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Climate Risk 2.0.

The next generation of physical climate risk measurement.

A generational upgrade for a field whose models were built for a climate that no longer exists.

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EXECUTIVE SUMMARY

Models for a climate that no longer exists.

The physical climate risk modelling field is producing outputs that appear authoritative yet rest on foundations that no longer reflect the world they are meant to measure. Data is stale, physics is approximated, uncertainty is concealed, and the link to financial outcomes is weak.

The result is a systematic underestimation of forward risk — evident in every major catastrophe loss report over the past five years. This paper contends that the industry needs a generational upgrade: Climate Risk 2.0. It is not about minor tweaks but a fundamental redefinition of what constitutes a credible physical risk assessment.

“Many economic models are failing to capture the extreme events, compounding shocks, and rising uncertainty likely to dominate impacts in a hotter world.”

UNIVERSITY OF EXETER & CARBON TRACKER · FEBRUARY 2026

The stakes are high. These are not anomalies; they are the predictable result of a field that has been assessing the wrong climate.

60%

Insurance protection gap for natural disasters worldwide.

2×

H1 2025 insured losses versus the 21st-century average of $41B.

20+

Billion-dollar U.S. weather events per year — one every 12–14 days.

PART I · THE FAILURE OF THE CURRENT GENERATION

Models built for a climate that no longer exists.

A decade of investment in climate scenario frameworks, NGFS pathways, SSP-based projections, and integrated assessment models has produced sophisticated tools that rely on assumptions increasingly detached from observed reality. Three structural failures define the current generation.

I. *Stale Data Foundations*

Most physical risk providers rely on meteorological forcing data from around 2015 — a full decade ago. The climate signal in those baselines does not reflect the recent acceleration in warming. 2024 was the first year on record to exceed 1.5°C above pre-industrial levels — a milestone entirely absent from models calibrated on pre-2015 data. Every risk estimate derived from those baselines is, in a literal sense, an estimate of a climate that no longer exists.

II. *Shortcut Physics*

Instead of running full hydrologic models for each scenario and warming level, most providers apply a scaled 'climate change factor' to historical discharge data. This shortcut — multiplying historical hazard estimates by a scenario-specific scalar — is faster and less computationally expensive. It is also systematically inaccurate. It smooths out extremes, misrepresents the actual distribution of outcomes, and produces results that are internally inconsistent across scenarios.

III. *The Long-Term Blindspot*

Standard SSP-based projections have uncertainty ranges that diverge only slightly before 2050. Regulators, insurers, and asset managers operating within 3–10-year horizons are making critical decisions based on models that cannot accurately assess near-term risks. The NGFS explicitly acknowledged this gap by releasing its first short-term scenario in May 2025 — but the field as a whole has been slow to respond.

EVIDENCE · WHAT THE LOSS DATA SHOWS

Decade-old baselines consistently failed to anticipate.

Outcomes that pre-2015-calibrated models had not priced — concentrated in non-peak perils and short-window losses.

$40B

2024 LA wildfire insured losses — an event that pre-2015-calibrated models had not priced.

$80B

H1 2025 insured losses, versus the 10-year average of $49B.

$166B

Non-peak peril losses in 2025 — exceeding the 30-year inflation-adjusted average of $90B.

12%

U.S. households now uninsured, up from 5% in 2019 as insurers retreat from misassessed regions.

These losses are not solely due to more assets being at risk. They stem from a persistent underestimation of future physical risks — risks that more accurate models would have identified years earlier. The industry is constantly playing catch-up because its basic data and methods lag behind actual climate signals.

1.3 · WHY THE CURRENT FRAMEWORKS FALL SHORT

Methodological choices, not missing science.

The limitations of current climate risk tools are not primarily due to a lack of scientific knowledge. Climate change science is well-founded. The real issues are methodological and commercial — choices to cut costs, speed up results, and avoid the computational challenges of running detailed physical models at scale. Those choices made sense in 2015. They are no longer appropriate in 2026.

