ETH zürich

Klimakosten im Gesundheitswesen – eine massiv unterschätzte Folge der Erderwärmung

AefU Tagung, 15. Mai 2025

Prof. Dr. Lint Barrage, Climate and Energy Economics, ETH Zurich

Image source: California Health Care Foundation

Outline

1. Context:
Quantifying the Economic Impacts of Climate Change

2. The Social Cost of Carbon:
What Is It and Why It Matters

➔ Are Healthcare Impacts Counted? → Spoiler: Mostly No

3. Healthcare Cost Impacts of Climate Change
4 Key Findings

4. Conclusion
Climate policy needs to better account for healthcare—and healthcare is key to resilience

1. Quantifying the Economic Impacts of Climate Change

Bottom-Up

Top-Down

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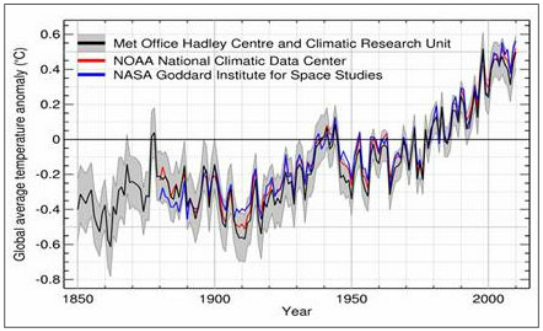
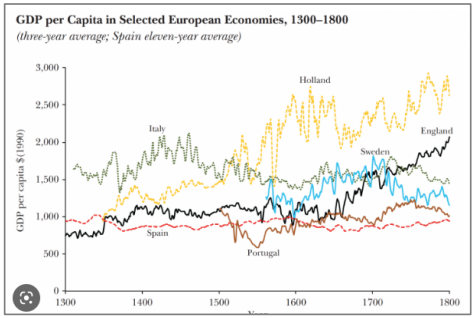
Bottom-Up

Top-Down

Statistical analyses of relationship between GDP and temperatures





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Bottom-Up

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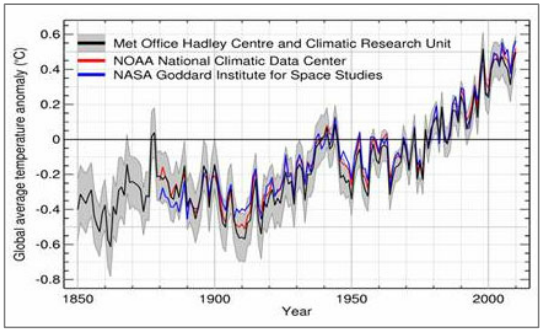
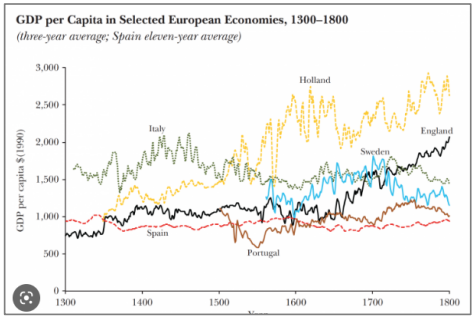


