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AGU 2010 Joint Assembly
The Meeting of the Americas

Abstract G23A-04

The SIRGAS Vertical Reference Frame as a Mandatory Tool for a future Unified South American Geoid Model

The SIRGAS Working Group on Vertical Datum (http://www.sirgas.org/index.php?id=83&L=2)

Session G23A – Intercomparison Between Future Height Systems in North and South America

1. Introduction

Although this session addresses aspects of the geoid models as vertical reference surfaces and the interconnection between the North- and South-American ones, a number of key issues, related to the suitability of the South-American geodetic infrastructure, have to be considered.

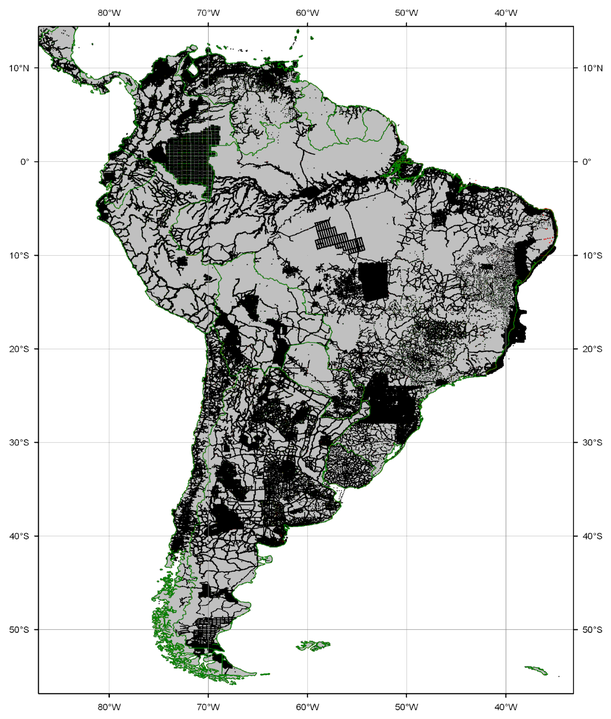

Fig.1 – South American gravity stations. From: Kenyon, *South American Gravity: Current Challenges and Future Plans*, IAG2009.

2. South-American geodetic infrastructure

First of all, the gravimetric coverage is far from enough, with large heterogeneities, as shown in **Figure 1**. This weakness is reflected, for instance, in the quality of EGM2008, which, accordingly recent evaluations (Newton's Bulletin, Special Issue), has an RMS around 12-13 cm in North America and 40-60 cm in South America. However, such a poor performance also reflects the small number and odd geographical distribution of the GPS-leveling stations used in that evaluation for South America (**Figure 2**), as well as the weaknesses of the national height networks. These networks lack actual gravity correction in the leveling lines, but other problems are also noteworthy, like the differences between the several vertical datums and the great challenge posed by the Amazon forest and river and the Andes mountain chain.

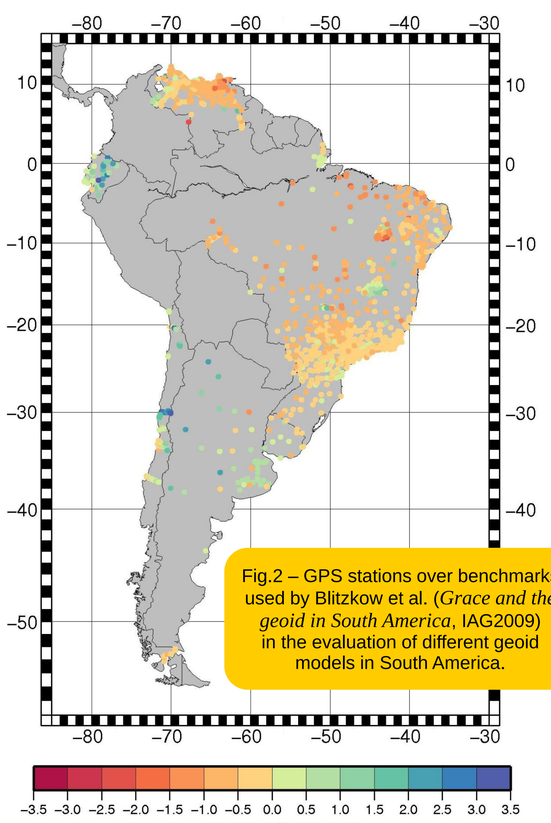

Fig.2 – GPS stations over benchmarks used by Blitzkow et al. (*Grace and the geoid in South America*, IAG2009) in the evaluation of different geoid models in South America.

