

# Risk Hazard and Natural Catastrophe Report

Renewable Energy Farms  
Glanmire NSW 2795, Australia



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**Important Notice**

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# Introduction to Steadfast iProfileRisk

## Steadfast Risk Group's Framework

Steadfast offers an end-to-end risk framework for brokers and their clients based on the internationally recognised ISO 31000 standard.

Steadfast Risk Group provides a spectrum of in-house services and solutions ranging from enterprise risk management, risk and natural catastrophe hazard identification, property engineering consultation/services and alternative risk transfer.

Framework diagram



## What is iProfileRisk?

iProfileRisk is a data driven and online accessible platform aimed at simplifying risk hazard identification and providing natural catastrophe high level summaries for brokers and their clients.

It empowers proactive risk identification and risk centred conversations between brokers and their clients, through enabling data driven risk decisions and mature financial acumen for insurance risk considerations.

## Objective of this report

Utilising iProfileRisk in conjunction with other Steadfast Risk Group offerings enables easy identification of the most prominent risks impacting an industry and SwissRe's natural catastrophe summary for a specific location.

# Risk Hazard and Natural Catastrophe Summary

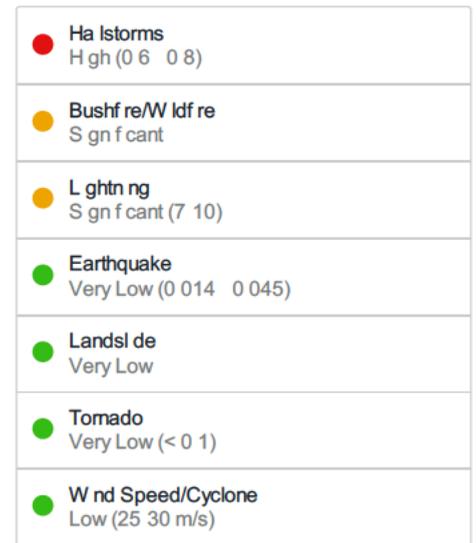
Identifying hazards in the workplace involves finding things and situations that could potentially cause harm to the organization. The following chart is a graphical representation of the likelihood and severity of a loss occurring within any of the classes of insurance listed in the chart.

## YOUR SEARCH RESULTS

### Risk Hazard rating



### Natural Catastrophe



## RISK HAZARD DETAILED DESCRIPTIONS

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### Property

**High risk: 9/10**

Physical premises are typically difficult to replace, as suitable alternative spaces to conduct business operations may be challenging to locate and replicate.

Physical premises are typically difficult to replace, as suitable alternative spaces to conduct business operations may be challenging to locate and replicate. Therefore, exposure is significant. Extensive physical space and infrastructure required to establish renewable energy farms, and often natural landscapes must be changed to suit the bespoke needs of the renewable energy farms. For example, wind turbines must be properly spaced out for efficient and effective energy generation. There is also significant exposure to natural risks, including windstorm, hail and bushfire, depending on location of premises. There may also be high exposure to fire hazard, especially where there is malfunctioning solar equipment. Fire is a common cause of property loss. Reducing fire hazards should be managed by ensuring that equipment does not overheat, that wires and cables are safe and detangled, and that any combustible materials are not kept near ignition sources. No smoking signs should be installed on the premises, with designated areas kept away from equipment and fire hazards. Given that specific and unique space, structural, safety or equipment is required on-premises, it may be financially costly and cause further operational losses. Losses vary according to operations. Furthermore, loss of reputation may occur during the relocation and setup process. Exposures that lead to property damage include malfunctioning equipment, faulty electrical wires and smoking hazards. Valuable equipment and/or items may also be damaged. Any upgrades or maintenance work on renewable energy farms, should follow strict protocol to avoid any unintentional damage to machinery, equipment and infrastructure.



## Business Interruption

**High risk: 7/10**

Loss of insured's premises, equipment or tools creates a business interruption as they are important to everyday operations.

Loss of insured's premises, equipment or tools creates a business interruption as they are important to everyday operations. Renewal energy farms may experience mechanical or electrical equipment breakdown, causing significant operational delays during business hours. Vehicles are generally not covered by property or business interruption insurance, though nonetheless may interfere with operations in the event of a loss. Exposure is assessed as high due to the specialised nature of the equipment used and likely premises location. As operations are 24 hours, 7 days a week, damage is likely to significant financial impacts on the business. Industries in this category can have more specialised equipment and facilities, carrying higher exposures than non-specialised industries, as solar panels, hydro and wind turbines can take time to replace and install, especially if imported equipment or replacements are required. Additionally, the location of alternative facilities are not easily sourced. In some cases, rebuilding may be more practical than complete relocation. Loss of income from machinery breakdown and further loss from replacing machinery may be considerable. Industries with high levels of competition need to consider retention of reputation through expert service, following a loss. For example, businesses may need to consider that clientele may have found other preferences for the same service during the time of rebuilding or relocation. Avoiding loss of records can be managed with solid backup and storage practices. Extra time may be required to rebuild client rapport. The insured should consider strong contingency plans to account for business interruption potential.



