



SISTEMA DE REFERENCIA
GEOCÉNTRICO PARA LAS AMÉRICAS

SIRGAS

The Geocentric Reference Systems of the Americas (SIRGAS)

Claudio Brunini
SIRGAS President

GNSS Workshop, Medellín, June 2008

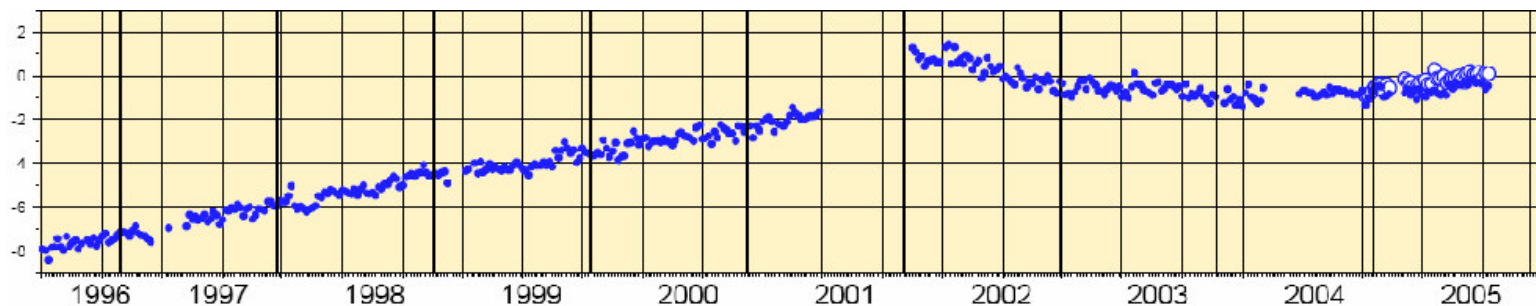


Subcomisión 1.3b de la IAG
Proyecto de la Comisión de Cartografía del IPGH



Introduction

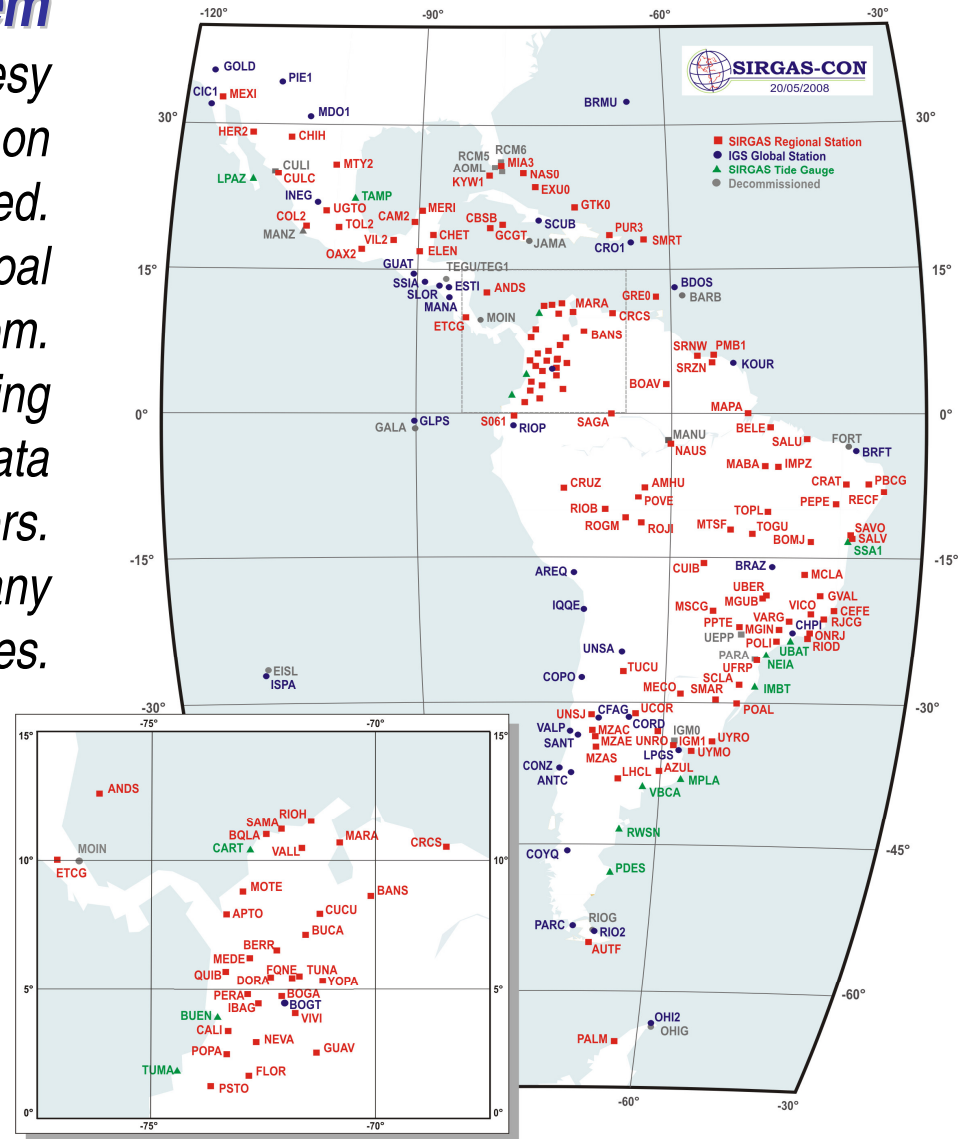
- ❑ *Geocentric reference frames are the fundamental layer of the spatial data infrastructures.*
- ❑ *State-of-the-art Geodesy demands reference frames capable to support coordinate determinations with mm-level accuracy.*
- ❑ *Reference frames consistency must be guaranteed at global scale and their stability must be ensured over decades.*
- ❑ *Coordinate changes on time (i.e., velocities) must be determined with 0.1 mm/a accuracy.*
- ❑ *The highest level of theory, technology and data analysis are used to realize the International Terrestrial Reference Frame (ITRF).*
- ❑ *SIRGAS realizes the ITRF in the Caribbean, Central and South American regions.*
- ❑ *The 8th Regional Cartographic Conference of the Americas (United Nations, New York, 2005) recommended SIRGAS for the IDE-Américas.*



