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SIRGAS: the geodetic reference frame for Latin America and the Caribbean

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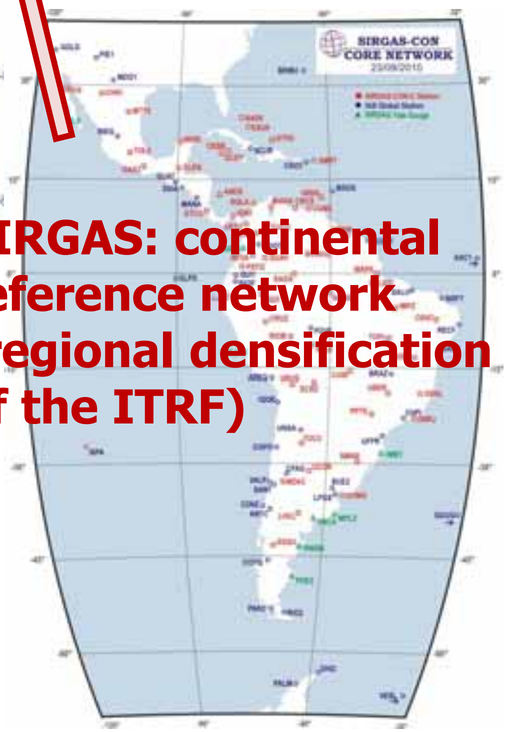
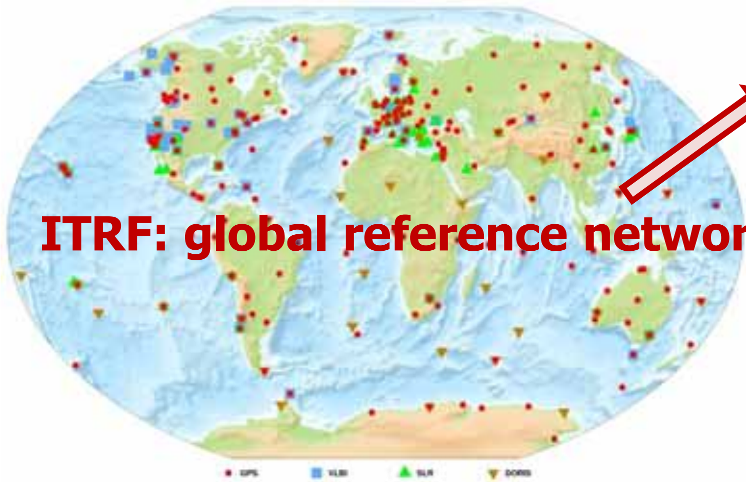
IAG Commission 1 Symposium on
Reference Frames for Applications in Geosciences 2010 (REFAG2010)
October 4 - 8, 2010. Marne-La-Vallée, France

SIRGAS realization

The realization of SIRGAS is a densification of the ITRF

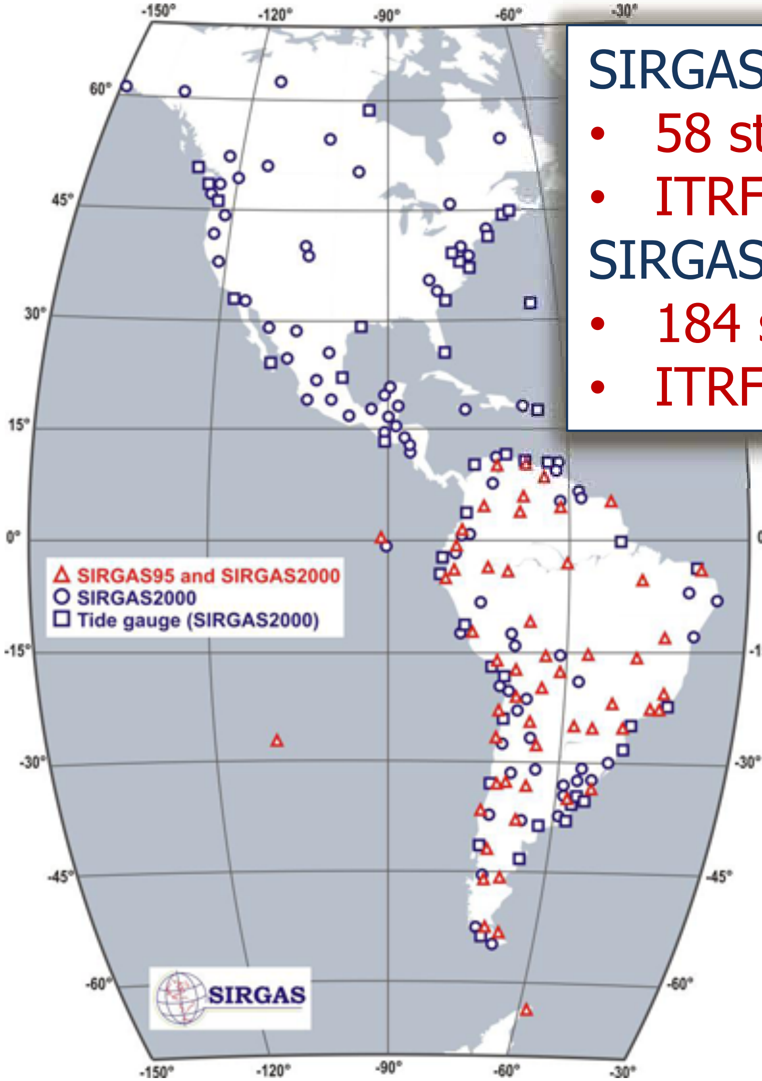
- to guarantee consistency between terrestrial reference stations and GNSS satellite orbits (provided by the IGS);
- to make the global reference frame available at national and local levels.





