



Network of European Research Infrastructures for  
Earthquake Risk Assessment and Mitigation

Report

D9.3 User Interaction specifications

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Responsible participant:	SED/ETHZ
Author:	Philipp Kästli, Laurentiu Danciu, Jochen Wössner, Cyrill Bonjour, Emilia Petronio, Florian Haslinger (all SED/ETHZ), Alessandro Spinuso (ORFEUS), Linus Kamb (EMSC)



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Various other on-going or recently completed projects provided data and products that are relevant for hazard and risk, and thus lend themselves to incorporation to EFEHR. In particular, as EFEHR also constitutes the European regional component for GEM, those services and products of GEM that are relevant for Europe shall be accessible through EFEHR.....	21
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# 1. Summary

In the NERA portal and services developments, a user needs assessment is mostly required for the parts on earthquake hazard and risk, as there few examples exist, and data producers and data users started to strengthen their direct coordination only recently.

User needs assessment is done for the purpose of the practical implementation of portal applications; thus it is basically designing the overlap between the expectation of a user to get an information or functionality in a specific preferred way, and the capability of science to provide the base data. In the first phase of NERA, this could be done for the hazard part, where the structure of the achievable results is well established from previous projects, and thus the potential target users are well identifiable. In this field, user needs were derived from own surveys, as well as from experience and second analysis of surveys from parallel and previous projects. Four different use cases (retrieval of hazard maps, curves, uniform hazard spectra, and hazard disaggregation) were identified, respective applications specified and implemented. Results are presented in chapter 4.

For risk models and datasets developed only inside NERA, the exact shape and focus of results becomes available only now, and steps to identify users, use cases, and adequate representations and derived functionality for this data started recently. For this field, a status report and working plan is presented in chapter 5.

# 2. Introduction

While the core functionalities of the seismic portal for accessing seismic waveforms and event data was specified (van Eck et al. 2007a), developed (Kamb et al., 2008, Frobert et al. 2011), evaluated and adjusted earlier, services for hazard and risk have been added to the concept of the joint European Mediterranean Earthquake Portal and Services (EMEPS) only with the NERA project. Defining data access services, and interfaces for this area is a relatively new endeavor in various aspects:

- Hazard products (mainly hazard maps) have been produced and assessed in general as static products up to now. Hazard as a service does not yet exist, nor has a common expectation of the audience (more precise: different types of audience) been formulated, how such services should look like (technically, content-wise as well regarding their interactivity).
- The NERA project is only at the beginning of the convergence process between the communities of hazard scientists (oriented mostly towards probabilities and their uncertainty), engineers (focused largely on design cases, e.g. design earthquakes) and the risk manager and insurance community (as the only one to deal directly with risk perception and expectations of society). However, a well designed roadmap for earthquake hazard and risk data portal components should start where the requirements of these three user groups overlap.

- The topic is relevant for the general public, however difficult to explain, mainly because of its probabilistic aspects. Compared to earthquake risk, the interpretation of seismic waveforms is as well difficult to communicate but less relevant (as the public is usually happy enough to look at waveform interpretations by experts, be they seismic events or tectonic models). The interpretation of earthquake observations / event parameters is as relevant, but less disputable (as it always happens post factum).

Thus, this documents focuses on the steps of user specification and user needs assessment carried out for the new, hazard & risk oriented parts of EMEPS, while the revision of the user needs assessment of the waveform- and event-related parts, as far as needed, are described in deliverable 9.2

The ERRN (European Rapid Response Network) communication platform is technically hosted within EMEPS, however conceptually a different type of application, rather oriented towards coordinated action within a closed group of participants than a data and service offer to an unnamed public. As a result, its user needs assessment is not developed within this document, but in deliverable D4.2 (“Guiding tool for deployment of joint rapid response networks”).

### **3. Steps towards a user needs assessment**

To achieve a best possible understanding of the needs of the potential user community for hazard and risk related products and services, in order to fulfill the a-priori goals of the EMEPS project, we followed a 4-step approach:

- a. Derive general tasks from the EFEHR concept as drafted in the NERA DoW and presented in autumn 2012 to the NERA annual meeting (Wiemer et al. 2012);
- b. Consolidate experts expectations solicited by a survey among all scientists involved in NERA, conducted in spring 2011;
- c. Review the results of the User Needs Assessment conducted for GEM portal & service plans (Scawthorn & Porter, 2010), of which the hazard and risk aspects developed by EFEHR within the NERA framework build the European component.
- d. Rework the functional specification for four hazard-oriented portal applications developed in the framework of the SHARE FP7 project for Seismic Hazard Harmonisation in Europe (Wössner et al. 2010)

### **3.1 On a) – Boundary conditions from the EFEHR mission**

EFEHR is based on the following mission statement (summarized from Wiemer et al. 2012):

*“EFEHR provides access to updated, living seismic hazard and risk models for the Euro-Mediterranean region, to the underlying data and models, and to the software infrastructure for hazard and risk assessment.”*

EFEHR builds on three pillars:

- A European hazard and risk competence center run at ETH in tight integration with the GEM Model Facility ([www.globalquakemodel.org](http://www.globalquakemodel.org)) jointly operated by ETH Zürich and EUCENTRE Pavia;
- A computing center with the scientific and technical capability of running and supporting various types of hazard and risk computation strategies and codes;
- A data center, providing long term access to earthquake hazard and earthquake risk models as well as their results. These datasets comprise the output data resulting from the scientific work packages of NERA, as well as the heritage of related projects, such as SHARE, NERIES, SYNER-G, and MATRIX.

Based on the above, the mission of the hazard and risk parts of the European Mediterranean Earthquake Portal and Services can be defined as follows:

- *Provide documentation of and interactive access to the competence center (first priority);*
- *Provide access to authoritative European hazard and risk datasets, and related tools for discovery, visualization, sub-selection, customization, and automated retrieval (first priority);*
- *Provide interfaces to online hazard and risk calculation tools, based on user-provided datasets and models for seismicity, exposure, and/or vulnerability (second priority).*

### **3.2 On b), expectations and requirements from NERA**

The NERA document of work declares the aim for the EMEPS as to bring the NERA scientific and coordination results to users and the general public; however, it remains quite open about functionality and focus. In order to substantiate this more, we conducted a survey among the work package leaders and task owners of the project in spring 2011, asking for

- Their knowledge and typical use of scientific portals and portal applications;
- Their evaluation of the importance of different types of portal-based services;
- The type of intended products (shared data and web-accessible applications) of their tasks, their target audience, and dissemination requirements;
- Their expectation on support by the portal team in implementing those.

While the number of received responses was not enough to allow for an elaborate statistical analysis, the outcome was homogeneous enough to provide some insight:

- Best known and widest used are portals of large national or international scientific and monitoring organizations (IRIS, ORFEUS, EMSC, USGS), while private services or project-based, short-lived (even if feature-rich) services are rarely used.
- Typical use cases are data discovery, visualization (mostly of spatial data), and interactive retrieval. While programmatic data retrieval is restricted to few power users, it accounts probably for the majority of the data shipped. Typically, interactive discovery precedes programmatic retrieval, however, it is not generally followed by it.
- Web-based processing as well as subscription services are known for very specific application cases, however not generally expected. With elaborate web-based computing services, people generally consider privacy and intellectual property rights on intermediate results as a potential issue.

