



Catastrophe & Climate Strategic Research Program Newsletter – October 2020





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Focus on Terminology: Mitigation and adaptation – are we talking past each other?

By Max J. Rudolph, Dr. Jesse Bell and Steve Bowen

For those actuaries who desire to become more active in climate awareness activities, there are times when language becomes an issue. Terms that have been used for decades in each specialty are used in ways that mean something else to the other groups. This column will likely be a semi-recurring feature of this newsletter, so please let us know if you have a term that you think actuaries, climatologists or people working in sustainability use in different ways. The format will be to introduce and define commonly used terminology that is used by multiple fields. The hope is that having an awareness of vocabulary differences between these different fields will improve communications between them.

IPCC DEFINITIONS¹

Mitigation (of climate change) - A human intervention to reduce emissions or enhance the *sinks* of *greenhouse gases*.

Adaptation - In *human systems*, the process of adjustment to actual or expected *climate* and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

FROM THE CLIMATE SCIENTISTS

For the climate scientist, or someone working on environmental sustainability, mitigation means changes are made at both the macro and micro levels to lower the level or rate of change of anthropogenic global warming on land and in the world's oceans, often by reducing greenhouse gases that are predominately driven by fossil fuel consumption.

Adaptation means we change what we do as a society – including improving infrastructure, strengthening building codes, retrofitting high-risk structures, and raising risk awareness – to better align our lives with changes in the future environment.

¹ IPCC, 2018: Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland, 32 pp.* <https://www.ipcc.ch/sr15/chapter/glossary/>

FROM THE ACTUARY

An actuary thinks of mitigation as something at the micro level that an individual or company might do to reduce their risk and expected cost – an example might be taking a driver’s education course, or something an insurer does to reduce its risk like buying reinsurance.

Adaptation is similar to the climate scientist’s definition but focuses more on what individuals and communities can do to adjust to the new normal. This would include developing drought tolerant crops or upgrading a town’s sewer system based on greater expectations of flooding.

SUMMARY

Actuaries have much to learn from climate scientists and those working in sustainability, but it’s important that we not talk past each other. In this case, mitigation and adaptation are considered by scientists as ways to improve the ecosystem, while the actuary generally thinks of them at the micro level as actions that can be taken by individuals or communities to reduce cost.

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Featured Research Projects – Sam Gutterman

SOCIAL DISCOUNTING – APPLICATION TO THE RISK MANAGEMENT OF CLIMATE CHANGE

The Climate and Environmental Sustainability Research Committee sponsored a paper written by Sam Gutterman. It can be found at <https://www.soa.org/resources/research-reports/2020/social-discounting-climate-change/>. The following is an overview of some of the highlights of the paper to whet your interest in reading it.

It discusses a key component of a public cost-benefit analysis, social discounting. This application of discount rates plays a crucial role in the quantitative portion of this analysis, especially when dealing with issues involving expected costs and benefits over prolonged periods, which is the case in assessing strategies, projects, and investments involving climate change considerations, which is the focus of the paper.

A social discounting process involves the assessment of related social externalities and co-benefits (that is, costs and benefits not considered in prices if a transactional approach is taken). In addition, in some cases the private sector should apply some aspects of this process, especially where one stakeholder's actions impose uncompensated costs or benefits on another party).

Social discount rates applied in the analysis of mitigation and adaptation programs in anticipation of or in response to the effects of climate change may differ from the analysis of other social issues because of: (1) the social externalities involved, (2) the irreversibility of greenhouse gas accumulations in the atmosphere and oceans, (3) its global nature, (4) the time periods involved, often measured in decades and even centuries, (5) its complexity, size and scope, potentially touching all human endeavors, (7) the uncertainties, especially with regard to tail risks associated with the timing and severity of effects, and (8) its social and ethical aspects, including intergenerational equity.

The objective of this paper is to discuss some of the key factors that should be considered in the development of climate change-related strategies, programs, and investments involving mitigation and ex-ante adaptation efforts. The considerations involved in the analysis of the possible effects of climate change can differ by country and region. A social cost-benefit analysis included in a comprehensive risk management process can assess a desired combination of or a choice between mitigation and adaptation efforts.

This paper not only addresses the fundamentals of the social discounting process, but also some of the contentious related issues raised, including the role of market rates, the treatment of social externalities, co-benefits, uncertainty, and the scope of its application. Although these affect public (government) led projects that only involve the public sector, they may also apply to the analysis of private sector investments and to social issues with a long planning horizon other than climate change.

It focuses on the economic approaches to this issue as described in a rich accumulation of literature, within which there has been a wide divergence in views and opinions. Actuarial experience with discounting cash flows over long time periods in a broad range of applications indicate that they can provide insight to this issue.

