18th International Workshop on Laser Ranging

Quality and Possible Improvements of the official ILRS products

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ILRS solutions

ILRS is delivering daily and weekly station coordinates and earth orientation parameters (x-, y-pole, LOD)

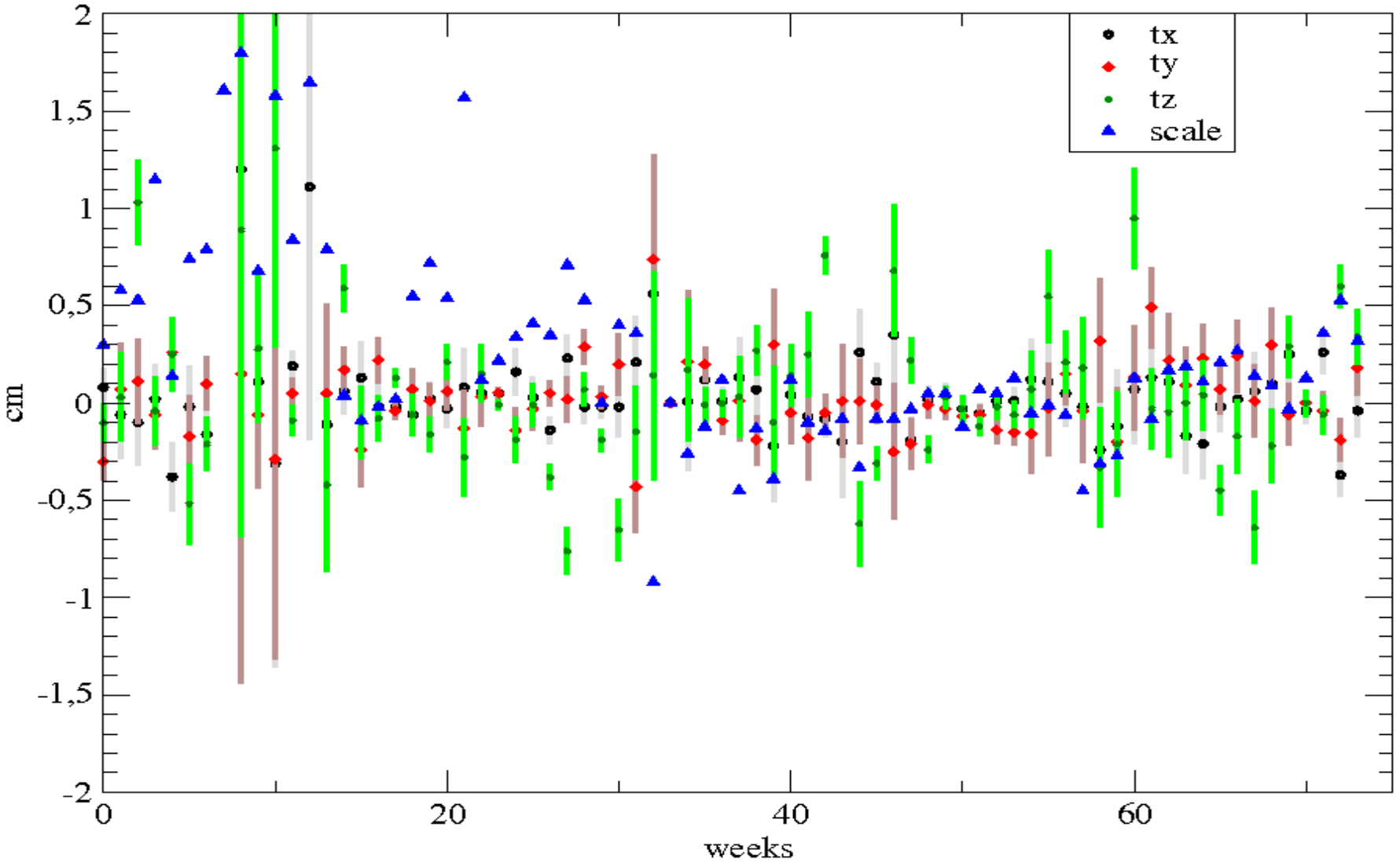
- Presently 8 analysis centers
- 2 combination centers

Quality

- Not easy to validate, unique solution
- Validated in ITRF2008, 1 cm level accuracy
- Combination of various AC solutions > reduce systematic errors
- Second combined solution only for validation and backup
  - We used the ILRSB solution to qualify the combined solution

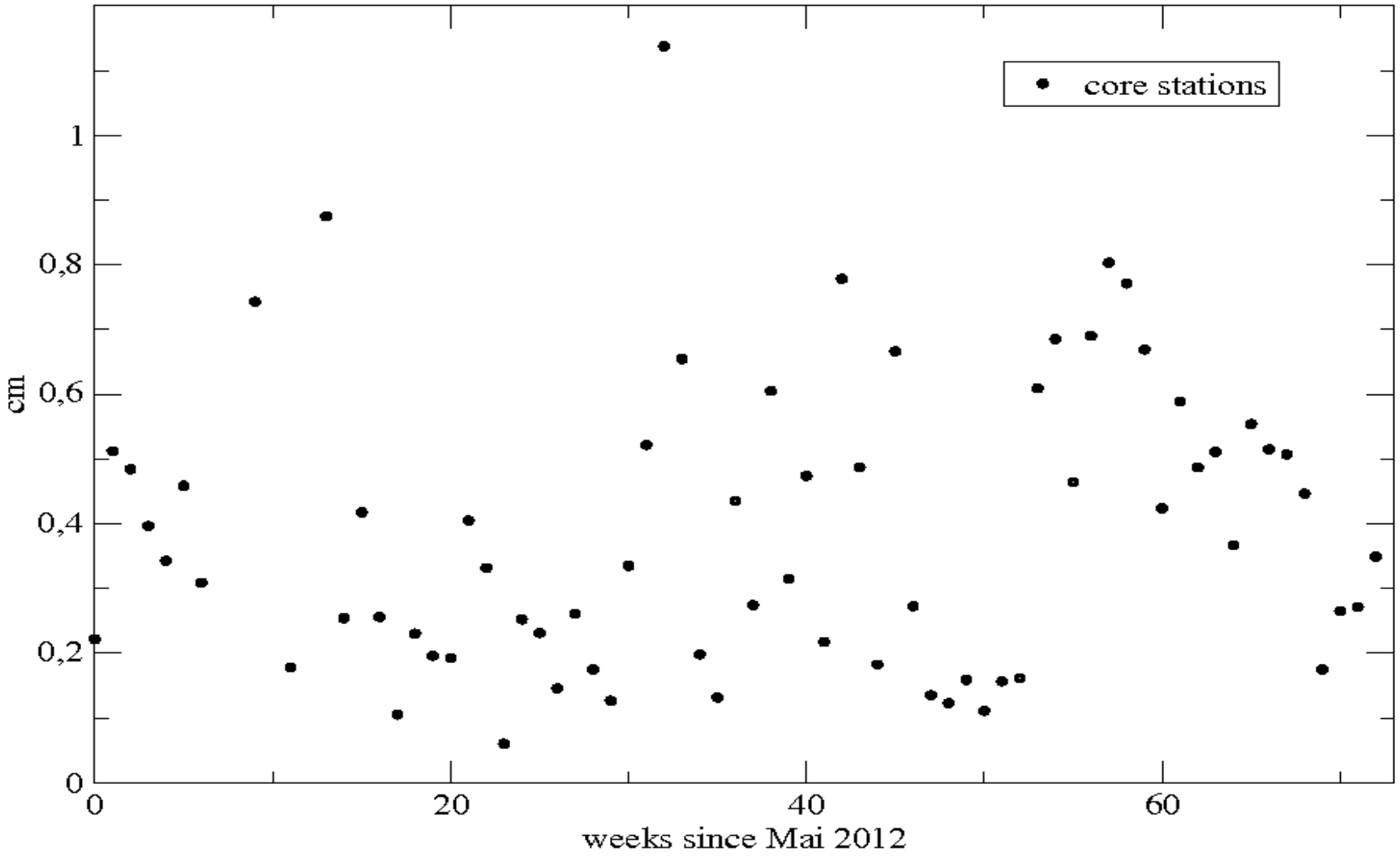
Quality

Difference between ILRSA and ILRSB using similarity transformation using the ILRS core stations,



