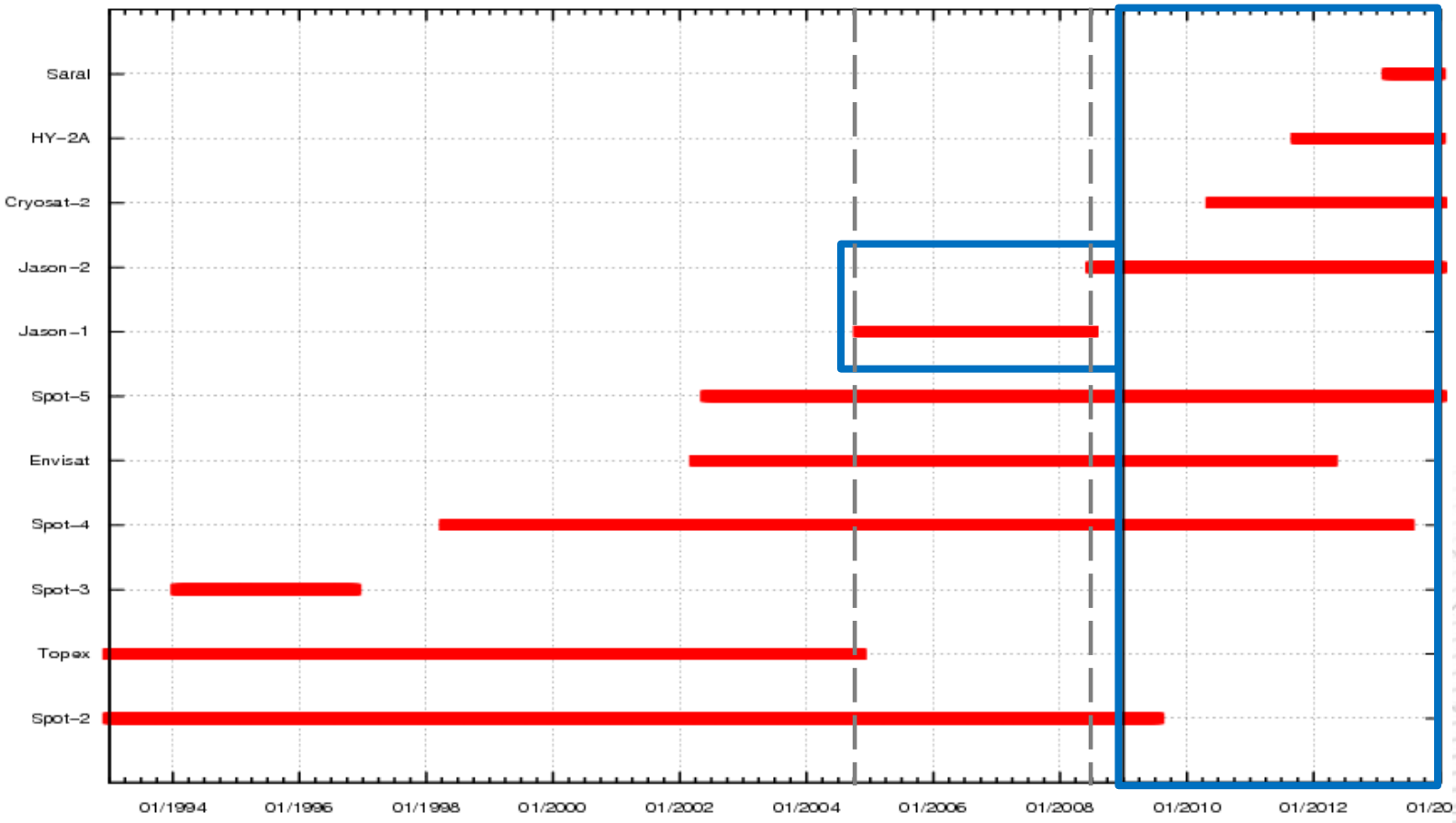
IDS Contribution to ITRF2013

G. Moreaux, F. Lemoine and all ACs

DORIS data for ITRF2013

Mission	ITRF2008	ITRF2013	Comments
Envisat	Yes	Yes	New Data 2002 to 2007/DOY178
Spot-2	Yes	Yes	Data after 1993 only
Spot-3	Yes	Yes	
Spot-4	Yes	Yes	New data set for 1998
Spot-5	Yes	Yes	New data set including SAA model correction from JM Lemoine, H Capdeville and P Stepanek
TOPEX	Yes	Yes	
Jason-1	No	Optional	New data set including SAA model correction from JM Lemoine and H Capdeville From end of TOPEX (Nov. 2004) to start of Jason-2 (July 2008)
Jason-2		Yes	
Cryosat-2		Yes	
HY-2A		Optional	ACs are free to include or not this mission as long as it does not degrade their solution (2.5 years of data)
Saral		Optional	ACs are free to include or not this mission as long as it does not degrade their solution (6 months of data)

DORIS ITRF2013 Constellation



➔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*)