## Directors' and Officers' Liability/Management Liability

**High risk: 7/10**

There is significant risk exposure.

There is significant risk exposure. Ensuring the integrity and trust of board members and senior management is crucial, with any personal interests declared and considered when appointing and maintaining their positions. The insured may have administrators that directly influence or control business operations and strategy. Implementing robust risk management frameworks in planning and execution phases of operationalising renewable energy farms is crucial to reduce disruption and delays in planning. There may be increased exposure to claims of alleged wrongful acts, especially as services and business operations conducted may be in industries with higher government or regulatory scrutiny. Management may also be involved in government related contracts, where transparency and ongoing compliance due diligence would be important. It is important for businesses and management to clearly document and train all employees on expected responsibilities on a continual basis, especially in regards to workplace safety, expected workplace culture and legal business conduct. There may be increased risk exposure depending on size and scale of businesses. Some examples of claims may include insider trading claims. Businesses may also interact regularly with shareholders, politicians, consumers, community interest groups etc. Investigations into director, management or employee conduct may result in negative perception and loss of confidence in business integrity and services, leading to reputational damage. Many businesses may also be bound to strict industry, professional body or government regulation standards, whereby tighter and formalised operational management standards may be required.



## Inland Marine

**High risk: 7/10**

Inland marine cargo exposure is high due to transit shipment risks which may be required for the insured.

Inland marine cargo exposure is high due to transit shipment risks which may be required for the insured. Main exposures include:

- Theft;
- Damage to stock or machinery;
- Crushing damage and insufficient packaging of equipment;
- Vehicle collisions

Contaminated or damaged products may cause legal and reputational liabilities, or third party damage may arise due to hazardous spillage during transit. Goods may be expensive in time and financial cost to replace. Exposures will be lower for companies that engage in subcontracted delivery practices of finished products, categorised under a contract where the manufacturer is liable for imports and exports. In that case, manufacturers may be responsible for loss or damage to materials, equipment and deliveries. Cover may need to include stock transfer between premises. Theft of equipment or machinery during transit and non-delivery of high value shipments are of significant risk, and cover for shipping containers is likely to be required. Additional exposures include loss of mobile equipment, records and papers that may be of high value. High-value items may require value estimations. Strong security measures should be installed to deter potential criminals from premises where shipments are handled, including video surveillance and well-trained security. Alarm systems should be considered. The insured should train employees in appropriate handling processes to prevent damage to goods. Vehicles should be stored in secure facilities.



## Workers' Compensation/ Employers' Liability

**High risk: 7/10**

Risk exposure is typically high, though may depend on the size and scale of the business.

Risk exposure is typically high, though may depend on the size and scale of the business. The nature of these industries may expose employees to natural and product hazards. Potential hazards can include cuts or burns, slipping or tripping, wet surfaces or equipment, falling over or falling from heights, electrocution, injuries from repetitive movements, back and neck strain, injuries from falling items. Mental health exposures may include burnout, high stress from job activities, and increased fatigue. For example, workers may be exposed to electrocution, have increased accessibility to malfunctioning solar panels, falling wind turbine parts, and increased exposure to eye and skin irritation. Employers should make occupational health and safety policies a priority and enforceable, always placing the safety of employees central to business operations. This includes personal protective equipment be worn by all employees at all times when on premises.

Workers may need to drive company-owned vehicles, carrying exposure in the case of a road accident. Given that most renewable energy farms are located in remote or regional areas there may be increased risk exposure. These hazards are best managed by appropriate employee training to avoid injuries, guidance in client management when on-premises and distribution of protective equipment practices. Technology and machines associated with the business must be appropriately set up to avoid further exposures. For industries requiring manual labour, muscular or skeletal issues from excessive strain may arise, incurring rehabilitation costs, particularly if the employee can no longer work due to their injuries. Clear instructions and operational guides and procedures should be communicated and strong preventative measures employed to avoid serious injury. Occupational health and safety regulations should be strictly followed at all times to prevent exposures. Hearing protection devices should be distributed when there is a risk of hearing damage or loss due to high noise hazards associated with manufacturing processes, especially in wind and hydro related renewable energy farms. Additionally, correct and regulation approved personal protective equipment is often required in these industries. Automated machinery safety locks, training, supervision and safe work procedures may significantly prevent employee injury.