Quality

Difference between ILRSA and ILRSB after similarity transformation



Quality

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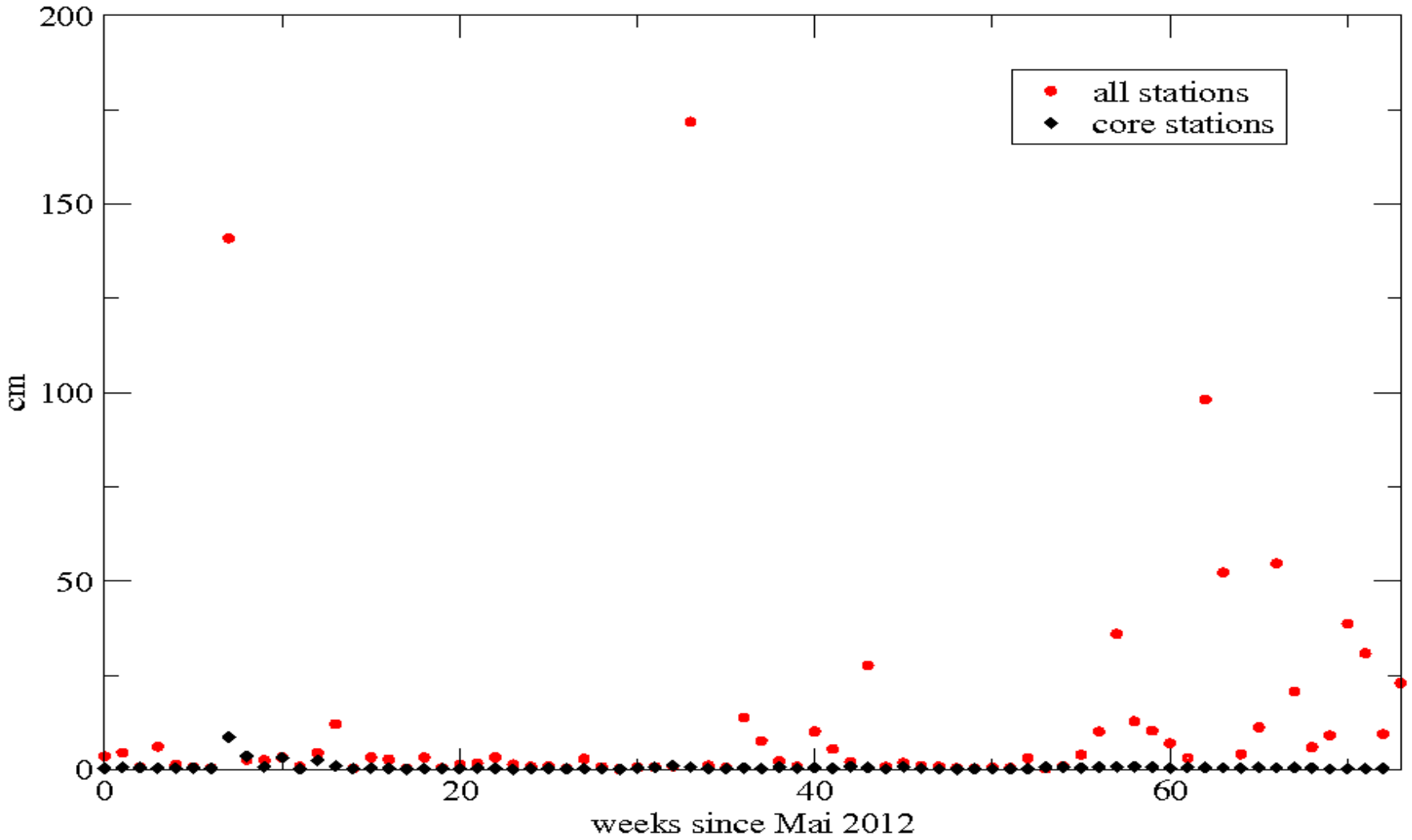


Quality

Reasons for the discrepancy:

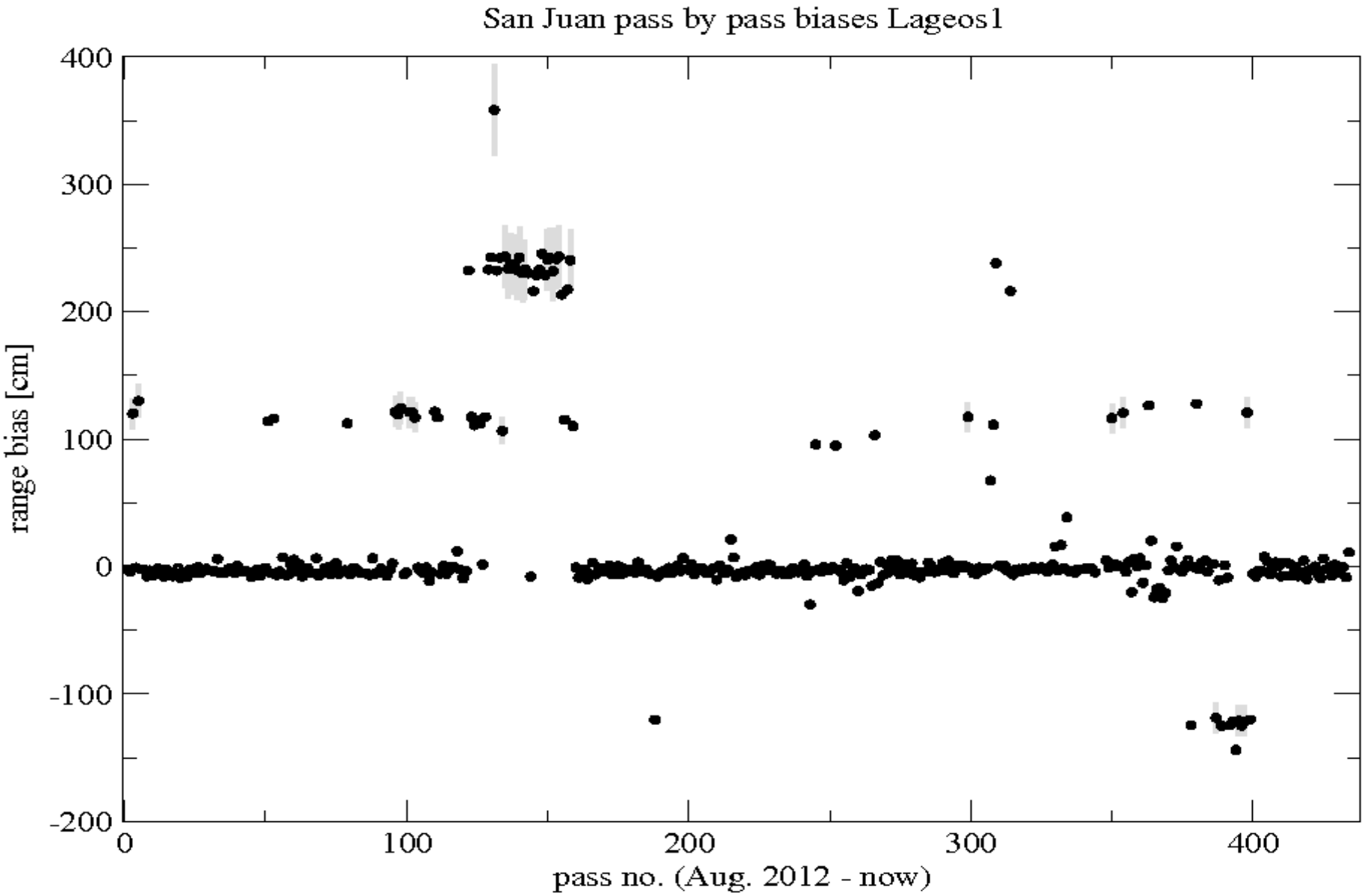
- Not all analysis centers solve for all stations
- Data handling is not unified up to now
- Editing is AC dependent

- Combination centers use different methods
- Editing of individual AC solutions is not unique

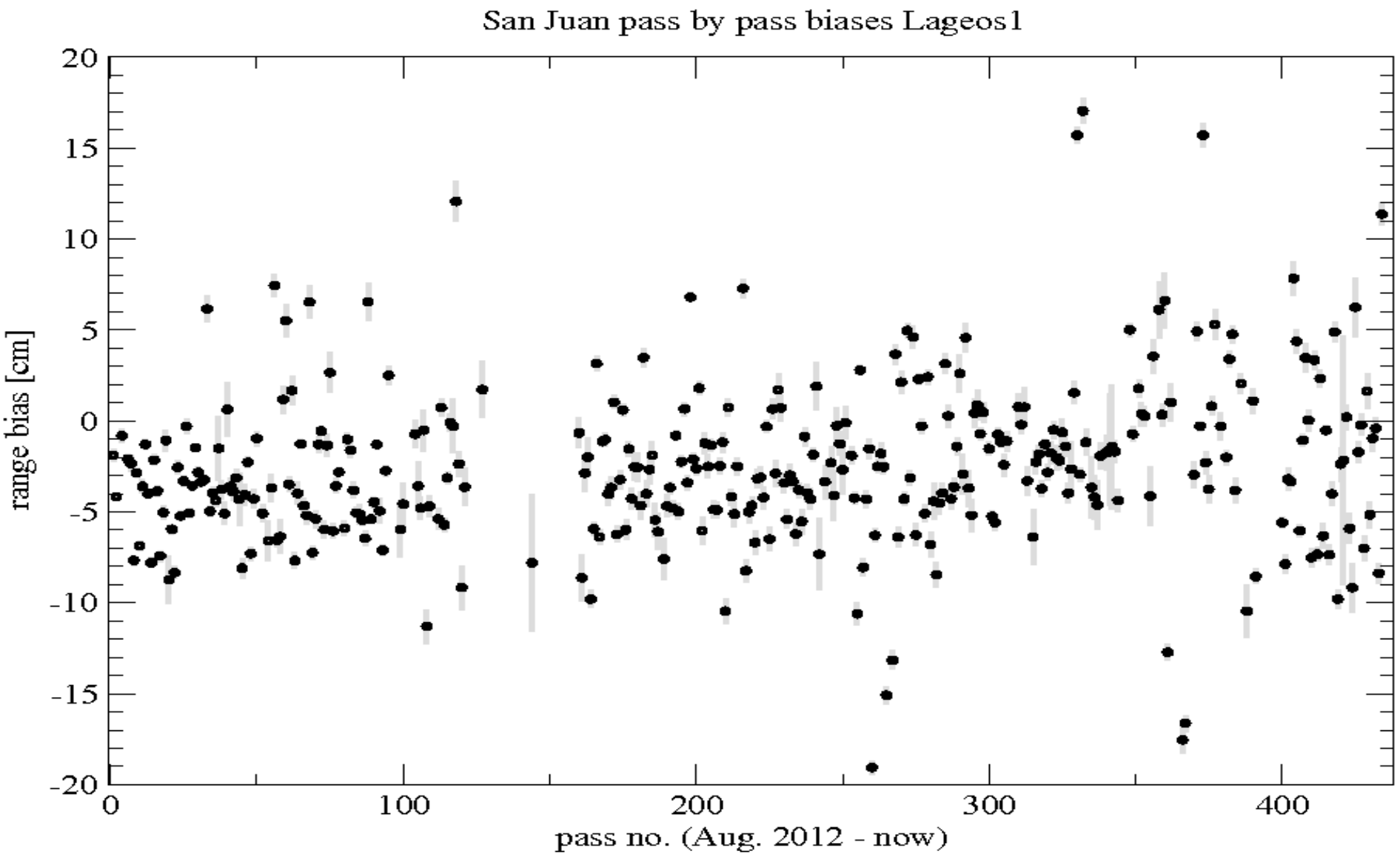
On the ILRS analysis working group meeting in Fuji-Yoshida on Nov. 9, 2013 steps in harmonizing the individual solutions were performed.

