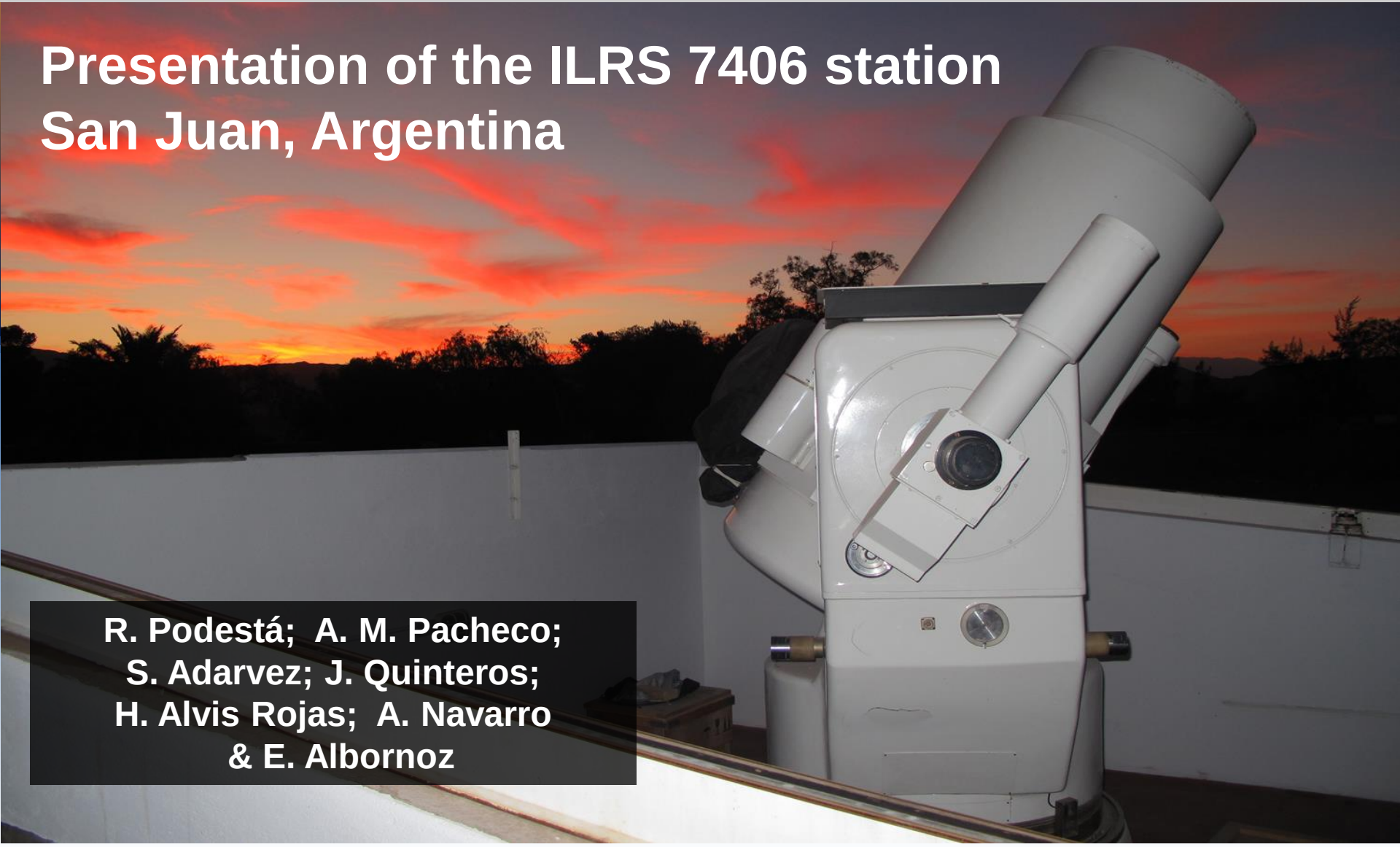
Universidad Nacional de San Juan

Presentation of the ILRS 7406 station San Juan, Argentina

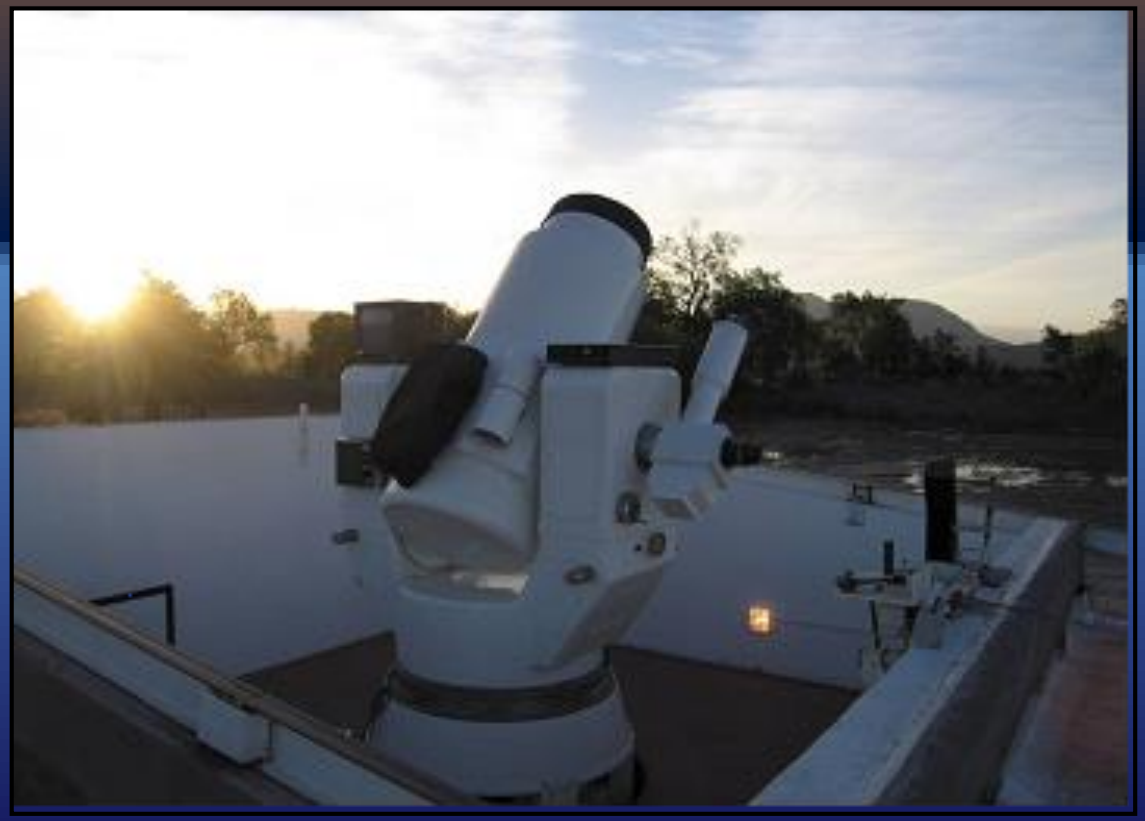


R. Podestá; A. M. Pacheco;
S. Adarvez; J. Quinteros;
H. Alvis Rojas; A. Navarro
& E. Albornoz

First SLR station in Argentina: SAN JUAN ILRS 7406

(An experience of 10 years of cooperation)

- International Agreement between our National University and the National Observatories of Beijing belong to the Chinese Academy of Sciences
- Officially our SLRt began to work on February 22, 2006 under the code International Laser Ranging Service Nº 7406



Chinese SLR set up in the Astronomical Observatory of San Juan (OAFA)

Old Laser Oscillator (2005)

Laser : Nd: YAG (Ytrium – Aluminum – Neodymium)

λ : 1064 nm $\rightarrow$ 532 nm

Energy : 50 – 80 mJ

Pulse Width : 30 – 50 ps

Detector : SPAD

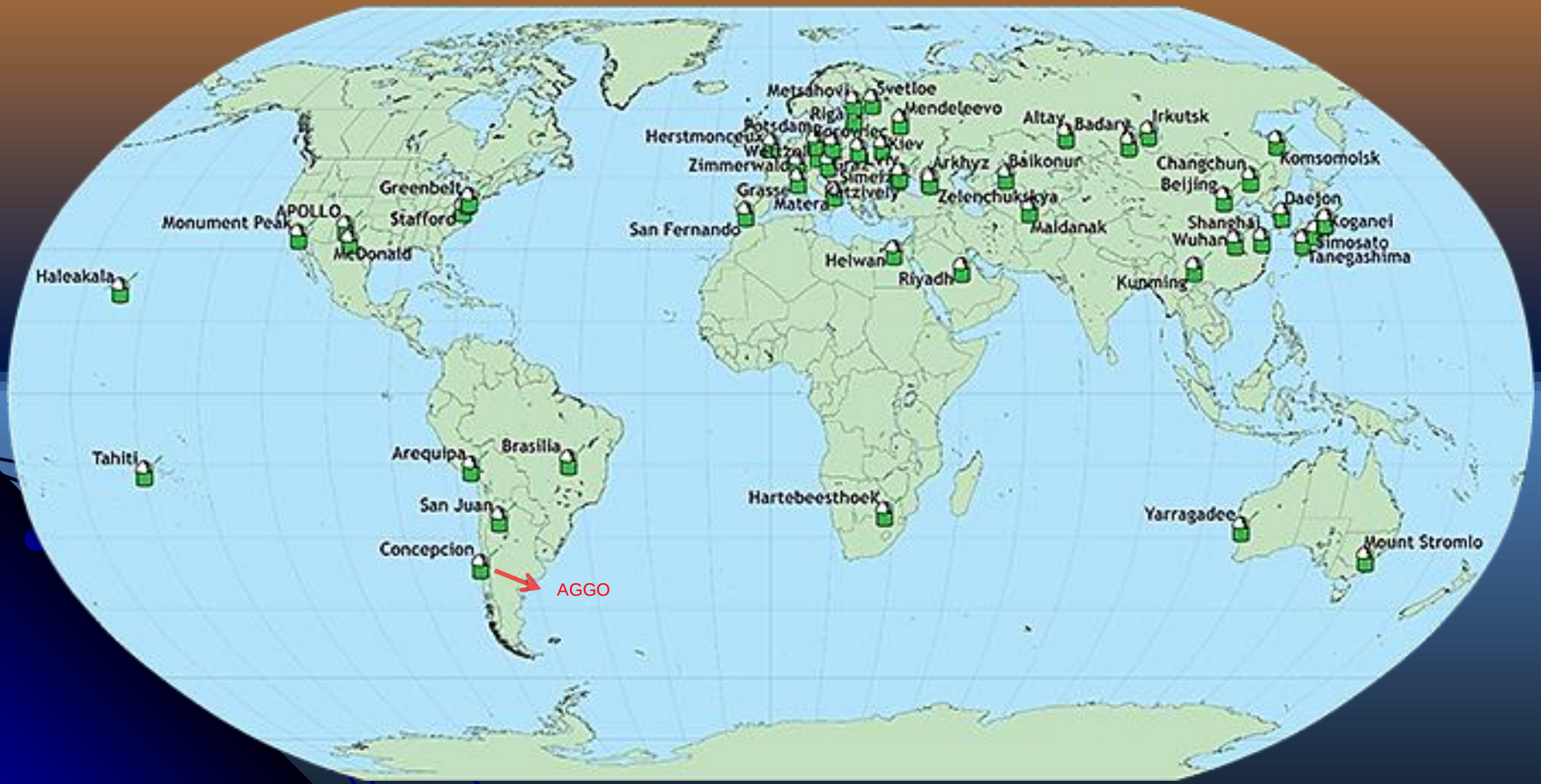
Repetition Rate : 20 Hz

GPS Timing : HP58503B

New Laser Oscillator (2018) : Repetition Rate : 1 KHz, Day and Night

International Laser Ranging Service (ILRS)

