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Introducing individual seismogenic sources and geology-derived strain rates into Europe's new seismic hazard model

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The EC-funded project SHARE (Seismic Hazard Harmonization in Europe) aims at delivering a new model of seismic hazard assessment that is both highly innovative in terms of procedures and input data and fully harmonized across national boundaries.

One of the most significant innovations brought about by SHARE is the creation of an authoritative community seismogenic source model and its integration into the hazard calculations. This pan-European model and database has been assembled at INGV through extensive expert elicitation and by seeking community feedback, especially for the most difficult and controversial areas. The database was implemented following the design illustrated by Basili et al. (2008, Tectonophysics), based on a presentation at the EGU annual meeting in 2006.

The release of the database that is being used for seismic hazard calculation includes about one thousand fully-parameterized seismogenic sources, for a total fault length of 66,000 km (98 sources and 8,500 km at the beginning of the project, mostly from Italy and surrounding seas), plus the parameterization of the three major Mediterranean active subduction zones (Calabrian, Aegean, Cyprian). Having been initially developed for Italy, the strategy adopted for collecting data was carefully tailored to accommodate the needs, data availability, and local scientific legacy of each individual portion of Europe.

Defining earthquake sources in the slow-deforming seismogenic areas of most of Europe has been rather hard, yet it is a much easier task than assessing current tectonic strain rates. For this reason, alongside the seismogenic source database, INGV produced a set of strain and slip rates that will be used by SHARE as a constraint in the hazard model building process. The rates were obtained through finite-element dynamic models and represent long-term total strain and slip rates, calculated as anelastic deformation on continuum following the design used by Barba et al., (2008, Geophys. Res. Lett.) and incorporating the elastic deformation released as slip rates on model faults through back-slip. The total strain and slip rates allows identifying areas where the deformation has been released or will be released as earthquakes or will be consumed in other processes, including areas where little or no information is available.

The strain rates have been obtained by collecting all finite-element geodynamic models available for Europe, gathering all required operational datasets and building four models of strain-slip rates: one at the European scale, one for Fennoscandia, one for the Dinarides and one for the Aegean-Anatolian region. Strain rates were computed over the entire region covered by SHARE, including plate margins, and will help constraining the earthquake production rate of both the identified seismogenic sources and of broader areas of diffuse or poorly-known deformation.