Catastrophe and Climate

SOCIETY OF ACTUARIES

Research Program Newsletter

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Focus on Terminology: Can sequestration be harmful? Sink

By Max Rudolph, Dr. Jesse Bell 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. Terms and definitions may mature over time. This column will rotate between inconsistent terms, evolving terms and terms that need a few extra words or examples to become commonplace in the actuarial space. It likely will be a semi-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 use in different ways. The format will be to introduce and define commonly used terminology used in multiple fields that need to work together. The hope is that having vocabulary awareness will improve communications between these professionals.

Intergovernmental Panel on Climate Change (IPCC) definition - Sink

A reservoir (natural or human, in soil, ocean, and plants) where a *greenhouse gas*, an *aerosol* or a *precursor* of a greenhouse gas is stored. Note that *UNFCCC* Article 1.8 refers to a sink as any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the *atmosphere*. See also *Uptake*.[1]

Actuarial clarification – Sink

Per Client Earth,[2] A carbon sink is anything that absorbs more carbon from the atmosphere than it releases – for example, plants, the ocean and soil. In contrast, a carbon source is anything that releases more carbon into the atmosphere than it absorbs – for example, the burning of fossil fuels or volcanic eruptions.

The IPCC definition gives the impression that sequestering carbon in any of these sinks has a positive outcome. This doesn't seem to be true for the oceans. More carbon acidifies the oceans, making it harder for marine life like shellfish to form their shells, and the oceans themselves are warmer.

From the climate scientists

This is very complicated, and research continues the topic. A carbon sink in the oceans is still not entirely well understood. The strength of circulation patterns can play a huge role in how much CO_2 the oceans absorb, and recent research from UNESCO suggests that the oceans may start to have a net-plus emission of CO_2 in the future.

https://unesdoc.unesco.org/ark:/48223/pf0000376708

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[1] IPCC, 2018: Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press https://www.ipcc.ch/sr15/chapter/glossary/

[2] https://www.clientearth.org/latest/latest-updates/stories/what-is-a-carbon-sink/

https://www.carbonbrief.org/scientists-solve-ocean-carbon-sink-puzzle

If oceans do start to absorb even more CO_2, that could end up having dire effects on underwater ecosystems – or at least cause an imbalance that severely disrupts the system. Acidification would be the main concern.

Summary

As actuaries become more aware of climate risk and modeling, they will find much in common with their own modeling work. The most important is that models are proxies that are constantly being improved. At this point the mathematical models are not as sophisticated as are found for the atmosphere, but there are groups working on this today.

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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Dr. Jesse Bell is the Claire E. Hubbard Professor of Health and Environment at the University of Nebraska Medical Center.

Steve Bowen is a Meteorologist and the Head of Catastrophe Insight at Aon.

NEW! Looking beyond the obvious: The knock-on effects of changes in climate and weather patterns

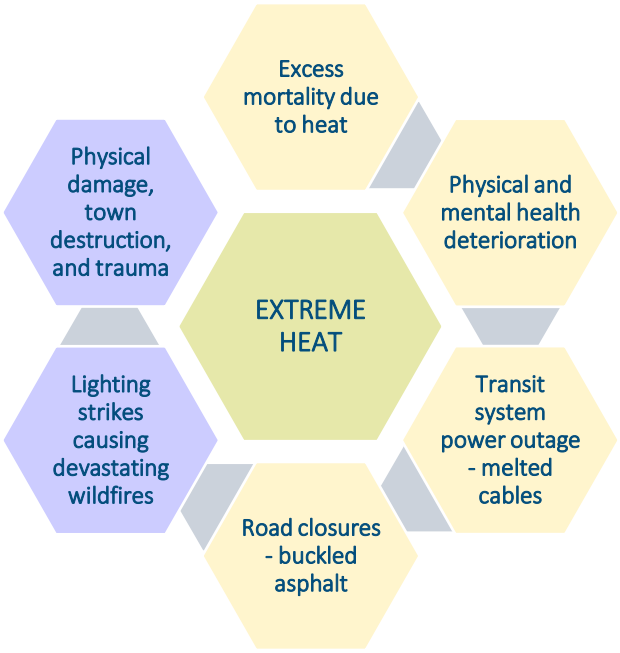
By Didier Serre, FSA, MSc

The frequency and intensity of extreme weather events is on the rise in some parts of the world. What we also observe is a proliferation of longer-term second- and third-degree effects (or "knock-on" effects) and compound effect which are causing additional physical damage, loss of lives and disruption beyond the first-degree impact of the initial, time-defined acute weather event.

In this NEW newsletter section, we look in greater details at a global extreme weather event which made the headlines in the prior quarter and analyze how changes in climate and weather patterns upstream can have downstream consequences, now and in the future. Climate-related risks are **complex** and **inter-connected**; understanding their direct and indirect impact, and potential for **compound** effect, is thus foundational to managing these risks **holistically** and improving societal resilience.

