SERVICE
DE GEODESIE
ET NIVELLEMENT

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ITRF Co-location Survey
Observatoire de la Côte d'Azur
Plateau de Calern (Grasse), France

Rattachement ITRF à Calern (Grasse)
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Résumé

Ce document présente les opérations et calculs du rattachement ITRF entre les instruments des différentes techniques de Géodésie spatiale de l'Observatoire de la Côte d'Azur (OCA) à Calern près de Grasse.

This document presents the local tie survey between the various space geodesy techniques of the "Observatoire de la Côte d'Azur" (OCA) Observatory of the French Riviera near Grasse.

Matériel

Système d'exploitation	**Logiciel**
Windows 7 Pro SP1	Microsoft Office

Validation

	Fonction	**Nom**	**Visa**
Commanditaire	Chef d'unité RSI	Bruno Garayt	18/07/2014 – signé
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Diffusion

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CONTENTS

INTRODUCTION

ITRF is the result of a combination of the different terrestrial reference frames provided by the four space geodetic techniques: GNSS, VLBI, SLR and DORIS. To perform this combination between independent reference frames, it is necessary to have some co-location sites where the various techniques are observing and for which ties have been surveyed in three dimensions.

In this frame of work and to monitor its time evolution, it has been decided to survey regularly the Grasse co-location site (Calern, France). Indeed, this site contains three space geodetic techniques (GNSS, SLR, Doris) and a VLBI campaign reference point.

In order to ease the survey, this site has been equipped with geodetic piers well distributed over the plot of land.

This survey was done in order to reach the ITRF accuracy requirements of 1 mm.

ACKNOWLEDGEMENTS

We would like to express our thanks to OCA team in Calern, with a special thank to all the team working on the Laser. Their very nice welcome, their cooperative work on technical and administrative aspects contributed for a great part to the success of this work.

1. CO-LOCATION SITE DESCRIPTION

Although this co-location site is located at Caussols on the "Plateau de Calern", it is also often called Grasse.

This site hosted by "Observatoire de la Côte d'Azur" (OCA) is about 10 km north of Grasse and 30 km west of Nice (see below an extract of the Geoportail website *http://www.geoportail.gouv.fr/accueil*).

On a geodetic point of view, this observatory site is of a great interest; indeed there are:

- two Laser ranging stations contributing to ILRS : they are called « GRSM », a 154 cm aperture telescope and « GRAF », the mobile Laser station;
- two IGS permanently operating Global Navigation Satellite System stations: these are GRAS (GNSS) and GRAC (GNSS) which are about 32 m apart;
- one DORIS station, GR4B.

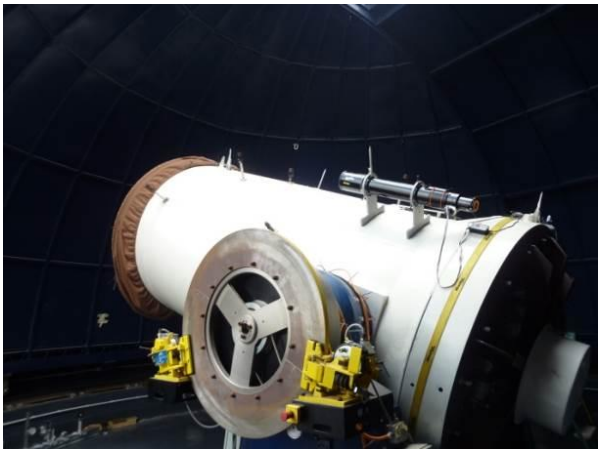
Furthermore, the importance of the site is complemented by one VLBI campaign station marker.

Several surveys have been conducted at Grasse over the last decades, particularly in 1994, 1999 and 2009, but restoring the local tie, after the big changes on the mechanics of the telescope MeO (Laser Moon) was crucial. The purpose is to compare this survey with the 2009 one and to start as far as possible tie surveys monitoring with yearly campaigns.

2. MAIN GEODETIC POINTS DESCRIPTION

2.1. SLR stations

2.1.1. Grasse LLR station

GRSM	DOMES number 10002S002 - CDP 7845
 Global view (picture 2009)	 Detail view
Description : intersection of the Azimuth and Elevation rotation axes	

The LLR measurements refer to a point in the telescope where the two rotation axes intersect. Of course, the Ranging System Reference Point (SRP) can't be materialized.

This telescope formerly called « Laser Lune » is now called « Laser MeO » because not only implicated as Laser Moon station but also in research and development in Optical Metrology activities.

2.1.2. Grasse FTLRS station

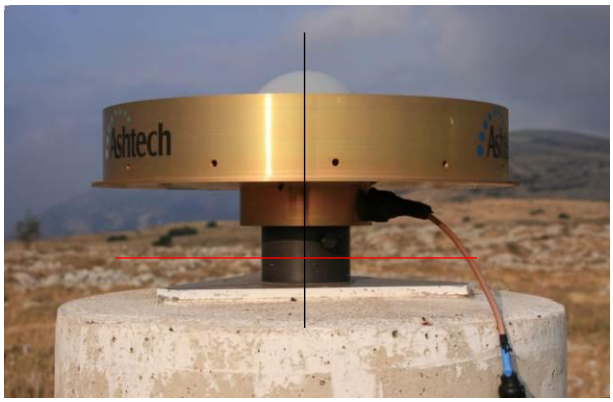
GRAF	DOMES number 10002S017 - CDP 7829
 Global view (picture 2009)	 Detail view
Description : intersection of the Azimuth and Elevation rotation axes	

When it is not operating outside, the French Transportable laser range station (FTLRS) is set up in a one storey building, on a dedicated platform with a sliding roof (see above). The FTLRS measurements refer to a point in the telescope where the two rotation axes intersect. As for all Laser stations, the Ranging System Reference Point (SRP) can't be materialized.

2.1.3. **Former mobile Laser station reference point**

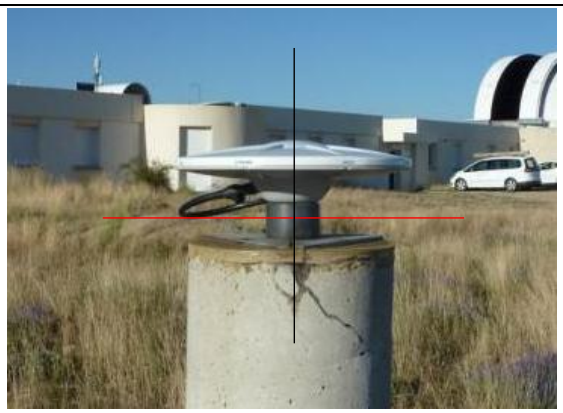
GRSF	DOMES number 10002M004 - CDP 7846
 Global view	 Detail view (picture 2009)
Description : benchmark fixed on concrete slab.	

2.2. **Permanent GNSS stations**

GRAS	DOMES number 10002M006
 Global view	 Detail view (reference point)
Description : the brass mark reference point is **0.0350 m under the Antenna Reference Point (ARP)**.	

GRAS is part of the « Réseau GNSS Permanent » (RGP) and the « International GNSS Service » (IGS) networks since 1996.

GRAC	DOMES number 10002M010

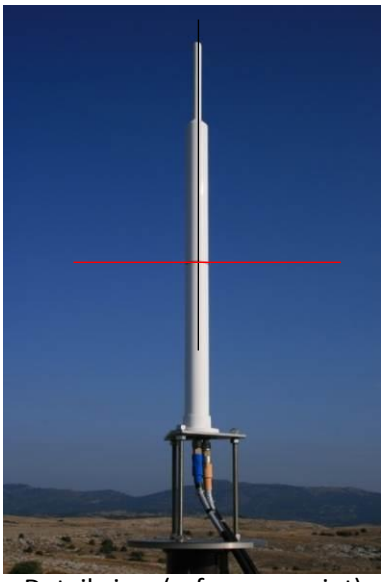
 Global view	 Detail view (reference point)
Description : the reference point is **0.0500 m under the ARP**.	

GRAC is part of RGP since 2001, and IGS since 2013

2.3. **DORIS station**

The DORIS antenna installed by the end of 2008 was moved on standard monument during the survey.

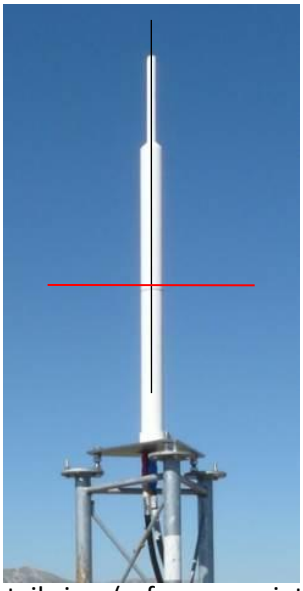
2.3.1. **Old Doris antenna**

GR3B	DOMES number 10002S018
 Global view	 Detail view (reference point)
Description : DORIS antenna reference point.	

2.3.2. **New DORIS antenna**

GR4B	DOMES number 10002S019

Global view



Detail view (reference point)

Description : DORIS Antenna reference point.

Furthermore, for the needs of DORIS three points on the bottom of the new mast and three points on the top were surveyed to check the long-term stability of the support and the monument.

On the top, the three points are screws where mini-prism can be fixed. They are called 211, 212, 213 (see map on § 3.4.).

Prisms fixed on the points

On the bottom, the points are just engraved on the bases of the mast.

Three points on the bottom

Point 215

2.4. **Former mobile VLBI campaign reference points**

VLBI	DOMES number 10002M003 – CDP 7605
	
Global view	Global view (auxiliary point)
Description : 1989 mobile VLBI campaign main reference mark.	

3. SURVEY DESCRIPTION

3.1. Organization

The local tie survey of Grasse co-location site has been carried out by Jean-Claude Poyard and Damien Pesce, with the useful help of the observatory staff. They are both from the Department of Geodesy and Levelling (SGN) of the National Institute of Geographic and Forest Information (IGN) and mainly deal with metrology and micro-geodesy.

The survey took place from the 24th of July to the 1st of August 2013. The weather conditions were correct except some fog patch and a thunderstorm on monday morning.

3.2. Equipment

All the topometric survey instruments and equipment belong to IGN and were brought on site for the purpose of the survey.

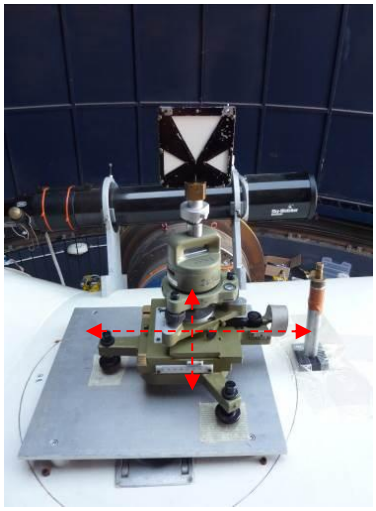
3.2.1. Instruments

Two Leica total stations (TM30 and TDA5005) were used for this work. These instruments, which are regularly calibrated by IGN's metrology unit, were associated with six Leica accurate prisms. Both have a standard deviation of 0.15 mgon for horizontal and vertical angles and 1 mm + 1 ppm for distances. The levelling observations were performed with a Leica electronic level (DNA03) associated with invar bar code levelling rods. This equipment, also regularly calibrated, has a resolution of 0.01 mm. Finally the GNSS observations were done with a Leica GX1230 receiver and a Leica AT504 choke ring antenna.

3.2.2. Equipment and accessories

Several very useful accessories have been also brought for this kind of field work, among which:

- Tripods, in order to ensure centring on marks;
- A translation stage in order to centre a target on the vertical telescope rotation axis (see picture hereafter);



Translation stage

- 0.5 m, 1.8 m and 3.0 m long invar staffs that are all calibrated and associated to each other;
- calibrated trefoil targets and prisms;
- regularly calibrated tribrachs.

3.3. Survey monuments

All the survey was conducted in order to provide the highest accuracy in the determination of the 3D vectors between the observing instruments.

3.3.1. Local tie survey piers

To make the regular surveys easier, four concrete piers were built around the site. Centring plates were embedded on the top of each pier and four levelling benchmarks were placed on each concrete base.

Pier

Centring plate

4 Levelling benchmarcks

3.3.2. **Tripod station**

To complete the network, we used a station centred on a mark. It is embedded on a concrete pad fixed on the roof of the telescopes building.

Concrete pad on the roof

brass benchmark

To complete the survey, a total station was centred on the old DORIS monument thanks to a special adaptor and another one was setup on the GRAC antenna pillar during the antenna replacement.

Total station on old DORIS monument

3.3.3. **Bearing**

To get the bearing to the ITRF, two points were setup far away. One is centred on air vent axis of the Calern's water reservoir (about 672 m from MeO). For the survey, it is called 10000, (see description sheet).

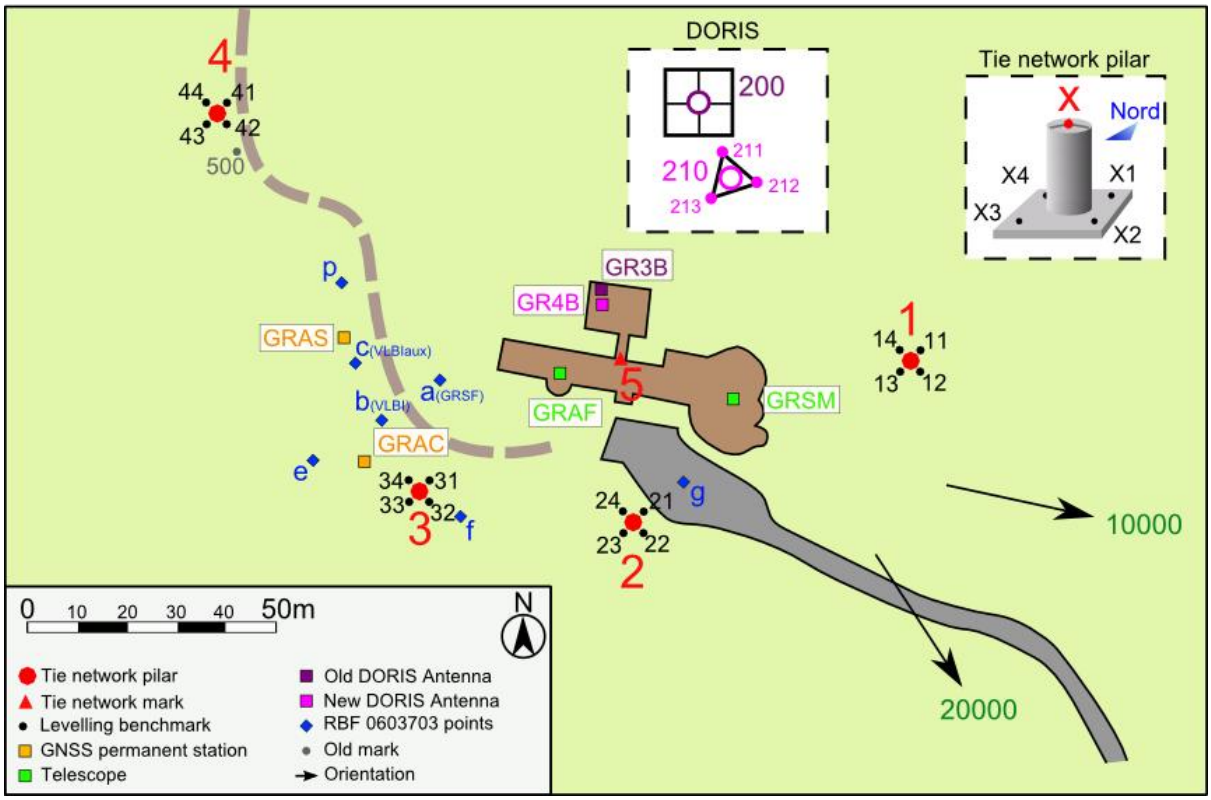
10000	
	
Global view (GNSS on 10000 point)	Detail view
Description: top of air vent (point engraved)	

The second one is a centring marker fixed on an old concrete pier near Tarot buildings (about 294 m from Meo). For the survey, it is called 20000.

