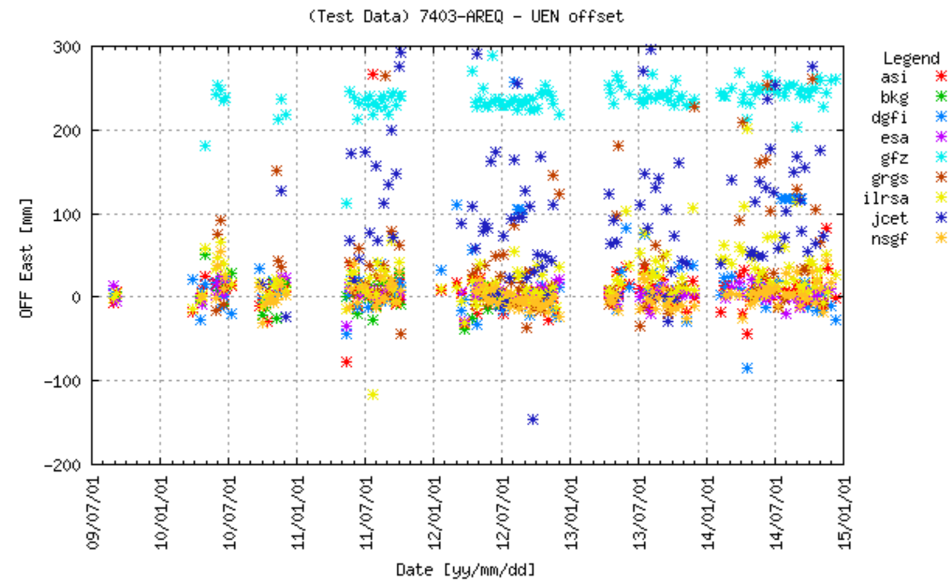
ILRSA combination

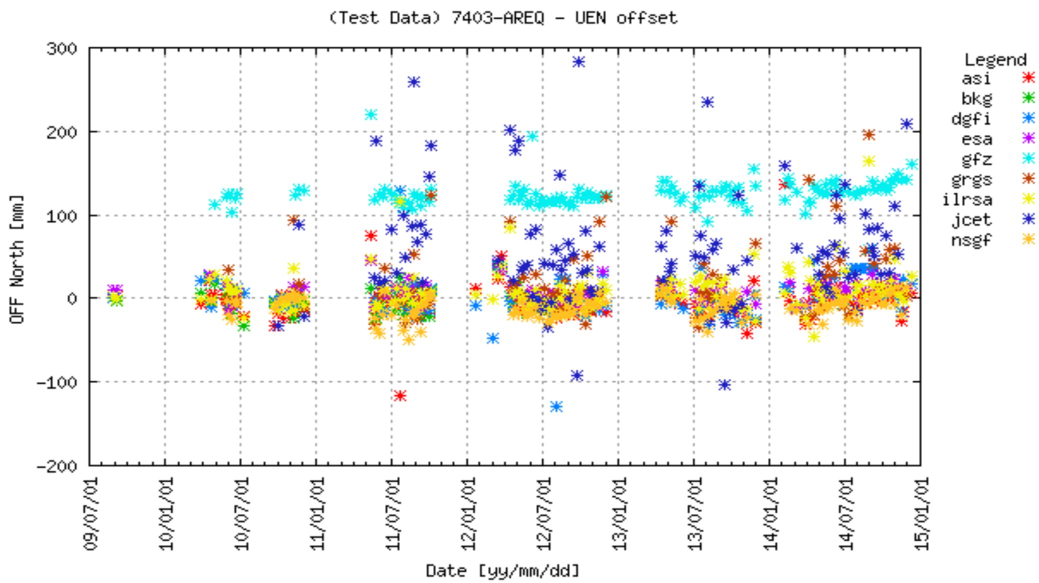
- The Post Seismic Deformation model has been integrated into the ILRSA processing chain.



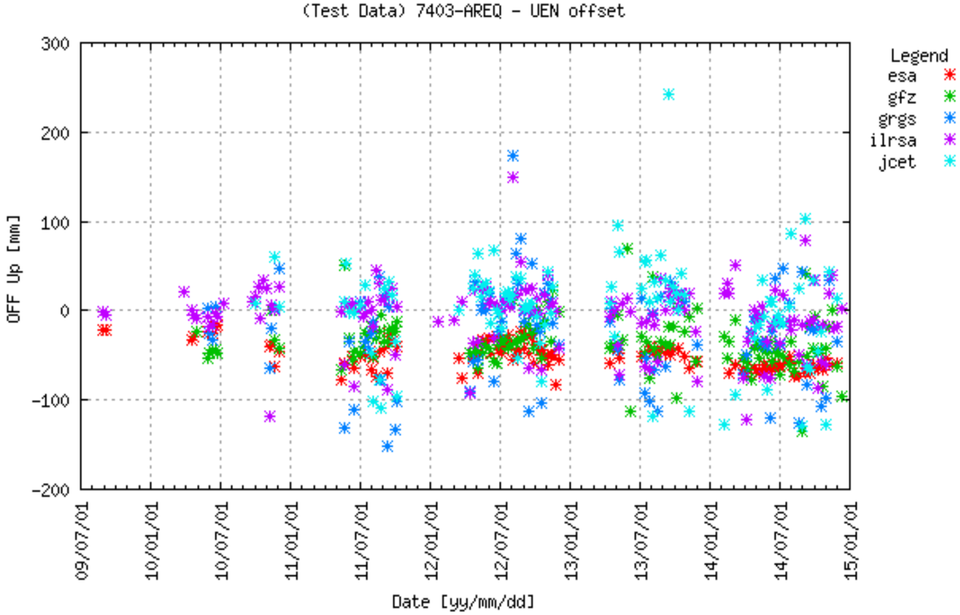
Arequipa 7403 w.r.t. ITRF2014

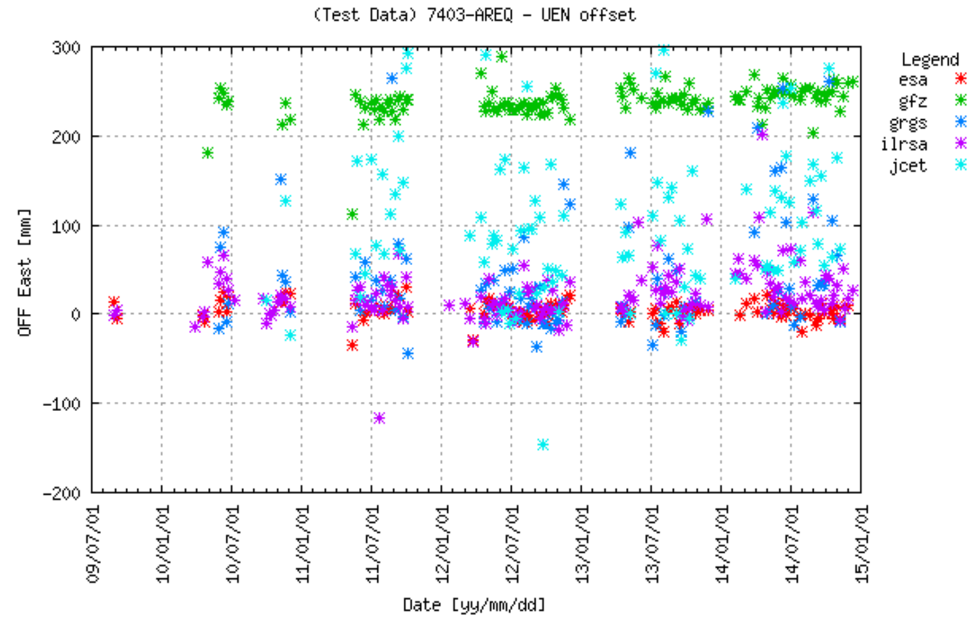


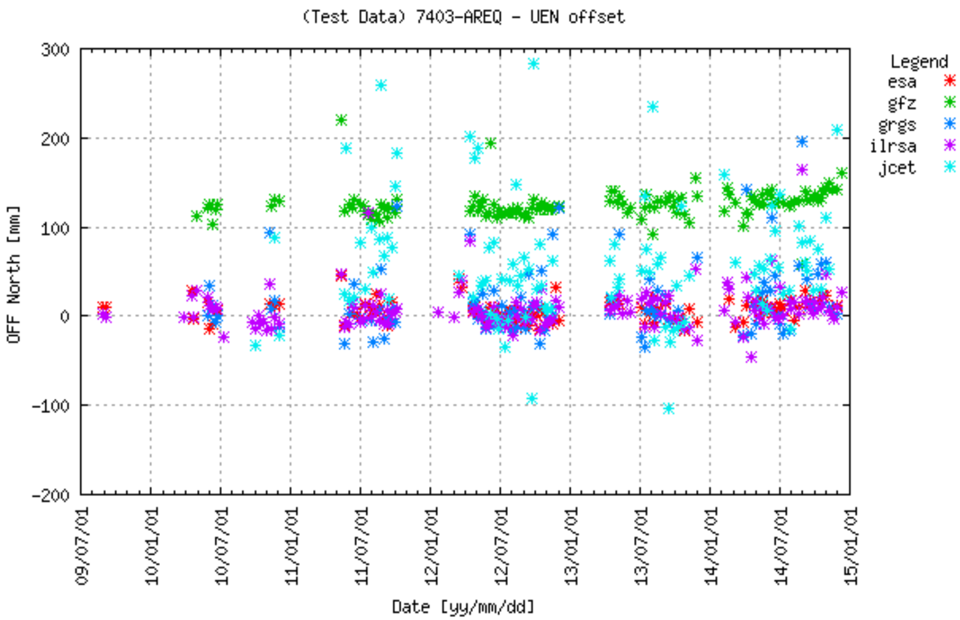




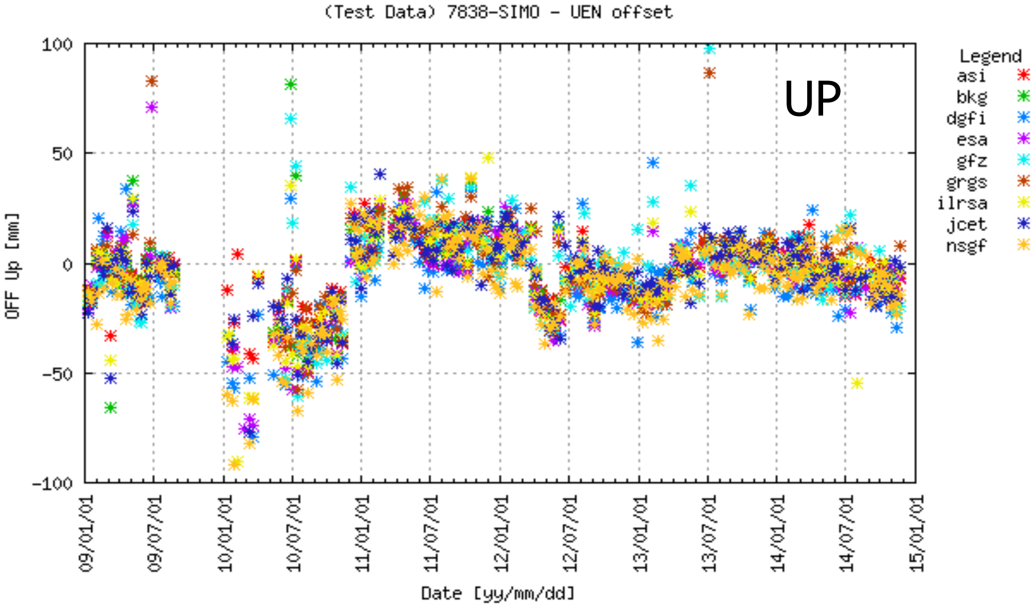
Arequipa 7403 w.r.t. ITRF2014

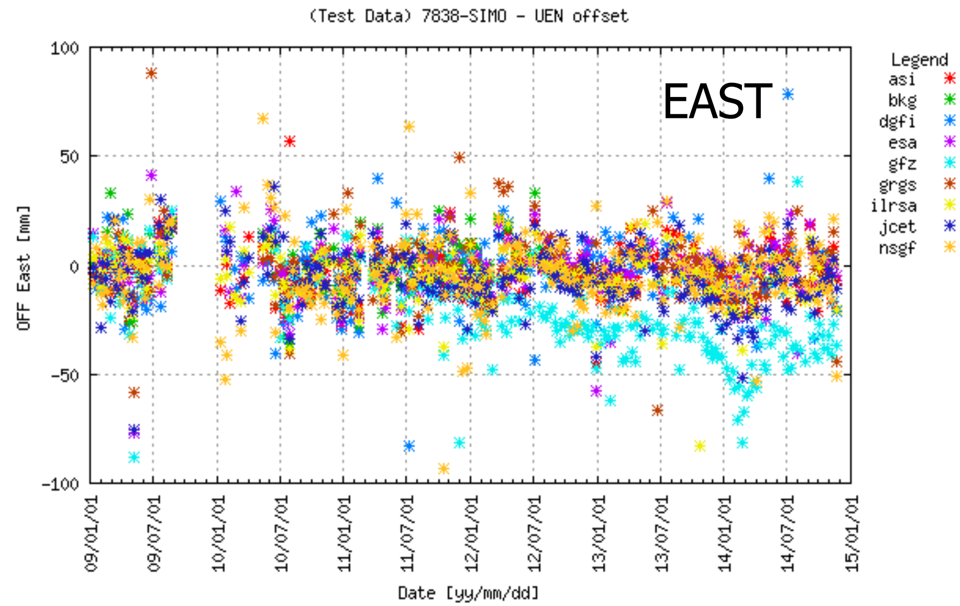


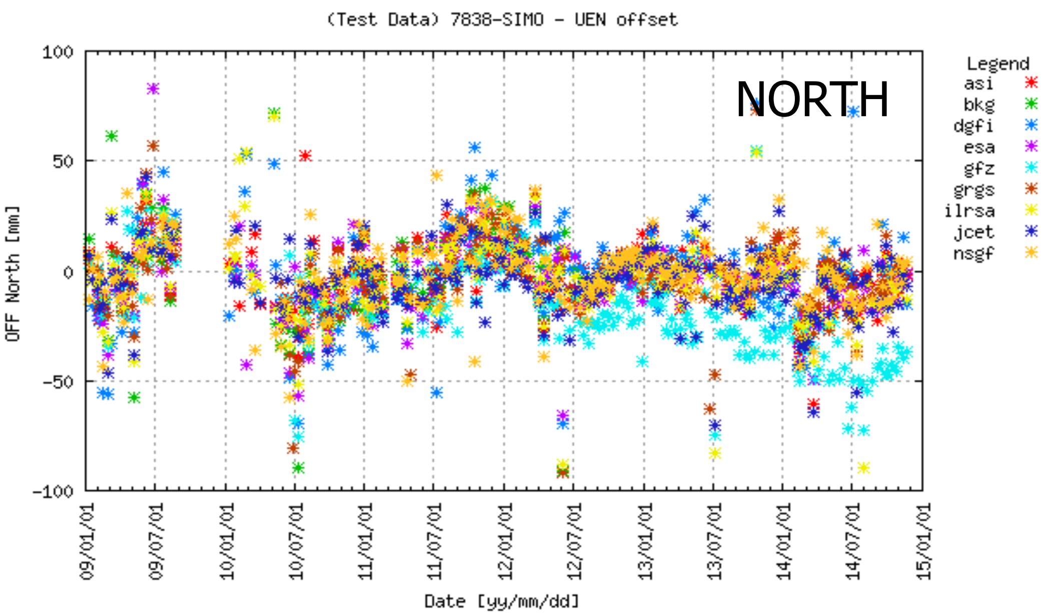




Simosato 7838 w.r.t. ITRF2014







PSD model

7838	11:070:20783	E 3	17.01	0.0844	-25.13	0.2911
		N 3	19.25	0.1311	-31.98	0.5166
		U 0				

ITRF2014 adoption

- ESA, GFZ need to make further checks for a few stations, most probably on the PSD model application
- GRGS and JCET have noisy results for a few stations (PSD model?)

Next steps

- Weekly solutions with ITRF2014 to be routinely submitted from November 2016
- ITRF2014 use in the official daily products from January 2017

SYSTEMATIC ERROR PILOT PROJECT

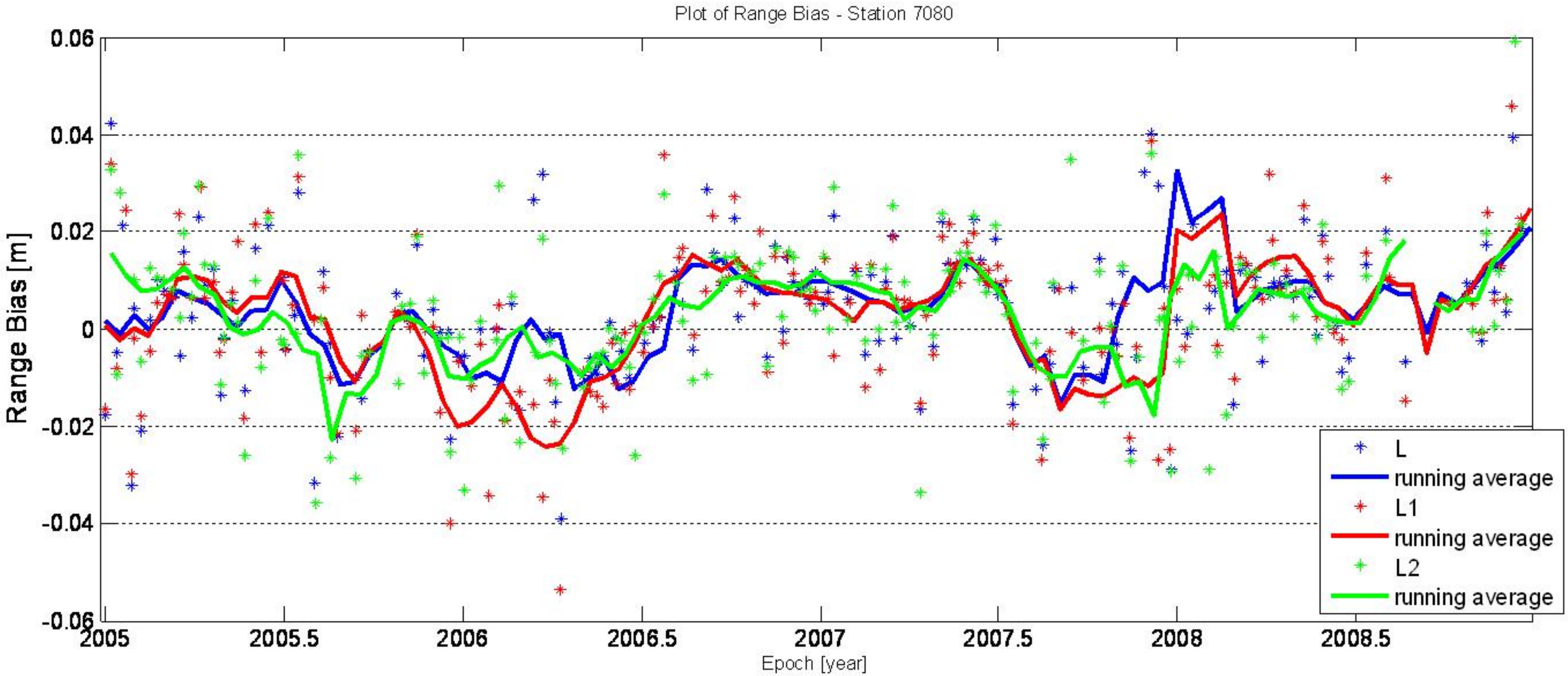
ILRS Pilot Project on systematic errors

PP Overview
- Weekly estimation of coordinates, EOP and biases
- Time frame: 2005-2008
- Data: L1 and L2
- 2 time series: unique and separate biases
- Available time series

AC	Date of submission
ASI	2 March 2016
DGFI	31 March 2016
GFZ	18 April 2016
JCET	1 April 2016
NSGF	15 April 2016

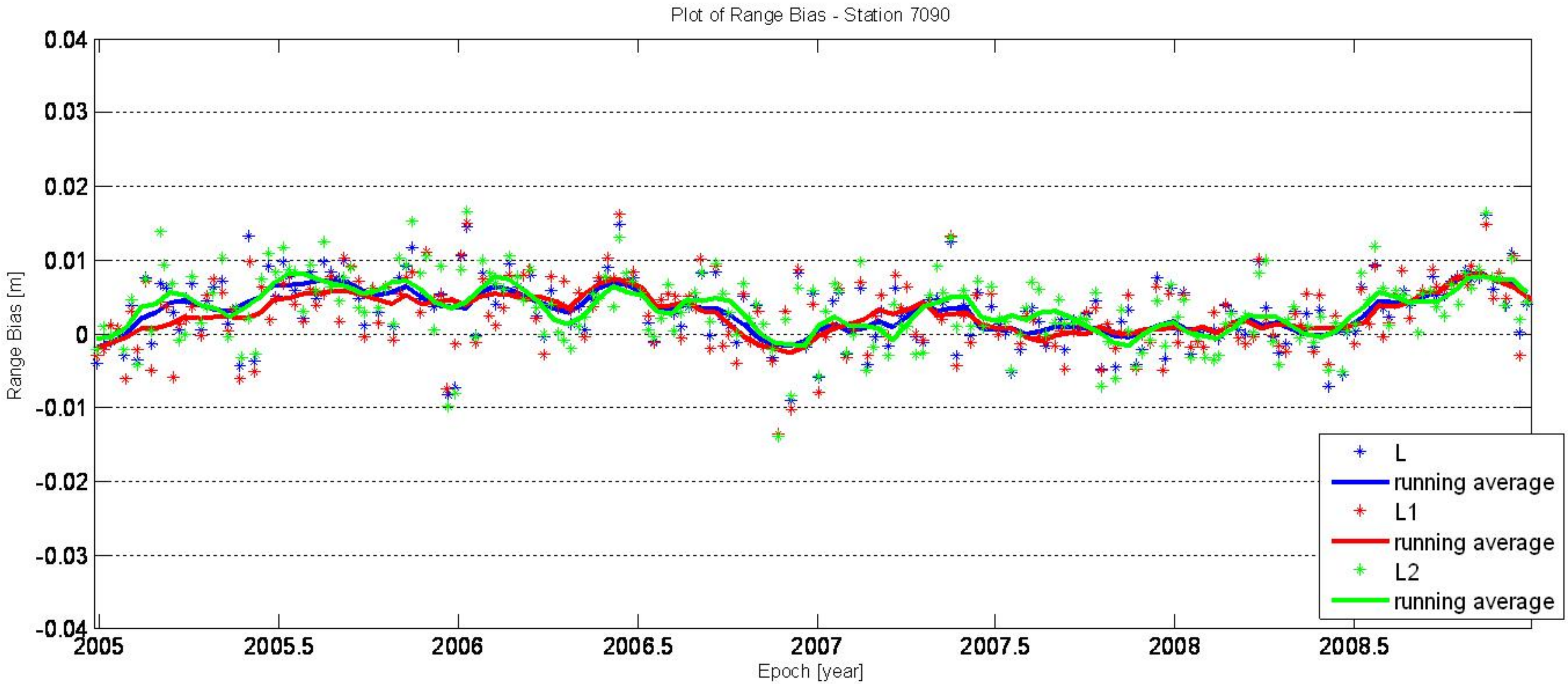
Status:
- First results presented at the ASC meeting in Vienna
- Further check and combination