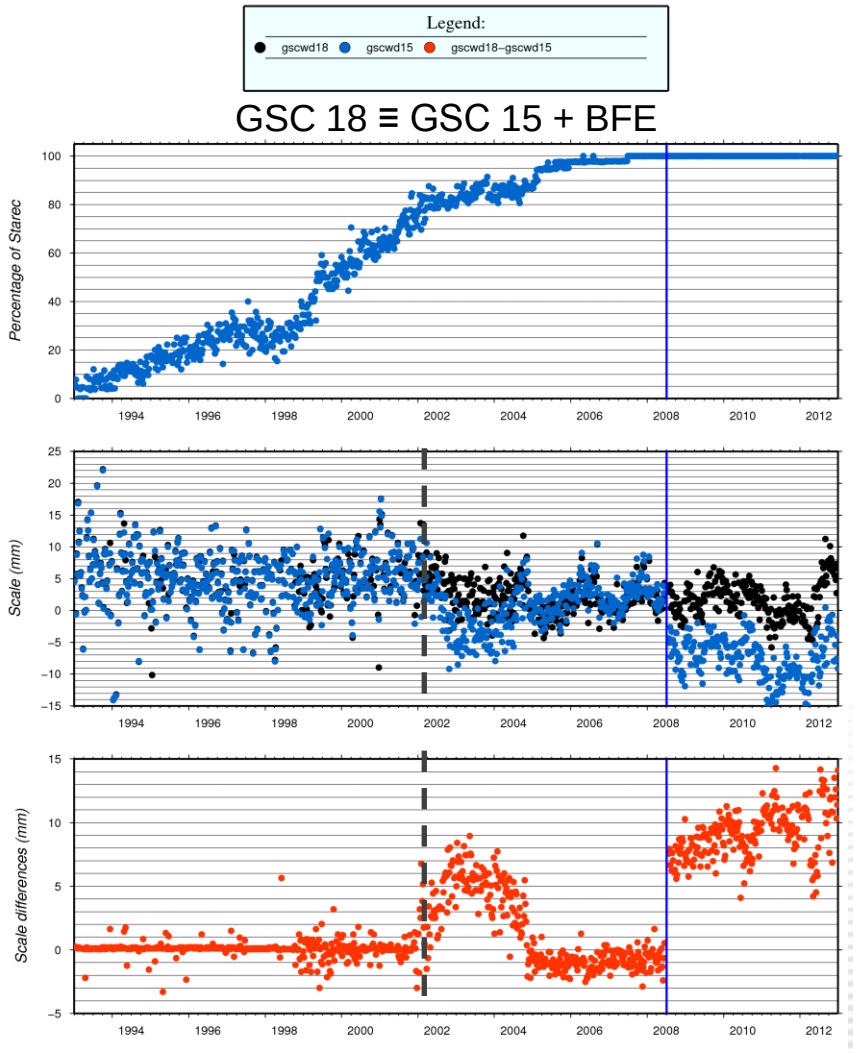
*not processed by all the ACs

Forces and Models for ITRF2013

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

Beacon Frequency Estimation

GSC 18 ≡ GSC 15 + BFE



ESA: GSA 07 ≡ FSA 06 + BFE

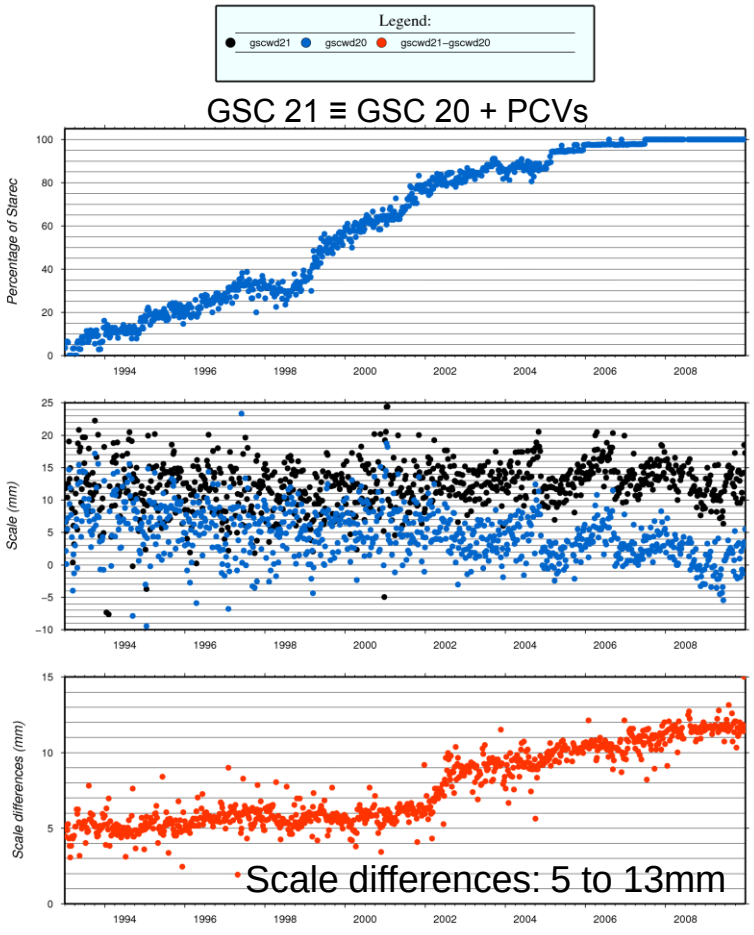
Estimation of beacon frequency

➔ **Impact on the scale after 2002.0**

➔ **Impact on the vertical component of some station positions**

Handled by all the ACs for ITRF2013 while by 3 of 7 ACs for ITRF2008

Phase Center Antennae Correction



Use of Starec and Alcatel PCVs

➔Impact on the scale factor only (differences from 5 to 13 mm)

