

CLIMATE RESILIENCE IN THE POLAR REGIONS

REBECCA PINCUS

DIRECTOR, WILSON CENTER POLAR INSTITUTE

AN IRON CURTAIN HAS
DESCENDED ACROSS
THE CONTINENT.

- WINSTON CHURCHILL,
1946

THE UNITED STATES SHOULD DO WHATEVER IS IT
ABLE TO DO TO ASSIST IN THE RETURN OF NORMAL
ECONOMIC HEALTH IN THE WORLD, WITHOUT
WHICH THERE CAN BE NO POLITICAL STABILITY AND
NO ASSURED PEACE.

- GEORGE C MARSHALL, 1947

THE WHOLE SUCCESS OF THE PROPOSED PROGRAM
HANGS ULTIMATELY ON RECOGNITION BY THIS
GOVERNMENT, THE AMERICAN PEOPLE, AND ALL
FREE PEOPLES, THAT THE COLD WAR IS IN FACT A
REAL WAR IN WHICH THE SURVIVAL OF THE FREE
WORLD IS AT STAKE.

- NSC-68, 1950

THE POLES ARE IMPORTANT.
THEY ARE IN CRISIS.
WE ARE OUT OF TIME.



A bearded seal pup resting on sea ice. Credit: NOAA Fisheries/Shawn Dahle



Shutterstock

WHY THE POLES?

THE ROLE OF THE POLES IN GLOBAL CLIMATE REGULATION

The bright surface of sea ice and ice caps reflects sunlight, so the poles stay cooler than other parts of the globe.

Sea ice also affects global ocean circulation: as sea ice forms, salt is extruded. Cold, dense polar water descends from the surface and flows along the ocean bottom towards the equator. Winds also drive this global ocean conveyor belt.

(NOAA)



CARBON LOCKED UP IN PERMAFROST

Northern permafrost regions contain about 1 600 billion metric tons of organic carbon, **twice as much as currently contained in the atmosphere.** (NOAA)

As permafrost thaws, microbes break this carbon down into carbon dioxide and methane and release it to the atmosphere.

Recent measurements indicate that permafrost ecosystems are already releasing net carbon to the atmosphere.



NOAA's Barrow Atmospheric Baseline Observatory sits on the northernmost point of land in the U.S., just outside the town of Utqiagvik (Barrow in English). NOAA photo.

ARCTIC COMMUNITIES

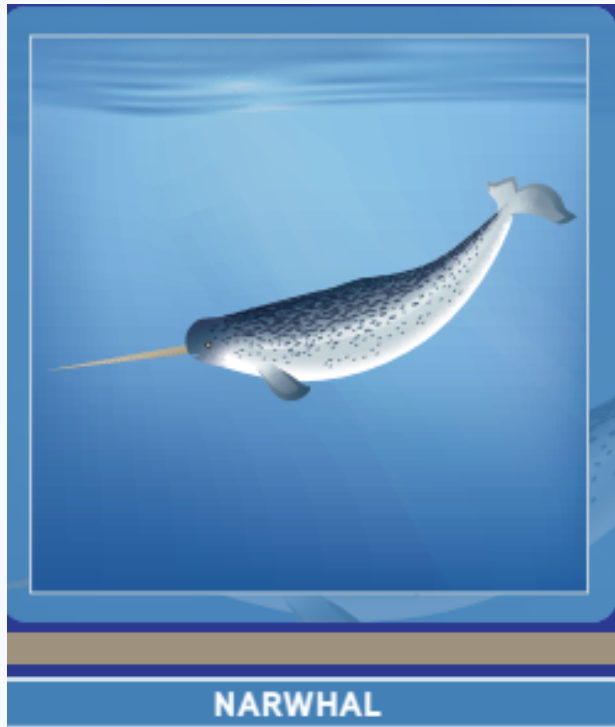


Stella Davidsen Olsen from Kangerlussuaq. Dogsledge musher. Photo by Aningaaq R. Carlsen, Visit Greenland

Over **500,000 Indigenous People** live in the Arctic, on three different continents, in seven countries, and across 30 million square kilometers

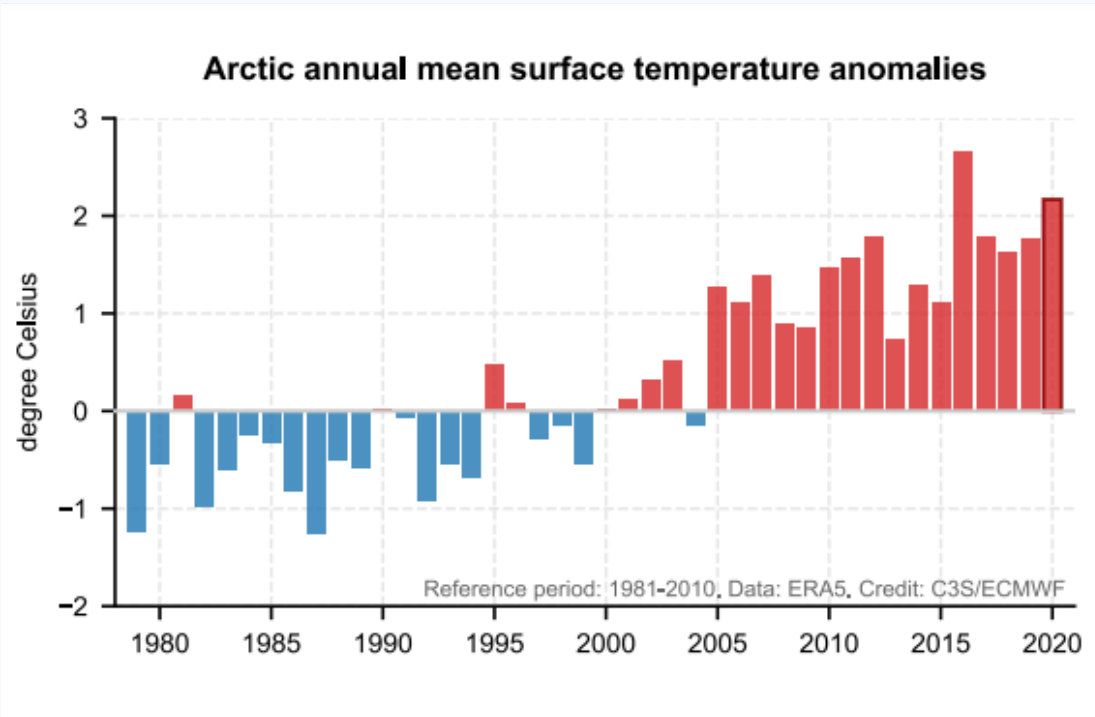
(Arctic Council Indigenous Peoples' Secretariat)

