

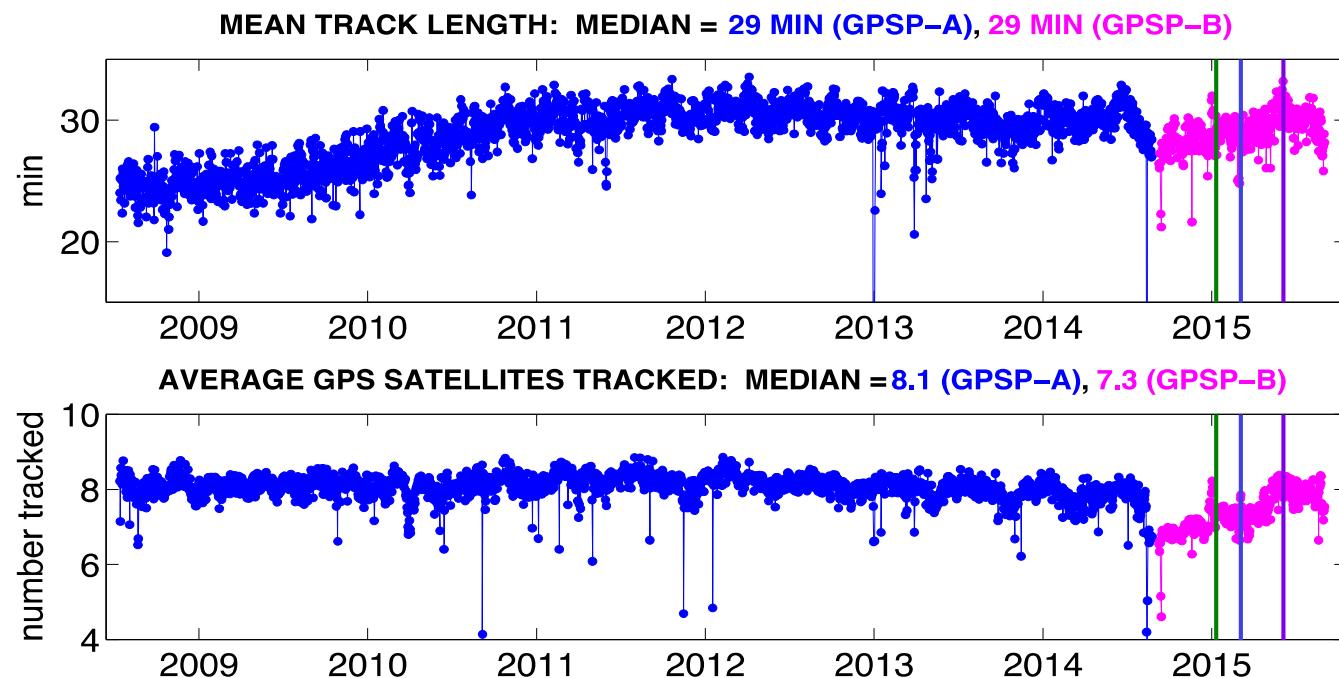


Jason-2 Orbit Determination With GPS, Instrument Status And Reference Frame Sensitivity

Willy Bertiger, Shailen Desai, Angie Dorsey, Bruce Haines, Felix Landerer, Mike Heflin, Aurore Sibois, David Wiese, Dah-Ning Yuan

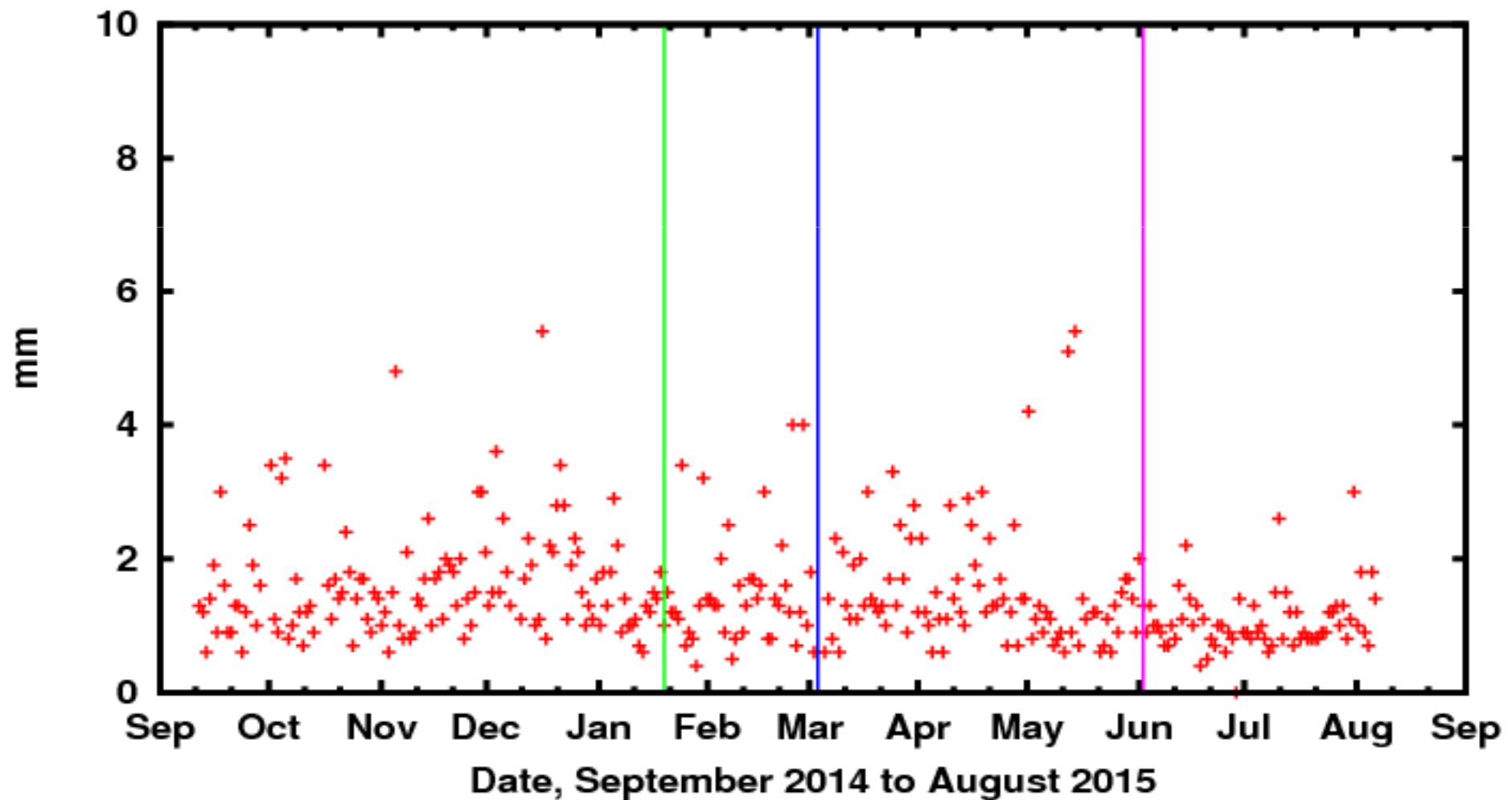
*Jet Propulsion Laboratory, Calif. Inst. of Tech.,
Pasadena CA USA*

- 2015-01-20 Max Sats 8 → 10
- 2015-03-04 Max Sats 10 → 12
- 2015-06-03 90-sec debug removed