It was obvious that the intended audience for most of the potential services would be scientific peers of the data providers (rather than downstream customers or the general public) Still, in May 2011 it was too early to really define how portal application or services providing NERA results should look like. So in autumn 2012, interviews were conducted with all work package leaders in order to define which work package results may be provided via web-portals, and what would be the expected functionality, and the intended audience. The results are included in chapter 5.

### **3.3 On c) Results adapted from the user needs assessment for global Hazard & Risk services**

In order to assess basically the same question on user needs for GEM, the Global Earthquake Model project, as EFEHR needs to answer for EMEPS in Europe, Scawthorn & Porter conducted a global survey among some 400 experts in earthquake hazard & risk, as well as interested laypersons. Participants were mostly recruited by the way of the *Alliance for Global Open Risk Assessment (AGORA)*. While people were addressed worldwide in English, Hindi, Chinese, Spanish and Japanese, answers were collected mainly in English, and with some bias towards European and US participants. While half of the addressed people were from academic research, also government representatives, consulting, financial & real estate industry, emergency management and NGOs got a decent coverage.

People were asked questions on the following 6 topics:

- *Who* are the current and potential users of hazard and risk information and software;
- *How* do users of hazards and risk information use the information – what are their risks, what decisions are they making, how is the information used in that decision-making?

- *How* do risk analysts and software users currently perform their analyses, and what particular capabilities could GEM offer that would materially improve upon these approaches;
- *How* might users interact with GEM, on a step-by-step basis, to implement these enhanced capabilities;
- *What* data interchange standards are needed to most easily interact with existing and developing hazard and risk software; and
- *How* could GEM best encourage, direct, and absorb voluntary data and software contributions by user-developers

All of these questions, with the exception of those on the direct usage of specific desktop hazard & risk assessment software products, are immediately helpful for defining the European portal and services. The results of the survey can be summarized as follows:

**Customers** were identified as follows: **Scientific community** (~ 50%) – looking for data and methodological input for further research. **Technical specialists** (engineers, urban planners etc.) (~ 25%) – looking for directly applicable technical results. **Policy and decision making** (~25%) – looking for background information for supporting political and economic decision processes. As this last group includes public (governmental) policymakers, private sector management decision makers, as well as (in open societies and a democratic context) the general public, it is probably the most heterogeneous one.

Given the wide range of application cases, **interests** are roughly evenly distributed between hazard and risk related topics, between spatially integrated results, such as risk mapping, and results directly applicable to individual sites or facilities, and between probabilistic and deterministic analyses. There is a strong interest in secondary effects and multi-hazard analyses.

The **level of experience** in dealing with earthquake hazard related terms, tools and data is also basically equally distributed, ranging from highly specialized experts to people with a general interest, but no specific experience.

Most desired **types of products** were hazard, risk, and loss maps (on both probabilistic models and scenario-based results), followed by hazard spectra, and stochastic event sets for further analysis.

Most requested **properties of results** were accuracy, defined uncertainty, graphical representation, extended documentation, and explorability (results responsive to boundary conditions / assumptions modified by the user).

As results and functionality are expected to be **web-mounted**, dependencies on specific user-side infrastructure requirements (except broadband internet) fall away. However, many users are principally to interface data and services in an automated way, requiring also **machine-readable data formats and interfaces** (e.g. web services), best based on open standards.

As a general consequence, given the dominant interest of the scientific community and the common ground between information producers and consumers (regarding previous knowledge, generally used tools and language, and representation habits), Scawthorn & Porter recommend developing any application, service or data product first in a way that it fulfills the typical requirements of the scientific community, and derive products for a general public only in a second step.

However, with the strong application-oriented focus of NERA and the commitment to provide useful information directly to the general public, this self-referencing initial focus may fall too short. In order to fulfill the requirements to *(from NERA-DoW)*:

- *Focus on effective dissemination both within and outside of the consortium, to the external technical community and industry as well as to the general public, administrators and other stakeholders, and*

*Progress in applying new seismological knowledge in engineering applications*, the general focus of the hazard and risk part of the EMEPS can be adjusted as follows:

- Develop and document data products and services to cover the full state of the art requirements of the scientific community providing them;
- Present them in a way adequate for application in an engineering context;
- Adapt *selected results* for public communication;
- Be transparent on the relationship between different representations of the same scientific result.

### **3.4 On d) Elaboration of a functional specification for four hazard-oriented portal applications**

Based on the generic strategy derived in the previous paragraph, and drawing from 33 use cases proposed by Scawthorn & Porter, four portal applications from the field of probabilistic hazard were selected for a first specification and implementation:

- Hazard Maps;
- Hazard Curves;
- Uniform Hazard Spectra;
- Hazard Disaggregation.

These applications were selected, as the structure of the scientific results could be drawn from the FP7 project SHARE (Seismic Hazard Harmonization in Europe, [www.share-eu.org](http://www.share-eu.org)) that had started in 2009 and was already fairly advanced in defining its outputs in the early phase of NERA. The resulting specification is given in chapter 4.

Applications based on information on the built environment (vulnerability and exposure) and seismic risk, both developed within the framework of NERA and not completed yet, will follow in the second phase of the project. A full list of the planned EMEPS/EFEHR portal applications by the end of NERA and their current state of specification and implementation is given in chapter 5.

## 4. Specification of the probabilistic hazard contributions for EMEPS

Based on previously elaborated specifications for GEM1 (Krishnamurthy et al. 2010) and SHARE (Wössner et al. 2010), and taking into account the general mission of EMEPS and EFEHR, simplified, streamlined and homogenized user interaction specifications for the for the probabilistic hazard-related EFEHR portal contributions were specified as follows:

### 4.1 Hazard map portlet

Target audience: Hazard scientists, earthquake engineers, general public – hazard maps are one of the typical tools of hazard and risk communication.

The hazard map portlet allows for an iterative selection of the hazard map to display, following a predefined basic workflow:

- Select your area of interest, based on a pair of coordinates or an interactive, map-based selection;
- Select a hazard model from the list of models available in the area of interest;
- Select a ground motion measure type (with the currently implemented hazard models: PGA, PGV, spectral accelerations; possibly additional: displacement, macroseismic intensity, Arias intensity, or others) from those provided with the model;
- Select a return period from those provided with the model;
- Select a soil class from those for which data is available;
- Select a level of data aggregation from the logic tree model branches (mean, median, quantiles);
- Plot the map.

The data selection process is tracked in the *log window*. After model selection, this window also provides links

- To download the map data;
- To interface a WMS (OGC-standardized web map service) providing the map to a GIS context.

As additional functionality, the map interface allows searching for (and zooming to) locations given by name, and it provides the modeling input data (earthquake catalogs, earthquake faults (surface projections), source zones, and background seismicity zones) as additional layers. Users may activate/deactivate all layers, and continuously adjust their transparency.

In order to fulfill the different requirements of general public hazard communication, and of the scientific audience, this application is provided in two realizations:

- One entirely open, but limited to providing median model results and quantiles, intended for the general public;
- One password-protected (however not access-restricted), with additional data describing individual branches of the model's logic tree for more in-depth exploring by hazard scientists.

