Supplement of "The communication strategy for the release of the first European Seismic Risk Model and the updated European Seismic Hazard Model"

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Publication date:
2023-05-15

Permanent link:
https://doi.org/10.3929/ethz-b-000612048

Supplement of

The communication strategy for the release of the first European Seismic Risk Model and the updated European Seismic Hazard Model

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Supplement S1: Survey interactive risk map viewer – Entire Questionnaire.

Below the entire questionnaire is listed. In total, 17 participants filled in the survey in December 2020. The questionnaire was programmed with SPSS and shared via the EFEHR LinkedIn account and personal contacts to end users.

Table S1: Questionnaire for the user survey of the interactive risk map viewer

Welcome

Thank you for taking the time to fill in this questionnaire. As a result of joint research activities supported by various projects and initiatives (including SERA, EPOS-IP, and EFEHR), we will soon release a European Seismic Risk Model. The results of this model will be presented in an interactive map viewer. In the following, we would like to collect your expectations concerning the presentation of the European Seismic Risk Model 2020 (ESRM20).

Please note that this questionnaire focuses on processed risk information that is available in the interactive map viewer and not on the input data used for advanced risk modeling (which will also be made available to the scientific community through other online channels).

[Consent form]

Expectations

Before exploring the interactive map viewer, we have some general questions.

- Which is your area of work?
  - Insurance/reinsurance/financial sector
  - Disaster risk management
  - Cat risk modeling
  - National civil protection
  - European civil protection
  - International civil protection
  - Structural/civil engineering
  - Research
  - Academia
  - Other: [Textbox]

- In your opinion, what kind of information do you expect to be part of the European Seismic Risk Model? [Textbox]

- In your professional context, what will or should be the main purpose of such a risk model? [Textbox]

- To what extent do you agree with the following statements? I / my institution would mainly benefit from a European Seismic Risk Model supporting…
  [1=strongly disagree to 5=strongly agree]
  - … the development of new services or products.
  - … the enhancement of existing services or products.
  - … the assessment and configuration of risk portfolios.
  - … disaster management and planning.
  - … others: [Textbox]

- What kind of information should be displayed in an interactive map viewer of the ESRM20? [Textbox]

- To what extent do you agree with the following statements. I / my institution would mainly benefit from an interactive map viewer displaying the following information.
  [1=strongly disagree to 5=strongly agree]
  - Seismic risk of different European countries
  - Seismic risk of different European regions/administrative units
  - Seismic risk of different European cities
  - Economic losses
  - Human losses
  - Building damages
  - Hazard maps
  - Earthquake catalogues
  - Exposure maps
  - Active fault maps
  - Social indicators for different European countries
  - Other: [Textbox]

Exploring the interactive map viewer

At first, please take a few minutes to get familiar with the interactive maps of the ESRM20. By clicking on the following link, you can access the map viewer. Please note that this is only a beta version that is being used for testing and **does not contain the final results of the ESRM20.** Also, the maps in this beta version currently only present economic loss, but all of the same information will also eventually be available for fatalities.

[Placeholder Website Link]

As soon as you are ready, you can click on "Continue".

Understanding

In a first step, we would like to analyze how accessible the risk information is. Do not hesitate to look at the map viewer in another window to answer the following questions. Link to the map viewer:[Placeholder link].

- Which country has the highest seismic risk based on the estimated average annual loss (AAL)?
  - Italy
  - Switzerland
  - Norway
  - France
  - Greece

- How large is the estimated industrial average annual loss (AAL) in Italy?
  - 569 Million Euro
  - 1601 Million Euro
  - 5446 Million Euro
  - Between 1666 – 5446 Million Euro
  - This information is not available.

- Which description best defines "total average annual loss ratio" (or AALR total) of a given country as currently presented in the map viewer?
  - The total average annual loss of all occupancy classes (residential, industrial and commercial) divided by the GDP of a given country
  - The total average annual loss of a given occupancy class (e.g. residential) divided by the total losses of all occupancy classes of a given country
  - The total average annual loss normalized by the total asset replacement cost within a given country

- How large is the total average annual loss ratio in Greece?
    - 1.796 per mille
    - 1.992 per mille
    - Between 1.018 - 2.230 per mille
    - This information is not available.

- How large are the estimated losses (in M EUR) in Norway for a return period of 500 years?
    - 200 Million Euro
    - 292 Million Euro
    - Between 0 - 486 Million Euro
    - This information is not available.

- What is the value of the Human Development Index of Italy?
    - 0.456
    - 0.883
    - This information is not available.

- Which of the maps are relevant for your work?
  [Multiple choices possible]
    - Map of average annual loss (M EUR)
    - Map of average annual loss ratio (per mille)
    - Map with the 200-years return period loss (M EUR)

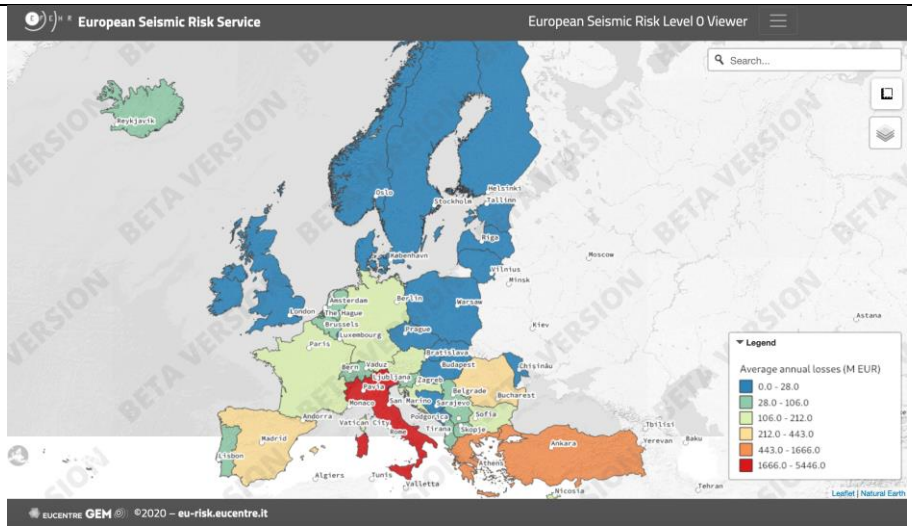
- Can you think of any further maps that would be useful for you?
  [Textbox]

- Which of the following map resolutions would be most needed/desired from your side?
  [*Select one*]
    - National level (as currently provided in the beta version)
    - Sub-national level: first administrative unit
    - CRESTA zone level
    - NUTS administrative level 1 (NUTS1)
    - Gridded map [e.g. 1km x 1km]
    - Other: [Textbox]

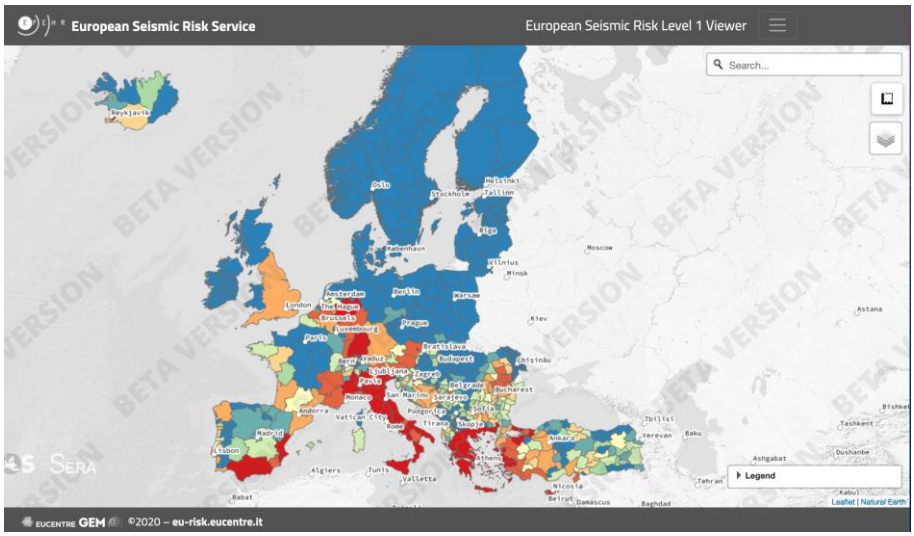
- We currently plan to prepare all of the risk results for at least two different levels of resolution: national level and first administrative unit level (see examples in the two screenshots below). To what extent do you agree with the following statements. [1=strongly disagree to 5=strongly agree]:

    - The risk results for all levels of resolution should be included in the same map viewer, so that all information is together.
    - The risk results for each level of resolution should be provided in separate map viewers, to avoid overcrowding the viewer.
    - Risk results covering both economic losses and fatalities should be provided together in the same interactive map viewer.
    - Other [textbox]

  National Level (as currently provided in the beta version of the map viewer):



First administrative unit level:



- In the information box on the right, we provide information about losses for selected return periods. Which of these are useful for you?
  [Multiple choices possible]
  - 50 years
  - 100 years
  - 200 years
  - 500 years
  - 1000 years
  - Others: [Textbox]

- Which of the available layers are useful for you?
  [Multiple choices possible]
  - Significant earthquakes (according to the NCEI WDS database)
  - Populated places
  - Shaded relief

- Can you think of further layers you would appreciate?
  [Textbox]

- Can you think of any additional information you would like to access in the map viewer?
  [Textbox]

Design

The following questions focus on the presentation of the information.

- To what extent do you agree with the following statements.
  [1=strongly disagree to 5=strongly agree]
  - The design of the interactive map viewer is attractive.
  - It is easy to navigate.
  - The map functionalities (e.g., zooming, opening and closing the legend) meet my expectations.
  - The topographic layer is well visible.
  - The selection of "populated" cities is adequate and useful.
  - I appreciate the layer of "significant earthquakes".
  - The inclusion of social indicators is complete and appropriate.

- The interactive European seismic risk **maps** are… ?
  [yes/no]
  - Clear
  - Confusing
  - Informative
  - Intuitive to understand
  - Useful and relevant for my work

Final Questions

- After having explored the presentation of the ESRM20 risk results, does it meet your expectations?
  [Textbox]
- Do you have any further comments?
  [Textbox]
- In a next step, we would also like to conduct virtual interviews to explore certain elements of the interactive map viewer in more detail. Through these interviews, you will also have the chance to give further feedback and voice your needs. In case you would be available for a virtual interview, please leave here your email address and we will contact you in mid-December:
  [Textline]

If you have answered all questions, please click on "Continue" and your answers will be saved.

End page

Thanks for answering all the questions and thus helping us to improve the ESRM20 interactive map viewer. Your answers have been saved.

Supplement S2: Survey interactive risk map viewer – All results.

In the following all the results of the survey are listed. From these results we derived the practical implications provided in the manuscript.

S2.1 – Participants' area of work

Most participants stated that they are from academia/research, structural/civil engineering or cat risk modelling. Further persons are also from national crisis centers or the financial sector.

