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ANALYSIS OF CRUSTAL MOVEMENT IN THE CENTRAL ANDES ACONCAGUA AREA

Instituto Geográfico Nacional (1)
Universidad Nacional de Cuyo (2)
AGU American Geophysical Union

Diego A. Piñón[1], Sergio R. Cimbaro[1], Luis Lenzano[2], Agustín A. Raffo[1]

dpinon@ign.gob.ar scimbaro@ign.gob.ar llenzano@mendoza-conicet.gob.ar araffo@ign.gob.ar

INTRODUCTION

A Continuous Operation Reference Station was installed at the top of Aconcagua Mountain (ACON) in 2006 in order to monitor the movement of the highest mountain in the Western Hemisphere. Due to adverse weather conditions, this GPS station wasn't operating consistently and in the summer of 2012 a replacement GPS station was installed at 5500 meters above sea level, also at Aconcagua Mountain (NICO). The new GPS station achieved continuous operation throughout 2012. Based on current records, the new GPS station is the highest in the world. With data collected by NICO and other GPS stations in the area over 2012, it was possible to calculate the time series of crustal movements at Aconcagua Mountain, part of the Andes Mountain Range.

Prior to February 27th, 2010, at the Maule region of Chile, the Earth crust moved in agreement with the VEMOS velocities model. The coordinate displacements shown in Figure 1 were a consequence of co-seismic slip produced by the M8.8 Maule, Chile earthquake. The regional velocity changes were produced by post-seismic deformation.

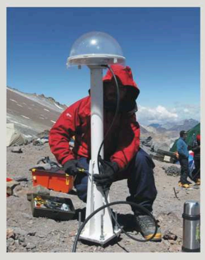
Since 2010, IGN has carried out GPS measurements on benchmarks belonging to the Central Andes Project (CAP, Memphis, Ohio and Hawaii universities) and to National Reference Frame POSGAR07, besides of continous measurements of national CORS RAMSAC. In addition to this, UNAVCO destinated funds for the instalation of 27 permanent stations in Argentina and Chile.
All this data is processed weekly by IGN in order to obtain coordinates for the sites, which will lead to the generation of a new velocity model for the region (Figure 2).

NICO INSTALLATION

Antenna Trimble Zephyr Geodetic plus TZGD dome

Solar panels structure

Solar panels



Steel mast

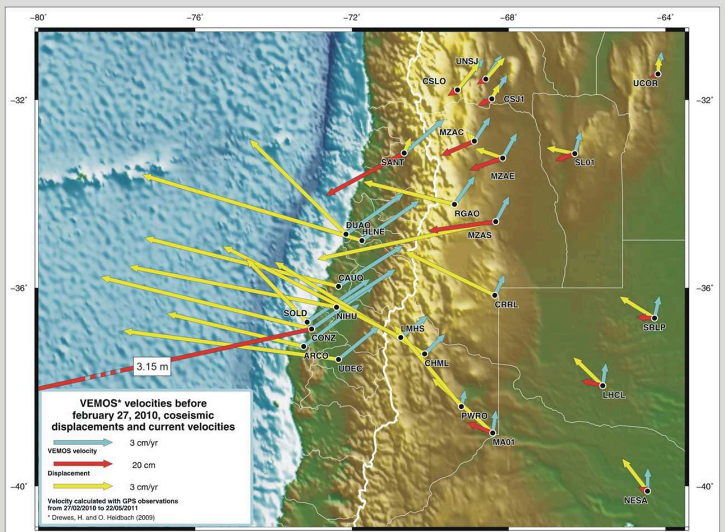


Figure 1

ESTIMATION OF VELOCITY FIELD

Velocity fields for the region of Argentina effected by the Maule, 2010, earthquake were estimated by kriging interpolation of the velocities of the sites in the RAMSAC GPS CORS network and in the CAP UNAVCO network. A secular inter-seismic velocity field was estimated using VEMOS2009 data (Fig. 3) and a post-seismic velocity field was estimated using data since 2011 (Fig. 4). Data immediately following the event (2010) was not used since the early post-seismic signal is strongly non-linear. While there are various physical models, all generating similar surface deformation, to explain this behavior the velocity field estimated here was calculated without assuming any lithospheric or sub-lithospheric models.