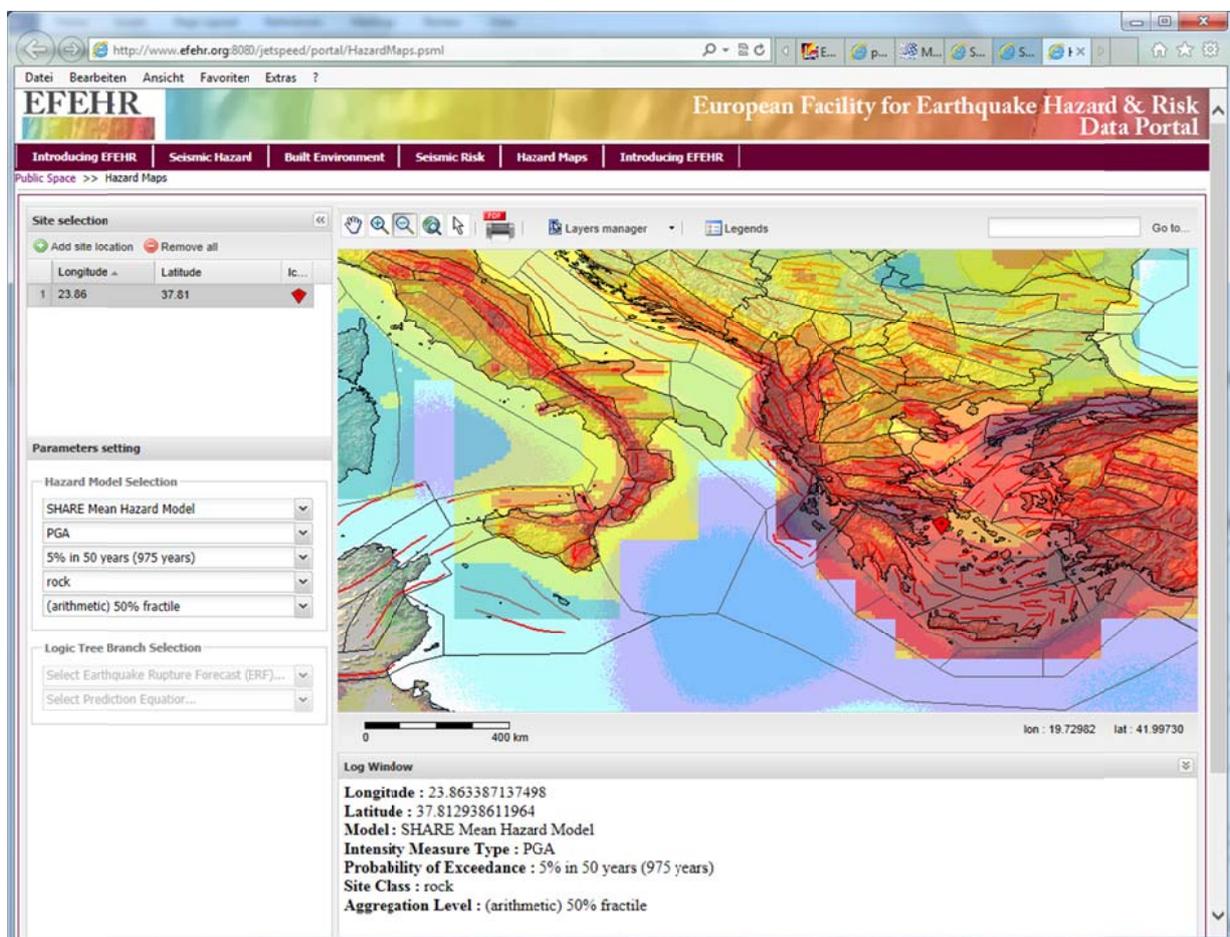


Figure 1: Display of the hazard map portlet for scientific use (draft) . The Log Window displays the choices.

## 4.2 Hazard curve portlet

Target audience: Hazard scientists (to a lesser extent also earthquake engineers, general public) – hazard curves are the standard representation of hazard results for hazard scientists.

While the data selection process for hazard curves is similar to the one for hazard maps (the exceedance parameter selection is omitted, as it varies over the curve), the hazard curve application is separate, and uses different data discovery services. This allows for the possibility to host models, intensity measurement types, and soil classes, for which one product is available, but the other not (e.g. older models like GSHAP or SESAME published only as maps). The handling of the user interface is similar: data selection is done on an incremental parameter selection dialog which is tracked in the log window. The map is used for the selection of the site of interest, while the curve itself is displayed in the right pane.

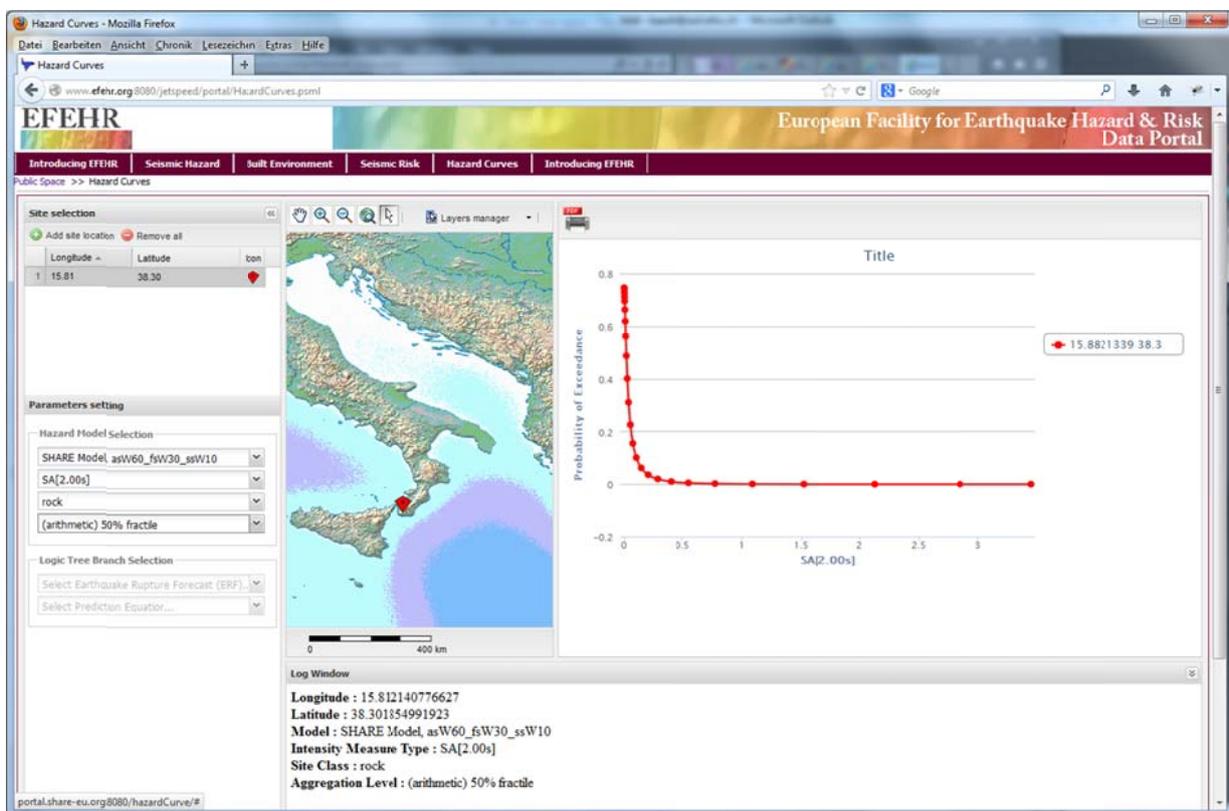


Figure 2: User interface for selecting and displaying hazard curves

### 4.3 Hazard spectra portlet

Target audience: (Hazard scientists), earthquake engineers – as spectra are the “currency” of building codes and the tool to verify earthquake resistant design.