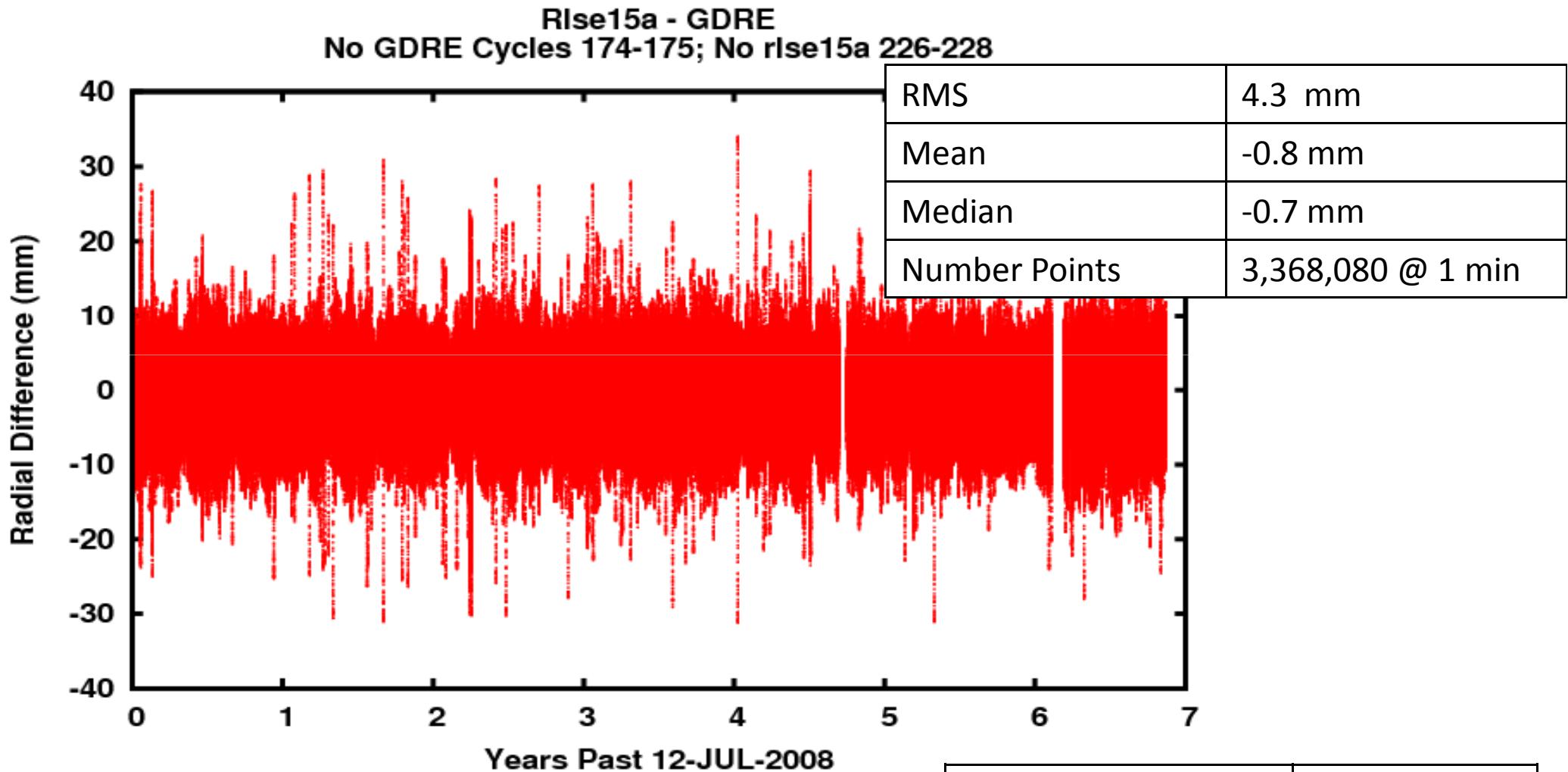


RMS Radial Overlap, Jason-2 Side-B GPS Rec.
2015-01-20 PODMAX 8->10; 2015-03-04 PODMAX 10->12;
2015-06-03 90SecDebugOff

Av. RIse14a: 1.2, PODMAX8: 2.9, PODMAX10: 1.4, PODMAX12: 1.3



- Processing as rlse14a (reduced dynamic, bias fixed)
 - Correct bug in atmospheric gravity (AOD)
- Side-B, initialization, configuration
 - New Antenna Map (residuals are similar to side-A)
 - Overlaps **May – Aug. 2015 1.2 mm, 1.7 mm before May**
 - Side-A overlaps: 1.2 mm
- Delivered through cycle 260
- RMS Radial with GDRE 4.3 mm
- RMS Radial with GSFC Reduced Dynamic SLR/DORIS 5.9 mm

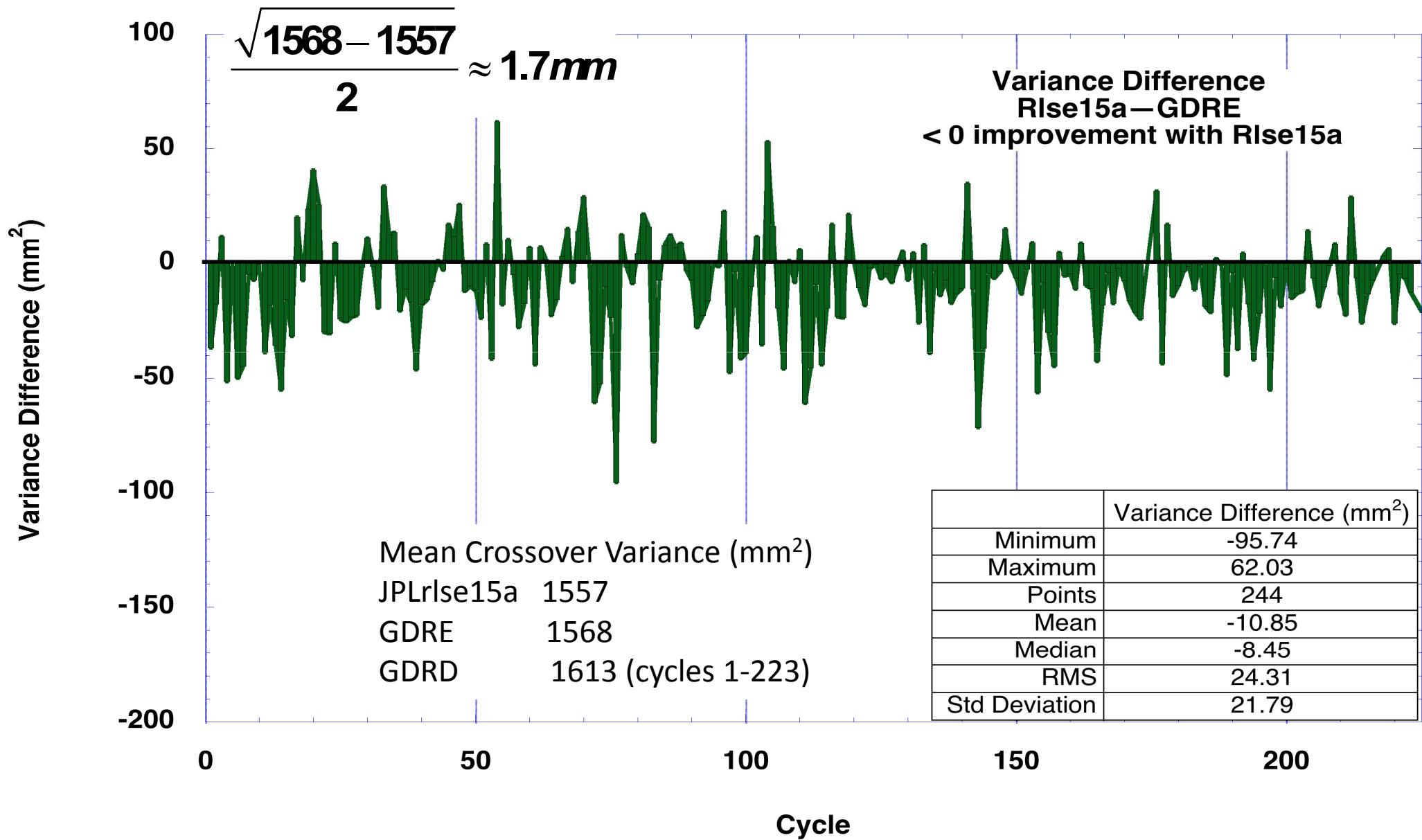


Fitting Linear, Annual:

