Mat-Su's Changing Environment: Connecting the past, present and future

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International Arctic Research Center/UAF

Mat-Su Salmon Science & Conservation Symposium
November 20, 2025

Today's agenda

- Common understanding
  - Weather vs. climate
  - Sources of information
- Big Picture Changes
  - Arctic and Alaska
- Drilling down to Mat-Su
- Possible Mat-Su climate futures

Denali

Weather vs. Climate

- Weather: ╖instantaneous╖ physical state of the atmosphere
  - In practice: a few days
- Climate: statistics of weather
  - Usually refers to statistics over weeks or longer timescales often referenced to longer term (decadal scale) baselines

Climate's what you expect, **weather**'s what you get" attributed to Mark Twain

Climate is what's in your closet, **Weather** is what you wear today

Climate: Babe Ruth was a great home run hitter.

Weather: Babe Ruth July 16, 1921, 0 for 5 against the Tigers.

Many sources of environmental information

- Place specific observations (Alaska)
  - Golden age of weather (this instant) observations
  - Dark ages of climate (consistently over time) observations
- Satellites: many “specialties”
  - Sea ice
  - Sea surface temperatures and sea level
  - Input to weather and climate models
- Climate analysis models
  - Interpolation using observations
  - Physical starting with lots of observations

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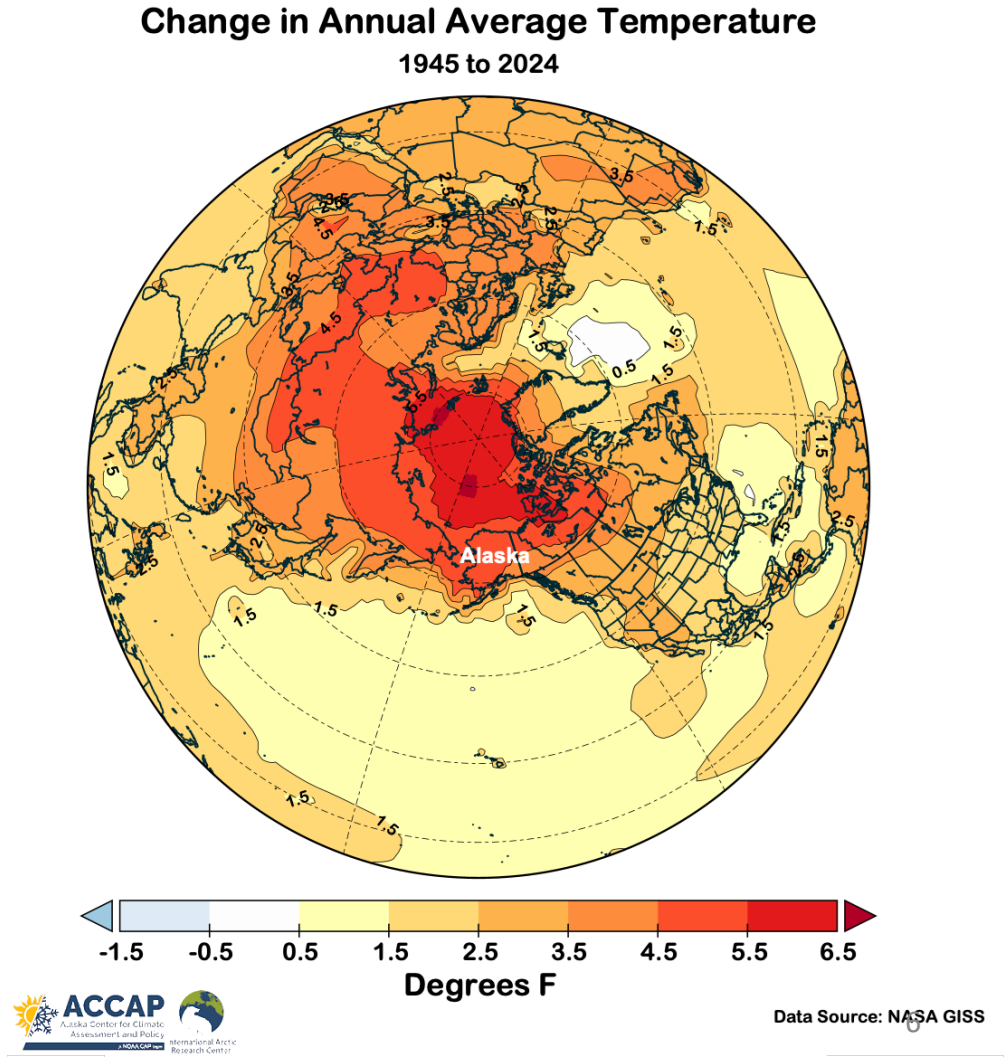
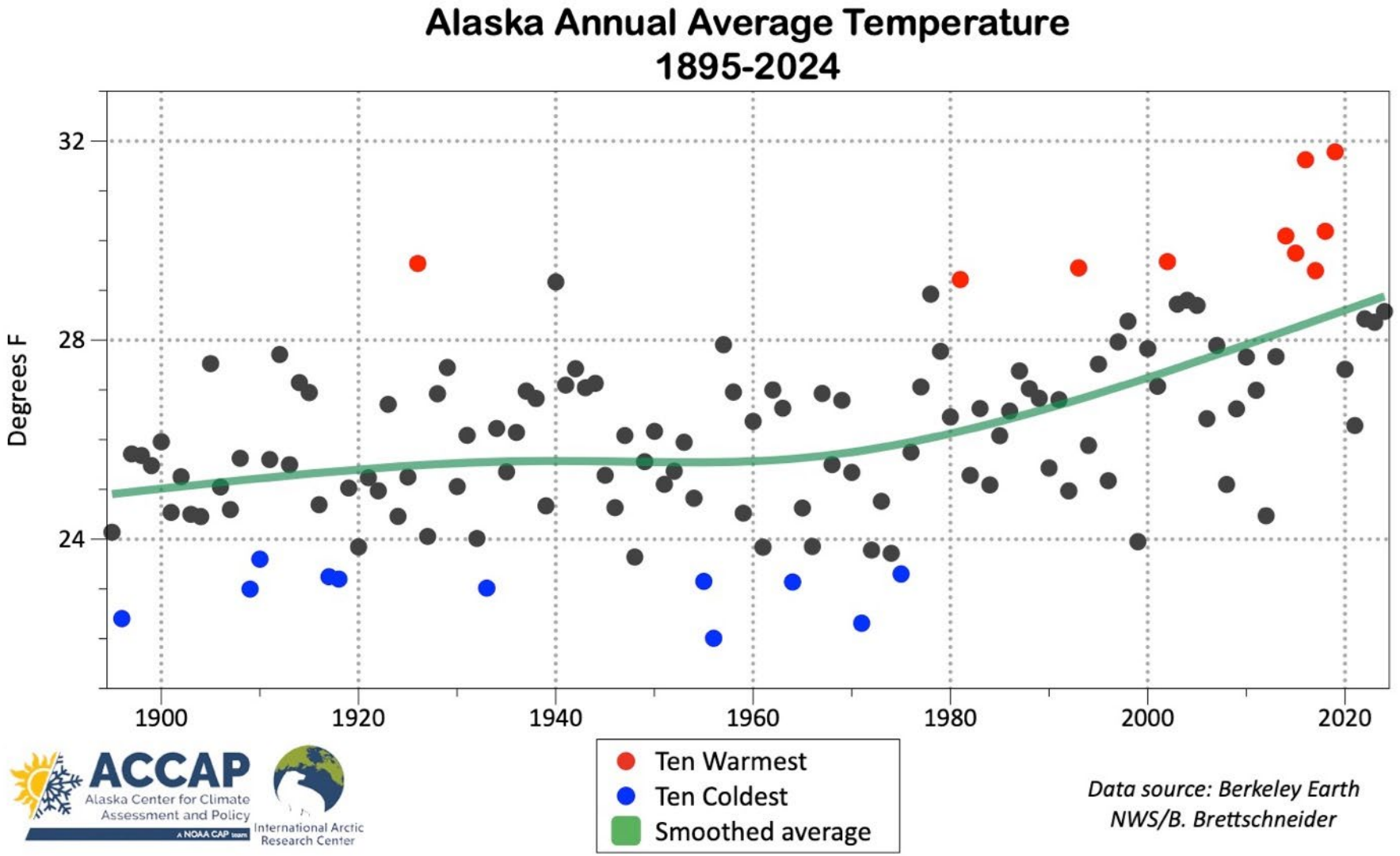
Denali

It’s becoming warmer

- Alaska has warmed 2-3 times as much as lower 48 states
- Part of “Arctic amplification”
  - Loss and thinning of sea ice
  - Reduction in snow cover season
  - Increased water vapor (also a greenhouse gas)
- Warming accelerated in the later 20th century

