ITRF2013 Reprocessing Status
from CNES/CLS Analysis Center (LCA)

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ITRF2013 PREPARATION

Standards and Models

Gravitational forces:
 Geopotential: EIGEN-6S2 (with derive terms)
 Ocean tides: FES2012
 Atmospheric gravity: 3hr ERA-interim / ECMWF up to degree 50
 (Atmospheric tides: none; considered through the ECMWF atmospheric data)
 Non tidal oceanic gravity: TUGO R12 up to degree 50
 Third body: JPL DE421 *(IERS conventions 2010)*

Non gravitational forces:
 Atmospheric drag: DTM 2012

Geometry:
 Troposphere: GPT2/VMF1 + one gradient per station in North & East directions
 Ocean loading: FES2012
 Tidal atmospheric loading: S1/S2 Ray&Ponte
 (IERS conventions 2010, ITRF2013 recom.)

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ITRF2013 PREPARATION

Changes brought in GINS software

• The phase law for STAREC and ALCATEL antennas given by CNES has been implemented in GINS and has been used for our ITRF processing

• A correction has been brought in the GINS software to take into account the last changes (beginning in 2012) of the orientation of solar panel for Spot-5 (GINS version used is the 13-2d2).

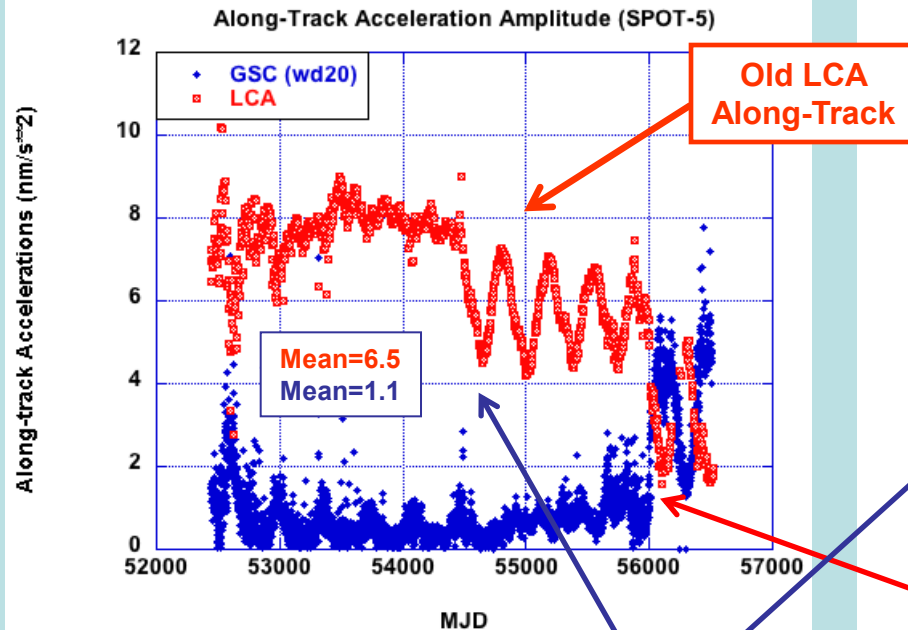## Changes brought in our processing

• For Cryosat-2, we applied the CNES 7-plate macromodel with a SRP value which has been estimated over a sufficiently long period.

•A study has been realized to reduce the Along-track and Cross-track OPR amplitudes for Spots satellites, Jason-1 and Envisat. This led to change SRP values for these satellites.
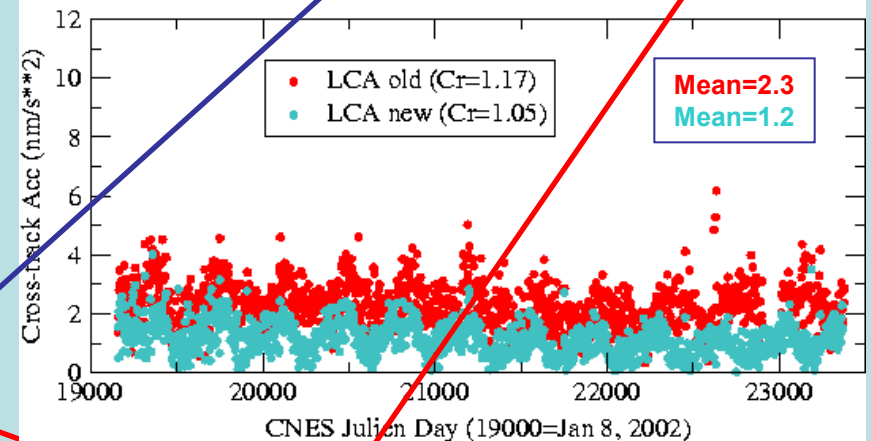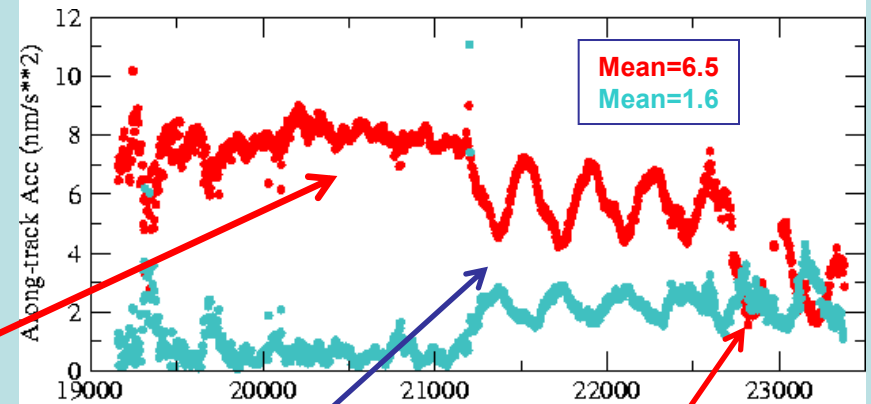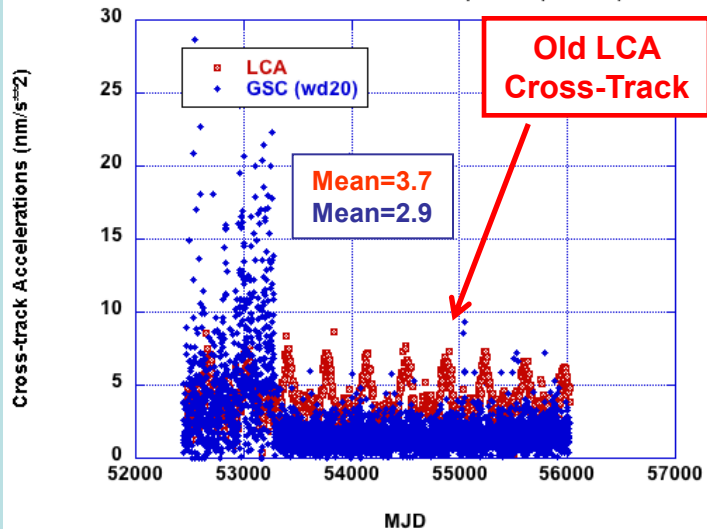
ITRF2013 PREPARATION

