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Geodetic Observatory Pecný

Current Activities of GOP DORIS Analysis centre

DORIS IDS WORKSHOP NICE 12-14th November 2008

DORIS Analysis at Geodetic Observatory Pecný (GOP)

- Modified “unofficial” version of the Bernese GPS software, derived from version 5.0 (and additional scripts)
- Routine processing tools developed as the extended BPE
- Current status: DORIS implemented, (semi)automatic processing developed, 4 years of data processed
- Achieved precision of the solutions looks almost comparable or only slightly worse in comparison to IGN, LCA solutions.

Basic processing strategy

- Input data:CDDIS, centre of mass and ionosphere corrections from file applied. CNES preprocessing + GOP preprocessing
- Range rate is transformed into the “difference between two pseudoranges”. The reason is to be as closed to GNSS processing as possible. This transformation is a simple multiplication of range rate by the negative value of the observation time interval

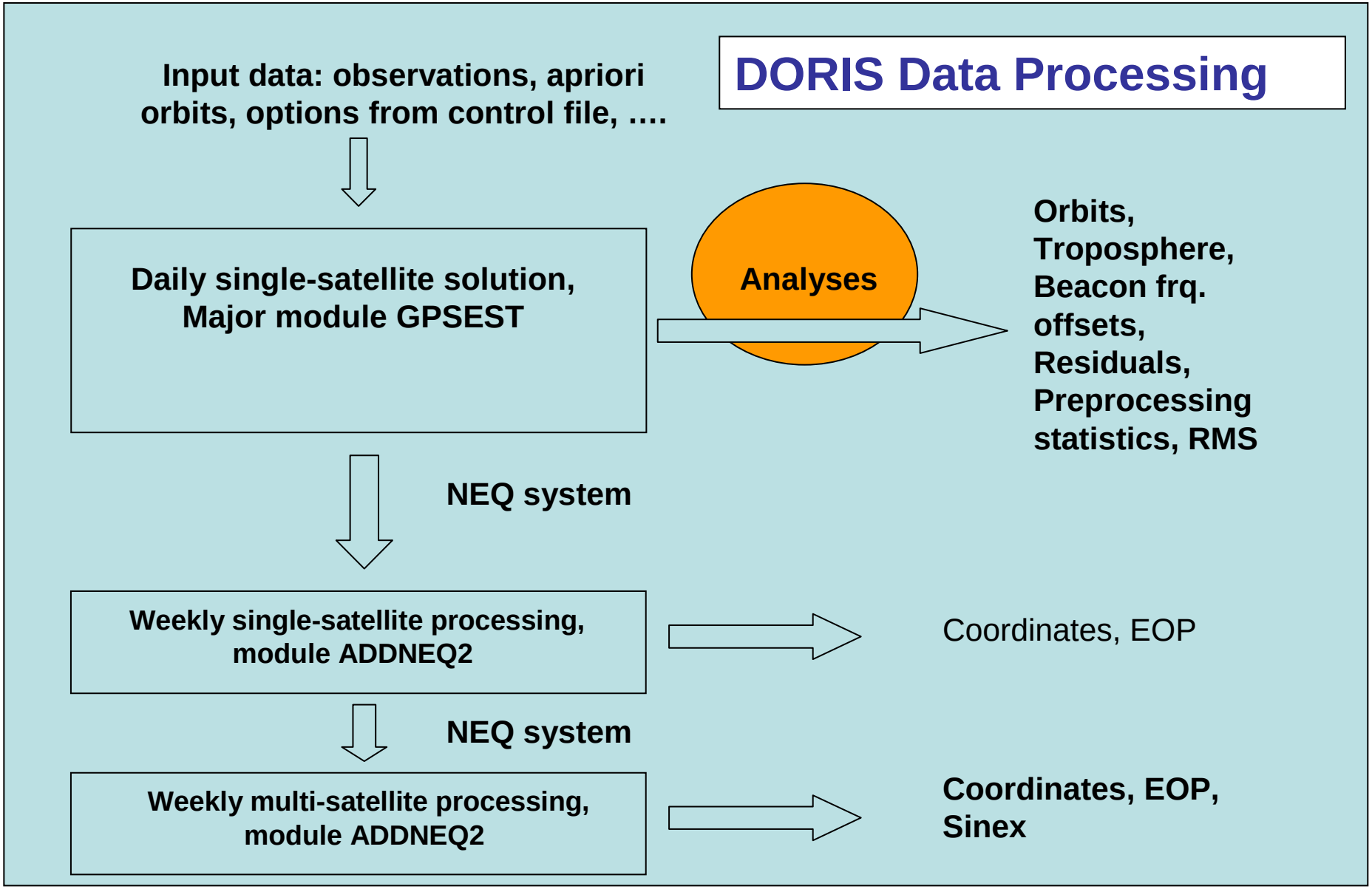
$$\Delta\rho = - V*\Delta t$$

- The solution minimize sum of the “pseudorange difference” square residuals and not range rate residuals, which is the difference from the IGN,LCA processing
- In fact the other groups minimize the sum of squared rang rate residuals v_i, while we minimize the sum of squared Δt_i v_i ,which means that we implicitly use different weighting in the case of the processing of data with different observation intervals (e.g. 7 and 10 s)

Basic models used in gopwd31 solution

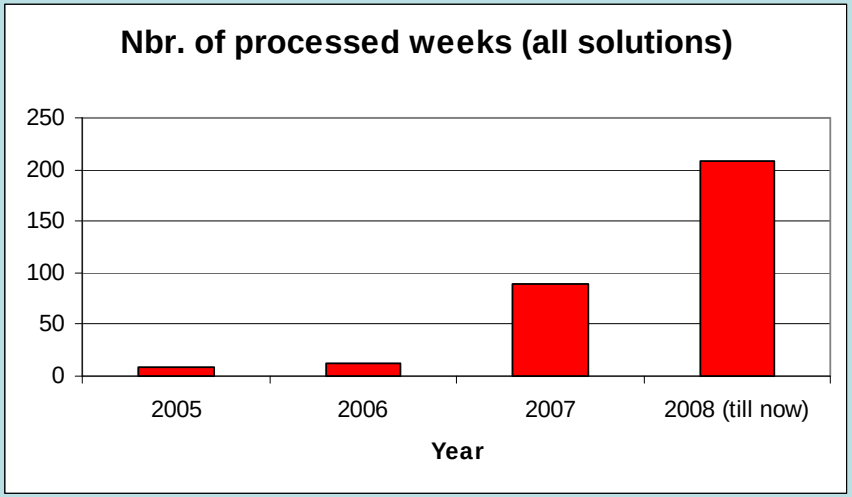
- Gravity EIGEN-GL04S Annual 100X100
- Atmosphere gravity ECMWF
- Apriori coordinates ITRF2005 (DPOD), apriori ERP IERS C04 model, Initial orbits GSC
- Subdaily pole model IERS 2000
- Nutation IAU80
- Earth tides IERS 2000
- Ocean tidas (dynamic) CSR30
- Ocean tidal loading FES2004
- Apriori troposphere : GPT with dry GMF
- Estimated troposphere: wet GMF map. Function
- Planetary Ephemeris DE405
- Eq. of motion pol. deg. 10, integration interval 0.025 hour
- Var. equations pol. deg. 10, integration interval 0.2 hour
- Apriori RMS 4 mm (~ 0.4 mm/s for 10 s observation interval)

