

## ***SIRGAS: an international collaborative enterprise of the geodetic community in Latin America and the Caribbean***



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## ***Organization of the presentation***

- I. Why do we need a Terrestrial Reference Frame (TRF) for Geosciences, Geospatial Data Infrastructures and Navigation?*
- II. How does SIRGAS provide to geoscientists, geospatial data users and navigation service providers the TRF for the Americas?*

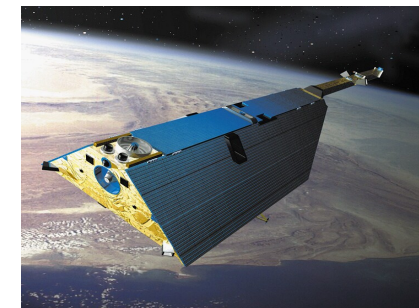
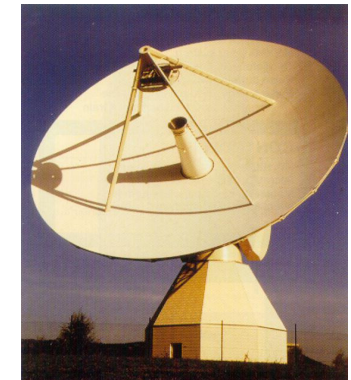
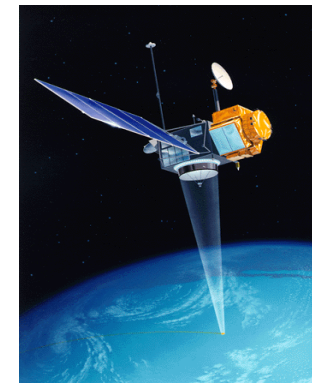
*According to Helmert (1880): the science of measuring the earth's surface.*



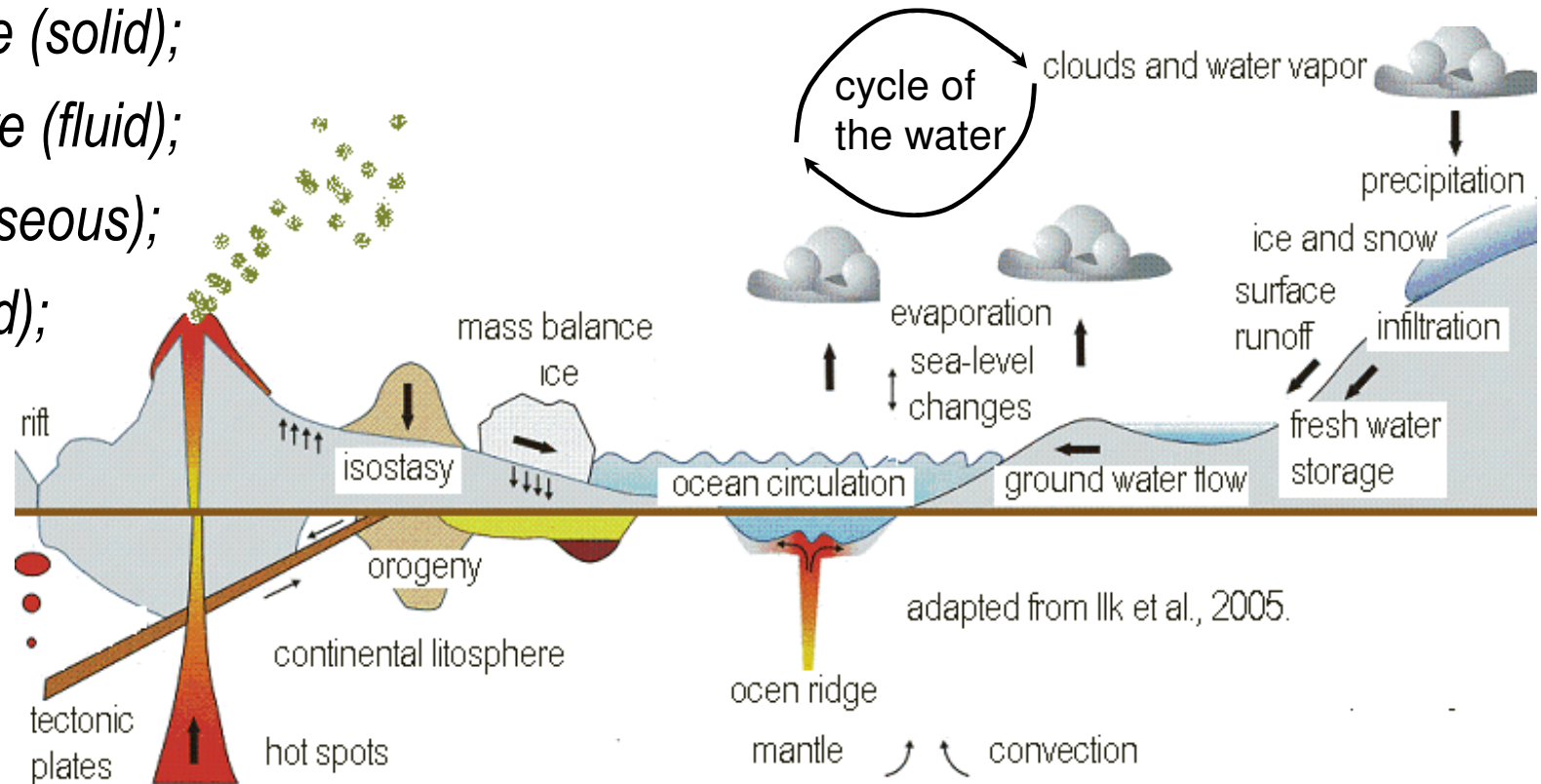
- ❑ *Technological advances (artificial satellites, extragalactic observations, etc.);*
- ❑ *Scientific advances (physical models, computational methods, etc.).*



