An Annotated Collection of Recent Communications Regarding Responding to Expanding Climate Risks

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By

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For Katie and Carrie and all of their friends.
They will inherit the world as we left it with all of its wonders
and all of its challenges.

When it comes to climate change, we have only three choices: abate, adapt, or suffer.
—John Holdren

Professor Holdren repeated a version of these words repeatedly as Science Advisor and Director of the Office of Science and Technology Policy for President Barack Obama from 2009 through 2017. His point, when he was speaking for the President of the United States all over the world and around the country, was that we get to choose how much we want to invest in mitigation (abatement that reduces the likelihoods of climate impacts) and/or adaptation (protective actions designed to reduce the damages caused by those impacts). The results of those investments hopefully leave us with residual risks to life and treasure that we have collectively agreed are tolerable.

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FOREWORD

INTRODUCTION TO THE ESSAYS AND THEIR ORGANIZATION

This volume is the second annotated collection of essays for the popular press with which I have been involved since 2019. The first was published in March of 2023:

Yohe, G., Richels, R., Jacoby, H. and Santer, B., March 2023, *Responding to the Climate Threat – Essays on humanity's greatest challenge,* Springer Nature, Dordrecht, Netherland,
https://link.springer.com/book/10.1007/978-3-030-96372-9

Each of the essays was motivated by a then current event that was in the public eye for more than the usual 24 hours. Each was an attempt to demonstrate how robust and evolving science can be relevant to public discourse about climate change. Taken as a whole, they confront the associated issues involved in building public support for making informed decisions about how to allocate the limited funds that are available for personal and social investments across the three possible ways to respond to climate risk: abate, adapt, or suffer (including covering the associated cost of disaster relief). The essays also sometimes address the distractions and deflections that are persistently advanced by organized programs of denial and misinformation.

You can read the essays in this book from front to back, or you can pick and choose your way through the collection in whatever order meets your fancy. To help you choose, the collection is divided into four parts:

- Reviews of the current state play with regard to climate science,
- Reviews of instances wherein climate science enters the public discourse,
- Reviews of domestic issues that have arisen within the United States, and
- Parallel reviews of issues that have arisen in an international context.

To be sure, each essay is an opinion piece drawn both from current events and my four decades of experience in contributing to climate science. I have, over those years, contributed to the climate arena by writing about rigorous ways to think about climate topics, conducting positive analyses of possible actions for all three of John Holdrens's choices of response: abate, adapt, or suffer, and participating in scores of assessments of the science on scales that range from the international (e.g., the periodic reports published by the Intergovernmental Panel on Climate Change) through the national (e.g., the periodic U.S. National Climate Assessments, and down to the local (e.g., the New York (city) Panel on Climate Change). I have appended selected publications at the end of this volume not to blow my own horn, but rather just in case you are curious about what my ideas look like when they are published in the academic literature.

Each essay is presented in its own chapter surrounded by a prologue where I describe why I wrote it and an afterword where I describe what has happened since its publication.

I do not claim in any of the afterword discussions that the essay made much of a difference in what happened with regard to the climate issues that caught my attention. Some of the essays have, though, provoked enough interest to inspire readers across the public sphere to offer their own opinions about one essay or another directly to me. Some of the comments thank me for a succinct description of an issue that has been on their mind. Other readers have written to me to tell me that I must have "my head up my a--" to think the way that I do. After all, they argue, climate change is a non-issue (at best) or my piece is evidence of my participation in grand conspiracy among climate scientists to line our pockets at their personal expense (at worst).

Finally, I offer, in a postscript, three fundamental lessons that emerge from the essays when they are taken together as a single body of work:

1. Progress toward effectively responding to climate risk by mitigating, adapting, or preparing to minimize residual damage has not been monotonic, and it will never be so.
2. Options for writing policy and implementing other approaches to responding to climate risks are many in number and diverse in character because the risks being confronted are different from place to place not mention from near-term to long-run.

3. Responses to climate risks cannot effectively be considered in isolation from other sources of stress from non-climate policies or singular events in the global geo-political sphere.