Continuous monitoring of the reference frame

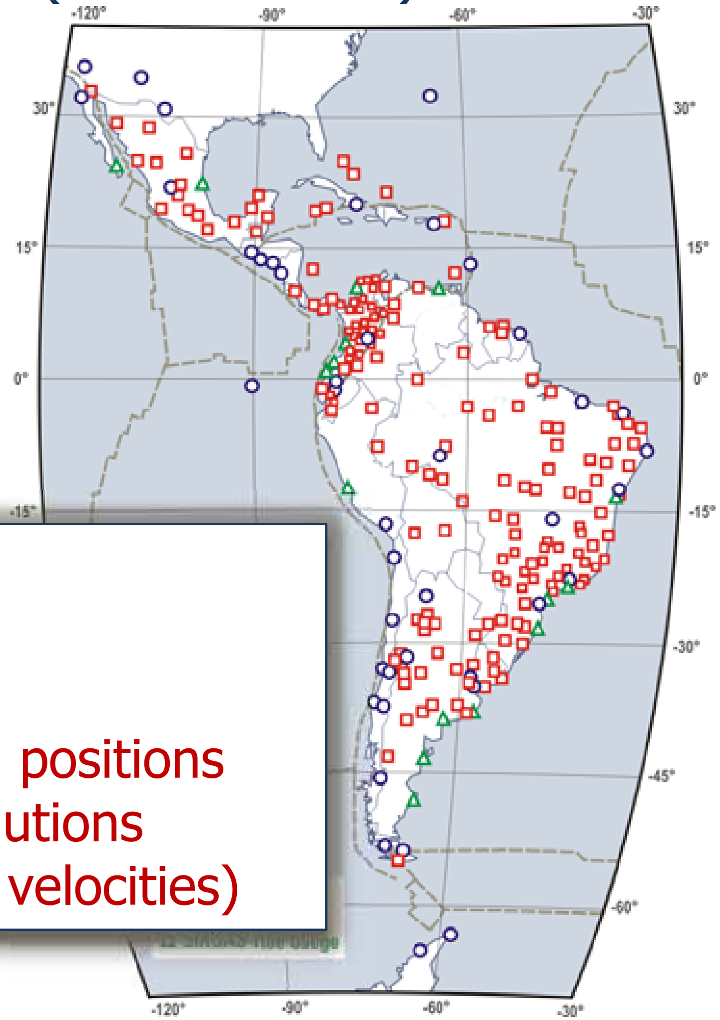
Before: Realization by means of GPS campaigns



SIRGAS95
- 58 stations
- ITRF94, 1995.4

SIRGAS2000
- 184 stations
- ITRF2000, 2000.4

Now: Realization by means of a continuously operating GNSS network (SIRGAS-CON)



SIRGAS-CON
- 237 stations
- Current ITRF
- Weekly station positions
- Cumulative solutions (positions and velocities)

Geographical densification of the reference stations (1/2)

