



A Human Health Perspective on Climate Change: Promoting Community-Based Adaptation Planning for Climate Change in Alaska

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Presentation Objectives

- 1) **Discuss the connection** between human health issues and climate change in Alaska
- 2) **Describe the methods traditionally** employed by public health scientists to assess and mitigate environmental challenges
- 3) **Identify alternative methods** to assess and mitigate the health effects of climate change in Alaska
- 4) **Describe an ongoing sentinel surveillance system** to capture baseline environmental and human health data in Alaska



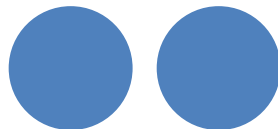
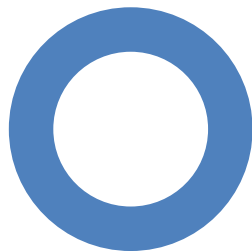
Impacts of Climate Change

Anthropological and Archeological Studies

Holocene

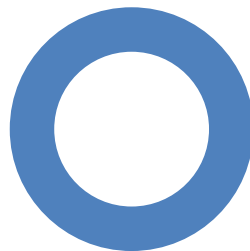
Pleistocene

Little Ice Age (1350)



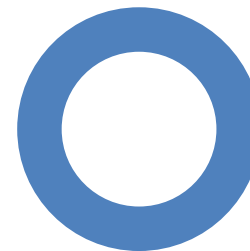
Climate Change
in Tropical Africa

Thompson et al,
Science: 2002



Human Ecology
of Beringia

Hoffecker et al,
Columbia: 2007



How Climate
Made History

Fagan, Basic
Books: 2001

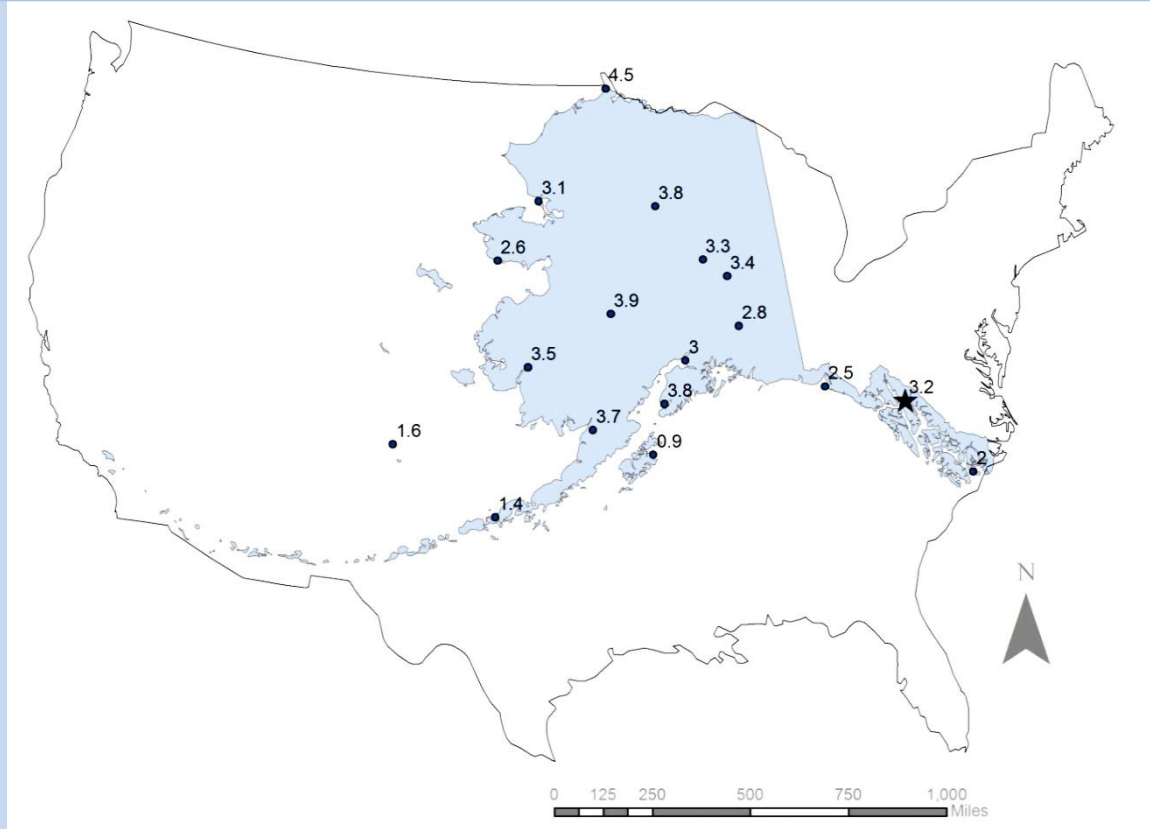


Family group - Noatak
Edward S. Curtis, 1930
Northwestern University Library, Edward S. Curtis's 'The North American Indian': the
Photographic Images



Total Change in Mean Annual Temp. (°F) 1949-2009

- Warming is unequivocal
- Physical and biological systems on all continents and oceans are already affected by climate changes
- Adaptation strategies are required



Statewide Average increase in mean annual temperature: 3.0 °F



Climate Change in Southeastern Alaska



ENVIRONMENTAL CHANGES

- Northern expansion of invasive species
- Warming water temperatures
- Changes in fish/animal behavior
- Reduced snow pack
- Glacial retreat

ENVIRONMENTAL CHANGES

- Flooding
- Drought
- Changed plant behavior
- Changed animal behavior
- Phenological disconnections
- Northern expansion of invasive species (e.g. spruce bark beetle)





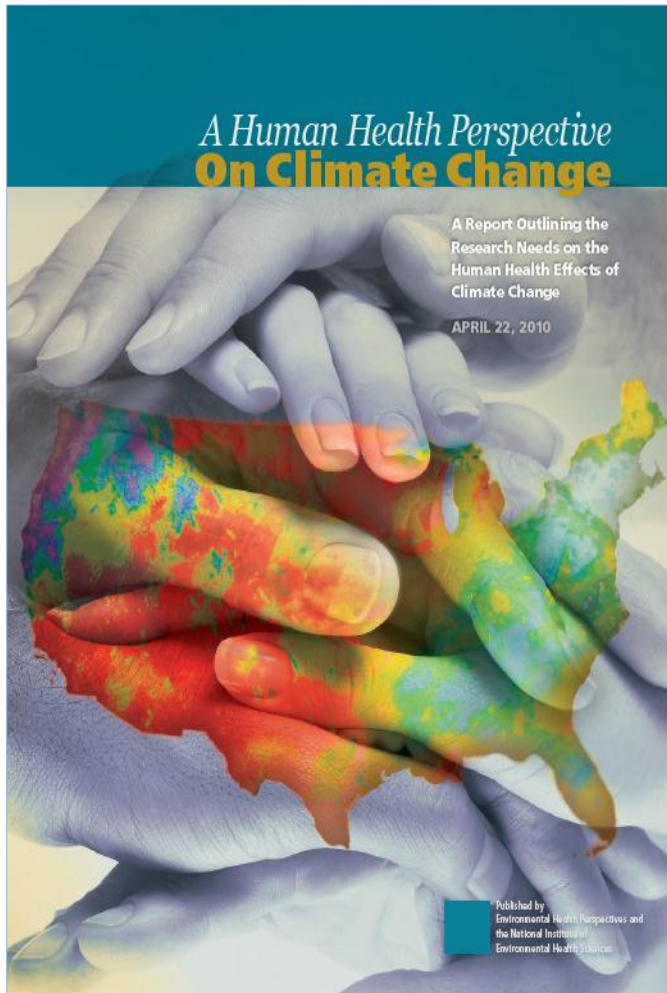
Climate Change in Northwestern Alaska



ENVIRONMENTAL CHANGES

- Extreme weather events
- Sea ice retreat
- Changed animal behavior
- Thawing permafrost
- Loss of tundra ponds
- Erosion of shoreline

