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Abstract:

Strong earthquakes cause large changes in the station positions and velocities of the geodetic reference stations; i.e., the global ITRF (International Terrestrial Reference Frame) and its regional densifications like SIRGAS (Sistema de Referencia Geocéntrico para Las Américas) in Latin America and the Caribbean. To ensure the long-term stability of the geodetic reference frames, the transformation of station positions between different epochs requires the computation of reliable continuous surface deformation (or velocity) models. This paper presents the computation of a new continental continuous crustal deformation model for Latin America and the Caribbean inferred from GNSS (GPS+GLONASS) measurements gained after the strong earthquakes occurred in 2010 in Chile and Mexico. It is based on a multi-year velocity solution for a network of 456 continuously operating GNSS stations and covering a five years period from March 14, 2010 to April 11, 2015. This new deformation model, called VEMOS2015 (Velocity Model for SIRGAS 2015), is computed using the least square collocation (LSC) approach with empirically determined covariance functions. The result is summarised as follows: While the effects of the Baja California earthquake can be considered as local, the effects of the Maule
earthquake changed the surface kinematics of a large area (between the latitudes 30°S - 45°S from the Pacific to the Atlantic coasts). Before the Maule earthquake, the strain rate field in this area showed a strong west-east compression with maximum rates of about 0.40 \( \text{strain/a} \) between latitudes 38°S and 44°S. In accordance, the deformation vectors were roughly parallel to the plate subduction direction and their magnitudes decreased with the distance from the subduction front. After the earthquake, the largest compression (0.25 \( \text{strain/a} \)) occurs between the latitudes 37°S and 40°S with a N30°E direction. The maximum extensional strain rate (0.20 to 0.35 \( \text{strain/a} \)) is observed in the Sub-Andean zone in the Patagonia south of latitude 40°S. The extensional axes rotate from a N30°E direction in the central Araucania zone to a westerly direction of N72°W in the western part of Patagonia. In the northern region of parallel 35°S, the extension is also directed to the Maule zone (S45°W) but with quite smaller rates (< 0.06 \( \text{strain/a} \)). This complex kinematics causes a large counter clockwise deformation pattern rotating around a point south of the epicentre (35.9° S, 72.7°W). The magnitude of the deformation vectors varies from 1 mm/a close to the rotation point up to 22 mm/a near the 2010 earthquake epicentre. The direction of the largest deformation vectors points to the epicentre. VEMOS2015 covers the region from 55°S, 110°W to 32°N, 35°W with a spatial resolution of 1° \( \times \) 1°. The average prediction uncertainty is \( \pm 0.6 \) mm/a in the north-south direction and \( \pm 1.2 \) mm/a in the east-west direction. The maximum is \( \pm 9 \) mm/a in the Maule deformation zone while the minimum values of about \( \pm 0.1 \) mm/a occur in the stable eastern part of the South American plate.

**Stichworte:**
Crustal deformation; deformation model; velocity model; Maule earthquake; VEMOS; SIRGAS; Latin America; Caribbean

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