*Nowadays: the science of measuring changes of the Earth System.*



- ❑ Geosphere (solid);
- ❑ Hydrosphere (fluid);
- ❑ Atmosphere (gaseous);
- ❑ Cryosphere (iced);
- ❑ Biosphere (live).

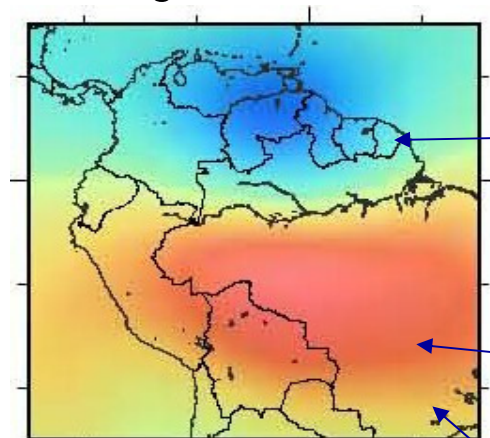


- ❑ Geodynamic and Global Change are processes inside and between the components of the Earth System.
- ❑ Geodetic observations are sensitive to those changes; just one example ...

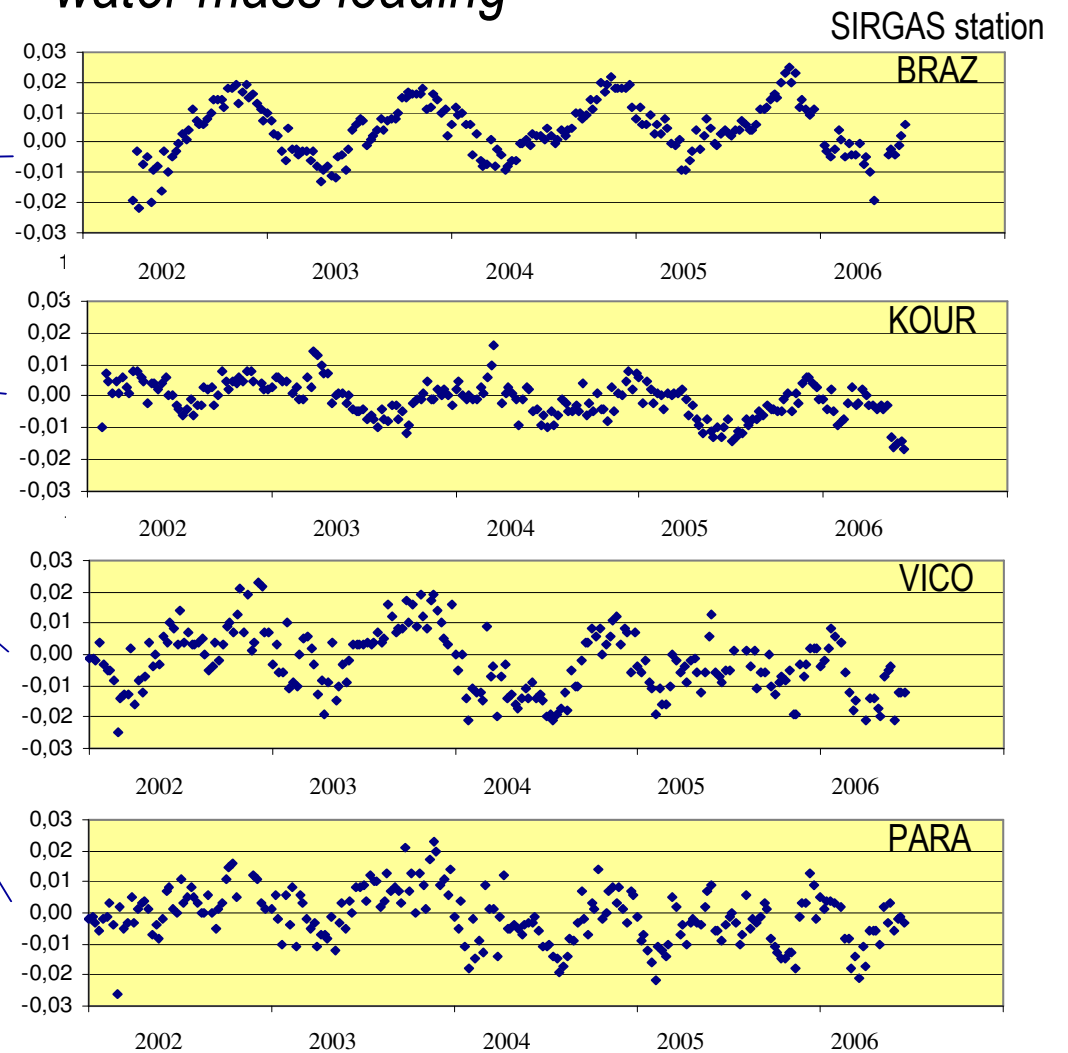
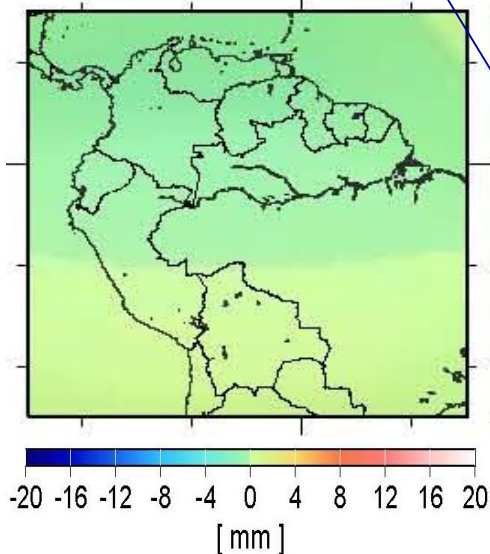