For the reprocessing of the SLR data starting 1982 a better harmonization of procedures and data handling is desired.

Biases San Juan



Biases San Juan



Latest improvements

- IERS 2010 standards mandatory for all centers
- New station and satellite dependent center of mass corrections
    - Verified by a pilot project
    - Implemented in the actual solutions
- Pilot project for non tidal atmospheric loading, finished but not implemented in the standard solution

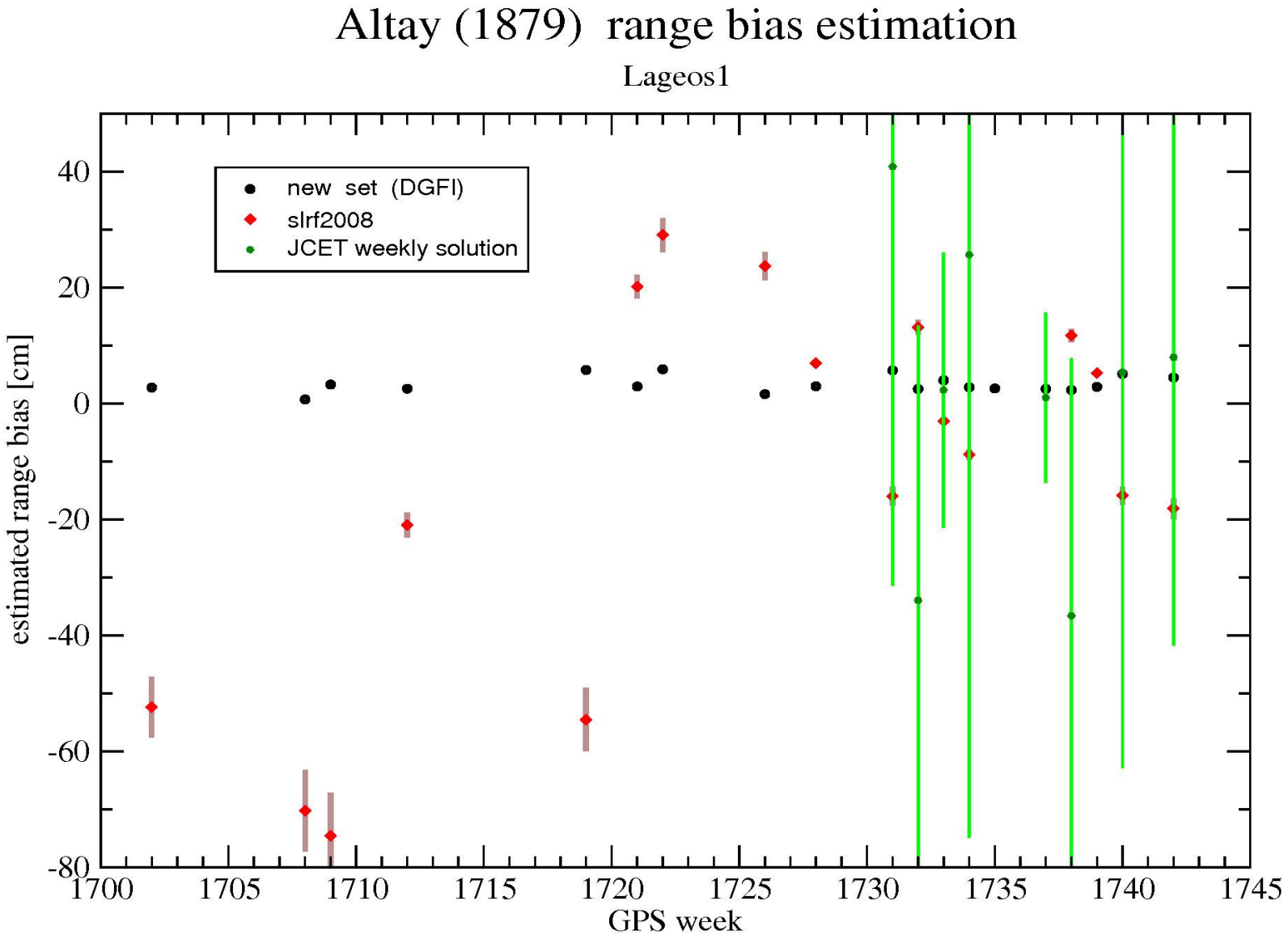
Common ILRS data handling file with instructions for all analysis centers, updated regularly

- Bias to be applied or solved for
- Data to be edited
- Information on data in quarantine

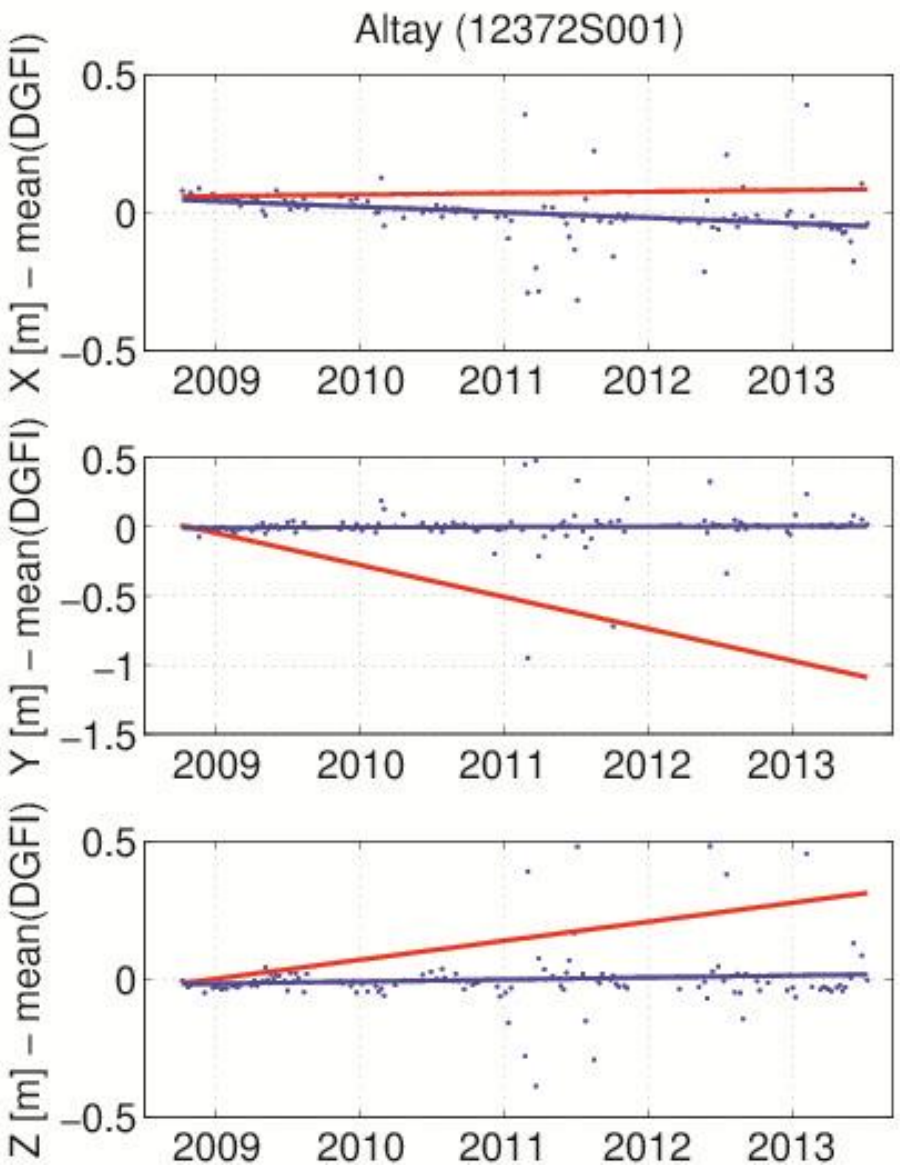
Still some critical points:

