INEGI Processing Center of GNSS Observations.

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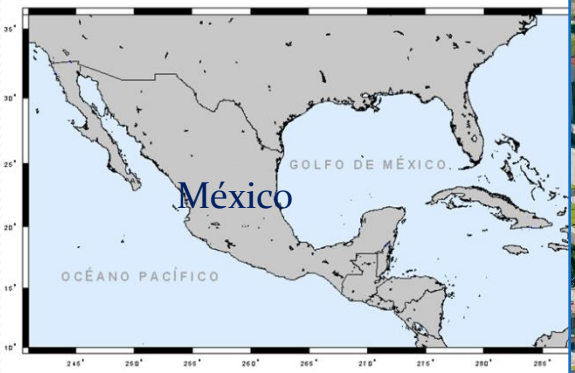
INEGI Center of Processing

INEGI (México) in collaboration with SIRGAS Project, Working Group I Reference Systems started the Experimental Center of Processing INEGI.

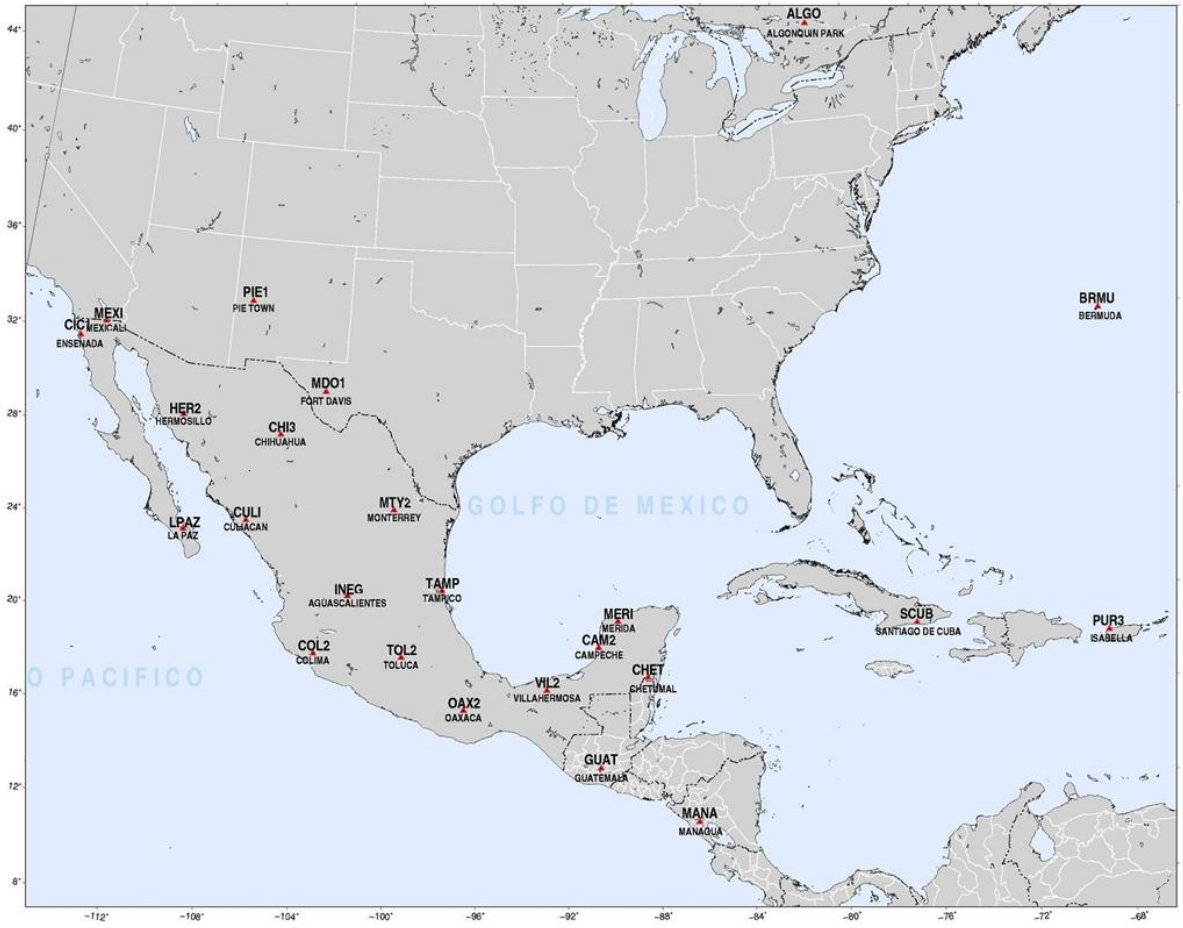


INEGI Headquarters

The activities of INEGI Processing Center are realized with the intention to be a SIRGAS regional processing center, monitor station coordinates, obtain and participate in Reference Frame solutions.

GIPSY OASIS II

From 2005 GIPSY OASIS II high precision software is used to obtain GNNS daily and weekly No fiducial and Fiducial solutions.



