INSURANCE
NAT CAT

# TECHNICAL DESCRIPTION: THE PILOT DASHBOARD ON INSURANCE PROTECTION GAP FOR NATURAL CATASTROPHES

EIOPA-BoS-20/663
4 December 2020

European Insurance and Occupational Pensions Authority

## Table of Contents

EIOPA acknowledges the limitations of the pilot version of the dashboard, which was developed, based on publicly available data and expert judgement. The main goal of the pilot dashboard is to establish a framework for identifying key risk drivers for the protection gap for natural catastrophes and for collecting relevant evidence and data. The methodology for deriving the relevant scoring, as well as the existence of data gaps will be subject to review and will be updated based on further evidence and discussion in the future. Views from stakeholders on the methodology, data used in the dashboard are welcome until 31st of March using the EU survey. Questions on the dashboard are also welcome to be sent to protection_gap_dashboard@eiopa.europa.eu.

## List of acronyms

| | |
|---|---|
| CCS: | Consorcio de Compensación de Seguros |
| EEA: | European Economic Area |
| GDP: | Gross Domestic Product |
| JRC: | Joint Research Center |
| Nat Cat: | Natural Catastrophe |
| NCA: | National Competent Authorities |
| RP: | Return Period |
| SSI: | Storm Severity Index |
| UNDRR: | United Nations focal point for disaster risk reduction |
| WISC: | Windstorm Information Service |

# Introduction

## Methodology

The overall methodology used by the dashboard is the following:

(1) Use scientific data as input data and when not available expert judgement (as described in more details in the Section 4 "Summary of the used data and expert judgements", in eight out of nine submodules the dashboard uses scientific data as input data).

(2) Use formula to derive an estimation of each defined index (the main concept behind the formula was inspired by the existing methodology of the dashboard INFORM[1] published by the European Commission).

(3) Derive a score (0=no risk, 1=low risk, 2=low-medium risk, 3=medium-high risk, 4=high risk) using the output of the formula and a defined threshold. The thresholds were chosen based on expert judgement.

The pilot dashboard aims at providing a common measure for the protection gap. For most indices, EIOPA used a quantitative approach with scientific based data (for example for exposure and hazard, EIOPA uses data from the Risk Data Hub and from the ESPON[2] project). Where no scientific data were available, EIOPA used expert judgement to fill the gap. Where assumptions and expert judgements have been applied, this is clearly stated, to allow users to understand the scores and draw meaningful conclusions. For some indices, EIOPA also used a qualitative approach as EIOPA estimated that available quantitative data were not sufficient (for example for the insurance penetration).

## Validation

The dashboard was discussed and validated by

- a group of selected expert from DG Clima, DG Fisma, DG Echo, JRC, industry (Munich Re, Axa, Perils, Swiss Re) (April – June 2019), EIOPA.

- National competent authorities from EEA countries (September 2020).

## Scope

The scope includes the countries of the EEA[3] (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece,

[1] https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Methodology
[2] Applied Research Projects | ESPON
[3] excluding UK

Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Norway, Iceland, and Lichtenstein).

A natural catastrophe is an unexpected event, caused by natural physical perils, such as an earthquake or flood, causing damage, injury or death. Natural catastrophes can be caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues)[4].

In the current pilot dashboard version, EIOPA focus on four perils:

- Flood: Flood is a hydrological disaster and defined in the EM-DAT[5] as a general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than-normal levels along the coast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell (flash floods). The dashboard mainly focuses on riverine flooding as the data on exposure and hazard from the JRC were taken for riverine floods.

**Hydrological**

| Disaster Group | Disaster Subgroup | Disaster Main Type | Disaster Sub-Type | Disaster Sub-Sub-Type |
|---|---|---|---|---|
| Natural Disaster | Hydrological | Flood | Coastal flood | |
| | | | Riverine flood | |
| | | | Flash flood | |
| | | | Ice jam flood | |
| | | Landslide | Avalanche (snow, debris, mudflow, rockfall) | |
| | | Wave action | Rogue wave | |
| | | | Seiche | |

- Windstorm[6]: The peril "windstorm" has different categories (cyclonic storms and convective storms):
  - Extra-tropical cyclones: Type of low-pressure cyclonic system in the middle and high latitude that primarily gets its energy from the horizontal temperature contrasts in the atmosphere.
  - Tropical cyclones: Originates over tropical or subtropical waters[7].

[4] Centre for Research on the Epidemiology of Disasters – CRED Université catholique de Louvain, Belgium https://www.emdat.be/classification.

[5] Centre for Research on the Epidemiology of Disasters – CRED Université catholique de Louvain, Belgium "Emergency Events Database (EM-DAT)", https://www.emdat.be/classification.

[6] The definition for Windstorm partly deviate from the definition of the EM-DAT for convective storms. The definition used in this paper was found to be more appropriate.

[7] Depending on their location, tropical cyclones are referred to as hurricanes (Atlantic, Northeast Pacific), typhoons (Northwest Pacific), or cyclones (South Pacific and Indian Ocean).

- Convective storm: Range of events generated by strong vertical movements in the troposphere, implying fast condensation and release of big amounts of energy. Among its effects are hail, lightning, heavy showers, strong winds and tornadoes.

Since the dashboard focuses on European countries, windstorms refers here to extra-tropical cyclones.

**Meteorological**

| Disaster Group | Disaster Subgroup | Disaster Main Type | Disaster Sub-Type | Disaster Sub-Sub-Type |
|---|---|---|---|---|
| Natural Disaster | Meteorological | Storm | Extra-tropical storm | |
| | | | Tropical storm | |
| | | | Convective Storm | Derecho |
| | | | | Hail |
| | | | | Lightning/thunderstorm |
| | | | | Rain |
| | | | | Tornado |
| | | | | Sand/dust storm |
| | | | | Winter storm/blizzard |
| | | | | Storm/surge |
| | | | | Wind |
| | | | | Severe storm |
| | | Extreme temperature | Cold wave | |
| | | | Heat wave | |
| | | | Severe winter conditions | Snow/ice |
| | | | | Frost/freeze |
| | | Fog | | |

- Wildfire: as per EM-DAT classification, wildfires are climatological disasters. Wildfires are defined as any uncontrolled and non-prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra, which consumes the natural fuels and spreads based on environmental conditions (e.g., wind, topography). Wildfires can be triggered by lightning or human actions. In the dashboard, EIOPA mainly focus on forest fire, which is a type of wildfire in a wooded area, as the data on the exposure and hazard from the JRC were taken for forest fire.

**Climatological**

| Disaster Group | Disaster Sub-Group | Disaster Main Type | Disaster Sub-Type | Disaster Sub-Sub-Type |
|---|---|---|---|---|
| Natural Disaster | Climatological | Drought | | |
| | | Glacial Lake Outburst | | |
| | | Wildfire | Forest Fire | |
| | | | Land fire: Brush, bush, Pasture | |

- Earthquake: as per EM-DAT classification, earthquakes are geophysical disasters. Earthquake are defined as a sudden movement of a block of the Earth's crust along a geological fault and associated ground shaking. The dashboard focuses on the ground movement as the JRC data do not consider tsunamis.

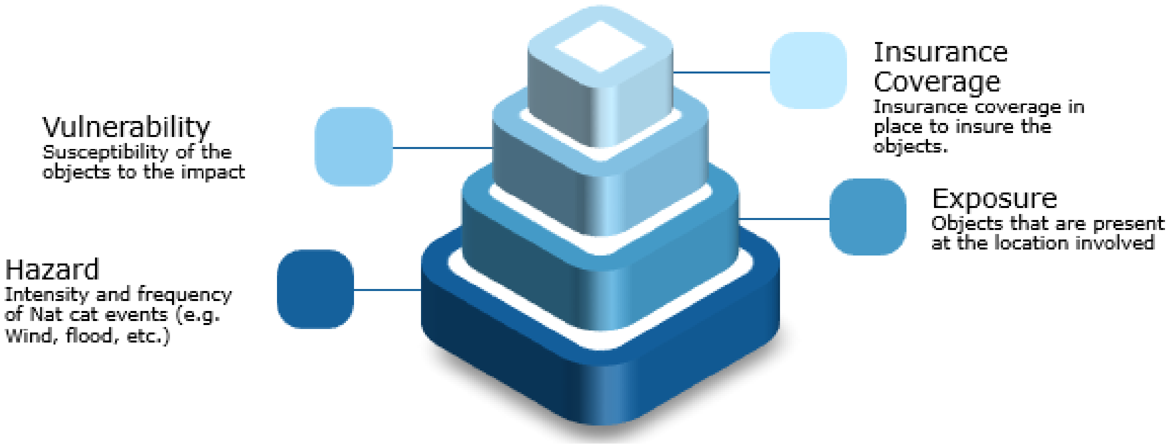
**Geophysical**

| Disaster Group | Disaster Subgroup | Disaster Main Type | Disaster Sub-Type | Disaster Sub-Sub-Type |
|---|---|---|---|---|
| Natural Disaster | Geophysical | Earthquake | Ground movement | |
| | | | Tsunami | |
| | | Mass Movement (dry) | Rock fall | |
| | | | Landslide | |
| | | Volcanic activity | Ash fall | |
| | | | Lahar | |
| | | | Pyroclastic flow | |
| | | | Lava flow | |

Flood, Wildfire and Windstorm were chosen because they are climate-related perils and the amount of damage caused by these perils in Europe is high. Earthquake was also chosen as the losses of this peril in some region is very high and the protection gap might be very high for this peril.