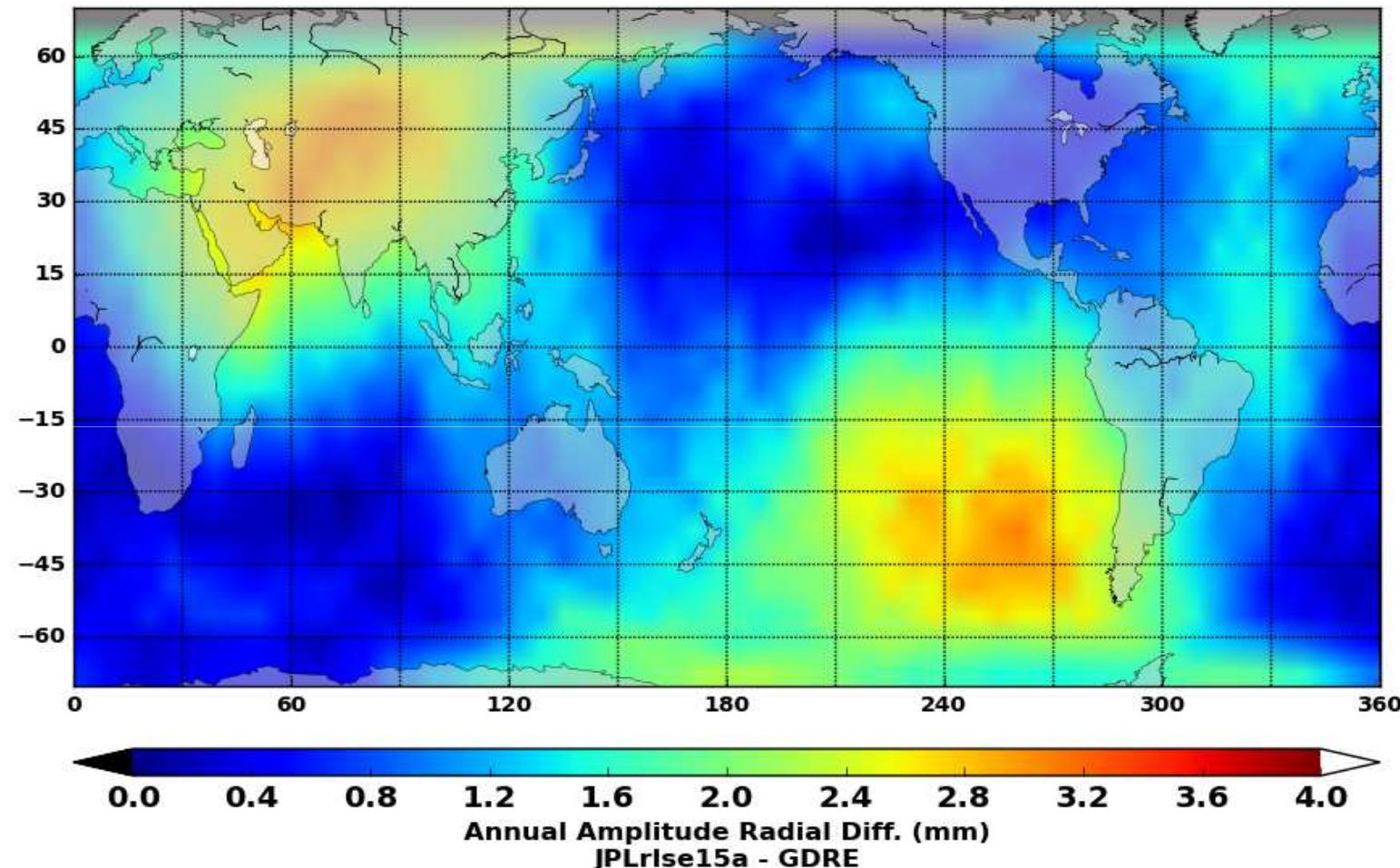
Drift	0.01 mm/yr
Annual Amplitude	0.02 mm