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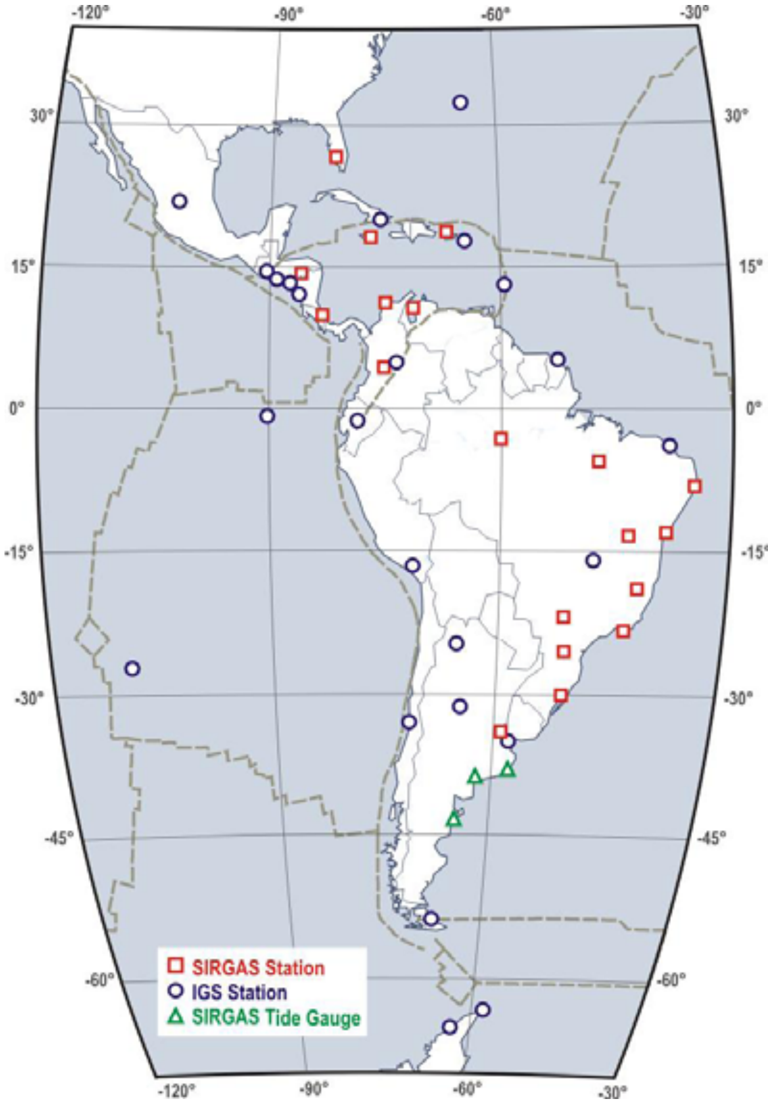
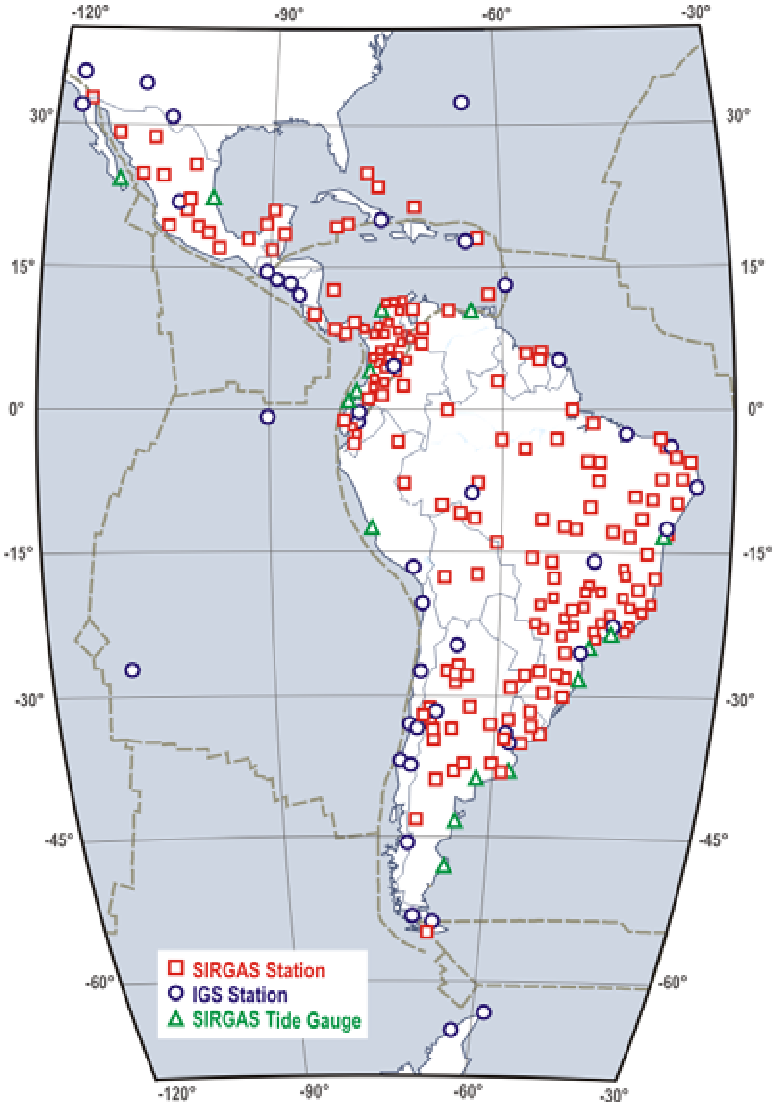
SIRGAS-CON in Sept. 2001
48 stations (24 IGS-stations)



