Combination of space geodesy techniques for monitoring the kinematics of the Earth

GRGS' project

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(2) OCA/département GEMINI - Grasse - France
(3) CNES/Observatoire Midi-Pyrénées - Toulouse - France
(4) Observatoire de Paris - Paris - France
(5) Société Noveltis - Toulouse - France
(6) Société CLS - Toulouse - France

Thanks to M. bougeard [4], M. Feissel [4-1] and P. Sillard (INSEE/France) for their interests in this work

Summary

1- Objectives and organisation

2- Individual results

3- Combination of observations

4- Combination of individual solutions

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Objectives and organization

♣ Objectives

to prove the efficiency of space technique combinations for computation of Earth Orientation Parameters and Terrestrial Reference Frames

- ♠ techniques used: SLR, DORIS, GPS, VLBI, LLR
- ♠ parameters: polar motion (xp and yp), universal time UT1-UTC, nutation corrections (every 6 hours) and station positions (every week)
- ♠ homogeneous computational framework (same software used for all individual computations)
- ♠ computations made over one year (2002)
- ♠ two combinations : observations and individual solutions

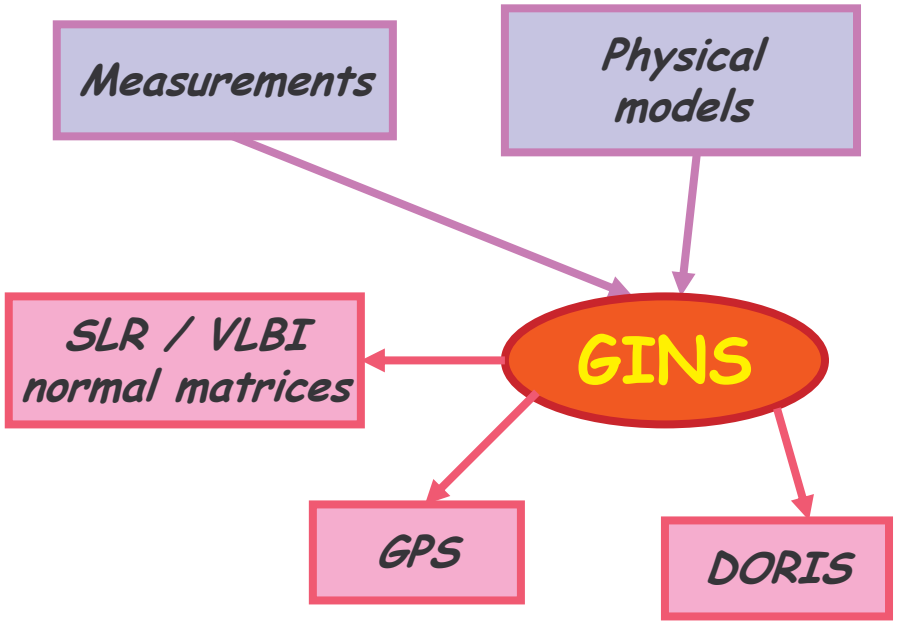
♣ Organization

Computations based on GRGS' experience and expertise

- ♠ with teams of OCA, CNES, LAREG, Noveltis, CLS and Paris' Observatory
- ♠ work started in 2000 with P. Yaya 's PhD (July 2002, 1st) under direction of N. Capitaine, D. Gambis (Paris' Obs.) and in cooperation with CNES/OMP team (R. Biancale)

Combination of observations

Softwares GINS + DYNAMO



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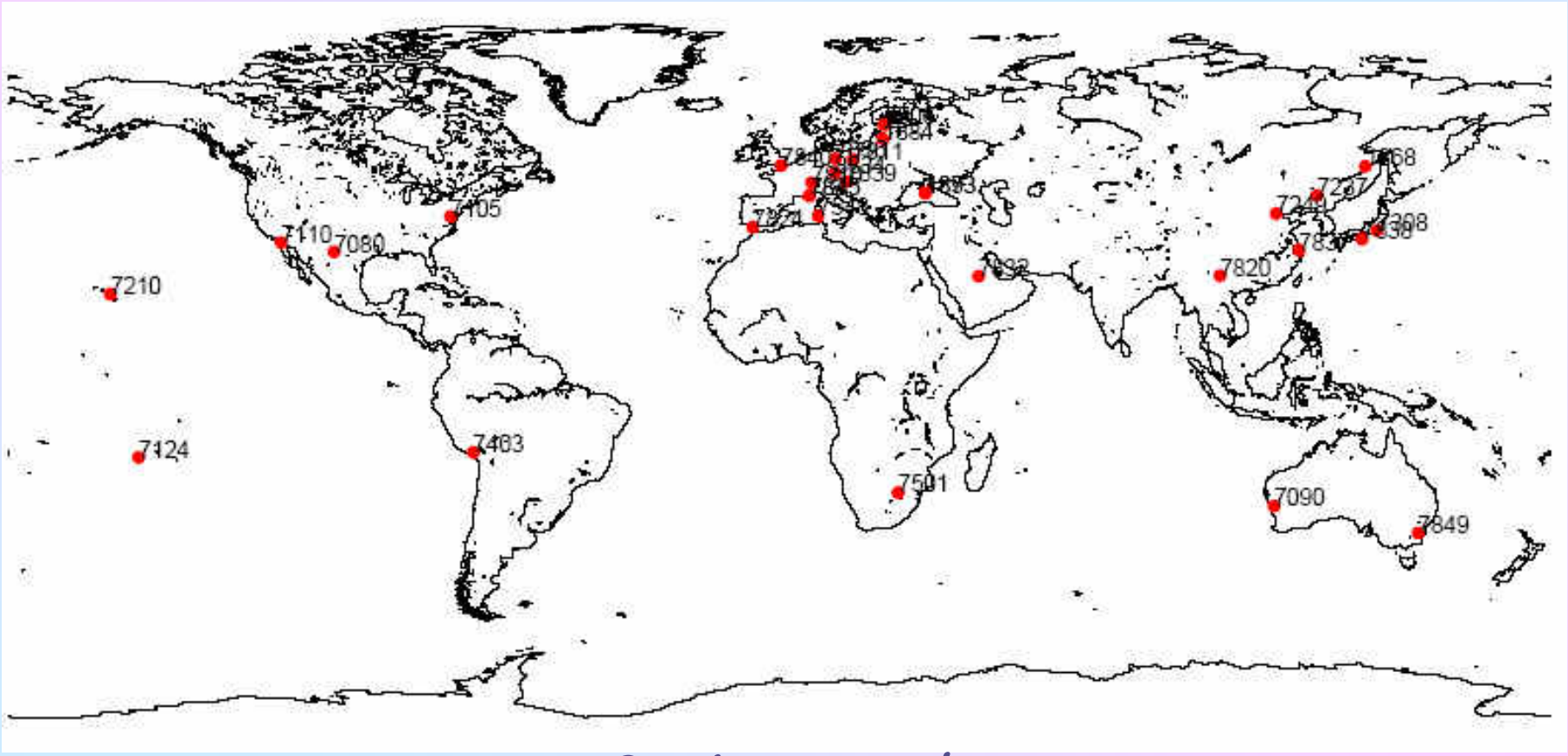
Satellite Laser Ranging

