

## SIRGAS: BASIS FOR GEOSCIENCES, GEODATA, AND NAVIGATION IN LATIN AMERICA



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**SIRGAS**

***Sistema de Referencia Geocéntrico para Las Américas***

***Geocentric Reference System for the Americas***

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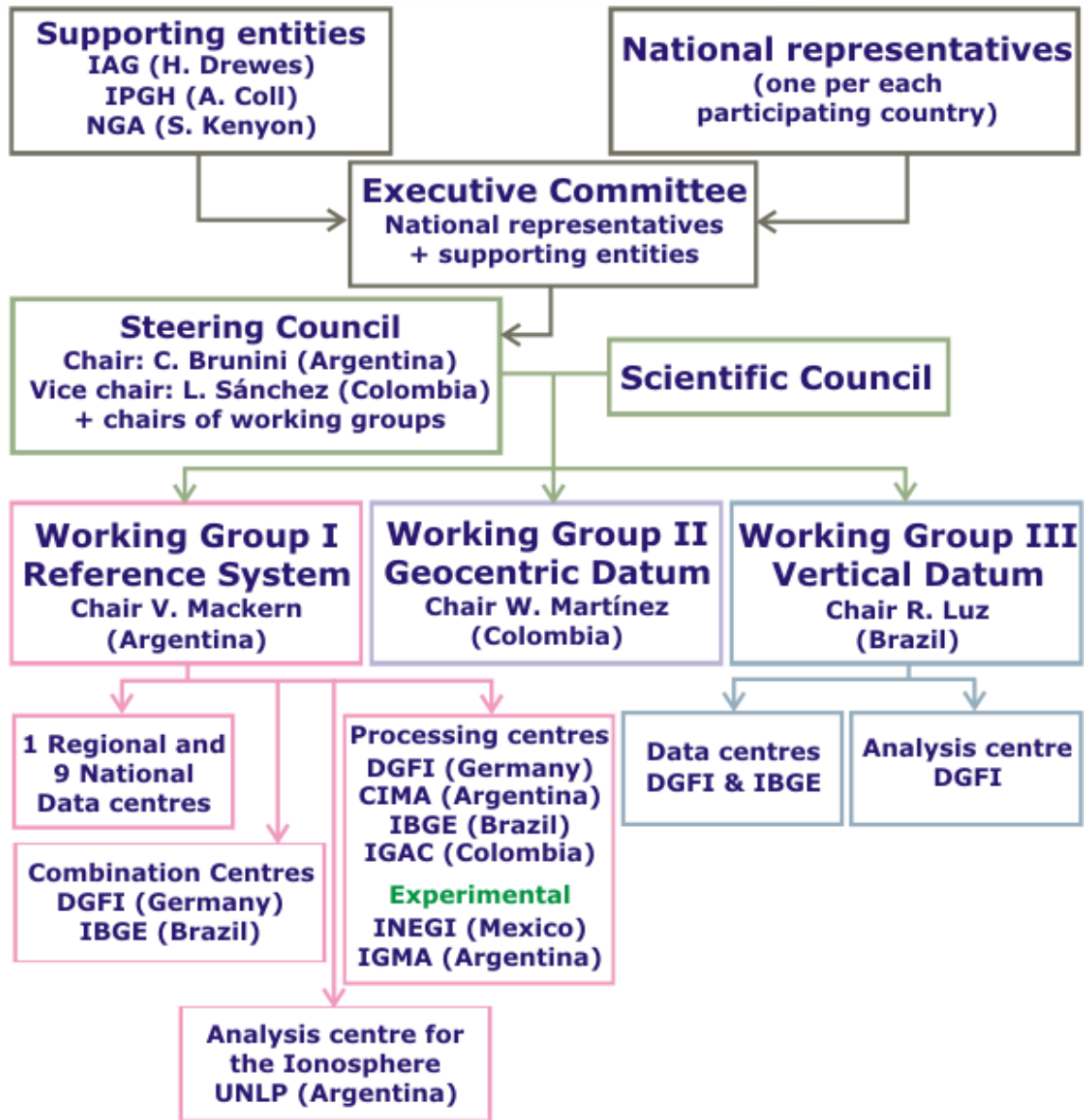
□ *SIRGAS was established in 1993 under the sponsorship of:*

- ✓ *International Association of Geodesy (IAG) - SIRGAS is the IAG Sub-commission 1.3b, "Regional Reference Frame for South and Central America";*
- ✓ *Pan American Institute of Geography and History (PAIGH) – SIRGAS is a Working Group of the PAIGH's Commission of Cartography;*
- ✓ *USA Defence Mapping Agency (today National Geoinformation Agency).*