Decrease of the Along-track and Cross-track OPR amplitudes for Spots satellites
Example for Spot-5

LCA OPR rate 3.5d
GSC OPR rate 1.0d

Results of Along-Track OPR LCA/GSC
(by F. Lemoine and N. Zelensky, AWG Oct. 2013)

Results of OPR Amplitude LCA old/new

Old LCA
Along-Track

Mean=6.5
Mean=1.6

Mean=2.3
Mean=1.2

Mean=6.5
Mean=1.1

Jun. 17, 2002 to Dec. 27, 2013

Changes of Solar panel orientation
January 2008 - March 2012

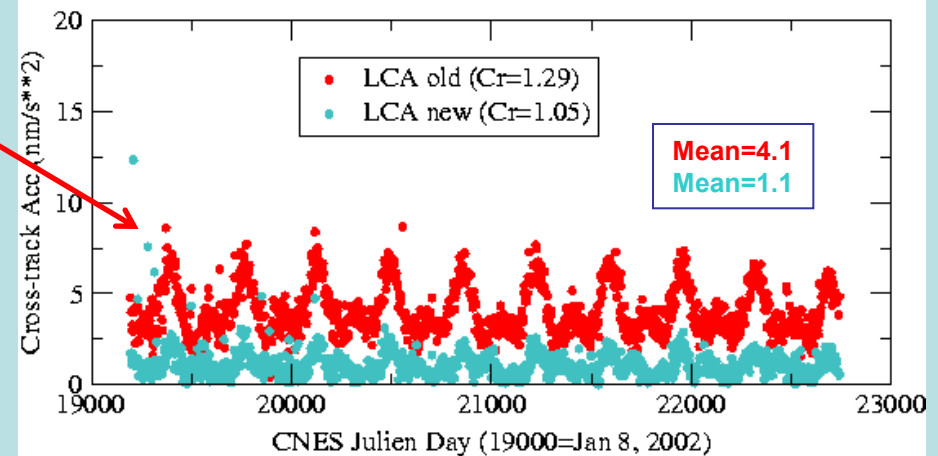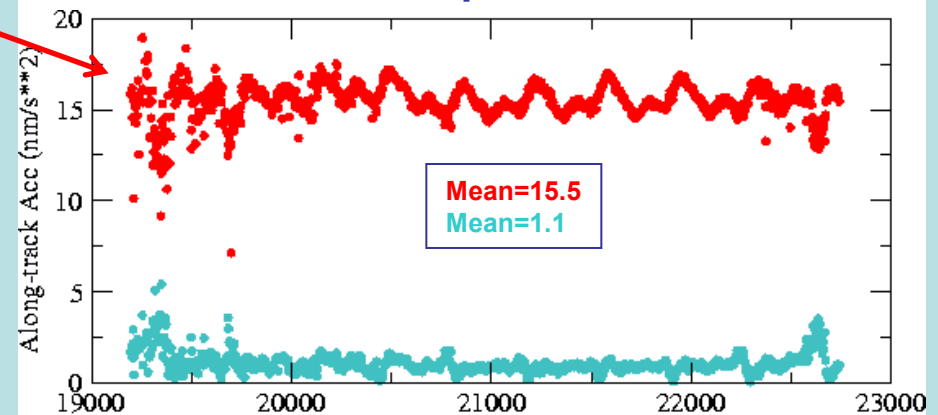## Decrease of the Along-track and Cross-track OPR amplitudes for ENVISAT

LCA OPR rate 3.5d / GSC OPR rate 1.0d

Results of OPR Amplitude LCA/GSC
(by F. Lemoine and N. Zelensky, AWG Oct. 2013)

Old LCA Along-Track

Mean=15.5
Mean=1.7

Old LCA Cross-Track

Mean=3.7
Mean=2.9

Results of OPR Amplitude LCA old/new

Mean=15.5
Mean=1.1

LCA old (Cr=1.29)
LCA new (Cr=1.05)

Mean=4.1
Mean=1.1

CNES Julien Day (19000=Jan 8, 2002)
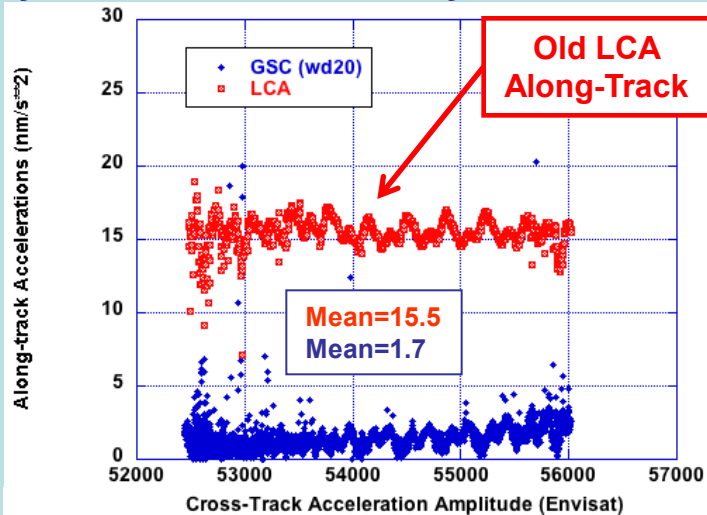
Jul. 23, 2002 to Apr. 04, 2012

ITRF2013 REPROCESSING

Data processed
The Table gives the DORIS DATA used and the satellite combination for the different periods

Period	Satellite combination
1993/01-1994/01	s2t
1994/02-1996/10	s2s3t
1996/11-1998/04	s2t
1998/05-2001/12	s2s4t
2002/01-2004/10	s2s4s5teJc
2004/11-2008/06	s2s4s5eJcj
2008/07-2010/05	s2s4s5eJc
2010/06-2012/04	s4s5eJc
2012/04-2013/06	s4s5Jc
2013/06-2013/12	s5Jc

- For all missions the elevation cut off is 12°, and a downweighting law is applied for elevations <= 20°

- For Jason-1 :
We compute new data set including SAA model correction from end of TOPEX (Nov. 2004) to start of Jason-2 (July 2008)
Downweight SAA stations in POD
We rename the SAA stations parameters for Jason-1 for the combination

- For SPOT5, since January 2006 we consider new data set including SAA model correction

- At the moment we do not use the HY2A and SARAL DATA

t=Topex, j=Jason-1, J=Jason-2
s2=Spot-2, s3=Spot-3, s4=Spot-4, s5=Spot-5
e=Envisat, c=Cryosat-2

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DORIS Residuals Orbit for Spots satellites

