Catastrophe and Climate

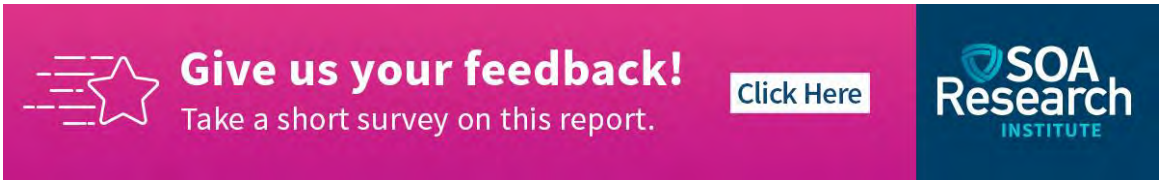
SOA Research INSTITUTE

Research Program Newsletter

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

February 2024

Contents



Focus on Terminology: Phenology

By Max J. Rudolph, Steve Bowen

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

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

Phenology

You may not be familiar with the specific term phenology but likely understand the concept. April showers bring May flowers and June bugs is a common saying for kids in the spring, but it describes a natural cycle that is under threat due to greenhouse gas emissions. Spring rains nourish dormant plants and, when they bloom, pollinating bugs magically appear. But it's not magic. It's millions of years of shared evolution between all living things that is currently at risk due to emissions generating increased temperatures and changing frequency/severity of extreme weather events. Animals (including insects and birds) may be triggered to start migrations based on the angle of the sun or temperature. Plants may start to grow when it warms to a certain temperature for the first time, so trees will bud during a brief temperature spike in the middle of winter. For living things that require cooler temperatures, their options include higher elevations or moving toward the poles; both are occurring.

We already see the prime location of vineyards and fish on the move, but this often means they are invasive species in their new habitat. This creates additional complexities.

IPCC definition – Phenology[1]

The IPCC defines phenology as the relationship between biological phenomena that recur periodically (e.g., development stages, migration) especially related to climate and seasonal changes.

In a paper published in 2007[2], the IPCC listed leaf unfolding, flowering, fruit ripening, leaf coloring, leaf fall of plants, bird migration, chorusing of amphibians, and appearance/ emergence of butterflies as among the observed events. At that time spring was arriving 2.3 to 5.2 days earlier per decade.

Summary

A phenological mismatch can weaken an ecosystem in ways that are difficult to anticipate. Interactions between predator-prey or combinations of plant-animal have evolved in unison but are now diverging with unexpected results. Fish spawn earlier, snow hares are exposed on the melting tundra with their white fur and hummingbirds

[1] IPCC, 2022: IPCC glossary associated with AR6 https://apps.ipcc.ch/glossary/

[2] IPCC Fourth Assessment Report: Climate Change 2007. Working Group II: Impacts, Adaptation and Vulnerability Section 1.3.5.1. https://archive.ipcc.ch/publications_and_data/ar4/wg2/en/ch1s1-3-5-1.html#:~:text=Phenology%20%E2%80%93%20the%20timing%20of%20seasonal,in%20response%20to%20climate%20change.

are starting their spring migration earlier than ever before. Many crops and flowering plants are pollinated by migrating birds and insects. When coordination is lost, entire species could disappear.

The uncertainty of the results and its implications should be of interest to actuaries and other financial analysts as there are potential repercussions for how first principles are used in our calculations. Thinking about this qualitatively will help quantitative models evolve.

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Steve Bowen is a Meteorologist and the Chief Science Officer at Gallagher Re.

Tradeoffs

By Sam Gutterman

As we have recovered from last November's COP-28 in Dubai, the multi-national world is again addressing the two-pronged question of (1) how many resources will be allocated to enhance the mitigation of and adaptation to the adverse effects of climate change and (2) who will pay for what is needed to achieve these ends. This COP did not answer key issues of (1) who will finance the newly established Loss and Damage Fund to help pay for adaptation and loss recovery, especially for the less developed countries, and (2) what to do about the deficient performance of almost all countries when measured against current national commitments to reduce greenhouse gas emissions.

Of course, each government has its non-climate related priorities to deal with, under tremendous pressure from its many stakeholders to satisfy a wide range of worthwhile objectives. But in this context, how do we deal with what is increasingly called a climate crisis or climate emergency? The challenge of allocation of resources needs to be addressed head-on, rather than being kicked down the road until some future year's budget or headache, which is the usual practice.

Everyday life is full of such tradeoffs. Inevitably, multiple objectives compete for a given set of resources. Inevitably, some will not be completely satisfied. If all of these objectives are valuable, allocation decisions will be difficult, especially if stakeholders differ in their assessment of the value of and risks involved in the outcomes. Choice is endemic in a world with many uncertainties. Yet decisions have to be made – no action means a decision has been made.

This decision process, which could be thought of as a risk management process, can be understood as a series of negotiations over available resources that involve numerous tradeoffs. How should individuals, households, businesses, communities, and countries allocate their current and future resources? Some important tradeoffs that need to be considered include:

Climate-related expense versus other expenses. Of course, there are many demands on our resources. But climate risk management is important to our future and needs to be of high priority, even when returns on such investments aren't immediately apparent.

Mitigation and adaptation. Although reducing the amount of greenhouse gas emissions will not have a material impact on climate in the short term, such efforts will help to reduce the impact in the longer term. In the meantime, actions to adapt to the climate will help control the effects of weather extremes will be needed. Although adaptation may provide a more immediate return, it will also have a more local effect. The relative amount of resources given to each is an important strategic decision.

Who pays. Should it be financed by those responsible for the problem or those who suffer the consequences? To the extent practical, the entity affected has the most at stake and thus will likely give it a higher priority. Despite this, it may not have the resources to effectively deal with the immediate event or condition; others may have to top up the needed financing, either now or at a greater level in the future.

Costs to and benefits for each stakeholder. A question often asked is "Why should I make a sacrifice when others don't seem to?" or "I am not vulnerable, so why should I care?". Ignoring the needs of the vulnerable is a short-sighted strategy, as those with higher income or wealth may have to pay or provide subsidies over the long term.

Time. A significant element of a decision or tradeoff is the value given to time – for example, the short-term compared with a corresponding long-term cost. One approach to overcome this problem is to reflect the time value of costs and benefits, that is, through the application of discount rates. Although ignoring the perspective of future generations may generate benefits over the short term, ignoring the costs and benefits for one's children and grandchildren will usually not be desirable.

Uncertainties. The future is far from settled. Nevertheless, loss prevention, especially when our resources (savings) are at risk, needs to be considered and, in some cases given more weight than short-term gains. In comparing results from multiple possible scenarios, beware of tail events!

Externalities and social value. Although it may be easier to only consider yourself, thinking about the needs of a larger population "for the greater good" may result in a superior resolution of this conundrum.

Value to the individual versus value to society. What can an individual do? Sometimes it may seem that any personal effort or investment can do little to mitigate climate change – further, one person's effort to decarbonize may seem minuscule compared with the massive amount of greenhouse gases generated by billions of cars. Although by taking a personal view, one would not act, if everyone thought that way, no progress would be made—only a collective effort will make a difference. In the case of a global problem such as climate change, a lack of consideration for society as a whole can be short-sighted.

Once you start looking at the world through the lens of tradeoffs, policy debates become less about right versus wrong or us versus them that can include contradictory value judgments, and more a matter of give and take, and desire for the best resource allocation for all. Then debates over tradeoffs will be based on facts, rather than politicized views, and closer to a Jeremy Bentham viewpoint. Everyone needs to do what they can and trust that others will do likewise, trading off against other worthwhile alternatives and giving their 'solutions' appropriate weight.

Decisions regarding climate policy can incorporate considerations of opportunities as well as risks, as mitigation and adaptation actions can simultaneously result in job creation, economic growth, and reduced dependence on (sometimes) hostile foreign energy suppliers. Voters may be swayed if they understand the underlying issues, consequences, and necessary tradeoffs involved. Many in rich democracies are now waking up to the fact that the energy transition will involve inconvenience and pain, at the same time that climate change for many is not high on their list of current risk priorities.