The paper indicates that social discount rates should be less than those used by the private sector because: (1) social externalities and co-benefits are not generally considered in private sector transactions, (2) many significant factors cannot be monetized or included in a discounted cash flow time-risk framework are important considerations, (3) the (almost) irreversible nature of climate change factors, (4) when future generations are involved, ethical considerations involve the implied social contract between generations, including provision for sustainability of our environment, (5) the global scope of mitigation effects, (6) the sheer size of, severity and long-term nature of the risks and issues involved, requiring in some cases aggregate analysis with especial attention to possible low probability tail events, and (7) the significant uncertainties involved, particularly since the trajectories of mitigation applications over the long-term future remain to be determined.

Economic formulations of social discounting are covered, including the Ramsey formula, which is a century-old growth model commonly used in the analysis of long-term investments covering multiple generations. Extensions of this formula, primarily the extension relating to uncertainty, as well as concerns with its application, are covered. In addition, the basis for two schools of economic thought (the descriptionists who rely primarily on market-based interest rates and the prescriptionists who rely primarily on ethical considerations) are discussed.

Because of the large amount of uncertainty that can snowball over time regarding the amount and timing of the adverse effects of climate change through the level and volatility of climatic factors (such as temperature and precipitation), uncertainty, asymmetric risks, and risk attitudes need to be considered using hyperbolic (decreasing by duration) discount rates in a time-risk framework.

Governments may not be able to allocate sufficient up-front investment immediately to all desirable climate risk-related programs and projects. As a result of the uncertainties involved and many political and economic options available, analysis of flexibility regarding the timing of implementation by means of an application of real options analysis can be used. This can be used to help allocate available resources over time to arrive at appropriate and timely decisions.

The controversial measures of the social cost of carbon and carbon pricing are also discussed. A wide range of estimates of the social cost of carbon generated by the application of the Ramsey formula and expert opinion are illustrated. These indicated price ranges also indicate the high degree of sensitivity of this measure to the social discount rate used.

Alternative approaches to stochastic modeling, such as scenario and sensitivity analysis and use of undiscounted values compared with relevant benchmarks, can supplement the quantification incorporated in a social cost-benefit analysis, in part to emphasize the importance of non-monetizable items in the analysis. The paper discusses the effective communication of recommendations, as well as the process, assumptions, and models followed, as

needed, because of the complexity of the social cost-benefit analysis process, as well as the climate change process itself, and the many stakeholders and generations who will be affected by climate-related issues and risks.

Sam Gutterman

In the News this Month – Priya Rohatgi

Here is a featured tool and some recent articles underlining the pace of climate change and its disruptive impact that needs to be tackled now and not in the distant future. This requires us to constantly review the data and assumptions to refine our understanding of the unfolding risks. We hope that this periodic update will assist you in this endeavor.

FEATURED TOOLS

Transition Check: A new online tool that takes a scenario-based approach for assessing transition risk and the potential impact of climate change on corporate lending portfolios within an overall framework consistent with the recommendations of the Financial Stability Board's Task Force on Climate related Financial Disclosures (TCFD). Both the webtool and analysis methodology are developed by Oliver Wyman in partnership with UNEP Financial Initiative (UNEP FI). Its freely available to all UNEP FI members.

NEWS CLIPPINGS

I) Warmest September on record for the globe since record keeping began in 1880.

<https://www.ncei.noaa.gov/news/global-climate-202009>

Earth just had its hottest September on record

The September 2020 globally averaged temperature departure from average over land and ocean surfaces was the highest for the month of September in the 141-year...

www.ncei.noaa.gov

With 3 months left, 2020 could rank among three-warmest years on record for globe.

II) Secondary Perils

<https://www.insurancejournal.com/news/international>

Catastrophe Losses Driven Higher by Secondary Perils – And Climate Change

Secondary perils, exacerbated by climate change, are driving catastrophe insurance losses, warn a growing chorus of reinsurers and brokers.

www.insurancejournal.com

III) New decarbonization targets and clean investment strategies

<https://www.bloomberg.com/news/articles/2020-09-24/the-most-important-climate-pledges>

The Most Important Climate Pledges Aren't the Splashy Ones

It's always worth watching these announcements, even if their impact is unclear at first. They're quieter; they're more technical; they start small. But they're also forcing functions—they won't just target change; they'll make it happen.

New Zealand will be the first country in the world to report on climate risks based on the Taskforce on Climate-related Financial Disclosures framework. Swiss Re AG to be the first multinational to levy a triple-digit price on "both direct and indirect operational emissions."

www.bloomberg.com

IV) US power players weigh carbon pricing

<https://www.ft.com/content/>

US power players weigh carbon pricing | Financial Times

Climate change has raced up the political agenda after a summer of heatwaves, wildfires and hurricanes, and puts pressure on electricity markets to consider the cost of carbon

www.ft.com

V) The Great Climate Migration – A Warming Planet and a Shifting Population

ProPublica and The New York Times Magazine, with support from the Pulitzer Center, examine the implications

<https://www.propublica.org/series/the-great-climate-migration>

New Climate Maps Show a Transformed United States

Heat alone, however, won't determine Americans' fate. A new climate analysis — presented for the first time here — projects how humidity and heat will collide to form "wet bulb" temperatures that will disrupt the norms of daily existence.

