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The DRMKC RDH Users' Guide

A tutorial for external users on the use of the DRMKC RDH

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Contents

Abstract

This report presents the main functionalities of the DRMKC Risk Data Hub (henceforth RDH) web portal. It is meant to provide users with concise guidance on how to use the tools offered by the platform. Firstly, the paper showcases the main features of the Risk Analysis module and of the Disaster Loss Data module. Furthermore, it covers the methodologies behind the risk estimation – exploring its main components - and behind the calculation of losses – providing insights onto the classification of fatalities and economic cost. Secondly, it recounts the detailed procedure to upload data into the RDH.

1. Introduction

The Web portal of the DRMKC Risk Data Hub is in ongoing development phase. The portal can be classified as a web application that displays maps of analysis composed partially on the fly (Risk Analysis Module[1], Disaster Loss Data Module[2]) and off the fly (External projects portal)

The interface is developed in JavaScript and it was created to resemble a common GIS desktop application. The client development includes a Web Application that offers the access to the following complementary Data Portals:

- **The Risk analysis** data portal - which is a European wide Data Portal – is intended to improve the access and sharing of curated European-wide risk data.
- **The Disaster Loss** data portal – it offers the access to the available European wide historical loss and damage data from open sources
- **The External projects outcome** portal – it offers access to outcomes from various projects (Ex. Horizon 2020, FP7 etc.) which are supporting Disaster Risk related actions.
- **The User Corner** data portal – it is created as a solution of accessing, storing and managing disaster risk data used mainly by national authorities.

The ***Risk Analysis and Disaster Loss*** data portals are hosting and sharing open data and analysis with European wide spatial extent. They offer an overview on available and commonly used data in terms of *risk components* (hazards, exposure, vulnerability and risk) for the Risk Analysis Module and *disaster loss and damage data* (fatalities, economic losses, non-economic losses) for the Disaster Loss data Module. These data are managed by the DRMKC RDH administrators and are freely available for downloading and use.

The portals, and specifically the risk analysis portal, make use of specific components to estimate risk values. Accordingly, we define risk as the potential loss or damage of a system in a specific period of time, determined probabilistically as a function of three risk components: hazards, exposure and vulnerability. Figure 1 provides readers with a brief overview onto these components which substantiate in normalized indicators from 0 to 10. A detailed explanation of each risk component follows in Chapter 2.

[1] The Risk Analysis portal uses single hazard exposure analysis which once uploaded triggers various types of calculations developed 'on the fly'. First a running code combines the exposure - assessed individually for different return periods – into an Expected Annual Exposure (EAE). Secondly a running code on the client side combines the EAE with the Vulnerability indicators values arriving to risk. A multi-hazard selection on the map portal will trigger a running code which will combine the single hazard exposures (EAE) to a multi-hazard exposure.

[2] The Disaster Loss Data portal will perform a running code which disaggregates the recorded economic losses from past events into sectors/sub-types of economic losses.

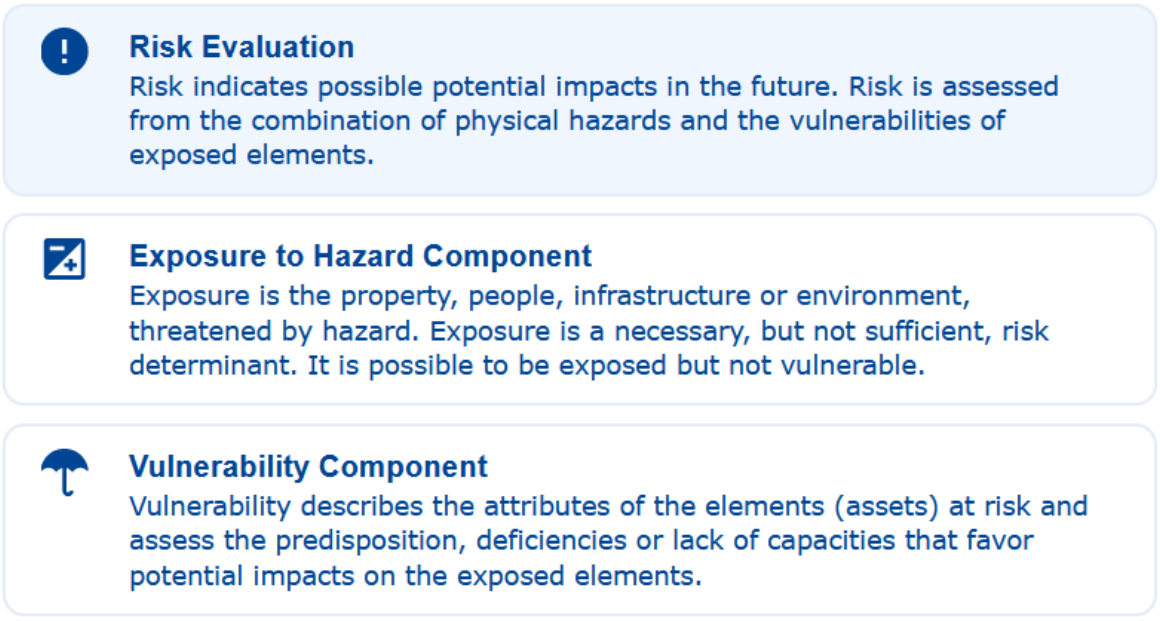


Figure 1: Component for the estimation of Risk values (Risk Data Hub 2021).

It is worth noting that ***the access to the Administrators application is restricted for external users.*** Rights to manage the data in terms of uploading, modifying, changing or any other data management action is restricted for these two modules.

To the external users (e.g. projects consortia, national authorities or any other user etc.) the DRMKC RDH is offering the possibility of storing and managing own disaster risk data with various ownership rights and governance at various geographical scales. The ***External projects outcome*** and the ***User Corner data portals*** are the places on the DRMKC RDH Web application where the external user, once granted access rights (by the main Administrator) can upload and manage its own disaster risk data (risk components or disaster loss and damage data). These two data portals are conceived as "empty boxes" with the data structure following the European–wide Data Portals of Risk Analysis and Disaster Loss data Modules.

The User Corner data portal replicates the 'on the fly' running codes from the client side (please see the foot notes). This allows the user to have various analyses automatically supported such as risk analysis as a function of Hazard, Exposure, Vulnerability or the aggregation into SENDAI targets of the recorded disaster loss data. The targeted users for this data portal are national and sub-national authorities.

The External projects outcome uploading and management on the other side is totally driven by the choice of the user. The running codes from the client side are not enabled here. The data structure follows the European–wide Data Portals (multiple single-hazards, multi-scale and multi-assets) with fully management rights of the data from the external user. The targeted users for this data portal are the project consortia as the Web Application of the Risk Data Hub can be organised to fit the outcome of projects.

One of the most important functionalities of the Risk Data Hub is that the uploaded data can be linked and visible across various Modules upon user's preference, which appear as data from different sources (users). This is possible because the data structure across various modules is replicated. In addition, thanks to this feature, the way the data is uploaded on the Web Application is replicated and similar across the various modules. The difference lays in the type of the risk data: Risk analysis data (with components of risk) or Disaster loss data (recording of disaster loss and damage data).

This report is composed of two main parts. Firstly, we present the main functionalities of the DRMKC RDH exploring its interface and options. Then we present the steps needed to upload data on the DRMKC RDH. We describe the file templates needed to be compiled and the various options available for structuring the data that is uploaded. For an additional information related with data structure and database architecture please consult also the previous JRC119500 and the JRC114712 reports.

2. Exploring the modules

The landing page of the DRMKC RDH (Figure 2) offers the access to the following complementary Data Portals or modules:

- **The Risk Analysis** data portal - it is a European wide Data Portal intended to improve the access and sharing of curated European-wide risk data computed into risk estimations. The data hosted here are: exposure, vulnerability and risk values in the form of normalized indicators ranging from 0 to 10. This portal intends to answers the questions: What is likely to be lost? Where are damage or losses more likely? What are the most likely – and potentially impacting - hazards?

- **The Disaster Loss data** portal – it offers an overview of the available/open source European wide historical loss and damage data from past events. This portal intends to answers the questions: What has been lost? Where? Due to What?

- **The External projects** outcome portal – it provides access to outcomes from various projects (Ex. Horizon Europe, Horizon 2020, FP7 etc.) which are focused on Disaster Risk related research. This portal offers means to capitalise on the existing knowledge, networks, tools, methods and data supporting their broad dissemination. It also intends to assess the progress made and to identify gaps in scope for DRM research.

- The **User Corner** data portal (underdevelopment)- it is created as a solution of accessing, storing and managing disaster risk data used mainly by national authorities.

- The **Facts and figures** (under assessment)

- The **Events** not applicable for this report. It lists the DRMKC events

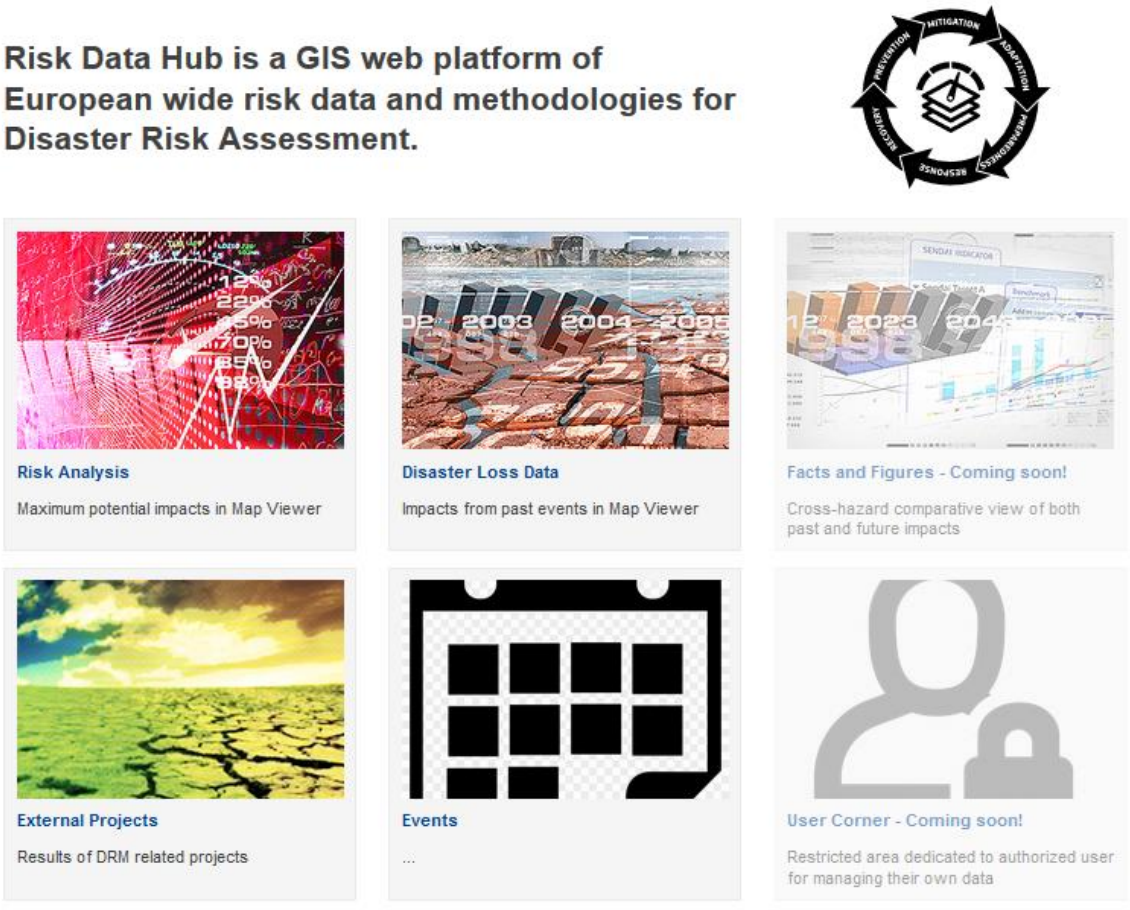


Figure 2 - RDH Modules Selection.

A detailed presentation of the structure and functionalities of the Data Portals of the DRMKC RDH is provided as follows. Firstly, we cover the Map viewer and the access through the Navigation datasets Panel, recounting the types of analysis hosted on the platform: risk analysis and disaster losses and damages.

3. General layout

Despite their different scope, the interfaces of the Risk Analysis, Disaster Loss Data and the External Projects modules are similar in their design. The interface is a map portal as portrayed in Figure 3. The map portal is divided in four parts: the Dataset Control Panel with a set of possible Options, the Map viewer and the supporting Figures under the maps.

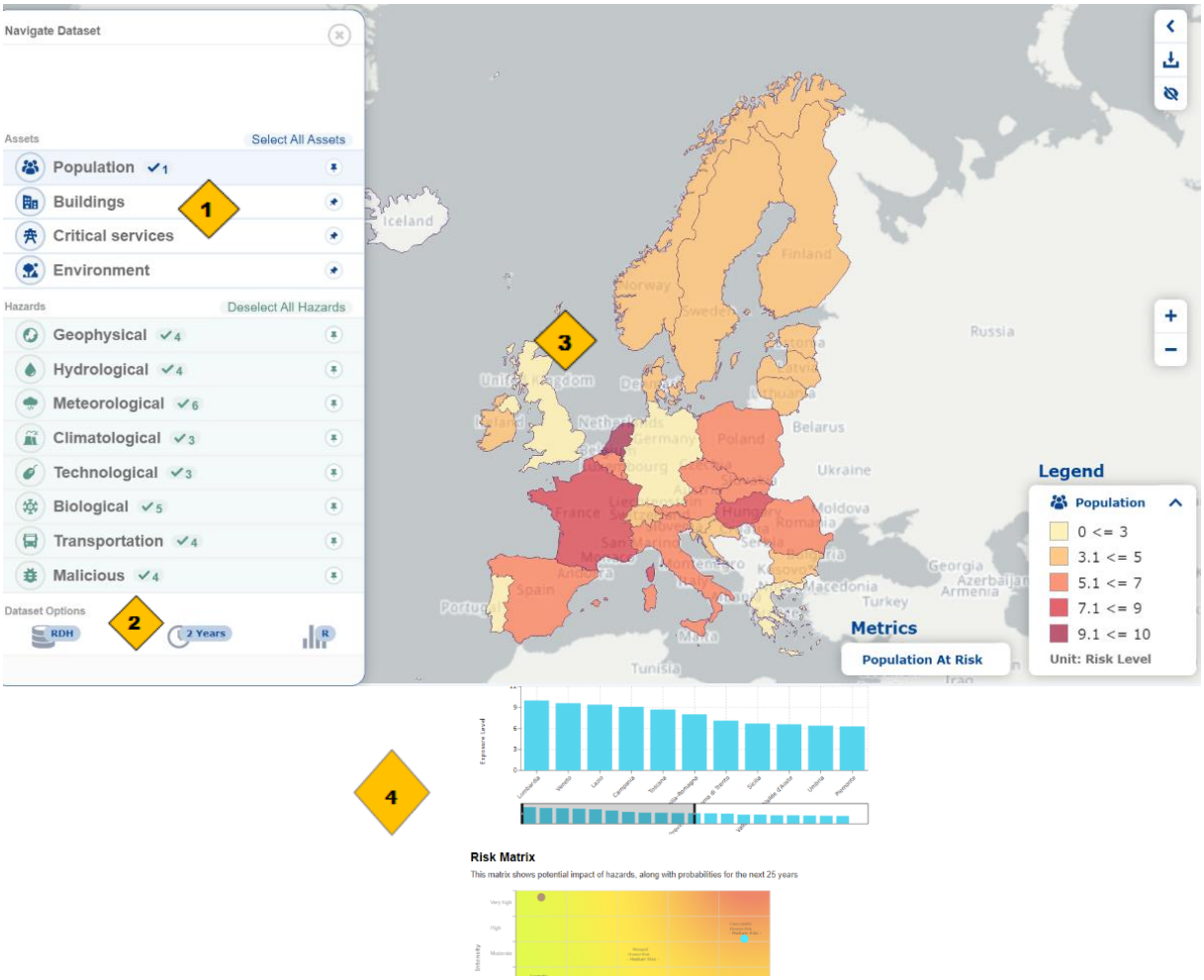


Figure 3 - Map Viewer of RDH.

3.1.1. The "Dataset Navigation Panel"

The "Dataset Navigation Panel" is overlaid on left-hand corner of the screen allows users to select the relevant assets and hazards to investigate. The geospatial information hosted on the platform is built on the relation asset – hazard. In order to visualize the disaster risk information (disaster losses, exposure, vulnerabilities, and risk) on the Map viewer, users need to select at least one asset and one hazard.

As a first step, the choice of an asset is required. To date, RDH hosts 4 macro-categories of assets, namely 'Population', 'Buildings', 'Critical services' and 'Environment'. Hovering the mouse onto these categories, users can view their specific components (e.g. commercial buildings) and select those of interests. In a similar fashion, hazards are gathered in 8 macro-categories. Hovering the mouse pointer over one of them allows for a more specific selection of hazard subcategories. An overview of the options included in the Dataset Navigation Panel is presented in Figure 4. It is worth noting that it is possible to select multiple assets – even from multiple macro-categories – at the same time as RDH is meant provide a multi-hazard, multi-asset a multi-sector tool for DRM. Having select the asset/s of interest, users need to select one or more hazards.