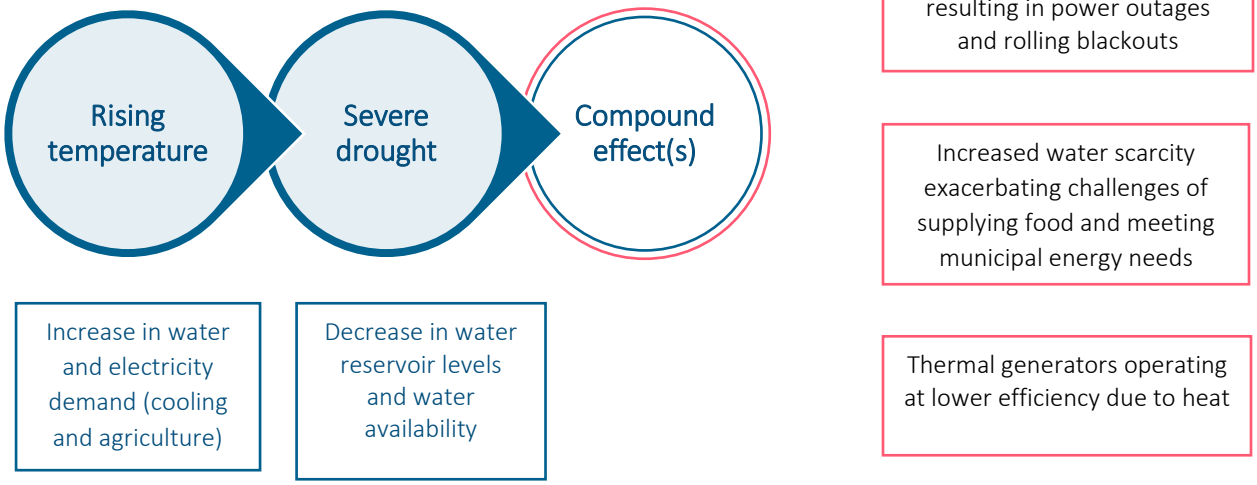
What: Historic extreme heat (121°F in British Columbia; 117°F in Portland, OR; 108°F in Seattle, WA)
When: End of June 2021
Where: Western Canada (British Colombia) and Pacific Northwest US (Oregon and Washington)
Return period: 1 in 1000-year event (0.1%) in historical period

Immediate Impact from Extreme Heat



From Another Angle: Compound Effect of Rising Temperature and Severe Drought

The Actuarial Weather Extremes: May 2021 edition highlights the severe drought conditions in Western US, pointing that the areas under the most severe drought conditions – severe, extreme, and exceptional drought – are increasing, after several months of prolonged drought. Combined with rising temperature, there is potential for a compound effect larger than the sum of parts, as shown below, given the inverse relationship between competing demands for water and energy, and their availability in times of stress.



Overall, extreme weather events like the extreme heat observed last June seem to signal that we may be past the point of pure play climate mitigation and highlights the need to improve societal resilience by investing in climate adaptation too. The complex nature of climate risks and their interdependencies call for a holistic approach to managing these risks to foster a brighter future.

Featured Research Project

By Priya Rohatgi, ASA

The SOA Catastrophe and Climate Strategic Research Program (previously known as CESRC) acknowledges the need and is making every effort to produce research work and literature surveys which complements the growing body of research on the topic of climate risk and its assessment, to supplement the work of actuaries and their learning.

From the work published so far, we have listed a few which you may find interesting and useful. They aim to help identify not only the various environmental/climate risks but also the tools and techniques available or are under development that will help model and assess these risks to better measure and manage the growing climate risks across the industry.

How Do They Know and What Could We Do? The Science of 21st Century Climate Projections and Opportunities for Actuaries (May 2018)

By Rob Erhardt, Ph.D., ACAS and Ron Von Burg, Ph.D.

This white paper provides actuaries with the necessary background and foundational scientific knowledge to understand both global climate change and climate model projections for the 21st century. The rising temperature and shifting weather patterns have impacted us all, be it property or non-property insurers. The authors recognize that Actuaries already utilize several variables included in climate models, including wind speed, precipitation and temperature, used in various index-based insurance products which can also be used in statistical models relating these quantities to estimates of flood, wind damage, heatwaves, events leading to crop losses, mortality risks and other loss scenarios. The goal of this paper is to build scientific literacy among the readers, allowing them to understand anthropogenic influences on climate change and further understand how scientists work to translate those influences into future projections of possibilities. Enabling actuaries to further enhance existing models and estimates with regional climate model output.

https://www.soa.org/resources/research-reports/2018/21st-century-climate-projections/

Predictive Modeling of Surface Temperature Extremes over North America, with Actuarial Applications in View (April 2018)

By Vytaras Brazauskas, Ph.D., ASA; Sergey Kravtsov, Ph.D. and Paul Roebber, Ph.D.

Key Outcomes of the project were:

Authors constructed a numerically efficient empirical model for simulating the non-stationary statistical characteristics of surface air temperature over North America, across a range of time scales and for all

seasons. They used a surface temperature data set based on National Center for Environmental Prediction North American Regional Reanalysis (NARR)

The model was then used to produce a large ensemble of surrogate simulations of the surface temperature over the 1979–2015 period, which is the major deliverable of this project. The associated data set is made publicly available and is hosted by nature.com. The dataset's user guide (Kravtsov et al. 2017) and the link to the actual data are available from https://www.nature.com/articles/sdata2017155.

