



Climate Risk Analysis for Life and Health Insurance Companies

JUNE | 2022



Climate Risk Analysis for Life and Health Insurance Companies

An Expert Panel Discussion

AUTHOR Didier Serre, FSA, MSc

SPONSORS SOA Catastrophe & Climate Strategic Research Program

Swiss Re Institute



Give us your feedback!

Take a short survey on this report.

[Click Here](#)



Caveat and Disclaimer

The opinions expressed and conclusions reached by the authors are their own and do not represent any official position or opinion of the Society of Actuaries Research Institute, the Society of Actuaries or its members. The Society of Actuaries Research Institute makes no representation or warranty to the accuracy of the information.

Copyright © 2022 by the Society of Actuaries Research Institute. All rights reserved.

CONTENTS

- Section 1: Background and Objectives 4**
- Section 2: Current Challenges with Climate Risk Analysis 5**
 - 2.1 Uncertainty and Purpose 5
 - 2.2 Scenarios 5
 - 2.3 Data and Attribution 6
- Section 3: Modelling Climate Risks in Practice 7**
 - 3.1 Key Model Assumptions 7
 - 3.2 Data Adjustments and Trends 7
 - 3.3 Risk Mitigants and Offsets 8
 - 3.4 Climate Risk Variables 9
- Section 4: Communicating Uncertainty and Disclosures 10**
 - 4.1 Audience and Purpose 10
 - 4.2 Ideas for Disclosures 10
- Section 5: Opportunities and Closing Remarks 11**
- Section 6: Acknowledgments 12**
- About The Society of Actuaries Research Institute 13**

Climate Risk Analysis for Life and Health Insurance Companies

An Expert Panel Discussion

Section 1: Background and Objectives

The use of climate risk analysis among insurance companies is growing, reaching beyond property and casualty insurance companies only. While modelling the impact of climate risks on balance sheet remains complex and multi-faceted, methodological approaches for reflecting climate risks are currently being developed to refine pricing, reporting and solvency assessment exercises. Life and health insurance companies are also among those starting to look for ways to assess the impact of climate risks qualitatively and quantitatively on their key business operations and functions.

On March 31, 2022, the SOA Research Institute assembled an expert panel to discuss key considerations related to climate risk analysis applied to life and health insurance companies. While the discussion focused on liabilities and primarily centered on the potential impact of climate risks on mortality in the United States (US), comments specific to longevity and morbidity were also summarized where appropriate. Considerations from a property and casualty (P&C) perspective were also provided to facilitate the connection and support potential lessons and best practices that US life and health insurance companies could leverage. Of note, themes covered in this report may also apply to other jurisdictions given the universality of climate risks.

The panelists, listed in Section 6, were selected to represent a wide and diverse array of opinions, and were encouraged to contribute from their own, individual perspective working in areas such as insurance, reinsurance, state regulation, consultancy, meteorology, and climate finance. No comments were attributed to panelists; instead, a summary of the main discussion points is presented in this report.

The objectives of the two-hour expert panel discussion were to:

- Discuss current challenges with climate risk analysis for life and health insurance companies
- Discuss considerations for potential qualitative and quantitative approaches for modelling climate risks for use in multiple actuarial responsibilities
- Discuss ways to reflect and adjust assumptions, trends, offsets, and climate data to assess the direct and indirect impacts, as well as compound effects across multiple scenarios
- Suggest effective communications and disclosures of climate-related information to various stakeholders amidst high uncertainty

Section 2: Current Challenges with Climate Risk Analysis

To lay the foundation for a fruitful discussion on key considerations for the modelling of climate risks, both from a qualitative and quantitative approach, panelists first shared their observations and perspectives on current challenges with trying to incorporate climate considerations into risk analysis, particularly when aiming to separately assess and model their potential impacts.

