IGN INSTITUT NATIONAL DE L'INFORMATION GÉOGRAPHIQUE ET FORESTIÈRE
SERVICE
DE GEODESIE
ET NIVELLEMENT

JC Poyard

CO-LOCATION SURVEY

(Le Lamentin, French West Indies)

July 2013

RT/G 171

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Résumé

Suite à l'installation d'une station DORIS au Lamentin (*cf. RT166_V1_POYARD_Installation DORISLeLamentin-juin2013*) un rattachement entre les antennes DORIS et GNSS est réalisé. L'occasion est également saisie pour rattacher le marégraphe situé à Fort-de-France.
Ce rapport décrit les travaux réalisés et les résultats obtenus.

Following the installation of a DORIS station in Martinique at Le Lamentin *(cf. RT166_V1_POYARD_ Installation DORISLeLamentin-juin2013)* a local tie survey was carried out between the DORIS and GNSS antennas. The tide gauge located at Fort-de-France was also connected.
This report describes the works performed and the results obtained.

Matériel

Système d'exploitation	**Logiciel**
Windows 7 Professionnel	LibreOffice Writer 4.0

Validation

	Fonction	**Nom**	**Visa**
Commanditaire	Chef d'unité RSI	Bruno Garayt	16/01/2014 – signé
Rédacteur principal	Responsable de production	Jean-Claude Poyard	28/11/2013 – signé
Lecteur	Responsable SIRS DORIS	Jérôme Saunier	13/12/2013 – signé
Approbateur	Chef de service	Alain Harmel	23/01/2014 – signé
Vérificateur	Responsable qualité	Thierry Person	28/03/2014 – signé

Diffusion

Organisme / Service	Fonction / Nom	Numérique	Papier
IGN / DPR	Directeur de la production des référentiels / Philippe Gerbe	oui	-
IGN / DPR	DPR adjoint / Didier Moisset	oui	-
IGN / DPC	Chargé MO géodésie / François Becirspahic	oui	-
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IGN / DPR / SGN / PMM	Jean-Claude Poyard	oui	-
IGN / DPR / SGN / PMM	Jérôme Saunier	oui	1
IGN / DPR / SGN / PMM	Charles Velut	oui	1
CNES / DCT / ME	REGINA.opération	oui	-
IGN / DPR / SGN / PMM	Archives DORIS	non	1

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INTRODUCTION

The International Terrestrial Reference Frame is the result of a combination of different terrestrial reference frames provided by the four space geodetic techniques (i.e. GNSS, SLR, DORIS and VLBI). To perform this combination between independent reference frames, it is necessary to have some co-location sites where the various techniques are observing and whose tie vectors between their reference points have been surveyed in three dimensions.

The ITRS realization improvement consists in adding some co-location sites in the combination or, with the advent of new instruments, in increasing the local surveys accuracy. The accuracy as stated by GGOS should reach 1 mm.

1. CO-LOCATED SITE DESCRIPTION

1.1. CONTEXT

On July 2009, a GNSS station has been installed by “Institut national de l'information géographique et forestière” (IGN-France) in the premises of Météo-France. This station managed by IGN is part of the French continuously operating network RGP and has been later integrated into IGS and REGINA networks.

On late June 2013, a DORIS station has been installed at Le Lamentin in co-location with this GNSS station.

Moreover, for a long time the harbour of Fort-de-France, situated 7 km apart, is equipped with a tide gauge. On October 2005 the tide gauge was upgraded and then tied to the GNSS station FFTG on December 2011. This tide gauge n°338 part of the GLOSS network is managed by SHOM in partnership with french entities (i.e. Météo-France, Marine Nationale, Université of La Rochelle, Institut de physique du globe de Paris).

After the DORIS station installation, the opportunity was taken to survey a local tie between these two stations by classic technique. At the same time a connection between the position of the antennas and the tide gauge GNSS monitoring station was achieved by GNSS survey.

Within this context, the local tie survey performed fulfils the triple purpose :

- assign coordinates to the new DORIS station (i.e. antennna reference point) ;
- provide vectors between instruments reference points (i.e. DORIS, GNSS, tide gauge) ;
- produce the results (i.e. SINEX file) to LAREG for the next ITRF solution.

1.2. SITE DESCRIPTION

Part of the West Indies archipelago, Martinique is located in the Caribbean Sea approximately by 15° north and 61° west, that's to say about 450 km north of the coast of South America or 900 km south-east of Dominican Republic.

Martinique stretches 60 km in length and less than 30 km in width ; so with a total area of 1,100 square kilometres, it's the 3rd largest island in the Lesser Antilles after Trinidad and Guadeloupe.

The island is volcanic in origin, lying along the subduction fault where the North American Plate slides beneath the Caribbean Plate. The highest point is the volcano of "Montagne Pelée" at 1,397 metres notorious for the island's most dramatic feature which suddenly destroyed Saint-Pierre and killed 28,000 people during the eruption of May 8th, 1902.

The northern end of the island is mountainous, heavily forested and catches the bulk of the rainfall when the southern part is drier and concentrates the white sand beaches.

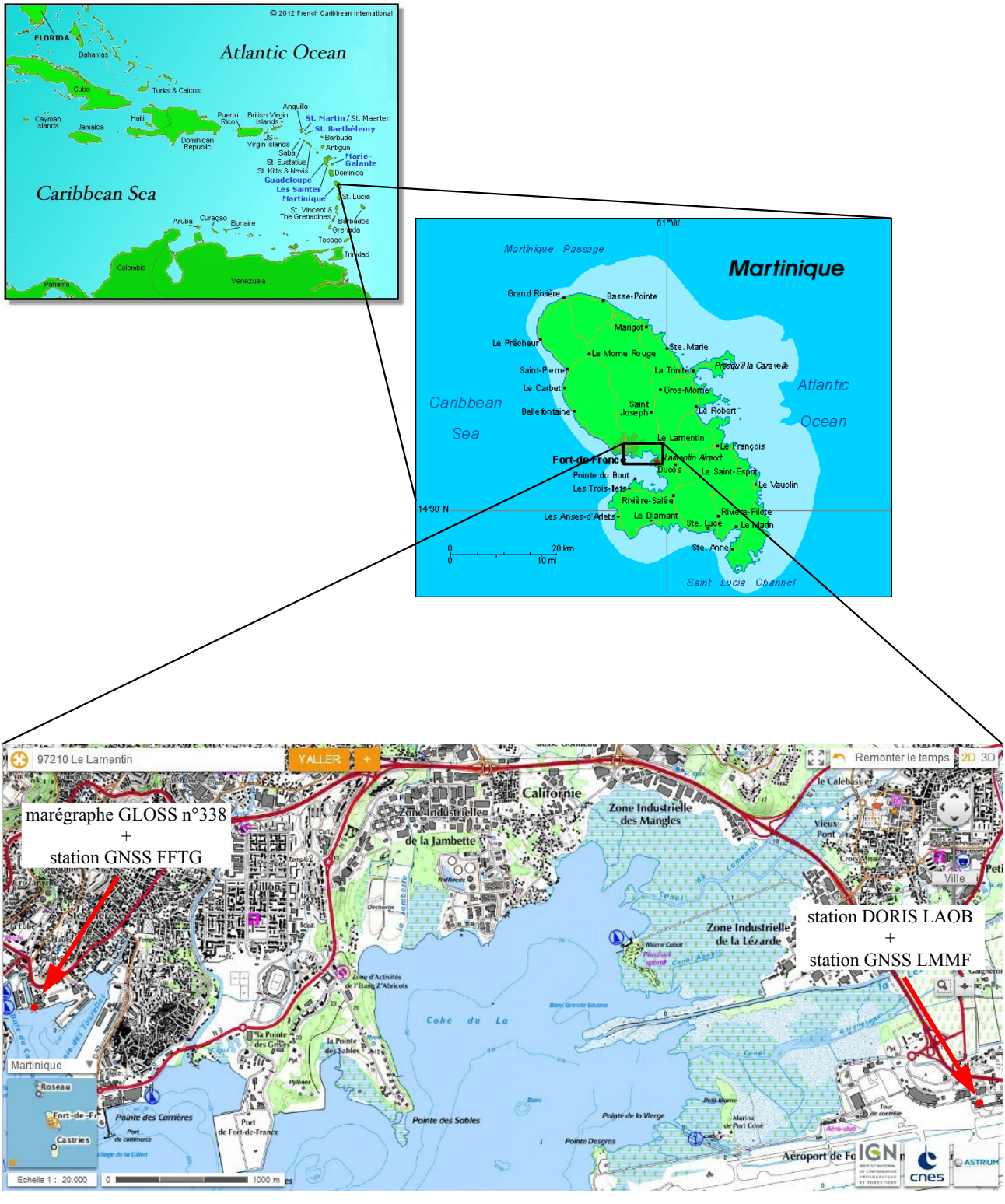
The "Météo-France" regional service of Martinique is located between these two parts on the west coast just on north of the international airport in Le Lamentin.

From a geodetic point of view, this site is equipped with various scientific instruments :

- a DORIS station;
- a GNSS station.

Moreover, the harbour of Fort-de-France, located 7 km away, is equipped with a tide gauge and GNSS station respectively managed by the "service hydrographique et océanographique de la Marine" (SHOM) and the LIENs laboratory.

Le Lamentin site location

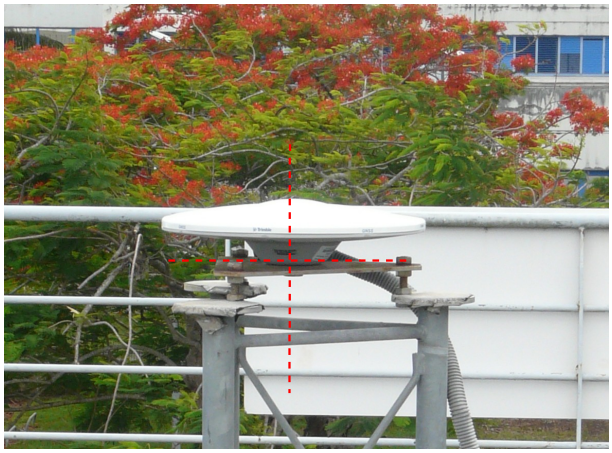


(source : www.geoportail.fr)

1.3. CO-LOCATED POINTS DESCRIPTION

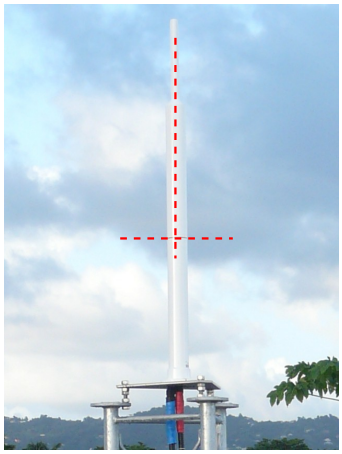
1.3.1. GNSS station

The GNSS station is installed on top of a 1 metre high galvanized mast, fixed on the terrace roof of Météo-France building. This GNSS station is part of the IGS network.

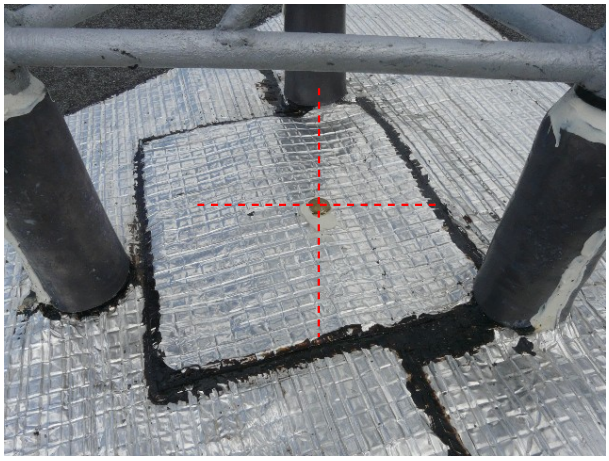
Acronym : LMMF	DOMES number : 97205M001
 General view	 Close-up view (reference point)
Description : Top and centre of a stainless steel triangular plate. Antenna height is **0,000 m**.	

1.3.2. DORIS station

Since late June 2013, a DORIS station is set up close to the GNSS station.

Acronym : LAOB	DOMES number : 97205S001
 General view	 Close-up view (reference point)
Description : DORIS antenna reference point (Starec type).	

The DORIS reference point is tied with a marker centred under the antenna.

Acronym : DORIS mark	No DOMES number
 General view	 Close-up view (reference point)
Description : domed hexagonal mark glued on the roof waterproof cladding.	

