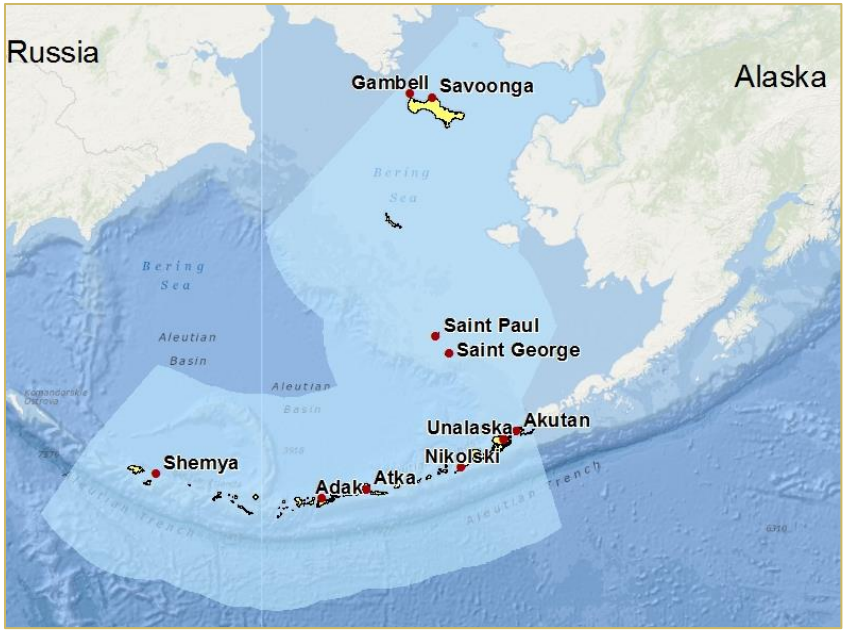
Aleutian & Bering Climate Vulnerability Assessment - ABCVA



Note, 9.22.14:
Responses in this session were collected in real time using Key Points audience response technology on 9/18 from an audience of about 40 individuals with responses to individual questions ranging from 20-35+ people. These insights will help guide the ABCVA team as look to make prioritized recommendations to the leadership of the sponsoring organizations.

Unalaska Lecture & Community Discussion- September 2014

AOOS Alaska Ocean Observing System

AK CSC Alaska Climate Science Center

absi Aleutian and Bering Sea Islands Landscape Conservation Cooperative

AGNEW::BECK

More at: https://absilcc.org

Who we are

Aaron Poe

US Fish and Wildlife Service, Aleutian Bering Sea Islands Landscape Conservation Cooperative

Ellen Tyler - Alaska Ocean Observing System

Nick Bond – University of Washington

Steve Gray

Alaska Climate Science Center

Chris Beck & Meghan Holtan

Agnew::Beck Consulting (facilitators)

Origin of this Project: The Aleutian and Bering Climate Vulnerability Assessment

- **Which?** Identify resources or ecosystems expected to be most affected by climate change (*what, where, when?*)
- **Why?** Understand the forces – the "*environmental* stressors" – driving resource change, including interactions among stressors
- **Impacts?** Potential vulnerability
  - Frequency of exposure to adverse changes
  - Magnitude of risk to services & resources
  - Adaptive capacity of managers & stakeholders

- **Information Needs?** Identify priority research recommendations
- **Options to Adapt?** Begin a dialog about potential adaptation strategies in the region.

*NWF 2011 publication: *Scanning the Conservation Horizon: A guide to Climate Change Vulnerability Assessment*

Purpose of the Meeting

- **Start a dialogue** on climate change impacts between communities and researchers
- **Listen** and take advantage of what local residents are observing about changes in the local environment
- **Share and discuss** emerging research results
- **Prioritize** future research

What have you noticed?

Where should we direct research?

Agenda

Introductions

Topic #1 Physical Changes in the Local Environment – "Environmental Drivers"

Audience Polling; Discussion

Topic #2 Changes in Marine Life + Coastal Sea Life

Audience Polling; Discussion

Topic #3 Impacts to People+ Communities

Audience Polling; Discussion

Topic #4, Greatest Concerns, Adaptation, Research Priorities

Next steps

We ask:

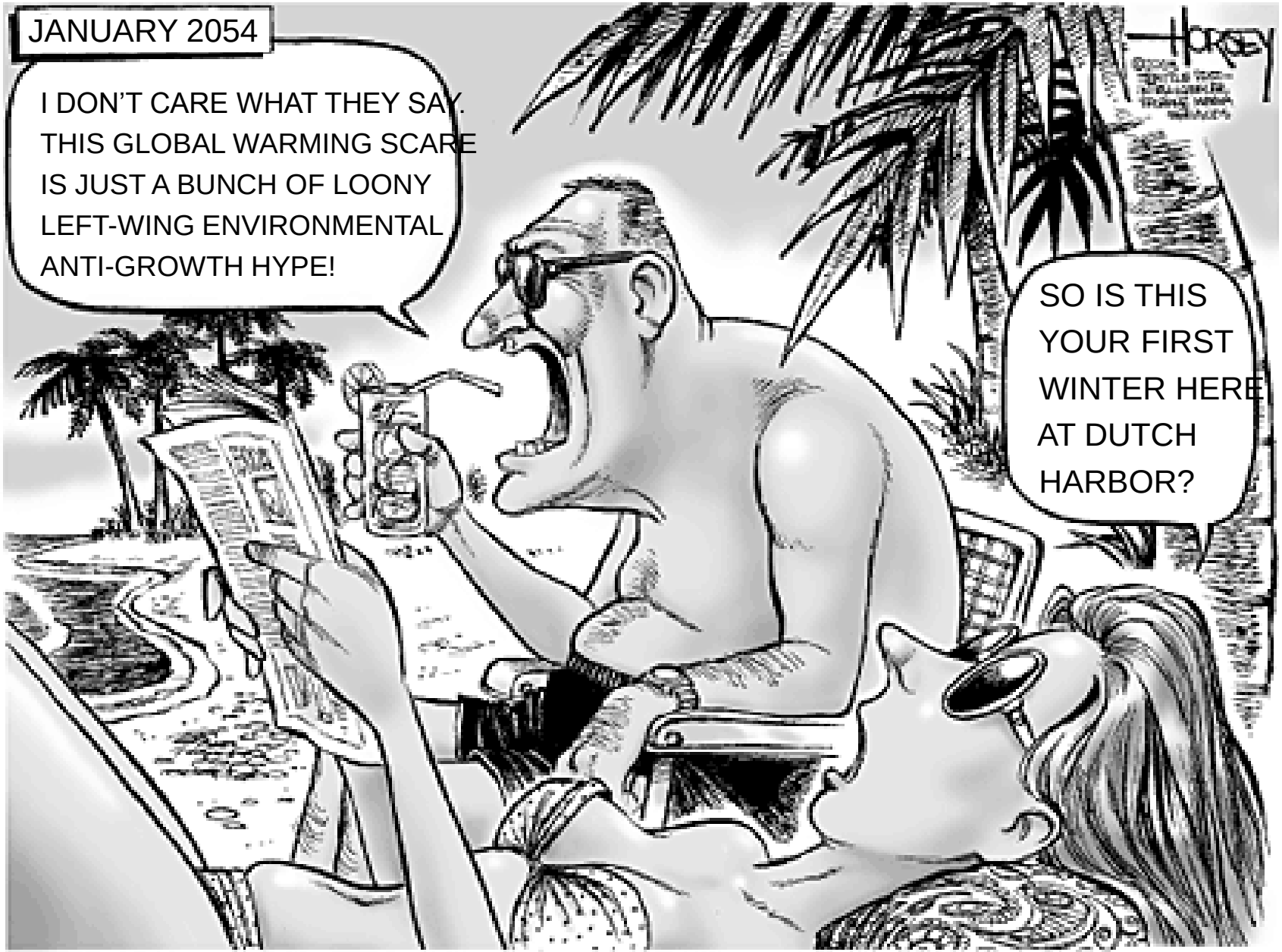
- "Tolerance for imprecision"
- Big picture thinking
- Help getting through a full agenda

Why are your views critical?

- The global climate is changing.
- Observed changes in Alaska are some of the most rapid in the world.
- Climate change could affect local communities in profound ways, some good, some bad, many unknown.
- Our job is to direct publically funded research to benefit landscapes and the people who live in them. We need your help.

Topic # 1

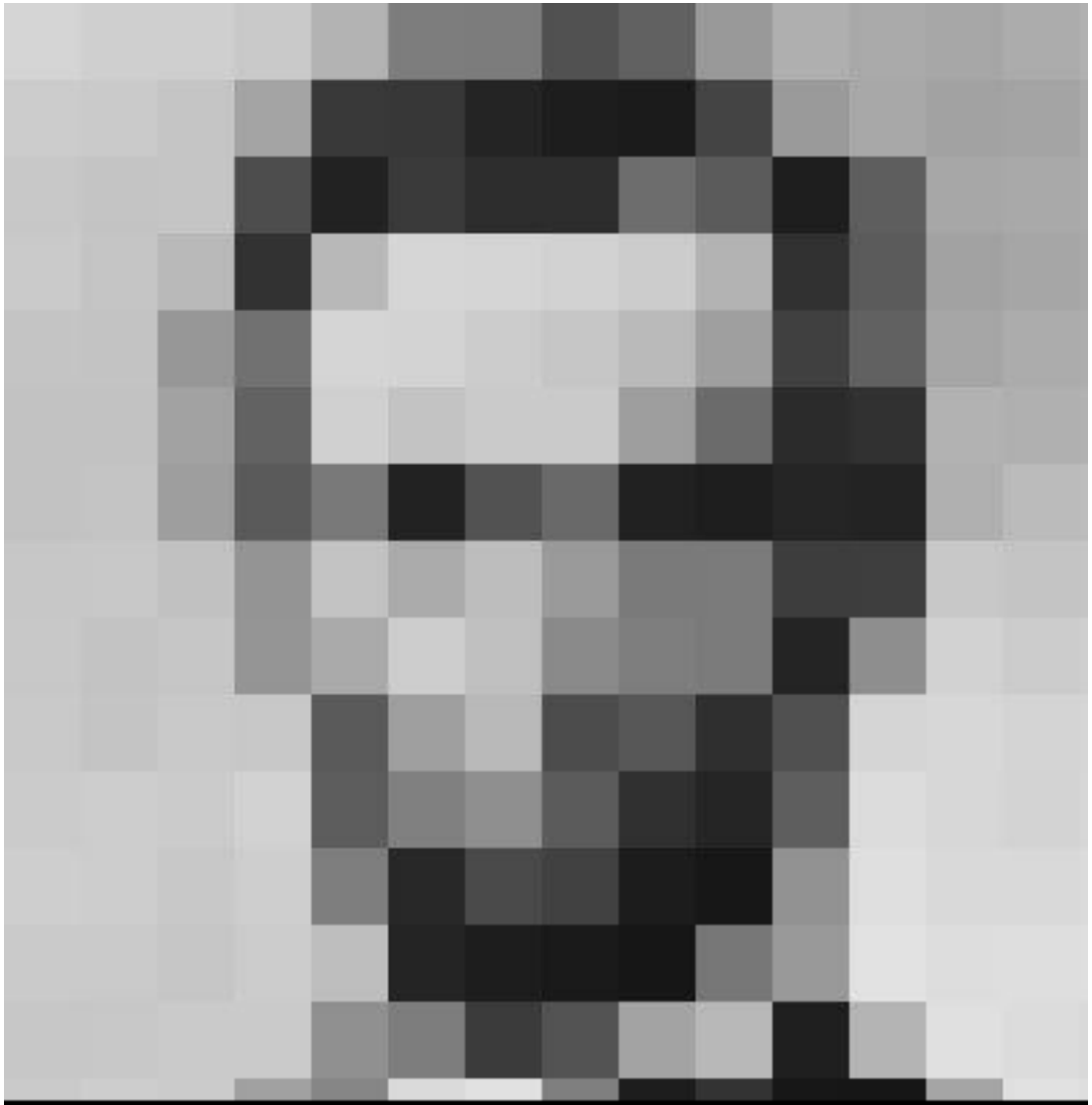
Physical Changes in the Local Environment

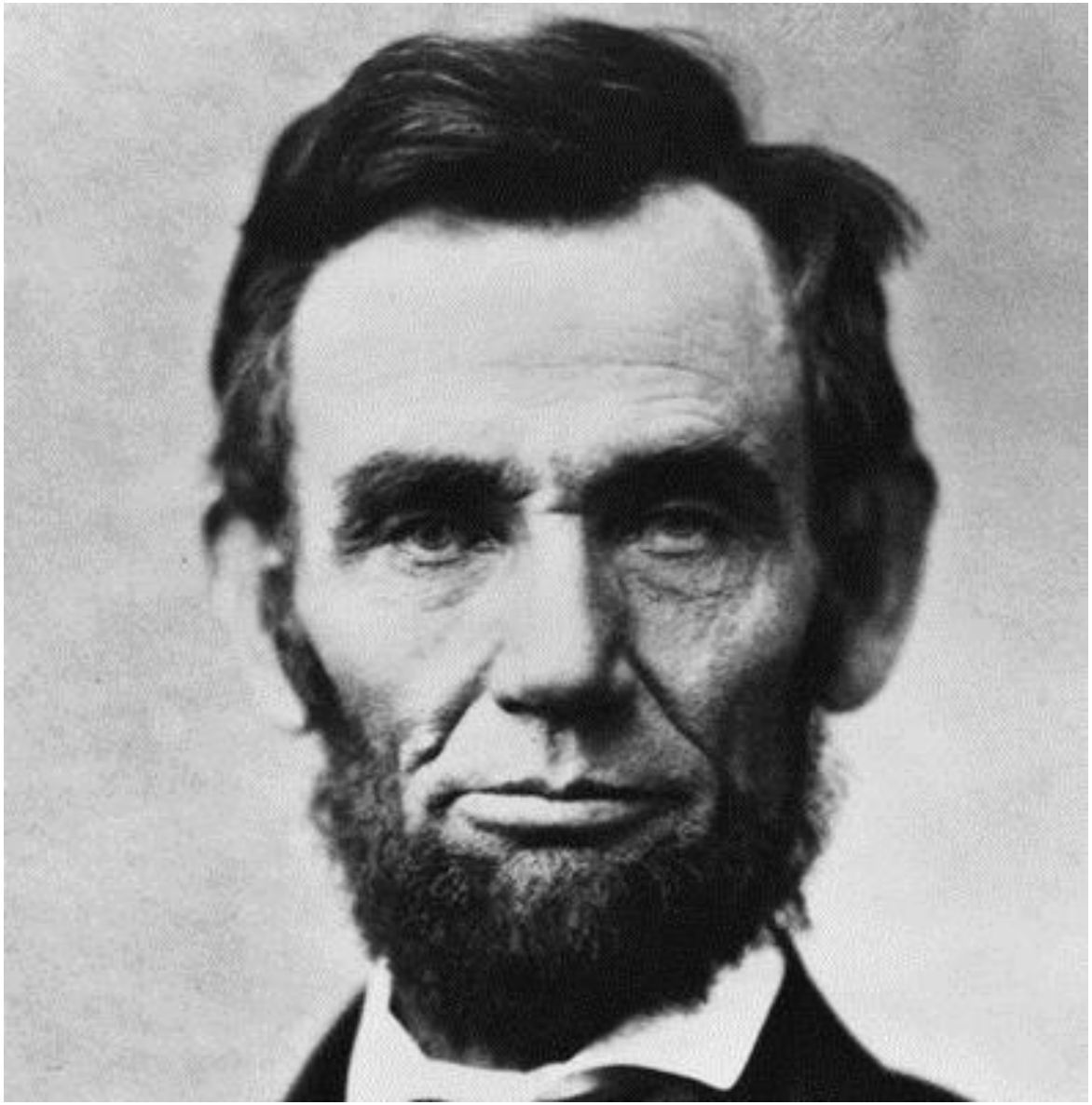

JANUARY 2054
I DON'T CARE WHAT THEY SAY. THIS GLOBAL WARMING SCARE IS JUST A BUNCH OF LOONY LEFT-WING ENVIRONMENTAL ANTI-GROWTH HYPE!
SO IS THIS YOUR FIRST WINTER HERE AT DUTCH HARBOR?
HORSEY

Climate Models

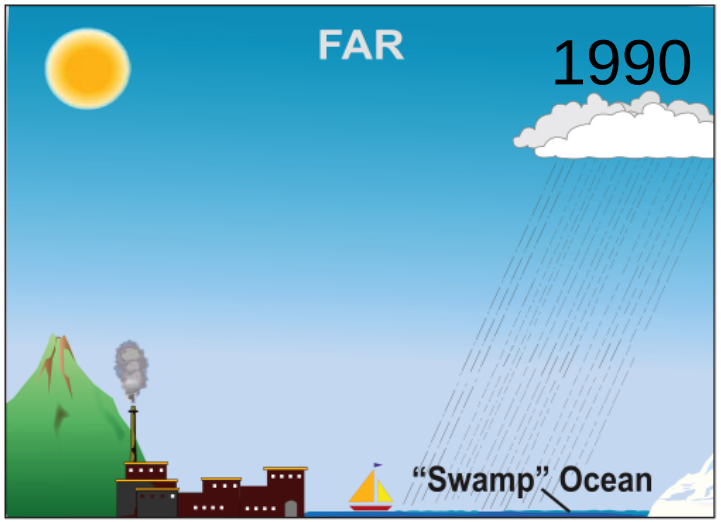
- Simulations from global climate models are being used to anticipate the likely impacts of climate change at the regional level

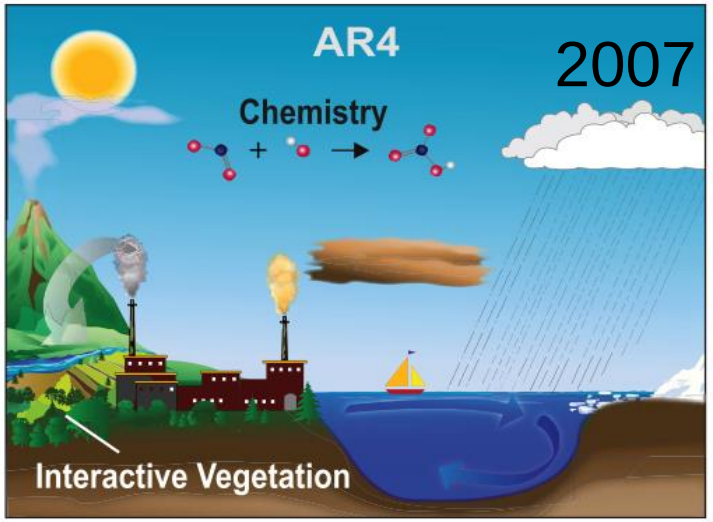
- Present climate models are far from perfect, but are still the best tool we have for projecting future conditions

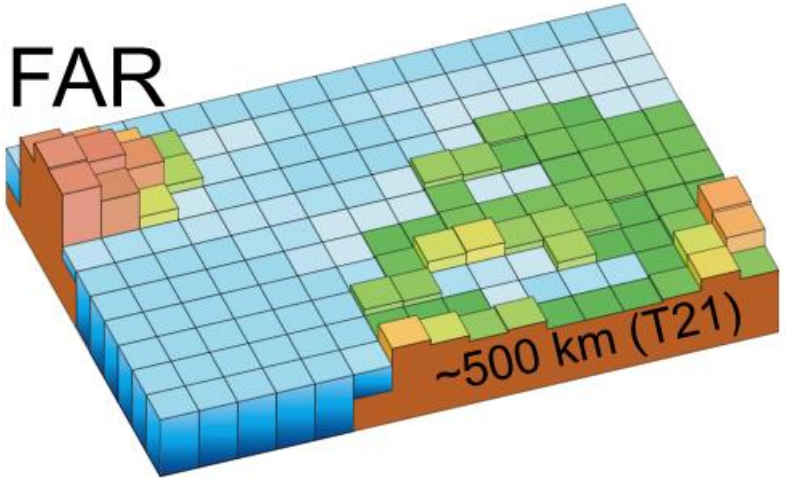

Click Through For Solution >>

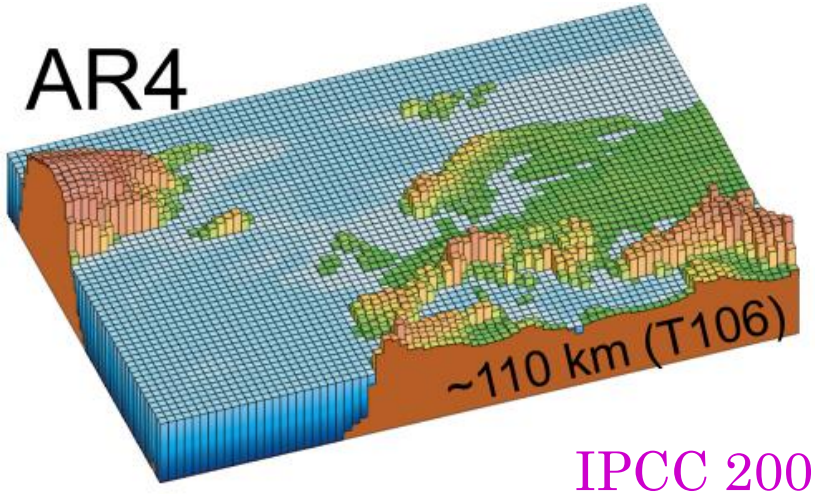


Progress in Climate Modeling









IPCC 2007

Please pull out your clicker and wait for instructions!

How to Use the Clickers

1. When submitting responses, please point your clicker at the laptop.
2. After entering your response, hit "Send."
3. If the question asks for more than one response, hit send after each response.
4. Raise your hand if you have questions.

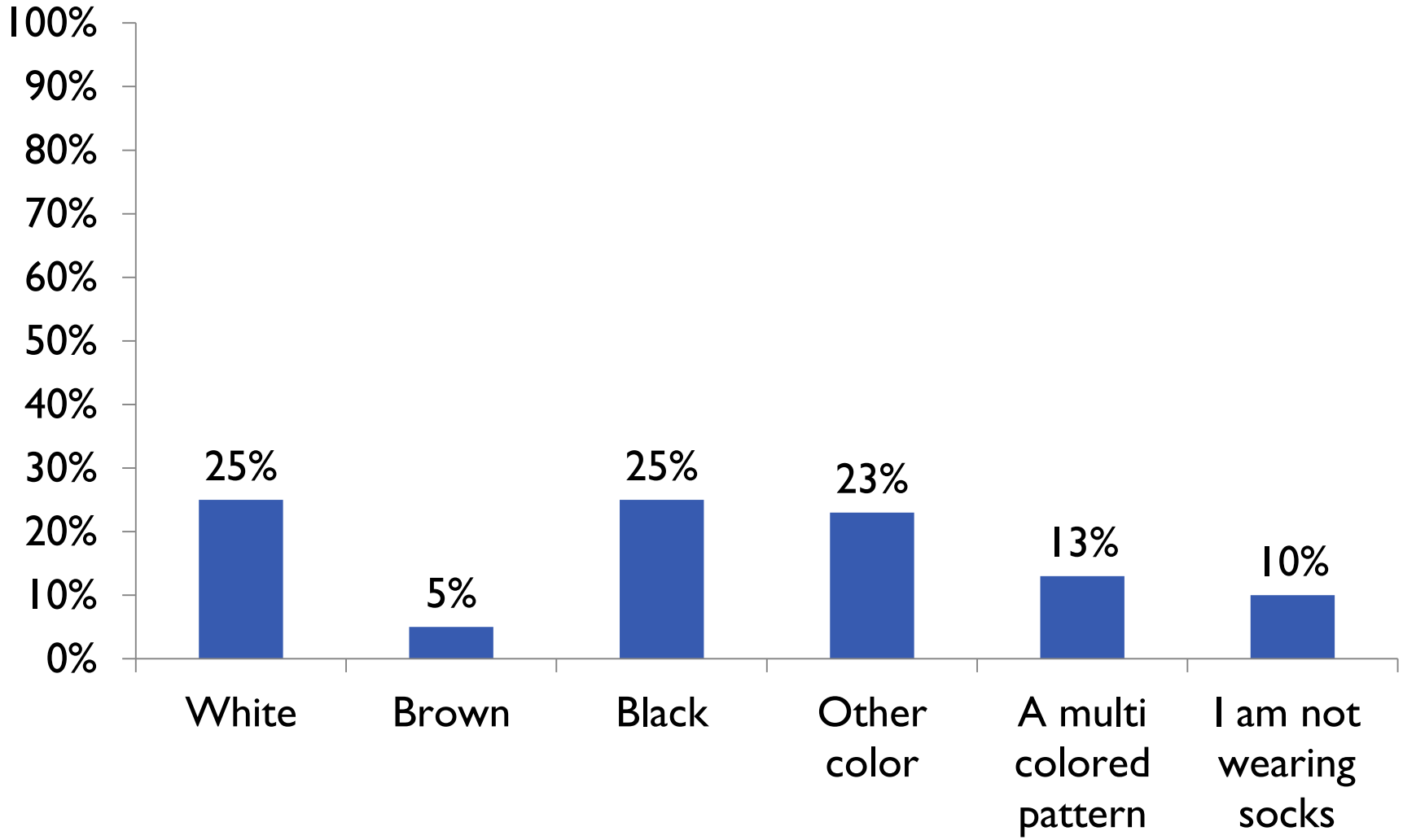
 = slide has a question for the audience

Warm-up

What color socks are you wearing?