□ *SIRGAS objectives are:*

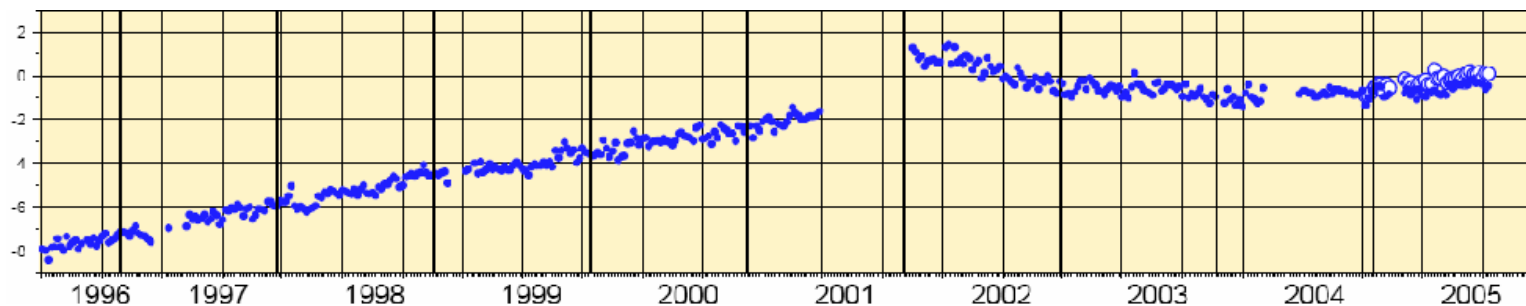
- ✓ *Define, realize, and maintain a geocentric reference system in Latin America and the Caribbean;*
- ✓ *Promote the use of SIRGAS as the unique reference frame in the region;*
- ✓ *Define, realize, and maintain a vertical reference system supporting physical and geometrical heights.*





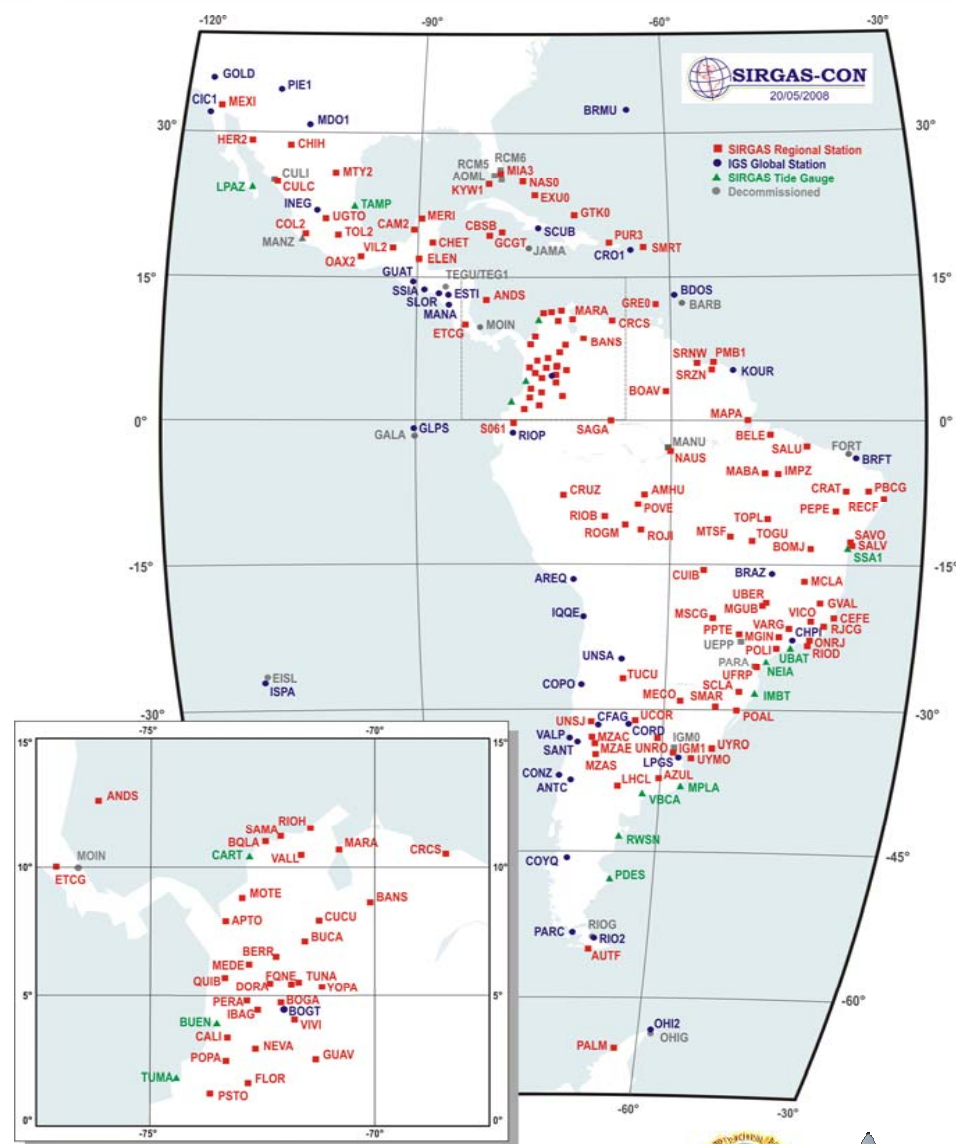
<i>Member countries</i>	
Argentina	Guatemala
Bolivia	Honduras
Brazil	Mexico
Canada	Nicaragua
Chile	Panama
Colombia	Paraguay
Costa Rica	Peru
Ecuador	Uruguay
El Salvador	Venezuela