Switching energy to renewables will inevitably cost money that could be used for other things and be accompanied by stranded assets and reduced sales of oil and gas-generated energy. Its cost-benefit analysis will incorporate explicit or implicit social discounting[3], for example, by insisting on minimum building standards or installing heat pumps, even when costly or tedious. And those who live in apartment blocks may not now have a place to plug in an electric car. A critical mass may be needed to reduce cost or inconvenience. Populist politicians in many countries are trying to win votes by pushing back against green policy by exaggerating its costs and minimizing the benefits, and painting green politicians as being out-of-touch urban elites who want to make everyone cycle to work and turn vegan.

We need to admit that the transition will involve cost and inconvenience, and craft policies and practices that minimize both as much as practical. I would ideally like a large percentage of our budgets to go for mitigation and shorter-term adaptation. But I doubt that will happen – the extent and types of tradeoffs we make individually and as a collective will determine our future climate and weather – how we do it will determine our futures – I am optimistic that our choices of tradeoffs will be good ones.

[3] See Gutterman, "Social Discounting" at https://www.soa.org/globalassets/assets/files/resources/research-report/2020/social-discounting-climate-change.pdf

FAIR Insurance – protection in high-risk areas, but at a cost.

By Rebecca Owen

A recent post on the author's NextDoor account was from a neighbor reporting that their Progressive home insurance was not renewed due to fire risk; they now had to shop for a new product and were finding some daunting prices. It gave all the readers a sort of chill – this is fire country and have been watching our neighbors to the south struggle with coverage. In my neighborhood we have risk of fire AND earthquake, floods, even coastal erosion that is a companion to the beautiful scenery.

This is a familiar scenario for people in many of the areas of the country with repeated jumbo weather events from hurricanes to wildfires. Many news stories describe the Florida insurance market as in "crisis" and companies like State Farm, Allstate and Kemper Corp are either exiting the California market or not issuing new policies[4]. Pundits worry about the Texas market. State insurance departments and legislatures have become involved trying to find solutions to protect homeowners, such as moratoria on non-renewals. In some states, there are plans available to those who cannot get insurance any other way, although they are not necessarily affordable options.

The FAIR (Fair Access to Insurance Requirements) Plan is a state-mandated program that provides property insurance to those who are unable to obtain it through the voluntary market. Currently, FAIR Plans are available in many states including California, Florida, Texas, Louisiana, and others and although they are fairly uniformly labeled, the specifics of qualifying for coverage and availability vary by state. The intent of FAIR plans is to ensure that all property owners have some form access to insurance, regardless of their property's risk factors or location as long as certain conditions are met.

The initial use of the FAIR insurance program in 1968 was to provide coverage in areas with urban decay and redlining. As more states have developed programs their utility is more and more for areas whose insurance market is stressed or failing due to climate-related losses. These are state pools – there can be more than one pool - backed by private insurers in proportion to their market share. Some states developed a similar residual program or joint underwriting plan and in all more than thirty states offer some sort of insurance of last resort for high-risk situations.

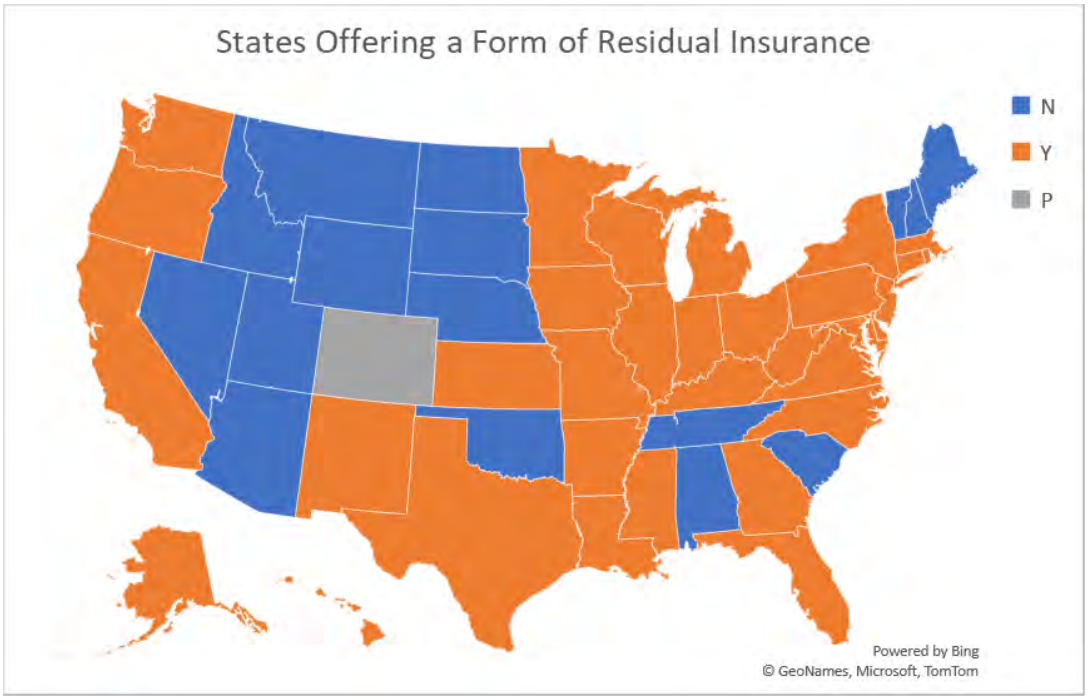
Generally FAIR plans have been developed to cover high-risk areas where a significant portion of the property owners can't qualify for traditional property insurance. The definition of a high-risk property usually has components for location such as weather-related risk due to hailstorms or flooding, but also may include high crime areas or even the condition of the building.

Usually being high risk is not sufficient to qualify for FAIR coverage. States may require property owners to institute mitigation efforts such as trimming vegetation or upgraded security systems or structural improvements. There may be a requirement that traditional insurers have declined to cover the property or that there be no outstanding liens or taxes due. There may be requirements to show that the building satisfies local building codes.

Since these plans are plans of last resort, they are often bare bones coverage. The items covered are typical – the dwelling, sometimes the contents and some medical costs – but the limits of the liability are usually not generous and coverages such as loss of use are not included. There may be options to add flood or earthquake coverage. FAIR plans are not usually inexpensive plans, despite offering limited protection.

According to the Insurance Information Institute, there were about 2.3 million policies both residential and business in force in 2022, with an exposure of nearly $850 million and premiums of $5 million.

[4] https://www.kiplinger.com/personal-finance/insurance/more-insurance-companies-are-leaving-california



Source: III list of states with residual insurance 2022. Colorado has a proposed plan due to start in 2025.

Some examples from states with FAIR type plans are instructive: Louisiana Citizens Property Insurance Corporation has a "policy take out" provision to return policies to the market. It also requires that insurance coverage not be less than the price of the coverage on the private market. In 2022 there were about 155,000 policies in force with an exposure estimated at $41million.

Citizen's in Florida is the largest plan with about 1.2 million policies and an exposure of about $425 million. The provisions of the Citizen's plan are hotly discussed in the media and in the legislature.

The Delaware FAIR plan is much smaller with about 1,100 policies in 2022 with an exposure of about $200K. It does cover some weather-related losses but was conceived as a solution to urban blight and still has that focus. It is not the smallest, Illinois with a much larger population has an exposure not much larger (about $260K).

In general, FAIR plans that are growing and straining resources are in geographies that have experienced repeated climate/fire events that have resulted in significant insured loss. Using a pooled financing through traditional means that while these losses are spread, their size means all residents are facing increased premiums to cover not only the higher likelihood that their own asset is at risk but also that of their neighbors.

