Improvements in DORIS Processing at the GSFC Analysis Center

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Outline

1. ITRF tests (2008, 2008d, 2005)
   - TOPEX, Jason-1, Jason-2.
   - Global tests & by satellite.
2. Tests with Envisat, Spot4, Spot5
   - (ITRF2008 vs. ITRF2005)
3. SPOT-5 SAA tests.
4. OPR summary, S4, S5, Envisat.
5. Future tests & Improvements.

Tests for ITRF2008

- Compute DORIS-only, SLR-only & SLR+DORIS orbits for TOPEX/Poseidon, Jason1, & Jason2 Altimeter satellites for select periods 1993 - 2010.
- Use RMS of fit and independent Altimeter Crossovers as metrics.
- Evaluate DPOD2005, ITRF2008, ITRF2008D complements globally and station-by-station.
- Evaluate orbit differences, esp., Mean-Z orbit differences, and radial orbit differences for TOPEX/Poseidon.
- Repeat some analyses SPOT4/Envisat.
- Station-by-station Residuals.

DORIS Complements: RMS of fit comparison vs. time for DORIS-only Altimeter satellite orbits

test DORIS-only	number stations	average points / cycle	average residuals per cycle		
			DORIS (mm/s)	SLR (cm)	Xover (cm)
TOPEX/Poseidon (Apr 19, 1993 – July 17, 1993)					
dpod2005	45	57135	0.5386	4.81	5.936
dpod2005*	42	54342	0.5393	4.94	5.939
itrf2008	42	54342	0.5391	4.90	5.942
itrf2008d	42	54342	0.5391	4.90	5.939
TOPEX/Poseidon (Jan. 15, 2002 – Aug. 11, 2002)					
dpod2005	53	57365	0.4733	4.16	5.622
itrf2008	51	56015	0.4736	4.20	5.621
itrf2008d	52	57251	0.4731	4.16	5.616
Jason-2 (Jan. 26, 2009 – Jan. 28, 2010)					
dpod2005 *	51	151295	0.3774	2.38	5.577
itrf2008	51	151307	0.3761	2.39	5.556
itrf2008d	51	151305	0.3766	2.39	5.559

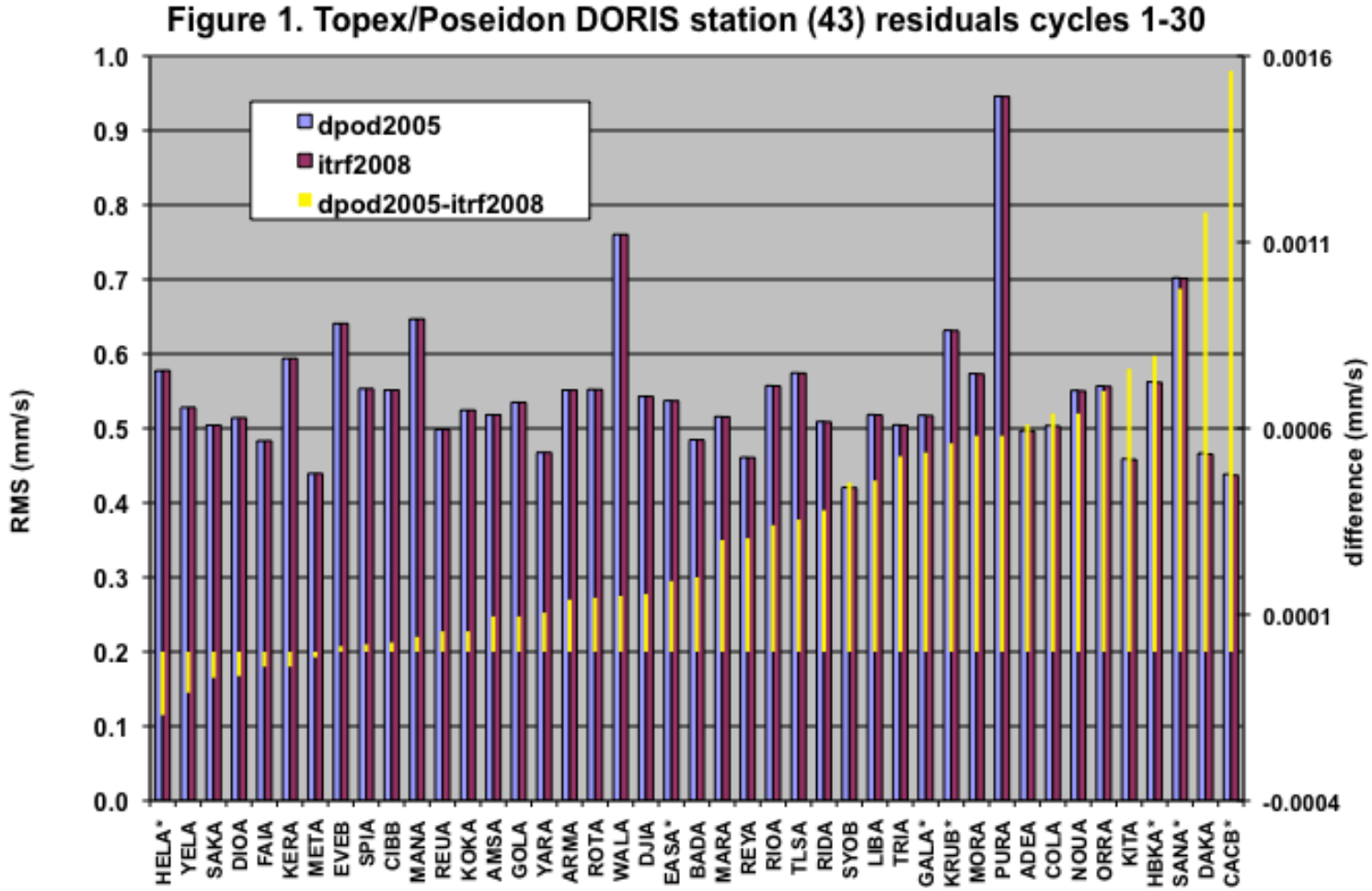
SLR & Xover fits are independent

Early period: Marginal improvements.

Later periods: ITRF2008 generally better.

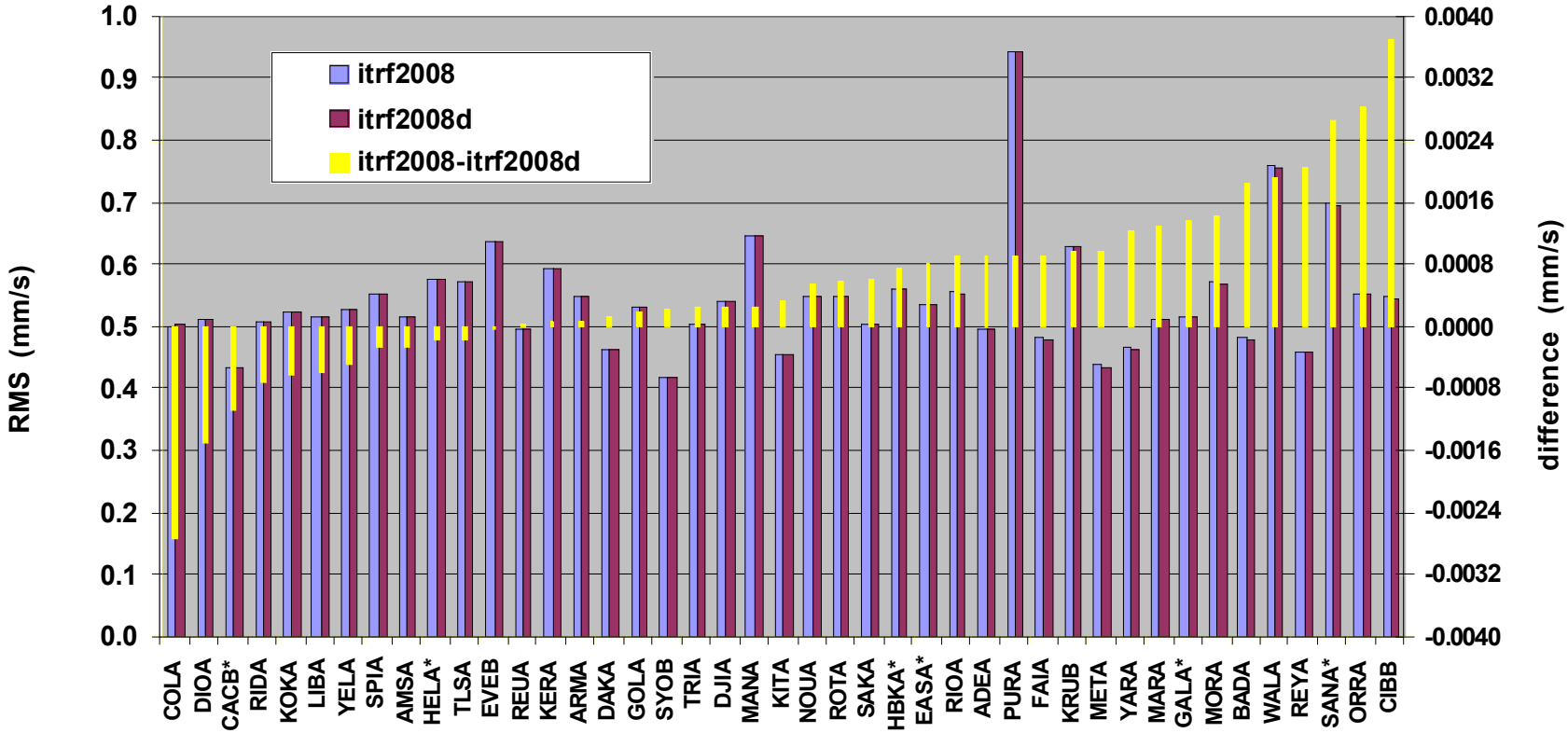
ITRF2008d:
>>glitches in velocity determinations for DORIS.
>> SODB (Soccoro) has to be excluded from tests.

