Monitoring Geocenter Motion

The ITRF origin is fixed in the datum definition. In any case, it should be considered as a figure origin related to the crust. In order to obtain a truly geocentric position, following the ITRS definition, one must apply the geocenter motion correction $\Delta\vec{X}_G$

$$\vec{X}_{ITRS} = \vec{X}_{ITRF} + \Delta\vec{X}_G.$$

Noting $O_G(t)$ the geocenter motion in ITRF, (see, Ray *et al.*, 1999), then

$$\Delta\vec{X}_G(t) = -\vec{O}_G(t).$$

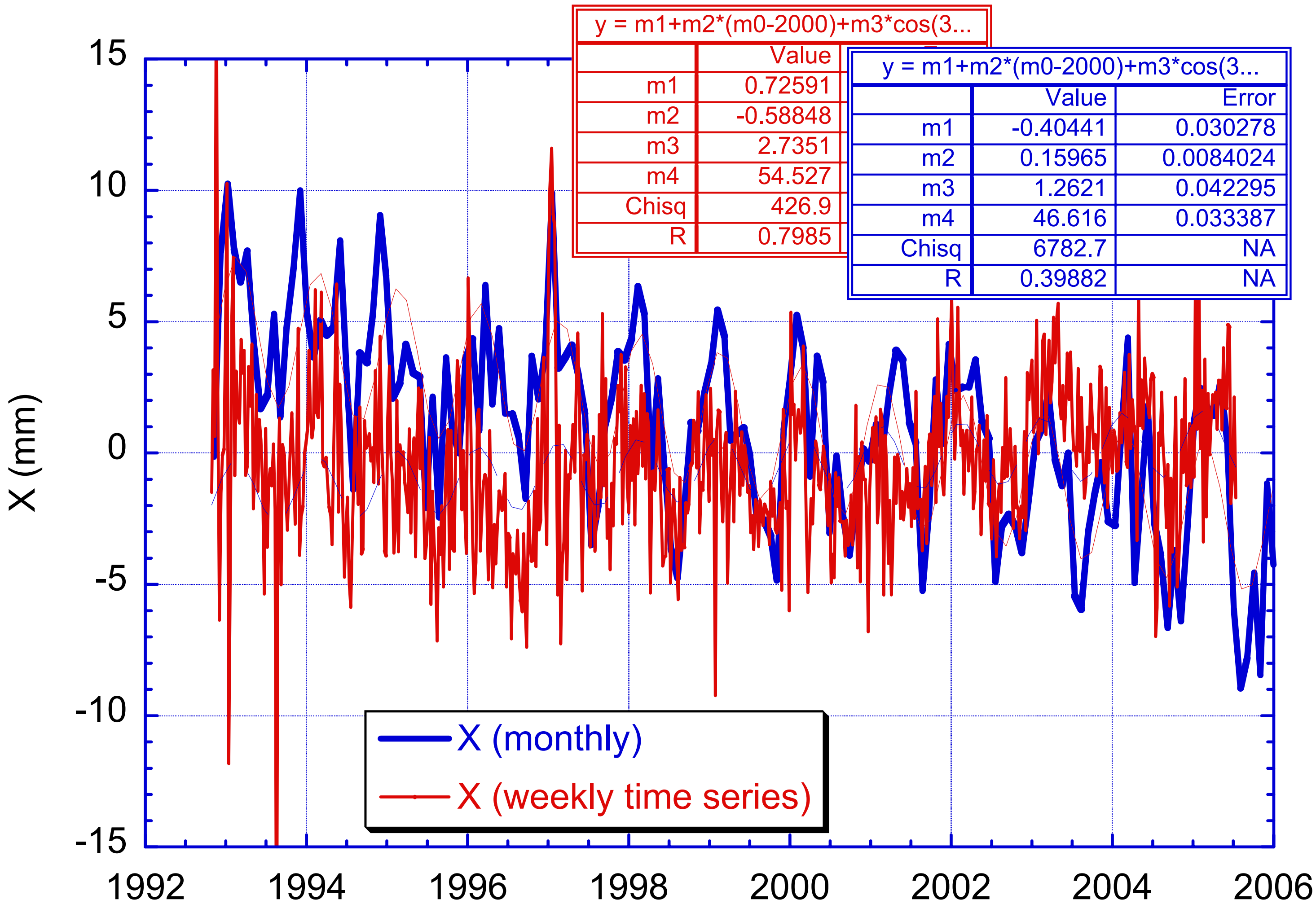
IERS2003 Standards

Techniques for monitoring geocenter motion:

- Time series of coordinate estimates relative to some reference solution
- Holding the TRF fixed, directly estimate geocenter motion (network shift)
- Degree 1 gravity harmonics (requires coriolis terms since origin is not at mass center)
- Degree 1 deformation (requires knowledge of higher degree loading information)

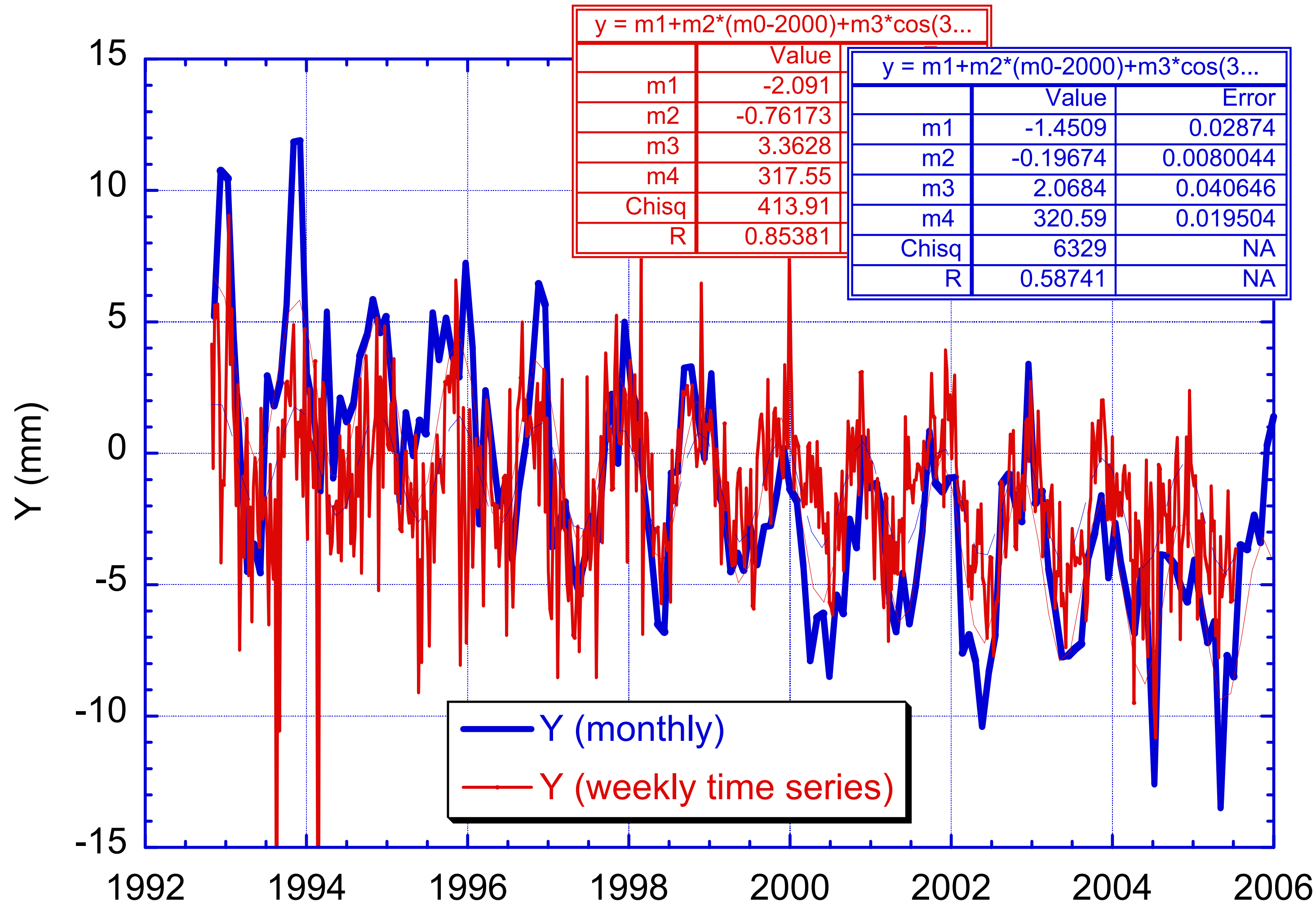
Geocenter Motion from SLR (X)

Monthly network shift vs weekly time series



Geocenter Motion from SLR (Y)

Monthly network shift vs weekly time series



y = m1+m2*(m0-2000)+m3*cos(3...

