2022 CLIMATE RISK SEMINAR - ALL SESSIONS INFORMATION

Table of Contents

2022 CLIMATE RISK SEMINAR - ALL SESSIONS INFORMATION 1

The basis for climate change scenarios, attribution of extreme events, and approaches for quantifying impacts of climate change 2

Managing Catastrophes Within a Changing Climate: Science, Scenarios and Insights 4

Intersection of Coastal Flood Risk and Social Vulnerability in Property Insurance 6

Understanding and Implementing the Impacts of Climate Change in Underwriting, Pricing, Risk Management, and Mitigation 8

Adapting Climate Models for Flood Risk Decisionmaking 10

American Academy of Actuaries: Public Policy and the Actuary's Role in Climate Change 12

Climate Risk's impact on Insurance Industry Claims and how Geospatial and Imagery data can be used to mitigate risk 14

Climate Change Scenario Analysis for Financial Institutions - Practitioners Guide & Best Practices 15

Social Discounting and Public Risk Management, an application to climate change 16

Data, Metrics, and Information for Climate Risk Analytics 17

Pricing a Set of Weather Derivatives to Insure Crops in Floodplains 19

Emerging Climate Change Regulations and Disclosures 20

The basis for climate change scenarios, attribution of extreme events, and approaches for quantifying impacts of climate change

Speakers:

- **Richard Murnane, Ph.D.** - Rick joined Kinetic Analysis Corporation in 2018 and has been CEO since April of 2019. His goal is to ensure complete client satisfaction and the greatest possible user experience. Rick is active in the American Geophysical Union (AGU) and is currently on the Board of the Thriving Earth Exchange. He has also been the chair of AGU's Meetings Committee and a member of the AGU Council. He was President of the AGU Natural Hazards Focus Group and a member of the AGU Council Leadership Team. In the past, Rick has held positions at Risk Management Solutions as Director, Developer Relations and at the Bermuda Institute of Ocean Sciences as a Senior Research Scientist and as the Program Manager for the Risk Prediction Initiative (RPI). He has also been a co-founder of several companies that developed catastrophe risk models and other tools for assessing and managing risk. Rick received a Ph.D. in Geological and Geophysical Sciences from Princeton University.

- **Claudia Tebaldi** - Claudia Tebaldi has been working on climate change science since the early 2000s. She is a statistician by training and has always enjoyed working on problems that involve signal-to-noise analysis. These have been mainly centered around uncertainty characterization in future projections, with focus on changes at the regional scale, particularly in extremes, and observation-based detection and attribution studies. She is keen to connect her work on the physical changes of the climate system to impact studies and risk assessment.

  Before joining the Joint Global Change Research Institute (PNNL), Dr. Tebaldi was a staff scientist at the National Center for Atmospheric Research (NCAR), and Climate Central Inc.

  Dr. Tebaldi was a Lead Author for Working Group 1 (The Physical Science Basis) of the Fifth and Sixth Assessments of the Intergovernmental Panel on Climate Change (IPCC), and a Contributing Author for Working Group 1 and 2 of the Fourth IPCC Assessment. She is currently an author for the 5th National Climate Assessment (NCA5).

- **Michael Wehner** - Michael F. Wehner is a senior staff scientist in the Computational Research Division at the Lawrence Berkeley National Laboratory. Dr. Wehner's current research concerns the behavior of extreme weather events in a changing climate, especially heat waves, intense precipitation, drought and tropical cyclones. Before joining the Berkeley Lab in 2002, Wehner was an analyst at the Lawrence Livermore National Laboratory in the Program for Climate Modeling Diagnosis and Intercomparison. He is the author or co-author of over 230 scientific papers and reports. He was a lead author for both the 2013 Fifth and 2021 Sixth Assessment Report of the Intergovernmental Panel on Climate Change and the 2nd,3rd and 4th US National Assessments on climate change. Dr. Wehner earned his master's degree and Ph.D. in nuclear engineering from the University of Wisconsin-Madison, and his bachelor's degree in Physics from the University of Delaware.

- **Charles Watson** - Charles C. Watson Jr. (Chuck) is the founder and President of Enki Holdings, LLC, and consultant to international, government, nongovernmental, and private sector organizations. His focus is creating advanced tools for natural and anthropogenic (human

caused) hazard analysis. Mr. Watson has conducted studies of such diverse phenomena as hurricanes and other weather systems, earthquakes, and tsunamis, as well as anthropogenic hazards including industrial accidents, terrorism, and weapons of mass destruction. He has authored or co-authored over a hundred peer-reviewed publications, and is a guest expert on television and radio news programs as well as print interviews.

