

*IDS Workshop, 12-14 November 2008*

# **GINs software evolutions for the Jason-2 data processing: RINEX and DORIS 2.2 formats**

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## Summary

- GINS 8.3: upgraded for Jason2 and RINEX/DORIS
- Comparative use of RINEX/DORIS and DORIS 2.2
- Orbit results
- Contribution of Jason2 to multi-satellite combination

## Software evolutions

Jason2:

- box & wing model and optical coefficients of Jason-1
- DORIS antenna and LRA, satellite mass and CoM: values given by L. Cerri (dorismail 552)

Data:

- DORIS 2.2 : no change; only measurements « considered to be good » (flag=0)
- RINEX/DORIS:
  - Retrieval of the daily files; header reading; record table preparation
  - phase measurements transformed into cycle numbers

## RINEX/DORIS processing

- The ionospheric correction is calculated for each phase measurement (2 GHz)

- $\varphi_{1(\text{corrected})} = \varphi_1 + f_2 / (f_2^2 - f_1^2) \times (f_1 \times \varphi_2 - f_2 \times \varphi_1)$

- Deltaphase is formed

$$\Delta\varphi(t_i) = - ( \varphi(t_{i+1}) - \varphi(t_i) ) \quad \text{where } t_{i+1} = t_i + 10 \text{ sec}$$

- Offset of the receiver's clock is added
- Preprocessing indicators taken into account:
  - Central frequency (11, 21)
  - Discontinuity of measurement (12, 22)
  - Station on Restart Mode (51, 61)

If one of them is not null, the weight of the data is put to 0

- Satellite passes are formed for each station

## RINEX/DORIS vs DORIS 2.2

Results of preliminary tests performed with one day of data  
(Jul.17 2008)

elevation cut-off = 12°

	RINEX/DORIS	DORIS 2.2
Data used (% edited data)	16504 (38%)	16446 (30%)
Orbit residuals WRMS (mm/s)	0.316	0.315

## Orbit comparison

	Bias (cm)			Std Dev (cm)		
	Radial	Cross-Tr	Along-Tr	Radial	Cross-Tr	Along-Tr
Rinex / DORIS 2.2	-0.03	-0.02	-34.69	1.78	1.78	4.02
Rinex / POE	-0.11	-0.30	-35.02	2.38	2.70	5.23

The along-track bias of  $\sim -35$  cm corresponds to the  $-51.83$  micro-seconds propagation delay between the 2Ghz signal reception at the phase center of the antenna and the Top TDI inside Doris that provides the 10s OUS synchronism.

The correction of the files is planned mid-Nov.

## Orbit residuals and elevation cut-off

Cut-off angle	Data used	Edited data	Residuals RMS
0°	22083	3855	0.364 mm/s
5°	21469	4601	0.355 mm/s
12°	16194	9744	0.326 mm/s

Low residual RMS even for low elevation cut-off:

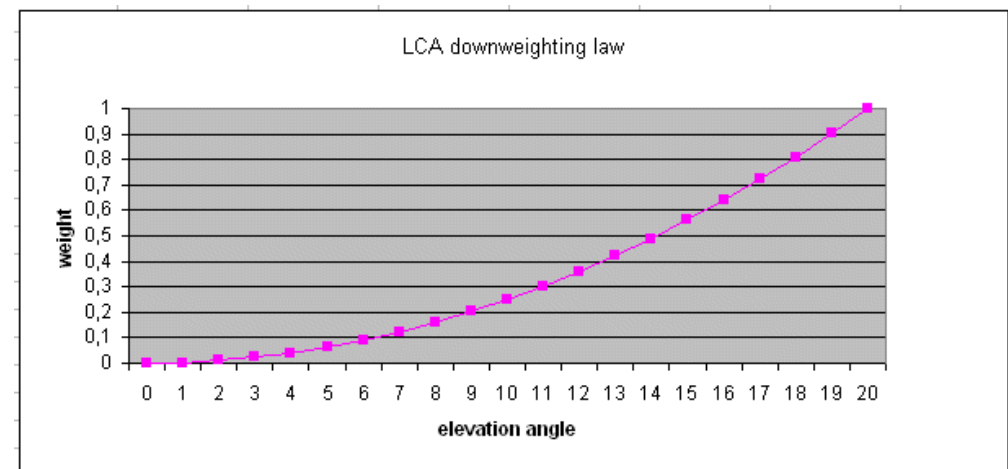
- quality of the tropospheric model
- efficiency of the downweighting law applied to measurements below 20 dg

For  $\text{elev\_dg} \leq 20 \text{ dg}$ :

Weight = Weight X F

where  $F = \text{elev\_dg}^2 / 400$

F=1 at 20 dg ; F=0 at 0 dg.



## Orbits results

DORIS 2.2 and SLR data

Cy. 001-008 = weeks 1488 to 1498 (08/07/13 to 08/09/27)

