



Catastrophe  
and Climate

# Research Program Newsletter

Sponsored by the SOA Catastrophe and Climate  
Strategic Research Program Steering Committee

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## Focus on Terminology: Complex, Cascade, Cluster, Compound

By Max J. Rudolph, Steve Bowen and Matti Goldberg

For those actuaries who desire to become more active in climate awareness activities, there are times when language becomes an issue. Terms used for decades in each specialty may mean something different to the other group or may be confusing to the layman.

Terms and definitions may mature over time. This column will alternate between inconsistent terms, evolving terms and terms that need a few extra words or examples to become understood by all. It is a recurring feature of this newsletter, so please let us know ([max.rudolph@rudolph-financial.com](mailto:max.rudolph@rudolph-financial.com)) if you have a term that you think actuaries, climatologists and sustainability experts use in different ways from each other or from common use. Vocabulary awareness will lead to improved communications between these professionals.

### Insurer use of clustering of events

Enterprise risk management extends typical risk management practices by including interactions between risks and aggregation of risks to the parent company. Companies set risk appetite, tolerance and risk limits holistically, much in the same way that holistic medicine considers how different parts of the body and mind interact. Considering multiple events simultaneously or sequentially occurring becomes a necessity for capital planning, and complex interactions lead to complicated mathematical capital models. Examples of these risk combinations could include multiple instances of the same type of event (e.g., hurricane) occurring within the same geographic area in a short amount of time, an earthquake that occurs during a pandemic, or a war followed immediately by an energy shock. The risks may or may not be highly correlated but can result in consequential disruption and have financial implications that could impact solvency.

### IPCC definition - Complex, Compound and Cascading Risks.<sup>1</sup>

*Climate change impacts and risks are becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions. Some responses to climate change result in new impacts and risks.*

The IPCC defines compound risks as the interactions of hazards that affect exposed and systems or sectors<sup>2</sup>. Several IPCC definitions are included in the footnote.

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<sup>1</sup> IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Lösche, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Lösche, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33, doi:10.1017/9781009325844.001. [https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_SummaryForPolicymakers.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf)

Cascading impacts (WGII) - Cascading impacts from *extreme weather/climate events* occur when an extreme *hazard* generates a sequence of secondary events in natural and *human systems* that result in physical, natural, social or economic disruption, whereby the resulting impact is significantly larger than the initial impact. Cascading impacts are complex and multi-dimensional, and are associated more with the magnitude of *vulnerability* than with that of the hazard (modified from Pescaroli and Alexander, 2015).

Compound risks (WGII) - arise from the interaction of *hazards*, which may be characterised by single extreme events or multiple coincident or sequential events that interact with exposed systems or sectors. <https://apps.ipcc.ch/glossary/>

<sup>2</sup> IPCC considers risk to be a result of a combination of hazard (physical climate impact), exposure (being in a location of setting potentially affected by a hazard), vulnerability (sensitivity to the hazard and lack of adaptation)

## Summary

The IPCC defines the terms complex/compound/cascading as the layman might, with compound focusing on interactions and cascading to describe impacts to various locations and sectors impacted by climate change (e.g., agriculture, energy). Where this might differ from the use of these terms by insurers is that the IPCC views climate change as the main driver of the outcome; where an insurer or risk manager might also consider instances where another risk impacts climate change. An example would be a war, where heavy use of fossil fuels would release greenhouse gases and accelerate global warming. Another potential difference is that while the insurer's usage focuses on complex interactions of events, the IPCC's definitions implies that compound risks involve interactions between multiple hazards combined with exposures and vulnerabilities of human and ecological systems.

The groups each need to be aware that these terms have nuances that vary by user so making sure the meaning is clear at the beginning of a project or article is important. By Seeking out terms that need clarification, actuaries can help to improve the overall process as well as improve their own work product.

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## New Guidelines by Canadian Federal Agency

### Climate Risk Management – Guideline B-15

*By Aadit Sheth, FSA, ACIA, CERA*

Over the last few years, regulators globally have started addressing climate-related risks and the threats it poses to financial institutions by integrating climate-related risks into financial disclosures. In March 2023, the Office of the Superintendent of Financial Institutions (OSFI) published the final [Guideline B-15: Climate Risk Management](#), which establishes their expectations for the management and disclosure of climate-related risks. OSFI is the Canadian federal government agency that regulates and supervises banks, insurance companies and private pension plans in Canada. This guideline is OSFI's first prudent framework that recognizes the financial vulnerabilities to banks and insurers from both physical and transition risks. From a Canadian perspective, this is timely given Canada's corporate emission reduction targets are the poorest amongst the G7 countries<sup>3</sup>; based on the ambition level in 2022, Canada is looking at a 3.1 Celsius rise compared to the 1.5 target per the Paris Agreement. In addition, all 5 large Canadian banks made the list of the top 20 oil and gas funders globally<sup>4</sup>, which accentuates the importance of OSFI's B-15 guideline.

