About the analysis of the SIRGAS-CON network:

a proposal on the station distribution, weekly processing, and continental combination

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Motivation

1. The number of stations included in the SIRGAS Continuously Operating Network (SIRGAS-CON) is increasing very quickly. Since GPS week 1395 (October 1, 2006) 52 new stations has been integrated into the weekly processing of this network.
2. If the number of continuously operating stations continues increasing with the same velocity as it does until now, in the near future the operational capabilities of the processing centres will be overflowed.
3. Until now, SIRGAS has included in the SIRGAS-CON network all available stations in Latin America; however, not all of them operate homogeneously. About 20% of the processed stations present very large data gaps or jumps in their time series; i.e. not all SIRGAS-CON stations fully satisfy accuracy, reliability, and homogeneity requirements for a precise reference frame with long-term stability.
4. SIRGAS shall make available very good stations that due to their operability, quality, and reliability could be included into the IGS global network and in the global ITRF solutions. Although this decision is an exclusive competence of IGS and IERS, respectively, SIRGAS must be capable to present candidate sites for this purpose.

Motivation (continuation)

5. At present, more and more Latin American countries are qualifying their national reference frames by installing GNSS continuously operating stations. As a consequence, in the near future the responsibilities of the SIRGAS-WGI (Reference System) and SIRGAS-WGII (Geocentric Datum) will not be clearly separable; i.e. national densification networks, which despite of being composed by continuously operating stations, remain densification networks and all of their stations do not have to be included in the continental reference frame.

6. The hierarchy of the geodetic reference frames shall be observed:

   Level 0: Global solution of ITRF

   Level 1: Continental densifications of ITRF: EUREF, SIRGAS, NAREF, AFREF,... (task of SIRGAS-WGI in Latin America)

   Level 2: National densifications of ITRF: RBMC, CR05, MAGNA-SIRGAS, SIRGAS-REGVEN, ... (task of the SIRGAS-WGII in Lain America)

   Level 3: Local/regional densifications of the national references frames...

7. At present, SIRGAS-CON comprises indistinctly Level 1 and Level 2, a precise distinction has to be implemented.

SIRGAS Proposal

1. To define two levels within the SIRGAS-CON network
   - A ‘core’ network: SIRGAS-CON-C
   - ‘Densification’ networks: SIRGAS-CON-D
2. The SIRGAS-CON ‘core’ network shall provide a good continental coverage and stabile site locations to ensure high long-term stability of the reference frame.
3. The SIRGAS-CON ‘densification’ networks shall correspond to the national reference frames realised by continuously operating stations, i.e. there should be given so many SIRGAS-CON ‘densification’ networks as countries in the region.
4. The stations included in the SIRGAS-CON ‘core’ network shall match the requirements, characteristics, and performance of the ITRF stations. This network shall serve as the reference frame for the SIRGAS-CON ‘densification’ networks.

Proposal (continuation)

5. The SIRGAS-CON ‘core’ network continues being processed by the IGS-RNAAC-SIR (i.e. DGFI)
6. The SIRGAS-CON ‘densification’ networks shall be processed by the SIRGAS ‘Local’ Processing Centres installed in Latin America. The main idea is that each country processes its own permanent stations. Since at present there are not enough local processing centres, the stations of the SIRGAS-CON ‘densification’ networks shall be allocated to the operating local processing centres until new ones are functional.
7. The individual solutions for the SIRGAS-CON ‘densification’ networks generated by the SIRGAS ‘Local’ Processing Centres shall be combined with the SIRGAS-CON ‘core’ network solution to get homogeneous accuracies for station positions and velocities in a continental level.