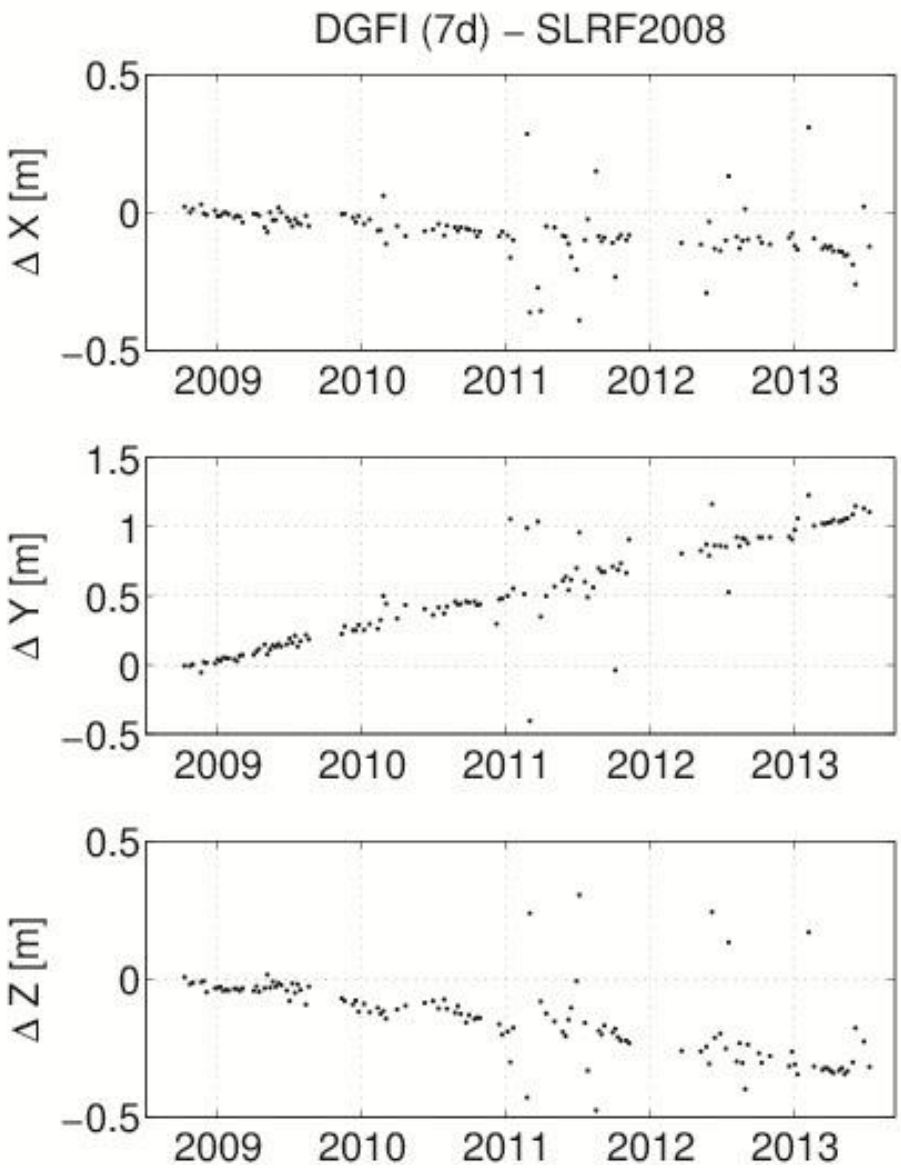
- Bias handling
- A priori station coordinates
    - New set of station coordinates for stations not included in SLRF2008 or in tectonic regions produced by ASI and DGFI
    - Solving Biases with preliminary station coordinates is critical.

Biases


Altay (1879) range bias estimation
Lageos1
new set (DGFI)
slrf2008
JCET weekly solution
estimated range bias [cm]
GPS week
40
20
0
-20
-40
-60
-80
1700
1705
1710
1715
1720
1725
1730
1735
1740
1745

