# Summary of findings: Physical Risk Central Climate Scenario

The workshop on physical risks was divided into three parts:

1. Discussion on how climate scenario analysis could support decision-making.
2. Three workstreams to develop more detail on how physical impacts translate into asset risks, liability risks and operational risks respectively.
3. An overview of the science, challenges and uncertainties inherent in downscaling climate to local impacts.

## How could climate scenario analysis support decision-making?

Insurers face increasing pressure to move beyond high-level scenario narratives towards more decision-useful analysis that supports both near-term risk management and longer-term strategic planning. This backdrop underscores the importance of developing credible central climate scenarios that reflect plausible future pathways and can be applied consistently across pricing, underwriting, capital, investment, and business planning decisions.

Participants discussed a range of use cases for assessing physical risk under a central case scenario, recognising that relevant time horizons and variables depend on the use case. For example:

- **Short term (1–3 years): Pricing, underwriting, reinsurance, and capital**. At this horizon, the focus is on the impact of **acute physical events** on claims volatility, asset valuation, and operational disruption.
- **Medium term (3–10 years): Business planning, risk appetite setting, and asset-liability management**, capturing the build-up of physical risk across geographies and lines of business and supporting decisions that may require action today to remain resilient.
- **Long term (10+ years): Strategic resilience, investment strategy, and adaptation planning**, helping to assess how physical risk could reshape markets, insurability and returns over time, and whether the business model remains viable under plausible future climate pathways.

## Transmission channels: How physical impacts translate into risks?

To enable focused discussion, participants were grouped into three sub-groups covering assets, liabilities (for both General Insurance and Life & Health) and business operations.

# Assets

Participants discussed how acute and chronic physical hazards propagate into asset value and investment strategy for insurers through three primary transmission channels – macroeconomic, operational and geopolitical

**Macroeconomic:** Physical risk can act as a "*triple whammy*" on asset values, driving higher inflation and costs, lower productivity, and weaker consumer demand. Firms may face rising resilience-related capital expenditure and higher insurance premium costs, whilst central bank responses can push interest rates higher, driven by higher costs including those from energy or food production, increasing discount rates and risk premia. Greater volatility and wider dispersion of future pathways can also depress investment, raising return hurdle rates and reducing future productivity gains.

**Operational:** There can be a direct operational impact from flood and severe storms on business premises. Physical hazards can also disrupt resource utilisation and cash flows even in the absence of direct damage. Some examples discussed include droughts reducing Rhine transport capacity and curtailing French nuclear output; wildfire risks triggering grid shutdowns; and flooding in Thailand reverberating through global semiconductor supply chains[1].

**Geopolitical:** Geopolitical tensions can magnify physical shocks, including through transboundary water disputes (e.g., India–Pakistan, the Mekong and the Nile)[2] and emerging dependencies on critical minerals as the energy system shifts. Non-climate conflicts can interact with climate-driven fragility, as seen in rerouting around chokepoints that raised shipping costs. Water sits at the heart of many of these pathways, linking agriculture, industry, transport and food security where harvest failures could spur localised crises.

The interplay of energy market volatility, accelerating climate and nature disruption, and emerging constraints on fertiliser availability and supply chains could plausibly generate comparable, or more severe, inflationary and humanitarian outcomes to the 2022 food and energy crisis[3]. Moreover, it is important to consider derailment risk (whereby a specific event overrides or invalidates prevailing assumptions) as a trigger for simultaneous energy, trade, and financial market shocks of considerable magnitude. The Middle East crisis could arguably constitute a derailment risk, resulting

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[1] How does severe weather disrupt supply chains? | Maersk

[2] Transboundary water conflicts, cooperation, and pathways forward - PMC

[3] Multiple heat, flooding, and drought events between 2020 and 2022 significantly hurt global food supplies and reserves.

in spikes in global energy prices, disruption to a critical shipping lane, broader regional conflict and the destabilisation of financial markets globally.

The group also discussed nature–climate interactions (e.g., forest loss leading to reduced flood resilience in high rainfall events) and increased risk of pandemic-type events as non-linear amplifiers. Separately, artificial Intelligence (AI) was identified as bringing wide intersecting uncertainty to these economic and productivity outlooks. There is significant potential for AI to mitigate risk: AI could accelerate scientific developments or optimise energy usage. Conversely, AI could cause significant competition for energy, water and commodity resources as well as it's potential for social and economic disruption.

