

Sustainability

Geospatial Asset Analytics - Physical Risk

Methodology & Research
Process

October 2026

Version 1.0

PUBLIC DISCLOSURE ON THE METHODOLOGY
MODELS, AND KEY RATING ASSUMPTIONS USED IN
ESG RATING ACTIVITIES

**ISS
STOXX**

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Terms / Acronyms

TERMS/ACRONYMS	DEFINITION
AR6	6th Assessment Report (of the IPCC)
CMIP6	Coupled Model Intercomparison Project 6
IPCC	Intergovernmental Panel on Climate Change
SSP	Shared Socioeconomic Pathway
WRI	World Resources Institute

Regulation (EU) 2024/3005: Public Disclosure on the Methodology, Models, and Key Rating Assumptions Used in ESG Rating Activities

This disclosure is published to meet the relevant requirements of the ESG Ratings Regulation (EU2024/3005) and related regulatory technical standards. The following index cross-references to the relevant information made available within the Geospatial Asset Analytics - Physical Risk Methodology Document and on our website.

Within this disclosure, the [Regulation \(EU\) 2024/3005 of the European Parliament and of the Council of 27 November 2024 on the transparency and integrity of Environmental, Social and Governance \(ESG\) rating activities](#) is referred to as “**Regulation (EU) 2024/3005**”.

Within this disclosure, the Commission Delegated Regulation (EU) 2026/871 of 21 April 2026 supplementing Regulation (EU) 2024/3005 of the European Parliament and of the Council with regard to regulatory technical standards specifying the elements to be disclosed to the public and to users of ESG ratings, rated items and issuers of rated items is referred to as “**Delegated Regulation**”.

REGULATION (EU) 2024/3005	DELEGATED REGULATION	REQUIRED INFORMATION	ISS GERMANY AG DISCLOSURE
Rating Product Disclosures			
ANNEX III.1.f	Article 3(1)	ESG rating providers shall disclose information on the ESG rating’s clearly defined objective and marking whether the rating is assessing risks, impacts, or both, according to the double materiality principle, or any other dimensions, and in the case of double materiality the proportion of the risk and impact materiality. ESG rating providers shall disclose at the level of each ESG rating product: a) a description of the risks covered, where the ESG rating is assessing risks;	Please refer to: Geospatial Asset Analytics - Physical Risk: Objective

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REGULATION (EU) 2024/3005	DELEGATED REGULATION	REQUIRED INFORMATION	ISS GERMANY AG DISCLOSURE
		b) a description of the impacts covered, where the ESG rating is assessing impacts; c) information on how the risk and impact materiality are taken into account according to the double materiality principle, where applicable; d) where the ESG rating is based on other materiality dimensions, a description of those dimensions.	
ANNEX III.1.g	Article 3(2)	ESG rating providers shall disclose the ESG rating's scope, namely, whether it covers an individual E, S, or G factor or whether it is an aggregated rating aggregating E, S and G factors, or whether it covers specific issues such as transition risks. ESG rating providers shall disclose at the level of each ESG rating product: a) a description of what is covered under the E, S or G factors and which factors are aggregated, where applicable; b) a description of the specific issues that the ESG rating covers.	Please refer to: • Geospatial Asset Analytics - Physical Risk: Objective • Physical Risk Data Framework
ANNEX III.1.h	N/A	ESG rating providers shall disclose in the case of an aggregated ESG rating, the weighting of the three overarching E, S and G categories of factors (for example 33 % for the E factor, 33 % for the S factor, 33 % for the G factor), and the explanation of the weighting method, including weight per individual E, S and G category.	• This requirement is not applicable to the Geospatial Asset Analytics – Physical Risk as it is not an aggregated ESG rating. The methodology assesses physical climate risk exposure and associated impacts within the

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			Environmental (E) pillar only and does not combine E, S, and G factors into a single rating. Therefore, no E, S, or G weightings are assigned.
ANNEX III.1.i	N/A	ESG rating providers shall disclose within the E, S or G factors, specification of the topics covered by the ESG rating, and whether they correspond to the topics from the sustainability reporting standards developed pursuant to Article 29b of Directive 2013/34/EU.	Please refer to: • Geospatial Asset Analytics - Physical Risk: Objective • Physical Risk Data Framework
ANNEX III.1.j	N/A	ESG rating providers shall disclose information on whether the rating is expressed in absolute or relative value.	Please refer to: • Modelling Approach
ANNEX III.1.o	Article 3(3)	ESG rating providers shall disclose if an ESG rating of a rated item covers the E factor, information on whether that rating takes into account the targets and objectives of the Paris Agreement or any other relevant international agreements. ESG rating providers shall disclose if an ESG rating of a rated item covers the S and G factors, information on whether that rating takes into account any relevant international agreements. ESG rating providers shall at the level of each ESG rating product:	Please refer to: • Scientific Foundations of the Methodology
ANNEX III.1.p	Article 3(4)		

REGULATION (EU) 2024/3005	DELEGATED REGULATION	REQUIRED INFORMATION	ISS GERMANY AG DISCLOSURE
		a) include an indication of whether the ESG rating takes into account the targets and objectives of the Paris Agreement and which other international agreements are considered, with reference to basic identifying information on these agreements together with an explanation of their relevance to the ESG rating; b) specify whether the ESG rating is assessing alignment of commitments against the objectives of the agreements referred to in point (a).	
Basic Methodological Disclosures			
ANNEX III.1.a	Article 4(1)	ESG rating providers shall disclose an overview of the rating methodologies used and changes thereto, including whether analysis is backward-looking or forward-looking and the time horizon covered. ESG rating providers shall disclose: a) the title of the rating methodology used; b) a description of the types of rated items in relation to which the methodology referred to in point (a) applies; c) the time horizon over which the ESG rating is considered valid, where applicable d) a list and overview of the relevant supporting models and key rating assumptions, where applicable; information on measures and procedures to ensure the quality and reliability of data used; e) a description of the defined ranking system of rating categories used, with reference to:	Please refer to: Points a) and f) • Appendix D: Version Control Points b) to e) • b) Methodology Overview • c) Time Horizons, Update Cycle • d) Appendix C: Relevant Supporting Models and Key Rating Assumptions, Quality Assurance • e) Hazard Exposure Categories, Appendix B: Hazard Exposure Categories Thresholds

REGULATION (EU) 2024/3005	DELEGATED REGULATION	REQUIRED INFORMATION	ISS GERMANY AG DISCLOSURE
		i. the meaning of each rating category for absolute and relative values and how the ranking system should be interpreted; ii. in the case of relative values, an explanation as to whether they are relative to a specific industry, geographical area, peer groups or other comparative references and their respective description. f) the dates of the most recent update of the methodology and a description of the changes introduced to the previous version.	
ANNEX III.1.b	Article 4(2)	ESG rating providers shall disclose the industry classification used. ESG rating providers shall provide: a) the name of the issuing body of the industry classification used; b) the name and version of the industry classification used; c) any publicly available link to the official documentation of the industry classification system.	• This requirement is not applicable to the Geospatial Asset Analytics – Physical Risk as Industry Classifications are not applied.
ANNEX III.1.c	Article 4(3)	ESG rating providers shall disclose an overview of data sources, including whether data is sourced from sustainability statements required under Directive 2013/34/EU or from information disclosed under Regulation (EU) 2019/2088 and whether sources are public or non-public, and an overview of data processes, estimation of input data in case of unavailability and frequency of data updates. ESG rating providers shall include a description of the engagement process with rated items or issuers of rated items, including how the input from such engagement is taken into account.	Please refer to: • Data Sources: Data Collection and Sources • Data Processes: Modelling Approach, Data Collection and Sources • Estimation of Input Data: Estimation of Data

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REGULATION (EU) 2024/3005	DELEGATED REGULATION	REQUIRED INFORMATION	ISS GERMANY AG DISCLOSURE
			- Frequency of Data Updates: Update Cycle - Engagement with rated items or issuers of rated items is not part of the Geospatial Asset Analytics - Physical Risk's process.
ANNEX III.1.e	Article 4(4)	ESG rating providers shall disclose information on whether and how the rating methodologies are based on scientific evidence. ESG rating providers shall where applicable, describe the process for identifying relevant scientific evidence.	Please refer to: Scientific Foundations of the Methodology
ANNEX III.1.k	N/A	ESG rating providers shall disclose where applicable, reference to the use of artificial intelligence in the data collection or rating process including information about current limitations and risks of using artificial intelligence.	Please refer to: Use of Artificial Intelligence
Limitations in data sources, methodologies and information			
ANNEX III.1.m	Article 5	ESG rating providers shall disclose any limitation in data sources and methodologies used for the construction of ESG ratings.	Please refer to: Limitations
ANNEX III.1.q	Article 5	ESG rating providers shall disclose any limitation on the information available to ESG rating providers. ESG rating providers shall explain any limitations in respect of the following:	Limitations to Methodologies & Data

