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Strategic Research Program Steering Committee

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Caveat and Disclaimer

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Key Announcements...

CALL FOR ESSAYS - THE UNTHINKABLE

Dealing with more known unknowns? More scary knowns? Or unknown unknowns?

The Catastrophe & Climate Strategic Research Program of the Society of Actuaries Research Institute (SOA) seeks essays exploring risks - What is the next unthinkable? What future events should actuaries actively be modelling and keep us up at night? Essays must be submitted in English and the targeted length is approximately 1-2 pages (200-400 words). There is no requirement for formal or extensive footnoting.

Deadline for submission is now **October 20, 2021**. Please refer to [From 911 to COVID-19: The Unthinkables Call for Essays](#) for more information.

INSIGHTS PODCAST

On the 20th anniversary of 9/11, the Society of Actuaries [released a podcast](#) commemorating the tragedy with a series of interviews, dedicated to the victims of the terrorist attacks and their families.

LAUNCHING IN OCTOBER 2021!

The SOA Research Institute presents its **fifth Strategic Research Program – ‘Catastrophe & Climate’**, **officially launching** in October, 2021. The key goal has been to study climate trends and their impact on extreme and catastrophic events. Learn more about the SOA Research Institute’s Strategic Research Programs <https://www.soa.org/programs/strategic-research-program/>

CLIMATE RISK SYMPOSIUM

Climate Risk Symposium - The Evolving Role of the Actuary in Climate Risk,

Come join us for a series of four sessions building on the work of the SOA’s Catastrophe & Climate Strategic Research Program and more. We are actively working to construct a webinar format in early November for attendees to gain perspectives on topics from regulatory disclosure, projected changes to actuarial tools and assumptions, and what practicing climate actuaries are doing today. You can follow the www.soa.org Professional Development page to watch for details.

Member thoughts on *IPCC AR6 Climate Change 2021: The Physical Science Basis*

IPCC6: MY THOUGHTS FROM THE FIRST ASSESSMENT REPORT

By Max J. Rudolph, FSA CFA CERA MAAA

The IPCC (Intergovernmental Panel on Climate Change) is finishing its sixth cycle and recently released the first of three assessment reports (AR) covering The Physical Science Basis (from Working Group 1). Yet to come are Impacts, Adaptation and Vulnerability (from WG2) and Mitigation of Climate Change (WG3), to be followed by a synthesis report that summarizes all findings of the sixth cycle.

The information involved in the Physical Science Basis report is not meant to be new – it summarizes research published elsewhere and aggregates results from climate system models. Some of the conclusions reached confirm those made long ago. Jim Hansen’s 1988 congressional testimony that projected global warming holds up well because temperature (in Celsius) is linearly related to cumulative carbon dioxide added to the atmosphere.

Each cycle adds higher resolution to the computer climate models and looks at phenomena that previous models struggled with. That continues today. The models aren’t perfect, but they do a marvelous job as a proxy for the ecosystem we live in. This cycle includes economic narratives that impact our greenhouse gas emission levels (CMIP6) while also acknowledging the need for geoengineering carbon capture solutions under most scenarios to hold temperatures below those that reach tipping points and feedback loops.

The report itself is nearly 4,000 pages. This is not a review of the entire report, although I hope to look through it over time. The executive summary is about 40 pages, and even that can be hard to follow at times. Another controversy over the summary is due to it being signed off on by countries with a wide range of fossil fuel interests. These countries kept the document wording from being as strong as it could have been. For example, the executive summary, Section A.1.1 says that GHG concentrations “since around 1750 are unequivocally caused by human activities” rather than specifically by fossil fuels. The United States has also rejoined the Paris Agreement on climate.

Several climate change groups have already started to publish their summaries and interpretations of the full report, and more will be discussed at the COP Glasgow conference this fall.

What is new (to me)?

Sea level rise will be driven by melting of the ice sheets on Greenland and then Antarctica, along with glacial melting and thermal expansion of water (about half of the increase) as temperatures in the oceans rise. The new report also mentions the impact of aquifer depletion (land water storage), and how this water evaporates or travels down rivers to eventually end up in the ocean.

Sea level rise is accelerating. Other changes to the climate system are expected to speed up as well, in particular extreme events. By 2100 coastal extreme events that occurred once in a century are expected to occur annually.

The growing season in the Northern Hemisphere has lengthened by about 2 days per decade since WW2.