FAIR plans do offer some protection for property owners, but they are not a solution for all people. Their expense and some of the provisions make them unattainable for many who cannot afford to protect their residences or who do not qualify for other reasons. As insurance markets are strained, legislatures and State Insurance Departments are looking to make modifications to help homeowners insure what may be their largest personal asset.

Further information on FAIR insurance and other types of insurance of last resort is available on the NAIC site (https://content.naic.org/cipr-topics/fair-access-insurance-requirements-fair-plans) or the Insurance Information Institute (https://www.iii.org/publications/a-firm-foundation-how-insurance-supports-the-economy/a-50-state-commitment/residual-markets). Each state plan is slightly different, so it is important to look at their site for specifics of coverage and financing.

SOA Research Reports - Recent Releases!

Listed below are some of the works SOA Research Institute published over the last quarter of 2023. There's some interesting analysis indicating the record-breaking extreme temperatures that were recorded every month last year and how 2024 is following suit. Also discussed, the most recent event of Atmospheric River (AR) experienced in California in early February. Check out the summary provided for a brief overview of the key learnings from all the papers in the series.

Read below the selected submissions that were received for The Catastrophe & Climate Steering Committee's recent Call for Essays. In addition, some interesting articles published in *The Actuary* magazine on the topic of interest.

Expert Panel on the Impact of Wildfires on U.S. Health and Life Insurers, Dec 2023

By Rebecca Owen, FSA, MAAA

To get a comprehensive perspective, a diverse panel of professionals including actuaries, a climate scientist, a meteorologist, and a clinician was convened. The goal was to discuss the health impacts of wildfires, aiming to educate actuaries and others on the potential insured risks from wildfires.

The panel focused on four areas:

- How the present differs from the past
- Smoke dispersion patterns.
- Health issues of wildfire smoke exposure
- how determinants of health interact with wildfires.

The panel recognized that Climate Change has made wildfire smoke a global concern affecting health and safety across continents. The wildfire seasons are becoming longer, more intense, and more widespread, with increased population exposure and higher levels of smoke. The 2023 wildfire season was notable for its widespread impact, affecting areas not traditionally exposed to severe wildfires, such as the Northeast U.S.

The panel discussed that the wind patterns and weather phenomena like La Niña and El Niño influences the smoke dispersion patterns and due to the feedback loop the scale of wildfires in turn influences the weather patterns, creating stable pressure troughs that influences the long-distance travel of smoke.

Talking about the impacts, besides the immediate physical damage, wildfires displace communities, and disrupt infrastructure, including healthcare facilities, schools, and grocery stores. There are also long-term impacts such as mental health issues, access to care for chronic diseases, and water quality concerns.

Wildfire smoke poses significant health risks concerns with particulate matter (PM 2.5) being a major concern due to its ability to penetrate deep into the lungs. Certain populations, including children, the elderly, and those with pre-existing respiratory conditions, are more vulnerable to the health effects of wildfire smoke. In addition, the determinants of health such as housing quality and income level also affect vulnerability.
The report also lists resources for actuaries interested in diving deeper into the topic. Please refer to:

https://www.soa.org/globalassets/wildfires-impact-ushealth-lifeinsurers.pdf

Analysis of U.S. Insurance Industry Climate Risk Financial Disclosures for Reporting Year 2021, October 2023

By Patrick Wiese, ASA, R. Dale Hall, FSA, MAAA, CERA, CFA, Jennifer Gardner, CPCU, AIDA, Jeff Czajkowski, PhD

The report presents an in-depth analysis of how the insurance industry is disclosing and managing climate-related risks. Here are the key ideas summarized in bullet points:

- The National Association of Insurance Commissioners (NAIC) updated their Insurer Climate Risk Disclosure Survey in 2022 to align with the Financial Stability Board's Task Force on Climate-related Financial Disclosure (TCFD) framework, enhancing climate risk reporting.
- The 2021 disclosures were the most recently available data at the time this analysis was conducted (in June and July of 2023).
- For the 2021 reporting year, nearly 450 unique climate risk disclosures were filed, representing over 1500 insurers and containing over 5 million characters of text, indicating varied approaches to climate risk among insurers.
- The report employs three analytical approaches to evaluate the disclosures: a high-level qualitative scan, a basic analysis scoring "risk awareness," and a detailed scoring against the TCFD's framework, focusing on governance, strategy, risk management, and metrics and targets.
- Key findings show substantial variation in the depth and breadth of disclosures across different lines of insurance business (health, life, P&C), with larger insurers generally providing more comprehensive disclosures.
- Health insurers often highlighted their ability to annually reprice contracts as a mitigating factor against climate risks, with less emphasis on investment risks.
- Life insurers focused more on the impact of climate risks on investment portfolios, with some assessing the carbon intensity of assets and modifying investment strategies accordingly.
- Property & Casualty (P&C) insurers showed a higher level of governance and strategy development for managing climate risks, with a focus on underwriting risks and investment portfolio impacts.
  The report suggests that despite the advancements in climate risk disclosure, there is significant room for improvement in how insurers assess, manage, and report on climate-related risks, especially in aligning with TCFD recommendations.

For more please refer to the link: https://www.soa.org/research-report/2023/climate-risk-fin-disclosures-2021.pdf

Actuarial Weather Extremes Series

California Precipitation February 3 - 7 2024, February 2024

By Michael Reis, FSA, CERA, JD and Aadit Seth FSA, CERA, FCIA

This analysis reports the impact of a recent series of Atmospheric rivers in California during Feb 03 - 07, 2024.

We can see that precipitation extremes were not concentrated in one area of California but extended all the way up the coast to Northern California. However, by looking at the percentiles, we can see that Los Angeles had the most extreme weather.

As per the GHCN daily rainfall data, three weather stations appear to have experienced their heaviest rainfall event since 1980, centered in Los Angeles: LAX, Torrance, and Long Beach.

Considering that this is also one of the densest populated areas of California, this event looks to have been very significant in terms of population exposure.

https://www.soa.org/2024/act-weather-extremes-cali-precipitation.pdf

For the Earth as a Whole, 2023 Was the Hottest Year on Record – January 2024

By Patrick Wiese, ASA

For the Earth as a whole, 2023 was the hottest on record according to data produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). Based on ECMWF data, the average worldwide air temperature1 in 2023 was 58.95F, which is more than 1.5F above the historical average of 57.42F computed across the period from 1960 to 2022. The standard deviation of the time series of global average temperatures is 0.62F; therefore, a temperature anomaly of 1.5F is equivalent to about 2.5 standard deviations above the 1960-to-2022 average.

https://www.soa.org/research-report/2024/actuarial-weather-extremes-2023-hottest-year.pdf

Five Consecutive Months of Record-High Global Average Temperatures – October 2023

By Patrick Wiese, ASA

According to data produced by the European Centre for Medium-Range Weather Forecasts (ECMWF), the average worldwide temperature exceeded the prior record-high for each of the last five months, from June 2023 through *October 2023*

https://www.soa.org/2023/act-weather-extremes-five-month-record-heat.pdf

The Actuary magazine

Checkout the recent articles in *The Actuary* magazine:

Impact of Climate Change on Life Insurers, September 2023

Insights on underwriting, pricing, and investment management
By *Sam Gutterman, FSA, FCAS, MAAA, CERA, FCA, HonFIA*
https://www.theactuarymagazine.org/impact-of-climate-change-on-life-insurers

Weather Perils and Carbon Policies, November 2023

Actuarial insights from climate scenario analysis
By *Timothy Cheng, ASA*
https://www.theactuarymagazine.org/weather-perils-and-carbon-policies/

Climate's Effects on Human Health, November 2023

Climate change is coming home to roost.
By *Sara Goldberg, FSA and Hannah Clouser, FSA*

SOA Call for Essays

Catastrophe & Climate Steering Committee had recently sponsored two Call for Essays, read below the selected submissions.