Human health impacts from climate change

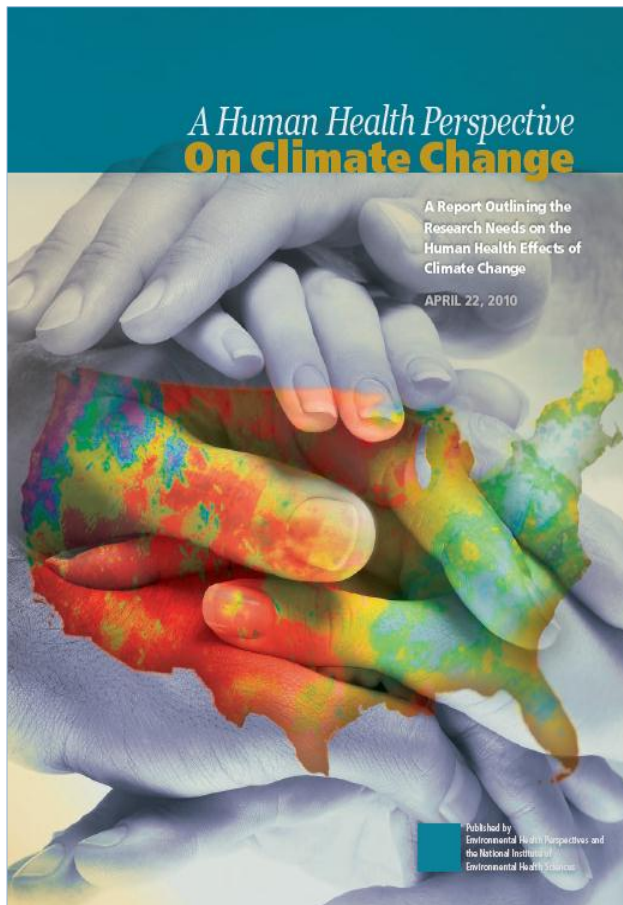


Categories of human health consequences of climate change:

- Asthma, Respiratory Allergies, and Airway Diseases
- Cancer
- Cardiovascular Disease and Stroke
- Foodborne Diseases and Nutrition
- Heat-Related Morbidity and Mortality
- Human Developmental Effects
- Mental Health and Stress-Related Disorders
- Neurological Diseases and Disorders
- Vectorborne and Zoonotic Diseases
- Waterborne Diseases
- Weather-Related Morbidity and Mortality



In Alaska?



What adverse health outcomes should we assess?

How?

Among whom?

When?

...and (most importantly)...

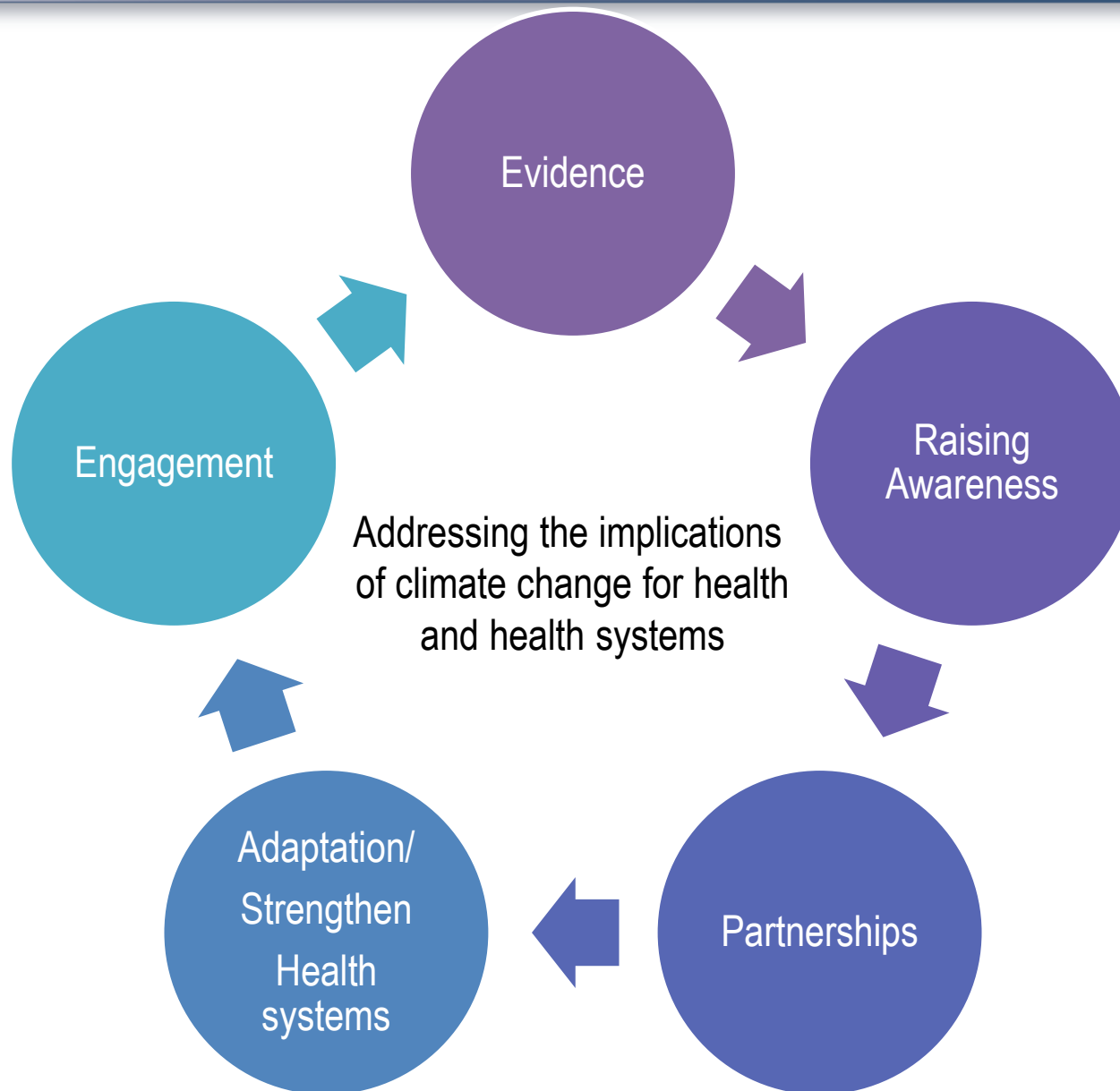
WHAT CAN WE DO TO PREVENT THEM?

What does Public Health do?