## Environmental Impairment Liability

Medium risk: 6/10

Environmental impairment is a moderate risk for this industry.

Environmental impairment is a moderate risk for this industry. Risk exposures from larger-scale operations could include land degradation due to excessive land clearing, changing the natural landscape of regional or remote areas. Furthermore, there may be risk exposure where natural habitat is impacted negatively, especially if there is impact to natural wildlife that is endangered. Risk exposure may exist during construction, development and operational phases. During the construction phase, careful consideration to procedures should be made to ensure that there is minimal environmental impact. For example from contaminated wastewater and/or polluted water that can cause a significant environmental threat and should be managed accordingly. Environmental laws and guidelines should be followed accordingly to avoid exposure, especially where renewable energy farms are located close to government protected lands.



## General Liability: Premises and Operations

Medium risk: 6/10

Depending on the size and location of the operation, in most cases, public liability is moderate.

Depending on the size and location of the operation, in most cases, public liability is moderate. This liability is due to the consistent flow of visitors to the premises in small to medium numbers. Where there were visitors on site, this would be scheduled in advanced, including media, politicians, safety specialists, engineers and technicians etc. There may be higher risk exposure during construction phase of renewable energy farms, where there would be an increased number of contractors on premises. Risks may include slipping and falling hazards, field risks, electrocution, burns etc which should be assessed according to the specific location and business operation.



## Automobile Liability

Medium risk: 5/10

Motor exposure in this category varies depending on the size of the operation and its nature.

Motor exposure in this category varies depending on the size of the operation and its nature. Most contractors will be heavily reliant on vehicles as part of their operations given typical remote or regional location, leading to business interruptions in the case of exposure. Many larger operations in this category may own a van or fleet of vehicles, carrying significant exposure. Vehicles may carry heavy items, e.g. equipment, machinery, and specialised wind turbine, solar or hydro parts. The risks associated with them must be considered. There may be increased risk exposure where specialised solar, wind turbine or hydro energy equipment or devices are installed, which may burden significant losses if not transported appropriately. Vehicles generally used for short-distance transport carry lower risks than those used for long-distance transport of passengers, services in case of emergency, or equipment. Ongoing and high standard of fleet management and occupational health and safety policies is essential. Long haul vehicles are prone to high accident rates, in addition to the extensive amount of time on the road, the size and radius of operations, driver fatigue and vandalism at the depot or parking premises. The nature of goods and safe storage and handling of the same are also important considerations. The use of employee vehicles could create indirect liability exposure.



## Crime

**Medium risk: 5/10**

The main source of loss is specialised renewable energy machinery, tools or equipment.

The main source of loss is specialised renewable energy machinery, tools or equipment. Operations with larger premises may not be able to track instances of crime as easily, especially as most renewable energy farms are located in remote, regional or rural areas. There may be potential for vandalism or stolen machinery, however risk exposure can be reduced where physical security infrastructure is present. For example, fences and CCTV. Open-air equipment may be more easily stolen, so storing essential equipment in a secure facility would be beneficial. Machinery and equipment may be expensive and take time to replace, especially where they are imported and require specialised manufacturing. Employee fidelity could be an exposure managed through careful staff selection procedures.



## Cyber Insurance

Medium risk: 5/10

Cyber hacks could result in security and privacy breaches.

Cyber hacks could result in security and privacy breaches. There is potential for large volumes of sensitive personal or corporate data to be leaked. This can be prevented by substantial training and compliance protocols for employees, background checks, and strong cyber protection policies and infrastructure. Business interruptions may be significantly increased as a result of cyber attacks, potentially damaging to the insured's reputation.

The risk of cyber threats, hacks and compromise of IT-related breaches are considerable. The nature of work and business operations can be dependent on IT and/or cloud platforms and systems with copious amounts of insured and client-sensitive data.