SIRGAS Strategy

The proposed approach corresponds to the global polyhedron strategy of the IGS:

1. The IGS Global Network Analysis Centres (AC) individually process the IGS global network: in our case the SIRGAS-CON 'core' network is comparable with the IGS global network, and the IGS-RNAAC-SIR (DGFI) acts as Analysis Centre
2. The individual solutions for the IGS global networks are weekly combined: in our case, until now we have considered only one processing centre for the SIRGAS-CON 'core' network (i.e. DGFI), but we should install one or two more centres in Latin America, which also process this network, and then a combination should be carried out.
3. The IGS Regional Network Associate Analysis Centres (RNAAC) process appointed densifications of the IGS global network: in our case, these regional networks correspond to the SIRGAS-CON 'densification' networks (national reference frames) and the SIRGAS 'Local' Processing Centres act as the RNAAC.
4. The individual solutions generated by the IGS-RNAAC are combined with the final IGS global network solution within the global polyhedron: in our case, the individual solutions obtained by the SIRGAS 'Local' Processing Centres shall be combined with the final solution of the SIRGAS-CON 'core' network. In this way, coordinates and velocities of all stations belonging to SIRGAS-CON are totally compatible and consistent.

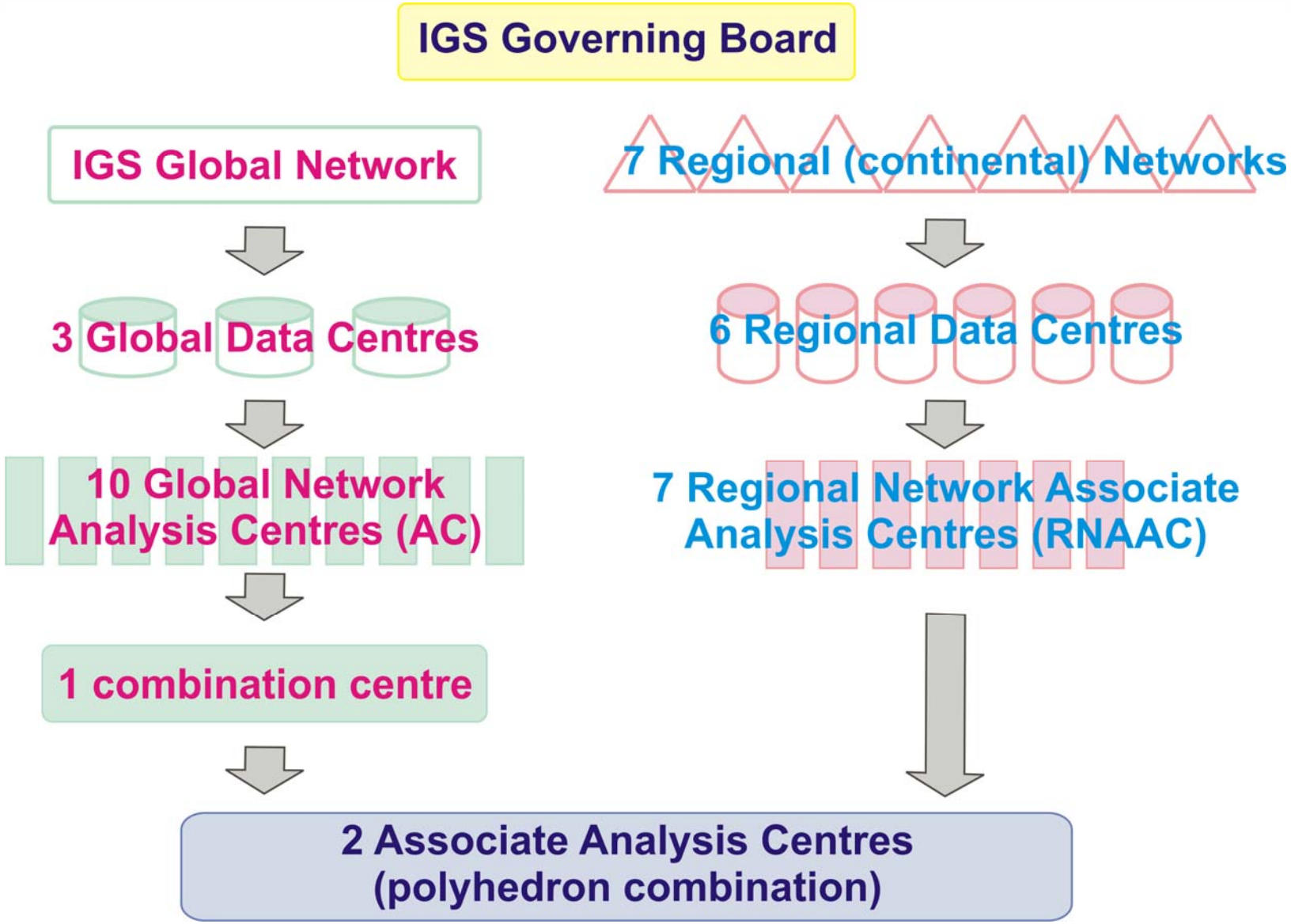
Strategy (continuation)

