

PRESENTATIONS

Infrastructure and Climate Change: Potential Indirect Impacts to Human Health



For: 2008 Climate Change & Impacts on Human Health in the Arctic

Sanitation Infrastructure

- Safe Drinking Water
- Water for Cleaning, Cooking, Hygiene
- Removal and Safe Disposal of Human Waste
- Removal and Safe Disposal of Solid Waste

Human Health Issues Associated with Sanitation

- Inadequate Water Treatment
 - Associated with Diseases such as Giardiasis, Cryptosporidiosis and Certain Cancers
- Inadequate Sanitation – Associated with Diseases such as Hepatitis A, Hepatitis B, Bronchitis, Impetigo, Meningitis

Disease Outbreak Examples

- 1993 Inadequate Water Treatment – Cited as Cause of 403,000 Illnesses, 440 Hospitalizations and 50 Deaths in Milwaukee
- 1989 a Pipeline Breach/Cross Connection in Cabool, Missouri, Resulted in 243 Illnesses and 4 Deaths
- Many other examples associated with contamination of water used for drinking or recreation

Climate Change Impact Mechanisms

- Changes in Water Quality
- Water Source Contamination
- Melting Permafrost
- Rising Sea Levels
- Drought or Heavy Storms
- Accelerated Coastal or Riverbank Erosion
- Increased Severity and Frequency of Coastal or River Flooding
- Impacts to Sanitation Infrastructure – Spread of Disease
- Impacts to Communities – Stress Related Issues

Anchorage Daily News

- *December 25, 2006 – Invasion of Beavers Felt in Far North (beavers sited around Nome)*
- *November 24, 2005 - Heavy rains continue, pose risk of mudslide, pollution, flying debris (flooding in Juneau septic systems)*

www.adn.com

Anchorage Daily News

- September 24, 2005 - *Western coast blasted (storm damage in Nome)*
- June 21, 2005 - *Warm-weather warning (shell fish poisoning due to warmer ocean temperatures)*



www.adn.com

Anchorage Daily News

- December 7, 2004 - *Storm creates village water crisis (water source saline contamination due to storm surge in Nunam Iqua)*



www.adn.com

Unreported Incidents



- June 2005 -
Community water source disappeared in Kwigillingok

- November 2000 -
Storm surge spread lagoon waste throughout Kipnuk



Sanitation in the North

- Individual Haul
- Community Haul
- Piped Distribution and
- Collection



- Harsh environment
- Limited Financial Resources
- High Construction Costs

Engineering Design

Based on Historic Environmental Parameters

- Raw Water Quality
- Wind velocity
- Snow load
- Rain intensity
- Air Temperature
- Flood elevation
- Erosion rates
- Wave heights
- Soils conditions

Water Source

(Potential Climate Change Impacts)

Reduced supply

- Drought
- Damage to intakes or impoundments

Contamination

- Rising sea level
- Storm surge (seawater contamination)
- Northward migration of animals with disease
- Saline intrusion into coastal groundwater



Water Treatment

(Potential Climate Change Impacts)

- Increase contaminant levels or new contaminants in the water source
- Algae blooms in the water source

Haul Distribution and Collection

(Potential Climate Change Impacts)

- River bank erosion intercepting trail/road/boardwalk
- Flood damage to trail/boardwalk/road
- Melting permafrost damaging trail/boardwalk/road



Piped Distribution and Collection (Potential Climate Change Impacts)

Structural Damage

- River bank erosion
- Flood damage
- Ice impact during flooding
- Melting permafrost



Wastewater Treatment (Potential Climate Change Impacts)

Lagoons

- Floodwater spreading waste
- Erosion intercepting lagoon
- Melting permafrost resulting in loss of containment



Septic Systems and Outfalls

- Erosion intercepting septic tanks, outfalls or drainfields
- Heavy precipitation resulting in system flooding

Solid Waste Collection and Disposal (Potential Climate Change Impacts)

Collection System

- Destruction/loss of access

Disposal System

- Erosion intercepting facility spreading waste.
- Flood water enter facility spreading waste
- Permafrost or waste melting and releasing contaminants