Description:

There is a growing interest in understanding how climate will change in the future and how the changes might impact a company's assets and business. This session will explore climate change and impact modeling. Also, it will attempt to quantify the audience's knowledge before and after the session's three presentation using interactive polling (assuming the platform will support this capability). The first presentation will cover the assumptions involved with the Representative Concentration Pathways (RCPs) and Shared Socio-economic Pathways (SSPs) used in the most recent IPCC report released in August 2021 and offer an overview of changes in extremes consistent with the different scenarios. The second presentation will focus on attribution studies with an emphasis on determining the man-made contribution to intense tropical cyclones. The final presentation will provide an example of how a climate model can be used to assess impacts to a portfolio. No handouts will be provided.

Learning Objectives:

1. Understand the basis of the RCPs and SSPs used in the IPCC climate scenarios.
2. Learn how scientists conduct attribution studies to determine the anthropogenic contribution to extreme events.
3. Understand one approach for coupling climate models with exposure data to estimate changes in portfolio risk consistent with different climate scenarios.

Managing Catastrophes Within a Changing Climate: Science, Scenarios and Insights

Speakers:

- **Kimberly Roberts** - With an academic background in hurricane wind and storm surge, Kimberly has brought her expertise in atmospheric perils into the business and (re)insurance industry. Kimberly completed a BS in Atmospheric and Oceanic Science from the University of Wisconsin as well as an MS in Atmospheric Science from Colorado State University. Prior to joining Guy Carpenter, Kimberly used remote sensing techniques to study hurricane wind structure at the Cooperative Institute for Research in the Atmosphere (CIRA), and built hazard models at Risk Management Solutions.

  As a senior member of the North America Peril Advisory Team, she works with colleagues to provide analytical solutions to complex issues surrounding natural catastrophe. Her areas of expertise include research and development of tools to help manage risk from weather perils and wildfire, as well as closely partnering with the (re) insurance sector to advise on accumulation management, growth strategies, and regulatory compliance in relation to climate change. She is committed to assisting clients to bridge the gap between science and solutions.

- **Joseph Becker** - Joseph Becker is a hydrologist working in Guy Carpenter's North America Peril Advisory team where his responsibilities include evaluating water related models and developing strategies around to innovate flood solutions. He has worked on the development of Guy Carpenter's Canadian Flood Model and contributed to Guy Carpenter's Model Suitability Analysis (MSA) framework to evaluate catastrophe models.

  During his time at Guy Carpenter, Joseph has worked with numerous clients, including FEMA, to build an understanding of flood models and how they can be most effectively used for flood risk management. Joseph earned a BS in Physics from Le Moyne College in New York and an MS in Water Resources Engineering from the State University of New York, College of Environmental Science and Forestry.

- **Kieran Bhatia** - Kieran Bhatia joined Guy Carpenter in September 2021 as the Vice President of Climate Change Perils on the North America Peril Advisory team. Prior to joining Guy Carpenter, Kieran held the role of Climate Science Program Lead at bp, located in London. In this capacity, Kieran was responsible for guiding climate change mitigation strategy, leading on physical risk resilience, creating science education material for executives, and producing corporate disclosures related to physical risk.

  Before bp, Kieran spent nearly 8 years in academia, obtaining a PhD in Meteorology and Physical Oceanography from the University of Miami and a post-doctoral fellowship at Princeton University. During this time, Kieran produced five first-authored publications in peer-reviewed journals including Nature Communications. He has also appeared as a co-author on several other academic manuscripts and book chapters. His research focuses on tropical cyclone forecasting, severe weather modelling, and how climate change can impact hurricane risk.

Description:
Climate change is creating both challenges and opportunities within the insurance industry. Insurers who understand the direct impacts of climate change on their business are able to implement strategies that will provide opportunities to grow. The challenge comes in understanding the science, evaluating multiple climate model scenarios, and building analytical tools that produce valuable and quantifiable insights. This session will explore the state of the science of climate change as it relates to extreme weather events such as flood, severe convective storm, tropical cyclones and wildfire. A basic understanding of the science is critical to interpreting the output of climate models and analyses that leverage climate models. Guy Carpenter scientists will present examples of strategies and analytical tools that are designed to manage climate change exposure within the context of the insurance industry, while also highlighting the inherent uncertainty in such insights.

Learning Objectives:
1. Attendees will be able to articulate basic climate change science, including which peril specific trends the scientific community has the most confidence in, and which perils are driving trends in loss within the insurance industry.
2. Attendees will further their understanding of climate modeling output, including various RCP pathways, output timeframes that are most applicable to insurance decision making, and the inherent uncertainty of results.
3. Attendees will gain knowledge of how to interpret and apply climate model conditioned analytical tools that aide in a suite of insurance applications including underwriting, risk selection, exposure management and reinsurance purchasing.

