Recent DORIS analysis at Geodetic Observatory Pecny

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Recent activities of GOP IDS analysis

- ➢ **Routine data processing (data processed untill June of 2016)**

- ➢ **Merging of the software versions Bernese/DORIS and Bernese 5.2**

  - ❑ **Update of the Bernese/DORIS version finished**

  - ❑ **About 10 years of independent development**

  - ❑ **DORIS not in the official version**

- ➢ **DORIS/RINEX processing implementation**

  - ❑ **Reading routines**

  - ❑ **Onboard clock estimation**

  - ❑ **COM corrections (nominal or measured attitude)**

- ➢ **Testing COM corrections from data files vs. calculated corrections**

- ➢ **LOD estimation**

Testing COM corrections from data files vs. calculated corrections

Motivation:
1. **Verification of the software tools**
2. **Scale increment issue**

Data span: 320/2011 - 220/2012 (period of the scale increment)
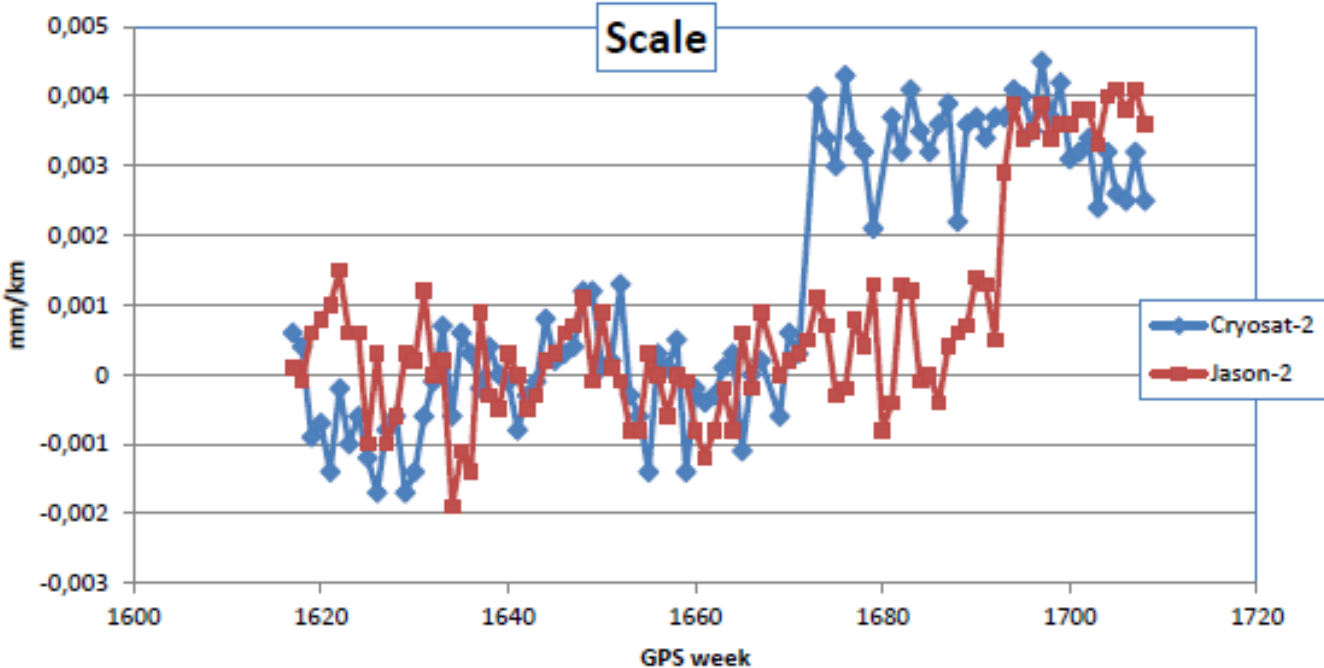**Satellites: SPOT-(4,5), Envisat, Cryosat, Hy-2A, Jason-2**

