



Catastrophe
and Climate

Research Program Newsletter

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Focus on Terminology: 100-year floods

By Max J. Rudolph and Steve Bowen

For those actuaries who desire to become more active in climate awareness activities, there are times when language becomes an issue. Terms that have been used for decades in each specialty are used in ways that mean something different to the other group or are 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 commonplace in the actuarial space and understood by all. It is a recurring feature of this newsletter, so please let us know (max.rudolph@rudolph-financial.com) if you have a term that you think actuaries, climatologists or people working in sustainability areas use in different ways from each other or from common use. The hope is that having vocabulary awareness will improve communications between professionals.

By focusing primarily on flood events in this essay, we will stay within a topic most people have some familiarity with. Hopefully, the explanation that follows will clarify the term for the next time it comes up.

100-year flood: the issue

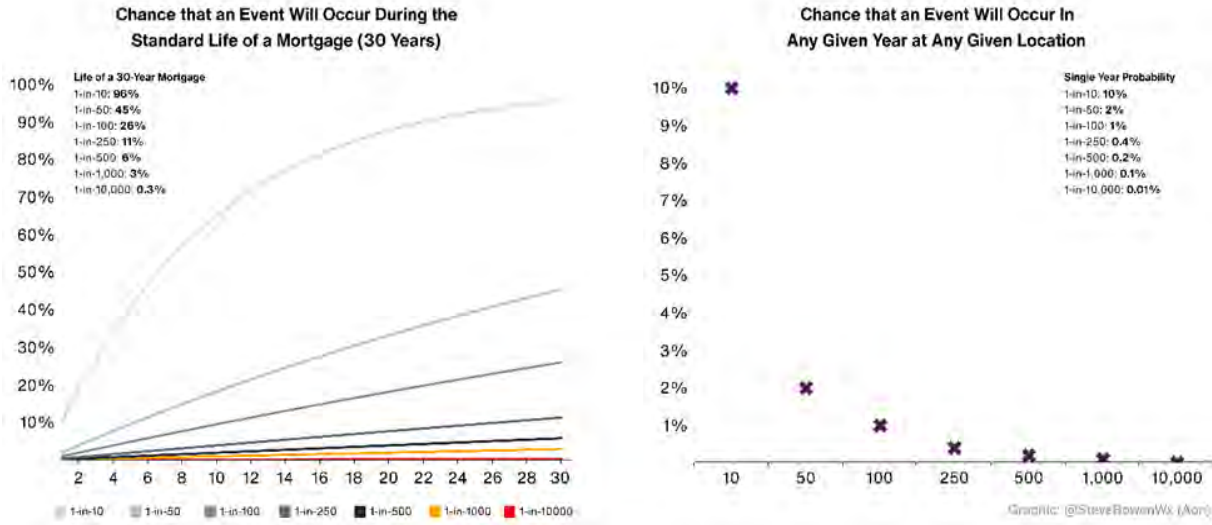
Before thinking about the frequency of a flood, it's important to differentiate between the flood and what caused it. A 100-year storm (measured by rainfall or maximum wind speed) does not automatically become a once per century flood, and a region susceptible to flood due to recent events could find a less extreme event inflict a severe flood. Recent rains, drought, a new dam or changing infrastructure upstream can make a flood more or less likely.

Scientists and statisticians have a specific meaning when they say something has a 1% probability or once in a century event (a similar discussion would surround once in a decade, millennium, etc.). The nuances of such a statement tend to be lost on the layman, so let's take a look at what might be confusing. We'll ignore longer term cycles that exceed our ability to track historical data (e.g., in North America data has been collected for only 2-5 centuries).

An event with a 1% probability has typically been calculated using historical data, occurring at a specific location and time over a long data collection period about once every 100 years. If you have 10,000 years of data, the event has occurred about 100 times and the recurrence interval is 100 years. $100/10,000 = 1\%$

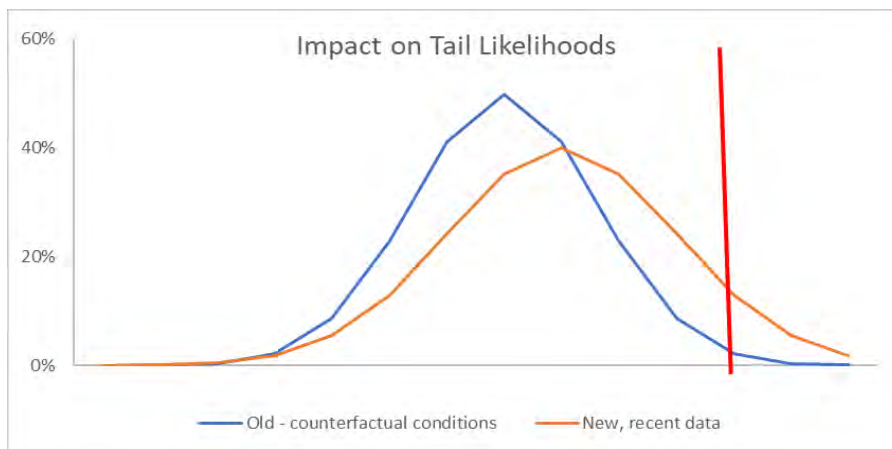
In the statistician's mind, these events are independent so he/she would not be surprised to see events two years in a row, or not at all for 400 years. It is only over long periods of time that the probability is estimated. Note that earthquakes are modeled differently, as the pressure building on tectonic plates makes the interval between events somewhat dependent on the time since the last event.

Another way to clarify 1% probability events, and put it in an insurance/investor context, is to consider how likely the event is to happen over the life of an asset. A new homeowner, buying in an area that has a 1% annual chance of flooding, is very likely to experience a flood during their lifetime. If investing in a mortgage for a commercial property, a 1% annual likelihood of flooding may correspond to about 25% likelihood over 30 years. Examples may help someone understand the risk better than using statistical terms.