- ❑ Reference systems provide the fundamental layer for the spatial data infrastructures and are needed for safe and accurate navigation and for understanding global change and geodynamics processes.
- ❑ State-of-the-art Geodesy demands reference systems capable to support coordinate determinations with mm-level accuracy.
- ❑ Consistency must be guaranteed at global scale and stability must be ensured over decades (coordinate changes on time must be determined with 0.1 mm/a accuracy).
- ❑ the highest level of theory and practice are used to establish the International Terrestrial Reference Frame (ITRF), which realizes the best geocentric system available today.
- ❑ SIRGAS realizes the ITRF in the Caribbean, Central and South America.



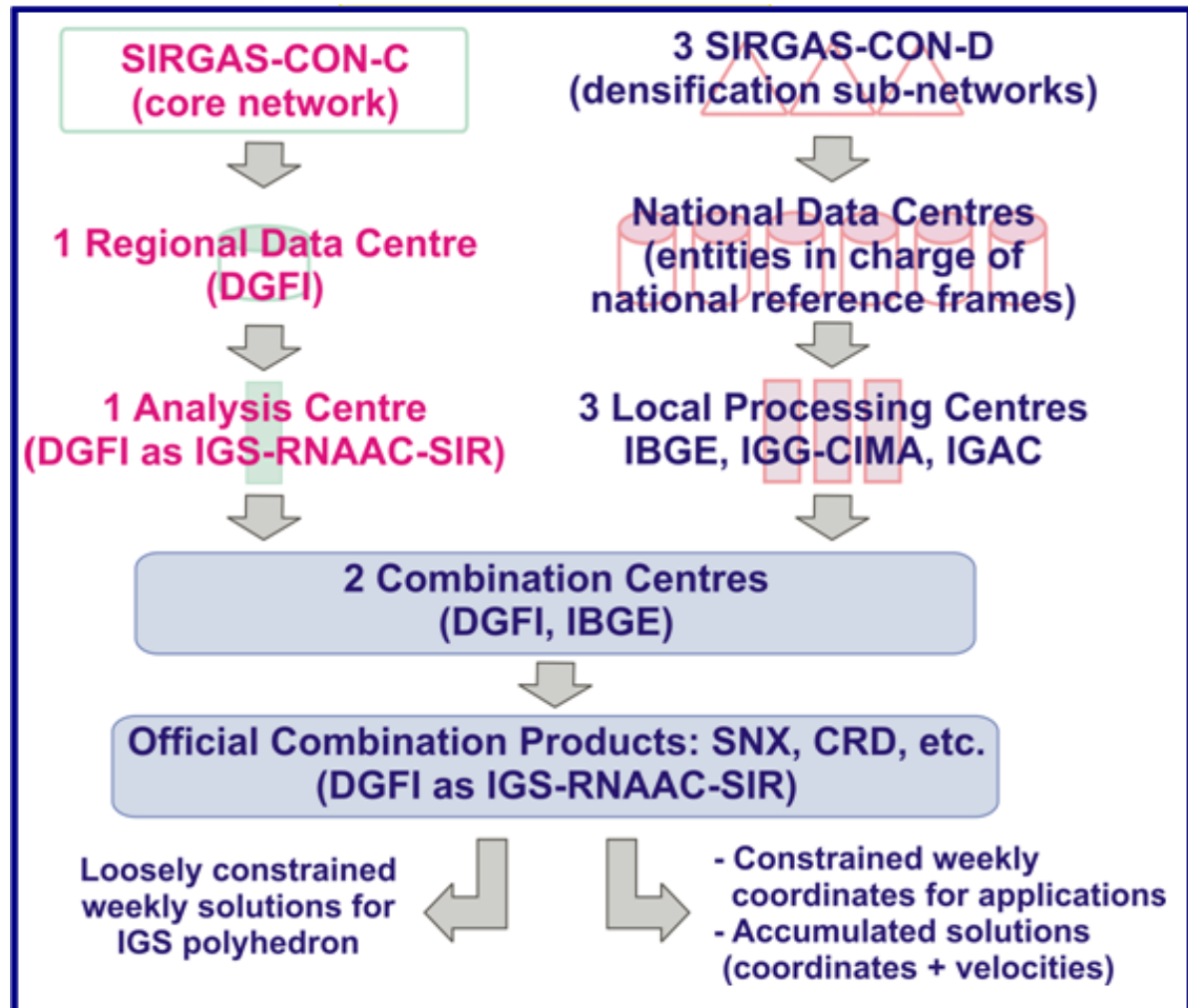
Variation of Arequipa coordinate, North component in cm, after W. Seemüller et al., DGFI.

