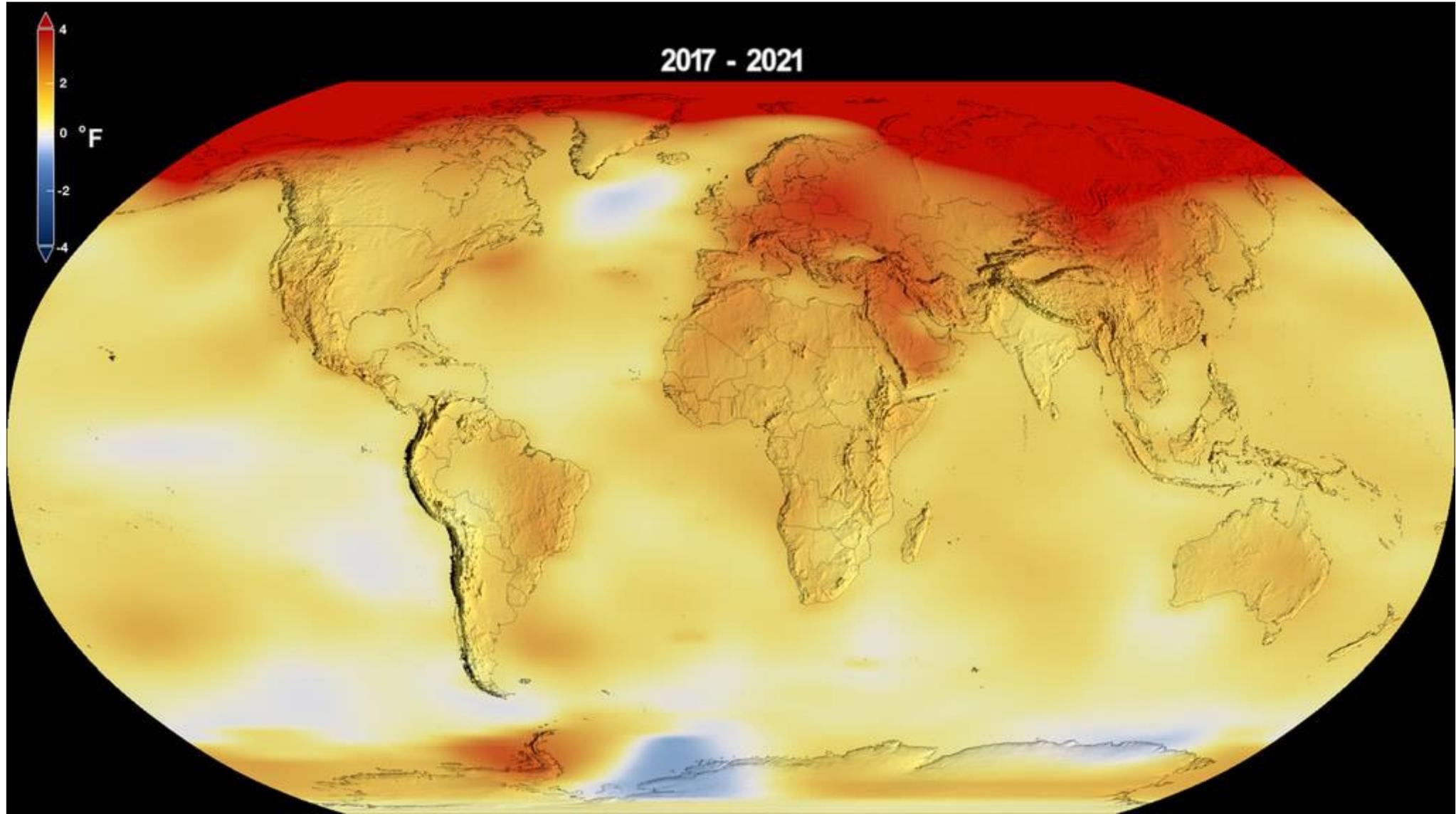




Preparing for Climate Change



Presenter: Dr. Lisa Doner



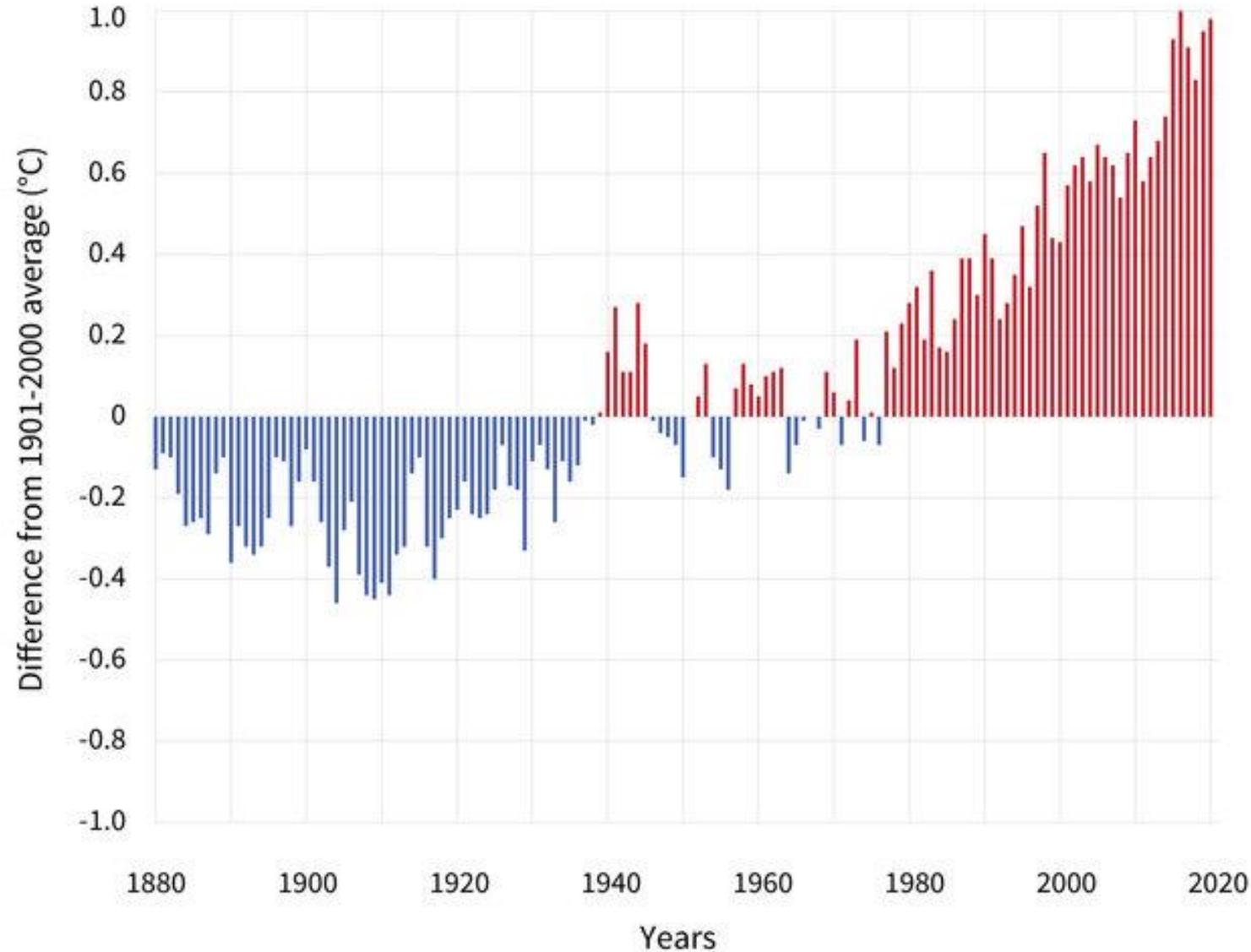
Global average temperatures are 1.0°C (1.8°F) above the 1880-2000 average.