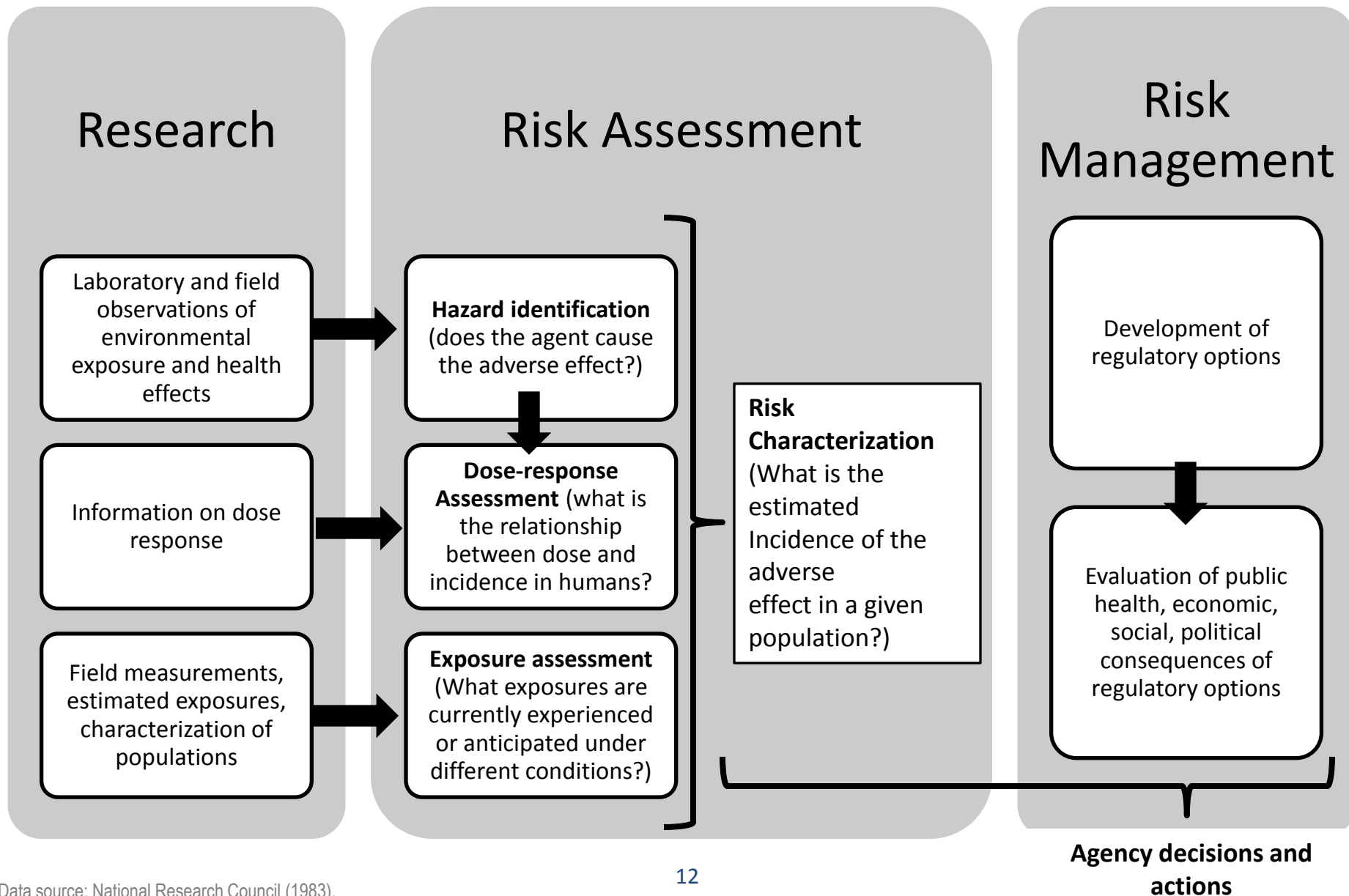
- Prevent epidemics and the spread of disease
- Protect against environmental hazards
- Prevent injuries
- Promote and encourage healthy behaviors and mental health
- Respond to disasters and assist communities in recovery
- Assure the quality and accessibility of health services



What can Public Health do?



Major Elements in Risk Assessment and Management



Quantifying Health Impacts from Climate Change

General research questions:

1. How much disease is caused by a particular risk factor (the attributable burden of disease)?
2. How much could be avoided by making plausible reduction in the risk factor (the avoidable burden of disease)?

Traditional approach: Risk Ratio

Exposure	Diseased	Nondiseased	Disease Incidence (Risk)	Probability Odds of Disease
Present	a	b	$q_+ = \frac{a}{a+b}$	$\frac{q_+}{1-q_+} = \frac{\frac{a}{a+b}}{1 - \left(\frac{a}{a+b}\right)} = \frac{a}{b}$
Absent	c	d	$q_- = \frac{c}{c+d}$	$\frac{q_-}{1-q_-} = \frac{\frac{c}{c+d}}{1 - \left(\frac{c}{c+d}\right)} = \frac{c}{d}$

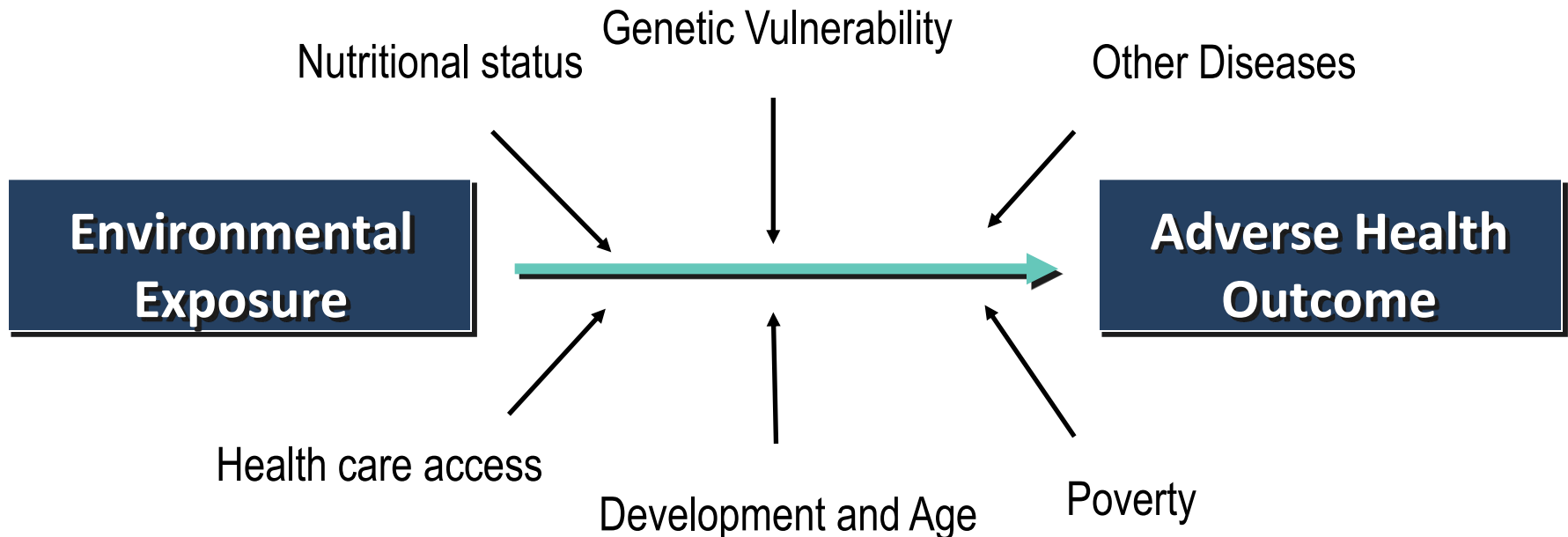
Estimating health effects of climate change:

1. Identify risks to public health from local climate variation (and/or other indirect influences of climate change) in the present and recent past
2. Assess associations between those risks and specific diseases/conditions
3. Apply these associations to projections of likely climate change models