Variation on time of the Arequipa coordinate, North component in cm, after W. Seemüller et al., DGFI.

The SIRGAS-CON system

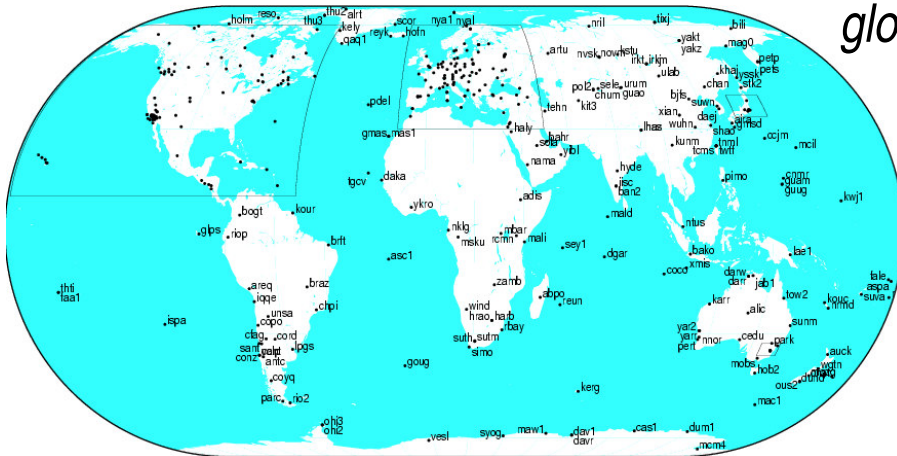
- The highest standards of modern Geodesy can only be fulfilled if coordinates changes on time are continuously monitored.
- The observations needed to achieve this goal are provided by the SIRGAS-CON system.
- It encompasses ~200 continuously observing GNSS receivers, communication links, two data centers and four analysis centers.
- Receivers are installed and operated by many institutions in different countries.
- Data center are operated by the Deutsches Geodätisches Forschungsinstitut (DGFI) and the Instituto Brasileiro de Geografia e Estatística (IBGE).
- This continental-size distributed observatory is coordinated by SIRGAS in a cooperative framework.