The database of these surrogate simulations can be used to estimate variable statistics of the surface temperature variability over the simulation period. Authors performed some analyses of this type and established the ability of the model to simulate climate shifts (for example, the 1997–1998 shift) and other forced signals (such as the SST forced drought conditions; see Kravtsov et al. 2016a).

https://www.soa.org/resources/research-reports/2018/predictive-modeling-surface-temperature/

Improving Disaster Financing (Nov 2016)

This is a series of papers sponsored by SOA, presented by world-renowned scholars on six governmental disaster insurance programs at the workshop, "Improving Disaster Financing: Evaluating Policy Interventions in Disaster Insurance Markets" in Nov 2016, where 'Resources for the Future' and the 'Wharton Risk Management and Decision Processes Center' brought together researchers, policymakers, and private sector experts for critical conversations about the role of government in disaster insurance markets. Participants discussed the ideal roles of the public and private sectors in disaster risk financing and evaluated each program against a range of topic areas, such as incentives for risk reduction, take-up rates, how costs are distributed, and the influence on the private market.

Series include the following papers - National Flood Insurance Program *by Carolyn Kousky*; Florida's Public Wind Pools *by Lorilee A. Medders and Jack E. Nicholson*; California Earthquake Authority *by Daniel Marshall*; Terrorism Risk Insurance Program *by Erwann Michel-Kerjan and Howard Kunreuther*; Flood Re (United Kingdom) *by Swenja Surminski*; All-Hazards Homeowners Policies *by Howard Kunreuther*

https://www.soa.org/resources/research-reports/2017/2017-improving-disaster-financing/

Environmental Risk Paper Series

In the ongoing Environmental risk series two more interesting papers were added:

Emerging Risks in the Health Sector (July 2021)

Climate change has the potential to wreak havoc on ecosystems worldwide. One anticipated repercussion is the change in suitable habitats of vectors, such as mosquitos and ticks, who can transmit serious and even life-threatening diseases to humans. In this report, we outline major vector-borne diseases, discuss their symptoms and treatment costs, and present the relevant research regarding their evolving spatial patterns due to climate change.

https://www.soa.org/globalassets/resources/research-report/2021/emerging-risks-health-sector.pdf

Integrated Assessment Models (June 2021)

This is a wide-ranging paper covering lots of topics that will be useful for actuaries. It provides a brief overview of Integrated Assessment Models (IAM) and Representative Concentration Pathways (RCPs) - based on radiative forcings driven by carbon dioxide equivalent additions to the climate system. It also talks about Shared socioeconomic pathways (SSPs) that are a key component of the scenario development framework currently in use by the IPCC sixth cycle and the climate research communities for evaluating climate risk and climate policy.

The paper also discusses Attribution science and how actuaries can use attribution analysis - anticipating trends in extreme events that can aid in calculating premiums or a distribution of events that exceed the norm. Another tool an actuary could develop would be to anticipate feedback loops that quickly change the claims distribution. It also lists some of the other reports on related topics published by IPCC and IFOA that the readers may find useful.

https://www.soa.org/globalassets/assets/files/resources/research-report/2021/integrated-assessment.pdf

Effects of Pollution and Environmental Degradation on Mortality and Morbidity Rates and Healthcare Costs (May 2021)

Increasingly, ill health attributable to environmental degradation is showing up on the radar through increased costs and/or elevated mortality. As actuaries we are interested in estimating healthcare costs and lifespan, hence it is critical for us to understand the impact of environmental stressors and how they may be changing over time.

The goal of the paper is to increase awareness and emphasize the relevance of environmental factors on various insurance products. Hence, this paper is of significance to all the insurance businesses where a life is involved, including liability/litigation insurance. The coverage here is broad and provides a comprehensive overview of various environmental drivers such as air pollution, chemical exposures such as neurotoxicants and endocrine disrupting chemicals, interaction and accumulation of pollutants, zoonotic diseases etc. In addition, it discusses how some of the costliest diseases are getting exacerbated due to environmental degradation and climate change and points to the recent research on the topic on quantification of these risks.

https://www.soa.org/globalassets/assets/files/resources/research-report/2021/effects-of-pollution-and-environmental-degradation.pdf

In the News

By Priya Rohatgi, ASA

Extreme weather events are now becoming the norm and the conversation is rapidly shifting from denial to mitigation to adaptation. The 1 in 100-, 500- or 1000-year events are becoming more frequent and intense. Contemplations and rhetorical arguments in the abstract, on the potential impact of climate change, have now become a harrowing reality covered on everyday news.

Selected articles cover some of the recent real-world examples of the connected extreme events and the compound effects. The scale of some of these events challenge our understanding of the Earth's Climate system and have revealed areas that merit further research. We have highlighted new regional and global challenges - mortality and morbidity, water scarcity, loss of biodiversity, food supply shocks and disruption

of food supply-chains etc., lack of preparedness and resilient infrastructure. 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. IPCC next report - Climate Change 2021: the Physical Science Basis

https://www.ipcc.ch/site/assets/uploads/2021/07/PR_WGI_approval_opening-.pdf

This Report aims to provide the latest knowledge on past warming and future warming projections, showing how and why the climate has changed to date, and including an improved understanding of human influence on the climate including extreme events. There will be a greater focus on regional information that can be used for climate risk assessments.

