POD Calibration and Validation of the Precise Orbits for OSTM and Extending the TOPEX, Jason-1, and Jason-2 Climate Data Record

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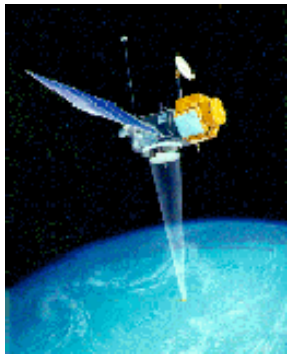
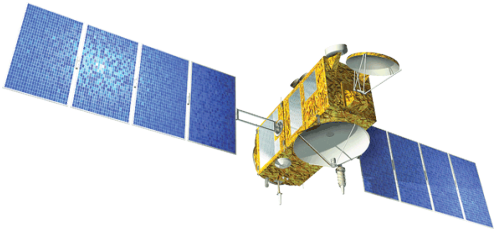


OSTST 2010 POD Splinter
Lisbon, Portugal
October 18-20, 2010



Meeting the OCEANOBS 2009 altimetry accuracy goal of 0.3 mm/yr in global mean sea level accuracy

Orbit accuracy goals from OCEANOBS 2009 Plenary Paper (Cazenave et al., 2009) :

1) **Radial orbit accuracy to 1-cm or better**
2) **Mean radial drift over water 0.05 mm/y to 0.1 mm/y which is primarily due to the TRF *.**
3) **Other errors assumed sufficiently random and will not cause any appreciable sub-mm/y drift in orbit when averaged over time**

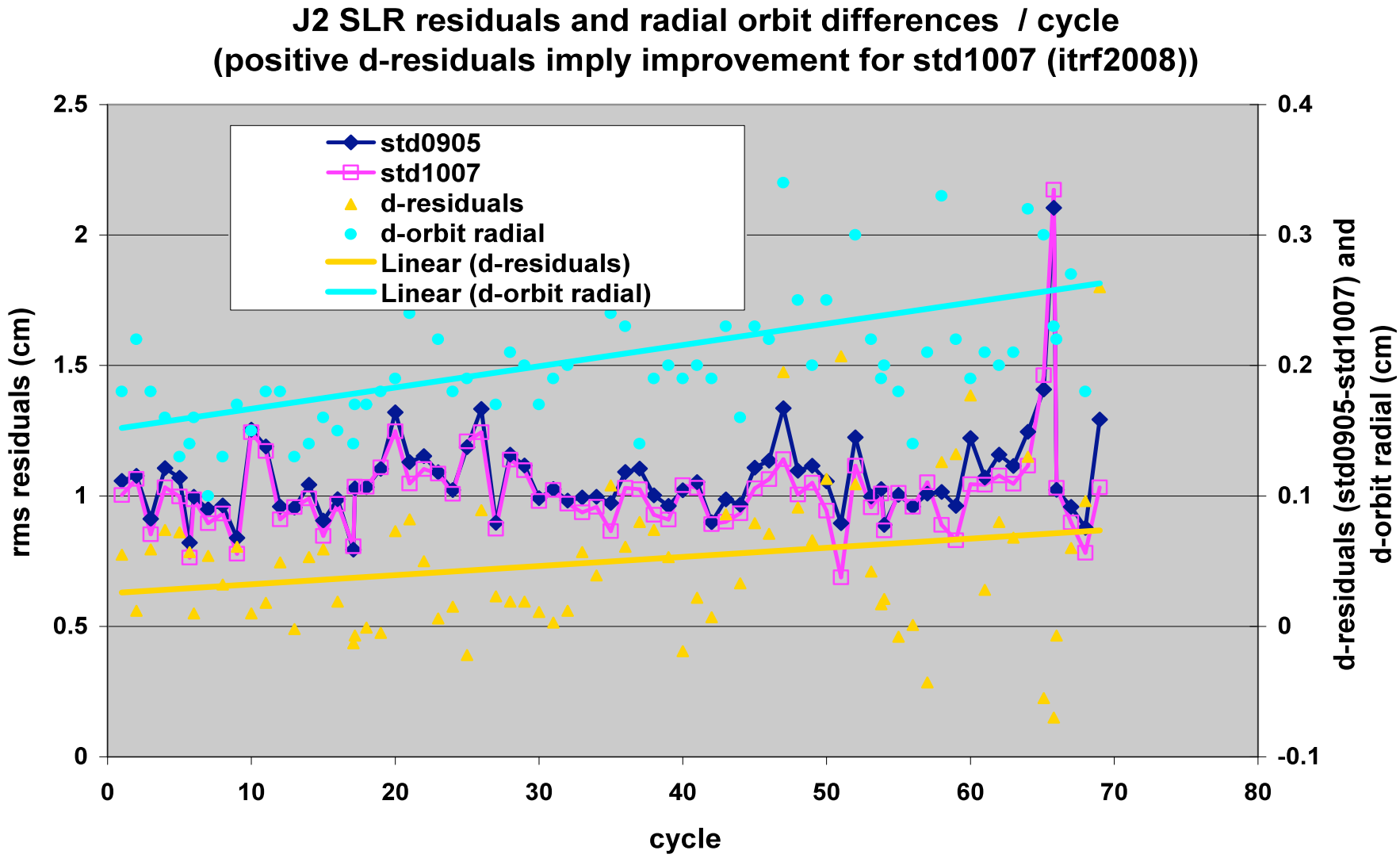
* TRF stable 0.5 mm/y to 1 mm/y with about 10% erroneous effect on orbit radial drift over water.