The data selection and display part of the hazard spectra portlet is structurally identical to the one of the hazard curve portlet (however, probability of exceedance is provided on an annual level).

As an additional functionality oriented towards the typical needs of an earthquake engineer a user can select design spectra of Eurocode 8, based on a design PGA level and a seismicity type (large or small earthquakes), and plot them together with the response spectra of the hazard model.

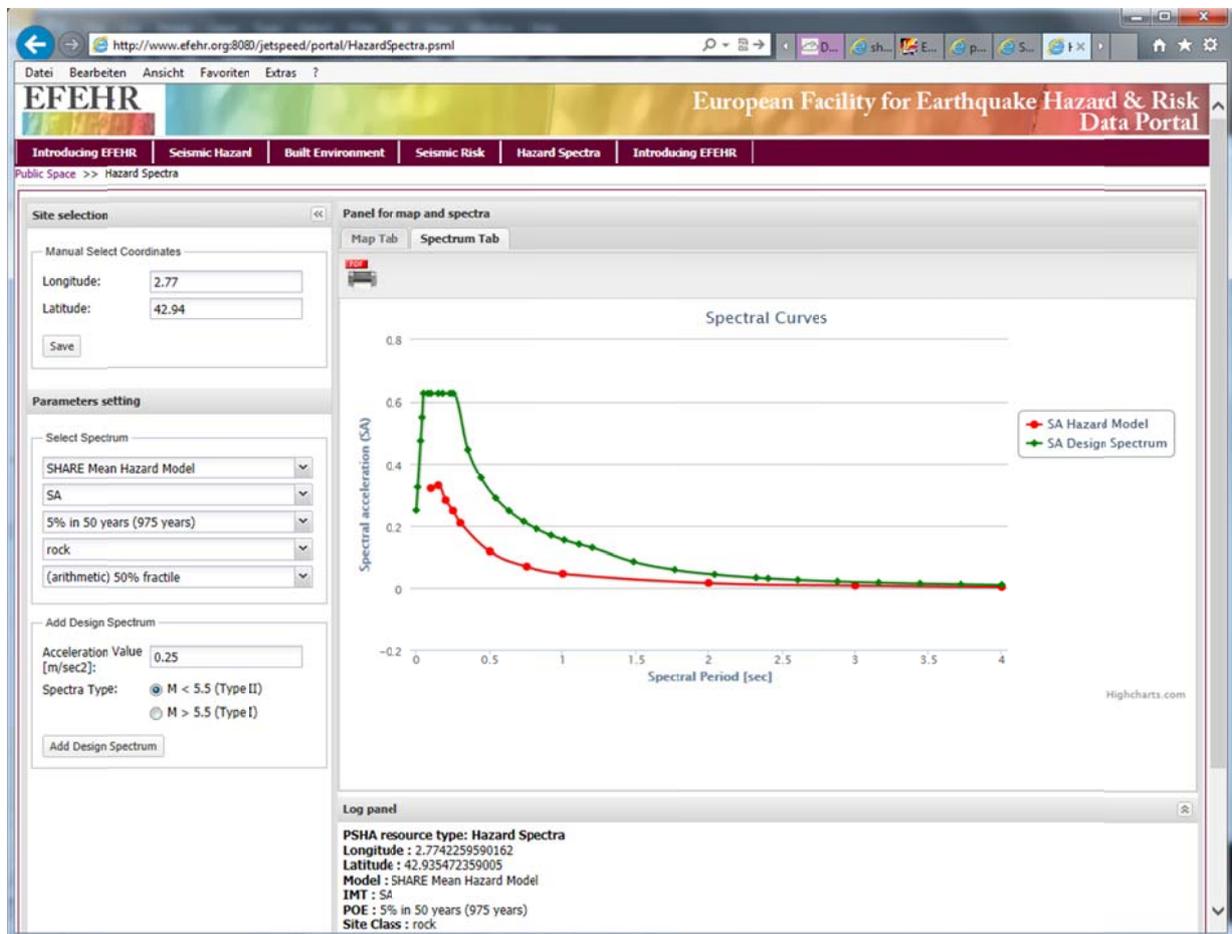


Figure 3: hazard spectra portlet.

### 4.4 Hazard disaggregation portlet

Target audience: Hazard scientists, earthquake engineers – both hazard scientists and engineers use disaggregations to rediscover the events driving an abstract probabilistic hazard figure, and engineers can derive design earthquakes for forward modeling.

The hazard disaggregation portlet features a data selection interface and a disaggregation viewer. The data selection interface queries incrementally the data services in the sequences described in the web service documentation. This allows selecting data spaces from large model spaces in a single step, without having to select between overwhelming numbers of options, and it avoids in any step that the user is selecting options for which no data is available later on.

For the first step (select a location), two workflows are currently presented: the site can either be selected from a map, or from a dropdown list with all place names for which precomputed disaggregations are available. Given the large amount of data (dozens of TB), it is currently not possible to serve precomputed hazard disaggregations for an arbitrary point on a fine-grain grid in Europe.

As a result of the data selection process, the link to the disaggregation data in xml format is displayed in the log, as well as passed to a viewer application (applet) which allows for graphical display of all disaggregation types with up to 3 axes. The viewer allows for histogram and surface/grid plots with configurable axes (variable per axis, axis range, linear/logarithmic display), turning of the graph around all 3 axes with the mouse pointer, and tabular as well as graphical data download.