1. White
2. Brown
3. Black
4. Other color
5. A multi colored pattern
6. I am not wearing socks

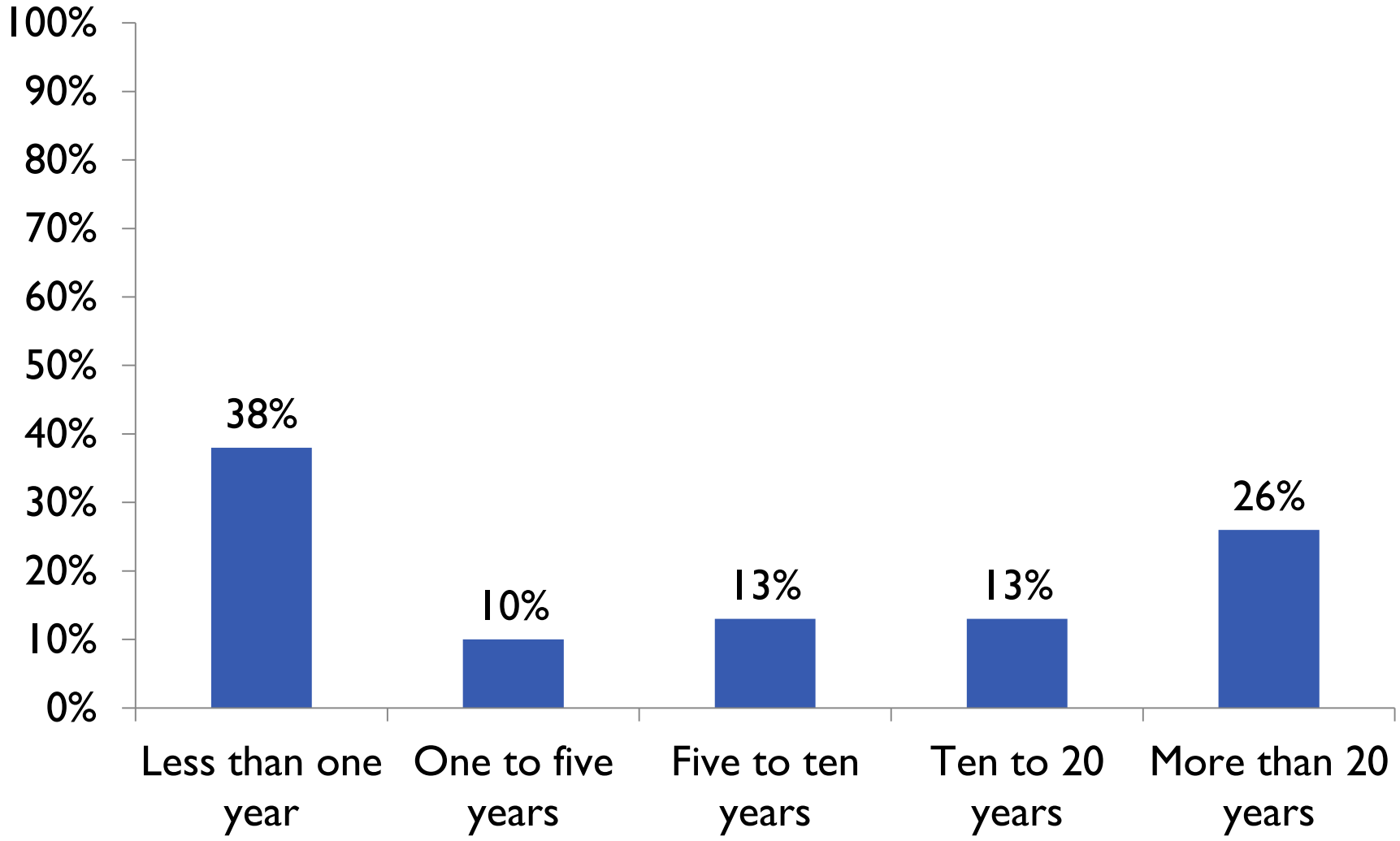
Sock Colors in the Room



How Long have You Lived in Unalaska?

1. Less than one year
2. One to five years
3. Five to ten years
4. Ten to 20 years
5. More than 20 years

Length of time in Unalaska

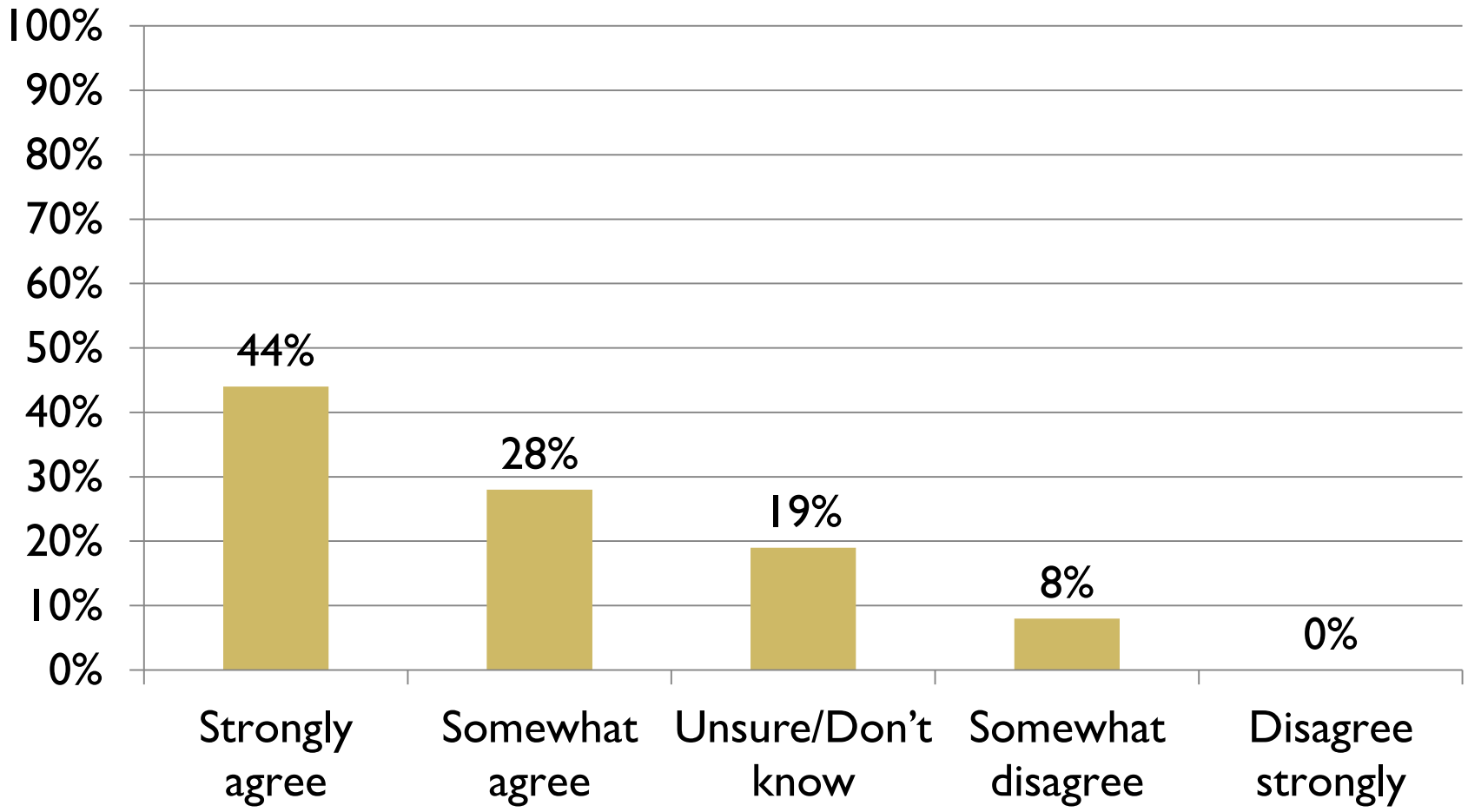


To what extent do you agree or disagree with the following statement:

Variability in weather and other physical processes naturally occur. However, over the last ten to twenty years, I have been seeing changes or have heard of changes in the local environment that seem to go beyond the normal range.

1. Strongly agree
2. Somewhat agree
3. Unsure/Don't know
4. Somewhat disagree
5. Disagree strongly

Changes are occurring in the local environment beyond the normal range



Part 1 - Physical Changes

Storminess + wind

Sea ice

"Cold pool"

Ocean temperature

Air temperature

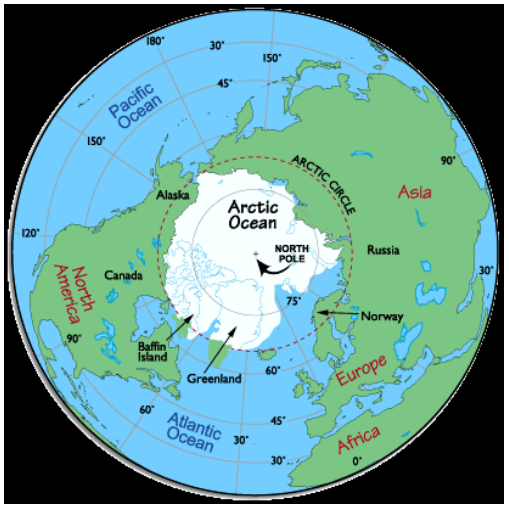
Future Climate of the Aleutians and Bering Sea

- Projected changes in mean climate
- Estimates of changes in extremes

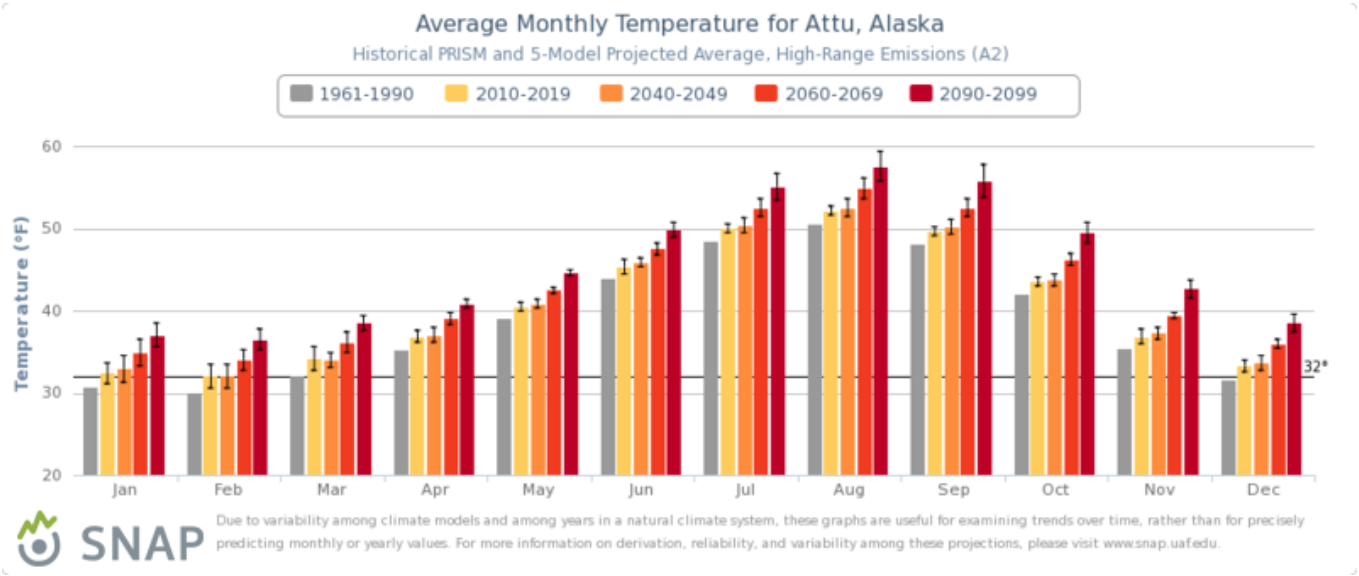
Downscaling of global climate models by SNAP (Scenarios Network for Alaska and Arctic Planning)

- **A set of 20+ models were compared with data (1958-2000) for surface air temperature, sea level pressure, and precipitation**

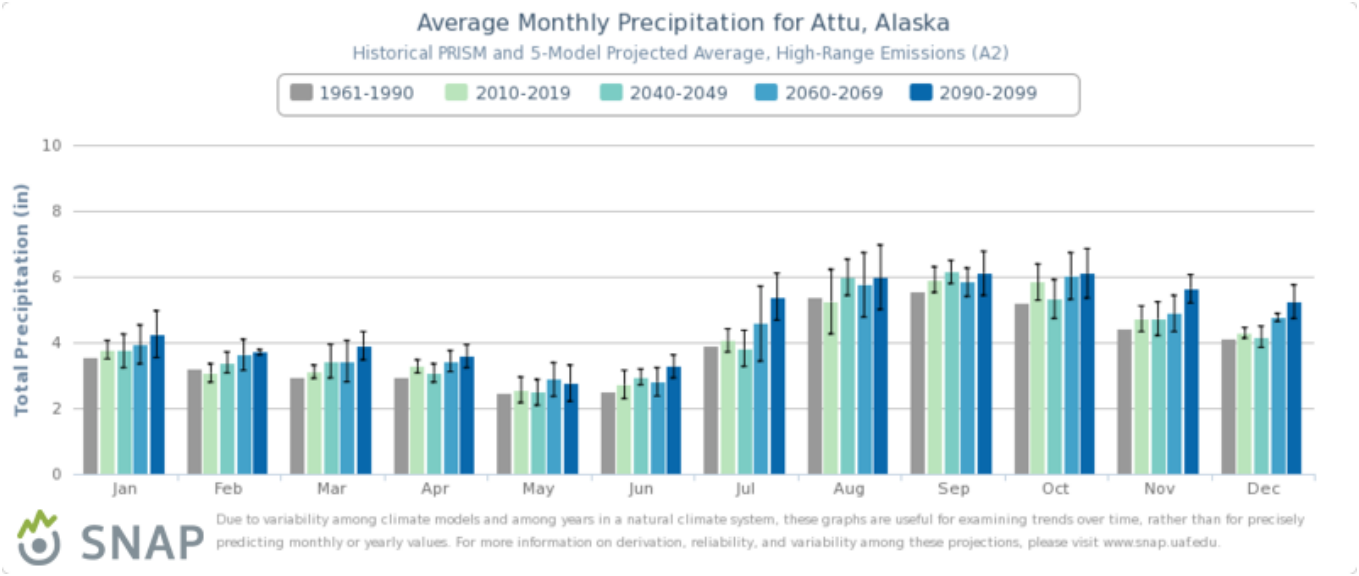
- **Models that perform best over Alaska have been selected**



Decadal temperature and precipitation, A2 scenario: Attu, AK



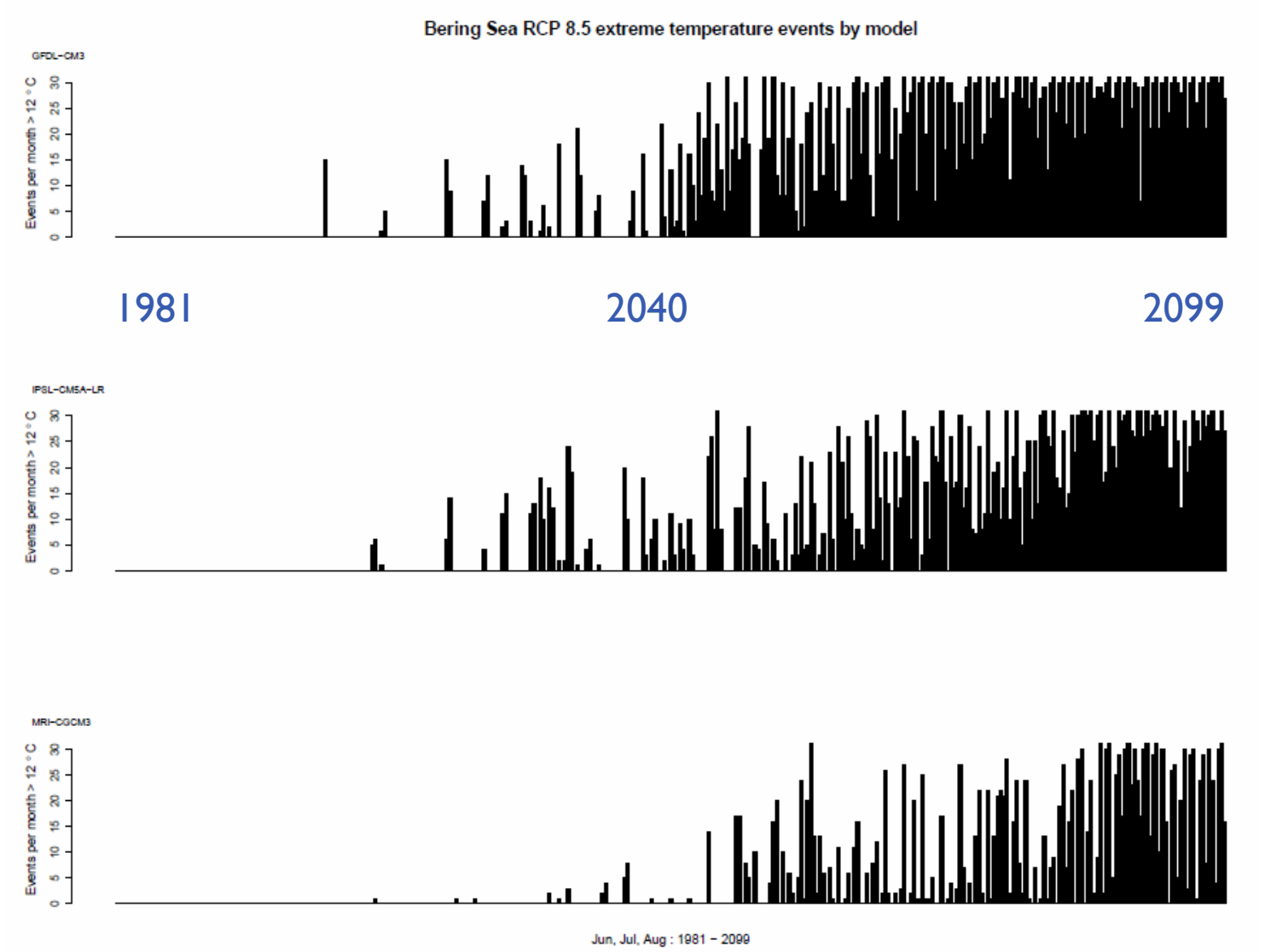
Temperature
Expected to increase



Precipitation
Expected to increase

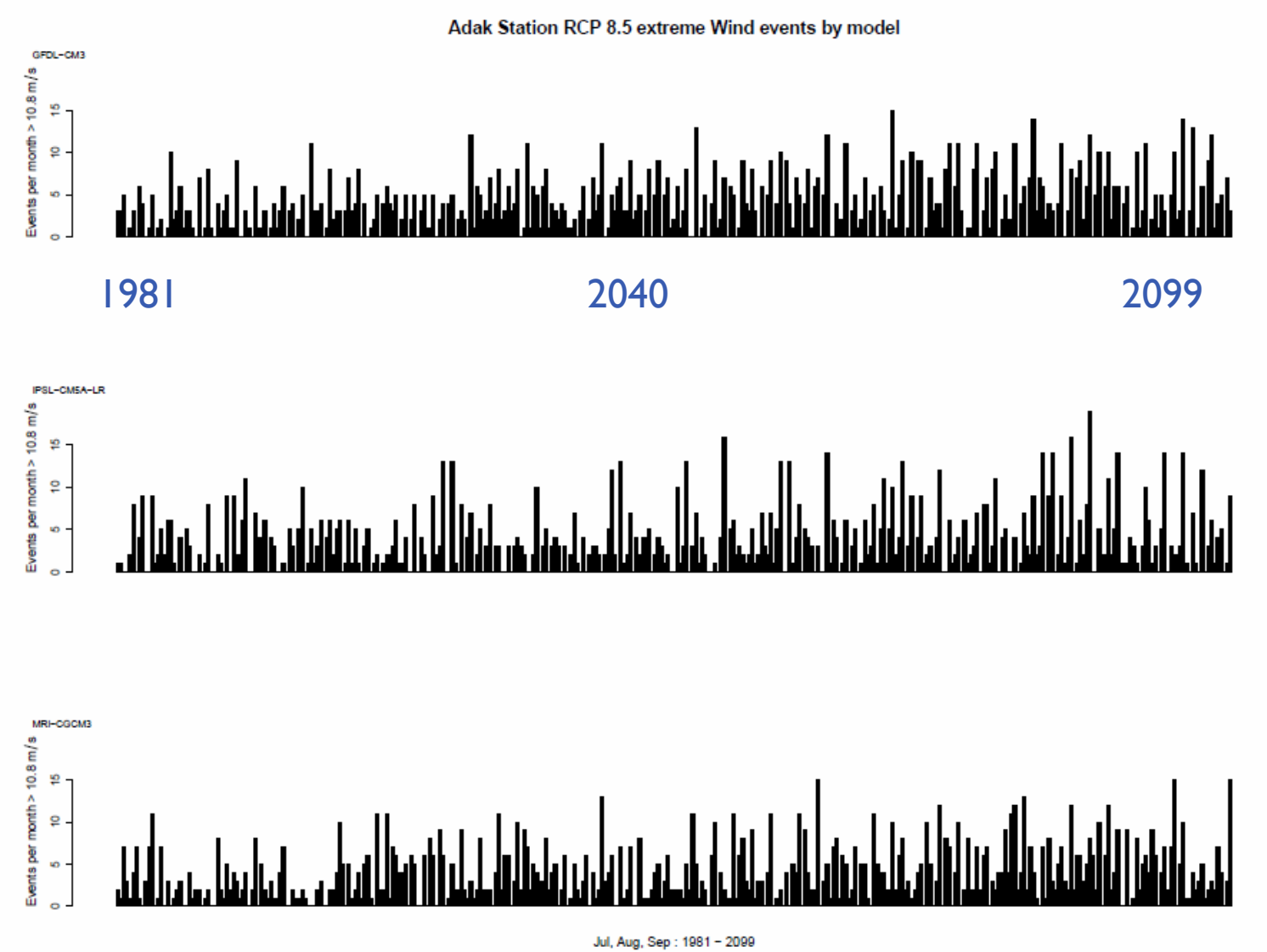
Episodic Events: # of days with average temperature > 12ºC Bering Sea, Jun-Aug 1981-2099, 3 models (RCP 8.5)

-- large increase in summer days warmer than 54ºF



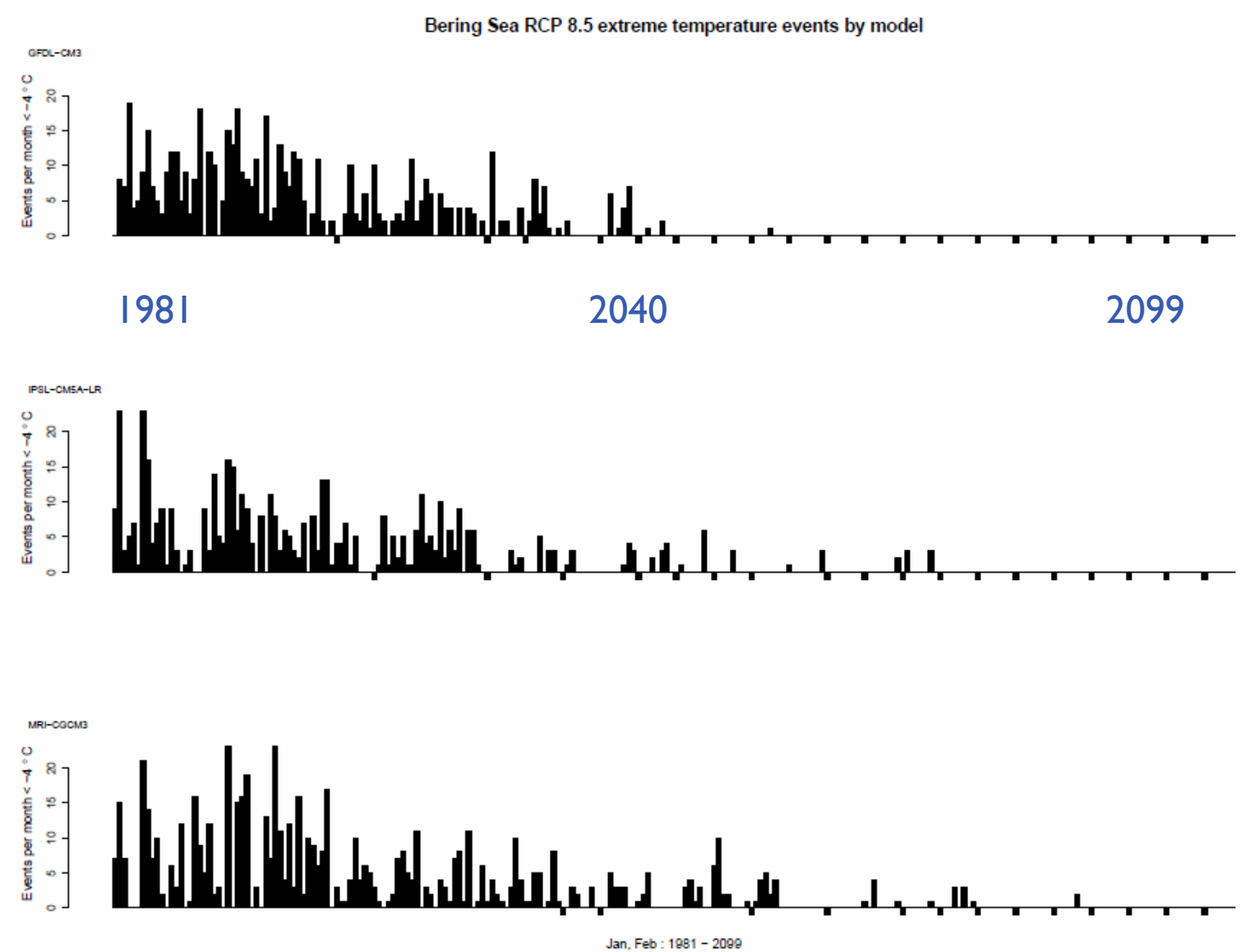
Sample plots: # of days with average windspeed >10.8 m/sec
Adak, Jul-Sep 1981-2099, 3 models (RCP 8.5)