Similar to other regulatory frameworks, the guideline leverages heavily on the TCFD framework and emphasizes the importance of ensuring financial resilience for the federally regulated financial institutions (FRFIs). The recently released guideline comprises of two chapters: (1) the governance and risk management expectations and (2) the

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<sup>3</sup> [https://cdn.cdp.net/cdp-production/cms/reports/documents/000/006/544/original/Missing\\_the\\_Mark\\_-\\_CDP\\_temperature\\_ratings\\_analysis\\_2022.pdf?1662412411](https://cdn.cdp.net/cdp-production/cms/reports/documents/000/006/544/original/Missing_the_Mark_-_CDP_temperature_ratings_analysis_2022.pdf?1662412411)

<sup>4</sup> <https://www.bankingonclimatechaos.org/#sector-panel>

climate-related financial disclosures. It is worth noting that the Guideline is expected to evolve with sections within chapters potentially developing into additional chapters. It was also made clear by OSFI that they intend to align the guideline with the International Sustainability Standards Board's (ISSB) IFRS S2 climate-related disclosures guideline, which is expected to be published in the coming months.

In terms of the actual guideline, **chapter one** is sub-divided into five key principles illustrating OSFI's risk management and governance expectations from FRFIs. One of the guiding principles relates to an appropriate governance and accountability structure, where senior management take responsibility for the FRFI's climate risk management strategies. Within the theme of governance and strategy, another principle within the guideline talks about the FRFI incorporating the implications of physical and transition risks to the overall business model. This is not limited to just identifying and understanding the impacts of climate-related risks, but also involves developing and implementing a transition plan to a lower greenhouse gas economy. The next principle discusses the integration of climate-related risks into the FRFI's risk appetite and ERM framework; this involves identification, measurement, management and monitoring of the impacts from climate-related risks to the FRFI's portfolio of exposures over both short- and long-term horizons. The penultimate principle relates to scenario analysis and OSFI expects FRFIs to assess their exposure to risks under a range of climate scenarios (including severe, yet plausible scenarios). In addition to exposure assessment, FRFIs must also evaluate the financial resiliency of its organization's strategy and business model- this includes assessing the likelihood of attaining its transition goals under severe scenarios such as NGFS's "hot house world" scenario. Lastly, the fifth principle expects FRFIs to maintain sufficient capital and liquidity buffers for its climate-related risks. This final principle can be viewed as an overall implication of the prior principles; once the FRFI has appropriate governance and has identified its key exposures from climate-related risks, it must manage and measure the impacts to its financial and solvency position under various adverse-yet-plausible climate scenarios.

The **second chapter** focuses on the climate-related financial disclosures that OSFI expects from the FRFIs. These primarily align with the TCFD framework and aim to encourage FRFIs to continually evolve and elevate the quality of its climate-related financial disclosures. At a high-level, the principles within this chapter mandate that FRFIs disclose relevant and pertinent information, which is specific, comprehensive, unambiguous, understandable, reliable and timely. OSFI stresses that "there is no one-size-fits-all approach for managing climate-related risks given the unique risks and vulnerabilities that will vary with a FRFI's size, nature, scope and complexity of its operations, and risk profile"- hence it is left to the FRFI to judge its own impact and disclose appropriately. In terms of timelines and effective dates, OSFI's B-15 guideline will be effective fiscal year-end 2024 for the Domestic Systemically Important Banks (DSIBs) and Internationally Active Insurance Groups (IAIGs) headquartered in Canada. For all other FRFIs, the guideline will become effective at fiscal year-end 2025. The format for the disclosures is expected to be flexible and in the format that best suits the FRFI.

Despite the guideline being a major first step in the right direction within the Canadian financial industry, there are several gaps which are worth pondering upon. One significant gap is that the current guideline does not require third-party verification or audit of the FRFIs' climate-related financial disclosures. FRFIs could very easily decide their own "materiality limit" and eliminate financially material impacts to the organization. Apart from the misstatement of financial disclosures, accuracy of the embedded climate risk is paramount; Canada's relatively late requirement (compared to other jurisdictions) for climate-related financial disclosures exacerbates the risk that inaccurate information could have on the overall Canadian financial system.