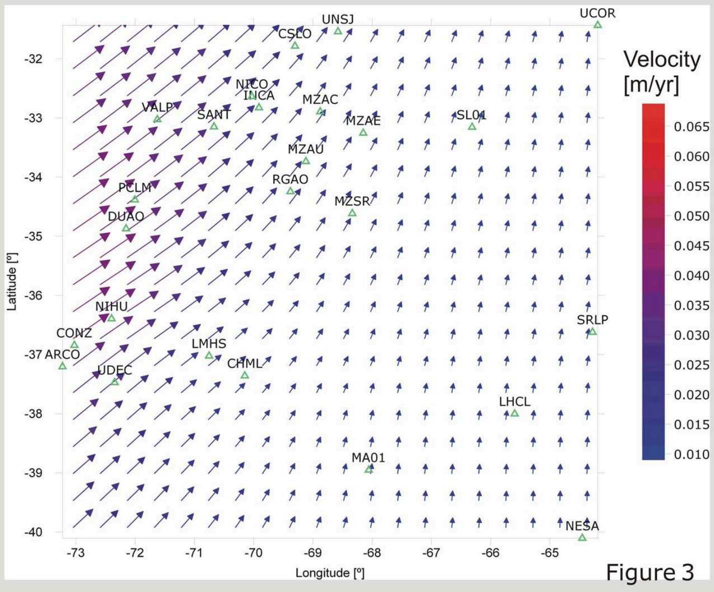


Figure 3

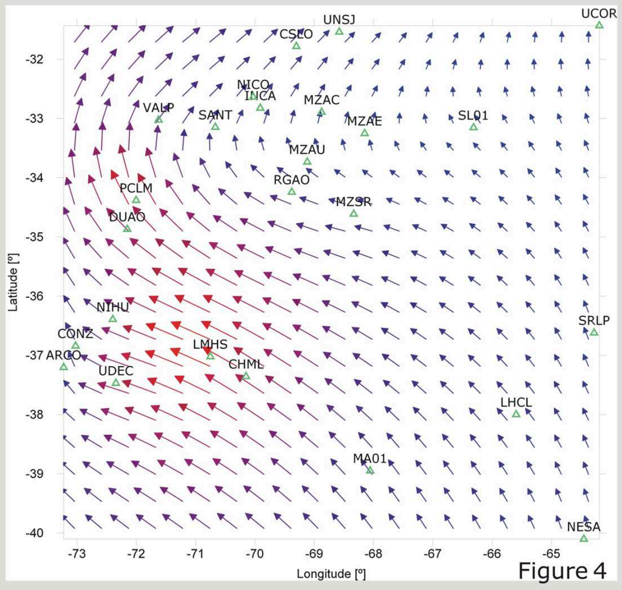


Figure 4

The velocity field was calculated without including stations NICO and INCA. Velocities for these sites were calculated and compared with the values estimated by the interpolated velocity field. Estimated and calculated velocities were in very good agreement. These results encourage the development of more complex velocity models to be used for readjusting the National Argentine Geodetic Reference Frame (POSGAR). Although these adjustments would not be appropriate for geodetic or geodynamic purposes, they are well within topographic precision and will be very useful to account for future displacements of the geodetic reference frame.
Conclusions

A velocity field was estimated for the region affected by the 2010 Maule earthquake. Velocities for NICO and INCA were estimated with the model and compared with the actual velocities of the sites and a very good agreement was found.