OCA/GEMINI : P. Berio & D. Coulot

♣ Satellites LAGEOS-1 et –2 : 7-day orbital arcs

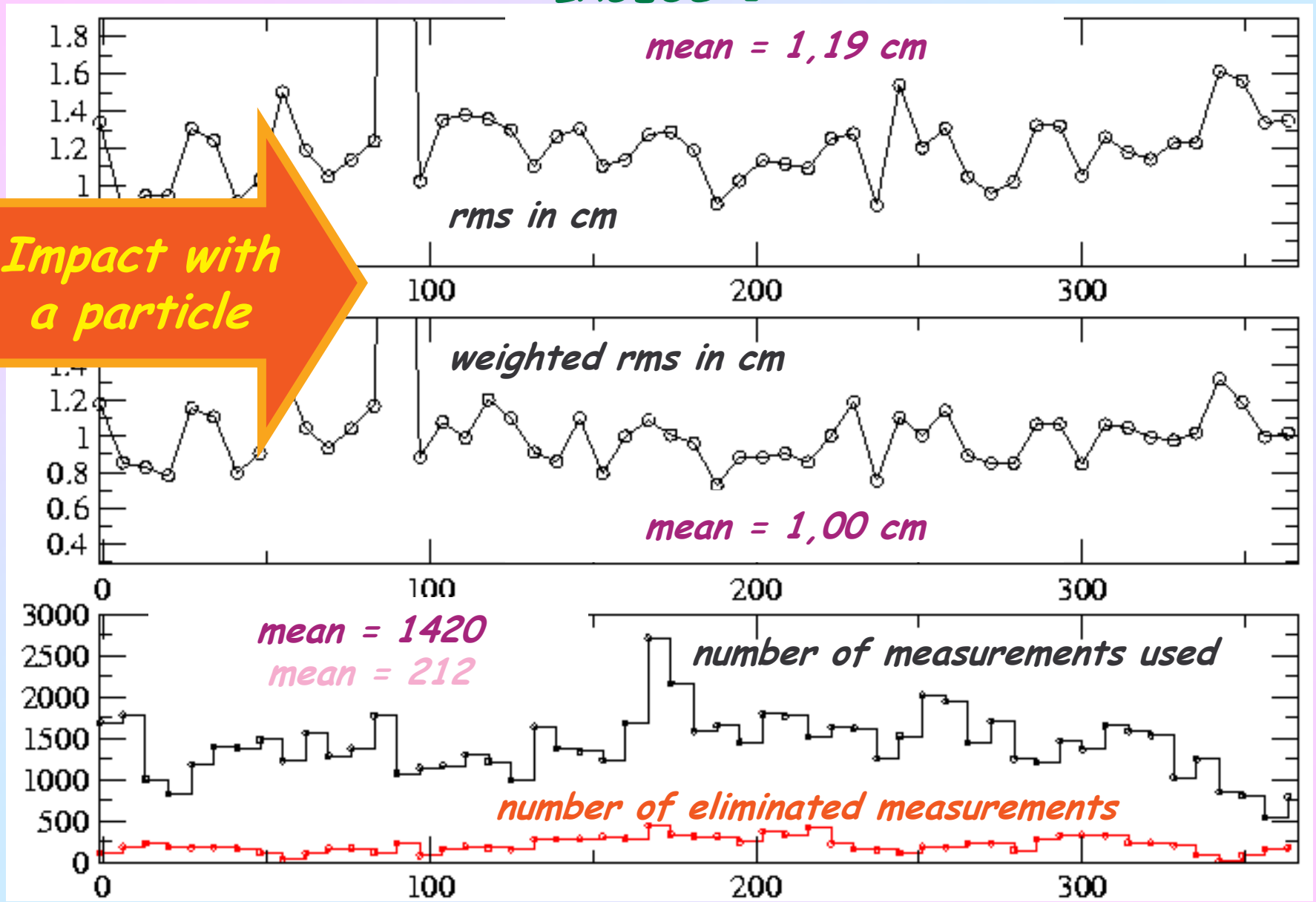
Hill's empirical modelling for orbital errors on three components (Radial, Along-track and Across-track)