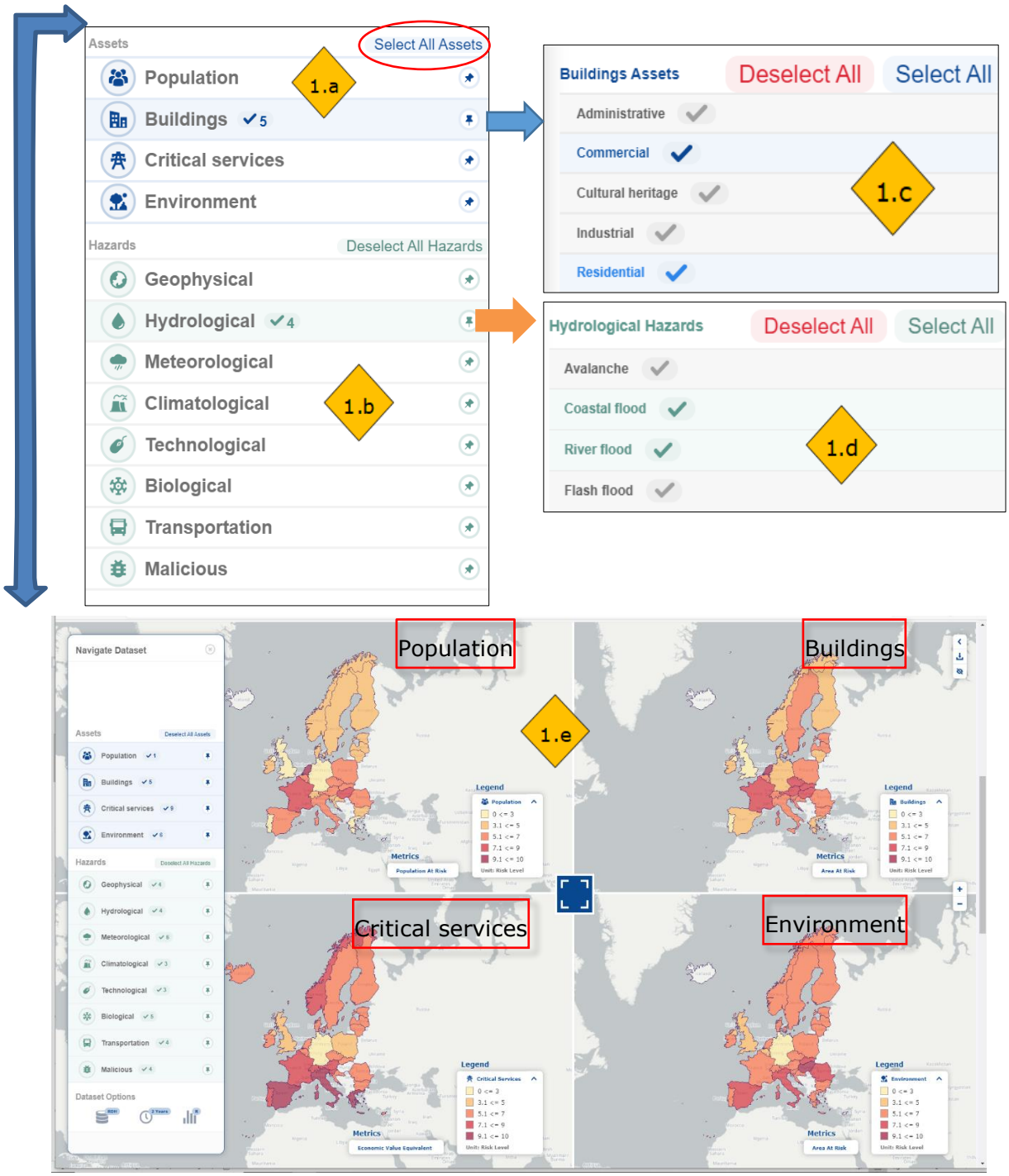


Figure 4 - Synchronised multiple map view produced upon selection of assets categories and hazards.

1.a - Assets macro-categories

1.b - Hazards macro-categories

1.c - Assets Subcategories (e.g. Buildings)

1.d - Hazards Subcategories(e.g. Hydrological Hazards)

1.e - Synchronised multiple maps produced upon 'Select all Assets' options applied on Macro-categories

Multiple-hazard and multiple-assets implementation on the DRMKC RDH platform. The geospatial information hosted on the platform is built on the relation asset – hazard. This approach provides information on potential risk components (exposure, vulnerability, risk) or losses from past events based essentially on pairs of hazards and assets. This information can also be aggregated when users choose to have a summary across multiple pairs of assets and hazards. The summarised view is possible for the selections of multiple assets paired with one hazard (many to one), single asset paired with multiple hazards (one to many) or multiple assets paired with multiple hazards (many to many). These rules are applied within macro-categories and subcategories selections of both hazards and assets. Please see Figure 5 and Figure 6 as implemented examples.

For the risk analysis only a multi-hazard or multi-asset selection on the map portal will trigger a running code which will: convert single pairs information (of the exposures) ***into a hot-spot analysis*** (characterised by z-scores and p-values), combine single hot-spots to a multi-hazard/assets information (comprehensive methodology on multi-hazard estimation to be published).

For the disaster and loss data from past events, a multi-hazard or multi-asset selection on the map portal will trigger a running code, which will: ***sum up the losses and damages*** according to the rules provided above (e.g. sum of the losses suffered by one asset to multiple-hazards, of multiple assets to one-hazard or of multiple assets to multiple hazards).

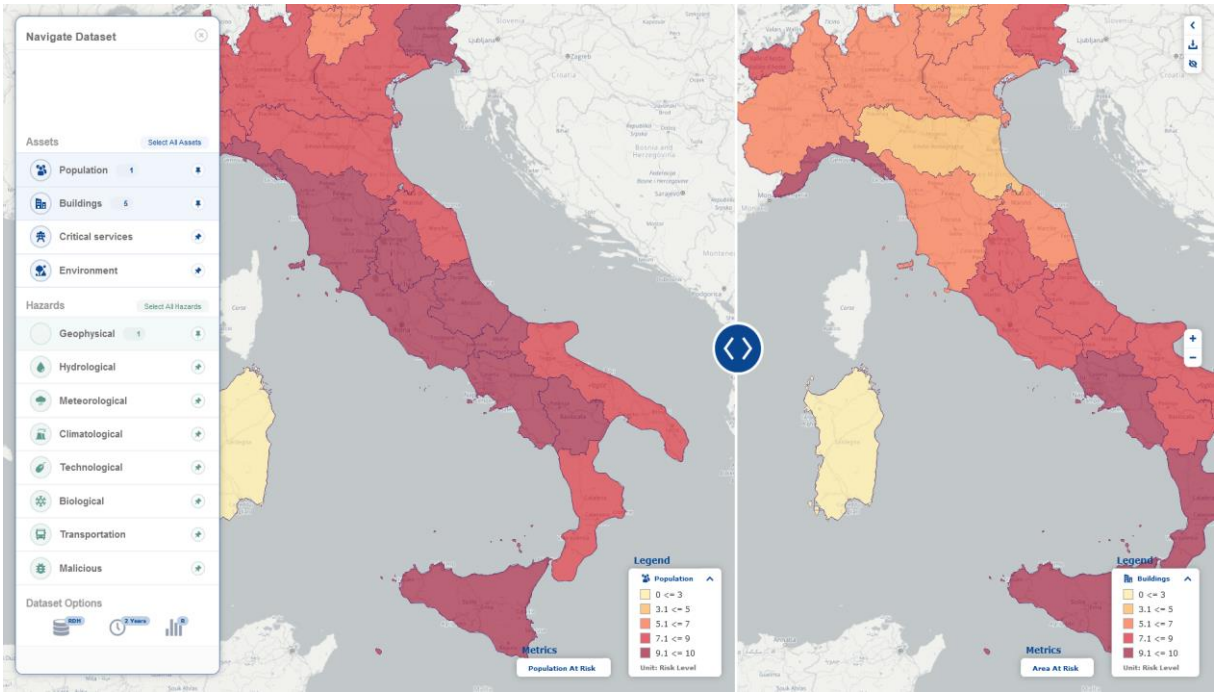


Figure 5 - Illustrative example of Assets/Hazard selection in Multiview Map. In this case, we selected all the subtypes within the "Buildings" macro-category as well as "Population" vis-a-vis earthquakes. The system shows the estimated risk two separate maps for each asset (Population on the left-hand side, Buildings on the right-hand side). Adding another hazard would keep the view in the same way, but the values portrayed on the maps would change accordingly.

Figure 6 - Illustrative example of Assets/Hazards selection. In this case, we selected all the subtypes within the "Buildings" macro-category vis-a-vis earthquakes. The system shows the estimated risk on a single map. Adding another hazard would keep the view in the same way, but the values portrayed on the map would change accordingly.

3.1.2. The ''Dataset Options''.

As shown in Figure 3, the bottom of the Dataset Navigation Panel presents further options that controls the results displayed on the map viewer. The controls are related with the time-frame and the data source of the analysis, common both to the Risk analysis and the Disaster loss modules. The third control allows the selection of the risk components (as discussed in the introduction: exposure, vulnerability and risk values) and is common to the Risk Analysis module only. Table 1 provides details on the different options and on their purpose and functionality.

Icon	Purpose and functioning
	Data sources: allow to filter data sources to view where multiple sources are available. 
	Time Horizon: allow to select the time-frame of the data. In the risk analysis module it shows how Exposure and Risk may change in a given number of years assuming

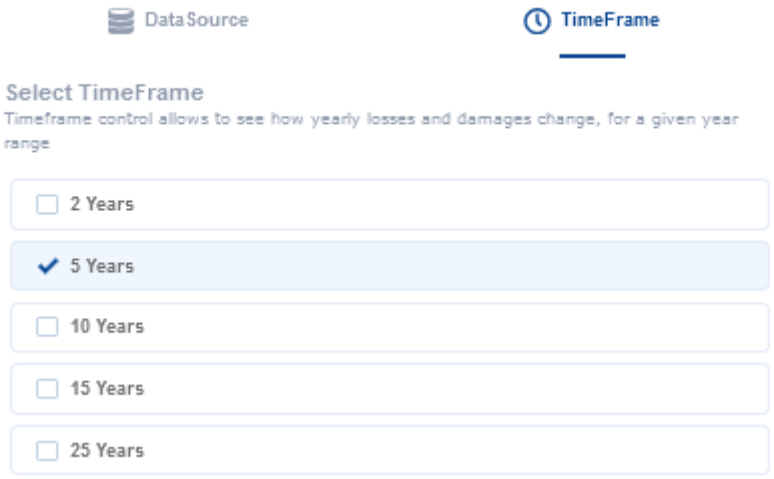
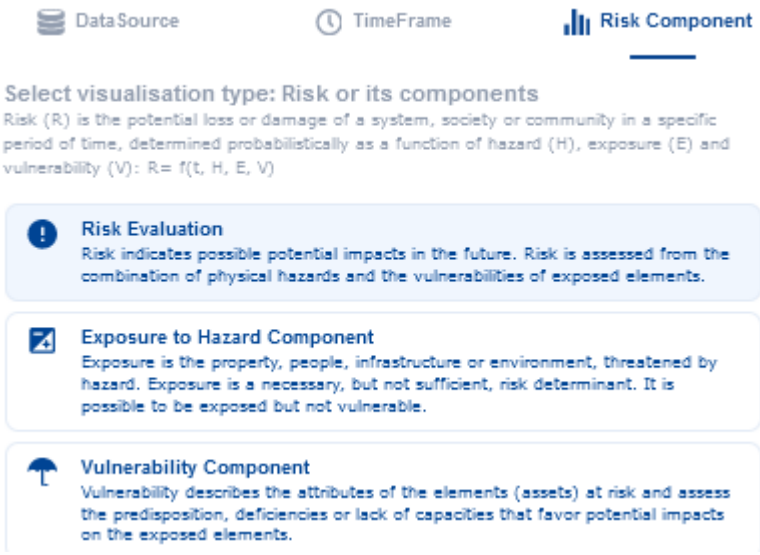
	that no action is taken. In the Disaster Loss Data it shows past values of losses and damages. Options include 2, 5, 10, 15 and 25 years. 
	Risk Components: allow to view risk components. - Risk indices - Exposure - Vulnerability This option is not available in the Disaster Loss Data module. 

Table 1 - Further Dataset Options.

3.1.3. The Map Viewer

The Map viewer is meant to provide an immediate view of the desired output (*Figure 7*). Switches and filters present on the Map viewer offer the user the possibility to navigate across administrative scales and spatial extend and offer access to the underlying data of the maps and analysis.

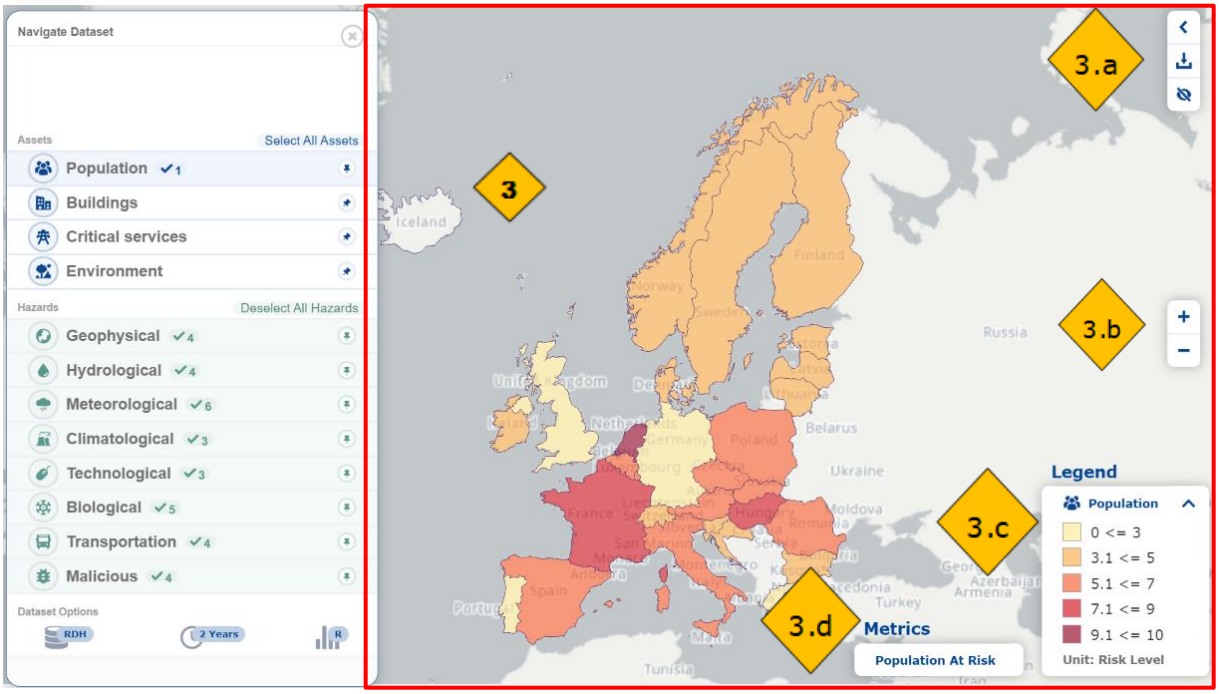


Figure 7 - The Map viewer and its functionalities.

3.a A block of three buttons in upper-right part of Map Viewer (see Figure 7) allows to go back to previous scale, download the data and hide the interface respectively.

Download. Another crucial feature to document, is the opportunity to download data shown in the map. It is worth mentioning that the system allows to download the data *that a user is currently visualizing* in tabular format (i.e. excel spreadsheet). The spatial limits are given by the administrative unit the user is viewing (it can be Europe, Country, Nut2, Nuts3).

For the Risk Analysis the user will automatically download all the components of risk (exposure, vulnerability, risk) as normalised values ranging from 0 to 10 (as shown on the map), for the temporal interval (e.g. 2, 5, 10, 15, 25yrs), metric and asset selected. Please see Figure 8 for an implemented example.

For the Disaster loss module the user will automatically download losses (as normalised values GDP (‰) or People / 100000 Population) upon selection of assets and hazards and temporal interval, limited by the administrative unit the user is viewing. (Europe, Country, Nut2, Nuts3). Please see Figure 9 for an implemented example.

	A	B	C	D	E	F	G	H	I	J
1	Region	Location	Assets	Hazards	Metric	Scenario	Years proj	Exposure	Vulnerabi	Risk
2	Europe	ITC1	populatio	EQ	populatio	Total	2	9.271019	8.397382	8.809865
3	Europe	ITC2	populatio	EQ	populatio	Total	2	8.869707	6.682623	7.67396
4	Europe	ITC4	populatio	EQ	populatio	Total	2	9.483616	7.162259	8.457618
5	Europe	ITC3	populatio	EQ	populatio	Total	2	9.738002	8.725022	9.356752
6	Europe	ITF1	populatio	EQ	populatio	Total	2	9.773445	9.582859	9.707781
7	Europe	ITF3	populatio	EQ	populatio	Total	2	9.938359	10	10
8	Europe	ITF2	populatio	EQ	populatio	Total	2	9.751399	8.085877	9.109588
9	Europe	ITI3	populatio	EQ	populatio	Total	2	9.396925	8.487487	8.958518
10	Europe	ITI4	populatio	EQ	populatio	Total	2	9.609996	9.2989	9.459542
11	Europe	ITI2	populatio	EQ	populatio	Total	2	9.962949	9.189899	9.734196
12	Europe	ITG2	populatio	EQ	populatio	Total	2	0	7.164881	0
13	Europe	ITH3	populatio	EQ	populatio	Total	2	9.560868	7.033449	8.46471
14	Europe	ITF4	populatio	EQ	populatio	Total	2	8.849872	9.629108	8.900403
15	Europe	ITG1	populatio	EQ	populatio	Total	2	9.39062	9.670164	9.397212
16	Europe	ITH4	populatio	EQ	populatio	Total	2	10	7.969265	9.281849
17	Europe	ITF5	populatio	EQ	populatio	Total	2	9.659484	9.230337	9.478476
18	Europe	ITI1	populatio	EQ	populatio	Total	2	9.693551	8.536244	9.242601
19	Europe	ITH1	populatio	EQ	populatio	Total	2	9.285639	3.336707	5.67941
20	Europe	ITH5	populatio	EQ	populatio	Total	2	9.714584	7.259192	8.709415
21	Europe	ITF6	populatio	EQ	populatio	Total	2	9.190631	8.394027	8.736802
22	Europe	ITH2	populatio	EQ	populatio	Total	2	9.50689	4.415786	6.831113

Figure 8 - Data Output for one hazard (earthquake) and one asset (population) for Italy in a 2-years' time horizon at the NUTS1 level of Italy. Exposure, Vulnerability and Risk are reported as normalised values from 0 to 10.

	A	B	C	D	E	F	G	H
1	Region	Location	Assets	Hazards	Metric	Unit of me	Value	
2	Europe	AD	populatio	FL	populatio	People / 1	5.67311	
3	Europe	AT	populatio	FL	populatio	People / 1	31.4894	
4	Europe	BE	populatio	FL	populatio	People / 1	1.32525	
5	Europe	BG	populatio	FL	populatio	People / 1	45.14473	
6	Europe	CH	populatio	FL	populatio	People / 1	4.65029	
7	Europe	CY	populatio	FL	populatio	People / 1	0	
8	Europe	CZ	populatio	FL	populatio	People / 1	81.83128	
9	Europe	DE	populatio	FL	populatio	People / 1	20.87452	
10	Europe	DK	populatio	FL	populatio	People / 1	0.26559	
11	Europe	EE	populatio	FL	populatio	People / 1	0	

37
38
39
40
41

Environment | Buildings | **Population** | Critical services

Edit

Figure 9 - Data Output for losses (macro-categories) from one hazard (river floods) and for Countries in a 25-years' time horizon.

Back button. Allow to navigate back to the previous scale selected.

Hide the interface. This functionality will hide the Dataset Navigation Panel for a better map view.

3.b

Spatial navigation.