## Measuring the insurance protection gap

The protection gap is a combination of different elements:




The dashboard provides two views of the insurance protection gap:

(1) <u>Historical protection gap</u>

What: based on historical data on economic and insured losses, which help to know the protection gap in the past. The historical losses will depend on the past hazards (past events), exposures, vulnerabilities and insurance coverages (the three last parameters measured at the time of the event).

Pros:

- It is a risk-based measure
- Clear quantitative way to measure the protection gap

Cons:

- It only measures the past protection gap
- It might underestimate the protection gap as if no event occurred in the past, no loss data will be available to measure the protection gap. It can be misleading for low-frequency events.
- It does not allow for the identification of the main source/cause of the protection gap.

(2) <u>Estimation of today's protection gap</u>

What: based on a modelling approach to have an estimation of today's protection gap. In order to estimate today's protection gap, the following information is required: hazard, vulnerability, exposure and insurance coverage at present time.

Pros:

- It uses a risk-based modelling approach
- It is an up-to-date estimation of the protection gap
- It allows for identification of the different sources of the protection gap (it explicitly considers separately the different sources of the insurance protection gap hazard / exposure / vulnerability / insurance coverage)

Cons:

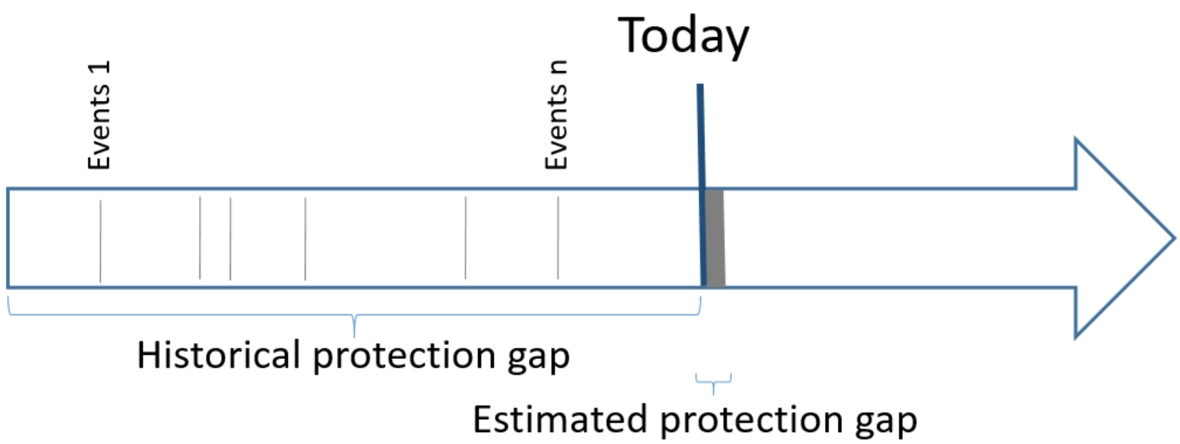
- Accessing the individual data is challenging
- Not trivial to derive the scoring factors as a combination of different types of scientific data; expert judgment

The estimation of today's protection gap will provide a more accurate view of today's risk as:

(a) from a **hazard** perspective just because an event hasn't occurred in the past doesn't mean it can't or won't in the near future. A modelling approach is therefore needed to ensure that all the risks are properly considered.

(b) In addition, the estimated protection gap also uses the up-to-date information on **exposure, vulnerability and insurance coverage** available. The historical losses are based on past exposure, vulnerability, hazard and insurance coverage. Some of these elements (mainly exposure or insurance coverage) can be expected to have changed significantly during the last 40 years. For example, in the historic protection gap, EIOPA uses historical economic and insured losses from storm Lothar, which occurred in 1999. These losses are based on the exposure, vulnerability and insurance coverage in place in 1999. The losses, which would result today from the same event would be different as the exposure, vulnerability and insurance coverages are different.

The historical protection gap can give insightful information but it is important to complete the view of the protection with a modelled approach to have an estimation of today's protection gap.



## Definition of the scores

### Historical protection gap

| | |
|---|---|
| **Definition** | **annual uninsured losses normalised by GDP** |
| **Formula** | (economic losses - insured losses)/(number of years[8]*GDP) |
| **Data** | Historical economic, insured losses per peril per country and GDP |
| **Data sources** | NatCat Service MunichRe<br>Swiss Re Sigma<br>Consorcio de Compensación de Seguros (CCS)<br>EUROSTAT |

EIOPA decided to normalise the score with the GDP in order to better compare the different countries. This normalisation should also allow to better weight the impact of the losses for each country. Indeed, if a country such shows large losses compared to another country, it might not necessarily mean that the hazard is bigger, it can be due to the fact that the economy is bigger. EIOPA therefore wanted to normalise the score in order to have a better idea of what the impacted exposure means for each countries' economies.

The final score is based on both Munich Re Nat Cat Service data and Swiss Re Sigma data. The comparative survey from Monti and Tagliapierta (2009), gives an overview of the main differences between MunichRe and SwissRe's loss data.

#### NatCat Service data

Historical economic and insured loss data from MunichRe are available for the time-period 1980-2018 for four categories (geophysical, meteorological, hydrological and climatological events) (see also Figure 1). EIOPA does not have access to the historical losses for individual perils (i.e. earthquake, flood, wildfire and windstorm) – only at level of type of events (i.e. geophysical, meteorological…). EIOPA assumes that the main losses in the different type of events come from earthquake for geophysical, flood for hydrological, windstorm for meteorological and wildfire for climatological. The NatCat Service database ignores losses from events, which can't be firmly measurable. It considers only events from Cat Classes 1 to 4 (see Figure 2). The data used in the dashboard were taken from MunichRe's website in April 2020. As of July 2020, the NatCat Service data are no longer available for free.

[8] Number of years depends on the time period considered for the historical data.

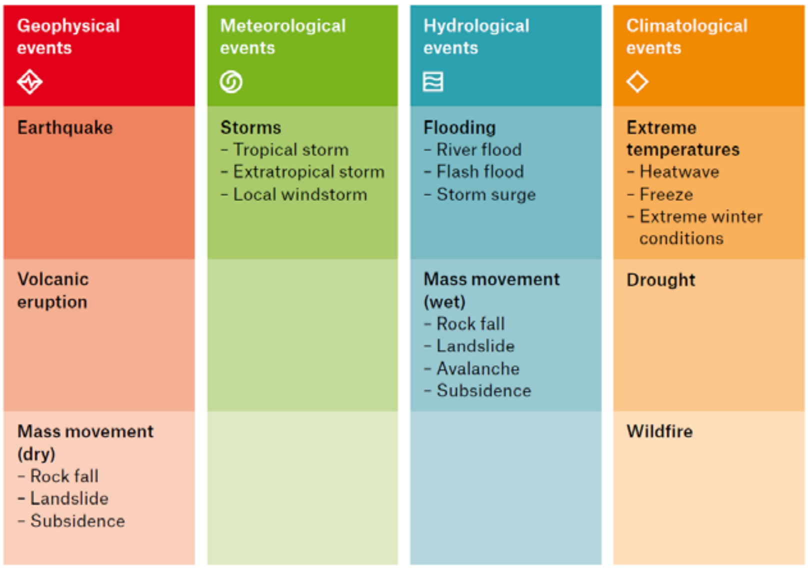



Figure 1: Four type of events considered in the historical data from MunichRe.

The five Cat Classes (0 to 4) can be paraphrased as follows:

| | |
|---|---|
| Cat Class 0: | Marginal impact (no noteworthy or firmly measurable loss occurred) |
| Cat Class 1: | Small loss, small impact |
| Cat Class 2: | Medium loss, moderate impact |
| Cat Class 3: | Large loss, major impact |
| Cat Class 4: | Catastrophic loss, catastrophic impact |

Figure 2: NatCat Service methodology

## Sigma data

Swiss Re historical economic and insured loss data are available per different perils as shown in Figure 3 for the time-period 1970-2019[9]. Swiss Re reports losses above a certain threshold. For example, in 2016, the threshold was set to Economic losses: USD 99.0 million, insured losses (claims): Maritime disasters USD 19.9 million / Aviation USD 39.8 million and other losses USD 49.5 million.