1.3.3. Tide gauge

The first sea level observations from the Fort-de-France tide gauge started on October 31th, 1976. After some big gaps, observations resumed on late 2005. Identified with the name “Fort-de-France” and GLOSS number 338, it is managed by SHOM in collaboration with local authorities including Météo-France (see http ://refmar. shom. fr/en/fort-de-france).

Many reference marks are available around this tide gauge (see extracts of FOM_Fort_de_France_SHOM.pdf in appendix 4). They have not been measured during this campaign.

2. LOCAL TIE DESCRIPTION

2.1. ORGANIZATION

The GNSS observations for the survey bearing started on Wednesday 26th June 2013 but most of the survey was carried out by GNSS or classic techniques on Monday 1st July.
All the topometric survey instruments and equipments belong to IGN and were sent by plane. No spirit leveling equipment was shipped.

2.2. MEASUREMENT INSTRUMENTS CHARACTERISTICS

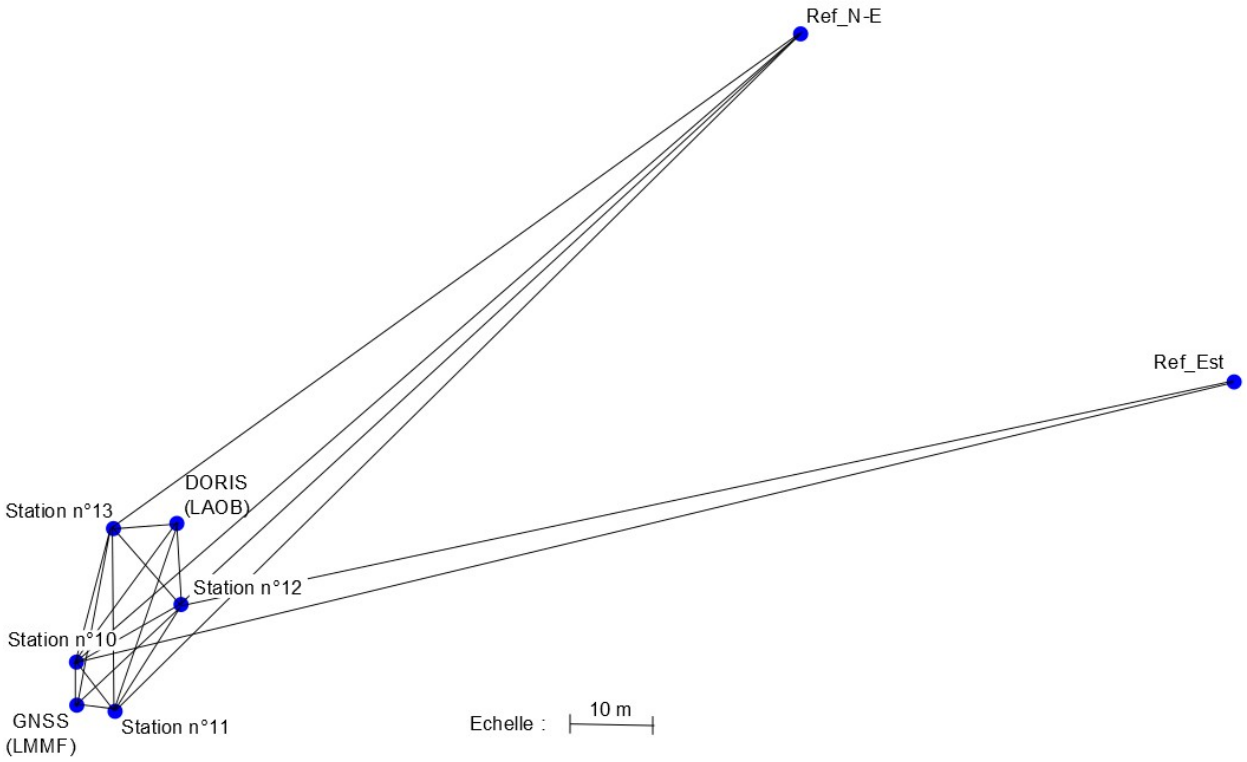
The equipment belongs to IGN and is regularly checked and calibrated in our offices.

The following table provides the specification and identification of the equipment used for the survey :

Equipment	Trademark, Serial ref. n°	Specifications, accuracy
Total station	Leica TC2002 n° 20102	EDM st. dev. 1mm + 1 pmm Angular st. dev. 0.15 mgon Checked by IGN on 01/01/2013
Prism	Leica GPH 1P n°20373	Dist. Corr. 0.0 mm
Prism	Leica GPH 1P n°20374	Dist. Corr. 0.0 mm
Device : Prism mini rod	Leica GLS14 n°40913	-
Meteorological station	Kestrel 4500NV serial n°672710	Temp. st. dev. 0.5°C Pressure st. dev. 1 hPa
GNSS unit	Receiver : Leica GS10 n°50113 Antenna : Leica AS10 n°50113	Static post-processing accuracies Horiz. 3 mm + 0.5 ppm Vert. 6 mm + 0.5 ppm
Tripods (5)	Leica (no references)	Made of wood,
Tribrack	Leica (no reference)	

2.3. OBSERVATIONS POLYGON

At Le Lamentin, in spite of the soft roof waterproof cladding, the survey was conducted on that site with close attention in order to provide the best possible accuracy in the determination of the 3D vectors between the observing reference points. Indeed the adjustment provides a suitable accuracy on all observed points. Hereafter is the observations polygon.



2.4. SURVEY METHOD

Four stations (numbered 10, 11, 12 and 13) in the immediate vicinity of the reference points were surveyed. All the visible lines of sight were observed with the total station. Horizontal directions and zenith angles were observed in data sets : each set consisting in one reading in both direct and reverse theodolite positions. Distance measurements were observed at least once over each line. Meteorological data (atmospheric pressure and temperature), used to correct the distances, were recorded at the beginning of each station occupation. During the survey these values were around 29 °C and 761 mm of mercury (see appendix 6).

2.4.1. Antennas reference points

As our strategy was to keep in place the DORIS or GNSS antennas (i.e. LAOB, LMMF), their reference points have to be determined indirectly.

For the planimetric position :
From each survey station aiming at the antennas, the right and left sides of the antenna theoretically centred on the antenna reference point (ARP) were observed. This element was chosen so that it is optically well defined for the operator, and in the adjustment, horizontal angle observations were simply averaged to get its planimetric centred position.
For the altimetric position :
Vertical angles have been measured on a well-defined element of the antenna. Then, the resulting position has been reduced to the reference point using the manufacturer values, and some centring equations have been included in the adjustment.

2.4.2. Centring equations

If a point is centred above another this leads to centring equations with distances and accuracies between these points.
The measurements come either from manufacturer values or from on field observations (calliper rule, tape measure).

2.4.3. GNSS observations

GNSS observations were carried out in order to provide the polygon bearing. For this purpose two references named Ref_Est and Ref_N-E have been determined.

Data from “LMMF” and “FFTG” GNSS stations were downloaded from either the RGP website or SONEL website in order to process the baseline.

3. COMPUTATION

3.1. ON SITE VALIDATION

All these instruments allowed the observations to be recorded electronically on memory cards or storage devices. GNSS and total station data were downloaded on a laptop PC for checkings and on site validation.

3.2. GNSS BEARINGS

Back at the office, GNSS baselines were processed with Leica Geo Office V 8.1 software using the original set of "absolute" GNSS antenna calibrations (igs08.atx). The IGb08 ep2005.0 coordinates of the fixed point LMMF introduced into the LGO calculation came from the IGS cumulative solution file IGS13P34.ssc (see LGO report file in appendix 5).

3.3. FINAL ADJUSTMENT

The final computation is carried out by a 3D least squares adjustment with Microsearch GeoLab 2001 version 2001.9.20.0 software. The input file (see appendix 6) comes from :

- total station observations : horizontal and zenithal angles, distances;
- centring equations : relative positions between points;
- bearing from GNSS data process;
- LMMF IGb08 ep2005.0 coordinates derived from IGS13P34. ssc file constrained at 1 mm.

The a priori standard deviations used for the different observations are :

- 0.8 mgon for horizontal angles;
- 1.2 mgon for vertical angles;
- 1 mm for distances;
- 1 mm for heights measured with a two-metre rule;
- 1 mm for height differences derived from spirit levelling made by SHOM.

These values are commonly used in most of our Microsearch GeoLab computation input file. The adjustment provides points coordinates (see appendix 7) and an associated covariance matrix.

4. RESULTS

4.1. STATION NAME TRANSLATION TABLE

The following list sums up the most interesting points used in the Microsearch GeoLab input file with the main points in bold (appendix 6).

Point description	Code or DOMES number	Computation name
DORIS station and marker		
LAOB Antenna Reference Point	97205S001	**LAOB**
DORIS conservation mark	97205M002	DORIS_mark
GNSS stations		
IGS GNSS antenna at ARP	97205M001	**LMMF**
Tide gauge GNSS antenna at ARP	97201M006	**FFTG**

4.2. ADJUSTED COORDINATES AND CONFIDENCE REGIONS

LMMF station was installed in 2008, so the last ITRS realization (ITRF2008) did not use LMMF data.. For the needs of the survey, LMMF coordinates (IGS08 ep2005.0) from the IGS cumulative solution file IGS13P34.ssc constrained at 1 mm were used..

The results of the adjustment are the coordinates of all points as well as their confidence ellipsoids in IGb08 reference frame at epoch 2005.0.
The table below provides the 3D coordinates and confidence regions at 95 % of the points of interest.

```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0003
================================================================================
Adjusted XYZ Coordinates:
                            X-COORDINATE       Y-COORDINATE       Z-COORDINATE
 CODE FFF STATION                STD DEV            STD DEV            STD DEV
 ---- --- ------------ ------------------ ------------------ ------------------
 XYZ      DORIS_rep1        2993392.5440      -5399349.6838       1596767.3898 m       0
                                 0.0012             0.0012             0.0012
 XYZ      FFTG              2986963.6671      -5402703.8389       1597459.1262 m       0
                                 0.0017             0.0022             0.0015
 XYZ      LAOB              2993393.6539      -5399351.6873       1596767.9871 m       0
                                 0.0013             0.0016             0.0013
 XYZ      LAOB/2GHz         2993393.8813      -5399352.0974       1596768.1093 m       0
```

```
                                   0.0012              0.0012              0.0012
XYZ      LAOB/400MHz           2993393.6532       -5399351.6871        1596767.9862 m        0
                                   0.0012              0.0012              0.0012
XYZ      LMMF                  2993387.2705       -5399363.9818        1596747.9471 m        0
                                   0.0011              0.0011              0.0011


================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0010
================================================================================
2-D and 1-D Station Confidence Regions (95.000 and 95.000 percent):
STATION                MAJOR SEMI-AXIS  AZ      MINOR SEMI-AXIS             VERTICAL
------------ --------------------- ---  -------------------- ---------------------
DORIS_rep1                  0.0031  30                0.0029               0.0024
FFTG                        0.0035  50                0.0034               0.0049
LAOB                        0.0032  30                0.0030               0.0033
LAOB/2GHz                   0.0031  30                0.0029               0.0024
LAOB/400MHz                 0.0031  30                0.0029               0.0024
LMMF                        0.0028   0                0.0028               0.0022
```

The whole covariance matrix was computed, then it was possible to extract from it the covariance submatrix for the 2 points of interest (i.e. LMMF and LAOB). Lastly, this covariance submatrix has been converted into SINEX format using "geotosnx" tool. The resulting SINEX file (97205_IGN_2013-183_v10.SNX) is presented in appendix 8.

4.3. VECTORS

The following table sums up LMMF coordinates and local tie vectors with the most interesting points :.