4. DGFI, as official IGS-RNAAC-SIR, shall continue providing the weekly solutions of the SIRGAS-CON network for the global polyhedron: in this case, IGS-RNAAC-SIR will deliver the weekly solutions of the SIRGAS-CON 'core' network. If more analysis centres in Latin America process the SIRGAS-CON 'core' network, the IGS-RNAAC-SIR will delivery the corresponding weekly combination.

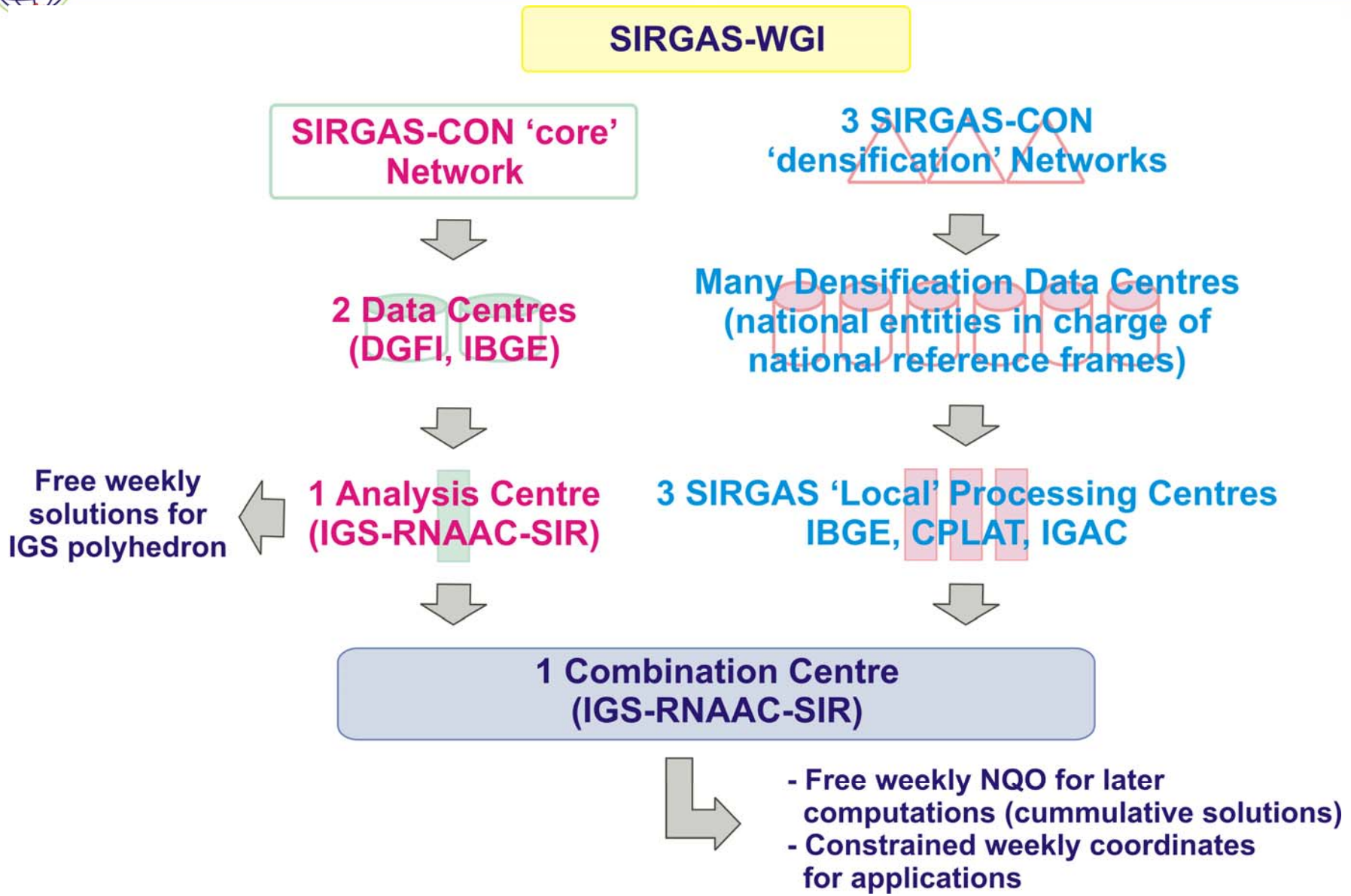
5. The combination of the 'core' and 'densification' networks should be carried out week by week generating two main products:

   - Free weekly SINEX (or NQ0) files for cumulative solutions and later computations.
   - Constrained weekly solutions (comparable with the present DGF coordinates) for practical applications.

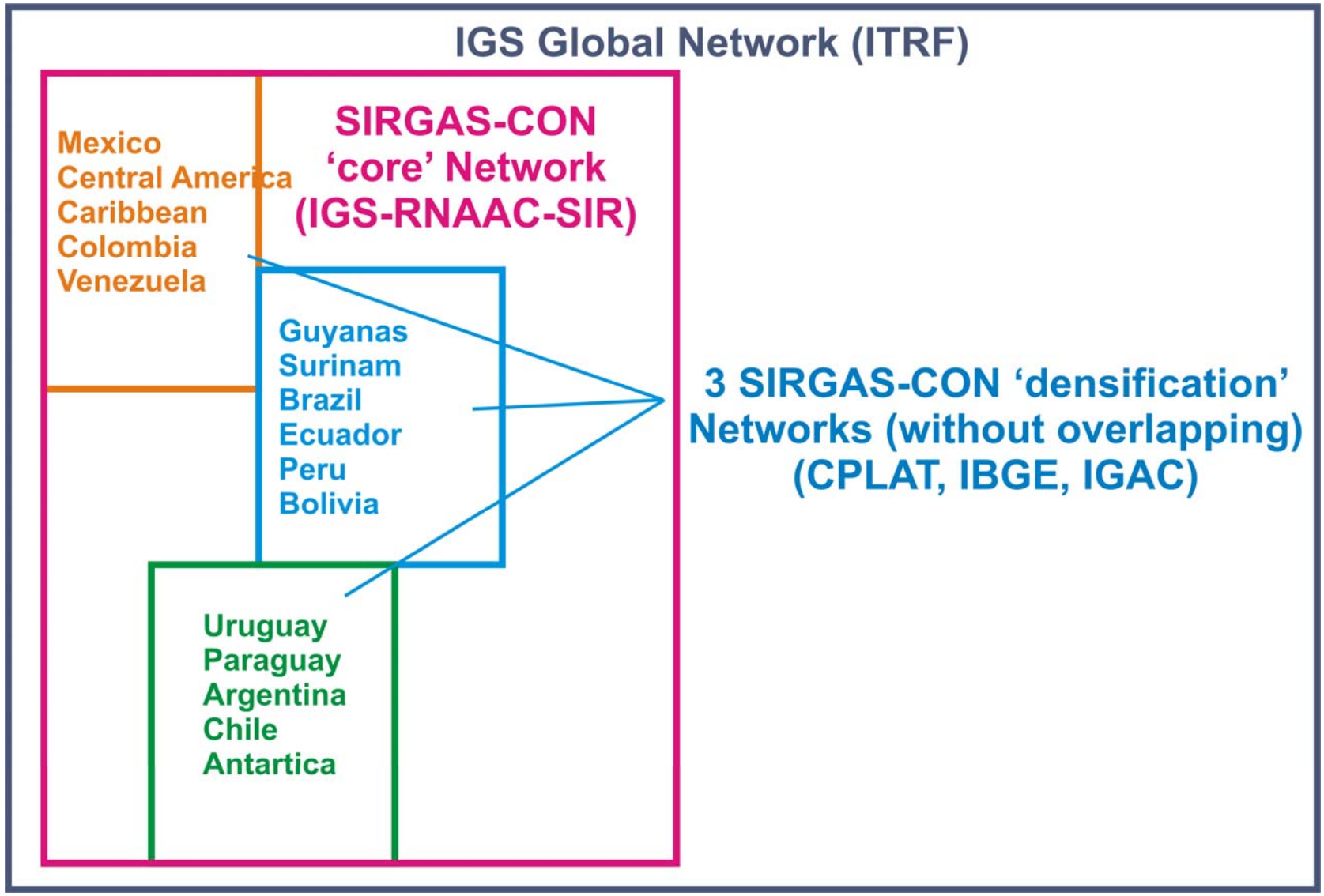
IGS Structure



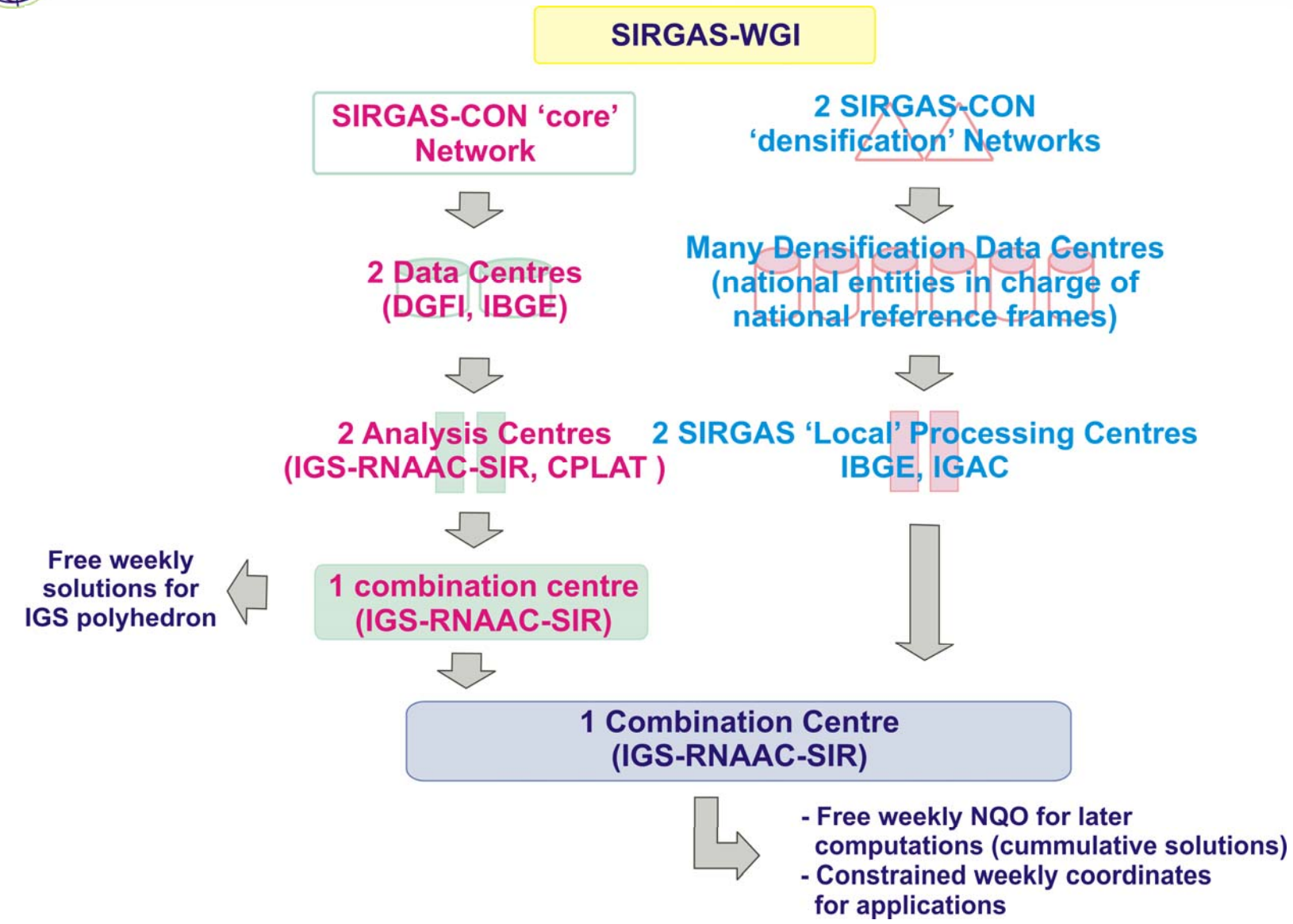
SIRGAS-CON Structure for processing: Proposal I