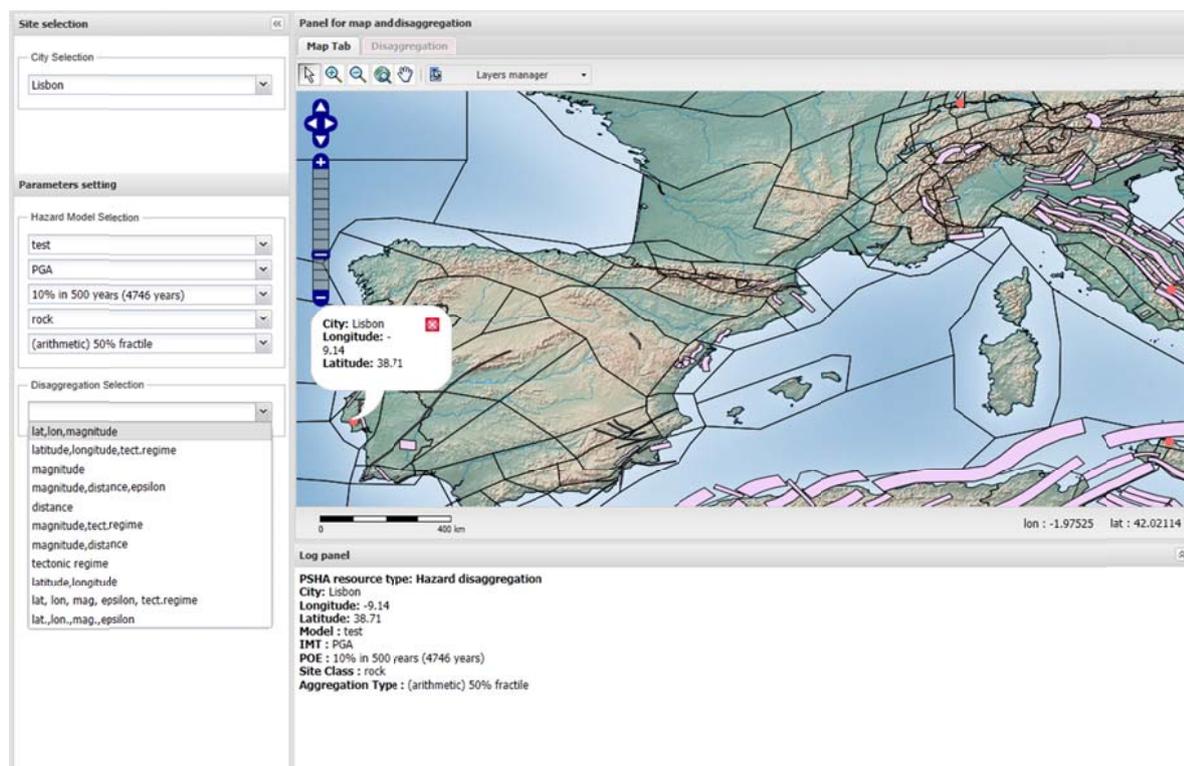


Figure 3: Data selection tab of the disaggregation viewer

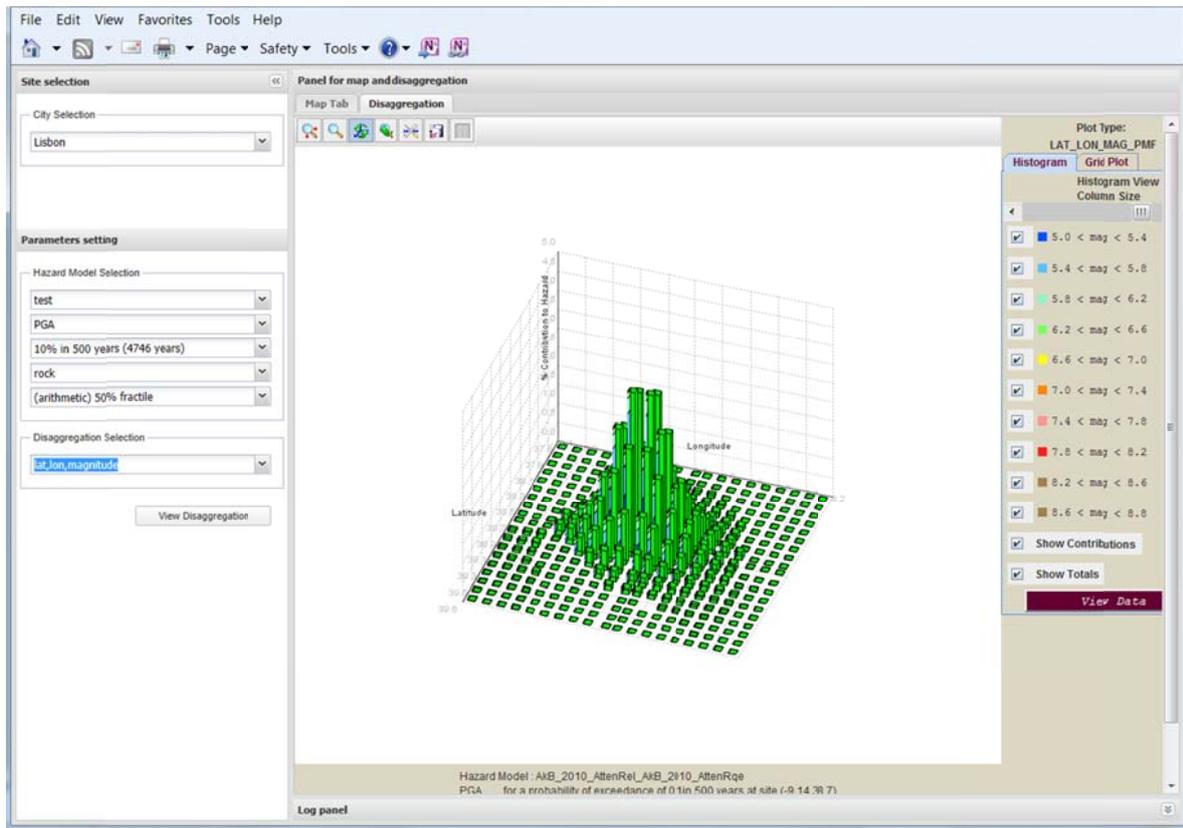


Figure 4: Data viewer tab of the disaggregation viewer

## 4.5 Data services

The workflow indicated for the interactive applications above is based directly on a set of RESTful web services for data discovery and retrieval, which in turn are based on XML data formats developed in GEM (Euchner et al. 2011) for the hazard data, and ad-hoc metadata structures developed in SHARE (Kästli et al. 2013).

As an example, the following paragraph describes the services and workflow for discovering and requesting a hazard curve. The full documentation of all data services is available from Kästli et al. (2013), or from the EFEHR portal site at [www.efehr.org](http://www.efehr.org)

### 4.5.1 Models that provide hazard curves

Note: Different from hazard maps, hazard curves always refer to the *annual* probability of ground motion exceedance.

User query	Which hazard models provide hazard curves for the site of my interest?
Request format	[base-url]/curve?lat=[latitude]&lon=[longitude]
Request example	<a href="http://appsrvr.share-eu.org:8080/share/curve?lat=47.5&amp;lon=7.6">http://appsrvr.share-eu.org:8080/share/curve?lat=47.5&amp;lon=7.6</a>
Response example	<pre> &lt;models&gt;   &lt;model&gt;     &lt;id&gt;57&lt;/id&gt;     &lt;name&gt;SHARE_201208.AsModel&lt;/name&gt;   &lt;/model&gt;   &lt;model&gt;     &lt;id&gt;58&lt;/id&gt;     &lt;name&gt;SHARE_201208.FsFbModel&lt;/name&gt;   &lt;/model&gt;   &lt;model&gt;     &lt;id&gt;60&lt;/id&gt;     &lt;name&gt;SHARE_201211.AsModelBranch01&lt;/name&gt;   &lt;/model&gt;   &lt;model&gt;     &lt;id&gt;61&lt;/id&gt;     &lt;name&gt;SHARE_201211.AsModelBranch02&lt;/name&gt;   &lt;/model&gt;   &lt;model&gt;     &lt;id&gt;59&lt;/id&gt;     &lt;name&gt;test&lt;/name&gt;   &lt;/model&gt; &lt;/models&gt; </pre>

