Center of Processing INEGI

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Key words: Geodetic Network, ITRF, data processing, time series.

SUMMARY

In collaboration with SIRGAS Project, Working Group I Reference Systems, INEGI has started the Pilot Center of Processing INEGI of GNSS observations in 2005. The GNSS station observations on stations located in North America and Central America (Mexico, United States, Canada, Nicaragua, Guatemala and Cuba) and United Kingdom are obtained, organized and processed to get daily solutions on a weekly basis.

Center of Processing started on GPS week 1317 (April 3 of 2005) using a scientific processing software, obtaining NO fiducial daily solutions which are transformed to the reference frame ITRF 2000.

RESUMEN

INEGI, en colaboración con el proyecto SIRGAS dentro del grupo de trabajo I denominado "Sistemas de Referencia", inició el centro de procesamiento piloto INEGI de observaciones GNSS en el año 2005. Las observaciones GNSS de estaciones ubicadas en Norte América y Centro América (México, Estados Unidos, Canadá, Nicaragua, Guatemala y Cuba) y Reino Unido son recopiladas, organizadas y procesadas para obtener soluciones diarias de manera semanal.

El Centro de procesamiento inició en la semana GPS 1317 (3 de abril del 2005) mediante la utilización de software de procesamiento científico y se obtienen soluciones diarias NO FIDUCIALES las cuales se transforman al marco de referencia ITRF 2000.

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1. INTRODUCTION

During the SIRGAS meeting held in December 9 and 10, 2004 at INEGI headquarters, Aguascalientes, Mexico, the agreement to start a Pilot Processing Center during a year was made in order to analyze the viability to distribute central SIRGAS data processing to regional processing centers.

INEGI started in January 2005 the following activities:

Research and selection of processing software.
Installation of LINUX and GIPSY OASIS II.
Software configuration.
Processing Tests.
Selection of stations.
Automatized File download.

Once concluded the previous activities, the formal beginning of Pilot Center of Processing INEGI on May 16, 2005; the data processing of the GPS week 1317 (April 3-9, 2005) was the first carried out.

Derived from the weekly processing, daily stacov and sinex files with a NO FIDUCIAL solution are transferred to INEGI FTP server in the Terrestrial Reference Frame Department in charge of José Guillermo Gasca Moncayo and the personnel that is doing the weekly processing, Alfonso Langle Gómez and Rolando Santiago Mejía Onofre.

The activities of Center of Processing INEGI, intended to be a SIRGAS regional processing center, monitor station coordinates, obtain and participate in Reference Frame solutions are related to the FIG commission 5 Positioning and Measurement on the Working Group 5.2, Reference Frame in Practice.

2. STATION SELECTION

The station selection was based on Seemuller, Kaniuth, Drewes (2004), DGFI Report No. 76, Central America and Caribbean stations on operation were identified and incorporated to Center of Processing INEGI, also were the stations of The Active National Geodetic Network (RGNA) and some IGS stations; a total of 24 stations were selected:

Station	Ubication	Country
ALGO	Algonquin Park	Canada
BRMU	Bermuda	U.K.
CAM2	Campeche	México
CHET	Chetumal	México
CHI3	Chihuahua	México
CIC1	Ensenada	México
COL2	Colima	México
CULI	Culiacán	México
GUAT	Guatemala	Guatemala
HER2	Hermosillo	México
INEG	Aguascalientes	México
LPAZ	La Paz	México
MANA	Managua	Nicaragua
MDO1	Fort Davis	USA
MERI	Mérida	México
MEXI	Mexicali	México
MTY2	Monterrey	México
OAX2	Oaxaca	México
PIE1	Pie Town	USA
PUR3	ISABELLA	USA
SCUB	Santiago de Cuba	Cuba
TAMP	Tampico	México
TOL2	Toluca	México
VIL2	Villahermosa	México

Table 1. Stations of Center of Processing INEGI

3. STATION DISTRIBUTION

The station distribution of sites included in The Center of Processing INEGI, sixteen stations located in the Mexican Territory, two in United States, two in Central America, and one in Canada, Bermuda, Cuba and Puerto Rico respectively, is shown in the next figure.