Global net SLR in more than 30 countries, with fixed and mobile stations



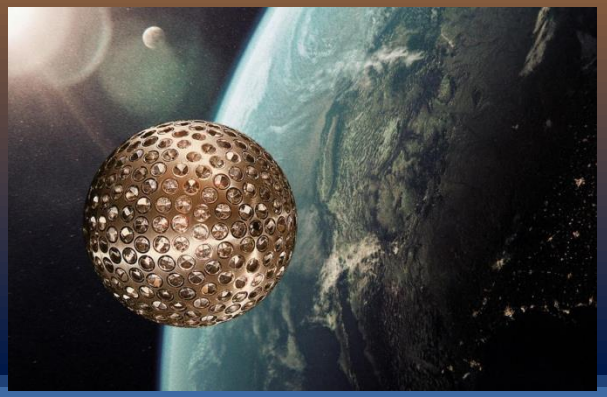
45 stations in activity
38 stations stopped

Constelación de satélites SLR

More than 100 pass satellites
71 current satellites with retro-reflectors
15 future satellites

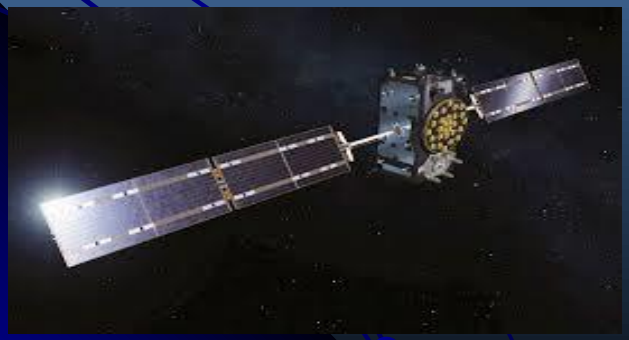
Low Earth Orbits (LEOs)

JASON 2 (1336 Km)



LAGEOS (5900 Km)

High Earth Orbits (HEOs)



GALILEO 101 (23220 Km)

GPS (20200 Km)

Performance ILRS 7406 in the first years

International Laser Ranging Service

Multi-Satellite Bias Analysis Report

Major upgrade in May 2005: more accurate, more satellites and more frequent!

Latest Analysis Report: >> from **09 Aug 2006** to **22 Aug 2006**

Stations with high productivity

	# pass/# NP	Site Name(ID)
Lageos1	45/524	San Juan (7406)
	44/585	Yarragadee (7090)
	33/308	Mt Stromlo (7825)
Etalon1	9/119	Yarragadee (7090)
	9/39	San Juan (7406)
	6/67	Mt Stromlo (7825)
Starlette	38/396	Changchun (7237)
	37/407	Yarragadee (7090)
	35/529	Graz (7839)
Ajisai	58/657	San Juan (7406)
	56/1043	Yarragadee (7090)
	47/754	Mt Stromlo (7825)
Lageos2	29/405	Mt Stromlo (7825)
	29/333	Yarragadee (7090)
	23/254	Matera (7941)
Etalon2	7/105	Yarragadee (7090)
	6/43	Wettzell (8834)
	6/32	Graz (7839)
	6/23	San Juan (7406)
Stella	19/227	Yarragadee (7090)
	17/142	Mt Stromlo (7825)
	17/133	San Juan (7406)

more satellites (GNSS and LEO) included in the daily reports!!

Multi-Satellite Bias Analysis Report

for Worldwide Satellite Laser Ranging Stations

http://www.science.hit-u.ac.jp/otsubo/slr/bias

Latest Analysis Report: >> from 21 Jun 2007 to 04 Jul 2007

Stations with high productivity

	# pass/# NP	Site Name(ID)
Lageos1	35/319	Yarragadee (7090)
	31/290	Matera (7941)
	20/213	San Juan (7406)
Etalon1	10/79	San Juan (7406)
	8/62	Yarragadee (7090)
	5/40	Matera (7941)
Starlette	38/371	San Juan (7406)
	30/239	Matera (7941)
	29/367	Yarragadee (7090)
Ajisai	45/753	Yarragadee (7090)
	44/766	San Fernando (7824)
	39/598	Hartebeesthoek (7501)
Lageos2	36/441	San Juan (7406)
	26/313	Yarragadee (7090)
	21/217	Haleakala (7119)
Etalon2	7/33	San Juan (7406)
	6/30	Yarragadee (7090)
	5/23	Maidanak (1864)
Stella	23/199	San Juan (7406)
	14/157	Yarragadee (7090)
	13/142	Haleakala (7119)
	13/138	Graz (7839)
	13/110	Matera (7941)
	13/90	Hartebeesthoek (7501)

more satellites (GNSS and LEO) included in the daily reports!!

Multi-Satellite Bias Analysis Report

for Worldwide Satellite Laser Ranging Stations

Latest Analysis Report: >> from **16 Apr 2008** to **29 Apr 2008**

Stations with high productivity

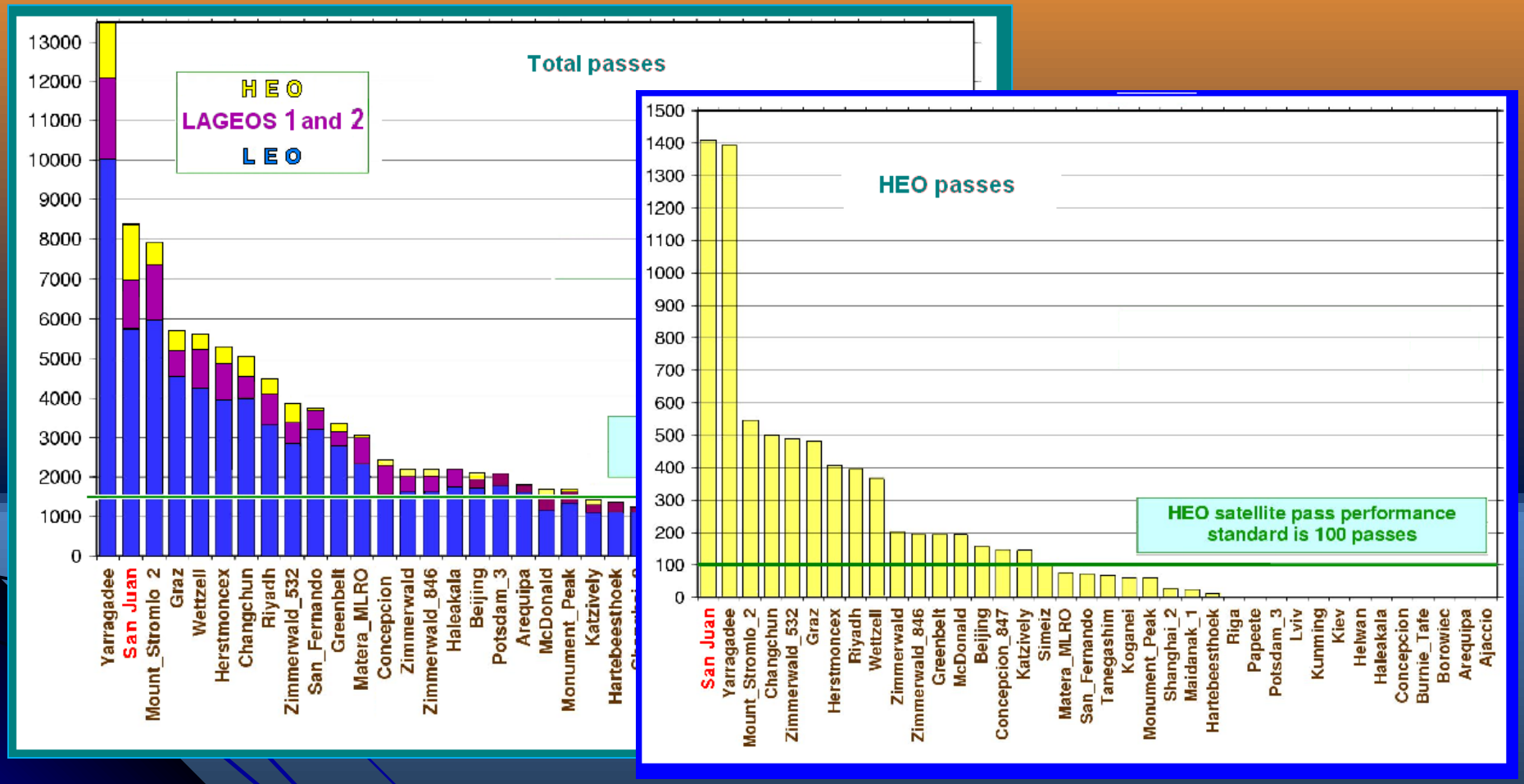
	# pass/# NP	Site Name(ID)
Lageos1	43/493	San Juan (7406)
	40/447	Yarragadee (7090)
	26/192	Wettzell (8834)
Etalon1	13/80	San Juan (7406)
	10/91	Yarragadee (7090)
	7/40	Mt Stromlo (7825)
Starlette	61/630	San Juan (7406)
	47/520	Mt Stromlo (7825)
	37/549	Yarragadee (7090)
Ajisai	51/650	San Juan (7406)
	46/667	Mt Stromlo (7825)
	45/855	Yarragadee (7090)
Lageos2	28/426	Yarragadee (7090)
	25/284	Riyadh (7832)
	23/199	Concepcion (7405)
Etalon2	10/53	San Juan (7406)
	6/70	Yarragadee (7090)
	5/55	Washington (7105)
	5/44	Wettzell (8834)
	5/38	Riyadh (7832)
Stella	26/253	San Juan (7406)
	20/250	Yarragadee (7090)
	19/134	Wettzell (8834)

more satellites (GNSS and LEO) included in the daily reports!!

"The San Juan Station is now the strongest station in South America and is becoming more crucial to both the evolution of the Terrestrial Reference Frame and the SLR precision orbit determination of the World."

Mike Pearlman- Director ILRS Central Bureau 2009

Performance global net SLR



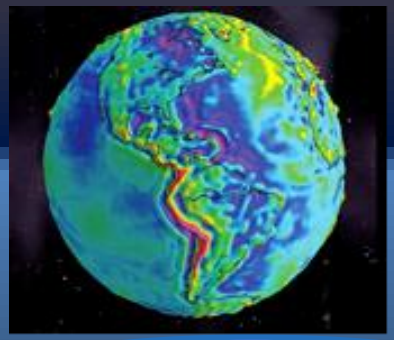
“Congratulations. We are very impressed with the performance of the San Juan SLR station during the past year. We note from the most recent SLR Global Performance Report Card that the San Juan Station was among the top three stations in the network in data yield. In particular, the data yield from the high satellites. “

(Mike Pearlman- Director ILRS Central Bureau)

SLR Aplications

Astronomy:

- **Precession and Nutation**
- ***EOPs determinations , Polar Motion and Rotation***
- **Precise orbits of satellites**
- **ITRS, ITRF**

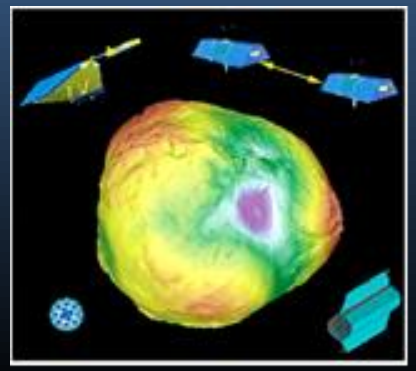


Geophysics:

- **Earth Gravitational Field**
- **Centrifugal force**
- **Tectonic Plate Movements**
- **Seismicity**

