INCORPORATING THE BROAD CONCEPT OF GNSS AS A TOOL OF HIGH IMPORTANCE IN ACADEMIC ASPECTS AND APPLIED RESEARCH IN COLOMBIA, SOUTH AMERICA

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OUTLINE

• Tectonic setting and main structural elements
• Space Geodesy in Colombia
• Challenges
• Conclusions
TECTONIC SETTING AND MAIN STRUCTURAL ELEMENTS
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MAIN EARTHQUAKES, 20th. CENTURY, (1900-1980)

Colombia-Ecuador Subduction Zone

1942
Mw = 7.6

Ramos, 2011
SPACE GEODESY IN COLOMBIA
Central And South America GPS Project

NSF – NASA – UNAVCO – JPS - USC

43 GPS receivers collected approx. 590 station-days of data in Colombia, Costa Rica, Ecuador, Panama, Venezuela, and American Samoa, Australia, Canada, New Zealand, Norway, Sweden, USA, West Germany

It was the beginning ...... It was the first civilian effort implementing a global GPS satellite technology network
CASA GPS RESULTS

Freymueller and Kellogg, (1991)
Mora (1995)
GeoRED PROJECT

The general purpose: Improve the technical, scientific and operational capabilities in Colombia for *analysis, interpretation and policy formulation regarding phenomena related to crustal deformation in Colombia, using GNSS satellite technology*

GeoRED is also designed to meet the following specific objectives:

- To implement an Active National GNSS Permanent Network for geodynamics with data transmission to an information-gathering center.
- To create GNSS mobile teams for campaign style data acquisition (passive network) - (active faults studies, post-seismic assistance, volcanic crisis assistance, mass movements monitoring, etc).
- To generate information about horizontal and vertical displacements as an essential input for the studies of crustal deformation.
- To establish a high precision geodetic reference frame for the multipurpose activities within the Colombian Geological Survey
- To provide information within the CGS as well as to other government institutions toward the execution of research and development projects using GNSS data. *(Mora, 2006)*
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GPS/GNSS
Permanent Stations

Status Mayo 2015
Source: http://geoportal.igac.gov.co/ssigl2.0/visor/galeria.req?mapaid=17 (05/05/2015)
15 GPS/GLONASS

PERMANENT STATIONS
- Datum Ingeniería
- Procálculo
- Geosystem
CHALLENGES
The final objective of the GEORED project is to increase the knowledge of the current crustal deformation stage at Colombia.

Specifically:

To obtain geodetic rates of fault displacements, as well as to characterize the kinematics of active faults and their seismogenic potential;

To generate crustal sub-block and regional deformation models to the Colombian territory, through the integration of geodetic, geological and geophysical data;

To establish an operative and dense geodetic network with geodynamic purposes.
GOALS

• The need of effectively complement, augment and extend geodetic infrastructure, technical capabilities, and regional networks.

• The need to bridge the gap between scientific understanding and knowledge and the application of that knowledge for public benefit.

• The need for bidirectional scientific partnerships.

• How to update the GNSS reference stations without affecting long-term stability, time series, products to be delivered to geodetic community.
The GeoRED Permanent Network established by the Colombian Geological Survey is based on the GPS and GLONASS satellite systems. However, we are still processing only GPS data.

Very soon, GeoRED and other networks will be facing a tremendous situation when new navigation systems such as GALILEO, BeiDOU and others, will be in complete operation.

CURRENT SITUATION IN COLOMBIA

Other institutions and local companies are also tracking and gathering data from both constellations, for non-geodynamics purposes
CURRENT SITUATION IN COLOMBIA

Major advances in space geodesy as well as the rapid development of GNSS hardware and data transmission capabilities has launched a global revolution in the field of geodesy, allowing its application in various disciplines.

Next step:

• Software comparison
• Analysis of GLONASS data
• Analysis of new GNSS signals
Therefore, it is important for the academy to strengthen teaching at the undergraduate and graduate level, so that students will be aware of the vast opportunities that arise with the GNSS technology as a broad concept. It is necessary to fill the informacion gap that exists regarding the simultaneous use of the existing constellations with different purposes.