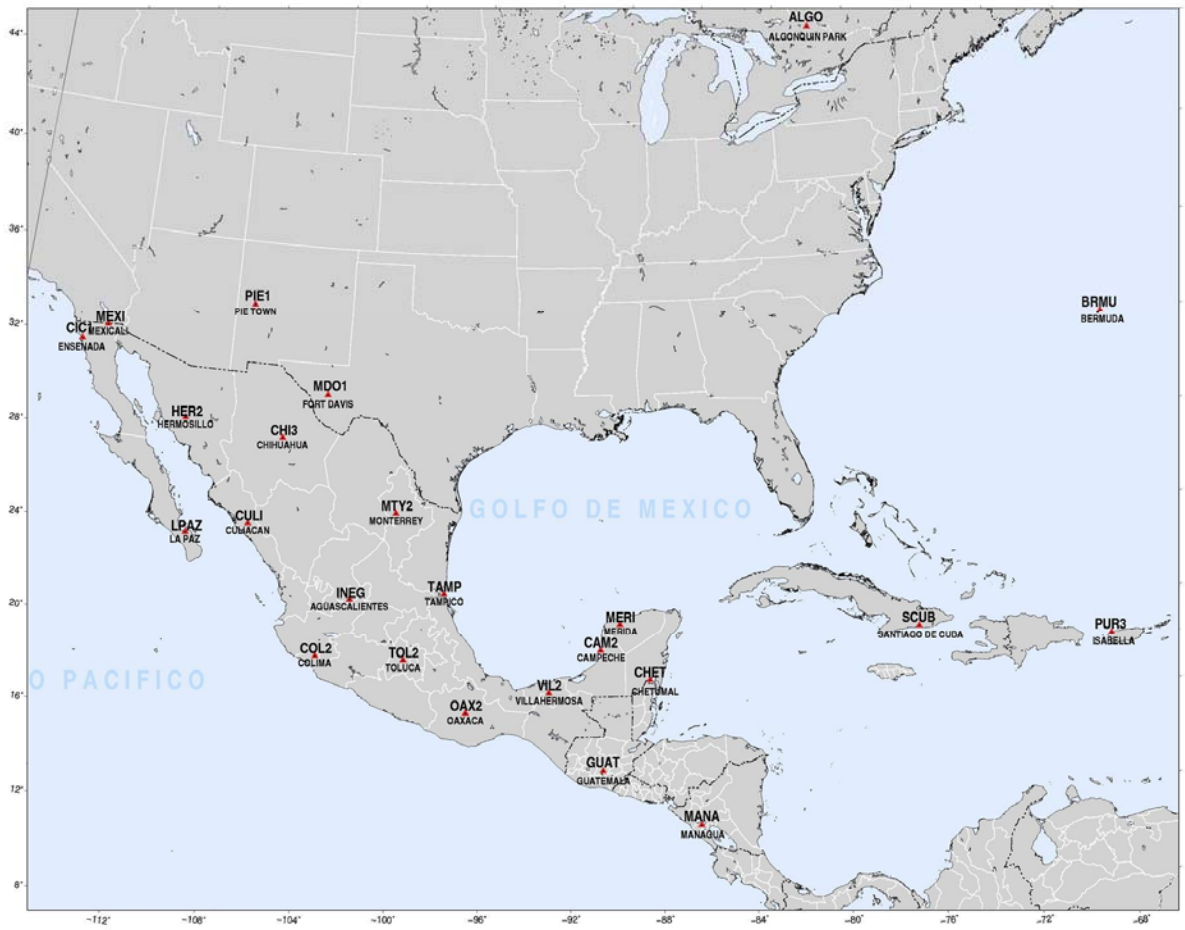


Figure 1. Stations of Center of Processing INEGI

4. PROCESSING PROCEDURE

Based on research of data processing methodology, information analysis and the paper of Webb & Zumberge, the conclusion was that the option more convenient and recommended for data processing in GIPSY OASIS II was to obtain NO FIDUCIAL solutions which are transformed to a reference frame using transformation parameters.

