1. Introduction
A new gravimetric geoid model for Argentina named GEOAR was developed using the remove-compute-restore technique and incorporating an optimal geopotential model (GGM) with approximately 230,000 land and marine gravimetric measurements. Terrain corrections were calculated for all gravimetric observations using a combination of the SRTM_v4.1 digital terrain model (DTM) and SRTM35_plus bathymetric models. For those regions that have gravimetric observations within a distance of 20 km, the observed gravimetric anomalies were gridded using the inverse distance weighted method; while for all the regions that lacked of such observations, the world gravity model IGGM2012 was utilized for the determination of gravity information. The resultant gravity anomaly grid was applied in the Stokes integral over the spherical multi-band FFT approach and the deterministic kernel method proposed by Wong and Gore. The accuracy of GEOAR was assessed by comparing it with GPS-leveling derived geoid undulations at more than 1,000 locations. Results showed that the new Argentinean geoid model can achieve an accuracy of better than 10 centimeters.

2. Gravity reductions
GEOAR was developed using the remove-compute-restore (RCR) technique (Schwarz, Sidors & Forsberg 1990), and therefore, the GGM and terrain topography contributions to the gravity field of the Earth were subtracted from the gravity measurements. Then, the residual gravity anomalies required for the geoid model computation are given by

$$\Delta g = \Delta g_b + \Delta g_a + \Delta g_h + \Delta g_D - \Delta g_{GGM}$$

Where:
- $\Delta g_b$ is the observed gravity referred to the IGKN71 gravity system;
- $\Delta g_a$ is the normal gravity formula proposed by Somigliana (1923);
- $\Delta g_h$ is the atmospheric correction given by Hinzé et al. (2005);
- $\Delta g_D$ is the first order formula of the free-air correction presented by Heiskanen and Moritz (1967);
- $\Delta g_{GGM}$ is the planar correction of the Bougereau correction given by Heiskanen and Moritz (1967);
- $\Delta g_D$ is the second order correction introduced by Moritz (1968) and it was determined up to a distance of 166.7 km using the SRTM_v4.1 (Jarvis et al. 2008) and SRTM35-Plus v10 (Becker et al. 2009) models in the TC software (Forsberg 1984), which applies the rectangular prism integration method (Nagy 1967); and
- $\Delta g_{GGM}$ is the long-wavelength contribution to the gravity field from the GOCC035 satellite-only GGM (Mayer-Gürr et al. 2012) and it was determined complete to degree and order 250 using the GEODEGM software from the GRAVSOFT package (Forsberg & Tscherning 2008).

3. Gridding procedure
Since the Stokes' integral was solved by means of the fast Fourier transform (FFT) technique, the $-230,000$ gravity anomalies were converted into gridded anomalies. Figures 1 and 2 show land and marine gravity measurements. It can be clearly seen in this figure that the gravity measurements are not homogeneously distributed in Argentina. Instead, they are usually at sparse points or along spirit-leveling and prospecting lines. Moreover, mountainous regions (e.g. Andes Mountains), where the gravity field usually varies the most, lack a regular distribution of gravity observations due to the complex accessibility.

The moving weighted average method (Shepard 1968), a commonly used gridding approach from irregularly distributed data, was applied for determining the residual gravity anomaly gridded values and the square of the inverse distance function $(1/r^2)$ was used for the determination of the weight.

The gridded area was extended up to 20 km from every gravity point measured, and therefore, the gravity anomaly grid presented big gaps or blanks due to the inhomogeneous distribution of the gravity points (Fig. 4). Consequently, the WGM12012 gridded model (Bonavia et al. 2012) was used to fill the voids (Fig. 5).

Then, the residual Faye anomaly grid was constructed (Fig. 6) by adding the negative Bouguer plate reduction, which was generated using the DTM to the above grid results (Featherstone & Kirby 2000).

4. Geoid determination
Since the geoid was determined using the RCR technique in the Stokes’-Heylet approach, the gravity field was spectrally decomposed into three parts: the long-wavelength contribution from the GGM, the medium-wavelength signal from regional gravity observations and the short-wavelength part from the topography. As a result, the geoid undulation $N$ can be expressed as follows (Forsberg 1993):

$$N = N_{GGM} + N_{R} + N_{GEOAR}$$

Where:
- $N_{GGM}$ represents the spherical harmonic expansion of the GGM, which was computed using the GOCC035 satellite-only GGM to complete and degree 250 in the GEODEGM software;
- $N_{R}$ is the terrain indirect effect from the Helmert's second method of condensation, which was determined using the planar approximation proposed by Wüstenhagen (1982) in the GOCOM software from the GRAVSOFT package; and
- $N_{GEOAR}$ is the residual geoid resulting from the Stokes’ integration, which was computed using the multi-band spherical FFT approximation technique (Forsberg & Tscherning 1980). The Wong and Gore modification to Stokes' kernel was adopted, where the low harmonics were completely removed up to degree 30 and then linearly tapered to degree 40.

5. Comparison with GPS-leveling and fitting
GEOAR's accuracy was evaluated using 1,173 co-located GPS-leveling benchmarks (Fig. 3). The benchmarks' geoid undulations were determined through the application of the following well-known relationship

$$N = h - H$$

Where:
- $h$ is the ellipsoidal height referred to the Argentinean POSGAR 97 reference frame, which is based in the TRF05 (Abatamii et al. 2007) at epoch 2008.6; and
- $H$ is the orthometric height (Mader 1954) of the Argentinean vertical datum (AVD).

The statistics of the differences are shown in columns (a) and (b) of Table 1, while the histograms of the differences can be seen in graphs (a) and (b) of Fig. 7. Moreover, the GPS-leveling geoid undulations were also compared with those from the EGM08 (Pavlis et al. 2012) GGM complete to degree and order 2160.

6. Conclusions and future work
The new Argentinean geoid model uses recent releases of DTG and GGM models, as well as the latest gravity and GPS-leveling measurements. The results show that it fits the Argentinean vertical datum significantly better than EGM08 and the previous Argentinean geoids, even though many universities in the dataset have not been determined and eliminated yet at this stage.

More land and marine gravity observations, held by several universities and public bodies, will be incorporated to the next version of the GEOAR geoid model. Moreover, a new project to define the Argentinean geoid measurement led by the Instituto Geográfico Nacional (National Geographic Institute) has been recently approved for the period 2018 – 2016. This is expected to be significantly beneficial to the next generation geoid determination for Argentina.

**References**