2014 ITRS Realization of DGFI: DTRF2014

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ITRF2014 computation

ITRF2014 is on the way:

- Feb 2015: all VLBI, SLR, GNSS and DORIS input data are available
- Up to 35 years of data (6 more than for ITRF2008)
- Many new stations for all techniques, better global distribution
- First ITRF which considers non-tidal atmospheric loading, individual model improvements

→ New level of accuracy and precision will be reached

ITRS Combination Centres:

Three Centres are in charge of ITRS realization in the framework of ITRF2014 computation: IGN (Paris), DGFI-TUM (Munich), JPL (Pasadena)

<u>ITRS CC at DGFI:</u>

- The only CC which performs combination on normal equation level
- Advantages of this strategy compared to combination of parameters:
  - No constraints related to geodetic datum have to be applied before combination
  - No similarity transformations are needed in combination process

ITRF2014: Input data

Space geodetic techniques:

	Service	Solution type	Resolution	Time span	
VLBI	IVS	Free NEQ	session-wise	04/80 - 12/14	**35 years**
SLR	ILRS	Loose constraint solution	before 1993.0 14 days after 1993.0 weekly	12/82 - 01/15	**32 years**
GNSS	IGS	Minimum constraint solution	daily	01/94 - 02/15	**21 years**
DORIS	IDS	Minimum constraint solution	weekly	01/93 - 09/14	**21.8 years**

Local ties and atmospheric loading data:

	Provided by …	Format
Local ties	– Co-location sites, surveying teams – Collected and prepared by Z. Altamimi	SINEX
Atmospheric loading data	– GGFC of IERS – Based on NCEP model *(Kalnay et al. 1996)*	Free format

ITRF2014: Parameters

Parameters included in SINEX and used for DTRF2014

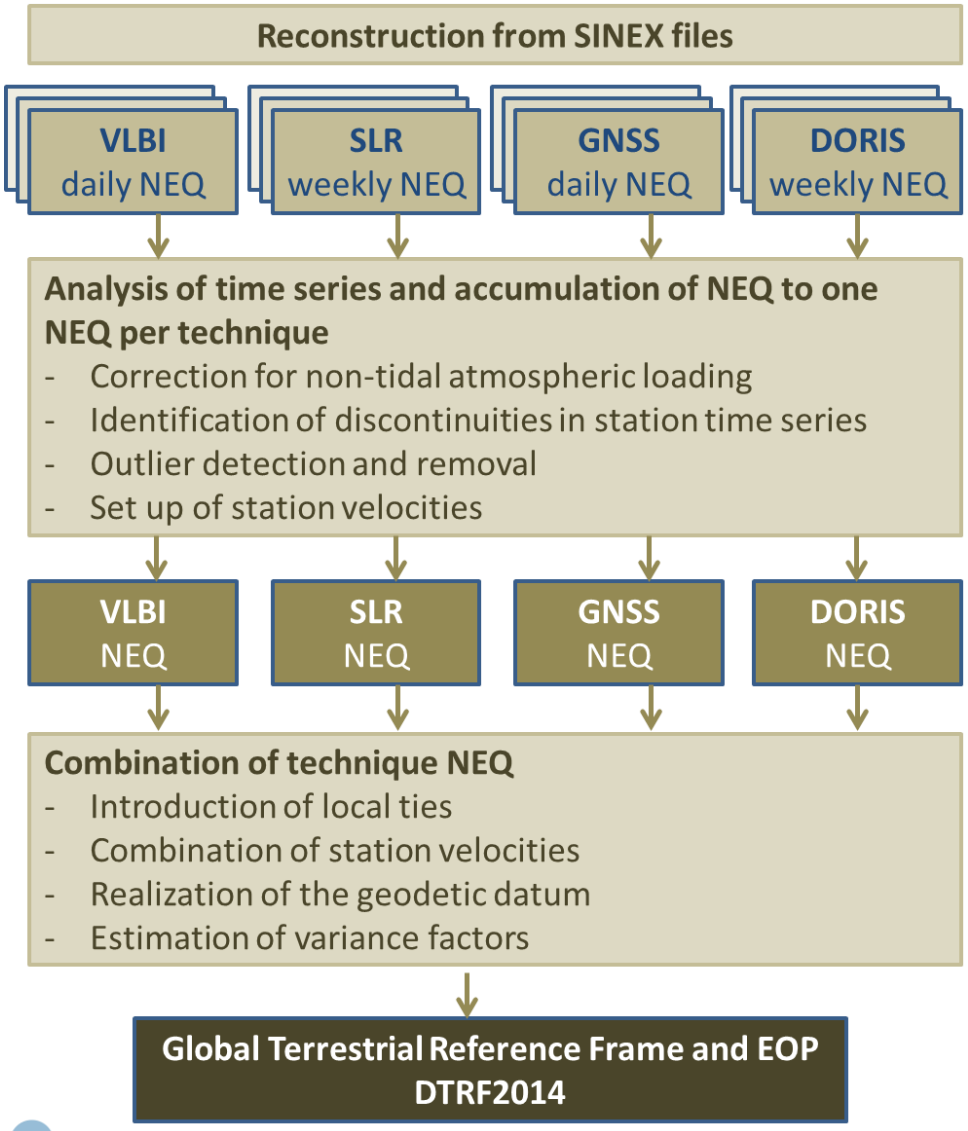
				Daily EOP at noon epochs		
	Station positions	Station velocities	Geocentre coord.	Pole	UT1	Nutation
VLBI	x			offsets and rates	UT1-UTC and LOD	offsets
SLR	x			offsets before 1993.0: 1/3 d after 1993.0: daily	LOD before 1993.0: 1/3 d after 1993.0: daily	
GNSS	x		x	offsets and rates	LOD	
DORIS	x			offsets		
DTRF2014	x	x	reduced	offsets and rates	UT1-UTC and LOD	offsets

