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Seismic Hazard Harmonization in Europe
Project Acronym: SHARE

SP 1-Cooperation

Collaborative project: Small or medium-scale focused research project

THEME 6: Enviroment

Call: ENV.2008.1.3.1.1 Development of a common methodology and tools to evaluate earthquake hazard in Europe

D3.5 – Reference strain rate models for the Euro-Mediterranean region

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Swiss Seismological Service, Eidgenössische Technische Hochschule (SED-ETHZ)

NAMES INVOLVED Salvatore Barba, Hilmar Bungum, Michele MC Carafa, Roberto Devoti, Juerg Hauser, Vanja Kastelic, Halfdan P Kierulf, Anna Rita Pisani

Revision: 1

Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	x
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

1.

1. Description of the Deliverable

The strain rates produced are long-tem total strain rates: they are calculated as anelastic deformation on continuum elements of the FEM model (Barba et al., 2008) and they incorporate the elastic deformation released as slip rates on FEM model faults through back-slip.

Here we developed four models (Table 1) whose edges are shown in Figure 1.

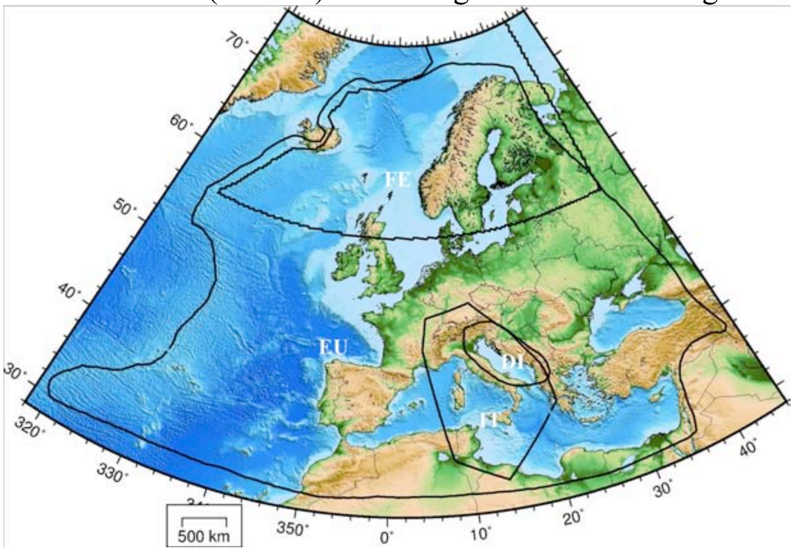

Figure 1: Model edges and model codes.

Model	Elements (volume)	Nodes	Fault segments
EU	~14000	~7700	~360
FE	~19000	~9900	NO
IT	~7700	~5000	~1100
DI	~4800	~2700	~180

Table 1: Models developed within Task3.3

These models were developed with the boundary conditions in Bird (2003), with the exception of the central Mediterranean, where more detail was introduced in the description of plates.

To determine strain rate, Task 3.3 used data covering different areas and qualitative information derived from studies of active deformation. Each dataset, such as the Moho thickness or the GPS measurements, has reached a high quality standards, but on its own fail to produce a realistic, deformation rates of seismogenic structures. Hence the importance and the need for a geodynamic model able to use all available data in a coherent framework arise. To reach such purpose, we integrated within the available global data sets with the literature data. Through the development of a geodynamic model consistent with each data set, we calculated horizontal velocities, stress azimuths, slip rates and strain rates for the entire SHARE area.

The main results are shown in Figure 2 and Figure 3.

