Improving ILRS products after an in-depth characterization of station biases
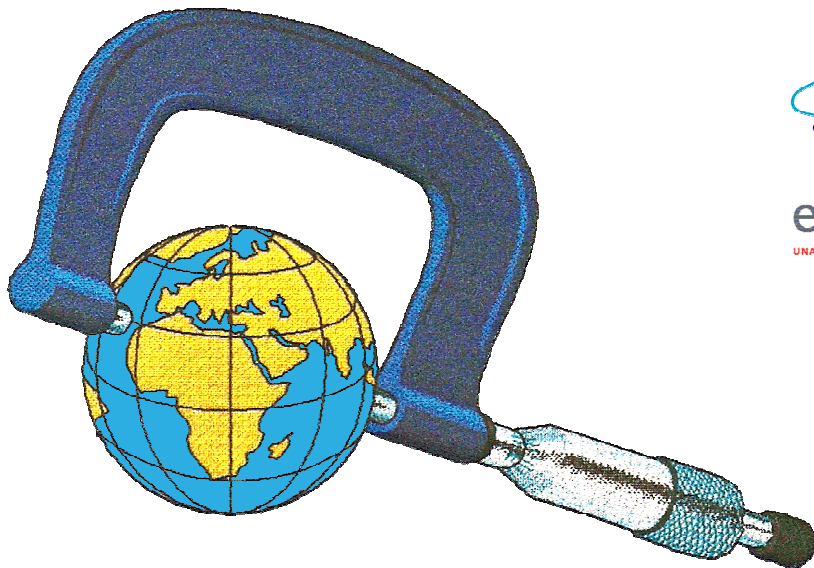
V. Luceri
e-GEOS S.p.A., ASI/CGS - Matera

G. Bianco
Agenzia Spaziale Italiana, CGS - Matera

C. Sciarretta
e-GEOS S.p.A., Rome

17th IWLR, 16-20 May 2011, Bad Kötzting

SLR biases

- SLR is a clean, absolute ranging technique with the potential of ***two types of bias*** due to errors at the stations e.g. calibration and/or synchronization issues, hardware malfunctioning:
  - time biases
  - range biases

- The range bias is the most critical, being highly correlated with height over short periods

- The presence of intermittent biases can introduce jumps in the coordinate time series

- A non homogeneous treatment of biases among the Analysis Centers affects the combined product, i.e. the ILRS contribution to ITRF

ILRS range bias information sources

Engineering bias report from CDDIS database and from the stations through SLRMail

Rapid, daily bias analysis report from the ILRS ACs

Bias time series estimated from a multi-year solution

Using these sources of information, the AWG has defined:

- biases to be applied

- biases to be estimated
  (to be kept at minimum)

