Current Earth Orientation Parameters and Global combinations

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IERS Retreat, Paris, 23 May 2013

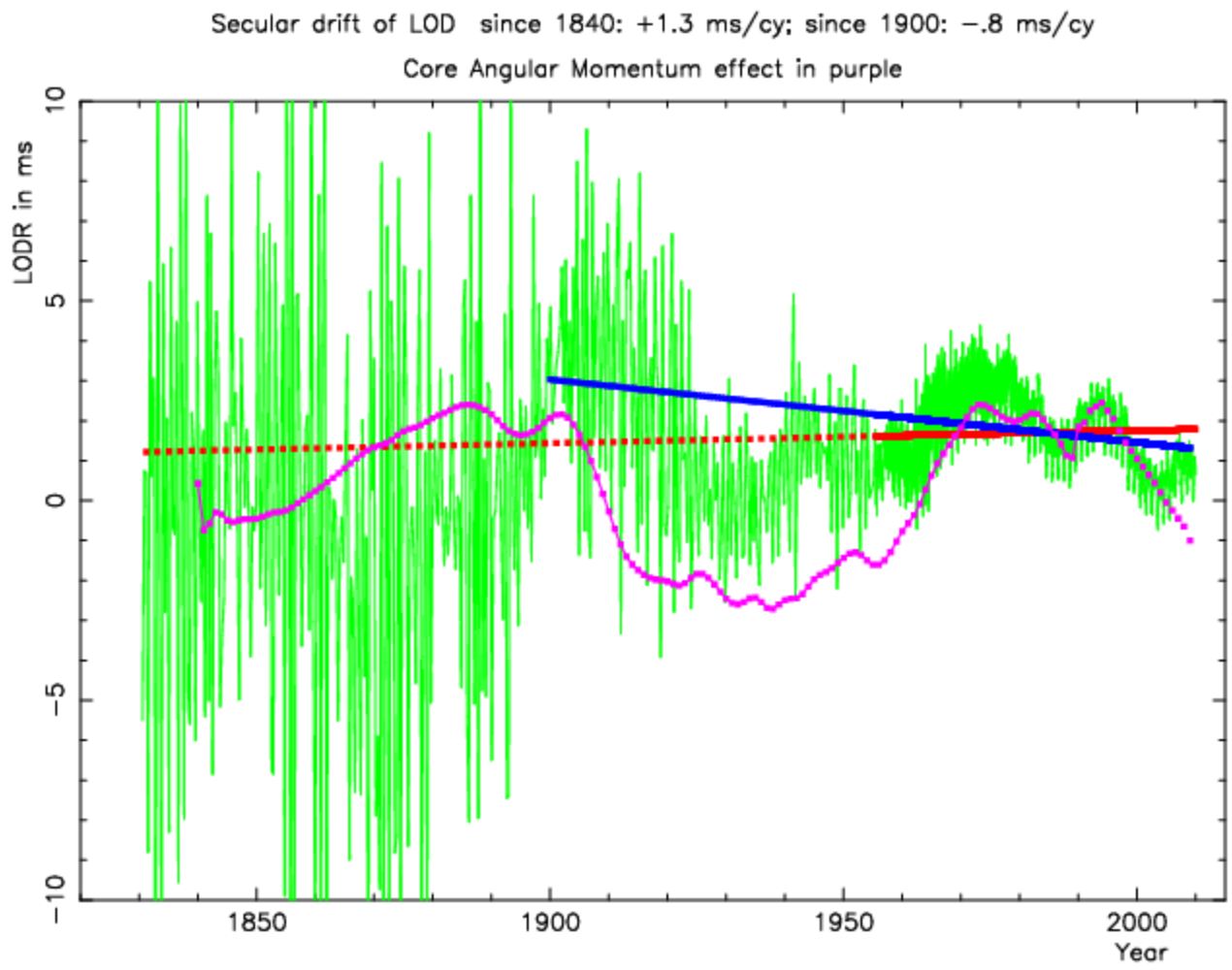
Main products

- Bulletin B
  - One month latency
  - Fixed solution
- C04
  - Bulletin B + preliminary extended solution
  - Recomputed after the release of ITRF_year
- Long-term C01, long-term LOD series
- Bulletin C
- Bulletin D

Long-term C 01

- Given at 0.1 year interval (1846 - 1889) and 0.05 year over the interval 1890 to now. C 01 is based on the following data:
- 1993 - now : IERS solution of x, y, UT1-UTC, LOD, dPsi, dEpsilon (normal points), based on VLBI, LLR, GPS and SLR.
- 1980 - 1992 : IERS solution of x, y, UT1-UTC, dPsi, dEpsilon (normal points), based on VLBI, LLR, GPS (from 1992), and SLR.
- 1962 - 1979 : IERS and BIH solutions, giving x, y, UT1-UTC (normal points). Space techniques are introduced starting with 1969 (LLR: UT) and 1972 (Doppler: polar motion).
- 1900 - 1961 : Vondrak(1995), Solution derived from optical astrometry analyses the series give polar motion, celestial pole offsets and Universal Time (since 1956).
- 1846 - 1899 : The solution derived by L.V. Rikhlova (Fedorov et al., 1976) from three series of absolute declination programs (Pulkovo, Greenwhich, Washington). The frequency band of the variations kept encompasses only the annual and Chandler terms. The y coordinate of the pole is missing from 1858.9 through 1860.9.