A rare event can be estimated over time periods less than a century by linearly extrapolating the annual probability of it occurring. On the other hand, the 10% example shown above demonstrates event independence as the cumulative likelihood is always less than the straight-line interpolation.

Due to climate change, many meteorological events are evolving. Many are increasing in both likelihood and severity. These are unknown knowns, where historical data is not predictive, but provide a basis for extrapolation that can be used for pricing and projection purposes. Perhaps a flooding event in a specific geographical region had an annual likelihood of 1% based on data collected from the recent past. Flooding from stronger convective storms or hurricanes may be anticipated based on attribution analysis that shows separate statistical distribution expectations prior to the industrial revolution and currently, with all points on the distribution moving to the right as greater intensity is expected.¹ Other differences could be due to economic development that reduces the natural hurricane protection from mangrove trees or rising sea levels that allow increased storm surge.



The difference in area under the curve beyond the threshold between conditions that would have prevailed had fossil fuels remained in the ground relative to a recent data set shows the increase in likelihood. Actuaries could also use, for example, data from 1980-2010 to represent prior conditions.

¹ Otto, Friederike et al. *Angry Weather*. Greystone Books. 2020.

A once in a century event that transpires more frequently than that either was random or needs an updated statistical distribution based on attribution analysis. Regular updates of flood zones and anticipated flooding events provide input to development and infrastructure plan discussions and influence estimates of future frequency and severity.

Summary

As actuaries interact with climate scientists, statisticians and the population at large, it becomes important for terms to be clarified so that public policy around infrastructure and safety measures reflect future expectations. Floods in many areas are becoming more frequent. Knowing if this is a random occurrence or a divergence from history due to increased storm severity or human development will lead to more effective mitigation and adaptation techniques.

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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“Mitigation of Climate Change” by Working Group III of the Intergovernmental Panel on Climate Change (IPCC)

By Sam Gutterman

The Intergovernmental Panel on Climate Change (IPCC), a body of experts convened by the United Nations, recently completed the last of three² broad and deep reports on climate change that form its Sixth³ Assessment (2021 and 2022). This report (the ‘report’), entitled “Mitigation of Climate Change” (63-page Summary for Policymakers, 142-page Technical Supplement, and 2,913 page full-report), can be found at: <https://www.ipcc.ch/report/ar6/wg3/>.

The aim of this report is to assess “the current state of knowledge on the scientific, technological, environmental, economic and social aspects of climate change mitigation”, reflecting knowledge gained since 2014, when the last global assessment was published. The experts of the IPCC detail the world’s shortfalls in its quest to limit warming to 1.5°C over pre-industrial levels, compared with 1.1°C now, unless rapid and deep emission cuts are achieved across all sectors, accompanied by massive changes to energy production, industry, transport, and consumption patterns.

At some point above that level, more dire consequences than recent heatwaves, floods, droughts, cyclones, and wildfires will occur. It underscores the urgent need for all countries to take action. The National Oceanic and Atmospheric Administration (NOAA) has estimated that last year in the United States alone, damages from weather and climate-related disasters totaled approximately \$145 billion, albeit not all due to climate change. The report provides information regarding the social, economic, and environmental dimensions of mitigation actions, as well as institutional, legal, and financial aspects.

Global net greenhouse gas emissions (GHG) during 2010 to 2019 were higher than any previous period in human history. The report findings indicate that current plans to meet Paris targets are seriously off track. The United Nations estimated in September that the Earth would be between 2.1° and 3.5°C warmer by 2100.

Looking to the next decade, governments and companies need to invest three to six times, roughly \$600 billion than they currently spend annually on clean energy and cutting emissions.

Need for negative emissions

The report warns that even in the best case, humanity is unlikely to eliminate all of its planet warming emissions. All scenarios limiting warming to 2°C or below include greatly reduced fossil fuel use, with unabated coal being completely phased out by 2050. Almost all models point to the need of negative emissions in the next several decades, which will remove billions of tons of carbon dioxide from the atmosphere each year by around midcentury.

The report considers the role of carbon removal technologies—ranging from planting trees and restoring ecosystems to absorb carbon dioxide, to more nascent technologies using chemical processes to trap carbon dioxide from the air. Based on approaches now in use, these have a limited role, possibly 10% of total emissions, to balance emissions from sectors known to be challenging to cut back, such as agriculture and aviation.

² The first, published in June 2021 entitled “The Physical Science Basis”, summarizing the current status of climate science. The second, published in February 2022, entitled “Impacts, Adaptation and Vulnerability” that evaluates humanity’s options for battling climate change, including ways of reducing GHG emissions. A summary of the second report was provided in the special April 2022 Newsletter; a summary of the first was prepared jointly by the International Actuarial Association and the IPCC and can be found at https://www.actuaries.org/iaa/IAA/Publications/Papers/Climate_Issues/IAA/Publications/Climate_Issues.aspx. 278 researchers from 65 countries participated in writing the third report.

³ Its first report was issued in 1990.

The world must remove as much carbon dioxide from the air as possible — while reducing emissions — if warming is to be limited to 1.5°C or even 2°C. Although most of the tools needed are available, we’re not deploying them at the scale needed to significantly cut carbon emissions. New technologies, like methods that suck emissions directly from the air, still have a long way to go before they can serve as a meaningful tool to cool the planet.

To have a 50% chance of avoiding more than 1.5°C of warming throughout the 21st century, global carbon emissions will have to reach net-zero by the early 2050s. To have a 50% chance of keeping warming below 2°C, global carbon emissions must reach net-zero by the early 2070s. For both, GHG emissions must peak by 2025.