IPCC6 confirms that the RCP (Representative Concentration Pathways) scenarios have been updated. While SSP5-8.5 (Shared Socioeconomic Pathways, with scenario listed first and RCP partner second) is still presented, it is generally thought to present higher emissions than are likely in a business-as-usual scenario. SSP3-7.0 has been added to better reflect what might be considered a worst-case scenario after media and others used 8.5 as the base case.

The definition of a hot temperature extreme is the daily maximum temperature over land that was exceeded once per decade on average or once per 50 years during a reference period covering the second half of the 19th century. Precipitation extremes are defined using the once per decade metric and drought events look at soil moisture below the 10th percentile.

Some carbon sinks, like plants, take up more carbon dioxide if it is available but this becomes less efficient as levels increase.

Urbanization increases precipitation over and downwind of cities.

New term: climatic impact-drivers (CID) Examples come from heat & cold, wet & dry, wind, snow & ice, coastal, open ocean and other.

What is thought provoking?

When I think about drought I typically think about precipitation, but the report points out the importance of soil moisture for agriculture and general drought conditions.

While I knew that volcanic eruptions emit sulfur that blocks the sun (sulfur falls from the atmosphere very quickly), the report talks about sulfur emissions (mainly from cars) that, as a by-product of pollution regulations, are being reduced and so increasing net GHG emissions.

In Figure SPM.2 aviation contrails are shown to have little impact on warming. This contradicts other information I have seen so I'll need to look further into this.

The chance of compound extreme events (e.g., heatwaves and droughts at the same time or in multiple locations) has increased.

Latitudes closer to the poles are warming about twice as fast as those closer to the equator. This has major repercussions for melting of Arctic sea ice and permafrost.

Precipitation is expected to become more variable both within seasons and from year to year. We may have more alternating drought and flood cycles.

As spring snowmelt occurs earlier, peak flows occur earlier at the expense of summer flows. Municipal planning should start now. Recent flood events worldwide are just the beginning.

What will IPCC7 look like?

There will likely be a number of improvements in the next cycle as understanding improves and computing power speeds up.

Ocean analysis – the ocean will be divided into more layers to measure and project temperature, acidification, deoxygenation and other aspects. Our understanding of the oceans is lacking, so these types of improvements will likely continue for many years.

Antarctic conditions – currently snowpack is increasing in some areas of Antarctica. We are just starting to understand why, and how it might play out in the long run. Ice shelves that extend over the ocean are being melted from below, so long term results may not look much different, but as an anomaly it should be studied so intermediate results can be tested against the overall warming hypothesis. Other regional deviations should also be analyzed.

Clouds are much more complex than was generally thought. They reflect radiation from the sun and form in ways that depend on the temperature. Clouds form at different heights and their role with respect to climate change differs with each. Some improvements have been integrated but the models also suggest some odd results in warmer conditions (e.g., some show that clouds at some heights stop forming).

Improvements are expected for ecosystem modeling for wetlands, permafrost and wildfires. Each are expected to release GHG as the earth warms.

About one major volcanic eruption (e.g., Mount Tambora in 1815) is expected to occur each century. This would provide a brief respite from climate change but lead to food insecurity and some claiming the “natural” cycle had reversed. Be prepared but don’t be fooled!

Conclusion

GHG emissions take thousands of years to settle out of the atmosphere, so the additional gases humans have released from sequestered fossil fuels can be considered cumulative. There is no easy solution. Moving to net zero emissions will not return the ice sheets or other changes made to the ecosystem.

It seems likely that somewhere around two- or three-degree Celsius warming will trigger feedback loops that take us to six degrees of warming as forest dieback occurs and melting impacts the Antarctic ice sheet and permafrost. We must turn our attention to carbon capture techniques that are neither cheap financial tricks (planting a few trees as an offset) nor geoengineering masks that rely on ever increasing interventions. Here in Nebraska, where I live, change is coming. Consumers are likely to eat less meat, so farmers will need to change their skill set. One option is to transition to renewable energy generation and transmission. Wind turbines change the skyline, but is it really more blighted than an existing cattle farm? Our time horizon needs to move from the four centuries that Europeans have lived in North America to thousands and millions of years.

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.

TAKING SOME OF THE UNCERTAINTY OUT OF CLIMATE PROJECTIONS

By Frank Grossman, FSA, FCIA, MAAA

The news conveyed by the first part of the IPCC's Sixth Assessment Report, *Climate Change 2021: The Physical Science Basis*, is pretty daunting. More than 1°C of global warming due to human activity, and extreme weather events around the world—floods, storms and wildfires—threatening to overtake past scenarios and forecasts. And yet, as Elizabeth Kolbert noted a couple of years ago, “On no other issue is the gap between what’s politically acceptable and what’s scientifically necessary wider than it is on climate change.”

