

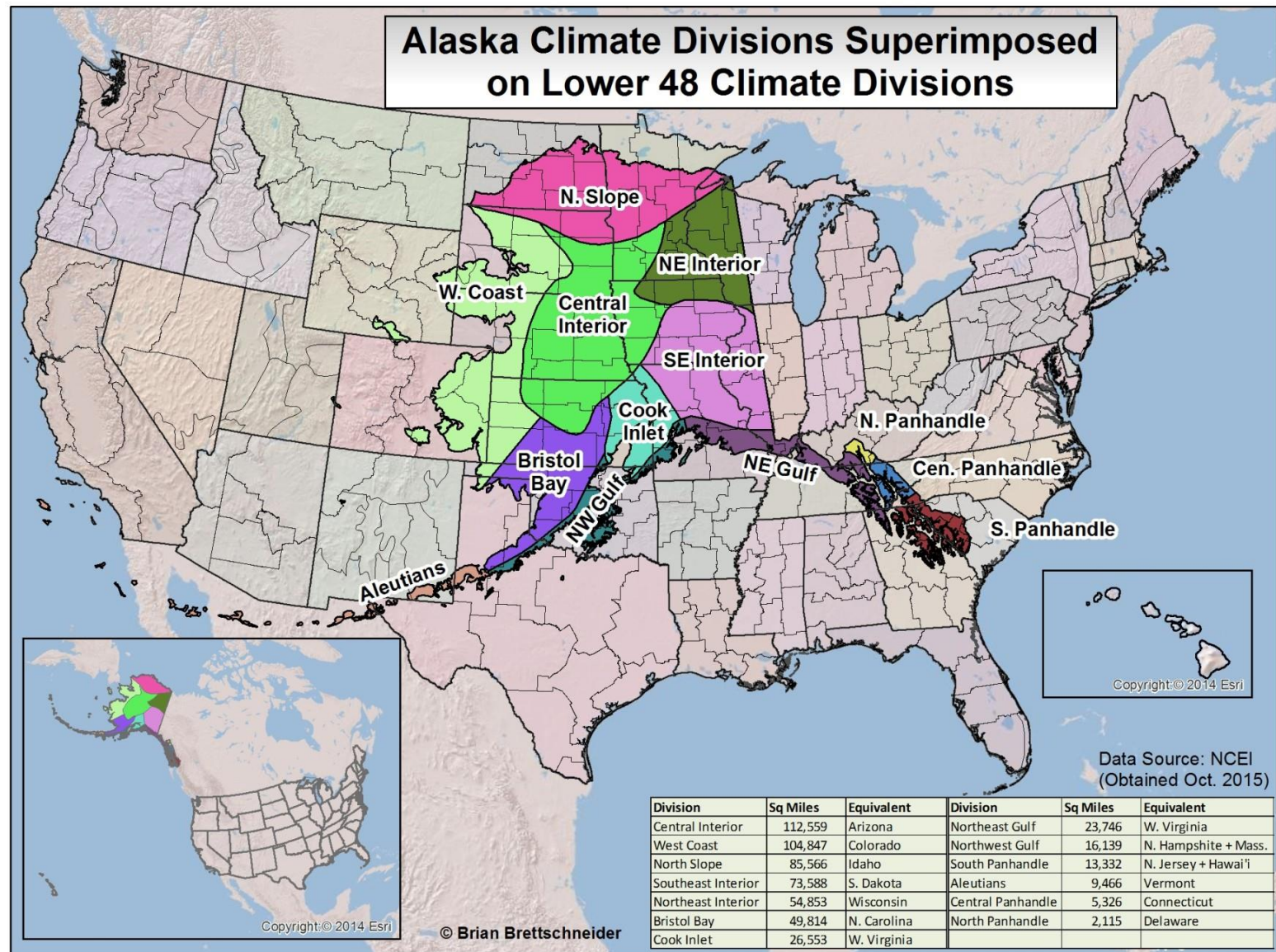
Alaska House Resources Committee Presentation on Climate Change in Alaska

January 24, 2019

Brian Brettschneider, PhD
University of Alaska Fairbanks



Alaska is a Big Place, With A Big Range of Climate Types



Weather



“What is Climate?”

The slowly varying aspects of the atmosphere–hydrosphere–land surface system.

Climate



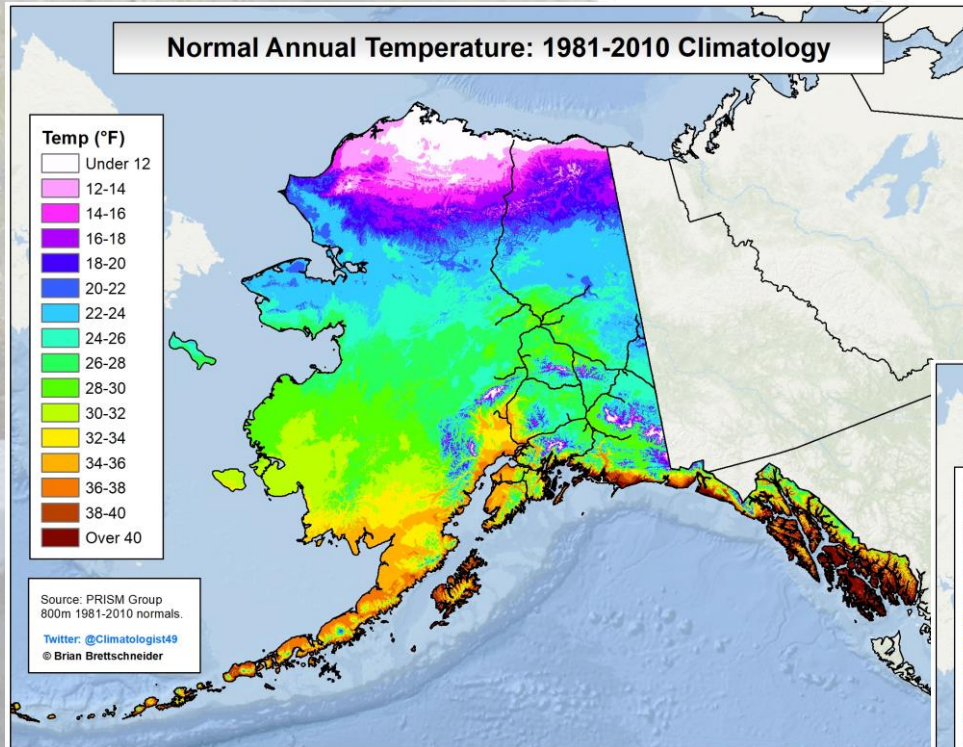
A photograph of a glacier flowing into a body of water, with icebergs floating in the foreground and rocky mountains in the background. The scene is captured in a monochromatic teal color. The glacier is a large, textured mass of ice and rock, flowing from the mountains in the background towards the water. The water in the foreground is dark with many small, white icebergs floating on its surface. The mountains in the background are rugged and rocky, with some snow or ice patches. The sky is a pale, uniform color.

Climate

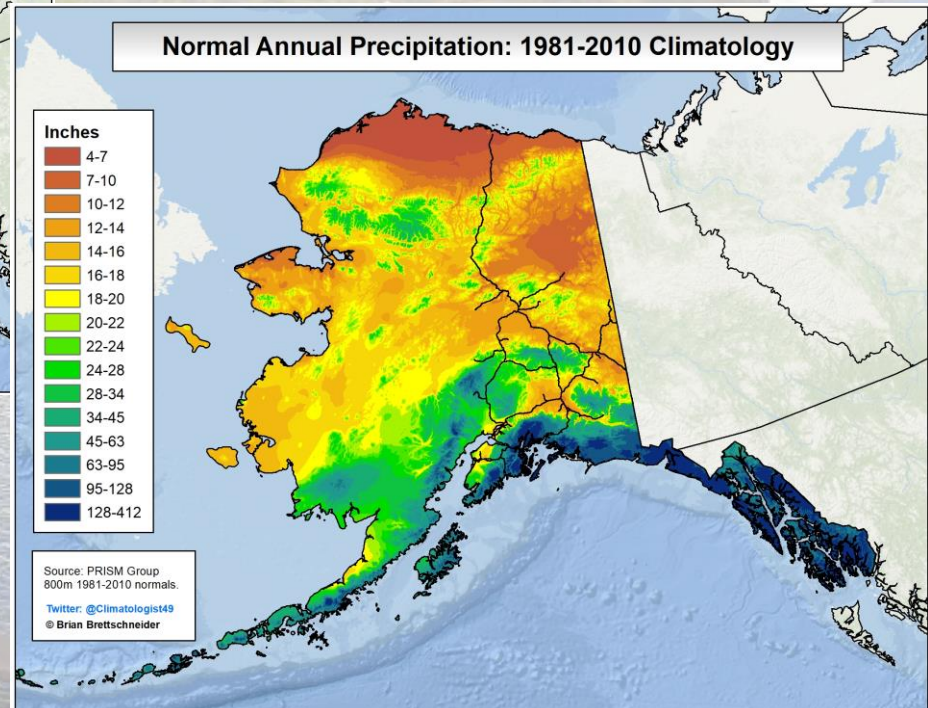
Weather

What is the Climate of Alaska Like Today?

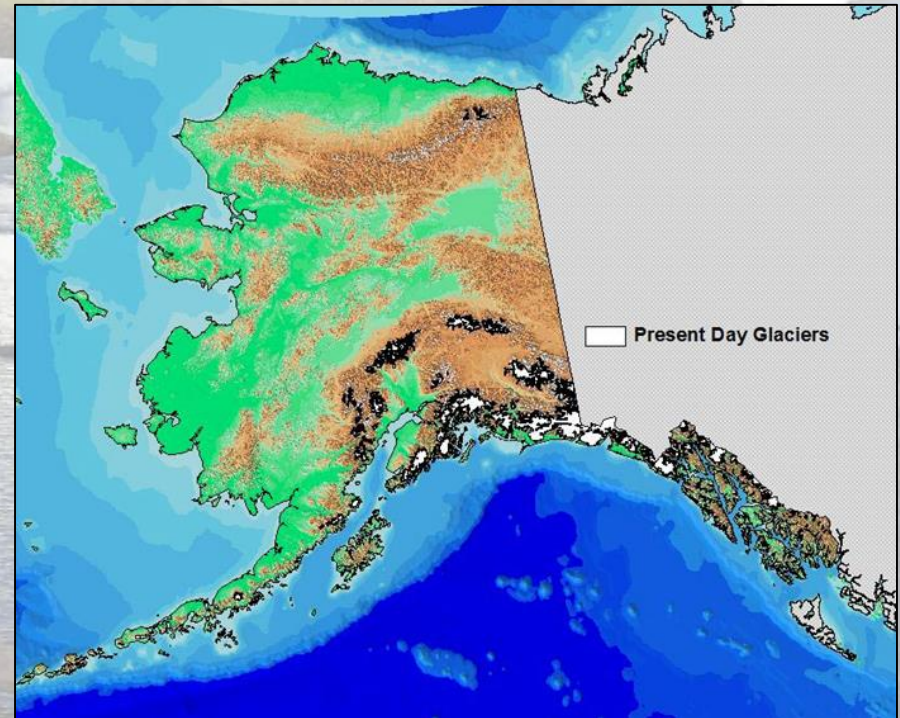
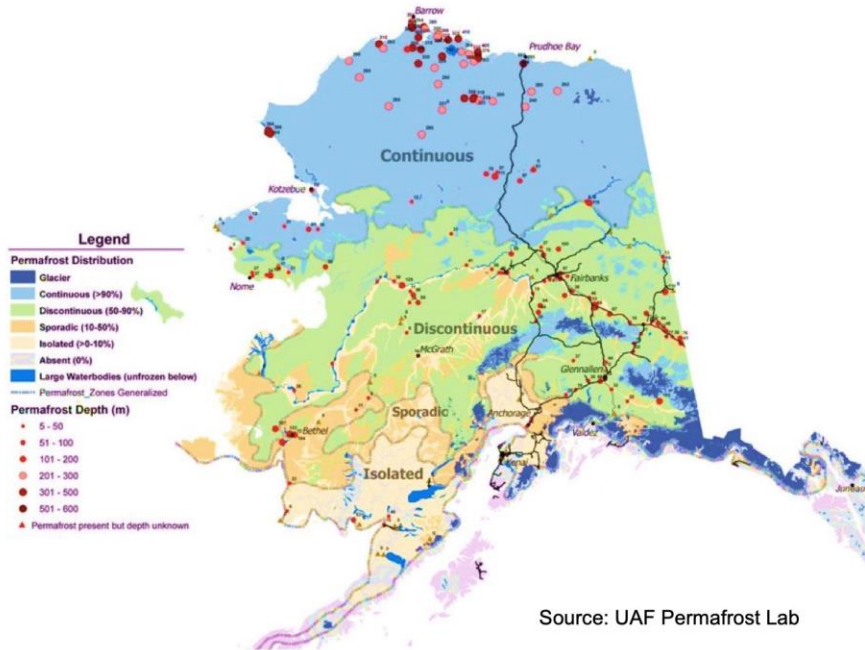
Annual Temperature



