

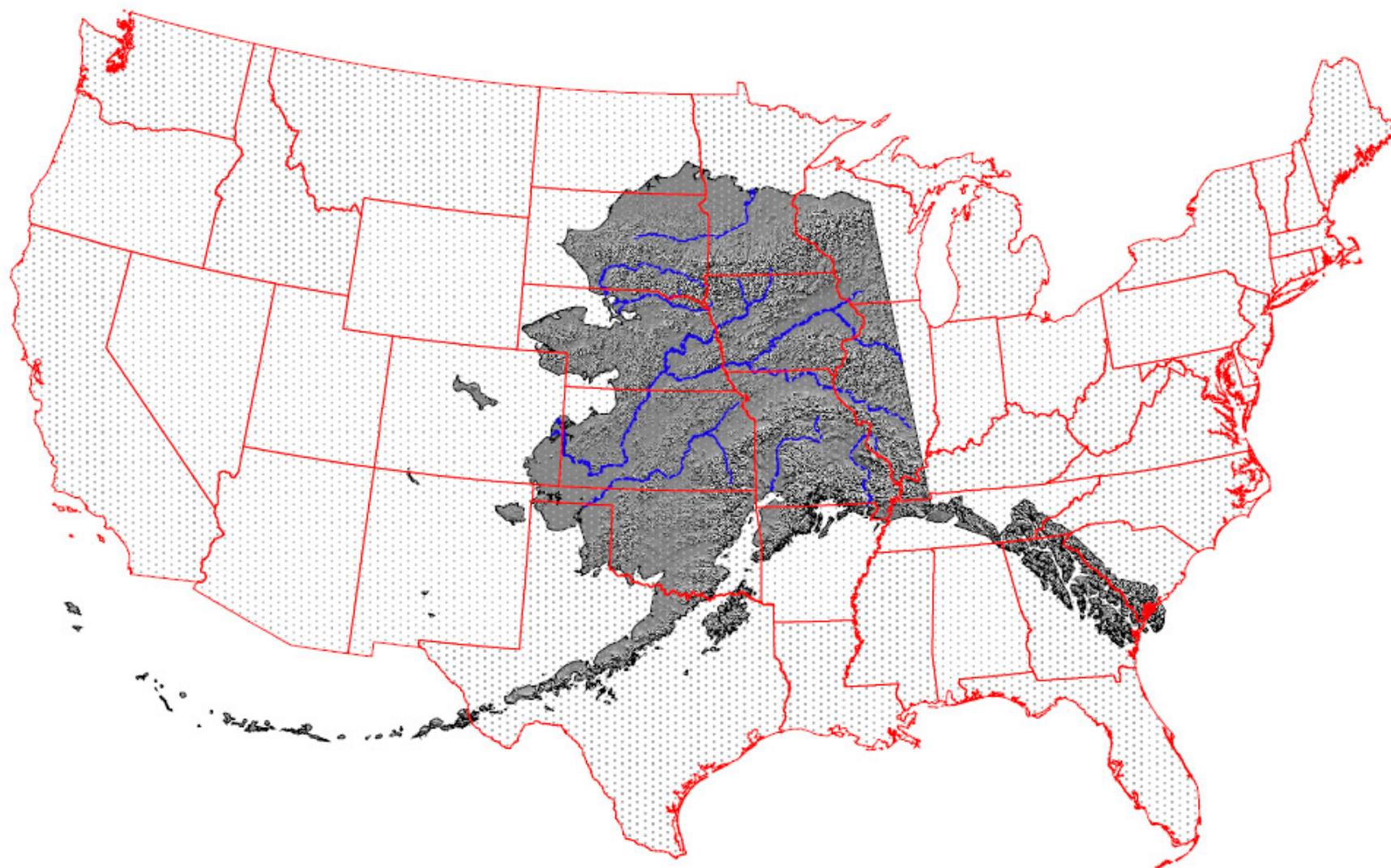
Adapting to Climate Change: Planning, Research and Action

Sarah F. Trainor, John E. Walsh, J. Brook Gamble
Alaska Center for Climate Assessment & Policy
University of Alaska Fairbanks

