THE GNSS NETWORK OF TUNISIA

FIG Working Week 2011
Bridging the Gap between Cultures

Marrakech, Morocco, 18-22 May 2011

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INTRODUCTION

CURRENT STATUS OF THE GNSS NETWORK OF TUNISIA

Since 2005, the TCO (Topographic and Cadastre Office) has installed three GNSS stations at Tunis, Monastir and Sfax.

During this year, the TCO undertakes the covering of the Tunisian territory by others GNSS stations (20).

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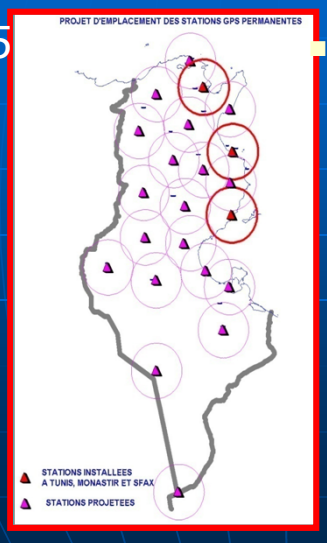
GNSS Network

- 2005



- 2010

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Each station is equipped with:

- A radio transmission module
- A GSM transmission module
- A weather sensor (Temperature and Pressure)
- A tilt sensor (Tilt meter)

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- These stations record daily files of 30 seconds and one second.
- Files stations Monastir and Sfax are transmitted to Tunis via FTP (File Transfer Protocol).

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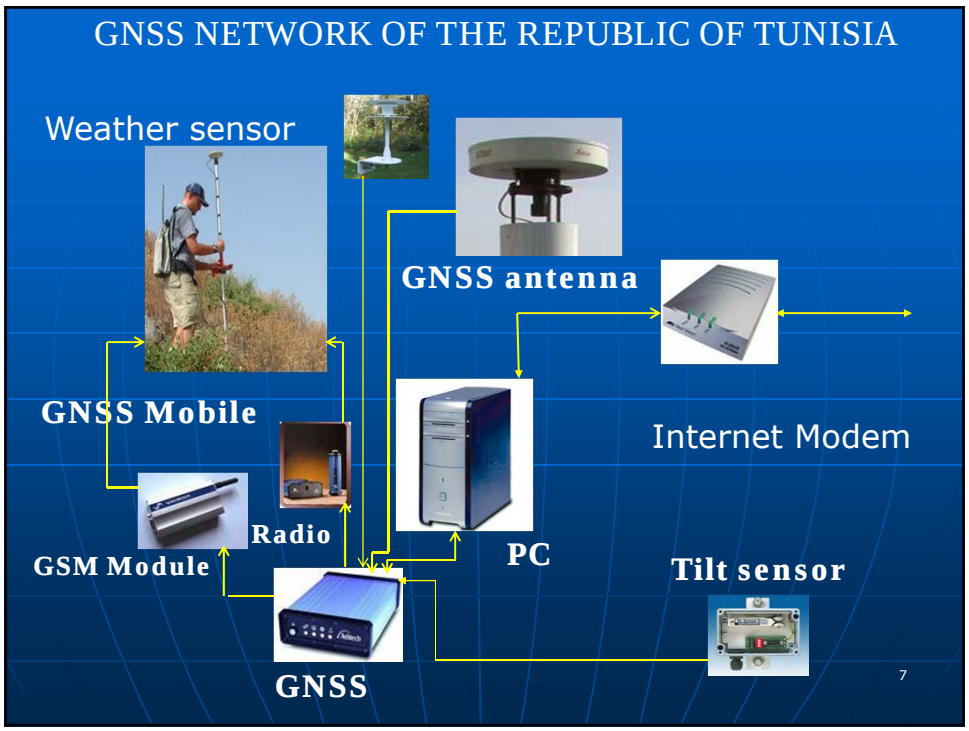

The coordinates are calculated daily with stations connected to the IGS network (ANKR, EBRE, GRAS, MATE, RABT and SFER). These calculations have permitted to obtain the precise coordinates of the three stations .