I. Hazard scores without uncertainty ranges hide tail risk and create a misleading impression of precision.

II. Single-peril models fail to account for the complex, cascading interactions that lead to the most severe loss events.

III. Outputs that lack a connection to financial metrics — asset values, credit risk, insurability — cannot be acted upon by the institutions that need them most.

IV. Black-box methodologies that cannot be audited or explained fail to meet supervisory and reporting standards now enforced in the US, Canada, the EU, and elsewhere.

V. Multi-year refresh cycles cause risk estimates to consistently lag the climate they aim to measure.

VI. A hurricane hitting when banks have high loan-to-value ratios and limited liquidity buffers can trigger credit cascades extending well beyond the immediate physical damage.

PART II · WHAT CLIMATE RISK 2.0 REQUIRES

A minimum standard, not a vendor claim.

Climate Risk 2.0 is not a product category. It is a set of requirements — a minimum standard that the field must meet to be suitable for the decisions that businesses, fiduciaries, and risk managers now need to make. These requirements span five domains.

I.

Data & Model Foundation

Up-to-date, consistent meteorological forcing data; full physical model runs; full probabilistic outputs with tail visibility.

II.

Near-Term Risk Resolution

A dedicated short-term risk layer — structurally separate from long-term scenarios — with annual vintages and event attribution.

III.

Compound & Cascading Risk

Multi-hazard correlation, infrastructure dependency mapping, and dynamic insurability threshold indicators.

IV.

Financial Translation

Asset value impairment curves, credit risk integration, and alignment with ISSB S2, OSFI B-15, CSRD and equivalent frameworks.

V.

Transparency & Auditability

Explainable outputs, vintage comparability, and open methodology sufficient for independent verification.

DOMAIN I · DATA & MODEL FOUNDATION

Run the physics. Show the distribution.

REQUIREMENT · *Up-to-date, consistent meteorological forcing data.*

Any physical risk model is only as reliable as the climate signal it relies on. Climate Risk 2.0 requires meteorological forcing data continuously updated to reflect observed conditions to the present — not data from ten years ago. A model calibrated on pre-2015 data cannot account for the accelerating warming trend that has defined the climate since. Critically, the same dataset must bias-correct both the historical baseline and future projections. Using different datasets across scenarios introduces internal contradictions that undermine confidence.

> *Bias correction is the statistical process of adjusting model outputs to match observed data. The problem: providers use different observed datasets to bias-correct different scenarios, making outputs mutually inconsistent within the same assessment.*

REQUIREMENT · *Full physical model runs across every scenario.*

The climate change factor shortcut must go. Climate Risk 2.0 requires full hydrological model simulations for each climate model–scenario pair rather than scaled estimates. The principle extends across perils: full fire-weather and fuel-moisture simulation for wildfire; dynamical downscaling for tropical cyclones; full urban heat-island simulation for heat stress. Run the physics rather than approximate it. No shortcuts.

REQUIREMENT · *Full probabilistic outputs.*

Reporting only the median projection obscures the details decision-makers need. Climate Risk 2.0 requires full probabilistic outputs — at minimum, the 10th, 50th, and 90th percentiles across all warming levels and model combinations. Tail risks must be visible, not averaged out. Financial institutions responsible for capital allocation and underwriting decisions need the full distribution, not a single point estimate.

DOMAIN II · NEAR-TERM RISK RESOLUTION

The 3–5-year blindspot is no longer acceptable.

REQUIREMENT · *Short-term scenario capability.*

The 3- to 5-year blindspot in current long-term models is unacceptable for financial risk management. Climate Risk 2.0 requires a dedicated short-term risk layer that captures annual variability, policy-shock transmission, and the effects of near-term extreme events on the financial sector. This capability must be structurally separate from long-term scenario modelling, as both serve different purposes and require different architectures.