Zoom (+ and – respectively). The map can be navigated with the mouse as in most common GIS map viewers and can be zoomed using the mouse-wheel or the buttons in the right-hand side of the screen.

Navigate across the administrative subdivisions is possible by clicking on the administrative unit which will put in focus and show its administrative subdivisions. These administrative divisions can be further divided into lower tier subdivisions (Figure 10). ***On Risk Analysis Module***, the DRMKC RDH supports four levels of spatial aggregation: NUTS1, NUTS2, NUTS3 and LAU. More levels are allowed. For example, a user with data that refers to administrative division at sub-municipality level (e.g. census track) or even buildings can generate these divisions (by uploading through the Admin tools in its user corner, please see second part of this report) and links the tabular risk data on this newly created 'administrative' divisions. For ***the Disaster loss data module*** the DRMKC RDH supports three levels of spatial aggregation: NUTS1, NUTS2 and NUTS3.

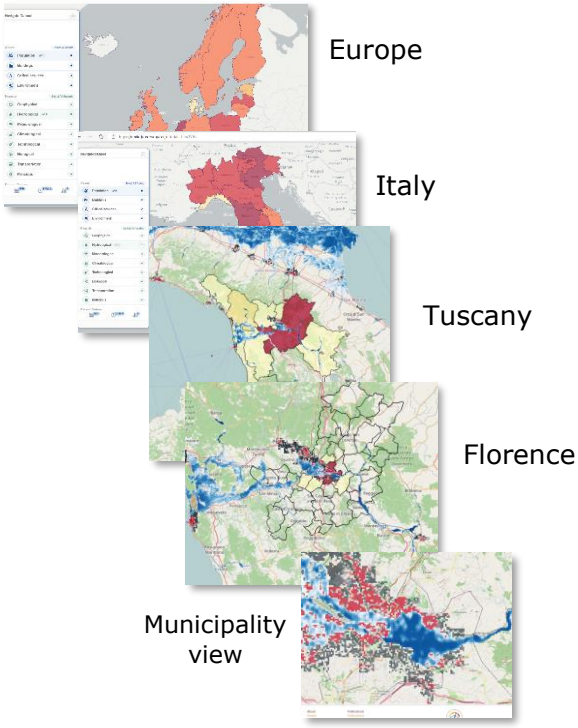


Figure 10 - Navigation across the Administrative units.

3.c

Legend provides the key of the maps. For the ***Risk Analysis Module*** it shows as UNIT of measure the Level of Risk, Exposure or Vulnerability as normalised values (0-10). For **the *Disaster loss data module*** it shows the as UNIT of measure people /100000 population for the losses in population (e.g. fatalities, people affected, people injured) and GDP (‰) respectively for the economic losses.

3.d

Metric defines the datasets. For ***the Risk Analysis Module*** the datasets can be defined as population, an area or an economic (equivalent) value that are at risk. Similarly for ***the Disaster loss data module*** the metric can be People affected, People injured or Fatalities (when losses of population are viewed), an economic impact value or non-economic damages (e.g. burned area).

4

3.1.4. Graphs and Figures

Both the Risk Analysis module and the Disaster Loss Data Module generate further graphs and figures based on the data viewed by the user. These results are displayed below the Map Viewer. To view them, it is sufficient to scroll the web page. The examples portrayed as follows are derived from the Disaster loss data Module and Risk Analysis module.

3.1.4.1. Risk Analysis module – representation in figures.

Upon the selection of assets and hazard the system – apart the displaying on the map viewer- automatically generate a spatial ranking of most affected administrative units and a Risk Matrix on the selected time horizon.

- ***Information on multiple hazards Risk and its probability as Risk matrix.*** The example below compares the population potential impact from various hazards and their probability to be equalled or exceeded in 2 years' time.

> ***It answers to questions:*** *What is the hazard with the highest potential impact and probability in the region/country?*

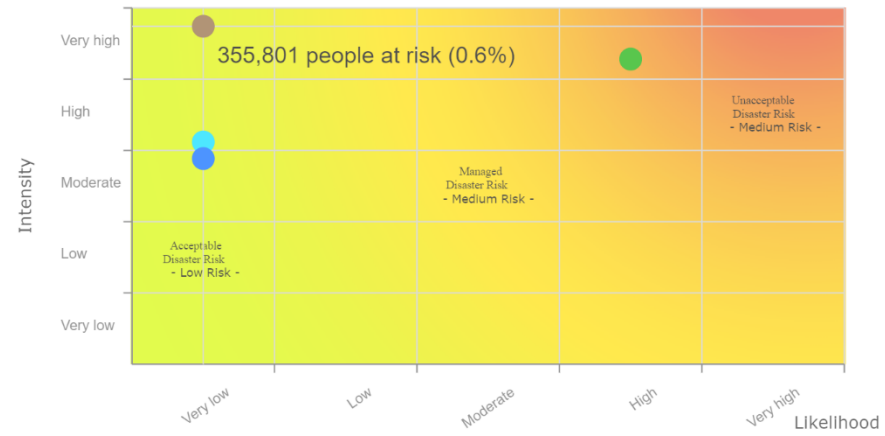


Figure 11 - Multi-hazard risk matrix.

- ***Information on single/multiple hazards Risk spatial variation.*** The example below compares the population potential impact across subnational regions. The analysis is considering multi-hazards occurrence.

> ***It answers to questions:*** *What is the region/country with the highest potential impact from single/multi-hazard?*

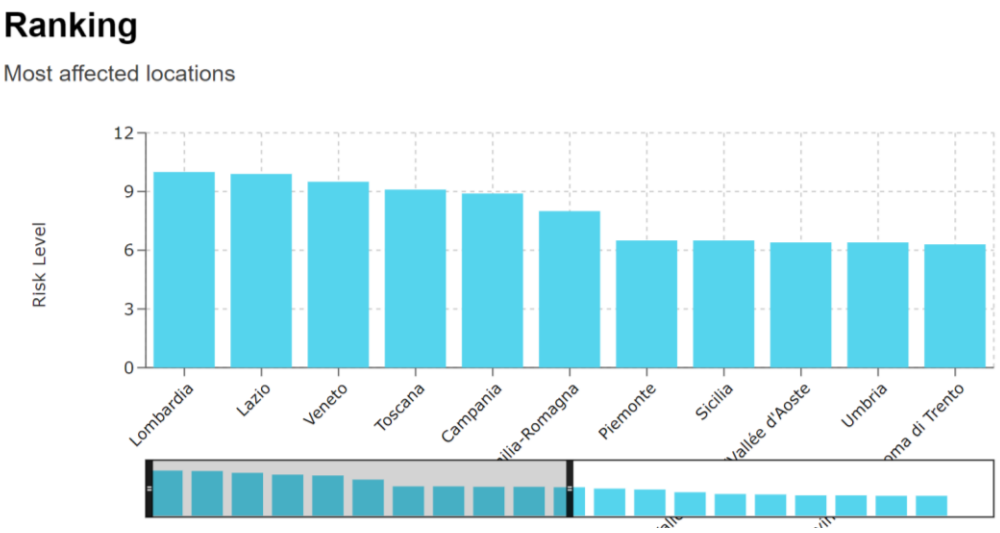


Figure 12 - Subnational regions ranked by their potential impact.

3.1.4.2. External projects projected potential impact – considering warming levels and socio-economic scenarios

- Information on single hazards projected impact, considering warming levels and socio-economic scenarios. Methodology is implemented if DRMKC RDH platform will be used for storing this data.

It answers to questions: *What is the projected potential impact for the warming levels (baseline, 1.5°C, 2°C, 3°C) and socio-economic scenarios (Baseline, 2050, 2100)?*

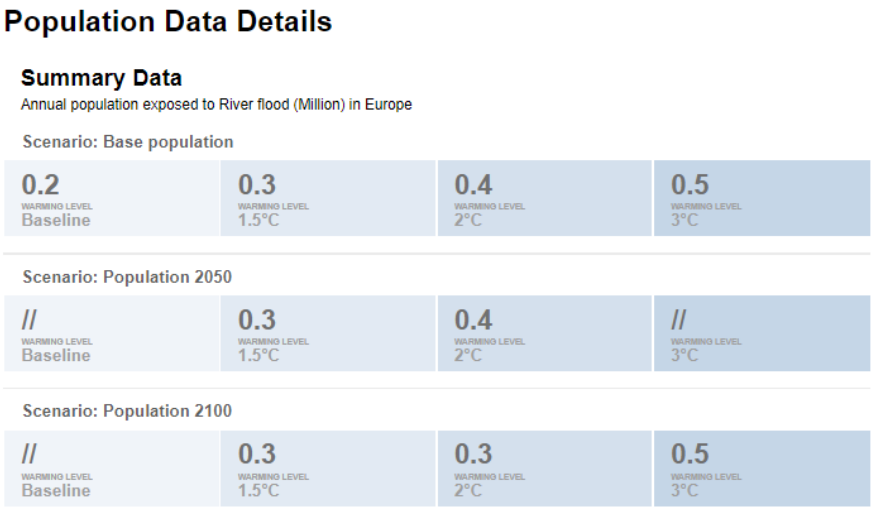


Figure 13 - Projected potential impact on population by a warming levels and socioeconomic scenarios.

3.1.4.3. Disaster Loss Data – representation in figures.

The DRMKC RDH disaster loss data values are represented in absolute and relative terms as 1/100 000 people for human losses. For economic losses, the values are represented by absolute and (‰) from the GDP of the Country. Based on these aggregations' types, various figures are prepared on the DRMKC RDH.

- Information on single-hazard category/subcategory share (%) of losses.

The DRMKC RDH presents the accumulated disaster damage data per categories and subcategories as in Figure 9. The total losses (population or economic losses) are divided into slices to illustrate numerical proportion (%) of losses per hazard.

***It answers to questions**: Which hazard (and hazard category) and type of losses has the highest amount in the region /country? (as % of the GDP or actual value mil. EUR)*

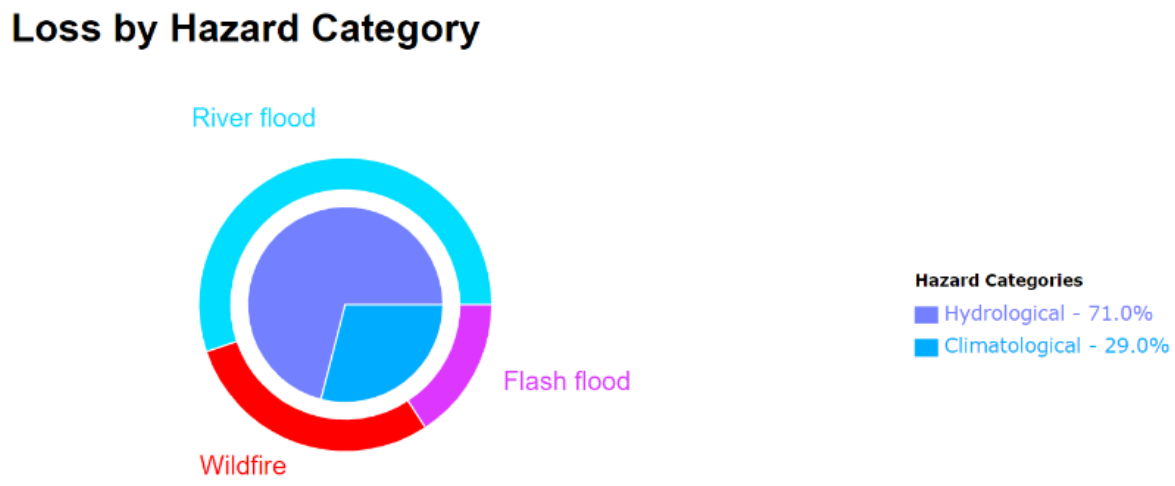


Figure 14 - Information on single/multiple hazards accumulated losses.

The DRMKC RDH disaster damage data is presented in ranges of 5yr, 10yr, 15yr, 25yr (in accordance with the Risk Module analysis). The data used for the analysis types goes far back to 2005 but the stored data available covers larger time spans (1900-2020 depending on the hazards).

- Information on single and multiple hazard past trends and rates of changes.

The DRMKC RDH presents the disaster damage data - within the temporal range selected – as trends and yearly range of change both for the number of events and the total losses. The example below shows the building economic losses trends and rates of changes related to river floods (up) and multiple-hazard (down) for the last 25 years in Italy.

***It answers to questions:** What has been the trends of losses per hazard and type of losses? Has the rate of losses increased or decreased for the temporal scale selected? Has the frequency of hazards increase or decrease for the temporal scale selected? ..for the region/country.*

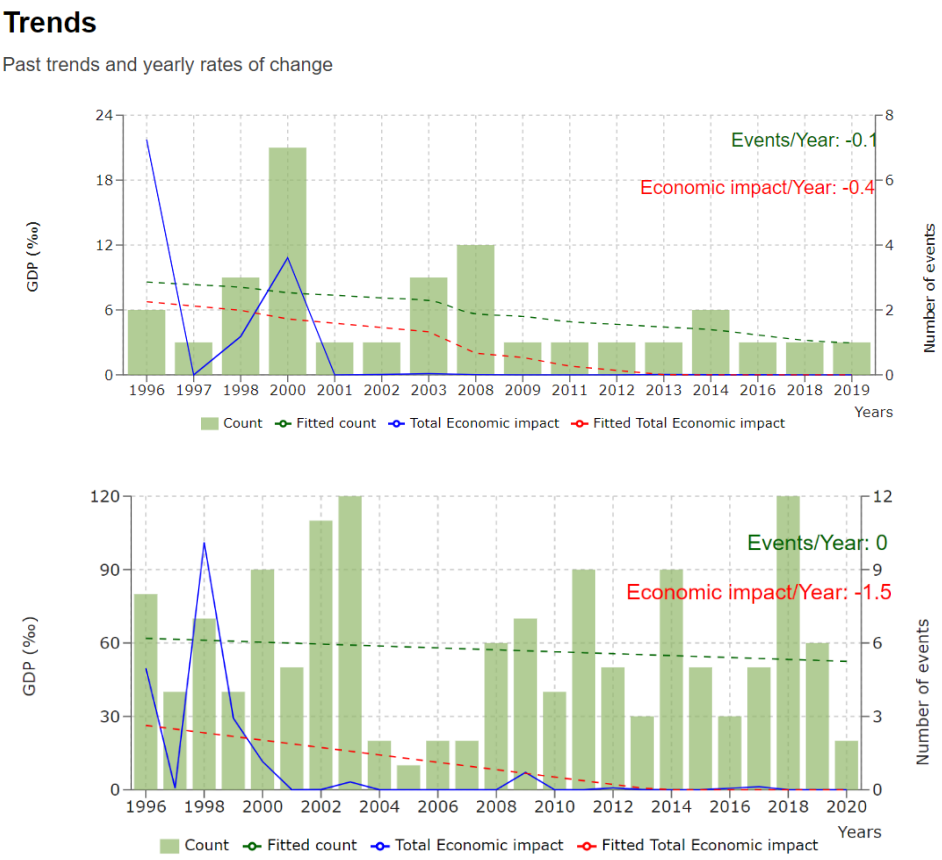


Figure 15 - Information on single-hazard (up) multiple hazard (down) past trends and rates of changes based on absolute values of buildings economic losses in Italy.

- Information on temporal variation on single-hazard/ multiple hazards based on SENDAI indicators aggregation

The DRMKC RDH presents the disaster damage data - based on SENDAI indicators aggregation. The aggregation has a yearly timeframe and shows the stacked share per hazard type from the total yearly damage (fig. 10). The example below shows the yearly aggregation of fatalities /100000 population from multi-hazard occurrence in Italy (Sendai Indicator A-1).

***It answers to questions**: What year recorded most human losses, human injuries or were most affected and from which hazard?*

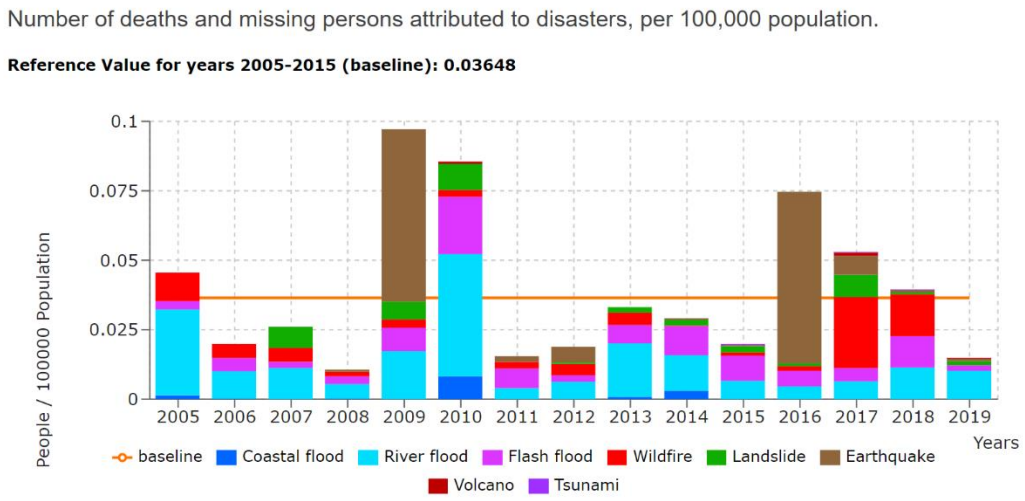


Figure 16 - Yearly variation of fatalities, information on stacked single-hazard share based on relative value (fatalities/100000 people).

The aggregation on spatial scale (Country or NUTS 2, NUTS3) of disaster and losses hosted on the DRMKC RDH is also presented as bar chart in support of the spatial variability represented as maps in the Map viewer.

- Information on single and multi-hazards spatial distribution of losses. The example below is an aggregation of Portugal's' people injured /100000 population from multiple-hazards and their spatial variability represented as bar chart.