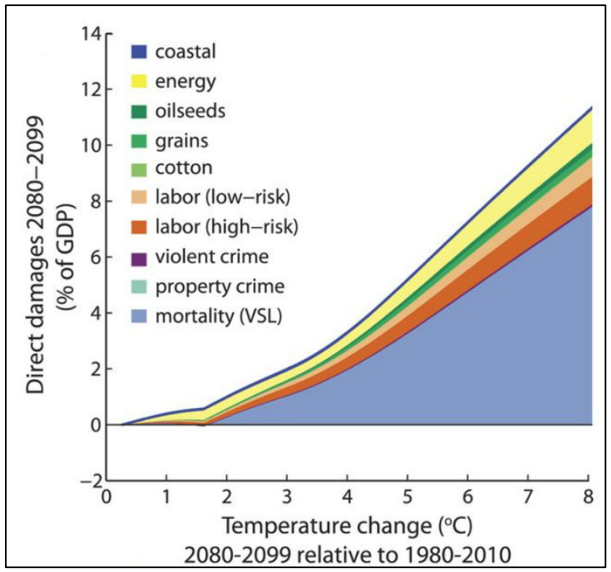


Health(care) Impact	Captured?	Valuation?
Mortality/Morbidity in **working** populations	**Partly** Typically only from short-term shocks (e.g., heat waves) but not long-run trends (e.g., disease vectors)	**Limited:** Only via lost GDP
Mortality/Morbidity in **non-working** populations	**Not really**	**Limited:** Only indirectly via lost GDP
Healthcare Costs	**Not really**	**Limited:** Only via healthcare sector productivity

1. Quantifying the Economic Impacts of Climate Change

Aggregation of impacts across different channels (mortality, agriculture, etc.) from statistical and/or model-based assessments

Bottom-Up | Top-Down



Source: Hsiang et al. (2017)

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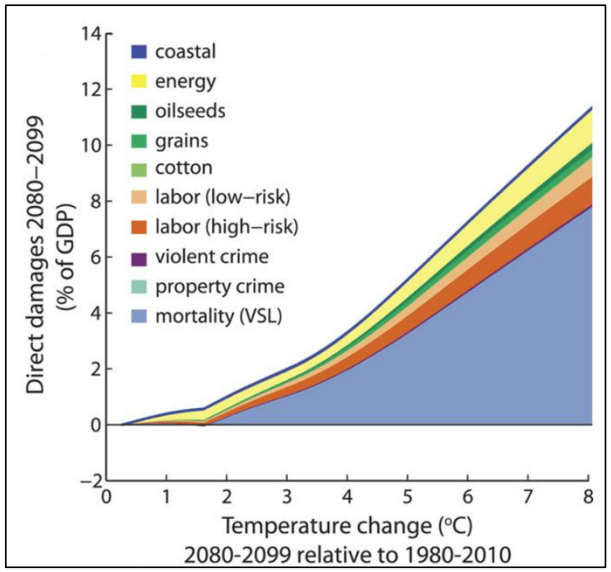
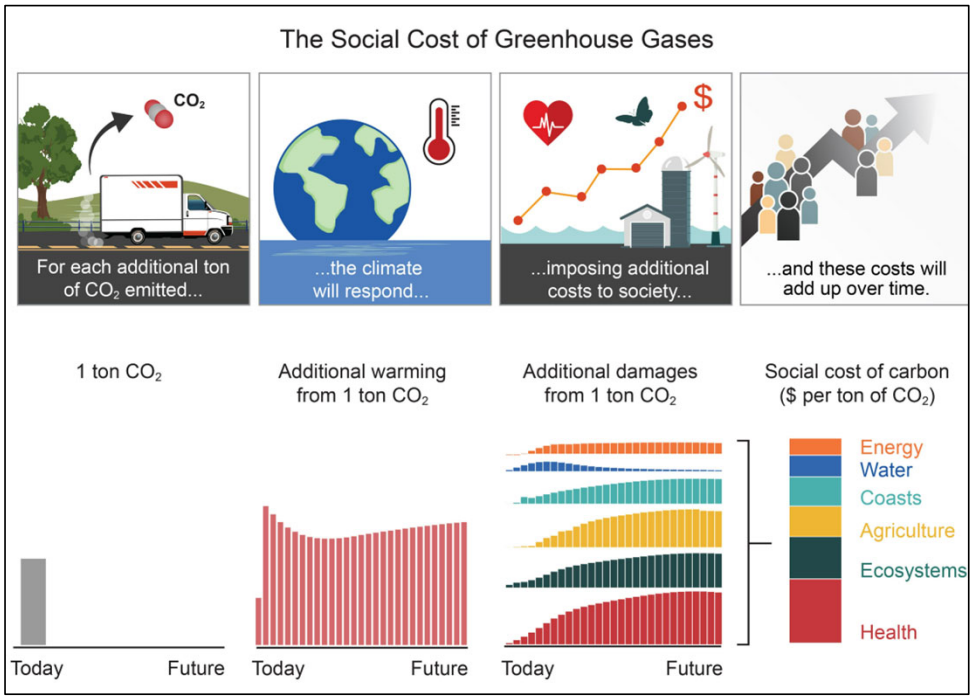