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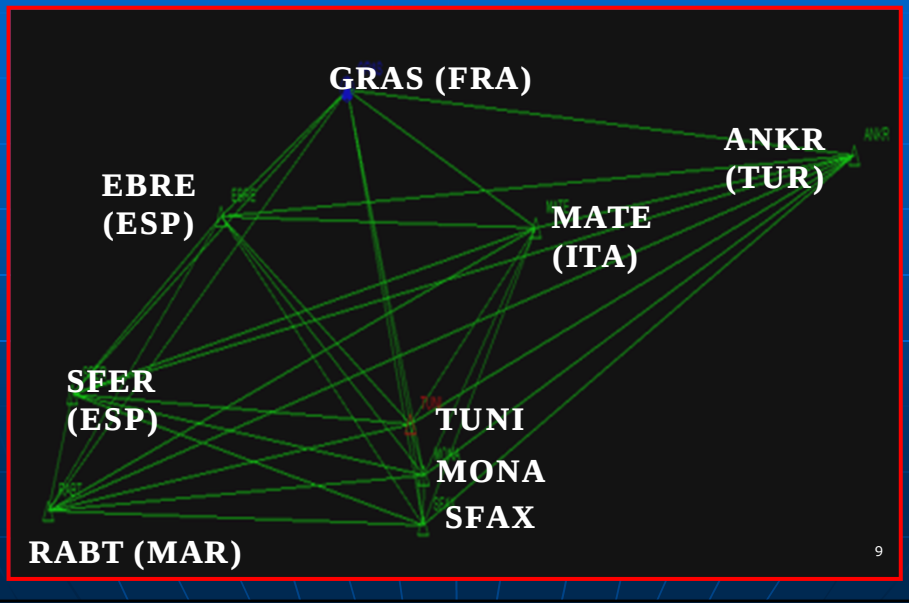
Connection of GNSS stations to the IGS Network



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Reliability Technology

The reliability of permanent GPS stations is proven.

However, a statistical analysis was performed to confirm the accuracy provided by the use of technology GNSS permanent stations.

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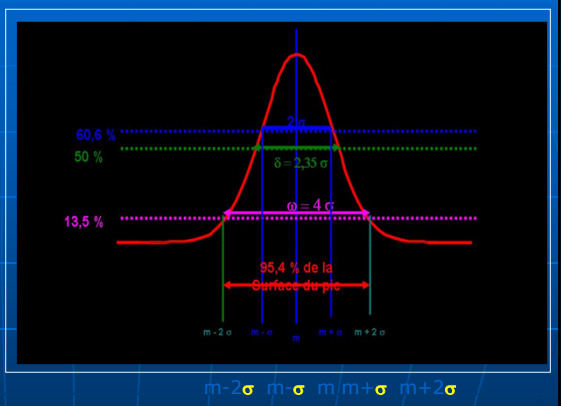
Statistical Analysis

Theoretical aspect

Normal distribution (Gauss curve): Density function of a normal probability distribution with mean m and a standard deviation σ



$$y = f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} \qquad y_{max} = \frac{1}{\sigma\sqrt{2\pi}}$$

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The certainty of a solution can be quantified by its standard deviation or a probability, eg :

A standard deviation 1σ → a probability of 68.3%

A standard deviation 2σ → a probability of **95 %**

A standard deviation 3σ → a probability of **99,73 %**

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Practical Aspect

Station as an example TUNIS

X	mean	rms
Tunis	53.2451	0.0068
Monastir	54.0589	0.0082
Sfax	66.6058	0.0082

Y	mean	rms
Tunis	28.1546	0.0062
Monastir	44.7745	0.0063
Sfax	78.0268	0.0062

Z	mean	rms
Tunis	30.3654	0.0068
Monastir	41.8522	0.0072
Sfax	72.0665	0.0074

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The Geocentric Coordinates

X = 5030053.2451 *m*

Y = 904828.1546 m

Z = 3803130.3654 m

We took a sample of 67 days of observations from GPS week 1342 to GPS week 1351.

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We have the following values:

Mean = 53.2451 m
standard deviation = 0.0068 m

The accuracy obtained for the measured data is :

$$Accuracy = \frac{\text{standard deviation}}{\sqrt{\text{number of samples}}}$$

$$= \frac{0.0068}{\sqrt{67}} = 0.0008 \quad m$$

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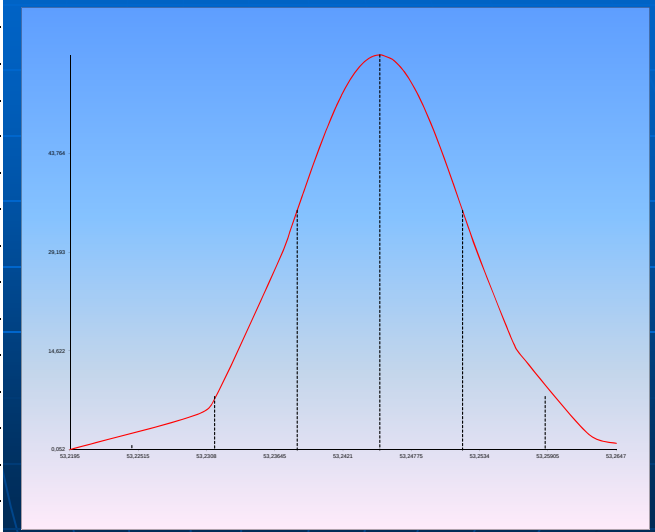
X_Tunis	y(X)
53.2195	0.05167287
53.2302	5.36320129
53.2318	8.70023058
53.2371	29.2221647
53.2376	31.7604966
53.2378	32.7874179
53.2382	34.8524045
53.2382	34.8524045
53.2383	35.3697488
53.2394	41.0104618
53.2394	41.0104618
53.2394	41.0104618
53.2396	42.0118289
53.2402	44.9338577
53.2412	49.4100171
53.2414	50.2283521