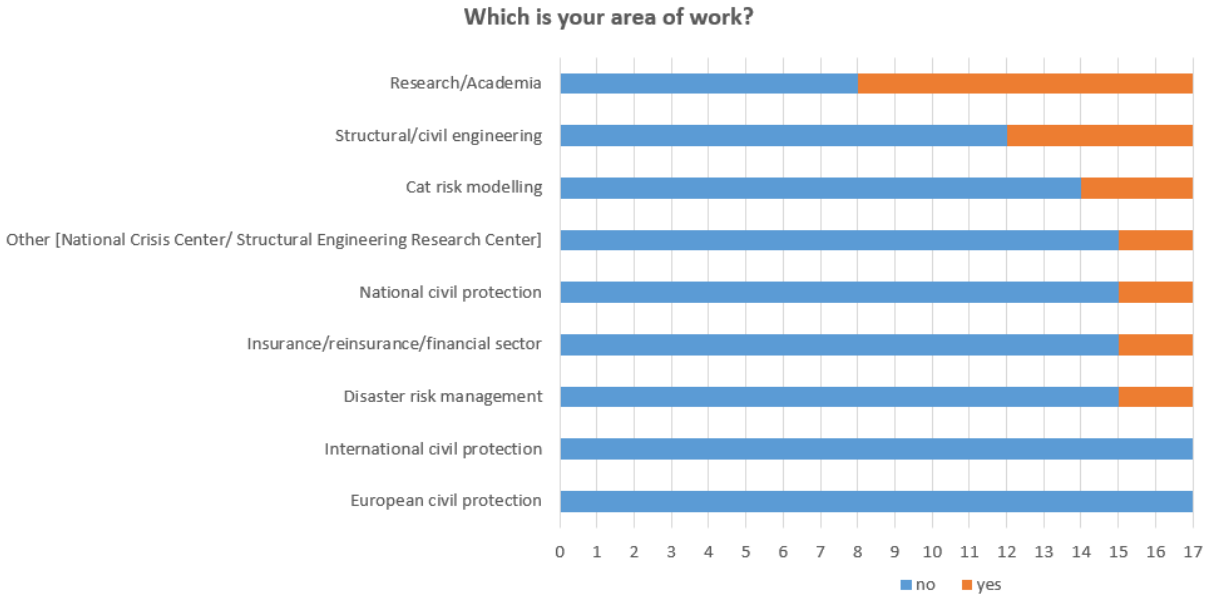
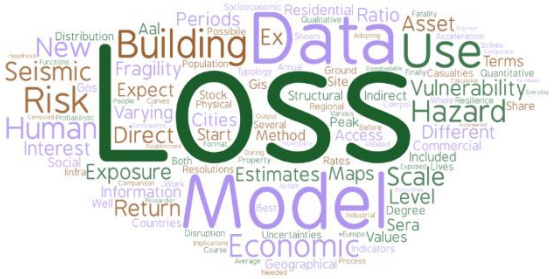


Fig. S1: Participants' area of work [absolute numbers]

S2.2 – Expected information part of the European Seismic Risk Model

The following information is expected:



- Losses: direct & indirect economic losses, causalities, fatalities, damages on physical assets (e.g. buildings)
- Resolution: countries, cities, municipalities
- Hazard data/map
- Exposure data (buildings and population)
- Fragility and vulnerability models for residential and commercial buildings
- Social vulnerability or resilience indicators
- PGA for several return periods
- Building stock information
- Access to all models and data used and transparency regarding the uncertainties
- Differentiation between commercial, industrial and residential buildings

S2.3 – Purpose of use

These are the main professional purposes of the risk models for the participants:

- To give **estimates of risk levels at various return period** for the mapped economic exposure and for the users to be able to slice and dice the exposure and get to comparisons of loss ratio levels across Europe.
- To provide **an overall view of seismic risk in Europe** and to **compare seismic risk** in the different EU countries.
- **Guide the development of public/private risk mitigation strategies** of all sorts, such as deployment of wide-scale structural upgrading campaigns, development of risk-aware urban planning, introduction of compulsory insurance schemes, or improvement of seismic design codes.
- **Disaster risk mitigation planning** (preparedness, prevention)
- To **identify the objects at risk** and the potential impacts of an earthquake in order to take measure to put the risk at lower levels.
- To **compare** with and **improve** existing vendor **models** of European seismic risk.
- To provide detailed information to **decision-makers, insurance companies** etc.
- To provide easy access for different kinds of users to specific risk metrics for the whole Europe accompanied by the data/models used for its development.
- To **raise awareness** within the scientific and engineering communities.
- To **establish priorities in policies** and strategies, compare different risks.
- To **provide reliable data** that can be quickly found.
- **Homogenization of seismic hazard maps along the boundaries** of the European countries. Development of unified methods and techniques for assessment of seismic vulnerability and associated risk. Exchange of knowledge and practices on the topic.
- Comparison with micro seismic observations; Comparison with local risk model; Comparison with hazard model; Homogeneous cross-border information; Public relation (authorities, scientist, citizens)
- To define a state-of-the-art characterization of seismic risk in Europe that allows to **identify areas of interest for further research and development**.
- To **increase awareness** of seismic risk in Europe at the levels of both the government and the public, that may lead to the development and/or implementation of risk reduction measures.
- **Estimation of displaced population and potential casualties**, as part of national disaster management plan (preparedness phase).

S2.4 – Benefits of the ESRM

I/my institution would mainly benefit from a ESRM supporting…

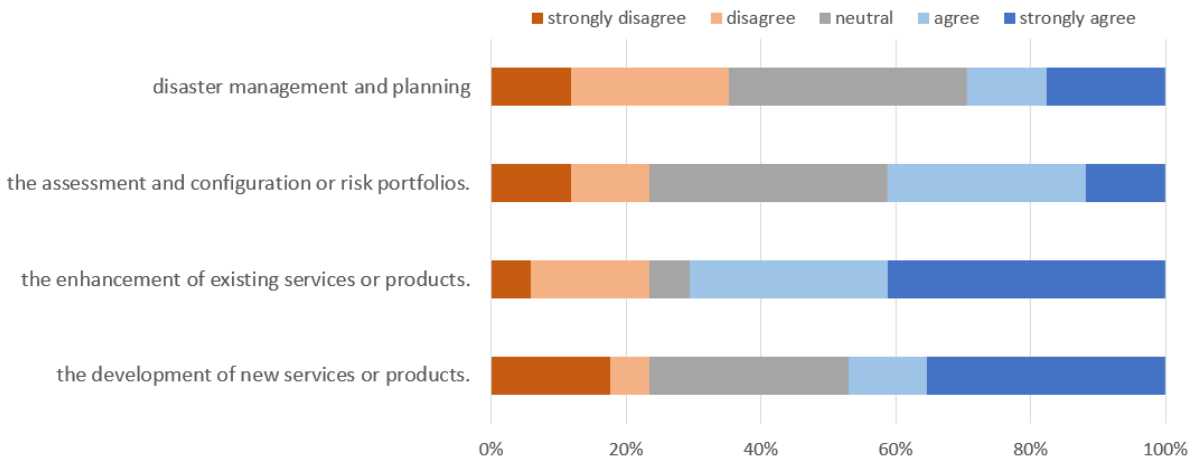


Fig. S2: Benefits of ESRM [percentage]

I/my institution would mainly benefit from an interactive map viewer displaying the following information:

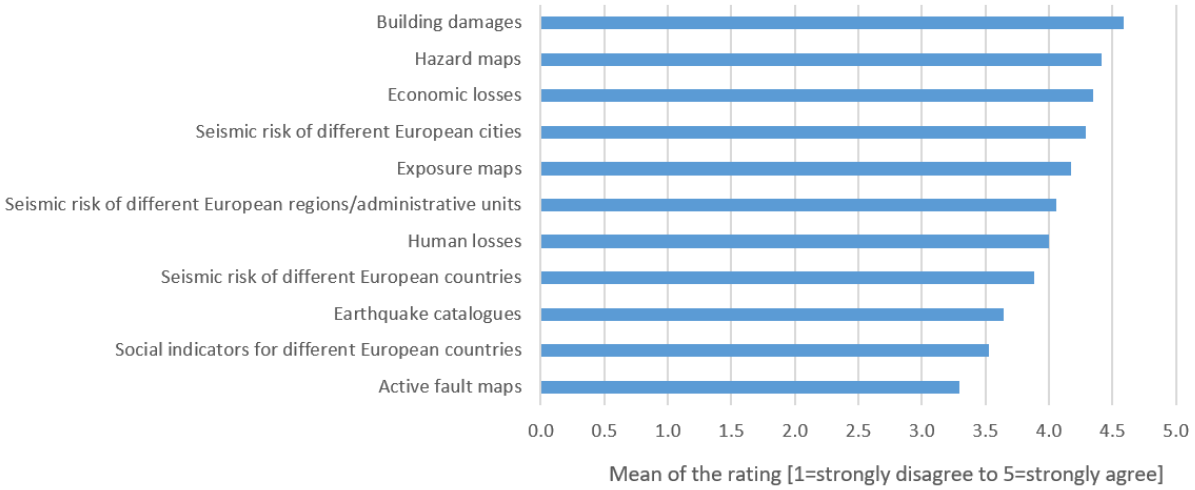


Fig. S3: Information preferences [mean]

S2.5 – Information needs

What kind of information should be displayed in an interactive map viewer of the ESRM20?

- AAL, AAL LR, and Loss and LR across various key return periods (50,100,250,1000). Also the Total Value of the exposed assets to be mentioned. The results at country level are useful but in many cases the main cities represent concentrations of exposure that might deviate significantly from the country estimates. Therefore, additions of data on the map for main cities would be very useful for risk managers.
- Expected losses for different assets, in terms of casualties, direct economic losses, indirect economic losses, degree of disruption of physical asset.
- Hazard data. Exposure data (buildings and population) at varying geographical scales. Estimates of economic and human losses at varying geographical resolutions.
- Building stock information and mean risk
- Average annual losses (economic and fatalities), economic losses and fatalities for specific return periods, physical damages for specific return periods
- Seismic hazard map, national hazard maps, seismic exposure maps for buildings (commercial, industrial, residential, etc) and other (infra)structures, display of fragility curves for each typology available in the exposure map, consequence functions, vs30 site models, human and economic losses in spatially refined regions (and not just per country)
- I think that it would be useful to easily read (e.g., through a pop up window), for a given point on a map, which are the elements that support that value of risk and their quality. Quality is important: in a model, you can use different input data, and their quality should be displayed to allow the user to manage correctly the provided values.
- Layers with data used (seismic catalog, active faults, seismotectonic zonation, GMPE or IPE zonation, site effects, hazard, vulnerability (class) /exposure, past intensities)
- Seismic risk of different European countries
- Loss and hazard maps associated with different return periods. EP curves with uncertainties included and shown on the graph. Total expected in financial, social and other terms...
- Average annual losses (colour scale on map), losses for a series of return periods (colour scale on map), loss curves (curves accessed when clicking on a location), proportion/number of buildings of different structural classes (plot accessed when clicking on a location), value of the exposed assets (colour scale on map), number of buildings (colour scale on map, sub-classified into occupancy cases), etc. The amount of information on hazard I would like to see

depends on whether this map viewer of the ESRM20 includes ESHM20 or not. If it doesn't (i.e. if there is a separate viewer for ESHM20), I believe at least a couple of hazard metrics should be shown in the ESRM20 as well, to facilitate analysis and comparison. I would expect to see hazard maps for different return periods, perhaps separated into a case purely on rock conditions and another in which the specific site conditions have been considered.

- Hazard, exposure, social, loss data

S2.6 – Correct interpretation

All participants were able to indicate which country has the highest AAL.

Table S2: Interpretation question 1 [absolute numbers]

Which country has the highest seismic risk based on the estimated annual loss (AAL)?	
Italy	17
Switzerland	0
Norway	0
France	0
Greece	0

Only half of the participants correctly indicated that the industrial AAL in Italy is 1601 Million Euro, by clicking on the country and finding the exact number in the information box on the right. The majority of the others only looked at the legend which, however, represents the **TOTAL** average annual loss and not the industrial AAL.

Table S3: Interpretation question 2 [absolute numbers]

How large is the estimated industrial average annual loss (AAL) in Italy?	
569 Million Euro	0
1601 Million Euro	9
5446 Million Euro	1
Between 1666-5446 Million Euro	6
This information is not available	1

All except of one person knew the definition of the AALR.

Table S4: Interpretation question 3 [absolute numbers]

Which description best defines "total average annual loss ratio" (or AALR total) of a given country as currently presented in the map viewer?	
The total average annual loss of all occupancy classes (residential, industrial and commercial) divided by the GDP of a given country	1
The total average annual loss of a given occupancy class (e.g. residential) divided by the total losses of all occupancy classes of a given country	0
The total average annual loss normalized by the total asset replacement cost within a given country	16

9 out of 17 participants correctly answered that the exact total AALR in Greece is 1.992 per mille. The other eight participants again only looked at the legend or thought that the information is not available.

Table S5: Interpretation question 4 [absolute numbers]

How large is the total average annual loss ratio in Greece?	
1.796 per mille	1
1.992 per mille	9
Between 1.018 - 2.230 per mille	5
This information is not available.	2

Only half of the participants found the value of the estimated losses for a return period of 500 years, which is listed in the information box on the right after clicking on a country.

Table S6: Interpretation question 5 [absolute numbers]

How large are the estimated losses (in M EUR) in Norway for a return period of 500 years?	
200 Million Euro	0
292 Million Euro	9
Between 0 - 486 Million Euro	0
This information is not available.	8

12 out of 15 participants found the value of the HDI in Italy. Also this value is listed in the information box on the right after clicking on a country.

Table S7: Interpretation question 6 [absolute numbers]

What is the value of the Human Development Index in Italy?	
0.883	12
0.456	0
This information is not available	5

S2.7 – Map preferences

Which of the maps are relevant for you work?

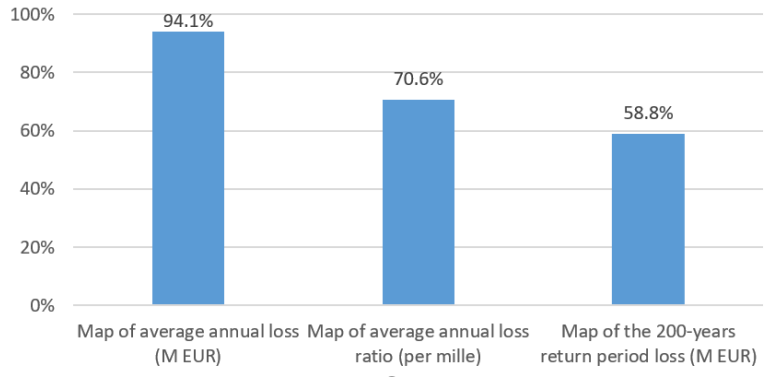


Fig. S4: Map preferences [percentage]

Which of the following map resolutions would be most needed/desired from your side?