One other down-side with the guideline is the lack of prescribed scenarios for the FRFIs. No mandate on required scenarios again provides flexibility to the FRFIs to run and illustrate scenarios which result in milder financial impacts. With the increasing frequency and severity of extreme climate events, we could be living through a disorderly transition scenario right now. If OSFI were to prescribe scenarios, the adequacy of the extreme scenarios

could be assessed on an industry-level, which would ensure the suitability of the scenarios. All in all, prescribed scenarios are one way to guarantee more meaningful and comparable disclosures.

Further on, a few disclosure requirements within the B-15 guideline currently remain TBD. For instance, the FRFI's climate transition plan and financial resiliency assessment of the FRFI's strategy having considered scenarios which limit warming to 1.5 degree Celsius currently do not have expected effective disclosure dates. The climate transition plan is a key governance component of the guideline and is a vital indicator of how the FRFI plans on adapting and mitigating both the physical and transition risks posed by climate change.

Another potential issue which has been heavily debated with climate-related financial disclosures (not specific to B-15 only) is that the guidelines laid out focus heavily on protecting banks and insurers from climate-related risks, but do not do enough on protecting the climate and nature from the wrongdoings of financial institutions. This harmonizes well with the Canadian financial system where FRFIs remain heavy funders of fossil fuels.

In conclusion, there are differing views on climate-related disclosures; some believe this is a "wasteful distraction," while others see this as a turning point within the climate-finance space. After all, OSFI's guideline is not going to solve climate change, but the hope is that the long-awaited B-15 guideline will establish climate-centric principles within financial institutions and protect the Canadian financial system from the adverse impacts of climate change.

## SOA Research Reports - Recent Releases!

Over the last three months SOA Research Institute published some very interesting analysis of recent extreme weather events, summary of the outcomes of the expert panel discussion on Catastrophe Cyber risk and research work focused on providing more practical and ready to use metrics, tools and techniques for Climate scenario Analysis and investments.

**Learn more about Climate Scenario Analysis and Investment** – Below is a quick introduction to two recent papers published on the topic, provided by *Timothy M.H. Cheng, ASA*

### Climate Risk Assessment and Scenario Analysis, February 2023

*By Robert Lee, FCAS, MAAA, Chris Beck, Judith-Anne Breliah, ASA, Blake Fleisher, Ryan Huff, Leighton Hunley, MBA*

Climate change is a broad and evolving topic – from natural catastrophes to rising temperature, from carbon tax to electric vehicles, we can really talk all day on this. How to consolidate these trends, risks and impact to businesses in a systematic way?

Working with the [Milliman](#) Team over the past months, we are very excited to share our latest research on Climate Risk Assessment and Scenario Analysis. This report aims to provide an iterative approach to building a model for climate scenario analysis, which takes the form of a Bayesian Network. Although it may sound technical, you will see many flowcharts, graphs and illustrations, so it is easy to follow the steps and build your own climate model for both narrative-based and data-driven analyses.

Many have asked me what sustainability means for actuaries – I believe this is definitely one of the starting points.

Read here for more details: [Climate Risk Assessment and Scenario Analysis | SOA](#)

### Climate Change and Investments: Making the process Transparent, February 2023

*Brian Kaul, Ed Toy, Kathy Huong, FSA, MAAA, Patricia Matson, FSA, MAAA*

Do you know that roughly 75% of Life and Annuity insurers in the U.S. reported that they have integrated ESG concerns into their investment processes in some form?

Over the years, climate change has changed how businesses operate, impacted government policies, and influenced individual consumption. As a result, various types of investments can be impacted by climate change and the associated risk ramifications.

To explore how insurers and asset management companies tackle climate change in their investment portfolios, we worked with Risk & Regulatory Consulting LLC (RRC) to publish a thought leadership report on climate change and investments.

The report will explore common metrics and assessment tools used by insurers and asset management firms, including Climate VaR, greenhouse gases (GHG) data and other in-house ESG measures. Popular changes in investment strategy like negative screening and ESG stewardship will also be explained.

[Climate Change and Investments: Making the Process Transparent | SOA](#)

## Actuarial Weather Extreme series

The group reviewed the weather data and published their analysis for couple of recent extreme weather events - Tornado in Mississippi at the end of March and extreme precipitation in Fort Lauderdale, FL in mid-April. Also, published an analysis examining the precipitation and snowfall totals across U.S. for the entire 2022-2023 Winter Season (November-to-February period) and explored the concept of Extreme-Value Theory applied to precipitation levels observed at Lambert Airport in St. Louis, Missouri in July of 2022.