Long-term LOD series



Bulletin C and Bulletin D

- Bulletin C: prediction and announcement of leap seconds to be introduced in UTC to maintain | UT1-UTC | < 0.9s
  - 6 month prediction
  - 3 years possible at 95%
  - Other methods in study (neural network)

Bulletin D : DUT1 = UT1-UTC truncated at 0.1 s

- 4-6 weeks prediction
- Seems obsolete but necessary for a bunch of users

Communities of users of Bulletins C and D

- Astronomy, astrophysics
- Time Service laboratories
- Computer centers
- Radio signal laboratories
- Radio-astronomy activities
- Geodesy,
- Geophysics
- Radio stationsPost and telecommunication
- Hydrographic and oceanographic labs
- Surveying and mapping institutes
- Civil engineeringSpace research
- Etc ……

Current characteristics of EOP estimates (C04)

Precision gives an estimation of the agreement of various individual solutions with respect to other combined solutions

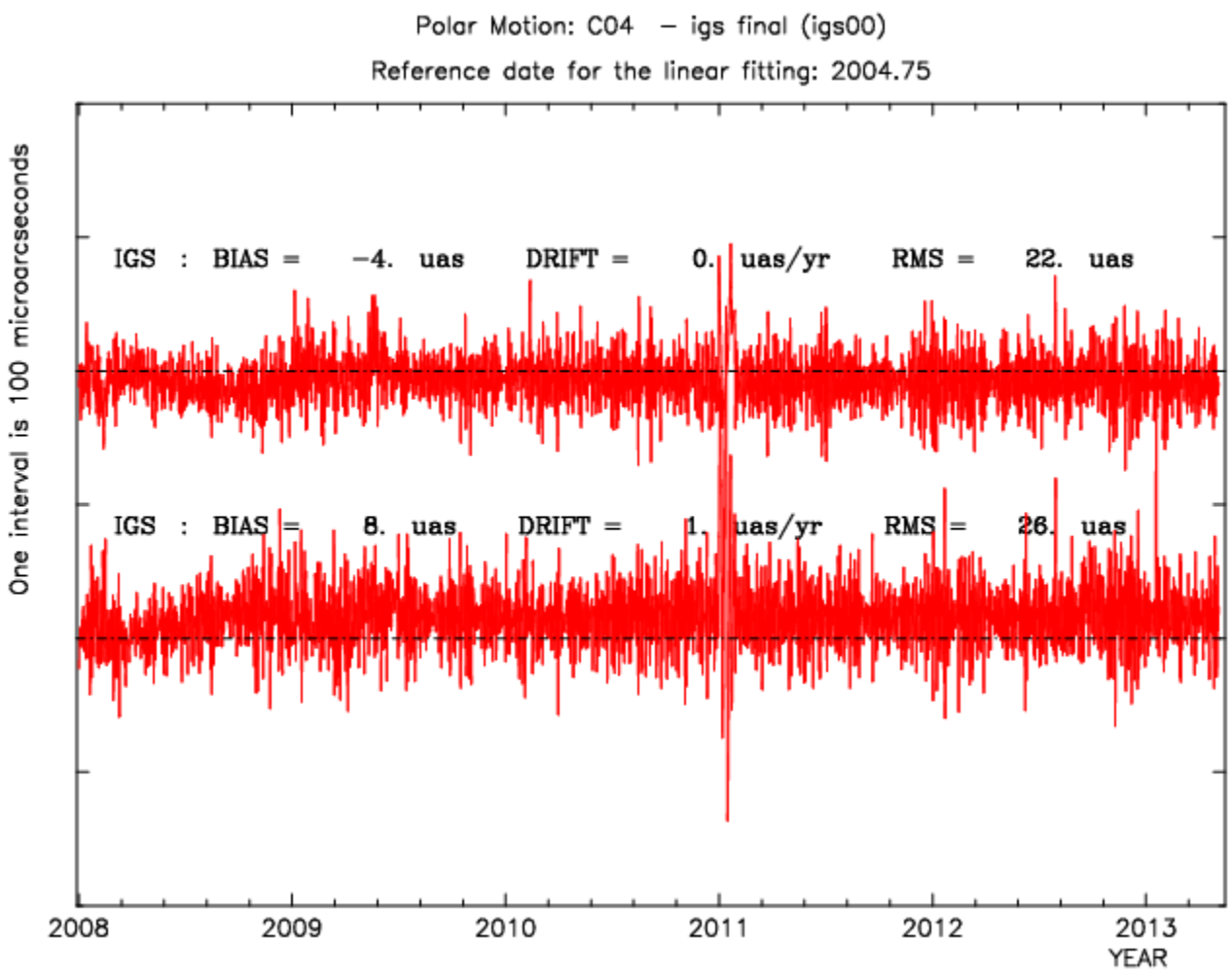
- Polar motion : 30 μas
- Universal Time: 3 μs
- Nutation offsets: 40 μas

Accuracy reflects the real uncertainties of the solutions taking into account the inconsistency of the EOP system with respect to the terrestrial (TRF) and celestial (CRF) frames; inconsistencies, systematic errors, more critical than precision.