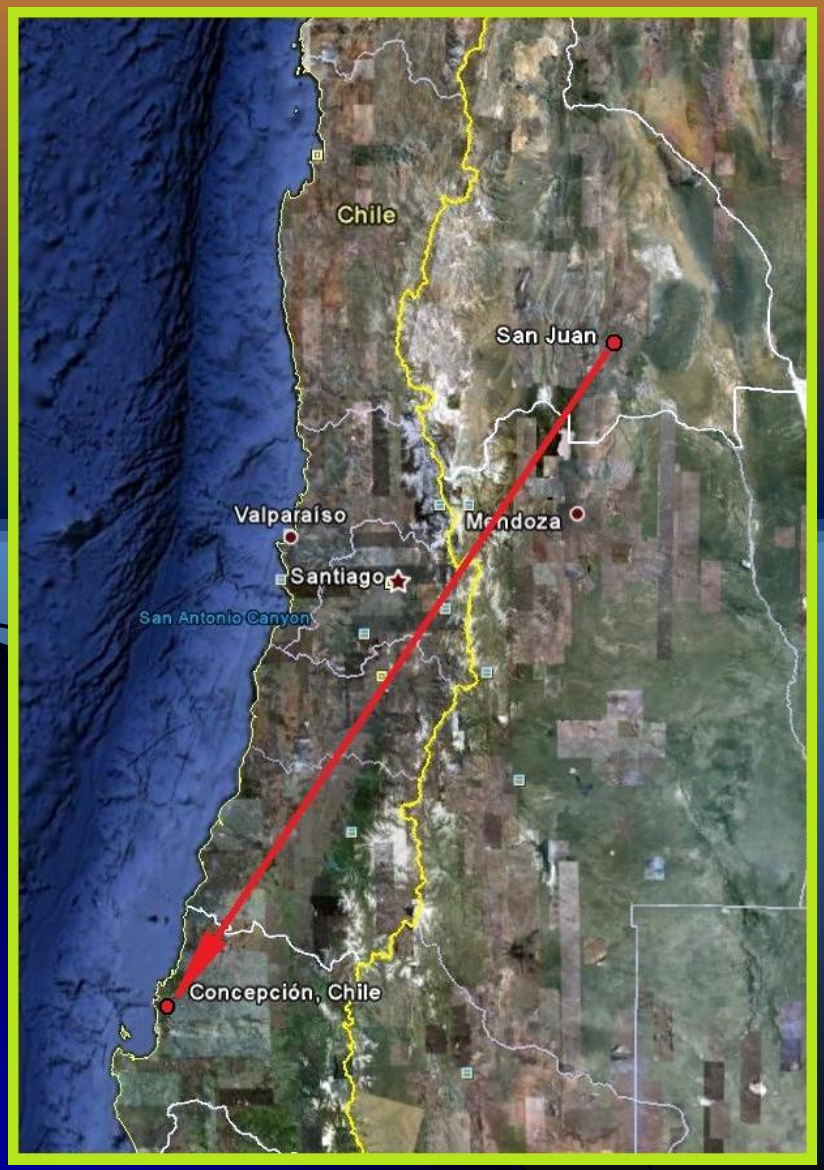
Geodesy:

- **Geoid and shape of the Earth**
- **Deflection of the Vertical**
- **Terrestrial Tides**
- **Geodynamics**
- **Calibration of GPS receivers**



GEODYNAMIC

Earthquake CHILE 27/02/2010



SLR- 7406 bef EQ:
X= 1984104,2205m
Y= -5068867,1380m
Z= -3314482,6836m

SLR- 7406 aft EQ:
X= 1984104,1988m
Y= -5068867,1653m
Z= -3314482,6986m

ΔX= -0,0217m
ΔY= -0,0273m
ΔZ= -0,015 m

SLR 7405 bef EQ:
X= 1492032,7583m
Y= -4887946,0478m
Z= -3803566,0389m

SLR- 7405 aft EQ:
X= 1492029,6433m
Y= -4887946,5663m
Z= -3803566,5262m

ΔX= -3,114m
ΔY= -0,518m
ΔZ= -0,4873m

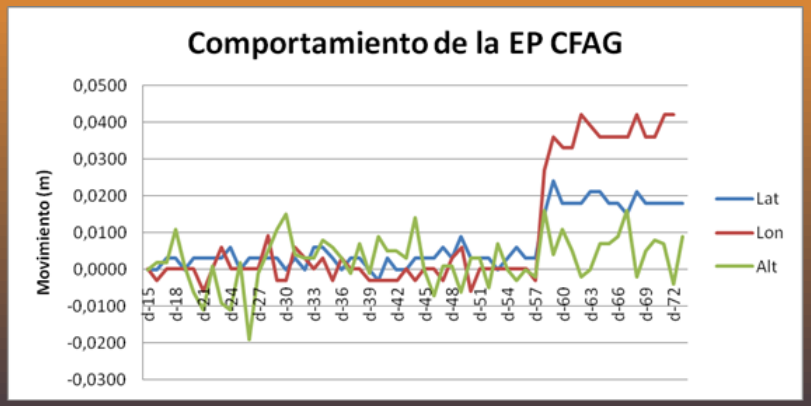
Earthquake CHILE 27/02/2010 M = 8,8

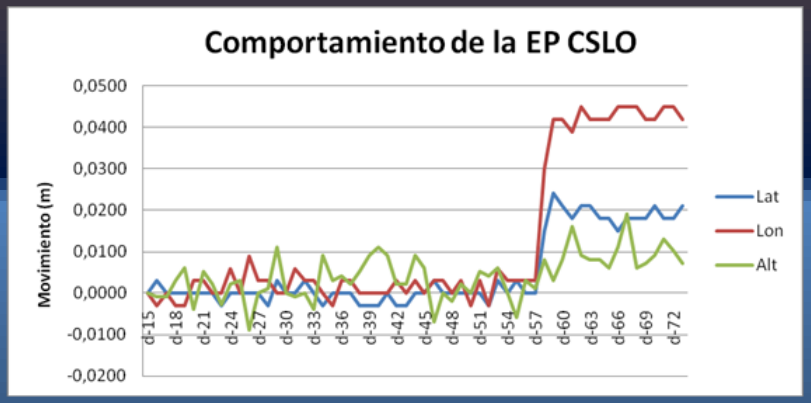
Station coordinates:

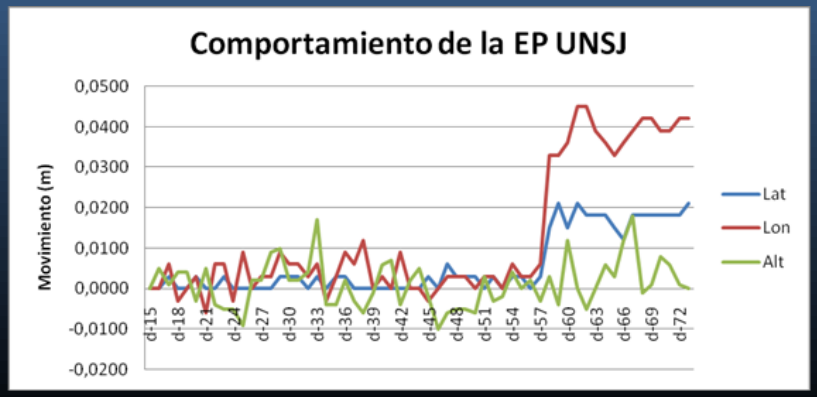
SLR- 7406 bef EQ:
X= 1984104,2205m
Y= -5068867,1380m
Z= -3314482,6836m