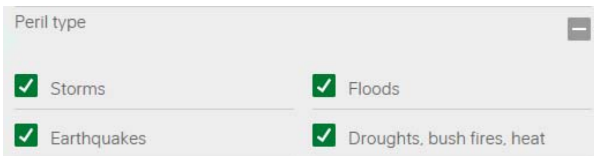



Figure 3: Used perils for the dashboard.

## Consorcio de Compensación de Seguros (CCS) data

In the case of Spain, the insured loss data from the NatCat Service from MunichRe do not take into account the data from the CCS which covers directly losses caused, among others, by flood, earthquake and most of losses caused by windstorms in Spain. We

[9] Note that not Swiss Re loss data are available for droughts, bush fires and heat for Europe when data were collected in September 2020.

have therefore used the data from the CCS[10] for insured losses in Spain instead of the NatCat Service data.

### Score threshold

| Score | Threshold (annual uninsured losses normalised by GDP) (%) |
|---|---|
| **0** | 0 |
| **1** | 0-0.01 |
| **2** | 0.01-0.05 |
| **3** | 0.05-0.1 |
| **4** | >0.1 |

The thresholds have been based on expert judgement to allow for a differentiation between high protection gap (score = 4) and no historical protection gap (score = 0).

**Estimation of today's protection gap**

The main concept behind the formula used to estimate today's protection gap, was inspired by the existing methodology of the dashboard published by the European Commission INFORM[11], which does a quantitative analysis relevant to humanitarian crises and disasters. The Joint Research Center of European Commission is the scientific lead for INFORM. The INFORM model is based on risk concepts published in scientific literature which expresses the risk as:

$$Risk = Hazard * Exposure * Vulnerability$$

In order to accommodate the INFORM methodology, where the vulnerability variable is split among three dimensions, the equation is updated to:

$$Risk = Hazard\&exposure^{1/3} * \text{Vulnerability}^{\,1/3} * \text{Lack of coping capacity}^{\,1/3}$$

In this pilot dashboard, EIOPA has therefore used a similar approach where the risk would also result from combining the hazard, exposure, vulnerability and insurance coverage.

| **Definition** | **Estimated protection gap** |
|---|---|
| **Formula** | Hazard&exposure^(1.5/3)* vulnerability^(0.5/3)* insurance coverage ^(1/3) |
| **Data** | Hazard & exposure, vulnerability, insurance penetration |
| **Data sources** | See below |

[10]https://www.consorseguros.es/web/documents/10184/44193/Estadistica_Riesgos_Extraordinarios_1971_2014/14ca6778-2081-4060-a86d-728d9a17c522
[11]https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Methodology

**Additional explanations:**

More weight is given to the hazard&exposure. Indeed, if there is no or very little exposure to a hazard component then the protection gap should also be low even if the vulnerability is high and insurance coverage is low.

## Exposure to hazard component

In the dashboard, the two risk elements "hazard and exposure" were combined together as the data from the JRC are presented in this way. The JRC did a spatial overlay of a hazard footprint of a particular event and elements at risk.

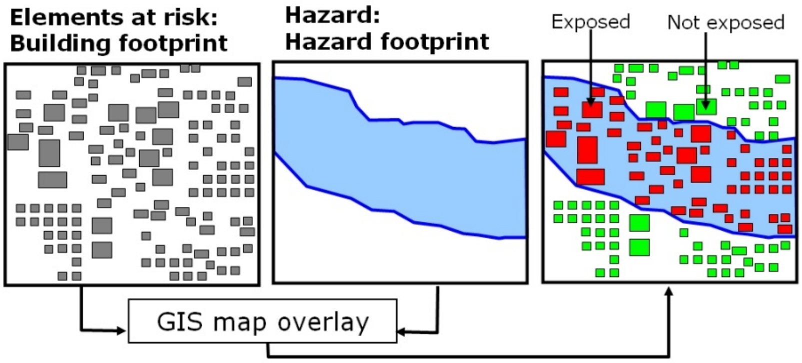



Figure 4: Exposure to hazard component (JRC, 2020)

*Earthquake*

| | |
|---|---|
| **Definition** | **Economic value of residential and commercial square kilometres in light, moderate and heavy potential damage zones normalised by GDP** |
| **Formula** | ((0.1*Residential and commercial km2 in light potential damage zones + 0.3*Residential and commercial km2 in moderate damage zones + 0.6*Residential and commercial km2 in heavy potential damage zones)*(GDP/country area))/(GDP) |
| **Data** | Intensity scale VI (Light potential damage zones) (Residential and commercial km2), Intensity scale VII (Moderate potential damage zones) (Residential and commercial km2), Intensity scale VIII (Heavy potential damage zones) (Residential and commercial km2) and GDP |
| **Data sources** | Risk Data Hub JRC<br>The pan-European seismic hazard map (Giardini et.al., 2013) produced in the context of SHARE project is available at http://www.efehr.org/en/home/ . The GHSL settlement model grid (model that classifies the human settlements on the base of the built-up and population density) was used to assess the "degree of urbanisation" and is available at: http://data.jrc.ec.europa.eu/collection/GHSL<br>Corine Land Cover (g100_clc12_V18_5a), EEA 2016. |

The above formula gives more weight to "Residential and commercial km2 in heavy potential damage zones" in order to get a high score (high score means high risk) whereas give less weight to “Residential and commercial km2 in light potential damage zones”. The weighting was based on an idea of the JRC.

The impacted square kilometres are then multiplied with an economic value of one square kilometre in each country (->GDP/total areas of country).

The score is then normalised with the GDP in order to better compare the different countries. This normalisation should also allow to better weight the impact of the hazard on the exposure (similarly, to what is done for the historical losses).

To assess the number of square kilometres, which are impacted by a certain hazard (see Figure 7), the JRC combines for example, Corine Land Cover data (see Figure 5) with earthquake hazard maps (see Figure 6).

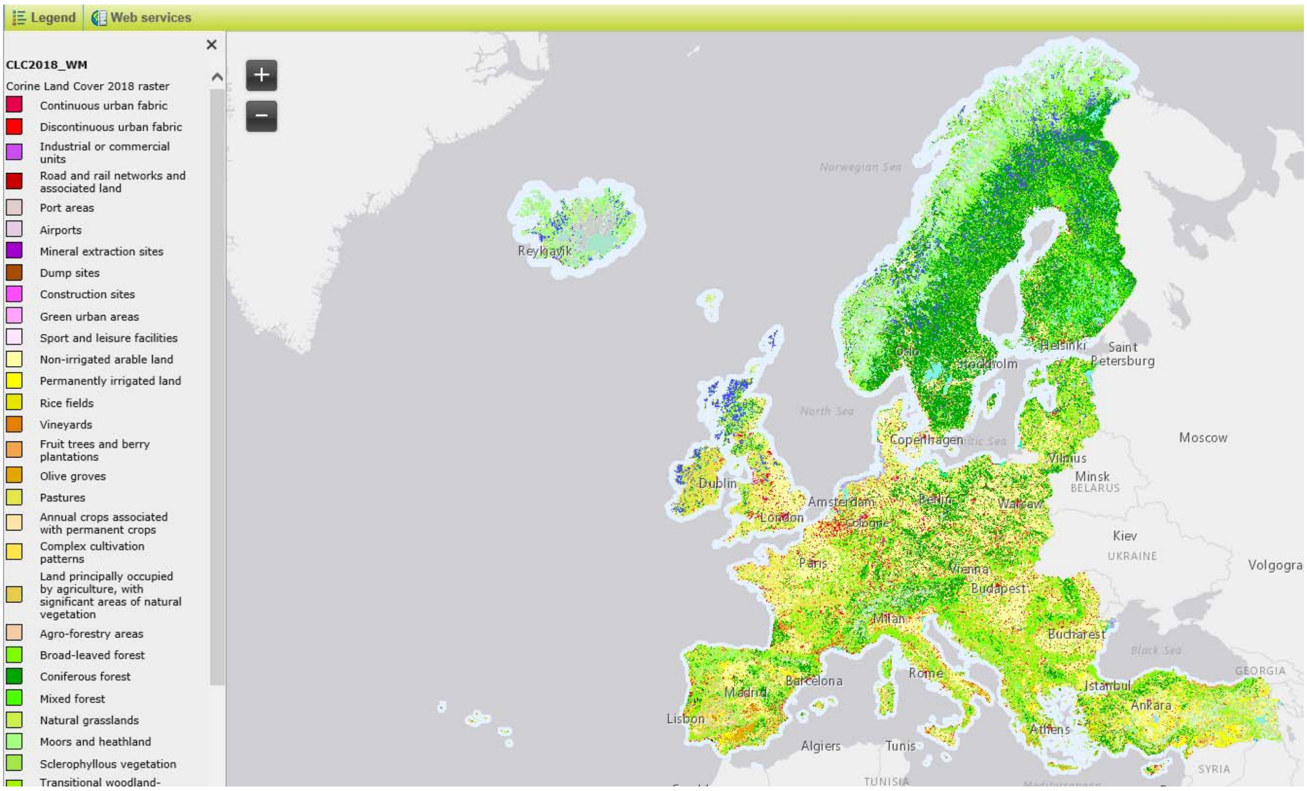



Figure 5: Corine Land use data for Europe.