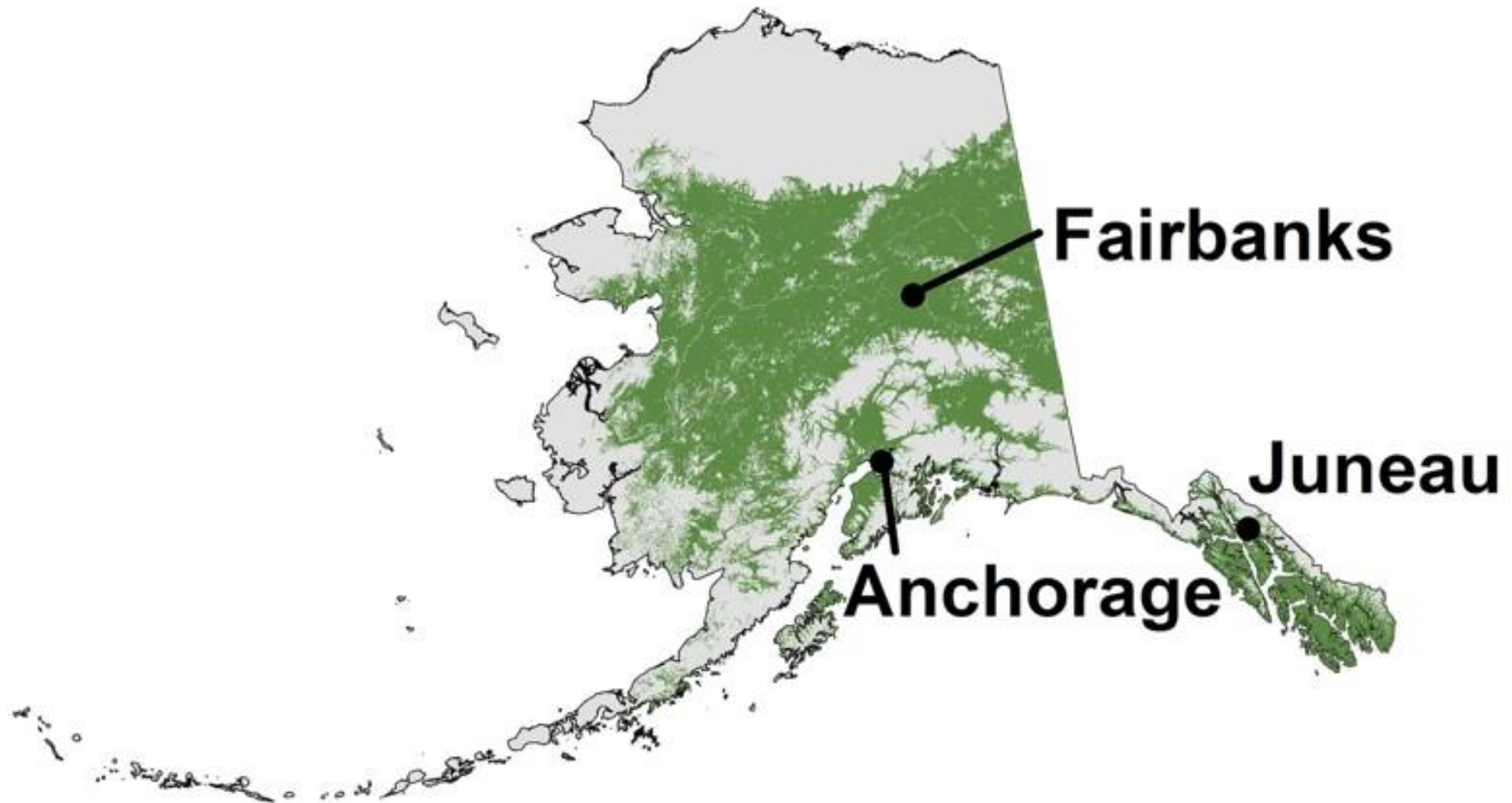
Annual Precipitation



Permafrost and Glaciers in Alaska



Forests of Alaska



Köppen Climate Classification for Alaska Using PRISM Data

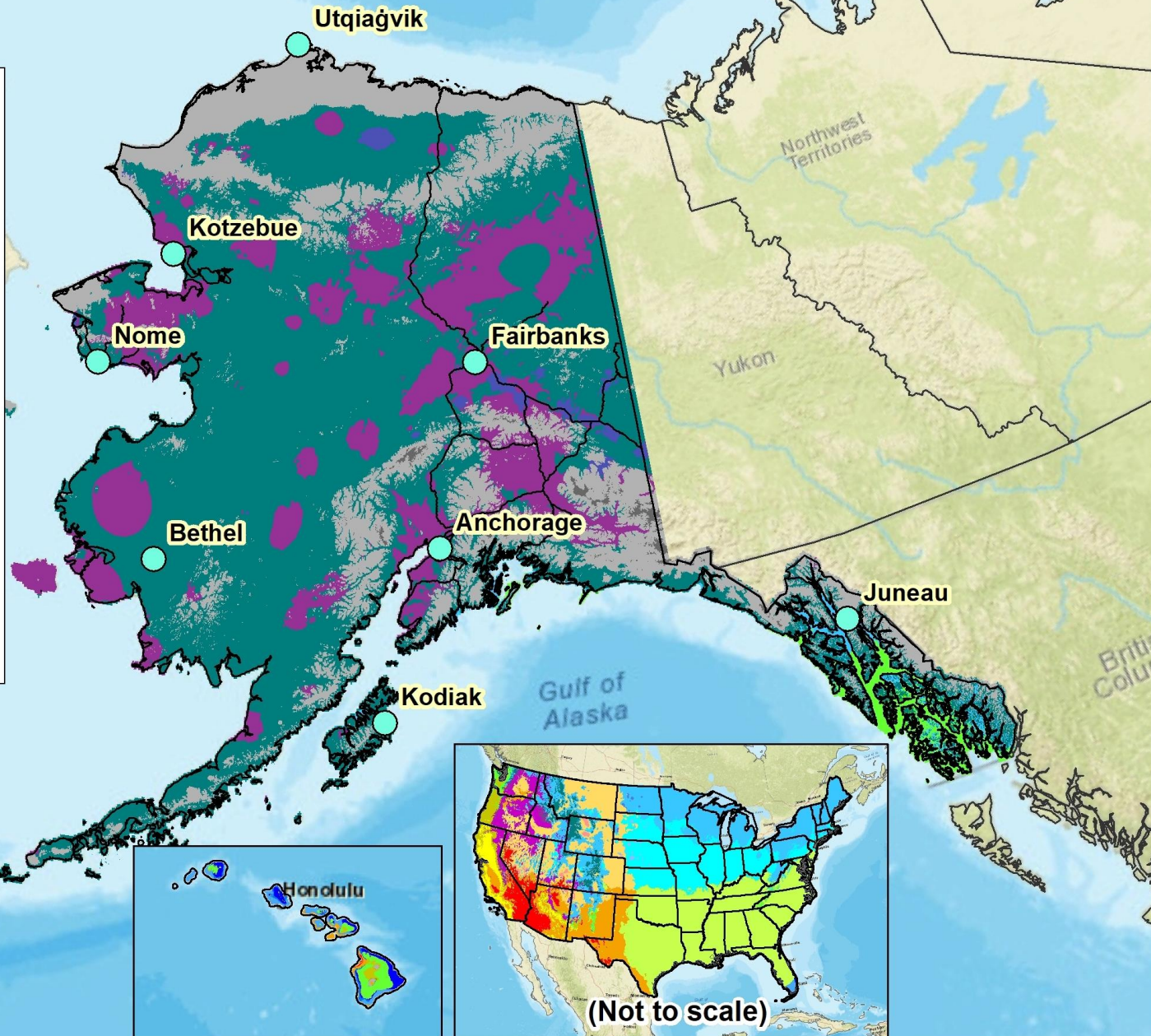
Description

- Cfb: Marine temperate (year round precipitation) [2.3%]
- Cfc: Marine subarctic (year round precipitation) [0.07%]
- Dfb: Continental warm summer (year round precipitation) [1.1%]
- Dfc: Continental subarctic (year round precipitation) [57.0%]
- Dsb: Continental warm summer (dry summer) [0.02%]
- Dsc: Continental subarctic (dry summer) [16.3%]
- Dwc: Continental subarctic (dry winter) [0.9%]
- EF: Ice Cap [0.5%]
- ET: Tundra [21.8%]

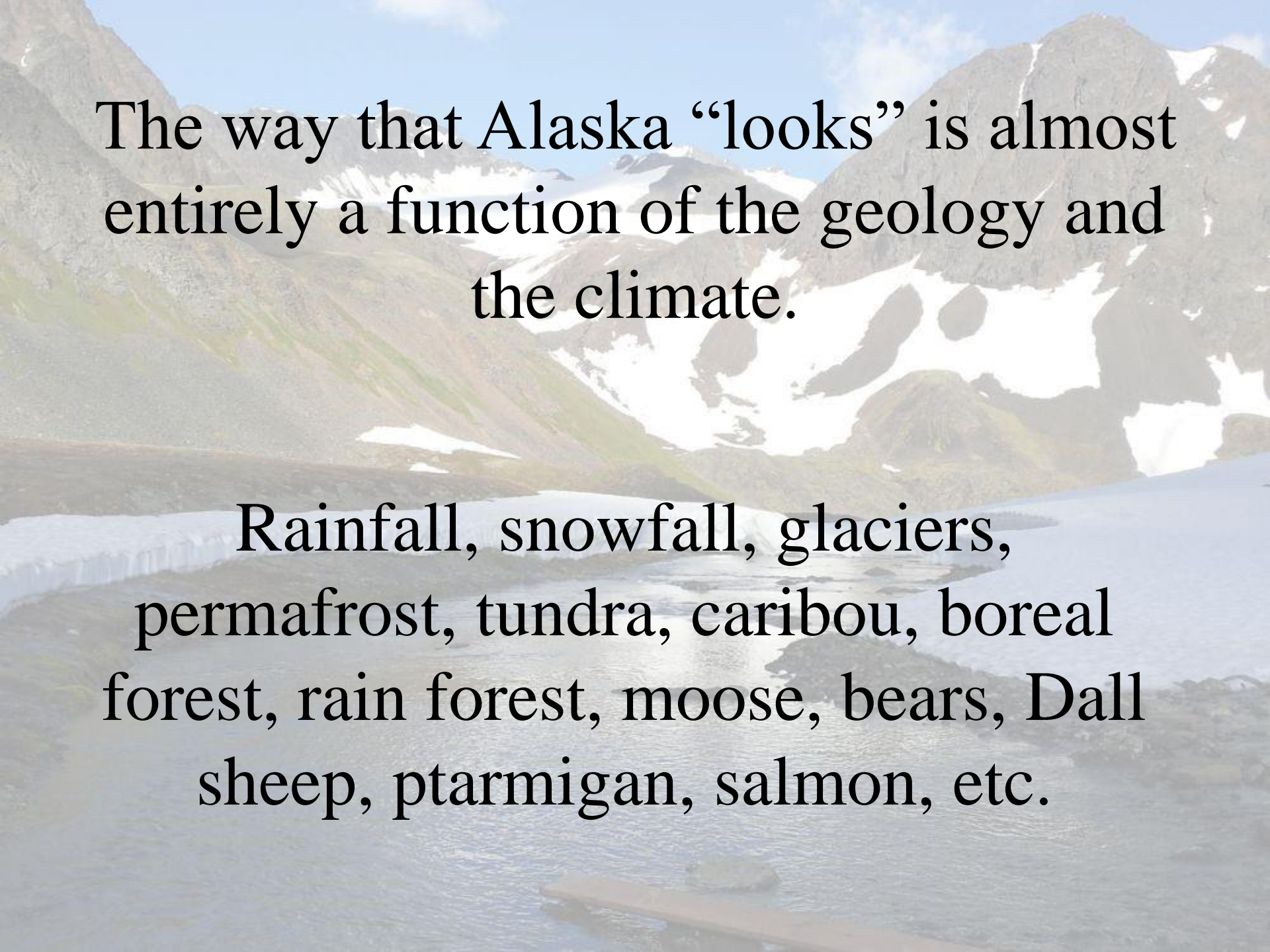
Source: PRISM Group
1981-2010 Normals

© Brian Brettschneider

© Brian Brettschneider
Twitter: @Climatologist49



(Not to scale)

A scenic view of a snow-capped mountain range with a body of water in the foreground. The mountains are rugged and covered in patches of snow and green vegetation. The water is calm and reflects the surrounding landscape.

The way that Alaska “looks” is almost entirely a function of the geology and the climate.

Rainfall, snowfall, glaciers, permafrost, tundra, caribou, boreal forest, rain forest, moose, bears, Dall sheep, ptarmigan, salmon, etc.

Climate Change Impacts in Alaska

The Climate Determines Where Moose & Caribou Are



They are already moving
in response to a changing
climate.

Climate Change Impacts in Alaska

The Climate Determines Where Salmon Are

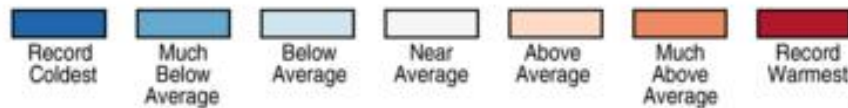
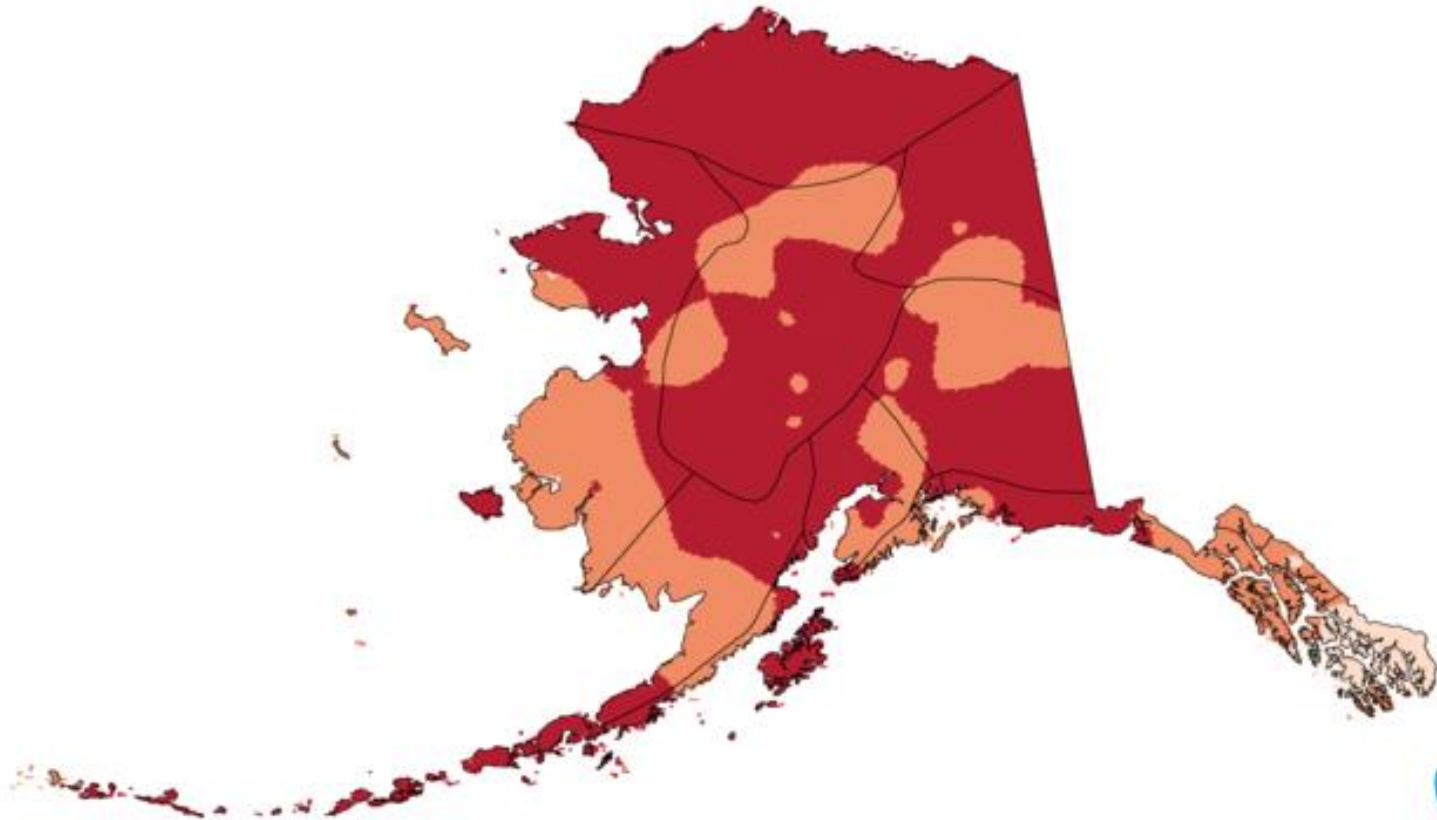


A scenic landscape photograph of a glacier flowing into a body of water, surrounded by snow-capped mountains under a blue sky. The text is overlaid on the center of the image.

Everything we love about Alaska as a place, is directly tied to the climate.

How Are We Doing?

Mean Temperature Percentiles
January–December 2019
Ranking Period: 1925–2019



National Centers for
Environmental
Information

Created: Mon Jan 06 2020

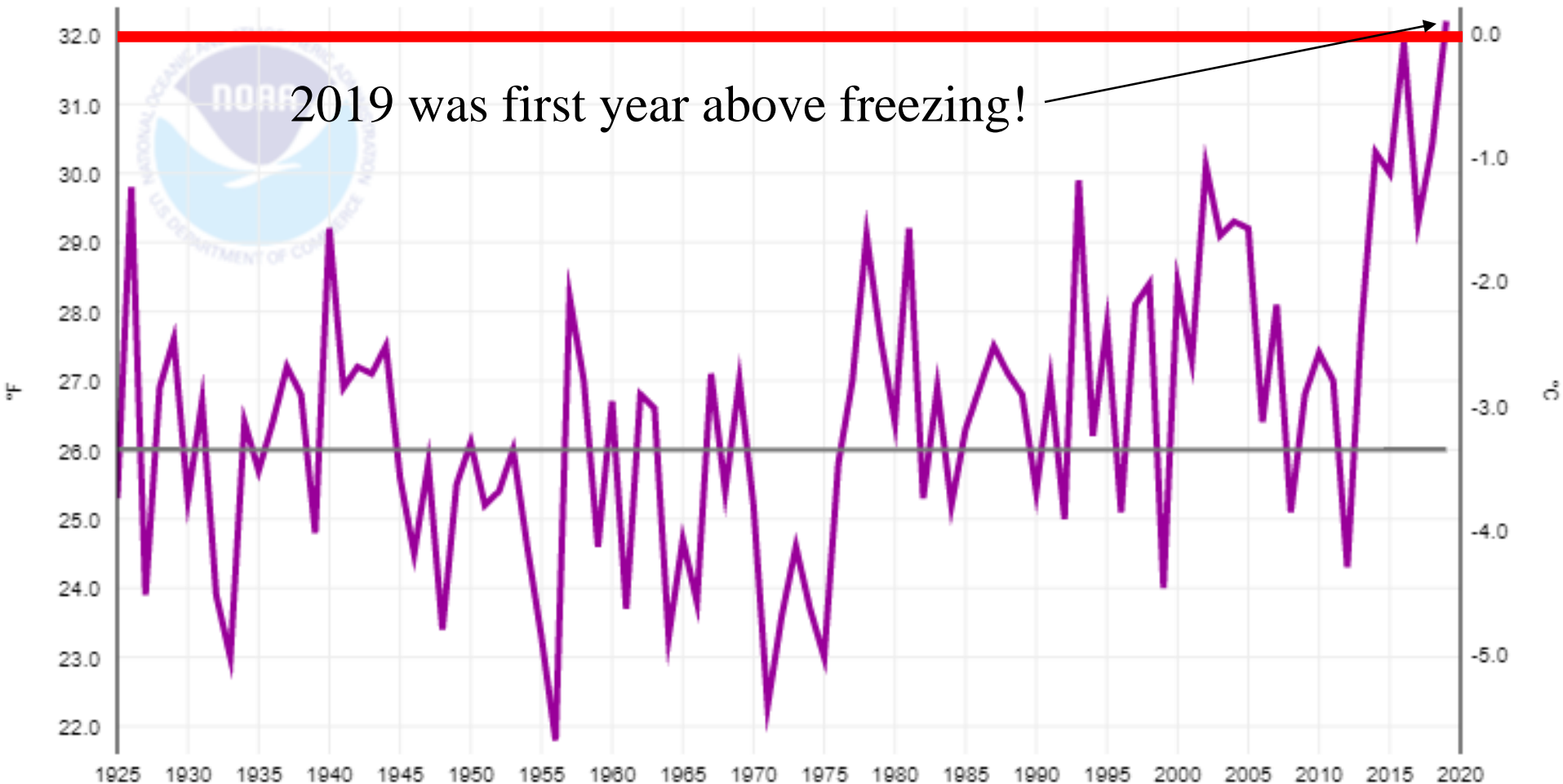
Data Source: 5km Gridded (nClimGrid)

How Are We Doing?