McDonald

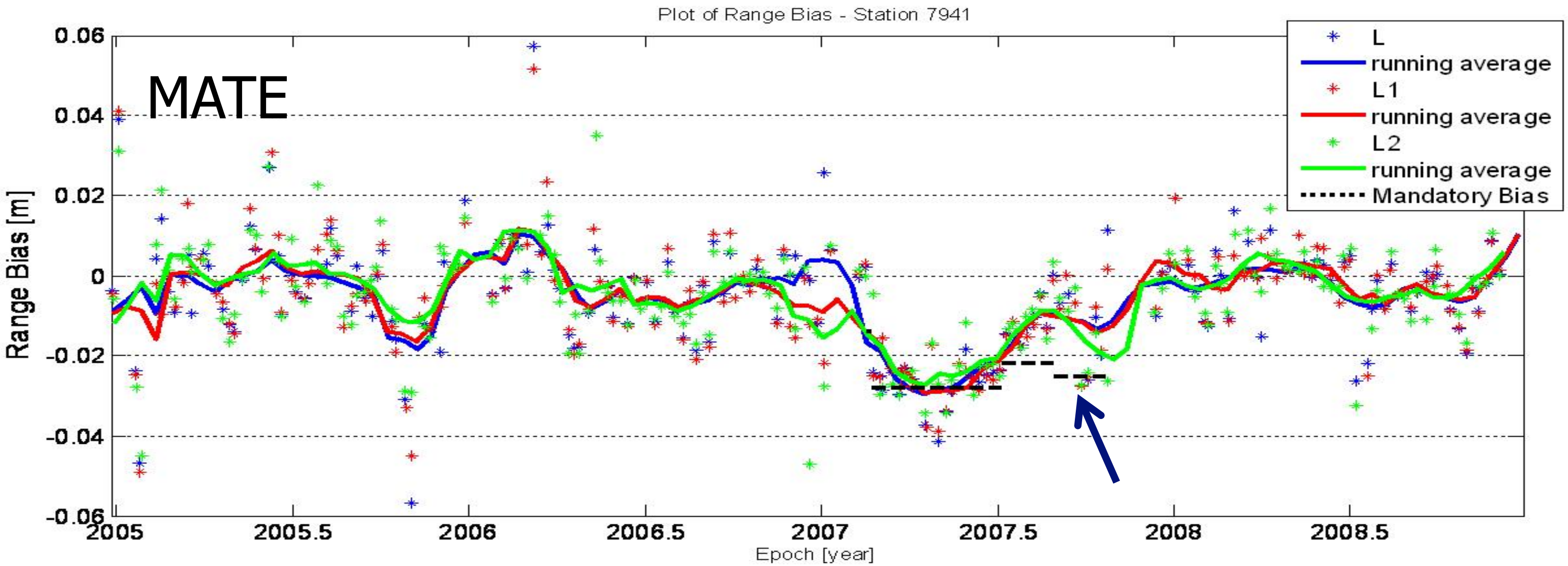


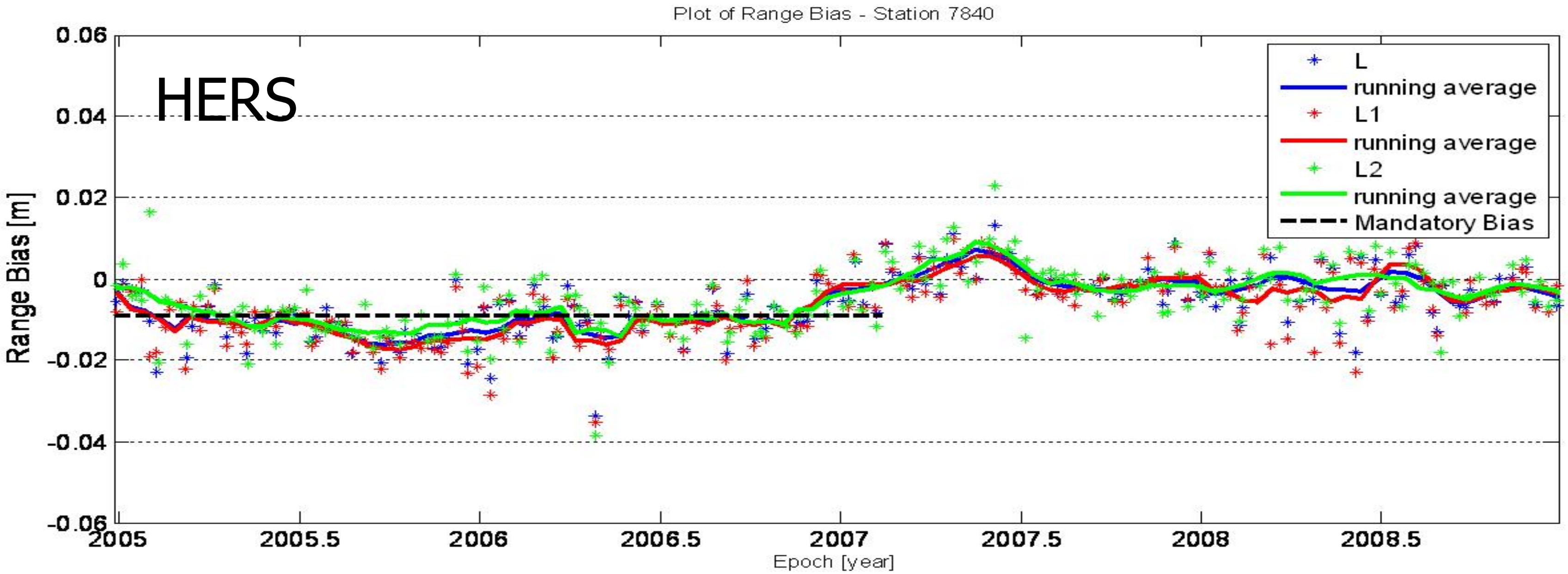
Plot of Range Bias - Station 7080
Range Bias [m]
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
2005
2005.5
2006
2006.5
2007
2007.5
2008
2008.5
Epoch [year]
L
running average
L1
running average
L2
running average

Yarragadee

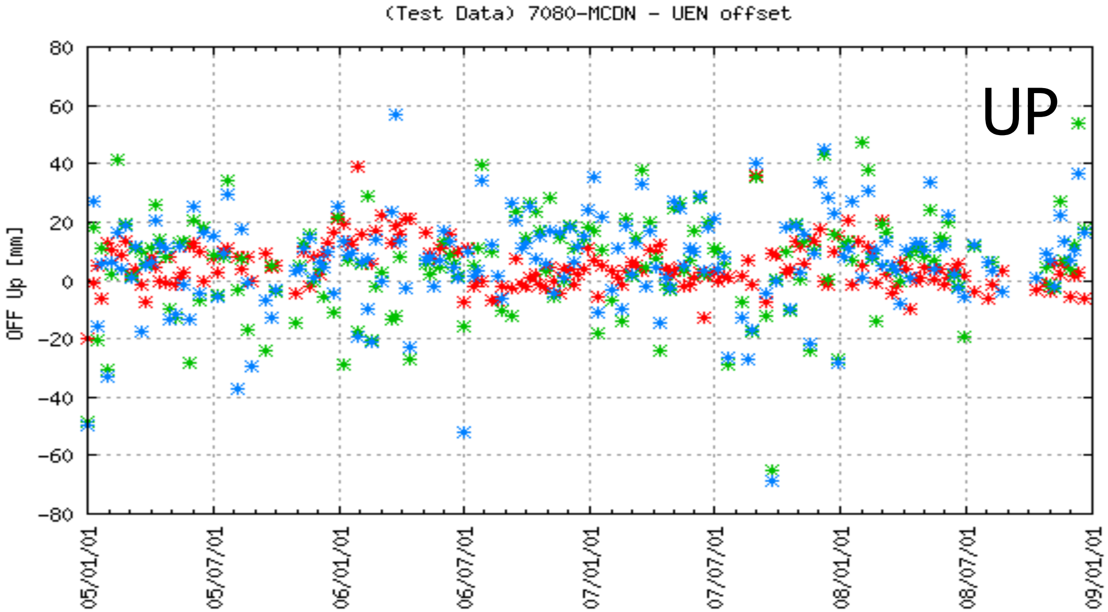

Plot of Range Bias - Station 7090
Range Bias [m]
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
2005
2005.5
2006
2006.5
2007
2007.5
2008
2008.5
Epoch [year]
L
running average
L1
running average
L2
running average

Comparison with standard ASC biases



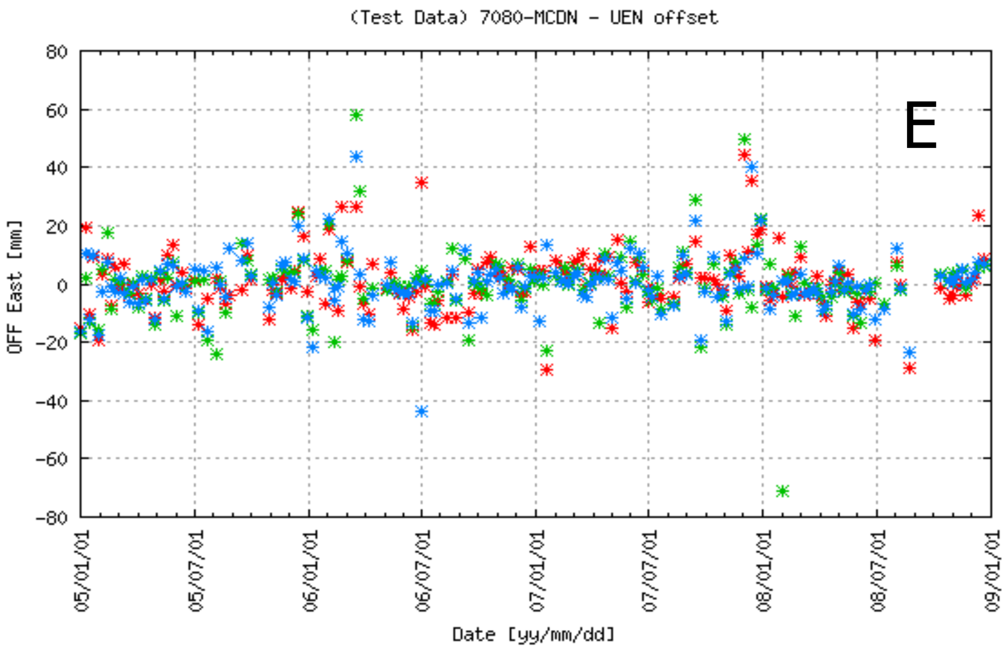


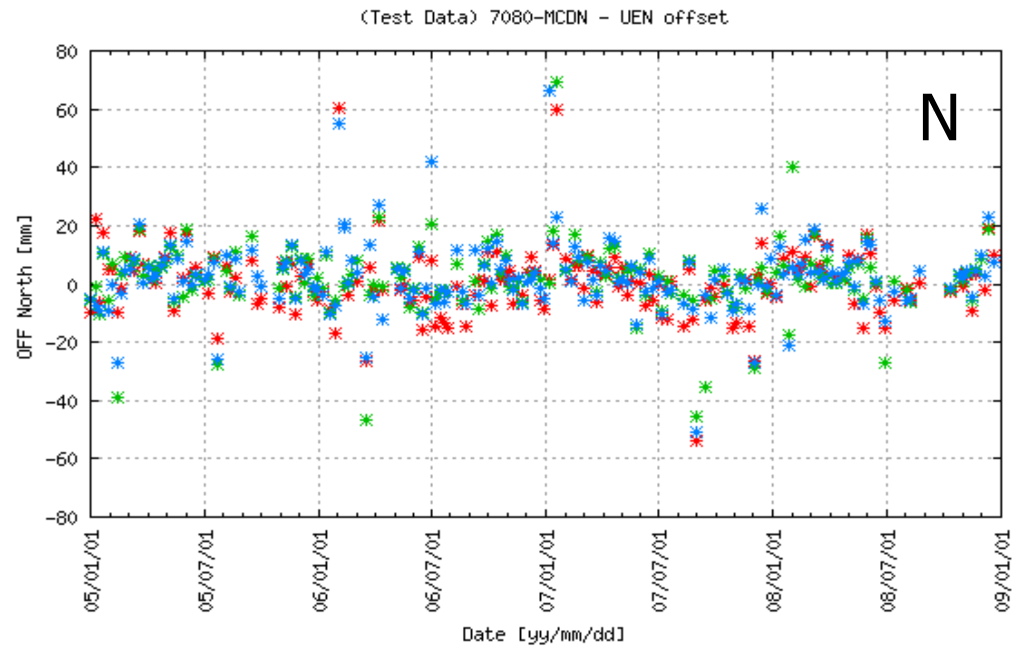
McDonald coordinates



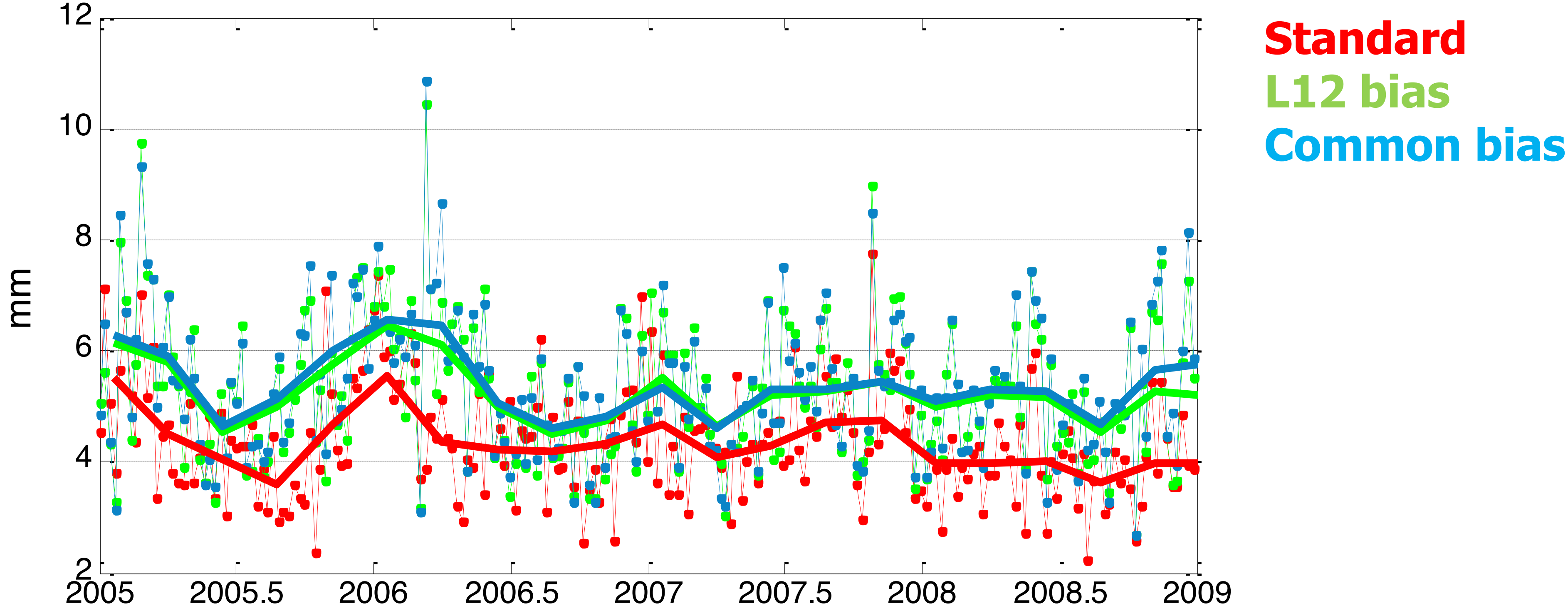
Standard
L12 bias
Common bias

	UP		**EAST**		**NORTH**	
	rms	sig	rms	sig	rms	sig
Std L12 comm	9.8 24.1 24.7	12.0 29.3 23.1	10.2 13.6 12.5	12.6 18.5 14.3	11.6 12.6 12.3	12.5 25.1 25.3

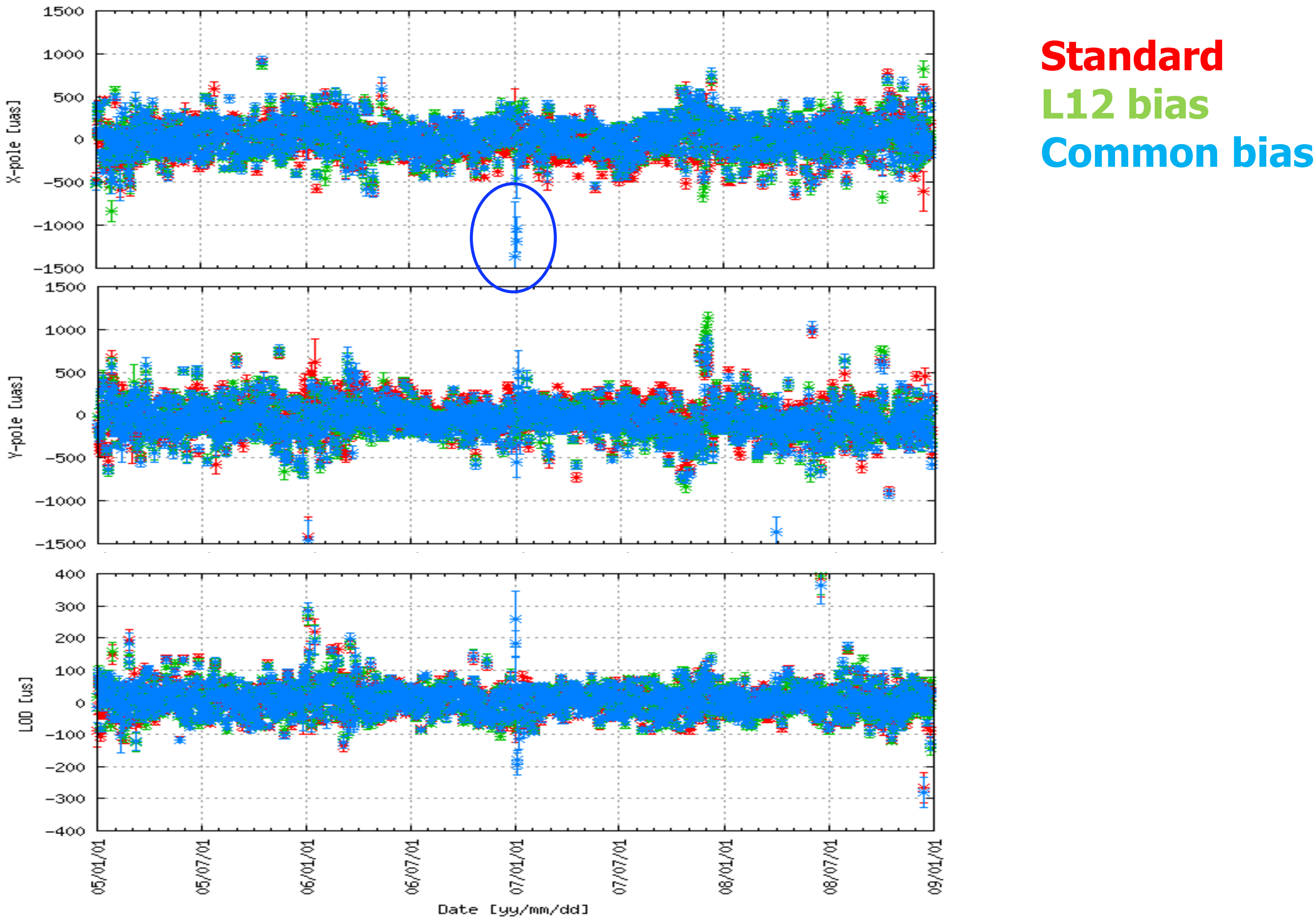




3D coordinate residual WRMS

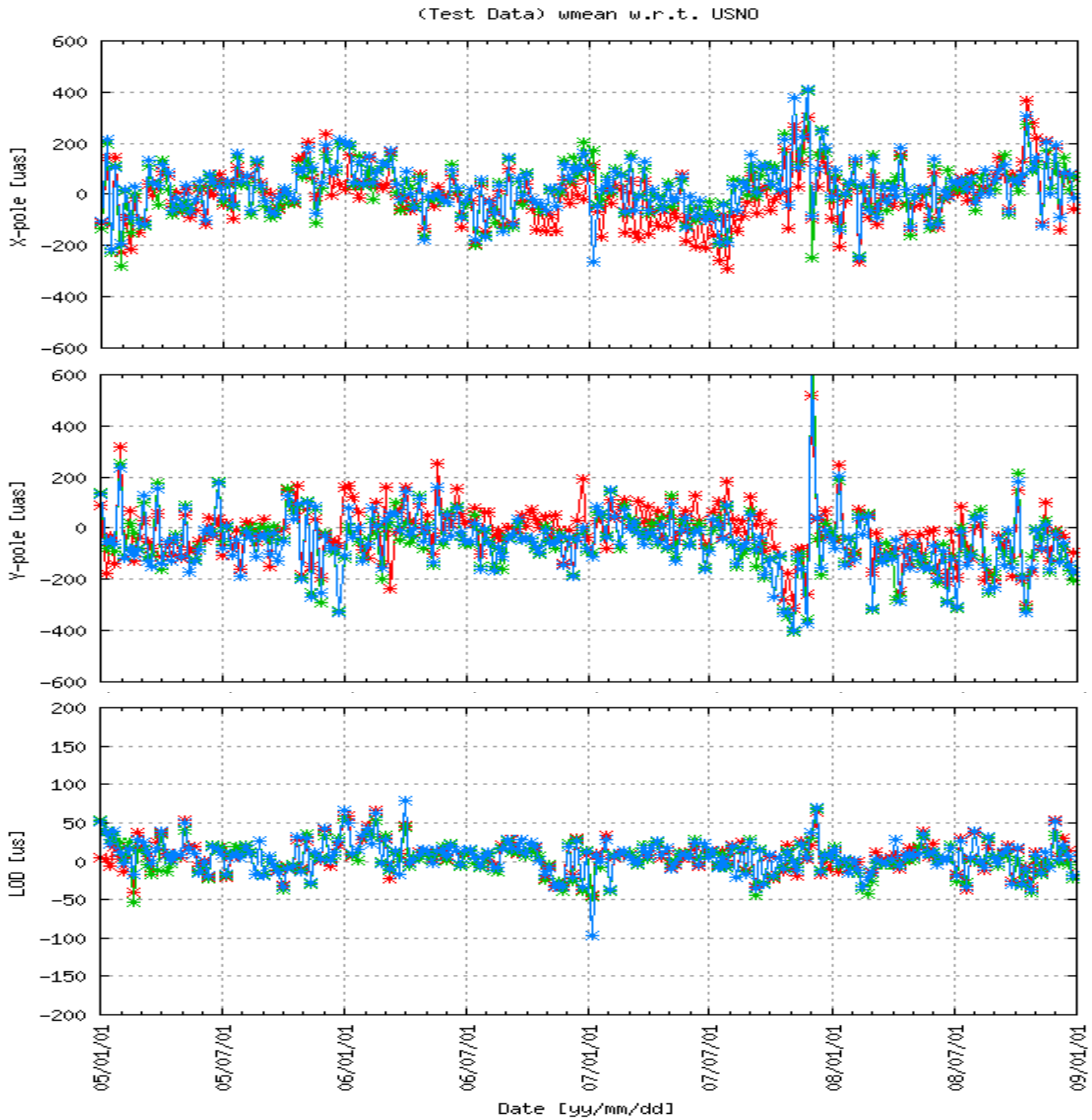


EOP w.r.t. USNO



X-pole [uas]
Y-pole [uas]
LOD [us]
05/01/01
05/07/01
06/01/01
06/07/01
07/01/01
07/07/01
08/01/01
08/07/01
09/01/01
Date [yy/mm/dd]
Standard
L12 bias
Common bias