Climate Change Contributions to Key Adverse Effects from Excessive Heat

It's Hot Outside! *by Sam Gutterman, FSA, CERA, FCAS, MAAA, FCA, HonFIA*

https://www.soa.org/2023/exccessive-heat-essay-gutterman.pdf

Severe Thunderstorm Frequency, Severity, and Vulnerability of Populations in the U.S.

Navigating the Storm:

The Actuarial Role in Addressing Severe Thunderstorm Risks *by Tianyang Wang, Ph.D., ASA, CFA, FRM*

https://www.soa.org/2023/severe-thunderstorm-frequency-severity-and-vulnerability-of-populations.pdf

In the News

By Priya Rohatgi, ASA

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

1. Loosing Fight Against Malaria

https://www.bloomberg.com/papua-new-guinea-s-losing-fight-against-malaria-is-a-lesson-for-the-world
Researchers blame changes to a Swiss company's bed nets for a rise in malaria thousands of miles away.

> One Business Decision Made the World's Losing Battle With Malaria Even Tougher, Feb 21, 2024
>
> Cheap, durable and easy to distribute, insecticide-coated bed nets have for more than two decades been a vital tool in managing malaria, which causes symptoms ranging from a racking cough to kidney failure and can kill in less than 24 hours. Nets don't just safeguard the people sleeping underneath — their chemical coatings can quell a contagion and reduce mosquito infestation by killing the insects. They have been credited with preventing 68% of malaria cases between 2000 and 2015, according to the Bill & Melinda Gates Foundation.
>
> But in the years since, something has gone badly wrong.
>
> The chemical coating on bed nets used in Papua New Guinea was changed without disclosure, leading to an 88% spike in malaria infections.
>
> www.bloomberg.com

2. Silent Hazard – underground climate change

https://www.ft.com/content/5eaba8d7-949f-4d71-9512-102f1bcfef82
Chicago, the city has reinvented itself before and may need to do so again.

> Sinking skyscrapers, new beaches: Chicago faces the climate crisis, Feb 19, 2024
>
> Of course, this Midwestern metropolis is far from alone in suffering the scourge of subsidence. Venice, Jakarta, New York and cities along the US East Coast are all sinking too. But marooned inland, Chicago doesn't share their rising sea-level worries — although it was built on marshland.
>
> According to a recent study by Northwestern University, there's a "silent hazard" beneath the streets: subsurface heat islands that deform the ground. Northwestern researcher Alessandro Rotta Loria says it's the first study to quantify the effect of "underground climate change" on urban infrastructure, which threatens cities around the world, especially those built near water.
>
> The team collected three years of temperature data from 150 underground sensors and found that beneath some buildings in the Chicago Loop — those in the central business district that create the famous skyline — it can be 18°F hotter than under local Grant Park, a large green area near Lake Michigan. He says underground climate change is the subterranean corollary of the "surface heat islands" in many US cities, but more subtle.
>
> www.ft.com

3. Natural Asset Companies: market based solution to environmental degradation

https://www.nytimes.com/natural-assets.

"Natural asset companies" would put a market price on improving ecosystems, rather than on destroying them.

> Nature Has Value. Could We Literally Invest in It?, Feb 18, 2024
>
> So in 2017, Mr. Eger founded the Intrinsic Exchange Group with the goal of incubating natural asset companies, NACs for short. Here's how it works: A landowner, whether a farmer or a government entity, works with investors to create a NAC that licenses the rights to the ecosystem services the land produces. If the company is listed on an exchange, the proceeds from the public offering of shares would provide the landowner with a revenue stream and pay for enhancing natural benefits, like havens for threatened species or a revitalized farming operation that heals the land rather than leaching it dry.
>
> If all goes according to plan, investments in the company would appreciate as environmental quality improves or demand for natural assets increases, yielding a return years down the road — not unlike art, or gold or even cryptocurrency.
>
> www.nytimes.com

4. Voltage fluctuations due to power grid instability imperil homes

https://www.bloomberg.com/us-grids-face-unpredictable-power-surges-with-potentially-dangerous-consequences

The US power grid is struggling to maintain an even flow of electricity — and putting homes at risk.

> Unpredictable Power Surges Threaten US Grid — And Your Home, Feb 14, 2024
>
> Power quality issues in the US are becoming increasingly problematic and pose a threat to the electrical grid and homes. Unstable surges or sags in voltage can lead to fires and other disasters, but utilities and regulators often lack.
>
> www.bloomberg.com

5. eDNA sampling – A new global disease surveillance system

https://undark.org/edna-emerging-pathogens

In their quest to detect early outbreaks, virus hunters are sampling environmental DNA in water, dirt, and air.

> The Uncharted World of Emerging Pathogens, Feb 14, 2024
>
> The field of eDNA research has mushroomed in the last 15 years as sequencing, computing technology, and metagenomics — the study of DNA from multiple organisms — has advanced. Now, scientists around the world can sample from a cup of dirt, a vial of water, or even a puff of air, and survey the eDNA present for thousands of microbial species. And while the field at-large has faced concerns about privacy and technical limitations, many scientists see an opportunity to further early detection of emerging pathogens. Wastewater surveillance is the most advanced method for monitoring population-level virus spikes, but other realms are catching up. As a result, health officials are becoming better prepared to detect an outbreak — and quickly take steps to contain it.
>
> www.undark.org

6. Health Insurance: Is that the next tipping point?

https://www.wsj.com/climate-change-has-hit-home-insurance-is-health-insurance-next

Insurers are adjusting to assessing climate risk as extreme heat and air pollution have been linked to a rise in hospitalizations.

> Climate Change Has Hit Home Insurance. Is Health Insurance Next?, Feb 14, 2024
>
> Climate change is making house insurance more expensive and harder to get. Health insurance could be next, as research shows extreme heat and wildfires are putting more people in the hospital.
>
> After the hottest year on record and increasingly extreme weather events, health insurers are battling to figure out how climate change is going to affect their business. The companies are building new models to reassess premiums, estimate risk and meet incoming climate reporting standards as coverage costs rise in a warming world.
>
> www.wsj.com

7. Rising insurance premiums exacerbate affordability crisis

https://www.ft.com/content/ed3a

Rising premiums are a de facto 'carbon price' on consumers as extreme weather events become more frequent.

> The uninsurable world: what climate change is costing homeowners, Feb 13, 2024
>
> As firms exit some areas and demand higher premiums in others, affordable home insurance cover — for many an essential annual outlay, often a condition of their mortgage debt — is getting harder to secure.
>
> The affordability crisis has society-wide impacts, from where people choose to live to where they decide to retire. Growing costs are "having effects on the valuation of properties, the stability of markets, it's having all these downstream implications," says Steve Bowen, chief science officer at reinsurance broker Gallagher Re. "There are discussions now about where people are going to retire. Are they [still] going to Florida?"
>
> www.ft.com

8. An emerging fungal disease - Valley fever

https://grist.org/intensifying-atmospheric-rivers-are-leading-to-a-surge-in-valley-fever-cases-in-california

The fungal pathogen is thriving as the Golden State bounces between drought and flooding.