- unrecoverable data to be edited

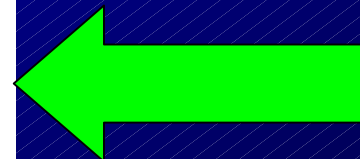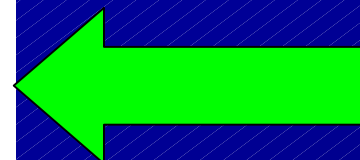# *ILRS AWG data handling file*

```
=SNX 2.00 DGF 10:322:00000 ALL 76:120:00000 00:000:00000 L 00000 2
*-----------------------------------------------------------------------
+FILE/REFERENCE
 RELEASE DATE      2010/04/23

 CONTACT          Horst Mueller <mueller@dgfi.badw.de>
 CONTACT          Margarita Vei <vei@gfz-potsdam.de>
-FILE/REFERENCE
*-----------------------------------------------------------------------
+FILE/COMMENT

Last Updated:  Nov. 18 2010  mandatory Bias correction for Wettzell (starting March 2009)
               Nov. 12 2010  Bias correction for Arequipa (7403) added
               Sep. 15 2010  -20cm range bias for Haleakala July and August 2010
               Aug. 12 2010  100 ms time bias for MLRO from doy 221 to 223 2010 included
               Apr. 23 2010  corrections of errors detected by F. Deleflie
               Apr. 15 2010  all corrections from Van's tables at cddis added


"M" Models codes:
    X = Exclude/delete data
    E = Estimation of range bias, known a priori values are given
    R = Range bias to be applied, no estimation of bias
    S = Stanford event counter bias
    T = Time bias in msec. to be applied, but not estimated
    U = Estimation of time bias in msec
    C = Target signature bias, Center-of-mass correction different to standard

 estimate values where provided must be substacted from the one-way observations
-FILE/COMMENT
*-----------------------------------------------------------------------


+SOLUTION/DATA_HANDLING
*-----------------------------------------------------------------------
---
*  list of sites with mandatory arc dependent biases to be estimated
*-----------------------------------------------------------------------
---
 1864 --- mm   A 00:000:00000 00:000:00000 E

 8834 --- mm   A 09:050:00000 00:000:00000 E                          laser problems
*-----------------------------------------------------------------------
*  list of mandatory range biases to be applied on observation (ILRS/AWG Oct 2007)
*  with updates from ILRS/AWG reprocessing results
*-----------------------------------------------------------------------
7080 --- mm   A 90:094:00000 93:031:00000 R       25.00       source CDDIS

 7119 --- ms   A 10:182:00000 10:273:86400 X                  uncorrected range bias
*-----------------------------------------------------------------------
*  list of data to be deleted
*-----------------------------------------------------------------------
 1863 ---      A 00:000:00000 94:001:00000 X

 8834 L52      A 99:308:80649 99:308:80650 X
-SOLUTION/DATA_HANDLING
*-----------------------------------------------------------------------
%ENDSNX
```
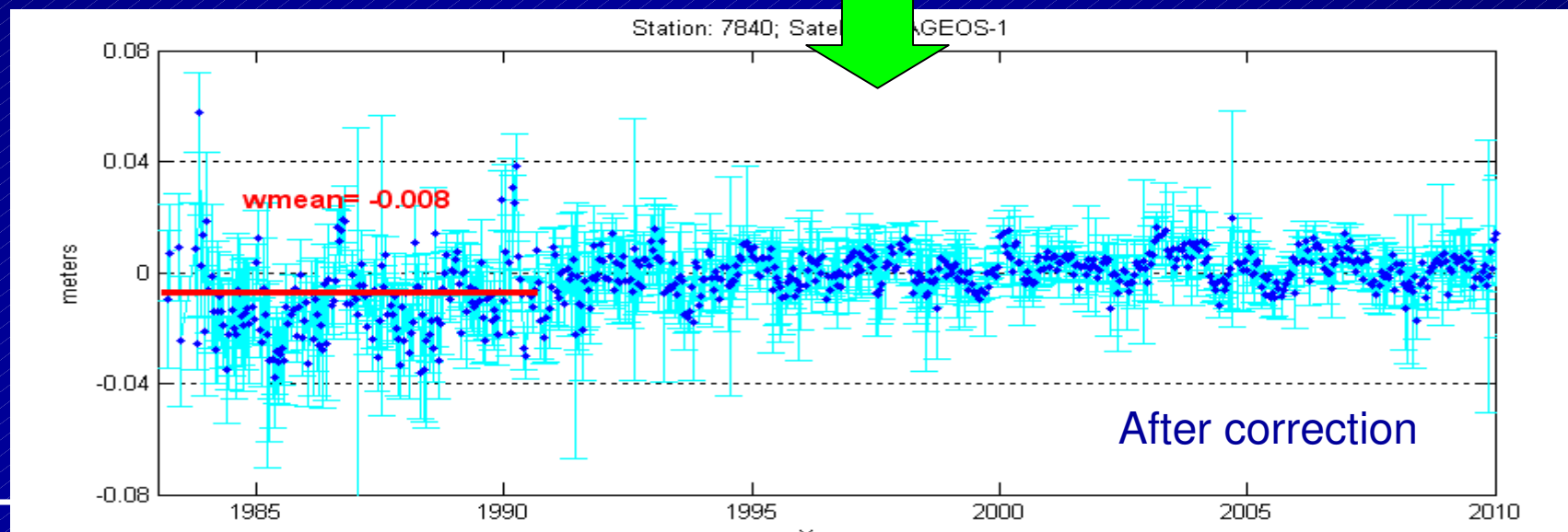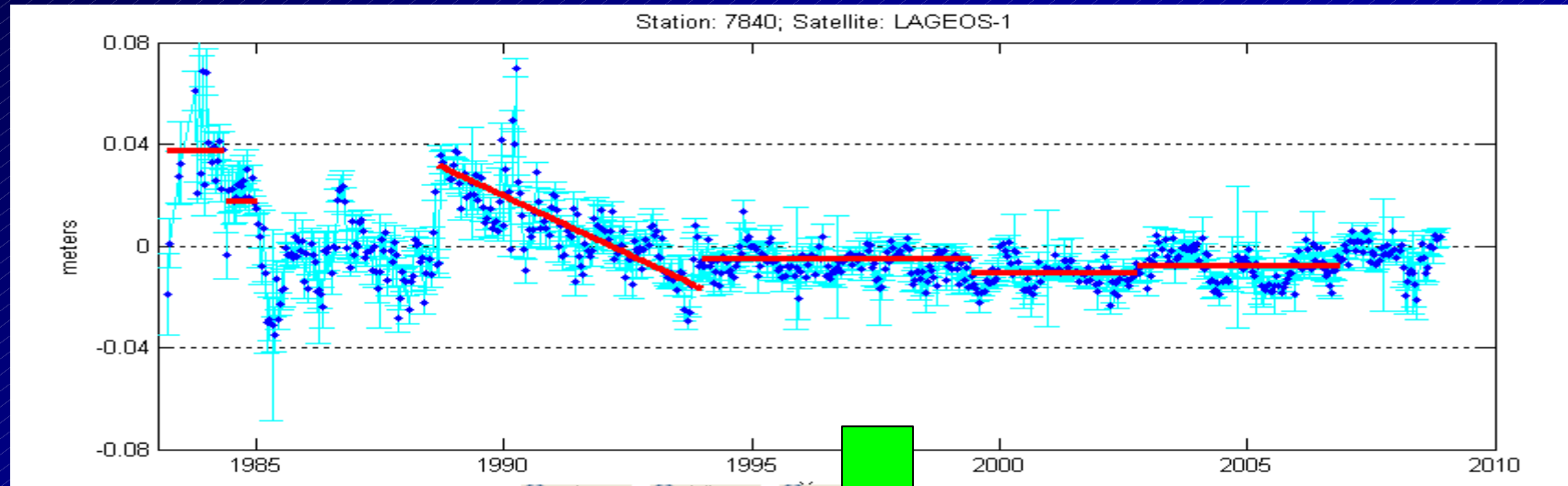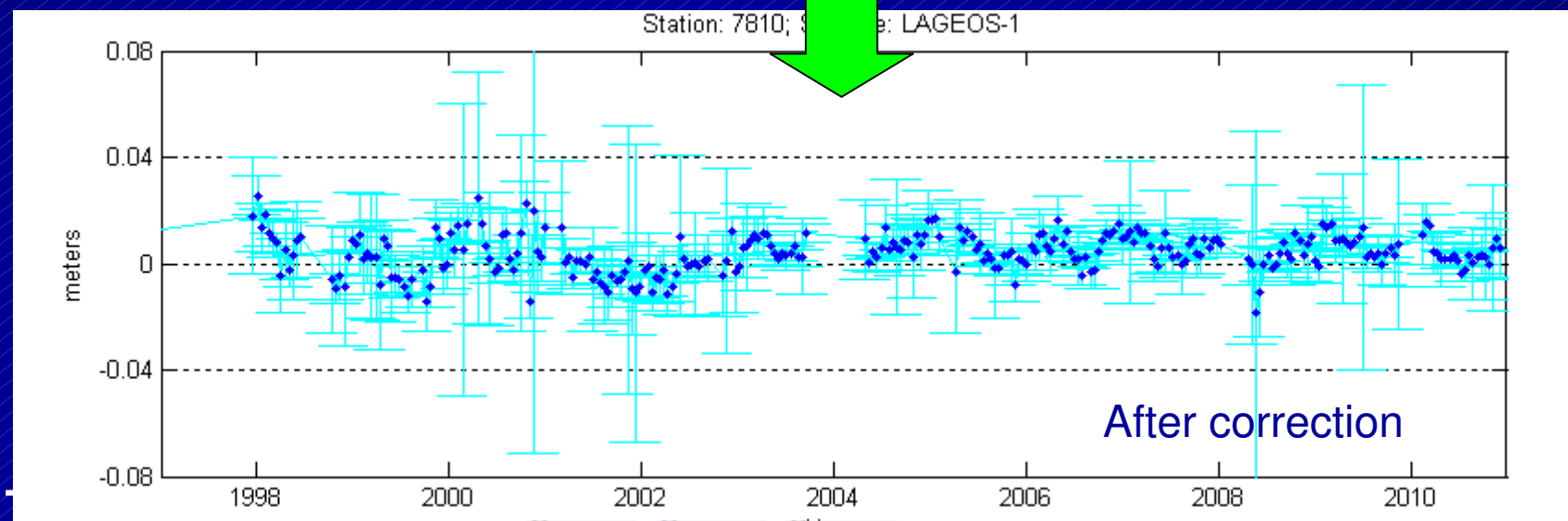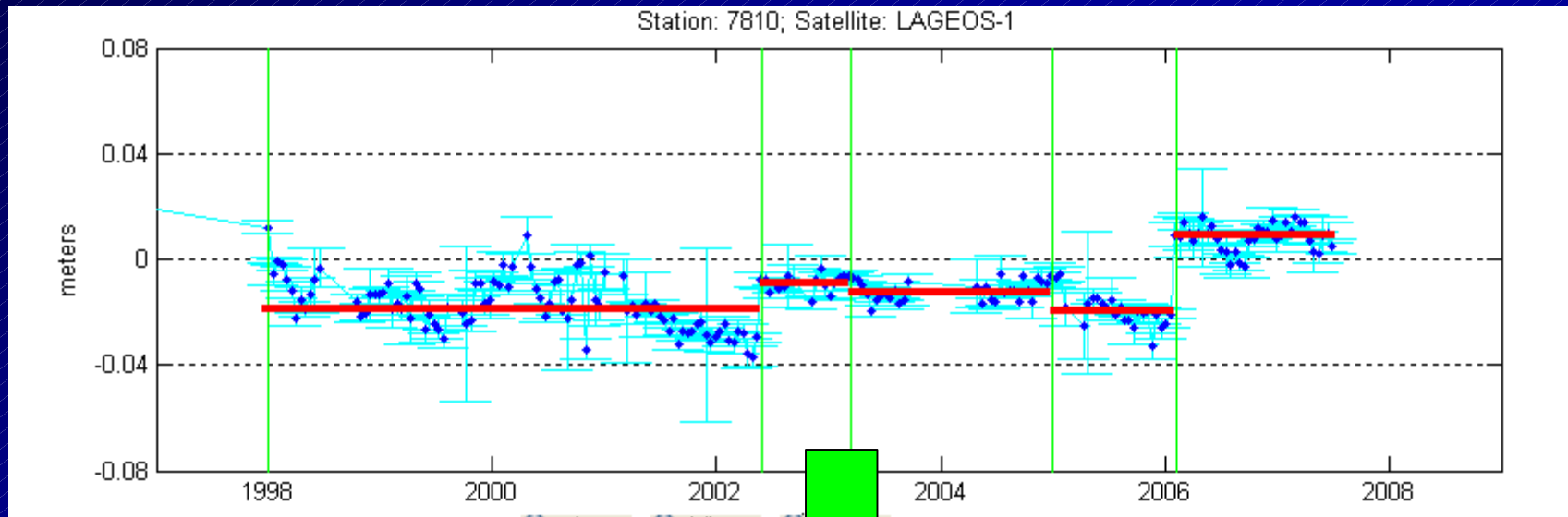
Herstmonceux

Station: 7840; Satellite: LAGEOS-1

Station: 7840; Satel... AGEOS-1

wmean= -0.008

After correction

Zimmerwald

After correction

The ILRS contribution to ITRF

- The ILRS contribution to ITRF2008 is a time series of loose solutions containing SSC and EOP, from 1983.0 to 2009.0. Each weekly solution is obtained through the combination of weekly solutions submitted by the official ILRS Analysis Centers

- AC solutions have strictly followed the **ILRS/AWG guidelines, bias policy included**

AC	Period
ASI	1983.0 -2009.0
DGFI	1983.0 -2009.0
GA	1983.0 -2009.0
GFZ	1983.0 -2009.0
GRGS	1993.0 -2009.0
JCET	1983.0 -2009.0
NSGF	1983.0 -2009.0