DORIS Data Processing



Weekly solution gopwd31

- S2+S4+S5+EN+TP
- Station coordinates, apriori constraints 10 m
- X,Y pole, apriori constraints 500 mas – estiamted noon value and daily rate
- Beacon frequency offset constant per path
- Troposphere tot. zen. Delay, constant per path
- Orbit parameters



gopwd31 for ITRF

2003-2006 processed

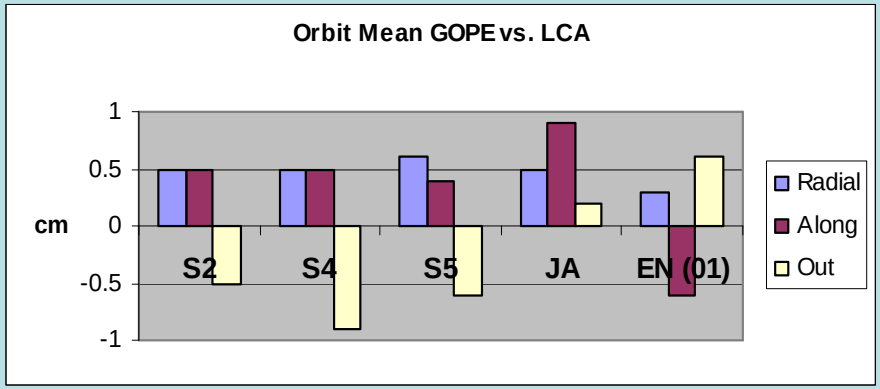
2007 in progress

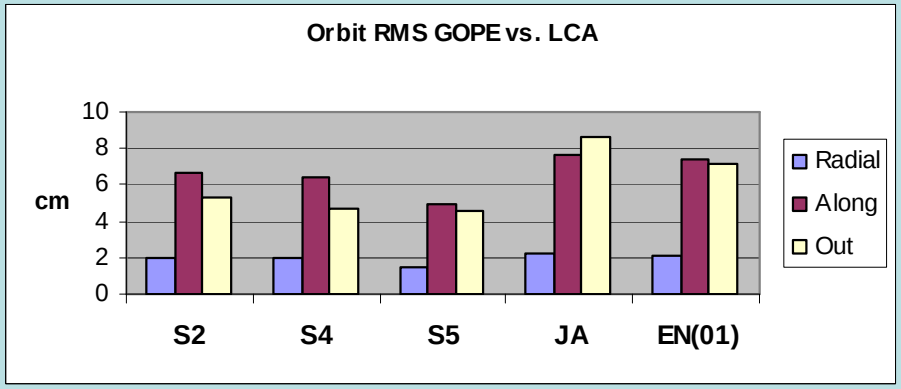
Orbitography

- Arc length 1 day (longer arcs processing is impossible with current models)
- Six Kepler initial elements
- Reduced dynamics - Empirical and Stochastic parameters
- no exact models for non-conservative forces
- Empirical constant parameters in Sun and Y-direction, per arc
- Empirical harmonic parameters in Sun and Y-direction
- Stochastic parameters in along-track direction, every 15 minutes, constraints 10^{-5} m/s

Orbit comparison vs. LCA

- Comparison for January 2005
- Radial Bias 0.3-0.7 cm
- RMS Radial ~ 2cm (1.5 cm for Spot-5), Tangential ~ 5-7 cm, Normal 4-8 cm



