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# **GUIDE01 SIRGAS NETWORK COORDINATION**


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	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021


## CONTENTS

LIST OF FIGURES.....	2
DOCUMENT CHANGE LOG .....	3
1 INTRODUCTION.....	4
2 ORGANIZATION OF THE SIRGAS-CON NETWORK .....	5
3 INSTALLATION, OPERATION AND PROCESSING OF THE SIRGAS-CON NETWORK .....	7
3.1 OPERATING CENTERS .....	7
3.2 NATIONAL DATA CENTERS.....	7
3.3 REGIONAL DATA CENTER.....	8
4 SIRGAS-CON NETWORK PROCESSING.....	8
4.1 LOCAL PROCESSING CENTERS.....	9
4.2 COMBINATION CENTERS .....	9
4.3 IGS-REGIONAL NETWORK ASSOCIATED ANALYSIS CENTER FOR SIRGAS (IGS-RNAAC-SIR) 10	
5 COORDINATION OF SIRGAS-CON ACTIVITIES.....	10
5.1 CHAIRPERSON OF SIRGAS-GTI .....	10
5.2 NETWORK COORDINATOR .....	11
5.3 ANALYSIS COORDINATOR .....	12
5.4 COORDINATOR WITH IGS .....	12
6 SIRGAS-CON PRODUCTS .....	13
7 BIBLIOGRAPHY .....	14
8 ACRONYMS .....	15

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

## LIST OF FIGURES

Figure 1 SIRGAS organizational chart .....	5
Figure 2 SIRGAS Working Groups .....	5

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

## DOCUMENT CHANGELOG

Version 2.0, 12.2021

(Previous edition: Version 1.4, 03.2017)


- 12.2021:** A detailed update of the SIRGAS guides prior to the current ones is made. Of the four existing guides:
1. Guide for the installation of SIRGAS-CON stations
  2. Procedure to register a new station in the SIRGAS-CON network
  3. Guide for the coordination of SIRGAS-CON
  4. Guide for SIRGAS Analysis Centers
- The order is changed and they are generated in 3 new guides:
1. Guide01 Coordination of the SIRGAS Network
  2. Guide02 Installation, operation and registration of SIRGAS-CON stations
  3. Guide03 Processing guidelines for SIRGAS-CON analysis centers
- A general review of the content is made, internet links and additional details related to the Analysis Centers, the structure of SIRGAS and Working Group I are updated. Most of the texts prepared in previous versions by L. Sánchez, C. Brunini, S. Costa , V.M. Mackern and V. Cioce remain. As of this version, the writing team is indicated in the source of this document.
- 03.2017:** Some links on the Internet have been updated.
- 08.2013:** Some links on the Internet have been updated.
- 07.2011:** Replace "CPAGS-LUZ: SIRGAS GNSS Processing and Analysis Center at the Laboratory of Physical and Satellite Geodesy of the University of Zulia (Venezuela)" with "CPAGS-LUZ: GNSS SIRGAS Processing and Analysis Center of the University of Zulia (Venezuela)."
- 01.2010:** The lists of the SIRGAS-CON Station Operating Centers and the National Data Centers (Annexes 1 and 2) are excluded, with the clarification that an updated list containing these details is available at <https://sirgas.ipgh.org/>
- 01.2009:** "General Directorate of Cadastre, Ministry of Finance, La Pampa Government (DGC La Pampa), Argentina" and "Private Technical University of Loja (UTPL), Ecuador" are added as SIRGAS-CON Station Operator Centers.

The objective of this document is to describe the components for the SIRGAS Continuous Operation Network (SIRGAS-CON), as well as their responsibilities and interaction. It has been prepared by the SIRGAS-GTI and complemented with recommendations made by various colleagues. SIRGAS appreciates this valuable collaboration.

In order to keep this document up-to-date, you are cordially invited to send your comments, questions or suggestions to the chair of SIRGAS-GTI, whose contact details may be found at <https://sirgas.ipgh.org/>

### Related documents:

- Guide02 Installation, Operation and Registration of SIRGAS-CON Stations.
- Guide03 Processing guidelines for the SIRGAS Analysis Centers.