Photo: Matthew Druckenmiller

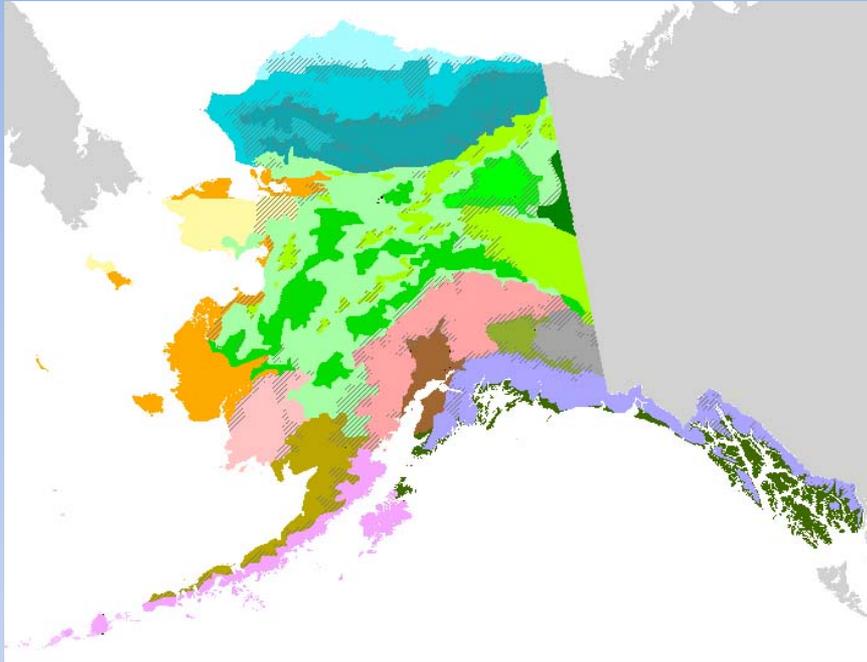


Alaska Superimposed over the Continental United States



500 0 500 1000 Miles

<http://www.ak.nrcs.usda.gov/technical/AKlower48.html>

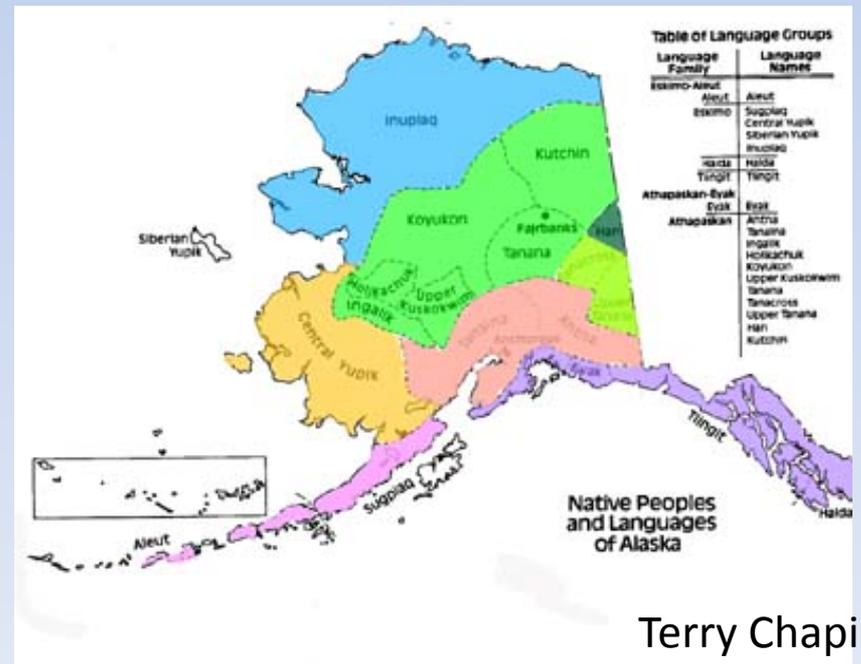


Native Peoples and Languages

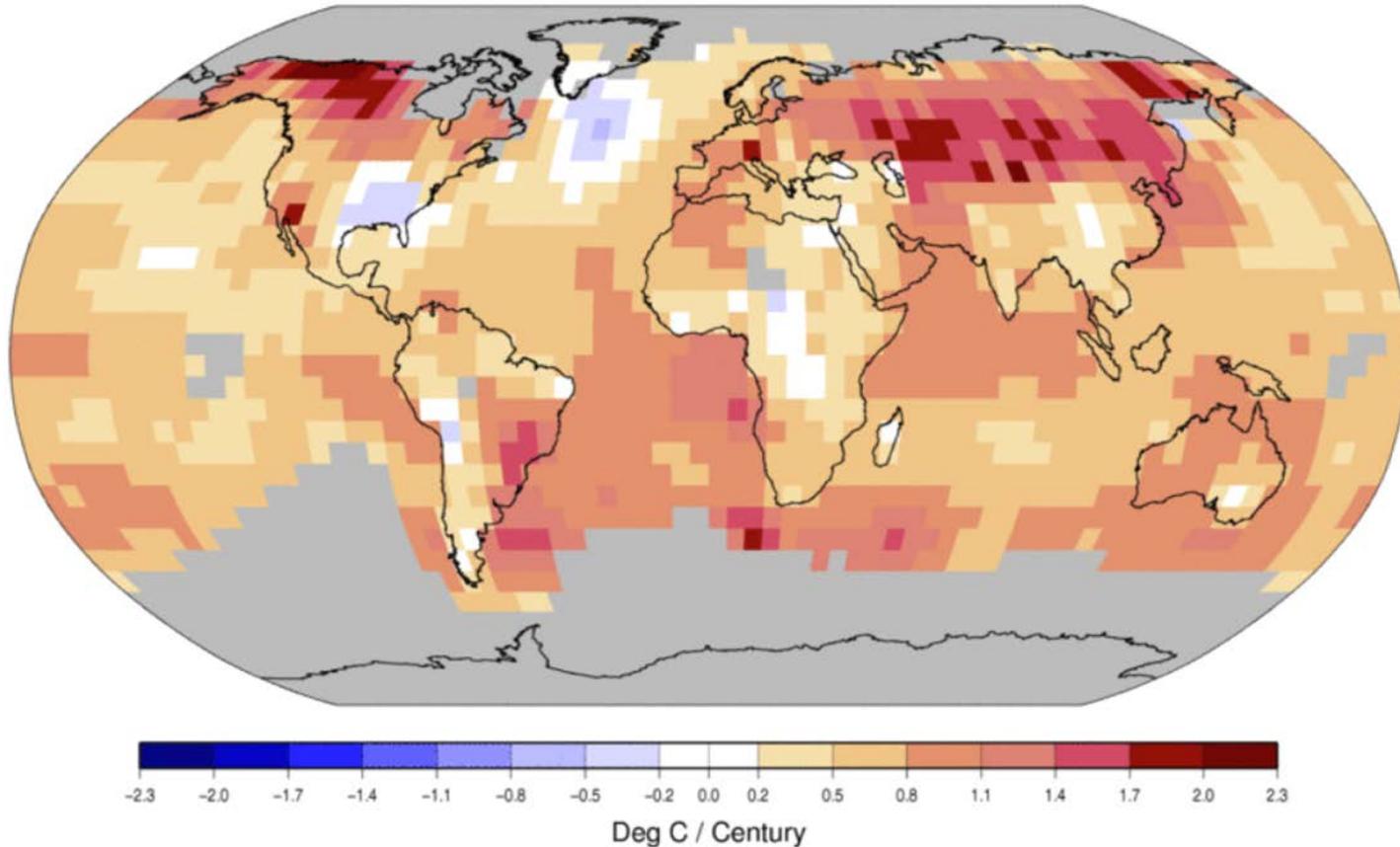
- Inupiat
- Athabaskan
- Yup'ik
- Tlingit/Tsimshian
- Aleut