ARCTIC ECOSYSTEMS



NSF ARCTIC ANIMALS TRADING CARDS

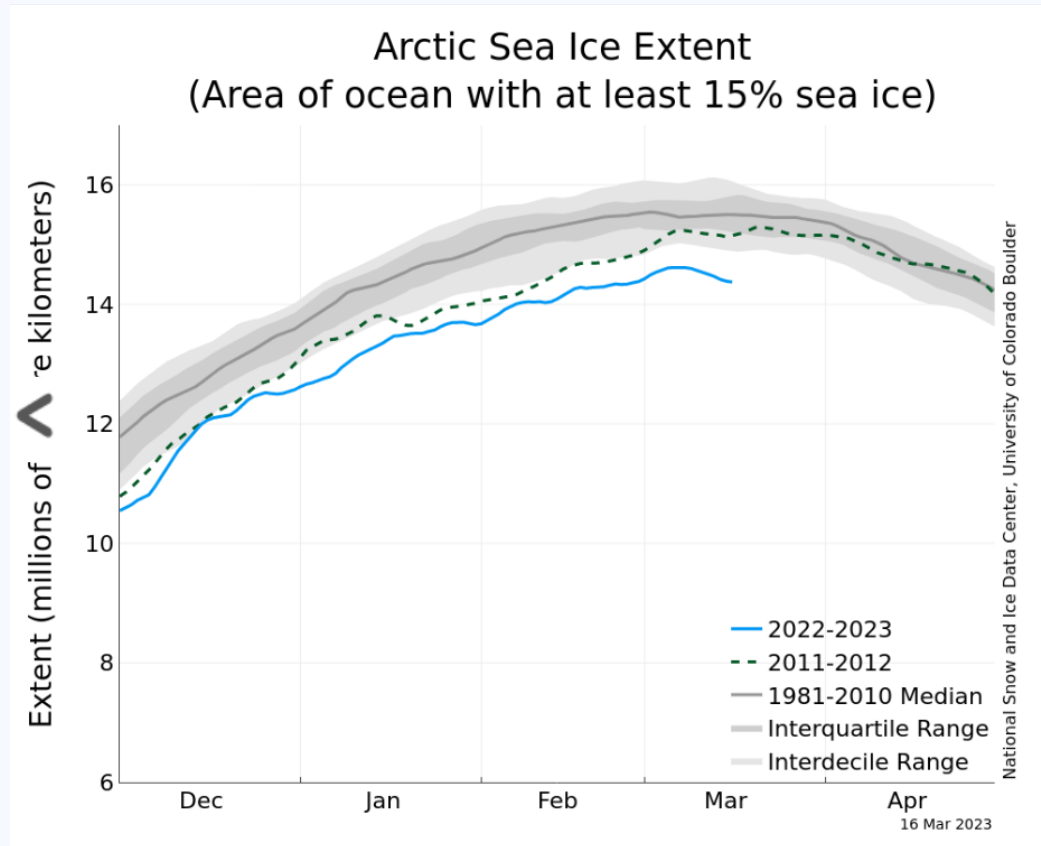
A WARMING ARCTIC



In the last few decades, the Arctic has been warming nearly **4x faster than the rest of the world**, due to the Arctic amplification phenomenon.

(Rantanen et al, 2022.)

DISAPPEARING SEA ICE



Arctic sea ice reached its maximum extent on March 6. It was the 5th-lowest in the 45-year satellite record.

NSIDC

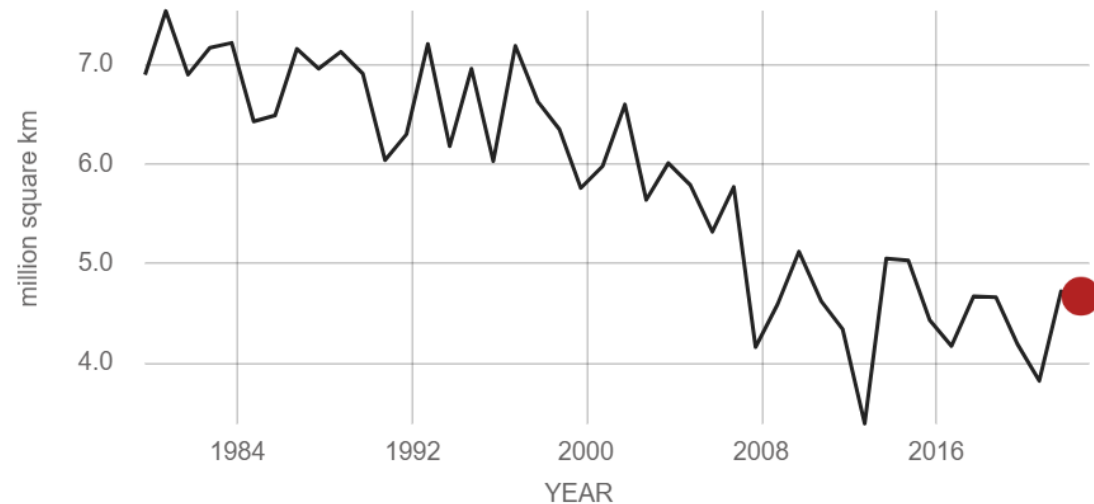
DISAPPEARING SEA ICE

ANNUAL SEPTEMBER MINIMUM EXTENT

Data source: Satellite observations. Credit: [NSIDC/NASA](#)