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

## I INTRODUCTION

The SIRGAS (*Sistema de Referencia Geodésico para las Américas – in the past Sistema de Referencia Geocéntrico para las Américas*) Continuously Operating Network (SIRGAS-CON) represents the regional densification of the International Terrestrial Reference Frame (ITRF), currently ITRF14,[1], [2] using the following as observation technique Global Navigation Satellite System (GNSS), International GNSS Service (IGS) products,[3] and a network of Continuously Operating Reference Station (CORS) GNSS stations distributed throughout the American continent. This network provides the Reference Frame for the geodetic infrastructure of member countries and relies on the voluntary cooperation from over fifty governmental, academic and scientific institutions in the region, which place the GNSS observations recorded by their stations at the disposal of the SIRGAS Analysis Centers. To date, SIRGAS is made up of a network of GNSS CORS with high-precision coordinates (associated with a specific reference epoch) and their changes over time (station velocities), which are routinely calculated by the SIRGAS Analysis Centers. The SIRGAS-CON network includes over 450 stations, as detailed [in https://sirgas.ipgh.org/](https://sirgas.ipgh.org/) [4]


As the countries of the Americas are continually improving their geodetic reference frames by installing more and more continuously operating GNSS stations, and bearing in mind that these stations have to be consistently integrated into the continental reference frame, the SIRGAS-CON network is divided up as follows:

1. A continental coverage network (SIRGAS-C), as the primary densification of the IGS on the American continent, including stable stations featuring optimal operations which are able to guarantee the consistency, durability and precision of the reference frame over time.
2. National reference networks (SIRGAS-N) that densify the continental network and provide access to the reference frame at both national and local levels. Both the continental and national networks share the same characteristics and quality standards, as each station is processed by at least three Analysis Centers.

The products created by the network's weekly processing routines demand without fail that these observables be accurately and precisely measured and processed. This requires both existing stations and the new sites selected by the administrators or operators of continuous stations to comply with certain standards and conventions guaranteeing their operation and the quality of the observations.

The same applies to the processing of the observations generated at the SIRGAS-CON stations, which must be processed according to certain standards and conventions guaranteeing the precision and quality of the results.

The coordination of activities related to the administration, maintenance and analysis is the responsibility of SIRGAS Working Group I (Reference System). This document shows the complete functional organization chart of Working Group I and the SIRGAS-CON network and lays out the responsibilities and commitments of all the organizations and professionals involved.

	<b>SIRGAS-CON Station Network Coordination</b>	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

## 2 ORGANIZATION OF THE SIRGAS-CON NETWORK

SIRGAS is a non-profit organization which functions thanks to the voluntary contributions of scientific organizations and the national geodetic, cartographic or geographic agencies of the members' countries. The organizational flowchart of its operations is as follows:




Figure 1 SIRGAS organizational chart

The red polygon is used to point out the organizational flowchart of Working Group I, which is in charge of coordinating the SIRGAS-CON network. The activities are divided mainly between the installation and the operation of the SIRGAS-CON stations, and network processing tasks.



Figure 2 SIRGAS Working Groups

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021


SIRGAS-GTI, is responsible for coordinating the evaluation and processing of the continental geodetic network densifying the ITRF/IGS in the Americas, with the aim of guaranteeing its long-term stability (i.e., ensuring the same quality over time) and uniform consistency (i.e., the same quality everywhere). In order to do this, a primary line of action is the regular processing of the SIRGAS continuous operation network, SIRGAS-CON, applying criteria attached to standards and conventions on GNSS data processing of high quality.

SIRGAS-CON operations are based on the voluntary contributions made by over fifty entities responsible for installing the stations, which are in charge of ensuring their proper operation before making the observed and stations metadata available to the Analysis Centers.

