EarthScan

Combined Signals & Ratings Methodology

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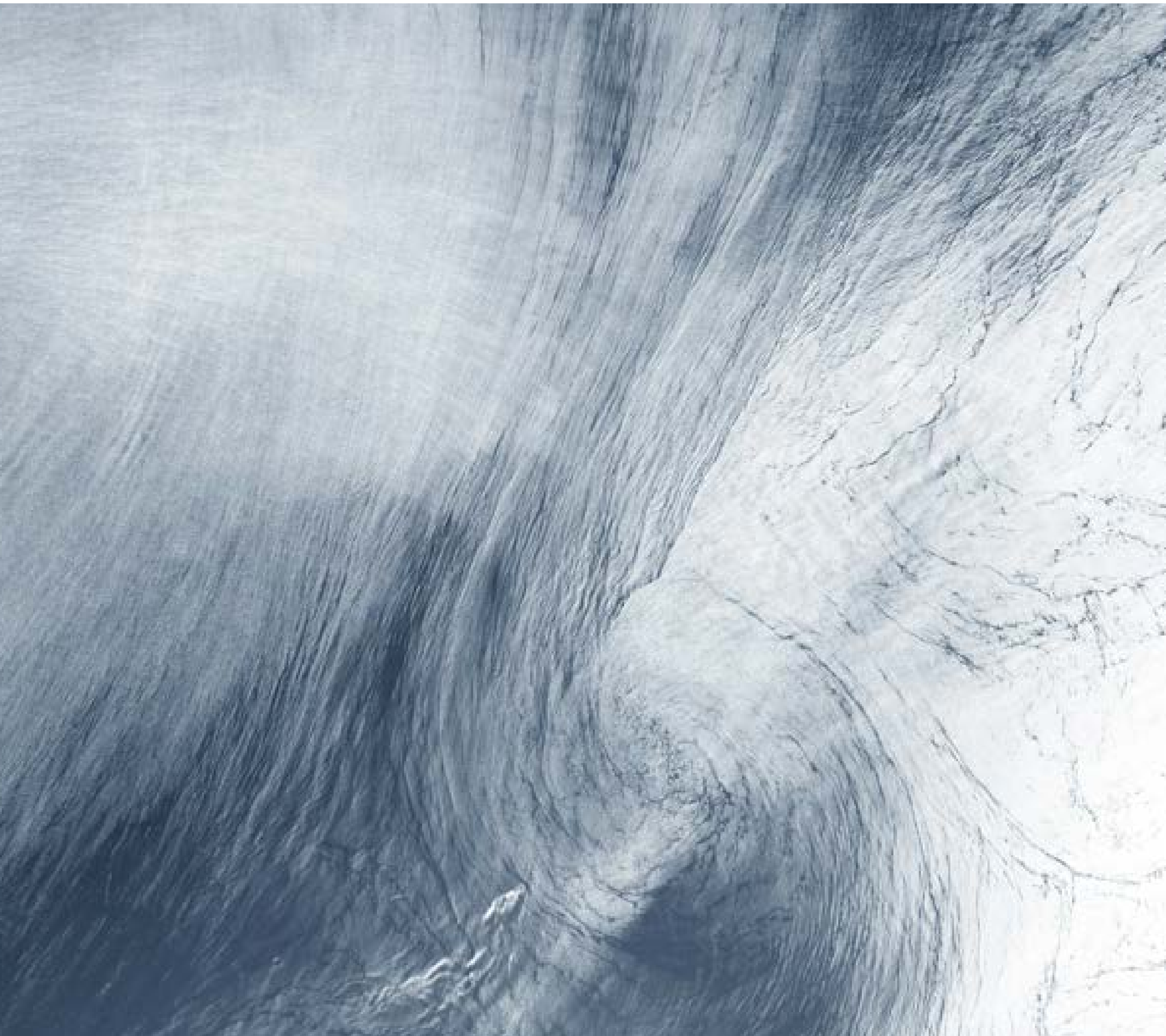

Disclaimer

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About this document

The following document outlines the components of EarthScan. The first section provides an overview of key physical climate risk terms and methodologies (page 2). The second section delves into the Physical Climate Risk Signals, divided into atmospheric (page 10) and flooding (page 17) signals—these represent the outputs of our climate models across different hazard categories. The final section details the EarthScan Ratings, a feature that delivers comparable estimates of climate hazard exposure and direct physical damage to built assets (page 21).

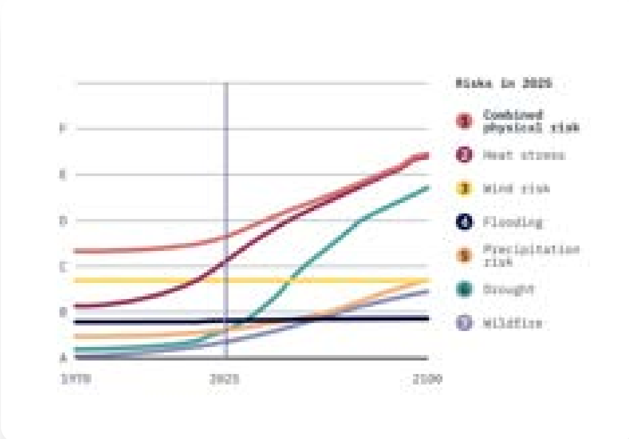
Risk Categories

Defining Terms & Methodologies

An Overview of Physical Climate Risk Signals

EarthScan's modelling framework provides users with decision-useful[1] insights on climate hazards relevant to their built assets.

Climate hazards are physical processes or events that have the potential to cause loss or damage, such as extreme weather events or floods. Risk categories describe distinct types of climate hazard or peril with the potential to cause direct damage or disruption to built assets, such as flooding or wildfire.



What are signals?

We use the term **signals** to describe how the different climate hazards are likely to changeover time. These signals are powered by **physical metrics**—the outputs of our climate models.

Climate hazard signals cover a historic period from 1970 to 2020 and future projections up to 2100 over three emission scenarios. Each signal contributes to a specific risk category; for example, riverine flooding and coastal flooding contribute to the flooding risk category.

In EarthScan, signals feed into the insights, maps, and visualisations that provide intelligence on potential changes to asset-level climate hazard exposure. All signals estimate exposure or danger to a specific climate hazard at a given location, based on the time horizon and climate scenario selected.

Signals focus on how climate hazards impact the built environment by quantifying the hazard characteristics that are likely to cause direct damage or disruption to built assets.

Damage focuses on hazard characteristics that result in direct damage to built assets, while disruption focuses on the hazard characteristics that can cause direct interruptions to built asset operational capabilities. For example, extreme wind speeds cause physical damage during storms and extreme temperatures during heatwaves can cause operational disruption.

(1) Decision utility refers to the suitability of the signals to make decisions around screening, reporting, and financial use cases.

Which climate hazards does EarthScan cover?

By selecting a chosen emission scenario, year and risk category, EarthScan users can explore how exposure to climate hazards changes over time and assess climate-related risks over the short, medium, and long-term.

Risk Category	Signal	Physical Metric
Heat Stress	Maximum Temperature	Maximum temperature (°C)
	Heatwave	Maximum heatwave length (days)
Extreme Precipitation	5-day maximum precipitation	5-day maximum precipitation (mm)
Drought	Consecutive dry days	Consecutive dry days (days)
Extreme Wind	Extreme wind	Maximum 3-second wind gust (m/s) at 10m
Flooding	Coastal flooding	Coastal flooding inundation depth (cm)
	Riverine flooding	Riverine flooding inundation depth (cm)
Wildfire	Wildfire danger	Fire Weather Index

Signal Methodology

Based on EarthScan's proprietary modelling frameworks, signals fall into two categories: **atmospheric signals** and **flooding signals**.