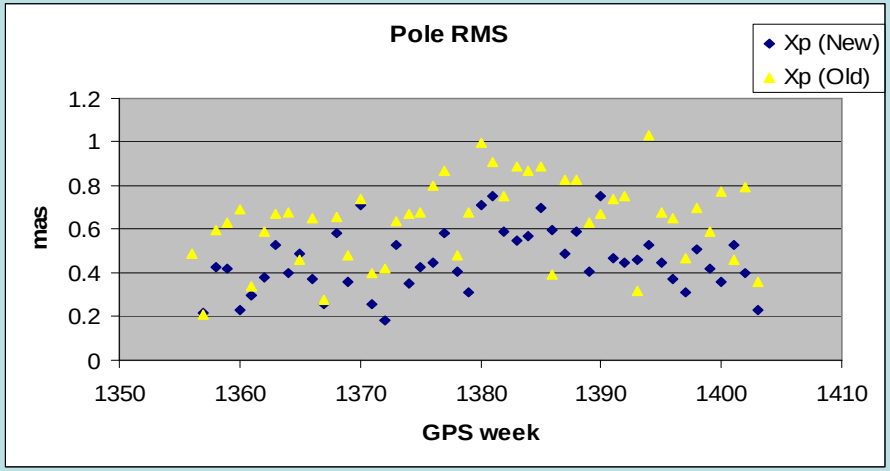


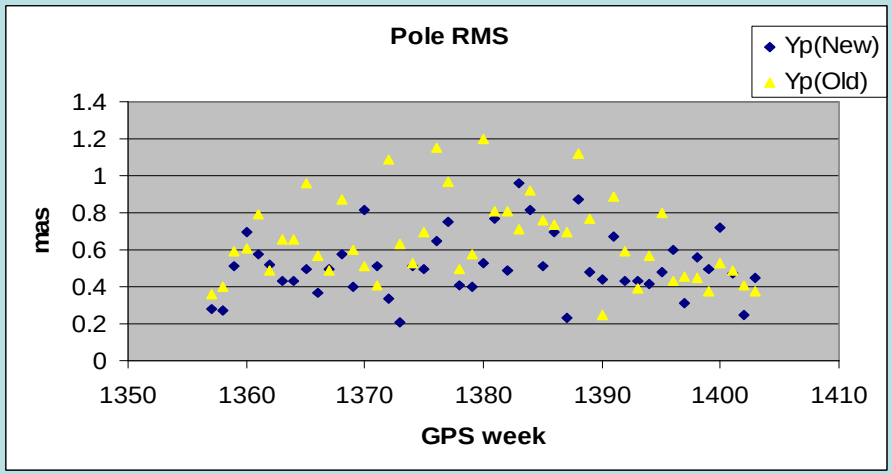
Pole coordinates estimation

Old strategy: Piecewise linear behaviour

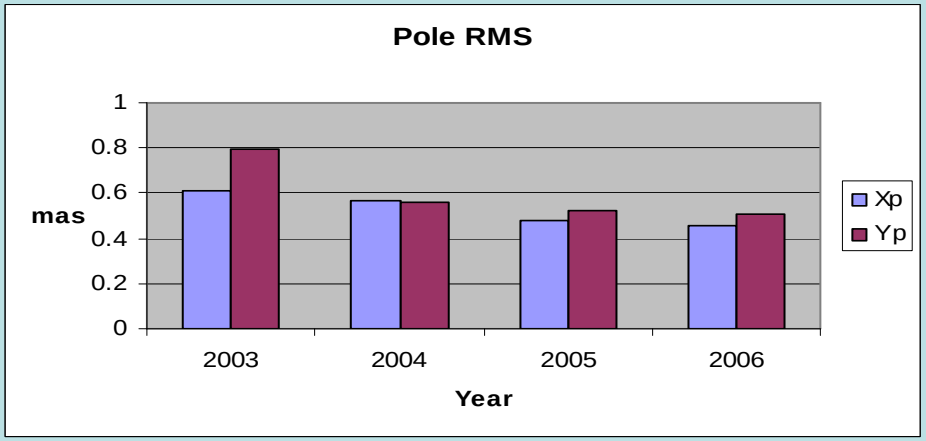
New strategy: Value at noon + rate

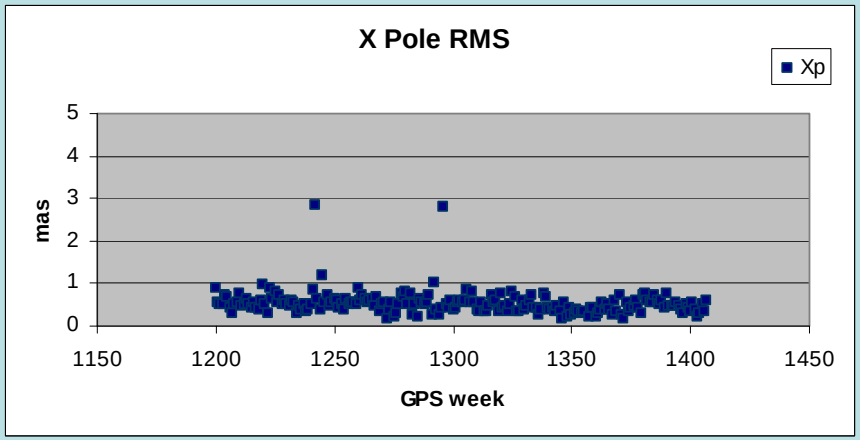
RMS (values at noon in mas) OLD Xp 0.64 Yp 0.65 NEW Xp 0.46 Yp 0.52