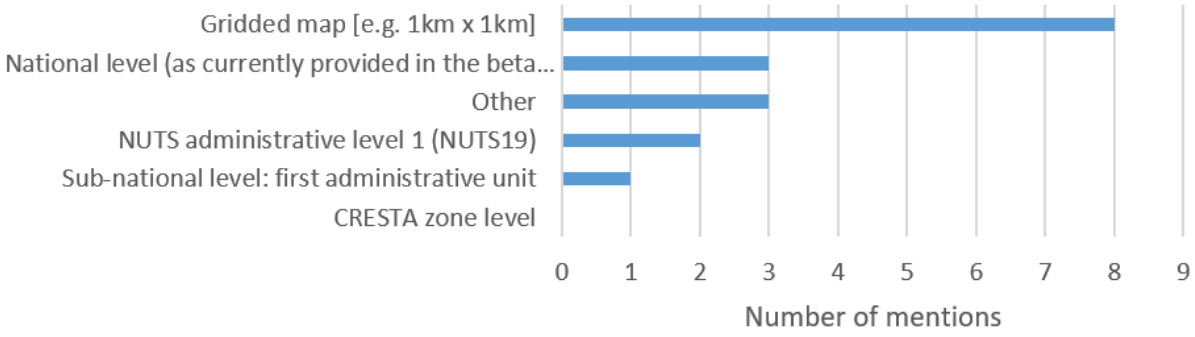


Fig. S5: Map resolution preferences [absolute number]

Further useful maps

- Additional return periods maps (5 mentions)
- Additional loss ratio displays
- Ability to download maps as csv
- Hazard and exposure maps (3 mentions)
- Mapping of social vulnerability indicators (2 mentions)
- Map of the distribution of the collapse risk of buildings/ building stock (2 mentions)
- AAL per population
- Losses also in terms of human lives

S2.8 – Map viewer preferences

To what extent do you agree with the following statements:

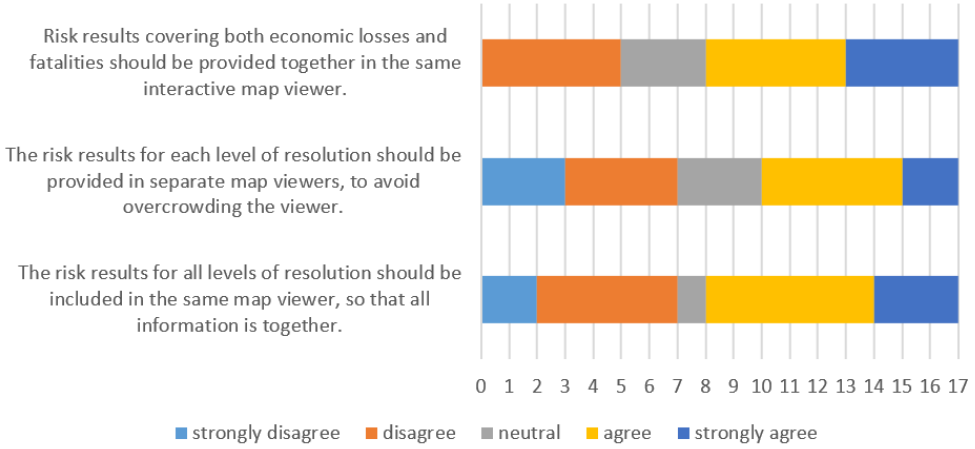


Fig. S6: Map viewer preferences [absolute number]

S2.9 – Map layer preferences

Which of the available layers are useful for you?

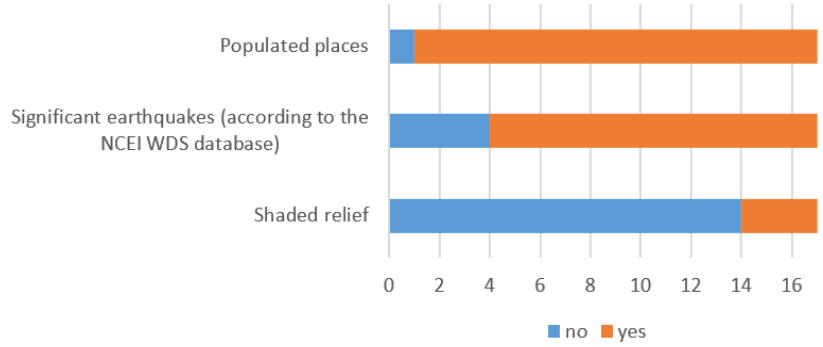


Fig. S7: May layer preferences [absolute number]

Which return periods would you appreciate?

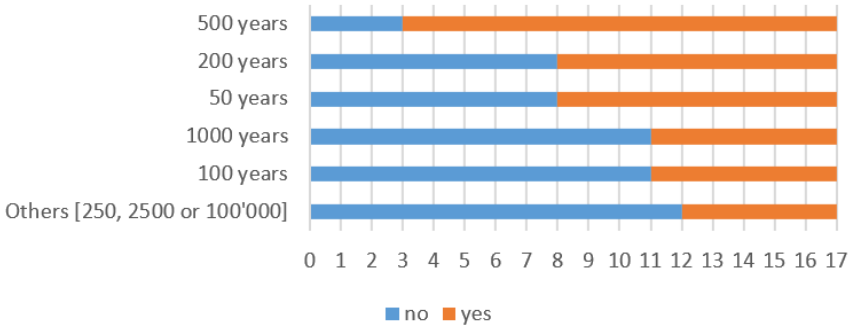


Fig. S8: Return periods preferences [absolute number]

<u>Further useful layers</u>

- Significant earthquakes: would be useful if we could click on an event and look at the event characteristics
- Active/major faults (4 mentions)
- Soil types
- GPA
- Slope
- Exposure (2 mentions)
- Seismic hazard (2 mentions)
- Geological maps released by the different member state geological surveys (2)
- Density of population

S2.10 – Missing information

The following issues were mentioned as missing information:

- The total replacement cost of buildings is necessary to be added, in order to understand the level of exposure in each country and subsequently at Admin1 level.
- Maybe it would be interesting to have a 'GetFeatuInfo' option available for the significant earthquakes layer(it was impossible on the beta viewer but it's maybe already planned)

- Something more about infrastructures/lifelines
- Vulnerability class of exposure model used
- Uncertainties associated with given results
- Social indicators data
- I think it would be great to show further information about the process used to calculate the risk for each country. For example, by clicking on certain results and values for a specific country, one should be able to get underlying info about assumptions made along the way, uncertainties involved and perhaps even a list of papers that explains in more detail how hazard & vulnerability were calculated for that region

S2.11 – Design evaluation

To what extent do you agree with the following statements?

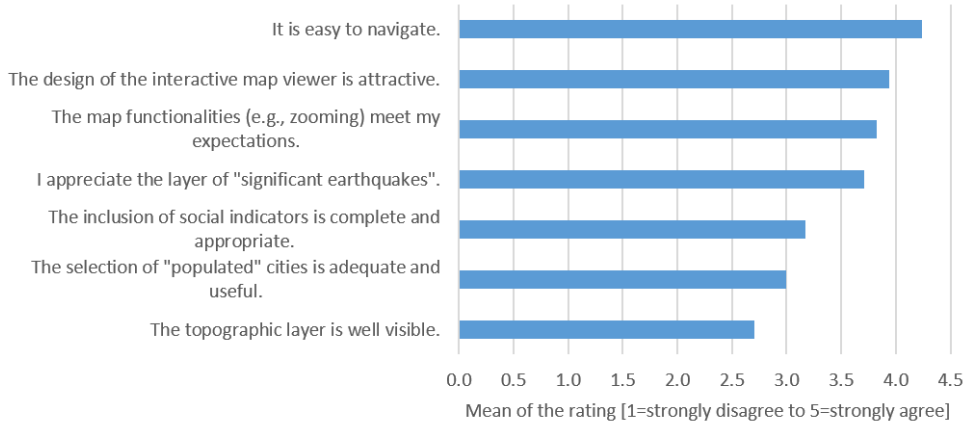


Fig. S9: Design evaluation[mean]

The European seismic risk maps are…?

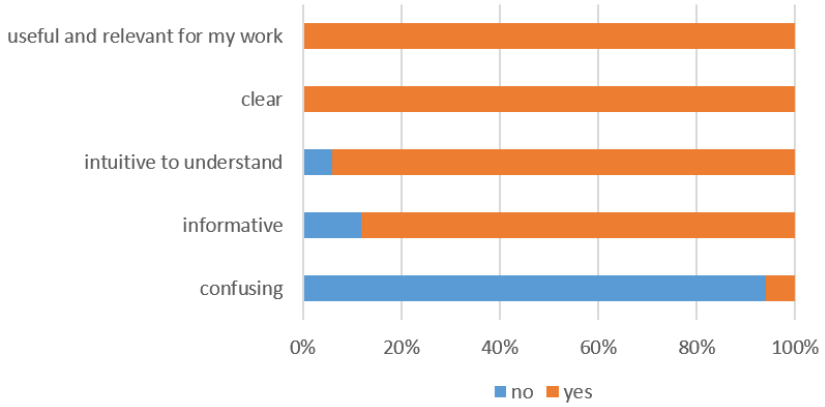


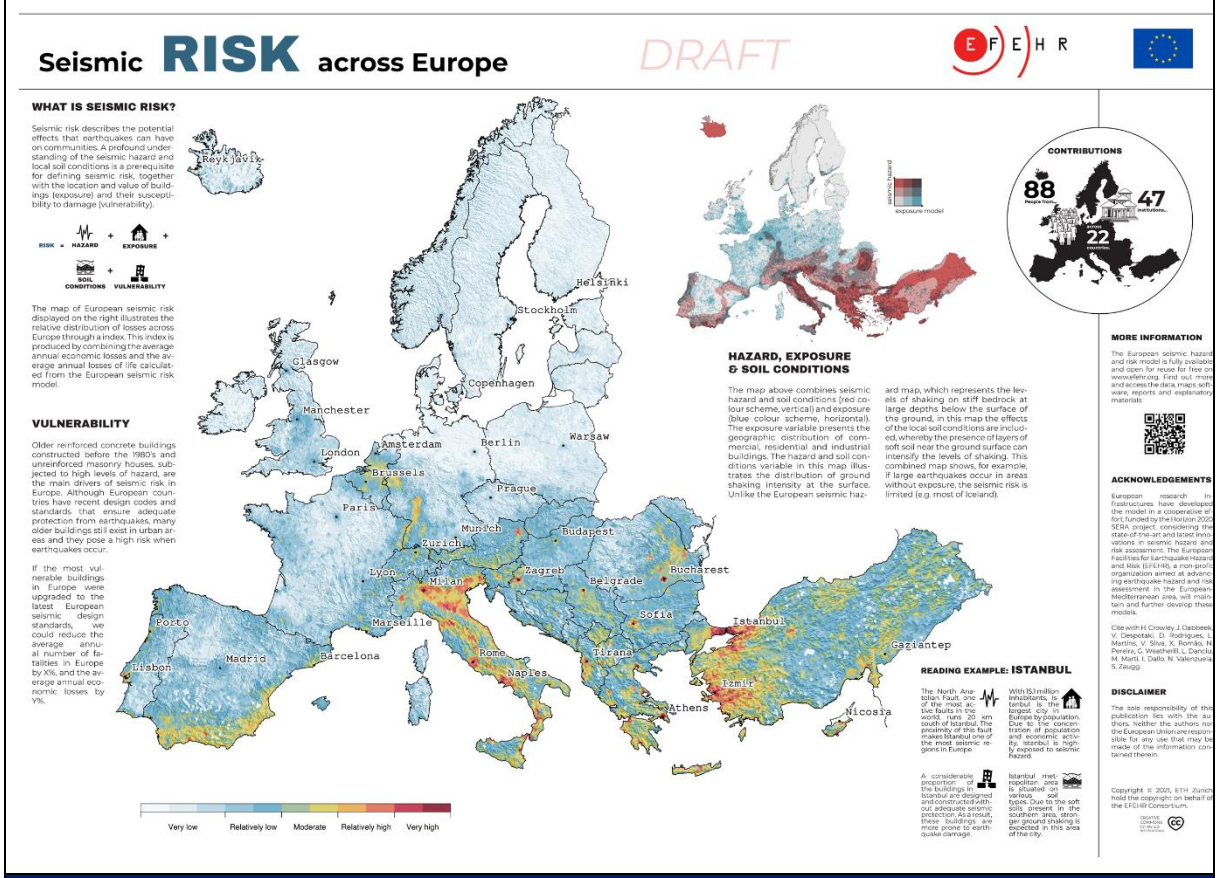
Fig. S10: Characteristics of the map [percentage]