> ***It answers to questions:*** *What is the region/country with the highest losses from single/multi-hazard occurence?*

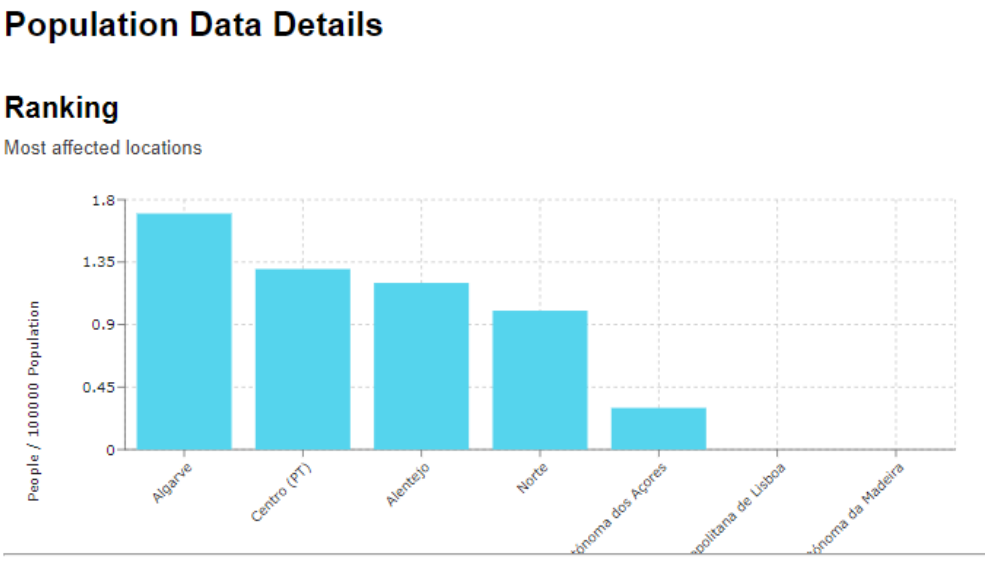


Figure 17 - Raking of the regions in Portugal with most injured people.

4. Methodological overview

4.1. Risk Analysis

The primary purpose of the risk analysis module is to convey in a convenient and user-friendly way the assessment of potential risk at the pan-European level. As discussed above, the module allows for a multi-hazard, multi-asset and multi-sector assessment across different spatial units (NUTS0, NUTS1, NUTS2 and NUTS3 and LAU depending on the availability of data). Maps in this module show the risk level (or one of its components, see below) of each spatial unit for which data are available.

4.2. The Risk indicator

Risk, in this context, is defined as the potential loss or damage of a system, society or community in a given period of time (t), determined probabilistically as a function of hazard (H), exposure (E) and vulnerability (V). This definition can be summarized in the following equation:

$$R = f(t, H, E, V).$$

In the RDH operationalization, this measure ranges from 0 (minimum risk) to 10 (maximum risk). The map viewer conveniently reports a legend of the measure of risk in the bottom right corner (see Figure 18). Each bracket of risk is color-coded for convenience.

Describing the full methodology behind the risk assessment of DRMKC RDH is beyond the scope of this paper, yet for the sake of completeness here we recount the most important information on the risk indicator and on its main components.

The Risk Indicator uses single hazard exposure analysis which once uploaded triggers various types of calculations performed 'on the fly'.

- First a running code combines the exposure - assessed individually for different return periods – into an Expected Annual Exposure (EAE) or Expected Exposure for various other temporal intervals (2yrs, 5yrs, 10yrs, 15yrsa and 25yrs).
- Secondly a running code on the client side combines the Expected exposure with the Vulnerability indicators values (which acts like ratio values 0-1) arriving to potential impact and its probability (risk).
- The potential impacts values are further normalised (0-10) and presented on the map viewer (Figure 3).
- A multi-hazard selection on the map portal will trigger a running code which will combine the single hazard exposures (EAE) to a multi-hazard exposure. Further on the multi-hazard values the vulnerability indicators are introduced arriving to the multi-hazard potential impact and probabilities (risk).

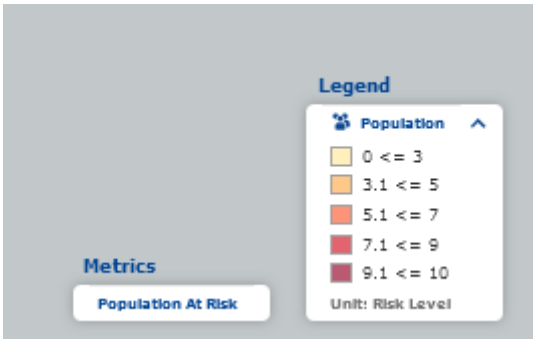


Figure 18 - Estimated Risk. Legend can be found in the bottom right corner of the map viewer.

4.3. Exposure

4.3.1. Exposure identification

The geospatial information provided in this analysis is built on the relation assets – hazard. The spatial extent of hazardous events' metrics, such as severities, frequencies or intensities is intersected (overlapped) with assets layers. The presence of the assets in the 'footprint' of the hazard (as graphically depicted in Figure 19) is further considered exposure. Please see the report JRC114120[3] and the supplementary xlsx file for a comprehensive description of the hazards and assets definition and sources.

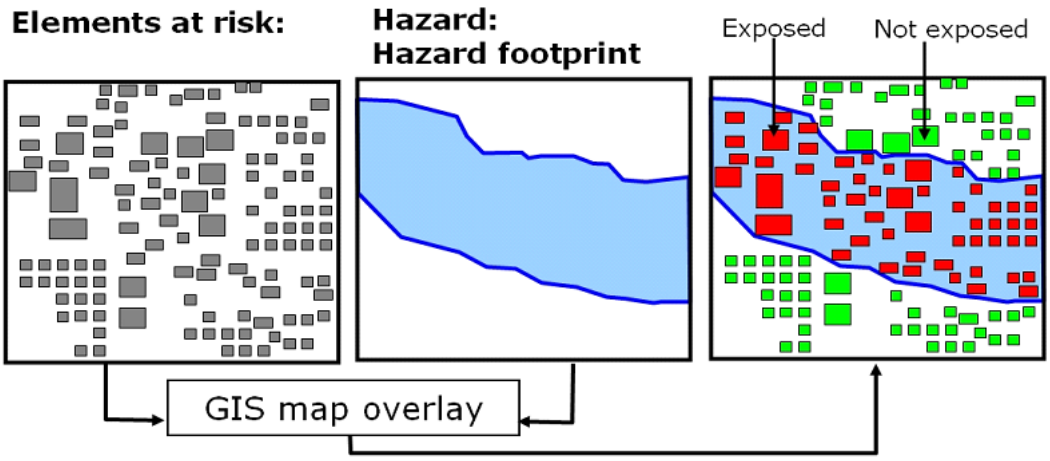


Figure 19 - Graphic representation of the quantification of exposed assets (Adapted: C. van Westen, 2012).

We further aggregate/sum the exposure within administrative units. We use the European administrative boundaries (Eurostat/GISCO)[4] as our geographical scale of interest. Therefore, the quantified presence of exposure to hazards is aggregated at different administrative levels: Country (NUTS 0), regions (NUTS 2), provinces (NUTS3) and LAU (Local Administrative Units) level.

4.3.2. Considering temporal probability

The hazard layers considered in the DRMKC RDH are probabilistic. The hazard intensities are assessed at different return periods. In order to quantify the exposure across various return periods we compute the Expected exposures for various temporal intervals (annual, 2yrs, 5yrs, 10yrs, 15yrsa and 25yrs). The expected exposure is defined as the sum of the exposure level multiplied (weighted) by the inverse of return period (the exceedance probability), as presented largely in the JRC 119500 (pg.9)[5]. The expected exposure is not further quantified as a monetary value. Therefore, the exposure is the area extend of assets or population densities which are normalised (0-10) in order to be represented on the map viewer.

4.4. Vulnerability

The vulnerability is built up by two main parts, hazard dependent and hazard independent. The hazard dependent part (or the physical dimension) is also asset specific and consists of indicators divided into three sub-dimensions. Structural, for buildings this can be Eurocodes and year of construction; Exposure-based, i.e. loss data, historical frequency of events or fatalities; Hazard-based, damage functions, hazard intensity or protection levels. The hazard independent part is based on socio-economic, political and environmental indicators and is a measure of the vulnerability of society in general and thus also asset independent. **Currently in the risk data hub only the hazard independent component is calculated and can be visualised.**

[3] http://publications.jrc.ec.europa.eu/repository/handle/JRC114120
[4] https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts
[5] https://publications.jrc.ec.europa.eu/repository/handle/JRC119500

To calculate the final score, or vulnerability index, for each administrative spatial unit, a bottom-up / top-down approach is used. Step one is to calculate Country, NUT2 and NUTS3 components based on the relevant indicators at each level. Once the component for each region and at each level is computed then it is a matter of putting them together appropriately to calculate the score for the region of interest. Country level vulnerability index is computed by averaging the country component with the NUTS2 and NUTS3 components aggregated over the entire area (country). In contrast, a NUTS3 level vulnerability index is calculated by averaging the NUTS3 component with the NUTS2 and Country level components in which the NUTS3 region is located (See Figure 20).

Subsequently, when the hazard and asset dependent components of vulnerability are calculated and made available, it will be possible to combine them with the hazard independent index to create a vulnerability index for the area of interest. This can be done for single or multiple hazards and/or assets, and risk analysis can then be made combining with exposure and hazard data.

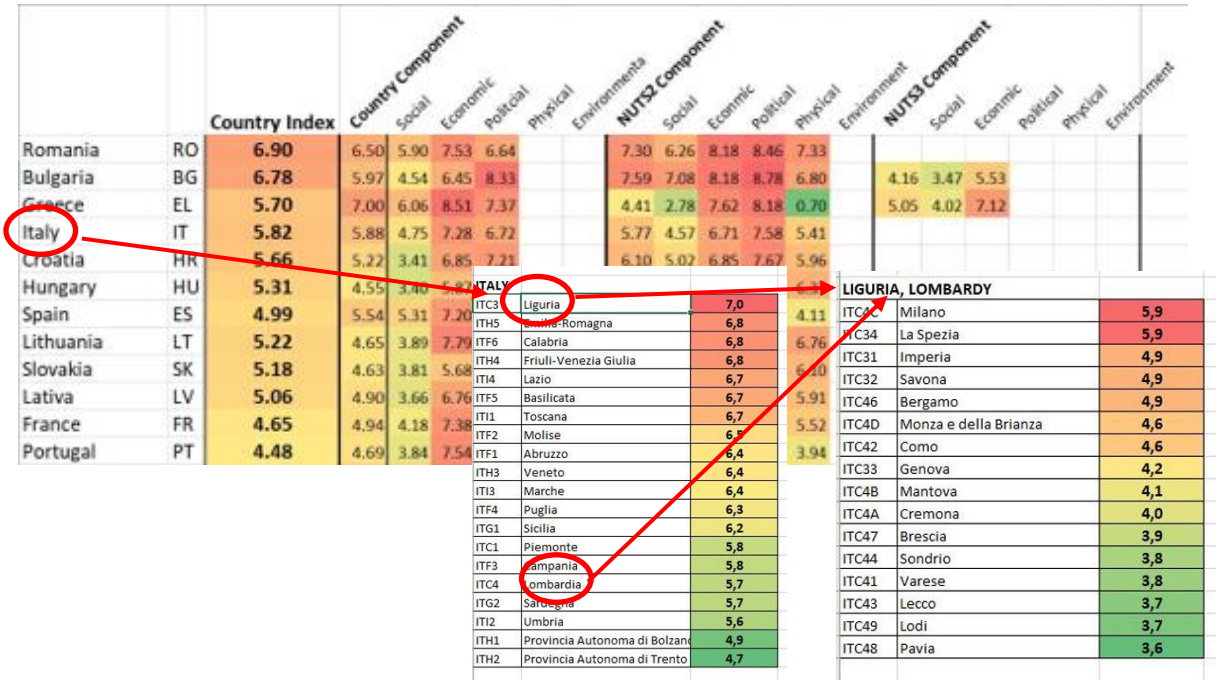


Figure 20 – Hazard independent vulnerability index computed across administrative scales.

Multi-dimensional	Vulnerability is influenced by different components as well as their interlinkages. For the purpose of the Risk Data Hub, the vulnerability is comprised by four dimensions: social, economic, political, environmental and physical.
Multi-hazard	Indicators are divided into **hazard-independen**t or **hazard-dependent**. The social, economic, political and environmental dimensions primarily constitute hazard-independent component. The physical dimension(s) are shown as hazards dependent.
Multi-Level	Levels, in this context, refer to functional levels that area and geographical scale may vary extremely across Europe. Therefore, vulnerability was tailored into levels for the integration into the RDH and are examined on three different levels: individual/household level (NUTS3), local administrative level (NUTS2), and national level (Country). **NUTS3**: an individual prepares his/her house for a storm; **NUTS2**: community authority revision of evacuation plans; **Country**: the national government develops policies for defining roles for emergency cases.

Multi-asset	In order to gain a holistic view, vulnerability needs to approach **sectors, categories and sub-categories**. The hazard and asset dependent component will address the vulnerability of the population, buildings (e.g. residential, commercial), critical services (e.g. health care facilities, energy) and environment (e.g. agriculture, protected areas).

Table 2 - A list of the main aspects which characterize the vulnerability as defined in the Risk Data Hub.

A list of the current risk, vulnerabilities and exposure datasets is presented in the supplementary xlsx file that accompanies this report.

4.5. Disaster Loss Data Module

The rationale behind this module is that of showing a European overview of losses and damages due to past disasters. Crucial questions that can be answered using the RDH Disaster Loss Data Module are: where have we lost more? What has been lost? Which were the causes?

The current data available through the DRMKC Risk Data Hub is the result of the not-exhaustive collection and curated aggregation of data available in several databases (EM-DAT[6], DFO[7], HANZE[8], EMSR[9], EFFIS[10], NCEI/WDS[11], GLC[12], EDII[13], EMM[14], CEDRE[15], MARS[16], WISC[17] , Wikipedia, media[18] etc.).

The DRMKC RDH losses and damages events records covers the European area. The records collected refer to all 28 European Union member states, all European Free Trade Agreement members, the four microstates located in Western Europe (Andorra, Monaco, San Marino and the Vatican).

The effort of accessing available open source losses and damage data from past hazardous events from different sources is complemented by efforts of offering homogeneity and comparability to these datasets. (Please, see the characteristics of these datasets summarised in ANNEX 2). A set of assumptions that had to be adopted in order to render the data uploaded on the platform homogeneous and comparable across various sources. As follow we present some approaches that were adopted in the process of data integration on the DRMKC RDH. For a more complementary description of the DRMKC Risk Data Hub disaster loss data please consult the report JRC116366[19].

4.5.1. Unique event code

The DRMKC RDH creates unique identifiers codes for the impact events. It is needed to be able to clearly identify the impact event across scales, from European to local scales. This will avoid duplications and will

[6] EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be
[7] DFO: Dartmouth Flood Observatory, https://floodobservatory.colorado.edu/
[8] HANZE: The Historical Analysis of Natural Hazards in Europe, https://data.4tu.nl/repository/collection:HANZE
[9] EMSR: Copernicus Emergency Management Service, https://emergency.copernicus.eu/
[10] EFFIS: The European Forest Fire Information System https://effis.jrc.ec.europa.eu/
[11] NCEI/WDS: National Geophysical Data Center Global Significant Earthquake Database (NGDC/WDS): Significant Earthquake Database, doi: 10.7289/V5TD9V7K; Global Historical Tsunami Database doi:10.7289/V5PN93H7 ; Global Significant Volcanic Eruptions Database doi:10.7289/V5JW8BSH ; National Geophysical Data Center, NOAA.
[12] GLC: Global Landslide Catalog , https://data.nasa.gov/Earth-Science/Global-Landslide-Catalog-Export/dd9e-wu2v
[13] EDII: European Drought Impact Report Inventory, http://www.geo.uio.no/edc/droughtdb/index.php
[14] EMM: European Media Monitor, http://labs.emm4u.eu/events.html
[15] CEDRE: Center of Documentation, Research and Experimentation of Accidental Water Pollution, Brest, France. www.cedre.fr
[16] MARS: Major Accident Reporting System for submitting accident reports to the European Commission according to the criteria of the Seveso II Directive 96/82/EC. http://eMARS.jrc.ec.europa.eu
[17] C3S WISC: Copernicus Climate change, Windstorm Climate Service (WISC) https://www.copernicus.eu/en/documentation/research-projects/windstorm-climate-service
[18] Floodlist: https://floodlist.com/
[19] See The Risk Data Hub loss datasets, The Risk Data Hub Historical Event Catalogue 2020, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC116366/ld_in_risk_data_hub_report_online.pdf

allow a homogenized reckoning across sources. Example: the 1999 storm "Anatol" in Germany, is known as the "December hurricane" or "Adam" in Denmark and as "Carola" in Sweden. This variation could be solved if a unique event code across sources would be available at European level. An example is the global GLIDE number (https://glidenumber.net/glide/public/search/search.jsp). The use of GLIDE number has limitations as it is not applied on medium/small events, or the date of the event.

The DRMKC RDH is automatically generating the '**Event code'**. The code composition is implemented as follows:

+ [Hazard] (code of two characters)

+ [Country] (ISO 3166-1 alpha-2 code of country)

+ [Begin date] (in YYYYMMDD format)

+ [Glide number] (four-digit serial number).

Figure 21 - Example of event code.

4.5.2. Recorded disaster damage with or without threshold

On the DRMKC RDH the threshold criteria is set by the characteristics of the datasets coming from various sources (please, see Annex 7). As general rule the threshold criteria is not considered when uploaded on the DRMKC RDH platform. The disaster data is recorded/stored without threshold.

4.5.3. Temporal scale of the recorded disaster damage

The RDMKC RDH aims on recording disaster damages and losses at ***daily temporal resolution***. When possible the temporal resolution of an event was refined to reach daily resolution. The disaggregation was done using the hazard information (e.g. daily registered MODIS wild fires burned area information was used to assign and dd/mm/yyyy to seasonal or yearly recorder economic and human damage data from forest fire). For some cases this was not possible. The impact is stored with its original temporal resolution and the event is used only at higher temporal aggregation (e.g. only on yearly analysis)

4.5.4. Spatial scale of the recorded disaster damage

The disaster damage data is stored in DRMKC RDH with ***NUTS 3 as the resolution for the location***. If not available, the location and the spatial extent of an event was refined and brought to the scale of NUTS 3 level. The spatial disaggregation is done using either the hazard location (e.g. using the satellite image of the hazard as MODIS-EFFIS for burned area or Copernicus -EMSR for earthquakes, river floods, landslides etc.) (Figure 22).

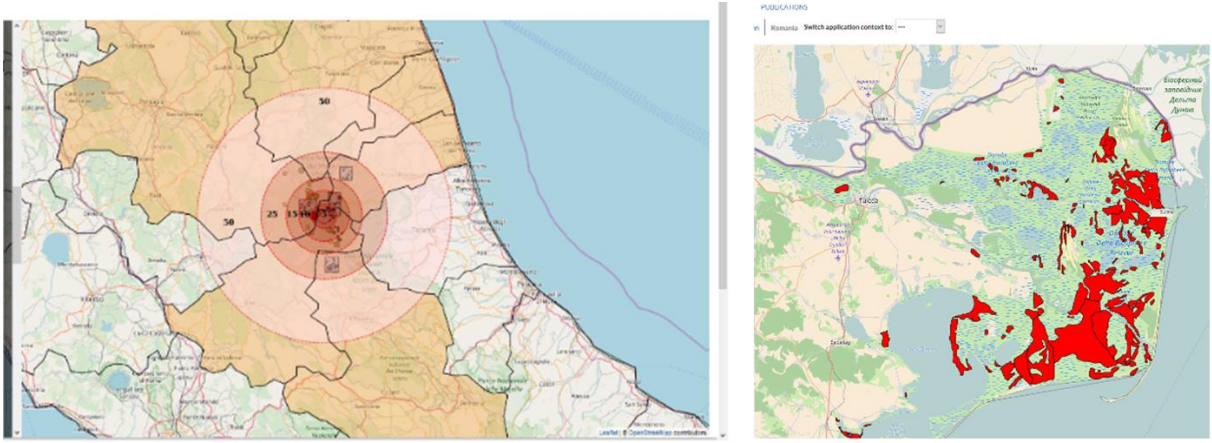


Figure 22 - High resolution information on spatial extent and location of the hazards (earthquake-left, burned areas – right).