At the current rate, global warming is *likely* to reach 1.5°C (2.7°F) – and addition 0.5° in the next 8-20 years.

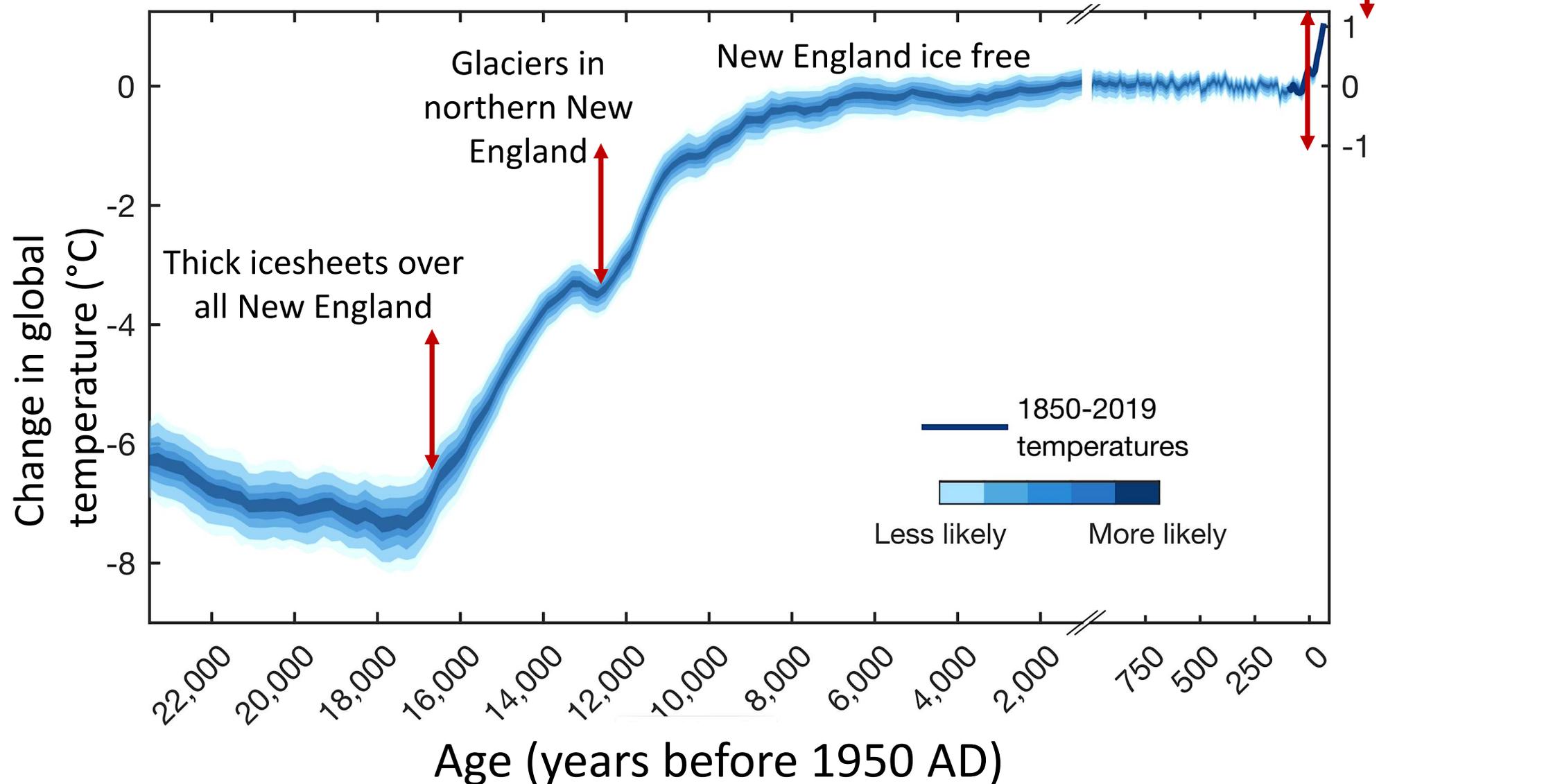
Climate disaster risks rise with each partial degree of global temperature increase.

