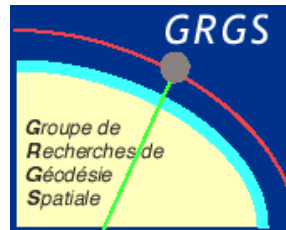


Multi-technique combination

Current status and concerns

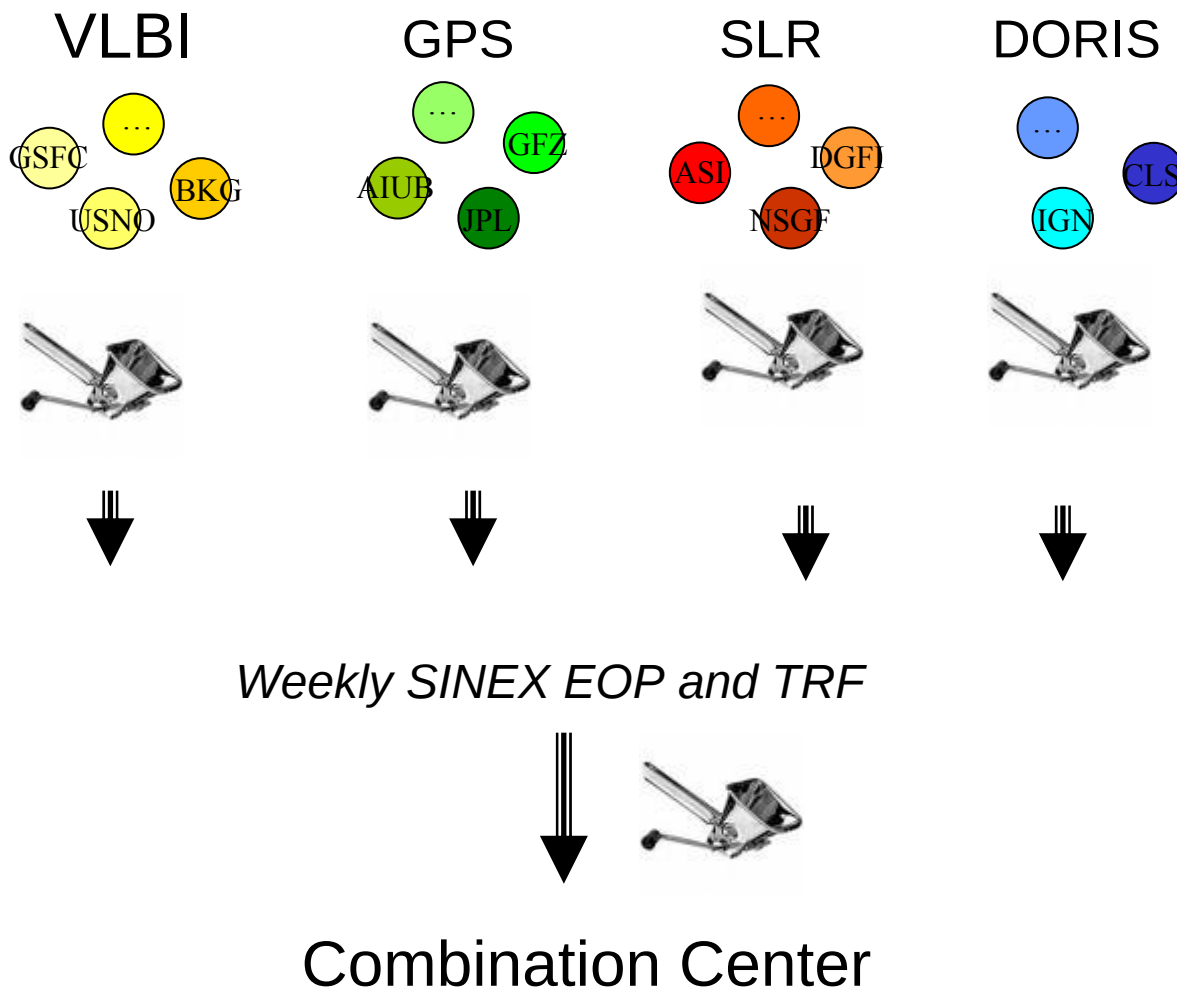


D. Gambis, R. Biancale, J.M. Lemoine, J.Y Richard

L. Soudarin, S. Loyer, G. Bourda , F. Deleflie

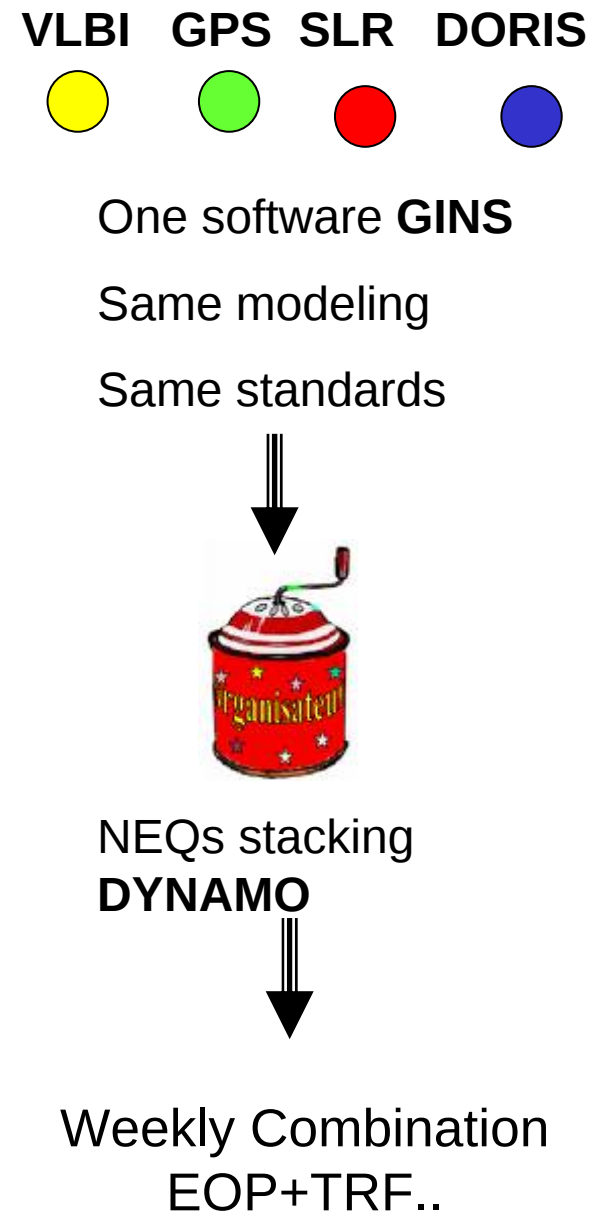


Current approach

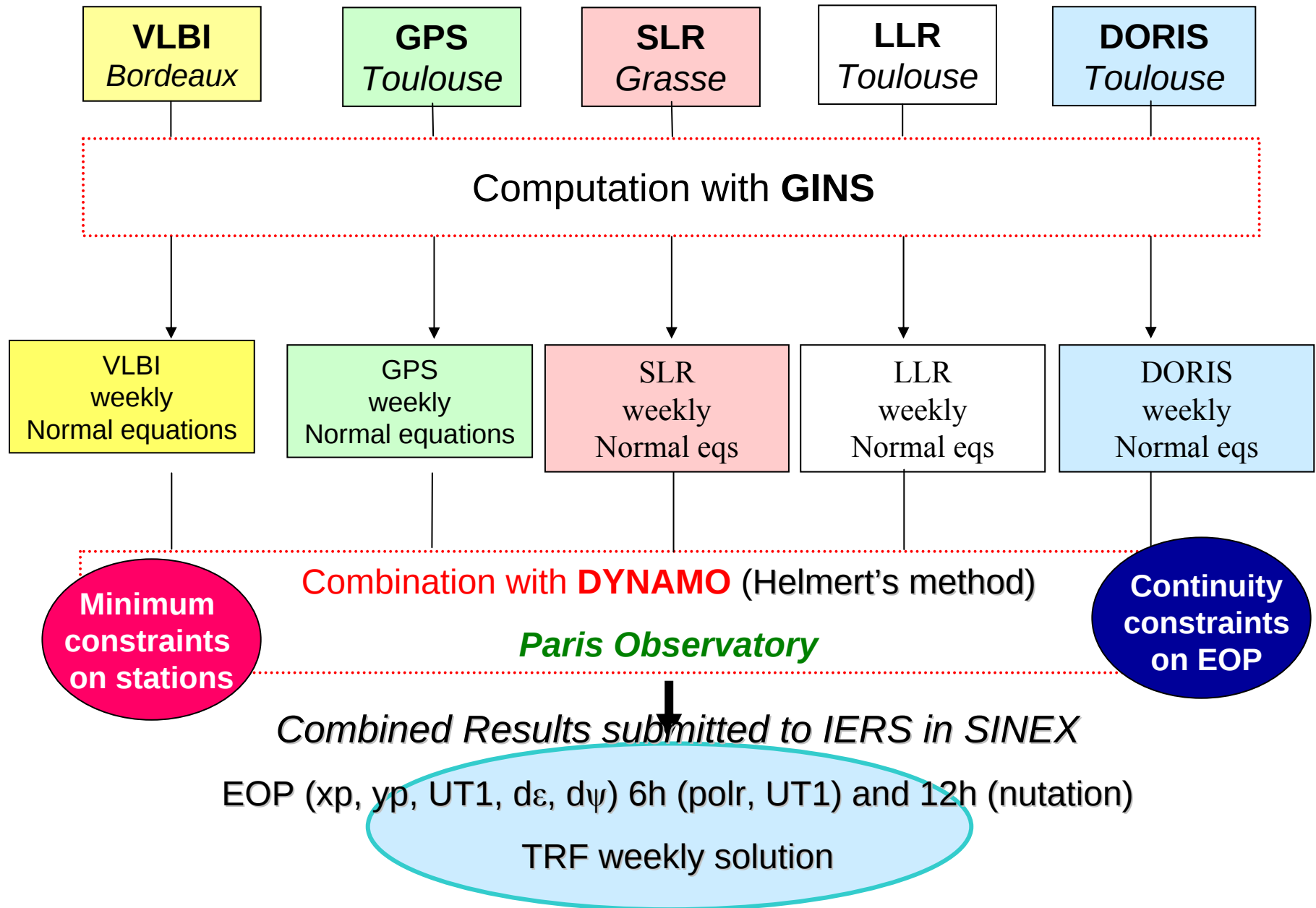


Example: ITRF2005

Alternative approach



Combination at the observational level



GINs, Géodésie par Intégrations Numériques Simultanées

GRGS geodetic software developed and maintained by the CNES' Space Geodesy Team since 1962 (Chassaing et al)

- Orbit computation around any body (Earth, Sun, planets or small bodies), for gravity field modeling of the Earth and planets, solid or oceanic tides, EOP, station coordinates, Quasars positions...
- Capability to process all geodetic measurement types : optical, TRANET, SLR, LLR, DORIS, GNSS, VLBI, DSN, Altimetry
- Available soon to the scientific community, on PC-Linux, with INTERNET access to its environmental data base;
- Performances of this tool will be also demonstrated through its acceptance in International Services :
CNES/CLS (Toulouse) already analysis group of IDS
OCA (Grasse) is an ILRS analysis group
CNES/CLS (Toulouse) is becoming an IGS analysis group
Bordeaux Observatory will submit a test solution to IVS