- *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 network.*
- *It encompasses ~200 continuously observing GNSS receivers, communication links, 10 data centers, 4 analysis centers and 2 combination centers.*
- *Receivers are installed and operated by many institutions in different countries.*
- *This continental-size distributed observatory is coordinated by SIRGAS in a cooperative framework.*



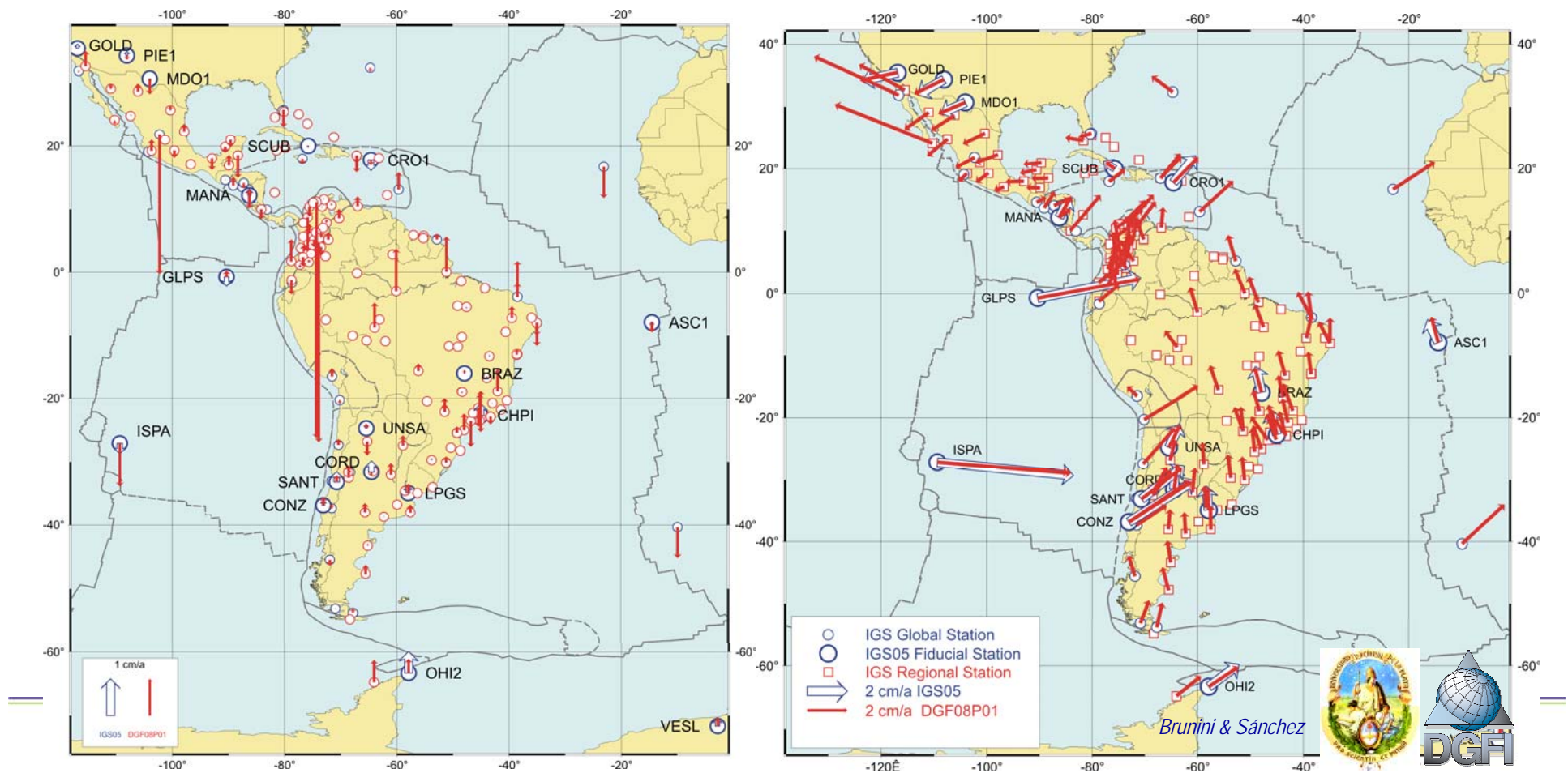


- The SIRGAS-CON network comprises two hierarchy levels:
  - ✓ a core network with 100 stations over the continent, ensuring accuracy and long-term stability;
  - ✓ densification networks containing the national reference stations.
- At present, there are three densification networks, but it is expected to have so many as SIRGAS countries.