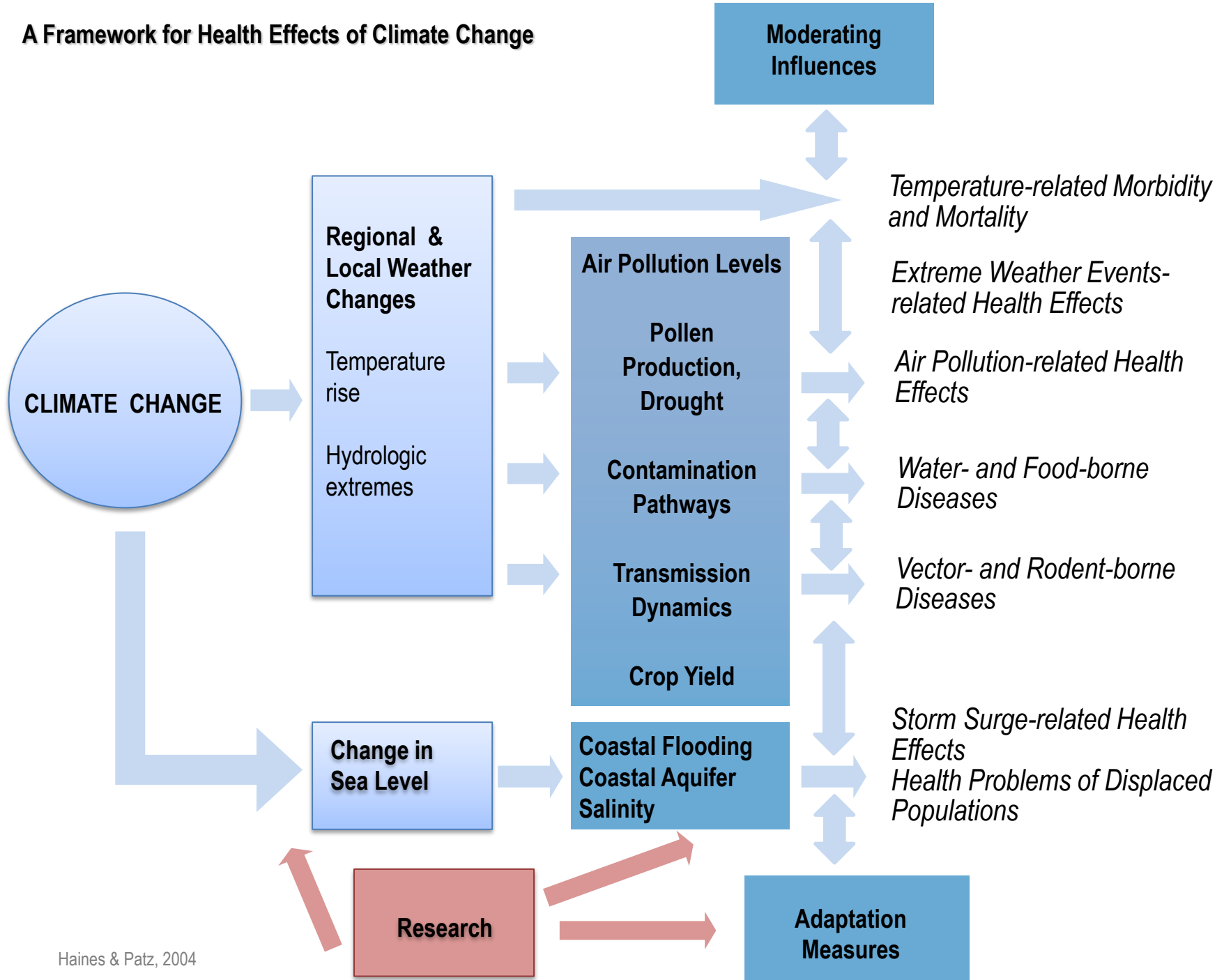
Causal web complexities

Complexity –

Why do certain people develop disease (or experience an adverse health outcome) when challenged with harmful environmental exposures, while others remain healthy?

