

Impact of 25 years of Etalon-1 and Etalon-2 data

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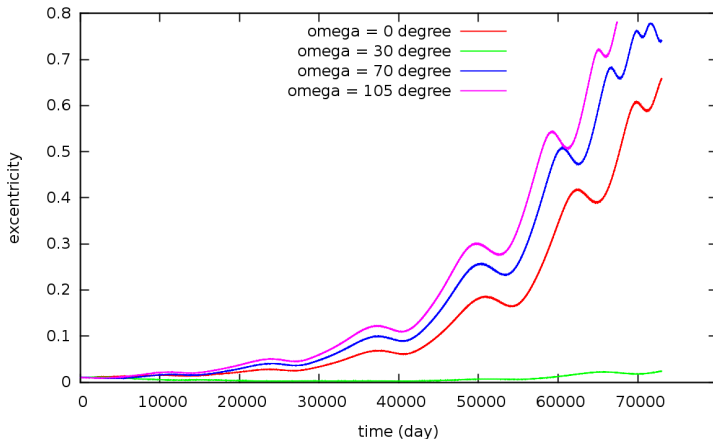
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28th October, 2014



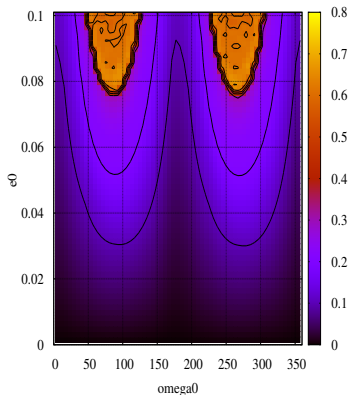
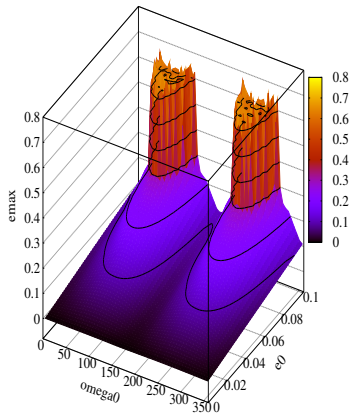
Celestial mechanics case study: Etalon1-like propagations

Etalon-1, over **2 centuries**: change of the initial perigee



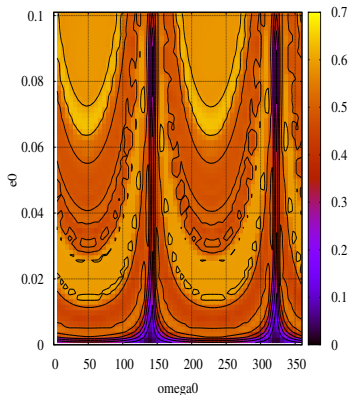
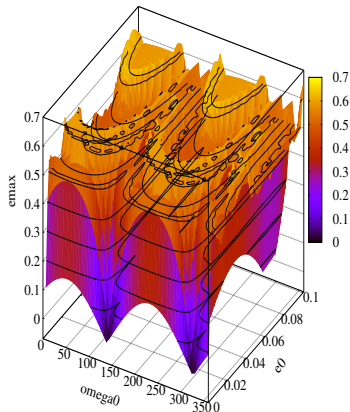
Celestial mechanics case study: Etalon1-like propagations

global (e_0, ω_0) map: Maximal eccentricity over 2 centuries
 $a = 25503 \text{ km}$, $e = 0.000697$, $i = 64.866^\circ$



Celestial mechanics case study: Etalon2-like propagations

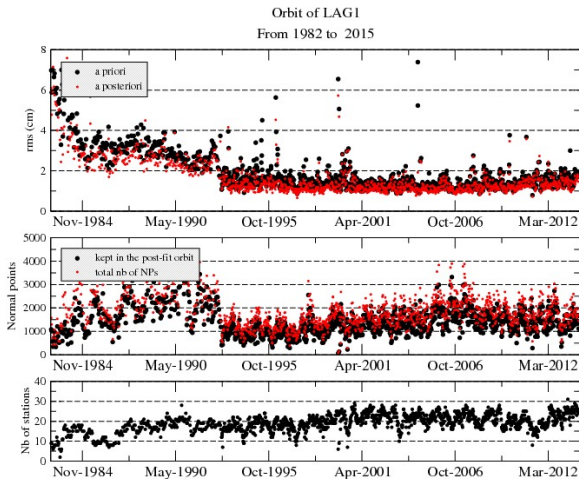
global (e_0, ω_0) map: Maximal eccentricity over 2 centuries
 $a = 25499$ km, $e = 0.000657$, $i = 64.958^\circ$ closer to the critical inclination