- Core and densification networks are weekly computed and combined to generate the final SIRGAS products (available at [www.sirgas.org](http://www.sirgas.org)).

- ❑ A set of station coordinates for a conventional epoch and velocities are periodically computed by DGFI as responsible of the IGS-RNAAC-SIR.
- ❑ The latest one is named DGF08P01 and encompasses 272 weeks (Dec 2002 - Mar 2008).
- ❑ It realizes the ITRF2005 (IGS05) for the conventional epoch 2004.4
- ❑ The precision is  $< \pm 2,2$  mm (hor),  $\pm 4,5$  mm (vert), and  $< \pm 2$  mm/a (vel).



▣ *Practical uses of SIRGAS are supported by the countries by deploying national densifications under the responsibility of the national (military) geographic institutes.*

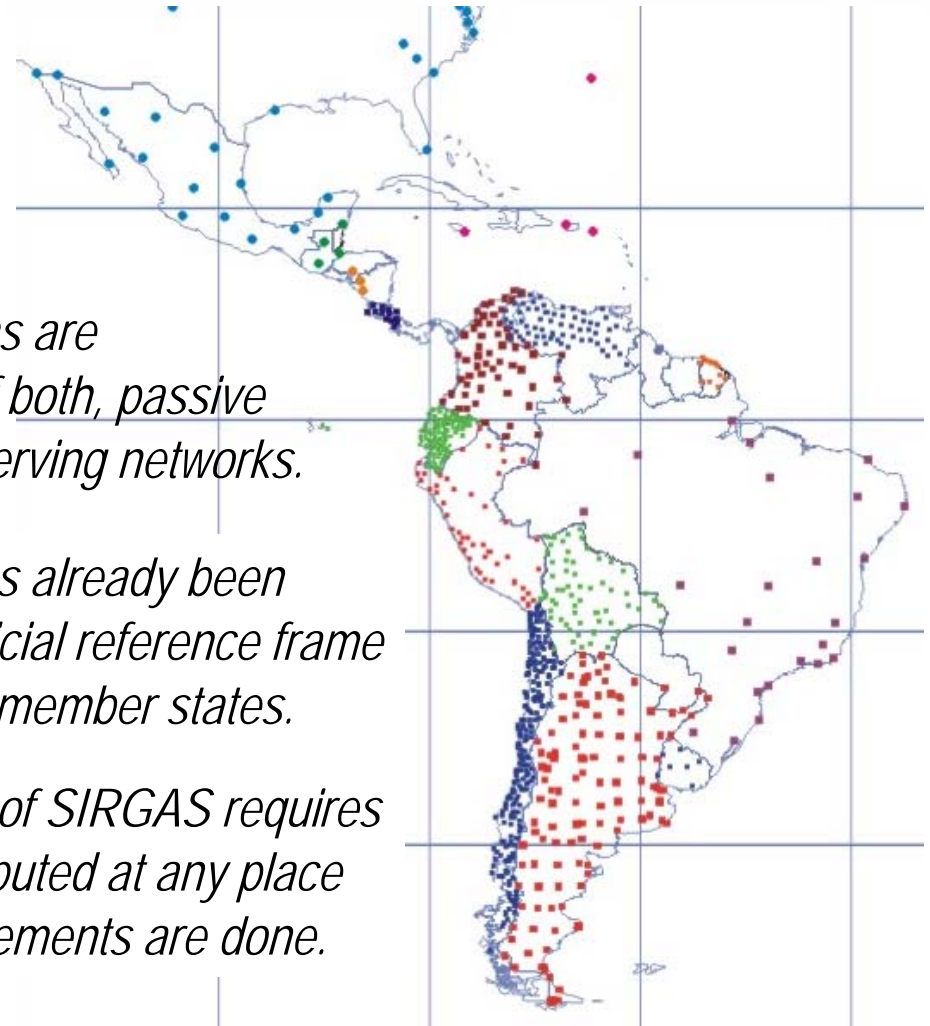
▣ *National densifications are established by means of both, passive and/or continuously observing networks.*

▣ *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.