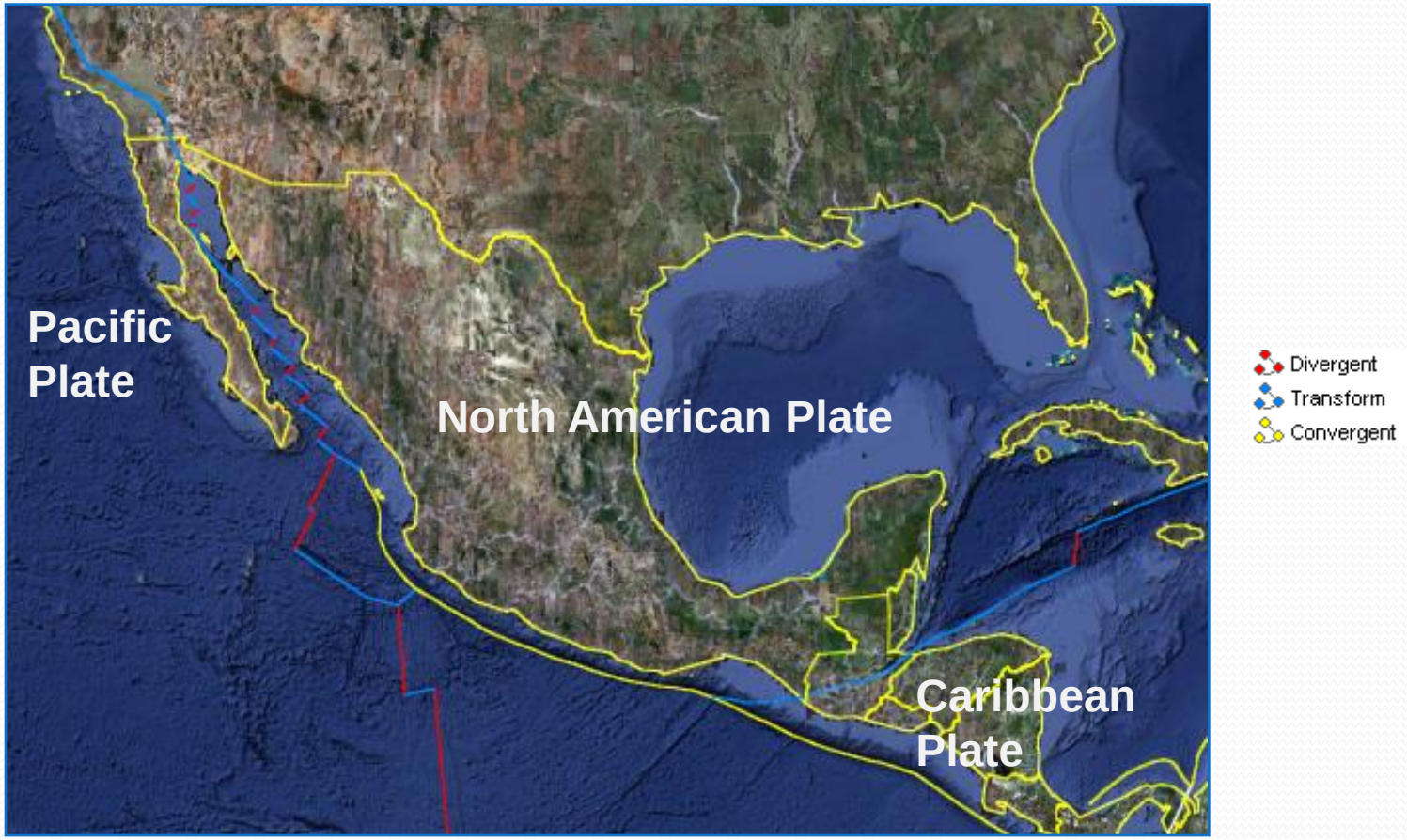
The station selection was based on DGFI Report No. 76, Central America and Caribbean stations on operation were identified and incorporated to Experimental Center of Processing INEGI.

GIPSY OASIS II RESULTS

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

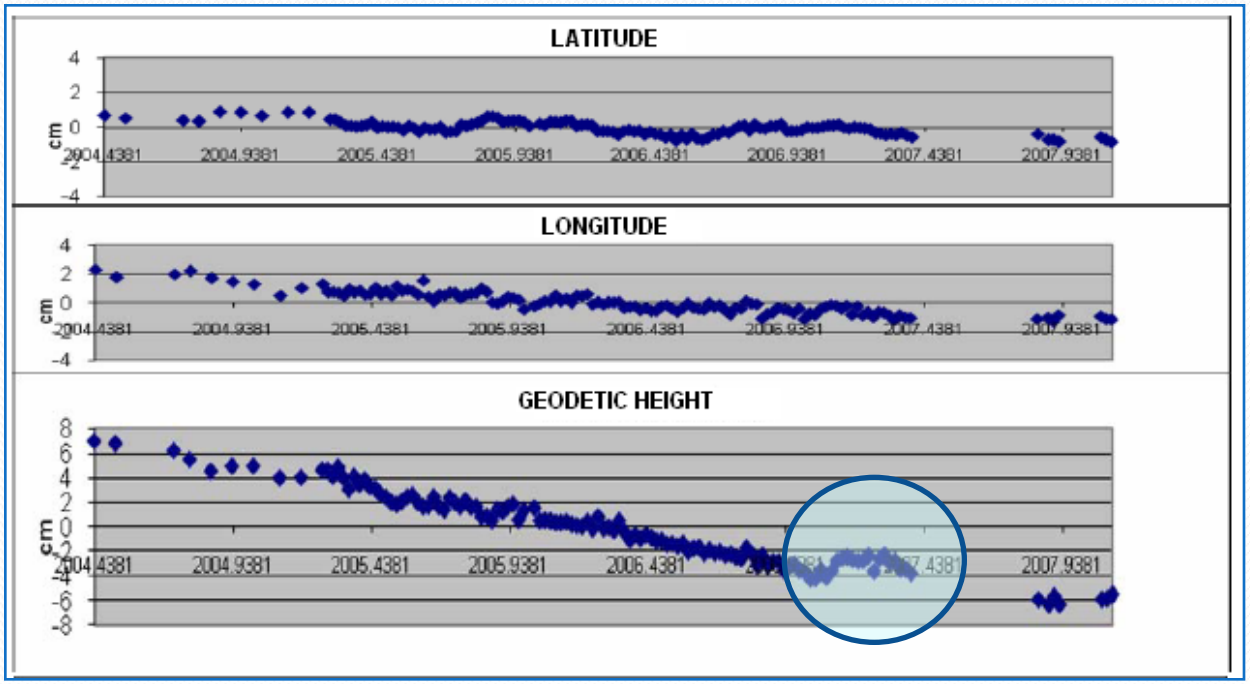
STATION	DAILY REPEATABILITY (meters)		
	Latitude	Longitude	Geodetic Height
MANA	0.004	0.007	0.010
MDO1	0.003	0.004	0.007
MERI	0.004	0.008	0.010
MEXI	0.004	0.005	0.007
MTY2	0.004	0.006	0.008
OAX2	0.004	0.008	0.009
PIE1	0.003	0.005	0.007
PUR3	0.003	0.005	0.009
SCUB	0.003	0.005	0.009
TAMP	0.005	0.010	0.012
TOL2	0.004	0.005	0.009
VIL2	0.004	0.008	0.009