Crossover Variance Tests

Cycles 1-253 Missing 3 cycles, Side-B Starts 229



Radial Difference Annual Amplitude, JPLrlse15a – GDRE, 6°x6° Bin Average

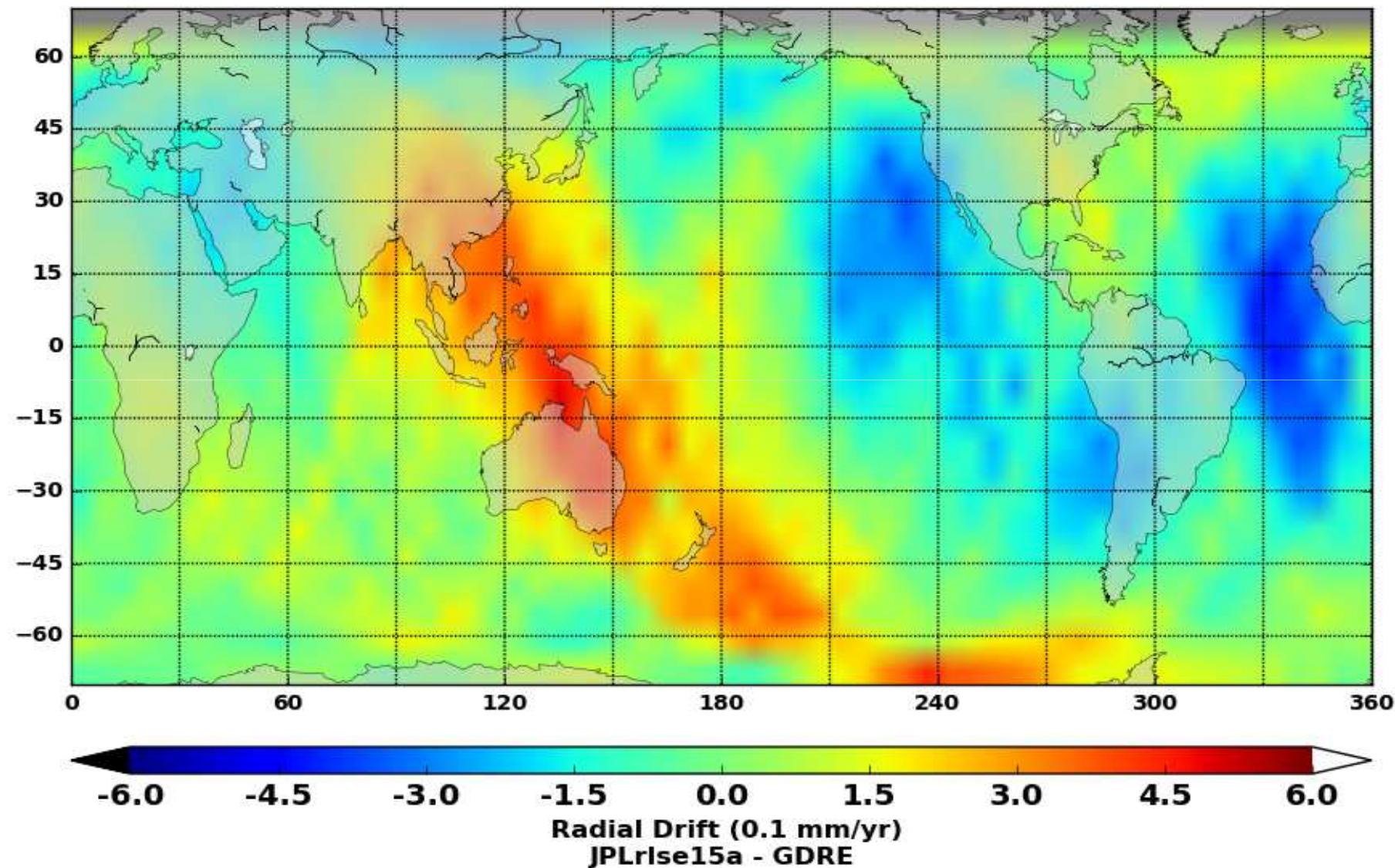


- Differences in Geocenter realization?
 - Bias fixing, DORIS



Radial Difference Drift, JPLrlse15a – GDRE

6°x6° Bin Average



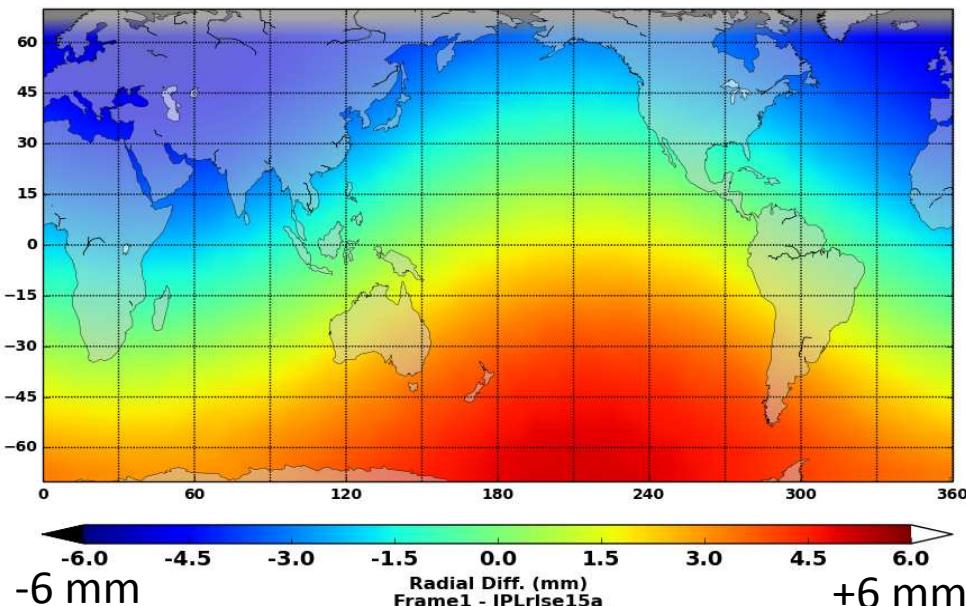
- Use ITRF2014 SINEX (station positions, covariance) with JPL ITRF Analysis Center software, produce candidate frames
- Re-process 2008-2014 FLINN (IGS GPS Contribution)
- Re-process Jason2 Cycles 1-225, July 2008 to Aug. 2014
- Orbit transfer functions are complex
 - GPS dynamics, GPS realization of the frame, Jason-2 dynamics, gravity field, bias fixing...

- Frame1, **traditional** – fit linear with breaks to VLBI, SLR, DORIS, GPS using technique combination center files
 - GPS,DORIS adjusted at combination center for geocenter
 - SLR no adjustment for annual geocenter, but weighted heavily to follow geocenter linear
- Frame4 – Use individual analysis center contributions (GPS/JPL, DORIS/IGN, SLR/ASI, VLBI/GSFC) no-net rotation solutions
 - Adjust **Geocenter** in SLR, GPS, DORIS series, de-weighting GPS for Z
- Frame1-Frame4 (14 Parameter of 485 Sites, 20 years)
 - Txyz,Scale,Rotxyz (mm): -0.4, -1.0, -0.3, 0.0, -0.1, 0.3 -0.1
 - Rates < 0.1 mm/yr

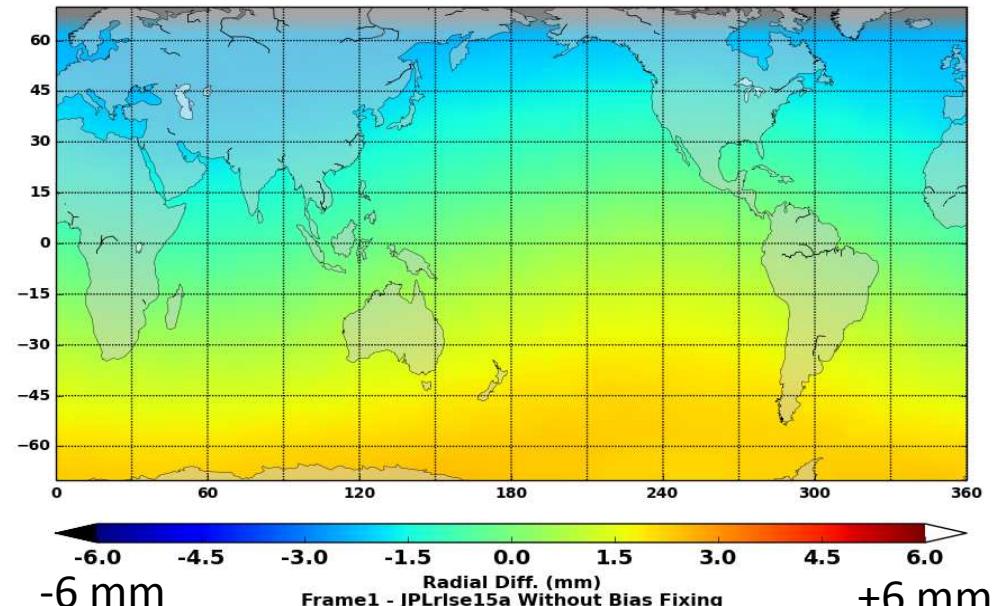
- 14 Parameter transformation(from frame station coordinates), T_{xyz} ; RateXYZ = -0.6, 0.6, 1.6 mm, -0.20, -0.03, 0.37 mm/yr (Epoch: 2008-07-12), scale ~2 mm at surface
- GPS orbit mean difference X,Y,Z: -0.7, -0.6, -1.8
- Looking at radial differences in Jason-2 averaged in $6^\circ \times 6^\circ$ lat/lon bins and then fit, Bias + Drift + Annual:

	Min/Max Bias Fixed; Bias Float
Bias (mm)	-5.0/5.1 -2.4/2.5
Drift (mm/yr)	-0.2/0.2 -0.7/0.8
Annual (mm)	0.1/2.9 0.0/1.8

Frame1 – JPLrlse15a



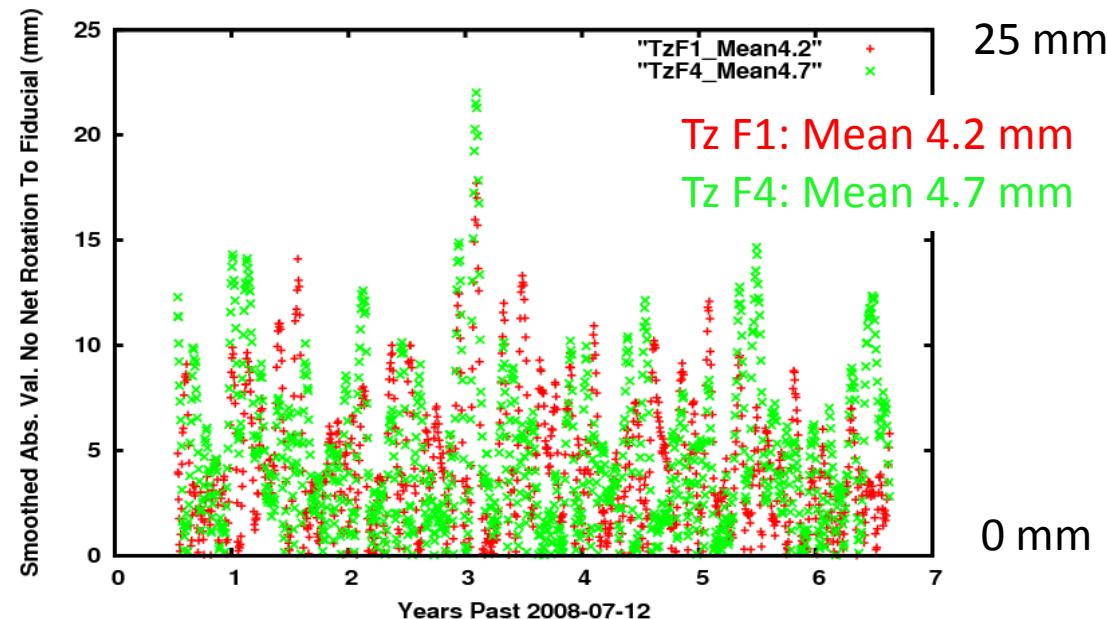
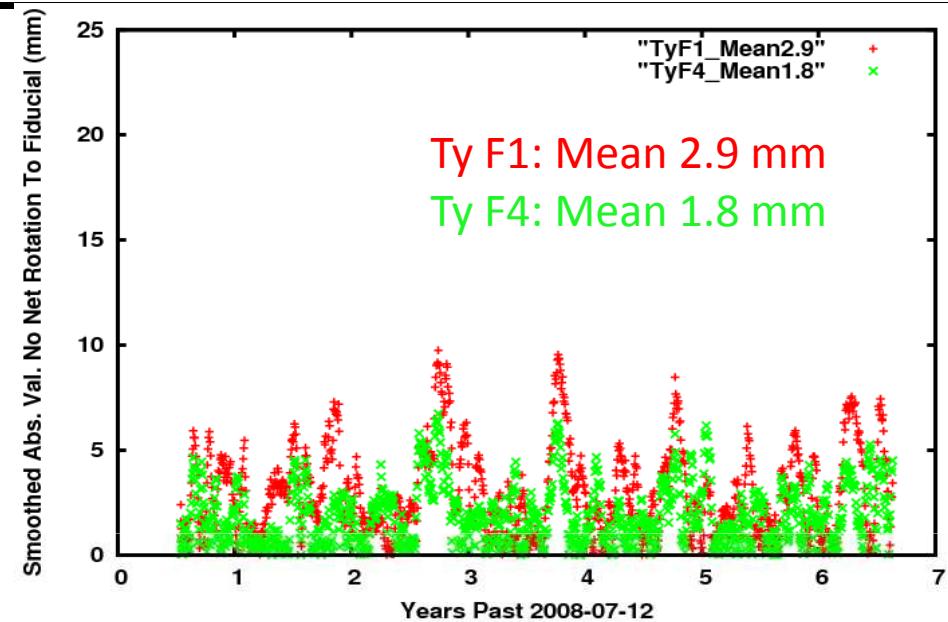
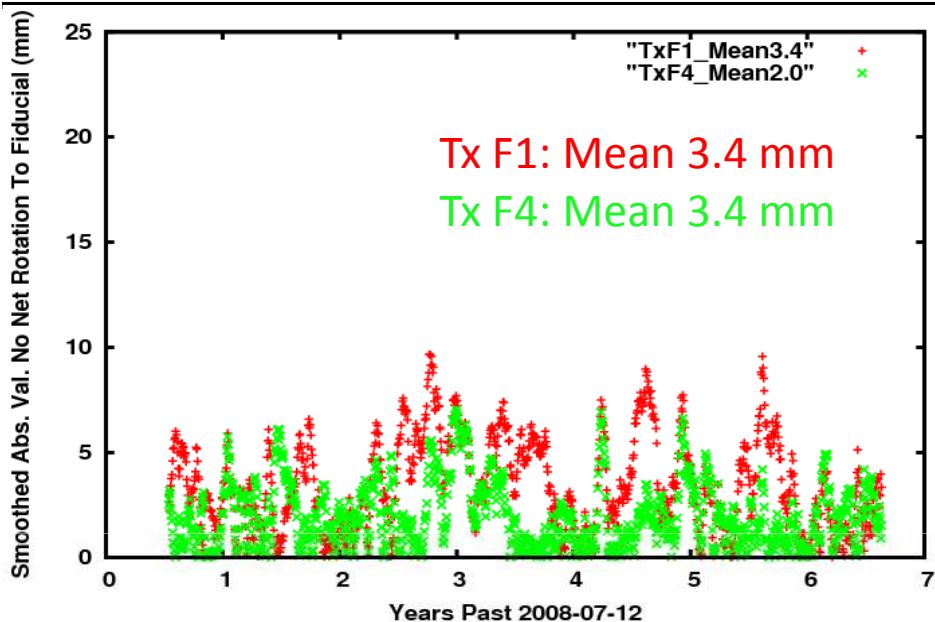
Without Bias Fixing