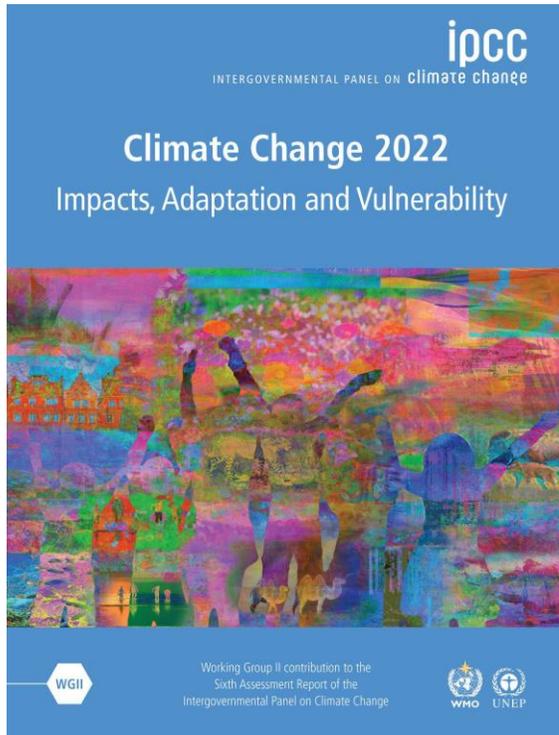
Future climate-related risks are even higher for global warming of 2.0°C (3.6°F)

GLOBAL AVERAGE SURFACE TEMPERATURE



Current climate trajectory is for an additional 2°C warming by 2080





The scientific evidence is unequivocal: climate change is a threat to human well-being and the health of the planet.

There are increasing gaps between adaptation action and what's needed to preserve life and prevent the worst outcomes.

Risk Perception

Some aspects of climate change gradually over time

Climate “impacts” are often experienced as disastrous weather events - floods, fires, hurricanes – predicted to occur more frequently with increased average temperature.

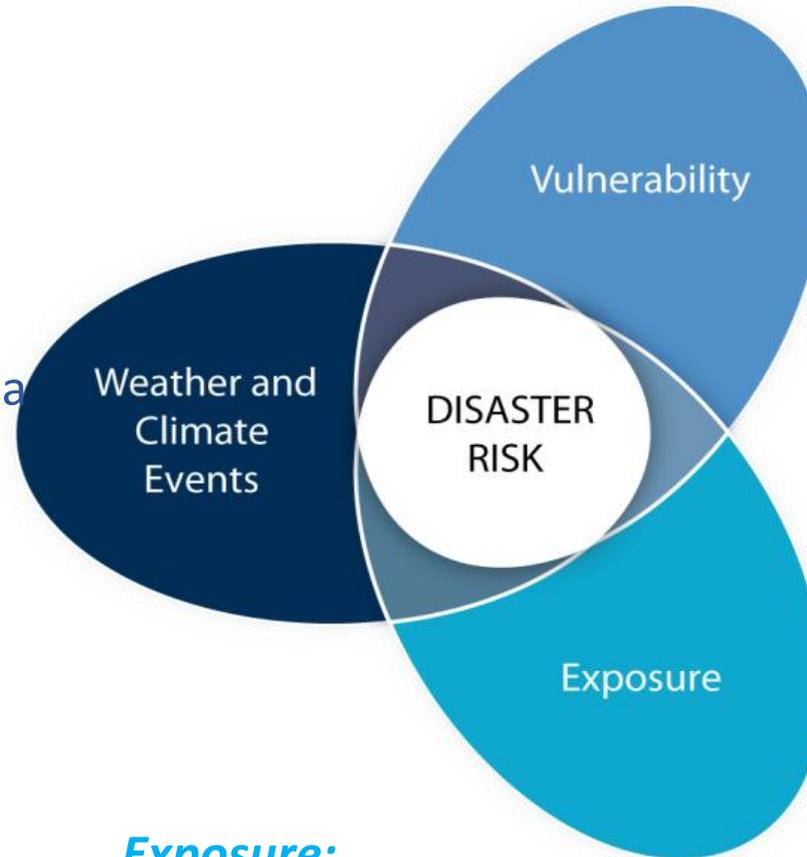
Disaster risk management is where the rubber hits the road in preparing for climate change



Socioeconomic development, natural climate variations, and human-caused climate change all interact and influence disaster risk

Disaster Risk:

the likelihood (probability) of severe alteration in the normal functioning of a community or society due to weather or climate events



Vulnerability:

the potential for a person or group to be adversely affected

example: living or working in an un-airconditioned building makes you vulnerable to suffering from heat waves

Exposure:

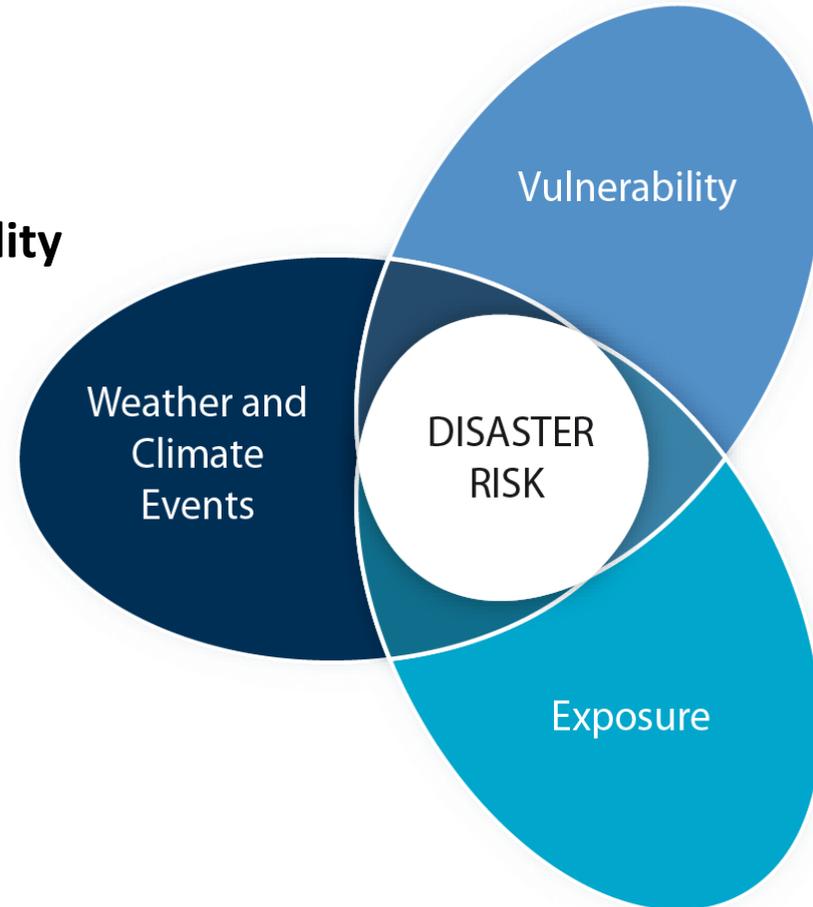
The presence of people, jobs, infrastructure, environmental services and resources, or economic, social, or cultural assets in places that could be adversely affected.