> Intensifying atmospheric rivers are leading to a surge in Valley fever cases in California , Feb 12, 2024
>
> The flooding caused by intensifying winter rainstorms in California is helping to spread a deadly fungal disease called coccidioidomycosis, or Valley fever.
>
> There's evidence that Coccidioides is already taking advantage of a warming U.S. The Centers for Disease Control and Prevention report that Valley fever cases in the U.S. rose from 2,271 in 1998 to 20,003 cases in 2019 — a 780 percent increase. In Arizona, where two-thirds of Valley fever diagnoses typically occur, cases rose 600 percent. But Coccidioides spores have cropped up in new regions in recent years, expanding through Southern California and into Northern California, even up into the drier parts of Oregon and Washington states. The rate of growth of Valley fever in California is higher than in Arizona; cases there rose more than 1,000 percent over the same time period. "What kind of disease do you see a 1,000 percent increase in a matter of two decades?" Yang asked. "This is one of the few."
>
> http://www.grist.org

9. Methodology mayhem – conflicting views on 1.5C global warming

https://www.economist.com/how-to-know-when-the-world-has-passed-15degc-of-global-warming

Explained using four charts…

> How to know when the world has passed 1.5°C of global warming Feb 09, 2024
>
> The Paris numbers, particularly the lower target, have become totemic. Yet the agreement does not precisely define its thresholds or when they will be passed. This mattered less when the world was still a good way from the first milestone—in 2015 the world was just 1°C warmer than pre-industrial levels. But that is no longer the case.
> www.economist.com

10. New Rule…

https://theconversation.com/4-essential-reads-on-the-health-effects-drivingepas-new-fine-particle-air-pollution-standard

Scientists from NOAA, NASA and 21 universities from three countries are deploying state-of-the-art instruments in multiple, coordinated research campaigns this month to investigate how air pollution sources have shifted over recent decades.

Heart attacks, cancer, dementia, premature deaths: 4 essential reads on the health effects driving EPA's new fine particle air pollution standard Feb 08, 2024

The U.S. Environmental Protection Agency has announced a new standard for protecting the public from fine particulate air pollution, known as PM2.5 because the particles are smaller than 2.5 millionths of a meter. These minute particles can penetrate deeply into the body and have been linked to many serious illnesses.

The new rule sets an annual limit of 9 micrograms per cubic meter of air, down from the previous level of 12 micrograms. States will be required to meet this standard and to take it into consideration when they evaluate applications for permits for new stationary air pollution sources, such as electric power plants, factories and oil refineries.
In the four articles that follow, scholars wrote about the many ways in which exposure to PM2.5 contributes to cardiovascular disease, lung cancer, other illnesses such as dementia, and premature deaths.
www.theconversation.com

11. Underground Infrastructure at risk: knock-on effect of sea level rise on coastal groundwater

https://knowablemagazine.org/asea-level-rise-groundwater-flooding-basement-broken-pipes

Sea level rise won't hit just homes on shorefronts, but also the infrastructure beneath our feet.

The hidden threat from rising coastal groundwater, Feb 07, 2024

As sea level rises, coastal groundwater levels rise too.

Cities have a crucial network of underground infrastructure, including water pipes, sewer systems, stormwater drains, electrical and fiber-optic lines and support structures for roadways and buildings. As coastal groundwater rises in our urban areas, it can flood this subterranean network. Often, that water is salty and corrosive.

Honolulu is particularly susceptible to groundwater rise because parts of the city were built on a wetland: During land reclamation projects in the early to mid-20th century, the area was filled with a thin layer of soil for development. Honolulu's underground infrastructure lies within this thin and porous veneer. But Honolulu is not unique; many major coastal cities were also expanded onto reclaimed land, including San Francisco, Boston, New York, Los Angeles, Tokyo, Osaka, Mumbai, Hong Kong, Singapore, Amsterdam and many others.

www.knowablemagazine.org

12. Power outages: poor last in line for restoration of service

https://theconversation.com/power-outages-leave-poor-communities-in-the-dark-longer

Electricity is essential to just about everyone – rich and poor, old and young. Yet, when severe storms strike, socio-economically disadvantaged communities often wait longest to recover.

> Power outages leave poor communities in the dark longer: Evidence from 15M outages raises questions about recovery times, Feb 07, 2024
>
> That isn't just a perception.
> We analyzed data from over 15 million consumers in 588 U.S. counties who lost power when hurricanes made landfall between January 2017 and October 2020. The results show that poorer communities did indeed wait longer for the lights to go back on.
>
> A 1-decile drop in socioeconomic status in the Centers for Disease Control and Prevention's social vulnerability index was associated with a 6.1% longer outage on average. This corresponds to waiting an extra 170 minutes on average for power to be restored, and sometimes much longer.
> www.theconversation.com

13. The Saffir–Simpson Hurricane Wind Scale inadequate for extreme storms

https://www.theatlantic.com/category-6-hurricanes-saffir-simpson-scale

Climate change could double the risk of hurricanes with wind speeds greater than 192 miles an hour in the Gulf of Mexico.

> Hurricanes Are Too Fast for Category 5, Feb 05, 2024
>
> Right now, every hurricane with maximum sustained wind speeds above 156 miles an hour is considered a Category 5 on the Saffir-Simpson Hurricane Wind Scale—whether it's blowing 160 mph, like Hurricane Ian, or roughly 215 mph, like Hurricane Patricia, which struck Mexico in 2015. To distinguish between extreme storms and, well, extremely extreme storms, James Kossin, a distinguished science adviser at the climate nonprofit First Street Foundation, and Michael Wehner, a senior scientist studying extreme weather events at Lawrence Berkeley National Laboratory, explored adding a hypothetical sixth step to the scale. Category 6 hurricanes, they write, would encompass winds above 192 miles an hour. By their definition, five hurricanes—all of which occurred in about the previous decade—would have been classified as Category 6.
>
> Latest study: The growing inadequacy of an open-ended Saffir–Simpson hurricane wind scale in a warming world
>
> www.theatlantic.com

14. Visualization: Cascading effects of climate disasters

https://www.scientificamerican.com/article/visualizing-climate-disasters-surprising-cascading-effects/
See how climate disasters cause rippling effects far beyond the initial event.

Visualizing Climate Disasters' Surprising Cascading Effects, Feb 01, 2024

When people imagine the aftermath of a natural disaster, skin infections and gastrointestinal illnesses aren't usually the problems that come to mind. But these conditions are embedded in a cascade of extensive and often unexpected consequences of wildfires, hurricanes, and other calamities related to climate change. A report entitled *Atlas of Disaster* connects the dots between the initial effects of climate hazards and the longer-term outcomes. Most of the U.S. is already feeling the impact—90 percent of American counties experienced a climate-related disaster in the decade from 2011 to 2021, and some have seen many. The damage is even worse in numerous other parts of the world.

www.scientificamerican.com

15. 'Systemic Resource Efficiency': increase equity and reduce GHG

https://amp-theguardian-com.cdn.ampproject.org/raw-materials-extraction-2060-un-report
Report proposes action to reduce overall demand rather than simply increasing 'green' production.

Extraction of raw materials to rise by 60% by 2060, says UN report, Jan 31, 2024

Janez Potočnik, a former European commissioner and a co-chair of the UN panel that produced the analysis, said a gouging of raw materials on the scale predicted would almost certainly trigger more frequent and more severe storms, droughts and other climate disasters.

The report prioritizes equity and human wellbeing measurements over GDP growth alone and proposes action to reduce overall demand rather than simply increasing "green" production.

This sort of "systemic resource efficiency" could increase equity and reduce greenhouse gas emissions by more than 80% by 2060, compared with current levels. Material and energy needs for mobility could be cut by more than 40% and for construction by about 30%, according to the report.

www.theguardian.com

16. The Perverse Policies That Fuel Wildfires

https://www.newyorker.com/the-perverse-policies-that-fuel-wildfires

Strategies intended to safeguard forests and homes have instead increased the likelihood that they'll burn.

The Perverse Policies That Fuel Wildfires, Jan 29, 2024

Once the U.S. government had pushed Native Americans onto reservations and seized their land, controlled burning ceased across much of the country. Then the U.S. Forest Service moved to eliminate wildfires entirely. The U.S. government's policy of fire suppression began with Gifford Pinchot in 1905, who considered flames to be the enemy of the trees. The policy was reinforced after the Big Blowup of 1910.

