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Ch 12: Mitigation Policies

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12.1 The Economic Basis of Climate Change
12.2 Conventional Regulations
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Case study: Future Species Distribution Modeling for informing Policy
Climate Policy for Wildlife Conservation

Introduction

Options to address climate change: adaptation, mitigation, solar radiation management, and CO2 removal (Ch 11).

Most experts agree that mitigation should be the centerpiece of long-term policy.

Efforts will make little difference before ~2050 but will affect the trajectory after.

Mitigation is likely to require reductions in carbon intensity via shifts to carbon-free energy sources.

12.1 The Economic Basis of Climate Change

Physics view: GHG warms the climate (Ch 4) and humans emit GHG to the atmosphere (Ch 5).

Economics view: GHG emission proportional to the value of goods/services consumed by society (Ch 8).

- **You can think of climate change as a side effect of economic activity.**
  More economic activity = More GHG emissions

- **Humans are the primary cause of modern climate change (Ch 7), and some impacts could be severe (Ch 9).**

- **Question: Why do we keep emitting?**

Emission reduction sufficient to stabilize the climate at levels that avoid dangerous climate change will not occur by itself.

Imagine a scenario:

- **You own a company that produces computer chips.**
- **It costs $10 to manufacture each computer chip.**
- **CO2 emitted during manufacture process causes $2 in damages.**

- Thus, total cost of a computer chip = $10 + $2 = $12.
- The manufacturer only pays $10, while the $2 cost in damages is shared by society.
- The benefit of producing a computer chip goes entirely to the manufacturer.

EXTERNALITY = term used by economists to describe costs imposed on the entire population:

- Costs imposed on others not part of the transaction.

Imagine a new scenario:

- Someone invents a new process to manufacture computer chips for $11, but with no CO2 emitted.
- Total cost per computer chip under the new process is $1 less than the older process, so it would be beneficial to the entire economy for the manufacturer to switch to the new process.
- However, the manufacturer does not switch - opts to use the older process, pays $10 for a computer chip, and externalizes $2 damages onto society.

COMMAND-AND-CONTROL REGULATION = requires all emitters in the economic sector to meet a single standard:

- **e.g., focus on technology - electric companies may be required to use wind or nuclear.**
- **e.g., focus on emission - car companies may be required to limit GHG emission per mile:**
  - **In 2012, the Obama Administration proposed that new power plants emit < 1000 lbs of CO_2 per MWh (megawatt-hour) → burning coal produces more than this, so the regulation effectively prohibited the construction of coal plants.**

The free market is unlikely to solve climate change without government intervention because it is currently free to emit GHG.

If emitters must pay, that will incentivize emission reduction - market-based solutions internalize the externalities.

Two examples of market-based approaches:

- **(1) Carbon tax.**
- **(2) Cap and trade.**

12.3.1 Carbon Tax

CARBON TAX = mitigation strategy where emitters have freedom to emit as much GHG as they choose, as long as they pay a specified fee for each ton released:

- **Market-based because the government does not tell emitters how much they can emit.**
- **MARGINAL COST = cost of reducing a particular ton of emissions.**

12.3.1 Carbon Tax

- **Conclusions under a PRICE ON CARBON:**
- **(1) Emitters will reduce emissions until the marginal cost of reduction equals the carbon tax.**
- **(2) Because marginal costs vary among emitters, the lowest marginal cost emitters will make deeper cuts than the higher marginal cost emitters.**

12.3.2 Cap and Trade

CAP AND TRADE = Mitigation strategy where the government issues a fixed number of permits per yr (via auctions or given away (for free)), with each permit allowing the holder to emit a fixed amount (e.g., 1 ton) of GHG into the atmosphere:

- Total number of permits sets a cap on total emissions.
- Emitters with extra permits can sell/give to those needing additional permits.
- Price of permit set by market, not government.
- Enforcement?

12.3.2 Cap and Trade

The economics of cap and trade are nearly identical to the carbon tax:

- **If the marginal cost of reducing 1 ton < the cost of a permit, emitters will not emit a ton.**
- **If the marginal cost of reducing 1 ton > the cost of a permit, emitters will acquire a permit.**
- **Emitters will reduce emissions until marginal cost = price of permit.**

12.3.3 Carbon Tax Versus Cap and Trade

Both reduce emissions by putting a price on emissions.

Both allow companies to emit as much as they want, as long as they pay tax or a permit.

Both move emission reductions to where they are cheapest – toward the lowest marginal cost emitters.

For both, emitters reduce emissions until the marginal cost of reducing the next ton.