As the countries of the Americas are continually improving their geodetic reference frames by installing more and more GNSS CORS, and bearing in mind that these stations have to be consistently integrated into the continental reference frame, the SIRGAS-CON network coordinated by the SIRGAS-GTI is based on the following centers:

- Operator Centers (CO)
- National Data Centers (NDC)
- Regional Data Centers (RDC)
- Analysis Centers (AC)
  - Local Processing Centers (LPC)
  - Combination Centers (CC)
  - IGS Regional Network Associated Analysis Center for SIRGAS (IGS-RNAAC-SIR)
  - Atmospheric Processing Centers (ASC)

To summarize, all the work carried out by the SIRGAS-GTI deals with the interrelation between permanent stations operators, the data centers, and the analysis centers, as it seeks to establish and disseminate the corresponding standards and guidelines for action as well as control the quality, reliability and timeliness of SIRGAS-CON products.

 <b>SIRGAS</b> <small>sirgas.ipgh.org</small>	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

### 3 INSTALLATION, OPERATION AND PROCESSING OF THE SIRGAS-CON NETWORK

The main bodies involved in the installation and operation of the SIRGAS-CON network are listed and described below:

**Operator Centers (OC):** These entities are in charge of guaranteeing the proper functioning of one or more GNSS CORS (e.g., in a local or national network). The list of existing OC is available at <https://sirgas.ipgh.org/> [4]. They are responsible for the installation, commissioning and proper functioning of the permanent stations.

**National Data Centers (NDC):** They manage, store and make available to users the observations produced by the permanent stations, which are provided by an Operator Center. The NDC makes the RINEX files (*Receiver Independent Exchange Format*) [5] available to the SIRGAS Analysis Centers in Hatanaka format [6] for the stations under their charge. The list of existing NDC is available at <https://sirgas.ipgh.org/> [4]. Generally, the Geographic Institutes of each country act as the National Data Center.

**Regional Data Center (RDC):** This entity is responsible for ensuring the long-term storage of the SIRGAS-CON stations' observations, subsequently processed by the IGS Regional Network Associate Analysis Center for SIRGAS (IGS-RNAAC-SIR). The SIRGAS Regional Data Center is located at the Deutsches Geodätisches Forschungsinstitut der Technischen Universität München (DGFI-TUM, Germany), and, like the SIRGAS Analysis Centers, is not authorized to transfer the RINEX files from the stations processed to third parties.

The OC, NDC and RDC are governed in technical terms according to the guidelines given in "**Guide 02 Installation, Operation and Registration of SIRGAS-CON Stations**", and their responsibilities are detailed below.

#### 3.1 OPERATING CENTERS

Their functions and responsibilities are as follows:


1. Install, commission and operate GNSS receivers and antennas in accordance with the standards set for geodetic reference stations.
2. Evaluate the observations recorded by the stations under their charge, converting these observations to RINEX format, compressing the RINEX files generated into Hatanaka format,<sup>[7]</sup> and making them available on FTP, HTTPS or any other protocol, allowing them to be distributed by the National Data Centers amongst the SIRGAS Analysis Centers within two days of the observation date.
3. Carry out preventive and/or corrective maintenance of the stations under their responsibility to ensure that operations are carried out in accordance with the needs of the national reference frames and regional SIRGAS.
4. Keep the log files of the stations under their responsibility updated, especially when there are changes, and send timely information to the Network Coordinator. In case of changes in the configuration of the stations, especially in the receiver, antenna or monumentation, the SIRGAS mailing list should be used to inform the Analysis Centers in a timely manner. (see <http://sirmail.dgfi.tum.de> [8]) and any changes should be reported no later than one day after the modification takes place.
5. Keeping the National Data Centers and the SIRGAS Analysis Centers informed in a timely fashion of any operating problems arising in any of the stations under their responsibility. The *SIRGAS Mail* should be used for this purpose (see <http://sirmail.dgfi.tum.de> [8]).