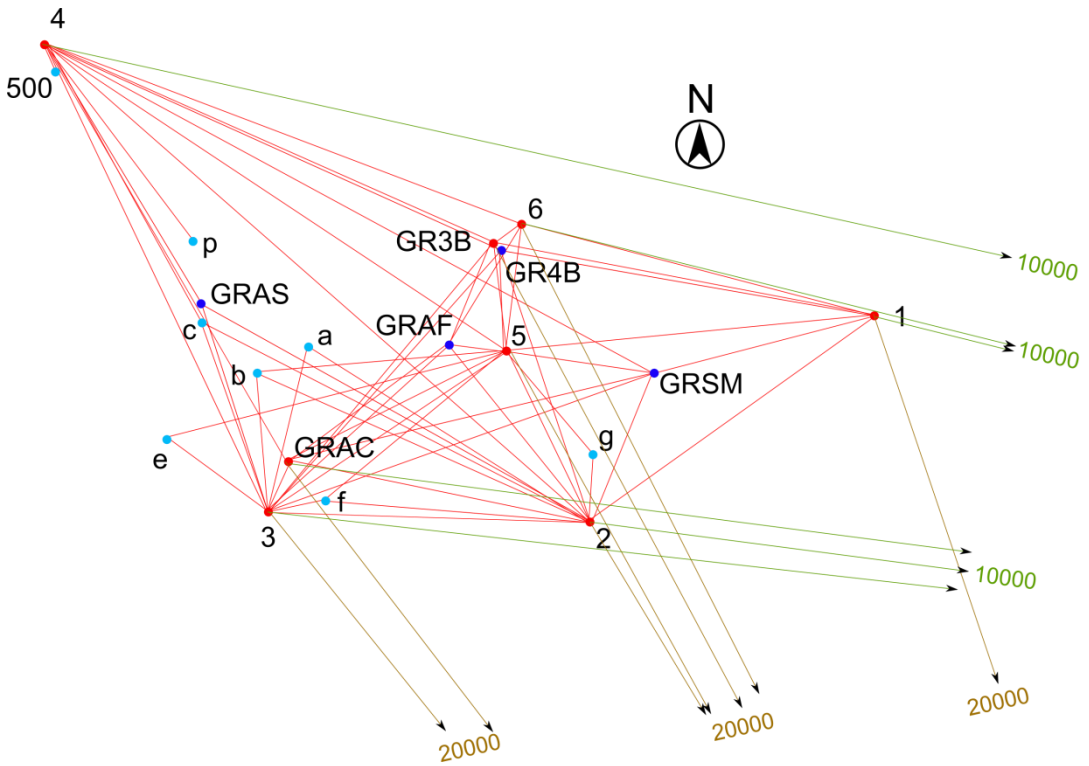
20000	
	
Global view	Detail view
Description : Top of pillar centring marker	

Target used to sight on the point 20000

3.4. **Observations polygon**



Site map and stations location



Calern observation sketch

3.5. **Survey method**

All the lines of sight have been observed with the total stations. Horizontal directions and zenith angles were observed in data sets, each set consisting in one reading in both direct and reverse theodolite positions. Any observed angle was rejected if the difference between the two measurements was too high. Distance measurements were observed over each line once in both direct and reverse positions. Meteorological data (atmospheric pressure and temperature) used to correct the distances, were recorded at the beginning of each station occupation.

As far as direct levelling is concerned, forward and backward runs were observed between each benchmark.

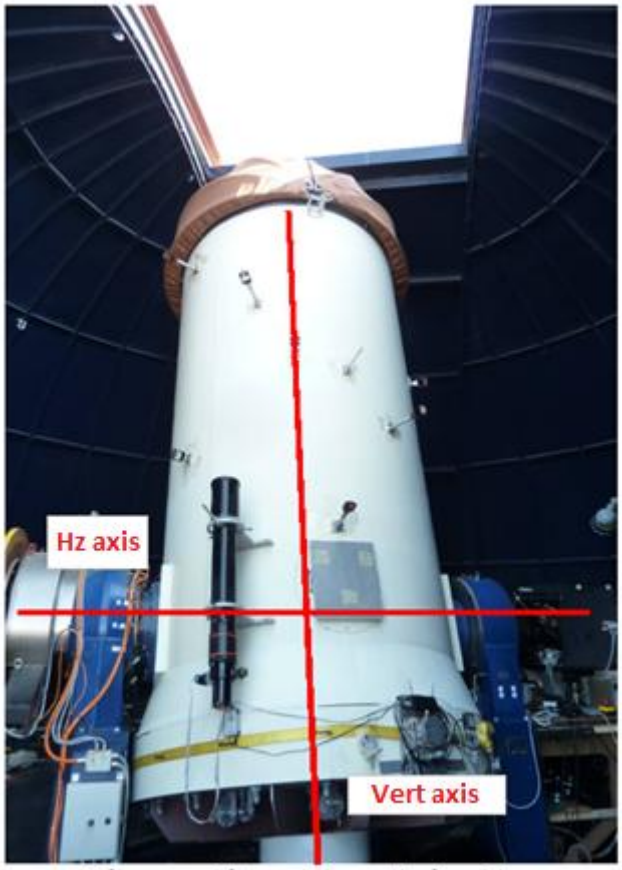
At the beginning of the spirit levelling, the instrument collimation was checked. The electronic level instrument was set to perform two readings on an invar bar code staff, and measurements were repeated if the difference between the two readings was inconsistent (i.e. greater than 0.1 mm). In the same way, we checked the difference between two runs, and a third run was completed if the difference between two runs was greater than 0.4 mm.

3.5.1. **Laser MeO reference point**

The reference point has been determined in two successive steps: the first one to determine the vertical axis, the second one to determine the horizontal one.

- *Vertical axis*

To measure its position from one theodolite set up on a tripod, a target on the two axes translation stage was sighted and the position of the target read on the micrometre. MeO was then rotated 180° around the vertical axis, and the target rotated towards the theodolite. The target was then shifted using the translation stage, until it was aimed from the same theodolite direction. The new target position was read on the micrometre. Then the translation stage was adjusted by half the difference of the two readings. The same thing was done with the telescope oriented at 90° from the original position. Finally, we checked with the theodolite that the target didn't move, as the telescope rotated around its vertical axis. For this operation, the telescope is supposed perfectly levelled; this was checked with the accurate bubble of the target (levelling then the telescope was rotated by 90° and 180°).

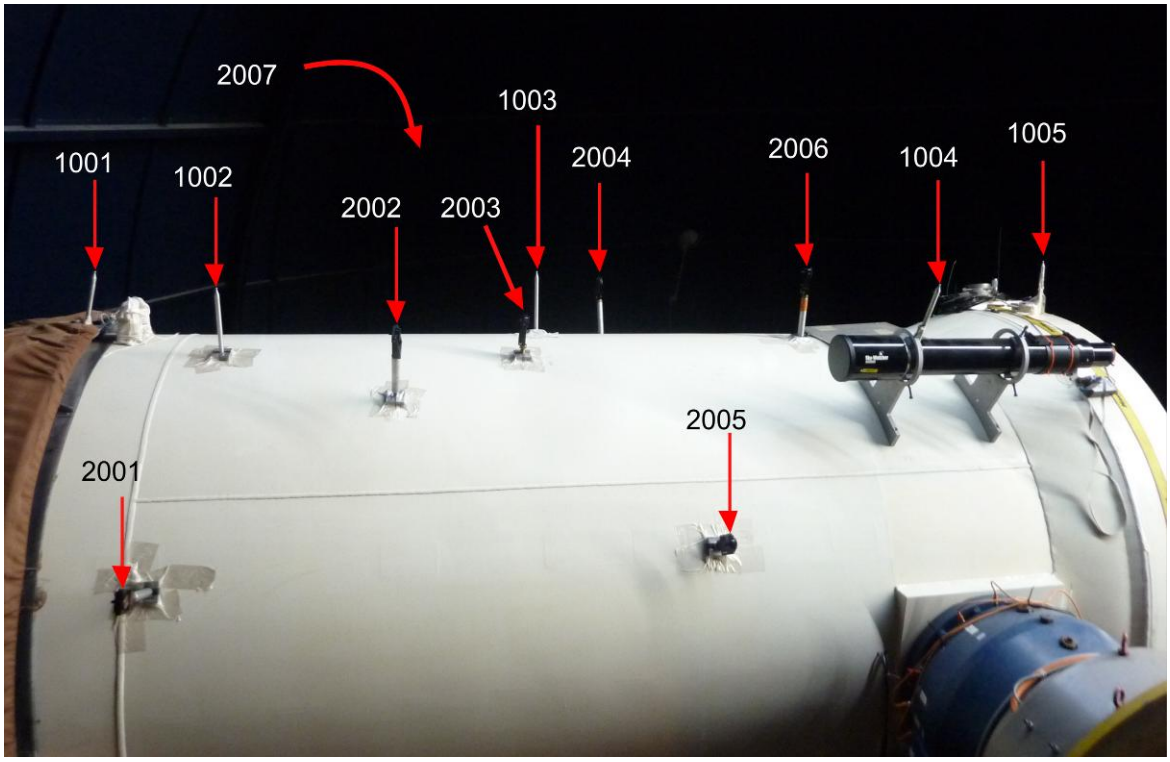


Telescope with targets in vertical position

- *Horizontal axis*

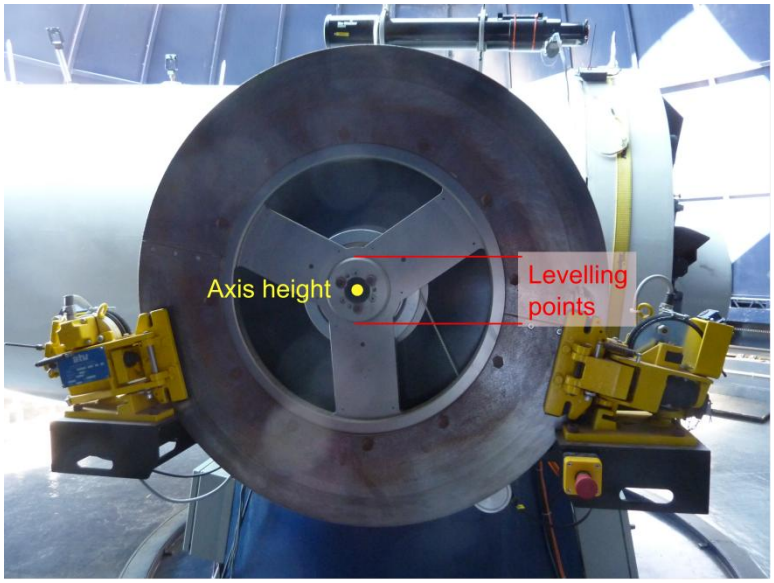
To determine the horizontal axis, we have moved the telescope from 4° to 89° in elevation in order to determine circles whose centres are on the horizontal axis. To do so, seven prisms and five targets were placed on the telescope and intersected in each position (about every 17 degrees) from four stations.

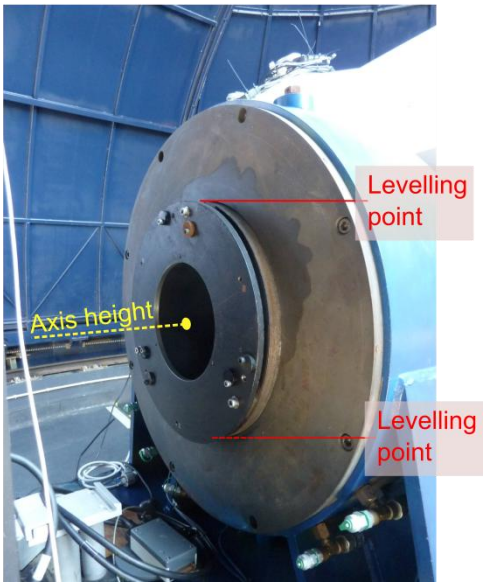
Points were numbered as follows: first position (4° in elevation): 2000 to 2007 for prisms and 1000 and 1005 for targets and then increased by 100 for each next positions.



Targets on the telescope

And some well-defined elements were levelled allowing the axis height check (See picture below).

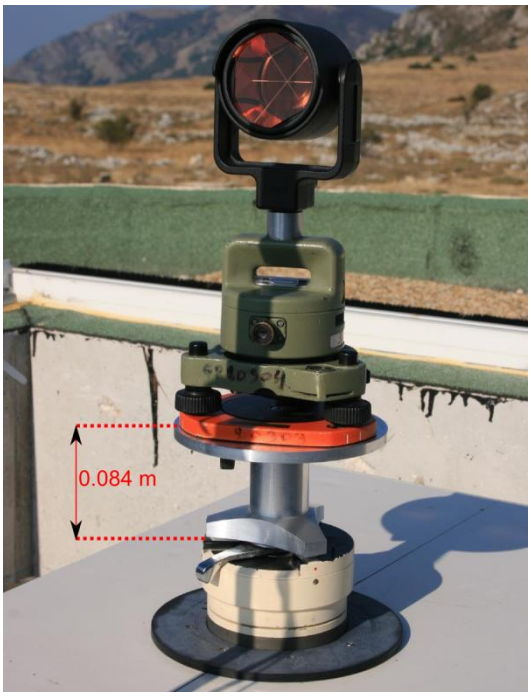




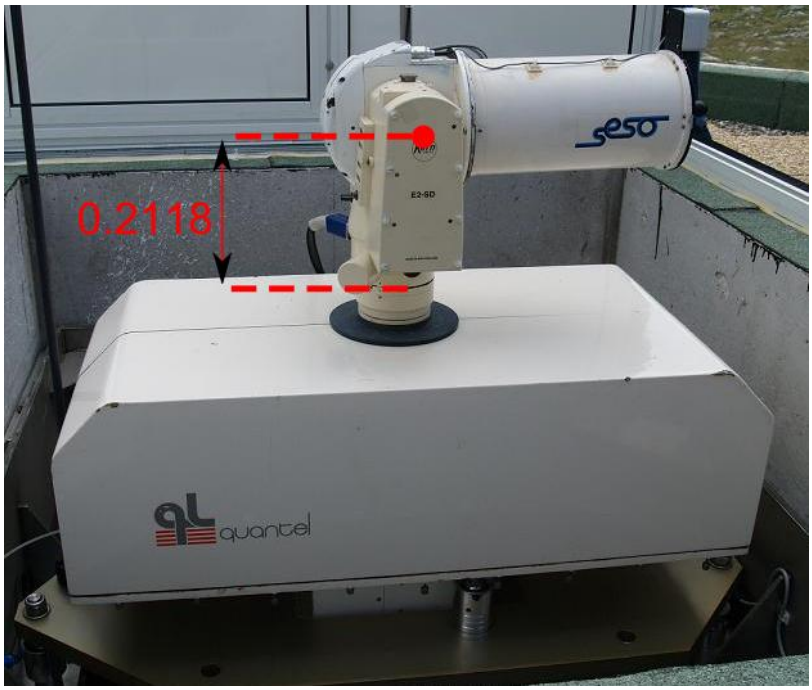
Horizntal axis levelling

3.5.2. **FTLRS reference point**

The telescope was set up on his platform, after levelling it, it was removed to install prism thanks to a special adaptor that height have been previously determined (see picture). The top of special adaptor was levelled from point 5. The height of FTLRS reference point has been also determined during previous survey.



Special adaptor (picture 2009)



Telescope height (picture 2007)

3.5.3. GRAS GNSS station

The antenna was only intersected from piers and the ARP was levelled.

3.5.4. GRAC GNSS station

The GRAC station antenna is difficult to intersect (model Zephyr Geodetic Trimble) but as this antenna had to be changed, a total station was centred on the pier before setting up the new antenna. The ARP was also levelled.

3.5.5. DORIS antennas

The old antenna (GR3B) was intersected from several topometric stations. A total station was also set up on the mast after the removal.

A prism centred on the new antenna support was determined from several network stations before the new antenna was set up.

The top of the both masts were levelled and the DORIS reference points have been deducted from the manufacturer value.

3.6. **GNSS observations**

GNSS observations have been carried out in order to align it to the ITRF frame with the following specifications:

- Cut-off angle 10°;
- 30 sec sampling.

Points 10000 and 20000 were observed 13 hours during days 205 and 206. The four piers were also observed by GNSS day 210 (7 hours for piers 1 and 2 and 12 hours for piers 3 and 4)

All antenna heights are related to antenna reference points (ARP).

4. **COMPUTATIONS**

4.1. **On-site validation**

The control network has been pre-processed on site in order to point out any problem in the observations. The observations have been checked in a local coordinate system.

The outliers have been detected and the precision has been estimated in order to check if the requirements of such a survey could be met.

4.2. **GNSS network**

The GNSS baselines have been first processed on site with Leica Geo Office software 8.1 for control. Then, at the office, they were processed with the scientific software Bernese version 5.0 of the University of Berne. This software incorporates the movements of the poles, information on satellites, the ocean overload FES2004 model, as well as specific changes in the position of the phase centres and reference points of antennas at ground stations and satellites.

4.2.1. **ITRF2008**

The international reference system for the whole Earth is undoubtedly the International Terrestrial Reference System (ITRS) as defined by the International Earth rotation and Reference systems Service (IERS). ITRS is an ideal reference system defined through theoretical prescriptions and conventions.

The ITRS needs to be realized on the basis of coordinates and velocities of a set of physical earth-related points. Such a realization is the so-called ITRFyyyy (International Terrestrial Reference Frame) where yyyy stands for the last year of observations taken into account.

ITRF2008 is the current realization of the ITRS released in May 2010. Following the procedure already used for the ITRF2005 formation, the ITRF2008 uses as input data time series of station positions and Earth Orientation Parameters (EOPs) provided by the Technique Centres of the four space geodetic techniques (GNSS, VLBI, SLR, DORIS).

A full description of ITRF2008 is available at http://itrf.ensg.ign.fr/ITRF_solutions/2008.

ITRS is stated to meet the "no net rotation" condition, i.e. the mean displacement due to tectonic plate motion for the whole Earth is zero. Hence, any realization has to provide coordinates and velocities of the involved stations. Therefore a specific epoch must be fixed to express coordinates in an operational geodetic reference set.

4.2.2. **IGS08**

The International GNSS Service (IGS) is currently maintaining the ITRF related to GNSS stations through a weekly solution. As far as the ITRF alignment is ensured, the main goal is to improve coordinates and velocities as well as to detect possible discontinuities.