SPOT-2
From GPS week 678 to 1540
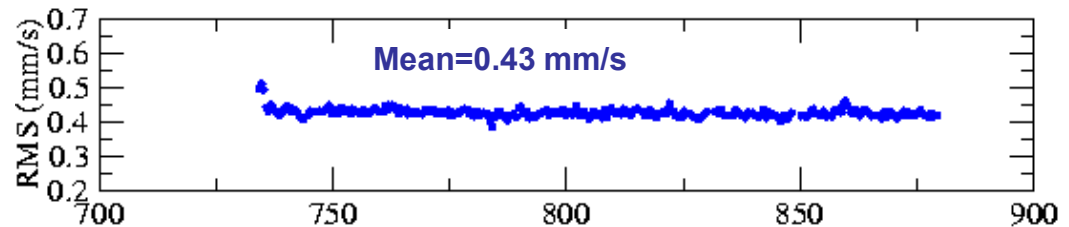(Jan. 4, 1993 to Jul. 13, 2009)
Mean=0.41 mm/s
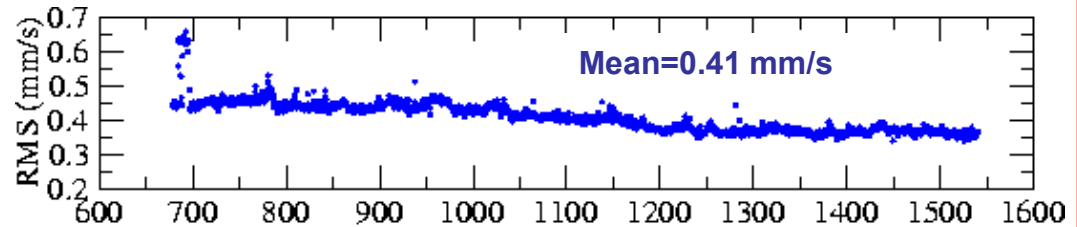
SPOT-3
From GPS week 734 to 879
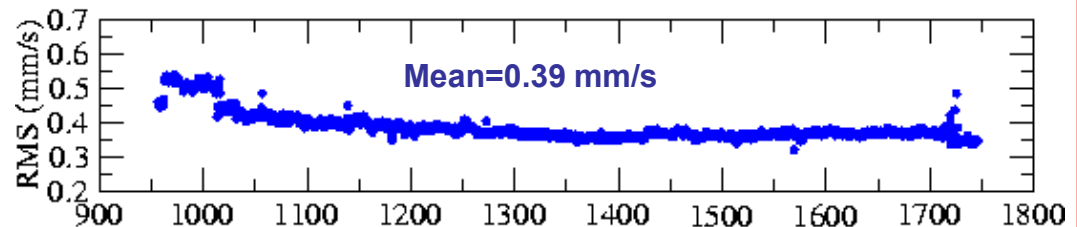(Feb. 01, 1994 to Nov. 11, 1996)
Mean=0.43 mm/s

SPOT-4
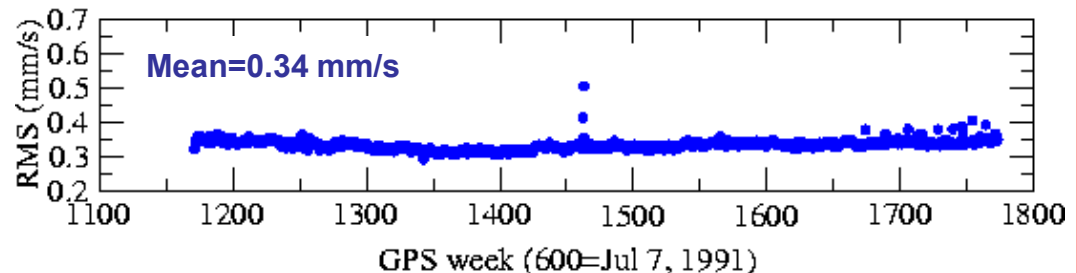From GPS week 956 to 1745
(May 04, 1998 to Jun. 26, 2013)
Mean=0.39 mm/s

SPOT-5
From GPS week 1171 to 1772
(Jun. 17, 2002 to Dec. 27, 2013)
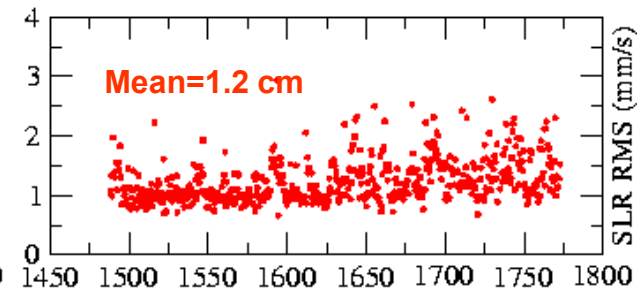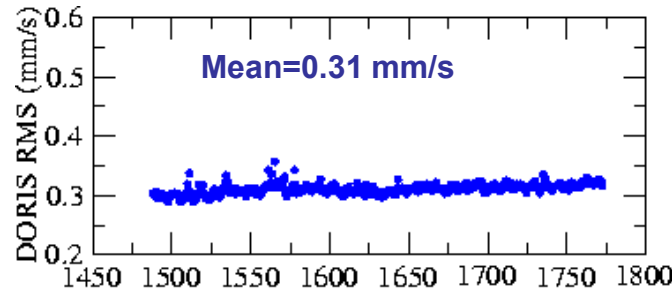**Mean=0.34 mm/s**

ITRF2013 REPROCESSING STATUS

DORIS and SLR Residuals Orbit for Topex, Jason1 and Jason2

JASON-2
From GPS week 1488 to 1772
(Jul. 14, 2008 to Dec. 27, 2013)
DORIS Mean=0.31 mm/s
SLR Mean=1.2 cm

