



# G11C-05 - IDS and ITRF2013: Contribution and Evaluation

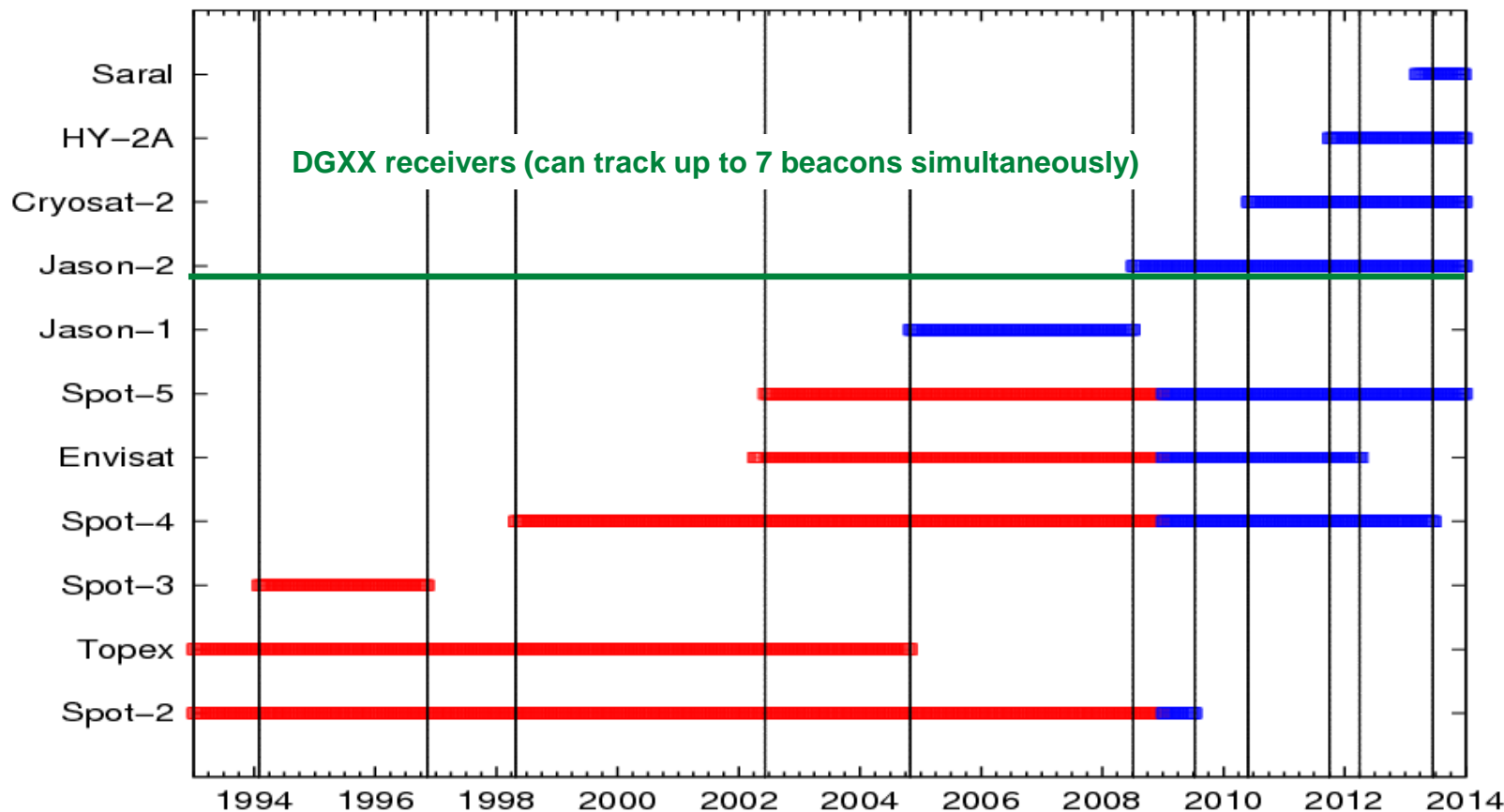
G. Moreaux, F. Lemoine and all IDS ACs

- **ITRF2013**
  - DORIS data and constellation
  - Forces and Models
  - Evaluation (Helmert parameters, station positions, EOPs)
- **IDS plans for possible extension of ITRF2013 to year 2014.**



