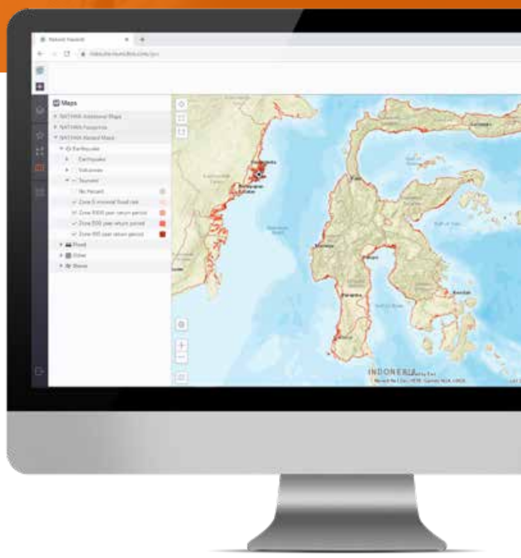
NOT IF, BUT HOW

Munich Re's Location Risk Intelligence
Natural Hazards Edition

Fact Sheet Version 2021/07



Location analytics for advanced decision making – comprehend your current risk landscape in eye-opening ways. Natural Hazards Edition connects local and real-time data seamlessly.

Integrated into your digital workflows, Natural Hazards Edition drives your spatial exploration, visualisation and evaluation. It automates the entire process of creating scalable insights from big data. Our market-leading filter options empower you by giving you deeper insight into new business opportunities. The next generation of geospatial services link multiple technological developments such as cloud-based data and artificial intelligence into a powerful decision-making solution. We are constantly pushing the envelope towards this goal.

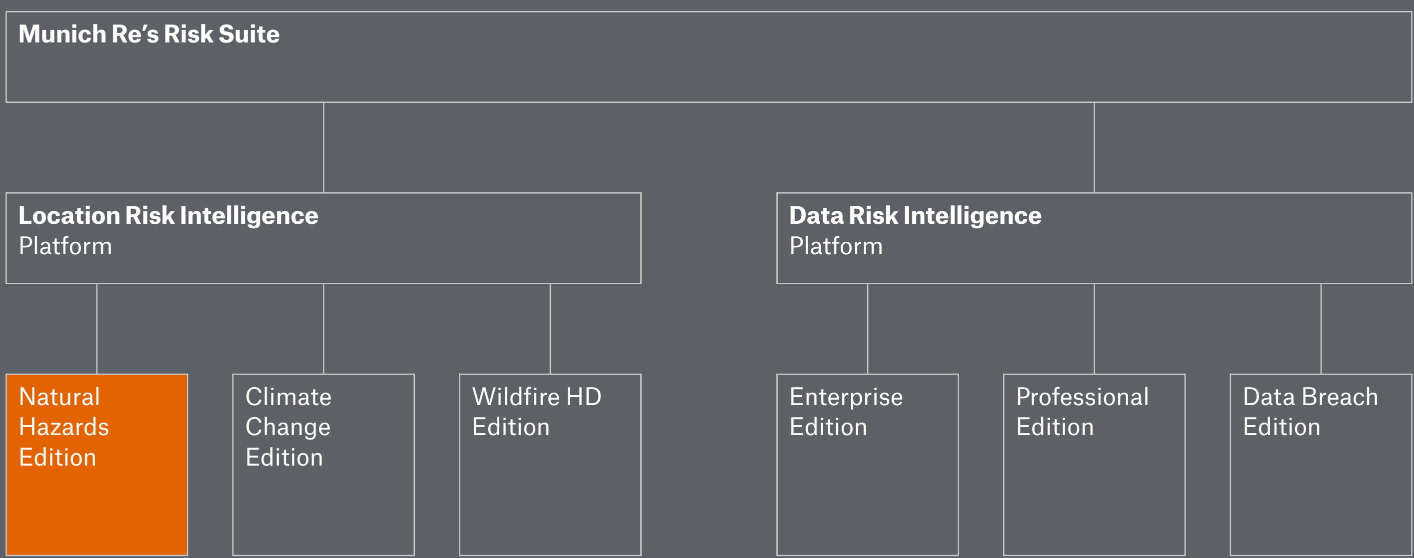
The evaluation criteria can be extended modularly at any time by adding those of the "Climate Change Edition" and additional modules.

Munich Re's Risk Suite

Munich Re's Risk Suite is a range of modular risk solutions provided as a software portfolio by Munich Re Service GmbH, a wholly owned subsidiary of the world's leading reinsurer.

It offers companies access to the risk management tools developed in-house and the knowledge and experience of 140 years of one of the world's leading providers of reinsurance, primary insurance and insurance-related risk solutions. Since the introduction of Nathan (Natural Hazards Assessment Network), Munich Re has been a pioneer in the global assessment of natural hazard risks. Munich Re's Risk Suite builds on this expertise and offers a selection of well-engineered risk assessment solutions for technical underwriting, data protection, investment decisions and climate change analysis.

On the other hand, Munich Re's Risk Suite draws on years of experience in global data transfer under regulatory requirements. Against this extensive background of experience, highly efficient solutions for data protection and IT security management were developed, originally for internal use, which ideally complement Munich Re's Risk Suite and thus provide companies with a comprehensive set of tools that covers the management of all risk aspects relevant to a company and is continually being developed further in view of the expected further increase in complexity in the field of data and IT security protection.



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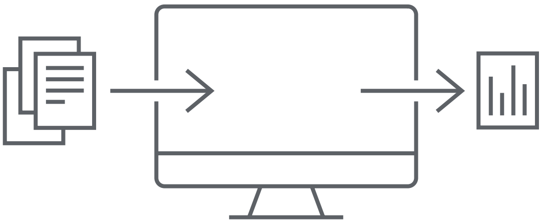
Potential and advantages of Natural Hazards Edition of Location Risk Intelligence

Natural Hazards Edition is the ideal modular SaaS solution for companies who want to reliably evaluate the current status of their portfolios or individual locations.

Munich Re offers high-quality natural hazard expertise to perform efficient exposure analyses of your individual risk locations or entire portfolios. You can cluster main risk hot spots, filter dynamically and identify accumulations in your portfolio to greater understanding for better decisions. You can also increase the profitability of your business with optimum risk diversification and advanced portfolio management. Over 50 million risk assessments every year and an annual customer satisfaction score of over 90% demonstrate that this is a globally proven, trusted tool.

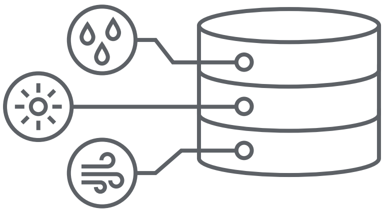


Easy input & output

Portfolio upload and filter search tools/ options for an easy start as well as APIs and different file options for a quick output of the results.

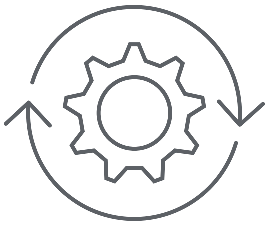
Easy to interpret visualisation

Clear visualisation of the risk scores based on performance indicators in different map types as well as colour shading.



Largest global data collection on natural hazards

40 years of natural hazards data collection from Munich Re combined with state-of-the-art scientific data sets for relevant risk scores.



Advanced analytics

Analyze your portfolios with regards to risks emerging from natural hazards.

Maximum flexibility	– Single location, portfolio (multiple locations) and area & line requests – API (Application Programming Interface) – 100% browser based, no plugin or download needed
Search options	– Postal address – Regions, e.g. states – Geo-coordinates (latitude-longitude)
Tools	– Text search – Drawing tools for filtering a portfolio or for scoring a drawn object: polygon, circle, line – GeoJSON upload
Portfolio management	– Easy management and organisation of the locations – Uploading your own portfolio from CSV or Excel (templates available)
Available content	– Scores of 12 Natural Hazard types – Four types of Risk Scores reflecting potential financial damages that we use for our own business – Track record of using Natural Hazard scores for our own business – Additional data sets as optional modules: GEM, ZÜRS, Wildfire HD (USA, Canada, Australia), JBA – Integration of own data sets like GEO data or portfolio location set
Advanced analytics	– Peril-specific evaluations with twelve different hazard categories – Different event families (geophysical, meteorological, hydrological, climatological)
Areas and lines scoring	– Scoring of geographical areas and lines for improved risk management of e.g. large sites or infrastructure assets – Comparison of scored areas and lines
Visualisation based on KPIs (Key Performance Indicators)	– Cluster – Heatmap – Grid – Regions (administrative and postcode regions, CRESTA zones) – Hazard maps for multiple time points and scenarios
Map views	– Streets – (Dark) grey – Hybrid – Satellite – OpenStreetMap – Topography – Terrain
Elevation profiles	– Height difference between two locations displayable
Reports and results	– Download as CSV, Excel or PDF – API access for individual further processing of the data – Clear visualisation of results (e.g. sum insured in different risk zones) in pie charts, tables and coloured heatmaps – Peril-specific evaluations with twelve different hazard categories

High value platform functionalities

Single location assessment

Using single location assessment, you can score hazard risks for individual locations using location search. The location search works both by coordinates and by name. Based on what your needs are, you can search for NATHAN scores or climate scores.

The scores are offered in two types: Risk scores to identify red flags and hazard zones to dive into the details.

Location geocoding

The Location Risk Intelligence application includes an integrated geocoder for location visualisation based on an address search within the application.

Geocoder transforms the description of a location, such as an address, or a name of a place to latitude and longitude coordinates on the earth's surface, which can be used for risk analysis.

Map services

Map services are the visualisation of the available hazard datasets and are provided for all the maps you can find in Location Risk Intelligence.

Via the map services endpoint in the API you can visualise the maps in your dedicated working environment.

Elevation profiles

Location Risk Intelligence allows to create elevation profiles between any two locations on the map.

By simply drawing a line between two points you can analyse the elevation (height above sea level) in a graph for the entire distance.

Traffic light visualization

Location Risk Intelligence provides hazard scores on a normalized scale, visualized by "traffic light" colours that are easy to interpret.

We therefore classified the hazard exposure into five categories: no or very low exposure, low exposure, medium exposure, high exposure and very high exposure. The traffic light visualisation simplifies the identification of red flags across hazards.

Location set filtering

Allows you to filter your location set according to different attributes like risk scores, per country, or depending on the level of geocoding quality. If your data contains additional attributes, you can use them as filter options as well.

Corresponding diagrams are shown per peril and selected filters are applied. You can download the results of your analysis as a CSV or Excel file or create a PDF report.

Portfolio assessment

Portfolio assessment allows you to score a set of assets, also called a portfolio. You can easily review the distribution of your portfolio across different hazard zones and filter by risk scores to identify red flags.