In 1933, the Roosevelt Administration created the Civilian Conservation Corps, one of the earliest New Deal programs. The C.C.C. put millions of (mostly single) men to work on projects that included building fire lookouts, digging firebreaks, and fighting forest fires. In 1935, the leader of the Forest Service, Ferdinand Silcox, announced the "10 A.M. Policy." All fires on Forest Service land were to be extinguished by the morning after the day they were reported. Other federal agencies, following the Forest Service's lead, soon adopted similar policies. Though many blazes pushed past the 10 A.M. deadline, the policy remained in effect until the late nineteen-seventies.

www.newyorker.com

17. Commercial real estate portfolios: a more granular risk-assessment needed

https://blogs.cfainstitute.org/climate-risk-and-the-future-of-us-commercial-real-estate/

Climate risks and the CRE loan market have many points of intersection that spotlight the urgent need for community and regional banks to recalibrate their risk assessment frameworks.

Climate Risk and the Future of US Commercial Real Estate, Jan 17, 2024

The imperatives of climate change demand enhanced risk management in the commercial real estate (CRE) loan market: Investors and lenders must refine their strategies and conduct meticulous property-level risk assessments as part of their credit analysis. Community and regional banks are particularly susceptible to climate-related financial risk due to their CRE loan balance sheet exposure and must navigate unpriced climate risks to ensure balanced and resilient loan portfolios. To maintain portfolio health and overall stability, these institutions must exercise ongoing vigilance in their risk monitoring.

blogs.cfainstitute.org

Studies/Research Published Outside the SOA

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.

A One-Stop Shop for Weather and Climate Information: My take on this year's annual American Meteorological Society Meeting

By Dr. Peter Sousounis,

The 104th Annual Meeting of the American Meteorological Society (AMS) was held in Baltimore, MD during Jan 26-Feb 2, 2024. The Annual AMS Meeting is the world's largest yearly gathering for the weather, water, and climate community. And lately, because climate change is becoming increasingly important, it is also attended by policy makers, politicians, and investors. This year included 52 different conferences and symposia – all tied together with a common theme of *Living in a Changing Environment*.

I had the pleasure of not only attending, but also the honor of presenting in two of the programs. Kicking things off on a Saturday morning was a two-day long student conference where soon-to-be graduates had an opportunity to showcase their work as well as to learn what the job market is like for them. I spoke as part of a panel during the session: So You Want to Study/Work on Insurance and Risk Analysis. I spoke about insurance industry concerns around climate change and I was joined by Ms. Brenna Meisenzahl (IBHS) who talked about *Wind and Hail in the Built Environment*; Jeff Schmidt (Guy Carpenter) who spoke on *Letting the Meteorological Cat(astrophe) out of the Bag*; and Shaveta Gupta (NAIC) who opined on *Charting a Career in Catastrophe Modelling: The Path to Protecting the Future*. The session was beautifully arranged and moderated by Dr. Jacob Hale from Texas A&M. Several dozen students were in attendance, and more were watching online. After we gave our presentations, we were answering great student questions like - *what skills are really needed for entry positions – and how important coding experience is (this seemed to be a big and general concern)*. The questions continued informally afterward as well. And the student conference continued through the weekend.

The Presidential Forum was the formal meeting kick-off on Sunday late afternoon just as the Chiefs were chiseling away the Baltimore Ravens' hopes for a Superbowl appearance a few hundred meters away. After some opening remarks by 2023 outgoing AMS President (Brad Coleman), a very engaging Fireside Chat was moderated by Professor Emeritus (MIT) Kerry Emanuel with panelists Bob Inglis (executive director of republicEn.org) and Monica Medina (president and CEO of the Wildlife Conservation Society) on the topic of how best to communicate the importance of climate change to the public.

On Monday morning I was up early for my second presentation, which was a discussion of Future Climate Change Projections of Wildfire Risk in Western U.S. My discussion was mostly guided by those from the study done for the SOA in 2021. In fact, I prefaced my talk with a plug for the SOA Research Institute and that it can be a source for research funding. (I noted a packed room of eyes light up - like coffee had just kicked in.) In my talk, I included some updates from the more recent study but could not say more because of confidentiality considerations. Importantly, I did say that despite extending the historical data from 2015 to 2020, creating new climate-wildfire relationships, and allowing for dynamical feedbacks (e.g., area that just burned can't burn again right away and scarred areas also act as fire breaks to impede future large fires in the area) that qualitatively the results in terms of which areas would become the most risker by 2050, did not really change.

There were many other talks on extreme weather and climate change throughout the week. And of course, there was tons more content on other important weather-related topics across the entire 52-symposia constellation of meetings. And even though I could only stay through Wednesday evening to catch the Annual Awards ceremony, I returned to snowy Boston exhausted but intellectually satisfied that I had caught up on the latest (climate) science had reconnected with colleagues.

It is too difficult to even say what the best takeaways were. From my standpoint though, a very important one was that the science of climate change attribution – that is responsible for quantifying the human fingerprint on extreme weather - has matured considerably since it was formally introduced in 2004. It is now to the point where the anthropogenic effect on even individual extreme weather events can be assessed and within hours. Quantifying the effect adds context to the impact of climate change and can further motivate effective change. The importance of the topic was further recognized by granting the Carl-Gustaf Rossby Research Award to Dr. Ben Santer for his *outstanding contributions to comprehending how climate change affects atmospheric structure and behavior based on detection and attribution methods*.

In closing, I will say that while the AMS hosts other subject-specific conferences throughout the year (e.g., conferences devoted entirely to radar meteorology, weather forecasting and numerical weather prediction, tropical meteorology and hurricanes, severe storms – to name but a small subset) the annual meeting is my one-stop shopping and gives me the biggest bang for my buck, even though it also makes my head spin and legs weary racking up 10000+ steps / day just going from one talk to the next. I therefore encourage you to take virtual steps using the hot links I have set for starters, and possibly follow up with authors or contact me on LinkedIn for any general AMS questions or any specific questions on what I presented while I was there.

Dr. Peter Sousounis, Independent Climate Risk Consultant & SOA Research Institute's Catastrophe and Climate Strategy Research Steering Committee member

Temporal compounding increases economic impacts of atmospheric rivers in California, January 2024

By Corinne Bowers, Katherine A. Serafin, Jack W. Baker

This recent study by the scientists from Stanford and the University of Florida indicates that when multiple atmospheric rivers hit California back-to-back, the economic damage from resulting rain and snowfall is three to four times higher than predicted from individual storms. The insights from this research could not only help water managers and disaster planners, better prepare for future impacts of climate change but will also help improve public communication about the dangers of incoming atmospheric rivers and help flood insurance companies analyze potential risks.

Temporally compounding atmospheric river (AR) events cause severe flooding and damage in California. However, the contribution of temporal compounding to AR-induced loss has yet to be systematically quantified. We show that

the strongest ARs are more likely to be part of sequences, which are periods of elevated hydrologic hazard associated with temporally clustered ARs. Sequences increase the likelihood of flood-related impacts by 8.3% on AR days and 5.4% on non-AR days, and across two independent loss datasets, we find that ARs within sequences have over three times higher expected losses compared to ARs outside of sequences. Expected losses also increase when the preceding AR is higher intensity, when time since the preceding AR is shorter, and when an AR is the second or later event within a sequence. We conclude that temporal compounding is a critical source of information for predicting an AR's potential consequences.

https://www.science.org/doi/10.1126/sciadv.adi7905

California SB 253 and SB 261: What Businesses Need to Know, Feb 2024

California has passed two new laws requiring businesses to disclose their carbon emissions and climate-related financial risks. These new laws cement the shift from voluntary climate reporting to mandatory reporting, further raising the bar for corporate climate action.

The state's laws are part of a wave of climate disclosure laws that include the European Union's Corporate Sustainability Reporting Directive (CSRD) and pending regulations from the US Securities Exchange Commission (SEC).

The new laws make California the first state in the US to require climate transparency at this level — and they will have a ripple effect beyond the state's borders. California is a major player in global markets and is rapidly moving up the ranks to become the world's fourth-largest economy, overtaking Germany.

