IMPROVING TOPEX/JASON ORBITS USING DORIS TRACKING

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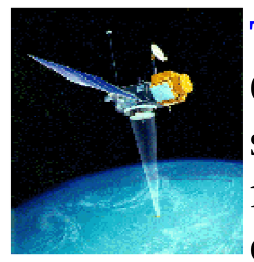


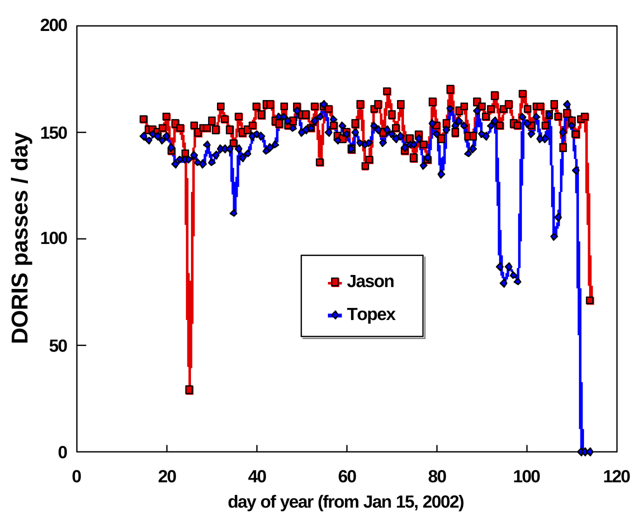
TOPEX/POSEIDON (T/P) orbits produced at GSFC with a 2-3 cm radial accuracy, have become a standard for other altimeter satellites, and are useful for evaluating orbit improvement strategies. T/P orbits are based on SLR and DORIS tracking.

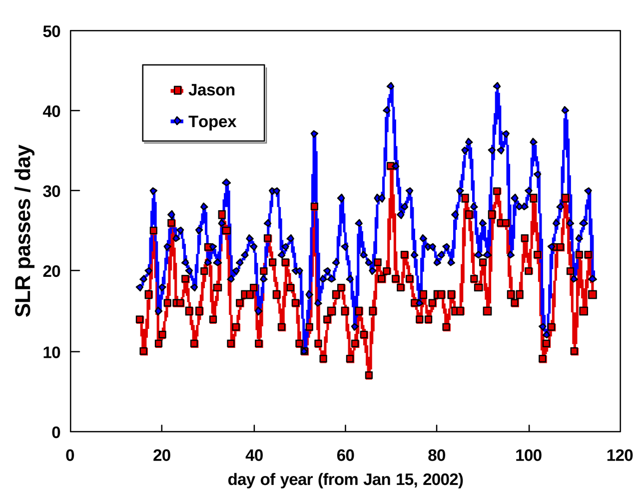
Jason-1 was injected into the T/P orbit, flying just 72 seconds ahead of T/P for verification. The Mission objective is T/P level accuracy, and goal is to reach 1-cm orbits. SLR, DORIS, and GPS tracking are available.

Jason and T/P orbits

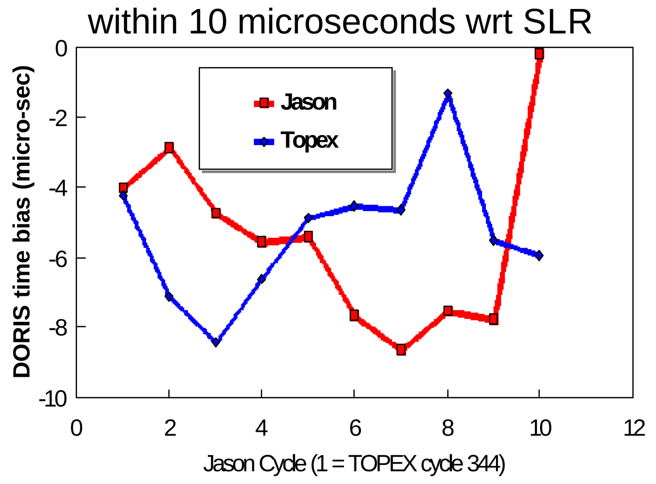
- **Intercomparison orbits are based on T/P standards and ITRF2000**
- **Initial tests show Jason SLR+DORIS orbits are close to T/P accuracy even before tuning**
- **DORIS data contributes more to Jason POD**
- **Jason SLR measurement modeling and data weighting need further study**