You can also run an analysis on your portfolio by filtering for different attributes in your location set. In addition you can also download reports from the portfolio assessment in the format of your choice.

Save locations

Location Risk Intelligence provides you with the option to save the results of your location assessment.

This means you don't need to score each time. Instead, you can view your assessment from the past whenever you want.

REST API

Location Risk Intelligence provides you with the option of getting all scores with the help of a REST API.

By using this stateless protocol, you can seamlessly integrate almost all assessment tools and data sets from Location Risk Intelligence into your own application environment. APIs are offered in 2 tiers: API Standard and API Advanced.

Areas and lines scoring

Location Risk Intelligence now expands its risk scoring capabilities from points to lines and areas. Business data is not always ideally represented by an address or a coordinate. This is the case, for example for railway lines, oil and gas pipelines, roads, airports, industrial plants and ecological areas.

Areas and lines scoring capabilities show the percentage of an area exposed to natural hazards.

Scores you can score with

Risk scores are a powerful tool to help you assess real risk situations, by providing a measure of financial loss potential for standard industrial businesses.

Risk Scores

While hazard zones describe the exposure of a location to a given hazard, Risk Scores describe the vulnerability, i.e. the magnitude of potential financial damage. We provide one Overall Risk Score as well as three Risk Scores for individual insurance coverage types, i.e. earthquake, flood and storm.

The Overall Risk Score can be used as a primary identifier of red flags.

Financial damage caused by e.g. tropical cyclone or hail events can differ substantially. Additionally, the financial damages that can be caused by all individual hazards need to be summed up to represent the total damage potential. Hence, for the Overall Risk Score, all individual hazards are weighted depending on their damage potential (derived from Munich Re`s proprietary collection of financial losses) and the corresponding risk scores are summed up.

The Earthquake Risk Score can be used to identify earthquake related risks and includes earthquake, volcano and tsunami risk.

The Storm Risk Score can be used to identify storm related risks includes tropical cyclone, extratropical storm, hail, tornado and lightening risk.

The Flood Risk Score can be used to identify flood related risks includes river flood, flash flood and storm surge risk.

Natural Hazards Defended scores*

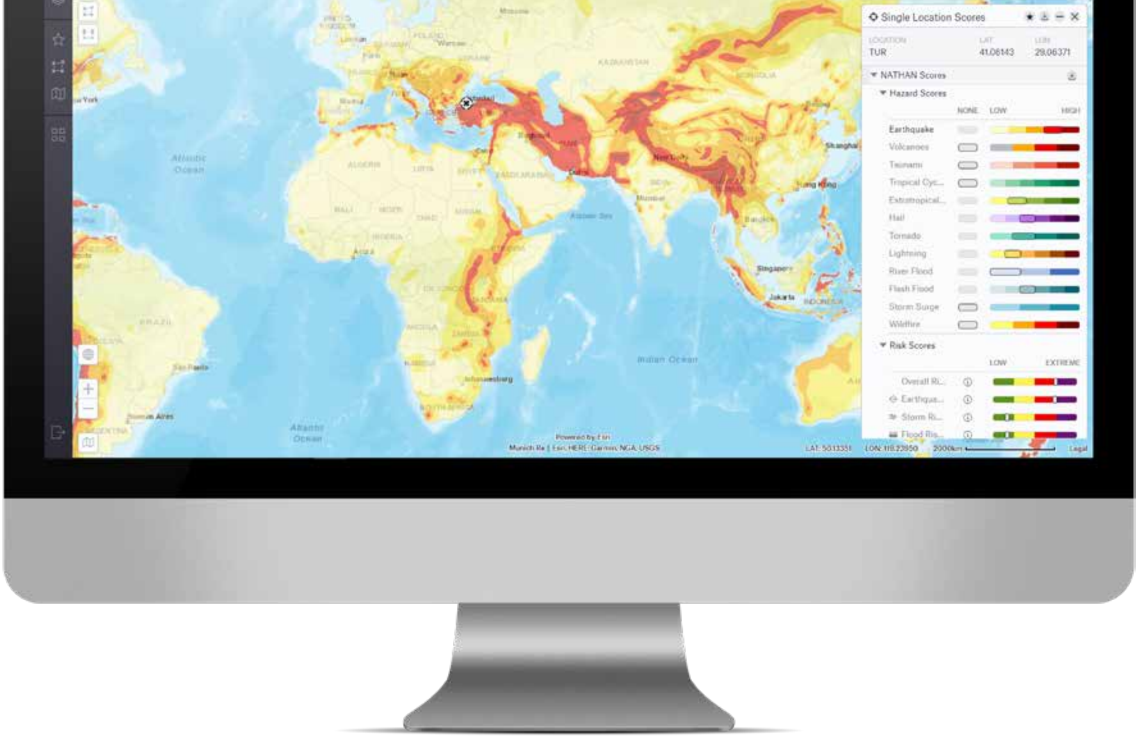
Natural Hazards Defended scores take into account flood defenses, licensed by JBA. They are calculated for the hazards of river flood and storm surge. Due to a conservative threshold, differences between defended and undefended scores affect at the moment only the Netherlands and Belgium.

*available on request

Earthquake Risk Scores
are visualized on the map
and can be used for
advanced analysis.

Storm Risk Scores
are visualized on the map
and can be used for
advanced analysis.

Flood Risk Scores
are visualized on the map
and can be used for
advanced analysis.



Earthquake

The earthquake map is graded according to the intensity that is to be expected once in a period of 475 years.

Intensity integrates a number of parameters such as ground acceleration and earthquake duration. The return period of 475 years corresponds to a 10% exceedance probability in 50 years, which represents the mean service life of modern buildings. The intensity is expressed in terms of the modified Mercalli scale (MM).

The earthquake map is based on an assemblage of existing hazard maps of individual countries. The source maps show:

- The minimum intensity or peak acceleration to be expected for an exceedance probability of 10% in 50 years
- The same parameters but for a different reference period
- The maximum intensity observed
- Active or potentially active faults
- Epicentres of earthquakes recorded by instruments and/or historical earthquakes

Merging such heterogeneous sources presents enormous problems, beginning with the process of converting acceleration values into macroseismic intensity, for which various formulas have been proposed (e.g. Trifunac and Brady 1975, Murphy and O'Brien 1977).

Summary:

Values in map show: probable maximum intensity (MM: modified Mercalli scale) with an exceedance probability of 10% in 50 years (equivalent to return period of 475 years) for medium subsoil conditions.

Creation Date: 2012
Last Modification: 2016
Data Type: Shapefile (Polygons)
Coverage: Global
Source: Munich Re

Global Earthquake Model (GEM)

The Global Earthquake Model (GEM) Global Seismic Hazard Map (version 2018.1) depicts the geographic distribution of the Peak Ground Acceleration (PGA) with a 10% probability of being exceeded in 50 years, computed for reference rock conditions (shear wave velocity, VS30, of 760–800 m/s).

The map was created by collected maps computed using national and regional probabilistic seismic hazard models developed by various institutions and projects, and by GEM Foundation scientists. The OpenQuake engine, an open-source seismic hazard and risk calculation software developed principally by the GEM Foundation, was used to calculate the hazard values. A smoothing methodology was applied to homogenize hazard values along the model borders.

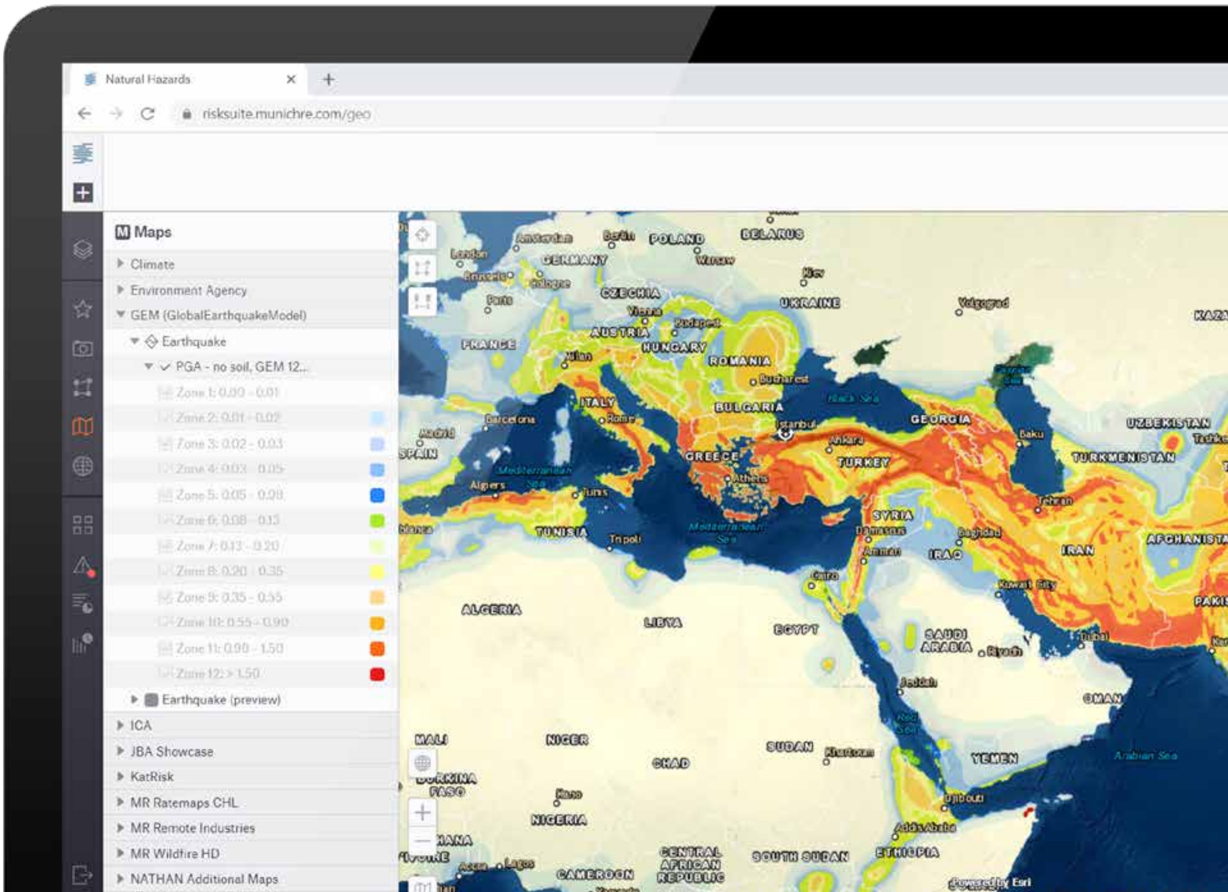
The map is based on a database of hazard models described using the OpenQuake engine data format (NRML); those models originally implemented in other software formats were converted into NRML. While translating these models, various checks were performed to test the compatibility between the original results and the new results computed using the OpenQuake engine. Overall the differences between the original and translated model results are small, notwithstanding some diversity in modelling methodologies implemented in different hazard modelling software. The hashed areas in the map (e.g. Greenland) are currently not covered by a hazard model.