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# DORIS ITRF2013 Constellation



→ ITRF2013 = ITRF2008

+ Jason-1 (SAA corrected data) between Topex and Jason-2 only

+ Spot-5 SAA corrected from 2006

+ new missions (Jason-2, Cryosat-2, HY-2A\*, Saral\*)

- **Main features**

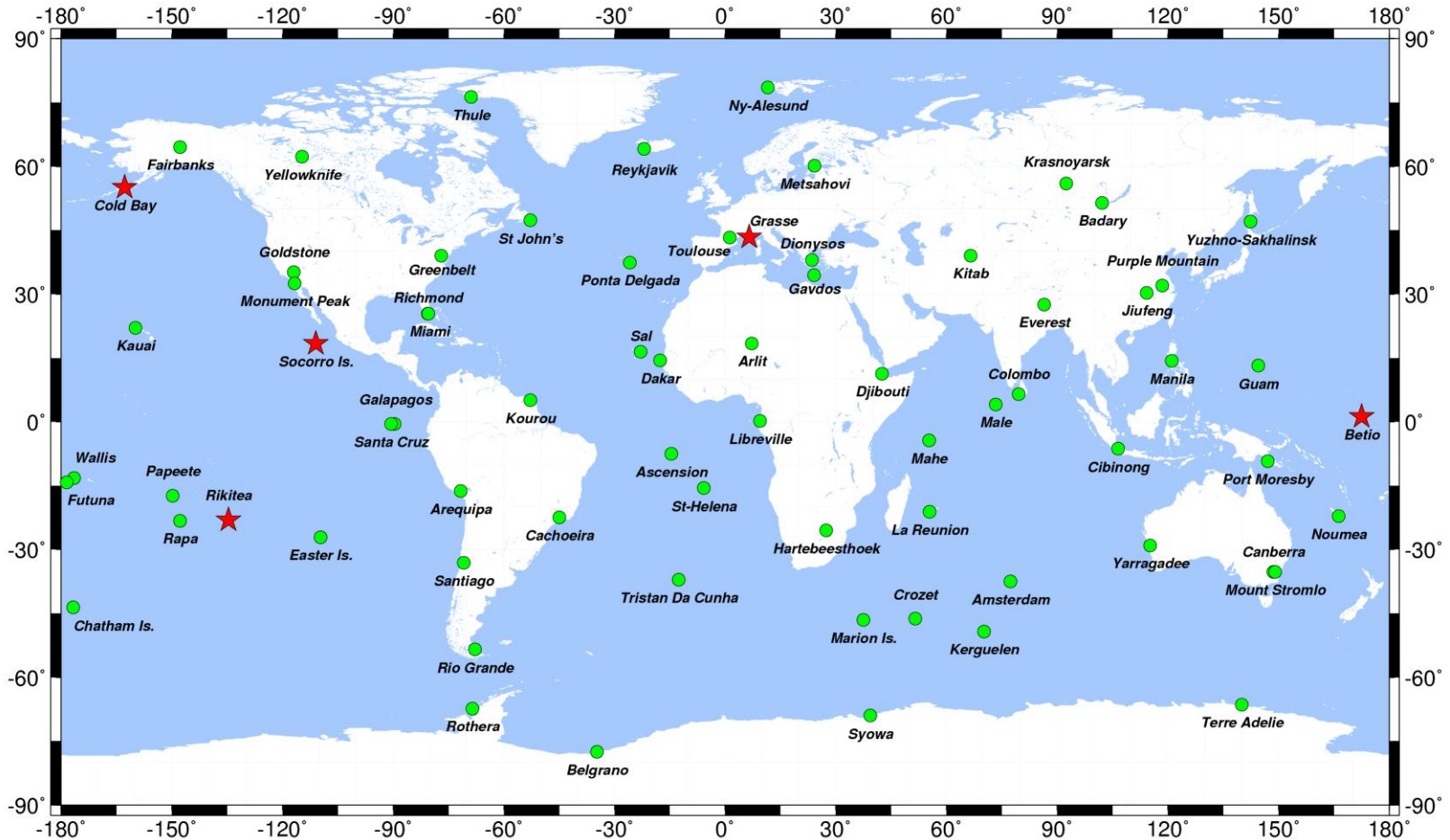
1. **Time variable Gravity field:** EIGEN-6S2 or GOCO02s (GRACE + GOCE model) + harmonic fit to 5x5 SLR-DORIS time series (Lemoine et al., 2011)
2. **Atmospheric loading:** Not applied, since not all the ACs can take it into account
3. **Nonconservative force models:** updated/improved as result of dedicated study initiated and managed by the IDS Analysis Coordinator
4. **Troposphere**
  - gradient estimation by some ACs (2-3 of 6 ACs)
5. **Beacon frequency offset:** now estimated by all the ACs
6. **Phase center antenna corrections** (PCV: Alcatel/Starec)