RATE OF CHANGE

↓ 12.6
percent per decade

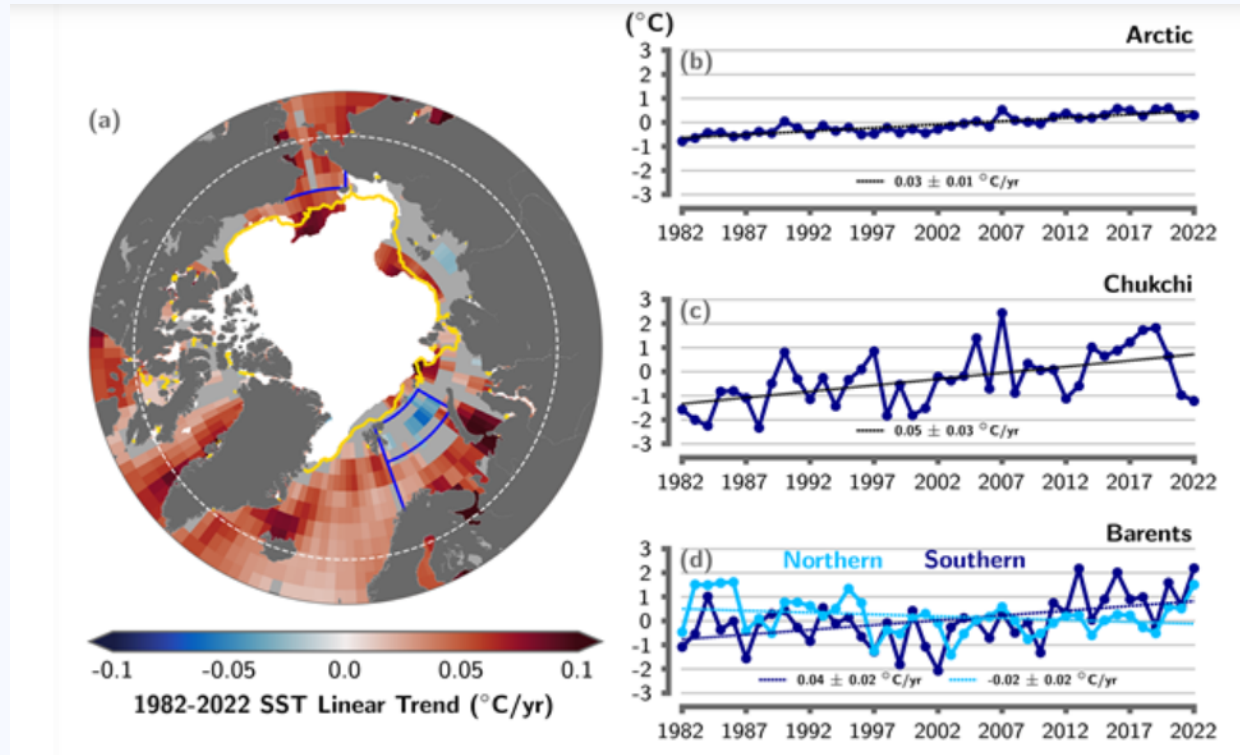


Arctic sea ice is disappearing at an accelerating rate of decline.

The first ice-free Arctic may be in the 2030s.

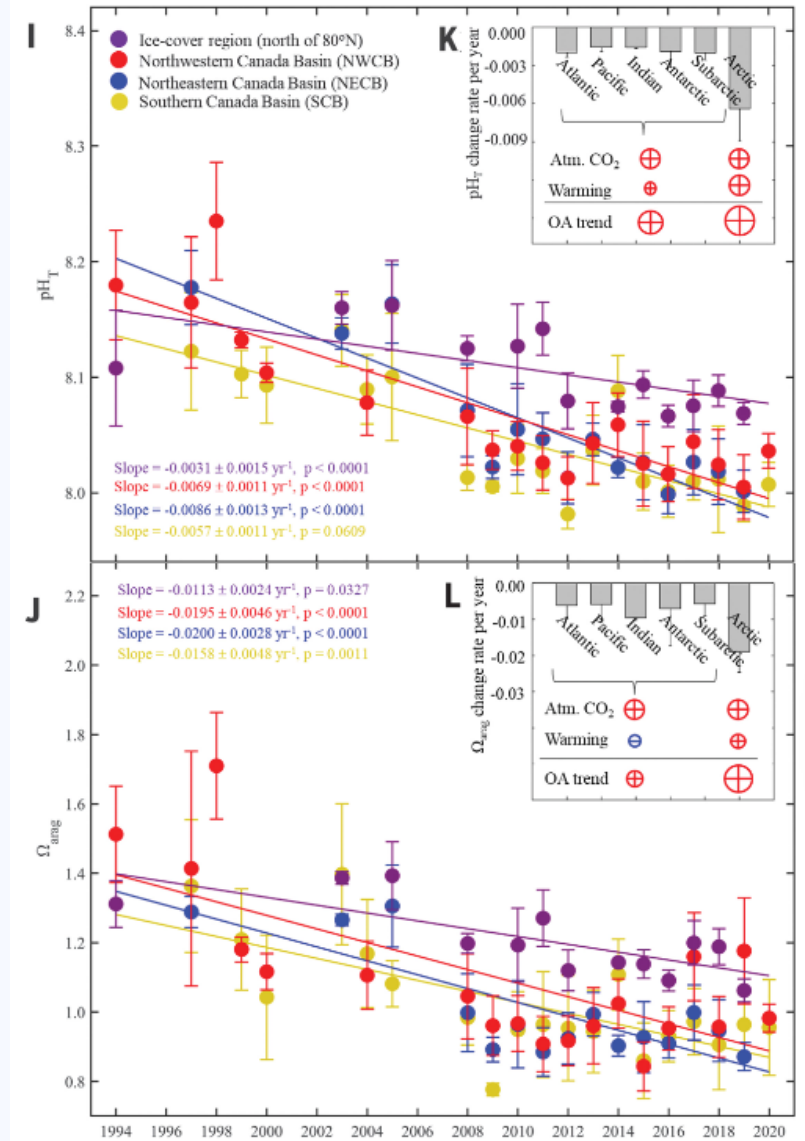
NOAA, Peng et al, 2020

THE ARCTIC ACID BATH



NOAA Arctic Report Card 2022

Qi et al, 2022



EFFECTS OF ACIDIFICATION

Acidification causes problems for animals that rely on calcium to build a shell or skeleton.

It affects plankton and corals, as well as shrimps, lobsters, snails, clams, starfish, and sea urchins.

Species may die out, or be outcompeted by others that are less affected. This will have knock-on effects through the food web.

(Norsk PolarInstitutt)



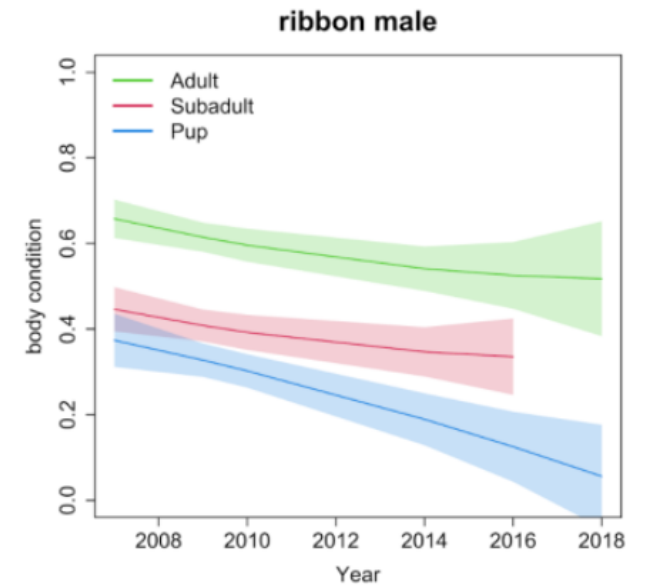
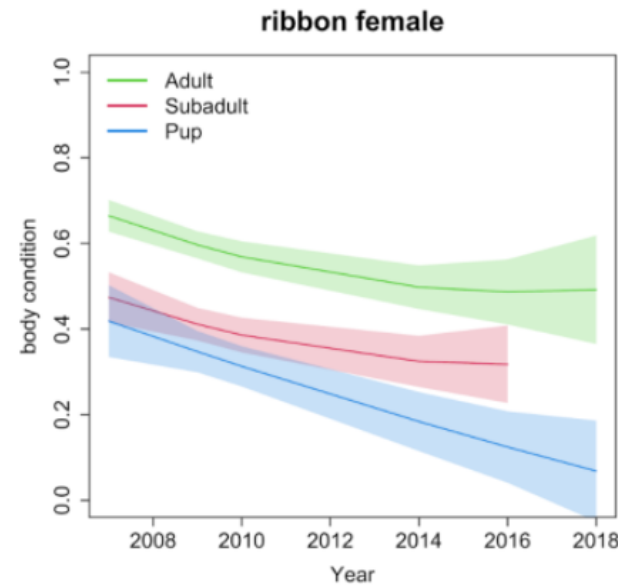
A shell placed in seawater with increased acidity slowly dissolves over 45 days.
National Oceanic and Atmospheric Administration, Pacific Marine Environmental Laboratory

MARINE HEATWAVES

Marine heatwaves include record temperatures at the sea bottom. The Gulf of Alaska and Bering Sea saw marine heatwaves in 2014-16, 2018, and 2019.

