HYDROGRAPHIC AND GEODETIC SERVICE OF THE REPUBLIC OF CUBA

NATIONAL OFFICE OF HYDROGRAPHY AND GEODESY

Title: Use of Global Navigation Satellite Systems (GNSS) in the Republic of Cuba.

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The global navigation satellite system (GNSS) is a constellation of satellites that transmit ranges of signals used for positioning and location in any part of the terrestrial globe (whether on land, sea or air) example of these satellite navigation systems we find the GPS, GLONASS and the recent Galileo

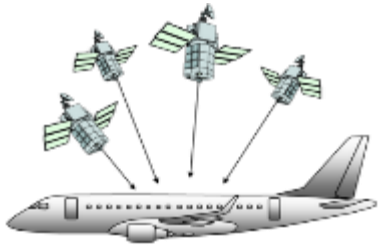
GNSS

Sistemas **G**lobales de **N**avegación por **S**atélite

*(**G**lobal **N**avigation **S**atellite **S**ystem)*

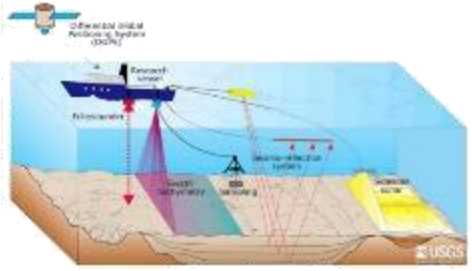
These satellites allow the altitude and geographic coordinates of a given point to be calculated as a result of receiving signals from constellations of artificial satellites on Earth for various purposes such as:

Air Navigation



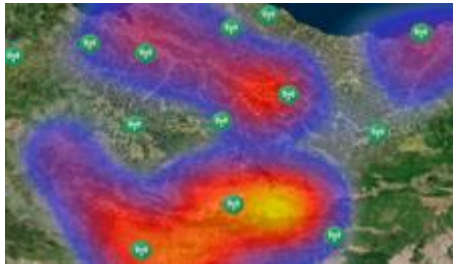
Transport

Hydrographipc Works



Geodetic Works

Agricultural Works



Seismological Services

RESULTS ACHIEVED IN THE MODERNIZATION OF THE STATE GEODETIC NETWORK THROUGH THE USE OF GNSS.

HIGH PRECISION GEODETIC NETWORKS

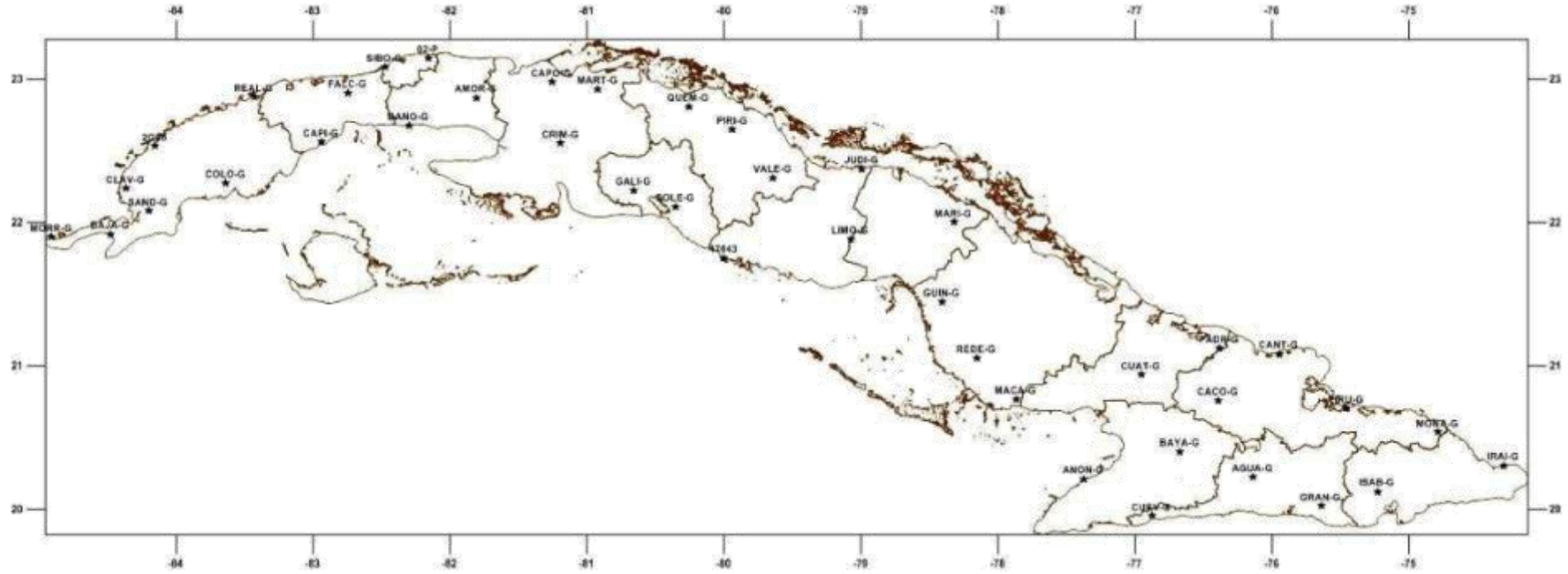
THE CREATED HIGH PRECISION NETWORKS ARE DIVIDED INTO TWO GNSS ORDERS:

FIRST ORDER: Composed of the Fundamental Geodetic Network (RGF), the GNSS Validation Polygons (PVG) and the Permanent Geodetic Network (RGP).

SECOND ORDER: Composed of the Basic Geodetic Network (RGB2)

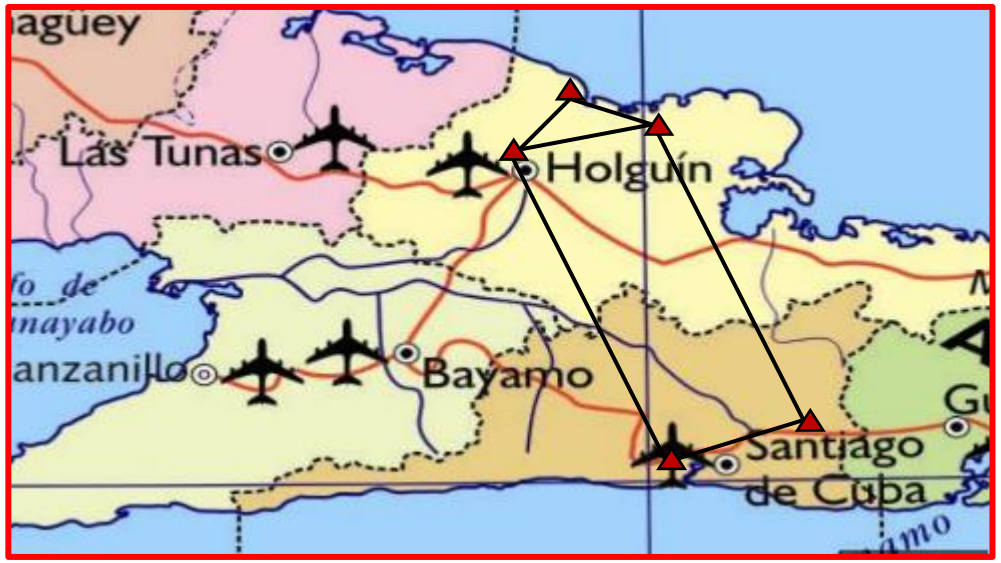
THE ESSENTIAL GNSS NETWORK

The RGF is made up of 41 stations and was built in two stages: from April to November 2015 and in March 2017. In turn, the first was created in two moments: 20 points were occupied for a space of 3 days (RGF1), while in the second (RGF2) in two sessions of 12 hours, in all cases forming quadrilateral figures with common sides.



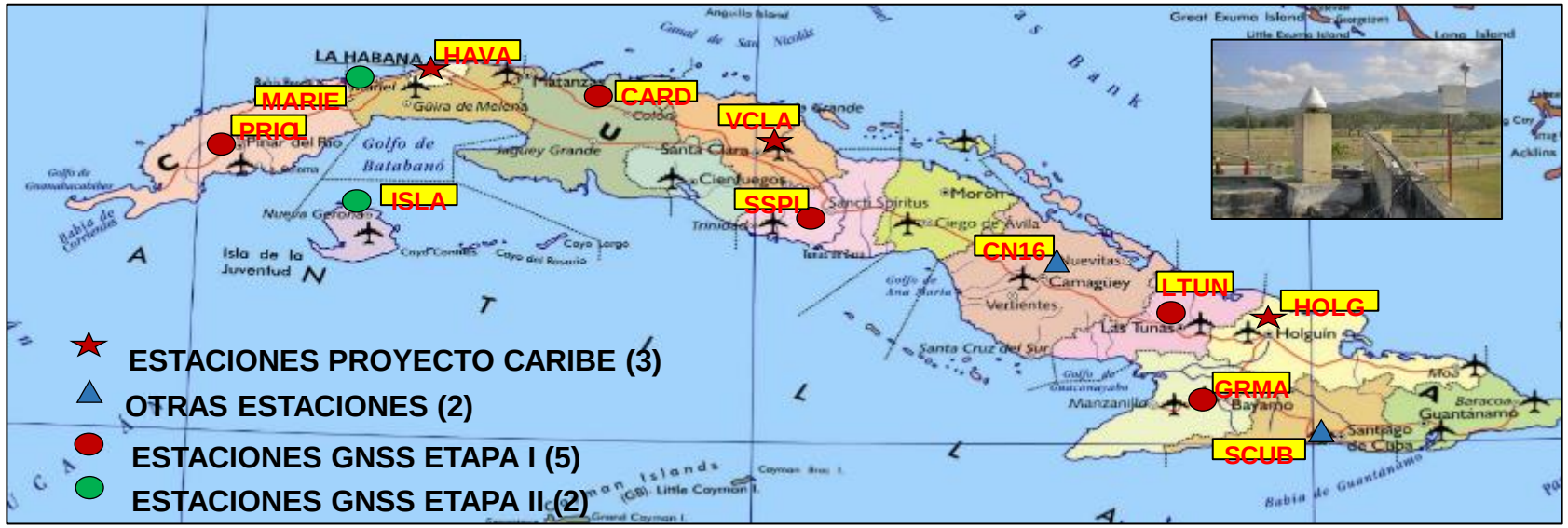
THE GNSS VALIDATION POLYGONS (PVG).