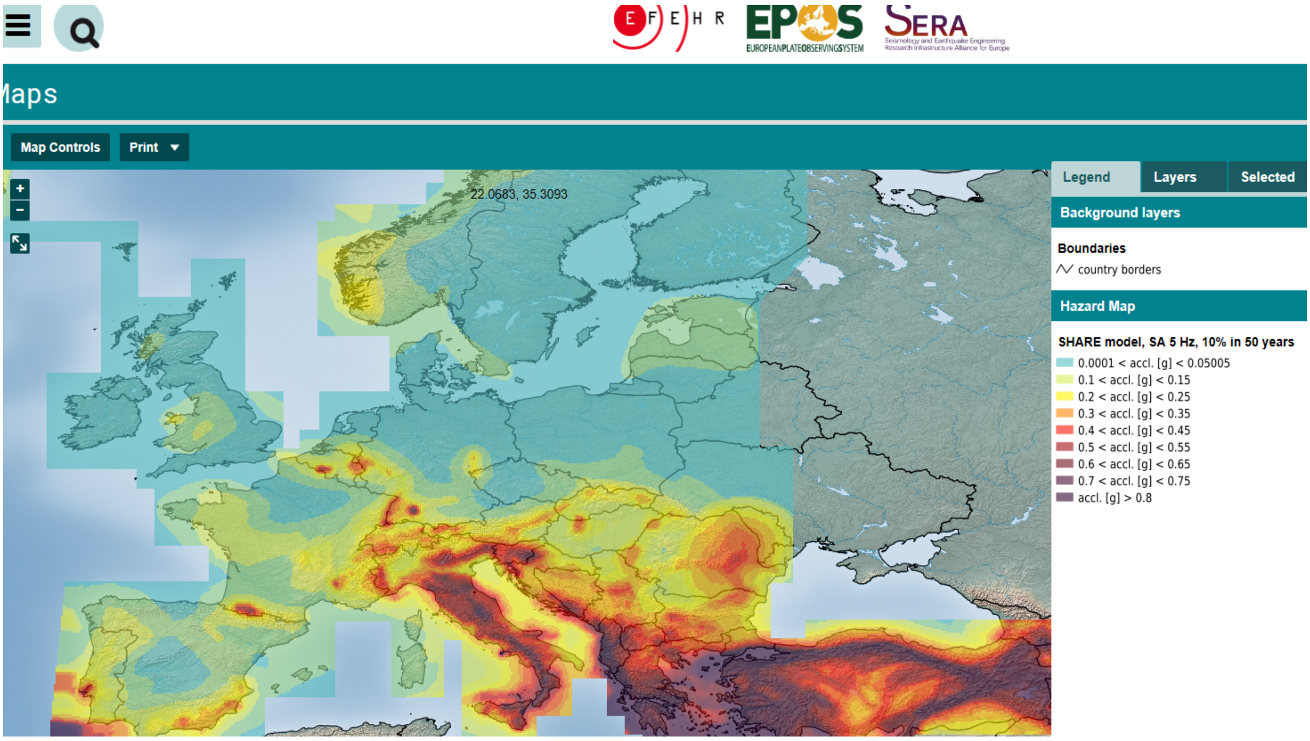



Figure 6: Earthquake hazard map.

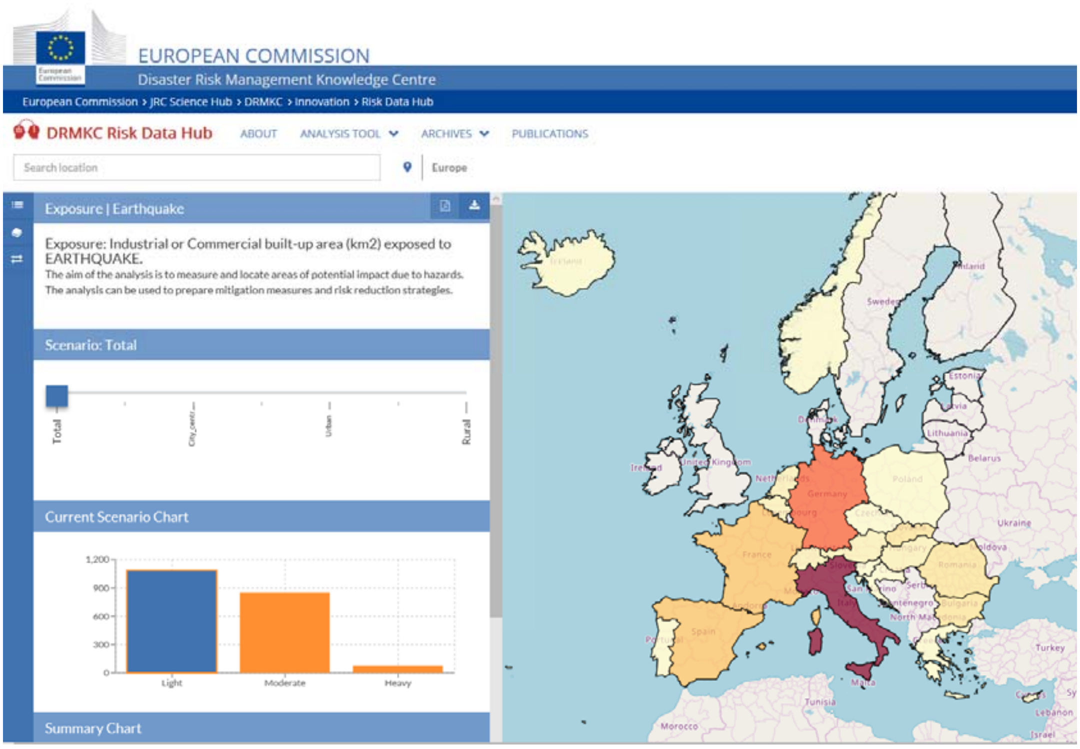



Figure 7: Example of Risk Data Hub data – Commercial building (km2) impacted by earthquake hazard.

For countries where Risk Data Hub data were not available, EIOPA estimated a score using ESPON maps (see Figure 8).

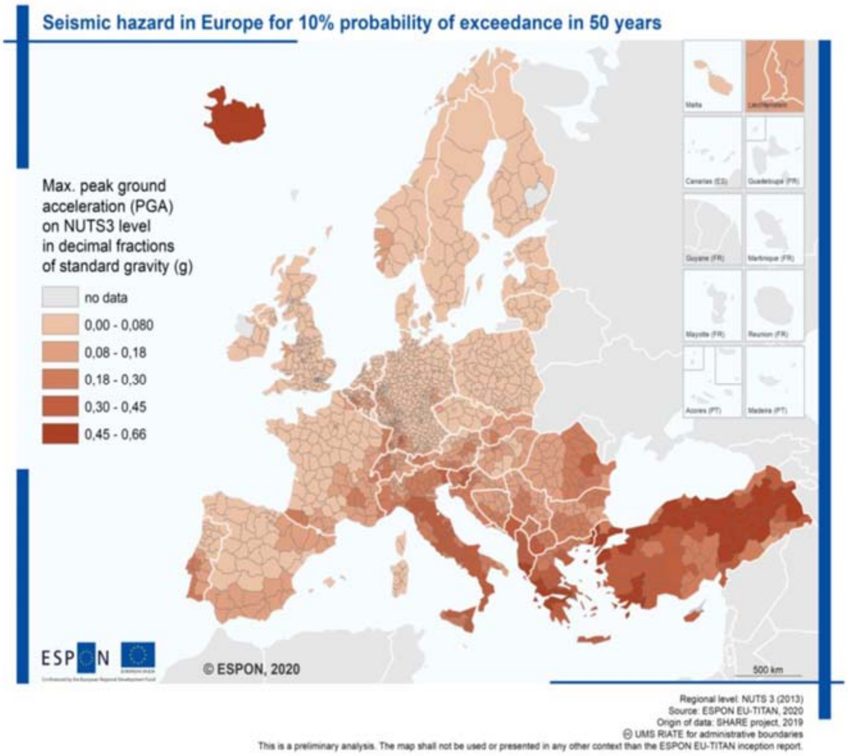



Figure 8:Seismic hazard in Europe.