Alaska, Average Temperature, January-December

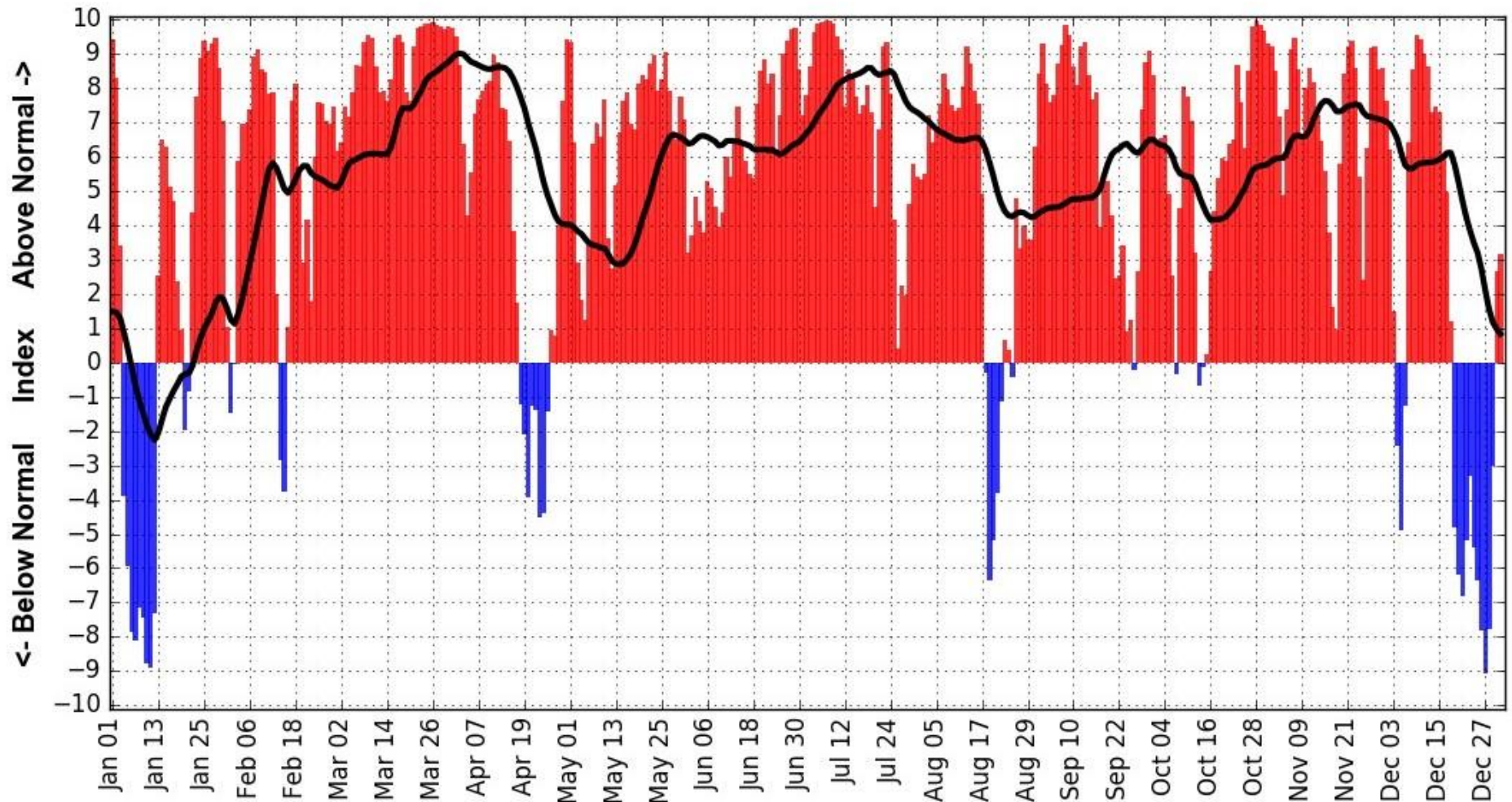
Avg Temperature

1925-2000 Mean: 26.0°F



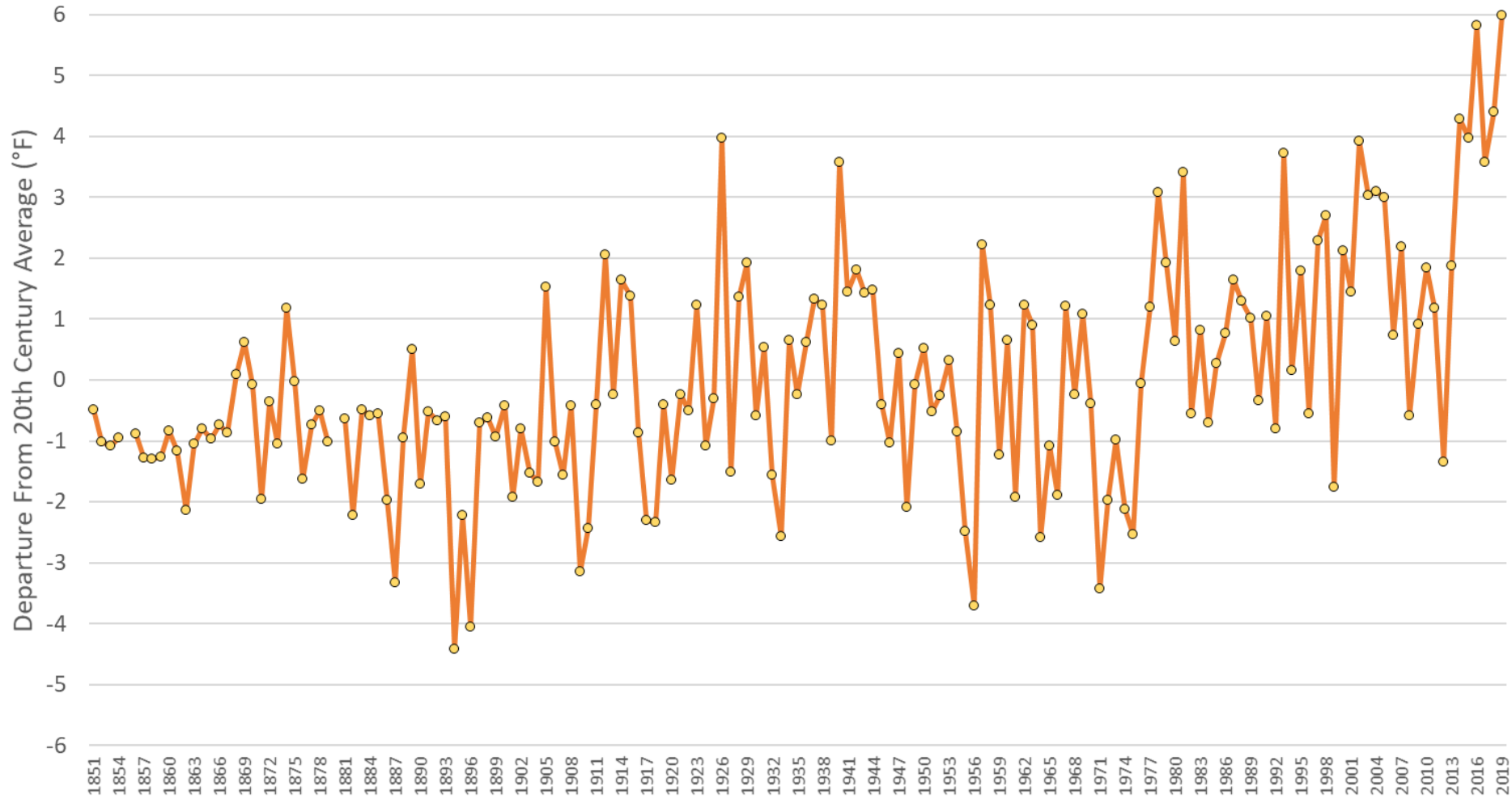
Alaska Statewide Temperature Index: 2019

Alaska Statewide Temperature Index: Jan 01, 2019, to Dec 31, 2019



How Are We Doing?

Alaska Statewide Temperature From Berkeley Earth Gridded Data: 1850-2019

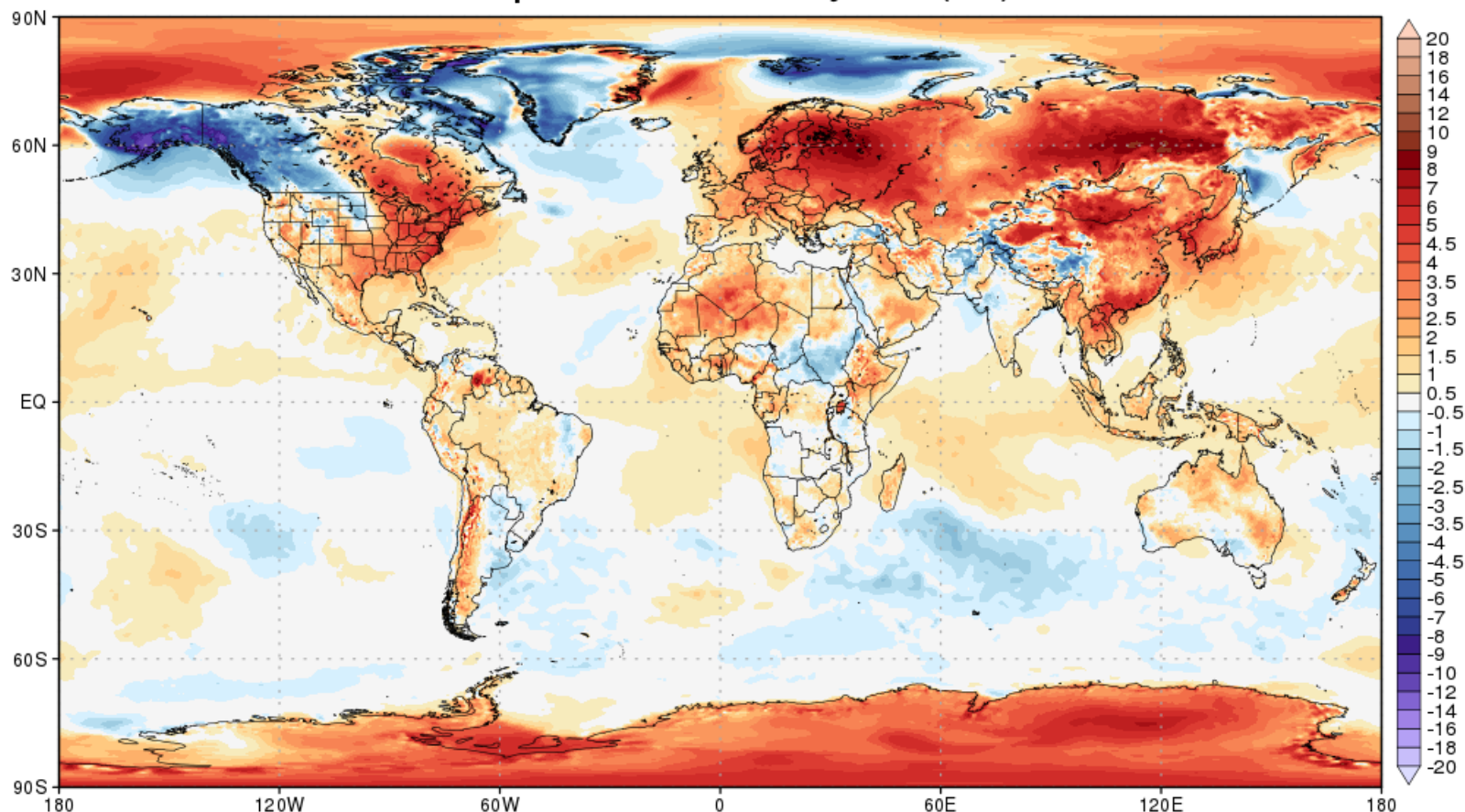


... but it's been cold this month.

NCEP GFS forecast vs CFSR reanalysis @0.5deg
Run: 23 Jan 2020 18z

30 day mixed mean
23 day hindcast and 7 day forecast

Temperature anomaly 2m (°C)



