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Kinematic model of crustal deformation in the Ibero-Maghreb region: Insights from geodetic, geophysical and geologic data.

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The convergent zone between the African and Eurasian plates in the western Mediterranean (Ibero-Maghreb region), is characterized by slow relative plate motions (less than 5 mm/yr), and a complex seismicity pattern and stress field. This is a wide and distributed zone of deformation, where the location and definition of the major elements of the plate boundary are not clear. For this reason kinematic models of this area (e.g., Udías and Buforn, 1991; Gutscher, 2004; Stich et. al., 2003a, 2006; Fadil et al., 2006, Serpelloni et al., 2007, Vernant et al., 2010) are controversial because in many cases geological and geophysical data do not agree. As a consequence the different kinematic models vary greatly. The aim of this study is to understand crustal deformation through kinematic modeling using GPS velocities, geological and seismological data. Despite the importance of GPS observations to understand crustal deformation, studies based exclusively on GPS data provide non-unique results. It is fundamental to incorporate other independent datasets, such as seismological and geological data (Wallace et al., 2007). The analysis of kinematic indicators from different data sources allows for a better definition of crustal deformation, because the consistency or discrepancy of data within a model can be assessed in a more thorough way. We present velocities from a network of Global Positioning System (GPS) sites spanning much of the Ibero-Maghreb region. We have defined distinct tectonic blocks, each Tectonic block is assumed to be a homogeneous elastic behaviour. The tectonic blocks are assumed to undergo minimal internal deformation and are bounded by major faults or deformation bands identified in previous works and interpreted as structures with seismological and/or geological evidences of recent activity. The GPS-derived velocities are used to explain the kinematics of major tectonic blocks in the region and the nature of strain accumulation on major faults in Ibero-Maghreb region. We simultaneously invert GPS velocities for the poles of rotation of the tectonic blocks and the degree of elastic strain accumulation on faults in the region. As a final application, the resulting model is used, for new estimations of seismic hazard at the region.