Carbon emissions: Climate Corporate Data Accountability Act (Senate Bill 253)

- *Law SB 253 requires large public and private US-based organizations that do business in California to disclose their greenhouse gas emissions in accordance with the GHG Protocol. The policy applies to US-based partnerships, corporations, limited liability companies, and other entities with operations in California and annual gross revenue of more than $1B USD — an estimated 5,400 companies.*
- *The move from a voluntary reporting landscape to a regulated one, emissions data will be treated in a similar manner to financial data — it will need to undergo intense financial and legal internal review, as well as third-party assurance.*
- *Under the law, impacted companies will need to report their full carbon inventories, including scope 3 emissions. By 2026, companies will need to adhere to Greenhouse Gas Protocol (GHGP) standards for measuring and reporting scope 1 and 2 emissions based on the prior fiscal year's data. They will also need to obtain limited third-party assurance for scope 1 and 2 emissions. By 2027, companies will need to adhere to the GHGP standards for measuring and reporting scope 3 emissions based on the prior fiscal year's data. By 2030, companies will need to obtain reasonable, third-party assurance for their scope 1 and 2 emissions reporting, as well as limited third-party assurance for their scope 3 emissions reporting.*

- *Climate Corporate Data Accountability Act stipulates that companies will have to submit emissions calculations to a digital reporting platform, and they must make disclosures easily comprehensible to residents, investors, and other stakeholders.*

- *The California Air Resources Board will oversee reporting and ensure verification of data by a registry or third-party auditor with expertise in carbon accounting. Companies that fail to comply with the new regulations could be subject to civil penalties from the state's attorney general.*

- *SB 253 does not address industries specifically.*

The Climate-Related Financial Risk Act (Senate Bill 261)

- *The bill applies to any US corporation or business entity with annual revenue over $500M USD doing business in California — a lower threshold than SB 253.*

- *Affected organizations will need to provide a biannual climate-related financial risk report detailing the physical and transition threats they face due to climate change, as well as the measures they're taking to mitigate and adapt to those risks.*

- *SB 261 is modeled after existing climate disclosure rules used by the state's teachers' retirement fund (CALSTRS) and hundreds of major financial institutions. It aims to safeguard consumers and investors from losses resulting from climate-related disruptions to supply chains, workforces, and infrastructure, which are increasing because of climate change.*

- *The initial round of climate risk disclosure reports will be due by January 1, 2026.*

- *Submissions will be reviewed by the Climate-Related Risk Disclosure Advisory Group, which will identify inadequate reports, as well as propose additional policy changes and best practices for disclosure.*

- ***Notable exception: Companies subject to regulation by the California Department of Insurance or that are in the business of insurance in any other state would be excluded**.*

- *The bill also addresses the financial risks businesses could face if they are unprepared for the transition toward a low-carbon economy. For instance, automobile manufacturers who fail to prepare for the shift towards electric vehicles will likely experience a decline in market share, resulting in revenue losses.*

A Comparison to the SEC's Proposed Climate Disclosure Rules

While California's SB 253 shares common ground with the SEC's climate proposal, it extends beyond the federal rule on two critical fronts:

- ***Type of emissions reported** - The SEC proposal would require all public companies to disclose scope 1 (direct emissions from their owned operations) and scope 2 (indirect emissions from purchasing electricity, steam, heating, and cooling) emissions. Businesses would only report on scope 3 emissions if they have set scope 3 reduction targets or if scope 3 emissions are deemed material. Moreover, smaller companies would not have to report their scope 3 emissions.*

California goes further. Its new policy calls for disclosure of all three types of emissions for any US company operating in the state with annual revenue over $1B USD. This is significant, as scope 3 emissions often make up the lion's share of corporate carbon inventory.

- ***Type of company required to report** - The proposed SEC rule targets public companies reporting to the SEC, including U.S. public companies and Foreign Private Issuers.*

California's policy targets both public and private entities. This could help drive decarbonization of the private market and would enable investors to initiate climate action across multi-asset portfolios.

https://www.persefoni.com/california-sb253-sb261#a-comparison-to-the-sec-proposed-climate-disclosure-rules

IAA Podcast - COP 28: The Key Takeaways and Insights for the Global Actuarial

Two IAA delegates, Rade Musulin (Chair of the IAA Resource and Environment Working Group and member of the IAA Climate Risk Task Force) and Simon Curtis (Chair of the IAA ISAP 8 Task Force and member of the Executive Committee) attended COP 28, representing the IAA on behalf of the global profession. In this IAA podcast Gabor Hanak (Chair of the IAA Climate Risk Task Force) leads a discussion with Rade and Simon taking us through their key takeaways and insights from COP28 as it relates to the global actuarial profession.

Following are some of the key points discussed*:*

- Climate and sustainability have become increasingly important to our profession, and this is evidenced by the great deal of activity among IAA's full member associations and many IAA initiatives including the paper series on climate related risk which has been developed to help educate actuaries.
- COP vs COP 28: COP27 focused more on adaptation and how to help developing countries and emerging economies cope with the effect of climate change while COP 28 focused on mitigation and language on fossil fuels. A key aspect of the climate initiatives discussed at COP 28 related to the monitoring and disclosure of emissions levels and the risk exposures impacts and transition plans for entities.
- Role of Actuaries: With respect to ISSB standards IFRS S1 and IFRS S2 – As we are moving from building the framework for standards to implementing them. An important part of that will be developing metrics and measures which is core to the Actuarial profession.
- Actuaries are well suited to help explain the huge uncertainty related to climate change and how firms are meeting their commitments.
- Actuaries can bring significant value due to their unique perspectives on Extreme events, risk management and also their service to the financial services industry.
- Also, important is that as actuaries we have professionalism standards which give our stakeholders and people who use our services confidence in the information and services that we deliver. It's important to get this message out to stakeholders as our profession is not top of mind for many of the scientists and other people who go to places like COP.
- The insurance sector is seen as critical to closing protection gaps and sending the right risk signals which help prioritize investments in protecting communities from the effects of climate risk.
- Life expectancy and health impacts of climate change were still considered more of an art than science but there were couple of studies discussing heat stress and its implications.
- For the actuaries working in the area of life and health, studies presented at the COP showed that in modeling, what if climate scenarios, heat events could cause significant mortality even in very developed economies. For instance, in Canada a repeat of 2003 North American Heatwave power outage would now cause significantly higher mortality than it did at that time due to aging population and with change in living arrangements such as more high-rise housing. In addition, heat driven and drought driven wildfire events can cause significant mortality like California and Hawaii. Canadian wildfires with the smoke induced pollution can have potential implications for long-term health issues.

- Two most relevant issues from IAA's perspective that were quite prominent at COP 28.
    - Water issue, - which is the key focus of the newly formed IAA task force. There were discussions around water conservation, agriculture and urban planning.

- United Nations Sustainable Development Goals- which is the focus of another IAA task force. The message of the experts was that all the SDGs are being adversely impacted by climate change but more importantly by addressing sustainable development will help improve the climate and thereby reduce the impact of climate change.

In the discussions on sustainability there was a particular focus on nature risk and biodiversity and environmental preservation.

- IAA members also touched upon the challenges of the emerging (specifically Africa) - pointing out a huge shortfall in the area of knowledge about insurance space.
- Hence there's a great opportunity to build the global actuarial profession by providing education and building techniques that are tailored to the local needs such as the Agriculture and micro Insurance products such as the parametric insurance.

https://www.youtube.com/watch?v=n2k1lnLOQsE&t=2s

Understanding Extreme Heat: An Increasing Risk for People, Businesses and Society, November 2023

In the wake of record-breaking high global temperatures in 2023, the rising frequency of extreme heat due to climate change creates an urgency for the risk industry to analyze climate trends for better risk mitigation.
Key Takeaways:

- *Of all perils, heatwaves pose the greatest threat to human health and life, causing more fatalities in the US than any other weather or climate-related peril.*
- *This rising frequency of extreme heat due to climate change creates an urgency for the risk industry, and businesses within the broader economy, to understand the diverse impacts of these events.*
- *Organizations spanning insurers to highly impacted sectors such as construction, agriculture and real estate need forward-looking diagnostics to help analyze climate trends and mitigate the risk.*

https://www.aon.com/en/insights/articles/understanding-extreme-heat

Podcast: TNFD and Beyond - An Introduction to Nature in Finance, November 2023

Hear from Simon Zadek, Executive Director at NatureFinance and Senior Advisor to the TNFD, as we explore the growing intersection of nature and finance.