They are associated with seabird die-offs, mass strandings of seals and whales, declines in salmon, cod, and snow crab.

(NOAA Fisheries)



A ribbon seal pup (probably 5 days old and 33 pounds) rests while researchers finish sampling his mother. Credit: NOAA Fisheries/Josh M. London



Ribbon seal - Photo: NOAA Fisheries

SEABIRD DIE-OFFS

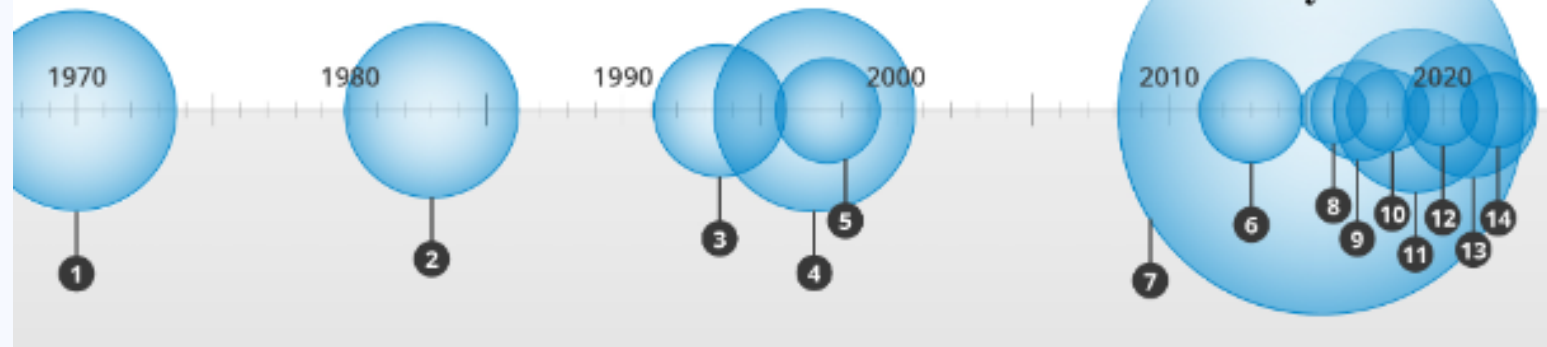
	2017	2018	2019	2020	2021	Total
Total Reported	>1,600	>1,200	>9,000	>330	>2,200	>14,330
Total Examined	19	25	39	20	14	117
Reported Cause of Death						
Emaciation	17	19	31	13	12	92
Undetermined	0	3	2	1	1	7
Other	2	3	6	6	1	18
Avian Influenza Detected	0	2	0	1	1	4
Saxitoxin Detected	11	BDL*	3	1 ^{&}		

NOAA Arctic Report Card, 2022



NPS

~1,010,000 Seabirds in the previous 40 years



ARCTIC ECOSYSTEMS



WILDLIFE
Caribou are vanishing at an alarming rate. **Is it too late to save them?**



Animals Are Shrinking and Freezing to Death in a Changing Arctic

Unusual weather brought by climate change is making it tough for muskoxen to get food—and sometimes even entombs them in ice.

BY CRAIG WELCH



PUBLISHED JANUARY 18, 2018 • 5 MIN READ

AP NEWS, JAPAN TIMES, REUTERS (L-R TOP)

CANADIAN GEOGRAPHIC, NATIONAL GEOGRAPHIC (L-R BOTTOM)

ARCTIC COMMUNITIES UNDER THREAT



© USGS/Christopher Arp | The erosion of permafrost on Alaska's Arctic Coast.



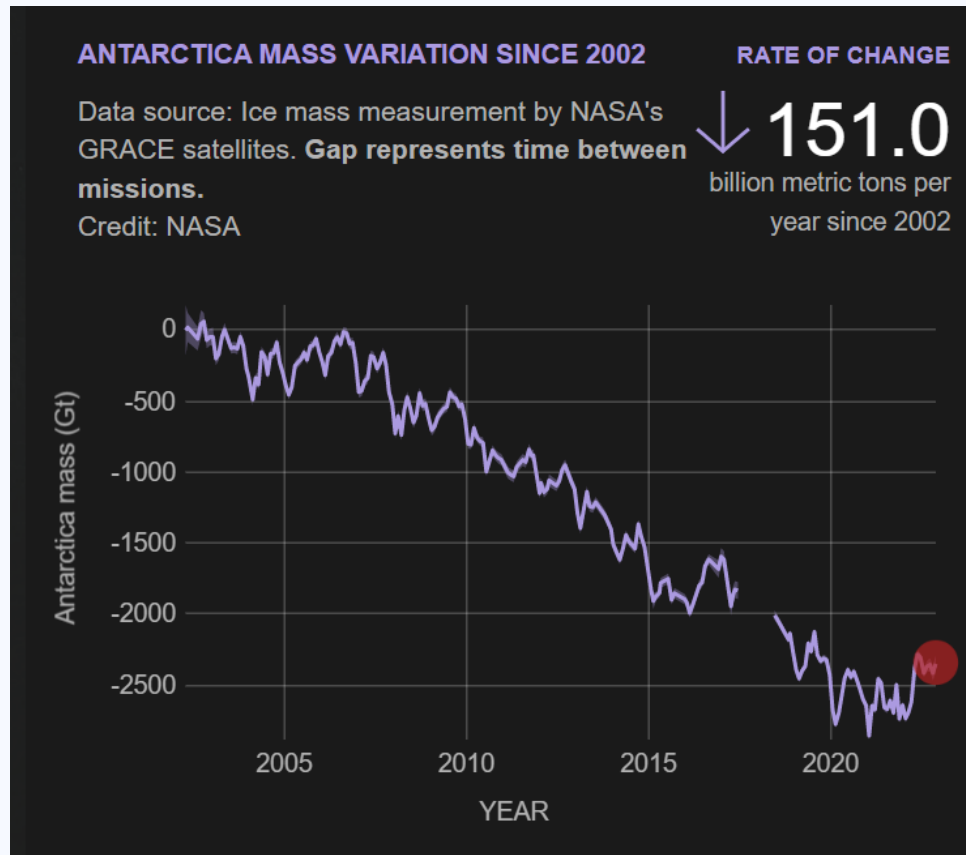
Figure 5. In 2010 an unprecedented November rain covered the frozen lake with water. On November 24 we waded almost a mile (about a kilometer) in shin-deep water to reach the fish net.
© Mike & Julie Collins



In recent years, an increase in large wildfires has been seen in Alaska. Credit: [USGCRP \(2014\)](#).