Improving TP, J1, and J2 SLR/DORIS orbits with ITRF2008

Evaluate ITRF2008 SLR/DORIS orbit performance for TP, J1, J2 [1]				
Mission	**dynamic orbit test**	**average RMS tracking data residuals**		
		DORIS (mm/s)	**SLR (cm)**	**Crossover (cm) (independent)**
TP cycles 1-446 xover: 30 cycles	**std0905 (itrf2005)**	**0.4989**	**1.751**	**5.482**
	std1007 (itrf2008)	**0.4985**	**1.663**	**5.477**
J1 cycles 1-259	**std0905 (itrf2005)**	**0.3857**	**1.076**	**5.460**
	std1007 (itrf2008)	**0.3851**	**1.055**	**5.457**
J2 cycles 1-75 xover cycles 1-52	**std0905 (itrf2005)**	**0.3618**	**1.095**	**5.564**
	std1007 (itrf2008)	**0.3609**	**1.032**	**5.550**

1) 1.5 cm radial accuracies have been achieved with the dynamic TP std0905 (itrf2005) orbits (Lemoine et al. 2010 , ASR, Towards development of a consistent orbit series for TOPEX, Jason-1, and Jason-2)

ITRF2005 degrades as we move into the future away from its solution span

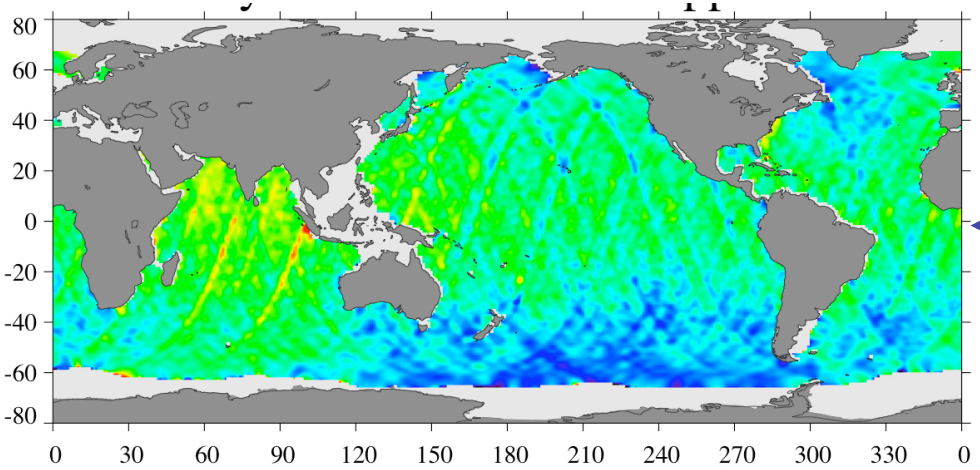


Jason-2 reduced-dynamic orbits have achieved 1-cm accuracy, the dynamic are close

Evaluate Jason-2 orbit performance over cycles 1-50 (48)			
test orbit (residuals computed over same itrf2005 complement for each test orbit)	average RMS tracking data residuals		
	DORIS (mm/s) itrf2005	SLR (cm) itrf2005	Crossover (cm) (independent)
gdrc (itrf2005-based)	0.3738	1.135	5.578
std0905 dynamic (itrf2005)	0.3738	1.148	5.551
std1007 dynamic (itrf2008)	0.3759	1.188	5.541
std0905 red-dyn (itrf2005)[1]	0.3730	1.106	5.500
std1007 red-dyn (itrf2008)	0.3751	1.153	5.484
jpl gps09a [2]	0.3736	1.265	5.439
jpl gps10a	0.3758	1.243	5.412

1) the std0905 reduced-dynamic orbits have achieved 1-cm accuracies (Zelensky et al. 2010 , ASR DORIS special issue)
2) the JPL GPS reduced-dynamic orbits have surpassed 1-cm accuracy (Bertiger et al., 2010. Marine Geodesy Jason-2 special issue)

Orbit Consistency -vs- Accuracy
Jason2 - Jason1 Mean SSH cycles 1-20
(itrf2008 orbits, no corrections)