- 6 ACs from 6 different institutions with 5 different software packages for orbit determination

AC	Software	Series number	Solution Type	Phase laws	Time Span	Nb of SINEXs	EOPs
ESA	NAPEOS	10	NEQ	Yes	1993.0-2014.0	1079 (1056)*	Motion+rate+LOD
GOP	BERNESE	43	COV	Yes	1993.0-2014.0	1088 (1073)*	Motion+rate
GSC	GEODYN	26	NEQ	Yes	1993.0-2014.0	1096 (1071)*	Motion
IGN	GIPSY-OASIS II	15	COV	Yes	1993.0-2014.0	1089 (1035)*	Motion+rate+LODR+UT
INA	GIPSY-OASIS	08	COV	No	1993.0-2014.0	1096 (913)*	Motion+rate+LODR+UT
GRG (LCA)	GINS-DYNAMO	40	COV	Yes	1993.0-2014.0	1092 (1083)*	Motion
<b>IDS</b>	<b>CATREF</b>	<b>07</b>	<b>COV</b>		<b>1993.0-2014.0</b>	<b>1093</b>	<b>Motion</b>

(xxx) \*= number of weeks included in the IDS combined solution

# DORIS ITRF2013 Network



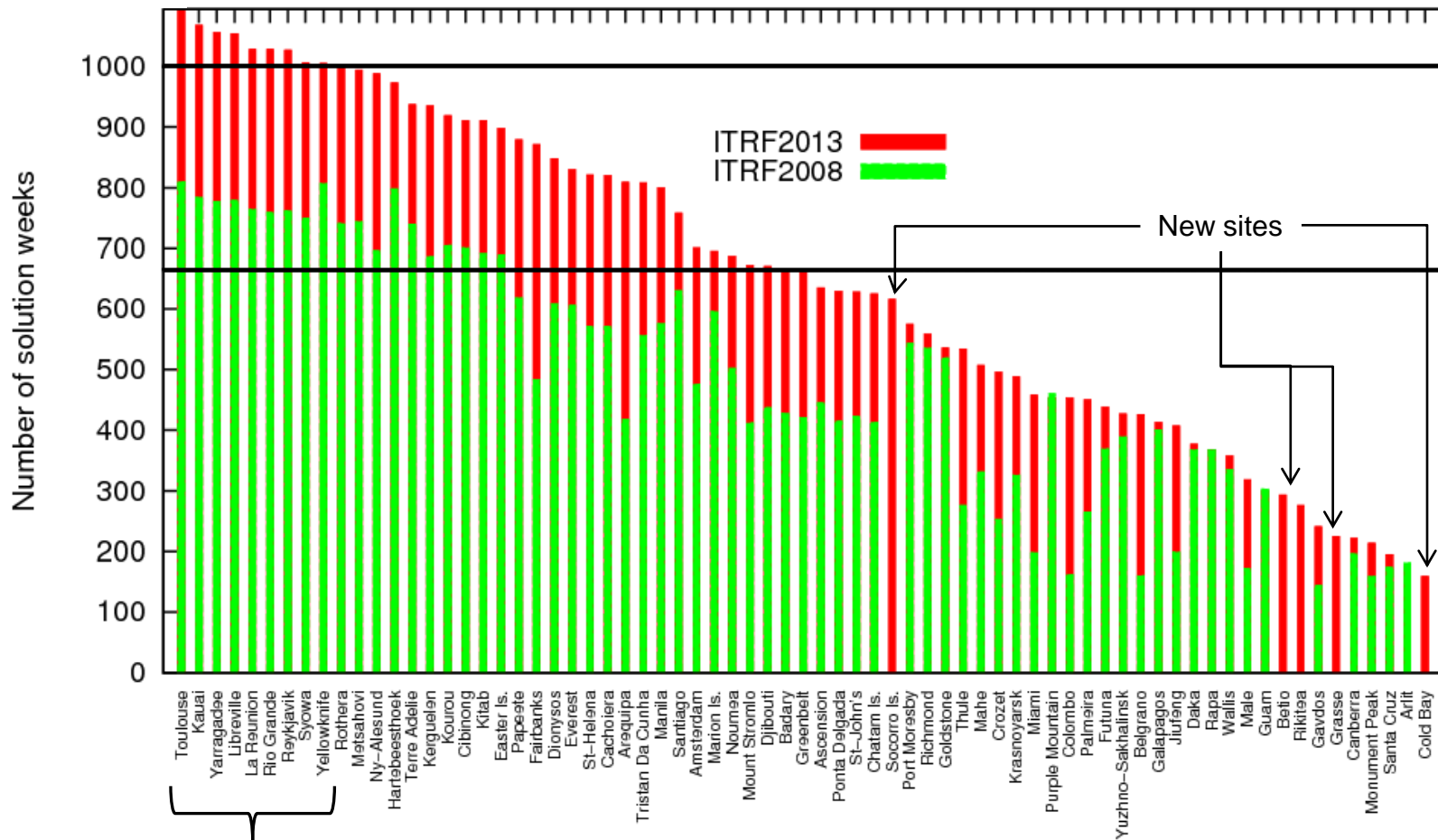
➔ 156 stations over 71 sites (38 in northern hemisphere).

