Climate Basics

FEMA Region X

National Oceanic and Atmospheric Administration

Dr. Joe Casola
Western Regional Climate Services Director,
NOAA/National Centers for Environmental Information

June 22, 2022

Questions to think about…

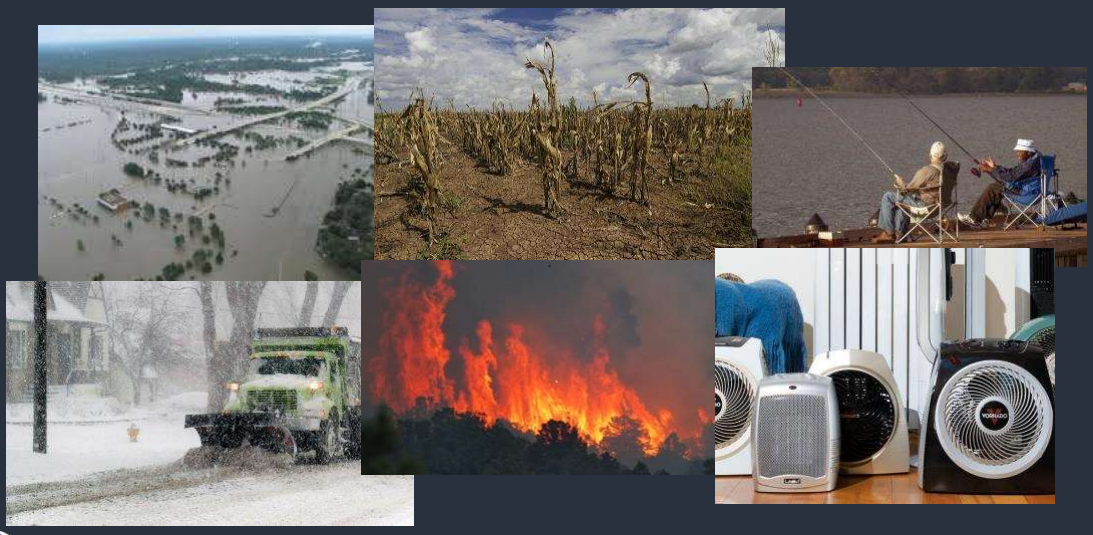
- What are your concerns about climate impacts?
- Who is your go-to climate resource?

Climate Basics

- The climate system
- Climate vs. Weather
- Climate variability and climate change
- Climate change and disaster risk in Region X

The Climate System

Why do we care?



Weather vs Climate

- Weather refers to variations in the atmosphere for minutes to days (AMS Glossary)
- Climate is what you expect, weather is what you get

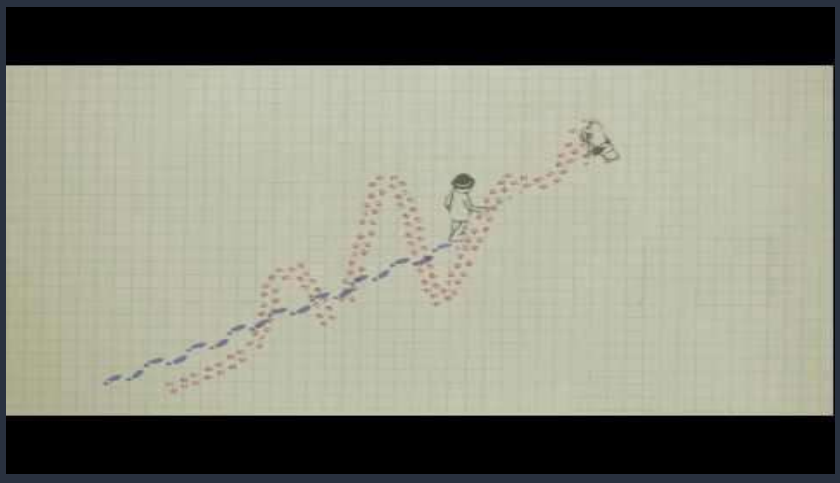
https://letstalkscience.ca/educational-resources/backgrounders/introduction-climate-change

Climate Variability

- Natural changes in climate that fall within the observed range of extremes for a particular region (USGCRP 2017)
- The “wiggles” in climate conditions