- Atmospheric signals (heat stress, extreme precipitation, wind risk, drought, and wildfire) are generated using the Multiple Futures Model.
- Flooding signals (coastal and riverine flooding) are generated using our flood modelling framework.

Atmospheric Signals: The Multiple Futures Model

EarthScan's proprietary Multiple Futures Model represents an ensemble of a full range of possible climate futures relating to the interaction between human activity and climate change over the next century.

Each simulation within the Multiple Futures Model describes a realistically plausible future. The modelling framework combines Earth System models and regional climate models with observational data to simulate calibrated long-term climate changes and produce robust future projections of physical climate risk across multiple emissions scenarios.

The Multiple Futures Model calculates datasets for climate hazard variables by combining a curated subset(2) of global climate models from the Coupled Model Intercomparison Project (CMIP6) with historical observational data containing tens of thousands of measurements around the globe.

(2) Subset selection is based on: model quality and resolution, spread of modelling centres worldwide, covering a representative range of the uncertainty incorporated within the CMIP6 repository, and exclusion of models that are near replicates of other models (to avoid model bias in our estimates).

Probability Modelling

To calibrate each signal, we combine ERA5 (see signal data sources on p.15 for dataset reference) reanalysis data with in-situ and remote sensing observational datasets to calculate statistical properties over a historical period (1980-2020). The Multiple Futures Model then calculates probability distributions describing the full range of possible values and potential outcomes for each metric over a specific range of locations, time horizons and climate scenarios.

We extract return periods from calculated probability distributions to express how the intensity of climate-related hazards will vary in the future. Climate scientists use return periods to assess two things. Firstly, the intensity of low probability events (a 100-year return period equates to a 1% probability of occurrence in any given year), and secondly, how such intensity changes over time as the result of climate change. The higher the return period, the greater the intensity (or return level) of a potential hazard event.

We refine model return levels iteratively by applying bias correction. Bias correction involves statistically comparing and calibrating model output data against additional reference datasets. Best practice in climate science, this ensures outputs are consistent with climate processes and representative of local climate for a given geography and time.

For climate hazards strongly influenced by local atmospheric processes, such as extreme wind, we leverage additional datasets that utilize dynamical downscaling techniques to increase signal accuracy and ensure that return levels reflect local and regional variations. Collectively, data from over 90,000 weather stations in 180 countries and territories are incorporated into the extreme wind signal and provide additional detail to represent those finer-scale atmospheric processes (see signal data sources on p.16 for dataset reference).

Flood Modelling Overview

To quantify asset-level exposure to flood hazards and enable scenario-based analysis, we have developed a proprietary flood modelling framework that maps historical flooding events and includes the effects of climate change.

Our framework incorporates a detailed understanding of terrain (elevation, land cover and rate of elevation, and land cover change over time), water body boundaries (seas, shorelines, estuaries, and rivers) and water flows (precipitation patterns, river discharge, storm surges, and relative sea level change). The effects of climate change are included by incorporating sea level, storm surges, and chronic precipitation change into our framework (see signal data sources on p.18 for dataset reference).

To allow users to consistently compare flooding exposure across assets, EarthScan's riverine and coastal flooding signals use global flooding models as their foundation. For riverine flooding, we incorporate hydrological models to account for the variation in processes, boundary conditions, and catchment properties across river networks to compute a future-looking perspective on riverine discharge. For coastal flooding, we leverage open access global sea level rise datasets, extreme sea level reanalysis data, and incorporate highly detailed modelling of historical coastlines to generate a holistic view of the contributing factors to local coastal flooding risk.

Digital Terrain Model

Mitiga's in-house Digital Terrain Model (DTM) improves on the Copernicus Digital Surface Model (DSM) by applying deep learning to correct for the elevation of buildings and vegetation, allowing for a more physically accurate flow of water over the topography.

To generate our flooding signals, the DTM is used to assess potential flooding inundation depths for dry land and account for the impact of local topography on flooding projections of water depth and spatial extent. Land elevation and flow direction provided by the in-house DTM are based on digital elevation and satellite data that map surface elevation values over time and account for vertical land movement such as subsidence.

The DTM does not account for special flood defences. Flood defences larger than 90m can be considered permanent features of the terrain landscape and are identified in the DTM.

Coastal and riverine flooding are calculated based on modelling that incorporates the in-house DTM to represent topography for Europe and North America. Topography for other locations uses a Digital Surface Model (DSM) based on the Copernicus Digital Elevation Model dataset (see signal data sources on p.20 for dataset reference).

Riverine Flooding

Riverine flooding is calculated based on historic and present day riverine discharge data and river and flood plain geometries. Detailed river basin data (including the spatial extent and basin geometry) enable modelled flood water volume and flow to follow realistic local-scale flooding patterns, simulating how flood water flows over surface topography.

Future projections of river discharge are taken from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) hydrological models, which incorporate a range of processes that may contribute to future changes in riverine discharge.

Return periods are calculated using reanalysis data and model projections across climate scenarios and converted to flood volumes to create flooding maps (see flood signal data sources on p.20 for dataset reference).

Coastal Flooding

The coastal flooding signal is calculated using detailed historical datasets, incorporating sea level reanalysis data driven with ERA5 meteorology, satellite retrievals, and GPS data.

Reanalysis data provide return periods for historical flood events, which are refined using other data sources (terrain movement, historical local sea level, and shoreline data) to ensure past changes in sea level and associated flood events are represented in the signal. To account for changing coastal morphology over time, the DTM is adjusted using historical shoreline datasets derived directly from remote-sensing data.

Sea level change scenarios are derived from end-of-century projections of global and regional sea level rise. Extreme sea levels are derived from a global dataset that includes the reanalysis of historical tides, storm surges, and simulated hurricanes (see flood signal data sources on p.20 for dataset reference).

Signal Validation

All signal outputs are continuously validated. The validation process includes a range of sanity checks, differential mapping, statistical validation, and scientific validation. The validation pipeline is run for any updates to the modelling framework, including the incorporation of new datasets.

Sanity checks ensure signals span a physically plausible range. For example, wind speed values greater than a certain threshold are deemed unphysical, and only data values below this maximum are carried through into signals. We also verify that return levels increase monotonically[(3)] with return periods, with no abrupt changes in signals. Models are developed iteratively and additional signals added sequentially, so differential mapping is employed to carefully map changes between model versions.

Scientific validation assesses signal quality against published scientific research across multiple physical metrics, regions, and model versions and processes. To create comparable mapping and version tracking, model versus literature comparisons are partially automated in our signal pipelines. In line with climate science best practice, visual comparisons of the spatial patterns in modeled signal outputs are evaluated by in-house domain experts.

All CMIP6 datasets are bias corrected against higher resolution ERA5 global reanalysis data for a representative historical period. Statistical validation, or backtesting, tests our generated signals against reference datasets[(4)] using key statistical metrics to confirm that adjusted return levels represent local climate. Individual signals are statistically validated against datasets most relevant to that signal; for example, riverine flooding compares signal outputs to independent US and UK discharge data and flood maps.

Insights and Ratings are subject to change based on new and improved scientific inputs and/or data.

(3) Always increasing or remaining constant, and never decreasing.