- Data breach: through electronic devices connected to insured networks. Access to confidential information through human error, lost devices etc.
- External cyber attacks through internal system vulnerabilities/negligence or deliberate acts or external attacks
- Electronic data/software loss/ replacement cost following a cyber attack
- Business interruption/increased in cost of working following a cyber-attack
- Businesses held to ransom before systems are released;
- Cyber-threat from interconnected supply chain business partners/outsourced services providers
- Internal control and other issues – e.g. non-segregation of sensitive data, inadequate user access control/password protection, outdated POS software applications, absence of up to date antivirus software/firewalls, unencrypted data/information/lack of end-to-end encryption
- Possible presence of older devices/computer systems with outdated operating systems and unsupported software
- Inadequate training for employees on data security/privacy/cyber risk. No or inadequate background checks conducted on employees/various service providers/suppliers etc.
- Compliance and control issues - possible lapses on policies, procedures and protocols on cybersecurity and related matters (if applicable)
- Cyber threat relating to - Bring your own devices, download and install personal or unauthorised software, use of USB or other media devices etc.
- Extra expenses following a cyber incident, including forensic investigation costs, crisis management expenses, notification and monitoring expenses, remediation/other extra expenses
- Brand and reputational damage following a cyber-attack/data breach
- Security lapses in company websites – cyber threat to own hardware and software; cyber threat to visitors of the website
- Lack of security measures including a combination of technology (e.g. IT security) and physical security at the premises.

**NATURAL CATASTROPHE DETAILED DESCRIPTIONS**



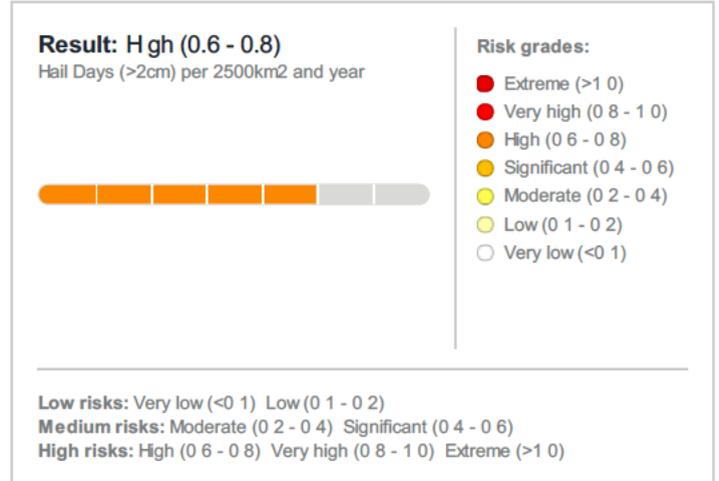
**Hailstorm**

**High risk**

The expected number of hail days per year with a hail diameter larger than 2 centimeters related to an area 50km x 50km is shown.

**Sources:**

Scientific literature about the global and regional climatic distribution of hail frequency and severity; Swiss Re's internal claims and hail mode data; reports of severe hail events; expert judgement of Swiss Re's Atmospheric Performance Specialists





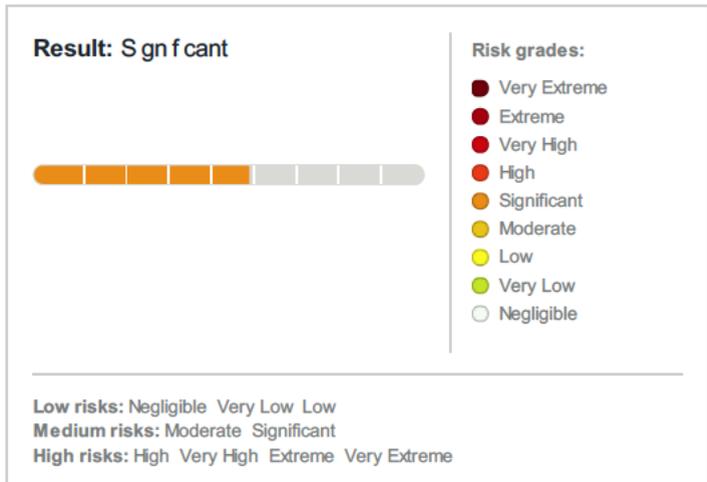
## Bushfire/Wildfire

Medium risk

The Wildfire Map shows the likelihood for the occurrence of wildfires in a certain area, depending on the intrinsic characteristics of the region. The layer resolution is 300m at the equator. The measure of land susceptibility to fire for this model is based on historic fire frequency per unit area (2001-2019), trend in climate change as a proxy for fire danger levels (2001-2020) and wildland-urban interface (WUI). Burned area and fire danger levels integrate event frequency, while WUI focus on the variable of interest from a damage perspective. Property in the wildland-urban interface (WUI), or regions adjacent to or within undeveloped natural areas, is particularly more susceptible to wildfire hazard given the proximity to vegetative fuels and the adopted set of predisposing factors.