New station coordinates

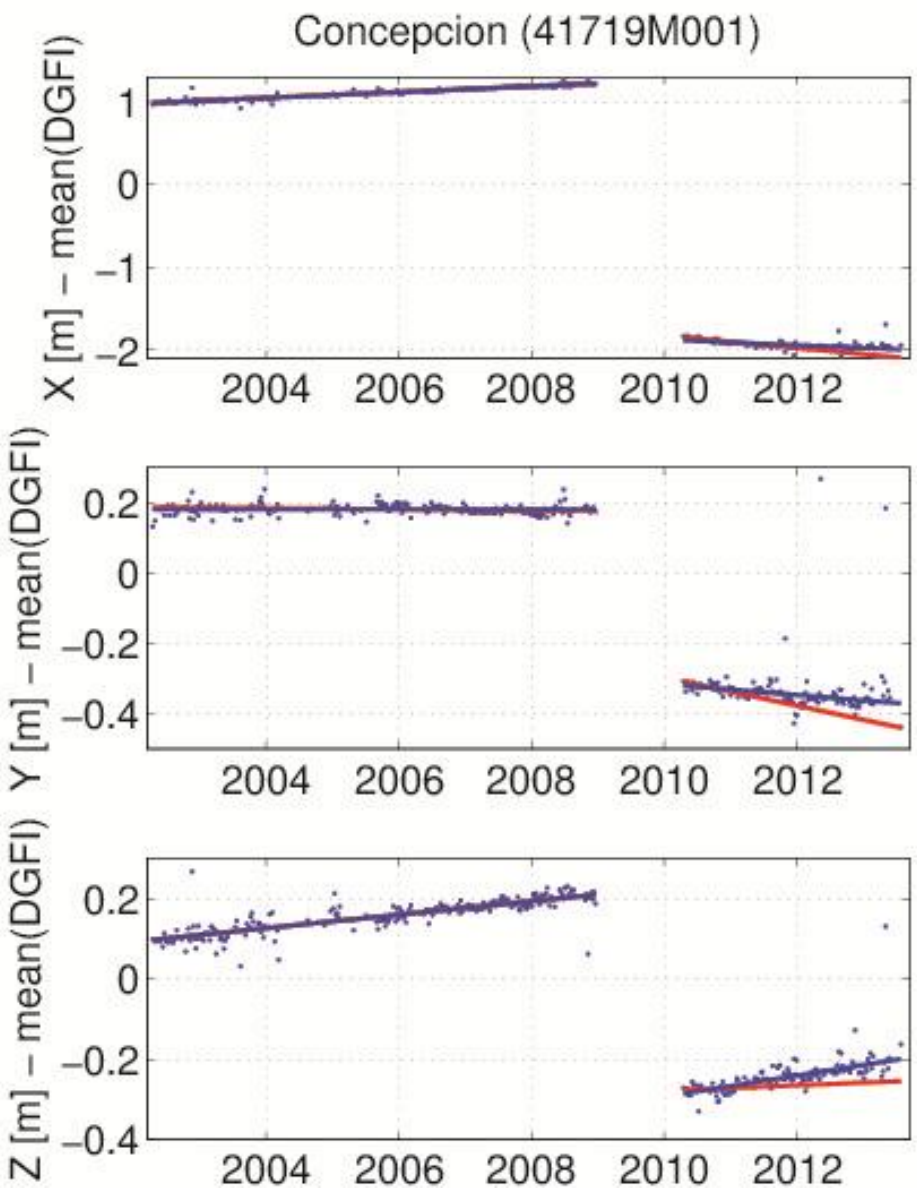


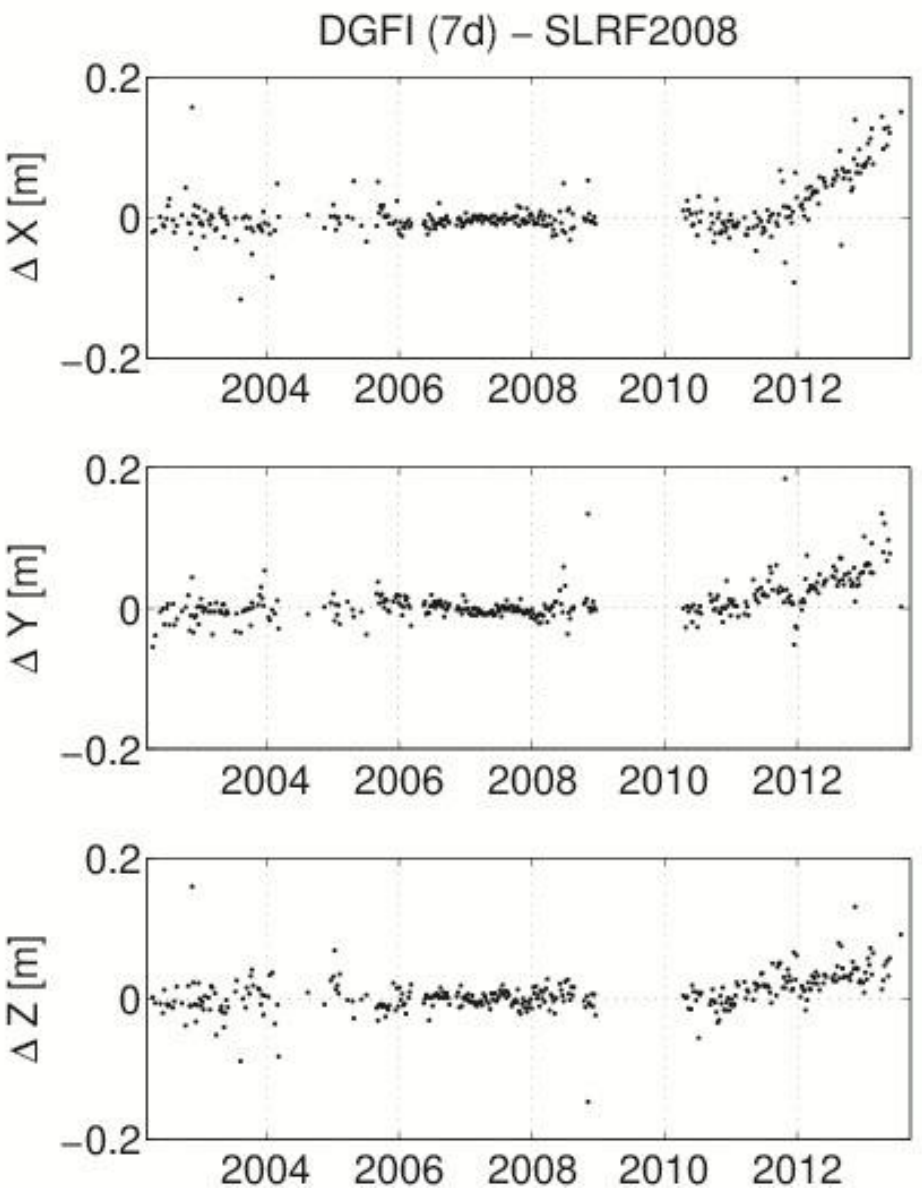


DGFI

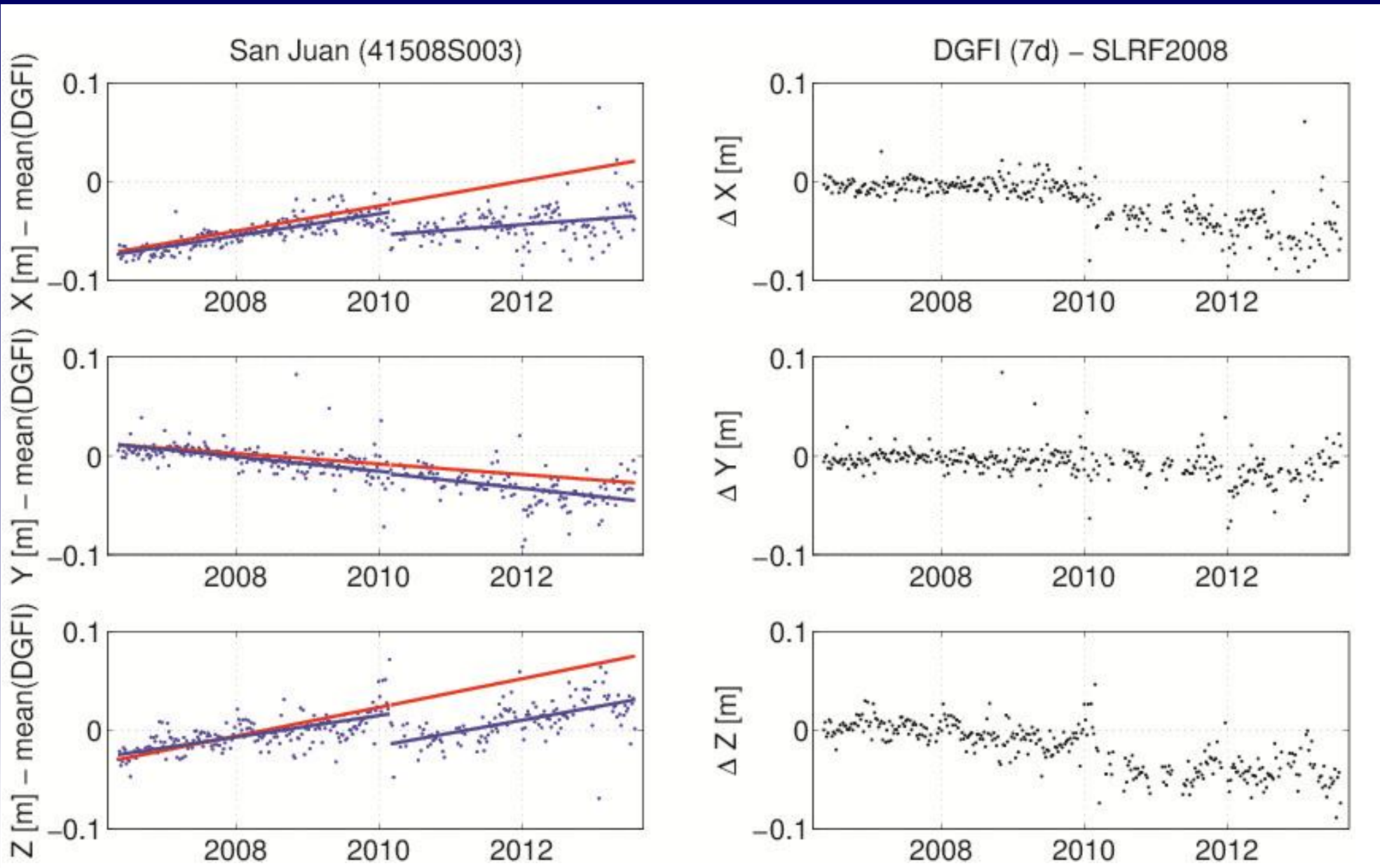
GGE

New station coordinates





New station coordinates

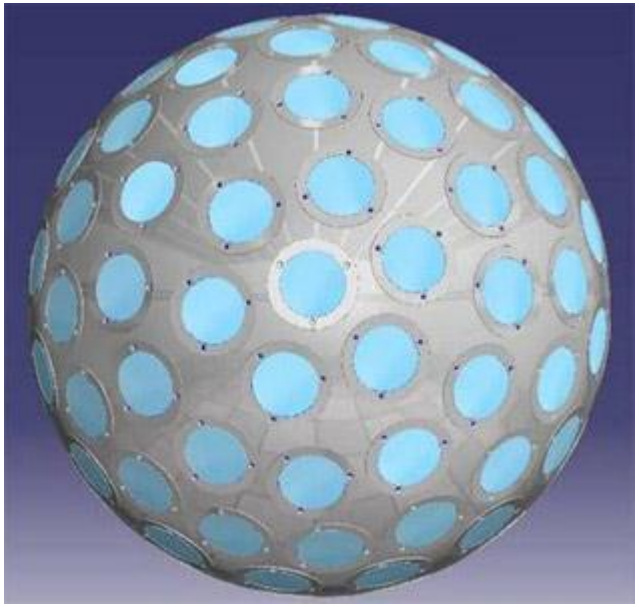


DGFI

GGE

Lares

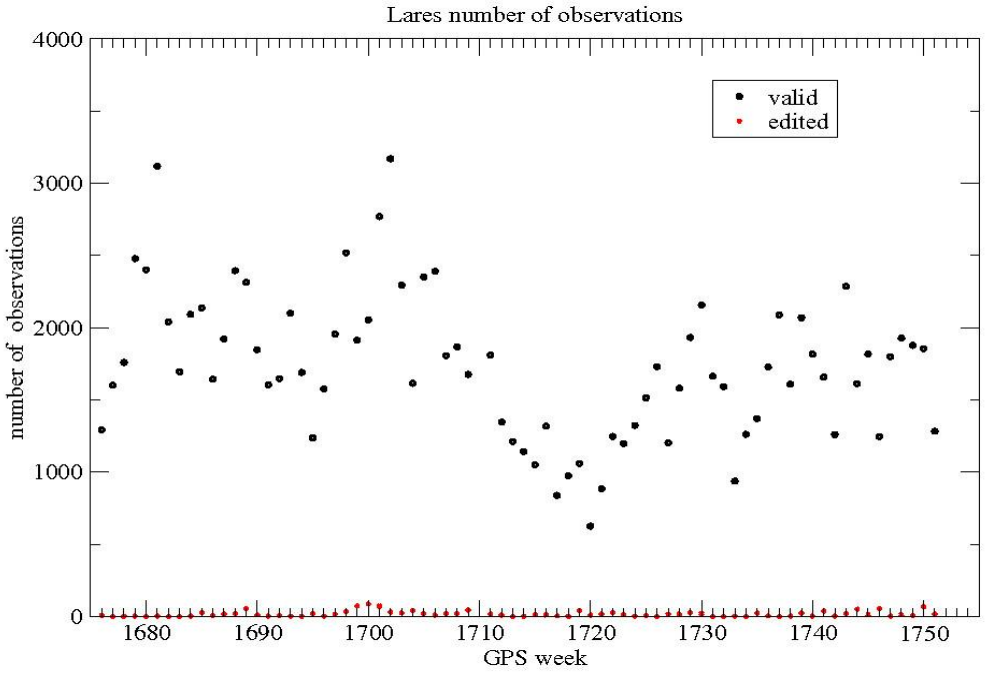
Lares, launched Feb. 2012 is a good target to improve the quality of the ILRS products



Height: 1450 km
Inclination 69,5 degrees
Near circular orbit

- Heavy satellite (386.8 kg) > small (18.2 cm radius) > a/m value very small
- No need to model drag force of the high atmosphere, simple empirical force is suffcient
- Low enough to solve for low degree harmonics
- Good number of observation, mean 1750 per week, sometime > 2000, and more than lageos1
- Good orbital fit ~ 2.5 cm without solving for spherical harmonic coefficients (see graph)
- Solving for low degree harmonics seems necessary (up to degree and order 4?)

