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Deformation and fault slip rates for Africa-Iberia plate boundary, determined by neotectonic modeling

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The segment of the Africa-Eurasia plate boundary that runs from the Gloria Fault across the Gibraltar Straits until the Northern Algerian margin is characterized by low convergence rates and long earthquake recurrence intervals, turning incomplete the assessment of the seismic potential based only on earthquake catalogs. In this work we estimate the deformation rates for this region, as triggered by geodynamic constraints. We developed improved neotectonic modeling of this region, using the most recent version of the thin-shell code SHELLS (Bird et al, 2008). We integrate a new lithospheric model and fault map of the region, in particular for the Gulf of Cadiz, where we used recent mapping of active faults. We modeled the long-term surface velocity field, fault slip rates and continuum strain rates. Given some open geodynamic questions, we tested alternative scenarios: two alternative plate models, respectively including or excluding an independently-driven Alboran domain; and two alternative sets of Africa-Eurasia velocity boundary conditions, which correspond to geodetic and geological-scale averages of plate motion. Finally, we performed an extensive parametric study of fault friction coefficient, subduction resistance, and surface velocities imposed within the Alboran nodes. The final run comprised 5240 experiments, each scored to geodetic velocities, stress direction data and seismic strain rates. The preferred model among these includes the Alboran plate driven by basal WSW-directed shear traction, suggesting that a slab-related mantle mechanism is required to drive the Alboran domain. The continuum strain rates and the fault slip rates estimated by our preferred model can be used in the estimation of long-term deformation and for earthquake and tsunami hazard studies (e.g. Carafa et al, 2015).
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