Ecology

- Tundra
- Tiaga
- Coastal Tundra
- Coastal Rain forest
- Pacific

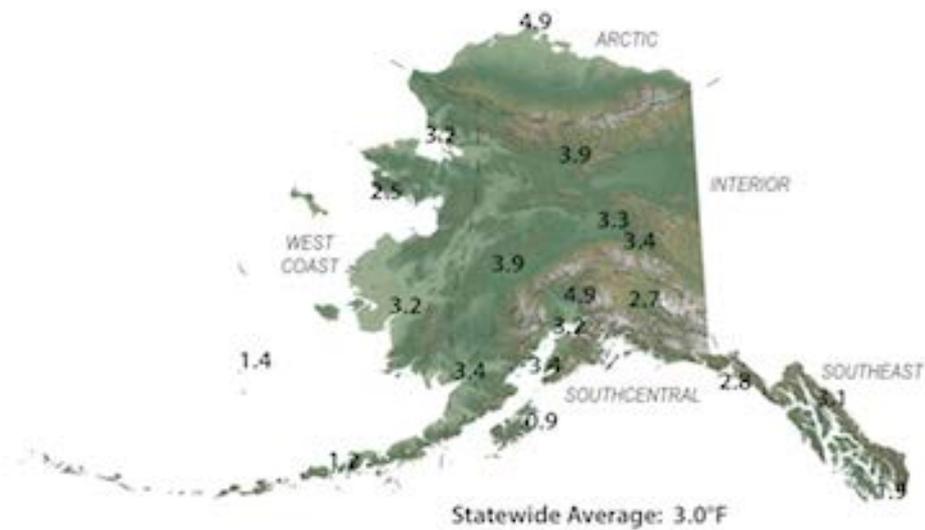


Trend in Annual TMEAN, 1900 to 2009

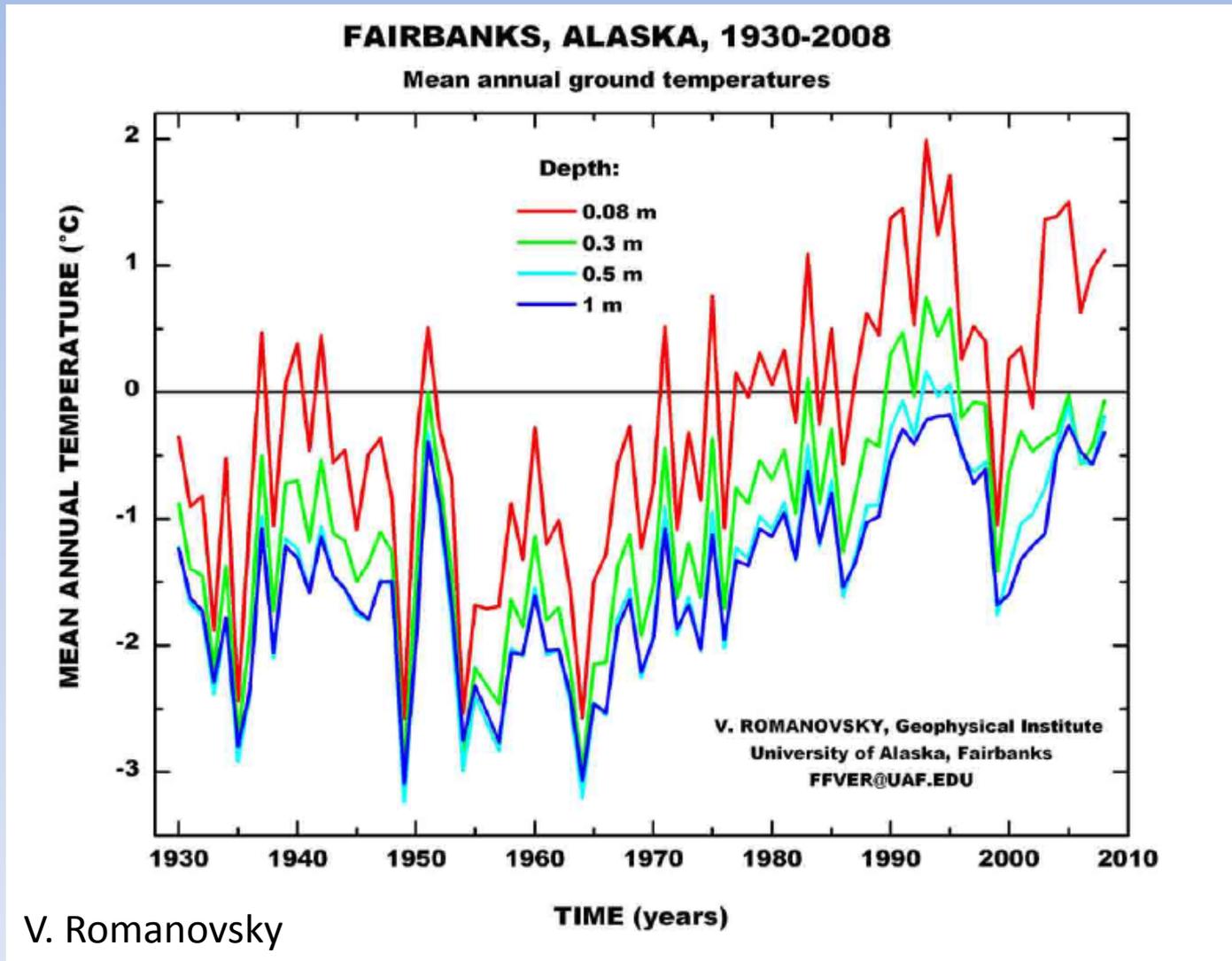


Trend in Annual Mean Temperature, 1900 – 2009, IPCC – J. Walsh

Total Change in Mean Annual Temperature (°F), 1949 - 2011

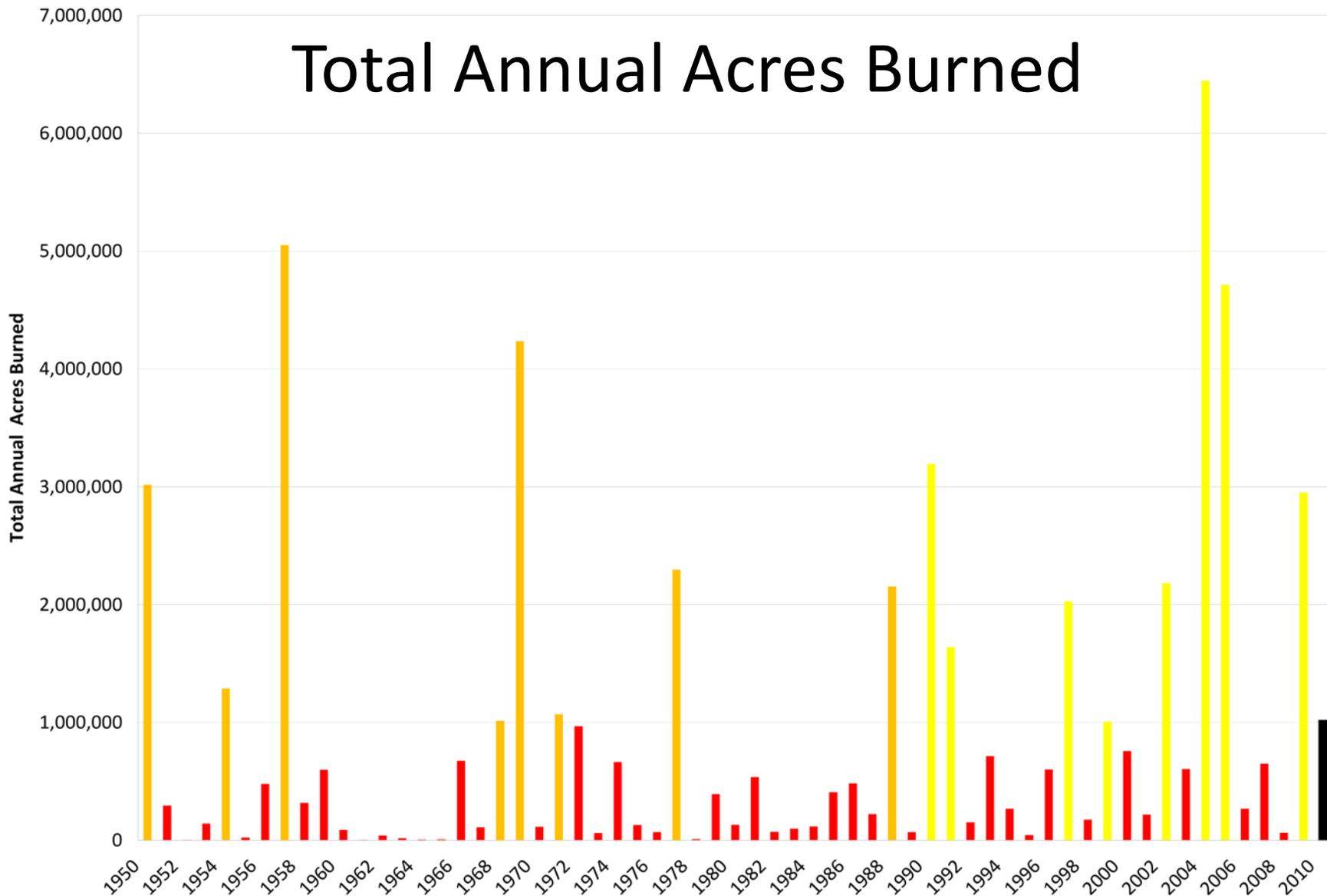


Permafrost temperatures are rising.

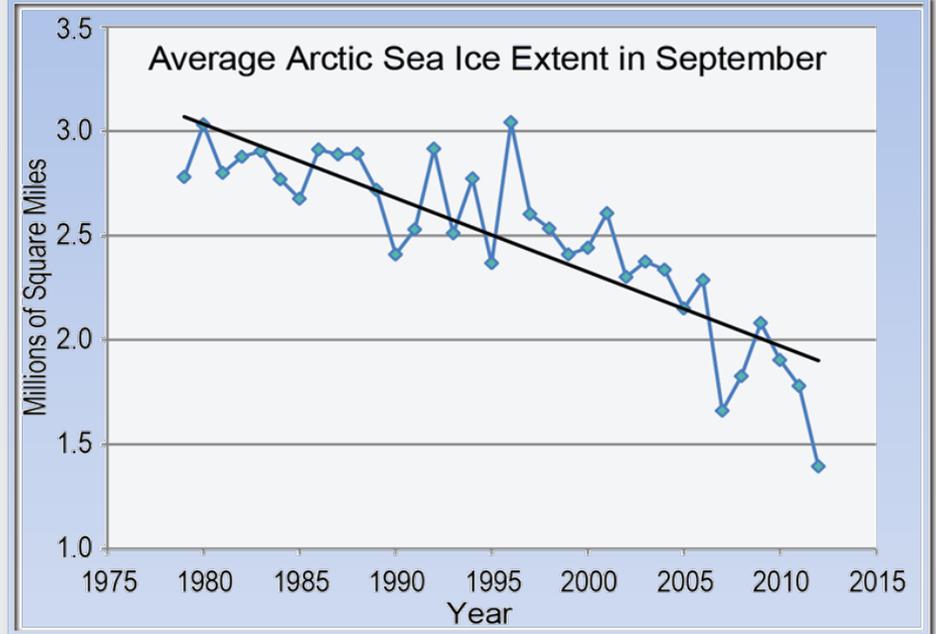
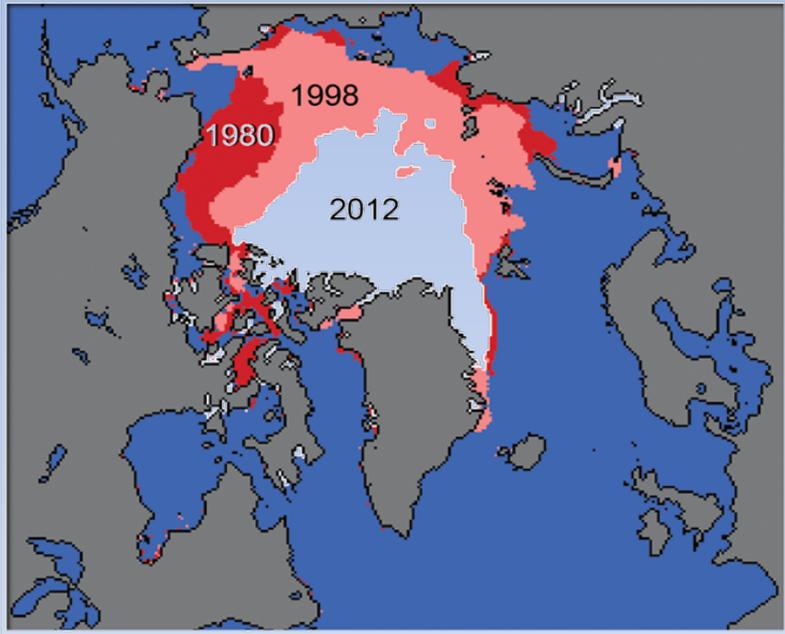