Hope

Nevertheless, the report does provide some hope, although our margin for error is now quite small. It lays out possible strategies that can be undertaken. Over the past decade, many nations have adopted ambitious climate policies, scaled back plans for new coal plants, and used subsidies and regulations to expand renewable energy. The rate of growth in emissions has slowed in the 2010s compared with the 2000s. And earlier worst-case scenarios no longer appear probable.

Clean energy technology has advanced far more quickly than expected – for instance, since 2010, the costs of solar panels and lithium-ion batteries for electric vehicles have plunged by 85%, while the cost of wind turbines has fallen by more than half – allowing us a way to drastically cut our carbon emissions. They are now economically viable, cost-competitive and even cheaper than some fossil fuels. The amount of electricity generated by wind and solar is growing rapidly, about 10% of its energy in 2020, although there are still huge upfront costs for installation that add to the inequities of the renewable energy transition. Thus, many developing countries — particularly in the Global South — lag behind in the adoption of solar and wind power.

Climatic justice

Developed countries, on the whole, “have not managed to reduce GHG emissions substantially” over the past several decades, while the Asia and the Pacific countries have rapidly increased their share of global GHG emissions since 1990, particularly since the 2000s. With the exception of eastern Europe and west-central Asia, emissions growth slowed across all regions of the world in the 2010s as compared to the prior two decades. The slowing of global emissions growth was primarily triggered by substantial reductions of emissions growth in China. Emissions from fossil fuel combustion in the three developing regions of Asia and the Pacific, Africa and Latin America grew by 26% over the past decade, as compared to 260% growth in the prior two decades. The fossil fuel combustion emissions of developed countries shrank by about 10% over both periods.

However, the rate of emissions differs widely with income level within a country, with the wealthiest 10% of people being responsible for 34-45% of consumption-based household emissions. The report notes that this 10% is found on all continents.

There will be substantial reallocations in employment and financial dislocations, with job creation in some sectors and job losses in others, although the impact is expected to be relatively small for employment levels as a whole. In the developing world, governments still need to expand access to electricity and modern cooking fuels for hundreds of millions of the poorest people, which over the near term will only be possible by burning more fossil fuels. The report calls for a focus on climate finance at all levels: to target national-level policies, to address global inequity, and to support local communities.

A just transition – securing livelihoods and addressing inequalities while moving towards a low-carbon future – will be “essential to reducing climate risks and addressing sustainable development priorities”. Not only will it require rapid change, but also removing the underlying drivers of vulnerability and high emissions, taking into consideration the interests of different communities and cultures.

Energy, buildings and industrial

Continuing to operate existing fossil fuel infrastructure puts the world off track for staying under 1.5°C. Any newly built fossil fuel projects risk becoming a stranded asset, or being abandoned, which carries massive financial risk. The estimated losses from stranded fossil fuel infrastructure are projected to be between \$1 trillion and \$4 trillion from 2015 to 2050, in a 2°C scenario.

Improved energy efficiency in certain sectors has led to some decarbonization gains, with the energy needed to generate each unit of GDP falling by 2% annually. But these gains have been largely offset by increases in demand for goods and services. Similarly, annual gains of 0.3% in the carbon intensity of the global economy (emissions per unit of energy use) have been insufficient to offset rising demand.

It is essential to cut energy supply sector emissions to limit warming by radically changing the energy systems of the future. The largest share relates to the generation of electricity and heat. Emissions must be all but eliminated, even as demand increases, because all scenarios staying below 2°C involve increased electrification of buildings, transport, and industry.

Many economic activities can't be easily electrified. For example, batteries are still too heavy for most airplanes; many industries, like cement and glass, require extreme heat and currently burn coal or gas. Governments and businesses will have to develop new fuels and industrial processes.

In 2019, buildings accounted for 31% of the world's energy demand, 18% of electricity demand, and 31% of CO₂ emissions. Of these, 57% were from electricity and heat generation elsewhere and 18% emissions embodied in steel and cement, with only 24% from direct emissions on site.

Up to 61% of global building emissions could be cut by 2050. Energy efficiency policies contribute 42% to this potential reduction, renewable energy policies 9%, and "sufficiency policies" that help avoid energy, water, material, and land-use contribute 10%.

Industrial emissions, which accounted for 24% of GHG emissions in 2019, are expected to decarbonize slower than other sectors. "Industry has so far largely been sheltered from the impacts of climate policy and carbon pricing due to concerns for competitiveness and carbon leakage", with many stakeholders attempting to minimize change.

Cities

Urban areas produce a substantial and growing share of global GHG emissions. The world's top 100 highest emitting cities account for roughly 18% of the global carbon footprint. In 2015, total urban emissions – accounting for consumption and excluding aviation, shipping, and biogenic sources – were estimated at 62% of the global total. In 2020, this increased to roughly 67-72% of global emissions.

Most of the world's future urban population growth is expected to be in developing countries. Urban land area is expected to triple between 2015 and 2050. The construction of new infrastructure and upgrading or retrofitting existing systems through to 2030 will result in significant emissions, more than double 2010's annual resource requirements for raw materials by 2050, resulting in future carbon lock-in.

The report states that cities can only achieve net-zero emissions through deep decarbonization and systemic transformation. There is an urgent need to integrate mitigation and adaptation for cities to address climate change and withstand its effects, which will require substantial financing.

Benefits and personal contributions

The global economic benefits of limiting warming to 2°C exceed the cost of mitigation in most of the assessed literature. There are many co-benefits from tackling climate change. For example, “the economic benefits for human health from air quality improvement arising from mitigation action can be of the same order of magnitude as mitigation costs, and potentially even larger”, averting 2.4 million premature deaths annually.