4.5.5. Disaster damage data typology/terminology

The definitions of the damage types (e.g people affected / people displaced, economic losses etc.) were described through their aggregation considering the SENDAI targets (Annex 5) and sub targets in the DRMKC RDH platform. The disaster data refers to the direct damage and is divided in three types of metrics: human losses, economic losses and non-economic quantitative losses such as area and number of assets. The link between the damage types and the Categories of Sendai targets is presented in Annex 6. A further more detailed level of recoded disaster damage data is foreseen with the implementation of NACE[20]economic categorisation.

4.5.6. Human losses

The human losses on the DRMKC RDH are recorded at present up to the level of Damage types as in *Table 3*. This is the level of detail achieved with open source data. Definitions should be researched from sources.

Disaster data Category	Damage type	Damage sub-type
Human losses	Fatalities	Killed
		Missing
	Affected	Affected
		Evacuated
		Homeless
		Relocated
		Displaced
	Injured	Injured

Table 3 - The disaster data recorded for human losses in the DRMKC RDH.

4.5.7. Economic losses

The economic losses on the DRMKC RDH are recorded at present at aggregated level (e.g. overall economic losses). Nevertheless, a methodology of disaggregation on sectors/sub-types of economic losses is presented in the Box 1. The insured or private attributes of disaster damage data are not considered at present on the DRMKC RDH.

Disaster data Category	Damage type	Sendai target	Description
	Aggregated	C-1	**Direct economic loss** attributed to disasters in relation to global gross domestic product.(compound indicator)
	Aggregated insured		Not addresses in the DRMKC RDH
	Aggregated private		

[20] Glossary:Statistical classification of economic activities in the European Community (NACE) - Statistics Explained (europa.eu)

Direct Economic losses	Sectors dissagregation	C-2	Direct **agricultural** loss attributed to disasters
			Agriculture is understood to include the crops, livestock, fisheries, apiculture, aquaculture and forest sectors as well as associated facilities and infrastructure.
		C-3	Direct economic loss to all other damaged or **destroyed productive assets** attributed to disasters.
			Productive assets would be disaggregated by economic sector, including services, according to standard international classifications. Countries would report against those economic sectors relevant to their economies. This would be described in the associated metadata.
		C-4	Direct economic loss in the **housing sector** attributed to disasters.
			Data would be disaggregated according to damaged and destroyed dwellings.
		C-5	Direct economic loss resulting from damaged or **destroyed critical infrastructure** attributed to disasters.
			The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant
		C-6	Direct economic loss to **cultural heritage** damaged or destroyed attributed to disasters.
	Sectors insured		Not addresses in the DRMKC RDH
	Sectors private		

Table 4 - The disaster data recorded for economic losses in the DRMKC RDH.

Box 1. Disaggregation of the economic losses

With the new updated version of the DRMKC RDH, the economic losses as recorded by various sources are disaggregated. The disaggregation aims at assigning the share of the overall economic losses to sectors/assets. The disaggregated assessment of the economic losses supports the DRMKC RDH development on several applications:

- The implementation of the SENDAI targets and sub targets. The Global target C is based on direct economic loss records and is composed by targets aimed on monitoring the direct losses for agriculture, critical services, housing, productive activities and cultural heritage.

- The development of the Vulnerability Indicators. Part of the Vulnerability Indicator hosted on the DRMKC RDH is based on the empirical data (losses and damages from past events), important component of the Physical Dimension of the indicator. The Vulnerability Indicators' multi-asset characteristics demands the use of this alternative for the empirical losses and damage data applied to sectors/assets.
- The temporal link between prevention (what can be lost?) and recovery (what has been lost?) established for the risk assessments. It is a needed analysis for disaster risk management planning, which the DRMKC RDH is considering in its development.

The economic losses are disaggregated according to the ratio (%) from the maximum damages per impact type proposed by Huizinga et al 2017. We use the maximum damages for buildings (residential, industrial, economic), infrastructure, transport and agriculture to find what is their share from the total general economic losses and damages.

A few characteristics needs to be mentioned:

- The maximum damage values is provided at country level, and is specified for six impact categories: residential, commercial, industrial, transport, infrastructure, and agriculture.
- A further scale disaggregation was needed to reach the NUS2 and NUTS3 level, based on the Gross Domestic Product (GDP) per capita following the formula:

max damage (NUTS 2) = country average max damage * GDP(NUTS2) / GDP (country average)

max damage (NUTS 3) = NUTS 2average max damage * GDP(NUTS3) / GDP (NUTS 2 average)

- Further adjustment and fine-tuning of the maximum damage values is allowed to account for specificities of the analyzed datasets in terms of its location, building structure, wealth, type of data (gridded, vector) and more. For details see the Quick Guide[21] and consult the accompanying report. For the buildings max damage, we applied 2 adjustments:

- Land-use based adjustment applied (0.2 for Residential, 0.3 for Commercial and Industrial from the Building based)
- Proportion of the un-damageable part;

Once the maximum damage was computed for the impact types (considering adjustment) and for the 3 geographical scale: country, NUTS2 and NUTS3, the economic losses were disaggregated as share (%) form their total. Please find in Annex 1 the ratios used to disaggregate the economic losses for country level.

A list of the current disaster loss datasets is presented in the supplementary xlsx file that will accompany this report.

4.5.8. Definition of the impact event in the DRMKC RDH

One of the most important and difficult aspects to be addressed is the disaggregation of the impact events in phenomena (or aggregation of the phenomena to events). Not fully addressed in the DRMKC RDH, the definition of both (events, phenomena) is based less on the relevance of the hazards' lineage\interaction (e.g. trigger, cascading) which may link phenomena from different hazard categories and subcategories within a single hazardous event.

In the DRMKC RDH the impact event is defined by hazard type and its spatial-temporal components. The loss and damage records spatially confined within a country and within an arbitrary chosen temporal buffer of 7 days will define an ***impact event***. All component loss and damage records within these spatial and temporal confines will be considered ***as phenomena*** for the overall aggregated event.

[21] https://publications.jrc.ec.europa.eu/repository/handle/JRC105688

5. How to Upload Data on the Portal?

5.1. Granting administrative rights

The uploading of the data on the DRMKC RDH web application is done by users with (limited) administrative permissions. The permissions are granted for the data portals: ***External projects outcome*** and the ***User Corner data portals.*** Within this portals the user will manage and upload data ***on a space*** in the web application defined by ***a geographical location*** (European scale, Country, and subnational divisions – NUTS and LAU[22]). A fundamental part of the concept of the RDH: data should always be linked to ***administrative divisions***[23]. A list with the DRMKC RDH administrative units and divisions is complementary to this document.

Both user permissions and the space are created by the DRMKC team in advance of data uploading.

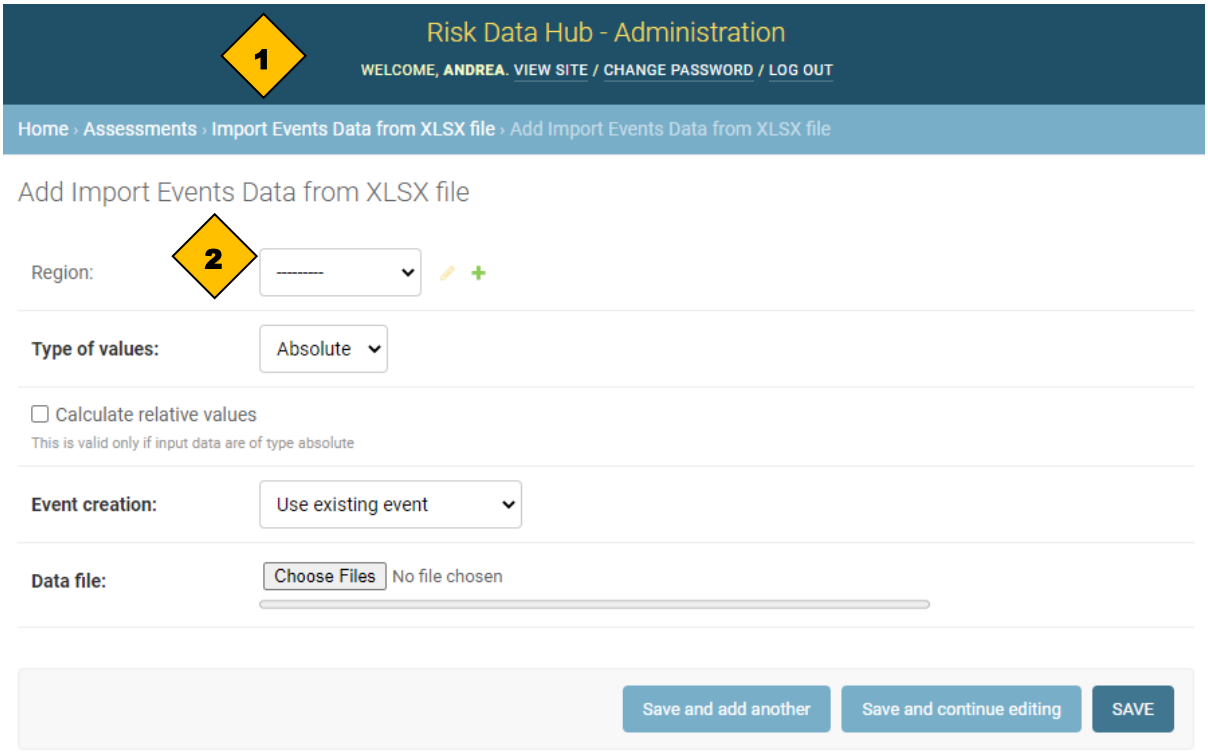


Figure 23 - Interface of RDH -Admin application (1 = User ID, 2 =Selected space where users uploads and manage data).

5.1.2. User permissions - characteristics

Administrators may use RDH Administration panel to upload and manage datasets and relative permissions.
Only authenticated users belonging to a specific User Corner\External projects may access datasets created within that User Corner.
Administrators may define Access Rules to apply further restrictions. RDH allows defining multiple Access Rules to completely customize access to data.
Administrators are able to create new Users and User Groups. For now, all users created by national\projects administrators have a lower level of privileges and cannot create other users or groups on their own; so, the creation of new administrators will be done by DRMKC RDH team only.

[22] https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts
[23] At present DRMKC RDH uses the 2013 EUROSAT NUTS version. Conversion tools from other versions are available.

6. Data preparation

The data is uploaded on the DRMKC RDH web application using .ini files and correspondent excel files.

Therefore, data upload on the DRMKC Risk Data Hub portal requires two main actions from the user:

- Declaration of the .ini file[24] according to the templates

- Preparation of the data in a .xlsx file according to the templates

Once those two steps are fulfilled, the user can proceed by uploading the data through the administrative site portal of the Risk Data Hub, available at the following link:
https://drmkc.jrc.ec.europa.eu/risk-data-hub/admin
The administrative dashboard (Figure 24) can contain dedicated sections related to the permissions granted to the user. This tutorial aims to explain the essential functionalities required to upload the data. Other possible visible options are beyond the scope of this section and for this reason they are not explained here. Please see the description of the sections in the Annex 4 or refer to the Antofie et. al., 2019 for additional information.

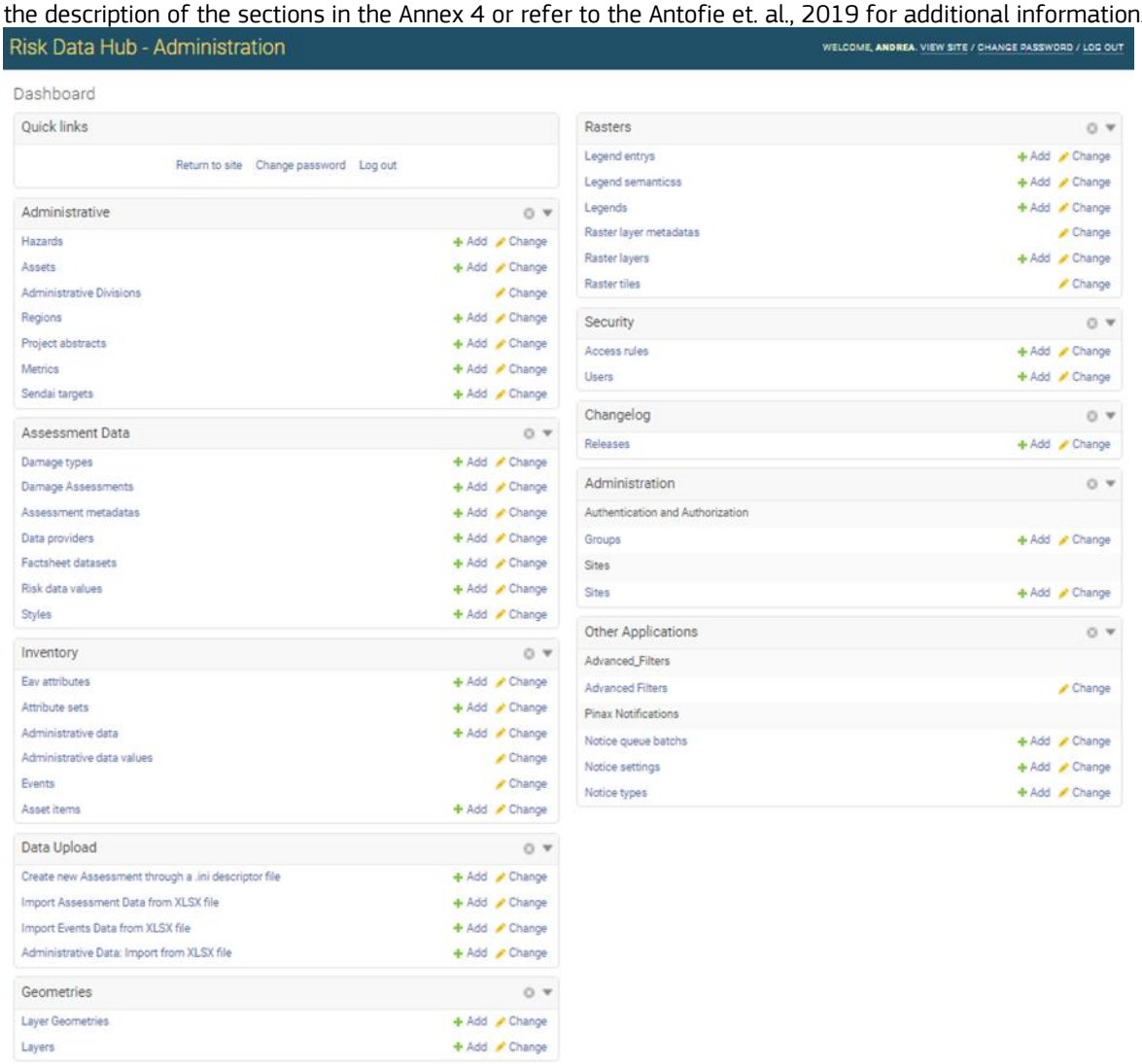


Figure 24 - Layout of the administrative dashboard of the Risk Data Hub as seen by the Administrator with full permissions. Based on the permission level of the user some of the modules could be hidden.

[24] The .ini file is a configuration file for the web application that consists of a text-based content which define the structure of the data, comprising key–value pairs for properties, and sections that organize the properties.

6.1. Declaration of .Ini file

The .ini file describes the structure and properties of the dataset uploaded in the Risk analysis (only master Admin), External projects and User Corner Modules. For each dataset only one .ini file is needed. Each dataset needs its own .ini file.

> The .ini file is necessary when uploading data in the ***Risk analysis*** (only master Admin), ***External projects and User Corner Modules***.
>
> For the ***Disaster Loss Data Module*** the declaration of events is done automatically, the .ini file is not needed.

The preparation of the .ini file is explained in the Box 2 and *Template_risk_components_RDH.ini* [25]*file*.

The .ini file is compiled manually through the creation of a text file. The text format of the .ini file must follow the structure shown below (the example comes from an EQ=earthquake, Risk Analysis – population exposure).

The lines starting with "#" are not to be modified as they are comments describing the elements needed.
The symbol "|" delimitate the different options to choose between parameters available on the RDH.