For property and real assets, insurance availability and affordability could be impacted to the point where cover becomes uneconomic, capital values could fall sharply, even on perceived risk alone. These valuation dynamics transmit to real estate equity, infrastructure, and mortgage-backed exposures, as well as to municipal, sovereign and utility debt with concentrated physical risks. The regulatory regime for utilities is often built on the basis of thin capital buffers and stiff price competition which can prove brittle amid volatile input costs. This was seen during the 2022 UK energy supplier failures, implying a need for a re-think of the regulatory regime re-examine capital buffers, risk-sharing mechanisms, and resilience incentives.

Insurers' portfolios could be impacted by higher rates and spreads in fixed income, margin profit and supply-chain risk in equities, valuation and capital expenditure headwinds in real assets and infrastructure making forward-looking, location-aware, and volatility-aware risk assessment essential. As next steps, the group highlighted the value interventions such as expenditure on resilience and adaptation planning for directly held assets and businesses.

# General Insurance

For GI, the short to medium-term scenarios are more relevant to support use cases such as natural catastrophe, reinsurance, and business planning. Key themes included shifts in the frequency and severity of flood, wind, and wildfire events, rising claims inflation, widening coverage gaps and increasing pressure on reinsurance pricing and availability.

**Higher temperatures** could reduce labour productivity and disrupt supply chains, leading to delays and higher repair costs, particularly in motor insurance, where specialist repairs are required. Outdoor work may become more hazardous and result in higher claims for employers and public liability lines as well as workers' compensation claims.

**Extreme weather events such as** flooding, cyclones and windstorms can damage infrastructure, housing and vehicles affecting a broad range of GI products. Floods and wildfires can affect ports, highways, and factories, leading to delays and increased costs in the supply chain. Increased storm severity, higher water levels, and more intense droughts could result in higher liability claims and more legal disputes related to insurance coverage.

**Escalating physical risk** has the potential to materially reshape GI markets, including through reduced insurability of certain products with impacts varying significantly by geography, peril, and line of business. A widening coverage gap could increase financial vulnerability for households and businesses, with broader economic and financial system resilience implications.

Insurance premiums may rise sharply leading to significant declines in demand. There may be new regulatory risks with some jurisdictions applying pricing caps or inclusive coverage requirements. This may be a significant strategic risk for insurers with concentrated geographic or limited lines

In contrast, participants also noted that these market disruptions could lead to enhanced returns for diversified and innovative insurers that appropriately reflect physical risk in pricing, underwriting and reinsurance strategies, and that leverage innovation to develop new products and solutions tailored to emerging risks and evolving customer needs and preferences.

## Life and Health

Participants explored how physical hazards could be reflected in the Own Risk and Solvency Assessment ("ORSA"), technical provisions, business planning, and pricing. Common themes included rising heat-related morbidity and mortality, increasing cardiorespiratory impacts linked to heat and air quality, the spread of vector borne diseases, deteriorating mental health outcomes, and shifts in seasonal disease patterns. Impacts are expected to be uneven across populations and geographies, with vulnerable groups particularly exposed.

**The elderly population** was identified as especially vulnerable. Changes in heat and cold exposure elevate risks of cardiovascular, cerebrovascular, and respiratory related mortality and morbidity. Geographic shift benefits could be observed in the North of the UK, but worse outcomes in the South, urban centres, and drier areas. As climate change increases, the frequency of extreme temperatures and weather events, adaptive strategies for high-risk groups and preparedness with health system are crucial.

**Respiratory disease, allergies and infectious disease** have a direct link with climate. Diseases that raise particular concern include asthma, respiratory allergic disease, chronic obstructive pulmonary disease, and respiratory tract infections. A move to cleaner (green) energy should improve air quality, albeit offset by impacts such as higher temperatures and any increased wildfires. The increased stress of, and encroachment into, ecosystems increase the risk of pandemics. In the UK, the frequency, variety and direct impacts from vector-borne infectious disease are expected to rise with temperature.