> *Short-range (SR) models must capture acute event dynamics, year-to-year variability, policy shocks, and near-term financial stress — closer to macro stress-test models. Long-range (LR) models must capture pathway divergence over decades. Merging them forces compromises that degrade both. Structural separation also makes each independently auditable.*

REQUIREMENT · *Annual vintage outputs with event attribution.*

Risk estimates must be updated at least annually to reflect current forcing data and the latest observed trend. Additionally, for each significant loss event, providers should produce attribution outputs — quantifying how the event's probability and severity changed relative to a pre-industrial baseline. This links observed losses to modelled outputs, builds credibility, and enables ongoing model validation.

The NGFS explicitly acknowledged this gap by releasing its first short-term scenario in May 2025. However, the field as a whole has been slow to respond. The result is a set of tools optimised for long-term academic analysis that are ill-suited for near-term financial decision-making.

DOMAIN III · COMPOUND & CASCADING RISK

The worst losses are never single-peril.

REQUIREMENT · *Multi-hazard correlation modelling.*

Single-peril models often underestimate tail risk because the most severe loss events are typically compound — a flood combined with a power outage, a drought combined with a wildfire, a storm surge combined with subsidence. Climate Risk 2.0 requires models that treat hazards as correlated rather than independent, estimating the joint probability of compound events and the resulting increased losses.

REQUIREMENT · *Infrastructure dependency mapping.*

Physical risk to a single asset does not remain confined to it. A flooded substation can disrupt a data centre. A damaged bridge can cut off a logistics hub. A compromised water treatment plant can shut down a manufacturing facility. Climate Risk 2.0 requires models that capture how physical risk propagates through infrastructure dependencies — the cascading channel that drives the worst systemic loss scenarios.

> *A bridge failure cuts off supply chains, increases transit costs, delays emergency response, and reduces asset values in the catchment. The modelling uses network dependency maps (transport, power, water, telecoms) to propagate a physical hazard through the graph and estimate second- and third-order financial impacts — not just direct damage to the flooded asset.*

REQUIREMENT · *Insurability threshold indicators.*

The path to insurability is one of the most vital yet underdeveloped aspects of physical climate risk. Climate Risk 2.0 calls for clear outcomes that signal when modelled risk reaches or exceeds actuarial thresholds — the point at which insurance becomes financially unviable at any commercially feasible premium. These indicators provide early signals of asset stranding and credit deterioration following the withdrawal of insurability.

DOMAINS IV & V · TRANSLATION · TRANSPARENCY

Speak the language of the institutions using it.

IV. FINANCIAL TRANSLATION

REQUIREMENT · *Asset value impairment curves.*

Hazard scores are not financial metrics. An asset manager cannot allocate capital, a lender cannot price a loan, and an insurer cannot set a premium based solely on a flood hazard score. Climate Risk 2.0 requires direct conversion of physical risk outputs into expected changes in asset value, projected over 5-, 10-, 20- and 30-year horizons. The financial metric is the outcome; the hazard score is an intermediate step.

REQUIREMENT · *Credit risk integration and regulatory alignment.*

Physical risk influences credit risk through a clear chain: asset impairment raises PD, collateral deterioration raises LGD, and revenue disruptions weaken debt-service capacity. Outputs must feed directly into stress testing, loan-level risk, and regulatory capital calculations — and must align with ISSB S2, OSFI B-15, CSRD, and central-bank stress-test frameworks, enabling users to move from assessment to submission without manual translation.

V. TRANSPARENCY & AUDITABILITY

REQUIREMENT · *Explainable outputs, comparable vintages, and open methodology.*

Every risk output must be accompanied by a plain-language explanation of its key drivers — the warming level, scenario pathway, physical mechanism, and model choices. Users should be able to compare current estimates with previous vintages to understand whether shifts arise from the climate signal or from methodology changes. The era of black-box climate risk modelling must end: providers should disclose enough methodological detail — data vintages, scenarios run, bias-correction methods, primary assumptions — to enable independent verification.