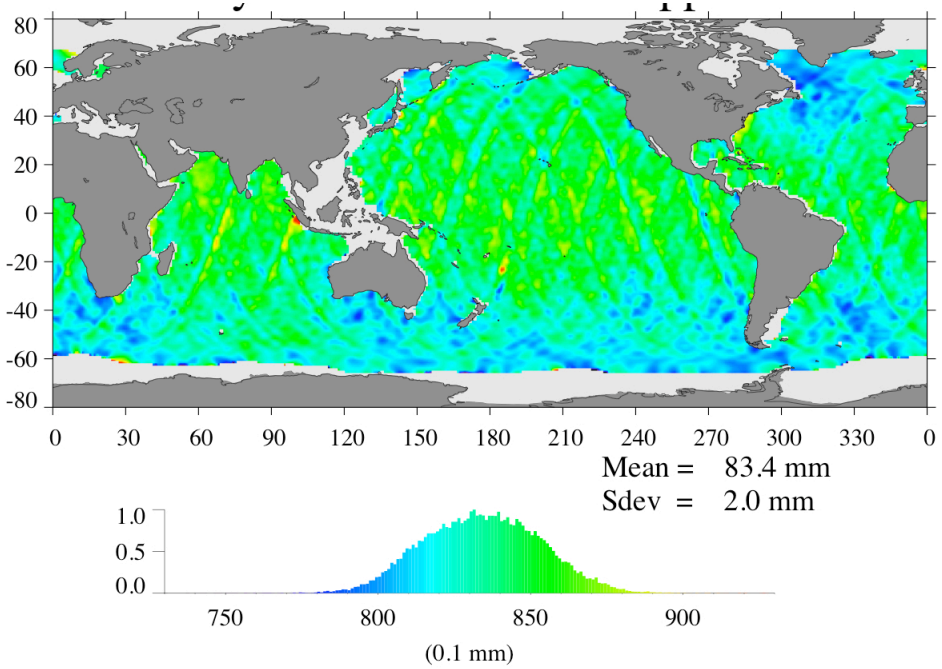


J2 reduced_dynamic -

J1 dynamic orbits

J2 dynamic -

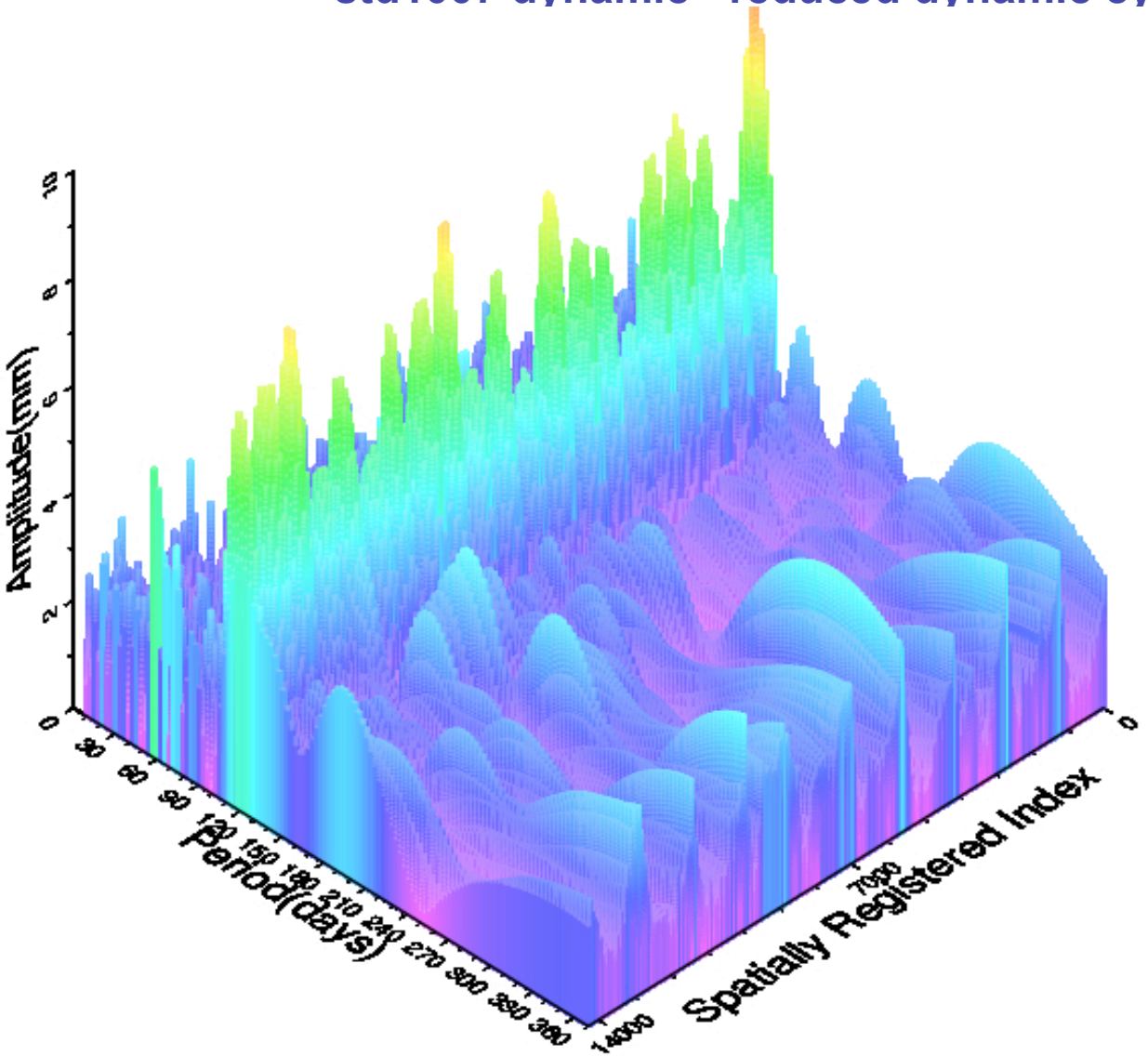
J1 dynamic orbits

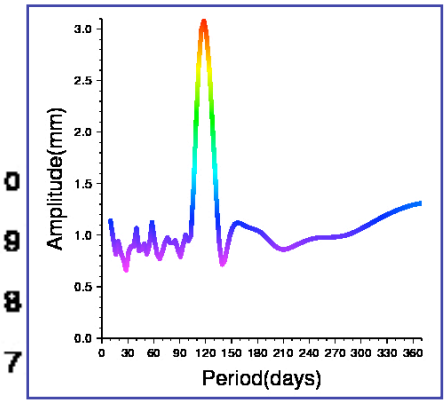


Remaining force model errors in J2 dynamic orbits

periodogram radial differences sampled over geographic points

std1007 dynamic - reduced dynamic cycles 1-75