2.1 UNCERTAINTY AND PURPOSE

There was a general sentiment that high uncertainty permeates climate risk analysis and as such quantifying the potential impact of climate risks can be challenging. Panelists confirmed the key characteristics of climate risks, namely:

- Complex chain reactions
- Risk interdependence and connected extremes
- Trigger and tipping points
- Compounded second-/third-order effects
- Increased overall volatility (extremes)

In this context, a panelist expressed the difficulty with trying to quantify climate risks beyond providing a directional vector and an order of magnitude. Spurious accuracy, or spurious precision, was also mentioned as a key element to consider, and avoid. Yet, many panelists expressed the need to adopt a more holistic, broader view of climate risks given its ramifications, interdependencies, and compound effects. Indeed, changes or events happening in one part of the world can trigger unintended consequences or knock-on effects elsewhere. An example from the past showed the potential consequences of a prolonged drought on food insecurity and its effect on political and economic instability.

This observation raises another essential element with climate risk analysis, namely around the purpose and value of quantifying separately the impacts of climate risks in a portfolio. In fact, the debate around how to treat climate risk, either as a standalone risk or as a multiplier to existing risks (e.g., liability, market, credit) is still ongoing. From a risk perspective the focus typically lies on analysing extreme situations, thus covering a wide range of possibilities seems reasonable. Yet, from a model perspective, accuracy is usually weighted against simplicity to reduce over-fitting and unnecessary complexity.

Understandably, some stakeholders are adding pressure to quantify climate risks in isolation from other types of risks. From a solvency assessment perspective however, a panelist noted that current solvency regimes and other stress tests exercises currently provide a buffer against deviations, pondering whether the impacts of climate risks would be larger than what is already captured in solvency and capital regimes, from a life insurance perspective. Similarly, other risk assessment mechanisms could be used from an earnings or pricing perspective. Yet, some other nuanced views expressed the relevance of conducting climate risk analysis and single out their potential effects, considering second- and third-order effects which could justify a higher risk charge.

2.2 SCENARIOS

Another area where panelists expressed their views was on scenarios. Actuaries, like other risk professionals, rely on assumptions tied to various scenarios, which tend to cover best estimate as well as more extreme scenarios. Typically, past data and experience will support best estimate assumptions. While there are many unknowns with climate risks, some panelists shared that the climate is changing, and what is happening now is already critical enough to warrant further consideration (as of now, there is a 1.1 °C

increase in global temperature relative to pre-industrial levels). From a meteorological perspective, those changes will have an impact later, for example through more heat- or moisture-related events, and not only at the tail of the risk distribution. Consequently, integrating climate risk considerations into traditional analysis seems justified not only for worst-case scenarios but also with best estimate assumptions.

As the use of climate scenarios in climate risk analysis increases, it will become critical for life and health insurance companies to review and understand the assumptions and limitations underpinning the modelling, as well as nuances between available scenarios. For example, Representative concentration pathways (RCP) scenarios present pathways for greenhouse gas emissions by 2100 and the associated global temperature increase. Other scenarios like the Shared socioeconomic pathways (SSP) include projections of socioeconomic global changes. In practical terms however, a panelist highlighted the importance of focusing on the delta change in temperature and timing of achieving specific temperature increase targets. More generally, actuaries will need to understand that some of the underlying data rely on the mass deployment of novel technologies not yet commercialized like carbon capture and storage to achieve ambitious carbon emission reductions. Thus, keeping a critical eye when appraising scenarios is necessary to ensure that the outcomes of the climate risk analysis are meaningful.

2.3 DATA AND ATTRIBUTION

Another challenge identified by several panelists was attribution. In fact, scientists have developed techniques to extrapolate results from the recent or distant past into the future. For example, a panelist mentioned the relevance of understanding whether an event was influenced or occurred because of climate change, as opposed to being subject to the natural variations in climate.

In a context where extreme weather-related mortality is on the decline worldwide (mostly due to improved early warning communication infrastructure in extreme weather prone areas), the need to consider second and third-order effects, which can be significantly greater than first-order effects, and relate these back to the extreme weather event, seems justified to some panelists. In other words, the need to capture indirect impacts alongside direct impacts, was widely acknowledged. A panelist shared the example of Hurricane Maria (2017), contrasting the initial government reports of 64 deaths against ~3,000 casualties reported a year later in follow-up studies adopting a holistic view of the indirect impacts of the hurricane.

