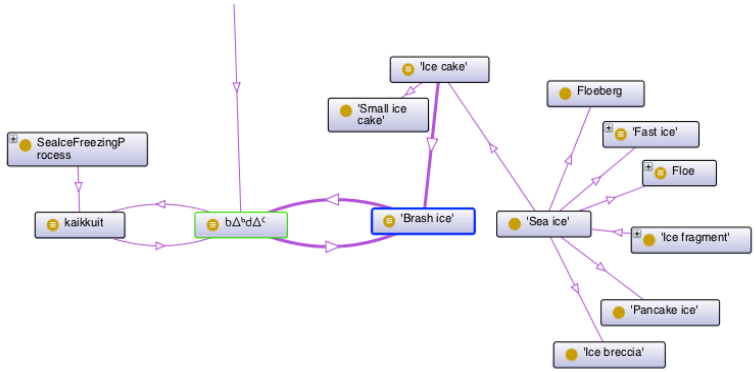


An Interoperable System for Sharing the Results of Community Based Monitoring

Peter L. Pulsifer & the ELOKA Team

H. McCann, C. McNeave, E. Sheffield, S. Gearheard, C. Strawhacker,
Henry Huntington National Snow and Ice Data Center

Exchange for Local Observations and Knowledge of the Arctic (ELOKA)

Arctic Observing Open Science Meeting
November 17, 2015, Seattle WA

National Snow and Ice Data Center
Supporting Cryospheric Research Since 1976

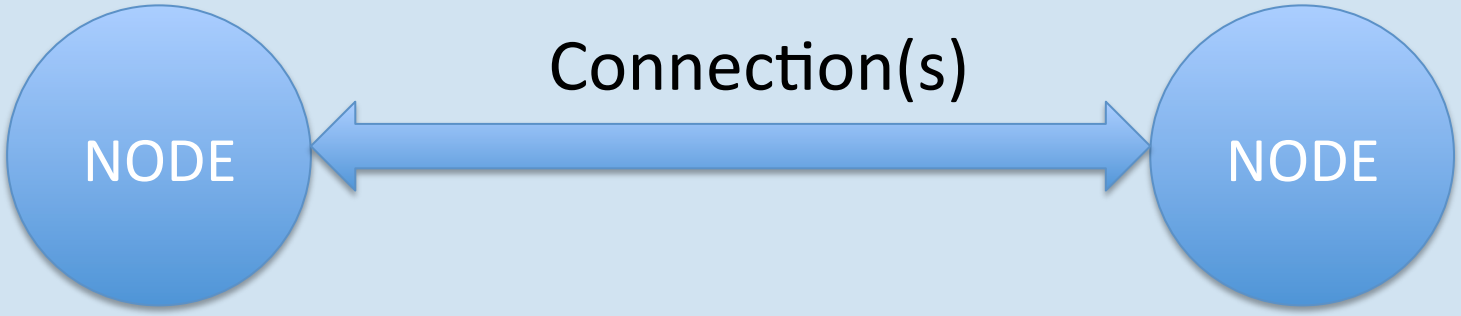
ELOKA - Mission Statement

To provide data management and user *support services* to facilitate the collection, preservation, exchange, and use of local observations and knowledge of the Arctic.

Interoperability

- Interoperability: *Property of a product or system, whose **interfaces** are completely **understood**, to work with other products or systems, present or future, without any restricted access or implementation.*
- *Task of building **coherent services** for users when the individual components are technically different and managed by different organizations* (Wikipedia)
- Semantic interoperability: *the ability to effectively **exchange meaning** between information systems*

Interoperability

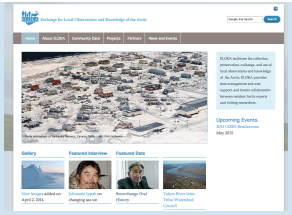


Knowledge,
observations,
documents,
data…

Knowledge,
observations,
documents,
data…

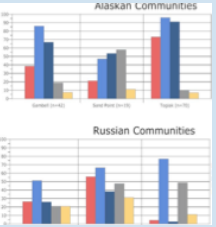
SUPPORTING INTEROPERABILITY THROUGH ELOKA