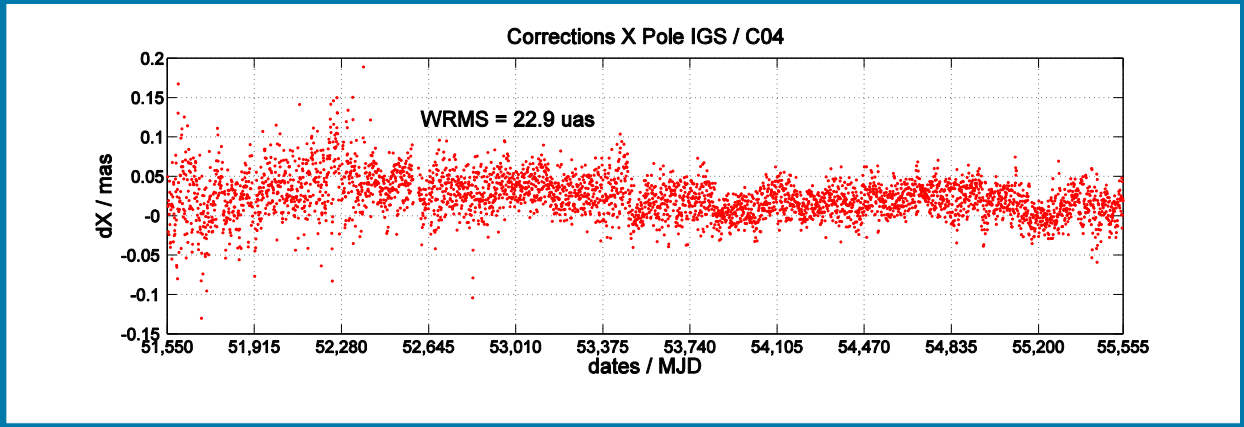
- Polar motion : 50 - 80 μas
- Universal Time: 10 - 20 μs
- Nutation offsets: 60 μas

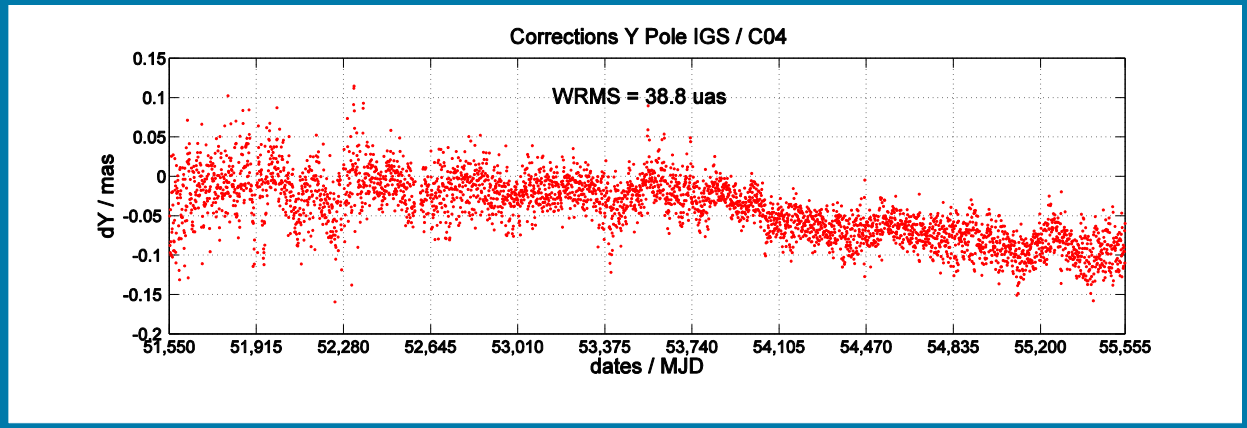
Present requirement of an homogeneous system : EOP, TRF and CRF via a global combination on a regular basis