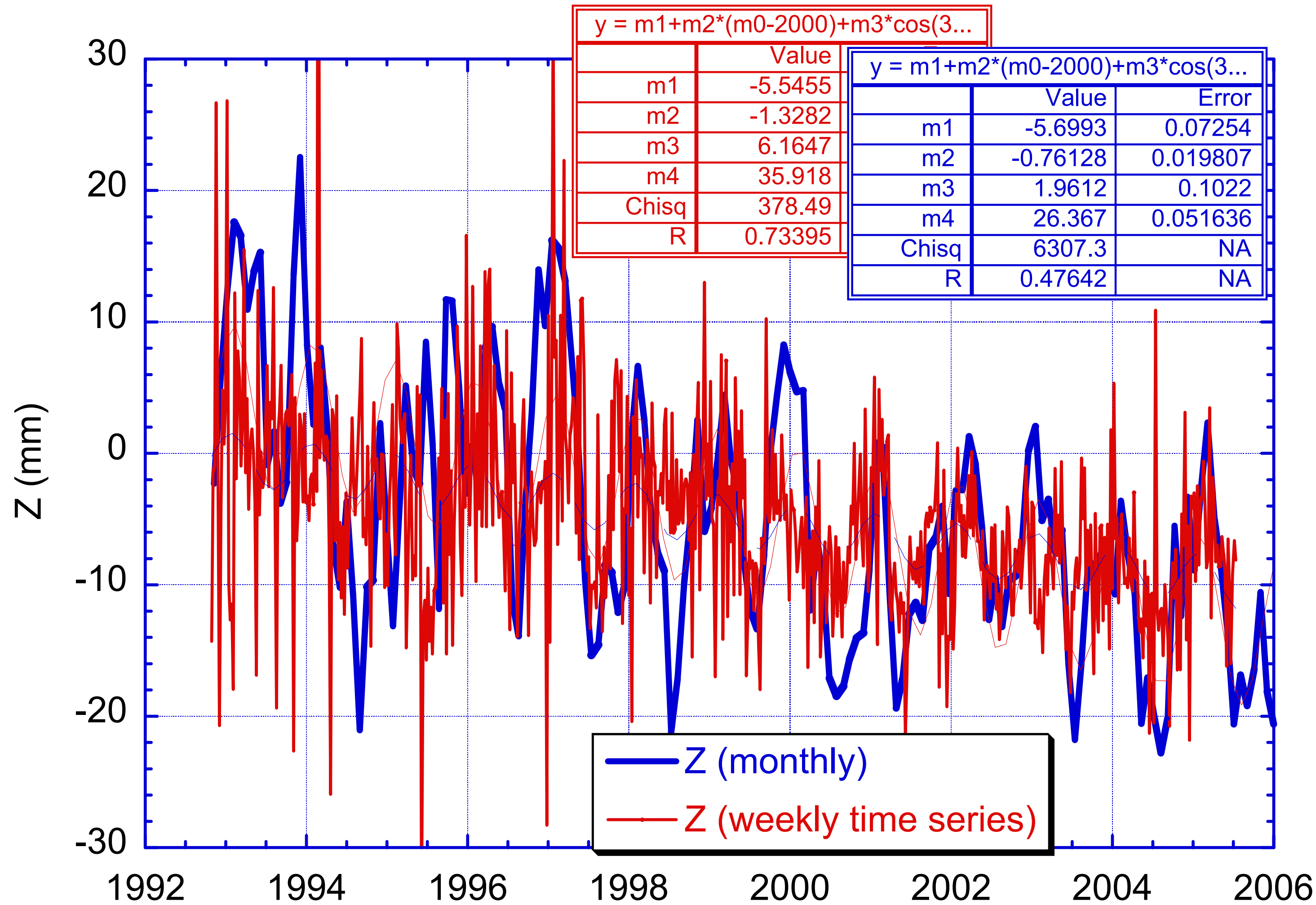
	Value
m1	-2.091
m2	-0.76173
m3	3.3628
m4	317.55
Chisq	413.91
R	0.85381

y = m1+m2*(m0-2000)+m3*cos(3...