#### 3.2 NATIONAL DATA CENTERS

Their functions and responsibilities are as follows:

1. Collect all observations recorded by the CORS GNSS stations belonging to a national reference frame.



	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

2. Put these observations at the disposition of the SIRGAS Analysis Centers within two days of the observation date, using FTP, HTTPS or any other automatic data download protocol.
3. Inform the SIRGAS Analysis Centers in a timely manner of any interruption in the flow of RINEX files from any of the stations under their charge. The *SIRGAS Mail* should be used for this purpose (see <http://sirmail.dgfi.tum.de>[8]).
4. If the corresponding Operating Center does not do any of the following, then the NDC should: evaluate the observations recorded by the stations under their responsibility, convert these observations to the RINEX format, compress the RINEX files generated into Hatanaka format and make them available on the FTP, HTTPS or any other protocol so that the SIRGAS Analysis Centers can access the data within the two days following the observation date.
5. If the corresponding Operating Center does not do so, the NDC should keep the log files of the stations under its responsibility up-to-date and send them promptly to the Network Coordinator. Any changes in equipment (receiver and antenna) must be recorded and informed using the *SIRGAS Mail* within two following business days.

*Note:* Many National Data Centers within SIRGAS are in the same location as the Operating Centers of the stations belonging to the national reference frames. In these cases, they must both follow the pertinent indications given, i.e., those for the Operating Centers and those for the National Data Centers.

### 3.3 REGIONAL DATA CENTER

Their functions and responsibilities are as follows:

1. Collection and storage of long-term observations (RINEX files) from SIRGAS-CON stations processed by the IGS-RNAAC-SIR.


Since June 1, 1996 till August 30, 2008, the IGS-RNAAC-SIR processed all SIRGAS stations. With the establishment of SIRGAS Local Processing Centers under the responsibility of Latin American organizations, from the GPS week 1495 (August 31, 2008), the IGS-RNAAC-SIR processes the stations belonging to the SIRGAS-C core network. The IGS-RNAAC-SIR is responsible for the long-term storage of the observational data of the entire SIRGAS-CON network from June 1, 1996 to August 31, 2008, and for the observations of the stations belonging to the SIRGAS-C core network since August 31, 2008. If these observations are needed, those interested must directly contact the stations managers, either at the National Data Centers or at the Operating Centers.

## 4 SIRGAS-CON NETWORK PROCESSING

The processing carried out as part of the SIRGAS-CON network are performed by the SIRGAS Analysis Centers, as follows:

**Local Processing Centers (LPC):** They are entities in charge of processing the SIRGAS-N network (national networks), generating loosely constrained weekly solutions for the positions of the stations contained in these networks. Currently the SIRGAS Local Processing Centers are:

- Centro de Procesamiento de Datos GNSS del Ecuador (CEPGE) del Instituto Geográfico Militar (IGM, Ecuador).
- Centro de Procesamiento y Análisis Geodésico de la Universidad de Santiago de Chile (USC).
- Instituto Brasileiro de Geografia e Estatística (IBGE, Brasil).
- Instituto Geográfico Agustín Codazzi (IGAC, Colombia).
- Instituto Geográfico Militar (IGM, Chile).
- Instituto Geográfico Militar (IGM, Uruguay).
- Instituto Geográfico Nacional (IGN, Argentina).
- Instituto Geográfico Nacional (IGN, Perú).

 SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
	Rev.	2.0
	Date	01.12.2021

- Instituto Nacional de Estadística y Geografía (INEGI, México).

The individual weekly solutions are combined with each other and with the solutions of the SIRGAS-C network to create the final products for the SIRGAS-CON network (i.e., loosely constrained weekly solutions, positions associated with a reference epoch and accumulated solutions with positions and velocities for all SIRGAS-CON stations). These products are made available to SIRGAS users on the <https://sirgas.ipgh.org/> website [4].

**Experimental Processing Centers (EPC):** These are candidates to become future SIRGAS Local Processing Centers. They adapt their calculation strategies to SIRGAS specifications during a specific training period (generally one year), and ensure the timely and continuous delivery of weekly solutions according to SIRGAS guidelines. Once they satisfy the given requirements, they are designated as official Local Processing Centers. During the trial period, the Experimental Centers calculate a certain set of SIRGAS stations, but their solutions are not included in the process to create the final SIRGAS products. They share the same responsibilities as the LPC, currently are:

- Instituto Geográfico Nacional (IGN, Costa Rica).