Anomaly global: 0.677K

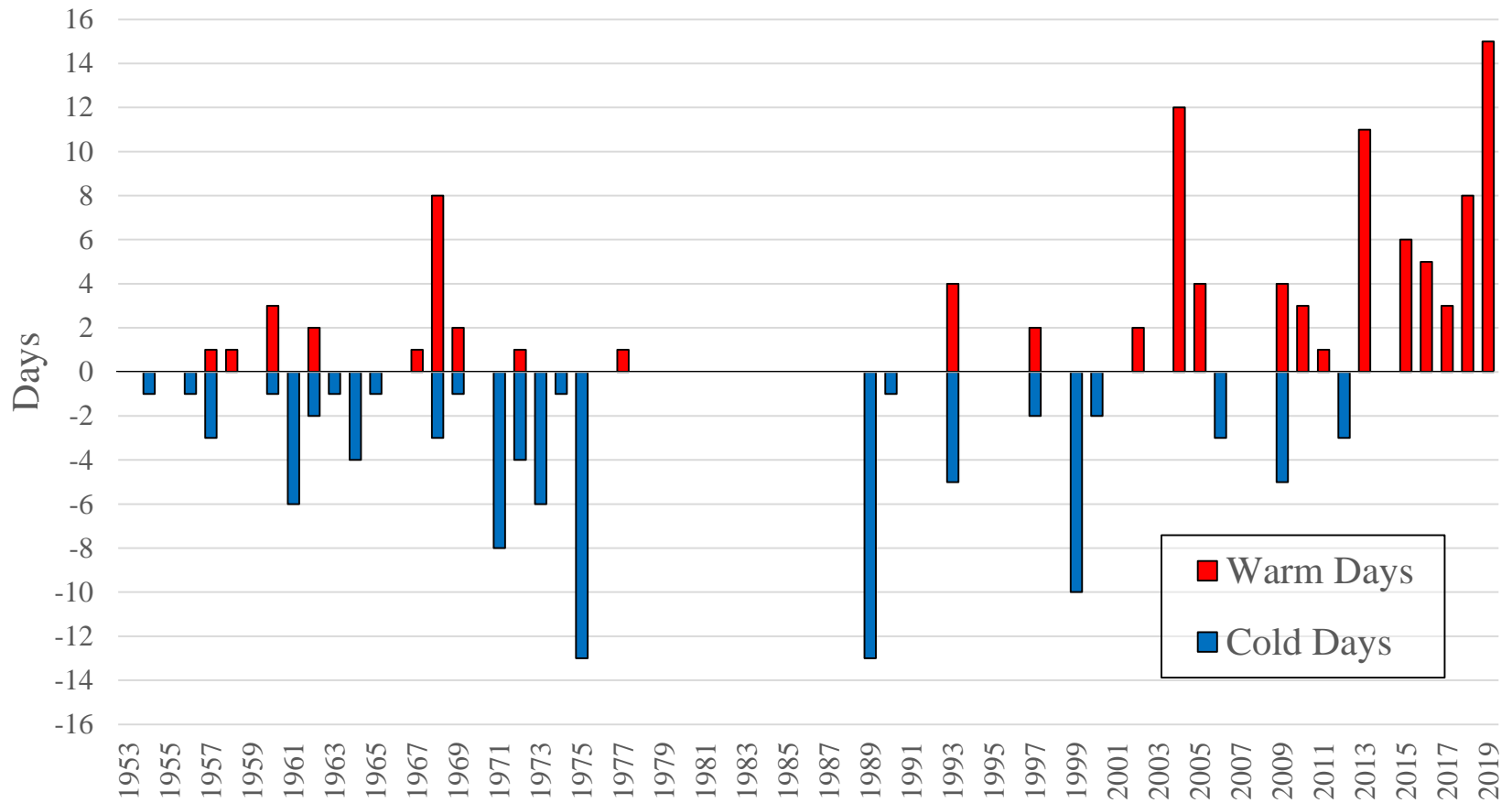
Arctic: 1.123K

Tropics: 0.563K

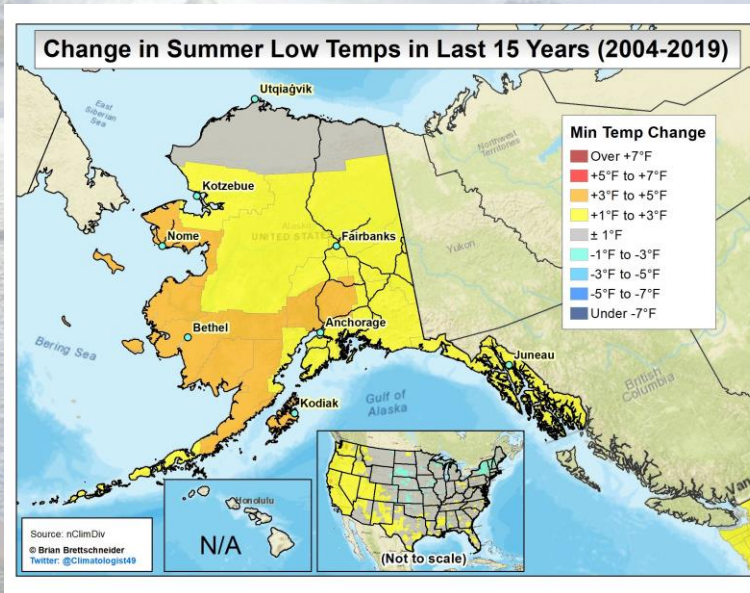
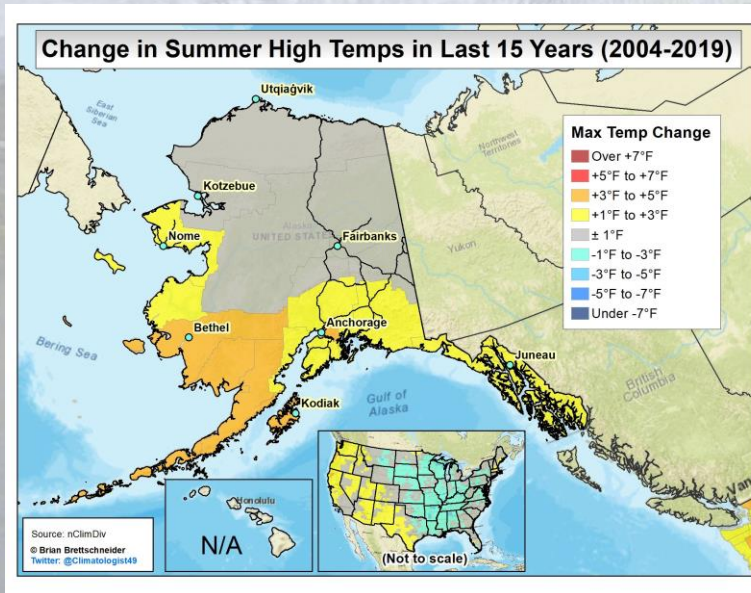
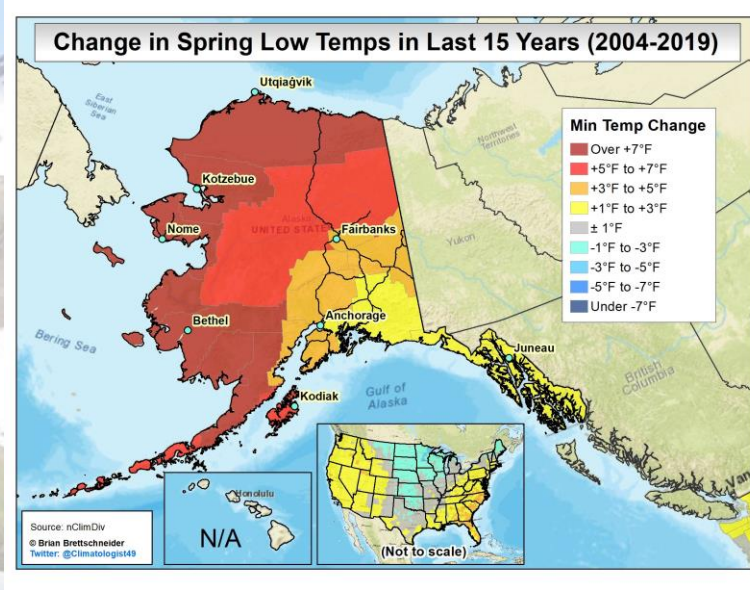
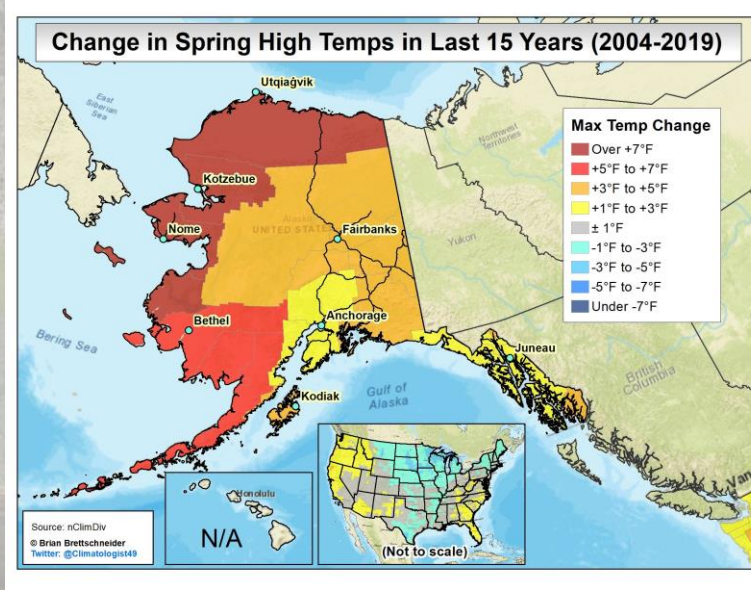
Antarctic: 1.421K

... but it's been cold this month.

**When Did The Top 100 Warmest and Coldest Days in Alaska
(1953-2020) Occur?**

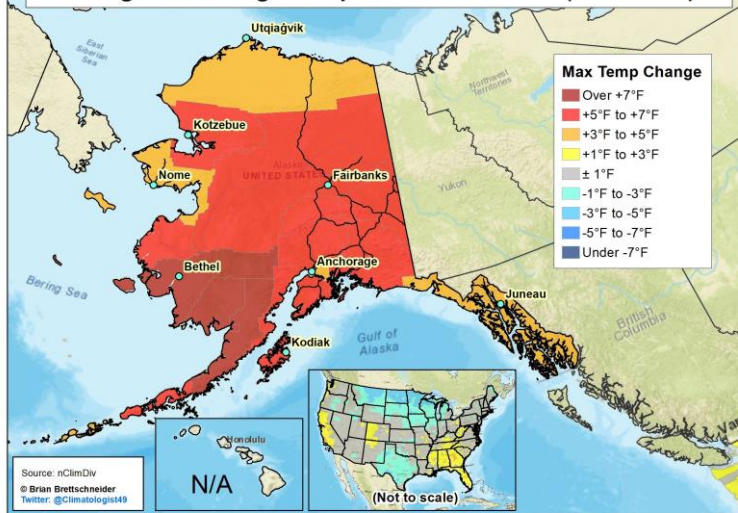


Recent Trends in Alaska: Spring-Summer

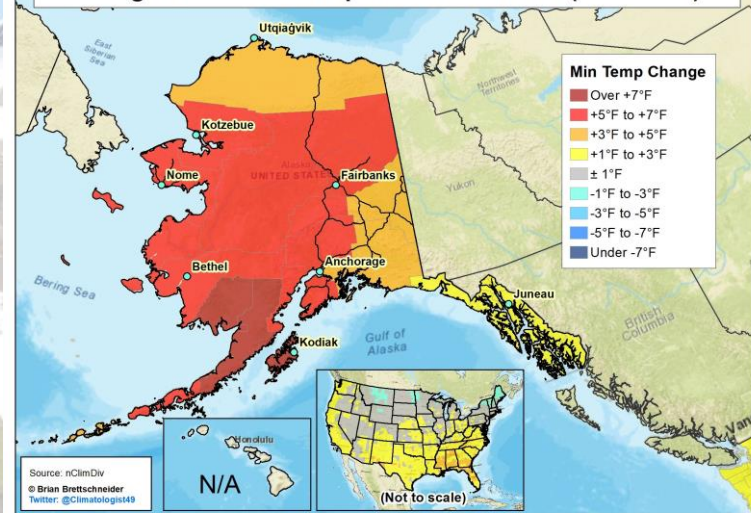


Recent Trends in Alaska: Fall-Winter

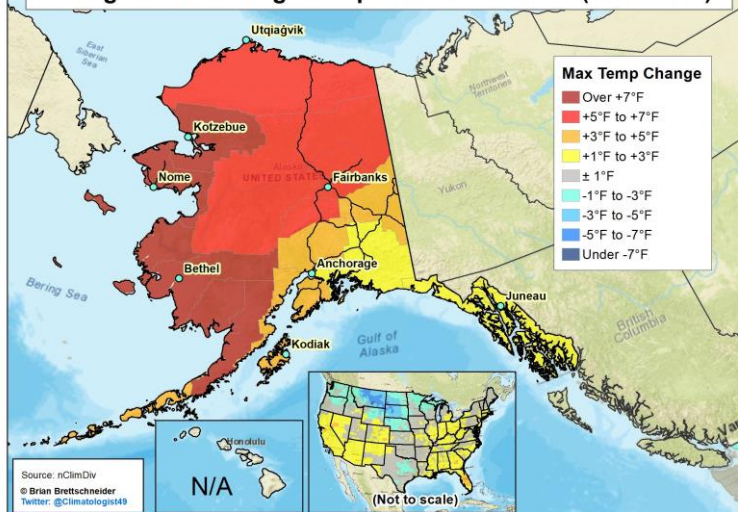
Change in Fall High Temps in Last 15 Years (2004-2019)



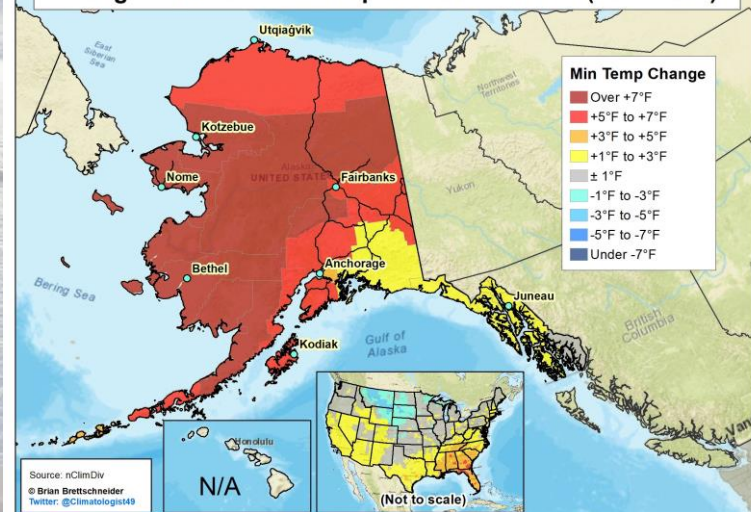
Change in Fall Low Temps in Last 15 Years (2004-2019)



Change in Winter High Temps in Last 15 Years (2004-2019)

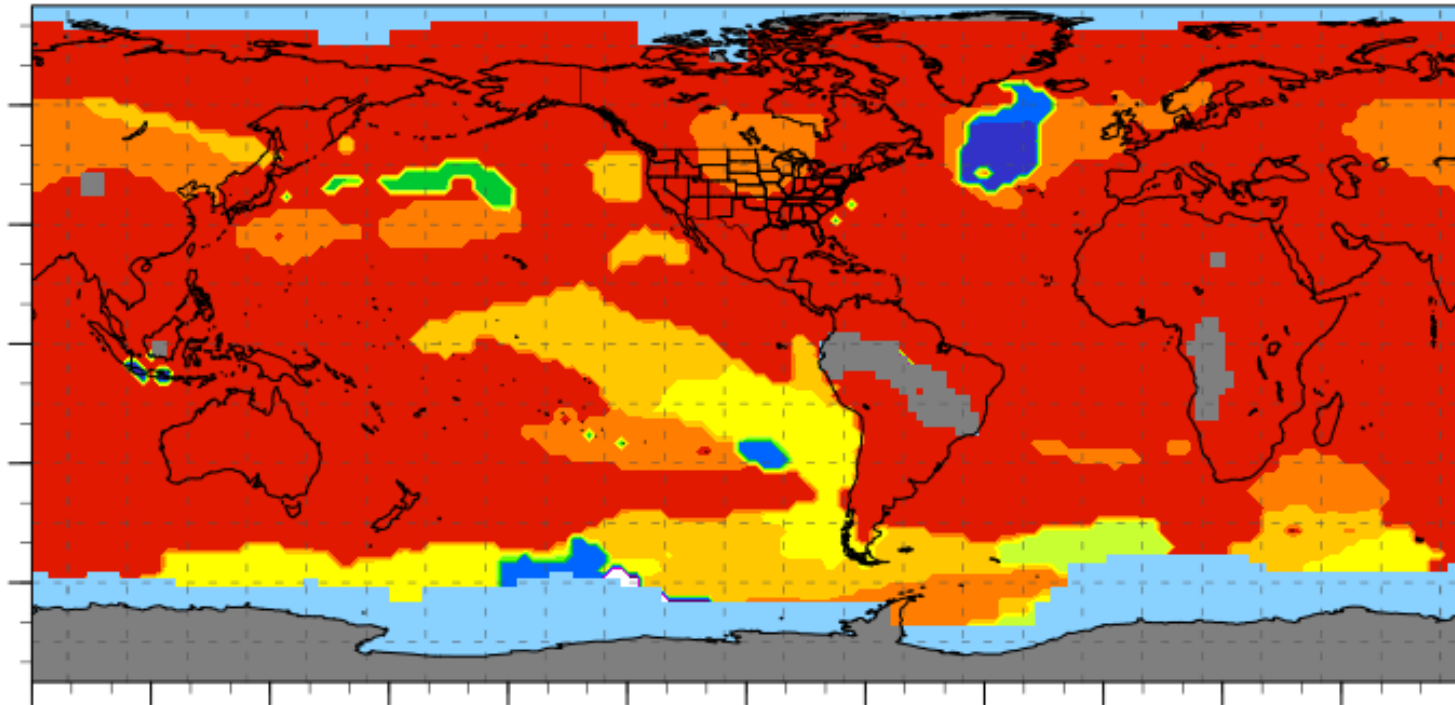


Change in Winter Low Temps in Last 15 Years (2004-2019)

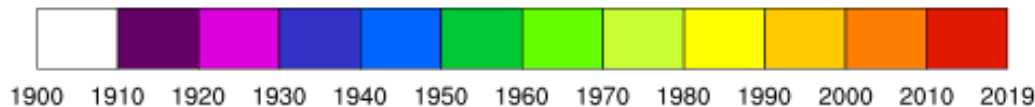


Warmest Decade Since 1900

NASA GISS Temp: January - December (Warmest Decade)



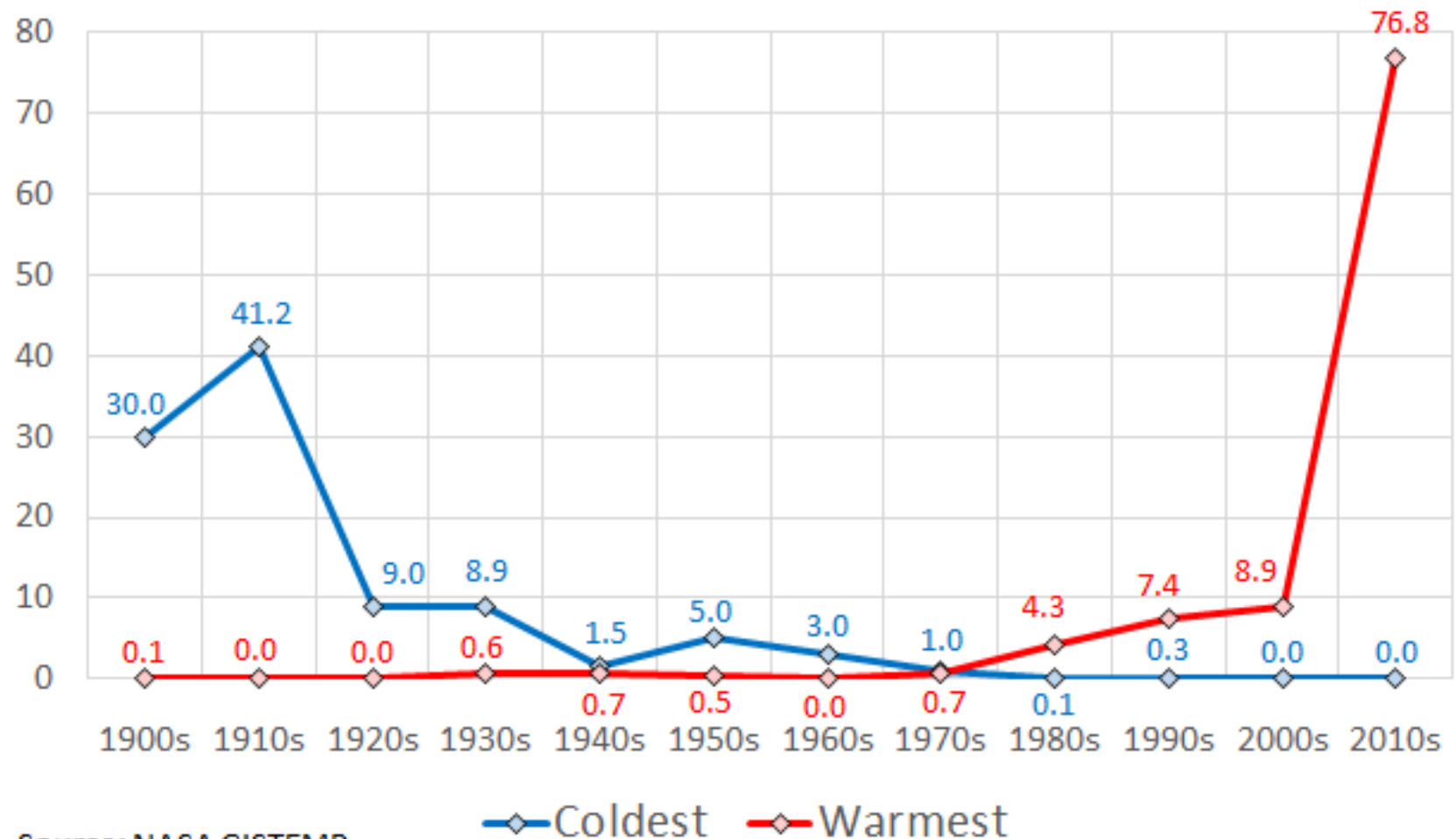
U. Alaska Fairbanks 2019 (Data Source: NASA).
Ranks are based on 120 years of data. [Since 1900]
Compared to all January - December periods.