-- slight increase in summer storminess



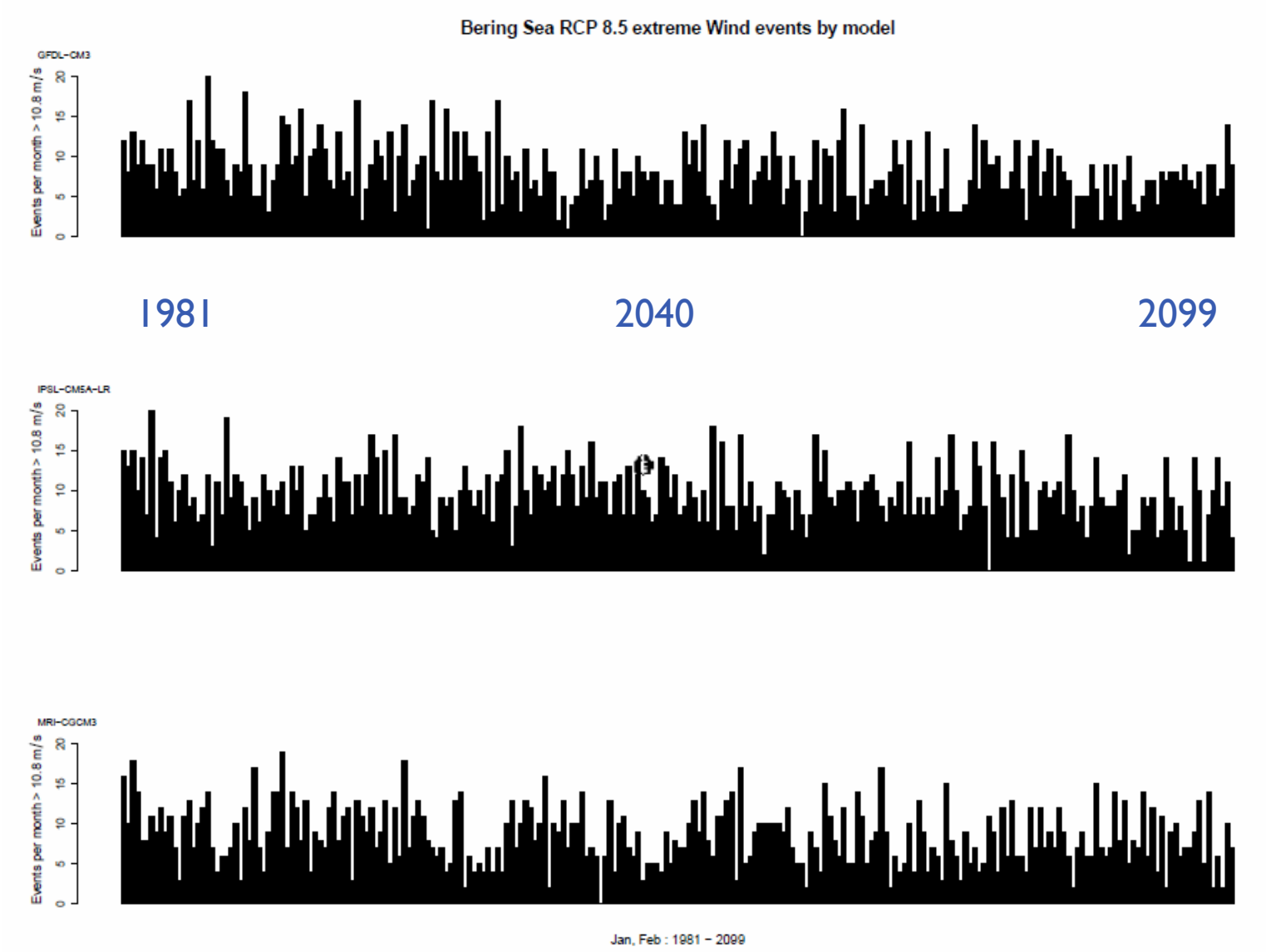
Sample plots: # of days with average temperature < -4ºC Bering Sea, Jan-Feb 1981-2099, 3 models (RCP 8.5)

-- large decrease in winter days colder than 25ºF



Sample plots: # of days with average windspeed >10.8 m/sec Bering Sea, Jan-Feb 1981-2099, 3 models (RCP 8.5)

-- slight decrease in winter storminess



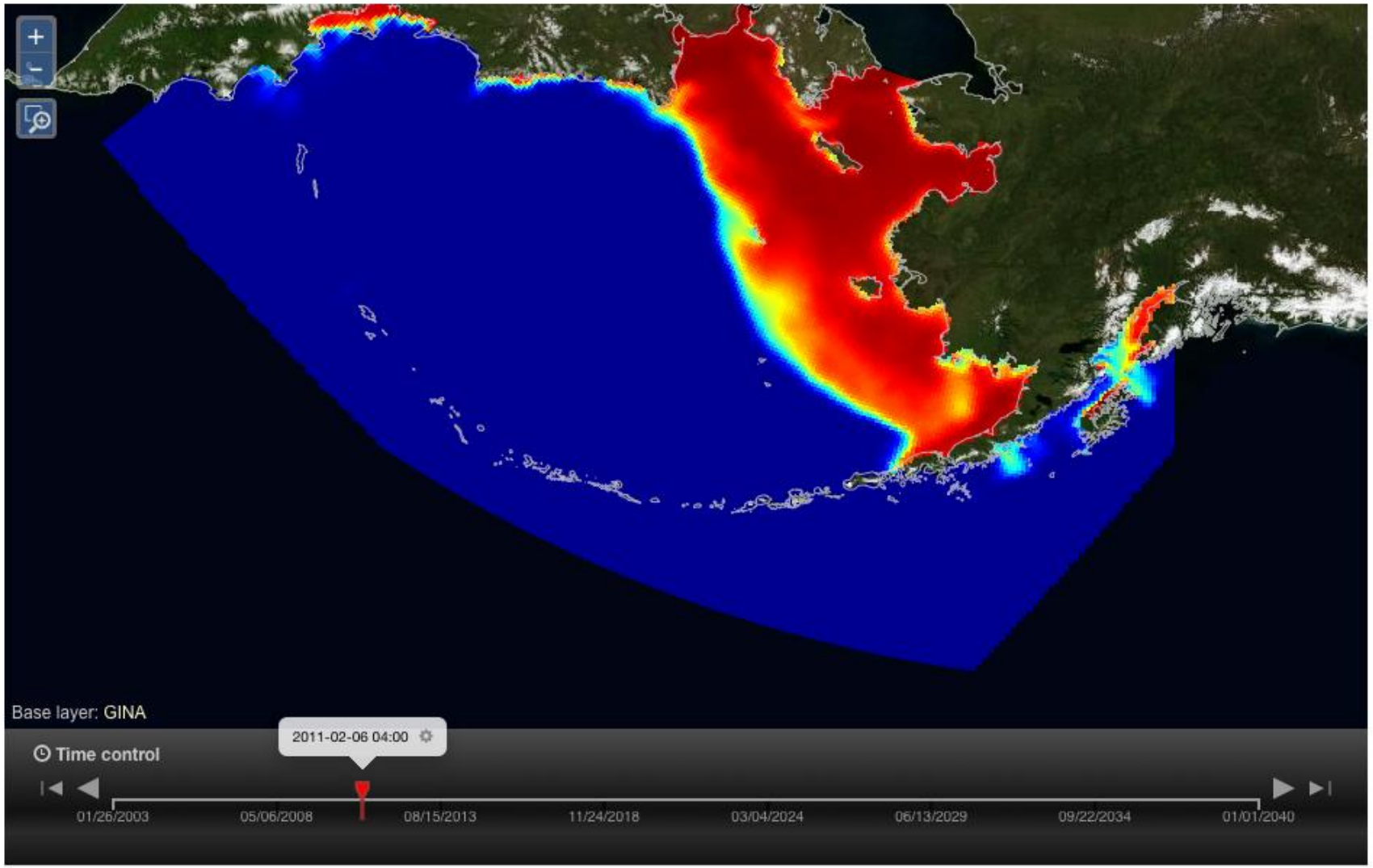
Sea Ice Area Fraction

Download | Portal | +

- **Date Range:** 01/26/2003 04:00 - 01/01/2040 04:00

The modeled fraction of ice averaged over time.

Present maximum sea ice



PMEL CCCma Climate Model

Sea Ice Area Fraction

0 0.25 0.5 0.75 1

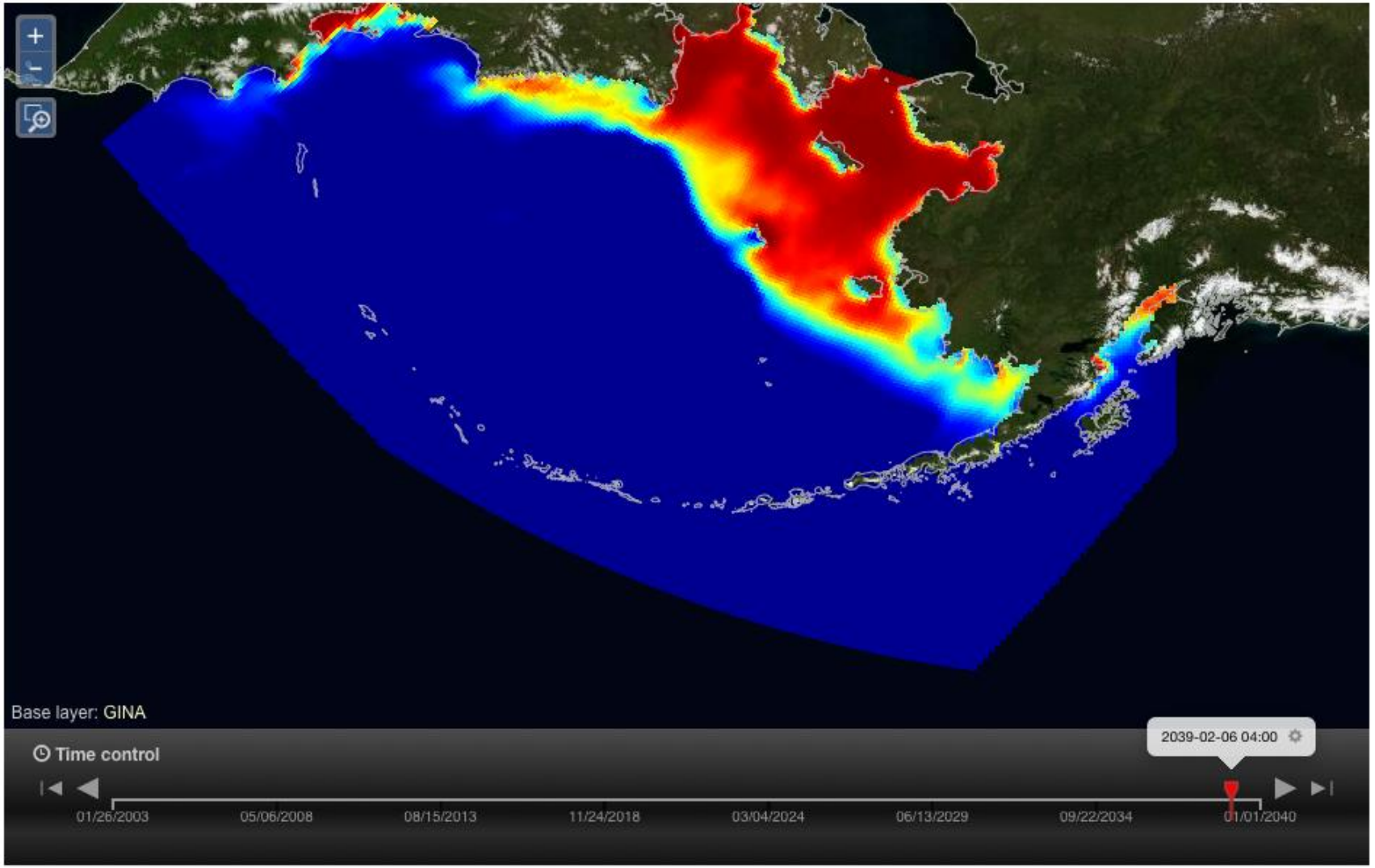
Sea Ice Area Fraction

Download | Portal | +

- **Date Range:** 01/26/2003 04:00 - 01/01/2040 04:00

The modeled fraction of ice averaged over time.

Projected future maximum sea ice



PMEL CCCma Climate Model

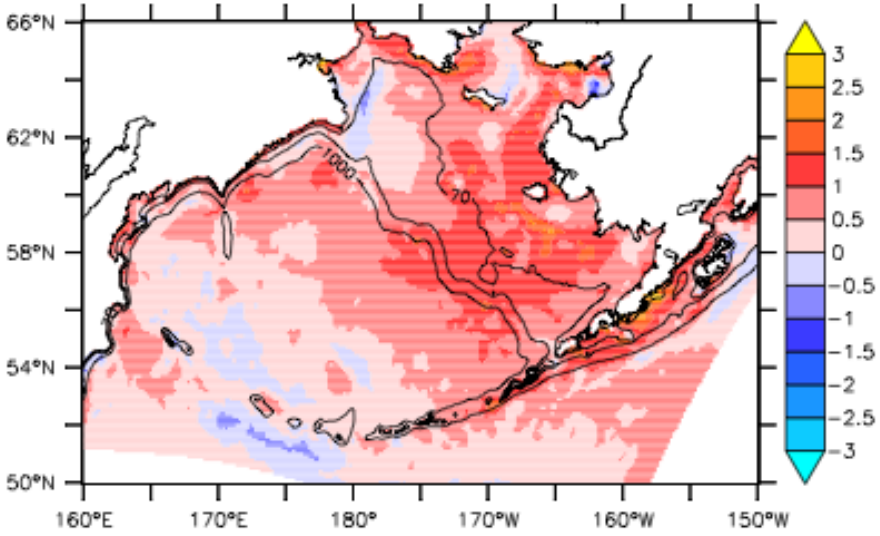
Sea Ice Area Fraction

0 0.25 0.5 0.75 1

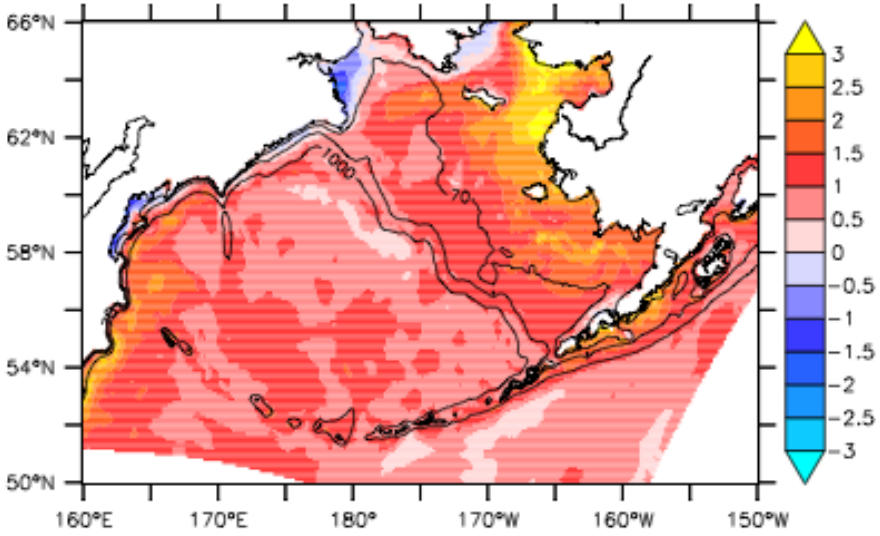
Different models, different results

Surface Temperature Changes (August) from Present to 2030s

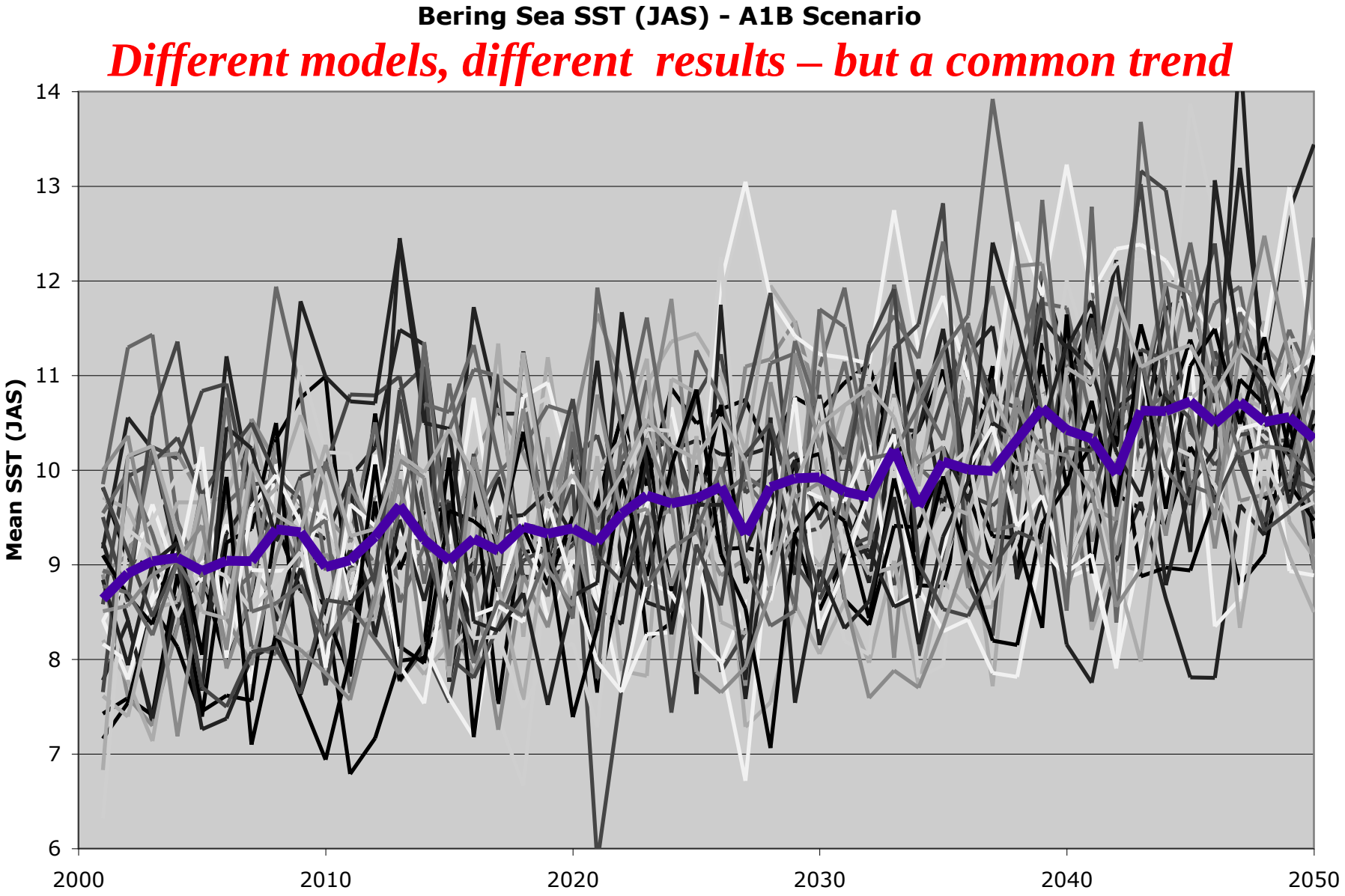
Al Hermann, UW



CCCMA



MIROC


Bering Sea SST (JAS) - A1B Scenario
Different models, different results – but a common trend
Mean SST (JAS)
14
13
12
11
10
9
8
7
6
2000
2010
2020
2030
2040
2050

Clicker Time!

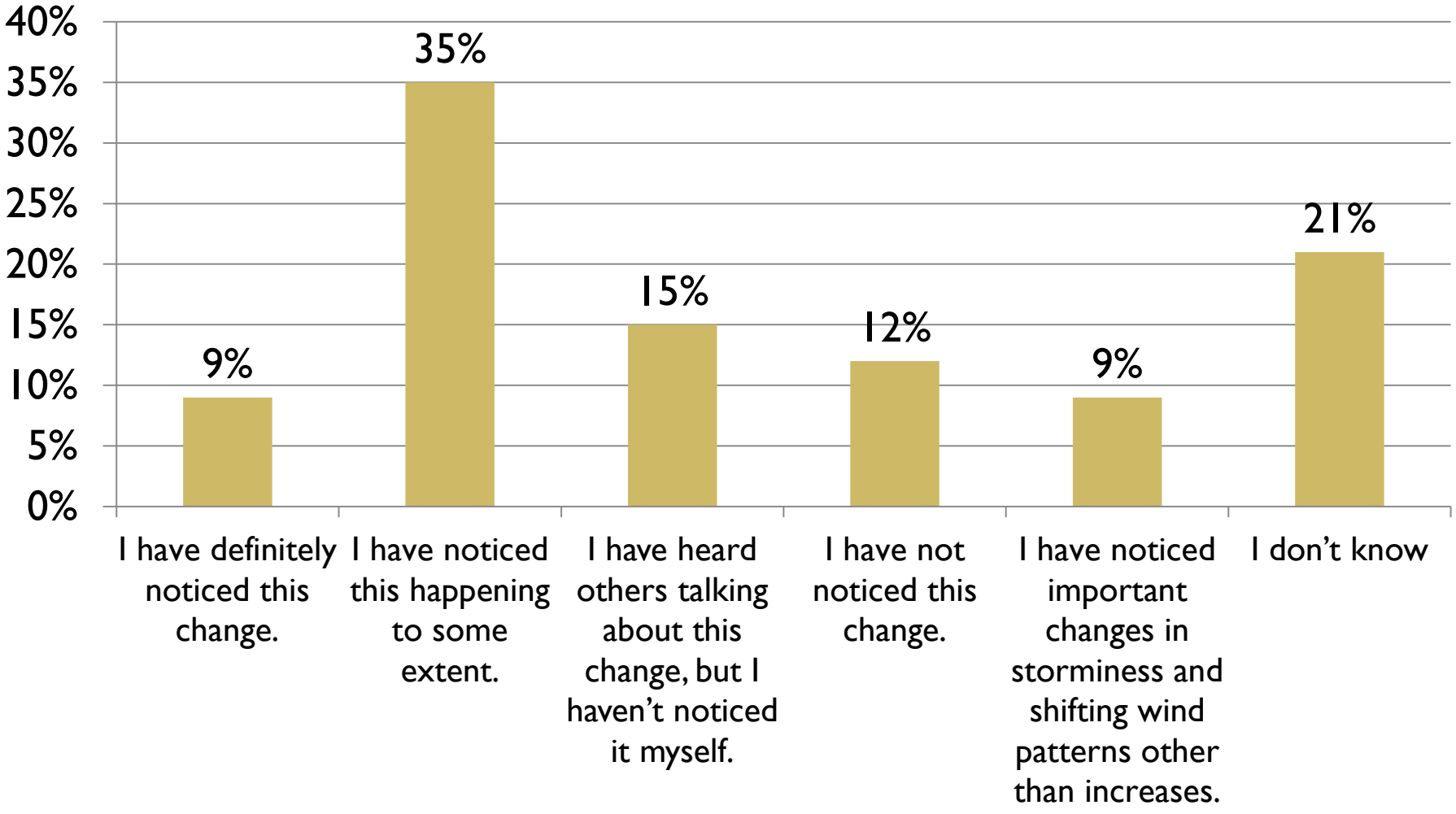
Part 1 of 4 – Changes in the Physical Environment; "Environmental Drivers"

Increased storminess and shifting wind patterns

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I have noticed important changes in storminess and shifting wind patterns *other than* increases.
6. I don't know