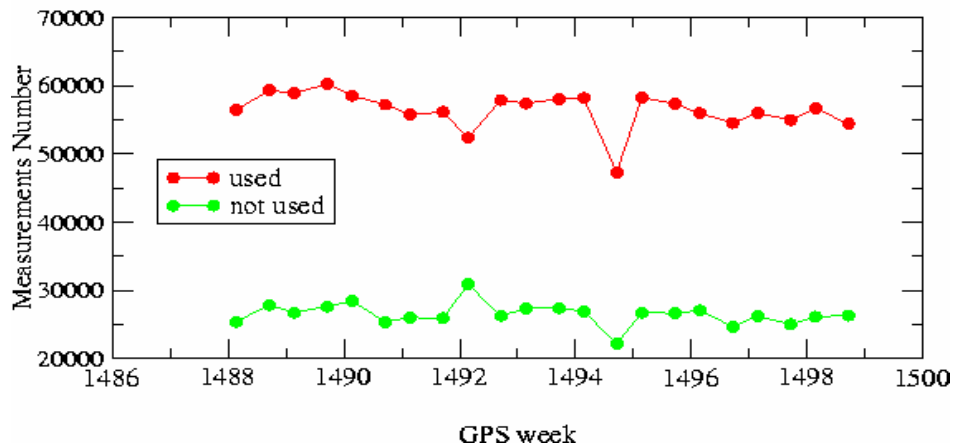
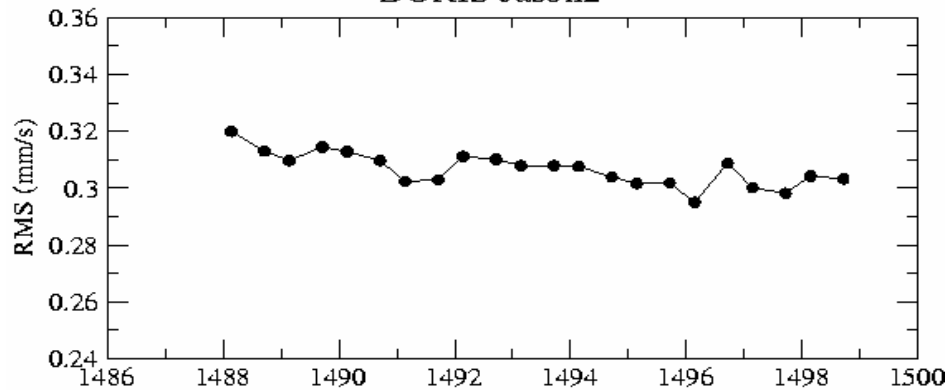
3.5-day arcs, elevation cut-off = 12 deg.

- RMS residuals and measurements number
- Overlap orbits
- Orbit comparison to GDR-C (POD CNES)



# DORIS residuals and number of measurements

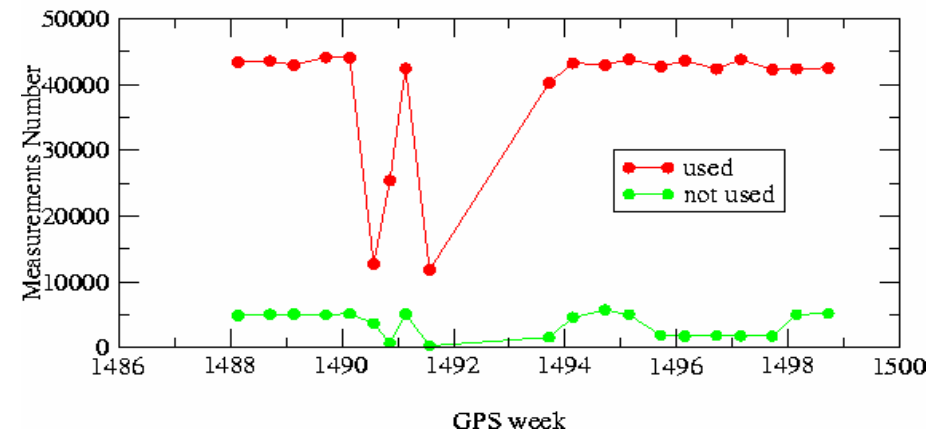
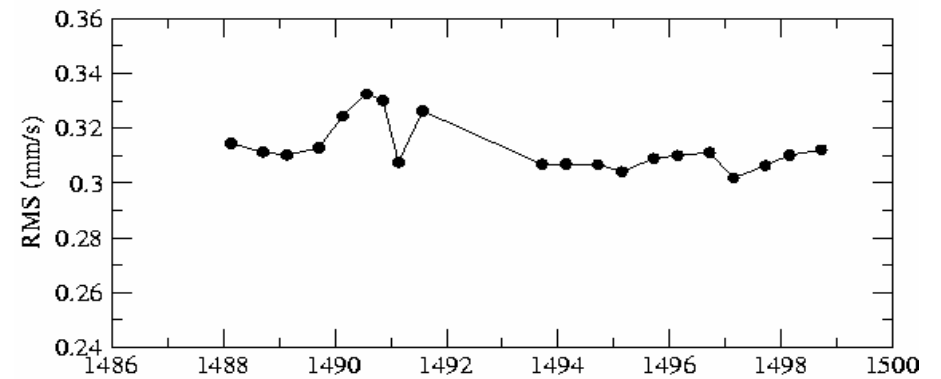
DORIS Jason2



