

## Instituto Geográfico Nacional of Spain

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### Abstract

This report updates the description of the space geodesy facilities of the Spanish National Geographic Institute (IGN). The current 40-m radio telescope at Yebes, a network station for IVS, has performed geodetic VLBI observations regularly since September 2008. In addition to this, the project to establish an Atlantic Network of Geodynamical and Space Stations (RAEGE) is progressing with the construction of the first antenna, which is being erected at Yebes.

### 1. General Information: the IGN Facilities at Yebes

The National Geographic Institute of Spain (Instituto Geográfico Nacional, Ministerio de Fomento), has run geodetic VLBI programs at Yebes Observatory since 1995 and now operates a 40-m radio telescope which is a network station for IVS. Yebes Observatory is also the reference station for the Spanish GNSS network and holds permanent facilities for gravimetry. A new VLBI2010-type antenna is being built at Yebes as part of the RAEGE project.

### 2. IGN Staff Working on VLBI Projects

Table 1 lists the IGN staff who are involved in space geodesy studies and operations. The VLBI activities are also supported by other staff such as receiver engineers, computer managers, telescope operators, secretaries, and students.

Table 1. Staff in the IGN VLBI group (e-mail: [vlbitech@oan.es](mailto:vlbitech@oan.es)).

Name	Background	Role	Address*
Francisco Colomer	Astronomer	VLBI Project coordinator	IGN
Susana García-Espada	Engineer	geoVLBI expert	CAY
Jesús Gómez-González	Astronomer	Deputy Director for Astronomy, Geophysics, and Space Applications	IGN
José Antonio López-Fdez	Engineer	Yebes and RAEGE Director	CAY
Javier López-Ramasco	Geodesist	Geodesist	CAY
Álvaro Santamaría	Geodesist	Geodesist	CAY
Pablo de Vicente	Astronomer	VLBI technical coordinator	CAY

#### Addresses:

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**CAY:** Centro Astronómico de Yebes. Apartado 148, E-19080 Guadalajara, Spain.

### 3. Status of Geodetic VLBI Activities at IGN

The 40-m radio telescope has participated in 37 sessions (five EURO, 12 R4, 19 R1, and one T2). Data to be correlated in Bonn (R1 experiments) and in WACO (R4) are transferred by Internet using the tsunami protocol.

The relative position of the reference points of the different space geodetic instruments is a key issue in the realization of the International Terrestrial Reference Frame. Following the works started in 2011 to realize such local ties at Yebes, simulations were carried out to estimate the Invariant Reference Point (IRP) coordinates of the 40-m radio telescope at the Yebes Observatory. From those simulations the authors showed the extent to which the precision of the estimated IRP coordinates depends on the number, the quality, and the geometry of the survey observations. Based on these results, an automated system will be set up at the Yebes Observatory in the future in order to determine the IRP of the 40-m radio telescope with a precision better than 1 mm (Santamaría-Gómez et al., 2012).

Using the estimated coordinates in a common terrestrial frame, we have obtained the relative vector between the reference points of the GPS station and the 14-m and 40-m VLBI radio telescopes. As a preliminary assessment of the local tie survey, the estimation of the position and the velocity in the ITRF2008 is used to derive the relative vector between these three instruments at the Yebes Observatory. In the absence of systematic errors in the VLBI, the GPS, and the terrestrial survey observations, local tie surveys, and ITRF-derived relative vectors should agree.