V. Romanovsky

Total Annual Acres Burned



Sea Ice is Declining



NSIDC



These changes have impacts on...

- Infrastructure
- Human health
- Commercial shipping
- Oil & gas industry
- Native subsistence food harvest
- Marine and terrestrial ecosystems



Research Motivation

- Climate change is occurring rapidly in northern latitudes.
- There has been very little documentation to date of adaptive responses to these changes. (Ford et al 2011, Adger et al. 2007, Bierbaum et al. 2012)



M. Brubaker



Research Questions

- What are communities, government and industry doing to respond to these changes?
- How can this inform climate adaptation theory and practice?





We looked at adaptation in a range of “sectors”

- Terrestrial Infrastructure
- Subsistence Food Harvest
- Coastal Vulnerability
- Forestry and Wildfire
- Arctic Shipping
- Commerce
 - Fishing, Oil & Gas



Patrick Kelley



Methods

- Semi-structured interviews (n=16)
- Document Analysis
- Literature Review

Aiming for a broad-
brush overview
Not comprehensive list



Robin Bronen



Results

- Three main categories of response



Categories of response

1. Strategic Planning & Coordination

- International, national, state, regional, local

Alaska's Climate Change Strategy: Addressing Impacts in Alaska



*Final Report
Submitted by the Adaptation
Advisory Group to the Alaska
Climate Change Sub-Cabinet*

January 2010



Categories of response

1. Strategic Planning & Coordination

- International, national, state, regional, local

2. Research & Monitoring

- Terrestrial, marine, weather, human dimensions





Categories of response

1. Strategic Planning & Coordination
 - International, national, state, regional, local
2. Research & Monitoring
 - Terrestrial, marine, weather, human dimensions
3. Action / Activity



Action / Activity - Examples -

- Wildfire
- Subsistence Food Harvest
- Community Relocation
- Commercial Fishing
- Oil & Gas Industry

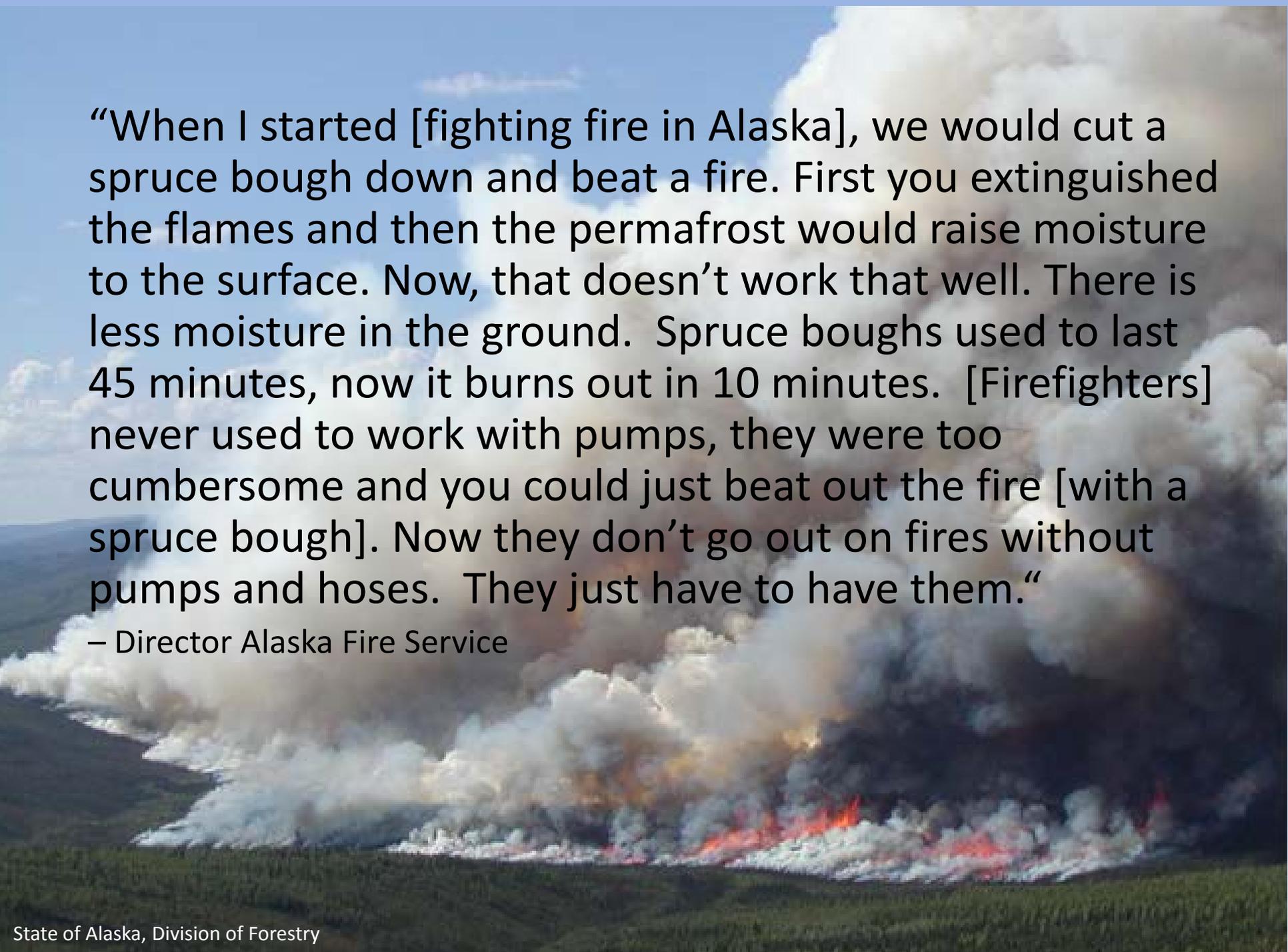


Action - Wildfire

- Statutory change in wildfire season
- Evolution of wildfire fighting tools
- New fire fighter training academy for local crews
- Increasing expenditures on wildfire suppression



Alaska DNR

A large fire is burning in a field, with thick white and grey smoke rising into a blue sky. The fire is visible as a bright orange and red line in the distance, with smoke billowing upwards and outwards. The foreground is a green field, and the background shows a hazy landscape under a clear blue sky.