TECTONIC PLATES (MEXICO)



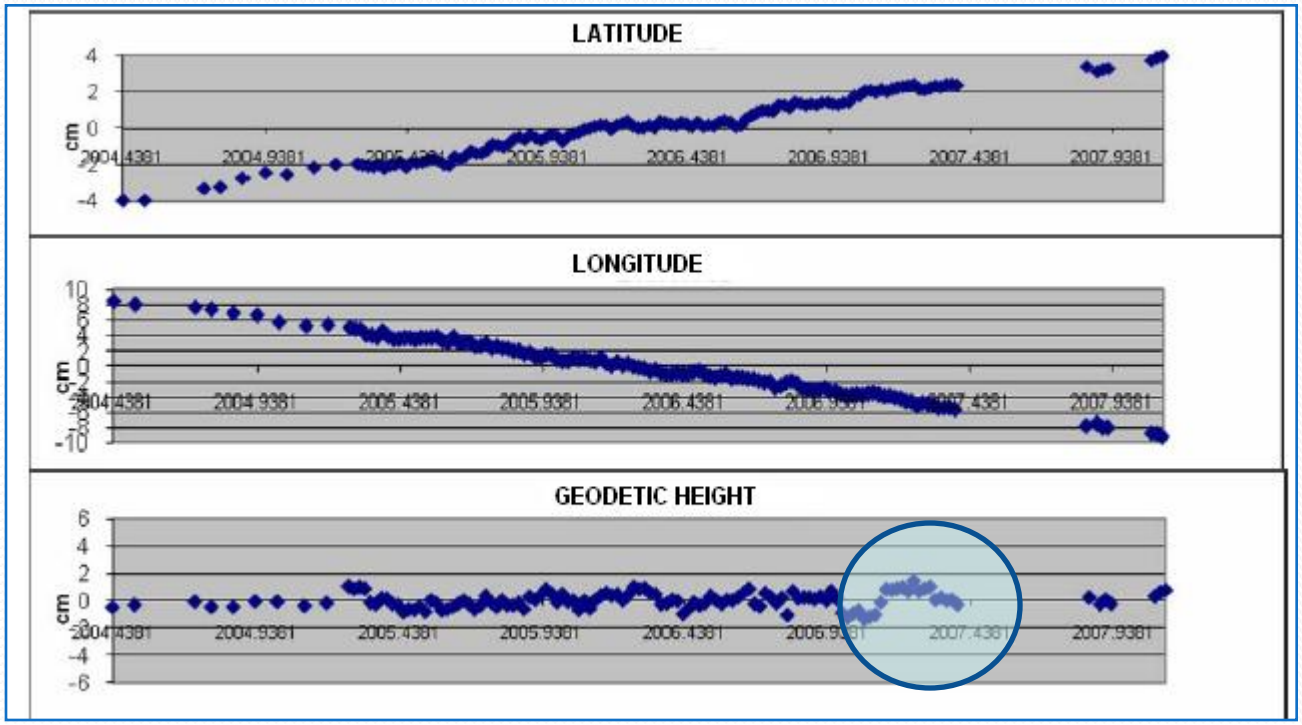
Source: Bird P. (2003), model PB2002, represented in Google Earth.

GIPSY OASIS II TIME SERIES (INEG)



INEG, station in the **North American Plate**

GIPSY OASIS II TIME SERIES (LPAZ)



LPAZ, station in the **Pacific Plate**

PROCESSING PROCEDURE

In the SIRGAS meeting in Rio de Janeiro, Brazil, some changes to the initial processing procedure were realized, between them the use of absolute variations of antenna phase centers.

Given that our processing in GIPSY OASIS II were with relative variations the need to change to absolute was identified, Jet Propulsory Laboratory (JPL) recommend us to update our version of GIPSY OASIS II to include absolute phase centers, but given some situations mainly of limited budget the use of other software was analyzed.

PROCESSING PROCEDURE

Thanks to Jet Propulsion Laboratory (JPL) to provide GIPSY OASIS II to INEGI that has permitted obtain high precision solutions and indirectly realize activities that promote geodetic research , sharing of knowledge and support the Mexican reference frame.