example: building located on a flood plain have high exposure to flood damage

Global strategy for climate adaptation and increased climate resilience: manage vulnerability and exposure, improve early warning capability

Improve Early Warning Capability

- ✓ improve forecasting and warning systems
- ✓ reduce greenhouse gas emissions



Reduce Societal Vulnerability:

- poverty reduction
- better education and awareness
- sustainable development

Reduce Exposure to Climate Impacts

- ❖ asset (vulnerable infrastructure) relocation
- ❖ weather-proofing assets
- ❖ early warning systems

Risks Specific to Climate Change

Direct Impacts:

- Temperature extremes (high & low)
- High precipitation & floods
- Low precipitation & droughts
- Extreme storms (tornados, hurricanes, blizzards)
- Sea level rise floods
- Wildfire frequency & range changes

Indirect Impacts:

- Agricultural losses
- Invasive pest & disease migrations
- Drinking water shortages
- Ecosystem stresses/deterioration
- Economic stresses & infrastructure deterioration
- Tourism, recreation, lifestyle adjustments

Climate change already affects North America

- wildfires nearly continuous year-round threat in western states
- extreme drought in the west affects crops, drinking supplies, energy production
- heat waves coming earlier, lasting longer, more extreme
- shortened period of “winter conditions” longer period of “summer conditions”

Greatest hazard in the Northeast – continues to be floods

- flood threat usually high Sept-Nov from remnants of tropical storms
- increasing flood threat from pop-up storms in summer (extremely heavy downpour lasting 1-2 hours) – small streams flood
- increasing likelihood of very heavy rain from passing fronts (2-3 days of heavy rain) – larger river floods

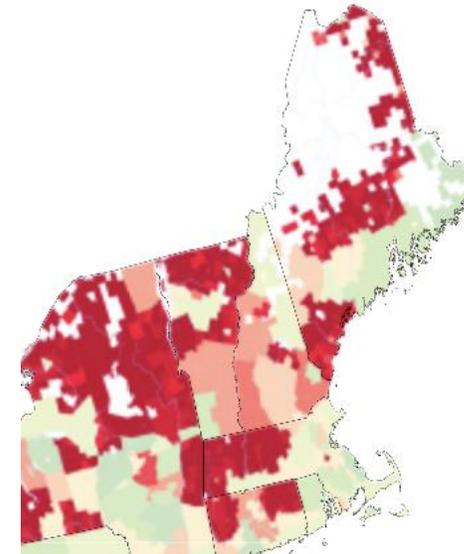
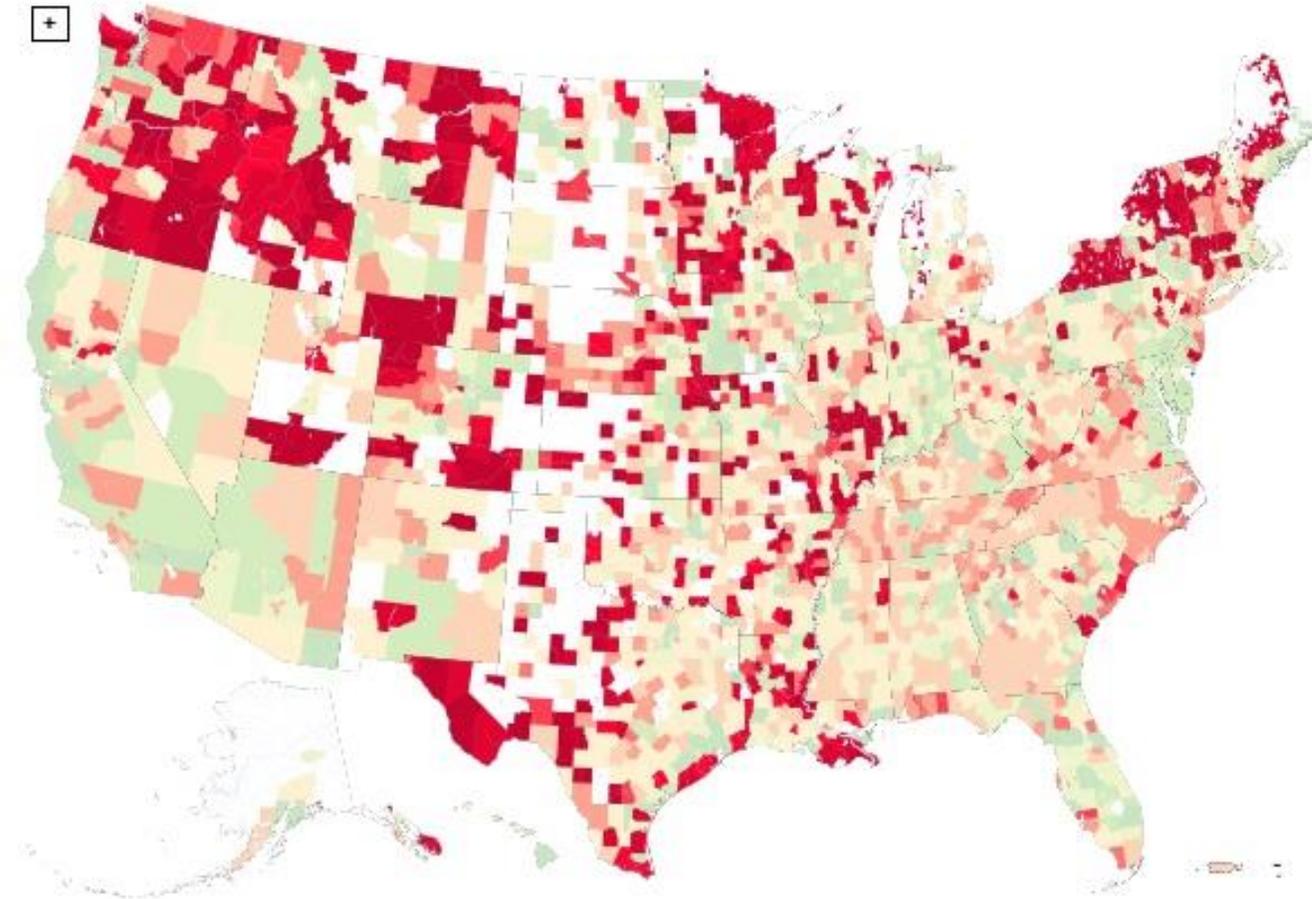
FEMA assesses flood risk for 22,000 communities