(4) Backtesting is the process of verifying the statistical properties of our signals and providing a quantitative comparison against historical observations using meaningful, carefully chosen error metrics.

Signal Overviews

Atmospheric Signals

Heat Stress

Signal Summary	Heat stress signals estimate exposure to heatwaves and extreme temperature events at your asset's location.	
Hazard Definition	Heat stress is the exposure of people, assets, and infrastructure to extreme, frequent, and sustained high temperatures. It can have direct and indirect financial impacts on all industries, especially those requiring outdoor manual labour (for example, construction and agriculture).	
Return Periods	2, 5, 10, 20, 50, 100	**Resolution** 25km
Signal	Maximum temperature	Heatwave
Physical Metric	Temperature maximum (°C)	Heatwave length (days)
Definition	The warmest temperature (°C) a given location experiences over a given year	Annual maximum number of days exceeding the 95th percentile of the warmest historical season

Asset-Level Impacts of Hazard

- Above a threshold of 45°C, temperatures can be deadly, even without pre-existing health conditions. If humidity is high, this threshold lowers. At 100% humidity, the livability threshold drops to 35°C.
- High temperatures cause the expansion or even melting of building materials (such as tarmac or asphalt), damaging buildings and roads and disrupting transportation, power, and communications networks.
- Metal rusts faster when exposed to high temperatures, which can weaken concrete structures internally reinforced with steel [(5)].
- Building foundations are vulnerable to subsidence, particularly in clay-rich soil areas, during extended hot and dry periods.

Signal Notes

We use historical data (1980-2020) to understand the distribution of daily maximum temperatures and heatwaves. By combining these data with future climate projections, we can interpret how the yearly maximum temperature and lengths of heatwaves will likely change in future. Users can understand the likelihood of events of a certain magnitude by using return periods, where lower return periods indicate a higher probability of occurrence and vice versa.

(5) https://www.sciencedirect.com/science/article/abs/pii/S0141029611000241

Extreme Precipitation

Signal Summary	The extreme precipitation signal estimates the annual maximum expected 5-day precipitation for a given year at an assets location.
Hazard Definition	Extreme precipitation refers to periods with exceptionally high volumes of precipitation (as rain, drizzle, sleet, hail, or snow) which could lead to localized flooding or water damage.
Return Periods	2, 5, 10, 20, 50, 100
Resolution	25km
Physical Metric	5-day maximum precipitation (mm)
Signal	Extreme precipitation
Definition	Annual maximum precipitation calculated as a rolling sum over 5 days for a given location

Asset-Level Impacts of Hazard

- Intense rainfall in urban areas with hard surfaces can overwhelm drainage system capacity, leading to water overflow in surrounding areas.
- Heavy precipitation can create secondary impacts including soil erosion and increase the risk of slope failure.
- Over time, extreme precipitation can cause physical damage to buildings impacting asset maintenance costs and service lifetime.[6]

Signal Notes

Higher values indicate an asset's geographical location has a greater probability of experiencing extreme precipitation events. Currently, the precipitation signal does not fully capture precipitation generated by severe convective storms.

(6) https://www.mdpi.com/2075-5309/10/3/53

Extreme Wind

Signal Summary	Extreme wind estimates exposure to high wind speeds by estimating wind gusts at an asset's location. The extreme wind signal covers a wide range of extreme storm events, including extratropical cyclones (often called mid-latitude winter storms), tropical cyclones (hurricanes, typhoons) and less intense tropical storms. The signal is able to reproduce key features of the local variability in exposure to extreme wind speeds associated with these storm events.
Hazard Definition	Extreme wind represents the maximum 3-second wind speed within an average of sustained wind speed over a 10 minute period and captures the most intense wind speeds experienced within around 10m of ground-level at an asset's location.
Return Periods	2, 5, 10, 20, 50, 100, 200, 500, 1000 — **Resolution** 25km
Physical Metric	Maximum 3-second wind gust (m/s) — **Signal** Extreme wind
Definition	The maximum 3-second wind speed within an average of sustained wind speed over a 10 minute period[8], capturing the most intense wind speeds experienced within around 10m of ground-level at an asset's location.
Asset-Level Impacts of Hazard	• Extreme winds cause direct physical damage to assets, from damage to roof tiles to structural damage. • Storms can disrupt operations and limit access to sites through structural damage and disruption to critical infrastructure, leading to temporary closures and loss of associated revenue. • Post-storm clean-up process can be costly and time consuming, especially where sites have to remain closed for the clean-up duration.
Signal Notes	Higher signal values indicate greater exposure to high wind speeds during wind events and potential damage caused by high wind intensities. The extreme wind signal contains larger uncertainties in comparison to other atmospheric signals. These uncertainties are inherent in best-in-class climate models and associated with difficulties in simulating the complex dynamical processes behind extreme wind events, particularly localized storms (such as tornadoes and extreme thunderstorms). As a result, there is considerable uncertainty surrounding future changes in extreme storm frequency and intensity particularly at local scales[9]. We incorporate dedicated tropical cyclone datasets into our extreme wind signal to improve the representation of strong hurricanes. Currently, the signal does not represent extreme winds associated with localized severe convective storms, like tornadoes and intense thunderstorms. We are developing model capability to capture severe convective storms, starting with tornadoes in the US.

(8) Definition follows that given by the World Meterological Organization (WMO)

(9) https://www.ipcc.ch/report/ar6/wg1/

Drought

Signal Summary	The drought signal captures the aridity of different geographies, providing information about current and future drought exposure for a given location.
Hazard Definition	Drought describes climate events related to water shortages, linked to periods of low precipitation. Drought drives direct and indirect risks to operations and revenue for many industries, especially those that use large quantities of water in their operational processes, such as the agriculture, textile, chemical, and automobile industries.

Return Periods	2, 5, 10, 20, 50, 100	**Resolution**	25km
Physical Metric	5-day maximum precipitation (mm)	**Signal**	Maximum number of consecutive dry days

Definition

The annual maximum number of consecutive days for which precipitation is less than 1 mm/day.

Asset-Level Impacts of Hazard

- Water is used in many manufacturing processes. Under drought conditions, reductions in or interruption of the water supply can reduce site productivity or close manufacturing facilities.
- Drought can physically impact built assets directly. Soil shrinks as it loses moisture, increasing the risk of subsidence and damage to underground infrastructure (e.g. burst water pipes).
- Sanitation and water availability issues can lead to building closure. Reduced flows in rivers and streams can concentrate pollutants and impact water quality.

Signal Notes

Higher metric values indicate the location of an asset is exposed to long periods of aridity. Consecutive Dry Days is an absolute metric, allowing users to interpret drought exposure by comparing future changes to current aridity and provides a clear spatial picture for current and changing risk.

Wildfire

Signal Summary	The wildfire signal estimates how meteorological and climatological wildfire conditions would impact the spread and intensity of wildfire given an ignition event on a particular day in a given year.
Hazard Definition	Wildfire danger refers to the potential intensity of an unplanned fire under certain fire weather conditions, should ignition occur. Fire weather describes how meteorological conditions (relative humidity, precipitation, wind speed and direction) determine favorable conditions for wildfires to grow and disperse.

Return Periods	2, 5, 10, 20, 50, 100, 200, 500, 1000	**Resolution**	25km (with 500m flammable area mask)
Physical Metric	Fire Weather Index (FWI)	**Signal**	Wildfire danger

Definition

The FWI is a meteorologically based index conceived by Météo France and the Meteorological Service of Canada. The FWI metric is combined with flammable class land cover data to project future changes in wildfire danger under different future emission scenarios. The FWI estimates the average daily danger of fire. The signal is calculated based on the 10% highest risk days in any given year, capturing peaks in the wildfire season.