Coordinates IGb08 ep2005.0				
Acronym	DOMES number	X (m)	Y (m)	Z (m)
LMMF	97205M001	2993387.271	-5399363.982	1596747.947
Local tie vectors from LMMF				
Acronym	DOMES number	dX (m)	dY (m)	dZ (m)
LAOB	97205S001	6.383	12.295	20.040
FFTG	97201M006	-6423.603	-3339.857	711.179

5. APPENDICES

5.1. APPENDIX 1 : "LAOB" DORIS station site log (extract)

Note : Only the points most relevant to this survey were retained in the following extract.
The complete version of this site log is available at : http ://ids-doris. org/network/sitelogs. html

```
     LE LAMENTIN DORIS site description form

0. Form
     Prepared by    : SIMB (DORIS installation and maintenance department)
     Date prepared : 04/10/2013

1. Site location information
     Site name               : LE LAMENTIN
     Site DOMES number       : 97205
     Host agency             : Meteo-France
     City                    : Le Lamentin
     State or province       : Martinique
     Country                 : France (Caribbean Islands)
     Tectonic plate          : CARB
     Geological information :
     Geographical coordinates (ITRF) :
         North Latitude      :    14 deg 35' 42''
         East Longitude      :   -60 deg 59' 46''
         Ellipsoid height    :   -29 m
         Approximate altitude :    12 m

2. DORIS antenna and reference point information
     Four character ID       : LAOB
     Antenna model           : Starec 52291 type
     Antenna serial number   : 161
     IERS DOMES number       : 97205S001
     CNES/IGN number         : 972051
     DORIS SSALTO number     : 337
     Date installed (dd/mm/yy): 29/06/2013
     Date removed (dd/mm/yy)  :
     Antenna support type    : 2m high very rigid metal tower
     Installed on            : terrace of a 3m high building
     Height above ground mark :  2.367 m
     Ground mark type        :
     Ground mark DOMES number :

3. DORIS beacons information
(   )

4. ITRF coordinates and velocities of the current DORIS ref. point (LAOB)
     Solution         : ITRF2008 (tie to LMMF)
     Epoch            : 2005.0

     X = 2993393.653 m    Y = -5399351.687 m    Z = 1596767.986 m
     Sig X = 0.001 m    Sig Y = 0.001 m    Sig Z = 0.001 m
     VX = 0.0082 m/y    VY = 0.0108 m/y    VZ = 0.0146 m/y
     Sig VX = 0.0002 m/y    Sig VY = 0.0004 m/y    Sig VZ = 0.0002 m/y

5.
(   )
(   )
```

5.2. APPENDIX 2 : "LMMF" GNSS station site log (extract)

Note : Only the points most relevant to this survey were retained in the following extract.

The complete version of this site log is available at : http ://igscb. jpl. nasa. gov/network/site/lmmf. html

```
     LMMF Site Information Form (site log)
     International GPS Service
     See Instructions at:
       ftp://igscb.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

0.   Form
     Prepared by (full name)  : Equipe RGP
     Date Prepared            : 2013-09-13
(   )

1.   Site Identification of the GNSS Monument

     Site Name                : Aeroport Aime CESAIRE-LE LAMENTIN-Meteo Fra.
     Four Character ID        : LMMF
     Monument Inscription     : NONE
     IERS DOMES Number        : 97205M001
     CDP Number               : NONE
     Monument Description     : INOX TRIANGULAR PLATE ON TOP OF METALLIC PILAR
       Height of the Monument : 1.0 m
       Monument Foundation    : ROOF
       Foundation Depth       : 10.0 m
     Marker Description       : TOP AND CENTRE OF THE TRIANGULAR PLATE
     Date Installed           : 2008-07-11
(   )


2.   Site Location Information

     City or Town             : LE LAMENTIN
     State or Province        : Martinique (972 )
     Country                  : France
     Tectonic Plate           : CARIBBEAN
     Approximate Position (ITRF)
       X coordinate (m)       : 2993387.952
       Y coordinate (m)       : -5399363.731
       Z coordinate (m)       : 1596748.042
       Latitude (N is +)      : +143541.33871
       Longitude (E is +)     : -0605946.21428
       Elevation (m,ellips.)  : -27.0
     Additional Information   : (multiple lines)


3.   GNSS Receiver Information
(   )

3.10 Receiver Type            : TRIMBLE NETR9
     Satellite System         : GPS+GLO+GAL+BDS+SBAS
     Serial Number            : 5118K75440
     Firmware Version         : 4.81
     Elevation Cutoff Setting : 3
     Date Installed           : 2013-09-13T08:00Z
     Date Removed             : (CCYY-MM-DDThh:mmZ)
```

```
     Temperature Stabiliz.    : (none or tolerance in degrees C)
     Additional Information   : (multiple lines)


4.   GNSS Antenna Information


4.3  Antenna Type             : TRM57971.00     NONE
     Serial Number            : 5311118262
     Antenna Reference Point  : BAM
     Marker->ARP Up Ecc. (m)  : 0.00
     Marker->ARP North Ecc(m) : 0.00
     Marker->ARP East Ecc(m)  : 0.00
     Alignment from True N    : 0
     Antenna Radome Type      : NONE
     Radome Serial Number     :
     Antenna Cable Type       : (vendor & type number)
     Antenna Cable Length     : 30 m
     Date Installed           : 2013-06-24T13:00Z
     Date Removed             : (CCYY-MM-DDThh:mmZ)
     Additional Information   : (multiple lines)


5.   Surveyed Local Ties
(   )
(   )


13.  More Information

     Primary Data Center      : IGNE
     Secondary Data Center    : CDDIS
     URL for More Information : http://rgp.ign.fr/STATIONS/liste.php
     Hardcopy on File
       Site Map               : http://rgp.ign.fr/
       Site Diagram           : (Y)
       Horizon Mask           : (Y)
       Monument Description   : (Y)
       Site Pictures          : http://rgp.ign.fr/
     Additional Information   : (multiple lines)
     Antenna Graphics with Dimensions

TRM57971.00

    / ----------------------+---------------------- \
   +                        +                        +
    \ ---------------------------------------------- /
                    \                /
                     \              /
                      \-----+-----/                    <--  0.0000  ARP=BAM

   <--                    0.3396                   -->
```

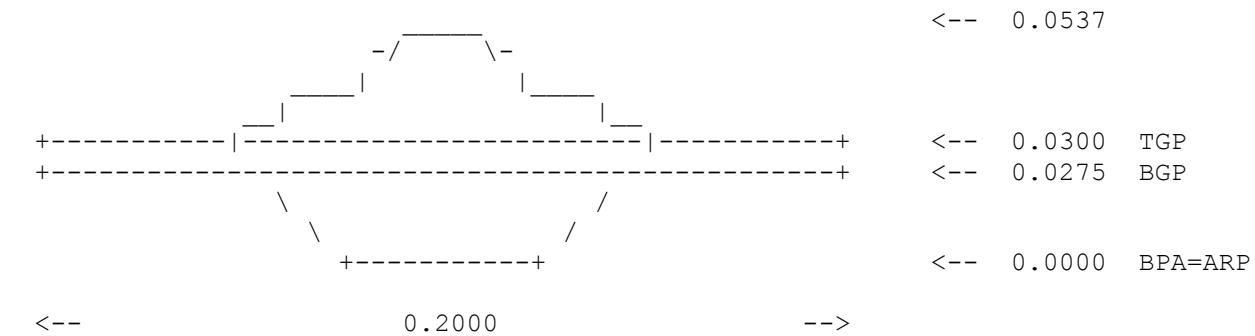
5.3. APPENDIX 3 : "FFTG" GNSS station site log (extract)

Note : Only the points most relevant to this survey were retained in the following extract.

The complete version of this site log (fftg_20130708. log) is available on SONEL website.

```
     FFTG Site Information Form (site log)
     International GNSS Service
     See Instructions at:
       ftp://igscb.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

0.   Form
(   )

1.   Site Identification of the GNSS Monument

     Site Name                 : Fort de France tide gauge
     Four Character ID         : FFTG
     Monument Inscription      :
     IERS DOMES Number         : 97201M006
     CDP Number                : (A4)
     Monument Description      :
       Height of the Monument  : (m)
       Monument Foundation     : (STEEL RODS, CONCRETE BLOCK, ROOF, etc)
       Foundation Depth        : (m)
     Marker Description        : (CHISELLED CROSS/DIVOT/BRASS NAIL/etc)
     Date Installed            : 2012-04-04T00:00Z
     Geologic Characteristic   : (BEDROCK/CLAY/CONGLOMERATE/GRAVEL/SAND/etc)
       Bedrock Type            : (IGNEOUS/METAMORPHIC/SEDIMENTARY)
       Bedrock Condition       : (FRESH/JOINTED/WEATHERED)
       Fracture Spacing        : (1-10 cm/11-50 cm/51-200 cm/over 200 cm)
       Fault zones nearby      : (YES/NO/Name of the zone)
         Distance/activity     : (multiple lines)
     Additional Information    :

2.   Site Location Information

     City or Town              : Fort de France
     State or Province         : Martinique
     Country                   : France
     Tectonic Plate            : CARIBBEAN
     Approximate Position (ITRF)
       X coordinate (m)        : 2987018.641
       Y coordinate (m)        : -5402770.779
       Z coordinate (m)        : 1597485.018
       Latitude (N is +)       : 143605.398416
       Longitude (E is +)      : -0610347.52684
       Elevation (m,ellips.)   : (F7.1)
     Additional Information    : (multiple lines)

3.   GNSS Receiver Information
(   )

4.   GNSS Antenna Information

4.1  Antenna Type              : TPSPG_A1+GP
     Serial Number             : 310-0972
     Antenna Reference Point   : BPA
```

```
     Marker->ARP Up Ecc. (m)  : 0.000
     Marker->ARP North Ecc(m) : 0.000
     Marker->ARP East Ecc(m)  : 0.000
     Alignment from True N    : 0.000 deg
     Antenna Radome Type      : NONE
     Radome Serial Number     :
     Antenna Cable Type       : (vendor & type number)
     Antenna Cable Length     : (m)
     Date Installed           : 2011-12-20
     Date Removed             : (CCYY-MM-DDThh:mmZ)
     Additional Information   : (multiple lines)

5.   Surveyed Local Ties
(   )

6.   Frequency Standard
(   )

7.   Collocation Information

7.1  Instrumentation Type     : TIDE GAUGE
       Status                 : PERMANENT
       Effective Dates        : 1976-10-31/CCYY-MM-DD
       Notes                  : (multiple lines)

8.   Meteorological Instrumentation
(   )

9.   Local Ongoing Conditions Possibly Affecting Computed Position
(   )

10.   Local Episodic Effects Possibly Affecting Data Quality
(   )

11.   On-Site, Point of Contact Agency Information
(   )

12.   Responsible Agency (if different from 11.)
(   )

13.   More Information
(   )

TPSPG_A1+GP
```



5.4. APPENDIX 4 : fiche d'observatoire de marée (extract)

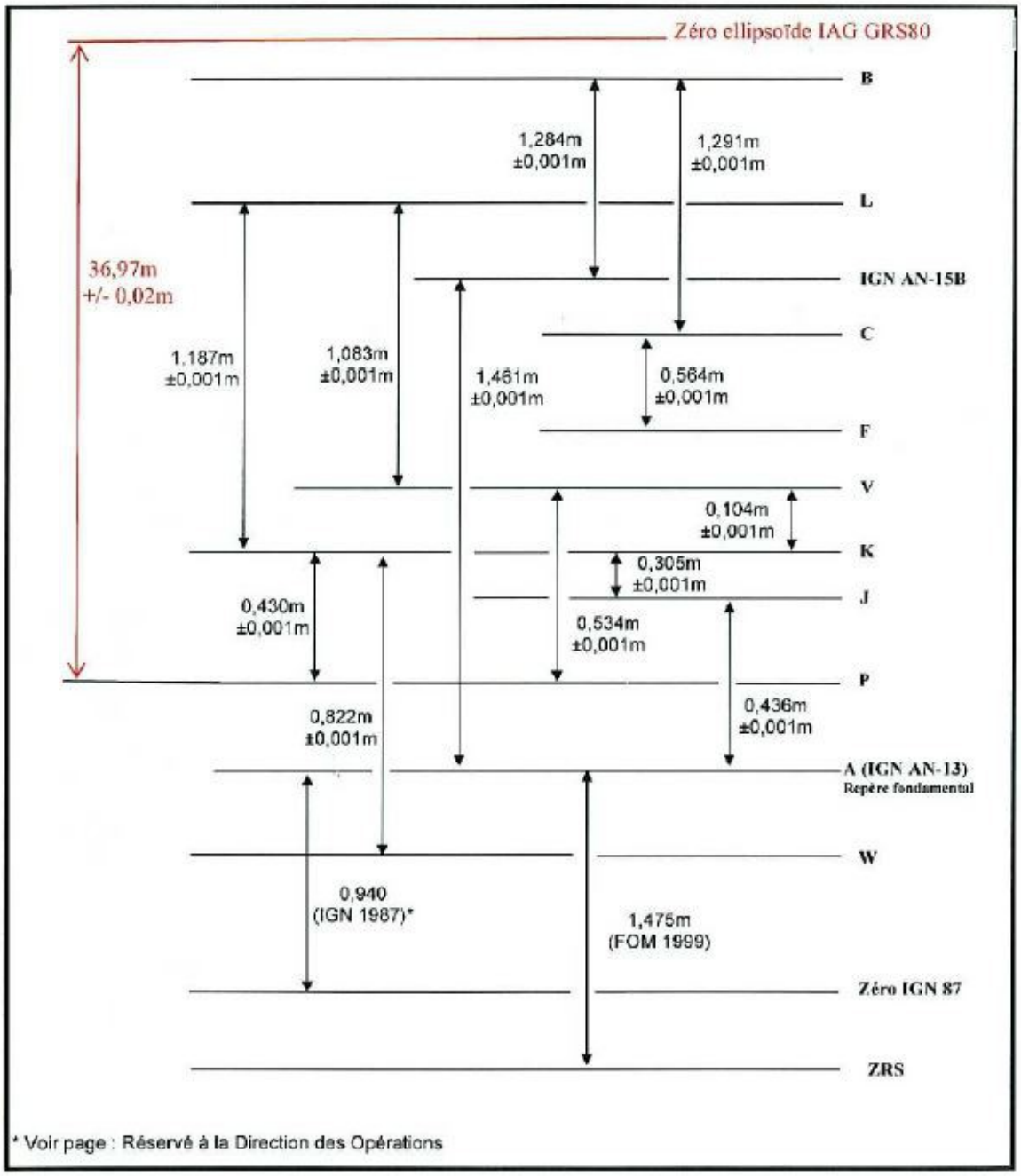
The complete version of FOM_Fort_de_France_SHOM. pdf is available on request to SHOM.