Impacts to Community and Health (Potential Climate Change Impacts)

Impact Mechanisms

- Destruction of Housing and infrastructure
- Economic Stress
- Forced Relocation



Health Impacts

- Mental Stress
- Depression
- Anxiety

Monitoring - Developing a Community Response to Climate Change

- Saline contamination of a water source
- Increase contaminant concentrations or types
in the water source
- Reduction or loss of a water source supply

Monitoring - Developing a Community Response to Climate Change

- Increased operational costs for water or
wastewater systems
- Increased repair costs for sanitation
infrastructure, boardwalks, and roads
- Structural failures due to increased snow or
wind loads

Monitoring - Developing a Community Response to Climate Change

- Increased movement of structures located on permafrost
- Acceleration of shoreline or river bank erosion
- Increased magnitude in flood depth or return frequency (precipitation, storm surge)

Monitoring - Developing a Community Response to Climate Change

- Increase in regulatory noncompliance events for sanitation systems
- Pollution of waterways caused by human waste or solid waste
- Increased incidence of waterborne diseases

Addressing Impacts of Climate Change

Planning Considerations

- Master Plans that consider climate change impacts

Engineering Considerations

- Infrastructure location
- Infrastructure type
- Foundation design
- Wind and snow load parameters
- Operational flexibility

Alaska Forum on the Environment 2008

Mike Bradley
ANTHC Emergency Preparedness Coordinator



Community Preparedness for Extreme Climate Events

FLOODS

STORMS

AVALANCHES

WILDLAND FIRES

POWER OUTAGES

TRANSPORTATION ACCIDENTS

LAND SLIDES

What we will cover

- Alaska Disaster Response Overview
- Emergency Management Planning
- Hazard and Vulnerability Assessments
- Developing a Community All Hazards Disaster plan
- Developing a Community Clinic All Hazards Disaster Plan
- How to get help!

Alaska Disaster Response Overview

(in a perfect world)

Alaska Constitution stresses maximum self-government

- Local governments direct disaster response.
(AS 26.23.060, 50% have a disaster plan)
- Borough government emergency services support local governments
(Boroughs only cover 1/3 of State)
(less than half have emergency response capacity)

Alaska Disaster Response Overview

(in a perfect world)

- The State of Alaska provides disaster support when:

The borough cannot manage the response

A community not in a borough cannot manage the response

“State responders coordinate their activities with local managers. The State does not intend to direct and control local response operation.”

- The State Emergency Coordination Center

Coordinates the response by State agencies and other entities.

Community Emergency Management Planning

- Obtain authority by ordinance/resolution for authority do emergency planning
- Conduct a Hazard and Vulnerability Assessment
- Draft emergency operations plan (EOP)
- Adopt EOP by ordinance/resolution
- Orient Incident Management Team to EOP
- Exercise the plan periodically & revise

Where to start an HVA?

- Decide who should be involved?
Community leaders
Elders
EMS
Health Care
- Identify the threats – natural/man-made
- Ask the questions: ...What has happened in the past?

Types of Events

- Natural – earthquakes, tsunami, floods
- Technological – generator fails, electrical
Fuel shortage, sewer fails, fuel shortage,
water failure, natural gas fails, etc.
- Human events – fire, explosions, Hazmat
infant abduction, hostage, infectious
disease outbreak

HVA Process

- List all hazards,
- Rank them by number
 - Could occur, or high = 3
 - Might occur or moderate = 2
 - Would never occur or not likely = 1
- Rank hazards by IMPACT:
 - Big Impact = 3
 - Moderate Impact = 2
 - Minimal Impact = 1
- Now you know what to prepare for.

How to Develop a Plan

- Steal someone else's plan
- Where can you steal a good plan?
 - Google
 - From YKRITWC: <http://www.yritwc.com/publications/default.htm>
 - From ANTHC: <http://www.anthc.org/>
- Modify the plan to fit your community
- Get someone else to help you.



