



GRGS Analysis Centre report



*Combination at the
Observation Level
IERS Working Group*

Processing of 3 weeks of data (10-30 August 2008)

1. **SLR (CNES-Observatoire de la Côte d'Azur)**
2. **VLBI (Observatoire de Bordeaux)**
3. **DORIS (CNES-CLS)**
4. **GNSS (CNES-CLS)**

SLR processing

Arcs

LAGEOS/LAGEOS2 weekly arcs from 10/8 to 30/8/2008

Models

1	.champgtp.gin/data/potentiel/EIGEN-GRGS.RL02MF	gravite
1	.biancale.gin.data.marees.fes2004_80M2_50_K202_ell	marees
1	presatm/default	press.
1	marees_atm/ecmwf	m.atmospheriques
1	albedo/grilles_9.0/default	albedo
1	.geodexp.gin/data/pole/eop97c04_itrf2008g	pole
1	lunisolaires/de403bdlf.ad.ibm	planetes
1	.geodexp.gin/data/stations/stations_slr_apres_i08	stations
1	.geodexp.gin/data/stations/pbstat_v2	problemes (Appleby corrections)
1	charge/ocean/load_fes2004_itrf2005	loading

LAGEOS residuals

21409.50000	LASER:CC	0.010852	0.009873	1877 mesures (	42 eliminees)	metre
21416.50000	LASER:CC	0.015008	0.014054	1647 mesures (	39 eliminees)	metre
21423.50000	LASER:CC	0.013952	0.011904	1871 mesures (	56 eliminees)	metre

LAGEOS2 residuals

21409.50000	LASER:CC	0.010293	0.009461	1576 mesures (	4 eliminees)	metre
21416.50000	LASER:CC	0.011178	0.010451	1572 mesures (	23 eliminees)	metre
21423.50000	LASER:CC	0.009853	0.008943	1684 mesures (	14 eliminees)	metre

LAGEOS

mesures laser (format Quick Look)

satellite 7603901

aout 2008

		jour :																																	
station	site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	pass.	obs.	
18248101	Lyg1 12356 S001 1824 KIEV	1	1					1				1	3							1	1							1					10	67	
18318501	Lyg1 12368 S001 1831 Lviv																										1	1					2	17	
18734901	Lyg1 12337 S003 1873 Simeiz	3	1		2	1		1	1	2	2	1			3	1	1	1	1	1	2	2	3	1	1	1	2	2	2	2		2	42	360	
18844401	Lyg1 12302 S002 1884 Riga						3					1			1				1														6	76	
18931801	Lyg1 12337 S006 1893 Katzively																										1	1	2	1	1	2	8	80	
D70802419	Lyg1 40442 M006 7080 Davis	1			2	1						1									1												6	55	
70900513	Lyg1 50107 M001 7090 Yarragadee	1		1	2	3	3	5	2	3	2	2	4	3	3	3	4	3	5	1			1	3	3	4	2	3	3	3	2	5	79	918	
71050725	Lyg1 40451 M105 7105 Washington	2			3	1	1	2	2						2				2	3	2	3	3			3		1					30	330	
71100412	Lyg1 40497 M001 7110 Monument_Pe																							1					1				2	23	
D71191401	Lyg1 40445 M004 7119 Haleakala	1	2			1		1							1	1	1	2	1	1	1	1	1		1	1		1	1	1		20	239		
D71240802	Lyg1 92201 M007 7124 Tahiti											1			1					1													3	39	
72371901	Lyg1 21611 S001 7237 Changchun	2	3	2	2	2	2	2	2	3				2		3	3			3	3			1	3	1	1	2			1	43	319		
D72496101	Lyg1 21601 S004 7249 Beijing		1																				2										3	16	
73085001	Lyg1 21704 S002 7308 Koganei							2																									2	13	
D73588901	Lyg1 21749 S001 7358 Tanegashima			1																													1	10	
D74031304	Lyg1 42202 M003 7403 Arequipa	1	1		1	2	1						2									1						1		1			11	65	
D74057902	Lts 41719 M001 7405 Concepcion				2	1		3	1				3					1															11	92	
74068801	Lyg1 41508 S003 7406 San_Juan	1	2		2	3	1	3	2	1	3	1	2		1	3	1	2	2	1	2	1	1	3	1	2	2	1	3	1	2	1	51	639	
75010602	Lyg1 30302 M003 7501 Hartebeesth					1				1			3	2	2	2	2		1		1	1	2			3	1	2					24	175	
D78106801	Lts 14001 S007 7810 Zimmerwald	2	1	3	3	1	4	2	2	5	4	3		3	2		3	2	3	3	1	3	3		4	2	4	5	4	4	2		78	1170	
D78113802	Lyg1 12205 S001 7811 Borowiec	1		1			1	1	2	1		1		1								1	1		2		1	2			2	1	19	208	
78212801	Lyg1 21605 S010 7821 Shanghai						2	1	1	2	2	1										1		1				1					13	126	
78244502	Lyg1 13402 S007 7824 San_Fernand	2	1			1	1	1			1	1	2	1	2		1	1	1		1		2	1	1	1	1	1	1	1			26	268	
D78259001	Lyg1 50119 S003 7825 Mount_Strom	2	2	5			2	1	3	2	2			3	3	1	5	4	3	3	2	2	3	5	1	2	2	3	3	3		4	71	642	
78325501	Lyg1 20101 S001 7832 Riyadh		2	1	1	2	2			2	2	2	1	1		1	2	2	2	2				2	2	1	1	2			2	1	36	308	
D78393402	Lyg1 11001 S002 7839 Graz	4		1	2	2	1	3	1	2	2	2	3	1	2		1	1	4	3	1	1	5		1	4	2	3	1	2		1	56	529	
78403501	Lyg1 13212 S001 7840 Herstmonceu	1	1		4	1	1	1			2		1	2	3	3		1					2	2	3	1			1		3	1	34	430	
78418701	Lyg1 14106 S011 7841 Potsdam	1				3	1	1	1	2		1		2	1				1	1	1												16	165	
79417701	Lyg1 12734 S008 7941 Matera	3	2	3	3	2	2	2	2	3	2	3	4	3	4	2	3	3	5	5	3	4	1	5	2	3	4	3	3	3	2	2	91	874	
88341001	Lyg1 14201 S018 8834 Wettzell	3	1							3	2	2		1	1			1	3			2		1	2	2	1	4	2	1	4	1	37	271	
total:		32		18		27		33		32		23		25		20		25		29		23		26		31		39		23		22			
			21		29		29		22		26		29		32		27		35		21		30		27		27		28		20			831	8524