Lares vs. Etalon



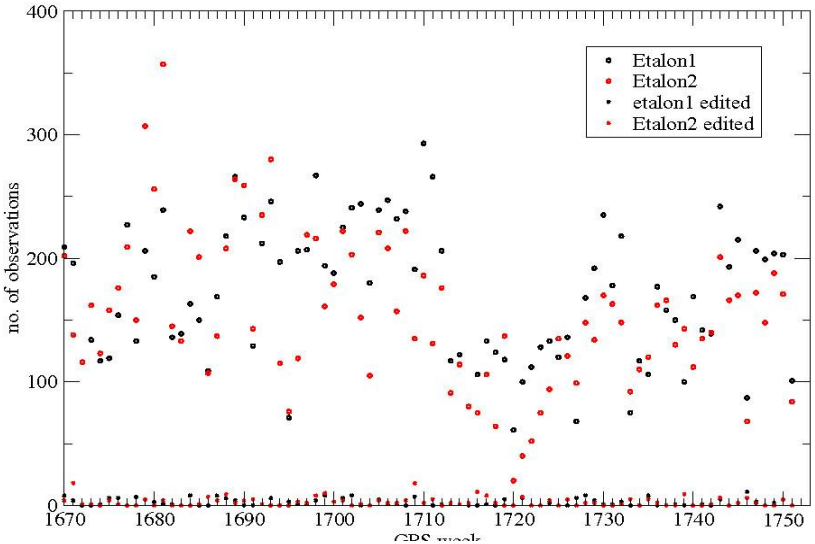
Lares has increasing number of Observations, presently around 2000 observations per week.

Allows good orbits and improves the skycoverage over stations

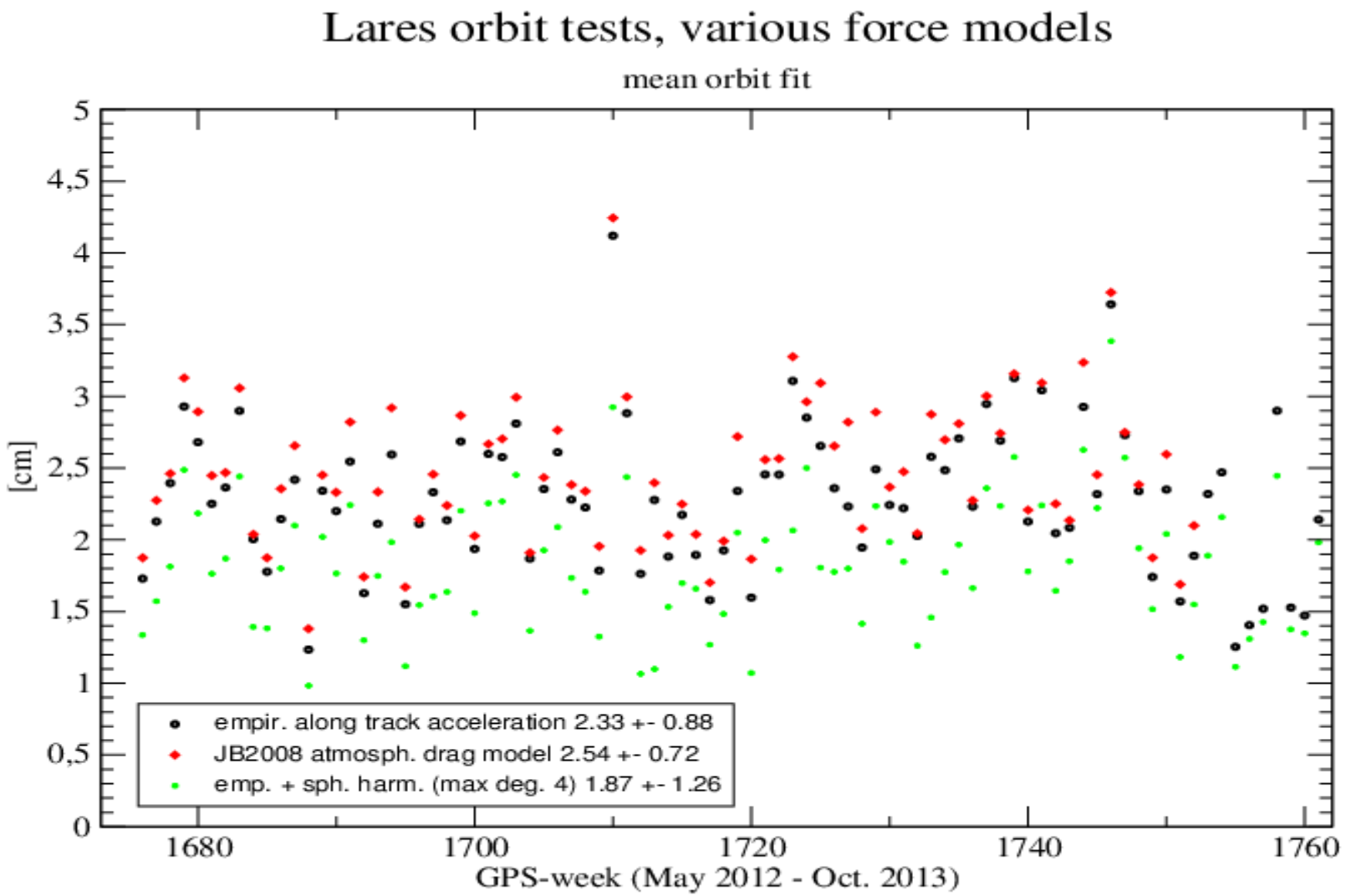
- better weekly coordinates
- higher reliabity

Eventually replace Etalons if tracking Is not improving.

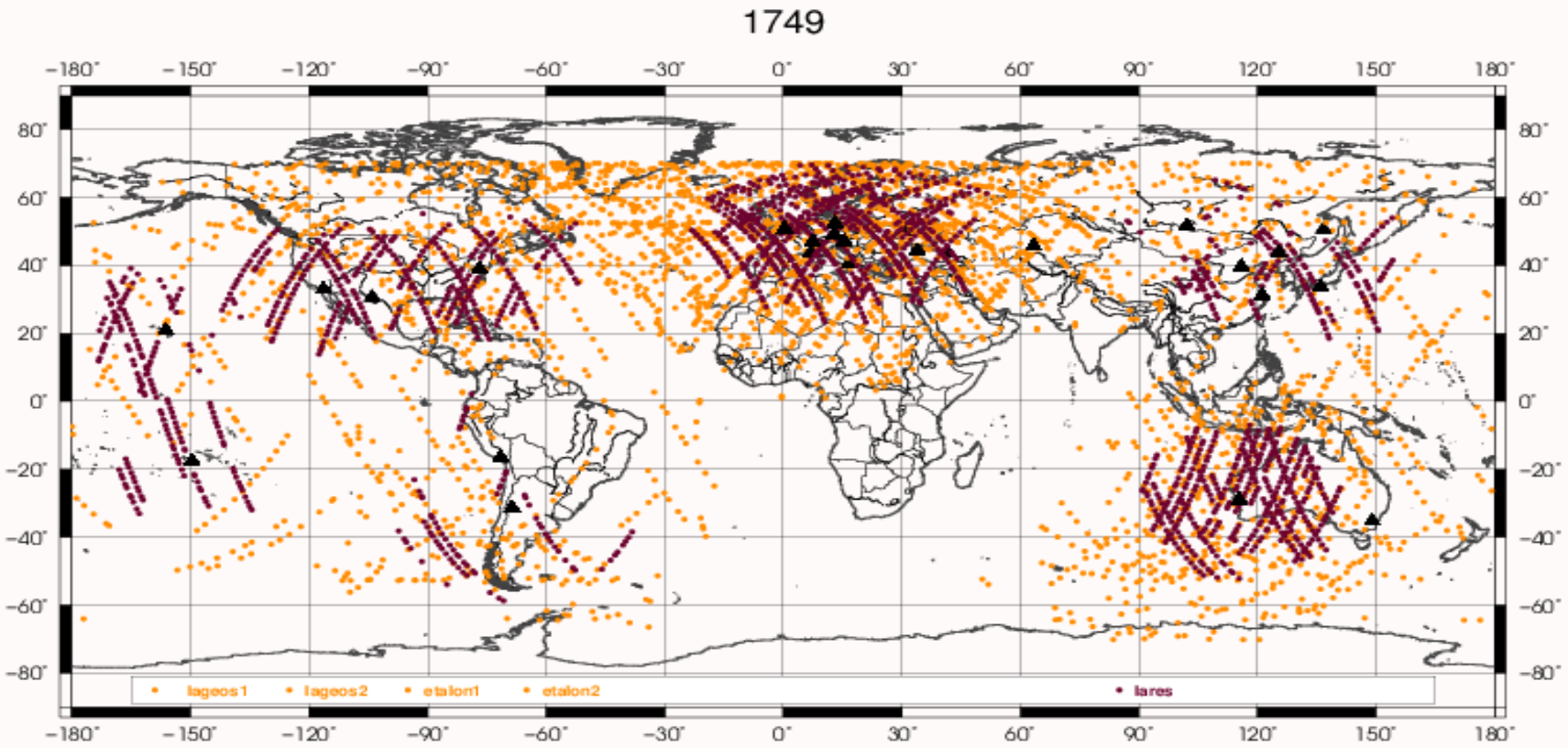
Etalon1/2 have a decreasing number of observations ~200 Etalon1 and ~150 Etalon2 presently. Sometimes < 100 observations/week. This does not allow a good and reliable orbit computation.
Either we get more etalon observations or we should remove Etalon from the satellites used for the ILRS products.
New NP formulation could help to increase number of observations.