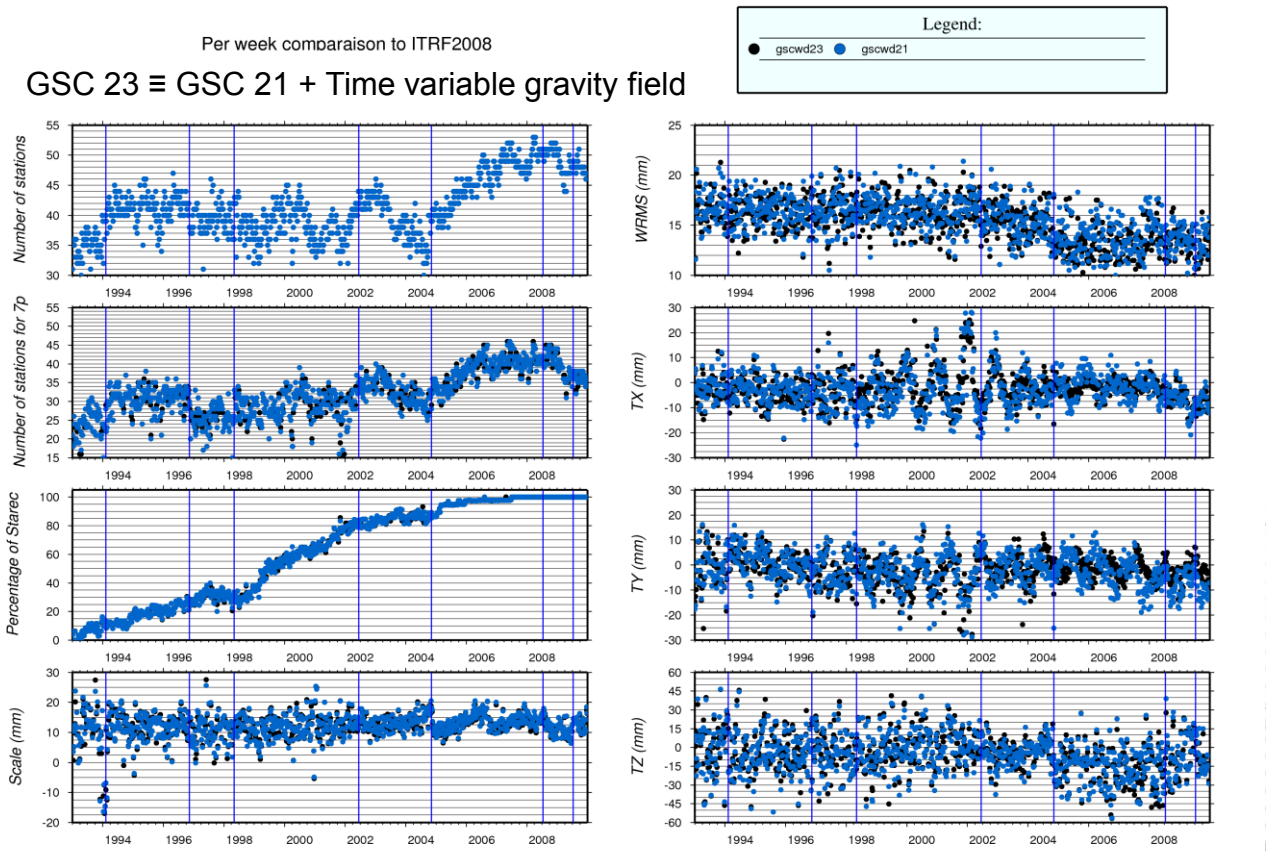
➔**AC not implementing DORIS antennas PCVs will not contribute to the combined scale factor**

➔ No impact on station positions

➔ Effect must depend on

- DORIS beacon network
- DORIS constellation
- Elevation cut-off angle

Time Variable Gravity Field



Time variable gravity field

- ➔ **Reduction of annual signals in Tx and Ty after 2002**
- ➔ **Slightly lower STDs of EOPs differences wrt IERS C04 series**
- ➔ No impact on station positions

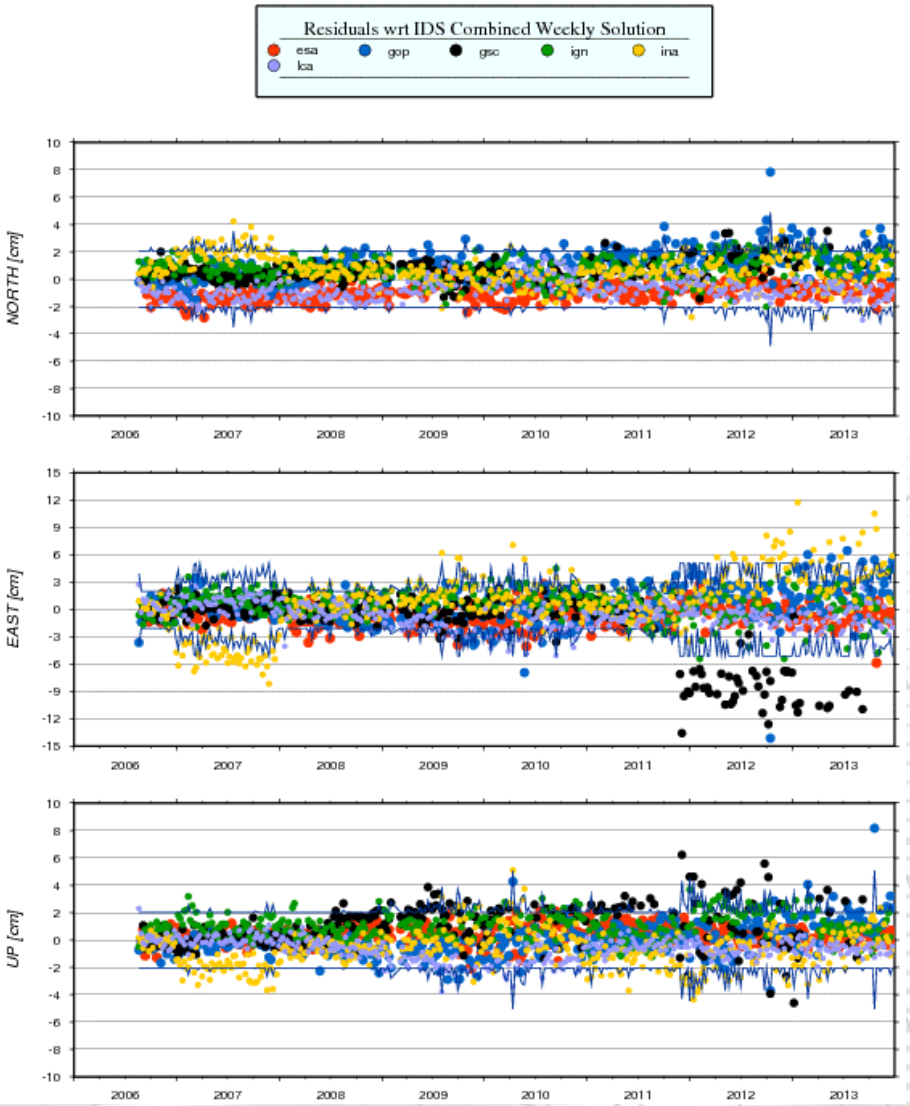
IDS Combination Process

- Overall rule from the CC: do not exclude any AC.