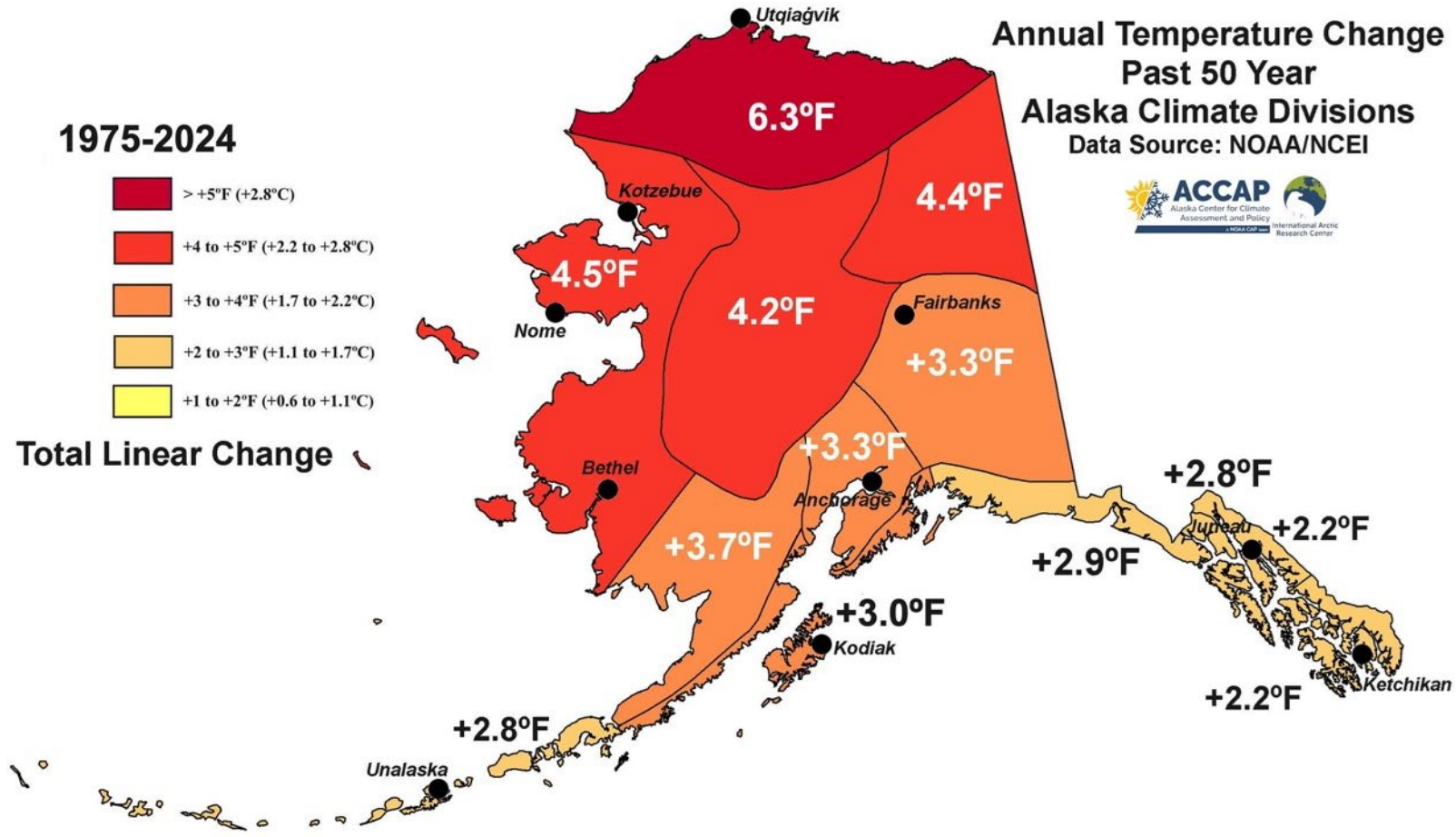


Alaska is warming

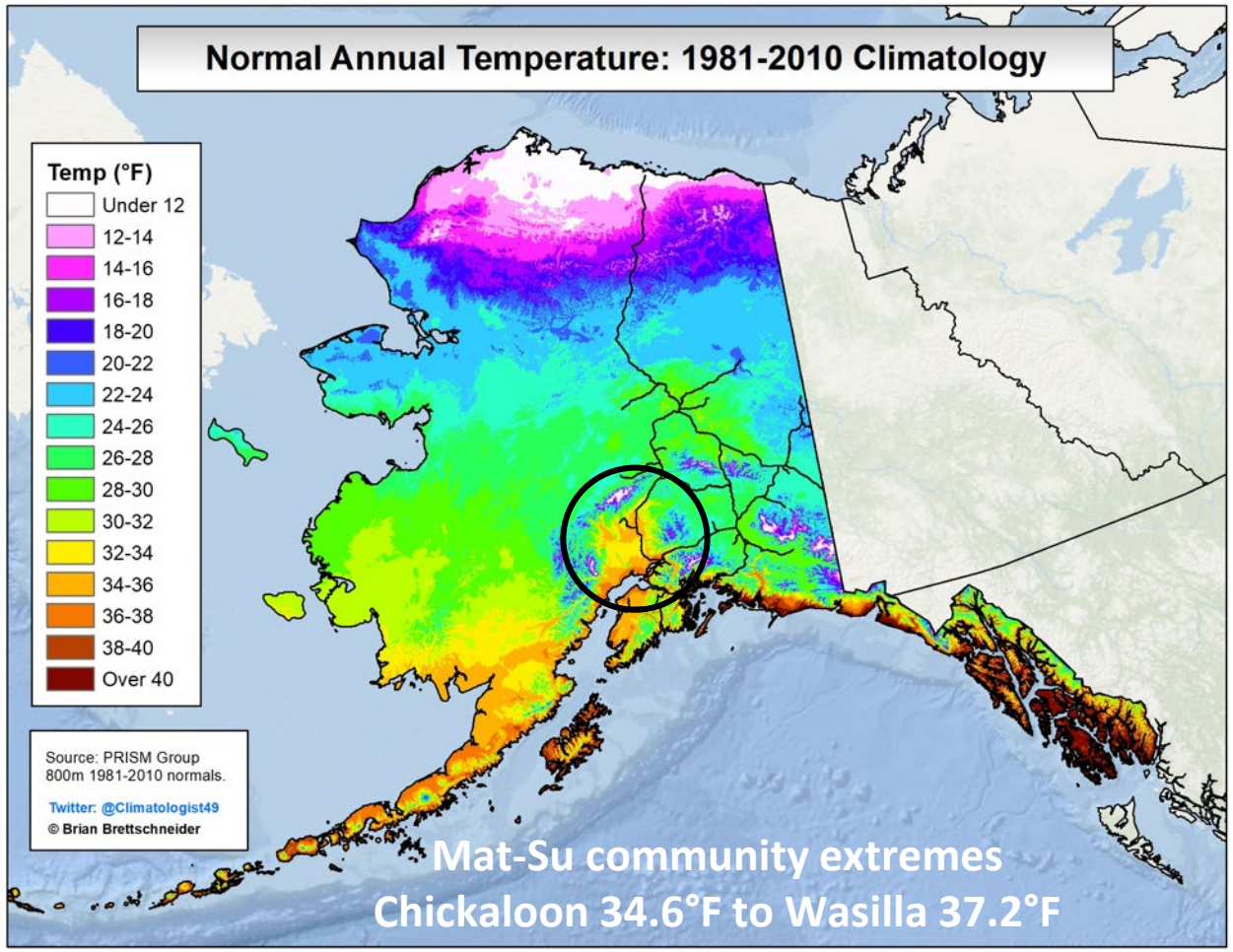


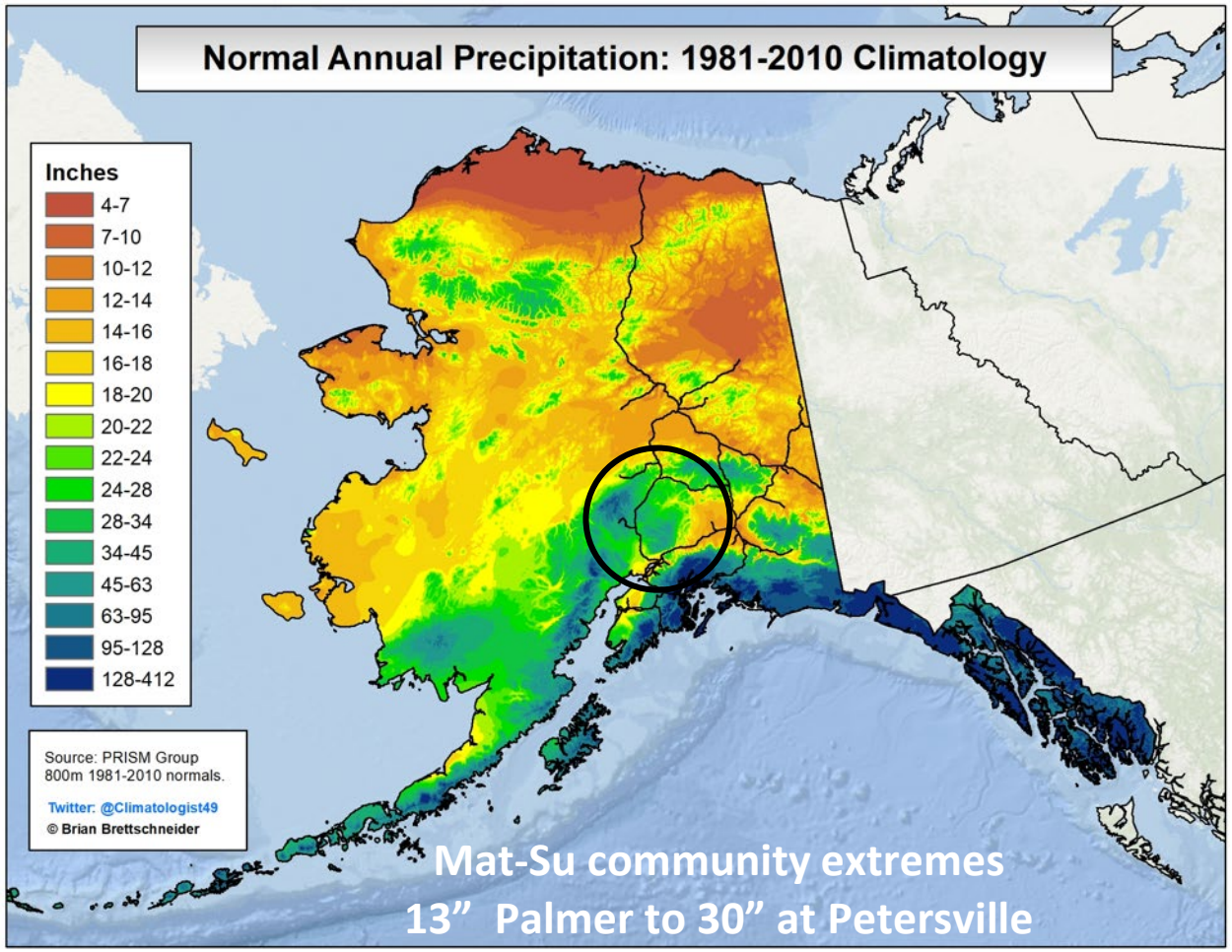
Annual temperature changes past 50 years

- Everywhere in Alaska is warming (3°F in 50 years)
- Changes are NOT spatially uniform
- Changes in snow cover and sea ice are big drivers in spatial differences