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 63  PARAMETERS ON 06OCT07.
  1   ALGO STA X          0.918126077600269E+06  +-  0.175818185274309E-02
  2   ALGO STA Y         -0.434607221613700E+07  +-  0.253002681791879E-02
  3   ALGO STA Z          0.456197764651448E+07  +-  0.243738520401898E-02
  4   CAM2 STA X         -0.565861645942433E+05  +-  0.736301527158365E-02
  5   CAM2 STA Y         -0.600144964543663E+07  +-  0.802197177502148E-02
  6   CAM2 STA Z          0.215150894738992E+07  +-  0.359894498026768E-02
  7   CHET STA X          0.179579919124108E+06  +-  0.740504029330046E-02
  8   CHET STA Y         -0.604808094584076E+07  +-  0.808093648624466E-02
  9   CHET STA Z          0.201044712770463E+07  +-  0.352371660995463E-02
 10   CHI3 STA X         -0.155231205679212E+07  +-  0.707350467729007E-02
 11   CHI3 STA Y         -0.538277081610982E+07  +-  0.736696023588135E-02
 12   CHI3 STA Z          0.304177970235446E+07  +-  0.421335738739260E-02
 13   COL2 STA X         -0.142701032436731E+07  +-  0.712253317483971E-02
 14   COL2 STA Y         -0.585297496212889E+07  +-  0.778487173574409E-02
 15   COL2 STA Z          0.208908884766117E+07  +-  0.345073411024103E-02
 16   HER2 STA X         -0.199600807267147E+07  +-  0.705024235391277E-02
 17   HER2 STA Y         -0.520867300445552E+07  +-  0.707700159726838E-02
 18   HER2 STA Z          0.308295951689549E+07  +-  0.409629707437314E-02
 19   INEG STA X         -0.126044031836226E+07  +-  0.734418677324573E-02
 20   INEG STA Y         -0.578854626147457E+07  +-  0.826795075675704E-02
 21   INEG STA Z          0.236033993249328E+07  +-  0.383363849066914E-02
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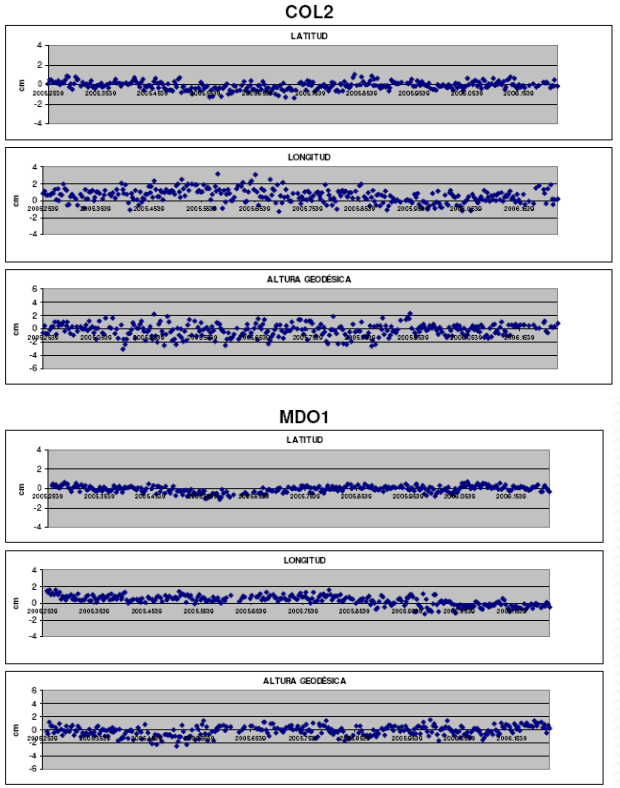
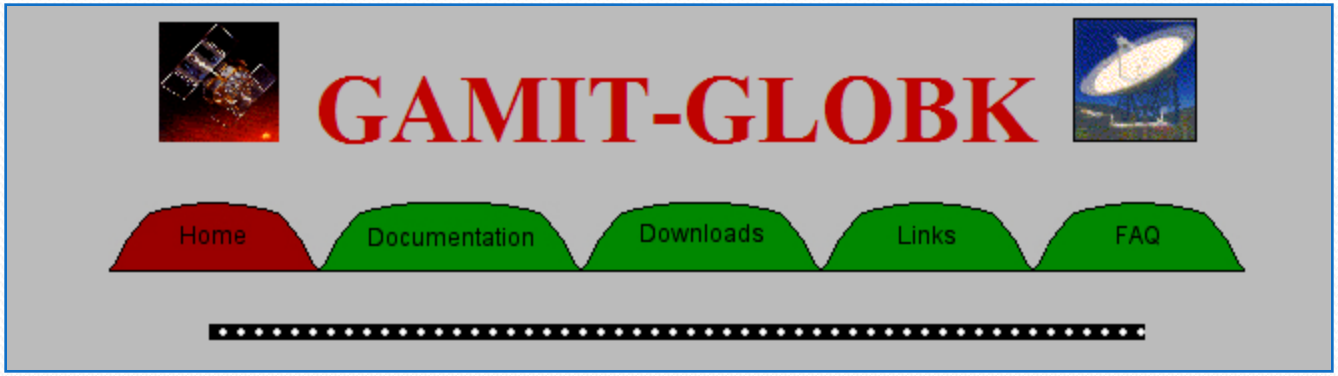
Partial stacov solution file.



GAMIT/GLOBK

GAMIT-GLOBK was identified to accomplish the requirements of the processing procedure from SIRGAS; communication was realized with Massachusetts Institute of Technology (MIT) through and thanks to Dr. Robert W. King GAMIT-GLOBK was obtained.



http://www-gpsg.mit.edu/~simon/gtgk/

GAMIT/GLOBK INSTALLATION

- **Linux Installation**

  Fedora Core 6 distribution was selected and considered adequate for our computer resources and the relation with Red Hat Linux, active network service like FTP is important to obtain GNSS data and other information required during processing.