- Weekly combination for weeks processed by at least 3 ACs.
- Time Span: 1993.0 – 2014.0

- Sites observed by less than 2.5 years are not part of the combined solution.
- For all the stations, periods referenced in the IDS DORIS station events data base as « data gap » or as « lack of data » are not taken into acccount even if they have been processed by some ACs.
- Each week, stations positioned by less than 3 ACs are not processed.

- AC not implementing DORIS beacon PCVs does not contribute to the combined scale.
- Iterative process to delete for a given week and a given station ACs contributions which differ too much from the combined solution.

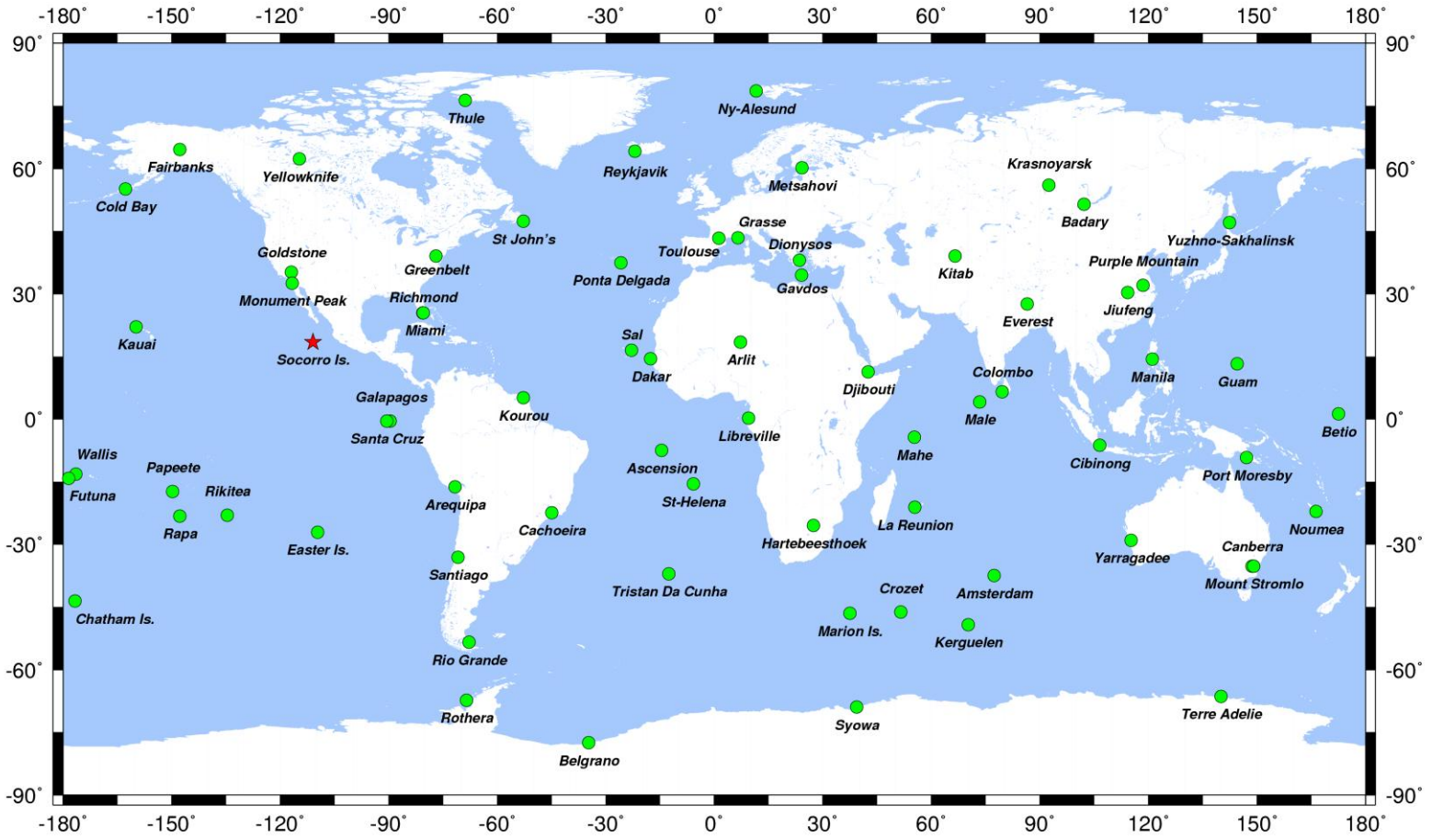


ACs Contributions

- 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 (08-)	NEQ	Yes	1993.0-2014.0	1079	Motion+rate+LOD
GOP	BERNESE	43 (42-)	COV	Yes	1993.0-2014.0	1088	Motion+rate
GSC	GEODYN	26 (20-)	NEQ	Yes	1993.0-2014.0	1096	Motion
IGN	GIPSY-OASIS II	15 (10-)	COV	Yes	1993.0-2014.0	1086	Motion+rate+LODR+UT
INA	GIPSY-OASIS	08	COV	No	1993.0-2014.0	1096	Motion+rate+LODR+UT
LCA	GINS-DYNAMO	40 (37-)	COV	Yes	1993.0-2014.0	1082	Motion
IDS	**CATREF**	**06 (04-)**	**COV**		**1993.0-2014.0**	**1093**	**Motion**