“When I started [fighting fire in Alaska], we would cut a spruce bough down and beat a fire. First you extinguished the flames and then the permafrost would raise moisture to the surface. Now, that doesn’t work that well. There is less moisture in the ground. Spruce boughs used to last 45 minutes, now it burns out in 10 minutes. [Firefighters] never used to work with pumps, they were too cumbersome and you could just beat out the fire [with a spruce bough]. Now they don’t go out on fires without pumps and hoses. They just have to have them.”

– Director Alaska Fire Service

"In our industry [wildfire suppression], all our responses are reactions. They are not so much planned responses to climate change. "

– Director Alaska Fire Service





Action – Changes in Subsistence Food Harvest

- People altering the timing of harvest
- Some people adjusting to new food species (others are not)



“[Adaptation] is going on because it has to go on. It is a matter of survival and of [people] feeding themselves.” – ADF&G Deputy Commissioner



Patrick Smith, Minto, Alaska. By Phil Loring.



Action – Community Relocation

- Newtok Planning Group and Relocation Efforts
- Other communities in need of relocation



The beginning of a new village...Mertarvik Barge landing, Access road and evacuation center foundation (right). Photo: Harvey Smith, DOT/PF

Challenge of Integrating Traditional Knowledge



“Communities were called into IAWG meetings and participated. There were sessions in Fairbanks and Anchorage and they brought in community members in need. *They are still struggling with how to deal with traditional knowledge [vs scientific knowledge].* For example, they know when shore-fast ice comes in and when storm season traditionally starts. The communities share with use the observations of change in physical environment and change in animals and subsistence, i.e. vegetation differences and differences in species.” - State Planner



Action – Commercial Fishing

- Risk averse and adaptive management implemented (North Pacific Fishery Management Council)
- Response to vibrio outbreaks - “lantern nets” for shellfish harvest



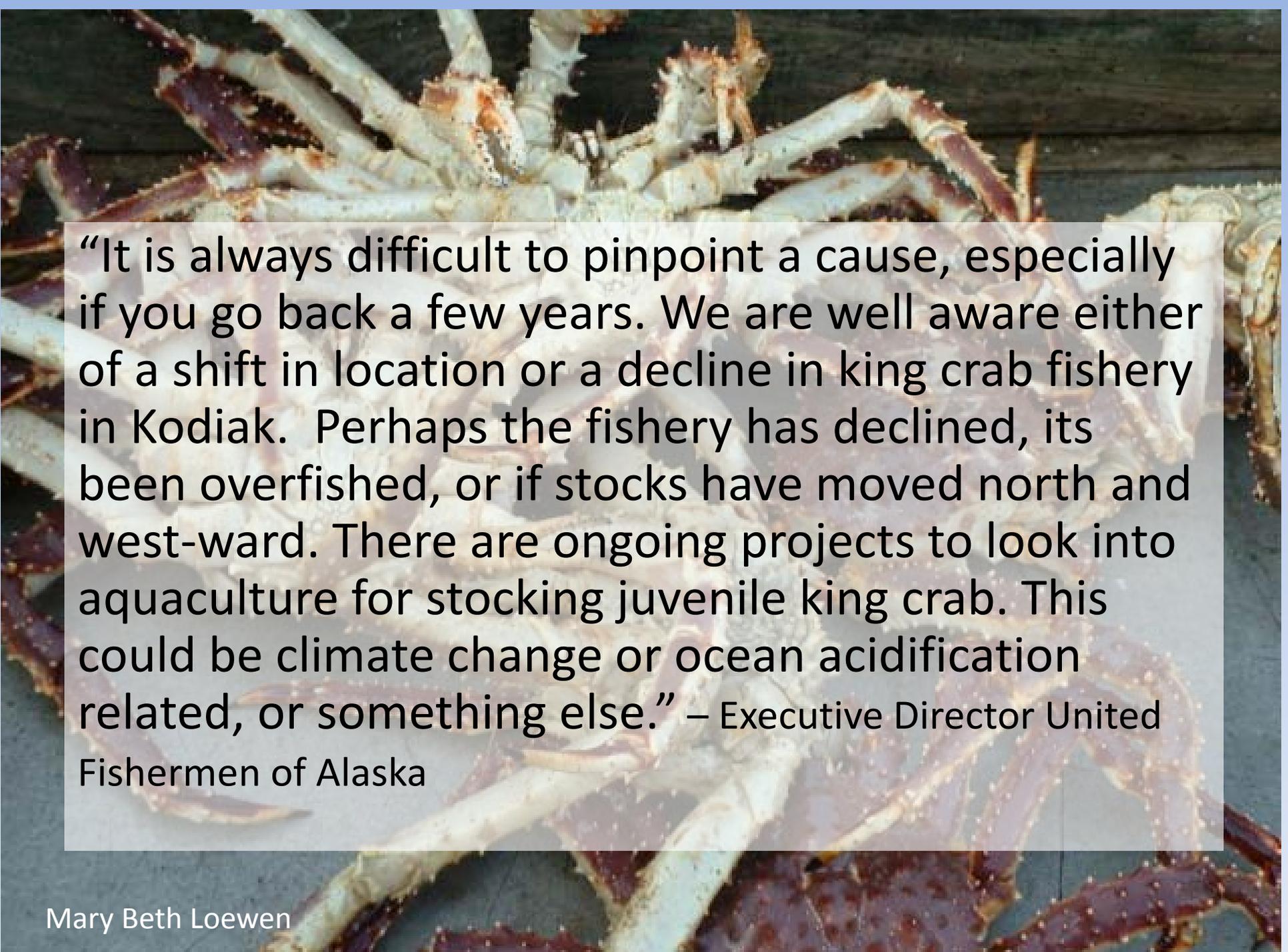
<http://www.man.eu>



HomerNews.com



“Most adaptation has been on an individual basis. It is simply a response to changes in the fisheries or the marine environment. People wouldn’t necessarily identify themselves as responding to climate change.” – Sea Grant Agent



“It is always difficult to pinpoint a cause, especially if you go back a few years. We are well aware either of a shift in location or a decline in king crab fishery in Kodiak. Perhaps the fishery has declined, its been overfished, or if stocks have moved north and west-ward. There are ongoing projects to look into aquaculture for stocking juvenile king crab. This could be climate change or ocean acidification related, or something else.” – Executive Director United Fishermen of Alaska



Action – Oil & Gas Industry

- Vulnerability Assessments
- Adjusting operations for worker health and safety
 - Tundra wildfire, lightening
- Adjusting operations for threatened species
 - Moving and closing ice roads to avoid polar bear on-shore dens
- Adjusting operations for efficiency
 - Two supply routes for river sites to avoid disruption from flooding
 - New methods for ice road construction to adjust to shorter season

An aerial photograph of a large industrial facility, likely an oil or gas processing plant, situated in a coastal wetland area. The facility features numerous green-roofed buildings, storage tanks, and complex piping. A large body of water, possibly a lagoon or bay, surrounds the site, with a narrow channel or inlet in the foreground. The surrounding landscape is flat and marshy, with patches of water and low-lying vegetation. The sky is overcast with grey clouds.

“Adaptation is all local.”
(Oil and Gas Industry Consultant)



Multiple Stressors

- Climate change does not occur in isolation.
- Communities, industry and government face multiple stressors and changing conditions





Summary: Action Occurs...

- At a local scale
 - Wildfire suppression exception
- As a response to immediate conditions, not necessarily implementation of planning
 - Oil & gas industry exception
- In response to multiple stressors
- Not necessarily in deliberate response to climate change



And there are disconnects...

- Planning
 - Proactive, but may never be implemented



And there are disconnects...