LAGEOS2

mesures laser (format Quick Look)

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satellite 9207002
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aout 2008

					jour :																																	
station		site			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	pass.	obs.	
18248101	Lyg1	12356	S001	1824	KIEV	1																														1	2	
D70802419	Lyg1	40442	M006	7080	Davis	2	1																			1			1						5	29		
70900513	Lyg1	50107	M001	7090	Yarragadee	1	2	1	3	3	4	3	3	1	4	3	4	2	4	3	3	5	3	3		2	2	4	3	4		2	2	3	3	3	83	1465
71050725	Lyg1	40451	M105	7105	Washington	1				1						1								1	1	1	1		1						1	9	91	
71100412	Lyg1	40497	M001	7110	Monument_Pe																											1			1	10		
D71191401	Lyg1	40445	M004	7119	Haleakala	1	1			2					1	1		1		2		3		2		1	2	1	1		3	1	3		26	323		
D71240802	Lyg1	92201	M007	7124	Tahiti													2						1											3	36		
72371901	Lyg1	21611	S001	7237	Changchun			1	1		1								1		1							1							7	39		
73085001	Lyg1	21704	S002	7308	Koganei													1	1	1															3	18		
D73588901	Lyg1	21749	S001	7358	Tanegashima	1	1	2																											4	39		
D74031304	Lyg1	42202	M003	7403	Arequipa				1	3				1			1							2	1	1				2	1	1	1	1		16	135	
D74057902	Lts	41719	M001	7405	Concepcion					3		1	2				1						2												9	128		
74068801	Lyg1	41508	S003	7406	San_Juan	3	2	2	2	3	2	4	2	4	2	3	3		4	2	4	4	4	2	4	2	3	2	4	2	4	2	4	2	2	3	82	1124
75010602	Lyg1	30302	M003	7501	Hartebeesth											3	1	2	1	1	1			1	1	1			1	1	2				16	97		
D78106801	Lts	14001	S007	7810	Zimmerwald		1	4		2	3		2	4	4	1		3	1		4	1	4	3		3	1		3	2	4	4	4	4	1	63	921	
78212801	Lyg1	21605	S010	7821	Shanghai								1																						1	7		
78244502	Lyg1	13402	S007	7824	San_Fernand										1		1																1		3	12		
D78259001	Lyg1	50119	S003	7825	Mount_Strom	2	3	2		2	3			3	2		3	3	2	4	3	2	2	4	1	4	3		4	3	3	3	3		3	67	966	
78325501	Lyg1	20101	S001	7832	Riyadh			1	1	1	1			1		1		1			1	1		1				1						1	13	102		
D78393402	Lyg1	11001	S002	7839	Graz	1			1	3	1	2		1	1	3	2		3		1		4	3			2		2	2	2	1	1		36	400		
78403501	Lyg1	13212	S001	7840	Herstmonceu	3	1		2			2			1		2		1	3					1			2		2	2			2	1	22	252	
78418701	Lyg1	14106	S011	7841	Potsdam														1																1	4		
79417701	Lyg1	12734	S008	7941	Matera	1	1	1	1	3	1	1		2	3	1	2	4	2	4	2	2	4	2	4	2	3	2	3	1	2	1	2	1	2	61	653	
88341001	Lyg1	14201	S018	8834	Wettzell	1	1				1				1		2	2				1	2		1	3		1	1		2	4		3	3	29	223	
total:					18		14		25		15		16		17		17		16		17		23		20		17		19		23		16		17			
						15		11		17		10		17		18		29		22		25		15		19		16		23		20		14		561	7076	