**BASIC TEMPLATE for an
ALASKA SMALL COMMUNITY
EMERGENCY OPERATIONS PLAN**

City of _____
Native Village of _____
_____ Village Corporation
_____ Community Association
Copy Number ___ of ___ Copies

Get someone else to help you.

- **Alaska Division of Homeland Security and
Emergency Management**

AS [26.23.060](#) ADHS&EM will help develop local disaster plans

- **Alaska Native Tribal Health Consortium**

Pete Petram wpetram@anmc.org 729-4493

Community Clinic All Hazards Disaster Plan Development

- **Steal a plan**

Google – California has published a model plan.

Alaska State Hospital and Nursing Home Association

Alaska Native Tribal Health Consortium <http://www.anthc.org/>

- **Modify it to fit your clinic**

- **Get help from**

ANTHC, Regional Tribal Health Corp, Alaska Primary Care

Association

BASIC TEMPLATE for an ALASKA TRIBAL CLINIC EMERGENCY OPERATIONS PLAN

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How to get help!

- Get smart on Emergency management
FEMA Courses
<http://training.fema.gov/IS/crslist.asp>
- Attend Community Emergency Preparedness Conferences
<http://www.avianflu.alaska.gov/PDFs/communityVisitStatus.pdf>
- Get help from others ADHS&EM, ANTHC

Monitoring and Surveillance for Climate and Health in the Circumpolar North

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Overview

- Arctic Climate Impact Assessment



- IPCC – Fourth Assessment Report



- Emerging Initiatives and Canadian Projects
- Future Directions

ACIA - Summary of Potential Impacts

Direct Impacts	Indirect Impacts
<ul style="list-style-type: none">• Thermal stress and related injuries and deaths• Extreme events and injuries and deaths• Increased UVB exposure, melanoma, cataracts and immunosuppression	<ul style="list-style-type: none">• Increased exposure to zoonotic diseases• Changes to ice and snow and increased travel hazards and injuries• Threats to food security (increased risks and loss of benefits)• Impacts to sanitation infrastructure and resulting illnesses• Changes in exposure to environmental contaminants• Stress related to threats to village sites and socio-cultural change



Arctic Climate Impact Assessment

- Change and associated impacts are variable (spatially and temporally)
- Some changes / impacts already taking place
- Some responses / adaptations already taking place
- Need to strengthen community ability to adapt



Arctic Climate Impact Assessment

“A key component in this ability to adapt and respond is the development of a better understanding of the relationship between climate and the health of northern peoples and access to locally relevant information on the changes taking place.”



Where to now ?

- Need standardized, comparable health data for northern populations
- Further description / analysis and measurement of mechanisms of climate interaction with health
- Standard local monitoring of environmental changes and effects on health
 - availability and safety (zoonotic diseases) of subsistence food species
 - conditions of ice and snow safety
 - UVB exposure



Where to now ? ...

- Expand coordinated monitoring and research of changes in contaminant transport and bioavailability where needed
- Documentation, assessment and communication of current adaptive / coping measures being used
- Utilization of Indigenous perspectives and knowledge in monitoring and understanding of changes and impacts
- Enhance local capacity to take advantage of opportunities that are created by local environmental change



Recommendations for Monitoring and Research

Thermal stress and arctic human health

- Establish organized monitoring and data collection programs (inclusive of local perspectives and indigenous knowledge) involving, but not limited to, the indicators identified in this chapter to support community understanding of changes in arctic health owing to thermal stress.

Wildlife, diet, and health

- Establish community based and regional scale monitoring programs for the indicators identified in the chapter. Where problems are identified (e.g., increasing incidences of exposure to zoonotic diseases), establish surveillance programs

UV-B radiation and arctic human health

- Measure incident UV-B radiation at ground and individual levels using personal dosimeters and ground-based integrating and spectral radiometers



Recommendations for Monitoring and Research

Snow, ice, and arctic community health

- Establish surveillance and communication networks at the community level to support early warning of dangerous conditions for travel and land-based activities (weather, ice conditions, etc.).