The current IGS reference frame, IGS08, was released on April 17th 2011. IGS08 was initially intended to be a direct subset of well performing, stable GNSS stations from ITRF2008 rather than a separate GNSS-only frame solution. But, while the IGS contribution to ITRF2008 was computed using the original set of "absolute" GNSS antenna calibrations (igs05.atx), IGS08 had to be consistent with the latest set of calibrations (igs08.atx) that includes new determinations for some existing antennas. Coordinate corrections due to the antenna calibration updates were thus estimated and applied when possible to the ITRF2008 coordinates of 64 affected stations (out of a total of 232 stations in IGS08).

More details are available in the reference publication : Rebischung, P.; Garayt, B.; Schmid, R.; Ray, J.; Collilieux, X.: IGS08: Elaboration, consequences and maintenance of the IGS realization of ITRF2008; European Geosciences Union General Assembly 2011, Wien, 07.04.2011 [*EGU2011-6850.pdf* and *igs08_egu11.pdf*].

4.3. **Survey Adjustment**

4.3.1. **Terrestrial adjustment**

Back at the office, the computation has been carried out by 3D least squares adjustment with IGN software COMP3D v.4. At a first step, a computation was done only with total stations and level observations in local coordinates system. The input files were created from all the terrestrial observations: horizontal and vertical angles, spirit levelling, distances, planimetric and altimetric centrings.

The a priori standard deviations used for the different observations are on precision prism and targets as follows :

- 0.8 mgon for horizontal angles and 1.2 mgon for vertical angles with an accuracy to within 0.1 mm on the target definition;
- 1 mm for distances;
- 0.1 mm for each levelling observation.

This adjustment gives us local coordinates and a covariance matrix of all points of the Grasse tie network.

4.3.2. **GNSS orientation**

COMP3D software is a micro-geodesy adjustment software which works in a local coordinates system with Z axis along the vertical.

Georeferenced points can be introduced. Their coordinates are automatically transformed into COMP3D local coordinates system, where Y^+ axis points to North. Geographic coordinates can also be obtained.

All the computations have been done in this local frame, using constraints on GNSS stations coordinates to orientate the network. GRAS coordinates have an accuracy of 0.5 mm in planimetry and 1 mm in altimetry. 10000 and 20000 parts planimetric coordinates are constrained at 5 mm, in order to express the orientation uncertainty. This process gives covariance matrix useful to create the SINEX file. The resulting coordinates can be changed into geocentric, simply by inverting the transformation.

4.3.3. **Geoid model**

In the area, the geoid has a steep slope. The difference between the ellipsoid and normal height varies of 7.7 mm between point 4 and point 1.

Therefore, the terrestrial adjustment was processed in a vertical system (NGF IGN 69) and then converted into an ellipsoid based system (ITRF 2008) using the official French geoid model RAF09. (See differences ellipsoid height/normal height in annex 6.1)

4.3.4. SLR reference point

4.3.4.1. Horizontal Axis

To get the horizontal axis parameters, 12 targets have been measured on the telescope in several different vertical orientations.

We used an octave/matlab least square adjustment script to estimate the axis position and orientation.

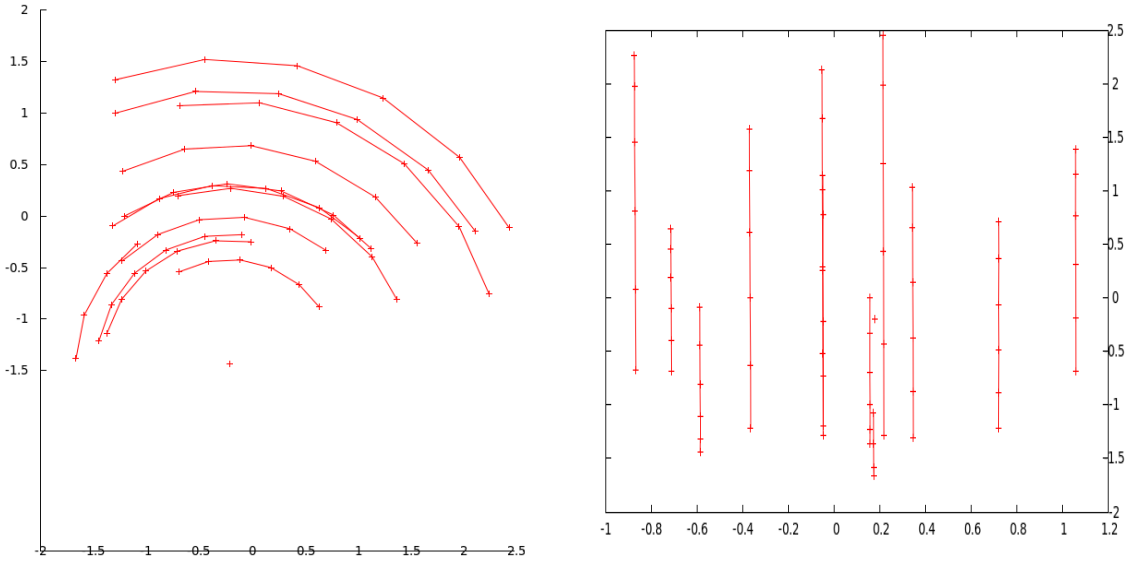
In the local frame, the axis parametric equations are:

$$x = a*l + x0$$
$$y = b*l + y0$$
$$z = c*l + z0$$

for every l in $]-\infty;+\infty[$.

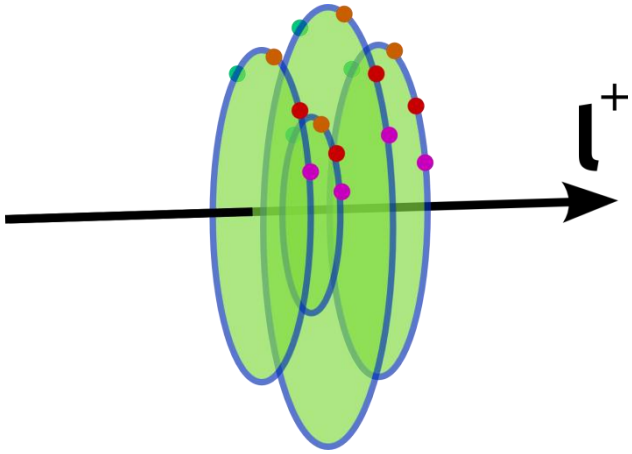
The axis has 4 degrees of freedom: b, c, y0 and z0. a is fixed to 1, and x0 to 70, x being the main direction of the axis.

For each position of the telescope we have several targets. With several positions we can have an estimation of the displacement of each target when the telescope moves.



Displacement of the targets, side and top view

The displacement of each target when the telescope moves is a circle, orthogonal to the axis. Two more parameters are needed for each target: the abscissa of the centre of the circle along the axis, and the circle radius.



Definition of the axis using several telescope positions

The observations are the 3D coordinates of the points, with their precisions.
The relations between observations and parameters are:

- the distance between a point and the centre of the circle is the radius;
- the vector between the centre and the point is orthogonal to the axis.

The parameters we get are:
x=l+79
y=l*0.00135215+ -11.64100016
z=l*-0.00015439 + 1272.63283695
The precisions of the most important parameters are:
sigma_y0 = 0.0002 m
sigma_z0 = 0.0004 m

4.3.4.2. **Vertical Axis**

The vertical axis is supposed to be strictly vertical. That is why it has been directly measured in one point above the telescope (Point 100).

To find this point a prism has been set up close to the axis. Then the telescope has been rotated and its prism has been moved to reach an invariant position for horizontal orientation of the telescope.

The vertical axis parameterization is:
x = 80.5976
y = -11.6411

4.3.4.3. **Reference point of the Telescope**

To check if the axes intersect, the distance between them can be computed. For x = 80.5976, what is "y" on the horizontal axis?
l=80.5976-x0

dy= b*l+y0 - -11.6411 = 0.00226m

We then are able to compute the middle of the common perpendicular of the two axis in the local frame:

80.5976 -11.6400 1272.6326

The precision is about **1 mm**.

4.3.5. **Importing telescope centre into georeferenced topometric computation**

A new observation is added to the COMP3D computation:

A sub-frame is created, including all the telescope targets and the telescope centre.

This sub-frame is described in a "XYZ" file for COMP3D, which is inserted in the global computation in order to have a full variance matrix with links between all the points.

5. RESULTS

5.1. Station names translation table

The following list sums up the most interesting points used in the process input file.

Point Description	Used name or code	Computation name
GNSS permanent station • **GRAS IGS reference point** • Antenna ARP	**10002M006 / GRAS**	**301** 300
GNSS permanent station • **GRAC RGP reference point** • Antenna ARP	**10002M010 / GRAC**	**311** 310
LASER MeO station • **System Reference Point (SRP)** • Prism on the translation stage	**10002S002 / (CDP n°7845) / GRSM**	**105** 100
Mobile LASER station • **System Reference Point (SRP)** • Prism on adaptor	**10002S017 / (CDP n°7829) / GRAF**	**111** 110
Former Mobile LASER station • Reference Point (marker)	10002M004 / (CDP n°7846)/ GRSF	510
DORIS station • **Antenna Reference Point** • support plate	**10002S019 / GR4B**	**218** 210
Former DORIS station • **Antenna Reference Point** • support plate • Mark under the DORIS antenna	**10002S018 / GR3B**	**208** 201 200
Former mobile VLBI station • Reference Point (main marker)	10002M003 / (CDP n°7605) / VLBI	520

5.2. Adjusted coordinates and confidence regions

The results of the adjustment are the coordinates of all points as well as their confidence ellipsoids in the IGS08 frame at the mean epoch of the observations (i.e. epoch 2013.56).

Hereafter is a table with the 3D coordinates and relative confidence region at 1 sigma of the main points of interest.

	X (m) / σ*x* (mm)	Y (m) / σ*y* (mm)	Z (m) / σ*z* (mm)

GRAS	4 581 690.7911	556 115.0010	4 389 360.8984
	0.5	*0.5*	*0.9*
GRAC	4 581 708.2391	556 132.8037	4 389 341.3778
	1.0	*1.5*	*1.0*
GRAF / 7829	4 581 692.3471	556 159.6321	4 389 357.8151
	1.0	*1.5*	*1.0*
GRSM / 7845	4 581 691.9605	556 196.3451	4 389 355.2772
	2.1	*2.4*	*2.6*
GRSF / 7846	4 581 693.2413	556 134.8666	4 389 354.9283
	1.0	*1.6*	*1.0*
GR4B	4 581 681.0688	556 166.8916	4 389 370.9620
	1.0	*1.5*	*1.0*
GR3B	4 581 680.3522	556 166.4595	4 389 371.5932
	1.0	*1.5*	*1.0*
VLBI / 7605	4 581 697.4301	556 126.0825	4 389 351.6618
	1.0	*1.6*	*1.0*

(the tenth of millimetre is given for information only)

The whole covariance matrix was computed. It was possible to extract from it the covariance submatrix and the vectors (see Annex 6.4) for the following points of interest:

- GRAS reference point 10002M006
- GRAC reference point 10002M010
- GRSM reference point 10002S002
- GRAF reference point 10002S017
- GRSF reference point 10002M004
- GR3B reference point 10002S018
- GR4B reference point 10002S019
- VLBI reference point 10002M003

Vector	X (m)	Y (m)	Z (m)
GRAS → GR3B	-10.4389	51.4585	10.6948
GRAS → GRAC	17.4480	17.8027	-19.5206
GRAS → GRAF	1.5560	44.6311	-3.0833
GRAS → GRSF	2.4502	19.8656	-5.9701
GRAS → GRSM	1.1694	81.3441	-5.6212
GRAS → VLBI	6.6390	11.0815	-9.2366

Then this covariance submatrix has been converted into the SINEX format. The resulting SINEX file (10002_IGN_2013-205_v10.snx) is given in annex 6.4.

To compare with 2009 survey result, it is useful to re-process it. In the 2009 process, 5 points have been constrained with GNSS coordinates. Now we prefer to heavily constrain only one point (1 mm) and to constrain some GNSS orientations (5 mgon for example), in order that the terrestrial survey, which is more accurate, is not distorted by the GNSS observations.

For this new process, GRAS was heavily constrain (0.5 mm in planimetry and 1 mm in altimetry) and two GNSS bearing were constrained at 5 mm in planimetry and 10 mm in altimetry.

Coordinates from 2009 survey in IGS08 epoch 2013.56

Name	X	Y	Z
GR3B	4581680.3431	556166.4536	4389371.5938
GRAC	4581708.2302	556132.7961	4389341.3765
GRAF	4581692.3417	556159.6270	4389357.8162
GRAS	4581690.7824	556114.9953	4389360.8970
GRSF	4581693.2325	556134.8609	4389354.9286
GRSM	4581691.9557	556196.3415	4389355.2773
VLBI	4581697.4202	556126.0758	4389351.6608

(the tenth of millimetre is given for information only)

	ITRF2008 epoch 2013.56 Coordinates		
Vector	X (m)	Y (m)	Z (m)
GRAS → GR3B	-10.4393	51.4583	10.6968
GRAS → GRAC	17.4478	17.8008	-19.5205
GRAS → GRAF	1.5593	44.6317	-3.0808
GRAS → GRSF	2.4501	19.8656	-5.9684
GRAS → GRSM	1.1733	81.3462	-5.6197
GRAS → VLBI	6.6378	11.0805	-9.2362

Comparison (mm) with our results

	Cartesian			Plane		
Vector	D_X	D_Y	D_Z	D_E	D_N	D_H
GRAS → GR3B	-0.4	-0.2	2.0	0.0	2.0	1.0
GRAS → GRAC	-0.2	-1.9	0.1	-2.0	0.0	1.0
GRAS → GRAF	3.3	0.6	2.5	1.0	-1.0	4.0
GRAS → GRSF	-0.1	0.0	1.7	0.0	2.0	1.0
GRAS → GRSM	3.9	2.1	1.5	1.0	-1.0	4.0
GRAS → VLBI	-1.2	-1.0	0.4	-1.0	1.0	0.0

Coordinates of other survey points in IGS08 epoch 2013.56
Planimetric points

Point	X (m)	Y (m)	Z (m)
1 (pier)	4581678.6435	556234.3680	4389360.6396
2 (pier)	4581709.2967	556187.1755	4389333.8464
3 (pier)	4581714.6492	556130.1951	4389334.4599
4 (pier)	4581661.5428	556083.1327	4389393.2572
5 (benchmark)	4581689.6913	556172.7062	4389359.1587
201 (old Doris plate)	4581680.0718	556166.4255	4389371.3227
10000 (water reservoir)	4581700.5223	556867.9586	4389283.8192
20000 (old pier)	4581860.0933	556345.3282	4389158.1537

(the tenth of millimetre is given for information only)

Altimetric points (4 benchmarks per pier)

Point	Normal height (m)	Point	Normal height (m)
11	1268.9395	31	1267.5748
12	1268.9335	32	1267.5767
13	1268.9361	33	1267.5761
14	1268.9332	34	1267.5744
21	1268.2781	41	1266.0611
22	1268.2806	42	1266.0728
23	1268.2774	43	1266.0595
24	1268.2757	44	1266.0599

(the tenth of millimetre is given for information only)

6. ANNEXES

6.1. Differences between ellipsoid and normal heights

Point	Difference (m)	Point	Difference (m)
1	50.5889	500	50.5963
2	50.5895	510	50.5927
3	50.5919	520	50.5929
4	50.5966	530	50.5936
5	50.5913	540	50.5931
6	50.5915	550	50.5915
10000	50.5594	560	50.5942
20000	50.5747	570	50.5900
110	50.5917	11	50.5889
111	50.5917	12	50.5889
100	50.5901	13	50.5889
200	50.5921	14	50.5889
201	50.5921	21	50.5895
207	50.5921	22	50.5895
208	50.5921	23	50.5895
209	50.5921	24	50.5895
210	50.5920	31	50.5919
211	50.5920	32	50.5919
212	50.5920	33	50.5919
213	50.5920	34	50.5919
214	50.5920	41	50.5966
215	50.5920	42	50.5966
216	50.5920	43	50.5966
218	50.5920	44	50.5966
219	50.5920	101	50.5901
300	50.5938	102	50.5901
301	50.5938	103	50.5901
310	50.5921	104	50.5901
311	50.5921		

(the tenth of millimetre is given for information only)