Models

a priori dynamical models :

GRIM5-C1 gravity field model (*changed in 2007 to the time dependent EIGEN-GL04S model*)

3rd body point mass attraction from Sun, Moon, other planets

Earth tide model: IERS Conventions 2003, FES-2004 ocean tide model

6h-ECMWF atmospheric pressure fields only over continents (IB hypothesis)

DTM94bis thermospheric model

Albedo and Infra-Red grids from ECMWF (resolution of 4.5 degrees)

a priori geometrical models :

A priori station coordinates from ITRF 2000 (*changed in 2007 to ITRF2005*)

A priori EOP from IERS C04 series (*changed to 05C04 in 2007*)

Earth tide model: IERS Conventions 2003

oceanic loading effect from FES-2004 ocean tide model

atmospheric loading from 6h-ECMWF atmospheric pressure fields only over continents

common tropospheric delay from Meteo-France/ECMWF for GPS, VLBI and DORIS (*from 2007*)

Strengths of the method

Strengths

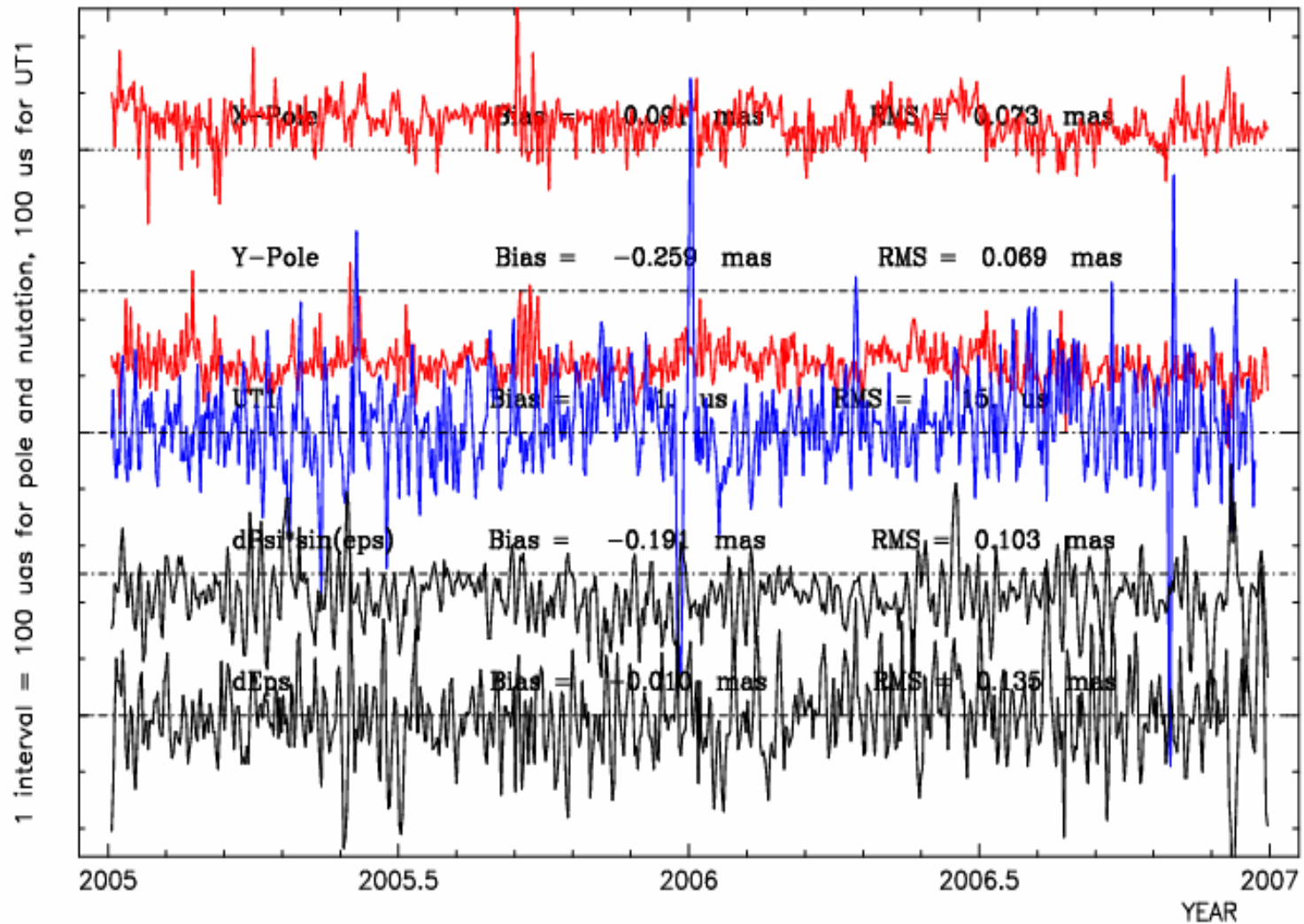
- Unified parametrization: unique software, same models
- Mutual constraints of the various techniques assumed to lead to improved solution

For Polar motion:

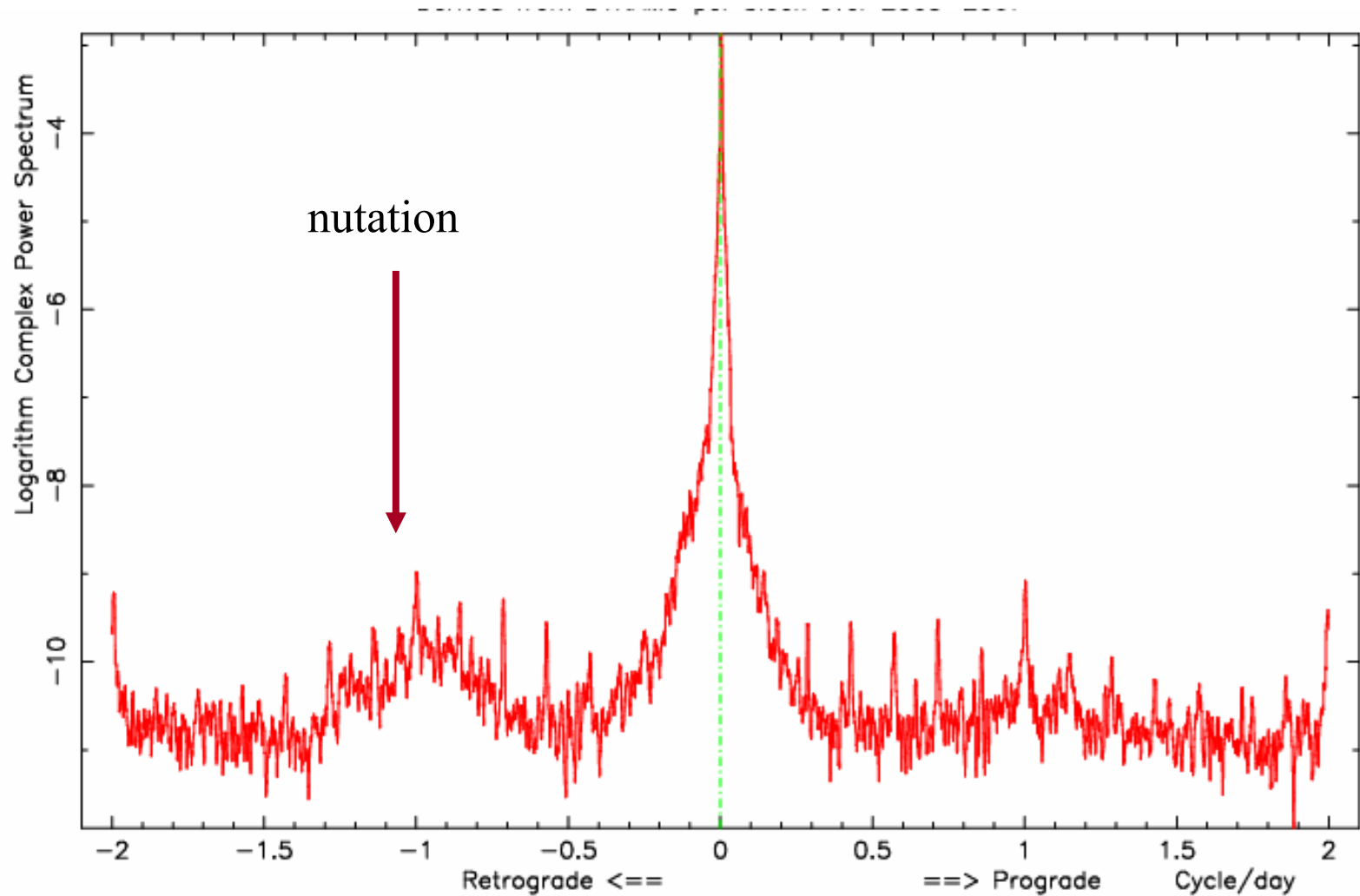
6h determination for pole, UT1 piece_wise linear representation

- GPS high accuracy, high time resolution
- SLR, VLBI long term stability
- Possibility to estimate some libration parameters for LLR
- High frequency determination of EOP
- Complementarity of UT1(VLBI) + GPS derived UT
- Complementarity of nutation (VLBI) + nutation drifts (GPS)

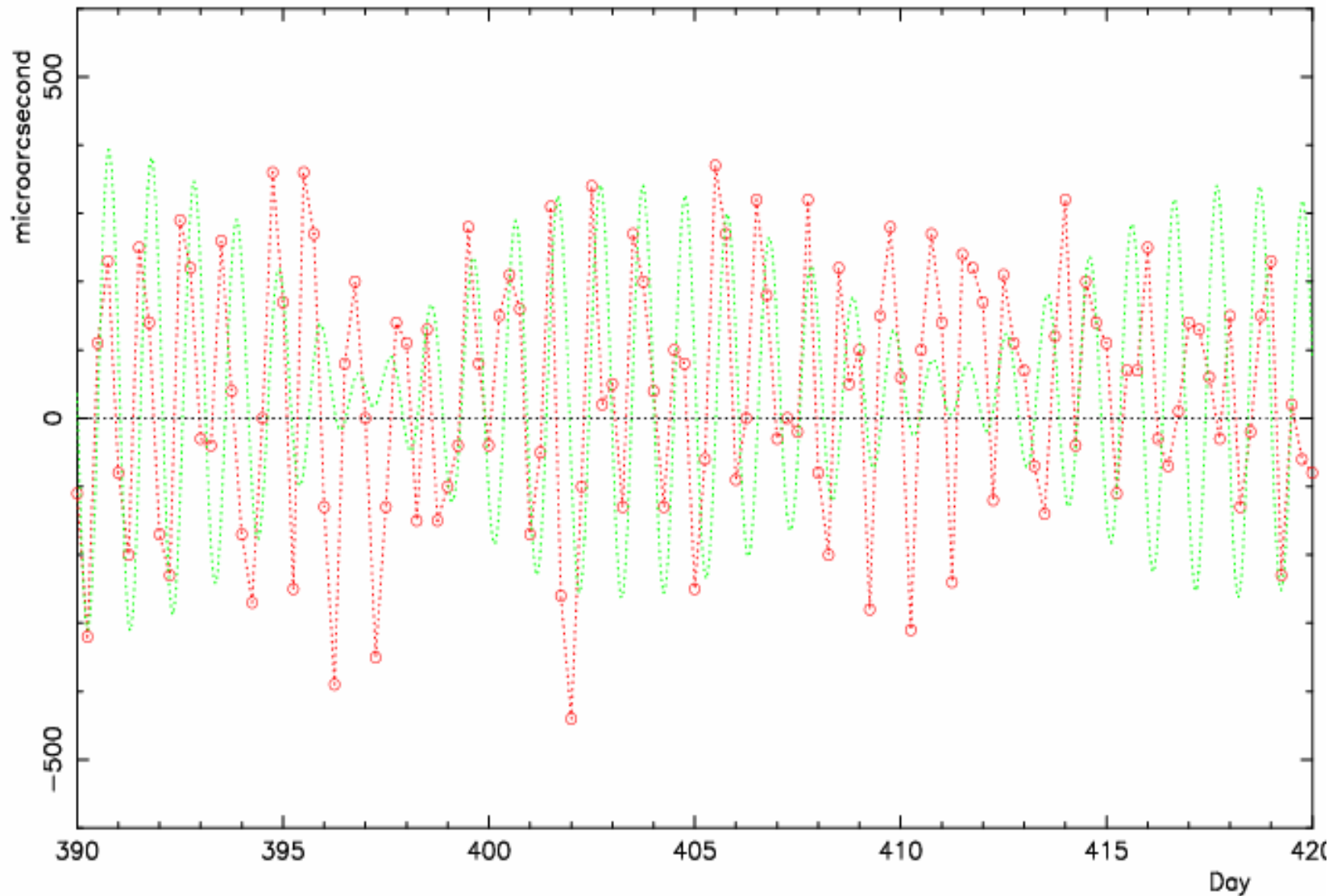
Combined solution differences to 05C04 EOP series 1d piece_wise linear fit