The economic wonder called globalism thrives by seeking out cross-border efficiencies. It also relies on the continuing availability of cheap oil, as well as external economies that effectively ignore harm done to the environment. The greenhouse gas (GHG) emissions associated with the production and assembly of electronic goods back and forth across the Pacific is one such externality, and a familiar example.

Another example concerns fruits and vegetables grown on an industrial scale in southern California, which are trucked to consumers throughout the continental United States and Canada. Agribusiness’ linchpin is access to a relatively inexpensive distribution system—namely diesel long-haul trucks and the inter-state highway network. Unfortunately, the climate change effect of the trucks’ GHG emissions is routinely ignored.

A potential solution is a carbon pricing regime geared to provide distributors with predictable financial incentives to reduce the GHG emissions of their trucks and remain price competitive. A carbon fee could take the form of a fuel tax, a highway toll, or a vehicle registration fee. The underlying principle is that higher emissions attract a larger fee. So, an actuary in St. Louis pays a smaller carbon fee for a California peach than does an actuary in Hartford.

In response, a west coast shipper could reduce its carbon fees by using lower or zero-GHG emission trucks or retrofitting existing vehicles. A concomitant effect might be the revitalization of local produce growers, newly competitive now that transportation externalities are taken into account. A renewed interest in regional varieties of fruits and vegetables, by growers located closer to their markets than those in California, could potentially translate into fresher produce and greater diet diversity—ultimately, better nutrition and consumer health.

But what’s to be done with the carbon fees collected by governments and their agencies? They could be used to fund the transition to a clean energy economy (e.g., rebates to partially offset the purchase of more fuel-efficient and alternative fuel vehicles) or encourage sustainable local agriculture. Or they could simply be recycled via a quarterly per capita dividend payment to all Americans, so that those who eat food with a low carbon footprint will pay less money in carbon fees than the dividends they receive and be ahead in net terms.

The latest National Climate Assessment (NCA) notes that climate change projections are usually based on scenarios that describe “how future emissions may change due to changes in population, energy use, technology, and economics.” The NCA goes on to make a crucial point: “By the second half of the century, however, human choices, as reflected in the scenarios, become the key determinant of future climate change.” While the uncertainty of temperature projections increases as time progresses, it’s the uncertainty about the level of future GHG emissions—resulting from choices such as how quickly and well we divorce ourselves from fossil fuel use—that eventually exceeds the influence of both natural variability and model uncertainty.

What's an actuary to do? One option is to contact your elected representatives, at all levels of government, to advocate for an effective carbon pricing policy. After all, politicians don't usually create political will—they respond to it. Influencing human choices to reduce future GHG emissions can take some of the uncertainty out of your climate projections by narrowing the gap between climate rhetoric and what science requires. It could even provide support for your long-term mortality improvement assumptions.

SOA Featured Research

PROJECTED CHANGES IN INSURABILITY AND AFFORDABILITY OF INSURANCE COVERAGES DUE TO CLIMATE CHANGE

Michael M. Hall, FCAS, MAAA and David Heppen, FCAS, MAAA, Risk & Regulatory Consulting

The Catastrophe & Climate Strategic Research Program engaged [Risk & Regulatory Consulting LLC](#) (RRC) to conduct research on the projected changes in insurability and affordability of agricultural crop insurance coverages due to climate change.

The researchers leveraged multiple studies to analyze the impact of climate change on crops and U.S. agricultural productivity, and the associated implications for crop insurance pricing, including the Federal Crop Insurance Program ("FCIP"). To further deepen the understanding, RRC conducted a case study of the Midwest region, which included modeling crop insurance prices and forecasting projections of those prices into the future. RRC also looked into the potential impact of new innovations on crop insurance, including Blockchain, FarmersEdge, and Index Insurance. Review the paper, to find out the key learnings and outcomes of this in-depth analysis.