The main characteristics of the daily processing are:

Software	Gipsy Oasis II
Record Interval	15 seconds
Elevation mask	10 degrees
Ambiguities	Estimated as real values
Ocean Loading	Scherneck
Generated Files	STACOV and SINEX

Once the weekly processing is made, the STACOV and SINEX files are transferred to INEGI FTP server on a directory structure based on the GPS week number.

For example, for the week of April 3 through 9 of 2005, the directory named 1317 is created, the files are upload with the next file format:

INEssssd.type

Where

INE : 3 letters representing Center of Processing INEGI
ssss : GPS week number
d : day of the GPS week (0..6)
type : stacov y snx.

For a complete week, 14 files are uploaded , 7 STACOV and 7 SINEX corresponding to the daily processing.

5. PROCESSING RESULTS

5.1 ITRF Solution

The ITRF solution referred to the reference frame ITRF 2000 epoch 2006.0 derived from the data processing of 51 GPS weeks from 1317 to 1367 is:

STATION	COMPONENT	VALUE	COVARIANCE MATRIX (meters)		
ALGO	LAT	45.955800317	0.0001	0.019518	-0.186532
ALGO	LON	-78.071368437	0.0001	-0.009819	
ALGO	ALT	200.9325	0.0003		
BRMU	LAT	32.370398726	0.0001	-0.059774	-0.059774
BRMU	LON	-64.696273272	0.0001	0.010193	
BRMU	ALT	-11.6070	0.0003		
CAM2	LAT	19.844427005	0.0002	0.031141	-0.153029
CAM2	LON	-90.540165535	0.0005	-0.049187	
CAM2	ALT	12.2355	0.0006		
CHET	LAT	18.495276577	0.0002	0.018581	-0.132659
CHET	LON	-88.299224584	0.0005	-0.052150	
CHET	ALT	3.0123	0.0006		
CHI3	LAT	28.662192641	0.0002	0.021974	-0.239864
CHI3	LON	-106.086739486	0.0005	-0.025998	
CHI3	ALT	1413.2423	0.0006		
CIC1	LAT	31.870678141	0.0002	0.024449	-0.327724
CIC1	LON	-116.665761455	0.0004	-0.038924	

STATION	COMPONENT	VALUE	COVARIANCE MATRIX (meters)		
CIC1	ALT	64.3493	0.0006		
COL2	LAT	19.244442867	0.0002	0.031559	-0.192106
COL2	LON	-103.701883806	0.0004	-0.017806	
COL2	ALT	528.8171	0.0005		
CULI	LAT	24.798552154	0.0002	0.003927	-0.226627
CULI	LON	-107.383942747	0.0005	-0.038174	
CULI	ALT	75.4513	0.0006		
GUAT	LAT	14.590404059	0.0001	0.051646	-0.117110
GUAT	LON	-90.520183031	0.0003	-0.063439	
GUAT	ALT	1519.8979	0.0003		
HER2	LAT	29.092546909	0.0002	-0.002535	-0.237305
HER2	LON	-110.967215095	0.0005	-0.025482	
HER2	ALT	187.0017	0.0006		
INEG	LAT	21.856153528	0.0002	0.018740	-0.201089
INEG	LON	-102.284203176	0.0005	-0.041146	
INEG	ALT	1887.9820	0.0006		