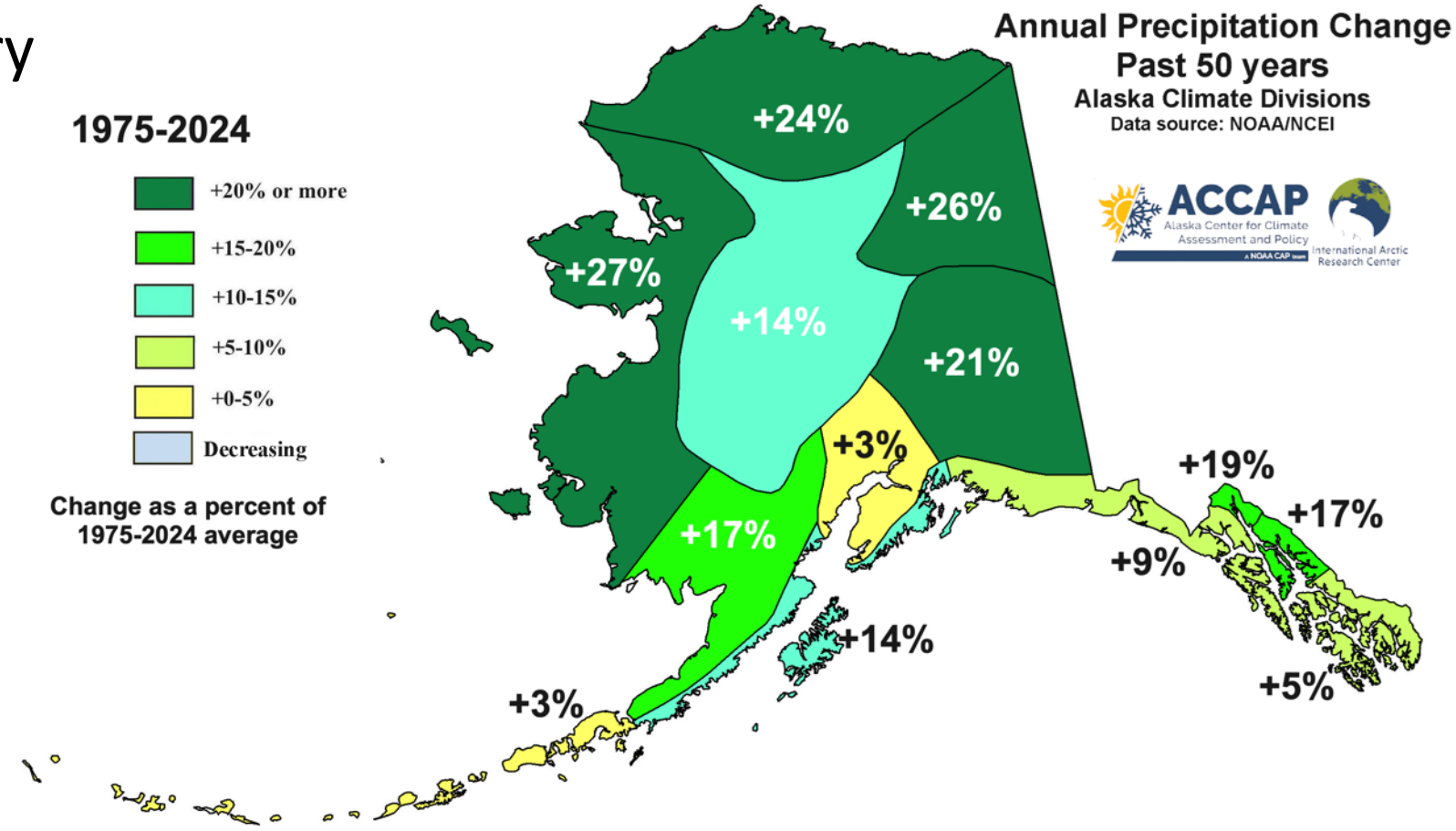
Alaska Climate



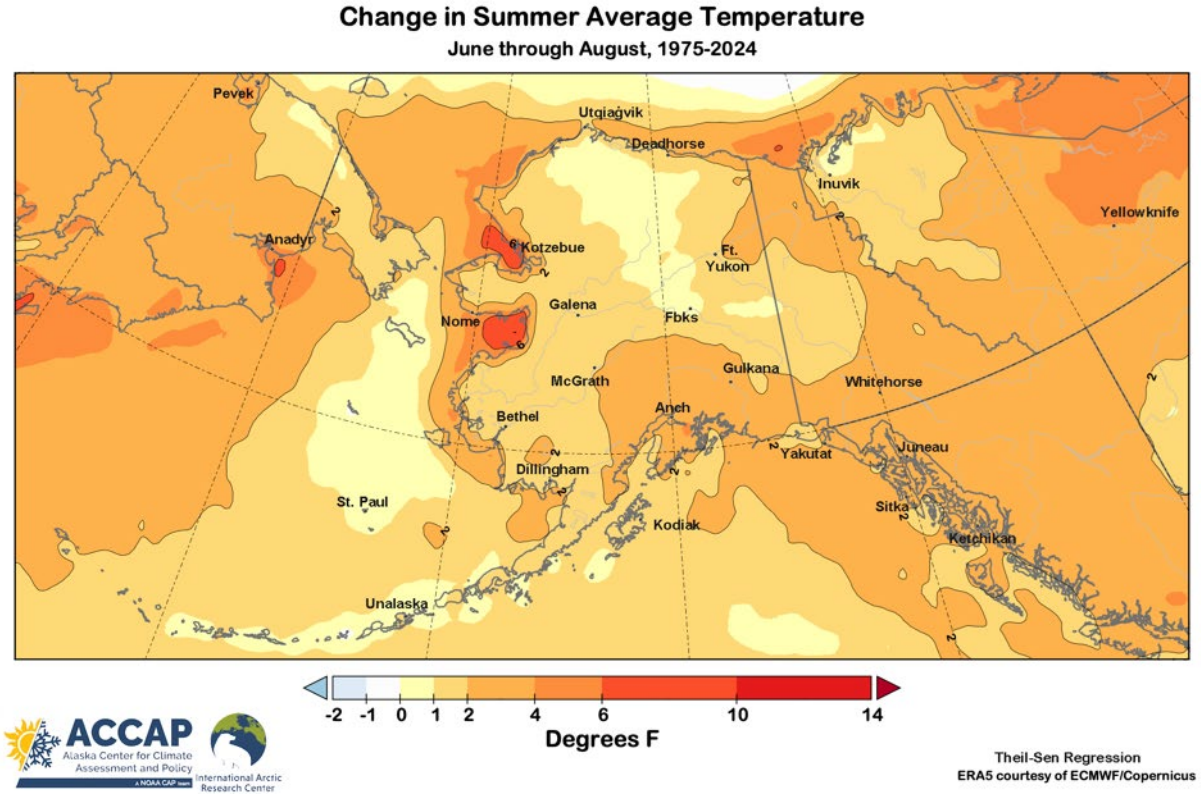


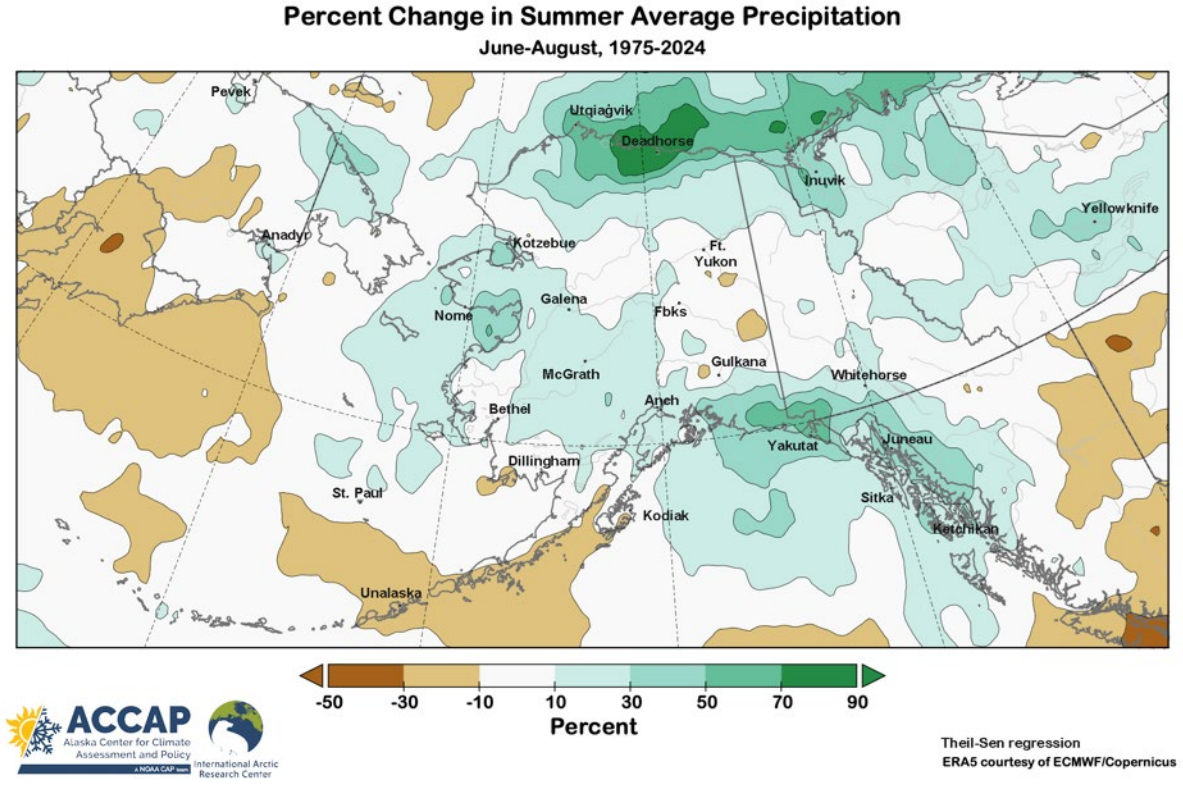
Annual precipitation changes

- Precipitation changes vary significantly
- Most areas in Alaska receiving more precipitation (rain and melted snow)
- Mountains play a profound role



Alaska's changing summer climate

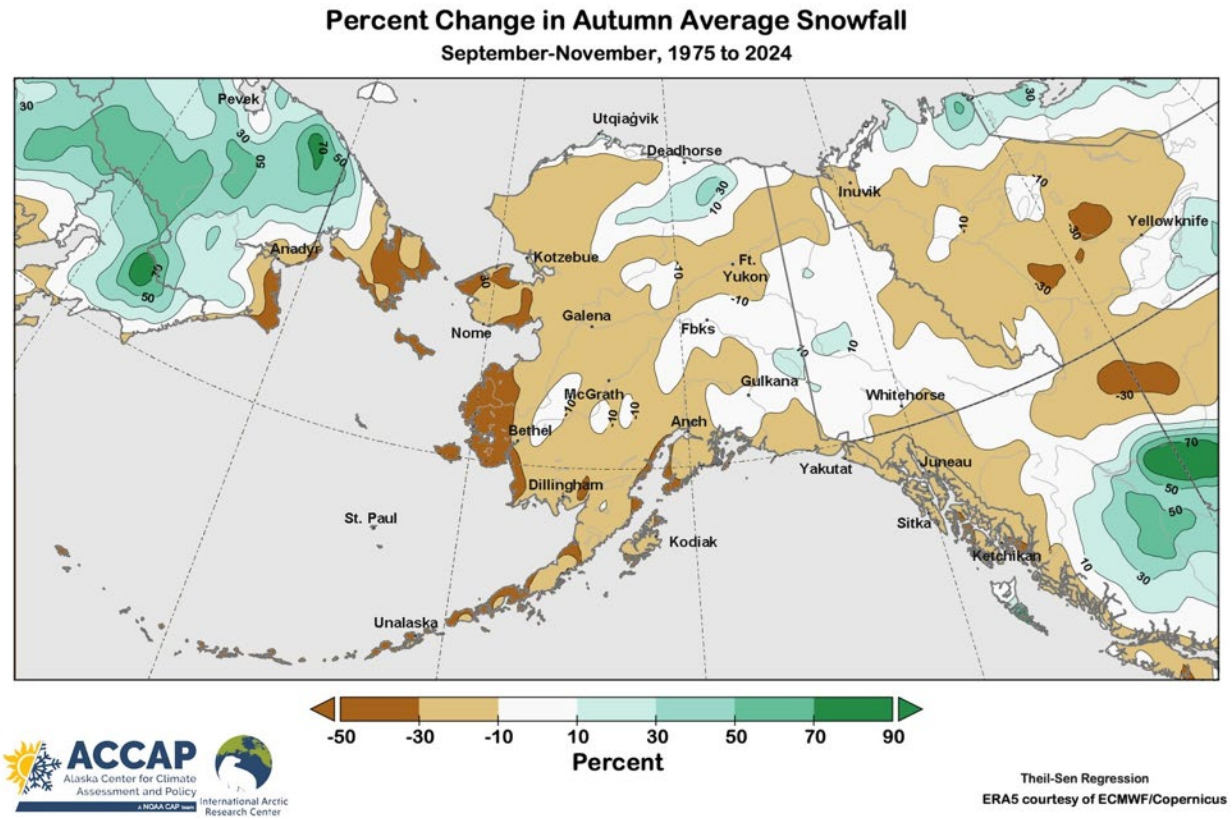


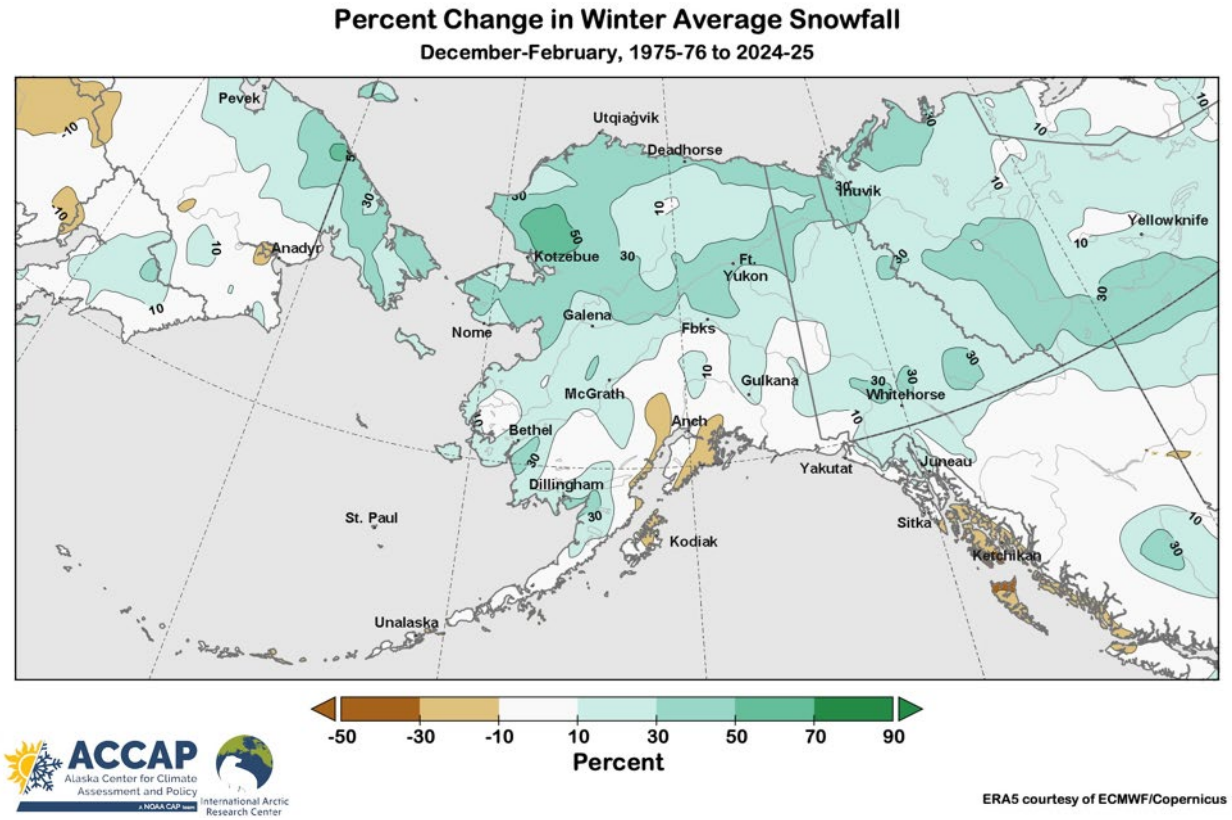


Temperatures: warming

Rain: more but not dramatically

Alaska's changing snowfall seasonality



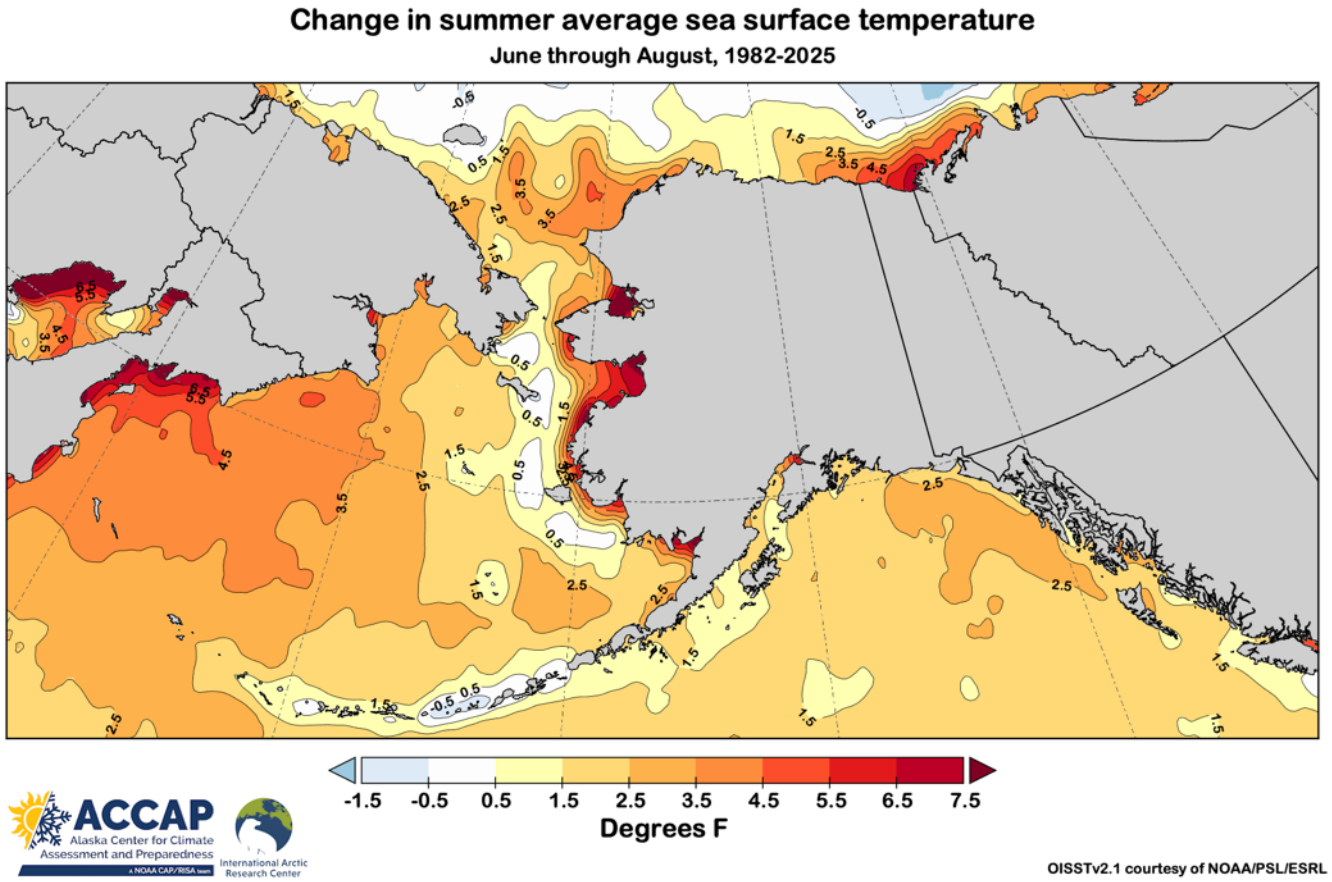


Autumn: more precipitation coming as rain

Winter: more snow because warmer air holds more moisture

Ocean temperature changes

- Oceans warming globally
- Gulf of Alaska warming
- Increasing water vapor available to storms
- Changing land-sea temperature variations