6.2. **Geodetic site description sheet (extract)**

IGN Réseau Géodésique Français

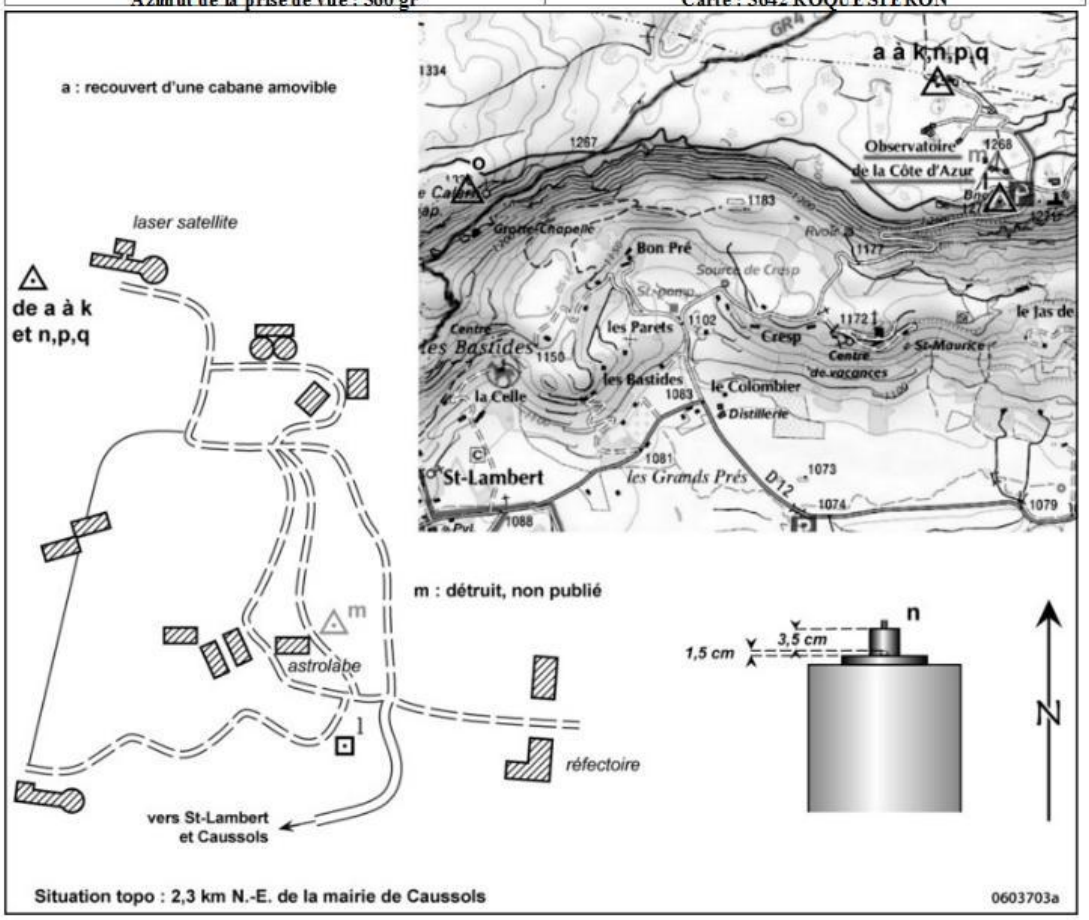
CAUSSOLS III

Département : ALPES-MARITIMES (06)
Commune : CAUSSOLS
Lieu-dit : Observatoire du C.E.R.G.A

No du Site **0603703**
Site du Réseau de base

Azimut de la prise de vue : 360 gr

Carte : 3642 ROQUESTERON



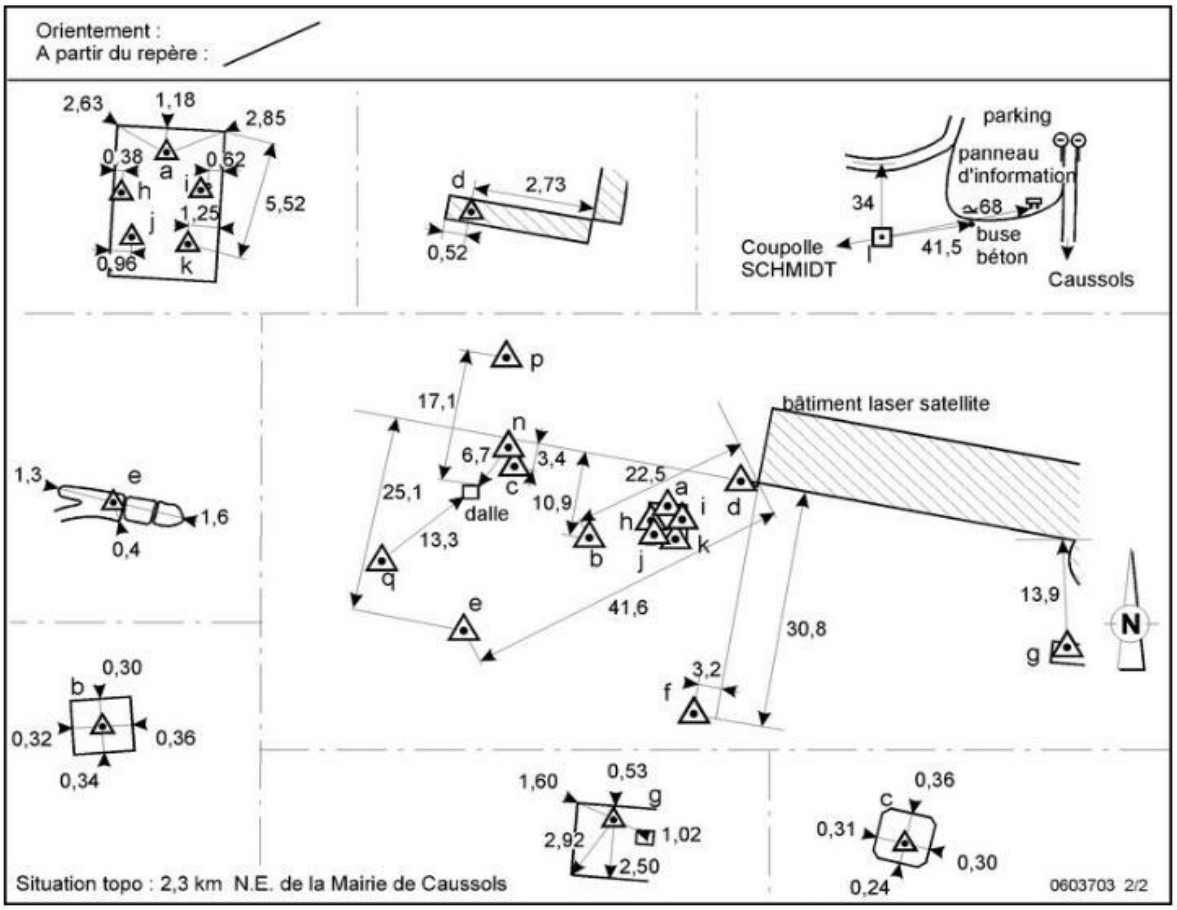
Situation topo : 2,3 km N.-E. de la mairie de Caussols

0603703a

IGN/SGN 04/09/2013 Page 1/9

IGN Réseau Géodésique Français

CAUSSOLS III



Point : a

Repère bronze de diamètre 4.5 cm scellé dans une plaque de béton. Station Laser Satellite Mobile

Point vu en place en 2009

Repère de nivellement : I'.C.B3 - 386-II

Le repère est au centre de la photo

IGN Réseau Géodésique Français

CAUSSOLS III

Point : b

Repère bronze GM scellé dans un bloc de béton. Repère VLBI Mobile principal.

Point vu en place en 2009

Azimut de la prise de vue : 50 gr
Le repère est au centre de la photo

Point : c

Repère bronze PM scellé dans un bloc de béton. Repère VLBI auxiliaire.

Point vu en place en 2009

Azimut de la prise de vue : 80 gr
Le repère est au centre de la photo

Point : d

Repère bronze PM scellé dans un muret. Repère VLBI auxiliaire

Point non retrouvé en 2009

Azimut de la prise de vue : 110 gr
Le repère est au centre de la photo

Point : e

Plaquette géodésique scellée dans un rocher. Repère VLBI auxiliaire.

Point vu en place en 2009

Azimut de la prise de vue : 120 gr
Le repère est au centre de la photo

IGN Réseau Géodésique Français

CAUSSOLS III

Point : f

Plaquette géodésique scellée dans un rocher. Repère EUREF.

Point vu en place en 2009

Azimut de la prise de vue : 100 gr
Le repère est au centre de la photo

Point : g

Plaque de béton : Repère bronze PM scellé.

Point vu en place en 2009

Azimut de la prise de vue : 20 gr
Le repère est au centre de la photo

Point : h

Repère bronze de diamètre 4.5 cm Nord-Ouest scellé dans une plaque de béton. Repère auxiliaire Laser Satellite Mobile

Point vu en place en 2009

Azimut de la prise de vue : 300 gr
Le repère est au centre de la photo

Point : i

Repère bronze de diamètre 4.5 cm Nord-Est scellé dans une plaque de béton. Repère auxiliaire Laser Satellite Mobile

Point vu en place en 2009

Azimut de la prise de vue : 220 gr
Le repère est au centre de la photo

IGN Réseau Géodésique Français

CAUSSOLS III

Point : j

Repère bronze de diamètre 4.5 cm Sud-Ouest scellé dans une plaque de béton. Repère auxiliaire Laser Satellite Mobile.

Point vu en place en 2009

Azimut de la prise de vue : 120 gr
Le repère est au centre de la photo

Point : k

Repère bronze de 4.5 cm Sud-E st scellé dans une plaque de béton. Repère auxiliaire Laser Satellite Mobile.

Point vu en place en 2009

Azimut de la prise de vue : 80 gr
Le repère est au centre de la photo

Point : l

Borne IGN 1975 : Repère 1995 hémisphérique en laiton de 12 mm de diamètre scellé a l'axe et au sommet

Point vu en place en 2009

Repère de nivellement : I'.C.B3 - 386-III
Azimut de la prise de vue : 20 gr
Le repère est au centre de la photo

Point : n

Pilier 1995 : Tige hémisphérique filetée au pas Wild scellée à l'axe et au sommet.(Station GPS permanente)

Point vu en place en 2009

Azimut de la prise de vue : 125 gr
Le repère est au centre de la photo

IGN Réseau Géodésique Français

CAUSSOLS III

Point : p

Repère 1995 hémisphérique en laiton de 25mm de diamètre scellé sur un rocher

Point vu en place en 2009

Azimut de la prise de vue : 151 gr
Le repère est au centre de la photo

Point : q

Repère 1995 hémisphérique en laiton de 25mm de diamètre scellé sur un rocher

Point vu en place en 2009

Azimut de la prise de vue : 88 gr
Le repère est au centre de la photo

Avertissement

Compte-tenu des risques de déplacement des bornes ou autres points géodésiques, il est indispensable de rattacher vos opérations de topométrie à plusieurs points géodésiques proches, ceci afin de s'assurer de leur stabilité.
La responsabilité de l'IGN ne saurait être engagée en l'absence d'un tel contrôle.
Toute remarque concernant la destruction, la disparition ou le mauvais état des points géodésiques doit être signalée au Service de la Géodésie et du Nivellement : sgn@ign.fr

Système : ETRS 89 - Ellipsoïde : IAG GRS 1980 - Méridien origine : GREENWICH

Point	Longitude (dms)	Latitude (dms)	Hauteur (m)	Précision
a	6° 55' 14.91889" E	43° 45' 16.79796" N	1318.674	< 5 cm
b	6° 55' 14.50662" E	43° 45' 16.65204" N	1318.653	< 5 cm
c	6° 55' 14.07991" E	43° 45' 16.95795" N	1318.406	< 5 cm
d	6° 55' 15.34146" E	43° 45' 16.89801" N	1318.582	< 5 cm
e	6° 55' 13.79817" E	43° 45' 16.28383" N	1318.109	< 5 cm
f	6° 55' 15.07232" E	43° 45' 15.92824" N	1318.060	< 5 cm
g	6° 55' 17.18547" E	43° 45' 16.19852" N	1319.135	< 5 cm
h	6° 55' 14.82858" E	43° 45' 16.73711" N	1318.680	< 5 cm
i	6° 55' 15.00332" E	43° 45' 16.74902" N	1318.683	< 5 cm
j	6° 55' 14.85031" E	43° 45' 16.66871" N	1318.686	< 5 cm
k	6° 55' 14.97109" E	43° 45' 16.66164" N	1318.685	< 5 cm
l	6° 55' 24.70633" E	43° 45' 04.30450" N	1320.502	< 5 cm
n	6° 55' 14.05071" E	43° 45' 17.04572" N	1319.316	< 1 cm
p	6° 55' 14.02824" E	43° 45' 17.42310" N	1317.823	< 5 cm
q	6° 55' 13.33208" E	43° 45' 16.57367" N	1317.977	< 5 cm

Système : ETRS 89 - Projection : LAMBERT-93 - Système altimétrique : NGF-IGN 1969

Point	e (m)	n (m)	Précision plani	Altitude (m)	Précision alti
a	1015697.194	6302910.987	< 5 cm	1268.068	< 5 mm
b	1015688.205	6302906.031	< 5 cm	1268.048	< 5 mm
c	1015678.200	6302914.988	< 5 cm	1267.796	< 1 cm
d	1015706.485	6302914.541	< 5 cm	1267.972	< 1 cm
e	1015672.936	6302893.891	< 5 cm	1267.507	< 5 mm
f	1015701.956	6302884.343	< 5 cm	1267.454	< 5 mm
g	1015748.766	6302895.023	< 5 cm	1268.526	< 1 cm
h	1015695.269	6302909.011	< 5 cm	1268.074	< 5 mm
i	1015699.156	6302909.572	< 5 cm	1268.078	< 5 mm
j	1015695.860	6302906.926	< 5 cm	1268.08	< 5 mm
k	1015698.570	6302906.842	< 5 cm	1268.079	< 5 mm
l	1015935.077	6302536.674	< 5 cm	1269.934	< 5 mm
n	1015677.413	6302917.662	< 1 cm	1268.722	< 1 cm
p	1015676.332	6302929.272	< 5 cm	1267.216	< 5 mm
q	1015662.076	6302902.310	< 5 cm	1267.372	< 5 mm

Réseau de référence gravimétrique : France métropolitaine 2012

Point	g (mGal)	Précision (ugal)	g ($m.s^{-2}$)	Précision	Année
a	980216.344	20	9.80216344	2.10^{-7}	2012
f	980216.421	20	9.80216421	2.10^{-7}	2012

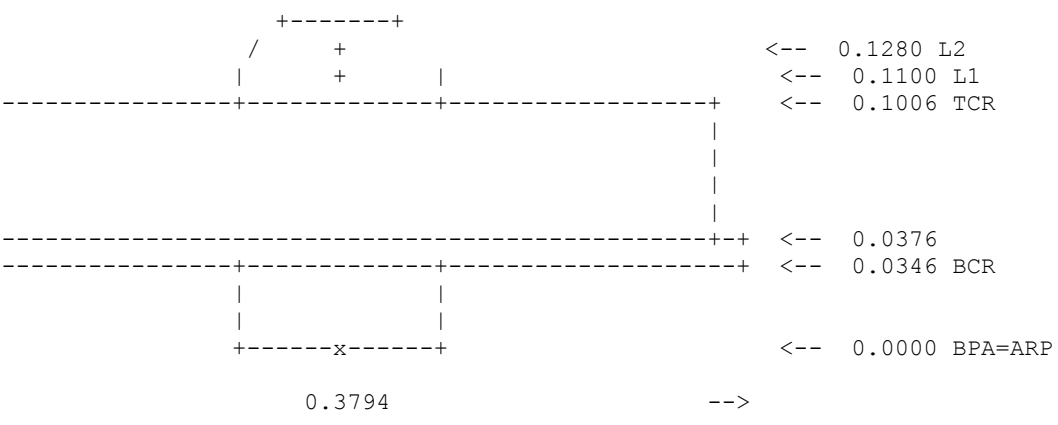
6.3. **Site logs**

6.3.1. **GRAS (extract)**

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

0.   Form
     Prepared by (full name)  : Jean-Paul Cardaliaguet
     Date Prepared            : 2011-03-17
     Report Type              : UPDATE
     If Update:
      Previous Site Log       : gras_20101013.log
      Modified/Added Sections : 2, 13

1.   Site Identification of the GNSS Monument

     Site Name                : Observatoire de Calern - OCA
     Four Character ID        : GRAS
     Monument Inscription     : none
     IERS DOMES Number        : 10002M006
     CDP Number               : (A4)
     Monument Description     : PILLAR
       Height of the Monument : 1 m
       Monument Foundation    : CONCRETE BLOCK
       Foundation Depth       : (m)
     Marker Description       : BRASS NAIL
     Date Installed           : 1995-02-10
     Geologic Characteristic  : BEDROCK
                              : Monument is a concrete pillar on bedrock
                              : with forced centering plate.

2.   Site Location Information

     City or Town             : Caussols
     State or Province        : Alpes-Maritimes
     Country                  : France
     Tectonic Plate           : EURASIAN
     Approximate Position (ITRF)
       X coordinate (m)       : 4581691.159
       Y coordinate (m)       : 556114.576
       Z coordinate (m)       : 4389360.566
       Latitude (N is +)      : +434517.04
       Longitude (E is +)     : +0065514.05
       Elevation (m,ellips.)  :  1319.3
     Additional Information   : coordinates XYZ RGF93-Lambert-93
                              : Observatory located at Caussols, on plateau
                              : de Calern, 10 Km NW of Grasse.