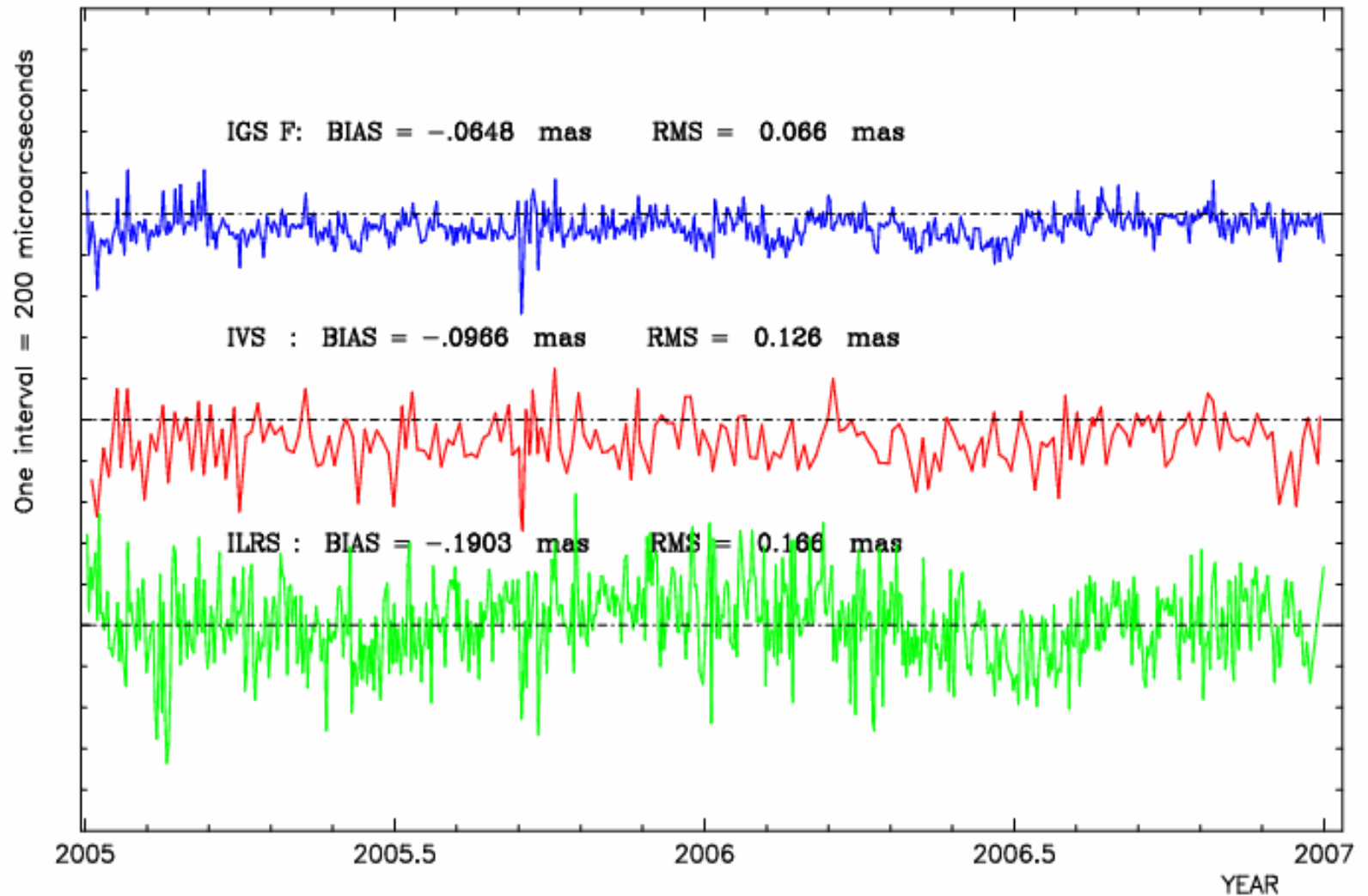
Log of Complex spectrum of polar motion derived at 6h intervals over 2005-2006