**Combination Centers (CC):** These entities are responsible for the combination of loosely constrained weekly solutions generated by SIRGAS Local Processing Centers for the SIRGAS-N national networks, and by DGFI-TUM for the continental network SIRGAS-C. Currently, the SIRGAS Combination Centers are DGFI-TUM and IBGE. Their main responsibilities are detailed in item 4.2.

**IGS Regional Network Associate Analysis Center for SIRGAS (IGS-RNAAC-SIR):** The IGS Regional Network Associate Analysis Center for SIRGAS, operated in Germany by the Deutsches Geodätisches Forschungsinstitut der Technischen Universität München (DGFI-TUM), is in charge of processing the SIRGAS-C network and combining it with the individual solutions provided by the LPC in a weekly basis. The weekly combination released by the IGS-RNAAC-SIR is delivered to the IGS Analysis Centres to be integrated into the global IGS polyhedron.

The LPC, EPC, CC and IGS-RNAAC-SIR are technically governed according to the guidelines of the "**Guide03 Processing guidelines for the SIRGAS Analysis Centers**" and their responsibilities are detailed as follows:


#### 4.1 LOCAL PROCESSING CENTERS

Their functions and responsibilities are as follows:

1. To generate and deliver loosely constrained weekly and daily solutions to the SIRGAS Combination Centers for the positions of those stations included in the network under their responsibility. These solutions must be presented in SINEX format (*Solution (Software/technique) INdependent EXchange Format*) within three weeks from the observation date. SINEX files must include all the constraints in the generation of daily and weekly solutions.
2. They must strictly follow the standards and guidelines issued by the International GNSS Service (IGS) as well as the SIRGAS specific processing strategy defined by SIRGAS-GTI in the document "**Guide03 Processing guidelines for the SIRGAS Analysis Centers**".
3. Sign up for the *SIRGAS Mail* to stay up-to-date about the events reported by the Operating Centers and National Data Centers related to the stations under their responsibility. The process to sign up for the *SIRGAS Mail* is explained in <http://sirmail.dgfi.tum.de>[8])
4. Sign up for the *IGS Station Exploder* and for the *IGS Mail Exploder* to stay abreast of changes in the global IGS stations and receive announcements of relevance to the IGS community. Instructions for subscribing to these two newsletters is described in <http://www.igs.org/mail>[9]

#### 4.2 COMBINATION CENTERS

These entities have the following functions and responsibilities:

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

1. Compare the weekly solutions (station positions in SINEX format) generated individually by the Local Processing Centers and combine them into a unified solution including all SIRGAS-CON stations (SIRGAS-C + SIRGAS-N).
2. Eliminate from the individual solutions sent by the LPC those stations whose positions present significant differences in comparison with the coordinates obtained in the combined solution.
3. Review the solutions generated by the LPC and formulate the necessary proposals to guarantee the routine generation of consistent solutions for the different subnetworks. This process must be carried out in agreement with the Analysis Coordinator.
4. Generate loosely constrained weekly solutions in SINEX format, weekly solutions aligned to the ITRF via the IGS reference frame (coordinates adjusted to the IGS and referred to the observation time) and accumulated multi-year solutions (positions + velocities). Weekly products must be available within the fourth week as from the observation date.
5. Report the main results of the comparison of the individual solutions sent by the LPC in SINEX format, including variance factors weighting the individual solutions in the combination.
6. Bring forward the analysis of the time series generated from the coordinates of the stations to identify and eliminate any jumps or gross errors occurring in these.
7. Inform the Chair of SIRGAS-GTI about any problems or irregularities arising in the combination.
8. Appoint, together with the Chair of the SIRGAS-GTI, specialists to investigate specific problems related to the combination.

#### 4.3 IGS-REGIONAL NETWORK ASSOCIATED ANALYSIS CENTER FOR SIRGAS (IGS-RNAAC-SIR)

This entity has the following functions and responsibilities:

1. Send loosely constrained weekly solutions for the entire network (combination of SIRGAS-C with the national SIRGAS-N networks) to the IGS to calculate the global polyhedron.
2. Generate multi-year solutions with positions and velocities for all SIRGAS-CON stations (SIRGAS-C continental network + SIRGAS-N national networks).