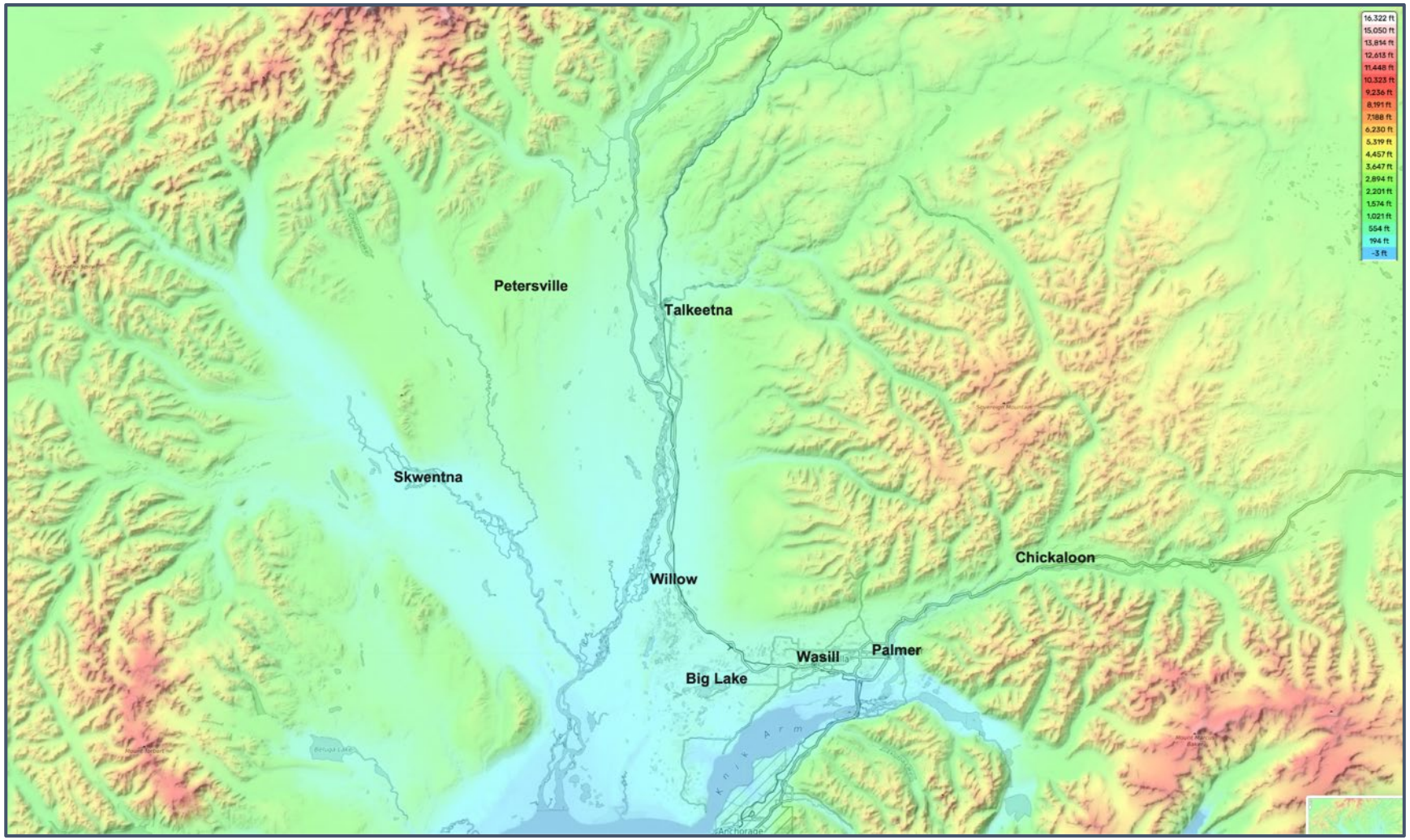


Today's agenda

- Common understanding
- Big Picture Changes
- Drilling down to Mat-Su
  - Typography matters a lot
  - Temperatures
  - Precipitation
  - Snowpack and river ice
  - Wildfire
- Possible Mat-Su climate futures

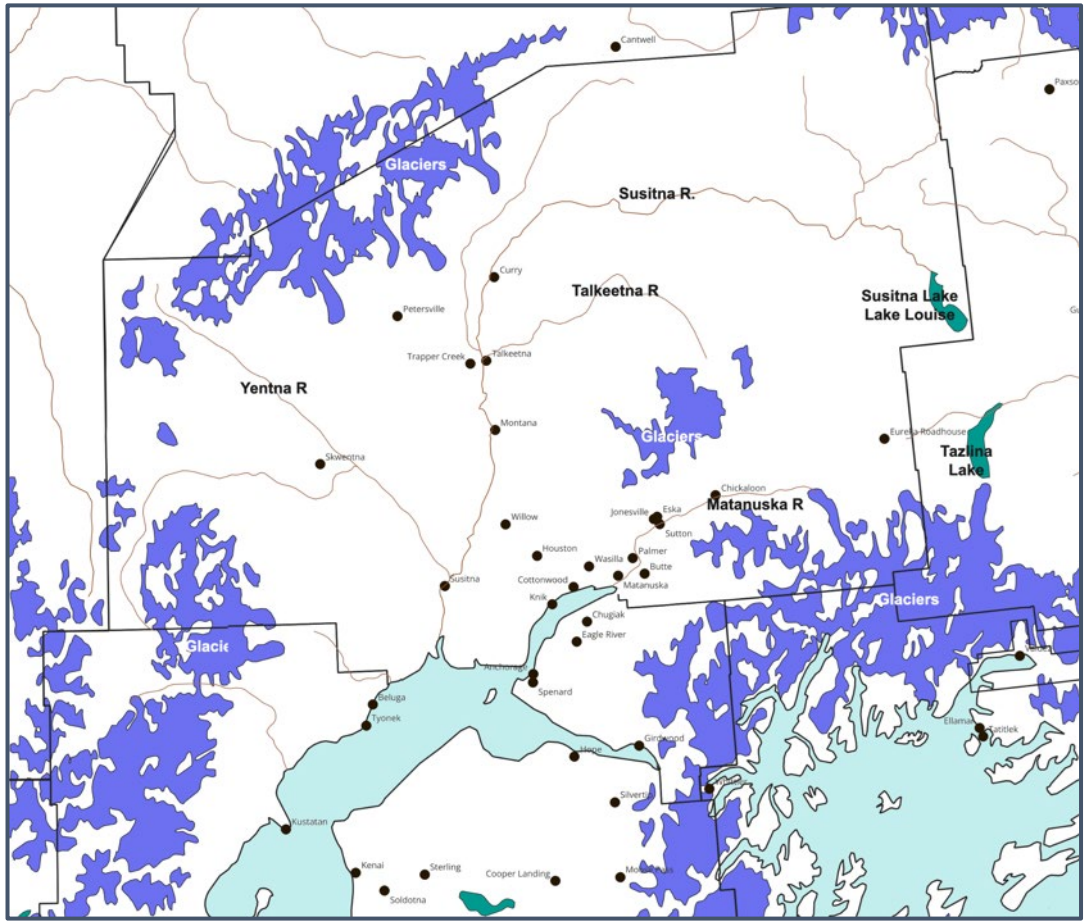
Denali

Mat-Su: complex terrain
Weather and climate strongly modulated

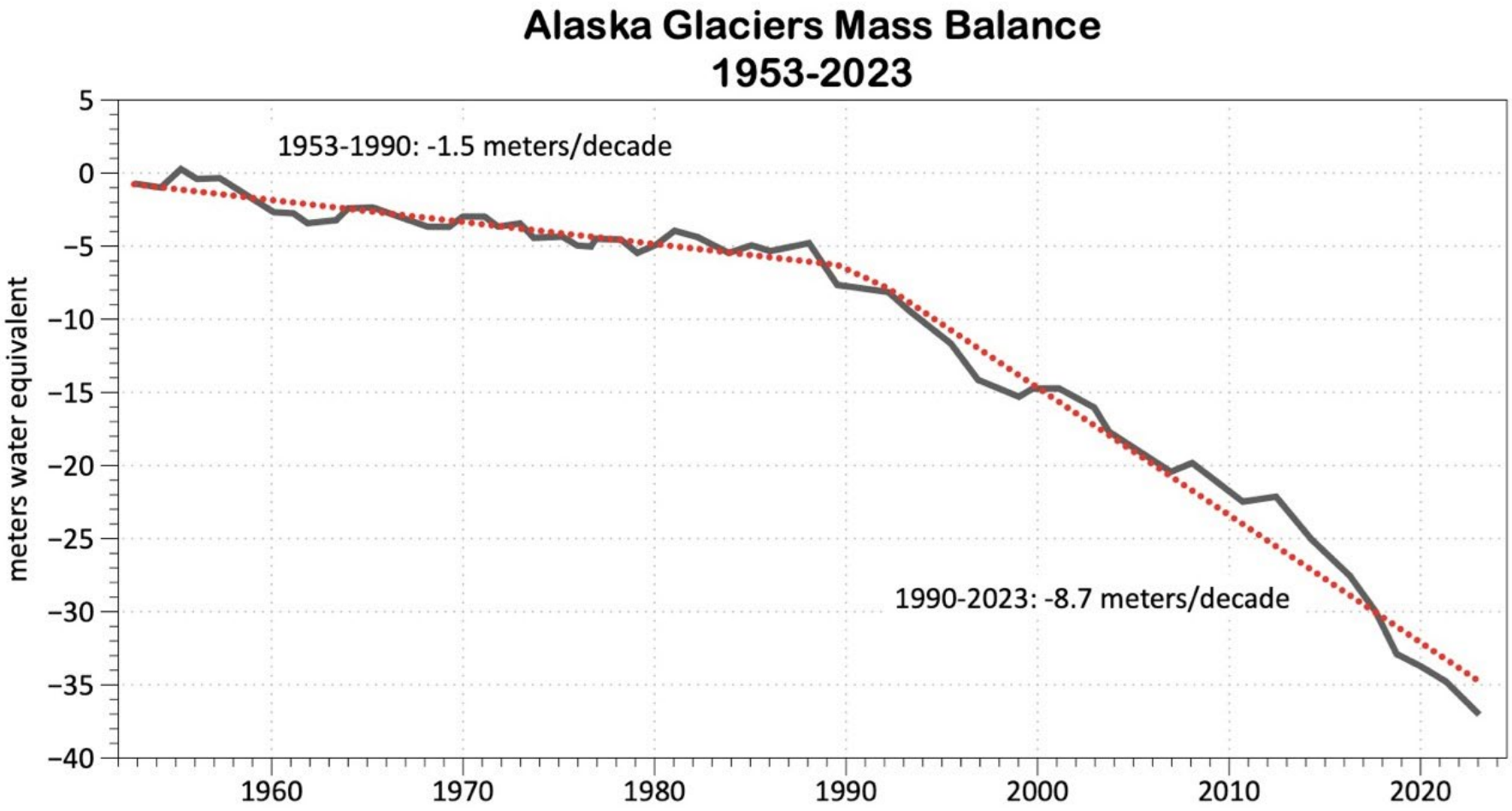


Glaciers and Mat-Su salmon

- Glaciers cover about four percent of Alaska
- Mat-Su surrounded by glaciers
- Related: snow fields that persist into late summer
- Significant impacts
  - Colder river water good for salmon