Orbital Computations and ILRS related products

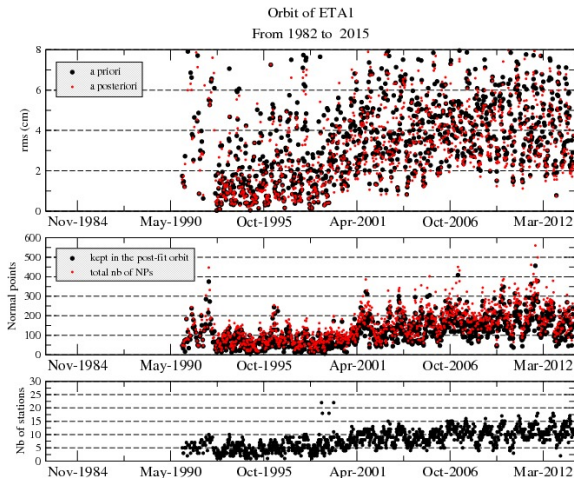
- Satellites:
 - LAG1: 26th, Nov. 1982 - 21st, Dec. 2013
 - LAG2: 3rd, Nov. 1992 - 21st, Dec. 2013
 - ETA1: 29th, Dec. 1990 - 21st, Dec. 2013
 - ETA2: 29th, Dec. 1990 - 21st, Dec. 2013
- Modelling: as the one recommended by AWG for ITRF2013
- Data a priori corrections, accordingly
- Elimination criteria in the gins s/w: 4σ , and a priori greater than 100m
- Related products:
 - SSC and EOP: 1 value every day or 3 days ("historical period")
 - Helmert transformation to get homogeneous results
 - 2 approaches:
 - Nominal one: LAG1+LAG2+ETA1+ETA2, as in the operational product
 - As well: LAG1+LAG2+ETA1+ETA2, as if LAG1 and LAG2 were observed in the same conditions as ETA1 and ETA2

Adjustment of LAG1 trajectory



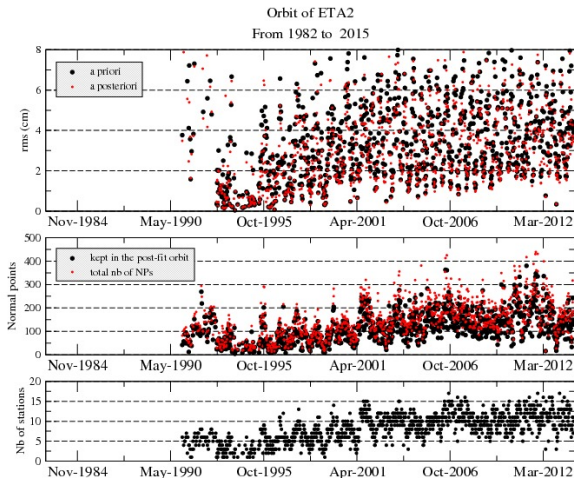
Disseminatory ILRS_AC (c) IAU/CRDS, generated Sun Oct 26 09:56:18 CET 2014

Adjustment of ETA1 trajectory



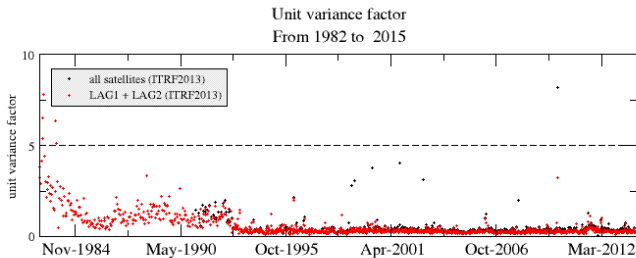
Directory ILLR_AC (a) FD/GRIS, generated Sun Oct 26 09:56:18 CET 2014

