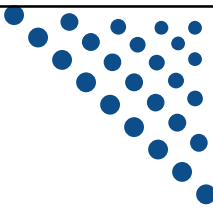


*Osher Lifelong Learning Institute, Summer 2026*

## Contemporary Economic Policy

University of Hawaii, Manoa

Host: Geoffrey Woglom, Director  
National Economic Education Delegation



## Course Schedule

### Contemporary Economic Policy

- Week 1 (7/2): Saving Social Security, Geoffrey Woglom, Amherst College
- Week 2 (7/9): Trade & Globalization, Luisa R. Blanco, Pepperdine University
- Week 3 (7/16): Crypto Currencies and the Future of Money, Geoffrey Woglom
- Week 4 (7/23): Economics of Immigration, Luisa R. Blanco, Pepperdine University
- Week 5 (7/30): Federal Debt and Deficits, Robert Rebelein, Vassar College
- **Week 6 (8/6): Climate Change Economics, Gary Yohe, Wesleyan University**

## Submitting Questions

- Submit questions in the chat. I will try to address questions after 10-minute intervals. We will also do a verbal Q&A once the material has been presented.
- Slides will be available from the NEED website:  
[https://needecon.org/delivered\\_presentations.php](https://needecon.org/delivered_presentations.php).



## National Economic Education Delegation

### Climate Change Economics Part 2

Gary W. Yohe, PhD LLC  
Wesleyan University



## Outline

- A working definition of risk
- Risks posed by climate change
- Climate example: sea level rise
- Responding to climate risk
- Insurance
- The science of characterizing risk



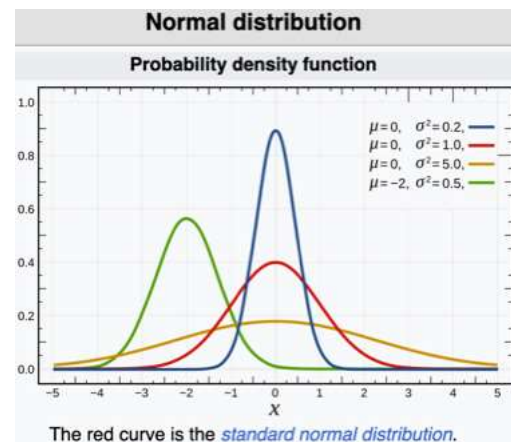
NATIONAL ECONOMIC  
EDUCATION DELEGATION

## A working definition of risk

Source: <https://www.ipcc.ch/report/ar4/syr/>

Risk imposed by any particular event is the product of the likelihood that it will occur and its consequences.

As a mathematical concept, it is the weighted average of those products.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Risk as a framing concept

As a framework for approaching climate change impacts, the components of risk can organize rigorous thinking about climate consequences.

Together, they make it clear that low likelihood climate change impacts with large consequences can be labeled “high risk” or “very high” risk without being criticized as “fear mongering”.



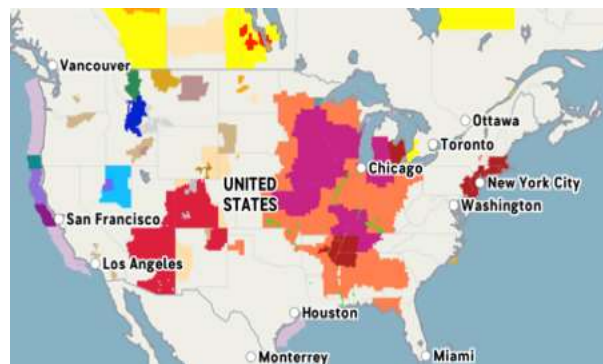
NATIONAL ECONOMIC  
EDUCATION DELEGATION

7

## Risks posed by climate change

- Civilization faces many risks driven by climate change: (e.g., 06/28/2026)