Glaciers are losing ice rapidly



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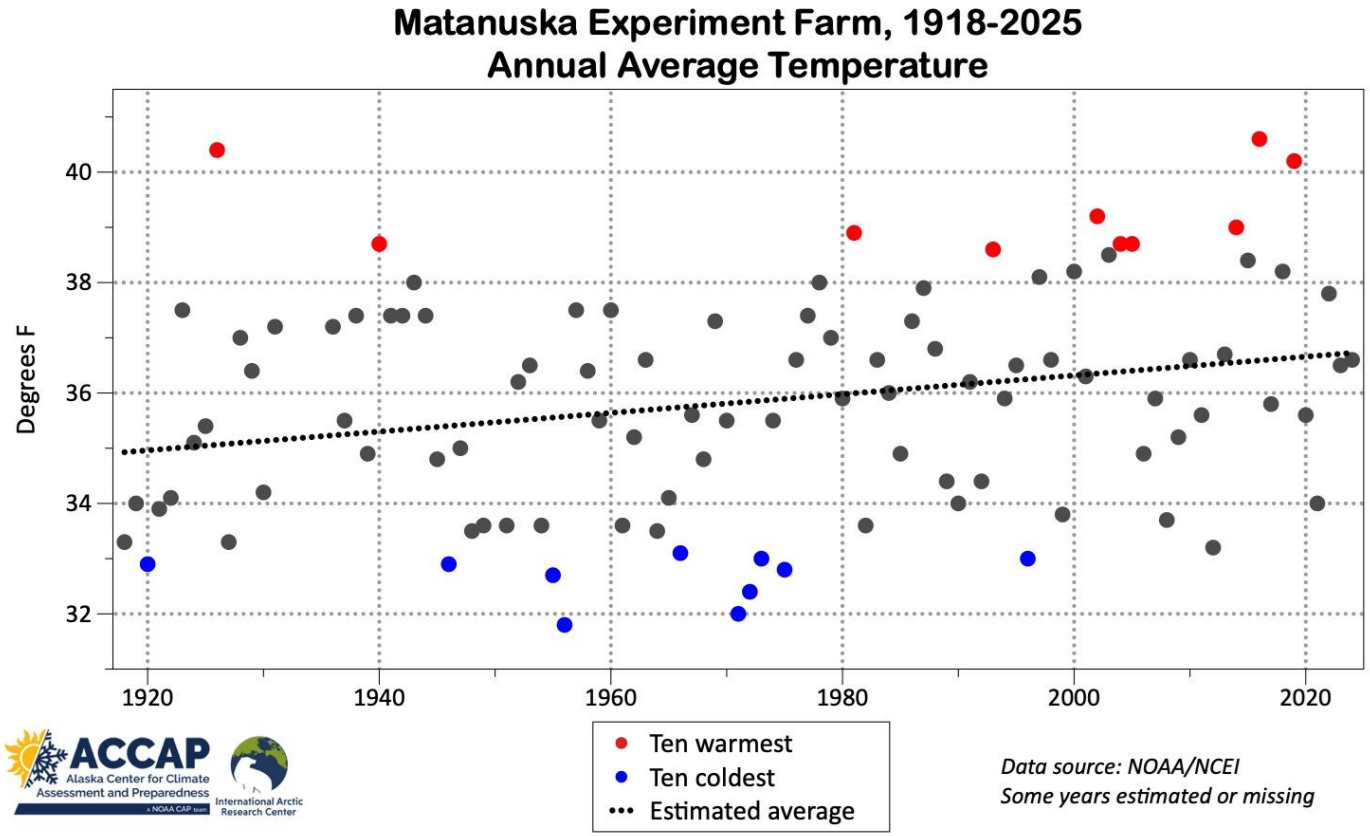
Date Source: Adapted from Burgess et. al. 2023

Mat-Su temperatures through time

Longest set of observations in Southcentral are at:

- 1917 **Palmer** at the UAF Matanuska Experiment Farm
- 1918 **Talkeetna**
  - Important diffs from in town vs. airport
  - Completely automated since the late 1990s

Both locations have months of missing data

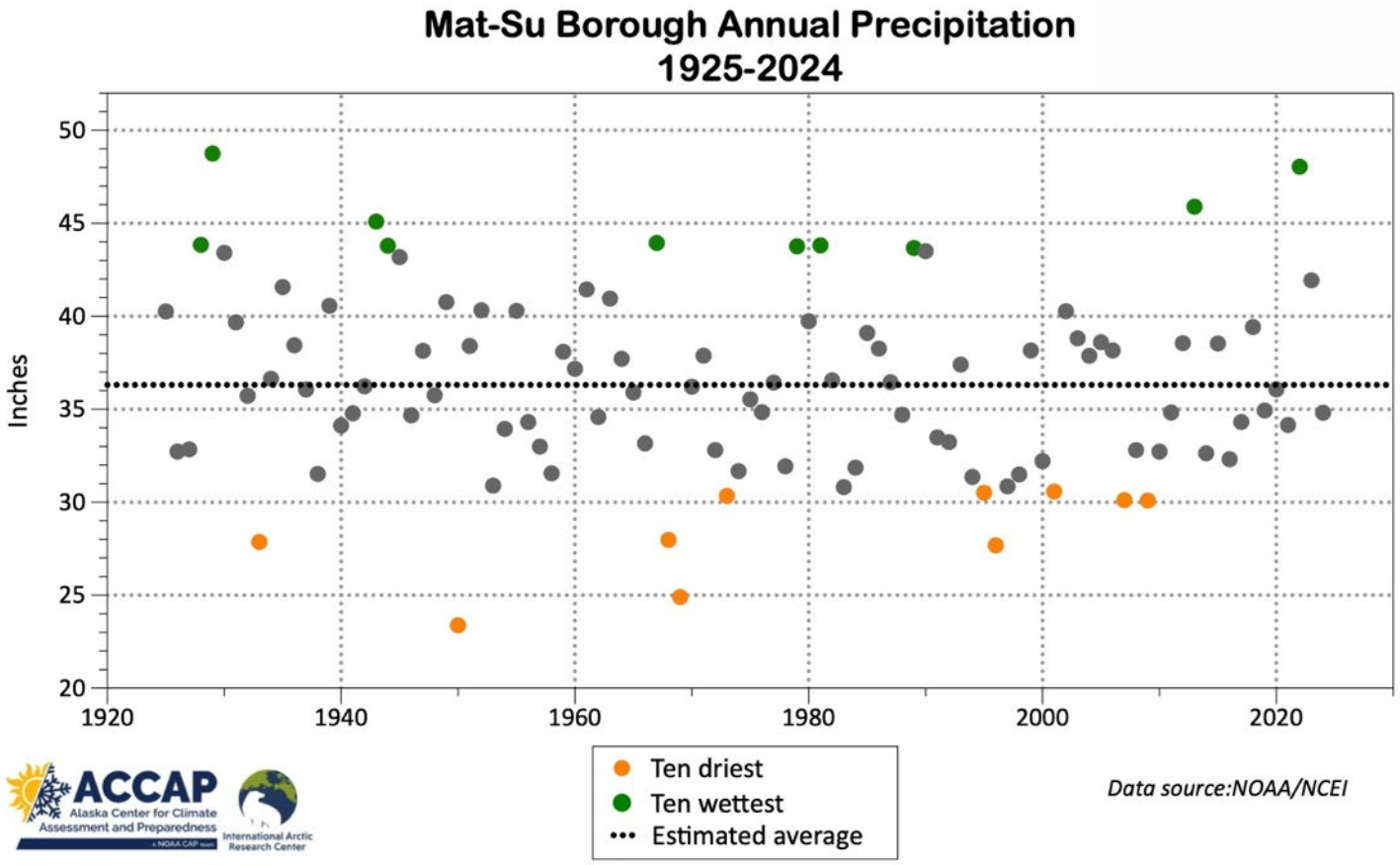


Mat-Su precipitation through time

No long term trend

Multi-decade variability

- 1925-45 wet
- 1965-85 dry
- 2004-2025 “average”