Supplement S3: The three poster versions

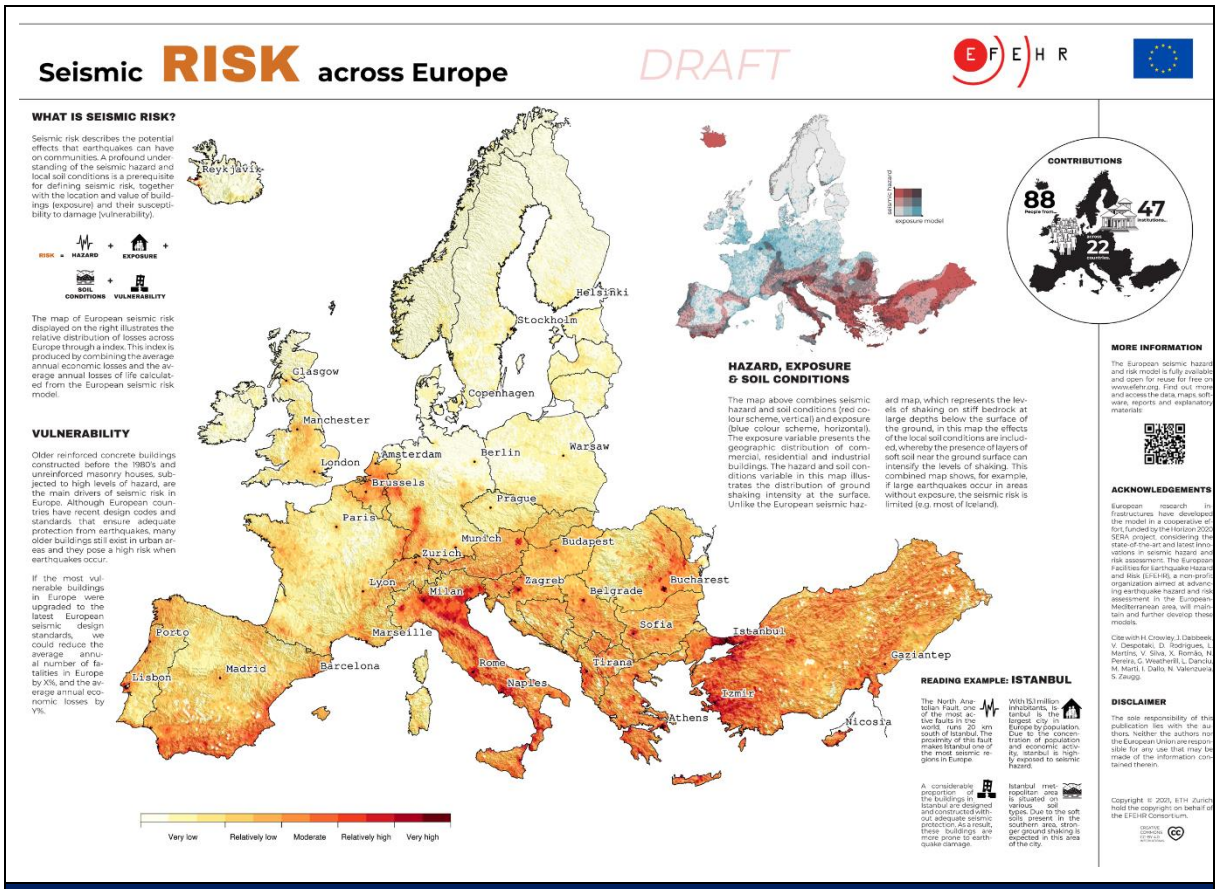
The three poster versions we tested with the survey. The only element that was varied is the risk map in the middle.

Table S8: The three posters we tested

Version 1



Version 2


Seismic RISK across Europe
DRAFT
WHAT IS SEISMIC RISK?
Seismic risk describes the potential effects that earthquakes can have on communities. A profound understanding of the seismic hazard and local soil conditions is a prerequisite for defining seismic risk, together with the location and value of buildings (exposure) and their susceptibility to damage (vulnerability).
RISK = HAZARD + EXPOSURE + SOIL CONDITIONS + VULNERABILITY
The map of European seismic risk displayed on the right illustrates the relative distribution of losses across Europe through a index. This index is produced by combining the average annual economic losses and the average annual losses of life calculated from the European seismic risk model.
VULNERABILITY
Older reinforced concrete buildings constructed before the 1980's and unreinforced masonry houses, subjected to high levels of hazard, are the main drivers of seismic risk in Europe. Although European countries have recent design codes and standards that ensure adequate protection from earthquakes, many older buildings still exist in urban areas and they pose a high risk when earthquakes occur.
If the most vulnerable buildings in Europe were upgraded to the latest European seismic design standards, we could reduce the average annual number of fatalities in Europe by X%, and the average annual economic losses by Y%.
Reykjavik
Helsinki
Stockholm
Glasgow
Copenhagen
Manchester
Amsterdam
Berlin
Warsaw
London
Brussels
Prague
Paris
Munich
Budapest
Zurich
Lyon
Zagreb
Bucharest
Milan
Belgrade
Sofia
Porto
Marseille
Istanbul
Madrid
Barcelona
Rome
Tirana
Gaziantep
Lisbon
Naples
Izmir
Athens
Nicosia
Very low
Relatively low
Moderate
Relatively high
Very high
seismic hazard
exposure model
HAZARD, EXPOSURE & SOIL CONDITIONS
The map above combines seismic hazard and soil conditions (red colour scheme, vertical) and exposure (blue colour scheme, horizontal). The exposure variable presents the geographic distribution of commercial, residential and industrial buildings. The hazard and soil conditions variable in this map illustrates the distribution of ground shaking intensity at the surface. Unlike the European seismic hazard map, which represents the levels of shaking on stiff bedrock at large depths below the surface of the ground, in this map the effects of the local soil conditions are included, whereby the presence of layers of soft soil near the ground surface can intensify the levels of shaking. This combined map shows, for example, if large earthquakes occur in areas without exposure, the seismic risk is limited (e.g. most of Iceland).
READING EXAMPLE: ISTANBUL
The North Anatolian Fault, one of the most active faults in the world, runs 20 km south of Istanbul. The proximity of this fault makes Istanbul one of the most seismic regions in Europe.
With 15.1 million inhabitants, Istanbul is the largest city in Europe by population. Due to the concentration of population and economic activity, Istanbul is highly exposed to seismic hazard.
A considerable proportion of the buildings in Istanbul are designed and constructed without adequate seismic protection. As a result, these buildings are more prone to earthquake damage.
Istanbul metropolitan area is situated on various soil types. Due to the soft soils present in the southern area, stronger ground shaking is expected in this area of the city.
CONTRIBUTIONS
88
47
22
MORE INFORMATION
The European seismic hazard and risk model is fully available and open for reuse for free on www.efehr.org. Find out more and access the data, maps, software, reports and explanatory materials!
ACKNOWLEDGEMENTS
European research infrastructures have developed the model in a cooperative effort, funded by the Horizon 2020 SERA project, considering the state-of-the-art and latest innovations in seismic hazard and risk assessment. The European Facilities for Earthquake Hazard and Risk (EFEHR), a non-profit organization aimed at advancing earthquake hazard and risk assessment in the European-Mediterranean area, will maintain and further develop these models.
Cite with H. Crowley, J. Dabbeek, V. Despotaki, D. Rodrigues, L. Martins, V. Silva, X. Romão, N. Pereira, G. Weatherill, L. Danciu, M. Martí, I. Dallo, N. Valenzuela, S. Zaugg.
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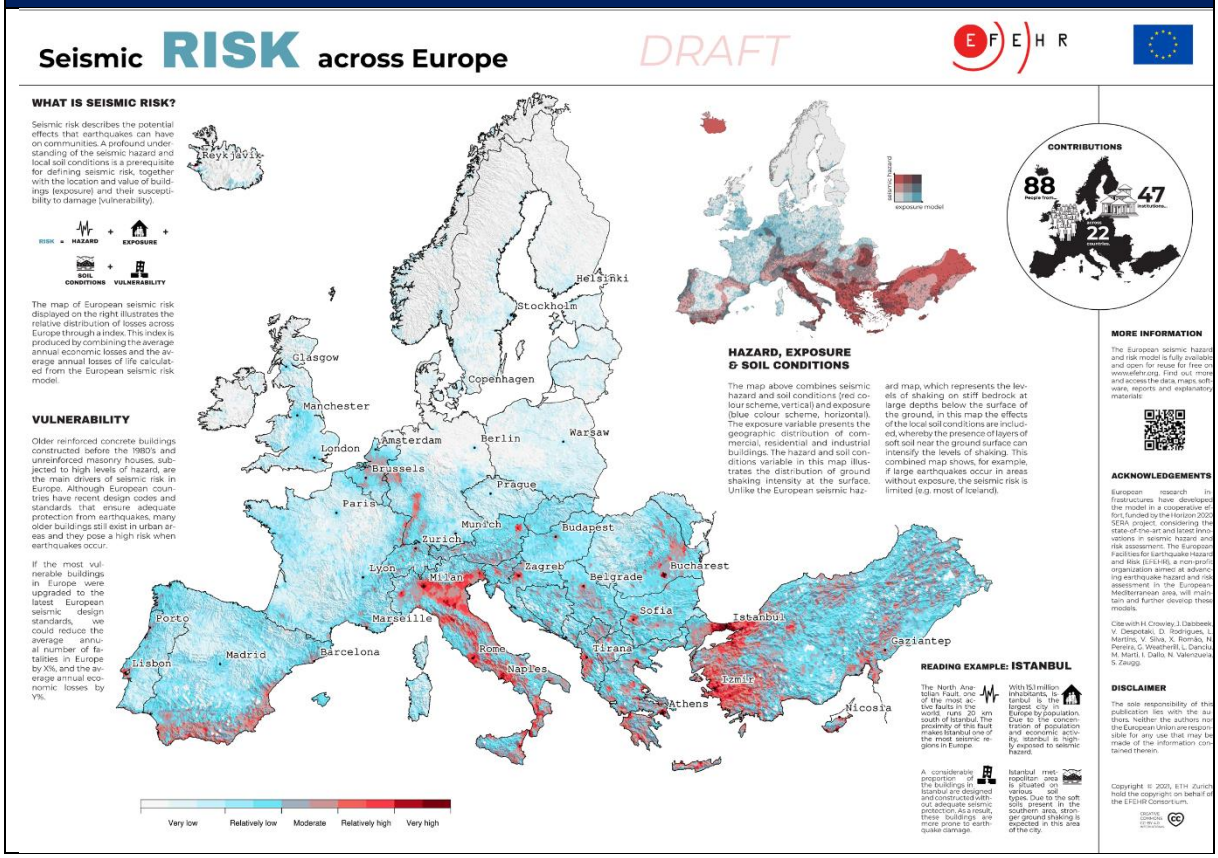
Version 3