Station network

Satellite Laser Ranging

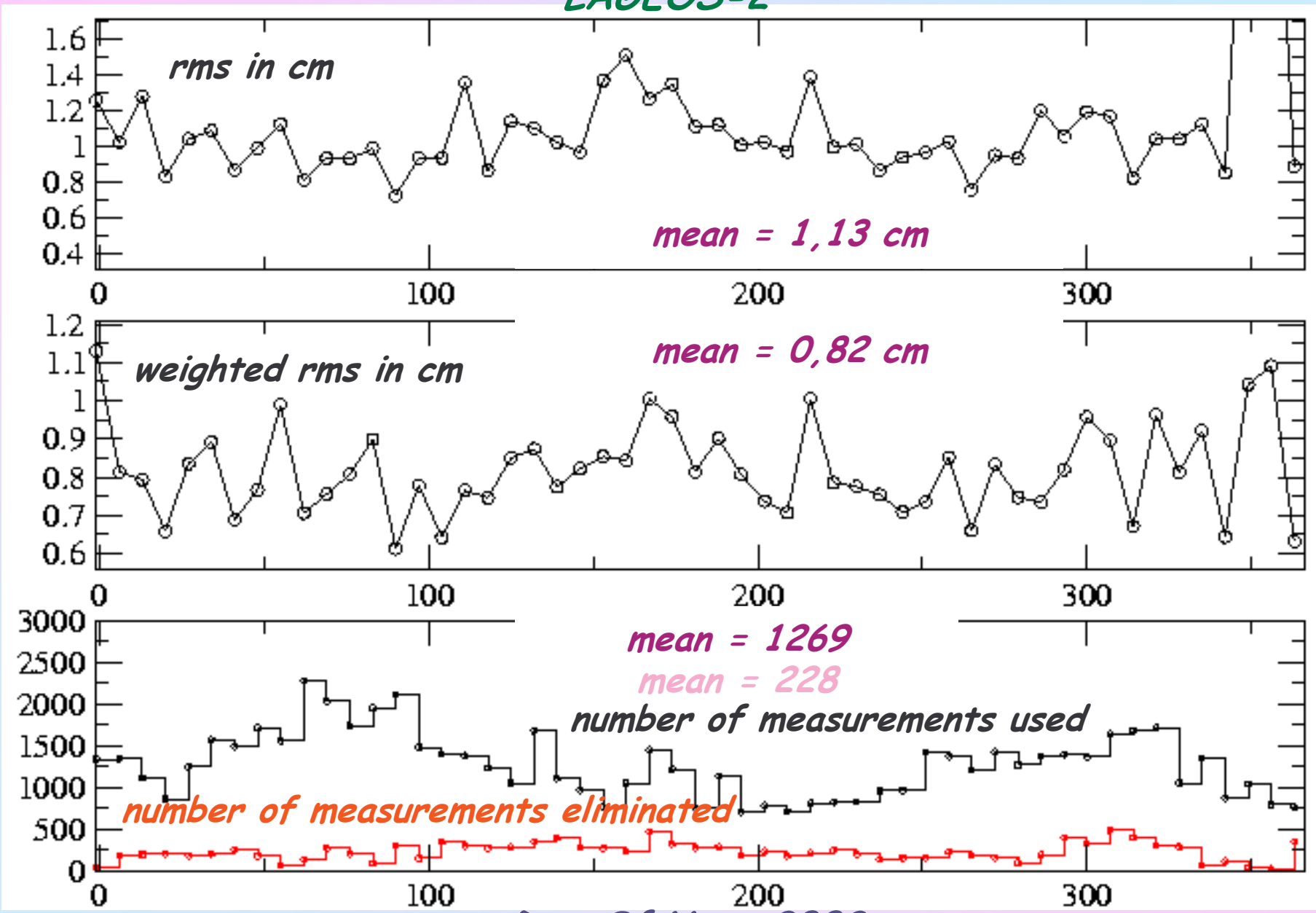
LAGEOS-1



Impact with a particle

Satellite Laser Ranging

LAGEOS-2



GPS

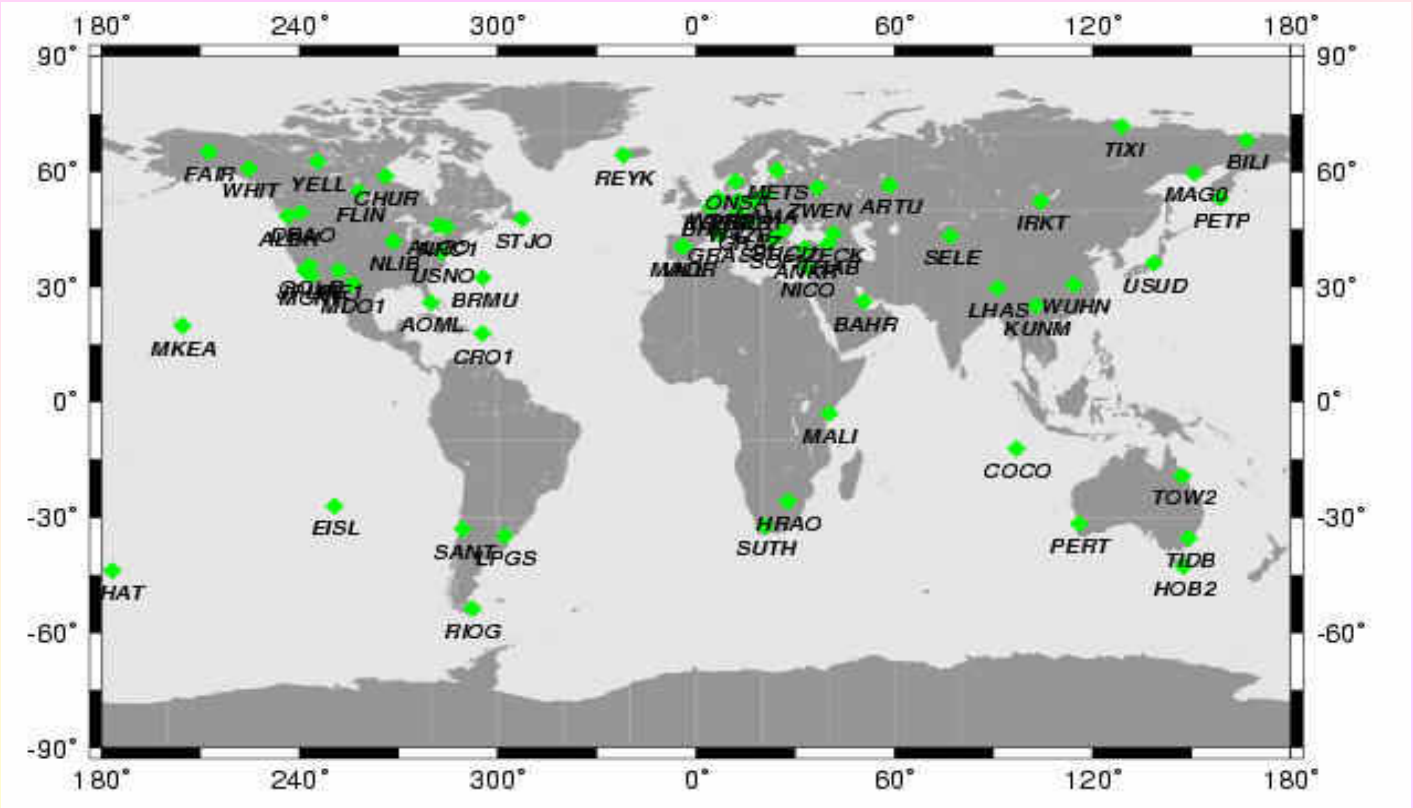
CNES/OMP/Noveltis : S. Loyer

- 2-day orbital arcs
- Strategy