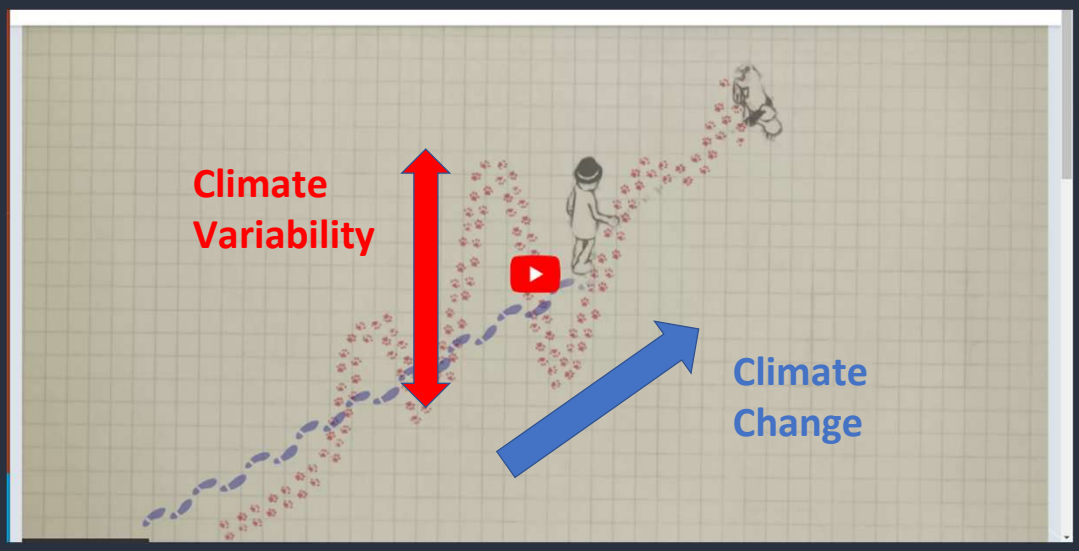
What is “climate change” ?

Changes in average weather conditions that persist over multiple decades or longer
(USGCRP 2017)



https://youtu.be/e0vj-0imOLw

https://scied.ucar.edu/video/dog-walking-weather-and-climate
Credit: Siffer, produced by TeddyTV for NRK. Animation by Ole Christoffer Haga



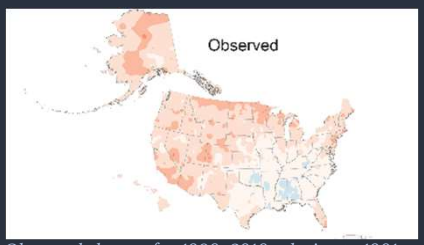
We manage BOTH climate change and variability

- Weather/climate disaster events include elements of climate variability AND climate change
- "Attribution" can be helpful, but should not be a barrier for planning
- Past variability can be a good test of RESILIENCE in the face of future change

Climate change in the Pacific Northwest and Alaska

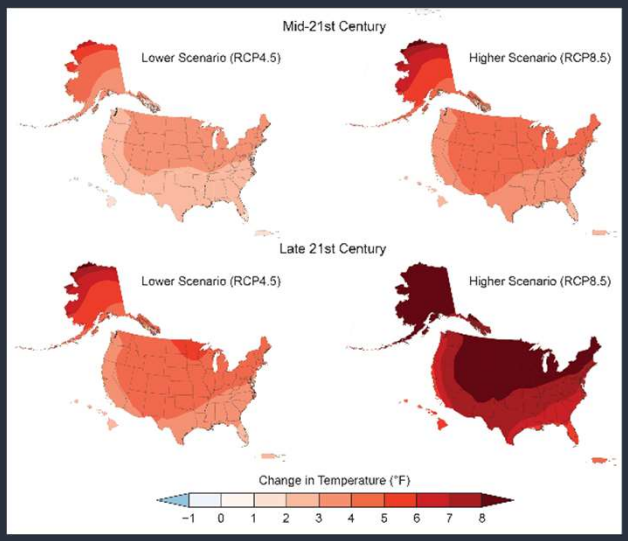
- Warming
- Sea level rise
- More frequent/intense heavy precipitation
- Less snow that melts earlier
- More intense drought impacts
- Loss of sea ice
- Loss of permafrost
- More frequent/intense wildfire

Warming



Observed change for 1986–2016 relative to 1901–1960

- Across the PNW and Alaska, we've warmed since the early 20th century
- Future warming anticipated to be larger and more rapid
- Warming expected to be largest/fastest in the Arctic



4th National Climate Assessment (2017)

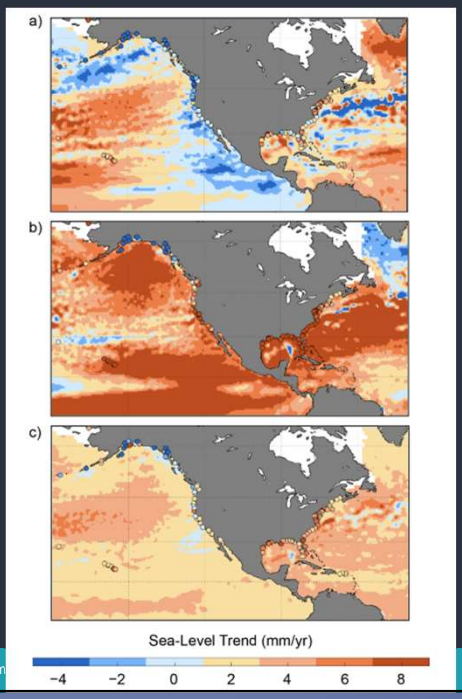
Sea Level Rise

1993-2006

Rate has sped up while rates of isostatic rebound in the Arctic/Sub-Arctic differ at each site