➔ 5 new sites (★) wrt ITRF2008: Betio, Cold-Bay, Grasse, Rikitea and Socorro.



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# DORIS ITRF2013 Network Observability



9 stations with more than 1000 weeks

Min: 159 weeks (≈ 3 years)

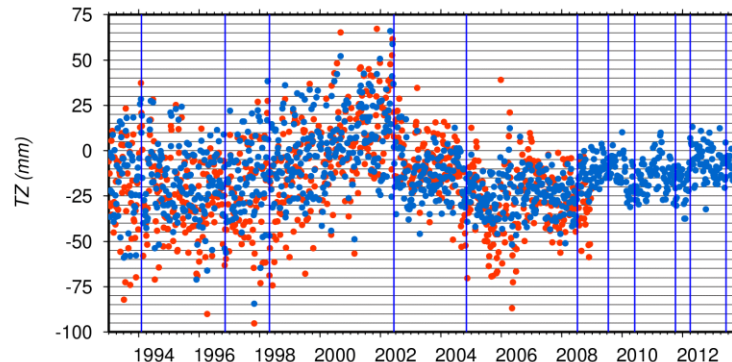
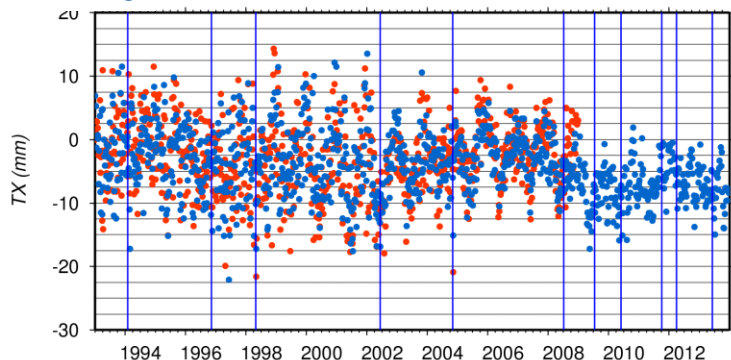
Max: 1093 weeks (≈ 21 years, i.e. 1993.0-2014.0)

Median: 665 weeks (≈ 13 years)

