New Results in the Determination of the Geoid Model in Argentina

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Abstract. Improvements in the geoid model of Argentina have been developed by means of incorporating new data, testing an other software package and adding GPS/levelling information.

In this way, a new model has been calculated and evaluated and the results are shown in this paper.

All these activities are carried out under the umbrella of the Sub-Commission for the Geoid in South America (SCGSA).

Keywords. Argentina, gravimetric geoid

1 Introduction

Theoretical studies about the figure of the earth were carried out one century ago. Nowadays improvements in computers and satellite technology allow us to use these theories in a practical sense.

On the other hand, GPS technique is more popular every day and it requires having a geoid model for its integral use. For these reasons, increasing efforts in research about geoid features were done in universities and research institutes along the world not only from a theoretical point of view, but also in order to meet GPS users requirements. In that sense, a few years ago the Work Team for Geoid Modelling of Argentina of the Comité Nacional de la Union Geodésica y Geofisica Internacional (CNUGGI) started a systematic compilation of previous information along all the territory.

Changing topography of Argentina leads to complexity in geodetic modelling. However, a realistic evaluation of the problem and the synergy of professionals, research institutes, universities, government agencies allow overcoming these difficulties and to optimise results.

2 Result

As in case of previous geoids calculated for Argentina (Font et al, 1997; Pacino et al, 1999) the methodology applied for the computation of the new geoid presented in this paper is the remove – restore technique. This technique permits the combination of the long wavelength of the gravity field obtained from a geopotential model with the short wavelength obtained from the appropriate use of gravity anomalies for the resolution of the Stokes integral and digital terrain models. The geopotential model adopted was the EGM96 (Lemoine et al., 1998) which, according to the comparative evaluation made for South America results better than the models published before (Blitzkow, 1997).

An important advance in front of previous calculations was the incorporation of more than 8000 gravity points in regions with low-density information. Dr Götze provided the gravimetric database from the University of Berlin that covers a vast sector in the Northwest of Argentina. The Instituto Geográfico Militar (IGM) completed the levelling and gravimetric network in the Patagonia area.

The planimetric locations of the gravimetric stations were referred to the official reference frame for Argentina POSGAR 94 (Posiciones Geodésicas Argentinas). Nevertheless, the planimetric differences between POSGAR 94 and POSGAR 98 are imperceptible, we can say that the geoid model in figure 1 (referred to POSGAR 94) will show no significant differences to an eventual transformation to POSGAR 98.

The treatment of all the information was developed following the proceedings and classical formulas for the computation of the gravimetric anomalies (Pacino et al, 1997).

The specific software Gravsoft was used for the interpolation, the estimation of mean gravity

H. Drewes et al. (eds.), *Vertical Reference Systems*

anomalies and the resolution of the Stokes integral, applying the Fast Fourier Transform (FFT) (Tscherning et al, 1992).

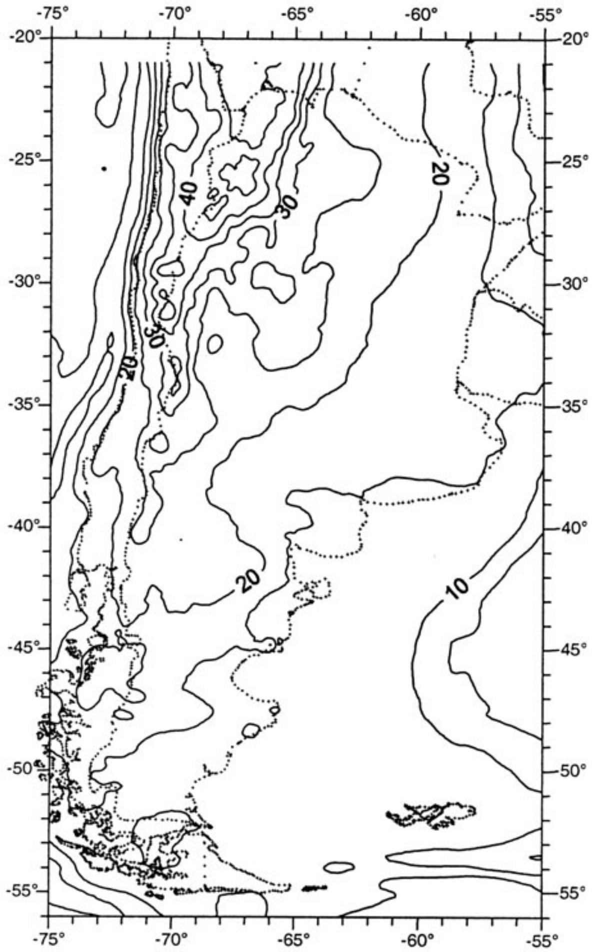

Fig. 1 Geoid model for Argentina (resolution 10'x10')