## 5 COORDINATION OF SIRGAS-CON ACTIVITIES

The coordination of the SIRGAS-CON networks activities is performed by:


- Chair of the SIRGAS-GTI.
- Coordinator of the SIRGAS-CON Network.
- Coordinator of the SIRGAS-CON Analysis.
- Coordinator with IGS.

Their roles and responsibilities are set out as follows.

### 5.1 CHAIR OF SIRGAS-GTI

Their roles and responsibilities are:

1. Coordinates the different activities of the SIRGAS-GTI related to the SIRGAS-CON network and is responsible for the generation of associated products with GTI in conjunction with the SIRGAS Executive Council and the Analysis Centers.
2. Prepare the annual report of Subcommittee (SC) 1.3b: South and Central America of the IAG in collaboration with the vice-chair of said SC.


	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

3. Maintains permanent contact and provides advice when necessary to the parties to the SIRGAS-CON network (Operating Centers, National Data Centers, Local Processing Centers and Combination Centers).
4. Designs procedures and promotes the actions required to improve the activities of each of the SIRGAS-CON components.
5. Informs the parties to the SIRGAS-CON about the innovations taking place in IGS standards and coordinates their introduction into the corresponding SIRGAS-CON activities.
6. Coordinates the generation, update and adequate application of processing strategies.
7. Evaluates the overall performance of the Working Group and directs the process to set up new Analysis Centers.
8. Requests annual activity reports from all the Analysis Centers (official and experimental).
9. Advises those entities wishing to become a SIRGAS Analysis Center.
10. Authorize, manage and inform if a station joins or leaves the network.
11. Execute the action of incorporating or de-incorporating stations (e.g., validation of data in RINEX format, evaluation of data availability and access, checking RINEX and log files, etc.).
12. Propose the total or partial distribution of the SIRGAS-CON stations to the different Analysis Centers.
13. Report on the integration of new stations to SIRGAS, specifying the Processing Centers responsible for their calculation.
14. Reviews and updates the SIRGAS-CON guidelines and protocols.
15. Keeps the SIRGAS community informed about the current state of affairs, any potential problems and the actions to be taken in relation to the network.
16. Draw up a yearly report on the activities carried out within the reference frame of the SIRGAS-CON network for presentation to the SIRGAS Board of Directors.
17. Organizes meetings and workshops covering different aspects of the SIRGAS-CON network and proposes and collaborates with studies and projects related to network operations.
18. Serves as a coordinator of the SIRGAS-CON network when the Board of Directors so decides.
19. Keep the network database updated on the SIRGAS corporate website.

## 5.2 NETWORK COORDINATOR

Their roles and responsibilities are:

1. Coordinate and control the adequate flow of data between the different SIRGAS-CON components.
2. Establish effective communication channels with the Data Centers in order to guarantee the availability of the data recorded by the stations and the early resolution of possible problems.
3. Review the integrity of the equipment in the log files sent by the Operating Centers and the National Data Centers and guarantee the availability of the updated log files for each SIRGAS-CON station.
4. Request a complete and updated version of all the log files from the Operating Centers and the National Data Centers involved in SIRGAS on an annual basis, as established in the corresponding guides.
5. Keep information up-to-date of SIRGAS-CON stations that are in operation, have been removed from the list, or are temporarily out of service.

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

6. Ensure that the SIRGAS FTP site has the latest versions of the files necessary for correct processing by the SIRGAS-CON stations, especially those related to the corrections of the variations at the phase centers of the GNSS antennas, corrections for oceanic and atmospheric loading effects, station equipment (receivers and antennas), height of station antennas, etc.
7. Ensure compliance with the guidelines governing the incorporation, installation and operation of SIRGAS-CON stations.