Two polygons were created: in the western (Western GNSS Validation Polygon) and eastern (Eastern GNSS Validation Polygon) of the country. The main objective of these is to have a network of geodetic points with precise coordinates, which serve as a standard to validate the GPS technology available to the GEOCUBA Companies. This will allow you to meet the quality requirements imposed for the certification of your metrological laboratory.



PERMANENT GNSS NETWORK

The RGP began to be created at the end of 2016, starting as a network in mid-2017 and currently consists of twelve stations. The results obtained in the mathematical elaboration of the RGP show the high quality of the geodetic positioning in its stations, so that the values of its coordinates can also serve as a reliable reference for GNSS determinations in the framework of different projects and applications. By obtaining the values of the annual coordinate velocities, in terms of mm per year, it is possible to reduce these magnitudes to the desired time and provide a higher level of certainty during precise GNSS determinations in different projects, since the framework of reference is no longer static.

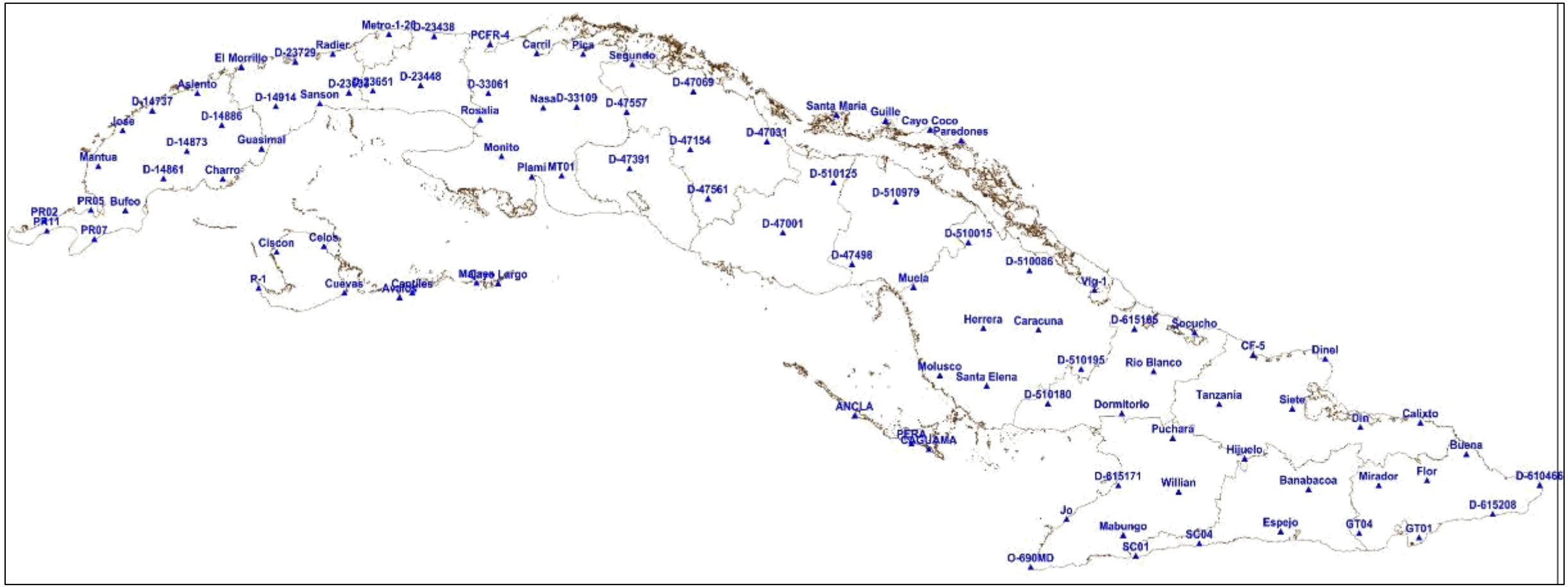


PERMANENT GNSS NETWORK

As a frame of reference for determining the coordinates and speeds, 16 IGS (International Navigation Systems Service) stations located around Cuba were used, of which 14 are global stations, with average distances with respect to the geometric center of the country, corresponding 1000 km (RDSD station) and 3200 km (NIST station). Figure 5 shows the distribution of these IGS stations.