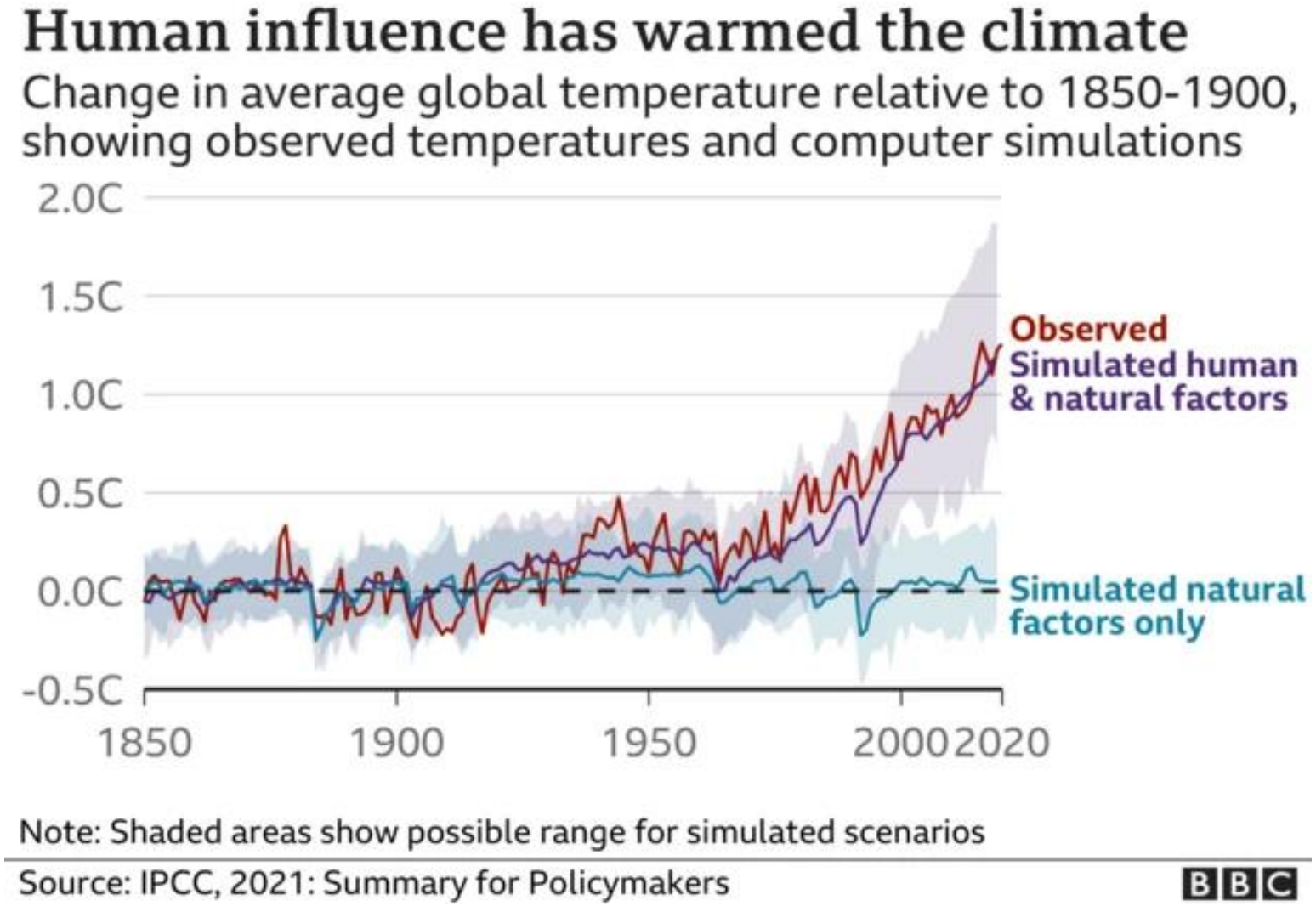
12.3.3 Carbon Tax Versus Cap and Trade

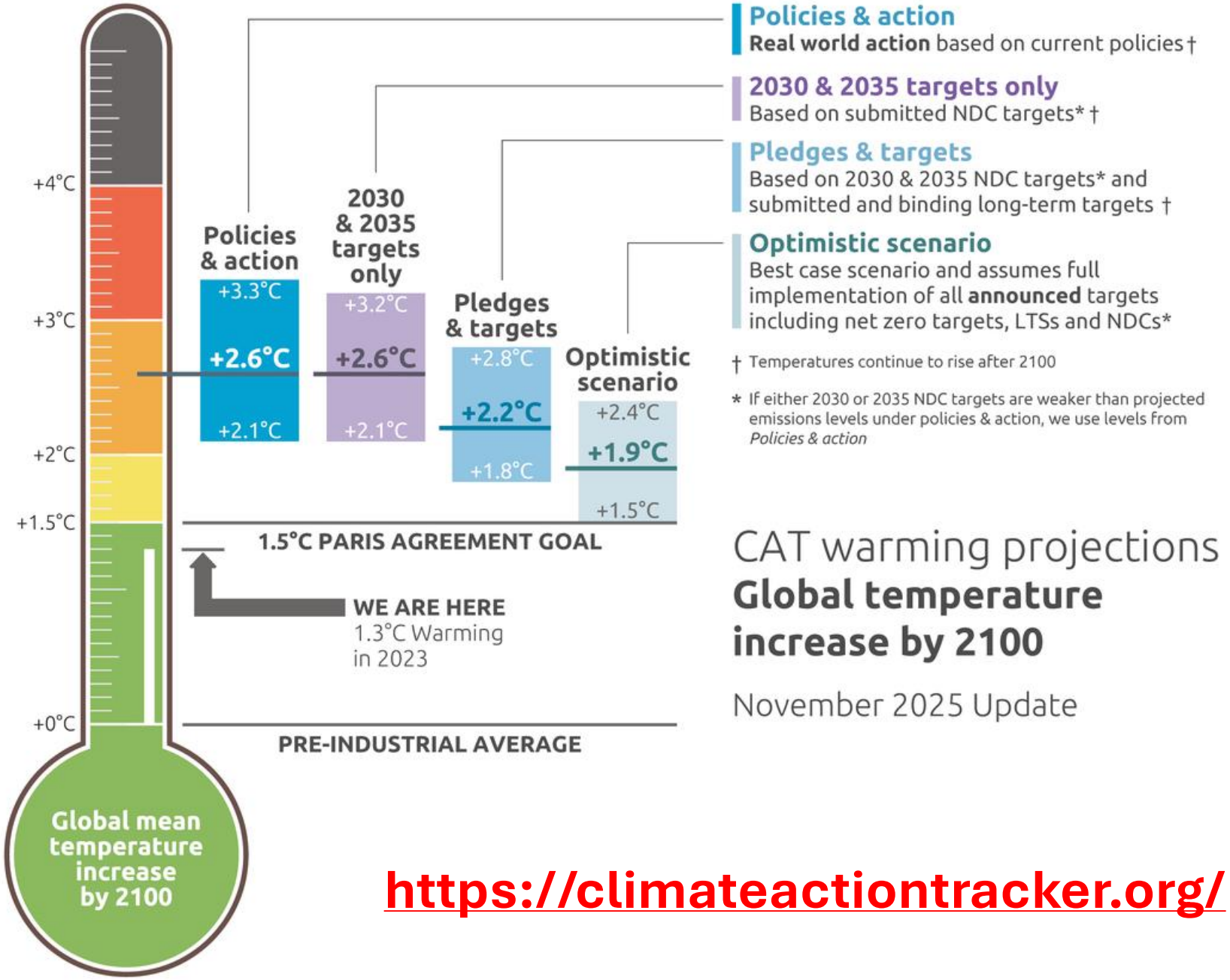
For both, the price on emission means an increase in the price of goods/services proportional to the amount of GHG emitted:

- **(1) Higher prices encourage consumers to reduce consumption of GHG-intensive goods/services.**
- **(2) Price on emission encourages economy to substitute climate-safe technology for present technology.**
- **(3) Encourages research and development of new technologies that can replace today's technology.**

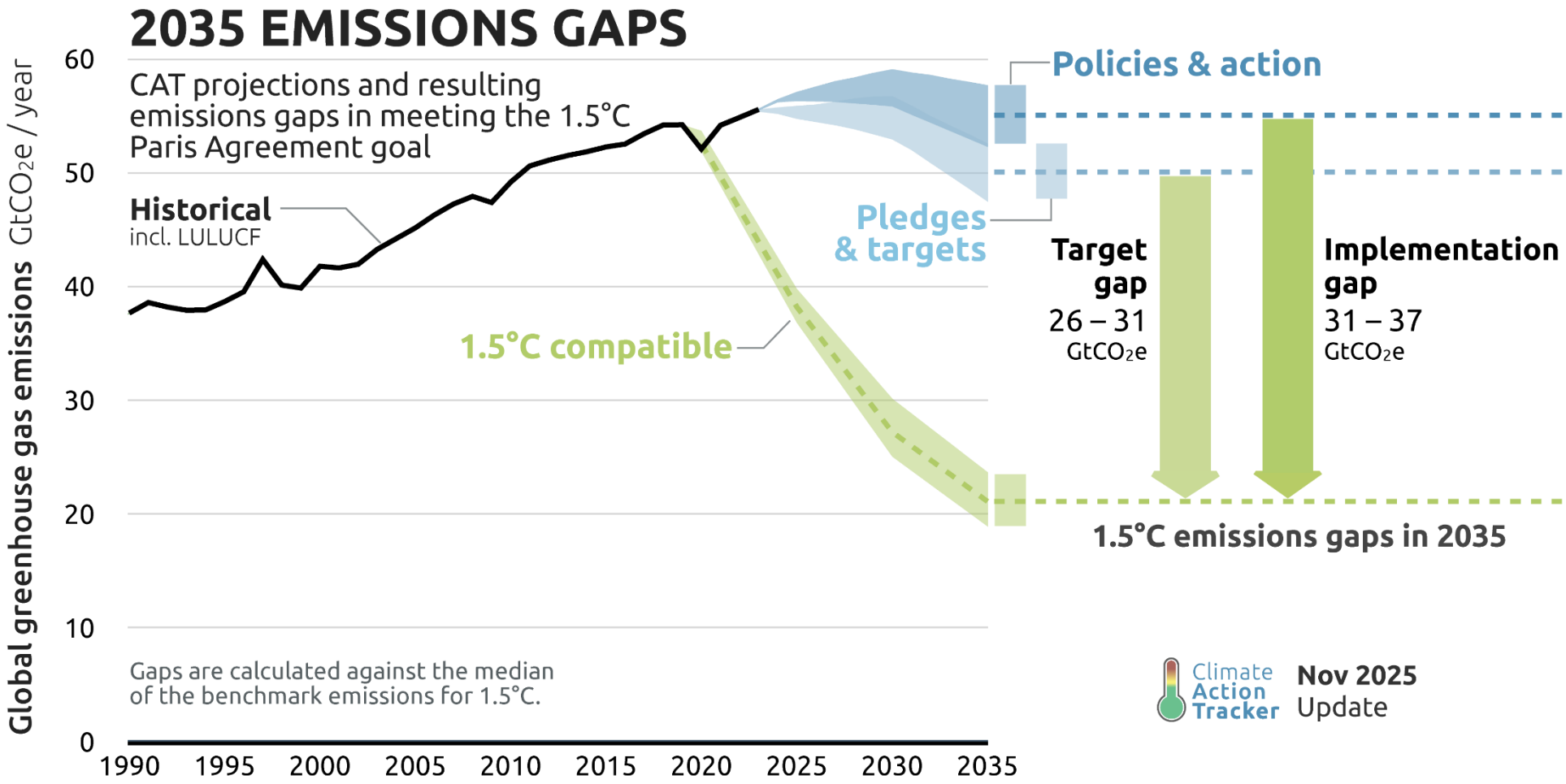
Some practical applications

Remember this from Chapter 7?