DORIS: station-by station comparisons, TOPEX: Sept. 1992-Apr. 1993, DPOD2005 vs. ITRF2008



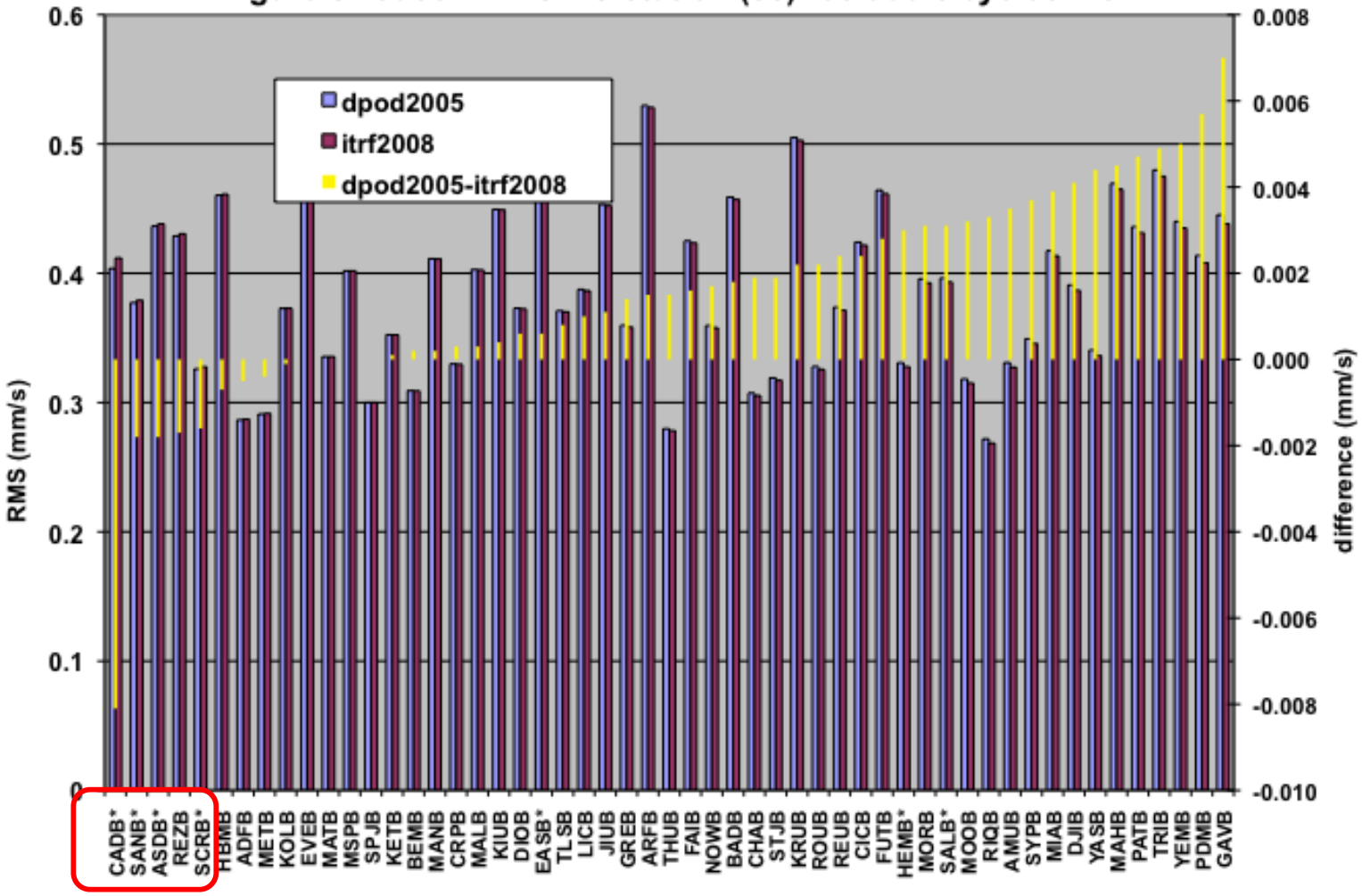
DORIS: station-by station comparisons,TOPEX: Sept 1992-July 1993, ITRF2008 vs. ITRF2008d

Figure 1. Topex/Poseidon 43 DORIS station residuals cycles 1-30 (positive implies improvement for itrf2008d)



DORIS: station-by station comparisons, Jason-2: July 2008 - Jan. 2010, DPOD2005 vs ITRF2008

Figure 3. Jason-2 DORIS station (53) residuals cycles 1-57



Predominantly SAA stations show degradation for Jason-2

SLR Complements: RMS of fit comparison vs time for SLR-only altimeter satellite orbits