JASON-1
From GPS week 1149 to 1745
(Jan. 01, 2002 to Jun.14, 2013)
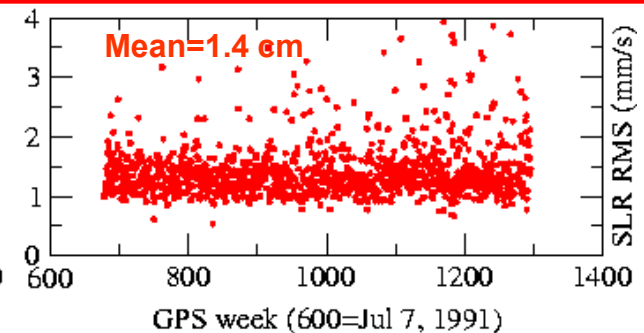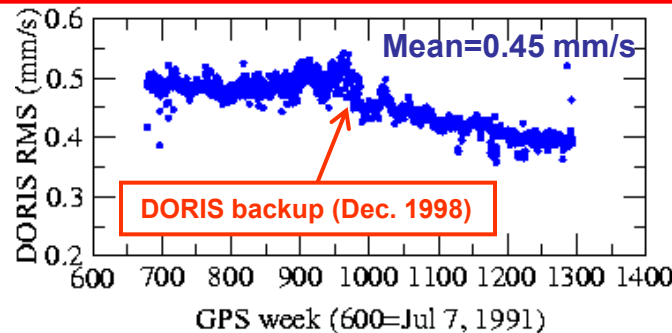**DORIS Mean=0.31 mm/s**
SLR Mean=1.2 cm
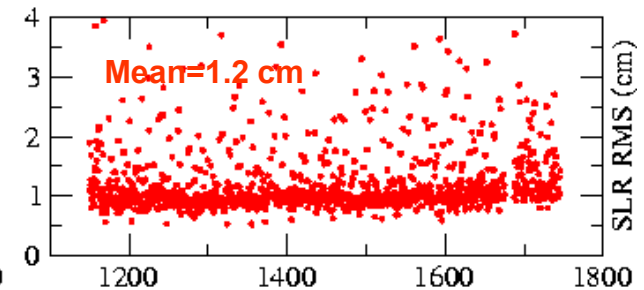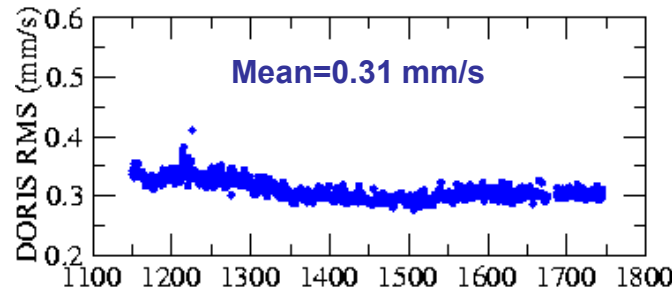
TOPEX
From GPS week 678 to 1293
(Jan. 04, 1993 to Oct. 29, 2004)
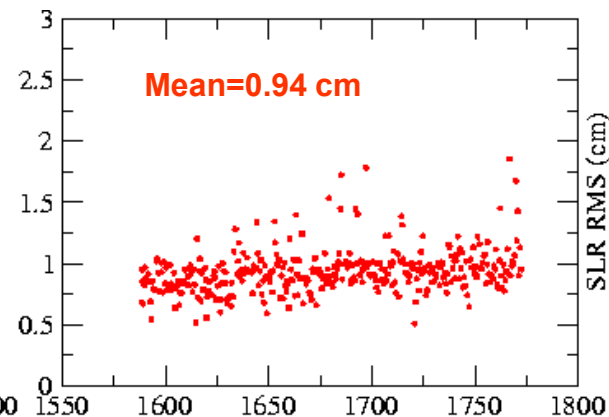**DORIS Mean=0.45 mm/s**
SLR Mean=1.4 cm
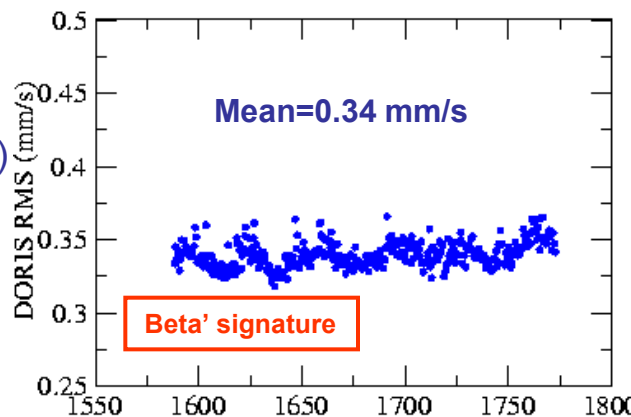
ITRF2013 REPROCESSING STATUS

DORIS and SLR Residuals Orbit for Envisat and Cryosat-2

CRYOSAT-2
From GPS week 1588 to 1772
(Jun. 16, 2010 to Dec. 27, 2013)
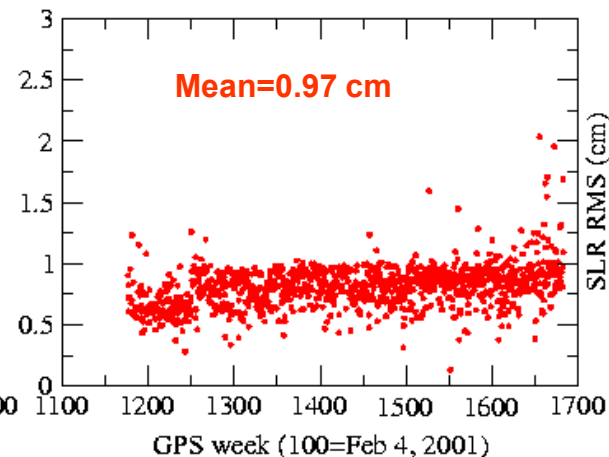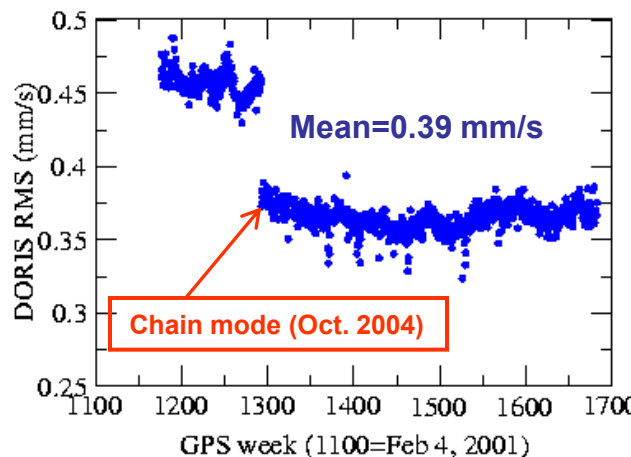
DORIS Mean=0.34 mm/s
SLR Mean=0.94 cm

ENVISAT
From GPS week 1176 to 1682
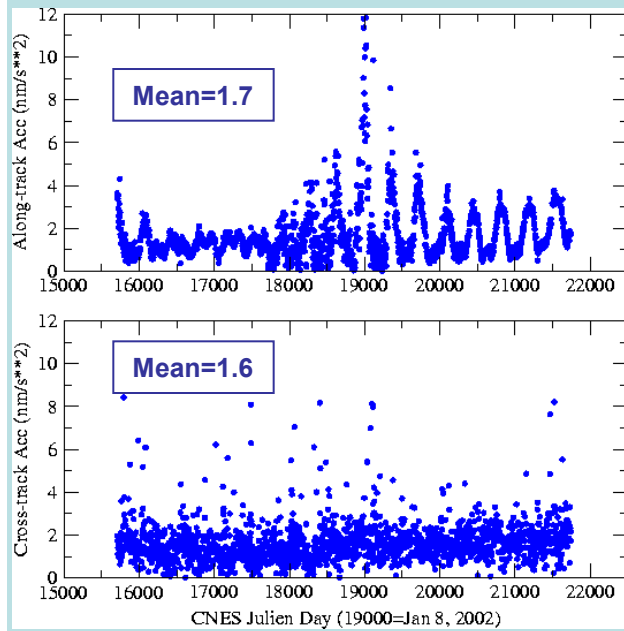(Jul. 23, 2002 to Apr. 04, 2012)