Mat-Su snowfall through time

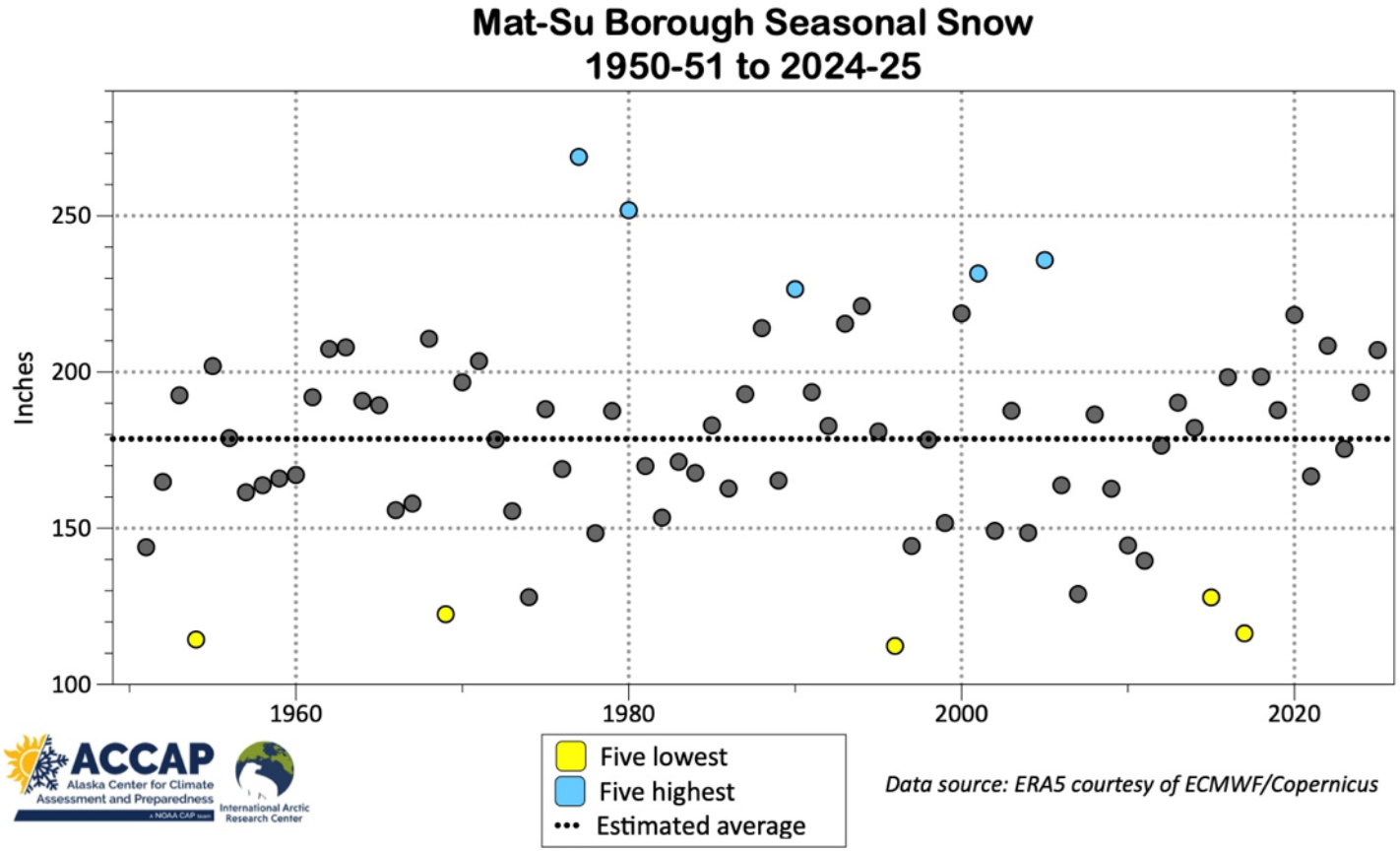
No long term trend

Large year-to-year variability

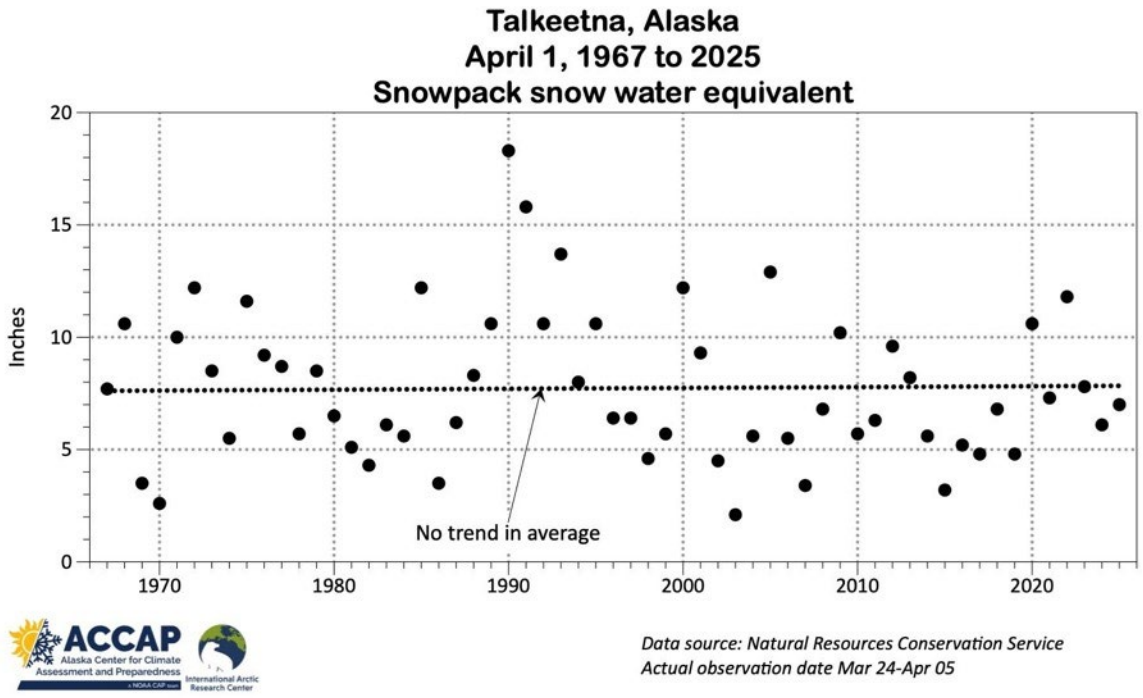
Some multi-decade

- 1950-1975 lower snow
- 1976-2005 higher snow
- since 2005 average

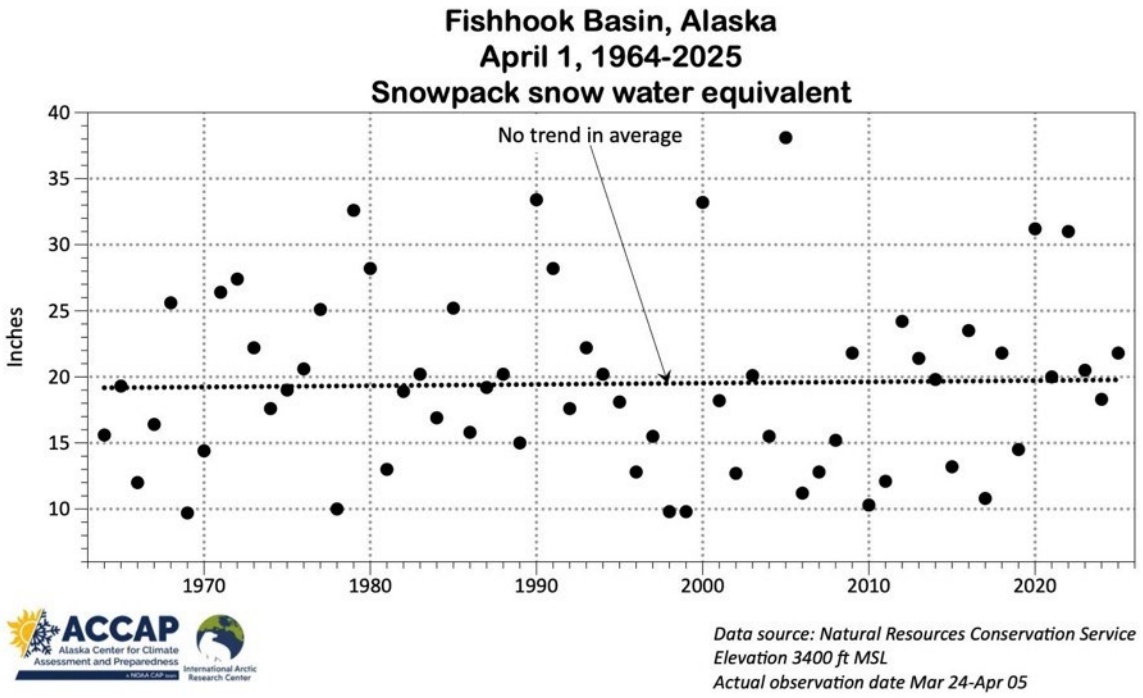
All this ⬆️ could be random



Mat-Su Spring snowpack

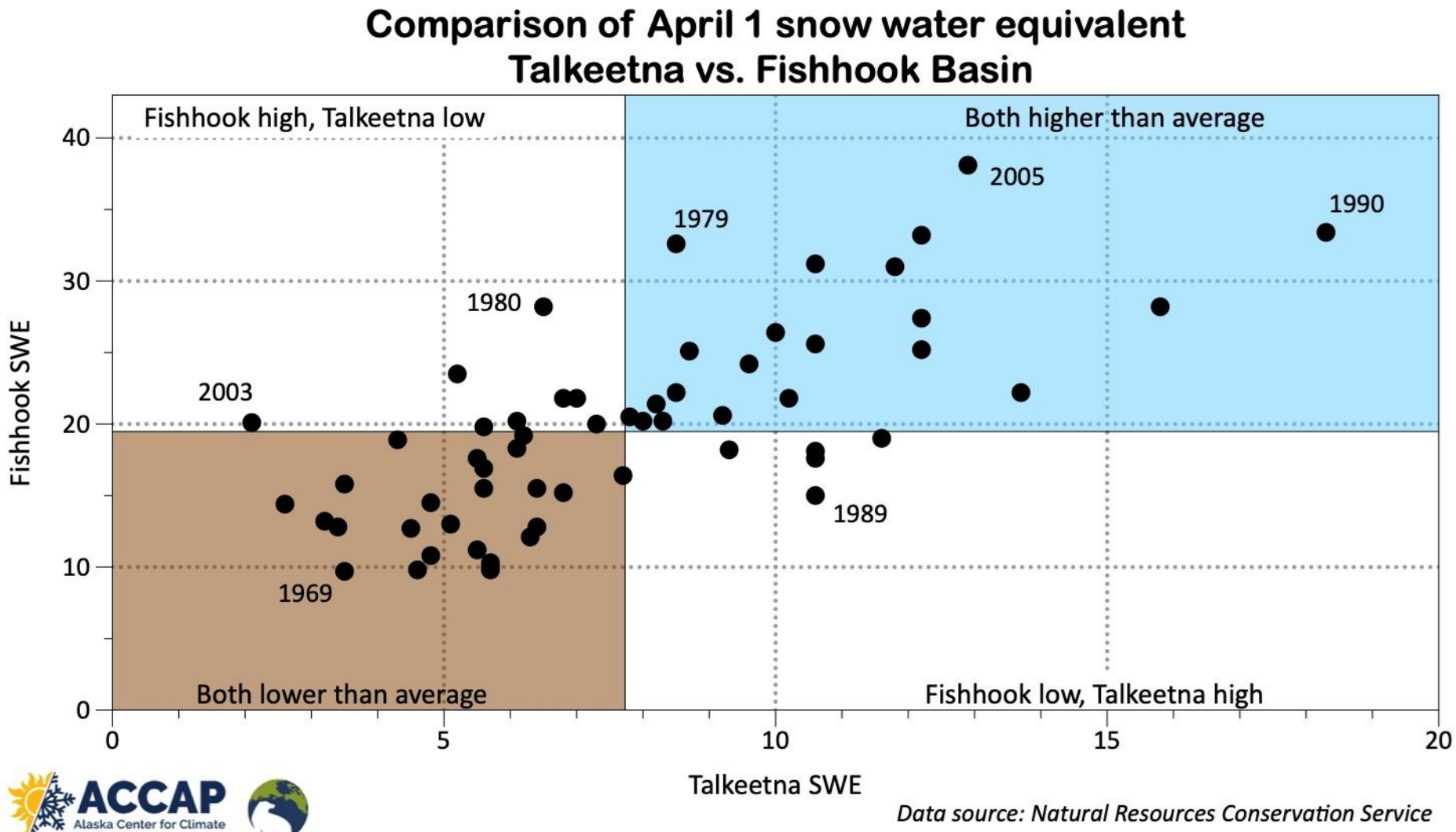


320 ft MSL



3400 ft MSL

Spring snowpack



Data source: Natural Resources Conservation Service

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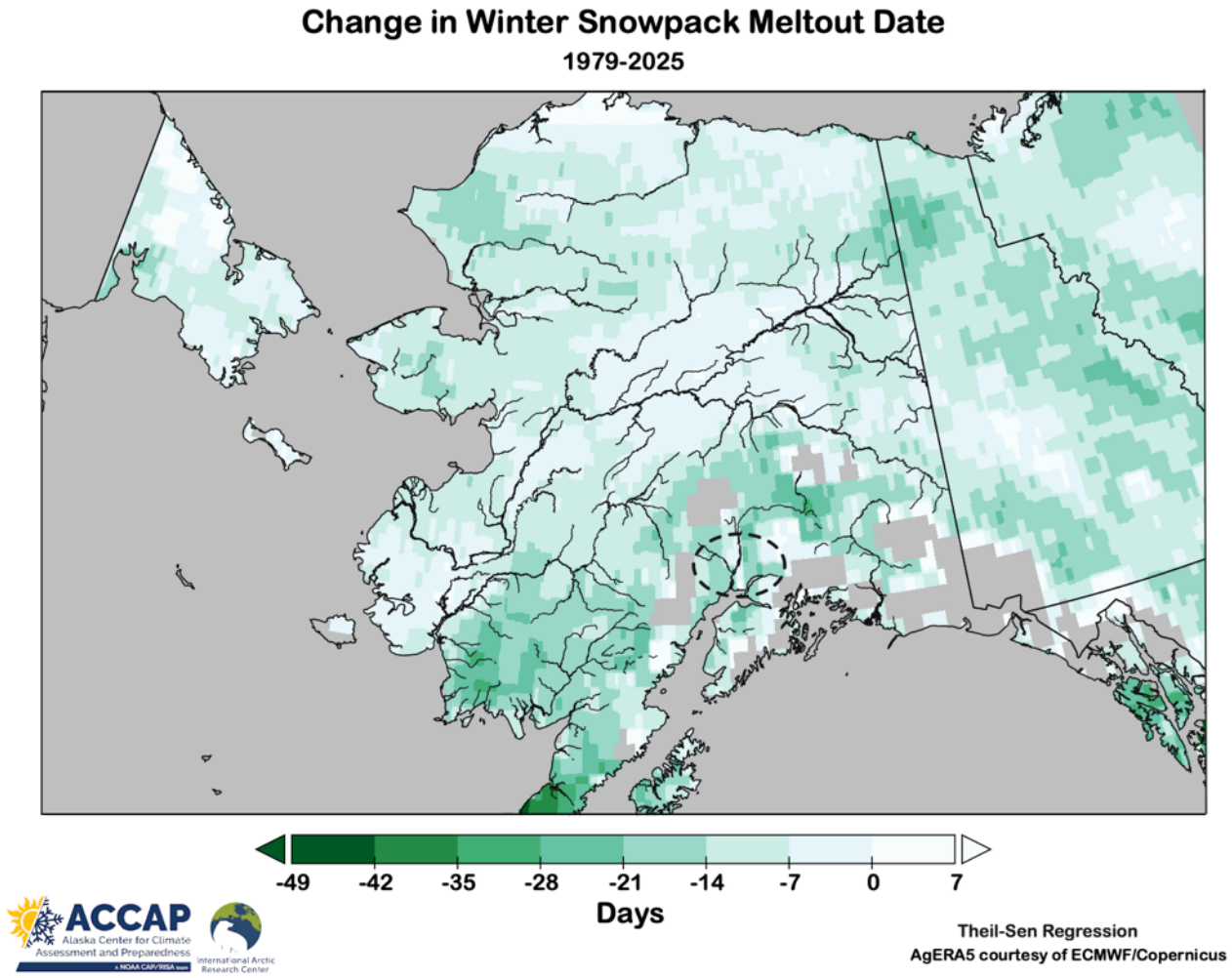
Change in Spring snow meltout timing