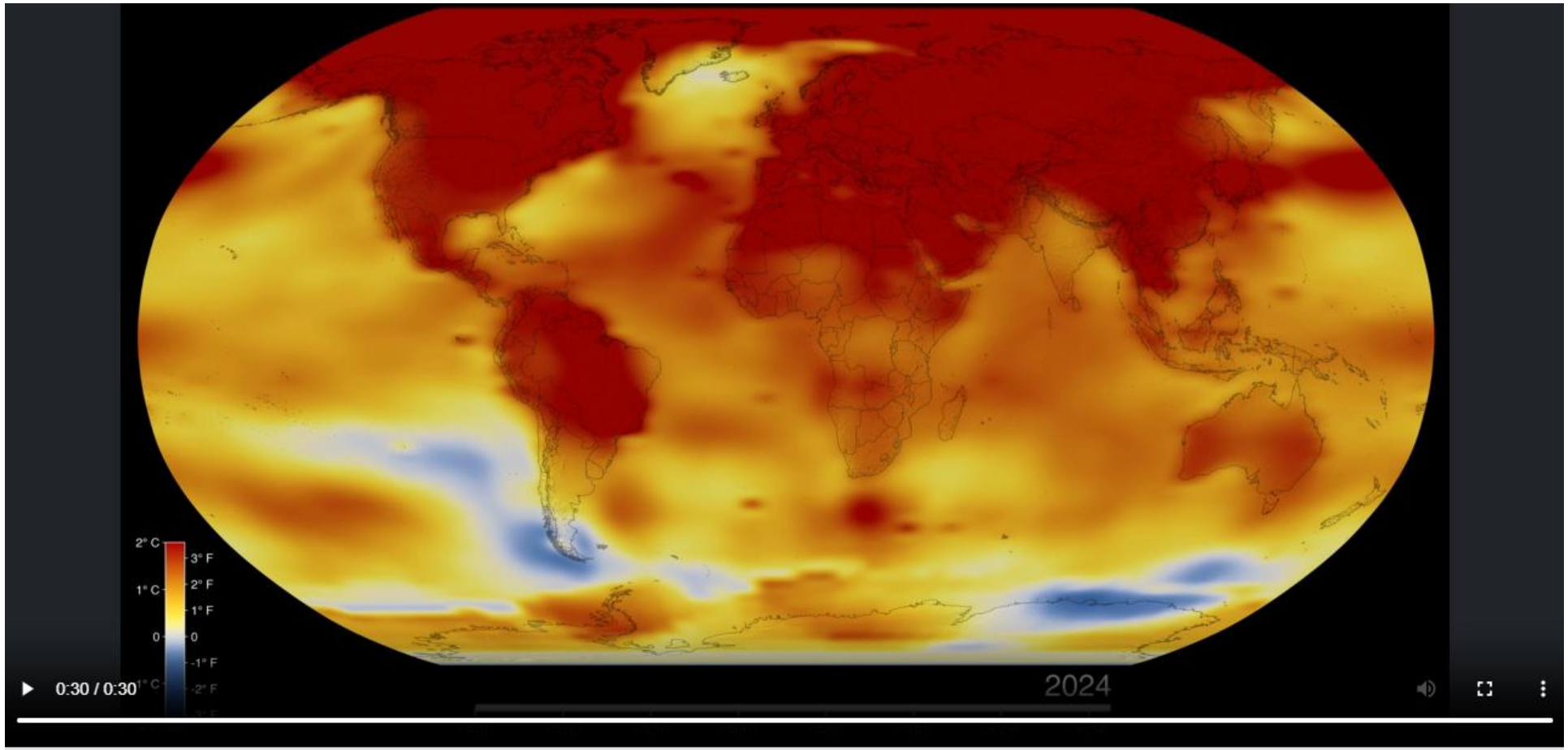




https://climateactiontracker.org/



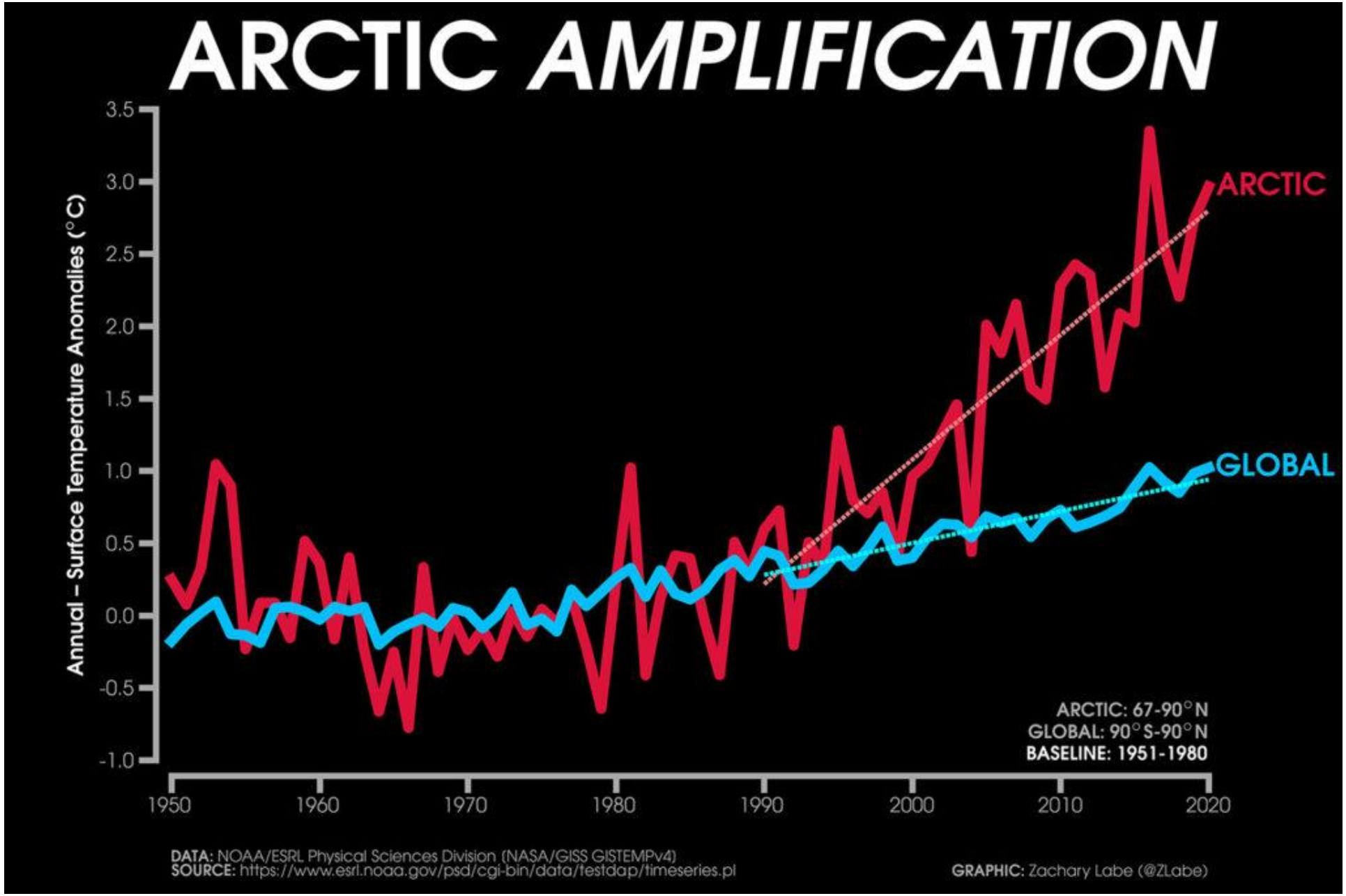
How is global climate change distributed across the planet?