rms: 0.30 - 0.31 mm/s  
~85000 mes. / 3.5d arc

*Maneuver on Aug. 27*

DORIS Jason1

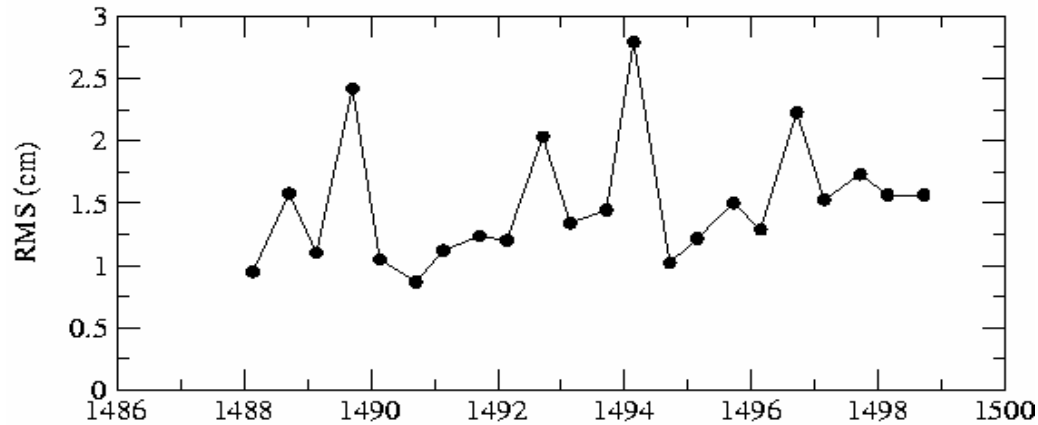


rms: 0.31 - 0.32 mm/s  
~50000 mes. / 3.5d arc

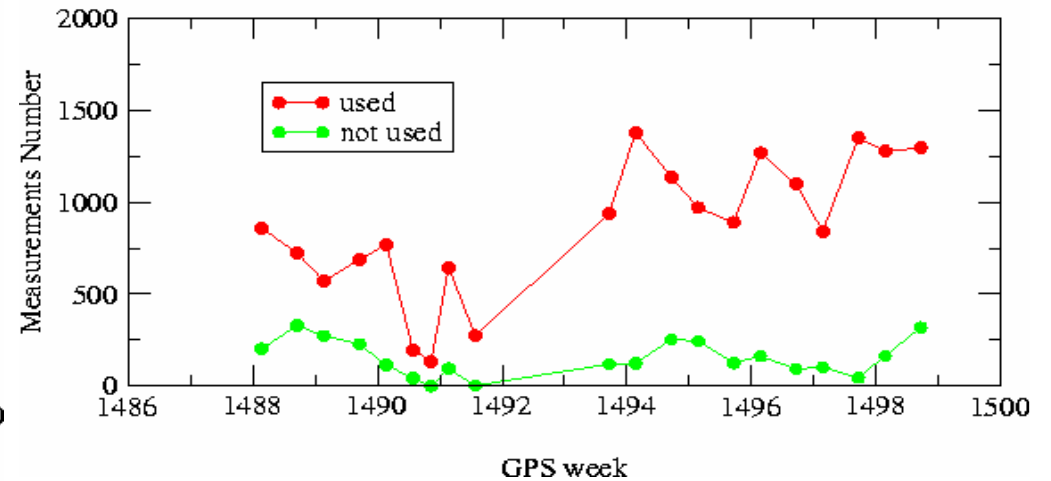
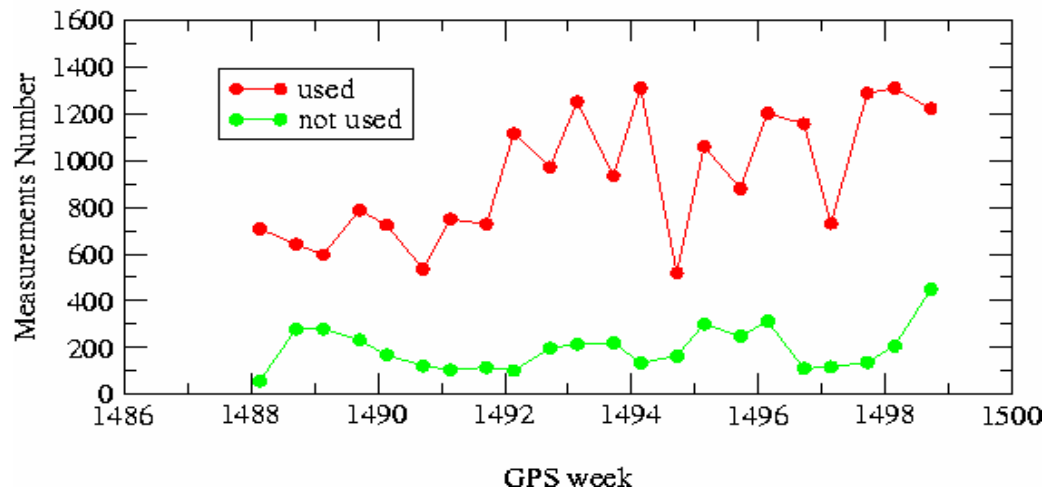
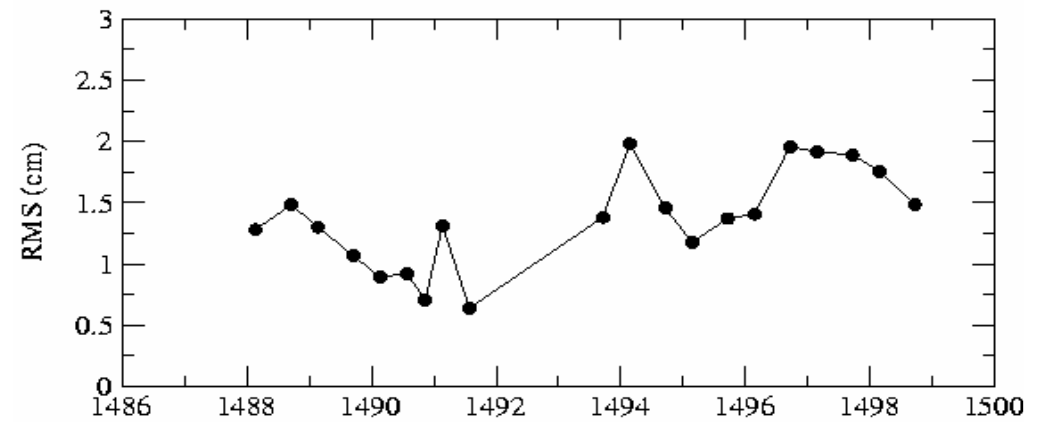
*Maneuver on Jul. 31; Incident on Aug. 7*