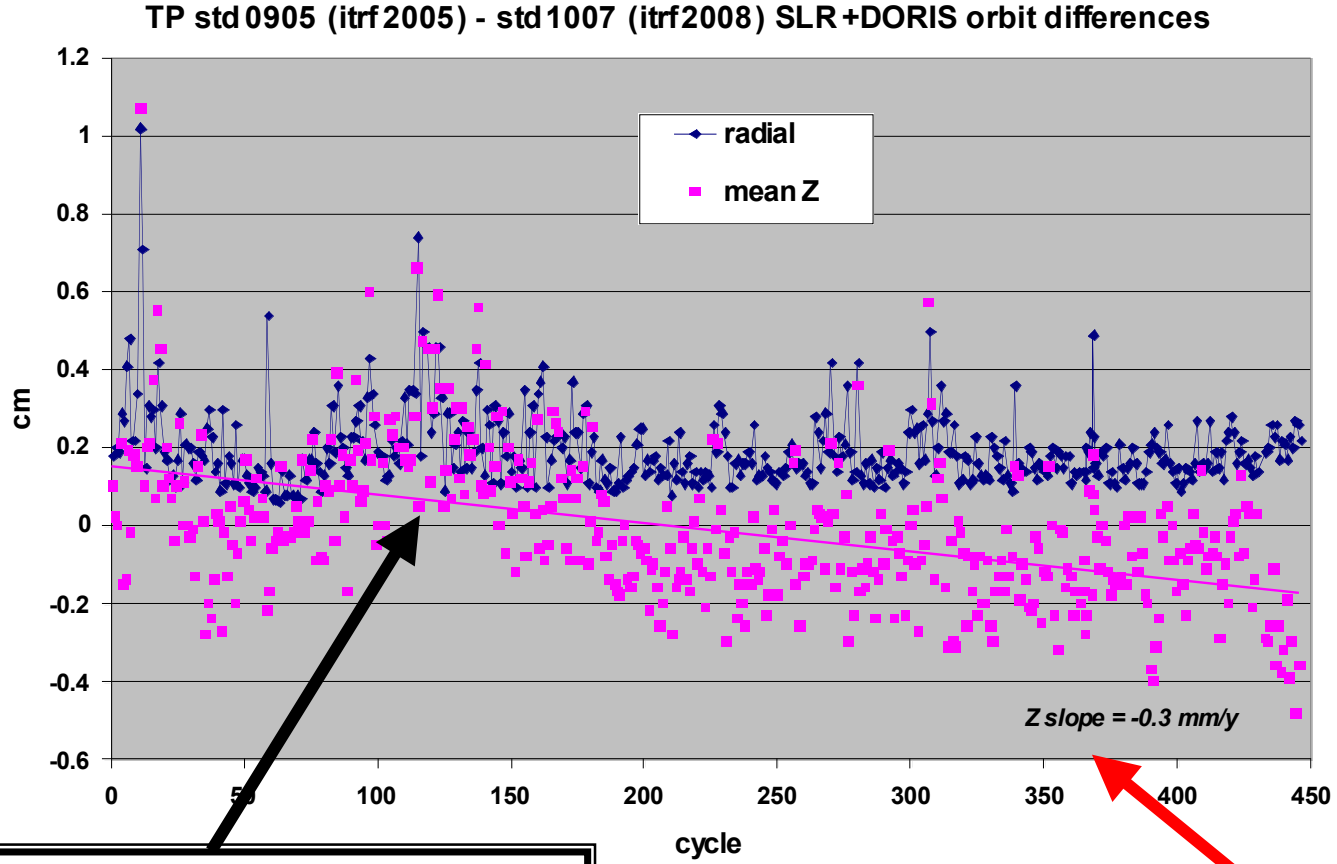
SLR-only, POD	number stations	average points / cycle	average rms residuals (cm)	
			SLR	XOVER
TOPEX/Poseidon Sept. 25, 1992 – July 17, 1993				
LPOD2005	36	4623	2.219	6.010
ITRF2008	36	4623	2.140	5.984
ITRF2008d	36	4623	**2.134**	**5.979**
TOPEX/Poseidon, Jan. 15, 2002 – Aug. 11, 2002				
LPOD2005	35	4102	1.537	5.565
ITRF2008	34	4095	1.448	5.548
ITRF2008d	34	4094	**1.423**	**5.542**
Jason-1, July 11, 2008 – Jan. 26, 2009				
LPOD2005	32	2690	1.029	5.555
ITRF2008	32	2690	1.014	5.531
ITRF2008d	32	2691	**0.990**	**5.521**
Jason-2, Jan. 26, 2009 – Jan. 28, 2010				
LPOD2005	32	5149	0.999	5.649
ITRF2008	32	5146	0.950	5.651
ITRF2008d	32	5145	**0.947**	**5.648**

- LPOD2005 & ITRF2008 applied each with their own Rosetta stone of biases.
- Both ITRF2008 & ITRF2008d represent improvements wrt. LPOD2005. The few missing stations are not significant for POD.

- ITRF2008d does slightly better in the SLR & Independent Xover comparisons. (slightly better centered?)

Xover fits are independent

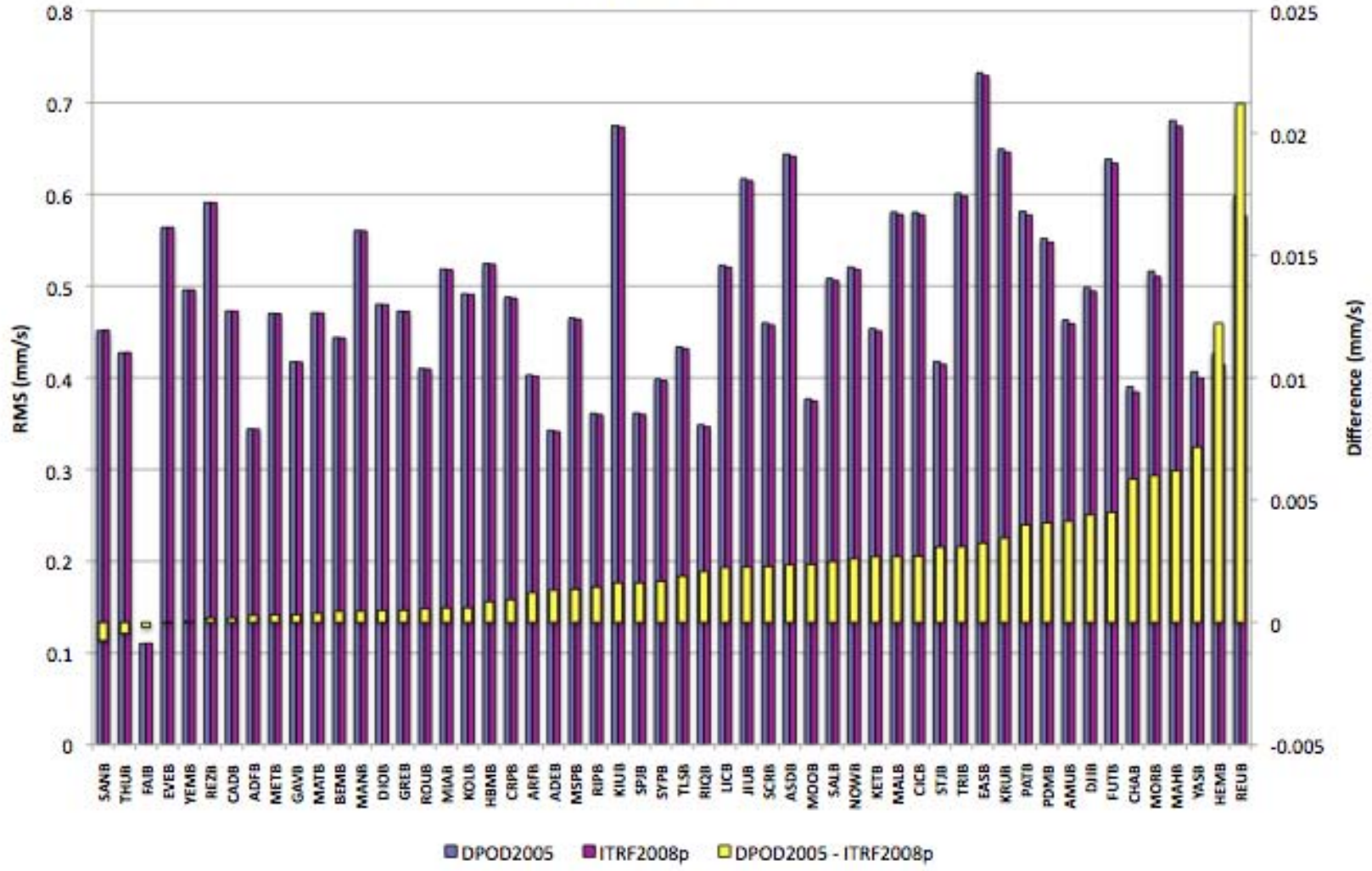
TOPEX SLR+DORIS Orbit Differences (ITRF2005 - ITRF2008)