  Solar Radiation Pressure :Bar-Sever 2003 for blocks II + 1 scale factor/day + Y-bias/day

  Atmospheric drag neglected

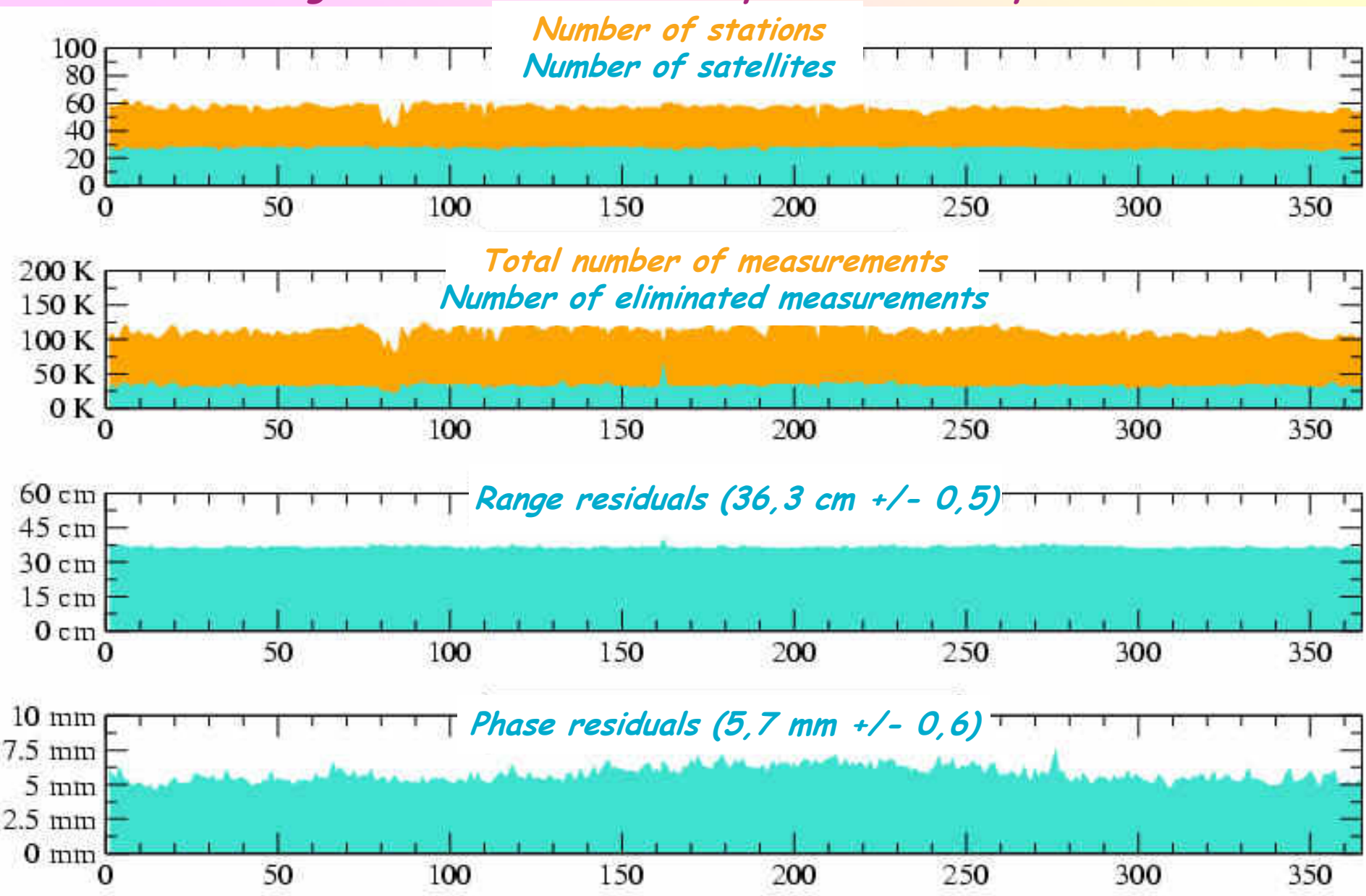
  Undifferenced iono-free observations



Station network

GPS

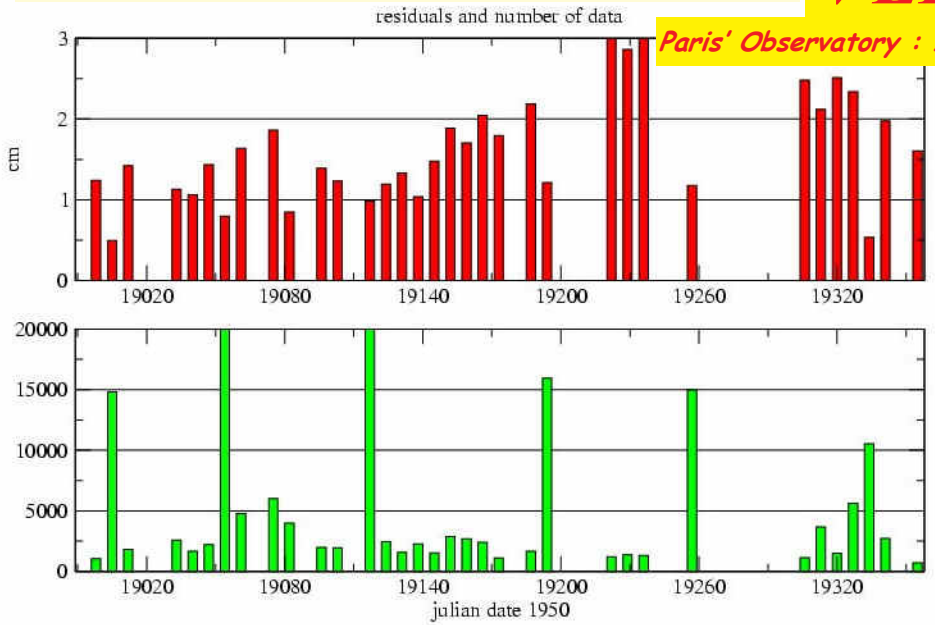
Average of orbit residuals and processed data per arc



