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Active strain-rates across the Messina Straits and kinematics of Sicily and Calabria from GPS data

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The Messina Straits is the locus of one of the strongest seismic event that ever hit Italy during historical times, the 1908 Mw 7.1 earthquake, and the same region also suffered major damage from other strong earthquakes in the last few centuries. However, despite the large amount of data and studies carried out, our knowledge of the present-day deformation of this area is still debated. While a general consensus has been reached about the kinematics of the 1908 causative fault, less is known about the rate and shape of interseismic loading across the Straits, and debate continues also about the general kinematics and geodynamic framework of this region which are strongly influenced by subduction and retreat of Ionian lithosphere. Thanks to the increasing number of GPS Networks in the study region it is now possible to study both the regional kinematics and strain loading across active faults. In this work we analyze all the observations collected over the Messina non-permanent GPS Network for the 1994-2008 time span, and data from about 600 CGPS stations in the Euro-Mediterranean region, using the GAMIT software.

The output of our analysis is a new and denser velocity field, which is used to study the plate kinematics and the rate of interseismic strain building across the Straits. GPS velocities show a sudden change in their orientation across the Straits moving to NNW-ward, in Estern Sicily, to NNE-ward in Western Calabria, depicting this area as a primary boundary between two different tectonic domains.

The maximum strain-rates observed across the Straits are about 120 nanostrain/yr, with extension oriented about normal to the coasts of Sicily according to the presence of a normal fault. The measured velocity gradient can be used to model the creeping dislocation at depth, however, over the Messina Straits the interseismic elastic strains accumulating across other nearby active faults can significantly affect the observed velocity gradient.For this reason we investigate, using a regional elastic block-modeling approach, these effects. We use the block model to test for different microplates configurations and to account for nearby active faults while inverting for optimal fault geometry and intersismic slip-rates across the Straits.