3. SIRGAS Vertical Reference System

Those difficulties have been extensively discussed within the SIRGAS community since this Initiative was launched in 1993, and mainly after the creation of its Working Group on Vertical Datum (WG-III) in 1997. A number of reference documents were organized with the results of these discussions, which are summarized as follows. The SIRGAS-VRS is already defined by means of two components. Its geometrical part is defined by ellipsoidal heights and has been realized since 2000 through the values referred to SIRGAS ellipsoid (GRS-80) resulting initially from the SIRGAS 2000 GPS Campaign, and later from the SIRGAS-CON (continuously operated network) Reference Network (the black circles in **Figure 3**). The physical component of the SIRGAS-VRS is defined by normal heights referred to the quasi-geoid, and will be realized with the adjustment of a suitable geopotential leveling network connecting the SIRGAS-CON stations and the availability of a properly unified quasi-geoid model – as depicted in **Figure 4**. Such a "proper unification" will be achieved only after the adjustment of the continental leveling network. Therefore, the SIRGAS Vertical Reference Frame will provide the consistent basis for the future development of the unified South-American geoid models.

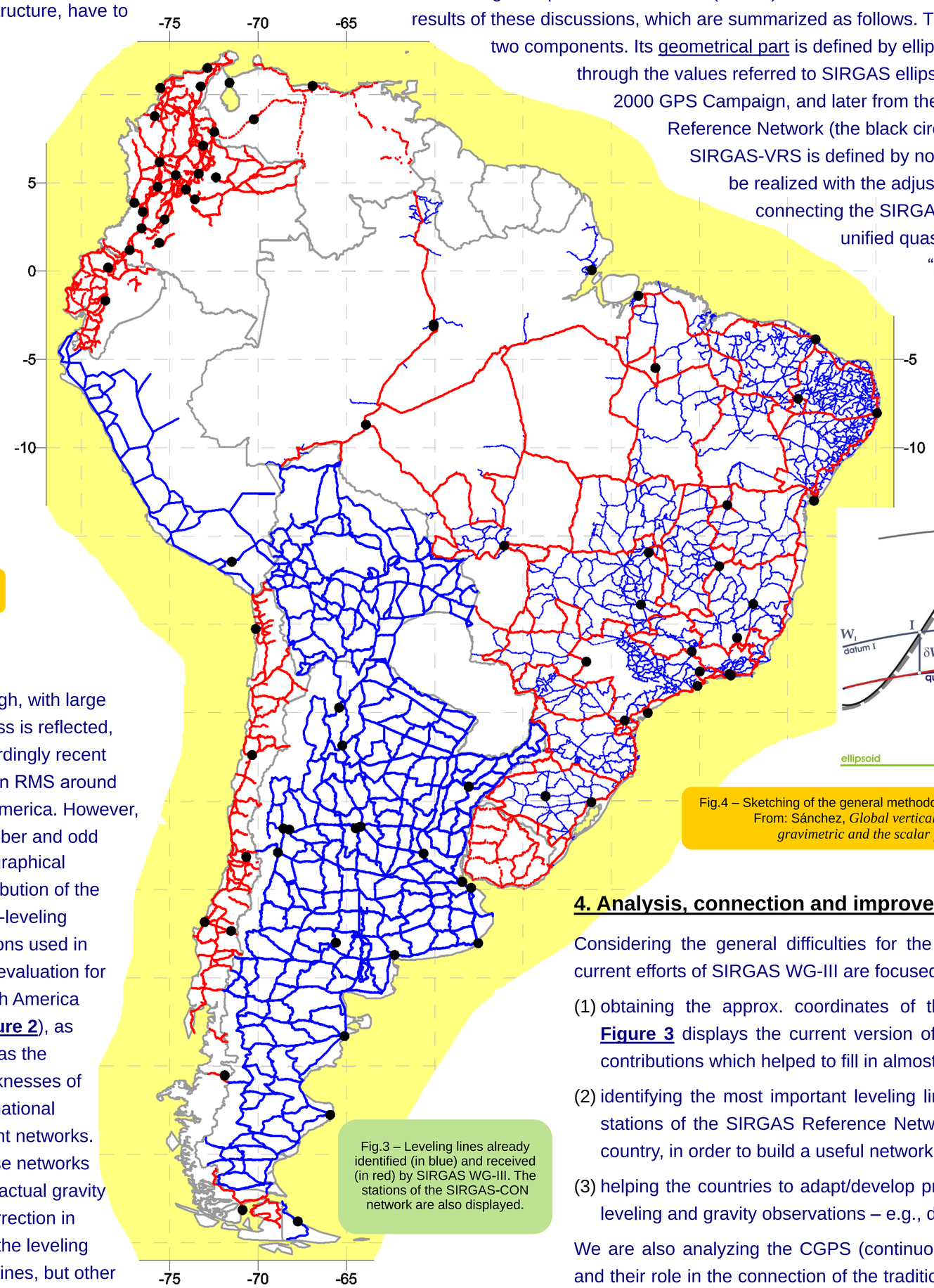

Fig.3 – Leveling lines already identified (in blue) and received (in red) by SIRGAS WG-III. The stations of the SIRGAS-CON network are also displayed.

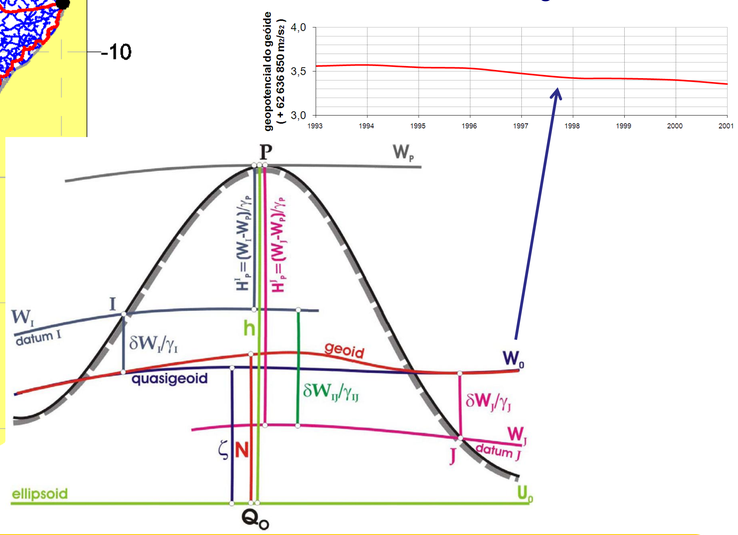