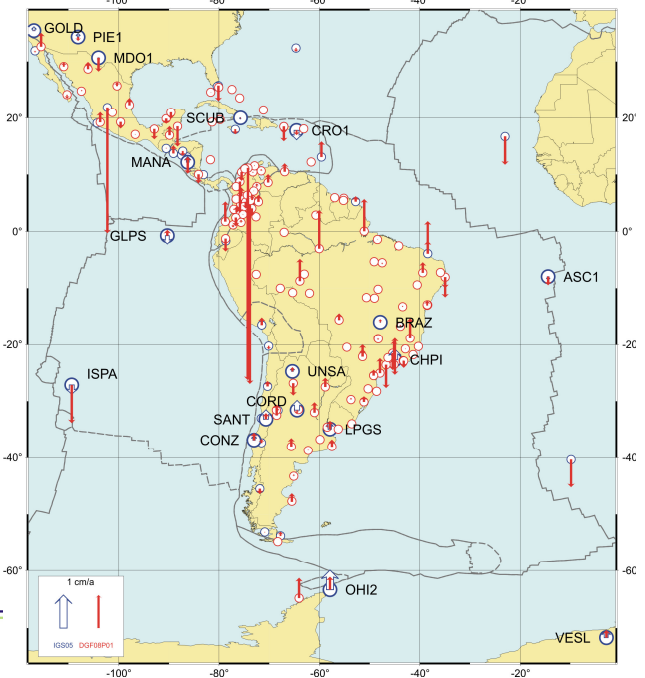
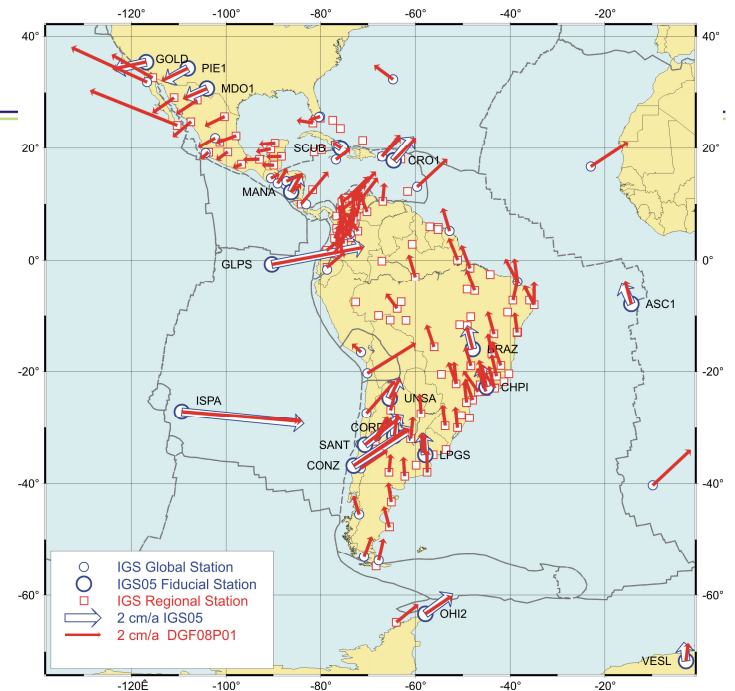
The IGS-RNAAC-SIR

- ❑ SIRGAS-CON observations are continuously processed by DGFI as responsible of IGS Regional Network Associated Analysis Center for SIRGAS.
- ❑ A set of coordinates for all SIRGAS-CON stations are computed on weekly-basis and delivered to IGS.
- ❑ IGS Associated Analysis Centers compute weekly



global solutions that merge SIRGAS and other regional solutions within the IGS global reference frame.

- ❑ Multi-years solutions (coordinates for a conventional epoch and velocities) are periodically computed by IGS-RNAAC-SIR.
- ❑ The latest one encompasses 272 weeks (Dec 2002 - Mar 2008) and realizes the best reference frame for the Americas.



SIRGAS in practice

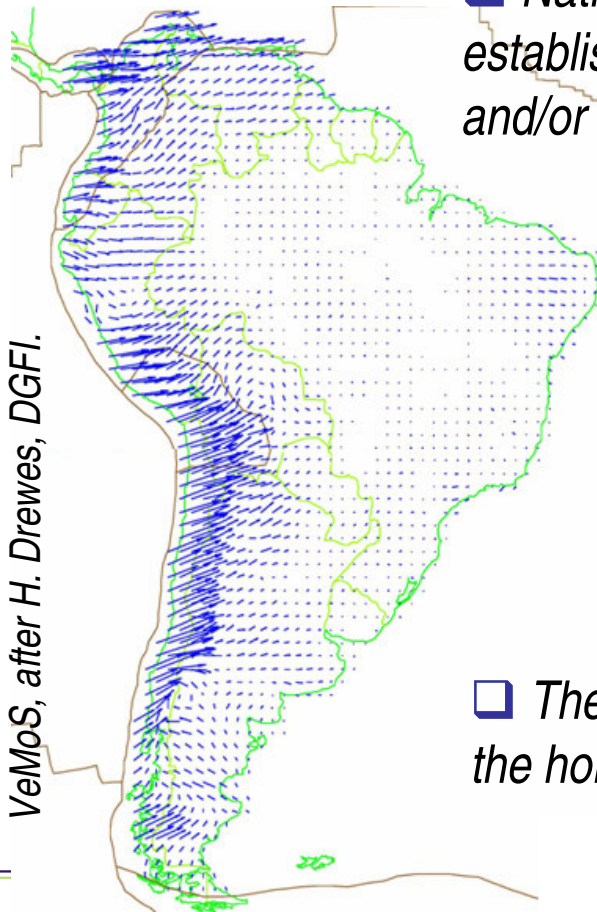
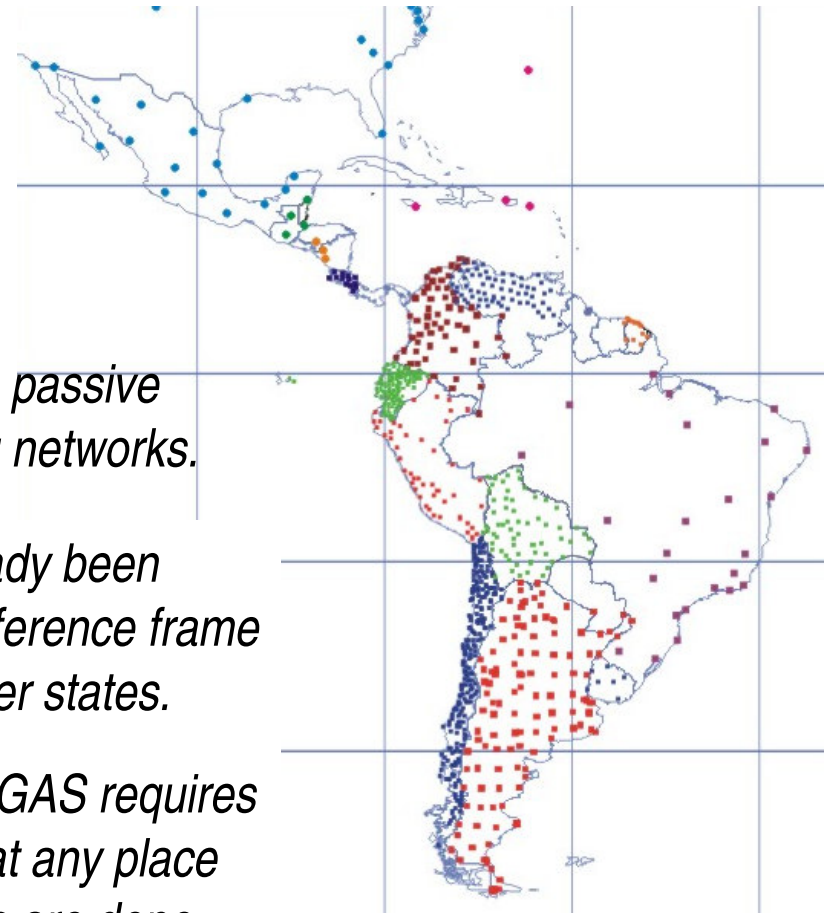
❑ *Practical uses of SIRGAS are supported by the countries by deploying national densifications.*