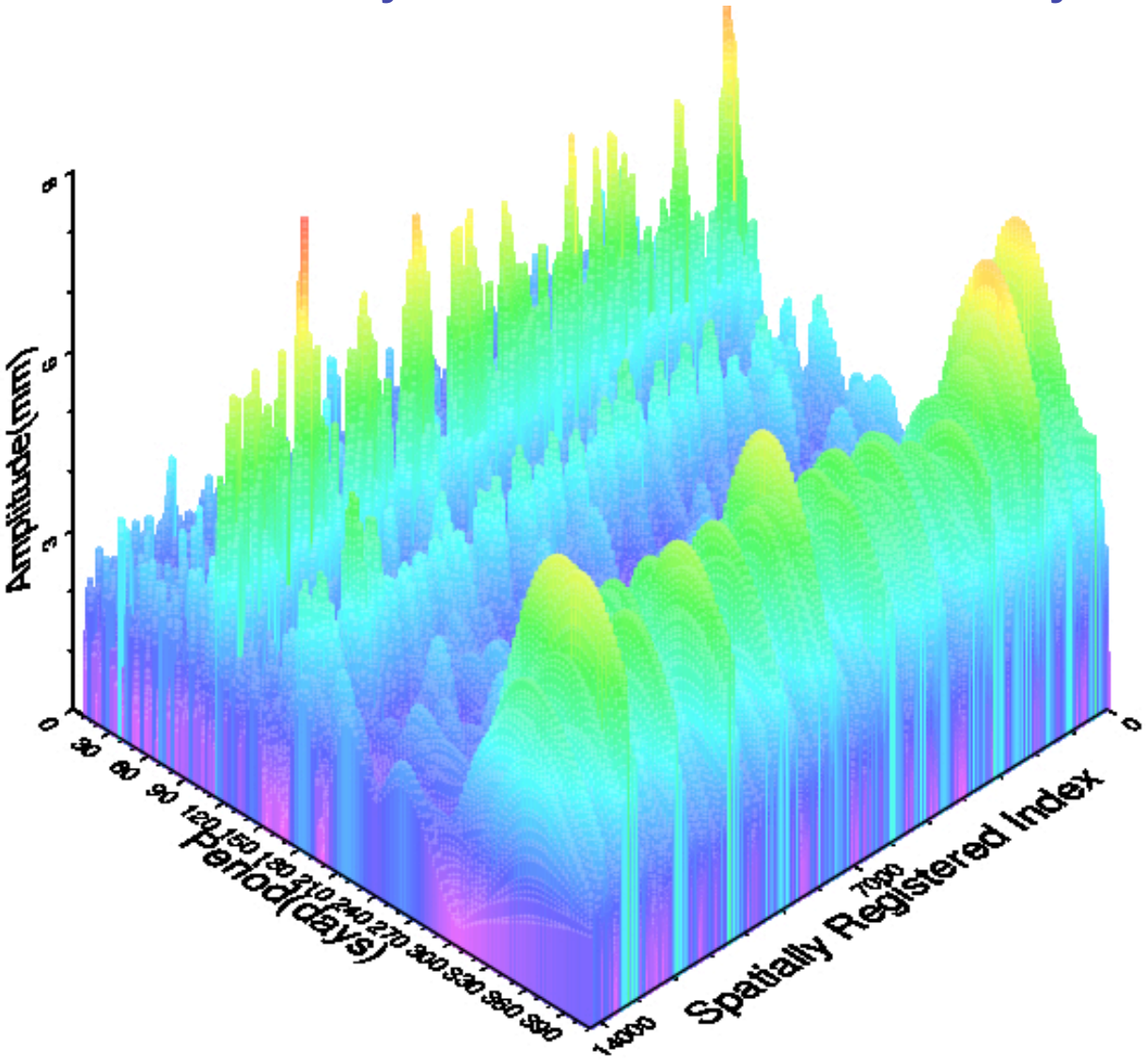


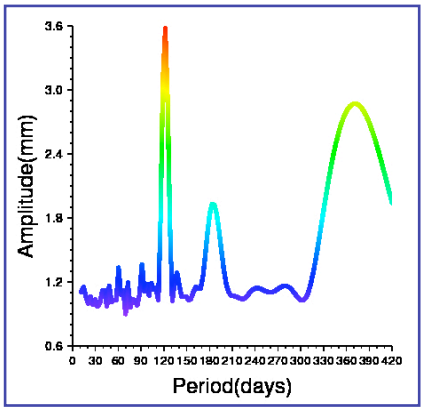
period (days)	peak (mm)
118	3

Remaining force model errors in J1 dynamic orbits

periodogram radial differences sampled over geographic points

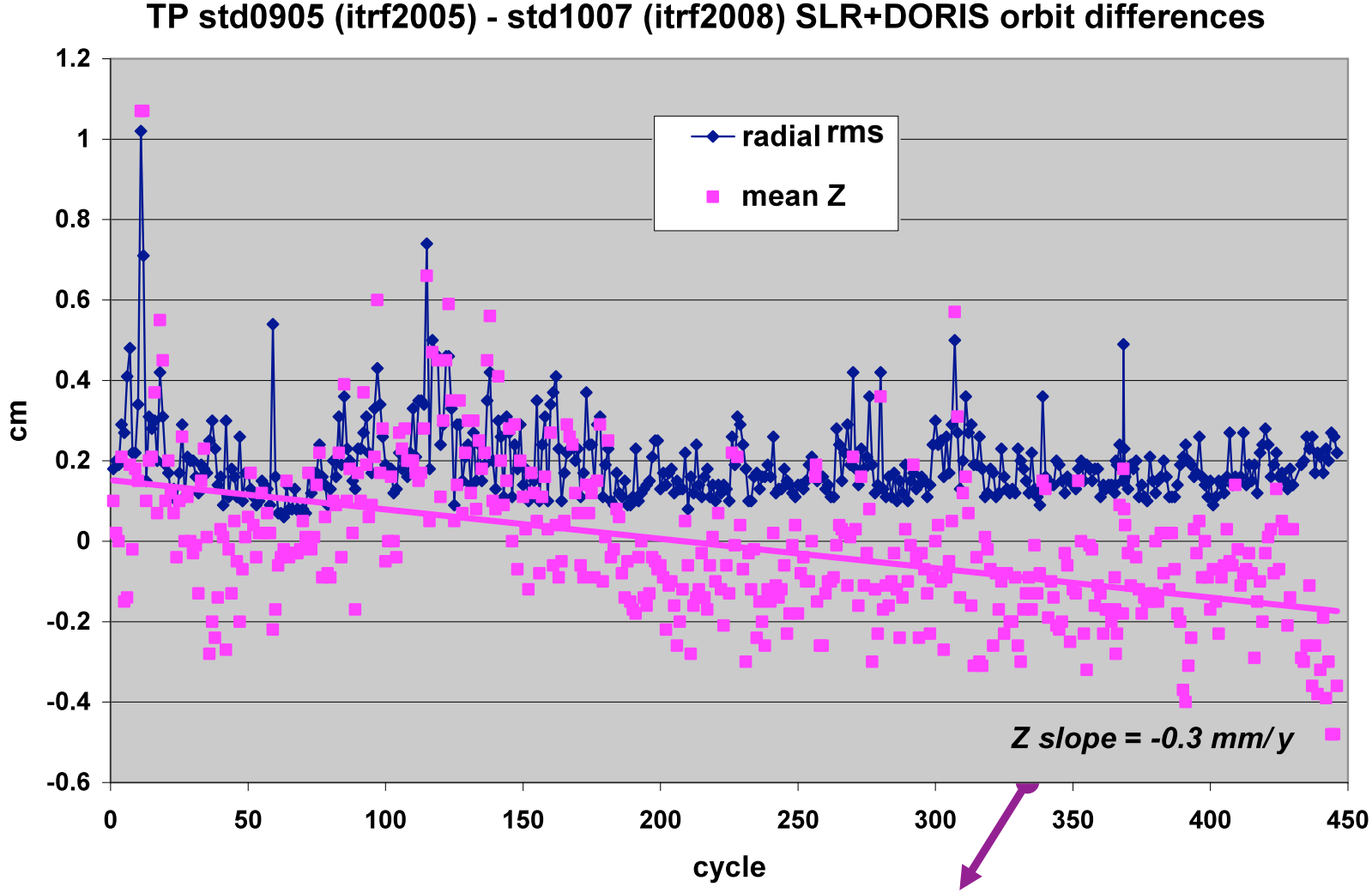
GDRC dynamic - JPL GPS 7a reduced dynamic cycles 11-169