<https://www.soa.org/globalassets/assets/files/resources/research-report/2021/2021-insurability-affordability-climate-change.pdf>

Studies/Research Published Outside the SOA

By Priya Rohatgi, ASA

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

IAA PAPER – CLIMATED-RELATED SCENARIOS APPLIED TO INSURERS AND OTHER FINANCIAL INSTITUTIONS

Rade Musulin (Lead), ACAS, MAAA, CCRMP (Australia); Eric Dal Moro, CERA, Member of the Association Suisse des Actuaire (Switzerland); Sam Gutterman, FSA, MAAA (United States); Evelyn Yong, FIAA (Australia); and Tracey Zalk, Qualified Actuary (United Kingdom)

Climate-related Scenarios Applied to Insurers and Other Financial Institutions is the third of the series of paper published by IAA's Climate Risk Task Force. This paper builds on an earlier IAA paper, "[Introduction to Climate-Related Scenarios](#)".

It examines the challenges faced by actuaries in implementing scenario analysis for climate-related risks and outlines a range of possible approaches. The scope and information provided cover a wide variety of situations faced by actuaries working in different contexts. In addition to considering scenario development, the paper examines the guidance provided by several actuarial organizations to their members regarding climate risk assessment.

Three simplified case studies are included to illustrate the concepts developed in this paper. These case studies have been chosen to stimulate broad thinking rather than to focus on an approach taken by a specific financial institution or for specific blocks of business. It is hoped this paper can assist actuaries and others to understand the building blocks of climate-related scenarios and how they can be used to inform many critical risk management functions surrounding climate-related risks.

The Climate Risk Task Force is hosting a webinar on September 29, 2021 at 8:00 AM (EDT) to present this paper. Follow the [link](#) to register.

Book reviews

The last edition of the Newsletter published a review of *The Plague* by Albert Camus. In continuation of the same theme, is Sara Goldberg's review of *The Plague* by Nobel Laureate Albert Camus, an iconic literary work that is ever so relevant now.

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 PLAGUE, ALBERT CAMUS, TRANSLATED BY ROBIN BUSS, AFTERWORD BY TONY JUDT, PENGUIN CLASSICS, 2013

By Sara Goldberg, FSA, MAAA

The trouble is, there is nothing less spectacular than a pestilence and, if only because they last so long, great misfortunes are monotonous. (p138)

The Plague is a tale of the stages of a pandemic spread by rats, where the narrator, Dr Rieux, takes us through personal journeys of disbelief, terror, death, monotony, and aftershocks on mental health. The novel is set in Oran, Algeria, where in the early stages the city gates closed and separated families and loved ones, much like travel restrictions have impeded some extended families from reuniting for over 15 months now.

Notably Camus was not recounting an actual pandemic, though Oran has been hard hit by multiple past epidemics. While the author was born in 1913, he likely did not draw from any personal experience with pandemic; perhaps his struggle with tuberculosis as a youth played a role in rendering the surprising detail and empathy he displays through the examples and description of communal and personal suffering: "Impatient with the present, hostile to the past, and deprived of a future..." (p57) Whatever his inspirations may have been, there were enough elements of truth found today to bring me to one of my soapboxes, not as historian but as actuary – that history continues to repeat itself.

The book is one of both literal and allegorical value. As for the allegory, one reads in the afterword that it was published just after World War II, as a comparison to the pain and loss of freedom during the wartime occupation of France – when the rats came to town, disease built up unsuspectingly just as toxic ideologies do (p244). The allegory is also relatable to today's pandemic, with our liberties and normalcy occupied violently. But the literal value is the one which caused me to finally pick the classic up this month, and from which I will draw here to exercise my confirmation bias.

Much description of human behavior seems prescient: "Up to now the plague had claimed many more victims in the outlying districts, which were more crowded and less affluent than the centre of town. But suddenly it seems to get closer..." (p130) We similarly recall the hoped otherness of COVID-19: it was in a different continent, then it was in Europe and the U.S. but in crowded areas or else holiday locales, and ... then our neighbor was on a ventilator. At first, too, Dr. Rieux and the town bureaucrats were slow to sound the alarm and initiate restrictions for fear of spreading fear. Resistance against imprisonment was also a theme throughout, where Camus astutely points to the resistance [mask behavior?] as preservation against the threat of slavery: "While evidently not as effective... it had its own logic and, in its very futility and contradictions, also bore witness to the element of pride..." (p106) This sentiment is neighbor to efforts to minimize. Comparisons with a seasonal flu ring similar to: "Oh, of course there's a risk. But after all before the plague there was just as much risk in crossing a busy road junction." (p110)

Admittedly some passages seem dated. When my mother recalls the polio outbreaks of the 1950s – as she has frequently this past year – she speaks about citizenship, decency, efforts to both protect children and get vaccinated, and how politics were placed aside [author’s aside: or is it that distance makes the heart grow fonder?]. In any case, here we are today, where I cannot say that this rings true for me: “it’s not getting any better, but at least everyone is in the same boat.” (p151) Togetherness gave way to disparities sometime between March 2020 and today. The same page, an actuary today in the mortality cause of death modelling space may bristle but smile at the simplifications behind: “Have you noticed ... that you cannot accumulate illnesses? Suppose you have a serious or incurable disease, a serious cancer or a good bout of TB, you will never catch plague or typhus; it impossible... you never see a cancer victim die in a car accident.”