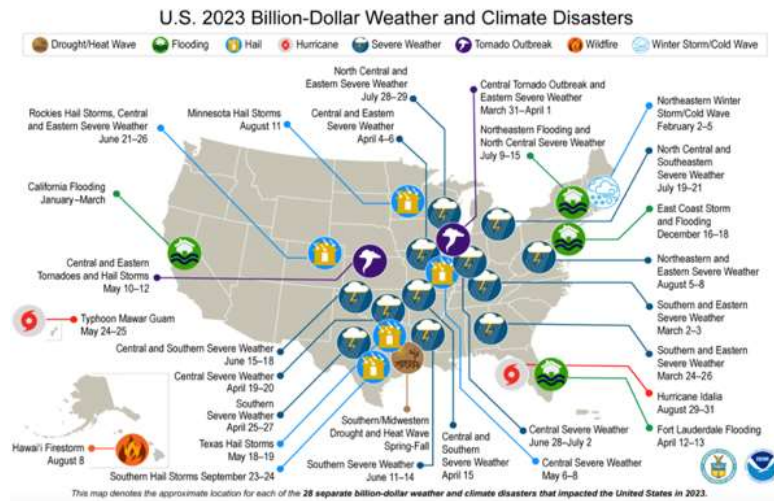
riverine flash floods,  
prolonged droughts,  
prolonged periods of extreme  
heat or cold,  
changing character & strength  
of cyclones and hurricanes,  
red flag alerts for wildfires,  
changes in the variation of  
cycles,  
*and the like...*



NATIONAL ECONOMIC  
EDUCATION DELEGATION

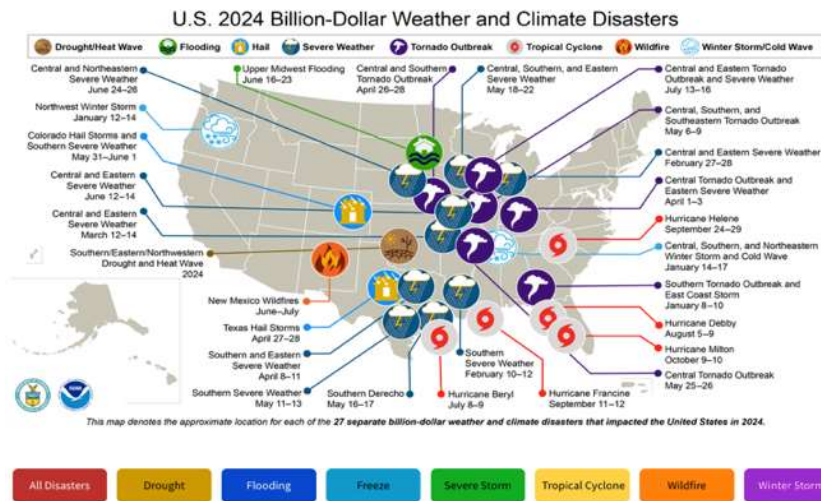
8

## Examples of extreme damage - 2023



Source: <https://www.noaa.gov/sites/default/files/202401/BillionDollarDisasters2023Summary.png>

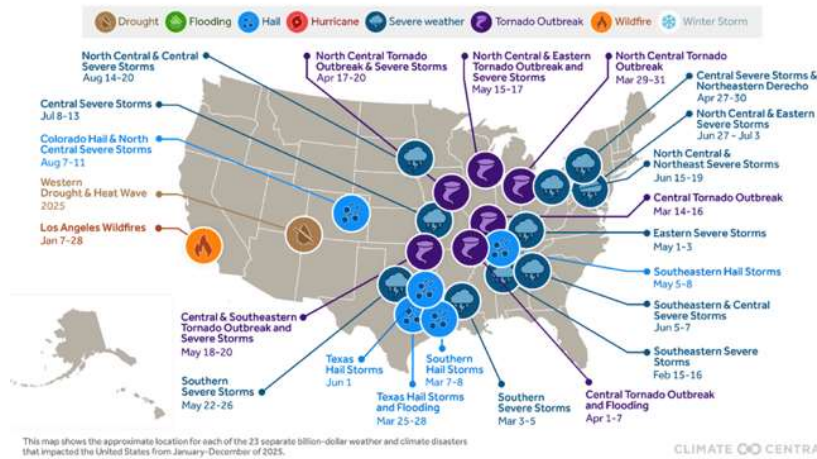
## More examples of catastrophic loss - 2024