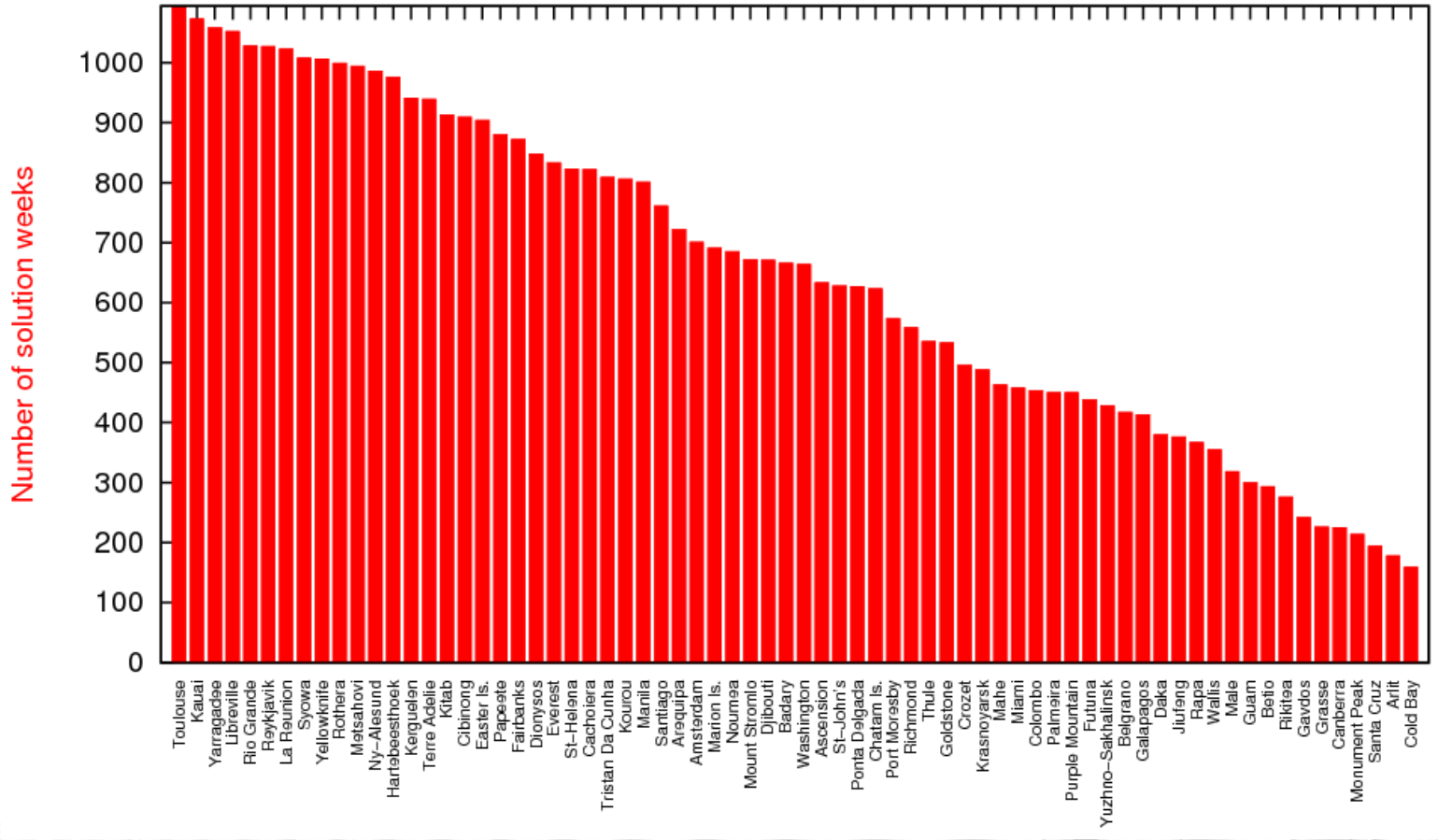
DORIS ITRF2013 Network from IDS 13v4.2



➔149+5 stations over 70+1 sites (38 in northern hemisphere)

