

Geoid Study in Tierra del Fuego

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Abstract. In 1993 a precise GPS network was established in the region of Tierra del Fuego. In 1998, a levelling line was measured with origin at Ushuaia tide gauge. Gravimetric measurements were also made to apply the orthometric correction.

This line is not enough to obtain a geoid model from GPS observations at the levelling points, so during 2000, new levelling and GPS measurements were made following secondary roads to improve the distribution of the points. In this work, these results are presented and compared with geoid undulations calculated from EGM96 model.

Keywords. Altimetric reference, geoid model, GPS, levelling

1 Introduction

The Tierra del Fuego island is the southern portion of South America. The eastern region belongs to Argentina and the western region to Chile. This study involves only the Argentine portion but in the near future it will be extended to the Chilean part in the frame of an international cooperation agreement.

It is an interesting region from a geological point of view because the northern portion of the island is on the South American plate, while the southern region is on the Scotia plate. The main fault runs east – west at the latitude -54.4 deg. (Dalziel, 1984; Olivero et al., 1995 and 1999).

In 1993, the La Plata University and the Tierra del Fuego government established a precise GPS geodetic network. In 1995 this network was related to POSGAR94, and recently, displaced to coincide with SIRGAS (SIRGAS, Relatorio final, 1997) in the point of the Estación Astronómica Río Grande (EARG), which is located more or less in the centre of the network.

In 1998, the Instituto Geografico Militar Argentino (IGM) measured a precise levelling line starting at the Ushuaia tide gauge and following the

main road of the island to the north. Simultaneous gravimetric measurements were carried out. This main line is about 340 km long.

Once the results of the levelling line were calculated, the EARG group measured the GPS ellipsoidal heights of most of the points, and published the preliminary attempts to analyse the geoid in 1999 (Perdomo and Hormaechea). It was clear from these first results that the geometry of the levelling line is far from a good geographical distribution.

During 2000, the EARG and IGM measured two other secondary profiles to improve the distribution of the data. They add in total 80 km more to the original data. This paper presents these new results and their integration into the 1999 preliminary model.

2 The New Data and the Treatment of the Observations

The new secondary profiles have been developed from the main levelling line to the west (figure 1). Their incorporation in the 1999 preliminary geoid model produces very interesting new features without distorting the general behaviour.

First of all, the main line heights were corrected with the gravity information to obtain orthometric and normal heights. Despite of the fact that this main line crosses the southern portion of the Andes, the orthometric and normal corrections are small (less than 12 mm). In this sense, the incorporation to a unique model of the data coming from the secondary profiles can be accepted, even if they have not been corrected using gravity.

The figure 1 shows the general behaviour of the obtained geoid model with the incorporation of all the data. The new profile at latitude -54.4 deg. running E-W shows that the relatively low geoid values extend to the west following the fault direction.

These results must be considered as preliminary because more measurements are obviously

necessary. However, it is clear now which are the priorities for the near future.

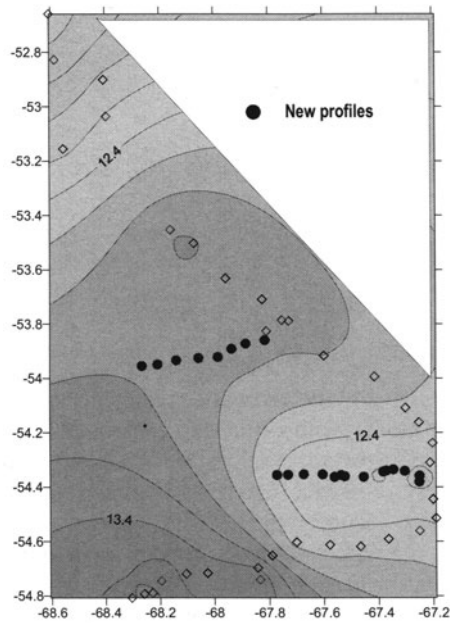


Fig. 1 Ellipsoidal – orthometric heights

The figure 2 shows the comparison of this model with the EGM96 (Lemoine et al., 1998). It is clear that the discrepancies are very important mainly to the interior of the island surely due to the lack of local gravimetric data in the EGM96 model

3 The Main Conclusions

The differences between orthometric, normal and measured heights were calculated for the main levelling line and, as they are smaller than 1.2 cm, the obtained height transformation model including the new data measured during 2000, may be considered a good approximation to a local geoid model with an accuracy of a few cm.

The new information added by the two E-W levelling profiles produced significant changes in the preliminary geoid model. The main improvements are in the southern region where the new features can be correlated with the Fagnano lake fault opening a new research line for that region.

Despite of the lack of roads, two new profiles are planned for this year. One of them running north-south in the western part of the island, and another, west-east from the main levelling line to the coast in the fault region.

Also a cooperation with Chilean geodesists is starting during 2001 to significantly improve the geographic data distribution and to get a unique geoid model for the Tierra del Fuego island.

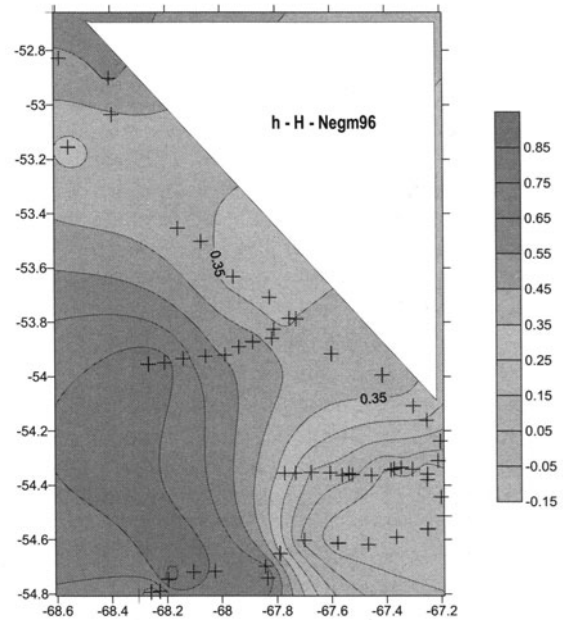


Fig. 2 Observed – EGM96 undulations

References

- Dalziel, IWD (1984). The Scotia Arc. An international geological laboratory. *Episodes*, Vol. 7 No. 3.
- Lemoine F., S. Kenyon, J. Factor, R. Trimmer, N. Pavlis, D. Chiuw, C. Cox, S. Klosko, S. Lutheke, M. Torrence, Y. Wang, R. Williamson, H. Pavlis, R. Rapp and T. Olson (1998). The development of the joint Nasa GSFC and NIMA Geopotential Model EGM96. *NASA/TP – 1998 – 206861*.
- Olivero E., D. Martinioni., N. Malumián, and S. Palamarczuk (1999). Bosquejo Geológico de la Isla Grande de Tierra del Fuego, Argentina. *IVX Congreso Geológico (Argentina)*. Salta.
- Olivero E., E. Malagnino, D. Gagliardini (1995). Interpretación Preliminar del Sistema de Fracturas del Este de Tierra del Fuego basada en Imágenes ERS-1. *SELPER, Rev. Técnica de Integración Iberoamericana y Mundial*. Vol. 11, Nro. 1-2. Pag 34-39.
- Perdomo, R. and J. L. Hormaechea (1999). A preliminary analysis of the geoid in Tierra del Fuego. *International Geoid Service, Bull. Nro 9*.
- SIRGAS, Relatorio final, informes de los grupos de trabajo I y II, 1997.