TOWARDS A NEW GRAVIMETRIC NETWORK IN ARGENTINA

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1. INTRODUCTION

The Official Gravimetric Network of Argentina is defined by approximately 80 benchmarks. The gravimetric measurements that define this network were undertaken between 1968 and 1969, and the Gravimetric System used was Potsdam. A few years later, the International Gravimetric System IGSN71 was established and the National Geographic Institute of Argentina (NGI) transformed the gravimetric values of the Official Gravimetric Network from the Potsdam System to the IGSN71 System.

During 2012, the NGI, together with the Universities of Rosario and San Juan, started a project to develop a new and denser First Order Gravimetric Network for Argentina, taking into account International Scientific recommendations. The field work was divided into five campaigns, of which three have been completed to date.

This poster shows the results that have been obtained so far in the development of the New First Order Gravimetric Network for Argentina.

2. OBJETIVES

The project's general objective is to establish a New First Order Gravimetric Network that fulfills the international standards of accuracy for many geodetic applications. It's important to achieve the following objectives:
a) Homogenous distribution of gravimetric benchmarks;
b) Validate existing data and analyze their compatibility with the new measurements;
c) Contribute to the integration of gravimetric continental networks; and
d) Contribute to the definition of a geoid for South America.

3. METHODOLOGY

3.1. Establishment of the New Absolute Gravity Network in Argentina

The New Absolute Gravity Network in Argentina will consist of approximately 30 points (*Fig. 1*). Measurement is planned for early 2014 with the collaboration of the University of Sao Paulo (L&R A10). The NGI is currently in communication with the International Gravimetric Bureau (BGI) to discuss the possibility of sourcing two extra absolute gravimeters (L&R A10 and L&R FG5).

3.2. New First Order Gravity Network

The New First Order Gravity Network will consist of approximately 250 benchmarks (*Fig. 2*), replacing the Official Gravity Network named BACARA (*Fig. 3*). All of the 250 benchmarks are very accessible, have gravity values in the IGSN71 system and also have an orthometric height value.

3.3. Relative Gravity Measurement

All relative measurements will be constrained to the New Absolute Gravity Network. The relative gravity measurement work began in 2012. The field work was divided into five campaigns (*Fig. 4*). Presently, the NGI has already measured 78% of the First Order Network. L&R G model N°43, N°673 and N°69, and a Scintrex CG-5 N°40484 relative gravimeters were used at the same time for data acquisition.