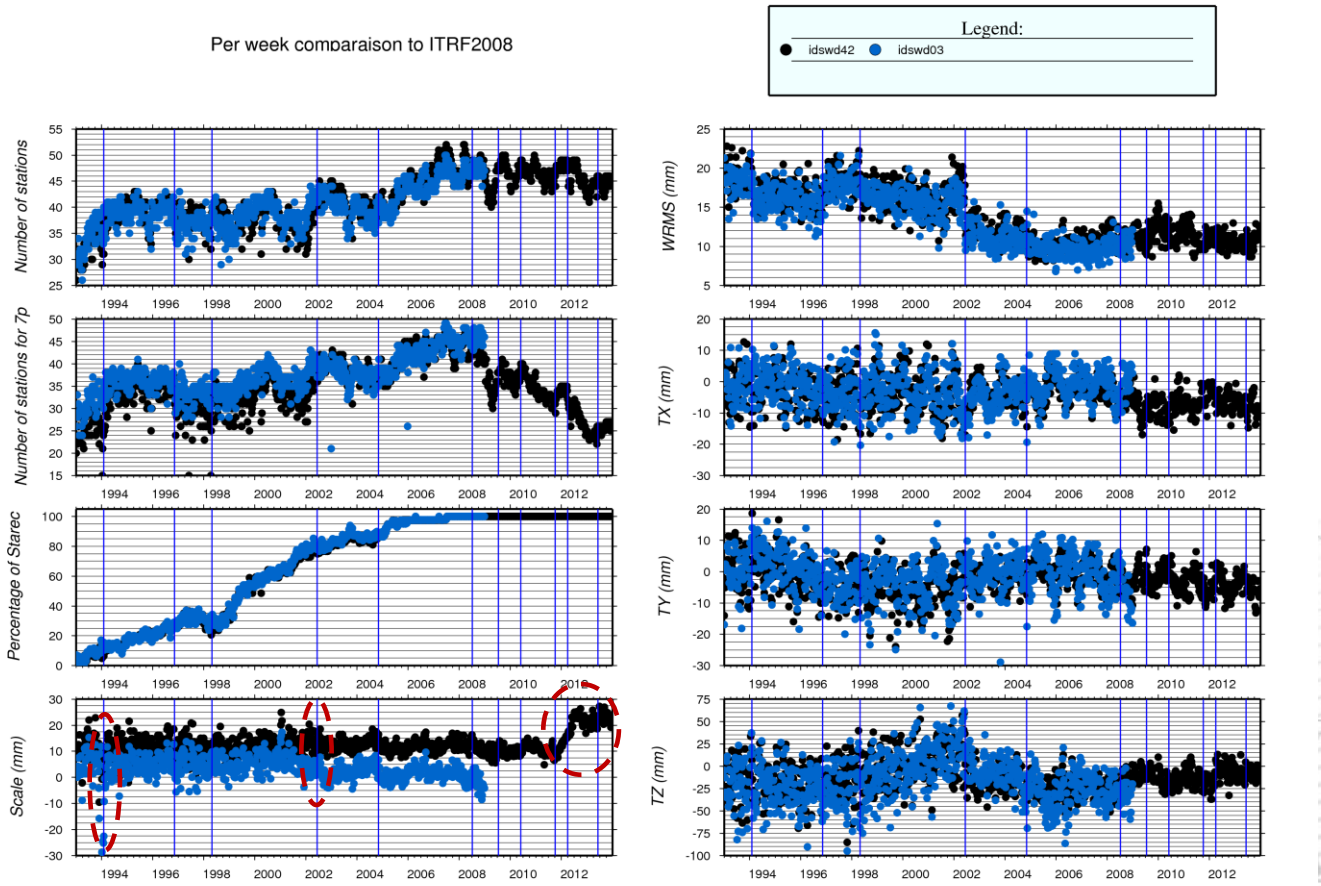
➔4+1 new sites wrt ITRF2008: Betio, Grasse, Rikitea and Cold-Bay + Socorro

DORIS ITRF2013 Network Observability from IDS 13v4.2



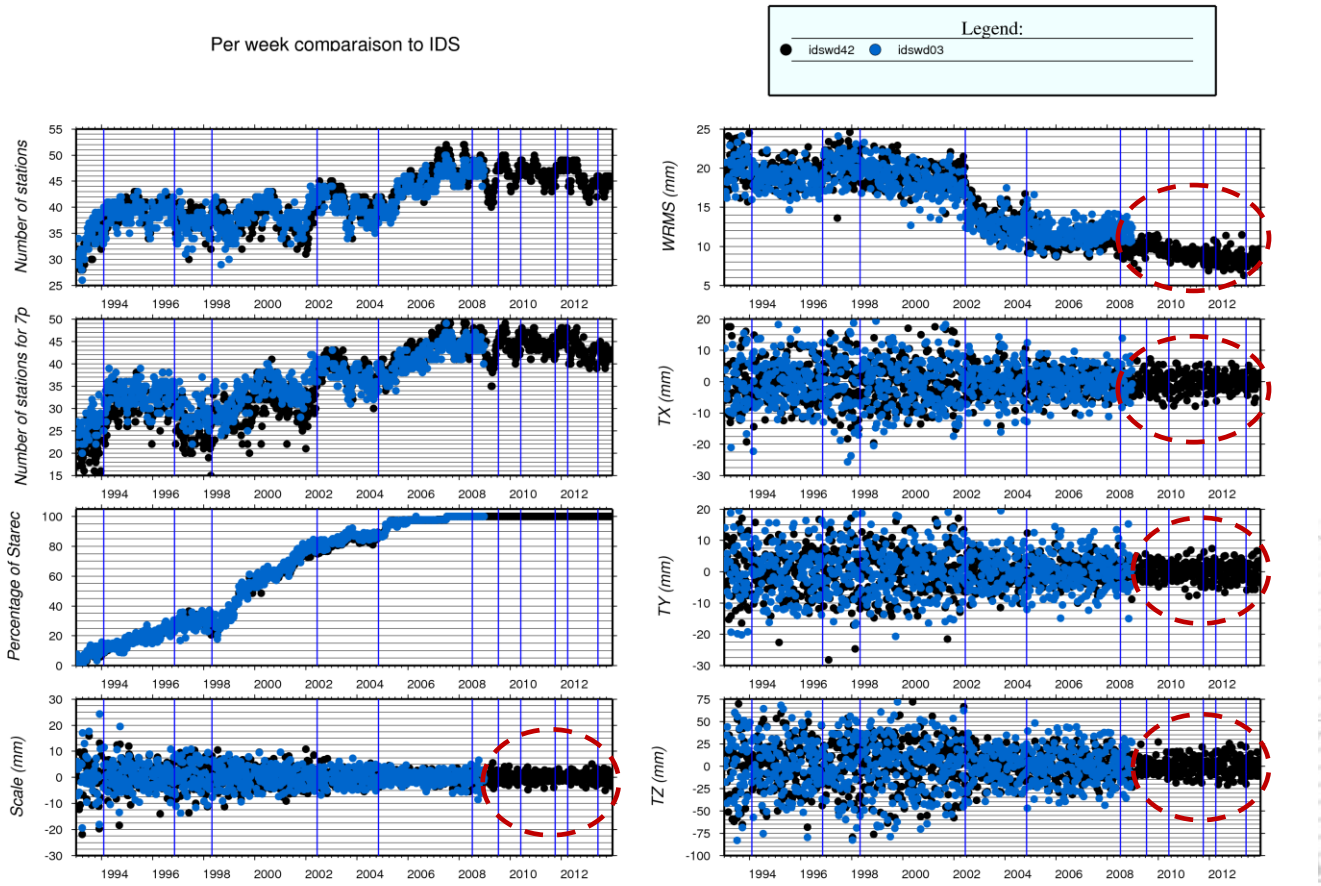
Min : 159 weeks (≈ 3 years)
Max : 1094 weeks (≈ 21 years)
Median : 665 weeks (≈ 13 years)