The scores used in the dashboard for the thresholds are the following:

| Score | Threshold (Economic value of residential and commercial square kilometres impacted by earthquake hazard normalised by GDP) |
|---|---|
| **0** | 0 |
| **1** | 0-0.0005 |
| **2** | 0.0005-0.001 |
| **3** | 0.001-0.005 |
| **4** | >0.005 |

The thresholds have been based on expert judgement to allow for a differentiation between high earthquake exposure hazard (score = 4) and no earthquake exposure hazard (score = 0). Note that the thresholds for wildfire, flood and earthquake exposure to hazard component are similar as they use similar type of data.

*Flood*

| | |
|---|---|
| **Definition** | **Residential and commercial square kilometres impacted by flood hazard normalised by GDP** |
| **Formula** | ((Residential and commercial km2 in 200 RP[12] flood hazard zone)*(GDP/country area))/GDP |

[12] RP: return period - A return period is an average time or an estimated average time between events such as for example earthquakes, floods, landslides, or a river discharge flows to occur.

| | |
|---|---|
| **Data** | 200-year return period (Residential and commercial km2) and GDP |
| **Data sources** | Risk Data Hub JRC<br>The flood inundation maps are available at http://data.jrc.ec.europa.eu/collection/floods . The GHSL settlement model grid (model that classifies the human settlements on the base of the built-up and population density) was used to assess the "degree of urbanisation" is available at: http://data.jrc.ec.europa.eu/collection/GHSL<br>Corine Land Cover (g100_clc12_V18_5a), EEA 2016. |

The impacted square kilometres are multiplied with an economic value of one square kilometres in each country (->GDP/total areas of country).

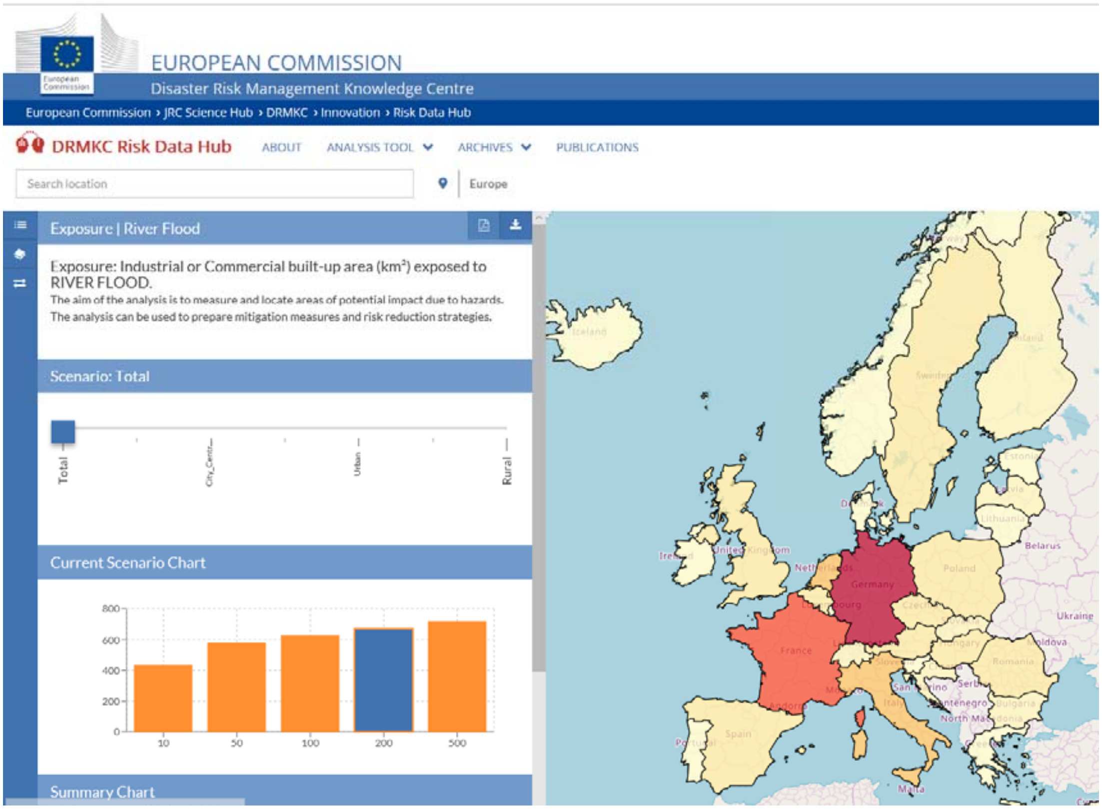



Figure 9: Example of Risk Data Hub data – Commercial building (km2) impacted by flood hazard.

For countries where Risk Data Hub data were not available, EIOPA estimated a score based on ESPON maps (see Figure 10).

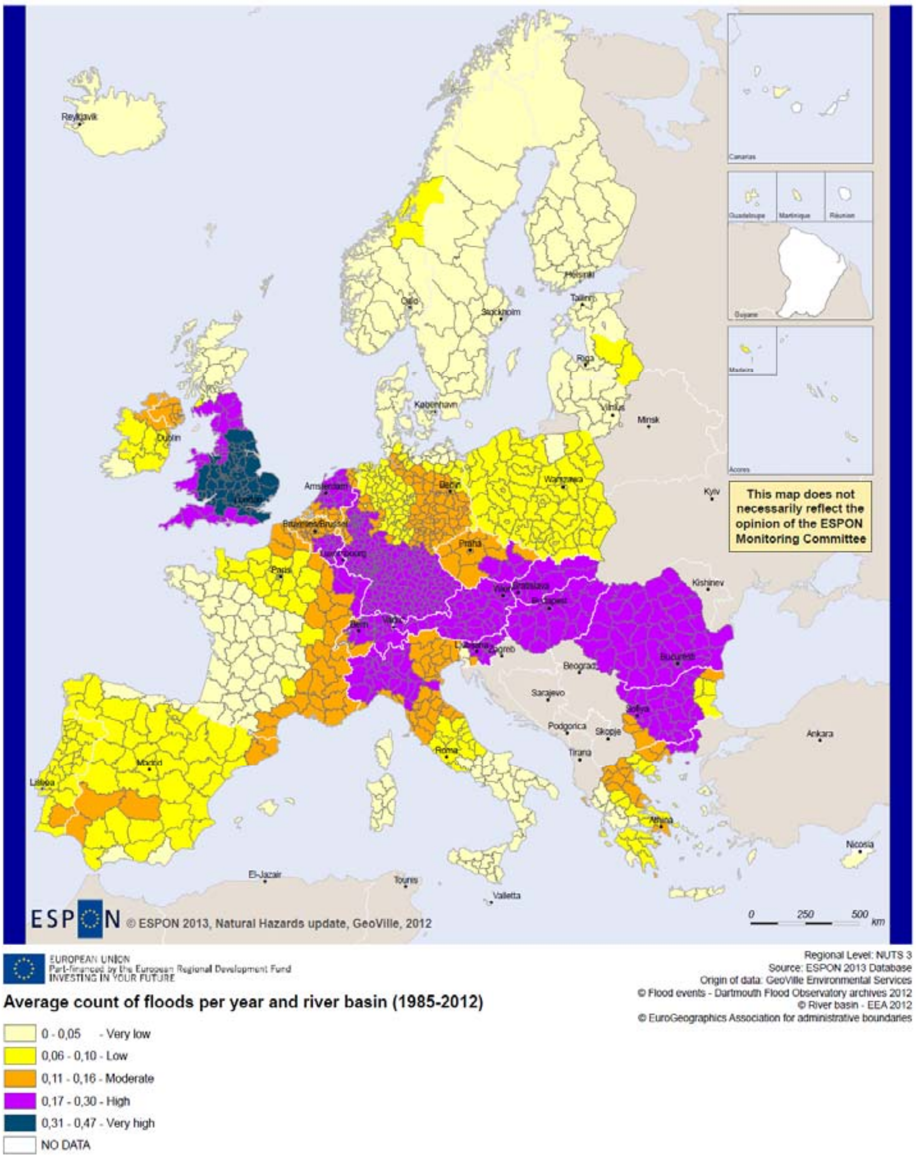



Figure 10: Average floods in Europe.