# SLR residuals and number of measurements

SLR Jason2



SLR Jason1

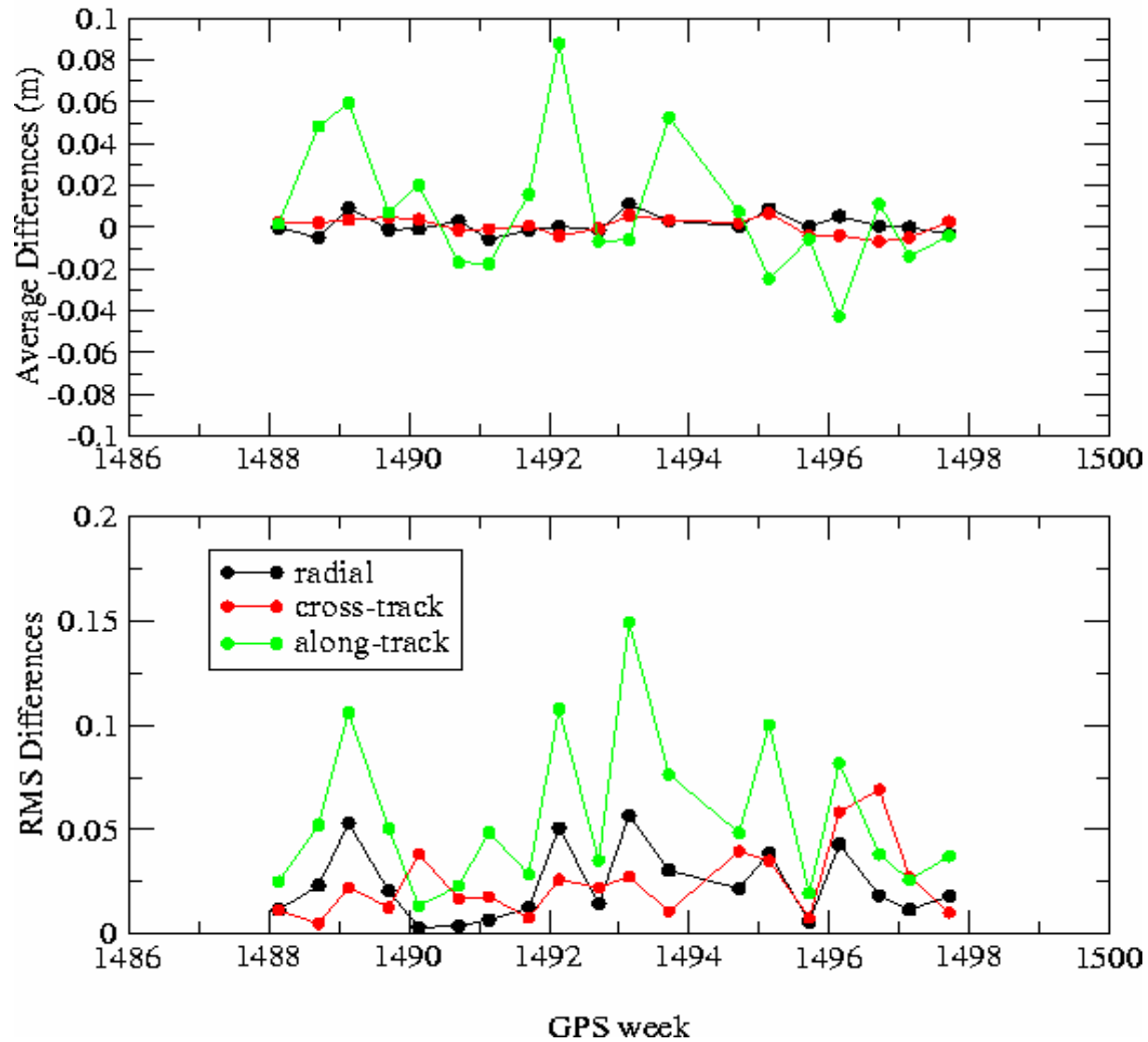


Maneuver on Aug. 27

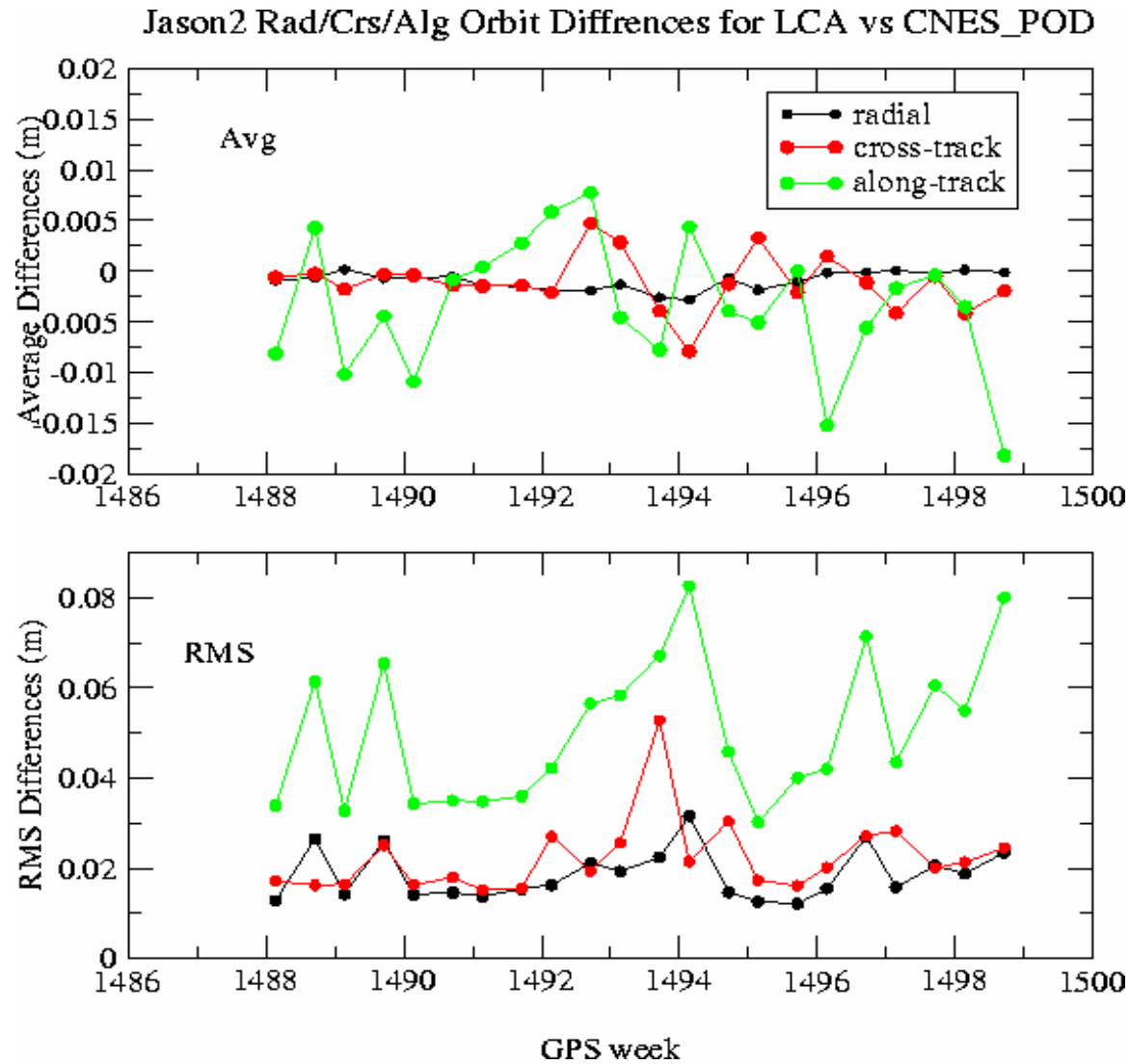
Maneuver on Jul. 31  
Incident on Aug. 7

