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Neotectonic deformation models as input for earthquake rate calculation

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Since the plate tectonics theory was introduced, fault slip rates and permanent deformation have been widely expected to provide a basis for the quantitative prediction of long-term average seismicity and seismic hazard. In the last decade the state of knowledge on the Earth structure and dynamics improved with proper 3D dynamic models that have acquired their scientific value and importance. Unfortunately, this progress has rarely led to deformation models having the needed requirements to compete with the empirical-statistical models in seismic hazard studies.
The empirical-statistical models project historical seismicity into future without the need of knowing the structure and kinematics of active faults and permanent deformation. Historical catalogs are limited through time and incomplete in space, failing to reproduce representative long-term deformation and earthquake rates. These limitations can be overcome by forward or inverse modeling, which aims at integrating neotectonic observations (e.g. fault geometry and activity, GPS velocities, focal mechanism solutions, stress orientation) to produce realistic output for seismicity forecast estimates. For the Central Mediterranean the last two decades have seen important initiatives aimed at compiling databases on active faults, GPS measurements and SHmax orientations, as well as historical catalogs. As the seismic hazard studies are implementing these data, we are becoming aware of the limitations that each of these input are subjected to; the fault mapping remains incomplete especially in the offshore areas; the GPS measurements, besides the long-term tectonic component, include also short-term transients; historical catalogs are incomplete and absent of reliable information on depth and focal mechanism. Our experience promotes the implementation of active fault and geodynamic data as seismic hazard input but cautions that the correct integration of any data (and related uncertainties) is required to calculate reliable seismicity forecasts able to compete with the ones estimated by means of statistical methods.