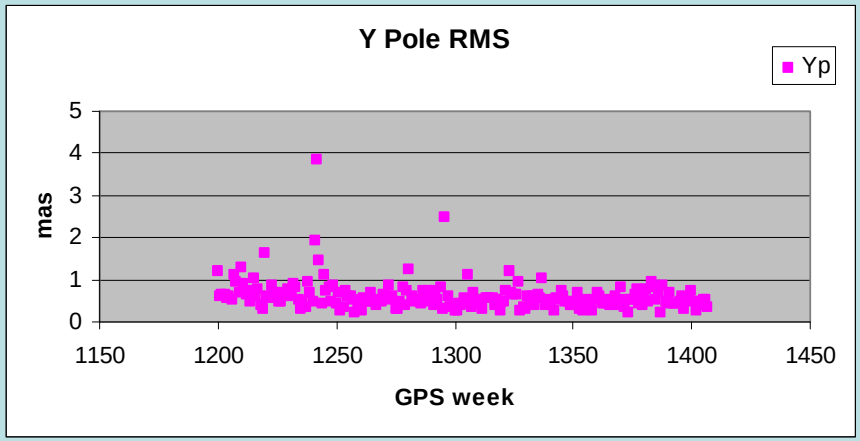




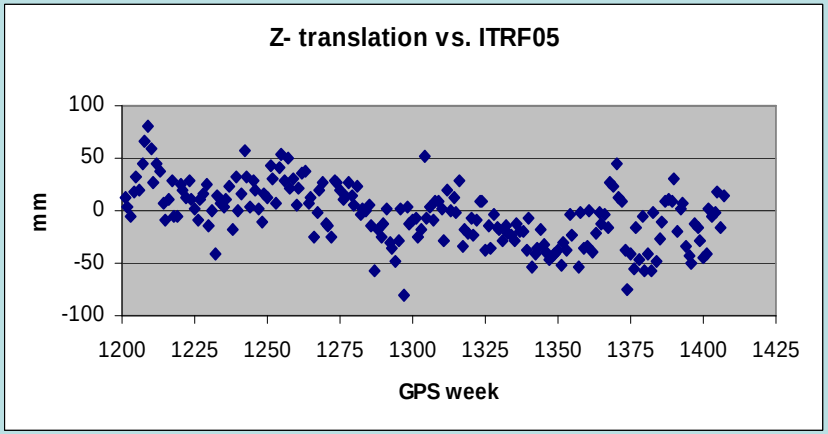
Pole RMS

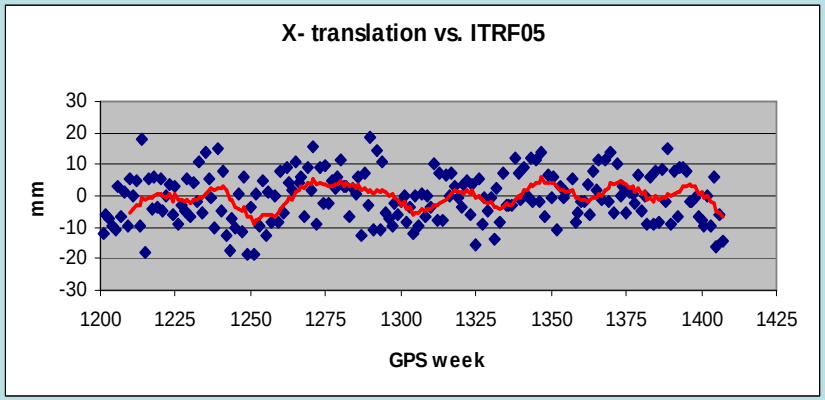

Pole RMS
mas
1
0.8
0.6
0.4
0.2
0
2003
2004
2005
2006
Year
Xp
Yp

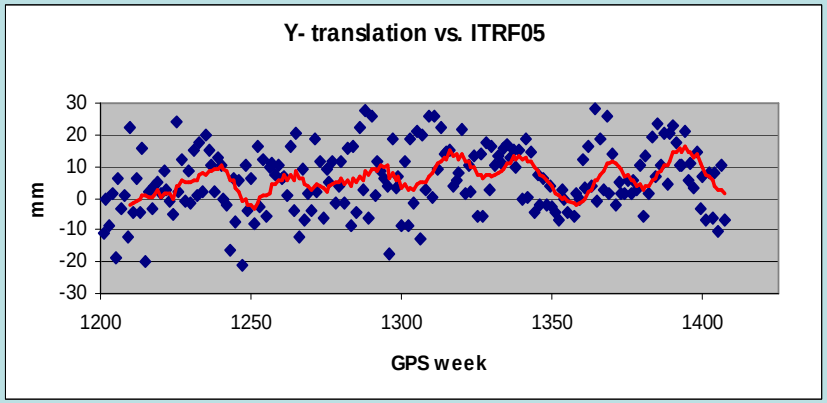

X Pole RMS
Xp
mas
5
4
3
2
1
0
1150
1200
1250
1300
1350
1400
1450
GPS week


Y Pole RMS
Yp
mas
5
4
3
2
1
0
1150
1200
1250
1300
1350
1400
1450
GPS week

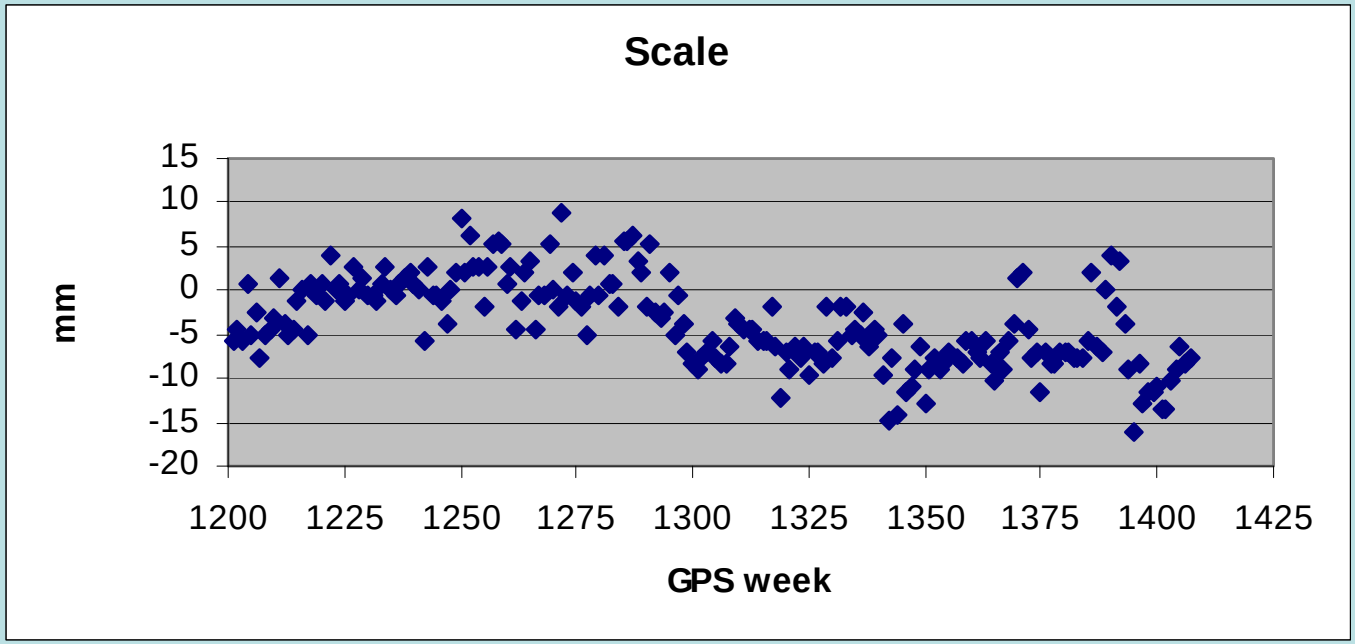
Estimated station coordinates – translation par. to ITRF05





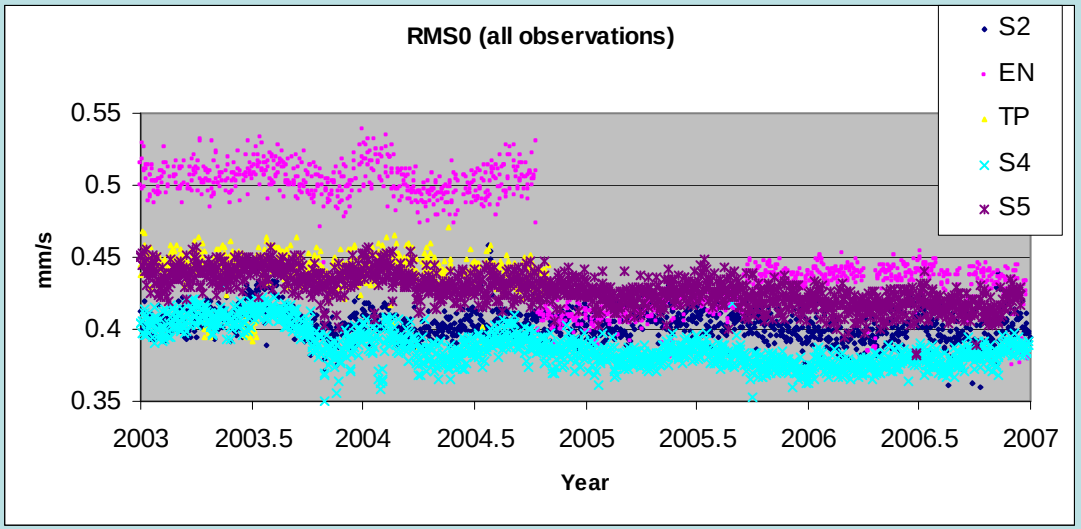


Scale par. X ITRF05



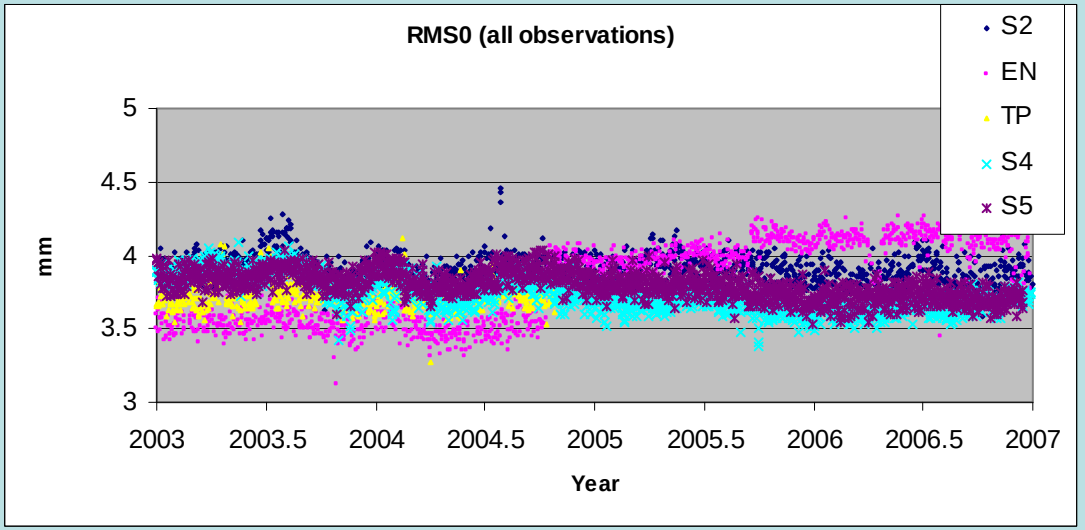
RMS in mm/s

(range rate)