SLR- 7406 aft EQ:
X= 1984104,1988m
Y= -5068867,1653m
Z= -3314482,6986m

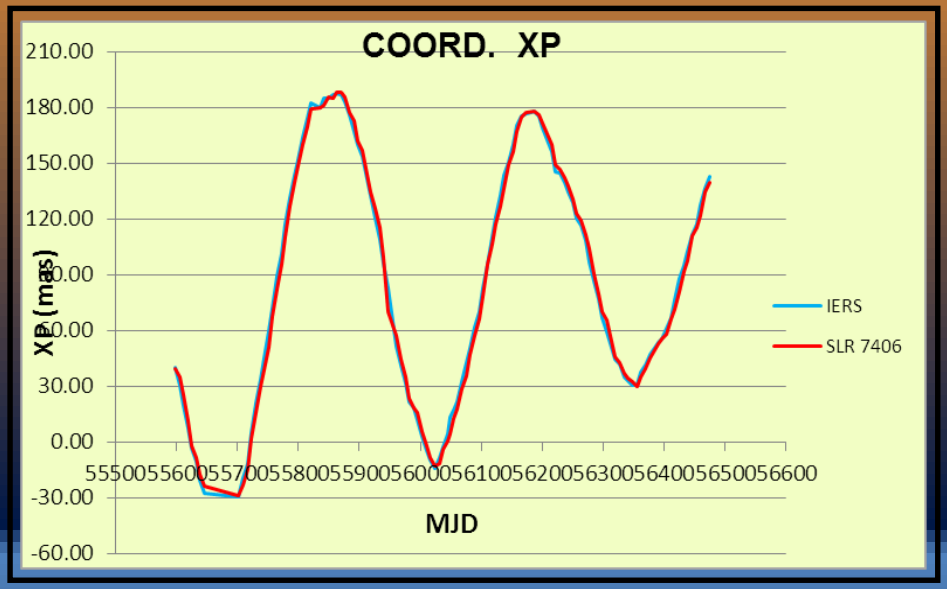
ΔX= -0,0217m
ΔY= -0,0273m
ΔZ= -0,015 m

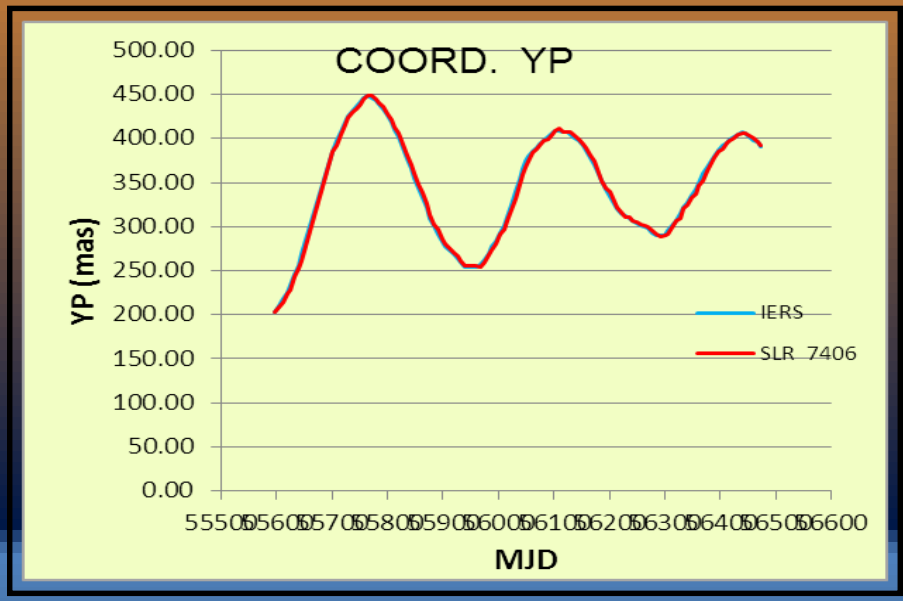


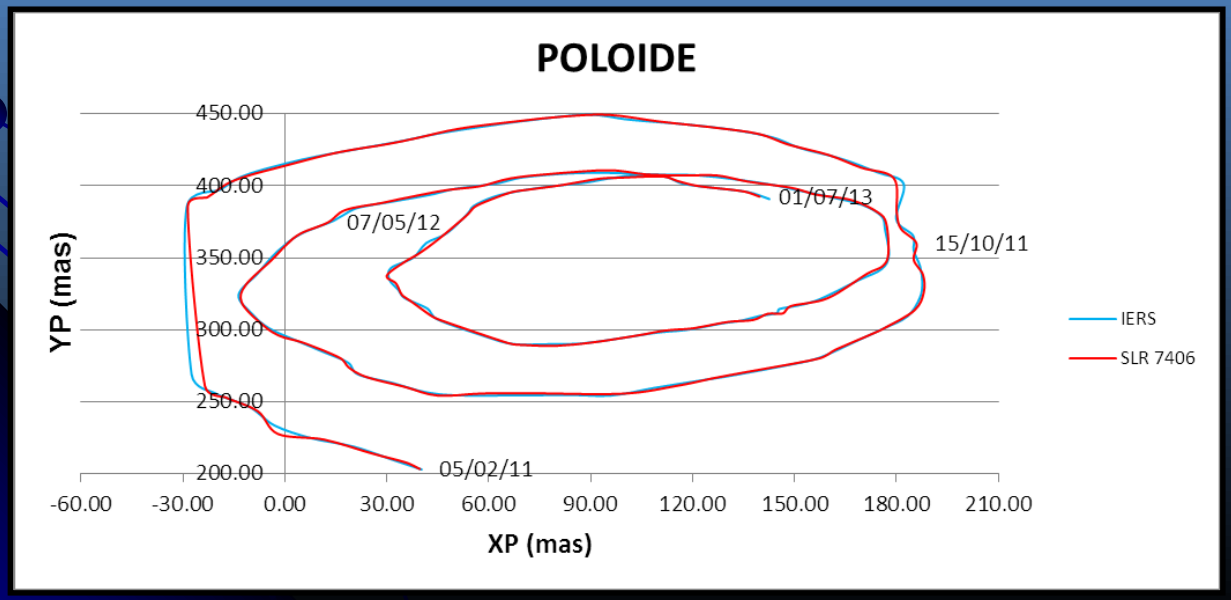


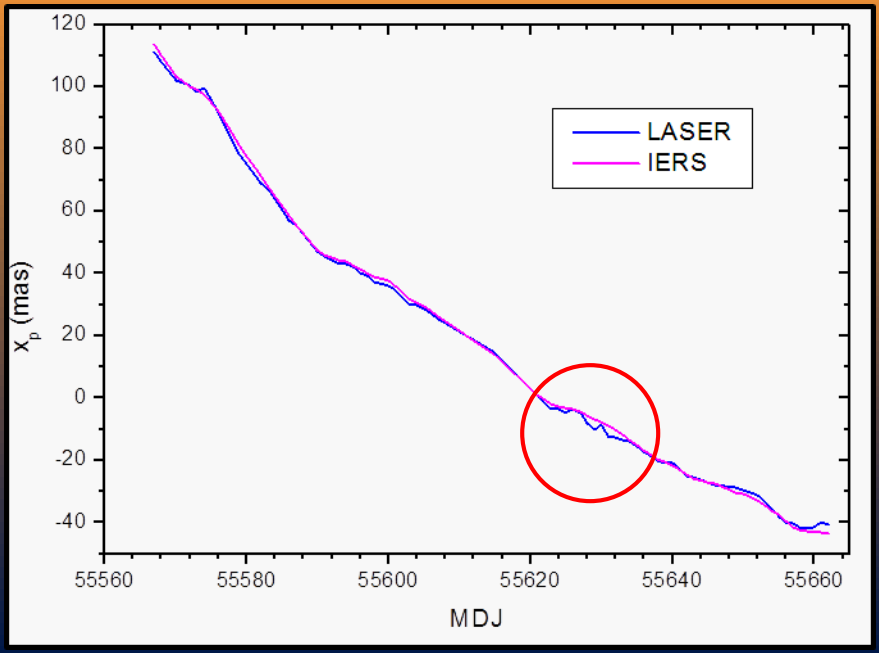


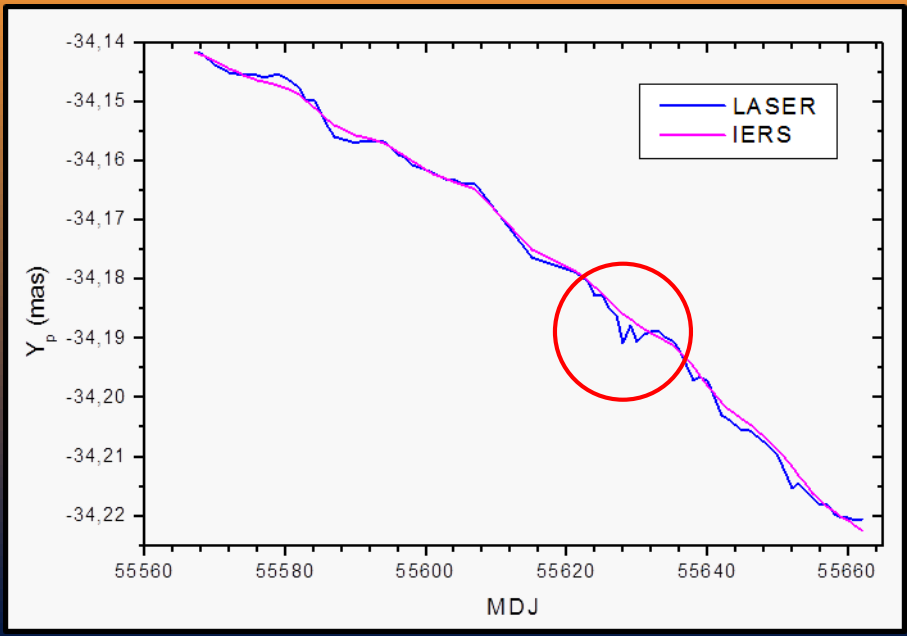
EOPs computed for San Juan SLR 7406 station using NAOC SLR software

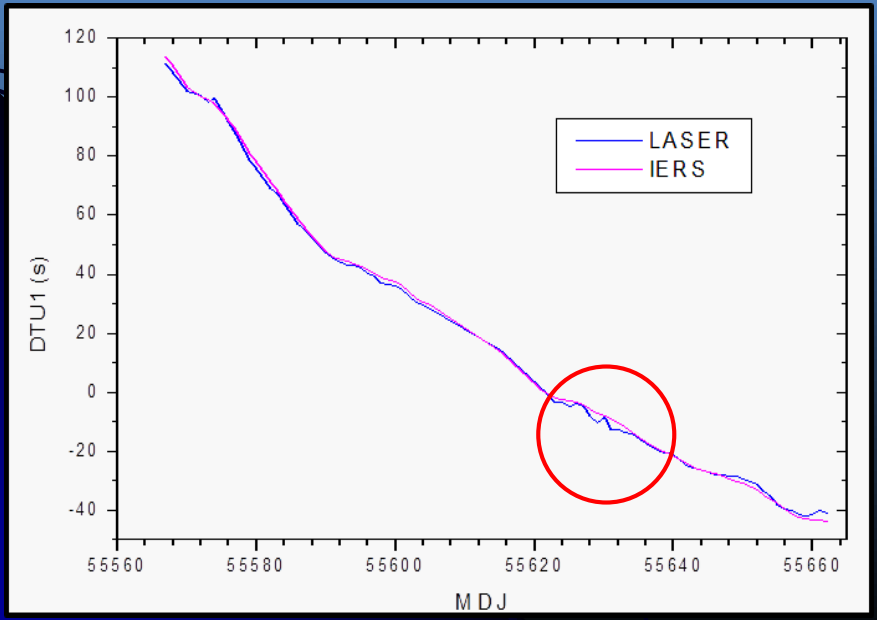












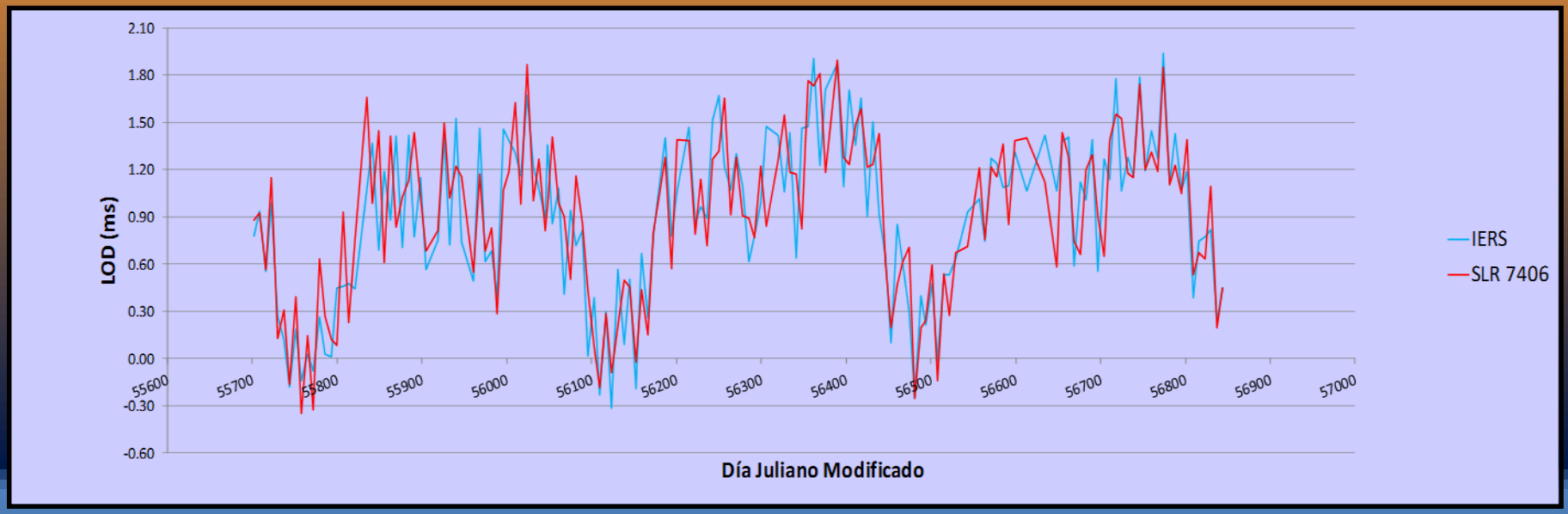
Greater discrepancies in:

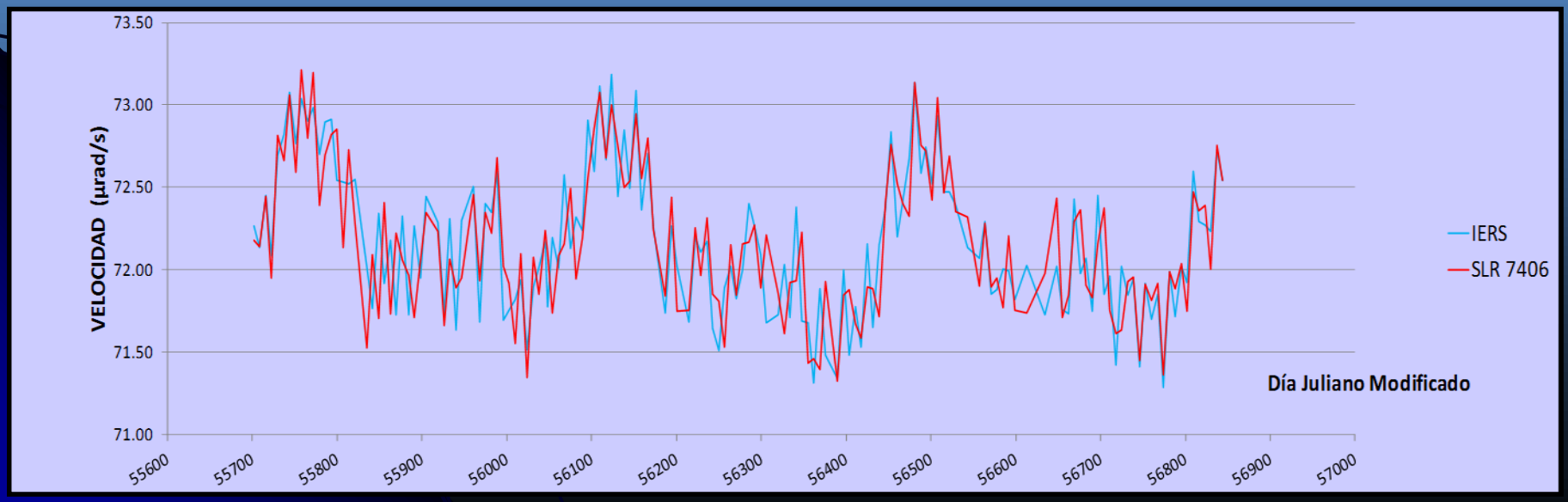
Yp , DUT1 → March 09 /2011
Earthquake in East Coast of Honshu, Japan , M = 7.2