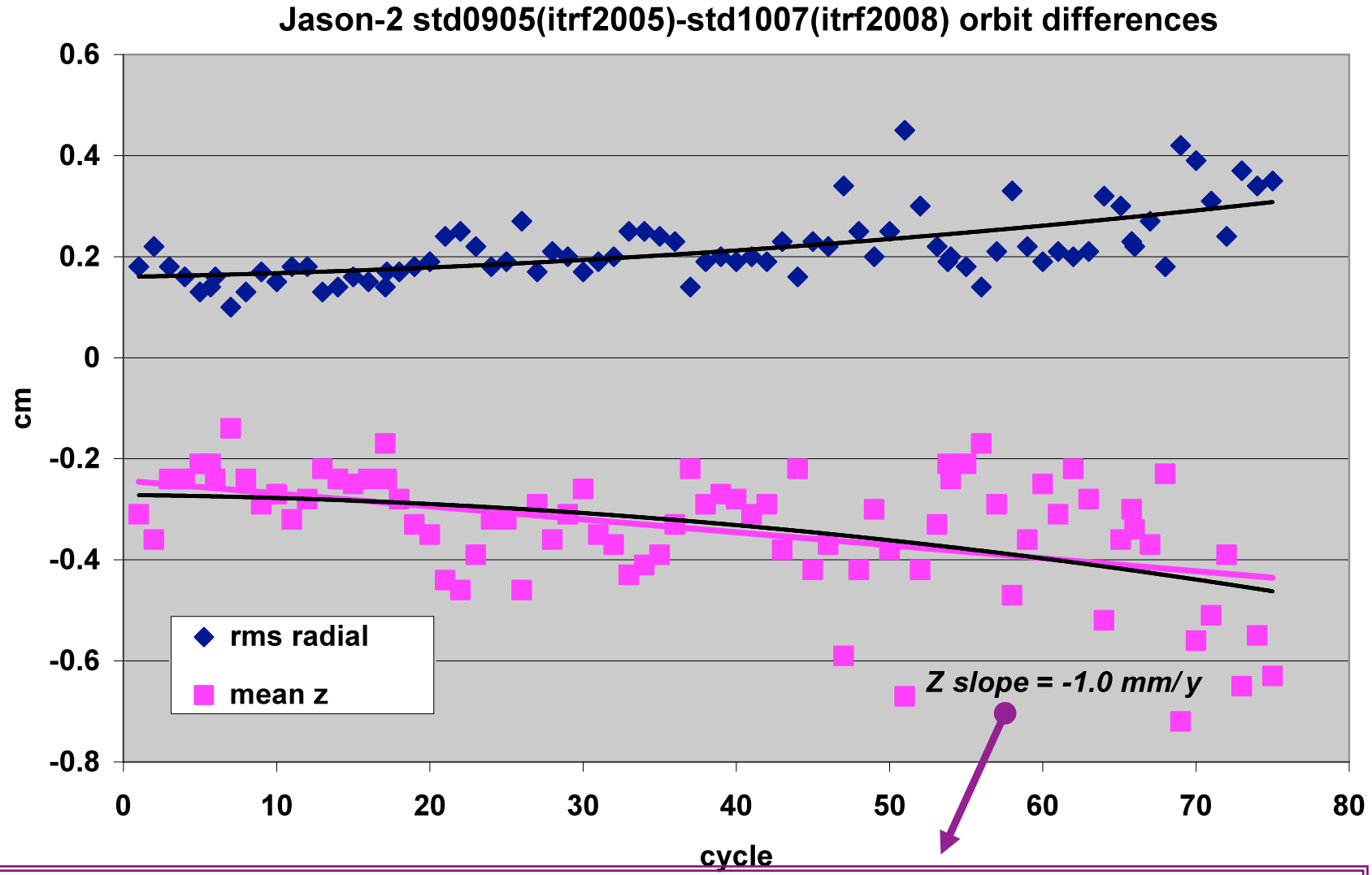
period (days)	peak (mm)
118	3.6
180	1.8
365	2.8

Sources of orbit instability - TRF realization ITRF2005 - ITRF2008



Implies mean radial drift over water ~ 0.06 mm/y 1992-2004 (inside itrf2005 solution period)

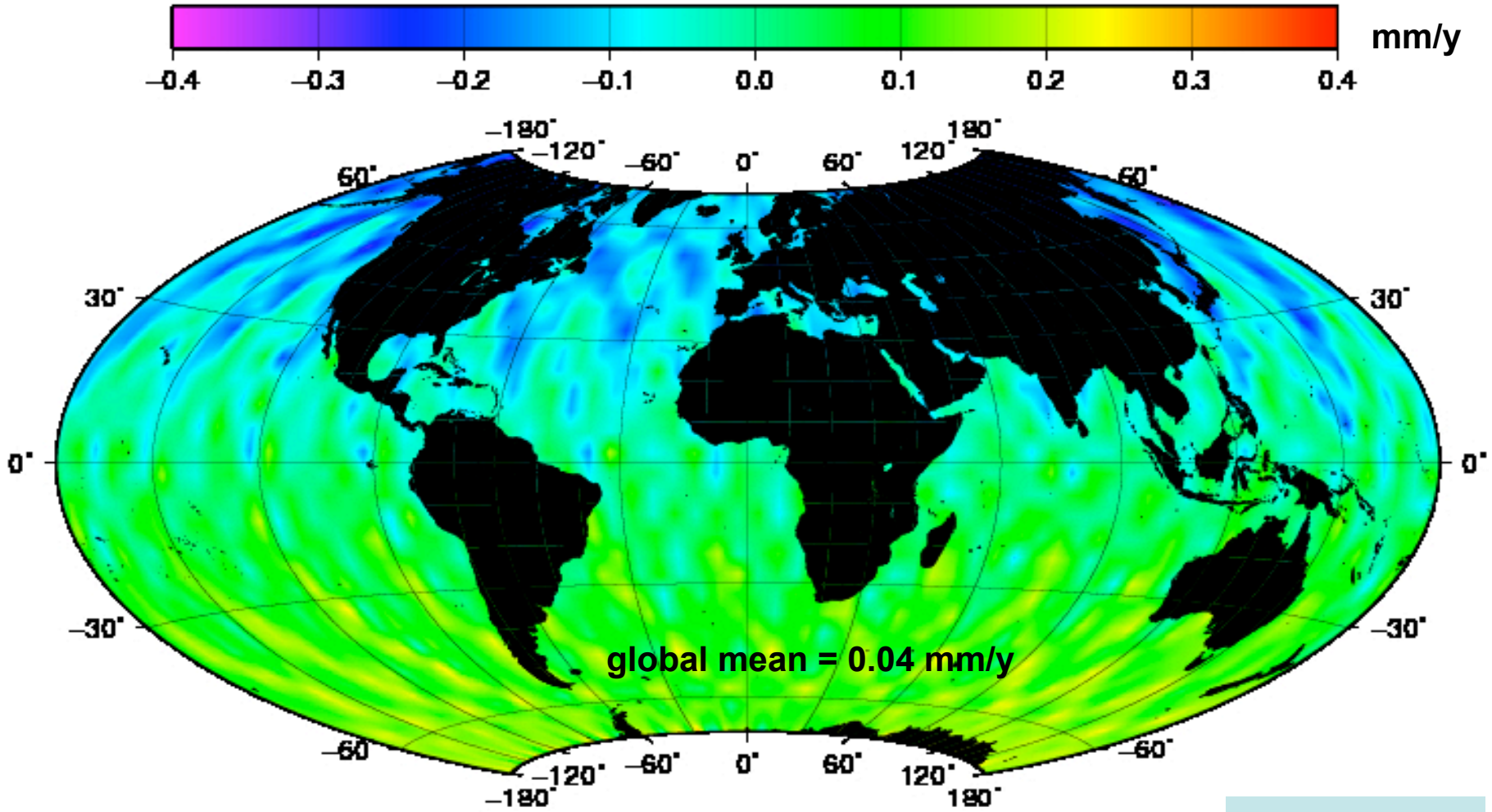
Sources of orbit instability - TRF realization ITRF2005 - ITRF2008