Seismic RISK across Europe
DRAFT
WHAT IS SEISMIC RISK?
Seismic risk describes the potential effects that earthquakes can have on communities. A profound understanding of the seismic hazard and local soil conditions is a prerequisite for defining seismic risk, together with the location and value of buildings (exposure) and their susceptibility to damage (vulnerability).
RISK = HAZARD + EXPOSURE + SOIL CONDITIONS + VULNERABILITY
The map of European seismic risk displayed on the right illustrates the relative distribution of losses across Europe through a index. This index is produced by combining the average annual economic losses and the average annual losses of life calculated from the European seismic risk model.
VULNERABILITY
Older reinforced concrete buildings constructed before the 1980's and unreinforced masonry houses, subjected to high levels of hazard, are the main drivers of seismic risk in Europe. Although European countries have recent design codes and standards that ensure adequate protection from earthquakes, many older buildings still exist in urban areas and they pose a high risk when earthquakes occur.
If the most vulnerable buildings in Europe were upgraded to the latest European seismic design standards, we could reduce the average annual number of fatalities in Europe by X%, and the average annual economic losses by Y%.
Reykjavik
Helsinki
Stockholm
Glasgow
Copenhagen
Manchester
Amsterdam
Berlin
Warsaw
London
Brussels
Prague
Paris
Munich
Budapest
Zurich
Lyon
Zagreb
Bucharest
Milan
Belgrade
Sofia
Porto
Marseille
Istanbul
Madrid
Barcelona
Rome
Tirana
Gaziantep
Lisbon
Naples
Izmir
Athens
Nicosia
Very low
Relatively low
Moderate
Relatively high
Very high
seismic hazard
exposure model
HAZARD, EXPOSURE & SOIL CONDITIONS
The map above combines seismic hazard and soil conditions (red colour scheme, vertical) and exposure (blue colour scheme, horizontal). The exposure variable presents the geographic distribution of commercial, residential and industrial buildings. The hazard and soil conditions variable in this map illustrates the distribution of ground shaking intensity at the surface. Unlike the European seismic hazard map, which represents the levels of shaking on stiff bedrock at large depths below the surface of the ground, in this map the effects of the local soil conditions are included, whereby the presence of layers of soft soil near the ground surface can intensify the levels of shaking. This combined map shows, for example, if large earthquakes occur in areas without exposure, the seismic risk is limited (e.g. most of Iceland).
READING EXAMPLE: ISTANBUL
The North Anatolian Fault, one of the most active faults in the world, runs 20 km south of Istanbul. The proximity of this fault makes Istanbul one of the most seismic regions in Europe.
With 15.1 million inhabitants, Istanbul is the largest city in Europe by population. Due to the concentration of population and economic activity, Istanbul is highly exposed to seismic hazard.
A considerable proportion of the buildings in Istanbul are designed and constructed without adequate seismic protection. As a result, these buildings are more prone to earthquake damage.
Istanbul metropolitan area is situated on various soil types. Due to the soft soils present in the southern area, stronger ground shaking is expected in this area of the city.
CONTRIBUTIONS
88
47
22
MORE INFORMATION
The European seismic hazard and risk model is fully available and open for reuse for free on www.efehr.org. Find out more and access the data, maps, software, reports and explanatory materials!
ACKNOWLEDGEMENTS
European research infrastructures have developed the model in a cooperative effort, funded by the Horizon 2020 SERA project, considering the state-of-the-art and latest innovations in seismic hazard and risk assessment. The European Facilities for Earthquake Hazard and Risk (EFEHR), a non-profit organization aimed at advancing earthquake hazard and risk assessment in the European-Mediterranean area, will maintain and further develop these models.
Cite with H. Crowley, J. Dabbeek, V. Despotaki, D. Rodrigues, L. Martins, V. Silva, X. Romão, N. Pereira, G. Weatherill, L. Danciu, M. Martí, I. Dallo, N. Valenzuela, S. Zaugg.
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Supplement S4: Survey risk poster – Entire Questionnaire.

In Table S9, the entire questionnaire is listed. In the column on the left, the questions are listed and, in the column on the right, their purpose and link to the communication goals. In total, 83 participants filled in the survey in July in 2021. The questionnaire was programmed with SPSS and shared via university platforms and personal contacts to professors.

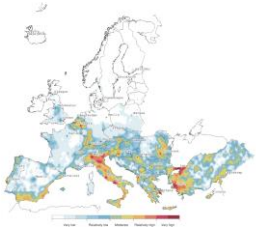
Table S9: Questionnaire for the risk poster survey

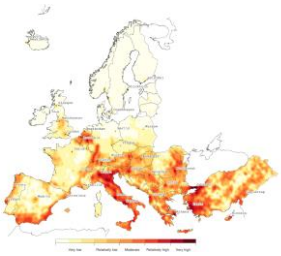
Consent Form	
Welcome Thank you for taking part in this survey, which is being conducted by the Swiss Seismological Service at ETH Zurich and the EFEHR Consortium. For several years, an international group of scientists has been working on a European seismic risk model. In autumn this year, the model will be released publicly. Before the release, we, a group of social scientists at ETH Zurich, are testing different products developed in the context of the European seismic risk model. In this survey, you will see some preliminary outputs of the model [**NOT** the final version]. Your comments and answers will help us to improve these outputs and make them more accessible and understandable. **How do we collect and process your data?** The survey takes about 10 to 15 minutes to complete. The data is collected in anonymous form and treated in accordance with Swiss data protection regulations. Your details can thus not be linked to your person and will not be passed on to third parties. Participation is voluntary and you can leave the survey at any time if you no longer wish to take part in the study. Your answers will then be deleted. ▣ I agree that my personal data will be processed in accordance with the information given above.	*Introducing the aim of the survey and providing information about the data protection policy applied.*
Question block 1 – Risk Poster [Between-subject design: each participant is randomly assigned to one of the 3 posters. The only difference is the big risk index map in the middle.]	
On this poster, you find the most important facts about seismic risk in Europe. Please look at it carefully before answering the questions below. **[Placeholder Poster]**	
1) After having looked at the poster, do you think that earthquakes in Europe pose a serious threat to Europe? *[textbox]*	
2) Please indicate whether the following statements are correct or not: *[1=wrong / 2=correct / 3=I do not know]* □ *randomized* - The European seismic risk model has been established through a collaborative effort of numerous research institutions in Europe under the umbrella of EFEHR. - The seismic risk model cannot be used for commercial purposes. - The research for the development of the European seismic risk model received funding from the European Union. - It is clearly indicated where I can access additional information. - The insights from the European seismic risk model help to define and evaluate risk mitigation measures. In addition, they allow to define transnational disaster mitigation strategies. - The reading example focusing on Istanbul helped me to understand how the different factors impact seismic risk. - The risk index is the normalized value of both economic loss and fatalities.	*General statements* - *Check whether the participants understand the information presented* - *Check whether the set Communication goals (CG) and Key messages (KM) are met*

3) Please indicate whether the following statements are correct or not? *[1=wrong / 2=correct / 3=I do not know]* □ *randomized* - Seismic risk consists of three components: exposure + vulnerability + soil conditions. - The seismic risk model estimates areas where we can expect more severe damages due to earthquakes. - Earthquakes are mainly a problem in the North of Europe. - The vulnerability of buildings is an important element of seismic risk. - Seismic risk manifests at urban places where many earthquakes occur. - Places built on rock tend to have a higher level of seismic risk. - The risk map also includes earthquake-induced environmental effects such as landslides or tsunamis. - The harmonized risk map allows the levels of threat between the European countries to be compared. - Old timber buildings are the main drivers of seismic risk in Europe.	*Specific statements*
4) Imagine that your house is located in an area with a colour indicating very high risk. The house next door is located in a differently coloured area indicating a lower seismic risk. Does your neighbor have a significant lower amount of seismic risk than you? - Yes, with all certainty - No, not necessarily - I do not know	
5) The poster is overall …? *[1=strongly disagree to 5=strongly agree]* - Useful - Reliable - Trustworthy - Understandable - Clearly structured - Appealing	*CG10: The target audiences perceive the models and communication products as useful, reliable and trustful sources of information.*
6) To which extent do you agree with the following statements regarding your personal use of the information about earthquake risk in Europe? [*1=strongly disagree to 5=strongly agree]* □ *randomized*	
- I will use the models and available information products such as the poster for my studies (e.g. research, modeling).	*CG12: The target audiences will make use of the communication products and models according to their particular needs.*
- I will share the information with my colleagues at university.	*CG13: The target audiences will share information related to or about the European seismic hazard and risk models in their professional or private network.*
- I will share the information in my personal network (e.g. friends, family).	*CG13: The target audiences will share information related to or about the European seismic hazard and risk models in their professional or private network.*
- The information motivates me to think about earthquake hazard and risk and what actions I personally could take to reduce the risk.	*CG15: The products motivate the target audiences to think about appropriate seismic risk-mitigating measures within their respective scope of action and to consult national models for detailed information.*
- I learned something new about earthquakes in Europe when looking at the poster.	*CG9: The target audiences develop a higher level of awareness on seismic hazard and risk in Europe and consider risk reduction measures useful and necessary.*
- I think it is important that people in my country would know more about seismic risk in Europe.	*CG3: The target audiences are aware of the models' value for Europe and know that they pose an additional source of*

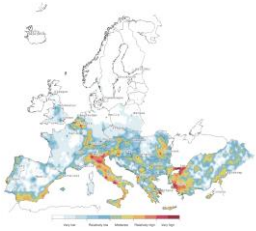
	information that is supporting and enriching the already existing national models.
– I think the risk model is very important to raise awareness for the human and financial losses earthquakes may have in Europe.	*CG9: The target audiences develop a higher level of awareness on seismic hazard and risk in Europe and consider risk reduction measures useful and necessary.*
– I am surprised by the information presented on the poster.	
7) Can you think of any additional information that should be displayed on the map? *[Textbox]*	*Check whether any relevant information is missing.*
Question block 2 – Risk Map [Between-subject design: each participant is randomly assigned to one of the three maps below]	
As a next step, we would like to focus on the seismic risk map you just saw in the center of the poster. Please have a look at the map before answering the questions below. **[Placeholder for one of the three risk map versions]**	
8) What is your first impression of the map? What comes to your mind? *[textbox]* 9) Which of the following cities are in an area with a very high risk level? *[several answers possible]* □ *randomized* – Rome (Italy) – Stockholm (Sweden) – Madrid (Spain) – Athens (Greece) – Istanbul (Turkey) – Budapest (Romania) – Zurich (Switzerland) *10)* Which of the following statements are correct and which are not? *[1=wrong / 2=correct / 3=I do not know]* □ *randomized* - The seismic risk is higher in Budapest than in Istanbul. - The seismic risk is higher in Madrid than in Paris. - The seismic risk in Prague is higher than in Berlin. - The European city with the highest risk is Istanbul (Turkey). - There are regions with no seismic risk at all. - The most vulnerable regions are rural. - In Iceland (Reykjavik), people may never experience an earthquake as the seismic risk is very low. - In Copenhagen, there is no risk of damage due to earthquakes.	*First impression* *Map reading skills (interpretation)* *Map reading skills (interpretation)*
11) The seismic risk map is… ? *[1=strongly disagree to 5=strongly agree]* □ *randomized* – Clear – Trustworthy – Informative – Understandable – Useful – Appealing	*Design* – *Check whether the map is perceived as clear, trustworthy, informative, understandable and useful.*
12) In a next step, you will see map designs with different color schemes and layers. Please indicate to which extent you like the different maps, from 1=not at all to 5=very much.	*Comparison of the three different color schemes.*

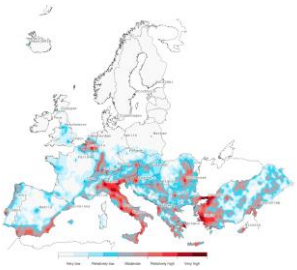
a) Comparison 1





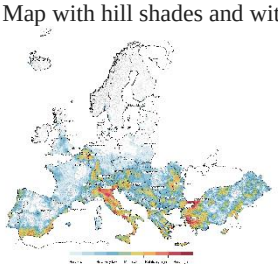
b) Comparison 2

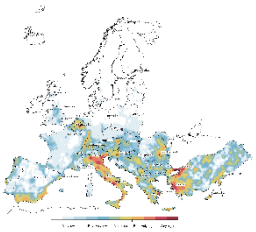




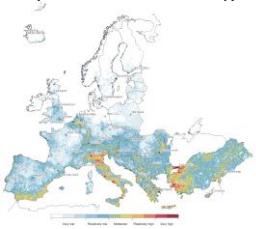
13) In the following, please first click again on the map that you like best and then answer the two corresponding questions:
Looking at the map displayed above, to which extent do you agree with the following statements:
   - In Budapest, the seismic risk is only elevated in the city center but not in the surroundings.
   - The largest part of Spain has 'no to very low levels' of seismic risk.

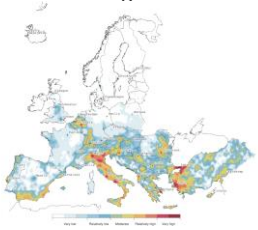
c) Map with hill shades and without hill shades



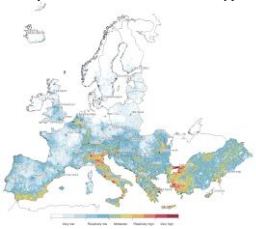


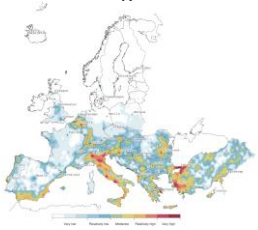
d) Map without smoothing and map with smoothing





e) Map without smoothing and map with smoothing and hill shades





Question block 3 – Sociodemographics *In a last step, we have some general questions about your person.*	
1) Please estimate your mathematical skills with the help of the following questions. *[Is very easy for me (1) / is very difficult for me (5)] randomized* - How good are you at fractions? - How well can you calculate with percentages? - How easy is it for you to calculate a tip of 15 percent? - How easy is it for you to calculate how much a T-shirt costs after deducting a 25% discount?	*Independent variable (numeracy skills)*
2) Are you colorblind? - Yes - No - I do not know	
3) What is your field of study? *[Drop-Down-List]* - Agricultural Science - Architecture - Arts - Biochemistry - Biology - Chemistry - Communication studies - Computational Science - Computer Sciences - Economics - Engineering - Environmental Sciences - Earth Sciences - Geography - Geology - Geophysics - History - Health Sciences - Law - Management - Mathematics - Medicine - Theology - Seismology - Social Sciences - Philosophy - Physics - Political Sciences - Psychology - Others: *textline*	*Assess whether participants have prior knowledge.*
4) At which university are you studying? *[textline]*	
5) What is your highest educational degree? - High school diploma - Bachelor's degree - Master's degree - Doctoral degree - Post-Doc - Other, please specify: *textline*	
6) How old are you [in years]? - *Textline*	
7) What gender are you?	