> IPCC opens meeting to approve physical science report
>
> The Intergovernmental Panel on Climate Change (IPCC) opened a meeting on Monday (July 26, 2021) to approve its next report on the physical science basis of climate change, the first part of the Sixth Assessment Report.
>
> www.ipcc.ch

2. More coming - Climate change will drive rise in 'record-shattering' heat extremes

https://www.carbonbrief.org/rise-in-record-shattering-climate-extremes

The study finds that record-shattering extreme events are likely to occur more frequently in the coming decades but notes that they would be "nearly impossible" without climate change. It adds that the speed of warming is more important than the level of warming reached when determining the likelihood of these extremes.

> "Record-shattering" extremes – which break weather records by large margins – will become more likely as a result of climate change, a new study finds.
>
> The paper, published in Nature Climate Change, finds that the northern mid-latitudes are particularly vulnerable to record-shattering heat. This is exemplified by the recent heatwave over north-western US and Canada, in which many long-standing temperature records were broken by as much as 5C.
>
> www.carbonbrief.org

3. "Sunny day" or "nuisance" floods

https://www.insurancejournal.com/news/national/2021/07/15/622805.htm

Damaging floods that used to happen mainly during storms now happen during regular events such a full-moon tide or with a change in prevailing winds.

> 'Sunny Day' Floods Will Increasingly Inundate U.S. Coasts as Sea Levels Rise: NOAA

Record high-tide flooding washed over U.S. coasts in the past year, and rising sea levels are expected to send the deluges into streets, homes and businesses even more frequently over the next decade, the National Oceanic and Atmospheric Administration said.

www.insurancejournal.com

4. Air quality warnings spread across the East

https://www.npr.org/2021/07/21/the-western-wildfires-are-affecting-people-3-000-miles-away

The warnings range from orange to red — orange meaning sensitive groups are at risk of being affected, and red meaning all people living in the area are at risk.

The Western Wildfires Are Affecting People 3,000 Miles Away

Smoke traveling from the Western wildfires is reaching all the way across the U.S., bringing vibrant red sunsets and moon glow to the East. But it's also carrying poor air quality and harmful health effects thousands of miles away from the flames.

www.npr.org

5. Ripple effect – Extreme weather is slammimg crops across the globe.

https://www.moneyweb.co.za/worlds-food-supplies-slammed-by-drought-floods-and-frost

Climate change and its associated weather volatility will make it increasingly harder to produce enough food for the world, with the poorest nations typically feeling the hardest blow.

World's food supply slammed by drought, floods and frost

Bloomberg reports that extreme weather is slamming crops across the globe, bringing with it the threat of further food inflation at a time costs are already hovering near the highest in a decade and hunger is on the rise. The Food Price Index from the UN's Food and Agriculture Organization rose for 12 consecutive months through May before easing in June to 124.6 points, still up 34% from a year earlier.

www.moneyweb.co.za

6. New Frontiers in Climate-Risk Analytics

https://www.spglobal.com/ratings/en/research/articles/environmental-social-and-governance

In the absence of a perfect solution, enhanced analytics can provide market participants with greater clarity about an entity's exposure to physical climate risks. Climate risk data is best used to inform analytical judgement, to improve transparency, and to enrich market participants' dialogue with exposed entities.

Model Behavior: How Enhanced Climate Risk Analytics Can Better Serve Financial Market Participants
Enhanced climate risk analytics combines outputs from climate models and other dedicated models (IAMs for example), scenario planning, and other entity-derived and asset-level data, with analytical judgement based on interactions with entities, to develop better informed views about entities' potential exposure to the physical impacts of climate change.
www.spglobal.com

7. No Oysters or shellfish unless cooked at 145° F

https://www.doh.wa.gov/Newsroom/High-heat-low-tide-likely-triggering-spike-in-shellfish-linked-infections
High heat, low tide likely triggering spike in shellfish-linked infections.

Rise in Shellfish-Related Food Poisoning Is Likely Linked to Extreme Heat in the Pacific Northwest

An outbreak of vibriosis in Washington has already surpassed the highest number of cases ever recorded by the state for the month of July. Recent high temperatures and low tides in Washington State are likely to blame for the increased rate of illness, which is associated with eating raw or undercooked shellfish, especially oysters that are contaminated with Vibrio.

Found naturally in the environment, Vibrio bacteria thrive in warm temperatures. When midday low tides coincide with warm weather, Vibrio bacteria can grow quickly, increasing risk of illness among people who eat raw or undercooked oysters.

www.doh.wa.gov

8. Warming California rivers are killing fish, imperiling industry

https://www.latimes.com/california/warming-california-rivers-killing-fish-imperiling-industry
"The pain we're going to feel is a few years from now, when there will be no naturally spawned salmon out in the ocean," said John McManus, executive director of the Golden State Salmon Association, which represents the fishing industry.

Hundreds of thousands of young salmon are dying in Northern California's Klamath River.