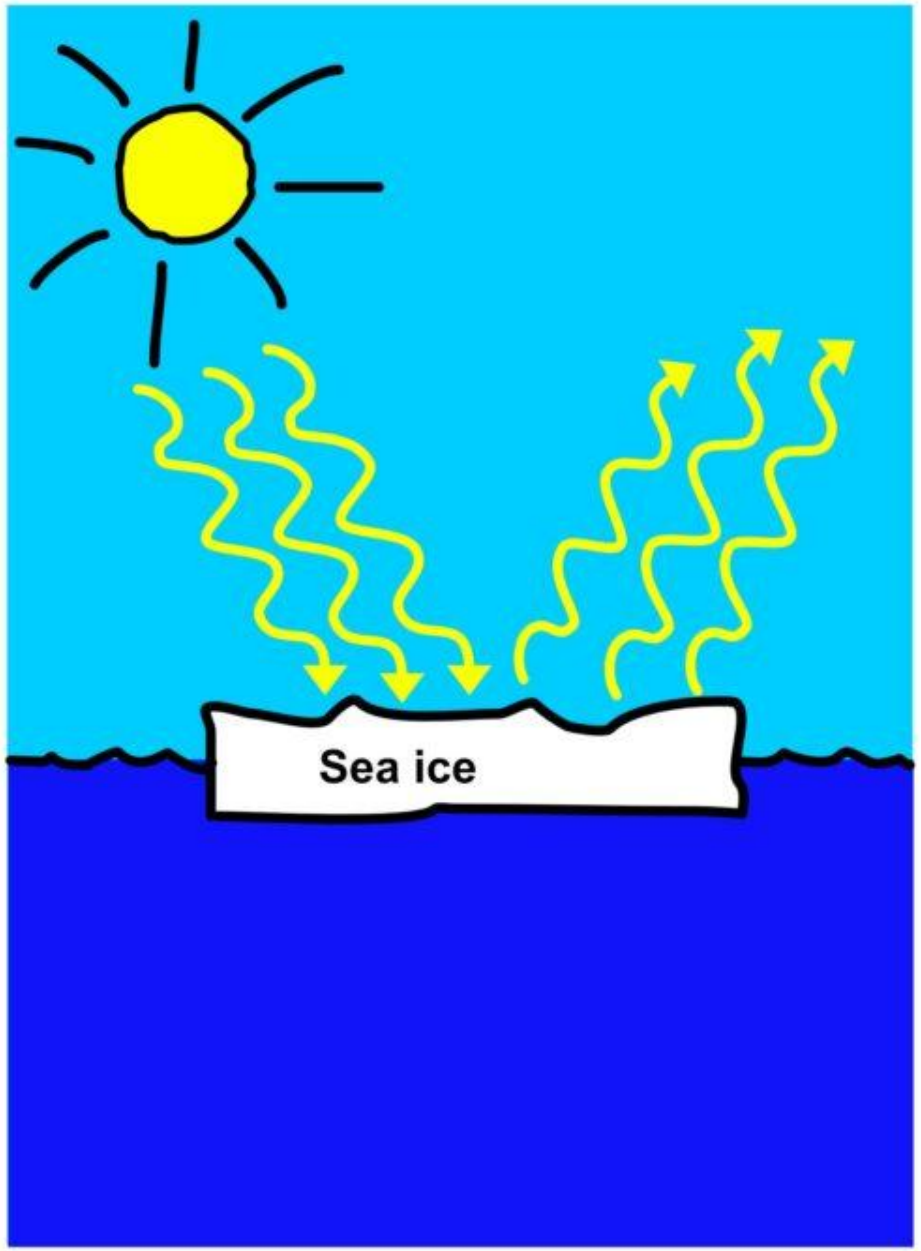


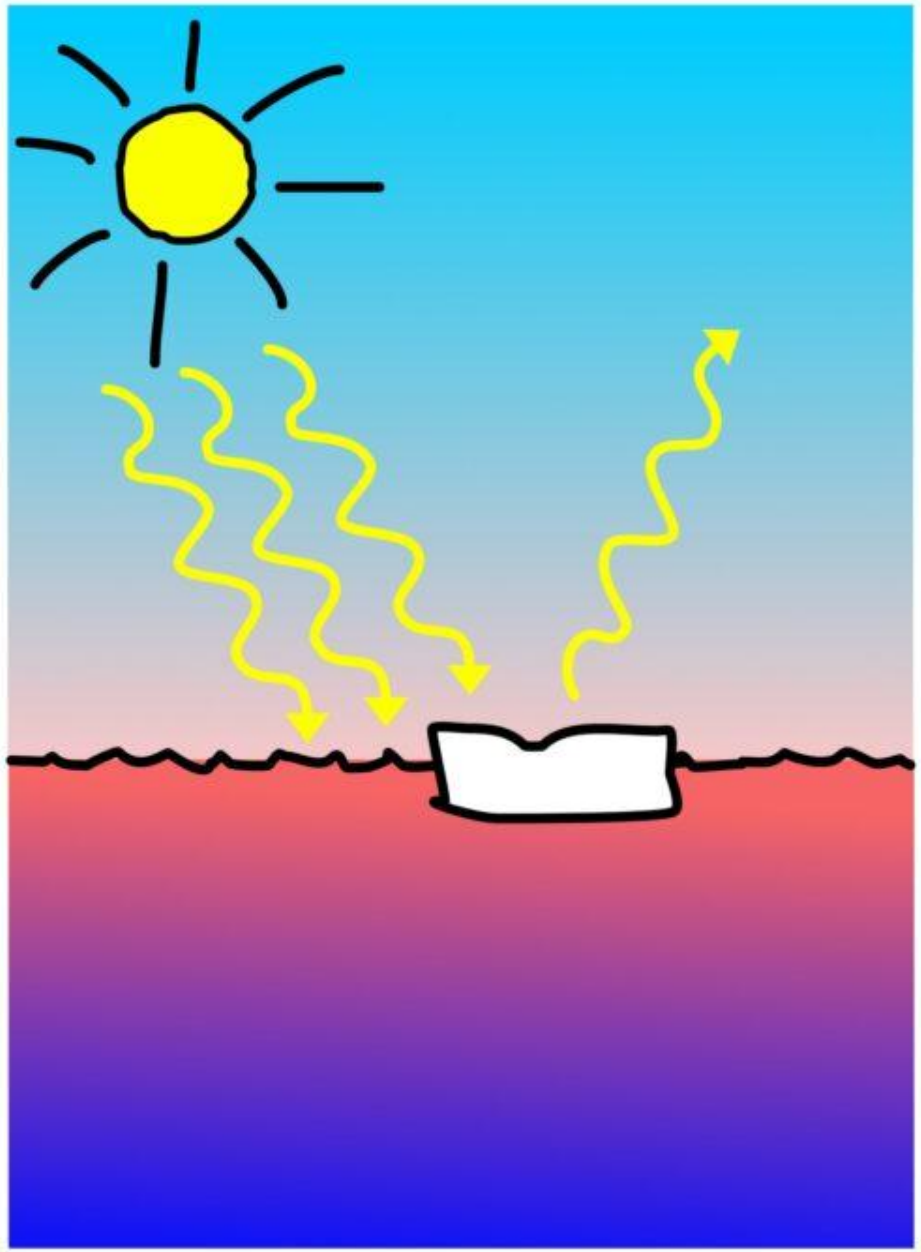
This color-coded map in Robinson projection displays a progression of changing global surface temperature anomalies. Normal temperatures are shown in white. Higher than normal temperatures are shown in red and lower than normal temperatures are shown in blue. Normal temperatures are calculated over the 30 year baseline period 1951-1980. The maps are averages over a running 24 month window. The final frame represents global temperature anomalies in 2024.