Implies mean radial drift over water ~ 0.2 mm/y 2008-2010 (outside itrf2005 solution period)

Sources of orbit instability - TRF solutions

J2 ITRF2008 (IGN) - ITRF2008D (DGFI) estimated radial orbit linear trends, c1-75

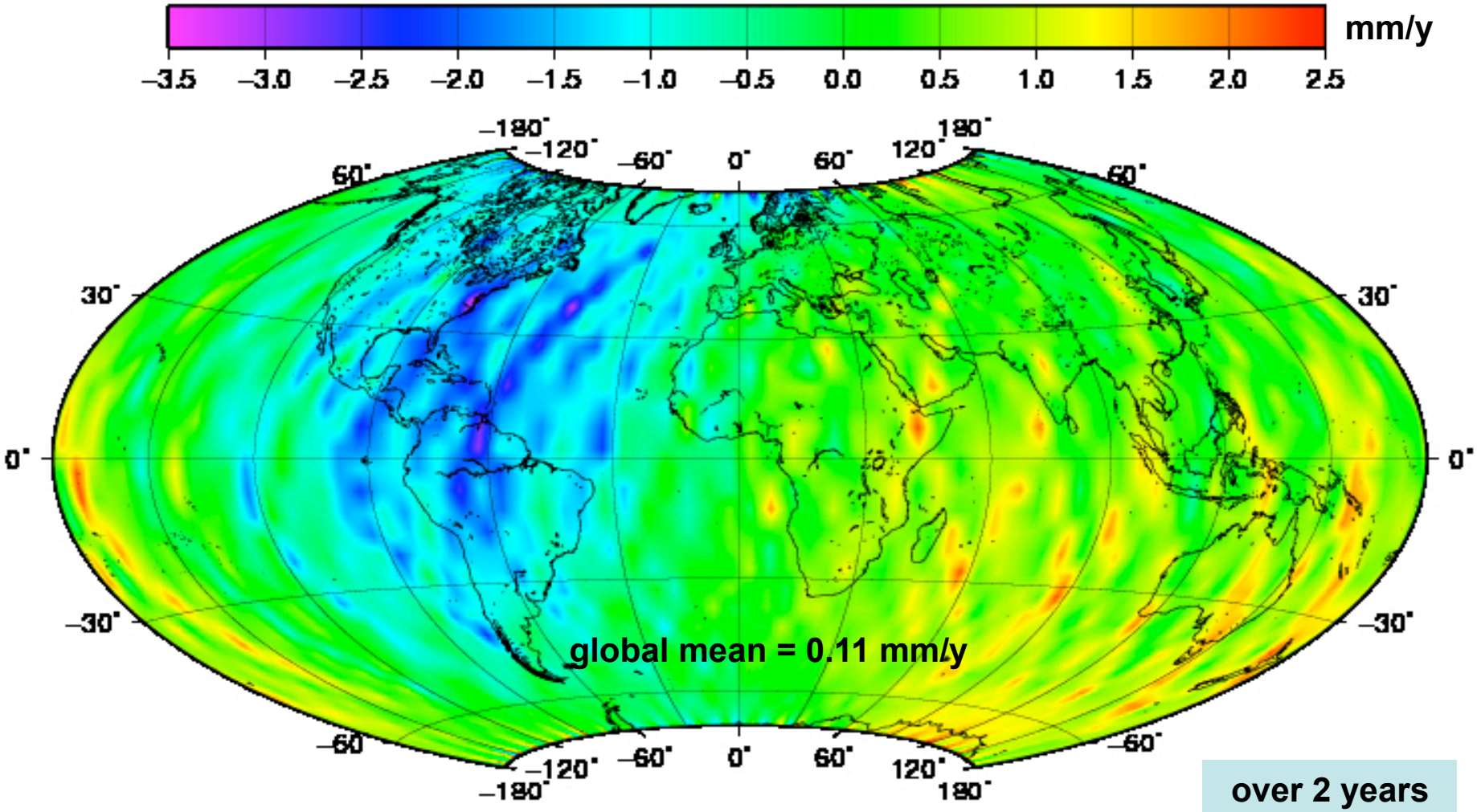


over 2 years

Sources of orbit instability - POD strategy

J2 itrf2008 dynamic-red_dyn est. radial trends after removing 365d+180d signals

(same results after removing 365d+180d+118d signals)