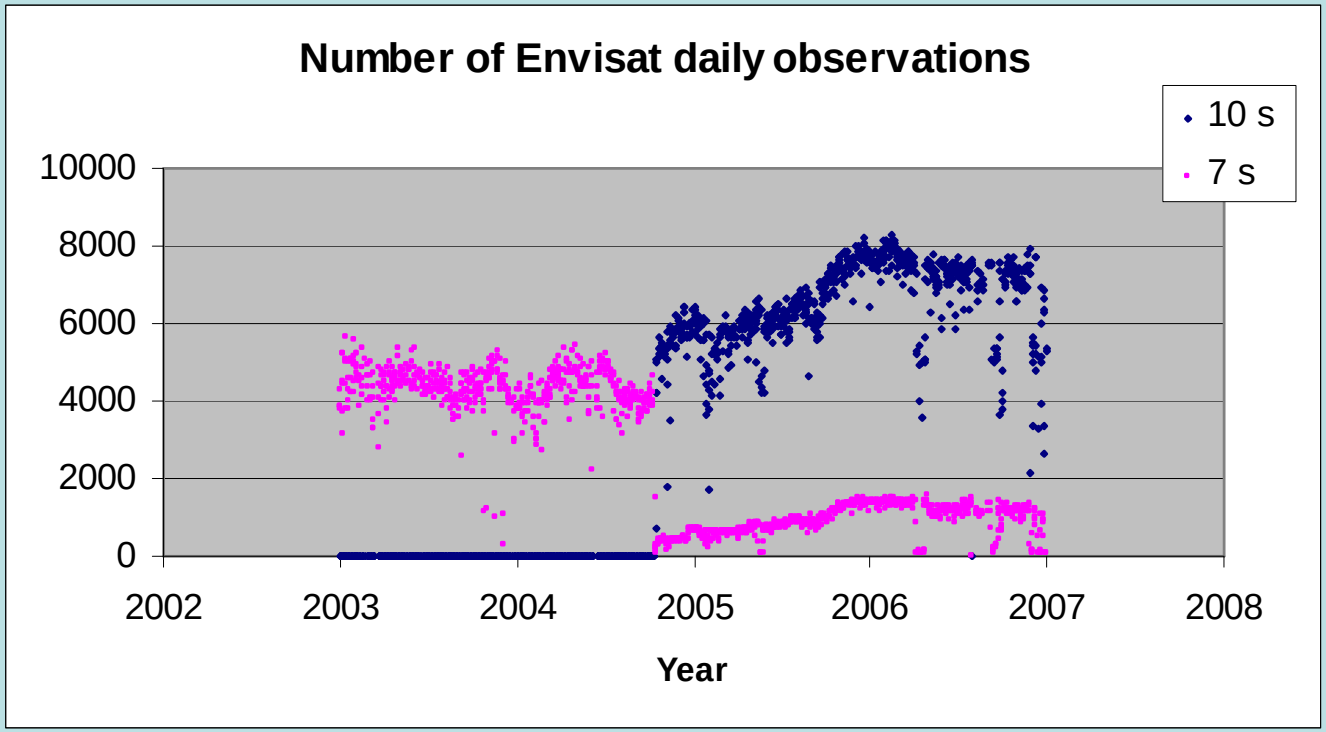


RMS in mm

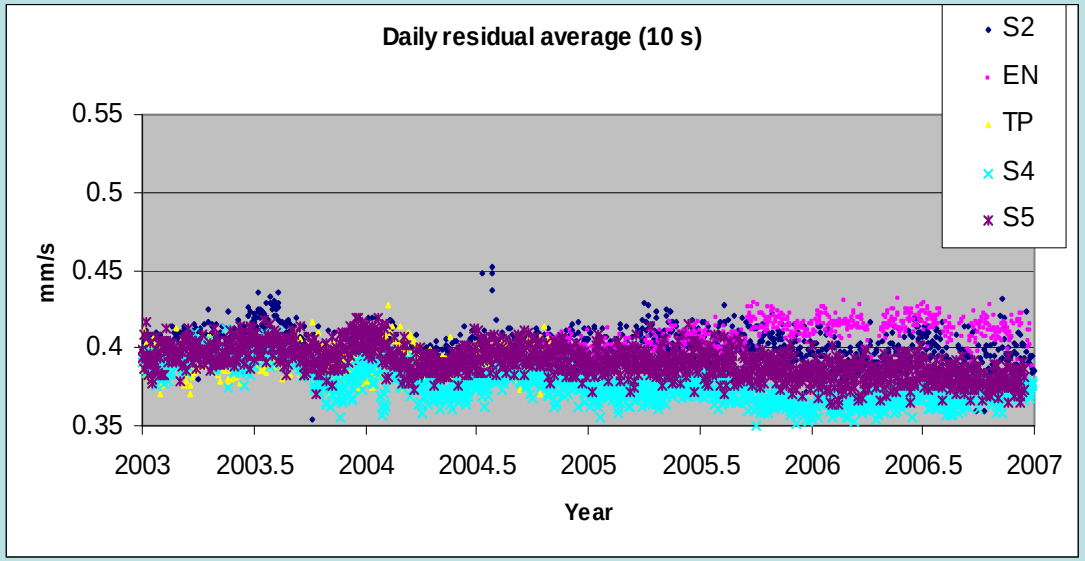
(pseudorange difference)



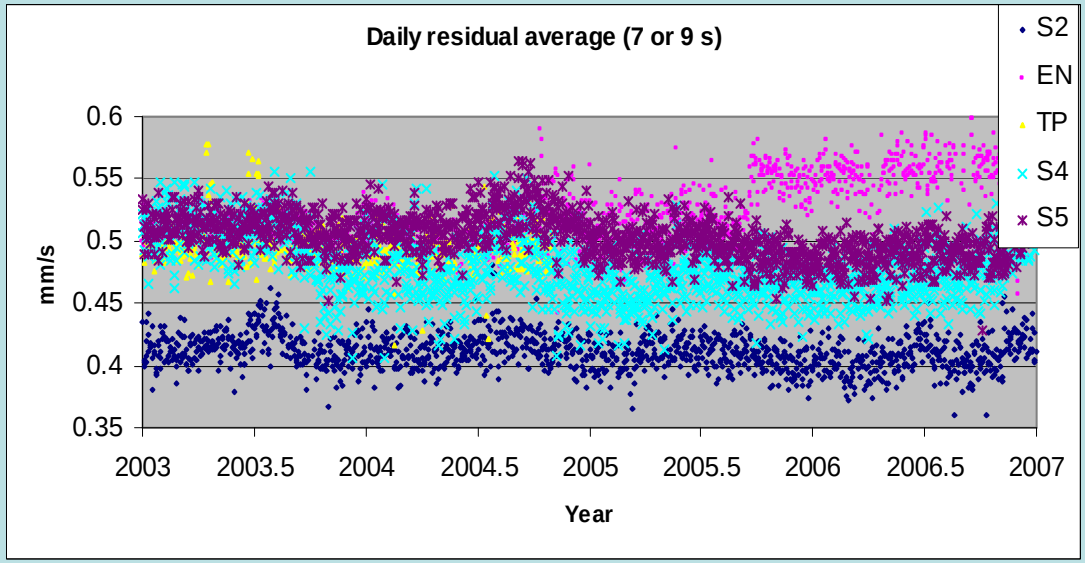
Number of Envisat observations (valid in GOP preprocessing)



Residuals
("long" observations)