REGULATION (EU) 2024/3005	DELEGATED REGULATION	REQUIRED INFORMATION	ISS GERMANY AG DISCLOSURE
		a) the availability or consistency of data used in the rating process; b) the completeness, timeliness and accuracy of information; c) the use of assumptions, proxy reference points and data estimation.	
Organisational Disclosures			
ANNEX III.1.d	Article 6(2)	ESG rating providers shall disclose the ownership structure of the ESG rating provider. ESG rating providers shall disclose: a) a chart illustrating their ownership links with any parent undertaking and subsidiaries. The chart shall indicate, where applicable, whether any of those entities perform any of the activities listed in Article 16 (1) or services referred to in Article 16(6) of Regulation (EU) 2024/3005.	Please refer to: Ownership Structure
ANNEX III.1.l	Article 6(3)	ESG rating providers shall disclose general information on criteria used for establishing fees charged to clients, specifying the various elements taken into consideration, and general information on the business/payment model. ESG rating providers shall disclose the following: a) how the criteria they apply for establishing fees ensure that fees are fair, reasonable, transparent and non-discriminatory in accordance with Article 27 of Regulation (EU) 2024/3005; b) whether the ESG rating provider operates a subscription-paid model, an issuer-paid model, a combination of those models, or another model;	Please refer to: Pricing Policy

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		c) a description of the relevant business model, and the proportion of total annual revenue derived from each model; d) where applicable, the impact of fees charged for services other than ESG rating activities on the determination of fees for ESG ratings, together with a description of those other services.	
ANNEX III.1.n	Article 6(1)	ESG rating providers shall disclose the main risks of conflicts of interest and the steps take to mitigate them. ESG rating providers shall indicate the areas of the ESG rating provider's activities, services or organisational structure from which the main risks of conflicts of interest may arise.	Please refer to: • Conflict of Interest Policy

Introduction

This document is intended to provide a comprehensive overview of ISS STOXX's approach to evaluating the physical risk exposure of assets and companies through the ISS STOXX "Geospatial Asset Analytics - Physical Risk" solution. It describes the physical climate hazards covered by the solution, the scenario frameworks used to generate forward-looking projections, the distinction between hazard exposure and physical impact data, and the methodologies used to translate climate hazards into asset-level risk indicators.

The methodology is designed to support institutional investors, asset managers, and owners of real asset portfolios in assessing how physical climate hazards may affect assets, issuers, and portfolios across current and future climate conditions.

Geospatial Asset Analytics - Physical Risk: Objective

The ISS STOXX Geospatial Asset Analytics – Physical Risk solution is a forward-looking, model-based analytical opinion of asset-level and portfolio-level exposure to physical climate hazards. The solution assesses exposure to physical climate hazards and associated asset-level impacts, including structural damage, business interruption, and productivity loss, under multiple climate scenarios and time horizons. The analysis provides absolute hazard exposure metrics, classified into High, Medium, and Low Hazard Exposure Categories, at both the asset and aggregated issuer level, supplemented by hazard-specific impact metrics.

The solution addresses the Environmental (E) pillar by assessing physical risks arising from climate hazards and their potential impacts on assets and portfolios. The Governance (G) pillar is also addressed through the assessment of operational impacts and through considerations relating to the prevention and management of physical climate risks. Decisions concerning the acquisition, development, and location of assets may reflect the extent to which physical climate risks have been identified and considered as part of relevant decision-making processes. As such, the solution supports the assessment of financial risks arising from physical climate hazards. The Social (S) pillar is not covered in this methodology.

The specific issues covered by the solution include asset exposure to acute physical climate hazards (wildfire, coastal flood, river flood, tropical cyclones) and chronic physical climate hazards (heat stress, water stress, sea level rise), together with their associated asset-level impacts: structural damage, business interruption, and productivity loss.

The content of the topics covered by the solution corresponds to climate-related physical risk topics within ESRS E1 (Climate Change) from the sustainability reporting standards developed pursuant to Article 29b of Directive 2013/34/EU.

Methodology Overview

The ISS STOXX Geospatial Asset Analytics - Physical Risk solution is provided via a physical climate risk assessment platform. The solution enables users to assess physical climate risk exposure at two levels:

- **Asset-level:** detailed exposure and impact assessment for individual physical assets.
- **Portfolio-level:** aggregated exposure and risk metrics across multiple assets, corporate issuers, or regions.

The solution supports two portfolio use cases:

- **Issuer Portfolios:** For equity or corporate credit portfolios, the solution uses the ISS STOXX Geospatial Asset Database (GAD), a proprietary database containing over 1.4 million physical asset locations linked to their owning or operating companies.
- **Real Asset Portfolios:** For direct real asset portfolios, users provide asset locations as coordinates or physical addresses. The solution assesses physical risk exposure for each submitted location.

ISS STOXX takes comprehensive measures to ensure data is validated and transparency is provided around the inputs feeding into the assessment so users can make decisions taking into account physical risks from climate hazards.

Scientific Foundations of the Methodology

The solution is grounded in established scientific literature and models used by the climate science and physical risk assessment communities.

- Climate hazard projections are based on outputs from climate models participating in the IPCC Sixth Assessment Report (AR6) and the Coupled Model Intercomparison Project Phase 6 (CMIP6).
- Scenario analysis applies IPCC Shared Socioeconomic Pathways (SSP2-4.5 and SSP5-8.5) and Network for Greening the Financial System (NGFS) climate scenarios, with temperature pathways used to generate forward-looking physical risk metrics.
- Hazard modelling incorporates peer-reviewed tools and datasets, including the STORM tropical cyclone model, WRI's Aqueduct flood hazard maps, NASA Global Downscaled Daily Projections (GDPP) climate projections, and published damage and impact functions linking climate variables to physical and economic impacts.
- Impact and vulnerability modelling is informed by empirically derived damage functions from the European Commission Joint Research Center (ECJRC), the US Army Corps of Engineers, the CLIMADA risk analysis framework, NIOSH occupational heat exposure criteria, ISO 7243

metabolic rate classifications, and the Kjellstrom et al. (2019) exposure-response methodology for heat stress productivity loss.

Relevant scientific evidence is identified through a structured review of publicly available climate scenarios, climate datasets, and associated technical documentation produced by recognized institutions, complemented by ongoing assessment of developments in climate science, industry standards, and methodological best practice as part of the methodology review and update process.

Note, this solution does not assess the alignment of an asset's or issuer's commitments, targets, or transition plans against the objectives of the Paris Agreement (or any other international agreement). It quantifies physical climate risk exposure and impacts under alternative climate scenarios that may be used by investors as an input to their own alignment analyses.

That said, the climate scenarios applied include IPCC SSP2-4.5 and SSP5-8.5 pathways as well as NGFS scenarios (including Net Zero 2050 and Below 2°C). These scenarios provide temperature trajectories and policy pathways used to generate forward-looking physical risk metrics. Among the scenarios supported by the solution, NGFS Net Zero 2050 and Below 2°C represent climate futures broadly consistent with the temperature objectives of the Paris Agreement, while other scenarios represent alternative warming pathways. These scenarios are used to assess how physical climate risks may evolve under different future climate conditions. The Paris Agreement is the relevant international agreement referenced for temperature-goal context, while NGFS and IPCC pathways are the scenario frameworks used to operationalize those temperature outcomes for risk quantification.

Physical Risk Data Framework

Physical climate risk is composed of two components: hazard intensity/frequency, the physical climate process itself, and impact, the resulting consequence to an exposed asset once vulnerability is accounted for. As shown in Figure 1, the Geospatial Asset Analytics - Physical Risk solution addresses both, providing a pathway from climate hazard exposure to asset-level physical and operational impact metrics.



Figure 1. Physical Risk Data Framework: hazard exposure is translated into asset-level physical impact through vulnerability and damage functions.

Hazard Exposure Data

Hazard exposure data quantifies the likelihood, frequency, and/or magnitude of a physical climate hazard occurring at a specific asset location. The hazard indicators are grounded in physical climate science and span both acute and chronic hazard types, consistent with IPCC terminology.

ISS STOXX's Geospatial Asset Analytics - Physical Risk data covers exposure to multiple hazards:

Acute hazards (discrete, event-driven perils):

- Wildfire
- Coastal Flood
- River Flood
- Tropical Cyclones

Chronic hazards (gradually emerging, longer-term shifts in climate norms):

- Heat Stress
- Water Stress
- Sea Level Rise (SLR)

Hazard exposure indicators are provided across multiple projection scenarios and time horizons, allowing users to assess both current exposure and how that exposure is projected to evolve under different climate pathways.

Physical Impact Data

While hazard exposure describes the physical climate signal, it does not by itself indicate the financial or operational consequence for a given asset. Physical impact data translates hazard exposure into asset-level consequences by accounting for asset vulnerability, damage relationships, and hazard-specific response functions.