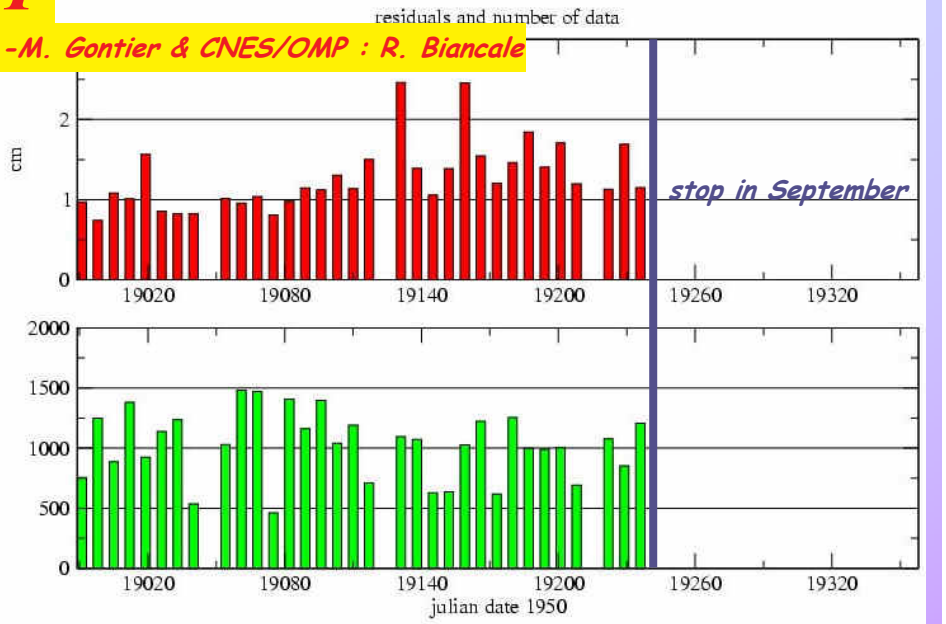
VLBI

Paris' Observatory : A.-M. Gontier & CNES/OMP : R. Biancale

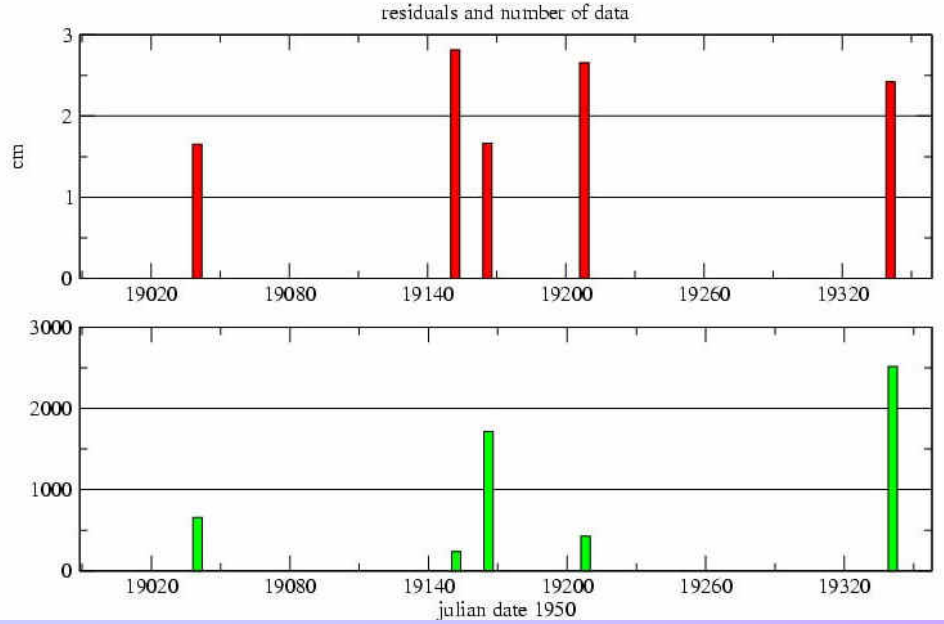
Session A : astronomical sessions



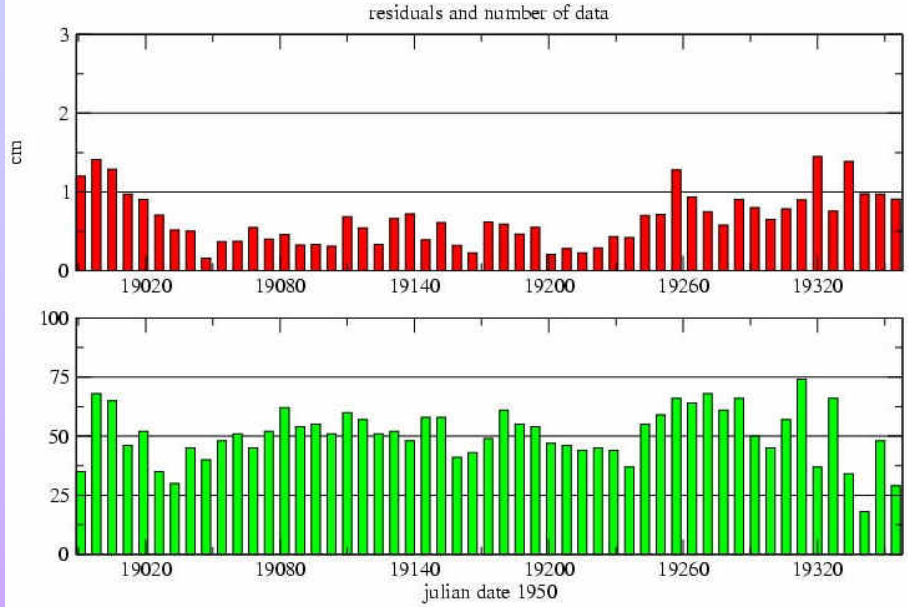
Session E : sessions dedicated to Earth's rotation



Session F : sessions of Japanese network



Session U : intensive sessions for baseline Kooke-Wettzell



DORIS

CLS : L. Soudarin

- From Sun 06.01.2002 (GPS week 1148 day 0) to Sat 28.12.2002 (GPS week 1198 day 6)
- Arc length: 3.5 days starting on Sunday 0:00 or Wednesday 12:00 (between 1 and 3.5 days in case of orbit correction manoeuvers or data lacks)
- Satellites: SPOT2, SPOT4, TOPEX, SPOT5 (start 16.06.2002 = GPS week 1171 day 0) and ENVISAT (start 21.07.2002 = GPS week 1176 day 0)
- Reduced parameters: orbit, drag coefficients, solar pressure coefficients, tropospheric zenital bias, frequency bias, Hill parameters