Increased storminess and shifting wind patterns

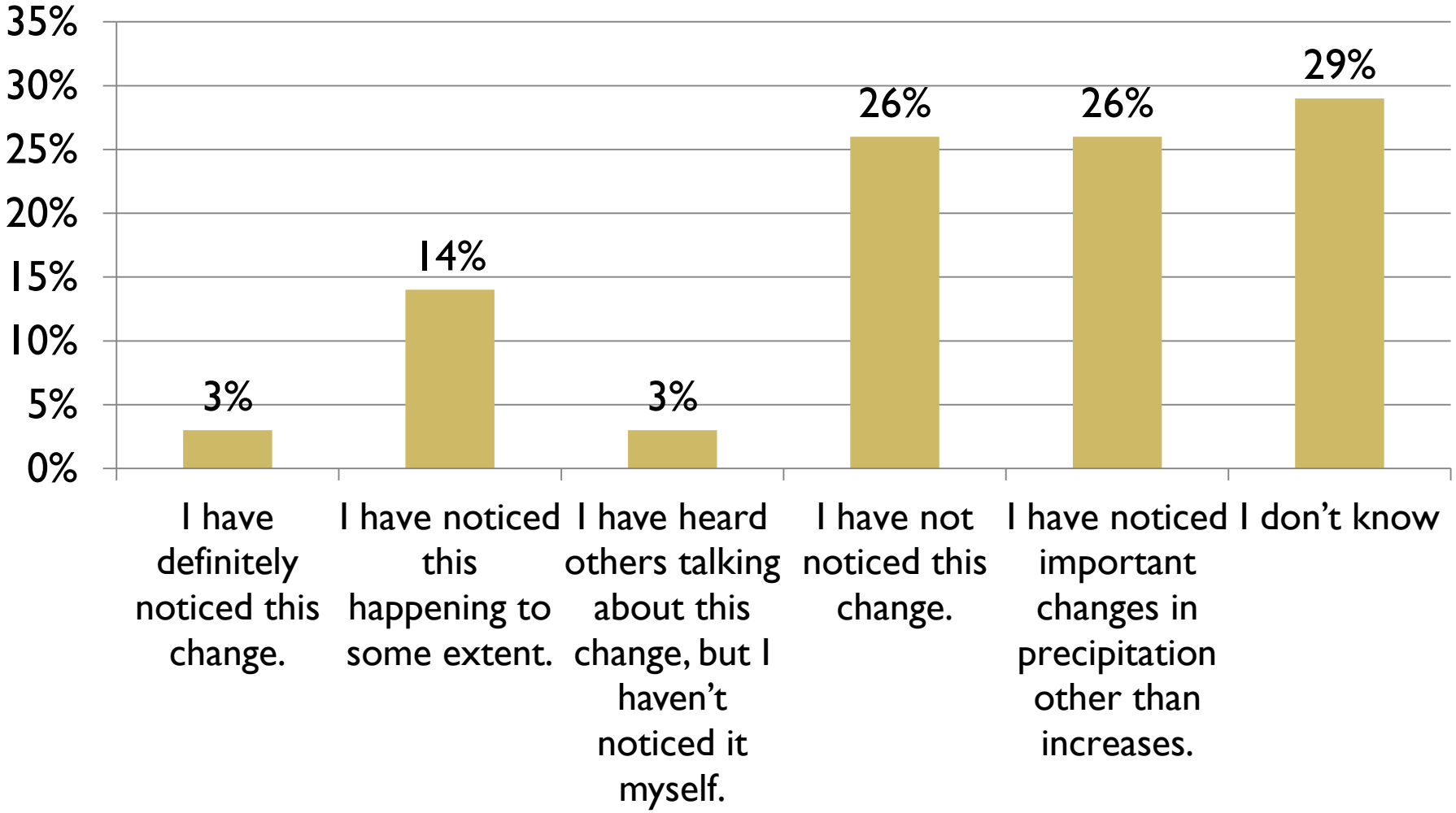


Increased Precipitation

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I have noticed important changes in precipitation *other than* increases.
6. I don't know

Increased precipitation

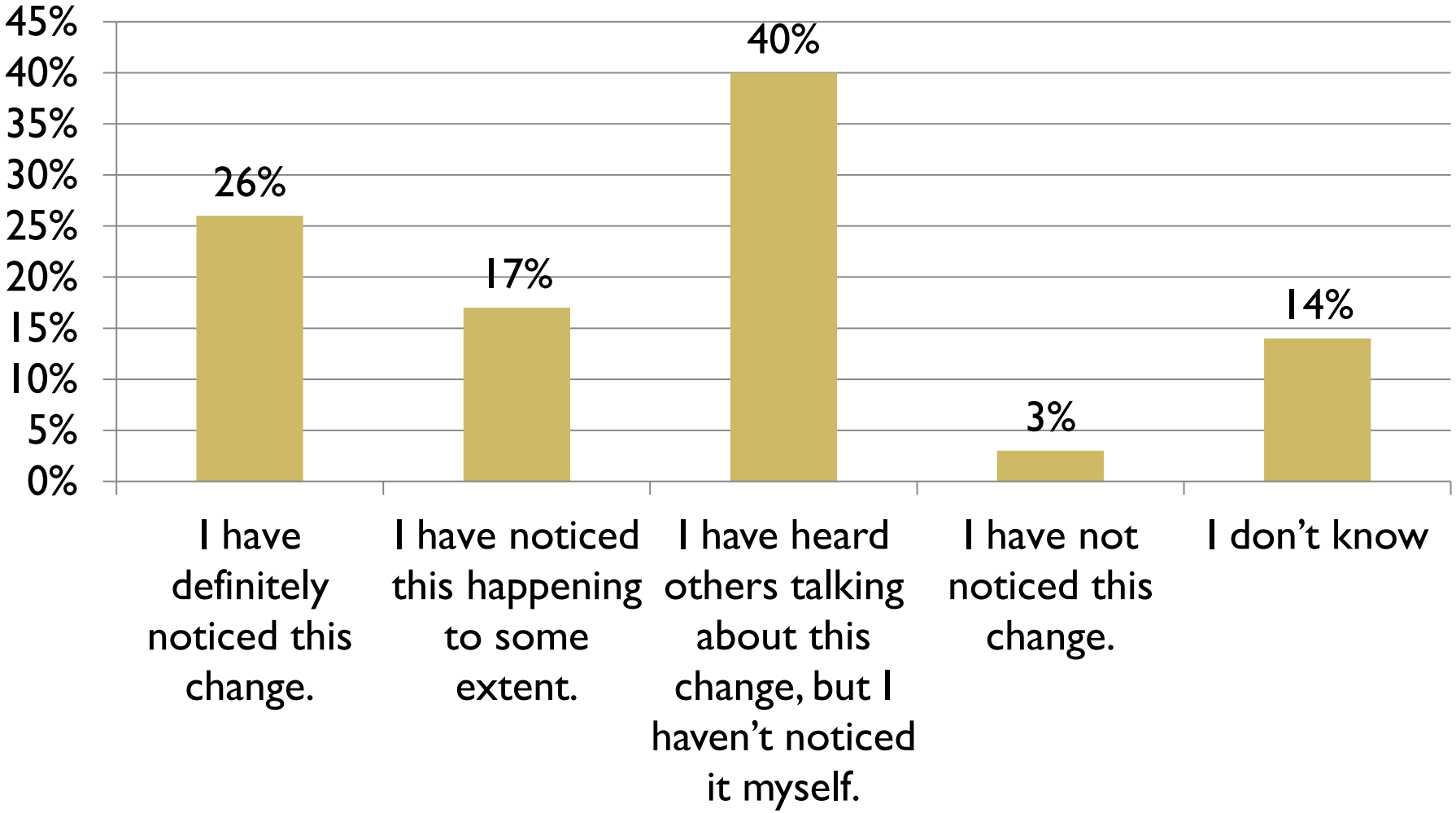


Changes in sea ice

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know

Changes in sea ice

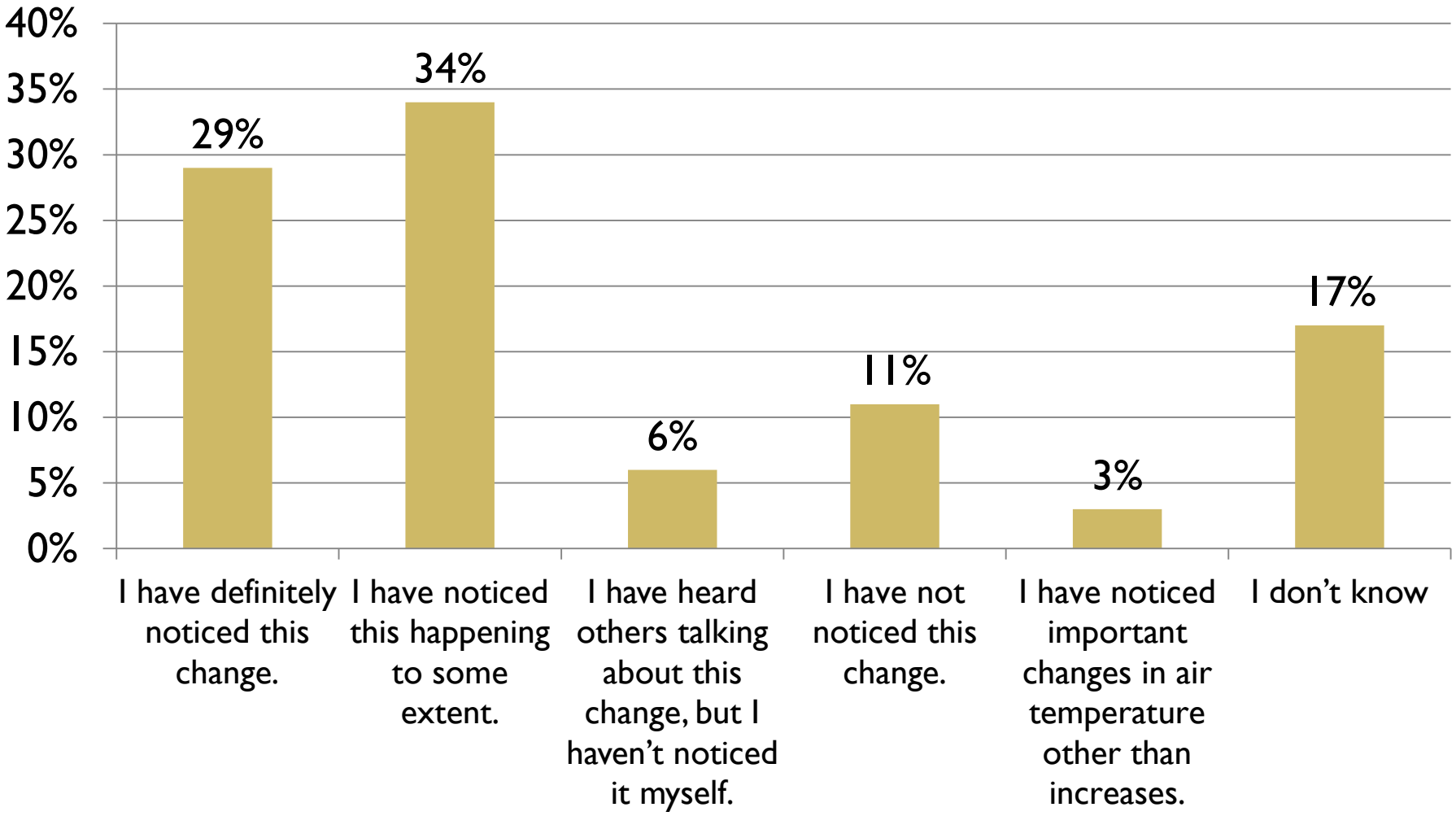


Increasing air temperatures

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I have noticed important changes in air temperature *other than* increases.
6. I don't know

Increasing air temperatures

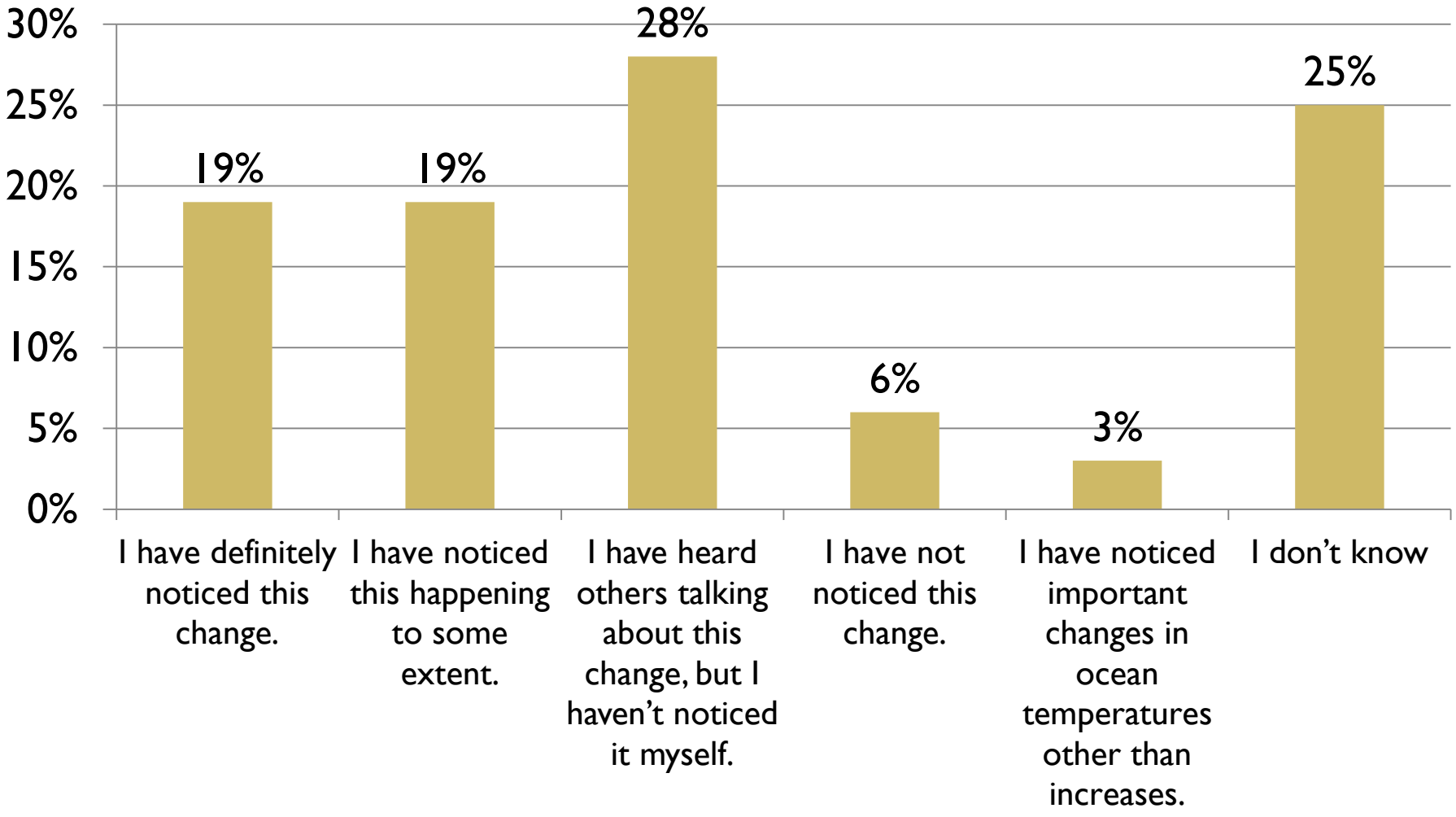


Increasing ocean temperatures

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I have noticed important changes in ocean temperatures *other than* increases.
6. I don't know

Increasing ocean temperatures

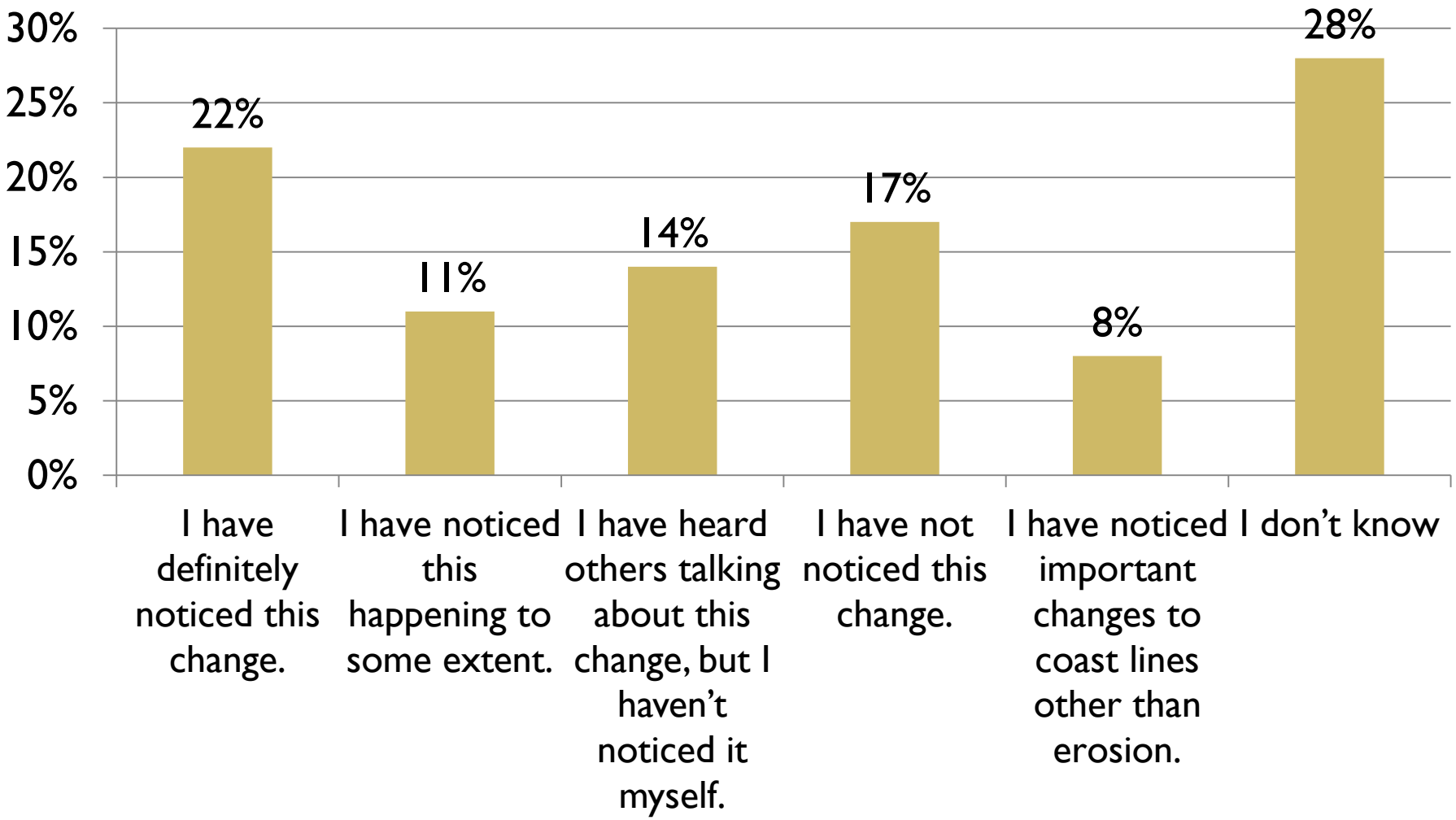


Coastal erosion

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I have noticed important changes to coast lines *other than* erosion.
6. I don't know

Coastal erosion



Seasonality

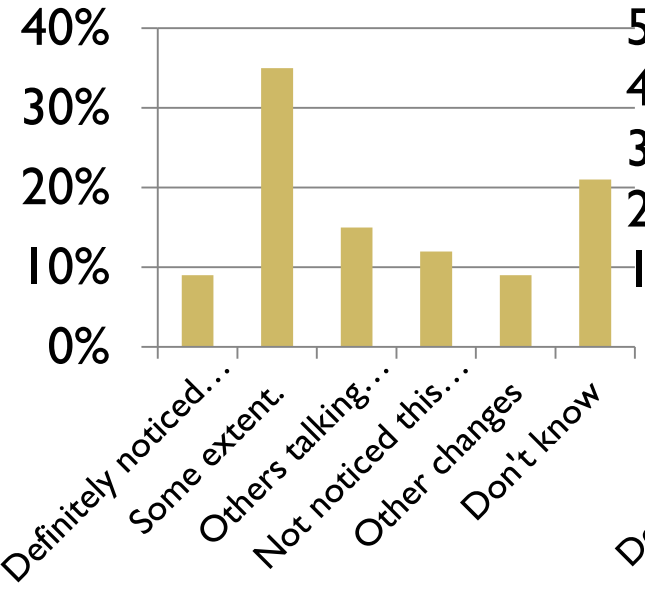
Have you noticed any of these changes? Select all that apply.

1. Shorter and warmer winters
2. Longer ice-free season
3. Spring break up is happening earlier and more quickly
4. Fall freeze up is happening later and more slowly, often with abnormal freeze-thaw cycles.
5. Changing weather conditions are most noticeable in the periods of spring break up and fall freeze up
6. Recent summers have been rainier than usual
7. I am not seeing significant changes
8. I don't know

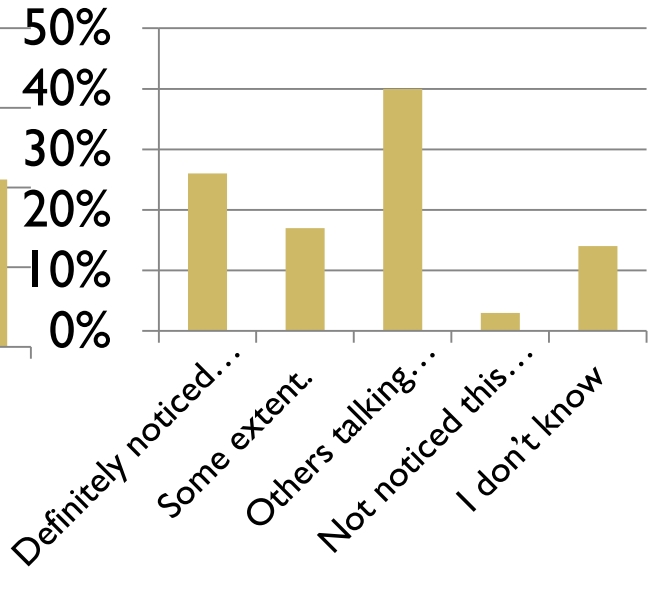
Seasonality Trends

15	Shorter and warmer winters
10	Fall freeze up is happening later and more slowly, often with abnormal freeze-thaw cycles.
8	Changing weather conditions are most noticeable in the periods of spring break up and fall freeze up
6	Longer ice-free season
5	I don't know
5	Spring break up is happening earlier and more quickly
4	I am not seeing significant changes
2	Recent summers have been rainier than usual