The solution provides three main asset-level impact metrics:

- **Structural Damage:** the expected proportion of an asset's value at risk of physical damage from acute hazards, including wildfire, river flood, coastal flood, and tropical cyclones.
- **Business Interruption:** the expected annual number of operational downtime days driven by direct physical damage from acute hazards.

- **Productivity Loss:** the expected annual reduction in agricultural output from water stress and labor productivity from heat stress, reflecting impacts that arise through chronic resource and physiological constraints rather than discrete physical destruction.

These metrics are available at the asset level and can support analysis across scenarios, time horizons, and portfolio groupings. The specific calculation approach varies by hazard and impact type and is described in the methodology section.

Note on Sea Level Rise: Sea Level Rise is provided as a hazard exposure indicator. As a slow-onset, cumulative shift in baseline coastal conditions rather than a discrete damaging event, it does not have an associated Structural Damage, Business Interruption, or Productivity Loss metric. Its primary risk-relevant application is as an indicator of increasing coastal flood exposure over time, which is separately captured within the Coastal Flood hazard and impact indicators.

Modelling Approach

ISS STOXX's Geospatial Asset Analytics - Physical Risk combines climate-model projections, high-resolution historical observations, and asset-level geospatial data to estimate historical baseline and forward-looking physical risk exposure and impacts. Hazard indicators are developed using General Circulation Models (GCMs) from CMIP6 together with observed datasets from satellites, sensors, and other authoritative sources. Where appropriate, statistical downscaling, bias correction, machine-learning methods, and hazard-specific modeling techniques are used to provide spatial resolution that is substantially more defined than global climate models alone.

Analysis sites can be supplied as points in the current version of the solution. Results are reported at the asset level and portfolio level (aggregated across multiple assets or issuers). For each asset or location, hazard exposure is evaluated under selected climate scenarios and time horizons. Depending on the hazard, exposure indicators describe the likelihood, frequency, intensity, or severity of the relevant physical climate process.

The solution provides outputs expressed as absolute values. Asset impact metrics are derived by translating hazard exposure into expected physical or productivity-related impacts using empirically derived damage functions, vulnerability assumptions, and response relationships. For acute hazards, these methods estimate potential structural damage and, where applicable, operational downtime. For chronic hazards, the methodology estimates productivity loss through labor or agricultural response relationships.

Hazard exposure indicators are reported as continuous numeric values (e.g., annual probability of wildfire, unitless flood score, fraction of year with heat stress exceedance) accompanied by Low, Medium, and High exposure labels. Additionally, Physical impact metrics are reported as expected annual structural damage (% of asset value), expected annual business interruption (fraction of year), and expected annual productivity loss (%).

For modeled hazards, results are produced across climate-model ensembles. Ensemble medians and uncertainty bounds are reported to represent central estimates and the range of plausible climate-model outcomes.

Data Validation

For every hazard, ISS STOXX derives asset-level exposure and impact data from forward-looking indicators based on climate science, historical observations, and peer-reviewed research. Modeled indicators are benchmarked and validated against historical observations where suitable hindcast or observed datasets are available.

Climate Scenarios and Uncertainty

Climate risk assessments require assumptions about future greenhouse gas emissions, socioeconomic development, technological change, and climate policy. The solution supports both climate-science scenarios derived from the Intergovernmental Panel on Climate Change (IPCC) framework and climate-risk scenarios developed by the Network for Greening the Financial System (NGFS). Together, these scenarios provide a range of plausible climate futures for assessing physical risk exposure and impacts.

IPCC Climate Scenarios

The underlying physical hazard models used within ISS STOXX Geospatial Asset Analytics are based on climate projections from the Coupled Model Intercomparison Project Phase 6 (CMIP6). These projections are generated under Shared Socioeconomic Pathways (SSPs), which describe alternative future emissions and socioeconomic trajectories.

- **Likely Scenario (SSP2-4.5)**

The Likely Scenario is based on the IPCC SSP2-4.5 pathway, often referred to as the "Middle of the Road" scenario. It assumes moderate economic growth, continued technological development, and gradual climate mitigation efforts. Emissions peak around mid-century before declining, resulting in approximately 2.4°C of global warming by 2100. This scenario is generally considered a plausible representation of future climate conditions under moderate policy action.

- **Worst-Case Scenario (SSP5-8.5)**

The Worst-Case Scenario is based on the IPCC SSP5-8.5 pathway, representing a future characterized by continued fossil-fuel-driven development and limited climate mitigation. Greenhouse gas emissions remain high throughout the century, leading to approximately 4.3°C of global warming by 2100. This scenario is used to evaluate physical risks under severe climate change outcomes.

NGFS Climate Scenarios

In addition to IPCC-based climate pathways, ISS STOXX's Physical Risk assessments are available under climate scenarios developed by the Network for Greening the Financial System (NGFS). These scenarios are widely used by financial institutions, regulators, and investors to assess climate-related financial risks and explore the impacts of different transition and warming pathways.

- **Net Zero 2050**

An ambitious transition scenario consistent with achieving net-zero greenhouse gas emissions globally by 2050 and limiting warming to approximately 1.5°C. Rapid emissions reductions, accelerated deployment of low-carbon technologies, and strong climate policies reduce long-term physical climate risks relative to higher-emission scenarios.

- **Below 2°C**

A Paris-aligned transition pathway that limits global warming to below 2°C by the end of the century. Significant emissions reductions are implemented globally, resulting in lower long-term physical climate risks than scenarios with weaker climate action.

- **Current Policies**

A scenario reflecting currently implemented climate and energy policies without significant additional mitigation measures. Global emissions remain comparatively high, leading to greater warming and elevated long-term physical climate risks relative to the Net Zero 2050 and Below 2°C scenarios.

The IPCC and NGFS scenarios serve different but complementary purposes. The IPCC SSP scenarios provide the underlying climate science used to model future changes in physical hazards such as wildfire, flooding, heat stress, water stress, tropical cyclones, and sea level rise. NGFS scenarios provide a decision-useful framework for assessing climate-related risks within financial portfolios and investment analyses. Physical risk assessments under NGFS pathways are therefore informed by climate projections derived from the broader CMIP6 and SSP modelling framework.

Data Bounds and Model Uncertainty

Climate projections are inherently uncertain due to the complexity of the Earth's climate system, uncertainty in future greenhouse gas emissions, and differences in how climate models represent physical processes. To address these uncertainties, the CMIP6 framework incorporates an ensemble of climate models developed by research institutions around the world, each providing a distinct representation of future climate conditions.

To provide transparency around this uncertainty, ISS STOXX reports an ensemble median projection together with upper and lower uncertainty bounds for all modeled hazards and indicators. These values are derived from the distribution of projections across the climate model ensemble and represent a plausible range of future outcomes. Specifically, ISS STOXX provides the ensemble median, along with the 16th and 84th percentile projections, which approximately correspond to a ± 1 standard deviation range around the central estimate. This enables users to assess both the expected level of future climate risk and the uncertainty surrounding that estimate.

Time Horizons

Physical risk projections are available across multiple time horizons, allowing users to assess both near-term exposure and how risk evolves over the course of the century. ISS STOXX's models are run on an annual cadence but are provided at aggregated timeframes. Figure 2 illustrates the averaging

window associated with each time horizon.

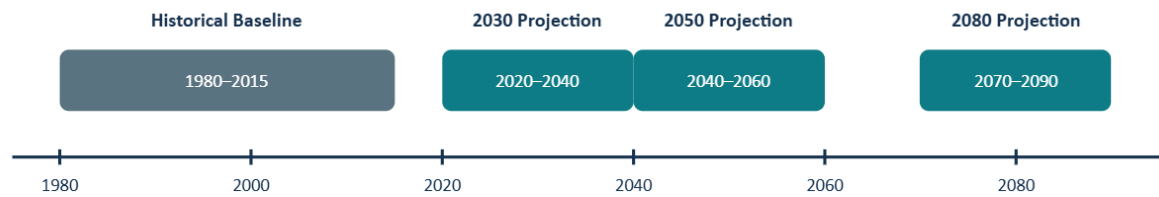


Figure 2. Time horizons and their corresponding averaging windows.

Each time horizon reflects the average expected hazard exposure and impact over its corresponding window, rather than a single-year estimate, consistent with the treatment of climate variability elsewhere in this methodology. Time horizons can be combined with any supported warming scenario to assess how physical risk is expected to change over time under a given emissions pathway.

Hazard Exposure Categories

In addition to the continuous numeric value reported for each hazard exposure indicator (e.g., a wildfire probability of 0.015), the solution also provides a categorical Low, Medium, or High exposure label for each asset location, hazard, scenario, and time horizon. This categorical label offers a simplified, at-a-glance view of relative exposure that complements the underlying numeric score.

Category thresholds are derived by analyzing the distribution of each hazard indicator across a representative sample of global points and defining breakpoints that best represent the overall risk distribution. These breakpoints are hazard-specific, since each indicator has a different unit and range (e.g., probability, unitless score, or fraction of year). See

Appendix B: Hazard Exposure Categories Thresholds in the Appendix for the specific threshold values used for each hazard.