Infrastructure Nodes

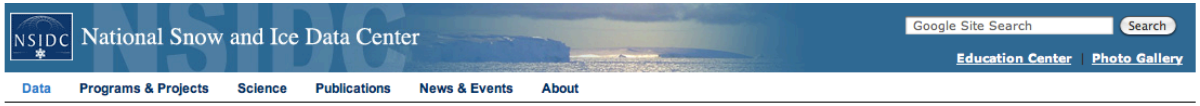


NODE

NODE



Data Listings and Catalog Service



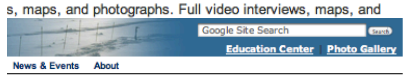
Sea Ice in the Belcher Islands, Nunavut, Canada

Access Data | Product Web Site

This data set contains interviews of three hunters from Sanikiliaq, Belcher Islands, in the territory of Nunavut, Canada. The hunters
icher Islands gathered from their many hunting expeditions. The local
reveals that the ice is changing and becoming more dangerous and

tant ice features and changes on maps which are included as part of
n the maps are available. Two of the three interviews are in English;

s, maps, and photographs. Full video interviews, maps, and



Icher

ikiliaq, Belcher Islands, in the territory of Nunavut, Canada.
ns around the Belcher Islands gathered from their many
TK) gathered from these interviews reveals that the ice is
ie than it once was.

mportant ice features and changes on maps which are
ons at specific places on the maps are available. Two of the
English.

files, maps, and photographs. Full video interviews, maps,
cess Data link.

Metadata Views

DIF Text-Only
Directory Interchange Format (DIF) in plain text

DIF XML
Directory Interchange Format (DIF) in Extensible Markup Language (XML)

FGDC HTML
U.S. Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM)

ISO HTML
International Organization for Standardization (ISO) 19115:2003 Geographic Information Metadata

Data Contributors

- FLEMING, MIRIAM
- KATTUK, PETER
- IPPAK, JOHNASSIE
- TAKATAK, LUCASSIE
- ARRAGUTAINAQ, LUCASSIE
- KASYNSKI, JESSIE
- KAVIK, DINAH

Parameters

- AIR TEMPERATURE
- BIRDS > eider ducks
- EROSION
- FREEZE/THAW
- ICE DEFORMATION
- ICE DEPTH/THICKNESS
- ICE EDGES
- ICE FLOES
- ICE GROWTH/MELT
- ICE ROUGHNESS
- ICE TYPES
- LAKE ICE
- LEADS
- LONGSHORE CURRENTS
- MAMMALS > Polar Bears
- OCEAN CURRENTS
- POLYNYAS
- RAIN

Atlas of Community-Based Monitoring in a Changing Arctic (Arctic CBM)

This atlas showcases Arctic communities actively involved in observing social and environmental change. It was designed to highlight the many community-based monitoring (CBM) and traditional knowledge (TK) initiatives across the circumpolar region.

Topics Environmental, ecological, and cultural changes and observations

Geographic areas Circumpolar region

Date range Ongoing

Local Observations from the Seasonal Ice Zone Observing Network (SIZONet)

This data set contains observations of sea ice, weather, and wildlife collected by Indigenous Inupiaq and Yup'ik sea ice experts in several communities along the northern and western coasts of Alaska, beginning in 2006.

Topics Sea Ice Snow Weather Wildlife

Geographic areas Alaska, United States

Date range 2006 to Present

Data Set Citation

Dataset Creator: Miriam Fleming
Dataset Title: Sea Ice Observations in the Belcher Islands, Nunavut, Canada
Dataset Release Date: 2010-04-01
Dataset Release Place: Boulder, Colorado USA
Dataset Publisher: National Snow and Ice Data Center (NSIDC)
Data Presentation Form: Digital Media
Online Resource: http://nsidc.org/data/eloka002.html

Temporal Coverage

Start Date: 1993-01-01
Stop Date: 2009-04-01

Location Keywords

- Continent › North America › Canada › Hudson Bay
- Continent › North America › Canada › Nunavut