The report uses a *avoid-shift-improve* framework to explore options for demand-side measures, through a combination of socio-cultural, infrastructural, and technological changes. In the transport sector, for example, emissions could be *avoided* by eliminating unnecessary travel to work; remaining journeys could be *shifted* from a car to a bus; and the bus could be *improved* by using an electric model.

The IPCC panel broadly evaluated how changes to daily activities and lifestyle could contribute to emissions reductions. For example, walking or biking instead of driving, shifting to sustainable diets that use less land and water, reducing food wastes and designing buildings that are more energy-efficient are examples of shifts. Cumulatively, such changes could contribute between 40% and 70% of emissions reductions by 2050. But these behavioral changes can only be effective if supported by institutions or governments.

Demand-side solutions require both motivation and capacity for change – motivation by people to change their energy consumption is generally low and insufficient unless embedded in structural and cultural change. How interventions or nudges based on how choices are communicated can shape their energy-related decisions and can make a difference.

Policy, strategies, and the Paris Agreement

The report estimates that taking the actions needed to keep temperatures below 2°C could reduce global GDP by 1.3% to 2.7% by 2050, when compared with sticking only to current national commitments. In addition, the report points out that these costs do not account for damage caused by climate change, or the sacrifices required for adaptation. Not adopting aggressive climate policies brings its own costs, including lost lives, livelihoods, destruction caused by extreme weather events, and lost productivity.

The strongest drivers of increased emissions from fossil fuel combustion are increases in per-capita GDP and population growth, responsible for emissions gains of 2.3% and 1.2% annually, respectively.

Although at least 90% of global GHG emissions are covered by climate targets, only 53% are covered by direct climate laws in 56 countries. In 2020, over 20% of global GHG emissions were covered by carbon taxes or emissions trading systems (ETS), although neither coverage nor prices have been sufficient to achieve deep reductions.

Many long-term strategies refer to net-zero emissions by 2050 or 2060, with one study estimating that 131 countries have adopted, announced or are discussing such goals, covering 72% of global emissions. More recent estimates indicate up to 88% of emissions are covered. Although the expansion of climate targets represents an important increase in climate mitigation momentum, the report indicates that net-zero emission targets in their current state vary enormously in scope, quality, and transparency, making scrutiny and comparison difficult.

Of all the climate policy instruments assessed, carbon pricing – including carbon taxes and ETSs – has been one of the most widely used and effective options to reduce emissions. As of May 2020, 30 carbon tax regimes and 31 ETSs were in effect or planned, covering 22% of annual global emissions. Despite this, both coverage and price are lower than needed for deep emissions reductions. In addition, carbon pricing has limitations – for example, in areas that are less sensitive to price incentives, such as energy efficiency, or for higher cost mitigation measures. In addition, carbon taxes are one of the least popular mitigation policy options among the public.

The report provides a ‘preliminary assessment’ of the Paris Agreement and the earlier Kyoto Protocol⁴. The former extended emissions goals to far more countries, enabling countries to set their own targets (nationally determined contributions, NDCs) for 2030 rather than establishing top-down ones. While international cooperation has helped to set a global direction of travel and helped cut emissions in many countries, “It remains to be seen whether it can achieve the kind of transformational changes needed to achieve the Paris Agreement’s long-term global goals.” In the meantime, an ‘implementation gap’ has developed. Implementing only to commitments through COP26 – in the absence of strong future mitigation later in the century – would likely result in warming of around 2.4°C.

Methane

It is usually carbon that is identified as the major culprit for climate change, primarily because it makes up a high percent of greenhouse gasses in the atmosphere and can remain there for several hundred years. However, methane is far more toxic (about 80 times), but only remains in the atmosphere for about a dozen years. Methane is not only the main component of natural gas, but also comes from sources such as landfills, agricultural operations, and wetlands. It is linked to the energy supply, particularly ‘fugitive’ emissions that escape from the production and transport of fossil fuels, accounting for as much as 8% of the world’s greenhouse gas pollution in 2019. The report states that 50% to 80% of these emissions could be avoided with current technologies.

The Global Methane Pledge, signed by over 100 countries, responsible for nearly half of global anthropogenic methane emissions, is an informal agreement to drastically reduce amount of global methane emissions. Its goal is to limit warming to 1.5°C. Unfortunately, according to NOAA, 2021 saw a record amount of such emissions, a move in the wrong direction. Current government commitments are insufficient to reduce emissions. The report indicates that if emissions aren’t curbed by 2030, limiting global warming to 1.5°C will be beyond reach.

Last thoughts

In chapter after chapter, the IPCC emphasizes that addressing climate change is not simply about replacing coal power with solar panels or exchanging an internal combustion engine car for an electric vehicle. It entails coordinated, comprehensive societal transformation.

The IPCC tells us we have sufficient knowledge and technology to make a difference. But despite more mitigation efforts by more governments, emissions continue to increase.

Many public officials and private investors have not shown sufficient appetite for the massive investments and aggressive social change it will take, to move the world away from its long reliance on coal, oil, and gas. Long-standing infrastructure and ingrained habits make it difficult to switch to more sustainable practices. For example, existing buildings were designed to be heated with gas; cities were built to be navigated by car; and much of the world depends on pipelines, power plants, and other infrastructure that cross borders, built to last for decades.

The scale needed is vast. The longer the delay, the shorter will have to be the energy transition. With each year that passes, shifts required to meet global climate targets become even more daunting. And a primary obstacle to expansive action remains political.

The upcoming decisions will prove difficult, as there are and will be many other worthwhile actions and programs. But it’s doable – we’re just not getting it done now.

⁴ The Kyoto Protocol led to reduced emissions in some countries, with those that took on binding Kyoto targets cutting emissions by around 7% on average over 2005-2012 relative to a no-Kyoto scenario.