– Male – Female – Other	
8) Have you ever lived or are you living in a country with high seismic risk? – Yes, in … *[textline]* – No – I do not know	
9) In which country have you spent most of your life? *[Drop-Down-List]* – Andorra – Armenia – Austria – Azerbaijan – Belarus – Belgium – Bosnia and Herzegovina – Bulgaria – Croatia – Cyprus – Czech Republic – Denmark – Estonia – Finland – France – Germany – Georgia – Greece – Hungary – Iceland – Ireland – Italy – Kazakhstan – Kosovo – Latvia – Liechtenstein – Lithuania – Luxembourg – Netherlands – North Macedonia – Norway – Malta – Moldova – Monaco – Montenegro – Poland – Portugal – Romania – San Marino – Serbia – Slovakia – Slovenia – Spain – Sweden – Switzerland – Turkey – Ukraine – United Kingdom – Vatican City	
10) Do you have any final comments? *[optional]*	
Final Page	
Thank you for completing the survey. Your answers have been saved. If you are interested in more details about the European seismic risk models, click here: https://eu-risk.eucentre.it/.	

Supplement S5: Survey risk poster – Participants' characteristics.

Table S10: Survey risk poster – Participants' characteristics.

Variable	Levels of the variable	Mean (SD) / or absolute number	Percentage [%]
Age		30.84 (10.17)	18-30 years: 67.5 % 31-40 years: 18.1% 41-50 years: 4.8 % 51-60 years: 8.4 % >60 years: 1.2 %
Gender	Female		59%
	Male		41%
	Other		
Numeracy skills	How good are you at fractions?	3.95 (1.02)	Cronbachs α = 0.922, N=4
	How well can you calculate with percentages?	4.12 (0.96)	
	How easy is it for you to calculate a tip of 15 percent?	4.10 (0.86)	
	How easy is it for you to calculate how much a T-shirt costs after deducting a 25% discount?	4.18 (0.97)	
	SUM variable	4.09 (0.86)	
Colour-blindness	Yes	4	4.8
	No	77	92.8
	I do not know	2	2.4
Field of study	Agricultural Science	-	
	Architecture	6	7.2
	Arts	-	-
	Biochemistry	-	-
	Biology	1	1.2
	Chemistry	-	
	Communication studies	1	1.2
	Computational Science	-	-
	Computer Sciences	-	-
	Economics	-	-
	Engineering	37	44.6
	Environmental Sciences	5	6.0
	Earth Sciences	14	16.9
	Geography	1	1.2
	Geology	3	3.6
	Geophysics	6	7.2
	History	-	-
	Health Sciences	1	1.2
	Law	1	1.2
	Management	-	-
	Mathematics	1	1.2
	Medicine	-	-
	Theology	-	-
	Seismology	1	1.2
	Social Sciences	-	-
	Philosophy	1	1.2
	Physics	-	-
	Political Sciences	-	-
	Psychology	-	-
	Others	1	1.2
Educational degree	High school diploma	13	15.7
	Bachelor's degree	23	27.7
	Master's degree	31	37.3
	Doctoral degree	7	8.4
	Post-Doc	5	6.0
	Other	4	4.8
Lived in a country with high risk	Yes	47	56.6
	No	33	39.8
	I do not know	3	3.6
Living place	Prefer not to answer	9	10.8

	Andorra	1	1.2
	Armenia	-	
	Austria	2	2.4
	Azerbaijan	-	
	Belarus	-	
	Belgium	-	
	Bosnia and Herzegovina	-	
	Bulgaria	-	
	Croatia	-	
	Cyprus	-	
	Czech Republic	1	1.2
	Denmark	-	
	Estonia	-	
	Finland	-	
	France	10	12.0
	Germany	6	7.2
	Georgia	-	
	Greece	4	4.8
	Hungary	-	
	Iceland	-	
	Ireland	-	
	Italy	11	13.3
	Kazakhstan	-	
	Kosovo	1	1.2
	Latvia	-	
	Liechtenstein	-	
	Lithuania	-	
	Luxembourg	-	
	Netherlands	-	
	North Macedonia	-	
	Norway	-	
	Malta	-	
	Moldova	-	
	Monaco	-	
	Montenegro	1	1.2
	Poland	1	1.2
	Portugal	1	1.2
	Romania	13	15.7
	San Marino	-	
	Serbia	-	
	Slovakia	-	
	Slovenia	-	
	Spain	-	
	Sweden	-	
	Switzerland	15	18.1
	Turkey	2	2.4
	Ukraine	-	
	United Kingdom	1	1.2
	Vatican City	-	

Supplement S6: Survey risk poster – All results.

S6.1 – Sample characteristics across the three risk map versions

Table S11: Survey risk poster – Sample characteristics.

Groups	n	Age [years]	Gender [%]	
		Mean [SD]	Female	Male
G2-Map	24	30.38 [9.50]	58.33	41.67
G3-Map	24	28.63 [6.48]	62.5	37.50
G4-Map	35	32.69 [12.36]	57.14	42.86

S6.2 – Statistical test of participants' characteristics across the three risk map versions

There are no significant differences between the participants' characteristics among the three experiment groups.

Table S12: Survey risk poster – Sample characteristics.

	ANOVAs
Participants' characteristics	**Across the 3 groups**
Age	F(2, 80)=1.18, p=.31
Educational degree	F(2, 80)=0.88, p=.42
Living place	F(2, 80)=1.07, p=.35
Country high risk	F(2, 80)=0.81, p=.45
Colorblind	F(2, 80)=0.15, p=.86
Field of study	F(2, 80)=0.12, p=.89

	Chi-Square
	Across the 3 groups
Gender	$X^2(2) = 0.176$, p = 0.92

S6.3 – Poster: first impression

After having looked at the poster, do you think that earthquakes in Europe pose a serious threat to Europe? [qualitative analysis]

Table S13: Risk poster – First impression.

	Group 1	Group 2	Group 3
Yes	5	1	8
No	0	2	3
Only in some parts	7	5	8
Central Europe	1	0	0
Southern Europe	4	4	3
Eastern Europe	1	0	1
Italy	3	5	5
Turkey	3	5	6
Greece	1	2	2
Spain	0	1	1
Albania	0	1	0
Old buildings	0	1	0
Poor countries	0	1	0
Balkans	0	1	0
High vulnerability	1	0	2
Exposure	1	1	0
Population density / growth	0	0	1
Nuclear power plants affected	1	0	0
Economic impacts	0	0	2

S6.4 – Poster: general understanding statements

Table S14 shows the percentages of the participants who correctly answered the different questions. In grey highlighted are the poster-groups with the lowest percentage of correctly answered questions. Aggregated over all three poster groups, participants struggled most with the statement whether the risk model can or cannot be used for commercial purposes (only 38.6% correct answers). Further, they were not sure whether the risk index is the normalized value of both economic loss and fatalities (only 61.4% correct answers).

Table S14: Risk poster – General understanding statements.

	Groups			Total
	Group 1 [map 2b]	Group 2 [map 3b]	Group 3 [map 4b]	
The European seismic risk model has been established through a collaborative effort of numerous research institutions in Europe under the umbrella of EFEHR.	95.8	87.5	91.4	91.6
The seismic risk model cannot be used for commercial purposes.	54.2	33.3	31.4	38.6
The research for the development of the European seismic risk model received funding from the European Union.	66.7	66.7	51.4	60.2
It is clearly indicated where I can access additional information.	91.7	79.2	88.6	86.7
The insights from the European seismic risk model help to define and evaluate risk mitigation measures. In addition, they allow to define transnational disaster mitigation strategies.	70.8	87.5	77.1	78.3
The reading example focusing on Istanbul helped me to understand how the different factors impact seismic risk.	79.2	91.7	88.6	86.7
The risk index is the normalized value of both economic loss and fatalities.	54.2	58.3	68.6	61.4

There are no significant differences between the three poster groups regarding the total number of correctly answered general questions:

Table S15: Risk poster – Influence of the poster version on the correct understanding.

Effect of the poster versions on the total number of correct answers (max. n = 7)				
		n	*Mean (SD)*	*One-Way ANOVA*
Poster version	Group 1 [map 2b]	24	5.13 (1.45)	$F(2, 80) = 0.103$, $p = .902$, $\eta^2 = 0.003$
	Group 2 [map 3b]	24	5.04 (1.12)	
	Group 3 [map 4b]	35	4.97 (1.25)	

S6.5 – Poster: specific understanding statements

Table S16 shows the percentages of the participants who correctly answered the different questions. In grey highlighted are the groups with the lowest percentage of correctly answered questions. The participants who saw map 4b (red-to-blue color scheme) performed the worst.

Aggregated over all poster groups (column Total), participants struggled most with the statement whether old timber buildings are the main drivers of seismic risk in Europe (only 16.9% correct answers). Further, they were not sure whether the following statements is correct or not: “Seismic risk

consists of three components: exposure + vulnerability + soil conditions." (only 57.8% correct answers) and "Seismic risk manifests at urban places where many earthquakes occur." (only 61.4 % correct answers).

Table S16: Risk poster – Specific understanding statements.

	Groups			Total
	Group 1 [map 2b]	Group 2 [map 3b]	Group 3 [map 4b]	
Seismic risk consists of three components: exposure + vulnerability + soil conditions.	58.3	70.8	48.6	57.8
The seismic risk model estimates areas where we can expect more severe damages due to earthquakes.	91.7	91.7	91.4	91.6
Earthquakes are mainly a problem in the North of Europe.	95.8	91.7	94.3	94.0
The vulnerability of buildings is an important element of seismic risk.	95.8	95.8	94.3	95.2
Seismic risk manifests at urban places where many earthquakes occur.	62.5	66.7	57.1	61.4
Places built on rock tend to have a higher level of seismic risk.	83.3	91.7	74.3	81.9
The risk map also includes earthquake-induced environmental effects such as landslides or tsunamis.	66.7	70.8	65.7	67.5
The harmonized risk map allows the levels of threat between the European countries to be compared.	79.2	91.7	80.0	83.1
Old timber buildings are the main drivers of seismic risk in Europe.	12.5	20.8	17.1	16.9

There were no significant differences between the three poster groups regarding the total number of correctly answered specific questions.

Table S17: Risk poster – Specific understanding statements.

Effect of the poster versions on the total number of correct answers (max. n = 9)				
		n	*Mean (SD)*	*One-Way ANOVA*
Poster version	Group 1 [map 2b]	24	6.46 (1.38)	$F(2, 80) = 1.70$ $p = .190$, $\eta^2 = 0.04$
	Group 2 [map 3b]	24	6.92 (1.41)	
	Group 3 [map 4b]	35	6.23 (1.44)	

S6.6 – Poster: border comparison

The majority of the participants of all three groups answered the question "Imagine that your house is located in an area with a colour indicating very high risk. The house next door is located in a differently coloured area indicating a lower seismic risk. Does your neighbor have a significant lower amount of seismic risk than you?" correctly with "No, not necessary".

