



# IDS Evaluation of ITRF2008

F.G. Lemoine<sup>1</sup>, N.P. Zelensky<sup>2</sup>, A. Couhert<sup>3</sup>, L. Cerri<sup>3</sup>,  
L. Soudarin<sup>4</sup>, P. Willis<sup>5,6</sup>, K. Le Bail<sup>7</sup>

<sup>1</sup> NASA Goddard Space Flight Center, Greenbelt, Maryland, U.S.A.

<sup>2</sup> SGT Inc., Greenbelt, Maryland, U.S.A.

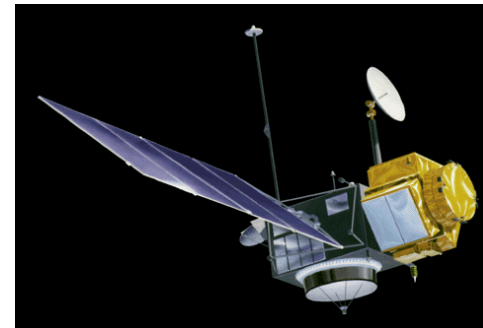
<sup>3</sup> Centre National D'Etudes Spatiales, Toulouse, FRANCE

<sup>4</sup> Collecte Localisation Satellites, Ramonville Saint-Agne, FRANCE

<sup>5</sup> Institut de Physique du Globe de Paris, Paris, FRANCE

<sup>6</sup> Institut Géographique National, FRANCE

<sup>7</sup> NVI Inc., Greenbelt, Maryland, U.S.A.



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## IDS Tests for ITRF2008

*International  
DORIS  
Service*

- 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 (including rates through time).
- Review horizontal and vertical station velocities for DORIS sites in ITRF2005, ITRF2008, ITRF2008d.



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

*International  
DORIS  
Service*

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

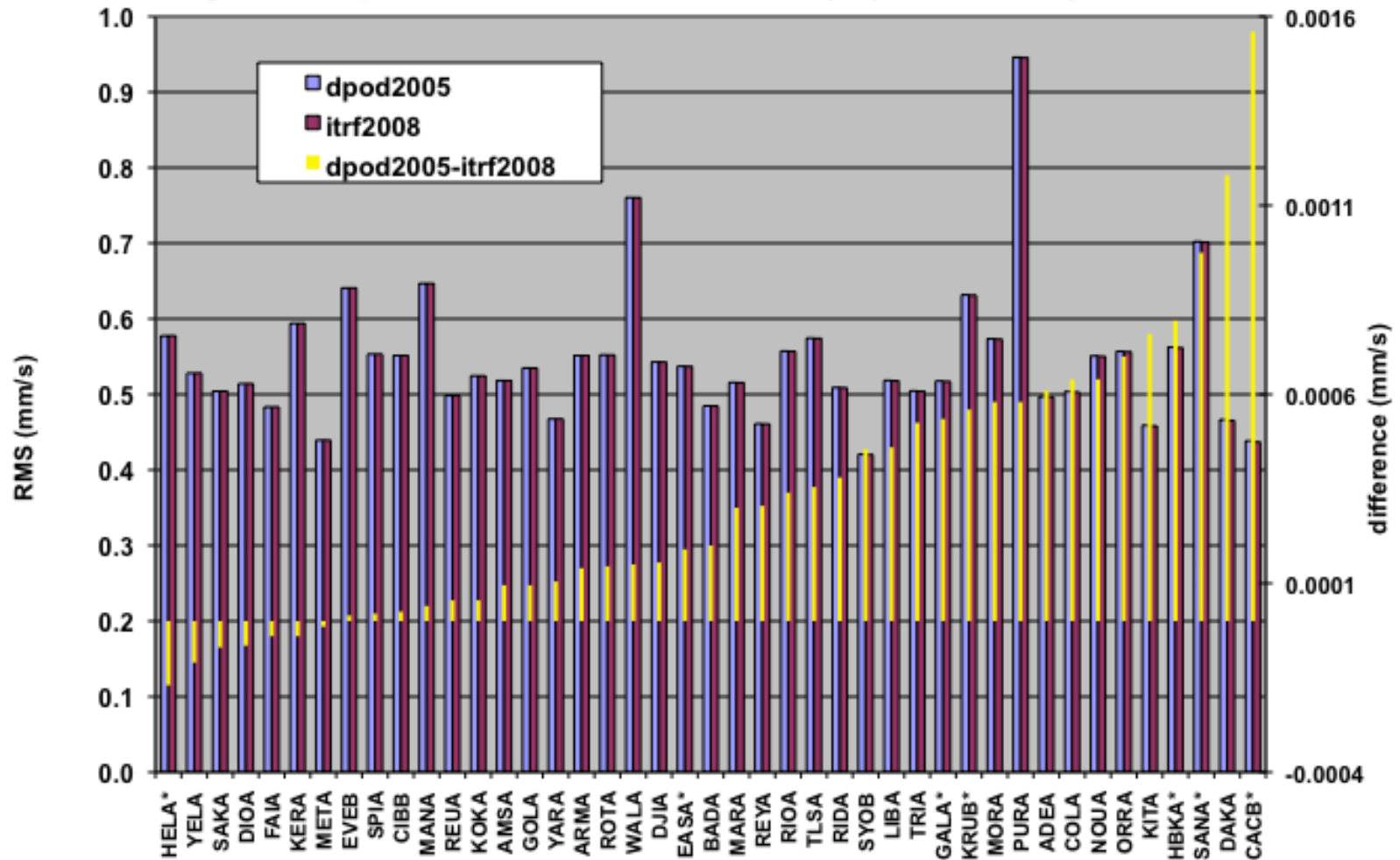
- ITRF2008 marginally better up to 2008. From 2008 (after DPOD2005 time span) ITRF2008 performs progressively better than DPOD2005.
- On a station-by-station basis, ITRF2008 slightly better than ITRF2008d.
- ~11-13 stations with coordinate diffs (2005.0) > 5 cm; Velocity diffs more significant
- Some glitches in ITRF2008d (SODB, Soccoro) has to be excluded from tests.