Climate Change Will Force a New American Migration

Wildfires rage in the West. Hurricanes batter the East. Droughts and floods wreak damage throughout the nation. Life has become increasingly untenable in the hardest-hit areas, but if the people there move, where will everyone go?

www.propublica.org

VI) 'Learning to live with it'

<https://www.economist.com/science-and-technology/2020/09/12/wildfires-will-be-more-common>

[Natural disasters - Wildfires will be more common in a warming world | Science & technology | The Economist](#) – October 12, 2020

CALIFORNIA BURNS every year. But amid a record-breaking heatwave, 2020 is the fieriest year yet (see map). As The Economist went to press, more than 7,600 fires had burned over 2.5m acres (1m hectares) of land. The season still has months to run.

www.economist.com

Clever designs of buildings and infrastructure can limit the damage.

VII) Rapid intensification – Laura strengthened from a tropical storm to a category 4 in 36 hours.

<https://www.washingtonpost.com/climate-environment/2020/08/27/hurricane-laura-rapid-intensification/>

[Hurricane Laura's rapid intensification is a sign of a warming climate, scientists say](#)

Hurricanes that go from dangerous to deadly very quickly are occurring more often, research suggests.

www.washingtonpost.com

VIII) Climate-Driven Housing Crisis - Home sales in areas most vulnerable to sea-level rise began falling around 2013.
<https://www.nytimes.com/2020/10/12/climate/home-sales-florida.html>

Florida Sees Signals of a Climate-Driven Housing Crisis

If rising seas cause America’s coastal housing market to dive — or, as many economists warn, *when* — the beginning might look a little like what’s happening in the tiny town of Bal Harbour, a glittering community on the northernmost tip of Miami Beach.

www.nytimes.com

IX) Link between rapid warming and landslides

<https://www.theguardian.com/environment/2020/oct/18/alaska-climate-change-tsunamis-melting-permafrost>

Alaska's new climate threat: tsunamis linked to melting permafrost

In Alaska and other high, cold places around the world, new research shows that mountains are collapsing as the permafrost that holds them together melts...

www.theguardian.com

Over the last 30 years, landslides in Alaska’s Glacier Bay correspond with the warmest year.

X) Climate change: Natural factors driving long-term cycles - Important to disentangle the natural, slow-moving drivers of climate change from the rapid changes attributed to the Anthropocene.

<https://www.forbes.com/sites/startswithabang/2020/10/16/ask-ethan-will-earths-temperature-start-decreasing-over-the-next-20000-years>

Ask Ethan: Will Earth’s Temperature Start Decreasing Over The Next 20,000 Years?

Sure, we are warming now. But will this continue, or will natural factors change things?

www.forbes.com

Book Review – The Wizard and the Prophet by Charles Mann

The public has been subjected to poor communicators with good information about climate change but lacking the means to convey it, by those seeking to confuse the message using tactics typically designed to sell the latest brand of coffee, and by visionaries touting the end of the world who failed to see how science could improve the odds. Charles Mann takes on a story of two scientists who each individually have good things to say yet talk past each other and fail to accomplish as much as they could have.

The Industrial Revolution was built on fossil fuels. Following one hundred thousand years of limited improvements for humans, the last 300 years have seen improvements in longevity, nutrition, income, control of indoor temperatures, etc. Retraining our economy away from fossil fuels with a pivot to renewable energy would be hard in the best of times and has proven especially challenging in the recent political environment.

THE PROPHET

William Vogt founded apocalyptic environmentalism as a disciple of Malthus. Reform or the end is near, as a prophet might say. The descendants of his ideas used television to spread his philosophy (most notably Paul Ehrlich on *The Tonight Show* with Johnny Carson). Norman Borlaug won the Nobel Peace Prize as the father of the Green Revolution, using his training as an agronomist to breed wheat resistant to wheat rust disease. His supporters say he kept billions of poor people from food insecurity and death. His detractors say he postponed the inevitable and created an ecocide.

While this book doesn't pit climate modelers against geoengineering solutions, it shows that well-meaning people can get so focused on their own agenda that they fail to incorporate (steal) the best ideas of others, avoiding an opportunity to leave everyone better off.