GAUSS curve for the station of Tunis



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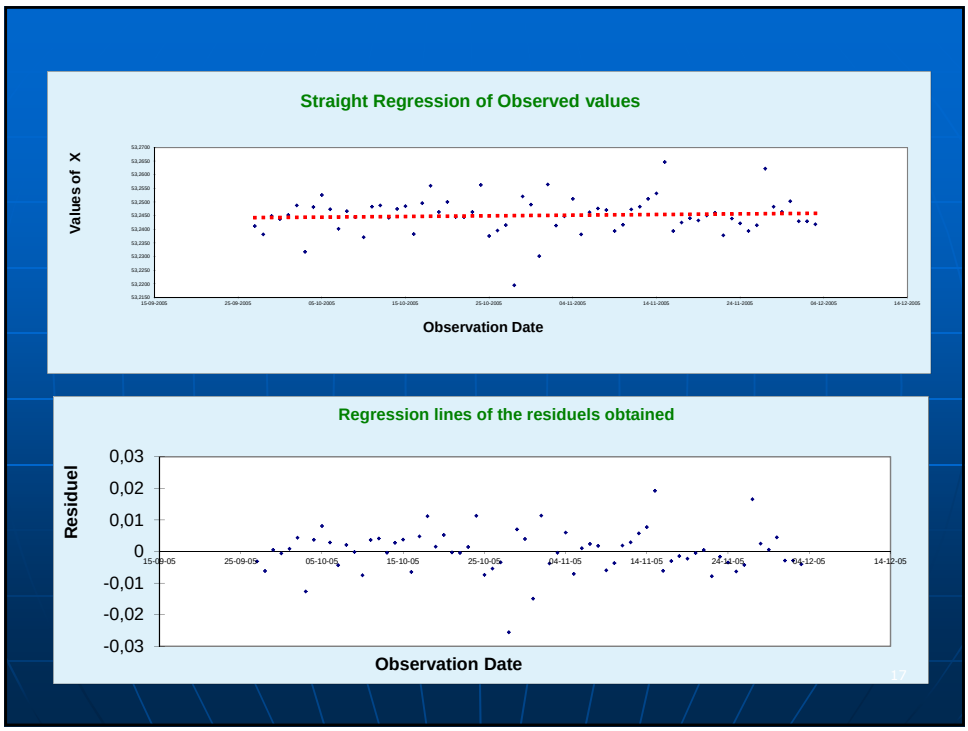

Correlation between the coordinates X, Y and Z of the station of Tunis

The study of deviations allowed us to determine the coefficients of correlation between the coordinates of the station of Tunis.

The same work is done for the stations of Monastir and Sfax.

X_Y	
	Y
X	0.9007767

X_Z	
	Z
X	0.98775997

Y_Z	
	Z
Y	0.87012314

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The coordinates determinated in m of the three stations are:

TUNIS

X =	5030053.2451
Y =	904828.1546
Z =	3803130.3654

MONASTIR

X =	5088454.0589
Y =	973044.7745
Z =	3708041.8522

SFAX

X =	5155566.6058
Y =	978978.0268
Z =	3613172.0665

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Future Prospects

On this map are reported the twenty three existing stations.

- Installation of twenty (20) permanents stations in 2010 to cover the northern and central area of the territory of Tunisia.
- Then extend the project to cover the whole country during the year 2011.
- Installation of stations according to the specifications IGS,
- Working under the strict rules of international standards (RTCM, RINEX NMEA).

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- Adoption of a scalable architecture for the network to take into account the constant changes that knows the field of spatial positioning.
- Responding to the growing needs of users for more interoperability, reliability and accuracy.

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- Ensure data quality control.
- Choosing a real-time network, at least in areas of high urban density and this means using all existing transmission: Radio (UHF), GSM / GPRS.
- Track changes and update the regulations of the GNSS NETWORK

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- To ensure the transmission of data in real time or post-treatment (post data on a website dedicated to RGPT).
- Provide all information on network status, available data, conversion utilities and quality control to users according to protocols OTC - users.

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- Having adopted a terrestrial reference only, make the gradual transition to this new datum reference (it is possible to have two systems provided to make available forms of transition between two completely reversible).

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The End!

Thanks for listening