Source: <https://www.ncei.noaa.gov/access/billions/10>

## The most recent yearly report of extreme damage - 2025

### U.S. 2025 Billion-Dollar Weather & Climate Disasters

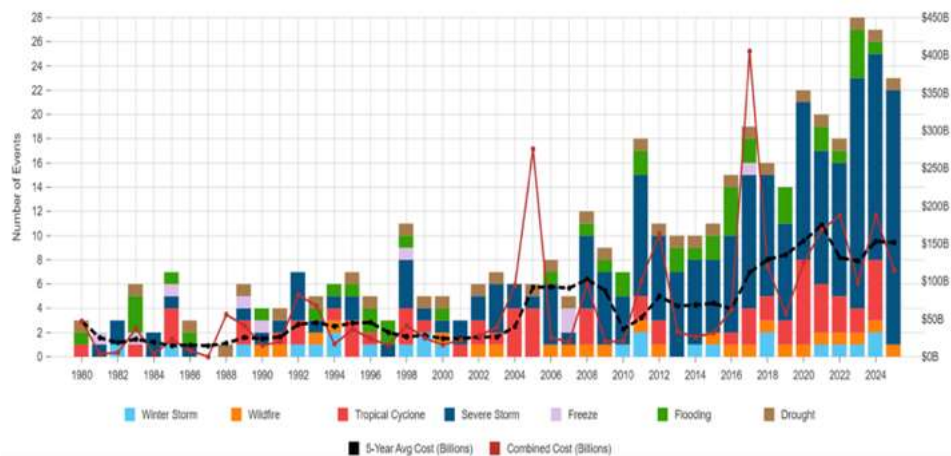


Source: [https://downloads.ctfassets.net/cxgxtg8r5d/1c7a1aKVzgh2GoLO74NZYN/32c28a9dbf1c5110929bf3ec2478b0f6/US\\_Billion-Dollar\\_Disasters\\_2025.pdf](https://downloads.ctfassets.net/cxgxtg8r5d/1c7a1aKVzgh2GoLO74NZYN/32c28a9dbf1c5110929bf3ec2478b0f6/US_Billion-Dollar_Disasters_2025.pdf)



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Billion dollar events – a time series from 1980



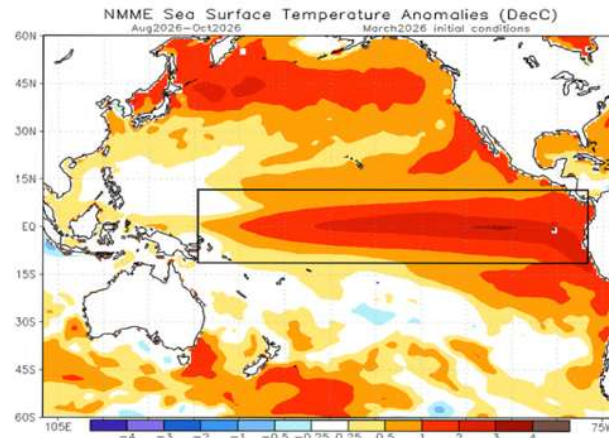
Source: [https://downloads.ctfassets.net/cxgxtg8r5d/1c7a1aKVzgh2GoLO74NZYN/32c28a9dbf1c5110929bf3ec2478b0f6/US\\_Billion-Dollar\\_Disasters\\_2025.pdf](https://downloads.ctfassets.net/cxgxtg8r5d/1c7a1aKVzgh2GoLO74NZYN/32c28a9dbf1c5110929bf3ec2478b0f6/US_Billion-Dollar_Disasters_2025.pdf)



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Record (“very strong”) El Nino on the way in 2026