Map Showing the Max January - December Time Period.
Percent With Max Value 2019 or later is: 76.8%.

How Are We Doing?

Percent of Earth With Warmest & Coldest Decade Since 1900



Source: NASA GISTEMP

A scenic landscape photograph of a mountain lake. In the foreground, a calm body of water reflects the sky and the surrounding mountains. A wooden plank or log lies partially submerged in the water. The middle ground shows a shoreline with patches of snow and dark rocks. In the background, steep, rugged mountains rise, their peaks and slopes covered in snow and patches of green vegetation. The sky is a clear, pale blue with a few wispy clouds.

The Science

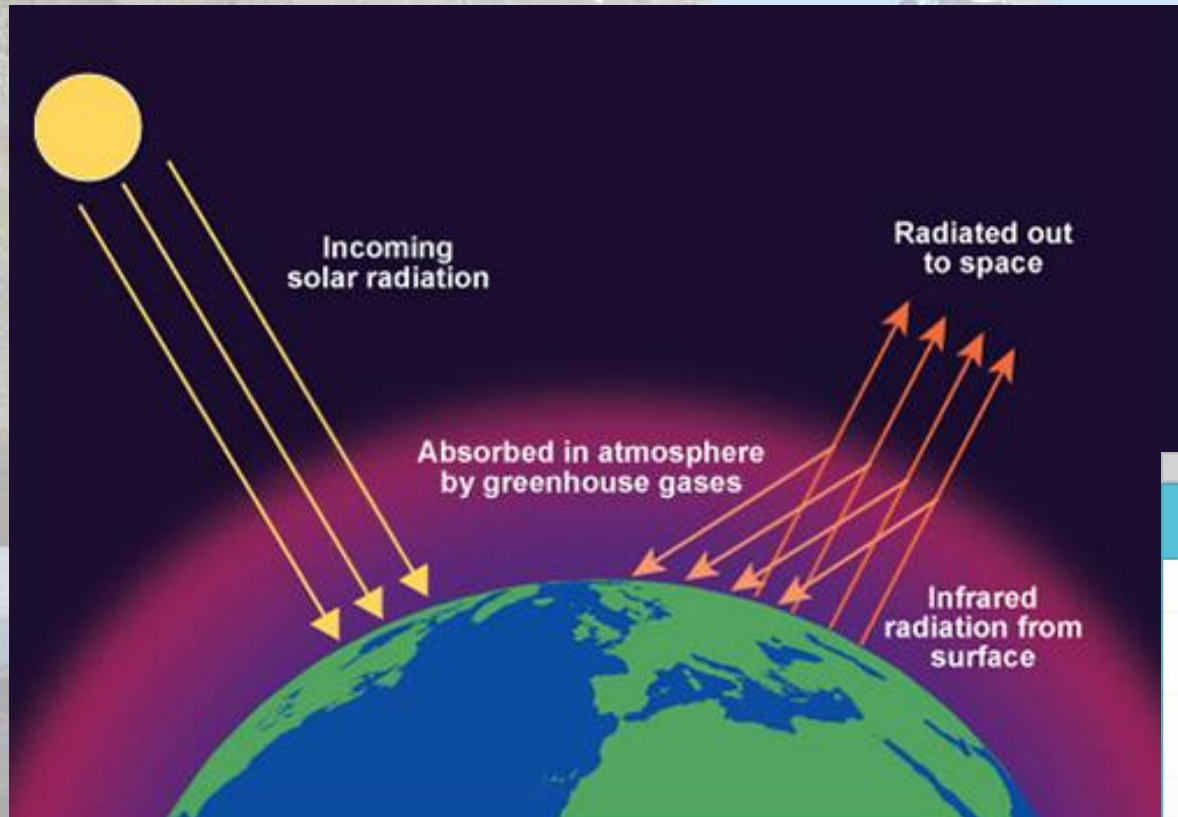
Pre-1900 History of Global Warming Science

Eunice Foote: American scientist discovered that CO_2 is a greenhouse gas that warms the Earth. Presented at a conference (by her husband) in 1856.

John Tyndall: Irish physicist published papers on the greenhouse effect starting in 1859.

Svante Arrhenius: Swedish chemist computed the amount of warming with a doubling of CO_2 ($4^\circ\text{-}5^\circ\text{C}$) in 1896.

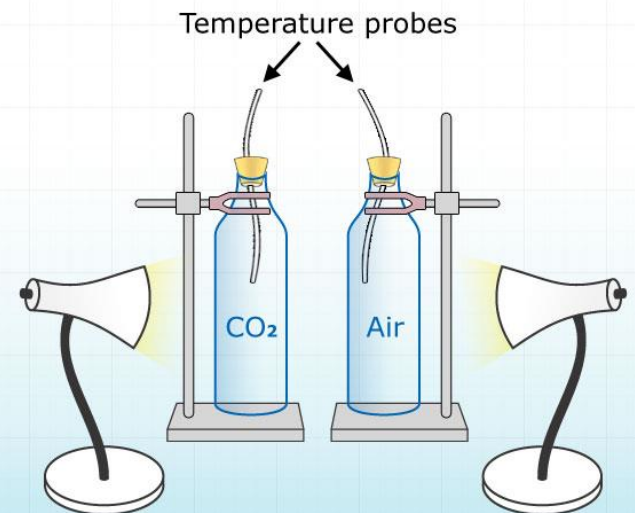
The Greenhouse Effect



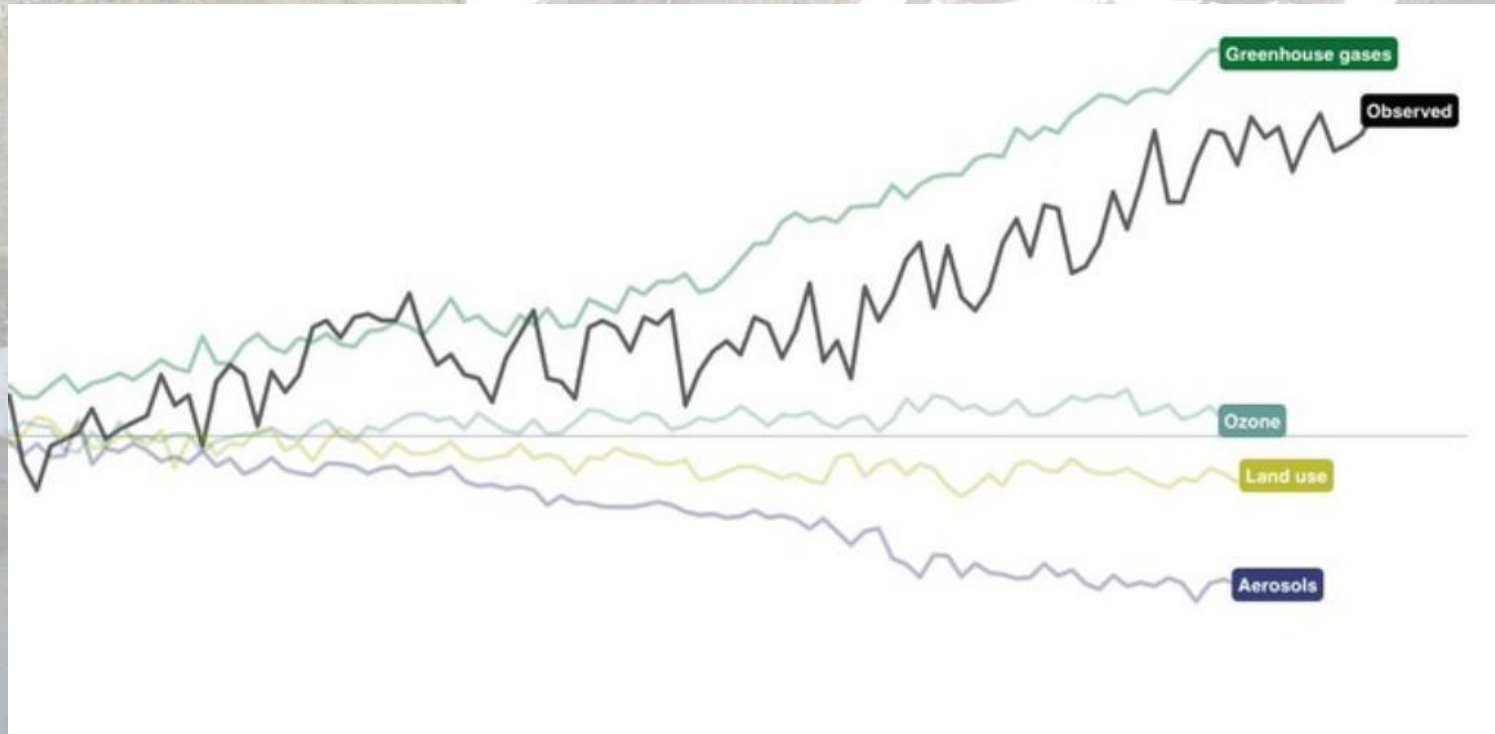
A Simple Science Experiment

Global Warming Practical

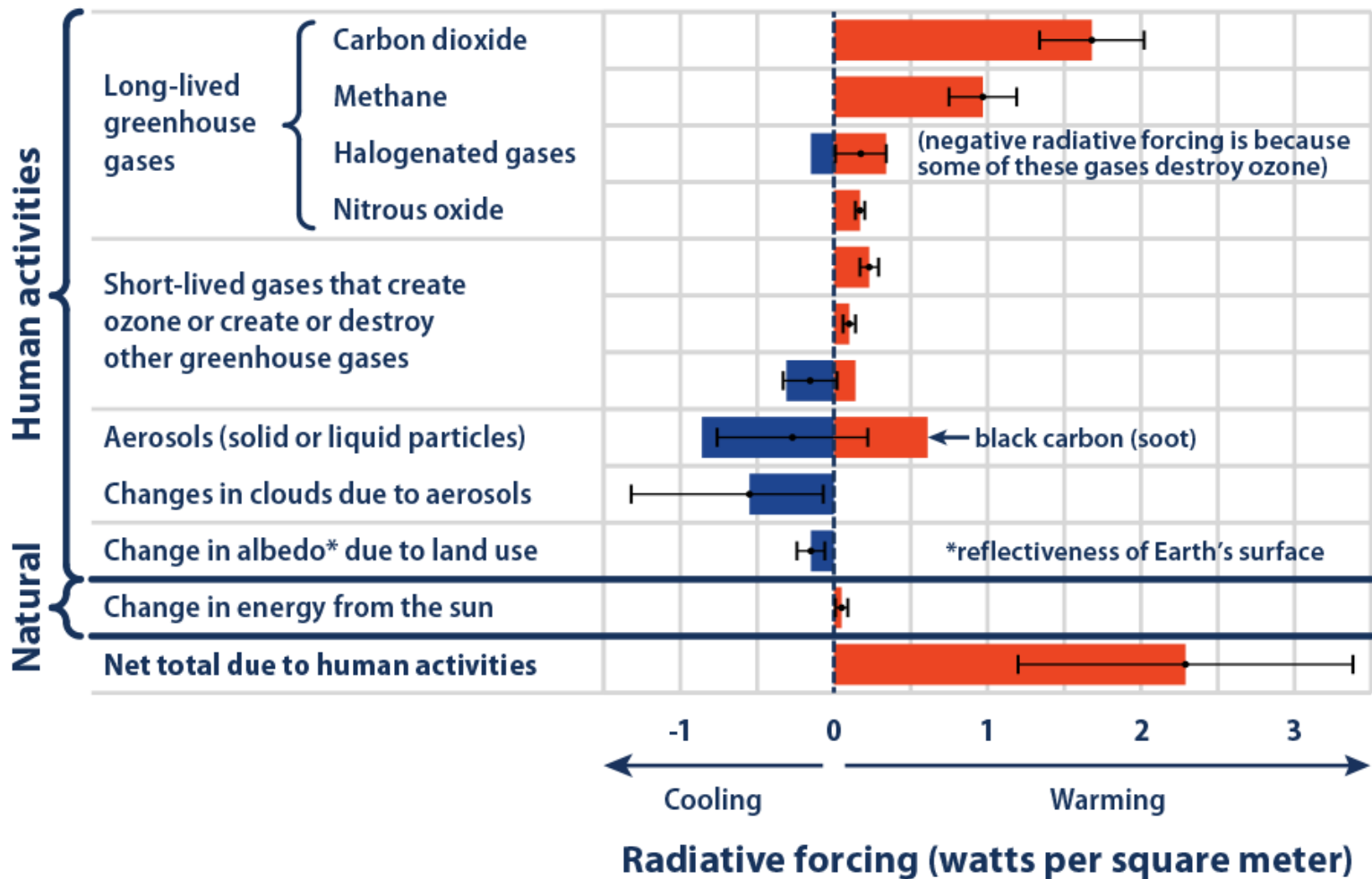
Global Warming



There are a lot of myths about what does and does not cause climate change.