Frame1(traditional), Frame4(Geocenter Adjusted With Frame)

Absolute Value No Net Rotation To Fiducial Transformations, 10-day
Moving Average

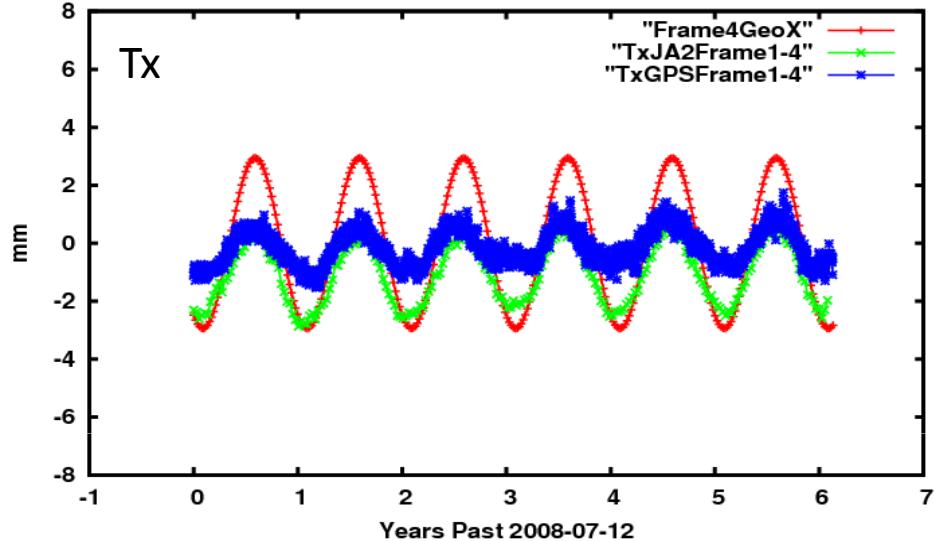




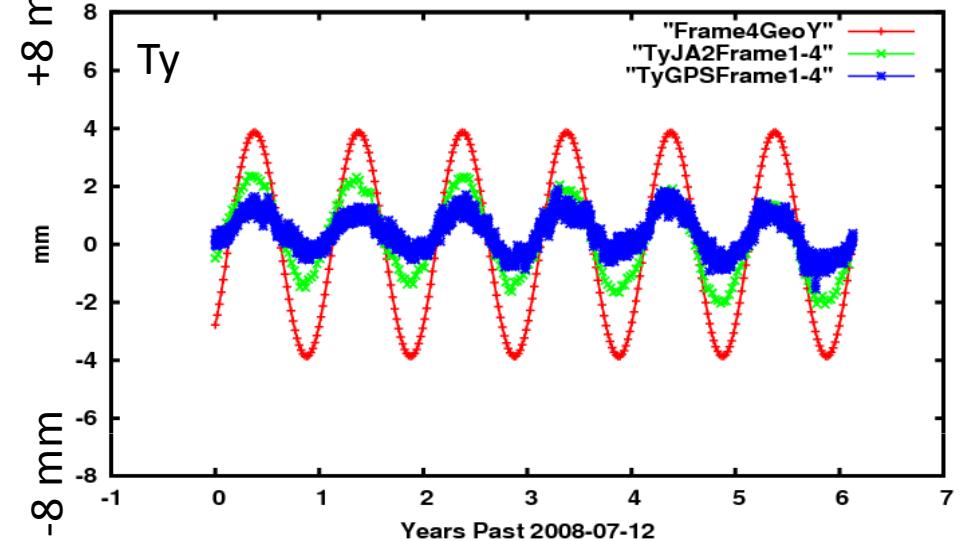
Frame1(traditional) – Frame4(**Geocenter Adjusted With Frame**)
Jason2 6Parameter Fit Per Cycle, GPS 7Parameter Daily



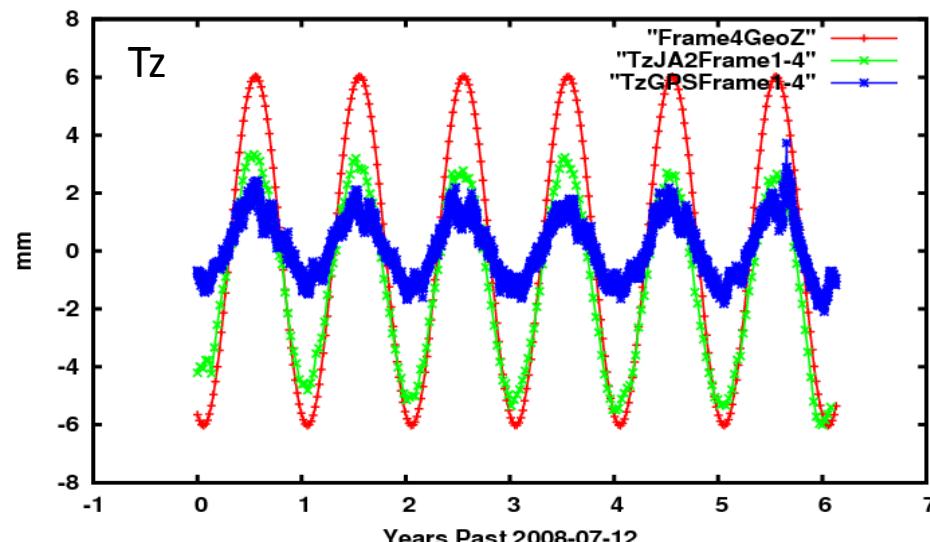
Frame4 GeoCntr Mdl, Jason2 Cycle Orbit Trans., GPS Daily Orbit Trans.
Tx