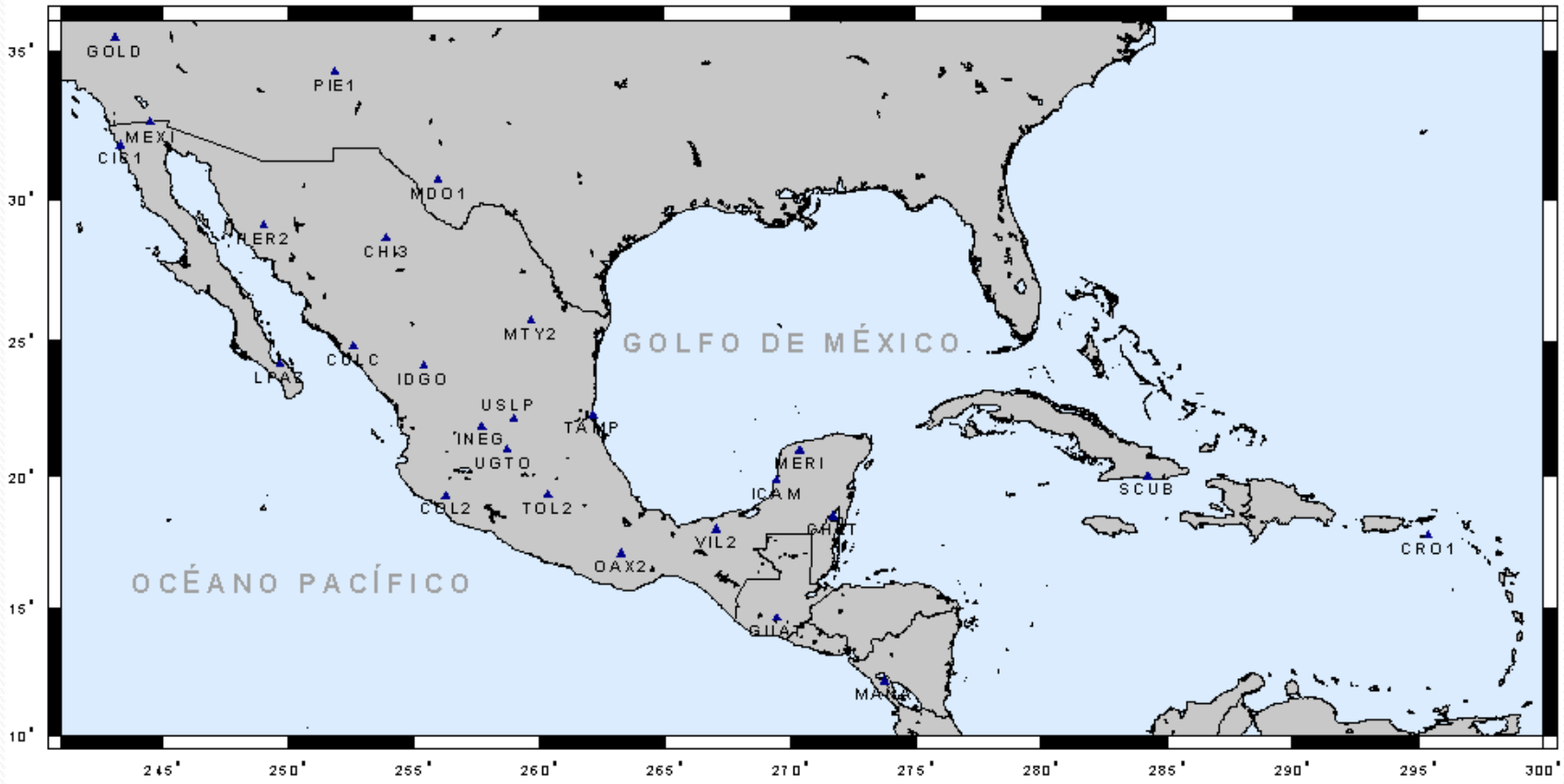
- **GAMIT/GLOBK 10.34 Installation**

  From sources files GAMIT/GLOBK was installed following and verifying the requirements of installation according to the Release Notes and README file of GAMIT/GLOBK.

- **Testing GAMIT/GLOBK Installation**

  The test of correct results for GAMIT/GLOBK was realized and passed, test data was processed and the verification of differences in coordinates resulted positive.

STATIONS FOR GAMIT-GLOBK



IGS stations: GOLD, CIC1, PIE1,MDO1, INEG,GUAT,MANA,SCUB, CRO1.

GOA II – GAMIT/GLOBK DIFFERENCES

COORDINATE DIFFERENCES (meters)			
STATION	Latitude	Longitude	Geodetic Height
CHET	-0.005	0.002	0.041
CHI3	-0.001	-0.009	0.044
COL2	-0.001	-0.012	0.034
CULC	0.000	-0.013	0.038
HER2	-0.001	-0.009	0.046
INEG	-0.001	-0.007	0.006
LPAZ	-0.001	-0.013	0.031
MERI	-0.004	-0.003	0.041
MEXI	0.000	-0.005	0.039
MTY2	-0.001	-0.006	0.042
OAX2	-0.005	-0.008	0.045
TAMP	-0.003	-0.006	0.039
TOL2	-0.004	-0.007	0.040
UGTO	-0.004	-0.009	0.033
USLP	-0.005	-0.002	0.020
VIL2	-0.005	-0.003	0.036

ITRF 2005 epoch 2009.06 solution in GOA II and GAMIT/GLOBK for INEGI network of permanent stations.

The main differences are observed in Geodetic Height, mainly because with GOA II relative phase centers were used while in GAMIT absolute phase centers were used.

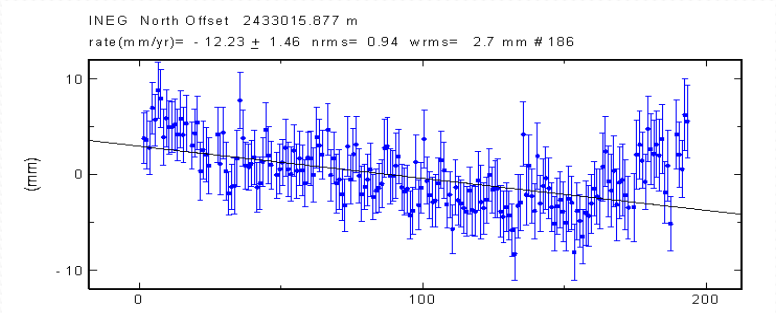
SIRGAS – GAMIT/GLOBK DIFFERENCES

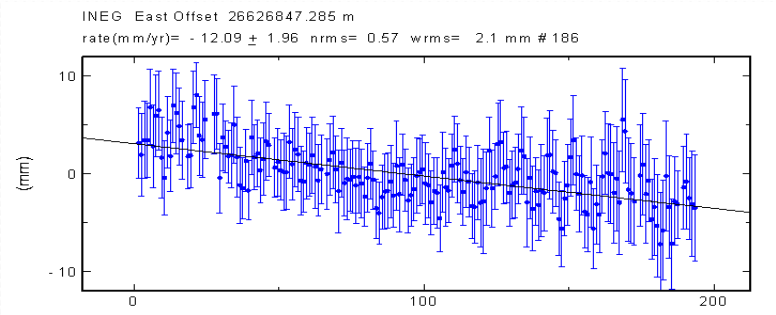
COORDINATE DIFFERENCES (meters)			
STATION	Latitude	Longitude	Geodetic Height
CHET	-0.001	0.001	0.006
CHI3	0.002	-0.002	-0.001
CIC1	0.003	-0.004	0.004
COL2	-0.001	-0.002	0.004
CULC	0.001	-0.002	0.004
GOLD	0.003	-0.001	0.002
GUAT	-0.003	-0.001	0.002
HER2	0.002	-0.002	0.002
INEG	-0.001	-0.002	0.002
LPAZ	0.001	-0.004	0.001
MANA	-0.001	0.002	-0.002