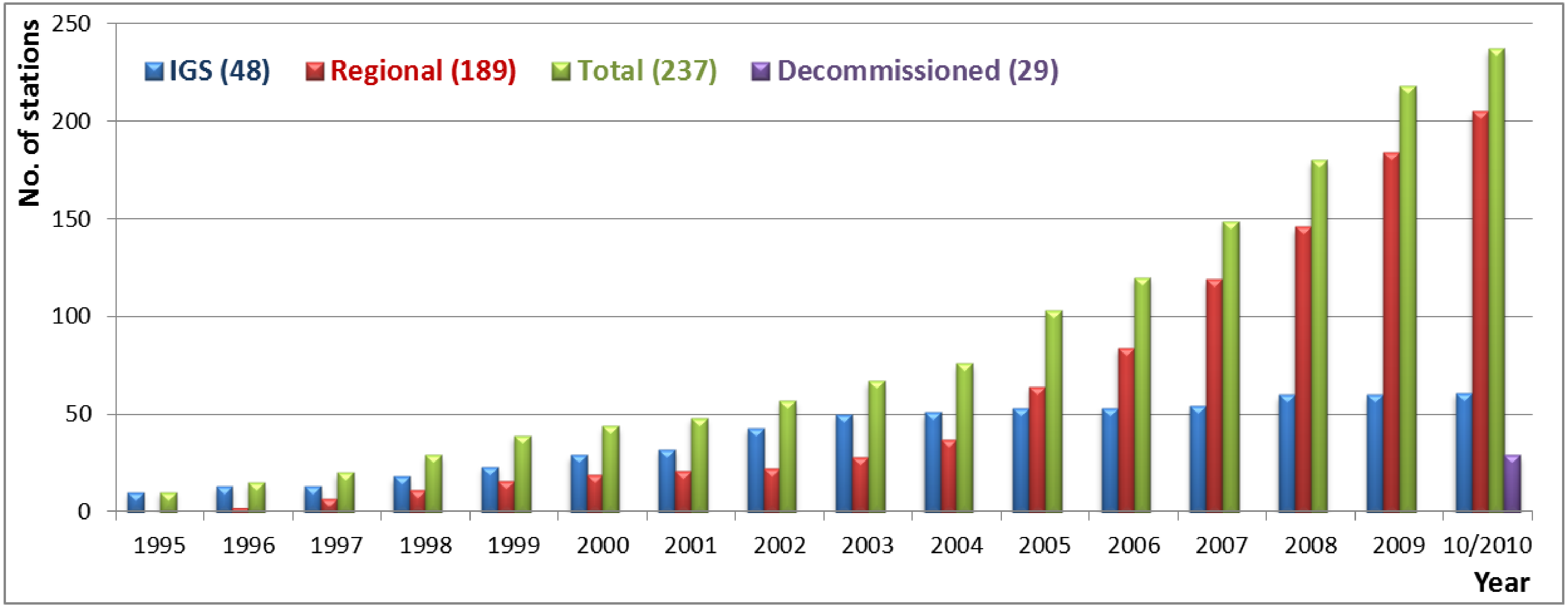
SIRGAS-CON in Sept. 2010
237 stations (48 IGS-stations)



DGFI IBGE

Geographical densification of the reference stations (2/2)

Number of SIRGAS-CON stations since 1995



- Improvement of the national reference frames by installing continuously operating GNSS stations (intensively since 2005);
- Integration of the national GNSS reference stations into the continental reference frame (SIRGAS-CON) for common processing and to guarantee consistency with the ITRF.