EOP w.r.t. USNO: weekly mean



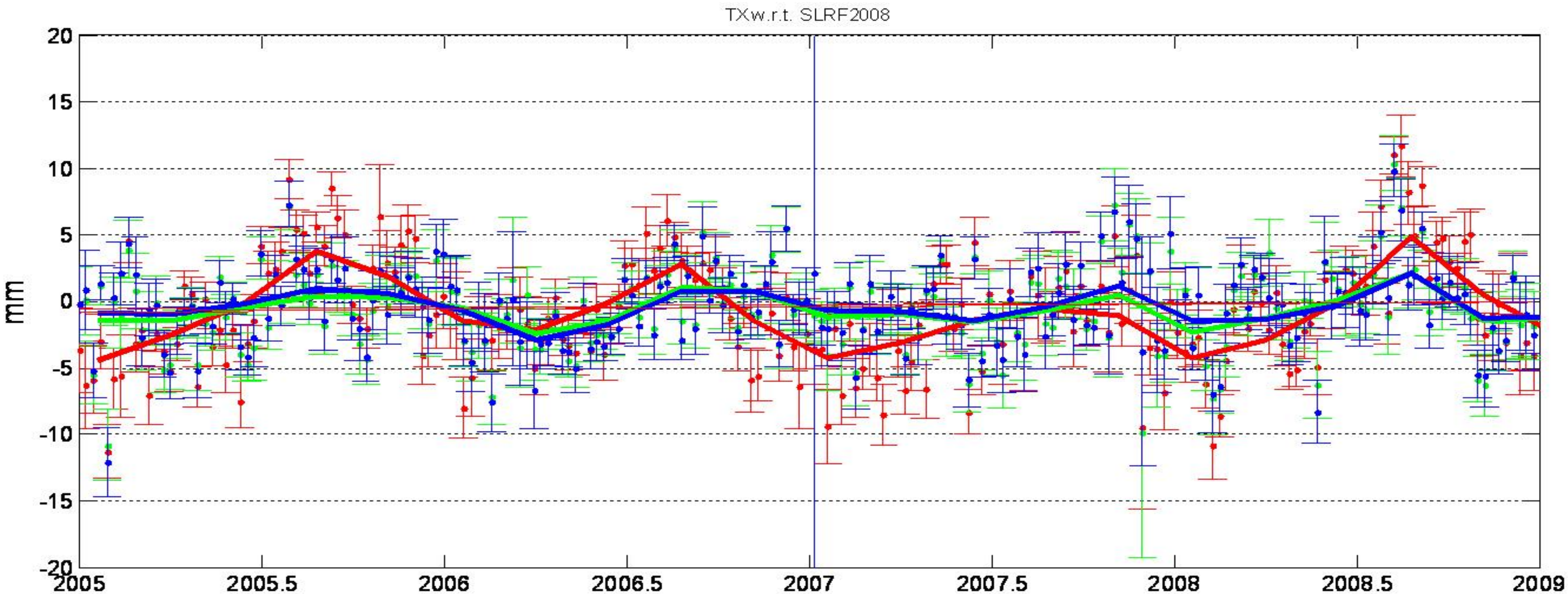
Standard

L12 bias

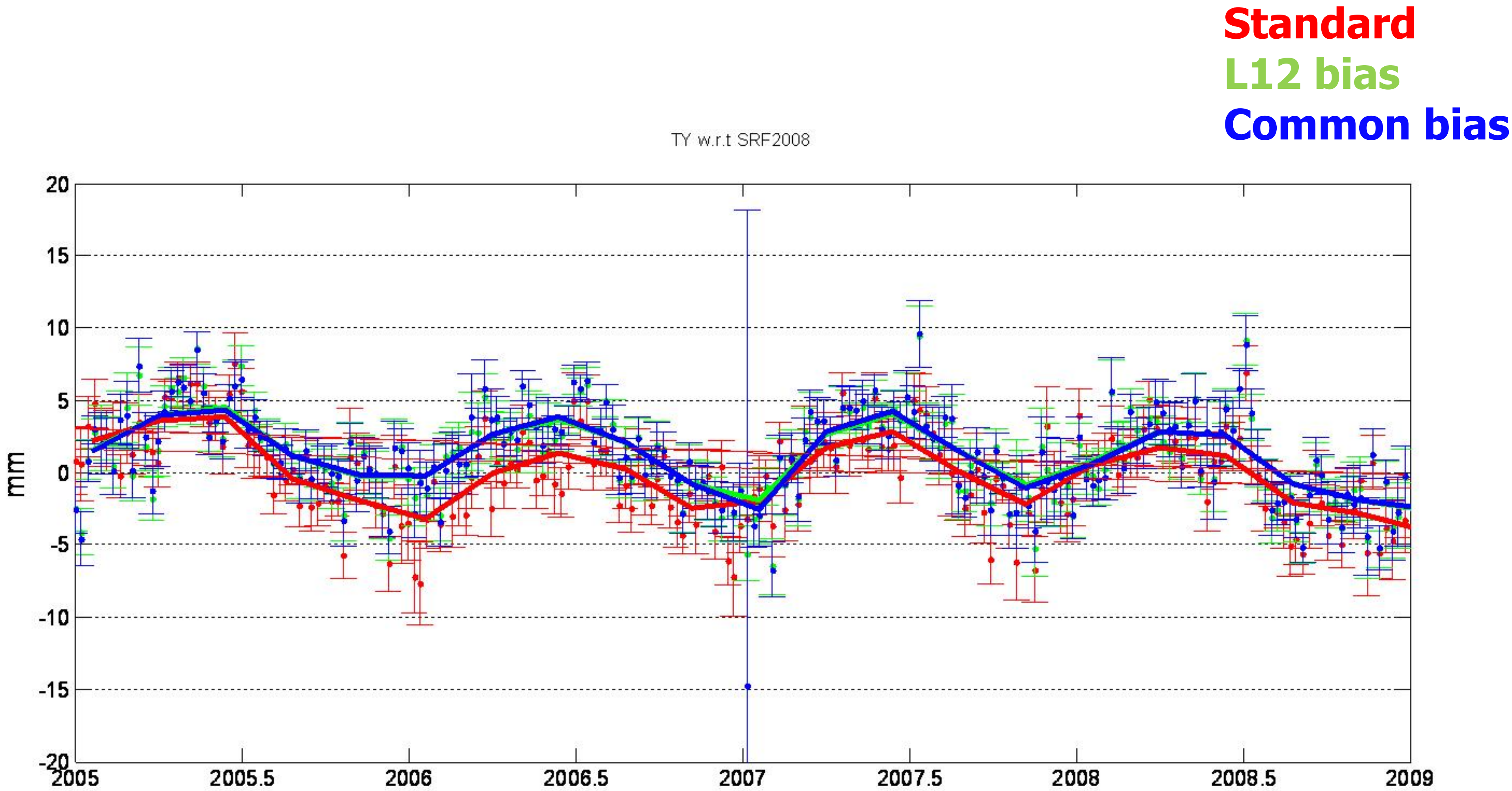
Common bias

TX w.r.t. SLRF2008

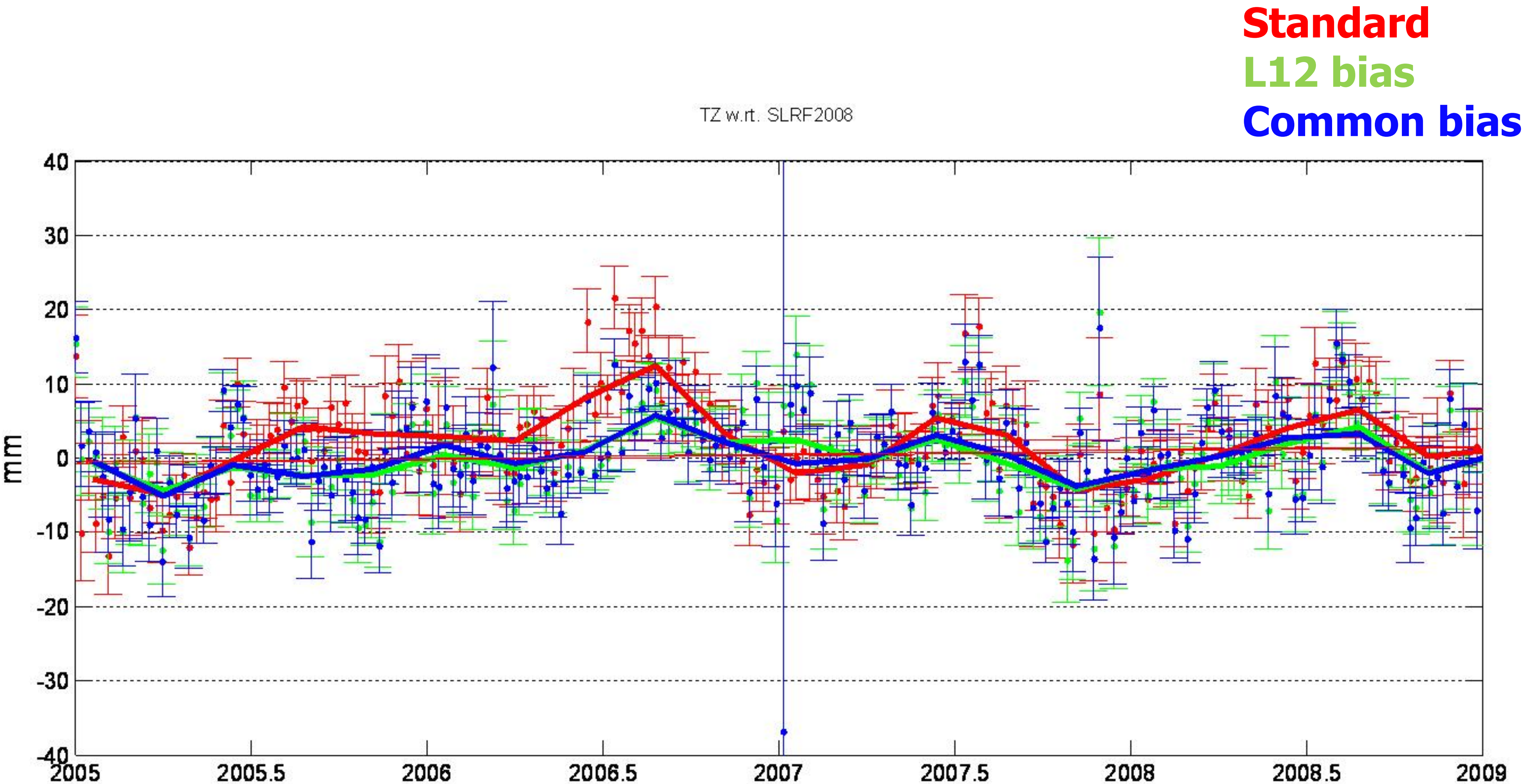
Standard
L12 bias
Common bias



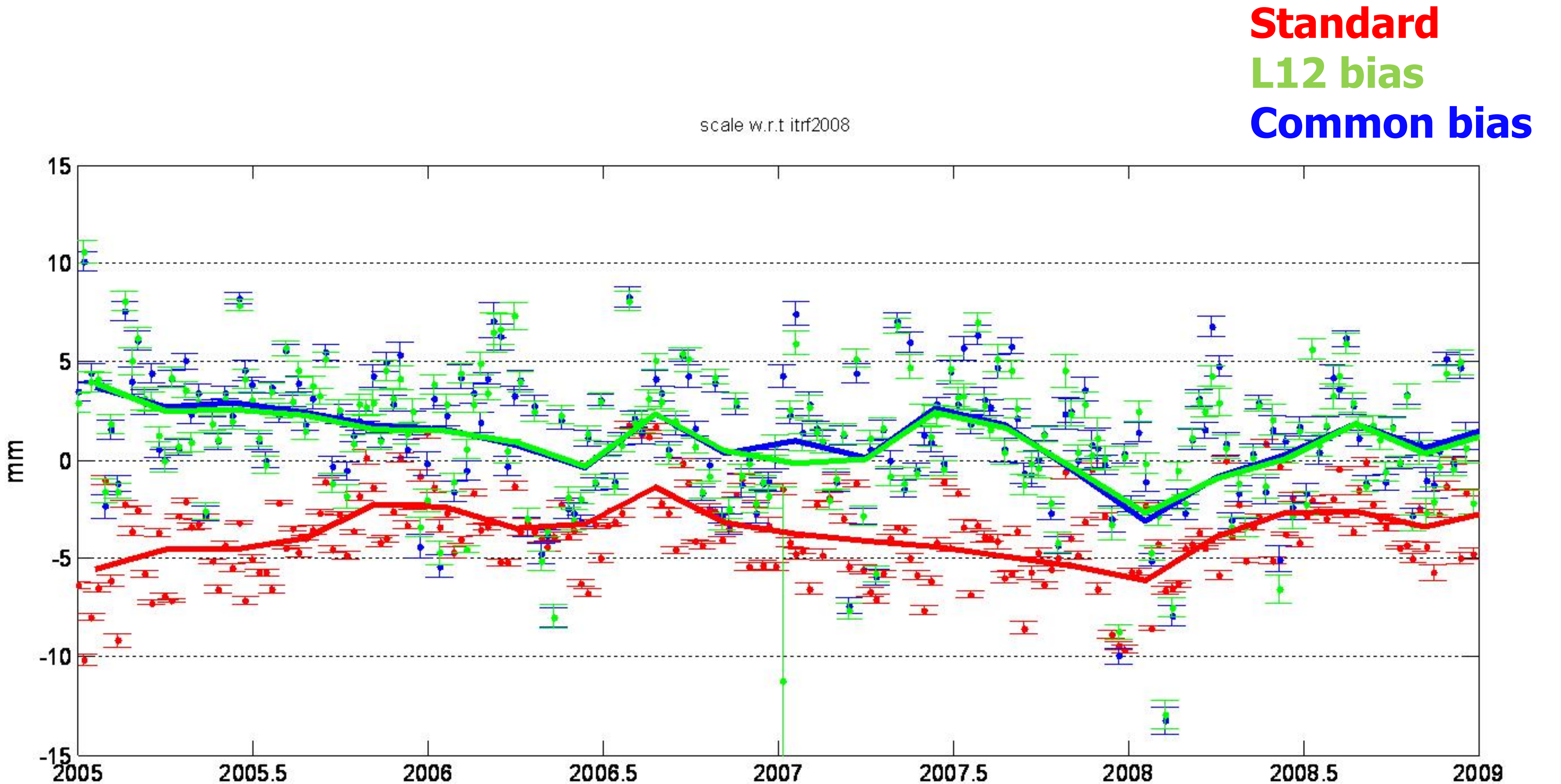
TY w.r.t. SLRF2008



TZ w.r.t. SLRF2008

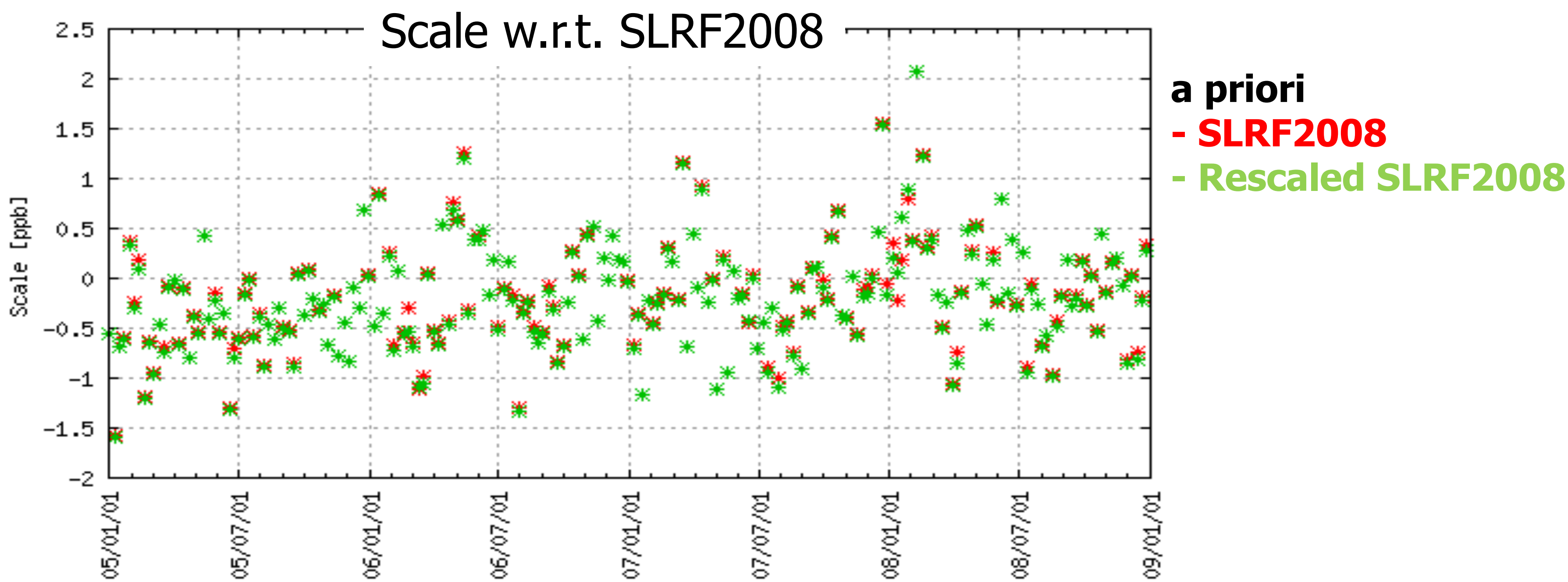


SCALE w.r.t. SLRF2008



SCALE assessment

Test of bias estimation using SLRF2008 rescaled by 1.0 ppb as a priori reference frame



The scale closest to zero is not linked to the *a priori* reference frame

Format Issue

- multiple wavelength and no direct correspondence with sites with different PT codes in the SOLUTION/ESTIMATE block
- BIAS epochs should be referred to the midpoint of the arc, similar to the site coordinates