Intersection of Coastal Flood Risk and Social Vulnerability in Property Insurance

Speakers:

- **Rehan Siddique** - Rehan Siddique is a consulting actuary with the Property and Casualty practice in Milliman's San Francisco office. He is a Fellow of the Casualty Actuarial Society and a Member of the American Academy of Actuaries. He specializes in climate resilience, flood insurance, homeowners insurance, auto insurance, Insurtech, and other catastrophic property risk. Rehan's consulting services include product pricing and development, reserve analyses, litigation support, claims analytics, use of catastrophe models and new data sources, competitive analysis, data visualization, and predictive analytics. As consultant on NFIP Risk Rating 2.0, he provides actuarial expertise and analytics support to FEMA. In prior roles, Rehan was an actuarial consultant at Oliver Wyman, and a pricing actuary at Homesite Insurance. In those roles, Rehan specialized in homeowners insurance pricing, product warranty, workers compensation, general liability, and self-insured programs. He also serves as the networking chair for the South Asian Network of Actuaries (SANA) working to support actuarial candidates of South Asian descent.

- **Molly Barth** - Molly Barth is a GIS analyst with Milliman's San Francisco Property and Casualty practice. Her work focuses on capturing geospatial indicators of hazard risk to support insurance pricing and climate resiliency planning and she has substantial experience working with large geospatial datasets to support flood insurance pricing. She has an MS in Forestry from the University of Montana.

- **Lauren Gentile** - Dr. Lauren E. Gentile is a geographer and environmental social scientist with the Office of Air and Radiation, Climate Change Division (CCD) at the U.S. Environmental Protection Agency. Her research interests center on the interactions between humans and the environment, applying a spatial and social science lens to climate change impact analyses through maps, indicators, and models. She currently works on a range of analytical efforts, including the Climate Change Impacts and Risk Analysis (CIRA) and Climate Change Indicators projects, as well as on science communications as a co-lead in building and managing EPA's new Climate Change Website. She also serves as lead on climate change adaptation for EPA's Office of Air and Radiation. Before joining CCD, she was a contractor for NOAA's National Marine Fisheries Service at the Northeast Fisheries Science Center, Social Sciences Branch where she conducted research on the socioeconomics and wellbeing of fishing communities. She was also a John D. Knauss Fellow in NOAA's Climate Program Office working at the interface of science, policy, and management in Washington D.C.

Description:

Climate change is anticipated to cause significant sea level rise and increased severity of flooding in many coastal US cities; however, the impact these hazards have coastal communities will not be uniform across different demographic groups. In this session, we will discuss how future storm surge flooding may affect populations and their properties differently, some historical drivers of these disparities, and the challenges vulnerable communities face when it comes to purchasing flood insurance to mitigate losses. First, Dr. Lauren Gentile from the EPA will present findings from the Climate Change and Social

Vulnerability in the United States report as they relate to the impact coastal flooding may have on vulnerable communities. Following this review, Milliman will discuss historical regulations that have led to current disproportionate flood risk for certain populations and explore the affordability and take-up rates of flood insurance for people living in high-risk areas by comparing NFIP rates to a private market alternative.

Learning Objectives:
1. Attendees will gain a better understanding as to how and why various demographic and socioeconomic groups are impacted by climate-driven coastal hazards differently.
2. Attendees will leave the presentation questioning how their current pricing methodologies may inadvertently promote these disparate impacts.
3. Attendees will better understand the need for improving availability, risk education, and access to insurance products in high risk areas.

Understanding and Implementing the Impacts of Climate Change in Underwriting, Pricing, Risk Management, and Mitigation

Speakers:

- **Michael Tine, CPCU, ARe** - Senior Director, Client Development - Mr. Tine has over 20 years experience in insurance and catastrophe modeling with in-depth knowledge of catastrophe models and their practical application in the insurance industry. Working with companies throughout the United States and globally, Mr. Tine has collaborated with regional, national, and global insurers at all stages of catastrophe management expertise. Prior to his 3-1/2 years with KCC, Mr. Tine worked for over 16 years at another leading catastrophe modeling firm and at Travelers Insurance prior to that.

- **Melinda Vasecka, ACAS, ARe** – Director, Actuarial Services - Ms. Vasecka has over 20 years of experience in the insurance and catastrophe modeling industries, with extensive experience in risk management, reinsurance, catastrophe modeling, and reserving. Prior to joining KCC, Ms. Vasecka lead the risk management and ceded reinsurance teams for catastrophe exposed primary insurers. In these roles, she conducted model reviews, helped develop reinsurance structures and the reinsurance placement, lead the companies' exposure management process, and developed profitability models.