❑ *National densifications are established by means of both, passive and/or continuously observing networks.*

❑ *SIRGAS has already been adopted as official reference frame by 13 of its 18 member states.*

❑ *Proper use of SIRGAS requires velocities computed at any place where measurements are done.*

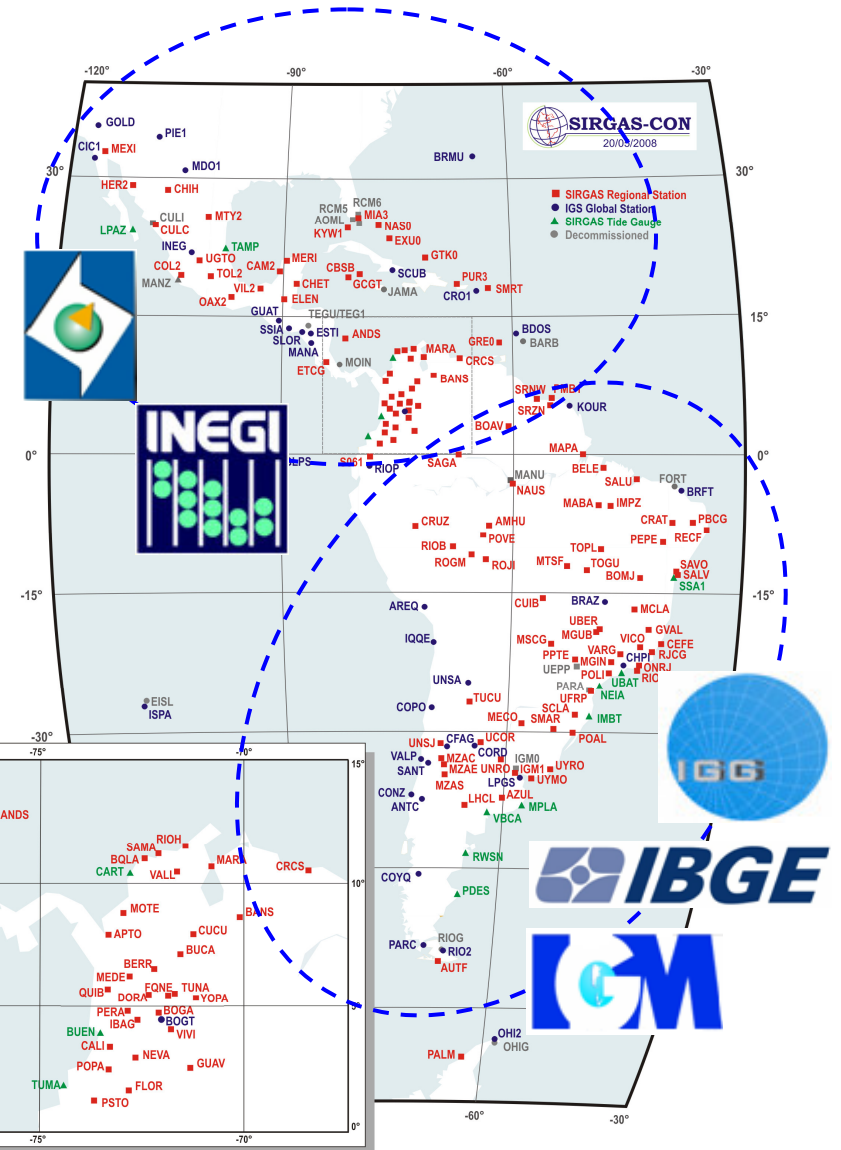
❑ *The Velocity Model for SIRGAS (VeMoS) allows interpolating the horizontal velocities at any given location in South America.*



VeMoS, after H. Drewes, DGFI.