Geodetic datum

- origin: realized by SLR data
- scale: realized by SLR and VLBI data
- orientation: by no-net-rotation conditions w.r.t. ITRF2008

ITRS realization at DGFI

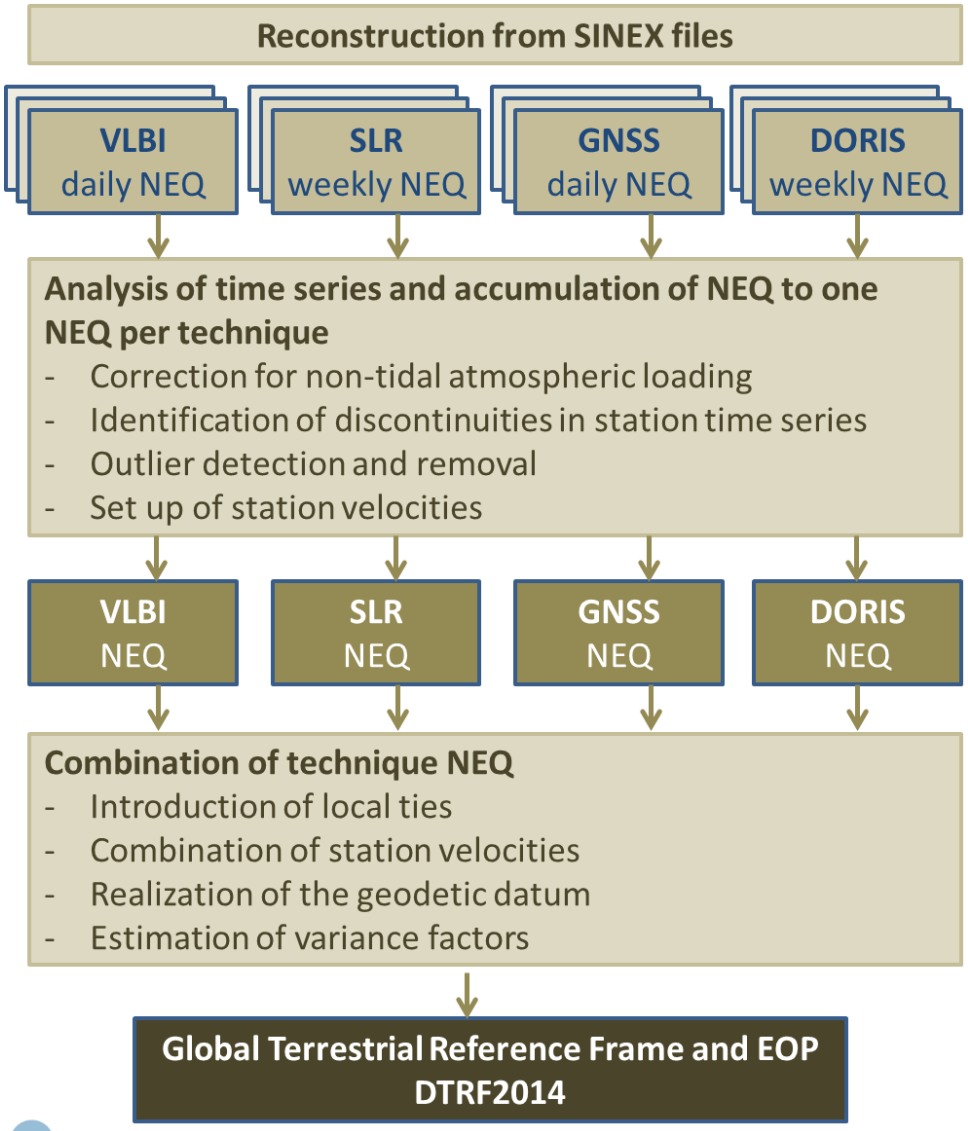
ITRS realization strategy at DGFI:



Input data from SINEX (improvements compared to DTRF2008)	
VLBI	- constraint free NEQ, - full statistical information.
SLR	- loose constraint NEQ, - full statistical information.
GNSS	- constraint free NEQ w.r.t. origin and orientation. Only daily scale parameters are set up. - statistical information is missing and must be roughly estimated
DORIS	- minimum constrained NEQ. Constraints not booked in SINEX. Origin, orientation and scale parameters must be set up for each weekly NEQ. - full statistical information.