The score used in the dashboard for the thresholds are the following:

| Score | Threshold (Residential and commercial square kilometres impacted by flood hazard normalised by GDP) |
|---|---|
| **0** | 0 |
| **1** | 0-0.0005 |
| **2** | 0.0005-0.001 |
| **3** | 0.001-0.005 |
| **4** | >0.005 |

The thresholds have been based on expert judgement to allow for a differentiation between high flood exposure hazard (score = 4) and no flood exposure hazard (score = 0). Note that the thresholds for wildfire, flood and earthquake exposure to hazard component are similar as they use similar type of data.

### *Wildfire*

| | |
|---|---|
| **Definition** | **Residential and commercial square kilometres impacted by fire hazard normalised by GDP** |
| **Formula** | ((Residential and commercial km2 in fire hazard zone)*(GDP/area))/GDP |
| **Data** | Residential and commercial km2 and GDP |
| **Data sources** | Risk Data Hub JRC<br>Forest Fires Information system (EFFIS, 2014). The GHSL settlement model grid (model that classifies the human settlements on the base of the built-up and population density) was used to assess the "degree of urbanisation" and is available at: http://data.jrc.ec.europa.eu/collection/GHSL .<br>Corine Land Cover (g100_clc12_V18_5a), EEA 2016. |

The impacted square kilometres are multiplied with an economic value of one square kilometre in each country (->GDP/total areas of country).

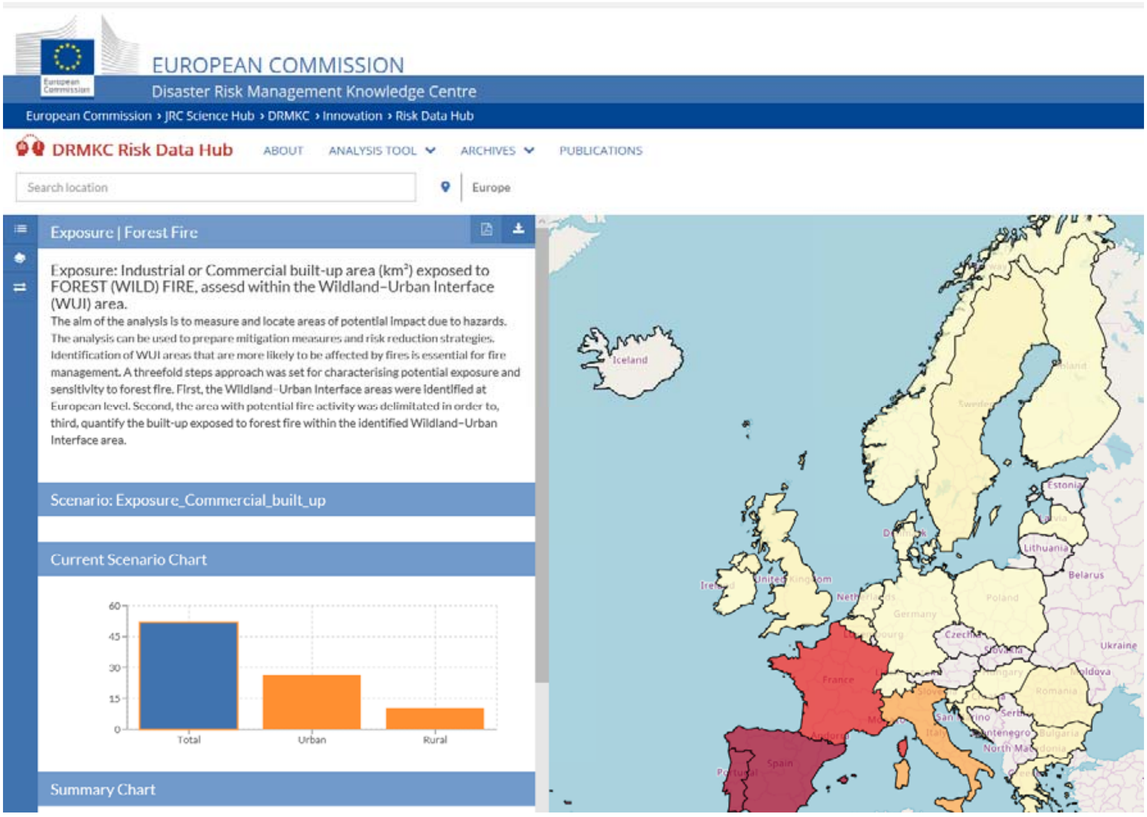



Figure 11: Example of Risk Data Hub data – Commercial building (km2) impacted by fire hazard.

For countries where Risk Data Hub data were not available, EIOPA estimated a score based on ESPON maps (see Figure 12).

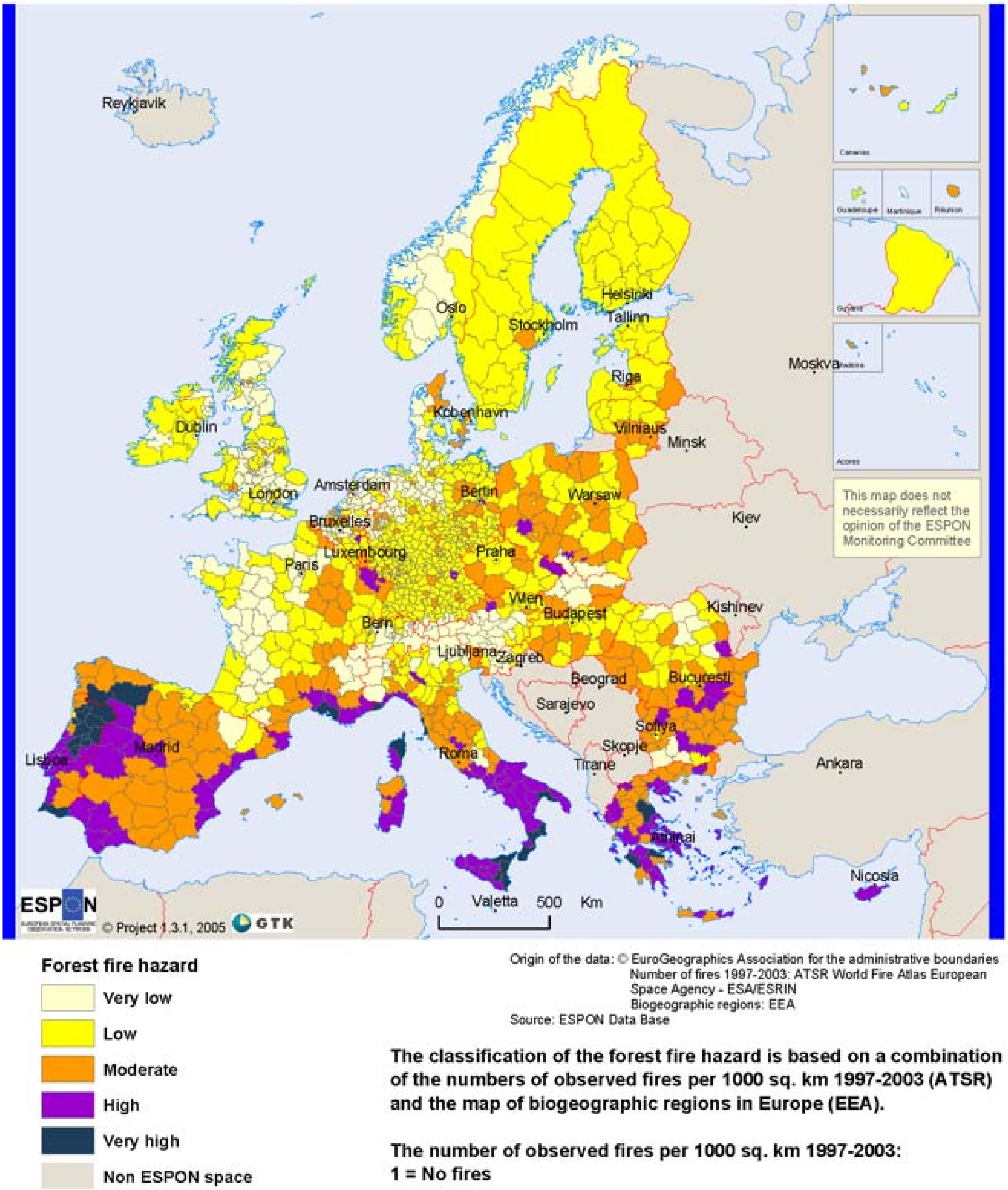



Figure 12: Forest fire hazard in Europe.

The score used in the dashboard for the thresholds are the following:

| Score | Threshold (Residential and commercial square kilometres impacted by fire hazard normalised by GDP) |
|---|---|
| **0** | 0 |
| **1** | 0-0.0005 |
| **2** | 0.0005-0.001 |
| **3** | 0.001-0.005 |
| **4** | >0.005 |

The thresholds have been based on expert judgement to allow for a differentiation between high wildfire exposure hazard (score = 4) and no wildfire exposure hazard (score = 0). Note that the thresholds for wildfire, flood and earthquake exposure to hazard component are similar as they use similar type of data.