# Orbit overlaps

Jason2 LCA orbit Overlap (3H)



# Orbit comparison to GDR-C (POD CNES)



## Positioning Results with Jason-2

DORIS 2.2 and SLR data

Cy. 001-008 = weeks 1488 to 1498 (08/07/13 to 08/09/27)

3.5-day arcs, elevation cut-off = 12 deg.

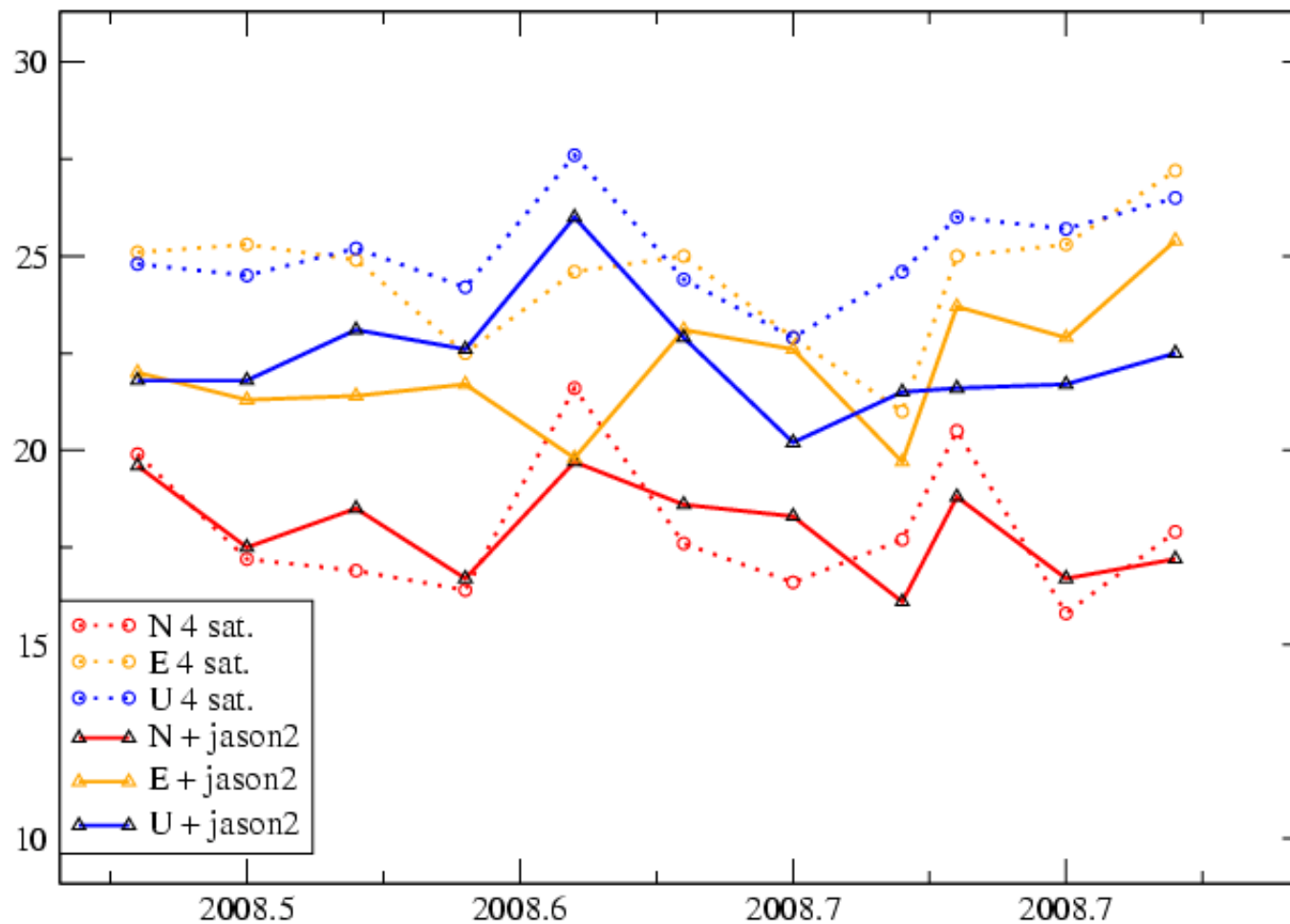
Comparison sp2/sp4/sp5/env vs 4 sat + jason2