DORIS Mean=0.39 mm/s
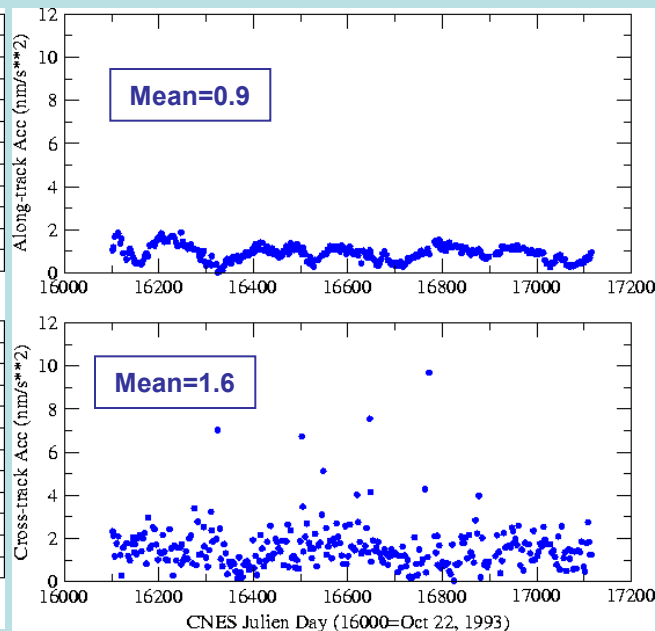**SLR Mean=0.97 cm**

ITRF2013 REPROCESSING STATUS

OPR Acceleration Amplitude
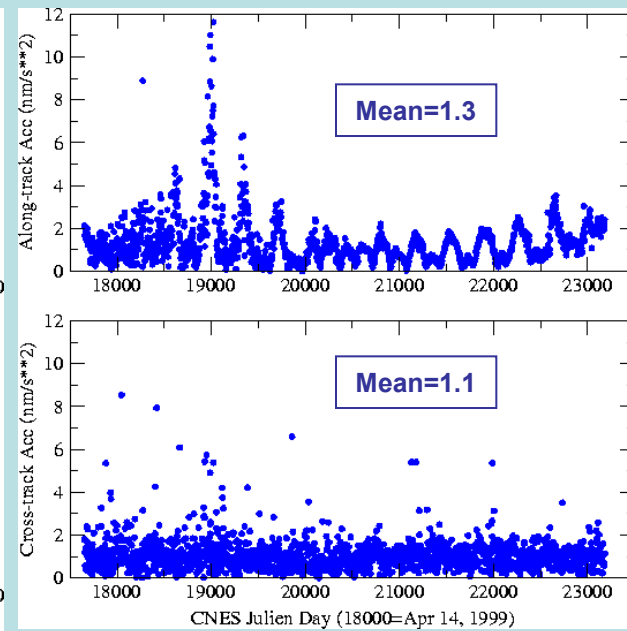### Along-track and Cross-track

LCA SPOT-2
Cr=1.07

LCA SPOT-3
Cr=1.07

LCA SPOT-4
Cr=1.16

Mean=1.7   Mean=0.9   Mean=1.3

Mean=1.6   Mean=1.6   Mean=1.1

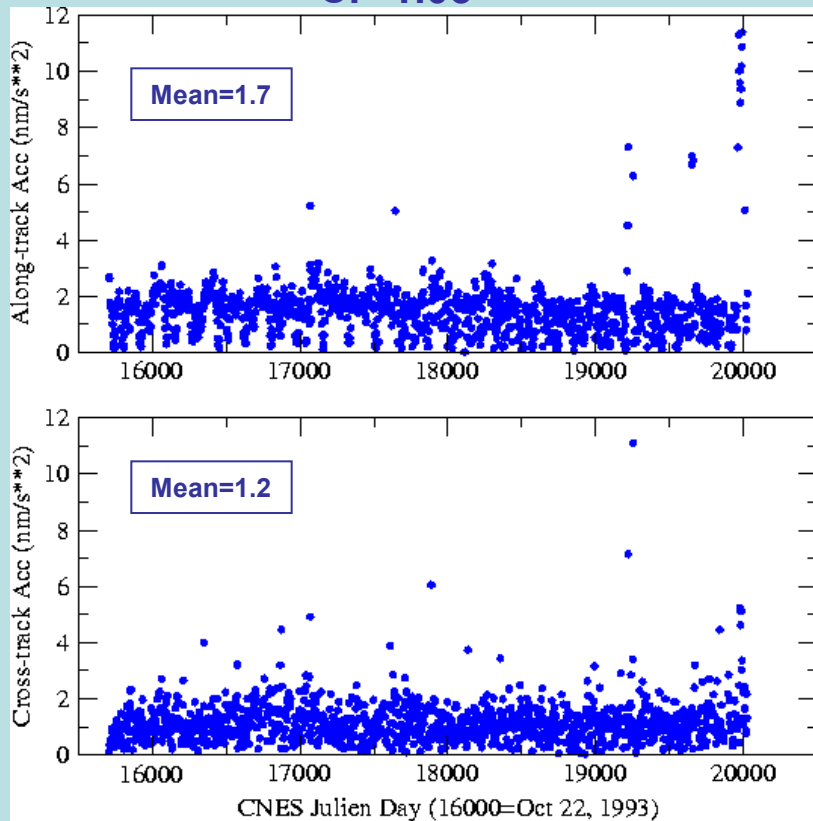Jan. 4, 1993 to Jul. 13, 2009   Feb. 01, 1994 to Nov. 11, 1996   May 04, 1998 to Jun. 26, 2013
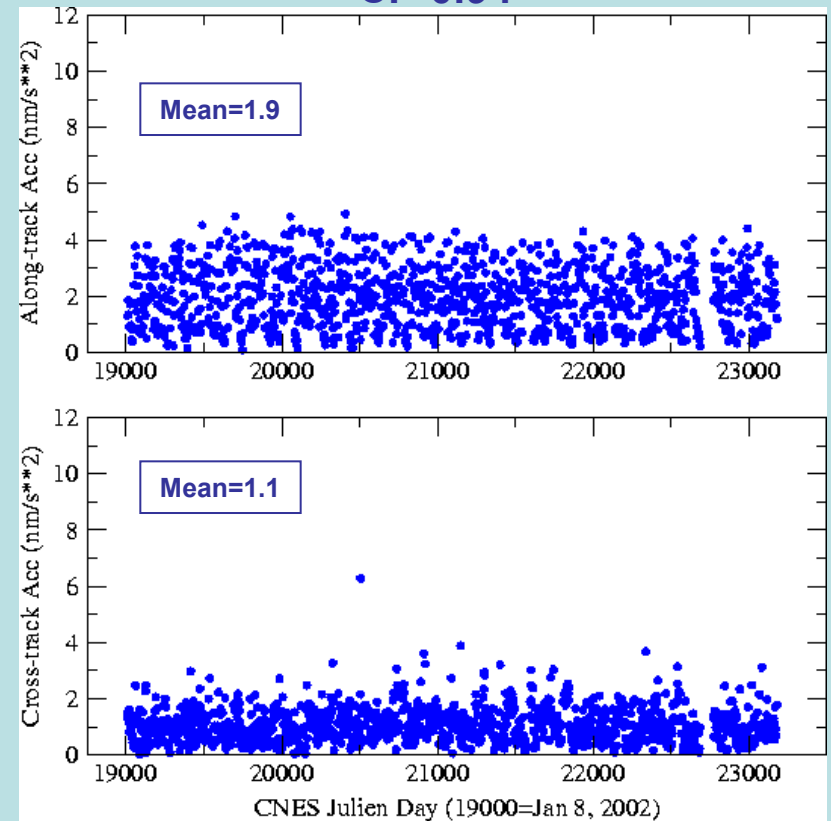
ITRF2013 REPROCESSING STATUS