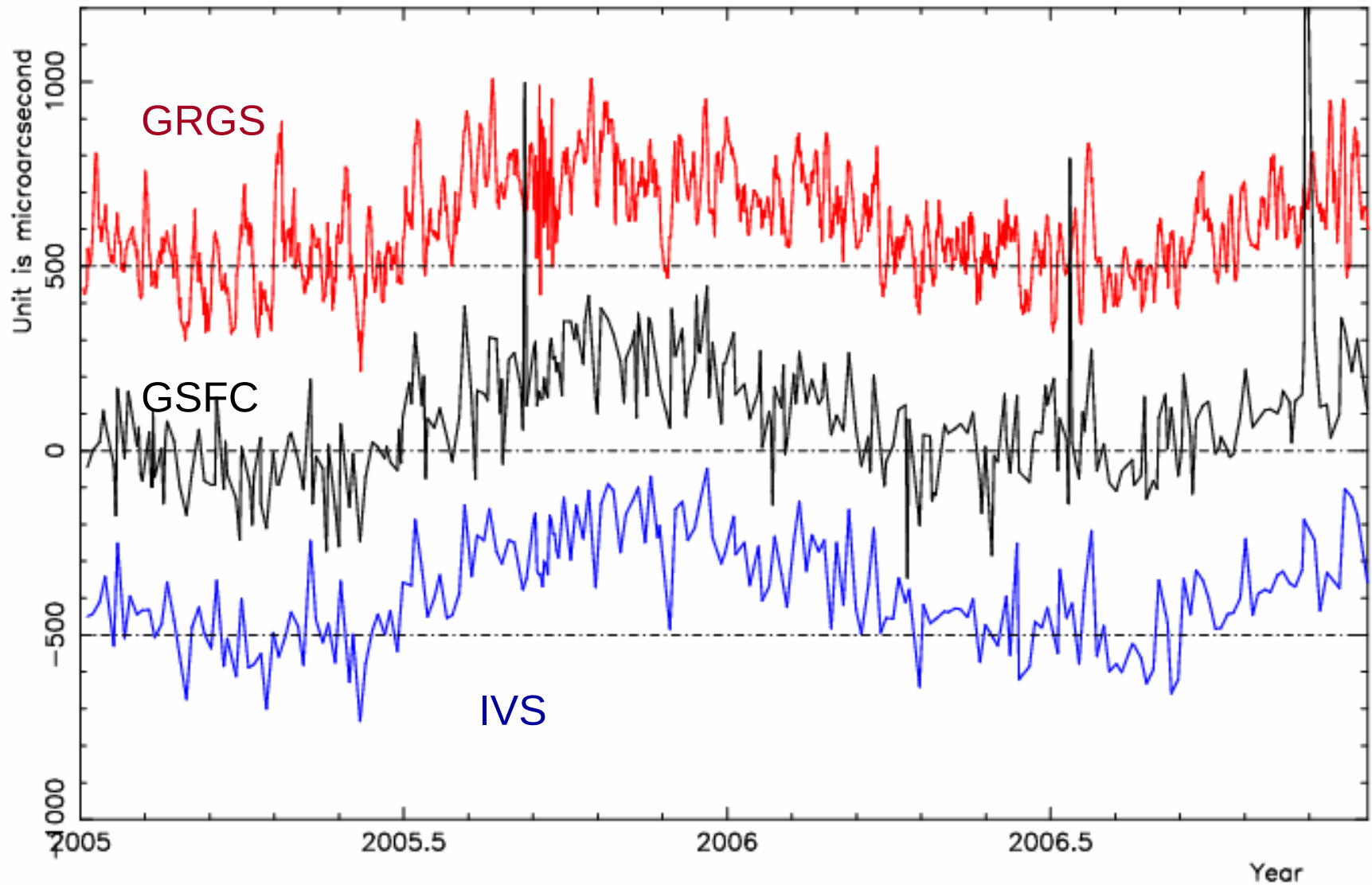
X-pole: high frequency GRGS (Red) and Ray oceanic diurnal model (Green)



