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Geodetic slip-rates from block-modeling of a dense GPS velocity field in Italy: comparison with geological slip-rates and seismic moment release

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The growing number of continuously operating GPS stations in Italy highlights local scale details of the velocity gradients across active seismogenic faults. The regional scale pattern of the velocity strain-rate field has been already constrained by several authors, adopting different algorithms of interpolation of sparse velocities and showing consistency with seismotectonics data. Nevertheless an estimate of the geodetic slip-rates from kinematically consistent elastic models is still missing. In this work we use velocities from >1000 cGPS stations, obtained from the analysis of position time-series realized in the IGS08 reference-frame. Raw data have been analyzed with the GAMIT/GLOBK software, and regional solutions from 60 sub-networks have been combined with global solutions from SOPAC. We use a principal component analysis (PCA) technique to estimate the pattern of spatially correlated common mode error (CME) at the Euro-Mediterranean scale. Filtering of the CME from raw time-series significantly improves the signal-to-noise ratio and provides smaller velocity uncertainties. We estimate the velocity uncertainties adopting a flicker+white noise error model, resulting from the spectral-index analysis of residual time-series. We use an elastic block-modeling approach to model interseismic fault slip-rates while accounting for rotations of crustal blocks and micro-plates in the study area. We use available catalogues of active faults to define the fault geometries, parameterized as uniformly slipping rectangular fault planes. The model provides a good fit to the horizontal velocities and fault kinematics that are largely consistent with other geological and seismotectonics information, despite the known structural complexity of the Italian region. We compare the geodetically estimated fault-slip rates with available databases of geologically determined slip-rates, and found a general agreement in both the kinematics and slip-rates values, considering the large uncertainties in the geological slip-rates. In general, geodetically determined slip-rates are faster than geologically determined ones. We use our best-fit block model to define a continuous horizontal velocity field, and estimate the velocity-gradient field. The strain-rate field estimated from the sparse GPS velocities shows areas, outside the major fault systems, with significant strain accumulation, which are interpreted as the effects of secondary localized deformation zones that would require additional investigations. We calculate the regional moment accumulation rate in Italy based on the geodetically determined fault slip rates, and compare it with the moment released from earthquake catalogues with the goal of estimating localized moment deficits.