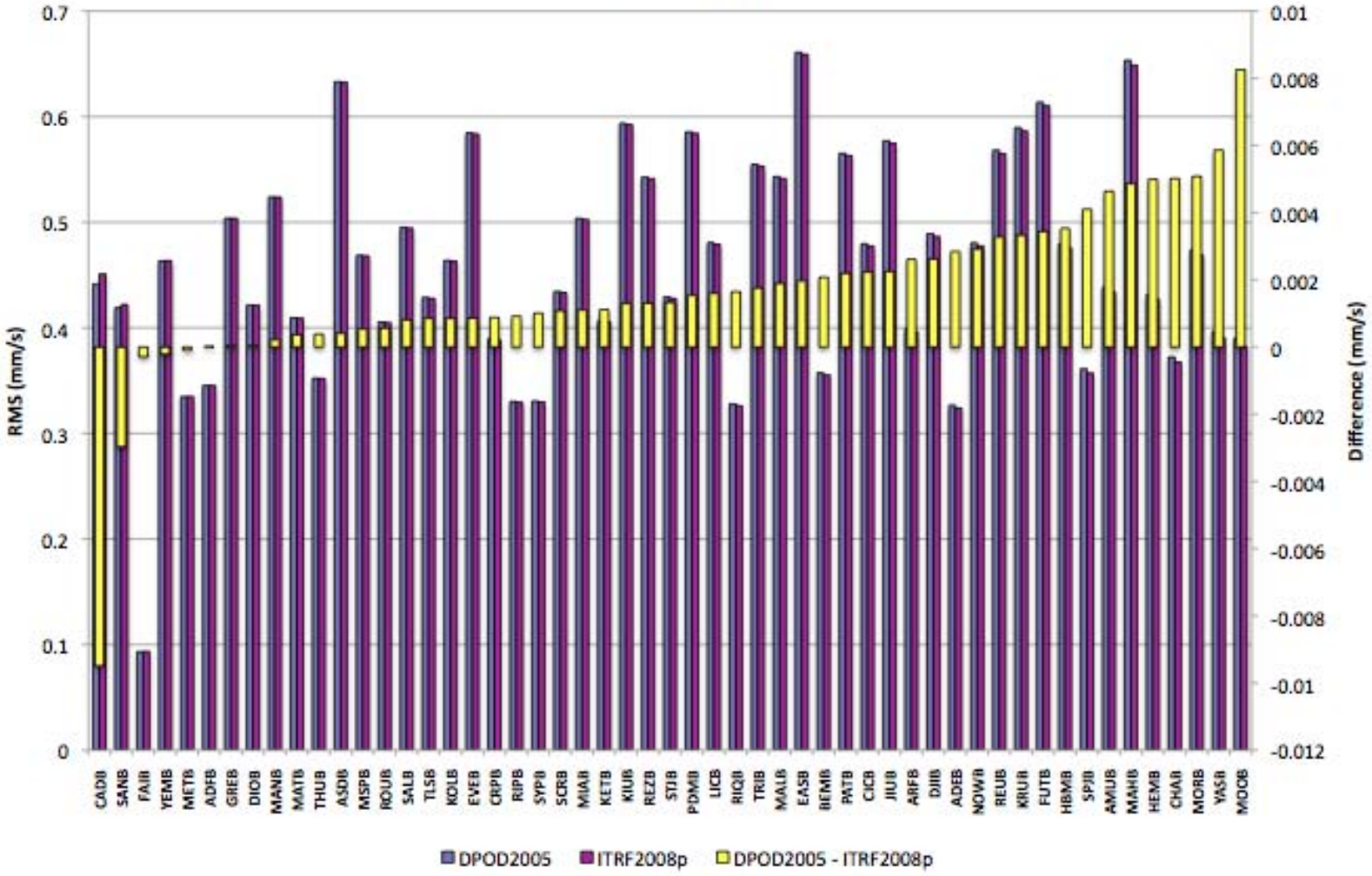
Network effect in differences, centered ~1995-1996? Coincident with SPOT-3? Or is this a temporary SLR issue?

From Beckley et al., 2007; Morel & Willis, 2005, change in sea level rate will be ~0.06 mm/yr.

DORIS: station-by station comparisons, Envisat Jan-Dec 2008, DPOD2005 vs ITRF2008



DORIS: station-by station comparisons, SPOT4 Jan-Dec 2008, DPOD2005 vs ITRF2008



DORIS: station-by station comparisons, highest vs. lowest RMS for SPOT4 & Envisat in 2008

Envisat:

Highest RMS: EASB, MAHB, KIUB, KRUB, ASDB, FUTB.
Lowest RMS: FAIB, ADEB, ADFB, RIQB, RIPB, SPJB

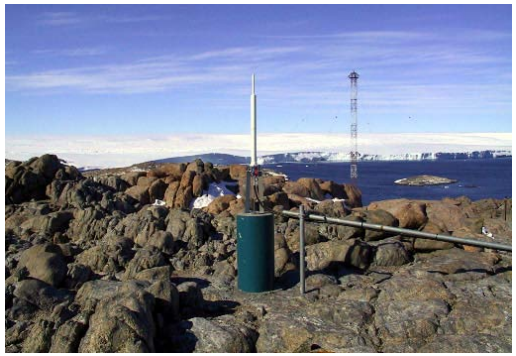
SPOT4:

Highest RMS: EASB, MAHB, ASDB, FUTB, KIUB
Lowest RMS: FAIB, ADEB, RIQB, RIPB, SYPB, METB

What characteristics distinguish the stations with the highest RMS with the lowest RMS of fit? USO's? Multipath? Other effects?