- **Dan Ward, Ph.D** - Director, Model Development - Dr. Ward has extensive studies and experience in atmospheric science and modeling. Responsible for the development of several of KCC's atmospheric models, he has conducted significant research into the most accurate methods for producing stochastic catastrophe models for the re/insurance industry. Prior to joining KCC, Dr. Ward studied global wildfire variability using fully coupled Earth System Models at Cornell University and at the Geophysical Fluid Dynamics Laboratory in Princeton, NJ. This work included development of the terrestrial and atmospheric components of the global models to address questions about the impacts of fire emissions on trace gas and aerosol concentrations, radiative forcing, and climate. Dr. Ward also has experience using regional weather models in research with a focus on topics of cloud microphysics. He has authored or co-authored more than 30 peer-reviewed journal articles and was a contributing author on the IPCC Fifth Assessment Report.

Description:

In this session we will provide an overview of the macro projections on climate change as delivered in the Sixth Assessment Report (AR6) from the Intergovernmental Panel on Climate Change (IPCC); connect these projections to specific natural perils such as hurricane, severe convective storm, wildfire, winter storm, and flood; and discuss several ways this can be implemented opportunistically by insurers. - By linking the academic science through probabilistic models to insurance use cases, we will show the audience how you can integrate these projections into your risk mitigation, pricing, reporting, and other actuarial activities. - We will look to engage the audience with a poll for thoughts and concerns regarding the explicit needs of insurers to address climate change for regulators and other constituents, focusing the final portion of the discussion to their specific interest.

Learning Objectives:

1. Understand the global climate projections being used by the insurers and regulators
2. Understand how macro climate projections relate to key perils impacting insurers
3. Understand climate change use cases such as determining top drivers of risk under different climate scenarios, including current and future climate scenarios in pricing, and reporting to regulators

Adapting Climate Models for Flood Risk Decisionmaking

Speakers:

- **Howard Kunst** - Howard began his actuarial career at a Wisconsin based insurance company in 1984. After holding a full range of actuarial roles with increasing responsibilities across multiple companies, Howard joined CoreLogic as Chief Actuary in June 2012. As part of the Science and Analytics team, Howard provides a variety of analytic services to customers, as well as providing thought leadership and Industry insight within CoreLogic's Product Development, Sales, Science and Analytic teams.

  Howard is a Fellow of the Casualty Actuarial Society, a member of the American Academy of Actuaries, and a Certified Catastrophe Risk Management Professional. He is currently a member of the Casualty Actuarial Society's Ratemaking, Product and Modeling (RPM) Seminar Planning Committee, and is a member of the Academy's Extreme Event Committee.

- **David Smith** - David Smith is Senior Leader in the Science and Analytics group at CoreLogic, based in Oakland, California. He plays a leading role in the development and support of CoreLogic's catastrophe risk models worldwide, including models for earthquake and various weather-related perils throughout 98 countries. David joined CoreLogic through the acquisition of EQECAT in 2013.

  David has led significant portions of the development of CoreLogic's US Flood, US Severe Convective Storm, US Wildfire, North Atlantic Hurricane, and Asia Typhoon models, and he is active in CoreLogic's work on conditioning its models for a range of climate change scenarios and time horizons. He oversees CoreLogic's annual submittal to the Florida Commission on Hurricane Loss Projection Methodology, through which the firm's model has been successfully certified since the process began in 1997, and he has also managed CoreLogic's support of several rate filings for its US insurer clients. David has been involved with parametric trigger design and risk analysis for several catastrophe risk transactions and facilities, including the Caribbean Catastrophe Risk Insurance Facility.

  David's prior experience includes work in financial software development and consulting. He earned an MS in Geophysics from Yale University and a BS in Mathematics from the University of Chicago.

- **Shelly Yerkes** – Senior Director, Product Management, CoreLogic - Shelly Evans Yerkes is Senior Director of Product Management for CoreLogic Protect, based in Oakland, California. She is responsible for driving CoreLogic's Hazard and Risk Management products organization, which includes natural and man-made hazards. Her passion for the outdoors drew her to the physical sciences and lifelong residency in California has put her directly into major earthquake, wildfire, and flood events. This experience has given her observational experience in property vulnerability and resiliency and directed her into a desire for understanding catastrophe impacts on the built landscape.

  Shelly's career has been focused on innovation in the measurement and management of natural peril risk to physical property. Shelly Joined CoreLogic in 2018 to bring leadership in the shaping

of CoreLogic's product roadmap to support the efficiency and accuracy of underwriting and enable improved risk transfer decisioning. She is currently focused on the transformation of digital content strategies to increase performance in the management of current and future climate risk to reduce loss and escalate the availability of individual property mitigation.

Shelly earned her degrees in Physical Geography from San Diego State University with emphasis in hydrology, climatology, and Remote Sensing.