Jason shows weaker SLR, but stronger DORIS tracking

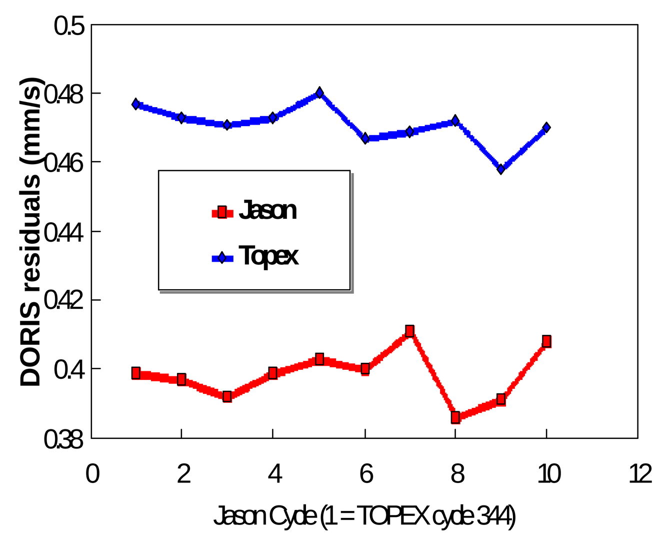


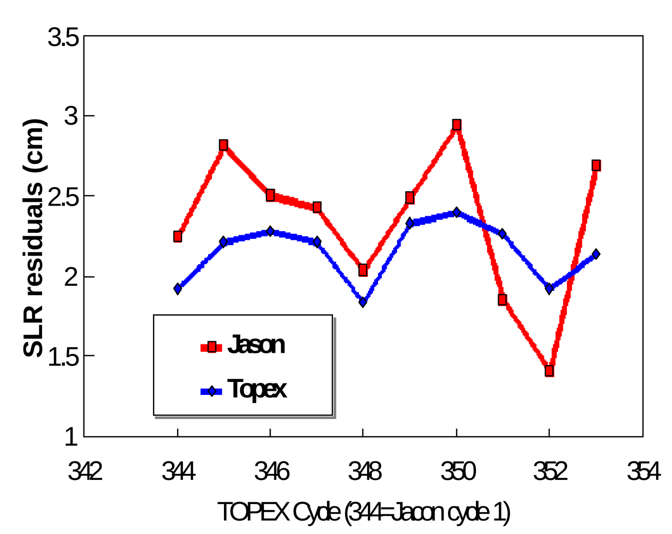


DORIS network time consistent to within 10 microseconds wrt SLR

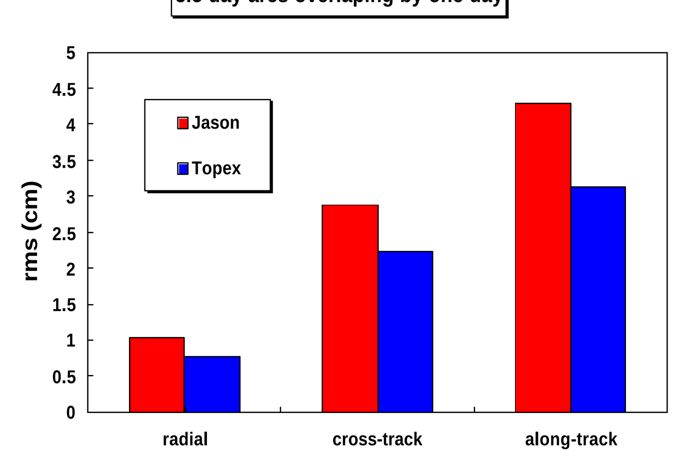


SLR+DORIS Orbits



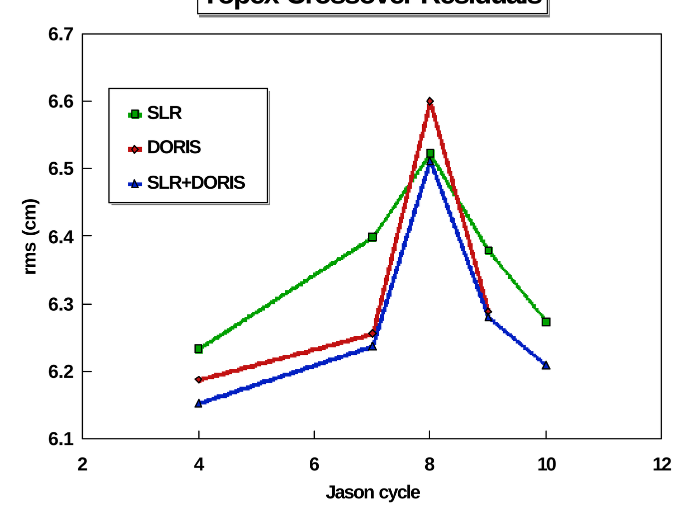


Orbit Overlap Difference
5.5 day arcs overlaping by one day

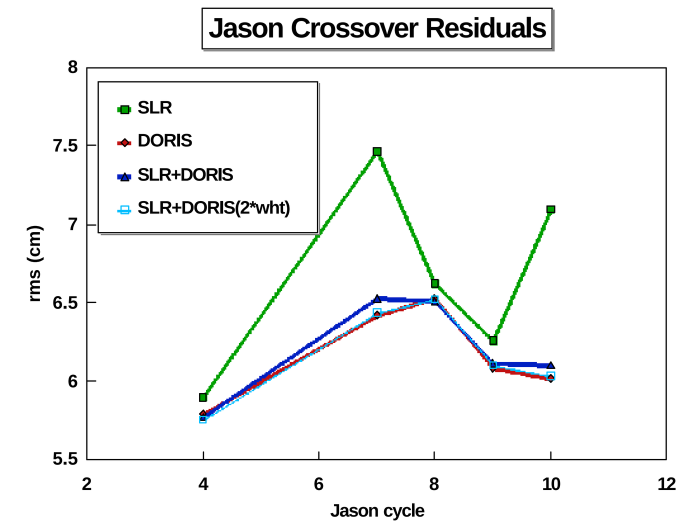


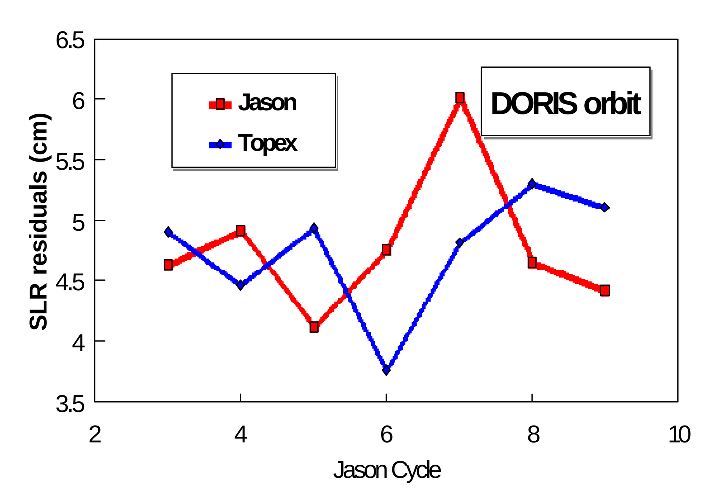
Altimeter crossover and SLR residuals can offer an independent measure of orbit accuracy