Science Keywords

Data Distribution

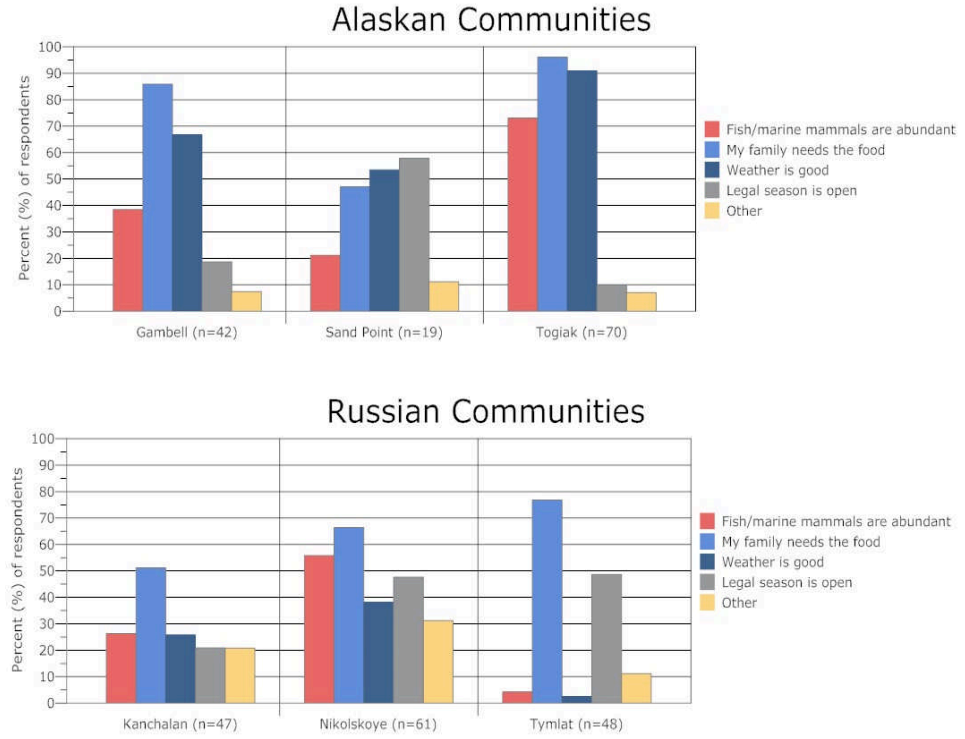
- Example: **Bearing Sea Sub-Network** Harvest data from a network of six coastal communities representing six Indigenous cultures
- **Detailed system for responding to access requests**

Russian Federation

- Kanchalan - *Chukchi* and *Tymlat*
- Koryak - *Western Aleut/Unangas*
- Nikolskoye - *Western Aleut/ Unangas*

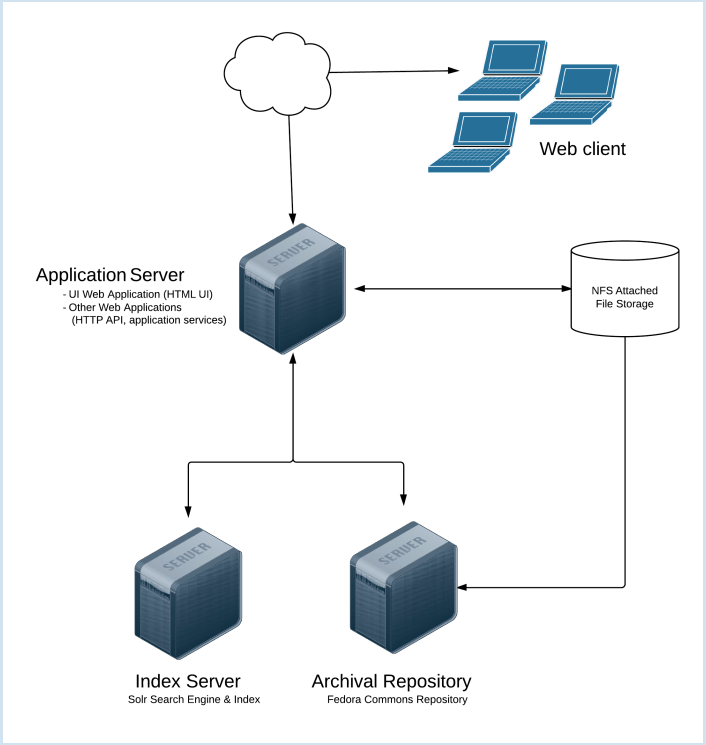
United States

- Gambell - *St. Lawrence Island Yupik*
- Togiak - *Central Yu'pik*
- Sand Point - *Eastern Aleut/Unangan*



Reasons for the timing of the next hunting/fishing trip for all BSSN communities

Long Term Preservation

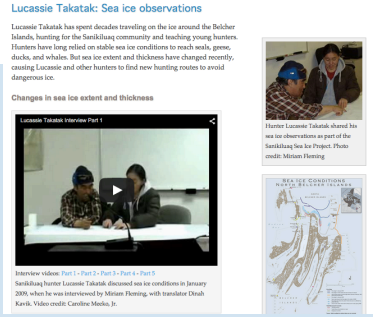


NSIDC
National Snow and Ice Data Center
Supporting Cryospheric Research Since 1976