3.   GNSS Receiver Information

3.10 Receiver Type            : TRIMBLE NETR5
     Satellite System         : GPS+GLO
     Serial Number            : 64043
     Firmware Version         : 4.17
     Elevation Cutoff Setting : 3 deg
     Date Installed           : 2010-10-13T12:18Z
     Date Removed             : CCYY-MM-DDThh:mmZ
     Temperature Stabiliz.    : 18 +/- 24
     Additional Information   : upgrade firmware version
```

```
                              : Set l2-cs signal off : use only l2-usuel signal

4.   GNSS Antenna Information

4.4  Antenna Type             : ASH701945E_M    NONE
     Serial Number            : 24222
     Antenna Reference Point  : BPA
     Marker->ARP Up Ecc. (m)  :   0.0350
     Marker->ARP North Ecc(m) :   0.0000
     Marker->ARP East Ecc(m)  :   0.0000
     Alignment from True N    : 0 deg
     Antenna Radome Type      : NONE
     Radome Serial Number     :
     Antenna Cable Type       : ASHTECH
     Antenna Cable Length     : 60 m
     Date Installed           : 2004-10-21T09:00Z
     Date Removed             : CCYY-MM-DDThh:mmZ
     Additional Information   : Cable with line amplifier at 30m

5.   Surveyed Local Ties

5.1  Tied Marker Name         : SLR
     Tied Marker Usage        : not known
     Tied Marker CDP Number   : 7835
     Tied Marker DOMES Number : 10002S001
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : 0.632
       dy (m)                 : 44.858
       dz (m)                 : -1.199
     Accuracy (mm)            : 2
     Survey method            : not known
     Date Measured            : 1995-02-17
     Additional Information   : (multiple lines)

5.2  Tied Marker Name         : Mobile VLBI marker
     Tied Marker Usage        : not known
     Tied Marker CDP Number   : 7605
     Tied Marker DOMES Number : 10002M003
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : 0.639
       dy (m)                 : 11.081
       dz (m)                 : -9.235
     Accuracy (mm)            : 1
     Survey method            : not known
     Date Measured            : 1995-02-17
     Additional Information   : (multiple lines)

7.   Collocation Information

7.1  Instrumentation Type     : SLR
       Status                 : PERMANENT
       Effective Dates        : 1995-02-17/CCYY-MM-DD
       Notes                  : (multiple lines)

7.2  Instrumentation Type     : VLBI
       Status                 : MOBILE
       Effective Dates        : 1995-02-17/CCYY-MM-DD
       Notes                  : (multiple lines)

11.  On-Site, Point of Contact Agency Information

     Agency                   : Observatoire de la cote d'Azur
     Preferred Abbreviation   : OCA
     Mailing Address          : Observatoire de la Cote d'Azur
                              : Avenue Nicolas Copernic
                              : 06130 GRASSE - France
     Primary Contact
```

```
      Contact Name           : Maurice LAPLANCHE
      Telephone (primary)    : (33) 4 93 40 54 20
      Telephone (secondary)  :
      Fax                    :
      E-mail                 : maurice.laplanche@obs-azur.fr
    Secondary Contact
      Contact Name           : Francis PIERRON
      Telephone (primary)    : (33) 4 93 40 54 20
      Telephone (secondary)  :
      Fax                    :
      E-mail                 : Francis.Pierron@obs-azur.fr
    Additional Information   : (multiple lines)

12. Responsible Agency (if different from 11.)

    Agency                   : Centre National d'Etudes Spatiales
    Preferred Abbreviation   : CNES
    Mailing Address          : CNES - DCT/OP/EM
                             : 18, avenue Edouard Belin
                             : 31401 TOULOUSE CEDEX 09 - France
    Primary Contact
      Contact Name           : Jean-Paul Cardaliaguet
      Telephone (primary)    : (33) 5 61 27 31 98
      Telephone (secondary)  :
      Fax                    : (33) 5 61 28 15 36
      E-mail                 : jean-paul.cardaliaguet@cnes.fr


 Antenna Graphics with Dimensions
```




```
  ARP: Antenna Reference Point
  L1 : L1 Phase Center                  L2 : L2 Phase Center
```

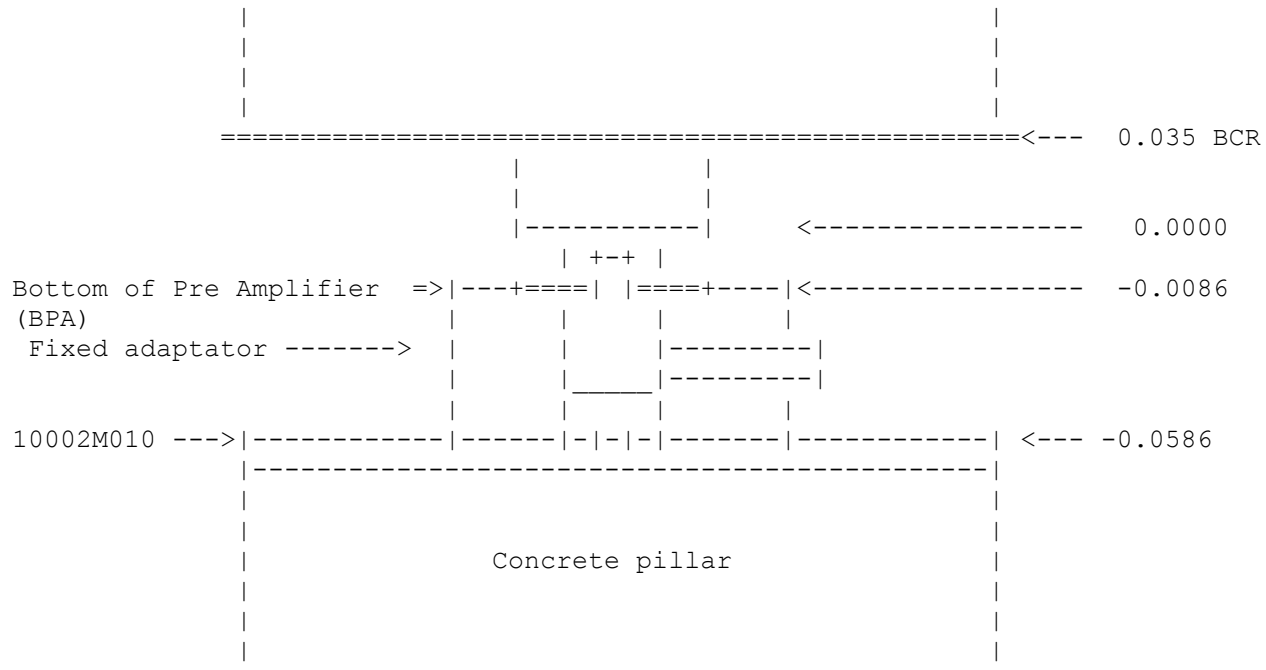
6.3.2. **GRAC (extract)**

```
     GRAC Site Information Form (site log)
     International GNSS Service

0.   Form

     Prepared by (full name)  : Equipe RGP
     Date Prepared            : 2014-09-03
     Report Type              : UPDATED
     If Update:
      Previous Site Log       : grac_20140801.log
      Modified/Added Sections : 3.15, 3.16, 5.2, 5.3, 5.4, 5.5, 7.4

1.   Site Identification of the GNSS Monument

     Site Name                : GRASSE
     Four Character ID        : GRAC
     Monument Inscription     : NONE
     IERS DOMES Number        : 10002M010
     CDP Number               : NONE
     Monument Description     : CONCRETE PILLAR WITH BRASS ADAPTATOR
       Height of the Monument :
       Monument Foundation    : CONCRETE BLOCK
       Foundation Depth       :
     Marker Description       : BASE AND CENTRE OF BRASS ADAPTATOR
     Date Installed           : 1998-11-27T10:00Z
     Geologic Characteristic  : BEDROCK
       Bedrock Type           : SEDIMENTARY
       Bedrock Condition      : FRESH

2.   Site Location Information

     City or Town             : Caussols
     State or Province        : Alpes-Maritimes
     Country                  : France
     Tectonic Plate           : EURASIAN
     Approximate Position (ITRF)
       X coordinate (m)       : 4581708.63
       Y coordinate (m)       : 556132.23
       Z coordinate (m)       : 4389340.93
       Latitude (N is +)      : +434516.15
       Longitude (E is +)     : +0065514.74
       Elevation (m,ellips.)  : 1319.8
     Additional Information   : Observatory located at Caussols, on plateau
                              : de Calern, 10 Km NW of Grasse.

3.   GNSS Receiver Information

3.16 Receiver Type            : LEICA GR25
     Satellite System         : GPS+GLO+GAL+BDS+SBAS
     Serial Number            : 1831110
     Firmware Version         : 3.10
     Elevation Cutoff Setting : 0 deg
     Date Installed           : 2014-09-03T11:00Z
     Date Removed             : (CCYY-MM-DDThh:mmZ)
     Temperature Stabiliz.    :
```

```
4.   GNSS Antenna Information

4.6  Antenna Type             : TRM57971.00     NONE
     Serial Number            : 5112118086
     Antenna Reference Point  : BAM
     Marker->ARP Up Ecc. (m)  : 0.0500
     Marker->ARP North Ecc(m) : 0.0000
     Marker->ARP East Ecc(m)  : 0.0000
     Alignment from True N    : 0 deg
     Antenna Radome Type      : NONE
     Radome Serial Number     :
     Antenna Cable Type       : ASHTECH
     Antenna Cable Length     : 30 m
     Date Installed           : 2013-07-30T15:00Z

5.   Surveyed Local Ties

5.1  Tied Marker Name         : IGS Station (GRAS)
     Tied Marker Usage        : GPS
     Tied Marker CDP Number   : none
     Tied Marker DOMES Number : 10002M006
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : -17.4488
       dy (m)                 : -17.8019
       dz (m)                 : 19.5219
     Accuracy (mm)            : 1 mm
     Survey method            : TRIANGULATION
     Date Measured            : 1999-10-10T10:00Z
     Additional Information   :

5.2  Tied Marker Name         : IGS Station (GRAS)
     Tied Marker Usage        : GPS
     Tied Marker CDP Number   : none
     Tied Marker DOMES Number : 10002M006
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : -17.4480
       dy (m)                 : -17.8027
       dz (m)                 : 19.5206
     Accuracy (mm)            : 1 mm
     Survey method            : TRIANGULATION
     Date Measured            : 2013-07-31T12:00Z
     Additional Information   :

5.3  Tied Marker Name         : Mobile Laser Station (GRAF)
     Tied Marker Usage        : SLR
     Tied Marker CDP Number   : 7829
     Tied Marker DOMES Number : 10002S017
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : -15.8920
       dy (m)                 : 26.8284
       dz (m)                 : 16.4373
     Accuracy (mm)            : 1 mm
     Survey method            : TRIANGULATION
     Date Measured            : 2013-07-31T12:00Z
     Additional Information   :

5.4  Tied Marker Name         : Laser MeO Station (GRSM)
     Tied Marker Usage        : SRP
     Tied Marker CDP Number   : 7845
     Tied Marker DOMES Number : 10002S002
```

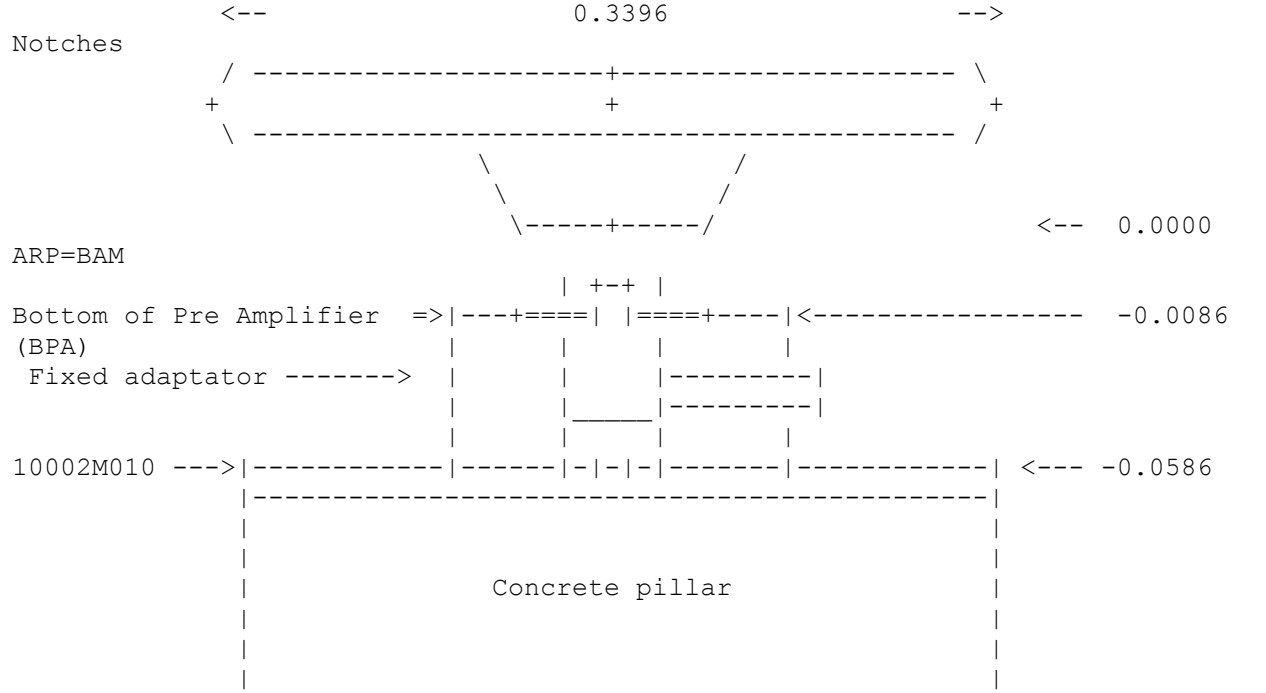
```
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : -16.2789
       dy (m)                 : 63.5414
       dz (m)                 : 13.8994
     Accuracy (mm)            : 1 mm
     Survey method            : TRIANGULATION
     Date Measured            : 2013-07-31T12:00Z
     Additional Information   :

5.5  Tied Marker Name         : DORIS Station (GR4B)
     Tied Marker Usage        :
     Tied Marker CDP Number   :
     Tied Marker DOMES Number : 10002S019
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : -27.1703
       dy (m)                 : 34.0879
       dz (m)                 : 29.5842
     Accuracy (mm)            : 1 mm
     Survey method            : TRIANGULATION
     Date Measured            : 2013-07-31T12:00Z
     Additional Information   :

5.6  Tied Marker Name         : Repère VLBI (VLBI)
     Tied Marker Usage        :
     Tied Marker CDP Number   :
     Tied Marker DOMES Number : 10002M003
     Differential Components from GNSS Marker to the tied monument (ITRS)
       dx (m)                 : -10.8090
       dy (m)                 : -6.7212
       dz (m)                 : 10.2840
     Accuracy (mm)            : 1 mm
     Survey method            : TRIANGULATION
     Date Measured            : 2013-07-31T12:00Z
     Additional Information   :

6.   Frequency Standard

6.1  Standard Type            : INTERNAL
       Input Frequency        :
       Effective Dates        : 2000-04-01/CCYY-MM-DD
       Notes                  :

7.   Collocation Information

7.1  Instrumentation Type     : SLR
       Status                 : PERMANENT
       Effective Dates        : 1980-09-01/CCYY-MM-DD
       Notes                  :

7.2  Instrumentation Type     : VLBI
       Status                 : MOBILE
       Effective Dates        : 1995-02-17/CCYY-MM-DD
       Notes                  :

7.3  Instrumentation Type     : GPS
       Status                 : PERMANENT
       Effective Dates        : 1995-02-10/CCYY-MM-DD
       Notes                  :

7.4  Instrumentation Type     : DORIS
```

```
       Status                  : PERMANENT
       Effective Dates         : 2008-09-11/CCYY-MM-DD
       Notes                   :

11.  On-Site, Point of Contact Agency Information

     Agency                    : Observatoire de Calern - Service Lasersat
     Preferred Abbreviation    : OCA
     Mailing Address           : Observatoire de la Cote d'Azur
                               : Avenue Nicolas Copernic
                               : 06100 GRASSE - France
     Primary Contact
       Contact Name            : Francis PIERRON
       Telephone (primary)     :
       Telephone (secondary)   :
       Fax                     :
       E-mail                  : francis.pierron@obs-azur.fr
     Secondary Contact
       Contact Name            : Jocelyn PARIS
       Telephone (primary)     : 00 33 (0)4 93 40 54 20
       Telephone (secondary)   : 00 33 (0)4 93 40 54 21
       Fax                     : 00 33 (0)4 93 09 26 14
       E-mail                  : Jocelyn.Paris@obs-azur.fr
     Additional Information    :

12.  Responsible Agency (if different from 11.)

     Agency                    : Institut National de l'Information
                               : Geographique et Forestiere
     Preferred Abbreviation    : IGN
     Mailing Address           : SGN department
                               : 73 avenue de Paris
                               : 94165 Saint-Mandé CEDEX France
     Primary Contact
       Contact Name            : Equipe RGP
       Telephone (primary)     : 00 33 (0)1 43 98 83 39
       Telephone (secondary)   :
       Fax                     : 00 33 (0)1 43 98 84 50
       E-mail                  : rgpadmin@ign.fr
     Secondary Contact
       Contact Name            :
       Telephone (primary)     :
       Telephone (secondary)   :
       Fax                     :
       E-mail                  :
     Additional Information    :

13.  More Information

     Primary Data Center       : IGN
     Secondary Data Center     : ENSG
     URL for More Information  : http://rgp.ign.fr
     Hardcopy on File
       Site Map                : http://rgp.ign.fr