ITRS realization at DGFI

ITRS realization strategy at DGFI:



Input data from SINEX (critical issues)	
VLBI	- constraint free NEQ, - full statistical information.
SLR	- loose constraint NEQ, - full statistical information.
GNSS	- constraint free NEQ w.r.t. origin and orientation. Only daily scale parameters are set up. - statistical information is missing and must be roughly estimated
DORIS	- minimum constrained NEQ. Constraints not booked in SINEX. Origin, orientation and scale parameters must be set up for each weekly NEQ. - full statistical information.

Station positions

Analysis of station positions: nearly finished for SLR, VLBI and DORIS

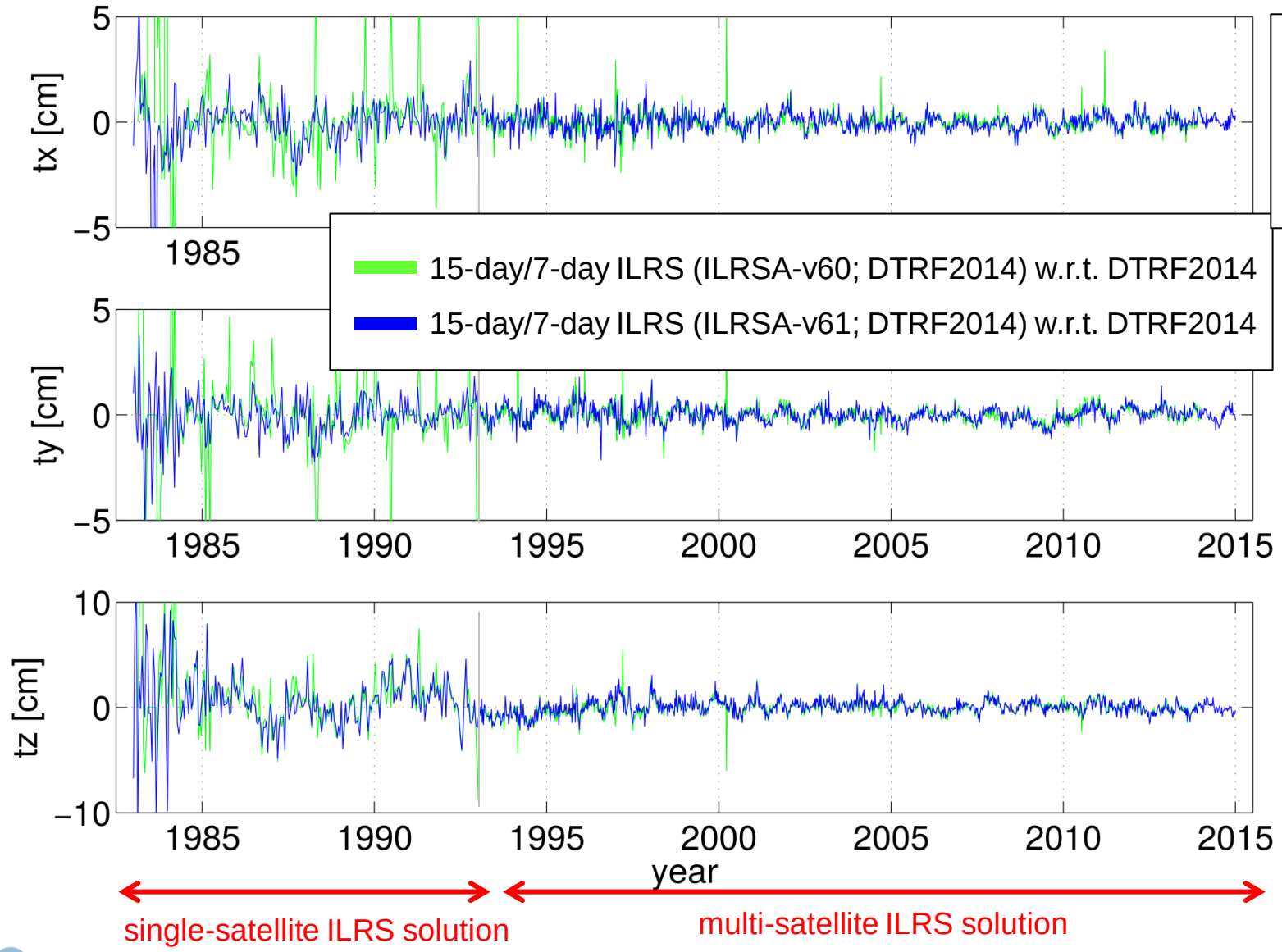
	stations in SINEX	reduced	discontinuites	stations in DTRF2014
SLR	142	43	17	116 (122)
VLBI	159	52	43	116 (106)
DORIS	160	14	36	144 (132)
GNSS	1810*	234*	226**	1576* (559) (~ 450 installed after 2007.0)