2017 Homeland Security report finds maps inaccurate for 9200 communities

Interval since last assessment too long a time (deep red is 40 years)

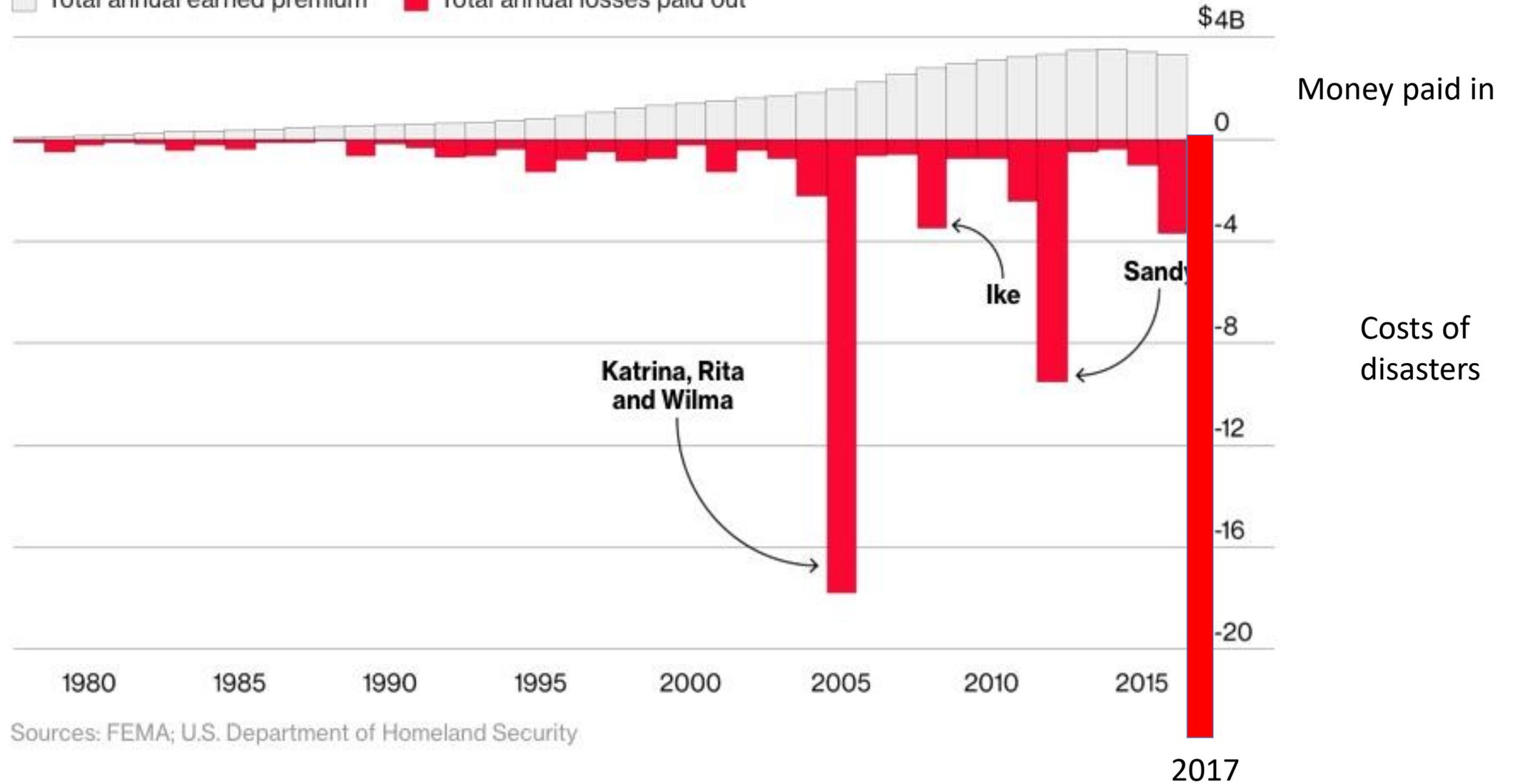
Age of effective date for FEMA flood maps

<1 1 3 5 7 9 11 13 15 20 30 40-years



National Flood Insurance Program balance sheet

■ Total annual earned premium ■ Total annual losses paid out



Sources: FEMA; U.S. Department of Homeland Security

Community Action on Flooding –

Conduct stream crossing surveys in your town; seek funding to fix undersized or collapsed culverts – this helps move flooding into channels and away from roads and structures

Let rainwater soak into the ground wherever possible. Replace asphalt with surfaces that allow rainwater to absorb into the ground. Leave dirt roads unpaved. Encourage permeable pavement in parking areas. Set limits to impermeable surface areas in developments, subdivisions, malls.