Internal parameters (7-day Lageos arc from 10/08/2008)

orbite	1	0.454885437005077E+07	+/-	0.000000000000000E+00	1	[EX INST 2008081000 LAG1]
orbite	2	-0.106343086536461E+08	+/-	0.000000000000000E+00	1	[EY INST 2008081000 LAG1]
orbite	3	0.411989137271572E+07	+/-	0.000000000000000E+00	1	[EZ INST 2008081000 LAG1]
orbite	4	-0.119818307789841E+04	+/-	0.000000000000000E+00	1	[EXP INST 2008081000 LAG1]
orbite	5	-0.242916495785588E+04	+/-	0.000000000000000E+00	1	[EYP INST 2008081000 LAG1]
orbite	6	-0.501152141995431E+04	+/-	0.000000000000000E+00	1	[EZP INST 2008081000 LAG1]
pression	7	0.999997632651766E+00	+/-	0.000000000000000E+00	1	[FS 2008081312 LAG1]
tbias	8	-0.347331931950040E-11	+/-	0.000000000000000E+00	1	[BT 2008081000 LAG1]
xbias	9	0.173660241693058E-10	+/-	0.000000000000000E+00	1	[BX 2008081000 LAG1]
ybias	10	0.183626010330153E-11	+/-	0.000000000000000E+00	1	[BY 2008081000 LAG1]

mesures	152	0.204833720279796E-01	+/-	0.000000000000000E+00	1	[MRB 1873490108081600LAG1]
mesures	153	-0.366210987762446E-01	+/-	0.000000000000000E+00	1	[MRB 1884440108081600LAG1]
mesures	154	0.604639180361218E-02	+/-	0.000000000000000E+00	1	[MRB 7080241908081600LAG1]
mesures	155	0.635233950238776E-02	+/-	0.000000000000000E+00	1	[MRB 7090051308081600LAG1]
mesures	156	-0.600672894692196E-02	+/-	0.000000000000000E+00	1	[MRB 7105072508081600LAG1]
mesures	157	0.553473590961904E-02	+/-	0.000000000000000E+00	1	[MRB 7119140108081600LAG1]
mesures	158	0.381253388679629E-02	+/-	0.000000000000000E+00	1	[MRB 7124080208081600LAG1]
mesures	159	-0.378602547838642E-02	+/-	0.000000000000000E+00	1	[MRB 7237190108081600LAG1]
mesures	160	0.873130862938725E-03	+/-	0.000000000000000E+00	1	[MRB 7403130408081600LAG1]
mesures	161	0.816967841411715E-03	+/-	0.000000000000000E+00	1	[MRB 7405790208081600LAG1]
mesures	162	-0.707410315742555E-02	+/-	0.000000000000000E+00	1	[MRB 7406880108081600LAG1]
mesures	163	-0.102138179682537E-01	+/-	0.000000000000000E+00	1	[MRB 7501060208081600LAG1]
mesures	164	-0.609998069869435E-02	+/-	0.000000000000000E+00	1	[MRB 7810680108081600LAG1]
mesures	165	0.786705055625890E-02	+/-	0.000000000000000E+00	1	[MRB 7811380208081600LAG1]
mesures	166	-0.241871466325746E-01	+/-	0.000000000000000E+00	1	[MRB 7821280108081600LAG1]
mesures	167	-0.240730467226832E-01	+/-	0.000000000000000E+00	1	[MRB 7824450208081600LAG1]
mesures	168	0.302308303287382E-02	+/-	0.000000000000000E+00	1	[MRB 7825900108081600LAG1]
mesures	169	-0.860680070331924E-02	+/-	0.000000000000000E+00	1	[MRB 7832550108081600LAG1]
mesures	170	-0.475101997155948E-02	+/-	0.000000000000000E+00	1	[MRB 7839340208081600LAG1]
mesures	171	-0.453845943577896E-02	+/-	0.000000000000000E+00	1	[MRB 7840350108081600LAG1]
mesures	172	-0.123422716586547E-01	+/-	0.000000000000000E+00	1	[MRB 7841870108081600LAG1]
mesures	173	-0.482305653707644E-02	+/-	0.000000000000000E+00	1	[MRB 7941770108081600LAG1]
mesures	174	0.620275572182679E-03	+/-	0.000000000000000E+00	1	[MRB 8834100108081600LAG1]