DGFI
ILRSB solution

ASI
ILRSA solution

IERS CC

SSC/SSV: Herstmonceux
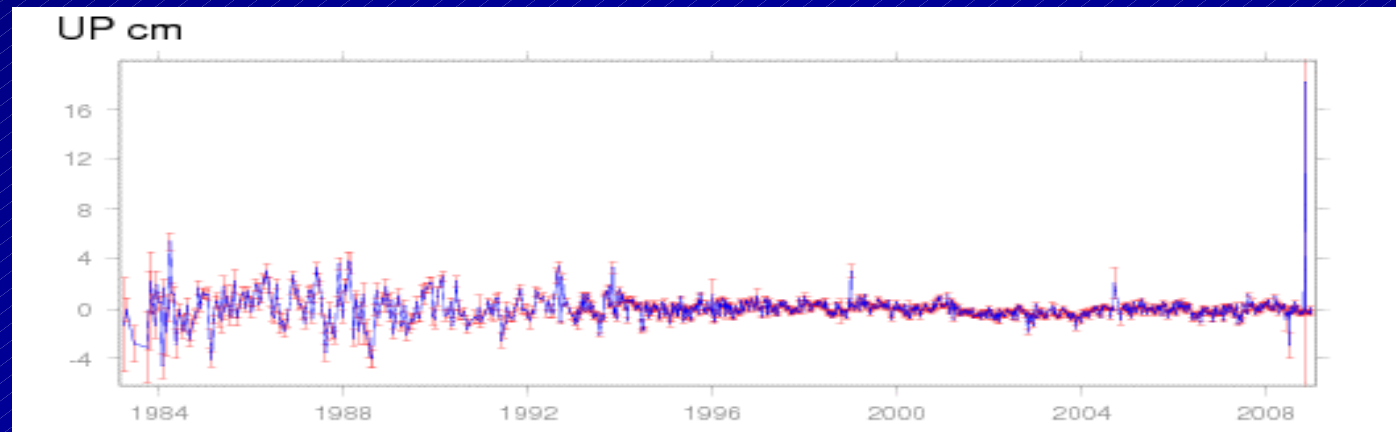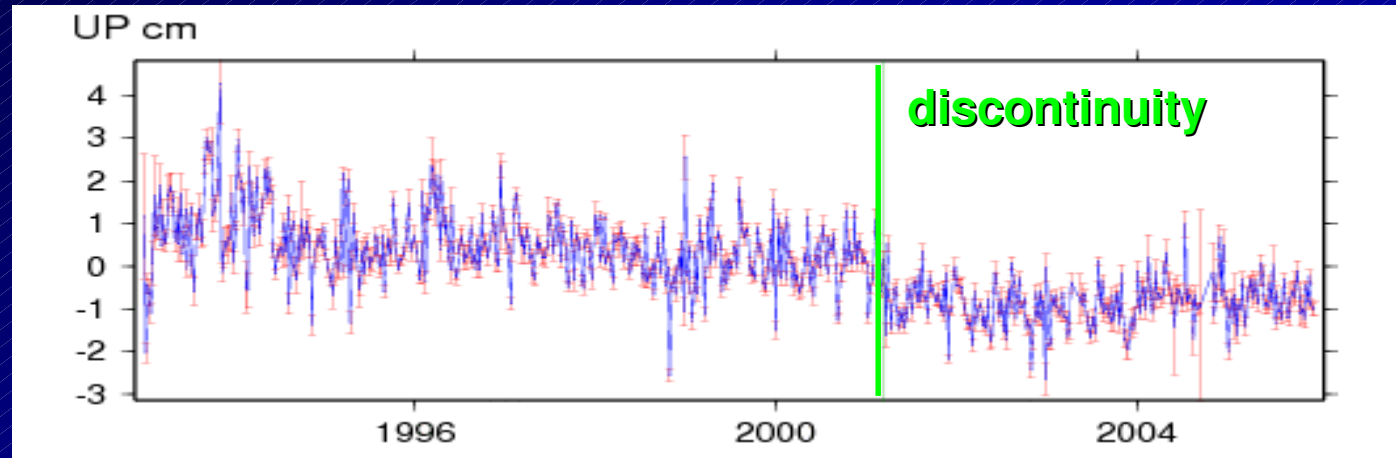
ITRF2005

ITRF2008

Plots from itrf.ensg.ign.fr

ILRSA origin & scale (1/2)

ITRF2005

ITRF2008

Plots from itrf.ensg.ign.fr
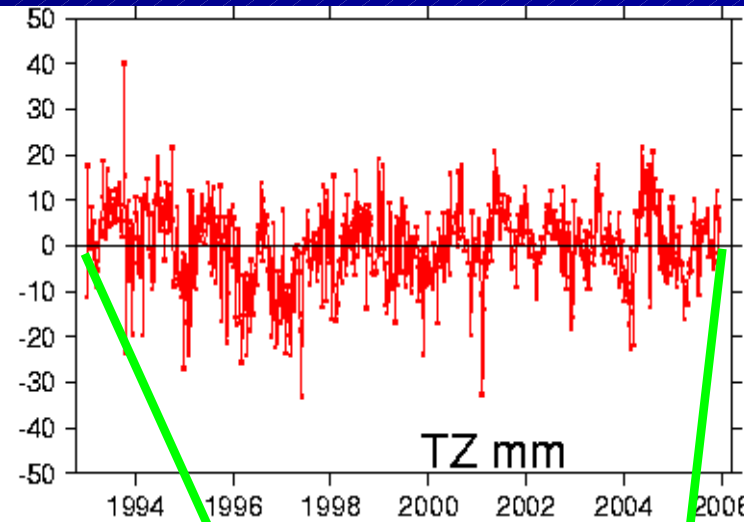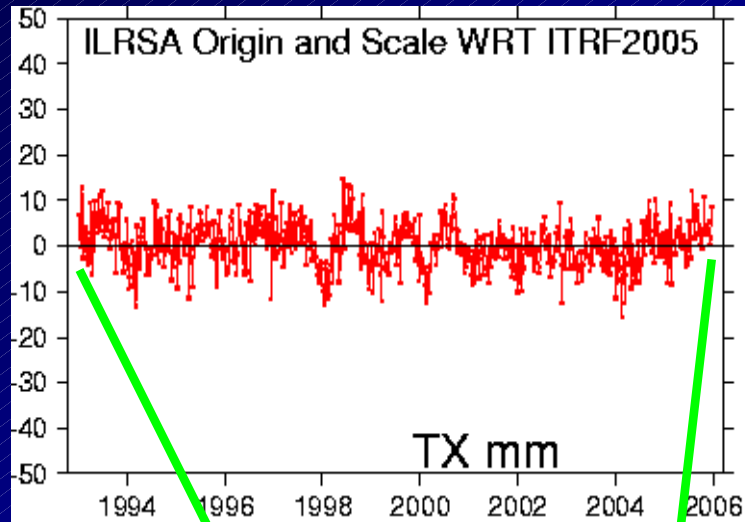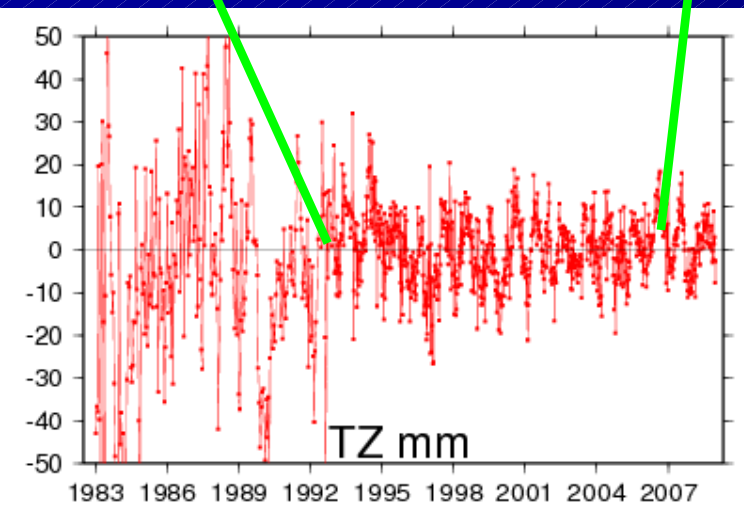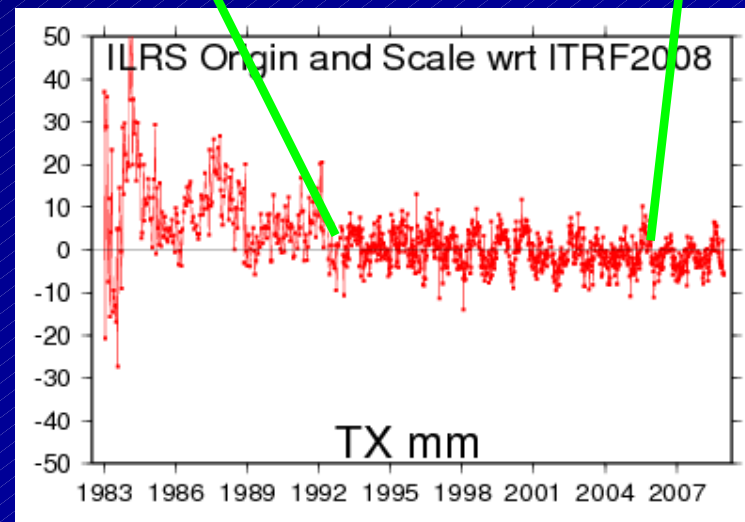
ILRSA origin & scale (2/2)