Promote zoning ordinances to protect floodplain habitat. Maintain floodplain forests.

Support and volunteer for organizations that protect open space (permeable ground!)

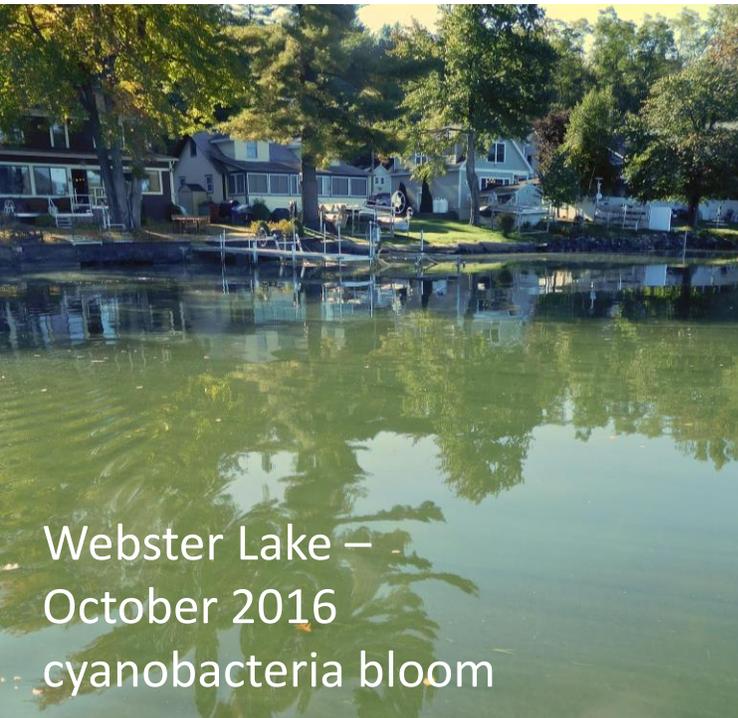
Plant or maintain vegetation along streams to reduce erosion, slow water flow.

Water Impacts -

Heavy exploitation of water supplies, deteriorating freshwater infrastructure, and reduced water quality heighten water security risks.

Water scarcity arises in droughts and from diminished snowpack. Summer peak water demand may exceed water supply, leading to economic losses and increased pressures on groundwater as a substitute for surface water supplies.

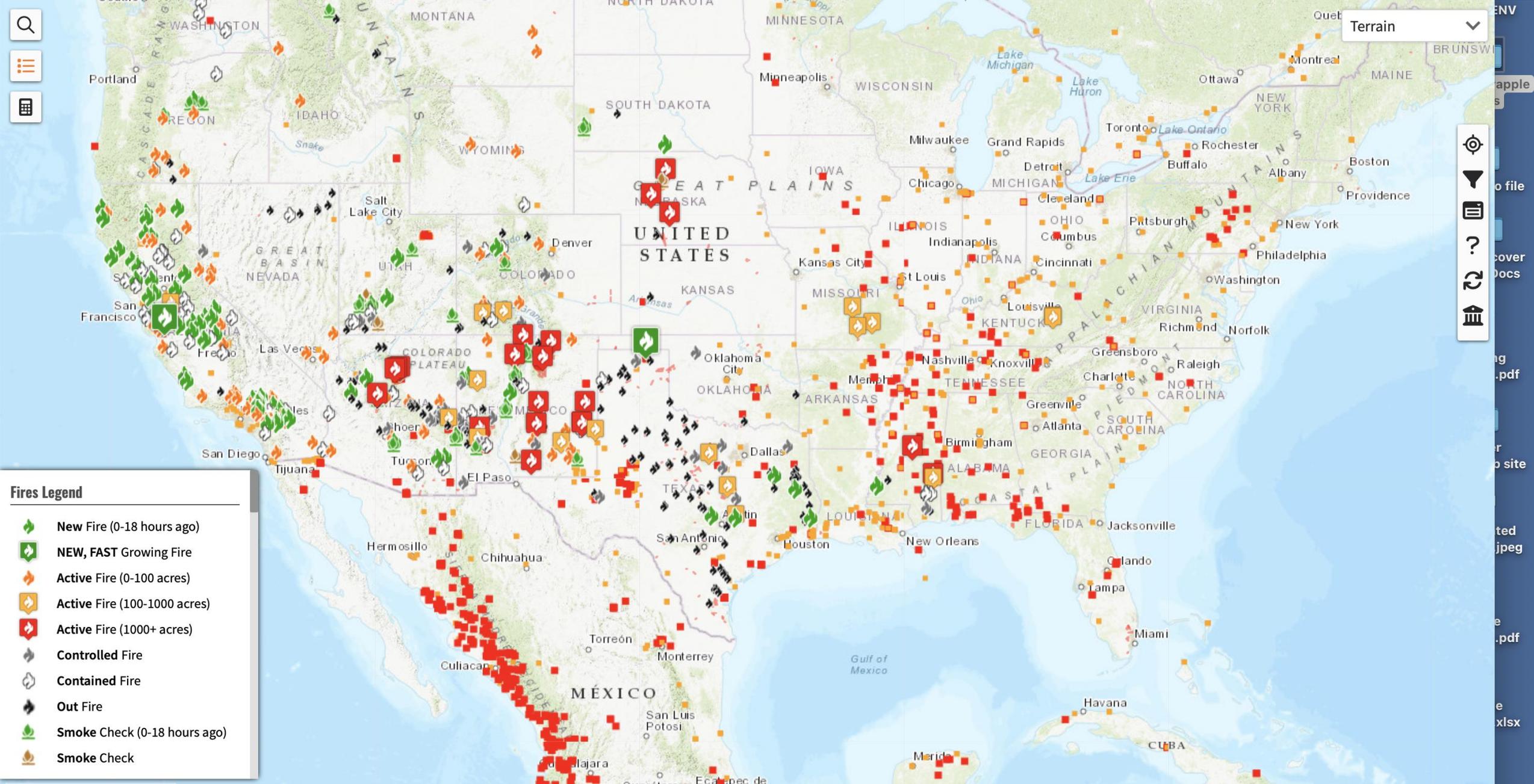
Golf courses, swimming pools, water parks and water features compete for high quality drinking water good quality ground water takes years to develop



Webster Lake –
October 2016
cyanobacteria bloom

- Climate change drives widespread shifts in lake thermal habitat. Kraemer et al 37 (2021). Nature Climate Change 11: 521-529.
- Widespread deoxygenation of temperate lakes. Jane et al. (2021). Nature 594: 66–70.
- Blue Waters, Green Bottoms: Benthic Filamentous Algal Blooms Are an Emerging Threat to Clear Lakes Worldwide. Vadeboncoeur et al. (2021). BioScience, biab049.