- Station coordinates

- EOP

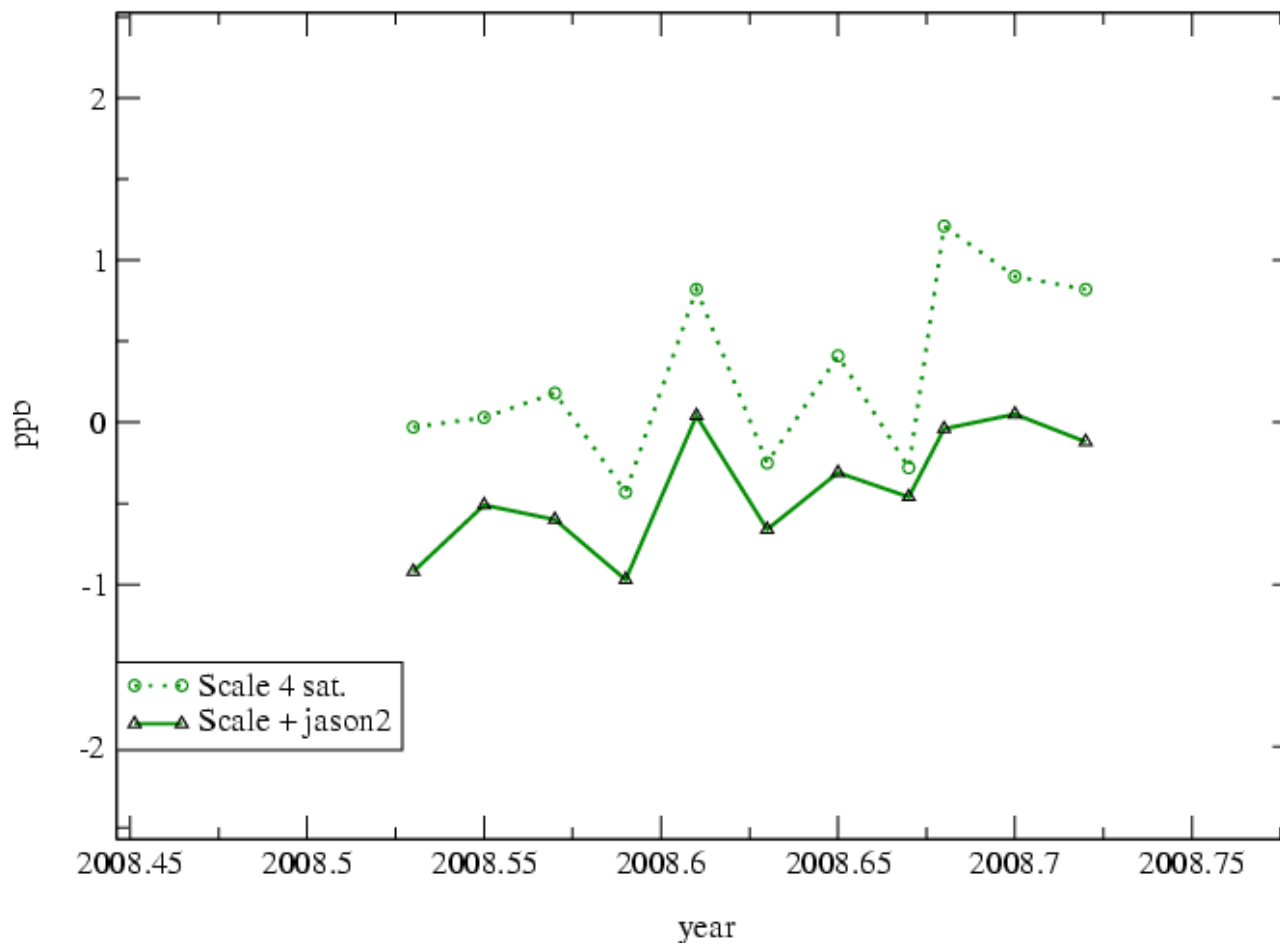
# Weekly multi-sat. solutions vs ITRF/DPOD2005

Weekly NEU rms for the whole network



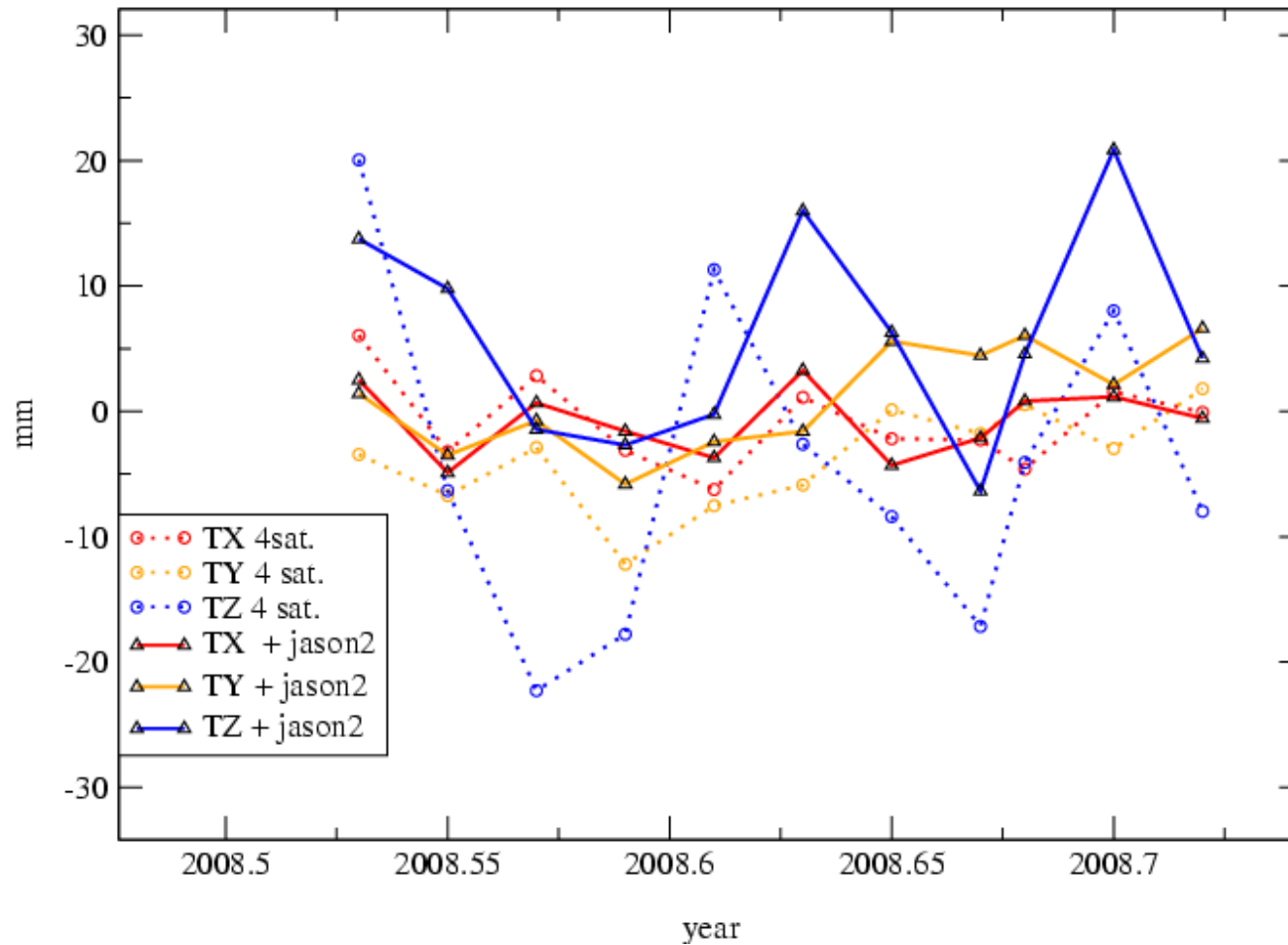
# Weekly multi-sat. solutions vs ITRF/DPOD2005