2007-2020

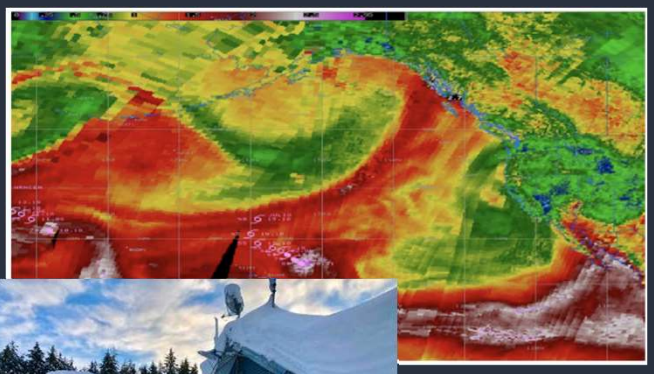
1993-2020



Sweet et al., 2022

Atmospheric Rivers

May be associated with heavy snowloads (Yakutat this past winter, called in Natl Guard), debris flows, avalanches, landslides, flooding



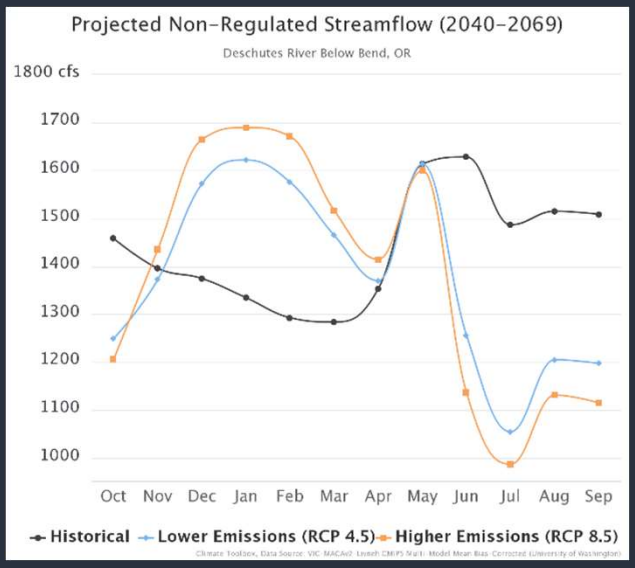
NOAA

Photo credit: Casey Mapes

Hydrological Change in the Pacific Northwest

For snowmelt driven watersheds:

- More precipitation falls as rain in the fall and winter → less snowpack but more streamflow
- The small snowpack leak to less summer streamflow
- The peak streamflow shifts earlier in the water year



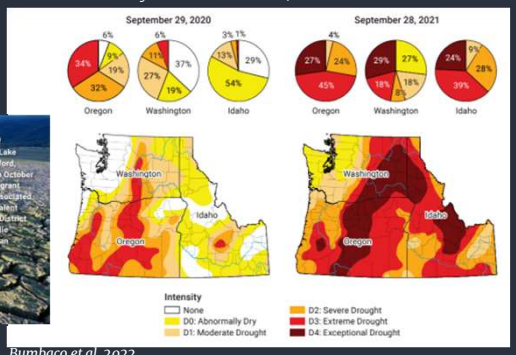
https://climatetoolbox.org/tool/Future-Streamflows

Drought

Impacts of dry periods can be exacerbated by warming

Some areas of the Pacific Northwest are experiencing multi-year drought events

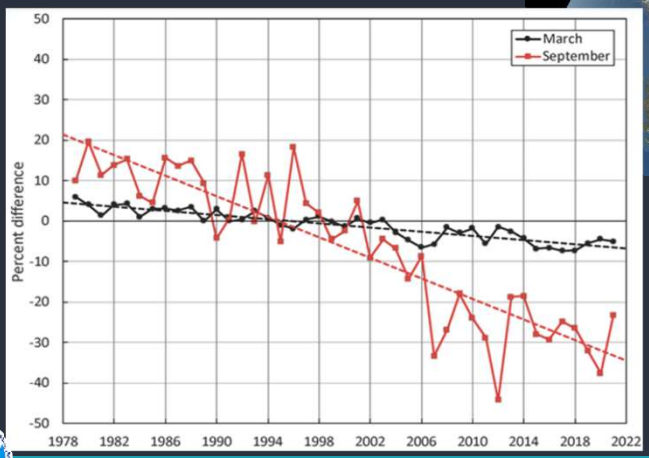
Impacts of sawfly outbreak 2018-2019, Alaska
Photo by Elizabeth Graham/U.S. Forest Service