Nominal attitude
1. **CNES POE processing satellite models**
2. **Nominal Phase center vector (time dependent)**

Measured attitude – quaternions, Jason-2 only

Scale increment in 2012

No significant differences for solutions with data file CoM corrections and solutions with calculated CoM corrections

POD: CoM corrections vs. nominal vs. measured attitude

➢ **RMS of the fit and comparison to SSALTO orbits**
➢ **For all satellites except Jason-2 no significant differences**
➢ **Results for Jason-2 summarized in the following tables**

RMS of the fit (mm)	Data correction	Nominal Attitude	Measured Attitude
	4.109	4.121	4.107

Estimated vs. SSALTO	Data correction	Nominal Attitude	Measured Attitude
Mean radial (cm)	-0.10	-0.10	-0.10
Mean tangential (cm)	-0.60	-0.47	-0.81
Mean normal (cm)	0.03	0.04	0.04
RMS radial (cm)	1.07	1.11	1.05
RMS radial (cm)	3.93	4.30	3.86
RMS radial (cm)	4.65	4.94	4.54

Earth Rotation Parameters from Space Geodesy techniques

➢ **XP, YP – all techniques, including DORIS (all the ACs)**

➢ **UT1-UTC only from VLBI**

➢ **Length of day (LOD – variation of UT1-UTC) from satellite techniques**

- o **From DORIS in the past with non-geodetic accuracy**

- o **Correlated with further parameters**

    the orbital node

    gravity field (zonal parameters)

➢ **For IERS models (C04), UT1-UTC directly from VLBI, satellite techniques not used due to correlation. (LOD is obtained from UT1-UTC)**

(1) see at: Bloßfeld M., Gerstl M., Hugentobler U., Angermann D., Müller H.: **Systematic effects in LOD from SLR observations.** *Advances in Space Research 54(6): 1049-1063, 10.1016/j.asr.2014.06.009, 2014 .*

LOD DORIS estimation

➢ **Preliminary results (2 years of data) presented at DORIS IDS workshop, Toulouse 2015**

➢ **Necessary condition: Cross track harmonics not adjusted**

New testing campaign

➢**9 years of DORIS data (2006-2014)**

➢**Satellites: all available except Jason-1.**

➢**Orbit model:**

o**Estimated SRP, Drag (satellite dependent number of parameters)**

o**A priori model for direct Earth radiation and Albedo**

o**Estimated Once per revolution along track parameter (cross-track not estimated)**

o**A priori model of gravitation parameters EIGEN-6S2 (data till 2012.0, extrapolation after 2012.0), consisting time varying gravity field (periodical 1 year + ½ year + piecewise linear elements), restricted to order 100.**

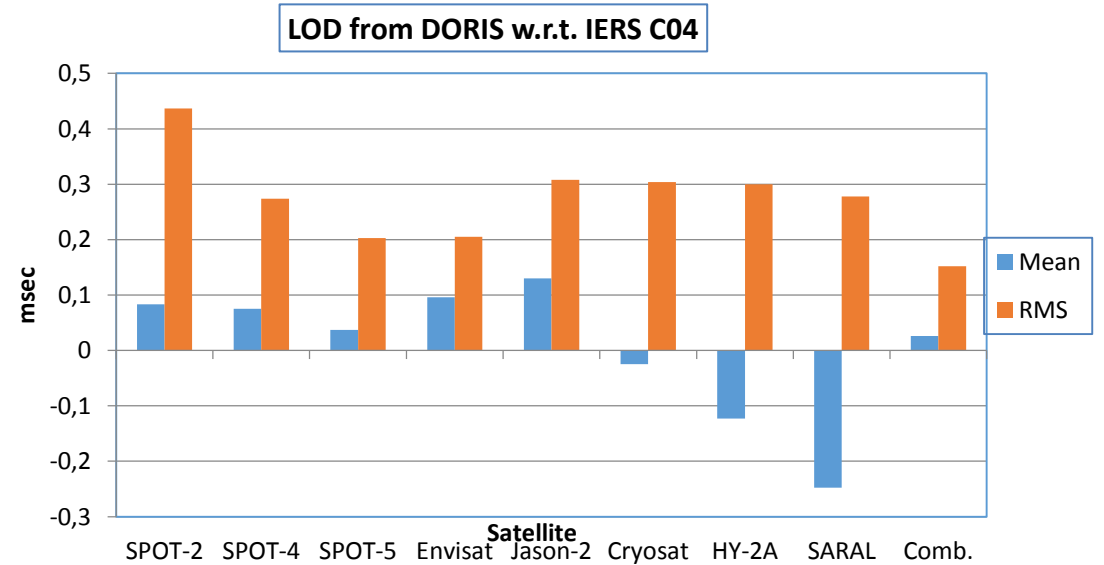➢**Estimating LOD with removed tidal variations (LODR)**