Topex Crossover Residuals



Jason Crossover Residuals

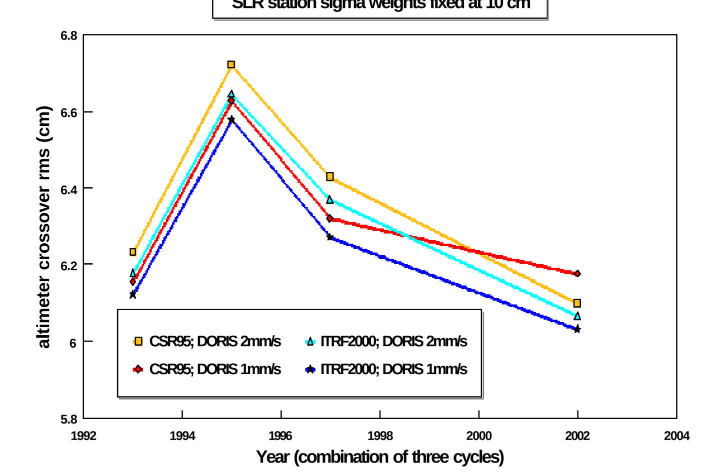




Orbit Improvement

- **Increasing DORIS weight will improve SLR+DORIS POD**
- **ITRF2000 offers an improvement over the CSR95 station positions**
- **SLR+DORIS reduced-dynamic orbits appear more accurate than those using GPS (from JPL)**
- **SLR+DORIS+Crossover reduced-dynamic orbits appear to exceed 2-cm accuracy**
- **Simulations indicate 1-cm orbits can be achieved with sufficiently precise and dense tracking**