Difference igs(00) – C04



Consistency survey
CATREF(IGS SINEX) – IERS C04



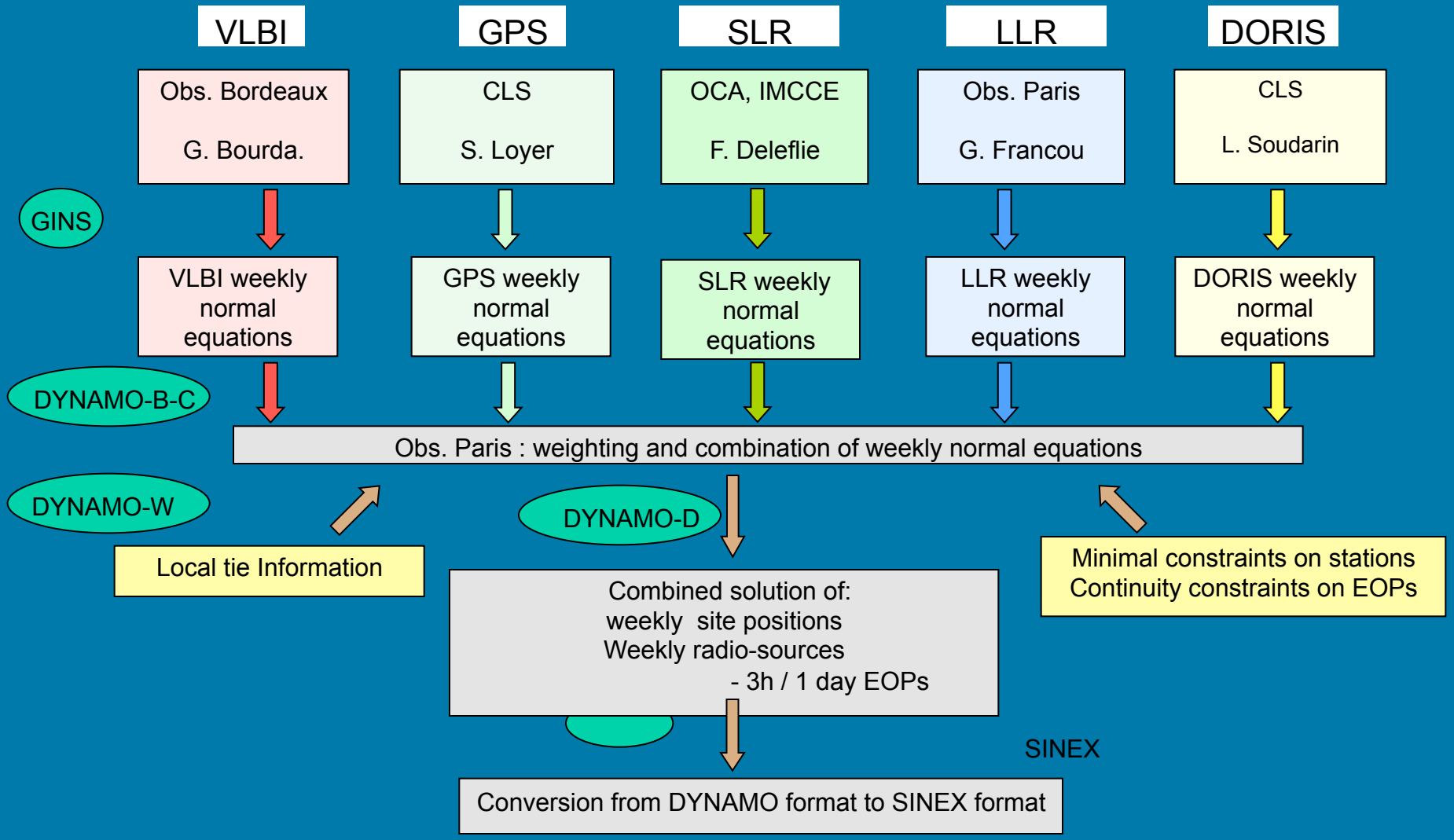


GRGS Combination at the Observation level
Brief history

- 2005: Implementation of DYNAMO at Paris Observatory
  - Upgrade of GINS for VLBI and LLR
  - Development of procedures (scripts..)
  - Tests (strategy, constraints,..)
- 2006 Routine bi-monthly production started. Combined NEQs delivered to IERS/BC