Box 2. Example and selectable options for an .ini file declaration. The example refers to the Risk Analysis Module – Exposure of population to earthquake by return periods and degree of urbanisation (City centres, Urban, Rural)

```
**********************************************************************************

[DEFAULT]

# 1. Title of the dataset | unique and less than 30 characters | Name convention: "Hazard mnemonics (see Table 1)" _ "Scope (see point 5.)" _ "asset (see point 2.)"_"unique feature as the country or the stakeholder who produced the data"

name = EQ_Exp_Population



# 2. Asset | must match one Asset on DB | Choose from: administrative_buildings | agriculture | all_economy | buildings | commercial_buildings | cultural_heritage | education_facilities |

| energy | fire_departments | forests | health_facilities | industrial_buildings | livestock | natural_cultural_heritage | other_critical_service | police_departments | population |

| power_generation | protected_area | railways | residential_buildings | roads | shipping | soil | water_supply

# Another Asset type can be added upon request.

asset = population



# 3. Hazard mnemonics. Choose from: CF | EQ | FL | LS | etc. see Annex 3

# Another Hazard mnemonics can be added upon request.

hazard = EQ



# 4. Date of the assessment preparation. Format: yyyy-mm-dd

assessment_date = 2018-12-18
```

[25] For users' convenience the file in the Supplementary material is saved as .txt

5. Scope. Choose from: risk | disaster loss data | external projects

scope = Risk

6. Metric. Choose from: annual_damage | area_at_risk | area_exposed | economic_impact | economic_value_equivalent | population_affected | population_at_risk | population_exposed |

|population_fatalities | population_injured | potential_economic_impact

Anther Metric type can be added upon request.

metric = population_at_risk

7. Tags | Useful for matching event and risk analysis

tags = risk analysis

8. Administrative data. Choose from: population | GDP | commercial built-up | residential built-up | area | electric lines | gas pipelines | education facilities | roads | railways | agricultural areas | protected areas Natura 2000 | protected areas WHS

Another Administrative data type can be added upon request.

related_administrative_data = population

9. Data type. Choose from: Exposure (probabilistic) - Use value “exp”| Exposure (non-probabilistic) - Use value “exp_nop” | Recorded loss- Use value “loss” | Impact (from ext project) - Use value “imp”

data_type = exp

#10. Parent | optional - If related to another assessment previously declared

Parent =

[DIM1]

11. Damage type. Choose from: Scenario | Return Period

damagetype = Scenario

12. Values 1 | the first one must be always the baseline | the order is important | Split into Degree of Urbanisation | XLSX sheet name – see 6.2.1.2 for implemented Examples

The values are in relationship to the damagetype

values =

Total

City_Centre

Urban

Rural

```
# 13. Axis 1 | layer 'x' always corresponds to the XLSX sheets
axis = x

# 14. Layer attribute 1
layer_attribute = dim1
[DIM2]
# 15. Damage type. Choose from: Scenario | Return Period
damagetype = Return Period

# 16. Values 2 | the first one must be always the baseline | the order is important | XLSX columns name (for each spreadsheet the columns name is required) – see 6.2.1.2 for implemented Examples
# The values are in relationship to the Damage type
values =
   250
   475
   975
  1500

# 17. Axis 2 | layer 'y' always corresponds to the XLSX columns
axis = y

# 18. Layer attribute 2
layer_attribute = dim2

 ********************************************************************************************************************
```

6.2 Preparation of the data in a .xlsx file according to the templates

There are two different templates that should be used based on the type of risk data which is uploaded on the portal:

- A template for the risk analysis components (*Template risk component_RDH.xlsx*.)
- A template for the Disaster Loss and Damage data(*Template_Disaster_Loss_Data_RDH.xlsx*)

Two .xlsx pre-structured files are used to upload data on the DRMKC RDH, one for risk components (hazard, exposure, vulnerability, impacts/risk) and one for the disaster loss and damage data.

6.2.1.1. Risk components .xlsx file structure and templates

The *Template risk component_RDH.xlsx* file is used to upload data of the components of risk: hazard, exposure, vulnerability impact/risk .

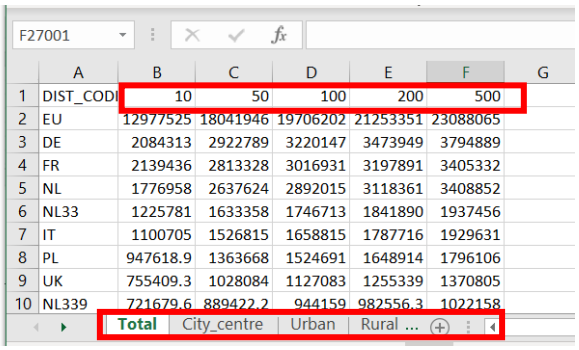
6.2.1.2. How to structure the risk component data?

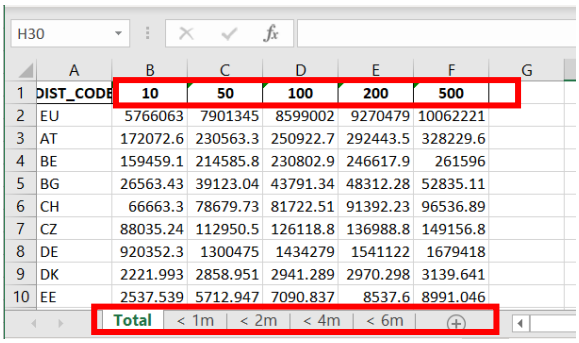
The risk component data is organised in the .xlsx files on two axes or dimensions (previously declared in the .ini file at # 13 and #17). These axes are represented ***by the spreadsheets*** representing DIM 1 (X axes) and ***by columns*** representing DIM 2 (Y axes) (Figure 25). The two dimensions are related and inclusive (DIM 2 structure is a subpart of the DIM 1); they are also interchangeable according to user choice.
Currently in the DRMKC RDH, the spreadsheets structure the data by hazards' intensity, socio-economic scenarios or degree of urbanisation (e.g. urban rural, city centres). The columns structure the data by administrative units and by hazards characteristics: the probability of the hazards (e.g. Return period), hazard susceptibility (categorical values: high, medium, low) by warming levels or Representative Concentration Pathway (RCP).

Figure 25 - Example of a filled template. Columns and spreadsheets are structured as defined in the ini file.

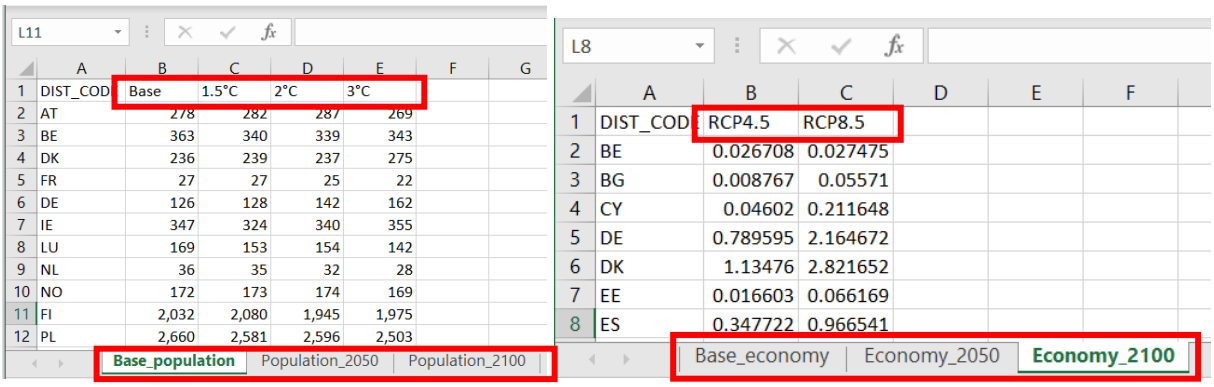
Implemented examples:

Example 1. Risk component values structured per Return period (Probabilistic) of the hazard on Y axis (DIM 2) and urbanisation scenario (left) and water heights (right) on X axis (DIM 1)





Example 2. Risk component values structured per Warming levels or RCP (Projections) on Y axis (DIM 2) of the hazard and socio-economic projections: population (left) and economy (right) on X axis (DIM 1)(PESETA IV example)



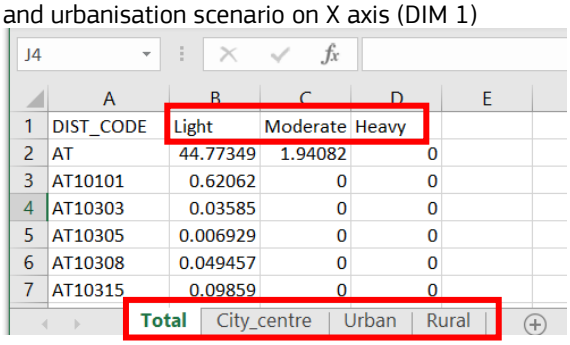
	A	B	C	D	E
1	DIST_COD	Base	1.5°C	2°C	3°C
2	AT	278	282	287	269
3	BE	363	340	339	343
4	DK	236	239	237	275
5	FR	27	27	25	22
6	DE	126	128	142	162
7	IE	347	324	340	355
8	LU	169	153	154	142
9	NL	36	35	32	28
10	NO	172	173	174	169
11	FI	2,032	2,080	1,945	1,975
12	PL	2,660	2,581	2,596	2,503

Base_population | Population_2050 | Population_2100

	A	B	C
1	DIST_COD	RCP4.5	RCP8.5
2	BE	0.026708	0.027475
3	BG	0.008767	0.05571
4	CY	0.04602	0.211648
5	DE	0.789595	2.164672
6	DK	1.13476	2.821652
7	EE	0.016603	0.066169
8	ES	0.347722	0.966541

Base_economy | Economy_2050 | Economy_2100

Example 3. Risk component values structured per Susceptibility of the hazard (Deterministic) on Y axis (DIM 2) and urbanisation scenario on X axis (DIM 1)



	A	B	C	D	E
1	DIST_CODE	Light	Moderate	Heavy	
2	AT	44.77349	1.94082	0	
3	AT10101	0.62062	0	0	
4	AT10303	0.03585	0	0	
5	AT10305	0.006929	0	0	
6	AT10308	0.049457	0	0	
7	AT10315	0.09859	0	0	

Total | City_centre | Urban | Rural

6.2.1.3. Disaster Loss and Damage data .xlsx file structure and templates

The *Template_Disaster_Loss_Data_RDH.xlsx* file is used to upload data of the past events disaster losses and damages.

The Disaster Loss Data template (*Template_Disaster_Loss_Data_RDH.xlsx*) is an Excel file containing two sheets. The first one, called *data_template*, is dedicated to the data collection; hence, it contains a table with multiple fields that help describe the event and its characteristics. The *user_guide* sheet contains further detailed information related to the recording of disaster loss data. It is recommended to go through that information before filling and uploading the template.

6.2.1.4. How to structure the disaster loss and damage data?

The structure of the disaster loss data is presented in the Table 5.

Event_Code	Optional field: automatically generated if left empty (recommended)
Adm_Code	Code of administrative division (e.g. AT for Austria, or AT21 for Kärnten); **Nuts1**, **Nuts2** or **Nuts3**. Best, **Nuts3**
Year	Year the event took place.
Begin_Date	Begin date of the event.
End_Date	End date of the event.
Value_Event	Numeric value of the whole event, according to unit of measure defined in the analysis. It can be zero.
Phenomenon_Begin_Date	Begin date of phenomenon.
Phenomenon_End_Date	End date of phenomenon.
Value_Phenomenon	Numeric value of phenomenon (optional field). It can be zero.

Hazard	Mnemonic (code) of an existing hazard (see the **user_guide** spreadsheet in the template for the full list of the codes used for each hazard).
Asset	Name of asset affected: **agriculture | commercial_buildings | energy | forests | industrial_buildings | other_critical_service | population | railways | residential_buildings | roads**
Metric	Name of metric related to assessed damages: **area_affected | burned_area | economic_impact | population_affected | population_fatalities | population_injured**
Currency	Required only for economic losses: **usd | eur | Local**
Adjusted_year	Required only for economic losses: it can be used to specify a year as reference (e.g. to compute relative impact of a value with inflation reported to year 2011).
Data_Source	Name of data source as (e.g. ZAMG).
Data_Source_Details	Details of the specific source (e.g. ZAMG ID 9999).
Item_Id	Item damaged by phenomenon (or event), which is a specific asset already existing in the database (e.g. Building X, Ottakringer Strasse 21, Vienna). Optional field.
Linked_Item_Id	Item linked to the previous one (e.g. People in the building at moment of event). Optional field.
Geometry	Geometry associated to the phenomenon, as GeoJson (Multi)Polygon. Optional field.

Table 5 - Structure of the Disaster Loss Data template.

6.2.2. Implemented example:

Example 1. Population injured from earthquake (EQ), Tsunami (TS) events

Event_ Code	Adm_Code	Year	Begin_Date	End_Date	Value_Event	Phenomenon _Begin_Date	Phenomenon _End_Date	Value_ Phenomenon	Hazard	Asset	Metric	Currency	Adjusted _year	Data_ Source	Data_Source_ Details	Item _Id	Linked _Item_ Id	Lat	Lon	Geometry
	BG332;RO223	1901	1901-03-31	1901-03-31	50				EQ	population	population_injured			NOAA	NOAA_ID:4377					
	BG332	1901	1901-03-31	1901-03-31	4	1901-03-31	1901-03-31	4	TS	population	population_injured			NOAA	NOAA_ID:3725					

6.3. Data Uploading

As previously mentioned, the data upload needs to be performed trough the Data Upload Module on the administrative dashboard. The available options within the module are shown in Figure 26.

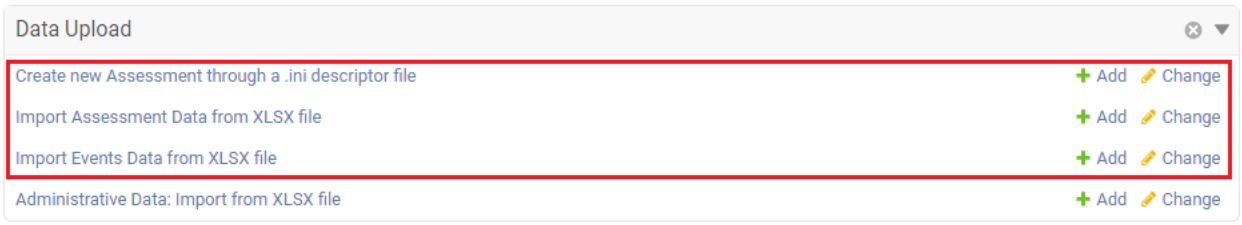


Figure 26 - Data Upload Module. The red rectangle highlights the options commonly used (Risk Data Hub, 2021).

The red rectangle highlights the most common options a user would use when new data needs to be uploaded, that are the upload of the .ini file descriptor, the upload of the assessment data and the upload of the events data.

New data can be uploaded by clicking on the *+Add* button. It opens a new page which is rather similar in all the cases. The common options across the pages are:

- Region: the available dropdown is used to define the project space related to the file uploaded (each project has a specific space; for example, the Risk Data Hub is named *Europe*); each user in the system belongs to a specific space (region) and so do the data owned by that user. This particular entity is used to separate data and settings for each User.
- Browsing option: it allows to browse and select the file the user has on his own machine.

Each user in the system uploads and manages data to a specific space (Region). This particular entity is used to separate data and settings for each User.

For the ini file descriptor those are actually the only available options as displayed in Figure 5. The upload of exposure data requires two more options (Figure 27): the *Assessment* and the *Type of values*. The *Assessment* refers to the related ini file, hence the user must upload the ini file first before proceeding with the exposure data upload. The file will automatically appear in the dropdown list. The *Type of values* specifies if the values contained in the xlsx file are absolute or relative.

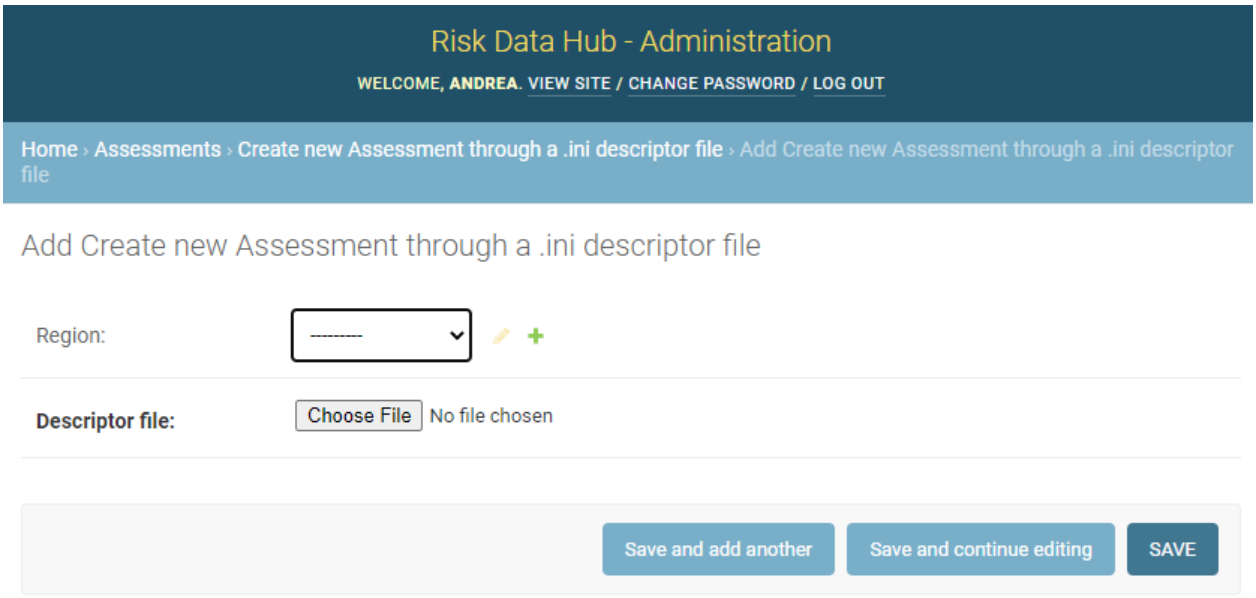


Figure 27 - Data upload interface for the ini file descriptor (Risk Data Hub, 2021).

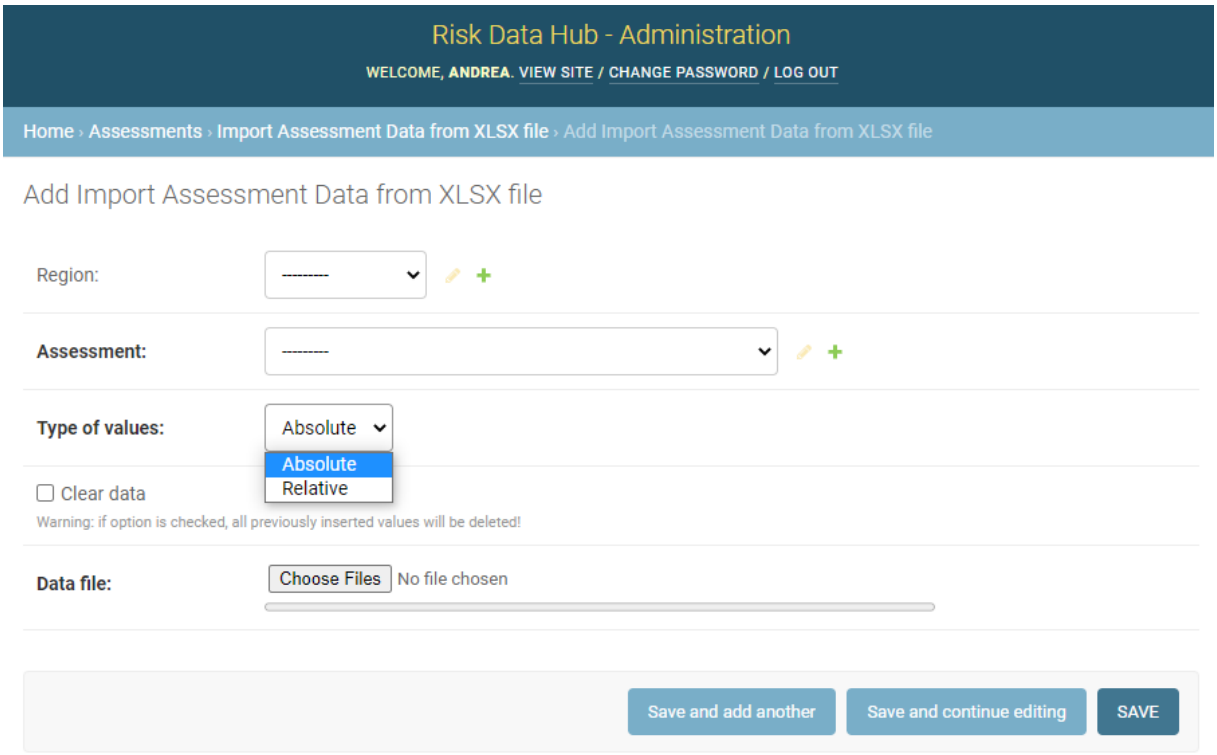


Figure 28 - Data upload interface for the risk components data. The user can specify if values are absolute or relative (Risk Data Hub, 2021).