Asset-Level Impacts of Hazard

- Wildfires can cause direct physical damage to assets through fire and smoke damage.
- They can also disrupt critical transportation, communication, power and water supply infrastructure, and endanger human health and well-being through fire danger, smoke inhalation, and deterioration of air quality.
- Regions with typically low or minimal wildfire danger are unlikely to be adapted to wildfires, but may experience increased wildfire danger as a result of climate change. These regions may have greater vulnerability than well-adapted areas should ignition occur.

Signal Notes

Higher FWI values indicate that meteorological conditions (for example, increasing temperatures and decreasing precipitation) are more favourable for triggering wildfires in areas with flammable vegetation coverage. The rate of change in wildfire danger over time can help to identify where assets are located in areas with rapidly increasing wildfire risk.

Wildfire ignition is a complex process to model because of the need to incorporate randomness (for example, human behaviour) as a significant factor. FWI is a proxy metric that estimates the conditions for wildfire intensity and spread for a given area, and not the likelihood of wildfire ignition directly.

In densely built-up urban areas, wildfire spread depends on how fire intensity interacts with building materials. For urban areas, the signal contains more uncertainty, as building material fuel type is not included in FWI calculations.

The FWI dataset is based on Canadian forests and how ecologically similar areas respond to wildfire. As vegetation differs regionally, the signal may overestimate risk in drier areas or areas well-adapted to wildfire.

Atmospheric Signal Data Sources

Atmospheric signals make use of:

- Selected CMIP6 model data, with development coordinated and promoted by the World Climate Research Programme through the Working Group on Coupled Modelling
- ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate including modified Copernicus Climate Change Service information, 2022 and modified Copernicus Atmosphere Monitoring Service information, 2022
- NASA GDDP: signals contain modified data from the NASA Global Daily Downscaled Projections model

In addition, the extreme wind signal makes use of:

- Regional climate model data from the Coordinated Regional Downscaling Experiment (CORDEX). These data provide better resolution of topographic features such as coastlines, valleys, and mountain ranges than global climate models by using grid boxes smaller than 25km
- The International Best Track Archive for Climate Stewardship (IBTrACS) global tropical storm observational dataset (version 4)
- Wind gust observations from over 90,000 stations across the globe from the Global Historical Climate Network-daily (GHCN-d) dataset

The wildfire signal makes use of:

- The Fire Weather Index (FWI). This dataset is produced by ECMWF in its role as the computational centre for fire danger forecast of the Copernicus Emergency Management Service (CEMS), on behalf of the Joint Research Centre which is the managing entity of the service. The data set contains modified Copernicus Climate Change Service information 2022 and modified Copernicus Atmosphere Monitoring Service information 2022
- European Space Agency (ESA) WorldCover 2020: Contains modified Copernicus Sentinel data (2020) processed by ESA WorldCover consortium

Signal Overviews

Flooding Signals

Riverine Flooding

Signal Summary

The signal estimates the inundation of land connected to inland bodies of rivers and streams based on riverine discharge data and river and flood plain geometries. It captures flood events caused by extensive rainfall or snowmelt over an extended period of time, exceeding river capacity.

Hazard Definition

Riverine flooding occurs when excessive precipitation or snowmelt causes a river or stream to exceed its natural capacity and overflow into surrounding land. Riverine flood damage can be widespread, as overflow impacts river systems downstream, causing smaller rivers to also overflow. Riverine flood impacts are amplified by existing factors such as soil saturation and local topography.

Return Periods	2, 5, 10, 20, 50, 100, 200, 500, 1000	**Resolution**	90m
Physical Metric	Riverine inundation depth (cm)	**Signal**	Riverine flooding

Definition

The maximum water inundation depth of riverine flooding at a given location based on undefended land

Asset-Level Impacts of Hazard

- When flood water inundates built assets, it can cause direct physical damage to building materials and structure and, in extreme situations, lead to total structural failure
- Damage to building contents (stock, furnishings, equipment, technology)
- Disrupt critical infrastructure and limit site access. Sewer overflow can affect sanitation and contaminate drinking water
- Clean-up and repair post-flood can be extremely costly and time consuming

Signal Notes

The riverine flooding signal is calculated using the next generation of our Digital Terrain Model (DTM).

Future projections are taken from ISIMIP discharge models, which are driven by climate models from the CMIP5 generation. The modelling capability used for ISIMIP is not as advanced as CMIP6, which forms the basis of the Multiple Futures Model for our atmospheric signals. ISIMIP is currently developing an update to its discharge models that utilizes CMIP6. As ISIMIP datasets do not cover RCP4.5, we use RCP6.0 data to infer the RCP4.5 scenario using a time-shift approach.

Currently, datasets with detailed maps of riverine systems and digital terrain models are not available beyond a latitude of 60°N and for small islands. For these locations, the model does not have access to input data to identify whether a specific river will have a higher predisposition for flooding.

The 2-year return period for riverine flooding is typically associated with bankfull discharge events[10]. When the 2-year return period is selected, no change in the riverine flooding signal between 1970-2020 is expected. The 100-year return period is a standard return period used by insurers and governments to assess general flood risk, and is a good starting point for analysis.

(10) Bankfull discharge describes events where the river channel fills up to its limit without overflowing onto the surrounding floodplains (WMO).

Coastal Flooding

Signal Summary	The signal provides a view of flood hazard risk for undefended land and estimates the inundation depth of land adjacent to oceans, seas and estuaries, accounting for relative sea level, local mean sea level, storm surges, terrain elevation, historical vertical land movement and extreme sea levels.
Hazard Definition	Coastal flooding events are driven by a combination of physical processes, including changing local mean sea-level, wind-driven waves, storm surges and tidal processes and can happen anywhere along the coastline. Flood impacts can be amplified by local topography and changing wind conditions. Sea level rise due to climate change is likely to increase coastal flooding in many areas. In some locations, increasing sea-level in combination with storm surges and high tides could mean local coastal flooding events reach greater depths and impact further inland.

Return Periods	2, 5, 10, 20, 50, 100, 200, 500, 1000	**Resolution**	130m
Physical Metric	Coastal inundation depth (cm)	**Signal**	Coastal flooding

Definition

The maximum water depth (cm) of coastal flooding at a given geographic location based on undefended land

Asset-Level Impacts of Hazard

- When flood water inundates built assets, it causes direct physical damage to building materials and structure. In extreme situations, this can lead to total structural failure
- Damage to building contents (stock, furnishings, equipment, technology)
- Disrupt critical infrastructure and limited site access. Sewer overflow can affect sanitation and contaminate drinking water
- Clean-up and repair post-flood can be extremely costly and time consuming

Signal Notes

The flooding signals provides information on undefended land. While the terrain model describes elevation in detail, smaller scale flood defence infrastructure is not included within the signals. Assets located within flood defence systems with large-scale elevation-based defences (for example, the Netherlands dyke system) still represent a view of undefended land if critical control points depend on small-scale infrastructure, such as pumping stations.

In addition, future projections of coastal flooding do not yet include projected coastal erosion. In some locations, the signal can underestimate the influence of wind waves and swell on local sea levels, due to limitations in the available observational data. This may lead to an underestimation of coastal flooding risk in areas on the Pacific coast.