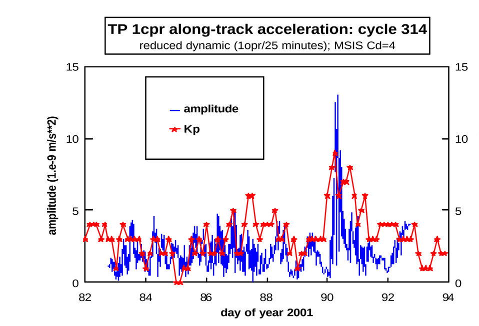
DORIS Weight in T/P Solution
SLR station sigma weights fixed at 10 cm



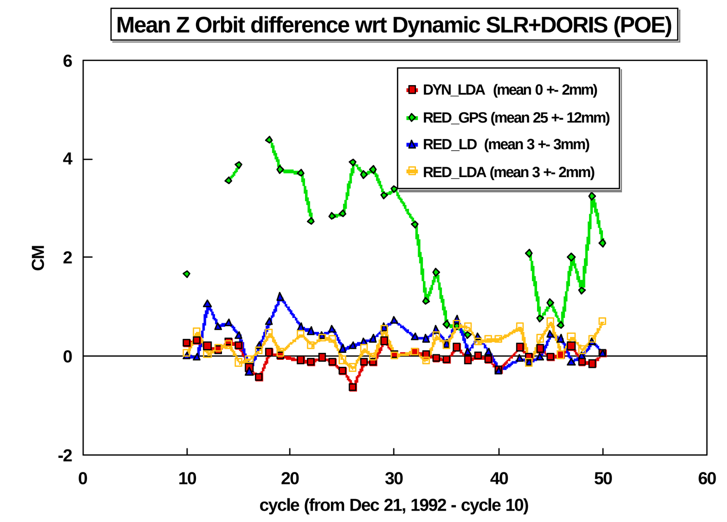
Reduced-Dynamic strategy

The reduced-dynamic strategy calls for the constrained adjustment of a time series of empirical accelerations, and is only possible with sufficiently precise and dense tracking. **GPS**, **DORIS** and **altimeter crossover** data offer such density.

The example indicates recovered accelerations represent actual mis-modeled forces

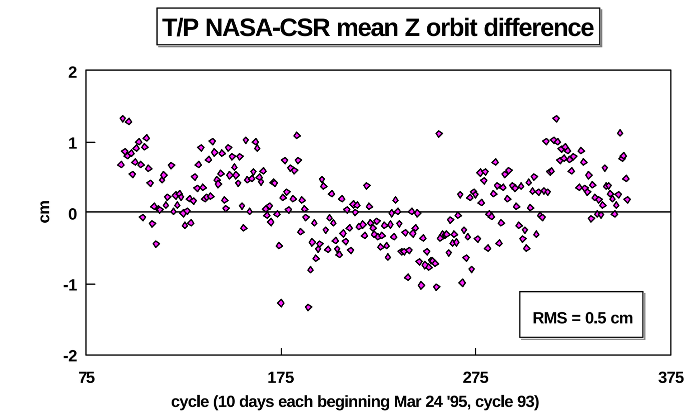


Mean Z Orbit difference wrt Dynamic SLR+DORIS (POE)