Bumbaco et al, 2022
2021 Pacific Northwest Water Year Impacts Assessment

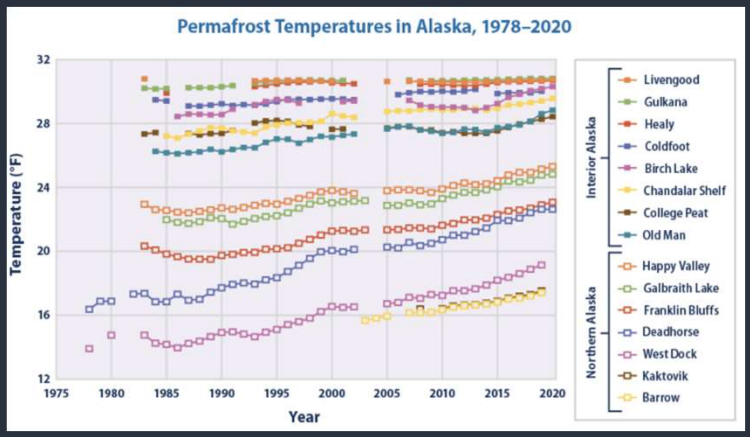
Dramatic Loss of Arctic Sea Ice

Schindler, NASA Scientific Visualization Studiohttps://svs.gsfc.nasa.gov/4941



Maier et al. 2021, Arctic Report Card

Thawing Permafrost



Romanovsky et al., UAF 2021

Fairbanks
https://grist.org/science/alaska-permafrost-thawing-ice-climate-change/

Usteq – permafrost thaw collapse
USGS, https://dggs.alaska.gov/hazards/permafrost.html

Growing threats from wildfire

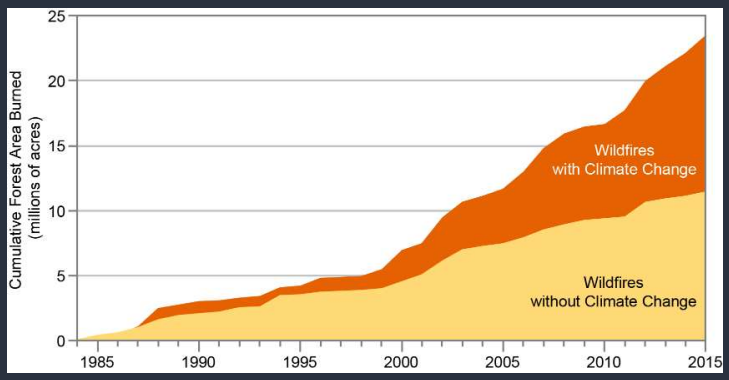


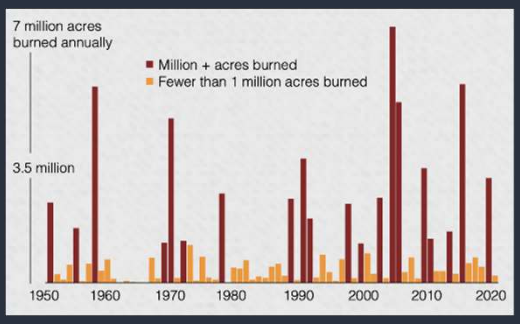
Fig. 25.4: Climate Change Has Increased Wildfire

NCA, 2017; adapted from Abatzoglou and Williams 2016

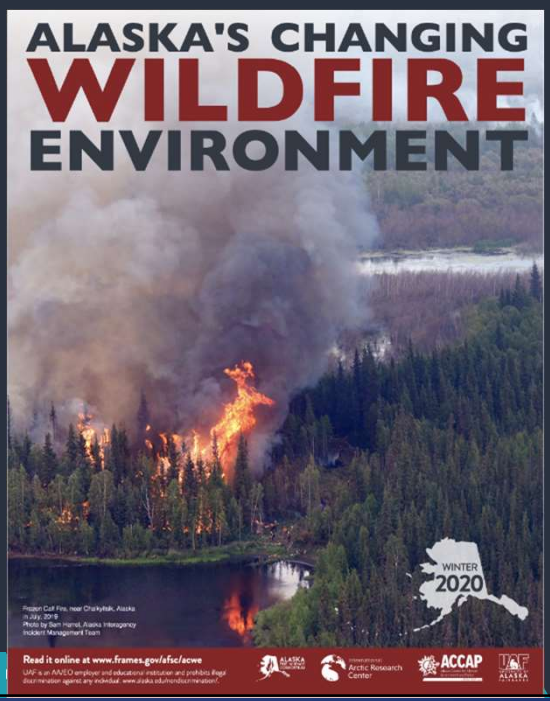
Fig. 24.8: Wildfires Affect Outdoor Recreation