SOA Featured Research Project

TCFD Best Practices

By Max J. Rudolph

The NAIC recently revised its climate survey tool to align with the TCFD (Task Force on Climate-Related Financial Disclosure) recommended framework. While many states have not yet opted in, current coverage is estimated at 80% of direct premiums written. Typical for NAIC documents, no estimate is provided for assets under management. Companies are asked to be in compliance by 2023 and do a good-faith attempt by November 2022. These filings will be publicly available.

The required information attempts to standardize responses to be consistent between companies and, while TCFD is a vast improvement over the previous NAIC survey, calculations such as carbon footprint tend to be a black box and lack transparency. Little consistency should be assumed between filings and the report seems to look backward rather than be predictive over an extended time horizon. A benefit to using TCFD is that the SEC is also going in this direction for publicly traded companies and is likely to move toward required calculations, so the NAIC will see improvements by default.

Coincidentally, the SOA recently completed a report summarizing the TCFD recommendations. PwC was the author and any company needing to complete TCFD will find it useful to familiarize themselves with the report and its three primary sections.

TCFD Framework

The initial section provides an overview of the TCFD Framework, separating disclosure requirements between governance, strategy, risk management, and metrics and targets. The TCFD website is also available for those interested in learning beyond a basic introduction.

There is unique guidance for banks, insurers, asset owners, asset managers, energy, transportation, materials and building, and agriculture, food and forest products. More companies in each of these specialties are pledging to participate each year. Differences by region and sector are provided.

In Section 2 that follows, practices are suggested that meet varying levels of disclosure. Each can be appropriate for a company based on size and complexity, considering spirit and intent of the framework.

The report goes on to consider specific company examples of TCFD approaches taken. A companion tableau program allows the reader to further investigate these companies.

You can find this report on the Research Institute tab of the SOA website, along with a link to the podcast that accompanies the report.

<https://www.soa.org/resources/research-reports/2022/tcf-best-practices/>.

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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.

Risk Factor™ launched by [First Street Foundation](#), a climate and technology nonprofit, working to make the climate risk more accessible to all and facilitate a better understanding of the environmental risk at the property -level from multiple perils across US. They have so far released two free online tools:

Fire Factor - *The First Street Foundation National Wildfire Model is a nationwide, behavioral wildfire model that shows a specific location's probabilistic risk of wildfire based on the vegetation, topography, and fire weather in the surrounding area. It considers the property's building materials, and distance to fire risk areas, and burnable materials, such as vegetation, to determine the risk of being impacted by wildfire.*

Flood Factor - *At a high level, this model will incorporate the four major contributors to flooding: tidal, rain, riverine and storm surge. By taking property level data, overlaying building footprints, and applying the flood hazard layers, it calculates the max depth of flood water reaching the building or center of an empty lot.*

Both these tools are powered by the first-of-its-kind methodologies analyzing wildfire and flood hazards, projects future climate scenarios, incorporates local controlled burning, and validates against satellite imagery and government records.

1. Are we over-reacting to Climate change?

Stuart Kirk, Global Head of Responsible Investments and the Research Division, made a short presentation that has generated a lot of controversy. Below is the link to the recording:

<https://www.youtube.com/watch?v=bfNamRmje-s>

2. Grim Outlook – Drought in the US West is expected to persist

<https://theconversation.com/grim-2022-drought-outlook-for-western-us>

[Grim 2022 drought outlook for Western US offers warnings for the future as climate change brings a hotter, thirstier atmosphere](#)

Much of the western U.S. has been in the grip of an unrelenting drought since early 2020. The dry spell has coincided with record-breaking wildfires, intense and long-lasting heat waves, low stream flows and dwindling water supplies in reservoirs that millions of people across the region rely on.

With a rapidly changing climate, we are entering unfamiliar territory. The world will need new ways to better anticipate future droughts that could transform natural and human systems.

www.theconversation.com

3. What to expect – 2022 Atlantic hurricane season

<https://www.noaa.gov/news-release/noaa-predicts-above-normal-2022-atlantic-hurricane-season>

Ongoing La Niña, above-average Atlantic temperatures set the stage for busy season ahead...

[NOAA predicts above-normal 2022 Atlantic Hurricane Season](#)

NOAA's outlook for the 2022 Atlantic hurricane season, which extends from June 1 to November 30, predicts a 65% chance of an above-normal season, a 25% chance of a near-normal season and a 10% chance of a below-normal season.

"Early preparation and understanding your risk is key to being hurricane resilient and climate-ready," said Secretary of Commerce Gina M. Raimondo. "Throughout the hurricane season, NOAA experts will work around-the-clock to provide early and accurate forecasts and warnings that communities in the path of storms can depend on to stay informed."

www.noaa.gov

4. Climate change and spread of infectious disease

<https://www.cbc.ca/news/climate/climate-change-diseases>

Cross-species virus spread will happen over 4,000 times among mammals alone due to migration.

[Climate change may increase risk of new infectious diseases](#)

Climate change will result in thousands of new viruses spread among animal species by 2070 — and that's likely to increase the risk of emerging infectious diseases jumping from animals to humans, according to a [new study](#).

This is especially true for Africa and Asia, continents that have been hotspots for deadly disease spread from humans to animals or vice versa over the last several decades, including the flu, HIV, Ebola and novel coronavirus.

Researchers used a phylogeographic model to examine how more than 3,000 mammal species might migrate and share viruses over the next 50 years if the world warms by 2 C (3.6 F), which recent research shows is possible.

www.cbc.ca

5. The Great Salinization...

<https://e360.yale.edu/features/salt-scourge-the-dual-threat-of-warming-and-rising-salinity>

As rising seas increase saltwater intrusion and soaring temperatures cause greater evaporation, scientists say that the mounting levels of salt in waters and in soils pose a major climate-related danger and could become a leading cause of climate migration globally.