***SLR & Xover fits are independent***



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

Figure 1. Topex/Poseidon DORIS station (43) residuals cycles 1-30

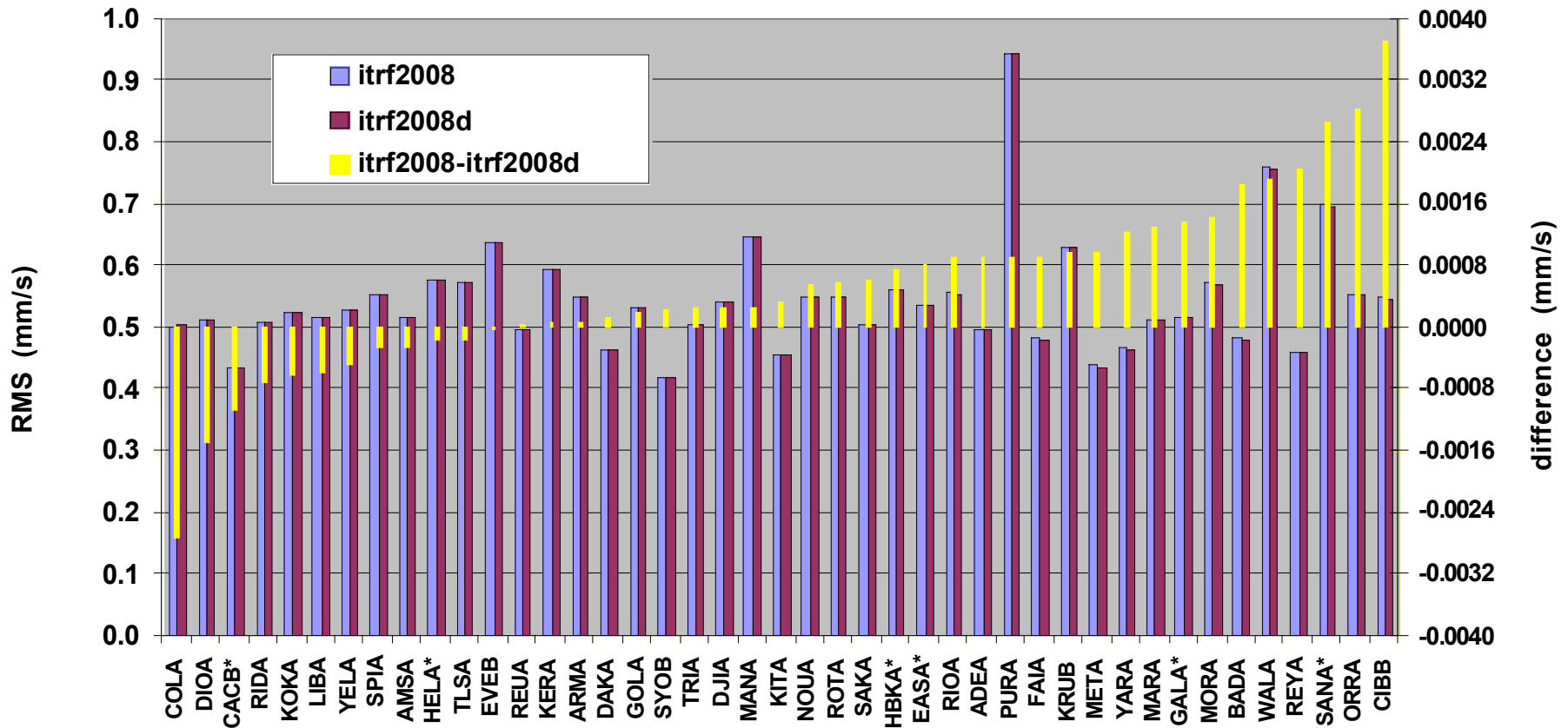




# DORIS: station-by station comparisons

## TOPEX: Sept 1992-July 1993, ITRF2008 vs. ITRF2008d

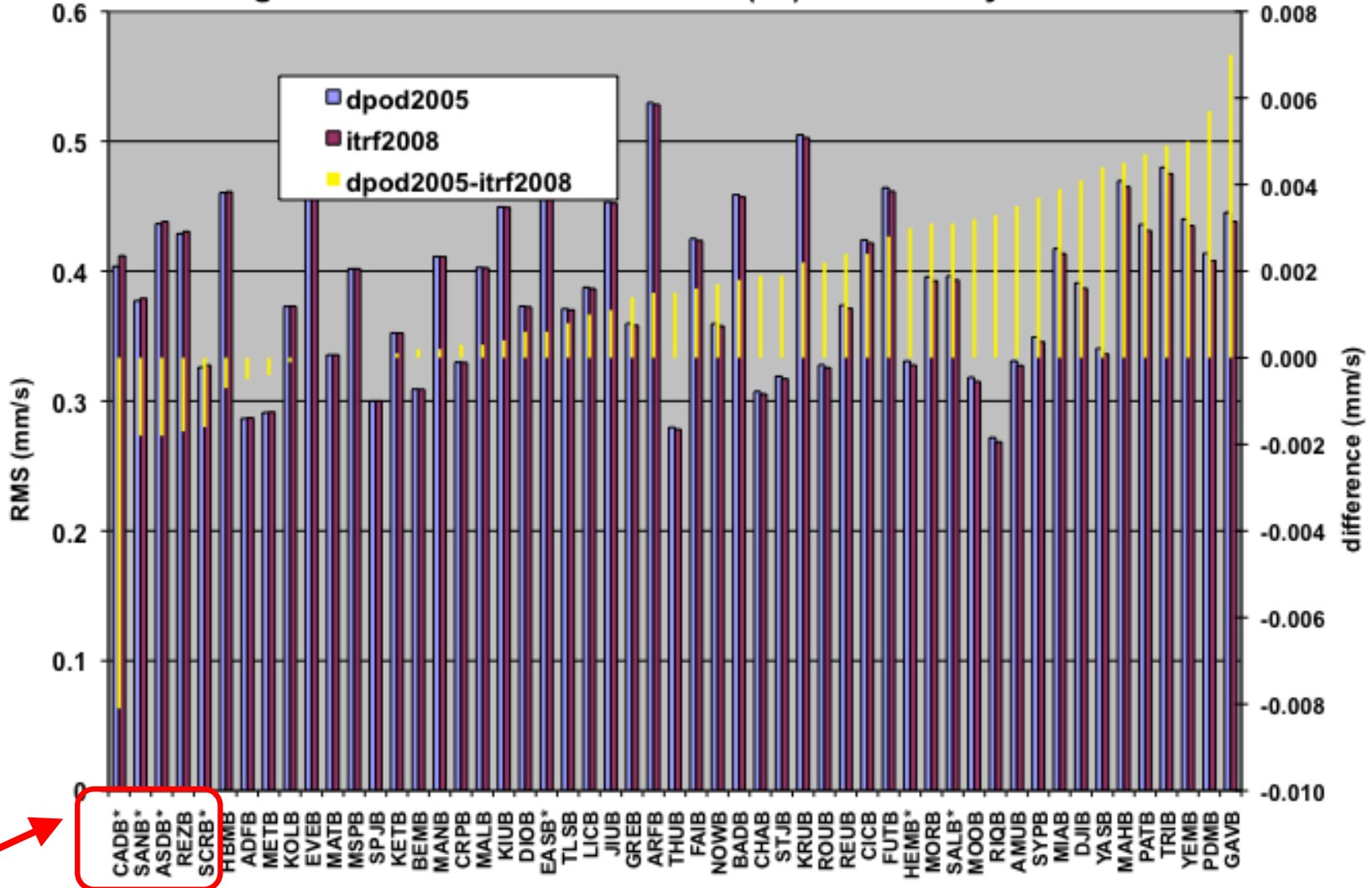
Figure 1. Topex/Poseidon 43 DORIS station residuals cycles 1-30 (positive implies improvement for itr2008d)