Map of active wildfires in the US- June 15, 2022



Emerging hazard in the Northeast – drought and wildfire

- summer and winter drought causing stress to forests
- insect pests leaving increasingly larger numbers of trees dead or dying

West – zoning laws prohibit certain roof types, strongly recommend creating a treeless buffer around homes, encourage no vegetation within 3 feet of house

Northeast - no public education/outreach about reducing risk of wildfires to residential areas, only guidance is on burn permits and (often) campfire bans

2022 Fire Season in New Hampshire :

March, 2022 - 4.6 acres, Strafford

May 9-12, 2022 – 48 acres Centennial Fire, White Mountain National Forest

May 18, 2022 – 106 acres Bemis Fire, Crawford Notch State Park

Ecosystem Risks

Increased temperature of air, water, ocean, and ground affect ecosystems.

Abnormal conditions cause stress and mortality in plants and animals and make them vulnerable to diseases.

Escalating climate change can outpace the ability for wildlife to adapt or migrate.

Iconic species and habitats may diminish or disappear – moose, sugar maples, birch

Economic activity

Extreme events and climate hazards adversely affect economic activities across North America. Under current economic and consumption trends, climate change impacts are projected to cause large market and non-market damages across North America.

Winter recreation and tourism (\$ billions) in New Hampshire - especially vulnerable as length of snow cover period becomes shorter.

By 2100, 85% loss in ski areas. The Northeast is receiving more winter precipitation as rain rather than snow. Expect both a decrease in the overall frequency of Northeast snowstorms this century (Zarzycki, 2018). *Geophysical Research Letters*, 45, 12,067–12,075.



Photo credit: Maarten Duineveld

Economic activity

Warmer July temperatures reduce sugar content of sap the following spring. By the end of the century, the tapping season will be 2-3 weeks earlier (Feb). The optimal region for maple sap production will move northward and most areas will have less production, especially within the U.S.

Morelli & Stinson (2018). Final Report for Climate Effects on the Culture and Ecology of Sugar Maple.
<https://www.sciencebase.gov/catalog/item/5bb25f79e4b08583a5d5999d>

Changing the timing of leaf peeping season - peak foliage now occurs a full week later than in 1950 (about 1 day per decade). Peak season is now about the second weekend of October. The delay is partly linked to warmer nighttime temperatures. Spera:
<http://www.stephaniespera.com/anpfallfoliage.html>

Costs of road repairs, salting/sanding – higher frequency of ice storms and icing events has already produced years of shortfalls in sand available for road treatments.

Food

Climate-induced redistribution and declines in North American food production are a risk to food and nutritional security. Climate change will continue to shift North American agricultural and fishery suitability ranges and intensify production losses of key crops, livestock, fisheries, and aquaculture products.

Adaptation – Build strong incentives for locally grown food, short supply chains, distributors to continue servicing rural regions.

Health

Health risks are projected to increase this century under all future emissions scenarios but the magnitude and severity of impacts depends on the implementation and effectiveness of adaptation strategies. Warming is projected to increase heat related mortality and morbidity.

Adaptation – Anticipate need for health services in heat waves. New Hampshire can deal with the cold; it's the heat that will hurt us most.

Greatest challenges ahead - interactive, compounding effects of multiple risks

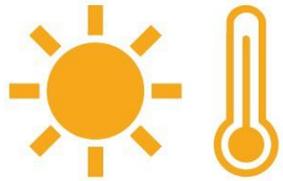
resource managers, town planners, first responders and residents face direct and indirect risks from all these simultaneous stressors:

- climate change
- invasive species
- disease
- shoreline erosion
- land use change and loss of ecosystem benefits
- urbanization
- nutrient loading
- pollution

Example: drought, low water levels in surface reservoirs, and a broken water main during a heat wave in Odessa, TX today – compounded problems. Possible NH version – heat wave, electrical outage, motorcycle week