Frame4 GeoCntr Mdl, Jason2 Cycle Orbit Trans., GPS Daily Orbit Trans.
Ty



Frame4 GeoCntr Mdl, Jason2 Cycle Orbit Trans., GPS Daily Orbit Trans.
Tz



Frame4 Geocenter
Amplitudes XYZ(mm):
2.94 3.87 6.03



Jason2 Quality Metrics

Frame4(Geocenter) – Frame1(traditional)



- Differences in RMS residual fits, < 0 => Frame4 improvement
 - RMS Range residuals ~230 mm; Phase ~3.4 mm
 - PC Mean RMS Difference: 0.05 mm
Pos/Neg/Zero: 1098/995/98
 - LC Mean RMS Difference: -0.01 mm
Pos/Neg/Zero: 548/920/731
- Differences RMS Radial Orbit Overlaps, < 0 => Frame4 improvement
 - RMS Radial ~1.1 mm
 - Mean: 0.0 mm
Pos/Neg/Zero: 699/771/665
- Crossover Variance per Cycle are nearly indistinguishable
 - Mean Variance JPLrlse15a, F1, F4: 1549.86 1549.68 1549.48 mm²
- Maybe slight case for Frame4

- GPS receiver A to B switch is performing well after initial setup recovery
- Close radial agreement between GDRE and JPLrlse15a
 - RMS Radial Difference: 4.3 mm, Drift: 0.01 mm/yr
 - Geographically correlated annual amplitudes peak in S. Pacific at 3 mm
- Frames
 - Some argument we should account for the Geocenter in the frame
 - Bookkeep geocenter in frame and all measurement systems

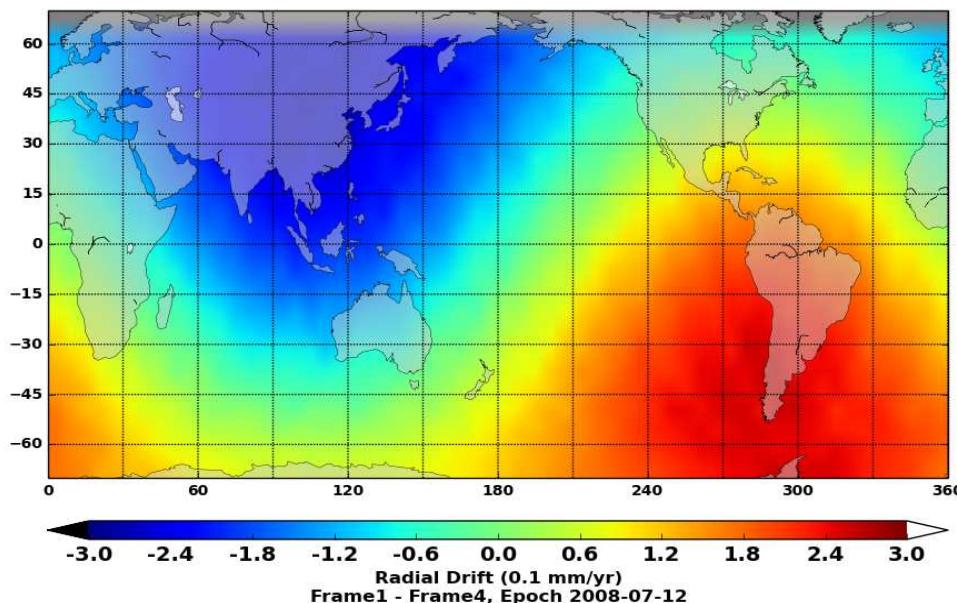
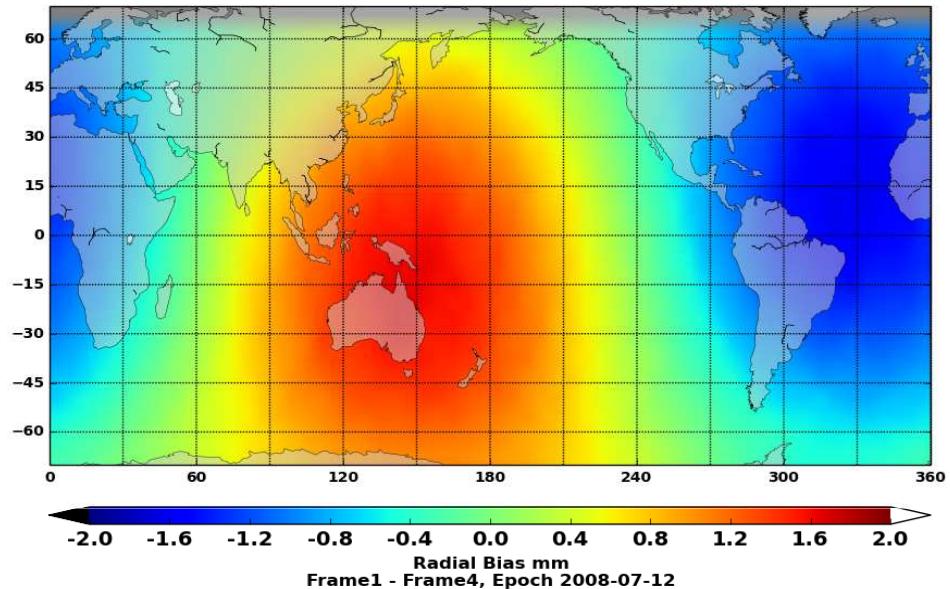
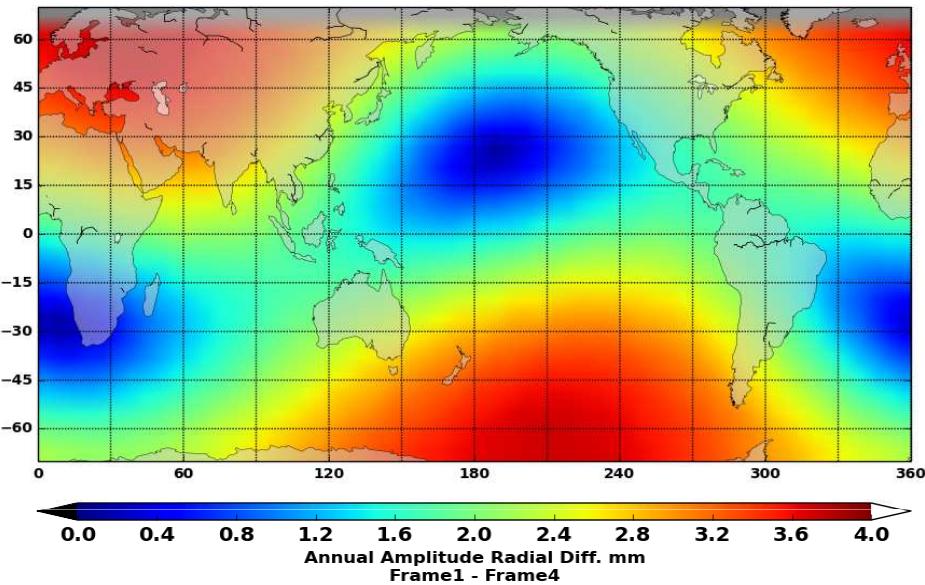