Hazard Exposure Analysis

Wildfire

Wildfire is an uncontrolled fire, caused by a combination of combustible fuels (such as dead, dry wood) and ignition sources (such as human activity or lightning). It is strongly influenced by prevailing weather conditions and typically occurs where human activity meets an accumulation of wild fuel along the Wildland Urban Interface (WUI).

Methodology

Metric: Annual probability of wildfire at an asset location.

This indicator combines global, high-resolution historic fire observations from a multi-decadal satellite record with historical data on a variety of factors that contribute to fire risk, including precipitation, temperature, topography, land cover, ignition sources, and ecology. Using peer-reviewed and patented AI technology, our model is able to determine, for every location on earth, the component of fire risk that is weather-driven. This lets us pinpoint the forests of the world where fire risk is most affected by weather conditions which will see sharp increases in fire risk under warming scenarios. We then run model inferences using ensembled simulations of future weather under a variety of scenarios, which lets us provide validated, asset-level estimates of future fire risk.

Known Limitations

Our fire model relies on static landcover into the future. This assumption is unlikely to hold given human development and changing forest extents, especially later into the 21st century.

Data Sources

- CMIP6¹
- MCD64A Observations²

References

- Keetch-Byram Drought Index (KBDI)³

¹ <https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6>

² https://lpdaac.usgs.gov/documents/115/MCD64_ATBD_V6.pdf

³ <https://twc.tamu.edu/kbdi>

River Flood

River flooding, also known as fluvial flooding, occurs when river discharge exceeds channel capacity and inundates surrounding floodplains. It is driven by precipitation, runoff, upstream catchment conditions, river-basin characteristics, and local terrain. River flood exposure is especially relevant for assets located near rivers, floodplains, low-lying inland areas, and drainage-sensitive regions.

Methodology

Metric: Unitless flood score at an asset location, based on expected annual flood depth.

This indicator quantifies river flood exposure using flood-depth return period data, high-resolution elevation information, and local flood-zone information where available. The underlying flood hazard data are derived from WRI's Aqueduct Flood Hazard Maps, which provide inland riverine flood depth estimates across multiple return periods and climate scenarios. The flood hazard data are first bias-corrected using local information on flood zones from government agencies, including the Federal Emergency Management Agency (FEMA), the UK Environment Agency, and Spain's Ministerio para la Transición Ecológica y el Reto Demográfico.

A terrain adjustment is then applied using high-resolution elevation data derived from calibrated NASA satellite products, including SRTM and ASTER. This step downscales and refines flood-depth estimates to better capture local topography and asset-level flood exposure. The indicator supports 90-meter regional and asset-level globally.

For each asset location, river flood depths are available across multiple return periods. Expected annual flood depth is calculated by integrating flood depth across the associated probability curve. The resulting expected annual flood depth is then converted into a normalized river flood score between 0 and 1 using a saturating power transform, allowing the indicator to reflect both flood likelihood and flood severity while limiting the influence of extreme outlier depths.

Known Limitations

River flood modeling is sensitive to elevation data, hydrological model assumptions, river-channel representation, local drainage, floodplain defenses, and upstream water management. The model may not fully capture levees, reservoirs, temporary flood controls, drainage blockages, or asset-specific mitigation measures.

Data Sources

- Aqueduct⁴

⁴ <https://www.wri.org/data/aqueduct-floods-hazard-maps>

- NASA MODIS⁵
- FEMA flood zones⁶
- UK flood zones⁷
- Spain flood zones⁸

References

- Aqueduct Flood Methodology⁹
- GeoFlood: Large-Scale Flood Inundation Mapping Based on High-Resolution Terrain Analysis¹⁰

Coastal Flood

Coastal flooding occurs when normally dry coastal land is inundated by seawater, typically due to storm surge, extreme sea levels, tides, wave-driven processes, and rising mean sea levels. It poses direct risks to coastal buildings, infrastructure, ports, industrial facilities, and transport networks, and can lead to physical damage and operational disruption in low-lying coastal areas.

Methodology

Metric: Unitless flood score at an asset location, based on expected annual flood depth.

This indicator quantifies coastal flood exposure using flood-depth return period data, high-resolution elevation information, and local flood-zone information where available. The underlying flood hazard data are derived from WRI's Aqueduct Flood Hazard Maps, which provide coastal flood depth estimates across multiple return periods and climate scenarios. The flood hazard data are first bias-corrected using local information on flood zones from government agencies, including the Federal Emergency Management Agency (FEMA), the UK Environment Agency, and Spain's Ministerio para la Transición Ecológica y el Reto Demográfico.

A terrain adjustment is then applied using high-resolution elevation data derived from calibrated NASA satellite products, including SRTM and ASTER. This step downscales and

⁵ <https://www.earthdata.nasa.gov/learn/find-data/near-real-time/modis-nrt-global-flood-product>

⁶ <https://catalog.data.gov/dataset/national-flood-hazard-layer-nfhl>

⁷ <https://flood-map-for-planning.service.gov.uk/>

⁸ <https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/agua/zi-lamina.aspx>

⁹ <https://www.wri.org/aqueduct>

¹⁰ Zheng, X., Maidment, D.R., Tarboton, D.G., Liu, Y.Y. and Passalacqua, P., 2018. GeoFlood: Large-scale flood inundation mapping based on high-resolution terrain analysis. *Water Resources Research*, 54(12), pp.10-013.

refines flood-depth estimates to better capture local topography and asset-level flood exposure. The indicator supports 90-meter regional and asset-level assessments globally.

For each asset location, coastal flood depths are available across multiple return periods. Expected annual flood depth is calculated by integrating flood depth across the associated probability curve. The resulting expected annual flood depth is then converted into a normalized coastal flood score between 0 and 1 using a saturating power transform, allowing the indicator to reflect both flood likelihood and flood severity while limiting the influence of extreme outlier depths.

Known Limitations

Coastal flood modeling is sensitive to the quality and resolution of elevation data, storm surge representation, local drainage, coastal defenses, shoreline characteristics, and the availability of flood-zone maps. The model may not fully capture asset-specific flood protection, temporary barriers, future adaptation measures, or highly localized coastal infrastructure.

Data Sources

- Aqueduct¹¹
- NASA MODIS¹²
- FEMA flood zones¹³
- UK flood zones¹⁴
- Spain flood zones¹⁵

References

- Aqueduct Flood Methodology¹⁶

¹¹ <https://www.wri.org/data/aqueduct-floods-hazard-maps>

¹² <https://www.earthdata.nasa.gov/learn/find-data/near-real-time/modis-nrt-global-flood-product>

¹³ <https://catalog.data.gov/dataset/national-flood-hazard-layer-nfhl>

¹⁴ <https://flood-map-for-planning.service.gov.uk/>

¹⁵ <https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/agua/zi-lamina.aspx>

¹⁶ <https://www.wri.org/aqueduct>

- GeoFlood: Large-Scale Flood Inundation Mapping Based on High-Resolution Terrain Analysis¹⁷

Tropical Cyclones

Tropical cyclones, also referred to as hurricanes and typhoons, are intense rotating storm systems that can produce damaging winds, storm surge, heavy rainfall, and inland flooding. Cyclone impacts can affect buildings, infrastructure, supply chains, and economic activity, particularly in coastal and tropical regions exposed to recurring storm activity.

Methodology

Metric: Annual probability of a Category 1 or higher tropical cyclone at an asset location.

This indicator quantifies projected tropical cyclones exposure using synthetic tropical cyclone simulations and historical cyclone observations. Future cyclone activity is modeled using the STORM tropical cyclone model, which simulates cyclone genesis, tracks, and intensity under changing climate conditions. The model incorporates projected environmental conditions derived from CMIP6 climate simulations, as well as historical cyclone information from the International Best Track Archive for Climate Stewardship (IBTrACS).

Historical cyclone observations are used to calibrate and validate modeled cyclone tracks and intensities. The resulting simulations provide annual estimates of the likelihood that a Category 1 or higher tropical cyclone affects an asset location. Cyclone exposure is evaluated across scenarios and time horizons, allowing changes in tropical cyclone risk to be assessed under different climate pathways.

Known Limitations

Future tropical cyclones behavior remains uncertain, particularly with respect to changes in frequency, intensity, storm tracks, and regional landfall patterns. The model may not fully capture localized wind-field variation, topographic effects, rainfall-driven flooding, storm surge, or asset-specific protective measures. This is a very active area of research in the climate resilience community. For more information, see this [Atlantic article](#) on the state of cyclone science.

Data Sources

- STORM tropical cyclone model¹⁸

¹⁷ Zheng, X., Maidment, D.R., Tarboton, D.G., Liu, Y.Y. and Passalacqua, P., 2018. GeoFlood: Large-scale flood inundation mapping based on high-resolution terrain analysis. *Water Resources Research*, 54(12), pp.10-013.