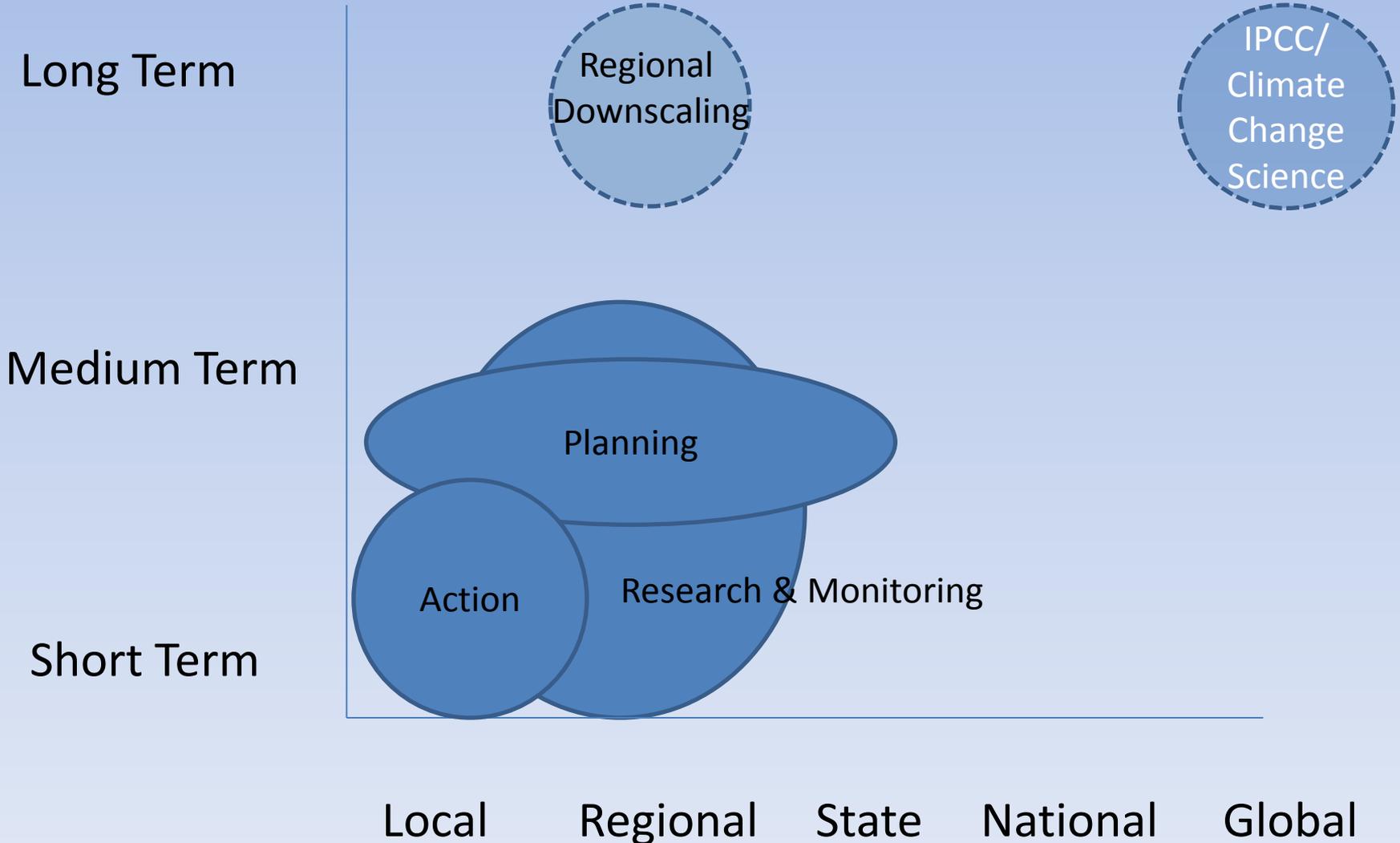
- Planning
 - Proactive, but may never be implemented
- Research & Monitoring
 - Compiles information, but is it relevant to planning and action?



And there are disconnects...

- Planning
 - Proactive, but may never be implemented
- Research & Monitoring
 - Compiles information, but is it relevant to planning and action?
- Actions and Activities
 - Not necessarily implementation of planning
 - Not necessarily deliberate response to information from research

Temporal and Spatial Map





Implications for Supporting or Promoting Climate Adaptation

- Develop local resources to be responsive
 - Access to information, networks
 - Flexible and creative thinking
 - Awareness of local conditions and multiple stressors



Implications – Continued...

- “Bottom-up” adaptation proceeds irrespective of “top-down” planning
 - Cross-scale learning to build adaptive capacity
- Questions the role of scientific information in adaptation action



Future Research Directions

- Comprehensive assessment of adaptation action in specific sectors
- Cross-sectoral comparisons
- Assessing adaptation effectiveness across time and space
- Motivations for actions
- What role does climate science really play in adaptation?
- Lessons from the hazards coping literature

Thank You



sarah.trainor@alaska.edu



Percent of stations in each region displaying increasing trends in occurrence of warm extremes and decreasing trends in frequency of cold extremes in spring (1950--2008)

Region	Warm Extremes	Cold Extremes
Arctic*	100%	100%
West Central	100%	100%
Interior	100%	100%
Southwest	100%	100%
South Central	100%	100%
Southeast	71%	86%

*Only one station (Barrow) had sufficient data for this analysis.

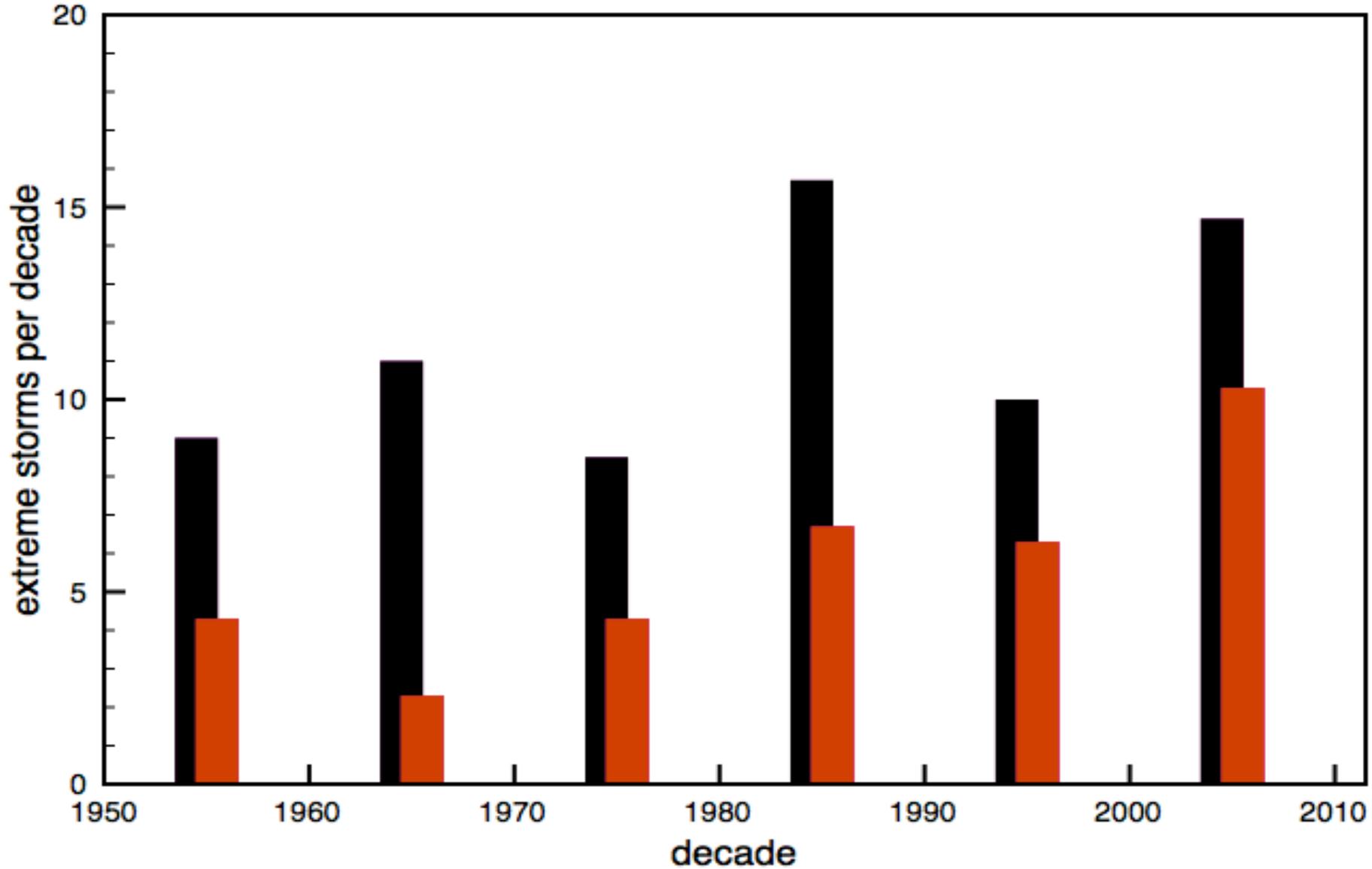
Percent of stations in each region displaying increasing trends in occurrence of extreme 3--day precipitation events from 1950 to 2008.