Flood Signal Data Sources

All flooding signals make use of:

- Copernicus GLO-30 and Copernicus GLO-90 coastal terrain elevation model data

The riverine flooding data product makes use of:

- Copernicus ERA-5 Global Flood Awareness System (GloFAS) reanalysis data representing recent hydrological activity with a hydrological model driven with ERA5 meteorology
- Copernicus historical river discharge data under the CEMS-FLOODS datasets license
- ISIMIP daily discharge data across a number of climate model and hydrological model simulations licensed under CC-BY-4.0
- HydroLakes, licensed by the authors under a CC-BY-4.0 license

The coastal flooding data product makes use of:

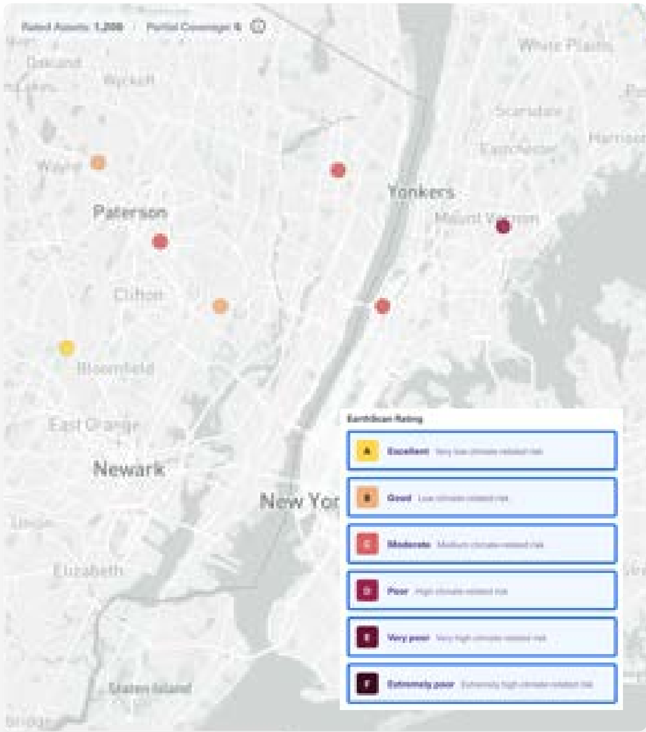
- European Commission Joint Research Centre's (JRC) Global Surface Water dataset, produced under the Copernicus program
- GPS station velocities provided by the Nevada Geodetic Laboratory
- IPCC AR6 sea level Rise Projections, licensed by the authors under a Creative Commons 4.0 International License
- COAST-RP: A global Coastal dataset of Storm Tide Return Periods dataset, licensed by the authors under the Creative Commons Attribution 4.0 International License

Ratings Overview

EarthScan's Framework

An Overview of EarthScan Ratings

EarthScan™ Ratings provide globally comparable estimates of climate hazard exposure[11] and direct physical damage to built assets. Built on a globally standardized framework, EarthScan Ratings summarize the latest climate science, data, and models to give decision-makers a quick and clear indication of an asset's climate-related risk.



Assets are the individual building blocks of the EarthScan Ratings framework. By starting at the asset-level—providing a shared, comparable, and standardized view of climate risk across different geographies, time horizons, and hazard types—ratings deliver climate intelligence across multiple scales, from individual assets to portfolios, and companies.

EarthScan Ratings are available across six individual hazard risk categories (see Table 1). Risk categories describe distinct types of climate hazard or peril with the potential to cause direct damage or disruption to built assets, such as flooding or wildfire. For each risk category, Ratings are calculated based on a suite of climate hazard exposure metrics[12], which are generated by applying statistical modelling approaches to describe how climate hazard probabilities change for a given location over time and across future emissions scenarios.

Currently, Ratings are available for the following climate hazards: heat stress, extreme precipitation, extreme wind, drought, coastal and riverine flooding and wildfire (see Table 1). Ratings for heat stress, extreme precipitation, wildfire, and drought (hazards that predominantly cause disruption to operations) are calculated using exposure metrics. Ratings for hazards that cause the greatest amount of direct physical damage to built assets, extreme wind and flooding, are calculated using exposure and Climate Value-At-Risk (CVaR) metrics.

(11) Exposure is defined as the presence of people, livelihoods, ecosystems, built assets and infrastructure, in places that could be adversely affected by a hazard. Definition adapted from IPCC AR6 report.

(12) Exposure metrics provide probabilistic description of climate-related hazards at a given location, time horizon and emission scenarios. For more details, see the Physical Climate Risk Signals Overview.

Table 1: An Overview of EarthScan Signals (1/2)

Hazard	Physical Metric	Resolution	Metric Definition
Heat Stress	Max temperature (°C)	25km	The warmest day a location experiences in a given year, based on daily maximum air temperature measurements (in °C at 2m above ground).
	Max heatwave length (days)	25km	Annual maximum number of days exceeding the 95th percentile of the warmest historical (1980-2020) season, based on maximum temperature data (°C at 2m above ground). Higher heatwave metric values indicate the location of an asset is more exposed to longer heatwaves.
Extreme Precipitation	Max 5 day precipitation (mm)	25km	Annual maximum precipitation (mm) based on measured or observed precipitation data over a rolling 5-day sum. Higher metric values indicate the location of an asset is more exposed to precipitation-related damage and disruption.
Flooding	Max coastal flooding inundation depth (cm)	130m	Maximum water inundation depth of undefended land at a given location, including the effects of relative sea level, local mean sea level, terrain elevation, historical vertical land movement and extreme sea levels. Higher metric values indicate an asset is exposed to flooding events of greater intensity.
	Max riverine flooding inundation depth (cm)	90m	Maximum water depth of riverine flooding on undefended land at a given location based on riverine discharge data and river and flood plain geometries. Higher metric values indicate an asset is exposed to flooding events of greater intensity.

Table 1: An Overview of EarthScan Signals (2/2)

Hazard	Physical Metric	Resolution	Metric definition
Extreme wind	Wind gust max (m/s)	25km	Annual maximum wind intensity (maximum 3-second wind gust at 10m above ground). Higher metric values indicate an asset is more exposed to wind-related damage due to high wind intensities.
Drought	Consecutive dry days (CDD) (days)	25km	Annual maximum number of consecutive days for which precipitation is less than 1 mm/day. Higher metric values indicate the location of an asset is exposed to greater aridity.
Wildfire	Fire Weather Index (FWI)	25km	Average daily danger of fire, based on the 10% highest risk days of the year. Higher metric values indicate danger of increased spread and intensity should wildfire ignition occur.

How to Use EarthScan Ratings

Use EarthScan Ratings to differentiate asset exposure and impact across geographies and time horizons. Ratings indicate the probability of climate hazard events with the potential to create a concerning level of physical damage and disruption to an exposed asset and its operations.

Assets and portfolios are assigned one of six EarthScan Ratings, from Rating A (very low climate-related risk) to Rating F (extremely high climate-related risk) (see Table 2). Assets experience a concerning level of physical damage and/or disruption when a climate hazard event exceeds a certain threshold, or when they experience hazards at higher levels of intensity than typical conditions. EarthScan Ratings are determined based on a projected score between 0-999 (see Table 2). The score is a relative assessment of the potential for climate hazard events to cause physical damage and/or disruption to a given built asset, based on comparison against a representative global benchmark set of assets. Higher scores represent better EarthScan Ratings with lower climate-related risk. A is the best EarthScan Rating and indicates very low climate-related risk. Lower scores represent worse EarthScan Ratings with higher climate-related risk. F is the worst EarthScan Rating and indicates extremely high climate-related risk.