- 2008_ - .. Testing the sensitivity of critical parameters onto the solutions
  - Minimal constraints
  - EOP continuity constraints
  - Local ties
  - Parametrization
  - Sub-network effects (Stabilisation method)

2010: Quality improved with the involvement of ACs in Techniques Centers

Project data flowchart



Global combination: interest of the method

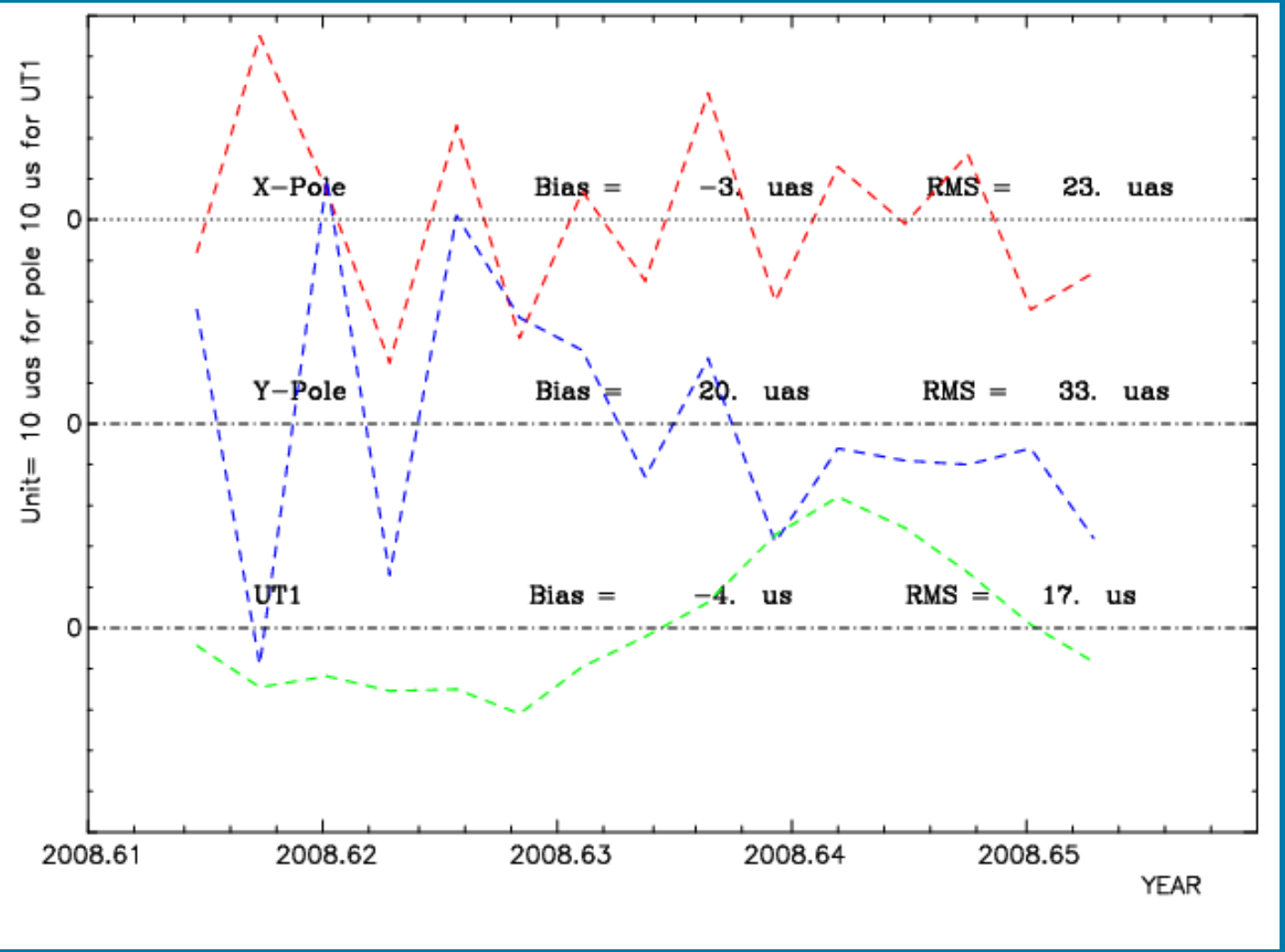
- Towards an optimal consistent combination of:
  EOP+ station coordinates, troposphere parameters, CRF