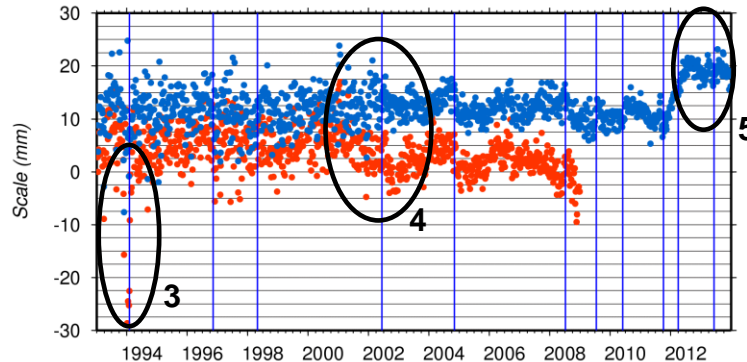
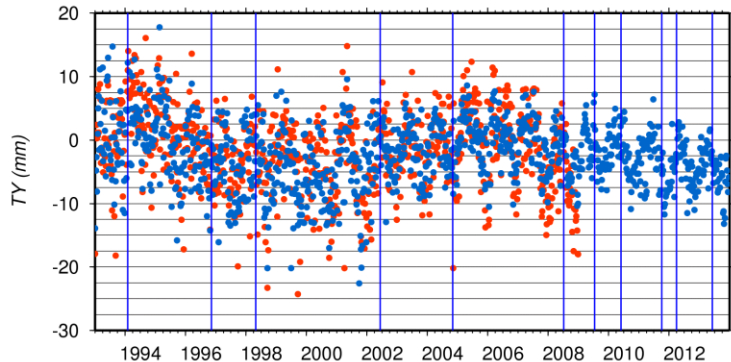


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# IDS Combined Solution Helmert parameters wrt ITRF2008



ITRF2008: **ids 01** – ITRF2013: **ids 07**



- 1) Improvements of Tx, Ty and Tz after 2002 (lower STDs, less annual signal).
- 2) Scale offset due to beacons PCVs in ITRF2013 processing.
- 3) Less scale spurious values early 1994 (Spot-2 is no more included in the combined scale).
- 4) No more scale factor discontinuity in 2002 thanks to beacon frequency offset estimations.
- 5) Scale factor increase mid 2012 (lower for ids 07 compared to ids 05/06 – previous deliveries to IERS).
- 6) Better week-to-week repeatability of Helmert parameters of ids 07 (solution more consistent).

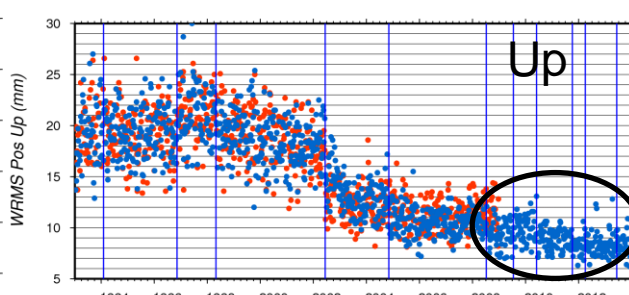
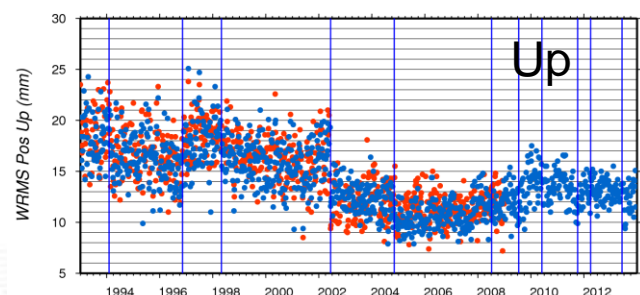
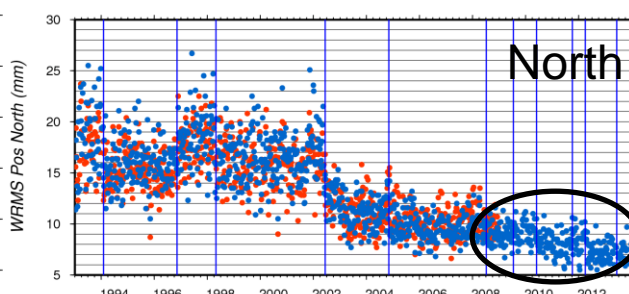
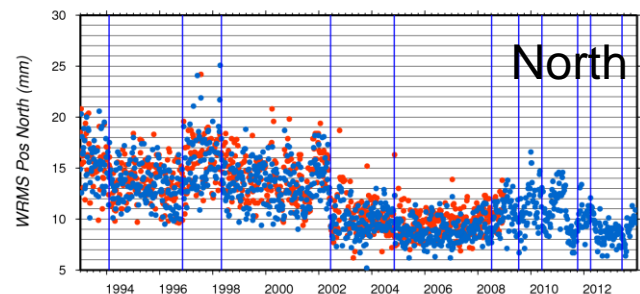
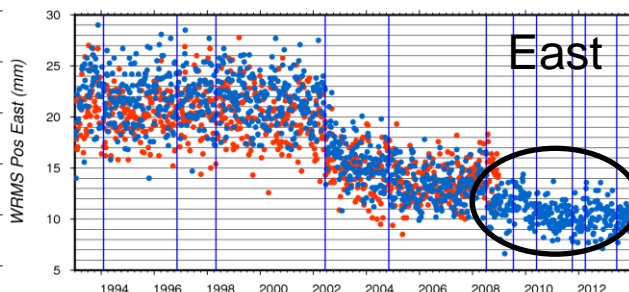
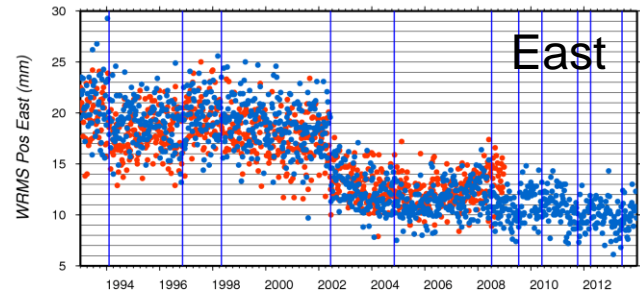