Table 2: Overview of EarthScan Ratings

Rating	Score	Description
A	999-833	Excellent Minimal risk of climate hazard events that have the potential to cause physical damage and/or disruption to built assets
B	832-667	Good Low risk of climate hazard events that have the potential to cause physical damage and/or disruption to built assets
C	666-501	Moderate Medium risk of climate hazard events that have the potential to cause physical damage and/or disruption to built assets (Rating C is the recommended guideline for screening assets)
D	500-334	Poor High risk of climate hazard events that have the potential to cause physical damage and/or disruption to built assets
E	333-167	Very poor Very high risk of climate hazard events that have the potential to cause physical damage and/or disruption to built assets
F	166-0	Extremely poor Extreme risk of climate hazard events that have the potential to cause physical damage and/or disruption to built assets

How EarthScan Ratings Are Calculated

The EarthScan Ratings Framework

The driving principle behind the EarthScan Ratings framework is to provide a comprehensive view of climate risk that provides comparable intelligence across as many hazards, geographies, and time horizons as possible. Climate science is constantly evolving and we've designed our framework intentionally so that it can evolve by incorporating new metrics in the future.

The scientific climate-related data and best-in-class climate models that underpin our hazard signals are the starting point for calculating EarthScan Ratings. Assets experience physical damage and/or disruption when a climate hazard event exceeds a certain threshold, or when they experience hazards at higher levels of intensity than typical conditions. EarthScan's modelling ensembles generate a range of exposure metrics to provide decision-useful[13] insights relevant to built assets across risk categories.

Signals indicate the probability of an asset (or portfolio of assets) being exposed to a climate hazard at varying levels of intensity[14], such as extreme winds of a particular speed, or floods of certain depths. They quantify the climate hazards' characteristics likely to cause direct damage or disruption to built assets and then calculate the probability of exposure for a given location. For example, EarthScan's extreme wind signal estimates a location's exposure to the extreme wind speeds that cause damage during storms. Similarly, EarthScan's heat stress signal estimates the extreme temperatures that cause disruption during a heatwave.

Defining Climate Hazard Events

To calculate EarthScan Ratings, a series of specific climate hazard events that have the potential to cause physical damage and/or disruption to built assets are quantitatively defined for each risk category, such as the duration of a heatwave, the depth of a flood, or a significant change in annual precipitation compared to recent historical conditions.

To provide an estimate of impact for the hazards most likely to cause direct physical damage to assets, EarthScan Ratings also incorporate CVaR into the coastal and riverine flooding, and extreme wind Ratings.

(13) Decision utility refers to the suitability of the signals to make decisions around screening, reporting, and due diligence use cases.

(14) Levels of intensity are defined using fixed return periods.

What is CVaR?

CVaR estimates the percentage of direct damage to an asset depending on the intensity of a climate hazard event. For EarthScan Ratings, CVaR is incorporated into the extreme wind, riverine and coastal flooding Ratings, directly linking the magnitude of exposure to wind and flooding events with quantified estimates of physical damage to built assets.

CVaR impact metrics provide a scientific framework for determining climate risk, enabling companies to measure and manage their climate risk exposure. Expressed as an estimate of the replacement cost, CVaR translates climate hazard exposure metrics into estimates of potential event impact by statistically assessing asset-level damage across a range of climate hazards, scenarios, geographies, and time horizons. To calculate CVaR, our financial modelling approach utilizes damage curves to connect climate hazard exposure to asset-level vulnerability [15].

Calculating Impact Estimates with CVaR

To calculate CVaR metrics for flooding and extreme wind events, we have developed an in-house set of hazard damage curves. Damage curves (also known as damage functions) translate the intensity of asset-level exposure to a climate hazard into an estimate of the percentage of physical damage to a built asset.

CVaR physical damage metrics are calculated by applying damage curves to exposure metric values over a series of fixed return periods. Taking a range of existing industry and academic hazard damage data as a starting point, an in-house set of hazard damage curves are calibrated using asset-specific information such as building function, materials, and number of floors. Hazard damage curves are validated against historical and industry datasets.

(15) Asset vulnerability is defined as the degree to which an asset has the potential to be impacted by exposure to hazardous conditions, which fundamentally depends on the material properties of the asset itself.

Using Damage Curves to Calculate Physical Damage Estimates

Damage curves describe the relationship between event intensity and damage as a ratio and represent the physical vulnerability of assets in relation to the potential impact from climate hazards. Damage curves defining an asset's physical vulnerability are a two-dimensional representation of a climate hazard and damage-related asset impacts, with hazard intensity on the x-axis and damage ratio on the y-axis. They classify an element or set of elements-at-risk for a built asset, and estimate the percentage of loss to a built asset exposed to a climate hazard of a given magnitude. This is expressed on a scale from 0% (no damage) to 100% (total damage).

The relationship between physical damage and climate hazard intensity varies across risk categories. For example, the shape of the damage curves for extreme wind tend to follow an S-shaped pattern: low wind speeds do not cause significant physical damages to most building stock but, once a certain threshold wind speed is reached, the damages can grow very quickly even for small increases in wind speed (see Fig. 1). For flooding, the shape of damage curve reflects that even small flood depths tend to cause material damages but damages increase in a steadier manner as flood depths grow.

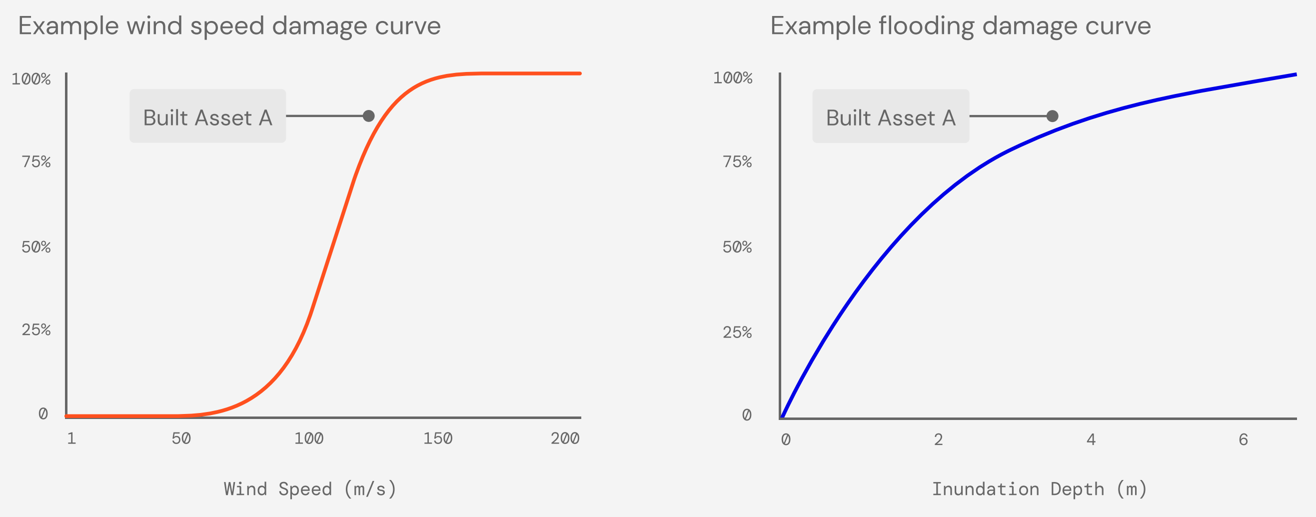


Figure 1: example extreme wind and flooding damage curves

To calculate extreme wind and flooding CVaR metrics on EarthScan, we have constructed vulnerability models using regional damage-related datasets, generating a separate set of damage curves for extreme wind and flooding.