The map and the underlying database of models are a dynamic framework, capable of incorporating newly released open models. Due to possible model limitations, regions portrayed with low hazard may still experience potentially damaging earthquakes.

Summary:

The GEM Global Seismic Hazard Map version 2018.1 (Pagani et al., 2018) depicts the geographic distribution of the Peak Ground Acceleration (PGA) with a 10% probability of being exceeded in 50 years, computed for reference rock conditions (shear wave velocity, Vs30, of 760–800 m/s).

Creation Date: 2018
Data Type: Shapefile (Polygons)
Coverage: Global
Source: GEM (Global Earthquake Model) Foundation



Volcano

The volcano hazard map is based on the activities of volcanoes. All volcanoes are located and mapped by coordinates. Munich Re calculated the volcanic hazard on the basis of the VEI (volcano explosivity index, US Geological Survey) and its annual return periods given for each VEI index.

As far as technically possible, all volcanoes with known VEI data are classified. 719 volcanoes are therefore classified and the other 830 remain unclassified with no information, due to the fact that those volcanoes have not been investigated or are insufficiently investigated.

Each of the 719 volcanoes is given three buffer zones with 10km, 50km and 100km radius. Each buffer zone is assigned with an annual return period of being affected by volcanic hazard. For a 10km buffer, VEI 2–7 are considered for the calculation of the return period, VEI 3–7 are considered for a 50km buffer, and VEI 5–7 for a 100km buffer. This is due to the fact that the area around a volcano affected by an eruption corresponds to the explosion intensity, e.g. a small radius area is affected by small to large eruptions while a large radius area is only affected by large eruptions. The buffer zones are given their different hazard index depending on the range of the return period. The 830 unclassified volcanoes are given a standard buffer of 50km.

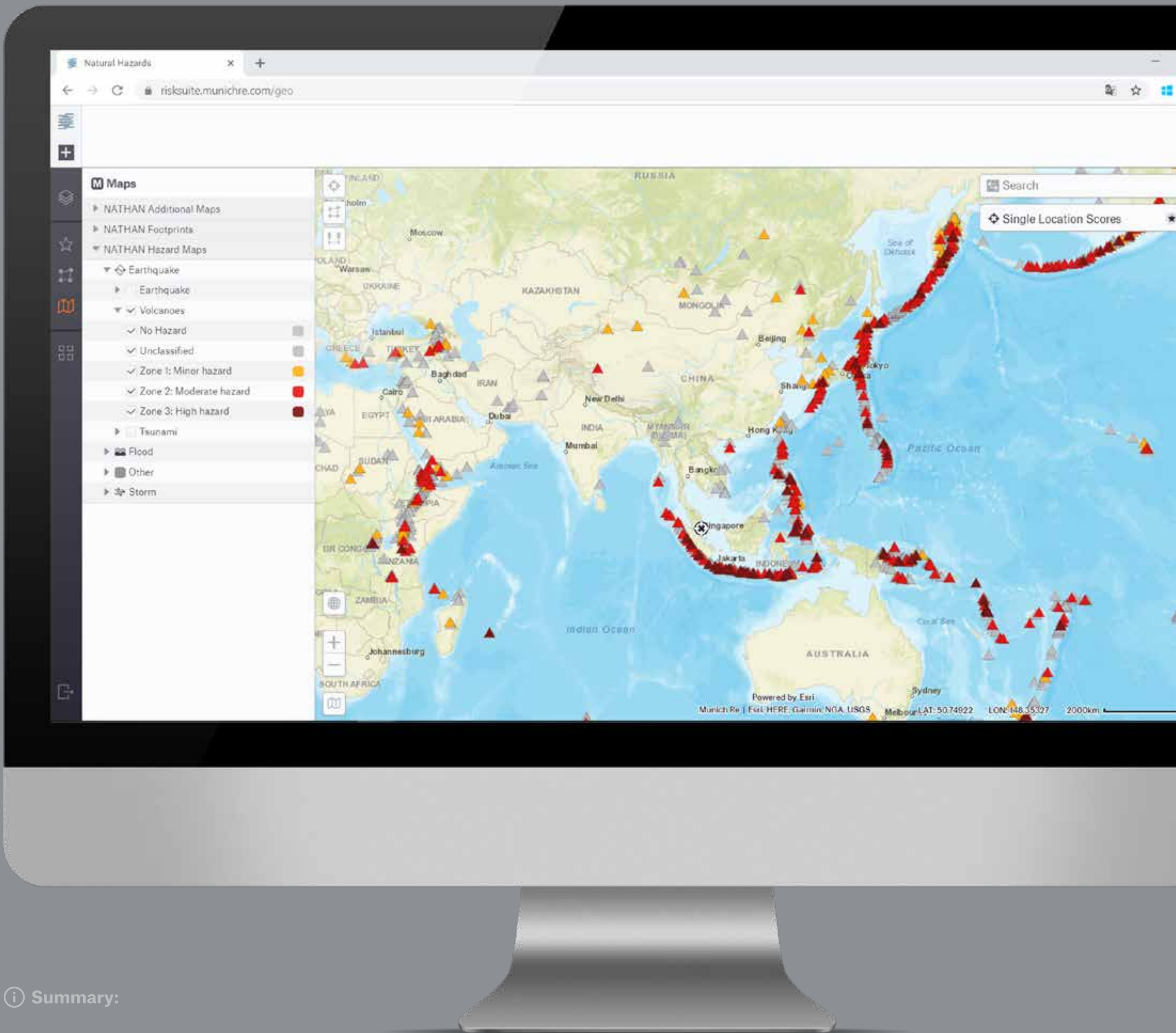
The volcano symbol itself derives its hazard index from the mean of the three buffer zone's annual return periods.

The sources used were the reports from the University of Bristol:
- Identifying volcanoes with high hazard and economic exposure
- Frequency-magnitude relationships for active explosive (ash-producing) volcanoes worldwide

Accordingly, the volcanoes were categorized as follows:
- Zone 0: Unclassified
- Zone 1: Minor hazard (> 15,000 years return period)
- Zone 2: Moderate hazard (200 to 15,000 years return period)
- Zone 3: High hazard (≤ 200 years return period)

There are several types of hazard associated with volcanoes, the principal hazards being:
- Ballistic debris av.
- Shockwaves
- Lava flows
- Pyroclastic flows
- Gases
- Lahars
- Lightning
- Acid rain
- Tephra fall

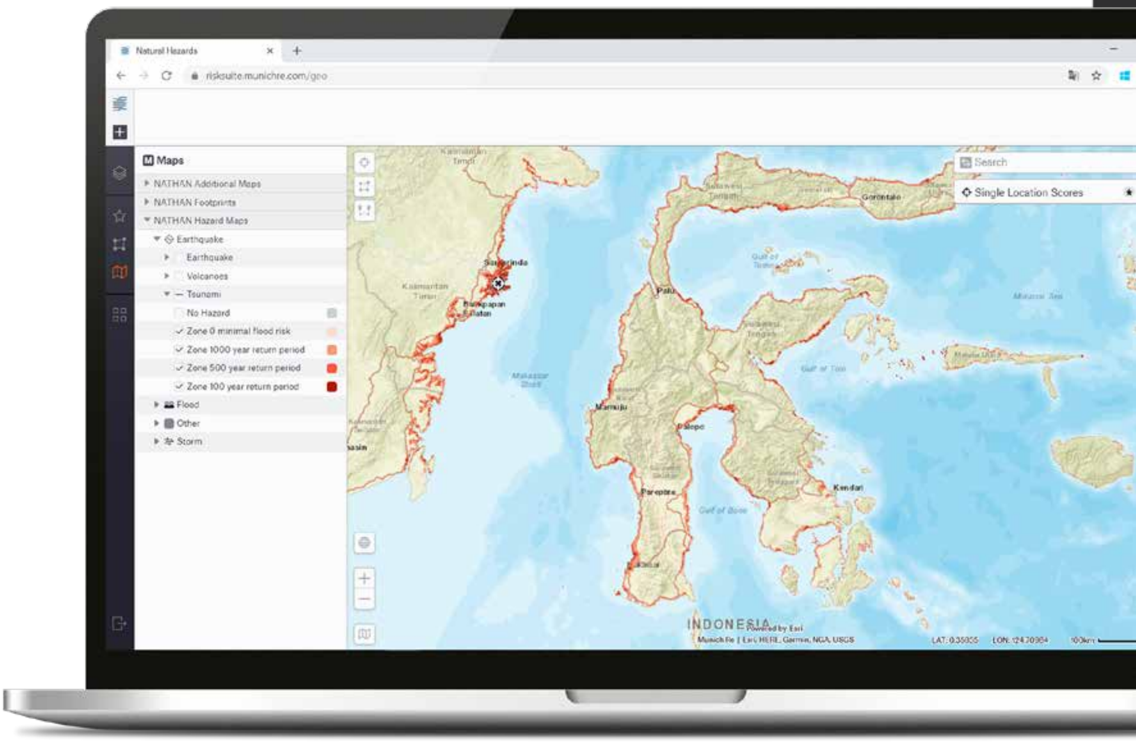
It is difficult to assess all the different types of hazard due to volcanism and classify their respective importance for the actual level of risk. As eruptions are typically rare events and systematic investigations on damage-related hazard parameters have just started in the recent past, an absolute measure of volcanic risk is prone to larger uncertainties. However, a relative measure of risk caused by different types of volcanic eruptions, their strengths and return periods seems to be a valid choice for volcanic risk classification for the moment.



Summary:

Values in map show: volcanoes classified depending on their VEI (volcano explosivity index) and their annual return periods.

Creation Date: 2016
Last Modification: 2017
Data Type: Shapefile (Points)
Coverage: Global
Source: Munich Re



Tsunami

Tsunamis are seismic sea waves and occur after strong seaquakes or large submarine landslides, often induced by earthquakes or volcanic eruptions in the sea or on the coast.

The greatest risk comes from tsunamis generated by meteorites crashing into the sea. This risk exists throughout the world but, with very low occurrence probabilities, is very difficult to quantify and any discussion of this would go beyond the bounds of this account. Tsunami waves spread out in all directions at a great speed which depends on the depth of water. As the waves can travel 10,000 km or more without much attenuation, regions that have not experienced any direct earthquake effects can be affected.