Station network

DORIS

Average of orbit residuals and processed data per arc

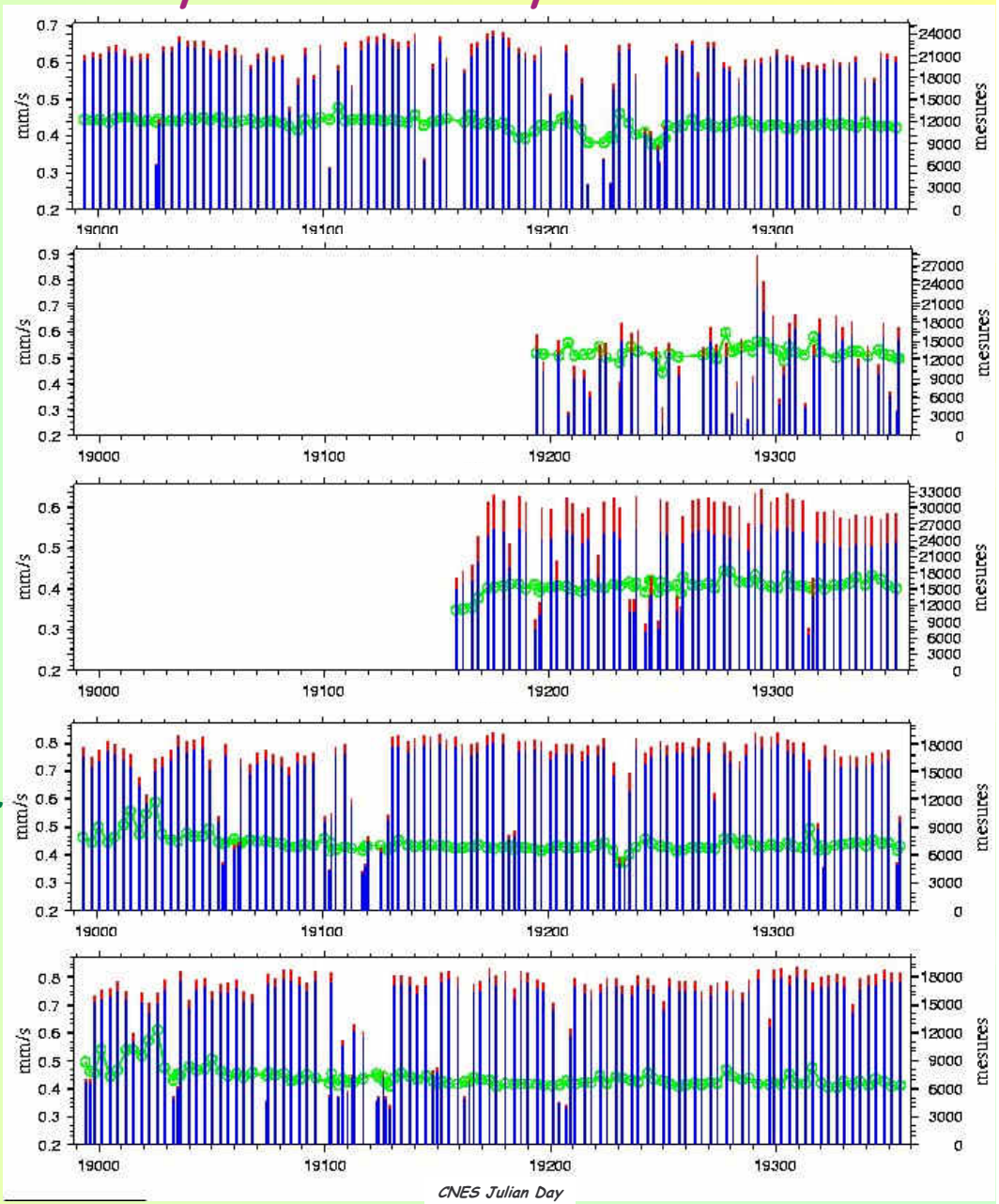
Topex: 106 arcs, residuals rms 0.44 mm/s
18763 measurements (752 rejected)

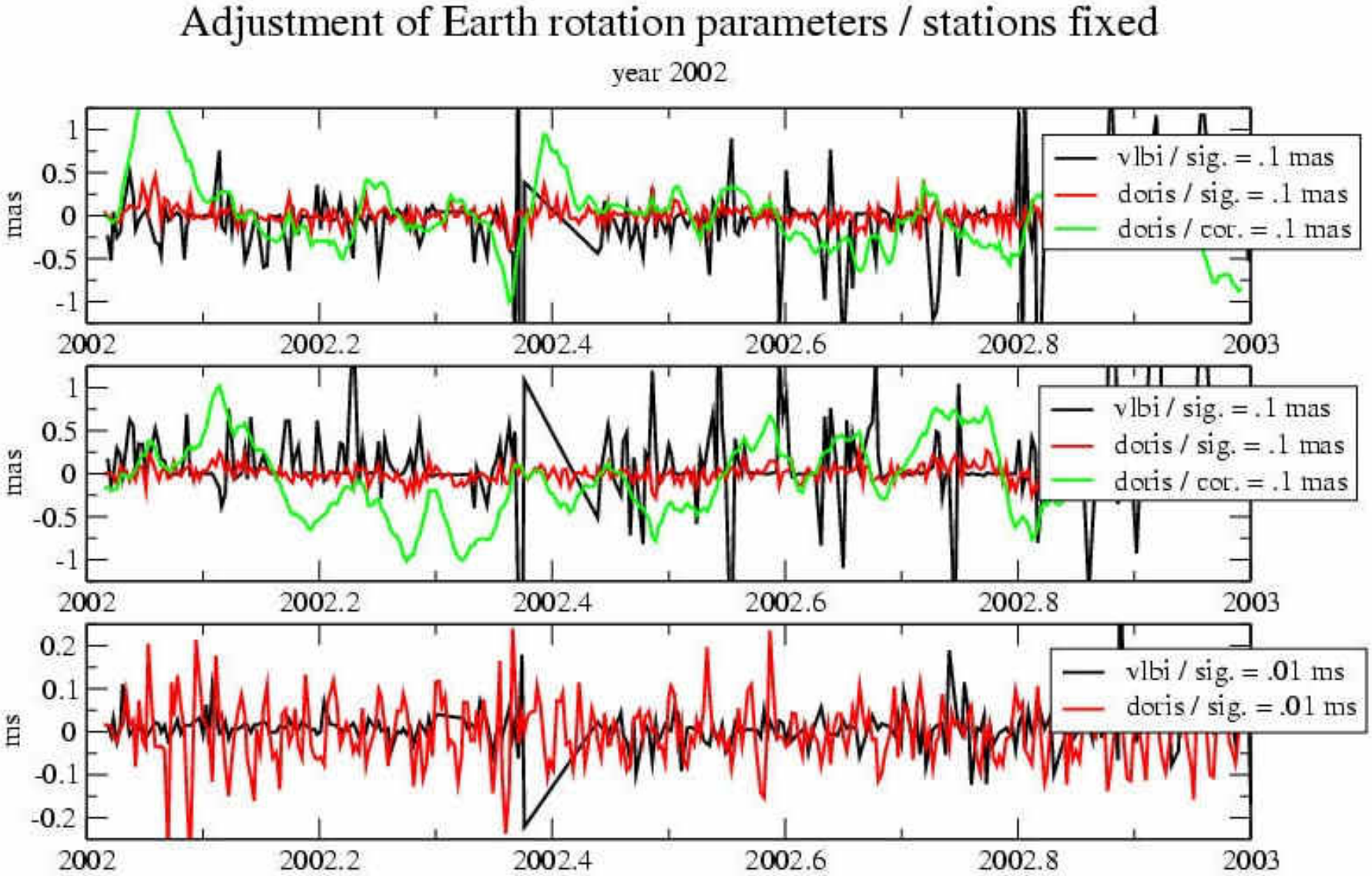
Envisat: 48 arcs, residuals rms 0.53 mm/s
11174 measurements (1754 rejected)

Spot5: 63 arcs, residuals rms 0.41 mm/s
20929 measurements (4926 rejected)

Spot4: 112 arcs, residuals rms 0.45 mm/s
14719 measurements (1018 rejected)