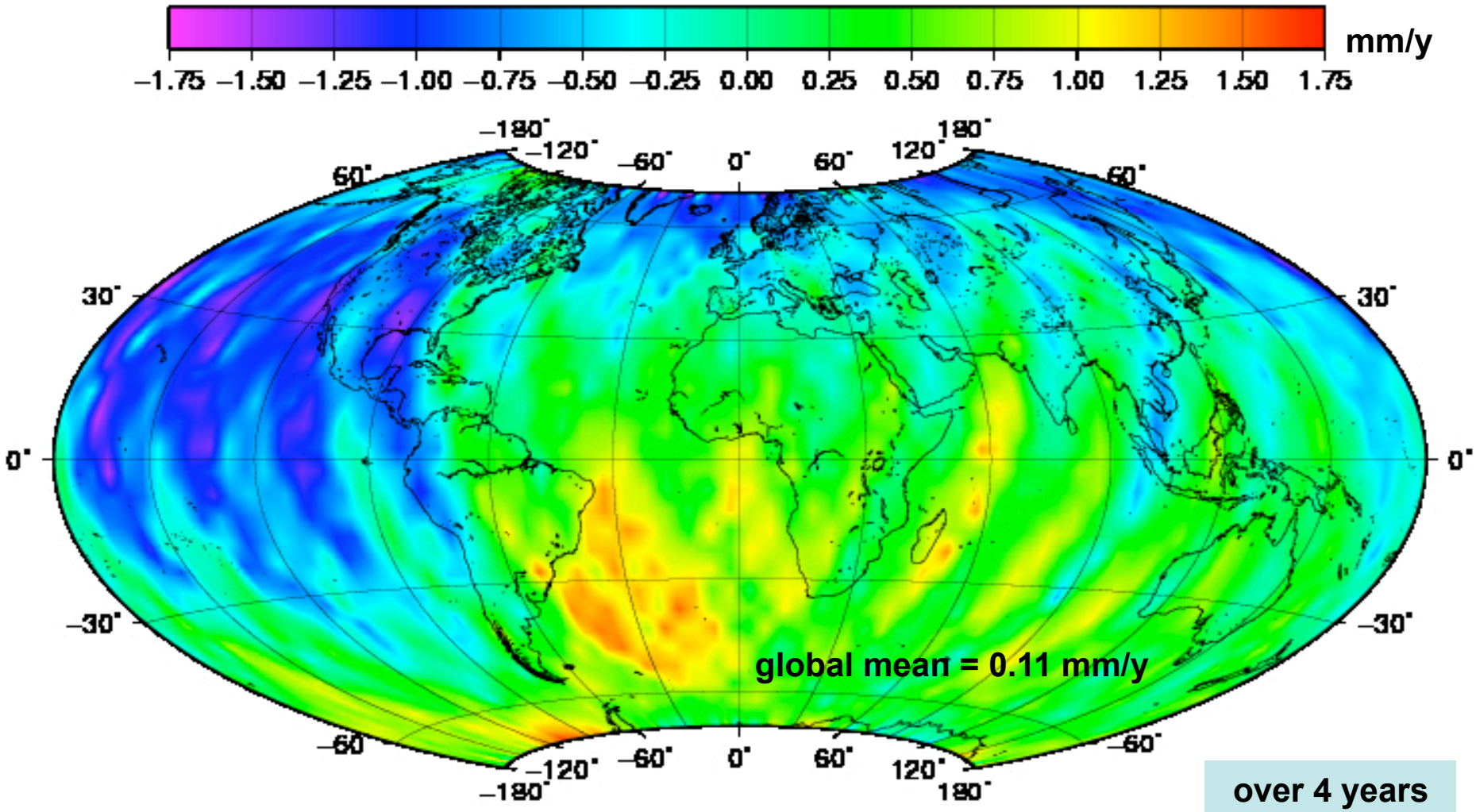


over 2 years

Sources of orbit instability - POD strategy

J1 GDRC - JPL GPS7a est. radial trends after removing annual+semi-annual signals

(same results after removing 365d+180d+118d signals)



over 4 years

Summary

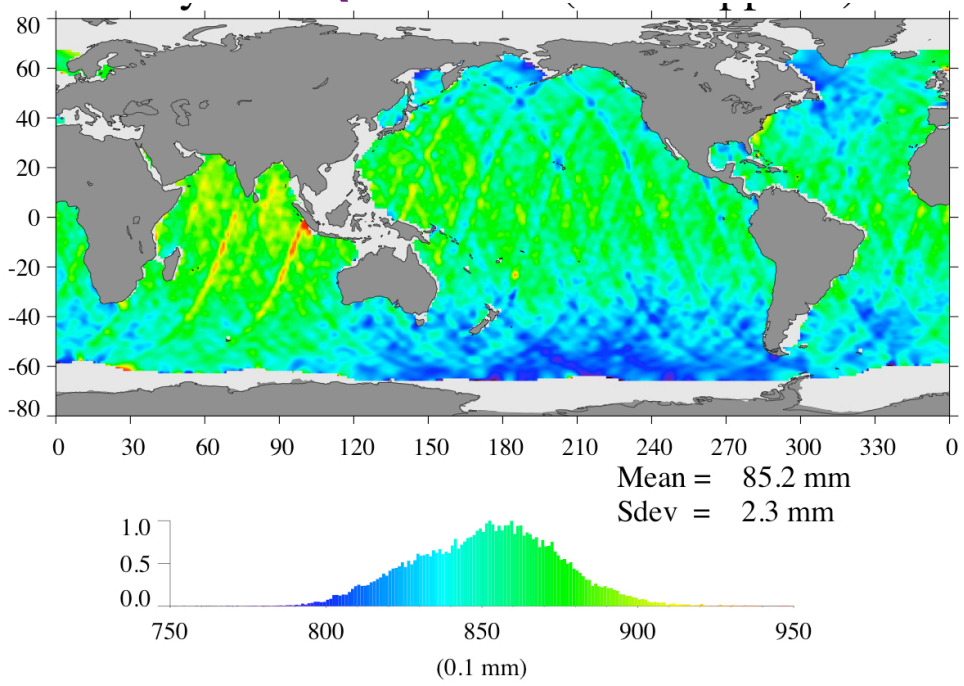
1) SLR/DORIS ITRF2008 orbits show improvement over ITRF2005 across TP, J1, and J2 missions.

2) *Have we achieved the OCEANOBS09 1-cm orbit goal?* No, not across all missions. We see 1-cm J2 orbits and 1-cm J1 orbits cycles 8-169, however using the most accurate orbits raises the issue of consistency across missions.

3) *Have we achieved the OCEANOBS09 0.1 mm/y orbit stability goal?* No. The causes for orbit instability are not well understood and include more than the TRF.