You will discover as you read the essays that none of these lessons appears explicitly in any one of them. That is why the postscript closes by discussing a short piece published in the *New York Times* in which the applicability of all three to a real-world event is clearly evident.

ACKNOWLEDGMENTS

I am immeasurably grateful to Henry Jacoby, Richard Richels, Benjamin Santer, and most recently Richard Alley for their support and collaboration over the past four decades and especially over the past 4 years. We have been traveling the troubled waters of climate science together for all of that time, and I have most recently continued to gain the strength to continue the good fight from the safety our weekly writing and therapy phone calls. I think that we have made a difference over the years in the ongoing global efforts to promote the public welfare. I know that working with them on a regular basis over the past few years has preserved my sanity.

I would also like to thank William Schiffer for something; not sure what it is, but he will tell me what he thinks of it at some point. I already know what he has done for me, though. He, Brett Seelig (who created the cover), Robert Schiffer (aka Frog), Lisa Ferguson, Phil Camargo plus newcomer Jack Reynolds and Pokey (our black and white therapy cat) have been my family away from Portland while I was living at Right Path House in Clinton, CT to build some better balance into my life. They have been here for me through some of my roughest times, and I am enormously thankful for all that they have done for me just because I joined their community. That is just the way they are, but the list would not be complete without mentioning Lisa Ferguson and William R. Schiffer (a.k.a Frog) for their inspired and inspiring leadership of the house. That is the way that they all are, and I know that they will to be there for me now that I have moved back home again.

PART A

AN INTRODUCTION TO CLIMATE CHANGE SCIENCE WITH REFERENCE TO INTERNATIONAL CONTEXT

The first essay included here as Chapter 1 is much longer than any other contribution that you will find in most of the volume, but it was written to provide a solid introduction to climate risks and how economists, political scientists, jurists, policymakers, and even opinion makers could organize their thoughts about the challenges involved in understanding the current state of our understanding of climate change and its associated impacts and risks to human activity. More specifically, it is Module 5 in a collection of solicited and peer reviewed topic presentations about climate that was requested and supported by then United States Supreme Court Justice Stephen Breyer in the early 2020s. Entitled *The Climate Science and Law for Judges Curriculum* of the Climate Judiciary Project of the Environmental Law Institute, that collection was prepared and published to meet the needs of members of the U.S. judiciary who were finding themselves to be ill-prepared to handle the increasing number of climate change related cases that they were seeing in their courtrooms with an increasing frequency.

The second essay represents a personal celebration of the awarding the 2021 Nobel Prize for Physics to two of the founders of climate science for their seminal work beginning in the 1960s – Syukuro Manabe for building, calibrating, and exercising a simple reduced form model of the global atmospheric climate system and Klaus Hasselmann for developing widely applicable statistical techniques with which to detect fingerprints of human influence within all three major components of the earth's climate system (atmosphere, oceans, and land). Professor Hasselmann was a mentor for Benjamin Santer – a writing colleague and one of my best friends on the planet. Ben went to a celebration in 2021to recognize Klaus for winning the Prize just like I went to Oslo to see William Nordhaus receive his award in economics in 2018. Top of the world, it was, for both of us.

CHAPTER 1

RISKS AND COSTS OF CLIMATE CHANGE

Prologue

This essay offers some approaches and tools for thinking about how best to understand climate risk in the short and long term. It speaks to supporting and communicating the economics underlying actions that reduce the likelihoods of climate-driven impacts either by reducing the emission of greenhouse gases (mitigation) or by reducing their associated damages (adaptation). While it was written to be part of a collection of curricular modules designed to present the fundamentals of climate change science and social science to members of the United States judiciary, it serves well here for the same purpose more narrowly focused on the foundational economics of assessments of climate risks.