NCA, 2017; Photo credit: Charles Luce

More fires, more acreage burned



Grabinski and McFarland, 2020

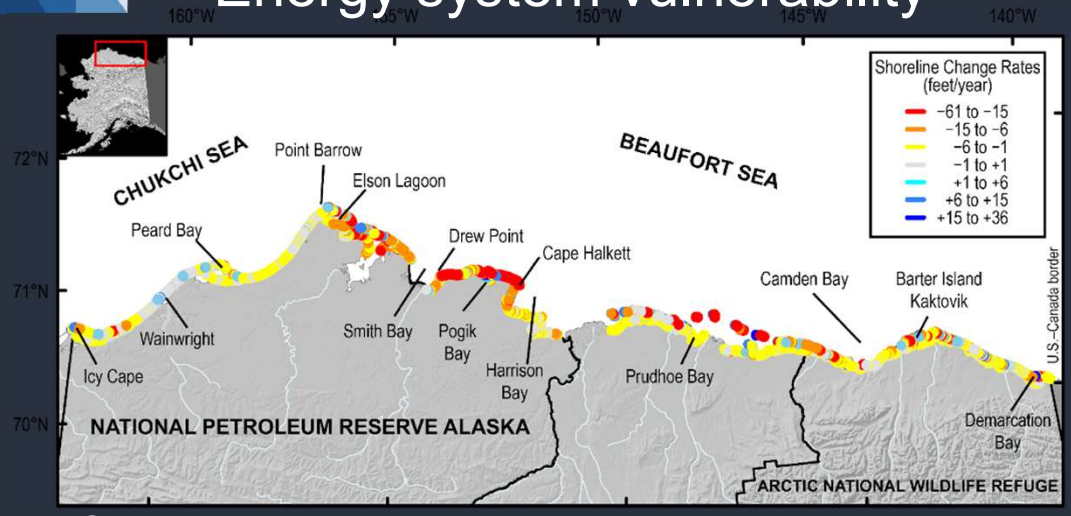


Linking climate change to disaster risk*

- Infrastructure impacts
- Human health impacts
- Agricultural and ecological impacts
- Cultural impacts
- Equity consideration

**NOT a comprehensive inventory of risks!*

Energy system vulnerability



4th National Climate Assessment (2017)

Coastal erosion: reduced sea ice, more wave action, permafrost thaw, higher sea level

Web of Climate Stressors

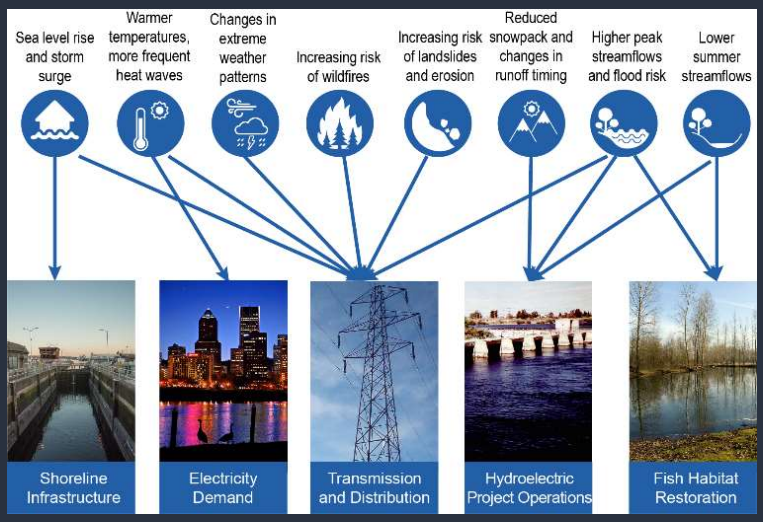


Fig. 24.11: Multiple Climate Stressors Affect Vulnerable Infrastructure
Source: adapted from Raymond 2015.
Photo credits: Emmet Anderson, Justin Miller, photojojo3, U.S. Department of Energy, Rick Swart, Oregon Department of Fish & Wildlife.

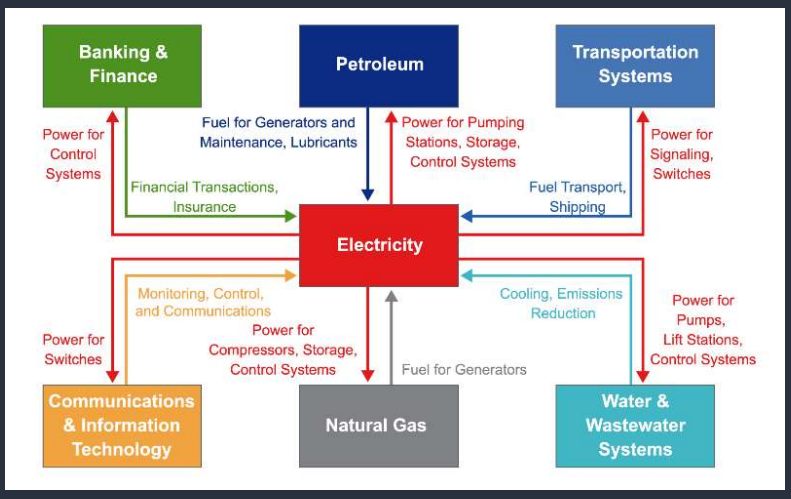
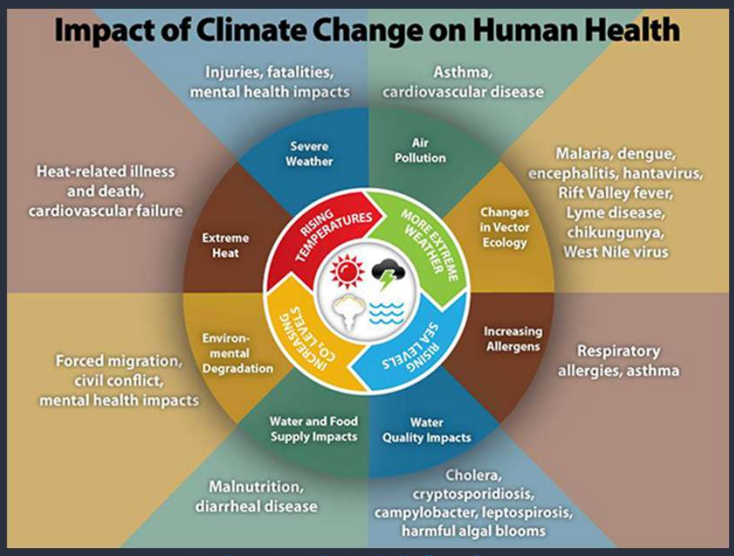