ITRF2005

ITRF2008

Plots from itrf.ensg.ign.fr
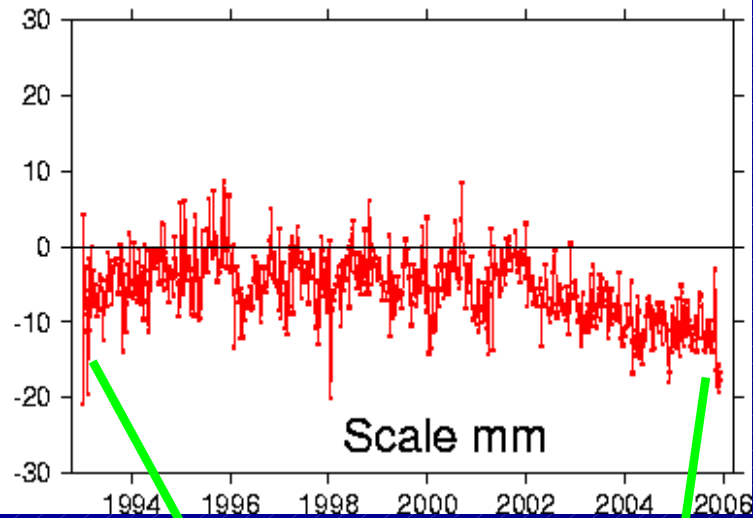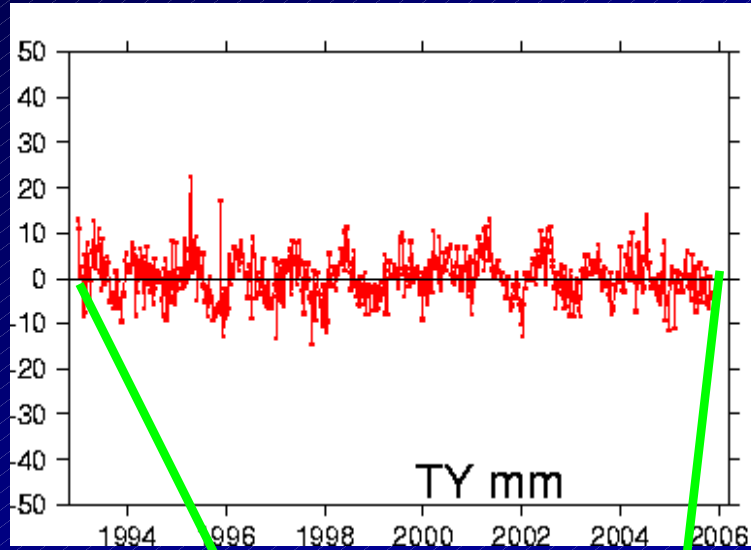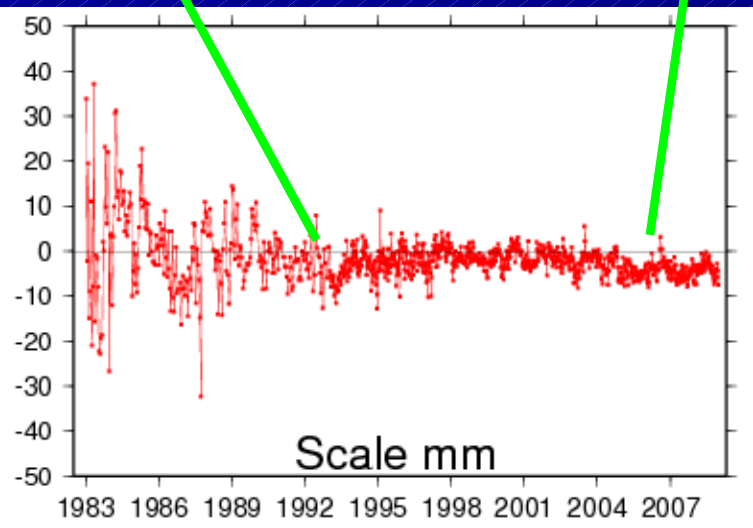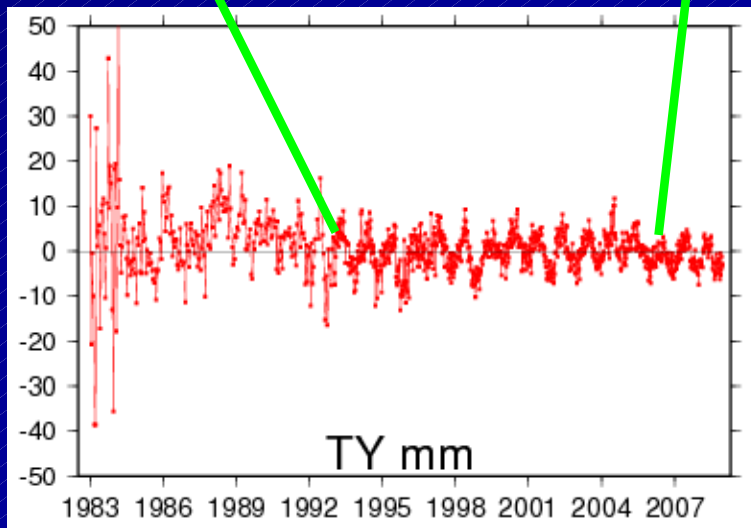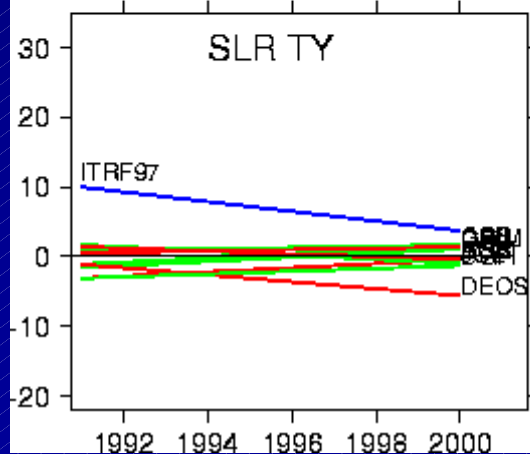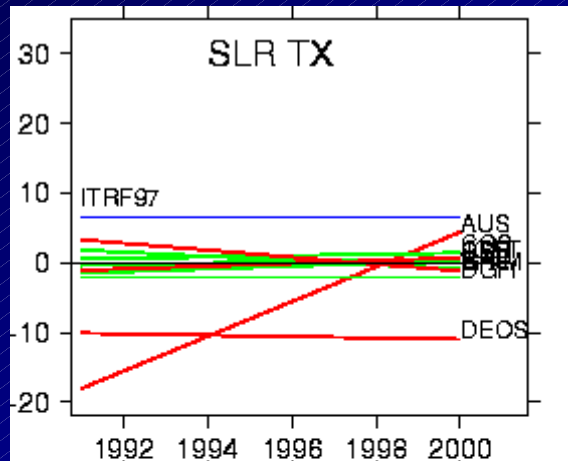
SLR AC solutions for ITRF2000