→ GNSS will clearly dominate the network (~80 % vs.~ 60% in ITRF2008)

* GNSS analyses not yet finished
** Initial list with earthquake-related discontinuities only
() values for DTRF2008

Datum parameters (I)

SLR: translation parameter time series

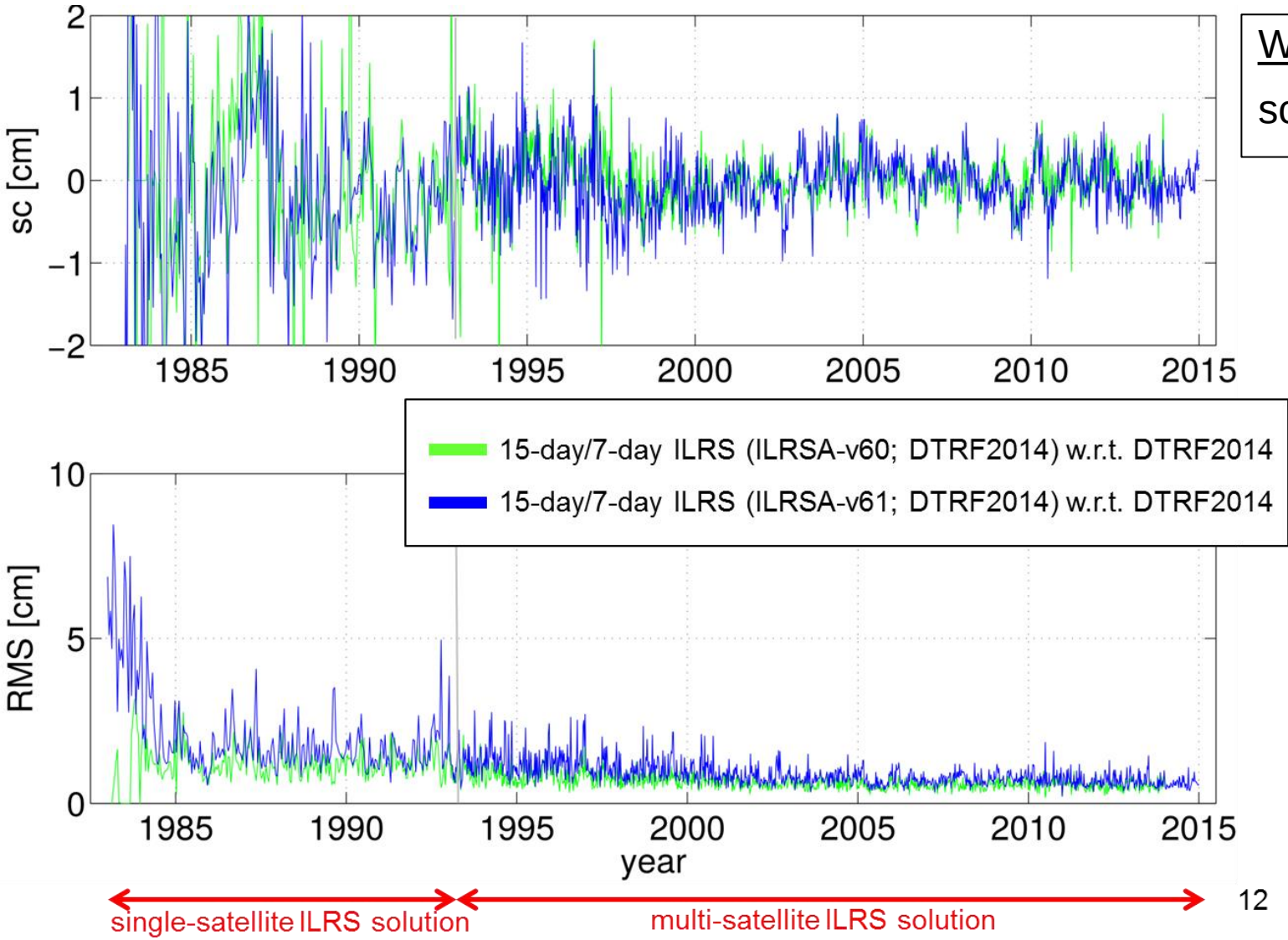


WRMS (v61):

tx = 3.7 mm
ty = 3.6 mm
tz = 6.6 mm

Datum parameters (II)