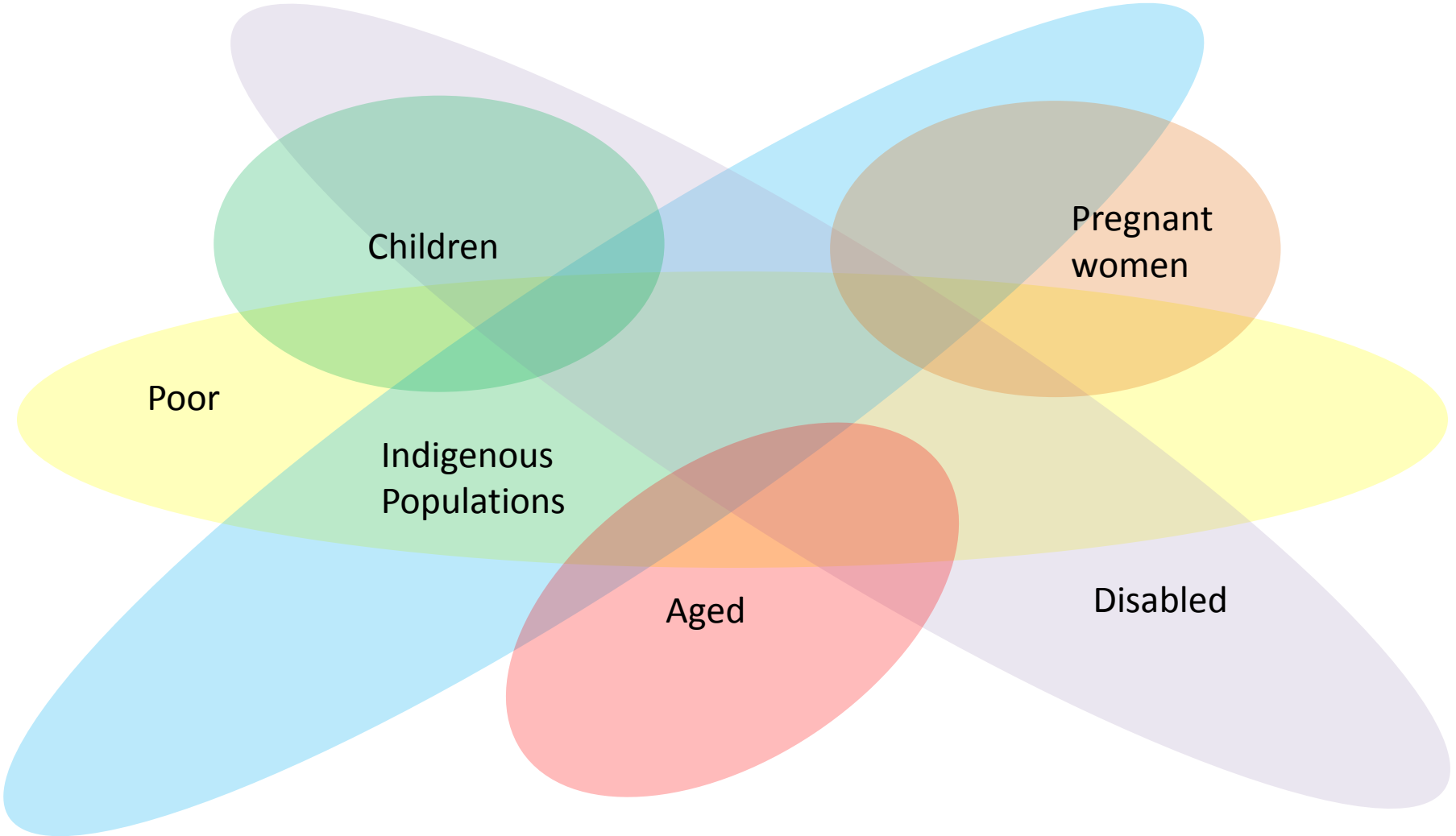


A Framework for Health Effects of Climate Change



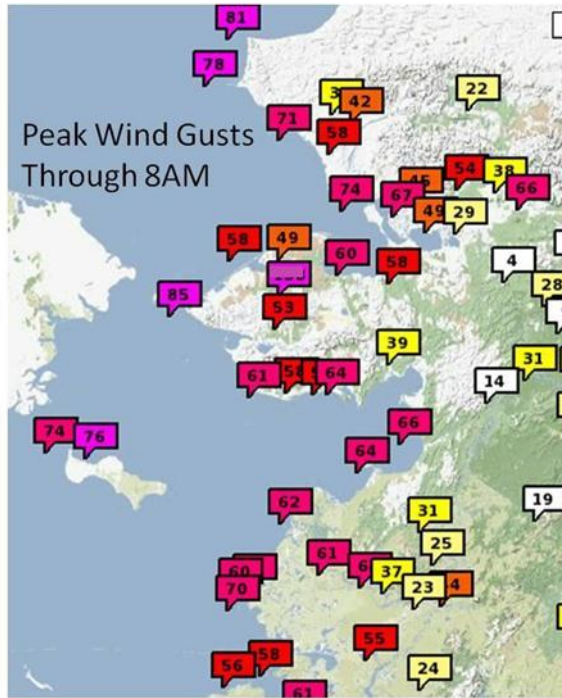


Populations in a state of vulnerability from climate change



WEATHER EVENT	HEALTH EFFECTS	POPULATIONS MOST AFFECTED
Extreme weather events (rain, hurricane, tornado, flooding, drought)	Injuries, drowning, mental health	Coastal, low-lying land dwellers, low SES, young, displaced, agriculture sector, low SES
Warming sea temperature	Paralytic shellfish poisoning	General population
Droughts, floods, increased mean temperature	Vector-, food- and water-borne diseases	Multiple populations at risk
Sea-level rise	Injuries, drowning, water and soil salinization, ecosystem and economic disruption	Coastal, low SES
Drought, ecosystem migration	Food and water shortages, malnutrition	Low SES, elderly, children
Increases in ground-level ozone, airborne allergens, and other pollutants	Respiratory disease exacerbations (COPD, asthma, allergic rhinitis, bronchitis)	Elderly, children, those with respiratory disease

Extreme Weather-Related Health Effects



Storms

Floods

Wildfires

Adverse health outcomes including:

- *Traumatic Injuries*
- *Deaths*
- *Mental Health Effects (e.g., PTSD)*
- *Diarrheal Illnesses*
- *Respiratory Illnesses*

58 wildfires active in Interior; no weather relief in sight

By RACHEL D'ORO
Associated Press

Published: June 1st, 2011 07:41 AM
Last Modified: June 1st, 2011 07:42 AM

Alaska's fire season is escalating, primarily in the state's hot and dry Interior, where lightning storms are sparking blazes, including one that struck close to riverside cabins.



[enlarge](#)

Bill Aney / Alaska Division of Forestry

Crews are shuttled to the East Volkmar fire 25 miles northeast of Delta Junction.



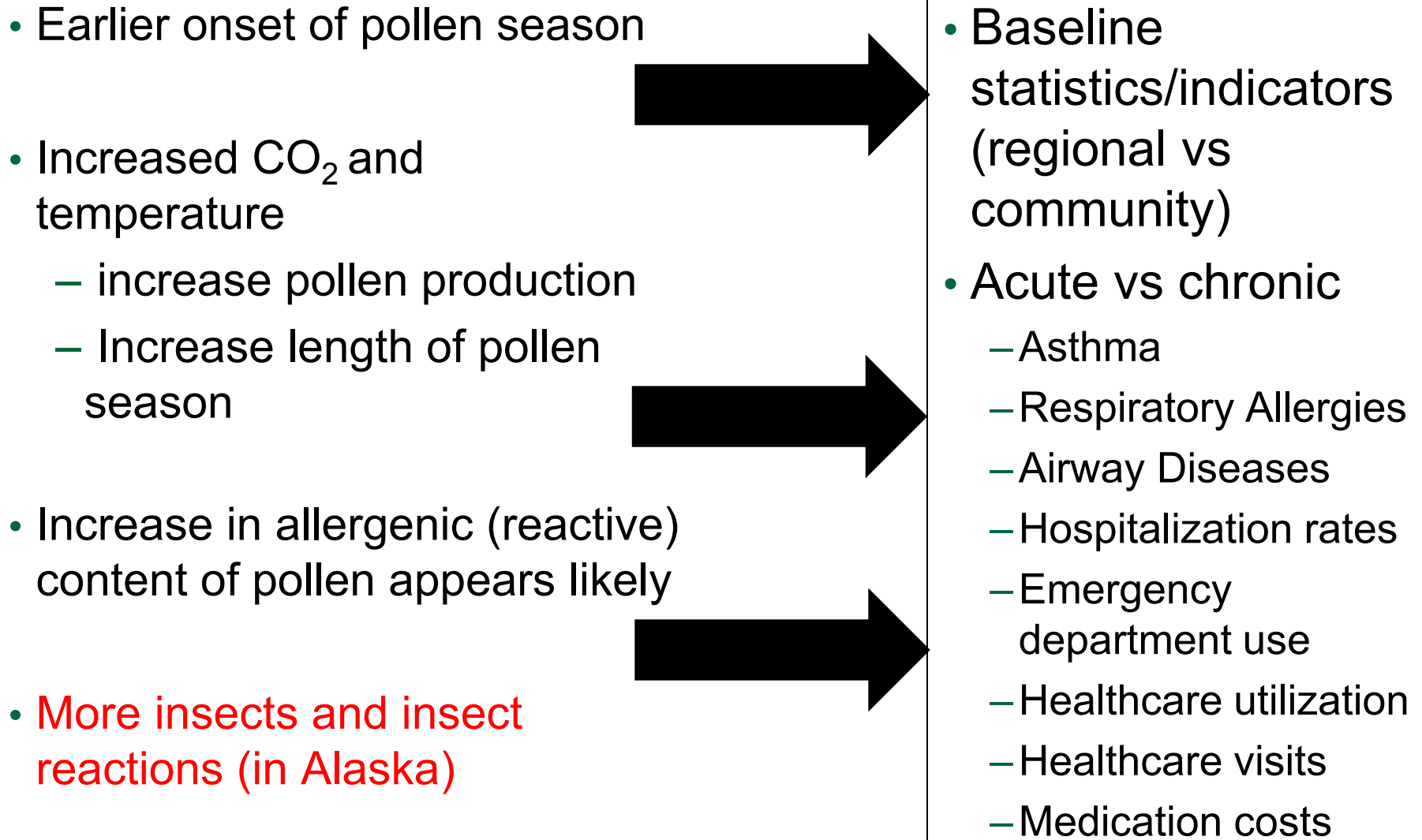
Temperature-Related Morbidity and Mortality

- Relationship between morbidity/mortality and **low** temperature exposure is more difficult to analyze than the relationship to **high** temperature exposure
- Alaska is experiencing fewer cold days in winter (Chapman & Walsh, 1993)
- Positive effect in arctic → more people travelling outside (Furgal, Martin, & Gosselin, 2002)