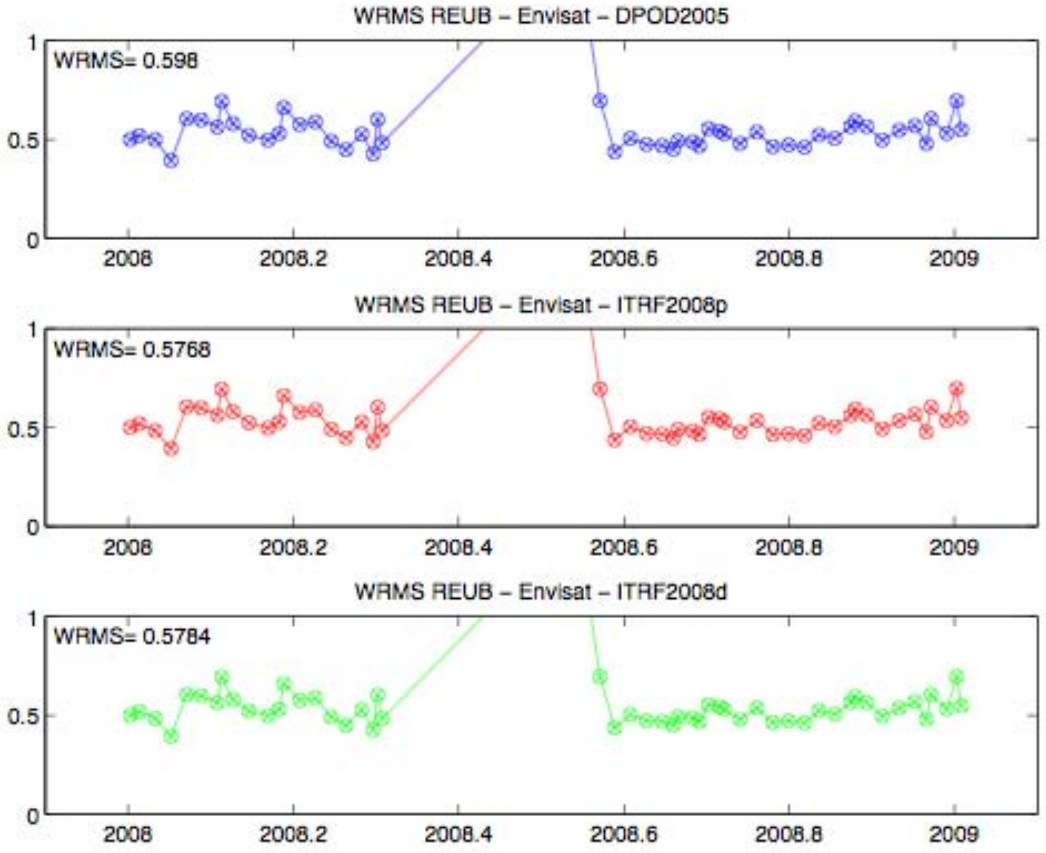
Easter Island

Futuna



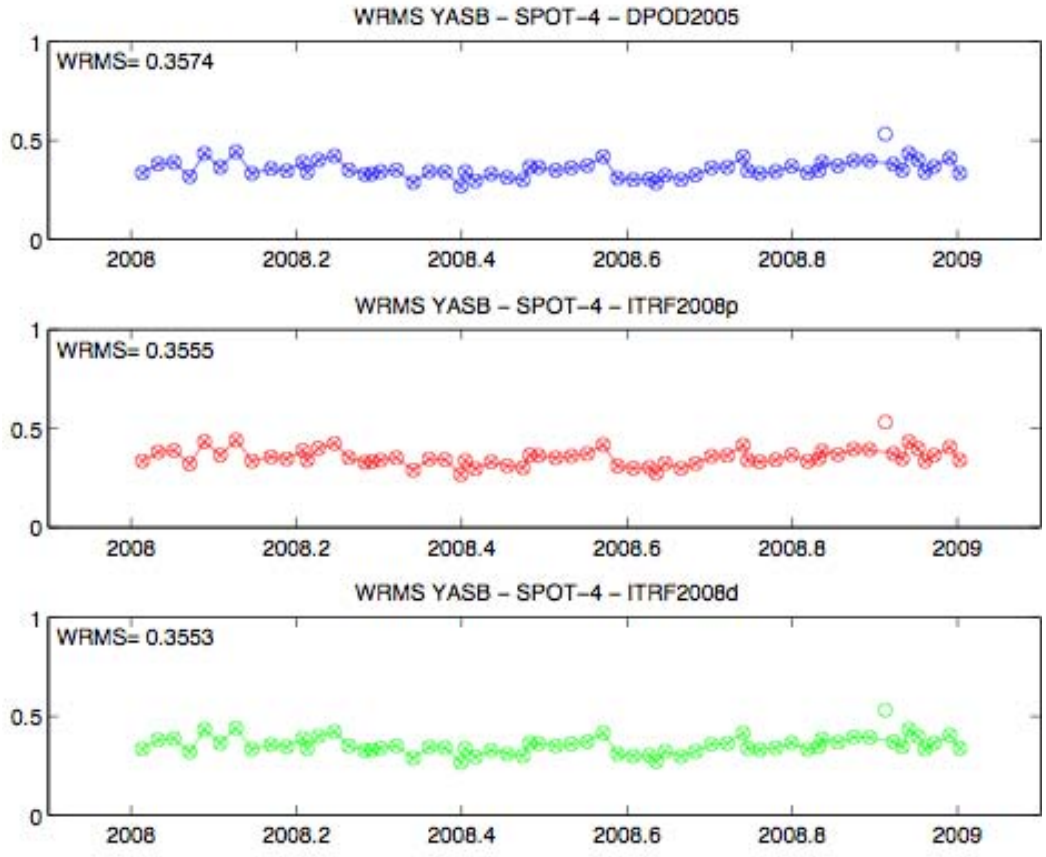
Terre Adélie

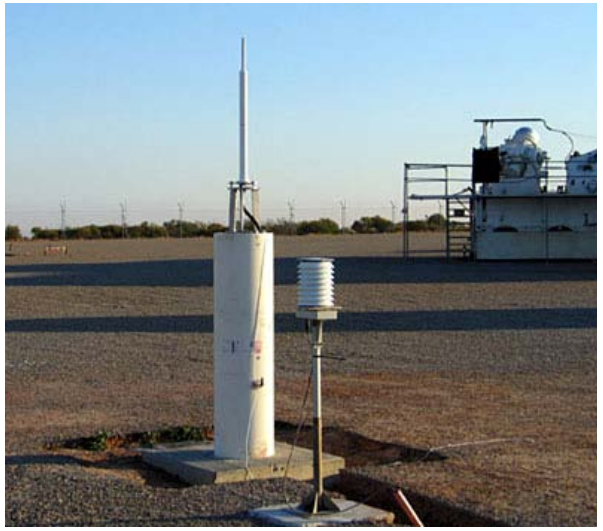
La Réunion, Envisat



Beacon change (June 2, 2008) apparently causes temporary degradation in station residuals. Also seen in other satellite residuals for this station ==> <u>SOLUTION</u>: Delete data from solution for some weeks.