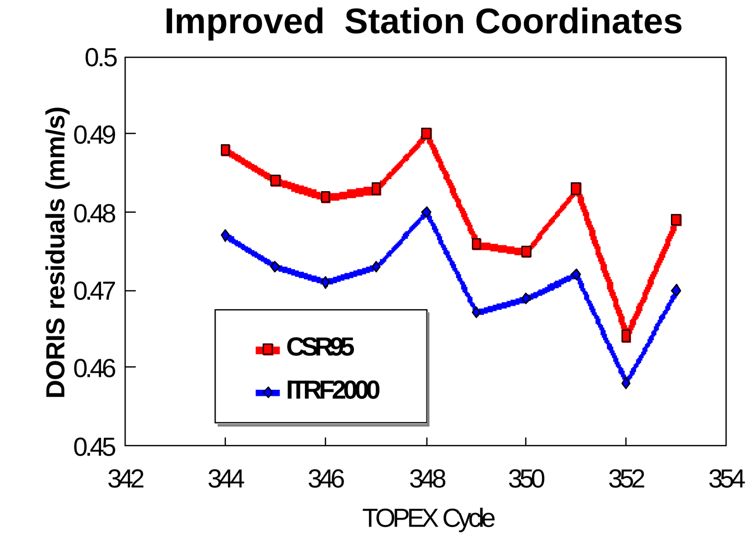


Orbit centering believed accurate to 5mm for dynamic SLR+DORIS

T/P NASA-CSR mean Z orbit difference



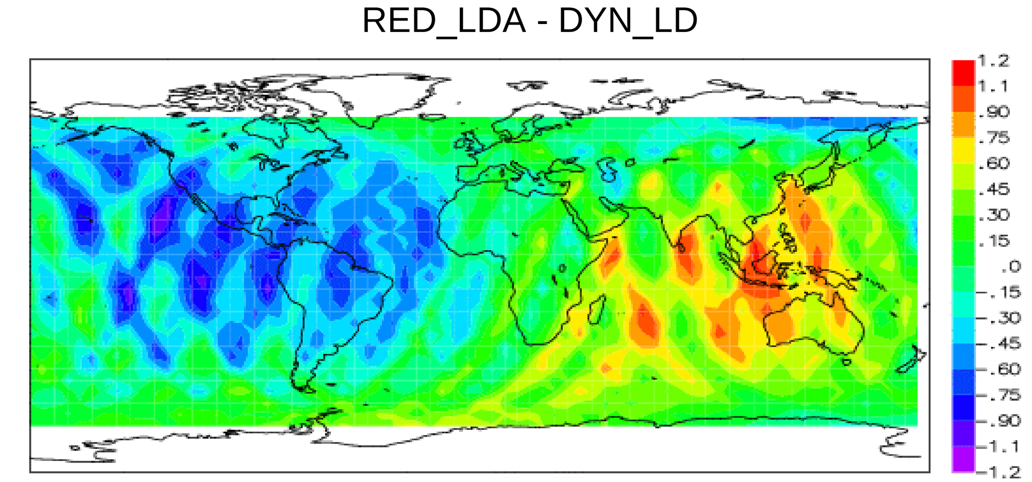
Improved Station Coordinates



Simulations indicate 1-cm orbits can be achieved if sufficiently precise and dense tracking data are available

Satellite / POD solutions Anticipated Force Model Error (Gravity model improvement)		Orbit Error RMS (cm) radial	cross track	along track
TOPEX	SLR	2.9	5.5	8.2
	GPS	2.0	3.7	6.0
	GPS+SLR	1.8	4.5	5.4
	Perfect Tracking	0.4	0.8	0.2
JASON	SLR	5.0	5.6	18.0
	GPS	2.1	3.6	6.1
	GPS+SLR	1.8	4.9	5.4
	Perfect Tracking	0.6	0.9	0.3

Radial Orbit Difference(cm)
RED_LDA - DYN_LD



POD Tests

38 TOPEX cycles spanning Dec '92 - Jan '94

Solution Strategy (using pgs7727, ITRF2000)		Number cycles	RMS DORIS (mm/sec)	RMS SLR (cm)	RMS Crossover (cm)	Collinear Altimeter Analysis (adjacent cycle difference (cm))			
Name	Description					Mean	Standard Deviation	RSS wrt DYN_LD	Orbit Error estimate
DYN_LD	Dynamic SLR+DORIS	38	0.552	3.40	6.24	0.014	8.454	-----	2.5
DYN_LDA	Dynamic SLR+DORIS+Crossover	38	0.553	3.51	6.18	0.011	8.361	1.25	2.2
RED_GPS	Reduced-Dynamic GPS (from JPL)	29	-----	-----	-----	0.178	8.428	0.66	2.4
RED_LD	Reduced-Dynamic SLR+DORIS	38	0.551	3.61	6.20	0.020	8.407	0.89	2.3
RED_LDA [1]	Reduced-Dynamic SLR+DORIS+Crossover	38	0.551	3.03	5.88	0.019	8.263	1.79	1.7

1. most aggressive strategy

Overlap Arc Test of Orbit Consistency

20 TOPEX cycles spanning Dec '92-July '93; 5.6 day arcs with 1 day overlap

Solution Strategy		RMS DORIS (mm/sec)	RMS SLR (cm)	RMS Crossover (cm)	RMS orbit overlap difference (cm)		
Name	Description				radial	cross-track	along-track
DYN_LD	Dynamic SLR+DORIS	.547	3.73	5.97	1.04	2.51	4.00
DYN_LDA	Dynamic SLR+DORIS+Crossover	.547	3.80	5.84	0.80	2.69	3.49
RED_LD	Reduced-Dynamic SLR+DORIS	.546	3.95	5.88	0.60	1.92	2.90
RED_LDA	Reduced-Dynamic SLR+DORIS+Crossover	.544	3.50	5.65	0.82	1.68	2.90