	Value	Error
m1	-1.4509	0.02874
m2	-0.19674	0.0080044
m3	2.0684	0.040646
m4	320.59	0.019504
Chisq	6329	NA
R	0.58741	NA

Geocenter Motion from SLR (Z)

Monthly network shift vs weekly time series



Geocenter Motion Survey

Data used	X (amp)	X (phase)	Y (amp)	Y (phase)	Z (amp)	Z (phase)	Reference (comments)
SLR (L1/L2)	2.2	60	3.2	303	2.8	46	Eanes et al., 1997
SLR	2.1	48	2.0	327	3.5	43	Bouille et al., 2000
Topex only (SLR/DORIS)	1.8	41	2.9	320	2.4	37	Eanes, 2000
SLR (L1/L2)	2.6	32	2.5	309	3.3	36	Creteaux et al., 2002
GPS loading + GRACE	1.7	45	2.5	322	3.5	39	Wu, 2005
SLR (L1/L2)	1.3	47	2.1	321	2.0	26	Eanes, 2005 (weekly solutions)
SLR (L1/L2)	2.7	55	3.4	317	6.2	36	Ries, 2006 (monthly)
Mean (mm)	2.1	47	2.7	317	3.4	38	
Stdev (mm)	0.5	9	0.5	8	1.4	6	

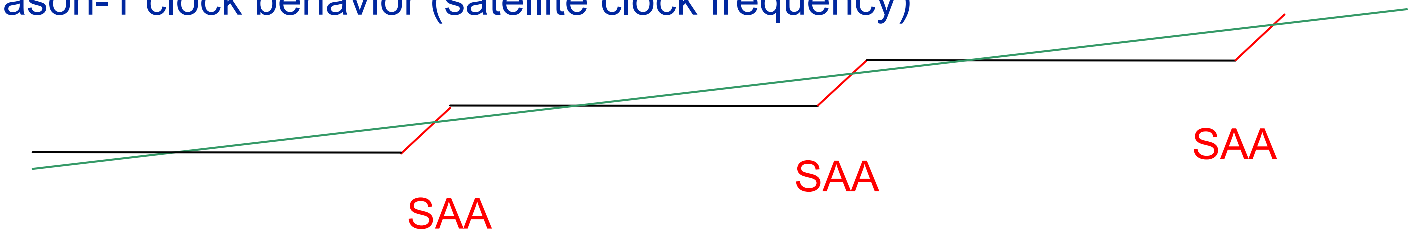
Convention: amp $\cos(\omega t - \text{phase})$

Questions

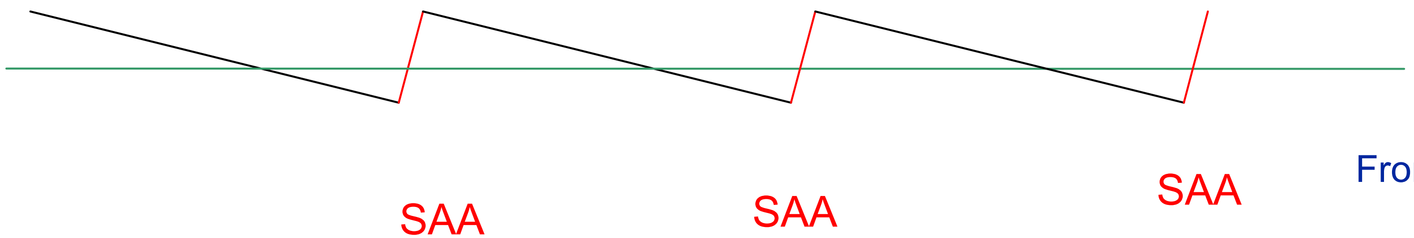
- Are geocenter time series based on weekly estimates too noisy?
- Are the larger rates in the monthly estimates, where ITRF2000 is held fixed in ‘network shift method, an artifact of velocity errors in the TRF?

Indirect Effect of SAA on 'non-SAA' Data

Actual Jason-1 clock behavior (satellite clock frequency)



Jason-1 satellite clock in DORIS data (after removal of a long-term polynomial by CNES)



From P. Willis

When the SAA effect was smaller, the impact on 'non-SAA' data was negligible

As SAA effect increases, however, the induced slope on 'non-SAA' data becomes a problem

Can problem for non-SAA stations be addressed with a global bias-drift parameter?
(effect is not station dependent, it is common to all non-SAA stations through clock model)