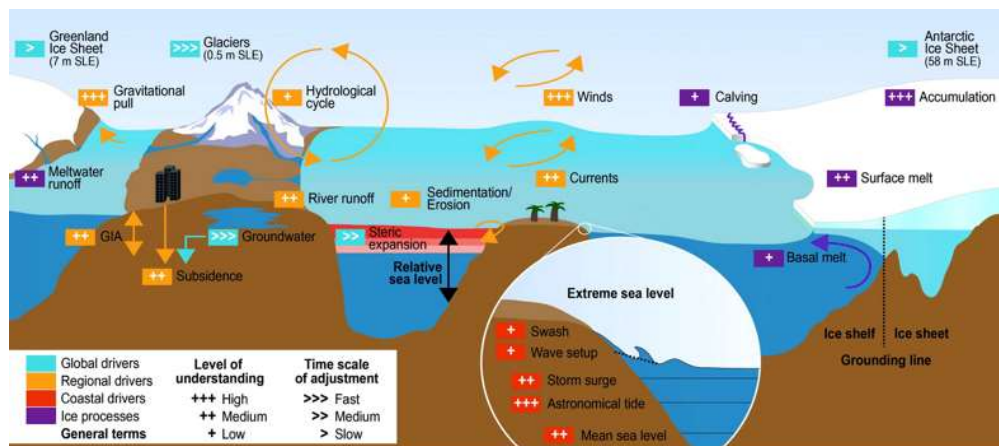
{Source: <https://www.downtoearth.org.in/climate-change/a-rare-super-el-ni%C3%B1o-may-be-forming-in-the-pacific-and-it-could-reshape-global-weather-starting-this-summer>}



NATIONAL ECONOMIC  
EDUCATION DELEGATION

13

## A risk example – sea level rise (SLR)



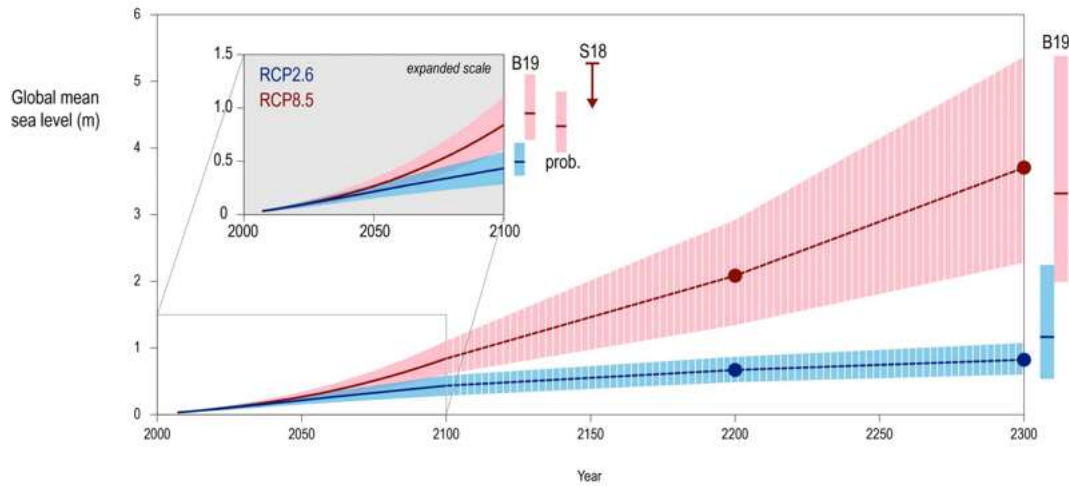
Source: Figure 4.5 in <https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities/>



NATIONAL ECONOMIC  
EDUCATION DELEGATION

14

## Projections of future SLR



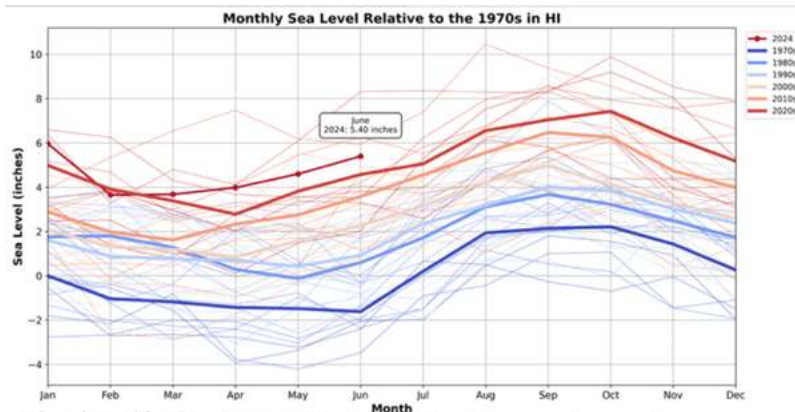
Source: Figure 4.2 in <https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities/>