PART III · REQUIREMENTS SUMMARY

Old baseline vs. Climate Risk 2.0.

A due-diligence framework for buyers, a self-assessment for providers, and a benchmark for regulators evaluating the adequacy of climate risk disclosures.

CAPABILITY	CURRENT INDUSTRY BASELINE	CLIMATE RISK 2.0
Data vintage	Meteorological forcing data to ~2015	**Continuously updated through present**
Physical modelling	Scaled approximation ('climate change factor')	**Full model run per scenario & warming level**
Bias correction	Applied inconsistently across scenarios	**Consistent dataset across historical & future**
Scenario depth	Representative pathways only	**Full ensemble across warming levels**
Near-term resolution	Poor resolution before 2050	**Explicit short-term (1–5 year) shock modelling**
Peril coverage	Primarily flood / hydrology	**Multi-peril: flood, wildfire, heat, drought, coastal**
Compound events	Single-peril, independent treatment	**Joint probability of compound & cascading events**
Financial translation	Hazard scores in isolation	**Asset value, credit risk, insurability outputs**
Uncertainty	Median projections only	**Full probabilistic distribution incl. tail risks**
Transparency	Black-box outputs	**Explainable drivers, auditable methodology**

PART IV · IMPLICATIONS FOR FINANCIAL INSTITUTIONS

Four audiences. One standard.

I. *Insurers & Reinsurers*

- Price risk that accounts for current climate signals.
- Measure compound and cascading exposures overlooked by single-peril models.
- Identify the path toward insurability before being forced to retreat reactively.
- Satisfy the regulatory stress-testing requirements now implemented across major insurance markets.

II. *Asset Managers & Investors*

- Shift from portfolio-level screening to asset-level due diligence.
- Incorporate physical risk into valuation models and investment committees.
- Spot stranded asset risks before market prices reflect them.
- Generate granular, auditable disclosures that regulators and beneficiaries now expect.

III. *Banks & Lenders*

- Embed physical risk into loan origination and pricing.
- Conduct the asset-level stress tests required by regulators.
- Identify geographic and sector concentrations before they become systemic.
- Produce the scenario-based disclosures required under ISSB S2 and equivalents.

IV. *Regulators & Policymakers*

- Define minimum data and methodological standards for climate risk disclosures.
- Advance beyond mere scenario compliance to true risk sufficiency.
- Establish the practical minimum standard — current data, full model runs, probabilistic outputs, compound risk, financial translation.

> *The ECB embedded climate risks into its core supervisory functions in January 2026, ran the Fit-for-55 stress test in 2024, and issued its first penalty (ABANCA, November 2025). OSFI (Canada) implemented Guideline B-15. The U.S. Fed, FDIC and OCC rescinded their climate risk guidance in October 2025 — making the EU, UK, and Canada the primary jurisdictions currently requiring climate stress testing.*

PART V · THE UPGRADE IS OVERDUE

The climate isn't waiting for better models.

The climate risk modelling field struggles with a credibility gap. The difference between modelled risk and actual loss has grown too large to be explained by bad luck alone. It exposes systemic model failures: outdated data, simplified physics, hidden uncertainties, and outputs that cannot be effectively translated into the financial decisions that matter.

Climate Risk 2.0 is the sector's response to that failure. It does not require new science — the science is available. It demands the discipline to use current data, run the full model, report the full distribution, model compound risks, and speak the financial language of the institutions that rely on these outputs. Institutions that implement Climate Risk 2.0 standards will be better prepared for the regulatory environment, more adept at pricing and managing current exposures, and more equipped for the climate that is already present.

"Climate Risk 2.0 is not a vendor claim or a product category. It is a minimum standard — the baseline of rigour that financial institutions, regulators, and the planet require from the tools used to measure physical climate risk."