Risks and Costs of Climate Change[1]

Gary Yohe
January 2023

1. Introduction

As other modules in this curriculum have demonstrated, the evidence is now unequivocal that the planet has been warming since the industrial revolution1 and that greenhouse gas emissions from human activities are largely to blame.[2] Scientists have widely accepted for decades that the specific risks posed by climate change continue to be characterized by substantial and cascading uncertainties.[3] Each step in estimating risk down the cascade of uncertainty—from global emissions scenarios to regional

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[1] Yohe, G., January 2023 "Risks and costs of climate change" in *Climate science and law for Judges,* Climate Judiciary Project, Environmental Law Institute, Washington, D.C, https://cjp.eli.org/curriculum/risks-and-costs-climate-change

climate effects and their possible impacts—involves its own uncertainties, which compound along the pathway from original cause to ultimate effect.

Risk is, of course, a fundamental concept for decision making of all kinds under uncertainty; it is the product of likelihood and consequence.[4] Decisions in a resource-constrained world rely on assessments of relative risks over space and time, and they are made based on trade-offs expressed in terms of likelihood estimates of what might happen if they do or do not take a particular action.

Cost-benefit analysis has been the traditional way of dealing with risk when evaluating humanity's three choices for responding to climate change—abate (mitigate), adapt, or suffer. However, cost-benefit procedures can be ill-suited to handle the profound uncertainties of the climate problem and the elaborate connections across populations, sectors, and time.[5] They typically examine the implications of individual policies almost in isolation and thus sometimes overlook how people might change their risk by responding privately to the stresses being analyzed. Many times, cost-benefit analyses favor inaction because they focus on uncertainties that may not be resolved before a policy decision is made. When there is a source of risk, of course, taking no action is as much of a decision as taking some action.

To accommodate these limitations of cost-benefit analyses, the Intergovernmental Panel on Climate Change (IPCC) adopted a new conceptual framework in its 2007 *Synthesis Report*: risk management.[6] The IPCC stated that "responding to climate change involves an iterative risk management process that includes both mitigation and adaptation and takes into account climate change damages, co-benefits, sustainability, equity and attitudes toward risk."[7] These 30 words changed the way the world approached questions about how to respond to detected and projected climate damages.

Though cost-benefit analyses are still relevant, over the past 15 years of climate deliberations, risk management has become the complementing standard for bringing the science and economics of climate change to bear on evaluations of past, present.[8] To be clear, risk management tools were designed explicitly to accommodate even enormous uncertainty. Cost-benefit analysis was not.

Risk management (even iterative risk management) has been adopted as the organizing principle by nearly every significant climate assessment since its publication: subsequent IPCC reports from Working Groups II and III through AR6, U.S. National Climate Assessments through NCA4 (and pending for NCA5), New York City Panel on Climate Change since 2010, New York State assessment of impacts and adaptation (pending as of 2022), and so on.

The U.S. National Academies of Sciences, Engineering, and Medicine has echoed the IPCC by accepting the working definition that:

> the inherent complexities and uncertainties of climate change are best met by applying an iterative *risk management framework* and making efforts to significantly reduce greenhouse gas emissions; prepare for adapting to impacts; invest in scientific research, technology development, and information systems; and facilitate engagement between scientific and technical experts and the many types of stakeholders making America's climate choices.[9]

Given that risk is a fundamental organizing concept behind understanding human and natural vulnerabilities to climate change, clearly communicating assessments of the components of risks over space, source, and time is essential. Decisionmakers need to be informed of tradeoffs expressed in likelihood estimates of the consequences of taking, or failing to take, a particular action. They also need to understand the potential consequences of maintaining the status quo.

This module describes the elements of iterative risk management in its modern context beginning with confidence language, coping with new knowledge, risk matrices, attitudes toward risk, and insurance. It then briefly addresses damages before turning to some of the details behind investing in mitigation and/or adaptation, where we explore the concept of "tolerable risk." Finally, it returns to some of the more technical details of calculating the social cost of carbon before offering some conclusions.