Infrastructure and arctic human health

- Establish local level monitoring programs for data collection on permafrost and infrastructure stability.
- Monitor basal depth of permafrost and compare to historic measurements.
- Monitor incidence of flooding caused by storm surges or heavy precipitation.



Environment and Health Indicators

Direct Health Impacts

Useful health indicators

- General health statistics (see AMAP, 2003)
- Rates of cold injuries (e.g., frostbite)
- Rates of coronary heart disease
- Rates of unintentional injury
- Rates of intentional injury

Extreme weather events, thermal stress, and health

- Extreme event-related use of regional and community rescue services
- Unintentional injury mortality associated with extreme weather events

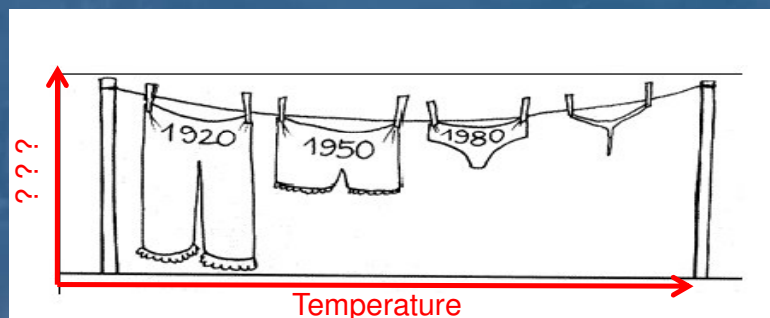


IPCC – Fourth Assessment Report Polar Regional Chapter

Uncertainty	Recommendation and Approach
The consequences of diversity and complexity in Arctic human health, socio-economic, cultural and political conditions' interactions between scales in these systems and the implications for adaptive capacity	Development of standardised baseline human system data for circumpolar regions; integrated multidisciplinary studies; conduct of sector-specific, regionally specific human vulnerability studies
The adaptive capacity of natural and human systems to cope with critical rates of change and thresholds/tipping points	Integration of existing human and biological climate-impact studies to identify and model biological adaptive capacities and formulate human adaptation strategies

Environmental Health Indicators

“an expression of the link between environment and health, targeted at an issue of specific policy or management concern and presented in a form which facilitates interpretation for effective decision making” (Briggs et al., 1996)



Common Characteristics:

- linkage within phenomenon (e.g. between health and environment)
- based on previous knowledge, experience, understanding of the relationship between indicator and phenomenon
- formed within the context of an underlying societal goal (value)

Identifying, Selecting and Monitoring Indicators for Climate Change and Health in the Canadian North

Chris Furgal, PhD Trent University

Pierre Gosselin, MD, MPH Institute national de sante publique du Quebec

Nunavik Regional Board of Health and Social Services

Labrador Inuit Association (now, Nunatsiavut Government)

Indicators and Potential Uses

Potential Uses:

- Compliance Indicator: assess current conditions
- Change Indicator: document trends (temporally or spatially)
- Early Warning Indicator: anticipate hazardous conditions (e.g. Outbreaks)
- Diagnostic: identify causative agents
- Relational: identify interdependence between indicators

(IJC, 1991)

Types:

- positive and negative measurements
- objective and subjective indicators
- qualitative and quantitative measurements
- Narratives, local observations
- aggregated, individual and composites

Community Climate, Environment and Health Indicators

1. ENVIRONMENTAL INDICATORS

1.1 WEATHER – GENERAL :

- Temperature (air) (mean weekly and monthly)
- Extreme events (incidence of annual extreme warm and cold days)
- Indicators of weather predictability - qualitative indicator and/or analysis to determine quantitative indicator (e.g. barometric pressure?, etc)

1.2 ICE

- Sea-ice (thickness, annual fast-ice edge distribution, annual date-in, annual date-out in local bay or nearest location)

2. HEALTH INDICATORS

2.2 INJURIES

- Description by occurrence : intentional and non-intentional, *location and circumstances*

Environmental / Public Health Surveillance and Action What is currently feasible in northern regions ?