OPR Acceleration Amplitude: Along-track and Cross-track

LCA TOPEX
Cr=1.03

LCA JASON-1
Cr=0.94

Mean=1.7

Mean=1.9

Mean=1.2

Mean=1.1
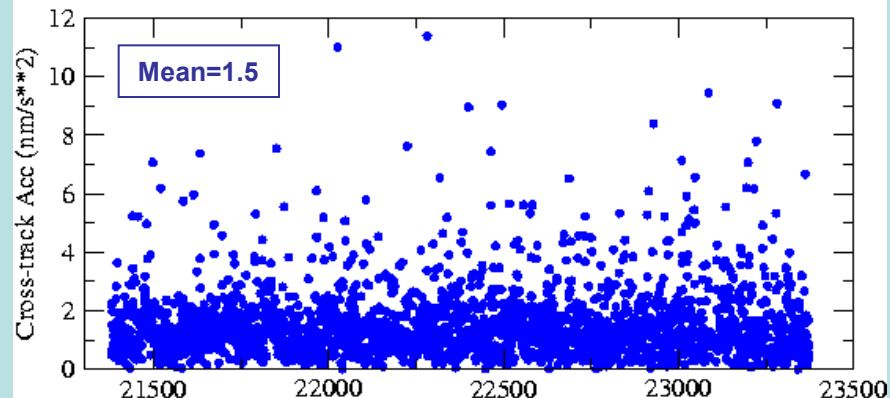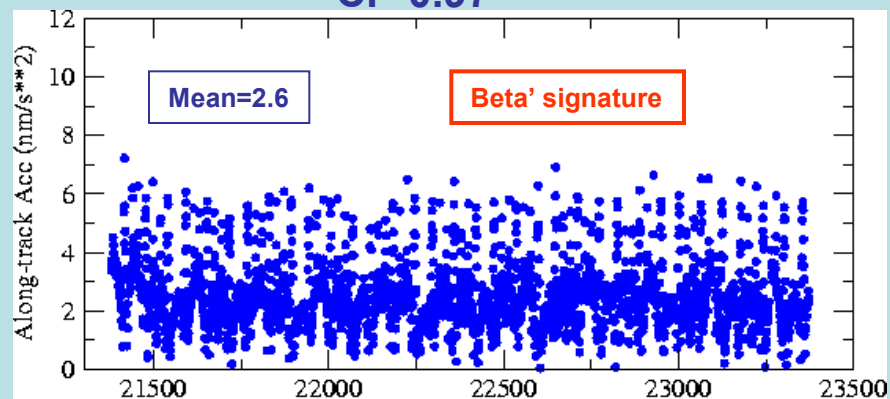
Jan. 04, 1993 to Oct. 29, 2004

Jan. 01, 2002 to Jun.14, 2013

ITRF2013 REPROCESSING STATUS

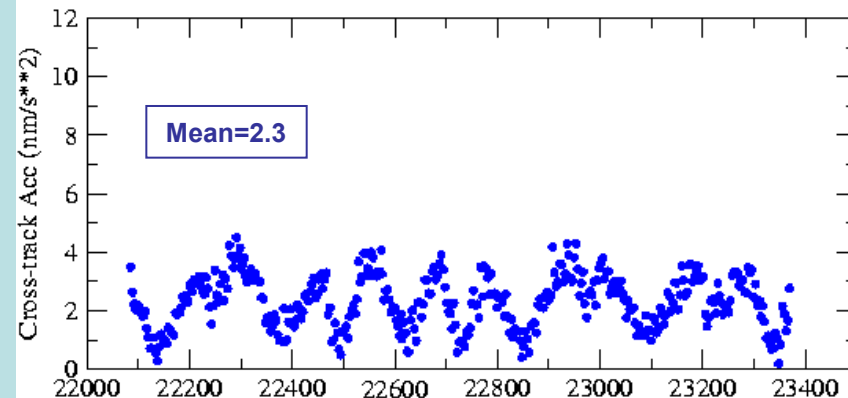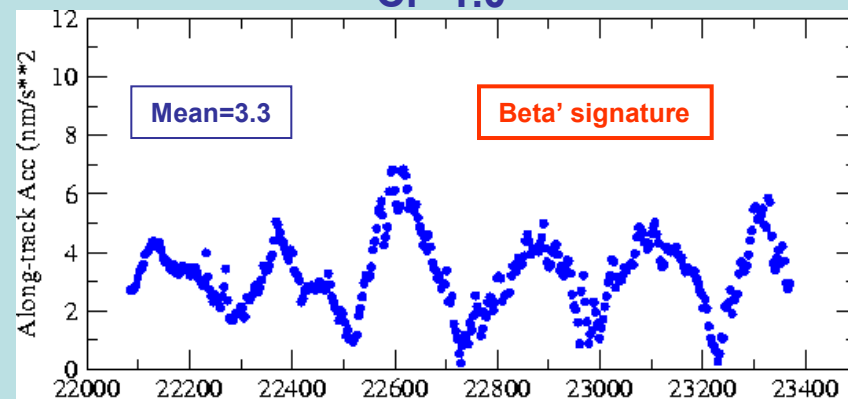## OPR Acceleration Amplitude: Along-track and Cross-track