Adjustment of ETA2 trajectory



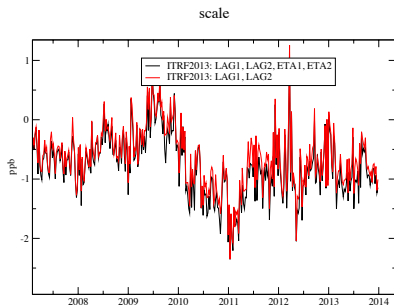
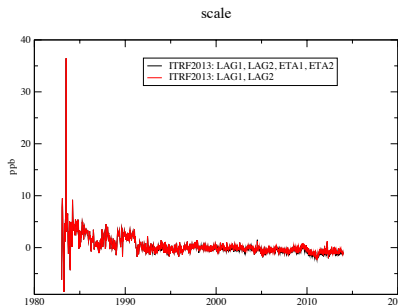
Directory ILLR_AC (a) FD/GRIS, generated Sun Oct 26 09:56:18 CEST 2014

4 satellites "nominal mode": Unit variance factor



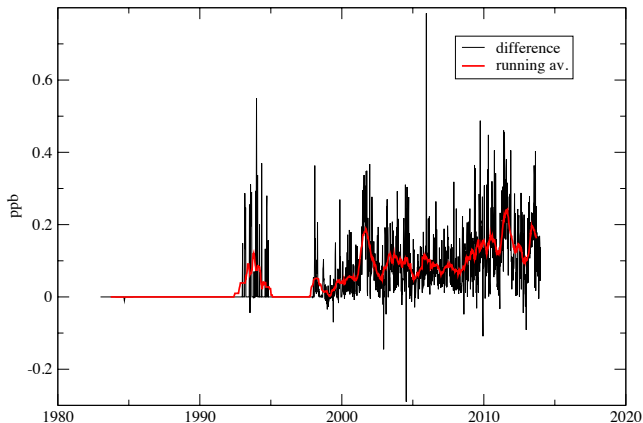
- Variance Factor: square sum of residuals / number of degrees of freedom
- Depending only on the data weighting
- Used here as an **criteria of internal consistency**

Impact on the scale



Impact on the scale

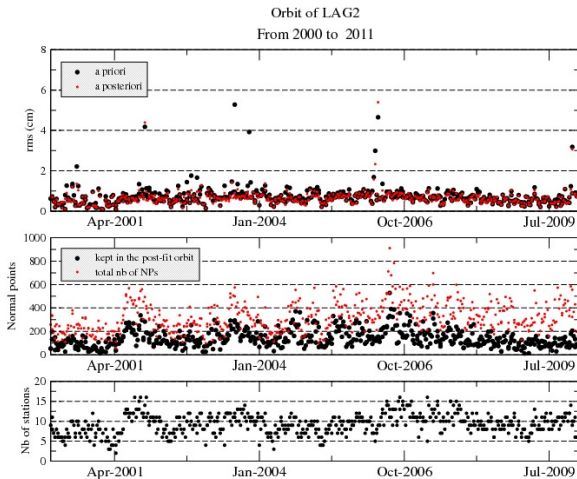
scale: w. or w/o ETALON data



Modified data sets for Lageos-1 and Lageos-2

- Over the time period 2000.0-2010.0 (10 years), **simulation of an "Etalon sampling"** for the measurements of both Lageos satellites.
- **Method 1:**
 - for each **Etalon** satellite, a monthly data files gives the **sampling** of the SLR measurements: stations, number of passes, number of data per pass
 - for each pass, **the closest corresponding pass** is chosen for the corresponding Lageos satellite (Lageos-1 for Etalon-1 and Lageos-2 for Etalon-2)
- **Method 2:**
 - same both steps than those used for method 1
 - the measurements of the corresponding passing were **randomly pruned** to get a number of data **as close as possible** than the one get for the considered Etalon satellite.