Effect of Editing and Global Drift

units are cm

Cycle 63 Tight Editing Only
(RMS = 0.36 mm/s)

station	# pass	east	std	north	std	ht	std
CHAB	45	4	1	-1	1	2	1
CICB	23	1	1	4	2	2	1
COLA	25	4	2	1	2	5	1
DJIB	19	3	2	7	3	8	2
EVEB	9	2	2	3	3	6	1
FAIB	58	1	1	0	1	4	1
FUTB	26	1	1	-3	2	6	1
GREB	28	0	1	0	2	8	1
KESB	27	7	2	-7	2	6	2
KIUB	32	-3	2	0	1	5	1
KOLB	27	2	2	13	2	5	1
KRAB	58	4	1	0	1	3	1
MAHB	13	7	1	4	2	3	3
MARB	48	0	1	-6	1	8	1
METB	6	12	2	-2	4	9	2
PAQB	23	-2	1	-10	2	3	1
PDMB	12	-4	2	-6	3	4	3
RAQB	26	0	1	-8	2	4	1
REUB	20	3	2	1	3	3	2
REYB	3	8	6	-8	3	-1	4
RIDA	21	-8	2	-4	2	9	3
RIPB	45	-6	1	-7	1	10	1
ROTA	34	0	1	3	1	6	1
SODB	21	-1	3	14	1	12	2
SPJB	12	14	2	-7	4	7	1
SYPB	45	-1	1	5	1	9	1
THUB	20	2	2	-5	1	3	1
TLHA	15	-7	3	-1	3	5	2
TRIB	12	0	2	-4	2	9	2
YARB	34	4	1	-1	2	1	1
YELB	56	2	1	-2	1	6	1
Average		2		-1		5	

Cycle 63 Tight Editing and Global Drift
(RMS=0.35 mm/s)

station	# pass	east	std	north	std	ht	std
CHAB	45	4	1	2	1	-3	1
CICB	23	0	1	3	1	-3	1
COLA	25	2	1	2	2	0	1
DJIB	23	-2	2	10	3	4	2
EVEB	10	3	1	2	2	2	1
FAIB	58	0	1	2	1	-2	1
FUTB	26	0	1	-3	2	0	1
GREB	27	0	1	-3	2	3	1
KESB	27	2	2	-5	2	2	1
KIUB	33	-1	1	1	1	0	1
KOLB	27	2	2	11	1	0	1
KRAB	58	1	1	-2	1	-2	1
MAHB	12	5	2	2	3	0	3
MARB	49	-1	1	-3	1	3	1
METB	6	3	2	-2	4	3	2
PAQB	23	-2	1	-10	2	-3	1
PDMB	12	-1	2	-6	3	-1	2
RAQB	26	-1	1	-6	2	-1	1
REUB	22	-1	1	-3	3	0	2
REYB	2	10	5	-3	4	-4	3
RIDA	22	-6	2	-6	2	5	3
RIPB	45	-6	1	-4	1	4	1
ROTA	36	-1	1	2	1	1	1
SODB	22	-4	2	13	1	8	2
SPJB	13	6	2	-3	4	3	2
SYPB	48	-3	1	2	1	4	1
THUB	20	-3	2	1	2	-1	1
TLHA	14	-6	3	0	3	0	2
TRIB	12	-4	2	-2	2	4	2
YARB	32	3	1	-1	1	-4	1
YELB	56	2	1	-1	1	0	1
Average		0		0		1	

Bias in all 3 components has been reduced or removed through a single extra parameter

Note: bias-drift parameter CANNOT be used if data affected by SAA are not edited

Impact of SAA on POD

- In some cases, treating DORIS data 'as usual' leads to a measurable degradation in the orbit quality
  - Strong editing of affected stations sometimes (but not always) improves orbits but considerable data is lost
  - Adding a global bias-drift parameters (combined with strong editing) sometimes helps POD but effect is felt much more for station positioning
  - Will require continued monitoring and investigation of mitigation strategies

CASE (Cycles 62, 63)	SLR RMS (mm)	DORIS RMS (mm/s)	CX RMS (mm)	Z-shift (mm)	Radial RMS diff (mm)
Normal edit, no bias-drift	16.2 18.2	0.442 (84243 obs) 0.448 (85434 obs)	61.6 55.7	-2 <1	3 <1
Strong edit, no bias-drift	15.9 18.0	0.354 (60575 obs) 0.359 (62452 obs)	61.4 55.7	<1 -2	1 2
Strong edit, global bias-drift	15.8 18.0	0.345 (60575 obs) 0.351 (62452 obs)	58.8 55.7	-	-