                                  ---
     L2 Phase Center =>          /    +    \             <----------  0.128
     L1 Phase Center =>         |     +     |            <----------  0.110
              +-------------------------------------------------+
```



BPA: Bottom of Pre Amplifier
BCR : Bottom of Choke ring
L1 : L1 Phase Center
L2 : L2 Phase Center

TRM55971.00



BPA: Bottom of Pre Amplifier
BCR : Bottom of Choke ring
L1 : L1 Phase Center
L2 : L2 Phase Center

6.3.3. **GR3B (extract)**

```
    GRASSE DORIS site description form

0. Form

    Prepared by   : SIMB (DORIS installation and maintenance department)
    Date prepared : 11/04/2013
    Report type   : NEW

1. Site location information

    Site name              : GRASSE
    Site DOMES number      : 10002
    Host agency            : Observatoire de la Côte d' Azur (OCA)
    City                   : Caussols
    State or province      : Provence
    Country                : FRANCE
    Tectonic plate         : EURA
    Geological information :

    Geographical coordinates (ITRF) :
        North Latitude       :    43 deg 45' 17''
        East Longitude       :     6 deg 55' 16''
        Ellipsoid height     :  1323 m
        Approximate altitude :  1272 m

2. DORIS antenna and reference point information

2.1
    Four character ID        : GR3B
    Antenna model            : Starec 52291 type
    Antenna serial number    : 148
    IERS DOMES number        : 10002S018
    CNES/IGN number          : 3
    DORIS SSALTO number      : 285
    Date installed (dd/mm/yy): 11/09/2008
    Date removed (dd/mm/yy)  :
    Antenna support type     : Metal tripod
    Installed on             : flat roof of a one-storey building

3. DORIS beacons information

3.1
    Beacon serial number        : 2819044
    Beacon model                : 3.0
    USO serial number           : NO USO
    4 Char. ID of the REF point : GR3B
    Date installed (dd/mm/yy)   : 11/09/2008
    Date removed (dd/mm/yy)     :

4. ITRF coordinates and velocities of the current DORIS ref. point (GR3B)

    Solution         : DPOD2008 (tie to GRSM)
    Epoch            : 2005.0

    X = 4581680.449 m    Y = 556166.289 m    Z = 4389371.473 m
    Sig X = 0.002 m    Sig Y = 0.002 m    Sig Z = 0.001 m

    VX = -0.0142 m/y    VY = 0.0188 m/y    VZ = 0.0116 m/y
    Sig VX =   m/y    Sig VY =   m/y    Sig VZ =   m/y
```

```
5. IERS colocation information

5.1
    Instrument type       : GNSS
    Status                : Permanent
    DOMES number of the
    instrument ref. point : 10002M010
    Notes                 : RGP station "GRAC"

5.2
    Instrument type       : VLBI
    Status                : Mobile
    DOMES number of the
    instrument ref. point : 10002M003
    Notes                 :

5.3
    Instrument type       : GNSS
    Status                : Permanent
    DOMES number of the
    instrument ref. point : 10002M006
    Notes                 : IGS station (GRAS)

5.4
    Instrument type       : SLR
    Status                : Mobile
    DOMES number of the
    instrument ref. point : 10002M004
    Notes                 :

5.5
    Instrument type       : SLR
    Status                : Permanent
    DOMES number of the
    instrument ref. point : 10002S002
    Notes                 : Laser Meo "GRSM"

5.6
    Instrument type       : SLR
    Status                : Mobile
    DOMES number of the
    instrument ref. point : 10002S017
    Notes                 : FTLRS "GRAF3"

7. Local site ties

7.1
    Point description      : DORIS Starec antenna reference point (GR2B)
    DOMES number           : 10002S016
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : -0.100
    dY (m)                 : -0.012
    dZ (m)                 : -0.096
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

7.2
    Point description      : FTLRS "GRAF" (CDP 7829)
```

```
    DOMES number           : 10002S017
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : 11.997
    dY (m)                 : -6.827
    dZ (m)                 : -13.779
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

7.3
    Point description      : GNSS station (GRAC) Base of brass adaptator
    DOMES number           : 10002M010
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : 27.886
    dY (m)                 : -33.660
    dZ (m)                 : -30.218
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

7.4
    Point description      : IGS station (GRAS) Brass nail
    DOMES number           : 10002M006
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : 10.439
    dY (m)                 : -51.456
    dZ (m)                 : -10.696
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

7.5
    Point description      : Laser MeO "GRSM" (CDP 7845)
    DOMES number           : 10002S002
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : 11.612
    dY (m)                 : 29.887
    dZ (m)                 : -16.319
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

7.6
    Point description      : Mobile laser Mark (CDP 7846)
    DOMES number           : 10002M004
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : 12.888
    dY (m)                 : -31.593
    dZ (m)                 : -16.666
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

7.7
    Point description      : VLBI Mark (CDP 7605)
```

```
    DOMES number           : 10002M003
    Differential components from the current DORIS ref. point (GR3B)
    to the above point (in the ITRS) :
    dX (m)                 : 17.075
    dY (m)                 : -40.379
    dZ (m)                 : -19.933
    Accuracy (m)           : 0.001
    Date measured          : 28/08/2009
    Additional information : Survey by IGN-F 2009

8. Meteorological Instrumentation

8.1 Humidity sensor
    Model        : HMP45D
    Manufacturer : VAISALA
    Accuracy     : +/- 3 percents

8.2 Pressure sensor
    Model        : PTU200 class B
    Manufacturer : VAISALA
    Accuracy     : +/- 0.25 hPa
    Height       :  m above the current DORIS ref. point (GR3B)
    Notes        : long term stability = +/- 0.1 hPa/year

8.3 Temperature sensor
    Model        : HMP45D
    Manufacturer : VAISALA
    Accuracy     : +/- 0.5 deg C

9. DORIS network contacts

    Primary contact:

    Name            : Jerome SAUNIER
    Agency          : Institut Geographique National
    Mailing address : Service de Geodesie et Nivellement
                    : 73 avenue de Paris
                    : 94165 SAINT-MANDE Cedex    FRANCE
    Telephone       : + 33 1 43 98 83 63
    Fax             : + 33 1 43 98 84 50
    E-mail          : jerome (.) saunier (@) ign.fr

    Secondary contact:

    Name            : Francois BOLDO
    Agency          : Institut Geographique National
    Mailing address : CNES (DCT/ME/OC)
                    : 18 Avenue Edouard Belin
                    : 31401 TOULOUSE Cedex    FRANCE
    Telephone       : + 33 5 61 27 40 72
    Fax             : + 33 5 61 28 25 95
    E-mail          : simb (.) doris (@) cnes.fr
```

6.4. **Network adjustment output file**

Compte rendu de compensation Comp3D

COMP3D version : 4.3.13 du 06/11/2013 alpha auto

Configuration du chantier

Nom du chantier : calern1 avec centre telescope
Nom du fichier COR : final1.cor
Nom du fichier OBS : final1.obs
Unité angulaire : 1
Origine du chantier : 0.0000 | 0.0000
Les coordonnées en entrée sont géographiques.
Longitude centre : 6.92057543
Latitude centre : 43.75473904
Niveau de réduction : 0.0000
Correction geoïde : 0.0000
Nombre de chiffres : 4
Itérations après convergence : 0
Coefficient de réfraction : 0.12
Latitude moyenne : 43.75473904
Type de calcul :1

Informations sur le calcul

σ0 initial : 0.9410
itération : 0.94095378 1.06275145400687E35
itération : Converge!
itération : 0.94102238 -0.00007290
σ0 final : 0.9410
Nombre d'itérations : 2
Initialisation de la projection stéréographique

Ellipsoïde
désignation : Ellipsoïde International
demi axe : 6378388
e2 : 0.00672267

Données du chantier
Latitude moy. : 43.7547 °
Rayon calculé : 6377417.0713

Point origine : calculé
X0 : 0.0000
Y0 : 0.0000

Données en entrée
Nombre de Points : 129
Nombre de Mesures : 1218
Nombre de Tours : 34

Nombre de visées verticales : 0
Nombre de Clichés : 0
Nombre de Repères : 1

Structuration de la matrice normale

Groupe : 129
Nb_groupe : 129

Rangement de la matrice normale

N_depart : 20
Nombre d'inconnues : 424
Taille de la matrice : 41630

Type de calcul

Inversion : VRAI
Avant compensation : FAUX
Juste propagation : FAUX
Contraintes internes : FAUX
Tirages Monte-Carlo : 0
Unité : mm

Les plus gros Résidus

Station	Vise	Type	Résidu Normalisé
5	20000	Zen	-145.73
5	20000	Zen	-145.58
5	20000	Zen	-145.58
5	20000	Zen	-145.48
5	20000	Zen	-145.33
5	20000	Zen	-145.09
2	10000	Zen	-39.14
3	10000	Zen	-39.11
2	210	Zen	-34.35
5	1	Zen	-33.50
1	2	Zen	-33.32
2	1	Zen	-33.10
2	10000	Zen	-31.82
2	10000	Zen	-31.71
3	10000	Zen	-31.17
2	10000	Zen	-31.07
2	10000	Zen	-30.74
2	10000	Zen	-30.64
5	3	Zen	-30.23
3	10000	Zen	-30.01

Coordonnées compensées

dans le système de coordonnées en entrée

	Coordonnées compensées				Déplacements				Résidu moyen	
Point	X	Y	Z	Norme Depl.	dX	dY	dZ	nb_rel	σ
reperetelescope	80.4204	-11.4379	1274.0680	0.0000	0.0000	0.0000	0.0000	213	0.49
maxicentretelescope	80.5976	-11.6399	1272.6326	0.0000	0.0000	0.0000	0.0000	3	----
1	119.9417	-1.7942	1270.1037	0.0000	0.0000	0.0000	0.0000	228	8.55
2	69.4077	-38.2526	1269.4457	0.0000	0.0000	0.0000	0.0000	301	8.03
3	12.2067	-36.7362	1268.7461	0.0001	0.0000	0.0000	0.0000	274	7.68

4	-28.1073	46.0999	1267.2288	0.0001	0.0000	0.0000	0.0000	84	6.80
5	57.4081	-5.3097	1271.6312	0.0000	0.0000	0.0000	0.0000	300	21.36
6	59.1517	2.3392	1272.5107	0.0000	0.0000	0.0000	0.0000	40	4.22
10000	746.1765	-125.0775	1287.8782	0.0058	-0.0009	-0.0014	-0.0056	43	19.84
20000	208.2157	-281.8195	1269.8575	0.0071	0.0002	0.0053	-0.0047	56	50.66
110	44.1114	-7.0137	1271.3402	0.0001	0.0000	0.0000	0.0000	22	5.39
111	44.1114	-7.0137	1271.4680	0.0001	0.0000	0.0000	0.0000	2	----
100	80.5976	-11.6411	1273.9246	0.0000	0.0000	0.0000	0.0000	21	2.64
200	52.3185	10.6156	1271.3782	0.0001	0.0000	0.0000	0.0000	8	6.01
201	52.3330	10.6012	1272.5982	0.0000	0.0000	0.0000	0.0000	28	3.03
207	52.3330	10.6012	1272.6092	0.0001	0.0000	0.0000	0.0000	5	3.43
208	52.3330	10.6012	1272.9892	0.0001	0.0000	0.0000	0.0000	7	2.98
209	52.3331	10.6012	1273.4752	0.0001	0.0000	0.0000	0.0000	7	4.30
210	52.6756	9.6175	1272.7133	0.0001	0.0000	0.0000	0.0000	23	10.80
211	52.5597	9.8120	1272.7472	0.0001	0.0000	0.0000	0.0000	5	0.71
212	52.9002	9.6234	1272.7517	0.0001	0.0000	0.0000	0.0000	14	2.42
213	52.5659	9.4197	1272.7582	0.0000	0.0000	0.0000	0.0000	15	1.38
214	52.8897	9.5498	1270.6787	0.0001	0.0000	0.0000	0.0000	6	1.43
215	52.5919	9.3696	1270.6855	0.0000	0.0000	0.0000	0.0000	6	1.79
216	52.6055	9.6971	1270.6789	0.0001	0.0000	0.0000	0.0000	6	1.39
218	52.6756	9.6175	1273.1043	0.0001	0.0000	0.0000	0.0000	2	----
219	52.6756	9.6175	1273.5903	0.0001	0.0000	0.0000	0.0000	2	----
300	0.0001	-0.0005	1268.6335	0.0000	0.0000	0.0000	0.0000	12	5.67
301	0.0001	-0.0005	1268.5985	0.0001	0.0000	0.0000	0.0001	5	0.10
310	15.5681	-27.5577	1269.2107	0.0000	0.0000	0.0000	0.0000	35	4.95
311	15.5681	-27.5577	1269.1607	0.0000	0.0000	0.0000	0.0000	2	----
500	-25.2910	40.5147	1265.8429	0.0000	0.0000	0.0000	0.0000	7	2.28
510	19.4225	-7.6489	1267.9568	0.0000	0.0000	0.0000	0.0000	12	6.91
520	10.1992	-12.1513	1267.9368	0.0000	0.0000	0.0000	0.0000	13	6.39
530	0.6521	-2.7109	1267.6895	0.0001	0.0000	0.0000	0.0000	6	1.96
540	-5.6504	-23.5222	1267.3968	0.0000	0.0000	0.0000	0.0000	8	2.58
550	22.8537	-34.4913	1267.3435	0.0000	0.0000	0.0000	0.0000	13	5.74
560	-0.9697	11.1900	1267.1045	0.0000	0.0000	0.0000	0.0000	6	0.78
570	70.1276	-26.1467	1268.4164	0.0001	0.0000	-0.0001	0.0000	6	2.16
11	119.4796	-2.2489	1268.8129	0.0000	0.0000	0.0000	0.0000	10	1.57
12	119.4796	-2.2489	1268.8069	0.0000	0.0000	0.0000	0.0000	4	0.04
13	119.4796	-2.2489	1268.8095	0.0000	0.0000	0.0000	0.0000	4	0.04
14	119.4796	-2.2489	1268.8066	0.0000	0.0000	0.0000	0.0000	4	0.04
21	68.9454	-38.7096	1268.1516	0.0000	0.0000	0.0000	0.0000	12	3.04
22	68.9454	-38.7096	1268.1541	0.0000	0.0000	0.0000	0.0000	4	0.12
23	68.9454	-38.7096	1268.1509	0.0000	0.0000	0.0000	0.0000	4	0.12
24	68.9454	-38.7096	1268.1492	0.0000	0.0000	0.0000	0.0000	4	0.12
31	11.7419	-37.1921	1267.4484	0.0000	0.0000	0.0000	0.0000	12	2.06
32	11.7419	-37.1921	1267.4503	0.0000	0.0000	0.0000	0.0000	4	0.51
33	11.7419	-37.1921	1267.4497	0.0000	0.0000	0.0000	0.0000	4	0.51
34	11.7419	-37.1921	1267.4481	0.0000	0.0000	0.0000	0.0000	6	1.50
41	-28.5752	45.6444	1265.9351	0.0000	0.0000	0.0000	0.0000	10	1.27
42	-28.5752	45.6444	1265.9467	0.0000	0.0000	0.0000	0.0000	4	0.04
43	-28.5752	45.6444	1265.9335	0.0000	0.0000	0.0000	0.0000	4	0.04
44	-28.5752	45.6444	1265.9338	0.0000	0.0000	0.0000	0.0000	4	0.04
101	80.5122	-11.7050	1272.4335	0.0000	0.0000	0.0000	0.0000	4	0.91
102	80.5122	-11.7050	1272.8338	0.0000	0.0000	0.0000	0.0000	4	0.91
103	80.5122	-11.7050	1272.7094	0.0000	0.0000	0.0000	0.0000	4	0.78
104	80.5122	-11.7050	1272.5593	0.0000	0.0000	0.0000	0.0000	4	0.78
1001	80.6339	-8.9902	1273.9553	0.0001	0.0000	-0.0001	0.0000	11	1.72
1002	80.3675	-9.3115	1273.9220	0.0001	0.0000	-0.0001	0.0000	11	1.27
1003	80.7637	-10.4014	1273.8524	0.0001	-0.0001	-0.0001	0.0000	9	3.39

1004	79.8316	-11.5249	1273.8868	0.0001	0.0000	-0.0001	0.0000	11	3.22
1005	80.5927	-12.5167	1273.7973	0.0001	0.0000	-0.0001	0.0000	11	3.64
1101	80.6342	-9.4574	1274.6346	0.0001	0.0000	-0.0001	0.0000	11	1.97
1102	80.3677	-9.7574	1274.5139	0.0001	0.0000	-0.0001	0.0000	11	1.70
1103	80.7640	-10.7856	1274.1463	0.0001	0.0000	-0.0001	0.0000	11	3.53
1104	79.8320	-11.8752	1273.8704	0.0001	0.0000	-0.0001	0.0000	11	1.10
1105	80.5932	-12.8040	1273.5104	0.0001	0.0000	0.0000	0.0000	11	1.42
1301	80.6351	-10.1827	1275.2110	0.0000	0.0000	0.0000	0.0000	11	1.96
1302	80.3686	-10.4308	1275.0037	0.0001	0.0000	0.0000	0.0000	11	2.48
1303	80.7648	-11.2953	1274.3359	0.0001	0.0000	-0.0001	0.0000	11	1.73
1304	79.8325	-12.2459	1273.7373	0.0001	0.0000	0.0000	0.0000	11	2.35
1305	80.5936	-13.0185	1273.1075	0.0000	0.0000	0.0000	0.0000	11	2.06
1401	80.6368	-11.0001	1275.5244	0.0001	0.0000	0.0000	0.0000	11	1.51
1402	80.3703	-11.1765	1275.2535	0.0001	0.0000	-0.0001	0.0000	11	1.16
1403	80.7665	-11.8082	1274.3618	0.0000	0.0000	0.0000	0.0000	11	1.41
1404	79.8336	-12.5423	1273.5118	0.0000	0.0000	0.0000	0.0000	11	1.14
1405	80.5944	-13.0972	1272.6833	0.0000	0.0000	0.0000	0.0000	9	3.57
1501	80.6377	-11.8734	1275.5850	0.0000	0.0000	0.0000	0.0000	11	1.49
1502	80.3710	-11.9630	1275.2747	0.0000	0.0000	0.0000	0.0000	11	0.97
1503	80.7669	-12.3062	1274.2367	0.0000	0.0000	0.0000	0.0000	11	1.44
1504	79.8336	-12.7596	1273.2098	0.0000	0.0000	0.0000	0.0000	11	0.75
1601	80.6387	-12.7260	1275.3880	0.0000	0.0000	0.0000	0.0000	11	1.54
1602	80.3722	-12.7212	1275.0649	0.0001	0.0000	0.0000	0.0000	11	2.21
1603	80.7675	-12.7462	1273.9719	0.0000	0.0000	0.0000	0.0000	11	2.82
1604	79.8332	-12.8793	1272.8576	0.0000	0.0000	0.0000	0.0000	9	2.14
2001	79.5444	-9.1799	1273.3136	0.0001	0.0000	-0.0001	0.0000	12	4.31
2002	80.0485	-9.8633	1273.8061	0.0001	0.0000	-0.0001	0.0000	15	2.60
2003	80.3710	-10.2957	1273.7499	0.0001	0.0000	-0.0001	-0.0001	12	0.95
2004	81.1419	-10.7273	1273.7351	0.0001	0.0000	-0.0001	0.0000	12	1.64
2005	79.7049	-10.7929	1273.1885	0.0001	0.0000	-0.0001	0.0000	12	1.45
2006	80.5772	-11.4385	1273.8178	0.0001	0.0000	-0.0001	0.0000	15	1.55
2007	81.4786	-10.0542	1273.2590	0.0001	-0.0001	-0.0001	0.0000	6	0.42
2101	79.5450	-9.4636	1273.9650	0.0001	0.0000	-0.0001	0.0000	12	2.16
2102	80.0489	-10.2565	1274.2497	0.0001	0.0000	-0.0001	0.0000	15	1.60
2103	80.3716	-10.6555	1274.0769	0.0001	0.0000	-0.0001	0.0000	15	1.97
2104	81.1425	-11.0672	1273.9434	0.0001	0.0000	-0.0001	0.0000	15	1.59
2105	79.7046	-10.9789	1273.4007	0.0001	0.0000	-0.0001	0.0000	12	1.25
2106	80.5770	-11.7738	1273.8274	0.0001	0.0000	-0.0001	0.0000	15	1.73
2107	81.4787	-10.2880	1273.6713	0.0001	-0.0001	-0.0001	0.0000	6	0.30
2301	79.5454	-9.9823	1274.5730	0.0001	0.0000	-0.0001	0.0000	12	1.97
2302	80.0508	-10.8259	1274.5978	0.0001	0.0000	-0.0001	0.0000	15	3.03
2303	80.3711	-11.1504	1274.3099	0.0001	0.0000	-0.0001	0.0000	15	2.70
2304	81.1416	-11.5016	1274.0552	0.0000	0.0000	0.0000	0.0000	15	1.86
2305	79.7051	-11.2485	1273.5677	0.0000	0.0000	0.0000	0.0000	12	2.12
2306	80.5770	-12.1371	1273.7265	0.0001	0.0000	0.0000	0.0000	12	1.74
2307	81.4785	-10.6755	1274.0377	0.0001	0.0000	-0.0001	0.0000	9	1.13
2401	79.5482	-10.6261	1274.9715	0.0001	0.0000	0.0000	0.0000	12	1.32
2402	80.0518	-11.4365	1274.7493	0.0000	0.0000	0.0000	0.0000	12	1.80
2403	80.3722	-11.6622	1274.3799	0.0001	0.0000	-0.0001	0.0000	15	1.51
2404	81.1425	-11.9249	1274.0324	0.0000	0.0000	0.0000	0.0000	12	1.48
2405	79.7058	-11.5391	1273.6415	0.0000	0.0000	0.0000	0.0000	12	1.27
2406	80.5782	-12.4350	1273.5333	0.0000	0.0000	0.0000	0.0000	12	2.19
2407	81.4797	-11.1284	1274.2582	0.0001	0.0000	0.0000	0.0000	9	0.87
2501	79.5494	-11.3562	1275.1648	0.0000	0.0000	0.0000	0.0000	12	2.42
2502	80.0539	-12.0653	1274.7157	0.0000	0.0000	0.0000	0.0000	12	1.24
2503	80.3730	-12.1721	1274.2964	0.0001	0.0000	0.0000	0.0000	15	1.84
2504	81.1418	-12.3213	1273.8876	0.0001	0.0000	0.0000	0.0000	12	1.54

2505	79.7064	-11.8384	1273.6270	0.0001	0.0000	0.0000	0.0000	12	2.07
2506	80.5780	-12.6639	1273.2604	0.0000	0.0000	0.0000	0.0000	12	1.06
2507	81.4800	-11.6264	1274.3360	0.0000	0.0000	0.0000	0.0000	9	1.26
2601	79.5515	-12.1095	1275.1372	0.0000	0.0000	0.0000	0.0000	12	3.31
2602	80.0546	-12.6557	1274.4999	0.0000	0.0000	0.0000	0.0000	12	1.46
2603	80.3730	-12.6351	1274.0683	0.0000	0.0000	0.0000	0.0000	15	3.65
2604	81.1412	-12.6588	1273.6327	0.0000	0.0000	0.0000	0.0000	12	1.37
2605	79.7071	-12.1203	1273.5258	0.0001	0.0000	0.0000	0.0000	12	2.45
2606	80.5778	-12.8027	1272.9332	0.0000	0.0000	0.0000	0.0000	9	0.61
2607	81.4804	-12.1249	1274.2652	0.0000	0.0000	0.0000	0.0000	9	0.53

Compensation des référentiels

	Mesure				Poids			Résidus terrain				Résidus locaux			
Pt_Vise	mes.X	mes.Y	mes.Z	h V	σX	σY	σZ	res.X mm	res.Y mm	res.Z mm	norme res.	res. radial	res.X norm	res.Y norm	res.Z norm
maxicentretelescope	0.1772	-0.2020	-1.4354	0	2.0	2.0	2.5	0.0	0.0	0.0			0.0	0.0	0.0
1001	0.2135	2.4478	-0.1127	0	1.0	1.0	1.0	0.1	0.5	0.1	0.5	0.5	0.1	0.5	0.1
1101	0.2138	1.9806	0.5666	0	1.0	1.0	1.0	0.0	0.3	0.1	0.3	0.3	0.1	0.3	0.1
1301	0.2147	1.2552	1.1430	0	1.0	1.0	1.0	0.1	0.2	0.0	0.3	0.2	0.1	0.2	0.0
1401	0.2164	0.4378	1.4564	0	1.0	1.0	1.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.0
1501	0.2173	-0.4354	1.5170	0	1.0	1.0	1.0	0.1	-0.1	0.0	0.1	0.1	0.1	-0.1	0.0
1601	0.2182	-1.2881	1.3200	0	1.0	1.0	1.0	0.1	-0.3	0.0	0.3	0.2	0.1	-0.3	0.0
1002	-0.0529	2.1265	-0.1460	0	1.0	1.0	1.0	0.0	0.4	0.0	0.4	0.4	0.0	0.4	0.0
1102	-0.0527	1.6806	0.4459	0	1.0	1.0	1.0	0.0	0.3	0.0	0.3	0.3	0.0	0.3	0.0
1302	-0.0518	1.0072	0.9357	0	1.0	1.0	1.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.0
1402	-0.0501	0.2615	1.1855	0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1502	-0.0494	-0.5251	1.2067	0	1.0	1.0	1.0	0.0	-0.1	0.0	0.1	0.0	0.0	-0.1	0.0
1602	-0.0483	-1.2833	0.9969	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.2	0.0	-0.2	0.0
1003	0.3433	1.0366	-0.2156	0	1.0	1.0	1.0	0.0	0.2	0.0	0.2	0.2	0.0	0.2	0.0
1103	0.3436	0.6523	0.0783	0	1.0	1.0	1.0	0.1	0.2	0.0	0.2	0.2	0.1	0.2	0.0
1303	0.3444	0.1427	0.2679	0	1.0	1.0	1.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0
1403	0.3460	-0.3703	0.2938	0	1.0	1.0	1.0	0.1	-0.1	0.0	0.1	0.1	0.1	-0.1	0.0
1503	0.3465	-0.8683	0.1687	0	1.0	1.0	1.0	0.1	-0.2	0.0	0.2	0.2	0.1	-0.2	0.0
1603	0.3471	-1.3083	-0.0961	0	1.0	1.0	1.0	0.1	-0.3	0.0	0.3	0.3	0.1	-0.3	0.0
1004	-0.5889	-0.0870	-0.1812	0	1.0	1.0	1.0	-0.1	0.0	0.0	0.1	0.1	-0.1	0.0	0.0
1104	-0.5884	-0.4372	-0.1976	0	1.0	1.0	1.0	-0.1	-0.1	0.0	0.1	0.1	-0.1	-0.1	0.0
1304	-0.5879	-0.8080	-0.3307	0	1.0	1.0	1.0	-0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1404	-0.5869	-1.1044	-0.5562	0	1.0	1.0	1.0	-0.1	-0.2	-0.1	0.2	0.2	-0.1	-0.2	-0.1
1504	-0.5869	-1.3217	-0.8582	0	1.0	1.0	1.0	-0.1	-0.2	0.0	0.2	0.2	-0.1	-0.2	0.0
1604	-0.5873	-1.4413	-1.2104	0	1.0	1.0	1.0	-0.1	-0.3	0.0	0.3	0.2	-0.1	-0.3	0.0
1005	0.1723	-1.0787	-0.2707	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.2	0.0	-0.2	0.0
1105	0.1728	-1.3660	-0.5576	0	1.0	1.0	1.0	0.0	-0.3	-0.1	0.3	0.3	0.0	-0.3	-0.1
1305	0.1732	-1.5805	-0.9605	0	1.0	1.0	1.0	0.1	-0.3	0.0	0.3	0.3	0.1	-0.3	0.0
1405	0.1740	-1.6593	-1.3847	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.2	0.0	-0.2	0.0
2001	-0.8760	2.2581	-0.7544	0	1.0	1.0	1.0	-0.2	0.4	0.0	0.5	0.4	-0.2	0.4	0.0
2101	-0.8754	1.9744	-0.1030	0	1.0	1.0	1.0	-0.2	0.3	0.0	0.4	0.4	-0.2	0.3	0.0
2301	-0.8750	1.4557	0.5050	0	1.0	1.0	1.0	-0.2	0.3	0.0	0.3	0.3	-0.2	0.3	0.0
2401	-0.8722	0.8118	0.9035	0	1.0	1.0	1.0	-0.2	0.2	0.0	0.2	0.2	-0.2	0.2	0.0
2501	-0.8711	0.0818	1.0968	0	1.0	1.0	1.0	-0.1	0.0	0.0	0.1	0.1	-0.1	0.0	0.0
2601	-0.8689	-0.6716	1.0692	0	1.0	1.0	1.0	-0.2	-0.1	0.0	0.3	0.2	-0.2	-0.1	0.0
2002	-0.3719	1.5746	-0.2619	0	1.0	1.0	1.0	-0.1	0.3	0.0	0.3	0.3	-0.1	0.3	0.0
2102	-0.3715	1.1815	0.1817	0	1.0	1.0	1.0	-0.1	0.2	0.0	0.2	0.2	-0.1	0.2	0.0
2302	-0.3696	0.6121	0.5298	0	1.0	1.0	1.0	-0.1	0.1	0.0	0.1	0.1	-0.1	0.1	0.0

2402	-0.3686	0.0014	0.6813	0	1.0	1.0	1.0	-0.1	0.0	0.0	0.1	0.0	-0.1	0.0	0.0
2502	-0.3665	-0.6274	0.6477	0	1.0	1.0	1.0	0.0	-0.1	-0.1	0.1	0.0	0.0	-0.1	-0.1
2602	-0.3658	-1.2178	0.4319	0	1.0	1.0	1.0	-0.1	-0.2	-0.1	0.2	0.2	-0.1	-0.2	-0.1
2003	-0.0494	1.1422	-0.3181	0	1.0	1.0	1.0	0.0	0.2	0.1	0.2	0.2	0.0	0.2	0.1
2103	-0.0488	0.7824	0.0089	0	1.0	1.0	1.0	0.0	0.2	0.0	0.2	0.2	0.0	0.2	0.0
2303	-0.0493	0.2876	0.2419	0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2403	-0.0482	-0.2243	0.3119	0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2503	-0.0474	-0.7341	0.2284	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.2	0.0	-0.2	0.0
2603	-0.0474	-1.1972	0.0003	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.2	0.0	-0.2	0.0