- Use of same software package (GINS), same constants and conventional models
- Should benefit from mutual constraints of the various techniques

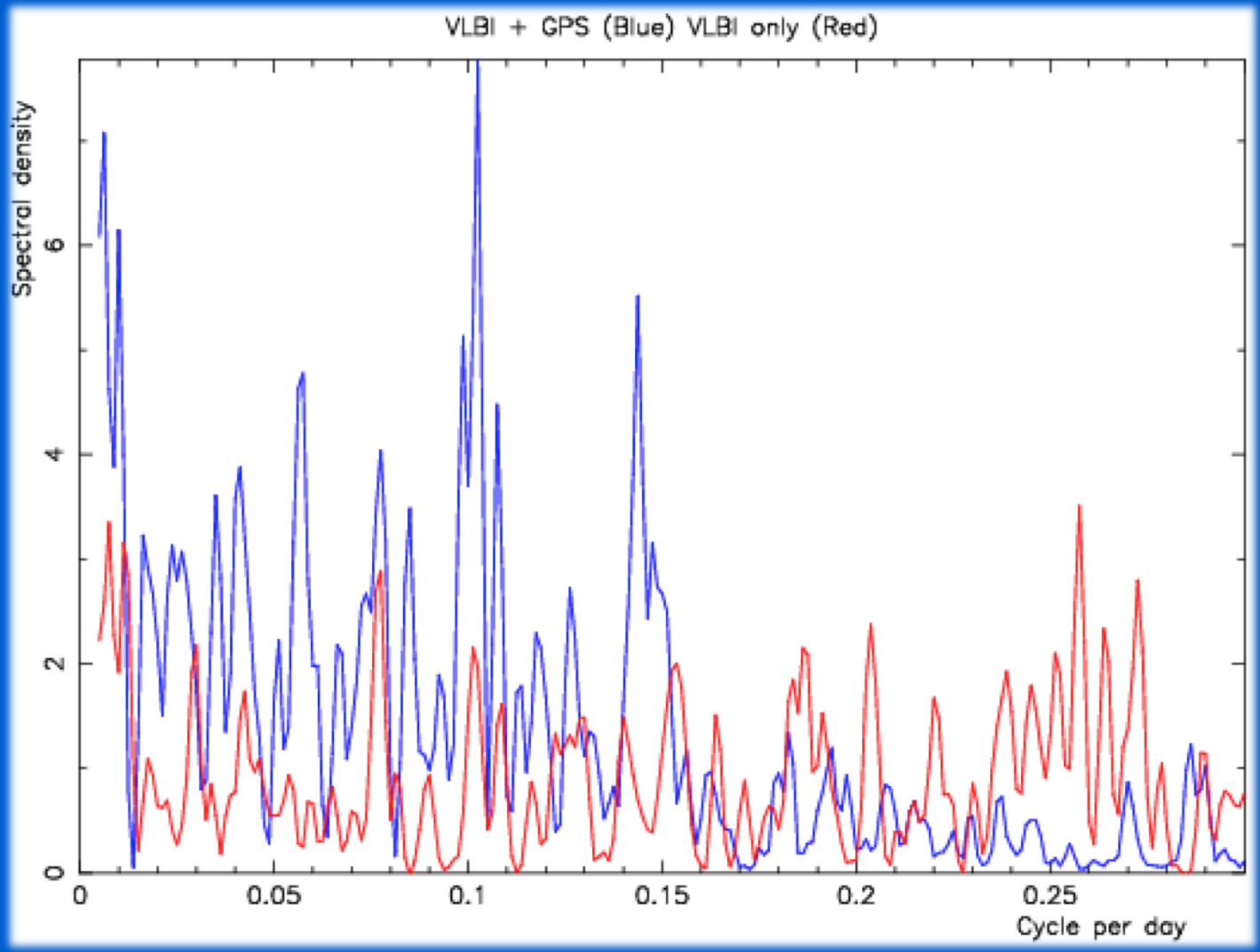
- EOP Densification and complementarity
- UT1 (VLBI) + LOD (GPS)
- Nutation (VLBI) + nutation drift (GPS)