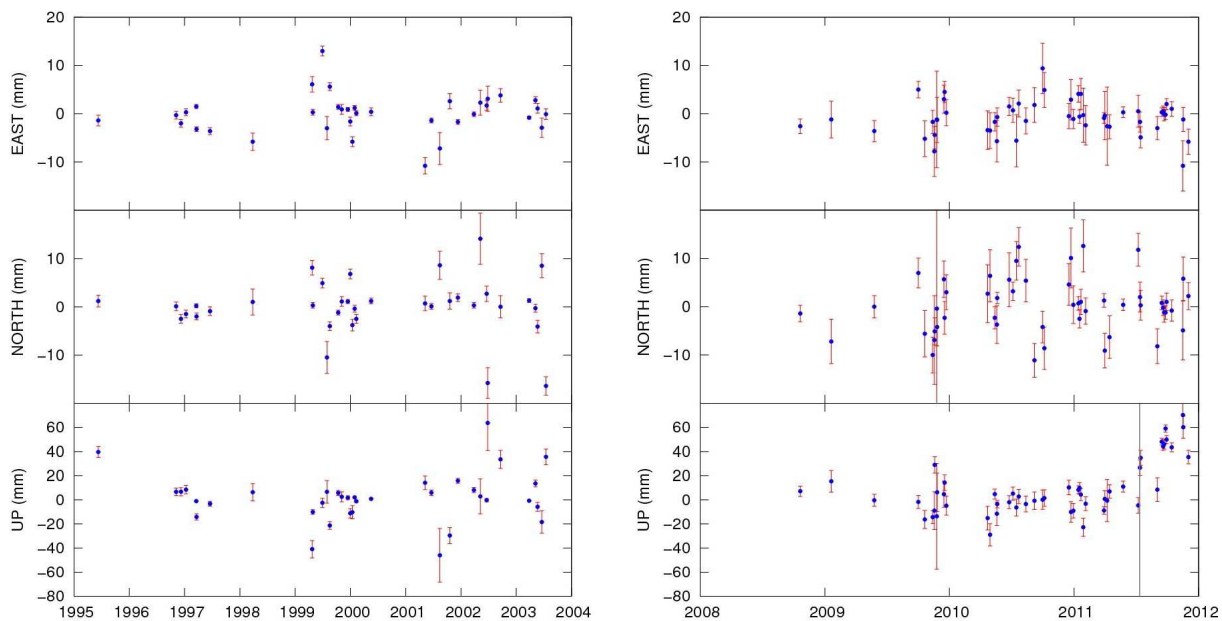


Figure 1. Residuals of the VLBI radio telescope positions at Yebes Observatory. Left: 14-m. Right: 40-m.

The subreflector of the 40-m radio telescope has been kept fixed to its optimum position for an elevation of  $45^\circ$  for sessions since July 12, 2011. A position offset was therefore discovered in the time series, and the radio telescope coordinates were estimated before and after the discontinuity. The radio telescope velocity was constrained between both segments. After the change of the focus, a significant offset of approximately 4.6 cm was found in the vertical coordinate (see Figure 1).

#### 4. Project RAEGE

IGN, together with its Portuguese colleagues in DSCIG (Azores Islands), continues the construction of a network of four new Fundamental Geodynamical and Space Stations. The RAEGE project has been described in previous IVS Annual Reports. The first antenna is being erected in Yebes (see Figure 2), and the construction of a tri-band (S/X/Ka) receiver and optics, developed at Yebes Labs, is also progressing. It is expected to be completed and to start operation in 2013. Activities have also started at RAEGE's Santa María site with the construction of the concrete tower and the infrastructure facilities. The assembly of the steel backstructure is anticipated for June 2013. On September 17, 2012, an official inauguration ceremony kicked off the start of construction. The event took place in the presence of local authorities as well as regional government representatives. The infrastructure project includes the construction of the main control building, a building for power distribution, a social facilities building (to be built in a second phase), and access roads. The Santa María site will include a completely isolated gravimetry pavilion, buried in a small hill, on top of which a permanent GNSS station will be installed.



Figure 2. Left: RAEGE telescope under construction at Yebes. Lifting of the azimuth cabin. Right: Work for the RAEGE telescope in Santa María (Azores Islands).

#### 5. Meetings

IGN hosted the 7<sup>th</sup> IVS General Meeting “Launching the Next-Generation IVS Network” on March 4-9 2012, at the premises of the Royal Observatory of Madrid. A total of 150 participants (see Figure 3) from 25 countries representing 65 institutions submitted 120 abstracts, delivering 60 oral presentations and 50 poster presentations, available at:

<http://www.oan.es/gm2012/show-presentations-pdf.php>.



Figure 3. Participants in the 7<sup>th</sup> IVS General Meeting are photographed in front of the IGN 40-m radio telescope at Yebes Observatory.

## References

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