2004	0.7215	0.7106	-0.3329	0	1.0	1.0	1.0	0.1	0.1	0.0	0.2	0.2	0.1	0.1	0.0
2104	0.7221	0.3708	-0.1246	0	1.0	1.0	1.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0
2304	0.7212	-0.0636	-0.0128	0	1.0	1.0	1.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0
2404	0.7221	-0.4869	-0.0356	0	1.0	1.0	1.0	0.1	-0.1	0.0	0.2	0.2	0.1	-0.1	0.0
2504	0.7214	-0.8834	-0.1804	0	1.0	1.0	1.0	0.1	-0.1	0.0	0.2	0.2	0.1	-0.1	0.0
2604	0.7208	-1.2209	-0.4353	0	1.0	1.0	1.0	0.1	-0.2	0.0	0.2	0.2	0.1	-0.2	0.0
2005	-0.7155	0.6451	-0.8795	0	1.0	1.0	1.0	-0.1	0.1	0.0	0.2	0.1	-0.1	0.1	0.0
2105	-0.7158	0.4591	-0.6673	0	1.0	1.0	1.0	-0.2	0.1	0.0	0.2	0.1	-0.2	0.1	0.0
2305	-0.7154	0.1895	-0.5003	0	1.0	1.0	1.0	-0.1	0.0	0.0	0.1	0.1	-0.1	0.0	0.0
2405	-0.7146	-0.1012	-0.4265	0	1.0	1.0	1.0	-0.1	0.0	0.0	0.1	0.1	-0.1	0.0	0.0
2505	-0.7140	-0.4004	-0.4410	0	1.0	1.0	1.0	-0.2	-0.1	0.0	0.2	0.2	-0.2	-0.1	0.0
2605	-0.7133	-0.6824	-0.5422	0	1.0	1.0	1.0	-0.1	-0.1	0.0	0.2	0.2	-0.1	-0.1	0.0
2006	0.1568	-0.0005	-0.2502	0	1.0	1.0	1.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0
2106	0.1566	-0.3358	-0.2406	0	1.0	1.0	1.0	0.0	-0.1	0.0	0.1	0.1	0.0	-0.1	0.0
2306	0.1566	-0.6992	-0.3415	0	1.0	1.0	1.0	0.0	-0.1	0.0	0.1	0.1	0.0	-0.1	0.0
2406	0.1578	-0.9971	-0.5347	0	1.0	1.0	1.0	0.1	-0.2	0.0	0.2	0.1	0.1	-0.2	0.0
2506	0.1576	-1.2260	-0.8076	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.1	0.0	-0.2	0.0
2606	0.1574	-1.3648	-1.1348	0	1.0	1.0	1.0	0.0	-0.2	0.0	0.2	0.2	0.0	-0.2	0.0
2007	1.0583	1.3838	-0.8090	0	1.0	1.0	1.0	0.1	0.3	0.0	0.3	0.2	0.1	0.3	0.0
2107	1.0584	1.1500	-0.3967	0	1.0	1.0	1.0	0.1	0.2	0.0	0.2	0.2	0.1	0.2	0.0
2307	1.0581	0.7625	-0.0303	0	1.0	1.0	1.0	0.2	0.1	0.0	0.3	0.2	0.2	0.1	0.0
2407	1.0593	0.3096	0.1902	0	1.0	1.0	1.0	0.2	0.0	0.0	0.2	0.2	0.2	0.0	0.0
2507	1.0596	-0.1885	0.2680	0	1.0	1.0	1.0	0.1	0.0	0.0	0.2	0.1	0.1	0.0	0.0
2607	1.0600	-0.6870	0.1972	0	1.0	1.0	1.0	0.2	-0.1	0.0	0.2	0.2	0.2	-0.1	0.0

Ecarts type

Ecarts type (en mm)

	½ gd axe	σX	σY	σZ	Nb	relInfo
reperetelescope	1.6396	0.9805	1.4648	0.9949	213	
maxicentretelescope	2.5545	2.1314	2.3888	2.5545	3	
1	1.6590	0.9715	1.5017	0.9891	228	
2	1.6456	1.0226	1.4591	0.9887	301	
3	1.7167	1.0203	1.5103	0.9880	274	
4	1.7131	0.9791	1.5866	0.9914	84	
5	1.6450	0.9699	1.4608	0.9887	300	
6	1.6517	0.9705	1.4698	0.9991	40	
10000	9.3226	4.6770	4.3007	9.3226	43	
20000	9.3242	2.5434	3.2619	9.3242	56	
110	1.6581	1.0036	1.4741	0.9909	22	
111	1.6608	1.0080	1.4771	1.0303	2	
100	1.6602	1.0173	1.4810	1.0222	21	
200	1.7743	1.0651	1.5607	0.9952	8	
201	1.6565	0.9678	1.4757	0.9941	28	
207	1.6587	0.9709	1.4782	1.0118	5	
208	1.6581	0.9703	1.4775	1.0118	7	
209	1.6581	0.9703	1.4775	1.0118	7	
210	1.6754	0.9840	1.4905	0.9924	23	
211	1.8619	1.3243	1.6479	1.4275	5	

212	1.6938	0.99581.50421.0136	14
213	1.6876	0.99281.49911.0136	15
214	1.7292	1.01151.53481.0201	6
215	1.7274	1.01391.53141.0200	6
216	1.7303	1.01361.53501.0206	6
218	1.6780	0.98841.49351.0101	2
219	1.6780	0.98841.49351.0101	2
300	0.9823	0.47830.47910.9823	12
301	0.9408	0.46910.46980.9408	5
310	1.6999	1.00261.49770.9911	35
311	1.7025	1.00711.50061.0305	2
500	1.8449	1.03181.69550.9893	7
510	1.7398	1.04681.58910.9845	12
520	1.7377	1.02021.56530.9859	13
530	1.8111	1.06341.64811.2095	6
540	1.8418	1.13711.61570.9889	8
550	1.7110	1.13661.50200.9881	13
560	0.9868	0.00090.00090.9868	6
570	1.7195	1.02471.55621.1049	6
11	0.9891	0.00090.00090.9891	10
12	0.9924	0.00090.00090.9924	4
13	0.9935	0.00090.00090.9935	4
14	0.9924	0.00090.00090.9924	4
21	0.9885	0.00090.00090.9885	12
22	0.9918	0.00090.00090.9918	4
23	0.9930	0.00090.00090.9930	4
24	0.9918	0.00090.00090.9918	4
31	0.9867	0.00090.00090.9867	12
32	0.9900	0.00090.00090.9900	4
33	0.9909	0.00090.00090.9909	4
34	0.9896	0.00090.00090.9896	6
41	0.9897	0.00090.00090.9897	10
42	0.9931	0.00090.00090.9931	4
43	0.9942	0.00090.00090.9942	4
44	0.9931	0.00090.00090.9931	4
101	0.9955	0.00090.00090.9955	4
102	0.9984	0.00090.00090.9984	4
103	0.9975	0.00090.00090.9975	4
104	0.9955	0.00090.00090.9955	4
1001	1.6487	1.01641.47240.9992	11
1002	1.6487	1.01501.47220.9990	11
1003	1.6829	1.15521.47371.0034	9
1004	1.6485	1.00981.47190.9986	11
1005	1.6483	1.01021.47270.9989	11
1101	1.6477	1.01261.47280.9992	11
1102	1.6477	1.01151.47260.9991	11
1103	1.6476	1.01081.47300.9991	11
1104	1.6476	1.00741.47230.9986	11
1105	1.6474	1.00821.47310.9988	11
1301	1.6499	1.01521.47330.9993	11
1302	1.6499	1.01421.47310.9991	11
1303	1.6498	1.01371.47360.9991	11
1304	1.6498	1.01041.47300.9986	11
1305	1.6496	1.01121.47380.9987	11
1401	1.6477	1.01011.47230.9993	11
1402	1.6477	1.00931.47200.9991	11
1403	1.6477	1.00961.47250.9991	11
1404	1.6477	1.00701.47190.9985	11
1405	1.6506	1.00891.47561.0006	9
1501	1.6477	1.01081.47220.9993	11
1502	1.6477	1.01011.47200.9991	11
1503	1.6477	1.01081.47240.9990	11
1504	1.6478	1.00831.47180.9985	11
1601	1.6485	1.01021.47390.9992	11
1602	1.6485	1.00961.47370.9990	11
1603	1.6485	1.01071.47410.9989	11

1604	1.6519	1.00941.47651.0002	9
2001	1.6498	1.00431.47291.0005	12
2002	1.6482	1.00111.47170.9988	15
2003	1.6581	1.03901.47321.0031	12
2004	1.6581	1.03871.47391.0037	12
2005	1.6500	1.00351.47331.0004	12
2006	1.6474	1.00081.47170.9989	15
2007	1.6790	1.13591.50451.0429	6
2101	1.6490	1.00191.47321.0005	12
2102	1.6466	0.99881.47140.9988	15
2103	1.6466	0.99901.47170.9989	15
2104	1.6466	0.99981.47230.9992	15
2105	1.6492	1.00141.47361.0004	12
2106	1.6466	0.99921.47190.9989	15
2107	1.6781	1.13441.50441.0432	6
2301	1.6506	1.00471.47341.0006	12
2302	1.6486	1.00141.47200.9988	15
2303	1.6486	1.00171.47230.9989	15
2304	1.6486	1.00241.47300.9991	15
2305	1.6508	1.00421.47391.0004	12
2306	1.6558	1.01061.49111.0076	12
2307	1.6587	1.01871.49681.0108	9
2401	1.6493	1.00161.47291.0006	12
2402	1.6494	1.00191.47361.0008	12
2403	1.6467	0.99921.47130.9989	15
2404	1.6532	1.00901.48931.0078	12
2405	1.6494	1.00151.47331.0003	12
2406	1.6534	1.00861.48971.0073	12
2407	1.6562	1.01611.49551.0106	9
2501	1.6493	1.00271.47291.0006	12
2502	1.6494	1.00301.47351.0007	12
2503	1.6467	1.00031.47120.9988	15
2504	1.6531	1.01051.48931.0075	12
2505	1.6494	1.00271.47321.0003	12
2506	1.6534	1.01001.48961.0071	12
2507	1.6560	1.01781.49551.0103	9
2601	1.6504	1.00261.47461.0005	12
2602	1.6505	1.00311.47521.0006	12
2603	1.6476	1.00051.47260.9993	15
2604	1.6535	1.01111.49001.0073	12
2605	1.6505	1.00281.47481.0003	12
2606	1.6694	1.01801.51961.0146	9
2607	1.6563	1.01861.49651.0100	9

▲Les plus gros Sigmas

unité : mm

Point	σX	σY	σZ	Nb rel	Info
▸20000	2.5434	3.2619	**9.3242**	56	
▸10000	4.6770	4.3007	**9.3226**	43	
▸10000	**4.6770**	4.3007	9.3226	43	
▸10000	4.6770	**4.3007**	9.3226	43	
▸20000	2.5434	**3.2619**	9.3242	56	
▸maxicentretelescope	2.1314	2.3888	**2.5545**	3	
▸20000	**2.5434**	3.2619	9.3242	56	
▸maxicentretelescope	2.1314	**2.3888**	2.5545	3	
▸maxicentretelescope	**2.1314**	2.3888	2.5545	3	
▸500	1.0318	**1.6955**	0.9893	7	
▸530	1.0634	**1.6481**	1.2095	6	
▸211	1.3243	**1.6479**	1.4275	5	
▸540	1.1371	**1.6157**	0.9889	8	
▸510	1.0468	**1.5891**	0.9845	12	
▸4	0.9791	**1.5866**	0.9914	84	
▸520	1.0202	**1.5653**	0.9859	13	

‣200	1.0651	**1.5607**	0.9952	8
‣570	1.0247	**1.5562**	1.1049	6
‣216	1.0136	**1.5350**	1.0206	6
‣214	1.0115	**1.5348**	1.0201	6

6.5. **Sinex file**

Sinex name : 10002_IGN_2013-205_v10.snx

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%=SNX 1.00 IGN 13:205:00000 IGN 13:204:00000 13:207:00000 C 00012
*-------------------------------------------------------------------------------
+FILE/COMMENT
* Original input file: Mat_var-cov.ods
* Matrix Scalling Factor used:         1.0000000000
-FILE/COMMENT
*-------------------------------------------------------------------------------
+SITE/ID
*CODE PT __DOMES__ T _STATION DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_H_
 7845  A 10002S002   10002S002                6 55 17.7  43 45 16.7  1323.4
 7829  A 10002S017   10002S017                6 55 16.0  43 45 16.8  1322.2
 GR3B  A 10002S018   10002S018                6 55 16.4  43 45 17.4  1323.7
 GR4B  A 10002S019   10002S019                6 55 16.4  43 45 17.4  1323.8
 GRAS  A 10002M006   10002M006                6 55 14.0  43 45 17.1  1319.3
 GRAC  A 10002M010   10002M010                6 55 14.8  43 45 16.2  1319.9
 7846  A 10002M004   10002M004                6 55 14.9  43 45 16.8  1318.7
 7605  A 10002M003   10002M003                6 55 14.5  43 45 16.7  1318.7
-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   7845  A    1 13:205:00000 m    2 0.458169196050000E+07 0.21310E-02
     2 STAY   7845  A    1 13:205:00000 m    2 0.556196345100000E+06 0.23890E-02
     3 STAZ   7845  A    1 13:205:00000 m    2 0.438935527720000E+07 0.25540E-02
     4 STAX   7829  A    1 13:205:00000 m    2 0.458169234710000E+07 0.10080E-02
     5 STAY   7829  A    1 13:205:00000 m    2 0.556159632100000E+06 0.14770E-02
     6 STAZ   7829  A    1 13:205:00000 m    2 0.438935781510000E+07 0.10300E-02
     7 STAX   GR3B  A    1 13:205:00000 m    2 0.458168035220000E+07 0.09700E-02
     8 STAY   GR3B  A    1 13:205:00000 m    2 0.556166459500000E+06 0.14780E-02
     9 STAZ   GR3B  A    1 13:205:00000 m    2 0.438937159320000E+07 0.10120E-02
    10 STAX   GR4B  A    1 13:205:00000 m    2 0.458168106880000E+07 0.09880E-02
    11 STAY   GR4B  A    1 13:205:00000 m    2 0.556166891600000E+06 0.14930E-02
    12 STAZ   GR4B  A    1 13:205:00000 m    2 0.438937096200000E+07 0.10100E-02
    13 STAX   GRAS  A    1 13:205:00000 m    2 0.458169079110000E+07 0.04690E-02
    14 STAY   GRAS  A    1 13:205:00000 m    2 0.556115001000000E+06 0.04700E-02
    15 STAZ   GRAS  A    1 13:205:00000 m    2 0.438936089840000E+07 0.09410E-02
    16 STAX   GRAC  A    1 13:205:00000 m    2 0.458170823910000E+07 0.10070E-02
    17 STAY   GRAC  A    1 13:205:00000 m    2 0.556132803700000E+06 0.15010E-02
    18 STAZ   GRAC  A    1 13:205:00000 m    2 0.438934137780000E+07 0.10310E-02
    19 STAX   7846  A    1 13:205:00000 m    2 0.458169324130000E+07 0.10470E-02
    20 STAY   7846  A    1 13:205:00000 m    2 0.556134866600000E+06 0.15890E-02
    21 STAZ   7846  A    1 13:205:00000 m    2 0.438935492830000E+07 0.09840E-02
    22 STAX   7605  A    1 13:205:00000 m    2 0.458169743010000E+07 0.10200E-02
    23 STAY   7605  A    1 13:205:00000 m    2 0.556126082500000E+06 0.15650E-02
    24 STAZ   7605  A    1 13:205:00000 m    2 0.438935166180000E+07 0.09860E-02
-SOLUTION/ESTIMATE
*-------------------------------------------------------------------------------
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+SOLUTION/MATRIX_ESTIMATE L COVA
*PARA1 PARA2 ____PARA2+0__________ ____PARA2+1__________ ____PARA2+2__________
     1     1 0.513017281910420E-05
     2     1 -.109212339837790E-05 0.644386184260600E-05
     3     1 0.637480072374900E-08 -.394272811150150E-08 0.736886327326510E-05
     4     1 0.105850607146190E-05 -.110720812501990E-05 0.847720839334450E-09
     4     4 0.114741998076080E-05
     5     1 -.114495026682230E-05 0.237846061095050E-05 -.135388245446320E-08
     5     4 -.113167056500850E-05 0.246388608063910E-05
     6     1 0.790361100922200E-09 -.149745320111620E-08 0.110320979078750E-05
     6     4 0.107631871783700E-08 -.165592373576620E-08 0.119871923981700E-05
     7     1 0.103552674588820E-05 -.111586327267560E-05 0.847689395094210E-09
     7     4 0.104722822695670E-05 -.113387972232290E-05 0.108531661620610E-08
     7     7 0.106311613435340E-05
     8     1 -.112740700682590E-05 0.237894458106470E-05 -.134828356355100E-08
     8     4 -.115774448371440E-05 0.240033326698290E-05 -.163143757733390E-08
     8     7 -.114251676243110E-05 0.246536285408630E-05
     9     1 0.789945358640780E-09 -.146088352027510E-08 0.110320219004130E-05
     9     4 0.103096177178280E-08 -.172178259294050E-08 0.110396331375160E-05
     9     7 0.102053170886300E-08 -.159140471022110E-08 0.115599899701500E-05
    10     1 0.103657153295070E-05 -.111537728542340E-05 0.870867345257660E-09
    10     4 0.103677037898880E-05 -.113383600570280E-05 0.108700248861010E-08
    10     7 0.103305222754300E-05 -.112319955131180E-05 0.107822056901640E-08
    10    10 0.110331984951700E-05
    11     1 -.112815340081370E-05 0.238107307284680E-05 -.139380421990720E-08
    11     4 -.114143899213860E-05 0.240102520524840E-05 -.165946552017050E-08
    11     7 -.112573681418460E-05 0.240145038532140E-05 -.175634421075890E-08
    11    10 -.117149526838740E-05 0.251878213975510E-05
    12     1 0.779807560471100E-09 -.146670809980000E-08 0.110321126334870E-05
    12     4 0.103084710219970E-08 -.165993151442650E-08 0.110389917698300E-05
    12     7 0.106449571258250E-08 -.162757604402400E-08 0.110620961187320E-05
    12    10 0.108443249301500E-08 -.172436641464410E-08 0.115209964851510E-05
    13     1 0.239934874069310E-06 -.143215319707170E-08 -.691266228952280E-11
    13     4 0.240791883985270E-06 0.431486342041110E-08 -.346032704779230E-11
    13     7 0.243729246704480E-06 0.295193139009650E-08 -.249810588143050E-11
    13    10 0.243527725591550E-06 0.291268673569730E-08 -.317811326801530E-11
    13    13 0.248477770090450E-06
    14     1 0.920658388123010E-09 0.213708056013590E-06 0.693081401944030E-11
    14     4 0.240696132689260E-08 0.226026908681120E-06 0.397737922495690E-11
    14     7 0.816934476622920E-08 0.223294597494310E-06 0.293590975506750E-11
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    14    13 0.355027018978000E-09 0.249281922714710E-06
    15     1 -.492989025918830E-11 -.798803070216790E-11 0.999594911957110E-06
    15     4 0.732906550150300E-12 -.904329427687120E-11 0.999594964191330E-06
    15     7 -.749627072482520E-12 -.116867808968980E-10 0.999594964760090E-06
    15    10 -.778805522037960E-12 -.115495989614060E-10 0.999594963323350E-06
    15    13 0.135896676800740E-11 -.399288458433810E-12 0.999632649412010E-06
    16     1 0.107824649707600E-05 -.110469520663500E-05 0.828229503442870E-09
    16     4 0.107129666524940E-05 -.118123668442000E-05 0.931613011201410E-09
    16     7 0.103238714489210E-05 -.116069079616190E-05 0.921377619147050E-09
    16    10 0.103347305139020E-05 -.116031776962430E-05 0.916335066193140E-09
    16    13 0.237746454612110E-06 -.471625607937940E-08 0.533205245729190E-11
    16    16 0.114526567807300E-05
    17     1 -.121220450106600E-05 0.234258608816560E-05 -.151476120082100E-08
    17     4 -.121222964458140E-05 0.242008267075660E-05 -.174653710412540E-08
    17     7 -.117465158731200E-05 0.239500819561560E-05 -.175092850438540E-08
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    17    16 -.124667364843010E-05 0.254307152626800E-05
    18     1 0.152634226772080E-08 -.286458250816420E-08 0.109902547938220E-05
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    18     7 0.151917008979730E-08 -.293630751523710E-08 0.109902567520530E-05
    18    10 0.152298422036330E-08 -.293860710891030E-08 0.109903006438180E-05
    18    13 -.111060448698520E-10 0.901637020318640E-11 0.999596093352310E-06
    18    16 0.176266459602890E-08 -.277394408284260E-08 0.119924678867110E-05
    19     1 0.104825174654340E-05 -.109381961346790E-05 0.867053317763760E-09
    19     4 0.104600274398410E-05 -.114021224541060E-05 0.967258015474380E-09
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-SOLUTION/MATRIX_ESTIMATE L COVA
%ENDSNX
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