### **Actuarial Weather Extremes Series Fort Lauderdale Florida Precipitation, April 2023, by Matthew Self**

This analysis examines the historical context of the record rainfall experienced on April 12 -13 in Fort Lauderdale, Florida which was hit by a slow-moving storm system that led to prolonged periods of very heavy rain and attempts to estimate the probability distribution of the annual maximum of daily precipitation observations for the respective weather station.

<https://www.soa.org/research-report/2023/cc203-actuarial-weather-extremes-april-2023.pdf>

### **Actuarial Weather Extremes Series Mississippi Tornadoes - March 24, 2023, by Matthew Self**

Using the two data sources Automated Surface Observing System (ASOS) and the National Oceanic and Atmospheric Administration's (NOAA) Storm Events database, this paper examines the historical frequency of violent tornadoes in March in both Mississippi and the U.S. at large.

<https://www.soa.org/research-report/actuarial-weather-extremes-march-2023-mississippi-tornadoes.pdf>

### **Analysis of Total Snowfall and Precipitation from Nov 2022 to Feb 2023 Across the United States, by Patrick Wiese**

*This analysis examines precipitation and snowfall totals across the entire November-to-February period which, in this report, we refer to as the "2022/2023 winter season". Data for this period was ranked against data from prior winters, focusing solely on weather stations with at least 50 years of historical data. The results were plotted on maps, revealing that much of the Western U.S. and parts of the Midwest experienced relatively high snowfall and/or precipitation across winter 2022/2023, with some locations experiencing record highs. Conversely, much of the mid-Atlantic and the Southeast experienced relatively low precipitation or snowfall, with some locations experiencing record lows.*

<https://www.soa.org/research-report/snow-prcp-2022nov-2023feb.pdf>

### **Precipitation Analysis using Extreme Value Theory - March 2023, by Matthew Self**

*This paper sets out to apply the core concepts of Extreme Value Theory to the precipitation history of Lambert Airport in St. Louis, Missouri (STL). In July 2022, 8.6 inches of rain was recorded in one day, breaking the previous record of 5.6 inches. Previously, the Society of Actuaries Research Institute (SOA) reported on this extreme precipitation.*

*The analysis described in this paper can easily be applied to other time series: either a different station or a different weather variable, such as temperature. By following the methodology below and working through the accompanying workbook, any actuary can begin analysis of extreme weather observations.*

<https://www.soa.org/2023-precipitation-extreme-value-theory.pdf>

## Catastrophic Cyber Risk: An Expert Panel Discussion Series

Integration of technology and digital transformation within organizations has created technological interdependencies within and across organizations, such that the impact of cybersecurity incidents can cascade very quickly from organization to organization and across borders. Thereby creating potentially, a systemic risk, often contagious and frequently beyond the understanding or control of any single entity. This has implications for insurance companies, reinsurers, regulators, consumers, and society.

The goal of the Expert panel study is to take a multi-disciplinary, holistic approach to catastrophic cyber risk in this four-part series of discussions and subsequent reports.

<https://www.soa.org/resources/research-reports/2023/cat-cyber-risk>

### Red Teaming Analysis of a Catastrophic Cyber Attack on Critical Infrastructure An Expert Panel Discussion - Part 2, March 2023

This report is the second output of a series. It uses the red teaming methodology which is a combination of small tabletop exercises and related debriefings for selected scenarios. The objective of this panel discussion was to answer the question: *“What are the potential impacts of catastrophic cyber-attacks targeting a critical infrastructure (CI) sector, such as the power grid or communication, would have on the insurance industry, economy, and the nation?”* Within this, several research questions were stipulated:

- *What would be the impact of a catastrophic cyber incident targeting a CI sector?*
- *What are the initial concerns and responses of the insurance industry, government agencies, and private sector in responding to a catastrophic cyber incident?*
- *How could public and private sector stakeholders collaborate to respond to a catastrophic cyber incident?*
- *What role would the insurance industry play in mitigating the effects of a catastrophic risk event affecting a CI sector?*

### Setting the Scene: Framing Catastrophic Cyber Risk An Expert Panel Discussion - Part 1, January 2023

This report is the first in a series of four to come. The goal of the discussion was not to reach a consensus but seek and identify all interpretations in the areas of interest. The discussion focused on three specific areas, including defining catastrophic cyber risk, how said risks are handled, and catastrophic cyber risk scenarios.



## In the News

By Priya Rohatgi, ASA

Here are some recent events that are at the intersection of Climate change, the evolving environmental risks and policy initiatives and regulatory framework to mitigate its impact. As you click through the articles below, we invite you to consider how these events may impact actuarial applications, and to note any associations to economic and insured losses.