We first generate a set of general vulnerability curves that are refined using country-specific information based on damage indicators for flooding and extreme wind and asset data on a range of factors, such as building height and occupancy class (see CVaR data sources on pg. 34 for dataset reference). Extreme wind damage curves incorporate additional considerations, based on the distribution of buildings made from specific materials; for example, in some European countries a large percentage of buildings are constructed using concrete.

For riverine and coastal flooding, damage curves cover occupancy type and industry (following the Global Industry Classification Standard[16]), and account for building features (for example, height). Damage curves are scaled and calibrated across different locations, using Flood Protection Standards (FLOPROS) data to account for country-specific flood protection mechanisms.

Damage curves incorporate up-to-date country-specific national flood protection policies (see CVaR data sources on pg. 34 for dataset reference). All damage curves are cross-geographically validated to ensure CVaR is comparable across assets in different locations.

This makes it possible to compare, for example, the CVaR values for properties in Brussels to assets in Chicago, using a metric that takes into account geographically-specific construction practices and policies for all assets.

(16) https://www.msci.com/our-solutions/indexes/gics

How EarthScan Ratings A-F are Determined

To rate the level of risk to an asset across different hazards, EarthScan Ratings calculate the probability of exceeding thresholds for defined climate hazard events (outlined in Table 3). Depending on the probability of exceeding these thresholds, EarthScan Ratings generate a score of 0-999 for each asset, which is then translated into an A-F EarthScan Rating (see Table 2). EarthScan Ratings map assets to Ratings based on the probability of an exposed asset experiencing a climate hazard event within a given year and across three different climate scenarios.

Calibrating Climate Hazard Event Thresholds

Event thresholds determine when climate hazards have the potential to place assetsat risk of direct physical damage and disruption. These are based on selected dimensions of change in the underlying exposure and impact metrics, including:

- The absolute magnitude of an event
- Relative change over time
- CVaR

Thresholds are based on the potential for physical damage to an asset or disruption to operations at a particular location, and vary depending on the intensity and type of hazard (for example, the heat stress threshold is based on its potential impact on local community health and wellbeing or workforce productivity). For each event, the quantitative threshold is calibrated based on climate science research literature, industry data on damage and disruption and data distribution analysis.

When an event exceeds the pre-defined threshold (for example, extreme temperatures exceed 40˚C, or precipitation exceeds 200mm over five days), the Ratings calculation determines that it has the potential to negatively impact an asset, either directly through physical damage or indirectly through disruption to operations (see Table 3).

EarthScan Ratings also take into account that different locations have different levels of tolerance to climate hazards based on historically normal local conditions. This means that under the same climate conditions, assets can be at greater risk of physical damage in one location compared to another. We quantify this by analysing median risk for historical conditions across a range of scenarios.

Multi-Threshold Risk Categories

Some risk categories have multiple thresholds for climate hazard events.

For example, heat stress considers relative and absolute changes in temperature and heatwave duration as events that expose an asset to damage and disruption.

The EarthScan Rating for hazards with more than one threshold, such as heat stress, is calculated based on the threshold that has the maximum probability of being exceeded.

This means that, at an asset's location, if the probability of a heatwave 15 days or longer occurring is greater than the probability of temperatures exceeding 40˚C, then exposure to heatwaves is the driver for an asset's heat stress Rating (see Table 3).

What is Combined Physical Risk?

EarthScan Ratings are calculated both for each hazard individually, and for Combined Physical Risk.

Combined Physical Risk synthesises risk categories across all hazards to provide a comprehensive view of which climate hazard is presenting the greatest risk to an asset or portfolio. It is designed to provide a starting point for climate-related risk analysis, highlighting assets with the greatest exposure. Users can drill down into Combined Physical Risk to interpret the precise metrics driving their Combined Physical Risk. Portfolio Ratings reflect the mean risk of the assets within that portfolio.

Like multi-threshold risk categories, Combined Physical Risk Ratings are also determined by the threshold with the maximum probability in relation to asset-level exposure and damage.

Table 3: How EarthScan Ratings are Calculated

Hazard Category	Defined Climate Events and Thresholds		COMBINED PHYSICAL RISK*
Heat Stress	Max temperature (Abs. exposure,°C)	≥40°C	Heat Stress Rating (A-F)
	Max temperature (Rel. Δ in exposure*, %)	≥20% increase relative to 2015 baseline conditions	
	Heatwave length (Abs. exposure, days)	≥15 days	
Extreme Precipitation	Max 5 day precipitation (Abs. exposure, mm)	≥200mm	Extreme Precipitation Rating (A-F)
	Max 5 day precipitation (Rel. Δ in exposure**, %)	≥50% increase relative to 2015 baseline conditions	
Flooding	Coastal flooding (Climate Value-at-Risk, %)	≥1% Climate Value-at-Risk	Flooding Rating (A-F)
	Riverine flooding (Climate Value-at-Risk, %)	≥1% Climate Value-at-Risk	
Extreme Wind	Extreme wind (Climate Value-at-Risk, %)	≥1% Climate Value-at-Risk	Extreme Wind Rating (A-F)
Drought	Consecutive Dry Days (Abs. exposure, days)	≥ 50 days	Drought Rating (A-F)
	Consecutive Dry Days (Rel. Δ in exposure**, %)	≥ 50% increase relative to 2015 baseline conditions	
Wildfire	Fire Weather Index (Abs. danger)	≥ 38	Wildfire Rating (A-F)

*Combined physical risk combines all hazard signals in EarthScan to indicate the hazard driving the greatest risks to an asset.

***The relative rating uses a threshold relative to the 2015, at a 2 year return level of that asset. 20% refers to an increase of 20% over the historical value. In that case, if the value in 2015 for that asset was 25, the relative threshold will be 30.*

Calculating the Boundaries for EarthScan Ratings A-F

For each risk category, the boundaries for EarthScan Ratings A-F are based on defined exceedance probability thresholds. These thresholds represent the probability of an event occurrence that exceeds the thresholds for potential direct physical damage and disruption determined for each metric (see Table 3).

They are derived from the probability distributions for each exposure and impact metric, based on analysis of climate-related risk across a representative global benchmark of assets. Probability distributions statistically describe the full range of possible values and potential outcomes for each metric, over a specific range of locations, time horizons and climate scenarios.

As climate hazard events behave differently from each other, each metric has a different probability distribution. This is reflected in the range of exceedance probabilities for Ratings A-F, which are different for each climate hazard (see Table 4).

Using EarthScan Rating C as an Indicator for Material Risk

Material risk is a subjective concept. What is material for one party may not be material for another, depending on factors such as industry, business model, or risk tolerance.

The process to determine materiality relies on organizational knowledge and experience. Any assessment should match how an organization determines materiality of non-climate-related risks.

As a baseline indication of significant risk, an EarthScan Rating C or below (D-F) can be viewed as potentially at material risk (see Table 2). This evaluation is based on an analysis of a set of representative assets across different types of climate hazards for the year 2020.