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Historical monthly sea level rise for Hawaii with decadal averages

(Source: <https://climate.hawaii.gov/hi-facts/sea-level-rise/>)

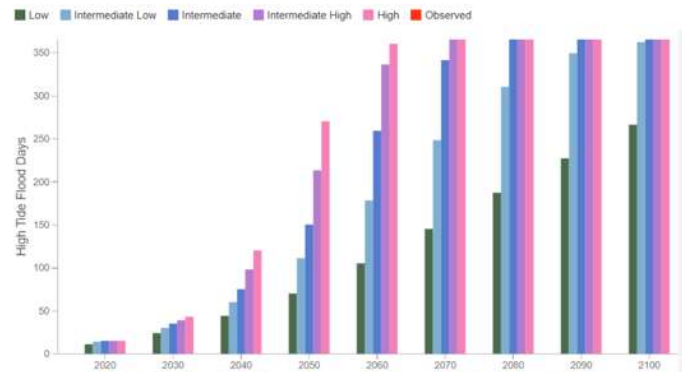


Sea level in Hawai'i from 1970 to 2024. Sea level has been increasing over time on average shown by the shift from blue lines to red lines. Graph by US Sea Level Change Task Force.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Associated number of days Hawaii can expect high tides from low to high levels (Source: <https://climate.hawaii.gov/hi-facts/sea-level-rise/>)



Future High Tide Flood Days. High tide flooding will increase significantly in the future. By mid century, we can expect some areas to flood nearly every day. Graph by US Sea Level Change Task Force.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

17

## The projected consequences of future flooding in HI

- 28,000 additional acres of unusable land
- 6,500 additional structures at risk from SLR
- 550 cultural sites, 38 miles of road and \$19+ billion in assets exposed to chronic flooding
- Waikiki and military infrastructure around Pearl Harbor at risk

→ → *existential threats to some parts of food security, water supply, economy, cultural heritage, and habitability*



NATIONAL ECONOMIC  
EDUCATION DELEGATION

18

## SLR vulnerability along southern Maui (1.5 & 3.0 feet)



NATIONAL ECONOMIC  
EDUCATION DELEGATION

19

## Responding to climate risk

1. Abate: (mitigate): reduce emissions of greenhouse gases;
2. Adapt: reduce the climate impacts' consequences;
3. Suffer: recognize that *no combination of mitigation and adaptation will eliminate climate risk completely,*



A home on O'ahu's north shore collapsing onto the beach in 2022.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

20

## The Intergovernmental Panel on Climate Change (IPCC) on approaching those three response options

*“Responding to climate change involves an **iterative risk management** process that includes both adaptation and mitigation and takes into account climate change damages, co-benefits, sustainability, equity and attitudes to risk.”*



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## The meaning of “iterative risk management”

Before 2007, the mitigation question was approached as an enormous intertemporal welfare maximizing problem fraught with enormous uncertainty and very long time horizons.

After 2007, the problem was framed in terms of minimizing cost of responses designed to maintain risk at a tolerable level:

*Cost minimization included taking advantage of the ability to make mid-course corrections (that is to say, “iterate”).*



NATIONAL ECONOMIC  
EDUCATION DELEGATION

22

## Taking advantage of the two components of risk

Mitigation can slow warming and thereby reduce the likelihood of an extreme event at any point in time.

Adaptation can reduce the consequences associated with that event.

**Both can work together as complements to reduce, but not eliminate, residual damages.**

Just because you invest more in one action does not mean that it would be effective to invest less in the other because:

***Mitigation** produces long-term likelihood benefits while **adaptation** can produce more immediate and targeted benefits in the short run.*



NATIONAL ECONOMIC  
EDUCATION DELEGATION

23

## The popular insurance analogy

Property and casualty insurance allows policyholders to lower premiums by accepting deductible provisions while still having coverage for larger damages (up to limits included in the policies).