¹⁸ Bloemendaal, N., De Moel, H., Martinez, A.B., Muis, S., Haigh, I.D., Van Der Wiel, K., Haarsma, R.J., Ward, P.J., Roberts, M.J., Dullaart, J.C. and Aerts, J.C., 2022. A globally consistent local-scale assessment of future tropical cyclone risk. *Science advances*, 8(17), p.eabm8438.

- IBTrACS¹⁹

References

- Bloemendaal, Nadia, Hans De Moel, Andrew B. Martinez, Sanne Muis, Ivan D. Haigh, Karin Van Der Wiel, Reindert J. Haarsma et al. "A globally consistent local-scale assessment of future tropical cyclone risk." *Science advances* 8, no. 17 (2022): eabm8438.
- Landsea, Christopher W., and James L. Franklin. "Atlantic hurricane database uncertainty and presentation of a new database format." *Monthly Weather Review* 141, no. 10 (2013): 3576-3592.

Heat Stress

Heat stress represents conditions in which high temperature, humidity, solar radiation, and other atmospheric factors create physiological stress for people. It is associated with human health risks, increased cooling demand, reduced labor productivity, and disruption to heat-sensitive economic activity, particularly where work involves outdoor or physically demanding activity.

Methodology

Metric: Annual percentage of days with daily-averaged wet-bulb globe temperature (WBGT) exceeding 26°C at an asset location.

This indicator estimates exposure to hazardous heat conditions using wet-bulb globe temperature (WBGT), a heat-stress measure that accounts for the combined effects of air temperature, humidity, radiation, and wind. A WBGT threshold of 26°C is used to identify days with potentially unsafe heat exposure for workers. This threshold is based on NIOSH exposure limit recommendations for acclimatized workers performing heavy workloads, approximately 400W, as reflected in Table 5-1 and Figure 8-2 of the 2016 NIOSH occupational heat exposure criteria. Heavy workload assumptions are informed by OSHA examples of physical activity levels and associated metabolic heat rates.

For each asset location, daily-averaged WBGT is calculated from climate data and evaluated against the 26°C threshold. The annual heat stress exposure indicator is calculated as the percentage of days in a year exceeding this threshold. Daily-averaged WBGT is used as a proxy for heat exposure over the workday, recognizing that actual worker exposure may vary with the diurnal cycle, work schedule, shade, ventilation, and local working conditions.

Known Limitations

Heat stress exposure depends on work timing, work intensity, clothing, acclimatization, rest breaks, shade, ventilation, and indoor cooling. Daily-averaged WBGT may differ from workday

¹⁹ <https://www.ncei.noaa.gov/products/international-best-track-archive>

or peak-hour WBGT and may therefore understate or overstate actual occupational heat exposure for specific assets or worker populations. The 26°C threshold is based on heavy-workload assumptions and may not represent all activity types.

Data Sources

- NASA Global Downscaled Daily Projections - GDDP²⁰

References

- NIOSH 2016, Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments²¹
- OSHA Heat Exposure: Metabolic Heat and Workload Physical Activity Level²²

Water Stress

Water is a requirement for societal development and progress, and its availability plays a critical role across a wide variety of activities. This includes food security, human health, electricity generation, manufacturing and mining. Changing water availability due to climate change, coupled with increasing demand from population growth and economic activity, will have substantial impacts across the globe. Rigorous, high resolution water supply and demand data is therefore needed to enable assessment of water risk exposure, both directly and throughout supply chains. Projections of future water availability can help companies and investors prepare for the complex economic and social challenges related to water stress.

Methodology

Metric: Water stress score at an asset location.

This indicator combines climate-driven drought information with water supply and demand data to estimate exposure to water stress. The methodology uses the World Resources Institute's (WRI) Aqueduct water stress data together with the Standardized Precipitation Evapotranspiration Index (SPEI). Aqueduct provides information on competition for local water resources, while SPEI captures precipitation deficits or surpluses after accounting for temperature-driven evapotranspiration.

The resulting water stress score provides a normalized measure of exposure to water stress, allowing comparison across assets and regions. Higher values indicate greater water stress. Forward-looking projections incorporate climate-model data to assess how drought-related

²⁰ <https://www.nccs.nasa.gov/services/data-collections/land-based-products/nex-gddp-cmip6>

²¹ Coco, A., Jacklitsch, B., Williams, J., Kim, J.H., Musolin, K. and Turner, N., 2016. Criteria for a recommended standard: occupational exposure to heat and hot environments. *DHHS (NIOSH) Publication*.

²² <https://www.osha.gov/heat-exposure/hazards#MetabolicHeatandWorkloadPhysicalActivityLevel>

and water-availability conditions may evolve under different climate scenarios and time horizons.

Known Limitations

Water stress modeling may not fully capture local water transfers, reservoirs, groundwater depletion, desalination, legal water rights, irrigation infrastructure, facility-specific water use, or adaptation measures. The indicator should be interpreted as a location-based exposure measure rather than a complete facility-level water balance.

Data Sources

- WRI Aqueduct²³
- NASA Global Downscaled Daily Projections - GDDP²⁴

References

- Aqueduct 3.0: Updated Decision-Relevant Global Water Risk Indicators²⁵
- Standardized Precipitation Evapotranspiration Index (SPEI)²⁶

Sea Level Rise

Global mean sea level increased by approximately 20cm in the past century, with 1 meter or more of rise expected by 2100. The major physical impacts of rising seas include coastal flooding, erosion of beaches, saltwater intrusion into aquifers, inundation of deltas, and loss of biodiversity in marshes and wetlands.

Methodology

Metric: Expected Sea Level Rise in meters from historic baseline sea levels, within 5km of an asset location.

This indicator quantifies the change in sea level across different climate scenarios and is consistent with projections from the IPCC Sixth Assessment Report. We base our modeling of projected sea level rise on climate model simulations from [CMIP6](#).

Projected sea level rise from CMIP6 climate models incorporates the effects of thermal expansion from warming of the ocean, melting of Greenland and Antarctic ice sheets, melting

²³ <https://www.wri.org/aqueduct>

²⁴ <https://www.nccs.nasa.gov/services/data-collections/land-based-products/nex-gddp-cmip6>

²⁵ <https://www.wri.org/research/aqueduct-30-updated-decision-relevant-global-water-risk-indicators>

²⁶ <https://spei.csic.es/>

of glaciers and ice caps, and local land subsidence and rebound. Land elevation rebound, whereby land elevation increases in response to ice melt, is more common in high latitude, polar regions.

This indicator reflects sea level rise relative to a 1995-2014 baseline period for assets within 5km from the coast. An asset's distance to the nearest coastline is derived using 0.01-degree resolution, satellite-derived estimates of coastline locations from NASA's [Ocean Color Group](#).

Known Limitations

The *Sea Level Rise* indicator shows the largest sea level rise experienced within 5km of an asset. This is in contrast to coastal flood products, which show flooding at an exact asset location.

Data Sources

- IPCC Sixth Assessment Report sea level projections²⁷

References

- IPCC Sixth Assessment Report²⁸

²⁷ https://sealevel.nasa.gov/data_tools/17

²⁸ <https://www.ipcc.ch/assessment-report/ar6/>

Hazard Impact Analysis

We utilize three key metrics to assess the impact that climate hazards will have on physical assets, providing asset managers with a detailed understanding of potential economic losses from physical and operational impacts.

1. **Structural Damage:** Expressed as a percentage of the asset's total value, this metric reflects the expected annual proportion of the asset that is likely to be damaged by a specific hazard event. The calculation considers the intensity of the climate hazard, the vulnerability of the asset, and utilizes empirically derived damage functions. Estimates are available for wildfire, river flood, coastal flood, and tropical cyclones.
2. **Business Interruption:** The expected annual downtime (in days) when operations are halted due to direct physical damage from acute hazards. It is calculated as a function of the asset-specific structural damage and the estimated time required to repair or restore the asset. Applicable to wildfire, river flood, coastal flood, and tropical cyclones.
3. **Productivity Loss:** The expected annual reduction in output driven by chronic hazards rather than discrete physical destruction. For heat stress, this reflects reduced labor productivity due to heat impact on working conditions. For water stress, this reflects reduced agricultural output due to water scarcity. Applicable to heat stress and water stress.

Hazard	Structural Damage	Business Interruption	Productivity Loss
Wildfire	✓	✓	—
River Flood	✓	✓	—
Coastal Flood	✓	✓	—
Tropical Cyclones	✓	✓	—
Heat Stress	—	—	✓
Water Stress	—	—	✓
Sea Level Rise	—	—	—

Sea Level Rise is provided as a hazard exposure indicator only and has no associated impact metric.

Figure 3. Applicability of Structural Damage, Business Interruption, and Productivity Loss by hazard

Figure 3 summarizes which impact metrics are available for each hazard. By combining structural damage, business interruption, and productivity loss, ISS STOXX's solution provides asset managers with a more complete picture of the financial risks associated with climate change and consistent with

IPCC methodologies. While the structural damage metric offers a clear assessment of the physical impact on assets, business interruption and productivity loss highlight the operational vulnerabilities that can cause prolonged losses. Together, these metrics allow for a comprehensive evaluation of risk across different warming scenarios, time horizons, and spatial scales, from individual assets to entire portfolios.