### 1. Product Innovation – Turning up the heat

<https://www.bloomberg.com/five-financial-products-that-lower-the-risk-of-heat-waves?>

From heatstroke insurance for humans to policies that reimburse farmers for lower milk output, more financial products are addressing climate change.

[Here Are Five Ways Finance Is Trying to De-Risk Heat Waves](#), May 02, 2023

Despite these efforts to adapt, heat waves are putting [costly burdens on businesses and individuals](#). To meet this problem, some financial service providers have started to offer instruments aimed at reducing personal and economic risk associated with heat waves. From heatstroke insurance to plans that reimburse dairy farmers when cows are too hot to produce milk, this new wave of products may help communities build financial resilience to the impact from warmer temperatures.

[www.bloomberg.com](http://www.bloomberg.com)

### 2. Prepare for unexpected and unforeseen

<https://www.theverge.com/heatwaves-extreme-weather-climate-change-research-most-at-risk>

Every region of the world needs to prepare for unprecedented heatwaves, warns research published in the journal [Nature Communications](#).

[These are the places most at risk for a record-shattering heatwave](#), April 25, 2023

“The key thing that we find is that anywhere in the world could experience one of these heat waves beyond what is currently seen as possible from the observational record ... everywhere needs to be prepared for them.”

Crucially, they find that communities facing the most risk have never dealt with such extreme heat in the past. That means they might not be prepared to handle the consequences since emergency response plans tend to take shape after a similar disaster has already taken place.

“Anywhere in the world could experience one of these heat waves beyond what is currently seen as possible.” They’ve had no reason to adapt, to learn how to live with it yet,” says Vikki Thompson, lead author of the paper.

[www.theverge.com](http://www.theverge.com)

### 3. Keep Your Seatbelts Fastened – Turbulent air ahead.

<https://www.wsj.com/articles/turbulence-flights-injuries-safety>

Meteorologists predict more bumpy flights as climate change makes hard-to-detect clear-air turbulence more common.

[Heavy Turbulence on Flights Is Likely to Get Worse](#), April 18, 2023

Pilots and meteorologists say bumps are a normal part of flying. The Federal Aviation Administration is still investigating the Lufthansa flight. But meteorologists say climate change is distorting the jet stream, making a certain type of severe turbulence—called clear-air turbulence—more likely in the future.

Severe turbulence injuries are rare. Between 2009 and 2022, 163 people were seriously injured during turbulence, according to National Transportation Safety Board data. Flight attendants, who are more likely to be standing during flights, are most likely to get injured, the data show.

<https://www.wsj.com>

### 4. Climate by the numbers – NOAA’s Monthly Climate Report

<https://www.noaa.gov/freight-train-of-atmospheric-rivers-brought-record-rain-snow-in-march>

March was a turbulent month weather-wise across the United States, as a series of western storms brought record amounts of precipitation and tornadoes ripped through parts of the South and the nation’s midsection.

[Freight train of atmospheric rivers brought record rain, snow in March](#) April 10, 2023

Year to date | January through March 2023 - The average contiguous U.S. temperature for the year to date was 37.4 degrees F (2.3 degrees above average), ranking as the 20th-warmest such YTD on record. The average precipitation for the first three months of 2023 was 7.75 inches — 0.79 of an inch above average — ranking in the wettest third of the historical record.

[www.noaa.gov](http://www.noaa.gov)

### 5. Pollen in the air – Longer and more intense seasons ahead

<https://www.theatlantic.com/seasonal-allergies-pollen-climate-change>

Climate change is pumping the air with pollen, and it’s a problem even for people who don’t think they’re allergic.

[There's No Stopping the Allergy Apocalypse](#), May 03, 2023

Complaints about allergies arise every spring, but the symptoms really do seem to be getting worse. Blame climate change: Allergy seasons, says Kenneth Mendez, the CEO of the Asthma and Allergy Foundation of America, are “getting longer and more intense” because plants are producing more pollen over a longer period. The problem is not just that higher temperatures lengthen plants’ growing season; carbon dioxide *itself* encourages pollen production.

[www.theatlantic.com](http://www.theatlantic.com)

## 6. Innovative Bonds a Way to Gain Confidence

<https://www.ft.com/content/d53e4de1-bf87-4424-a3cd-8ad03680bbdb>

Sovereign issuers plan ‘sustainability-linked bonds’ as a way of trying to woo ethical investors.

[Climate penalties to be built in to more debt issuances](#), April 21, 2023

More countries are opting for new innovative bonds that impose penalties on issuer them for failing to meet climate change targets, in an effort to win over investors wary of issuers’ commitment to sustainability.