LOD from DORIS and IERS C04

LOD value
Combination of all available satellites
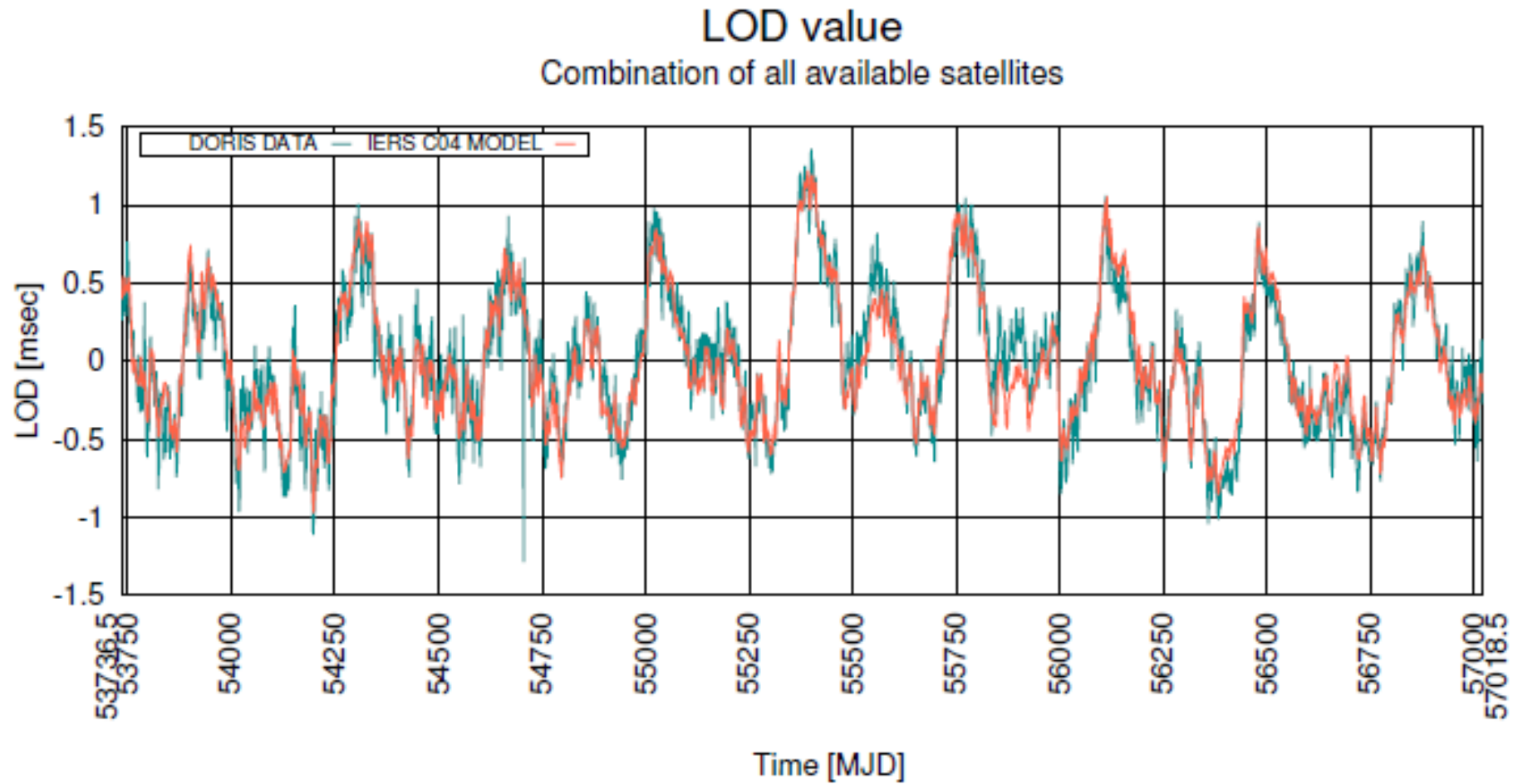
LOD from DORIS w.r.t. IERS C04