Translations and scale w.r.t. ITRF2000

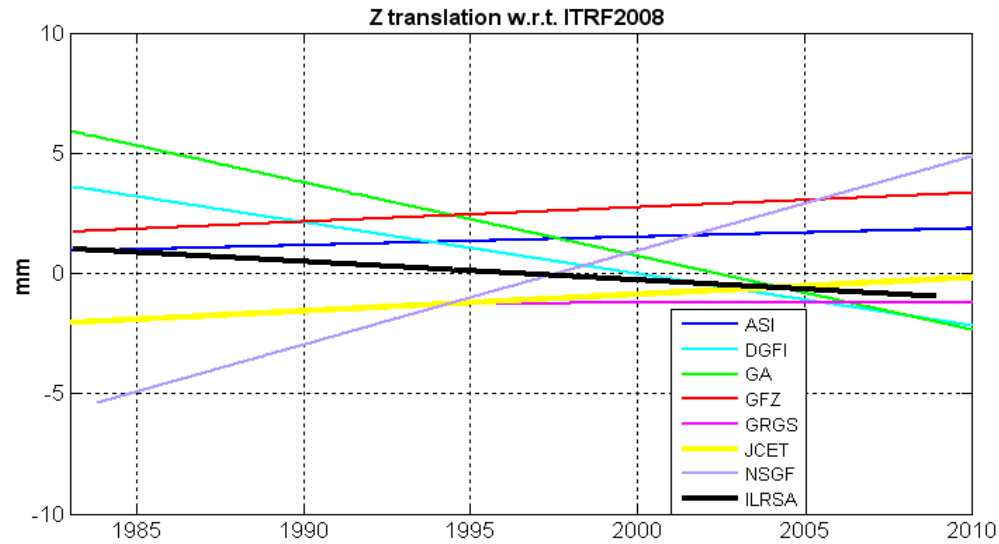SLR scale

Plots from itrf.ensg.ign.fr
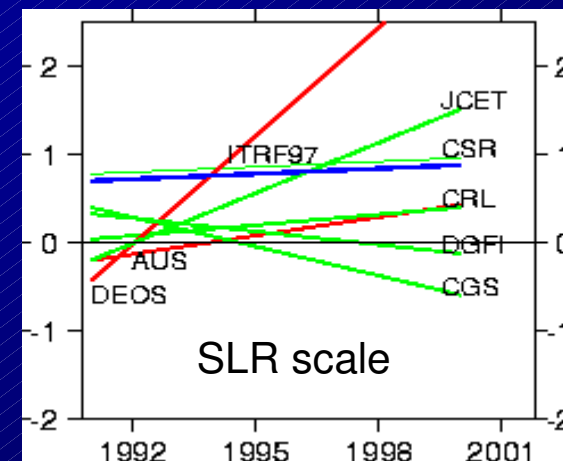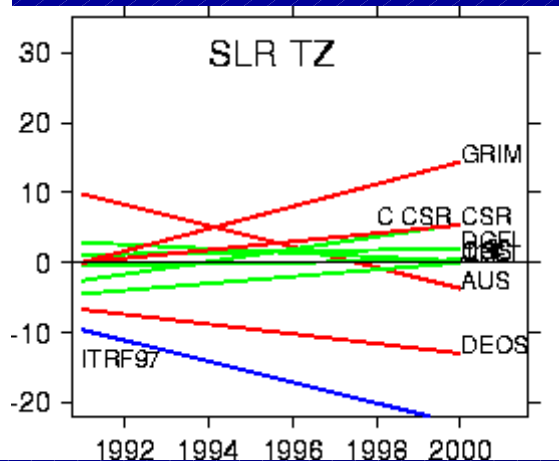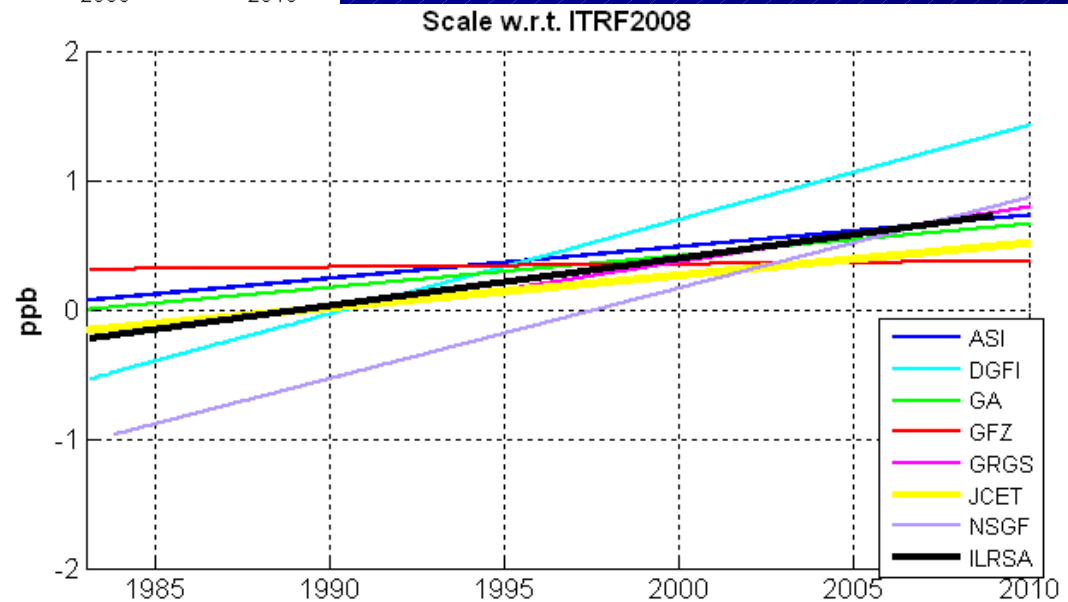