Simultaneous extreme events create compound risks

Increasing heat and drought



Heat stress among farm workers

Reduced crop yield



Reduced productivity

Increased food prices



Reduced household incomes

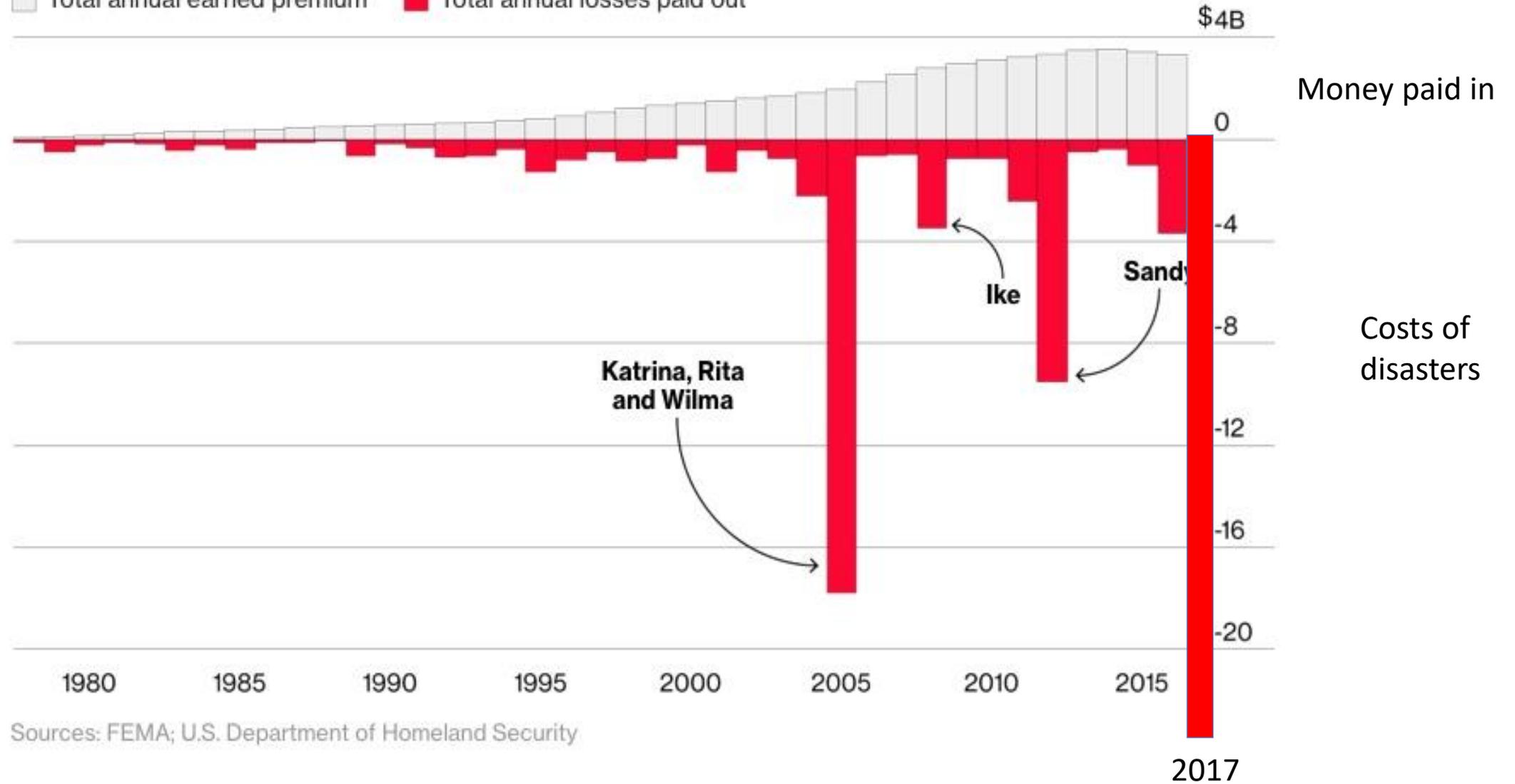
Local effects



Potentially global effects

National Flood Insurance Program balance sheet

■ Total annual earned premium ■ Total annual losses paid out



Sources: FEMA; U.S. Department of Homeland Security

Anticipated future global climate risks



Heat stress

Exposure to heat waves will increase with additional warming.



Water scarcity

At 2°C, regions relying on snowmelt likely to experience 20% decline in water for agriculture by 2050.



Food security

Climate change will increasingly undermine food security.



Flood risk

About a billion people in low-lying cities by the sea and on Small Islands at risk from sea level rise by mid-century.

Barriers to action on a national level (possibly less so locally)

Politicization of climate change science still effectively limits climate action (*lagging scientist recommendations by 30+ years*)

Warnings about climate risk and the urgent needs are not translating into actions – this includes adaptation planning and implementation.

Responsibilities for climate-based planning, disaster management, mitigation and adaptation actions are fragmented across governmental levels, agencies and community action groups.

Community Adaptation options

Approaches that incorporate climate change into near-term and long-term decision-making will reduce (not eliminate) future risks. Plan now, but don't expect a risk-free future.

Develop new, creative policies that focus on sustainability and resilient land use, nature-based solutions (shade trees versus air-conditioning), and economies that support lower consumption and reduced growth. Find a way for your community to thrive without continued dependence on growth.

Anticipate that Murphy's Law will be the norm – every small disaster may escalate into a bigger one, so plan for the bigger, more complex event.

Support each other with encouragement and ideas – resilience is not a competition.

Transportation – stop complaining about the cost of gas – need less of it!

- Encourage smart growth – less sprawl, walkable/ridable/busable development.
- Opt for cleaner (electric) vehicles or shorter commutes (live closer to work, shopping, schools/activities).
- Shift away from fuel-heavy recreation (less often, not the default activity)
- Combine errands to reduce "cold starts" of your car, avoid idling. Don't run your car just to charge your phone!
- Improve your miles per gallon – keep tires inflated, engine tuned, choose the least heavy vehicle (sedan versus truck)

If you want to take direct action against climate change but are leery of political pitfalls, some short-term solutions bypass the greenhouse gas problem.

Albedo-engineering takes a direct approach to reduce heating of the earth's surface by sunlight by reflecting light away (back through the atmosphere to space) before it becomes heat. Light is NOT heat. Light becomes heat when it is absorbed. Prevent absorption, prevent heating.



Mirrors reflect 95-98% of light

My research team is exploring the possible effectiveness of ground-based mirrors that could be set-up by communities to increase the earth's albedo.

Reliable websites with science evidence-based climate information

General Climate Sites:

<https://svs.gsfc.nasa.gov/>

<https://climate.nasa.gov/>

<https://www.usgs.gov/programs/climate-adaptation-science-centers>

Mitigation Sites:

<https://www.ipcc.ch/report/ar6/wg3/>

<https://cmi.princeton.edu/resources/stabilization-wedges/>

<https://iopscience.iop.org/article/10.1088/1748-9326/8/1/011001/meta>

Adaptation Sites:

<https://climate.nasa.gov/solutions/adaptation-mitigation/>

<https://climate.nasa.gov/news/1026/just-5-questions-community-initiatives-against-climate-change/>

<https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/>

<https://www.epa.gov/arc-x/strategies-climate-change-adaptation>

We are the problem, therefore we are the solution.
We just need time to get there, so every small delaying action is important.



Thank you!