IDS Combined Solution
Helmert parameters wrt ITRF2008



➔ No more scale factor discontinuity in 2002 and less scattered early 1994
➔ Improvements of Tx, Ty and Tz after 2002 (lower STDs, less annual signal)
➔ Slightly higher WRMS
➔ Scale factor increase mid 2012

IDS Combined Solution
Week-to-Week Repeatability of Helmert Parameters

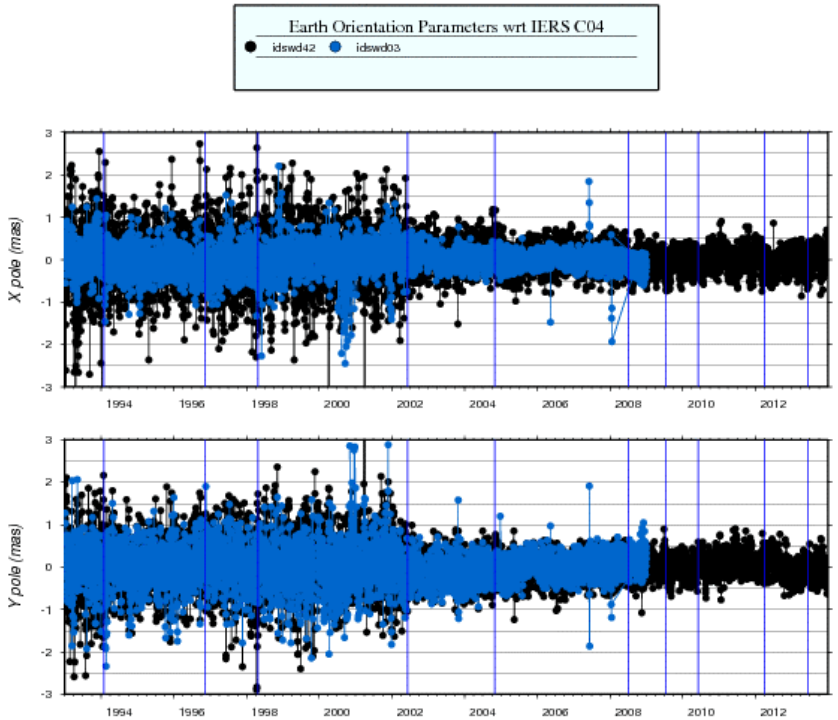


➔**More stable Helmert parameters**

➔**Positive impact of DG-XX missions (Jason-2, Cryosat-2…)**

IDS Combined Solution

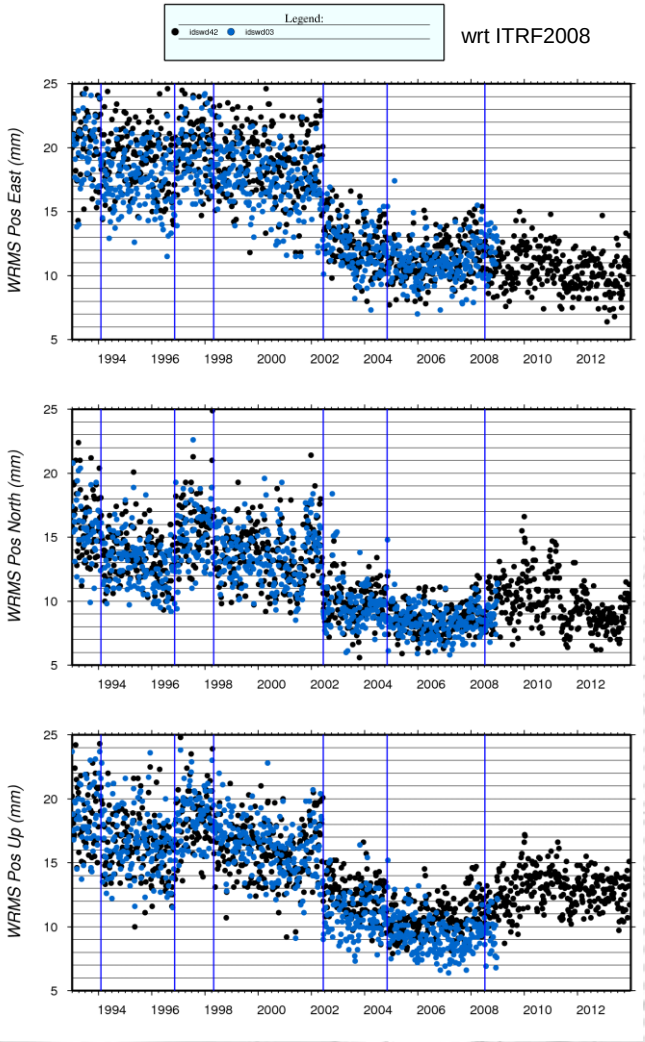
EOPs differences wrt IERS C04



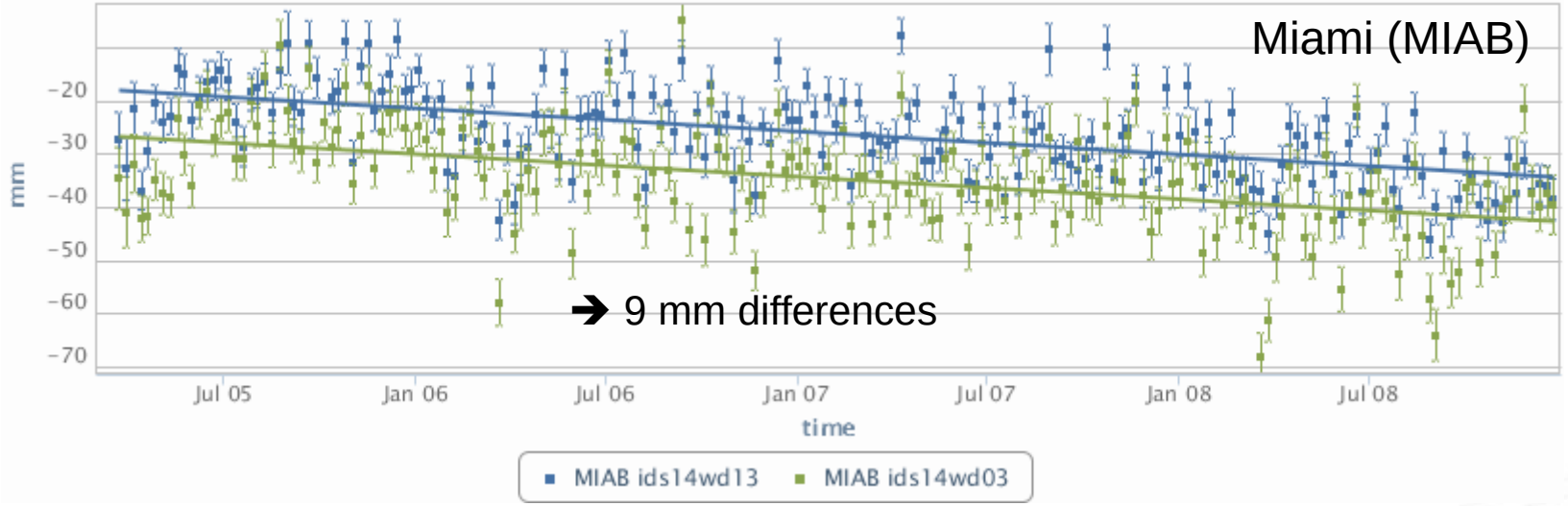
AC	serie	# days	X pole (mas)			Y pole (mas)			LOD (ms)		
			trend	mean	std	trend	mean	std	trend	mean	std