Such bonds offer higher payouts to investors if issuers fail to deliver on their nationally determined emission cuts under the Paris climate agreement. Adding such a green ‘slap on the wrist’ to national debt issuances could help ease fears that countries may backtrack on decarbonization pledges, say analysts, and also widen the pool of capital available to sovereigns with poor track records on sustainability.

[www.ft.com](http://www.ft.com)

## 7. Fungal infections are on the rise

<https://www.nationalgeographic.com/candida-auris-deadly-fungus-climate-change>

Candidas auris, which is spreading around the world, is difficult to detect and even harder to treat. Here’s what we know about it so far, and who’s at risk.

[A deadly fungus with mysterious origins is raising alarms](#), April 13, 2023

Early research suggests rising global temperatures, a byproduct of climate change, may have helped it evolve to live inside the human body. But the fungus’ origins remain a mystery—where it emerged and why it did so suddenly are still unclear.

Candida auris infected just over 2,300 people in the U.S. in the past year and has been spreading at an alarming rate according to the Centers for Disease Control. Today it’s been found in 28 states and the District of Columbia.

[www.nationalgeographic.com](http://www.nationalgeographic.com)

## 8. Shift in Philosophy – 3 big changes White house is proposing.

<https://heatmap.news/politics/cost-benefit-analysis-white-house-regulation>

Here are three big changes the White House is proposing.

[Why This White House Regulatory Overhaul is a Big Deal for Climate Policy](#), April 08, 2023

The White House proposed a major overhaul to the country’s guidelines for analyzing regulations and government spending on Thursday. The changes to an incredibly dense, wonky set of documents known as “Circular A-4” and “Circular A-94” would affect how government agencies, like the Environmental Protection Agency, measure the costs and benefits of decisions that have big implications for climate change, like power plant regulations, clean car rules, and highway expansion projects. The proposed guidance – Changing the discount rate, factoring in global impacts and equity-weighting.

[www.heatmap.com](http://www.heatmap.com)

## 9. Predict & Prevent

<https://riskandinsurance.com/predict-prevent>

If insurers and other entities don't fully apply the science of predicting and preventing losses, they may face unmanageable claims.

[Predict & Prevent™: How The Intersection of Technology and Resiliency Is Revolutionizing the Way We Manage Risk](#) April 07 2023

Looking at the balance sheets of insurance companies, it might seem unfathomable to some that accelerating losses in property and other lines could possibly outstrip coverage capacity. But the facts are that climate change, auto losses and other dangers are outrunning the reach of traditional risk transfer approaches.

More and more, risk managers and their partners, along with private and public sector leaders of all stripes, are talking about shifting resources to prediction and prevention. If we can stop a loss from ever happening, the reasoning goes, why not do so and sidestep the need to spend precious resources on insurance premiums and claims payments. For more checkout <https://www.predictandprevent.org/#about>

[www.riskandinsurance.com](http://www.riskandinsurance.com)

## 10. Neutral Spring

<https://www.noaa.gov/spring-outlook-california-drought-cut-by-half-with-more-relief-to-come>

Moderate to major spring flooding predicted along upper Mississippi River from Minneapolis to St. Louis.

[Spring Outlook: California drought cut by half with more relief to come](#) March 16, 2023

Spring Outlook for drought, temperature, and precipitation - On March 9, NOAA forecasters declared La Nina over. "ENSO-neutral - the transition period between El Nino and La Nina — is likely to continue into the early summer with elevated chances of El Nino developing thereafter. ENSO-neutral is factored into NOAA's Spring Outlook."

Above-average temperatures are favored for much of the southern and eastern half of the U.S.

NOAA forecasters predict above-average precipitation this spring across the Great Lakes, Ohio Valley, and into parts of the mid-Atlantic and Northeast. Below-average precipitation is most likely for the Southwest and parts of the Pacific Northwest.

Unlike the floods that hit California over the past few months, which were mostly due to torrential rain, spring floods are likely to come from rivers saturated with snowmelt overtopping their banks.

[www.noaa.gov](http://www.noaa.gov)

#### 11. Banana Index to Make Food Choices

<https://www.economist.com/a-different-way-to-measure-the-climate-impact-of-food>

Introducing The Economist's banana index

[A different way to measure the climate impact of food](#), April 11, 2013

Going vegan can dramatically cut the carbon footprint of your diet. But what about the fewer calories, and lower levels of protein, found in most plant-based foods when compared with meat? That makes it hard to compare emissions of meals that are equally nutritious.

To make the relative carbon impact of foods easier to digest, The Economist proposes a banana index (see our interactive chart below). It compares popular foodstuffs on three metrics—weight, calories and protein—indexed to the humble banana, a fruit of middling climate impact and nutritional value.