Investing in mitigation and adaption has been likened to buying this type of insurance, but

this misses their inability to cover residual damages from the unavoidable suffering choice that are usually the most severe outcomes even if they are **unknowingly unlikely**.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Crisis in the insurance industry from climate risk

- In California: State Farm and Allstate have stopped selling property insurance to new customers.
- In Florida: Farmers Insurance has announced it will no longer offer any new property coverage; AIG will no longer insure houses along the Florida coastline.
- In Louisiana: The providers of policies for one-fifth of homeowners have canceled coverage.
- In Texas: Many small insurance companies have become insolvent.

Source (from 2024): <https://www.eli.org/sites/default/files/files-general/2024-03-13%20Coastal%20Property%20Insurance%20Read%20Ahead%20Document.pdf>



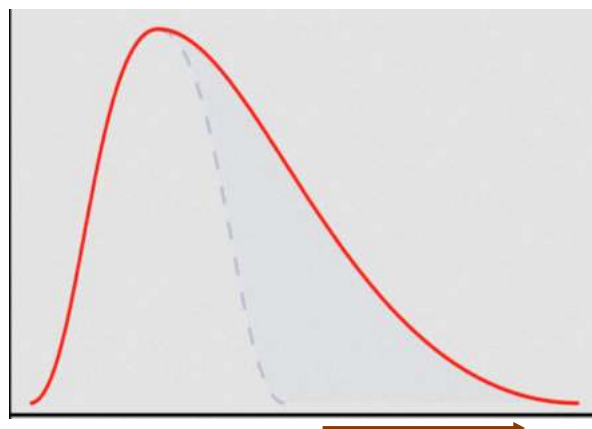
NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Risk management and accounting for the extremes

When data are sufficient, robust statistical analysis can tell iterative managers to worry more about the upper regions of damage possible impacts.

New science can then suggest how those extremes may be more likely than previously thought.

Here, the dashed blue probability curve moves to the right to depict the effect of accepting the new science.

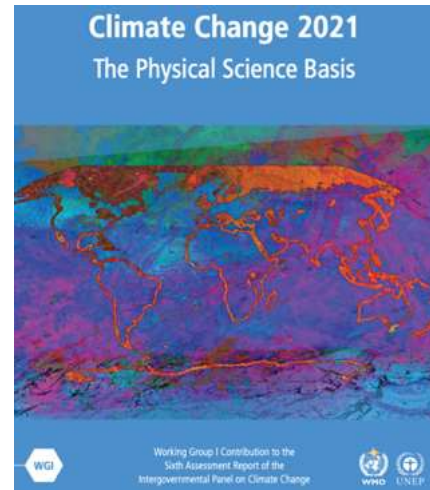


Damages calibrated in currency, lives, etc...



NATIONAL ECONOMIC  
EDUCATION DELEGATION

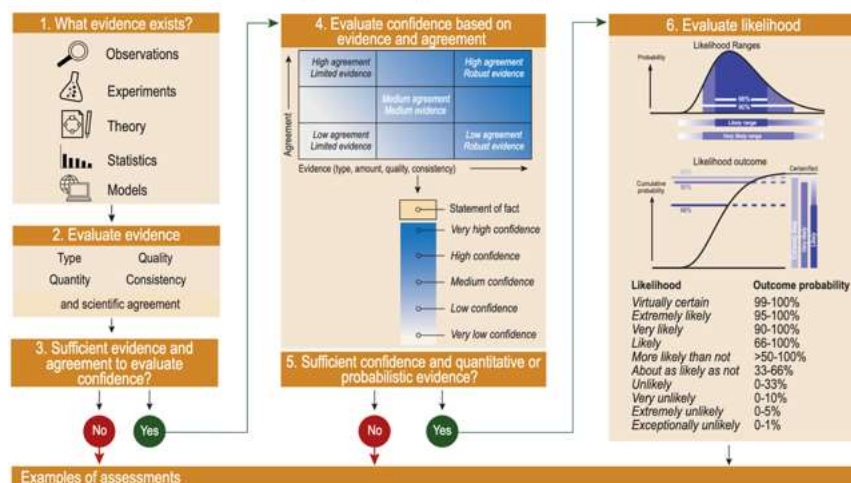
## What if the data do not support statistical analysis?