# 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

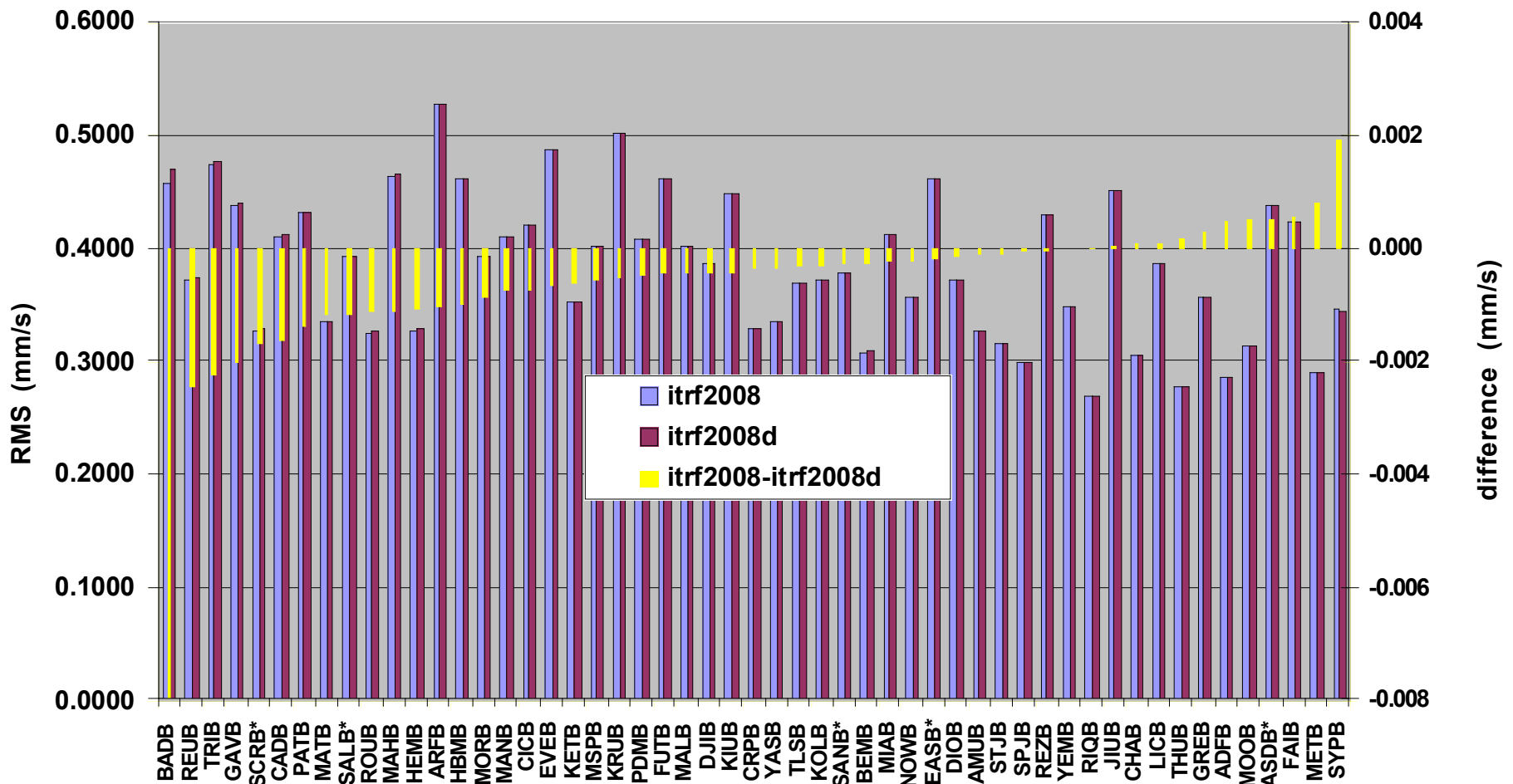


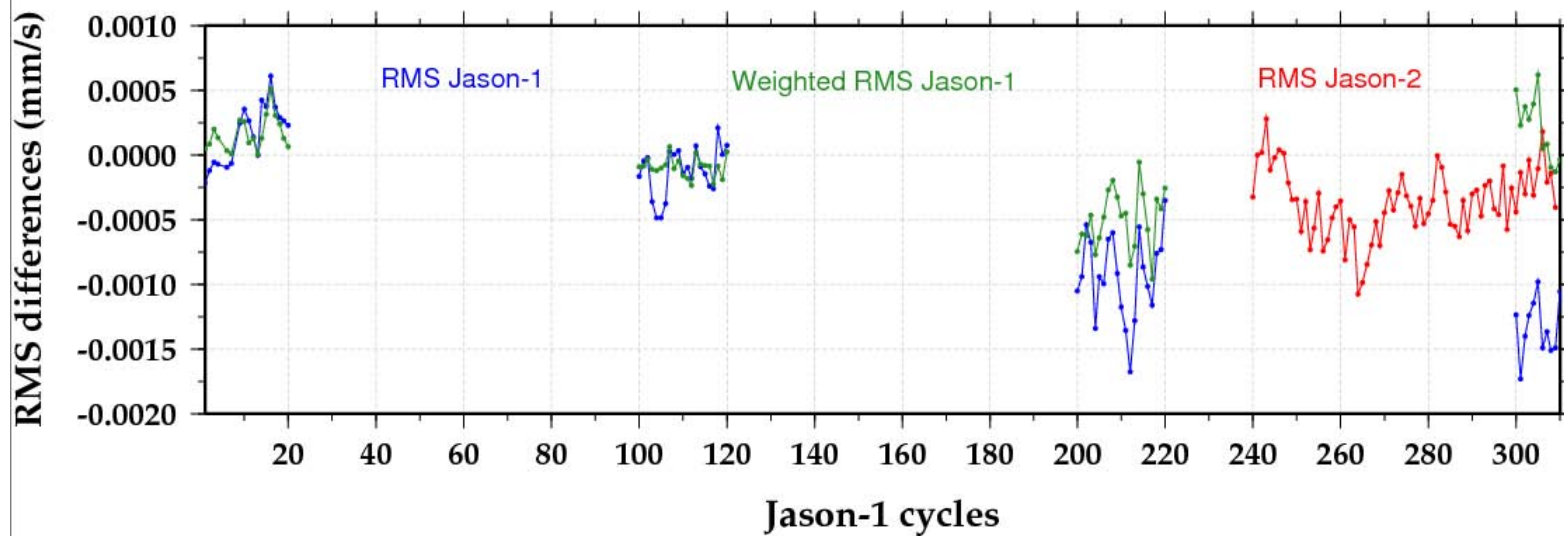
Predominantly SAA stations show degradation for Jason-2