- TRF
  Weekly time series of coordinates, comparison of local ties wrt ground geodesy

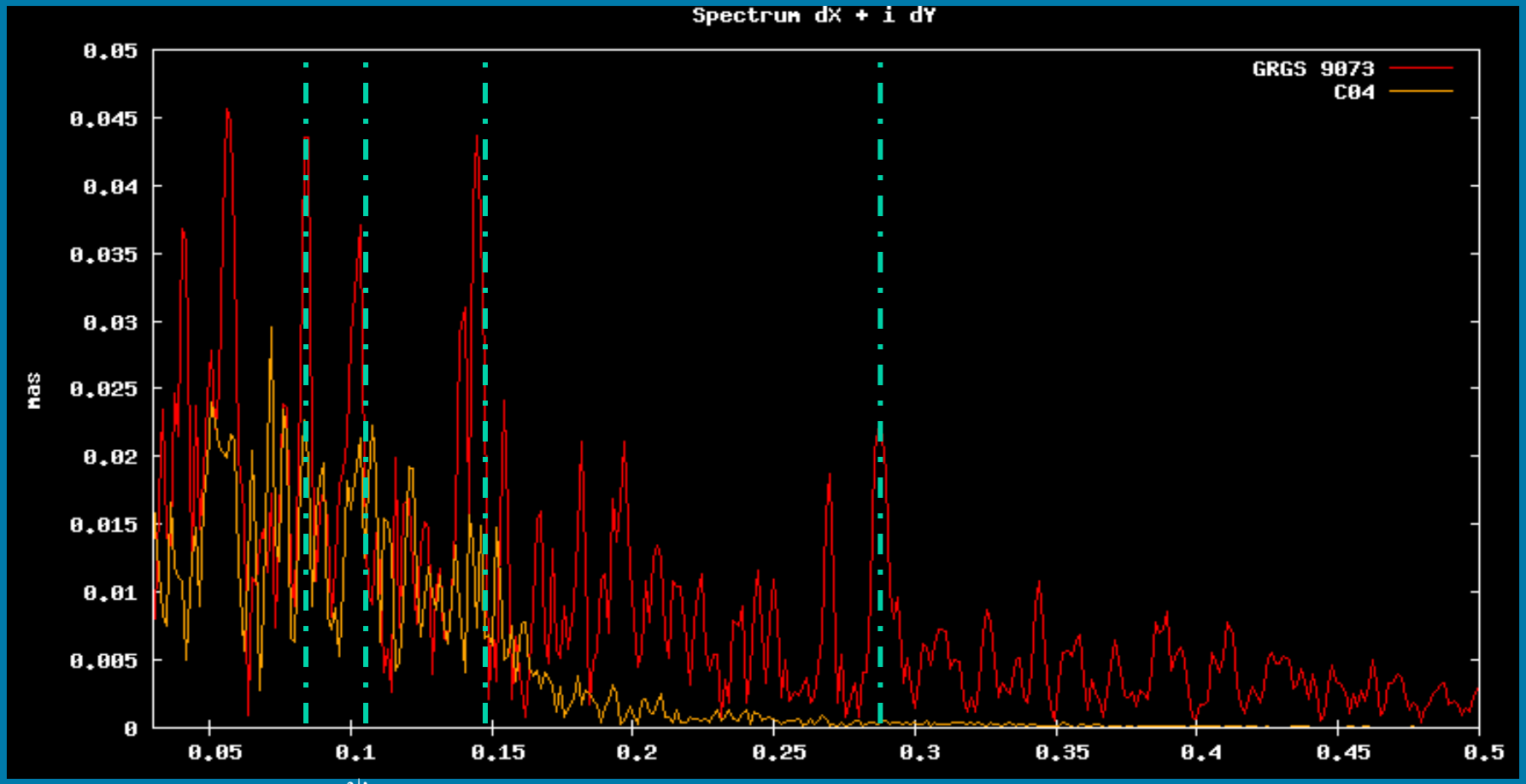
Pole and UT1 wrt IERS C04



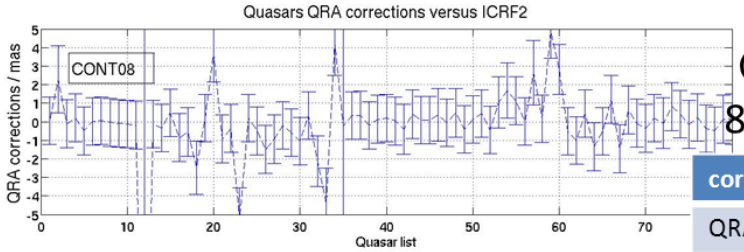
Nutation Combination wrt IERS C04



Nutation offsets dX + I dY : prograde spectrum

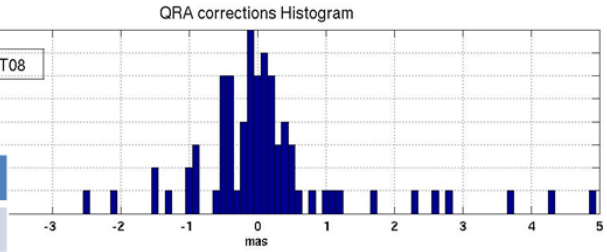


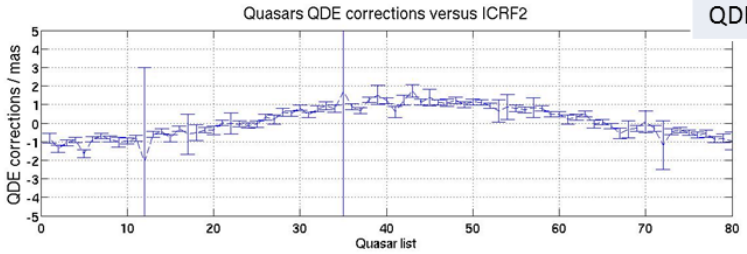
Quasar coordinates estimation wrt ICRF2



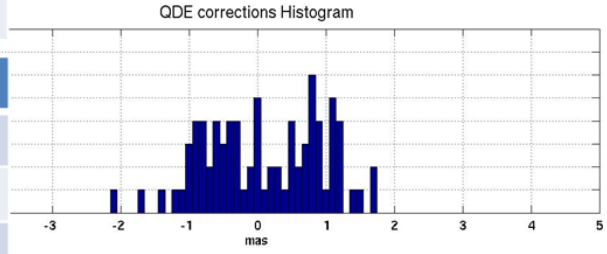
CONT08
80 quasars

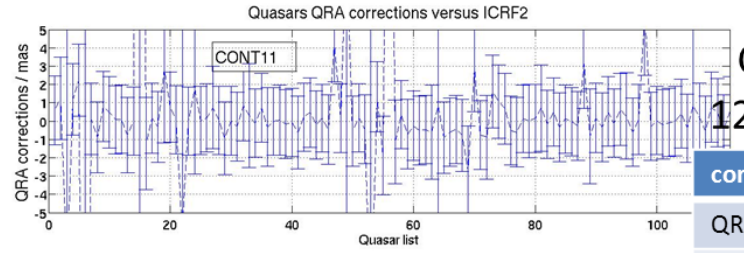
corrections	WRMS
QRA / mas	0.951
QDE / mas	1.070





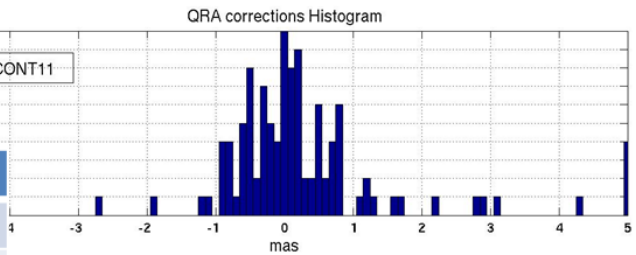
NNR	CONT08
R_1 µas	2,4 ± 6,4
R_2 µas	2,6 ± 3,6
R_3 µas	7,6 ± 10,8

