

## **Crustal deformation across the Southern Patagonian Icefield: GNSS observations and GIA models**

Luciano Mendoza (1,2), Andreas Richter (1,2,3), Eric Marderwald (1,2), José Luis Hormaechea (4), Erik Ivins (5), Raúl Perdomo (2,6), Heiner Lange (3), Ludwig Schröder (3), and Reinhard Dietrich (3)

(1) Laboratorio MAGGIA, Facultad de Ciencias Astronómicas y Geofísicas (FCAG), Universidad Nacional de La Plata (UNLP), Argentina (lmendoza@fcaglp.unlp.edu.ar), (2) Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina, (3) Institut für Planetare Geodäsie (IPG), Technische Universität Dresden (TUD), Germany, (4) Estación Astronómica Río Grande (EARG), Argentina, (5) Jet Propulsion Laboratory (JPL), California Institute of Technology (Caltech), Pasadena, USA, (6) Facultad de Ciencias Astronómicas y Geofísicas (FCAG), Universidad Nacional de La Plata (UNLP), Argentina

We present the geodetic observation and geodynamic interpretation of crustal deformation rates in a network of 43 GNSS sites covering the region of the Southern Patagonian Icefield (Argentina and Chile). Repeated and semi-permanent GNSS observations initiated in 1996 yield 3D site velocities within a terrestrial reference frame with mean accuracies of 1 mm/a and 6 mm/a for the horizontal and vertical components, respectively. These site velocities are interpreted with regard to the magnitude, patterns and primary driving processes of vertical and horizontal present-day crustal deformation (Richter et al. 2016).

The vertical site velocities document a rapid uplift causally related to glacial-isostatic adjustment (GIA) reaching 4 cm/a. They yield now an unambiguous preference between two competing regional GIA models (Lange et al. 2014). Remaining discrepancies between the preferred model and our observations point toward an exceptionally low effective upper mantle viscosity and effects of lateral rheological heterogeneities.

The extension and geometry of our network allow, for the first time, also a detailed analysis of the horizontal velocity components. An analysis of the horizontal strain-rate field reveals a complex composite, with compression dominating in the west and extension in the east. The observed velocities suggest significant contributions from three processes: GIA, a western interseismic tectonic deformation field related to plate subduction, and an extensional strain-rate field related to active Patagonian slab window tectonics.

They document a dual interaction between the peculiar tectonic situation and the visco-elastic response to ice-load changes: First, a mechanical superposition of the characteristic patterns of each of the three processes, which results in the complex superposition of horizontal deformation revealed by our strain analysis. And second, the lateral differentiation of the glacial-isostatic response imposed by the three-dimensional rheological structure and mantle flow as revealed by the observed localized, asymmetric uplift pattern. The mantle circulation, in turn, is affected by the load-induced movement of mantle material. Future improvement in modeling and understanding the present-day crustal deformation in southern Patagonia calls for careful integration of the three processes that we have identified here from observations, within a three-dimensional, time-dependent framework of rheological structure and mantle circulation.

### References:

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