SLR scale time series

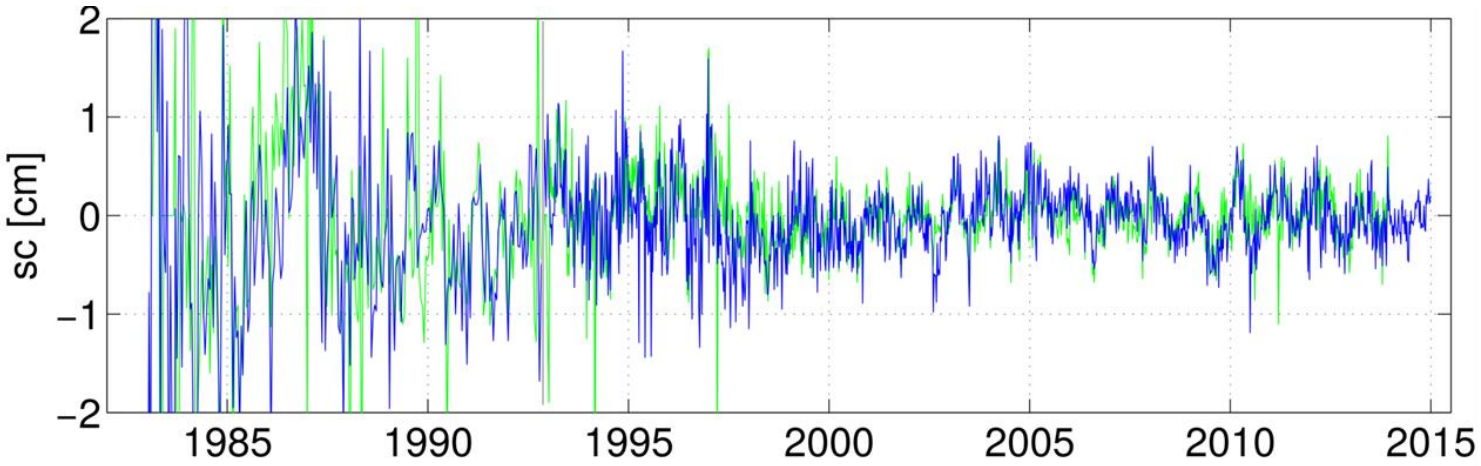


WRMS (v61):

sc = 2.9 mm

Datum parameters (III)

SLR datum parameters

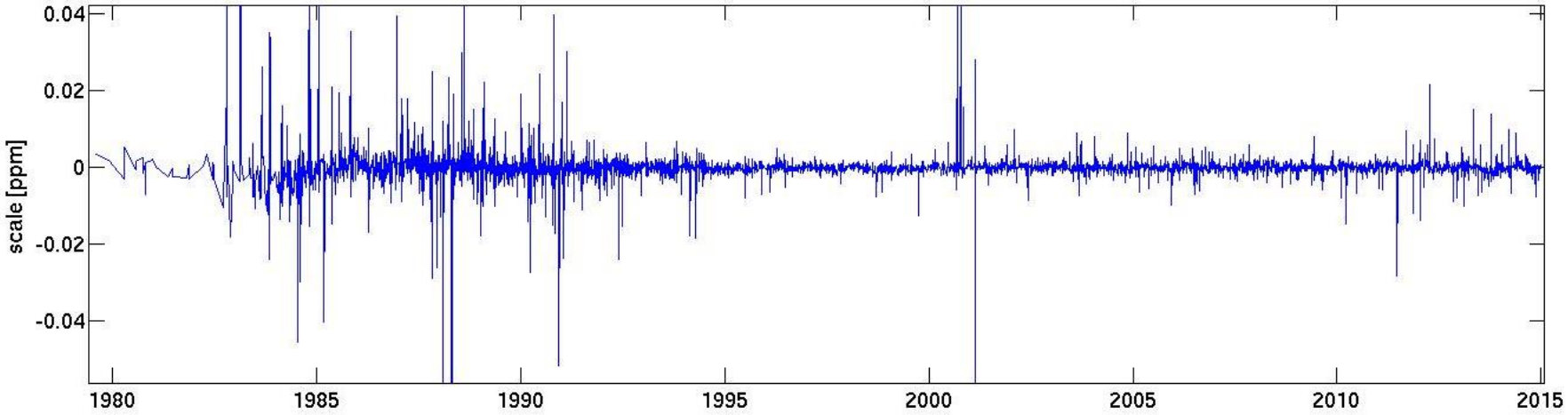


		Tx	Ty	Tz	Sc	
WMEAN [mm]	since 1983.0	0.01	-0.23	0.76	-0.22	differences below 0.15 mm
	since 1993.0	0.01	-0.24	0.61	-0.17	
Drift [mm/yr]	since 1983.0	0.016	0.002	-0.073	0.052	differences below 0.2 mm/yr
	since 1993.0	-0.002	-0.031	0.097	0.006	

→ Effect of signals in time span 1983 – 1992 very small:
Complete time series used for datum realization

Datum parameters (IV)