Attribution is possible with reliable data. Yet, from a mortality and morbidity perspective, coding on medical claims may not often be granular enough to allow for the interconnectedness between climate risks and the medical condition, mortality status or cause of death. In addition, while there may exist some techniques to differentiate excess mortality caused by extreme weather from natural volatility, and exacerbated by comorbidities, some challenges remain when attempting to attribute mortality or morbidity to a single extreme weather event for a particular area over a defined timeframe. Besides, for reinsurance, there is of course the additional consideration of relying on claims from direct insurance.

Despite current challenges with climate risk analysis, panelists still proposed some pathways for integrating climate risks into modelling and identified areas for further exploration, presented in the next section.

Section 3: Modelling Climate Risks in Practice

While there is an important level of uncertainty with climate risks, life and health insurance companies are starting to develop ways of integrating climate risks into modelling. Given the primary focus on mortality, two key climate risks were identified as mostly relevant to US life insurance: air pollution (e.g., from human-induced pollution and/or wildfires) and extreme heat. Of note, specific regions may also be subject to additional climate risks.

3.1 KEY MODEL ASSUMPTIONS

Collectively, panelists assembled a list of key model assumptions relevant to life and health insurance which could be impacted by climate risks, namely:

- Incidence
 - Mortality
 - Morbidity
 - Disability
- Behavioral
 - Lapses
 - Anti-selection (longer term)
- Additional expenses
 - Reporting and disclosure requirements

Specific to mortality, panelists discussed existing studies describing how, in the US, deaths related to extreme cold are greater than those related to extreme heat which, overall, could lead to a regional improvement in mortality experience in the short-term as global temperature rises. Other studies in the UK and other Nordic countries support similar findings. Yet it is likely to only be a temporary relief or offset as the toll of extreme heat is expected to increase and potentially overtake that of extreme cold over time.

Further mortality rates are typically presented using mortality shock and trend assumptions. Both could be adversely impacted by climate risks, either directly from extreme weather including extreme heat, floods, wildfires, extreme rainfall, storms, etc., or from physical chronic risks including the gradual changes in temperature and precipitation patterns and sea level rise among others, which could impact the long-term mortality improvement assumption. One panelist hinted at a potential downward adjustment to the mortality improvement assumption as a first step and suggested further quantitative exploration, noting that very specific adjustments to mortality rates, likely to be small at this stage, might foster spurious accuracy given available data.

Interestingly, one panelist indicated expenses as another category that could be impacted, if not already, by increasing and evolving regulations around climate-related reporting and disclosure requirements. Such increase in disclosure requirements seems likely to be sustained rather than being transitional.

3.2 DATA ADJUSTMENTS AND TRENDS

Panelists also expressed their views on typical adjustments, trends, and other considerations specific to life and health insurance companies and agreed that impacts on liabilities could vary across portfolios.

A key element is the insured vs. general population adjustment. To date, panelists pointed to the limited evidence available on the quantification of climate risks on mortality, with even fewer available studies strictly focusing on insured populations. Yet, the most vulnerable population groups (e.g., lowest socio-

economic groups, under-insured population) are likely to continue to disproportionately feel the brunt of first-order effects and be adversely impacted by climate risks. Similarly, there may continue to be adjustments within group insurance to account for certain higher risk industries (e.g., outdoors occupations being at higher risk from rising temperature). However, the extent to which climate risks will impact group versus individual insurance remains unclear.

Furthermore, trends, current and anticipated ones, represent another element to consider when conducting climate risk analysis. Looking back at the experience from Covid-19 and the work from home trend which prompted many workers to move out of urban centers and towards suburban or rural spaces, this new reality may change future exposure to some climate risks, namely extreme heat which tends to be exacerbated in urban centers because of the urban heat island effect. Particularly, the Paris (2003) and Chicago (1995) heatwaves caused greater impacts in the urban versus the surrounding suburban areas.