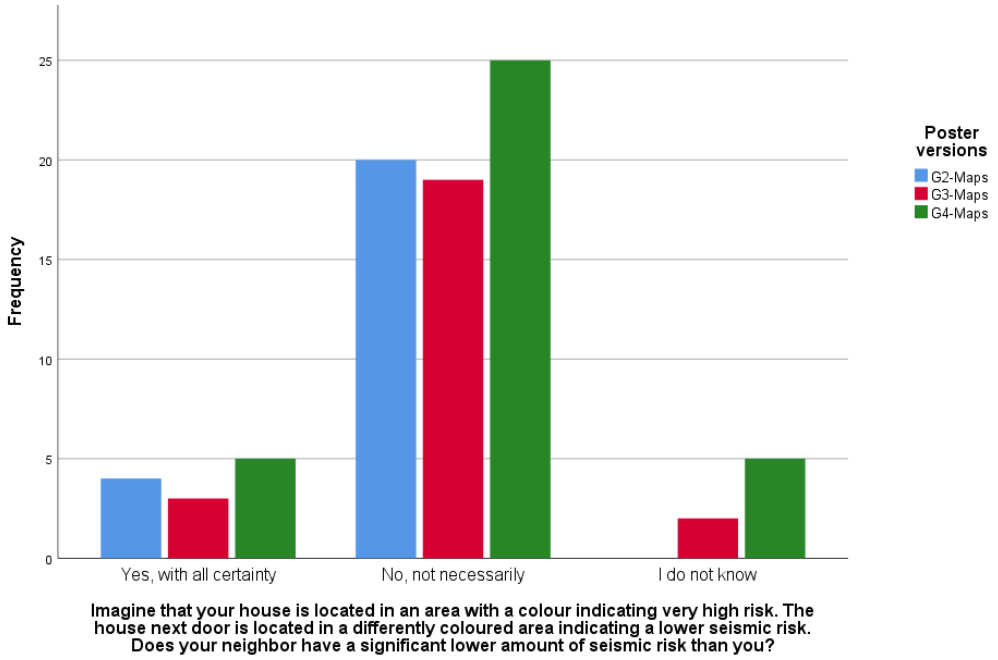


Fig. S11: Interpretation question 1

S6.7 – Poster: design evaluation

All three poster versions were well perceived (useful, reliable, trustworthy, understandable, clearly structured and appealing) by the participants.

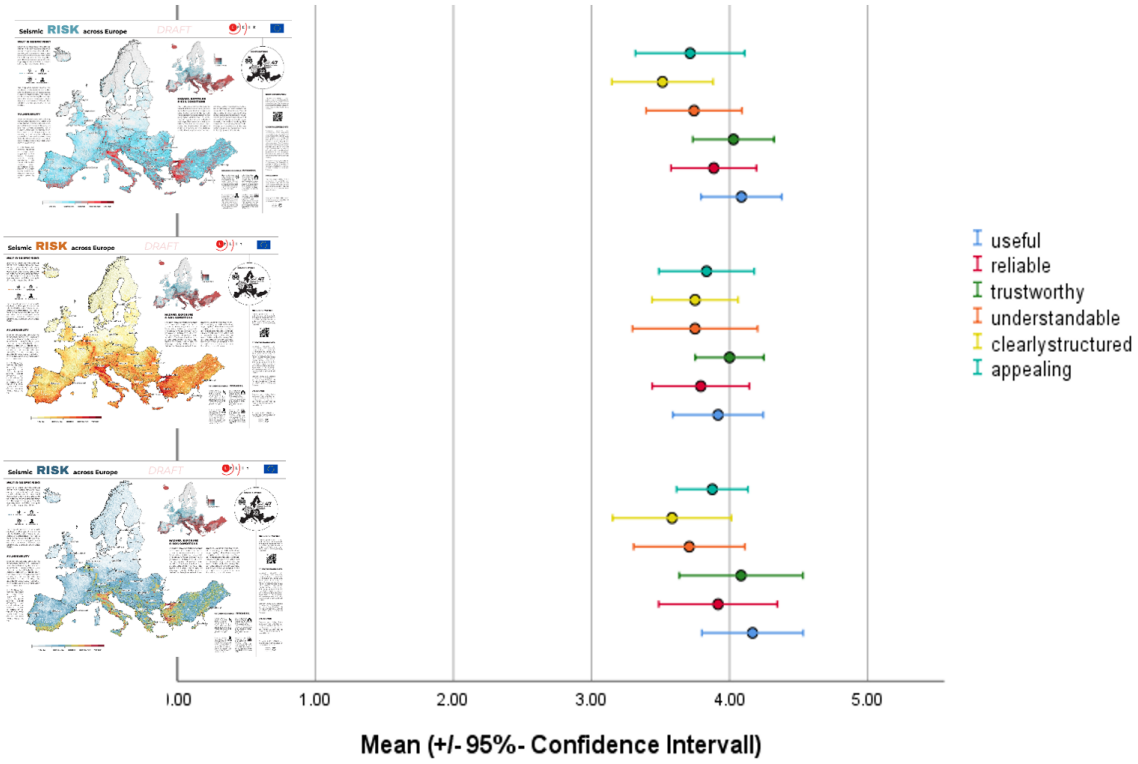


Fig. S12: Design evaluation of the three posters. The colors represent the different attributes participants could rate from 1=not at all to 5=very much, n=83.

The participants rated the posters especially as useful (M=4.06, SD=0.83) and trustworthy (M=4.04, SD=0.85). What could be improved is to make the posters more understandable (M=3.73, SD=1.00) and to structure them more clearly (M=3.60, SD=0.96).

Table S18: Risk poster – Design evaluation [descriptive statistics]

Descriptive statistics for the variable design evaluation. The scale ranged from 1=not at all to 5=very much, N=83. The answer items show good internal consistency (α=0.86, n=6).

Factor	N	Mean	SD	α [# items]
Design single items				
useful	83	4.06	0.83	.86 [N=6]
reliable	83	3.87	0.91	
trustworthy	83	4.04	0.85	
understandable	83	3.73	1.00	
Clearly structured	83	3.60	0.96	
appealing	83	3.80	0.92	
Design sum variable	83	3.85	0.70	

There are no significant differences between the design evaluations of the three posters:

Table S19: Risk poster – Influence of the poster versions on the Design evaluation

Effect of the poster versions on the design evaluation, range from 1=not at all to 5=very much

		n	*Mean (SD)*	*One-Way ANOVA*
Poster version	Group 1 [map 2b]	24	3.89 (0.70)	$F(2, 80) = 0.054$ $p = .947$, $\eta^2 = 0.001$
	Group 2 [map 3b]	24	3.84 (0.59)	
	Group 3 [map 4b]	35	3.83 (0.79)	

S6.8 – Poster: personal use

Aggregated over the three poster groups, participants mainly think that the risk model is very important to raise awareness for the human and financial losses earthquakes may have in Europe. In addition, they think that it is important that people in their country would know more about seismic risk in Europe. Few participants were surprised by the information presented on the poster and will use the models and available information products for their studies.

Table S20: Risk poster – Personal use [descriptive statistics]

	Mean	**SD**
I will use the models and available information products such as the poster for my studies (e.g. research, modeling).	3.11	1.33
I will share the information with my colleagues at university.	3.39	1.14
I will share the information in my personal network (e.g. friends, family).	3.28	1.21
The information motivates me to think about earthquake hazard and risk and what actions I personally could take to reduce the risk.	3.33	1.00
I learned something new about earthquakes in Europe when looking at the poster.	3.46	1.12
I think it is important that people in my country would know more about seismic risk in Europe.	3.94	0.97

I think the risk model is very important to raise awareness for the human and financial losses earthquakes may have in Europe.	4.18	0.90
I am surprised by the information presented on the poster.	2.69	1.07

Regarding the significant differences between the three groups, participants who saw the poster with map 3b (yellow-red color scheme) said significantly more often that they will use the models and available information products such as the poster for their studies.

Table S21: Risk poster – Influence of the poster versions on the personal use

	Mean [SD]			Statistical test
Personal uses	Group 1 [map 2b]	Group 2 [map 3b]	Group 3 [map 4b]	One-way ANOVAs
I will use the models and available information products such as the poster for my studies (e.g. research, modeling).	**2.88 (1.26)[b]**	**3.96 (0.91)[a,c]**	**2.69 (1.37)[b]**	**F(2,82) = 8.360, p = 0.001, η^2 = 0.21**
I will share the information with my colleagues at university.	3.33 (1.20)	3.67 (1.01)	3.23 (1.17)	F(2,82) = 1.099, p = 0.338, η^2 = 0.03
I will share the information in my personal network (e.g. friends, family).	3.08 (1.18)	3.63 (1.01)	3.17 (1.34)	F(2,82) = 1.442, p = 0.243, η^2 = 0.04
The information motivates me to think about earthquake hazard and risk and what actions I personally could take to reduce the risk.	3.50 (1.02)	3.50 (0.93)	3.09 (1.01)	F(2,82) = 1.765, p = 0.178, η^2 = 0.04
I learned something new about earthquakes in Europe when looking at the poster.	3.92 (1.02)	3.21 (0.98)	3.31 (1.21)	F(2,82) = 3.049, p = 0.053, η^2 = 0.08
I think it is important that people in my country would know more about seismic risk in Europe.	4.04 (0.95)	4.13 (0.74)	3.74 (1.09)	F(2,82) = 1.309, p = 0.276, η^2 = 0.03
I think the risk model is very important to raise awareness for the human and financial losses earthquakes may have in Europe.	4.17 (0.87)	4.29 (0.81)	4.11 (0.99)	F(2,82) = 0.276, p = 0.759, η^2 = 0.007
I am surprised by the information presented on the poster.	2.75 (1.15)	2.71 (1.00)	2.63 (1.07)	F(2,82) = 0.096, p = 0.908, η^2 = 0.002

S6.9 – Poster: missing information

Table S22 lists the missing information which were mentioned by the participants in the different poster groups (qualitative analysis).

Table S22: Risk poster – Missing information

	Group 1	**Group 2**	**Group 3**
Nothing	1	1	1
Population density	1		
Arrow to indicate geographic north	1		
Distance scale indication [km]	1		
Other reading example (e.g. more prominent city)	1		1
Economic loss	1		
Displacement	1		
Secondary hazards (e.g. tsunami)	2		
Climate change	1		
Further regions	1	1	
Azores	1		2
Expected magnitude of earthquakes in certain regions	1		
Map with major fault systems across Europe		1	1
Name the scale bar		1	
Separate exposure and hazard map		1	1
ONE key message			1
Reduce amount of text			1
Highlight key information with different style			1
Difference between the big and small map not clear			1
Indicate scale/resolution of the map			1
Explain: risk can vary strongly locally due to the building quality			1
Portuguese archipelagos			2

S6.10 – Map: first impression

What is your first impression of the map? What comes to your mind?

Table S23: Risk map – First impression

	Group 1	Group 2	Group 3
Southern Europe most affected	3	7	7
Low risk across most of Europe	1		
Only certain regions have high risk	3		3
Spots with high risk recognizable	1		2
Italy and Turkey most affected	3	2	
Istanbul at high risk	1	2	
Populated cities most at risk		1	2
Old cities most affected	1		
Coastal areas most affected	1		
Europe is safe	1		
Vast part of Europe prone to seismic risk		1	
Risk variable within a country (e.g. Spain)		1	
Add Ucraine and Russia (part of geographical Europe)	1		1
Meaning of "relatively high" not clear	1	1	
Nice to have a harmonized-across-boundaries map	1		
Increase the smoothing	1		
Nice color scale	2	3	1
Clear	2		1
Surprised by South Spain	1		
Surprised that Italy and Spain have similar risk as Greece		1	
Southern Portugal blue? 1755 earthquake?			2
Population density is missing?	1		
Switzerland & Turkey not in the EU. Why are the displayed?	1		
Why are certain regions vulnerable?	1		
Lots of white/yellow areas = no earthquakes at all possible?		1	1
White dots within a country?		1	
Heat map		2	1
Contrast between colors not enough		1	
My country is not affected	1	1	
Scared			1
Good not to use green as a low risk indicator			1
Different color scale than Swiss map			1
Iceland little risk			3
Looks cold			1
Interactive map needed			1
Reference to soil condition good			1
Blue and red not appropriate colors			2
Intermediate levels of risk difficult to read from the map			1

S6.11 – Map: correct interpretation of risk values in selected cities

Table S24 shows the percentages of the participants who correctly answered the different questions. In grey highlighted are the groups with the lowest percentage of correctly answered questions. It is visible, that participants who saw map 4b [blue-red color scheme] struggled more to correctly indicate whether the listed cities are in an area with very high seismic risk. Aggregated over all three maps, they mainly struggled with the risk value in Rome (Italy) and Athens (Greece).

Table S24: Risk map – Risk values in selected cities.

	Groups			Total
	Group 1 [map 2b]	Group 2 [map 3b]	Group 3 [map 4b]	
Rome (Italy)	95.8	70.8	65.7	75.9
Stockholm (Sweden)	100.0	100.0	97.1	98.8
Madrid (Spain)	95.8	100.0	97.1	97.6
Athens (Greece)	83.3	70.8	80.0	78.3

Istanbul (Turkey)	100.0	95.8	94.3	96.4
Budapest (Hungray)	83.3	87.5	88.6	86.7
Zurich (Switzerland)	95.8	100.0	94.3	96.4

There are no significant differences between the three map groups regarding the number of correctly answered questions.

Table S25: Risk map – Influence of the map versions on the correct interpretation of the risk values in selected cities.