*Windstorm*

| **Definition** | **Storm severity index (SSI) divided by GDP** |
|---|---|
| **Formula** | SSI/GDP |
| **Data** | SSI and GDP |
| **Data sources** | WISC |

Currently, windstorms are not available in the Risk Data Hub. Another data source was therefore used, which means that the methodology behind the score is different for windstorms compared to the other perils in the dashboard (earthquake, wildfire and flood). The Storm Severity Index gives an indication of the storm intensity as well as the affected kilometres. It does however not provide any information on the exposure (residential areas, commercial areas…). SSI is calculated across a number of regions (France, Germany, Scandinavia, Iberia, Benelux, Denmark…). It is assumed that the region with no SSI have very little to no windstorm hazard.

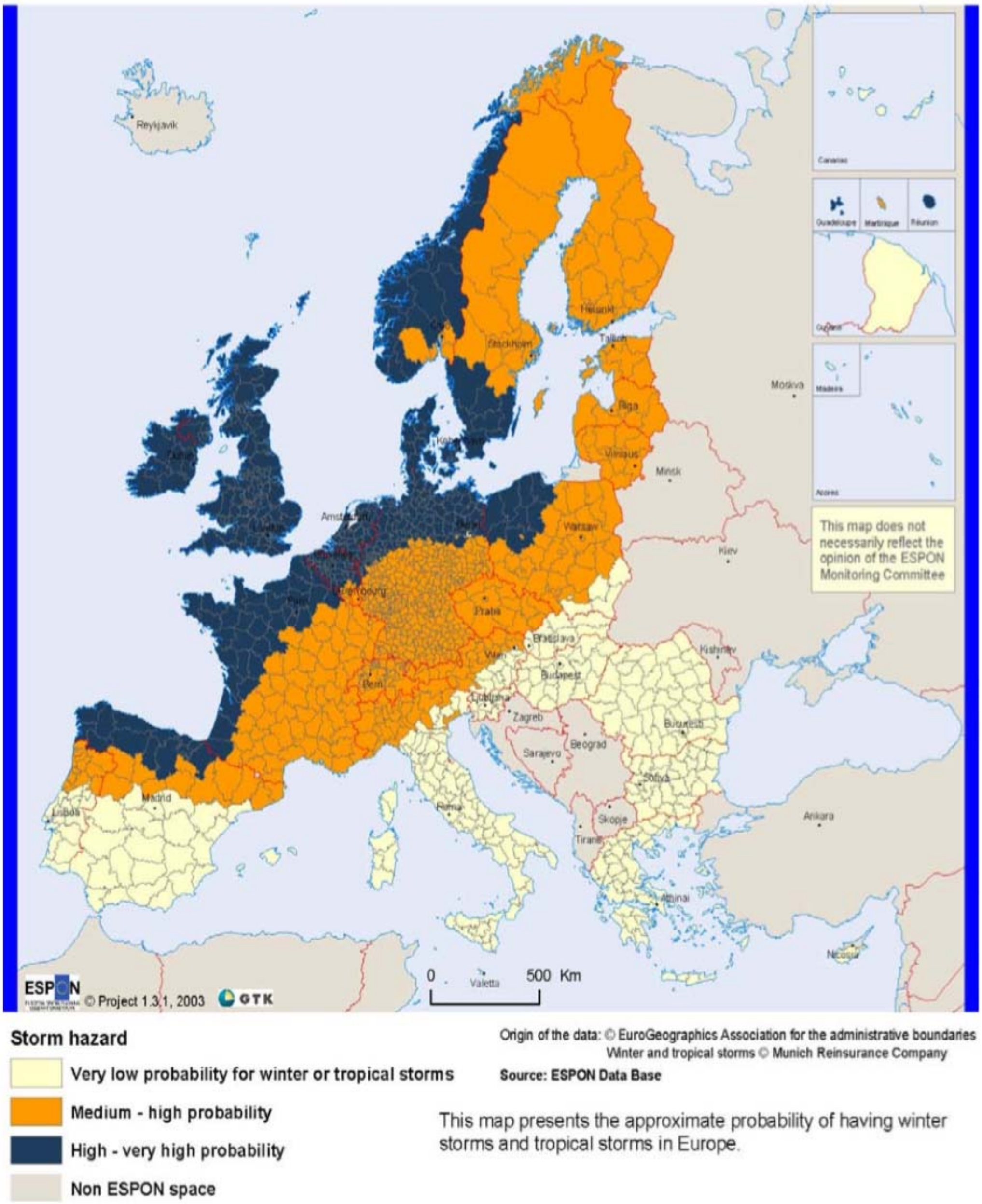
Storm Severity Index (SSI) is defined as:

$$SSI = A * [mean(u_{10m} > 14.7)]^3$$

Where A is the area over land in $km^2$ and u_10m is 10m wind speed calculated from the re-analysis data.

As for some regions such as Scandinavia or Iberia, the SSI was provided for the entire region, EIOPA scaled the SSI down depending on the area that each country represented compared to the entire countries area.

For countries where Risk Data Hub data were not available, EIOPA estimated a score based on ESPON maps (see Figure 13).




**Map 11. Winter storms**

Figure 13: Winter or tropical storms[13] hazard in Europe.

The score used in the dashboard for the thresholds are the following:

| Score | Threshold: SSI / GDP |
|---|---|
| **0** | 0 |
| **1** | 0-50 |
| **2** | 50-100 |
| **3** | 100-150 |

[13] Extratropical cyclones are also winter storms.

| | |
|---|---|
| **4** | >150 |

The thresholds have been based on expert judgement to allow for a differentiation between high windstorm exposure hazard (score = 4) and no windstorm exposure hazard (score = 0). Note that the threshold are different as for wildfire, earthquake and flood. This is due to the fact that the data used to derive the score for windstorm are different as windstorm in not available in the Risk Data Hub. As soon as windstorms will be available in the Risk Data Hub, EIOPA will use these data to have a uniform methodology among the perils considered in the dashboard (earthquake, flood and wildfire).

## Vulnerability

The vulnerability is an important element of the risk and looks at the conditions determined by for example physical factors, which increase the susceptibility of an object to the impact of hazards. In this dashboard, EIOPA considers the vulnerability on the buildings. For example, for earthquake, EIOPA has looked into seismic resistant building codes.

*Earthquake*

| **Definition** | **Building vulnerability** |
|---|---|
| **Formula** | 4*% of building designed with no code + 2*% of building designed with moderate-level code + % of building designed with high-level code |
| **Data** | Building designed with no code, Building designed with moderate-level code and Building designed with high-level code |
| **Data sources** | JRC – Palermo et al. 2018 https://ec.europa.eu/jrc/en/publication/building-stock-inventory-assess-seismic-vulnerability-across-europe-0 |

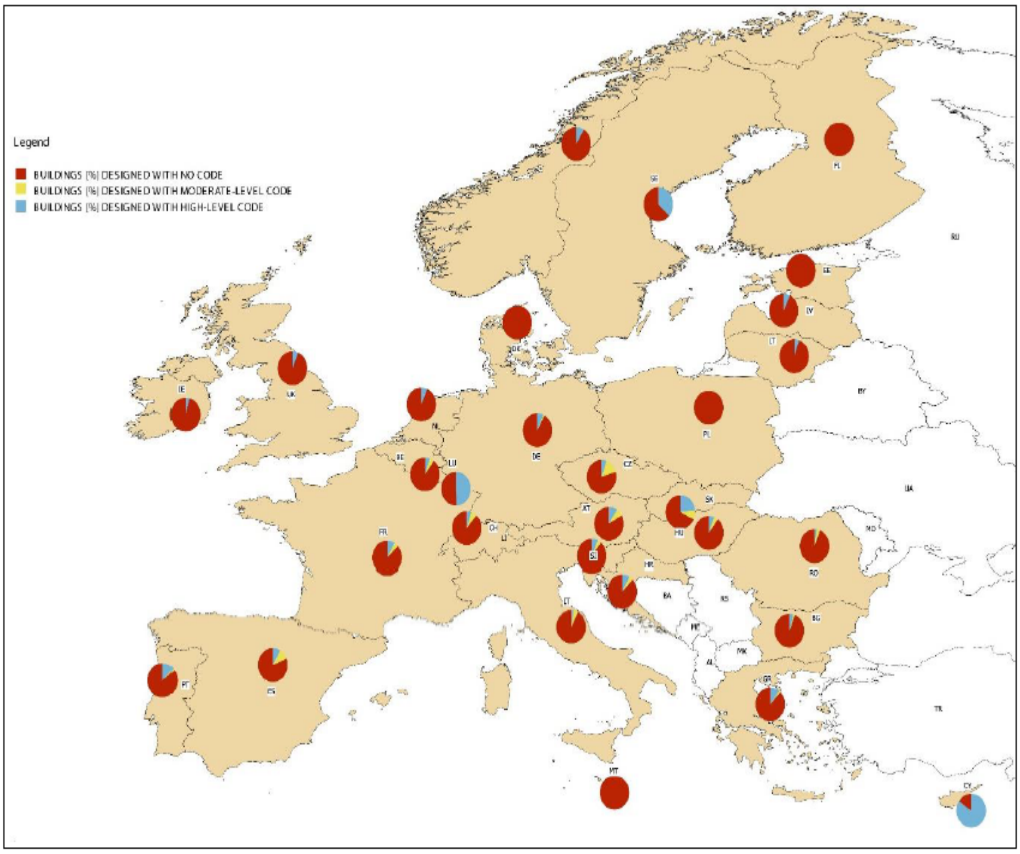



Figure 14: Earthquake resistant design level of the building stock across Europe (Palermo et al., 2018).