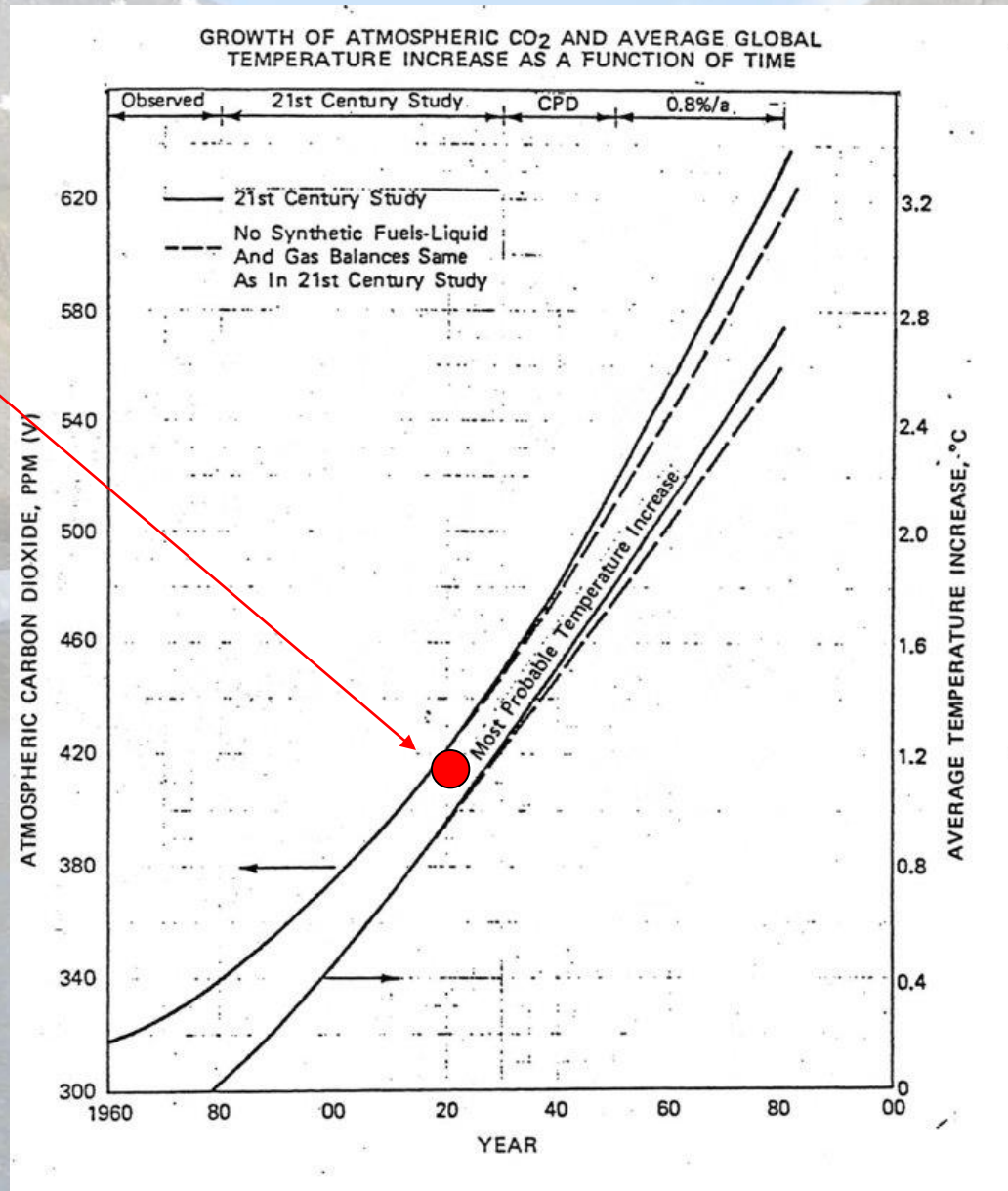


The Science is Simple



Exxon Internal Climate Projection: 1982

We are here

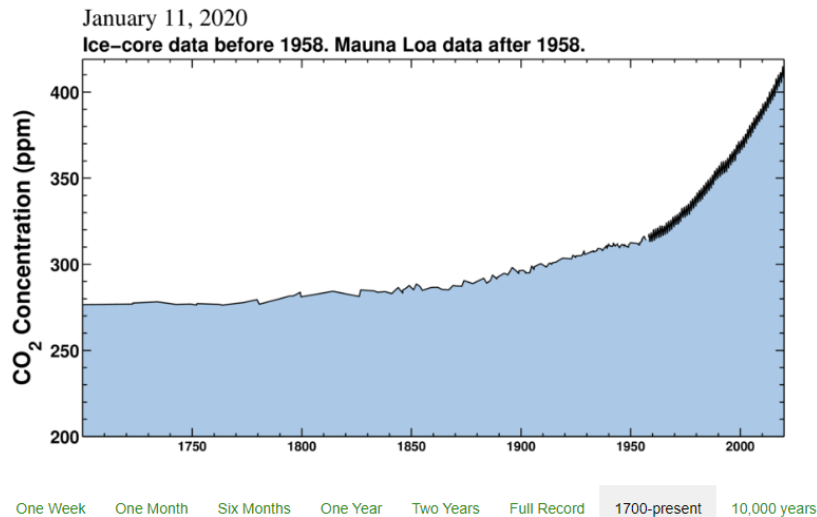


A scenic view of a mountain valley. In the foreground, a calm lake reflects the sky and the surrounding landscape. The middle ground shows a valley floor with patches of snow and green grass. In the background, steep, rocky mountains rise, their peaks and slopes partially covered in snow. The sky is a clear, pale blue with a few wispy clouds. The overall atmosphere is serene and majestic.

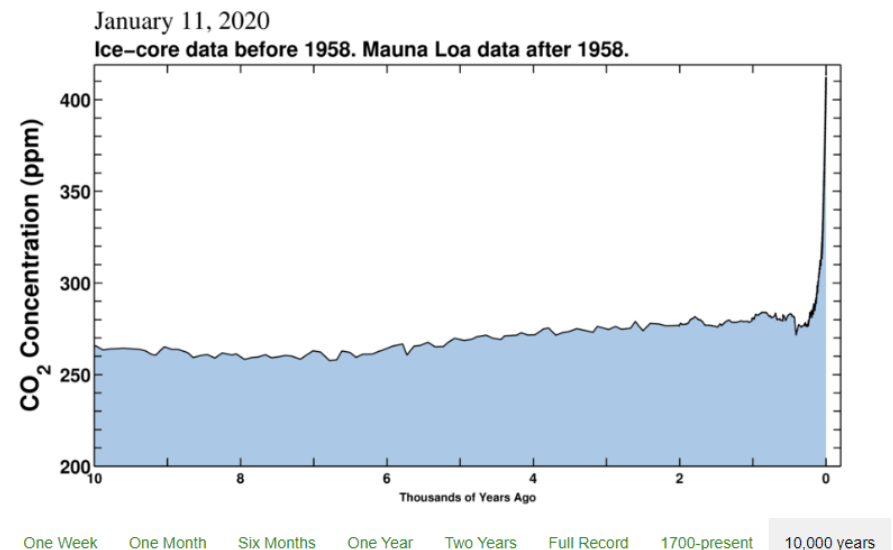
**It's all about the greenhouse gasses.
Everything else is noise.**

CO₂ Since 1700 & Last 10,000 Years

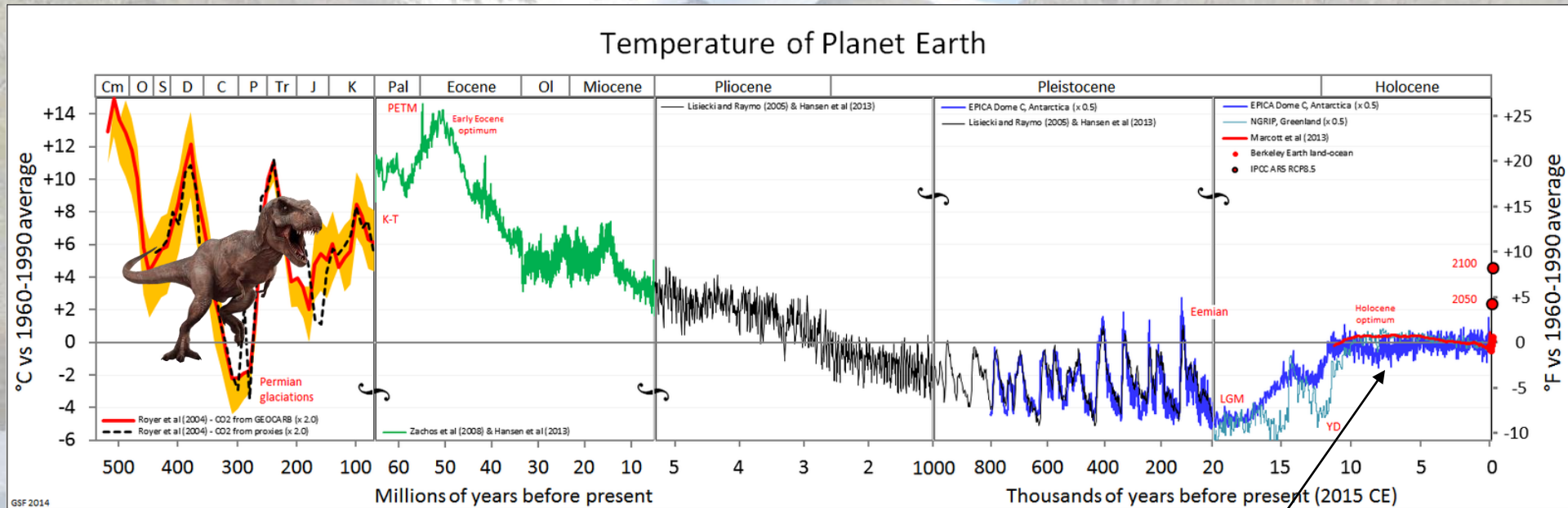
Latest CO₂ reading: 413.20 ppm



Latest CO₂ reading: 413.20 ppm



Long-Term Temperature Time Series



The entire history of human civilization has taken place within a very stable climate.

Major Scientific Organizations Speak With a Single Voice

American Association for the Advancement of Science

American Chemical Society

American Geophysical Union

American Institute of Biological Sciences

American Meteorological Society

American Public Health Association

American Society of Agronomy

American Society of Ichthyologists and Herpetologists

American Society of Naturalists

American Society of Plant Biologists

American Statistical Association

Association for the Sciences of Limnology and Oceanography

Association for Tropical Biology and Conservation

Association of Ecosystem Research Centers

BioQUEST Curriculum Consortium

Botanical Society of America

Consortium for Ocean Leadership

Crop Science Society of America

Ecological Society of America

Entomological Society of America

Geological Society of America

National Association of Marine Laboratories

Natural Science Collections Alliance

Organization of Biological Field Stations

Society for Industrial and Applied Mathematics

Society for Mathematical Biology

Society for the Study of Amphibians and Reptiles

Society of Nematologists

Society of Systematic Biologists

Soil Science Society of America

University Corporation for Atmospheric Research

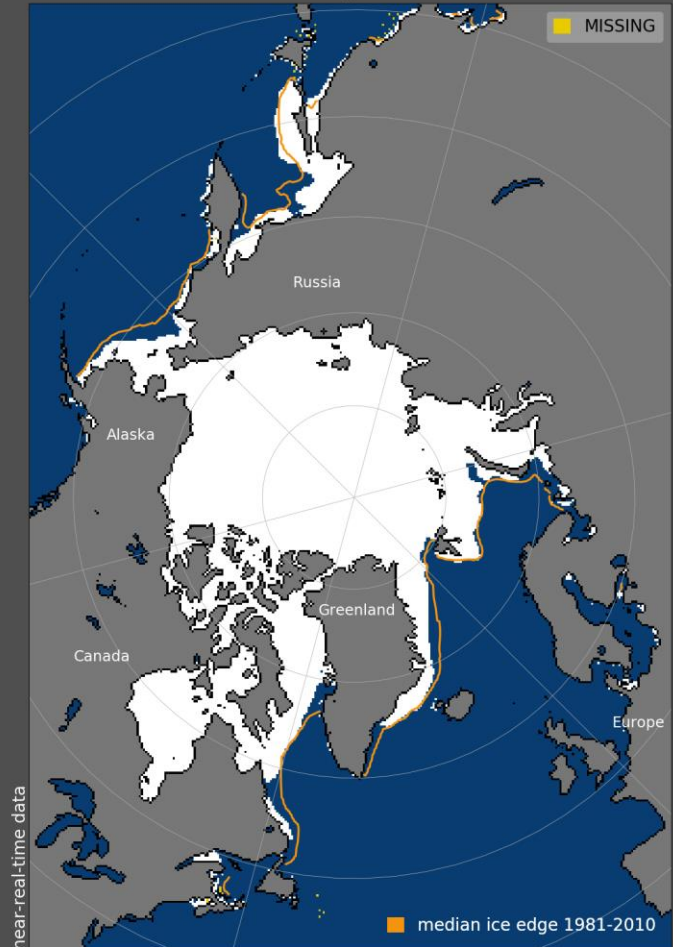
Outlier

American Association of Petroleum Geologists

Why is the Arctic warming so fast?

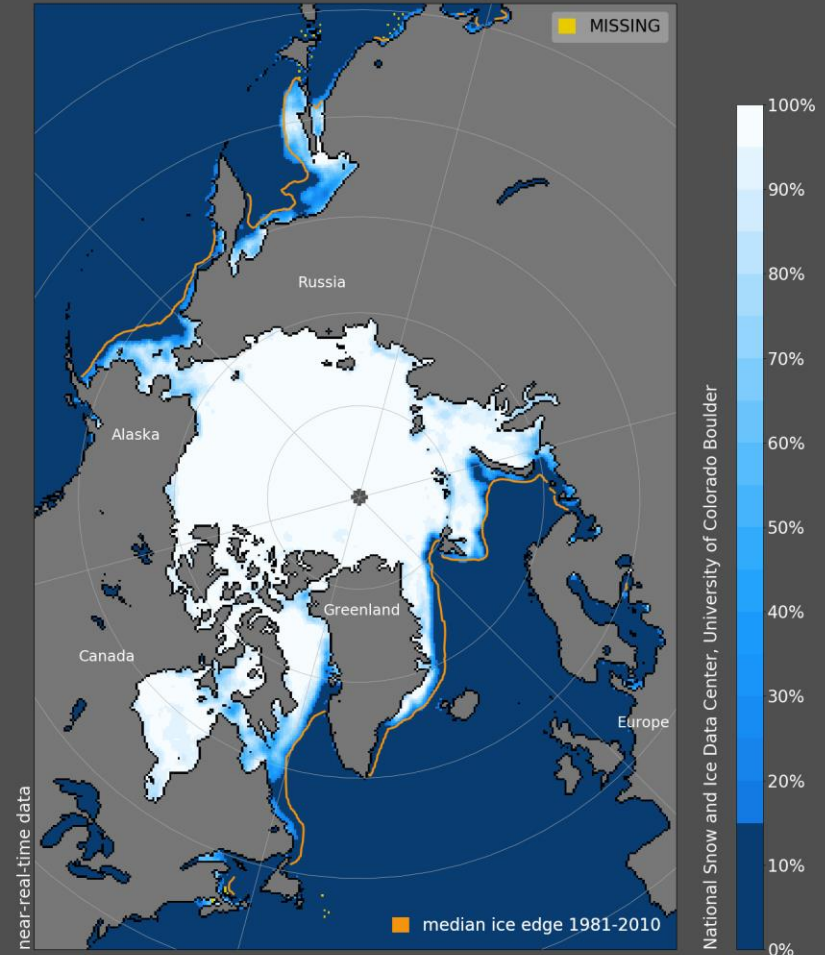
The Loss of Ice/Snow is Everything

Sea Ice Extent, 13 Jan 2020



National Snow and Ice Data Center, University of Colorado Boulder

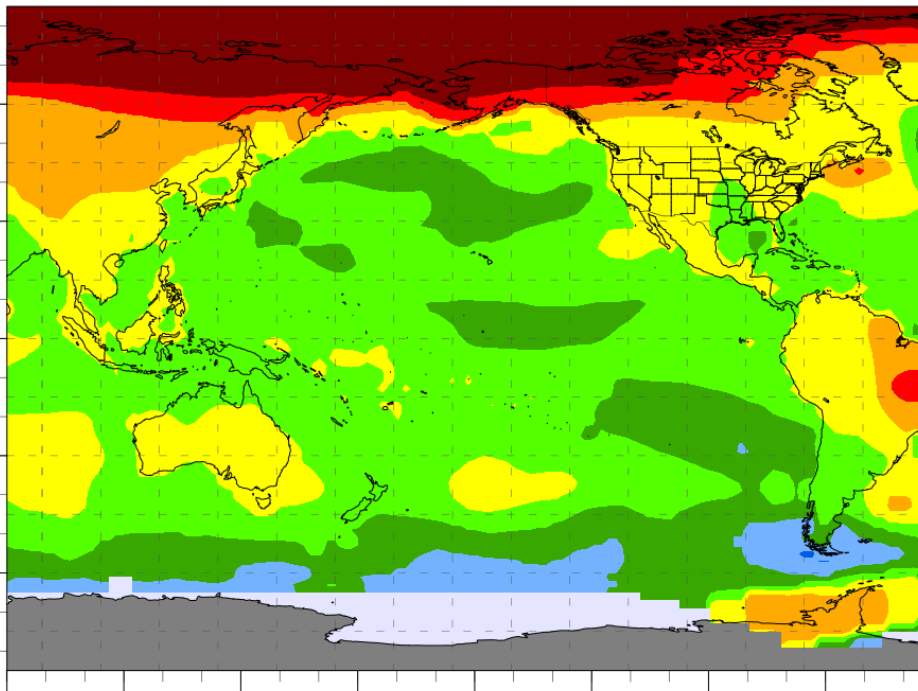
Sea Ice Concentration, 13 Jan 2020



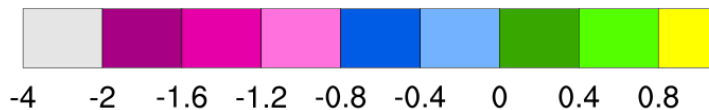
National Snow and Ice Data Center, University of Colorado Boulder

Arctic Amplification

NASA GISS Temp: Ave Depart from Normal (C) Jan 2010 - Dec 2019

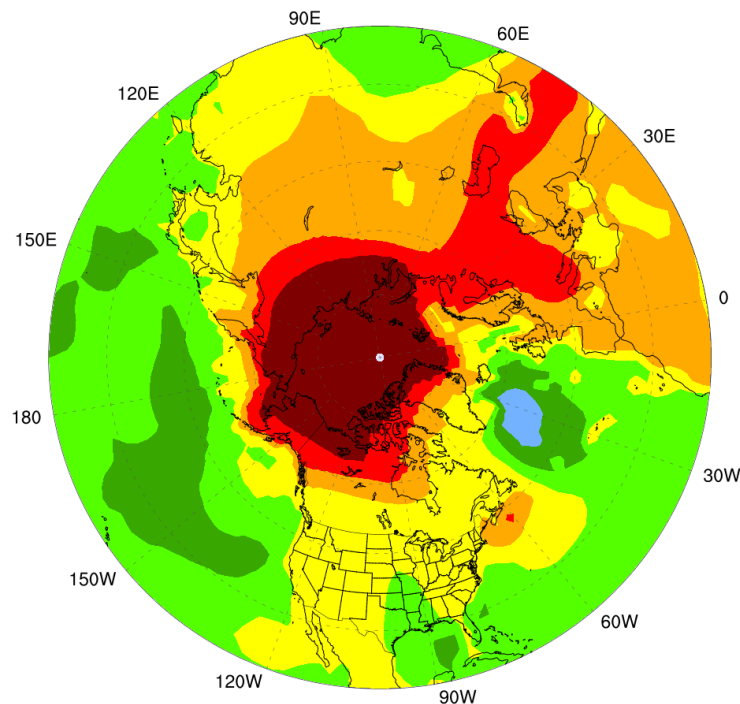


(c) U. of Alaska Fairbanks 2019 (Data Source: NASA).
Based on a total of 120 possible months
using the 1951-1980 climate normal period

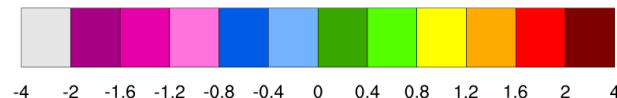


Analysis of all months between January 2010 and December 2019
Global Average is: 0.82 C

NASA GISS Temp: Ave Depart from Normal (C) Jan 2010 - Dec 2019



(c) U. of Alaska Fairbanks 2019 (Data Source: NASA).
Based on a total of 120 possible months
using the 1951-1980 climate normal period.



