

SIRGAS2000: Brazil's Geocentric Reference Frame¹

Marcelo C. Santos
Department of Geodesy and Geomatics Engineering
University of New Brunswick, Canada

Since February 2005 Brazil has a new geodetic reference frame. It is called SIRGAS2000. This article provides a plain explanation, in a non-technical language, on what is a geodetic reference frame and what it is its purpose, what is SIRGAS2000, and what is the importance of this new reference frame for the country.

The expression *reference frame* is a technical jargon that means a reference, something basic, fundamental, which helps us to know the location of any object on the Earth. This location is possible through coordinates, for example, latitude and longitude, linked to the frame. Let us look at an example. How can we know where the water pipes are buried in the street where we live? Well, we could dig the whole street (with the risk of perforating the pipes), or get the street map on which the pipes were designed. Using the pipes' coordinates we can dig exactly where the pipes are.

A complicating factor is when there is more than one frame. That is when things become more difficult. Imagine the pilot of an airplane that will take off from Rio de Janeiro and land in Manaus. The pilot knows the coordinates from both airports, Rio and Manaus. This permits him to take the airplane, the crew and passengers with safety till the end of the flight, provided the coordinates of Rio's airport are in the same reference frame as the ones it Manaus airport. But if the reference frames are different, the trip could end not in Manaus, but in any other place on the Amazon Forest.

Well, up to now two things should be clear. The first one, what is a reference frame and its importance (location of objects on the Earth). Second, that different reference frames mean different locations for the same object, being confusing. Using different reference frames, we may never find the pipelines in our street. Or we may never get lost in the Amazon.

Sometimes we use the term "geodetic frame". The word geodetic is referred to a very old science, *geodesy*, which deals with the location on and around the Earth, and is concerned with the shape of the planet. So, a geodetic frame is used for positioning, considering the Earth as an ellipsoid (a sphere flattened around the north and south poles).

When elaborating maps, nowadays using computers and geographic information systems, reference frames are always used. Reference frames are known by names or acronyms. In Brazil, two reference frames have been deemed as the most important ones. They are known as *Córrego Alegre* and (by the acronym) *SAD69*.

Above we said that different reference frames cause confusion! It is a fact. Let's do a comparison. Imagine each of the reference frames as a different language. For one person to understand another it is necessary a translator. Let's call this translator as *transformation parameters*. The problem to deal with reference frames is that the translator is not very good, and the translation is a version with problems of interpretation.

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To be positioned on Earth, we need to use positioning techniques. At present, the most used are the ones based on artificial satellites that orbit our planet. The interesting is that, for the satellites, the Earth is mostly reduced to be a point at the center of the planet (*geocenter*). The satellites “feel” as if all the mass of Earth were concentrated in this geocenter. The consequence of using artificial satellites to positioning is that it required a geocentric reference frame, in which the origin is at the geocenter.

Going back to our analogy with languages, start using a new reference frame corresponds to start using a new language. The advantage is that the geocentric reference frame speaks the same language that the modern satellite positioning techniques.

In the year 2000, IBGE, the institution responsible for the geodetic activities in Brazil, and the other countries in South, Central and North America, got together under the auspices of the International Association of Geodesy. From this partnership emerged a geocentric system compatible with the modern satellites positioning techniques: SIRGAS. SIRGAS is an acronym that means Geocentric Reference System for the Americas.

By adopting SIRGAS2000, in 2005, as a new reference for positioning, mapping and geographic information systems, Brazil moved ahead to provide ease of use and management of the physical space of the country.

As far as the other reference frames still in use, Córrego Alegre and SAD69, it is expected that with time they will cease to be used in favour of SIRGAS2000. When this happens, there will be no more need for the “translation service”, as well as problems will be avoided, as of the pilot that wanted to go to Manaus, due to the uniqueness of reference. It is expected that the information of Córrego Alegre and SAD69 will be translated to SIRGAS2000 until 2015, and that new information (new mapping) will be done solely in SIRGAS2000.

The advantage to the country in adopting only one geocentric reference frame is tremendous. Not only considering the economic aspect (it is more advantageous to use the same reference frame), but also for social aspects. Only as example we quote the activities of colonization and land reform. The consistent use of the same reference frame will provide integrity in the rural realty registry. We know how the land reform issue is complicated in Brazil. A consistent reference frame will not solve conflicts but it will certainly facilitate their solution.

This article is essentially non-technical. The next issue of *Ponto de Referência* will contain more technical information about SIRGAS2000. For those who do not want to wait for the next issue, go to: <http://www.ibge.gov.br/home/geociencias/sirgas> (in Portuguese)