Under this premise, the intention of the University of Manizales is to serve as a university center to build skills and strengthen human resources, so that students are conceptually and academically prepared to exploit the opportunities that GNSS space geodesy offers for research as well as the performance of projects that can impact the development of the country.
The University of Manizales, is a non-profit regional educational institution, founded in 1972. It is located on Manizales city, the capital of the province of Caldas, the smallest province of Colombia, founded in 1849. It is a city with an economic, industrial, cultural and tourism sectors. In 1943, the first university opened in the city; since then, new universities have been created. It is within Colombia named as a “University Town”.

Manizales city won first place in the special category of business promotion in the V Iberoamerican Digital Cities Award, organized by the Latin American Association of Research Centers and Telecommunication Enterprises (AHCIET). In a 2010 study conducted by the World Bank, Manizales ranked first as the city of Colombia where it is best and easiest to do business.

Currently, the University of Manizales has careers in 15 academic programs, and to these we add 24 graduate programs, and has signed over 20 MOU with major centers of higher education in countries like Mexico, Italy, Chile, Argentina, Spain, and, of course, with the best institutions in Colombia.
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EARTHQUAKES

- 7.2 - Nov 23 1979
- 6.3 - Feb 08 1995
- 6.1 - Jan 25 1999
- 5.5 - Jan 25 1999
SISMICITY IN THE COLOMBIA-VENEZUELA BORDER
THE CUCUTA May 18, 1875, EARTHQUAKE

SOFTWARE COMPARISON

• GAMIT-GLOBK
• BERNESE

USGS/University of Rome, Maurizio Battaglia
Computer and Telecommunications Engineering (Undergraduate program)

Graduate academic programs:

- Specialization in GIS, one-year program
- Master in Technologies of Geographical Information, two years program
- Master in Environment and Sustainable Development, two years program

GNSS Processing Center
It is important to recognize the significant contribution of the “super-network” of reference stations of the *International GNSS Service* (IGS) to Geodesy, and to the GNSS community in general. Several hundred globally distributed GPS receivers (many now with GLONASS tracking capability) operate on a continuous basis, many for over 10 years, contributing data to the various IGS analysis centers and other users.
The IGS Tracking Network (South America)

Source: https://igscb.jpl.nasa.gov/network/netindex.html
Brazil: Roscosmos installed a GLONASS monitoring station at the Centre for Technological Development (CDT) on the campus of the University of Brasilia.

There are plans to install additional GLONASS stations at the Federal University of Santa Maria, Rio Grande do Sul, and the Technological Institute of Pernambuco at the Federal University of Pernambuco

Is Roscosmos seeking partnerships with other Latin American countries to extend the number of control stations?
To provide support to:

Tropospheric, ionosphere, subsidence and mass movement, sea level studies, among others

• Relationship between earthquakes and ionospheric anomalies
• Imaging geodesy
• How to use GLONASS signals in these scientific matters?
• How is used the GLONASS system in general applications?
Our countries are gradually making great efforts toward the implementation of GNSS geodetic networks at different levels (national, regional and local networks), but the data is commonly processed with only the GPS component, leaving aside the GLONASS component, usually through ignorance or by not being able to count on the appropriate tools for proper use. Our purpose is to establish some programs of cooperation with experienced research centers, allowing us to develop research projects in the study fields of Solid, Liquid and Atmospheric Earth, from the broad concept of GNSS.

It is evident that the application of the modern technology of Space Geodesy is capable of contributing to a multitude of research activities, the reach and success of which has been demonstrated in the developed world in an environment of great research capability. By now, GPS signals are widely used for geodesy positioning, and there has recently been an increase in its use for understanding the deformation of the earth's crust, of both tectonic and volcanic origin. However, there is still limited use of GNSS signals for ionospheric and tropospheric studies, to name just two examples. Therefore, it is essential to expand the knowledge levels of these applications, but preferably from the concept of GNSS that will greatly enhance the accuracy and reliability of the positioning geodesy as a source for the National Spatial Data Infrastructure (SDI) in each country.
Thank you

Muchas gracias

большое спасибо