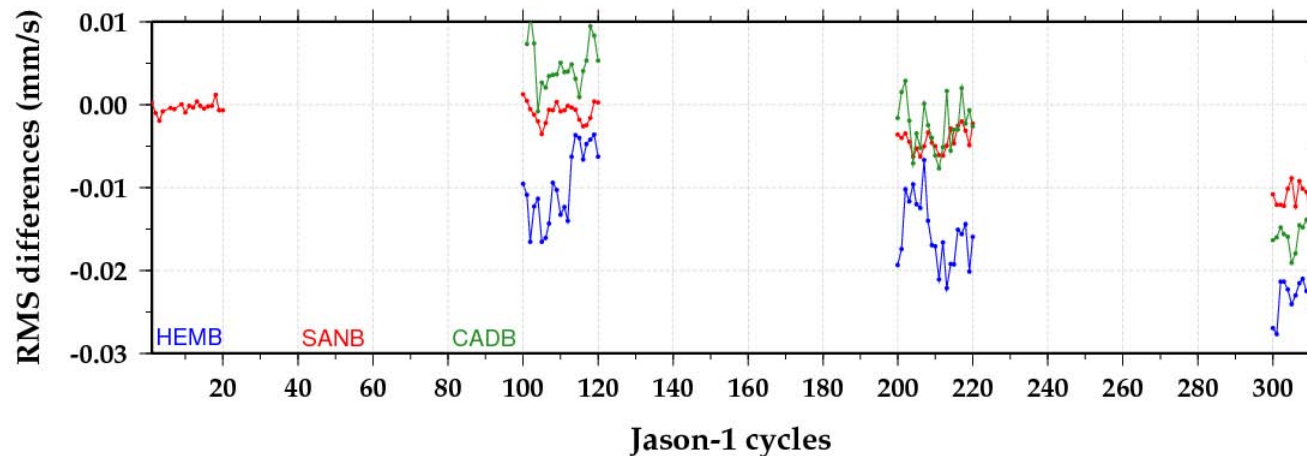
# DORIS: station-by station comparisons, Jason-2: July 2008 - Jan. 2010, ITRF2008 vs. ITRF2008d

Figure 3. Jason-2 53 DORIS station residuals cycles 1-57  
(positive implies improvement for itr2008d)





Global DORIS RMS residuals differences per cycle (ITRF2005-ITRF2008)



Jason-1 DORIS RMS residuals differences per cycle (ITRF2005-ITRF2008)

*From A. Couhert & L. Cerri (CNES)*





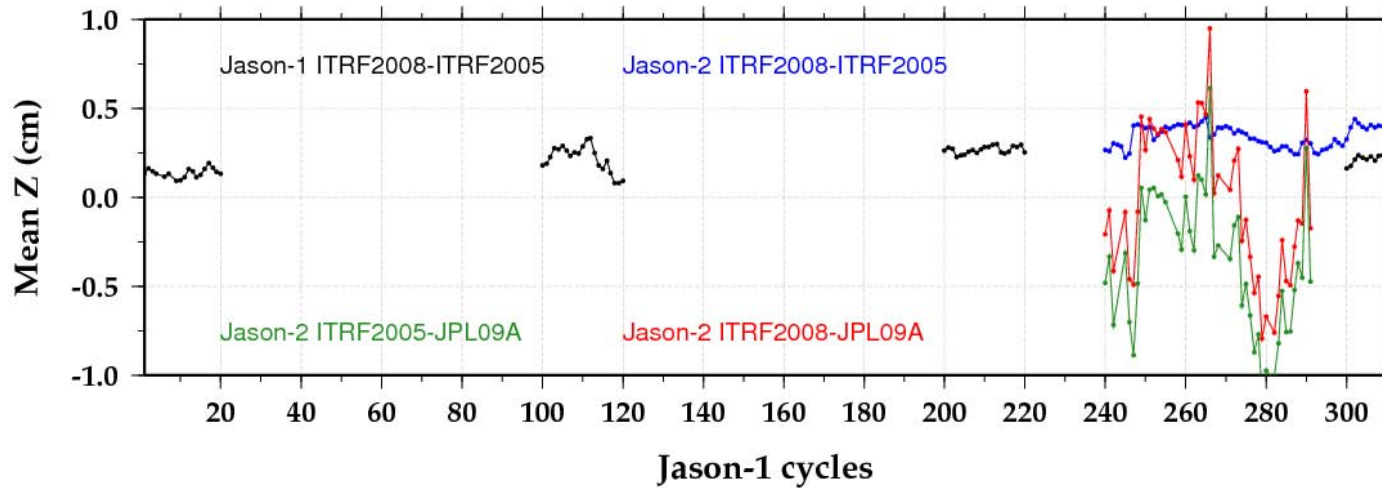
# SLR Complements: RMS of fit comparison vs time for SLR-only altimeter satellite orbits

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

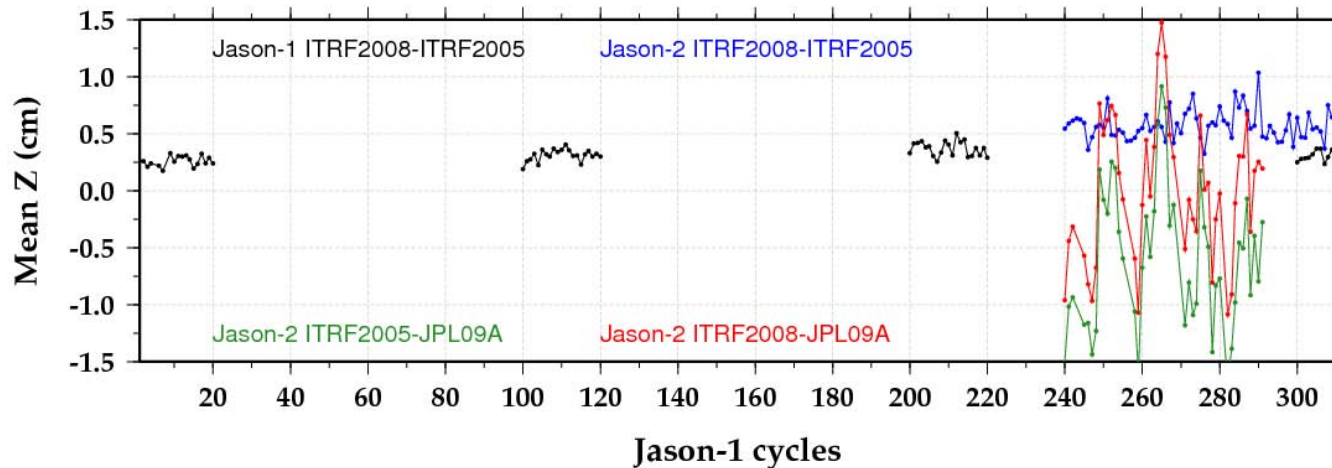
- Both ITRF2008 & ITRF2008d represent improvements wrt. LPOD2005. The few missing stations are not significant for POD.
- ITRF2008d does slightly better in the SLR & Independent Xover comparisons.
- BARG, SANF, KIEV are better (> 0.4 cm) for ITRF2008; SIME, BORO, SHAN are better (> 0.4 cm), for ITRF2008d.