Xp → March 11/2011
Miyagi Earthquake, Japan , M = 9.0

Length of Day (LOD) - Angular Velocity of Earth Rotation

SLR 7406 San Juan





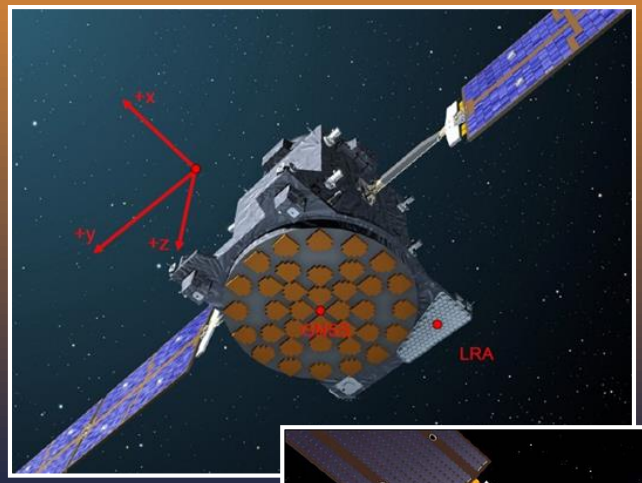
- **The results obtained from the EOP and in Geodynamics have shown that the NAOC SLR software allows the estimation of geodetic parameters with very high precision.**

- **The EOPs found with the observable SLR of station 7406 San Juan are totally consistent with the values given by the IERS for the same time**

- **The biggest differences (IERS - SLR), obtained for the dates of the earthquake in Japan (March 11, 2011) and the strong earthquake that occurred two days before (March 9, 2011), show that the SLR observations clearly detect changes in the axis of rotation of the Earth when they are caused by important seismic events of the planet. This is in full agreement with the analysis of the change in mass distribution inside the Earth and consequently the coordinates of the pole**

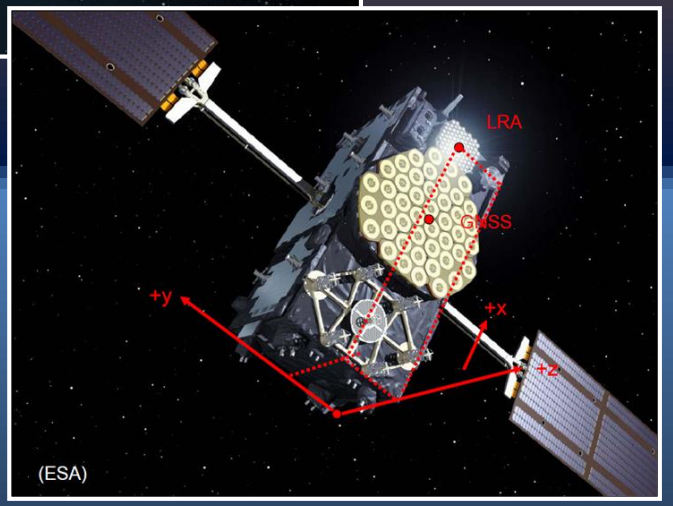
- **The SLR system can determine positions of ITRF stations with very good precisions (of the order of mm)**

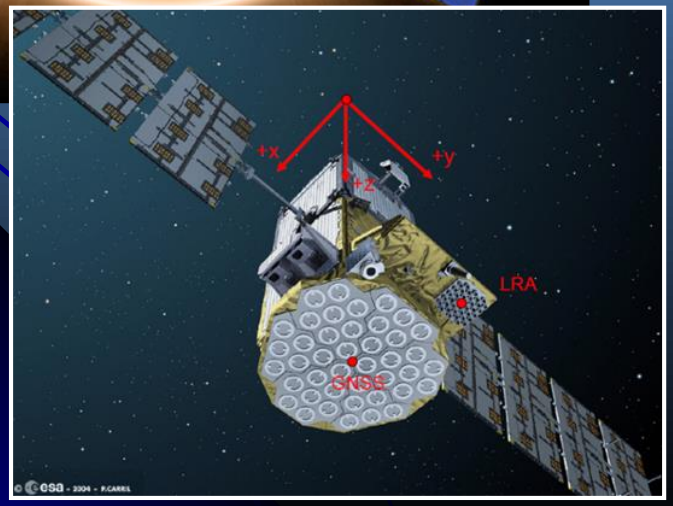
Tracking to GNSS Satellite Constellation