Region	Winter	Spring	Summer	Fall
Arctic*	0%	0%	0%	0%
West Central	67%	100%	0%	67%
Interior	33%	50%	50%	50%
Southwest	50%	25%	25%	75%
South Central	40%	40%	40%	60%
Southeast	71%	57%	43%	57%

*Only one station (Barrow) had sufficient data for this analysis.

Extreme storm events by decade, northern Alaskan coast

[red = open water]



Total Change in Mean Seasonal and Annual Temperature (°F), 1949 - 2011

<i>Region</i>	<i>Location</i>	Winter	Spring	Summer	Autumn	Annual
<i>Arctic</i>	Barrow	7.3	4.8	3.2	4.5	4.9
<i>Interior</i>	Bettles	7.2	4.7	1.8	1.6	3.9
	Fairbanks	7.0	3.9	2.3	0.1	3.3
	Big Delta	9.0	3.6	1.1	0.2	3.4
	McGrath	7.4	4.7	2.5	1.0	3.9
<i>West Coast</i>	Kotzebue	6.6	1.8	2.7	1.7	3.2
	Nome	4.5	3.1	2.3	0.4	2.5
	Bethel	6.7	4.3	1.8	-0.1	3.2
	King Salmon	8.0	4.1	1.2	0.6	3.4
	St Paul	0.7	1.4	2.3	1.1	1.4
	Cold Bay	1.5	1.2	1.5	0.8	1.2
<i>Southcentral</i>	Talkeetna	8.9	5.4	2.9	2.5	4.9
	Gulkana	7.5	2.4	0.8	0.1	2.7
	Anchorage	5.8	3.5	1.4	1.7	3.2
	Homer	5.4	3.4	2.8	1.4	3.4
	Kodiak	1.3	2.0	1.1	-0.5	0.9
<i>Southeast</i>	Yakutat	5.4	3.0	2.1	0.7	2.8
	Juneau	6.4	2.9	2.0	1.3	3.1
	Annette	3.9	2.3	1.7	0.2	1.9
	Average	5.8	3.3	2.0	1.0	3.0



Strategic Planning & Coordination - Highlights -

- Occur on international, national, state, municipal and local levels
- Includes state funding for community hazard assessment and adaptation planning

I.C.L.E.I Local Governments for Sustainability

Fairbanks Economic Development Corporation

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IIC News

Climate Change Taskforce

Steering Committee:

Luke Hopkins

lukethopkins@yahoo.com

Sarah Trainor

fsft@uaf.edu

Karl Monetti

karlmonetti@gmail.com



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Strategic Planning – International/Federal

- Arctic Council – implementation plan for Arctic Marine Shipping Assessment
- Alaska Executive Climate Change Roundtable
- NOAA Regional Climate Directors
- US Navy – Arctic Roadmap
- Arctic Shield Program



Strategic Planning – State

- Governor’s Sub-Cabinet on Climate Change
 - Adaptation, Mitigation, Research Needs, Immediate Action Advisory Groups and Technical Working Groups
 - ADF&G – Climate Change Strategy Document
- Alaska Climate Change Impact Mitigation Program (ACCIMP)
- Northern Waters Task Force



Strategic Planning – Municipal

- Municipal planning and vulnerability assessment
 - ICLEI (Homer, Fairbanks, Juneau)
 - ACCIMP grant recipients (Shishmaref, Kivalina, Newtok, Koyukuk, Unalakleet and Shaktoolik)

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Research & Monitoring - Highlights -

- Wide range of disciplines & topics
- Federal, state, industry, university, non-profit



Doug Kane



Research & Monitoring – Who?

- NOAA, BOEMRE, NPS, BLM, USFWS
- US Coast Guard
- DOI Climate Science Center
- USFWS – Landscape Conservation Cooperatives
- Kachemak Bay Research Reserve
- USGS Alaska Science Center
- Alaska Dept. of Fish & Game
- Alaska Dept. of Transportation
- Alaska Dept. of Environmental Conservation
- American Water Works Association
- Sitka Public Utilities
- Cook Inlet Keeper
- University scientists
- Private industry



Research & Monitoring – Weather

- Coastal storm events
- Off-shore weather buoys
- Remote Automated Weather Stations (RAWS)



Doug Kane



Research & Monitoring – Marine & Coastal

- Changes in fisheries and marine ecosystems
- Sea ice dynamics – land-fast & off-shore
- Ocean temperature & currents
- Invasive species monitoring
- Marine hydrographic data
- Ocean Acidification
- Sea level rise
- Tide stations
- Bathymetry





Research & Monitoring – Terrestrial

- Health, population dynamics, migration of subsistence species; salmon, moose, caribou, etc.
- River and stream water temperatures
- Carbon sequestration and release
- Impacts on forested ecosystems
- Rates of glacial mass loss
- Permafrost temperature
- Wildfire extent





Research & Monitoring – Human Dimension

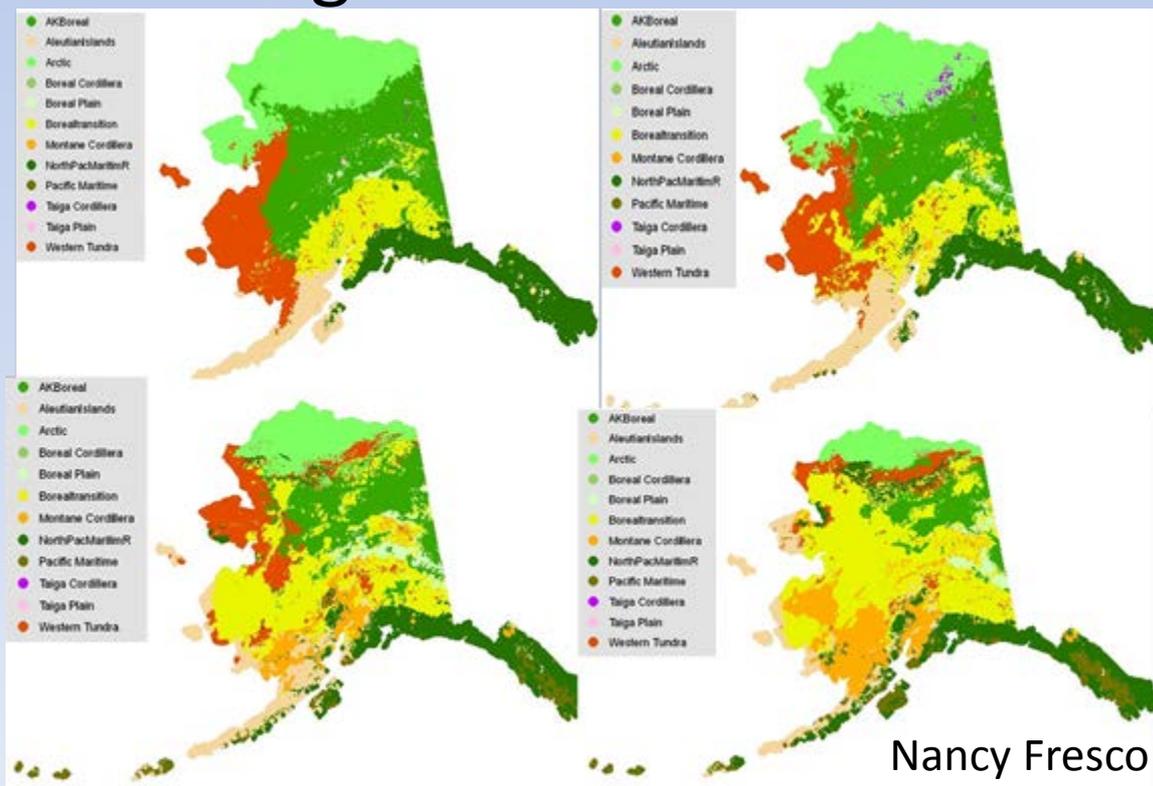
- Traditional Ecological Knowledge
- Impacts on hydropower utilities
- Infrastructure impacts
- Local observations
- Human health
- Ship traffic





