United Nations/Argentina Workshop on the Applications of Global Navigation Satellite Systems

Supporting GNSS applications in Latin America through the SIRGAS reference frame

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1. Why SIRGAS in Latin America?

• Incompatibilities between classical reference systems together an extensive use of GPS in Latin America were evidents in the 90s.

• Establishing a well-defined reference system in terms of satellite techniques foundations and applications became a requirement (also a challenge) for the regional geo-community.

• In 1993, the first effort to adopt a geocentric reference system brought a new kind of integration and collaboration in Latin America thanks to the SIRGAS Project.

• UN recognized this successful project and recomended to all countries in the region to adopt SIRGAS as reference system.

• Nowadays, SIRGAS is the core geodetic infrastructure for 20 countries and it is based on GNSS.
2. The SIRGAS reference frame

• The SIRGAS reference system is identical to ITRS (International Terrestrial Reference System) by definition being geocentric and consistent at global scale.

• To get access to ITRS its realization is available, i.e. ITRF (International Terrestrial Reference Frame). In this sense, its regional densification for Latin America is provided by SIRGAS.

• At national and local levels, subsequent densifications of the regional frame guarantee GNSS applications refered to SIRGAS.

• SIRGAS counts with three realizations, in all cases given by high-precision geodetic networks.
• A continuously GNSS network is the third (and current) SIRGAS realization:
  – It is called SIRGAS-CON (SIRGAS Continuously Operating Network).
  – It extends homogeneously from Mexico to Argentina and includes IGS stations and national networks.
  – It comprises 420 stations tracking GPS, GLONASS, Galileo, BeiDuo.
  – It is processed on a weekly basis by SIRGAS Analysis Centres providing an up-to-date reference frame.

www.sirgas.org
• About SIRGAS Analysis Centres:
  - DGFI-TUM* (Germany) is the International GNSS Service Regional Network Associate Analysis Centre for SIRGAS (IGS RNAAC SIRGAS) since 1996.
  - Nine Local AnalysisCentres operate in Latin America countries being responsible for national densifications.
  - The network processing is performed in a rigorous way applying currents standards and conventions from IERS* and IGS. Only GPS+GLONASS observations are treated.
  - Two Combination Centres combine (adjusts) individual solutions defining the frame every week.

*Deutsches Geodätisches Forschungsinstitut der Technischen Universität München, http://www.dgfi.tum.de
• Each station is processed by three Analysis Centres according to SIRGAS-WGI distribution plan.

• Only IGS RNAAAC SIRGAS process the so-called SIRGAS-CON C network.

• Local Analysis Centers generates loosely-constrained solutions for SIRGAS-CON N networks.

• The combination of every solution is the contribution for IGS global polyhedron.

• After aligning the individual solutions to the reference frame, station positions are estimated for every week with

  accuracy → ± 1mm for horizontal positions
  ± 3mm for vertical positions
3. Benefits of SIRGAS-CON

SIRGAS-CON

Provides
- an stable and accurate geodetic reference frame,
- accessibility at regional, national and local levels,
- consistency with GNSS orbits.

Supports
- management for geospatial acquisition and treatment,
- referencing for geodata of Latin American countries (differents realizations/epochs),
- worldwide compatibility (all turn around ITRF).

Contributes
- detection and modelling of Global Change,
- the improvement of the reference frame itself,
- with the GGRF (Global Geodetic Reference Frame) implementation according to UN resolutions.

Coordinates estimated (loosely-constrained and aligned to ITRF) within the processing of SIRGAS-CON are key products at weekly and multi-annual basis.
Benefits of SIRGAS-CON

- Weekly determination is strongly necessary in the region:
  - Secular, seasonal, and sporadic events degrade frame accuracy.
  - GNSS is sensitive to these events.
  - Response and evolution of the frame must be considered.

www.sirgas.org
SIRGAS-CON multi-annual determination come from weekly solutions:

- It realizes the long-term SIRGAS reference frame.
- Its kinematic can be monitored.
- Velocities are provided to extrapolate coordinates in time.
- Deformations due to seismic and seasonal effects on reference frame are under study.
4. Applications of SIRGAS as reference frame

→ Remark: every country in the SIRGAS region realices the reference frame (by GPS/GNSS) at certain epoch.

In practice, how the SIRGAS reference frame is implemented?

• Scientific applications:
  – Maintenance of the reference frame.
  – Ionospheric studies.
  – Neutral atmosphere studies.
  – Redefinition of the vertical reference frame, it is SIRGAS-WGIII (Vertical Datum) responsability.

http://cplat.fcaglp.unlp.edu.ar

(Cioce, 2018)

(Sánchez et al., 2017)
Applications of SIRGAS as reference frame

- Practical applications:
  - Positioning for surveying, geomatics, engineering, navigation and more...
  - Developments in Real Time GNSS (network solution mode).
  - SIRGAS-WGII (National Level) is in charge.

(Briceño et al., 2009)
5. Closing remarks

• SIRGAS is the infrastructure for supporting any scientific and technical application based on GNSS technique in Latin America.

• The SIRGAS Continuously Operating Network (SIRGAS-CON)
  – offers the highest (geodetic) precision in the region.
  – guarantees consistency for any geo-database (since its acquisition to final product generation).
  – establishes and recommend guidelines for geodesy developments in members countries.

• Beyond scientific/technical scopes, SIRGAS is also an example of successful international cooperation.

• Some challenge:
  – reinforcement of SIRGAS-CON.
  – incorporation of other GNSS (Galileo, BeiDou...) to SIRGAS-CON.
  – approaching of SIRGAS to other Space Geodesy techniques.
Closing remarks

Visit our web page:

www.sirgas.org

Our next symposium will be in

Aguas Calientes, Mexico

(november-2018)
Thank you very much!

(specially to the Workshop organizers)

questions?

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