TABLEAU DES REPÈRES D'ALTITUDE

Désignation[19]	Description[20]	Cote rapportée au zéro de réduction des sondes (en m)[21]	Cote rapportée au zéro IGN 87 (en m)[22]	Cote Rapportée à l'ellipsoïde mondial GRS80 de l'ITRS (en m)[23]
A	Repère de nivellement (IGN AN-13) scellé horizontalement dans le quai sur l'escalier ouest du bassin de radoub. **Repère fondamental.**	1,475 m	0,940m* (IGN 1987)	
B	Repère SII MOA76 scellé horizontalement dans le mur d'enceinte du Fort Saint-Louis, à droite de la porte d'accès au Quai des Avisos. (à 0,83 m au-dessus du sol et à 1,08 m sur la gauche de la cabine téléphonique)	4,220 m (2010)	3,685 m ±0,001 m (GOA 2010)	
C	Repère MOA 80 scellé horizontalement dans le mur d'enceinte du Quai des Avisos, entre un ALGECO et le local plongeur. (à 10 m de l'extrémité est du mur d'enceinte)	2,929 m (2010)	2,394 m ±0,001 m (GOA 2010)	
F	Repère SHOM scellé verticalement sur l'extrémité sud du Quai des Avisos. (à 2 m de la bitte d'amarrage et à 0,95 m du mur)	2,365 m (2010)	1,830 m ±0,001 m (GOA 2010)	
J	Rivet métallique scellé verticalement sur l'extrémité sud du Quai aux huiles (zone civile) au pied de la bitte d'amarrage.	1,911 m (2010)	1,376 m ±0,001 m (GOA 2010)	
K	Douille SHOM scellée horizontalement à gauche de la porte du local marégraphe M1 et à 0,30 m du sol.	2,216 m (2010)	1,681 m ±0,001 m (GOA 2010)	
L	Plaque support du capteur radar. **Repère de tirant d'air.**	3,403 m (2010)	2,868 m ±0,001 m (GOA 2010)	
P	Douille SHOM scellée verticalement dans le rebord du Quai aux huiles. (à 18 m de l'extrémité ouest du quai et à 0,9 m du bord) Possibilité de mettre un GPS en station.	1,786 m (2010)	1,251 m ±0,001 m (GOA 2010)	-36,97m* +/-0,02m (2005)
V	Repère de nivellement scellé horizontalement dans l'angle sud-ouest du hangar du Quai aux huiles entre le caniveau d'eaux pluviales et le local en béton (Hygiènes).	2,320 m (2010)	1,785 m ±0,001 m (GOA 2010)	
W	Sommet de l'échelle de marée installée à l'extrémité ouest du Quai aux huiles, près du repère K et du local marégraphe M1.	1,394 m (2010)	0,859 m ±0,001 m (GOA 2010)	
AN-15B	Repère de nivellement IGN AN-15B scellé dans le pilier sud du portail de l'entrée secondaire du Fort Saint-Louis située sur le Boulevard Chevalier de Sainte-Marthe.	2,936 m (2010)	2,401 m ±0,001 m (GOA 2010)	

* Il existe une incohérence d'altitude pour le repère A entre la fiche de marée SHOM de 1999 et la fiche de nivellement AN-13 de l'IGN.
Voir partie réservée au directeur technique pages 25 et 26.
Voir page : Réservé à la Direction des Opérations.

SCHEMA DE SITUATION EN ÉLÉVATION DES REPÈRES D'ALTITUDE ET DES DIFFERENTS ZEROS DE REFERENCE[18]



[18] Sur cette page doit figurer un schéma (et non un croquis à l'échelle) donnant :
- les dénivelées mesurées entre les repères (généralement obtenues par nivellement géométrique),
- la hauteur mesurée d'un repère par rapport à l'ellipsoïde mondial GRS80 de l'ITRS,
- les zéros instrumentaux (du marégraphe, de l'échelle) par rapport au zéro de réduction des sondes,
- le zéro de réduction des sondes par rapport au repère fondamental.

On indiquera les incertitudes associées aux mesures réalisées.
Si des mesures antérieures aux travaux sont portées sur le schéma, on précisera en complément l'organisme et la date.

In the same report " Compte-rendu d'intervention sur le MCN Fort-de-France " the permanent GNSS station installation is described. The leveling performed with a laser distance sensor and the results are in the extract hereafter :

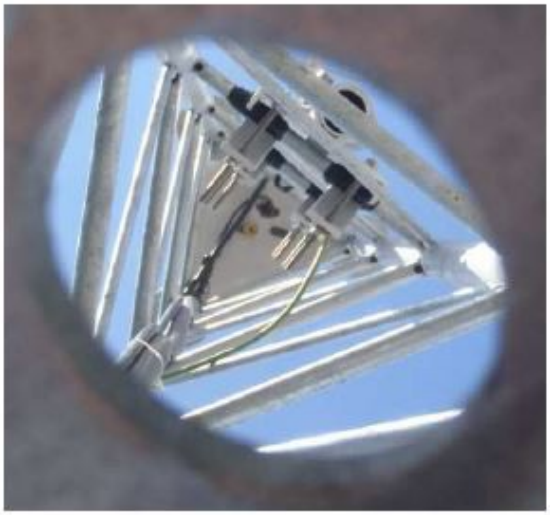
Installation de la station GNSS permanente

Le site d'observatoire de marées de Fort-de-France a été choisie par l'ULR pour être équipé d'une antenne GNSS. En raison de l'indisponibilité de Pascal Tiphaneau de l'UMR Littoral, Environnement et Sociétés (LIENSs) de l'ULR a effectuer la mission, le matériel fourni par l'ULR a été installé par DMGS/IES. L'antenne GNSS a été fixée sur le pylône servant également de support au mât de l'antenne Yagi. Celui-ci est vissé sur une chaise fixée au mur par 8 chevilles inox et sa verticalité contrôlée au niveau à bulle. La plaque support triangulaire de l'antenne est montée au sommet du pylône et réglée horizontalement au niveau à bulle. L'antenne GNSS est vissée directement sur cette plaque de support dont la partie inférieure sert de repère de nivellement.

Vue des parties inférieures et supérieures du pylône de support

Nivellement de l'antenne

La détermination de la hauteur de l'antenne n'a pas pu être réalisée par nivellement direct car il est impossible de placer le plan optique du niveau au-dessus de la plaque, située à plus de 5 mètres du sol. Cette configuration ayant été prévue, la hauteur de la plaque de support a donc été déterminée par mesure au distance-mètre laser. Le centre du montant incliné à 45° de la "chaise" ayant été percé au préalable pour permettre les visées au laser, une fois le pylône et l'antenne GNSS fixés, un trou a été percé dans le toit de l'abri du marégraphe à la verticale de cette fenêtre de visée afin de pouvoir réaliser une mesure complète de la distance entre le dessous de la plaque de support de l'antenne (repère Y) et un repère temporaire Z positionné au sol à l'intérieur de l'abri.



Vue de la plaque par la fenêtre de visée optique

Une série de sept mesures au distance-mètre laser a été réalisée, l'appareil en appui sur le repère Z et visant la face inférieure de la plaque. Les mesures et résultats figurent dans le tableau ci-dessous. La moyenne de la dénivelée entre le repère Z et la face inférieure de la plaque triangulaire (Y) par cette méthode est 5,525 mètres.

Mesures disto laser Z -> Y (Face inférieure)	
Série de 7 mesures (m)	5,527
	5,526
	5,524
	5,526
	5,525
	5,525
	5,525
Moyenne (m)	5,525
Ecart-type (m)	0,001

Mesures au distance-mètre laser entre les repères Z et Y (face inférieure)

Le faible écart type obtenu sur la série de mesures montre une bonne cohérence entre les différentes visées. L'épaisseur de la plaque de support triangulaire a été mesurée à 0.008 m, ce qui donne une dénivelée entre Z et le dessus de la plaque support soit le point de référence de l'antenne GNSS (base de l'antenne : repère ARP) de 5,533 m.
Le repère temporaire au sol Z a ensuite pu être nivelé par rapport aux repères de nivellement K et V décrits dans la FOM n°1904 en date du 26/03/2010 afin de déterminer la cote du point de référence ARP. Les résultats de ce nivellement sont décrits dans le tableau ci-dessous :

Désignation	Description	Cote rapportée au zéro de réduction des sondes (en m)
K	Douille SHOM scellée horizontalement à gauche de la porte du local du marégraphe et à 0,30m du sol.	2,216 m (GOA 2010)
V	Repère de nivellement scellé horizontalement dans l'angle sud-ouest du hangar du Quai aux Huiles entre le caniveau d'eaux pluviales et le local en béton (Hygiènes)	2,320 m (GOA 2010)
Z	Repère temporaire posé au sol dans l'abri du marégraphe	2,130 m
Y	Face inférieur de la plaque triangulaire support de l'antenne GPS.	7,655 m
ARP	Point de référence de l'antenne GPS = base de l'antenne.	7,663 m

Descriptif des repères et résultats de nivellement

Les incertitudes des dénivelés mesurés sont de ± 0,001 m dans le cas des mesures du GOA de 2010 de même que pour le repère Z mesuré au niveau optique de précision (Leica DNA03) et peuvent être également estimées à ± 0,001 m pour la mesure au distance-mètre laser (Leica DISTO Pro)

5.5. APPENDIX 5 : LEICA Geo Office report file

Récapitulatif du Traitement

MQ_Mareg

Informations sur le Projet

Nom du Projet:	MQ_Mareg
Date de création:	09/13/2013 20:06:59
Fuseau Horaire:	2h 00'
Nom Syst. Coordonnées:	WGS 1984
Logiciel d'application:	LEICA Geo Office 8.1
Date et heure de début:	03/25/2013 01:59:44
Date et heure de fin:	03/26/2013 01:59:14
Points occupés manuellement:	1
Noyau de Post-Traitement:	PSI-Pro 3.0
Traité:	09/13/2013 20:16:30

Paramètres de Traitement

Paramètres	Sélectionnés
Angle de Coupure:	15°
Type d'Ephémérides:	Précises
Type de solution:	Automatique
Type GNSS:	GPS / GLONASS
Fréquence:	Automatique
Fixer les ambiguïtés jusqu'à:	80 km
Durée mini pour solution flottante (statique):	5' 00"
Taux d'échantillonnage:	Tout Utiliser
Modèle Troposphérique:	Hopfield
Modèle Ionosphérique:	Automatique
Utiliser modélisation statistique:	Oui
Distance mini.:	8 km
Activité ionosphérique:	Automatique