Description:
Legacy catastrophe models were developed to forecast risk into the immediate future presuming a stable and measurable hazard, and users of models relied upon loss-experience data to validate the usability. None of these are valid for estimating climate change risk. Join us as we focus on two aspects: Translating climate science into a reliable weather risk hazard projection, and gaining clarity on precisely the benefits of today's mitigation efforts are - a necessary part of understanding the marginal change from future risk

Learning Objectives:
1. Attendees will learn how Climate change scenarios can be incorporated into real model input parameters
2. Attendees will learn what types of data are needed to properly capture climate change parameters
3. Attendees will be able to take catastrophe model output and use it for risk decisionmaking.

American Academy of Actuaries: Public Policy and the Actuary's Role in Climate Change

Speakers:

- **Steve Jackson, Ph.D.** - Steve Jackson is the assistant director for research (public policy) at the American Academy of Actuaries. He works with all of the Academy's practice councils to generate, develop, and execute research projects that will enhance the work of the councils. As part of that work, he has been the primary Academy staff member working on the technical development of the Actuaries Climate Index and was the principal author of the Preliminary Findings of the Actuaries Climate Risk Index. Prior to his work at the Academy, Jackson was a member of the faculty at Cornell University and at Washington University in St. Louis.

- **Michelle Young, MAAA, FSA** - Michelle Young is the Chairperson of the American Academy of Actuaries' Work Group on Climate-Related Financial Disclosures and the Vice Chairperson of the ERM/ORSA Committee and the Climate Change Joint Task Force. She is also a member of the Society of Actuaries' Catastrophe & Climate Steering Committee. Michelle has more than 14 years of experience in life reinsurance, with various roles in pricing, valuation, retrocession, ERM, and strategic partnerships. She graduated from Baylor University, receiving a Bachelor of Arts. She later attended Florida State University for further studies in Actuarial Science and Applied Math.

- **Peter Ott, MAAA, FCAS** - Peter Ott is the Chairperson of the American Academy of Actuaries' Actuaries Climate Index/Actuaries Climate Risk Index Work Group, and a member of the Extreme Events and Property Lines Committee as well as the Climate Change Joint Task Force. Currently, Peter is in a hybrid actuarial and underwriting role at Swiss Re where he focuses on U.S. regional property treaty reinsurance. He has been in the insurance/reinsurance industry since 2012 where he has held roles in admitted markets ratemaking, catastrophe modeling, actuarial research, stochastic reserving, and large account pricing. Peter graduated from the University of Puget Sound with a Bachelor of Science in Mathematics and Master of Arts in Teaching. More recently, Peter finished his Masters in Applied and Computational Mathematics from Johns Hopkins University.

- **Lisa Slotznick, MAAA, FCAS** – Lisa Slotznick is Chairperson of the American Academy of Actuaries Climate Change Joint Task Force. She is recently retired after 42 years as a practicing actuary, with over 33 of those years providing advisory and audit services for insurers and self-insurers, specializing in many property and casualty exposures such as automobile liability and workers' compensation, as well as asbestos exposures and both old and new environmental exposures. Her areas of expertise include financial reporting, reserving and actuarial opinions. Lisa graduated from Bryn Mawr College with a Bachelor of Arts.

Description:

The Academy has been examining climate and sustainability issues from an actuarial perspective in two particular ways, financial statement disclosures for insurers and through the Actuaries Climate Index (ACI), an index of six climate-related elements of weather and sea level sponsored by the Academy, CAS, SOA and CIA. Based on the ACI, the Academy has produced and are now revising an Actuaries Climate

Risk Index (ACRI), estimating the losses due to climate change, controlling for changes in exposure. Because many of our comment letters to various insurance and other financial services regulators related to climate issues emphasize that there are variations in impact dependent upon the particular type of insurance involved, the exposed geography, the time horizon under consideration and other factors, we are working on projects that will more explicitly describe this range of impacts. This session will cover our financial statement disclosure research, the ACI/ACRI in general terms and our additional work related to variations in climate impact.

Learning Objectives:
1. Understand the level of consistency and inconsistency of current climate related financial statement disclosures for insurers
2. Become aware of the level of variations of underlying exposures that impact the ability to achieve meaningful consistency among financial statement disclosures
3. Understand the public policy applications for the Actuaries Climate Index

Climate Risk's Impact on Homeowners Insurance Industry

Speakers:

- **Prasanth Kambhatla** – Prasanth Kambhatla is Senior Director, Analytics, at LexisNexis Risk Solutions. In this role, Prasanth manages the analytics functions for all aspects of the Personal Lines Auto and Commercial Vertical in the U.S., including new product innovation and development. He is responsible for several industry-leading data solutions, including LexisNexis® Rooftop. Prasanth has been with LexisNexis Risk Solutions since 2020, working in analytics leadership roles supporting Product and Vertical divisions within the Insurance business unit of Risk Solutions Group. He holds a Bachelors in Business Management from Bangalore University, an MBA from the University of Arkansas and a Masters in Mathematical Risk Management from Georgia State University

- **Luke Dolezal** - Luke Dolezal is a Data Science Manager with LexisNexis Risk Solutions specializing in the application of Geospatial and Imagery analytics for P&C risk management. He holds a MS degree in Statistics and has been a practicing Data Scientist for over 20 years.