Research & Monitoring – Modeling

- Impacts on subsistence species
- Modeling for oil spill response
- Fire and vegetation change
- Biome shifts





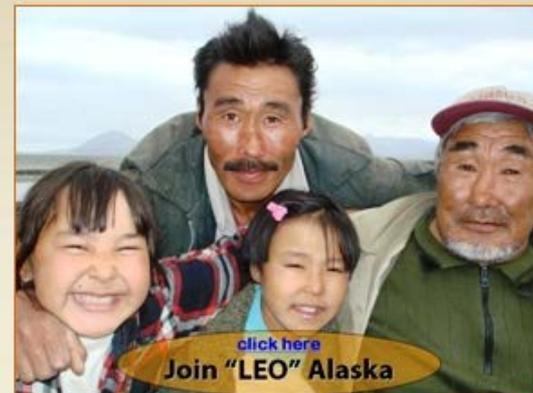
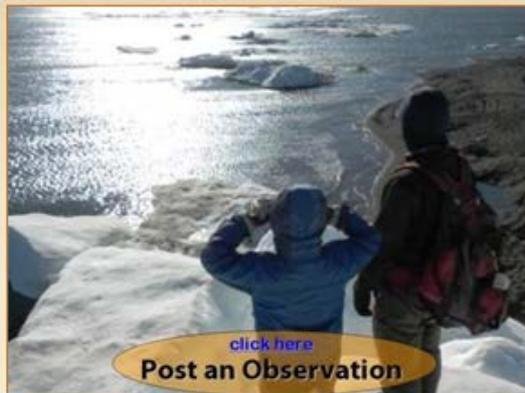
Local Community Observer Programs

- NWS – weather and river ice observers
- ANTCH – local environment observer
- Invasive species



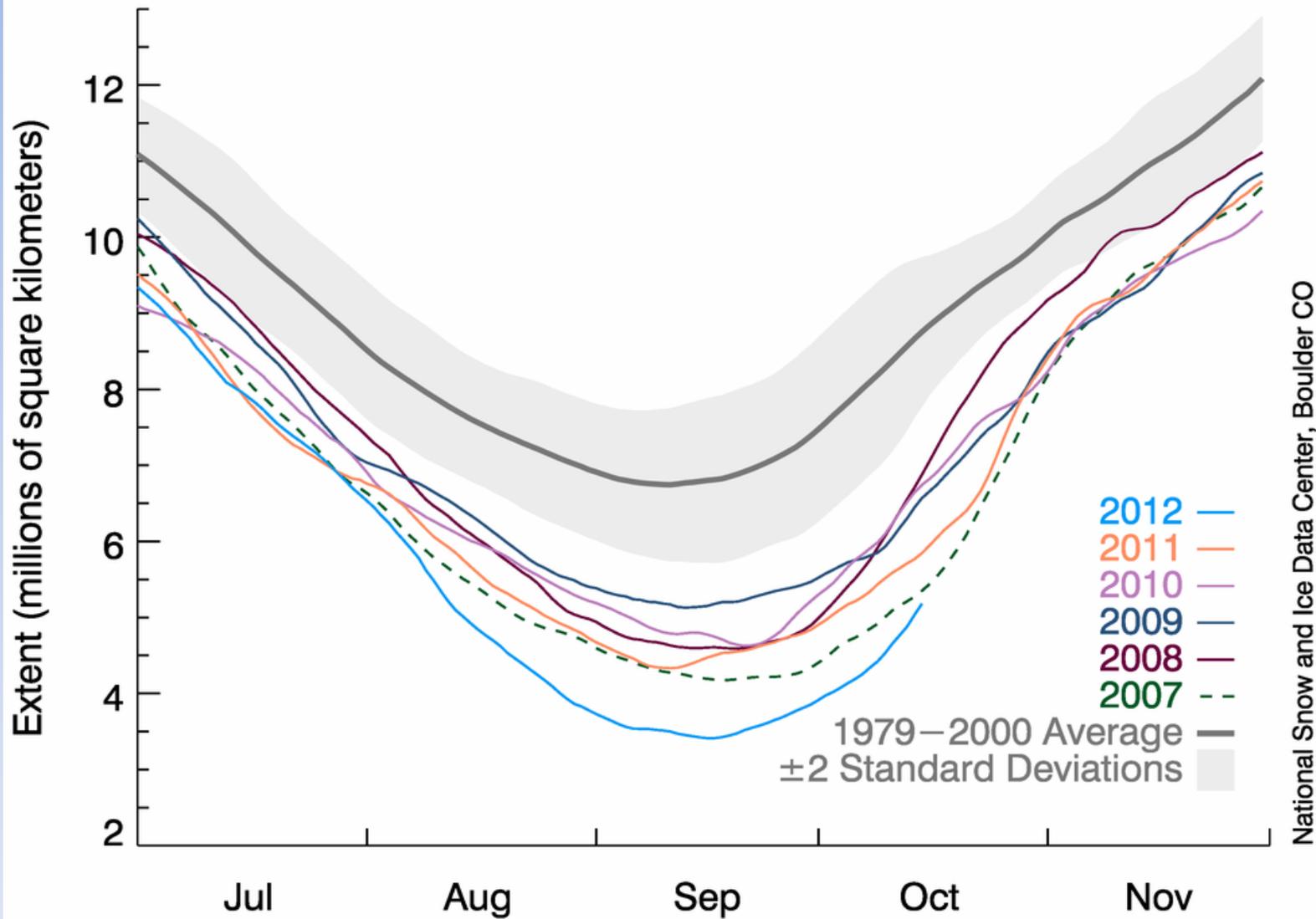
Local Environmental Observer (LEO) Network

Arctic communities are changing due to environmental impacts, climate change and development. Monitoring the environment is important for understanding the risks and benefits and for adaptation. The LEOs are the eyes, ears and voice of environmental change in Alaska communities.



<http://www.anthc.org/chs/ces/climate/leo/>

Arctic Sea Ice Extent (Area of ocean with at least 15% sea ice)



National Snow and Ice Data Center, Boulder CO



Contributions to Climate Adaptation Literature

- Most climate adaptation literature assumes that adaptation will result from planning, implementation and monitoring initiated by municipal, state or national governments, or by outside organizations. (Adger et al, 2009)
- This research shows that at least some adaptation action in Alaska occurs as response to immediate conditions, often on at an individual or community scale, and can occur without direct attribution to climate change per se.