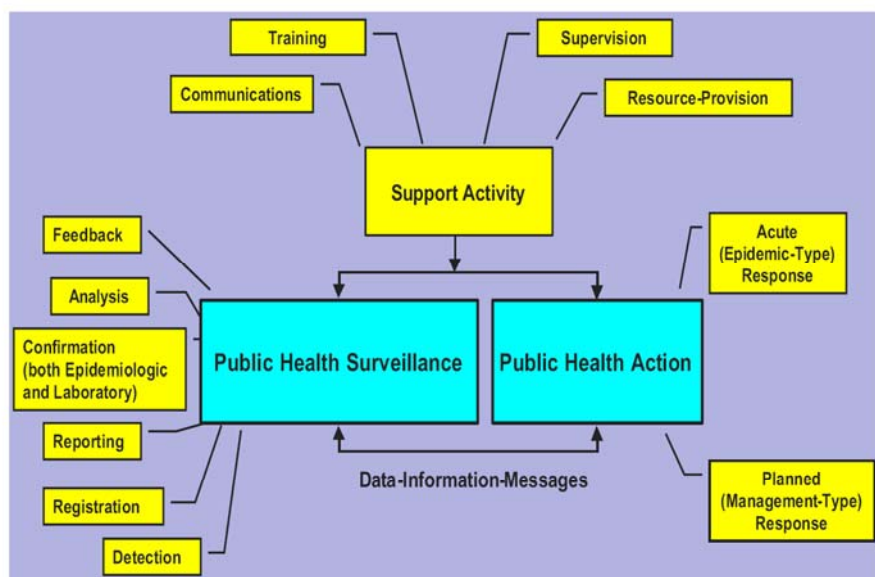


Figure 1
Conceptual framework of public health surveillance and action
McNabb et al., 2002

Objectives

- Propose, through regular interaction with stakeholders, options and recommendations on the above-mentioned topics to develop capacity-building initiatives.
- Develop pilot projects for upgrading the health surveillance programs in areas such as (i) mortality, (ii) diseases, (iii) social determinants of health, (iv) injuries and search and rescue.