Download

https://svs.gsfc.nasa.gov/5450/


ARCTIC AMPLIFICATION
Annual – Surface Temperature Anomalies (°C)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1950
1960
1970
1980
1990
2000
2010
2020
ARCTIC
GLOBAL
ARCTIC: 67-90° N
GLOBAL: 90° S-90° N
BASELINE: 1951-1980
DATA: NOAA/ESRL Physical Sciences Division (NASA/GISS GISTEMPv4)
SOURCE: https://www.esrl.noaa.gov/psd/cgi-bin/data/testdap/timeseries.pl
GRAPHIC: Zachary Labe (@ZLabe)


Sea ice

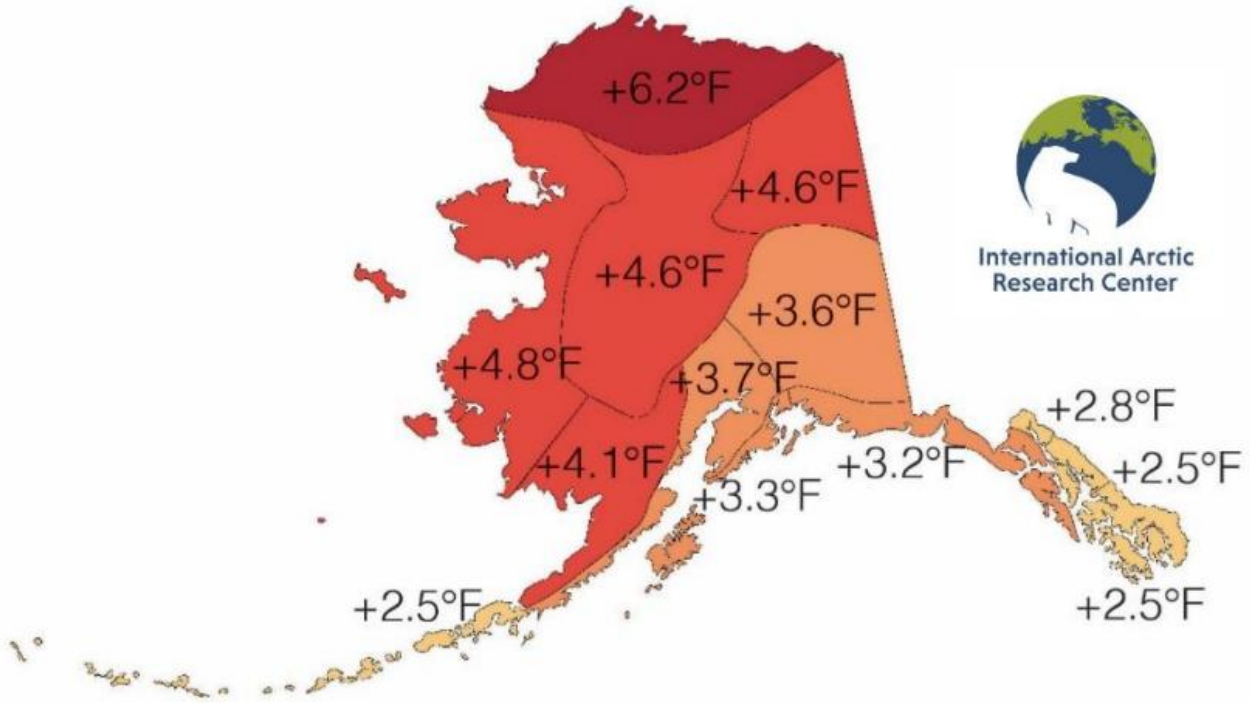


Case study: Alaska

Figure 1. Alaska's Annual Temperature Trend

Annual temperature trends in Alaska since 1970 show significant warming, with more extreme increases in the northern part of the state. Arctic warming is associated with a range of changes including loss of summer sea ice, permafrost degradation, and coastal erosion.