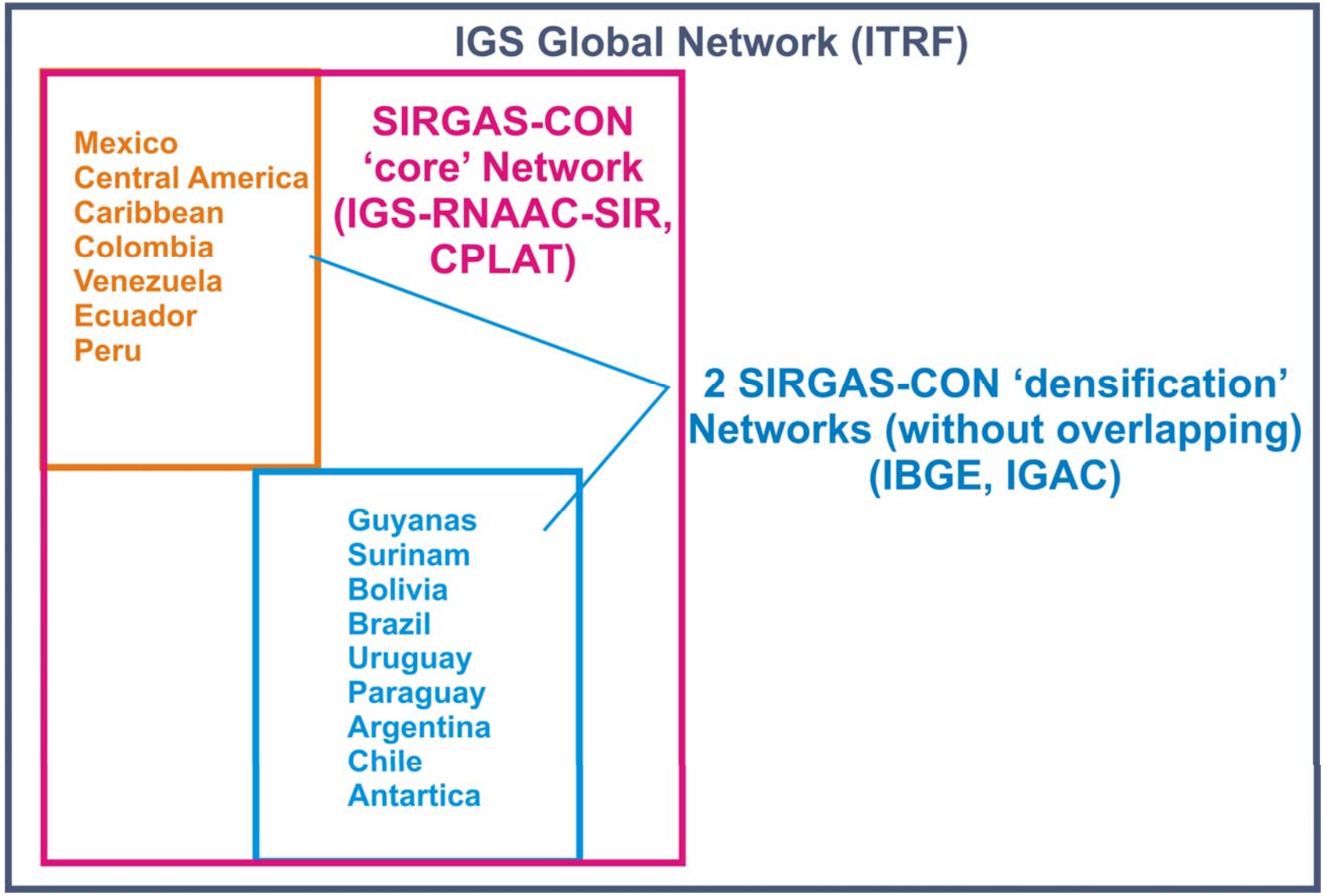
SIRGAS-CON ‘core’ and ‘densification’ networks: Proposal I