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Comparing of likelihood and confidence

Evaluation and communication of degree of certainty in AR6 findings



NATIONAL ECONOMIC  
EDUCATION DELEGATION

28

## CLOSING REMARKS (beyond "it all depends on something")

- Risk management is the state of the art – the product of the likelihood of an event and its consequences
- Climate impacts drive climate consequences wherein damages (and occasionally benefits) are produced
- Mitigation can reduce likelihoods by delaying impacts
- Adaptation can reduce consequences by reducing vulnerabilities of exposure, but it can be overwhelmed during extremes events
- Mitigation and adaptation cannot completely eliminate risk leaving residual consequences that can be very large



At least 12 wildfires were burning across Utah, Ty  
Daily Associated Press



NATIONAL ECONOMIC  
EDUCATION DELEGATION

29

## Thank you!

**Gary Yohe, LLC**  
[gyohe@Wesleyan.edu](mailto:gyohe@Wesleyan.edu)  
[climatecafe.substack.com](http://climatecafe.substack.com)

Contact NEED: [info@NEEDEcon.org](mailto:info@NEEDEcon.org)



NATIONAL ECONOMIC  
EDUCATION DELEGATION

30

## Time for questions

- About the talk
- About recent events with regard to confidence about climate change risk findings
- About defending science in a hostile world
- About the difference between hope v optimism
- About scientists' responsibilities to carry on
- About science consumers' responsibilities in assessing and processing climate science uncertainties and climate change risks



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Thank you!

## Any Questions?

[www.NEEDEcon.org](http://www.NEEDEcon.org)

Gary Yohe

[gyohe@wesleyan.edu](mailto:gyohe@wesleyan.edu)

Contact NEED: [info@NEEDEcon.org](mailto:info@NEEDEcon.org)

Submit a testimonial: [www.NEEDEcon.org/testimonials.php](http://www.NEEDEcon.org/testimonials.php)

Become a Friend of NEED: [www.NEEDEcon.org/friend.php](http://www.NEEDEcon.org/friend.php)



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Reserve slides

- Science success story – slides 34 & 35
- Story about RCP8.5 – slide 36
- San Francisco SLR response – slides 37-41



NATIONAL ECONOMIC  
EDUCATION DELEGATION

33

## An example of a new science success story

M. Kotz, A. Levermann, and L.Wenz) paper published “The economic commitment of climate change” published in *Nature* by in April of 2024 {<https://www.nature.com/articles/s41586-024-07219-0.pdf> }. It attracted significant interest in the climate science community and beyond.

As always happens when that happens, other scholars (e.g., T. Bearpark, D. Hogan, S. Hsiang, and C. Schotz) examined it carefully and likely undertook some replication experiments.

They voiced some serious concerns about the methods and one batch of data.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## The authors intend to submit a new paper