Geoid variations from GRACE, attributed to seasonal changes in the water mass

Height variations from GNSS, attributed to water mass loading

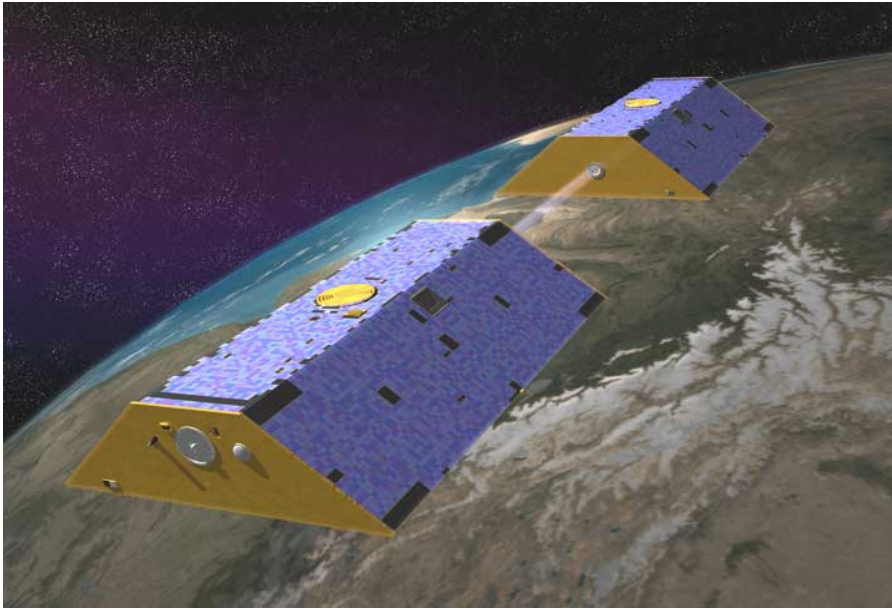
Apr. 2003



Sep. 2003







- ❑ GRACE continuously measures the range between two satellites with micron-level precision.
- ❑ This range varies in response to the irregularities in the mass distribution of the Earth System.
- ❑ Provided that satellite orbits are accurately known, GRACE