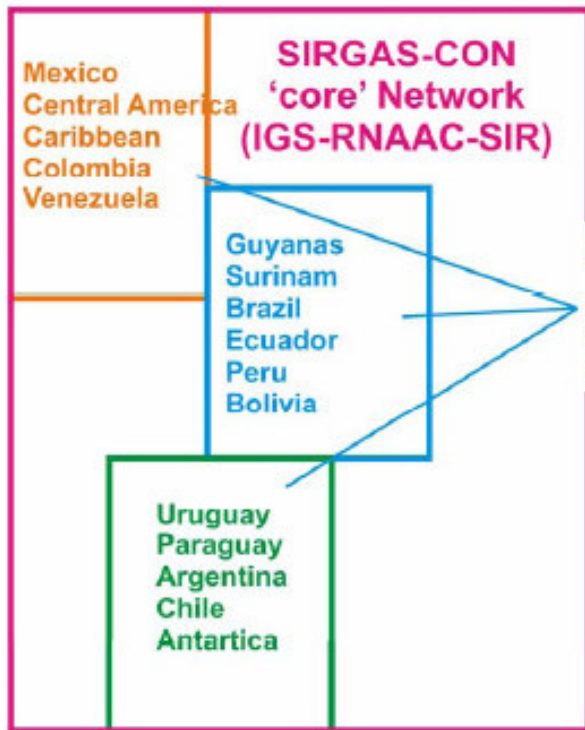
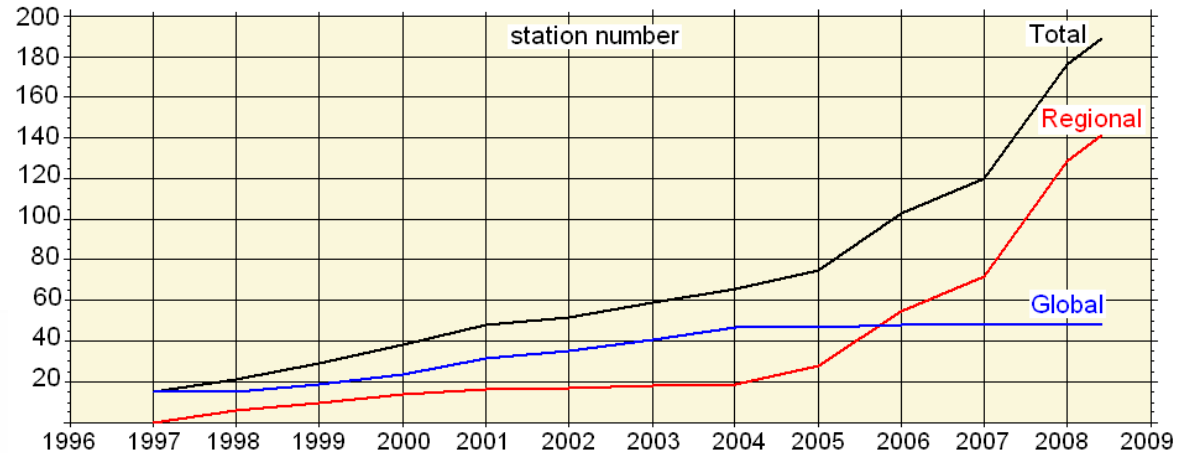
Capacity building

- ❑ *SIRGAS promotes capacity building activities in order to maximize the social benefits of geopositioning products.*
- ❑ *Experimental analysis centers (EAC) supported by Latin-American institutions were established in 2006:*
 - ✓ *Instituto Geográfico Agustín Codazzi, Colombia;*
 - ✓ *Instituto Nacional de Estadística, Geografía e Informática, México;*
 - ✓ *Instituto de Geodesia y Geodinámica, Argentina;*
 - ✓ *Instituto Brasileiro de Geografia e Estatística;*
 - ✓ *Instituto Geográfico Militar, Argentina*
- ❑ *EAC were recently evaluated (SIRGAS meeting, Montevideo, May 2008).*
- ❑ *Independent evaluations conducted by DGFI and IBGE concluded that IGAC, IGG and IBGE EAC can be declared official.*



Handling the growth of the SIRGAS-CON system

□ The number of SIRGAS-CON stations has constantly increased since the establishment of the system, in late 1996.