External parameters (7-day Lageos arc from 10/08/2008)

pole-x	11	0.141304765123548E-05	+/-	0.000000000000000E+00	1	[PX	2008080900	]
pole-x	12	0.141533597181031E-05	+/-	0.000000000000000E+00	1	[PX	2008081000	]
...								
pole-x	18	0.142364083016772E-05	+/-	0.000000000000000E+00	1	[PX	2008081600	]
pole-x	19	0.142645274951815E-05	+/-	0.000000000000000E+00	1	[PX	2008081700	]
pole-y	20	0.190333003066793E-05	+/-	0.000000000000000E+00	1	[PY	2008080900	]
pole-y	21	0.188837837674251E-05	+/-	0.000000000000000E+00	1	[PY	2008081000	]
...								
pole-y	27	0.179663708386615E-05	+/-	0.000000000000000E+00	1	[PY	2008081600	]
pole-y	28	0.178426948686105E-05	+/-	0.000000000000000E+00	1	[PY	2008081700	]
pole-t	29	-0.334572240000000E+02	+/-	0.000000000000000E+00	1	[PTI	2008080900 LAG1]	
pole-t	30	-0.334572520000000E+02	+/-	0.000000000000000E+00	1	[PT	2008081000 LAG1]	
...								
pole-t	36	-0.334568160000000E+02	+/-	0.000000000000000E+00	1	[PT	2008081600 LAG1]	
pole-t	37	-0.334571430000000E+02	+/-	0.000000000000000E+00	1	[PTF	2008081700 LAG1]	
nutat-eps	38	-0.373888310871674E-07	+/-	0.000000000000000E+00	1	[NE	2008081000	]
nutat-eps	39	-0.371682408622626E-07	+/-	0.000000000000000E+00	1	[NE	2008081012	]
...								
nutat-eps	51	-0.369331062269245E-07	+/-	0.000000000000000E+00	1	[NE	2008081612	]
nutat-eps	52	-0.367537251649139E-07	+/-	0.000000000000000E+00	1	[NE	2008081700	]
nutat-psi	53	-0.336552809289429E-06	+/-	0.000000000000000E+00	1	[NP	2008081000	]
nutat-psi	54	-0.335689840937054E-06	+/-	0.000000000000000E+00	1	[NP	2008081012	]
...								
nutat-psi	66	-0.334070563242148E-06	+/-	0.000000000000000E+00	1	[NP	2008081612	]
nutat-psi	67	-0.334172374115181E-06	+/-	0.000000000000000E+00	1	[NP	2008081700	]
stations	68	0.419442631843162E+07	+/-	0.000000000000000E+00	1	[SX	1312000011001S002088]	
stations	69	0.116269424107598E+07	+/-	0.000000000000000E+00	1	[SY	1312000011001S002088]	
stations	70	0.464724677049172E+07	+/-	0.000000000000000E+00	1	[SZ	1312000011001S002088]	
...								
stations	134	-0.524640724692854E+07	+/-	0.000000000000000E+00	1	[SX	1312000092201M007088]	
stations	135	-0.307728438461807E+07	+/-	0.000000000000000E+00	1	[SY	1312000092201M007088]	
stations	136	-0.191381380352485E+07	+/-	0.000000000000000E+00	1	[SZ	1312000092201M007088]	