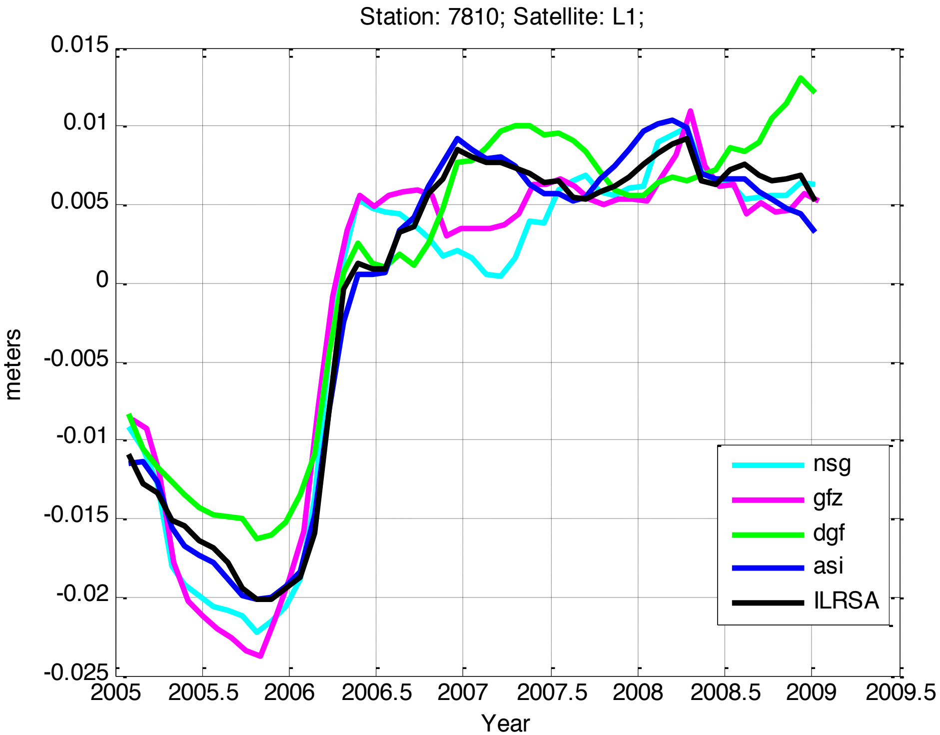
```
+BIAS/EPOCHS
*CODE PT SOLN T _DATA_START_ __DATA_END__ _MEAN_EPOCH_
 1831 L1    1 R 05:017:16134 05:018:11408 05:017:62700
 1831 L2    1 R 05:018:13033 05:018:13597 05:018:13315
 7405 L1    2 R 05:017:76988 05:017:78003 05:017:77496
 7405 L2    2 R 05:018:08386 05:019:30271 05:019:02930
 7810 L1    2 R 05:016:19778 05:022:68676 05:018:39532
 7810 L2    2 R 05:016:11027 05:022:45538 05:017:48197
 ................................

+SOLUTION/ESTIMATE
*INDEX _TYPE_ CODE PT SOLN _REF_EPOCH__ UNIT S '__ESTIMATED VALUE____ __STD_DEV_
     1 RBIAS  1831 L1    1 05:017:62700 m    2 0.163319098038446E+00 .370439E-01
     2 RBIAS  1831 L2    1 05:018:13315 m    2 0.153068393363257E+00 .386664E-01
     3 RBIAS  7405 L1    2 05:017:77496 m    2 0.249763868855504E-01 .493191E-02
     4 RBIAS  7405 L2    2 05:019:02930 m    2 0.158990843744622E-01 .458641E-02
     5 RBIAS  7810 L1    2 05:018:39532 m    2 -.181429871702343E-01 .133180E-02
     6 RBIAS  7810 L2    2 05:017:48197 m    2 -.129832927545893E-01 .143155E-02
..................
   110 STAX   7810  B    1 05:019:43200 m    2 0.433128308108095E+07 .709719E-01
```

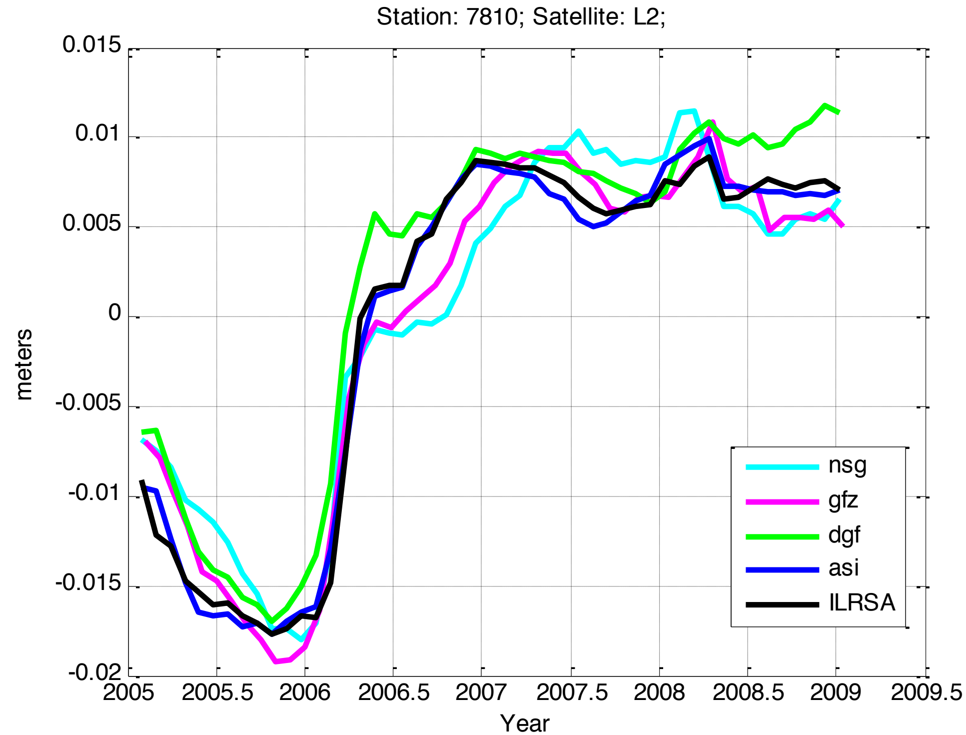
Combined biases

The SW used at ASI CC has been updated to include the combination of biases

Zimmerwald

Running mean on estimated biases





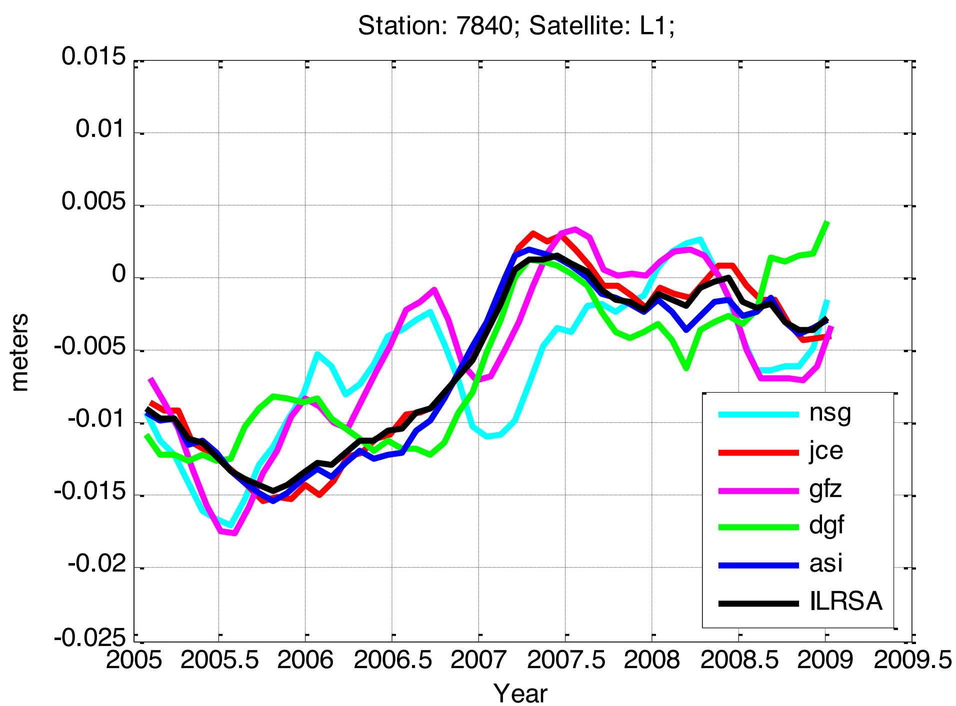
Data handling file

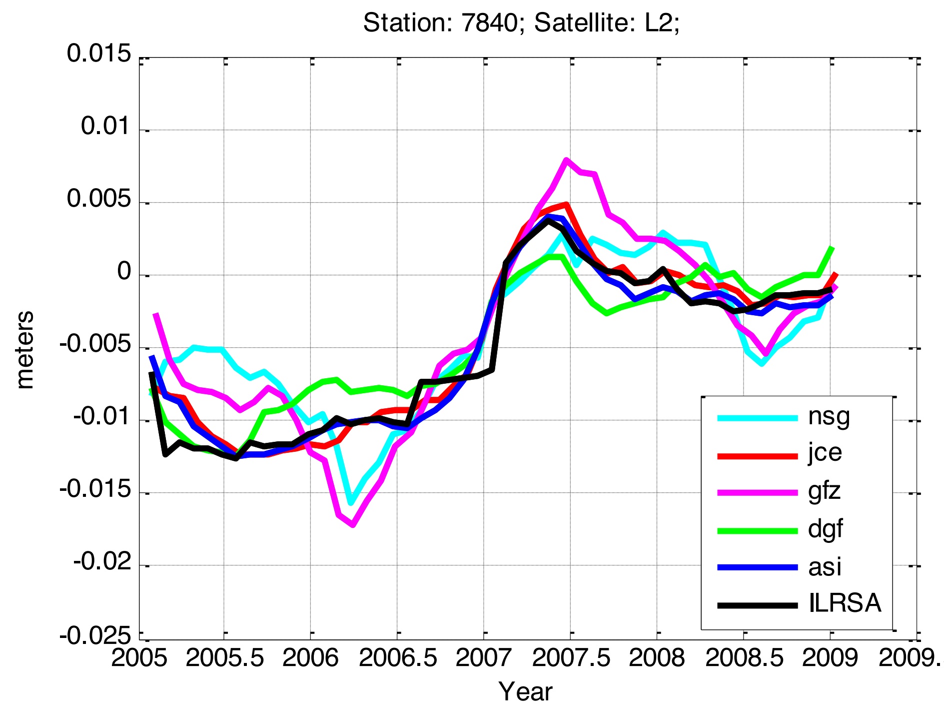
7810 --- mm B 04:363:00000 06:037:00000 R -26.00

Combined biases

Herstmonceux

Running mean on estimated biases



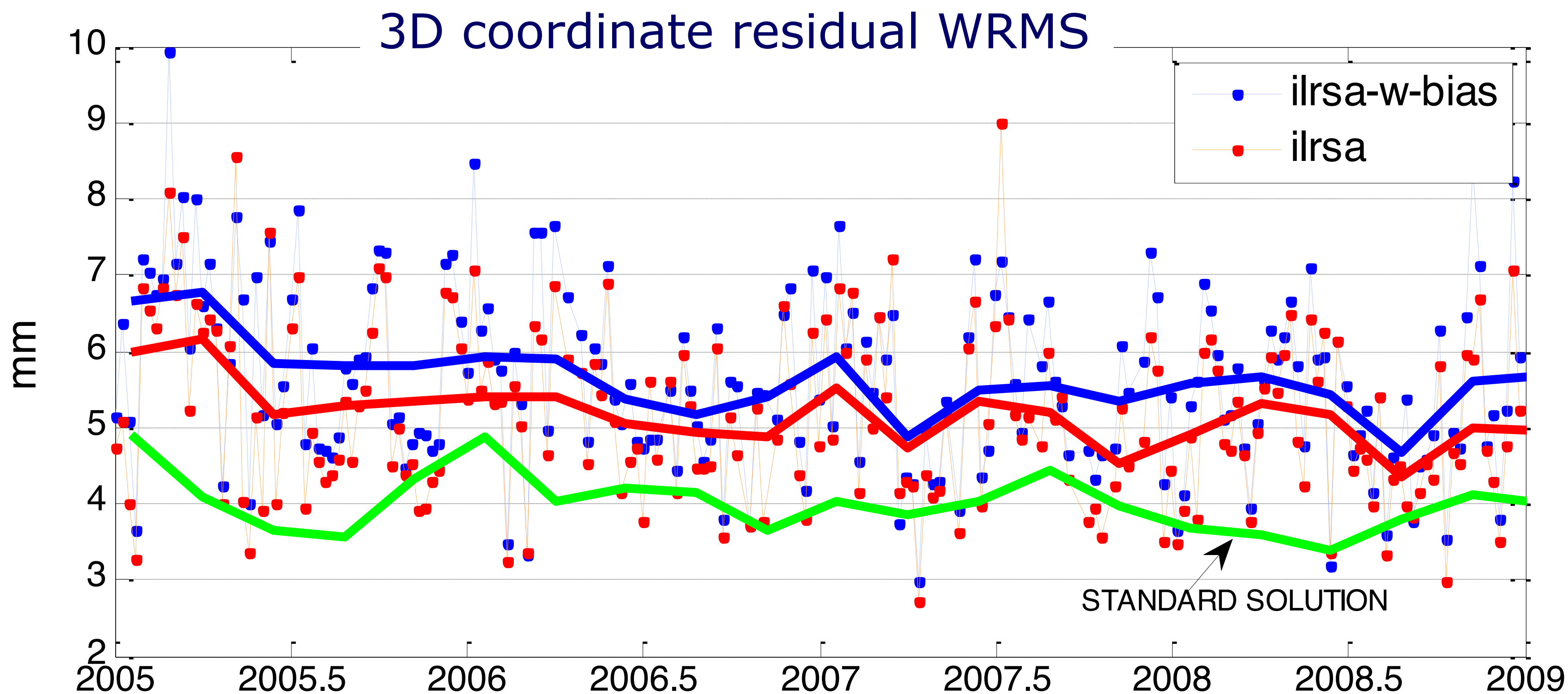


Data handling file

7840 --- mm A 02:032:00000 07:042:00000 R -9.00

Impact on the combined coordinates

Combined solution when considering or neglecting the estimated AC biases in the input solutions, compared to the standard one



Path forward

Question:
How can we use the bias time series?

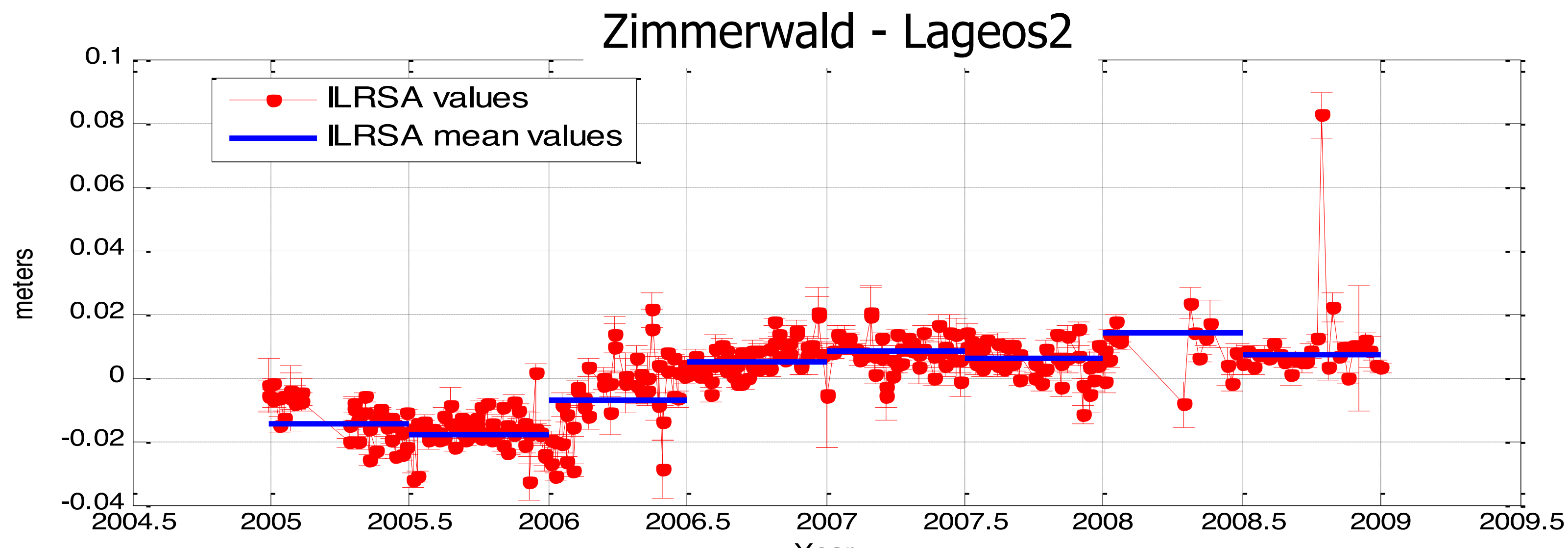
Points to note:

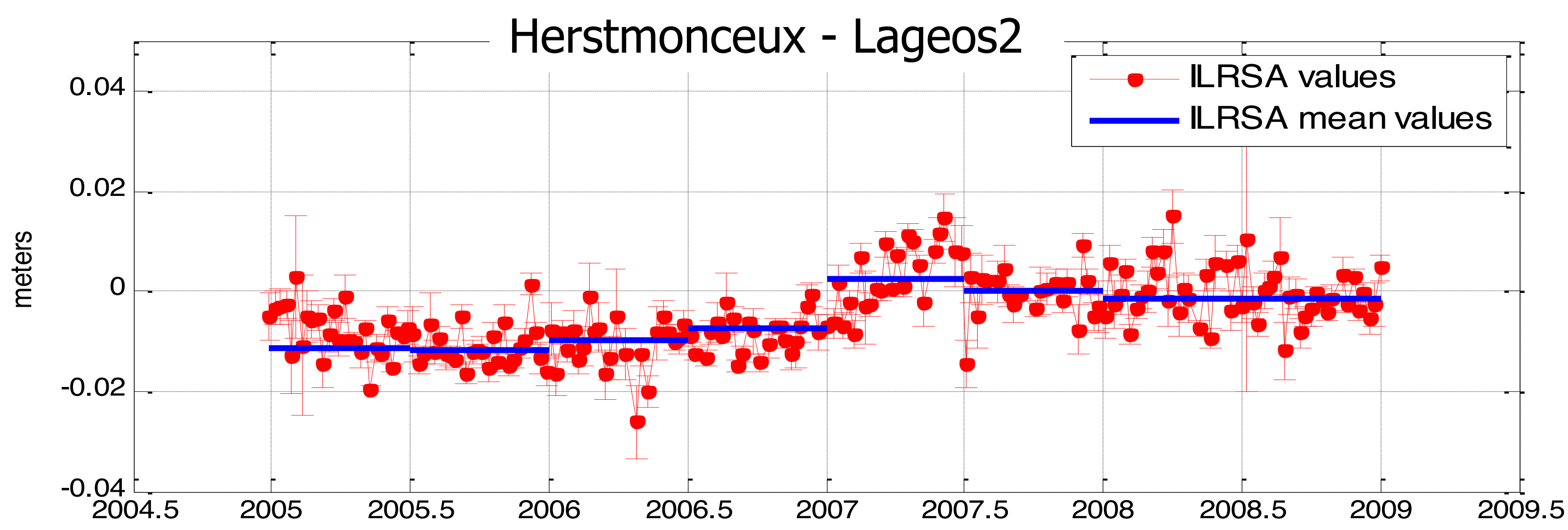
- Estimating the biases for all the sites together with the coordinates weakens the official products
- The 7-day estimation is a medium/long term monitoring, not a quick QC
- Essential to trace the biases at centimeter level

Possible use:

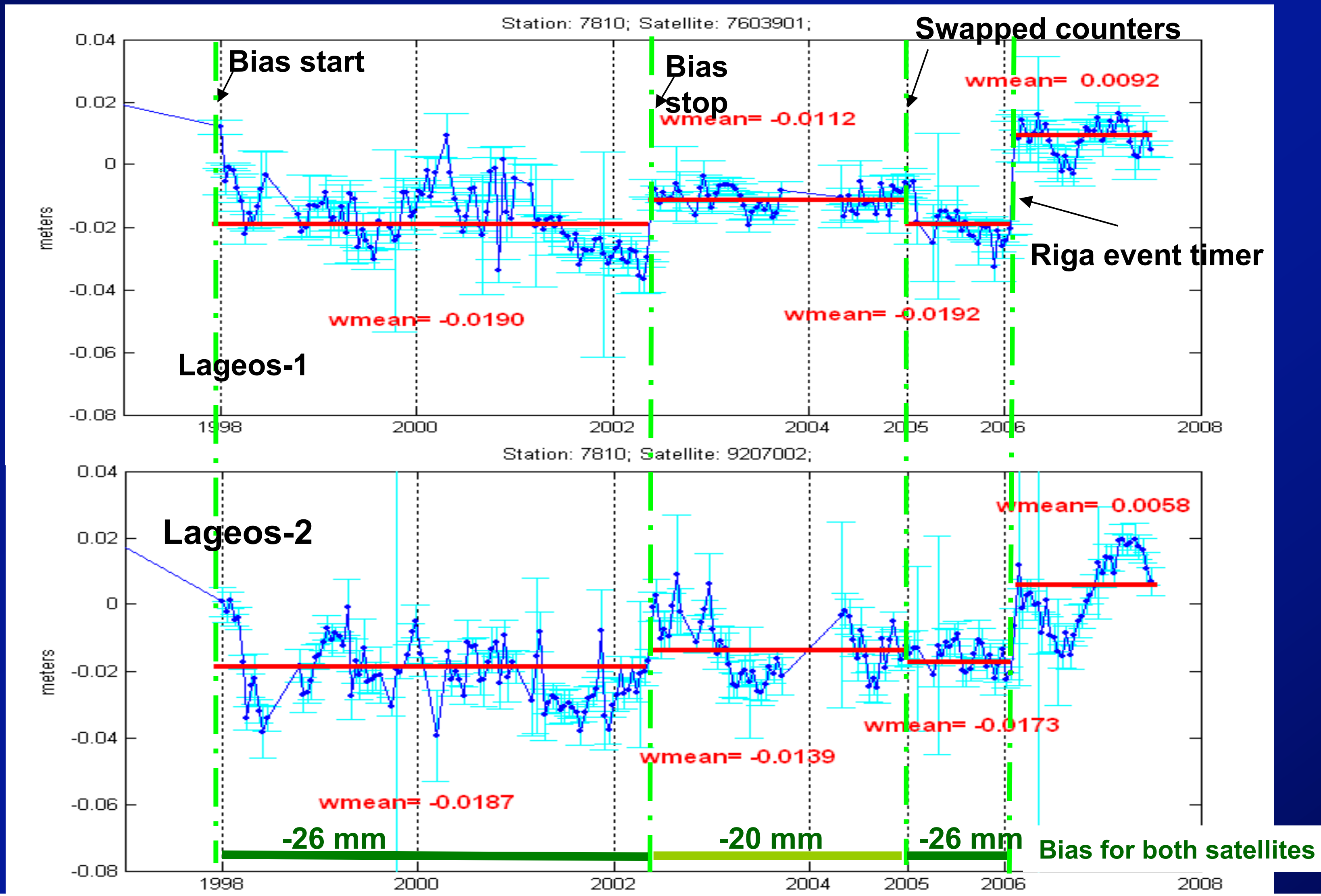
- make a table of biases, e.g. mean values over 6 months
- continue to estimate them in the weekly solutions to keep the table updated.
- use the table for the long term time series (next ITRF)
- the official daily solutions will use the values in the table.

Stepwise mean biases?