3 SIRGAS-CON densification networks (IGAC, IBGE, IGG)

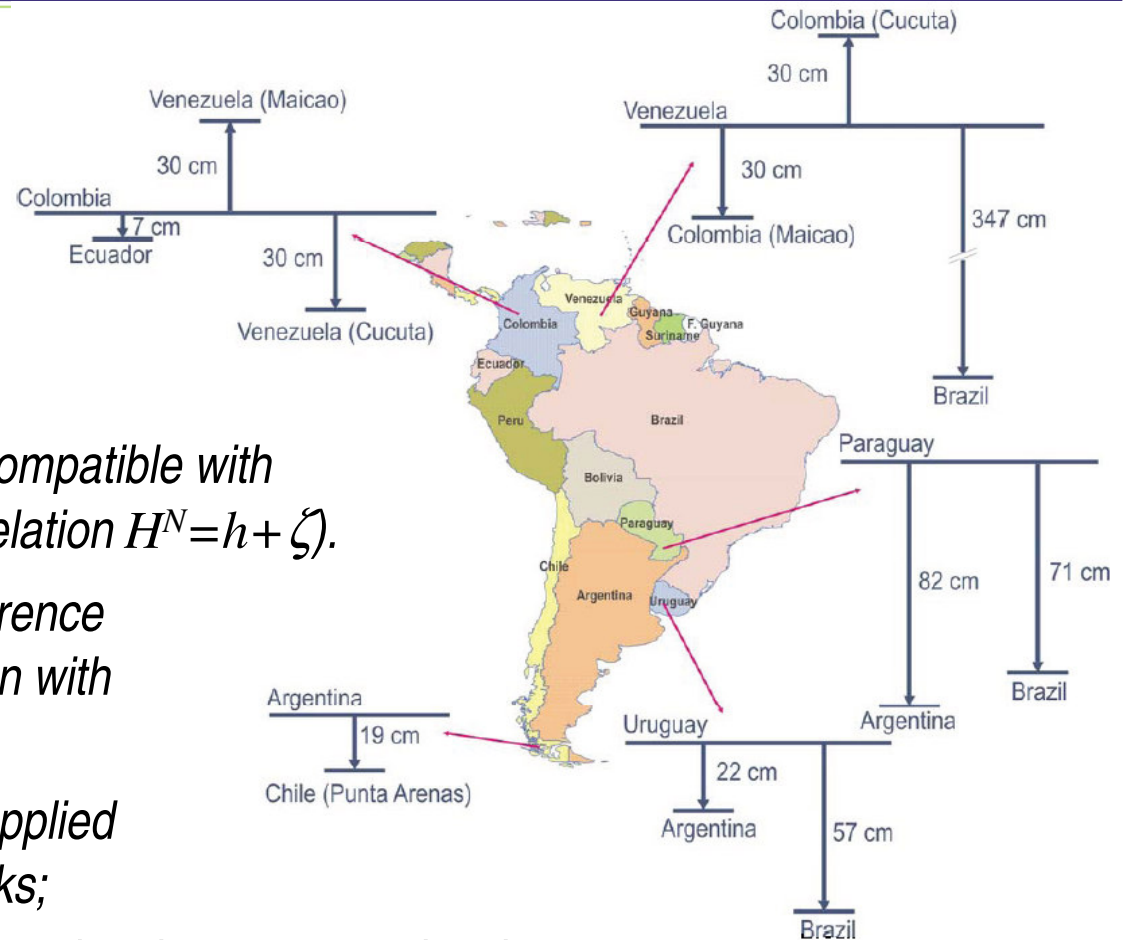
□ A new strategy for handling the system was recently proposed (SIRGAS meeting, Montevideo, May 2008).

□ It relays on:

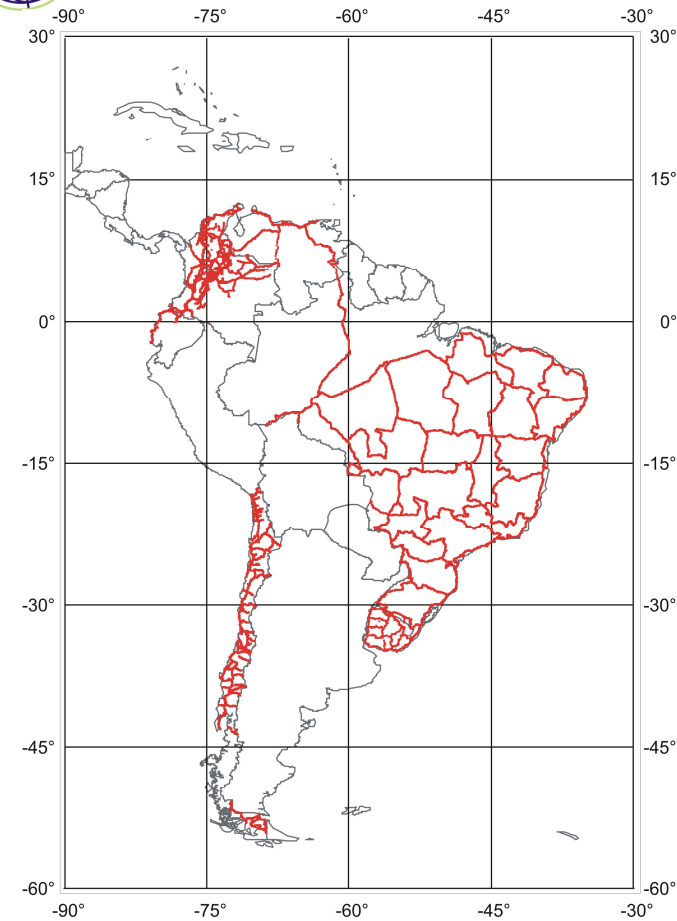
- ✓ 1 core network + 3 densification networks
- ✓ 2 data centers (DGFI and IBGE)
- ✓ 4 analysis centers (IGS-RNAAC-SIR, IGAC, IBGE and IGG)
- ✓ 2 combination centers (DGFI and IBGE)