<https://www.economist.com>

#### 12. Insurtech and Innovative solutions

<https://riskandinsurance.com/insurers-embrace-evolutionary-ideas-to-address-climate-catastrophe>

Unique solutions created by innovative Insurtechs are helping to address climate catastrophe from various angles.

[As Floods Rage and Wildfires Roar, Insurers Embrace Evolutionary Ideas To Address Climate Catastrophe](#), March 31, 2023

Industry experts convened at the recent Insurtech Insights Europe event in London, held March 1-2, 2023. There is a protection gap in coverage that exists in many parts of the world, which also stresses communities, governments and individuals when catastrophic weather events strike.

Industry is now producing innovative solutions designed to help address the climate catastrophe from various angles. Read the article to learn about some of these innovative products.

The panelists largely agreed more education about insurance products — and greater availability of affordable products — could help reduce this gap.

[www.riskandinsurance.com](http://www.riskandinsurance.com)

### 13. One Size (does NOT) Fit All

<https://knowablemagazine.org/controlled-burns-california-wildfire>

We have two different landscapes with two very different fire regimes that require two very different management practices. That's really what we're trying to focus on, a researcher says.

[Controlled burns won't save all of California from wildfire](#), March 01, 2013

The common stories told about California's wildfire problem center on forest fires, where climate change and a buildup of burnable fuels from a century of intense fire suppression are the culprits. But there's another story to tell too, says Keeley. Wind-driven fires like the Thomas fire that strike California's chaparral landscape — shrub, grass and woodland common to the coast and southern region of the state — are also on the rise. For this type of fire, Keeley says, climate change and fuel aren't primarily to blame — rather, a growing population and faulty power lines.

Big, wind-driven wildfires used to strike once every 30 to 130 years or so, says Keeley; now it's every 10 to 15 years. And that's proving lethal to several native plants. Without time to recover between fires, whole landscapes are being transformed and taken over by invasive species.

<https://www.knowablemagazine.org>

### 14. Another Tick-Borne Disease is on the Rise

<https://www.forbes.com/what-to-know-about-babesiosis-another-tick-disease-spreading-quickly-in-northeast>

A recent Centers for Disease Control and Prevention (CDC) study found reported cases of babesiosis, a parasitic disease transported by ticks known to cause flu-like symptoms and even be fatal, more than doubled in some states between 2011 and 2019 as it spread primarily in the Northeast and parts of the Midwest.

[What To Know About Babesiosis: Another Tick Disease Spreading Quickly In Northeast](#), March 22 2023

Babesiosis, or *Babesia microti*, passes from rodents to humans by blacklegged ticks, but the parasite can also be passed from mothers to fetuses in the womb, and through infected blood transfusions and organ donations.

A CDC study published last week found cases of babesiosis increased in the United States between 2011 and 2019 and became endemic, or consistently prevalent, in Vermont, Maine and New Hampshire, in addition to Connecticut, Massachusetts, Minnesota, New Jersey, New York, Rhode Island, Wisconsin, which were already endemic.

Of the 16,456 total cases of babesiosis reported to the CDC from 37 states between 2011 to 2019, the vast majority (16,174 cases) came from the 10 endemic states.

New York and Massachusetts had the largest number of reported cases of babesiosis between 2011 and 2019, with 4,738 and 4,136 total cases, respectively.

Vermont and New Hampshire had the lowest number of reported cases between 2011 and 2019, at 114 and 340 total cases, respectively.

<https://www.forbes.com>

**15. Sustainability for Actuaries**

<https://www.actuaries.digital/2023/04/03/actuaries-and-sustainability>

Social, economic and financial systems are increasingly being affected by environmental and societal risks, and by government measures taken to try to deal with these risks. As these risks increase, so does the likelihood and expected future impact of changes and government measures.

[Actuaries and Sustainability](#), March 22 2023

Authors: *Stephanie Wong and Jim O'Donnell*

Very important amongst sustainability risks is climate change, which is an existential threat to the social, economic and financial systems we rely on. Other sustainability impacts on actuarial work include:

- Environmental changes and resource limitations, which have implications for prices, economic growth, investment returns and liability reserving across all practice areas.
- The trend for businesses to be held to a higher social standard than previously.
- The expectation that businesses should contribute to broader societal objectives that recognize the importance of health, education, poverty reduction, the natural environment (embodied in concepts such as a 'social license to operate' or 'stakeholder capitalism').

<https://www.forbes.com>

**16. Could we be Next?**

<https://www.theguardian.com/bird-flu-peru-sea-lions-suffer-death-beach-aoe-h5n1>

Avian flu has decimated the marine creatures on the country's Pacific coastline and scientists fear it could be jumping from mammal to mammal.