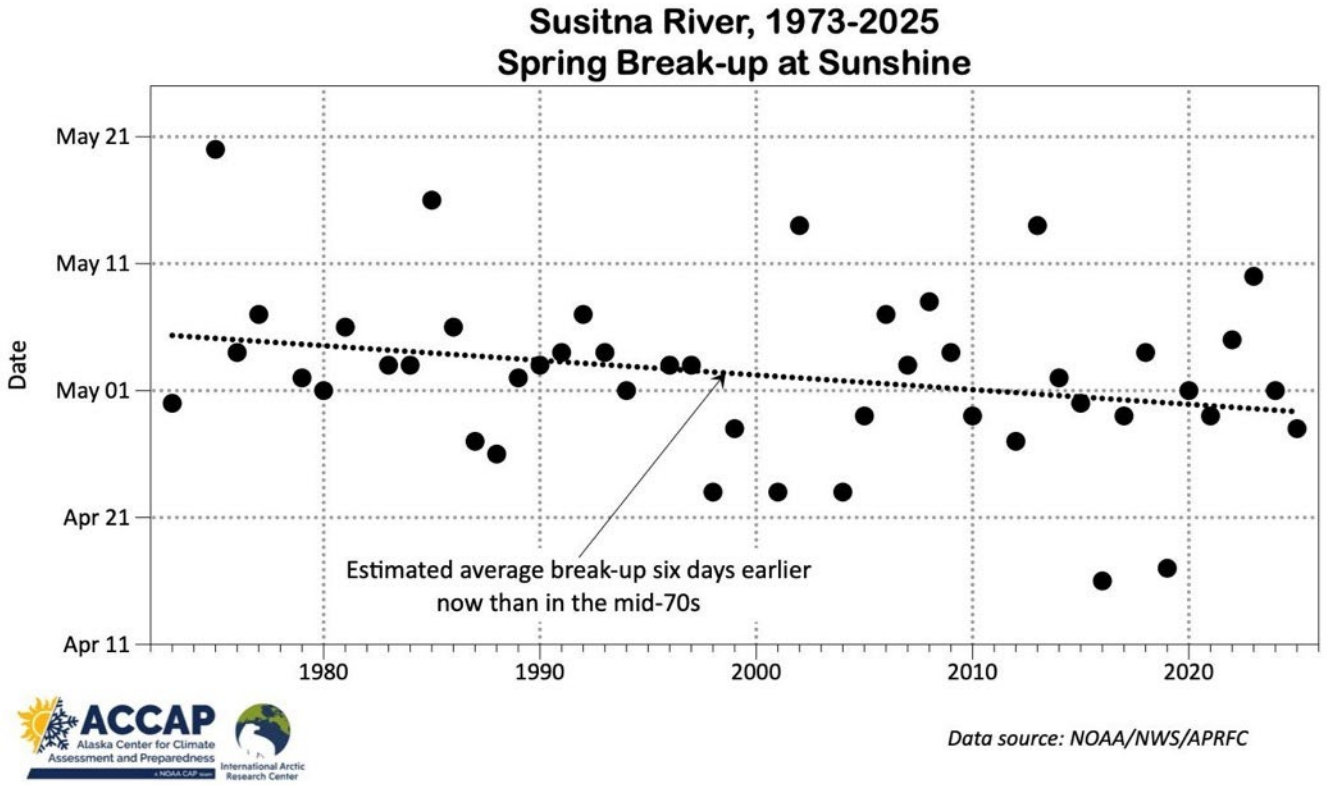
Mat-Su region

- Spring snowmelt generally 2 to 4 weeks earlier nowadays than in the early 1980s
- Less change in the higher mountains
- More change upper Susitna valley

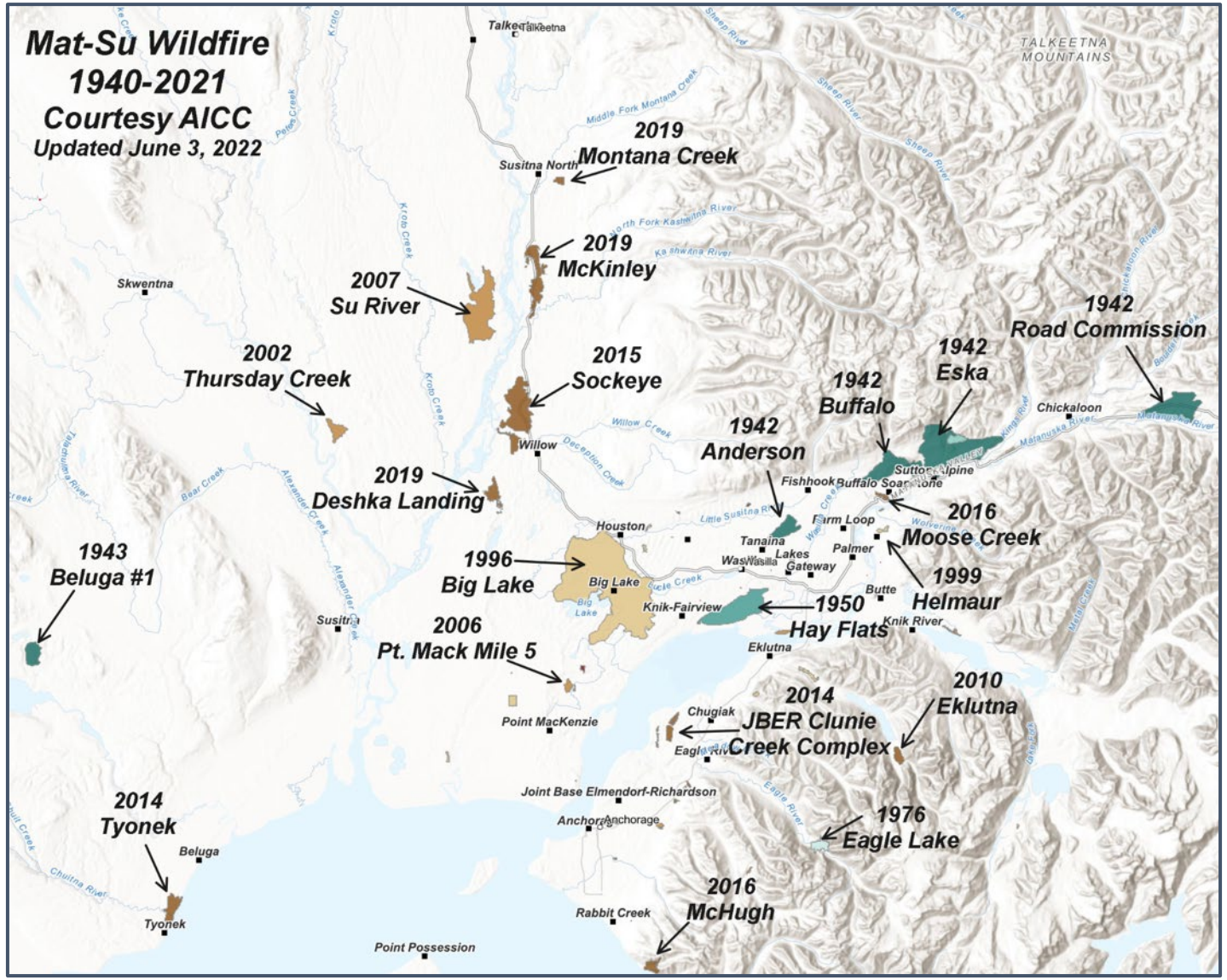


River Transition from ice to water

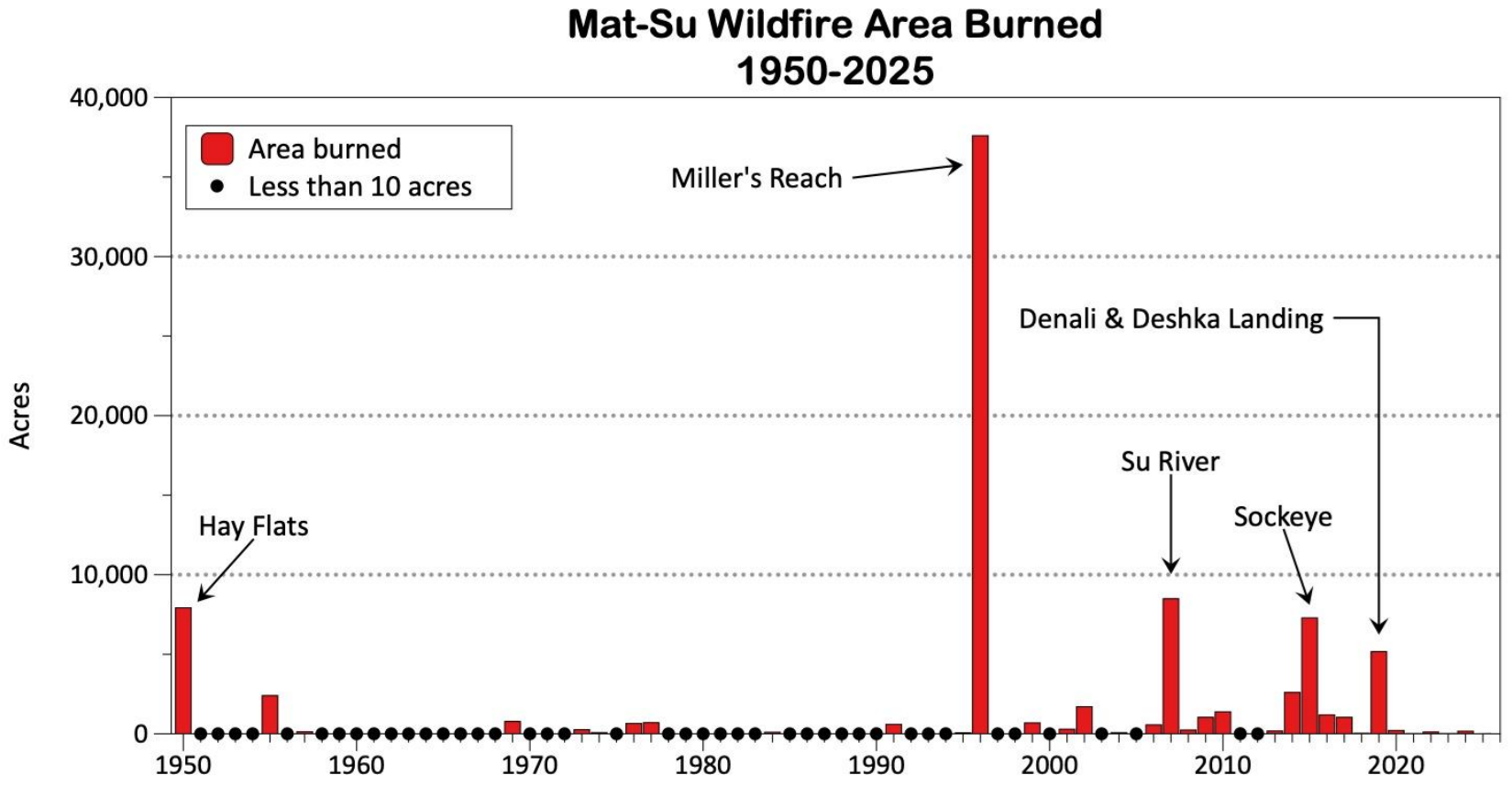
- Spring river ice break-up is trending earlier
- Week to ten days change in the few places with century scale observation
- Earlier break-up → longer duration elevated water levels as mountain snows melt



Mat-Su wildfires on the land



Mat-Su wildfire through time



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Data source: Alaska Interagency Coordination Center

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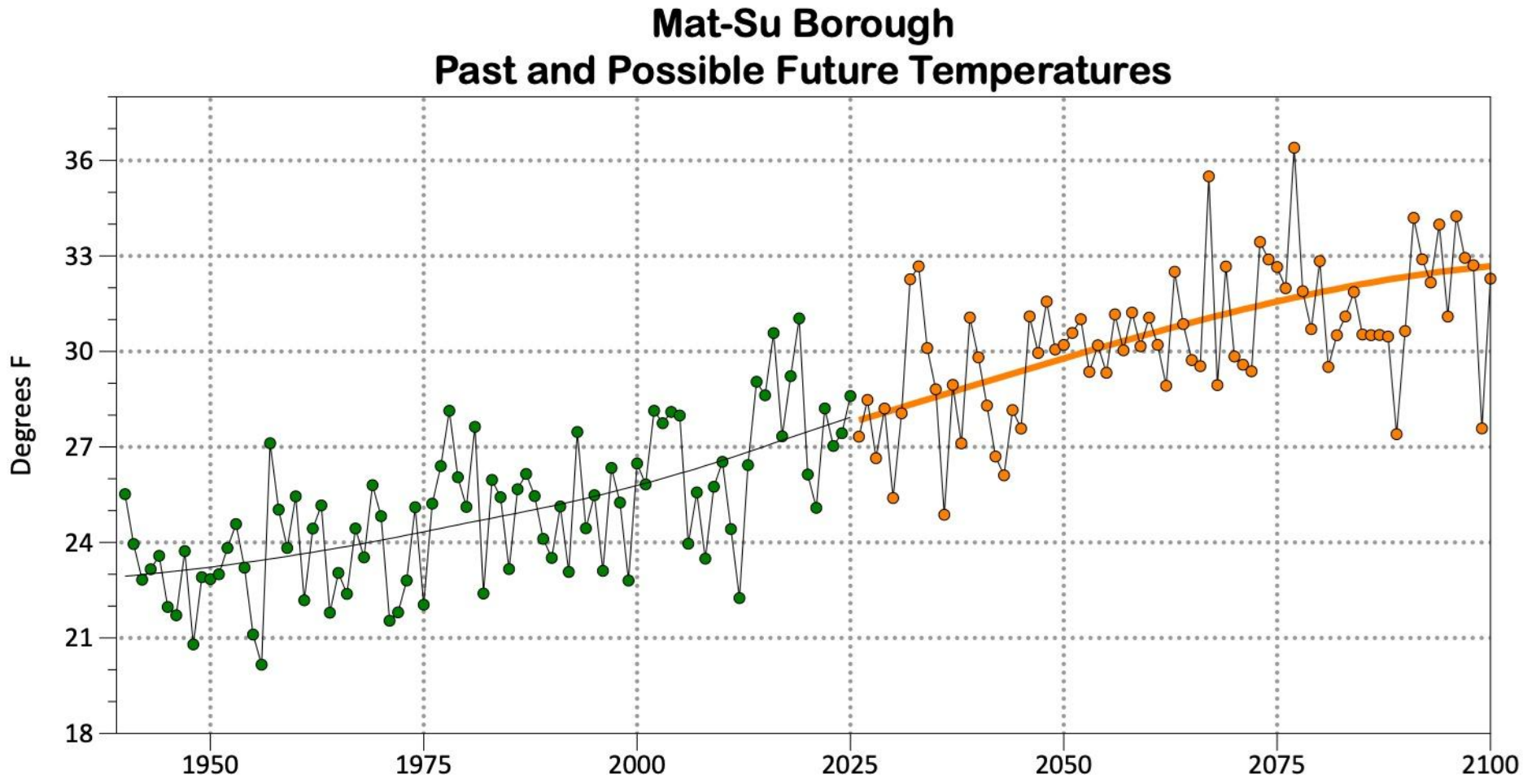
- Possible Mat-Su climate futures
    - Warmer and wetter