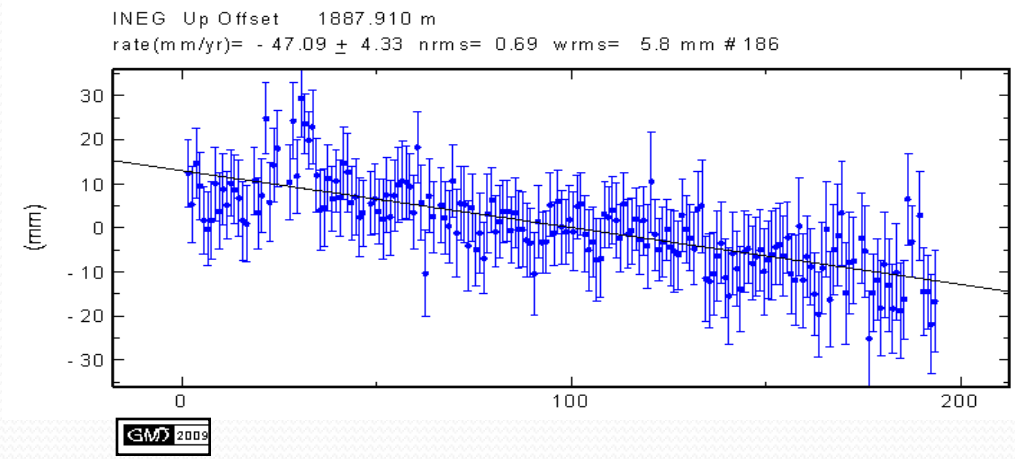
COORDINATE DIFFERENCES (meters)			
STATION	Latitude	Longitude	Geodetic Height
MDO1	0.002	0.000	-0.004
MERI	0.000	0.001	0.006
MEXI	0.002	-0.003	0.002
MTY2	0.002	-0.002	0.000
OAX2	-0.001	-0.001	0.002
PIE1	0.002	-0.001	-0.001
SCUB	-0.001	0.002	0.001
TAMP	0.000	-0.002	0.001
TOL2	-0.001	-0.002	0.003
UGTO	-0.001	-0.001	0.002
USLP	0.001	-0.001	0.004
VIL2	-0.001	0.001	0.003

Week 1515 solution of GAMIT/GLOBK versus SIRGAS 1515 weekly combined solution fixed to IGS05.

GAMIT/GLOBK TIME-SERIES (INEG)