GIOVE A

GIOVE B





GALILEO
I - V

Height: 23220km
Everyone with LRA

GIOVE-A

BEIDOU

Stations with ranging capacity to

GALILEO

Riga - Lituania

Yarragadee - Australia

Greenbelt - Maryland, USA

Matera - Italia

Changchun - China

San Juan – Argentina

Hartebeesthoek - Sudáfrica

Zimmerwald - Suiza

Mt Stromlo – Australia

Graz – Austria

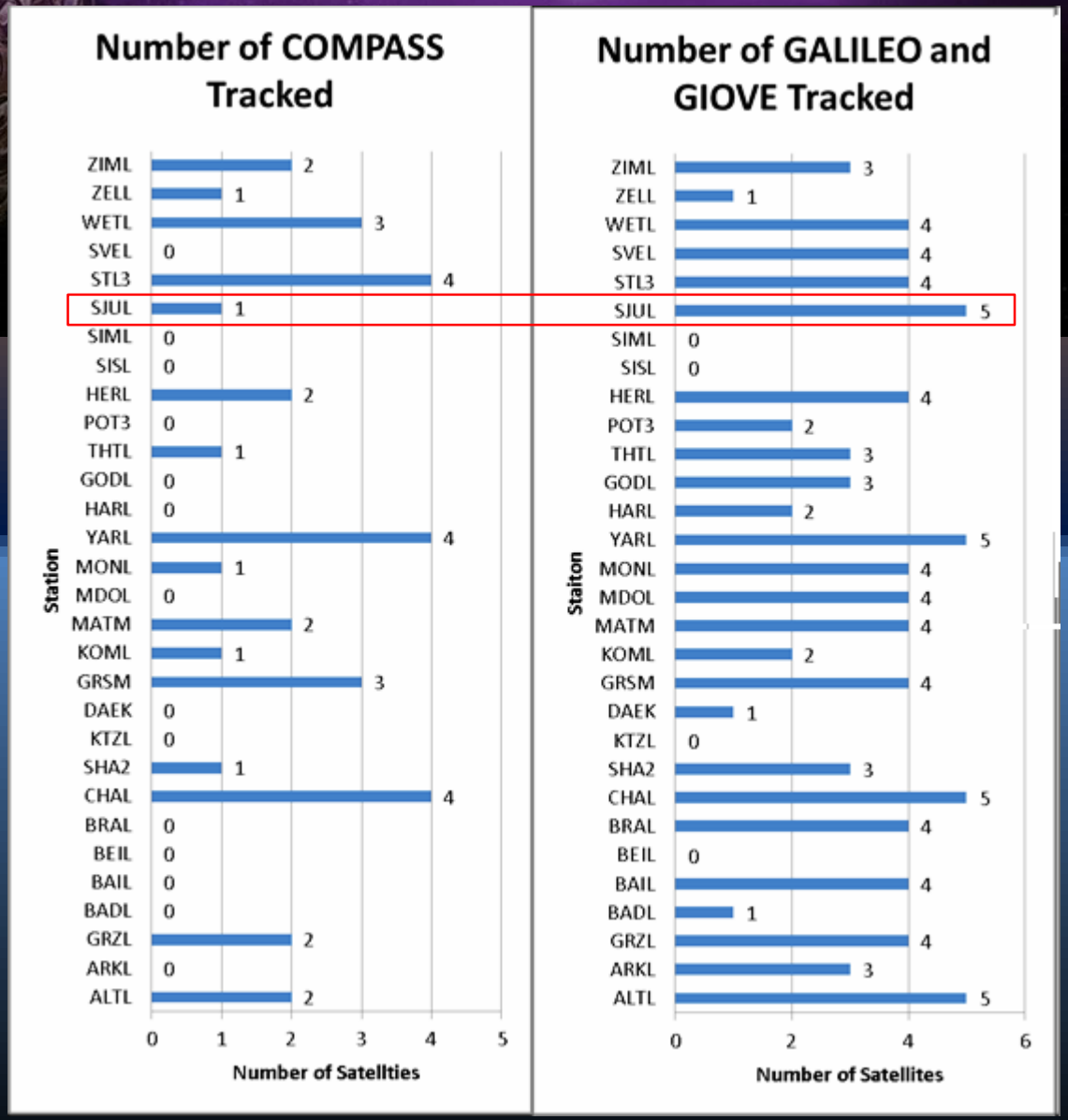
Herstmonceaux - Reino Unido

Wettzell – Alemania

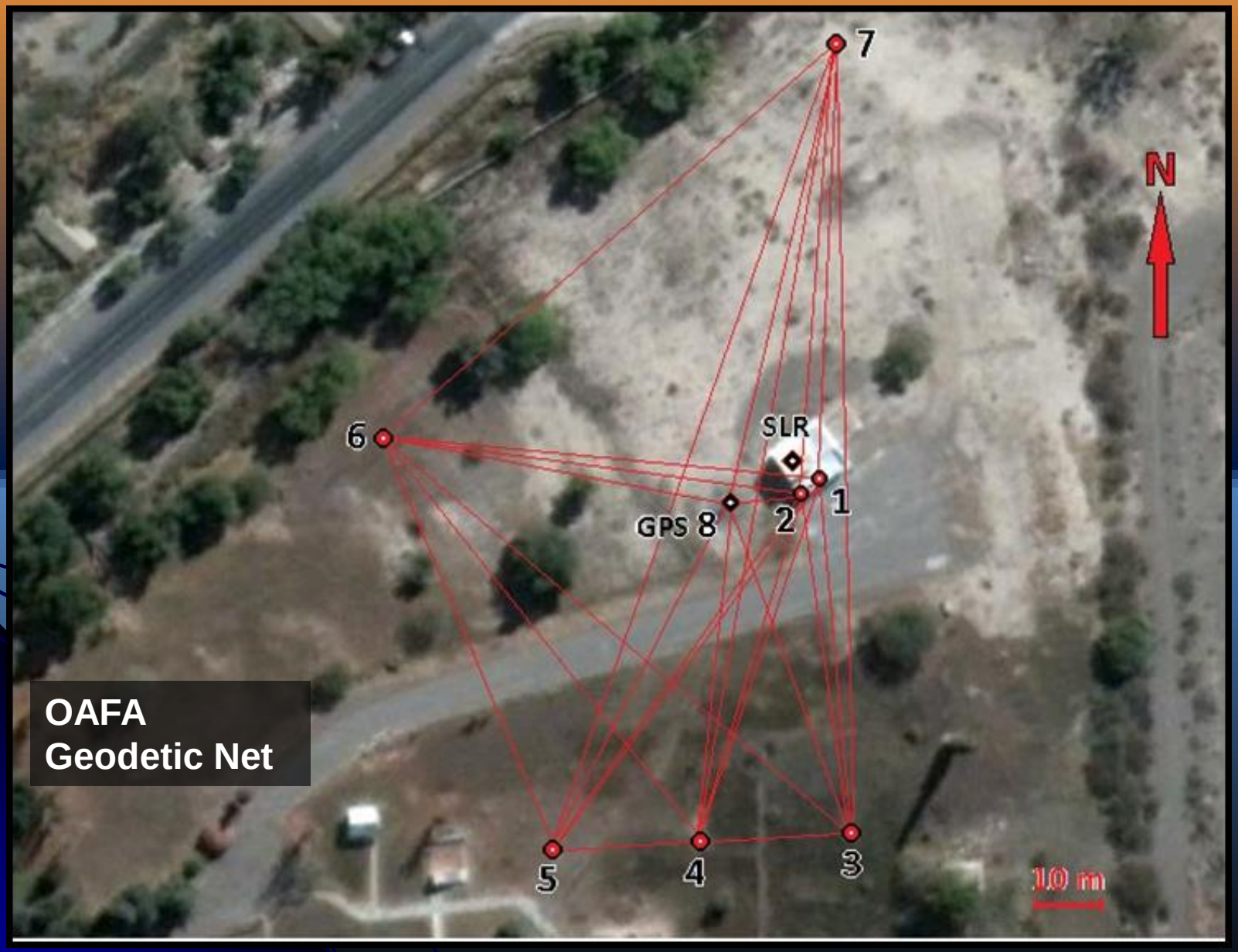
Monument Peak - California, USA

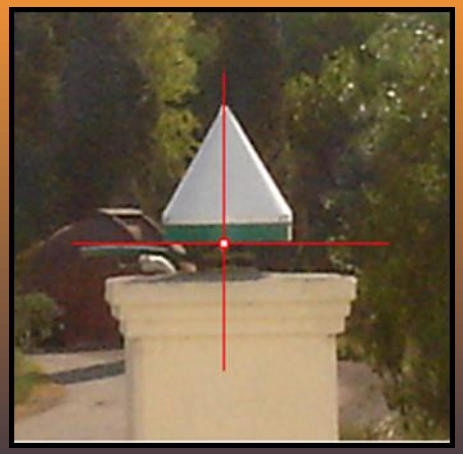
McDonald Observatory - Texas, USA

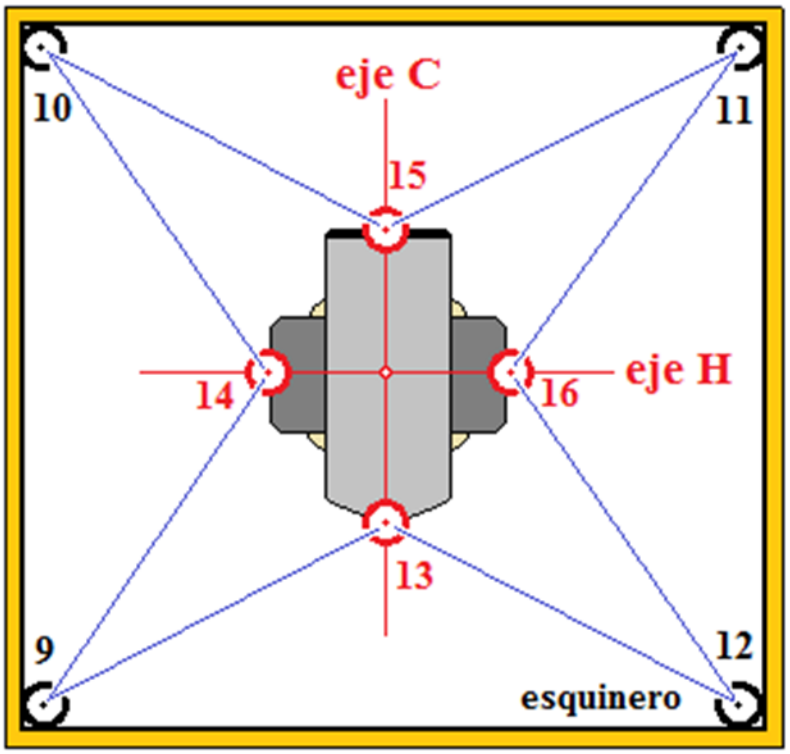
Satelite	Ubicación	Estacion	Inicio	Fin	N° de Pasajes	N° de Puntos
COMPASS-M3	Yarragadee	7090	11/07/2012 18:40	06/03/2015 13:05	309	1004
	Matera	7941	12/07/2012 19:02	03/03/2015 00:16	233	817
	Graz	7839	16/08/2012 11:00	10/03/2015 22:24	154	814
	Zimmerwald	7810	09/08/2012 14:39	03/11/2014 06:42	200	781
	Changchun	7237	16/07/2012 13:13	10/03/2015 10:35	274	715
	Mount Stromlo	7825	12/07/2012 23:41	10/03/2015 03:09	166	687
	San Juan	**7406**	**12/07/2012 07:17**	**19/11/2014 02:28**	**117**	**683**
	Wettzell	8834	24/07/2012 00:38	09/03/2015 22:09	149	533
	Herstmonceux	7840	15/07/2012 22:33	10/03/2015 23:42	133	394
	Greenbelt	7105	17/07/2012 01:40	06/02/2015 04:32	99	366
	Grasse	7845	13/08/2012 22:38	26/09/2014 19:08	111	358
	Monument Peak	7110	18/07/2012 03:44	06/03/2015 03:38	117	281
	Shanghai	7821	23/07/2012 12:40	13/02/2015 20:01	59	210
	Simosato	7838	23/10/2012 08:34	13/06/2014 10:48	24	190
	Tahiti	7124	13/07/2012 09:30	03/10/2014 11:49	41	147
	Beijing	7249	03/10/2012 11:05	10/03/2015 11:19	17	74
	Potsdam	7841	16/10/2012 04:16	16/04/2014 23:08	8	66
	Katzively	1893	20/07/2012 20:01	07/05/2014 23:41	8	54
	Hartebeesthoek	7501	27/07/2012 20:12	26/07/2014 02:16	16	52
	Koganei	7308	04/12/2012 14:12	12/03/2014 11:23	5	24
	Zelenchukskaya	1889	09/11/2014 01:12	11/03/2015 00:58	8	22
	Greenbelt	7125	31/05/2013 21:17	14/03/2014 00:36	7	21
	Altay	1879	24/09/2014 13:50	07/03/2015 17:18	7	18
	Brasilia	7407	12/01/2015 23:58	03/03/2015 23:20	6	18
	Concepcion	7405	27/09/2013 08:46	07/12/2013 07:20	3	18
	Arkhyz	1886	06/12/2014 22:18	24/01/2015 19:07	5	15
	Kiev	1824	30/12/2012 22:06	09/03/2014 18:35	4	14
	Komsomolsk	1868	19/11/2014 19:23	29/01/2015 16:42	3	9
	McDonald	7080	17/09/2012 19:06	06/04/2014 03:09	2	9
	Simeiz	1873	22/05/2013 20:39	22/05/2013 20:39	1	9
	Daejon	7359	21/03/2014 16:04	21/03/2014 16:04	1	7
	Svetloe	1888	29/10/2014 09:19	30/10/2014 11:52	2	4
	Badary	1890	01/01/2015 18:59	01/01/2015 18:59	1	3
	Baikonur	1887	27/02/2015 17:08	27/02/2015 17:08	1	3

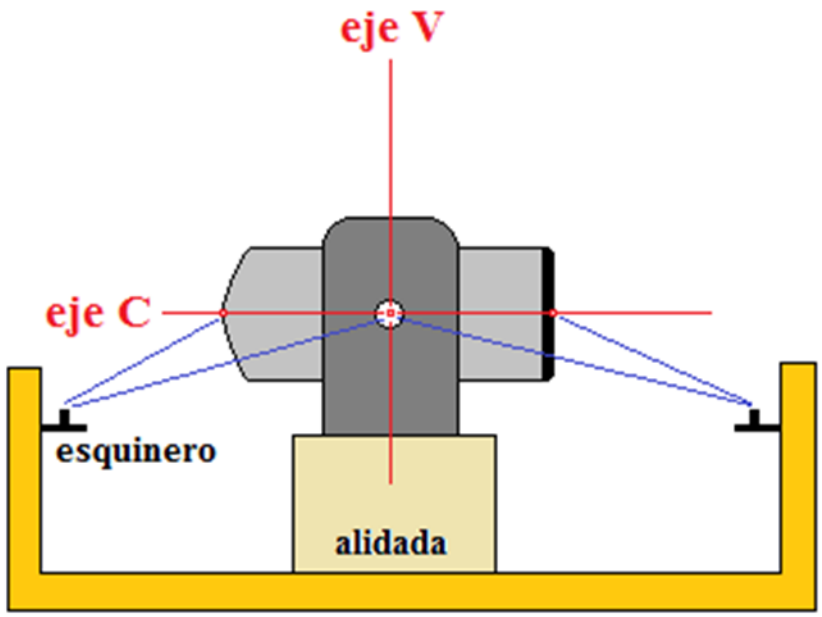

Number of COMPASS Tracked
ZIML 2
ZELL 1
WETL 3
SVEL 0
STL3 4
SJUL 1
SIML 0
SISL 0
HERL 2
POT3 0
THTL 1
GODL 0
HARL 0
YARL 4
MONL 1
MDOL 0
MATM 2
KOML 1
GRSM 3
DAEK 0
KTZL 0
SHA2 1
CHAL 4
BRAL 0
BEIL 0
BAIL 0
BADL 0
GRZL 2
ARKL 0
ALTL 2
Station
0 1 2 3 4 5
Number of Satellties
Number of GALILEO and GIOVE Tracked
ZIML 3
ZELL 1
WETL 4
SVEL 4
STL3 4
SJUL 5
SIML 0
SISL 0
HERL 4
POT3 2
THTL 3
GODL 3
HARL 2
YARL 5
MONL 4
MDOL 4
MATM 4
KOML 2
GRSM 4
DAEK 1
KTZL 0
SHA2 3
CHAL 5
BRAL 4
BEIL 0
BAIL 4
BADL 1
GRZL 4
ARKL 3
ALTL 5
Staiton
0 2 4 6
Number of Satellites