VLBI processing

Laboratoire d'Astrophysique de Bordeaux, France

G. Bourda & A. Bellanger

CONT08 campaign analysis synthesis

- Constraints Troposphere: $dZ_{t+\Delta t} - dZ_t = 0 \pm 10 \text{ cm}$ $\Delta t = 1h$
- Constraints Clocks: $dC_{t+\Delta t} - dC_t = 0 \pm 10 \mu s$ $\Delta t = 1h$

	Week 1	Week 2	Week 3
# measures used (# measures removed)	44 569 (2 660)	63 172 (2 162)	26 153 (2 099)
# quasars	78	80	80
# stations	11	11	11
Mean weighted residuals	1.1 cm	1.1 cm	1.6 cm

Stations: Nyalesund, Westford, Svetloe, Wettzell, Onsala, Tsukuba, Medicina, Zelenchukskaya, Hartrao, Kokee, Tigoconc.

DORIS processing

Statistics (mean values per arc)

JASON2: 6 arcs

DORIS wrms 0.319 mm/s validated data 59523 edited 22077

SLR wrms 1.53 cm validated data 1133 edited 67

Envisat: 7 arcs

DORIS wrms 0.364 mm/s validated data 26738 edited 6673

SLR wrms 1.04 cm validated data 1017 edited 44

SPOT2: 6 arcs

DORIS wrms 0.381 mm/s validated data 11105 edited 1307

SPOT4: 7 arcs

DORIS wrms 0.387 mm/s validated data 15546 edited 525

SPOT5: 6 arcs

DORIS wrms 0.353 mm/s validated data 33419 edited 2584

DORIS normal equations

grg08223dw01.n2

grg08230dw01.n2

grg08237dw01.n2

Normal equation content:

- Station coordinates for all stations: weekly parameters, epoch Wednesday 12:00
- X-pole, Y-pole, UT1-UTC: daily parameters at 00:00
- Nutation: at 00:00 and 12:00
- X,Y,Z components of the vector « satellite center of mass – DORIS antenna phase center »
- Tropospheric zenithal bias per pass for the stations: Hartebeesthoek, Greenbelt, Mont Stromlo, Papeete, Kokee Park, Ny-Alesund

Models:

Gravity field : EIGEN-GRGS.RL02MF

Reference system: ITRF2008 (DPOD2008 for stations, EOP08C04 for EOP)

Mean pole: IERS conventions 2010

Troposphere : GMF + GPT

Ocean tides: FES2004

Tuned macro-model « Stab5 » from GRGS (JM Lemoine) for Jason-2

GNSS processing changes

IERS Conventions (2010) :

- Mean pole model
- Oceanic pole tide (Desai up to degree 12)

Others changes :

- Use of PCO's from igs08.atx (instead of IGS05.atx before)
- Inclusion of tropospheric gradients
(see impact on displacements below)
- Tropospheric zenithal biases and gradients let un-reduced in the NEQ for the following collocated sites : hrao conz usn3 gode str1 thti kokb nya1 nyal

Two solution including previous changes have been delivered :

Solution n6 (October 2011) : contains errors in EOP parametrization and should be not used !

Solution n7 (November 2011) : The errors are (hopefully) corrected.

Residuals (~8 mm for undifferenced phase)

Comming next :

- GNSS PCV in NEQ
- Glonass
- Possibility to deliver diurnal NEQ (instead of weekly today)
- Attitude law during eclipses seasons (Jan Kouba modelling)