Paramètres de Traitement

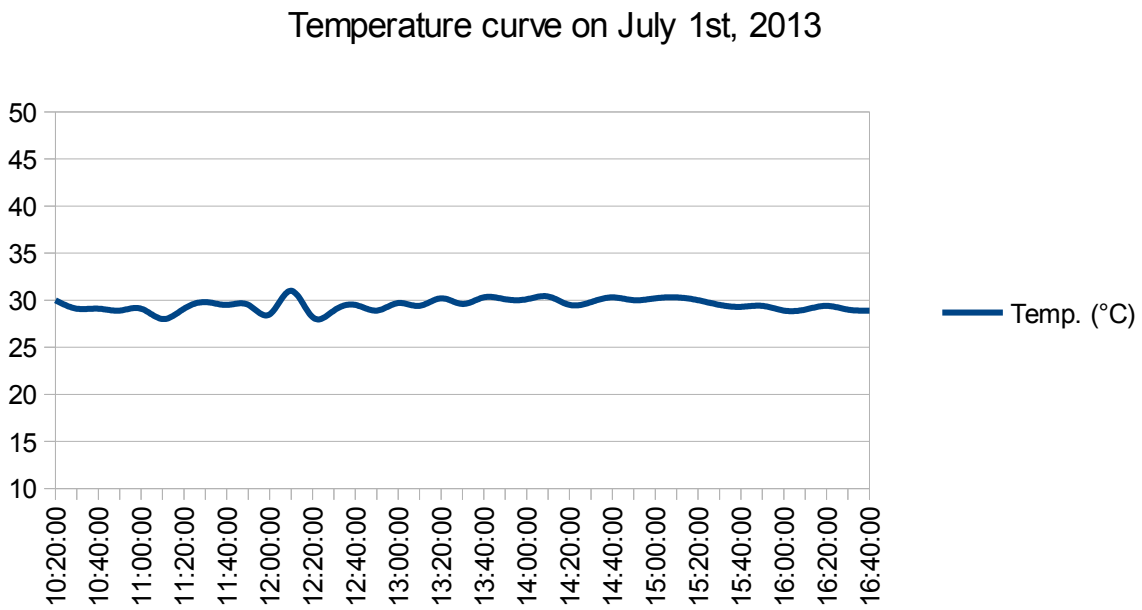
Paramètres	Sélectionnés
Angle de Coupure:	15°
Type d'Ephémérides:	Précises
Type de solution:	Automatique
Type GNSS:	GPS / GLONASS
Fréquence:	Automatique
Fixer les ambiguïtés jusqu'à:	80 km
Durée mini pour solution flottante (statique):	5' 00"
Taux d'échantillonnage:	Tout Utiliser
Modèle Troposphérique:	Hopfield
Modèle Ionosphérique:	Automatique
Utiliser modélisation statistique:	Oui
Distance mini.:	8 km
Activité ionosphérique:	Automatique

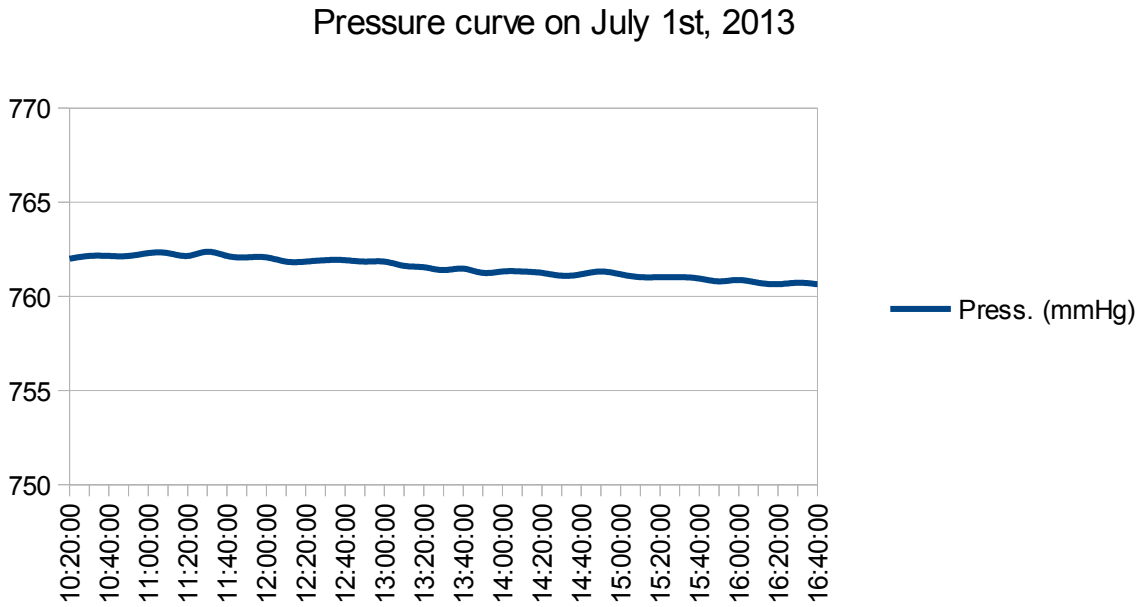
Ligne de Base - Aperçu

LMMF - FFTG	Référence: LMMF	Mobile: FFTG
Type de capteur / N° S:	TRIMBLE / 5118	TOPCON / 8
Type d'antenne / N° S:	TRM55971.00 NONE / -	TPSPG_A1+GP NONE / -
Hauteur d'antenne:	0.0000 m	0.0000 m
Coordonnées:		
X:	2993387.9520 m	2986964.3486 m
Y:	-5399363.7310 m	-5402703.5881 m
Z:	1596748.0420 m	1597459.2211 m
Type de solution:	Phase: toutes fixes	
Type GNSS:	GPS / GLONASS	
Fréquence:	L1/E1 et L2	
Ambiguïté:	Oui	
Plage horaire:	03/25/2013 01:59:44 - 03/26/2013 01:59:14	
Durée:	23h 59' 30"	

Qualité:	ET X: 0.0003 m	ET Y: 0.0004 m	ET Z: 0.0002 m
	Qlté Pos: 0.0003 m	Qlté Alt: 0.0005 m	ET Pente: 0.0002 m
Vecteur Ligne Base:	dX: -6423.6034 m	dY: -3339.8571 m	dZ: 711.1791 m
	Pente: 7274.8266 m	dAlt: -4.0040 m	
DOP (min-max):	GDOP: 1.4 - 8.0		
	PDOP: 1.2 - 6.3	HDOP: 0.6 - 3.2	VDOP: 1.1 - 5.7
Nombre de satellites utilisés:	GPS: 31		
	GLONASS: 22		

5.6. APPENDIX 6 : weather tracker data





5.7. APPENDIX 7 : adjustment input file

```
 TITL (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
 SURVEY CARRIED OUT BY J-C POYARD (IGN-F) ON JULY 2013

 COMP ADJ
 ELIP GRS 80                 6378137  6356752.3141   0.0000   0.0000   0.0000 m
 MAXI         15
 CONF YES YES YES YES NO
 PSOL NO  YES
 PMIS NO  NO
 PRES YES NO
 PADJ NO  NO  YES NO  YES NO
 VARF YES YES NO
 RTST TAU MAX
 LUNT m    1.000000000000
 CONV    0.00010
 CLEV     95.000
 ANGT GRD
 LDEC 4

*************************************************************************************************
*  LIST OF POINTS for the SURVEY ADJUSTMENT   (ITRF ACRONYMS, n° DOMES  and  POINTS DESCRIPTION) *
*************************************************************************************************

*POINTS OF INTEREST
*------------------

*GNSS
*LMMF        : 97205M001 = RGP/REGINA ref. pt. (IGS GNSS station) Antenna Height = 0.000 m

*DORIS
*LAOB        : (DOMES 97205S001) = DORIS antenna ref. pt. (Starec type)
*LAOB/2GHz   : (no DOMES ) = DORIS LAOB 2GHz Phase Centre
*DORIS_rep1  : 97205M002 = DORIS_marker_1 (under LAOB) (glued mark, will last ???)

*TIDE GAUGE
*FFTG         : (DOMES 97201M006) = Tide Gauge GNSS station

*OTHER POINTS
*10   : (no DOMES number) = temporary station
*11   : (no DOMES number) = temporary station
*12   : (no DOMES number) = temporary station
*13   : (no DOMES number) = temporary station

*xxxx_P     : Prism on a mini-pole (H=0,20m) on mark xxxx
*LMMF_Prism : Mini-prism under the GNSS antenna (H = -0,116 / LMMF_ARP)
*LMMF_axis  : GNSS ANTENNA AXIS (value issued from average from left and right antenna sides values)


**********************AZIMUT DEDUCTED FROM THE GPS DETERMINATION**********************************
 AZIM     LMMF         Ref_N-East                  52 49    65.0      0.005
 AZIM     LMMF         Ref_East                    82 72    23.0      0.004


*LMMF IGS08 EP 2005:001 COORDINATES ISSUED FROM IGS13P34.ssc FILE CONSTRAINED AT 1 MM
 3DC
 XYZ  000 LMMF               2993387.2705      -5399363.9818       1596747.9471 m
 COV  CT DIAG
 ELEM                0.000001               0.000001               0.000001


*Approximate Coordinates
 PLH  000 Ref_N-East   N 14 35  43.89038 W 60 59  43.40171     -35.0396 m       0
 PLH  000 Ref_East     N 14 35  42.56500 W 60 59  41.70524     -33.4681 m       0
 PLH  000 10           N 14 35  41.50192 W 60 59  46.24229     -26.7792 m       0
 PLH  000 11           N 14 35  41.31883 W 60 59  46.09571     -26.7984 m       0
 PLH  000 12           N 14 35  41.72379 W 60 59  45.83420     -30.2182 m       0
 PLH  000 13           N 14 35  42.00820 W 60 59  46.09448     -30.3690 m       0
 PLH  000 LMMF_axis    N 14 35  41.33665 W 60 59  46.23825     -27.0521 m       0
 PLH  000 DORIS_rep1   N 14 35  42.03039 W 60 59  45.85253     -31.8283 m       0
 PLH  000 DORIS_rep1_P N 14 35  42.03038 W 60 59  45.85251     -31.6290 m       0
 PLH  000 LAOB/2GHz    N 14 35  42.03042 W 60 59  45.85255     -28.9776 m       0
```

```
 PLH  000 LAOB         N 14 35  42.03040 W 60 59  45.85257     -29.4617 m       0
 PLH  000 LAOB/400MHz  N 14 35  42.03040 W 60 59  45.85257     -29.4617 m       0
 PLH  000 LAOB/base    N 14 35  42.03040 W 60 59  45.85258     -29.8388 m       0
 PLH  000 LMMF         N 14 35  41.33664 W 60 59  46.23825     -27.1007 m       0
 PLH  000 LMMF_Prism   N 14 35  41.33664 W 60 59  46.23825     -27.2167 m       0


***********************************CENTRING EQUATIONS*****************************************

*LMMF centred 0.1160 m above LMMF_Prism
 3DD
 PLH  000 LMMF         n 14 35 41.337000 w 60 59 46.238000     -27.0000
 PLH  000 LMMF_Prism   n 14 35 41.337000 w 60 59 46.238000     -27.1160
 COV  LG DIAG
 ELEM              0.00000009              0.00000009              0.00000016

 2DD
 PL   00  LMMF_axis    n 14 35 41.337000 w 60 59 46.238000
 PL   00  LMMF         n 14 35 41.337000 w 60 59 46.238000
 COV  LG DIAG
 ELEM              0.00000009              0.00000009

 3DD
 PLH  000 DORIS_rep1_P N 14 35  42.03000 W 60 59  45.85300     -31.6000
 PLH  000 DORIS_rep1   N 14 35  42.03000 W 60 59  45.85300     -31.8000
 COV  LG DIAG
 ELEM              0.00000009              0.00000009              0.00000009

 2DD
 PL   00  LAOB/2GHz    n 14 35 42.030000 w 60 59 45.853000
 PL   00  LAOB         n 14 35 42.030000 w 60 59 45.853000
 COV  LG DIAG
 ELEM              0.00000009              0.00000009


***********************************DORIS HEIGHT (tape measurement)****************************

 OHDF     DORIS_rep1   LAOB                                 2.367      0.001


****************************TOTAL STATION OBSERVATIONS*****************************************
 SIGM AH         8.0
 SIGM ZA        12.0
 SIGM DP      0.0010

 HIST NEW

 DSET AH
 DIR      10          Ref_East                  0  0     0.0
 DIR      10          11                       72 87    94.0
 DIR      10          LMMF_Prism              113 51    98.1
 DIR      10          LMMF_axis               113 51    84.3
 DIR      10          13                      332 66    85.4
 DIR      10          LAOB/2GHz               354 68    19.9
 DIR      10          LAOB/400MHz             354 68    20.8
 DIR      10          LAOB/base               354 68    12.3
 DIR      10          12                      382 61    80.8
 DIR      10          Ref_N-East              369 69     1.3
 DSET AH
 DIR      11          Ref_N-East                0  0     0.0
 DIR      11          LMMF_Prism              257 48    59.4
 DIR      11          LMMF_axis               257 49    20.4
 DIR      11          10                      307 20    65.6
 DIR      11          13                      349 47    37.6
 DIR      11          DORIS_rep1              369 81    71.2
 DIR      11          LAOB/2GHz               369 81    36.0
 DIR      11          LAOB/400MHz             369 81    25.7
 DIR      11          LAOB/base               369 81    22.2
 DIR      11          12                      385 10    20.3
 DSET AH
 DIR      12          Ref_East                  0  0     0.0
 DIR      12          10                      180 71    40.7
 DIR      12          LMMF_Prism              163 64    48.7
 DIR      12          LMMF_axis               163 64    51.2
 DIR      12          11                      148 86    74.4
```