Table 2. ITRF 2000 epoch 2006.0 Solution

STATION	COMPONENT	VALUE	COVARIANCE MATRIX (meters)		
LPAZ	LAT	24.138797767	0.0001	-0.018864	-0.201925
LPAZ	LON	-110.319346996	0.0003	-0.005226	
LPAZ	ALT	-6.7894	0.0004		
MANA	LAT	12.148938357	0.0001	0.046490	-0.076794
MANA	LON	-86.248993967	0.0004	-0.017675	
MANA	ALT	71.0622	0.0005		
MDO1	LAT	30.680511037	0.0001	0.045952	-0.227156
MDO1	LON	-104.014993270	0.0002	-0.067183	
MDO1	ALT	2004.5095	0.0004		
MERI	LAT	20.980045212	0.0002	0.025277	-0.131926
MERI	LON	-89.620317232	0.0005	-0.049597	
MERI	ALT	7.9131	0.0006		
MEXI	LAT	32.632991305	0.0001	-0.022721	-0.254708
MEXI	LON	-115.475703182	0.0003	0.012403	
MEXI	ALT	-22.4022	0.0004		
MTY2	LAT	25.715506545	0.0002	0.031503	-0.213253
MTY2	LON	-100.312905905	0.0005	-0.045284	
MTY2	ALT	521.7944	0.0006		
OAX2	LAT	17.078339680	0.0002	0.042910	-0.169293
OAX2	LON	-96.716739366	0.0005	-0.059081	
OAX2	ALT	1607.3075	0.0006		
PIE1	LAT	34.301505770	0.0001	0.027989	-0.159911

STATION	COMPONENT	VALUE	COVARIANCE MATRIX (meters)		
PIE1	LON	-108.118927243	0.0002	-0.007261	
PIE1	ALT	2347.7660	0.0003		
PUR3	LAT	18.462976605	0.0001	-0.123109	-0.168743
PUR3	LON	-67.066957428	0.0002	0.072877	
PUR3	ALT	89.6255	0.0003		
SCUB	LAT	20.012063268	0.0001	-0.089055	-0.060181
SCUB	LON	-75.762316480	0.0002	-0.037853	
SCUB	ALT	20.9381	0.0003		
TAMP	LAT	22.278320877	0.0002	0.037129	-0.203629
TAMP	LON	-97.864027091	0.0005	-0.051926	
TAMP	ALT	21.0602	0.0006		
TOL2	LAT	19.293234206	0.0001	0.028611	-0.161588
TOL2	LON	-99.643472123	0.0003	-0.043707	
TOL2	ALT	2651.7817	0.0004		
VIL2	LAT	17.990410454	0.0002	0.039644	-0.174191
VIL2	LON	-92.931098285	0.0006	-0.067279	
VIL2	ALT	27.7992	0.0006		

Table 2. ITRF 2000 epoch 2006.0 Solution

5.2 Daily Repeatability

The daily repeatabilities of the solutions from GPS week 1317 to 1367 of the latitude, longitude and geodetic height coordinates are:

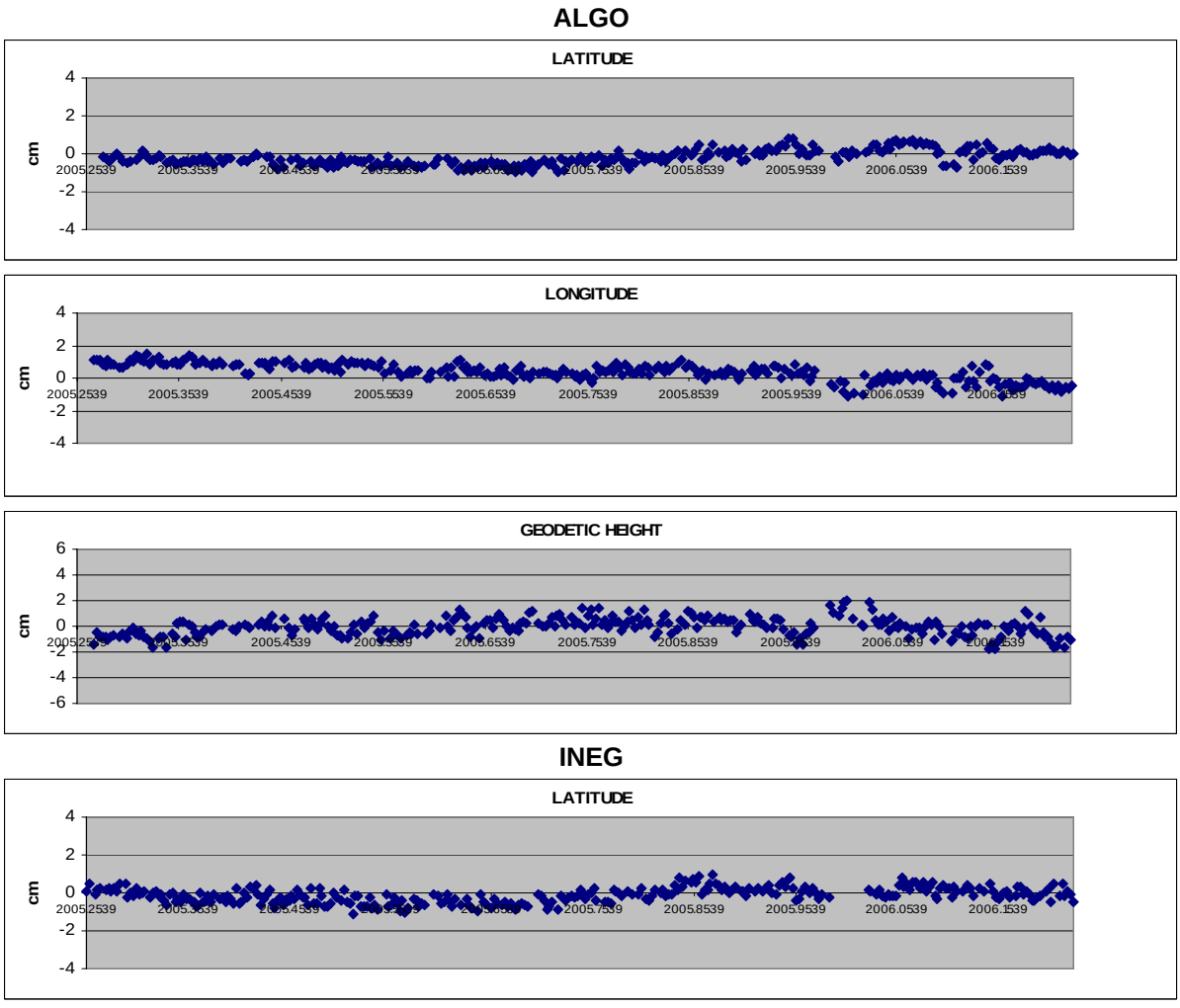
STATION	DAILY REPEATABILITY (meters)		
	Latitude	Longitude	Geodetic Height
ALGO	0.003	0.003	0.007
BRMU	0.004	0.005	0.006
CAM2	0.004	0.007	0.009
CHET	0.004	0.009	0.012
CHI3	0.004	0.006	0.009
CIC1	0.003	0.003	0.006
COL2	0.004	0.007	0.009
CULI	0.004	0.006	0.008
GUAT	0.003	0.007	0.007
HER2	0.004	0.006	0.008
INEG	0.004	0.005	0.008
LPAZ	0.003	0.005	0.008
MANA	0.004	0.007	0.010
MDO1	0.003	0.004	0.007
MERI	0.004	0.008	0.010
MEXI	0.004	0.005	0.007
MTY2	0.004	0.006	0.008

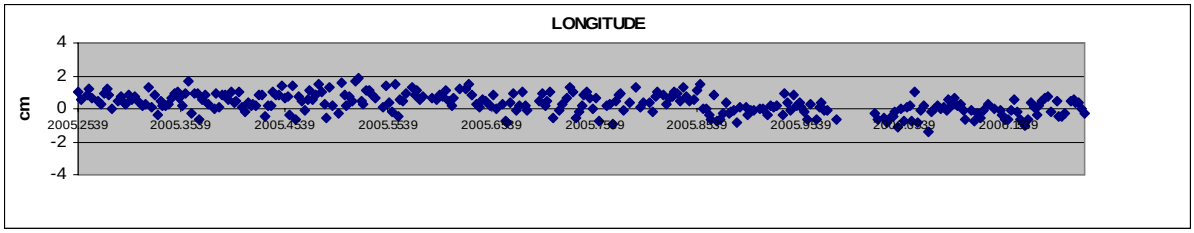
STATION	DAILY REPEATABILITY (meters)		
	Latitude	Longitude	Geodetic Height
OAX2	0.004	0.008	0.009
PIE1	0.003	0.005	0.007
PUR3	0.003	0.005	0.009
SCUB	0.003	0.005	0.009
TAMP	0.005	0.010	0.012
TOL2	0.004	0.005	0.009
VIL2	0.004	0.008	0.009