### 5.3 ANALYSIS COORDINATOR


Their roles and responsibilities are:

1. Analyze the weekly solutions generated by the Processing and Combination Centers.
2. Evaluate the distribution of stations assigned to the Analysis Centers and make suggestions for changes.
3. Report inconsistencies detected during the network adjustment.
4. Report which stations are no longer included in the weekly solutions.
5. Coordinate the tasks related to network reprocessing with the Analysis Centers.

### 5.4 COORDINATOR WITH IGS

Their roles and responsibilities are:


1. Serve as a liaison between IGS and SIRGAS regarding the SIRGAS-CON network
2. Keep the SIRGAS Processing Centers informed about IERS standards and the IGS guidelines for GNSS data processing.
3. Process the continental fundamental SIRGAS network (SIRGAS-C) on a weekly basis.
4. Combine the SIRGAS-C network with the networks calculated by the SIRGAS Processing Centers on a weekly basis. This combination supports the one calculated by IBGE as the SIRGAS Combination Center.
5. Calculate the multi-annual solutions of the SIRGAS reference frame.
6. Make previous SIRGAS products available through <https://sirgas.ipgh.org/> [4] and [ftp://ftp.sirgas.org/\[10\]](ftp://ftp.sirgas.org/[10]) or through official channels.

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

## 6 SIRGAS-CON PRODUCTS


The loosely constrained weekly solutions of the national networks are combined with the SIRGAS-C network, ensuring that the positions and velocities of all stations (continental and densification) are compatible with each other. The final products of the SIRGAS-CON network are:

- **loosely constrained weekly solutions** to integrate SIRGAS into the IGS global polyhedron and for the generation of multi-year solutions
- **weekly coordinates aligned to the ITRF through the IGS reference frame** (referred to the time of observation) for practical applications on the American continent
- **multi-year solutions** (accumulated) with positions and velocities adjusted to the ITRF for practical and scientific applications requiring the variability of geodetic coordinates with time
- **tropospheric delays**, provide daily files per station with zenithal tropospheric delay (ZPD) values at an hourly sampling interval.

	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
		Date	01.12.2021

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	SIRGAS-CON Station Network Coordination	Ref.:	Guide 01
		Rev.	2.0
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## 8 ACRONYMS

*APC: Atmospheric Processing Centers*

*CC: Combination Centers*

*CO: Operator Centers*

*CORS: Continuously Operating Reference Station*

*EPC: Experimental Processing Centers*

*FTP: File Transfer Protocol*

*GNSS: Global Navigation Satellite System*

*HTTPS: HyperText Transfer Protocol Secure*

*IERS: International Earth Rotation and Reference Systems Service*

*IGS-RNAAC-SIR IGS Regional Network Associate Analysis Centre for SIRGAS*

*IGS: International GNSS Service*

*ITRF: International Terrestrial Reference Frame*

*LPC: Local Processing Centers*

*NDC: National Data Centers*

*RDC: Regional Data Center*

*RINEX: Receiver Independent Exchange Format*

*SINEX: Solution (Software/technique) INdependent EXchange Format*

*CHL: Instituto Geográfico Militar, Chile (Military Geographical Institute, Chile)*

*CRI: Instituto Geográfico Nacional, Costa Rica (National Geographic Institute, Costa Rica)*

*DGFI-TUM: Deutsches Geodätisches Forschungsinstitut der Technischen Universität München*

*ECU: Centro de Procesamiento de Datos GNSS del Ecuador – IGM (Ecuador GNSS Data Processing Center – IGM)*

*GNA: Instituto Geográfico Nacional, Argentina (National Geographic Institute, Argentina)*

*IBG: Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)*

*IGA: Instituto Geográfico Agustín Codazzi, Colombia (Agustín Codazzi Geographic Institute, Colombia)*

*INE: Instituto Nacional de Estadística y Geografía, México (National Institute of Statistics and Geography, México)*

*PER: Instituto Geográfico Militar, Perú (Military Geographical Institute, Peru)*

*URY: Instituto Geográfico Militar, Uruguay (Military Geographical Institute, Uruguay)*

*USC: Centro de Procesamiento y Análisis Geodésico de la USACH, Chile (Processing Center and Geodesic Analysis of the USACH, Chile)*