Those same modelers might have recently made statements that preventable deaths are declining – with the seat belt and smoking cessation, what’s left? Unfortunately, the road from an outbreak to a pandemic is a shorter one than we had thought in January 2020, and the road past the pandemic is also much longer than we had collectively thought or at least hoped for when the vaccine rollout began last December. “When war breaks out, people say: ‘It won’t last, it’s too stupid.’ And war is certainly too stupid, but that doesn’t prevent it from lasting. Stupidity always carries doggedly on, as people would notice if they were not always thinking about themselves.” (p30) This long tail of COVID-19, with additional waves, has been predicted, but the main thing we sought collectively through vaccines was a clean cut – illustrated with Britain’s attempted Freedom Day despite the emerging Delta variant.

Camus’ pandemic also saw yearning for intimacy, the future, and normalcy, and ultimately citizens deciding perhaps prematurely, “it’s time it ended.” (p139) Who is our hero today? Interestingly, Camus was accused of being a nihilist which he vehemently denied, yet there was a hero in his book – Grant, a tortured statistician who seemingly kept count of the case and death records and perhaps also made predictions on the course of the pandemic. He had not much more than “a little goodness in his heart and an apparently ridiculous ideal. This would be to give truth its due, to give the sum of two and two its total of four.... Such language could not be applied to the little, daily efforts of Grant, for example, and could not describe Grant’s significance in the midst of the plague. (p105-106) Though I would not go so far as to say that the actuary has been the hero of this pandemic, this conclusion is good news for the actuary!

What have we learned in recent history? Preparedness for catastrophic events can help on some level, but warning signs from Ebola have been ignored, with control, testing, tracing implemented too late in most countries. We don’t even learn in real-time history: where we see near-best practices in testing and tracing mitigating certain countries like Australia and South Korea, and where recent ramp-up in mass testing serving countries like Germany well – not mimicked elsewhere.

Will history repeat itself more frequently in the future? That’s where the book review ends, and the epidemiological, virologic, yes, also actuarial work begins.

Glossary

By Priya Rohatgi, ASA

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

Not to be missed: Glossary section provided by IPCC AR6 WGI

https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Annex_VII.pdf

Brown Ocean effect

What kept Hurricane IDA going for long, even after making its landfall, was the result of Brown Ocean effect'

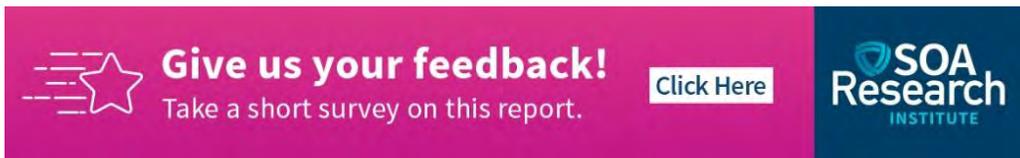
We understand that Hurricanes/ Tropical Cyclones draw their energy from warm ocean waters. But when they make landfall over a wet, marshy, or saturated spot, they can still power themselves with evaporating moisture.

According to a [NASA funded study](#) by Theresa Andersen and Marshall Shepherd of the University of Georgia, three criteria need to be met for the brown ocean effect to occur:

- The soil needs to contain ample amounts of moisture.
- Atmospheric conditions near the ground must have tropical characteristics with minimal variation in temperature.
- Evaporation rates must be high enough to provide the storm with sufficient latent heat that it uses for fuel, at least 70 watts averaged per square meter.

Although this process supplies less energy than the ocean, it is enough to sustain a storm for a longer period than normal over land. www.weathergamut.com

"We always knew that places like the Everglades or the swampy wetlands of Louisiana could provide a fuel supply for storms that might linger over them, and I think that's what we saw with Ida," said Marshall Shepherd, a meteorologist and the director of the Atmospheric Sciences Program at the University of Georgia.



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About the Society of Actuaries Research Institute

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

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

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

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

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