# IDS Combined Solution WRMS of Station Position Residuals

wrt ITRF2008

wrt ITSELF

(→ week-to-week repeatability)



- wrt ITRF2008  
Impact of ITRF2008 after 2009.

- Week-to-week Repeatability  
Positive impact of DG-XX missions.  
Better results of ids 07 compared to ids05/06

		ids 01	ids 07
1993-2002	North	16.2 (2.4)	16.8 (2.7)
	East	20.4 (2.5)	21.9 (2.5)
	Up	19.2 (2.7)	19.3 (2.7)
2002-2008	North	10.6 (1.6)	10.4 (1.6)
	East	14.1 (2.0)	14.2 (2.3)
	Up	11.6 (1.7)	11.6 (2.0)
2008-2014	North	9.7 (0.9)	8.2 (1.3)
	East	14.5 (1.8)	10.6 (1.4)
	Up	11.3 (1.5)	8.9 (1.3)

Statistics (mean and std - mm)  
of week-to-week repeatability

ITRF2008: **ids 01** – ITRF2013: **ids 07**

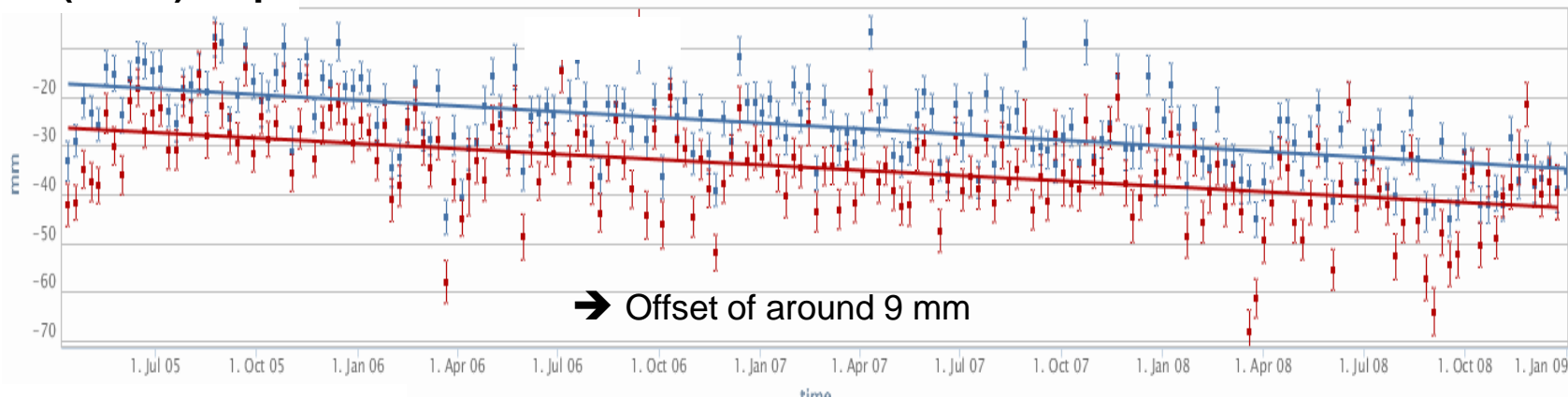


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# IDS ITRF2013 vs IDS ITRF2008 Impact of Beacon Frequency Offsets - Examples