LCA JASON-2
Cr=0.97

LCA CRYOSAT-2
Cr=1.0

Jul. 14, 2008 to Dec. 27, 2013
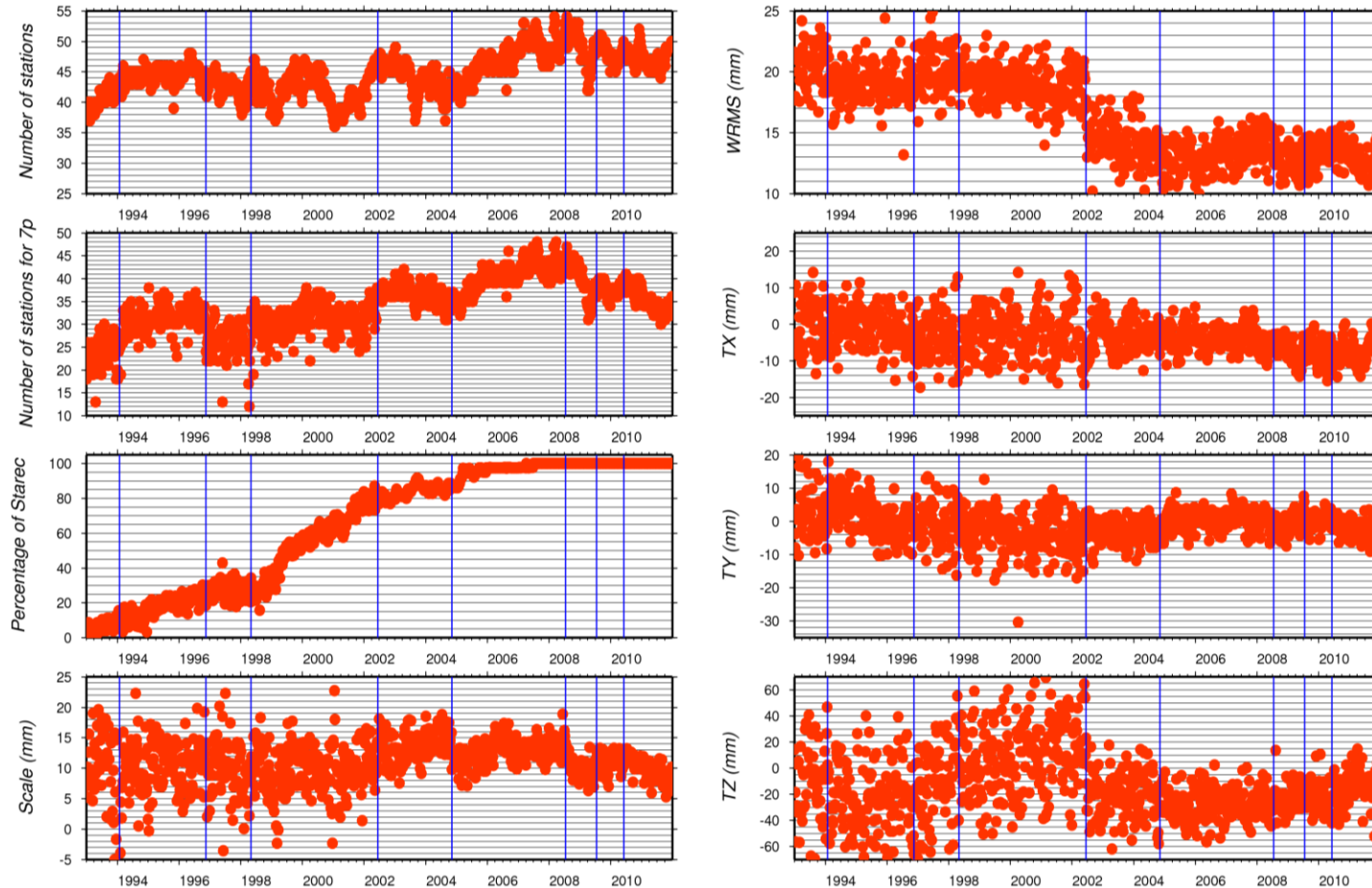
Jun. 16, 2010 to Dec. 27, 2013

ITRF2013 REPROCESSING STATUS

Helmert parameters (Geocenter and Scale) estimated by the IDS Combination Center with LCA solution (lcawd40)

- bias on the scale compared to ITRF2008 explained by the application of the phase law
- long term periodic signal of 18,6 years on the Tx and Ty is clearly reduced with the lcawd40 solution
- different time periods corresponding to the change of satellite number in the constellation (vertical blue lines). In particular before and after 2002 (introduction of the 2G instruments with Spot-5, Envisat and Jason-1)

ITRF2013 REPROCESSING PERSPECTIVE

Processing schedule
At the moment all the ITRF2013 period has been processed for satellites
- Spot-2 -3 -4 -5
- Topex
- Envisat
- Jason-1 -2
- Cryosat-2

**Possible Improvements of the ITRF reprocessing**
- To correct the abnormal Tz behavior visible in the single satellite Cryosat-2 solution

- Add the HY2A satellite in the multi-satellite combination (problem in the scale factor ??)

- Add SARAL satellite (only 6 months of DATA)