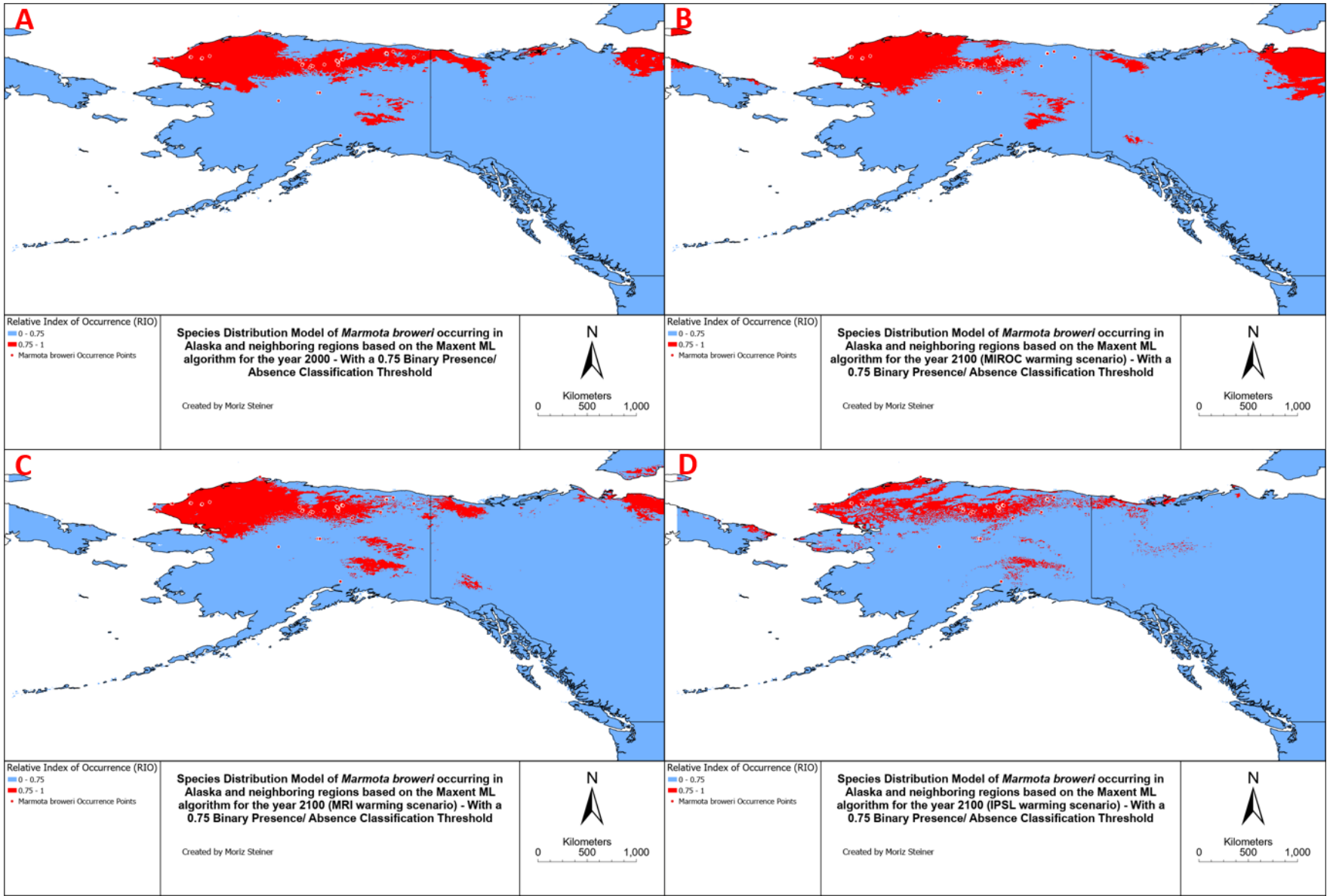
Annual temperature trend, 1970-2019. *Credit: Thoman, R. (2020). Summer's getting hotter.* Alaska's Changing Wildfire Environment, *Grabinski, Z. & H. R. McFarland,* *www.frames.gov/afsc/acwe.* *Data source: NOAA/NCEI & NWS.*