Munich Re classified the hazard into four categories; Zone 0, 100, 500 and 1000. Coasts in Zone 100 are exposed to a 100 year return period of tsunamis (1% annual flood chance), those in Zone 500 a 500 year return period (0.2% annual flood chance) and those in Zone 1000 a 1000 year return period (0.1% annual flood chance). Coasts in Zone 0 (minimal flood risk) have a very low tsunami exposure. The tsunami map is based on SRTM data (version 4.1.). The hazard was calculated with the cost-distance function of ESRI´s ArcGIS. Munich Re simulated multiple wave heights for each coast and calculated the maximum expansion. Historical tsunami and earthquake data were also taken into account.

Summary:

Values in map show: tsunami hazard distinct in four return periods (100, 500, 1000, minimal risk). The tsunami map is based on SRTM data (version 4.1.).

Creation Date: 2017
Data Type: Raster
Spatial Resolution: Approximately 90 metres
Coverage: Global
Source: Munich Re

Tropical cyclones

Tropical cyclones are among the most destructive weather phenomena. Coastal regions and islands are particularly exposed as they are affected not only by the direct impact of a storm, but also by the secondary hazards, such as storm surges and pounding waves.

The intensity of a storm rapidly decreases as it moves inland because of the friction increase due to the roughness of the Earth's surface and reduction in the supply of energy (primarily from water vapour) to the storm system. Orographic effects can also lead to high amounts of rainfall, which in turn can result in severe flooding, producing multi-billion dollar losses in populated regions with high GDP.

The Tropical Cyclone zoning system uses forward wind, maximum wind speed, minimum central pressure, radius of maximum wind speeds and track of the centre ("eye") in 3- to 6-hourly intervals (in exceptional cases, 12-hourly intervals) as main variables for modelling. The wind fields of all historical windstorms were simulated and superimposed in a grid network with a mesh size of 0.1 x 0.1 degrees of geographical longitude and latitude. By means of frequency analysis for each grid coordinate, the maximum wind speed to be expected (probable maximum intensity with an average exceedance probability of 10% in 10 years) was derived for the return period of 100 years chosen for the world map. The hazard zoning is represented by a five-level scale (maximum wind speed that can be expected once in 100 years) based on the Saffir-Simpson scale, multiplied by a gust factor of 1.2. Tropical Cyclone projections for the years 2030, 2050 and 2100 are available in Munich Re's Climate Change Edition.

Summary:

Values in map show: mean exceedance probability of less than 10% in ten years (a probability of 10% in ten years is equivalent to a return period of one hundred years) for peak wind speeds of six different categories.

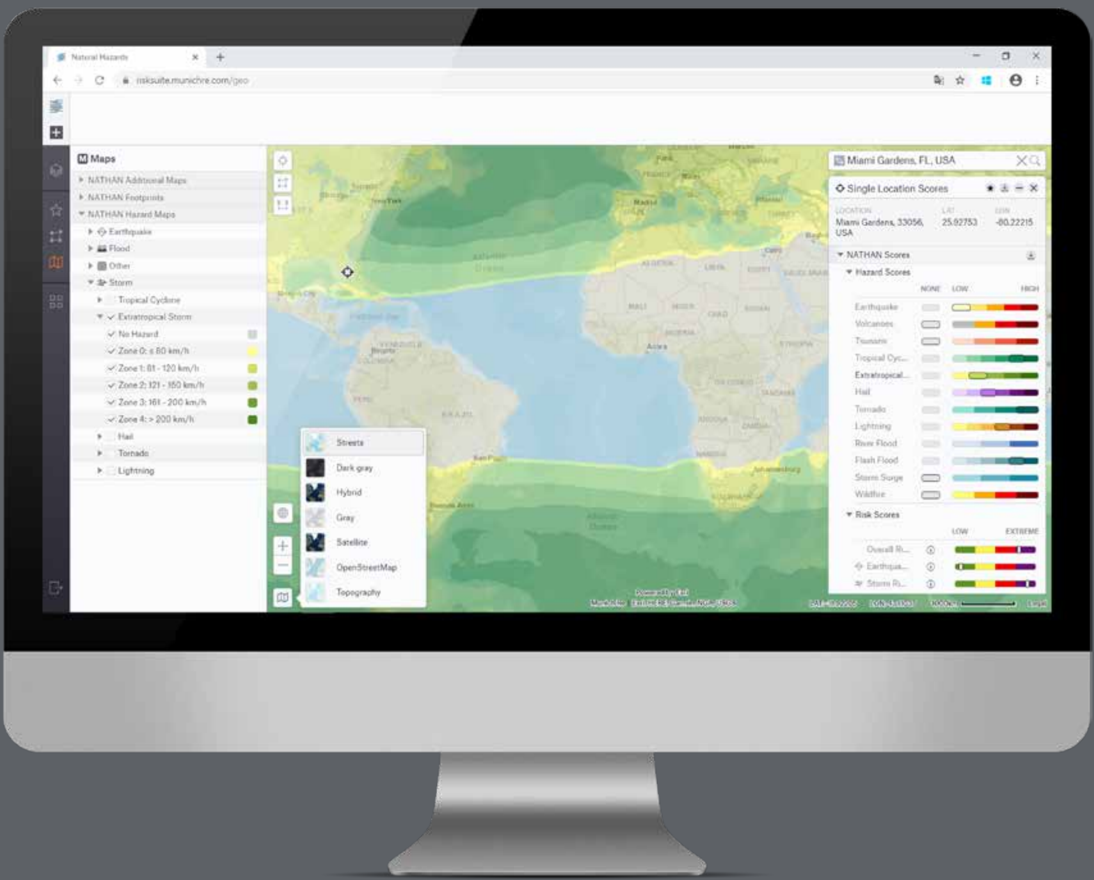
Creation Date: 2017
Data Type: Raster
Spatial Resolution: Approximately 5 kilometres
Coverage: Global
Source: Munich Re

Extratropical storms (winter storms)

Extratropical storms are created in the transition region between subtropical and polar climatic zones, i.e. in the latitudes between about 30° and 70°. In these regions, cold polar air masses collide with tropical air masses, forming extensive low-pressure eddies.

The intensity of the storm areas within these eddies is proportional to the difference in temperature between the two air masses, and is therefore at its greatest in late autumn and winter, when the oceans are still warm but the polar atmosphere is already extremely cold. This is why extratropical storms are also referred to as winter storms. Blizzards and ice storms are variants of this type of storm and their potential for damage is often underestimated.

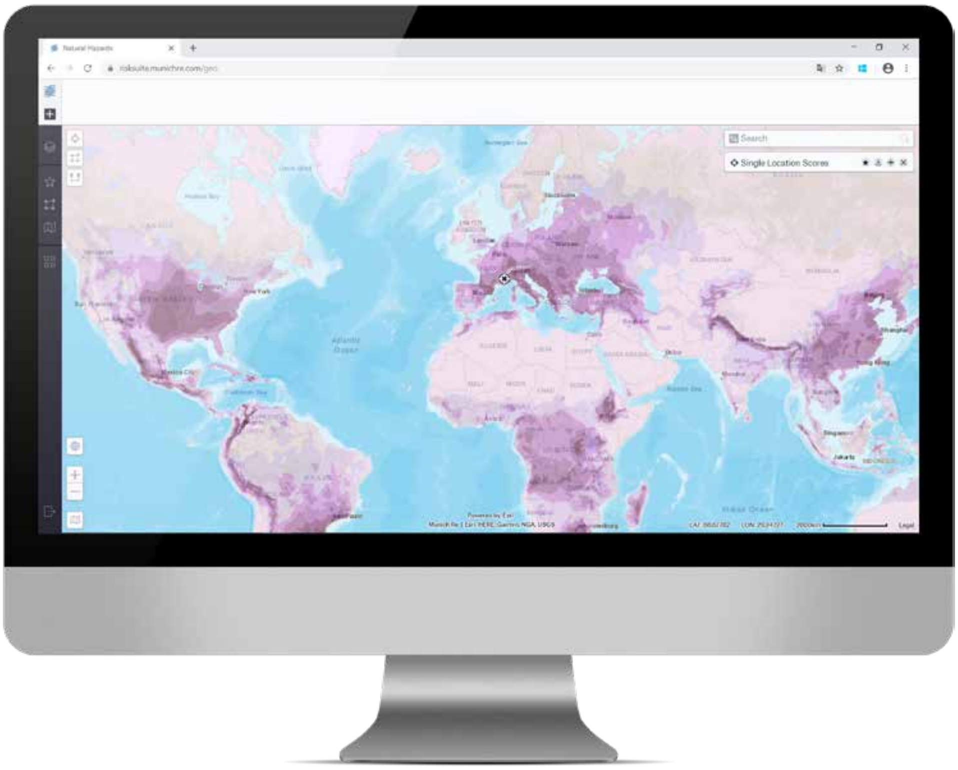
The extratropical storm maps are based on freely available reanalysis data sets which have been downscaled and calibrated by using data from various national weather services, as well as information from global digital terrain models. Gust information from the following centres has been used particularly intensively: the German Weather Service, the Royal Netherlands Meteorological Institute, the UK Met Office, Meteo France, the Bureau of Meteorology (Australia) and the National Oceanic and Atmospheric Administration (USA). An extreme value distribution approach (generalized Pareto distribution including an upper bound estimation) was used to calculate storm maps with higher return periods. The hazard map is classified into five zones based on peak wind speeds (3 sec gust in km/h). The most exposed areas with respect to extratropical storms are located between 30° and 70° north and south of the equator. The final resolution of the storm maps is 0.01 degrees (roughly 1km).



Summary:

Values in map show: peak wind speeds in five different categories. Probable maximum intensity with an average exceedance probability of 10% in 10 years (equivalent to 'return period' of 100 years). Areas were examined in which there is a high frequency of extratropical storms (approx. 30°–70° north and south of the equator).

Creation Date: 2017
Data Type: Raster
Spatial Resolution: Approximately 1 kilometre
Coverage: Global
Source: Munich Re



Summary:

Values in map show: definition of frequency and intensity of hailstorms on a scale from 1 (low) to 6 (high).