Redundancy in the analysis of the reference frame

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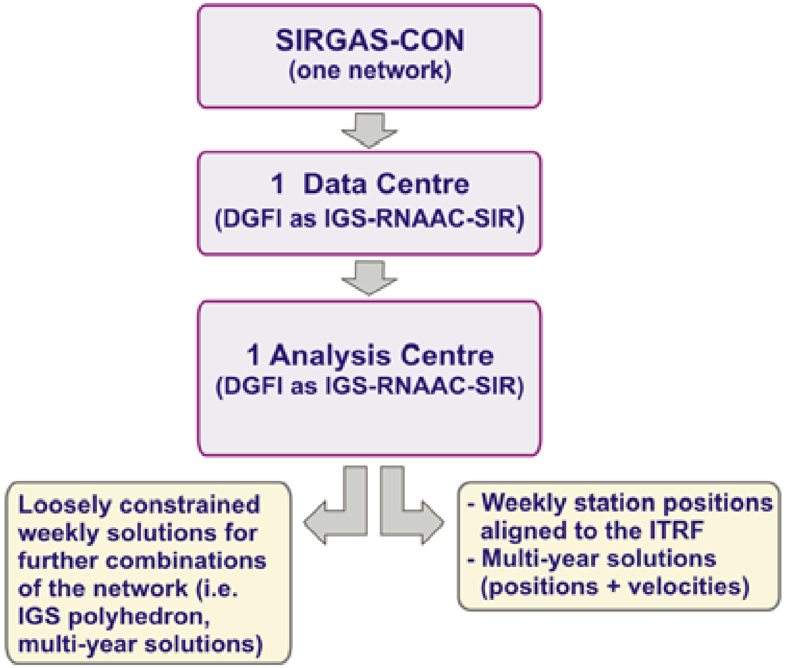
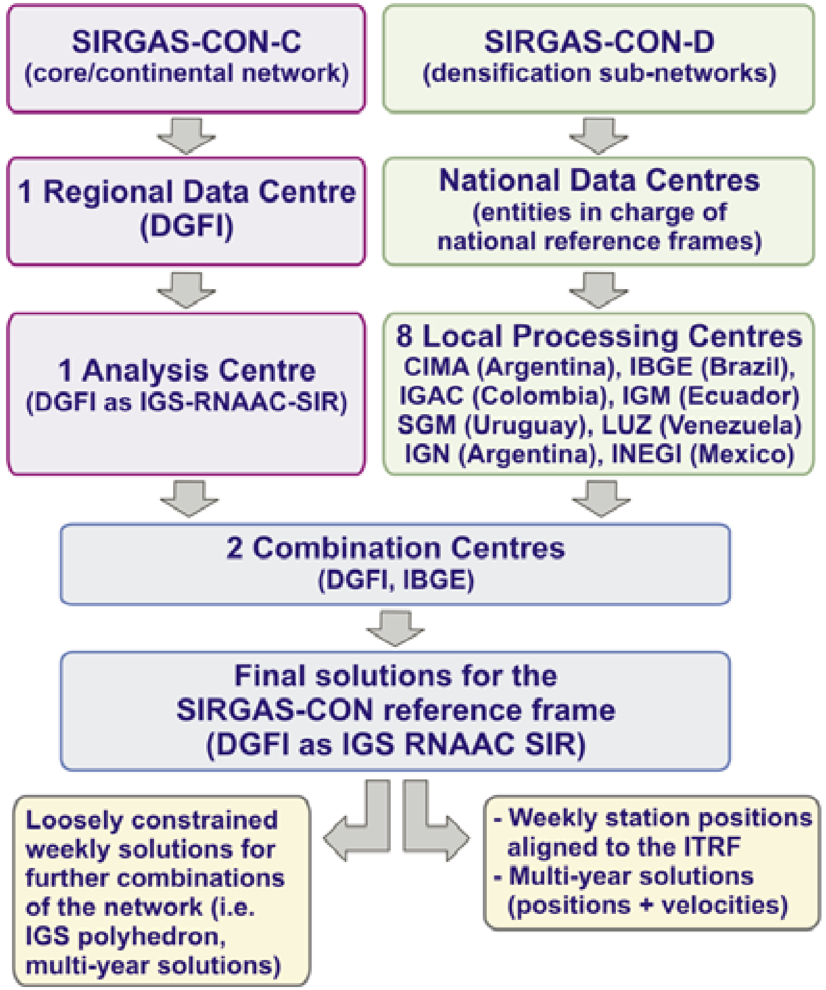
Before: one processing centre, one network processed in one block. Each station processed once.



Now: 9 processing centres, 2 combination centres, one core network and many densification sub-networks (clusters). Each station processed by 3 analysis centres.