BACKUP

Orbit Consistency -vs- Accuracy
Jason2 - Jason1 Mean SSH cycles 1-20
(itrf2008, no corrections, SSB applied)

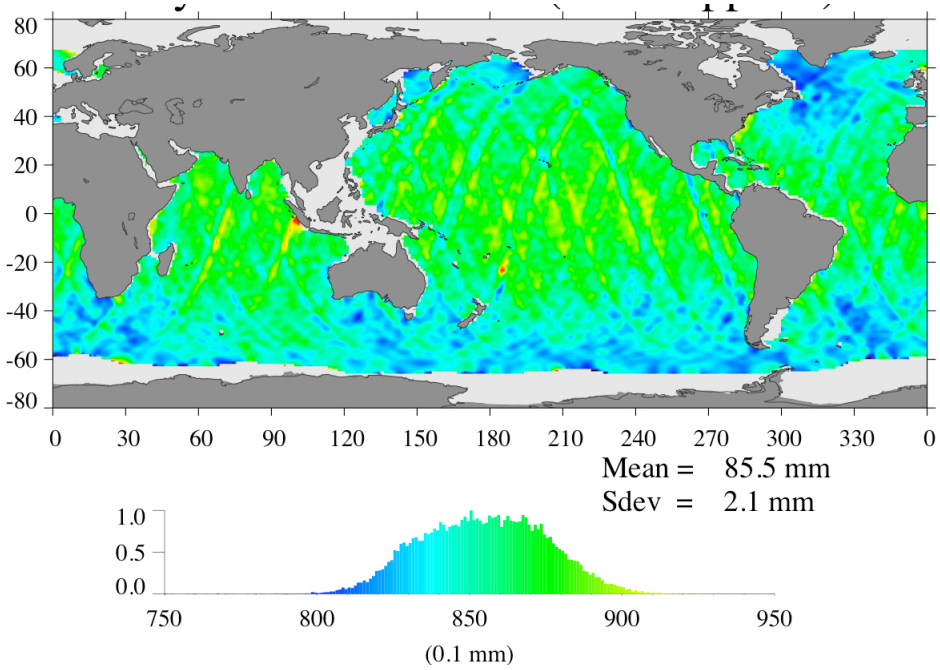


J2 reduced_dynamic -

J1 dynamic orbits

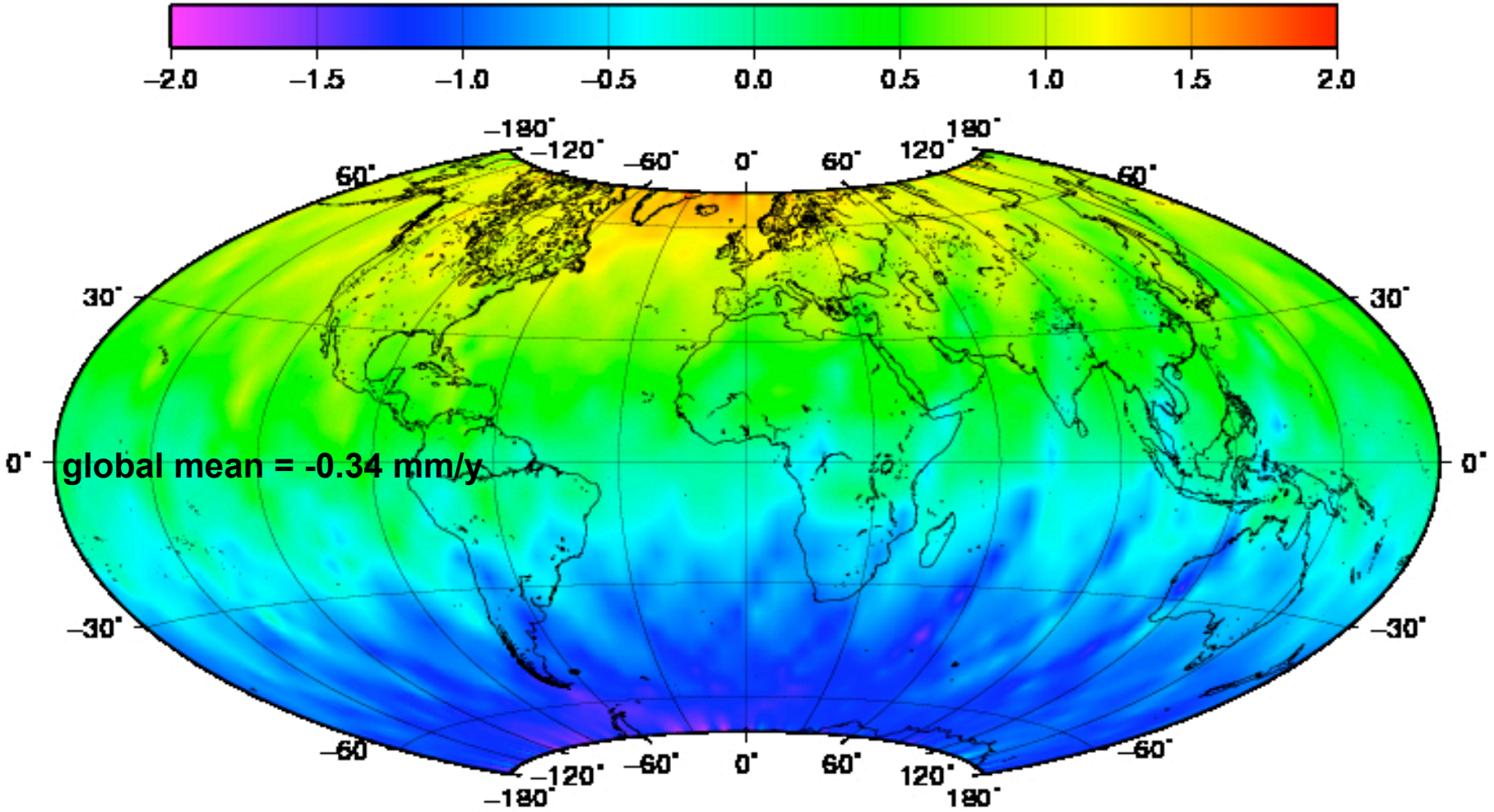
J2 dynamic -

J1 dynamic orbits



Sources of orbit instability –TRF realization

TP std1007 (ITRF2008) - GDR (CSR95) estimated radial orbit linear trends, c11-340



Sources of orbit instability –TRF realization

J2 std0905(ITRF2005) – std1007(ITRF2008) estimated radial orbit linear trends, c11-340