As previously mentioned, the upload of *Disaster loss and damage* data does not require the definition of the ini file. Thus, the user can upload the Excel file without performing any other operation on the administrative portal. The interface is similar to the assessment data one, however here the user has to define the Event creation option (Figure 29).

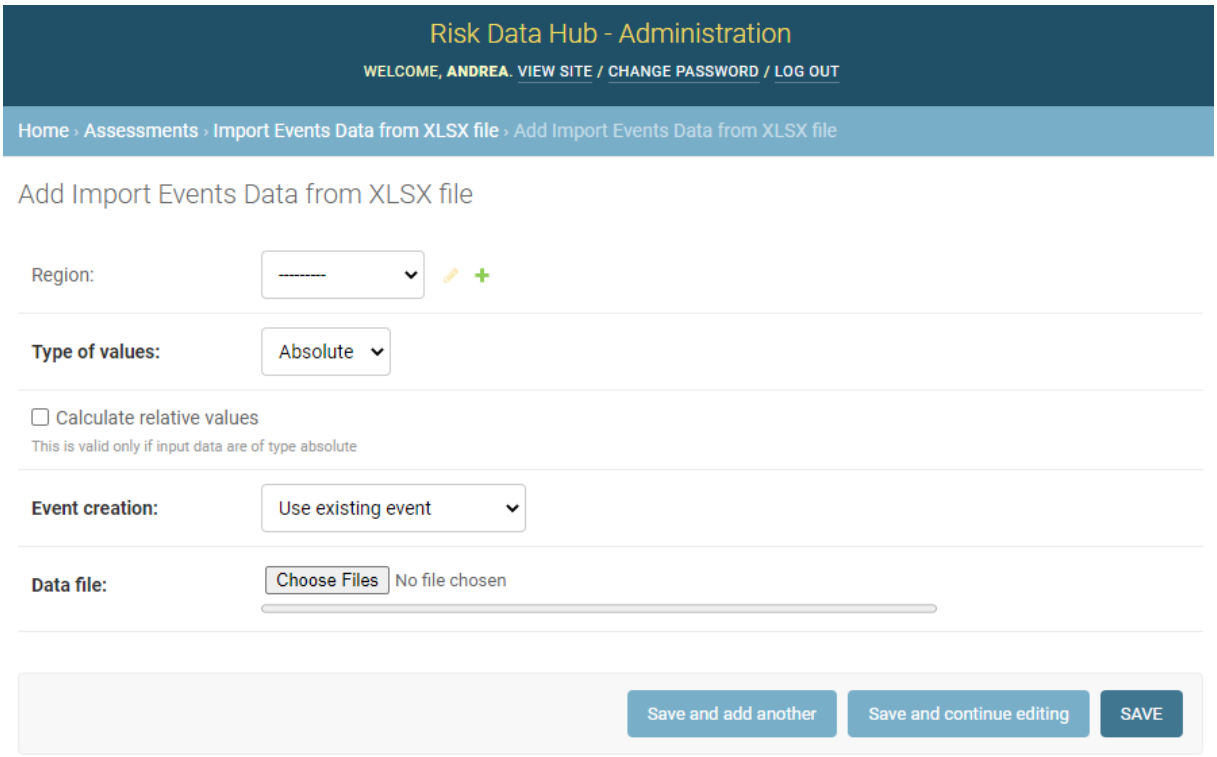


Figure 29 - Data upload interface for the events. In this case the users can specify the kind of values (absolute or relative) and if he wants to use an existing event (that is already loaded on the portal) or force the creation of a new event (Risk Data Hub, 2021).

An event is composed of one, or many phenomena. Depending on the availability of data events and phenomena may ***be created in different ways***. Four examples describing the event creation is presented below.

Example 1

- Event creation setting: use existing event

In this example, 2 rows identify 2 phenomena with a declared value (2 and 3). Since phenomena share common Country, Hazard and Dates and the "Event creation" setting is "use existing event", only one event will be created

Event_Code	Adm_Code	Year	Begin_Date	End_Date	Value_Event
	AT21	2017	2017-03-08	2017-03-11	5
	AT21	2017	2017-03-08	2017-03-11	5

-continued table-

Phenomenon_Begin_Date	Phenomenon_End_Date	Value_Phenomenon	Hazard
2017-03-08	2017-03-08	2	FL
2017-03-09	2017-03-11	3	FL

-continued table-

Metric	Currency	Adjusted_Year	Data_Source
population_fatalities			JRC
population_fatalities			JRC

Example 2

- Event creation setting: force event creation

In this example, 2 events will be created as the "Event creation" settings imposes to create an event for each row

Event_Code	Adm_Code	Year	Begin_Date	End_Date	Value_Event
	AT21	2017	2017-03-08	2017-03-11	5

	AT21	2017	2017-03-08	2017-03-11	5

- -continued table-

Phenomenon_Begin_Date	Phenomenon_End_Date	Value_Phenomenon	Hazard
2017-03-08	2017-03-08	2	FL
2017-03-09	2017-03-11	3	FL

- -continued table-

Metric	Currency	Adjusted_Year	Data_Source
population_fatalities			JRC
population_fatalities			JRC

Example 3

- Event creation setting: use existing event

In this example, two events will be created, as codes are explicitly inserted in the first column

Event_Code	Adm_Code	Year	Begin_Date	End_Date	Value_Event
FL12345678	AT21	2017	2017-03-08	2017-03-11	5
FL12345679	AT21	2017	2017-03-08	2017-03-11	5

- -continued table-

Phenomenon_Begin_Date	Phenomenon_End_Date	Value_Phenomenon	Hazard
2017-03-08	2017-03-08	2	FL
2017-03-09	2017-03-11	3	FL

- -continued table-

Metric	Currency	Adjusted_Year	Data_Source
population_fatalities			JRC
population_fatalities			JRC

Example 4

- Event creation setting: use existing event

In this example, no data about phenomena are specified. In the end we will have 1 event and 2 phenomena, one for each location code inserted in the third column. Phenomena will not contain a numeric value, but they are the way to link the event to multiple locations.

Event_Code	Adm_Code	Year	Begin_Date	End_Date	Value_Event
FL12345678	AT21,AT22	2017	2017-03-08	2017-03-11	5

Phenomenon_Begin_Date	Phenomenon_End_Date	Value_Phenomenon	Hazard
			FL

Metric	Currency	Adjusted_Year	Data_Source
population_fatalities			JRC

References

Antofie, T., Luoni, S., Eklund, L. and Marin Ferrer, M., Update of Risk Data Hub software and data architecture, EUR 30065 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-15386-3 (online), doi:10.2760/798003 (online), JRC119500.

Antofie, T. and Luoni, S., Risk Data Hub software and data architecture, Faiella, A., Rios Diaz, F. and Marin Ferrer, M. editor(s), EUR 29756 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-03978-5 (online), doi:10.2760/67169 (online), JRC114712.

Antofie, T., Luoni, S., Marin Ferrer, M. and Faiella, A., Risk Data Hub – web platform to facilitate management of disaster risks, EUR 29700 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-01385-3 (online),978-92-76-05483-2 (ePub), doi:10.2760/68372 (online),10.2760/346270 (ePub), JRC114120

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Annexes

Annex 1 – Share per impact type assigned from the economic losses at country level.

Country	MaxDamage-Residential	MaxDamage-Commercial	MaxDamage-Industrial	MaxDamage-Agriculture	MaxDamage-Infrastructure (Railways)	MaxDamage-Infrastructure (Roads)	MaxDamage-Transport (Energy)	MaxDamage-Transport (Other,gas)
AD	0	0	0	0	0	0	0	0
AT	0.087	0.181	0.146	0.0001	0.01	0.01	0.285	0.285
BE	0.089	0.184	0.149	0.0002	0.01	0.01	0.281	0.281
BG	0.141	0.308	0.266	0.0001	0.005	0.005	0.139	0.139
HR	0.124	0.265	0.223	0.0002	0.007	0.007	0.189	0.189
CY	0.103	0.216	0.177	0.0003	0.009	0.009	0.245	0.245
CZ	0.113	0.239	0.199	0.0001	0.008	0.008	0.218	0.218
DK	0.081	0.166	0.133	0.0001	0.011	0.011	0.301	0.301
EE	0.122	0.26	0.218	0.0001	0.007	0.007	0.195	0.195
FO	0	0	0	0	0	0	0	0
FI	0.088	0.181	0.146	0.0002	0.01	0.01	0.284	0.284
FR	0.091	0.19	0.154	0.0001	0.01	0.01	0.275	0.275
DE	0.091	0.188	0.152	0.0001	0.01	0.01	0.277	0.277
EL	0.104	0.218	0.18	0.0001	0.009	0.009	0.242	0.242
GI	0.139	0.302	0.259	0.0005	0.005	0.005	0.146	0.146
HU	0.125	0.268	0.225	0.0001	0.007	0.007	0.186	0.186
IS	0.091	0.188	0.152	0.0001	0.01	0.01	0.277	0.277
IE	0.086	0.178	0.144	0.0001	0.01	0.01	0.287	0.287
IM	0	0	0	0	0	0	0	0
IT	0.095	0.198	0.162	0.0002	0.009	0.009	0.265	0.265
LV	0.128	0.276	0.233	0.0001	0.006	0.006	0.177	0.177
LI	0	0	0	0	0	0	0	0
LT	0.127	0.273	0.231	0.0001	0.006	0.006	0.18	0.18
LU	0.064	0.13	0.102	0.0001	0.012	0.012	0.341	0.341
MT	0.113	0.239	0.199	0.0011	0.008	0.008	0.218	0.218
MC	0.055	0.111	0.086	0	0.013	0.013	0.363	0.363
NL	0.085	0.175	0.141	0.0003	0.01	0.01	0.291	0.291
NO	0.069	0.141	0.111	0.0002	0.011	0.011	0.33	0.33
PL	0.126	0.27	0.228	0.0001	0.007	0.007	0.183	0.183
PT	0.109	0.23	0.191	0.0001	0.008	0.008	0.229	0.229
RO	0.136	0.296	0.253	0.0001	0.006	0.006	0.153	0.153
SK	0.118	0.252	0.21	0.0002	0.007	0.007	0.204	0.204
SI	0.108	0.228	0.188	0.0002	0.008	0.008	0.232	0.232
ES	0.1	0.209	0.171	0.0001	0.009	0.009	0.253	0.253
SE	0.084	0.173	0.139	0.0001	0.01	0.01	0.293	0.293
CH	0.073	0.15	0.119	0.0001	0.011	0.011	0.319	0.319

UK	0.093	0.194	0.157	0.0001	0.009	0.009	0.27	0.27

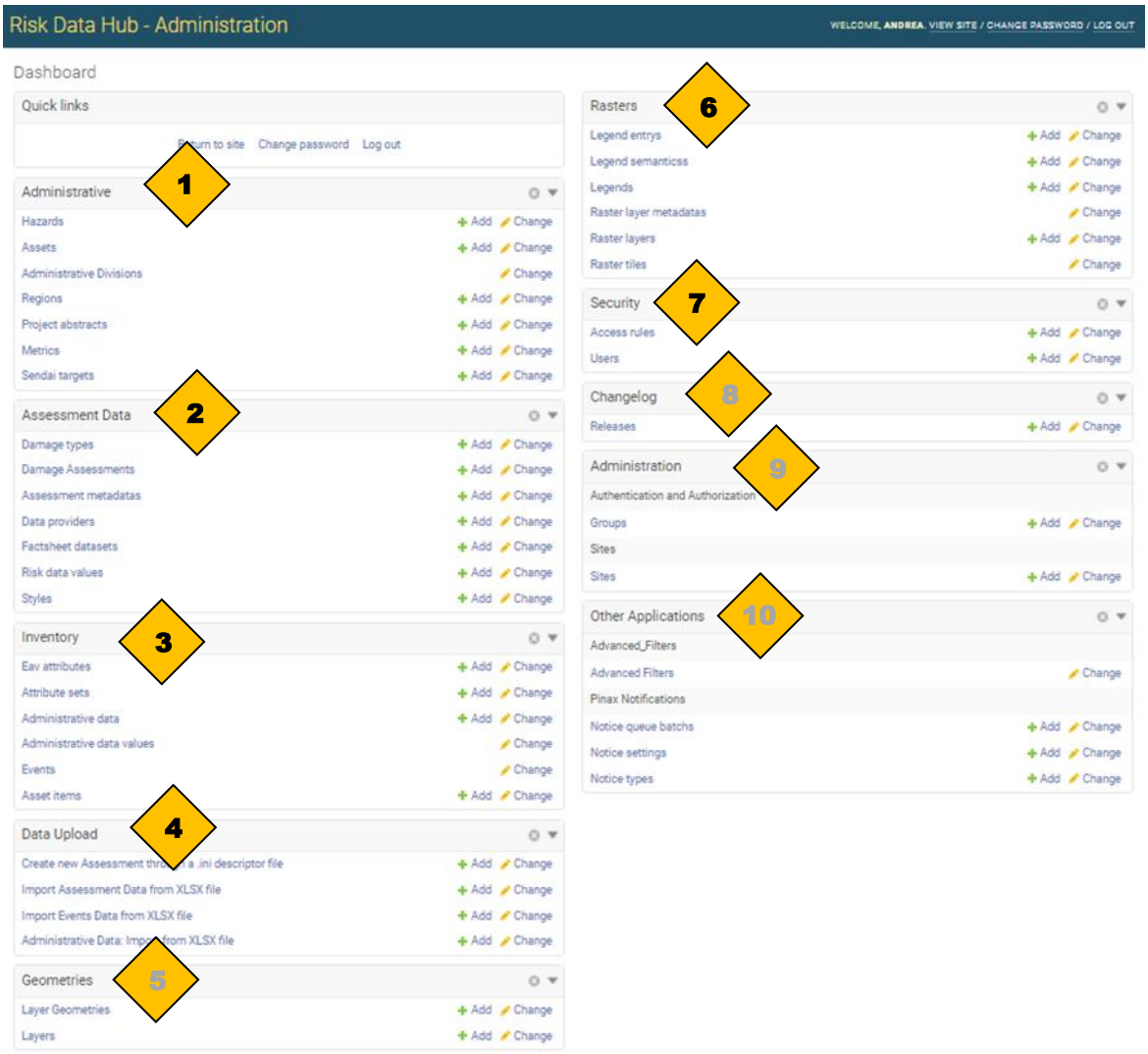
Annex 2 – Hazard Abbreviations

Categories	Subcategories	Abbreviation
Geophysical	Earthquake	EQ
	Landslide	LS
	Volcano	VO
	Tsunami	TS
Hydrological	River Flood	FL
	Coastal flood	CF
	Avalanche	AV
	Flash flood	FLSH
Meteorological	Cold wave	CW
	Heat wave	HW
	Hail	HA
	Lightning	LI
	Windstorm	WS
	Extreme weather (hot days, cold days, tropical nights, torrential rain)	EW
Climatological	Drought	DR
	Wildfire	FF
	Subsidence	SD
Biological	Epidemics / Pandemics	EP
	Insect infestation, animal and plant diseases	DI
	Marine pollution	MP
	Air pollution	AP
Technological	Structural collapse	SC
	Natech	NA
	Industrial	IN
	Chemical Spill	CH
	Miscellaneous Explosion	TX
	Miscellaneous Fire	TF
	Miscellaneous Other	MO
Transportation	Aviation	AI
	Railways	RW
	Roads	RO
	Sea travel	ST
Malicious	Crime	CR
	Civil Disturbance	CD
	Terrorism	TE
	Cyber crime	CC

Annex 3 – Assets classification on Categories and Subcategories on DRMCK RDH (updated continuously)

Categories	Subcategories
Population	Population
Critical services	Roads Railways Energy Public water supply Others Health facilities Education Fire departments Police departments
Buildings	Residential Commercial Industrial Immovable Cultural Heritage: buildings, monuments and fixed infrastructures Administrative
Environmental	Agriculture Livestock Forests Protected areas Natural cultural heritage Soils

Annex 4 - Contents available in Admin panel



1

Administrative

This section where entities used as base for data stored on the DRMKC RDH are defined. Here we define the hazards and assets definitions, spatial coverage of the dataset or project the metric used to represent the data and the definitions of the SENDAI Target.

Hazard

Description: This contains the definition of a Hazard, such as River Flood, Earthquake, Landslide etc. Please see Annex 3 for the list of hazard currently considered. It is the place were hazards can be defined (edited, added, deleted)

Fields:

- Id (int): unique identifier
- Code (varchar): e.g. FL for flood
- Description (varchar)

Asset

Description: This contains the definition of asset affected, such as population, residential/commercial buildings, protected areas, cultural heritage, agriculture etc. It is the place were new assets can be defined (edited, added, deleted). Please see Annex 4 for the list of assets currently considered

Fields:

• Id (int): unique identifier

• Entity_type (enum): defines entity type for mapping fitting attributes

• Owner_id (int): reference to reference_people

• Asset_location_id (int): reference to locations

• Asset_category_id (int): reference to categories

• Attribute_set_id: reference to attribute_set.

Administrative Division

Description: this entity stores basic data regarding administrative divisions. Currently 7 administrative divisions are used covering geographical scales from EU wide, countries, NUTS2,3 to city, census areas and buildings level.

Fields:

• Code (varchar): ISO 3166-1 alpha-2 code for countries, or relevant NUTS code

according to Eurostat

• Name (varchar): name of administrative division

• Level (int) : admin level level

• Geom (binary): spatial data

• Parent_id (int): parent adm division

• Centroid: lat long

Region

Description: this is crucial for ownership management of data and visibility. Each user in the system belongs to a specific region and so do the data owned by that user. This particular entity is used to separate data and settings for each User.

Fields:

• Id (int): unique identifier

• Name (varchar): name of region (e.g. Europe, or country corner, like Austria)

Metric

Description: the metric used to define the datasets. It links information from the **# 6. Metric** in the .ini file.