This podcast takes a closer look at the concept of nature in finance. It covers the following:

- *How it's defined, and what risks it presents to our economies;*
- *What the TNFD framework covers and what this means for risk professionals; and*
- *The risks and opportunities that nature presents.*

https://www.garp.org/podcast/tnfd-nature-finance-cr-110923

Book Recommendations

The Blue Machine, by Dr. Helen Czerski

Reviewed by Max J. Rudolph

In my time learning about climate change/global warming the material has focused on interactions with the atmosphere, but the total excess heat energy in the atmosphere is overwhelmed by that in the oceans. We take the oceans for granted. They are so big that we think nothing can harm or even change them. Unfortunately, this is far from the truth and 8 billion humans are changing it very quickly and in ways that make it unlivable for some sea creatures. Fish have been eradicated in areas that were once thought to have infinite quantities. Much as we did with large animals that lived on land, our influence is leading many large ocean animals to extinction.

Greenhouse gases are released into the air, usually by burning non-renewable fossil fuels, and act like a blanket holding in radiation that would otherwise have escaped to space. Carbon in the atmosphere drives temperature. I knew that carbon was also found in the soil and plants, and that an unknown amount of carbon could be found in the oceans. In a quest to learn more I ran across an excerpt of The Blue Machine, a 2023 book written by Dr. Helen Czerski, in the Wall Street Journal. Reading the book did not disappoint. Dr. Czerski is a British physicist by training and combines excellent storytelling skills, using experiences to explain concepts. I learned a lot and recommend both this book and author.

How Oceans Work

Similar to learning about greenhouse gases in the atmosphere, understanding the impact of carbon in the oceans requires a basic understanding of how the oceans work, how circulation occurs and how water separates into layers. Ocean circulation patterns create ways for heat to move from the equator toward the poles, making it easier for people to live in areas like northern Europe. This cyclical movement of warm and cold water occurs in each ocean that interacts with the poles, with the equator serving as an asymptotic barrier. This means that the Atlantic and Pacific Oceans each have two patterns, one on each side of the equator. Each of these also interacts with the atmospheric air currents that come in contact with them. These ocean cycles allow energy to be redistributed through temperature, salinity, density and spin as it plays out through wind, waves, evaporation and currents between the equator and poles.

Warm water is carried toward the poles. Colder water near ice is denser, sinking and starting a slow trek back toward the equator. Salt concentration plays a role since fresh water floats relative to salt water. Ice drives salt out of the water, meaning that melting ice is nearly fresh water and is less dense. Light is plentiful at the top of the ocean, but nutrients are found in the depths. The food pyramid needs phytoplankton to grow so needs both, along with carbon dioxide and water, to live. Something must force the nutrients up, and where that happens huge food sources appear. The west coast of South America sees this phenomenon and the result is up to 20% of the global fish catch. Even some of these areas have been overfished and collapsed.

The Ocean Engine

The polar oceans drive the ocean engine and currents. Ice there is less dense so is buoyant. The layer below it becomes extra salty as the ice pushes out the salt and the higher density water sinks. This process is being threatened in the North Atlantic as ice on Greenland melts and enters the ocean as cold fresh water. Without the denser saltwater that sinks, the cycle to return cold water to the south could stop.

Some seas are nearly cut off from the rest of the oceans so have extreme levels of salt, in both directions. For example, the Mediterranean Sea is very salty since evaporating fresh water is not offset by incoming water from rain

and rivers, while the Baltic Sea is nearly fresh since it gets lots of incoming water relative to evaporation. This matters in part because density is the driver of ocean circulation.

An extended continental shelf in the North Atlantic marks a separation between cold, dense and salty Arctic water and the warmer north Atlantic water arriving from the Caribbean that is less dense. Water flows off the ledge and down on the southern side like a waterfall. This allows the Gulf Stream to continue its journey north toward Europe, carrying warm water in the surface layer.

Ocean Details

Dr. Czerski tells fascinating tales including life at the bottom of the ocean near volcanic vents, plants that grow in the ocean, wind and mountains that provide the source of the Nile, and how light and sound move through water.

The oceans consist of layers of water, separated by density with the freshest water on top and more salty water as you move deeper (along with nutrients). This allows sound to travel long distances as it bounces within a layer for thousands of miles. There are also internal waves within a layer, leading sometimes to conditions where a sailing ship is dead in the water, extremely inconvenient for a warship.

The oceans near the poles have distinct characteristics. The ice has high albedo, so reflects radiation (sunlight) back into space, but also negates the role of waves in distributing energy between air and water. The water just below the ice has low salinity and is slightly warmer than freezing.

Where warm and cold waters mix, nutrients draw every part of the food chain to an ocean front area. These regions are predictable so important to many bigger predators like penguins who have to travel far and can't stay long before returning to their young. For those with less pressing time demands, spinning islands of water form consistently but not in the same place in some regions of the ocean and are a buffet for big feeders like the bluefin tuna.

The Ocean's Role in Climate Change

Only in the final chapter does Dr. Czerski focus on the interaction of the oceans with climate change strategies. In general, the problem can be defined pretty simply – more energy is being added to the system than leaves it. Less than 300 years ago the system was in balance, with natural cycles making small changes over many years in a stable environment. Human activity has added energy to the oceans, with much of the heat found in the surface layer. This is a problem since nutrients reside in cold water below the surface, so phytoplankton is starved if the layers don't mix. The warmer surface layer forces more warmth into the atmosphere through wind and wave interaction and stronger storms.

The ocean absorbs about one-third of the excess carbon dioxide in the atmosphere. It is unclear if this ratio will continue. As temperatures increase, about a third of sea level rise is due to thermal expansion – warmer water expands. The fresh water entering the oceans that was previously ice changes the ocean's density and salinity, with the ocean layers changing in ways we are still discovering.

Oxygen levels have dropped by 2% in the ocean over the past century, partially tied to the lack of oxygen given off by phytoplankton photosynthesis and a warmer ocean. This is already being felt in layers below the ocean's surface. Warmer water will absorb less carbon dioxide, leaving it in the atmosphere. Ocean acidification is another by-product of additional carbon dioxide in the ocean. A key component of calcium carbonate that forms shells for many ocean species, including oysters, snails and coccolithophores, a form of phytoplankton. The pH of the surface ocean has fallen from 8.25 to 8.1. At the same time, humans have removed fish and other nutrients from the oceans, forever changing the natural cycles of the ecosystem.

If only this was our only impact on the oceans. Fossil fuel sourced plastics have been found everywhere, including the depths of the ocean, mountain peaks, and the infamous Great Pacific Garbage Patch. Fishing gear and microplastics create direct consequences as well as long-lasting ones as small pieces end up being eaten and enter the food chain. The noises we blast in the oceans stress those who live there as much as hunting them once did (whales).

Conclusion

We have lost our stable environment and created feedback loops likely to accelerate the changes to temperature and ocean acidification. Think qualitatively about how interactions between wind, waves, tide and current will impact a local region in the future. These factors combine to drive ocean circulation. Avoid linear extrapolation. We can't recreate a past environment, so don't try. Be like an athlete tracking a fly ball and plan for what the environment will be in the future, not the past. Be open to scientists talking about how conditions are changing. Listen only to credible sources on social media. Do your own research and seek out answers when something doesn't make sense.

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

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