Each of these metrics is calculated as an annualized expected value: for acute hazards with return-period-based exposure data, the metric is derived by integrating potential damage across the full range of hazard return periods, rather than reflecting the impact of any single event. This ensures the metric represents the expected annual loss, averaged over many years, rather than a single "worst case" outcome.

Moreover, these metrics support scenario-based planning by providing insights into how risks might evolve over time, under different climate change scenarios. Asset managers can assess risks not just for the present but for future timeframes of 2030, 2050, or 2080, enabling long-term financial planning that considers potential increases in hazard frequency, intensity and impact.

Hazard-Specific Impact Methodologies

For each asset within a portfolio, climate physical impact is evaluated under a variety of warming scenarios throughout the 21st century across multiple hazards. To estimate resulting impacts at the asset level, damage functions are used to translate hazard exposure (e.g., 1 meter of flooding) into impacts like structural damage (e.g., 10% of structure value), business interruption (e.g., 10 days), or productivity loss. Our damage functions are empirically derived and based on publicly available and peer-reviewed research.

Coastal and River Floods

Structural Damage: Flood structural damage is estimated by combining two inputs: the likelihood of various flood depths at the asset location (derived from the bias-corrected, terrain-adjusted return period curves described in the Hazard Exposure section) and an asset-specific depth-damage curve. Using a trapezoid integration method, the area under the curve formed by combining these two inputs is calculated, yielding the total estimated annualized structural damage.

Depth-damage curves are empirically derived from the European Commission Joint Research Center (ECJRC²⁹) and the US Army Corps of Engineers³⁰, covering 240 unique damage functions across 39 asset categories (e.g., residential, commercial, industrial). Where asset-specific type information is unavailable, a generalized default curve is applied.

²⁹ Huizinga, J., De Moel, H. and Szewczyk, W., Global flood depth-damage functions: Methodology and the database with guidelines, EUR 28552 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-67781-6, doi:10.2760/16510, JRC105688

³⁰ <https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/6789/>

Because flood vulnerability depends heavily on local building standards, regional corrections are applied using the CLIMADA risk analysis framework³¹. For example, a given flood depth causes substantially less damage to a structure in a region with stringent building codes than in a region with lower construction standards.

Business Interruption: Flood business interruption estimates the number of days per year that operations are disrupted due to direct physical damage from flooding. It is calculated as a function of the asset's expected annual structural damage and its estimated repair time (see Business Interruption Calculation below).

Tropical Cyclones

Structural Damage: Tropical cyclones structural damage is estimated by combining two inputs: the likelihood of various sustained wind speeds at the asset location and a region-specific wind speed-damage curve. Nine distinct wind-damage curves are used, varying by geographic region to reflect differences in regional building standards and resilience to high winds. Using the trapezoid integration method, the area under the curve is calculated to quantify total annualized structural damage. These damage functions follow the methodology of Emanuel (2011)³², as further refined by Eberenz et al. (2020)³³.

Business Interruption: Tropical cyclone business interruption estimates the number of days per year that operations are disrupted due to wind damage. It is calculated as a function of the asset's expected annual structural damage and its estimated repair time (see Business Interruption Calculation below).

Wildfire

Structural Damage: Unlike flood or cyclone damage, wildfire structural damage operates on a binary basis. An asset is either directly impacted by fire or it escapes largely unaffected. The damage function is derived from historical property loss data, in particular the 2018 Camp Fire in California, which destroyed 18,000 structures and caused an estimated \$16.5 billion in damage. Based on this analysis, if a wildfire occurs at an asset location, there is an estimated 10% chance the asset is directly impacted; if impacted, 75% of the asset's total value is assumed lost.

Annualized structural damage is calculated as:

$$\text{Structural Damage} = \text{Wildfire Probability} \times \text{Asset Loss} \times \text{Impact Chance}$$

where Wildfire Probability is the asset's annual wildfire probability, Asset Loss (0.75) is the expected percentage loss in asset value if impacted, and Impact Chance (0.10) is the likelihood the asset is

³¹ Aznar-Siguan, G. and Bresch, D.N., 2019. CLIMADA v1: a global weather and climate risk assessment platform. *Geoscientific Model Development*, 12(7), pp.3085-3097.

³² Emanuel, K., 2011. Global warming effects on US hurricane damage. *Weather, Climate, and Society*, 3(4), pp.261-268.

³³ Eberenz, S., Lüthi, S. and Bresch, D.N., 2020. Regional tropical cyclone impact functions for globally consistent risk assessments. *Natural Hazards and Earth System Sciences Discussions*, 2020, pp.1-29.

directly impacted given a nearby wildfire. For example, an asset with a 5% annual wildfire probability has an expected annual structural damage of $0.05 \times 0.75 \times 0.10 = 0.375\%$.

Business Interruption: Wildfire business interruption estimates the number of days per year that operations are disrupted due to wildfire damage. It is calculated as a function of the asset's expected annual structural damage and its estimated repair time (see Business Interruption Calculation below).

Heat Stress

Productivity Loss: Heat stress productivity loss reflects the expected annual reduction in labor output due to physiologically demanding heat conditions, following the exposure-response methodology developed by Kjellstrom et al. (2019)³⁴. Rather than treating heat stress as a fixed daily threshold, this approach models productivity loss as a continuous function of Wet-Bulb Globe Temperature (WBGT), reflecting the additional rest time workers require as heat rises to avoid exceeding safe core body temperature.

Below approximately 24–26°C WBGT, no work capacity is lost. Above this range, productivity declines progressively: at 33–34°C, a worker performing moderate-intensity work loses approximately 50% of their work capacity, meaning they produce in one hour only what they would otherwise produce in half an hour. Above roughly 38°C, sustained work becomes largely impossible without protective measures such as air conditioning or relocation to shade.

The relationship between WBGT and productivity loss varies by physical work intensity, consistent with ISO 7243 metabolic rate classifications³⁵:

- **200 W** – light or clerical work (e.g., office-based roles)
- **300 W** – moderate-intensity work (e.g., manufacturing/industrial roles)
- **400 W** – heavy physical work (e.g., agriculture and construction)

For a given WBGT level, productivity loss is higher for higher work intensities: heavy outdoor labor (400 W) experiences the steepest loss, while light indoor work (200 W) is affected only at more extreme temperatures. Each exposure-response curve follows a cumulative normal distribution fitted to epidemiological data and ISO 7243 guidance, producing a smooth transition from no loss to near-total loss of work capacity as WBGT rises.

The asset-level productivity loss estimate is calculated by applying the work-intensity-specific exposure response function to the asset's projected WBGT distribution across the year.

³⁴ Kjellstrom, T., Maitre, N., Saget, C., Otto, M. and Karimova, T., 2019. *Working on a warmer planet: The impact of heat stress on labour productivity and decent work*. ILO.

³⁵ Parsons, K., 2006. Heat stress standard ISO 7243 and its global application. *Industrial health*, 44(3), pp.368-379.

Water Stress

Productivity Loss: Water stress productivity loss reflects the expected annual reduction in agricultural output due to drought conditions, based on the Standardized Precipitation Evapotranspiration Index (SPEI). SPEI is a multi-scalar drought index that measures the climatic water balance (precipitation minus potential evapotranspiration, PET), standardized against the local long-term distribution so that values are comparable across regions and time periods. Negative SPEI values indicate drier-than-normal conditions, with more negative values corresponding to more severe drought; positive values indicate wetter-than-normal conditions. PET is estimated using the Thornthwaite equation³⁶, a temperature-based method.

Monthly SPEI is calculated for each asset location, and agricultural productivity loss is calculated as the fraction of months in a year with SPEI at or below a threshold of -2.0, corresponding to extreme drought conditions. For example, an asset location that experiences $SPEI \leq -2.0$ in 3 of 12 months in a given year has an estimated productivity loss of 0.25 (25%) for that year.

The -2.0 threshold was selected empirically by comparing modeled agricultural GDP losses against historical disaster loss records from the EM-DAT database³⁷ for the world's largest economies by agricultural GDP.

Business Interruption Calculation

For wildfire, river flood, coastal flood, and tropical cyclones business interruption days (BI) are calculated as a function of the asset's expected annual structural damage (SD) and the estimated time required to repair or restore the asset (RepairTime):

$$BI = [(2 \times SD) / (SD + 1)] \times RepairTime$$

The relationship between structural damage and business interruption days is nonlinear and varies significantly by asset type. For example, a 50% structural damage estimate corresponds to substantially more business interruption days for an agriculture asset than for a metals/minerals processing asset, reflecting differences in typical repair times. Repair time estimates are available for a range of asset types. Figure 4 illustrates this nonlinear relationship and its sensitivity to asset-specific repair time.