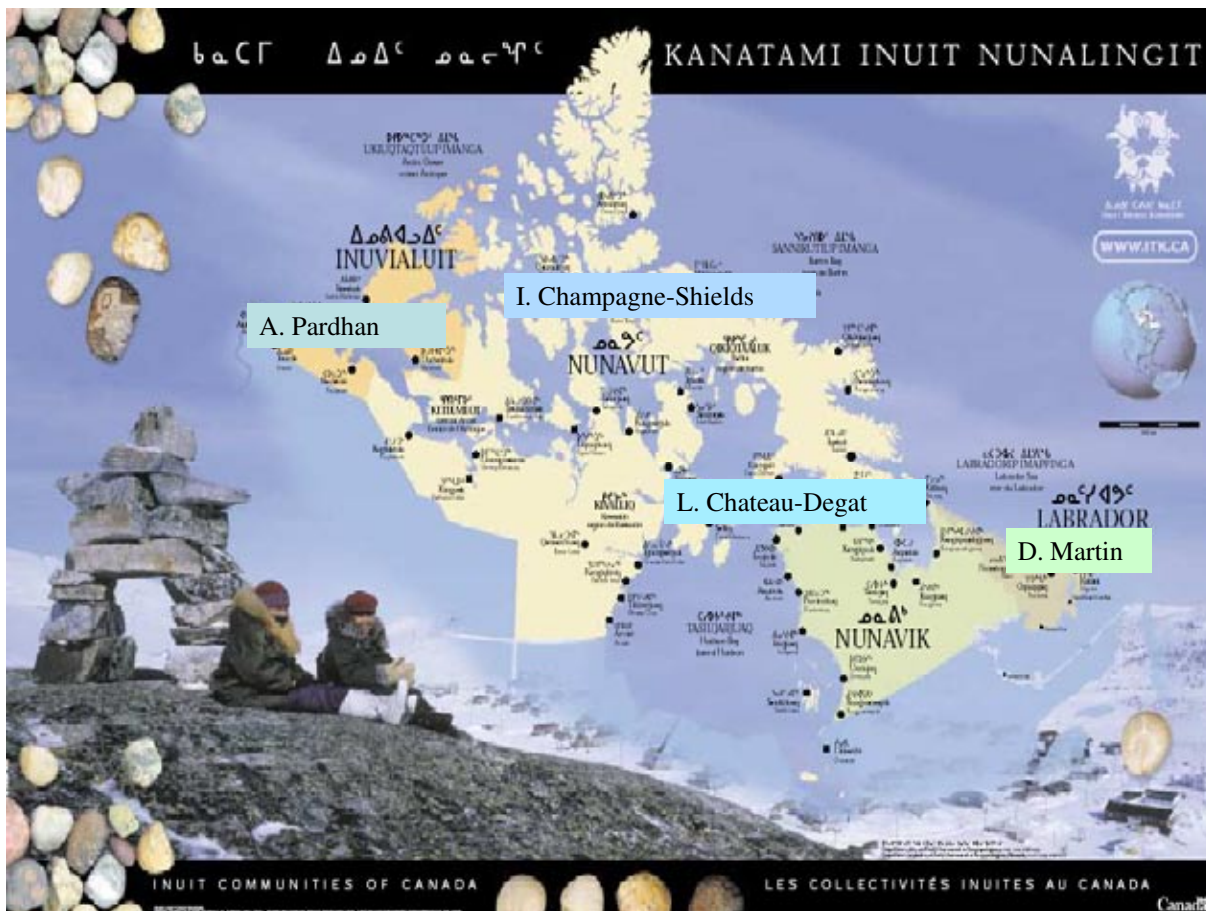
Environmental Health and Climate Change



State of Regional Environmental and Public Health Surveillance System : Climate Change Indicators

Surveillance Core Activities	Interface																	
	ENVIRONMENT					HEALTH												
	Weather	Ice	Drink water	Fresh water	Contaminants	Sea level	Perma /erosion	Biota	U-V radiation	Mortality	Injuries	MADO	Non MADO	Chronic disease	Biomonitoring	Social	Community	Lost persons
Detection/measurement	†		†				†			†	†	†	v	†				†
Registration	†		†				†			†	v	†	v	†				†
Confirmation	NA		NA				NA			†	v	†	v	†				†
Reporting	†		†				†			†	v	†	v	†				†
Analyses	†		†				†			†	v	†	v	†				†
Feedback	•		†							v	v	†	v	†				†
Communication	†		†							†	v	†	†	†				†
Education	•		v				v			•	v	•	v	•				†
Prevention Programs	•		v				v			•	v	†	•	•				

LEGEND: † = activity underway, v = activity not underway, • = activity partially underway, NA = Not Applicable



Arctic Research Studies: ArcticNet and IPY Projects

V. Edge, PhD Senior Epidemiologist, PHAC

Nunavik: “Enhancing Public Health Surveillance”

- Community nurses provided with Palm Handheld Computers programmed to capture patient visit information: focus GI

Links with proposals to:

- investigate weather, water quality and cases of human GI
- test both traditional and retail foods for pathogens and also AMR



Centre for Foodborne, Environmental and Zoonotic Infectious Diseases

Arctic Research Studies: ArcticNet and IPY Projects

V. Edge, PhD Senior Epidemiologist, PHAC

Nunatsiavut: “Weather, Water Quality and Human Health”

- Enhancing public health capacity in vulnerable and under-serviced communities.
- Investigate associations between weather (precipitation, temperature), water quality (turbidity, pathogens), and community cases of GI (patient visit data)



Centre for Foodborne, Environmental and Zoonotic Infectious Diseases

Climate Change, Access to Resources and Trail Safety in Nunavik and Northern Quebec:

Development of an Integrated Community-Based Ice Monitoring Program in Nunavik and Beyond

C. Furgal¹, M. Tremblay², E. Angiyou², P. Tookalook², T. Annanack², N. Swappie³, M. Qiisik², M. Allard⁴, and J.-P. Savard⁵, M. Barrett²

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Climate Change and Human Safety

Nunatsiaq News - January 31, 2003

Two men drown in Inukjuak

Snowmobile crashes through thin ice

Two young Inukjuak men died last Thursday night after their snowmobile plunged through a weak patch of ice on the village's river.