[First birds, now mammals: how H5N1 is killing thousands of sea lions in Peru](#), March 21, 2023

The outbreak of highly pathogenic avian influenza subtype A, the (HPAI) H5N1 variant, was first detected in Peruvian pelicans on the northern coast in November but soon spread south, killing Peruvian boobies, sanderlings and Guanay cormorants. Sernanp has counted at least 63,000 dead sea birds in national parks and protected guano islands, many more can be seen strewn along the country's coastline, home to one of the world's richest fisheries. Infected birds wobble along public beaches unafraid of the crowds of beachgoers enjoying the summer sunshine.

"The fact that the virus is not only in birds but also in mammals means it is potentially risky for the public," says Ayala. "It is currently being seen in different species of mammals, so we must take precautions in order to avoid another pandemic for humans."

The virus has spread to 15 countries in the Americas but Peru has seen the biggest mortality in mammals.

<https://www.theguardian.com>

### 17. Sick Plants Driving Crop Yields Lower

<https://www.axios.com/2023/02/09/plant-health-food-insecurity>

It might not be obvious why the health of plants is a contributing factor to food shortages in developed countries. But there's a direct connection — when they're diseased, there's less food to go around, and food prices rise accordingly. A heady cocktail of climate impacts mixed with conservation failures is contributing to the problem.

[When plants get sick, we do too](#), February 09, 2023

Declining plant health could mean increased food prices for already constrained American consumers; experts tell Axios.

The relationship between crop production and food security in developing countries has been well established, but the impacts on wealthier nations, where food insecurity is more of a social problem, have been less clear. The U.S. isn't "immune" to the impacts of declining food production, per the CDC.

Warming temperatures fueled by climate change are increasing the risk of plant pathogens and pests spreading into new ecosystems.

Plus, higher temperatures add extra stress on plants, which can make them more vulnerable and severely impacted by diseases and destructive insects.

<https://www.axios.com>

### 18. Model Forecasts get a Reality Check

<https://www.economist.com/extreme-weather-events-are-getting-more-frequent>

Meteorologists are trying to work out just how common they will become.

[How to predict record-shattering weather events](#), February 08, 2023

As the world gets hotter, phenomena once considered rare are becoming common and others, believed impossible, are happening.

This shift in weather patterns has inspired modelers to pay more attention to the tails of the frequency distributions of meteorological possibility which their models generate (see chart), in search of such unprecedented extremes.

<https://www.economist.com>



## Studies/Research Published Outside the SOA

By Priya Rohatgi, ASA

In this section we try to direct our readers to some of the work done by fellow actuarial societies and other professional associations/institutions in the U.S. and around the world. The risks related to climate instability and loss of biodiversity are not only global in scale but are long term, uncertain and highly complex. Therefore, we feel the need to collaborate, share knowledge and tap into the research and developments that are happening around the world and across disciplines.

Here I have added two recent research works published by Casualty Actuarial Society. The report abstracts indicate the technical nature of the research. In addition, entertaining yet informative and engaging is Bloomberg Green's Original show 'Getting Warmer with Kal Penn'.

### Climate, Spatial Dependence and Flood Risk: A U.S. Case Study, December 2022

By Robert J. Erhardt Ph.D., ACAS, Mathieu Boudreault, Ph.D., FSA, FCIA, David A. Carozza, Ph.D. and Kejia Yu, MA,

[https://www.casact.org/2022-12/RP\\_ClimateSpatialDependence\\_FloodRisk.pdf](https://www.casact.org/2022-12/RP_ClimateSpatialDependence_FloodRisk.pdf)

### Spatial-Temporal Modeling of Wildfire Losses with Applications in Insurance-Linked Securities Pricing

By By Hong Li, Ph.D., and Jianxi Su, Ph.D

[https://www.casact.org/sites/default/files/2023-01/RP\\_SpatTempModWFire.pdf](https://www.casact.org/sites/default/files/2023-01/RP_SpatTempModWFire.pdf)

### Bloomberg ORIGINALS, Getting Warmer with Kal Penn

<https://www.bloomberg.com/originals/series/getting-warmer-kal-penn>

## COMING UP...

### Catastrophe & Climate Research Virtual Discussion, June 21, 2023

The Society of Actuaries (SOA) Research Institute will host a virtual open house on **Wednesday June 21, 2023**. This is an interactive session with the primary goal of connecting with our audience to better understand their needs and share the latest research sponsored by the SOA Research Institute.

Look out for the emails that will be coming out soon. Thanks, and we hope to see you there.

## 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 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.

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