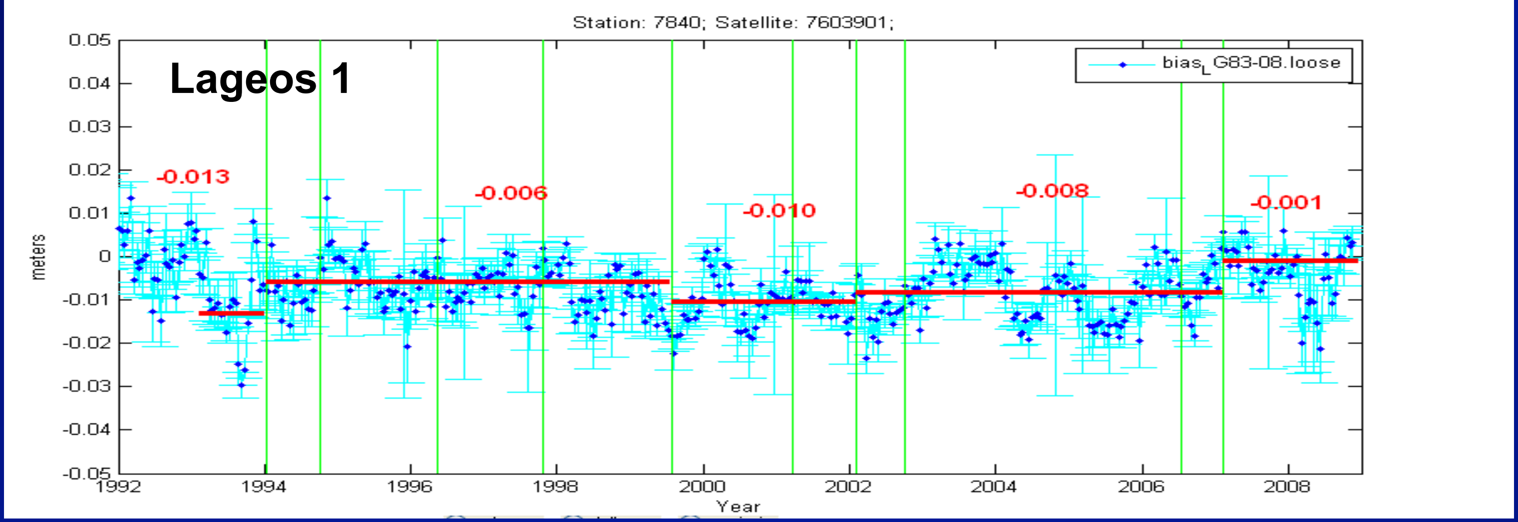


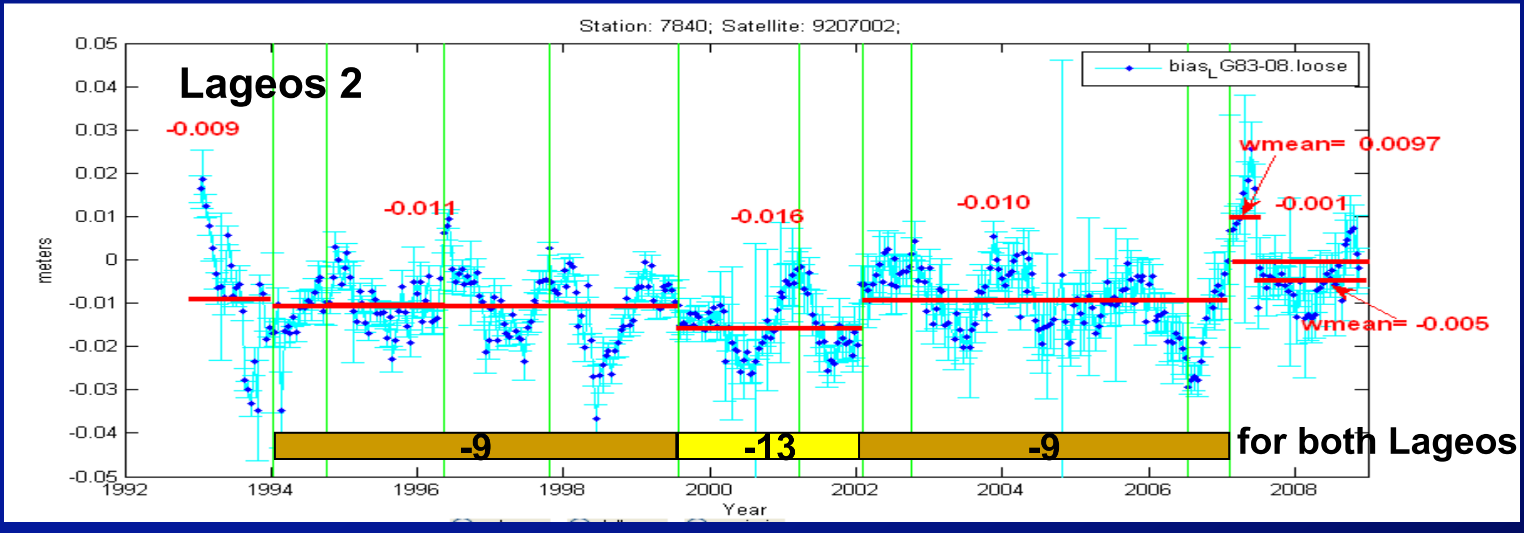


Zimmerwald: ASI estimated range biases



Herstmonceux bias from ASI multi-year solution 1983-2008





The JCET AC/CC Report to the ILRS ASC & Systematics Monitoring PP Summary

October 8, 2016

E. C. Pavlis, M. Kuzmicz-Cieslak and D. König,

Outline

- Operational Products Status
- Network support (Quarantined and Validated stations, etc.)
- Station Systematic Error Monitoring Pilot Project
- Preparations for the adoption of ITRF2014
- The orbital files (SP3c) combination process
- Journal of Geodesy ILRS Special Issue

Operational Products Status

- Daily and Weekly series delivered routinely and consistently by five-six of the eight ACs
- Since early July we have not received contributions from GRGS
  - Latest news from Florent indicate that a restart is imminent
- Starting in early July BKG has ceased contributing
  - No word yet on future developments here
- ESA has been dropping off at times, not clear why
- With the routinely contributing ACs down to five-six, it is important that all ACs make an effort to deliver their contributions regularly, to maintain the quality of our products!

Network support

FROM: http://edc.dgfi.tum.de/en/stations/

Quarantine Stations

Station	Code	Site	DC	SOD	DOMES	First Data	Last Data	
1831	LVIL	Lviv, Ukraine	EDC	18318501	12368S001	2002-07-01	2009-11-26	2506 day(s)
1863	MAID	Maidanak 2, Uzbekistan	EDC	18635101	12340S001	1991-07-31	2004-01-17	4646 day(s)
1864	MAIL	Maidanak 1, Uzbekistan	EDC	18645401	12340S002	1992-06-02	2007-10-29	3266 day(s)
1884	RIGL	Riga, Latvia	EDC	18844401	12302S002	1987-09-21	2016-10-04	3 day(s)
7231	WUHL	Wuhan, China	CDDIS	72312901	21602S004	2000-08-26	2005-12-18	3945 day(s)
7308	KOGC	Koganei, Japan (CRL)	CDDIS	73085001	21704S002	1995-02-10	2015-01-07	638 day(s)
7358	GMSL	Tanegashima, Japan	CDDIS	73588901	21749S001	2004-09-01	2016-09-23	14 day(s)
7359	DAEK	Daedeok, Korea	EDC	73592601	23902S002	2013-04-12	2014-11-18	688 day(s)
7406	SJUL	San Juan, Argentina	EDC	74068801	41508S003	2006-02-23	2014-11-19	687 day(s)
7806	METL	Metsahovi, Finland	CDDIS	78067601	10503S014	1998-09-06	2005-05-20	4158 day(s)
7820	KUNL	Kunming, China	EDC	78208201	21609S002	2000-04-22	2016-06-23	106 day(s)
7824	SFEL	San Fernando, Spain	EDC	78244502	13402S007	1999-04-08	2016-10-06	1 day(s)
7831	HLWL	Helwan, Egypt	EDC	78314601	30101S001	1983-10-25	2007-12-30	3203 day(s)
7832	RIYL	Riyadh, Saudi Arabia	EDC	78325501	20101S001	1996-01-30	2012-03-14	1668 day(s)
7838	SISL	Simosato, Japan	CDDIS	78383603	21726S001	2016-06-02	2016-06-23	106 day(s)

http://edc.dgfi.tum.de/en/stations/ascii/

EDC List of Station Status

78403501	V	HERL	EDC	13212S001	1983-03-31	2016-10-06	Herstmonceux, United Kingdom
78418701	V	POT3	EDC	14106S011	2010-02-27	2016-10-04	Potsdam, Germany
78457801	V	GRSM	EDC	10002S002	1997-11-29	2016-10-05	Grasse, France (LLR)
79417701	V	MATM	EDC	12734S008	2001-08-28	2016-10-06	Matera, Italy (MLRO)
88341001	V	WETL	EDC	14201S018	1991-01-08	2016-10-05	Wettzell, Germany (WLRS)
18318501	Q	LVIL	EDC	12368S001	2002-07-01	2009-11-26	Lviv, Ukraine
18635101	Q	MAID	EDC	12340S001	1991-07-31	2004-01-17	Maidanak 2, Uzbekistan
18645401	Q	MAIL	EDC	12340S002	1992-06-02	2007-10-29	Maidanak 1, Uzbekistan
18844401	Q	RIGL	EDC	12302S002	1987-09-21	2016-10-04	Riga, Latvia
72312901	Q	WUHL	CDDIS	21602S004	2000-08-26	2005-12-18	Wuhan, China
73085001	Q	KOGC	CDDIS	21704S002	1995-02-10	2015-01-07	Koganei, Japan (CRL)
73588901	Q	GMSL	CDDIS	21749S001	2004-09-01	2016-09-23	Tanegashima, Japan
73592601	Q	DAEK	EDC	23902S002	2013-04-12	2014-11-18	Daedeok, Korea
74068801	Q	SJUL	EDC	41508S003	2006-02-23	2014-11-19	San Juan, Argentina
78067601	Q	METL	CDDIS	10503S014	1998-09-06	2005-05-20	Metsahovi, Finland
78208201	Q	KUNL	EDC	21609S002	2000-04-22	2016-06-23	Kunming, China
78244502	Q	SFEL	EDC	13402S007	1999-04-08	2016-10-06	San Fernando, Spain
78314601	Q	HLWL	EDC	30101S001	1983-10-25	2007-12-30	Helwan, Egypt
78325501	Q	RIYL	EDC	20101S001	1996-01-30	2012-03-14	Riyadh, Saudi Arabia
78383603	Q	SISL	CDDIS	21726S001	2016-06-02	2016-06-23	Simosato, Japan
11480901	P	None	None	None	1989-01-29	1989-01-29	Ondrejov, Czech Republic
11813901	P	None	None	14106S001	1983-09-02	1993-04-15	Potsdam, Germany
18630000	P	MAID	EDC	12340S001	None	None	Maidanak 2, Uzbekistan
18630702	P	MAID	EDC	12340S001	None	None	Maidanak 2, Uzbekistan
18640000	P	MAIL	EDC	12340S002	None	None	Maidanak 1, Uzbekistan
18665201	P	None	None	12347S001	None	None	Dunaovcy, Serbia
18670000	P	None	None	None	None	None	Evpator, Ukraine
18675301	P	None	None	12344S001	1992-09-01	1994-04-14	Evpator, Ukraine
18680000	P	KOML	EDC	12341S001	None	None	Komsomolsk-na-Amure, Russia

CDDIS Stations’ Table Update

ILRS Operational Station Identification Table

Below is a table of the current site identification schemes for ILRS stations (i.e., 4-letter site codes, SODs, and DOMES numbers). Lists of engineering, inactive/closed stations, and pre-ILRS stations are available.

The table is sortable; click in the column header to sort.

Monument	Code	Location Name, Country	CDDIS SOD	IERS DOMES Numbers	IGS Site Log	IVS Site Log	IDS Site Log	Date of Latest Site Log
1824	GLSL	Golosiiv, Ukraine	18248101	12356S001	X	-	-	20110421
1831	LVIL	Lviv, Ukraine	18318501	12368S001	X	-	-	20140113
1864	MAIL	Maidanak 1, Uzbekistan	18645401	12340S002	-	-	-	20030513
1868	KOML	Komsomolsk-na-Amure, Russia	18685901	12341S001	-	-	-	20140127
1873	SIML	Simeiz, Ukraine	18734901	12337S003	X	X	-	20160322
1874	MDVS	Mendeleevo 2, Russia	18748301	12309S003	X	-	-	20130814
1879	ALTL	Altay, Russia	18799401	12372S001	-	-	-	20090325
1884	RIGL	Riga, Latvia	18844401	12302S002	X	-	-	20160727
1886	ARKL	Arkhyz, Russia	18869601	12373S001	-	-	-	20120215
1887	BAIL	Baikonur, Kazakhstan	18879701	25603S001	-	-	-	20120213
1888	SVEL	Svetloe, Russia	18889801	12350S002	X	X	-	20120131
1889	ZELL	Zelenchukskya, Russia	18899901	12351S002	X	X	-	20120131
1890	BADL	Badary, Russia	18900901	12338S004	X	X	X	20120131
1891	IRKL	Irkutsk, Russia	18915301	12313S007	X	-	-	20140902
1893	KTZL	Katzively, Ukraine	18931801	12337S006	X	X	-	20110802
7045	APOL	Apache Point, NM	70459501	49447S001	-	-	-	20090629
7080	MDOL	McDonald Observatory, Texas	70802419	40442M006	X	X	-	20160309
7090	YARL	Yarragadee, Australia	70900513	50107M001	X	X	X	20150623

http://ilrs.gsfc.nasa.gov/network/stations/active/index.html

Station Systematic Error Monitoring PP- SSEM

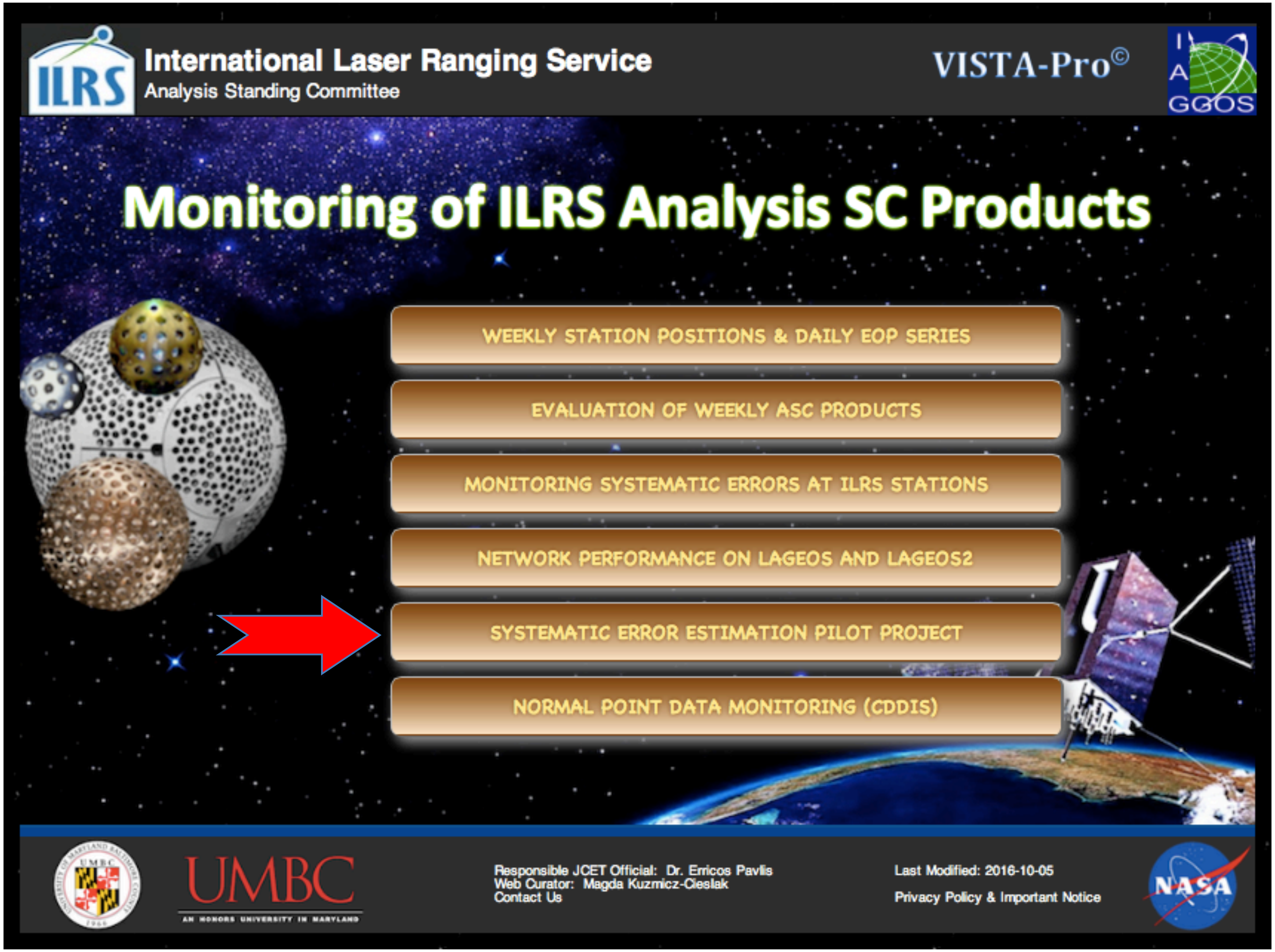
- Five ACs contributed series so far (see next)
- Two combinations completed; we will likely need at least a third one before this phase is complete
- We need to resolve the common convention of identifying which estimate belongs to which wavelength for sites that support ranging in more than one wavelength (see proposal later)
- Commitment from ACs (hopefully more than the five that participated in the PP) needed to support a weekly product, once the PP is completed and we launch the operational phase

ACs Supporting the SSEM PP

- AC-contributed series that we received so far:

Analysis Center	Date of Submission
ASI	April 14, 2016
DGFI	March 31, 2016
JCET	April 1, 2016
NSGF	April 15, 2016
GFZ	July 13, 2016

JCET Portal



http://geodesy.jcet.umbc.edu/ILRS_AWG_MONITORING/

Systematic Error PP Results

Systematic Errors Estimated from LAGEOS and LAGEOS-2 SLR DATA
Pilot Project Results from period 2005-2009

INDIVIDUAL ESTIMATE L1	INDIVIDUAL ESTIMATE L2	COMBINED ESTIMATE L1+L2
ASI v201	**ASI v201**	**ASI v211**
*BKG v200**	*BKG v200**	*BKG v210**
DGFI v200	**DGFI v200**	**DGFI v210**
*ESA v200**	*ESA v200**	*ESA v210**
*GRGS v200**	*GRGS v200**	*GRGS v210**
GFZ v200	**GFZ v200**	**GFZ v210**
JCET v200	**JCET v200**	**JCET v210**
NSGF v200	**NSGF v200**	**NSGF v210**
*ILRSA v200**	*ILRSA v200**	*ILRSA v210**
ILRSB v200	**ILRSB v200**	**ILRSB v210**

Start (MM-DD-YYYY):

End Date (MM-DD-YYYY)

Station: Station

Plot Size — Minimum — Maximum

"*" indicates no submission available from that AC

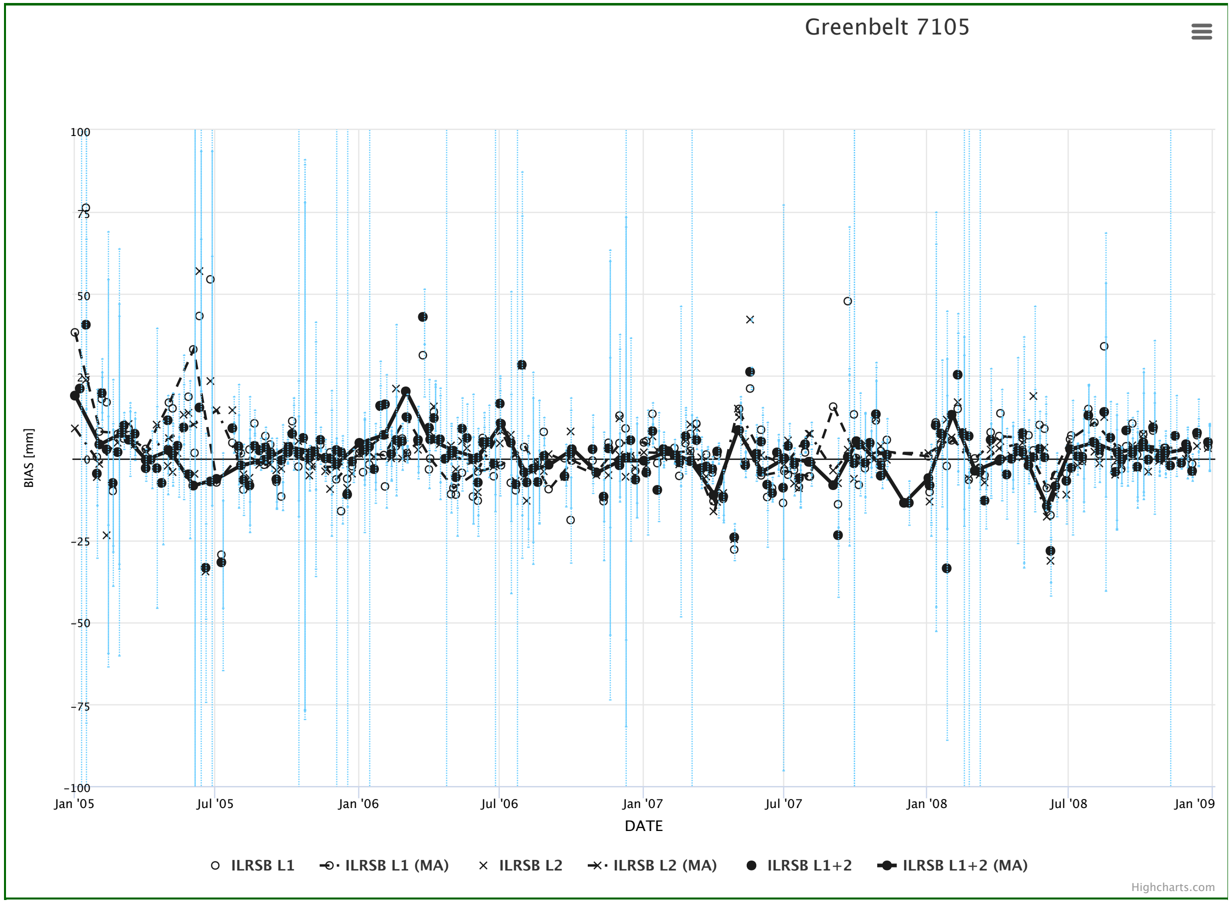
Y axis

Submit

Reset form

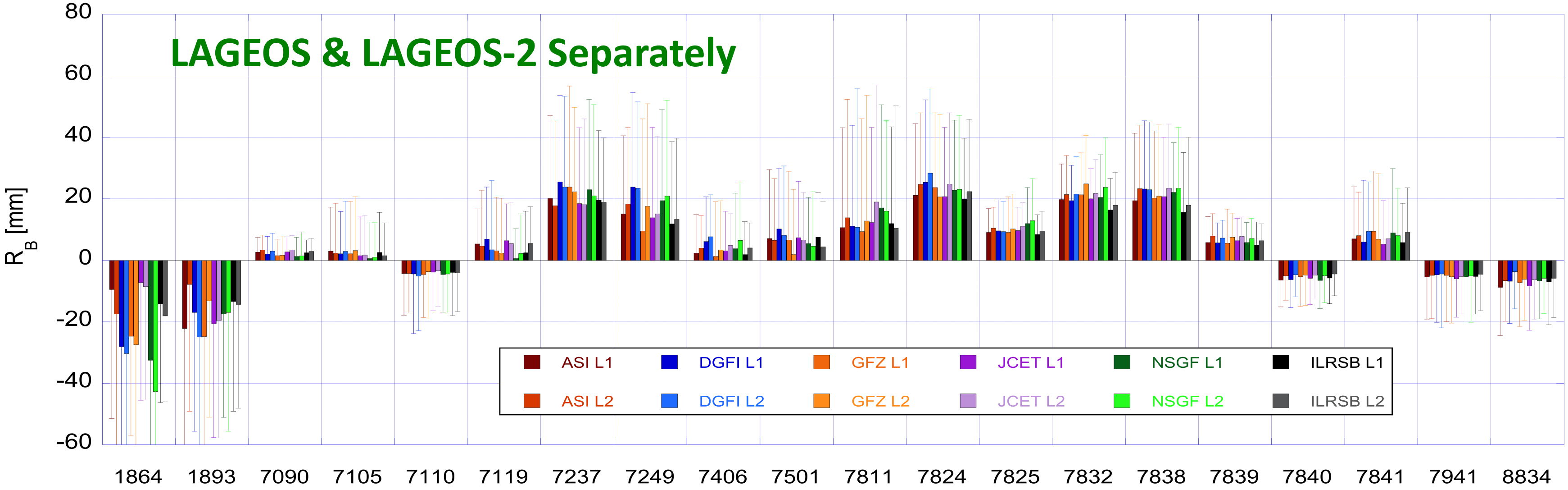
GGAO 7105 Example (ILRS – B)