2. Iterative Risk Management

As suggested in the introduction, it is many times difficult, if not impossible, to estimate accurately the likelihoods of some events associated with climate change. Calibrating these events' consequences can be equally difficult. Still, looking through even a qualitative risk-based lens can be enormously useful for making, implementing, evaluating, and/or interpreting policy even in the most challenging of circumstances. This means considering the elements of risk, consequences and likelihoods, one at a time and then together.

A. Accounting consistently for uncertainties in confidence testimonies

The IPCC gave guidance to its authors about handling the challenges of consistently accounting for uncertainties regarding specific findings. The guidance proposes organizing one's thoughts around two distinct criteria:

1. Confidence in a particular finding, which can be assessed by evaluating the "type, quality and consistency" of the available evidence and data from which the finding or hypothesis was drawn.
2. The "degree of agreement" in understanding what is driving a finding and describing rigorously the underlying causal processes behind those understandings.[10]

To take one example, there are lots of quality data demonstrating that gravity works, and there is widespread acceptance of the physics behind why it works. So, if you climb the Leaning Tower of Pisa and drop an apple, somebody can accurately project how long it will take for it to hit the ground, where it will land, and even whether it will bounce.

To take another example, macroeconomic data collected daily, weekly, and monthly across the United States are extremely well respected, much like the gravity data gathered in the 500 years since Galileo's famous experiment.[11] The distributions that characterize the behavior of macro-scale metrics like inflation and unemployment are widely understood and accepted. Nonetheless, there are two conflicting perspectives about how the economy works. One is "neo-Keynesian," wherein federal spending can sustain employment. The other is "monetarist," wherein federal spending can only generate inflation. When you ask whether the post-COVID outbreak federal spending under the American Rescue Plan[12] was a good idea, monetarists will say "No!" and neo-Keynesians will say "For sure!" Two years later, inflation hit a 50-year high, and unemployment hit a 75-year low. So, either could be right, but only partly.

And so, the quandary—How can we assess confidence in a particular scientific or economic finding, like whether higher federal spending will increase economic activity and increase employment? Figure 1 shows the IPCC approach by plotting limited, medium, or robust evidence against low, medium, or high agreement to establish the foundations for five different levels of confidence: very high, high, medium, low, and very low. These are judged relative to the confidence scale on the right-hand side of the figure. Exactly where the divisions lie is, of course, subjective. Within this matrix, movement toward higher agreement but lower levels of evidence can increase or decrease confidence in a finding depending upon the relative subjective weights of agreement and evidence. Moving toward lower agreement with greater evidence can similarly move confidence in either direction. However, moving simultaneously toward higher (lower) agreement and stronger (weaker) evidence means higher (lower) confidence, and stronger (weaker) evidence means higher (lower) confidence. For our macroeconomic federal spending example, robust evidence but low agreement (falling in the lower right-hand corner of Figure 1), means that it garners little more than medium confidence.

Why should findings with medium, low, or even very low confidence assessments be reported at all? Some climate-related events have a low likelihood of ever occurring but could generate enormous impacts. Considering events with low or extremely low confidence assessments enables decision makers and opinion-makers to account for these low-probability, high-impact possibilities. For example, there is a low likelihood of a runaway greenhouse effect caused by the accelerated release of methane or carbon dioxide from melting tundra in the Arctic, but such an occurrence would have enormous effects across a wide range of measures. This is one of a small collection of large-scale singularities that the countries of the world would view as “dangerous anthropogenic interference with the climate system” per Article 2 of the United Nations Framework Convention on Climate Change.[13]

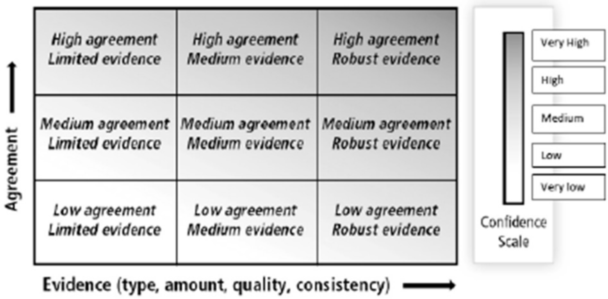

Figure 1.1 Assessments of agreement plotted against evidence. Confidence assessments depend on the quality of the underlying evidence and on agreement in understanding underlying processes that can be contingent on a wide range of possible futures; for example, a trajectory limiting temperature increases to 1.5 or 2.0 or 3.0 degrees Centigrade.