Table 3. Repeatability

6. TIME SERIES

The resulting time series of the four stations ALGO, INEG, LPAZ and MEXI are:




LONGITUDE
cm
4
2
0
-2
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2005.5539
2005.6539
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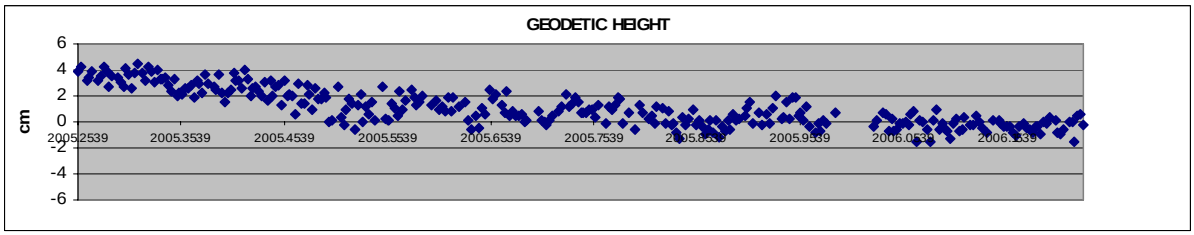
2005.8539
2005.9539


GEODETIC HEIGHT
cm
6
4
2
0
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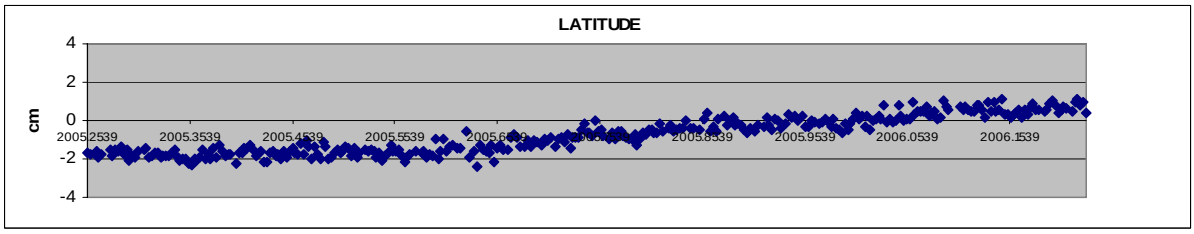
2005.5539
2005.6539
2005.7539
2005.9539
2006.0539

LPAZ


LATITUDE
cm
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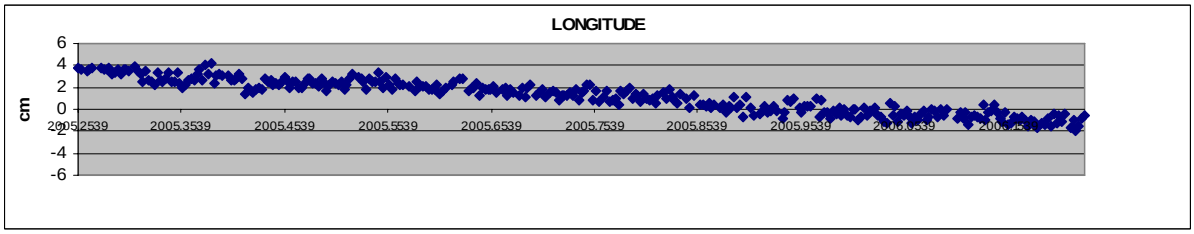
2006.0539
2006.1539