Scale



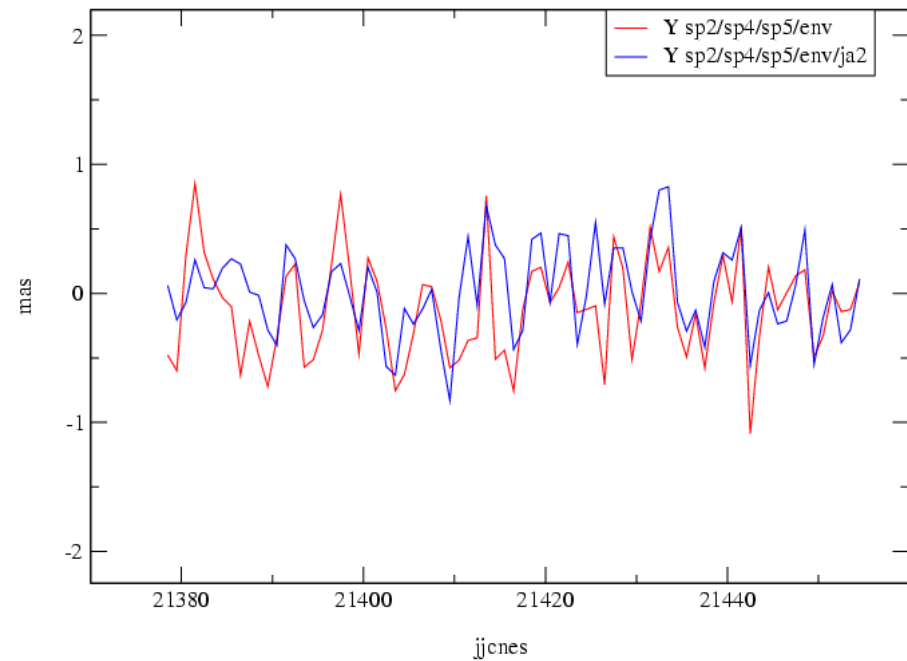
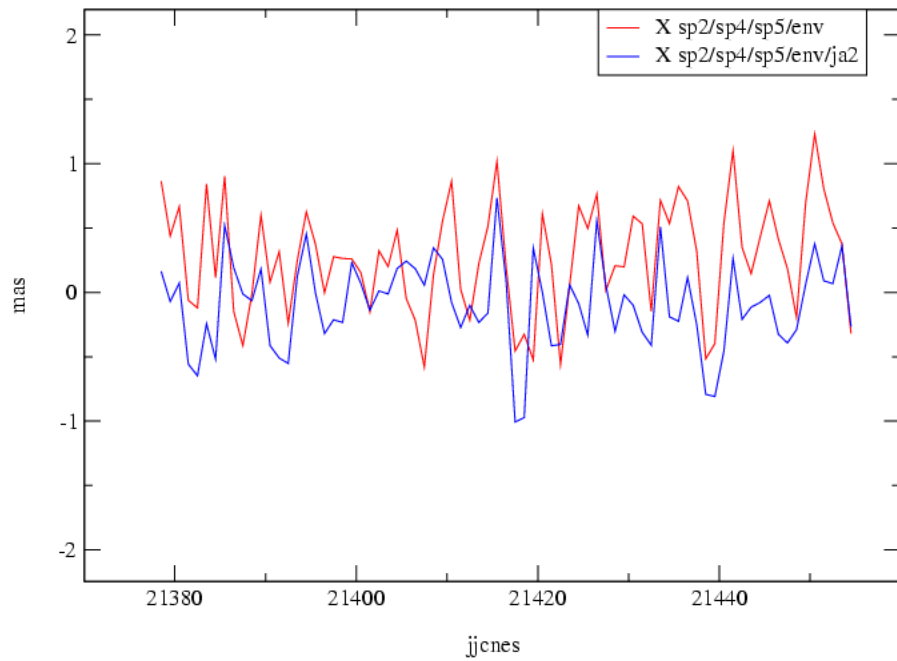
# Weekly multi-sat. solutions vs ITRF/DPOD2005