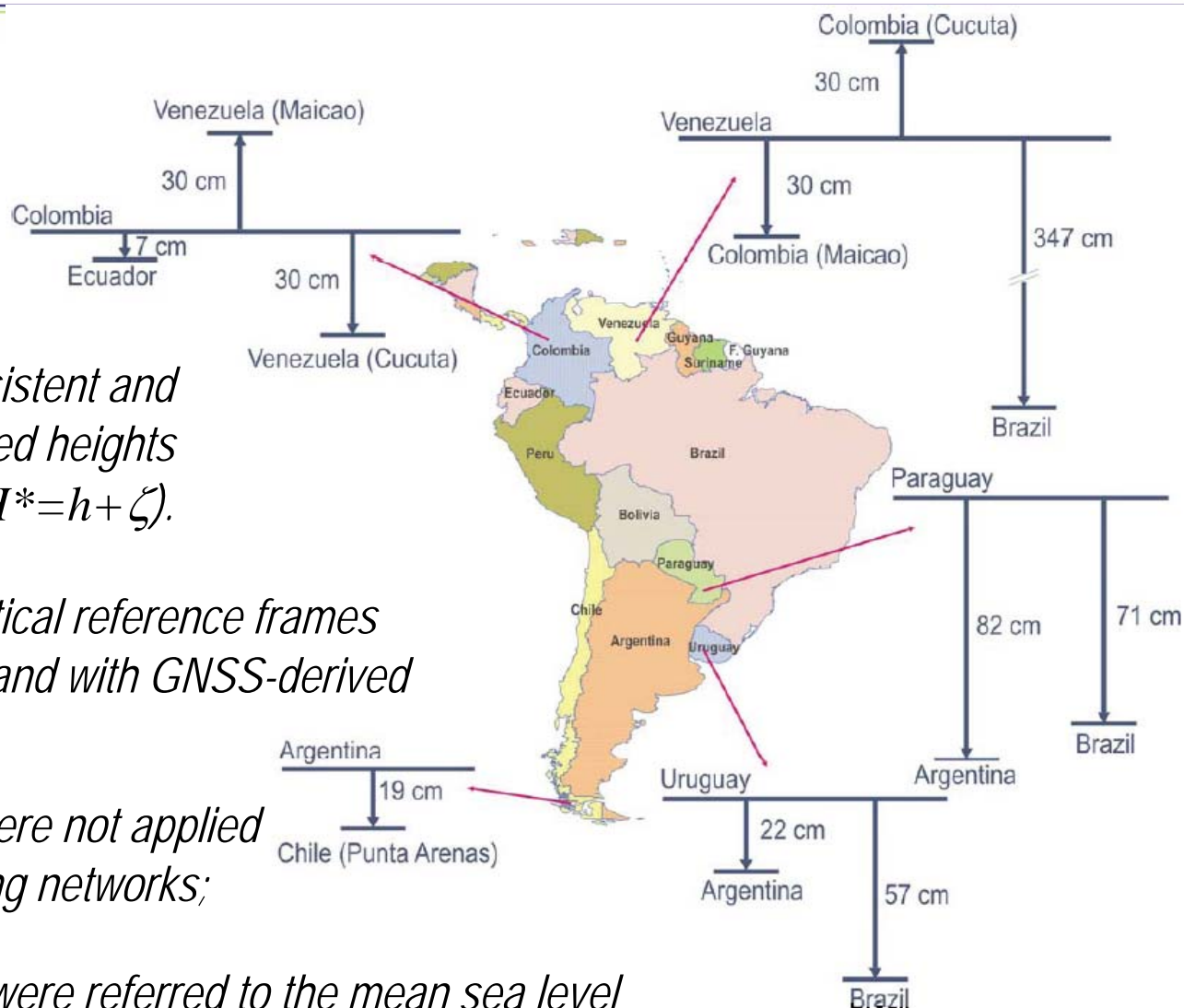


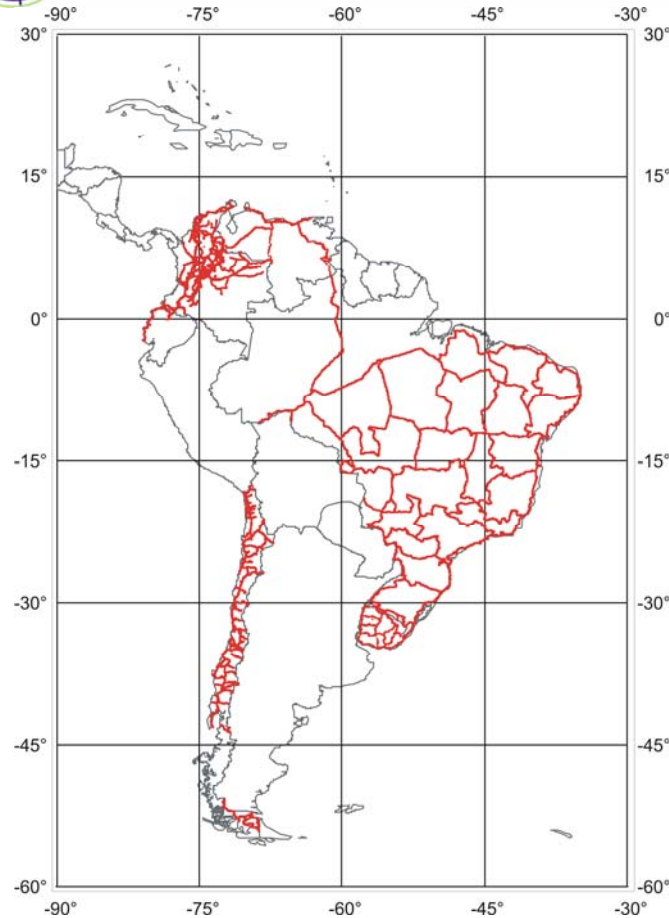
❑ *SIRGAS objectives include the realization of a gravity-related vertical reference frame based on normal heights.*