*Xover fits are independent*

# Jason-1 & Jason-2 Mean-Z orbit differences



DORIS-only  
orbits

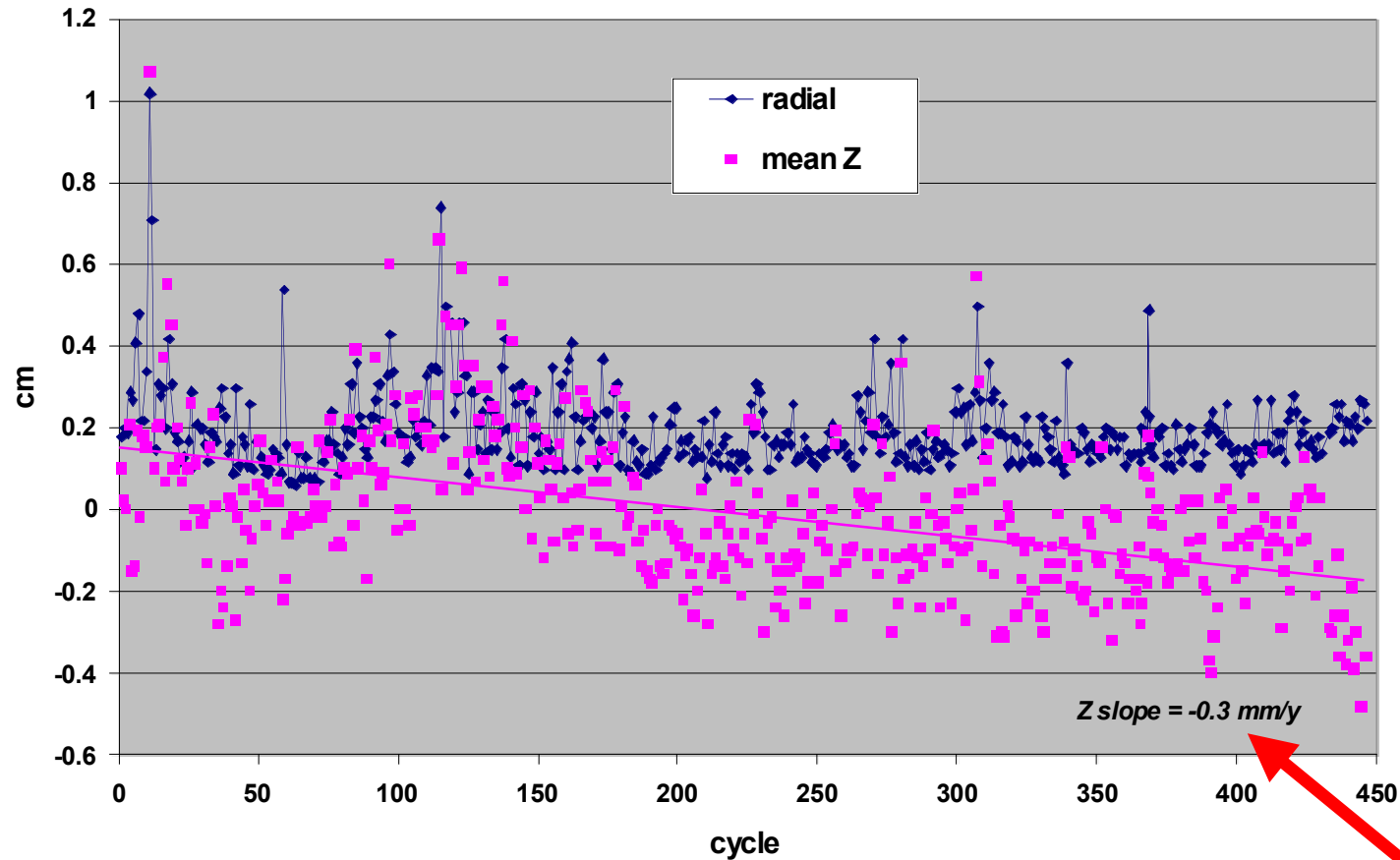


SLR+DORIS  
orbits

- Zshift in ITRF2008 orbits consistent with published transformations
- ITRF2008 DORIS & SLR/DORIS orbits agree better in Z with JPL09A GPS orbits.

*From A. Couhert & L. Cerri (CNES)*

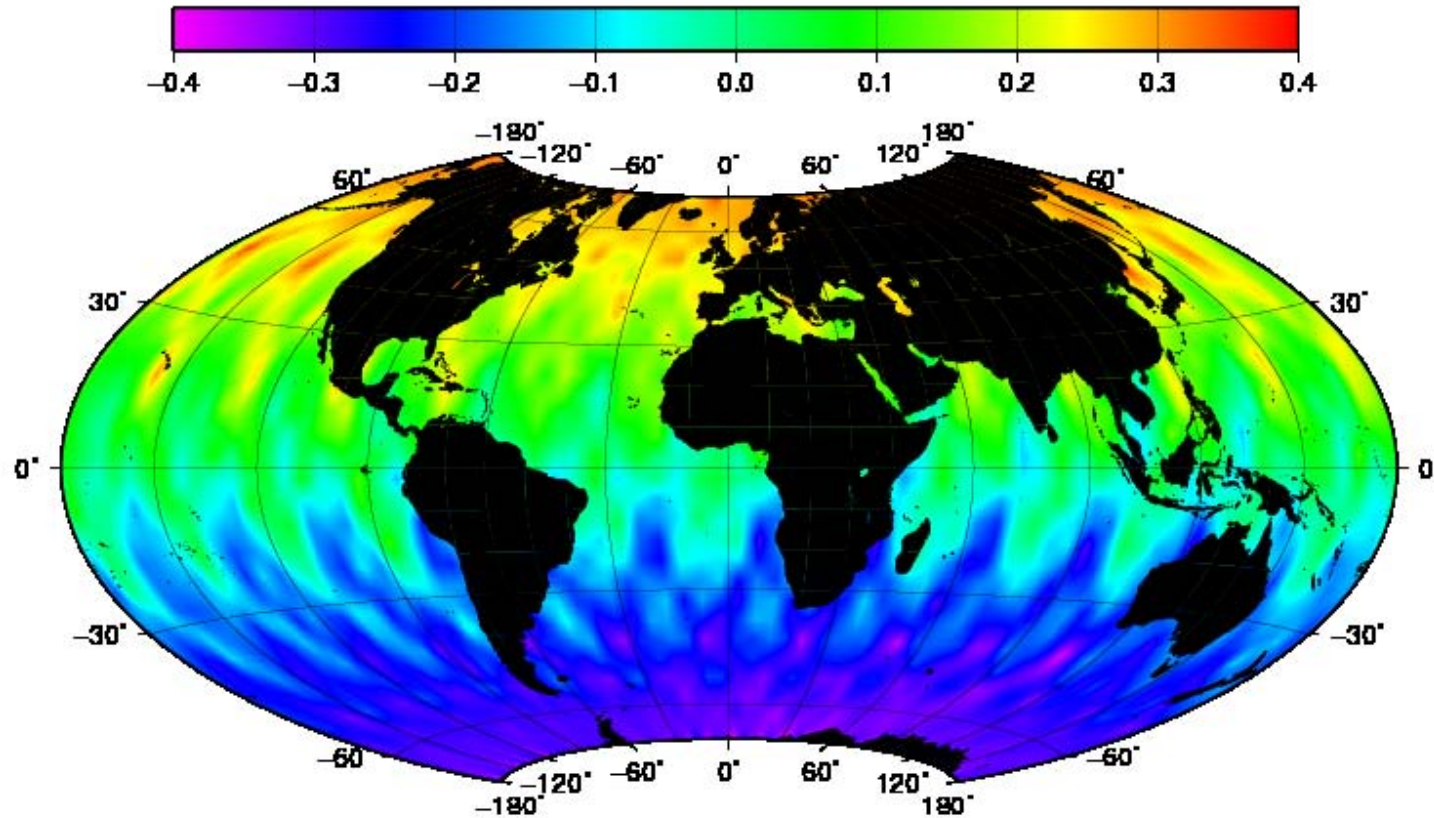
## TOPEX SLR+DORIS Orbit Differences (ITRF2005 - ITRF2008)



Network effect in differences,  
centered ~1996?

