Surface deformation deduced from CGPS data in the eastern Betic External Zones (SE Spain). Implications on SHA

Ivan Martin-Rojas¹, Alberto Sánchez-Alzola², Ivan Medina-Cascales¹, Maria Jose Borque³,⁴, Pedro Alfaro¹, Antonio Jose Gil³,⁴, Juan Luis Soler-Llorens¹, Maria Clara de Lacy³,⁴, Jose Miguel Andreu¹, and Manuel Aviles³

¹Departamento de Ciencias de la Tierra y del Medio Ambiente, Universidad de Alicante, Alicante, Spain (ivan.martin@ua.es)
²Departamento de Estadística e Investigación Operativa, Universidad de Cádiz, Jerez de la Fra. (Cádiz), Spain (alberto.sanchez@uca.es)
³Departamento de Ingeniería Cartográfica, Geodésica y Fotogrametría, Universidad de Jaén, Jaén, Spain (mjborque@ujaen.es)
⁴Centro de Estudios Avanzados en Ciencias de la Tierra CEACTierra. Universidad de Jaén, Jaén, Spain (mjborque@ujaen.es)

The Betic Cordillera (S Spain), located in the convergent plate boundary between Eurasia and Nubia, is an area of moderate seismicity. These plates converge at a rate of approximately 4 to 6 mm/yr in the NW-SE direction (see review by Nocquet, 2012). Between 2.7 to 3.9 mm/yr of present-day plate convergence is accommodated in N Africa. Active shortening must occur at rates ranging from 1.6 to 2.7±0.6 mm/year across the Algero-Balearic Basin and the SE Iberian Peninsula (Serpelloni et al., 2007; Pérez-Peña et al., 2010; Echeverría et al., 2013). In the Betic Cordillera, most of the deformation is concentrated in the Betic Internal Zones, while the Betic External zones are considered as a slow-strain area.

In SE of Spain onshore active deformation and seismicity are mainly located along the Eastern Betic Shear Zone (EBSZ), a major strike-slip tectonic corridor belonging to the Betic Internal Zones. Regional and local geodetic studies indicate that the EBSZ is absorbing between 0.2 and 1.3 mm/yr (Serpelloni et al., 2007; Pérez-Peña et al., 2010; Echeverría et al., 2013; Borque et al., 2019), i.e. only a portion of regional deformation. We postulate that part of this deformation not absorbed by the EBSZ is accommodated in the eastern Betic External Zones, located to the north of the EBSZ, where several major historical earthquakes occurred (e.g., the 1748 Estubeny, 1396 Tavernes, and 2017 Caudete earthquakes). These major events have been attributed to the Jumilla Fault, the only major active structure described in this area (Giner-Robles et al. 2014; García-Mayordomo, J. and Jiménez-Diaz, A., 2015).

We present new CGPS data analysis that corroborate that the eastern Betic External Zones accommodate a significant part of the present convergence. Furthermore, our preliminary data quantify deformation in this area for the first time, as we obtain a shortening rate in the N-S direction of 1.43±0.06 mm/yr in the western sector of the Jumilla Fault (Murcia sector) and of 1.69±0.07 mm/yr in the eastern sector of the fault (Valencia sector). We propose that this deformation is likely related to the Jumilla Fault. Our study place constraints on the seismic
potential of the highly populated eastern Betic External Zones, as the preliminary values that we obtained are significantly higher than those previously stated. Consequently, we propose that a reassessment of seismic hazard is necessary for this highly populated region. Moreover, we also propose a regional geodynamic model that provide insights into mechanisms controlling earthquakes in the eastern Betic External Zones.

References

Borque et al. (2019). Tectonics, 38, 5, 1824-1839
Giner-Robles et al. (2014). Resúmenes de la 2ª Reunión Ibérica sobre Fallas Activas y Paleosismología, Lorca, España, 155-158.
Pérez-Peña et al. (2010). Geomorphology, 119, 74-87