Creation Date: 2012
Last Modification: 2016
Data Type: Shapefile (Polygons)
Coverage: Global
Source: Munich Re

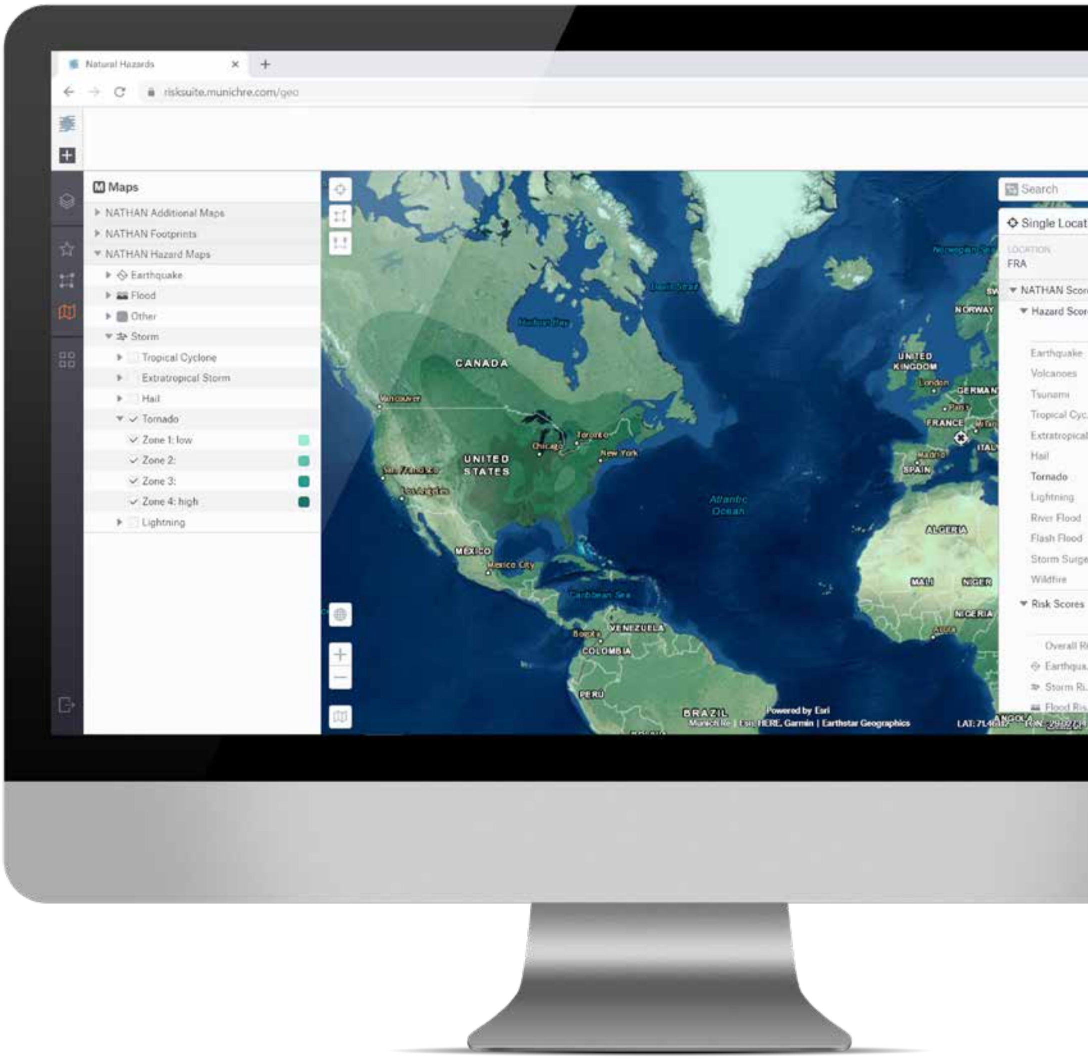
Hail

Hailstorms cause extensive damage to agriculture, as well as to buildings and vehicles. Heavy hailstorms are usually triggered by wide cold fronts. Occasionally, local hot weather thunderstorms – a result of intense insolation over land or mountain slopes – also lead to severe localized hailstorms.

An important precondition for hailstorms is strong instability. This gives rising air at ground level a strong uplift and results in an even higher-reaching upwind zone with powerful cloud formations. In an upwind zone of this kind, hail particles are suspended in the upper section of the cloud so that water droplets and ice crystals are created and the hail seeds grow in layers as the winds successively carry them up. When the weight of the hail seeds becomes too great or the upwind weakens, the ice seeds fall from the cloud and it begins to hail.

The hailstorm map is based on the global distribution of lightning activity (lightning per km^2 and year). Data sources of the hailstorm map are OTD/LIS data from NASA, a DEM (interpolated from SRTM data), global temperature data and global precipitation data. Hail as a natural hazard is based on the frequency and intensity of hailstorms. Munich Re does not use statistics on the occurrence of hail events, as such global statistics are not available and/or comparable. Therefore, global standardized records of meteorological data were used. On the basis of this meteorological data it was possible to represent atmospheric conditions which have the potential to create a hailstorm. In fact, the hailstorm map is based on a number of atmospheric conditions with the potential to create a hailstorm. The following parameters were taken into account for the calculation:

- Average annual evapotranspiration [mm]
- Average annual temperature gradient [°C/km]
- Average annual potential height of fall of hail [m]



Tornado

Tornadoes occur worldwide at latitudes between 20° and 60°, but are undeniably most frequent in the USA. Tornadoes are very localized but extremely intense. The direct damage caused by the high wind speeds is exacerbated by the sharp drop in air pressure (10% or more) at the centre of the funnel.

The tornado zones are based on frequency and intensity interpolated from meteorological data. NOAA data serves as a meteorological parameter. The tornado map is a rough estimate of the global situation and is used to identify risk.

ⓘ **Summary:**

Values in map show: frequency and intensity of tornadoes on a scale from 1 (low) to 4 (high).

Creation Date: 2012
Last Modification: 2016
Data Type: Shapefile (Polygons)
Coverage: Global
Source: Munich Re

Lightning

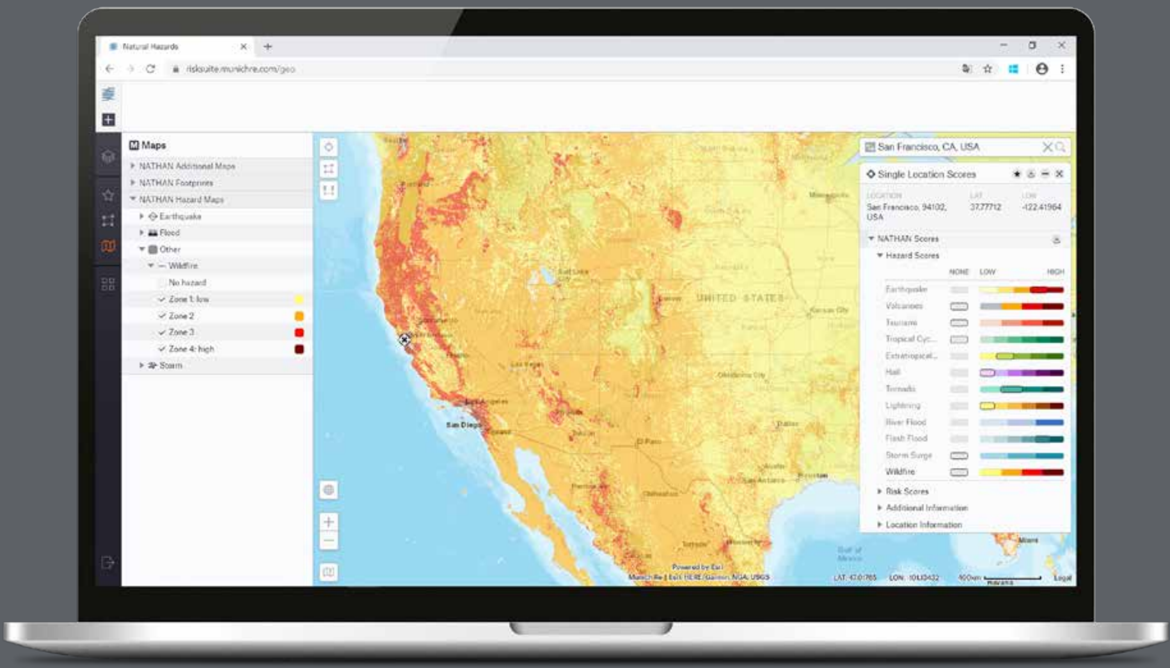
At any given time about 1500 thunderstorms are taking place all over the world, with hardly any region remaining unaffected. Lightning strikes are the main cause of natural fires, which can destroy whole forests and often buildings.

The lightning map shows the global frequency of lightning strikes per km^2 and year recorded by satellites and ground-based lightning detection networks. Munich Re classified lightning in 6 categories based on frequency of lightning strikes. It is based on data from NASA: "the product (v2.2) is a 0.5 deg × 0.5 deg gridded composite of total (IC+CG) lightning bulk production, expressed as a flash rate density (fl/km^2/yr). Climatologies (v2.2) from the 5-yr OTD (4/95-3/00) and 8-yr LIS (1/98-12/05) missions are included, as well as a combined OTD+LIS climatology and supporting base data (flash counts and viewing times). Best-available detection efficiency corrections and instrument cross normalizations have been applied."

Summary:

Values in map show: global frequency of lightning strikes per km^2 and year a scale from 1 (low) to 6 (high).

Creation Date: 2012
Data Type: Shapefile (Polygons)
Coverage: Global
Source: Munich Re



Wildfire

Wildfires are the result of a complex interaction between certain influencing factors, e.g. ignition of the fire, vegetation, meteorological conditions (El Niño/La Niña) and topography.

The wildfire map is based on climatological historical data and GlobeCover (ESA) land cover data:

- Wildfires are rare in areas where rain is frequent
- Regions with sparse vegetation are also unlikely to be affected by wildfire
- Wildfire potential is particularly high when coniferous forests are exposed to dry spells lasting several weeks or even months

The model does not replace a probabilistic model, but it is nevertheless of great value in identifying areas at risk.

Summary:

Values in map show: hazard of wildfire in certain areas on a scale from 1 (low) to 4 (high). The effects of wind, arson and fire-prevention measures are not considered.

Creation Date: 2011
Data Type: Raster
Spatial Resolution: Approximately 1 kilometre
Coverage: Global
Source. Munich Re

River flood

Munich Re's river flood hazard data (provided by JBA Risk Management) offer state-of-the-art flood hazard information (with a 30m horizontal resolution), available on a global scale. The global flood maps are constantly improved and are a market standard.

They are based on bare-earth digital terrain data and a consistent worldwide digital surface model. The river flood hazard is represented by three return period zones, ranging from Zone 0 (areas of minimal flood risk) to Zone 100 (100 year return period of river flood). Information on the flood defences' standard of protection (SoP) is available upon request. River flood projections for the years 2030, 2050 and 2100 are available in Munich Re's Climate Change Edition.