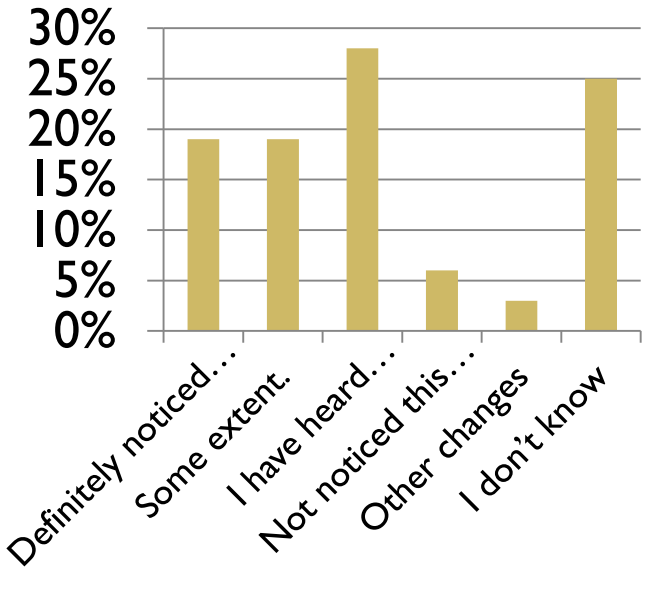
Storminess

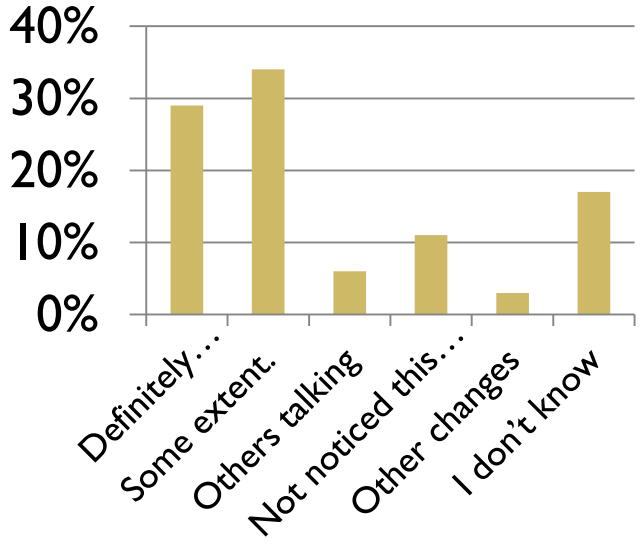


Sea Ice

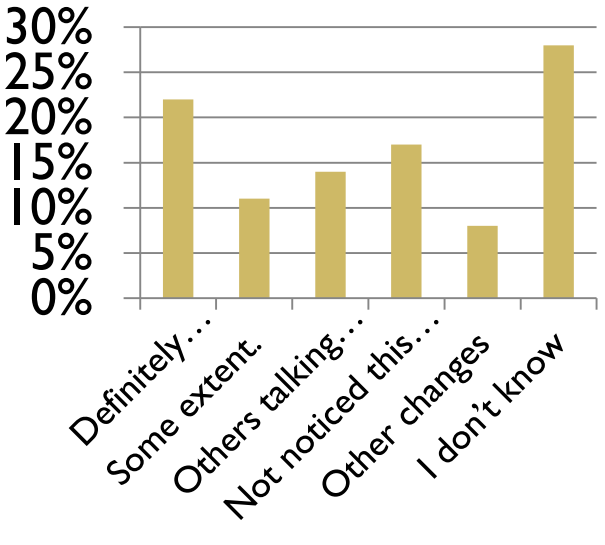


Ocean Temp





Air Temp



Erosion

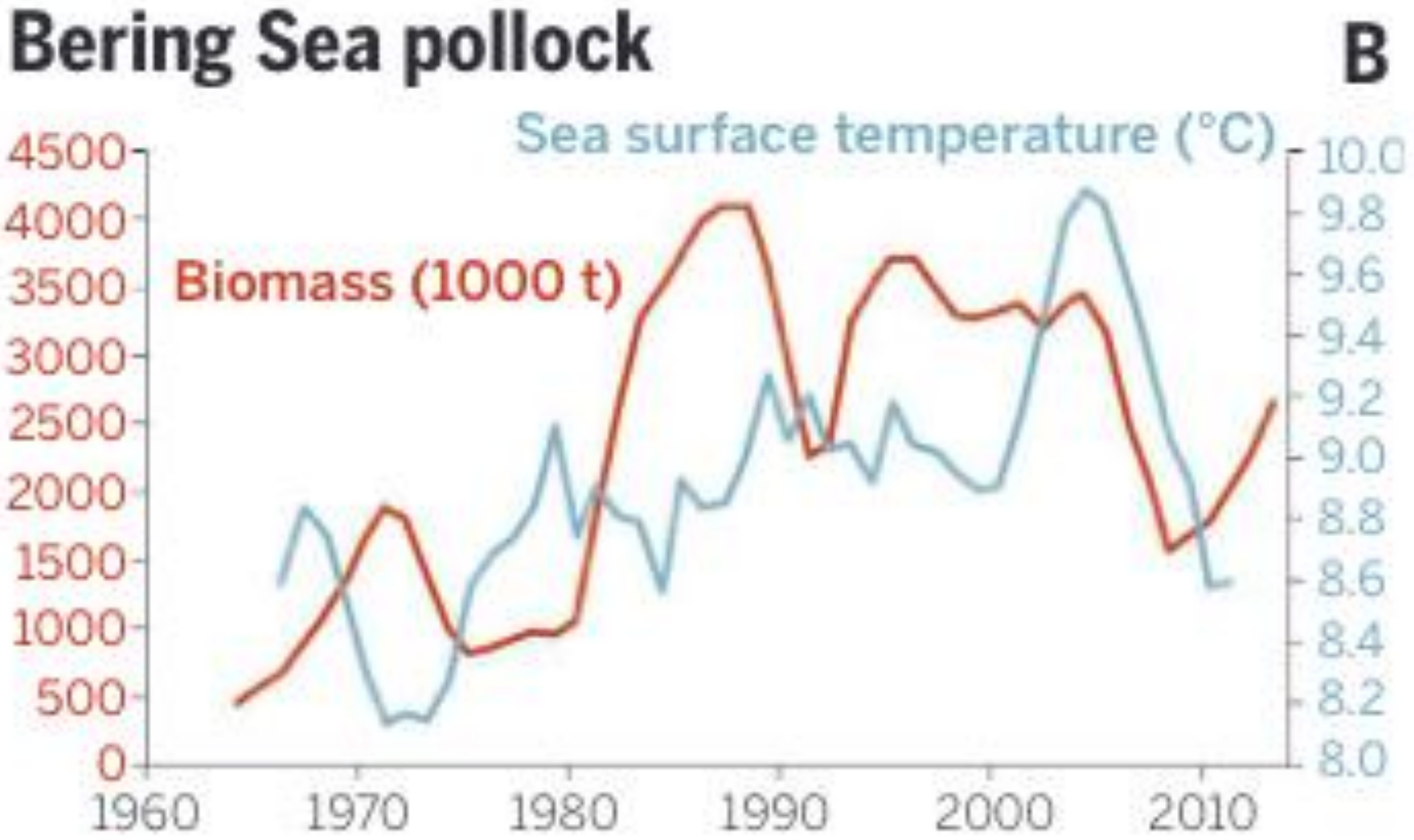
Topic 2

Changes in Marine + Coastal Sea Life

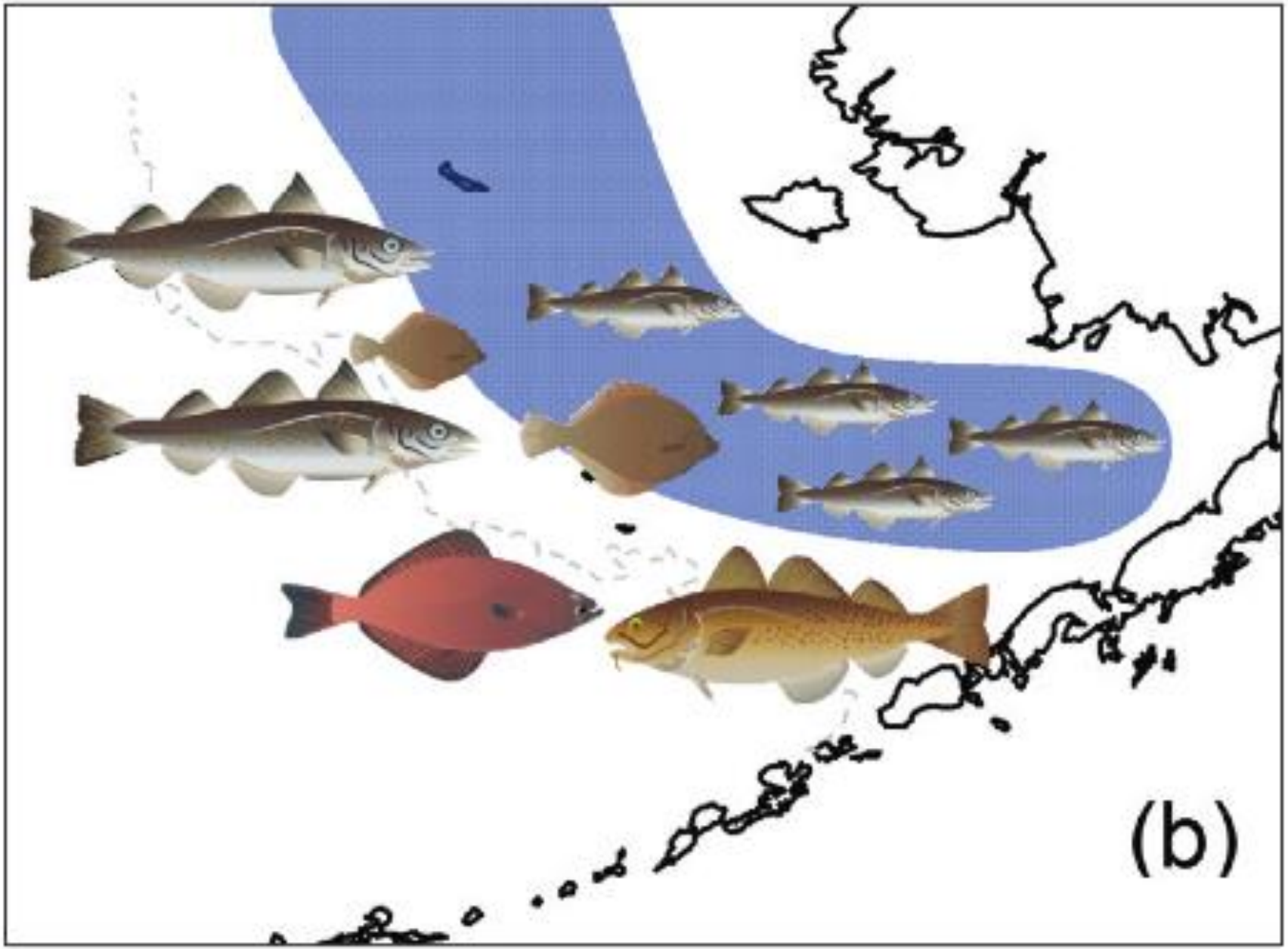
Changes in Marine and Coastal Sea Life

- Examples of observed changes
- Examples of expected future changes

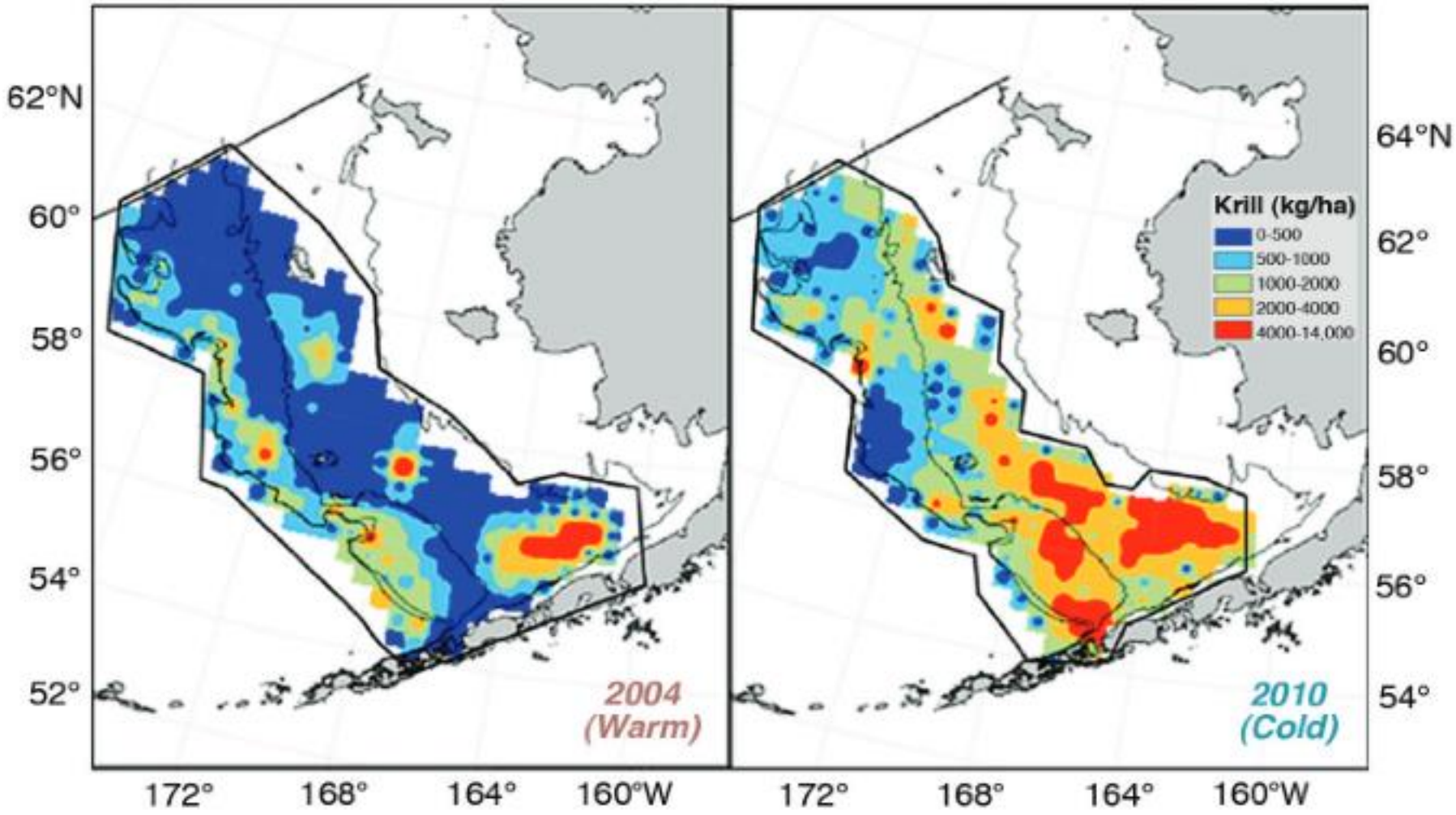
Changes in climate cause changes in fish populations



Cold Pool- a "driver"



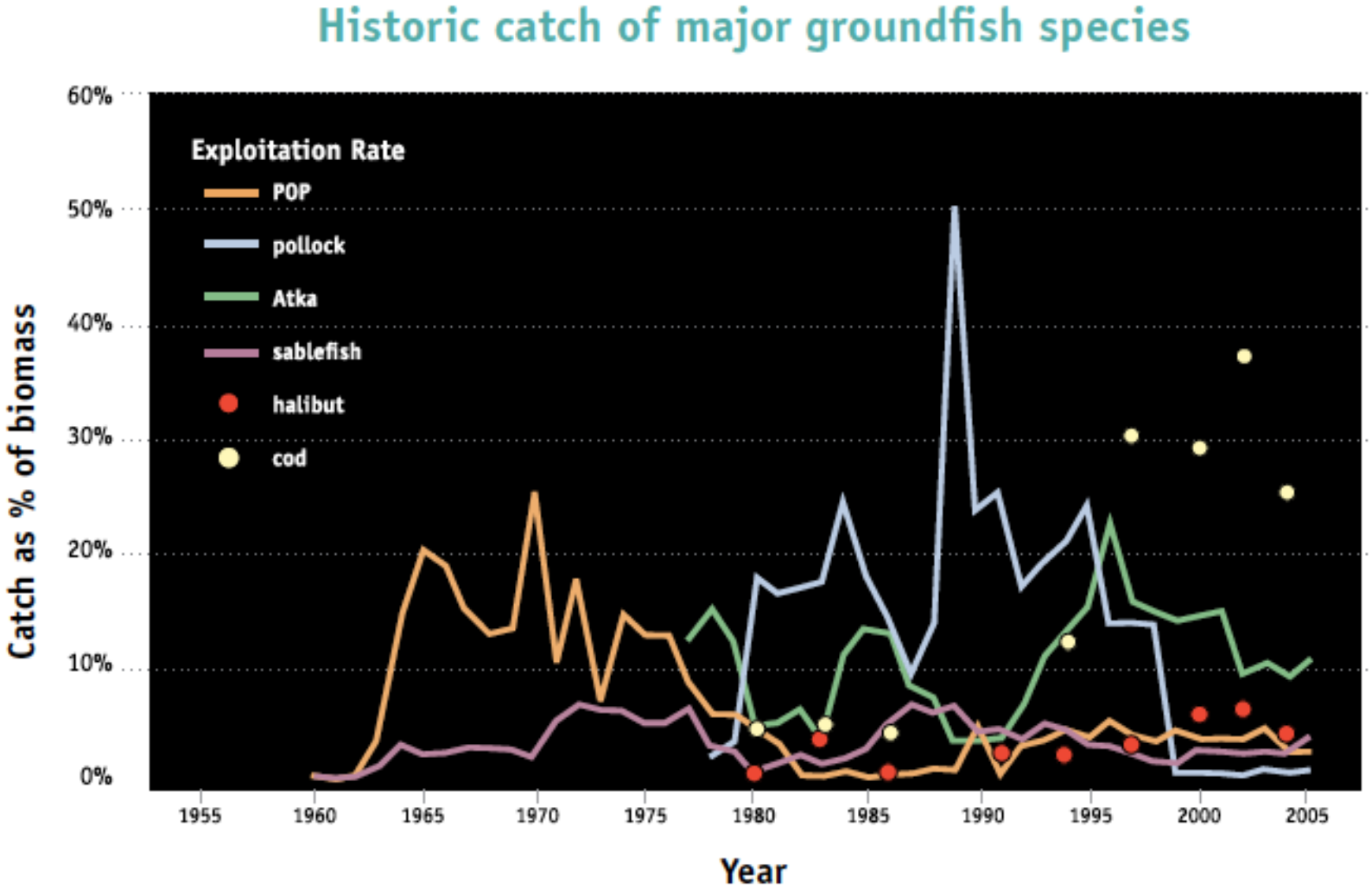
Krill respond to water temperatures



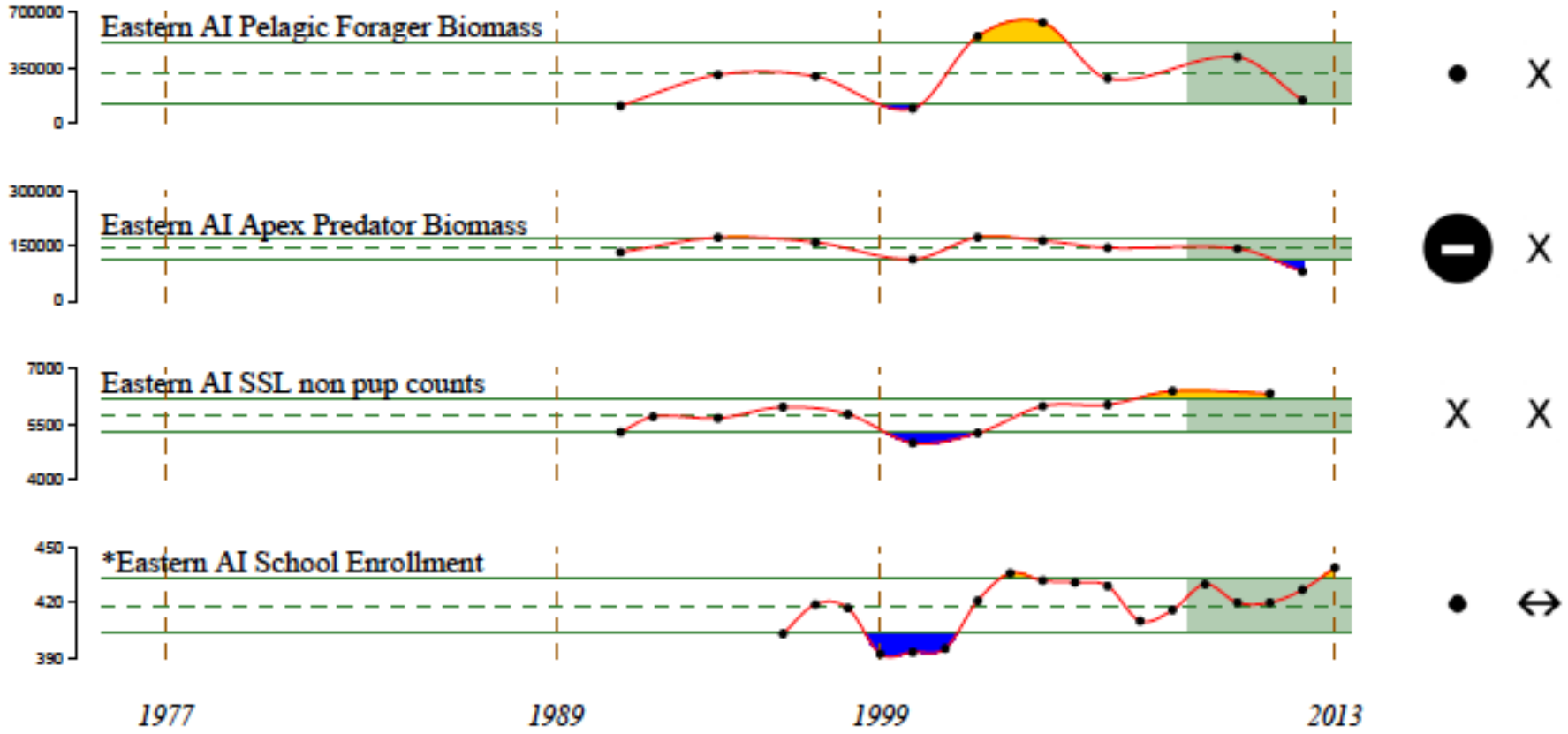
C. Loren Buck

center: Jeff Field right: Alison Banks

Independent of climate change, populations go up and down



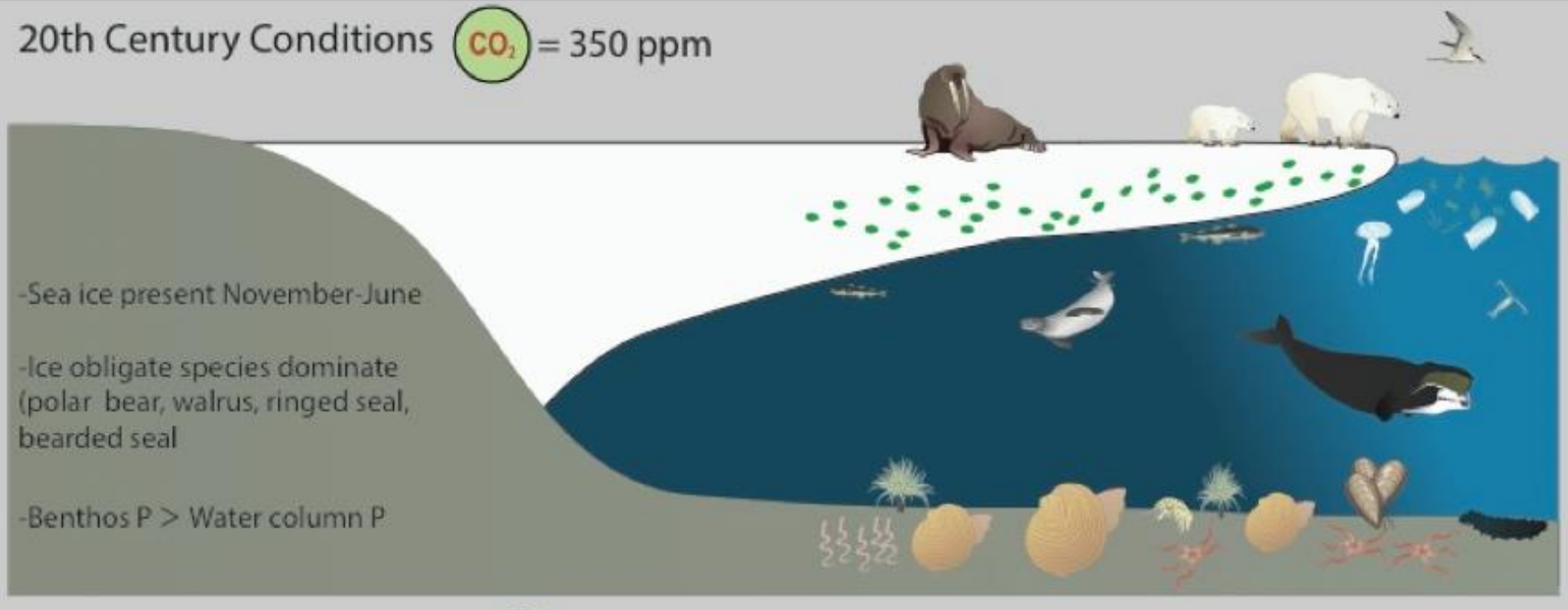
Independent of climate change, populations go up and down