Source: Hsiang et al. (2017)

Health(care) Impact	Captured?	Valuation?
Mortality (all populations)	**Partly** Typically only from limited set of climatic risks, such as temperature extremes or storms	**Broad** via Value of Statistical Life
Morbidity (all populations)	**Limited** Excluded in most models but considered for a subset of climatic risks in some	Disease-Adjusted Life Years x Value of Statistical Life
Healthcare Costs	**No** With very few exceptions	

2. The Social Cost of Carbon

- Individual studies estimating some of these missing impacts do exist…
- …but they are generally not incorporated into aggregator models used to estimate the **Social Cost of Carbon (SCC)**
- SCC: The present value of the total economic costs imposed by +1 ton of CO_2 released today



Source: Hsiang et al. (2023)

2. The Social Cost of Carbon

- **Importance:** Governments around the world use the Social Cost of Carbon
  - In cost-benefit analyses of proposed new rules and policies
  - To guide policy design, e.g., to benchmark carbon pricing
  - To set subsidy rates for zero-emissions electricity
  - To calculate environmentally adjusted aggregate economic statistics (savings rates, GDP)

Examples of U.S. Regulations where SCC was used in Cost-Benefit Assessments:

Rule title	Agency	Date
Energy Conservation Program: Energy Conservation Standards for External Power Supplies	DOE	10/02/2014
Energy Conservation Program: Energy Conservation Standards for Metal Halide Lamp Fixtures	DOE	10/02/2014
Energy Conservation Program: Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens	DOE	17/06/2013
Energy Conservation Program: Energy Conservation Standards for Distribution Transformers	DOE	18/04/2013
National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters	EPA	31/01/2013
2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards	EPA; DOT; NHTSA	15/10/2012
Energy Conservation Program: Energy Conservation Standards for Dishwashers	DOE	01/10/2012
Standards of Performance for Petroleum Refineries; Standards of Performance for Petroleum Refineries for Which Construction, Reconstruction, or Modification Commenced After May 14, 2007	EPA	12/09/2012
Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews	EPA	16/08/2012
Energy Conservation Program: Energy Conservation Standards for Residential Clothes Washers	DOE	31/05/2012
Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers	DOE	30/05/2012
Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment	DOE	16/05/2012
National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units	EPA	16/02/2012
Energy Conservation Program: Energy Conservation Standards for Fluorescent Lamp Ballasts	DOE	14/11/2011
Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles	EPA; DOT; NHTSA	15/09/2011
Energy Conservation Program: Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers	DOE	15/09/2011

Source: Barrage (2019)

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Country	SCC Valuation	Health Impacts Covered?
Switzerland Germany	Variant of GIVE Model (Rennert et al. 2022)	Temperature-related mortality
United States Canada	Multi-Model Based (EPA 2022)	Temperature-related mortality Some other mortality/morbidity

➔ Estimates of the economic costs of climate change currently used by governments generally **ignore healthcare cost impacts**