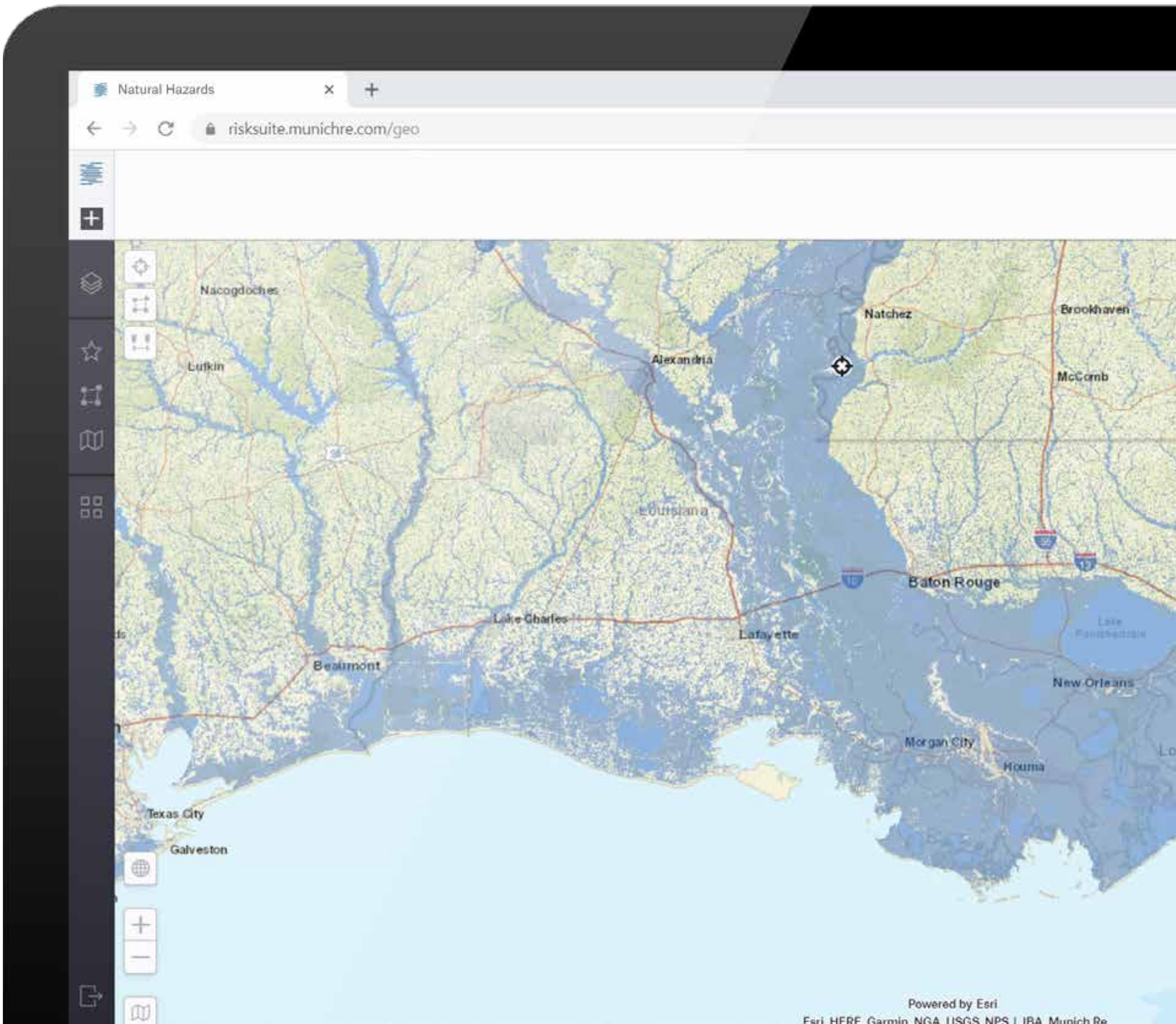
Flood zone Description of flood zones

Flood zone	Description
Zone 0	Areas outside the 0.2% annual chance floodplain
Zone 100	1% annual chance flood event (100 year return period)
Zone 500	0.2% annual chance flood event (500 year return period)

ⓘ **Summary:**

Values in map show: river flood hazard distinct in four return periods (minimal risk 0, 100, 500).

Last Update: 2017
Data Type: Raster
Spatial Resolution: 30 metres
Coverage: Global
Source: JBA Risk Management Limited



Flash flood

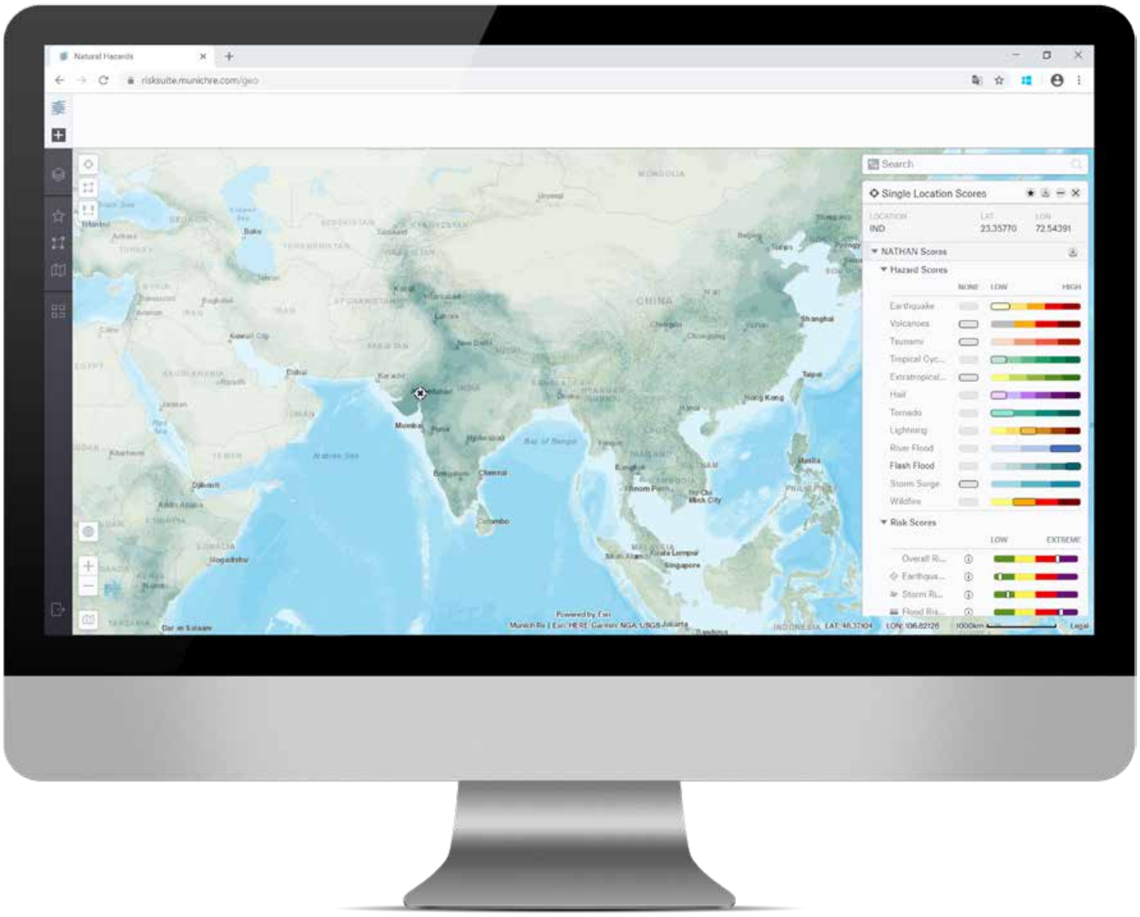
Flash floods are short-term events which can be produced by severe convective storms or heavy rain events over one area. Flash floods can be heavily destructive due to the enormous amount of water which often carries rocks, debris and mud.

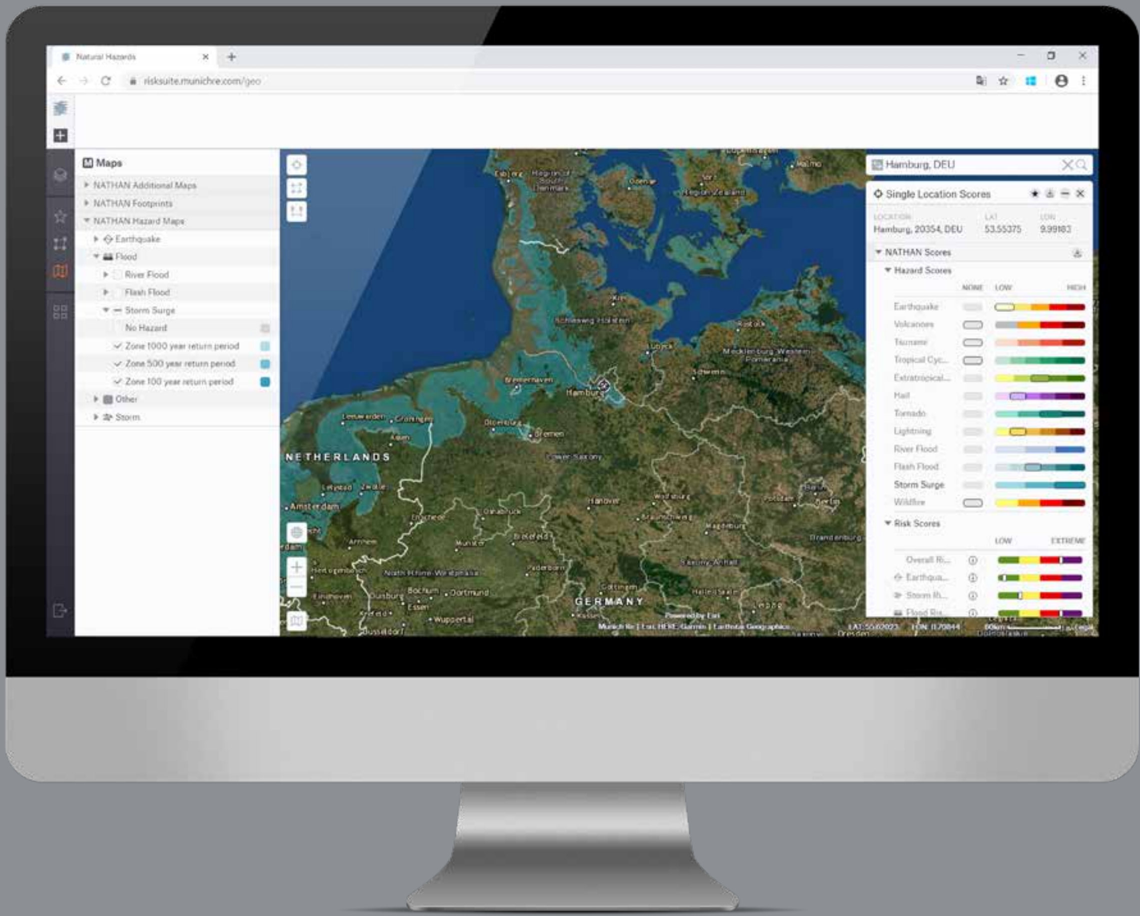
The hazard is represented by 6 zones, starting from Zone 1 (low hazard) to Zone 6 (high hazard). The flash flood map is based on meteorological data, as well as soil, terrain and hydrographic data (slope and flow accumulation). The meteorological data includes the amount, variability and extreme behaviour of rainfall. Munich Re used soil-sealing maps (detected by looking at impervious surfaces), curvature (from global multi-resolution terrain elevation data with a resolution of 7.5 arcseconds), slope and flow accumulation (from conditioned terrain data based on SRTM elevation with a resolution of 15 arcseconds) as modifiers to generate the final flash flood map. The data is gridded on a 250-metre raster.