**Cardiovascular disease:** extreme and prolonged heat, combined with air pollution could increase the risk of cardiovascular diseases, such as ischemic heart disease, stroke, heart failure, arrhythmias, and cardiac death. Higher temperature could lead to increased hospitalisations for conditions such as myocardial infarction. Air quality may improve or worsen depending on technological progress and government policy.

The group also discussed **mental health impacts**, including anxiety, depression, post-traumatic stress, and suicide as well as the interdependencies between mental health and other factors such as technology and the geopolitical environment.

In the UK context, NHS funding could come under strain in most climate scenarios leading to poorer overall health outcomes. In more extreme physical scenarios, NHS spending could increase significantly to mitigate catastrophic declines in health, but systems may become overwhelmed.

Public finances could be strained by recovery and adaptation needs, potentially crowding out health and other services, while heat and air-quality effects reduce labour productivity—feeding back into growth, profitability, and credit quality. At the same time, opportunities may emerge for insurers to develop new products and services such as expanded private health and critical illness insurance offerings.

Finally, the group recognised that climate change and mitigation actions have complex, compounding and sometimes offsetting effects on mortality (for example, climate change induced milder winters could reduce mortality rates). Figures 1 and 2 below share initial findings from a prototype causal model for UK mortality rates which explores the interactions of various climate and socioeconomic factors on excess mortality. Figure 1 shows the UK excess mortality distribution (mean and 90th percentile) from climate factors under different global average temperatures and shows higher excess mortality at higher global average temperatures. Figure 2 shows the UK excess mortality with the influence of vector disease on excess deaths minimised within the model, and under this model there is a reduction in excess deaths for the UK. This is as a result of the relative influence of excess cold-related deaths compared to heat-related deaths currently in UK data.

**Figure 1: UK Excess Mortality Distribution Mean and 90th Percentile From Climate Factors (per 1,000 population) Under Different Global Average Temperatures**

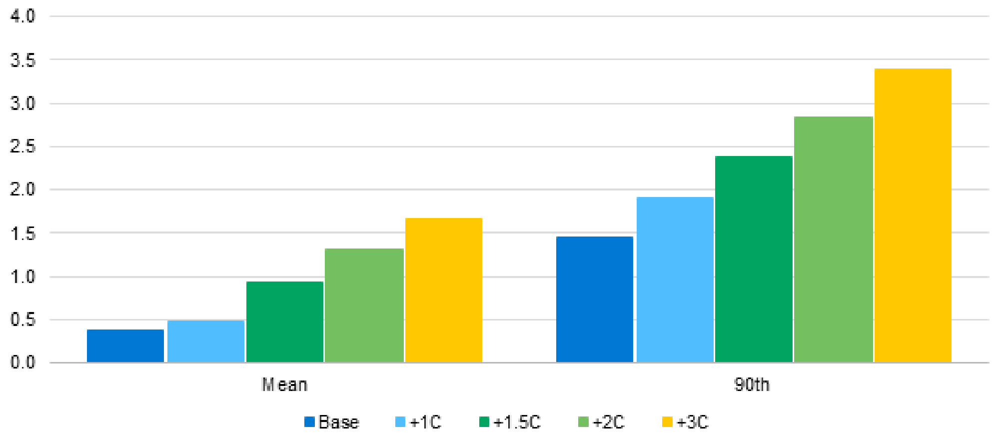
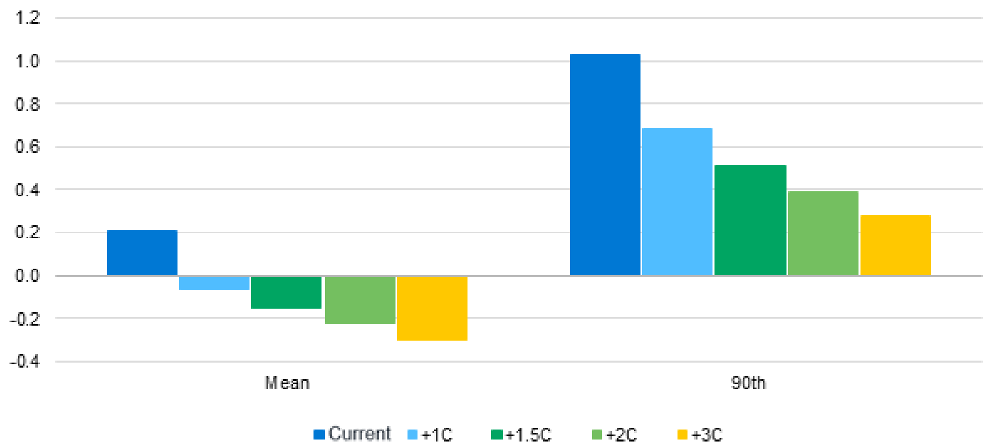