Analysis of all months between January 2010 and December 2019
Global Average is: 0.82 C

Tangible Effects of Changing Climate in Alaska

Thawing Permafrost

Coastal Erosion

Thinner Ice

Increased Wildfires

More Frequent Droughts

Fewer Snow Days

More Ice-on-Snow Events

Receding Glaciers

Ocean Acidification

Methane Releases

Damage to Property

Safety Hazard for Travel

Public Health Issues

Water Shortages / Wildfire

Loss of Recreation

Safety Concern

Loss of Tourism \$\$\$

Impacts to Commercial Fishing

All of this is bad for cultural identity and subsistence.

Climate Change Impacts in Alaska

Science

Massive die-off of Pacific seabirds linked to a warm-water 'blob'

✎ Author: [Morgan Krakow](#) ⓘ Updated: 23 hours ago 📅 Published 1 day ago



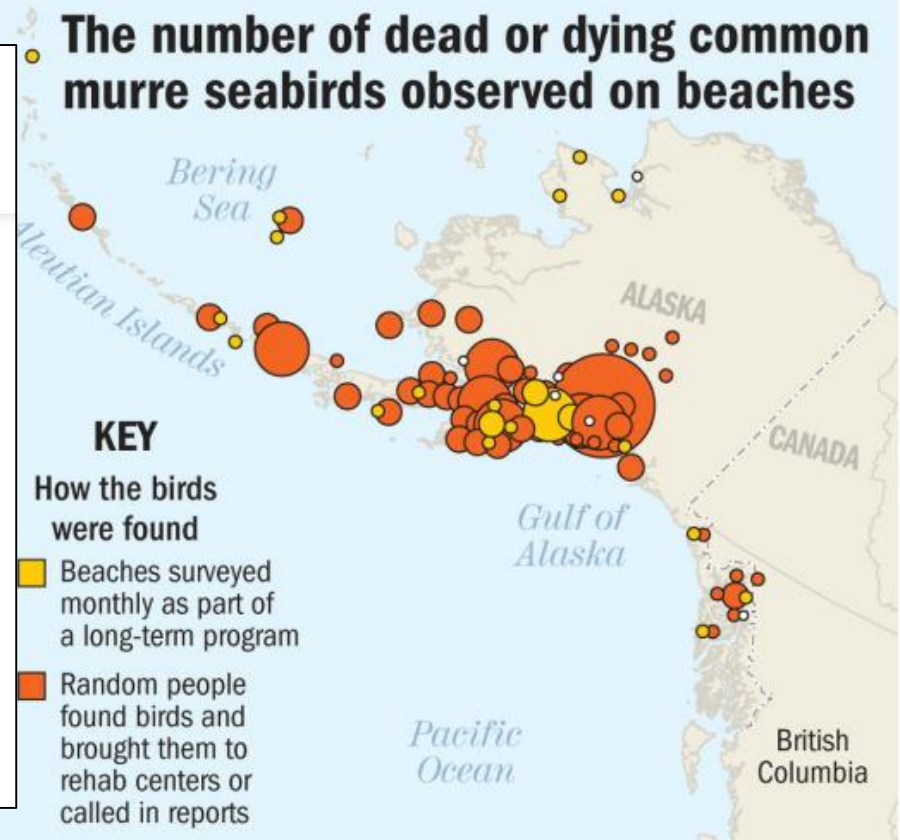
TELEVISION ▾ RADIO ▾ NEWS ▾ EDUCATION ▾ SUPPORT ▾ ABOUT US ▾ [CONTRIBUTE](#)

Record summer heat that killed Kuskokwim salmon wiped out at least 100,000 fish in Bristol Bay, scientists say

By Isabelle Ross, Alaska's Energy Desk - Dillingham - January 15, 2020



The number of dead or dying common murre seabirds observed on beaches



Climate Change Impacts in Alaska

Increased Fire Danger With More Thunderstorms
Significant Impact to Tourism

Alaska News

Fighting Alaska's wildfires cost over \$300 million this year

✍ Author: James Brooks ⓘ Updated: December 7, 2019 📅 Published December 7, 2019



Climate Change Impacts in Alaska

11 KTVA

VOTE NOW

NEWS

WEATHER

ONLY ON 11

CRIME

POLITICS

LIVESTREAM

CONTACT US

Troopers investigating deaths of 3 snowmachiners near Noatak

Monday, April 15th 2019, 3:21 PM AKDT

Updated: Monday, April 15th 2019, 4:24 PM AKDT

By: [Angela Krenzien](#)



Alaska State Troopers and Alaska Wildlife Troopers are investigating an incident that left three snowmachiners, including an 11-year-old child, dead near Noatak early Monday morning.

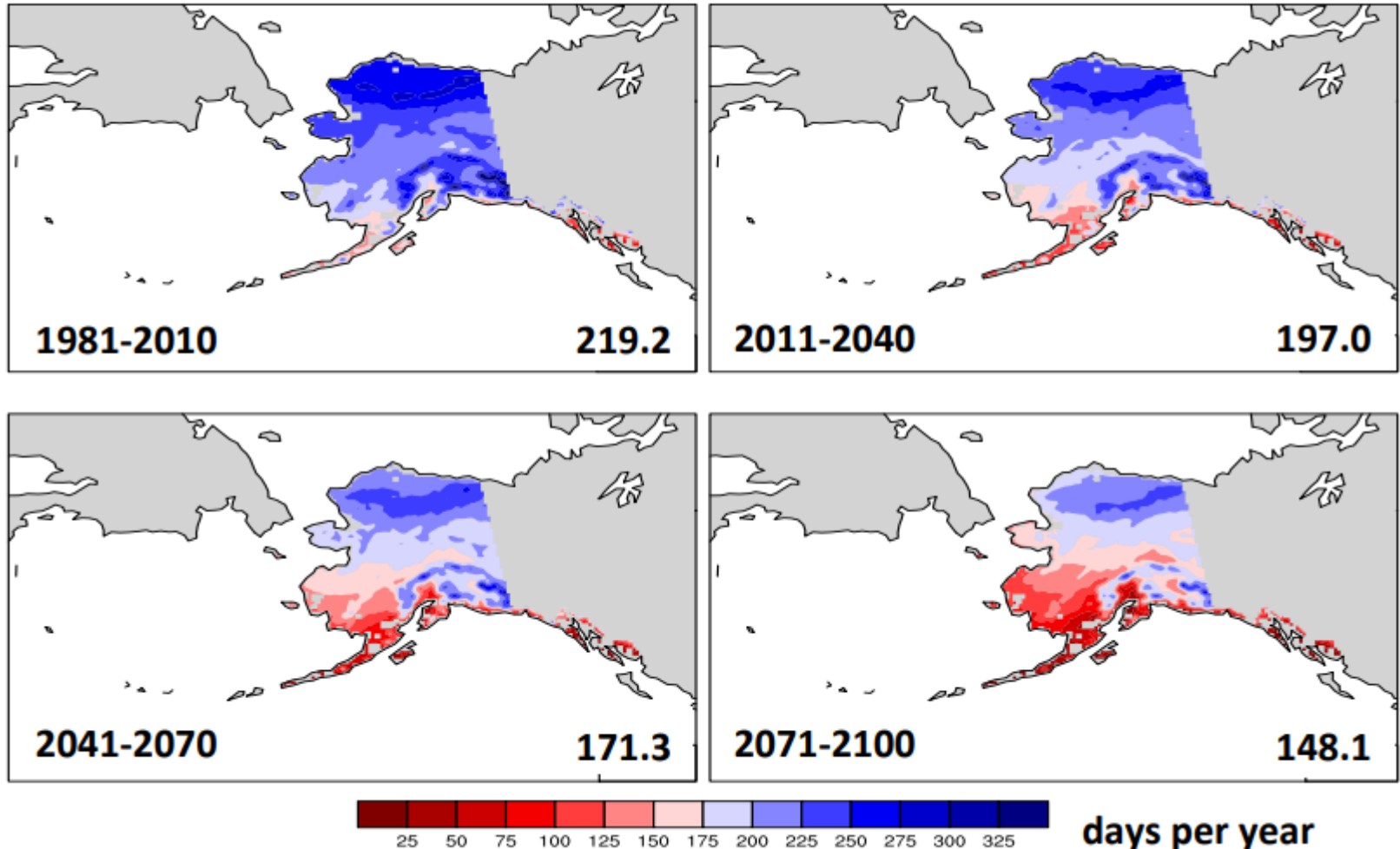
A scenic landscape photograph of a mountain range. In the foreground, a calm body of water reflects the sky and the surrounding terrain. A small wooden dock or pier extends into the water from the bottom center. The middle ground features steep, rocky slopes with patches of snow and some green vegetation. In the background, more rugged mountain peaks are visible, some with significant snow cover. The sky is a clear, pale blue with a few wispy clouds. The overall tone is serene and majestic.

The Future of Alaska

Climate Change Impacts in Alaska

Some Thoughts on Future Temperatures (Freezing Days)

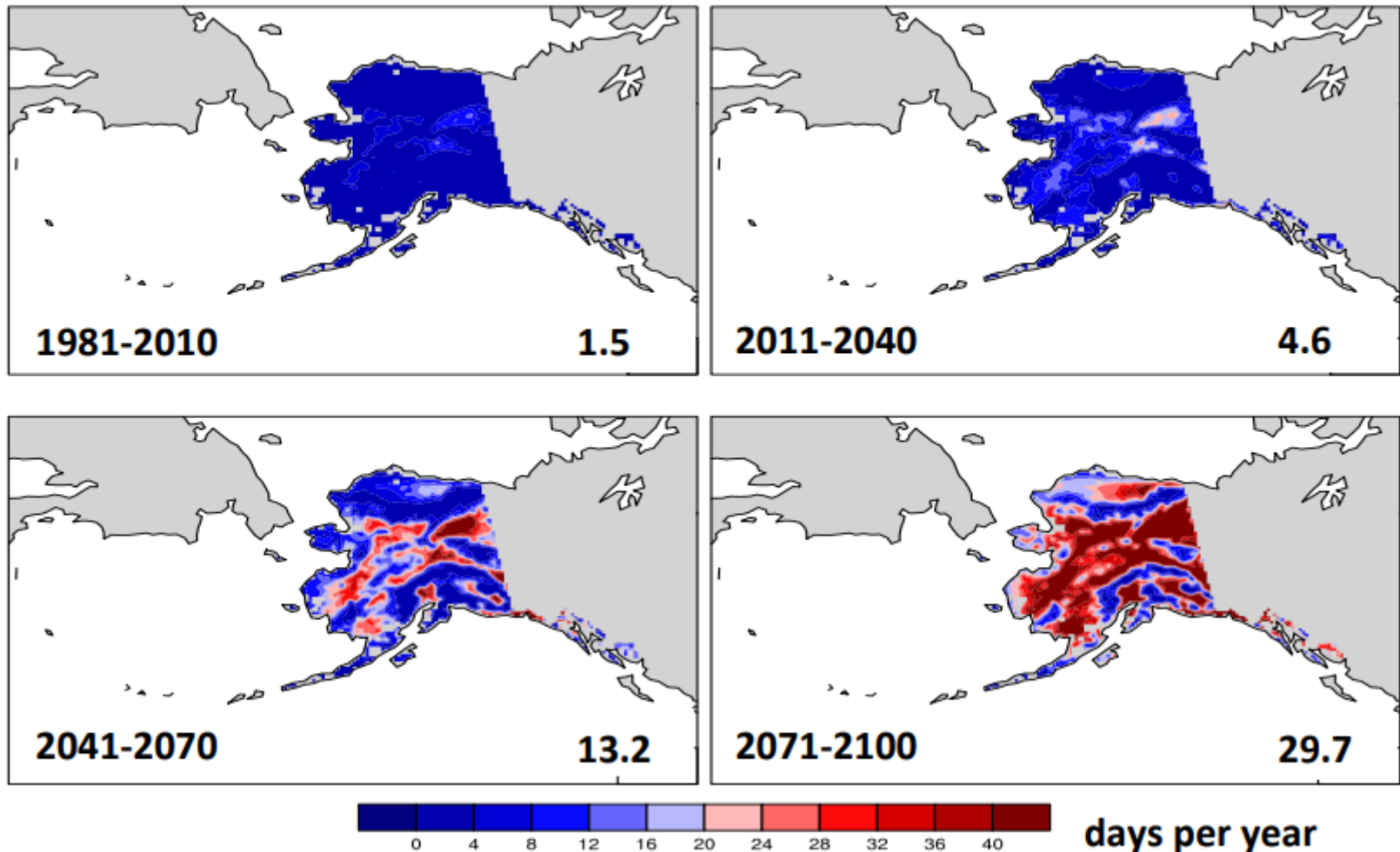
Days Below 32°F



Climate Change Impacts in Alaska

Some Thoughts on Future Temperatures (Warm Days)

Days Above 77°F



Who in Alaska is Addressing Climate Change?



[International Arctic Research Center](#)



[Alaska Center for Climate Assessment and Policy](#)



[Scenarios Network for Alaska + Arctic Planning](#)



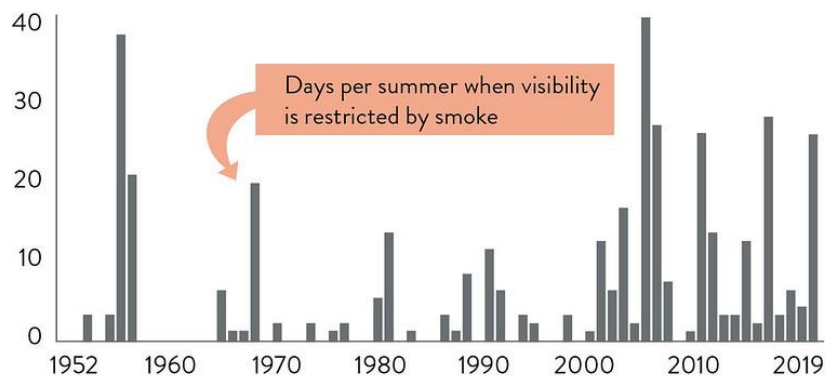
[Alaska Climate Adaptation Science Center](#)



[Alaska Coastal Rainforest Center](#)

Alaska's Changing Environment

Smoky days in Alaska, 1952–2019

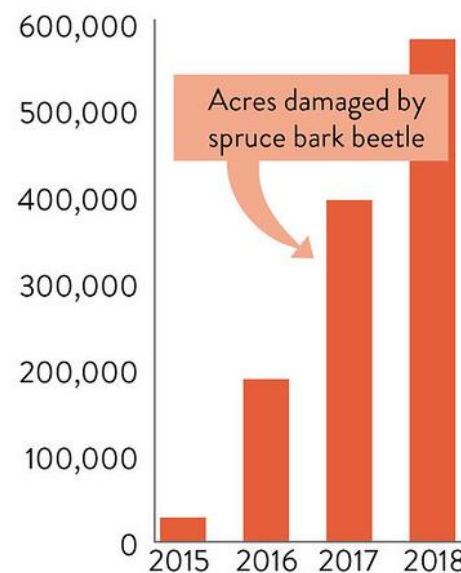


Credit: Rick Thoman, Alaska Center for Climate Assessment and Policy.