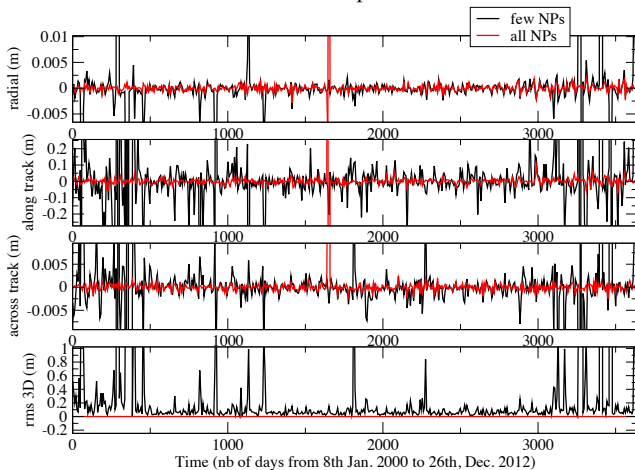
Impact on the orbit determination: Lageos-2



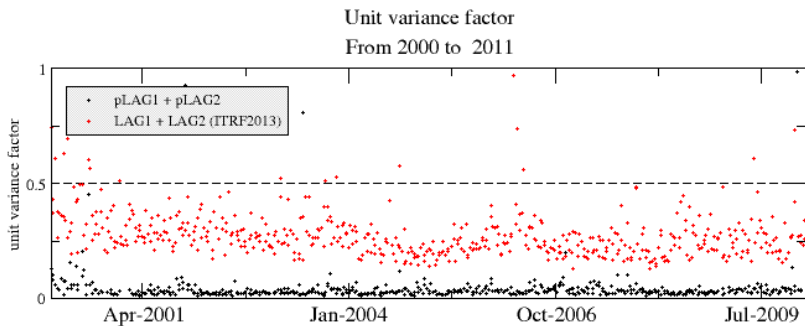
Dissebury Etude (a) PD/CROD, generated Sun Oct 26 10:08:22 CET 2014

Impact on the orbit determination: Lageos-2

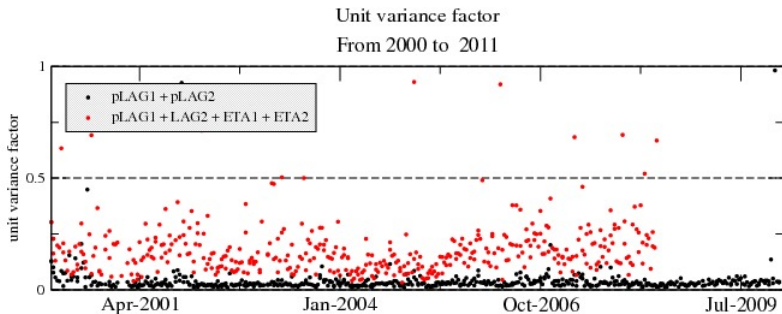
LAG2 overlap differences



Comparison nominal solution / modified data sets

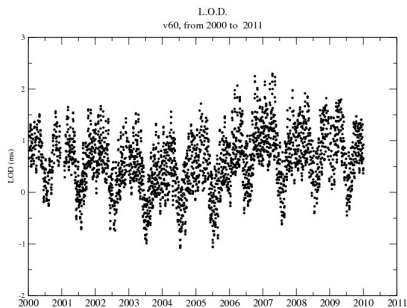


Comparison: Impact of the Etalon data



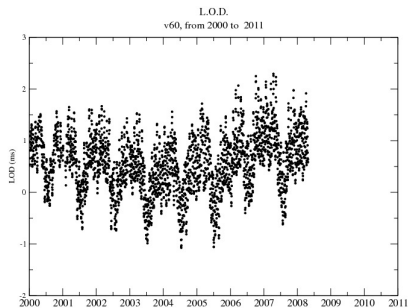
Example: Impact on the LOD

ETA1+ETA2



Directory: Rhde (c) PD/GSD, generated Sat Oct 25 04:52:36 CEST 2014

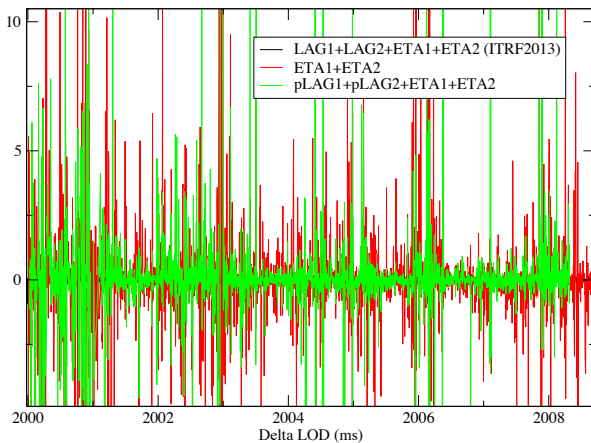
pLAG1+pLAG2+ETA1+ETA2



Directory: Rhde (c) PD/GSD, generated Sat Oct 25 05:07:44 CEST 2014

Example: Impact on the LOD

LOD(SLR)-LOD(IERS-C04)