*measurements can be converted to changes in the mass distribution.*

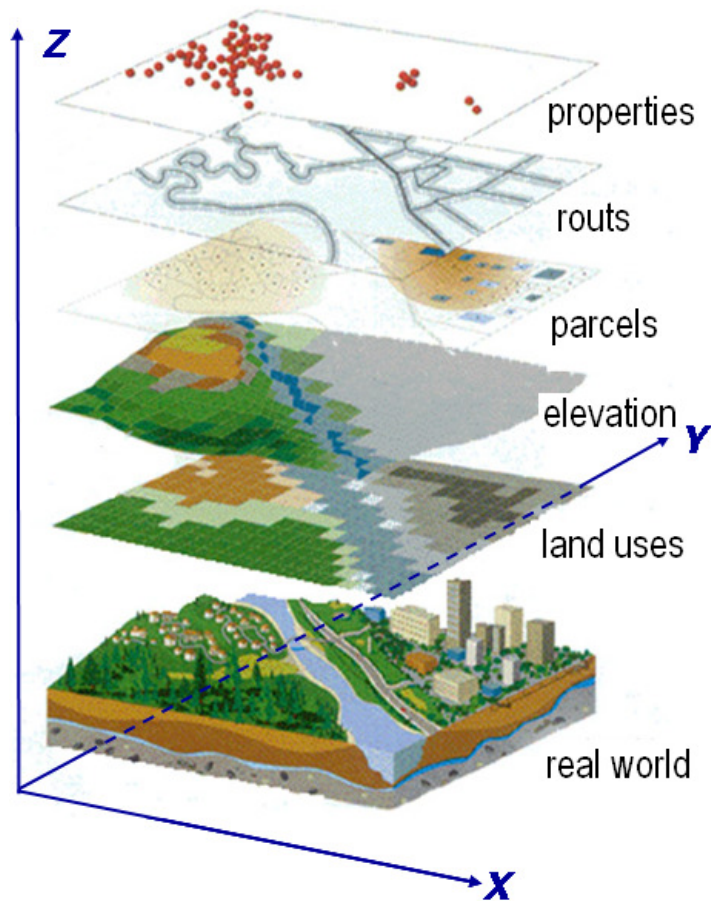
- ❑ *The largest change is attributed to water mass exchange:*

*precipitation – evapotranspiration – water runoff = water storage in the soil*

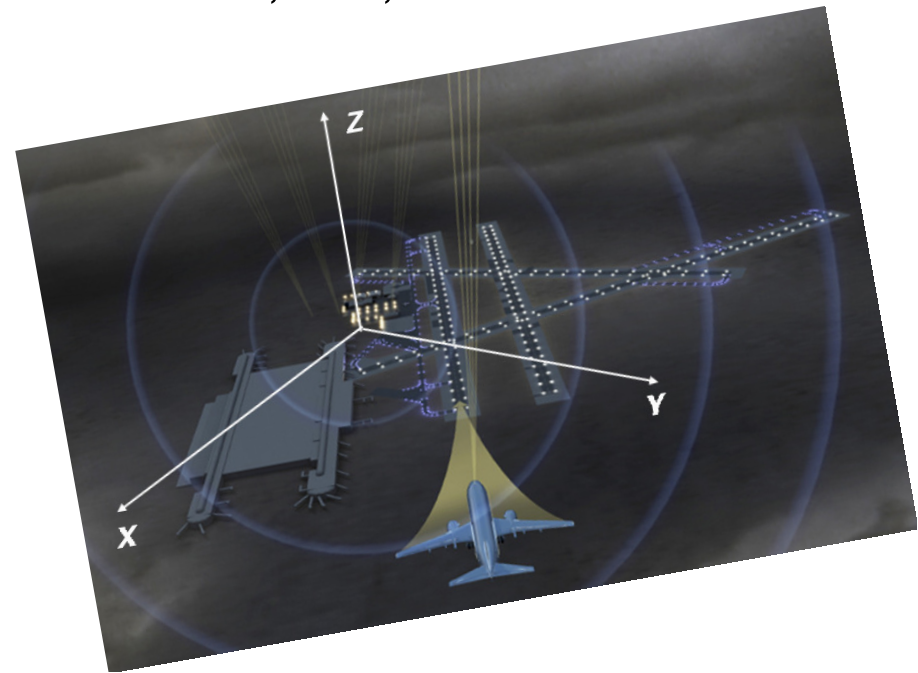
- ❑ *Satellites orbits must be tied to an accurate and stable TRF, otherwise TRF variations can be translated to satellite orbits and misinterpreted as mass variations.*