Description:

As insurance claims trends year over year for weather related claims goes higher, there is an increased emphasis on what is driving that change. An analysis of extreme weather events over the past 20years suggests, not only is the frequency and severity of the losses going up, but the magnitude of such extreme weather events has been trending higher. Our presentation shows the impact of weather events, population migration patterns and the use of geospatial and imagery data is being used to assess and predict the real risk of climate change

Learning Objectives:

1. A look back of the climate risk's impact on the Insurance Industry Claims trends
2. How are weather events and catastrophic events impacting the industry today and how to assess them?
3. How novel data (geospatial and imagery) is being used to mitigate climate risks

Climate Change Scenario Analysis for Financial Institutions - Practitioners Guide & Best Practices

Speakers:

- **Adam Kallin, FCAS** - Adam is a Senior Manager in the PwC's Risk Modeling Services group where he focuses on supporting PwC's ESG practice in assessing and understanding the landscape of current scope 3 emissions calculations methodologies and approaches, in order to help insurers define and navigate pathways to Net-Zero. He additionally focuses on climate scenario analysis for financial and non-financial institutions, where he helps companies assess the financial implications of the risks and opportunities associated with the transition to a low-carbon economy.

  Adam also has a background in P&C reserving and has significant experience in designing and implementing IFRS17 programs for insurers, including a 2 year secondment to P&C in Germany to support the execution of such projects with German insurers.

- **Paige Fox, FCAS** - Paige is a Manager with PwC's Risk Modeling Services practice in New York. Paige has over 7 years of experience in the property and casualty insurance industry, primarily focusing on providing audit and consulting solutions to a wide array of large insurers. In addition, Paige supports PwC's ESG practice as a part of the PwC climate risk modeling team, where she has helped financial and non financial institutions perform TCFD scenario testing across their areas of business most susceptible to climate risk. Most recently, she has helped design a scenario analysis program for a multinational insurance company in accordance with the principles set forth in international climate regulations.

- **Joshua Rosenheck** - Joshua is a Senior Associate within PwC's Risk Modeling Services group where he works within the ESG and Climate Risk space. He primarily focuses on physical and transition risk scenario modeling, Greenhouse Gas quantification in line with the GHG Protocol, and climate-related reporting. Josh has worked with clients in the oil & gas, banking, telecommunications, energy, and insurance spaces to quantify the financial impacts of their climate-related risks and opportunities and to help align their strategy towards a Net Zero target.

Description:

An analysis of the impact of climate change on financial institution solvency, profitability, and other key performance metrics is, or is likely to be, required by financial regulators in most major economies in the very near future. Regulators are signaling that such impacts should be assessed through the use of scenario analysis, both qualitatively and quantitatively. This session will first provide an overview of the emerging regulatory landscape for insurers as it relates to the disclosure of climate risk. The session will then explore the mechanics and current best practices that actuaries and risk modelers may use in performing qualitative and quantitative climate risk scenario analyses, covering both physical and transition risks.

Learning Objectives

1. Develop an understanding of regulatory requirements for climate risk disclosure across the world.

2. Identify and develop awareness of industry standard climate ‘pathways’ to consider within climate risk scenario modeling
3. Develop understanding of key variables to consider within climate scenario analysis including decarbonization, asset mix, time horizon, & KPIs.

Social Discounting and Public Risk Management, an application to climate change

Speaker:

- **Sam Gutterman, FSA, FCAS, MAAA, CERA, FCA, HonFIA** - Sam is a retired consulting actuary whose interests span insurance, social insurance, valuation, accounting, demography and the environment. Prior to his retirement in 2014, he provided actuarial consulting and audit services to a wide range of life, health and property & casualty insurance companies, self-insureds and government agencies. He served as President of the Society of Actuaries (SOA) and chair of numerous committees of the SOA, International Actuarial Association (IAA), American Academy of Actuaries and Casualty Actuarial Society. He recently served as a vice-chair of the IAA’s Resource & Environment Working Group and has been active in writing papers on the environment, including climate change.