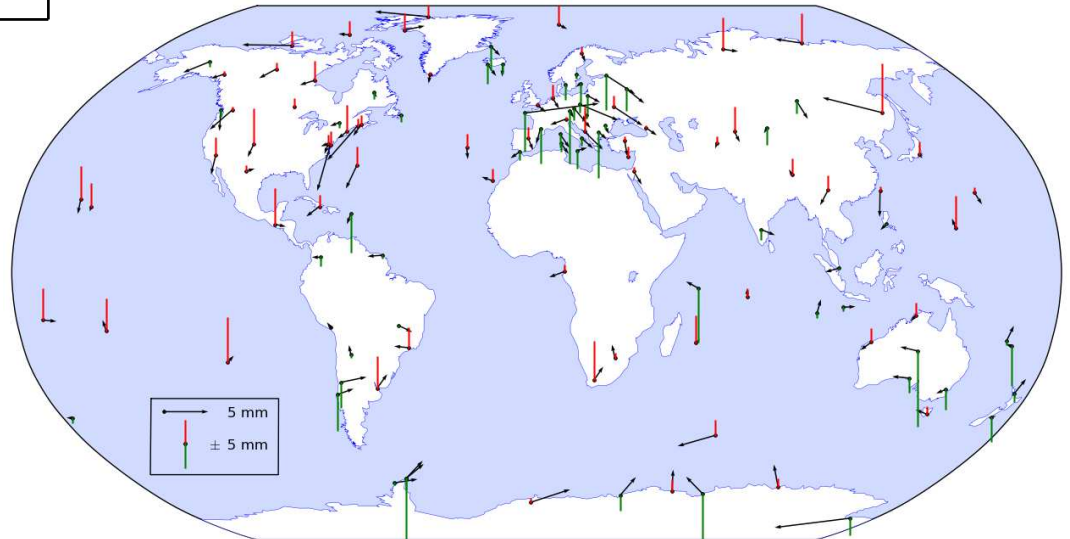
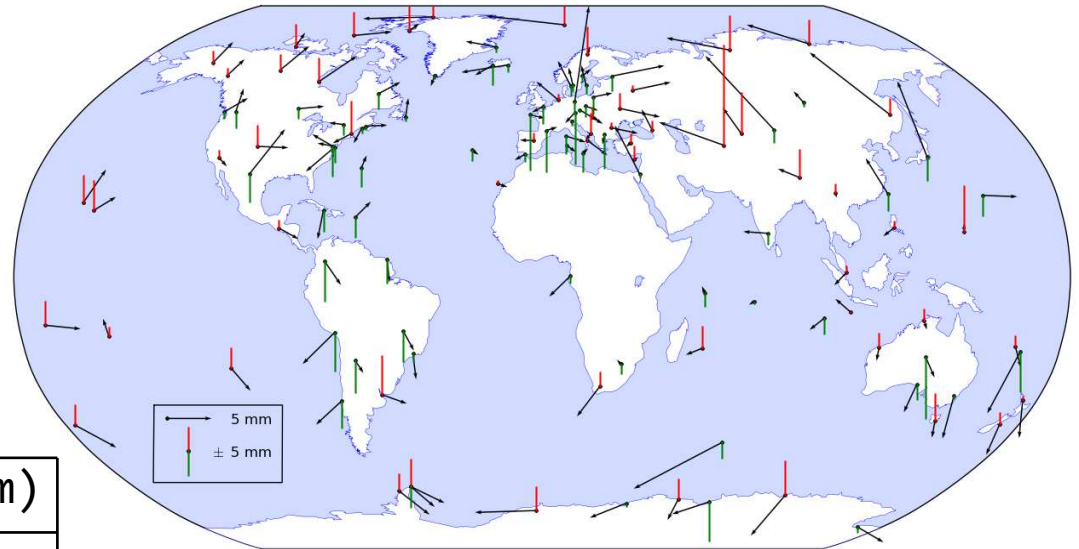
Introduction of tropospheric gradients