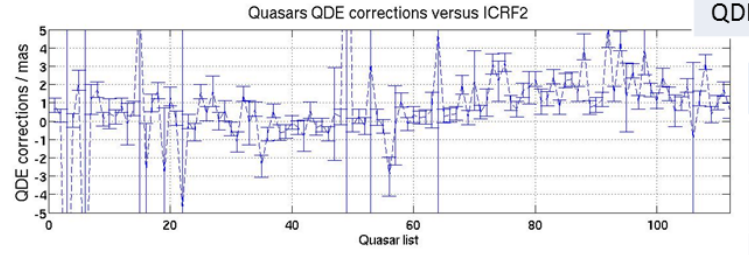




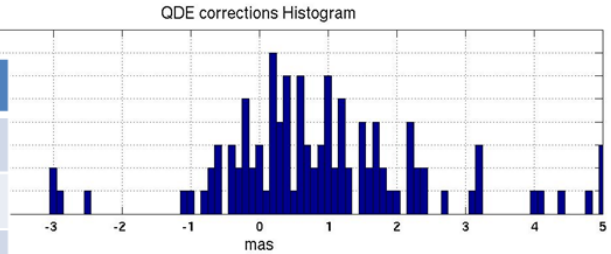
CONT11
120 quasars

corrections	WRMS
QRA / mas	1.549
QDE / mas	1.047



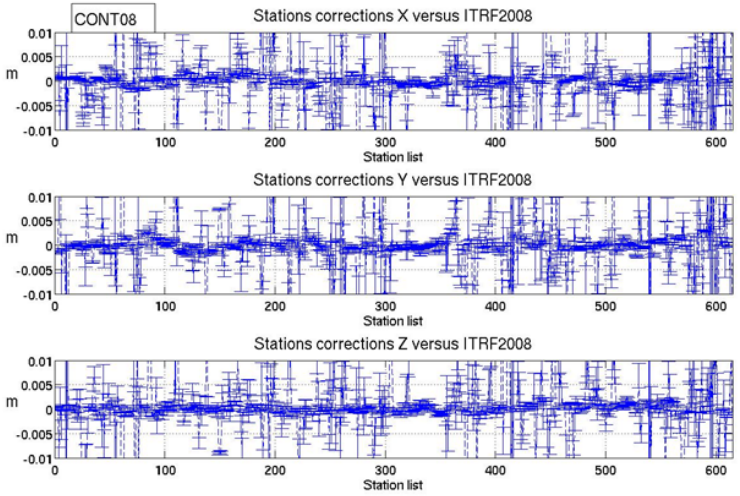


NNR	CONT11
R_1 µas	-2,6 ± 3,5
R_2 µas	0,1 ± 1,4
R_3 µas	1,0 ± 1,0



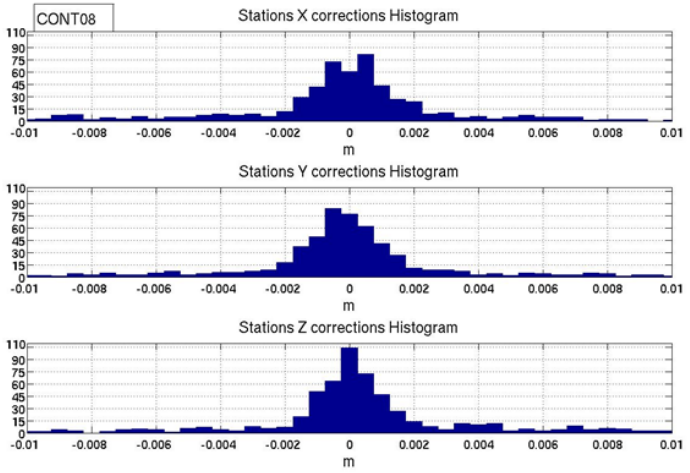
Station coordinates corrections with respect to ITRF2008

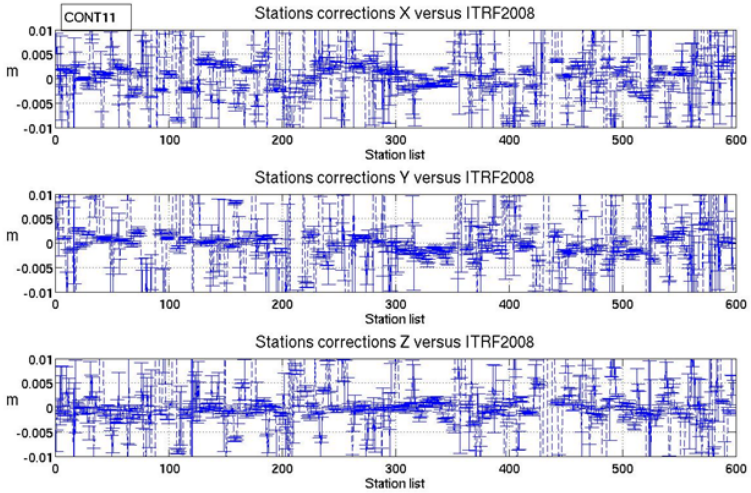
Coordinate corrections for the ensemble of stations



CONT08
615 Stations

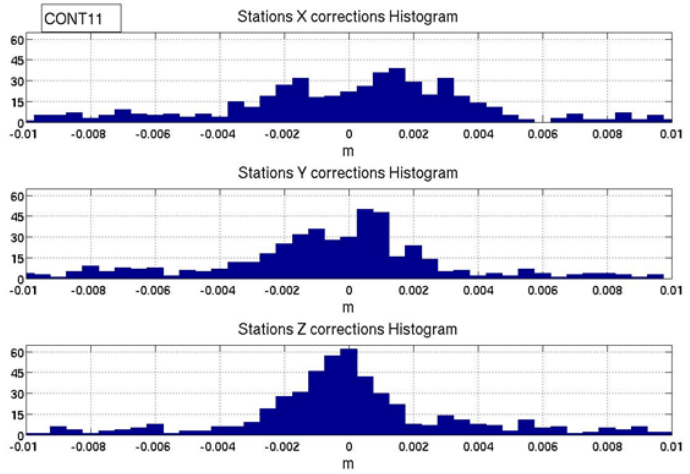
	CONT08 WRMS
X	1.68mm
Y	1.57mm
Z	1.97mm





CONT11
598 Stations

	CONT11 WRMS
X	15.18mm
Y	16.88mm
Z	5.72mm



Station corrections versus ITRF2008 show a good homogeneous dispersion at the level of millimeter for CONT08 and cm for X and Y component for CONT11.

Critical points and limiting parameters

Technical points

Formats, labelling, datation,..

Strategy

- Network geometry changes cause instabilities in CRF
  - Need to firstly stabilize sub-networks
- Local ties
- Weighting of the techniques
- Application of non rotation conditions for CRF
- Application of minimal constraints
    - If tight; TRF constrained to ITRF but EOP unstable
    - If loose, better EOP, but unstabilities in successive TRF

Conclusion 1
Current EOP determination using time series

Precision

- Polar motion : 30 μas
- Universal Time: 3 μs
- Nutation offsets: 40 μas

Accuracy

- Polar motion : 50 - 80 μas
- Universal Time: 10 - 20 μs
- Nutation offsets: 60 μas

Conclusion 2

- Combination at the observation level on track since 2006 within GRGS
- Operational
  - Latency: 3 to 6 weeks, limitation due to DORIS NEQ availability
  - Simultaneous determination of: EOP, TRF, CRF, ZTD
  - Precision of products not yet optimal due to difficulties to handle properly TRF stability
- Quality is improving in parallel to individual techniques processing upgrade
- Maybe not the best global method (level of geodetic targets?)