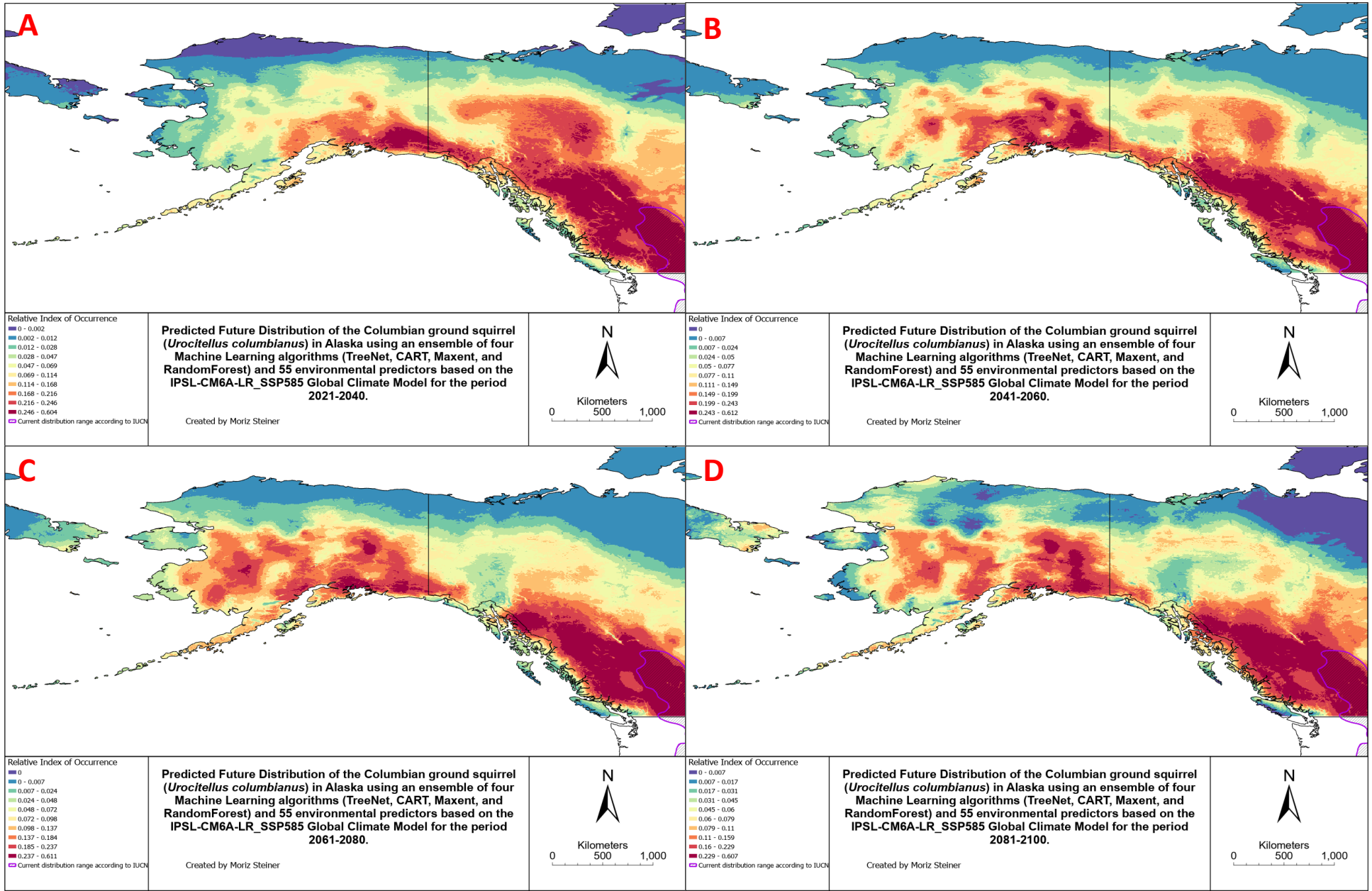

Alaska
Shishmaref
Arctic Lagoon


ARCTIC OCEAN
170° W
70° N
60° N
Bering Strait
Shishmaref
Tin Creek
Arctic Circle
Nome
ALASKA
(UNITED STATES)
CANADA
Gulf of Alaska
PACIFIC OCEAN
0 200 400 miles
0 200 400 kilometers
Conformal Conic Projection
Area of Main Map
UNITED STATES

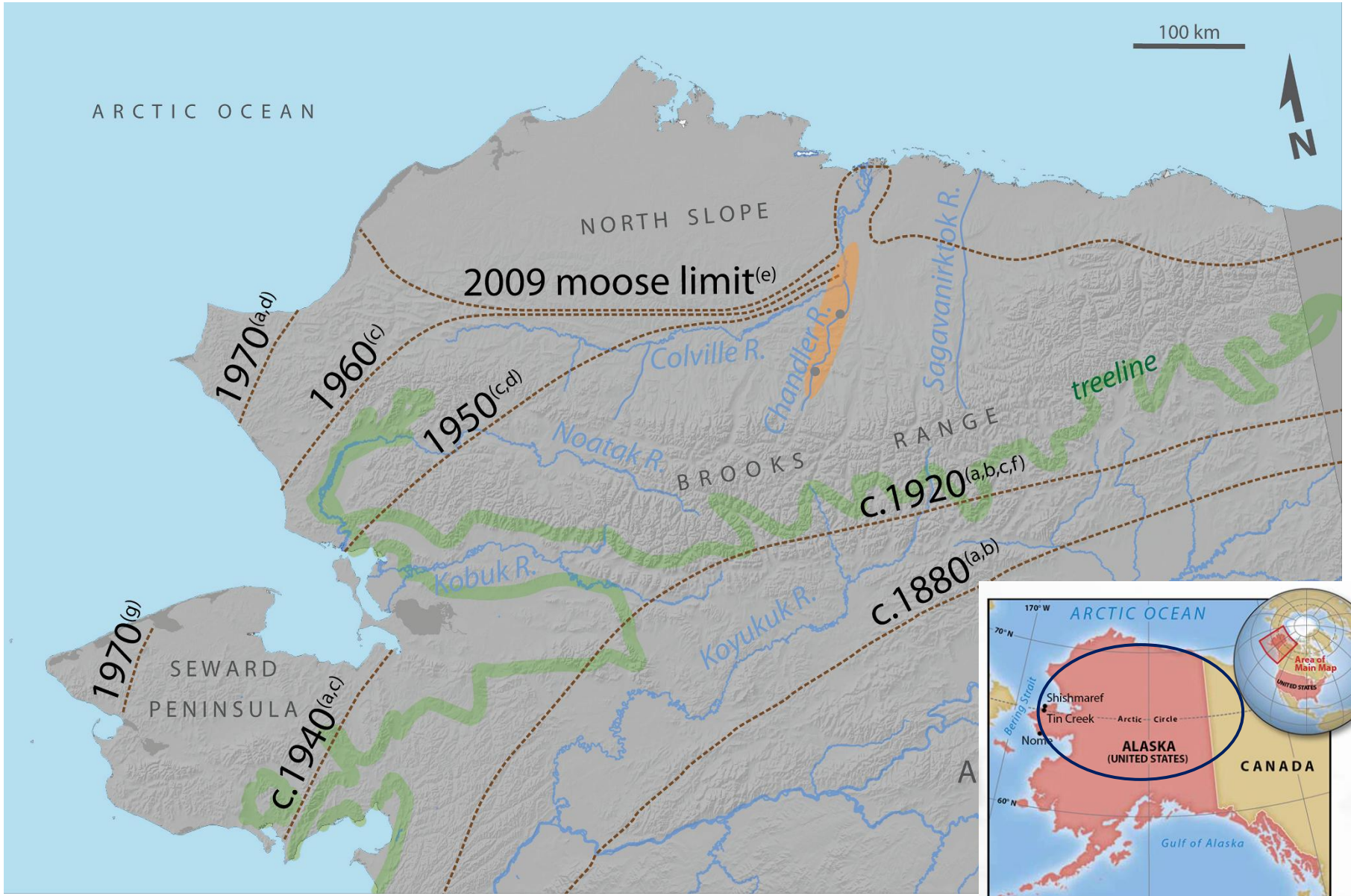
Case study: Future Species Distribution Modeling for informing Policy



Policy for Wildlife Conservation



Moose in Alaska



Range

Beaves to mitigate climate change effects (droughts)

Beaver Drop

My conservation-oriented take-home message

While human-driven climate change has and is continuously expected to have a negative impact on the global biodiversity, the flora, fauna, and funga can help us mitigate climate change, and hence necessitate long-term sustainable biodiversity conservation initiatives!

Textbook take-home message

Climate mitigation actions are primarily driven by financial incentives of the stakeholders/ actors.

Climate mitigation plans and policies must incorporate a price increase on GHG emissions to turn around the Anthropocene's unsustainable GHG emissions trajectory