Summary:

Values in map show: frequency and intensity of flashflood on a scale from 1 (low) to 6 (high).

Creation Date: 2014
Data Type: Raster
Spatial Resolution: Approximately 250 metres
Coverage: Global
Source: Munich Re





Storm surge

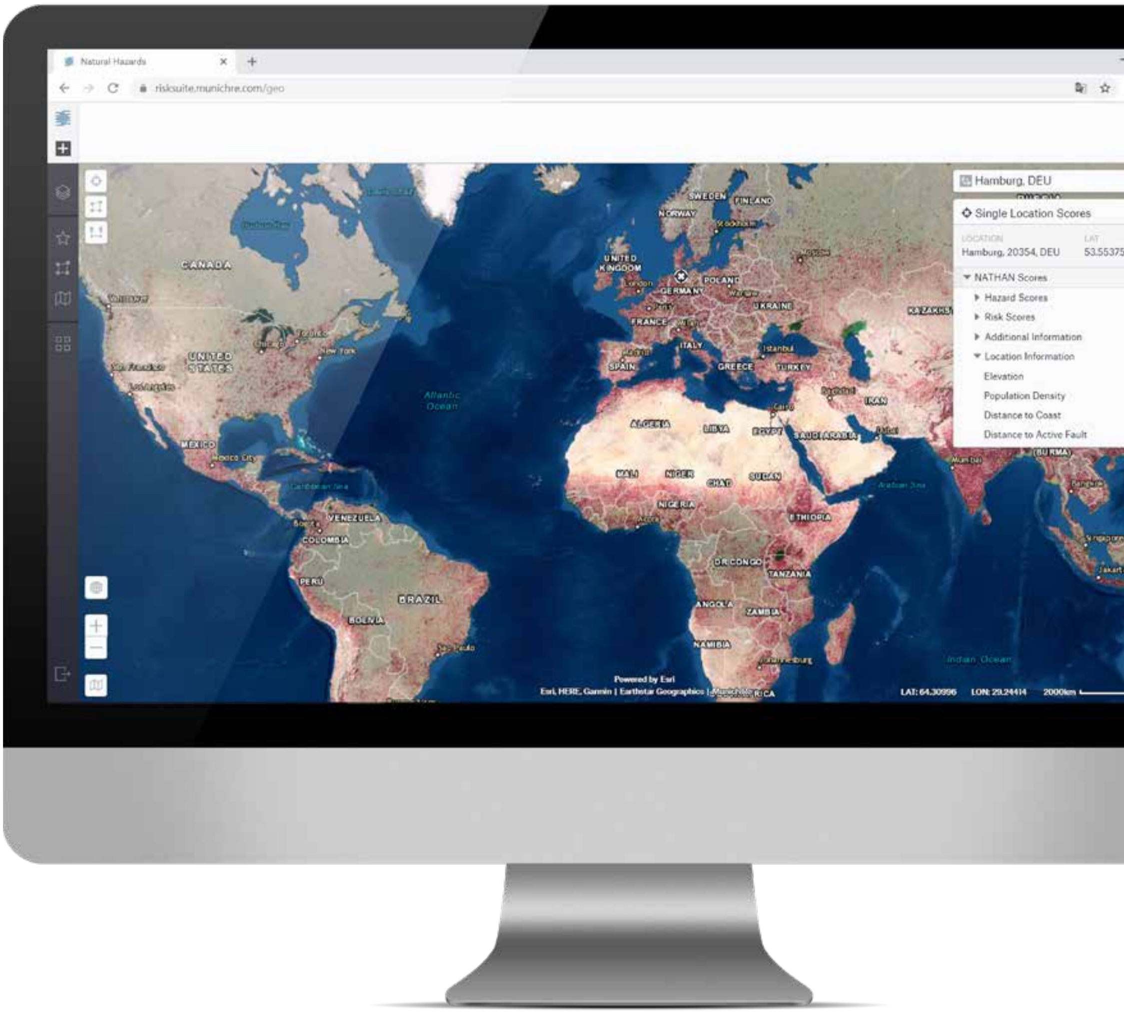
Storm surges can occur along sea coasts if constant strong wind from one direction causes wind setup on the coast, which can measure up to several metres. Therefore in conjunction with the astronomic tide and high seas, extremely high water levels may occur on certain sections of the coast. The geometry of the coast itself plays an important role regarding the exposure to storm surge. The effects of a rise in sea level also depend on the shape of the coast. The flatter the strip of the coast, the more extreme the effects will be.

Munich Re classified the hazard into three categories; zones 100, 500 and 1000. Coasts in Zone 100 are exposed to a 100 year return period of storm surge (1% annual flood chance), those in Zone 500 a 500 year return period (0.2% annual flood chance) and those in Zone 1000 a 1000 year return period (0.1% annual flood chance). The storm surge map is based on ALOS data (version 1.1.; ©JAXA).
The inundation area of these return periods were simulated by applying cost-weighted distance tools. Munich Re simulated multiple wave heights for each coast and calculated the maximum expansion. Wind speeds and bathymetry data were also taken into account.

ⓘ **Summary:**

Values in map show: storm surge hazard distinct in three return periods (100, 500 and 1000). The storm surge map is based on ALOS data (version 1.1.).

Creation Date: 2017
Data Type: Raster
Spatial Resolution: Approximately 30 metres
Coverage: Global
Source: Munich Re



Population density

The population density map is derived from global population distribution data (based on population counts) by LandScan™. LandScan™ is a community standard developed by the Oak Ridge National Laboratory, it uses an algorithm to disaggregate census counts within an administrative boundary.

Using the LandScan™ global distribution data, Munich Re calculated the population density of each individual country and region. The population density is classified into five categories based on people per km^2. The population density represents a 24 hour average value. This means that the figures include daily movements, such as commuter journeys, and not just the night time population.

Population: LandScan™ Population Dataset created by UT-Battelle, LLC, the managing and operating contractor of the Oak Ridge National Laboratory acting on behalf of the U.S. Department of Energy under Contract No. DE-AC05-000R22725

Summary:

Values in map show: geographical distribution of population in 2016 at one-kilometre resolution over an average 24 hour period, classified into five categories.

Creation Date: 2018
Data Type: Raster
Spatial Resolution: Approximately 900 metres
Coverage: Global
Source: Oak Ridge National Laboratory

Summary:

Values in map show: metre per pixel, classified into seven categories.

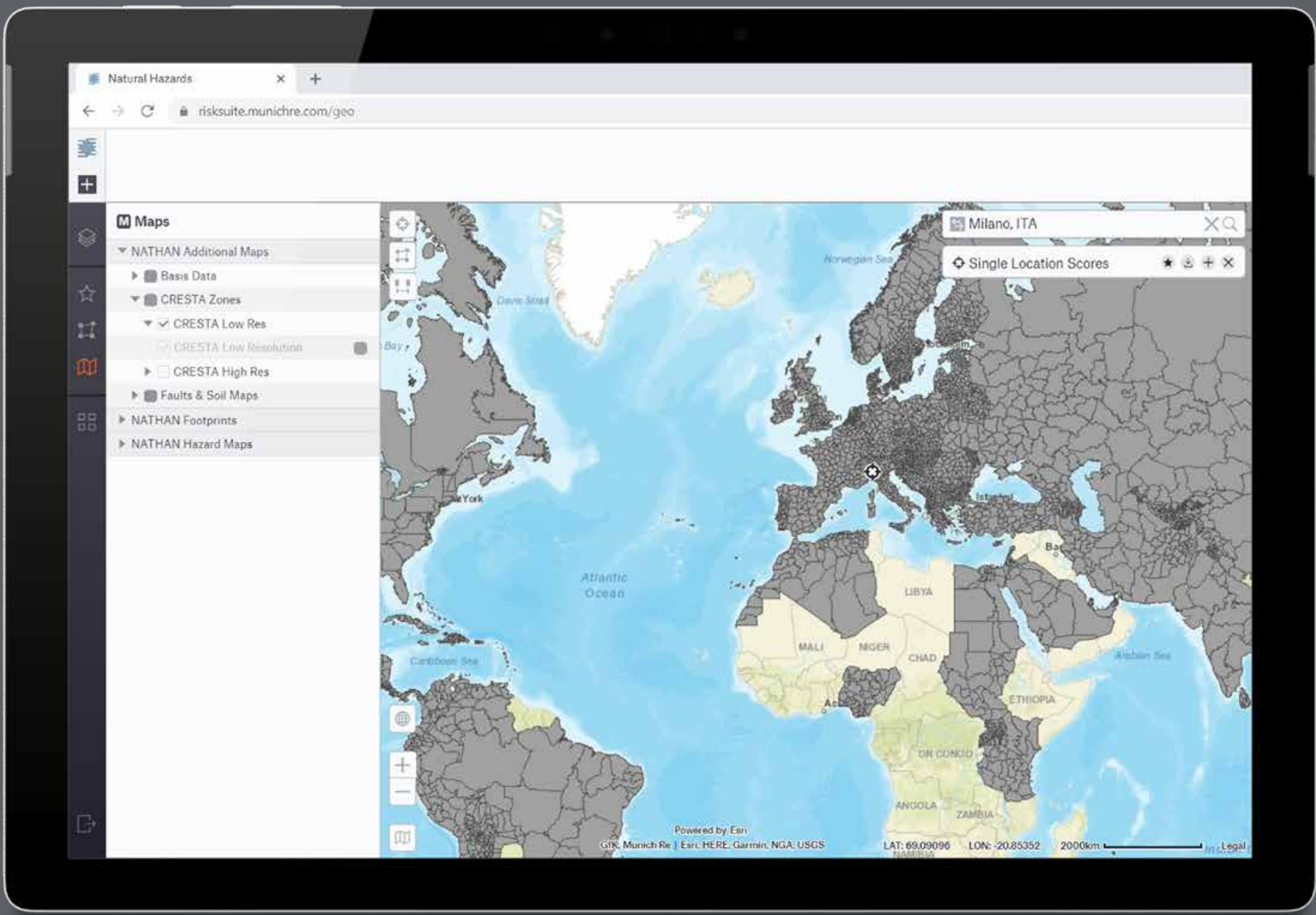
Creation Date: 2018
Data Type: Raster
Spatial Resolution: Approximately 30 metres
Coverage: Global
Source: Japan Aerospace Exploration Agency (JAXA), United States Geological Survey (USGS)

Elevation

The elevation map is composed of different models. The main component is the digital elevation model "ALOS World 3D-30m (AW3D30; ©JAXA)", which is provided by the Japan Aerospace Exploration Agency (JAXA).