❑ *It must be globally consistent and compatible with GNSS-derived heights (i.e.: fulfill the relation  $H^* = h + \zeta$ ).*

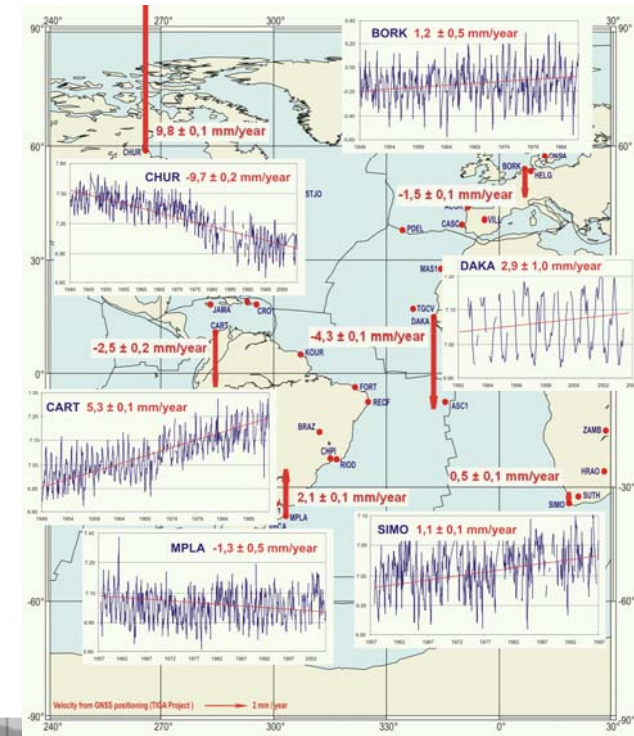
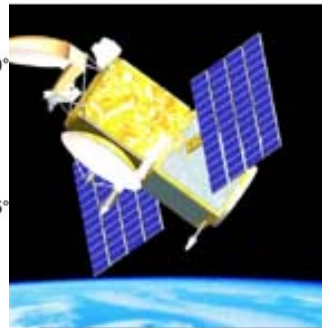
❑ *Existing gravity-related vertical reference frames are inconsistent among them and with GNSS-derived heights because:*

- ✓ *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);*

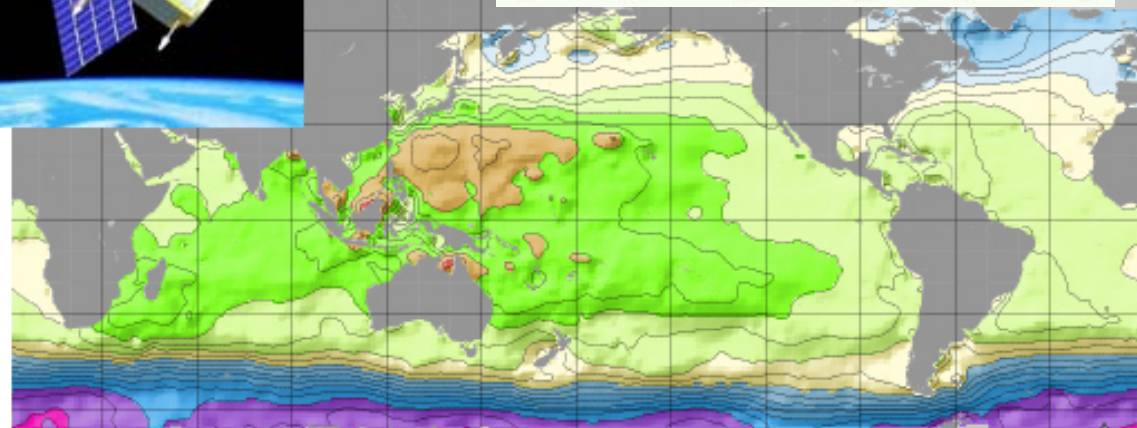




*Define and realize a global-consistent reference level by means of tide-gauges controlled with GNSS, and satellite altimetry.*