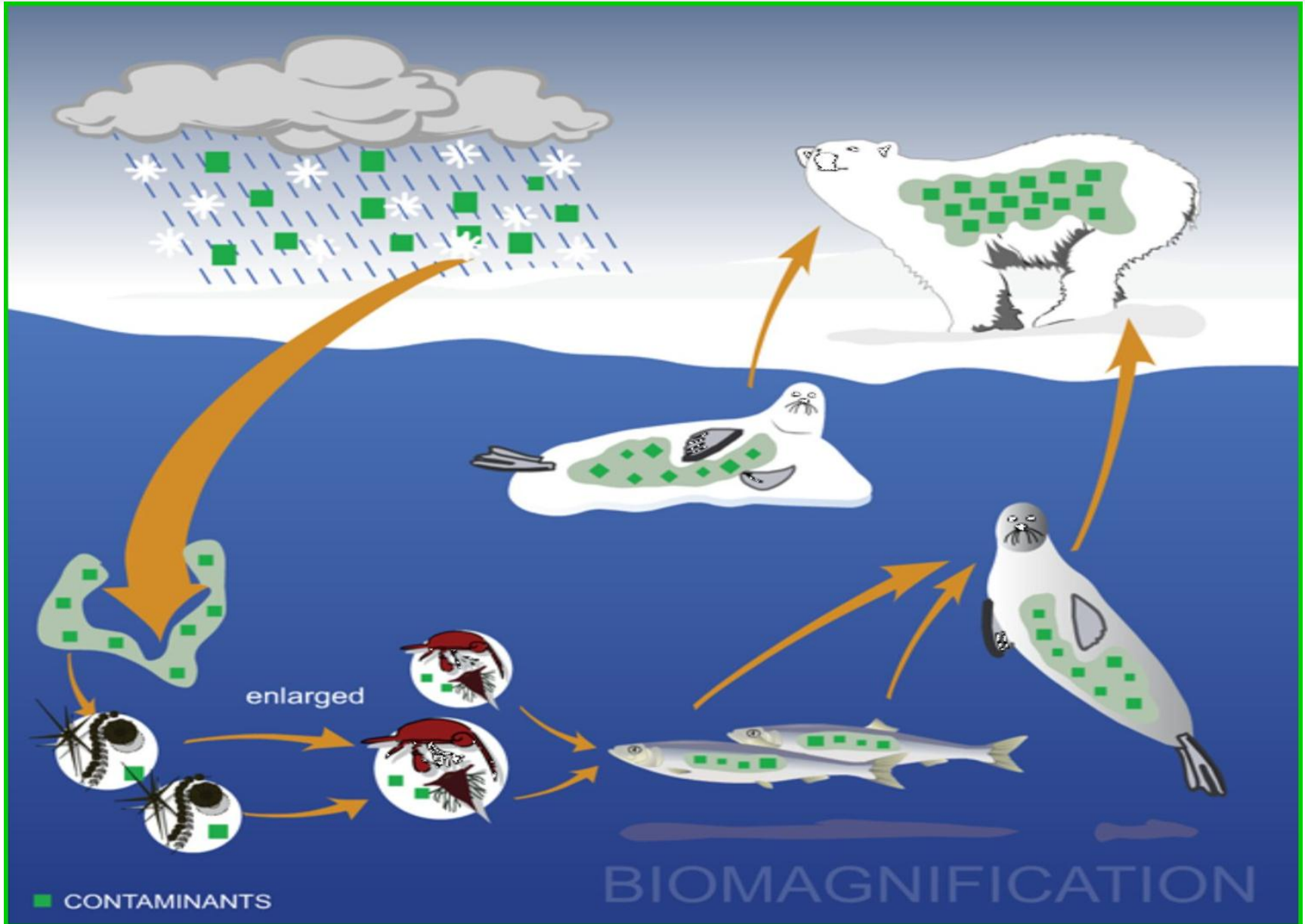
- Cold-related injuries
 - Frostbite
 - Hypothermia
- Cold-related diseases
 - Circulatory disease
 - Respiratory diseases



Air Pollution-related Health Effects



Water and Food-borne Diseases



Bi-directional effects

Globally

	Negative impact	Positive impact
Very high confidence Malaria: contraction and expansion, changes in transmission season	←	→
High confidence Increase in malnutrition	←	
Increase in the number of people suffering from deaths, disease and injuries from extreme weather events	←	
Increase in the frequency of cardio-respiratory diseases from changes in air quality	←	
Change in the range of infectious disease vectors	←	→
Reduction of cold-related deaths		→
Medium confidence Increase in the burden of diarrhoeal diseases	←	

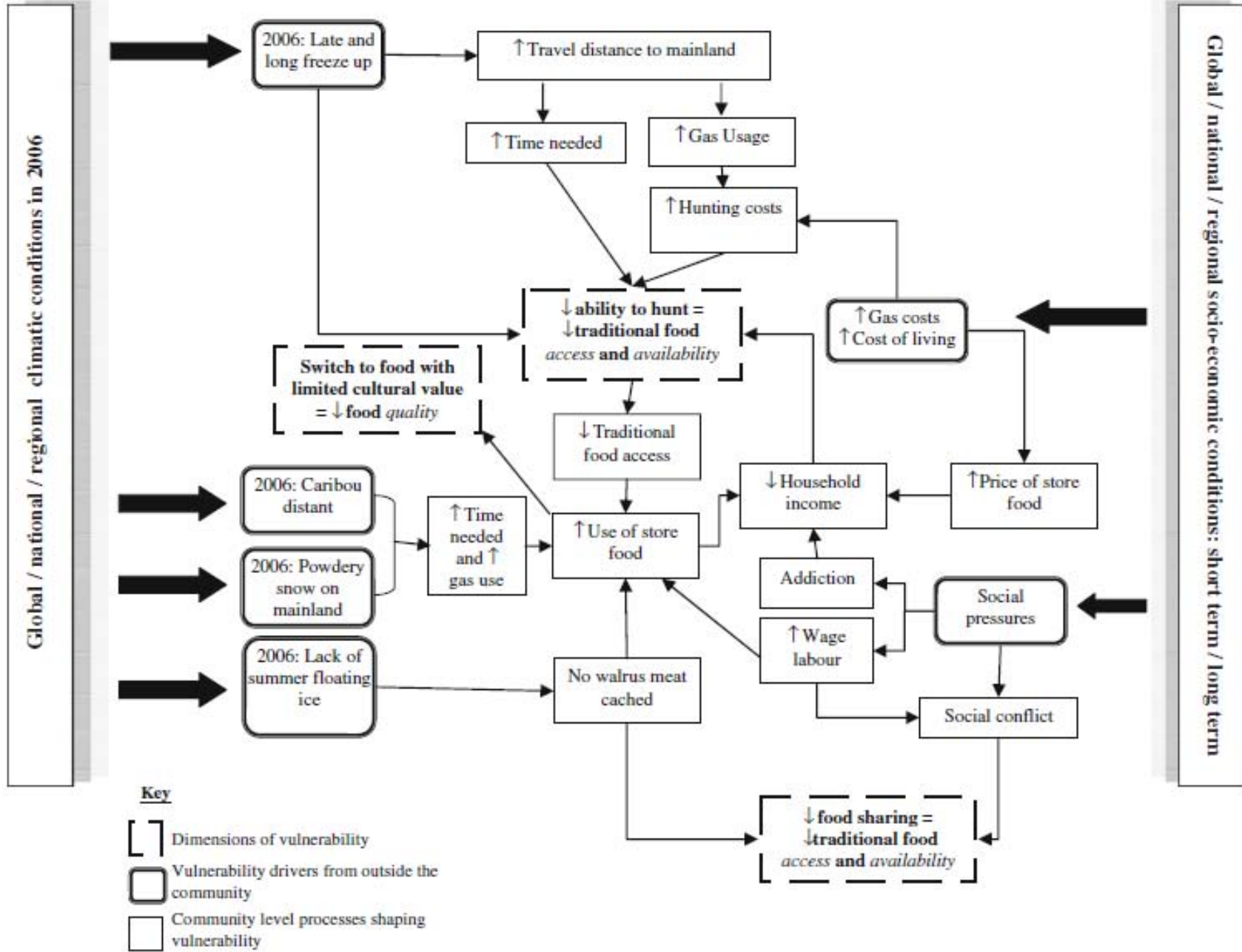
In Alaska

Warmer temp → Increase Physical activity?