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

# TOPEX SLR+DORIS Mean Radial Orbit Difference trends over cycles 11-360 (ITRF2008 - ITRF2005) (mm/yr)



**RMS over water: +0.06 mm/yr**

Figure 8. Jason-2 ITRF2005-ITRF2008 mean radial orbit difference trends over cycles 1-75 (mm/y)

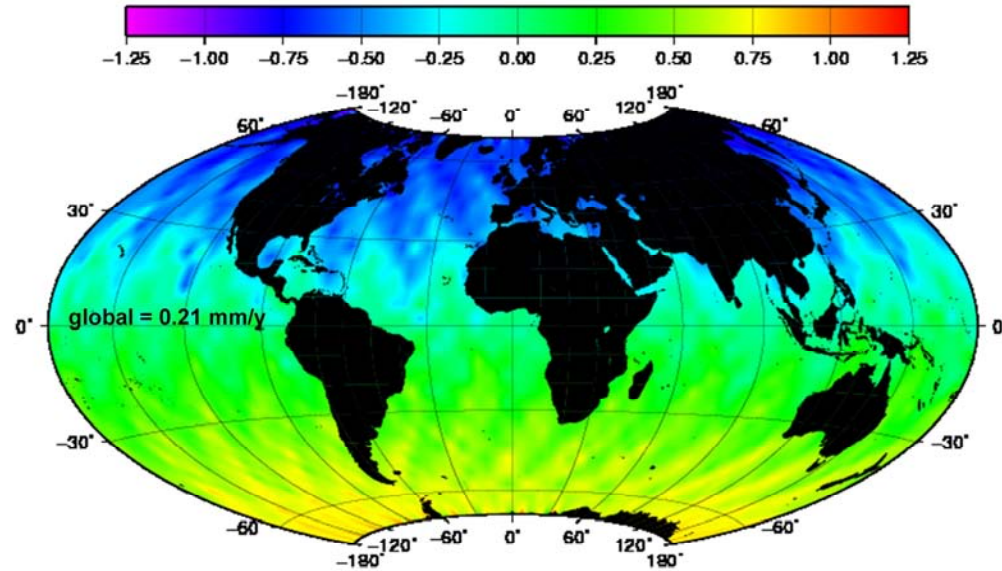
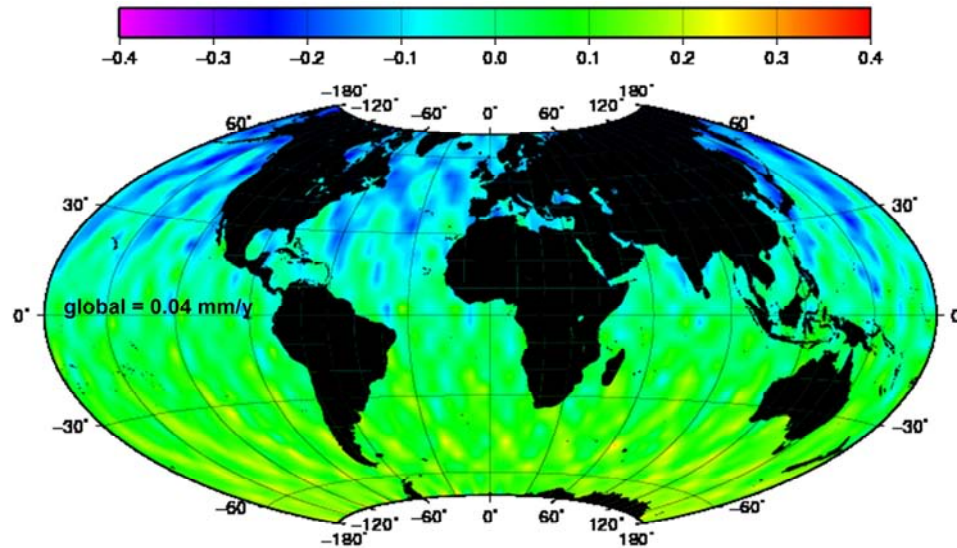
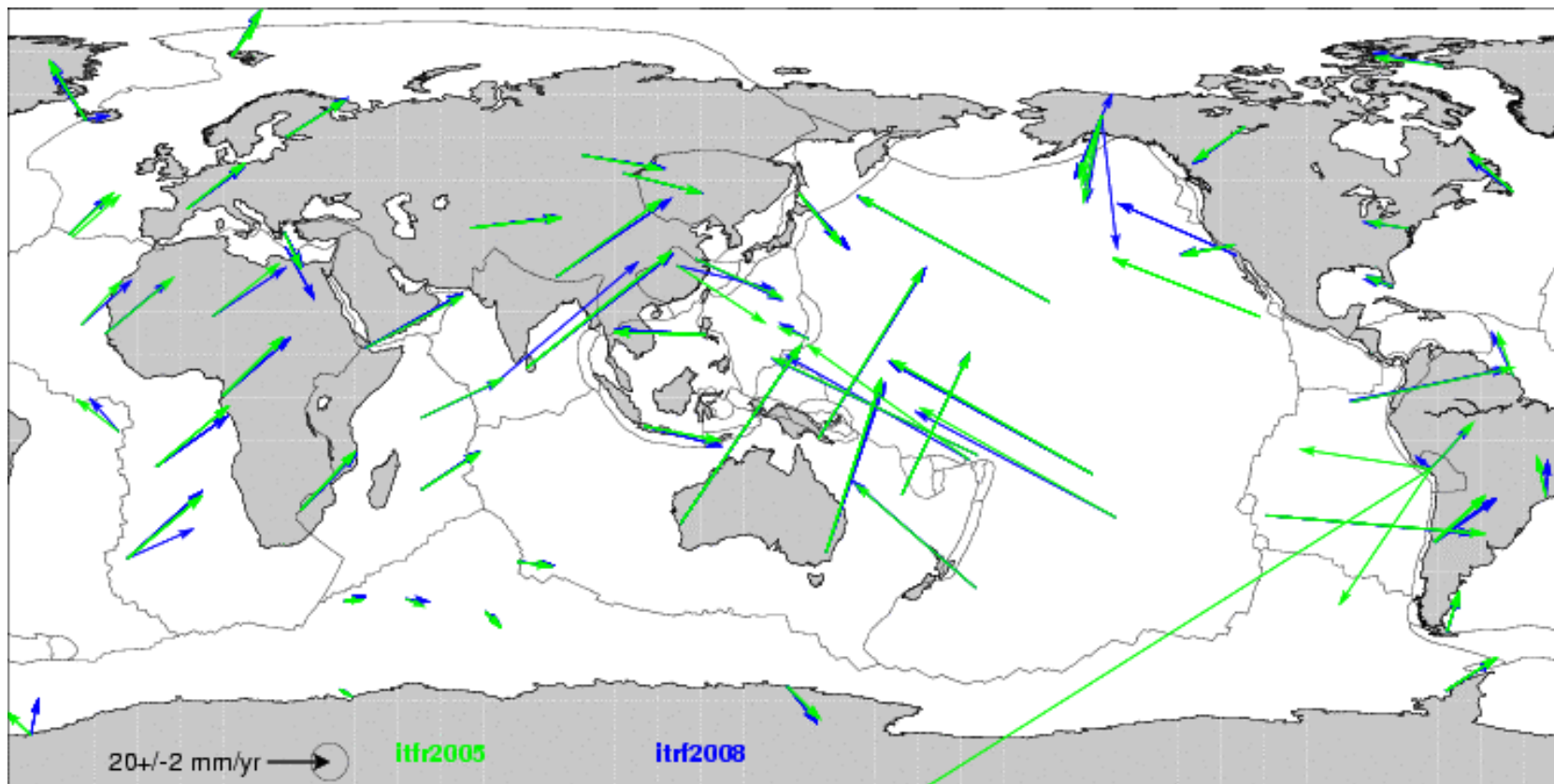