- ❑ *Geodesy is able to measure several signals of geodynamic and global change processes, including the whole cycle of the water.*
- ❑ *Signals are very small (mm/year)!*
- ❑ *Changes refer to something that does not change, i.e.: measurements and satellite orbits must be referred to a fixed TRF!!*
- ❑ *This fixed TRF must be materialized over a continuously changing planet!!!*
- ❑ *It must support millimeter-level accuracy and ensure stability over decades.*
- ❑ *TRF changes must be continuously monitored with mm/year-level accuracy to allow reducing the observations to a conventionally fixed TRF.*
- ❑ *Continuously means 24 hours per day and 365 days per year.*

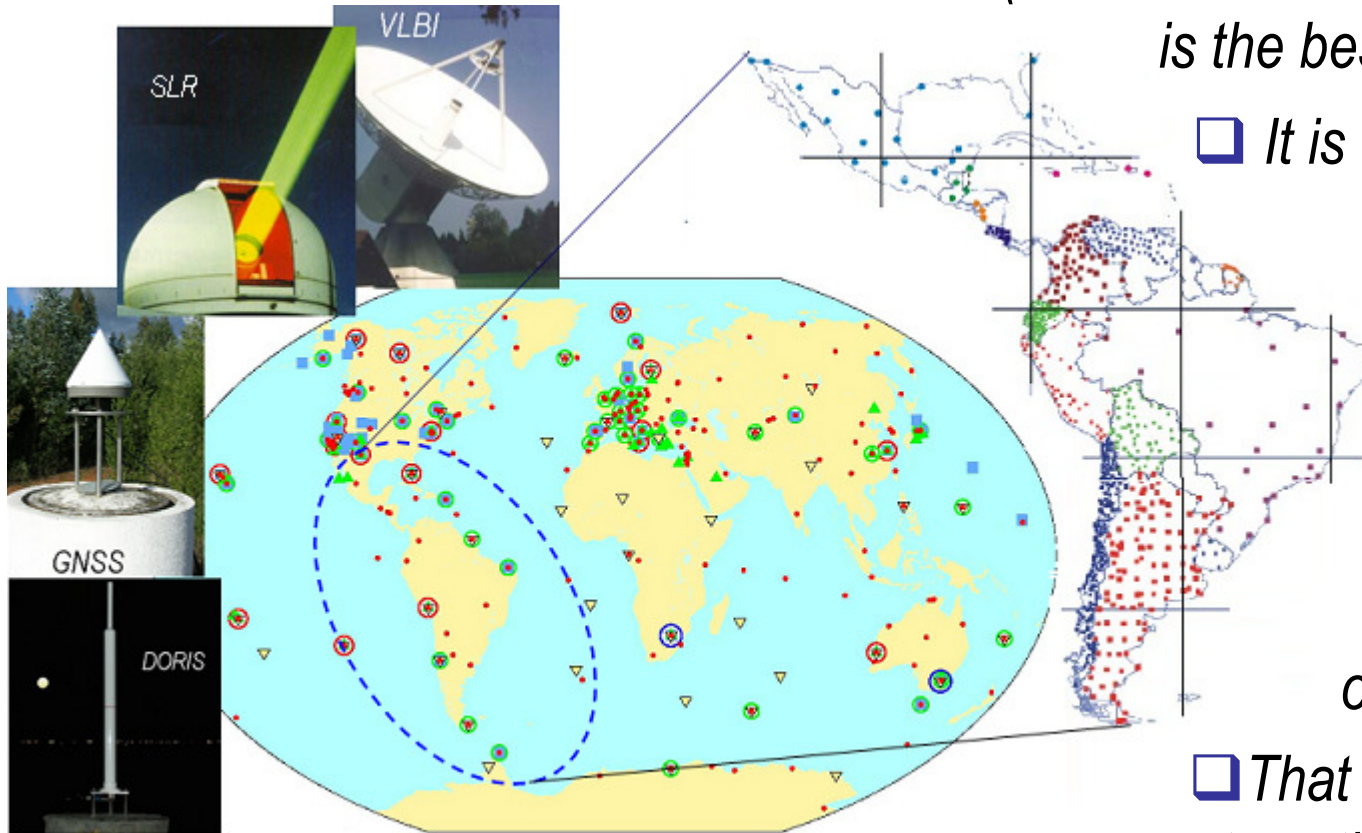
□ TRF provides the backbone of the global geospatial data infrastructure, which encompasses cadastre, natural resources, and much other information needed for ensuring the sustainable development of humanity.