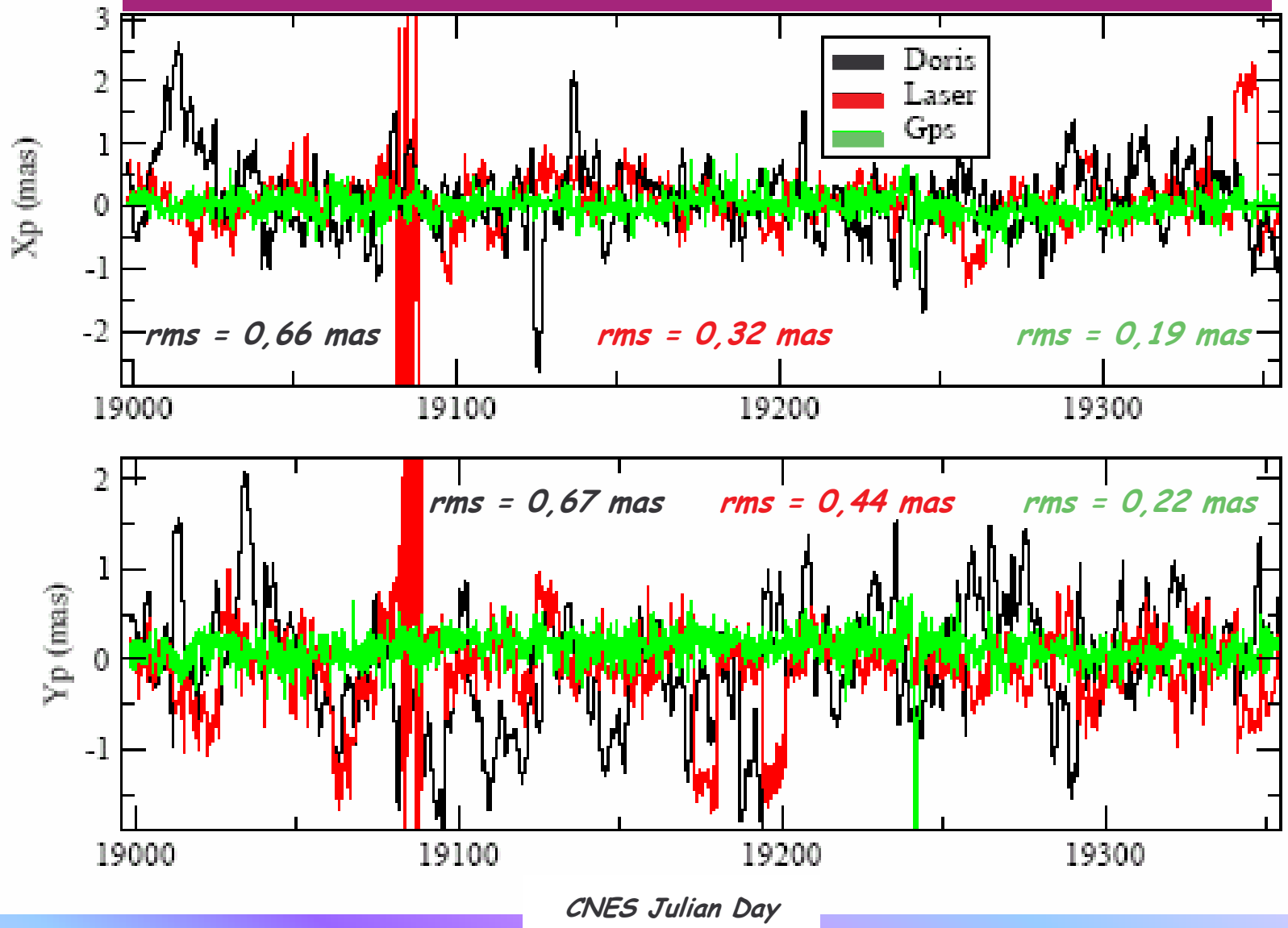
Spot2: 113 arcs, residuals rms 0.45 mm/s
14273 measurements (892 rejected)




Adjustment of Earth rotation parameters / stations fixed
year 2002
mas
1
0.5
0
-0.5
-1
2002
2002.2
2002.4
2002.6
2002.8
2003
vlbi / sig. = .1 mas
doris / sig. = .1 mas
doris / cor. = .1 mas
mas
1
0.5
0
-0.5
-1
2002
2002.2
2002.4
2002.6
2002.8
2003
vlbi / sig. = .1 mas
doris / sig. = .1 mas
doris / cor. = .1 mas
ms
0.2
0.1
0
-0.1
-0.2
2002
2002.2
2002.4
2002.6
2002.8
2003
vlbi / sig. = .01 ms
doris / sig. = .01 ms

Results for EOPs

Minimal constraints on station positions and continuity constraints on EOPs



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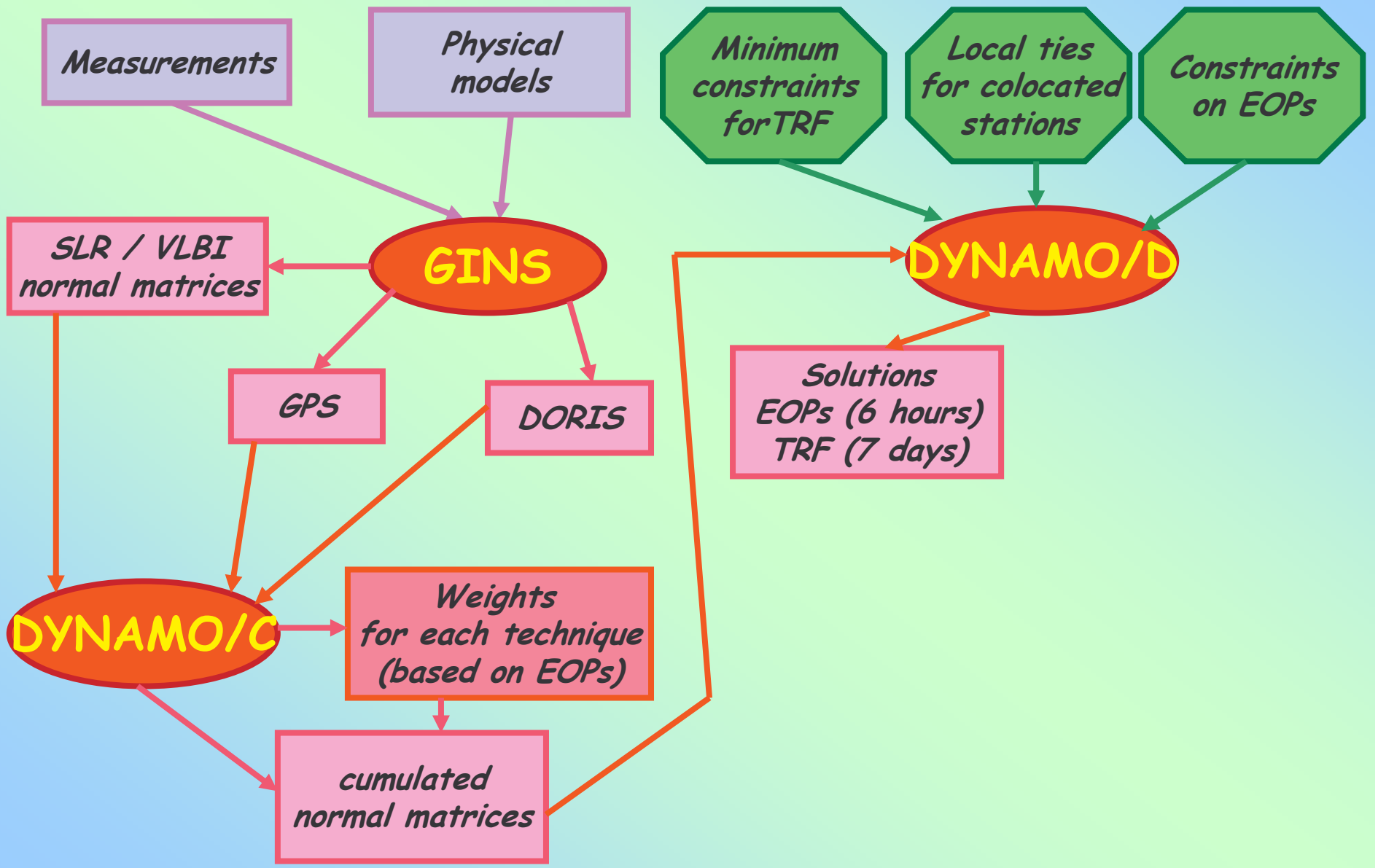
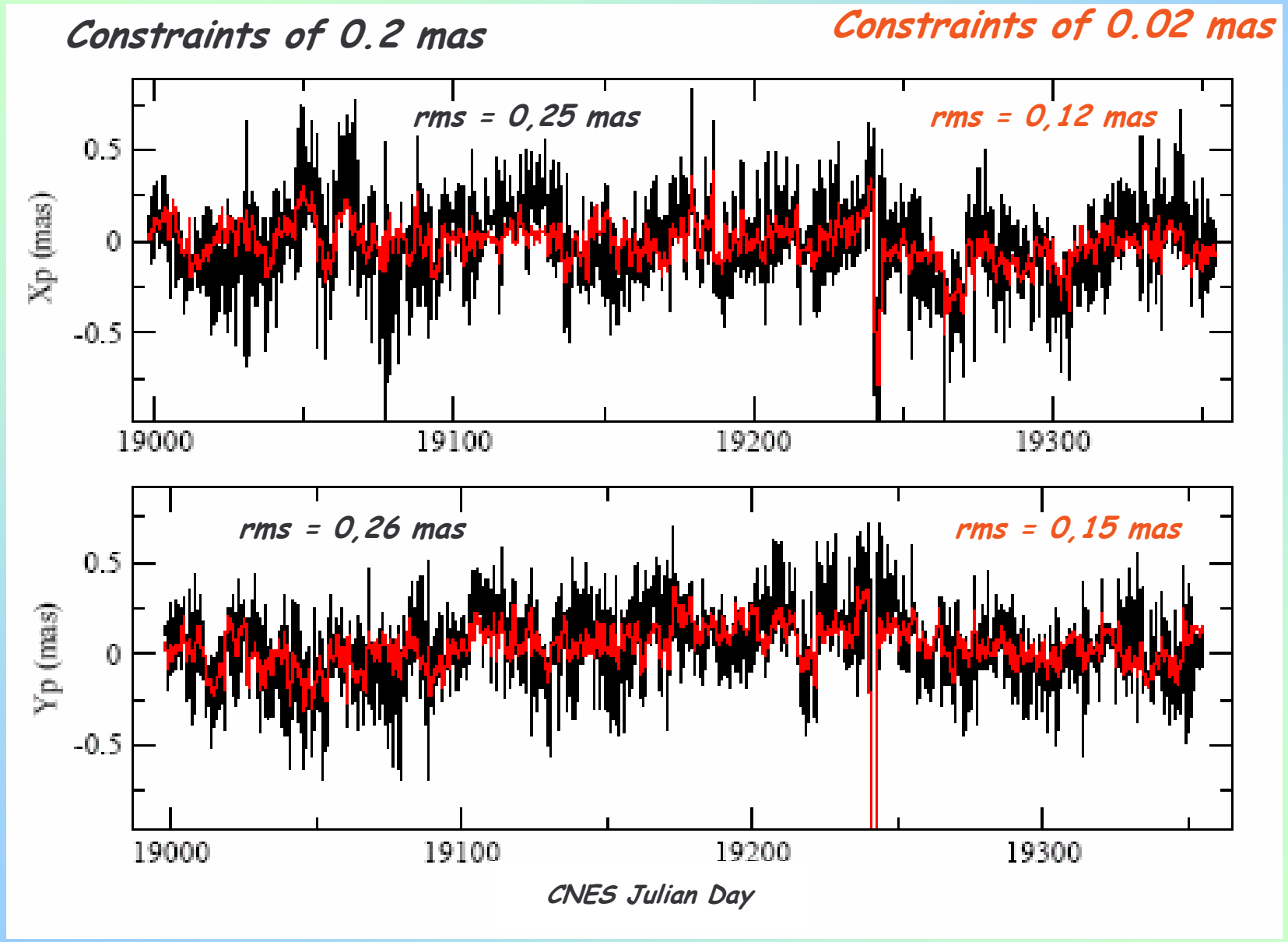
Combination of observations

