

Introduction

Three working groups organize the technical support activities of Geodetic Reference System for the Americas (SIRGAS). Working Group II (WGII) focuses on education, training, and capacity building of the SIRGAS Member States, and one goal is to promote the adoption of the SIRGAS geometric (ITRF/SIRGAS) and vertical (IHRF) frames. The workgroup directs these efforts by assessing each Member State's status of the 'geodetic capacity'. In 2021, WGII took a significant step in this direction by participating in the design and worldwide deployment of a comprehensive survey carried out by the United Nations Subcommittee on Geodesy of the Committee of Experts on Global Geospatial Information Management (UN-GGIM). The questions included in the survey were based on branching eLearning scenarios. The survey topics were organized around three main themes: (1) geodetic infrastructure and human resources, (2) geocentric reference frames (RFs) and national densifications, and (3) geodetic vertical reference frames. This work presents the general status of the SIRGAS Member States and a preliminary analysis of the regional trends along these three axes. This comprehensive analysis of the survey results will be crucial to identifying the primary aspects of the WGII action plan in the coming years.

Participation

21 SIRGAS Member States answered the survey, representing **58% of the UN-GGIM Americas Regional Committee members**. This is in line with – and slightly above- the mean response rate of all five Regional Committees.

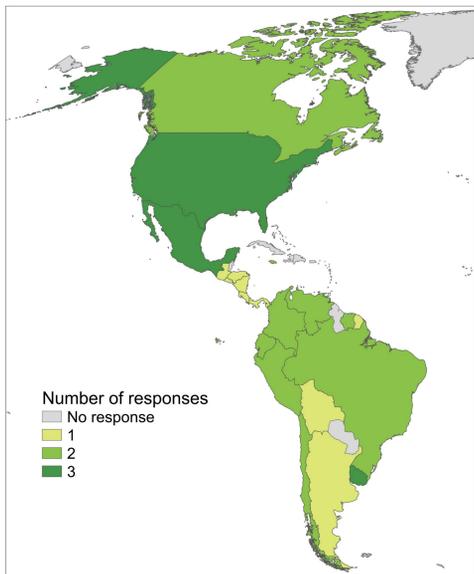


Figure 1. Number of responses submitted by the UN-GGIM Americas Regional Committee Member States.

However, a total of 36 responses were received, meaning that some Member States responded more than once. Figure 1 shows the number of responses submitted by each State. In general, the information provided by different agencies from the same Member State was consistent, but in some cases the responses were in fact contradictory. This highlights the importance of counting with a national agency or entity that coordinates and unifies the criteria regarding the management and distribution of geospatial data.

FAIR data principles

FAIR data are data that meet principles of Findability, Accessibility, Interoperability and Reusability (Wilkinson et al., 2016). Member States were asked about the FAIR principles on the vertical RF data. **Around 50% of the Member States believe that their national vertical RF currently follows all four FAIR principles**. On the other hand, nearly 15% claim that their vertical RF follows the principles of Findability and Accessibility, and nearly 10% of the States acknowledged that their vertical RF data are only Findable.

Vertical RFs

SIRGAS advocates for the transition towards a densification of the International Height Reference Frame (IHRF). Although some progress has been made on the IHRF effort (Working group III), **tide gauges remain the most common origin for vertical datums in the Americas today**. Our survey revealed that only one country (Canada) does not link their vertical datum to a tide gauge.

When asked whether the vertical datum definition included gravity observations, 8 Member States answered “No”, 7 answered “Yes”, 3 reported not to be sure, and 3 submitted contradictory answers.

Moreover, the vertical datum accessibility is not homogeneous across the region. Of the 19 Member States that responded this specific question, only 6 reported that the vertical datum can be openly-accessed online. Therefore, **in most Member States, the vertical datum can only be accessed by request**, either online (5 States), or in paper (8 States).

Reference: Wilkinson et al. (2016) “The FAIR Guiding Principles for scientific data management and stewardship” *Scientific Data*. doi: 10.1038/sdata.2016.18

Geocentric RFs and National densifications

The survey revealed that the majority of the Member States have implemented a national geometric reference frame that is connected to ITRF. Only one State reported a local horizontal datum to be still in place in its territory. The advancement made in this direction is closely linked to the expansion of the geodetic infrastructure in the Americas. The increasing number of GNSS Continuously Operating Reference Stations (CORS) has made the transition towards geocentric reference frames possible. However, the distribution and density of GNSS CORS networks is not homogeneous across the region.