#### 4.5.2 Intensity measurement types

User query	For which IMT are hazard curves available from the model of my interest, describing the site of my interest?
Request format	[base-url]/curve?lat=[latitude]&lon=[longitude]&modelid=57
Request example	http://appsrvr.share-eu.org:8080/share/curve?lat=47.0&lon=6.0&modelid=57
Response example	<pre> &lt;imtcodes&gt;   &lt;imtcode&gt;     &lt;code&gt;PGA&lt;/code&gt;     &lt;imunittype&gt;g&lt;/imunittype&gt;     &lt;imunitdescr&gt;gravity, 1g = 980.5 cm/s/s &lt;/imunitdescr&gt;   &lt;/imtcode&gt;   &lt;imtcode&gt;     &lt;code&gt;SA2sec&lt;/code&gt;     &lt;imunittype&gt;g&lt;/imunittype&gt;     &lt;imunitdescr&gt;gravity, 1g = 980.5 cm/s/s &lt;/imunitdescr&gt;   &lt;/imtcode&gt;   &lt;imtcode&gt;     &lt;code&gt;SA1sec&lt;/code&gt;     &lt;imunittype&gt;g&lt;/imunittype&gt;     &lt;imunitdescr&gt;gravity, 1g = 980.5 cm/s/s &lt;/imunitdescr&gt;   &lt;/imtcode&gt;   &lt;imtcode&gt;     &lt;code&gt;SA0.2sec&lt;/code&gt;     &lt;imunittype&gt;g&lt;/imunittype&gt;     &lt;imunitdescr&gt;gravity, 1g = 980.5 cm/s/s &lt;/imunitdescr&gt;   &lt;/imtcode&gt;   &lt;imtcode&gt;     &lt;code&gt;SA0.1sec&lt;/code&gt;     &lt;imunittype&gt;g&lt;/imunittype&gt;     &lt;imunitdescr&gt;gravity, 1g = 980.5 cm/s/s &lt;/imunitdescr&gt;   &lt;/imtcode&gt; &lt;/imtcodes&gt; </pre>

#### 4.5.3 Site class

User query	For which soil classes /surface geology conditions are hazard curves available from the model of my interest, describing the hazard in the units of my interest at the site of my interest?
Request format	[base-url]/curve?lat=[latitude]&lon=[longitude]&modelid=57&imt=PGA
Request example	http://appsrvr.share-eu.org:8080/share/curve?lat=47.0&lon=6.0&modelid=57&imt=PGA
Response example	<pre> &lt;soiltype&gt;   &lt;type&gt;rock&lt;/type&gt; &lt;/soiltype&gt; </pre>

#### 4.5.4 Hazard aggregation in Logic Tree models

User query	Given a model, an IMT, and a soil type, how was the hazard of a multi-branch logic tree model aggregated for the available curves? Answers are arithmetic mean, quantiles (ordinal aggregation with levels from 0 ... 1), or "single" for single branch models without model branch aggregation.
Request format	[base-url]/curve?id=lat=[latitude]&lon=[longitude]&[model-id]&IMT=[IMT]&soiltype=[soiltype]
Request example	http://appsrvr.share-eu.org:8080/share/curve?lat=47.5&lon=7.6&modelid=57&imt=PGA&soiltype=rock
Response example	<hazardcurvetypes> <hazardcurvetype> <aggregationtype>arithmetic</aggregationtype> <aggregationlevel>0.5</aggregationlevel> </hazardcurvetype> </hazardcurvetypes>

#### 4.5.5 Hazard curve retrieval

User query	What is the hazard curve that provides all the above specifications?
Request format	[base-url]/curve?id=lat=[latitude]&lon=[longitude]&[model-id]&IMT=[IMT]&soiltype=[soiltype]&aggregationtype=[ arithmetic   ordinal   single ]&aggregationlevel=[0...1]
Request example	http://appsrvr.share-eu.org:8080/share/curve?modelid=57&longitude=7.6821339&latitude=47.5&imt=PGA&soiltype=rock&aggregationtype=arithmetic&aggregationlevel=0.5
Response example	<?xml version="1.0" encoding="UTF-8" standalone="yes"?> <ns2:nrml xmlns:ns2="http://openquake.org/xmlns/nrml/0.3" xmlns:ns1="http://www.opengis.net/gml" xmlns:ns4="http://www.w3.org/1999/xlink" xmlns:ns3="http://quakeml.org/xmlns/quakeml/1.1"> <ns2:hazardResult ns1:id="gml_id_8"> <ns2:config> <ns2:hazardProcessing saDamping="0.05" saPeriod="0.1" IDmodel="SHARE_201208.AsModel" investigationTimeSpan="50.0"/> </ns2:config> <ns2:hazardCurveField quantileValue="0.5" statistics="mean" ns1:id="gml_id_9"> <ns2:IML IMT="PGA">0.005 0.007 0.0098 0.0137 0.0192 0.0269 0.0376 0.0527 0.0738 0.103 0.145 0.203 0.284 0.397 0.556 0.556 0.778 1.09 1.09 1.52 2.13 2.85 3.45</ns2:IML> <ns2:HCNode ns1:id="gml_id_10"> <ns2:site> <ns1:Point srsName="4326"> <ns1:pos>7.7821339 47.5</ns1:pos> </ns1:Point> </ns2:site> <ns2:hazardCurve> <ns2:poE>0.911 0.841 0.738 0.615 0.491 0.380 0.288 0.212 0.151 0.103 0.0653 0.038 0.0202 0.00958 0.00398 0.00146 4.804E-4 1.507E-4 4.448E-5 1.452E-5 6.546E-6</ns2:poE> </ns2:hazardCurve> </ns2:HCNode> </ns2:hazardCurveField> </ns2:hazardResult> </ns2:nrml>

## 5. Extended list of hazard & risk related EMEPS content

Based on the interaction with relevant NERA work package leaders, and key scientists of other related projects, an 'extended list' of contents to be presented on the EMEPS has been put together. This list, respectively the contents listed, should be understood as a starting point that reflects currently available (or known as in development) data and products, which can reasonably be planned for integration on EFEHR within the timespan (but partly exceeding the work plan of) NERA.

### 5.1 Probabilistic seismic hazard

Seismic hazard data and products for Europe will be provided from the SHARE project. These SHARE results will remain available 'frozen' on EFEHR, such providing a well defined baseline, while future updates of parts or the whole will be incorporated into the portal with clear reference to their provenance.