EarthScan Rating C can be used as an approximate threshold for assessing exposed assets and portfolios. The threshold is an indication of climate-related risk that users may need to consider as part of their decision-making processes and climate-related risk reporting.

Table 4 (1/3):
Exceedance Probability Thresholds for EarthScan Ratings A-F

Flood Ratings

Event definition

A flood hazard event is defined as when an asset experiences a flood that has the capacity to cause direct physical damage and have substantial financial impact. A flood hazard event occurs when any of the flood metrics below exceed a defined threshold for a given asset in any given year; the probability of exceeding this threshold determines the asset's flood rating.

Event thresholds

Coastal Flooding CVaR: ≥ 1%	Riverine Flooding CVaR: ≥ 1%

Rating definition (exceedance probability)

A	B	C	D	E	F
Minimal risk (<0.4%)	Low risk (<4%)	Medium risk (<35%)	High risk (<49%)	Very high risk (<98%)	Extreme risk (≥98%)

Heat Stress

Event definition

A heat stress hazard event is defined as when, in any given year, an asset's location experiences an extreme temperature event that has the capacity to cause damage and disruption to assets as well as regional transport, power and communications infrastructure, trigger local restrictions of working hours/conditions, and negatively impact local community health and well-being.

Event thresholds

Max Temperature (Abs. exposure) ≥ 40°C	Max Temperature (Rel. Δ in exposure) ≥ 20%	Heatwave Length (Abs. exposure) ≥ 15 days

Rating definition (exceedance probability)

Rating	Description
A	Minimal risk Max temperature: <0.002% Heatwave length: <2%
B	Low risk Max temperature: <0.3% Heatwave length: <15%
C	Medium risk Max temperature: <4% Heatwave length: <43%
D	High risk Max temperature: <59% Heatwave length: <72%
E	Very high risk Max temperature: <99.9%, Heatwave length: <99.9%
F	Extreme risk Max temperature: ≥99.9%, Heatwave length: ≥99.9%

Table 4 (2/3): Exceedance Probability Thresholds for EarthScan Ratings A–F

Extreme Precipitation

Event definition	An extreme precipitation event is defined as when, in any given year, an asset's location experiences high levels of precipitation over a short period of time. Extreme precipitation events have the capacity to cause damage and disruption to physical assets through impacts such as the slowdown/closure of operations and critical infrastructure, including water and drainage systems, transportation, power networks, and supply chains.
Event thresholds	Max Precipitation (Abs. exposure): ≥ 200mm; Max Precipitation (Rel. Δ in exposure): ≥ 50%

Rating definition (exceedance probability)	A	B	C	D	E	F
	Minimal risk (<5%)	Low risk (<9%)	Medium risk (<14%)	High risk (<20%)	Very high risk (<42%)	Extreme risk (≥42%)

Extreme Wind

Event definition	An extreme wind event occurs when any of the wind metrics exceed a defined threshold for a given asset in any given year; the probability of exceeding this threshold determines the asset's wind rating. Wind intensity can vary rapidly over short periods of time. Short bursts of high wind speeds can cause significant physical damage to assets and critical infrastructure.
Event threshold	Extreme Wind CVaR: ≥ 1%

Rating definition (exceedance probability)	A	B	C	D	E	F
	Minimal risk (<0.005%)	Low risk (<0.2%)	Medium risk (<0.9%)	High risk (<4%)	Very high risk (<14%)	Extreme risk (≥14%)

**The relative Rating uses a threshold relative to the 2015 2-year return level of that asset. 20% refers to an increase of 20% over the historical value for example, if the wildfire Fire Weather Index value in 2015 for that asset was 25, the relative threshold will be 30.*

Table 4 (3/3):
Exceedance Probability Thresholds for EarthScan Ratings A–F

Drought

Event definition	A drought hazard event is defined as when, in any given year, an asset's location experiences a long period of aridity (less than 0.1 mm precipitation a day). Drought hazard events have the capacity to cause asset-level damage and disruption through impacts such as the slow down or complete closure of operations, particularly for water intensive operations, and local/regional water usage restrictions.
Event thresholds	Consecutive Dry Days: (Abs. exposure): ≥ 50 days; Consecutive Dry Days: (Rel. Δ in exposure): ≥ 50% increase

Rating definition (exceedance probability)	A	B	C	D	E	F
	Minimal risk (<8%)	Low risk (<15%)	Medium risk (<33%)	High risk (<67%)	Very high risk (<92%)	Extreme risk (≥92%)

Wildfire

Even definition	An asset's location experiences wildfire danger when meteorological conditions (fire weather) are favorable for wildfires with the intensity and spread to cause physical damage or disruption to physical assets should ignition occur or when an increase in wildfire danger occurs in regions with typically low or minimal wildfire danger, as they are unlikely to be adapted to wildfires.
Even threshold	Fire Weather Index (Abs. danger): ≥ 38

Rating definition (exceedance probability)	A	B	C	D	E	F
	Minimal risk (<0.8%)	Low risk (<6%)	Medium risk (<22%)	High risk (<54%)	Very high risk (<80%)	Extreme risk (≥80%)

CVaR Data Sources

The CVaR metrics incorporated into EarthScan Ratings for extreme wind, coastal flooding and riverine flooding make use of the following data sources:

- Building type data from the U.S. Department of Housing and Urban Development (HUD) from surveys conducted by the U.S. Census Bureau.
- Building type data and material distribution of built asset stock within each country come from the Prompt Assessment of Global Earthquakes for Response (PAGER) Inventory Database v2.0, US Geological Survey, Golden, Colorado, USA.
- Data on flood damage from FEMA, 2004. "HAZUS-MH. FEMA's Methodology for Estimating Potential Losses from Disasters". US Federal Emergency Management Agency. [http://www.fema.gov/plan/prevent/HAZUS/index.shtm].
- Data on global flood protection standards comes from the FLOPROS (Flood Protection Standards) database. Scussolini, P., Aerts, J., Jongman, B., Bouwer, L., Winsemius, H., de Moel, H. and Ward, P., 2016. FLOPROS: an evolving global database of flood protection standards. Natural Hazards and Earth System Sciences, 16(5), pp.1049-1061.
- Data on flood damage functions from Huizinga H.J. (2007): Flood damage functions for EU member states. Technical report, HKV Consultants. Implemented in the framework of the contract #382441 F1SC awarded by the European Commission - Joint Research Centre.
- Data on flood damage from Englhardt, J., de Moel, H., Huyck, C., de Ruiter, M., Aerts, J. and Ward, P., 2019. Enhancement of large-scale flood risk assessments using building-material-based vulnerability curves for an object-based approach in urban and rural areas. Natural Hazards and Earth System Sciences, 19(8), pp.1703-1722.
- Data on material-level wind damage from Feuerstein et al, (2011). Towards an improved wind speed scale and damage description adapted for Central Europe.
- Data on wind damage from Koks, E. and Haer., T., 2020. A high resolution wind damage model for Europe. Scientific Reports, 10(1).

About EarthScan™

EarthScan is powered by Mitiga Solutions. Founded in 2018, Mitiga Solutions provides climate risk intelligence that combines science, AI and high-performance computing. We help our customers analyse, report and act on their business exposure to climate risk through our self-serve platform EarthScan and our risk models.

Our mission is to make the world a more resilient place under a changing climate. Mitiga is headquartered in Barcelona, Spain and backed by Elaia, Kibo Ventures, Telefónica, Matmut, Microsoft Climate Innovation Fund, Nationwide Ventures, Creas IMPACTO and Faber.

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