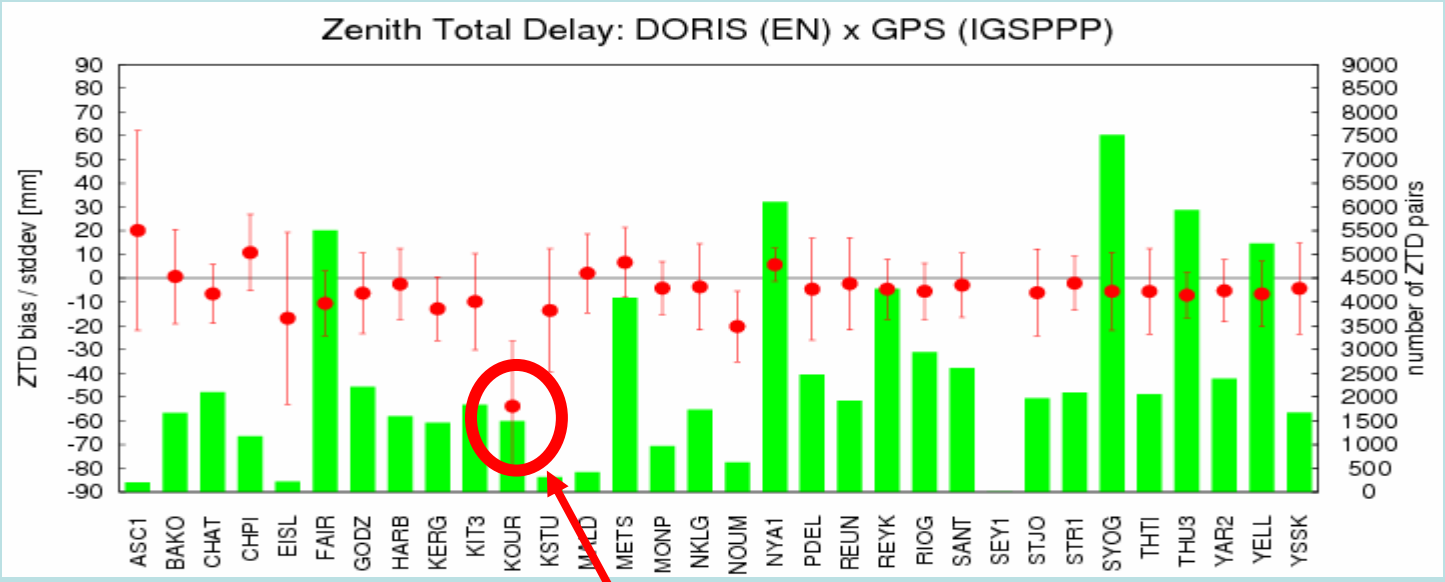


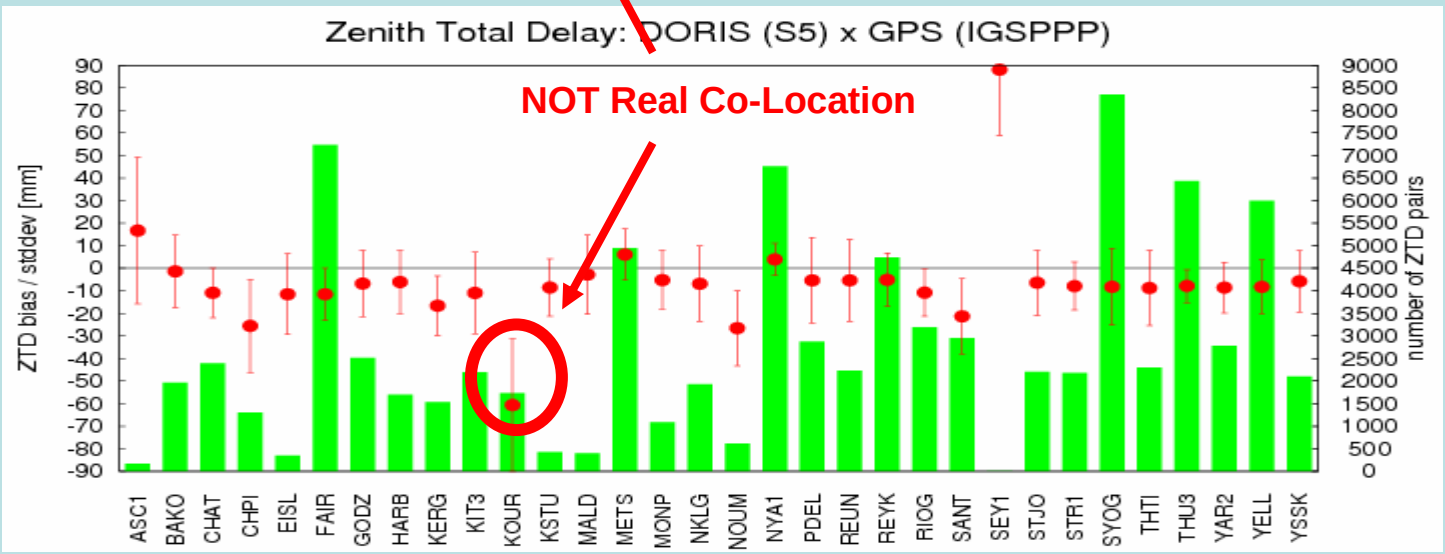
Residuals
("short" observations)