3. Healthcare Cost Impacts of Climate Change

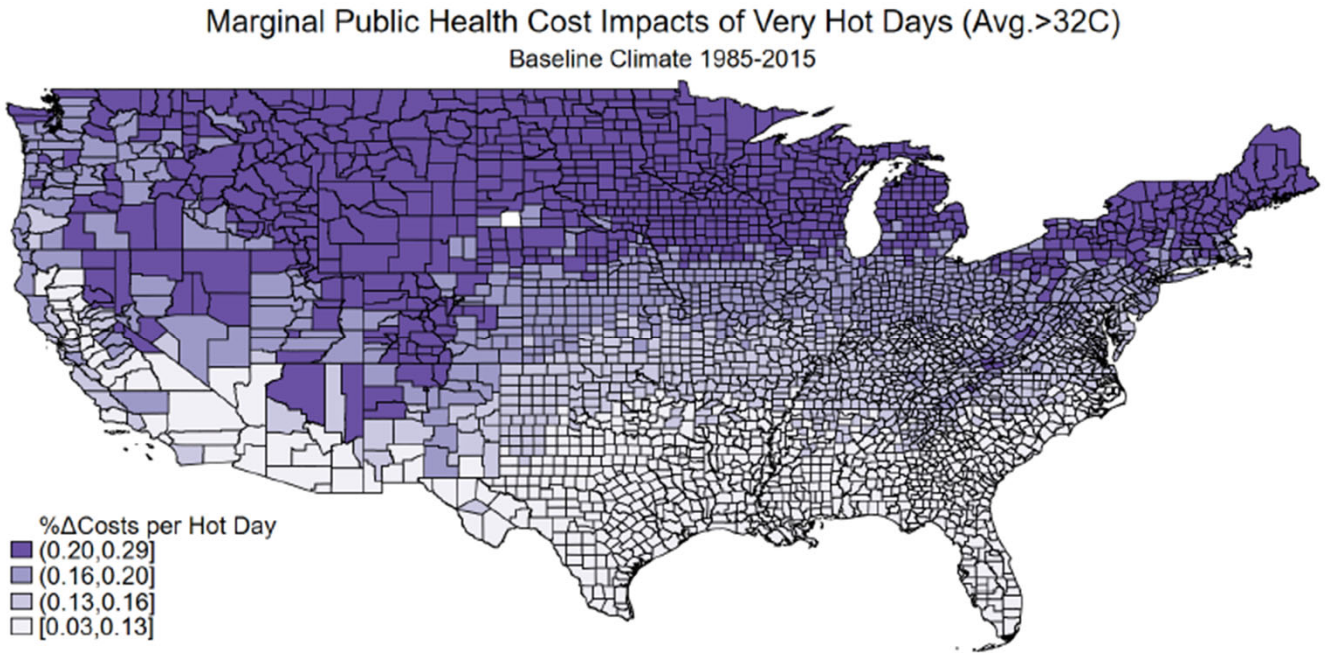
- Growing number of studies evaluate how (public) health expenditures and healthcare utilization are affected by climate-sensitive events such as temperature extremes, storms, and wildfires.

- 4 Key findings:

1. Adverse climatic events can lead to **large increases** in healthcare utilization and expenditures
2. Increased *public* health expenditures can strain public finances → **indirect macroeconomic costs**
3. Accounting for (1) and (2) can lead to **substantial increases in the Social Cost of Carbon**
4. Focus on short-term effects of extreme events may **misrepresent** climate healthcare cost effects

3. Healthcare Cost Impacts of Climate Change

- In the U.S.:
  - +1 Hurricane increase local public health expenditures 3-5% for 10 years after storm (Deryugina 2017)
  - +1 Wildfire smoke day (≥ 50 μgm^{-3}) increases respiratory emergency room visits +30% in following week (Heft-Neal et al. 2023)
  - +1 Hot day (>32°C) increases local total *annual* public medical spending by up to +0.3% (Barrage 2024)