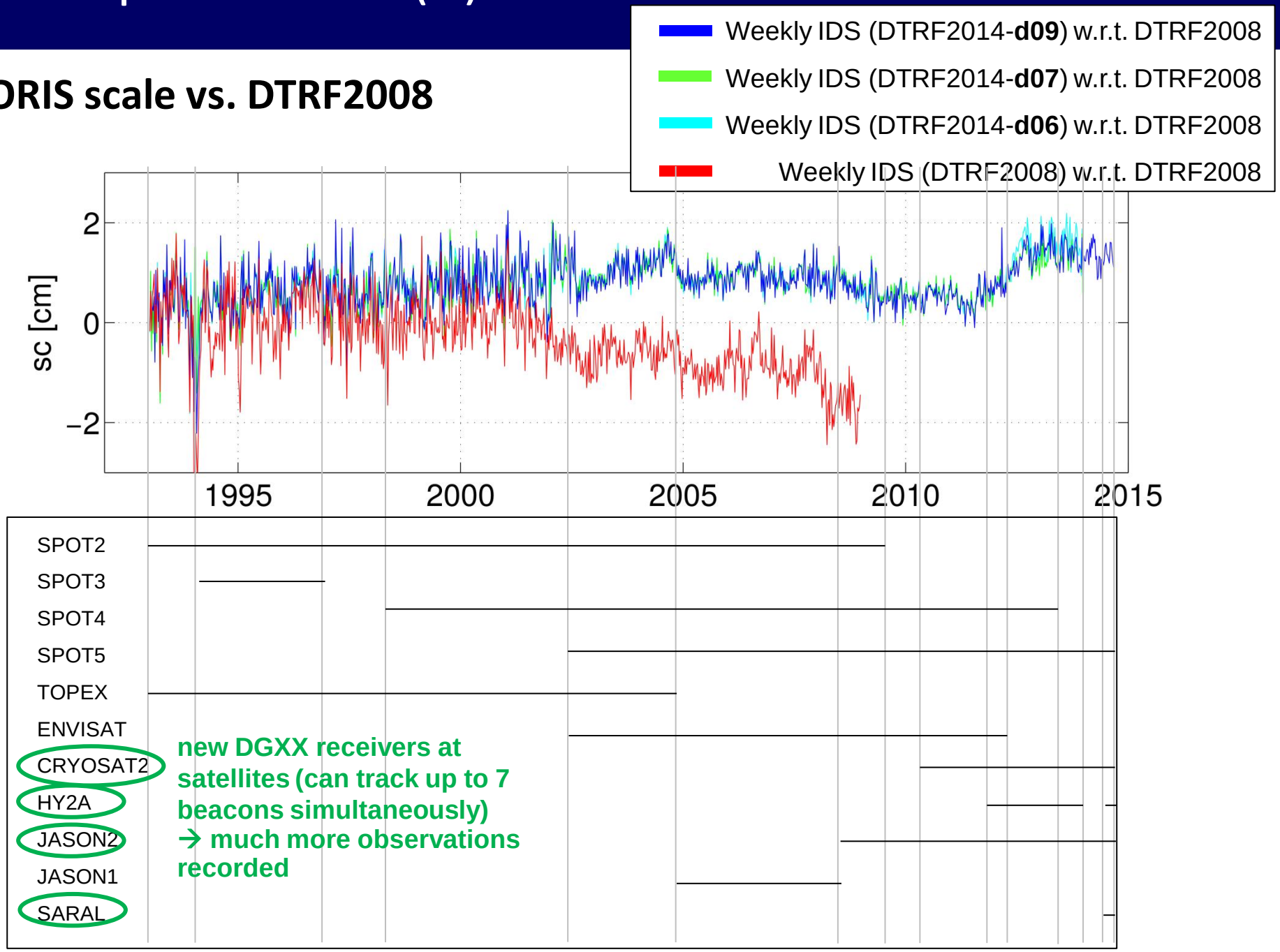
VLBI scale time series



→ Effect of signals in the first years on TRF scale is not significant: Complete time series used for scale realization

Datum parameters (V)

