IAG Sub commission 1.3b
SIRGAS reference system
On going activities

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Introduction

- **SIRGAS** is the Geocentric Reference System for the Americas. Its definition corresponds to the ITRS and it is realized by a regional densification of the ITRF.

- **SIRGAS** is a member of the IAG Commission 1 (Reference Frames), through the Sub-commission 1.3 (Regional Reference Frames); it is responsible for the regional reference frame for Central and South America.

- **SIRGAS** is also a working group of the Cartographic Commission of the Pan-American Institute of Geography and History.

- Besides the geometrical reference system, **SIRGAS** includes the definition and realization of a **unified vertical reference system**, based on ellipsoidal heights as geometrical component and geopotential numbers (referred to a global conventional $W_0$ value) as physical component.
SIRGAS realizations

- SIRGAS has three realizations: SIRGAS95, SIRGAS2000 and SIRGAS-CON

- SIRGAS95: ITRF94, epoch 1995.4: 58 stations over South America.

- SIRGAS2000: ITRF2000, epoch 2000.4: 184 stations over the Americas: North, Central and South America

www.sirgas.org
SIRGAS Continuously Observing Network (SIRGAS-CON)

- More than 160 continuously observing stations
- 36 new stations since July 2007
- Contribution to the IGS through the IGS-RNAAC-SIR at the DGFI (Munich, Germany)
- Installation of 5 processing centres in Latin America (2 in Argentina, 1 in Brazil, 1 in Colombia, 1 in Mexico)
- Installation of 2 intra technique combination centres in Latin America (1 in Argentina, 1 in Brazil)

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SIRGAS-CON processing strategy

- Absolute PCVs are applied since GPS week 1400 (GPS weeks 1200-1399 are being reprocessed using absolute PCVs).
- Satellite orbits and clocks and EOPs are fixed to the combined IGS solutions.
- The earlier satellite orbits are transformed from ITRF97 or ITRF00 to ITRF05.
- Free normal equations generated by the daily network adjustments are combined to determine an accumulative solution with coordinates and linear velocities.
- Discontinuities and systematic effects to be modelled in the combination are pre-analysed by generating time series of stations coordinates.
- Regional stations with short time series (less than one year) are not included in the cumulative solution.
- The geodetic datum is defined by constraining coordinates and velocities of 17 IGS05 stations to the NNT+NNR conditions.
- The final solution (DGF08P01-SIR) refers to the IGS05 frame, epoch 2003.0.
- Coordinates / velocities precision: ±2.2 mm (hor), ±4.5 mm (ver); ±1-2 m/a (vel).
SIRGAS-CON station velocities
✓ horizontal component
SIRGAS-CON station velocities
✓ vertical component
Velocity model for SIRGAS

- Released in November 2003 (available at www.sirgas.org)
- Input data
  - SIRGAS95 coordinates
  - SIRGAS2000 coordinates
  - IGS RNAAC-SIR velocities
  - Other velocities from geodynamic projects in South America (CAP, CASA, SAGA, SNAPP)
- The continuous velocity field results from the combination of two solutions: one by least-squares collocation and another by finite elements.
- Efforts are currently done in order to improve the velocity model.
National densifications of SIRGAS

- 13 of the 18 SIRGAS's members countries have already introduced SIRGAS as the official national reference system.

- The national reference frames correspond to densification networks of SIRGAS by continuously observing stations and/or passive marks.

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Vertical reference system

- Geometrical Component
  - Coordinates: ellipsoidal heights, $h$, referred to the SIRGAS system, i.e. ITRS realized by ITRF2000, epoch 2000.4.
  - Reference surface: GRS80 (SIRGAS datum).
  - Time dependency: $dh/dt$ from continuous GNSS positioning.

- By adoption of SIRGAS as Reference System in the Region, the geometrical component is realized!

- Physical component
  - Coordinates: Normal heights $H_N$ derived from geopotential numbers.
  - Reference surface: quasigeoid model (GGM + refined terrestrial gravity data).
  - Time dependency: $dH_N/dt \approx dh/dt$. 

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Current activities for the vertical reference system realization

- The South American countries are concentrated on:
  - Controlling first order levelling networks.
  - Checking terrestrial gravity data.
  - Levelling reference frame and tide gauge stations.
  - Connecting neighbouring levelling networks.

- Near future objectives:
  - Determination and continental adjustment of geopotential numbers wrt a unified and globally determined $W_0$ value.
  - Estimation of a high resolution quasigeoid model for the region.
Regional ionosphere maps for SIRGAS

- The operational infrastructure of the SIRGAS-CON network is also used for atmospheric studies.
- Hourly maps of vertical total electron content (vTEC) are routinely produced since July 2007 (available at www.sirgas.org).
- Here, 1-hour South American Regional Ionosphere Maps (SAIM) for August 3, 2007.
Main objectives for the incoming years

- To extend the SIRGAS-CON network into those countries with few (or without) GNSS continuously operating stations.
- To improve (specially the vertical component) the South American deformation (velocity) model by including the new stations of the SIRGAS-CON.
- To install (initially) five GNSS processing centres and two intra-technique combination centres in Latin America.
- To support the densification and the official adoption of SIRGAS in the Central American and Caribbean countries.
- To realize a global vertical reference system in the SIRGAS region.

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