Topic	Audience	Requirements, technique	Status & Time line	Implementation by	Data by
Hazard maps	Hazard scientists, Earthquake engineers, general public	Interactive data selection portlet based on data discovery and retrieval web services, with mapping integration	Public version: Specification completed Software completed Setup completed Data arriving  Scientists' version (with logic tree branches): Specification completed Software completed Setup pending Data pending	SED, BRGM	SHARE consortium
Hazard curves	Hazard scientists, Earthquake engineers, (general public)	Interactive data selection portlet based on data web services, with mapping and curve plotter integration	Specification completed Software completed Setup completed Data arriving	SED, BRGM	SHARE consortium
Hazard spectra	(Hazard scientists), Earthquake engineers	Interactive data selection portlet based on data web services, with mapping	Specification completed Software completed Setup completed Data arriving	SED	SHARE consortium

		integration			
Hazard disaggregation	Hazard scientists, earthquake engineers	Interactive data selection portlet based on data web services, with mapping integration	Specification completed Software completed, improvement of 3D-plotting pending Setup completed Data arriving	SED, contractors	SHARE consortium
Hazard input – source models	Hazard scientists, general public	Mapping within hazard map viewer, download	Software completed, improvement of 3D-plotting pending Setup completed Full text description pending	SED	SHARE consortium
Seismicity and strong motion databases for SHARE model	Hazard scientists (for engineers, the updated RRSM and ESM by NERA NA3 will be more relevant)	Documentation and download Including short description  Links to original sources if needed	Setup completed Description completed Data completed	Web: Petronio	SHARE consortium

## 5.2 Earthquake forecast models and Test results

Within completed and ongoing EU-projects, time-independent and time-varying forecast models have been produced, mainly on the national scale. Results of the earthquake rate forecasts and test results should be displayed. Projects that we can leverage from are CSEP, SAFER, NERIES, REAKT, and NERA.

For **time-independent models**, we can build upon European scale projects:

Topic	Audience	Requirements, technique	Status & Time line	Implementation by	Data by
Time-independent rate models	Hazard scientists	Mapping of rate forecast with modified map viewer	Generic map viewer completed Setup pending Data available	SED	SHARE (area source model, fault source/background model, smoothed seismicity model)
Rate Testing results of the long-term model	Statistical seismologists	CSEP automated model testing framework, CSEP results web viewer	Framework & models deployed Web viewer (access-protected) deployed Waiting for test intervals to complete Negotiation on access rights pending Portal integration pending	SED, based on previous work of USC	CSEP/SED

For **time-varying models**, the portal can serve examples produced for certain test regions as these models are not readily available for European scale projects. These results should be seen as prototypes of what in future is envisioned on the EFEHR portal on the European scale. This should probably remain password-protected.

Topic	Audience	Requirements, technique	Status & Time line	Implementation by	Data by
Time-varying short-term forecast / hazard on national scale	Statistical Seismologists Potentially general public	Mapping of rate forecast with modified map viewer Mapping of hazard values	Modelling environment implemented (example area: Switzerland) Data discovery services and draft web viewer implemented Portal integration pending Communication strategy pending (publicly accessible „earthquake weather“)	SED	SED
Rate Testing Results of time-varying models	Statistical Seismologists (CSEP community) Potentially general public	CSEP automated model testing framework, CSEP results web viewer	Framework & models deployed Web viewer (access-protected) deployed Waiting for test intervals to complete Negotiation on access rights pending Portal integration pending	SED, based on previous work of USC	CSEP-ETH, REAKT, NERA-WP14

### 5.3 NERA WP contributions:

This is a list of items that came out of discussions within NERA. These are contributions that shall be specified by the data providers in more detail and then the display and technical requirements need to be defined before the respective services can be implemented.

Topic	Audience	Requirements, technique	Status & Time line	Implementation by	Data by
WP3 / NA3, RRSN realtime strong motion database	Earthquake engineers	Realtime waveform acquisition	Software implemented Setup in progress Frontend specification pending Frontend implementation pending	DB & code specs: SED Code : GEMPA Frontend : EMSC	ORFEUS
WP3 / NA3, ESM	Earthquake engineers	Pre-existing database and web project (ITACA)	DB & web presentation software completed NERA-specific setup pending Processing software in progress	METU, INGV	NERA consortium NA3 partners
WP14 and 15:	Earthquake	Offline calculation	Calculation pending	Not assigned	EUCENTRE

Capacity curves and time dependent fragility functions	engineers, Risk/loss modellers	using SPBELA and OpenSEES .	Integration with SYNER-G and GEM functions pending. Frontend specification pending		VCE
WP7 European building inventory	Earthquake engineers, Risk/loss modellers, urban planning, general public	Gridded mapping, OGC services	Further specification pending (depending on data structure)	EUCENTRE or SED	Expected Summer 2013
WP7 crowd sourcing tool for building inventory data	General public	Web application for data acquisition, backend database	Specification completed Code completed Portal integration pending	JKU, VCE	public
WP 13 documentation and download of source models	Earthquake source modellers	Content management system, large file access	Generic documentation tools implemented Texts and data pending	SED	SED
WP 14 Static description, and software download of a European time-dependent risk modeling package. No real-time risk maps (maybe mounting of Swiss Model as a teaser)	Risk modellers	Content management system, Potentially map viewer	Completion of the model scheduled for end of 2013 Time dependent web map viewer available Full set of requirements, adaptation & portal integration pending	SED	SED

## 5.4 Possible contributions from other projects

Various other on-going or recently completed projects provided data and products that are relevant for hazard and risk, and thus lend themselves to incorporation to EFEHR. In particular, as EFEHR also constitutes the European regional component for GEM, those services and products of GEM that are relevant for Europe shall be accessible through EFEHR.

Topic	Audience	Requirements, technique	Status & Time line	Implementation by	Data by
SYNER-G fragility functions	Earthquake engineers	Static download & documentation	Data completed Web functionality specification and implementation pending	SED	VCE

IRIS eqviz platform reference	Loss Modellers	Documentation (CMS)		SED	
GEISER geothermal reservoir modelling toolbox	Not assigned	Not assigned	Specification pending, as GEISER product definition not completed	Not assigned	FP7-GEISER
GEM european risk maps			Negotiations pending (hosting or linking)	Not assigned	GEM
GEM European building inventory database: with levels 0 to 3. The data from WP7 will form levels 0 and 1, and the crowd sourcing building data tool will be input into the level 3	Earthquake engineers, loss modellers, civil protection & emergency response, general public		Negotiations pending (hosting or linking)	Not assigned	GEM
OpenQuake Probabilistic hazard and risk assessment	Hazard & risk modellers	Computing cluster CMS (documentation), potentially application server (in a later phase)	OpenQuake cluster as part of EFEHR and GEM Modelling Facility implemented Web representation and outreach specification pending	SED, GEM-MF	GEM
GEM Database of European capacity curves, fragility functions, and vulnerability functions			Negotiations pending (hosting or linking)	Not assigned	GEM
MATRIX multi-risk modeling MATRIX-CITY software, computing center, and documentation	Risk modellers	Computing server with MATRIX-CITY installation and user management, software repository, documentation	Software completed Documentation completed Portal-porting of the documentation pending MATRIX-CITY public installation pending	MATRIX/SED	-

## 6. Literature

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## 7. Appendix 1: NERA portal enquiry

Dear colleagues, The NERA portal, a further development of the NERIES portal at <http://www.seismicportal.eu>, is designated to be a central interface to access European data and services in the fields of seismology, seismic risk and earthquake engineering. Thus, the portal development is a service task, to be tightly coordinated with the products and needs of the other NERA work packages. NA9 would like to establish a dialogue with the coordinators of the other work packages and key persons in their implementation in order to keep the developments well aligned. A first step to this is this small survey on your expectations and your specific use cases for the portal. The survey covers two topics: a) your current use of scientific portal applications in general, and b) potential portal applications to be developed for NERA work package. Answering will not take you more than 5-10 minutes. Thank you very much for your help! NERA NA9; Linus Kamb (EMSC), Alessandro Spinuso (ORFEUS), Philipp Kästli (ETHZ)

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### You

Please give your contact information name, email

Which NERA work packages are you involved in?