Denali

Mat-Su Past and Future



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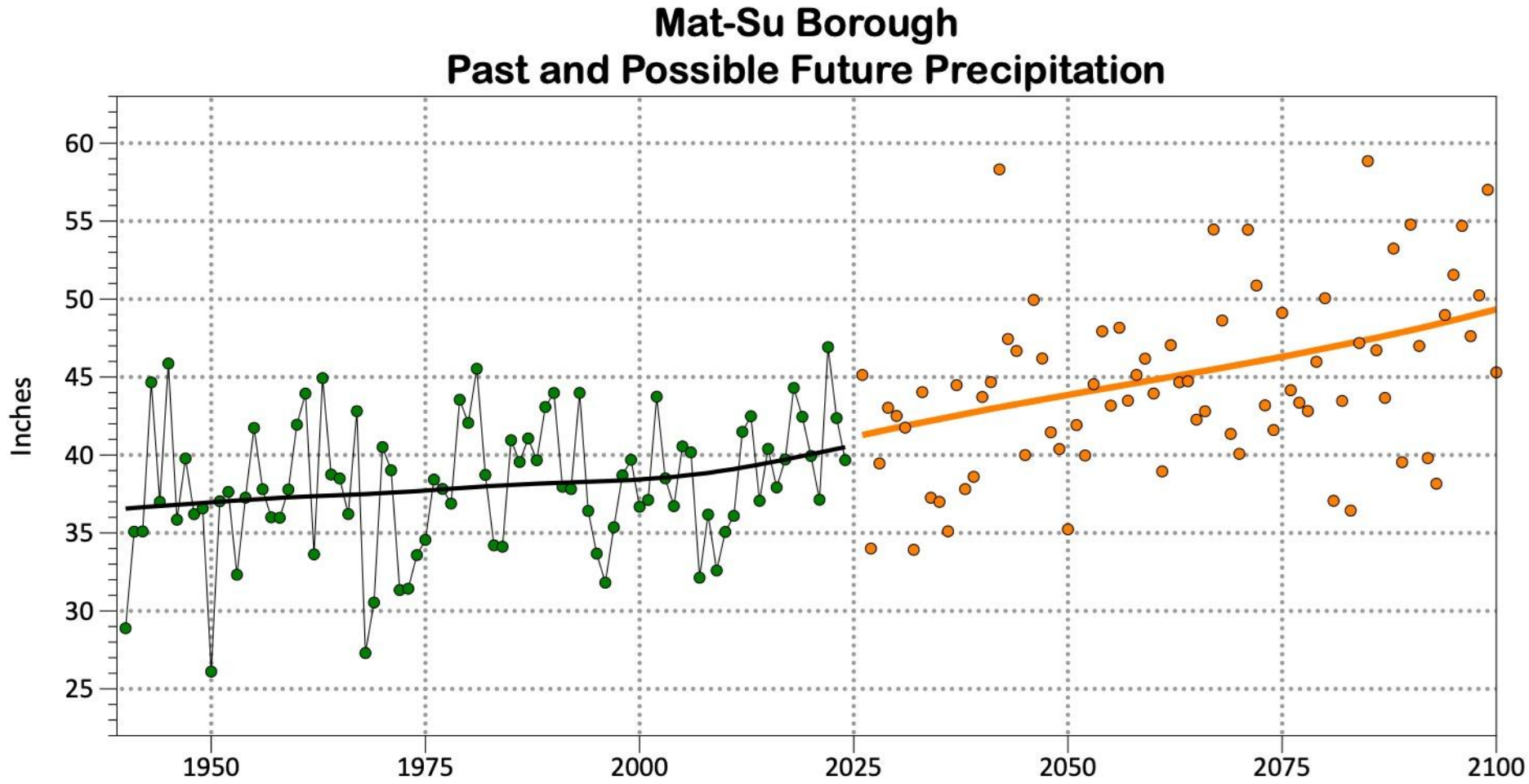
Data source: ERA5 courtesy of ECMWF/Copernicus
UAF/SNAP
Assumes moderate mitigation (RCP 6.0)

Mat-Su Past and Future



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Data source: ERA5 courtesy of ECMWF/Copernicus
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Assumes moderate mitigation (RCP 6.0)

Mat-Su climate summary

Temperatures

Past: rising but slower than other parts of Alaska

Future: continued warming, continued variability

Precipitation

Past: no significant change, high variability

Future: likely increases, continued variability

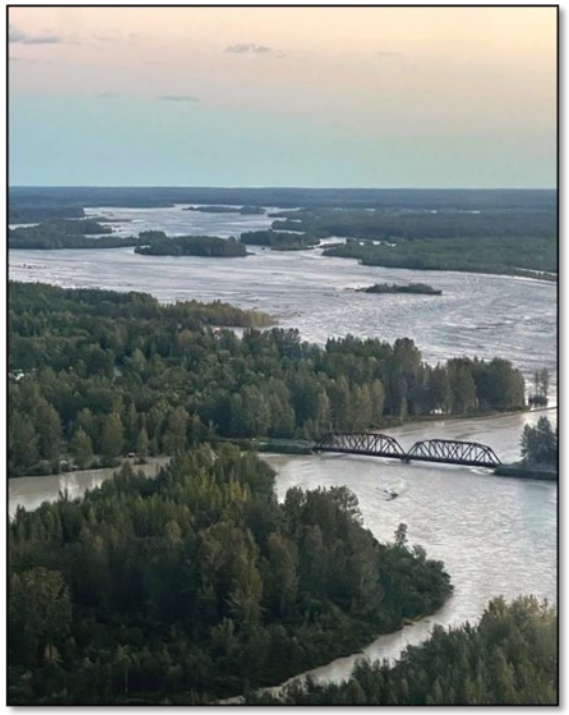
Snow

Past: no significant change in seasonal totals

Changing seasonality of snow

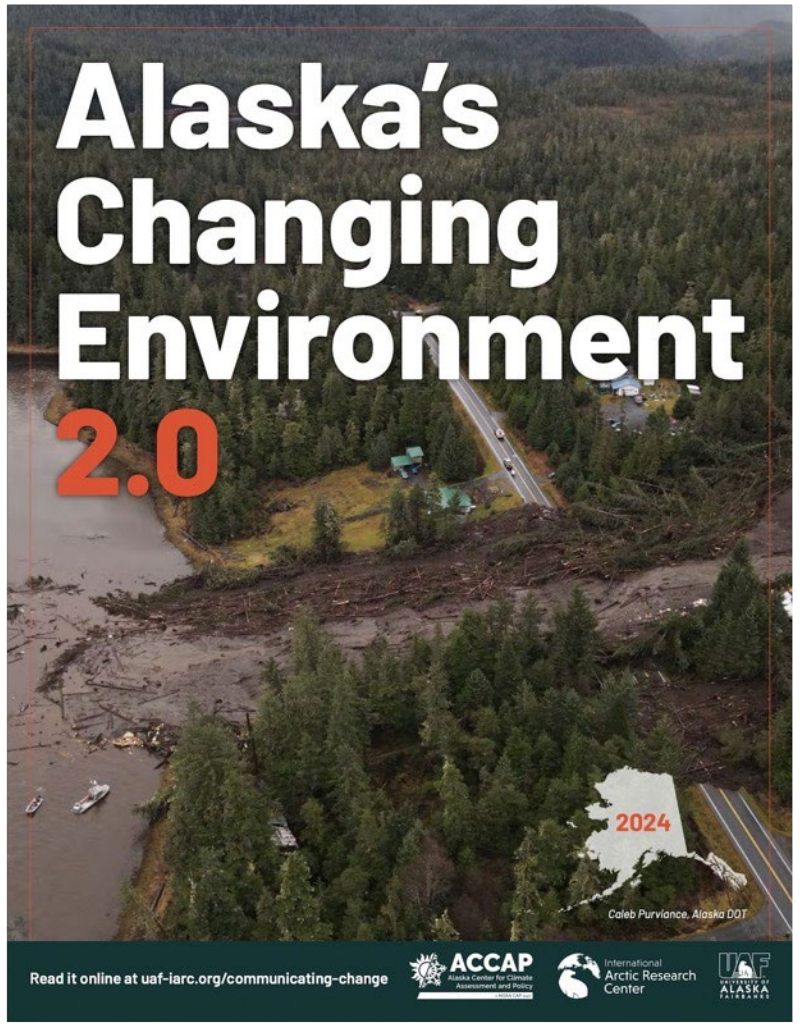
Future: decreasing valley level snow

smaller change in the mountains

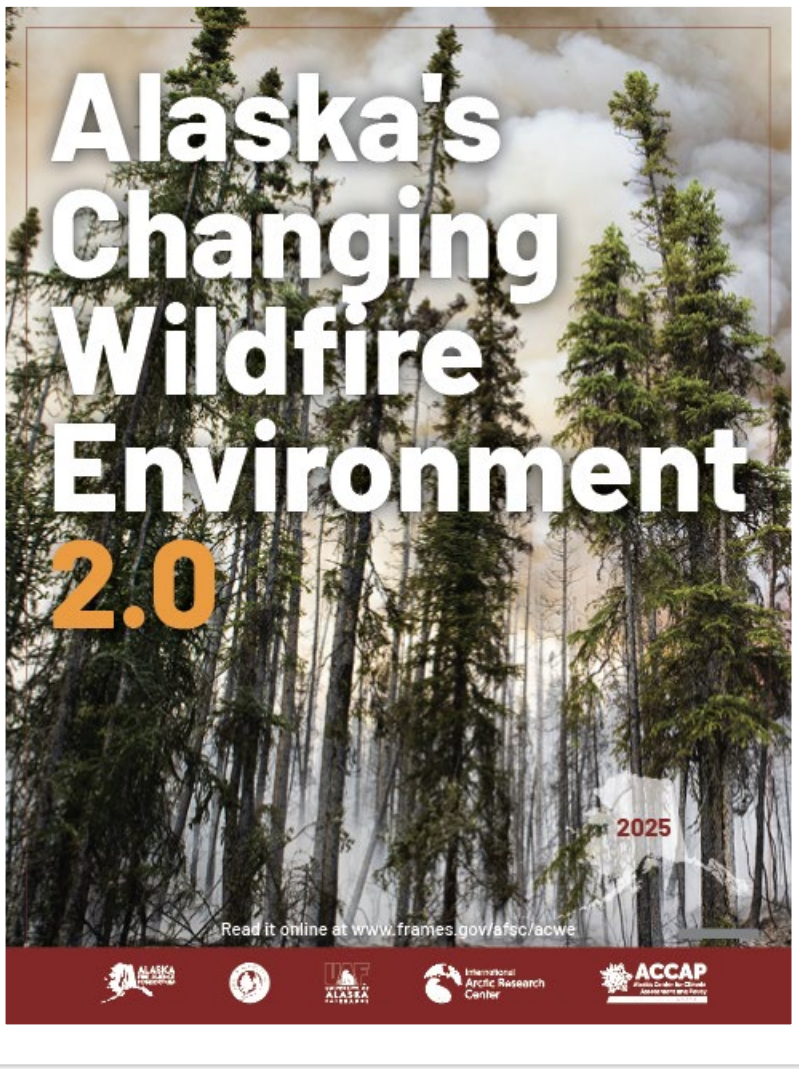


Flooding on the Talkeetna River
August 29, 2025
Photo courtesy K. Writer

ACCAP Alaska focused environmental reports



https://uaf-accap.org/alaskas-changing-environment/



https://www.frames.gov/afsc/ACWE

Basi' Thank you Chin'an

Thanks to **Jessica Speed and the planning committee** for the invitation

More Alaska and Arctic climate and environmental information:

- Alaska Center for Climate Assessment and Preparedness **https://uaf-accap.org/**
  - 100s of climate graphics
  - Mini-library of past extreme events factsheets
  - Monthly climate outlook webinar
- Rick's Alaska and Arctic Climate newsletter https://alaskaclimate.substack.com/
- Rick's social media: BlueSky @AlaskaWx

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