Malthus' ideas about population, at their simplest, were that population grows geometrically and food arithmetically. I have written elsewhere my thought that he is right over a long time horizon but that numerous pivots occurred that expanded food production.² Natural balance occurs due to war, disease and famine, or preventive checks like education or reduced wages that incentivizes childbirth to be delayed or avoided. This cycle repeats, with the high point of each one as humans overconsume leading to one of the automatic rebalancers kicking in. This leads to regional conflicts as resources become limited, similar to both world wars in the past century. This could play out as climate change worsens and fresh water and arable land become in short supply. Biodiversity and fertilizer are also important to consider as they interact with limited resources. A reduced fertility rate has at least bought some time for humanity to act but forced migration as regions become unlivable will add to the challenge.

Vogt believed that Americans were especially susceptible to economic goals that encouraged them to mold nature in unsustainable ways despite a limited carrying capacity. This is consistent with *2052: A Global Forecast for the Next Forty Years*³ (a follow up to *Limits to Growth*) showing that natural resources would be expected to hit a peak and decline slowly after having generated additional population.

THE WIZARD

Norman Borlaug took his expertise in crop genetics to develop a wheat plant that was resistant to the fungus stem rust, a problem that led to recurring crop failures in developed countries and famine throughout the emerging

² <http://rudolph-financial.com/201806%20-%20Malthus.pdf> Rudolph, Max. Was Malthus right, but early? June 2018.

³ Randers, Jorgen. *2052: A Global Forecast for the Next Forty Years*. 2012.

economies. Borlaug developed these crops in Mexico and then, with the Rockefeller Foundation, introduced them to India and elsewhere.

But there is a downside to the technique developed. It requires a lot of fertilizer, uses DDT to eradicate insects, and contributes to air pollution and greenhouse gases. As a complex adaptive system, earth's ecosystem can't be reduced to a few levers to be manipulated that solve all problems. Interactions matter, and there are often unintended consequences. After all, the critical path for plant growth is the nutrient least present in the soil, generally nitrogen. For fertilizer use the world has pivoted from human waste to bat guano to synthetic ammonia, with side uses related to explosives and mustard gas. Along with the ozone and climate change, unwanted nitrogen will keep scientists engaged until they can successfully manage these issues. Rice was later added as a "miracle" crop, but irrigation and artificial fertilizer also created unwanted side effects including drained aquifers, aquatic dead zones and social upheaval. Perennial crops that store carbon and don't require as much tilling of the soil will perhaps be a new pivot to help slow climate change. Getting fresh water to the right place to support crops and humans may be another. We can learn from humanity's plundering of what was once called the Fertile Crescent.

CONCLUSION

There is no easy fix. Geoengineering solutions inevitably will lead to unintended consequences that also need to be addressed. Even if initially successful, they create an increasing cycle of actions that work until they don't. We are near one of those critical points now, where increasing temperatures will lead to sea level rise, zoonotic diseases, freshwater shortages, regional conflicts and weather pattern changes that alter agricultural patterns.

The Green Revolution turned out to have major faults, but also saved the lives of many by increasing crop yields. Had people like Borlaug and Vogt talked the issue through they perhaps could have made adjustments to the science that would make it less impactful on the climate today. Good intentions and a short time horizon for decision making lead to bad policy that should be constantly reviewed for unintended consequences. We have made many pivots around agriculture in the past. It is time to make another, but other advances are also needed.

We forget that others came before us and learned to maintain the habitat, and that the earth will survive whether we inhabit it or not. We should be aware of the rate of change on the planet, whether it is temperature or biodiversity, and manage it so all living things have the ability to adjust. This matters even more than the rise in temperature, and if we continue to enact policies that let it run wild, we will soon hit a tipping point that turns the environment into a Mad Max film. We think that we are masters of the universe, but our short time horizon for decision making will remind us of earth's need for balance.

Neither side in this discussion is above nature. We need to always be skeptical but let the process work. We will be wrong – build scenarios so our reaction time is short.

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Studies / Research Published Outside the SOA

IMPORTANCE OF CLIMATE-RELATED RISK FOR ACTUARIES

International Actuarial Association

The Climate Risk Task Force (CRTF) of the International Actuarial Association (IAA) recently published a paper on the [*Importance of Climate-Related Risks for Actuaries*](#). This is the first in a series of papers that CRTF has committed to develop over the coming years to address the needs of actuaries. This paper examines the categories of climate-related risks and their importance for actuaries in identifying, measuring, managing and reporting this type of risk. The impact of climate related risks on actuarial work are summarized under five broad categories: actuarial modelling, product management, risk and capital management, investment management and disclosure. The paper concludes with implications and suggested next steps for actuaries.

About The Society of Actuaries

The Society of Actuaries (SOA), formed in 1949, is one of the largest actuarial professional organizations in the world dedicated to serving more than 31,000 actuarial members and the public in the United States, Canada and worldwide. In line with the SOA Vision Statement, actuaries act as business leaders who develop and use mathematical models to measure and manage risk in support of financial security for individuals, organizations and the public.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

Relevance: The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

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