NPS, Alaska Park
Science

WARMING IN ANTARCTICA



Antarctic sea ice reached its annual minimum on February 21, 2023, at 691,000 square miles. This is the lowest extent in the 45-year satellite record. The second-lowest extent was 2022.

(NSIDC)

ANTARCTIC ICE SHEET

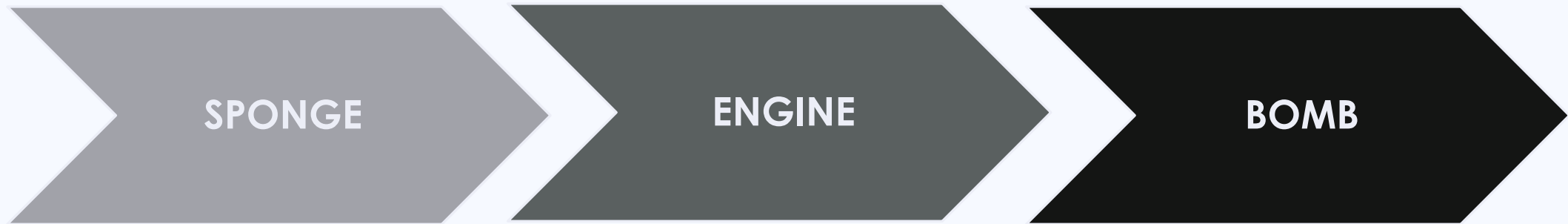


The Antarctic ice sheet is thinning and melting. Antarctic glaciers run into the sea, forming ice shelves. As the ocean warms, these shelves melt from the bottom and calve off.

NSIDC

The 200-foot-tall (60-meter-tall) front of the Getz Ice Shelf in Antarctica is scored with cracks where icebergs are likely to break off, or calve, in this 2016 photo. The first estimate of Antarctic calving has found that since 1997 ice shelves have lost as much ice from calving as from melting. Credit: NASA/GSFC/OIB

THE GLOBAL CLIMATE IMPLICATIONS OF POLAR CHANGE



- Oceans absorb the majority of excess heat, the Southern Ocean most of all.

- Warmer polar oceans will drive further ice loss, sea level rise, and long-term changes.

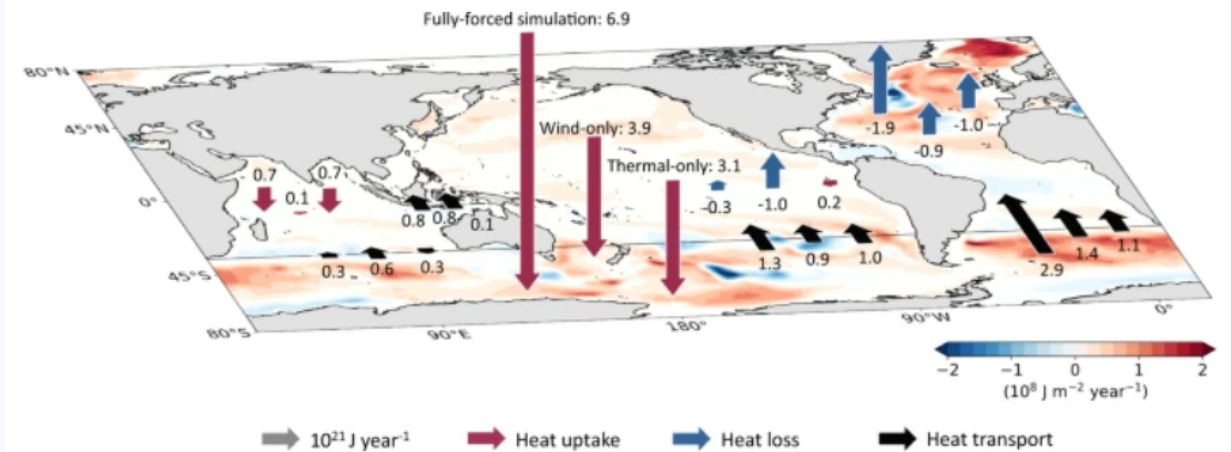
- There is about 2x carbon and methane trapped in permafrost than currently in the atmosphere.

SPONGE: SOAKING UP THE HEAT

“It is virtually certain that the global ocean has warmed unabated since 1970 and has taken up more than 90% of the excess heat in the climate system. Since 1998, the **rate of ocean warming has more than doubled.**”

IPCC, Cryosphere 2019, Summary for Policymakers

Fig. 6: Schematic summarising anomalous global ocean heat uptake, heat loss and heat transport over the last half century in different historical simulations.



Huguenin et al, 2022

ENGINE:

“Ocean warming, acidification and deoxygenation, ice sheet and glacier mass loss, and permafrost degradation are expected to be **irreversible on time scales relevant to human societies** and ecosystems.

Long response times of decades to millennia mean that **the ocean and cryosphere are committed to long-term change** even after atmospheric greenhouse gas concentrations and radiative forcing stabilize.

Ice-melt or the thawing of permafrost involve thresholds (state changes) that allow for **abrupt, nonlinear responses to ongoing climate warming**.

These characteristics of ocean and cryosphere change pose risks and challenges to adaptation.”