Fig. 4.4: Examples of Critical Infrastructure Interdependencies

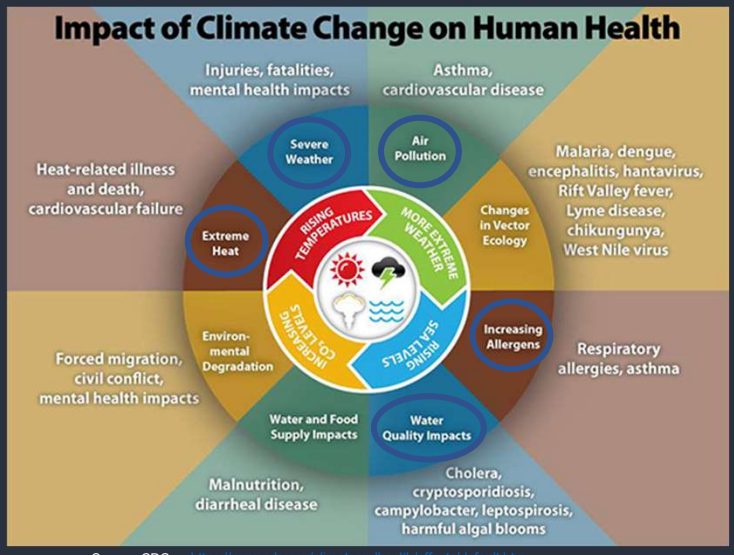
Source: adapted from DOE 2017

Human health impacts



Source: CDC https://www.cdc.gov/climateandhealth/effects/default.htm

Human health impacts



Source: CDC https://www.cdc.gov/climateandhealth/effects/default.htm

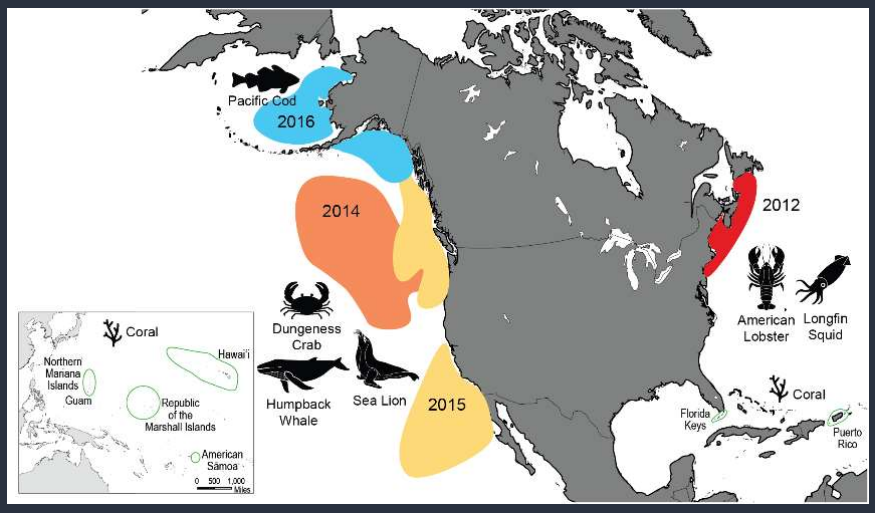
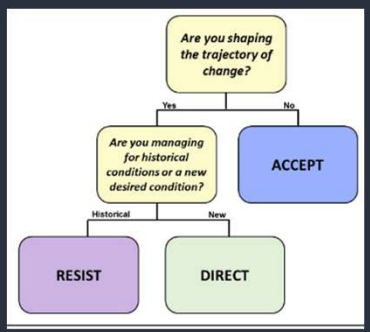


Fig. 9.3: Extreme Events in U.S. Waters Since 2012

Source: Gulf of Maine Research Institute

Ecological impacts



RAD—A Framework for the 21st-century Natural Resource Manager Natural Resource Report NPS/NRSS/CCRP/NRR—2020/ 2213
https://www.nps.gov/subjects/climatechange/radframework.htm

https://www.usgs.gov/media/images/resist-accept-direct-rad-management-framework-and-case-study

Cultural Resources

- Landscapes, flora, and fauna have cultural and historical significance
- For indigenous communities, identity and existence are threatened

Fig. 24.9: Pacific Salmon and the Identity and Culture of Northwest Tribes
Photo credit: Matt Nagle, Puyallup Tribal News