### Sources:

- MODIS MCD64CMQ Composite Mapping Grid Burned Area Product ([MCD64A1 User's Guide](#) (umd.edu)). Accessed from University of Maryland and fuoco SFTP (former y FTP) server.
- Daily Fire Weather Index (FWI) data (<https://effs.jrc.ec.europa.eu/about-effs/data-cense>). Accessed from Copernicus Composite Change Data Store (<https://cds.composite.copernicus.eu/cdsapp#!/home>).
- ESA-CCI Land cover v2.1.1 Epoch 2019 (<https://cds.composite.copernicus.eu/ap/v2/terms/statc/satellite-and-cover.pdf>). Accessed from Copernicus Composite Change Service ([Land cover classification maps from 1992 to present derived from satellite observations](#) (copernicus.eu))





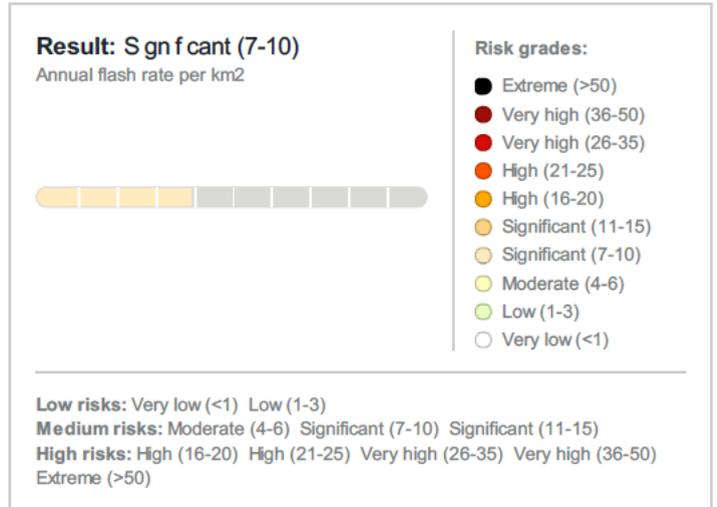
## Lightning

Medium risk

The global lightning hazard layer shows the mean annual flash rate per square kilometer.

Sources:

- NASA Earth Science Data and Information System (ESDIS) Project
- Global Hydrology Resource Centre (GHRC)
- Distributed Active Archive Centre (DAAC)





## Earthquake

Low risk

The earthquake hazard layer is a global map of Peak Ground Acceleration (PGA) in units of g for a return period of 475 years at 1-kilometer spatial resolution for reference site condition. Additional information provided in Modified Mercalli Intensity (MM). The data are provided by the Global Earthquake Model (GEM) Global Seismic Hazard Map (version 2018.1)

Sources:

- Global Earthquake Model (GEM) Global Seismic Hazard Map (version 2018.1)

**Result: Very Low (0.014 - 0.045)**  
MM & PGA (g)

**Risk grades:**

- Very extreme (> 0.750)
- Extreme (0.551 - 0.750)
- Very high (0.401 - 0.550)
- High (0.291 - 0.400)
- Significant (0.161 - 0.29)
- Moderate (0.085 - 0.160)
- Low (0.046 - 0.084)
- Very low (0.014 - 0.045)
- Negligible (< 0.014)

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**Low risks:** Negligible (< 0.014) Very low (0.014 - 0.045) Low (0.046 - 0.084)  
**Medium risks:** Moderate (0.085 - 0.160) Significant (0.161 - 0.29)  
**High risks:** High (0.291 - 0.400) Very high (0.401 - 0.550) Extreme (0.551 - 0.750) Very extreme (> 0.750)