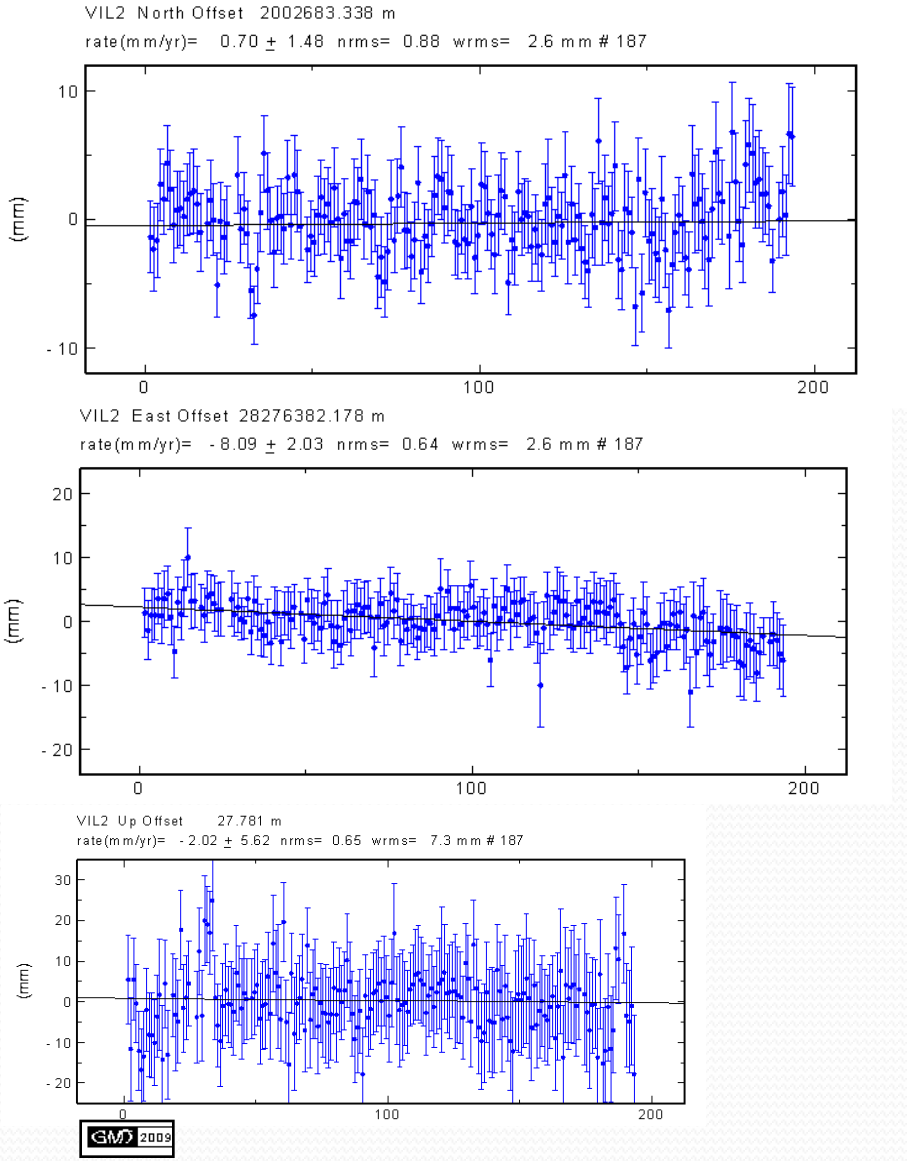






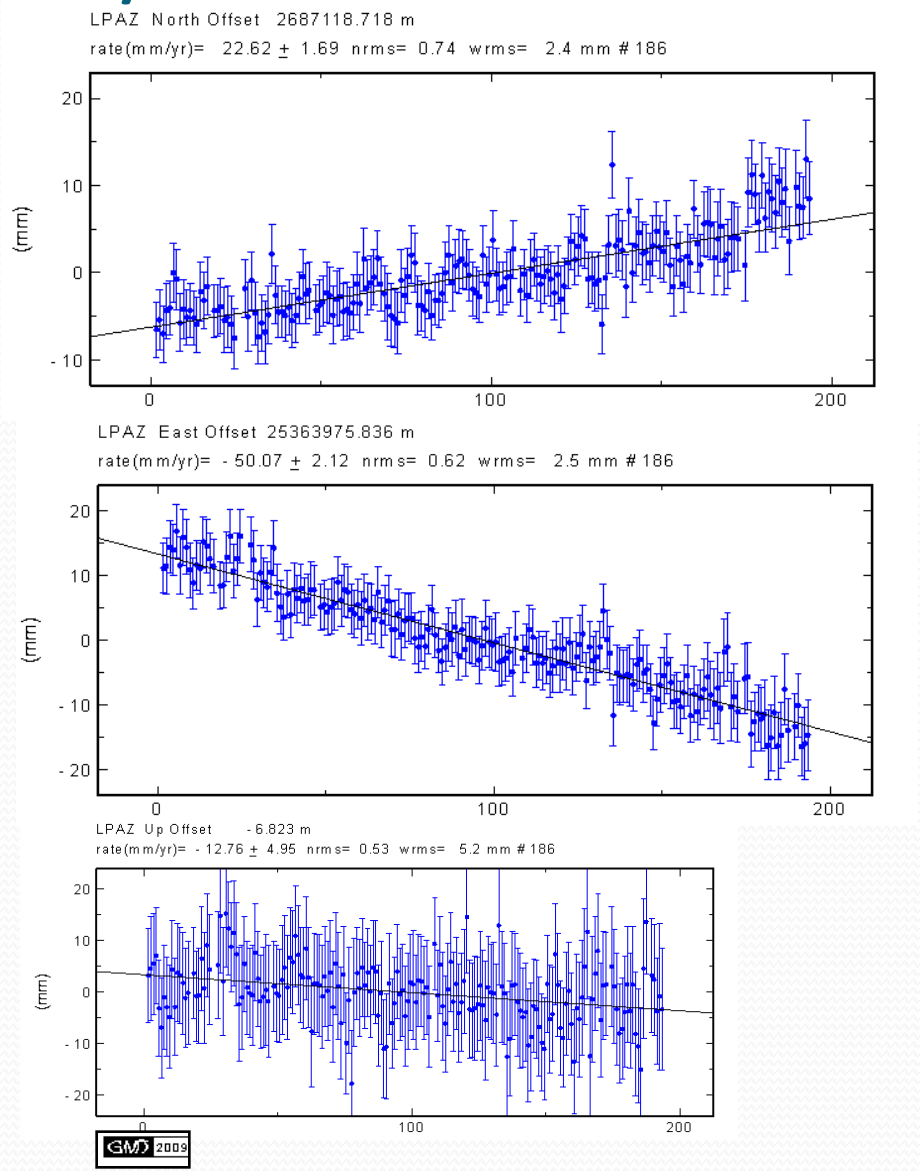
INEG, station in the **North American Plate**

GAMIT/GLOBK TIME-SERIES (VIL2)



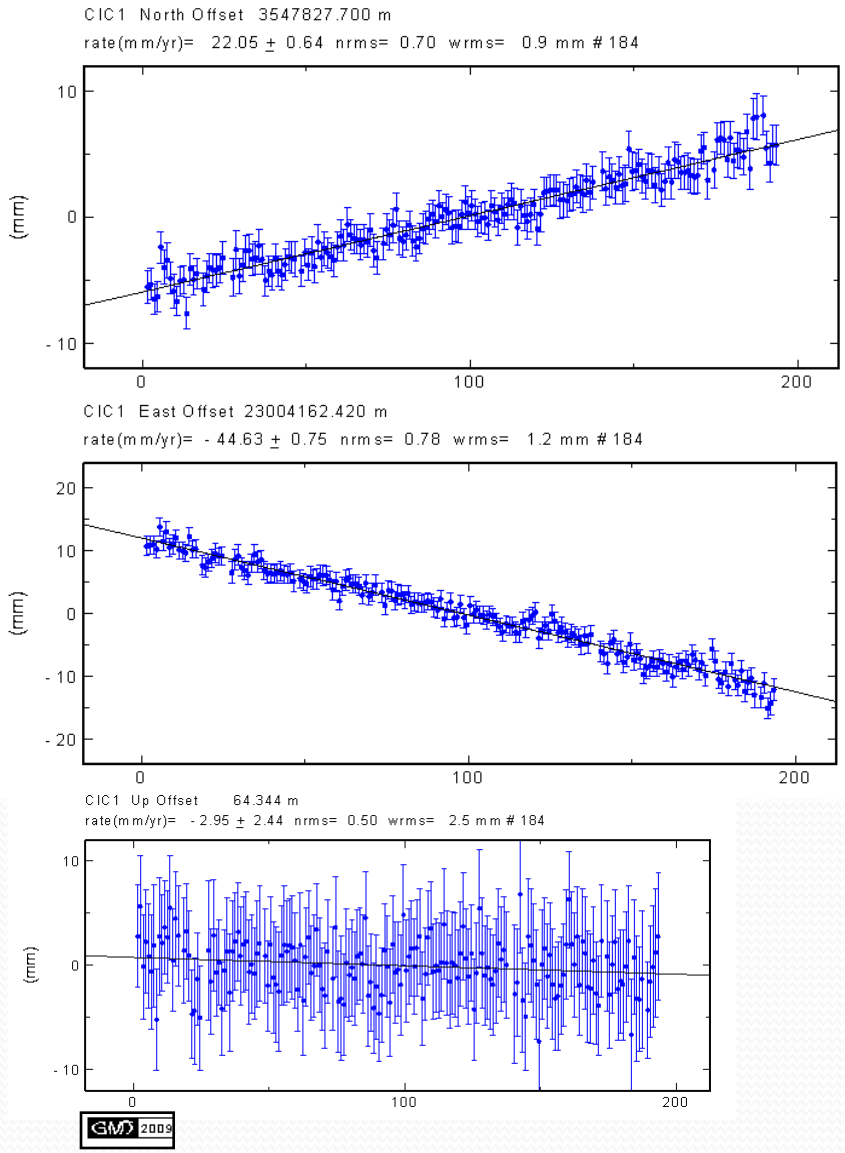
VIL2, station in the North American Plate