□ TRF is crucial for accurate and safe global navigation over air, sea, and land.







□ *ITRF (International Terrestrial Reference Frame) is the best TRF available worldwide.*

□ *It is established and maintained by an IAG Service (the International Earth Rotation and Reference Systems Service – IERS)*

□ *It is realized by a global network of continuously observing geodetic stations.*

□ *That network is further extended at continental and national levels*

*in order to provide detailed reference to all users of geospatial data.*

□ *SIRGAS is the ITRF densification in Latin America and the Caribbean.*



# Sistema de Referencia Geocéntrico para Las Américas

## Geocentric Reference System for the Americas

*Established in 1993 under the sponsorship of:*

- ✓ *International Association of Geodesy;*
- ✓ *Pan-American Institute of Geography and History;*
- ✓ *USA National Geoinformation Agency.*



*Executive Committee*  
*Member Countries (18) + Supporting Entities*



*Steering Council*  
*President + Vice-president + WG Presidents*

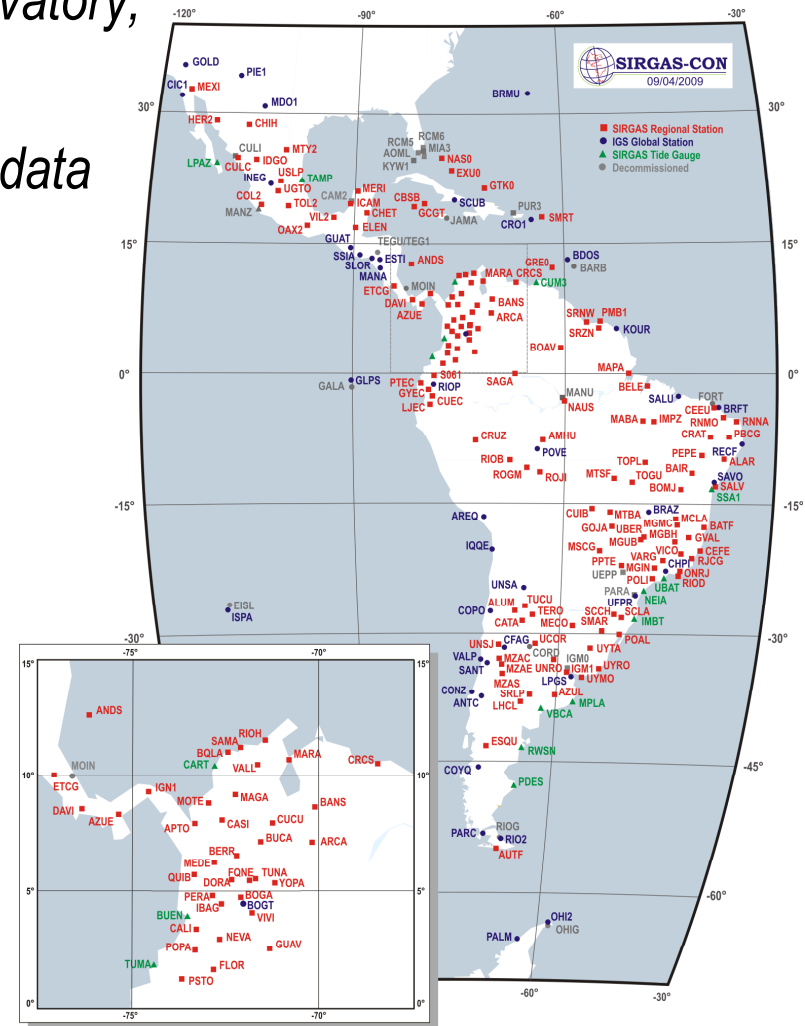


*Working Groups 1, 2 and 3*



*Scientific Council*

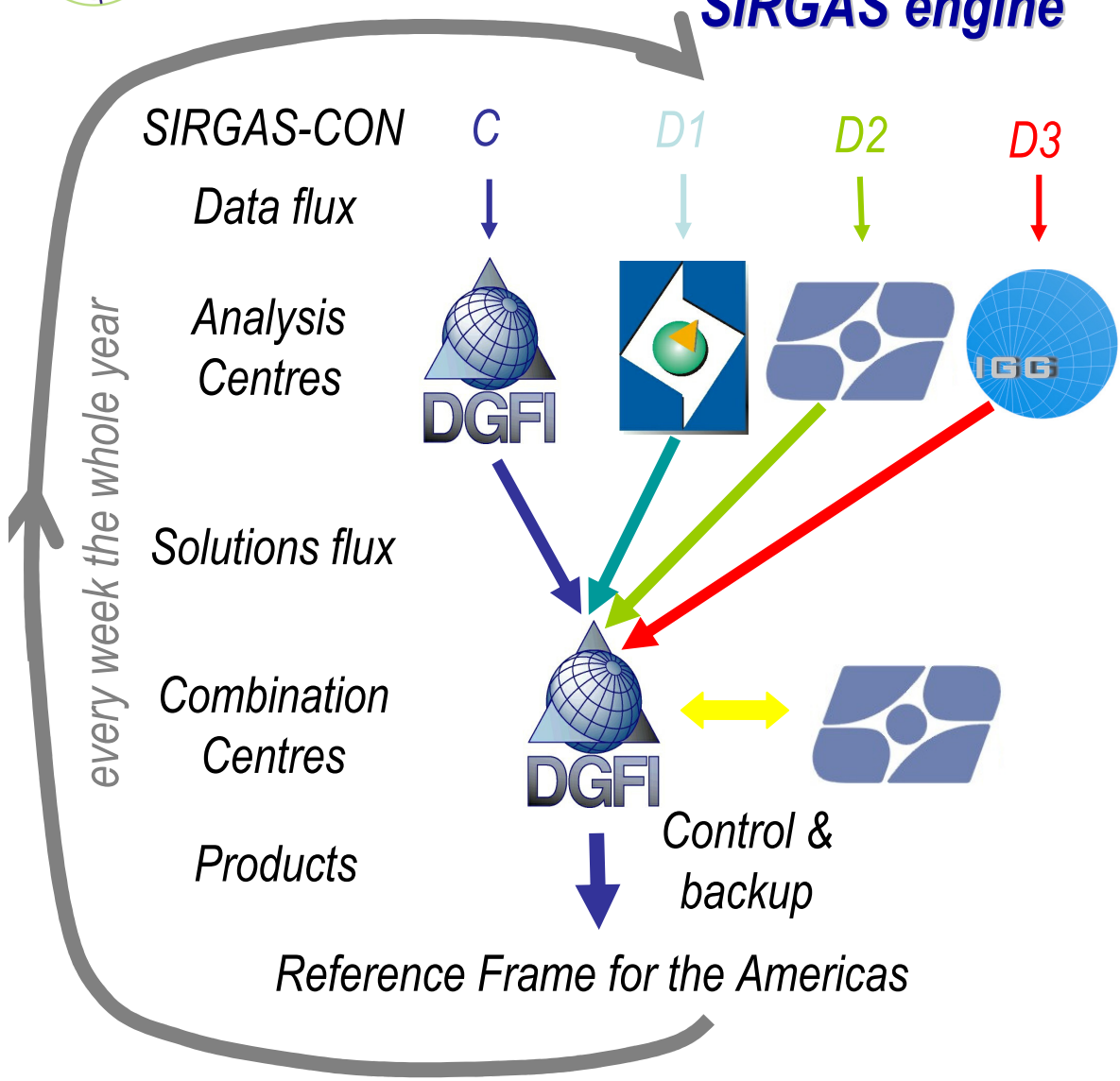
- ❑ SIRGAS operates a continental-size distributed observatory, the SIRGAS-CON (Continuously Observing Network).
- ❑ It encompasses ~200 GNSS receivers, data links, 10 data centres, 4 analysis centres and 2 combination centres.
- ❑ Receivers are operated by many institutions in an international voluntary cooperation framework.
- ❑ SIRGAS-CON comprises two hierarchical levels:
  - ✓ a continental (C) network, with ~100 stations all over the continent;
  - ✓ several densification (D) networks comprising the fundamental points of the national networks of all SIRGAS countries.
- ❑ At present, there are 3 D-networks but it is expected to have one per country.