Softwares GINS + DYNAMO



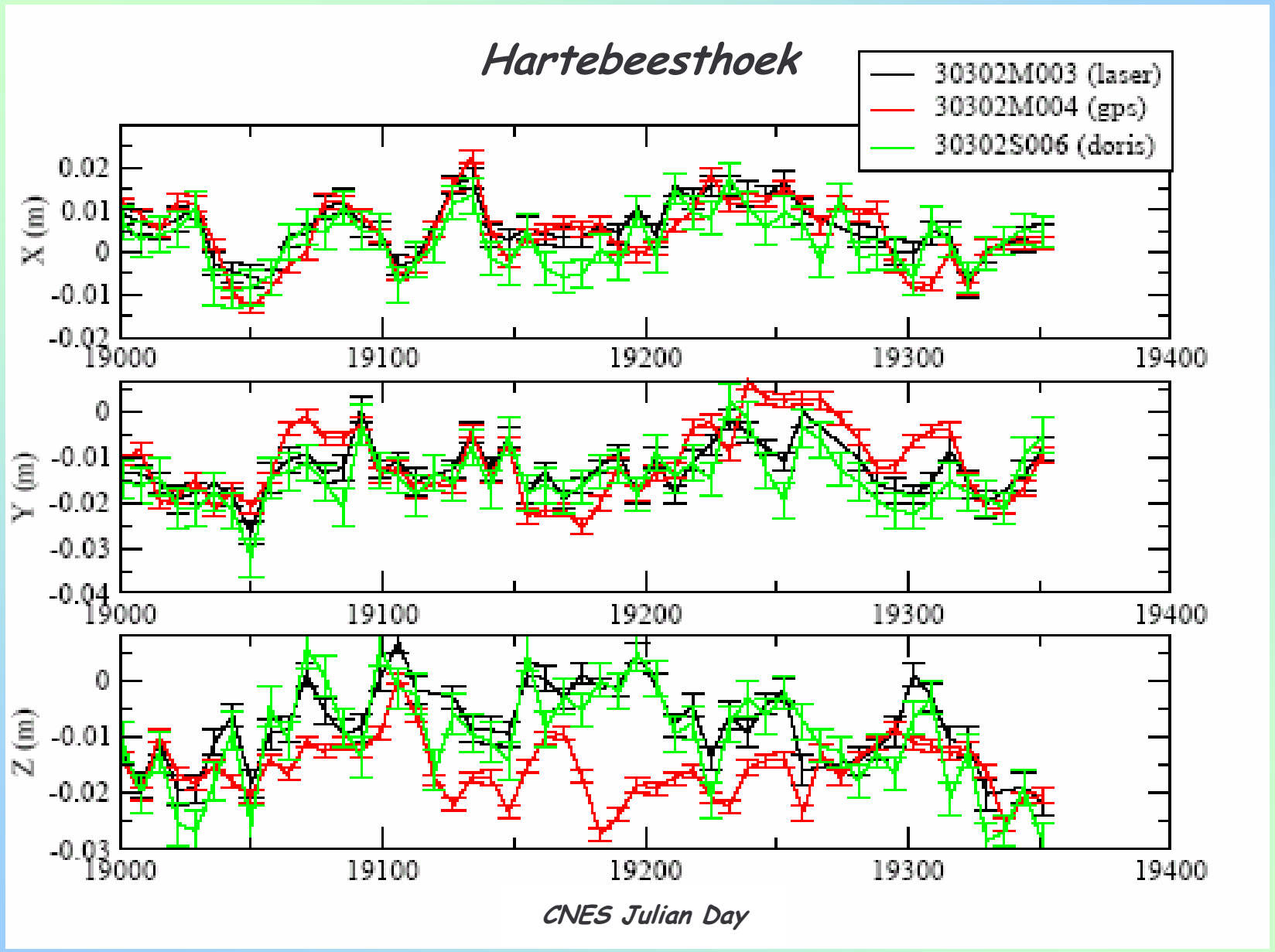
Combination of observations

Results for EOPs

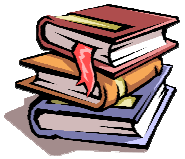


Combination of observations

Results for colocated station positions



Summary



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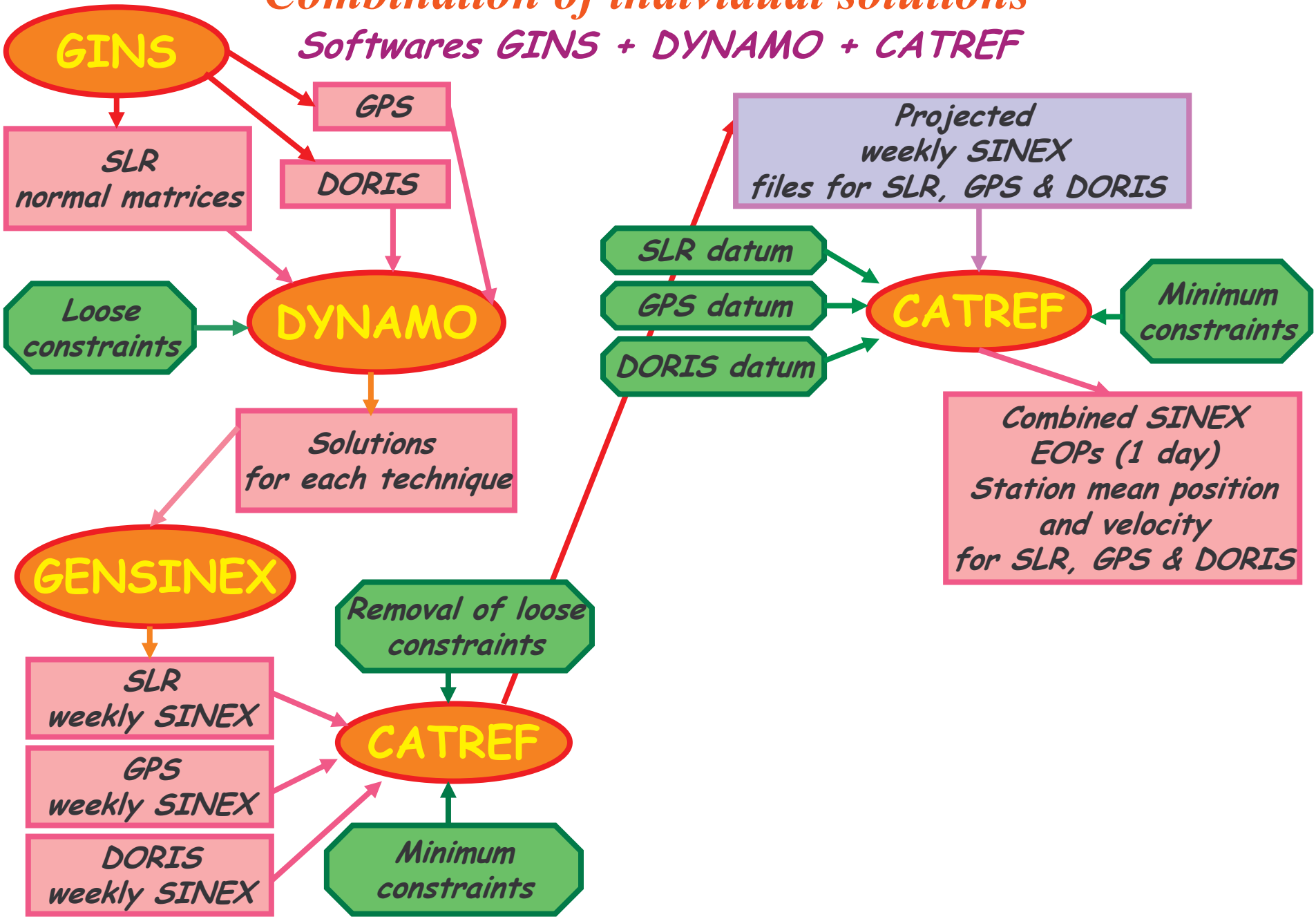
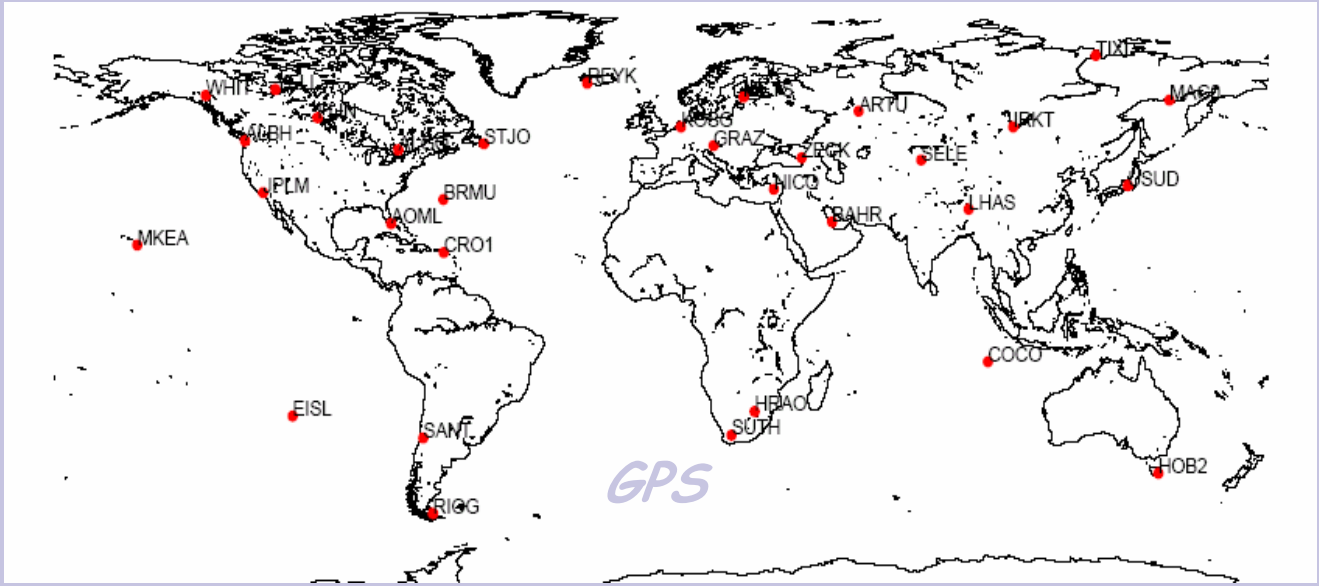
Combination of individual solutions

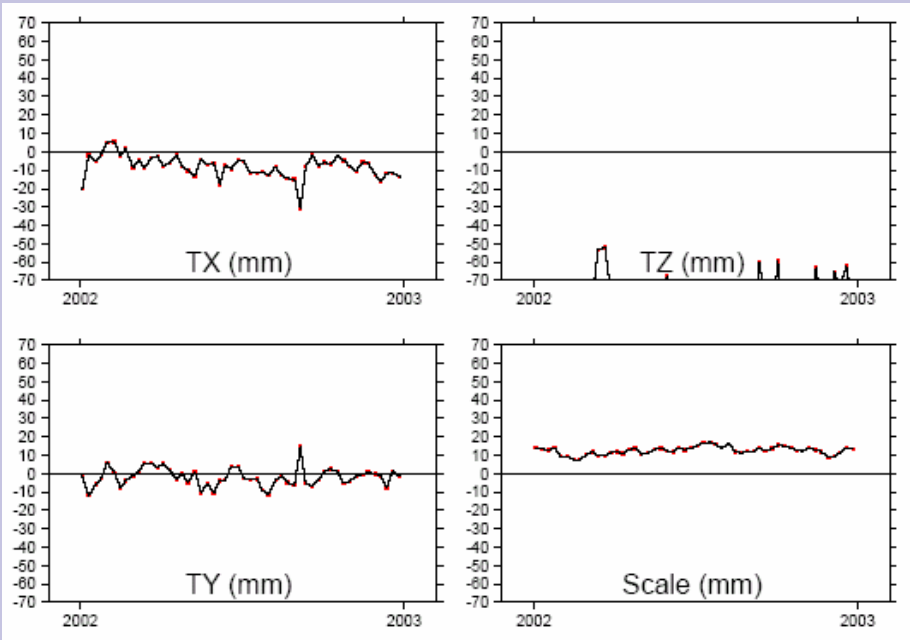
Softwares GINS + DYNAMO + CATREF



Combination of individual solutions

Datum, translations and scale for individual solutions





Comparison of the two combinations