Multi-satellite solutions per year

LOD from DORIS w.r.t. IERS C04
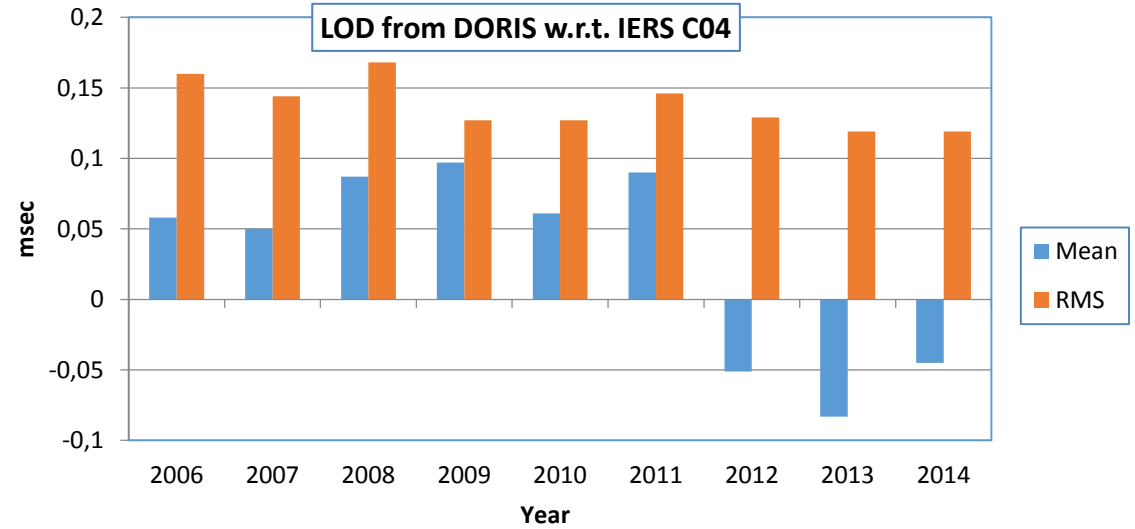
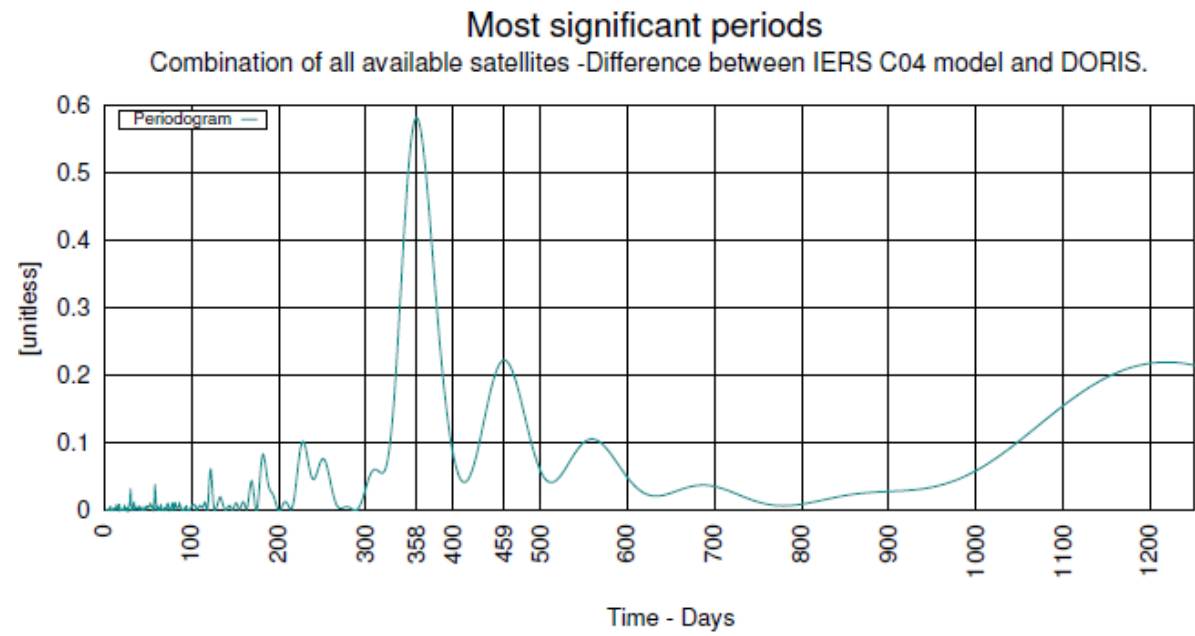**Single-Satellite solutions (max. time span)**