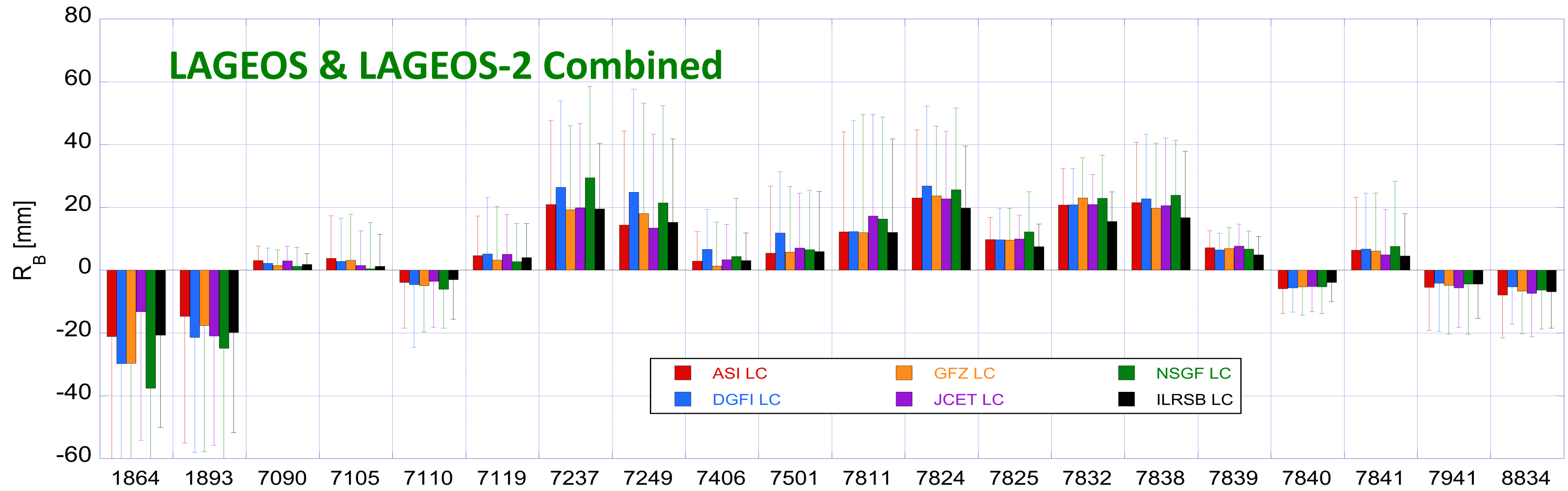
MONITORING SYSTEMATIC ERRORS AT ILRS STATIONS



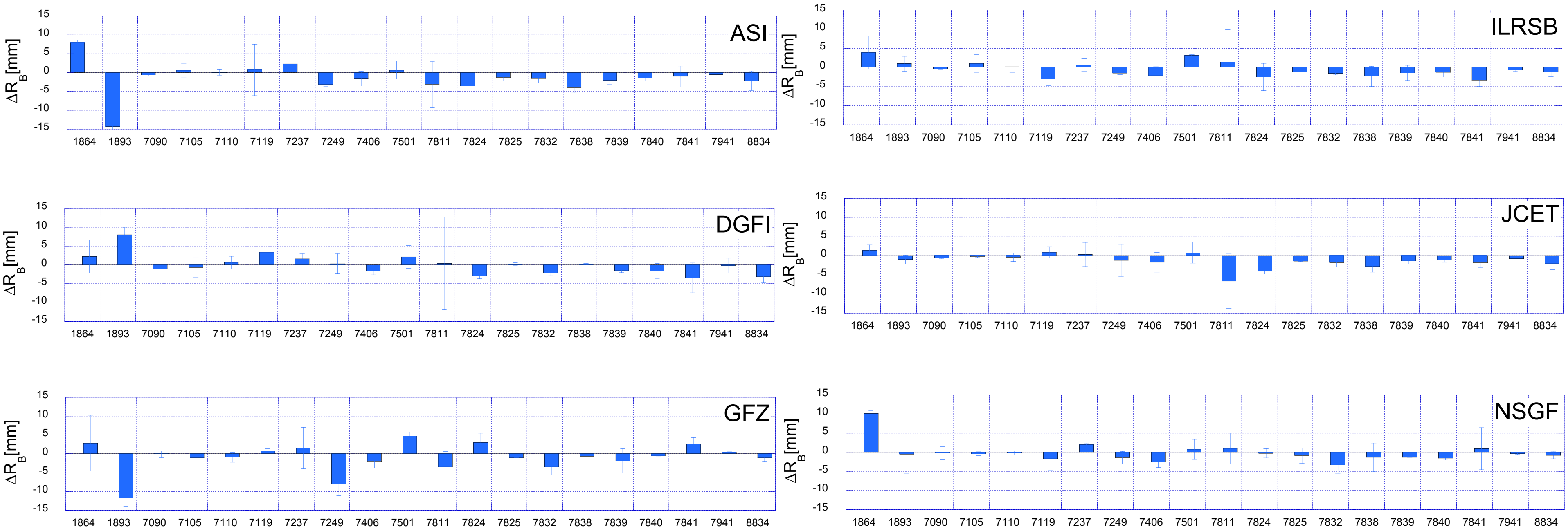
ILRSB LAGEOS1	Mean/Std. Dev.:2.58±12.99 Count:151
ILRSB LAGEOS2	Mean/Std. Dev.:1.52±10.7 Count:149
ILRSB LAGEOS1+2	Mean/Std. Dev.:1.21±10.19 Count:173

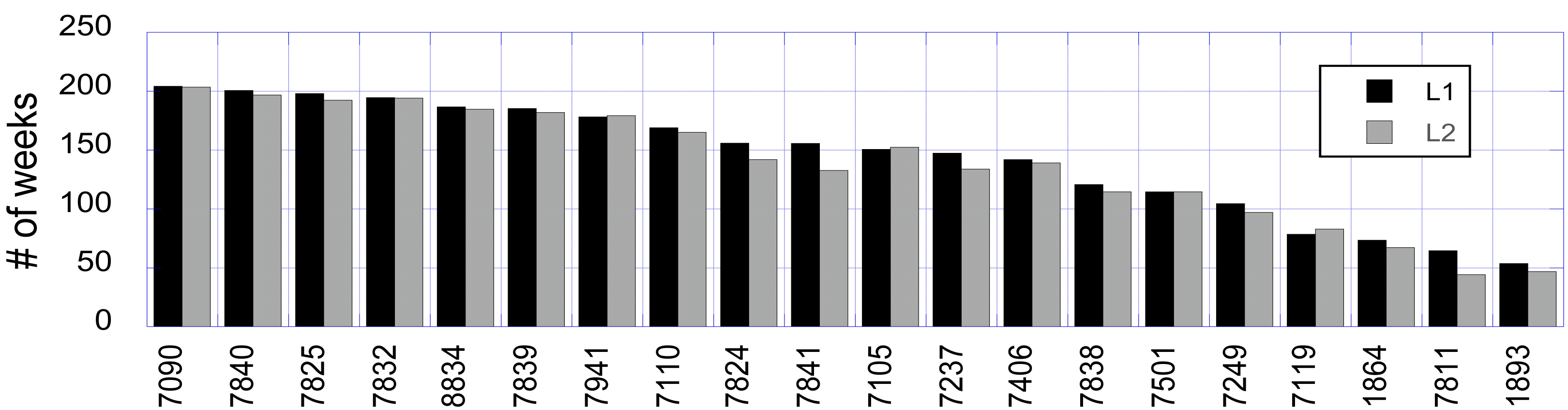
Average Error over 2005 - 2008



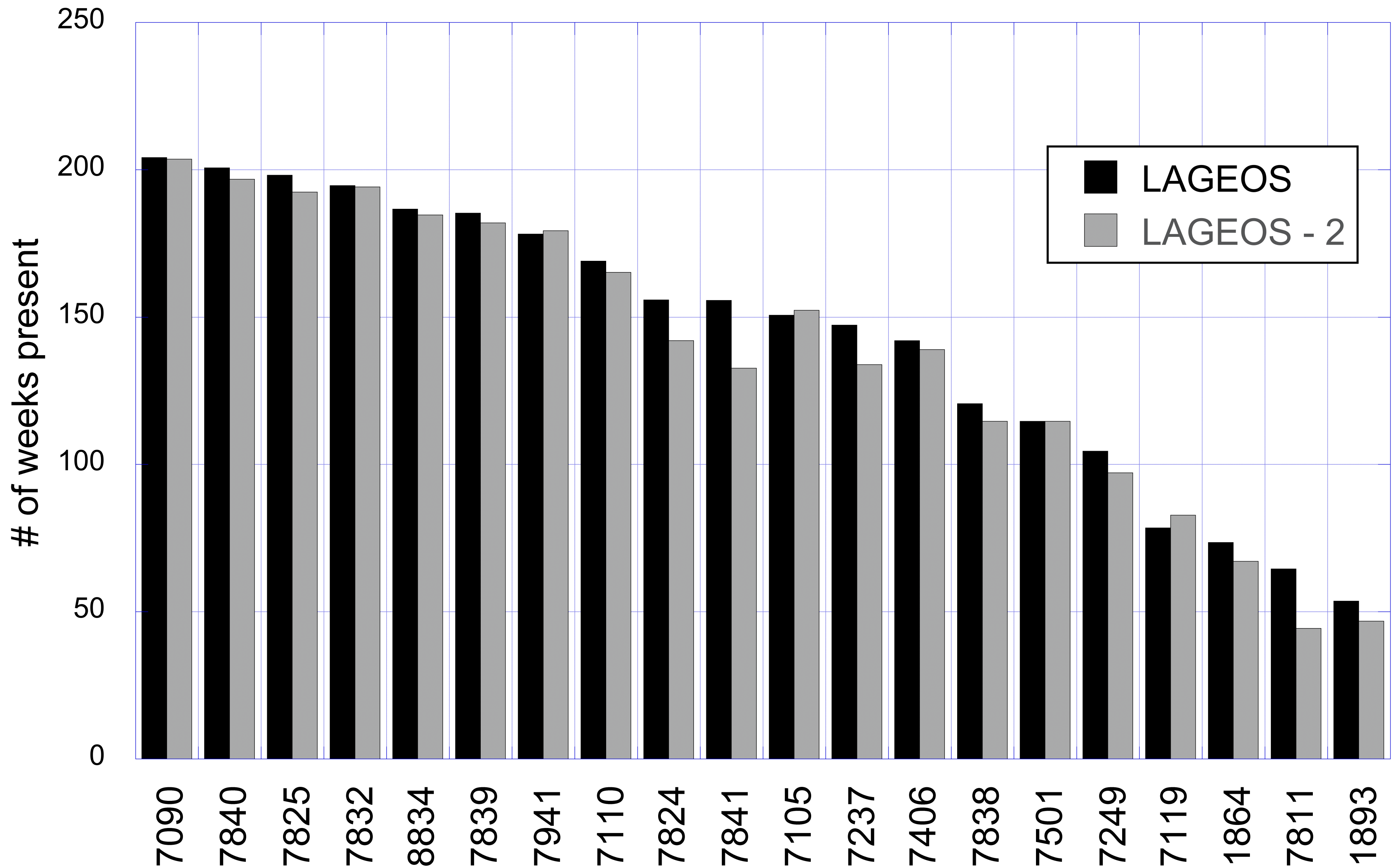


LAGEOS – LAGEOS-2 Differences





Station Participation (Arcs)



Multiple Wavelength Sites

- One of the issues not agreed at the time of planning the PP is the consistent assignment of estimated parameters for sites that operate simultaneously in more than one wavelength;
- During the PP period two such sites were active:
  - Concepcion 7405, and
  - Zimmerwald 7810
- We propose to adopt the "SOLN" flag in SINEX to assign the same value in all contributions for the same wavelengths in each arc, according to the following table
- All "bias" parameters should be assigned to the mid-point of the arc, NO other option will work!

Sample Entries from all ACs

```
Examples from {AC}.pos+eop.050917.v210.snx.Z:

ASI:

    15 RBIAS   7405 L     1 05:256:21112 m     2 -.319110306489010E-02 .352598E-02
     5 RBIAS   7405 L     2 05:257:34286 m     2 0.741544004406786E-02 .315922E-02

    17 RBIAS   7810 L     1 05:257:75825 m     2 -.220110958968871E-01 .153326E-02
     6 RBIAS   7810 L     2 05:257:69888 m     2 -.154523166980184E-01 .169428E-02

JCET:

    13 RBIAS   7405 L     1 90:183:00000 m     2 -.925332570752370E-02 .327409E-02
    14 RBIAS   7405 L     2 90:183:00000 m     2 -.314789993473082E-02 .290209E-02

    16 RBIAS   7810 L     1 90:183:00000 m     2 -.215633914226635E-01 .107731E-02
    17 RBIAS   7810 L     2 90:183:00000 m     2 -.179383068419403E-01 .106037E-02

GFZ:

   101 RBIAS   7405 LC    1 05:254:10302 m     2 -2.04363732688110e-03 5.18388e-03

    57 RBIAS   7810 LC    1 05:256:00916 m     2 -2.40129141363800e-02 1.86466e-03

DGFI:

    11 RBIAS   7810 LC    1 05:257:43200 m     0 -.166691366342384E-01 .205128E-02

NSGF:

    73 RBIAS   7405 LC    1 05:254:10302 m     2 -0.115472236648 20E-01 0.64260E-02

    75 RBIAS   7810 LC    1 05:255:71266 m     2 -0.114145297557 12E-01 0.27357E-02
```

Multiple Wavelength Flag Table

System	CDP ID#	SOLN Flag	Wavelength
Concepcion	7405	2	423
Concepcion	7405	1	846
Zimmerwald	7810	2	423
Zimmerwald	7810	1	532
Zimmerwald	7810	1	846
SOS Wettzell	7827	2	425
SOS Wettzell	7827	1	850
Matera	7941	2	346
Matera	7941	1	532

Use the hundreds instead of 1,2,3, etc.

Preparations for the adoption of ITRF2014

- SLRF2008 is well beyond its expected lifespan, missing several news sites that did not exist when it was constructed and its velocities are no longer predicting with sufficient accuracy current station positions, even for the best sites in the network;
- The final ITRF2014 is available since about a year, however, the corresponding EOP series aligned with it is still pending approval from the IERS (expected by the end of the year);
- The availability of the new series in early 2017 will coincide with the time that a new Mean Pole series should be available from IERS, likely in February 2017.

Preliminary Steps on the way to ITRF2014

- We will prepare an SLRF2014 to be used as the official a priori TRF for all ILRS applications (~end of October)
- We have generated already an extension of the long-wavelength gravity terms from UT/CSR's 15^{d} series and they can be obtained in the same form as for the ITRF2014 reanalysis from:

  http://geodesy.jcet.umbc.edu/ILRS_ASC_2016_EXTENSION.html

  *** EXTENSION of the 2015 Re-analysis files: FOR NON-GEODYN USERS ONLY

  *** EXTENSION of the 2015 Re-analysis files: FOR GEODYN USERS ONLY

- As an initial step we ask all ACs to extend their product for ITRF2014 up to the time spanned by these new series, approximately mid-April 2016;
- The new series will serve as a test for the complete reanalysis based on ITRF2014/SLRF2014 and it will give us a chance to compare the operational products based on the old modeling standards over a period that is not covered by ITRF2014 (IERS).

Station Discontinuities File for ITRF2014

Edited version based on ZA PSD model

	Discontinuities FINAL (mkc)					
Site ID#	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy
1868	2003:155					
1893	2008:300					
7110	1999:289 E	2010:094 E				
7122	1985:264	1991:091				
7124	2001:207					
7210	1989:256	1994:022	2000:264			
7237	2011:070 E					
7249	2011:070 E					
7307	1997:307					
7308	2011:070 E					
7328	2011:070 E					
7358	2011:070 E					
7403	1994:160	1996:317	2001:174 E	2001:188	2007:227	2014:091
7405	2010:058 E	2010:064 E (new)	2011:043			
7406	2010:058					
7501	2012:099					
7811	2002:208					
7820	2002:098	2007:245 (new)				
7821	2008:001	2010:028	2011:070 E			
7835	1990:071	1999:335				
7837	1995:274					
7838	2004:249	2011:070 E				
7839	1995:361	1999:315				
7843	1988:001	1992:121				
7907	1988:103					
8834	2000:344	2009:045	2010:323			

2002:098	*not exist in the Z file*
2007:245 (new)	*what was changed*
7307	not is Z file
7328	not is C file

Z file = Zuheir's Final ITRF2014 file of discontinuities

C file = Cinzia's Excel file of discontinuities "FINAL (ORG)"

As shown in Matera

	Discontinuities FINAL (ORG)					
Site ID#	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy
1868	2003:157					
1893	2008:298					
7110	1999:289 E	2010:092 E				
7122	1985:266	1991:087				
7124	2001:138					
7210	1989:263	1994:020	1999:216			
7237	2011:069 E					
7249	2011:031 E					
7307	1997:307					
7308	2011:056 E					
7358	2011:064 E					
7403	1994:161	1996:321	2001:166 E	2001:186	2007:230	2014:093
7405	2010:058 E	2011:038				
7406	2010:051					
7501	2012:098					
7811	2002:208					
7820	2002:098					
7821	2009:135	2010:028	2011:068 E			
7835	1990:071	1999:335				
7837	1995:229					
7838	2004:249	2011:070 E				
7839	1995:332	1999:316				
7843	1988:001	1992:121				
7907	1988:104					
8834	2000:343	2009:045				

Proposed Discontinuities for ITRF2014

	Discontinuities FINAL (mkc)					
Site ID#	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy	yyyy:doy
1868	2003:155					
1893	2008:300					
7110	1999:289 E	2010:094 E				
7122	1985:264	1991:091				
7124	2001:207					
7210	1989:256	1994:022	2000:264			
7237	2011:070 E					
7249	2011:070 E					
7307	1997:307					
7308	2011:070 E					
7328	2011:070 E					
7358	2011:070 E					
7403	1994:160	1996:317	2001:174 E	2001:188	2007:227	2014:091
7405	2010:058 E	2010:064 E (new)	2011:043			
7406	2010:058					
7501	2012:099					
7811	2002:208					
7820	2002:098	2007:245 (new)				
7821	2008:001	2010:028	2011:070 E			
7835	1990:071	1999:335				
7837	1995:274					
7838	2004:249	2011:070 E				
7839	1995:361	1999:315				
7843	1988:001	1992:121				
7907	1988:103					
8834	2000:344	2009:045	2010:323			

2002:098	*not in the Z file*
2007:245 (new)	*what was changed*
7307	not in Z file
7328	not in C file

Z file = Zuheir's Final ITRF2014 file of discontinuities

C file = Cinzia's Excel file of discontinuities "FINAL (ORG)"

JCET: ITRF2014 vs. SLRF2008

To convert SLRF2008 to ITRF2014 (JCET, based on best SLR sites only)

Parameter	Estimate	Linear Rate
T_X	-1.4 ± 8.1 mm	0.13 ± 0.97 mm/y
T_Y	-1.4 ± 7.9 mm	-0.18 ± 1.12 mm/y
T_Z	-0.1 ± 6.7 mm	0.09 ± 1.09 mm/y
D_S	0.2 ± 1.2 ppb	-0.09 ± 0.16 ppb/y
R_X	-17 ± 307 µas	-3.8 ± 46 µas/y
R_Y	6 ± 271 µas	3.7 ± 42 µas/y
R_Z	-3 ± 340 µas	-3.3 ± 42 µas/y