3 Comparative Evaluation of the Model Computed

An evaluation of the gravimetric geoid was performed in points with values of geoid undulations "N" calculated from ellipsoidal heights "h" and orthometric heights "H". A total of more than 200 GPS benchmark points, from different geodetic networks were used for the evaluation. Figure 2 shows the distribution of these GPS benchmarks across Argentina. The different geodetic networks used were: the national network POSGAR 94 (Brunini, 1999) recalculated as POSGAR 98 and the networks of Santa Fe province (Rodriguez and Pacino, 1999) and Buenos Aires province (Perdomo and Del Cogliano, 1999).

A great amount of information with these characteristics exists in our country (other geodetic province networks, PASMA project, etc.) but this information is not available yet. We expect to access them as soon as possible in order to make a better evaluation.

The arithmetic mean between the point differences calculated between the model in figure 1 (POSGAR 94 – 98) and the values N derived from the geometric method (POSGAR 98) is 0.48 meters with a standard deviation of 0.63 meters.

We must take into account that these values only show the differences between both proceedings.

From the characteristics of the existent information (levelling heights without corrections, uncertainty of the order of 500 meters in the planimetric position of the first order Argentinean Levelling Network, lack of detail information for the computation of the indirect effect, etc) it is not appropriate to express in an absolute way in terms of quality or precision of any of the results obtained from any of the different methods.

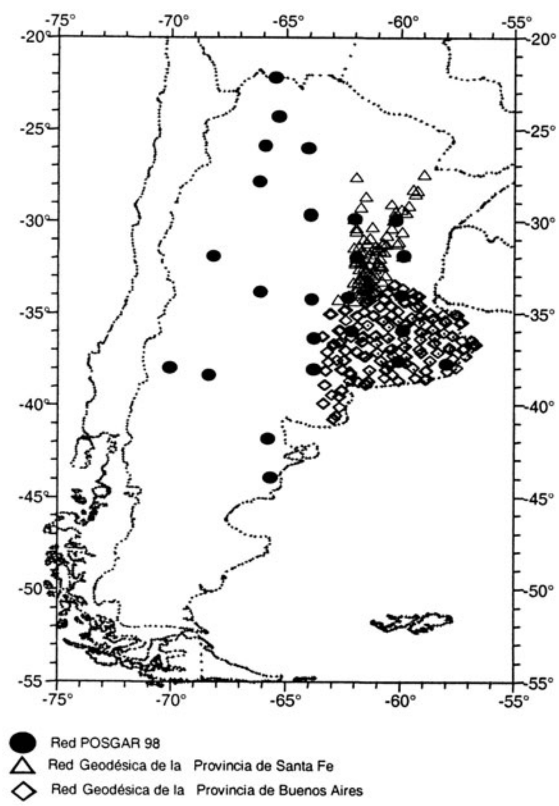

Fig. 2 Distribution of GPS benchmarks in Argentina

4 Discussion and Conclusions

When information of geopotential models are combined with land gravimetric information (or aerogravimetric information) and altimetric information obtained with GPS, we must take care about the relationship between the reference frames used. EGM96 was developed under a reference frame coincident with ITRF94 so the rest of the information must be referred to this frame.

Although the official reference frame for Argentina is POSGAR 94, a new reference frame has been calculated (POSGAR 98) referred to the ITRF94 which results are more appropriate for the calculation and evaluation of geoid models. The comparison between the values of N obtained from the gravimetric geoid (figure 1) and the values of N obtained from the geometric method in the points shown in figure 2, the ellipsoidal height h were calculated in POSGAR 98 (in Buenos Aires province, the GPS Network was vinculated to the reference frame SAGA, which can be approximated to ITRF 96, which can be considered coincident with ITRF 94 for this evaluation).

Another aspect that we have to consider is the lack of corrections in the values of H of our levelling network. The orthometric correction (or normal) is about a few centimetres in a great part of our country, in regions of rough topography it could be greater than one meter. Besides, that the indirect effect over N, which is not considered in this gravimetric geoid model, could be more than 0.20 meters in the areas of rough topography.

An improvement of the geoid model could be achieved with the incorporation of new gravimetric data and the estimation of the precision of the existing data.

Acknowledgement

The authors would like to thank all the institutions that supply gravimetric and altimetric data, especially the IGM (Instituto Geográfico Militar) and Dr. H.J.Götze Freie Universität Berlin, Germany.

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