Back Ups



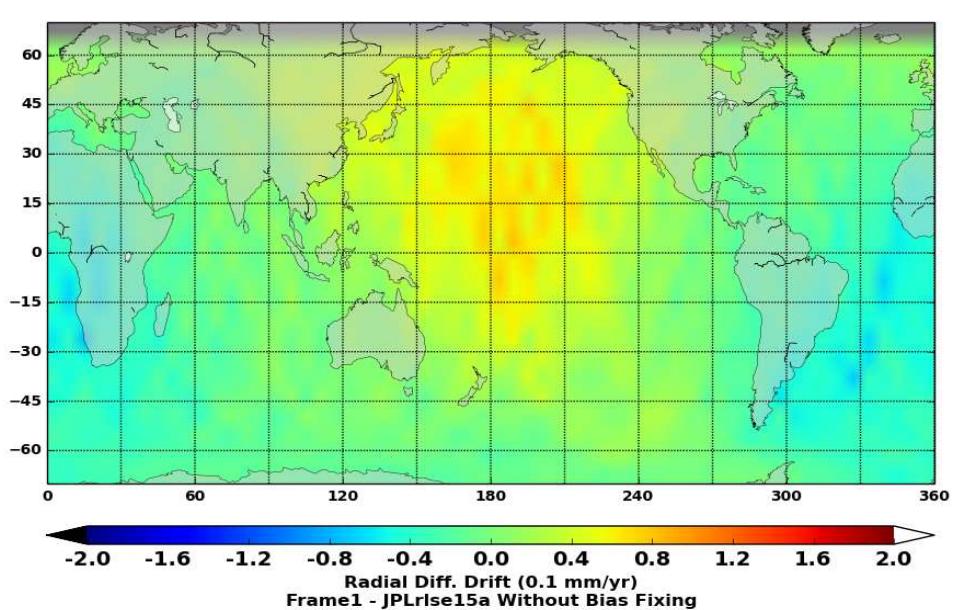
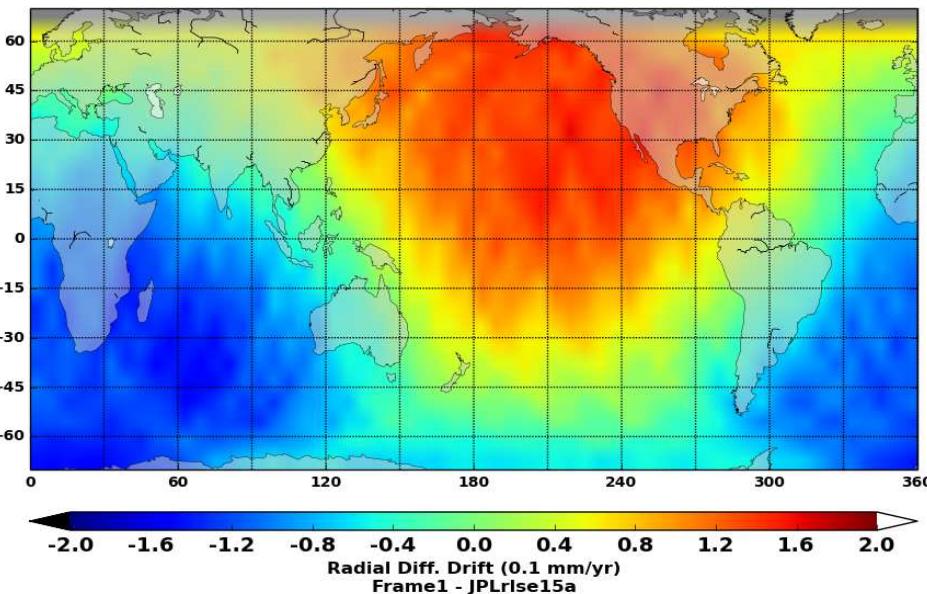
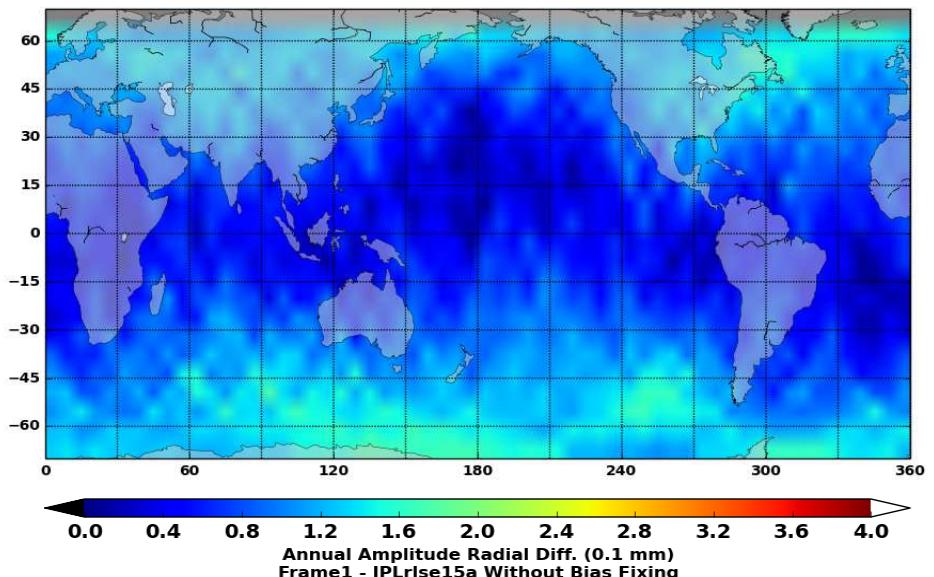
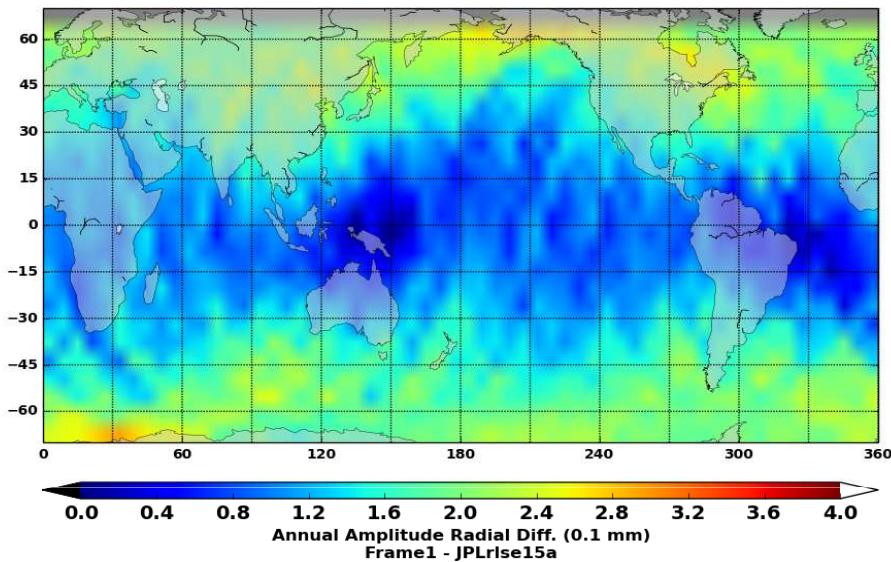