GAMIT/GLOBK TIME-SERIES (LPAZ)



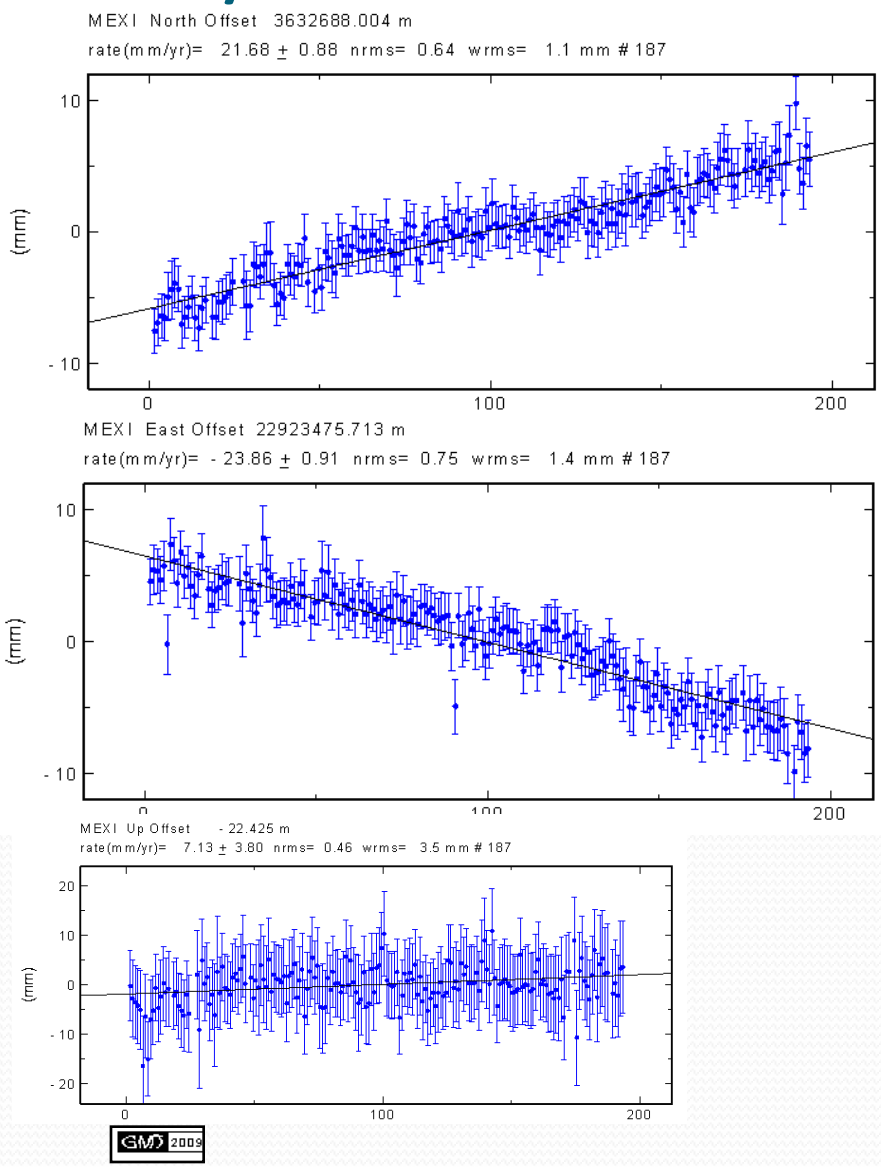
LPAZ, station in the **Pacific Plate**

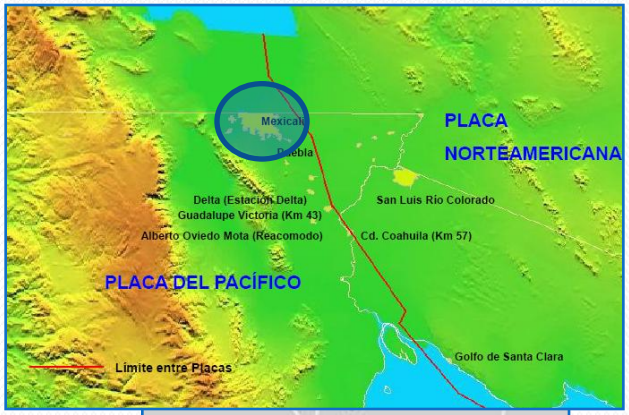
GAMIT/GLOBK TIME-SERIES (CIC1)



CIC1, station in the Pacific Plate

GAMIT/GLOBK TIME-SERIES (MEXI)





MEXI, station in the Pacific Plate

SUMMARY

- Coordinate differences SIRGAS vs GAMIT/GLOBK and the tendency of the series seems to conclude that INEGI Center of Processing can obtain trusty solutions.
- Comparative analysis during more weeks of INEGI solutions and other source will help to confirm the results.
- Daily or Weekly No Fiducial solutions can be generated in INEGI Center of Processing with the knowledge acquired until date but more research and study is required to obtain Fiducial solutions.

Bibliography

- Seemuller Wolfgang, Krugel Manuela, Sanchez Laura, Drewes Hermann, 2008

  DGFI Report No. 79

  The Position and Velocity Solution DGF08P01 of IGS Regional Network Associate Analysis Centre SIRGAS (IGS RNAAC SIR)

  DGFI

- Department of Earth, Atmospheric, and Planetary Sciences Massachusetts Institute of Technology.

  Documentation for the GAMIT GPS Analysis Software

  Scripps Institution of Oceanography University of California at San Diego

  Release 10.0 - December 2000

- Bird Peter

  An updated digital model of plate boundaries (2003)

  Geochemistry Geophysics Geosystems

  4(3), 1027, doi:10.1029/2001GC000252