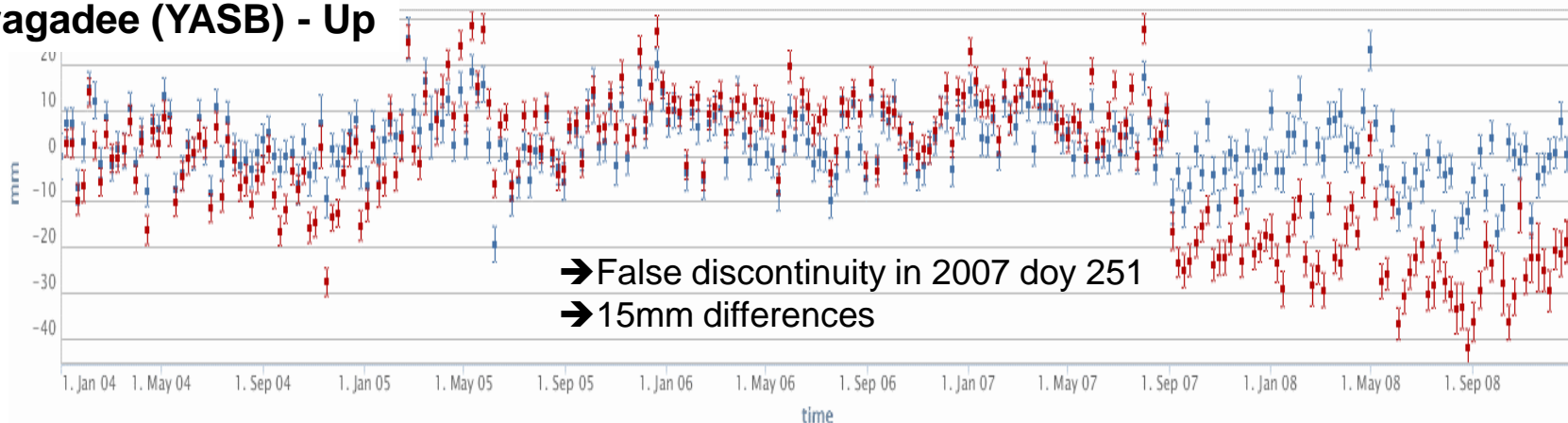
## Miami (MIAB) - Up

ITRF2008: **ids 01** – ITRF2013: **ids 07**



→ Offset of around 9 mm

## Yarragadee (YASB) - Up

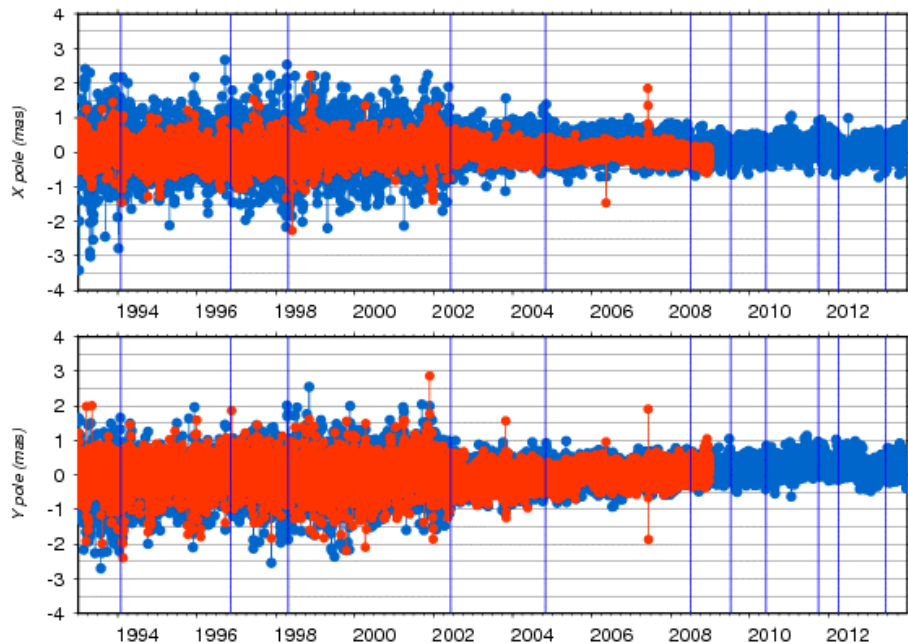


→ False discontinuity in 2007 doy 251

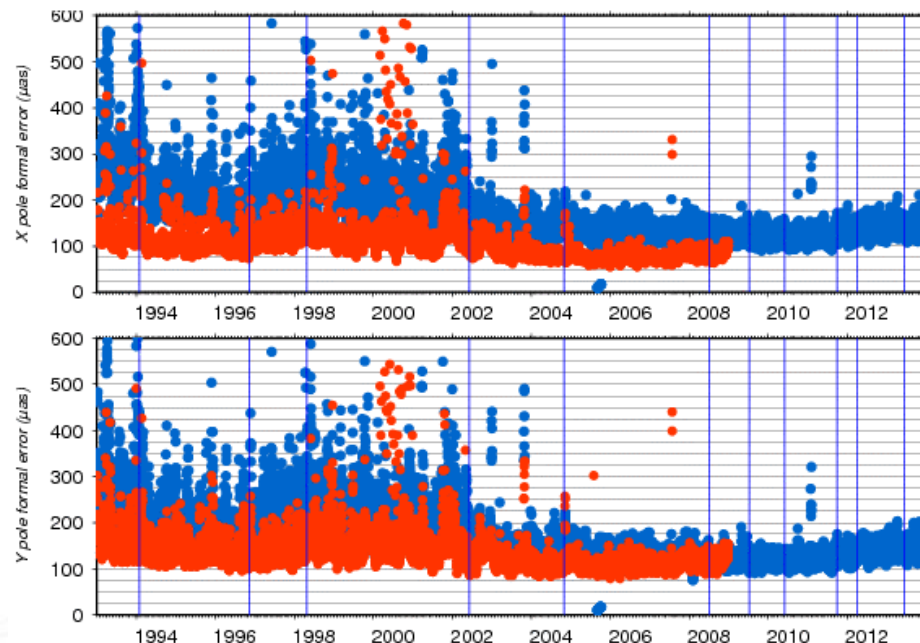
→ 15mm differences

→ Less discontinuities compared to ITRF2008 between 1993.0 and 2009.0

Differences wrt IERS C04 series



Formal errors



ITRF2008: **ids 01** – ITRF2013: **ids 07**

1. Slightly better performances of ids 07 compared to ids 05/06.
2. Substantial degradation of ids 07 before 2002 mainly
  - i. STDs of differences with IERS C04 are 2 times larger on X.
  - ii. Formal errors are higher.

Possible origin: two ACs less for ITRF2013 (ESA and GAU)

+ larger STDs for some individual solutions wrt ITRF2008 contribution's.

- **Summary of IDS contribution to ITRF2013**

- **For DORIS: 6 Analyses Centers**
- **Data Span: 1993.0-2014.0**
- **Results improved**
  - **When more satellites are available (after 2002.5)**
  - **With new DGXX receivers data (Jason-2, Cryosat-2, HY-2A...)**
  - **With beacon frequency offsets included: removes sporadic jumps in the station height for some stations as well as scale jump early 2002**
  - **With updated satellites macromodels**
- **Deliveries: 4 series from April 17th to December 5th (07).**
- **All the series (Helmert parameters and station position) can be visualized through the IDS Web Service (<http://apps.ids-doris.org/apps/>)**

- **What about 2014 ?**

**Due to data and external files latency and to strictly respect the IERS deadline of February 27th, IDS propose to go through late August 2014 → new data span: 1993.0 – 2014.75**