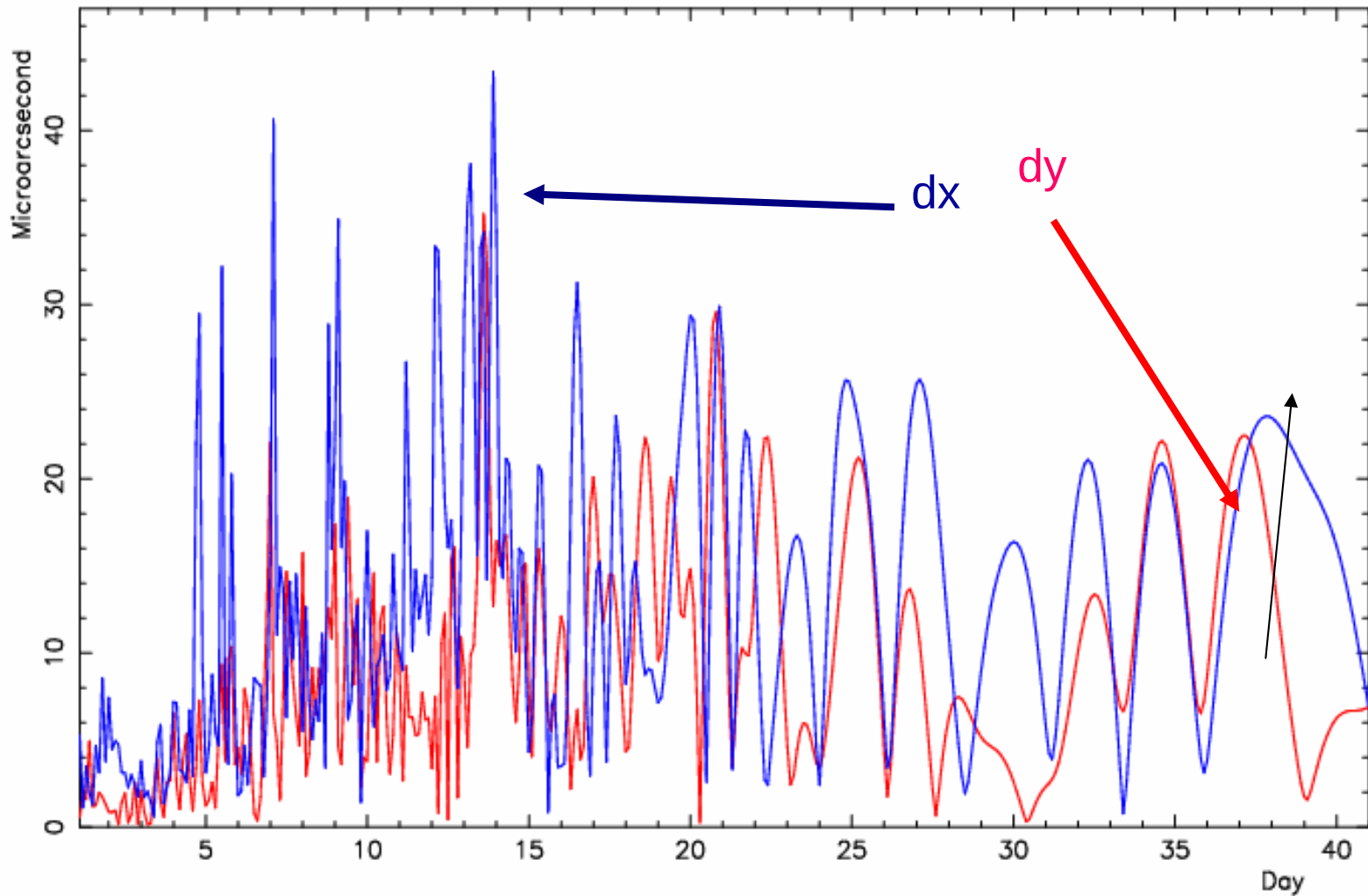
X-pole GRGS - IG, IV and ILRS



Nutation dx: GRGS , GSFC and IVS

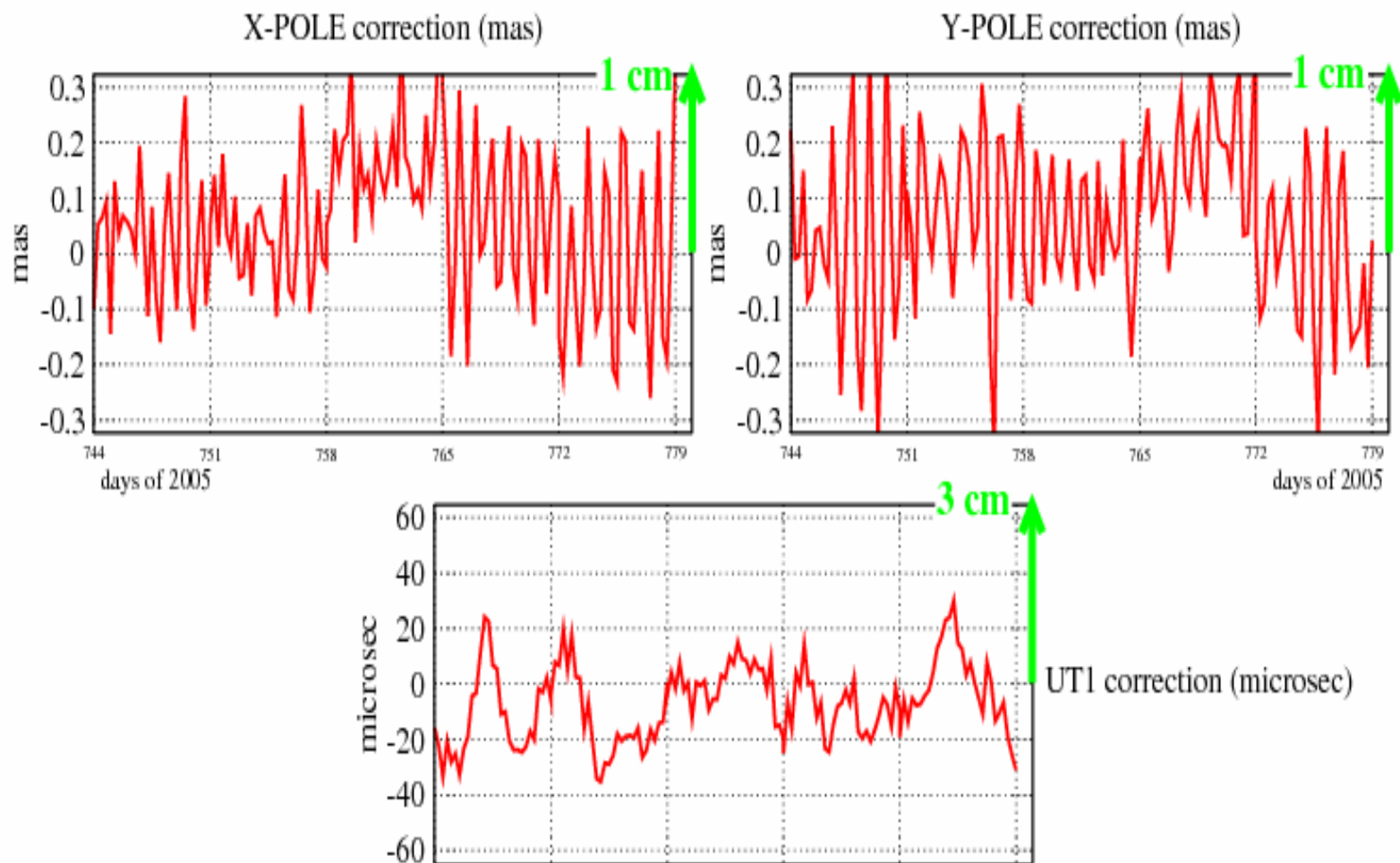


Nutation offset: LSQ periodogram of GRGS dx (Red) and dy (Blue)

