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Strain Accumulation Across the Messina Straits and Crati Valley and Kinematics of Sicily and Calabria from GPS data and Dislocation Modeling

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We use Global Positioning System (GPS) velocities and dislocation modeling to investigate the rate and nature of interseismic strain accumulation in the area affected by the 1908 Mw 7.1 Messina earthquake and, in northern Calabria, across the Crati Basin and the Sila Massif (southern Italy). The region investigated in this work is among the most seismically hazardous sectors of the Mediterranean plate boundary, and few is known, or is still largely debated, about the present day kinematics and geometry of active seismogenic faults there. Given the tectonic and geodynamic complexity of the study region, active fault systems in Sicily and Calabria must be analyzed in the framework of the complex central Mediterranean microplates kinematics. Our data confirm a change in the velocity trends between Sicily and Calabria, moving from NNW-ward to NE-ward with respect to Eurasia, and details a fan-like pattern across the Messina Straits where $\sim$3 mm/yr NW-SE extension are accommodated. In northern Calabria, where GPS stations move NE-ward, $\sim$2 mm/yr about E-W extension are accommodated across the Crati Valley and Sila Massif. Half space dislocation models of the horizontal and vertical GPS velocities are used to infer, using model optimization algorithms, the kinematics (i.e, slip-rates) and geometric parameters of the two fault zones taken into consideration. The observed velocity gradients across the Messina Straits and Crati Valley can be rather well explained by elastic strain accumulation due to slip below the seismogenic layer of $\sim$SE-ward and $\sim$E-ward dipping normal faults, respectively, with slip-rates that are of the same order of magnitude than, even if higher, than the ones constrained by geological and paleoseismological data. By developing a regional elastic block model that accounts for both crustal block rotations and strain loading at block-bounding faults, we investigate if the measured velocity gradient across the two fault segments may be significantly affected by the elastic strain contribution from other nearby faults. Our results show that the measured velocity gradients across NE-Sicily and Calabria are not likely to be significantly affected by the elastic strain contribution of the possibly locked Calabrian subduction interface. We find that this longer wavelength signal can be presently super-imposed on the observed velocity gradients in NE-Sicily and Calabria, and the inferred slip rates on the Messina and Northern Calabria faults are impacted by elastic strain from Calabria.