It is interesting to note, in passing, that this approach to low-confidence high-impact events is remarkably similar to and uses the same language as the U.S. and United Nations intelligence communities in assessing and reporting its findings.[14] There, analysts assess the credibility of the source of a finding given corroboration or inconsistencies in the underlying explanations. They also assess the quality of the underlying information, paying careful attention to whether it is direct evidence or circumstantial. Perhaps placing the summary information in both dimensions in a matrix-like Figure 1, they offer confidence assessments from “very high” to “very low”—and they report “very low” confidence findings if the consequences could be “very high.”[15]

B. The use of new knowledge in iterative risk management

The concepts of confidence and iterative risk management can be especially helpful when thinking about climate responses and incorporating new science into an existing body of knowledge. What to do with new knowledge in a courtroom is a corollary question. Iteration of the risk management process is critical in such contexts when they are dominated by temporal uncertainty such that planning to make mid-course corrections based on new information is prudent—or when it is time to incorporate new science that may advance, reinforce, or undermine conventional wisdom with decades of acceptance. Iteration only becomes more vital for considerations of climate science that carry unavoidable political and cultural baggage in the current environment.

Consider the earlier example of a runaway greenhouse effect caused by the accelerated release of methane or carbon dioxide from melting tundra in the Arctic. What can be said about the confidence of such an event occurring? What would happen to that confidence if new science undercut an earlier consensus? How should such news be communicated?

In 2007, the IPCC reported high agreement from land surface models that the extent of Arctic permafrost will decline during the 21st century, in large measure because of particularly rapid warming across the region. The next IPCC assessment in 2014 continued to voice concern about a positive feedback loop—that melting permafrost could release increasing amounts of greenhouse gases into the atmosphere and thereby accelerate the pace of future warming. In 2020, though, a team of Canadian scientists concluded from newly analyzed paleoclimatic data that the released frozen store of carbon might not be so sizable.[16] In accordance with the IPCC confidence language protocol, this finding reduced confidence in the conclusion that the planet may experience a runaway methane emissions scenario.

This brought another question to the forefront: how should new science regarding the possible release of methane from permafrost be communicated to decision makers and influence makers who have adopted a risk management approach? The answer to this question should begin with the observation that new science rarely contradicts current understanding completely. And just because a study's impact conclusions are wildly different from conventional wisdom does not imply the value of giving the new study extra weight. In the vast majority of cases, a study with new conclusions simply means altering assessors' subjective views about the confidence with which a former conclusion is held.

In this case, views of the consequences of a runaway greenhouse effect were not altered. Rather, the likelihood that future methane releases and associated damages would be small was increased. As a result, the assessment team could conclude that a more benign future was now a little more likely; however, they could also add that runaway warming from permafrost melting was still possible and that continued research into the matter would be prudent.

The news is not always this good. Recent science from Antarctica suggests two very troubling findings wherein it could be much worse. First, the pace of routine melting from the West Antarctic Ice Sheet has increased over the past decade or so. New sea-level rise estimates reflect that finding in their high-warming scenario with high confidence associated with an extra increase in global sea rise of about one foot through 2100. Secondly, more limited time series observations strongly suggest that the ice structures supporting the Thwaites glacier are disintegrating—and that they are disintegrating quickly and perhaps irreversibly. That potential raises the possibility of a second extra increase in sea-level rise of more than one foot within the next five years or so.[17] The first finding is troubling, but the second could be catastrophic.