Description:
Those involved in developing long-range cost benefit analysis regarding public policy analysis deal need to apply a (set of) discount rate(s). This session is intended to enhance the understand the key issues involved, including the application of externalities, co-benefits, uncertainty, non-qualititative elements such as ethical considerations such as inter-generational equity. Hyperbolic discounting will also be discussed. It is based on Sam Gutterman's paper entitled "Social Discounting, Application to the Risk Management of Climate Change" available on the Society of Actuaries' website.

Learning Objectives:
1. Understand the issues involved in developing cost-benefit analysis of a long-term nature, focusing on climate change
2. Understand the basic considerations applicable to deriving a social discount rate
3. Understanding the role of uncertainty in climate change cost-benefit analysis

Data, Metrics, and Information for Climate Risk Analytics

Speakers:

- **Steve Kolk, ACAS, MAAA** - Steve Kolk is president of Kolkulations, LLC, a climate risk consulting firm that solves property catastrophe risk problems collaborating with insurers, government agencies, economists and scientists to source pertinent data, build risk models, and employ geospatial technology intelligently. A sought- after speaker, Steve is considered one of the nation's foremost actuarial experts in climate change.

  He chairs the CAS Climate Change Committee and is active on the Climate Index Work Group, which constructed the first of-its-kind Actuaries Climate Index in collaboration with the SOA, CIA and the AAA. Launched in 2016, the public index reveals climate risk trends on a quarterly basis. He is also vice chair of the American Academy of Actuaries' *Extreme Events and Property Lines Committee* that prepared a *Flood Monograph* to assist the U.S. Congress with the National Flood Insurance Program.

  He is a Property/Casualty actuary with over forty years of experience, including serving as chief actuary for three companies. He is also a Michigan Native who graduated from Calvin University with a Bachelor of Arts with honors in mathematics.

- **Casey Clunas** - Casey Clunas has been a Policy Analyst with the Canadian Centre for Climate Services at Environment and Climate Change Canada since May 2018 where she works on Outreach and Engagement files.

  She holds a Master of Climate Change (MCC) degree from the University of Waterloo. She also holds a Bachelors degree in Environmental Studies and a Diploma of Environmental Assessment from the University of Waterloo.

- **Zainab Moghal, PhD** - Zainab Moghal, PhD, is a Sr. Policy Advisor with the 'outreach and engagement team' of the Canadian Centre for Climate Services (CCCS), Environment and Climate Change Canada. At the CCCS, she engages diverse stakeholders, partners and sectors to access and utilize climate information to support risk assessment and adaptation

  Prior to joining the federal government in 2018, Zainab worked extensively as a consultant and researcher with industry, government, community and indigenous organizations on climate action and environmental management. Her work and award-winning research has included sectoral focus on natural resources management, sustainable infrastructure, extractive industries, tourism, finance and urban planning. Her professional experiences include 5 years of living and working in Canada's north (Nunavut and the NWT) and research in the Caribbean, Thailand and India.

  Zainab has a PhD in *Geography & Environmental Management* from the University of Waterloo, a *Masters in Environmental Planning* (M.E.S.) from York University and a B.Sc. in *Environmental Sciences* from the University of Guelph.

- **Doug Collins** is a retired actuary living in Maine. He has served on the Casualty Actuarial Society's Climate Change Committee since 2008, and as its Chair from 2014-2017. He has been Chair of the Climate Index Task Force since 2017. Mr. Collins spent the majority of his career with Tillinghast, Nelson & Warren, and its successor organization, Towers Perrin, in Connecticut, Bermuda and London. As a consultant, Doug worked on a wide variety of actuarial projects, including the development and evaluation of natural hazard catastrophe models. He has a BS in Mathematics from Rensselaer Polytechnic Institute and is a Fellow of the Casualty Actuarial Society and a Member of the American Academy of Actuaries.

Description:
Insurance organizations continue to consider the increasing climate change impacts on their property and casualty insurance, reinsurance, finance, risk management, and enterprise risk management activities. This includes actuarial organizations examining the financial consequences of physical risks to property and casualty. To support sound financial risk management, future impacts and risks of climate change need to be understood to inform risk assessment. Climate risk analysis is being tackled by economists, statisticians, mathematicians and others. Many of these professionals are using downscaling methods to make small-scale inferences from large-scale data.

Part I of this presentation will introduce the Canadian Centre for Climate Services (CCCS), which provides Canadians with climate information and data to consider climate change in their decisions.

Part II will also provide previews of version 2.0 of the Actuaries Climate Index (ACI 2.0) and the Actuaries Climate Risk Index (ACRI 2.0). These ACI/ACRI 2.0 previews will be illustrated with prototype ERA5 and US Billion Dollar (B$D) disaster data respectively.