Low water levels brought about by drought allow a parasite to thrive, devastating a Native American tribe whose diet and traditions are tied to the fish. And wildlife officials said the Sacramento River is facing a "near-complete loss" of young Chinook salmon due to abnormally warm water. Climate Change could be devastating to the commercial salmon fishing industry, which in California alone is worth $1.4 billion.

www.latimes.com

9. Reducing global heating could save millions of people from mosquito-borne diseases
https://www.theguardian.com/global-development/climate-crisis-risk-of-malaria-and-dengue

More than 8 billion people could be at risk of malaria and dengue fever by 2080 if greenhouse gas emissions continue to rise unabated, a new study says. The study found that if emission levels continue to rise at current rates, the effect on global temperatures could lengthen transmission seasons by more than a month for malaria and four months for dengue over the next 50 years.

> Climate crisis 'may put 8bn at risk of malaria and dengue'
>
> Felipe J Colón-González, assistant professor at London School of Hygiene & Tropical Medicine (LSHTM) and one of the report's authors, said
>
> "The results show low-emission scenarios significantly reduce length of transmission, as well as the number of people at risk. Action to limit global temperature increases well below 2C [3.6F] must continue. "But policymakers and public health officials should get ready for all scenarios, including those where emissions remain at high levels. This is particularly important in areas that are currently disease-free and where the health systems are likely to be unprepared for major outbreaks."
>
> www.theguardian.com

10. Protections for people with disabilities are essential in emergency planning
https://abcnews.go.com/heat-waves-climate-change-put-people-disabilities-risk

In a study by the United Nations, the organization affirmed that climate change will continue to have direct and indirect impacts on the human rights of people with disabilities. In climate emergencies, disabled people disproportionately experience higher rates of morbidity and mortality, and are typically the least able to access emergency support, the study said...

> How heat waves, climate change put people with disabilities at risk
>
> The way that climate change affects people with disabilities is as diverse as the population.
>
> Director of the Disability Mobility Initiative Anna Zivarts said "Many folks in the disability community are poor. So, they can't afford to flee, to relocate, to get air conditioners, to have a car, to hire an Uber. There's so many reasons that people get trapped or stuck in situations that are really, really harmful."
>
> This often gives them a disadvantage when it comes to fighting, escaping, or living with the consequences of climate change.
>
> www.abcnewsgo.com

11. Accelerated effort needed

https://californianewstimes.com/insurers-are-falling-short-in-tackling-climate-risk

Insurers have not gone far enough in overhauling their underwriting practices to respond to climate change, with US groups the furthest behind…

> Insurers are falling short in tackling climate risk, warns top policy adviser
>
> Policymakers, investors and campaigners are increasing pressure on insurers to reduce their "insured emissions", or the carbon footprint of the companies for which they provide cover.
>
> Iyahen said the UN-convened Net-Zero Insurance Alliance launched earlier this month had made a welcome start in drawing together eight European groups in a pledge to bring their insurance and reinsurance portfolios in line with a goal of net zero greenhouse gas emissions by 2050.
> www.californianewstimes.com

12. Beyond human endurance – "wet-bulb temperature"

https://www.washingtonpost.com/world/interactive/2021/climate-change-humidity/

Deadly heat waves have swept the globe and will continue to because of climate change. The trends are prompting doomsday questions: Will parts of the world soon become too hot to live in? How will we survive?

> How climate change is making parts of the world too hot and humid to survive
> When it comes to heat, the human body is remarkably resilient — it's the humidity that makes it harder to cool down. And humidity, driven in part by climate change, is increasing. Scientists are using this metric to figure out which regions of the world may become too dangerous for humans.
>
> www.washingtonpost.com

13. Invasive Species – Database for better assessment of financial costs.

https://www.theguardian.com/environment/invasive-species

An international group of researchers have built the first global database of invasion costs – InvaCost – led by a team at Paris-Saclay University. In addition, the UN's scientific body on biodiversity, IPBES, is working on a major assessment of invasive and alien species around the world, which will be published in 2023.

> Invasive species have cost UK at least £5bn since 1970s, study reveals
> The European rabbit, Japanese knotweed and the rock pigeon account for most of the cost, estimated at between £5.4bn and £13.7bn over the past 45 years, among the highest in Europe. Peer-reviewed information on financial cost exists for only 42 of the 520 invasive species in the UK identified in the study, with nothing available for high-profile plants and animals with significant ecological impacts such as the Asian hornet and the fungus that causes ash dieback.
> www.theguardian.com

14. Jet stream is key link in climate disasters

https://www.bloomberg.com/how-climate-change-impacts-the-jet-stream-and-your-weather

"Jet streams are the weather—they create it and they steer it," said Jennifer Francis, a senior scientist at the Woodwell Climate Research Center. "Sometimes the jet stream takes on a very convoluted pattern. When we see it taking big swings north and big dips southward, we know we're going to see some unusual weather conditions."

> Deadly weather as far apart as China, Germany and the U.S. reveal the devastating impact of a swinging jet stream.
>
> Meteorologists worry whenever those swings and dips form omega-shaped curves that look like waves. When that happens, warm air travels further north and cold air penetrates further south. The result is a succession of unusually hot and cold weather systems along the same latitude. Under these conditions, winds often weaken, and dangerous weather can remain stuck in the same place for days or weeks at a time—rather than just a few hours or a day—leading to prolonged rains and heat waves.
>
> The situation in the atmosphere may have been brought on by jet stream weakening, "but it will require additional analysis to confirm," said Michael Mann, an atmospheric science professor at Pennsylvania State University.
>
> www.bloomberg.com

15. Western Drought has lasted longer than the Dust Bowl in 1930

https://www.scientificamerican.com/western-drought-has-lasted-longer-than-the-dust-bowl/

Dry conditions have drawn down reservoirs, fueled massive wildfires and stunted. And worst of all, the drought blanketing the western United States is not going away.