Analysis of a week

	10th, March, 2007				2007.201		
	NPk	NPe	rms	NbSta		LOD: corr.(std)	scale(ppb)
LAG1	2966	809	1.1cm	26st	(1)	0.018ms (0.006)	-0.184
LAG2	2670	875	1.2cm	24st	(2)	0.008ms (0.005)	-0.172
ETA1	408	42	3.6cm	14st	(3)	0.133ms (0.047)	1.062
ETA2	218	53	1.8cm	14st	(4)	-0.180ms (0.022)	5.382
p-LAG1	402	349	0.74cm	14st	(5)	0.008ms (0.028)	0.763
p-LAG2	210	381	1.06cm	14st			

Solutions:

- (1) LAG1+LAG2+ETA1+ETA2
- (2) LAG1+LAG2
- (3) ETA1+ETA2
- (4) pLAG1+pLAG2
- (5) pLAG1+pLAG2+ETA1+ETA2

	2007.201		
	Xp (ΔX_p) mas	Yp (ΔY_p) mas	
(1)	0.091 (0.708)	0.227 (1.266)	
(2)	0.087 (0.647)	0.248 (1.156)	
(3)	1.047 (2.042)	1.294 (1.642)	
(4)	-0.467 (1.159)	-0.843 (0.7652)	
(5)	0.488 (1.062)	0.517 (1.116)	

Example: Impact on a station (Zimmerwald)

2007.236

	E (ΔE) cm	N(ΔN)cm	U(ΔU)cm
(1)	-0.07 (1.14)	0.73 (1.14)	0.12 (0.48)
(2)	-0.01 (1.09)	0.77 (1.09)	0.11 (0.46)
(3)	-0.55 (7.99)	-6.10 (5.88)	4.65 (1.08)
(4)	-0.87 (0.98)	-0.04 (1.02)	0.29 (0.26)
(5)	-1.66 (3.03)	-1.54 (2.54)	2.55 (2.89)

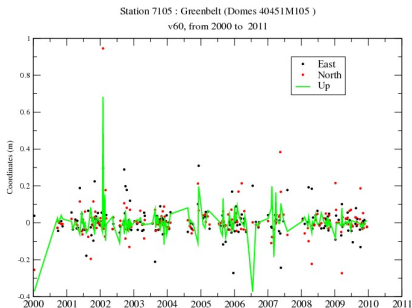
Solutions:

- (1) LAG1+LAG2+ETA1+ETA2
- (2) LAG1+LAG2
- (3) ETA1+ETA2
- (4) pLAG1+pLAG2
- (5) pLAG1+pLAG2+ETA1+ETA2



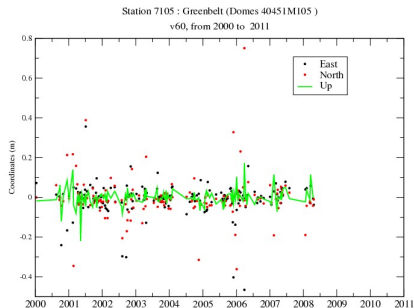
Example: Impact on a station (Greenbelt)

ETA1+ETA2



Directory Rhde (c) IPU/IGRS, generated Sat Oct 25 04:52:36 CEST 2014

pLAG1+pLAG2+ETA1+ETA2



Directory Rhde (c) IPU/IGRS, generated Sat Oct 25 05:07:44 CEST 2014

Conclusions

- Celestial mechanics case study: Etalon data useful for long term stability
- Orbit computation with (very...) few NP
 - OK over the last few years
 - very difficult from the beginning up to 1997
 - a majority of NPs that are eliminated from the LS adjustment
- Geodetic products
 - further investigation still needed
 - "real life" (ITRF2013): slight effect, even during the pre-Lageos2 period
 - Etalon- and Lageos- "competitive" data sets
 - global parameters: Etalon data could be of **great** interest in some cases
 - SSC of some stations: Etalon data could be of **some** interest in some cases
- a new campaign useful ?

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