**Single-satellite Solutions
Helmert parameters (Geocenter and Scale) estimated by the IDS
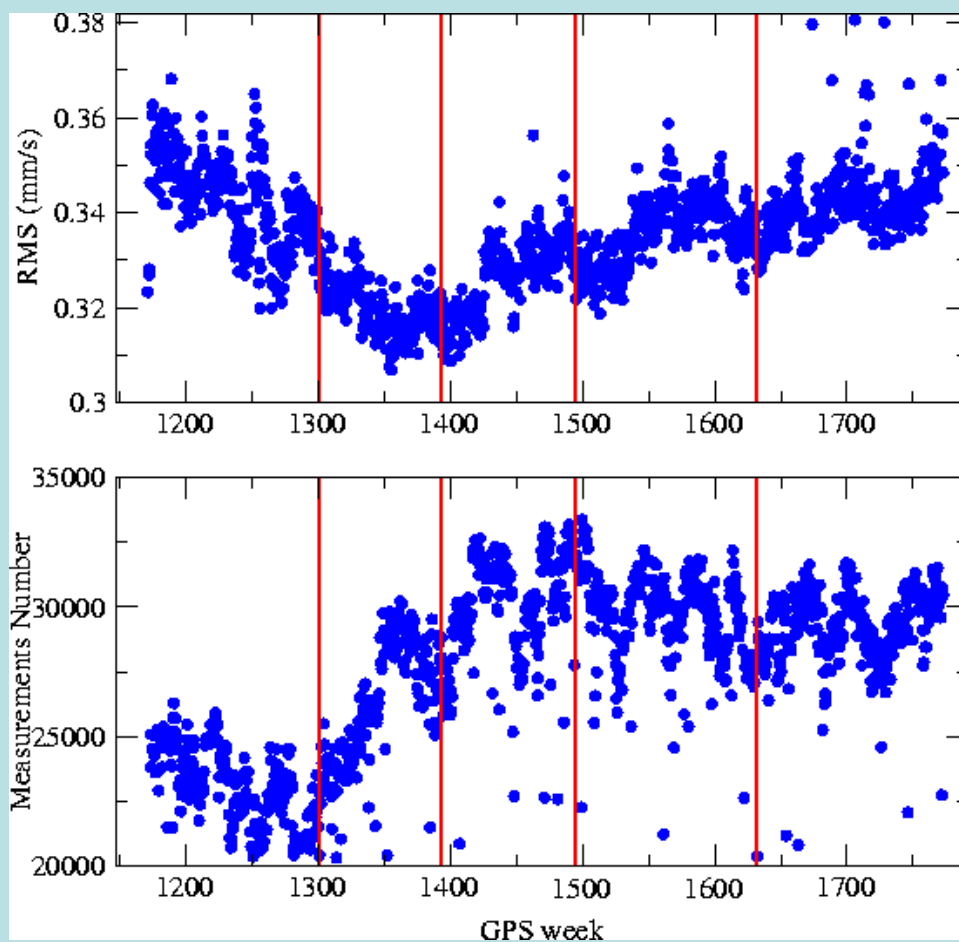Combination Center with LCA solution Spot-5**
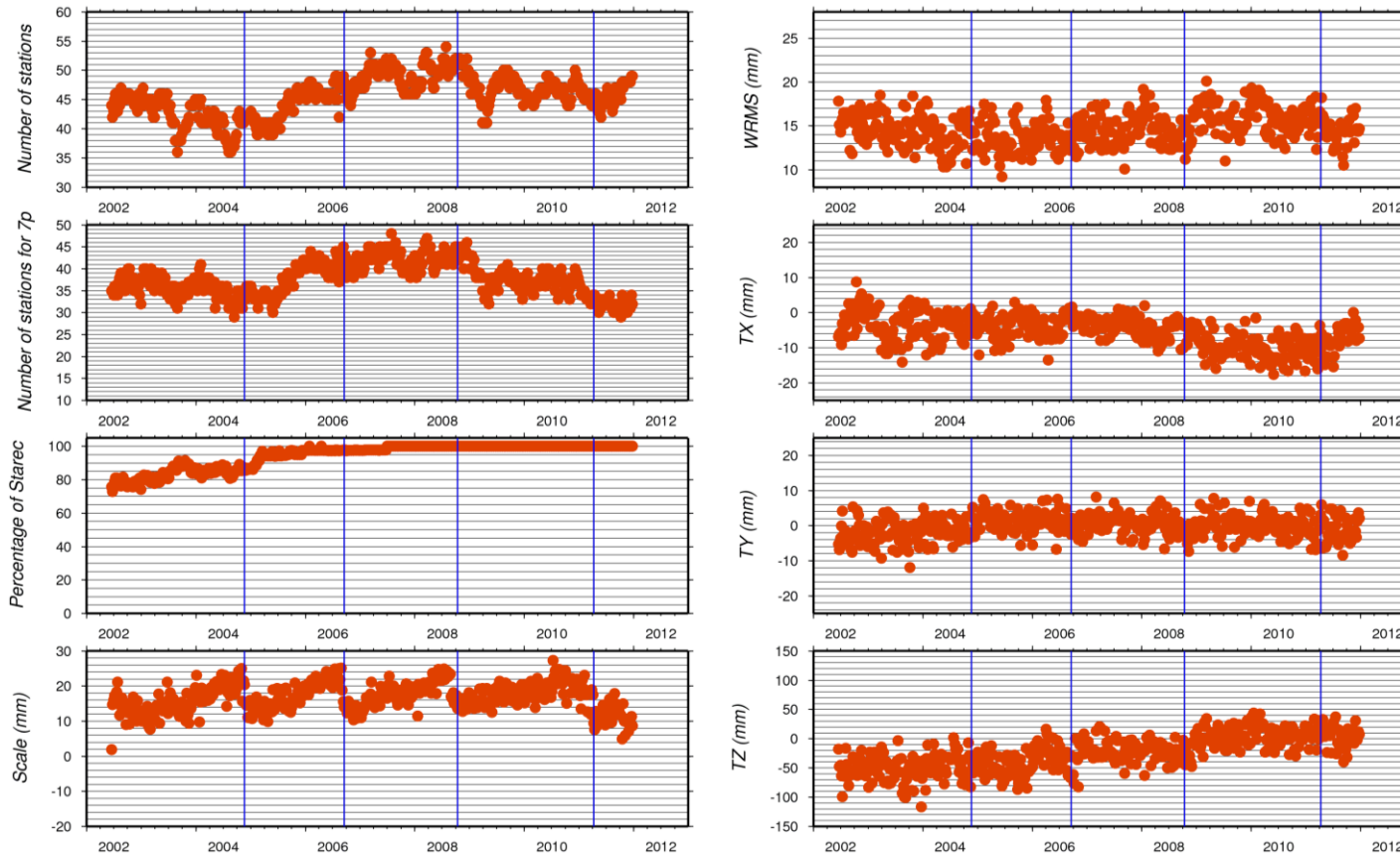
Dates:
- **Nov. 21, 2004**
- **Sep. 17, 2006**
- **Aug. 27, 2008**
- **Apr. 10, 2011**

AWG, 26-27 March 2014, Paris

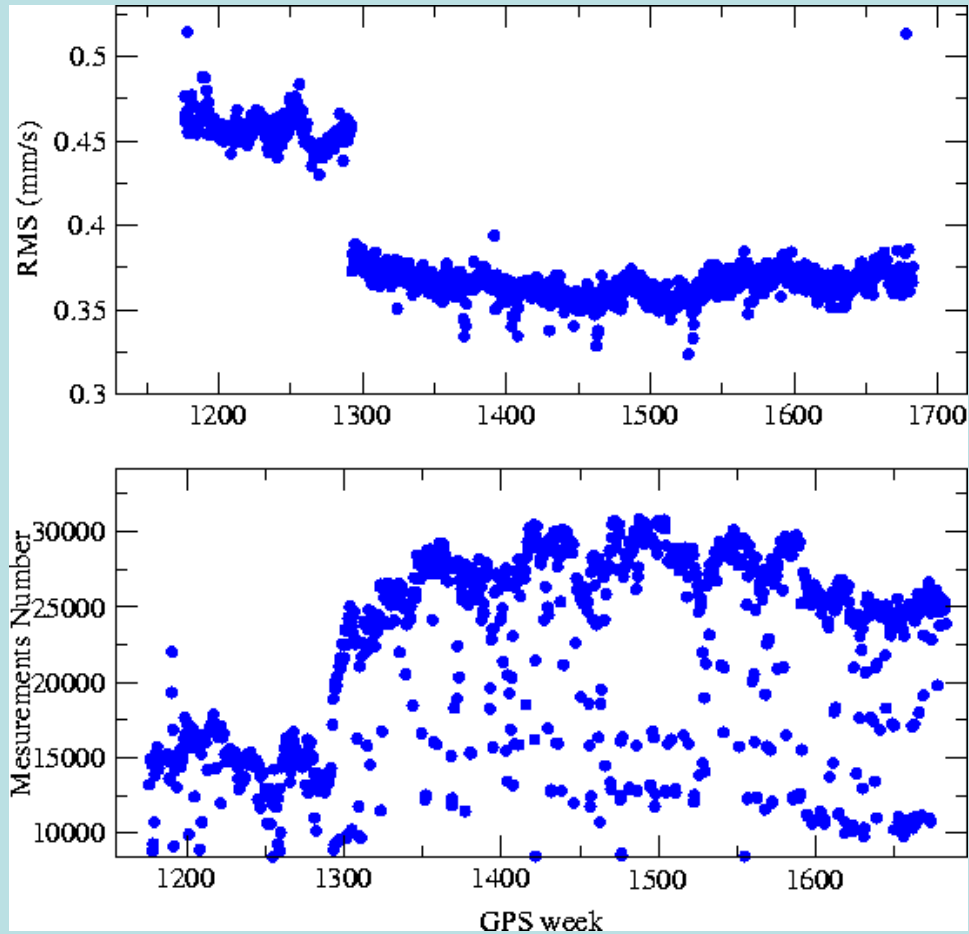## DORIS Residuals Orbit and Measurements Number for Spot-5

Jun. 17, 2002 to Dec. 27, 2013

Dates:
- Nov. 21, 2004
- Sep. 17, 2006
- Aug. 27, 2008
- Apr. 10, 2011

DORIS Residuals Orbit and Measurements Number for Envisat

Jul. 23, 2002 to Apr. 04, 2012

Single-satellite Solutions
Helmert parameters (Geocenter and Scale) estimated by the IDS Combination Center with LCA solution Cryosat-2