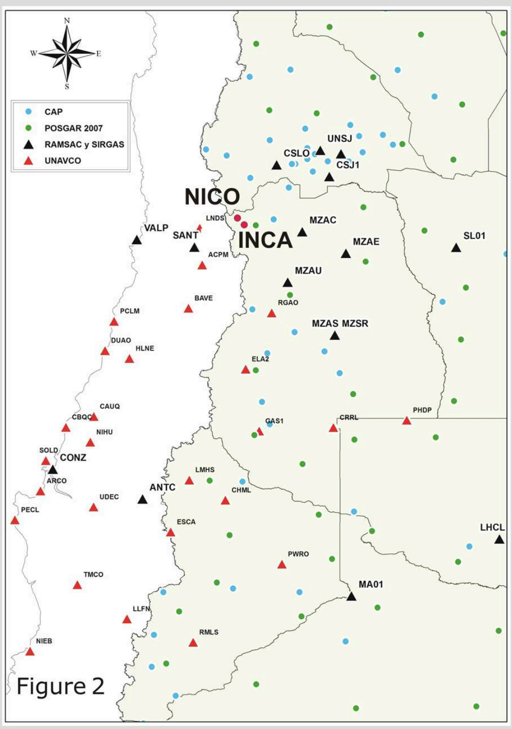


Figure 2

CONCLUSIONS

A velocity field was estimated for the region affected by the 2010 Maule earthquake. Velocities for NICO and INCA were estimated with the model and compared with the actual velocities of the sites and a very good agreement was found.

PROCESSING AND ADJUSTMENT

IGN has adopted GAMIT-GLOBK as the cientific sofware used to process and adjust GPS measurements. National CORS network RAMSAC (Argentine Continous Satellite Monitoring Network) is processed weekly and adjusted to ITRF2005. This high precision reference frame makes it possible to accurately quantify displacements generated by seismic events.

IGN also provides solutions to the IGS polyhedron through weekly contributions of loosely constrained solutions of SIRGAS-CON-D-SUR (South Densification of Continental Reference Frame SIRGAS).

The main characteristics of the proces were listed in Table 1.

Observable	Ionospheric Free linear combination
Ionospheric constraint	0.00 mm + 8.00 ppm
Antenna model	Azimut and elevation model
SV antenna model	Elevation model
Earth tide model	IERS2003
Ocean loading model	FES2004
Tropospheric Mapping Function	Geometric Mapping Function
Reference Frame	ITRF2005

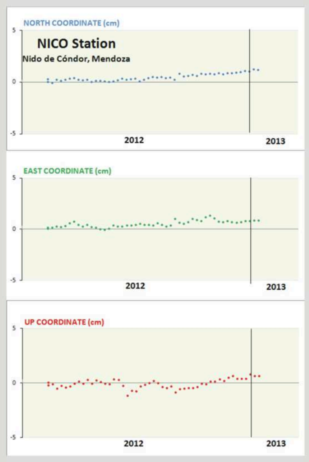
Table 1

STATIONS AND EQUIPMENT

NICO
Receiver: Trimble NetRS
Antenna: Trimble Zephyr Geodetic + TZGD

- Coordinates ITRF2005 (Epoch 2013.089, week 1725)

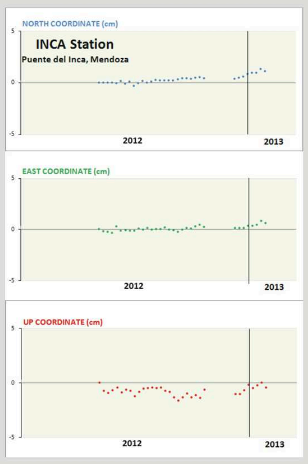
Lat: -32º 38′ 15.17507″
Long: -70º 01′ 46.74035″
Ellip. height : 5602.874m



INCA
Receiver: Trimble NetRS
Antenna: Trimble Zephyr Geodetic

- Coordinates ITRF2005 (epoch 2013.089, week 1725)

Lat: -32º 49′ 34.53692″
Long: -69º 54′ 36.04133″
Ellip. height: 2765.525m



ACON
Receiver: Trimble NetRS
Antenna: Trimble Zephyr Geodetic

- Coordinates ITRF2005 (epoch 2013.108, week 1726)

Lat: -32º 39′ 13.14235″
Long: -70º 00′ 43.38529″
Ellip. Height: 6984.474m