[Salt Scourge: The Dual Threat of Warming and Rising Salinity](#)

Hotspots for climate change-induced salinization include Australia, Mexico, South Africa, the U.S. Southwest, and Brazil... www.e360.yale.edu

6. Climate Resilience Opportunity

<https://www.dig-in.com/capgemini-climate-change-resiliency-insurance-report>

[Only 8% of insurers are sustainability leaders, Capgemini](#)

Nearly three-fourths, 73%, of policyholders, consider climate change as one of their top concerns, with around 40% of insurers sharing this as a priority, according to The World Property and Casualty Insurance Report, published by Capgemini and Efma.

“Walking the Talk: How insurers can lead climate change resiliency,” addresses that while over 80% of small commercial companies have taken steps in climate resiliency within the past year, only 8% are identified as “resilience champions,” or leaders of sustainability and climate awareness. The report, which includes interviews with 270 insurance executives and about 5,000 consumers, emphasizes the effects of climate change on the insurance industry and identifies how insurers can approach climate resiliency, mitigate climate risks and integrate sustainability in corporate models.

www.dig-in.com

7. SEC rule and its transformative potential

<https://hbr.org/what-if-banks-had-to-disclose-the-climate-impact-of-their-investments>

[What If Banks Had to Disclose the Climate Impact of Their Investments?](#)

The U.S. Securities and Exchange Commission recently proposed a new federal rule requiring all publicly traded companies to disclose climate risks and carbon emissions. It’s meant to provide greater transparency to guide investor decisions. The proposed regulation is not a surprise in itself — it was broadly signaled and much anticipated. But whether the rulemaking is finalized into regulation or not, there’s a transformative impact that few realize. By covering U.S. publicly traded banks, this rule would, in one giant step, cover climate emissions across a major swath of the global economy.

www.hbr.org

8. Warmer temperatures and the risk of insufficient sleep

<https://www.theguardian.com/environment/global-heating-cutting-sleep-study-health-impacts>

Data shows people finding it harder to sleep, especially women and older people, with serious health impacts.

[Global heating is cutting sleep across the world, study finds](#)

Good sleep is critical to health and wellbeing. But global heating is increasing night-time temperatures, even faster than in the day, making it harder to sleep. The [analysis](#) revealed that the average global citizen is already losing 44 hours of sleep a year, leading to 11 nights with less than seven hours’ sleep, a standard benchmark of sufficient sleep.

The sleep loss per degree of warming is about a quarter higher for women than men, twice as high for those over 65 years old and three times higher for those in less affluent nations. The researchers used data from sleep-tracking wristbands used by 47,000 people over 7 million nights and across 68 countries.

www.theguardian.com

9. Attribution analysis – two new studies

<https://www.axios.com/2022/05/19/climate-change-india-heat-japan-typhoon>

Two new climate attribution studies underline the growing role human-caused climate change plays in worsening extreme weather events.

[Studies show climate change is increasingly driving extreme weather risks](#)

The [first study](#), out May 18 from the U.K. Met Office, shows that climate change has already made the stifling and record heat seen this spring in northern India and Pakistan 100 times more likely to occur.

The study examines the shifting probability of exceeding the record-breaking temperatures seen in April and May of 2010.

- It shows the probability of setting such records without human influence is about once in 312 years.
- But due to climate change, this has ballooned to once every 3 years.
- By the end of the century, this level of heat, with widespread temperatures at or above 120°F, may be an annual occurrence

Another [study](#) published recently examined one of Japan's most damaging typhoons on record, 2019's Typhoon Hagibis, which brought devastating flooding.

Threat level: The study, from researchers affiliated with the international World Weather Attribution effort, found that human emissions of greenhouse gases made the extreme rainfall as the storm made landfall 67% more likely.

- In a stark finding, the study concluded that the effects of climate change boosted the storm's damage by at least \$4 billion out of the \$10 billion in insured losses.

www.axios.org

10. E-liability accounting system

<https://hbr.org/2021/11/accounting-for-climate-change>

An alternative approach to measuring greenhouse gases...

[Accounting for Climate Change](#)

Corporations are facing growing pressure—from investors, advocacy groups, politicians, and even business leaders themselves—to reduce greenhouse gas (GHG) emissions from their operations and their supply and distribution chains. About 90% of the companies in the S&P 500 now issue some form of environmental, social, and governance report, almost always including an estimate of the company’s GHG emissions. The authors describe these as “catchall reports that are often made up of inaccurate, unverifiable, and contradictory data.” They propose a remedy: the E-liability accounting system, whereby emissions are measured using a combination of chemistry and engineering, and principles of cost accounting are applied to assign the emissions to individual outputs. The authors provide a detailed method for assigning E-liabilities across an entire value chain, using the example of a car-door manufacturer whose furthest-removed supplier is a mining company, which transfers its products to a shipping company, which transports them to a steel company, and so on until the car reaches the end customer. www.hbr.org

11. Hidden costs to life from climate-related disasters

<https://www.publichealth.columbia.edu/hurricanes-and-other-tropical-cyclones-linked-rise-us-deaths>

Landmark study in JAMA reveals potential hidden deadly cost of climate-related disasters to injuries, infectious and parasitic diseases, respiratory diseases, cardiovascular diseases, and neuropsychiatric disorders.