Datum definition strategy and availability of weekly reference coordinates

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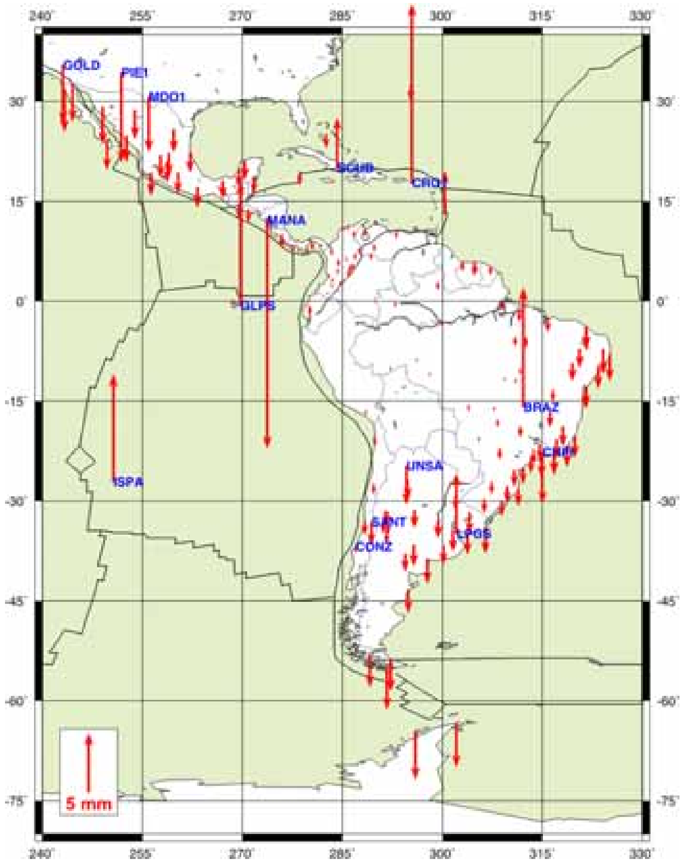
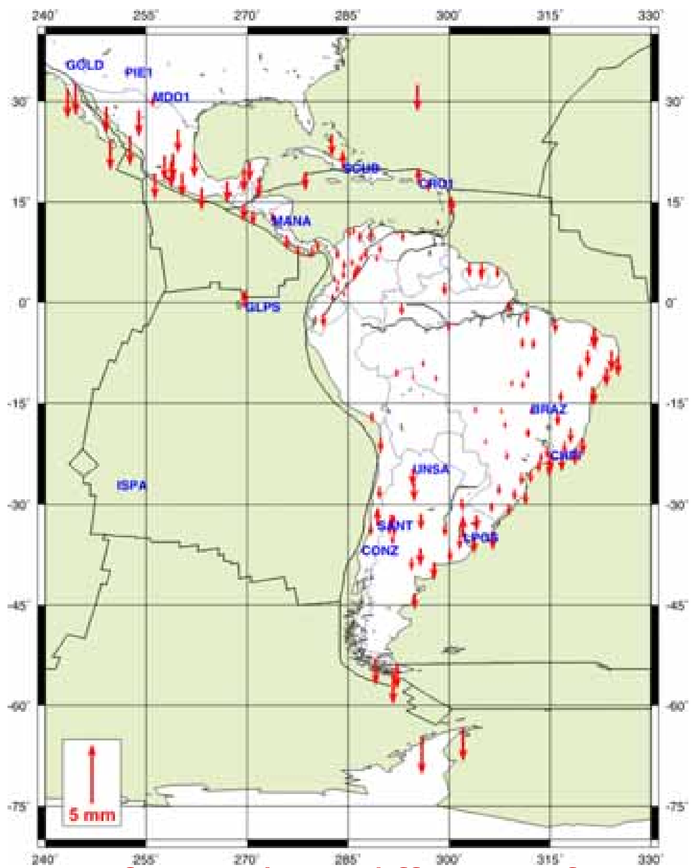
Before: Reference station positions were transformed from a conventional reference epoch applying constant velocities: $X(t_i) = X(t_0) + Vx(t_i - t_0)$

Now: Reference positions are computed by aligning the weekly solutions of the SIRGAS frame to the same frame in which the GNSS orbits are computed, i.e. the IGS weekly solutions.