ILRS Analysis Centers origin & scale (1/2)
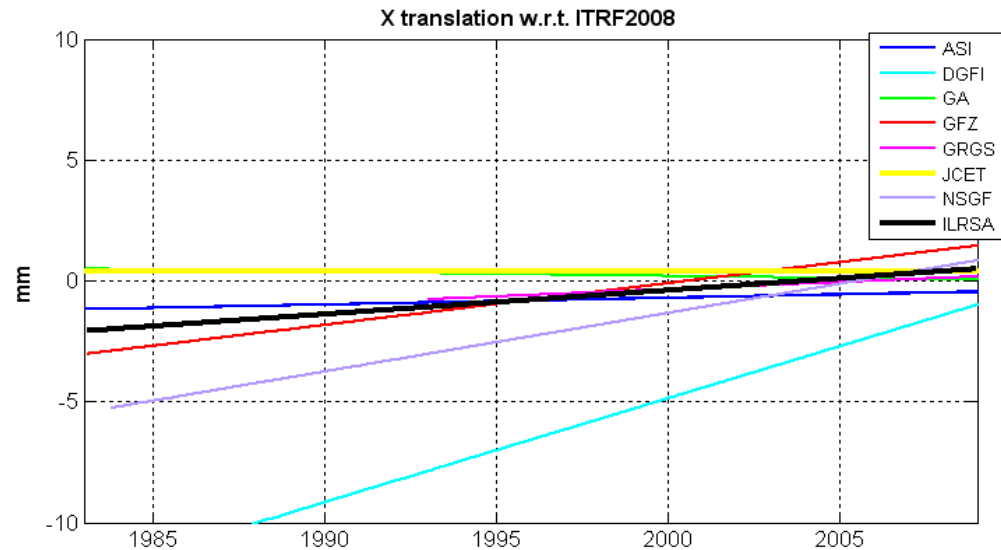
Offsets estimated @ 2005.0
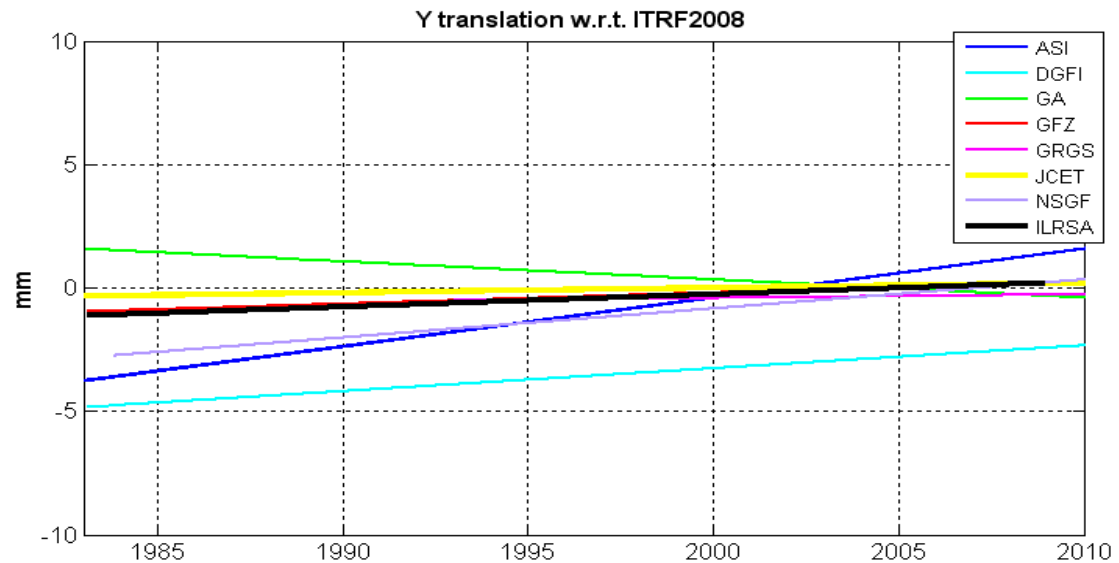
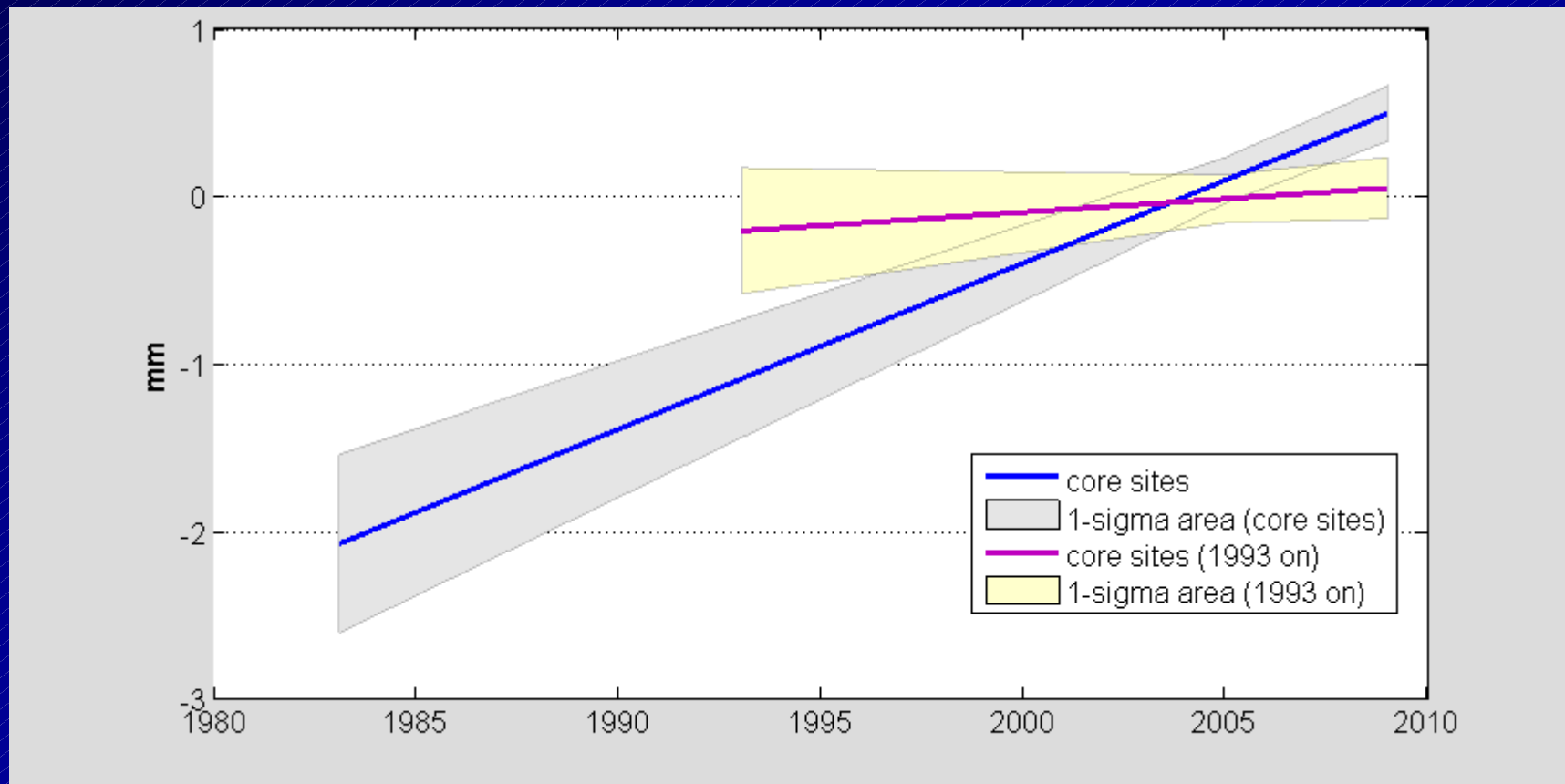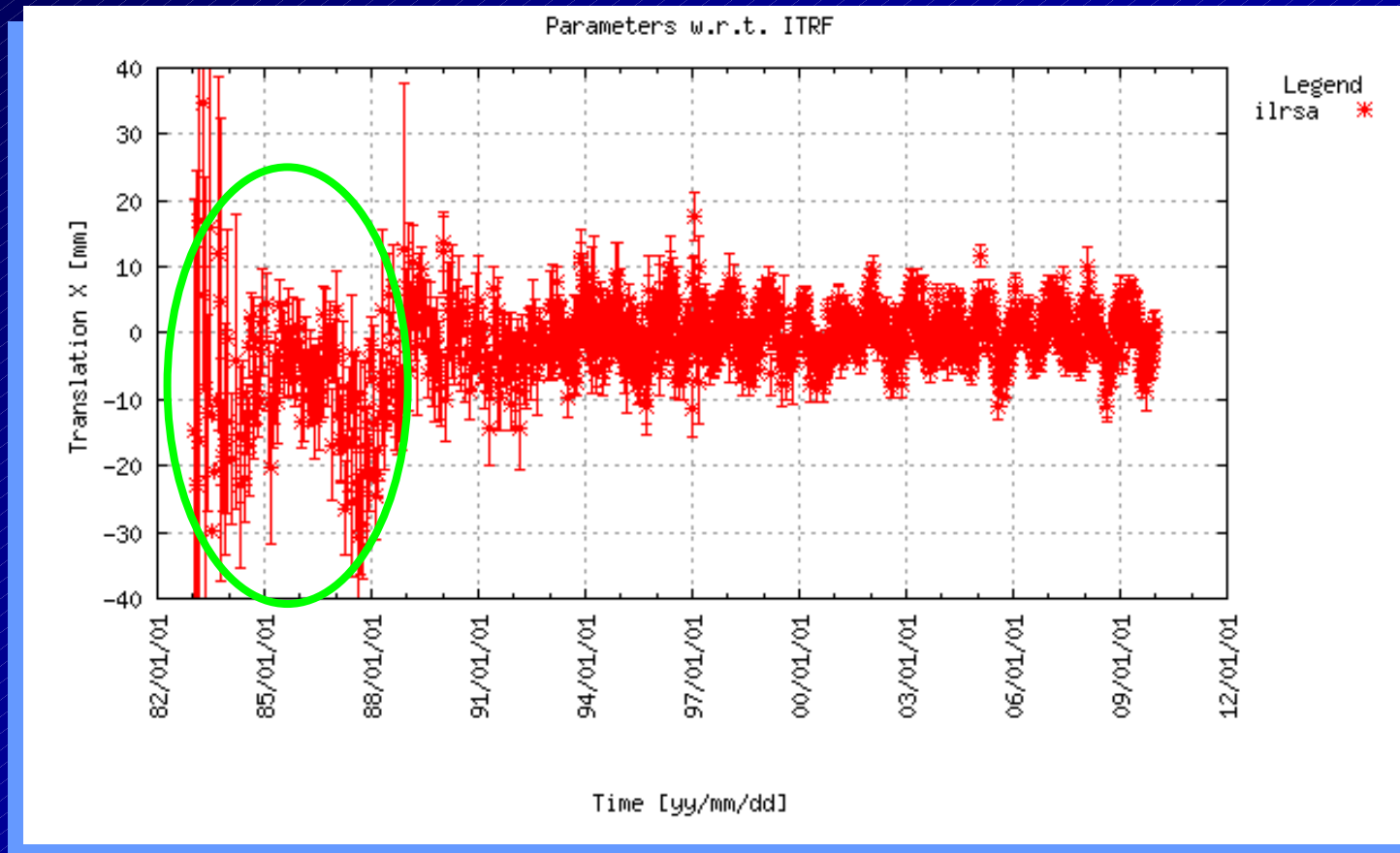# ILRS Analysis Centers origin & scale (2/2)