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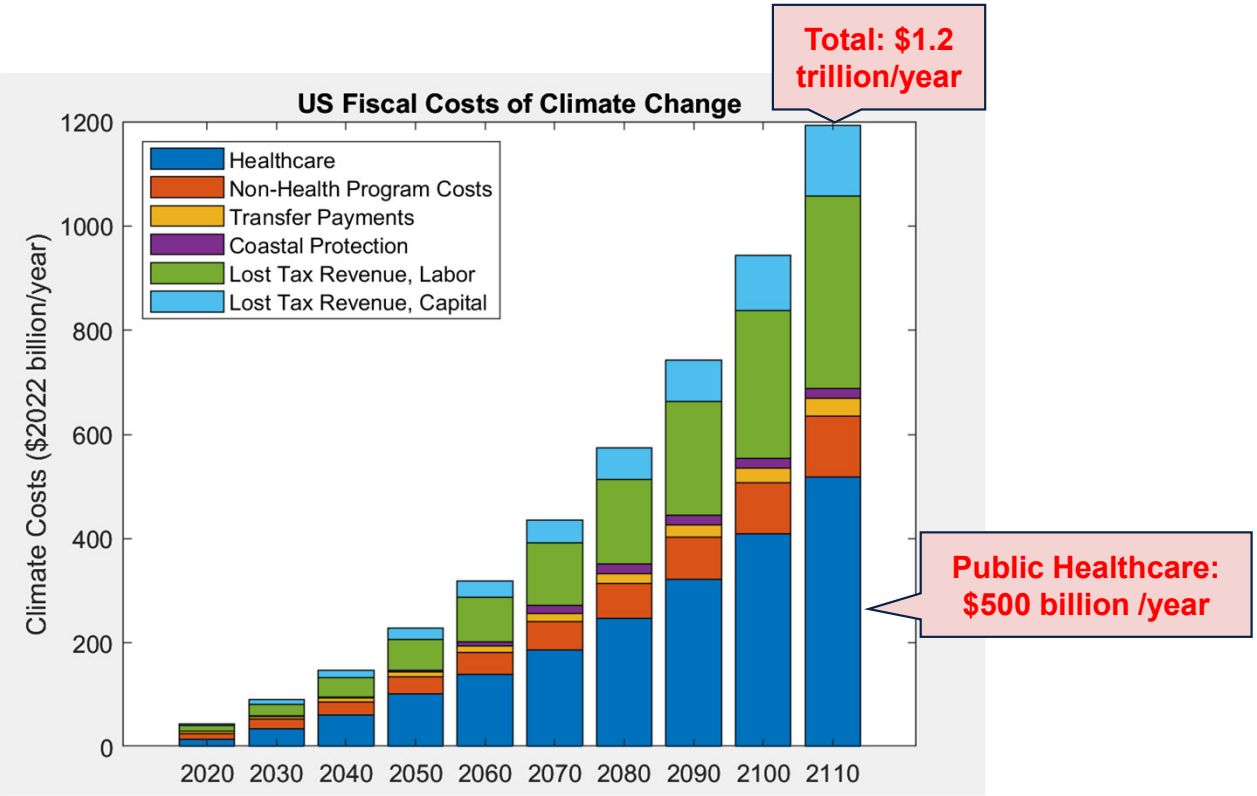
- Public **healthcare costs** are largest component of overall **fiscal burden of climate change** (in U.S.)
  - Ageing populations, rising healthcare costs compound economic burdens of climate change
  - Fiscal burdens require **tax increases** and/or other **public program cuts** → indirect macroeconomic cost



Source: Barrage (2024), assuming moderate-high emissions ~RCP 6.0

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   - Public healthcare costs (+ other public expenditure effects) increase **U.S. SCC +23-33%** (Barrage 2024)