> Half of the U.S. population lives in a drought-stricken area.
>
> Drought conditions now afflict 96% of seven Western states — Arizona, California, Idaho, Montana, Nevada, Oregon and Washington — the highest percentage since record keeping began in 2000.
>
> The drought has reduced river and stream flows across the West, most notably on the Colorado River, threatening electric plants that rely on hydropower and water supplies in Southern California.
>
> Lake Mead, the nation's largest reservoir and a water source for 20 million people in Arizona, California and Nevada, is at just 35% of its capacity.
>
> www.scientificamerican.com

16. 'Carbon responsible' or 'Carbon neutral'?

https://www.bloomberg.com/offsets-can-play-a-role-to-make-companies-carbon-responsible

There's a debate about how companies should be recognized for buying carbon offsets based on avoiding emissions. Better to call them "carbon responsible" instead.

> Net Zero Is Hard Work, So Companies Are Going 'Carbon Neutral'
> The push to adopt the "carbon neutral" label is causing concern among climate experts, who fear it creates a watered-down definition for those who are more interested in greenwashing than genuinely seeking to reach net zero.
>
> www.bloomberg.com

17. Climate-related statements should be required in 10-K annual reports

https://www.wsj.com/sec-weighs-making-companies-liable-for-climate-disclosures

The Securities and Exchange Commission is looking at whether climate-related disclosures should be filed in companies' annual reports.

SEC Weighs Making Companies Liable for Climate Disclosures

Current SEC guidelines for public companies suggest both types of risks might need to be disclosed in federal filings. But the guidance doesn't spell out specific, required disclosures, and companies decide what to say about risks.

www.wsj.com

18. 'Fit for 55' – Transformative Package – Lengthy negotiations ahead!

https://www.carbonbrief.org/how-fit-for-55-reforms-will-help-eu-meet-its-climate-goals
The European Commission has published proposals on how the European Union should reach its legally binding target to cut emissions to 55% below 1990 levels by 2030.

Fit for 55 marks Europe's climate moment of truth
The package of 13 proposals includes tightening the EU Emissions Trading Scheme (EU ETS), pricing emissions from heat and transport in a parallel ETS and adding a carbon border adjustment mechanism (CBAM) to tax high-carbon imports, such as steel and cement.

Other proposals include phasing out petrol and diesel car sales across the bloc by 2035, raising targets for renewables and energy efficiency, setting higher, binding national targets for sectors outside the EU ETS and, separately, setting binding goals for carbon dioxide (CO2) removals.

A new "social climate fund" is proposed to help vulnerable households disproportionately affected by higher fossil fuel prices, offering "temporary" income support and longer-term investment.
www.Carbonbrief.com

19. Who was Eunice Foote?

https://www.fastcompany.com/the-first-scientist-to-chart-the-physics-of-climate-change
The year was 1856. Foote's brief scientific paper was the first to describe the extraordinary power of carbon dioxide gas to absorb heat—the driving force of global warming.

This woman was the first scientist to chart the physics of climate change—in 1856

Eunice Foote discovered that carbon dioxide absorbs heat and theorized that if the Earth's air filled with more CO2, the planet's temperature would rise.

www.fastcompany.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 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.

For this edition we have selected couple of articles from the **Perspective**[3] section of the monthly journal *Nature Climate Change.* They tie in very well to the current situation and should stimulate discussion to explore new avenues to tackle the challenges of compound events and connected extreme events.

Understanding and managing connected extreme events

Colin Raymond, Radley M. Horton, Jakob Zscheischler, Olivia Martius, Amir AghaKouchak, Jennifer Balch, Steven G. Bowen, Suzana J. Camargo, Jeremy Hess, Kai Kornhuber, Michael Oppenheimer, Alex C. Ruane, Thomas Wahl & Kathleen White

Extreme weather and climate events and their impacts can occur in complex combinations, an interaction shaped by physical drivers and societal forces. In these situations, governance, markets and other decision-making structures—together with population exposure and vulnerability—create nonphysical interconnections among events by linking their impacts, to positive or negative effect. Various anthropogenic actions can also directly affect the severity of events, further complicating these feedback loops. Such relationships are rarely characterized or considered in physical-sciences-based research contexts. Here, we present a multidisciplinary argument for the concept of connected extreme events, and we suggest vantage points and approaches for producing climate information useful in guiding decisions about them.

Future climate risk from compound events

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Floods, wildfires, heatwaves and droughts often result from a combination of interacting physical processes across multiple spatial and temporal scales. The combination of processes (climate drivers and hazards) leading to a significant impact is referred to as a 'compound event'. Traditional risk assessment methods typically only consider one driver and/or hazard at a time, potentially leading to underestimation of risk, as the processes that cause extreme events often interact and are spatially and/or temporally dependent. Here we show how a better understanding of compound events may improve projections of potential high-impact events, and can provide a bridge between climate scientists, engineers, social scientists, impact modelers and decision-makers, who need to work closely together to understand these complex events.