In addition, many panelists mentioned the need to focus on complex relationships including migration patterns. For example, while climate-related events like the melting of glaciers contributes to sea level rise that later can accelerate population movements away from some coastal areas, a prolonged drought impacting food security could also later trigger political turmoil, economic instability or even war prompting massive population displacement. These population movements can create long-term changes in the demographic profile of insurers, and appropriate monitoring should be implemented to foresee such changes, if possible, or at the very least, monitor its evolution and their interdependencies over time.

Overall, understanding future exposures in the portfolio will become increasingly important as companies start to think about ways to mitigate and adapt to climate risks.

3.3 RISK MITIGANTS AND OFFSETS

According to panelists, there is high relevance in considering potential risk mitigants (e.g., climate adaptation) and offsets to climate risks, starting with qualitative statements and narratives when full quantification is not possible. Specific to risk mitigation and climate adaptation strategies, panelists shared examples from other areas to help with making parallels with life and health insurance and offer guidance.

From an infrastructure / P&C insurance perspective, understanding the current context before assessing the adaptation gaps and taking actions to meet the standards of tomorrow's climate is critical. An example shared in the discussion was on building codes, and how these were significantly revamped following Hurricane Andrew's devastating toll (1992). In fact, studies showed that follow-on hurricanes in the same area caused greater infrastructure damage in buildings which had survived Hurricane Andrew and thus were not subject to the newer building codes at the time, relative to buildings rebuilt using stricter standards. This example shows that vulnerability can vary significantly among a portfolio, and that lessons from the past can become a major incentive for improving adaptability. Acknowledging that revamping building codes can be a difficult, time-consuming task, focusing on immediate on-the-ground improvements to infrastructure may also be considered.

In fact, this adaptability effect is already observed in mortality studies. In particular, the first major shock of the year typically causes the greatest damage relative to follow-on events of comparable severity causing fewer damage; this may be due to the additional time spent to improve preparedness and mitigation. Examples provided included the Paris (2003) and Chicago (1995) heatwaves. Similarly, southern areas in the US exposed to warmer temperature and more extreme heat events seem to cope better with higher temperatures (e.g., better equipped with mitigation tools and cooling infrastructure) than northern areas for whom heatwaves have been a much rarer occurrence in the past. Overall, panelists believed in the relevance of considering both shorter and longer term mitigants when assessing climate risks.

Yet, even when risk mitigation measures exist and are in place, such as air conditioning for home cooling, they might still be subject to service interruption, for example, an electricity grid overload. Thus, keeping a system view will continue to remain critical in the context of climate risk analysis, even when risk mitigation measures seem effective in isolation, or under less extreme situations.

Another example, from the recent Covid-19 experience, showed how some employers provided additional equipment like generators to critical employees who were remotely working from areas with higher physical risk (to reduce the risk of online access interruption). A deeper analysis showed that these employees had less seniority and thus were potentially less able to provide their own mitigation measures. So, taking this example back to life and health insurance, it highlights the importance of knowing the geo-distribution of the portfolio, as well as the demographic and socio-economic information as those most at risk may also be more vulnerable to weather-related events due to fewer available risk mitigation options.

Regarding offsets, product characteristics may also provide some inherent protection against climate risks. Specific to life insurance, climate-related impacts on the mortality block of business may be offset by those on the longevity side, thus providing some hedging for companies offering both types of products.

Overall, a complete climate risk analysis should consider risk mitigants and offsets, and where applicable, the experience from other areas may be relevant in helping to draw parallels with life and health insurance.

3.4 CLIMATE RISK VARIABLES

Understanding the nuances among available climate risk variables is important when conducting climate risk analysis to ensure that outcomes of the analysis are meaningful.