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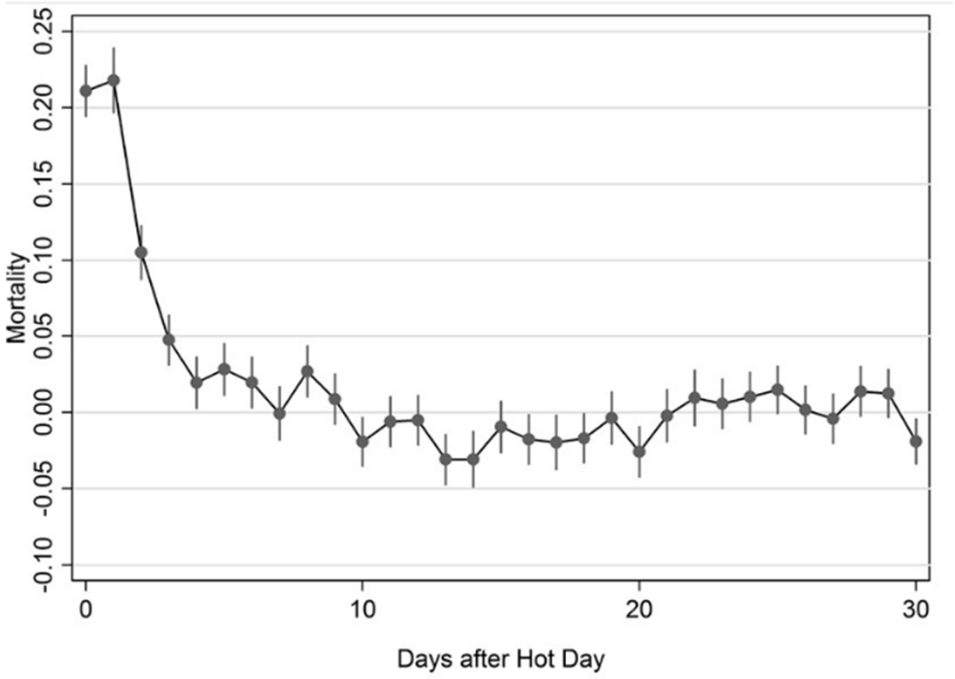
- Reason 1: **“Harvesting” Effects**
  - Extreme heat days may lead to immediate spike but subsequent declines in in hospitalizations, mortality

All-Cause Mortality in Germany after “Hot Day” (max. temp > 30°C)



Source: Karlsson and Ziebarth (2018)

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  ➔ Healthcare cost of +1 hot day in Germany **90% lower** if measured at annual vs. daily level (Karlsson and Ziebarth 2018)

3. Healthcare Cost Impacts of Climate Change

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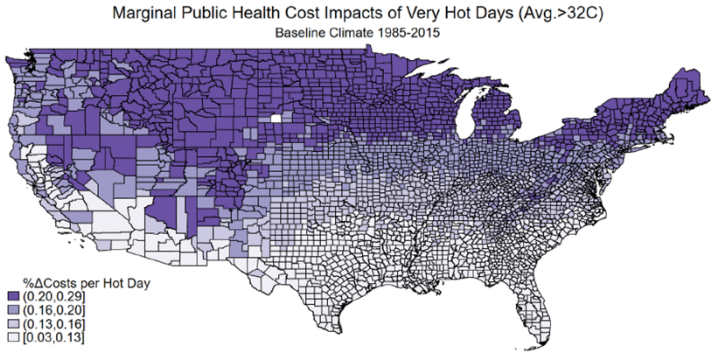
- Reason 2: **Adaptation**
  - Already see significantly lower cost impacts in areas used to dealing with, e.g., heat
  - Caveat: Requires sufficient income, good institutions, information, etc. – neither guaranteed nor always possible



Source: Barrage (2024)