LOD from DORIS w.r.t. IERS C04

LOD from DORIS and IERS C04 – Fourier spectrum

DORIS and IERS C04
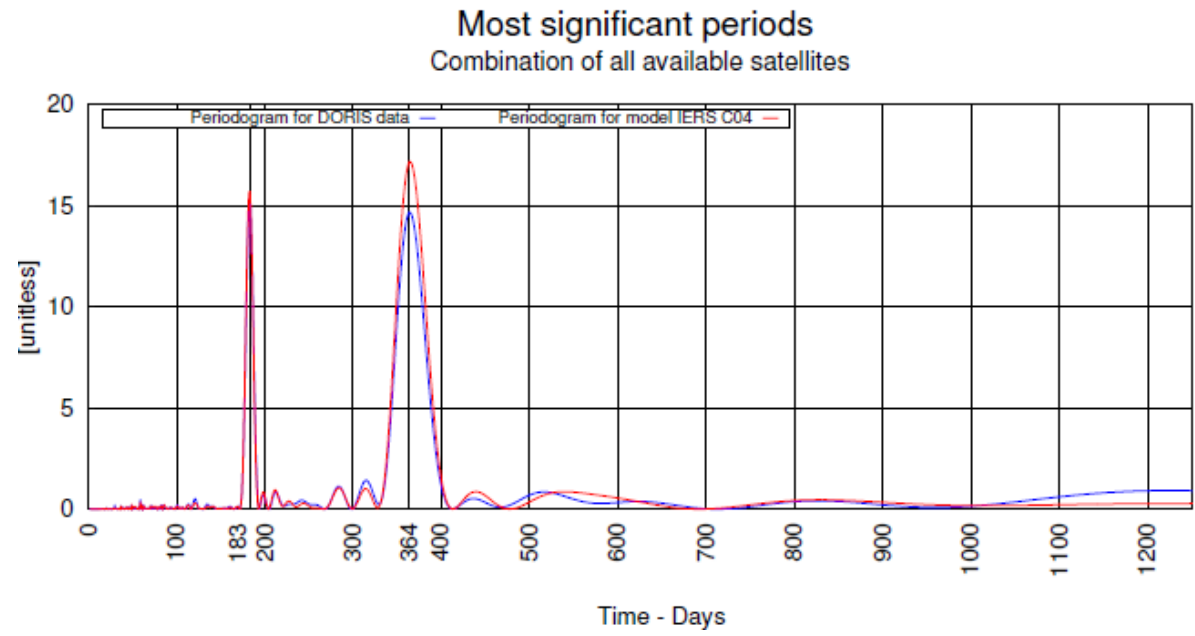
DORIS and IERS C04 difference