[3] A Perspective is intended to provide a forum for authors to discuss models and ideas from a personal viewpoint. They are more forward looking and/or speculative than Review Articles and may take a narrower field of view. They may be opinionated but expected to remain balanced and are intended to stimulate discussion and new experimental approaches.

Book reviews

The topic is 'Plague', and its all too familiar afflictions - the pain, emotional distress and loss that many have endured due to COVID, over a year and half and with seemingly no clear end in sight. The carefully selected recommendations by our committee members take the long view and provide a much needed historical perspective which is conspicuously missing from the narrative on the pandemic.

Published herein is a review by Frank Grossman, *The Flail of God: Climate Change and Catastrophe in the Fourteenth Century* and be sure to check-out Sara Goldberg's review of Albert Camus' *The Plague*, appearing in our upcoming edition.

We hope this will give our readers an opportunity to compare and contrast different perspectives and provide a richer insight into our current condition.

The Flail of God: Climate Change and Catastrophe in the Fourteenth Century

By Frank Grossman, FSA, FCIA, MAAA

A flail is a basic agricultural implement comprised of a wooden staff with a short heavy stick that hangs swinging freely from one end. It has been used by farmers for millennia to thresh or separate kernels of grain from their husks. The flail and shepherd's crook can be seen in the iconography of the Egyptian pharaohs, representing a ruler's duty to provide for his subjects. But the flail had yet another meaning during the Middle Ages. Catastrophes, such as crop failure, floods and pestilence, were often seen as a marks of divine disapproval, and thought to be an instrument of God's will—the flail of God (flagellum Dei)—punishing his people, as a parent might punish a child who has transgressed. Today, we recognize that there were other influences and interactions, but such a fatalistic way of thinking about loss and harm was deeply ingrained in the medieval mind, and one needs to bear this in mind when approaching the history of this period. This review briefly examines three interesting books about the 14th century and its various catastrophes, while noting some possible similarities to our current circumstances along the way.

Philip Ziegler's The Black Death, first published in 1969, is a comprehensive synthesis of the records of medieval chroniclers, as well as the works of later historians, regarding the 14th century's great plague. Bubonic plague first appeared in Crimea in 1346, having broken out from southern China during the prior decade, and by the end of that year, "it was widely known, at least in major European seaports, that a plague of unparalleled fury was raging in the East." Genoese traders, fleeing their outpost at Kaffa (now Feodosija) on the Black Sea, conveyed the pestilence by sea to Sicily and home to Genoa in the spring of 1348. Within two years all of Europe was sorely afflicted, including Iceland and Sweden. Plague has since been associated with travelers and commerce because its historical progress closely followed main trade-routes.

Ziegler takes care to distinguish between the several variants of plague—bubonic, pneumonic and septicaemic—each with different symptoms and transmission modes, but the same general outcome, that confounded medieval doctors. He also notes that while rats greatly helped spread the bubonic plague (as a host for infected fleas), they were not strictly necessary for the pandemic—effectively dispelling the familiar "no ship rats, no plague" adage. Perhaps unsurprisingly, communities that (both then as now) imposed and maintained strict quarantine measures were spared the worst of the pandemic.

When faced with the statistical challenge of estimating a mortality rate for the Black Death in England, Ziegler invokes the "lapidary wisdom" of historian Sir Geoffrey Elton:

"Those determined to put their faith in 'sophisticated' mathematical methods and to apply 'general laws' to the pitifully meagre and very uncertain detail that historical evidence often provides ... are either to be pitied because they will be sinking in quicksand while believing themselves to be standing on solid earth, or to be combated because they darken counsel with their errors."

At length, Ziegler concludes that roughly a third of England's population died of the Black Death, while acknowledging that this figure could easily range from a low of 30 percent to a high of 40 percent. A crucial point is that there were several outbreaks of plague—in 1361, 1368-9, 1371, 1390 and 1405—following the first and most devastating pandemic of 1348, and that the damage done was cumulative. According to Ziegler, "The progressive depopulation of England ... as each new generation was attacked before it had made good the losses of the last, was economically and psychologically a depressive quite as dangerous as the holocaust of the Black Death itself."

At the risk of a making a strained comparison, the current anti-vaxxer mania and cancel culture hysteria seem vaguely reminiscent of the idealism, discipline and superstitious fervor—though certainly not the worst excesses—of the Flagellant Movement that briefly threatened the security of certain medieval governments. Pope Clement VI initially endorsed ceremonies involving public flagellation at his palace at Avignon in May 1348. Yet the Pope eventually realized that "large concourses, attended by the devout from all over the region, were a sure means of spreading the plague still further, as well as providing a breeding ground for every kind of hysterical mob outburst." Ultimately, the Flagellant's pilgrimages were suppressed by papal Bull in October 1349, which called for assistance from secular authorities if necessary.

The Black Death was reissued in a second edition in 1998, with a new preface and a historiography listing more recent sources and remains an accessibly nuanced and reliable guide to its subject.