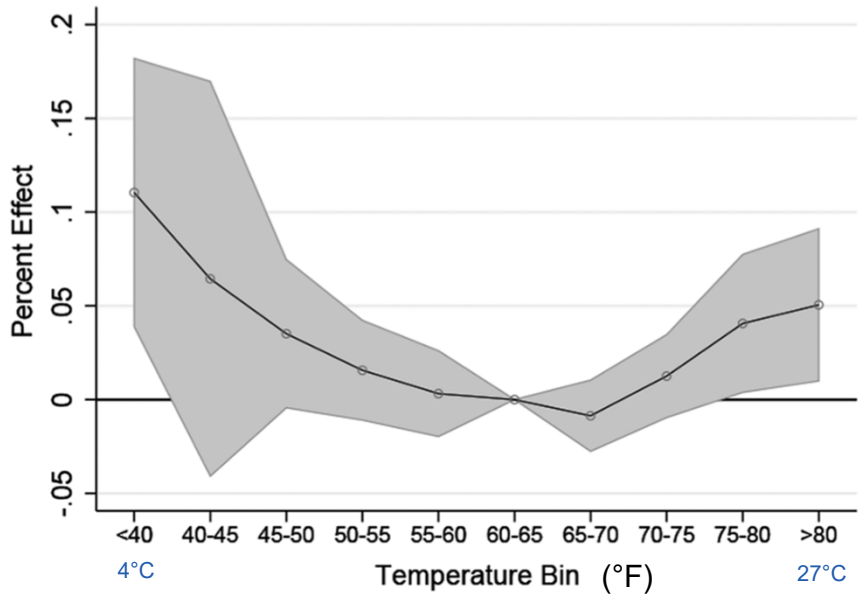
France Summer 2003 Heatwave
~15,000 dead from daily max. temperatures around 39-40°C

Phoenix AZ, home to 1.6 million people, sees daily max. temperatures of 43°C on average for 21 days each year (!)

3. Healthcare Cost Impacts of Climate Change

- Focus on short-term effects of extreme events may **misrepresent** climate healthcare costs
- Reason 3: **Importance of Gradual Changes**
  - Cold temperatures can also increase healthcare costs → Reduction in freezing days may provide hidden benefit

Cumulative Monthly Change in Emergency Department Visits from Daily Temperatures (US)



Source: White (2017)

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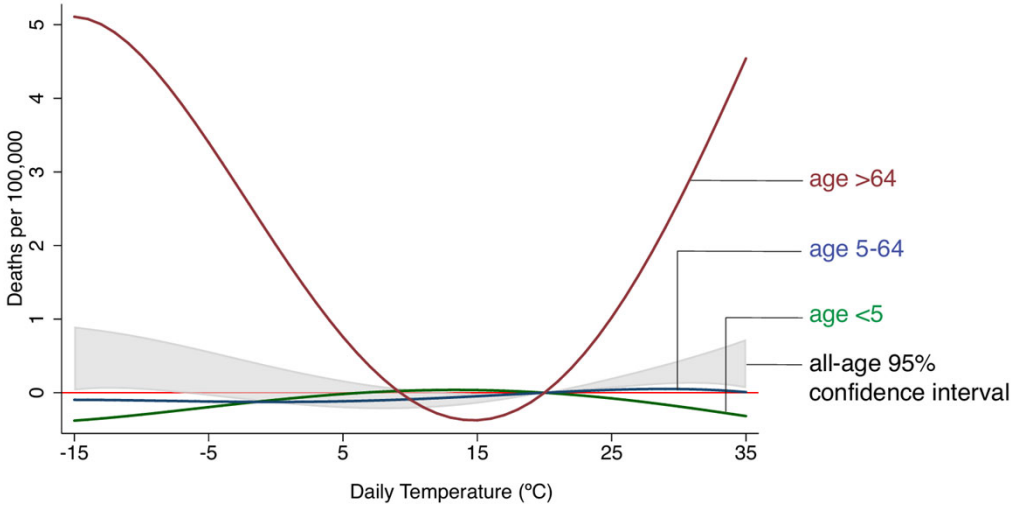
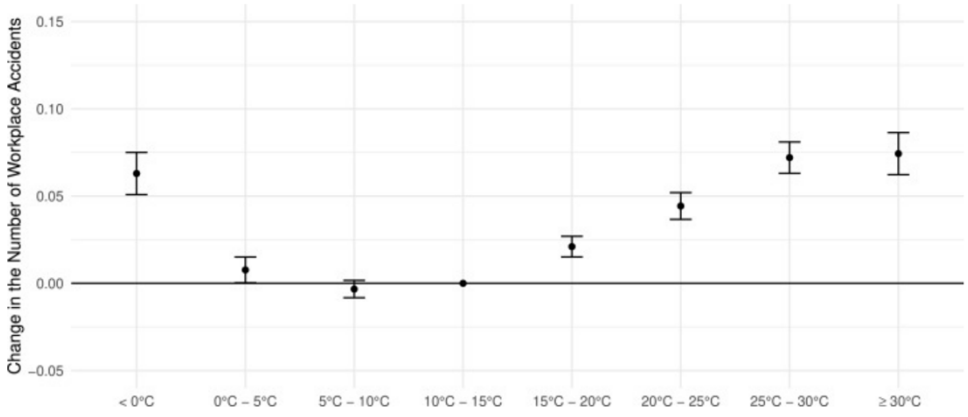
Global Mortality and Daily Temperatures