Vertical reference frame

- ❑ *SIRGAS objectives include the realization of a gravity-related vertical reference frame based on normal heights (H^N).*
- ❑ *It must be globally consistent and compatible with GNSS-derived heights (i.e.: fulfill the relation $H^N = h + \zeta$).*
- ❑ *Existing gravity-related vertical reference frames are inconsistent among them and with GNSS-derived heights because:*
 - ✓ *gravitational corrections were not applied to the existing national leveling networks;*
 - ✓ *national leveling networks were referred to the mean sea level (i.e.: they are affected by sea surface topography irregularities); and*
 - ✓ *existing quasi-geoidal models are not enough accurate (a lot of efforts are being done abroad SIRGAS for improving them at continental and global scales).*

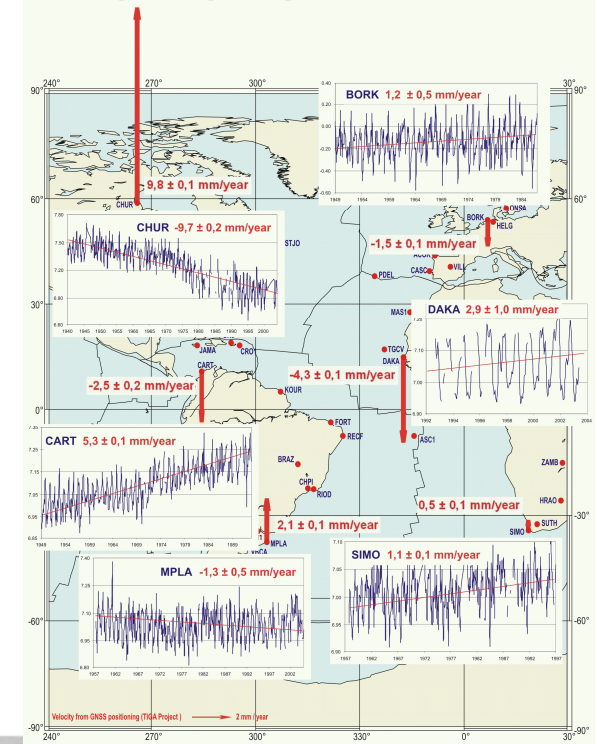
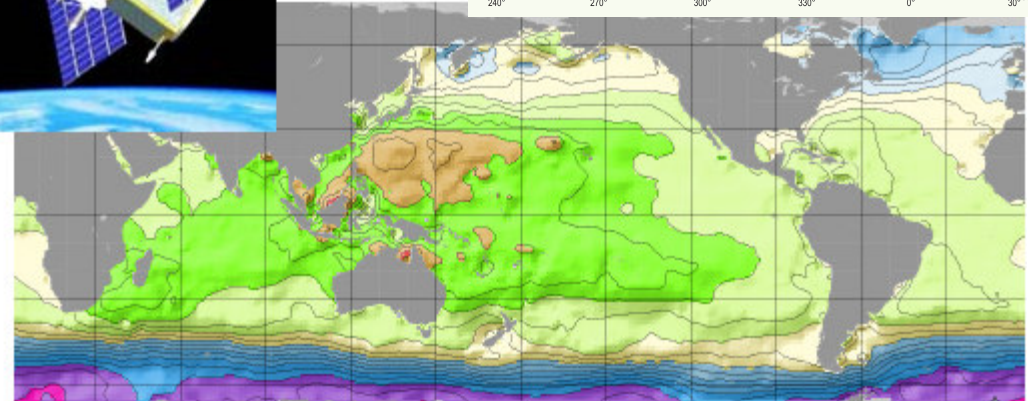
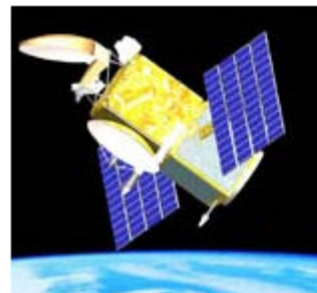