Without →

Gradients	E(mm)	N(mm)	Up(mm)
without	2.7	3.8	6.8
with	1.2	1.4	4.4

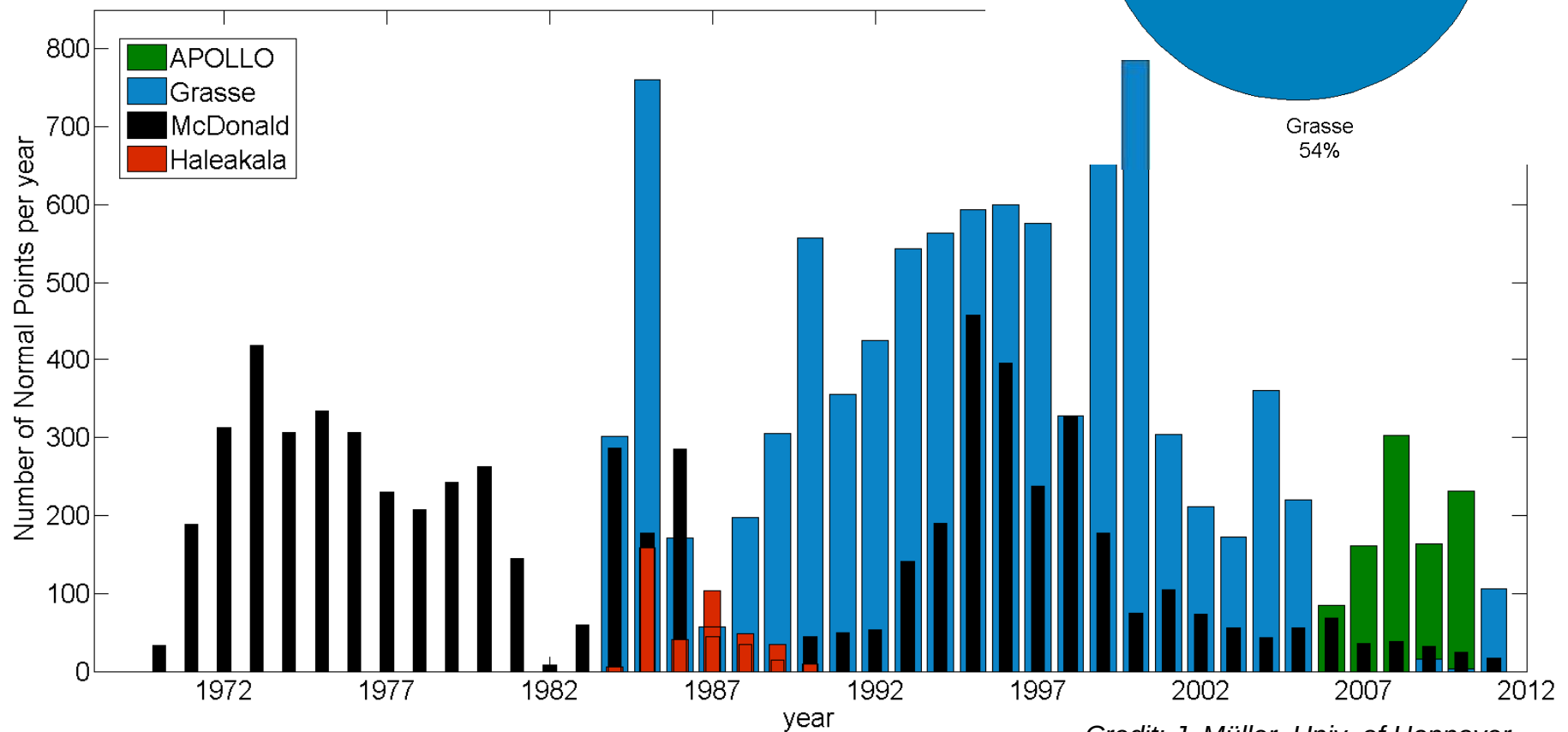
***Global RMS of Helmert residuals
between GRG and IGS combined
solution with or without tropospheric
gradients (from P. Rebischung)***

With →

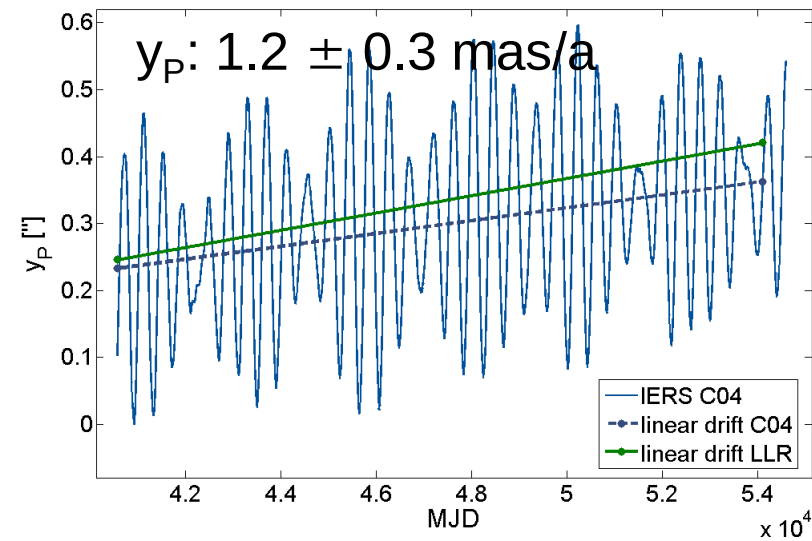
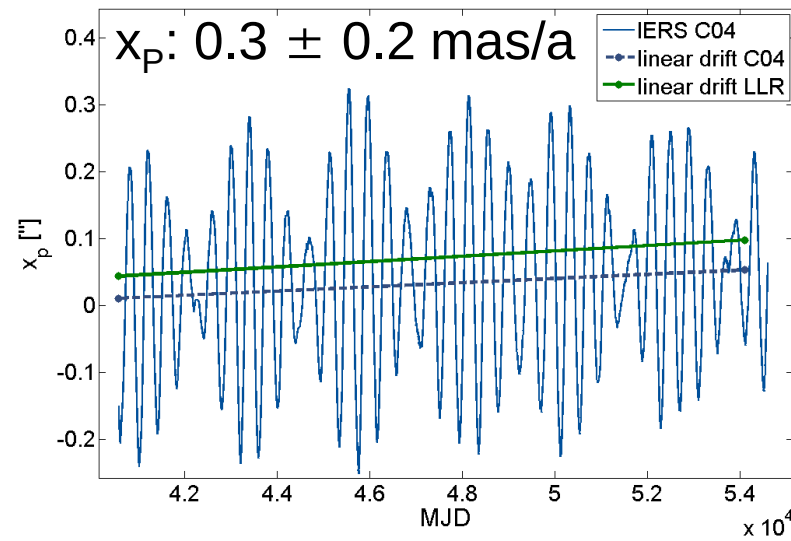