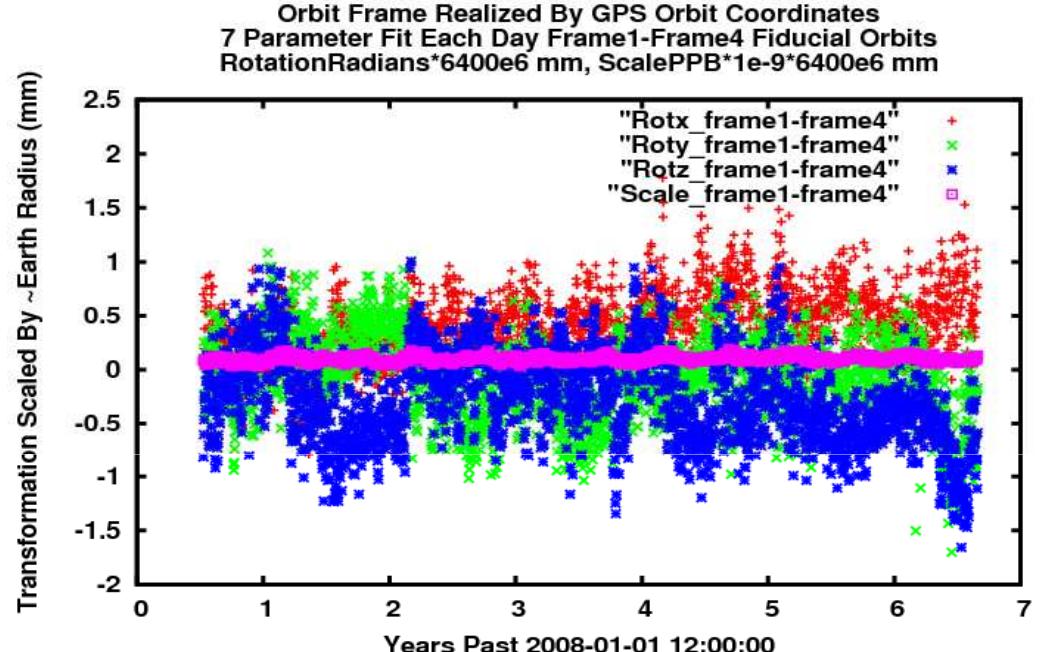
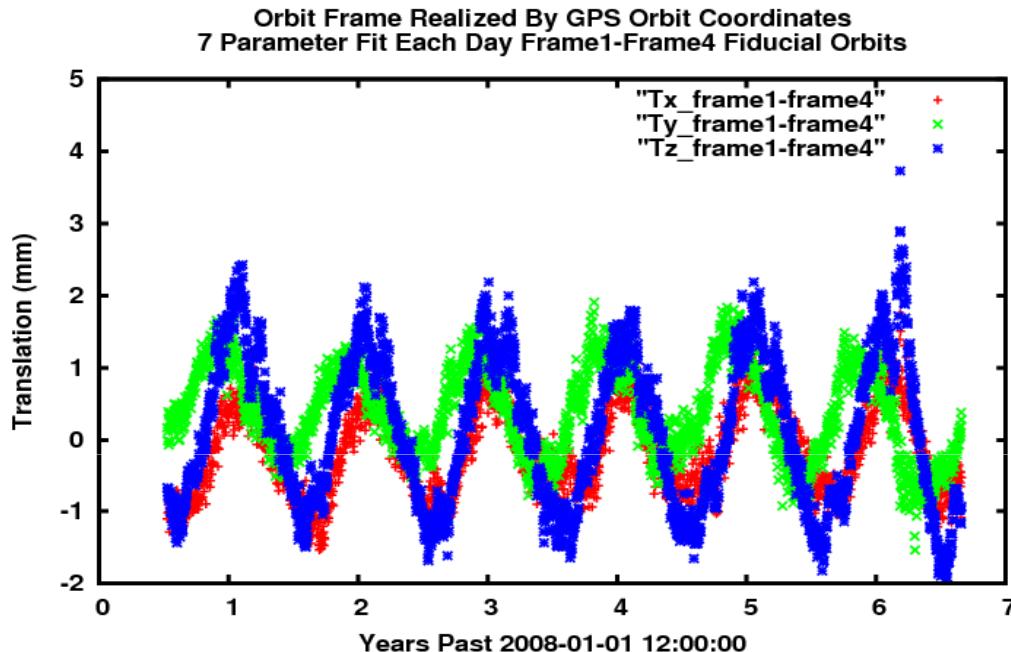
Jason-2 Radial Orbit Differences, Frame1 –Frame4 6°x6° Bin Averages



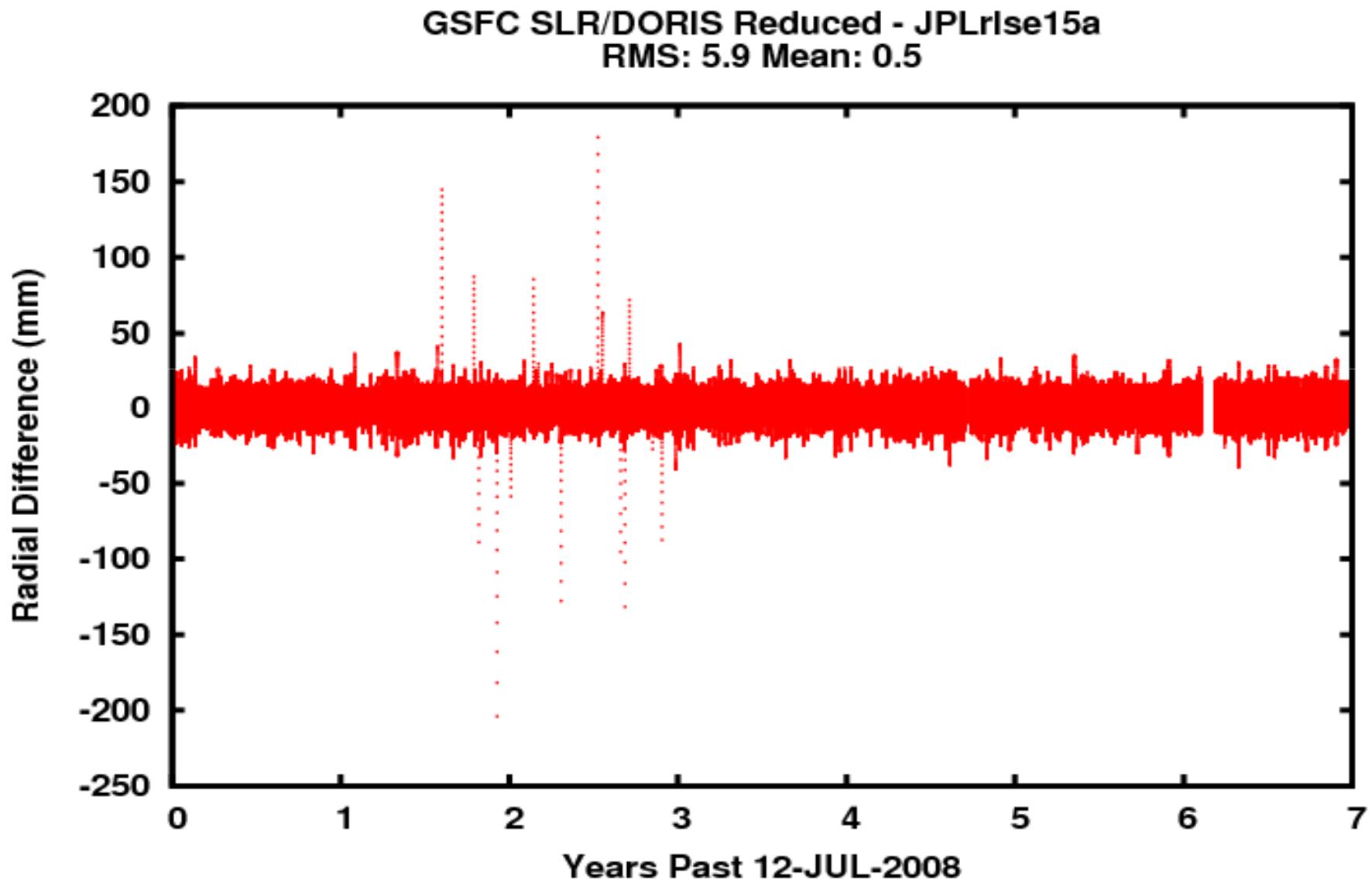


Frame1 – JPLrlse15a(IGB08/ITRF08) Bias Fixing Ties Tighter To The Crust





Frame4 Geocenter Amplitudes XYZ(mm): 2.94 3.87 6.03
 Frame1-Frame4 Stations Shift(mm): -2.4 0.6 -2.1





Frame Definition Transform



Transformation parameters from ITRF2008 to GIPSY frame1 on January 1, 2005:

	TX	TY	TZ	S	RX	RY	RZ
OFFSET	0.069	0.696	0.306	2.163	0.128	0.082	0.110 mm
OFFSET SIGMA	0.130	0.126	0.194	0.234	0.067	0.067	0.068 mm
RATE	-0.195	-0.027	0.368	-0.082	0.019	0.047	-0.031 mm/yr
RATE SIGMA	0.018	0.017	0.029	0.048	0.008	0.007	0.008 mm/yr

Transformation parameters from ITRF2008 to GIPSY frame4 on January 1, 2005:

	TX	TY	TZ	S	RX	RY	RZ
OFFSET	0.440	-0.507	-1.818	1.905	-0.029	0.055	0.024 mm
OFFSET SIGMA	0.134	0.137	0.186	0.212	0.139	0.137	0.126 mm
RATE	-0.205	0.068	0.433	-0.105	0.015	0.006	-0.000 mm/yr
RATE SIGMA	0.016	0.016	0.025	0.040	0.015	0.014	0.014 mm/yr

Here are the transformation parameters from GIPSY frame1 to frame4 on January 1, 2005:

	TX	TY	TZ	S	RX	RY	RZ
OFFSET	-0.444	-0.982	0.254	-0.008	-0.070	0.323	-0.122 mm
OFFSET SIGMA	0.104	0.116	0.204	0.067	0.117	0.116	0.103 mm
RATE	0.054	0.074	-0.119	-0.079	-0.011	-0.040	0.046 mm/yr
RATE SIGMA	0.013	0.014	0.030	0.008	0.012	0.012	0.010 mm/yr

These numbers are based on 485 common DORIS, GPS, SLR, and VLBI sites.