SIRGAS-CON Structure for processing: Proposal II



SIRGAS-CON ‘core’ and ‘densification’ networks: Proposal II



Requirements

1. Each continuously operating reference station installed in Latin America (i.e. 'core' or 'densification' station) should be processed under the umbrella of SIRGAS. Therefore, it is necessary to promote the installation of SIRGAS 'Local' (or densification) Processing Centres, which allow each country in the region to process their own permanent networks in the near future. Complementary, the SIRGAS 'densification' networks shall be combined in a continental solution together with the SIRGAS-CON 'core' network; i.e. SIRGAS should also promote and realize the installation of operative combination centres.

2. Since the SIRGAS 'densification' networks shall be combined with the SIRGAS-CON 'core' network, a well-coordinated effort is necessary to distribute the regional SIRGAS-CON stations between the SIRGAS 'Local' Processing Centres to get homogeneous accuracies for station positions and velocities in the combined solutions; i.e. each regional SIRGAS-CON station shall be included in the same number of individual solutions.

3. Common stations for the different SIRGAS-CON 'densification' Networks shall exclusively be IGS05 Stations. The other IGS global stations shall be managed as the SIRGAS regional stations; i.e. they should be included in the same number of individual solutions.

Requirements (continuation)

4. SIRGAS analysis centres (for the ‘core’ and for the ‘densification’ networks) shall permanently adapt their processing strategies following the IERS (i.e. IGS) conventions, but coordinated by the SIRGAS-WGI to simultaneously introduce changes and updates.

5. The individual solutions delivered for the combination should meet common standards and models. In order to avoid problems concerning the reduction of constraints, unconstrained normal solutions should be provided. If constrained solutions are delivered, all constraints have to be reported in the corresponding SINEX files.

6. The establishment of SIRGAS processing and combination centres in Latin America, as well as the processing and combination strategies, shall guarantee the highest possible consistency and accuracy of the SIRGAS-CON network as a reference frame for the Americas. Therefore, a well-planned and coordinated effort is required to define analysis strategies, responsibilities, and scopes of the contributing bodies: station administrators, local processing centres, combination centres.

SIRGAS Implementation

Definition of the SIRGAS-CON 'core' network:

1. Similarly to the SIRGAS campaign performed in 1995, each country shall contribute with a number of stations for the continental reference frame (i.e. SIRGAS-CON 'core' network). The number of stations per country should be defined according to the area of the country. SIRGAS-WGI shall appoint these numbers.
2. Each country shall select the corresponding stations; for instance, if Colombia should contribute with 8 stations, the national entity responsible for the geodetic reference frame in this country shall inform SIRGAS which 8 MAGNA-ECO stations are to be included in the SIRGAS-CON 'core' network
3. Countries shall ensure that the selected stations are be the best ones, not only in operability, continuity, and reliability, but also in geographical coverage.
4. SIRGAS-WGI shall evaluate (and accept or refuse) the proposed stations by analysing the corresponding time series, RMS values, and accuracy (in coordinates and velocities) obtained in the last multi year solution calculated by the IGS-RNAAC-SIR (solution DGF08P01-SIR).

Implementation (continuation)

Definition of the SIRGAS-CON 'densification' networks:

5. New permanent stations in the Region shall fulfil the requirements outlined by the SIRGAS-WGI to become a SIRGAS-CON station. Primarily, new stations are to be classified as 'densification' stations. If a new station is located in a geographically region without SIRGAS-CON 'core' stations, SIRGAS-WGI shall evaluate the convenience to integrate it in the 'core' network.

6. SIRGAS-WGI shall specify which SIRGAS 'Local' Processing Centres should include the new station(s) in their weekly analysis.

7. All standards, conventions, and recommendations generated by the SIRGAS-WGI shall be designed and be observed to get a consistent operability between station operators, processing centres, and combination centres.