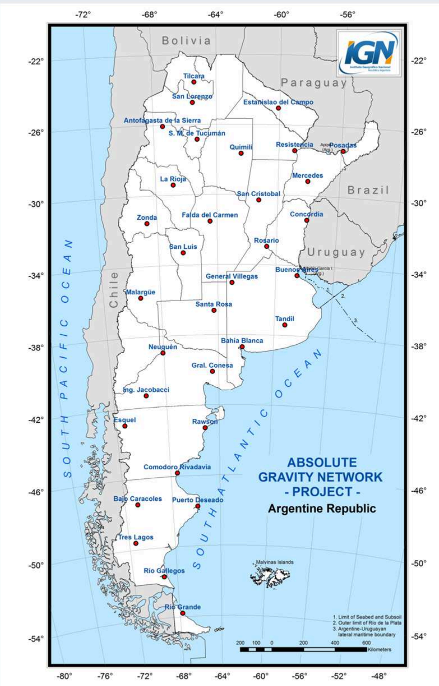


Fig.1

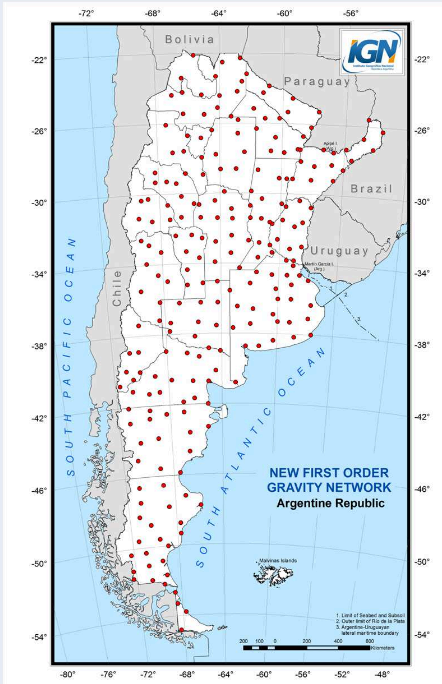


Fig.2

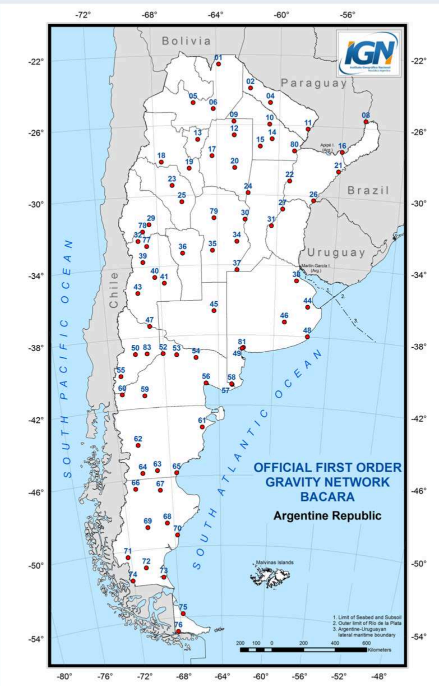


Fig.3

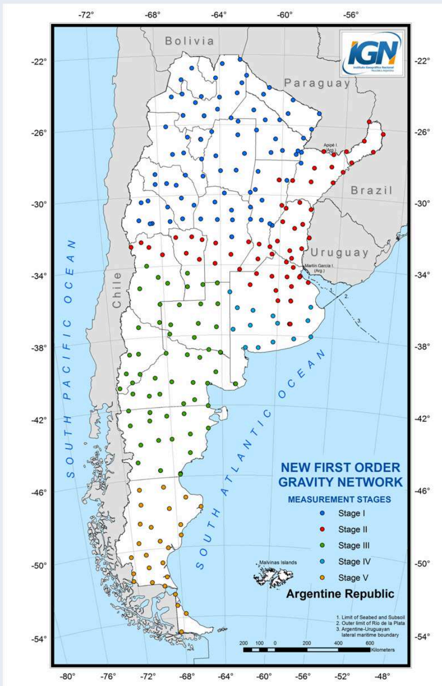


Fig.4

4. CALCULATION, DATA ANALYSIS AND VALIDATION

The results obtained from the first calculation will serve as a basis to improve further measurement and processes. Moreover, these results, that were obtained from the comparison between the original gravity values of the benchmarks and the values obtained after the new measurements, will bring to light the precision of the original network. Based on the analysis of the deviation values, any requirement to measure benchmarks again will be identified.

GRAVDATA / GRAVNETD software (H.Drewes) were used to perform the earth tide correction and the adjustment of the gravimetric loops. The GRAVDATA earth tide correction package applies the tidal potential catalogue design by Hartmannn and Wenzel (1995). The GRAVNETD adjustment package applies the least squares method to adjust the gravimetric network.

$$v_{i,i+1} = g_{i+1} - g_i - k_{1m}(l_i - l_{i+1}) - D_q DT_{i,i+1} - Dl_{i,i+1} \quad \big| p_i, p_{i,i+1}$$

$$q_{ii} = \frac{1}{p_i}; \qquad q_{i,i+1} = q_{i+1,i} = -0,5\sqrt{q_{ii}q_{i+1,i+1}}; \qquad P_{ll} = Q_{ll}^{-1}$$

Dl : gravimeters lectures
$g_{i,i+1}$: gravimetric values
D : drift
$DT_{i,i+1}$: time interval
P_{ll} : weigth matrix
Q_{ll} : cofactors matrix

Drift is determined through the Taylor series expansion of the measurements:

$$l(t) = l(t_0) + \left(\frac{\partial l}{\partial t}\right)_0 (t - t_0) + \frac{1}{2}\left(\frac{\partial^2 l}{\partial t^2}\right)_0 (t - t_0)^2 + \left(\frac{\partial^3 l}{\partial t^3}\right)_0 (t - t_0)^3 + \ldots$$

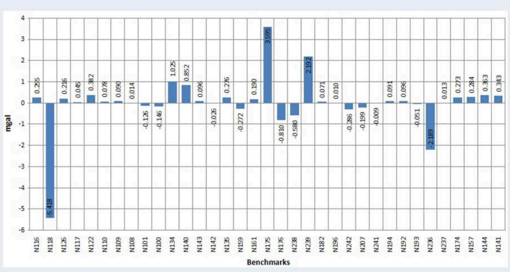
$$l(t) = l(t_0) + d_1(t - t_0) + d_2(t - t_0)^2 + d_3(t - t_0)^3 + \ldots$$

$l(t_o)$: gravimeter lecture
d_i : drift coefficients

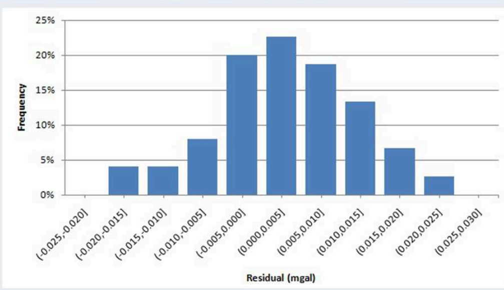
5. EARLY RESULTS

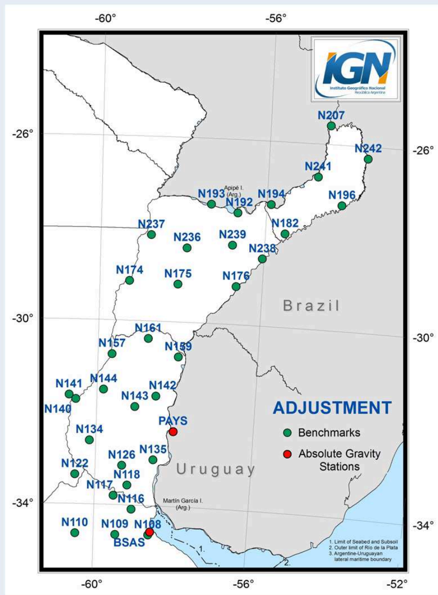
An adjustment of gravimetric observations was performed in a region of Argentina. This network consists of 35 benchmarks that were linked to the absolute network. All of the 35 benchmarks already had gravity values in the IGSN71 system.

New Gravity Values vs. Official Gravity Values



Histogram - R.M.S. Deviation





6. CONCLUSION

a) The realization of the New Argentine Gravity Network will be completed in 2015.
- New Absolute Network: 30 benchmarks
- New First Order Network: 250 benchmarks
- Second Order Network: approximately 16.000 benchmarks (leveling network)

b) The early results are very consistent with the international standards so far.

c) In order to setup a precise gravity network is important to keep in mind the following considerations:
- Calibration of the gravimeters
- Definition of earth tide correction parameters and calculation methods
- Weighting the gravimeter's observations

D) The New Argentine Network will contribute to further development of a Geoid for South America. In this way, the standardization of gravimetric observations is really important to combine data sets from different agencies.

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