[Hurricanes and Other Tropical Cyclones Linked to Rise in U.S. Deaths from Several Major Causes](#)

In the U.S., tropical cyclones, such as hurricanes and tropical storms, have a devastating effect on society, yet a comprehensive assessment of their continuing health impacts had been lacking,” said Marianthi-Anna Kioumourtzoglou, ScD, assistant professor of Environmental Health Sciences at Columbia Mailman, and senior author. “Our study is a first major step in better understanding how cyclones may affect deaths, which provides an essential foundation for improving resilience to climate-related disasters across the days, weeks, months, and years after they wreak destruction.” www.publichealth.columbia.edu

12. Rising tick-borne diseases – multiple factors and competing theories.

<https://knowablemagazine.org/article/health-disease/2022/lyme-other-tickborne-diseases-rise>

The complex interplay of ticks, their habitats and hosts — along with changes in land use and climate — may be enabling the spread of the pathogens they carry

[Lyme and other tick-borne diseases are on the rise. But why?](#)

Scientists are working to disentangle a patchwork of drivers — such as land development, climate change and the availability of blood to suck from an array of different critters, large and small. All will have consequences for the number of ticks in a given area, as well as for the likelihood that a tick’s saliva will carry at least one of the 18 tick-borne pathogens identified in the US and the 27-plus known globally.

www.knowablemagazine.org

13. Permafrost - an icy shield

<https://knowablemagazine.org/article/physical-world/2022/race-against-radon>

Scientists are working to map out the risks of the permafrost thaw, which could expose millions of people to the invisible cancer-causing gas

[The race against radon](#)

Significant areas of Arctic and sub-Arctic ground contain permafrost — but today it is melting, and the rate of that thaw is accelerating. In a report published in January, Glover and coauthor Martin Blouin, now technical director at the mapping software firm Geostack, used modeling techniques to show that homes with basements built on areas of permafrost could be exposed to high levels of radon gas in the future. “As the permafrost melts, this reservoir of active radon can flood to the surface and get into buildings — and by being in buildings, cause a health hazard,” Glover says. www.knowablemagazine.org

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 US 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.

IAA Paper - Application of Climate-Related Risk Scenarios to Asset Portfolios

André Choquet (Lead), FCIA, FSA, CIM (Canada), Loudina Erasmus, AAG, FASSA (Netherlands), Paul Meins, FIA (UK), R. Dale Hall, FSA, MAAA (USA), Eileen Tay, FIA, FSAS (Singapore)

International Actuarial Association's (IAA) Climate Risk Task Force published its most recent paper, [Application of Climate-related Risk Scenarios to Asset Portfolios](#) this month. This is the fourth in the series, focusing on the impact of physical and transition risks to the asset side of the balance sheet while the earlier papers provided an overview of climate-related risk and how to assess the potential impact, focusing primarily on the liability side.

The key points of this paper are:

- *Scenarios and pathways available to actuaries to understand and integrate climate-related risks into the measurement and management of asset portfolios include the Representative Concentration Pathways (RCPs) from the Intergovernmental Panel on Climate Change (IPCC) and the energy emissions scenarios of the International Energy Agency (IEA). An analysis of the climate-forcing (physical risk) and emissions-reduction (transition risk) requirements is included in the Network for Greening the Financial System (NGFS) scenarios.*
- *Depending on the purpose of a climate-related risk assessment, actuaries advising asset owners could start with a bottom-up approach considering the exposure of individual investments to climate-related risks or a top-down approach modelling the impact of climate scenarios on macro-economic parameters. However, using both would provide a more complete picture.*
- *There are additional considerations by asset class, the main classes being bonds, equities, real estate and infrastructure. Difficulties in defining what is meant by "green" are highlighted. Efforts are made around the world to establish "green taxonomies" and to limit "greenwashing", where unjustified claims are made.*
- *Various risk measures and metrics have been developed in recent years, such as portfolio alignment, Climate Value-at-Risk and Implied Temperature Rise, but these need to be treated with caution at present as there can be a lack of transparency and comparability*
- *Case studies are provided to illustrate how climate-related risk scenarios are applied to asset portfolios, particularly in the context of life insurers, pension funds, general insurers and lending banks.*

Questions for Actuaries – New!

"Questions for Actuaries", this is a new section of the Newsletter starting 2022. Here we will be conducting a series of interviews with actuaries in different stages of their career, who are at the frontlines addressing Climate risk and managing the shift towards a more sustainable and resilient future for their respective organizations. Like many of us, if you feel overwhelmed by the pace of information in this domain, please keep an eye out for subsequent editions of our Newsletter. We hope you find answers to some of your questions and benefit from the experience of fellow actuaries in this evolving and exciting area.

Also, if you have questions that you would like us to include or if you would like to participate and share your own journey, please reach out to us at research@soa.org

For this edition, we reached out to Rémi Villeneuve, FSA, FCIA an actuary working in the area of agricultural insurance to learn from his perspective, the challenges and how this practice area is evolving and adapting to the risks of climate change. As it turns out, this is particularly well-timed as we are in the midst of global food crisis, further worsened by the War in Ukraine, persistent drought in US West and the current heatwave in India and Pakistan, significantly impacting the agricultural output. He is also a member of the SOA Catastrophe and Climate Strategic Research Program Steering Committee.

Could you please introduce yourself and share your background and practice area?



My name is Rémi Villeneuve, I'm the Chief Actuary of Agriculture and Agri-Food Canada. I've been working in agricultural insurance for about 15 years and spent few years as well in employment insurance after completing my fellowship in group benefits.

What prompted you transition into this new area of Climate risk and Sustainability and what was the path to your current role?

Well, I did not really transition into the area of climate risk and sustainability; Climate risk was already a predominant risk in agricultural insurance but as the climate is changing, climate risk and sustainability naturally became a high priority from both a risk assessment and a communication perspective.

Has the scope of your work expanded to incorporate these new risks/ practices or are you now focusing on completely new risks?

The scope has expanded to consider new climate risks. Until recently, the underlying assumption of agricultural insurance pricing was that historical climate patterns would reproduce themselves in the future. The challenge was to capture the appropriate number of years in the claim averaging to capture the vast majority of climate patterns and obtain a fair estimate of expected losses. Things are different now.