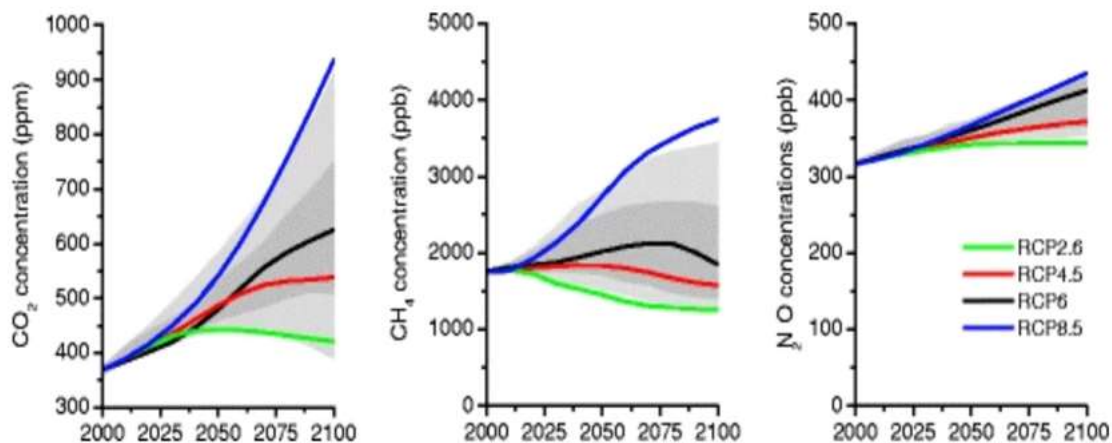
- The authors acknowledged the errors (the results were sensitive to the removal of one country where the data were suspect (evidence) and collinearities in the data had not been caught (analytics))
- The authors made the changes; their estimates of economic effects were reduced a little, and the confidence intervals expanded.
- They agreed that the changes were too large for a simple revision of the original paper, so they agreed to a retraction and intend to submit an entirely new paper.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## RCP concentration ranges for 3 GHGs

Source: Figure 9 in <https://doi.org/10.1007/s10584-011-0148-z>



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## SLR example of how iterative risk management can work San Francisco

Source: [https://www.swt.usace.army.mil/Portals/41/SFWCFS\\_DIFR\\_EIS\\_Main%20Report\\_1.pdf](https://www.swt.usace.army.mil/Portals/41/SFWCFS_DIFR_EIS_Main%20Report_1.pdf)



**Figure 1 - Extent of inundation expected under 1% AEP flood event in FWOP Conditions under the three RSLC curves**

**Note:** The shades of blue reflect the three SLR curves, with the lightest blue being the USACE low curve, and darkest the high curve.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## San Francisco planning description

Formulation of alternatives to reduce coastal flood risk included:

- An overall approach to defend, accommodate, or retreat from coastal flood risk consisting of structural and nonstructural measures and natural and nature-based features along different lines of defense including:
  - the existing shoreline,
  - a more bayward alignment, and
  - an inland alignment requiring partial retreat of buildings and infrastructure over time;
- Varied scales of features to reflect uncertain timing of RSLC; and
- Phased implementation of features within most alternatives.



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## SLR alternative scenarios: 1.5', 3.5' & 7' by 2090

**Alternative A** No Action

**Alternative B** Nonstructural (e.g., floodproofing)

**Alternatives C and D**

Alternative C Defend, Scaled for Lower Risk (low rate of SLC)

Alternative D Defend, Scaled for Low-Moderate Risk (intermediate rate of SLC)

**Alternatives E, F, and G**

Alternative E Defend Existing Shoreline, Scaled for Higher Risk (high SLC)

Alternative F Manage the Water, Scaled for Higher Risk (high SLC)

Alternative G Partial Retreat, Scaled for Higher Risk (high SLC)

Alternatives D, E, F, and G were all designed to be adaptive, with a second action



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## Iterative risk management results

Table 1-2 - TSP First and Second Actions

| Table 2: Conceptual Framework for TSP Subsequent Actions |                     |                        |                                 |                         |
|----------------------------------------------------------|---------------------|------------------------|---------------------------------|-------------------------|
| Reach                                                    | First Action        | Second Action Low RSLC | Second Action Intermediate RSLC | Second Action High RSLC |
| Fisherman's Wharf, Reach 1                               | Alternative B       | No action              | Alternative B (Additional NS)   | Alternative G 19'       |
| Embarcadero, Reach 2                                     | Alternative G 15.5' | No action              | No action                       | Alternative G 19'       |
| South Beach/Mission Bay, Reach 3                         | Alternative D 13.5' | No action              | Alternative D 15.5'             | Alternative E 19'       |
| Islais Creek/Bayview, Reach 4                            | Alternative D 13.5' | No action              | Alternative D 15.5'             | Alternative E 19'       |



NATIONAL ECONOMIC  
EDUCATION DELEGATION

## The chosen adaptation plans for 4 SF reaches



NATIONAL ECONOMIC  
EDUCATION DELEGATION