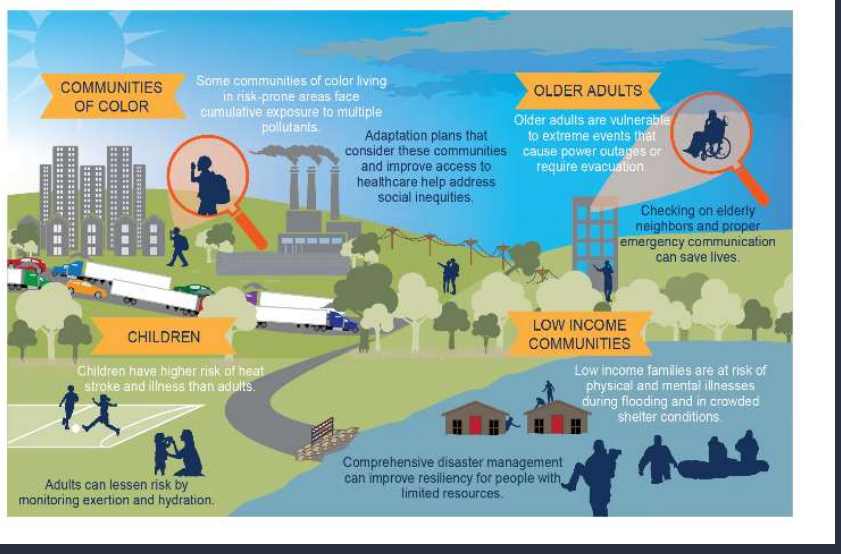


Fig. 14.2: Vulnerable Populations

Source: EPA

What to do with all this "bad news?"

- The risk landscape is changing…
  "The future ain't what it used to be"
- Decisions about mitigation and recovery reduce or amplify risk
- Take a systems approach – land use, infrastructure, resource use, economic development, and equity are interconnected
- Capacity matters – Make it someone's job!

Thank you!

Feel free to reach out with questions or comments:

Joe Casola
Joseph.casola@noaa.gov

For images and background information:
https://nca2018.globalchange.gov/

DOC: 14 disaster determinations for Alaska Fisheries issued 1/2022

- Upper Cook Inlet East Side Set Net (2018) and Upper Cook Inlet salmon fisheries (2020)
- Copper River Chinook and sockeye salmon fisheries (2018)
- Prince William Sound salmon fisheries (2020)
- Copper River Chinook, sockeye, and chum salmon fisheries (2020)
- Eastern Bering Sea Tanner crab (2019/2020)
- Pacific cod in the Gulf of Alaska (2020)
- Alaska Norton Sound, Yukon River, Chignik, Kuskokwim River, and Southeast Alaska salmon fisheries (2020)
- Yukon River salmon fishery (2021)

Likely climate drivers: food web, temp-driven mortality

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Search NOAA sites

Home / News & Features

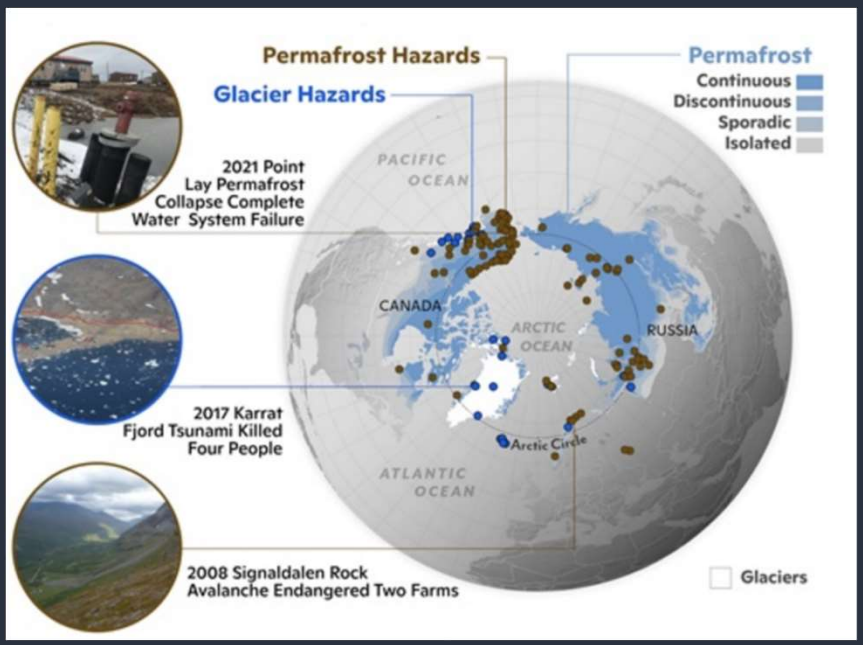
Secretary of Commerce issues multiple fishery disaster determinations for Alaska

Determinations address economic impacts from 2018 to 2021

Focus areas: Fisheries Topics: economic data Share:

January 21, 2022

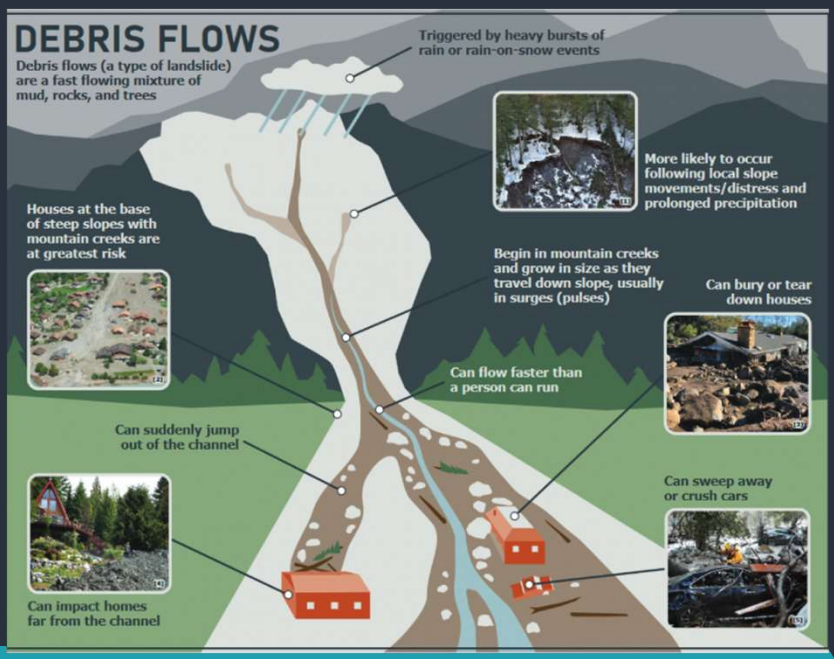
Permafrost and Glacier-related hazards

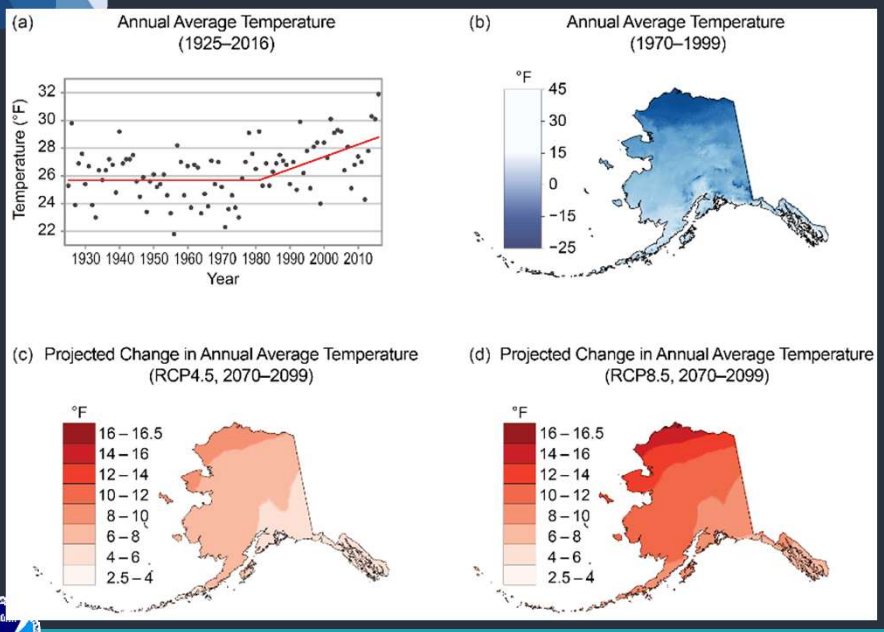


NOAA Arctic Report Card, 2021

Haines debris flow disaster of 2020: 2 deaths

Sitka another vulnerable community



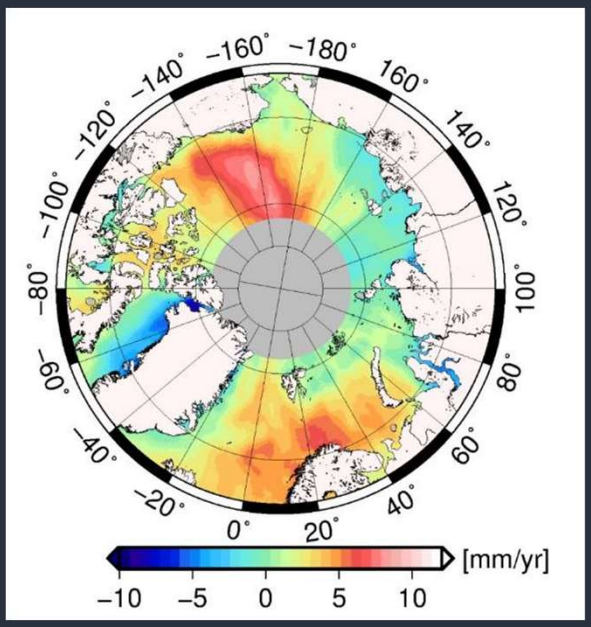


This trend is expected to intensify in the near future under all emissions pathways

4th National Climate Assessment (2017)

Sea Level Rise in the Arctic:

Melting Greenland Ice Sheet, Melting Sea Ice, changing ocean thermodynamics



1991 to 2018

Rose et al. *Remote Sensing*, 2019