The score used in the dashboard for the thresholds are based on the following approach:

The formula defined in the table above allows to directly derive the score. For example, if 100% of building are designed with no code then score = 4, if 100% of the building are designed with high level code then score = 1 etc.

### *Windstorm*

| **Definition** | **Building vulnerability** |
|---|---|
| **Formula** | 4*Weakest outbuildings+4*Outbuildings+3*Strong outbuilding+3*Weak brick structure+2*Strong brick structure+concrete building |
| **Data** | Weakest outbuildings ratio, Outbuildings ratio, Strong outbuilding ratio, Weak brick structure ratio, Strong brick structure ratio, concrete building ratio |
| **Data sources** | WISC |

The score used in the dashboard for the thresholds are based on the following approach:

The formula defined in the table above allows to directly derive the score. For example, if 100% of building are designed with the weakest outbuilding then score = 4, if 100% of the building are designed as concrete building then score = 1 etc.

### Insurance coverage

| Definition | Insurance coverage |
|---|---|
| Formula | (2*score insurance penetration + score policy condition)/3 |
| Data | See below |
| Data sources | See below |

More weight was given to the insurance penetration as this is assumed to be the main parameter in the insurance coverage. However, policy conditions are also an important aspect: even if insurance penetration is high, if the contractual limits are low or the deductibles are high, the policyholder will not be well protected.

| Definition | Insurance penetration |
|---|---|
| Formula | Based on NCAs judgement and available literature compiled a qualitative estimation of the insurance penetration. |
| Data | NCA expert judgement, Hudson et al. 2019; OECD 2016&2018; Insurance Europe; EC 2017; Tesselaar et al. 2020. |
| Data sources | NCA's expert estimations<br>Literature |

Score threshold:

| Score | Threshold |
|---|---|
| 0 | Very high penetration rate |
| 1 | High penetration rate |
| 2 | Medium penetration rate |
| 3 | Low penetration rate |
| 4 | Very low penetration rate |

The thresholds have been based on expert judgement to allow for a differentiation between very low insurance penetration rate (score = 4) and very high insurance penetration (score = 0).

| Definition | Policy conditions |
|---|---|
| Formula | (score deductible + score limit)/2 |
| Data | Policy condition data (deductibles and limits as a percentage of sum insured). |
| Data sources | Data collected by EIOPA[14]. |

[14] EIOPA was able to use data collected as part of a data collection exercise on policy conditions, conducted for the purpose of assessing policy conditions under the 2020 review.

| Score | Thresholds for deductible (% of sum insured) |
|---|---|
| **0** | 0 |
| **1** | 0-0.01 |
| **2** | 0.01-0.05 |
| **3** | 0.05-0.1 |
| **4** | >0.1 |

The thresholds have been based on expert judgement to allow for a differentiation between very high deductibles (score = 4) and no deductibles (score = 0).

| Score | Thresholds for limit (% of sum insured) |
|---|---|
| **0** | 1 |
| **1** | 0.9-1 |
| **2** | 0.7-0.9 |
| **3** | 0.5-0.7 |
| **4** | <0.5 |

The thresholds have been based on expert judgement to allow for a differentiation between very low limits (score = 4) and no limits (score = 0).

In addition, the dashboard also provides information about the insurance schemes in place in the different member states. This information is currently not used to derive the final score for the insurance coverage.

**Aggregated views**

### EU level

The dashboard also offers a view at EEA level. This view is a simple average of the Member state scores.

### All perils

The dashboard also offers a view for all perils combined together. This view is a simple average of the different perils.

## Summary of the used data and expert judgements

The data and expert judgements used in the dashboard are summarised in the below table. All thresholds used in the dashboard are based on expert judgement. The formula to derive the indices was inspired by the existing methodology of the dashboard published by the European Commission INFORM.

| **Main module** | **Sub module** | **Category** | **Input data** | **Comments** |
|---|---|---|---|---|
| Historical protection gap | | | Data Munich Re, Swiss Re | Methodologies for collecting historical losses are not aligned between different data sources used to collect historical losses. Reliance on data which are not fully open source (i.e. not always possible to access the loss per event for example). Reliance on data from the private sector, which may limit use for public purposes. Data used in the dashboard are not publicly accessible anymore (i.e. NAT CAT SERVICE from MunichRe) |
| Estimated protection gap | Exposure to hazard component | Earthquake | Risk Data Hub Data and complemented with ESPON study. | Only affected square kilometres are available, there is no monetary value associated to the metric. |
| Estimated protection gap | Exposure to hazard component | Flood | Risk Data Hub Data and complemented with ESPON study. | Only affected square kilometres are available, there is no monetary value associated to the metric. |
| Estimated protection gap | Exposure to hazard component | Wildfire | Risk Data Hub Data and complemented with ESPON study. | Only affected square kilometres are available, there is no monetary value associated to the metric. |

| | | | | |
|---|---|---|---|---|
| Estimated protection gap | Exposure to hazard component | Windstorm | WISC Data and complemented with ESPON study. | Data missing for windstorm in Risk Data Hub (another approach was therefore used for windstorms). |
| Estimated protection gap | Vulnerability | Earthquake | Academic Data. | Data missing for wildfire and flood.<br>Not straightforward to find available data. |
| Estimated protection gap | Vulnerability | Windstorm | WISC Data | Not straightforward to find available data. |
| Estimated protection gap | Insurance coverage | Insurance penetration | Expert judgement (from NCAs) and complemented with data when available. | Data are compiled from various sources and the definitions used for the insurance penetration might differ.<br>No harmonised source of data and definitions is available.<br>Reliance on qualitative description of the insurance penetration. |
| Estimated protection gap | Insurance coverage | Deductibles and limits | Data | For policy conditions: Data currently collected can suffer from a lot of biases as the collected sample might not be consistent between the different Member States. |

# References

EC, 2017. Background information: Insurance of weather and climate related disaster risk: Inventory and analysis of mechanisms to support damage prevention in the EU. https://op.europa.eu/en/publication-detail/-/publication/4f366956-a19e-11e7-b92d-01aa75ed71a1/language-en

EIOPA (2019). Staff discussion paper: Protection gap for natural catastrophes.

Giardini D. et al (2013) Seismic Hazard Harmonization in Europe (SHARE): online data resource. doi:10.12686/SED-00000001-SHARE

Hudson et al., 2019. Flood insurance arrangements in the European Union for future flood risk under climate and socioeconomic change. *Global Environmental Change*, *58*, 1-13. [101966]. https://doi.org/10.1016/j.gloenvcha.2019.101966

JRC (2020). Risk Data Hub - Data structure and availability.

Monti, A. and Tagliapietra, C. (2009). Tracking insurance industry exposure to CAT Risks and quantifying insured and economic losses in the aftermath of disaster events: a comparative survey.

OECD, (2016). Financial Management of Flood Risk. http://www.oecd.org/daf/fin/insurance/Financial-Management-of-Flood-Risk.pdf

OECD, (2018). Financial Management of Earthquake Risk. www.oecd.org/finance/Financial-Management-of-Earthquake-Risk.htm

Palermo et al., (2018). Building stock inventory to assess seismic vulnerability across Europe. 10.2760/530683

Tesselaar et al., (2020). Impacts of Climate Change and Remote Natural Catastrophes on EU Flood Insurance Markets: An Analysis of Soft and Hard Reinsurance Markets for Flood Coverage. Atmosphere 2020, 11, 146; doi:10.3390/atmos11020146

**EIOPA**

Westhafen Tower, Westhafenplatz 1
60327 Frankfurt – Germany
Tel. + 49 69-951119-20
info@eiopa.europa.eu
https://www.eiopa.europa.eu