IPCC, Cryosphere 2019, Summary for Policymakers



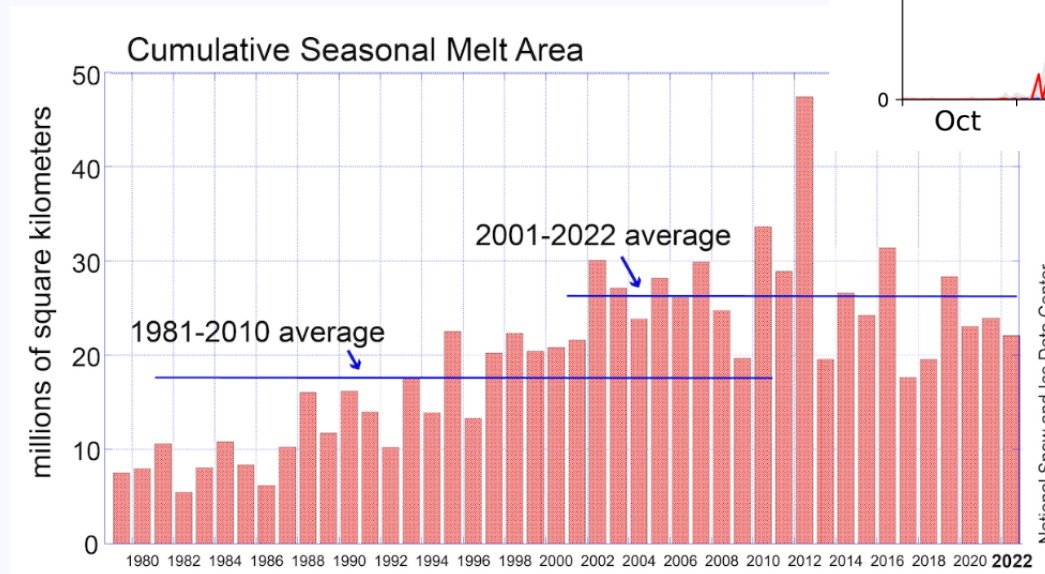
USGS, Lockhart

ENGINE: SEA LEVEL RISE

If the entire Antarctic ice sheet melted, sea level would rise about 200 feet.

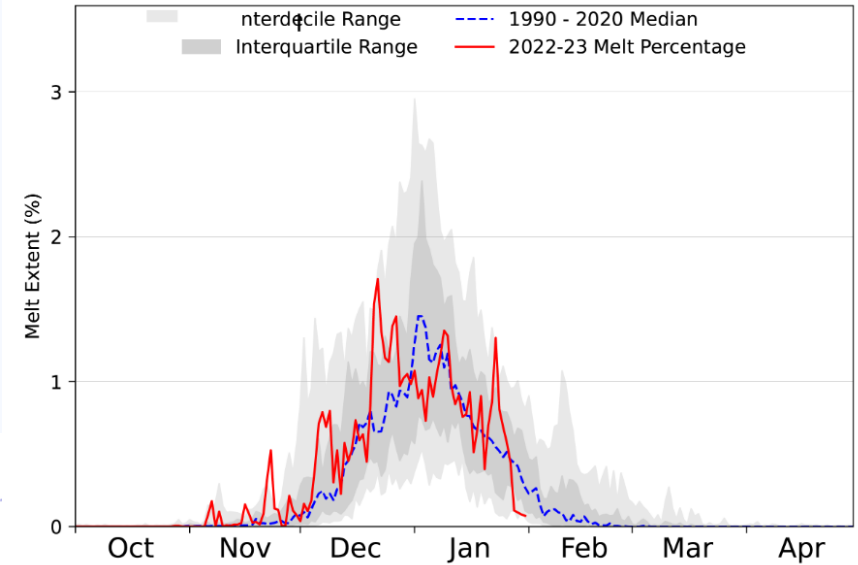
If the entire Greenland ice sheet melted, sea level would rise about 24 feet.

NSIDC



Antarctic Melt Extent

November 1, 2022 to January 31, 2023



NSIDC

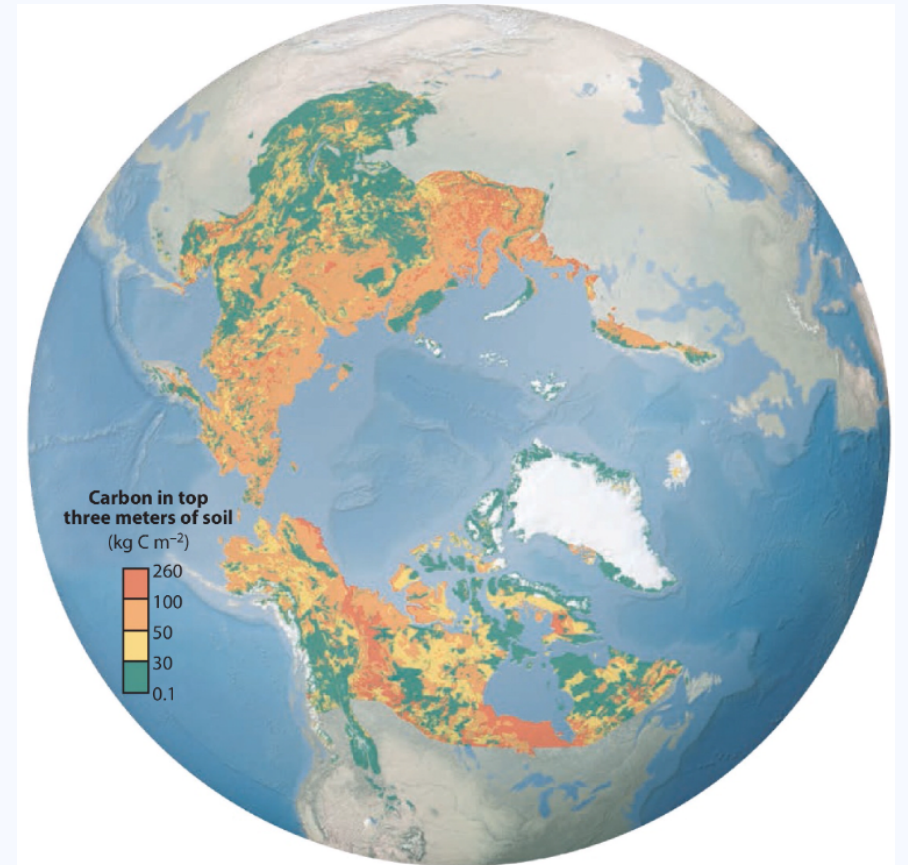
BOMB: PERMAFROST CARBON

There is **twice as much carbon stored in permafrost soils as there is in the atmosphere**. This frozen carbon is climate-sensitive. It is released as carbon dioxide and methane. Permafrost around the world is warming from the surface, contributing to gradual carbon releases.

20% of the Arctic landscape contains 50% of the surface permafrost carbon pool and is susceptible to **abrupt thaw**.

Carbon dioxide and methane emissions from permafrost carbon are expected to **accelerate the pace of climate change**.

Schuur et al, 2022; Biskaborn et al, 2019.



 Schuur EAG, et al. 2022
Annu. Rev. Environ. Resour. 47:343–71

WHAT CAN WE DO?



Courtesy of NOAA

COMMUNITIES

ECOSYSTEMS

GLOBE

Mitigation and
resilience

Minimize non-climate
harms

Novel solutions?

Challenge: resources

Challenge: capacity

Risks, distraction

Reduce emissions

Reduce emissions

Reduce emissions

COMMUNITY RESILIENCE



Houses, seen on Aug. 2, teeter on the edge of an Utqiagvik bluff that is being rapidly eroded by permafrost thaw. The house on the right has been abandoned. At the base of the bluff are SuperSacks filled with sand, placed there as part of the effort to hold back ocean waves and slow down erosion. (Photo by Yereth Rosen/Alaska Beacon)

KTOO

Arctic communities face numerous climate challenges, including coastal erosion, loss of cold storage, wild land fire, dangerous weather, loss of food species.