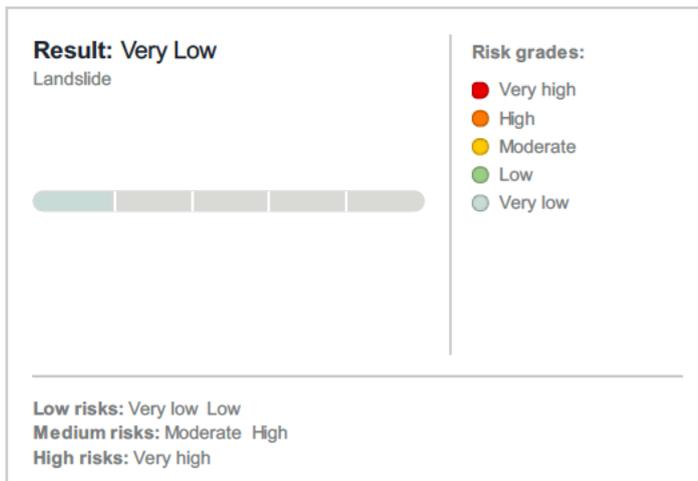
## Landslide

Low risk

The global landslide layer reflects both the landslide susceptibility and landslide runout risk. As a result, the likelihood of terrain failure, the propagation of risk down slope and deposition areas of possible landslides are depicted in the layer, whereby primarily earthquake-induced landslide processes are considered. In this model, the term 'landslide' refers to mass movement processes including rockfall, debris flow sand mud slides(Varnes1978). While the visualization provides information on the overall landslide risk, the risk lookups enable the user to get details on the underlying susceptibility and runout hazard values. The layer has global coverage (upto +59.9°N) at 1 second of arc of resolution (~30m at the equator).

Sources:

Data Set		Description	Vintage	Source
Global Landslide Inventory	Global Disastrous Landslides	Landslide data collected by NASA	2007 and younger	<a href="#">Nasa Data</a>
	Global Landslide Polygons	Dataset created by Emanuel Buechi	Regularly updated	<a href="#">Dave Petley's Landslide Blog</a>
Local Landslide Inventory	Nepal 2015	Landslides which happened after the Gorkha Earthquake 2015	2015 or Younger	<a href="#">Landslide Blog</a>
	Japan 2016	Landslides which happened after the Kumamoto earthquake 2016	2016 or younger	<a href="#">Landslide Blog</a>
	El Salvador 2001	Landslides that happened after an earthquake in February 2001	2010	<a href="#">Ministerio de Medio Ambiente Recursos Naturales</a>
	Cordillera Blanca	Peruvian Landslide inventory of Cordillera Blanca as established by Emmanuel for his Master Thesis	2018	<a href="#">Buechi et al 2018</a>
	Austria Hora	Landslide inventory of the Natural Hazard Overview & Risk assessment Austria (HORA)	regularly updated	<a href="#">HORA</a>
Slope	InterMap 30m DEM	The Intermap DEM with 30m resolution was used for computation		<a href="#">intermap</a>



Geology	GLiM	Glim Global Lithology Map University of Hamburg	2015	<a href="#">GLiM</a> hosted by <a href="#">CGMW</a>
Earthquake Risk	nternal EQ-Layer	Model developed internally	2015	<a href="#">Catnet</a>
Rainfall Risk	Open Weather Map	Relevant since water-content in soil can be a decisive triggering factor		nternal Layer can be found <a href="#">here</a>



## Tornado

Low risk

The hazard map consists of three parts with different data granularity:

### United States & Canada

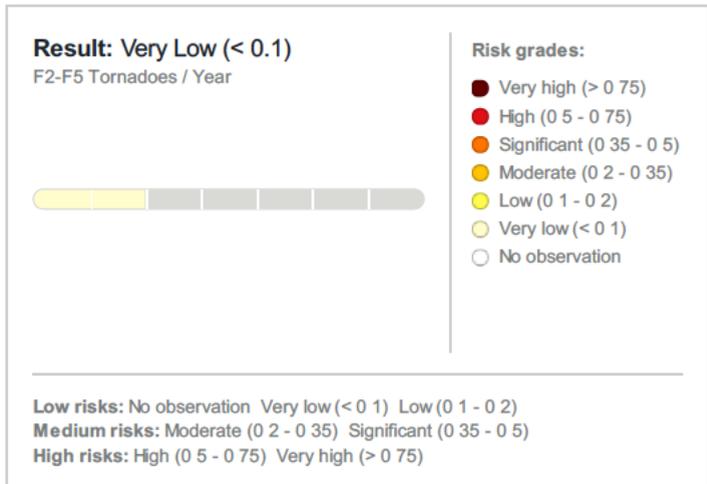
Data represents the average yearly tornado occurrence (F2-F5) within a grid cell of 50km x 50km based on 64 observation years and 30 years respectively

### Rest of the world

Data for the calculation was derived from numerous scientific documentations, observations and expert knowledge

#### Sources:

- **USA:** data from NOAA's Storm Prediction Center (SPC), NOAA's National Hurricane Center
- **Canada:** Paper from 'Environment Canada' (David S. S.)
- **Rest of the World:** combination of the knowledge of Swiss Re's Atmospheric Perils Specialists, own interpretations of tornado modes, recent event observations