Change driven by many factors

Change driven by many factors

20th Century Conditions CO_2 = 350 ppm

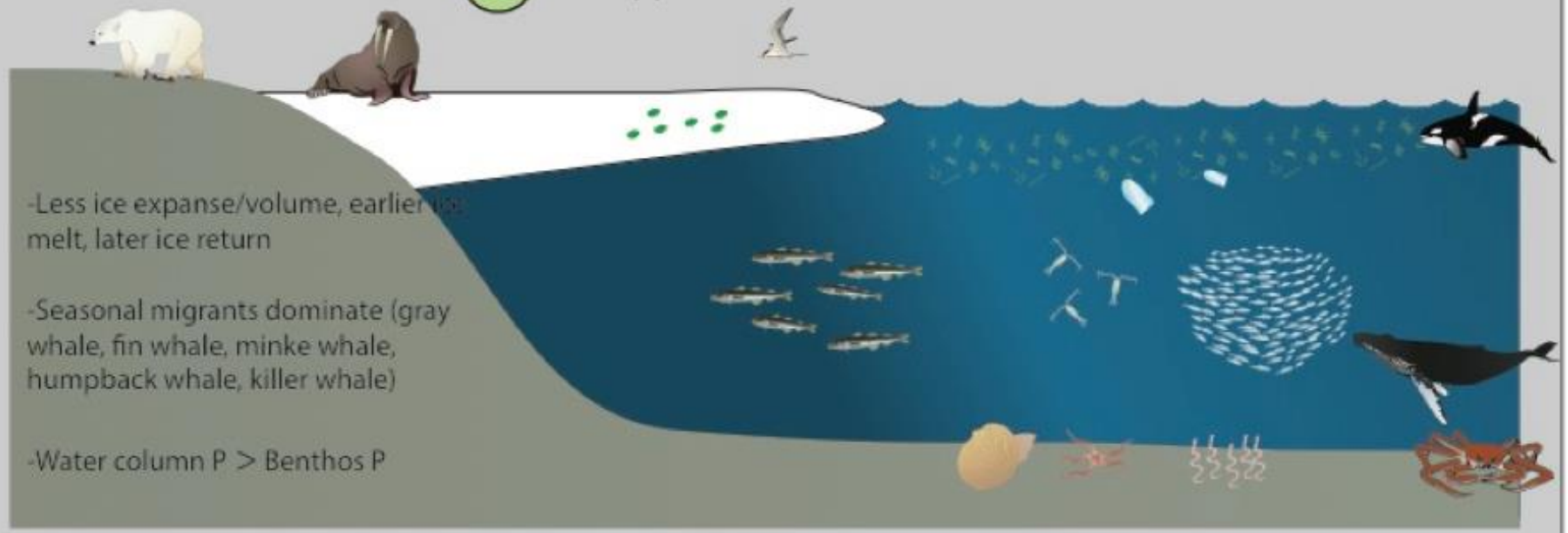


-Sea ice present November-June

-Ice obligate species dominate (polar bear, walrus, ringed seal, bearded seal

-Benthos P > Water column P

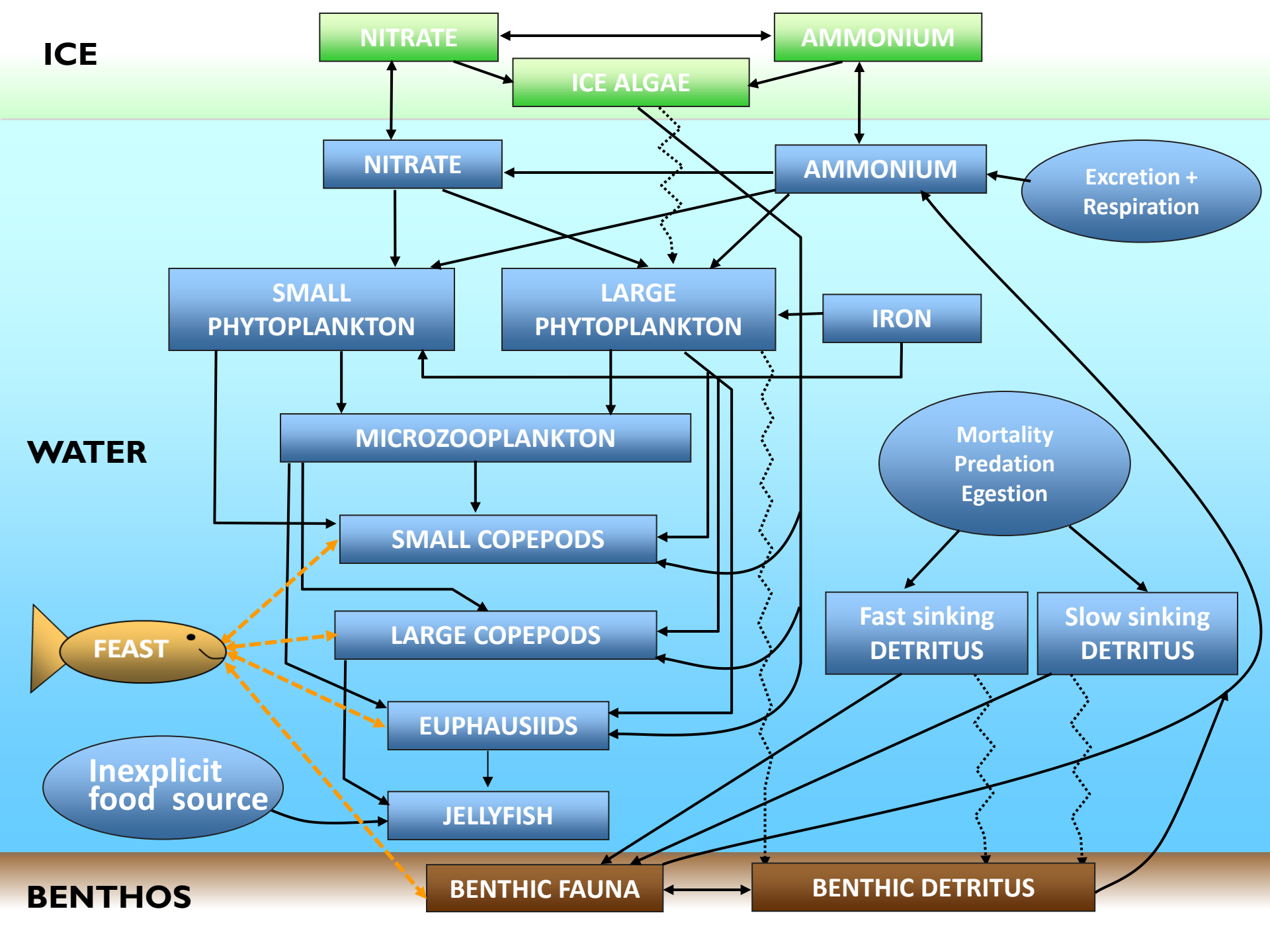
21st Century Conditions CO_2 > 400ppmm

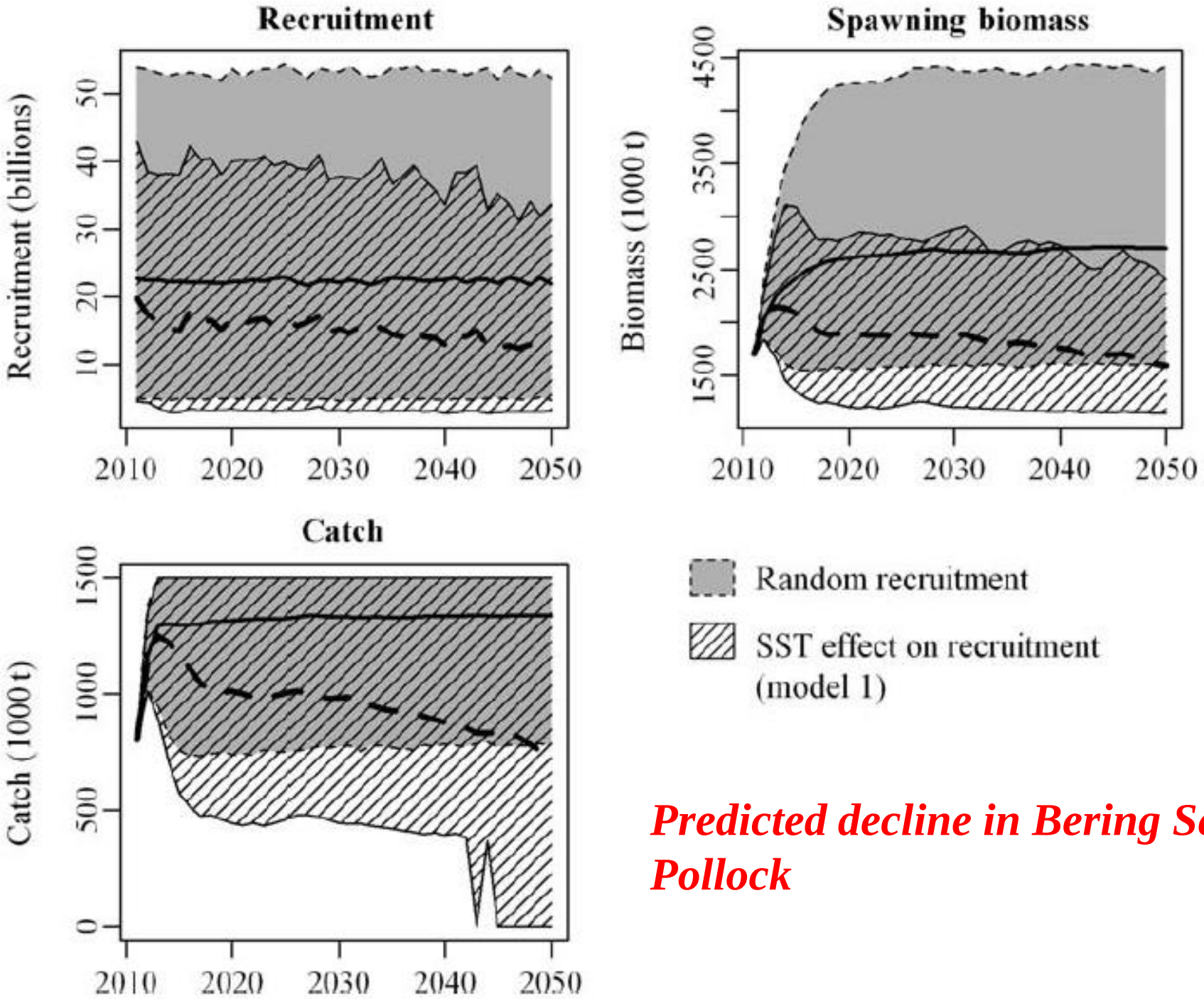


-Less ice expanse/volume, earlier ice melt, later ice return

-Seasonal migrants dominate (gray whale, fin whale, minke whale, humpback whale, killer whale)

-Water column P > Benthos P

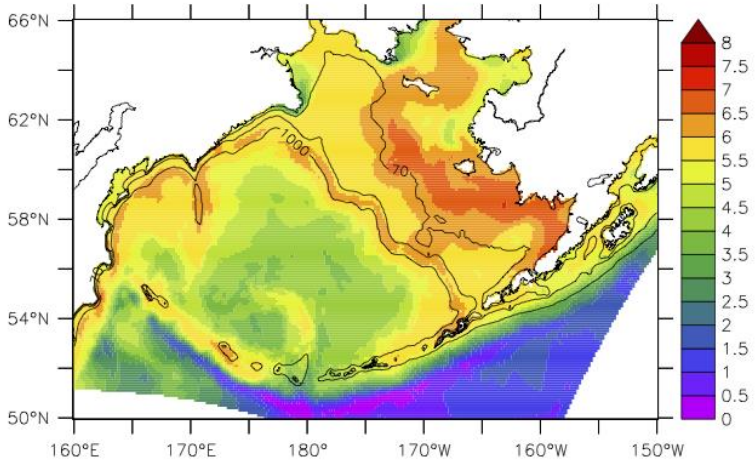

ICE
NITRATE
AMMONIUM
ICE ALGAE
NITRATE
AMMONIUM
Excretion +
Respiration
SMALL
PHYTOPLANKTON
LARGE
PHYTOPLANKTON
IRON
WATER
MICROZOOPLANKTON
Mortality
Predation
Egestion
SMALL COPEPODS
FEAST
LARGE COPEPODS
Fast sinking
DETRITUS
Slow sinking
DETRITUS
EUPHAUSIIDS
Inexplicit
food source
JELLYFISH
BENTHOS
BENTHIC FAUNA
BENTHIC DETRITUS



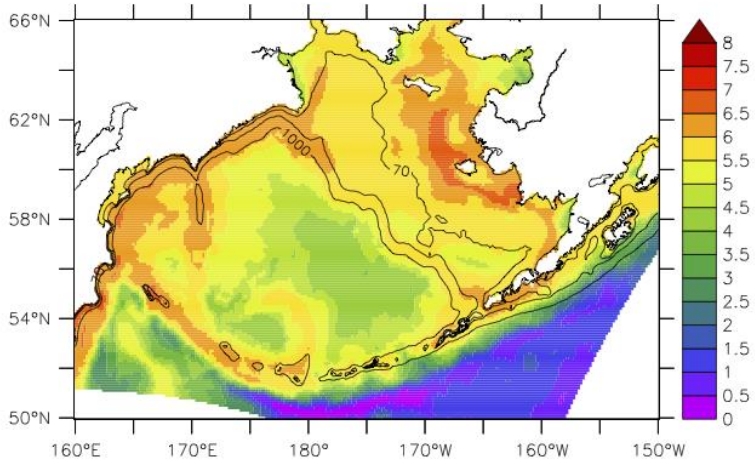
Predicted decline in Bering Sea Pollock

Near surface concentrations of euphausiids (krill) in August

Georgina Gibson UAF, Al Hermann UW

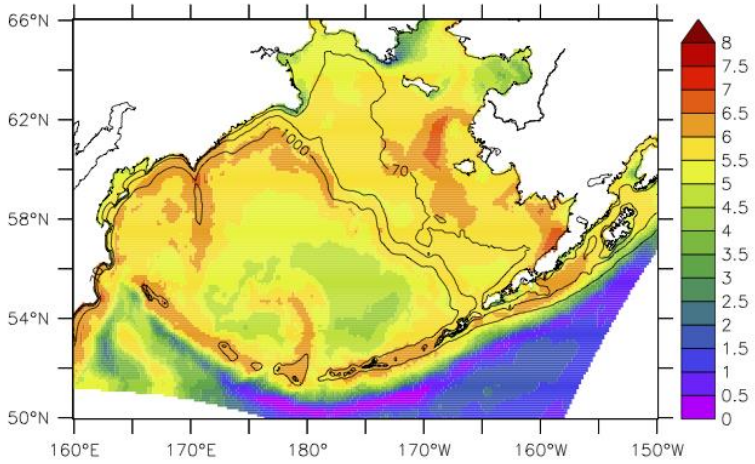


Present

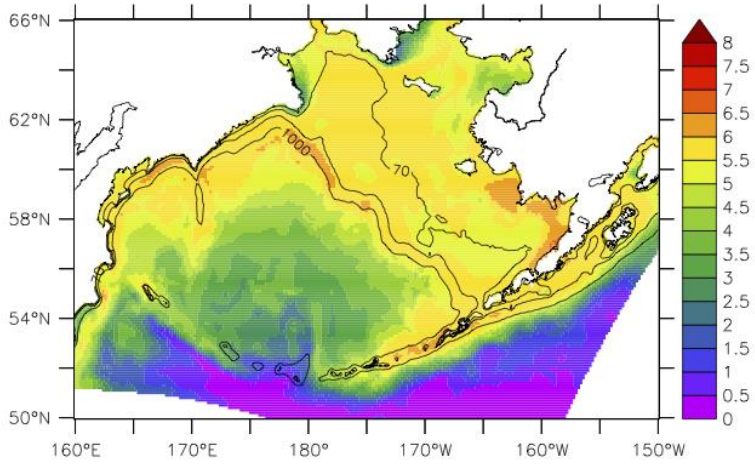


CCCMA (2030s)

Future of key prey species? Model results vary



ECHOG (2030s)



MIROC (2030s)

Clicker Time!

Part 2 of 4 – Changes in fish and wildlife habitats and species

Fish/Shellfish

Are you observing or hearing of important changes, that you believe may be climate change driven, in the following species? Select all that apply.

1. Herring
2. Pollock
3. Halibut
4. Cod
5. Crab species
6. Rockfish
7. Other

Changes in Fish

16	Crab species
12	Halibut
12	Pollock
6	Herring
5	Other
4	Rockfish
3	Cod

Fish

Of the species this group identified as the most affected by climate change (_____), how is this species changing?
Select all that apply.

1. Overall increase
2. No change
3. Overall decrease
4. Shifting locations
5. Shifting timing

Changes in Selected Fish/Shellfish Species

13	Shifting locations
9	Overall decrease
9	Shifting timing
3	Overall increase
2	No change

Fish/Shellfish

Of the species this group identified as the second most affected by climate change (_____), how is this species changing? Select all that apply.

1. Overall increase
2. No change
3. Overall decrease
4. Shifting locations
5. Shifting timing

Changes in Second Selected Fish/Shellfish Species

14	Overall decrease
8	Shifting locations
4	Shifting timing
1	Overall increase

Marine Mammals

Are you observing or hearing of important changes, that you believe might be climate change driven, in the following species? Select all that apply.

1. Sea lions
2. Sea otters
3. Seals
4. Whales
5. Walrus
6. Other

Marine Mammal Changes

10	Whales
9	Sea lions
6	Walrus
5	Other
2	Sea otters
2	Seals

Marine Mammals

Of the species this group identified as most affected by climate change, how is this species changing? Select all that apply.

1. Overall increase
2. No change
3. Overall decrease
4. Shifting locations
5. Shifting timing

Changes in Marine Mammals

11	Shifting locations
5	Overall decrease
4	Shifting timing
3	Overall increase
1	No change

Have you observed any of the following other changes in marine and coastal life? Select all that apply.

1. More piles of seaweed on the beach
2. Increased abundance of jellyfish
3. Increased abundance of octopus
4. Increased abundance of eagles
5. Occurrence of "weird bugs"
6. Increased abundance of salmon sharks.
7. New types of birds
8. Invasive or nonnative species
9. Other
10. I have not noticed any changes

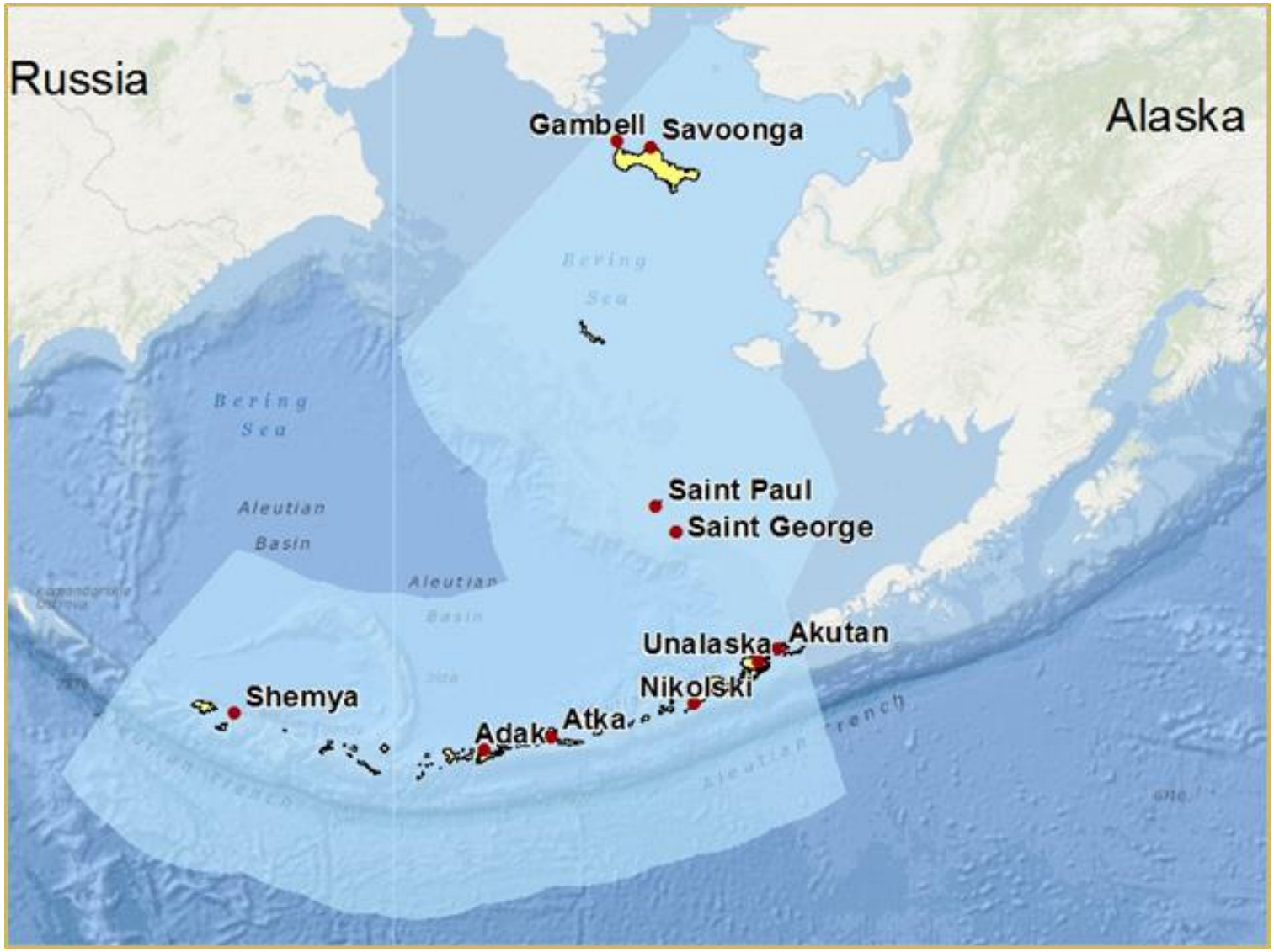
Other changes in marine and coastal life

9	Increased abundance of jellyfish
6	Invasive or nonnative species
3	Occurrence of "weird bugs"
2	New types of birds
2	Increased abundance of salmon sharks.
1	Other
1	More piles of seaweed on the beach
1	Increased abundance of eagles
1	I have not noticed any changes

Topic # 3

Impacts to People + Communities

ABSI Region Communities



Identified Vulnerabilities of Island Communities around the World*

- Sea level rise
- Coastal erosion
- Increased storminess
- Isolation from emergency response
- Less access to Federal and State resources
- Rapid shifts in fish stocks and other ocean life

*International Panel on Climate Change

"Drivers" of Vulnerabilities in ABSI Region Communities

All the subjects we've been discussing…

- Increased ice and snow free season
- Unpredictable changes in fish and marine mammal movements
- Increased abundance of nuisance species (e.g., jellyfish, salmon sharks, flounders)
- Etc., etc.

Potential Regional Vulnerabilities

- Commercial Fishing, e.g., shifting fish stocks
- Subsistence Culture & Harvest, e.g., forced change in traditional harvest practices
- Cultural Resources, e.g. erosion of archeological sites
- Infrastructure, e.g., impacts on buildings, sewage lagoons, landfills, roads

Secondary Changes Related to Climate Change

- Increased vessel traffic from arctic development
- Spread of invasive species
- Distribution and prevalence of pathogens
- Re-exposure of contaminated materials from previous military sites
- Broader, secondary socio-economic changes, e.g., impacts on jobs, on out-migration, on energy policy

Clicker Time!

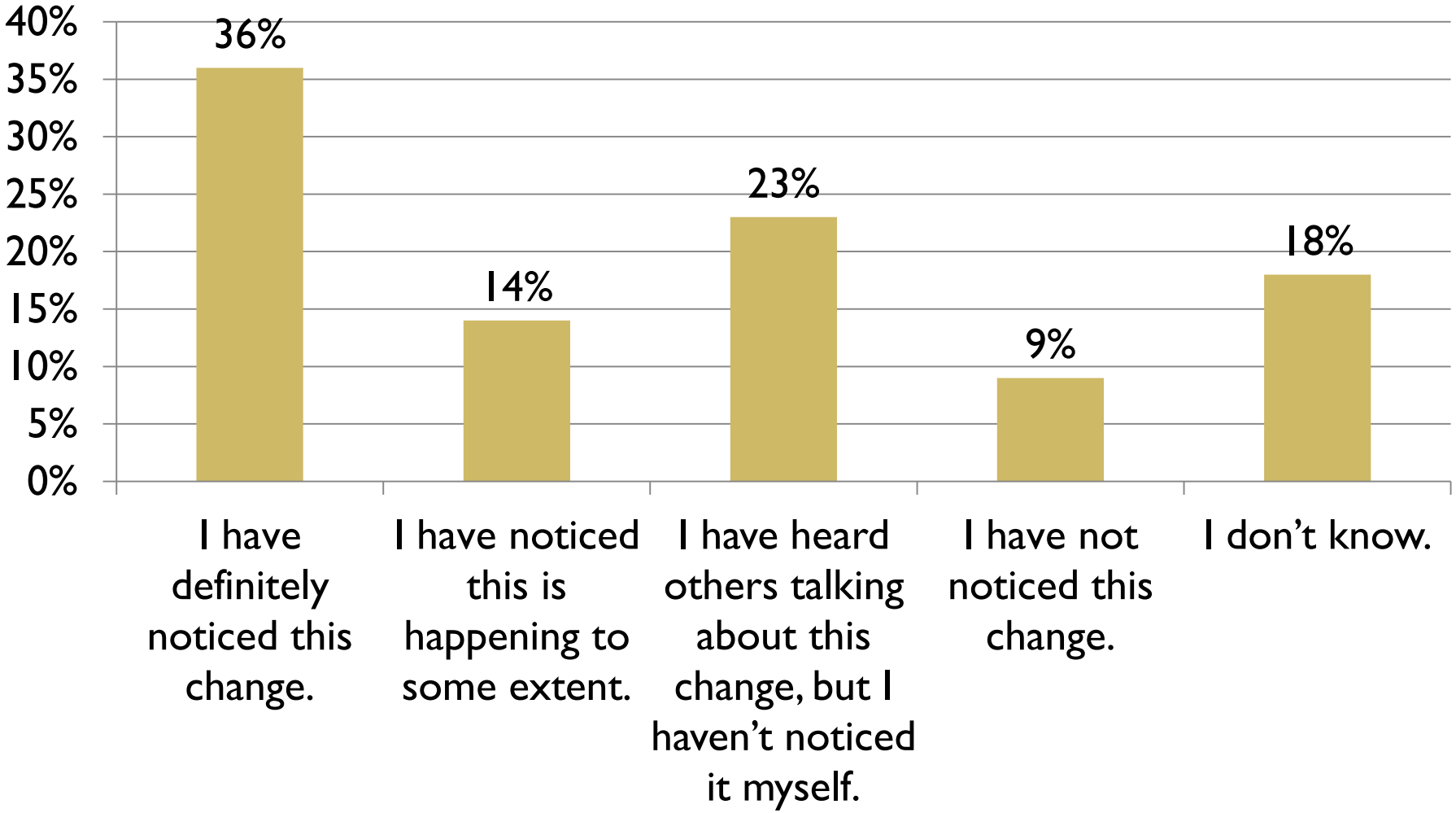
Part 3 of 4 – Impact on People & Communities

Decreased availability of subsistence resources.