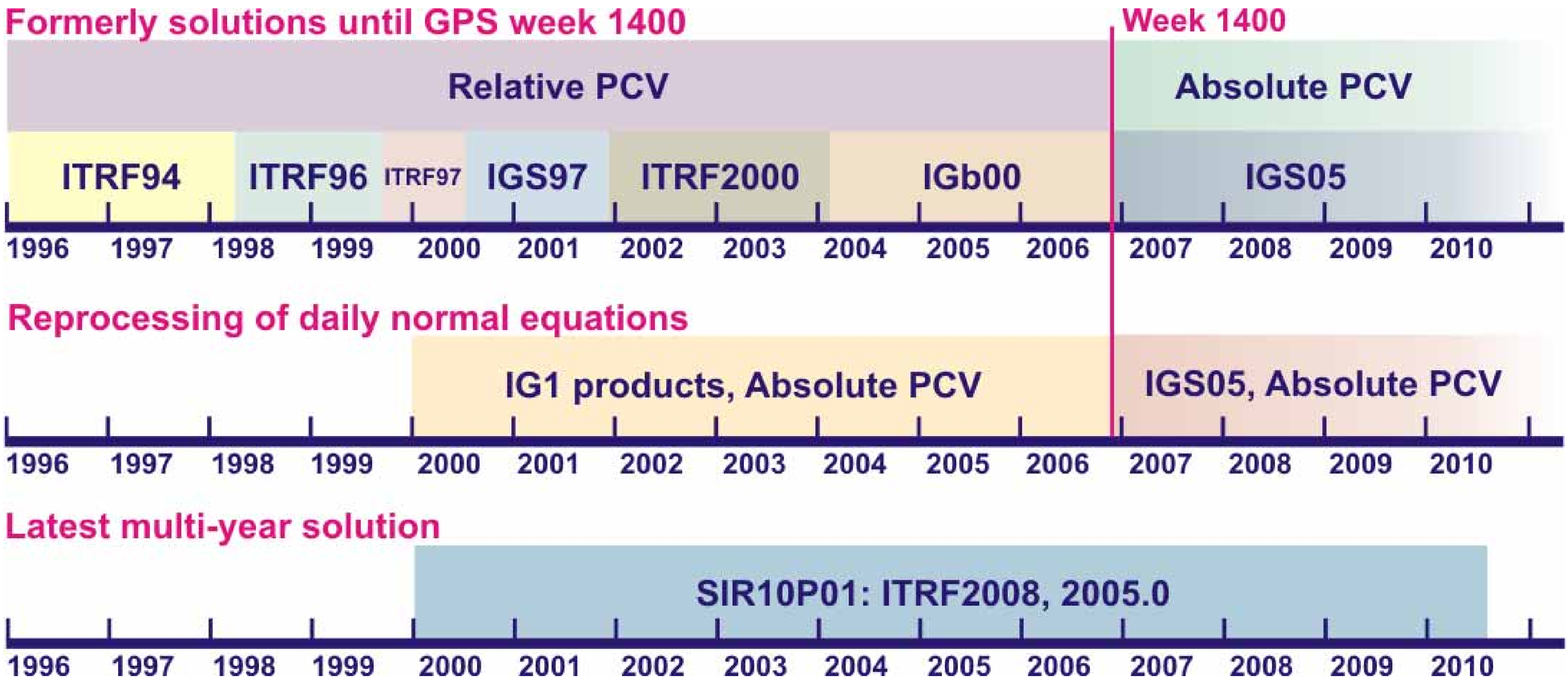




Discrepancies wrt loosely constrained solutions after applying different reference coordinates for the datum definition (GPS week 1504)

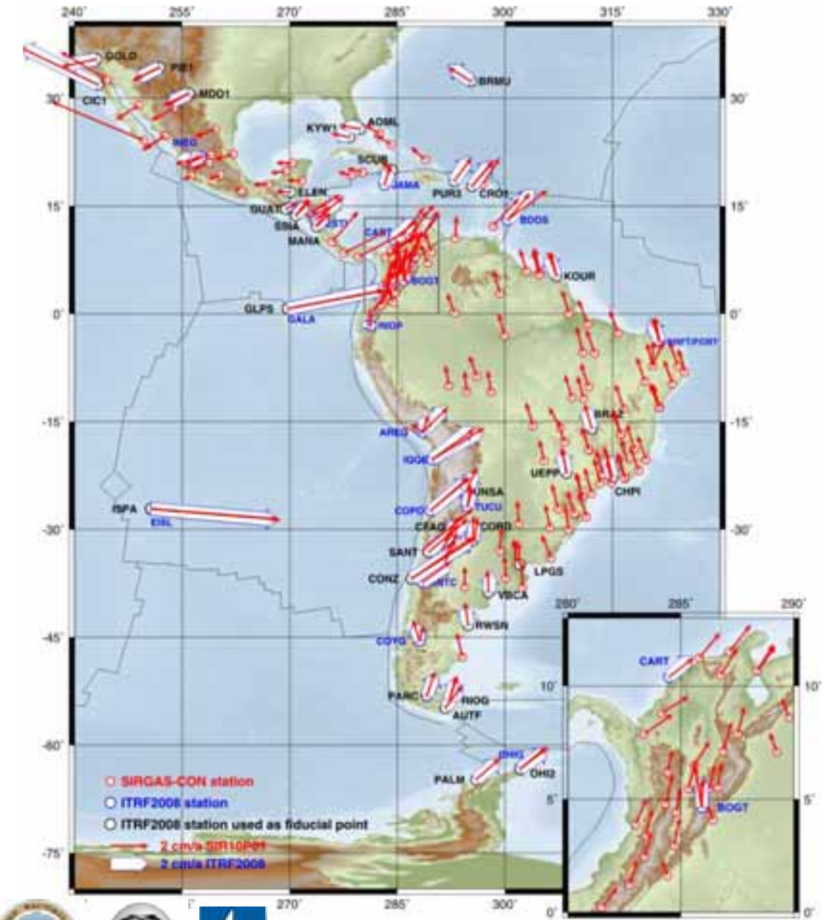
Reprocessing of the entire SIRGAS-CON network applying the reprocessed IGS products (IG1)

Every year cumulative (multi-year) solutions are computed to determine the kinematics of the SIRGAS reference frame.