Warmer temp → Increase positive mood and decreases in Depression?

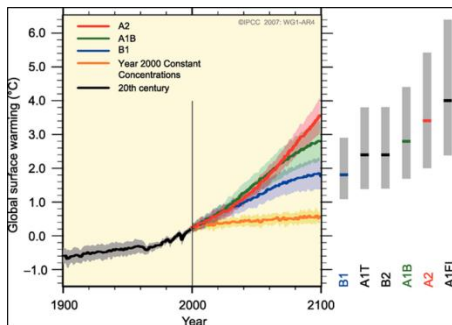
Longer growing season → Increase in local harvests?

Figure 8.3. Direction and magnitude of change of selected health impacts of climate change (confidence levels are assigned based on the IPCC guidelines on uncertainty, see <http://www.ipcc.ch/activity/uncertaintyguidancenote.pdf>).



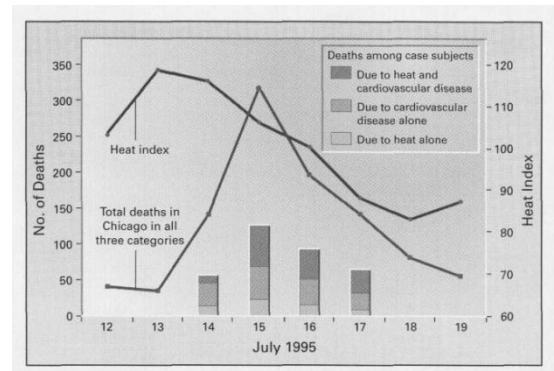
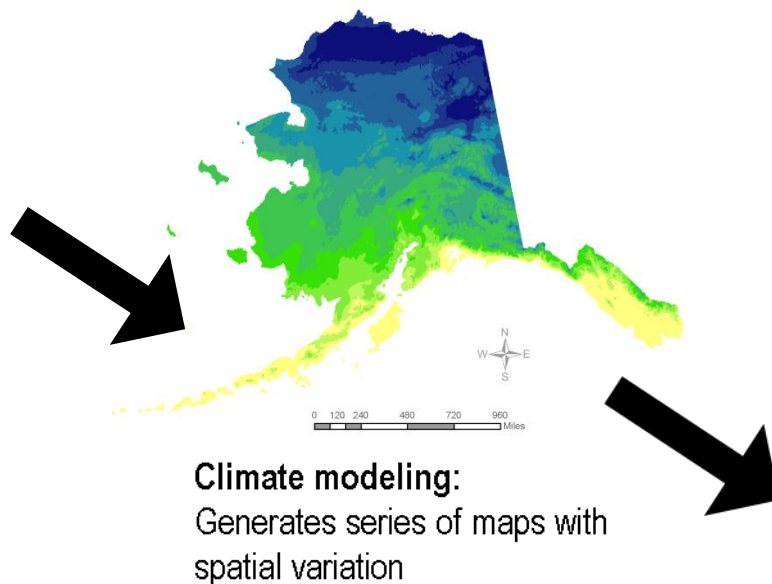


Method for Quantifying Health Impacts from Climate Change



Climate summary statistics:

- Temperature
- Precipitation
- Soil moisture
- Sea ice (thickness/concn)



Health Impact Model

Estimates the change in relative risk of specific diseases

Climate Data



Demographic Data




Health Data

Assessing Health Risks of Climate Change in Alaska

- Data to say where we are
- Systems to monitor what is happening
- Systems to **INTEGRATE** different data sources
 - Human and animal health
 - Air and water quality; other ecosystem factors
- Data-driven modeling to plan for future
- Ability to intervene and mitigate
- Evaluation of process and outcomes

State of Alaska
Epidemiology



Bulletin

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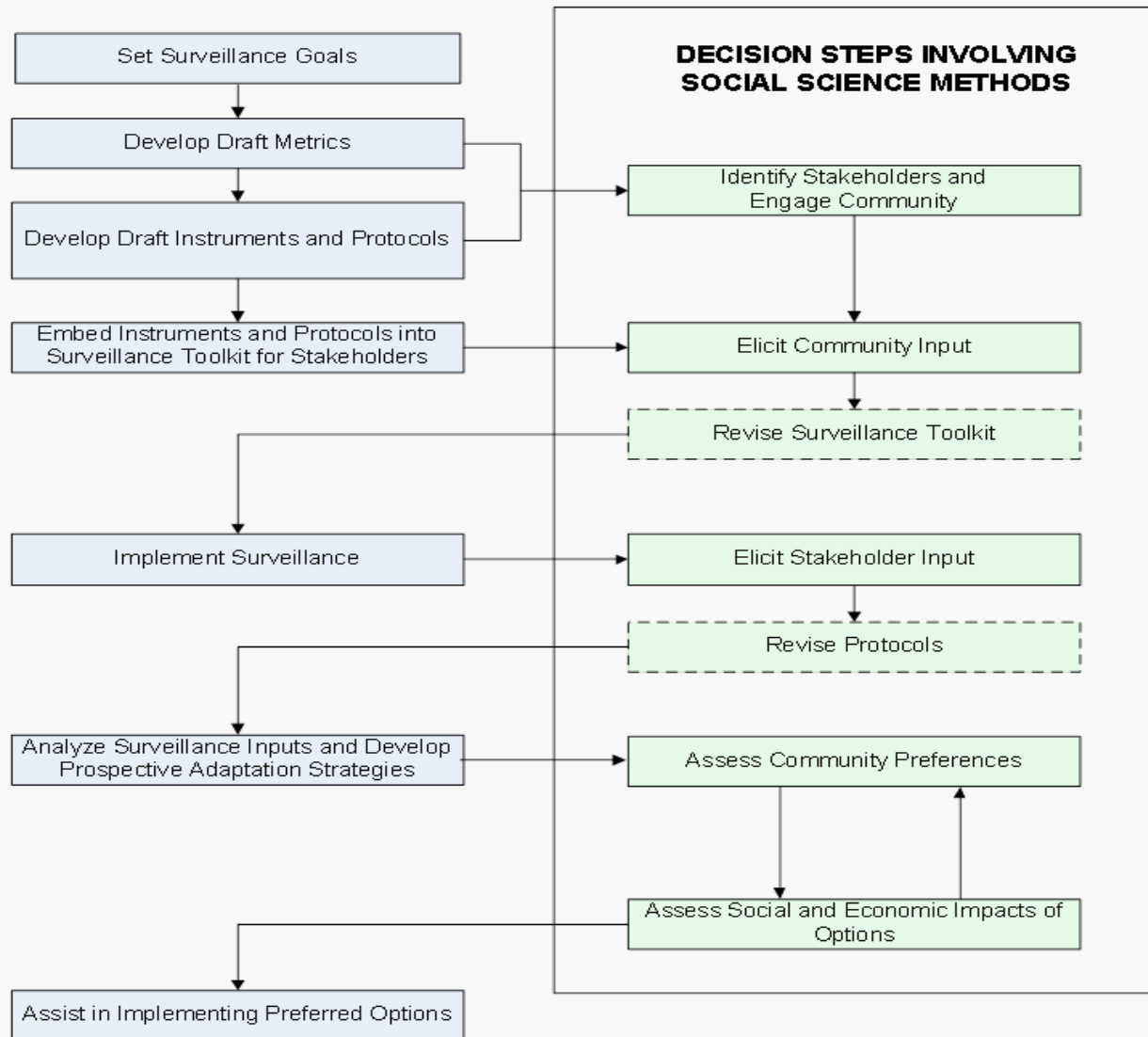
Paralytic Shellfish Poisoning in Southeast Alaska, May–June 2011



Key Message

- Human health is inextricably bound to weather and climate as well as to many complex natural and man-made systems.
- There are many uncertainties, but projected changes in climate are likely to impose risks to human health.
- Health impacts are multi-factorial with interactions that cascade across a range of confounding and moderating factors.
- An extensive suite of adaptation strategies will be key to addressing climate-related health outcomes.