³⁶ Thornthwaite, C.W., 1948. An approach toward a rational classification of climate. *Geographical review*, 38(1), pp.55-94.

³⁷ <https://www.emdat.be/>

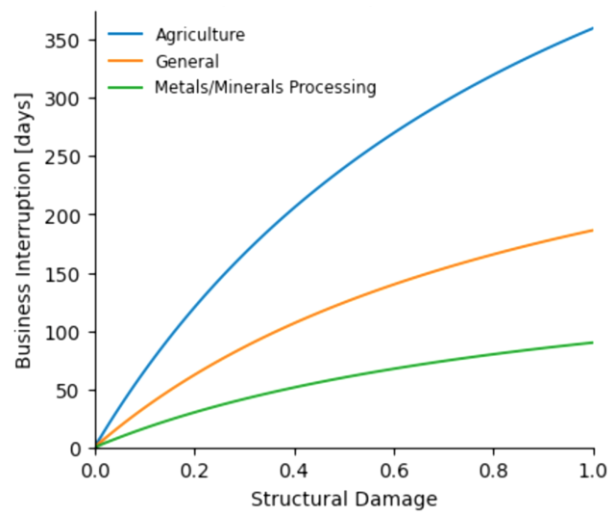


Figure 4. Relationship between structural damage and business interruption days for three example asset types (Agriculture vs. General vs Metals/Minerals Processing).

Assessment Process

Data Collection and Sources

The data used for the Geospatial Asset Analytics – Physical Risk solution is collected by ISS STOXX from publicly available scientific datasets, third-party climate data products, and proprietary resources and databases:

- Climate hazard inputs are derived from established scientific sources and models, including CMIP6 climate model projections from NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP), WRI Aqueduct Flood Hazard Maps, the STORM tropical cyclone model, IBTrACS, MODIS MCD64A satellite fire observations, and IPCC AR6 sea level projections. All climate hazard data sources are publicly available.
- Asset location data is provided by users (for Real Asset Portfolios) or sourced from the ISS STOXX Geospatial Asset Database (for Issuer Portfolios), a proprietary non-public database.
- Elevation and terrain data are derived from publicly available NASA satellite products (SRTM, ASTER).
- Government flood zone data from FEMA (US), UK Environment Agency, and Spain's Ministerio para la Transición Ecológica are publicly available.

Relevant references and links to underlying data sources are provided throughout the document in the respective sections. Data is not sourced from sustainability statements required under Directive 2013/34/EU or from information disclosed under Regulation (EU) 2019/2088.

Estimation of Data

- Where asset-specific type information is unavailable for damage function assignment, a generalized default damage curve is applied.
- Regional building-standard corrections are applied using the CLIMADA framework.
- For issuers with incomplete asset disclosures, the assessed asset inventory may represent only a subset of the issuer's total physical asset footprint.

Use of Artificial Intelligence

Artificial Intelligence is used in the wildfire hazard exposure model underpinning the solution. More specifically, the model applies peer-reviewed and patented machine-learning technology to determine the extent to which wildfire risk at any location worldwide is driven by weather conditions. The assessment considers historical fire observations alongside weather, topographical, land-cover, ignition-source, and ecological data.

No other AI or machine-learning methods are used in the data collection or assessment process for the remaining hazards.

Update Cycle

The Geospatial Asset Analytics – Physical Risk solution is updated on an annual basis. Updates may include enhancements to hazard models, source datasets, impact methodologies, assumptions, and underlying data inputs, as well as the correction of identified issues and incorporation of methodological improvements. These updates are intended to reflect advances in climate science, data availability, and industry best practices and are incorporated into the annual model release cycle.

In addition, there may be instances where material enhancements to the methodology or updates to the underlying scenarios are introduced outside the standard update cycle. These changes are implemented as required to ensure the solution continues to reflect best available assumptions and practices.

The outputs of the solution, together with the underlying raw data, remain valid and applicable until the next scheduled update.

Limitations

The Geospatial Asset Analytics – Physical Risk solution assesses current and forward-looking physical climate risks by translating modelled climate hazards into asset-level exposure and impact metrics. This approach relies on climate scenarios, hazard models, damage functions, and vulnerability assumptions, each of which represents a simplified representation of complex physical processes. Results are scenario-dependent and reflect modelled average outcomes over time rather than the timing or severity of individual extreme events.

Accordingly, the solution's methodology and data may be subject to certain limitations. The below summarizes such limitations as well as the action taken to address these. Further details can be found in the [Hazard Exposure Analysis](#) section:

Limitations in availability or consistency of data sources

- Companies' Asset-level geolocation data are derived from publicly available disclosures and other publicly available sources. The completeness, accuracy, and granularity of disclosed asset information can vary significantly across issuers. The availability and level of granularity of issuer data varies across companies, regions, and sectors. Some issuers may disclose a comprehensive inventory of physical assets, while others may disclose only a subset of locations or provide limited location detail. As a result, differences in asset disclosure practices and data coverage may affect the completeness and comparability of physical risk assessments across issuers.
- Climate hazard projections are derived from CMIP6 climate model ensembles. The availability and spatial resolution of climate model outputs vary across models and hazards,

and projections are inherently uncertain due to differences in how climate models represent physical processes.

- Asset type information necessary for Coastal and River Flood impact analysis may not be available for all assets; where unavailable, a generalized default damage curve is applied.

Limitations in the completeness, timeliness and accuracy of information

- Company-reported asset information is primarily derived from publicly available disclosures and third-party data providers and are updated in line with their respective reporting cycles. As a result, the dataset may not fully reflect the most recent changes to issuer asset locations and ownership at the time of analysis.
- Climate model outputs and hazard data are updated in line with the release of new climate model generations (e.g., CMIP6) and scenario frameworks (e.g., NGFS). As a result, the solution may not incorporate the latest scientific findings between update cycles.
- Forward-looking projections are contingent on scenario-specific climate model outputs and cannot predict the actual evolution of climate conditions.

Limitations in the use of assumptions, proxy reference points and data estimation

- Future risk estimates are contingent on scenario-specific climate model outputs and the assumptions embedded within the underlying hazard and impact models. While these approaches are applied consistently across issuers, they may not fully capture issuer-specific adaptive measures or localized risk-mitigation actions.
- The analysis generally reflects hazard exposure and vulnerability under the assumptions embedded within the underlying models and may not fully capture future adaptation measures, resilience investments, asset hardening, or operational risk-management actions implemented in the future.
- The wildfire AI model relies on static land cover into the future. Additionally, model performance is dependent on the quality and representativeness of historical training data (MCD64A satellite fire observations). As with any machine-learning model, predictions may be less reliable in regions or conditions not well represented in the training dataset.
- River and coastal flood models may not fully capture levees, reservoirs, temporary flood controls, drainage infrastructure, or asset-specific mitigation measures. Tropical cyclone models may not fully capture localized wind-field variation, rainfall-driven flooding, storm surge effects, or topographic influences.
- Heat stress uses a daily-averaged Wet-Bulb Globe Temperature (WBGT), which may differ from actual worker exposure due to variations in work schedules, work intensity, acclimatization, clothing, shade, ventilation, indoor cooling, and local operating conditions.

Quality Assurance

The Quality Assurance process for the Geospatial Asset Analytics – Physical Risk combines scientific validation, robust data controls, and disciplined model governance to ensure consistent and reliable outputs.

The methodology relies on established climate science inputs and scenario frameworks, including CMIP6 model outputs, IPCC Shared Socioeconomic Pathways (SSP2-4.5 and SSP5-8.5), and NGFS scenarios, which provide a scientifically grounded basis for the generation of forward-looking physical risk metrics. Quality assurance procedures include validation against historical observations where appropriate and, where supported by the underlying methodologies, the application of bias-correction and other adjustment techniques to improve consistency with observed conditions.

Additionally, model and pipeline development follow a controlled lifecycle that incorporates version control, structured review, documentation, and release management processes designed to support reproducibility, stability, and traceability of results. Changes to models, data, methodologies, and assumptions are incorporated through documented releases to maintain transparency and auditability across versions.

Methodology Review Process

The Geospatial Asset Analytics – Physical Risk methodology is reviewed on an annual basis and is also subject to periodic reviews and updates. These are overseen by experienced methodology and research leaders who continuously monitor industry and scientific evolution by reviewing relevant frameworks or regulations in order to align the methodology with market requirements.

The solution's underlying methodology is considered valid until an update is carried out and applied.

Appendix

Appendix A: Available Asset Types

The available asset types are given in the table below. For the ISS STOXX Geospatial Asset Analytics platform to recognize an asset type, you must include a column that matches exactly the label given below in **bold**.