DIR	12	13	266	78	76.0		
DIR	12	DORIS_rep1	309	42	68.5		
DIR	12	LAOB/2GHz	309	42	31.6		
DIR	12	LAOB/400MHz	309	41	91.6		
DIR	12	LAOB/base	309	41	76.3		
DIR	12	DORIS_rep1_P	309	43	12.4		
DIR	12	Ref_N-East	365	96	57.6		
DSET AH							
DIR	13	Ref_N-East	0	0	0.0		
DIR	13	DORIS_rep1	33	65	46.5		
DIR	13	LAOB/2GHz	33	64	60.9		
DIR	13	LAOB/400MHz	33	65	23.2		
DIR	13	LAOB/base	33	65	10.6		
DIR	13	12	93	29	27.3		
DIR	13	LMMF_Prism	152	71	77.5		
DSET AH							
DIR	13	Ref_N-East	0	0	0.0		
DIR	13	11	139	74	27.8		
DIR	13	10	157	26	78.5		
DIR	13	LMMF_axis	152	71	63.6		
DIR	13	DORIS_rep1_P	33	65	75.3		
*ZANG ZA	10	Ref_East	103	4	30.4	20.0	
ZANG ZA	10	11	100	16	56.3	15.0	
ZANG ZA	10	LMMF_Prism	105	46	78.2		
*ZANG ZA	10	LMMF_axis	103	42	17.9	25.0	
ZANG ZA	10	LAOB/2GHz	106	97	17.7		
ZANG ZA	10	LAOB/400MHz	108	49	29.3		
*ZANG ZA	10	LAOB/base	109	65	48.5		
ZANG ZA	10	12	115	34	51.8		
*ZANG ZA	10	Ref_N-East	104	67	41.3		
*ZANG ZA	11	Ref_N-East	104	63	88.1		
ZANG ZA	11	LMMF_Prism	106	17	24.7		
*ZANG ZA	11	LMMF_axis	103	74	93.7		
ZANG ZA	11	10	99	82	70.5		
ZANG ZA	11	13	110	62	70.5		
ZANG ZA	11	DORIS_rep1	113	67	85.5		
ZANG ZA	11	LAOB/2GHz	106	0	10.8		
ZANG ZA	11	LAOB/400MHz	107	32	67.8		
*ZANG ZA	11	LAOB/base	108	34	14.7		
ZANG ZA	11	12	114	54	82.5		
*ZANG ZA	12	Ref_East	101	64	26.8	15.0	
ZANG ZA	12	10	84	65	37.3		
ZANG ZA	12	LMMF_Prism	88	85	33.7		
*ZANG ZA	12	LMMF_axis	88	24	65.2		
ZANG ZA	12	11	85	45	0.9		
ZANG ZA	12	13	100	81	65.8		
ZANG ZA	12	DORIS_rep1	110	75	55.1		
ZANG ZA	12	LAOB/2GHz	91	67	30.3		
ZANG ZA	12	LAOB/400MHz	94	90	94.8		
*ZANG ZA	12	LAOB/base	97	44	90.3		
ZANG ZA	12	DORIS_rep1_P	109	44	59.4		
*ZANG ZA	12	Ref_N-East	103	10	88.1		
*ZANG ZA	13	Ref_N-East	102	99	60.1		
ZANG ZA	13	DORIS_rep1	112	60	51.4		
ZANG ZA	13	LAOB/2GHz	87	95	92.6		
ZANG ZA	13	LAOB/400MHz	92	10	12.3		
*ZANG ZA	13	LAOB/base	95	36	50.2		
ZANG ZA	13	12	99	17	99.7		
ZANG ZA	13	LMMF_Prism	90	55	27.5		
*ZANG ZA	13	Ref_N-East	102	99	51.0		
ZANG ZA	13	11	89	37	22.5		
ZANG ZA	13	10	86	9	84.9		
*ZANG ZA	13	LMMF_axis	90	6	38.4		
ZANG ZA	13	DORIS_rep1_P	110	91	88.2		
DIST DP	10	11			7.13522		
DIST DP	10	LMMF_Prism			5.09979		
DIST DP	10	13			16.57048		
DIST DP	10	12			14.40510		
DIST DP	11	LMMF_Prism			4.32172		
DIST DP	11	10			7.13532		
DIST DP	11	13			21.48625		
DIST DP	11	12			15.09525		
DIST DP	12	10			14.40548		

```
 DIST DP  12          LMMF_Prism                      17.22903
 DIST DP  12          11                              15.09554
 DIST DP  12          13                              11.71009
 DIST DP  12          DORIS_rep1_P                     9.54350
 DIST DP  13          12                              11.70993
 DIST DP  13          LMMF_Prism                      21.31828
 DIST DP  13          11                              21.48654
 DIST DP  13          10                              16.57081
 DIST DP  13          DORIS_rep1_P                     7.38212

*************************************************************************************************
*  The tide gauge shelter is equiped with a GNSS station. The antenna FFTG is tied by levelling  *
* to the tide gauge marks (see "FOM_Fort_de_France_SHOM.pdf" report). March 25th, 2013 data from *
* these 2 stations FFTG and LMMF have been processed.                                           *
*************************************************************************************************

 VSCA              15

*GRP  Obs #00001 mareg.asc
 3DD
 DXYZ     LMMF         FFTG            -6423.6034    -3339.8571      711.1791 m
 COV  CT UPPR
 ELEM   8.943193799999999e-08  -8.943193799999999e-08   3.577277519999999e-08 m
 ELEM   1.788638760000000e-07  -5.365916279999999e-08                         m
 ELEM   5.365916279999999e-08                                                  m

 HIST ALL Toutes les observations
 END
```

5.8. APPENDIX 8 : adjustment output file

```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0              GRS 80      UNITS: m,GRAD Page 0001
================================================================================
Fri Mar 21 13:46:31 2014

Input file:  D:\JCPOYARD\En_cours_Poy\2013001_Le_Lamentin\Geolab\LeLamentin_2013_sansRep-
Maregra.iob
Output file: D:\JCPOYARD\En_cours_Poy\2013001_Le_Lamentin\Geolab\LeLamentin_2013_sansRep-
Maregra.lst
Options file: C:\Program Files (x86)\Microsearch\GeoLab\default.gpj
```

PARAMETERS		OBSERVATIONS	
Description	Number	Description	Number
No. of Stations	16	Directions	44
Coord Parameters	44	Distances	18
Free Latitudes	16	Azimuths	2
Free Longitudes	16	Vertical Angles	0
Free Heights	12	Zenithal Angles	28
Fixed Coordinates	4	Angles	0
Astro. Latitudes	0	Heights	0
Astro. Longitudes	0	Height Differences	1
Geoid Records	0	Auxiliary Params.	0
All Aux. Pars.	5	2-D Coords.	0
Direction Pars.	5	2-D Coord. Diffs.	4
Scale Parameters	0	3-D Coords.	3
Constant Pars.	0	3-D Coord. Diffs.	9
Rotation Pars.	0		
Translation Pars.	0		
	--------		--------
Total Parameters	49	Total Observations	109

```
|-------------------------------------------------------------------------------|
|                      Degrees of Freedom =        60                           |
 -------------------------------------------------------------------------------

-------------------------------------------------------------------------------
                        SUMMARY OF SELECTED OPTIONS
-------------------------------------------------------------------------------
    OPTION                              |   SELECTION
-------------------------------------------------------------------------------
    Computation Mode                    |   Adjustment
    Maximum Iterations                  |   15
    Convergence Criterion               |   0.00010
    Residual Rejection Criterion        |   Tau Max
    Confidence Region Types             |   1D 2D 3D Station
    Variance Factor (VF) Known          |   Yes
    Scale Covariance Matrix With VF     |   Yes
    Scale Residual Variances With VF    |   No
    Force Convergence in Max Iters      |   No
    Distances Contribute To Heights     |   No
    Compute Full Inverse                |   Yes
    Optimize Band Width                 |   Yes
    Generate Initial Coordinates        |   Yes
    Re-Transform Obs After 1st Pass     |   Yes
    Geoid Interpolation Method          |   Bi-Quadratic
-------------------------------------------------------------------------------

===============================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0002
===============================================================================
Adjusted PLH Coordinates:
                                    LATITUDE          LONGITUDE  ELIP-HEIGHT
 CODE FFF STATION                    STD DEV            STD DEV      STD DEV
 ---- --- ------------ ------------------ ------------------ ------------
 PLH  000 10           N 14 35  41.50192 W 60 59  46.24229     -26.7792 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 11           N 14 35  41.31882 W 60 59  46.09572     -26.7984 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 12           N 14 35  41.72378 W 60 59  45.83421     -30.2183 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 13           N 14 35  42.00820 W 60 59  46.09448     -30.3690 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 DORIS_rep1   N 14 35  42.03038 W 60 59  45.85253     -31.8284 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 DORIS_rep1_P N 14 35  42.03038 W 60 59  45.85251     -31.6290 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 FFTG         N 14 36   5.28189 W 61  3  48.05214     -31.1039 m       0
                                  0.0014             0.0014       0.0025
 PLH  000 LAOB         N 14 35  42.03042 W 60 59  45.85256     -29.4614 m       0
                                  0.0013             0.0012       0.0017
 PLH  000 LAOB/2GHz    N 14 35  42.03042 W 60 59  45.85256     -28.9768 m       0
                                  0.0012             0.0012       0.0012
 PLH  000 LAOB/400MHz  N 14 35  42.03039 W 60 59  45.85257     -29.4621 m       0
                                  0.0012             0.0012       0.0012
 PLH  001 LAOB/base    N 14 35  42.03039 W 60 59  45.85258     -29.8388 m       0
                                  0.0012             0.0012       0.0000
 PLH  000 LMMF         N 14 35  41.33664 W 60 59  46.23825     -27.1007 m       0
                                  0.0011             0.0011       0.0011
 PLH  000 LMMF_Prism   N 14 35  41.33663 W 60 59  46.23825     -27.2167 m       0
                                  0.0012             0.0012       0.0012
 PLH  001 LMMF_axis    N 14 35  41.33664 W 60 59  46.23825     -27.0521 m       0
                                  0.0012             0.0012       0.0000
 PLH  001 Ref_East     N 14 35  42.56499 W 60 59  41.70528     -33.4681 m       0
                                  0.0088             0.0313       0.0000
 PLH  001 Ref_N-East   N 14 35  43.89038 W 60 59  43.40171     -35.0396 m       0
                                  0.0091             0.0098       0.0000
```

```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0003
================================================================================
Adjusted XYZ Coordinates:
                              X-COORDINATE       Y-COORDINATE       Z-COORDINATE
 CODE FFF STATION                  STD DEV            STD DEV            STD DEV
 ---- --- ------------ ------------------ ------------------ ------------------
 XYZ      10                2993386.6950      -5399363.1930       1596752.9440 m       0
                                  0.0012             0.0012             0.0012
 XYZ      11                2993391.2104      -5399362.2898       1596747.4934 m       0
                                  0.0012             0.0012             0.0012
 XYZ      12                2993394.9305      -5399352.8573       1596758.6762 m       0
                                  0.0012             0.0012             0.0012
 XYZ      13                2993386.9787      -5399354.5805       1596767.0976 m       0
                                  0.0012             0.0012             0.0012
 XYZ      DORIS_rep1        2993392.5440      -5399349.6838       1596767.3898 m       0
                                  0.0012             0.0012             0.0012
 XYZ      DORIS_rep1_P      2993392.6380      -5399349.8524       1596767.4397 m       0
                                  0.0012             0.0012             0.0012
 XYZ      FFTG              2986963.6671      -5402703.8389       1597459.1262 m       0
                                  0.0017             0.0022             0.0015
 XYZ      LAOB              2993393.6539      -5399351.6873       1596767.9871 m       0
                                  0.0013             0.0016             0.0013
 XYZ      LAOB/2GHz         2993393.8813      -5399352.0974       1596768.1093 m       0
                                  0.0012             0.0012             0.0012
 XYZ      LAOB/400MHz       2993393.6532      -5399351.6871       1596767.9862 m       0
                                  0.0012             0.0012             0.0012
 XYZ      LAOB/base         2993393.4762      -5399351.3684       1596767.8914 m       0
                                  0.0010             0.0007             0.0012
 XYZ      LMMF              2993387.2705      -5399363.9818       1596747.9471 m       0
                                  0.0011             0.0011             0.0011
 XYZ      LMMF_Prism        2993387.2160      -5399363.8837       1596747.9177 m       0
                                  0.0012             0.0012             0.0012
 XYZ      LMMF_axis         2993387.2933      -5399364.0229       1596747.9595 m       0
                                  0.0010             0.0006             0.0011
 XYZ      Ref_East          2993498.3282      -5399284.4874       1596782.8771 m       0
                                  0.0263             0.0171             0.0085
 XYZ      Ref_N-East        2993448.2068      -5399298.7998       1596821.9020 m       0
                                  0.0075             0.0067             0.0088
```

```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0004
================================================================================
Residuals (critical value = 3.525):
NOTE: Observation values shown are reduced to mark-to-mark.
                                                  OBSERVATION RESIDUAL  STD RES
TYPE AT           FROM         TO                       STD DEV  STD DEV      PPM
---- ------------ ------------ ------------ ------------------ -------- --------
AZIM               LMMF         Ref_N-East      52 49     65.0      0.0      0.0
                                                          0.0      0.0         *
AZIM               LMMF         Ref_East        82 72     23.0     -0.0     -0.0
                                                          0.0      0.0         *
XCT  LMMF                                      2993387.27050   0.0000   0.0000
                                                     0.0010   0.0000         *
YCT  LMMF                                     -5399363.98180  -0.0000  -0.0000
                                                     0.0010   0.0000         *
ZCT  LMMF                                      1596747.94710   0.0000   0.0000
                                                     0.0010   0.0000         *
ELAT               LMMF         LMMF_Prism      0 00   0.00000  -0.0002  -0.9106
                                                     0.0003   0.0002  1639.04
```

```
ELON            LMMF         LMMF_Prism      0 00   0.00000  -0.0001  -0.3451
                                                     0.0003   0.0002   618.60
EHGT            LMMF         LMMF_Prism            -0.11600   0.0000   7.6561
                                                     0.0004   0.0000     0.00
                                                  ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
ELAT            LMMF_axis    LMMF            0 00   0.00000  -0.0002  -0.7296
                                                     0.0003   0.0003  3852.17
ELON            LMMF_axis    LMMF            0 00   0.00000  -0.0000  -0.0000
                                                     0.0003  -0.0000  1006.96
ELAT            DORIS_rep1_P DORIS_rep1      0 00   0.00000   0.0003   1.0696
                                                     0.0003   0.0003  1438.84
ELON            DORIS_rep1_P DORIS_rep1      0 00   0.00000  -0.0005  -1.8493
                                                     0.0003   0.0003  2447.21
EHGT            DORIS_rep1_P DORIS_rep1            -0.20000   0.0006   2.1242
                                                     0.0003   0.0003  2834.01
ELAT            LAOB/2GHz    LAOB            0 00   0.00000   0.0000   0.0000
                                                     0.0003   0.0001     0.00
ELON            LAOB/2GHz    LAOB            0 00   0.00000   0.0000   0.0000
                                                     0.0003  -0.0000     0.00
OHDF            DORIS_rep1   LAOB                   2.36700   0.0000   0.0000
                                                     0.0010   0.0000     0.00*
DIR             10           Ref_East         0  0      0.0     13.9      2.2
                                                       8.0      6.3
DIR             10           11              72 87     94.0    -11.2     -2.2
                                                       8.0      5.1
DIR             10           LMMF_Prism     113 51     98.1     -0.8     -0.3
                                                       8.0      2.3
DIR             10           LMMF_axis      113 51     84.3     -3.3     -1.3
                                                       8.0      2.5
DIR             10           13             332 66     85.4     -4.3     -0.7
                                                       8.0      6.1
DIR             10           LAOB/2GHz      354 68     19.9     -0.2     -0.0
                                                       8.0      6.8
DIR             10           LAOB/400MHz    354 68     20.8     -1.3     -0.2
                                                       8.0      6.8
DIR             10           LAOB/base      354 68     12.3     -0.7     -0.1
                                                       8.0      6.8
DIR             10           12             382 61     80.8      2.6      0.4
                                                       8.0      6.0
DIR             10           Ref_N-East     369 69      1.3      5.3      0.8
                                                       8.0      6.7
DIR             11           Ref_N-East       0  0      0.0     -7.3     -1.4
                                                       8.0      5.2
DIR             11           LMMF_Prism     257 48     59.4      1.1      0.7
                                                       8.0      1.7
DIR             11           LMMF_axis      257 49     20.4     -2.2     -1.4
                                                       8.0      1.6
DIR             11           10             307 20     65.6     11.3      2.1
                                                       8.0      5.3
DIR             11           13             349 47     37.6      1.2      0.2
                                                       8.0      6.6
DIR             11           DORIS_rep1     369 81     71.2     -5.8     -0.8
                                                       8.0      6.9
DIR             11           LAOB/2GHz      369 81     36.0      2.3      0.3
                                                       8.0      7.0
DIR             11           LAOB/400MHz    369 81     25.7      4.7      0.7
                                                       8.0      7.0
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0005
================================================================================
Residuals (critical value = 3.525):
NOTE: Observation values shown are reduced to mark-to-mark.
                                                 OBSERVATION RESIDUAL  STD RES
TYPE AT          FROM         TO                     STD DEV  STD DEV      PPM
---- ------------ ------------ ------------ ----------------- -------- --------
DIR             11           LAOB/base      369 81     22.2      1.4      0.2
```