Multiple climate variables were discussed to show the wide array of relevant considerations when starting to integrate such metrics into mortality and/or morbidity models. While non-exhaustive, the list below focuses on examples specific to air temperature, namely:

- *Tmax*: maximum air temperature on a given day
- *Tmin*: minimum air temperature on a given day (generally nighttime)
- Number of consecutive/non-consecutive days with air temperature above X

Regarding *Tmax*, life and health insurance companies may want to look at various thresholds, including absolute thresholds varying by region, while also incorporating relative thresholds (e.g., 95th percentile) to account for changes in adaptability by area, by type of infrastructure or by any other relevant factor. The same approach can be followed for the metric showing the number of days with air temperature above X . Besides, several panelists warned against looking back in time to predict the future, suggesting that some of the largest impacts may be felt in areas which, to date, were not directly exposed to climate risks. This view reinforces the nexus between prior experience, preparedness and adaptability that was alluded to earlier. Again, relative metrics may become especially useful in such context.

Another climate risk variable, *Tmin*, is also important, especially as the body typically regenerates at night, allowing the body to cool down. One panelist noted that *Tmin* (nighttime temperature) is rising faster than *Tmax* (daytime temperature), thus providing less opportunity for the body to recover overnight, which could then translate into short- and long-term effects on morbidity and mortality for life and health insurance companies. Another panelist further commented that adapting to increases in *Tmin* vs. *Tmax* may be more difficult, where cooling and other adaptation strategies can be used.

Overall, climate risks can be presented from multiple perspectives. Thus, selecting relevant climate risk variables which can be tied back to portfolio characteristics and are adjusted for local considerations will be important to develop meaningful risk assessment analyses and guide risk management decisions.

Section 4: Communicating Uncertainty and Disclosures

With an ever-growing movement towards greater disclosures from investors, credit ratings, regulators, and beyond, communication remains a key consideration for life and health insurance companies embarking on the journey of climate risk analysis. Overall, panelists recognized the important level of uncertainty with climate risk analysis and the evolutionary nature of disclosures from qualitative to quantitative in providing some ideas for future disclosures.

4.1 AUDIENCE AND PURPOSE

Like other analyses, climate risk analysis follows basic communication principles. Namely, panelists stressed the importance of knowing the audience, while also recognizing that it may be composed of several stakeholders, ranging from policyholders to regulators. As such the need to tailor messaging may be justified to meet the audience ‘where it is at,’ especially given the characteristics of climate risks previously described and the important level of uncertainty around climate risks.

Purpose is another key consideration intrinsically tied to audience; a panelist defined purpose as knowing what the audience should do with the information provided. Panelists shared multiple views on purpose; some argued that convincing the audience was the dominant purpose, while others mentioned that it could also be used to (re)affirm the role of insurance in society given the type of activities that it supports. Another idea came from a panelist suggesting that insurance companies share targeted infographics to policyholders, thus indicating that education and raising awareness should be another purpose of communications. These infographics can be highly effective at communicating easily digestible information prior to shocks (e.g., extreme weather events), which could provide another channel for insurance companies to potentially reduce future losses or deaths as specific events later materialize.

4.2 IDEAS FOR DISCLOSURES

While a one-size-fits-all solution to disclosures may not necessarily exist or be ideal, nevertheless panelists shared their views on specific features of effective disclosures, namely:

- Relatable
 - Analogy with local, tail events to increase relevance to primary audience
- Wide range of scenarios across plausibility spectrum
 - Including favorable and unfavorable or catastrophic scenarios; leveraging IPCC scenarios
- Meaningful metrics
 - Multiple options possible based on audience: impact on earnings, claims, or reserves

Tying these considerations together, an example of an effective disclosure specific to life insurance could include the probability of extreme heat (defined using relevant and meaningful climate variables) under multiple climate scenarios (e.g., IPCC). This would be analogous to disclosing the probability of a ‘Hurricane Katrina’ type under a two-, three- and four-degree increase in global temperature, relevant to P&C. To supplement disclosing the related potential impact of these events on earnings over a defined timeframe, focusing on the tail of the distribution rather than the average can also improve resilience planning.

Finally, panelists acknowledged that no disclosures are perfect, and that these may continue to be subject to criticism and scrutiny. And regardless of the extent to which climate risk considerations are integrated in the financial model, there may continue to be differences between what is featured in financial models and what is shared to the outside world. As previously described, natural offsets and risk mitigants can dampen climate-related impacts when an aggregate company view is adopted.