Some communities may need to relocate, while others may be able to mitigate some of these challenges.

All of these impose **costs**.

BIA estimated \$3.45 billion for Alaskan Native infrastructure.

(BIA, Unmet Needs, FY2020)

ECOSYSTEM RESILIENCE



Female polar bear with cubs. (Ian Stirling)

MMC

Protection, restoration, precautionary management, and reduction of pollution and other stressors can support ocean and polar ecosystems.

IPCC, Cryosphere 2019.

Climate intervention is gaining attention.

Solar radiation management is not a substitute for mitigation. SRM would introduce new risks to people and ecosystems.

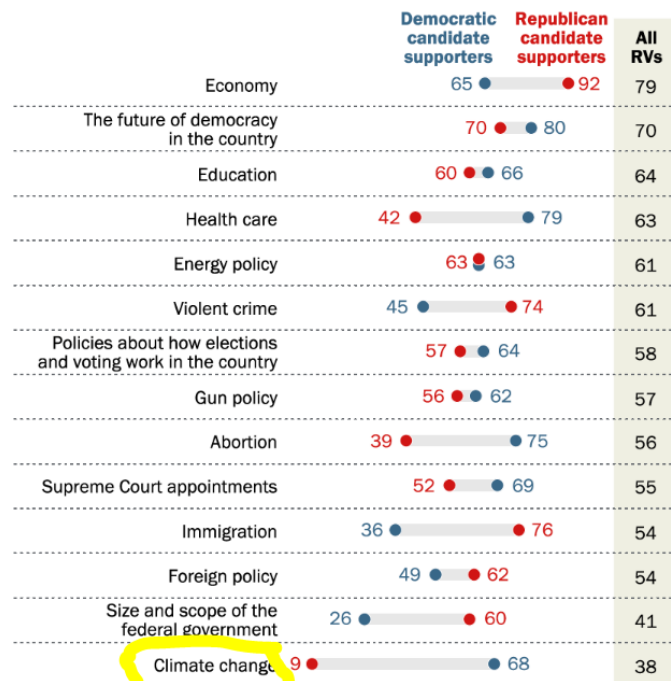
UNEP, 2023



Where are the politics?

The economy remains the top issue for voters in the midterms

% of registered voters who say each is **very important** to their vote in the 2022 congressional elections

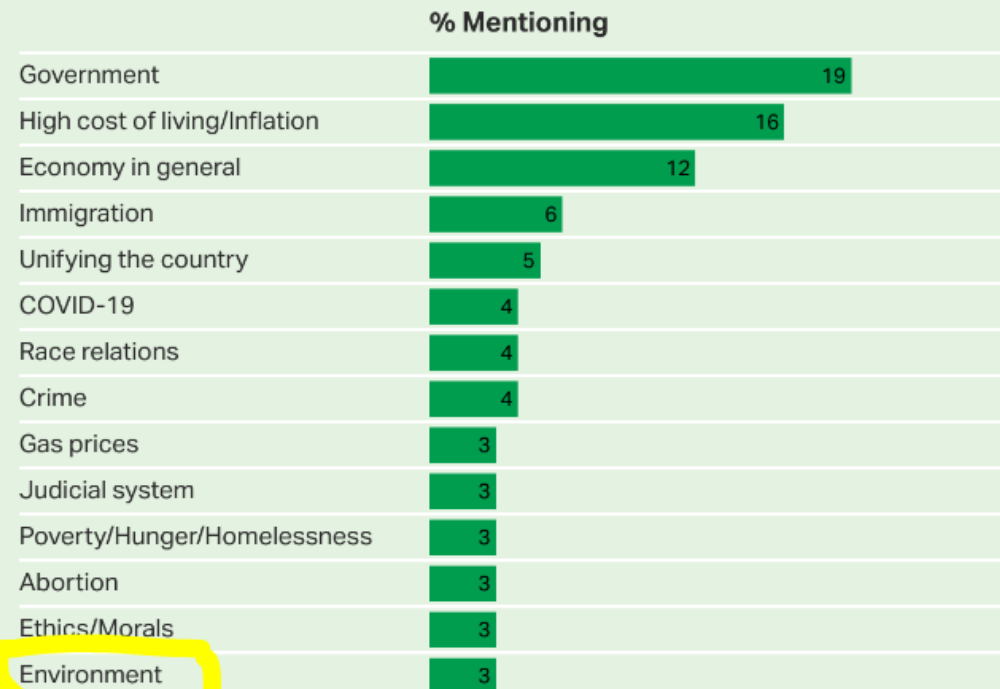


Note: Based on registered voters.
Source: Survey of U.S. adults conducted Oct. 10-16, 2022.

PEW RESEARCH CENTER

2022 Average Most Important Problem Mentions

Annual average of January-December monthly results

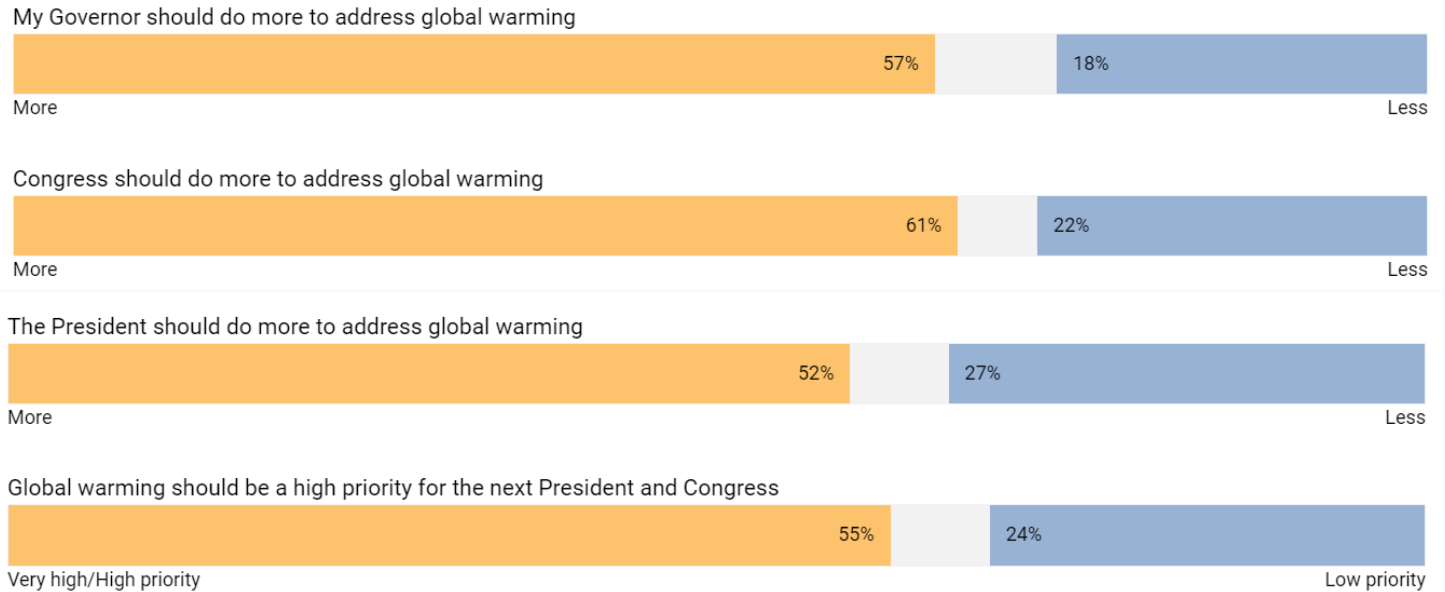


Issues with mentions from less than 3% of U.S. adults are not shown.