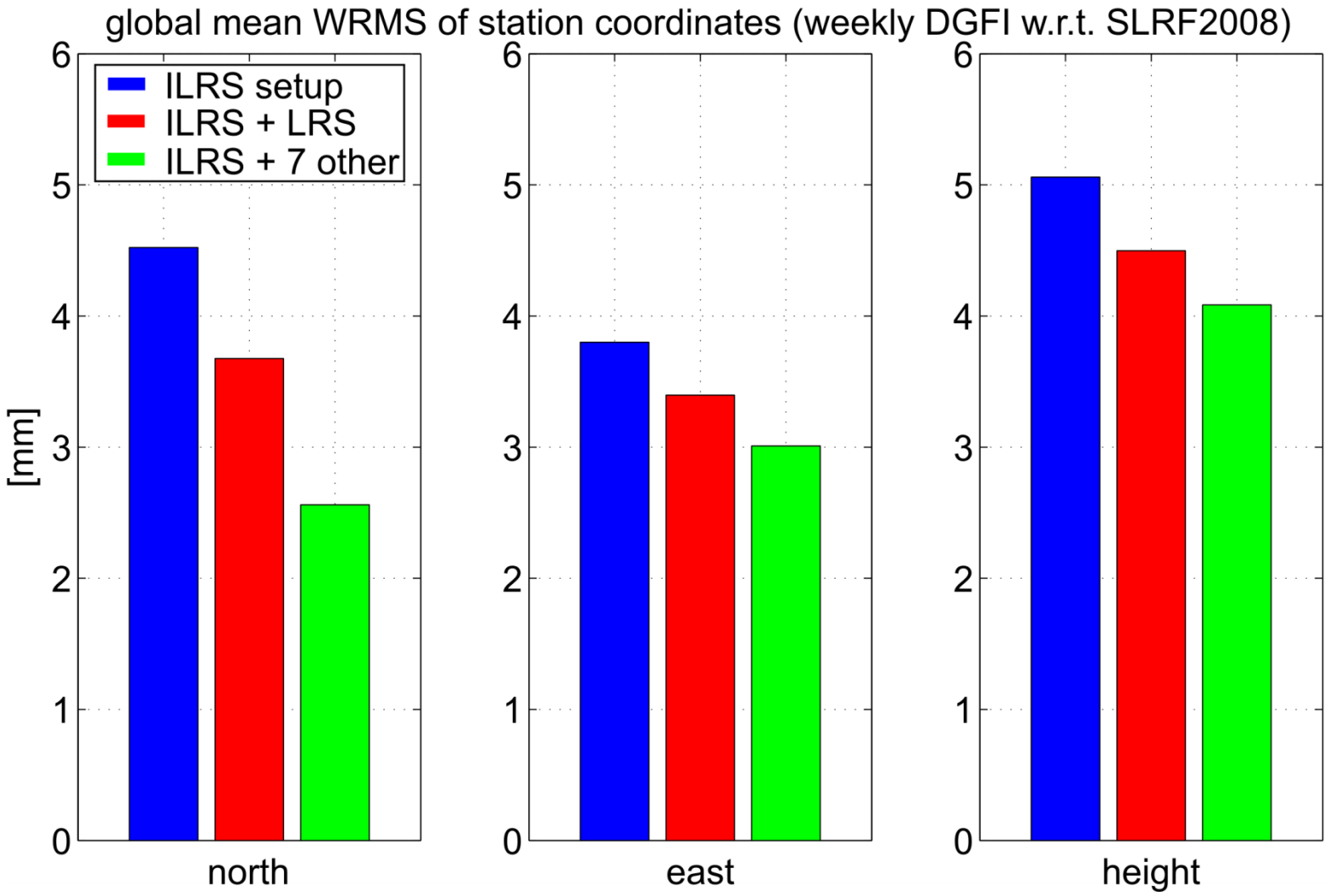
Lares


Lares orbit tests, various force models
mean orbit fit
[cm]
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
1680
1700
1720
1740
1760
GPS-week (May 2012 - Oct. 2013)
empir. along track acceleration 2.33 +- 0.88
JB2008 atmosph. drag model 2.54 +- 0.72
emp. + sph. harm. (max deg. 4) 1.87 +- 1.26

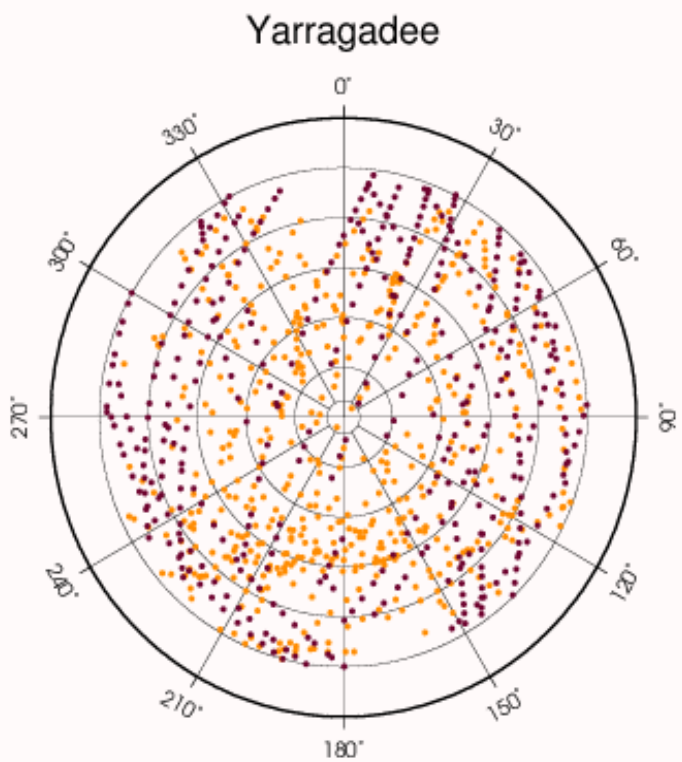
Lares

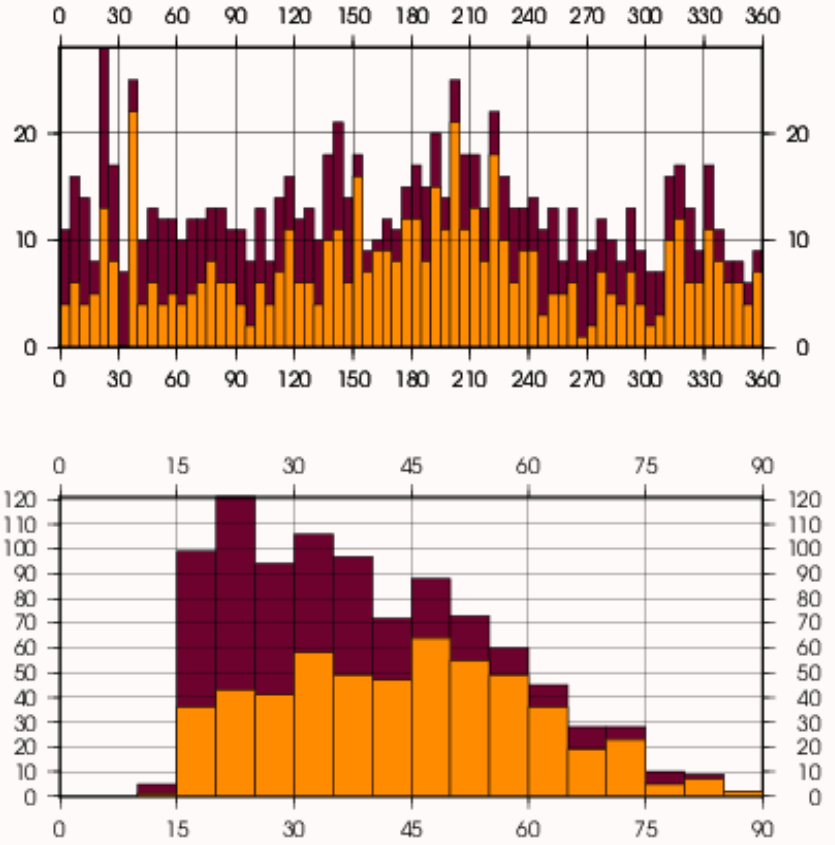


Lares


global mean WRMS of station coordinates (weekly DGFI w.r.t. SLRF2008)
ILRS setup
ILRS + LRS
ILRS + 7 other
[mm]
0
1
2
3
4
5
6
north
east
height