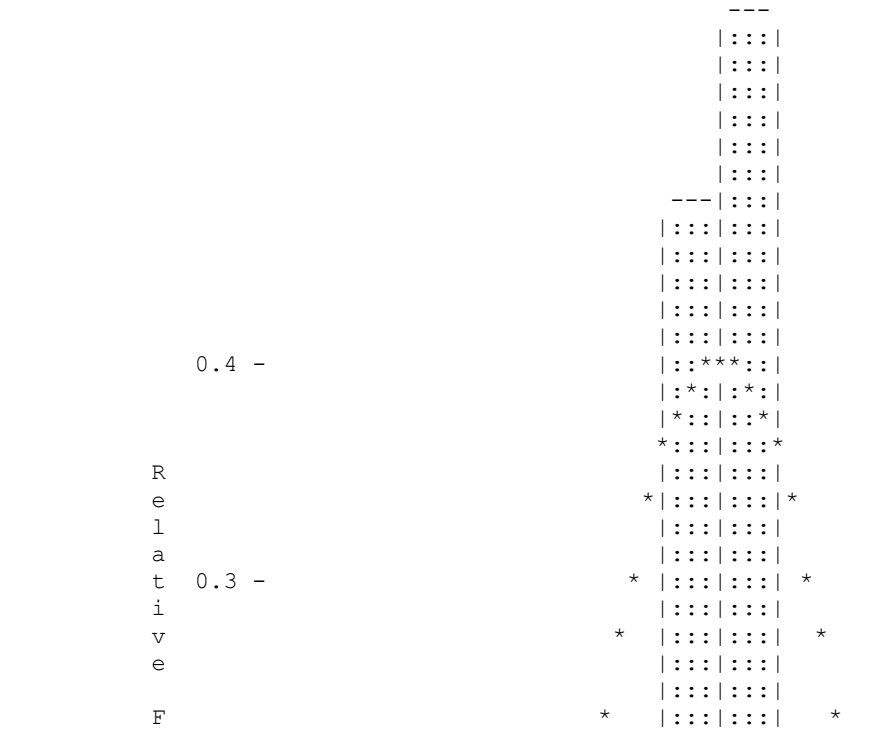
					8.0	7.0	
DIR	11	12	385	10	20.3	-6.7	-1.0
					8.0	6.7	
DIR	12	Ref_East	0	0	0.0	-6.8	-2.2
					8.0	3.1	
DIR	12	10	180	71	40.7	-1.9	-0.3
					8.0	5.9	
DIR	12	LMMF_Prism	163	64	48.7	0.1	0.0
					8.0	6.9	
DIR	12	LMMF_axis	163	64	51.2	4.5	0.7
					8.0	6.8	
DIR	12	11	148	86	74.4	0.4	0.1
					8.0	5.8	
DIR	12	13	266	78	76.0	5.2	1.1
					8.0	4.9	
DIR	12	DORIS_rep1	309	42	68.5	7.0	1.9
					8.0	3.6	
DIR	12	LAOB/2GHz	309	42	31.6	-0.8	-0.2
					8.0	3.3	
DIR	12	LAOB/400MHz	309	41	91.6	-1.3	-0.4
					8.0	3.3	
DIR	12	LAOB/base	309	41	76.3	-0.3	-0.1
					8.0	3.3	
DIR	12	DORIS_rep1_P	309	43	12.4	-5.2	-1.8
					8.0	2.9	
DIR	12	Ref_N-East	365	96	57.6	-1.0	-0.2
					8.0	5.6	
DIR	13	Ref_N-East	0	0	0.0	1.5	0.3
					8.0	4.8	
DIR	13	DORIS_rep1	33	65	46.5	3.2	1.4
					8.0	2.3	
DIR	13	LAOB/2GHz	33	64	60.9	-0.2	-0.1
					8.0	1.7	
DIR	13	LAOB/400MHz	33	65	23.2	-0.3	-0.2
					8.0	1.7	
DIR	13	LAOB/base	33	65	10.6	0.0	0.0
					8.0	1.7	
DIR	13	12	93	29	27.3	-6.9	-1.4
					8.0	5.1	
DIR	13	LMMF_Prism	152	71	77.5	2.7	0.5
					8.0	5.5	
DIR	13	Ref_N-East	0	0	0.0	-4.3	-0.9
					8.0	4.7	
DIR	13	11	139	74	27.8	5.7	0.9
					8.0	6.2	
DIR	13	10	157	26	78.5	-8.7	-1.4
					8.0	6.4	
DIR	13	LMMF_axis	152	71	63.6	9.6	1.5
					8.0	6.6	
DIR	13	DORIS_rep1_P	33	65	75.3	-2.3	-1.0
					8.0	2.3	
ZANG	10	11	100	16	56.3	-55.4	-3.1
					19.2	17.9	
ZANG	10	LMMF_Prism	105	46	78.2	-2.8	-0.4
					12.0	7.4	
ZANG	10	LAOB/2GHz	106	97	17.7	37.1	3.3
					12.0	11.2	
ZANG	10	LAOB/400MHz	108	49	29.3	23.1	2.1
					12.0	11.2	
ZANG	10	12	115	34	51.8	-19.7	-1.8
					12.0	11.1	
ZANG	11	LMMF_Prism	106	17	24.7	-1.9	-0.3
					12.0	6.4	
ZANG	11	10	99	82	70.5	-18.5	-1.9
					12.0	9.8	
ZANG	11	13	110	62	70.5	-17.1	-1.5
					12.0	11.5	