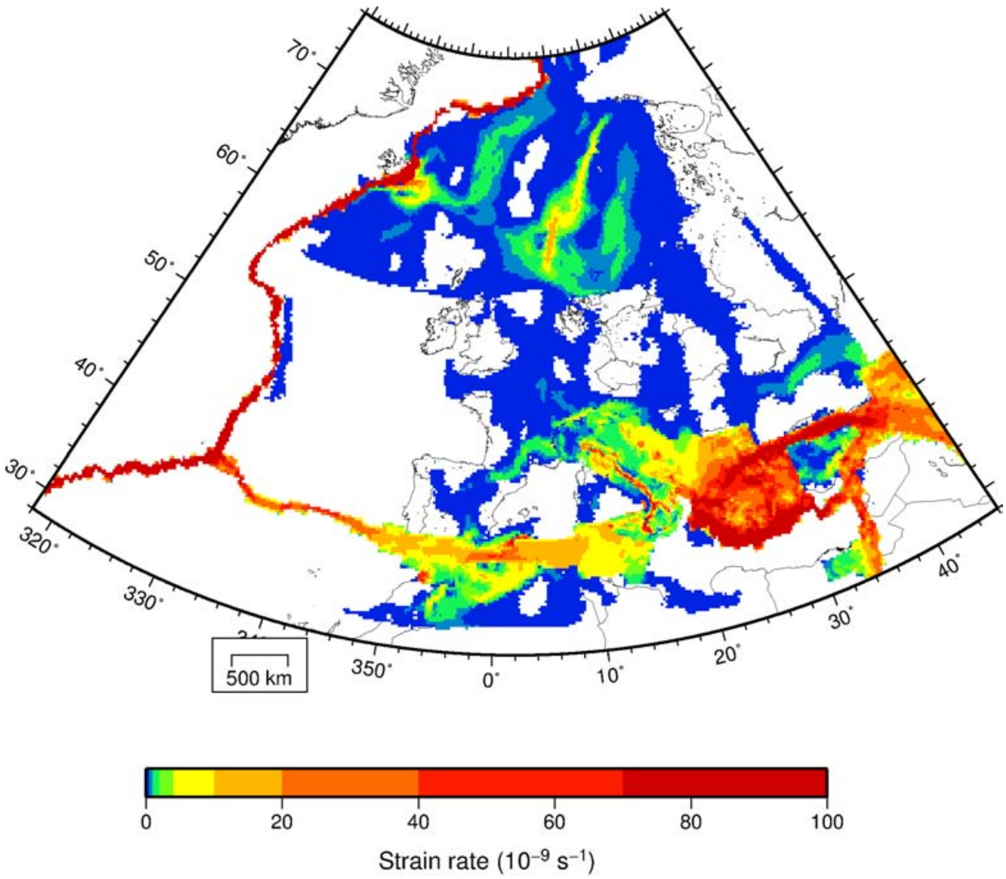

Figure 2: Strain rates in the whole model area.

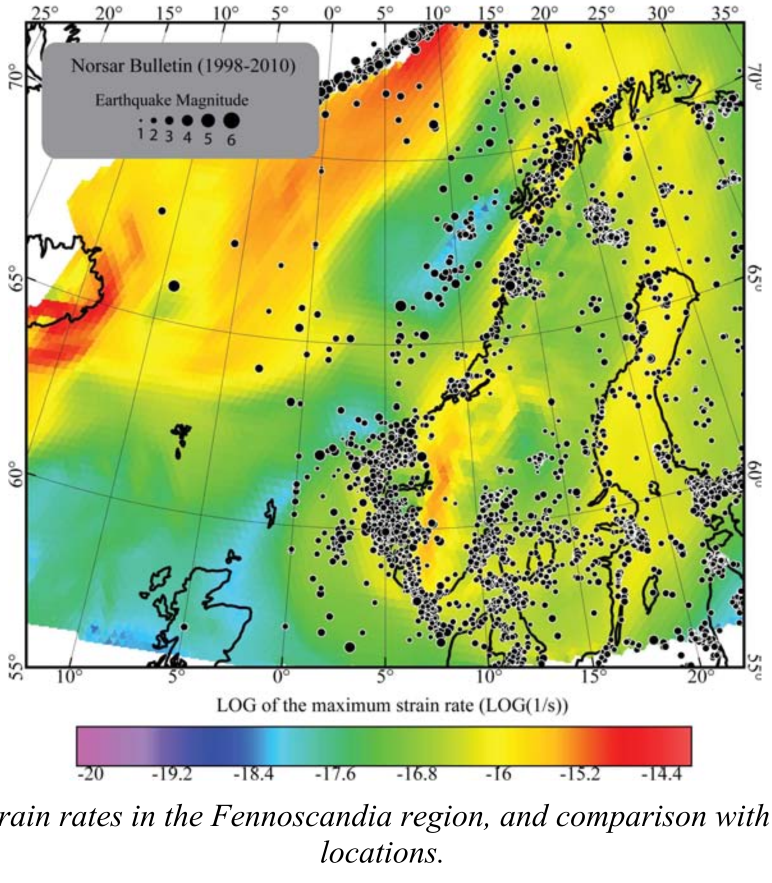

Figure 3: Strain rates in the Fennoscandia region, and comparison with earthquake locations.

Relevance for SHARE and/or for the scientific community:

The total strain rate allows identifying places where the deformation has been released or has to be released as earthquakes or into other processes. It helps identifying the places where deformation is expected and is expected to be released as earthquakes in the long term (~100 kyr) or dissipated by other known geological processes.

The predicted earthquake rates, based on average predicted moment rates and seismicity parameters have to be considered as an example of integrating different methods and give a basis to compute uncertainties.

The moment rate density becomes earthquake rate density $\dot{N}_{>M}$ (or earthquake potential) under the assumption that the moment rate budget at r distributes into earthquake sizes that follow a truncated Gutenberg-Richter (Gutenberg and Richter, 1954) distribution of given b-value and M_{max} (Ward, 1994)

$$\dot{N}_{>M}(\mathbf{r}) = \left[\frac{1.5+b}{b}\right] \frac{\left[\dot{M}(\mathbf{r})/Nm\right]\left[10^{bM_{max}} - 10^{bM}\right]}{10^{(1.5+b)M_{max}+9.05}}$$

We assume that b and Mmax are derived over large regions of interest. Earthquake rate density $\dot{N}_{>M}(\mathbf{r})$ has units of 1/(m^2 y) and it is usually presented averaged over, or multiplied by, some area A (50 km^2 in tables 2 and 3). The mean recurrence interval in years for magnitude M+ events in area A is

$$T_{>M}(\mathbf{r}) = [A\dot{N}_{>M}(\mathbf{r})]^{-1}$$

Changes with respect to the original plans and reasons for it:

To improve accuracy, we anticipated the development of more detailed models, and four models were actually developed instead of one. This has slowed down the determination of the errors which will be computed at a later time.

In order to speed-up the computation, the strain rate was computed only within the SHARE edges and not along the edges, where the results of Kreemer et al. (2003) were temporarily assumed. However, the computation of the strain rates along the edges is on the way.

Disclaimer

The content of this Deliverable is restricted to the use of the SHARE participants. It will be improved during the project time life.

References

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Key publications

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