## Translations

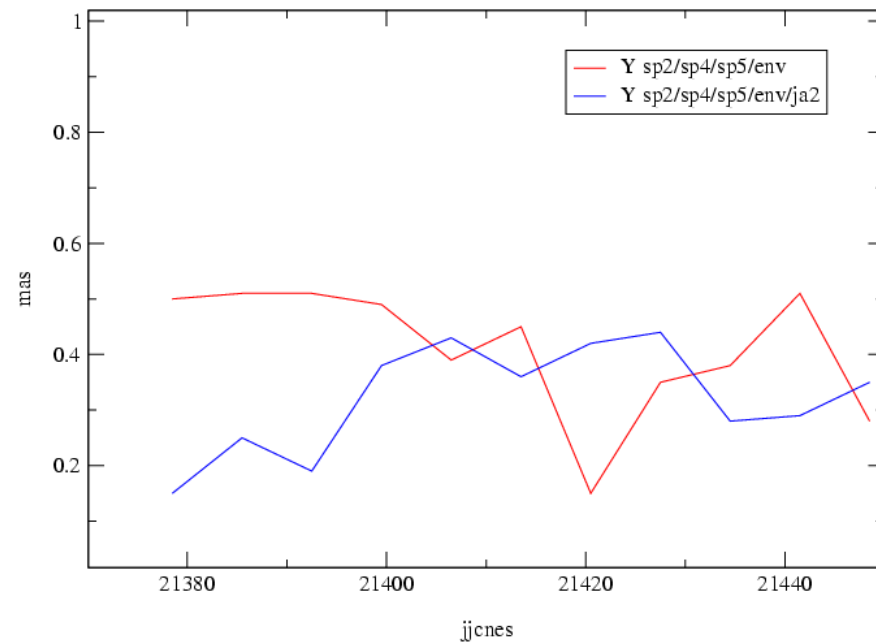
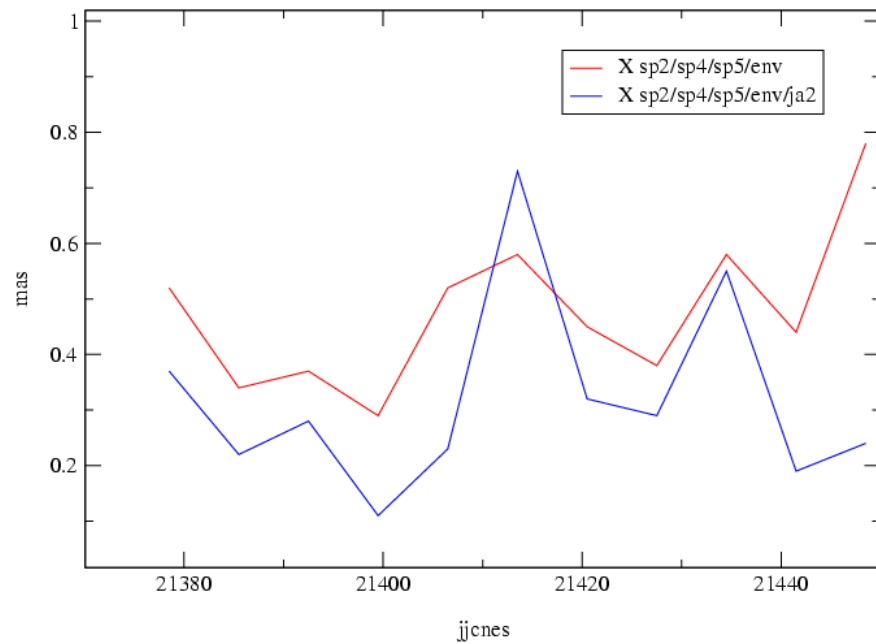




# EOP daily values: differences with EOP05C04



# EOP: weekly WRMS w.r.t. EOP05C04



# Conclusion

**RINEX/DORIS: phase measurements are transformed into cycle numbers**

**RINEX vs 2.2 :**

- same residuals WRMS of fit:  $\sim 0.31$  mm/s
- 35 cm along-tr. differences but electronic propagation delay not taken into account (-51.83 microsec.)

**Jason-2 DORIS 2.2 orbit results:**

- residuals of fit: DORIS 0.31mm/s, Laser 10-15 mm
- orbit comparaisn with CNES POE: no bias; rms  $\sim 2$ cm in Rad. and Cross-tr.,  $\sim 5$ cm Along-tr.

**Multi-satellite weekly station solutions:**

- 1-4 mm improvement in East and vertical.
- Effect on scale: 1 ppb

**Multi-satellite EOP daily solutions:**

- $\sim 0.3$  mas RMS with Jason2,  $\sim 0.5$  mas RMS w/o Jason2

# Backups

# DORIS 2.2

**DORIS 2.1 slightly adapted to the new orbit pre-processing (column 35) and new 7-channel feature of the DGXX receiver**

Preprocessing indicators (column 35)

0 = point considered to be good

1 = point edited during pre-processing

2 = point edited during post-processing

**3 = point edited: null Doppler measurement, possibly erroneous**

**4 = point edited: 3.0 beacon in restart mode (RS=1)**

Channel indicator (column 90)

First generation receiver (SPOT-2, SPOT-3, SPOT-4 & TOPEX/POSEIDON)

1 = channel 1

Second generation receiver (Jason-1 ,SPOT-5 & ENVISAT)

1 = channel 1

2 = channel 2

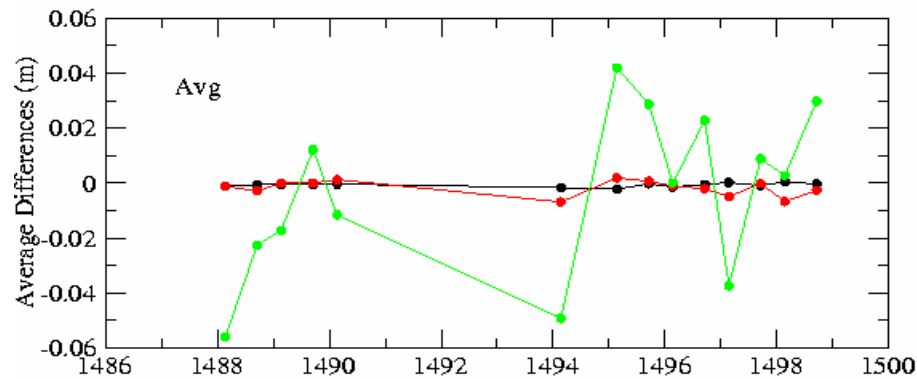
**3 = channel 1 & 2 (2 channels performing measurements on the same station)**

**DGXX receiver (starting with Jason-2)**

**i = channel i (i=1 to 7)**

# Orbit comparison to GDR-C (POD CNES)

Jason1 Rad/Crs/Alg Orbit Differences for LCA vs CNES\_POD



Jason2 Rad/Crs/Alg Orbit Differences for LCA vs CNES\_POD