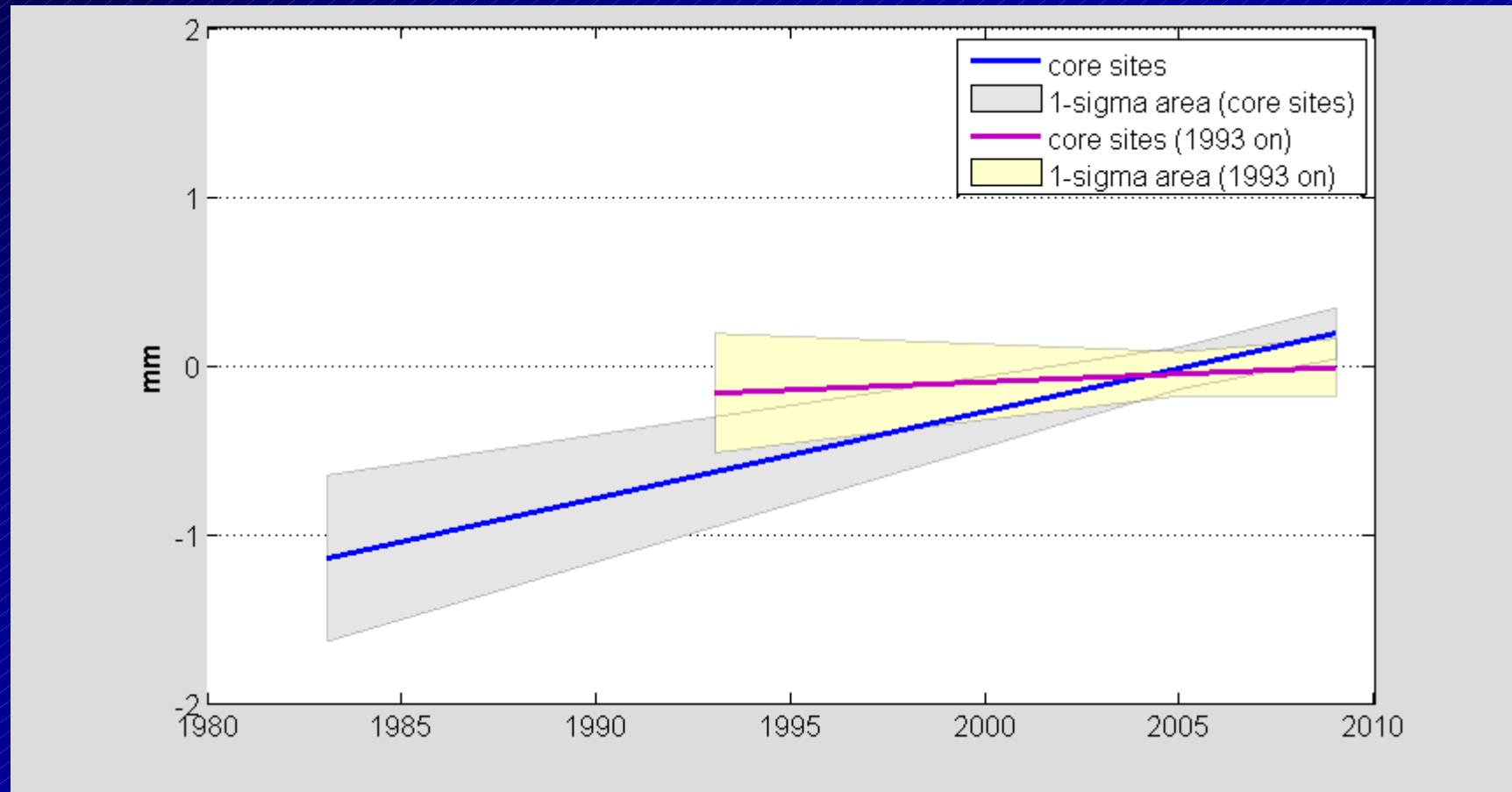Offsets estimated @ 2005.0

ILRSA offset and rate to ITRF2008: TX

	Offset(mm)@2005	Slope (mm/y)
TX (1983-2009)	0.09± 0.14	0.10± 0.02

ILRSA X-Translation to ITRF2008

The translations have been estimated according to the following formula
ITRF2008 = T + SF·R ·AC
where T is the translation vector, SF the scale factor and R the rotation matrix.

ILRSA offset and rate to ITRF2008: TY
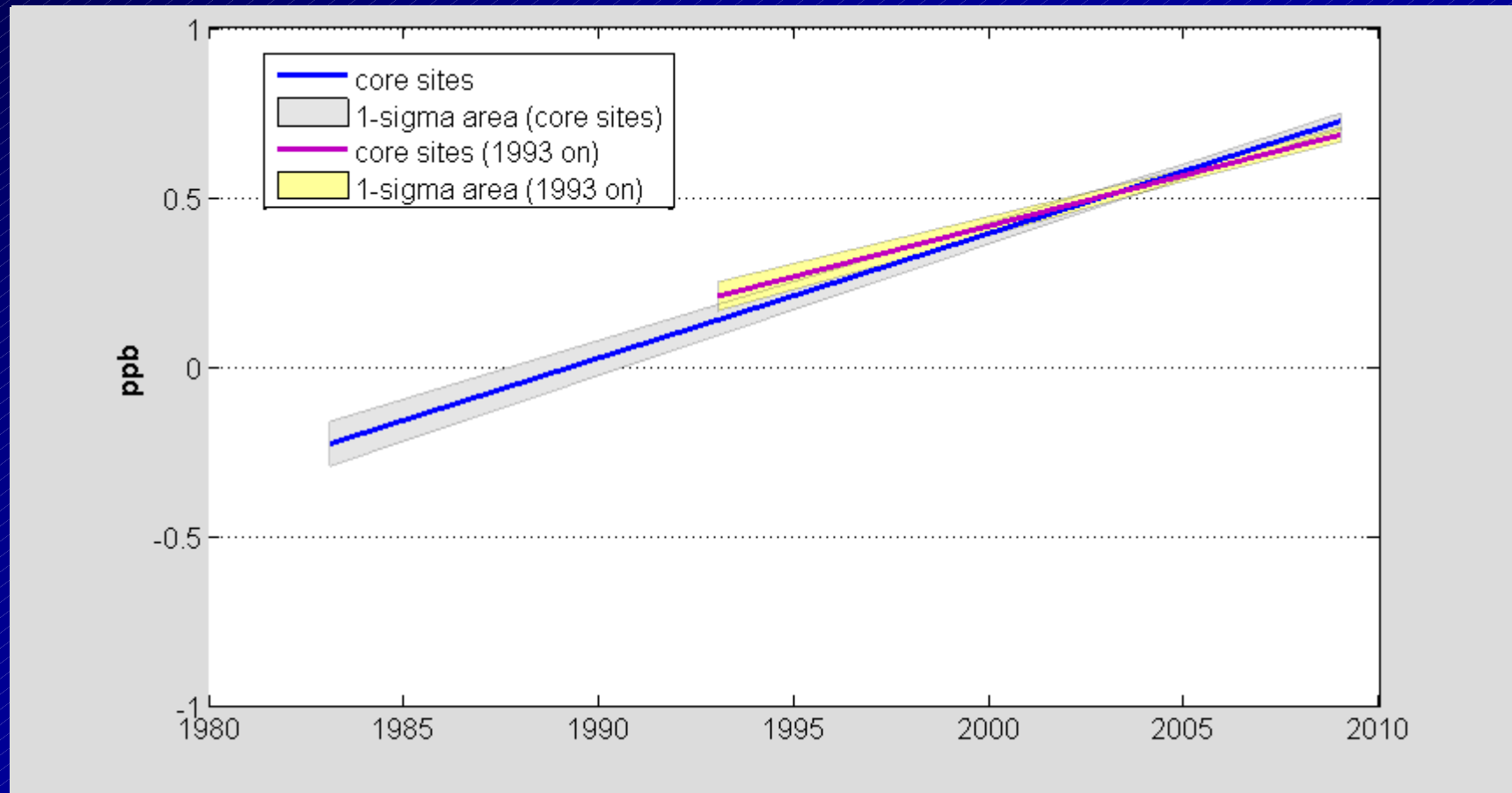


```
                    Offset(mm)@2005   Slope (mm/y)
TY (1983-2009)        -0.01± 0.12       0.05± 0.02
```