**SIRGAS**

# The continuously moving SIRGAS engine



✓ Instituto Brasileiro de Geografia e Estatística, Brasil



✓ Instituto Geográfico Agustín Codazzi, Colombia



✓ Universidad Nacional de Cuyo, Argentina



✓ Deutsches Geodätisches Forschungsinstitut, Germany



**Experimental Analysis Centres**

✓ Instituto Nacional de Estadística, Geografía e Informática, México



✓ Instituto Geográfico Militar, Argentina



✓ Instituto Geográfico Militar, Ecuador



✓ Universidad del Zulia, Venezuela



✓ Servicio Geográfico Nacional, Uruguay

- ❑ *SIRGAS is driving a powerful capacity building process in the Americas.*
- ❑ *Eight Analysis Centres were installed during the last four years in Latin American institutions.*
- ❑ *Three of them have successfully suppurated the experimental phase and are fully operational, while the others are in process of validation.*
- ❑ *Capacity building activities are performed by:*
  - ✓ *The “SIRGAS School on Reference Systems”, intended to provide the theoretical background; and*
  - ✓ *The “Training Courses for Analysis Centres”, intended to provide the practical training.*
- ❑ *The next SIRGAS School will take place from July 13 to 17, 2009, at the Instituto Geográfico Agustín Codazzi (Colombia).*

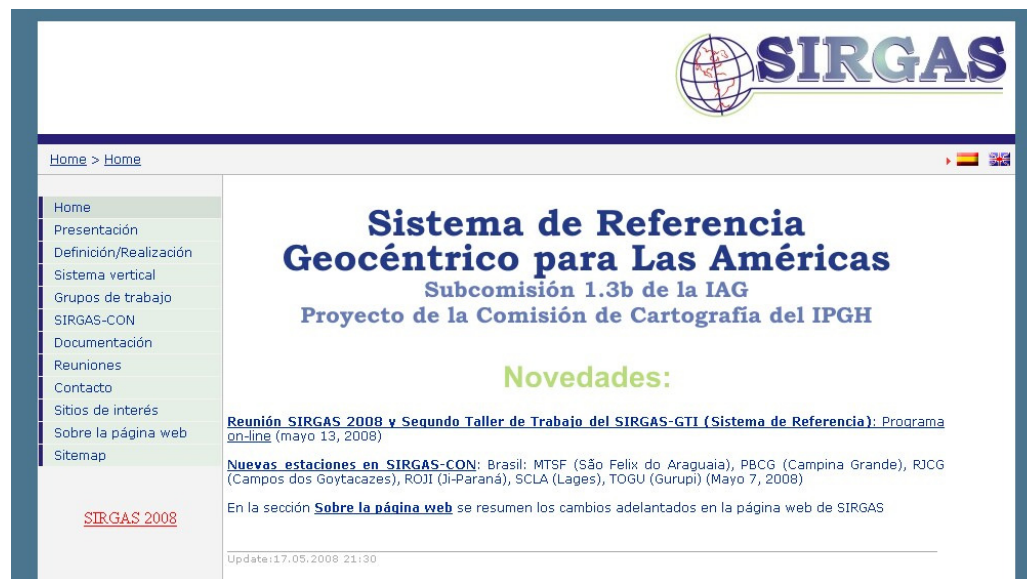


- SIRGAS was recommended as official reference frame for the America's countries by the 7<sup>th</sup> United Nations Regional Cartographic Conference for the Americas (New York, January 2001).*
- It is the basis for all practical applications that require reliability and accuracy such as cadastre and land information, oil prospecting, GNSS navigation, etc.*
- It provides the best reference frame for scientific studies such as cortical deformation, mass transport, sea-level height variations, etc.*
- Besides reference frame maintenance, SIRGAS-CON observations are used for remote sounding of the earth's atmosphere (water vapor and electron content estimation, space weather monitoring, etc.) and for SBAS assessment in the region.*
- It is one of the most successful initiatives of Geodesy regarding international, voluntary collaboration.*

*Many thanks for your attention*

*See more in ...*

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



The screenshot shows the SIRGAS website interface. At the top right is the SIRGAS logo. Below it is a navigation bar with "Home > Home" and flags for Spain and the UK. A left sidebar contains a menu with items: Home, Presentación, Definición/Realización, Sistema vertical, Grupos de trabajo, SIRGAS-CON, Documentación, Reuniones, Contacto, Sitios de interés, Sobre la página web, and Sitemap. The main content area features the title "Sistema de Referencia Geocéntrico para Las Américas" and "Subcomisión 1.3b de la IAG Proyecto de la Comisión de Cartografía del IPGH". A "Novedades:" section lists recent events: "Reunión SIRGAS 2008 y Segundo Taller de Trabajo del SIRGAS-GTI (Sistema de Referencia): Programa on-line (mayo 13, 2008)" and "Nuevas estaciones en SIRGAS-CON: Brasil: MTSF (São Felix do Araguaia), PBCG (Campina Grande), RCG (Campos dos Goytacazes), ROJI (Ji-Paraná), SCLA (Lages), TOGU (Gurupi) (Mayo 7, 2008)". A note mentions updates in the "Sobre la página web" section. The footer shows "Update: 17.05.2008 21:30".