Assessing Health Risks of Climate Change





Study Objectives

1. Select surveillance metrics for climate change-related events and related health outcomes.
2. Collect community-based sentinel data as part of an active surveillance system.
3. Analyze and assess historical environmental trends and associations with health outcomes.
4. Assist local communities in prioritizing health risks and developing adaptation strategies.

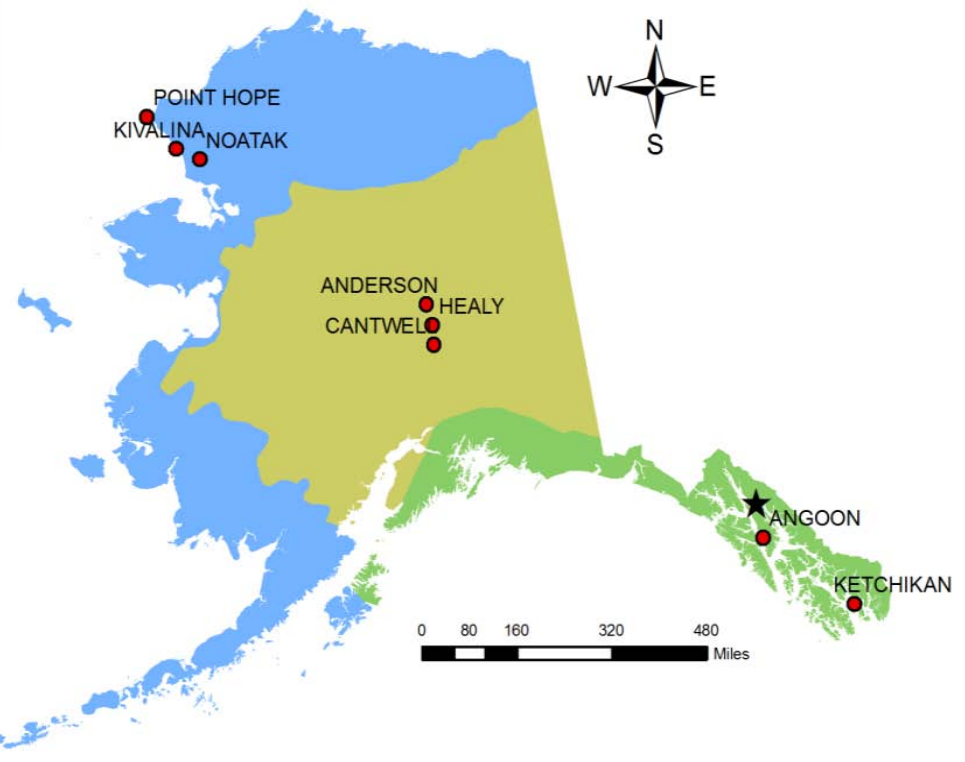
1. Select Surveillance Metrics



Photo courtesy of N. Luvsandagva

- Colloquium to develop surveillance metrics, October 7-8, 2010
- Attendees include:
 - Community members/ liaisons
 - State and federal govt. agencies
 - Tribal health agencies
 - Environmental scientists
 - Public health scientists
 - Clinicians

2. Collect Surveillance Data



Community-based Sentinel Surveillance



Elucidate mechanisms between climate change and human health impacts at the local level



Especially relevant for indirect health effects where more research is needed *(e.g., subsistence hunting and harvesting, water and food security)*



Climate-sensitive Health Outcomes

Climate Effects on Health	Outcome Measure(s)	Monthly Surveillance Survey Question
Direct impact of unusual weather	Non-fatal injuries and fatalities	“In the past 30 days, has someone in your community been injured/killed as a result of unusual weather?”



Climate-sensitive Health Outcomes

Climate Effects on Health	Outcome Measure	Monthly Surveillance Survey Question
Indirect health effects from hunting and harvesting	Paralytic shellfish poisoning (PSP)	“In the past 30 days, have you (or other community members) complained about numbness and tingling around the mouth, face, and/or fingers accompanied by dizziness within a few hours of eating shellfish?”



Climate-sensitive Health Outcomes

Climate Effects on Health	Outcome Measure	Monthly Surveillance Survey Question
Temperature effects on food-borne diseases	Botulism	<p>“In the past 30 days, have you (or people you know in the community) experienced three or more of the following five symptoms 12 – 36 hours after eating fermented or dried foods:”</p> <ul style="list-style-type: none">• Nausea or vomiting• Trouble swallowing• Double vision• Dilated or unreactive pupils• Dry throat or mouth

3. Next Step: Assess Trends and Associations

Research questions:

1. What is the attributable burden of disease? i.e. How much disease is caused by a particular local environmental event?
2. What is the avoidable burden of disease? i.e. How much could be avoided by making plausible reductions in human exposure to that event?

Traditional approach: Risk Ratio

Exposure	Diseased	Nondiseased	Disease Incidence (Risk)	Probability Odds of Disease
Present	a	b	$q_+ = \frac{a}{a+b}$	$\frac{q_+}{1-q_+} = \frac{\frac{a}{a+b}}{1 - \left(\frac{a}{a+b}\right)} = \frac{a}{b}$
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Planned approach...

1. Community as unit of analysis, diseases and exposures as dichotomous variables
2. Logistical regression of associations between risks and health outcomes
3. Assess trends in local events from retrospective secondary data
4. Apply these associations to projections of likely climate change models



4. Next Step: Community Adaptation Planning

- **Strategic Adaptation/Mitigation Planning**
 - Preference elicitation focus groups with community partners
 - Develop/disseminate findings and recommendations
 - Promote community-based adaptation strategies

- **Provide Technical Assistance to Communities**
 - Adapt surveillance system for other Alaskan communities
 - Assist in grant writing for planning and capacity-building grants for study communities
 - Assist in building collaborations with other research entities

Adaptation Strategies to Reduce Climate-related Health Risks

	Vectorborne Diseases	Waterborne Diseases	Air Quality
Decision Support Tools	Enhance early warning systems based on climate and environmental data for selected diseases	Develop early warning systems based on climate and environmental data for conditions that may increase selected disease	Enhance alert systems for high air pollution days
Technology Development	Develop vaccines for West Nile and other vectorborne diseases	Develop more rapid diagnostic tests	
Surveillance and Monitoring	Enhance vector surveillance and control programs and monitor disease occurrence	Enhance surveillance and monitoring programs for waterborne diseases	Enhance health data collection systems to monitor for health outcomes due to air pollution
Infrastructure development	Consider possible impacts of infrastructure development such as water storage tanks	Consider possible impacts of placement of sources of water and food borne pathogens	Improve public transit systems to reduce traffic emissions.



Questions & Acknowledgements

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Thank you!

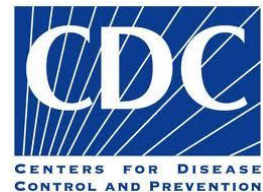
People of Alaska

Our Alaskan communities

CDC

Community organizers

ICHS office staff



The Institute for Circumpolar Health Studies (ICHS) is located at the University of Alaska, Anchorage and provides support and coordination for health research, information, and training. ICHS was created by the Alaska State Legislature in 1988 to develop new solutions to health problems in Alaska and the north

The mission of ICHS is to improve the health of peoples of Alaska and other circumpolar areas.