Most significant periods
Combination of all available satellites

Most significant periods
Combination of all available satellites -Difference between IERS C04 model and DORIS.
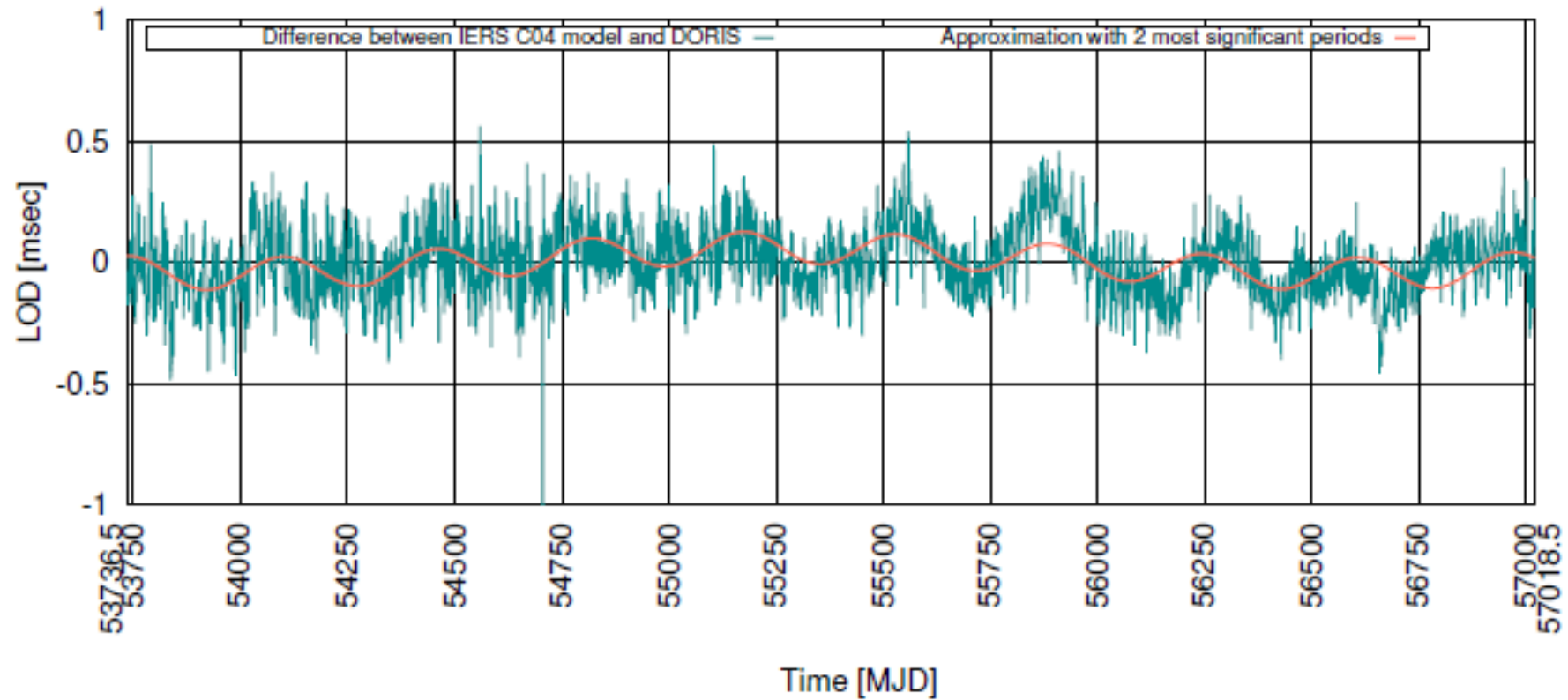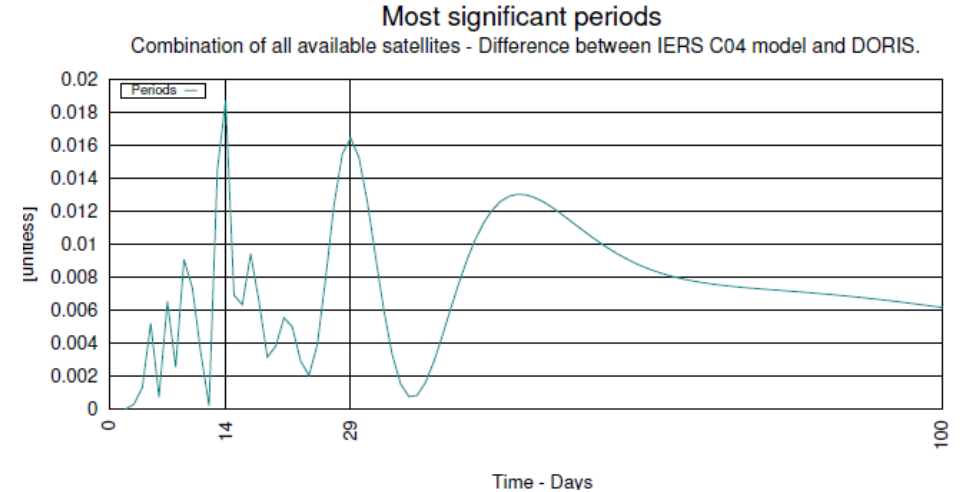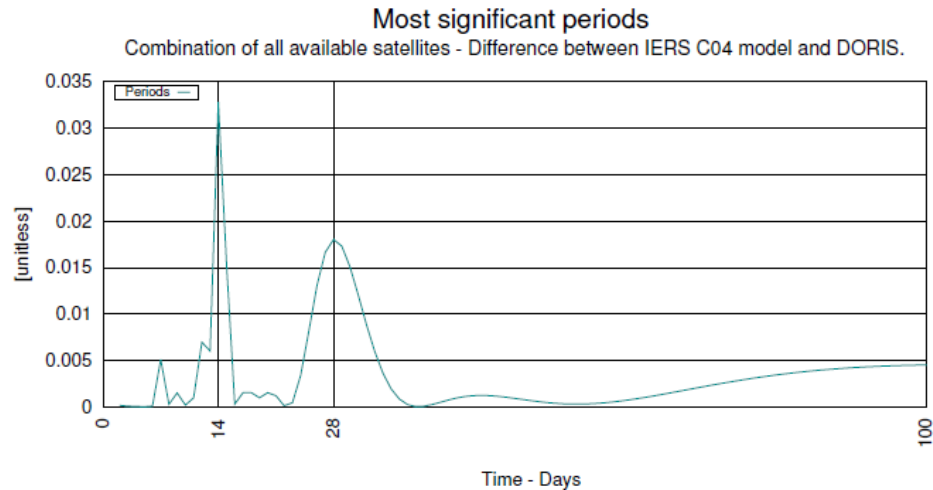
LOD from DORIS w.r.t. IERS C04