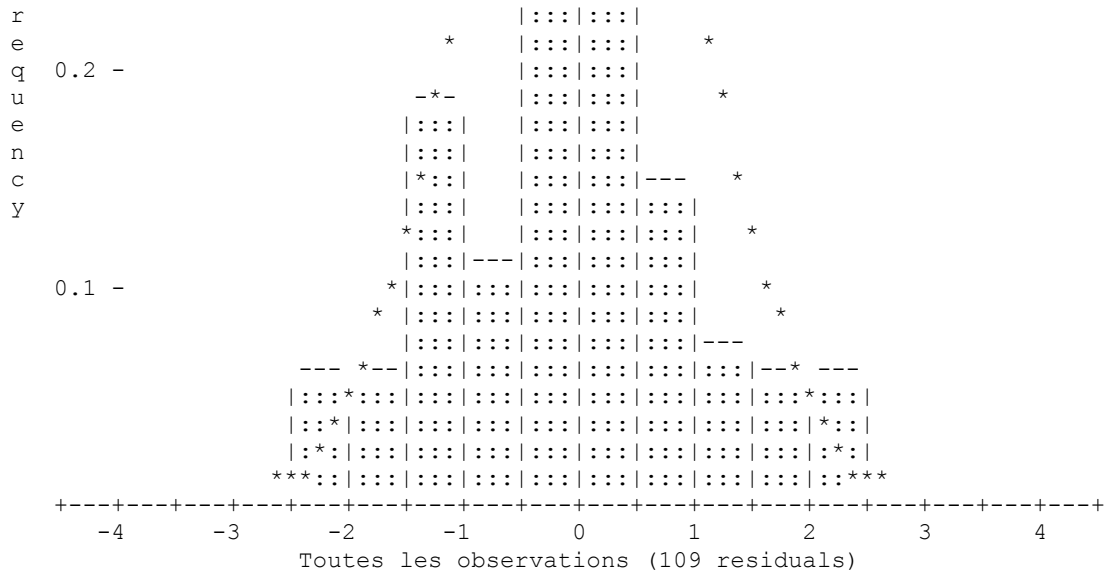
```
ZANG              11           DORIS_rep1     113 67     85.5     -2.1     -0.2
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0006
================================================================================
Residuals (critical value = 3.525):
NOTE: Observation values shown are reduced to mark-to-mark.
                                                 OBSERVATION RESIDUAL  STD RES
TYPE AT           FROM         TO                     STD DEV  STD DEV      PPM
---- ------------ ------------ ------------ ----------------- -------- --------
                                                        12.0     11.4
ZANG              11           LAOB/2GHz      106  0     10.8     21.4      1.9
                                                        12.0     11.4
ZANG              11           LAOB/400MHz    107 32     67.8     18.9      1.7
                                                        12.0     11.4
ZANG              11           12             114 54     82.5    -12.8     -1.1
                                                        12.0     11.2
ZANG              12           10              84 65     37.3      7.4      0.7
                                                        12.0     11.1
ZANG              12           LMMF_Prism      88 85     33.7     11.9      1.1
                                                        12.0     11.3
ZANG              12           11              85 45      0.9     -5.3     -0.5
                                                        12.0     11.2
ZANG              12           13             100 81     65.8    -25.1     -2.3
                                                        12.0     11.1
ZANG              12           DORIS_rep1     110 75     55.1      0.5      0.1
                                                        12.0      9.3
ZANG              12           LAOB/2GHz       91 67     30.3    -22.4     -2.4
                                                        12.0      9.2
ZANG              12           LAOB/400MHz     94 90     94.8    -10.9     -1.2
                                                        12.0      9.2
ZANG              12           DORIS_rep1_P   109 44     59.4     16.1      1.8
                                                        12.0      9.1
ZANG              13           DORIS_rep1     112 60     51.4    -10.5     -1.3
                                                        12.0      7.8
ZANG              13           LAOB/2GHz       87 95     92.6     -3.2     -0.4
                                                        12.0      7.5
ZANG              13           LAOB/400MHz     92 10     12.3     -5.9     -0.8
                                                        12.0      7.5
ZANG              13           12              99 17     99.7    -10.6     -1.0
                                                        12.0     11.1
ZANG              13           LMMF_Prism      90 55     27.5      6.9      0.6
                                                        12.0     11.5
ZANG              13           11              89 37     22.5      7.9      0.7
                                                        12.0     11.5
ZANG              13           10              86  9     84.9      2.4      0.2
                                                        12.0     11.2
ZANG              13           DORIS_rep1_P   110 91     88.2     -1.8     -0.2
                                                        12.0      7.5
DIST              10           11                      7.13520   0.0002   0.1798
                                                       0.0010   0.0010    24.72
DIST              10           LMMF_Prism              5.09970   0.0006   0.5639
                                                       0.0010   0.0010   109.08
DIST              10           13                     16.57040   0.0000   0.0041
                                                       0.0010   0.0010     0.23
DIST              10           12                     14.40510   0.0001   0.0675
                                                       0.0010   0.0010     4.54
DIST              11           LMMF_Prism              4.32170  -0.0002  -0.2143
                                                       0.0010   0.0010    49.05
DIST              11           10                      7.13530   0.0001   0.0779
                                                       0.0010   0.0010    10.70
DIST              11           13                     21.48620   0.0002   0.1656
                                                       0.0010   0.0009     7.19
DIST              11           12                     15.09520   0.0001   0.0724
                                                       0.0010   0.0010     4.62
DIST              12           10                     14.40540  -0.0002  -0.2422
                                                       0.0010   0.0010    16.29
```

DIST	12	LMMF_Prism	17.22900	0.0001	0.0593
			0.0010	0.0010	3.27
DIST	12	11	15.09550	-0.0002	-0.2391
			0.0010	0.0010	15.25
DIST	12	13	11.71000	-0.0002	-0.1806
			0.0010	0.0010	14.95
DIST	12	DORIS_rep1_P	9.54350	0.0003	0.3298
			0.0010	0.0010	33.50
DIST	13	12	11.70990	-0.0001	-0.0774
			0.0010	0.0010	6.41
DIST	13	LMMF_Prism	21.31820	0.0002	0.1809
			0.0010	0.0009	7.91

Residuals (critical value = 3.525):
NOTE: Observation values shown are reduced to mark-to-mark.

TYPE	AT	FROM	TO	OBSERVATION STD DEV	RESIDUAL STD DEV	STD RES PPM
DIST		13	11	21.48650	-0.0001	-0.1560
				0.0010	0.0009	6.77
DIST		13	10	16.57080	-0.0004	-0.4142
				0.0010	0.0010	23.90
DIST		13	DORIS_rep1_P	7.38210	0.0003	0.3388
				0.0010	0.0010	44.86
DXCT		LMMF	FFTG	-6423.60340	0.0000	0.0000
				0.0012	0.0000	*
DYCT		LMMF	FFTG	-3339.85710	-0.0000	-0.0000
				0.0016	0.0000	0.00*
DZCT		LMMF	FFTG	711.17910	-0.0000	-0.0000
				0.0009	0.0000	0.00*






```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0009
================================================================================
```

S T A T I S T I C S S U M M A R Y	
Residual Critical Value Type	Tau Max
Residual Critical Value	3.5246
Number of Flagged Residuals	1
Convergence Criterion	0.0001
Final Iteration Counter Value	3
Confidence Level Used	95.0000
Estimated Variance Factor	1.2867
Number of Degrees of Freedom	60

Chi-Square Test on the Variance Factor:

9.2682e-01 < 1.0000 < 1.9071e+00 ?

THE TEST PASSES

NOTE: All confidence regions were computed using the following factors:

Variance factor used	=	1.2867
1-D expansion factor	=	1.9600
2-D expansion factor	=	2.4477
3-D expansion factor	=	2.7955

Note that, for relative confidence regions, precisions are computed from the ratio of the major semi-axis and the spatial distance between the two stations.

```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0010
================================================================================
2-D and 1-D Station Confidence Regions (95.000 and 95.000 percent):
STATION            MAJOR SEMI-AXIS  AZ     MINOR SEMI-AXIS             VERTICAL
------------ --------------------- --- ------------------- --------------------
10                          0.0029   7              0.0028               0.0024
11                          0.0029  90              0.0028               0.0024
12                          0.0030  43              0.0028               0.0024
13                          0.0030  16              0.0029               0.0024
DORIS_rep1                  0.0031  30              0.0029               0.0024
DORIS_rep1_P                0.0031  29              0.0029               0.0024
FFTG                        0.0035  50              0.0034               0.0049
LAOB                        0.0032  30              0.0030               0.0033
LAOB/2GHz                   0.0031  30              0.0029               0.0024
LAOB/400MHz                 0.0031  30              0.0029               0.0024
LAOB/base                   0.0031  30              0.0029               0.0000
LMMF                        0.0028   0              0.0028               0.0022
LMMF_Prism                  0.0028 113              0.0028               0.0024
LMMF_axis                   0.0028 113              0.0028               0.0000
Ref_East                    0.0795  74              0.0028               0.0000
Ref_N-East                  0.0326  47              0.0028               0.0000
```

```
================================================================================
         (LE LAMENTIN - MARTINIQUE) REGINA&DORIS (and TIDE GAUGE) TIES
Microsearch GeoLab, V2001.9.20.0             GRS 80      UNITS: m,GRAD Page 0011
================================================================================
3D Station Confidence Regions (95.000 percent):
STATION         MAJ-SEMI (AZ,VANG)    MED-SEMI (AZ,VANG)    MIN-SEMI (AZ,VANG)
------------ -------------------- --------------------- --------------------
10               0.0034 (192, 90)      0.0033 (  7,  0)      0.0032 ( 97,  0)
11               0.0034 (195, 90)      0.0033 ( 90,  0)      0.0032 (360,  0)
12               0.0034 (216, 90)      0.0034 ( 43,  0)      0.0033 (313,  0)
13               0.0034 (196,  0)      0.0034 ( 16, 90)      0.0033 (106,  0)
DORIS_rep1       0.0035 (210,  0)      0.0034 ( 36, 90)      0.0033 (300,  0)
DORIS_rep1_P     0.0035 (209,  0)      0.0034 ( 34, 90)      0.0033 (299,  0)
FFTG             0.0070 ( 42, 86)      0.0039 (232,  4)      0.0038 (142,  1)
LAOB             0.0047 (163, 90)      0.0036 ( 30,  0)      0.0034 (300,  0)
LAOB/2GHz        0.0035 (210,  0)      0.0034 ( 36, 90)      0.0033 (300,  0)
LAOB/400MHz      0.0035 (210,  0)      0.0034 ( 36, 90)      0.0033 (300,  0)
LAOB/base        0.0035 ( 30,  0)      0.0033 (120,  0)      0.0000 (  0, 90)
LMMF             0.0032 (209,  0)      0.0032 (303, 90)      0.0032 (119,  0)
LMMF_Prism       0.0034 (193, 90)      0.0032 (293,  0)      0.0032 ( 23,  0)
LMMF_axis        0.0032 (113,  0)      0.0032 ( 23,  0)      0.0000 (  0, 90)
Ref_East         0.0908 ( 74,  0)      0.0032 (344,  0)      0.0000 (  0, 90)
Ref_N-East       0.0373 ( 47,  0)      0.0032 (317,  0)      0.0000 (  0, 90)

Fri Mar 21 13:46:31 2014
```

5.9. APPENDIX 9 : Le Lamentin SINEX file

```
%=SNX 1.00 IGN 14:080:00000 IGN 13:183:00000 13:183:00000 C 00006
*-------------------------------------------------------------------------------
+FILE/COMMENT
* File created by geotosnx software (Z.Altamimi)
* Original input file: LeLam.cov
* Matrix Scalling Factor used:         1.0000000000
-FILE/COMMENT
*-------------------------------------------------------------------------------
+SITE/ID
*CODE PT __DOMES__ T _STATION DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_H_
 LMMF  A 97205M001   97205M001              299 00 13.7  14 35 41.3   -27.1
 LAOB  A 97205S001   97205S001              299 00 14.1  14 35 42.0   -29.5
-SITE/ID
*-------------------------------------------------------------------------------
+SOLUTION/EPOCHS
*Code PT SOLN T Data_start__ Data_end____ Mean_epoch__
-SOLUTION/EPOCHS
*-------------------------------------------------------------------------------
+SOLUTION/ESTIMATE
*INDEX TYPE__ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ _STD_DEV___
     1 STAX   LMMF  A    1 13:183:00000 m    2 0.2993387270500000E+07 0.11343E-02
     2 STAY   LMMF  A    1 13:183:00000 m    2 -.5399363981800000E+07 0.11343E-02
     3 STAZ   LMMF  A    1 13:183:00000 m    2 0.1596747947100000E+07 0.11343E-02
     4 STAX   LAOB  A    1 13:183:00000 m    2 0.2993393653900000E+07 0.16505E-02
     5 STAY   LAOB  A    1 13:183:00000 m    2 -.5399351687300000E+07 0.13046E-02
     6 STAZ   LAOB  A    1 13:183:00000 m    2 0.1596767987100000E+07 0.12554E-02
-SOLUTION/ESTIMATE
*-------------------------------------------------------------------------------
+SOLUTION/MATRIX_ESTIMATE L COVA
*PARA1 PARA2 ____PARA2+0__________ ____PARA2+1__________ ____PARA2+2__________
     1     1 0.128670048528899E-05
     2     1 0.446229431531178E-19 0.128670048541122E-05
     3     1 0.343770350820598E-17 -.176005839054785E-18 0.128670048527669E-05
     4     1 0.128669961411643E-05 -.133692290963747E-12 -.225054740628992E-12
     4     4 0.272398523502339E-05
     5     1 0.153952335595383E-12 0.128669972862593E-05 -.591407879802004E-12
     5     4 0.711660960045920E-09 0.170185644429716E-05
     6     1 -.225042952976020E-12 0.513379080355237E-12 0.128670041980531E-05
     6     4 0.320660850988232E-06 -.273310350912590E-08 0.157599645535550E-05
-SOLUTION/MATRIX_ESTIMATE L COVA
%ENDSNX
```