A skillful interweaving of medieval weather, economics, and history forms the basis of William Rosen's 2014 book, The Third Horseman—its title is an allusion to the pale rider of famine described in the Book of Revelations. Much of Rosen's book is given over to a vivid recounting of the dynastic conflict between the rulers of England, Scotland and France. But its touchstone is the Great Famine of 1315-21 that led to an excess mortality of five to twelve percent across northern Europe.

The famine's backstory is the Medieval Warm Period—from the end of the 9th century to the beginning of the 14th century—during which northern Europe was an estimated 2°C warmer on average than it is today. Cereal crops could be grown at altitudes greater than 1,000 feet above sea level and there were vineyards in northern England. As agricultural output grew over this four-century period, of Europe's population increased from approximately 10 to 40 million.

However, agricultural yields began to decline by the close of the 13th century as less productive land came under cultivation. There was also under-employment accompanied by falling wages, as well as growing political and military conflict—the limits to medieval growth were nigh. Then the rains came, accompanied by cooler temperatures, in 1315-16. Successive years of crop and livestock failure ensued, and eventually there was widespread famine as stores of food were consumed.

Modern science—transcending medieval understanding—has since confirmed that the Earth's climate has continually evolved over the centuries. Yet Rosen clearly states that the catastrophe that began with the failed 1315 harvest was not a direct result of climate change:

"(T)he Great Famine was the product of a mechanism even more complex than climate ... the conditions that destroyed millions of lives during the seven years of the Great Famine appeared during the four centuries of the Medieval Warm Period ... (as) the balance between producing food and consuming it grew more fragile every year."

The fault lines in the manorial system of land tenure were also visible in the growing gap between the economic fortunes of the nobility and the peasantry. Those who worked the land were subjected to higher rents and restrictions, seizure of crops and animals by their own seigneurs, and marauding raids (chevauchées) by soldiers—both friend and foe. A desire for greater mobility and control over the terms of one's employment led to a series of popular revolts: notably, among town dwellers in Flanders in 1323-28, the Jacquerie north of the Seine River in 1358, and the English Peasants' Revolt of 1381.

Rosen concludes his wide-ranging and informative book by noting that the powerful lesson of the Great Famine is just how perilously sensitive early 14th century food security was to "a sudden shift in the weather."

Over the past few years, Jack Weatherford has single-handedly rehabilitated the reputation of Genghis Khan via a series of books, beginning with the publication of **Genghis Khan and the Making of the Modern World** in 2004. Key concepts underpinning today's global system—such as free commerce, international law and diplomatic immunity, religious tolerance and the separation of church and state—all have their origins in the universal principles of Genghis Khan. The commercial influence of the Mongol Empire extended much beyond that of its military, and the conditions of its financial growth and ultimate collapse in the 14th century merit some examination.

According to their tribal ethos, every Mongol soldier, widow and orphan was entitled to a share of the spoils of war. Genghis Khan formalized a similar system of shares (khubi) whereby each member of the ruling family had a share of the wealth, including the knowledge capital—astronomers, doctors, miners, weavers, and acrobats—of the empire, somewhat akin to owning the stock of a modern-day multinational corporation. To regulate the provision of credit to merchants and consumers, the Mongols permitted declarations of bankruptcy—although a third bankruptcy risked punishment by death. Genghis Khan's grandson, Kublai Khan, pressed for the transfer of Muslim and Indian technology to China, and the concomitant expansion of trade in Chinese manufactured wares across the empire from Korea to Persia, and from Mongolia to Vietnam.

Shortly before his death in 1227, Genghis Khan authorized the use of paper money backed by precious metals and silk, a crucial innovation that enabled the transfer of money in place of physical goods. Mongke Khan, another of the Genghis Khan's grandsons, appointed a supervisor in 1253 to oversee the supply of paper money and safeguard its value. He also implemented a convertible imperial currency to monetize taxes formerly paid in local currency and kind.

Unfortunately, a Mongol succession crisis in 1328-32 and the outbreak of bubonic plague combined to interrupt the flow of people, trade goods and information throughout the empire, and the Mongol's interlocking ownership system faltered. According to Weatherford, "The principles by which the economy utilized paper currency had proven more complex and unpredictable than realized by the officials, and the system gradually spiraled out of control." Inflation ultimately rendered the Mongol currency worthless by 1356, but not before the successor Ming dynasty abolished paper money and returned to metal coinage.

Each of these three books has valuable insights for actuarial readers. In the preface to his book's second edition, Philip Ziegler observed: "An immense chasm stretches between the fourteenth century and today, but the more that one studies the medieval chronicles, the more convinced one is that human nature remains substantially the same." This is especially so during *our* pandemic times.

In case you missed…

Save the date!

The Catastrophe and Climate Strategic Research program presents a half-day ***Climate Risk Symposium – The Evolving Role of the Actuary in Climate Risk @ 2021 ImpACT Conference***, ***Oct 24 - 27 2021*** and other presentations during the SOA annual event. Follow the link for more details.

Climate Risk Symposium – The Evolving Role of the Actuary in Climate Risk

About The Society of Actuaries

With roots dating back to 1889, the Society of Actuaries (SOA) is the world's largest actuarial professional organizations with more than 31,000 members. Through research and education, the SOA's mission is to advance actuarial knowledge and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business and societal challenges. The SOA's vision is for actuaries to be the leading professionals in the measurement and management of risk.

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