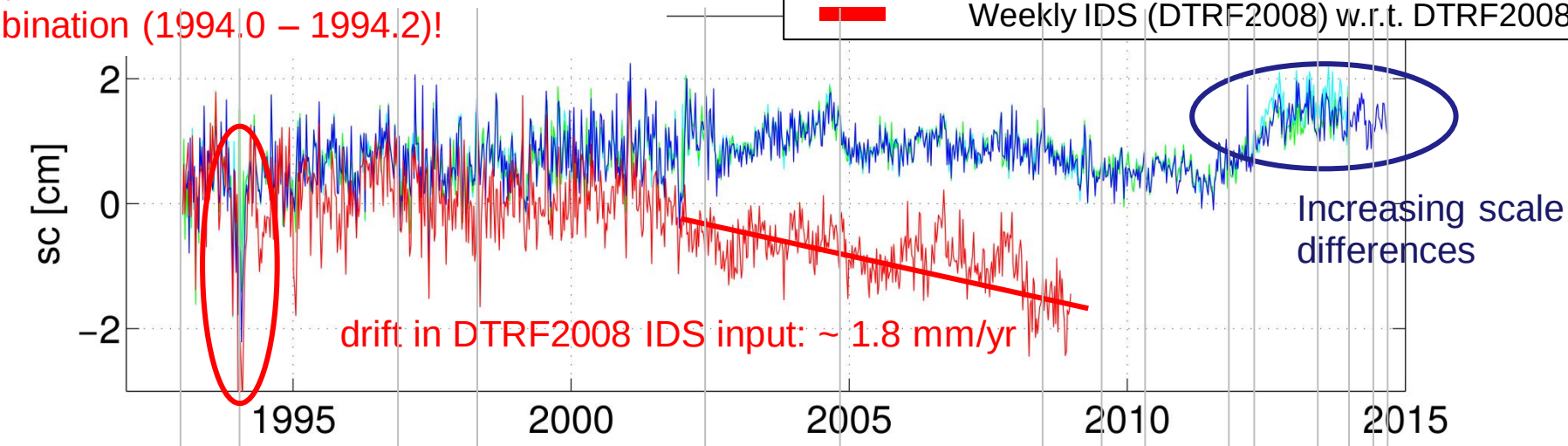
DORIS scale vs. DTRF2008

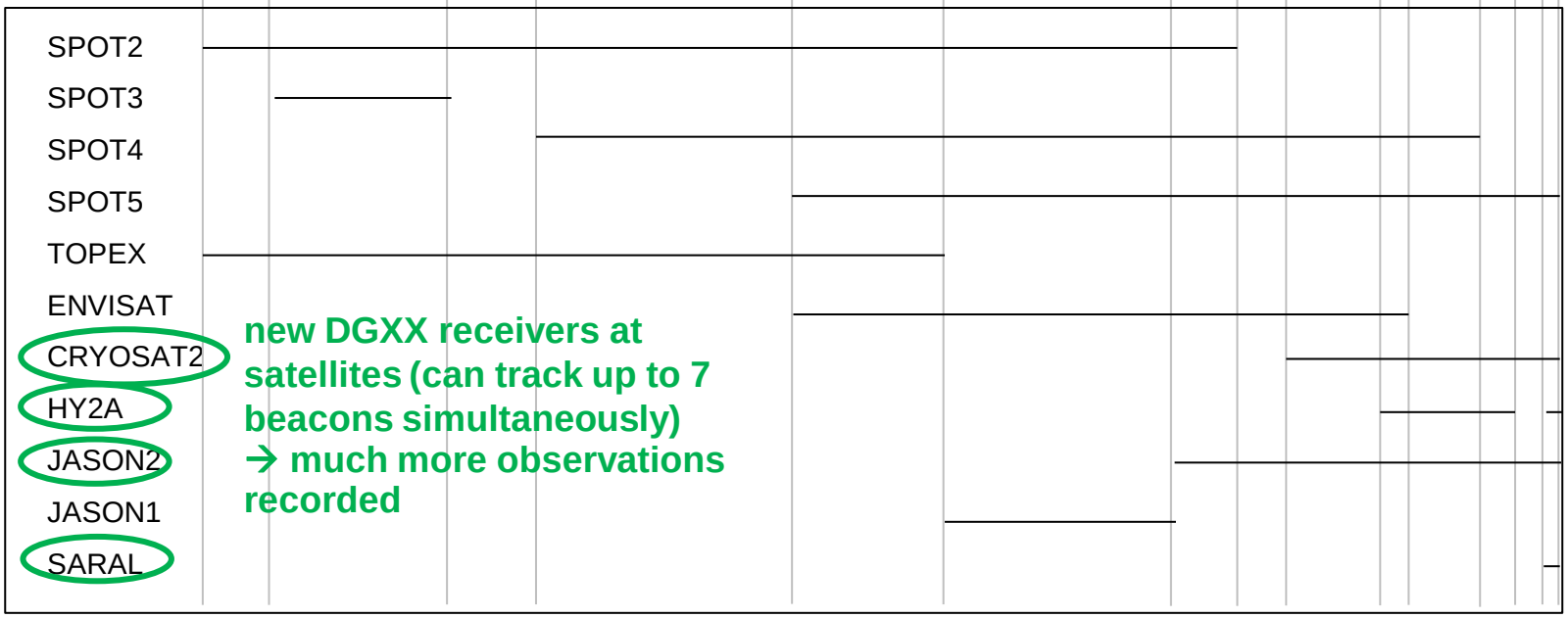


Datum parameters (V)

DORIS scale vs. DTRF2008

ESA, IGN and INA excluded from scale combination (1994.0 – 1994.2)!





Transformation parameters w.r.t. DTRF2008

SLR TRF2014 solution (epoch 2005.0)

	Tx	Ty	Tz	Scale	STD	RMS
Offset [mm]	-0.2	-1.3	0.6	-0.4	0.6	2.4
Rate [mm/yr]	0.2	-0.2	-0.1	0.3	0.12	0.49

VLBI TRF2014 solution (epoch 2005.0)