Sometimes, the story moves past physical impacts and into quantifiable monetary consequences. For example, Marshall Burke et al. (2015) stood alone in suggesting that damages from climate change through 2100 could be as high as 25% of global gross domestic product (GDP).[18] This estimate has been contested and even its distribution is controversial, but it should have entered the iterative risk management equation. In context, 2100 is well after the first or second iteration of this century. If the Burke study is right about 2100, then adjusting in 2050 and 2075 would be more expensive than getting it right this year. However, potential "mid-course corrections" are a responsible hedge so that the question is "What should we monitor to get an early warning?" That is, the critical factor in iterative risk management, ensuring that there is agreement and understanding about why any disagreement exists.[19]

C. Risk matrices

To accommodate situations like the last example, the context of the potential costs of climate change has come to reinforce the conventional definition that risk is the product of the likelihood of an uncertain event's occurring multiplied by the consequences of that event.

In response to the critical need to reflect this definition, risk matrices have emerged as one of the most effective tools by which analysts, scientists, policymakers, opinion-makers, judges, and others can communicate clearly with one another.[20] Figure 2 shows how a matrix can be used to project current and future risks in terms of likelihood and consequence.

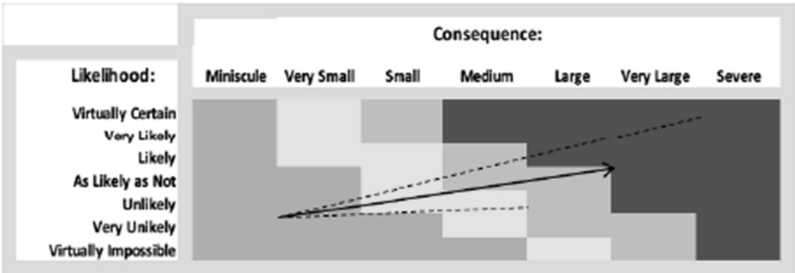

Figure 1.2. A typical risk matrix. The conceptualization of risk as the product of likelihood and consequence can be portrayed by a two-dimensional matrix. Source: "On the Value of Conducting and Communicating Counterfactual Exercise: Lessons from Epidemiology and Climate Science" in *Environment Issues and Sustainable Development (2021).*

Following the protocol of the U.S. intelligence community, calibrations of likelihood that run up the vertical dimension span seven categories ranging from "Virtually Impossible" to "Virtually Certain," with probabilities close but not equal to zero and close but not equal to one, respectively. The rationale for these seven categories, once again drawn from the intelligence community, is displayed in Table 1. The table replicates intelligence community protocol and supports recommending that climate analyses categorize likelihoods of climate risks according to seven categories ranging from “Minuscule” to “Severe.”

almost no chance	very unlikely	unlikely	roughly even chance	likely	very likely	almost certain(ly)
remote	highly improbable	improbable (improbably)	roughly even odds	probable (probably)	highly probable	nearly certain
01-05%	05-20%	20-45%	45-55%	55-80%	80-95%	95-99%

Table 1.1. Calibration of the subjective likelihood that an event might occur. Source: Central Intelligence Agency Directive 203 (2015)

Categorizations of consequence also have seven possibilities in Figure 2—but that is mostly to cement some consistency of thought from impacts calibrated in whatever metric makes the most sense for the case at hand.

Green boxes identify low-risk combinations of likelihood and consequence; they are relatively benign and unlikely, so they are of smaller concern. Yellow boxes suggest moderate concern, while the orange boxes capture combinations that fall just short of the red-shaded combinations of major concern.

Such a matrix can be used to identify how risks adjust as the climate actually changes and outcomes become more certain or impacts more severe. The beginning of the solid arrow indicates a particular risk under the current climate. Decision makers can envision how this location could move across the matrix as time progresses and climate change occurs. The solid arrow shows, for example, how a particular risk could move quickly into the orange region and closer to the troubling red combinations for which some reactive or proactive preventative action might be appropriate.

Figure 2 also suggests how risk matrices could be used to account for uncertainty about the future. The upper dotted line represents a hypothetical 95th percentile scenario that portends larger consequences with growing likelihood sooner than the baseline. The lower dotted line represents a 5th percentile scenario trajectory. It is shorter because it tracks below the median and thereby depicts cases where the consequences of climate change increase more slowly.

