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Kinematic block modeling of GPS velocities in Italy and seismic potential

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We use a dense GPS velocity field, from the analysis of >1000 continuous stations, and elastic block modeling to study the interseismic strain accumulation along the Alpine and Apennines active tectonic belts in Italy. We consider available fault catalogues, instrumental and historical seismicity to determine the blocks boundaries geometry, parameterized as uniformly slipping rectangular planes. We invert horizontal velocities to estimate Euler vectors of tectonic blocks together with slip-rates at block-bounding faults. When allowed by density of GPS data, we optimize faults dip and locking-depth by searching the parameters that provide the best fit to local GPS data. Overall we obtain a good fit of the horizontal velocities and geodetic slip rates that are kinematically consistent with available geological and seismotectonic information.

We use the best-fit geometric and kinematic model parameters to compute the expected GPS velocities over a dense regular grid. Denser model velocities are used to estimate the velocity gradient field on a regular grid, made by cell elements of 0.25°x0.25°. Geodetic strain-rates at each cell are converted into seismic moment accumulation rates, following the Kostrov formulation, considering as seismogenic thickness values obtained from a crustal (EPcrust) model and earthquake hypocentral distribution. Geodetic moment accumulation rates are compared with seismic moment rates released by earthquakes, obtained from the analysis of a seismic catalogue realized by merging several instrumental and historical catalogues covering the 1600-2012 time-span, and uniformly defined moment magnitudes. The comparison between geodetic moment accumulation rates and seismic moment release rates highlights regions with significant moment deficits but also areas with a surplus of the seismic moment released, with important implications for seismic hazard evaluations and assumptions behind the approach used in this work.