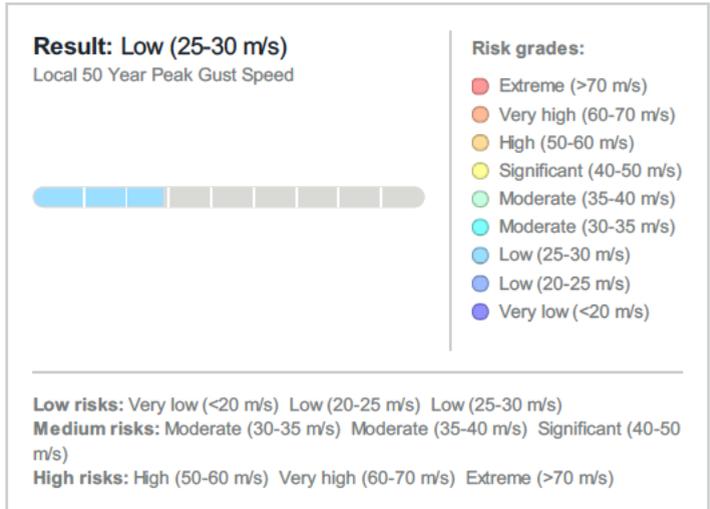
## Wind Speed/Cyclone

Low risk

The wind speed data shows the 3 seconds peak gust with a return period of 50 years.

Sources:

- Hazard module of Swiss Re's proprietary wind loss models; Global reanalysis dataset
- '20<sup>th</sup> century reanalysis project' designed by the Physical Sciences Division of the Earth System Laboratory of NOAA





## Coastal Flood

No risk data

Swiss Re's Coastal Flood Layer depicts coastal regions that are potentially affected by storm surges or tsunamis, defined by the 'distance to the coast' and the 'elevation above mean sea level'.

### Sources:

- 90 m resolution on SRTM DTED1 digital elevation model;
- SRTM Water Body Data Set

### Result:

Coastal Flooding



### Risk grades:

- Very High Risk
- High Risk
- Moderate Risk
- Low Risk
- Outside

**Low risks:** Outside Low Risk  
**Medium risks:** Moderate Risk  
**High risks:** High Risk Very High Risk



## Pluvial Flood

No risk data

Swiss Re's Global Pluvial Flood Zones provide information about the extent and frequency of flooding due to direct rainfall, minor channel and flash flooding. The zones are available worldwide (from 60°S to 60°N) at the high resolution of 10 meters in USA and Europe and 30 meters for the rest of the world.

### Sources:

- Copernicus Climate Change Service (C3S) (2018): *ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate*. Copernicus Climate Change Service Climate Data Store (CDS), accessed June 2020, <https://cds.climate.copernicus.eu/cdsapp#!/home>
- Guadon, M., Chen, A. S., Ghimire, B., Keedwell, E. C., Djordjevic, S., & Savic, D. A. (2016). A weighted cellular automata 2D inundation model for rapid flood analysis. *Environmental Modelling & Software* 84, 378-394.
- Intermap 10 and 30m digital elevation model.
- NOAA Atlas 14 (2018): *Precipitation-Frequency Atlas of the United States*. NOAA's National Weather Service, accessed June 2020, <https://www.nws.noaa.gov/oh/hdsc/index.htm>
- Ross, C.W., L. Prudhomme, J.Y. Anchan, S.S. Kumar, W. J., and N.P. Hanan. 2018. Global Hydrologic Soil Groups (HYSOGs250m) for Curve Number-Based Runoff Modeling. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1566>
- U.S. Geological Survey. *National Hydrography Dataset*.

### Result:

Return Period



### Risk grades:

- 50 year
- 100 year
- 200 year
- 500 year
- Outside

Low risks: Outside 500 year  
 Medium risks: 200 year 100 year  
 High risks: 50 year



## River Flood

No risk data

River flood zones are based either on Swiss Re Global Flood Zones™ (based on Swiss Re's proprietary and patented multiple regression approach) or on flood zones that are officially used or developed by the insurance industry (available for Austria, Czech Republic, Hungary, Italy, Luxemburg, Poland, Romania, Slovenia, Slovakia, Switzerland, UK, and USA).