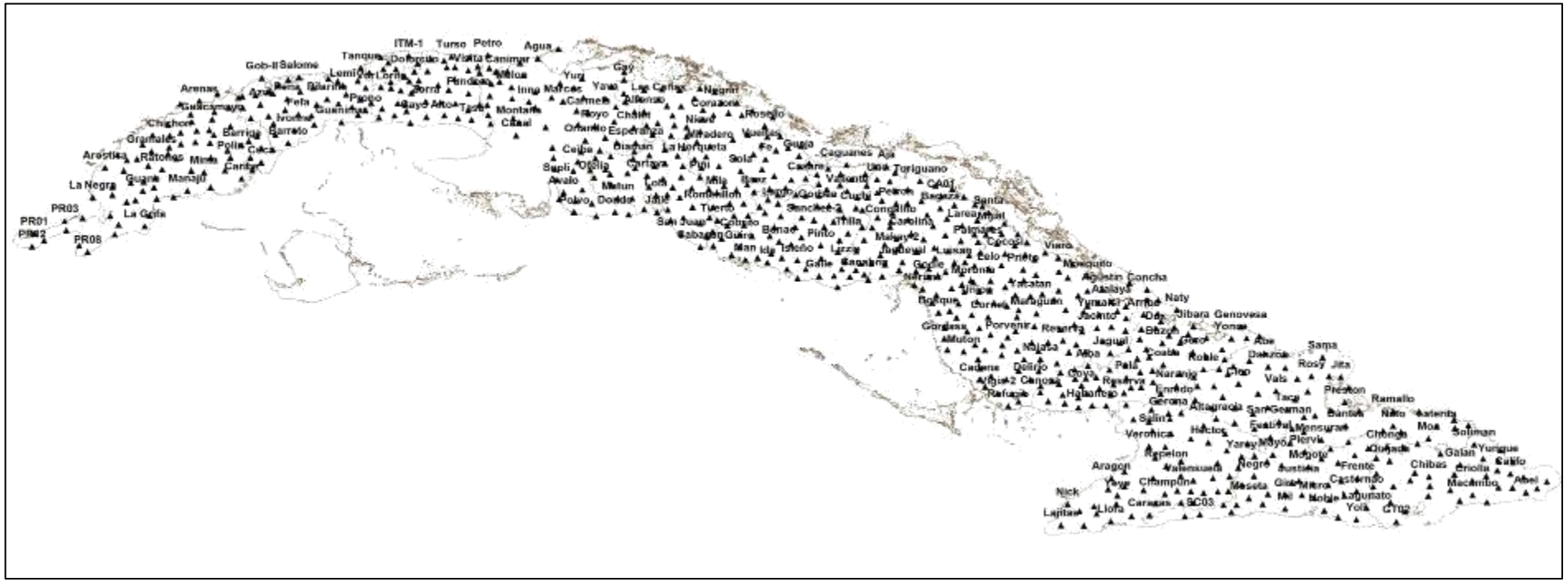
THE BASIC GEODETIC NETWORK OF 2ND. ORDER

RGB2 is made up of 95 stations. The works for its construction were developed during 2016 and early 2017.



CONCLUSIONS

For the Modernization of the previously described Networks we used equipment from Leica (GPS model GS-10, GS-14 and GS-15 and Leica Flexline Total Stations model TS-02, TS-06, TS-06 +, TS-07 , TS-10, Leica Viva model TS-11, TS-12, TS-15 and TS-16, Leica Nova MS-50 and MS-60 the latter multistation with laser scanner included.



CONCLUSIONS

The GNSS have been used in works for Hydrographic and Geodetic purposes, contributing a very important development in the National Economy of our country, promoting an advance in the study and preparation of our specialists in these topics; as well as in the use of equipment for Geodetic and Hydrographic works.

Currently, work is under way to create RGB3, which will be made up of about 900 points (simple monuments). This, together with the RGF, the PVG, the RGB2 and the RGP will constitute the State Geodetic Network of the country. The RGN is expected to have a density of 1 point per 100 km2.

Thank you very much for your attention