Approximation with 2 most significant periods
Combination of all available satellites - Difference between IERS C04 model and DORIS.

LOD from DORIS w.r.t. IERS C04 – Short periodic signal

➢ **Undetected for whole time span (signal phase changes? numerical issue?)**
➢ **Significant singnal of periods about 14 and 28 days detected for shorter time window (but not for all of them)**
➢ **The same also for X,Y pole**
➢ **Tides? Weekly solutions?**
➢ **Examples : MJD 55359-55759 (left), MJD 54147-54247 (right)**

Most significant periods
Combination of all available satellites - Difference between IERS C04 model and DORIS.

Most significant periods
Combination of all available satellites - Difference between IERS C04 model and DORIS.

LOD from DORIS – Gravity field

- **Experiment - for 2013 LOD re-estimated not applying annual and semiannual gravity field variations**
- **RMS w.r.t. IERS C04 increase 0.119 -> 0.123 ms**

LOD difference
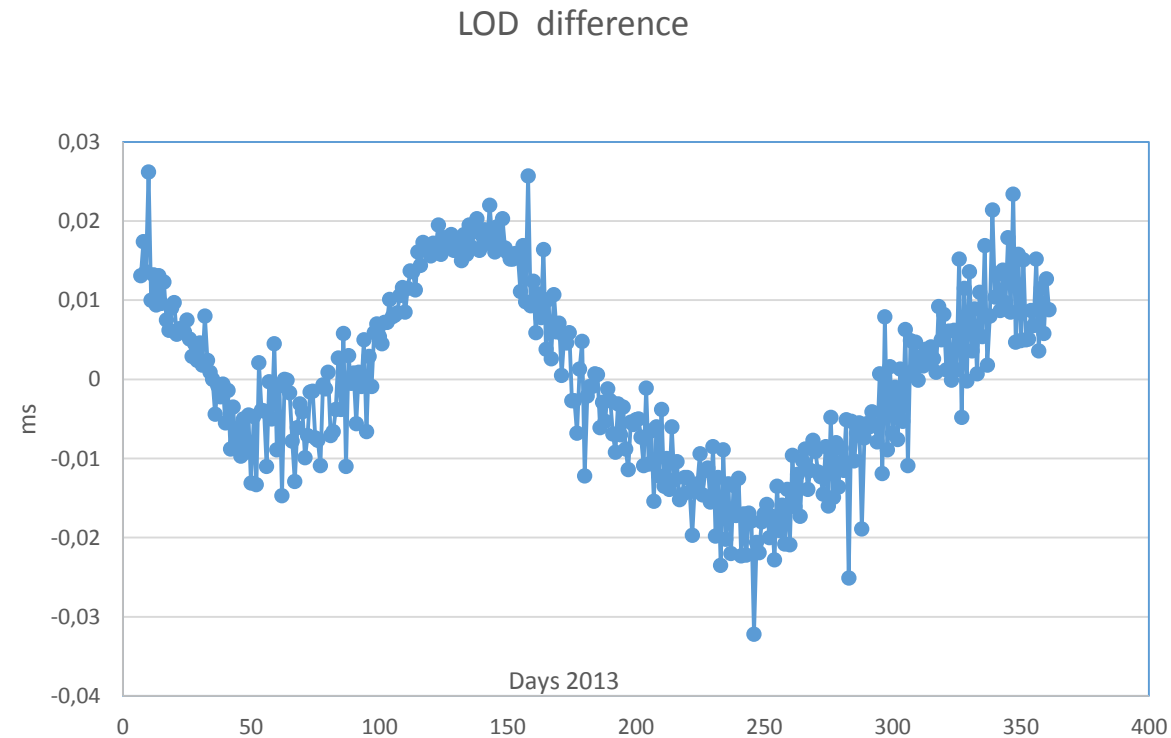
LOD - Conclusions

➢Skipping estimation of cross track harmonics improves LOD quality from DORIS significantly (mean offset to C04 = 0.026 ms and RMS = 0.152 ms in our tests).

➢RMS in last years of campaign close to 0.1 ms, about twice higher than from SLR. (SLR LOD Accuracy (ILRS official product info): ILRS(A) Mean 0.003 ms, RMS 0.47 ms, ILRS(B) Mean - 0.003 ms, RMS 0.54 ms.)

➢Significant mean offset, also varying among satellites. Change in offset to C04 after 2012 may be caused also by extrapolating gravity field in the a priori gravity model.

➢ Signal w.r.t. IERS C04 (annual, 14 days, 28 days)

➢Better accuracy would be achieved also by IDS combination, from more AC's.

Thanks for the attention