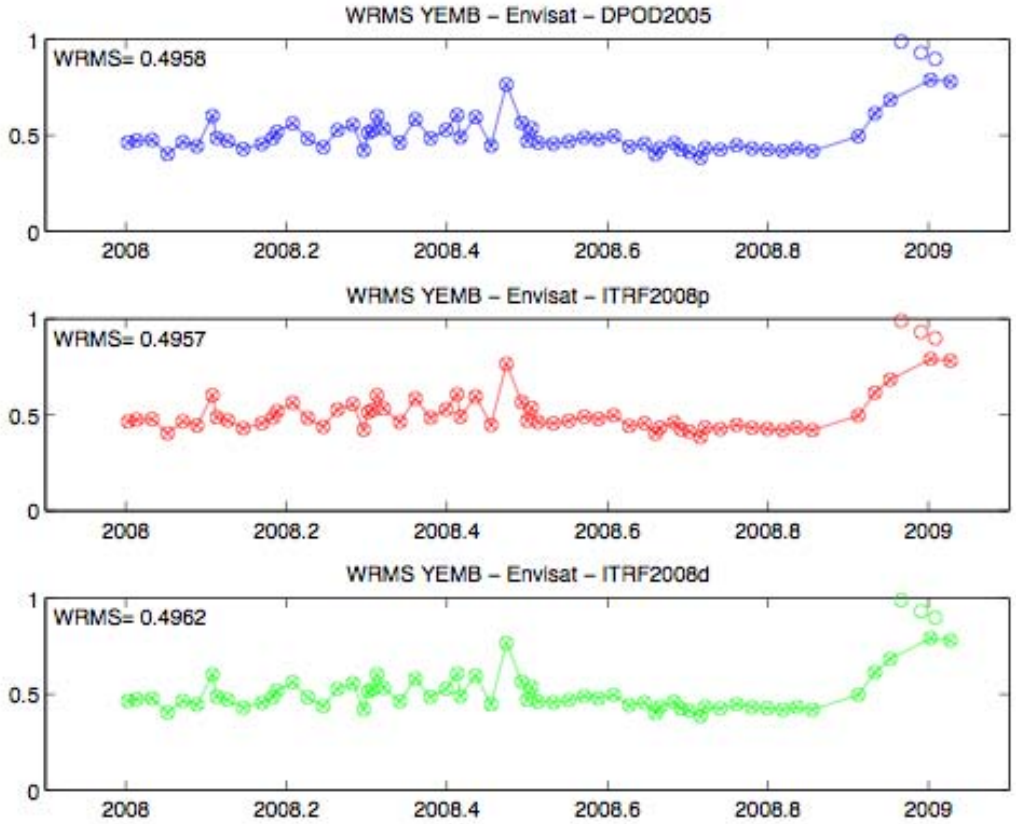
Yaragadee, SPOT4





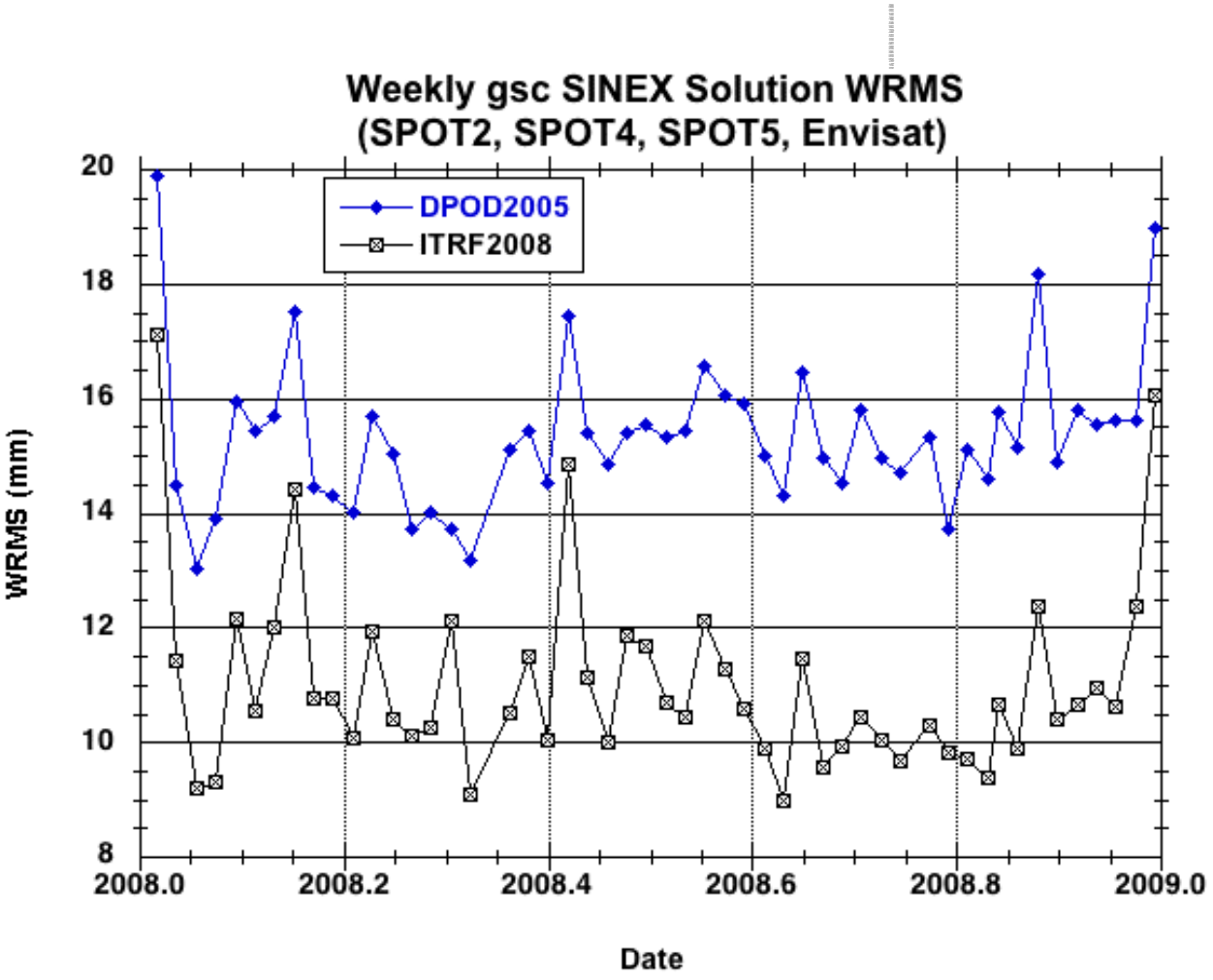
Very small changes in residuals with new ITRF; Same patterns present in old & new series. Other effects must dominate (USO? Multipath? Unmodeled effects? Second order ionosphere?…….)

Yellowknife, Envisat



Very small changes in residuals with new ITRF; Same patterns present in old & new series. Other effects must dominate (USO? Multipath? Unmodeled effects? Second order ionosphere?)

ITRF2008 vs. ITRF2005 (DPOD2005) tests



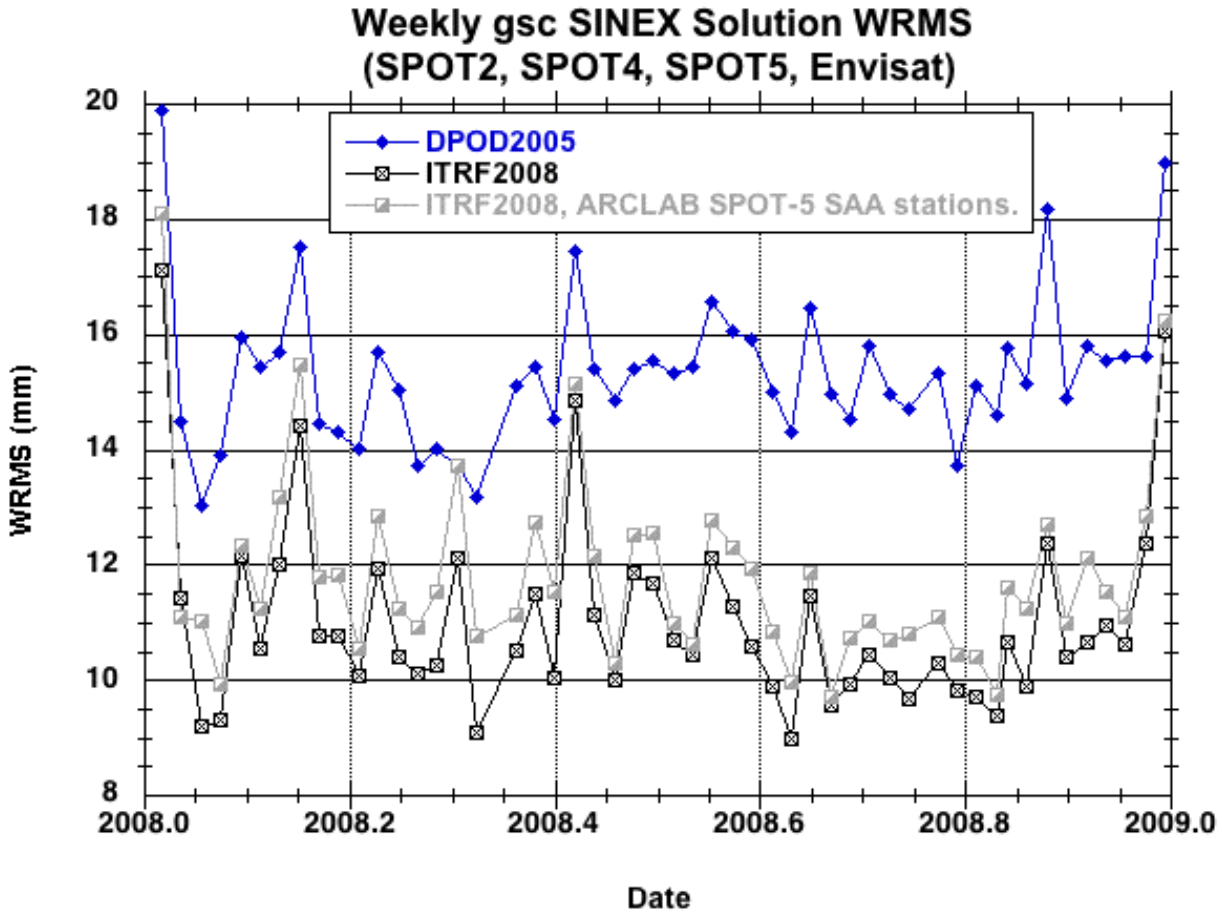
Develop weekly normal equations & SINEX solutions with DPOD2005 as *a priori* (basically ITRF2008 gscwd10 submission) & with ITRF2008 as *a priori).*

- Exclude REUB for some weeks in mid-2008 (bad after beacon change).
- Exclude week 2008.342285 (week 18)

DPOD2005:
Avg. WRMS = 15.3 mm
Median WRMS = 15.3 mm

ITRF2008:
Avg. WRMS = 11.0 mm
Median WRMS = 10.6 mm

Simple SPOT5 SAA Test (1)



Adjust ~five SAA stations separately for SPOT-5 and exclude from common weekly solution.