Your preferences with data portals

What are your main professional interests?

- Seismicity monitoring
- Ground motion monitoring & effects
- Earthquake engineering
- Waveform modeling
- Earthquake hazard

- Earthquake risk and loss modeling
- Other:

Which data portals do you know or use?

	I do not know or not use this	I use this site for interactive, web based data visualization	I use it for it's server-side processing capabilities	I use it to interactively retrieve data from there, for local processing	I use it for script-based access to data sources available within or along with the portal.
<a href="http://www.seismicportal.eu">www.seismicportal.eu</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<a href="http://portal.onegeology.org">portal.onegeology.org</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<a href="http://www.iris.edu">www.iris.edu</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<a href="http://earthquake.usgs.gov">earthquake.usgs.gov</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<a href="http://www.eriskzone.net">www.eriskzone.net</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<a href="http://www.geomind.eu">www.geomind.eu</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<a href="http://www.eoportal.org">www.eoportal.org</a>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Which data services do you know or use?

	I've never heard of it	I've tested it.	I use it occasionally	I use it regularly	I have scripts that access it.
quakeml/event of seismicportal.eu	<input type="checkbox"/>				
SeismoLink of ORFEUS	<input type="checkbox"/>				
SMI-RDF of seismicportal.eu	<input type="checkbox"/>				
TauP of of seismicportal.eu	<input type="checkbox"/>				
arclink, of any provider	<input type="checkbox"/>				
autoDRM, of any provider	<input type="checkbox"/>				
WMS or WFS services, of any provider	<input type="checkbox"/>				
RSS feeds on events or shakemaps, by USGS	<input type="checkbox"/>				

Which other portals and web services do you use regularly?

In your opinion, which type of services should a future version of a NERA Seismic Portal put emphasis on?

	not relevant	of minor importance	important	very important	most important
Data visualization	<input type="checkbox"/>				
Interactive data retrieval	<input type="checkbox"/>				
Programmatic data retrieval (request-based data services, "pull")	<input type="checkbox"/>				
Server-based calculation services	<input type="checkbox"/>				
Subscription to data products with configurable properties and processing (push services)	<input type="checkbox"/>				

Other types of requested functionality?

**The portal requirements of your NERA NA/JRA/WP**

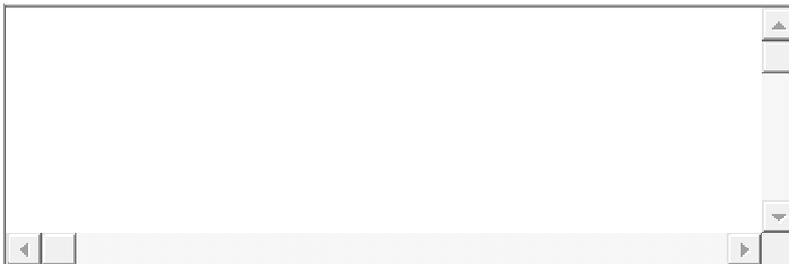
Does your NERA WP result in any data that you would like to make available to the public via the NERA portal?

- yes
- no

If yes, what support would you expect from the NERA portal Working Group (NA9)?

- We would like to provide the data, and have everything else done by NA9
- We will develop/run own data access application and would just like to have it mounted on the portal
- We would like to have an integration into general lookup tools (e.g. use a general earthquake finder to find also our earthquake-related data)
- We would like to get help with web-mounted visualisation technologies (maps, graphs, etc.)
- We would like to get some support in data format development / homogenization
- Other:

What type of data resulting from your workpackage would you like to have integrated into the NERA seismic portal?



Does your NERA WP develop data processing routines that you wish to have operational within the portal, either using portal-mounted data or local (client-side) data?

- yes
- no

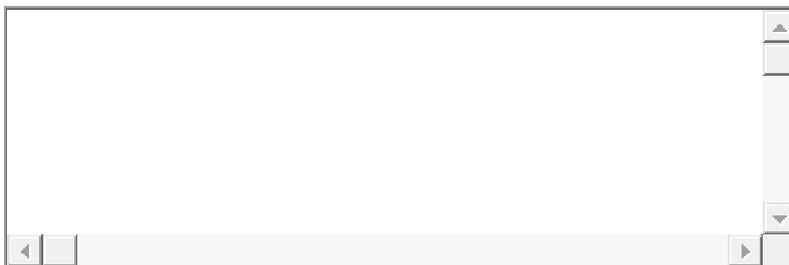
If yes, what support would you expect from the NERA portal Working Group (NA9)?

- We would like to provide the algorithm/calculation core, and have everything else done by NA9
- We will develop/run own calculation servers and service frontend, we would just like to mount or link it to the portal
- Would like to make our calculator run directly with input data available one portal or provided by other NERA work packages)
- Other:

What type of service resulting from your workpackage would you like to have integrated into the NERA seismic portal?

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Do you have ideas of multi-step workflows to be exposed through the portal that would be useful/desirable in the field of your NERA work package? (workflow examples: A: Search for events according to parameters, then search for waveforms, visualize, then download (This workflow is currently implemented on the NERIES portal). B: Select event, select observed ground motion from a strong motion sensor, get the return period of this ground motion from a selected hazard model. C: Subscribe to custom processed event waveform files, to be sent to you if a magnitude fulfills certain restrictions in location and magnitude. D: use workflows internally, but do not offer them explicitly.)

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Thank you very much for your participation!

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## 8. Appendix 2: Abbreviations

AGORA	Alliance for Global Open Risk Assessment, <a href="http://www.risk-agera.org">www.risk-agera.org</a>
EFEHR	European Facility for Earthquake Hazard and Risk, <a href="http://www.efehr.org">www.efehr.org</a>
EMEPS	European Mediterranean Earthquake Portal and Services <a href="http://www.seismicportal.eu">www.seismicportal.eu</a>
ERRN	European Rapid Response Network
GEISER	Geothermal Engineering Integrating Mitigation of Induced Seismicity in Reservoirs, <a href="http://www.geiser-fp7.eu">www.geiser-fp7.eu</a> , an FP7 project
GEM	Global Earthquake Model Foundation, <a href="http://www.globalquakemodel.org">www.globalquakemodel.org</a>
GEM-MF	Modelling Facility of the GEM Foundation
IRIS (1)	Incorporated Research Institutions For Seismology, <a href="http://www.iris.edu">www.iris.edu</a>
IRIS (2)	An FP7 project on risk management, <a href="http://www.vce.at/iris/">http://www.vce.at/iris/</a>
MATRIX	Multi-Hazard and Multi-Risk Assessment Methods for Europe, an FP7 project, <a href="http://matrix.gpi.kit.edu/">http://matrix.gpi.kit.edu/</a>
SYNER-G	Systemic Seismic Vulnerability and Risk Analysis for Buildings, Lifeline Networks and Infrastructures Safety Gain, <a href="http://www.syner-g.eu">www.syner-g.eu</a> , an FP7 project