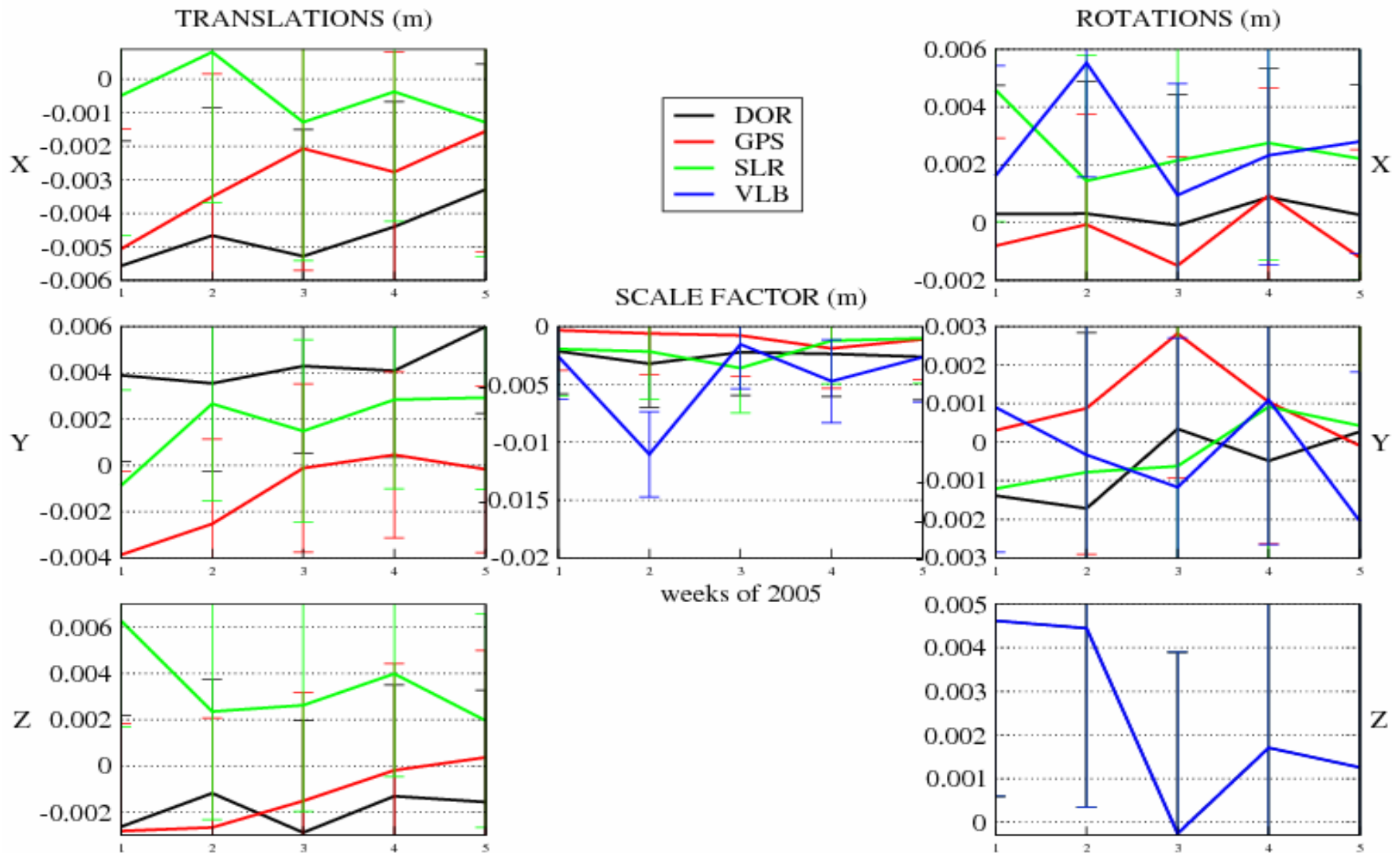


Recent upgrade of the processing chain

Combined GRGS – 05C04 over one month



Transformation parameters to ITRF2005 over one month



Conclusion and perspectives

- GRGS organization for a routine production
- Two approaches
 - 1) long-term inter-stacking then intra technique stacking
 - 2) weekly intra-technique stacking then long-term stacking
 - 3) So far no weekly determination
- individual technique analyses improved significantly
- GRGS weekly SINEX files since 2005 are stored at IERS as multi-technique products
- Processing has been upgraded in 2007 (J.M. Lemoine)
- It now includes common (except now for SLR) tropospheric biases as well (based on Meteo-France/ECMWF dry and wet zenithal delay)

In the future

CRF (VLBI) Gravity fields (SLR),

Some issues and concerns

- Quality of individual technique results should be at the best level
- Time resolution from 6 to 3 hours?
- Problems in ensuring EOP and TRF estimates stability
- The process is not very robust, modification in parameters may strongly affect the solution, weighting, constraints applications
- Relatively small number of local ties and confidence in their accuracy
- Weighting is critical
- Increasing size of matrices to invert
- Correlation sub-diurnal polar motion and nutation
- Optimal technique weighting
- Rigorous quality control has to be done by external analyses
- Evaluation, validation
- Improvement in the latency
- Long run and weekly determination
- Need of a strategy for weekly determination: 2 weeks slidding interval?