Figure 9. Jason-2 ITRF2008-ITRF2008D mean radial orbit difference trends over cycles 1-75 (mm/y)

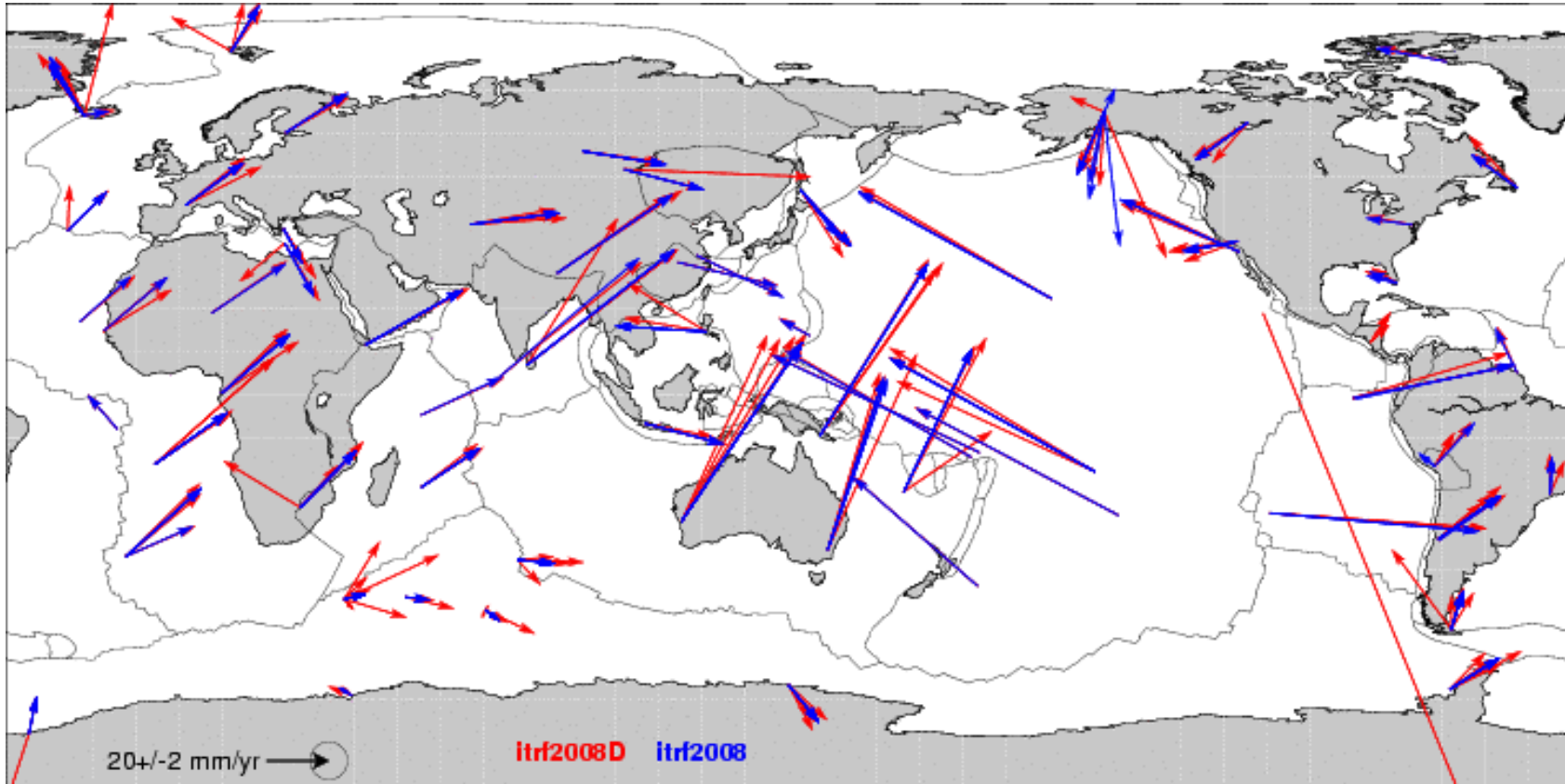


## Station horizontal velocities (ITRF2005 vs. ITRF2008)



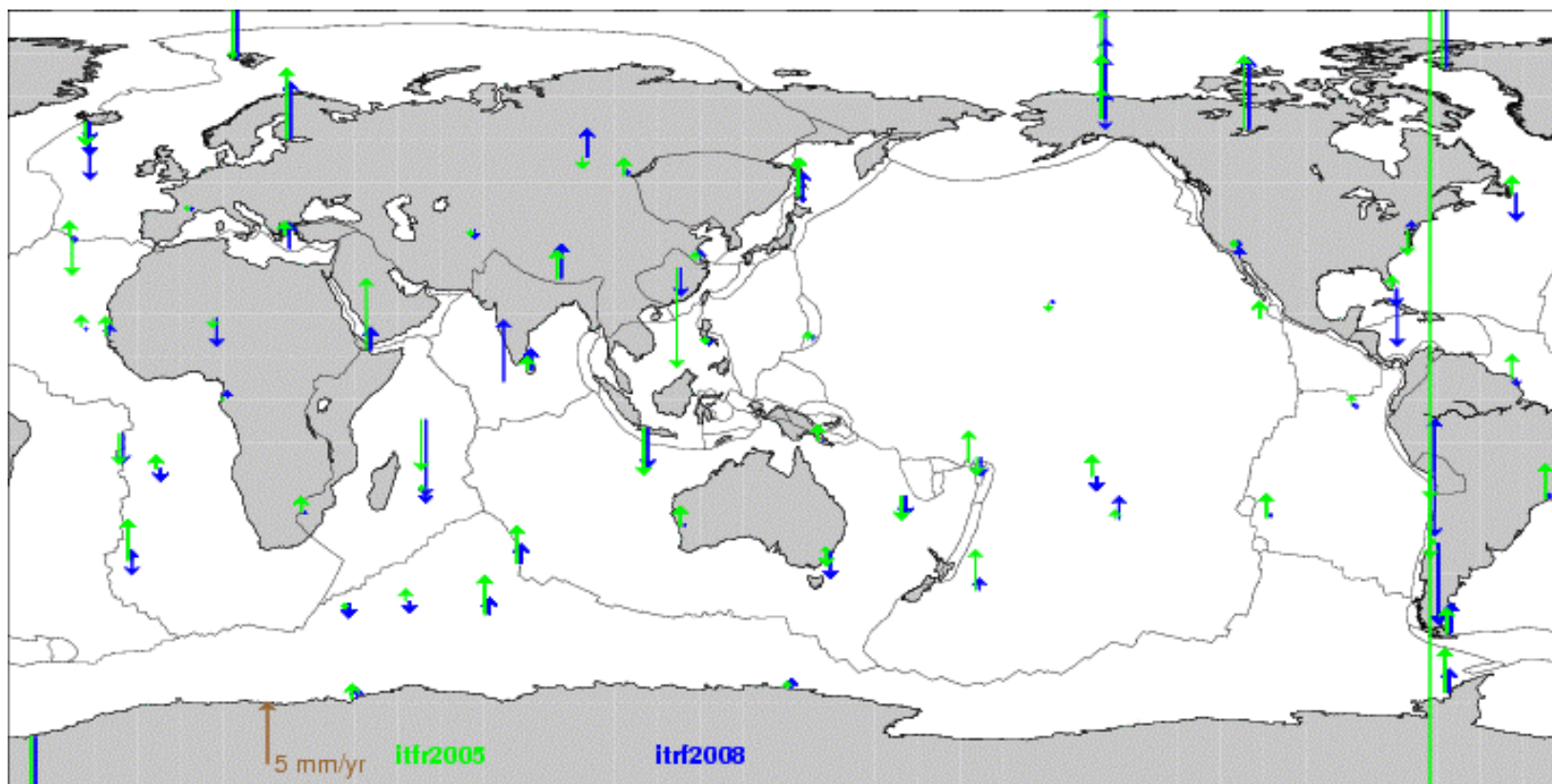
*From L. Soudarin (CLS)*

## Station horizontal velocities (ITRF2008 vs ITRF2008d)



*From L. Soudarin (CLS)*

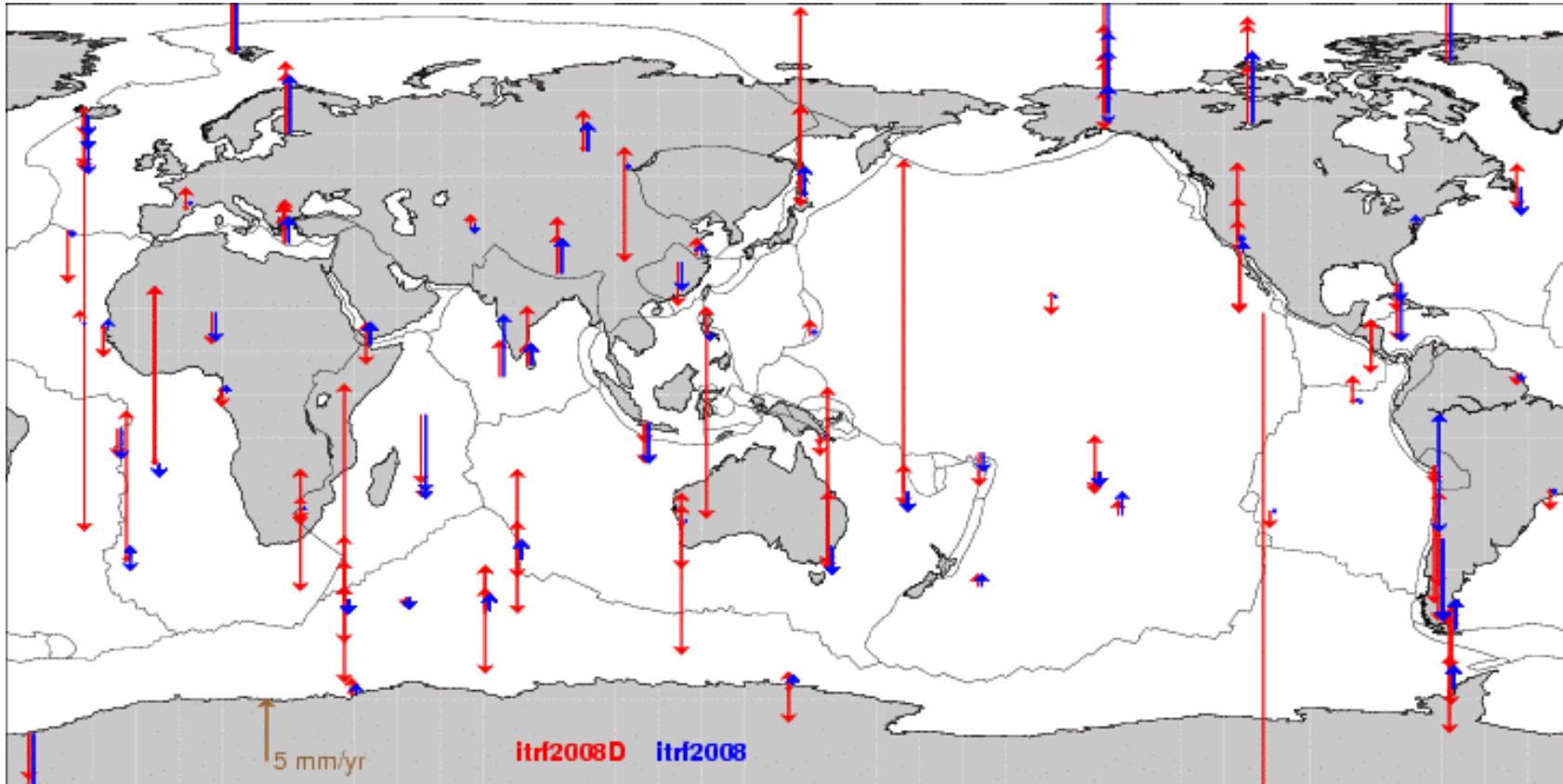
## Station vertical velocities (ITRF2005 vs ITRF2008)



*From L. Soudarin (CLS)*



## Station vertical velocities (ITRF2008 vs ITRF2008d)



From L. Soudarin (CLS)



# Summary

## DORIS:

- ITRF2008 appears to be an improvement over ITRF2005 (DPOD2005)- improvement for many stations.
- When ITRF2008d is compared to ITRF2008, it appears ITRF2008 has better fits for most DORIS stations (this may be related to station velocity issues at some sites in ITRF2008d).

## SLR:

- ITRF2008 is an across the board improvement compared to ITRF2005 (LPOD2005). ITRF2008d SLR complement may be slightly better centered than that of ITRF2008 - hence the reason for the improved xover fits (eg. RSS difference in Xover variances corresponds to ~2mm of radial orbit improvement for TP in 2002)

## DORIS+SLR

- Over 1993-2002 (TOPEX); Total Zrate is -0.3 mm/yr; change in radial orbit diff trends (over oceans) is -0.06 mm/yr
- Over 2008-2010 (Jason2) mean radial orbit diff. trends (over oceans) is 0.2 mm/yr for ITRF2005-ITRF2008, and 0.04 mm/yr for ITRF2008-ITRF2008d

## DORIS Ground Network