	Scale	STD	RMS
Offset [mm]	-1.2	0.3	1.1
Rate [mm/yr]	-0.4	0.09	0.34

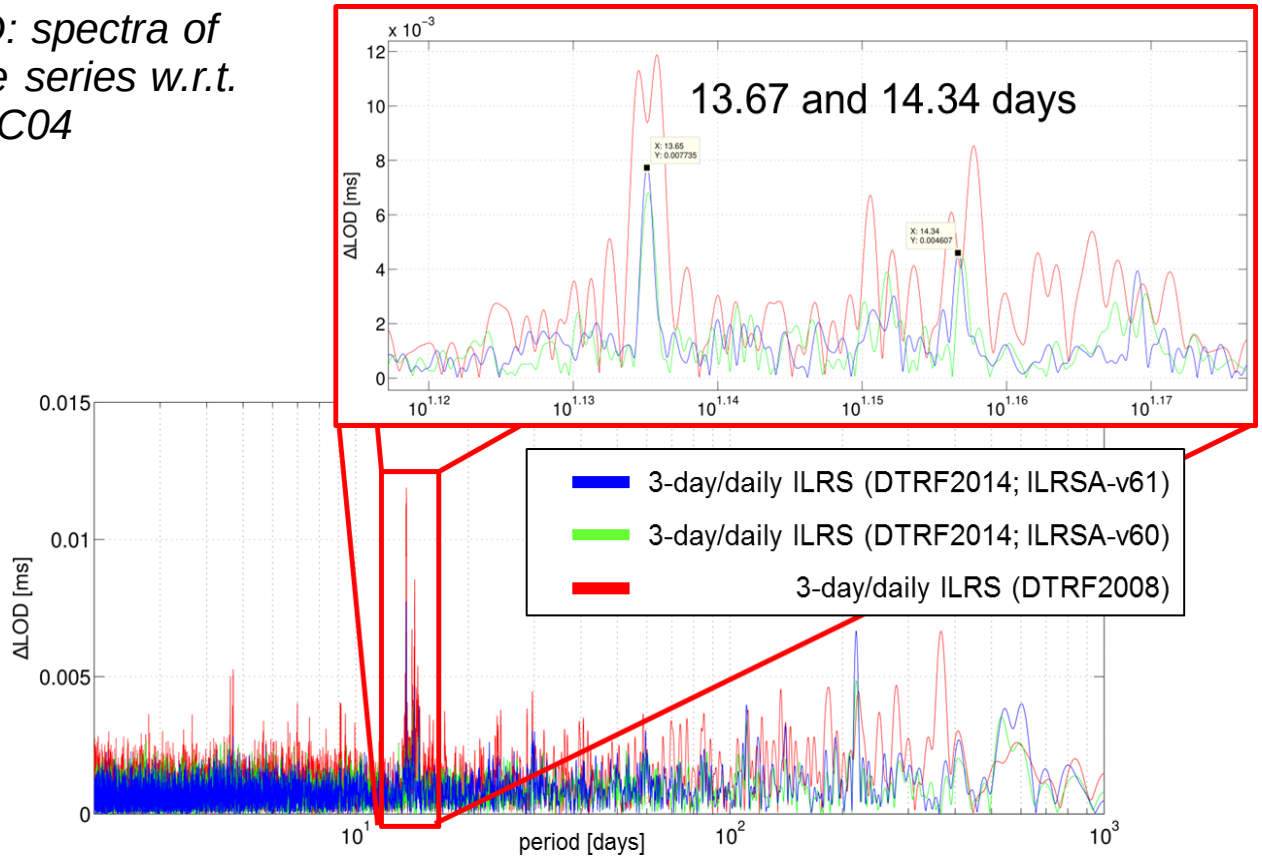
→ Scale offset of 0.1 mm for previous IVS series ending 2014.0! Reason not yet identified.

→ Very good agreement with DTRF2008.
→ No significant scale change due to model changes.
→ Consistency of VLBI and SLR scale for DTRF2014 scale realization have still to be analysed.

Earth Orientation Parameters (I)

- Time series look fine in general
- Increased standard deviations for SLR and DORIS EOP vs. DTRF2008 (new methods for statistical computations applied ?)
- Periodic signals in SLR LOD (tidal terms?) and DORIS pole (arc length, LA2 draconitics)

SLR LOD: spectra of difference series w.r.t. IERS 08 C04



Modelling differences to be discussed

Mean pole model

- ILRS model differs from IERS conventional model used by the other techniques → differences in pole tide corrections significant?

Ocean tide loading model

- Scherneck model at www.holt.oso.chalrmers.se/loading/ provides two options:
  - CMC=1: CoM of Earth is the center of solid Earth + atmosphere/ocean. Used by ILRS.
  - CMC=0: used by IVS (communication with John Gipson).
    --> Differences to CMC=1 can reach several millimeters.
  - Which type of model is used by IGS and IDS?

→ Homogenization of applied models is highly recommended.

DTRF2014 computation: status and outlook

DGFI activities:

VLBI, SLR and DORIS

- input data are analysed (without atmospheric loading corrections)
- Multi-year solutions are computed
- Time series for stations, datum parameters and EOP are analysed
- Lists of discontinuities are compiled (homogen. with other ITRS CC tbd)
- Comparison of multi-year solution with DTRF2008 performed

GPS

- Input data read from SINEX
- Initial list of discontinuities compiled

Next steps

- Analysis of GNSS data
- Analysis of all techniques applying atmospheric loading correction
- Combination of techniques

→ Final solution in Sep/Oct 2015

Thank you for your attention!

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