Colocation SLR and GPS



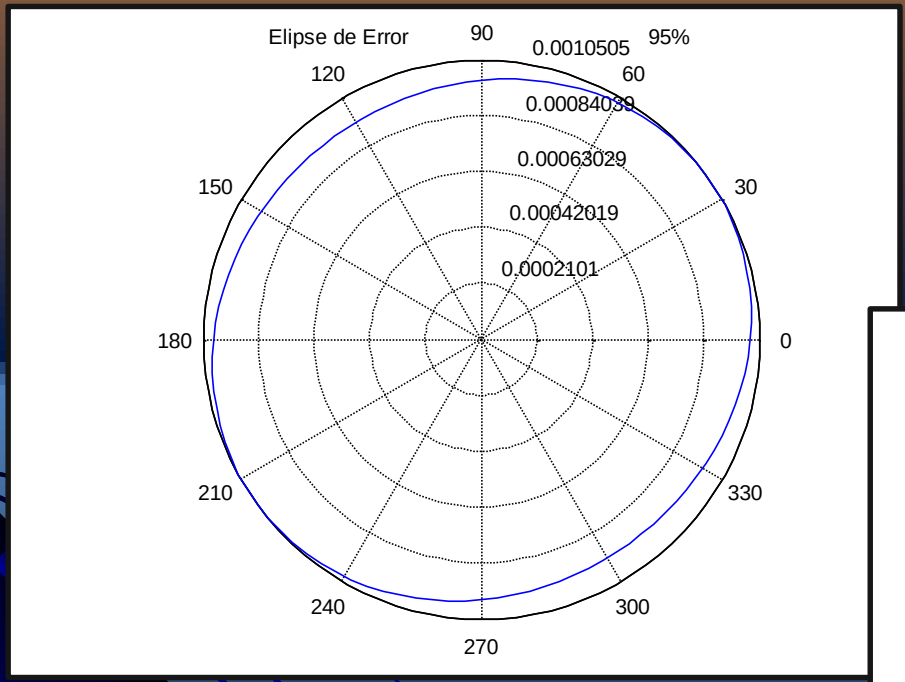



eje C
10
11
15
eje H
14
16
13
9
12
esquinero

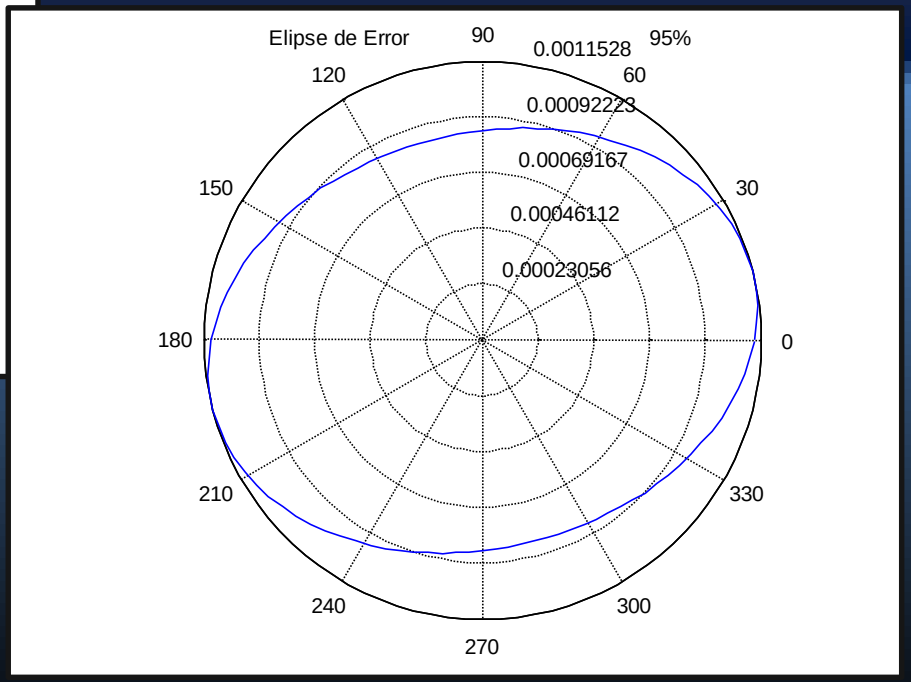

eje V
eje C
esquinero
alidada

Error Ellipses

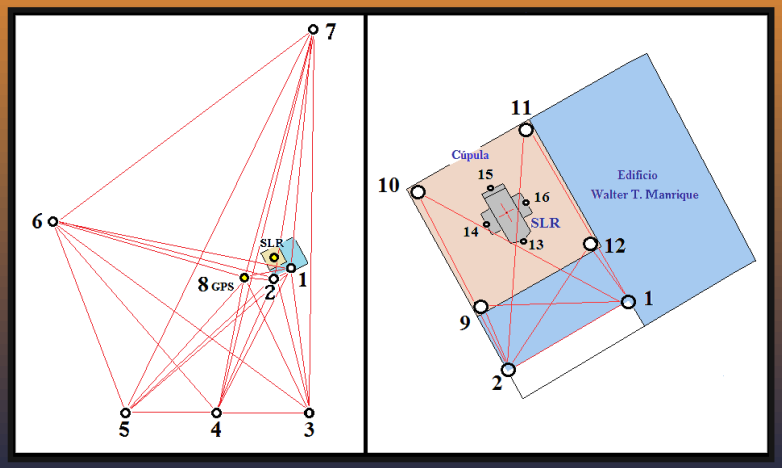
ELIPSE PUNTO 1
*SEMIEJE MAYOR A=0.0011 m ,
*SEMIEJE MENOR B=0.0009 m
*AZIMUT FI=34.83 grados ,
*EXCENT. =0.1881 , *AREA (cm2) = 0.03

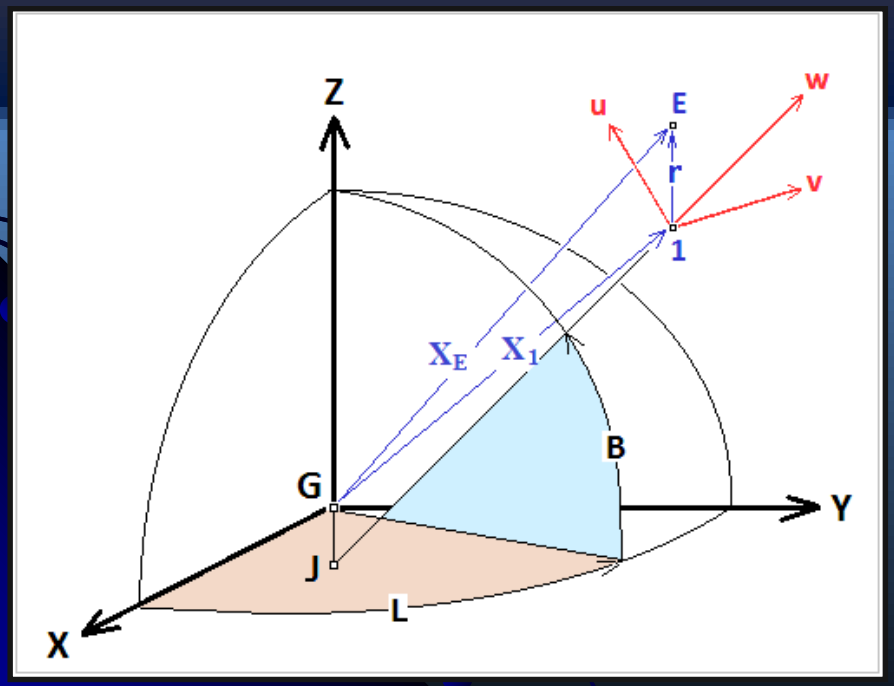


ELIPSE PUNTO 7
*SEMIEJE MAYOR A=0.0012 m ,
*SEMIEJE MENOR B=0.0009 m
*AZIMUT FI=14.54 grados ,
*EXCENT. =0.4456 , *AREA (cm2) = 0.03



Propagation of Errors





Taking the local net as a basis centered on the vertex 1, the errors propagated by the linear and angular measurements to the corner points are determined, according to the formulas

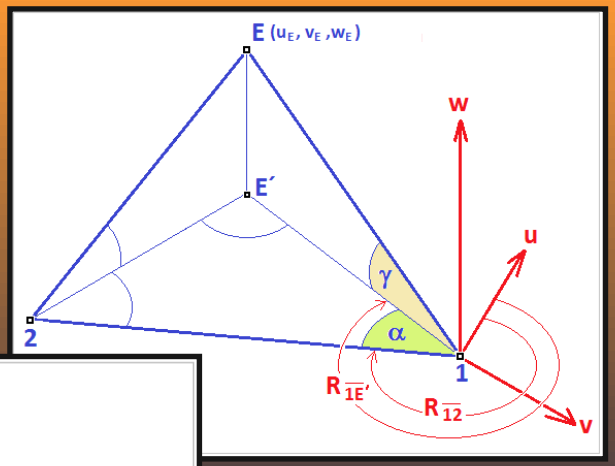
$$\mathbf{X_E} = \begin{bmatrix} X_E \\ Y_E \\ Z_E \end{bmatrix} \Rightarrow \text{Coordenadas geocéntricas de E}$$

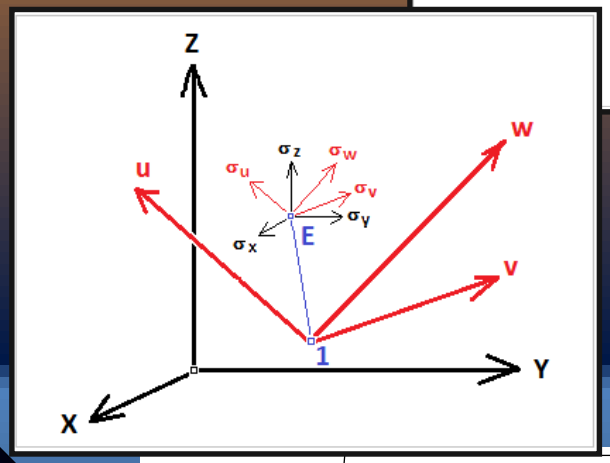
$$\mathbf{r} = \begin{bmatrix} u_r \\ v_r \\ w_r \end{bmatrix} \Rightarrow \text{Coord. de E respecto al SGHL}$$

$$\mathbf{X_1} = \begin{bmatrix} X_1 \\ Y_1 \\ Z_1 \end{bmatrix} \Rightarrow \text{Coord. geodésicas del origen}$$

$$\mathbf{R_{L,B}} = \begin{bmatrix} -senB\cos L & -senL & \cos B\cos L \\ -senB\,senL & \cos L & \cos B\,senL \\ \cos B & 0 & senB \end{bmatrix} \Rightarrow \text{Matriz de rotación}$$

$$\Sigma_{\mathbf{X_E}} = \begin{bmatrix} \sigma_X^2 & \sigma_{XY} & \sigma_{XZ} \\ \sigma_{XY} & \sigma_Y^2 & \sigma_{YZ} \\ \sigma_{XZ} & \sigma_{YZ} & \sigma_Z^2 \end{bmatrix} = \Sigma\mathbf{X_1} + \mathbf{R_{L,B}}\,\Sigma\mathbf{r}\,\mathbf{R_{L,B}^T}$$





$$u_E = \overline{1E}\,\cos\gamma\,\cos(R_{\overline{12}} \pm \alpha) = f\,(\,\overline{1E}, \alpha,\ \gamma\,,\ R_{\overline{12}}\,)$$

$$v_E = \overline{1E}\,\cos\gamma\,\operatorname{sen}(R_{\overline{12}} \pm \alpha) = f\,(\,\overline{1E},\ \alpha,\ \gamma\,,\ R_{\overline{12}})$$

$$w_E = \overline{1E}\,\operatorname{sen}\gamma = f\,(\,\overline{1E},\ \gamma\,)$$

$$\sigma_{u_E} = \sqrt{\left(\frac{\partial f}{\partial \overline{1E}}\right)^2 \sigma^2_{\overline{1E}} + \left(\frac{\partial f}{\partial \alpha}\right)^2 \frac{\sigma^2_{\alpha}}{206265^2} + \left(\frac{\partial f}{\partial \gamma}\right)^2 \frac{\sigma^2_{\gamma}}{206265^2} + \left(\frac{\partial f}{\partial R_{\overline{12}}}\right)^2 \frac{\sigma^2_{R_{\overline{12}}}}{206265^2}}$$

$$\sigma_{v_E} = \sqrt{\left(\frac{\partial f}{\partial \overline{1E}}\right)^2 \sigma^2_{\overline{1E}} + \left(\frac{\partial f}{\partial \alpha}\right)^2 \frac{\sigma^2_{\alpha}}{206265^2} + \left(\frac{\partial f}{\partial \gamma}\right)^2 \frac{\sigma^2_{\gamma}}{206265^2} + \left(\frac{\partial f}{\partial R_{\overline{12}}}\right)^2 \frac{\sigma^2_{R_{\overline{12}}}}{206265^2}}$$

$$\sigma_{w_E} = \sqrt{\left(\frac{\partial f}{\partial \overline{1E}}\right)^2 \sigma^2_{\overline{1E}} + \left(\frac{\partial f}{\partial \gamma}\right)^2 \frac{\sigma^2_{\gamma}}{206265^2}}$$