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Decreased availability of subsistence resources.

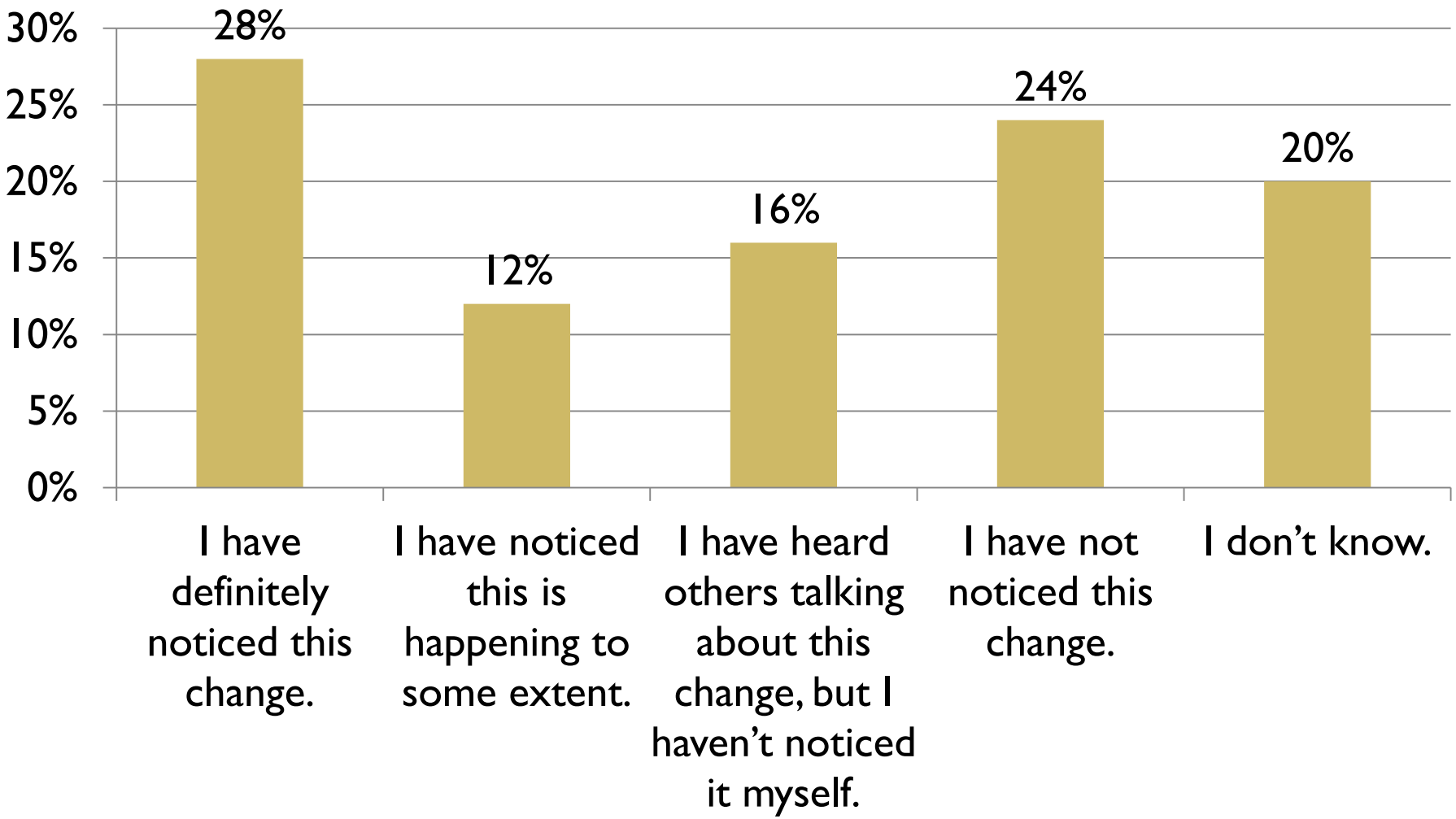


Increased travel distances, costs, and safety concerns related to storminess and accessing subsistence resources.

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Availability and access to subsistence resources.

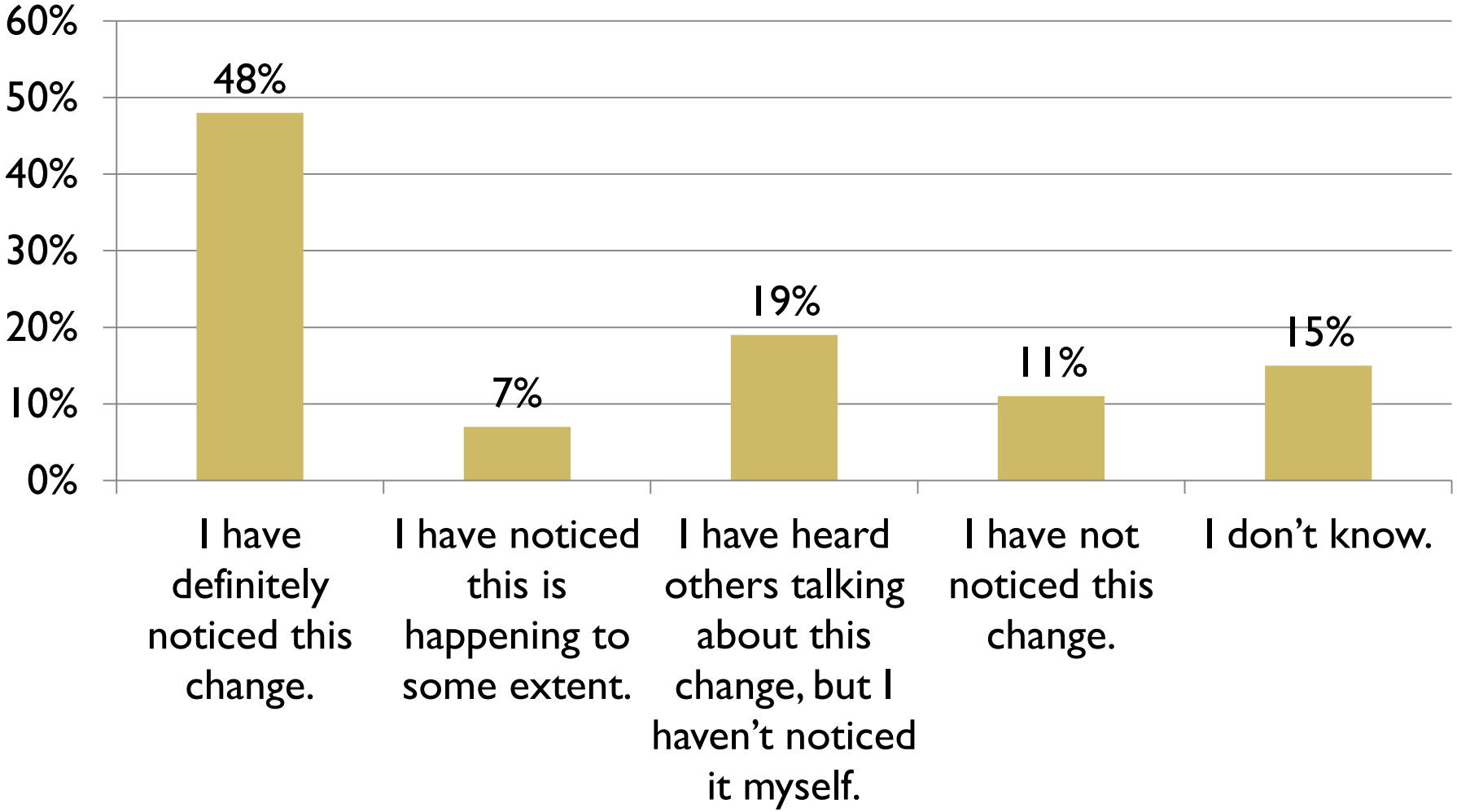


Decreased availability of commercial fishing resources.

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Decreased availability of commercial resources.



Increased travel distances, costs, and safety concerns related to storminess and accessing commercial resources.

To what extent have you noticed this change?

1. I have definitely noticed this change.
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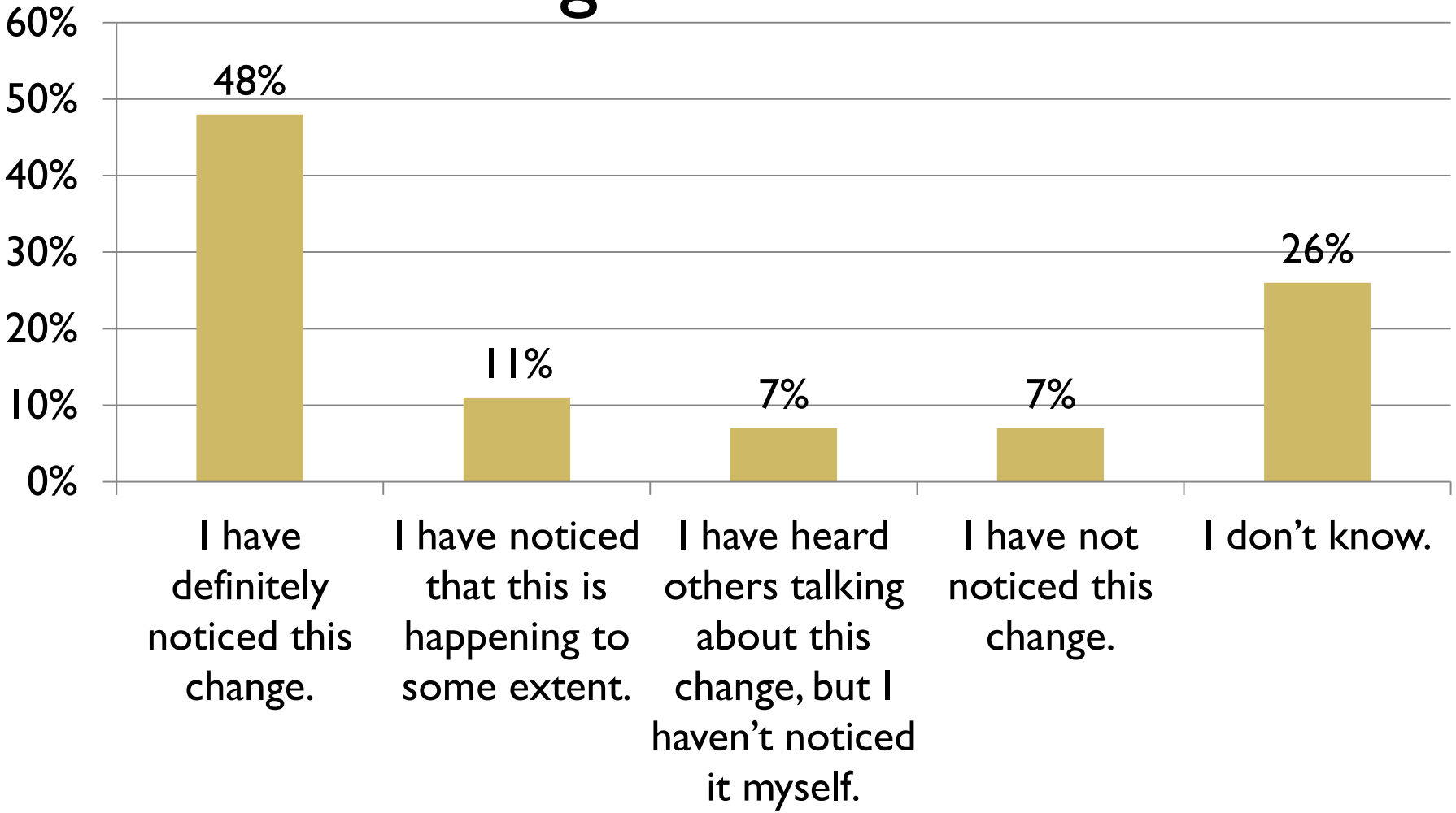
5. I don't know.

Increased travel distances, costs, and safety concerns related to storminess and accessing commercial resources.

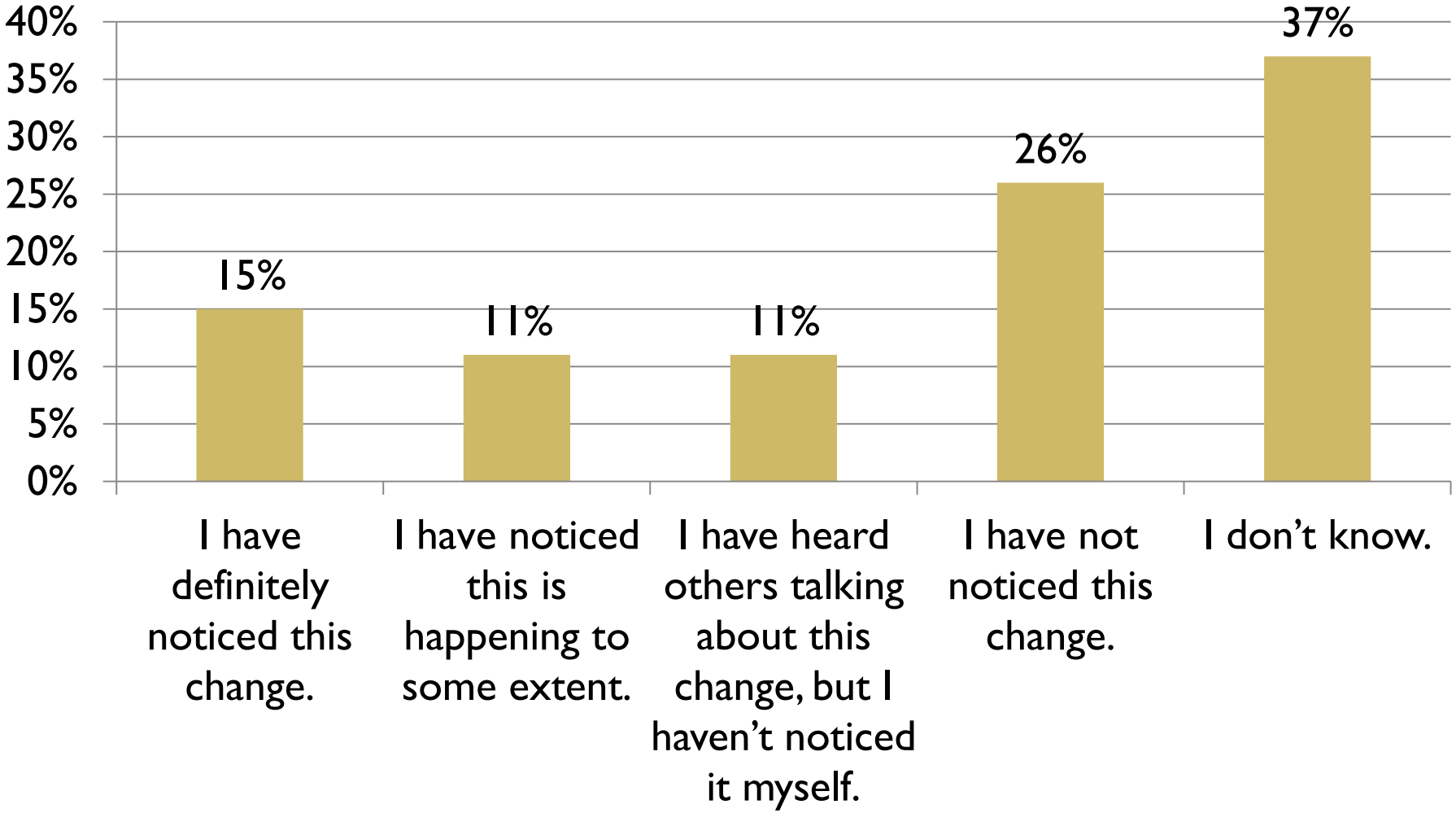


Loss of cultural resources due to coastal erosion or other climate related effects.

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Loss of cultural resources due to coastal erosion or other climate related effects.

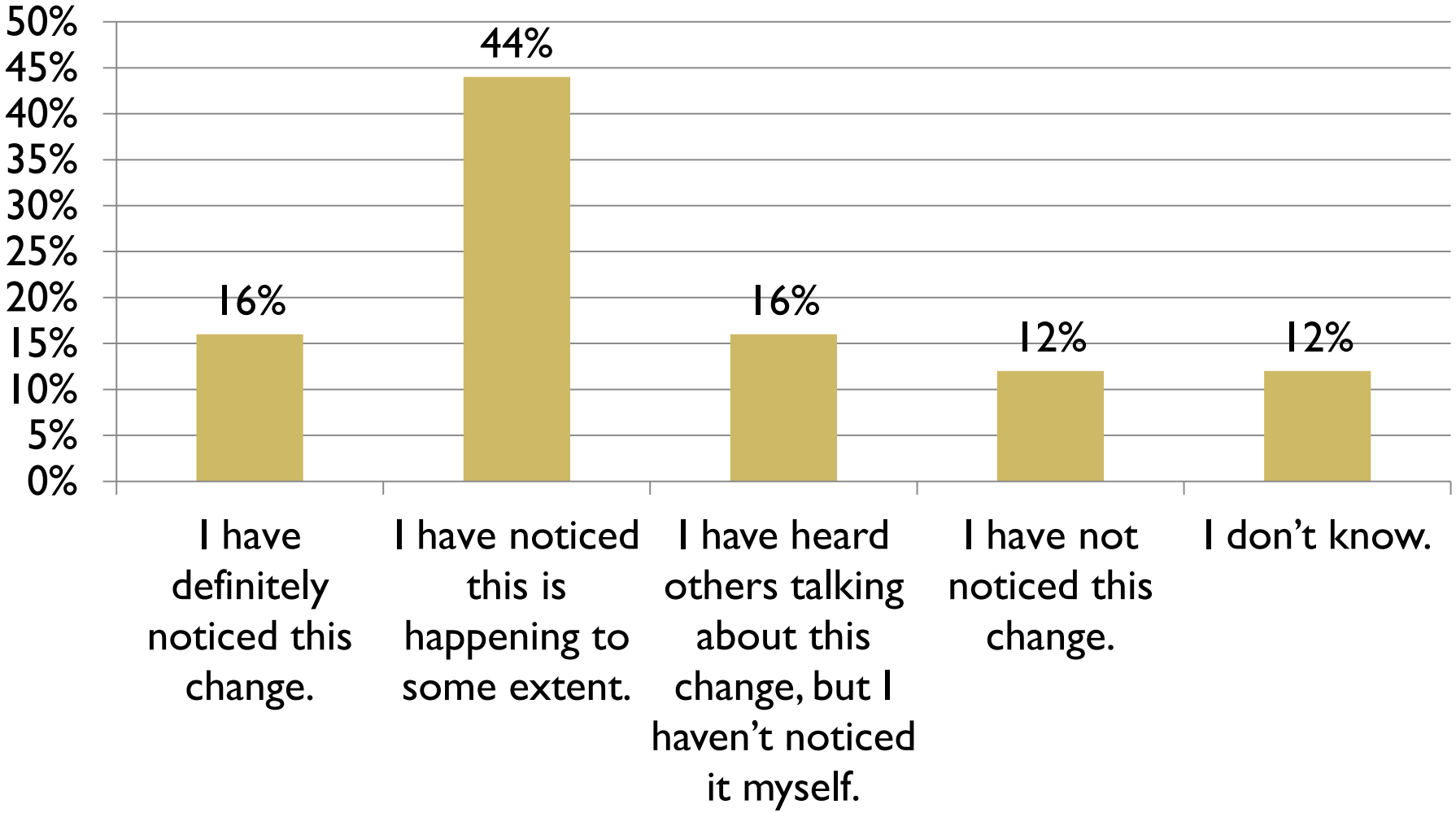


Impacts to infrastructure (e.g. docks, roads, breakwaters).

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Impacts to infrastructure due (e.g., docks, bridges, roads, breakwaters).

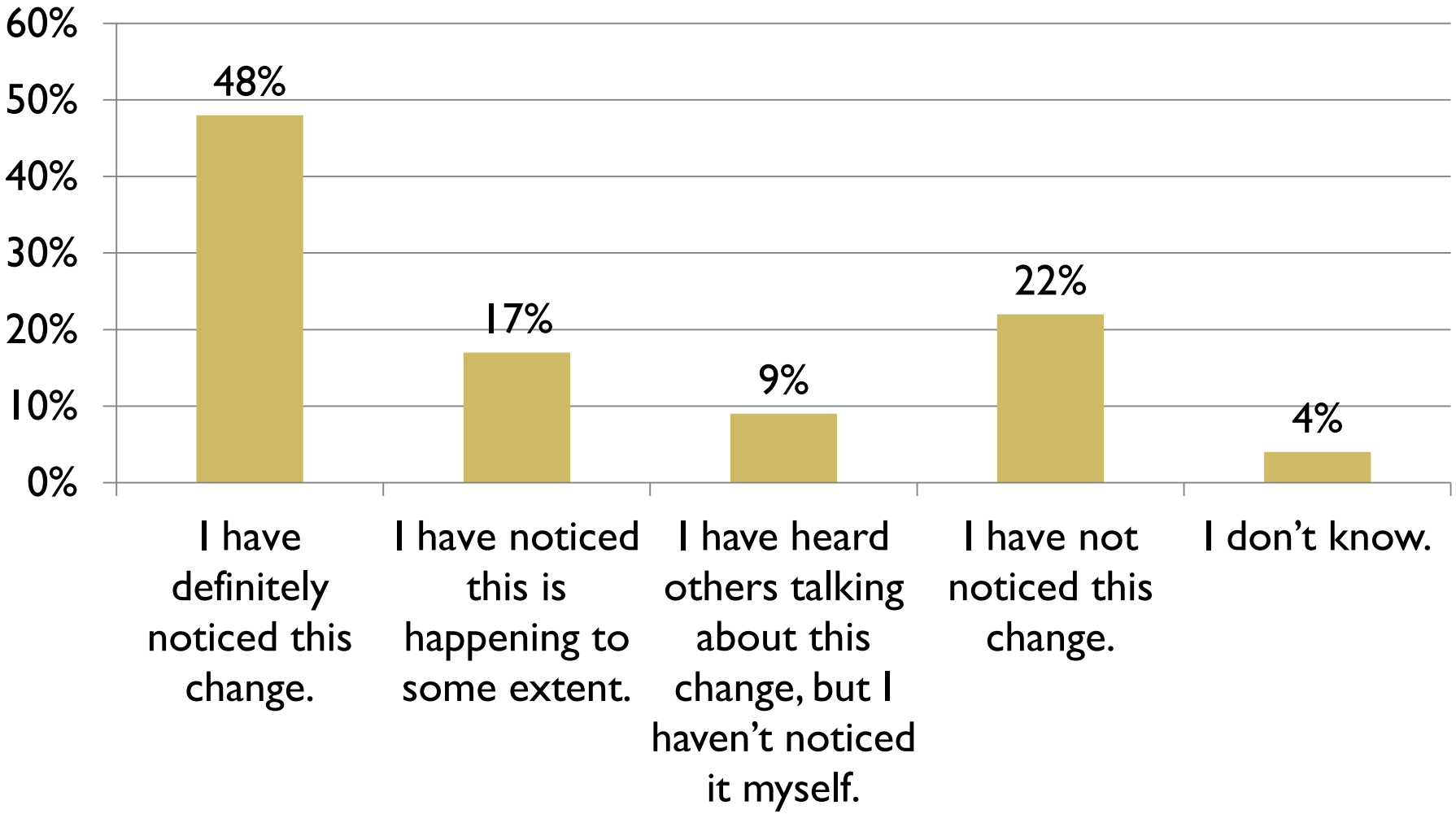


Increased vessel traffic.

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Increased vessel traffic.