### Sources:

- *Swiss Re GFZ*: Swiss Re's patented Geomorph Approach using Intermap's NEXTMap World 30 digital surface model terrain data
- *Official Flood Zones*:
  - Swiss Re's patented Geomorph Approach using MMC's 10m terrain data; CZE, SVK BAFU, CHE
  - FEMA's NFHL flood zones provided by FEMA; USA
  - Global Water Body Data: EC JRC/Google: Jean-Francois Peke, Andrew Cottam, Noe Goreck, Alan S. Beard, High-resolution mapping of global surface water and its long-term changes. *Nature* 540, 418-422 (2016). (doi:10.1038/nature20584)
  - UK Environment Agency
  - Natura Resources Wales
  - Instituto Superiore per a Protecció e a Recerca Ambiental (ISPRA)
  - Administration de la gestion de l'eau - Division de l'hydrologie (AGE), Luxemburg
  - National Authority for Water Administration - Poland (Wody.gov.pl)
  - National Authority for Water Administration - Hungary (OVF)
  - The data belongs to the National Administration "Romanian Waters" <http://www.rowater.ro/default.aspx> - Romania (ROWATER)
  - Institute of Water Slovenia - Slovenia (eVode)

### Result:

Official River Flood Zones



### Risk grades:

- 5 years
- 10 years
- 20 years
- 30 years
- 50 years
- 100 years
- 200 years
- 250 years
- 500 years
- >500 years
- No Data

Low risks: No data > 500 years 500 years

Medium risks: 250 years 200 years 100 years

High risks: 50 years 30 years 20 years 10 years 5 years



## Storm Surge

No risk data

Swiss Re's Global Storm Surge Zones provide information about the frequency of flooding due to storm surge from the ocean. The zones are available worldwide (from 60°S to 60°N) and cover all the ocean coastlines (except for the Black Sea and the Caspian Sea)

### Sources:

- Intermap 30m digital terrain model
- Copernicus Global Ocean Reanalysis, using E.U. Copernicus Marine Service Information
- Global Water Occurrence Layer (Jean-François Peke, Andrew Cottam, Noé Goreck, Alan S. Beard,
- High-resolution mapping of global surface water and its long-term changes. Nature 540, 418-422 (2016). (doi:10.1038/nature20584)

### Result:

Return period



### Risk grades:

- 50 years
- 100 years
- 250 years
- 500 years
- 1000 years
- No data

Low risks: No data 1000 years 500 years

Medium risks: 250 years 100 years

High risks: 50 years



## Tsunami

No risk data

Calculated Swiss Re tsunami hazard zones in CatNet® are available for all countries in the Pacific basin on a 30 meter resolution, reflecting the Tsunami hazard in a near-global consistent manner.

### Sources:

- Swiss Re proprietary models; NCTR Propagation Database by the NOAA Center for Tsunami Research
- Historical earthquake catalogues (NEIC, Centennial); Swiss Re global 30 m resolution data evaluation model and the Global Surface Water dataset (Jean-François Peke, 2016)

### Result:

Tsunami return period



### Risk grades:

- 500 years
- 1000 years
- 2500 years
- 5000 years
- 10000 years
- No data

**Low risks:** No data 10000 years 5000 years

**Medium risks:** 2500 years 1000 years

**High risks:** 500 years



## Volcano

No risk data

The global map shows the volcanic hazard, represented as the local ash thickness around volcanoes (150km) from a major eruption with a return period of 475y.

### Sources:

- SR Models Swiss Re proprietary
- Global Volcanism Program, 2013. Volcanoes of the World, v. 4.4.1. Venzke, E (ed.).
- Smithsonian Institution. Downloaded 9th July 2015. (<http://volcano.si.edu/>)
- Gonzalez-Meado, A. O., & Cruz-Reyna, S. (2010): A simple semi-empirical approach to model thickness of ash-deposits for different eruption scenarios. *Natural Hazards and Earth System Science*, 10(11), 2241-2257.
- Jenkins, S., Maguire, C., McAneney, J., & Bonga, R. (2012): Regional ashfall hazard: a probabilistic assessment methodology. *Bulletin of Volcanology*, 74(7), 1699-1712.
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### Result:

Return Period 475y



### Risk grades:

- Extreme (> 100cm)
- Very high (50 - 100 cm)
- Very high (40 - 50 cm)
- High (30 - 40 cm)
- High (20 - 30 cm)
- Significant (10 - 20 cm)
- Moderate (5 - 10 cm)
- Moderate (2 - 5 cm)
- Low (1 - 2 cm)
- Low (0.1 - 1 cm)

**Low risks:** Low (0.1 - 1 cm) Low (1 - 2 cm)

**Medium risks:** Moderate (2 - 5 cm) Moderate (5 - 10 cm) Significant (10 - 20 cm)

**High risks:** High (20 - 30 cm) High (30 - 40 cm) Very high (40 - 50 cm) Very high (50 - 100 cm) Extreme (> 100cm)



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