Fig.4 – Sketching of the general methodology adopted by SIRGAS WG-III for the vertical datum unification. From: Sánchez, *Global vertical datum unification based on the combination of the fixed gravimetric and the scalar free geodetic boundary value problems*, GGEO2008.

4. Analysis, connection and improvement of the national leveling networks

Considering the general difficulties for the organization of leveling and gravity data, the current efforts of SIRGAS WG-III are focused in the following subjects:

(1) obtaining the approx. coordinates of the respective stations in each country – the **Figure 3** displays the current version of WG-III leveling map, including recent national contributions which helped to fill in almost all the gaps;

(2) identifying the most important leveling lines – those connecting neighbor countries and stations of the SIRGAS Reference Network – to be prioritized and worked out by each country, in order to build a useful network; and

(3) helping the countries to adapt/develop procedures and tools to process and analyze the leveling and gravity observations – e.g., data digitization and gravity interpolation.

We are also analyzing the CGPS (continuous GPS) stations availability at the tide gauges and their role in the connection of the traditional vertical datums to the SIRGAS-VRF, as well as the use of gravity disturbances associated to GPS surveys to strenghten the leveling networks in areas not suited for the spirit leveling. Considering the subject of integration of the future North- and South-American vertical reference surfaces, it is essential to start the discussion of procedures to minimize the geodetic gap between northern and southern South America created by the Amazon area.