ITRS: ITRF2014 vs. ITRF2008

To convert ITRF2008 to ITRF2014 (ITRS, based on 127 sites)

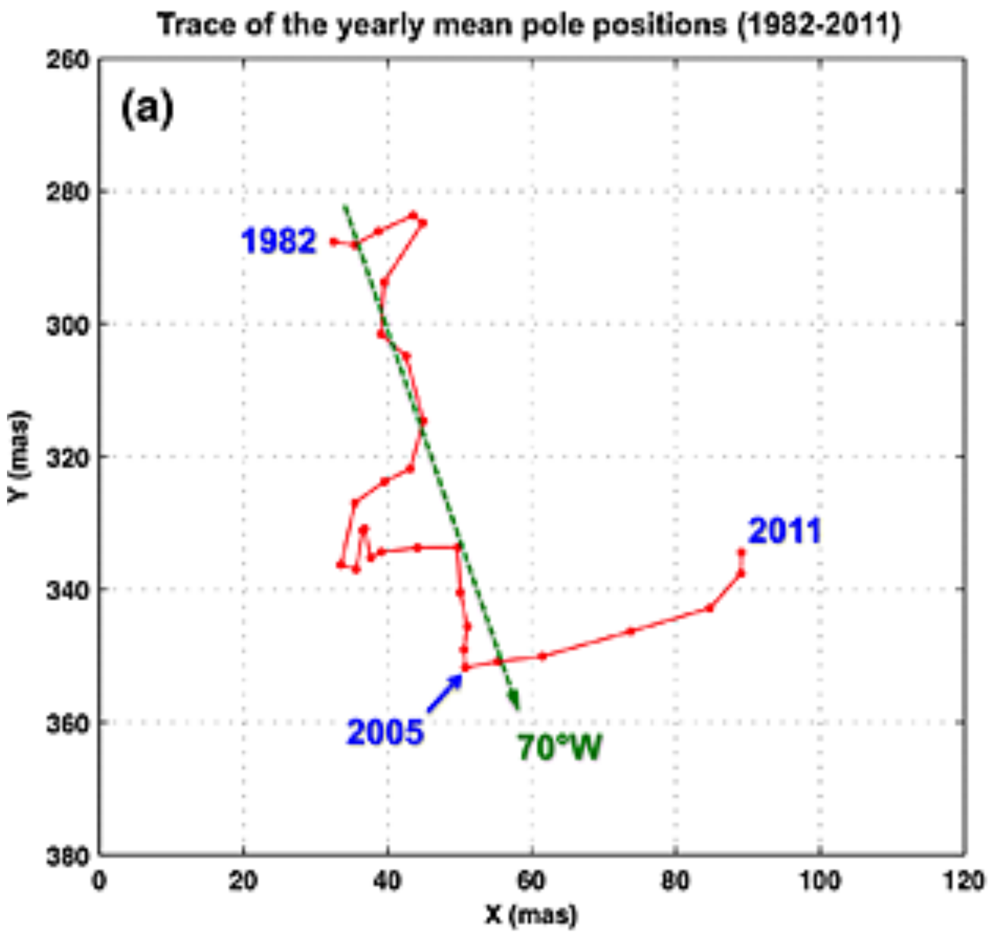
Parameter	Estimate	Linear Rate
T_X	-1.6 ± 0.2 mm	0.0 ± 0.2 mm/y
T_Y	-1.9 ± 0.1 mm	0.0 ± 0.1 mm/y
T_Z	-2.4 ± 0.1 mm	0.1 ± 0.1 mm/y
D_S	0.02 ± 0.02 ppb	-0.03 ± 0.02 ppb/y
R_X	0 ± 0.006 µas	0 ± 0.006 µas/y
R_Y	0 ± 0.006 µas	0 ± 0.006 µas/y
R_Z	0 ± 0.006 µas	0 ± 0.006 µas/y

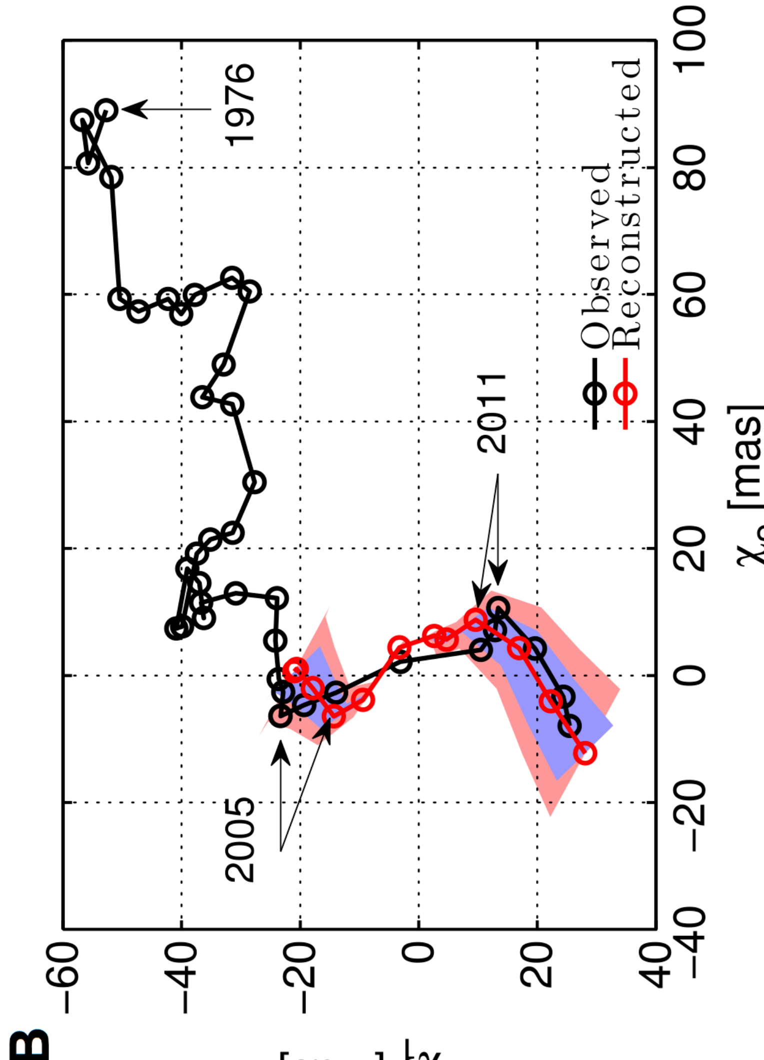
Eccentricity Data Base Clean-up

- A review of the current station site log files indicated some inconsistencies between what is on file in there and the information in our eccentricity data base and files (SINEX-like)
- After looking further into this issue, we identified some stations:
  - that show small discrepancies between the two data bases (likely due to the transformation from Cartesian to NEU or vice versa) and
  - some stations where there are bona fide mistakes or omissions
- We will look into the first to correct things and notify the second group about their errors.
- The bottom line is that we will be releasing a new set of eccentricity files (the online SINEX-like files) in the near future, that should reflect what the stations' most recent site logs contain.

Climate-driven Polar Motion: 2003-2015

S. Adhikari & Erik R. Ivins
JPL





IERS 2010 Conventions Update

For this purpose, a Conventional Mean Pole (CMP) model is provided by the IERS Conventions. The CMP was provided previously in the IERS Conventions (2003) as a linear model and in the IERS Conventions (2010) as a cubic model with a linear extrapolation after 2010.0. However, in view of present-day ice sheet mass losses, the motion of the mean pole is not likely to be predictable (see e.g., Chen, et al. 2013) at the level required for the pole tide correction. Therefore, starting with year 2015, the CMP of the IERS Conventions will no longer be represented by a polynomial but will be provided by a FORTRAN subroutine, updated yearly and referenced as IERS CMP YYYY.f for year YYYY, based on observations made available by the IERS Earth Orientation Centre. At the beginning of year YYYY, the IERS Earth Orientation Centre will generate a table of observed values of the mean pole with the last point at epoch YYYY.0 by filtering periodic terms in the EOP(IERS) C01 series **<[8]>**. The IERS Convention Center then incorporates it in the subroutine **IERS CMP YYYY.f**, updated annually at **<[9]>**, that generates the components $\bar{x}_p$ and $\bar{y}_p$ of the IERS CMP(YYYY) for epochs after 1970.

These values are computed by linear interpolation of the yearly values taken from the observations provided by the IERS Earth Orientation Centre. Because of the filtering process, the values of the mean pole are likely to change as the polar motion time series is extended, but the changes should remain within the range of the required accuracy. The subroutine also provides options to obtain the CMP coordinates as described in previous versions of the IERS Conventions. The use of the most recent version is recommended as significant departures from observations may result using earlier versions for years that lie outside of the range for which they were designed. In any case, users should document the version they use.

Chapter 7, section 7.1.4

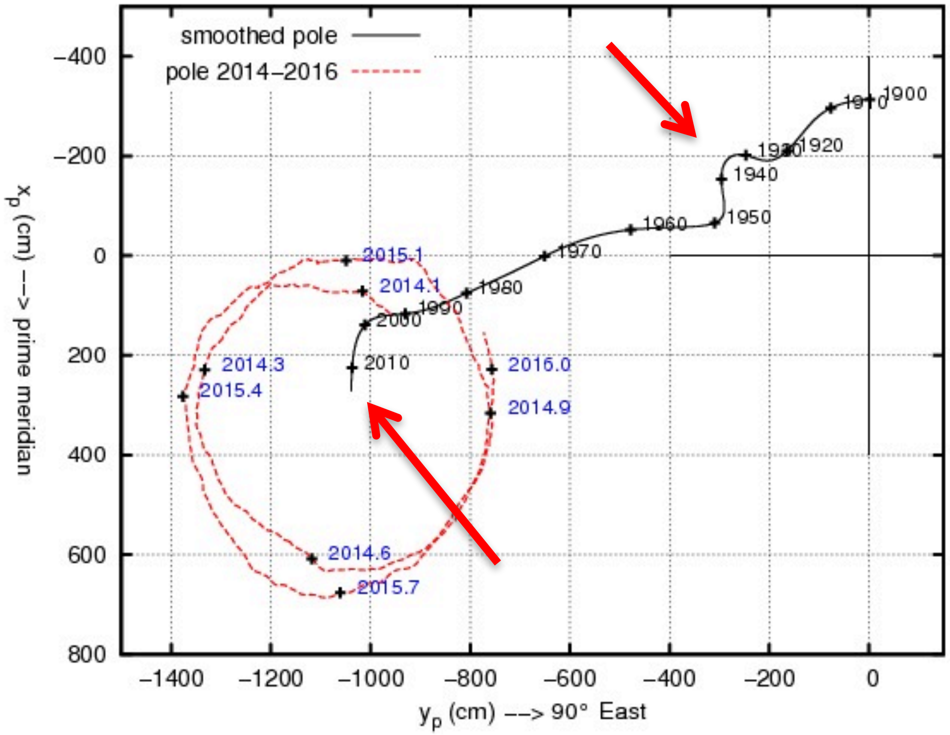
---

[8] ftp://hpiers.obspm.fr/iers/eop/eopc01

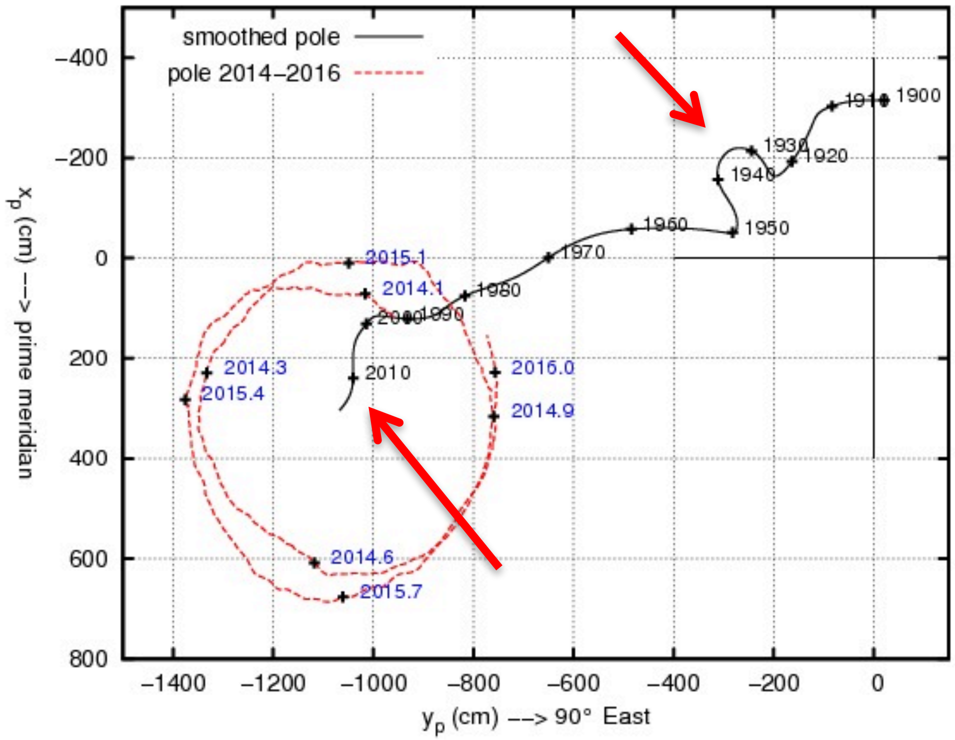
[9] ftp://tai.bipm.org/iers/convupdt/chapter7/