Section 5: Opportunities and Closing Remarks

Panelists recognized that climate risk analysis can also introduce and pave the way to opportunities for life and health insurance companies.

On the opportunity side, insurance companies can continue to play a critical societal role through risk mitigation by providing new types of policies, benefits and products that respond to the needs of tomorrow and account for vulnerabilities. In fact, while focusing on the need to protect the most vulnerable populations has a universal appeal, it also has strong relevance and purpose in the US given the wide socio-economic disparities. Besides, looking into the future to guide decisions in the present could also help address long-term insurance affordability and availability concerns, and help reduce the insurance protection gap.

Further, collaboration between private insurance companies and public entities like municipalities and other levels of government can be another area to consider. Some P&C insurance companies are starting on this collaborative journey; as some lessons learned and best practices emerge, life and health insurance companies may also find relevance in this approach. In fact, these partnerships could lead to better assessment and management of climate risks, both from direct and indirect (societal) perspectives.

As a final remark, panelists agreed that climate risk analysis presents a constantly evolving landscape with the added challenge of aiming to tie short- and long-term climate risk considerations into risk planning. While some questions and pathways to quantitatively assess climate risk into the modelling remain unanswered, given the infancy stages of climate risk quantification, there certainly is immense value in validating that the questions posed are shared among industry participants, and in paving the way for additional collaboration with stakeholders both inside and outside the actuarial profession.

Section 6: Acknowledgments

The SOA Research Institute would like to acknowledge The Swiss Re Institute for their expertise helping to shape the conversation topics to discuss with the expert panel, to best fulfill the research objectives of the project.

The researchers' deepest gratitude goes to those without whose efforts this project could not have come to fruition: the expert panel participants and others for their diligent work overseeing questionnaire development, analyzing and discussing respondent answers, and reviewing and editing this report for accuracy and relevance.

Kathryn Bakos, BSc, MEB

Steve Bochanski, FSA, CERA, MAAA

Steve Bowen

Cindy Bruyere, PhD

Nina Chen

Sara Goldberg, FSA, MAAA

Sam Gutterman, FSA, CERA, FCA, FCAS, MAAA, HonFIA

Frank Horn

Li Liu

Alice McKenney

Max Rudolph, FSA, CFA, CERA, MAAA

Peter Sousounis, PhD

Lawrence Tsui, FIAA

Michelle Young (Chair), FSA, MAAA

Sahana Zutshi

At the Society of Actuaries Research Institute

R. Dale Hall, FSA, MAAA, CERA, Managing Director of Research

Rob Montgomery, ASA, MAAA, FLMI, Consultant - Research Project Manager

About The Society of Actuaries Research Institute

Serving as the research arm of the Society of Actuaries (SOA), the SOA Research Institute provides objective, data-driven research bringing together tried and true practices and future-focused approaches to address societal challenges and your business needs. The Institute provides trusted knowledge, extensive experience and new technologies to help effectively identify, predict and manage risks.

Representing the thousands of actuaries who help conduct critical research, the SOA Research Institute provides clarity and solutions on risks and societal challenges. The Institute connects actuaries, academics, employers, the insurance industry, regulators, research partners, foundations and research institutions, sponsors and non-governmental organizations, building an effective network which provides support, knowledge and expertise regarding the management of risk to benefit the industry and the public.

Managed by experienced actuaries and research experts from a broad range of industries, the SOA Research Institute creates, funds, develops and distributes research to elevate actuaries as leaders in measuring and managing risk. These efforts include studies, essay collections, webcasts, research papers, survey reports, and original research on topics impacting society.

Harnessing its peer-reviewed research, leading-edge technologies, new data tools and innovative practices, the Institute seeks to understand the underlying causes of risk and the possible outcomes. The Institute develops objective research spanning a variety of topics with its [strategic research programs](#): aging and retirement; actuarial innovation and technology; mortality and longevity; diversity, equity and inclusion; health care cost trends; and catastrophe and climate risk. The Institute has a large volume of [topical research available](#), including an expanding collection of international and market-specific research, experience studies, models and timely research.

Society of Actuaries Research Institute
475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
www.SOA.org