Data source: NOAA/NCEI



Alaska spruce bark beetle damage, 2015–2018

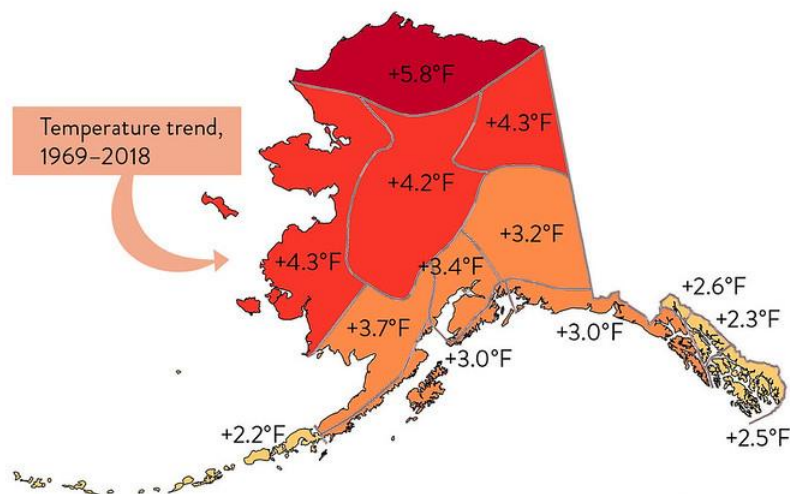


Credit: John Walsh, International Arctic Research Center.

Data source: USDA Forest Service



Warming across western and northern Alaska, 1969–2018

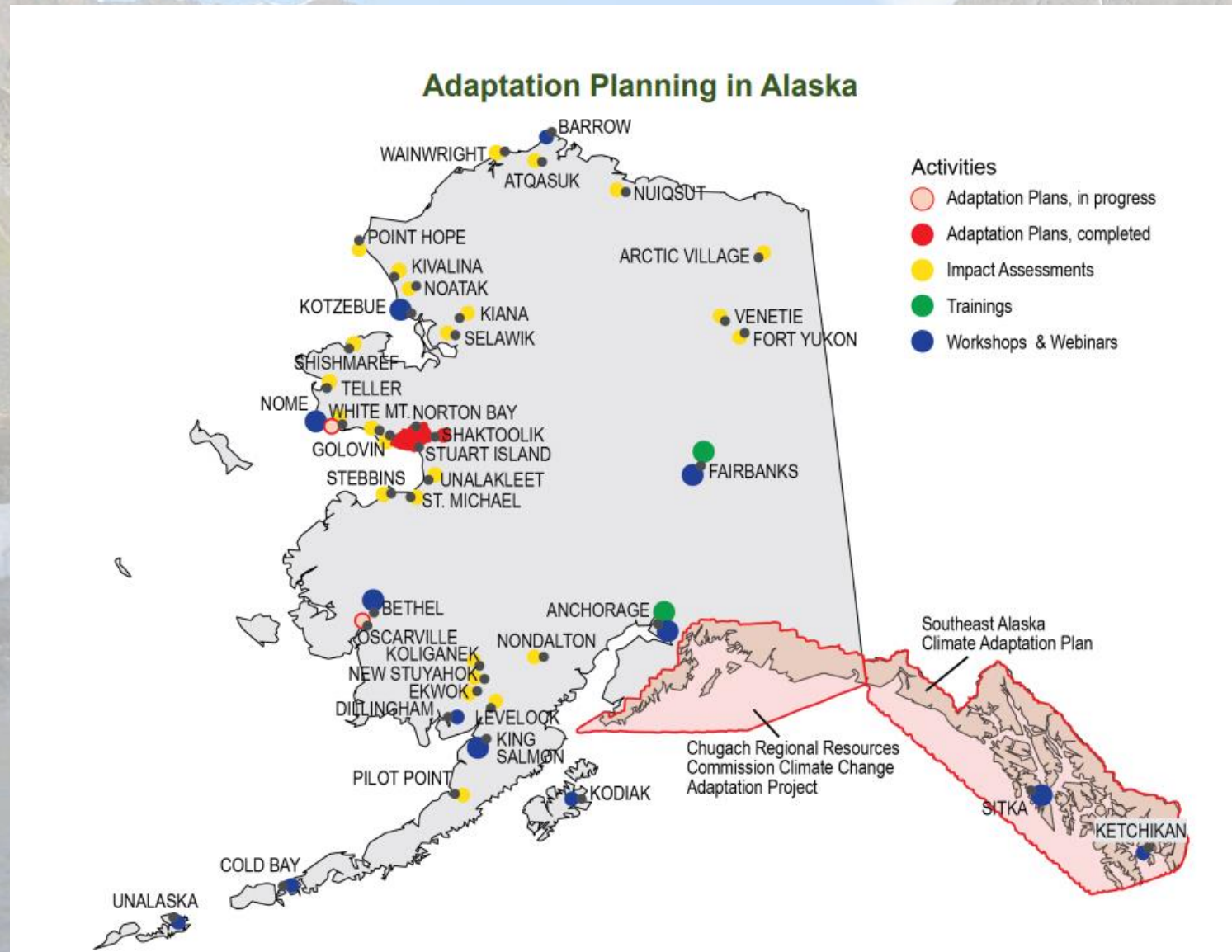


Credit: Rick Thoman, Alaska Center for Climate Assessment and Policy.

Data source: NOAA/NCEI



What Can Alaskans Do?



Alaskans Understand the Climate is Changing

ALASKA

Public Opinion on Climate Change, 2019

Public opinion data come from the Yale Climate Opinion Maps (YCOM), which are based on a statistical model that employs nationally representative Climate Change in the American Mind (CCAM) surveys conducted between 2008 and 2019. The model combines geographic, census, socioeconomic, and political data with CCAM survey data collected by the Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication (combined n > 24,000). For more information about the survey question wording and methodology, please visit YCOM: climatecommunication.yale.edu/visualizations-data/ycom-us



Beliefs

Global Warming is Happening

65%

Alaska



Alaska counties

Global warming is caused mostly by human activities

48%

Most scientists think global warming is happening

50%

Global warming is affecting the weather

55%

Risk Perceptions

Worried about Global Warming

56%

Alaska



Alaska counties

Global warming will harm future generations

64%

Global warming will harm people in the developing countries

61%

Global warming will harm people in the US

55%

Global warming will harm me personally

38%

Policy Support

Schools Should Teach Global Warming

75%

Alaska



Alaska counties

Fund research into renewable energy sources

83%

Provide tax rebates for energy efficient vehicles or solar panels

81%

Regulate CO₂ as a pollutant

69%

Set strict CO₂ limits on existing coal-fired power plants

63%

MATANUSKA-SUSITNA BOROUGH, ALASKA

Public Opinion on Climate Change, 2019

Public opinion data come from the Yale Climate Opinion Maps (YCOM), which are based on a statistical model that employs nationally representative Climate Change in the American Mind (CCAM) surveys conducted between 2008 and 2019. The model combines geographic, census, socioeconomic, and political data with CCAM survey data collected by the Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication (combined n > 24,000). For more information about the survey question wording and methodology, please visit YCOM: climatecommunication.yale.edu/visualizations-data/ycom-us



Beliefs

Global Warming is Happening

64%

Matanuska-Susitna
Borough, Alaska



Alaska average (65%)

Global warming is caused mostly by human activities

50%

Most scientists think global warming is happening

51%

Global warming is affecting the weather

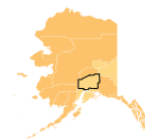
57%

Risk Perceptions

Worried about Global Warming

57%

Matanuska-Susitna
Borough, Alaska



Alaska average (56%)

Global warming will harm future generations

66%

Global warming will harm people in the developing countries

61%

Global warming will harm people in the US

57%

Global warming will harm me personally

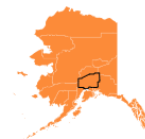
40%

Policy Support

Schools Should Teach Global Warming

75%

Matanuska-Susitna
Borough, Alaska



Alaska average (75%)

Fund research into renewable energy sources

82%

Provide tax rebates for energy efficient vehicles or solar panels

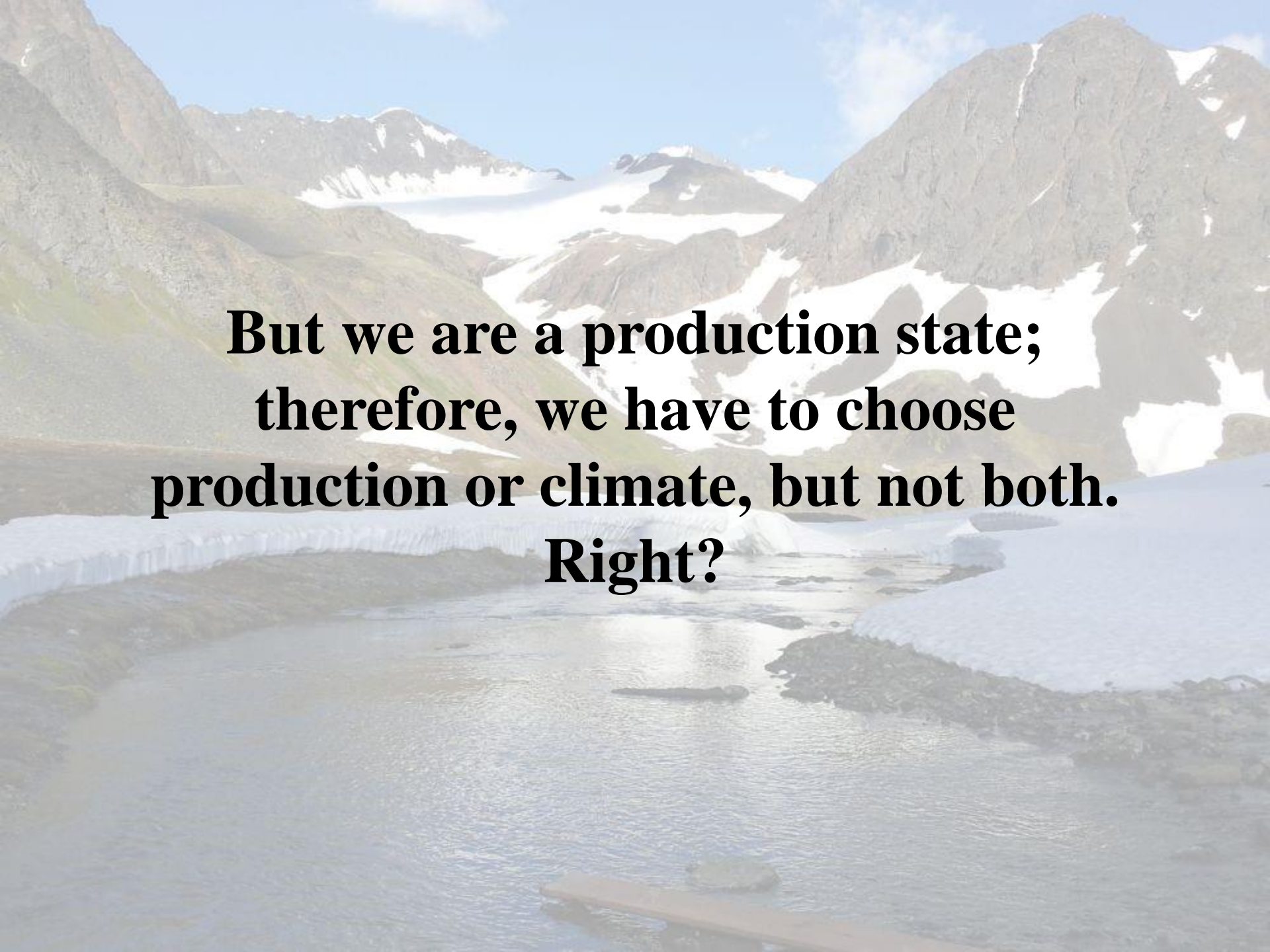
81%

Regulate CO₂ as a pollutant

70%

Set strict CO₂ limits on existing coal-fired power plants

64%

A scenic view of a mountain valley. In the foreground, a river flows through a lush green valley. The middle ground shows steep, rocky slopes with patches of snow. In the background, majestic snow-capped mountain peaks rise against a clear blue sky with a few wispy clouds. The overall atmosphere is serene and majestic.

**But we are a production state;
therefore, we have to choose
production or climate, but not both.
Right?**

Alaska Often Looks to Norway as an Example



Alaska Often Looks to Norway as an Example

Norway pledges to become climate neutral by 2030

Parliament approves radical proposal of accelerated emissions cuts and carbon offsetting to achieve climate goal 20 years earlier than planned

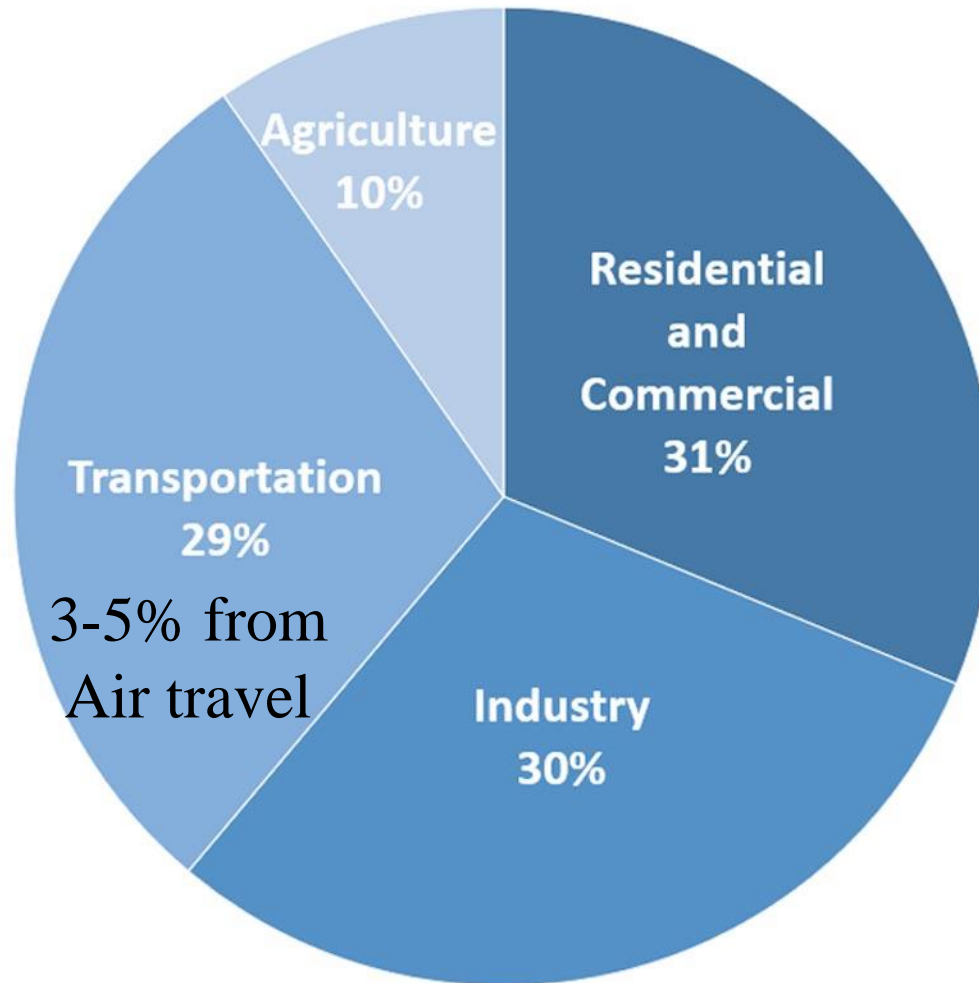


Both Climate Leader and Oil Giant? A Norwegian Paradox



Where are Carbon Emissions Coming From?

Total U.S. Greenhouse Gas Emissions by Sector with Electricity Distributed



U.S. Environmental Protection Agency (2019). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017

The Business Case for Being Climate Proactive

Markets

Exxon, Chevron Targeted by Climate-Activist Investor Group

By [Laura Hurst](#)

December 15, 2019, 3:00 PM AKST *Updated on December 15, 2019, 11:49 PM AKS*

- ▶ Follow This group targets U.S. companies for the first time
- ▶ Resolutions ask companies to align strategy with Paris accord

[LISTEN TO ARTICLE](#)

▶ 2:18

The Dutch activist fund that has filed shareholder resolutions pressuring major oil companies in Europe to take action on climate change has set its sights on the U.S.



BUSINESS

World's Largest Asset Manager Puts Climate At The Center Of Its Investment Strategy

January 14, 2020 · 3:22 PM ET

Final Thoughts

- Climate change is here.
- Greenhouse gas emissions are responsible.
- Alaska's people and economy are affected.
- Climate change is bad for business.
- We can be a producer state AND a climate leader.
- Alaskan's are resilient and adaptive.
- Divestment movements and activist shareholders are a fact of life now. Good optics are good for business.