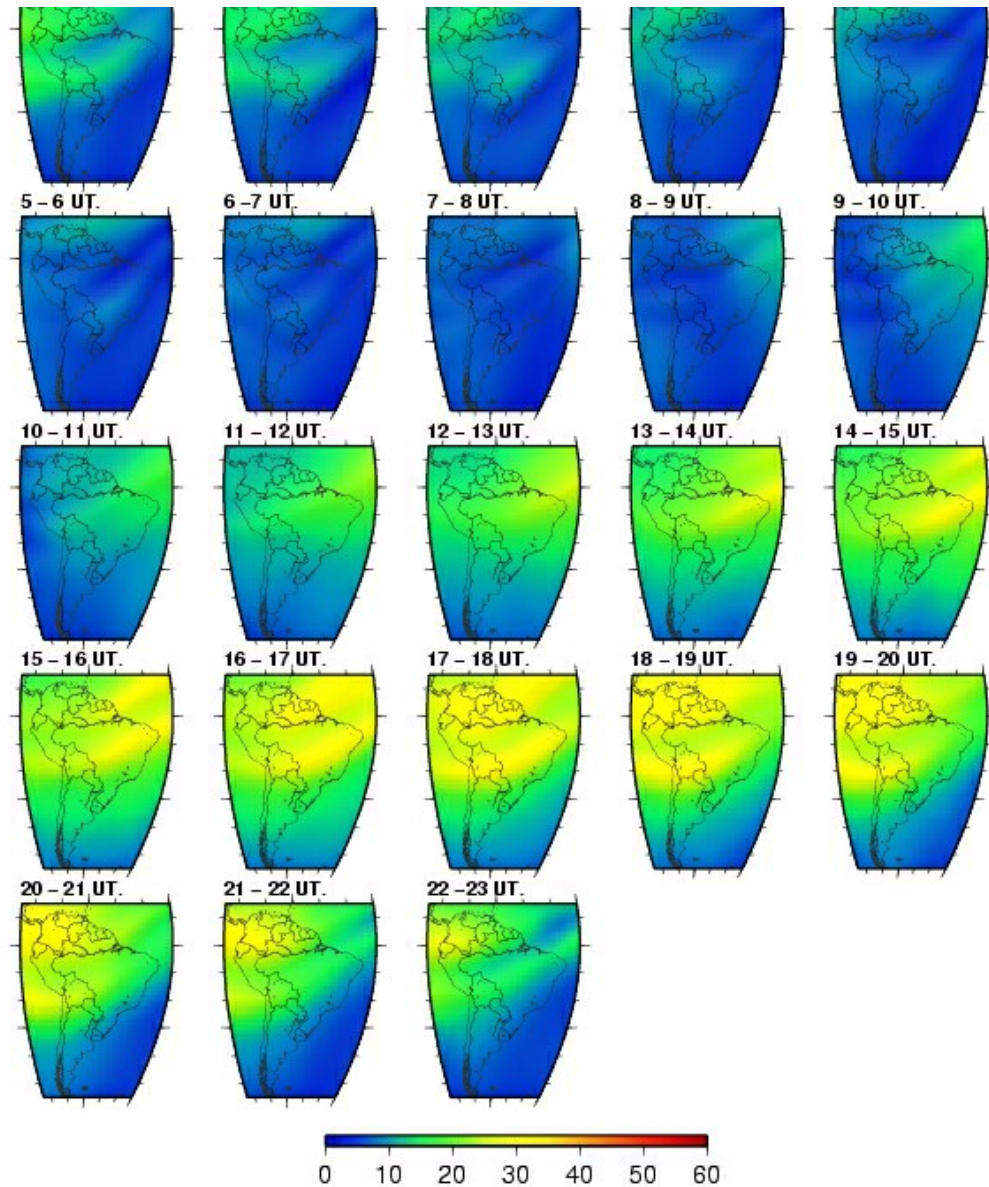


*Compute geopotential numbers for the first-order national leveling networks and refer them to a global-consistent reference level.*





- 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  $vTEC$  are computed and delivered to the community.
    - They have been used for:
      - ✓ validation of the International Reference Ionosphere (IRI);
      - ✓ improvement positioning with single-frequency GNSS receivers;
      - ✓ feasibility studies for a SBAS in the region (supported by the International Civil Aviation Organization - ICAO).



- ❑ *SIRGAS was recommended as the Americas' official reference frame by the 7<sup>th</sup> United Nations Regional Cartographic Conference for the Americas (New York, January 2001)*
- ❑ *It is the basis for many practical application, e.g.: digital cartography, geo information systems, spatial data infrastructures, navigation, augmentation systems, geophysical exploration, engineering projects, etc.*
- ❑ *It is also the platform for a wide range of scientific studies, e.g.: monitoring of cortical deformations, vertical movements, sea level variations, atmospheric studies, etc.*
- ❑ *SIRGAS has been a crucial tool for capacity building in the region; many SIRGAS scientists are today involved in international competitive scientific projects.*
- ❑ *SIRGAS represents one of the most successfully initiatives in international (voluntary) cooperation.*



***Many thanks for your attention!***

*Please, have a look to ...*

***[www.sirgas.org](http://www.sirgas.org)***