Tasks being done in the SIRGAS framework



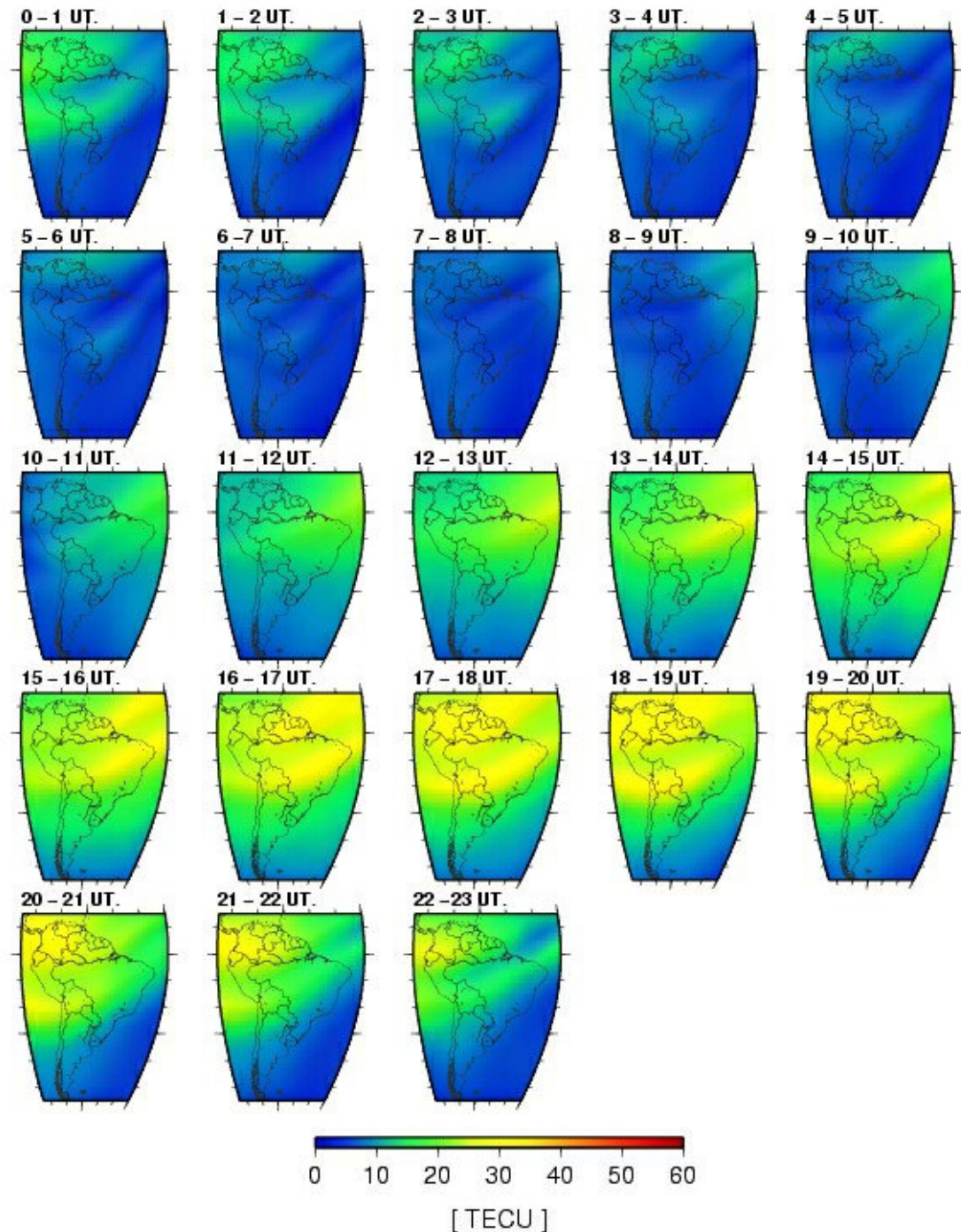
❑ Compute geopotential numbers for the first-order national leveling networks and refer them to a global-consistent reference level.

❑ Define and realize a global-consistent reference level by means of tide-gauges controlled with GNSS and satellite altimetry.



Expanding SIRGAS-CON applications

- Understanding and forecast ionospheric conditions is necessary for practical applications (e.g.: global navigation, communications, etc.).
- The Central and South American ionosphere presents challenging problems for aeronomers.
- Since July 2006, SIRGAS operates an Ionospheric Analysis Center under the responsibility of La Plata National University, Argentina.
- Hourly regional maps of Vertical Total Electron Content (TEC) are computed and delivered to the community.



SIRGAS Steering Committee

President: Claudio Brunini, Universidad Nacional de La Plata, Argentina;

Vice-President: Laura Sanchez, Deutsches Geodätisches Forschungsinstitut, Germany;

WGI President: Sonia Costa, Instituto Brasileiro de Geografia e Estatística, Brazil;

WGII President: Tomás Marino, Observatorio Sismológico y Volcánico, Costa Rica;

WGIII President: William Martínez, Instituto Geográfico Agustín Codazzi, Colombia.

Many thanks for your attention

www.sirgas.org