Risk analyses must sometimes be conducted despite the lack of sufficient data to support quantitative estimates of the distributions of relative likelihoods across a range of possible future climate-related impacts and associated economic events. In those cases, a risk matrix can provide a suitable qualitative substitute for specific confidence assessments.

D. Attitudes toward tolerable risk

The term "risk" has many definitions in colloquial use, such as the possibility of a loss or injury, a person or thing that is a specific hazard to an insurer, or the chance that an investment will lose value. But the more rigorous definition of risk as "the product of likelihood and consequence" has specific implications for climate change science. First, ***"tolerable risk"*** can be seen as the levels of risk deemed acceptable by a society or by an individual to sustain some particular benefit or level of functionality. Achieving tolerable risk does not mean eliminating all harm. It does not even mean that the damage from an event, such as a storm or wildfire, will not be catastrophic to some people. It does mean that the risk has been evaluated and is being managed to an acceptable level of comfort according to the particular risk aversion applied.

Public health provides an example from the United States. Figure 3 shows mortality proportions by state from ordinary flu and pneumonia.[21] The categories illustrated by different shades of blue indicate different levels of tolerable risk with which each state's citizens have become comfortable. How do we know they find this risk tolerable? Because those citizens are not demanding greater safety even though the means to reduce flu mortality are available.

More closely relevant to climate, the New York (City) Panel on Climate Change (NPCC 2010) employed tolerable risk to frame both its evaluation and management of climate change risks to public and private infrastructure.[22] NPCC communicated this concept to planners and decisionmakers by pointing out that building codes imposed across the city did not try to guarantee that a building would never collapse. Instead, they were designed to produce an environment in which the likelihood of a collapse was acceptable given the cost and feasibility of doing more to prevent collapse. However, if climate change or another stressor pushed a particular risk profile closer to the thresholds of social tolerability by increasing likelihoods of harm, investments in risk-reducing adaptations would be expected to increase.

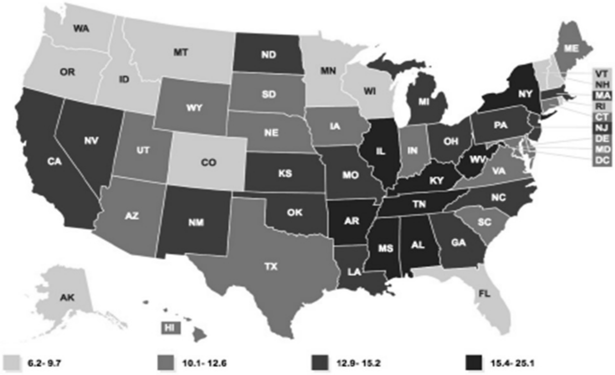

Figure 1.3. Reported deaths per 100,000 people (about the seating capacity of the Los Angeles Memorial Coliseum). Source: Centers for Disease Control and Prevention (2020)

Achieving broad acceptance for any tolerable risk threshold across a population is a huge task. For one, risk tolerance varies widely across societies and individuals. For another, policymakers confronting a pandemic or extreme climate change are often navigating between different and sometimes strongly contradictory risk management priorities.

Individuals, communities, and institutions can meet such challenges by agreeing on a common set of facts about the likelihood and consequences of an event. They can then explore together how much risk is acceptable and why. During the second wave of the COVID-19 pandemic, for example, New York State relied on science to frame its strategies to avoid overwhelming its hospital system after what had been a successful initial response. New York implemented two forward-looking criteria: (1) hold the transmission rate of the virus below 1.0 *and* (2) keep vacancies of hospital beds and ICU beds across the state above 30% of total bed capacity. These criteria represented thresholds of tolerable risk that could be monitored and projected into the future using results from integrated epidemiological-economic models.

E. Insuring against risks

One way of managing risks is through insurance. Sometimes, insurance comes in the form of hedging against an adverse event by being careful to lower the likelihood of an event. Other times, insurance means taking