Final coordinates of the network points

Epoch 2012,403
ITRF 2005

Punto	X	Y	Z
1	1984110,4081	-5068864,3161	-3314482,4443
2	1984106,3887	-5068864,5135	-3314484,5838
3	1984100,2568	-5068831,6577	-3314531,0416
4	1984077,8903	-5068840,3763	-3314531,1024
5	1984055,5276	-5068849,0898	-3314531,1517
6	1984053,2547	-5068880,6993	-3314485,7836
7	1984132,7308	-5068898,3303	-3314412,1670
8	1984095,7826	-5068868,3277	-3314485,5004
9	1984105,4952	-5068866,0664	-3314482,3068
10	1984104,1382	-5068868,7369	-3314479,3020
11	1984107,6748	-5068868,1806	-3314477,1238
12	1984109,0978	-5068865,6022	-3314480,1866
CGL	1984106,7928	-5068867,4829	-3314479,9346

$$\text{Vector Punto 8 - CGL} = \sqrt{(X_8 - X_{CGL})^2 + (Y_8 - Y_{CGL})^2 + (Z_8 - Z_{CGL})^2} = 12.3659 \text{ metros}$$

Standard errors of the adjusted coordinates (meters)

Punto	sigma X	sigma Y	sigma Z
1	0,0005	0,0007	0,0005
2	0,0006	0,0008	0,0007
3	0,0005	0,0007	0,0005
4	0,0005	0,0007	0,0005
5	0,0005	0,0006	0,0005
6	0,0005	0,0007	0,0005
7	0,0005	0,0007	0,0004
8	0,0004	0,0006	0,0004
9	0,0015	0,0011	0,0023
10	0,0014	0,0016	0,0022
11	0,0010	0,0024	0,0016
12	0,0011	0,0023	0,0016
CGL	0,0010	0,0031	0,0014

The IERS stipulates to obtain errors between 2 and 3 millimeters

This tolerances were accomplished totally

Works published in SLR (magazines, conferences and meetings)

The SLR of San Juan officially began its observations in February 2006. These are our publications since that date:

**** Láser Satelital San Juan***
WORKSHOP SOBRE ASTRONOMÍA OBSERVACIONAL EN ARGENTINA. PROBLEMAS Y PERSPECTIVAS (LA PLATA –ARGENTINA 2006)

**** New SLR Station Running in San Juan of Argentina***
15TH INTERNATIONAL WORKSHOP ON LASER RANGING (CANBERRA – AUSTRALIA 2006)

**** Instalación y primeras observaciones con el SLR San Juan***
49º REUNIÓN ANUAL DE LA ASOCIACIÓN ARGENTINA DE ASTRONOMÍA (CAPILLA DEL MONTE – CÓRDOBA – ARGENTINA 2006)

**** Comparación de los resultados de la Estación ILRS 7406 con otras estaciones de la Red Mundial***
50º REUNIÓN ANUAL DE LA ASOCIACIÓN ARGENTINA DE ASTRONOMÍA (MALARGUE – ARGENTINA 2007)

**** Successful operation of a cooperative SLR station of China and Argentina in San Juan***
CHINESE SCIENCE BULLETIN (A&A) (2008)

**** San Juan Satellite Laser Ranging. Performance and Precission in the Observations***
XII LATIN AMERICAN REGIONAL IAU MEETING (ISLA DE MARGARITA – VENEZUELA 2007)

**** Contribution to the Galileo System by the SLR San Juan Station***
51º REUNIÓN ANUAL DE LA ASOCIACIÓN ARGENTINA DE ASTRONOMÍA (SAN JUAN – ARGENTINA 2008)

**** Actuality and Futurity of the SLR System Used in Cooperation between China and Argentina***
4TH KOREA-CHINA SLR WORKSHOP (GYEONGJU – SOUTH KOREA 2008)

**** Estación San Juan SLR 7406***
1º WORKSHOP SUDAMERICANO SLR (SAN JUAN – ARGENTINA 2009)

**** Status and future of the cooperative San Juan SLR Station***
XXVIITH GENERAL ASSEMBLY INTERNATIONAL ASTRONOMICAL UNION (RÍO DE JANEIRO – BRASIL 2009)

**** San Juan Satellite Laser Ranging. Performance and Precission in the Observations***
REVISTA MEXICANA DE ASTRONOMÍA Y ASTROFÍSICA (2009)

**** Observaciones y resultados con Satellite Laser Ranging (San Juan SLR)***
JORNADAS DE CIENCIA Y TÉCNICA. UNIVERSIDAD NACIONAL DE SAN JUAN (SAN JUAN – ARGENTINA 2010)

**** San Juan Satellite Laser Ranging. Observaciones y Geodinámica dentro del ITRF***
53º REUNIÓN ANUAL DE LA ASOCIACIÓN ARGENTINA DE ASTRONOMÍA (SALTA –ARGENTINA 2010)

**** Estación Satellite Laser Ranging ILRS 7406 de San Juan. Perfomance de las Observaciones y futuros proyectos para la Estación***
XXV REUNIÓN CIENTÍFICA DE LA ASOCIACIÓN ARGENTINA DE GEOFÍSICOS Y GEODESTAS (CÓRDOBA – ARGENTINA 2010)

**** Estudios Geodinámicos Mediante la Técnica Espacial Satellite Laser Ranging (SLR)***
XXV REUNIÓN CIENTÍFICA DE LA ASOCIACIÓN ARGENTINA DE GEOFÍSICOS Y GEODESTAS (CÓRDOBA – ARGENTINA 2010)

**** Current situation and future of cooperative San Juan SLR Station between Chinese-Argentinean***
17TH INTERNATIONAL WORKSHOP ON LASER RANGING AND 23RD GENERAL ASSEMBLY OF THE INTERNATIONAL LASER RANGING SERVICE (BAD KOTZTING – GERMANY 2011)

**** The SLR Monitoring Crustal Movement in South America***
17TH INTERNATIONAL WORKSHOP ON LASER RANGING AND 23RD GENERAL ASSEMBLY OF THE INTERNATIONAL LASER RANGING SERVICE (BAD KOTZTING – GERMANY 2011)

** South American SLR stations monitoring ground displacement caused by the M8.8 Chilean earthquake of 2010*
CHINESE SCIENCE BULLETIN (A&A) (2011)

** Determinación SLR de coordenadas de Estaciones ITRF*
PRIMERA REUNIÓN ANUAL BINACIONAL ARGENTINA – CHILE (SAN JUAN – ARGENTINA 2011)

** Determinación de los Parámetros de Rotación de la Tierra con observaciones Satellite Laser Ranging*
PRIMERA REUNIÓN ANUAL BINACIONAL ARGENTINA – CHILE (SAN JUAN – ARGENTINA 2011)

** Estudios Geodinámicos de la Estación San Juan SLR dentro de la Red ITRF en Sudamérica*
ASTRONOMÍA DINÁMICA EN LATINO AMÉRICA ADELA (LA PLATA – ARGENTINA 2012)

** Actualidad y Proyectos Futuros de la Estación 7406 San Juan, Argentina*
SIMPOSIO SIRGAS 2012 (CONCEPCIÓN – CHILE 2012)

** Geodinámica empleando coordenadas geodésicas de la Estación San Juan SLR*
ASTRONOMÍA DINÁMICA EN LATINO AMÉRICA ADELA (LA PLATA – ARGENTINA 2012)

** SLR - GPS Progress in Co-location at San Juan (Argentina) Station*
IAU GENERAL ASSEMBLY, JOINT DISCUSSION SPACE-TIME REFERENCE SYSTEMS FOR FUTURE RESEARCHS (BEIGING – CHINA 2012)

** SLR And GPS Spatial Techniques In ITRF. Argentine Results.*
IAU GENERAL ASSEMBLY, JOINT DISCUSSION SPACE-TIME REFERENCE SYSTEMS FOR FUTURE RESEARCHS (BEIGING – CHINA 2012)

** Primera Comparación de Coordenadas SLR y GPS de la Estación OAFA*
SIMPOSIO SIRGAS 2013 (PANAMÁ 2013)

** Colocación de las técnicas geodésicas satelitales SLR y GPS en el Observatorio Astronómico Félix Aguilar de San Juan, Argentina*
SIMPOSIO SIRGAS 2013 (PANAMÁ 2013)

** Determinación de la velocidad angular de la rotación Terrestre con SLR*
XXVII REUNIÓN CIENTÍFICA DE LA ASOCIACIÓN ARGENTINA DE GEOFÍSICOS Y GEODESTAS (SAN JUAN – ARGENTINA 2014)

** Análisis Geodinámico de la Estación OAFA utilizando las Técnicas SLR y GPS*
XXVII REUNIÓN CIENTÍFICA DE LA ASOCIACIÓN ARGENTINA DE GEOFÍSICOS Y GEODESTAS (SAN JUAN – ARGENTINA 2014)

**** LOD first estimates in 7406 SLR San Juan Argentina station***
ASTRONOMÍA DINÁMICA EN LATINO AMÉRICA ADELA (SANTIAGO DE CHILE 2014)

**** Earth Orientation Parameters (EOP´s) using SLR data from ILRS 7406 station at San Juan, Argentina***
19TH INTERNATIONAL WORKSHOP ON LASER RANGING. CELEBRATING 50 YEARS OF SLR (ANNAPOLIS – USA 2014)

**** Local ties to determine the co-location vector from the SLR telescope and GPS antenna in San Juan, Argentina.***
19TH INTERNATIONAL WORKSHOP ON LASER RANGING. CELEBRATING 50 YEARS OF SLR (ANNAPOLIS – USA 2014)

**** Beneficios del Tracking SLR a las constalaciones GNSS***
SIMPOSIO SIRGAS 2015 (SANTO DOMINGO – REPÚBLICA DOMINICANA 2015)

**** LOD First estimates in 7406 SLR San Juan - Argentina station***
REVISTA MEXICANA DE ASTRONOMÍA Y ASTROFÍSICA (2015)

Astrometric Progress at "Félix Aguilar Astronomical Observatory (San Juan, Argentina)" and proposals of research and postgraduate projects
ASTRONOMÍA DINÁMICA EN AMÉRICA LATINA ADELA (BOGOTÁ – COLOMBIA 2016)

Ten years of SLR production in Argentina
LATIN AMERICAN REGIONAL IAU MEETING (CARTAGENA DE INDIAS - COLOMBIA 2016)

Geodesia Espacial en la Argentina
2º ENCUENTRO DE INVESTIGADORES DE AGRIMENSURA. (SANTA FE - ARGENTINA 2016)

Co-location satellite GPS and SLR geodetic techniques at the Felix Aguilar Astronomical Observatory of San Juan, Argentina
ASTRONOMÍA DINÁMICA EN LATINO AMÉRICA ADELA (BOGOTÁ- COLOMBIA 2016)

New International Agreements about Spatial Technics among Argentina, China and France
LATIN AMERICAN REGIONAL IAU MEETING (CARTAGENA DE INDIAS - COLOMBIA 2016)

** Ten years of SLR production in Argentina*
REVISTA MEXICANA DE ASTRONOMÍA Y ASTROFÍSICA (2017)

** Terrestrial Rotation studies from SLR station at San Juan – Argentina (ILRS 7406)*
JOURNEES 2017 DES SYSTEMS DE REFERENCE ET DE LA ROTACION TERRESTRE (ALICANTE – SPAIN 2017)

MUCHAS GRACIAS