Source: Carleton et al. (2022)

Swiss Workplace Accidents and Daily Temperatures

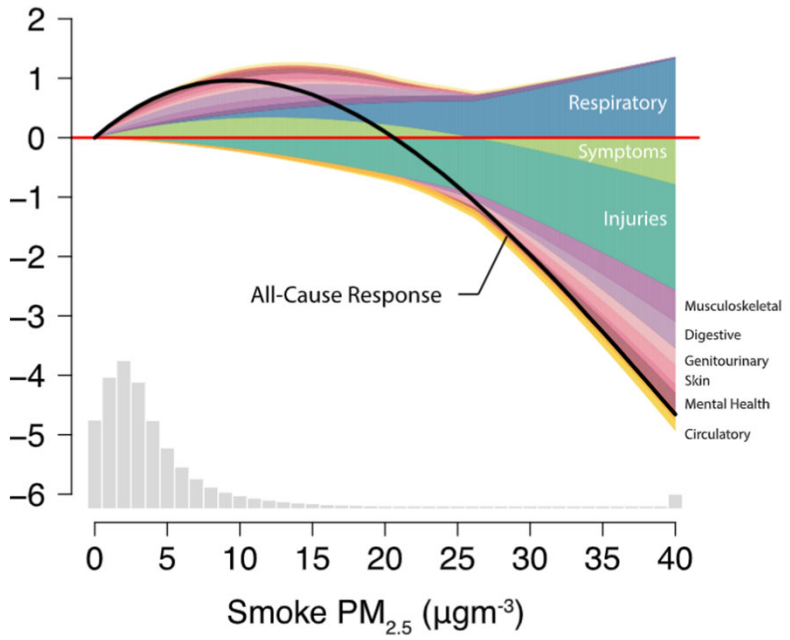


Source: Drescher and Janzen (2025)

3. Healthcare Cost Impacts of Climate Change

- Focus on short-term effects of extreme events may **misrepresent** climate healthcare costs
- But: Bias from focus on short-term effects can go in either direction
  - May miss effects of damaging gradual changes, such as change in disease vectors
  - May also miss long-term costs of households' delaying medical care due to extreme events

Change in Emergency Department Visits from Wildfire Smoke (U.S.)



Source: Heft-Neal et al. (2023)

4. Conclusion

- Standard models used to value economic impacts of climate change have limited coverage of health and essentially zero coverage of healthcare cost impacts

- Emerging literature projects large potential increases in healthcare demand due to climate change
  - Direct costs & indirect macroeconomic costs (via fiscal pressures) may add substantially to SCC

- Important: Utilization of healthcare services also essential for resilience to climate change
  - Studies using quasi-experimental variation in healthcare availability have found large effects
    - Rollout of "Seguro Popular" public health program in Mexico lowered cold mortality 1,600 deaths/yr (Cohen and Dechezlepretre 2022)
    - Rollout of "Community Health Centers" in US lowered heat mortality effects -14% (Mullins and White 2020)

➔ Governments must plan for fiscal pressures to ensure availability of healthcare in a changing climate

➔ Governments must do more on climate both to facilitate and support adaptation and of course mitigation

Thank you for your time.