Lares

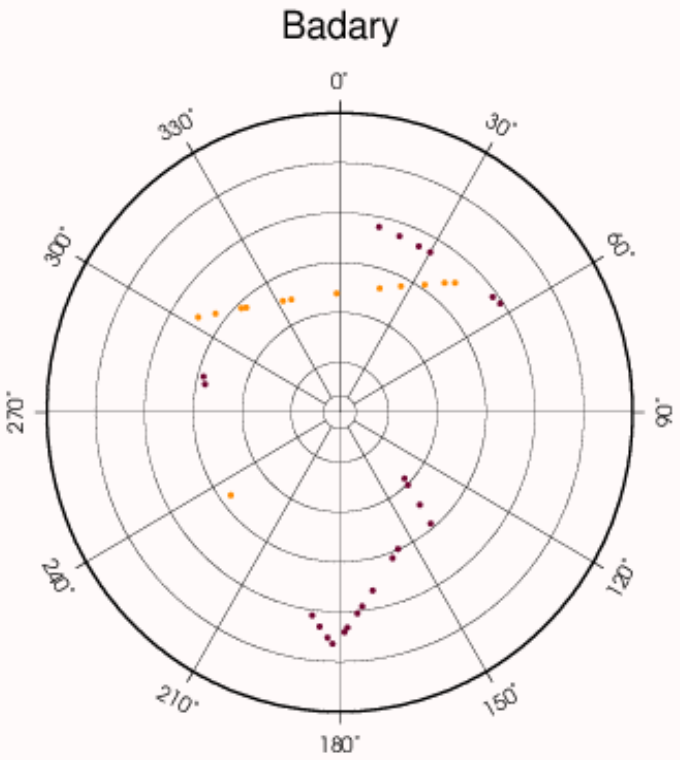


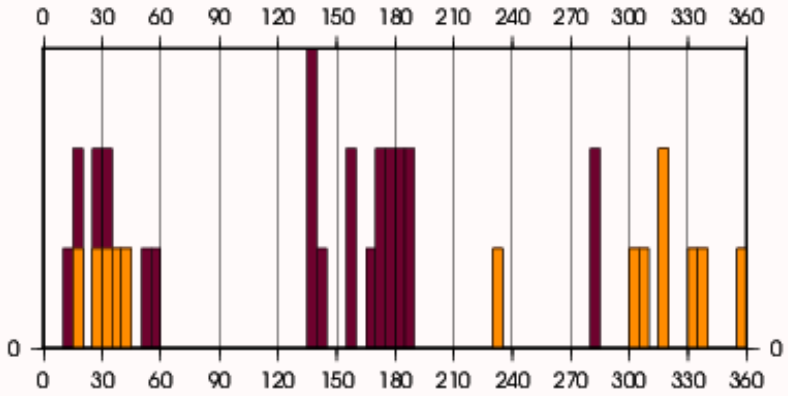


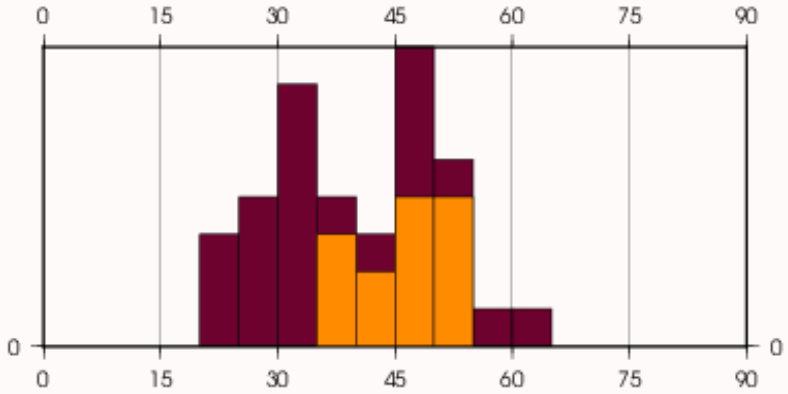
DGFI

EGE

Lares


Badary
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°


0 30 60 90 120 150 180 210 240 270 300 330 360
0
0
0 30 60 90 120 150 180 210 240 270 300 330 360


0 15 30 45 60 75 90
0
0
0 15 30 45 60 75 90

Lares

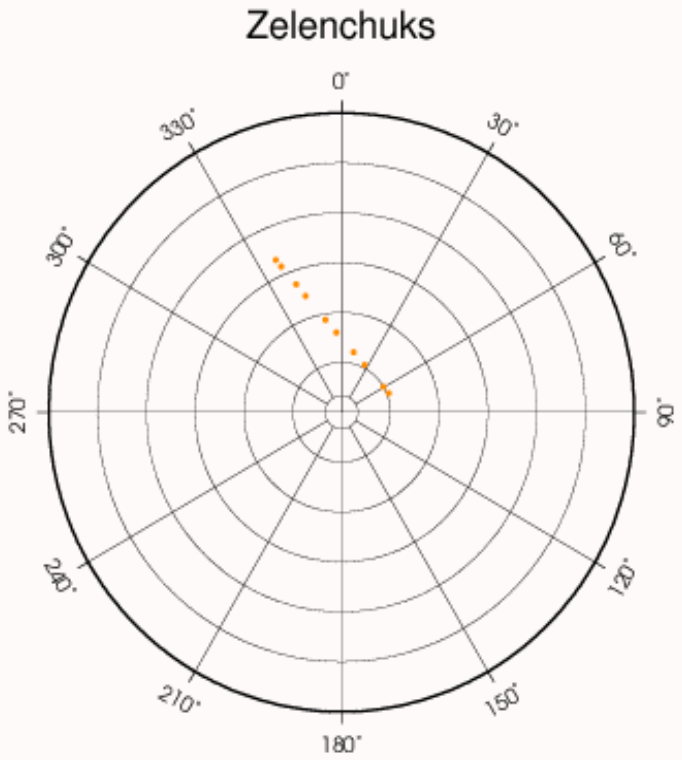
Similariity transformation to SLRF2008 north, east ,up [cm]

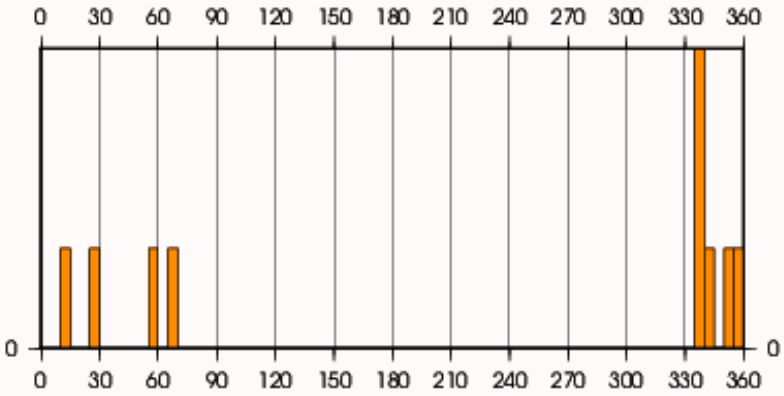
10002S002	A02 *		0.08	0.23	5.17
11001S002	A03 *		0.79	-0.44	2.12
12337S003	A01 *		10.96	6.56	1.53
12338S004	A01 *		-7.49	3.85	10.85
12351S002	A01 *	Zelenchuskya	38.08	52.04	-13.54
12356S001	A01 *		-4.33	-3.12	1.90
12734S008	A01 *		-2.71	-4.95	2.15
14106S011	A01 *		-0.36	-1.61	2.52
14201S018	A02		0.24	-0.30	-0.08
21601S004	**A02 ***	**Badary**	**10.90**	**6.35**	**-10.18**
21605S010	A01 *		1.79	2.00	-5.66
21611S001	A01 *		1.77	3.85	6.28
25603S001	A01 *		2.95	3.28	5.53
40445M004	A01 *		1.23	2.92	-0.87
40497M001	A01		0.25	0.18	-0.19
42202M003	A06 *		5.14	4.56	0.87
50107M001	A01	Yarragadee	-0.08	0.05	0.27
92201M007	A02 *		-0.21	2.43	1.23

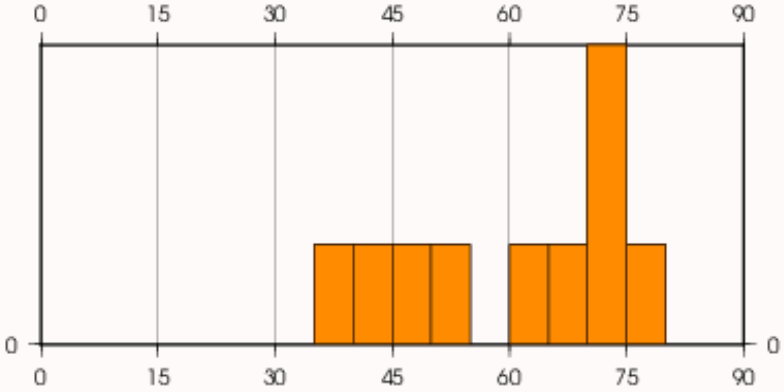
Lares

10002S002	A02	*		-0.73	0.01	5.51
11001S002	A03	*		-0.08	-0.54	2.34
12337S003	A01	*		9.95	5.52	2.16
12338S004	A01	*		0.14	2.42	3.70
12351S002	A01	*	Zelenchuskya	39.52	53.15	-13.91
12356S001	A01	*		-4.91	-3.00	1.60
12734S008	A01	*		-0.66	-3.66	1.81
14106S011	A01	*		1.04	-0.94	1.62
14201S018	A02			0.01	0.07	-0.18
21601S004	**A02**	*****	**Badary**	**2.62**	**2.98**	**0.92**
21605S010	A01	*		-0.57	-0.54	-6.32
21611S001	A01	*		-0.65	2.65	5.16
25603S001	A01	*		3.78	3.85	4.18
40445M004	A01	*		1.94	2.18	-0.13
40497M001	A01			0.04	0.09	0.15
42202M003	A06	*		4.62	5.02	5.07
50107M001	A01		Yarragadee	0.04	-0.13	0.03
92201M007	A02	*		-1.19	2.63	0.33

Lares


Zelenchuks
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°


0 30 60 90 120 150 180 210 240 270 300 330 360
0
0
0 30 60 90 120 150 180 210 240 270 300 330 360


0 15 30 45 60 75 90
0
0
0 15 30 45 60 75 90

Conclusion

- Present solutions are of quite good quality
- Some improvements possible
  - Harmonization of analysis processes (in progress)
  - Harmonization of data editing (still pending)
  - New station coordinates for new stations and those in tectonic areas (already done)
  - Adding Lares to the satellites used in the analysis
    - Needs a pilot project first

Thank you for your attention!