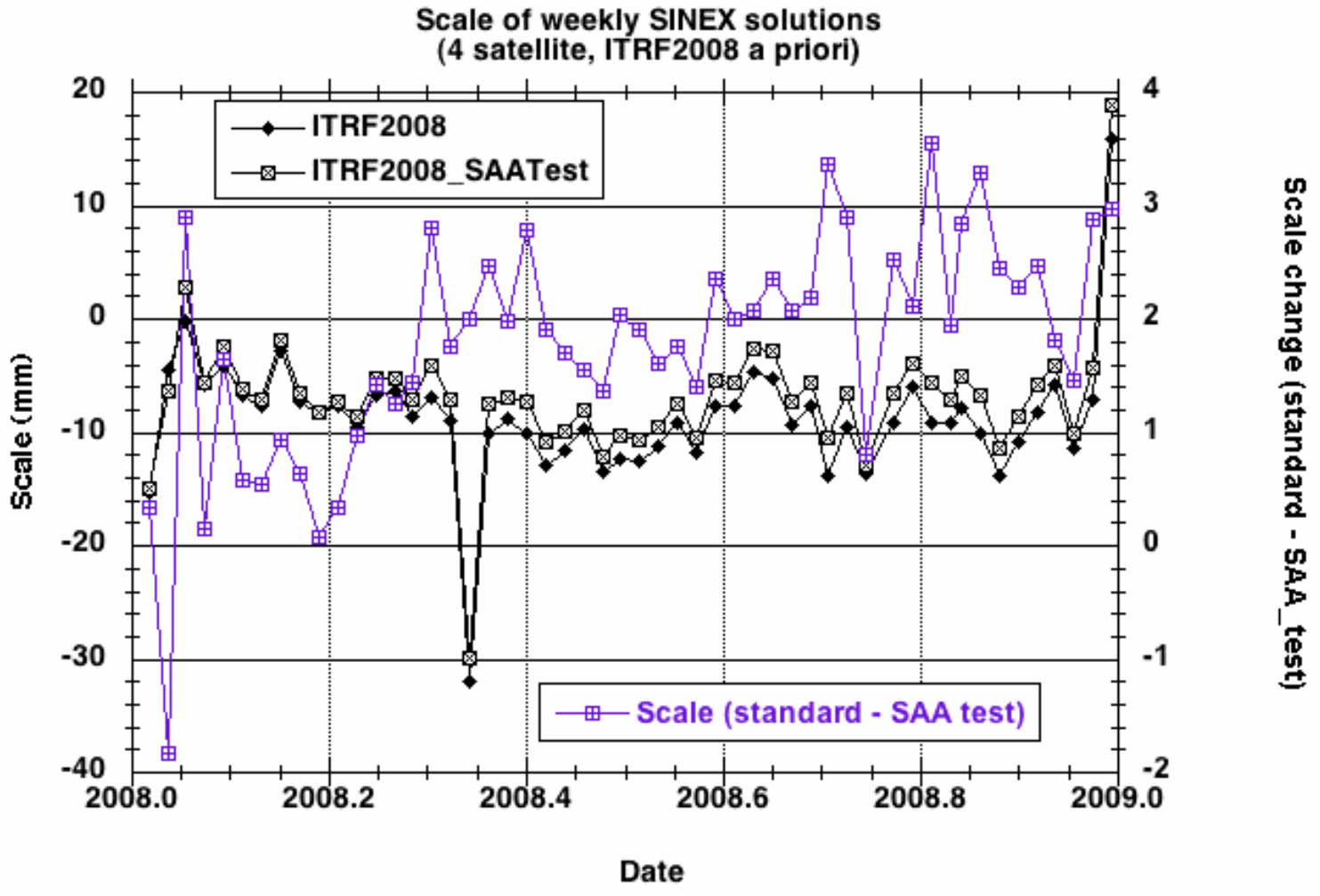
- Exclude REUB for some weeks in mid-2008 (bad after beacon change).
- Exclude week 2008.342285 (week 18)

DPOD2005:
Avg. WRMS = 15.3 mm
Median WRMS = 15.3 mm

ITRF2008:
Avg. WRMS = 11.0 mm
Median WRMS = 10.6 mm

ITRF2008/SPOT5-SAA Adj.
Avg. WRMS = 11.8 mm
Median WRMS 11.2 mm

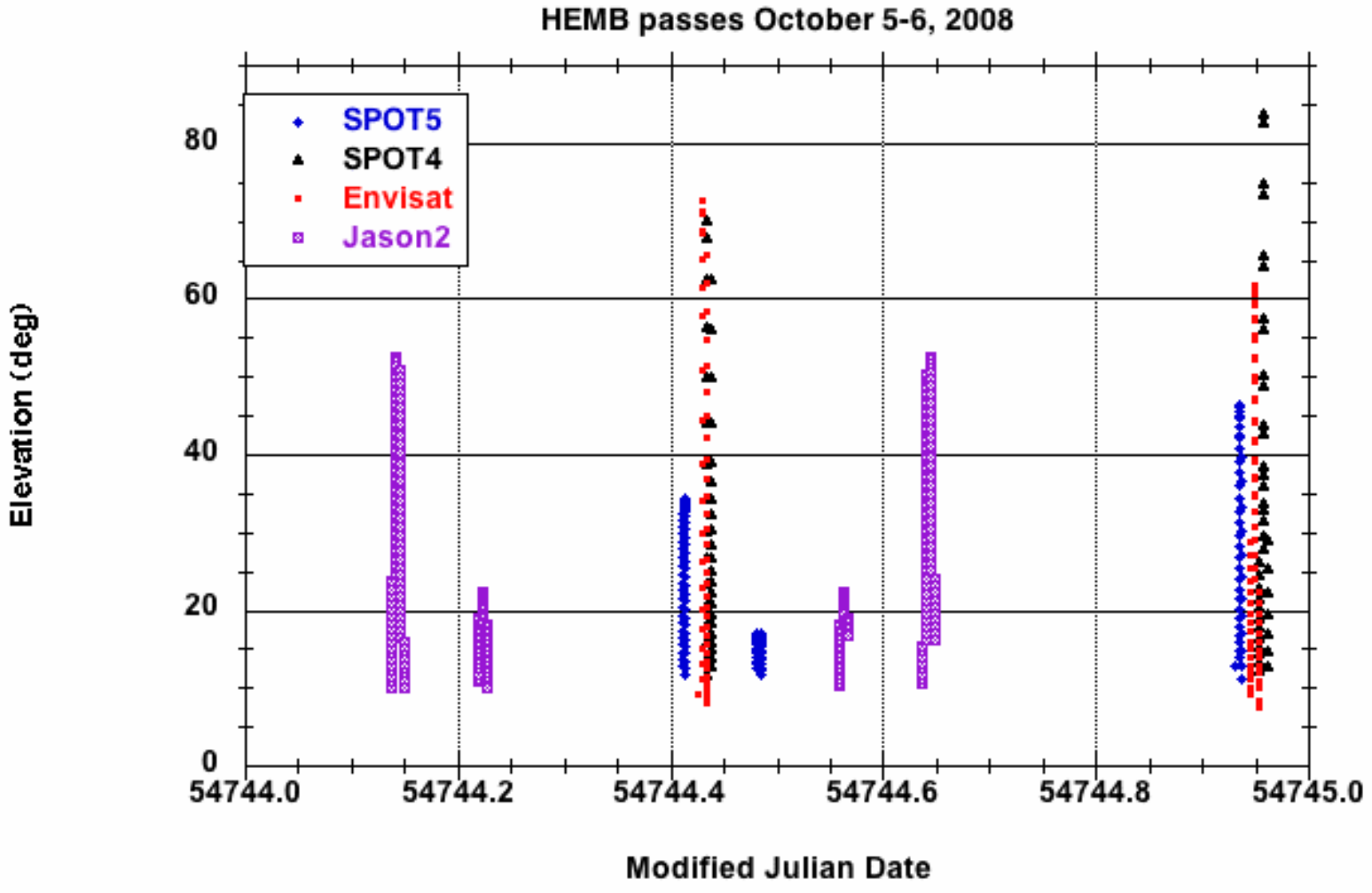
Simple SPOT5 SAA Test (2)