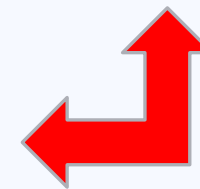
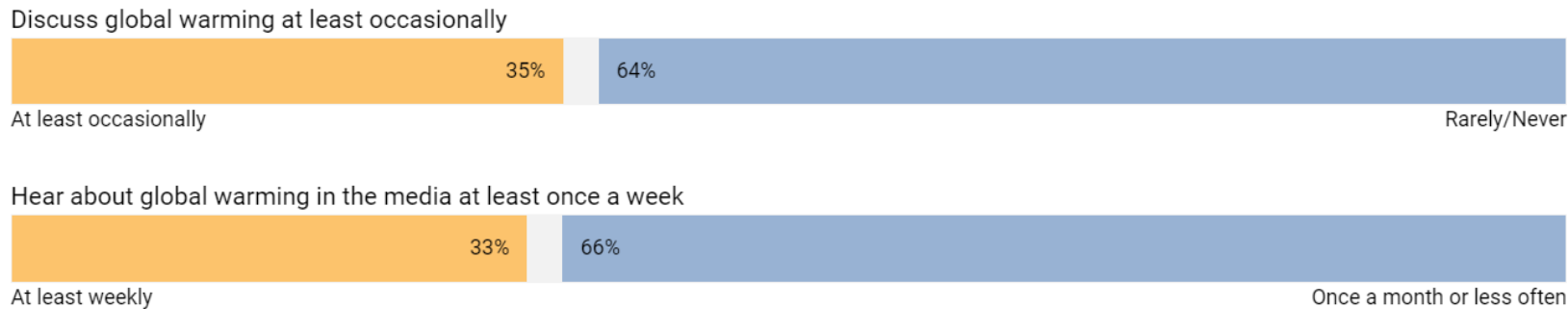
GALLUP



Map · Feb 23, 2022
Yale Climate Opinion Maps 2021
By Jennifer Marlon, Liz Neyens, Martial Jefferson, Peter Howe, Matto Mildenberger and Anthony Leiserowitz



Behaviors



Is there space here?

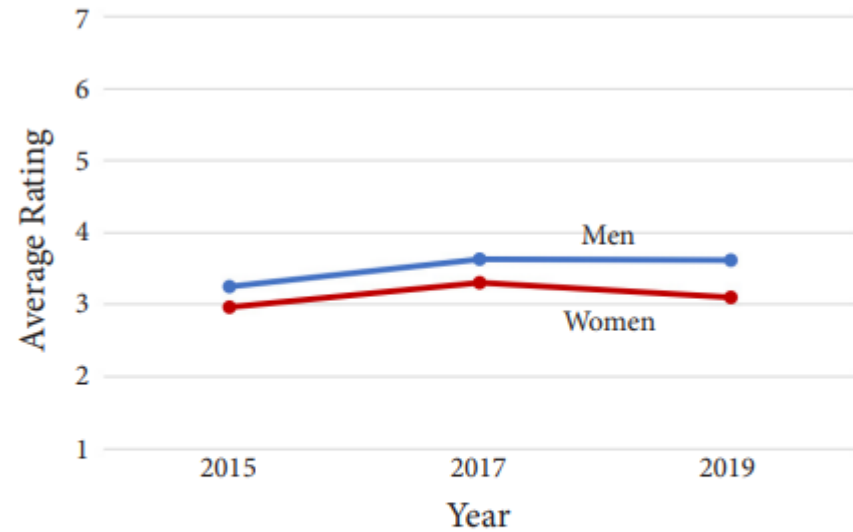


Figure 1. “How much do you agree or disagree with the following statement? ‘The United States is an Arctic Nation with broad and fundamental interests in the Arctic Region.’” United States responses, 2015-2019.

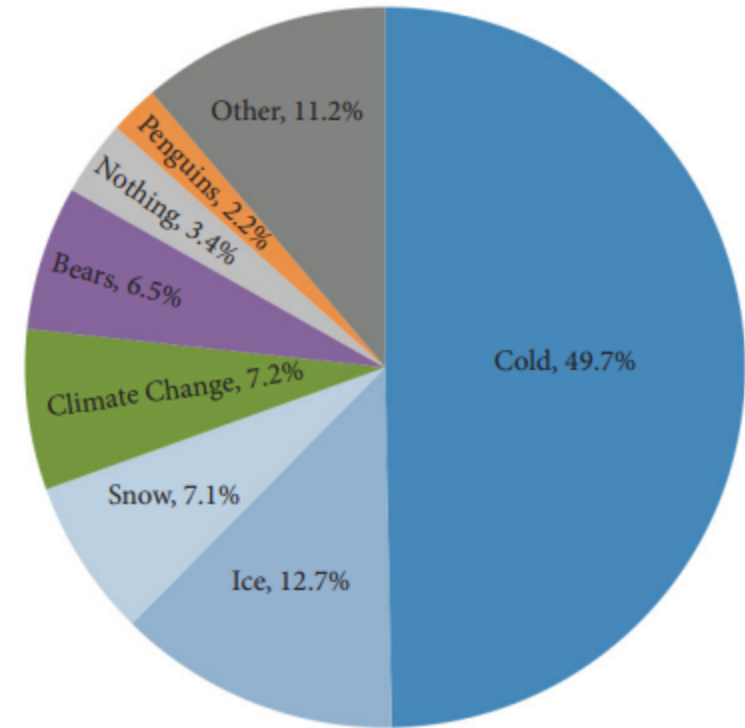


Figure 6. “When you think about the Arctic, what is the first thing that comes to mind?” United States responses, 2019.



The science is clear. We have a problem aligning policy with science.

Research has found that “attributing weather-related natural disasters to climate change may be a losing political proposition with voters.”

(Hai and Perlman, 2022)



Climate Justice Global Tipping Points

Shutterstock/FloridaStock



We have mobilized to meet existential challenges before, and we can do it again.

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