LONGITUDE
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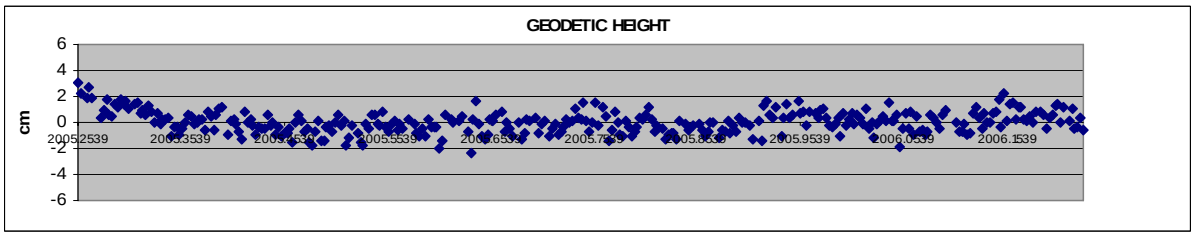
2005.2539
2005.3539
2005.4539
2005.5539
2005.6539
2005.7539
2005.8539
2005.9539


GEODETIC HEIGHT
cm
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4
2
0
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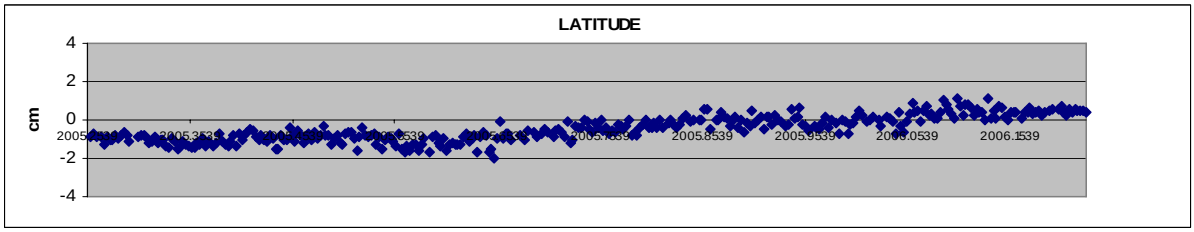
-4
-6
2005.2539
2005.9539
2006.0539
2006.1539

MEXI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2
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-2
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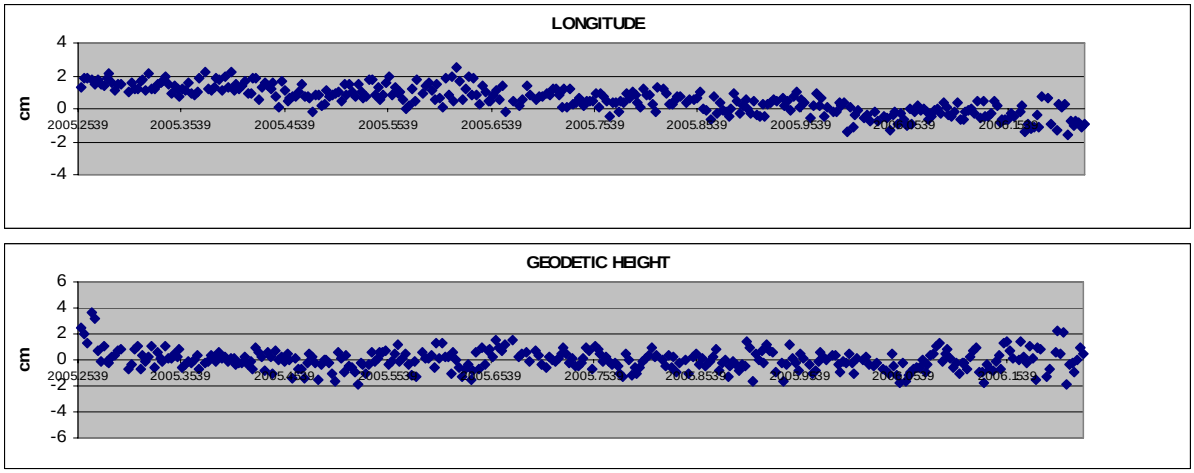
2006.0539
2006.1539


LONGITUDE
cm
4
2
0
-2
-4
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2005.3539
2005.4539
2005.5539
2005.6539
2005.7539
2005.8539
2005.9539

GEODETIC HEIGHT
cm
6
4
2
0
-2
-4
-6
2005.2539
2005.3539
2005.6539

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