Future Work

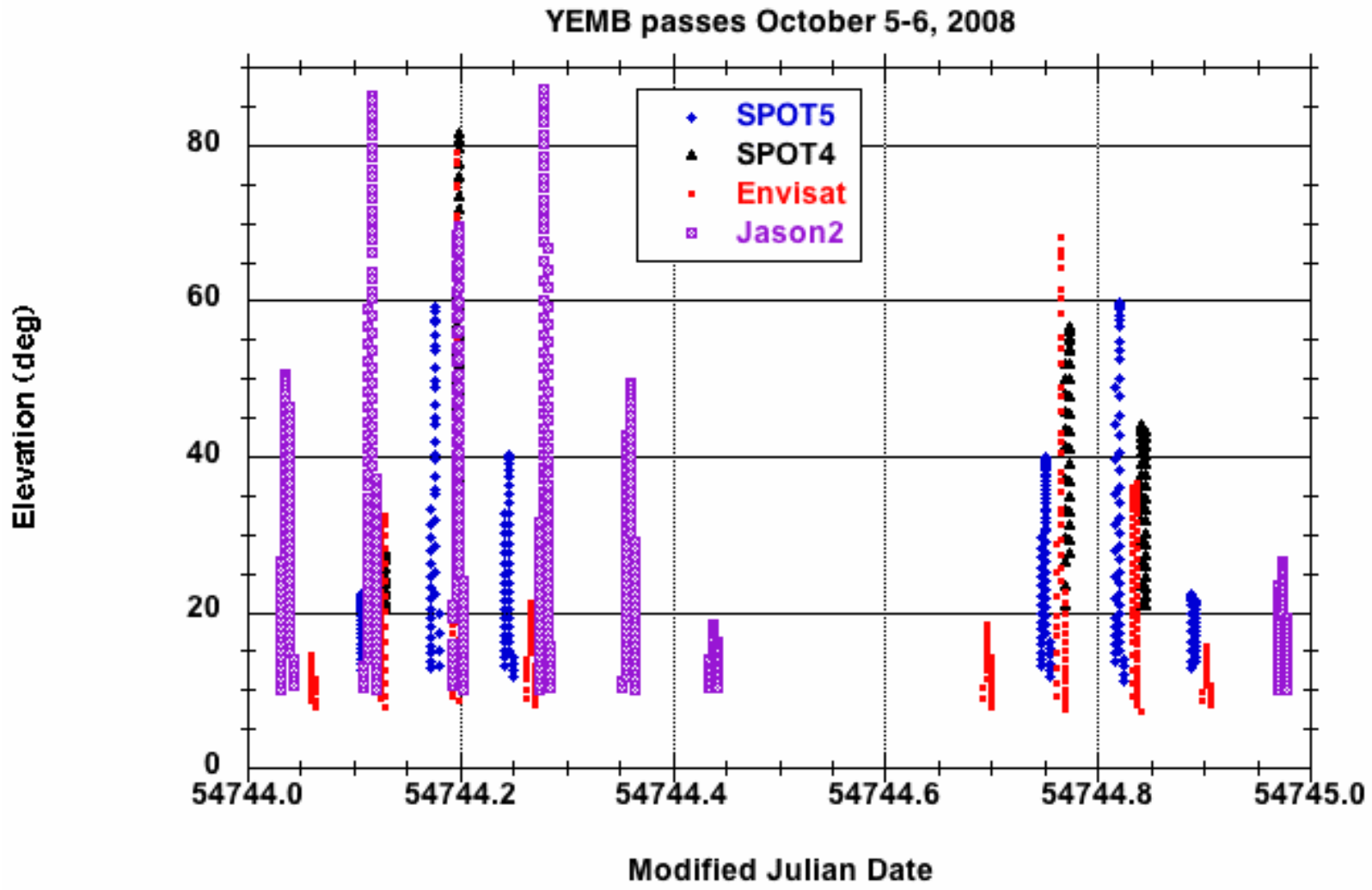
- **Update to ITRF2008 as a priori.**
- Update to GMF Mapping Function (now implemented in GEODYN).
- Retune SPOT4/SPOT5 macromodels (?) after updates; Continue tests with UCL model (Envisat) & optimize model for Jason-2.
- Evaluate new gravity models, esp. for time-variable gravity; Test new Tide models - especially S2 terms; Some may offer improved Oloads in polar regions & coastal areas.
- Apply time-biases (determined from SLR) for TP & Envisat in DORIS processing.
- Test combined troposphere processing per week; Test estimation of tropospheric gradients.
- Long term: Update to new IERS standards; Test Atmospheric loading; Test new atmosphere density model (e.g. JB2006)

Daily pass Distribution, e.g. HEMB

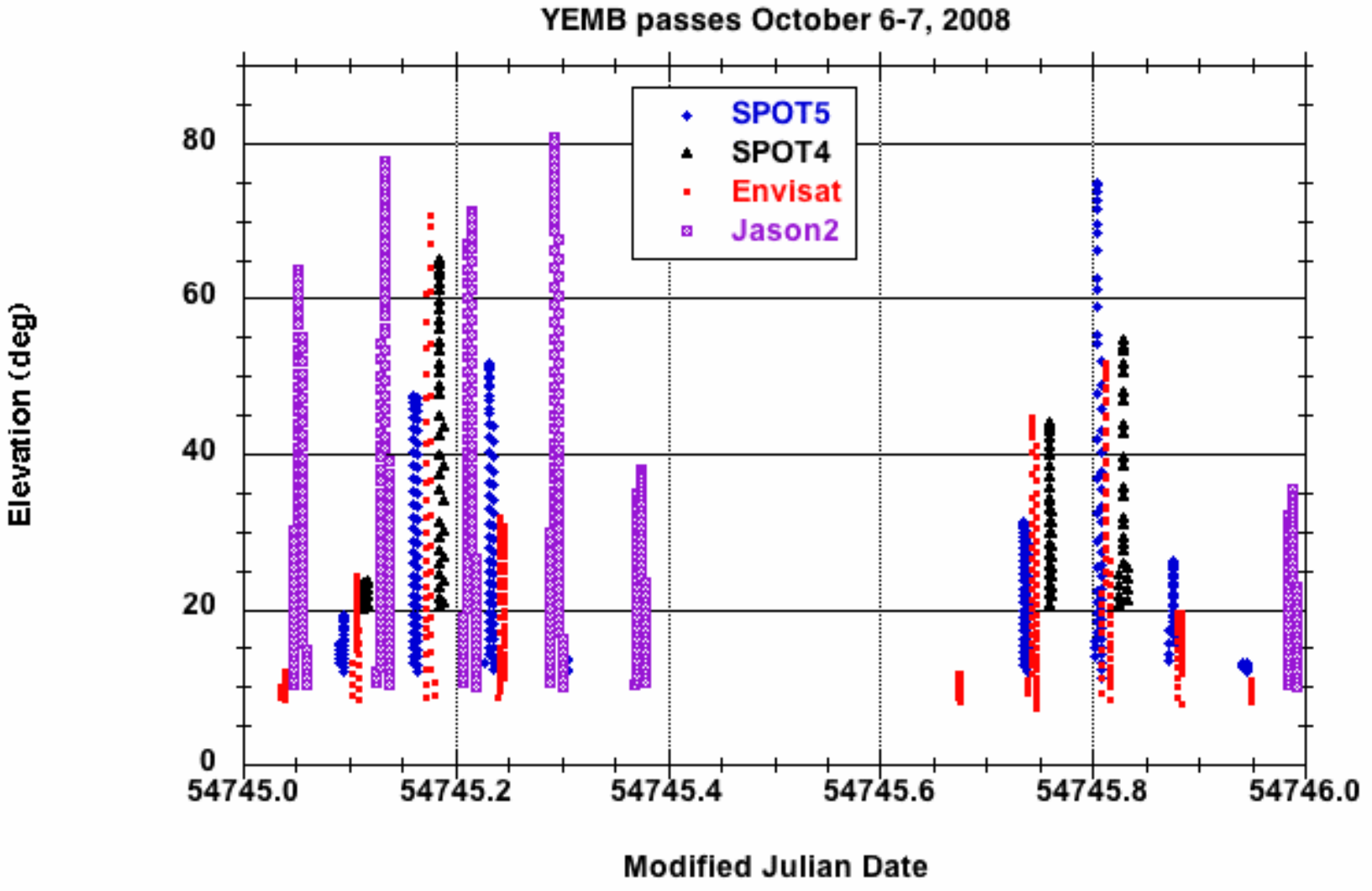


Since SPOT4, SPOT5, Envisat are sun-synchronous at similar node angles … passes are always close together.

Daily pass Distribution, Ex. YEMB



Daily pass Distribution, Another Ex. YEMB



Obrigado

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