Assessment Data 

This section represents the core of the RDH, as it defines the type of assessments and how the datasets are organised. The analysis types entity basically defines a dataset in terms of data analysed (buildings, people etc.) and of scope (risk analysis components or disaster loss and damage data from historical events). The damage types defines the dimensions used to measure data within the assessment (e.g. climate change scenarios, return periods of events).

Damage Type

Used to describe dimensions bound to a specific dataset, identified by axis X and Y of a chart. It links information from **# 11. Damage type** in the .ini file.

Damage Assessment

This is the main model for the datasets and it presents the list of the datasets uploaded as shown to the user. It is the place where the datasets can be managed (edited, added, deleted). Here is the list of the fields describing the datasets:

Owner: the user that is owner of the dataset. This fields affects permissions on the frontend, as only Owner itself and user belonging to its group can visualize data. On creation, the dataset owner is automatically set to the current user.

Name: name of the dataset

Metric: depending on type of data shown by dataset. It will be km2 (square kilometres) for exposed or affected area, Euro or other currencies for economic values, and so on

Scope: this identifies the type of assessment (currently Risk, Disaster Loss Data or External Projects)

Tags: it may contain tags relevant to Analysis topic. This field is also used in exposure analysis to match a particular type of event (e.g. River); it is needed for visualization in Event Details view.

Dataset type: can be “Simple” or “Grouped”

Parent: parent dataset of a simple one, used for type “Grouped”. Children dataset of a group are not directly visible on the frontend

Region: this is tightly coupled with the User Corner. By attaching a dataset to a specific Region, you will define the geographical scope (whole Europe, a country, or even a lower administrative division) and all the basic permissions applied to your data.

Asset: see definition above

Hazard: see definition above

Related administrative data: this is needed to compute relative values (e.g. percentual of population affected)

Style: used to render colours on the map

Vector overlays / Raster overlays: thes fields let the user bind one or more additional layers to the Analysis. Choices are resources already uploaded, both raster and shape files. Additional layers will be shown as GIS overlays on the frontend.

Descriptor file: descriptor file used to create the Analysis

Data file: excel file used to upload data

Metadata file: excel file used to upload metadata

State: read-only field. The value is always “Ready”, unless Analysis is in a lock state

Factsheet datasets (deprecated)

Factsheets are built using only data from selected datasets, so it’s necessary to fill factsheet datasets list to see an output in the Factsheet section of the application

Assessment metadata(work ongoing)

This contains all metadata for a specific dataset

Data Provider

This is used to associate a data source to dataset values, in order to manage priorities when multiple sources are used for a single dataset

Description: data source (or provider, e.g. Eurostat)

Fields:

- Id (int): unique identifier
- Name (varchar)
- Region_id (int): reference to Region
- Colour (varchar): colour assigned (HEX code) to be used for legends

Risk Data Values

This is used to manage the normalised risk values (exposure, vulnerability, risk). It acts like a cache and it be updates if new risk data is introduced.

Styles

Styles define how the maps will be coloured, according to the values of a dataset

Description: style assigned to a dataset (automatically generated)

Fields:

- Id (int): unique identifier
- Assessment (int): reference to Assessment
- ParentAdministrativeDivision (int): reference to AdministrativeDivision
- Level (int): level of AdministrativeDivision style is applied for
- Content (jsonb): style in json format to be used in Leaflet maps

Inventory

EAV attributes

Description: attributes relevant to events and assets (and more) are defined in a single place. This feature allows to define new attributes at any time, without the need to change the structure of database.

Fields:

- Id (int): unique identifier
- Entity_type_id (int): defines entity type for mapping fitting attributes
- Data_type (varchar): defines data type (varchar, text, integer, decimal, datetime)
- Name (varchar):

- Description (varchar):

Attribute set

Description: attribute sets are used to link attributes to specific instances of an entity

Fields:

- Id (int): unique identifier
- Name (varchar):

Administrative data

Description: definition of data related to Administrative Divisions, like GDP, Population, Area, and so on.

Fields:

- Id (int): unique identifier
- Code (varchar): e.g. GDP
- Description (varchar): description of data
- UnitOfMeasure (varchar): e.g. Mln EUR

Administrative data values

Description: relation between Administrative Data and Administrative Divisions.

Fields:

- Administrative_division_id (int):
- Administrative_data_id (int):
- Dimension (varchar): e.g. Year 2018 of GDP
- Value (decimal):

Events

List the Events uploaded on the RDH. This class contains all basic information about an event. Events may not be created directly from website forms, but can be uploaded from excel files.

Description: an event is a generic entity which may be the cause of a damage.

Fields:

- Id (int): unique identifier of the event
- Entity_type_id (int): defines entity type for mapping fitting attributes
- Region_id (int): could be Europe, or any country corner
- LinkedEvent_id (int): optional link to an event identified as cause of the current one (chained events)
- Hazard_id (int): identifier of the hazard (eg. Flood)
- Begin_date (datetime): starting date of recognized event
- End_date (datetime): starting date of recognized event
- AttributeSet_id: reference to AttributeSet

Asset items

Description: single item included in the asset (equal to asset in the simplest case).

Fields:

• Id (int): unique identifier

• Asset_id (int): reference to assets

• Name (varchar).

Data upload

This section is used to upload datasets on the RDH web application. See 2.3 Data uploading from the report.

Create new Assessment through a .ini descriptor file

Upload the pre-compiled ini file related to a risk analysis component.

Import Assessment Data from XLSX file

Upload the pre-compiled .xlsx file related to a risk analysis component.

Import Events Data from XLSX file

Upload the pre-compiled .xlsx file related to disaster loss and damage data.

Administrative data: Import from XLSX file

Upload associated datasets which is used generally in defining specific analysis. Example of associated datasets: GDP, Currency

Geometries (ongoing work)

Layer Geometries

Upload Geographical vectorial layers (gojson). Example: buildings multipolygons.

Layers

Rasters

This sections manages the raster layers that are associated layers of the analysis. Example: hazard flood layers with various return periods.

Legend entries

Manages raster layers legends.

Legend semantics

Manages raster legends properties.

Legends

Manages raster legends properties

Raster layers metadata

Manages raster layers metadata.

Raster layer

Manages raster layers properties

Raster tiles

Manages raster tiles properties

Security

Access rules

Used to filter access to data. Multiple rules may be defined and processed in a given order.

Users

Users may belong to one or multiple groups and may or may not access to Admin panel

Annex 5 – Sendai targets considered in the DRMKC RDH

No.	Indicator
A-1	Number of deaths and missing persons attributed to disasters, per 100,000 population.
A-2	Number of deaths attributed to disasters, per 100,000 population.
A-3	Number of missing persons attributed to disasters, per 100,000 population.

*The data on number of deaths and number of missing/presumed dead are mutually exclusive, so no-one should be double counted.

No.	Indicator
B-1	Number of directly affected people attributed to disasters, per 100,000 population.
B-2	Number of injured or ill people attributed to disasters, per 100,000 population.
B-3	Number of people whose damaged dwellings were attributed to disasters.
B-4	Number of people whose destroyed dwellings were attributed to disasters.
B-5	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

No.	Indicator

C-1	Direct economic loss attributed to disasters in relation to global gross domestic product.(compound indicator)
C-2	Direct agricultural loss attributed to disasters Agriculture is understood to include the crops, livestock, fisheries, apiculture, aquaculture and forest sectors as well as associated facilities and infrastructure.
C-3	Direct economic loss to all other damaged or destroyed productive assets attributed to disasters. Productive assets would be disaggregated by economic sector, including services, according to standard international classifications. Countries would report against those economic sectors relevant to their economies. This would be described in the associated metadata.
C-4	Direct economic loss in the housing sector attributed to disasters. Data would be disaggregated according to damaged and destroyed dwellings.
C-5	Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters. The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant
C-6	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters.

Annex 6 – Damage types and correspondence with Sendai targets considered in the DRMKC RDH

Disaster data Category	Damage type	Damage sub-type	SENDAI correspondence	Description
Human losses	Fatalities		A-1	Number of deaths and missing persons attributed to disasters(compound)
		Killed	A-2	Number of deaths attributed to disasters
		Missing	A-3	Number of missing persons attributed to disasters
	Affected	Affected	B-1	Number of directly affected people attributed to disasters
		Evacuated	B-3	Number of people whose damaged dwellings were attributed to disasters.
		Homeless	B-4	Number of people whose destroyed dwellings were attributed to disasters.
		Relocated Displaced	B-5	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.
	Injured	Injured	B-2	Number of injured or ill people attributed to disasters
	Aggregated		C-1	**Direct economic loss** attributed to disasters in relation to global

				gross domestic product.(compound indicator)
	Aggregated insured			Not addresses in the DRMKC RDH
	Aggregated private			
Direct Economic losses	Sectors		C-2	Direct **agricultural** loss attributed to disasters Agriculture is understood to include the crops, livestock, fisheries, apiculture, aquaculture and forest sectors as well as associated facilities and infrastructure.
			C-3	Direct economic loss to all other damaged or **destroyed productive assets** attributed to disasters. Productive assets would be disaggregated by economic sector, including services, according to standard international classifications. Countries would report against those economic sectors relevant to their economies. This would be described in the associated metadata.
			C-4	Direct economic loss in the **housing sector** attributed to disasters. Data would be disaggregated according to damaged and destroyed dwellings.
			C-5	Direct economic loss resulting from damaged or **destroyed critical infrastructure** attributed to disasters. The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant
			C-6	Direct economic loss to **cultural heritage** damaged or destroyed attributed to disasters.

	Sectors insured			Not addresses in the DRMKC RDH
	Sectors private			
Indirect Economic losses	Not addresses in the DRMKC RDH			
Non-economic quantitative	Critical services/infrastructure		D-1	Damage to critical infrastructure attributed to disasters. (compound indicator)
			D-2	Number of destroyed or damaged **health facilities** attributed to disasters.
			D-3	Number of destroyed or damaged **educational facilities** attributed to disasters.
			D-4	Number of other destroyed or damaged **critical infrastructure** units and facilities attributed to disasters. The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and **green infrastructure** should be included where relevant.
	Basic services		D-5	Number of disruptions to basic services attributed to disasters. (compound indicator)
			D-6	Number of disruptions to **educational services** attributed to disasters.
			D-7	Number of disruptions to **health service**s attributed to disasters.
			D-8	Number of disruptions to other basic services attributed to disasters. The decision regarding those elements of basic services to be included in the calculation will be left to the Member States and described in the accompanying metadata.

Annex 7 - The characteristics of open source (C3S, EM-DAT, DFO, EFFIS, LRC, GLC, EMSR, HANZE, NOAA, Media, Wikipedia) datasets recording.

Data_source	Hazard	Time coverage in RDH	Recording Thresholds	Spatial scale	Temporary scale	Validation	Data consistency/limitations
C3S	WS	1979-2017	Some particular windstorm events were chosen and the economic loss was computed according to the WISC model.	The Nomenclature of Territorial Units for Statistics (NUTS) 3, 2010 edition.	The day in which the event took place.	Modelled damage.	Despite this limitation, the OSM database offers the most consistent and extensive building dataset for Europe. Since the OSM database is constantly being updated, the model always extracts the most up-to-date OSM data. The OSM data is combined with the CORINE land cover to categorize buildings per sector.
EM-DAT	FL	2000-2020	≥10 fatalities, ≥100 affected, declaration of state of emergency, or call for international assistance	The country (ISO) in which the disaster has occurred or had an impact and Province name. If a disaster has affected more than one country, there will be one entry for each country.	Start day/month/year: The date when the disaster occurred. This date is well defined for all sudden-impact disasters. For disaster situations developing gradually over a longer time period (i.e. drought) with no onset date, the field « day » can be left blank. End day/month/year: The date when the disaster ended. This date is well defined	In the majority of cases, a disaster will only be entered into EM-DAT if at least two sources report the disaster's occurrence in terms of deaths and/or affected persons.	A reliability score going ranking from (1) very low - to (5) very high, has been established in order to ensure the quality of the data.
	FLSH	2000-2019					
	FF	2000-2018					
	EQ	1908-2020					

					for all sudden-impact disasters. For disaster situations ending over a longer time period (i.e. drought) with no definite concluding date, the field « day » can be left blank.		
DFO	FL	1985-2020	≥ 1 or more fatalities and/or ≥ 1 or more population affected and/or ≥ 1 m2 or more area affected	The affected areas are located by drawing polygons within their geographic information system. The information is provided in various formats.	Occasionally, there is no specific beginning date mentioned in news reports, only a month; in that case the DFO date will be the middle of that month. Ending dates are often harder to determine - sometimes the news will note when the floods start to recede. We make an estimate based on a qualitative judgement concerning the flood event.	The information presented in the archive is derived from news, governmental, instrumental, and remote sensing sources.	Because this database combines different information source and cover 18 years, it can not be totally consistent. This question of data consistency is recursive with this kind of database. Usually this question of consistency is avoided or quickly presented. The originality of this project is to acknowledge the data inconsistency, to make the user aware of the reliability of the data. This concept is part of a research project.

EFFIS	FF	2000-2019	≥ 1 or more fatalities and/or ≥ 1 or more population injured and/or ≥ 30 ha or more area burned	At the Territorial Units for Statistics (NUTS) 3 and country level (sometime disaggregated as described in chapter 2.1).	Seasonal data for the fatalities and economic losses. For the burned area the date is daily.	Since 2004 the forest fire data provided each year by individual EU Member States and other European countries are checked, stored and managed by JRC within EFFIS. At present the database contains fire data from 22 countries: Bulgaria, Croatia, Cyprus, Czech, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lebanon, Lithuania, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey.	-
EMSR	FL	2012-2020	While there is not a particular threshold for the recording, authorised Users may trigger the service, by sending a Service Request Form (SRF) directly to the European Response Coordination Centre (ERCC). Authorised Users include National Focal Points (NFPs) in EU Member States and in most countries participating in the European Civil	The affected areas are located by drawing polygons represented on a map. The formats can be a PDF for the map or shapefiles for the vector data.	The temporary scale depends on the number of maps, one map represents a particular day.	The Copernicus EMS - Rapid Mapping Service performs systematic checks after the publication of each product. The validation service is normally triggered by the European Commission, and it may also be suggested by the authorised users in case of specific issues. The JRC prepares the technical specifications for the validation of a specific product and	From 2019 there has been a change in terminology. There is no longer provided the estimation of the People affected by the event, but the number of people living in the area of interest.
	CF	2019					
	LS	2013-2019					
	EQ	2012-2019					

			Protection Mechanism as well as EC Services (DGs), the Situation Room of the EEAS and the EU delegations.			starts the contracting procedure. The validation methodology is based on the validation protocol developed by the JRC.	
LRC	LS	2000-2020	≥ 1 or more fatalities and/or ≥ 1 or more population injured	Nominal location information (town/village, county, province, country).	The day in which the event took place.	The citizen reports an event and a team at NASA checks the incoming landslide reports for accuracy and detail.	There is extensive misreporting of landslide events because landslides are often grouped with primary triggering hazards such as floods, tropical cyclones, and flooding. As a result, fatality estimates and location information for the landslide events are almost impossible to distinguish from areas severely affected by the other hazards.
GLC	LS	1993-2020	≥ 1 or more fatalities and/or ≥ 1 or more population injured	Nominal location information (town/village, county, province, country).	The day in which the event took place.	The Cooperative Open Online Landslide Repository (COOLR) contains citizen science data from Landslide Reporter put into the database as Landslide Reporter Catalog (event_import_source = 'LRC') and data from NASA's Global Landslide Catalog (event_import_source = 'GLC'). The GLC considers all types of mass movements triggered by rainfall, which have been reported in the media, disaster databases,	It is extremely challenging to compile a global catalog of landslide events due to limited data availability and heterogeneous reporting at this scale. Consequently, the landslide database is severely limited in its accuracy and completeness. Variations in landslide reporting frequency and accuracy represent the most challenging and unquantifiable component of this study. This problem is consistent with similar studies that find substantial heterogeneities in landslide reporting, documentation, and reliability of size and impact estimates (Castellanos Abella and van

						scientific reports, or other sources.	Westen 2007; Chau et al. 2004; Guzzetti et al. 1994; Petley et al. 2005, 2007).
Hanze	FL	1900-2016	≥ 1 or more fatalities and/or ≥ 1 or more population injured and/or ≥ Loss of 1 or more local currency	Most of those statistics have been collected at regional level. The Nomenclature of Territorial Units for Statistics (NUTS),2010 edition (European Union, 2011), was used here to de-fine the region.	The start date is the date on which the flood event started and ended; the exact daily dates are not always known, or are imprecise, but an event was included in the database as long as the starting month could be identified. The end date is the date on which the flood event ended.	The reliability of past flood loss data remains an open question. Efforts were made to gather multiple sources for past events, especially large ones. Large events which were not verified by local information were not included in the database.	Data completeness varies substantially between countries, few of which maintain publicly available databases of flood losses.
	CF	1906-2014					
	FLSH	1900-2016					
Media	FL	2019-2020	≥ 1 or more fatalities and/or ≥ 1 or more population affected and/or ≥ 1 or more population injured and/or ≥ 1 m2 or more area affected	The information is provided at either country, regional or city level.	The time duration of the event from one to several days.	The data sources of the events are news reports or official sources.	Sometimes the data values are partial retrieved or cannot be verified by other sources.
	CF	2010-2020					
	FLSH	2018-2020					
	FF	2012-2018					
	LS	2020					
	EQ	1976-2016					

NOAA	EQ	1901-2020	≥ 1 or more fatalities and/or ≥ 1 or more population injured and/or ≥ Loss of 1 or more US dollars	Location: country, region. Latitude and longitude are provided.	The day in which the event took place.	The database has been significantly improved over the last few years by careful checking of historical entries, verifying source information, and flagging questionable or meteorological events.	While every effort has been made to ensure that these data are accurate and reliable within the limits of the current state of the art, NOAA cannot assume liability for any damages caused by any errors or omissions in the data, nor as a result of the failure of the data to function on a particular system. NOAA makes no warranty, expressed or implied, nor does the fact of distribution constitute such a warranty.
	TS	1901-2020					
	VA	1905-2019					
Wikipedia	FL	1999-2020	≥ 1 or more fatalities and/or ≥ 1 or more population affected and/or ≥ 1 or more population injured and/or ≥ Loss of 1 or more Euro/Local currency/US dollars	The information is provided at either country, regional or city level.	The time duration of the event from one to several days.	The data sources of the events are news reports, peer-review articles or official sources.	Sometimes the data values are partial retrieved or cannot be verified by other sources.
	FLSH	1952-2018					
	FF	2007-2018					
	EQ	1904-2020					

For more details regarding the accessible links and other characteristics please consult the:
https://publications.jrc.ec.europa.eu/repository/bitstream/JRC116366/ld_in_risk_data_hub_report_online.pdf

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