ids	42	5827	0.003	0.010	0.587	0.020	-0.004	0.533	--------	--------	--------
ids	03	5783	-0.000	-0.000	0.309	0.000	-0.001	0.422	--------	--------	--------

➔ **Higher STDs on X and at a degree less on Y**

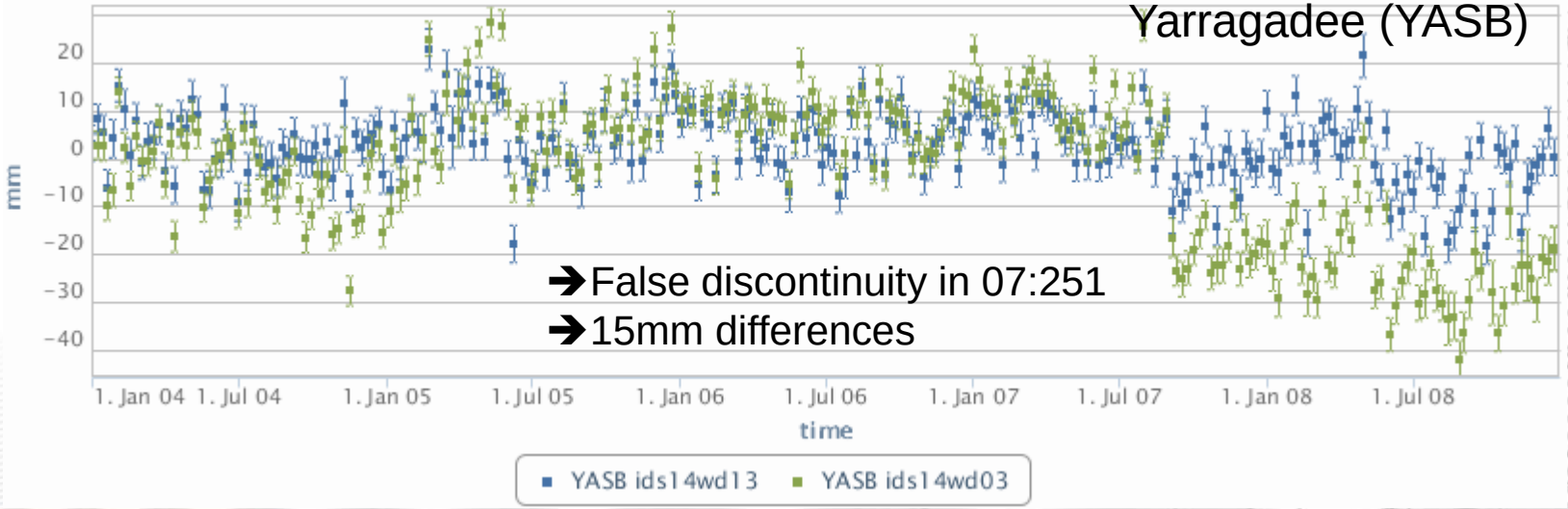
WRMS of Station Position Residuals



IDS ITRF2013 vs IDS ITRF2008
Impact of Beacon Frequency - Examples



➔ 9 mm differences



➔False discontinuity in 07:251

➔15mm differences

Whta's next ?

- **IDS CC reprocessing to include Socorro (SODA, SODB), JIVB, KRWB and MAIB. Deadline: November 14th**
- **Oral presentation at AGU**
- **Submission of a paper to the DORIS special issue of JASR**
- **ITRF2013 validation**
- **Production of combined LOD**