Table 1: Asset Categories and Types

CATEGORY	ASSET TYPE LABEL	EXAMPLE
<i>Agriculture</i>	Agriculture	Agricultural areas, horse stalls, veterinary offices
<i>Commercial</i>	Retail Trade	Appliances, Auto Dealer, Auto Dealership, Bait Stand, Bait Stand, Bakery, Bakery, Boat Sales/Service, Book Store, Book Store, Camera Store, Candy Store, Carpet and Paint Shop, Clothing, Clothing Store, Clothing-Mens, Convenience Store, Crafts, Department Store, Department Store, Drive thru market, Drug, Drug Store, Fabric Store, Feed Store, Flea Market, Florist, Fruit Stand, Furniture, Furniture Store, Gas Station, Gas/Butane Supply, Gift Shop, Greenhouse, Gun Shop, Hardware, Hardware, Hobby Shop, Home Repair Store, Large Furniture, Large Grocery, Lawnmower, Liquor, Liquor Store, Liquor Store, Meat Market, Medium Grocery, Motorcycle Dealer, Music Center, Neighborhood Grocery, Nursery, Paint Store, Pawn Shop, Remnant Shop, Service Station, Service Station, Shoe Repair, Shoe Store, Small Grocery, Supermarket, Toy Store, Tractor Sales, Trophy Shop, Upholstery Shop, Used Appliances/Cloth, Used Furniture, Vacuum Cleaner Sales, Variety Store, Video Games, Wine Store.
	Parking	Garage
	Wholesale Trade	Auto Junk Yard, Auto Parts/Mufflers, Beer Warehouse, Bottled Gases Warehouse, Food Warehouse, Heavy Equipment Storage, Jewelry, Lumber Yard, Lumber, Machine Parts Storage, Medical Supplies, Municipal Storage Warehouse, Paper Products Warehouse, Private Storage, Quonset Hut Storage, Safety Equipment, Sporting Goods Warehouse, T.V. Repair, T.V. Station, Trailer Parts, Warehouse
	Personal and Repair Services	Auto Repair, Barber Shop, Beauty Salon, Boat Service, Car Wash, Cemetery, Cleaners substation, Funeral Home, Laundry, Photo Studio, Private Day Care, Re-Upholstery, Truck Mfg & Sales, Washateria, Watch Repair
	Professional/Technical Services	Accounting Firm, Airport, Big Office Commercial, Boat Storage, Business, Filtering Plant, Import Sales, Legal Office, Office Building, Piers, Professional, Real Estate Office, Sewage Treatment, Transport Company, Utility Company
	Banks	Bank
	Hospital	Hospital
	Medical Office/Clinic	Chiropractic Clinic, Dentist's Office, Doctor's Office, Medical Office, X-Ray Service
	Entertainment & Recreation	Bowling Alley, Cafeteria Restaurant, Country Club, Drive-In Restaurant, Fast Food Restaurant, Fishing Party Boat, Full-Service Restaurant, Lounge, Physical

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		Fitness, Private Club, Private Golf Course, Private Pool, Recreation Facilities, Restaurant, T.V. Station, Tavern, Telephone Exchange
	Theaters	Private Hall, Indoor Theater, Movie Theater, Organization Hall, Drive-In Theater
	Commercial	Generic grouping for items in <i>Commercial</i> category
<i>Education</i>	Grade Schools	Commercial School, Library, School, Elementary School
	Colleges/Universities	College, University
	Education	Generic grouping for items in <i>Education</i> category
Government	General Services	City Hall, Post Office, Government facility
	Emergency Response	Fire Station, Police Station
	Government	Generic grouping for items in <i>Government</i> category
<i>Industrial</i>	Heavy	Boiler Building, Cabinet Shop Mfg, Concrete Mfg, Door Mfg, Fabrication Shop, Heat Exchanger Mfg, Heavy Machine Shop, Lumber Mill, Metal Coatings Services, Metal Recycling, Pipe Threader Facility, Research Lab-Machine, Welding-Machine
	Light	Battery Mfg, Commercial Printing, Cooling Tower, Electronic Equip Mfg, Frame Shop, Furniture Mfg, Industrial Loading Dock, Instrument Mfg, Leather Goods Mfg, Locker Bldg, Maint Bldg-Mfg Facility, Newspaper Print Plant, Newspaper Sales Office, Office-Mfg Facility
	Food/Drugs/Chemicals	Chemical Laboratory, Chemical Plant Bonding, Chemical Plant, Chemical refinery, Detergent Mfg Facility, Feed Mill, Food Processor, Meat Packing, Oil Storage Tanks, Plastic Mfg
	Metals/Minerals Processing	Foundry, Refinery-Lead, Sand & Gravel, Sheet Metal
	High Technology	Data Center, Microchip Mfg
	Construction	Carpet Tile Flooring, Carpeting Service, Construction Co, Contractor Roofing, Contractor-Electric, Heating & Air Conditioning Service, Pier Drilling Co, Plumbing Co, Plumbing Services, Sandblasting Co, Water Well Service
	Industrial	Generic grouping for items in <i>Industrial</i> category
<i>Religion</i>	Churches and Other Non-profit Org.	Church, Civic Association
<i>Single Family</i>	Single Family Dwelling	One, two, or three story, with or without basement
<i>Residential</i>	Manuf. Housing	Mobile Home, Manufactured Home
	Multifamily Dwelling	Apartments, Condominium
	Temporary Lodging	Hotel, Motel
	Institutional Dormitory	Institutional Dormitory
	Nursing Home	Nursing Home, Rest Home
	Residential	Generic grouping for items in <i>Residential</i> category

Appendix B: Hazard Exposure Categories Thresholds

To create hazard exposure categories, ISS STOXX analyzes a representative sample of global points and defines breakpoints that best represent the overall risk distribution. Hazard exposure categories are bucketed using the following values:

Table 2: Hazard Exposure Categories Thresholds

HAZARD	UNIT	LOW RANGE	MEDIUM RANGE	HIGH RANGE
Wildfire	Probability	0.0 - 0.001	0.001 - 0.01	0.01 - 1.0
Coastal Flood	Unitless Score	0.0 - 0.2	0.2 - 0.5	0.5 - 1.0
River Flood	Unitless Score	0.0 - 0.2	0.2 - 0.5	0.5 - 1.0
Tropical Cyclones	Probability	0.0 - 0.01	0.01 - 0.05	0.05 - 1.0
Heat Stress	Fraction of Year	0.0 - 0.027	0.027 - 0.164	0.164 - 1.0
Water Stress	Unitless Score	0.0 - 0.3	0.3 - 0.6	0.6 - 1.0
Sea Level Rise	Relative change in meters	0.0 - 0.375	0.375 - 0.75	0.75 - 3.0

Appendix C: Relevant Supporting Models and Key Rating Assumptions

Models

- **Geospatial Asset Analytics - Physical Risk assessment and scoring model:** Assessment of asset-level and portfolio-level exposure to physical climate hazards through the integration of climate-model projections, high-resolution historical observations, and asset-level geospatial data.
- **Climate scenario model suite (IPCC SSP):** Evaluates forward-looking physical risk levels under two IPCC Shared Socioeconomic Pathways derived from CMIP6: SSP2-4.5 ('Likely Scenario', ~2.4°C warming by 2100) and SSP5-8.5 ('Worst-Case Scenario', ~4.3°C warming by 2100)
- **Climate scenario model suite (NGFS):** Provides physical risk metrics under three NGFS climate scenarios: Net Zero 2050 (~1.5°C), Below 2°C, and Current Policies. NGFS scenarios complement IPCC SSP scenarios by providing a decision-useful framework for portfolio and investment analysis.
- **Hazard Models:** Covers six hazards (wildfires, river floods, coastal floods, tropical cyclones, heat stress, and sea level rise) and produces metrics for exposures and impacts.

Assumptions

- **Climate scenario selection:** IPCC SSP2-4.5 is used as the 'Likely Scenario' and SSP5-8.5 as the 'Worst-Case Scenario'. These represent a plausible range of future climate conditions under moderate and high-emission pathways respectively.

- **Time horizon averaging windows:** Each time horizon reflects the average expected hazard exposure and impact over a corresponding averaging window rather than a single-year estimate. This is consistent with the treatment of climate variability and reduces the influence of individual-year outliers.
- **Ensemble uncertainty representation:** Ensemble median projections are reported as central estimates. Upper and lower uncertainty bounds (16th and 84th percentile projections, approximately ±1 standard deviation) are provided to represent the range of plausible climate-model outcomes.
- **Annualized expected value approach:** All impact metrics (structural damage, business interruption, productivity loss) are calculated as annualized expected values. For acute hazards with return-period-based exposure, the metric is derived by integrating potential damage across the full range of hazard return periods, representing expected annual loss averaged over many years.

Appendix D: Version Control

Name of Methodology: Geospatial Asset Analytics - Physical Risk

VERSION	DATE	DETAILS
1.0	October 2026	Publication of the Geospatial Asset Analytics - Physical Risk Methodology and Research Process document Inclusion of the Public Disclosure on the Methodology, Models, and Key Rating Assumptions Used in ESG Rating Activities (as defined by the Regulation (EU) 2024/3005)



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