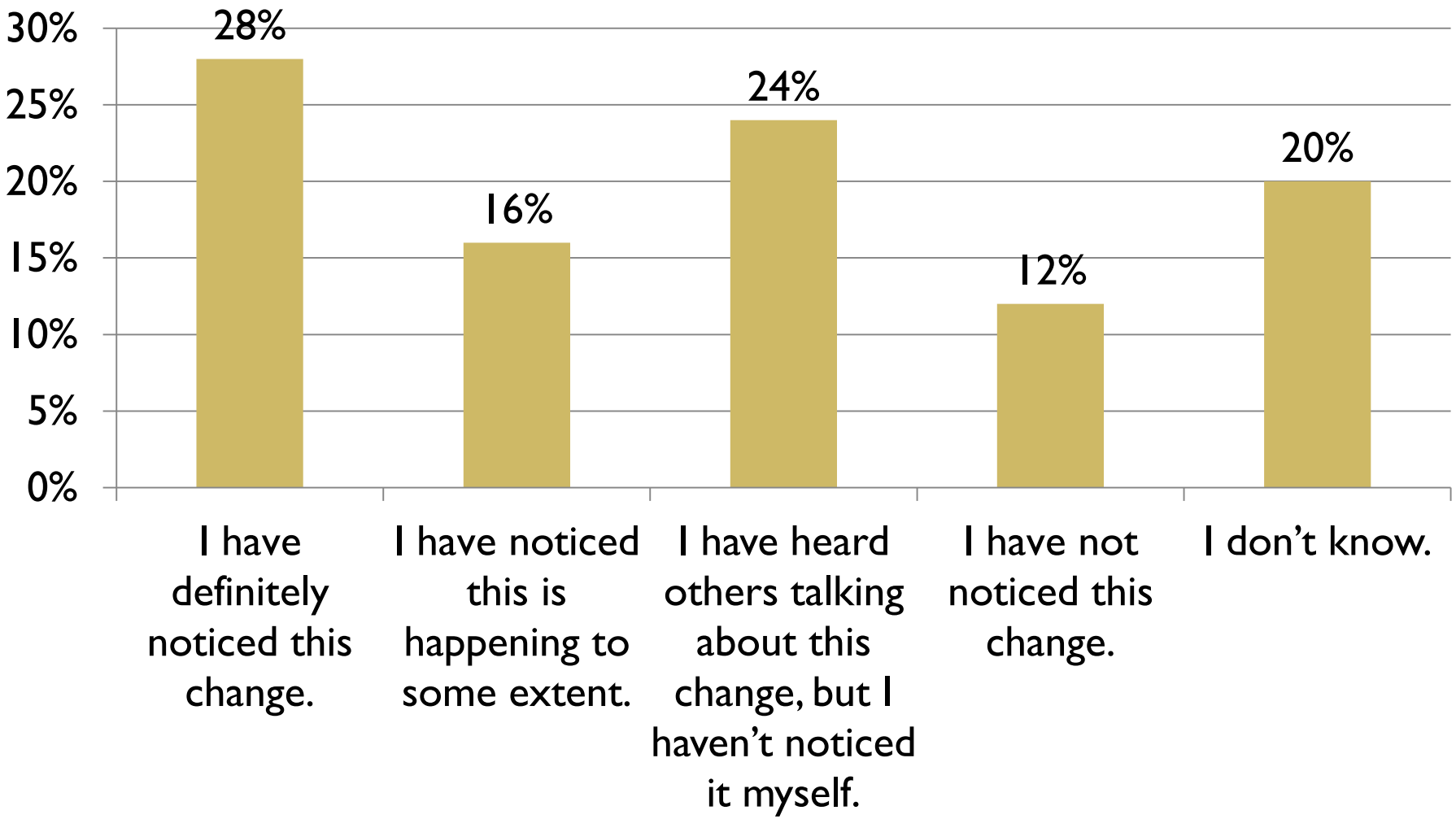


Spread of pathogens (e.g., PSP).

To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

Spread of pathogens.

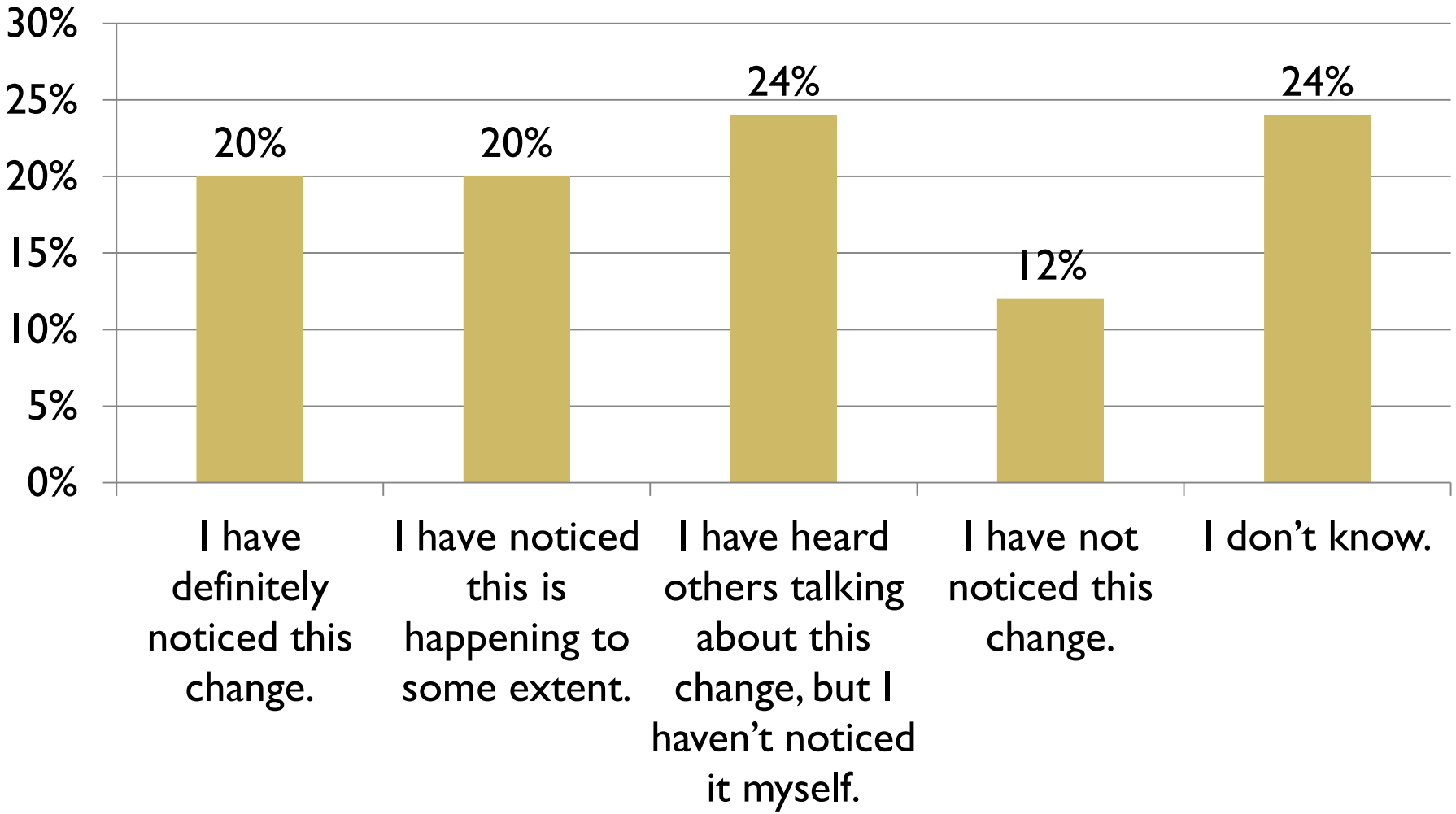


Re-exposure of contaminated sites.

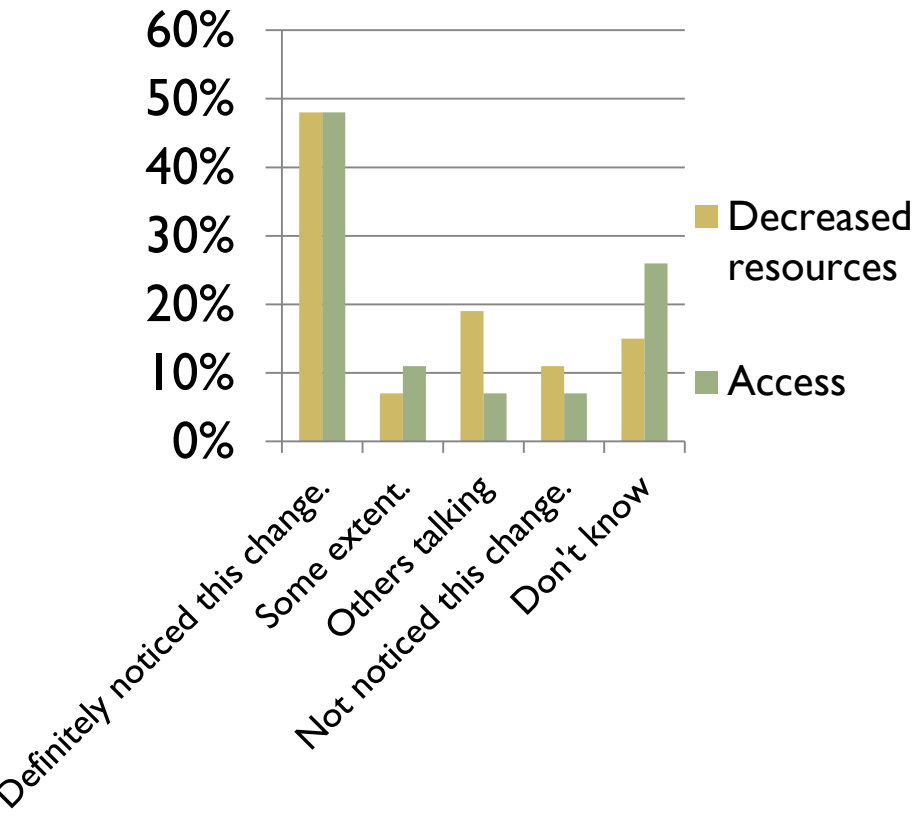
To what extent have you noticed this change?

1. I have definitely noticed this change.
2. I have noticed this is happening to some extent.
3. I have heard others talking about this change, but I haven't noticed it myself.
4. I have not noticed this change.
5. I don't know.

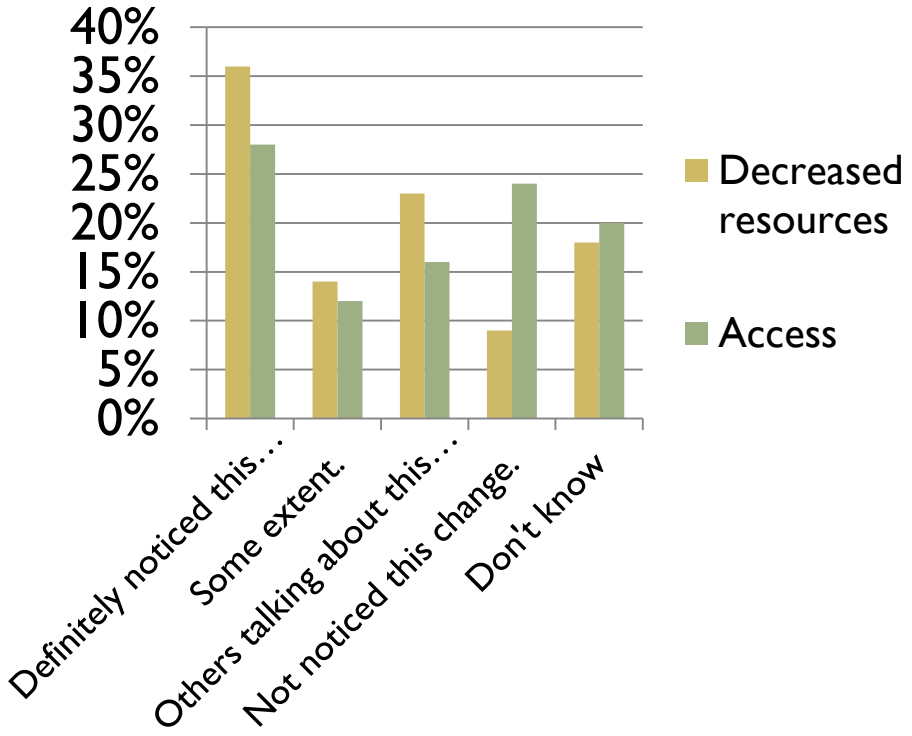
Re-exposure of contaminated sites.



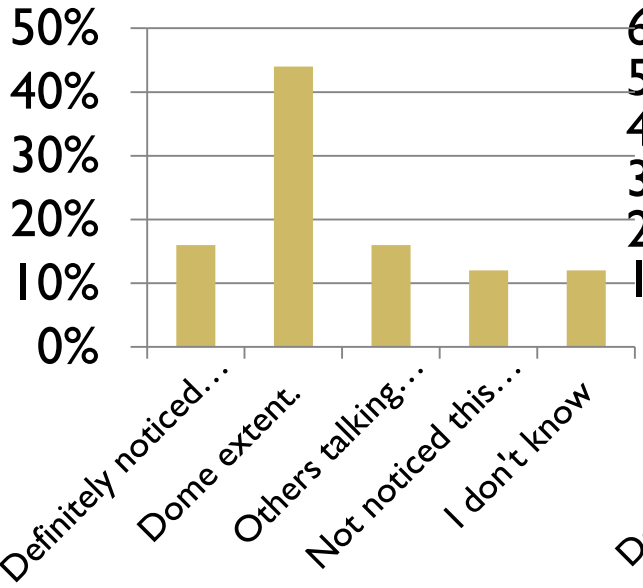
Commercial Resources



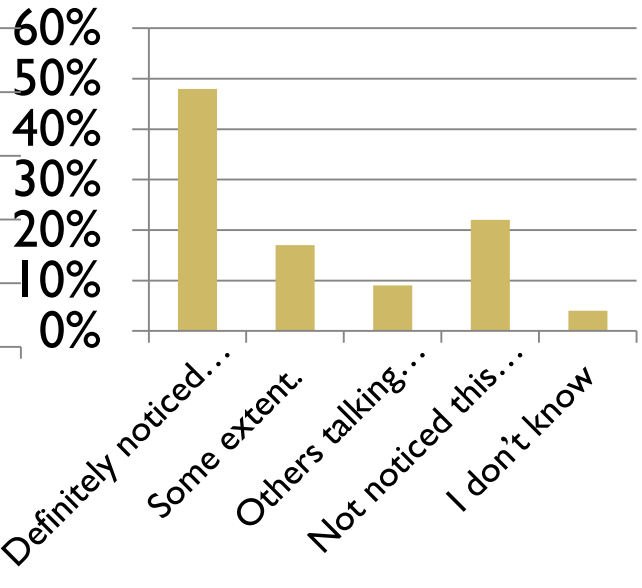
Subsistence Resources



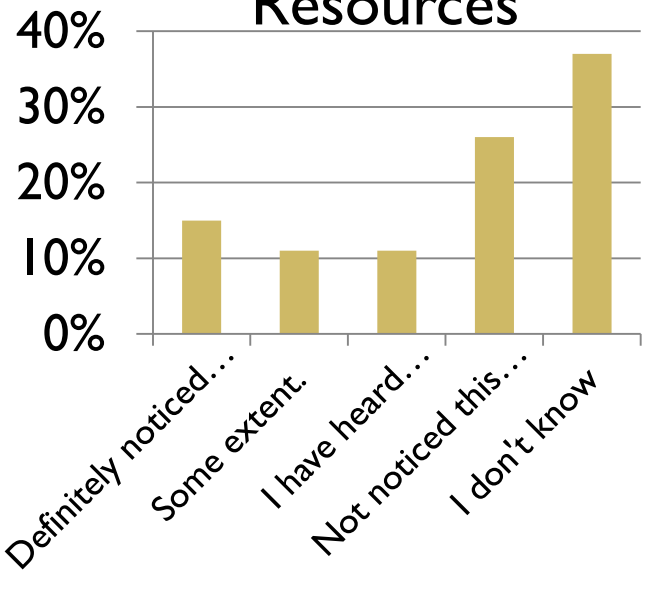
Infrastructure

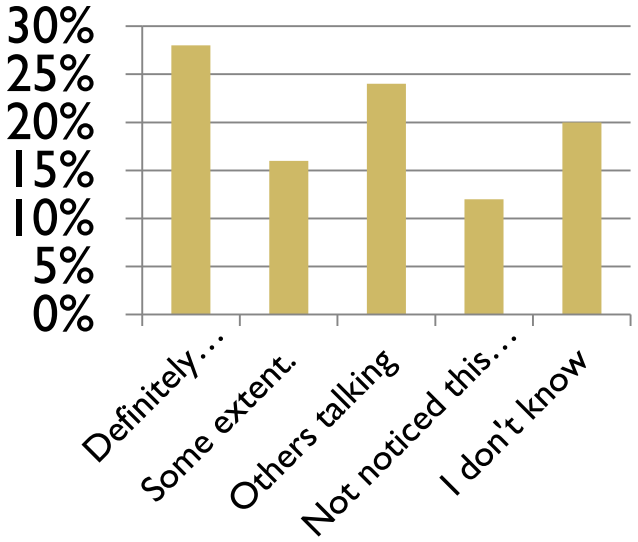


Vessel Traffic

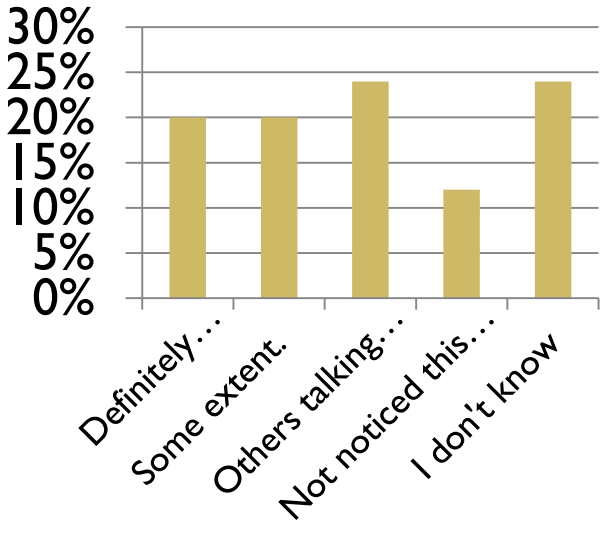


Cultural Resources





Pathogens



Contaminated Sites

Topic # 4

Greatest Concerns, Adaptation, and Research Priorities

Changes of greatest concern

Of the possible vulnerabilities of the area which may be due to climate related changes, which three give you the greatest concern? Select three.

1. Changes in commercial fishing
2. Changes in subsistence
3. Impacts to cultural resources
4. Impacts to infrastructure
5. Vessel traffic
6. Pathogens
7. Contaminated sites
8. Generally not concerned

Topics of Greatest Concern

15	Changes in commercial fishing
12	Changes in subsistence
7	Vessel traffic
6	Impacts to cultural resources
5	Contaminated sites
5	Impacts to infrastructure
5	Pathogens

Which areas should be priorities for research related to climate change? Please pick your top 3.

"Environmental Drivers"

1. Storminess + wind patterns
2. Precipitation
3. Sea ice
4. Air temperature
5. Ocean temperature + the cold pool

Potential Vulnerabilities

6. Coastal erosion
7. Commercial fisheries
8. Subsistence resources
9. Other marine and coastal species
10. Vessel traffic
11. Contaminated sites
12. Pathogens
13. Local economy
14. Adaptation strategies
15. Other
16. None of the above, I don't want to direct research to climate change issues

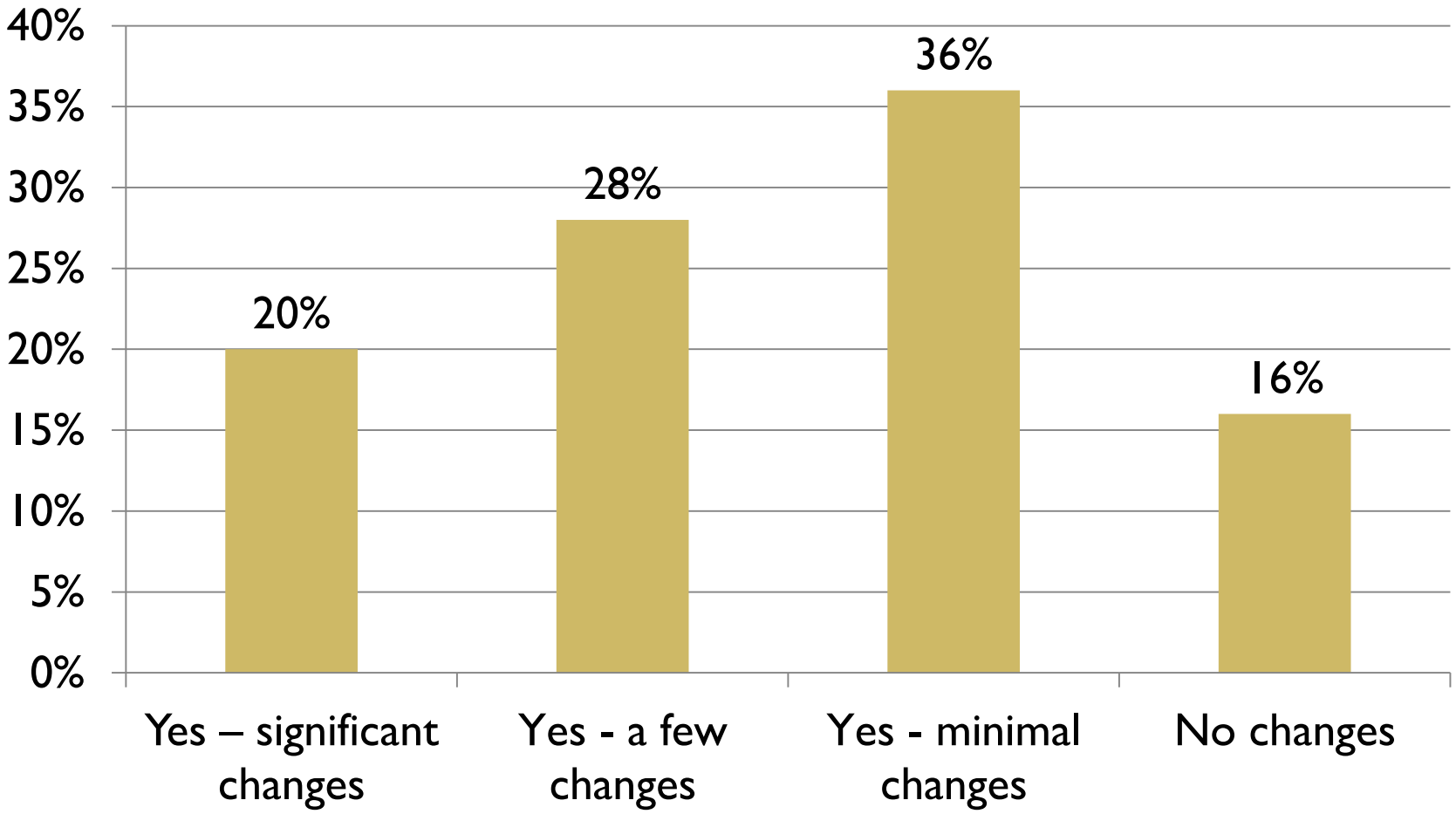
Research Direction

13	Air temperature
6	Precipitation
5	Coastal erosion
5	Commercial fisheries
4	Pathogens
4	Potential Vulnerabilities
4	"Environmental Drivers"
3	Contaminated sites
3	Subsistence resources
2	Ocean temperature + the cold pool
2	Vessel traffic

Are you already making changes in your life due to what you believe are the result of climate change?

1. Yes – significant changes
2. Yes - a few changes
3. Yes - minimal changes
4. No changes

Making changes in your life



Discussion

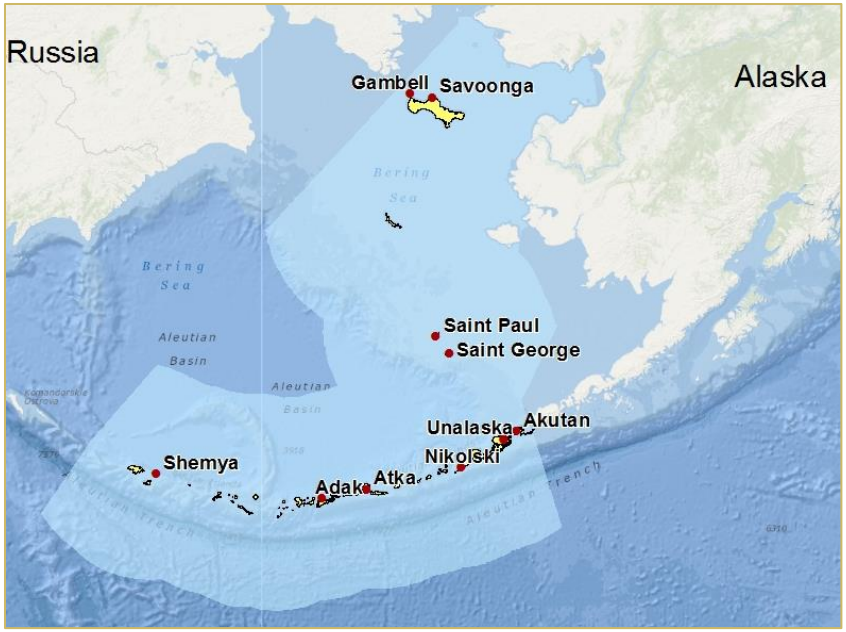
If you think about changing your life to respond to climate change:

- What kinds of changes?
- What adaptation strategies, if any?

Thanks for your time, and energy!
Some things to remember…

- This huge, important, complex topic won't be 'answered' by this one assessment.
- There is significant uncertainty around *any* vulnerability assessment. We're working "at 50,000 feet"
- New information will come forward, and undoubtedly change our understanding
- By reaching out to you who live in and know the area we aim to make this vulnerability assessment more useful and more accurate, for the project sponsors & the region.
- Let's keep the conversation going!
  - Draft report out in February
  - Contact

Aleutian & Bering Climate Vulnerability Assessment - ABCVA



Unalaska Lecture & Community Lecture - September 2014

AOOS Alaska Ocean Observing System

AK CSC Alaska Climate Science Center

absi Aleutian and Bering Sea Islands Landscape Conservation Cooperative

AGNEW::BECK

More at: https://absilcc.org