Effect of the map versions on the number of correct answered questions [max. n =7]				
		n	*Mean (SD)*	*One-Way ANOVA*
Map version	Group 1 [map 2b]	24	6.54 (0.78)	F(2, 80) = 1.328 p =.271 , η^2 = 0.03
	Group 2 [map 3b]	24	6.25 (0.85)	
	Group 3 [map 4b]	35	6.17 (0.95)	

S6.12 – Map: understanding of specific statements

Table S26 shows the percentages of the participants who correctly answered the different questions. In grey highlighted are the groups with the lowest percentage of correctly answered questions. Aggregated over all three maps, the participants struggled most with the following two statements: "The seismic risk is higher in Madrid than in Paris." and "In Iceland (Reykjavik), people may never experience any earthquake as the seismic risk is very low.".

Table S26: Risk map – Understanding of specific statements.

	Groups			Total
	Group 1 [map 2b]	Group 2 [map 3b]	Group 3 [map 4b]	
The seismic risk is higher in Budapest than in Istanbul.	91.7	95.8	94.3	94.0
The seismic risk is higher in Madrid than in Paris.	41.7	50.0	17.1	33.7
The seismic risk in Prague is higher than in Berlin.	54.2	50.0	62.9	56.6
The European city with the highest risk is Istanbul (Turkey).	87.5	91.7	91.4	90.4
There are regions with no seismic risk at all.	66.7	54.2	42.9	53.0
The most vulnerable regions are rural.	87.5	70.8	82.9	80.7
In Iceland (Reykjavik), people may never experience any earthquake, as the seismic risk is very low.	25.0	12.5	34.3	25.3
In Copenhagen, there is no risk of damage due to earthquakes.	62.5	62.5	60.0	61.4

There are no significant differences between the three map groups regarding the number of correctly answered questions.

Table S27: Risk map – Influence of the map versions on the correct understanding of the specific statements.

Effect of the map versions on the number of correct answered questions [max. n =8]				
		n	*Mean (SD)*	*One-Way ANOVA*
Map version	Group 1 [map 2b]	24	5.17 (1.40)	F(2, 80) = 0.466 p =.629 , η^2 = 0.01
	Group 2 [map 3b]	24	4.88 (1.51)	
	Group 3 [map 4b]	35	4.86 (1.03)	

S6.13 – Map: design evaluation

All three map versions were well perceived (useful, reliable, trustworthy, understandable, clearly structured and appealing) by the participants.

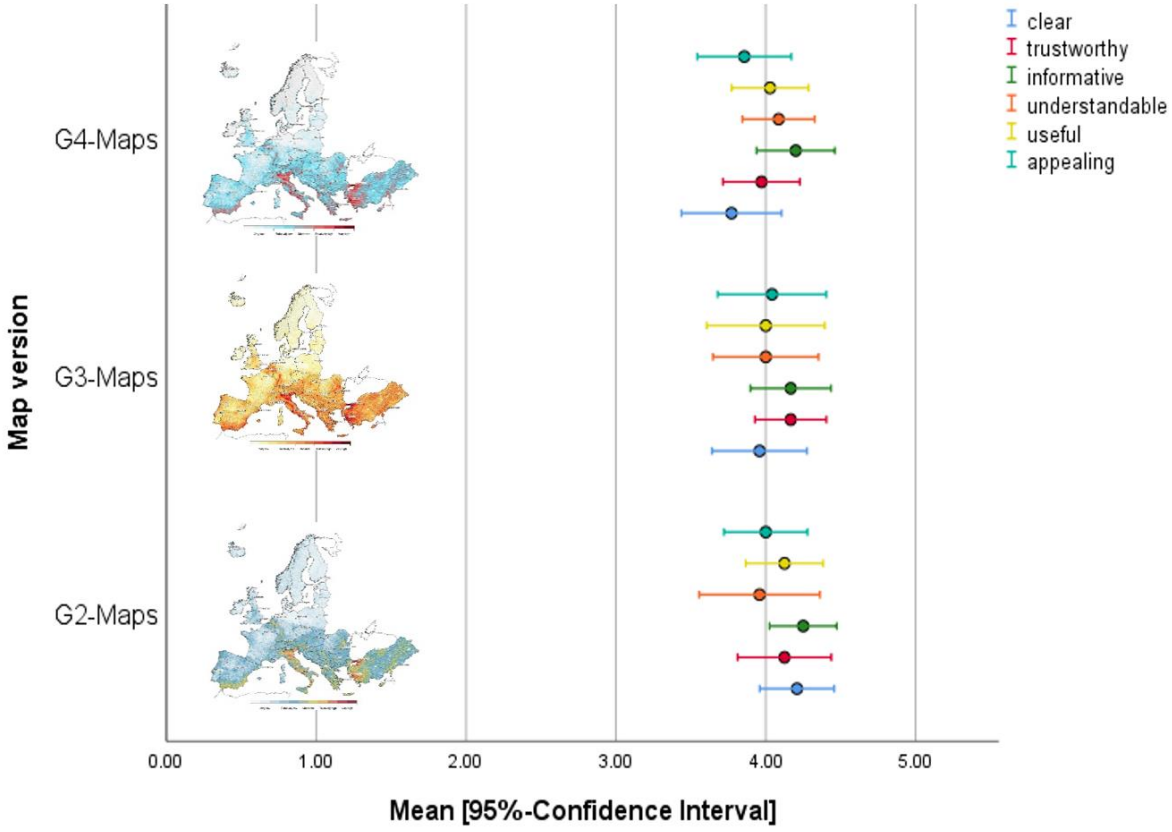


Fig. S13: Design evaluation of the three maps

The participants rated the posters especially as informative (M=4.20, SD=0.66) and trustworthy (M=4.07, SD=0.69).

Table S28: Risk map – Design evaluation.

Mean and SD of the design attributes participants rated from 1=not at all to 5=very much. The items showed good internal consistency (α=0.85, n=6).				
	N	Mean	SD	α [# items]
Design single items				
clear	83	3.95	0.82	.85 [N=6]
trustworthy	83	4.07	0.69	
informative	83	4.20	0.66	
understandable	83	4.02	0.81	
useful	83	4.05	0.76	
appealing	83	3.95	0.82	
Design sum variable	83	4.04	0.58	

There are no significant differences between the design evaluations of the three maps:

Table S29: Risk map – Influence of the map versions on the design evaluation.

Effect of the poster versions on the design evaluation [range 1=lowest to 5=highest]				
		n	*Mean (SD)*	*One-Way ANOVA*
Poster version	Group 1 [map 2b]	24	4.11 (0.47)	F(2, 80) = 0.337 p =.715 , η^2 = 0.008
	Group 2 [map 3b]	24	4.06 (0.63)	
	Group 3 [map 4b]	35	3.99 (0.62)	

S6.14 – Map: color preferences

The colors of map 2b (M=3.36, SD=1.42) were significantly preferred over map 3b (M=3.01, SD=1.38) and map 4b (M=3.00, SD=1.41).

Table S30: Risk map – Color preferences.

T-tests to test whether there are significant differences between the color preferences of the maps.				
		n	*Mean (SD)*	*t-test*
map version	Group 1 [map 2b]	24	**3.36 (1.42)[b,c]**	with Group 2: T(82) = 2.014, p =.047 with Group 4: T(82) = 2.157, p=.034
	Group 2 [map 3b]	24	**3.01 (1.38)[a]**	Group 3 & 4: T(82) = -0.061. p=.952
	Group 3 [map 4b]	35	**3.00 (1.41)[a]**	

S6.15 – Map: smoothing and hill shades preferences

Two main insights were that i) hill shade versions are preferred, and ii) regarding the smoothing, there are no clear differences. However, for the yellow-to-red color scale and the blue-red color scale the version with smoothing and no hill shades were significantly less preferred.

Table S31: Risk map – Smoothing and hill shades preferences.

		Mean	SD	
Group 1	Version 2a [no smoothing / no hill shades]	**3.08**[c,d]	1.41	- Version c was significantly preferred over version a (T=2.398, p=.025) - Version d was significantly preferred over version a (T=2.304, p=.031)
	Version 2b [no smoothing / hill shades]	3.46	1.41	
	Version 2c [smoothing / no hill shades]	**3.58**[a]	1.47	
	Version 2d [smoothing / hill shades]	**3.58**[a]	1.38	
Group 2	Version 3a [no smoothing / no hill shades]	3.42	1.02	- Version b was significantly preferred over version c (T=2.106, p=.046) - Version d was significantly preferred over version c (T=2.532, p=.019)
	Version 3b [no smoothing / hill shades]	**3.63**[c]	0.92	
	Version 3c [smoothing / no hill shades]	**2.96**[b,d]	0.91	
	Version 3d [smoothing / hill shades]	**3.58**[c]	0.88	
Group 3	Version 3a [no smoothing / no hill shades]	2.66	1.44	- Version b was significantly preferred over version a (T=2.806, p=.008) - Version b was significantly preferred over version c (T=2.836, p=.008) - Version d was significantly preferred over version a (T=2.424, p=.021) - Version d was significantly preferred over version c (T=2.472, p=.019)
	Version 3b [no smoothing / hill shades]	3.26	1.44	
	Version 3c [smoothing / no hill shades]	2.60	1.46	
	Version 3d [smoothing / hill shades]	3.06	1.35	

S6.16 – Map: influence of the smoothing and hill shade on the risk perception

There were to main insights from participants responses: First, the smoothing versions lead people to think that Budapest and the surroundings are at elevated risk. Second, the smoothing versions lead people to think that large parts in Spain have no seismic risk.

Table S32: Risk map – Influence of the smoothing and hill shade on the risk perception [group 1].

	Group 1 [map 2b]					
	Version 2a [no smoothing/ no hill shades]		Version 2c [smoothing/ no hill shades]		Version 2d [smoothing / hill shades]	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
In Budapest, the seismic risk is only elevated in the city center but not in the surroundings.	15	9	6	18	6	18
There are large parts in Spain where there is no seismic risk.	9	15	16	8	13	11

Table S33: Risk map – Influence of the smoothing and hill shade on the risk perception [group 2].

	Group 2 [map 3b]					
	Version 3a [no smoothing/ no hill shades]		Version 3c [smoothing/ no hill shades]		Version 3d [smoothing / hill shades]	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
In Budapest, the seismic risk is only elevated in the city center but not in the surroundings.	13	11	6	18	7	17
There are large parts in Spain where there is no seismic risk.	3	21	14	10	9	15

Table S34: Risk map – Influence of the smoothing and hill shade on the risk perception [group 3].

	Group 3 [map 4b]					
	Version 4a [no smoothing/ no hill shades]		Version 4c [smoothing/ no hill shades]		Version 4d [smoothing / hill shades]	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
In Budapest, the seismic risk is only elevated in the city center but not in the surroundings.	17	18	10	25	7	28
There are large parts in Spain where there is no seismic risk.	19	16	25	10	22	13

S6.17 – Overall final comments

Table S35: Risk map – Final comments.

I spent most of my Life in Albania. **I would suggest removing from the map the black dots that denote the capitals because it gives the impression of high seismic risk**. They could have probably a symbol with the same colour of the risk of the region.
I think that it is a matter of great importance to inform people from countries that do not face earthquakes of great magnitudes that it is a problem that other countries such as Greece, Italy, Turkey and **others face, and that building codes should get reviewed and updated more often**. Furthermore, it should be made clear that buildings especially state buildings, **should get insurance for hazards such as earthquakes** (and all the side effects an earthquake may have), floods, hurricanes. These maps that were presented in this study, were clear enough for me, however the distinction between seismic risk and seismic hazard was not addressed. This issue may have to be better clarified for those without an earthquake engineering background. **The example of Istanbul helped but could be better explained, according to my opinion.**
I would like to have **some explanation on the risk levels (meaning of high, low etc.**). I would place the reading example below the explanation of risk (left side); e.g. switch position of reading example and vulnerability.
As I mentioned before, I believe that other territories should be displayed, like the Azores islands (we usually have strong earthquakes with life loss and economic damage nearly every 20 years), **Madeira, and for example the DOM of France**. The work you have done seems great, I will be very happy when it will be finally revealed. But please, correct the maps, as there are other European territories that must appear. Thank you.
The city displayed on the map seems quite random. In some countries, several cities are displayed and for some other countries, there is no city appearing on the map and also no name of the country.
The most useful part of the poster, in order to its comprehension, is the guided reading about Istanbul.
The poster has too much text, people would rather look at cartoons than reading the text. **Without reading the text the difference between the two maps is not clear** -> confusing for non-seismologists.
Why don't the **islands of the Azores archipelago appear, since they belong to Portugal and are part of Europe?**
Warnings on the limitations of the risk estimates are not enough emphasized.
I could not find 2 Portuguese archipelagos in the map - **The Azores (9 islands) & Madeira/Porto Santo (2 islands**), also part of Portugal, therefore Europe.