Learning Objectives:
1. Become acquainted with how to find data, information and services to understand, assess impacts and adapt to climate change, on US and Canadian platforms.
2. Understand the importance of using climate information to assess financial climate-related risks, and how the insurance industry plays a role in adaptation. Illustrate the types of climate information that could be of benefit to the insurance and finance sectors.
3. Become acquainted with emerging statistical downscaling tools by comparing them with actuarial credibility methods. Illustration will come from climate-driven catastrophe costs: damages to property, injuries to people, and fatalities.
4. Compare climate risk metrics of actuarial credibility methods to statistical downscaling. Compare these climate risk metrics for several different disasters: Hurricanes, Floods, and other Severe Storms

Pricing a Set of Weather Derivatives to Insure Crops in Floodplains

Speaker:

- **Diego Terranova** – Diego has a degree in mathematics at Università and Scuola Normale Superiore di Pisa (1980) and is a teacher of mathematics and physics at Liceo Statale Maffeo Vegio – Lodi – Italy.

  Other teaching experiences: assistant professor of mathematical analysis (Politecnico di Milano); professor of mathematical analysis (Scuola Universitaria Professionale della Svizzera Italiana); adjunct professor of statistics (University of Milan)

  Consultant in operations research and environmental statistics in telecommunications companies and public agencies (Italtel, Alcatel, Fondazione Lombardia per l'Ambiente).

  He is interested in the application of weather derivatives to agriculture.

Description:

As in other countries in the world, agriculture in Italy is subsidized. The Italian government pays to the farmers 65% of the premium of the insurance policies against the risk of adverse weather conditions and animal and plant diseases; the government also reinsures the insurance companies delivering such policies. Unfortunately there is a risk that insurance companies refuse to insure: the flood risk for crops in floodplains; only crops at sufficient distance from the river's bed can be insured against floods. There are, in the Italian agricultural associations, ideas to utilize weather derivatives for these risks: in this paper a method of pricing a set of weather derivatives linked to the hydrometric level of a group of rivers is examined.

Learning Objectives:

1. Consider the possibility to insure crops in floodplains
2. price weather derivatives linked to hydrometric levels of rivers
3. the utility of the simulation of multivariate probability distributions to price sets of weather derivatives

Emerging Climate Change Regulations – How P&C insurers may be affected

Speakers:

- **Hannah Clouser, ASA** - Hannah Clouser is a Senior Associate in the Climate Change team within the Actuarial Services practice at PwC. She is an Associate of the Society of Actuaries and has a background in climate-related reporting including climate risk assessments, scenario analysis, and climate disclosures, such as TCFD and CDP. She has worked on several climate related projects, including performing gap assessments, qualitative risk assessments, scenario analyses, and drafting climate reports for clients in multiple industries.

- **Maggie Brickner** - Maggie is a Senior Associate in the Actuarial Services practice at PwC based out of San Francisco. As a member of the group's Climate Change team, she focuses on physical risk modeling and climate change risk management. Maggie holds a Master's of Environmental Science & Management from the Bren School at University of California, Santa Barbara where she specialized in Corporate Environmental Management.

- **André Choquet, FCIA, FSA, CIM -** André recently joined Millani as an Associate where he will leverage his pension finance and investment expertise to help integrating ESG factors and managing climate-related risks for corporations and investors.

  As Chair Climate Change & Sustainability Committee of the CIA, he is responsible for, in collaboration with other experts, developing and implementing education and research programs for actuaries on the relevance of climate change risks to all practice areas. He also supports the Board in providing input on public policy and in promoting the expertise of actuaries in the area of climate related risks, both within Canada and abroad.

  He lives in Toronto, Canada with his wife Annie and their two soccer fanatic boys, thrilled with Canada's qualification to the World Cup!

Description:

Regulation on climate related reporting is rapidly developing both within the US and globally. During this session, we will discuss upcoming requirements that P&C insurers may be subject to, and provide examples of relevant global regulation. While the focus will be on US regulation, such as the guidance from the NYDFS on managing financial risk, NAIC climate risk disclosure survey, and pending SEC guidance, this session will also provide examples of regulation in mainland Europe, the United Kingdom and Canada, where regulation around climate disclosures is more mature and may provide an example of what is to come. The session will also provide examples of ways to respond to regulation, discuss current climate disclosure frameworks such as Task Force on Climate-Related Financial Disclosures (TCFD) and CDP (formerly Carbon Disclosure Project), cover the growing expectation of climate disclosure from investors, and consider where the future of climate regulation may be heading.

Learning Objectives:

1. Understand the current climate change regulation requirements for P&C insurers in the United States.

2. Obtain the knowledge necessary to adequately respond to climate change regulation within your business, both from a legal and regulatory perspective and from an investor demands perspective.
3. Gain perspective on the potential future of climate change regulation by examining other countries and current best-practice regulation frameworks.