IERS CMP Plots Online

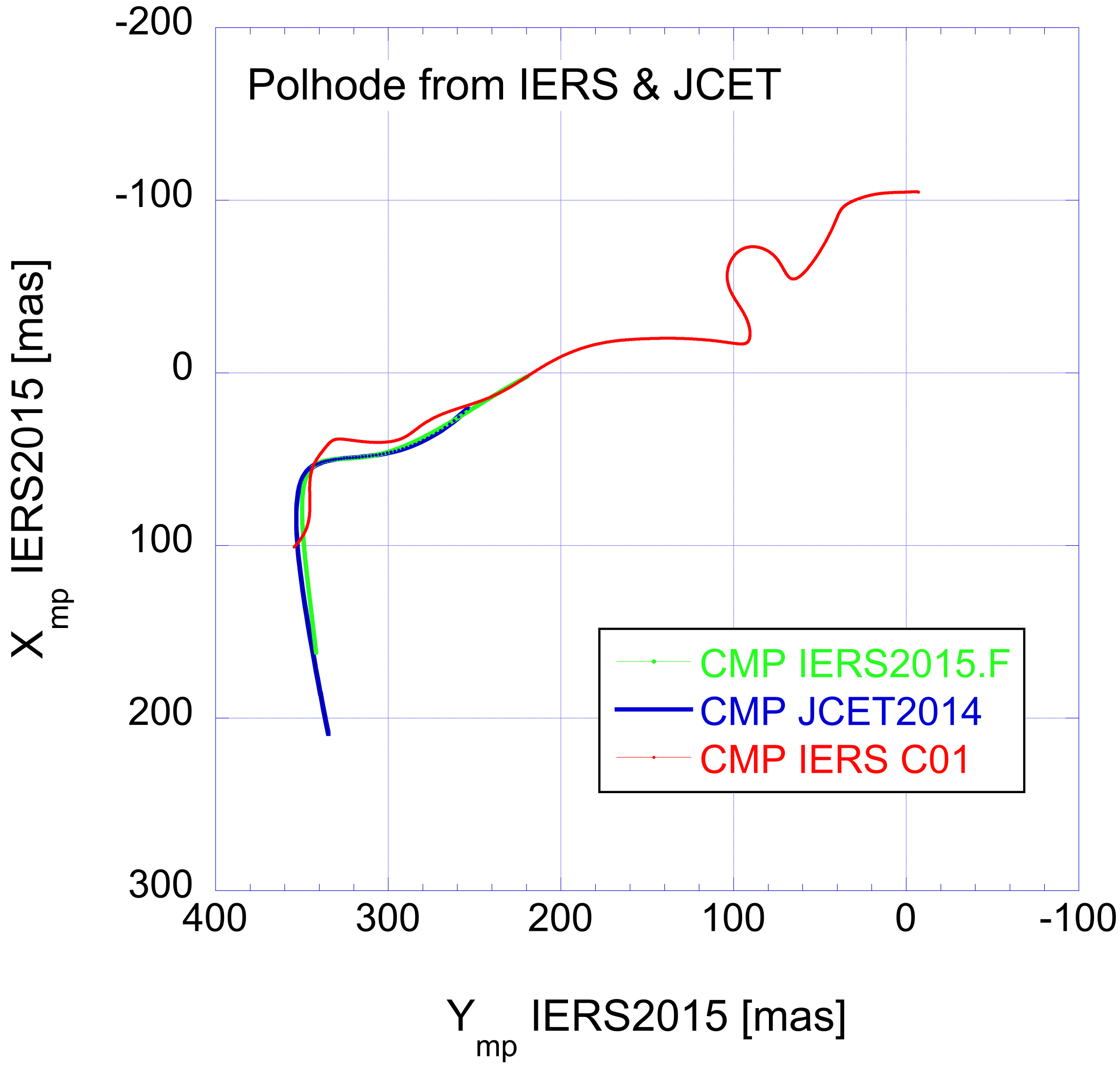
Downloaded: 2016.05.17



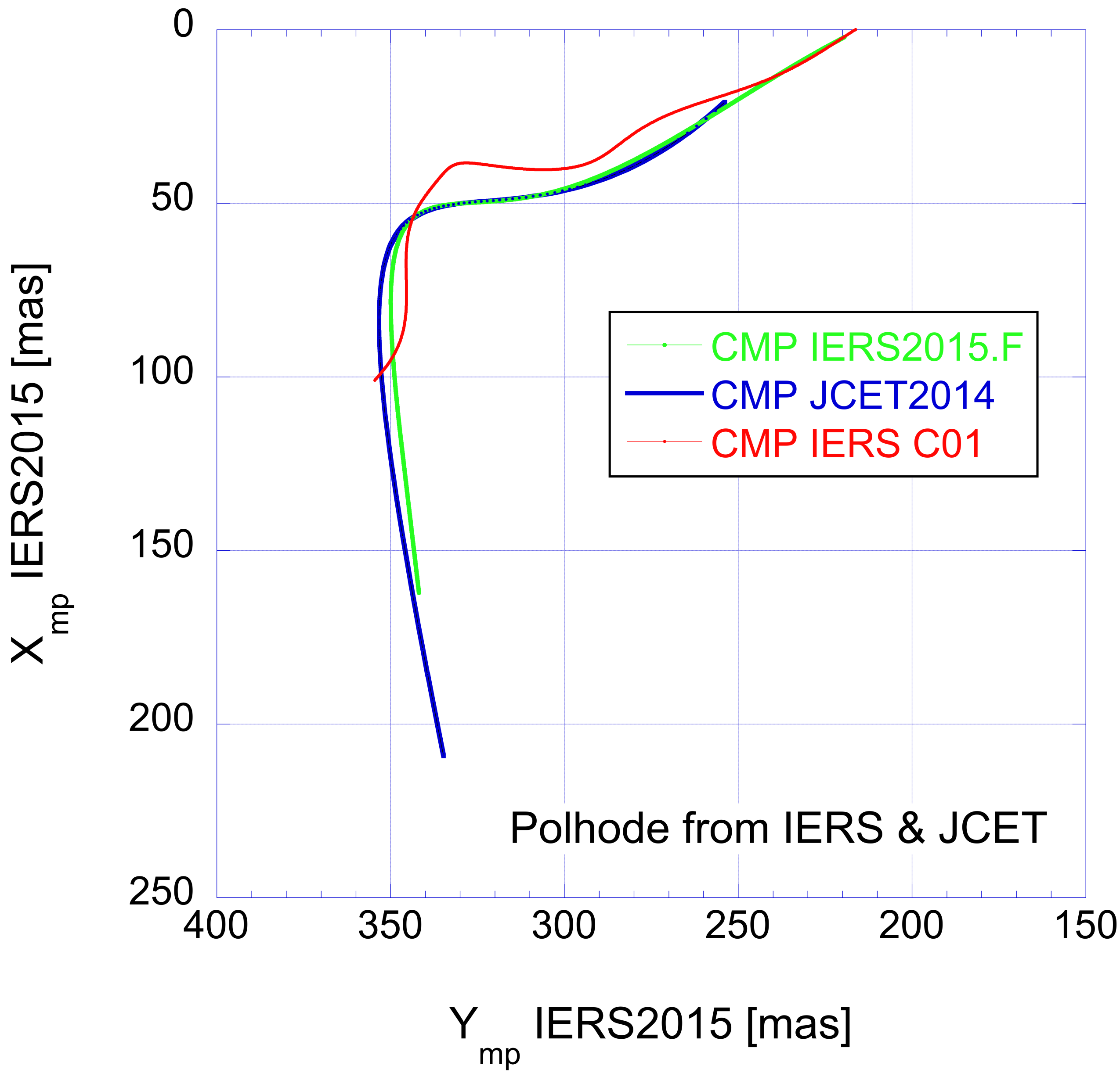
Downloaded: 2016.09.27



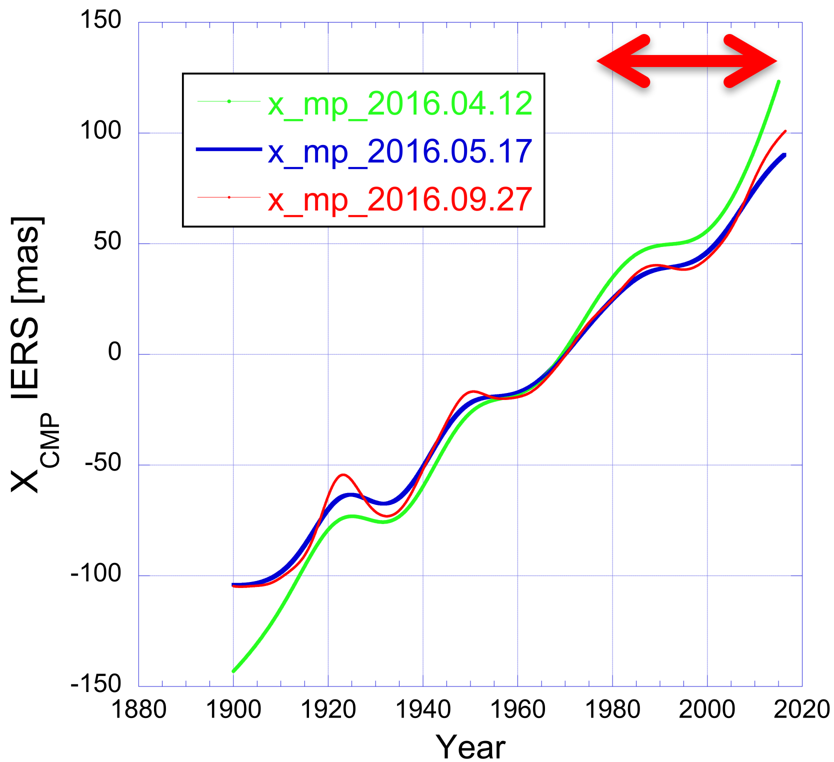
IERS CMP Comparison

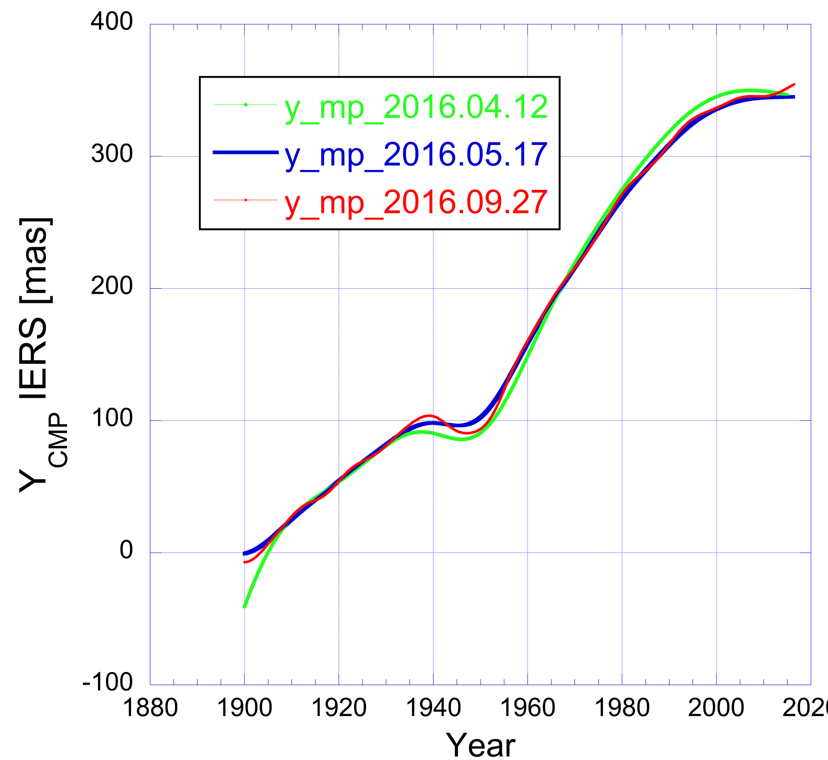


IERS CMP Comparison - detail



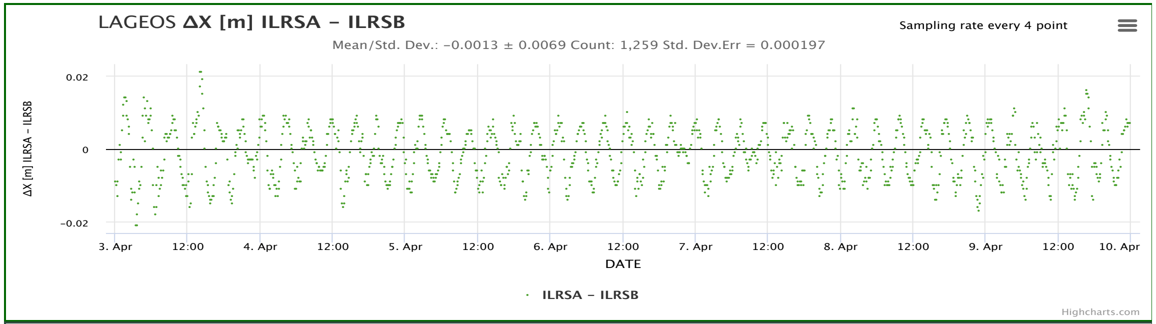
CMP Differences of IERS Updates

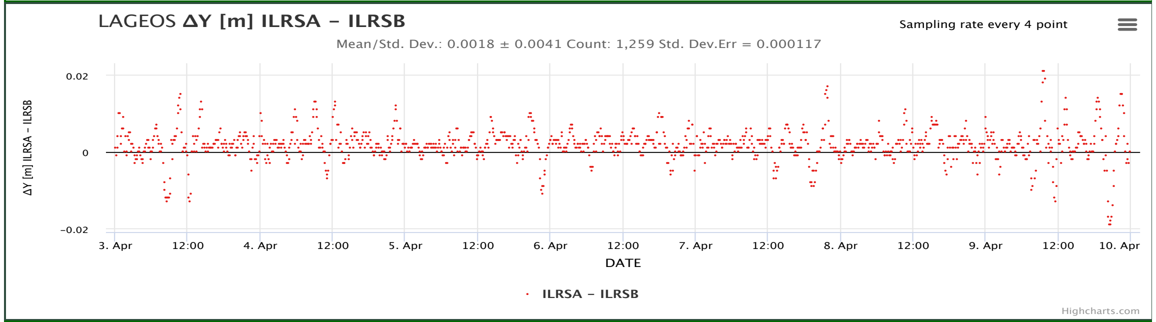


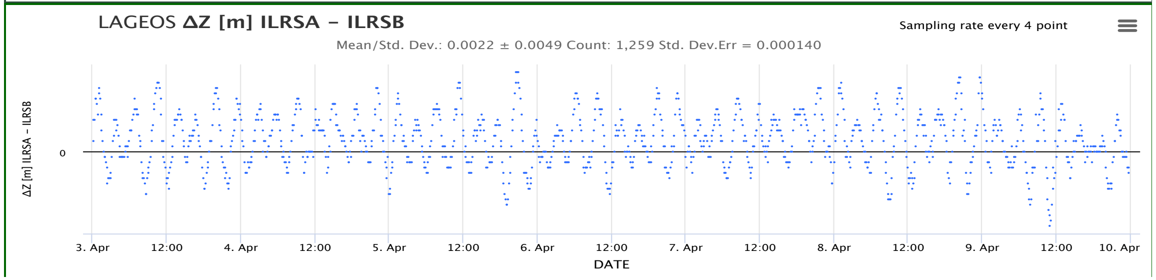


These modifications of the series in the special table "*mean-pole.tab*" were not announced and to this point no one has documented anywhere that they ever happened. Unless someone checked the file often, we do not know how many times it was changed.

LAGEOS SP3c ΔPOSITION: ILRSA-ILRSB



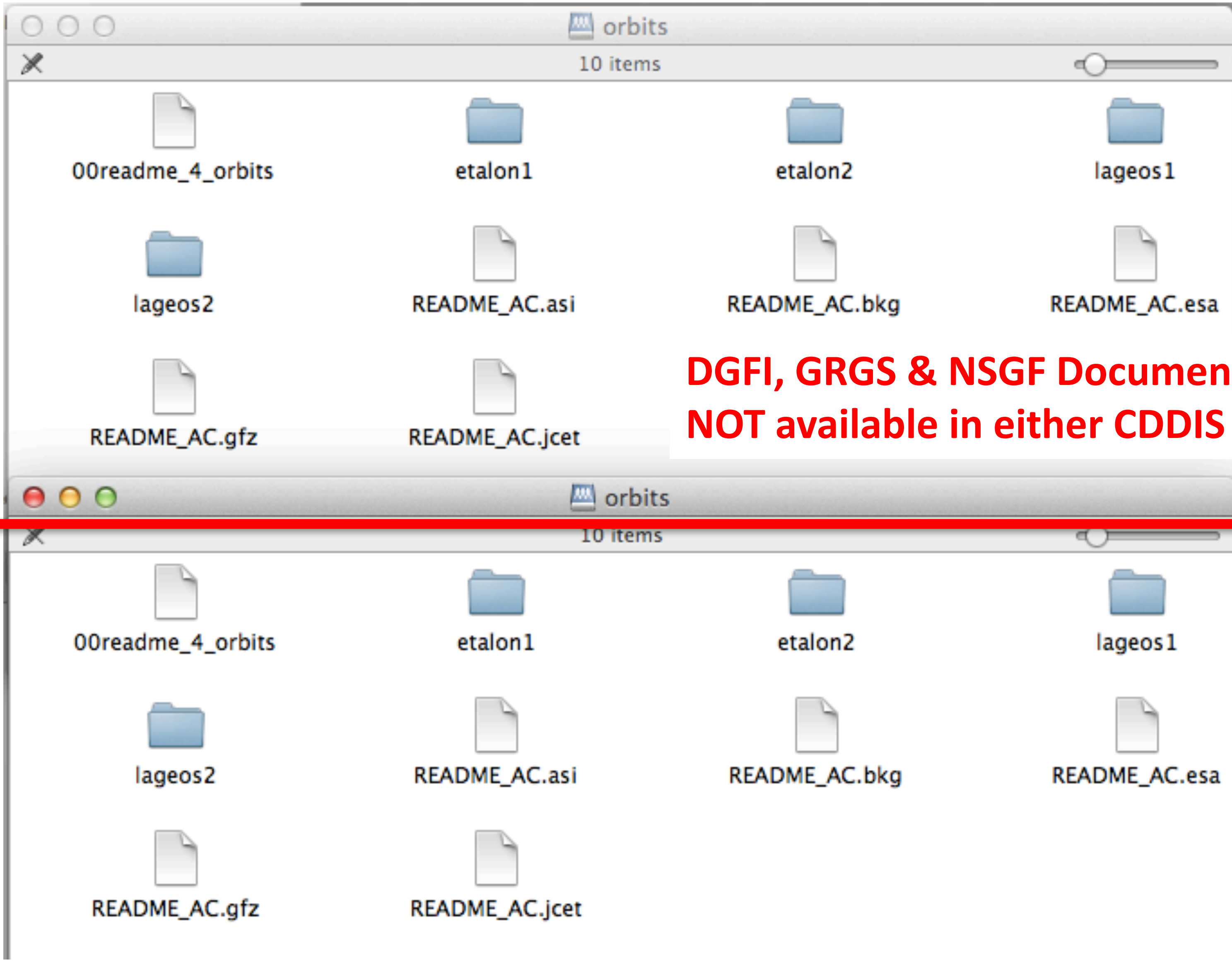




ΔX [m] ILRSA - ILRSB LAGEOS	ΔY [m] ILRSA - ILRSB LAGEOS	ΔZ [m] ILRSA - ILRSB LAGEOS	ΔVX [mm/s] ILRSA - ILRSB LAGEOS	ΔVY [mm/s] ILRSA - ILRSB LAGEOS	ΔVZ [mm/s] ILRSA - ILRSB LAGEOS
Mean/Std. Dev.: -0.0013 ± 0.0069 Count: 1,259 Std. Dev.Err = 0.000197	Mean/Std. Dev.: 0.0018 ± 0.0041 Count: 1,259 Std. Dev.Err = 0.000117	Mean/Std. Dev.: 0.0022 ± 0.0049 Count: 1,259 Std. Dev.Err = 0.000140	Mean/Std. Dev.: -0.0000 ± 0.0029 Count: 1,259 Std. Dev.Err = 0.000083	Mean/Std. Dev.: 0.0002 ± 0.0030 Count: 1,259 Std. Dev.Err = 0.000086	Mean/Std. Dev.: 0.0001 ± 0.0032 Count: 1,259 Std. Dev.Err = 0.000091

ILRS Orbital Product Archives: Status

CDDIS



DGFI, GRGS & NSGF Documentation
NOT available in either CDDIS or EDC !!!

EDC

Journal of Geodesy ILRS Special Issue

#	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*	***Dunn**, Torrence, Pearlman, Varghese and McCormick ???*
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**
5a	**Altimetric missions and SLR (???)**	**Lemoine, ???**
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**	**Luceri and Pavlis**
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 ASC ACs and CCs*

We also had EIGHT (8) "un-solicited" abstracts (still interested???)

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!!!*

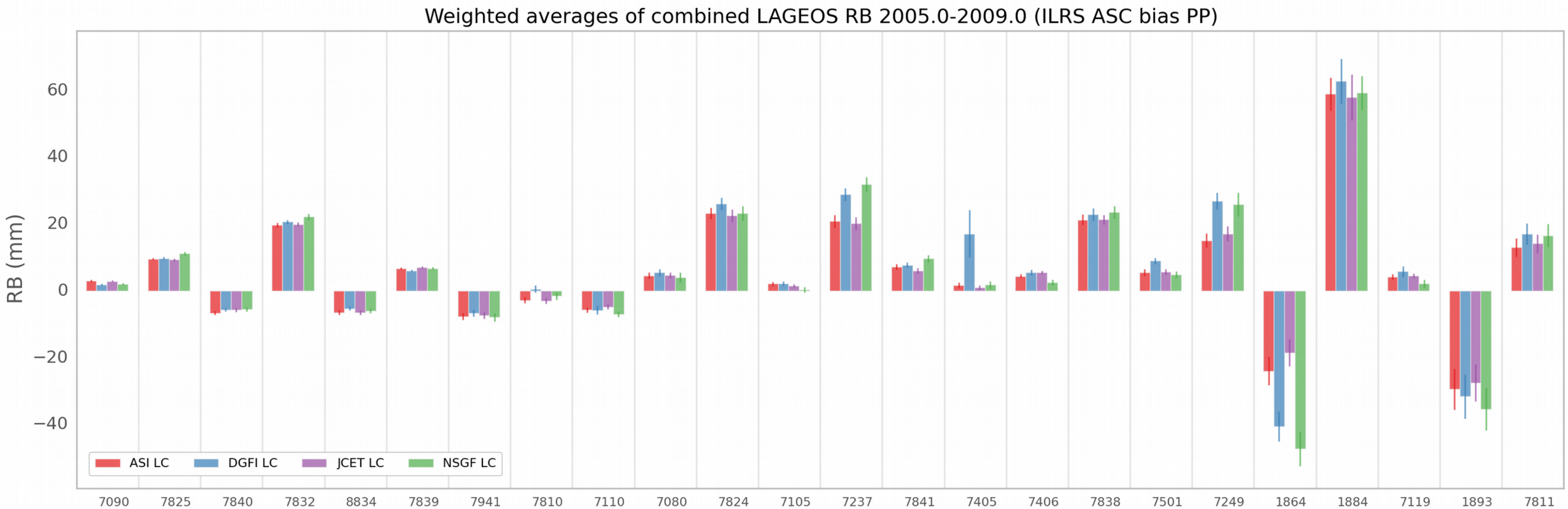
ILRS ASC meeting, Potsdam 2016
NSGF report

Graham Appleby, José Rodríguez

NSGF recent activities:

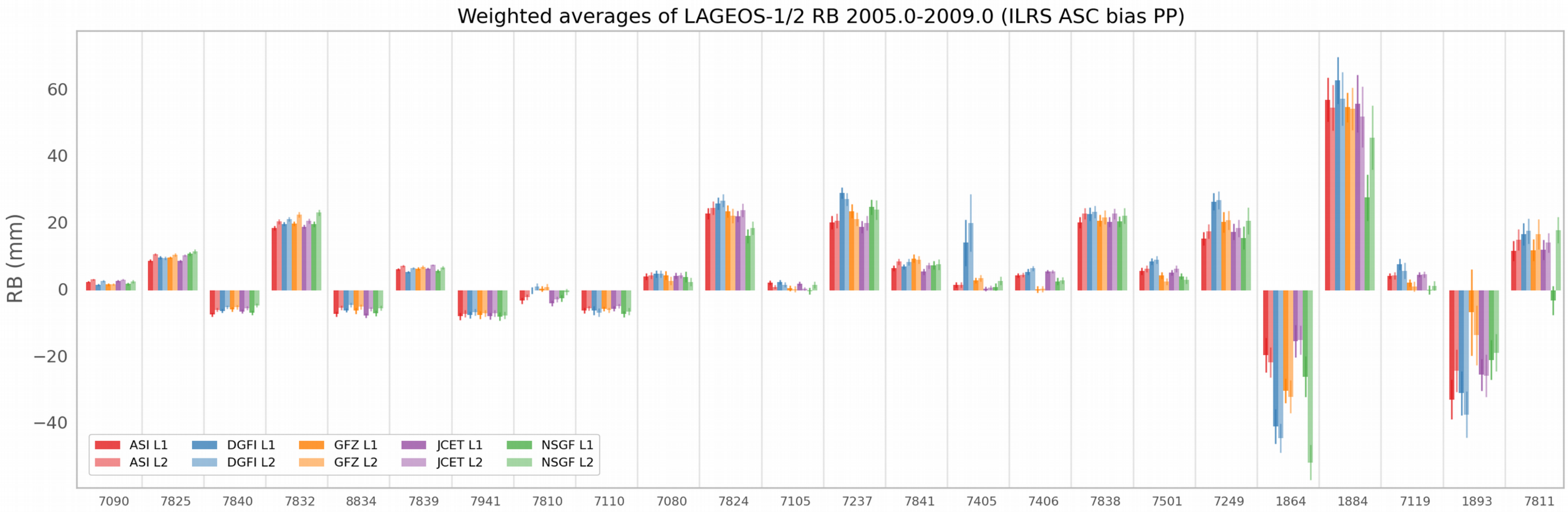
- Initial assessment of RB PP
- LARES tests
- Comparisons with T. Otsubo’s C++
- Etalon (and more) CoM modelling

Initial assesment on RB pilot project consistency



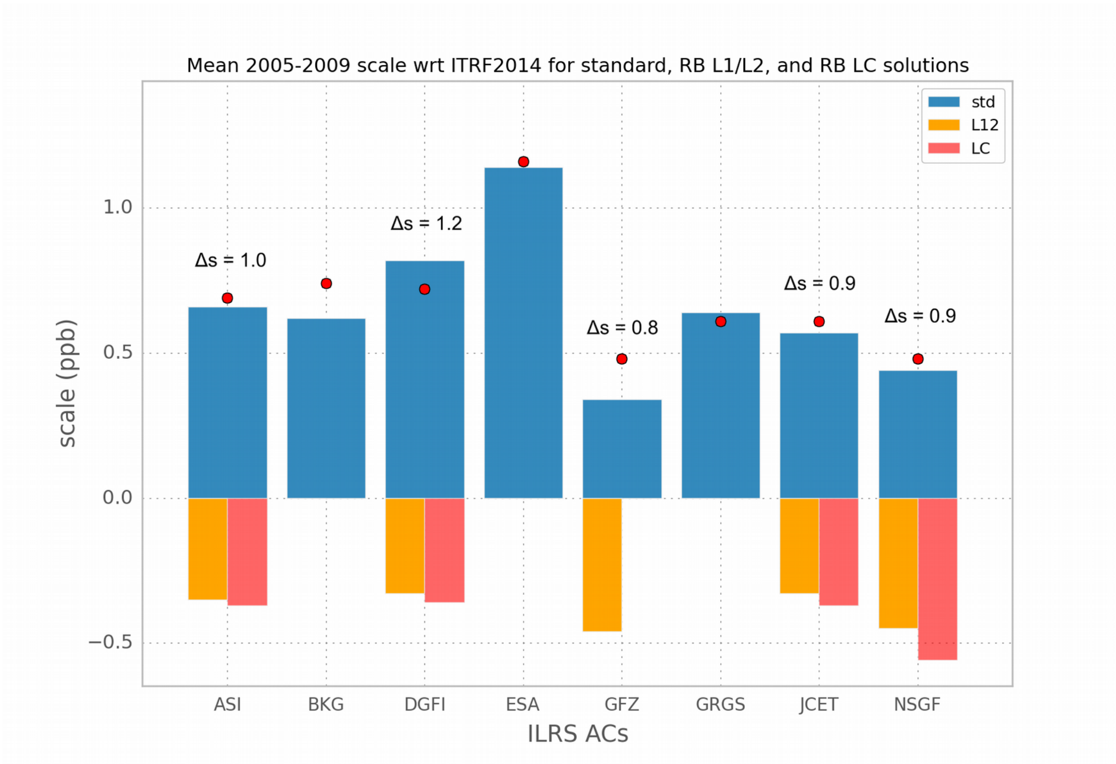
- Excellent agreement between ACs

Initial assesment on RB pilot project consistency



- Excellent agreement between Acs
- both in the combined and separate LAGEOS solutions

Initial assesment on RB pilot project consistency



- Excellent agreement between ACs
- both in the combined and separate LAGEOS solutions
- as well as in the overall frame scale change (~0.9 ppb in the good™ direction in the period considered)

LARES tests

- Inclusion of LARES in SATAN’s developing version
- Good orbit fits (EIGEN-6S2/6S4 geopotential)
- Experimented with different empirical parameter sets:

  - adding an extra set of OPR parameters good compromise (3 OPRs per week)

  - four OPRs decrease RMS only marginally

Comparisons with C++

- T. Otsubo spent 3 months as visiting researcher at Herstmonceux
- C++ / SATAN comparisons carried out
- Solid Earth tides, Ocean tides (FES2004), LAGEOS orbits, station coordinates, weighing schemes, range bias estimation
- LOD determination issues

Etalon CoM modelling

- As reported at ASC in Vienna 2016, Etalon RB estimation reveals large positive biases for many stations
- The cause appears to be a CoM modelling deficiency
- We investigated possible improvements to the current modelling
- Taking into account all the information available from the hardware in use at the stations (laser width, detector characteristics) we obtained CoM values that can partly explain the estimated RBs (shorter)
- These changes to the CoM modelling would also affect the CoM values for other satellites, making them smaller
- Plan: asses consensus/acceptance on newer modelling and prepare updated CoM tables for all geodetic satellites (CoM technical note)

(talk on Monday)

Mea culpa/excuses

- No further work done on gravity estimation. As reported previously, it is in place, but no proper/standard output generated (but do we really need gravity estimation for initial comparison purposes?)
- No CoM tables done for LARES/Starlette/Stella (given the latest Etalon RB/CoM developments this might be premature if not a waste of time!)

Other relevant work at SGF

- Mathew Wilkinson and Toshimichi Otsubo investigating optimal raw data clipping criteria for maximum NP stability (included on Matt's talk on Thursday)
- Poisson filtering to reject possible multi-photon detections (JR talk on Thursday)

Questions?