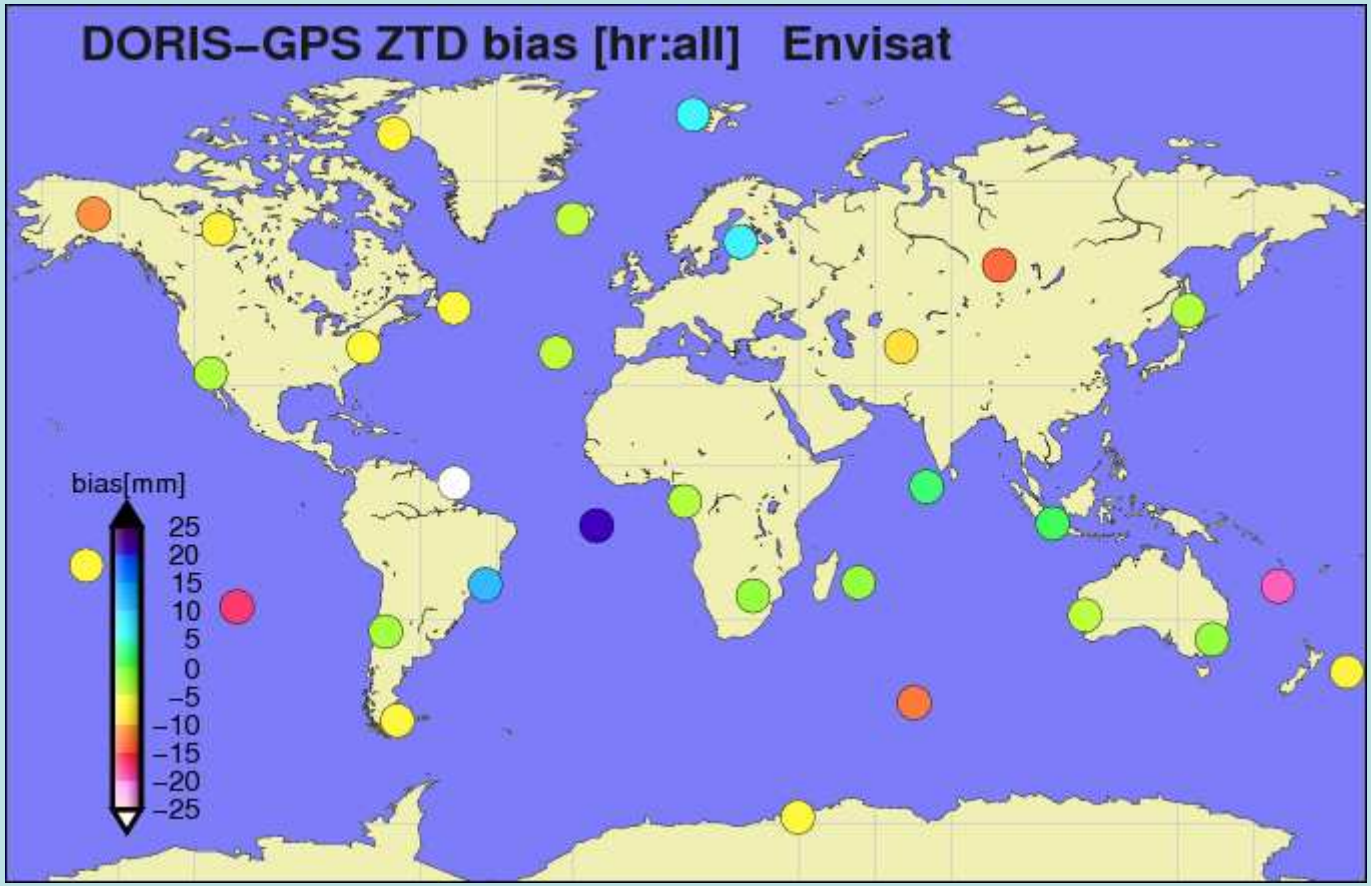
Total Zenith Delay DORIS X GNSS

- Results achieved shortly before Nice workshop (preliminary)
- ZTD from low constrained single-satellite daily solutions
- GNSS ZTD from new IGS troposphere product (PPP)
- Significant differences
- More comparison needed (solution with fixed orbit, coord.+other AC ZTD)


Zenith Total Delay: DORIS (EN) x GPS (IGSPPP)
ZTD bias / stddev [mm]
number of ZTD pairs
ASC1 BAKO CHAT CHPI EISL FAIR GODZ HARB KERG KIT3 KOUR KSTU MALD METS MONP NKLG NOUM NYA1 PDEL REUN REYK RIOG SANT SEY1 STJO STR1 SYOG THTI THU3 YAR2 YELL YSSK

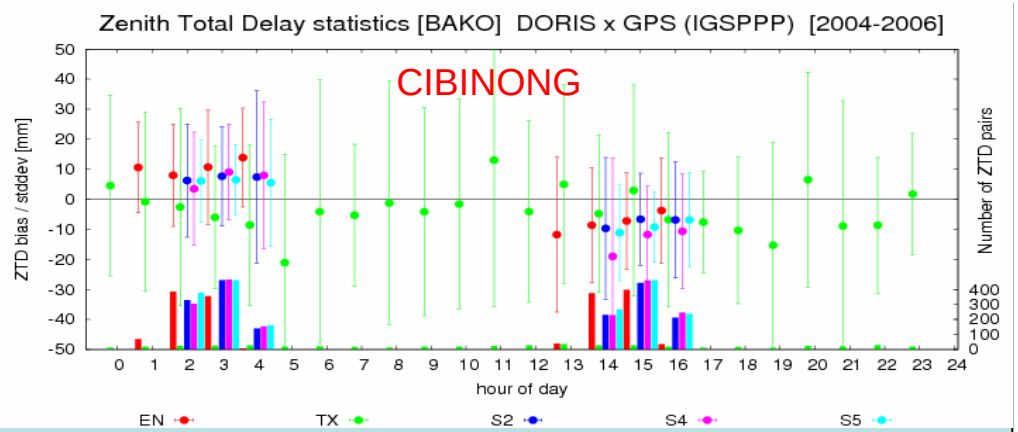

Zenith Total Delay: DORIS (S5) x GPS (IGSPPP)
NOT Real Co-Location
ZTD bias / stddev [mm]
number of ZTD pairs
ASC1 BAKO CHAT CHPI EISL FAIR GODZ HARB KERG KIT3 KOUR KSTU MALD METS MONP NKLG NOUM NYA1 PDEL REUN REYK RIOG SANT SEY1 STJO STR1 SYOG THTI THU3 YAR2 YELL YSSK

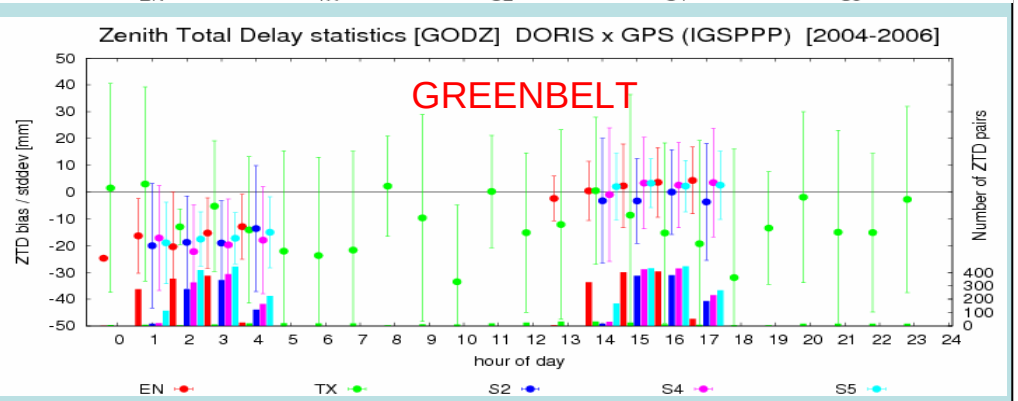
Geographical Distribution of ZTD differences