ILRSA offset and rate to ITRF2008: TZ
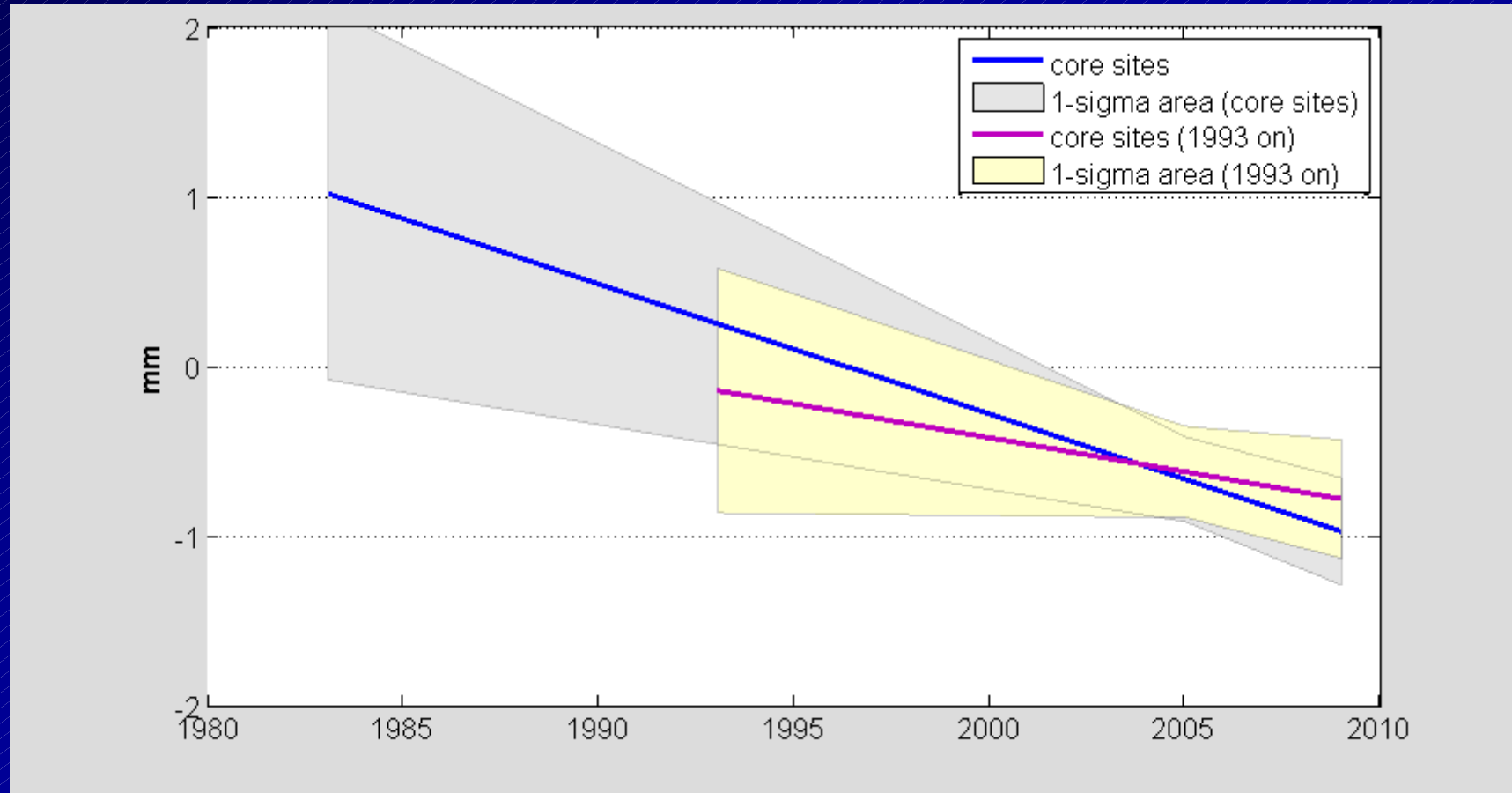

```
                        Offset(mm)@2005   Slope (mm/y)
TZ (1983-2009)            -0.66± 0.25      -0.08± 0.05
```
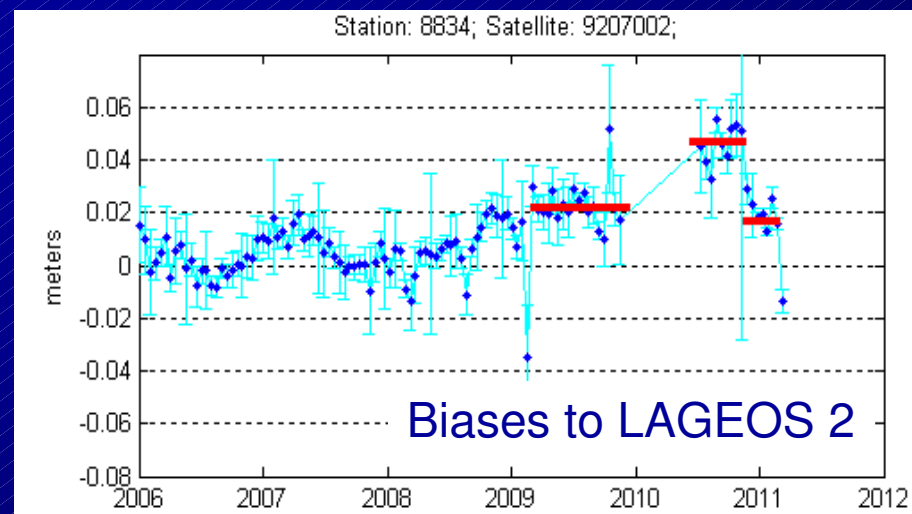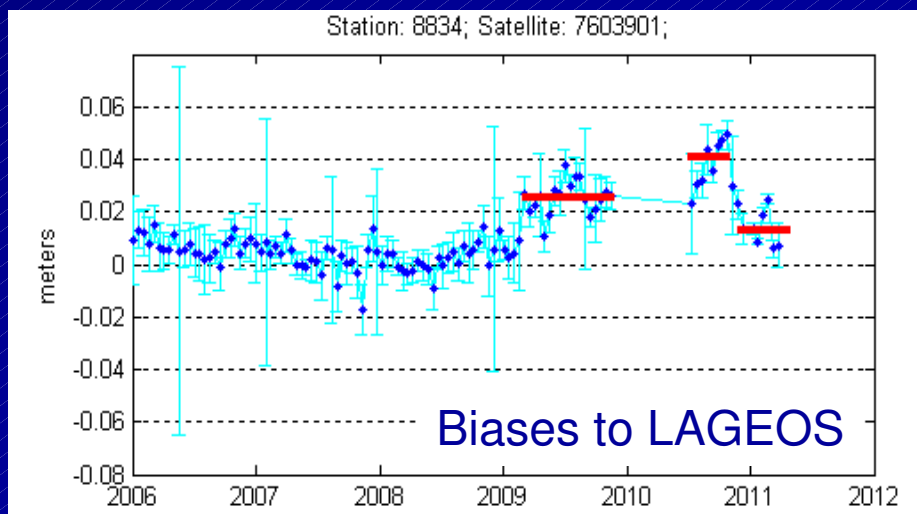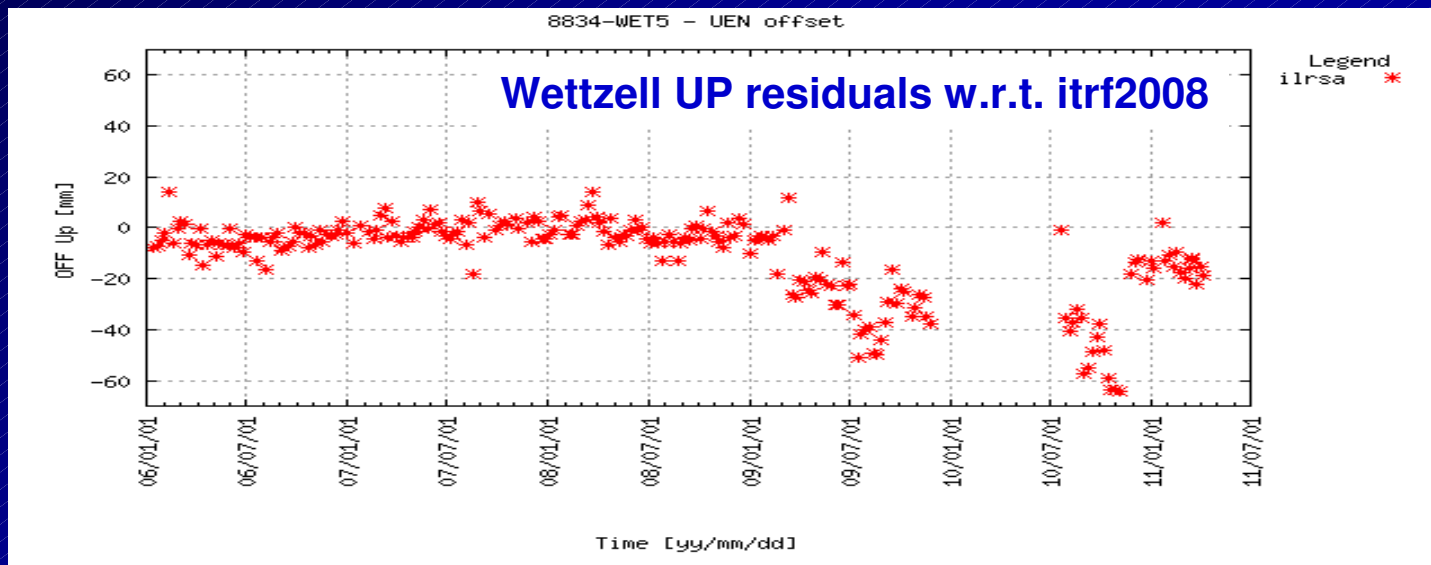
ILRSA offset and rate to ITRF2008: Scale


```
                Offset(ppb)@2005 Slope (ppb/y)
SC (1983-2009)      0.58± 0.02       0.04± 0.0
```

Never ending work.....

8834-WET5 - UEN offset

Wettzell UP residuals w.r.t. itrf2008

Legend
ilrsa

Time [yy/mm/dd]

Station: 8834; Satellite: 7603901;

Biases to LAGEOS

Station: 8834; Satellite: 9207002;

Biases to LAGEOS 2

Remarks

❑ The latest ILRS official product for ITRF2008 has adopted a common bias strategy for the single AC solutions (data handling sinex file available)

❑ The bias monitoring is an ongoing work to keep the ILRS routine product to a high quality standard, in close contact with the site engineers

The update of the system change file, system configuration file and site log is essential