Police called the drowning a freak accident of nature. "For the past few years, there's a phenomenon where a patch of the river ice becomes covered again with water — about six to eight feet of it. Then a small layer of ice freezes on top of the water," said Captain Larry Hubert of the Kativik Regional Police Force.

"The town had been warning people that day to stay off the ice but for whatever reason the kids decided to go across. Unfortunately, they never made it."

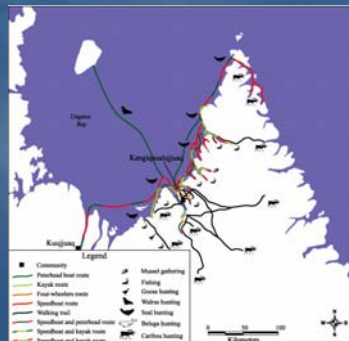
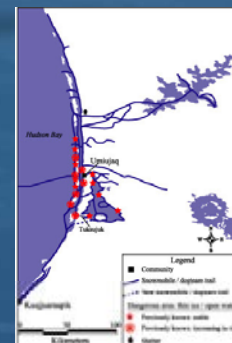
Need for Local Monitoring Program



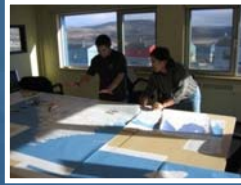
Can you tell me how you know when the ice is safe to travel on?

"I can not answer you on this question because now the ice behaviour is different than what it is used to be. Paulasi Qaunaaluk, Ivujivik

Documentation of changes in ice conditions and hazards and impacts on traveling and hunting activities



Local Ice Mapping Workshops and Local Monitoring



Map Interviews with active hunters and elders in each community

Objective: Document climate change impacts on the trail networks in northern communities

Routes and trails:

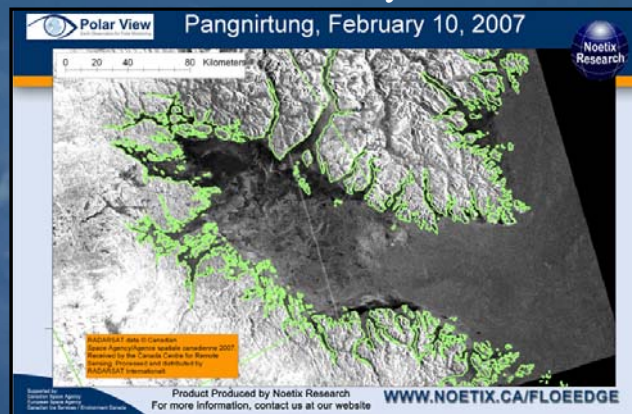
Other information:

- Risky Areas
- Alternate Trails
- Shelters
- Anchorage Spots

Polar View Floe Edge Service

G Laidler, Carleton University

- implement the service
- community information sessions and workshops
- evaluate how the products are used
- tailor products to community needs
- evaluate ability of products to detect conditions of interest to communities to enhance travel safety



Many Other New Data initiatives Exist



What is SLiCA?

The Survey of Living Conditions in the Arctic, or SLiCA, is an international joint effort of research and indigenous people to measure and understand living conditions in the Arctic. This website is intended to promote the use and understanding of SLiCA data.

Indigenous peoples and researchers from the United States, Canada, Greenland, Norway, Sweden, Finland and the indigenous peoples of the Kola Peninsula and Chukotka in Russia have contributed to SLiCA.

www.livingconditions.org

Conclusions / Future Directions

- The time is NOW
- Understand existing surveillance abilities
- Include aspects of the 'informal' surveillance network in many northern communities
- Incorporate or include local observations and narratives (qualitative indicators) as well
- Coordinate among existing data collection initiatives