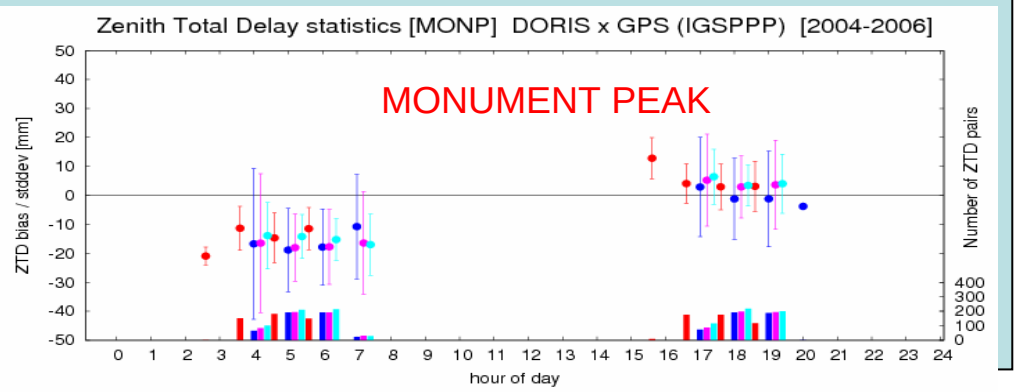


ZTD difference -dependence on part of the day

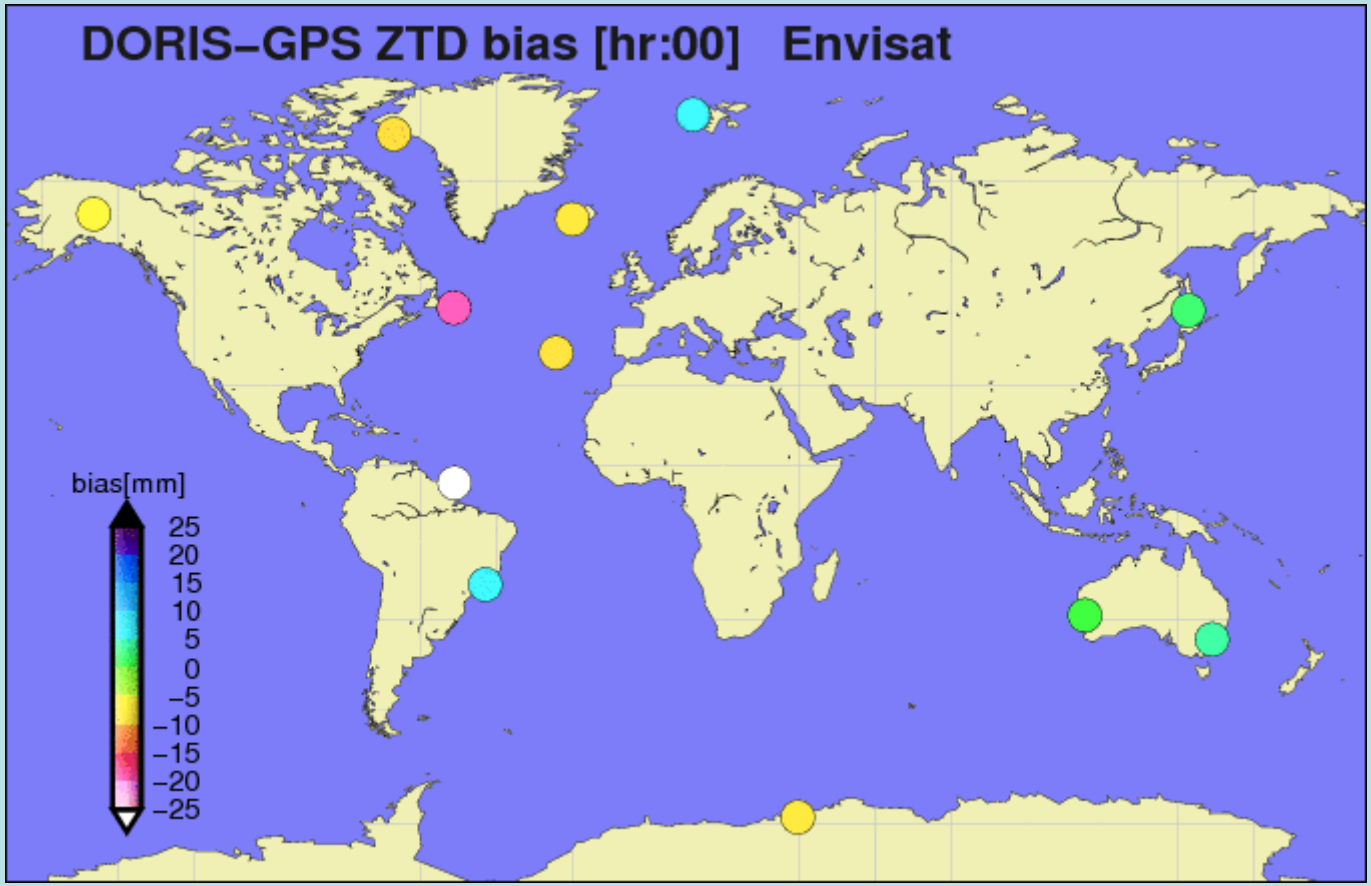
Ascending X Descending orbit ?

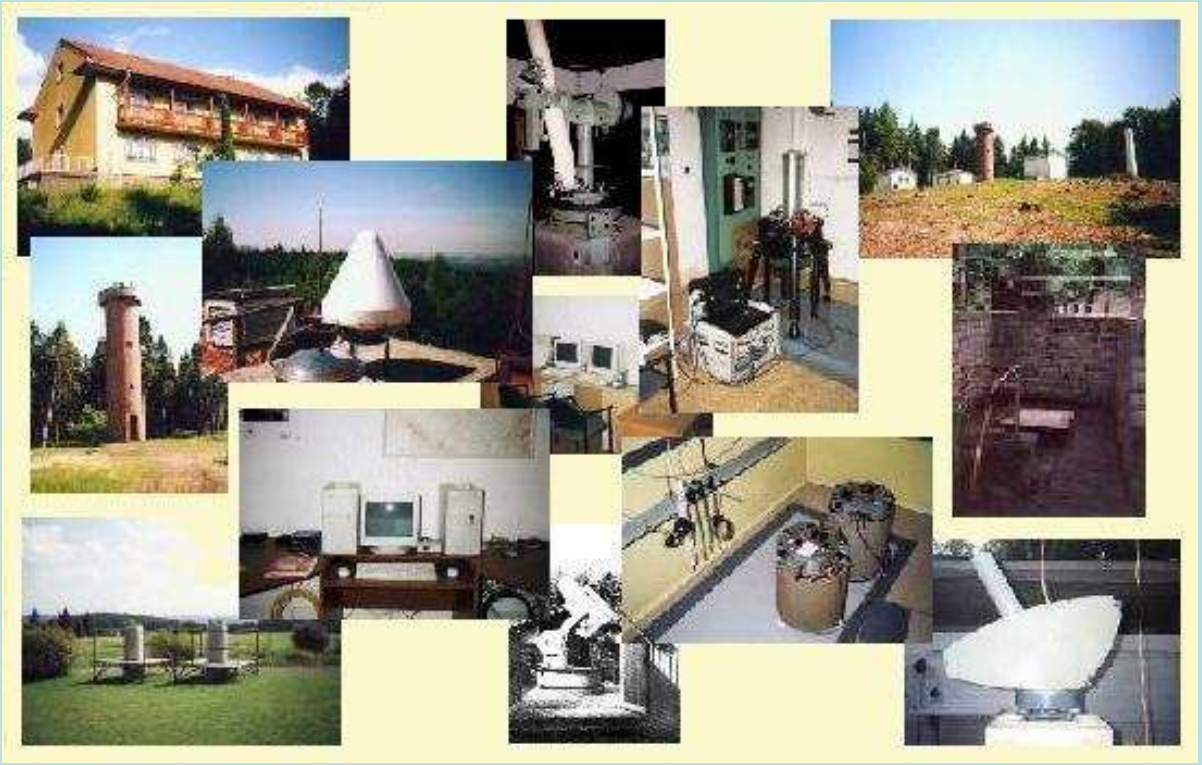






Distribution of ZTD diff. every hour





Thanks for the Attention