We can no longer fully rely on historical climate events to be representative of future patterns. Indirect impact of climate change should not be underestimated as well. Disturbances in worldwide agricultural production will affect supply and demand equilibrium, commodity prices, agricultural insurance liabilities and premiums. New

uncertainties on commodity prices makes us believe other agricultural insurance programs, like revenue insurance, should be explored to better mitigate price risks. More details on these concepts are presented in the article [“Agricultural Insurance Must Adapt”](#)

How relevant have been the classic actuarial skills, tools and techniques to your current role?

It is really fascinating to see how relevant classic actuarial skills and techniques are regardless of the challenge we’re facing. Stochastic simulations, modelling, stress testing, pricing techniques and communication, which is also a classic actuarial skill by the way, are essential skills and techniques to address climate risk.

What challenges have you faced in this area of work and how were you able to tackle them?

I guess the initial challenges were awareness and prioritization. We were concerned about climate change when it was still considered as a theoretical threat by stakeholders. We started slowly with concepts, stress testing and articles review to raise awareness to a point where more research and resources were deemed necessary to explore the implications of this growing risk. There is no doubt today with the vast majority of stakeholders that financial impact of climate change and resilience of agricultural insurance programs have to be assessed and we’re proud to say we started looking at this years ago when it was not yet a priority.

Are there any initiatives related to these emerging risks that you are engaged with at your organization or elsewhere that you would like to share? Are there any resources you would recommend that can help prepare the Actuarial community for these evolving risks?

The challenge with agricultural risk and climate change is to determine by how much the climate is changing the risk. We use to rely on historical losses to assess the loss profile of insurance programs but this might not work anymore. The initiative we’re involved in is related to agricultural risk and it is about using climate scenarios to simulate weather patterns, transpose them in commodity yields, financial losses and premium rates. This could make agricultural insurance shifting to a completely new paradigm where forward looking climate scenarios would play a more important role than observed historical climate patterns.

What skillset and mindset you would recommend to practitioners to succeed in such a role?

Be open to changing environments and be prepared to communicate innovative views even if they are partially based on your instincts. Actuaries are trained to support conclusions with analysis but sometimes we need to start working in a direction our instinct leads us.

Do not hesitate as well to frame your results in a long term strategy of risk mitigation as opposed to focusing only on short-term results.

“ Actuaries are trained to support conclusions with analysis but sometimes we need to start working in a direction our instinct leads us”.

What would be your advice to young actuaries who want to focus on Climate risk and Sustainability? Do you have a view as to how they should plan and prepare for such a career? Also, if you had to recommend a resource(s) for educational purposes what would that be?

Young actuaries with freshly acquired actuarial skills are best positioned professionals to transpose climate risk into potential losses, especially with predictive modelling. In agricultural insurance, where production practices evolves rapidly, it becomes critical to assess the effect of practices on risk to charge the right premium to program participants. That being said, some skills in climate modelling would certainly help young actuaries to use actuarial skills more efficiently and offer the best combination of talent to employers concerned with climate change.

What can actuaries do to proactively engage with the stakeholders to improve assessment and management of climate related risks?

Highlight the financial impact of climate risk to stakeholders. Potential losses of \$1B speaks more than a 1° increase in temperature.

“Potential losses of \$1B speaks more than a 1° increase in temperature”.

How do you see the role of practicing actuaries in US and Canada evolve over the next 3-5 years?

Institutions and public companies will likely have to demonstrate to regulators in a near future how they are prepared to handle climate change risk and actuaries will have a key role to play in this new discussion.

In what ways can the actuaries support or facilitate the transition to net-zero, sustainable and resilient economy?

At a glance, this sounds out of scope of the actuarial profession; but when we think about this question further we realize quantifying losses the economy is exposed to with climate change is the strongest argument to transition towards a more resilient economy. The core skill of actuaries, to prepare a probabilistic view of loss and uncertainty, will be essential to this enterprise.

Also if you are interested in learning more on the topic of agricultural/crop insurance, please check out the SOA research published last year [*Projected Changes in Insurability and Affordability of Insurance Coverages due to Climate Change*](#) – “The research leverages multiple studies to analyze the impact of climate change on crops and U.S. agricultural productivity, and the associated implications for crop insurance pricing, including the Federal Crop Insurance Program (“FCIP”), with emphasis on the Midwest region of the United States. A case study was conducted of the Midwest region, which included modeling crop insurance prices and forecasting projections of those prices into the future. Researchers also looked into the potential impact of new innovations on crop insurance, including Blockchain, FarmersEdge, and Index Insurance”.

Glossary

By Priya Rohatgi, ASA

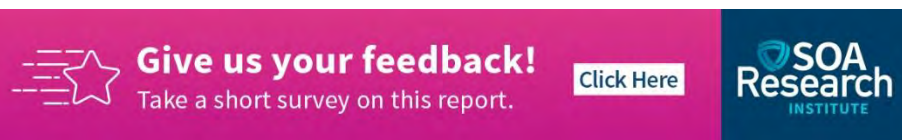
In this section we explain terms that appear across climate research and related news articles. You might be familiar with some of them as they are probably common to your practice area or have seen it a number of times recently but would be good to add to our repository. In addition, we'll also direct you to the resources that we feel can be helpful in enhancing our understanding of Climate modeling, science and other related phenomena.


The recent IPCC WGIII Report was released and came along with the glossary section and addenda that we feel are great sections to keep handy.


Glossary - https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_Annex-I.pdf

Definitions, Units and Conventions - https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_Annex-II.pdf

Scenarios and modelling methods - https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_Annex-III.pdf



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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.

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