JAXA released AW3D30 in May 2016 with a horizontal resolution of approximately 30 metres mesh (1 arcsecond latitude and longitude) generated from 5m resolution DSM. Void height values in cloud and snow pixels between 60º north and 60º south are filled with existing DEMs using the Delta Surface Fill method from the update in March 2017. This dataset is highly expected to be used in scientific research and geospatial information application services.

In order to ensure a global coverage, downsampled SRTM90 data were used to complete the dataset. The elevation is represented in metres.



CRESTA zones

CRESTA is an independent organization that evaluates catastrophe risk and standardizes target accumulations. The CRESTA organization established country-specific zones for the insurance and reinsurance industry. The main goal of CRESTA is the uniform aggregation of insurance data. Each CRESTA zone has an individual name and ID.

With a new release in June 2013, CRESTA introduced a completely revised zoning concept. Zones are now no longer based on natural hazards, but consist of administrative boundaries. There are also now two levels: HighRes for detailed accumulation analysis and pricing, and LowRes for a rough overview of the portfolio. You can find further information about the CRESTA organization in general and the changes in the zoning concept on www.cresta.org.

Soil and shaking hazard

The soil and shaking hazard layer shows underground conditions that influence earthquake intensity.

There are six different classes from 1 (low risk) to 6 (high risk). The classification is based on geological, soil and hydrological datasets such as:

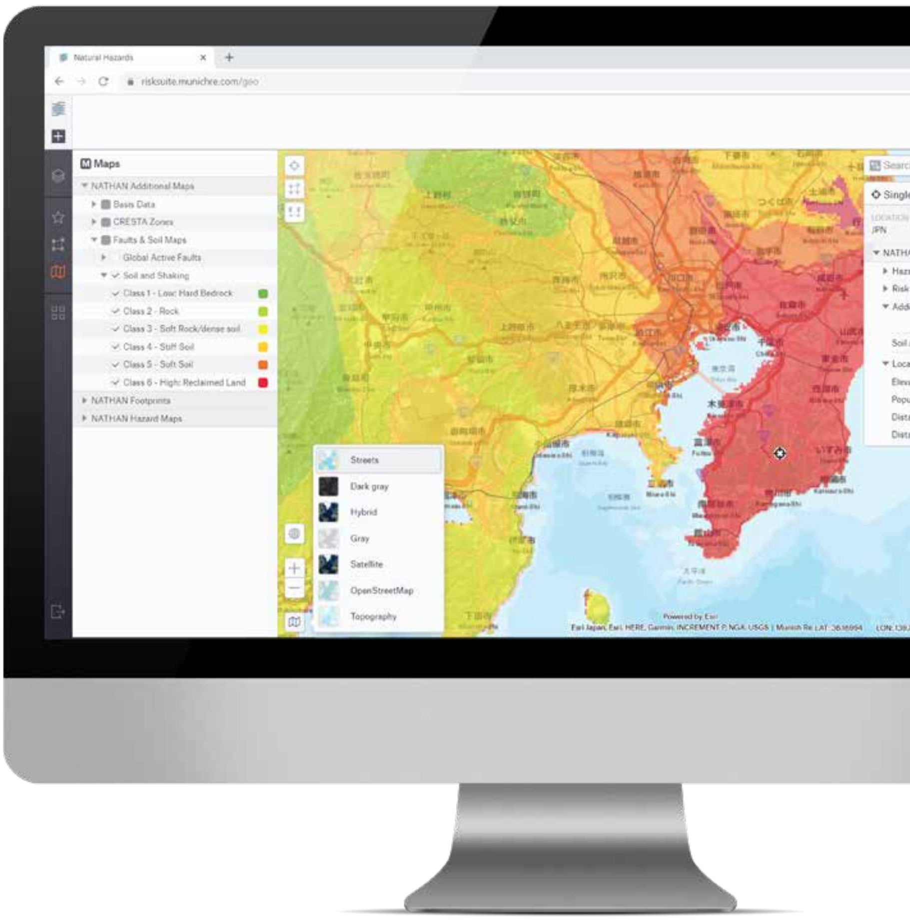
– Geological information: geological map of the world, 1:25m, CGMW/UNESCO 2000
– Soil information: digital soil map of the world and derived soil properties, 1:5m, FAO/UNESCO 1997
– Hydrological information: ArcWorld 1:3m cartographic layer: rivers and water bodies (->RIV3M), ESRI 1992
– Digital elevation model: provided by Shuttle Radar Topography Mission (SRTM) 30m
– World map of sediment thickness: by Gaby Laske

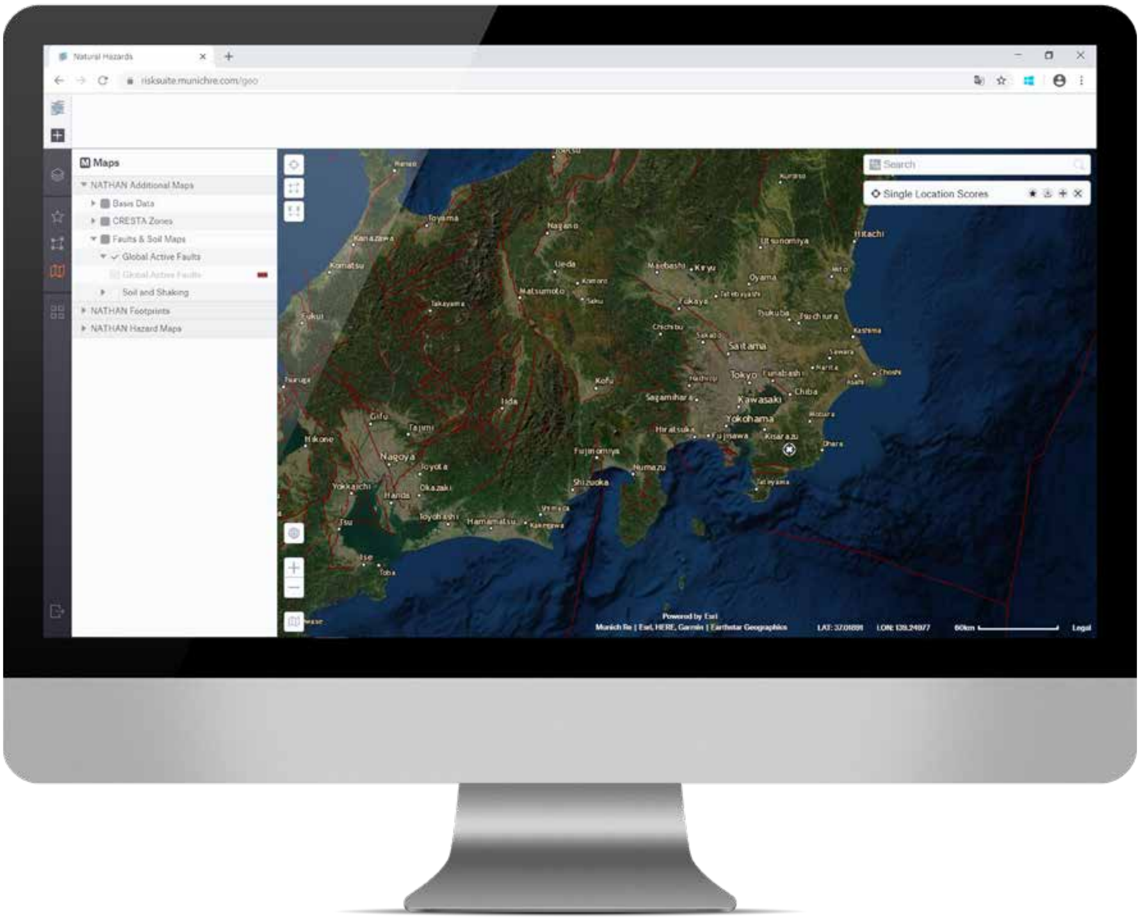
This data complements the interpretation of the earthquake perils by elaborating information about how fast earthquake waves move through the ground based on the soil's natural composition and its impact on the area of interest.

Summary:

Values in map show: underground conditions that influence earthquake intensity. There are six different classes from 1 (low risk) to 6 (high risk).

Creation Date: 2018
Data Type: Raster
Spatial Resolution: Approximately 900 metres
Coverage: Global
Source: Munich Re





Global active faults

The GEM Global Active Faults project (GEM-GAF) compiles a global dataset of active faults for seismic hazard assessment. The GEM-GAF is building a comprehensive global dataset of active fault traces of seismogenic concern.

The dataset consists of GIS files hosted inhouse, of fault traces and small amounts of relevant attributes or metadata (fault geometry, kinematics, slip rate, etc.) useful for seismic hazard modelling, identifying the distance from a certain point to the nearest fault and other tectonic applications. The dataset currently covers most of the deforming continental regions on earth, with the exception of northeast Asia, the Malay Archipelago, Madagascar, Canada, and a few other regions. These are to be added progressively.

Summary:

The GEM Global Active Faults project compiles a global dataset of active faults for seismic hazard assessment.

Creation Date: 2017
Data Type: Shapefile (Polylines)
Coverage: Global
Source: GEM (Global Earthquake Model) Foundation

Choose the plan that suits you best

	Platform options				API options	
Subscription plans	**On Demand**	**Business**	**Corporate**	**Enterprise**	**Standard API**	**Advanced API**
Functionalities						
– Single location assessment	●	●	●	●	●	●
– Location geocoding	●	●	●	●	●	●
– Map services	●	●	●	●	●	●
– Portfolio assessment		●	●	●	●	●
– Save locations		●	●	●		
– Elevation profiles		●	●	●		
– Traffic light functionality			●	●		
– Location set filtering			●	●		
– REST API		○	○	●	●	●
– Areas and lines scoring				●		●
Natural Hazards Edition[1]		○	○	○	○	○
– Flood Module[2]		⊕	⊕	⊕	⊕	⊕

[1] Natural Hazards Edition includes the following risk scores: earthquake, volcano, tsunami, tropical cyclone, extratropical storm, storm surge, tornado, hail, lightning, wildfire, river flood, flash flood (see also fact sheet). [2] Flood Module includes Natural Hazards Defended (Netherlands and Belgium only) and enables the integration of additional data sources such as JBA, ZÜRS (Germany only), Environment Agency (UK only).

● Included in this edition ○ Can be purchased additionally

✓ Included in the corresponding edition ⊕ Can be purchased additionally for the corresponding edition

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