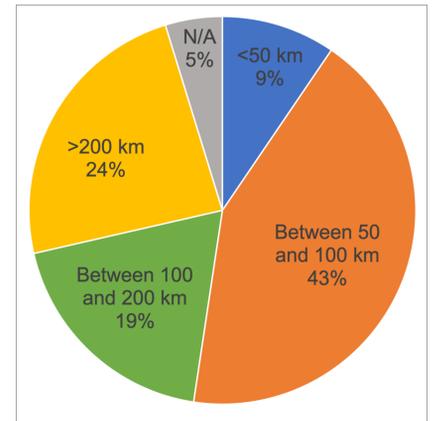


Figure 2. Average distance between GNSS CORS. N/A corresponds to States that did not answer this specific question.

In fact, over 40% of the participants reported that the average distance between GNSS CORS ranges between 50 km and 100 km, and it is larger than 200 km in almost 25% of the cases (see Figure 2). Meanwhile, only 9% of the Member States reported that the GNSS CORS in their networks are located at less than 50 km from each other. This is a clear indicator of the need to keep densifying the GNSS CORS networks, especially in States with extensive land areas. **Nearly 75% of the Member States claim to have the capability to build new and maintain their current GNSS CORS, meaning that 25% are in need of assistance and should be prioritized whenever training is provided.**

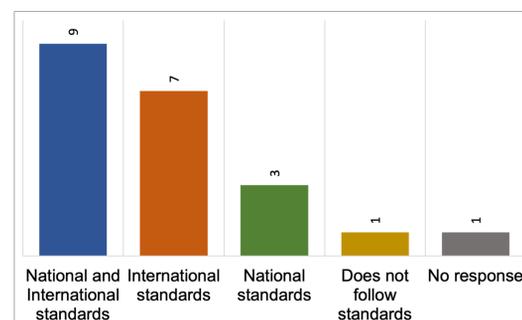


Figure 3. Types of guidelines/standards that Member States follow when building a CORS.

In terms of the monumentation standards, 70% of the participants follow some sort of best-practices guidelines for all of the GNSS CORS deployed on their territory. **Meanwhile 20% reported to have followed standards for some stations but not for all**. Figure 3 shows that the majority of the Member States use a combination of both national and international

guidelines when building a CORS. However, **some States only follow their own national standards**, and one State does not follow standardized guidelines.

The participants were asked about the geodetic and/or positioning services provided to the public, and whether they are offered for free or not. The results are shown in Figure 4. We can observe that DGNSS (GNSS observation files) is the most common service offered for free (in line with the global trend). However, other rather essential products, such as coordinates and heights, are only provided for a fee in a significant number of Member States.

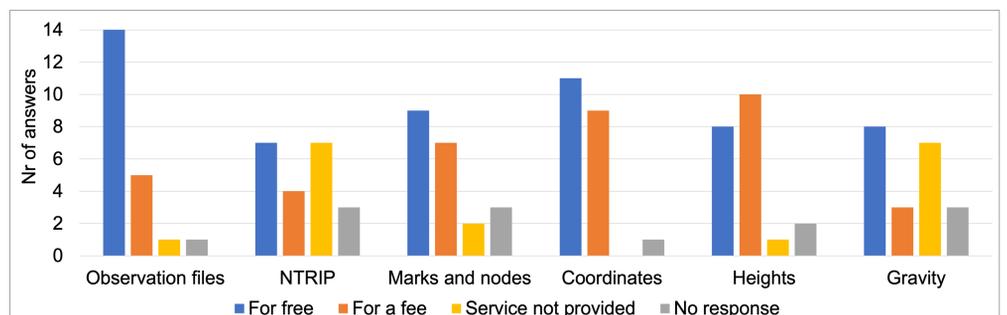


Figure 4. Geodetic and positioning services offered by the Member States and their cost

Conclusions

- The **high participation level** evidences the willingness of the SIRGAS Member States to collaborate and work together for the advancement of the geodetic capabilities in the region.
- This survey has made evident the heterogeneity among the different States in terms of standards as well as geodetic infrastructure. **The unification of the monumentation standards for CORS should be a priority** moving forward.
- It is important to keep stimulating the participation in **surveys like this one, as they become useful governance tools** and instruments to develop public policies to boost the geodetic capacity in the Americas.