**Figure 2: UK Excess Mortality From Climate Factors (per 1,000 population) Under Different Global Average Temperatures Reducing the Impact of Vector Disease**




Source: Figure 1 and Figure 2, "Climate forecast: Looking beyond net-zero mortality predictions", Milliman

# Business operations

The conversation covered operational, reputational and litigation risks. Key themes included site disruption, property damage, deterioration in workforce health, and volatilities in third-party, IT and supply chain resilience, as well as the adequacy of crisis responses.

**Operational risk,** supply chain, and IT infrastructure dependencies (particularly where third-party providers operate in climatically vulnerable geographies) represent a material and frequently underassessed source of operational risk. Workforce resilience, outsourced processing relationships, and business continuity arrangements all warrant rigorous stress-testing against credible physical risk scenarios. Due diligence of supplier operations, for example understanding supplier controls and evaluating supplier adaptation efforts is critical for long-term resilience.

**Litigation risk** could arise from both actions taken and actions not taken by firms. Greenwashing claims may result from misrepresentation of actions, whilst investors could face litigation for failing to encourage sufficient transition. Legal systems often evolve in line with cultural and the political environment, which may be hard to anticipate. This complexity is compounded by polarised litigation across jurisdictions: anti-ESG legal challenges have occurred[4], whilst the International Court of Justice (ICJ) issued a landmark 2025 advisory opinion confirming that states have a legal obligation to protect the climate system from greenhouse gas (GHG) emissions, marking a major, non-binding shift toward international climate accountability. This presents firms with a genuinely difficult operating environment. A clearly and consistently articulated and evidence-based position that feeds into business strategy represents the most defensible posture.

**Reputational risk** may arise from decisions made in response to physical hazards, such as market withdrawal, premium increases, coverage revision, as well as from failures in customer communication and expectation management. The actuarial community has a professional responsibility to ensure that technically sound pricing and reserving decisions are implemented in ways that are transparent and clearly explained to policyholders, particularly at point of sale and renewal. This is applicable across both GI products (e.g. ensuring that policyholders understand what physical hazards are covered under their policy) as well as Life Insurance and Investment-based products (e.g. ensuring return commitments are clearly communicated and delivered).

## The importance, challenges and uncertainties of downscaling and local climate uncertainties

Assessing physical risk requires climate models capable of representing hazards at a high degree of granularity. Climate hazard information for assessment of risk or scenario analysis ideally needs to be available at local scales (where assets are located) and incorporate the effects of relevant physical processes, such as atmospheric convection[4] and local land-surface feedback[5], which are important driving factors in present and future extreme weather. As coarse-scale global climate models do not typically satisfy either of these needs, there is a requirement for downscaling methods to apply to the coarse-scale climate model outputs. Different classes of downscaling method can be applied, including dynamic downscaling using physically based regional and local climate models, statistical methods, and AI-based methods. The latter are rapidly evolving in their sophistication and utility.

While the downscaling step in the modelling chain aims to reduce biases between the model and the real world, and produce more credible results, the methods are another element of uncertainty in simulated climate hazards. The fraction of the total uncertainty varies depending on the metric (e.g. temperature, rainfall or windspeed), the location and the future time-horizon considered. It is our view that good practice in risk assessment is to apply downscaling methods, but practitioners should also consider the benefits and limitations of the downscaling methods chosen, including how they may affect the size of impacts resulting from climate hazards.

[4] Atmospheric convection is the vertical transport of heat, moisture, and momentum within the Earth's atmosphere, driven by density differences where warm, less-dense air rises and cooler, denser air sinks.
[5] Local land-surface feedback involves the interaction between soil moisture, vegetation, and the atmosphere, where surface conditions directly influence, and are influenced by, local climate.