Latest multi-year solution: SIR10P01

Time period: 02-01-2000 – 05-06-2010 (543 GPS weeks);
Stations: 183 (204 occupations);
Reference frame: ITF2008, epoch 2005.0;
Precision of positions at reference epoch: ±0,5 mm (hor), ±0,9 mm (up);
Precision of velocities: ±0,4 mm/a

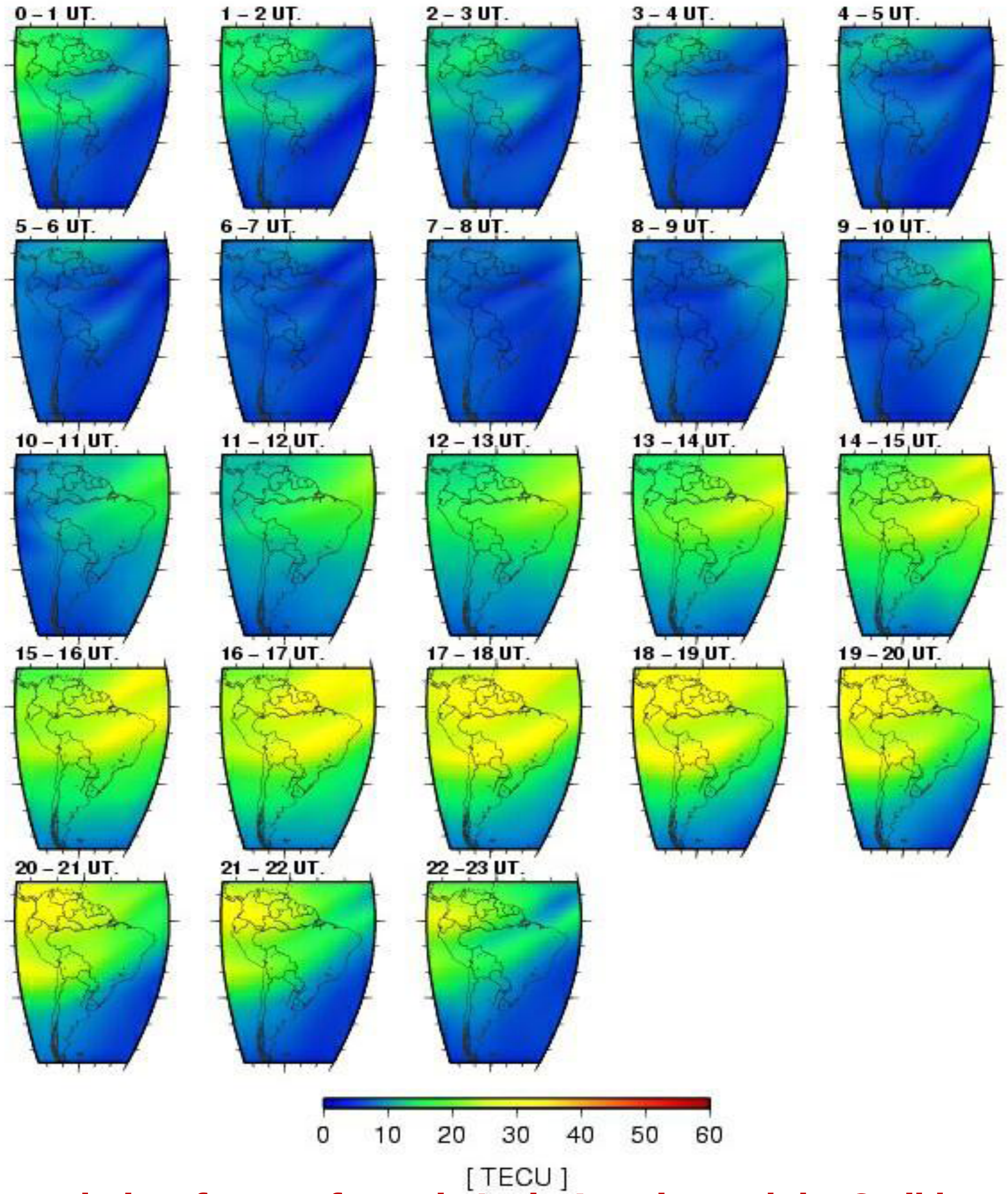


Ionospheric models of high-resolution

- Since July 2006, SIRGAS operates an Ionospheric Analysis Centre under the responsibility of La Plata National University, Argentina;
- Hourly regional maps of vTEC are computed and delivered to the community.

They are applied for:

- validation of the International Reference Ionosphere (IRI);
- improvement of positioning with single-frequency GNSS receivers;
- feasibility studies for a SBAS in the region (supported by the International Civil Aviation Organization - ICAO).



Applicability of SIRGAS as reference frame

16 countries of 18 SIRGAS member countries adopted SIRGAS as official reference frame, i.e. the SIRGAS continental network is extended through national densification networks.

Users of precise GNSS positioning refer to SIRGAS (or their densifications) by:

1. Introducing weekly station positions of the SIRGAS-CON stations as reference coordinates to process GNSS surveying;
2. Applying the velocities provided by the multi-year solutions to reduce new station positions to the conventional reference epoch defining the official reference frame.

$$X(t_o) = X(t_i) - Vx(t_i - t_0)$$

On-going activities

1. Implementation of a real-time GNSS infrastructure using NTRIP;
2. Routine analysis of the GLONASS network;
3. Modelling of atmospheric loading to understand seasonal variations of station positions;
4. Realization of a unified vertical reference system within a global definition.