SIMPOSIO SIRGAS 2021
Del 29 de noviembre al 01 de diciembre de 2021

Comparison of physical heights in the Brazilian Geodetic System

Samuel Tarso da Silva, Gabriel do Nascimento Guimarães, Leydimere Janny Cota Oliveira

Universidade Federal de Uberlândia

Introduction

Since 2015, with the publication of Resolution No. 1 of the International Association of Geodesy, on the definition and implementation of the International Height Reference System/Frame (IHRS/F), efforts in this direction have intensified. In Brazil, the Brazilian Institute of Geography and Statistics presented, in 2018, the new readjustment of the altimetric network where normal heights were calculated from geopotential numbers. In addition, in August 2021, it made available a tool called *hgeoHNOR* that makes it possible to convert geometric heights into physical heights. The aim of this work is to compare physical heights based on IHRF methodology using a regional gravity field model with the values of the physical heights at the GNSS continuous monitoring stations.

Methodology

The computation was based on Sánchez et al (2021). In the solution of the Geodetic Value Boundary Problem the GEOID2021 model (Matos et al., 2021) in zero tide system (C_{20}^{ZT}) was used and the 147 stations coordinates (X^{NT}) (in tide-free system) was acquired from IBGE website. The entire process is described in Figure 1. Computation procedure requires gravity value observations in the stations. In this case, g values were interpolated using PREDGRAV program (Drewes, 2015).

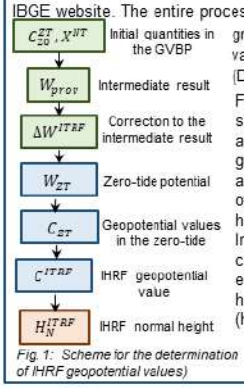

Fig. 1: Scheme for the determination of IHRF geopotential values)

Figure 2 shows the search radius according to the gravity stations adjacent to the point of interest. Normal heights based on Imbituba datum were computed from ellipsoidal height and height anomaly (hgeoHNOR).

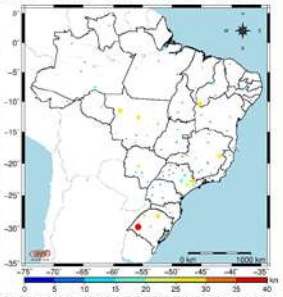

Fig 2: Search radius for PREDGRAV interpolation

Results and Discussion

Figure 3 shows the comparison between IHRF heights and heights from the Local Vertical Datum. The farther away from the greater the differences are. However on the coast, the difference is lesser than inside the country. In the west part of Brazil, three stations presented smaller differences because at this part of the country hgeoHNOR tool does not work. The national geoid model was used to get the height anomaly. The mean value is -0.44 m, the standard deviation is 0.24, the maximum positive is 0.10 and the maximum negative is -1.09 m. Sánchez and Sideris (2017) presented na offset between W_0 and the LVD (0.387 ± 0.018 m). This offset was applied and the discrepancies can be seen in Figure 4.

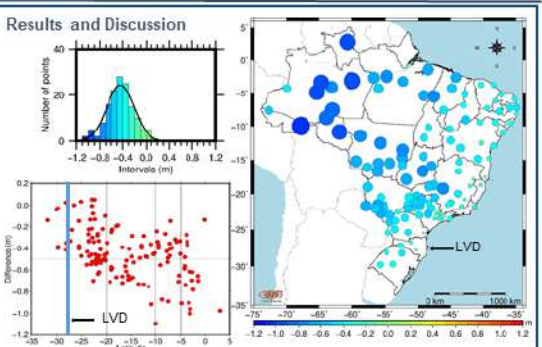

Fig. 3: Comparison involving IHRF normal heights and LVD normal heights

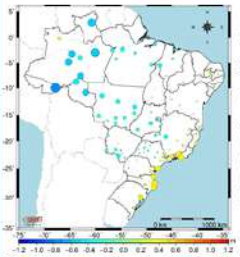

Fig. 4: Discrepancies after use the offset

Height anomalies were also computed from ICGEM service (zero tide system and zero-degree term). Then, the normal height was computed using ellipsoidal heights. Four global gravity models were used in the comparison and the results are show in Table 1 and Figure 5 (only XGM2019 model).

Table 1: Statistics values (meters)

	XGM2019	EIGEN6C4	GECO	SGGUGM-1
Mean	0.042	0.034	0.039	0.29
SD	±0.11	±0.14	±0.15	±0.14
Max neg	−0.24	−0.52	−0.45	−0.56
Max pos	0.55	0.68	0.76	0.60

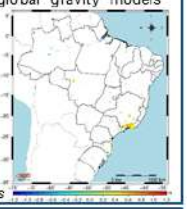

Fig. 5: XGM2019 comparison with IHRF normal heights

Next Steps

Investigate the causes of the discrepancies
Carry out the same procedure using GNSS/leveling stations

References

Matos et al., (2021) will be presented at the SIRGAS Symposium
Sánchez et al (2021) doi: 10.1007/s00190-021-01481-0
Sánchez and Sideris (2017) doi: 10.1093/gji/ggx025