LLR processing

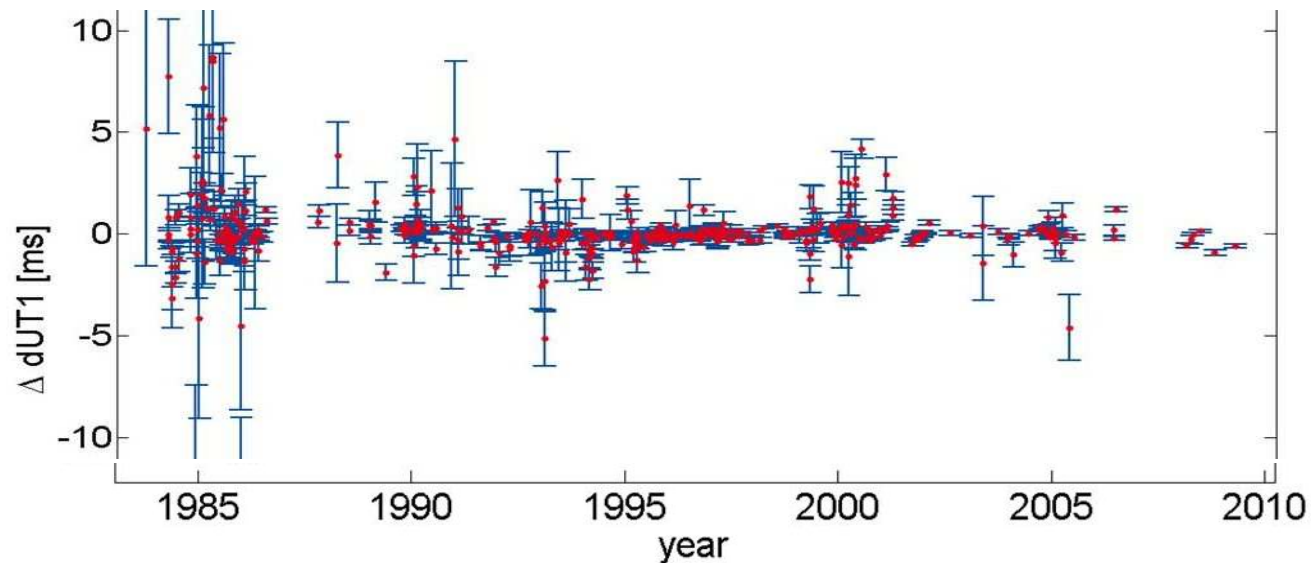
1970 - 2011: ca.17,000 normal points



Differences between polar motion linear drift from IERS C04 and LLR for time span 1970-2008



Determination of UT1-UTC in global LLR adjustment



Credit: J. Müller, Univ. of Hannover

Open items (from Juergen Mueller)

- Added-value for long-term EOP monitoring by LLR?
- Celestial reference frame: better alignment of dynamic and ICRS equator possible/required?
- Change of time scale in planetary/lunar ephemeris ($T_{\text{eph}} - \text{TCB}$)?

Future steps

- Enhanced studies on ephemeris, earth rotation and relativity
- Software update to include and process novel observations from lunar transponders and orbiters (and VLBI in a more direct way)