ELOKA

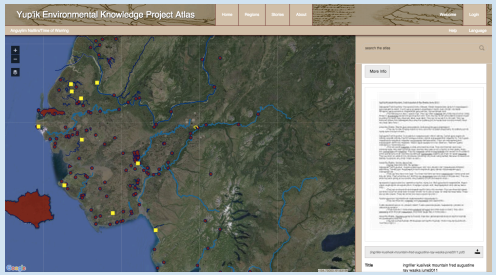
DataConservancy

Knowledge Nodes



NODE

NODE



Community Sites – Narrative

Narwhal Home

Narwhal Tusk Research

About Narwhals

Canadian Communities

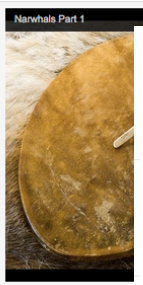
Greenland Communities

Interviews

Baffin Bay Region Narwhal Research

The Narwhal Tusk Research project integrates traditional knowledge and interdisciplı study the narwhal's unique tusk. Photo credits: Glenn Williams and Joseph Meehan

High Arctic communities in Nunavut, Canada, and in Northwestern Green narwhals. For centuries, the narwhal has been part of the Inuit diet, provid Arctic is home to many unique animals, it is the narwhal's long, protruding stumped scientists for centuries.



Interview videos: Part 1 - Pa

Cornelius Nutarak Intervi

Nutarak: We as inuit cannot say how fast they go, we just know by hunting them that they can be pretty fast, we cannot tell you like how fast they go with western numerical systems, but I can say that when you hunt them they can go pretty fast like if you are watching them being hunted, they can be swift in their attempts to get away from the hunters. When they do that we say unguukaaluungmata, when they swim away.

Lucassie Takatak: Sea ice observations

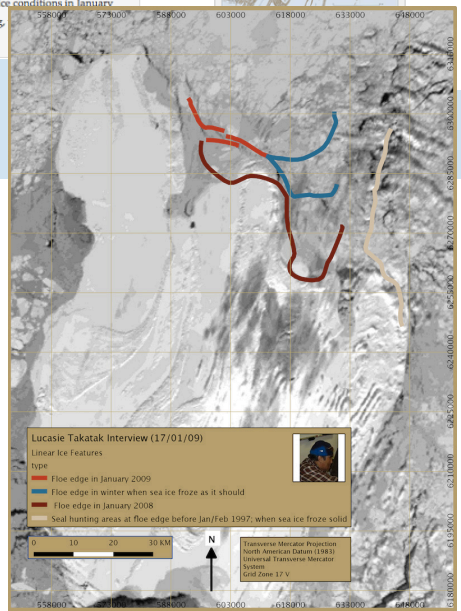
Lucassie Takatak has spent decades traveling on the ice around the Belcher Islands, hunting for the Sanikiluaq community and teaching young hunters. Hunters have long relied on stable sea ice conditions to reach seals, geese, ducks, and whales. But sea ice extent and thickness have changed recently, causing Lucassie and other hunters to find new hunting routes to avoid dangerous ice.

Changes in sea ice extent and thickness

Interview videos: Part 1 - Part 2 - Part 3 - Part 4 - Part 5

Sanikiluaq hunter Lucassie Takatak discussed sea ice conditions in January 2009, when he was interviewed by Miriam Fleming, Kavik. Video credit: Caroline Meeko, Jr.

Hunter Lucassie Takatak shared his sea ice observations as part of the Sanikiluaq Sea Ice Project. Photo credit: Miriam Fleming



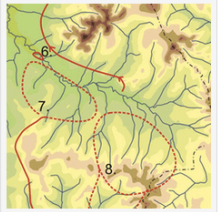
English | Русский

Snowchange Oral History: Nutendli Chukchi Obshchina

The Nutendli Chukchi obshchina has reindeer herding areas on the Eastern bank of the Kolyma river. The Nutendli community formed when they split from the Turvaurgin community in 1989, and the process was completed in the early 1990s. In 1992, 1,107 reindeer were given to Nutendli from the *sovkhoz*, or the state-owned farm, to start their herd. Today over 2,000 reindeer form the economic base of the community.

The community is led by Vyacheslav Kemlil, son of Grandmother Akulina Kemlil and Grandfather Jegor Nutendli, the Elders of the community. Other relatives such as Zoja Nikolajevna Tokareva, sister of Akulina, belong to the community.

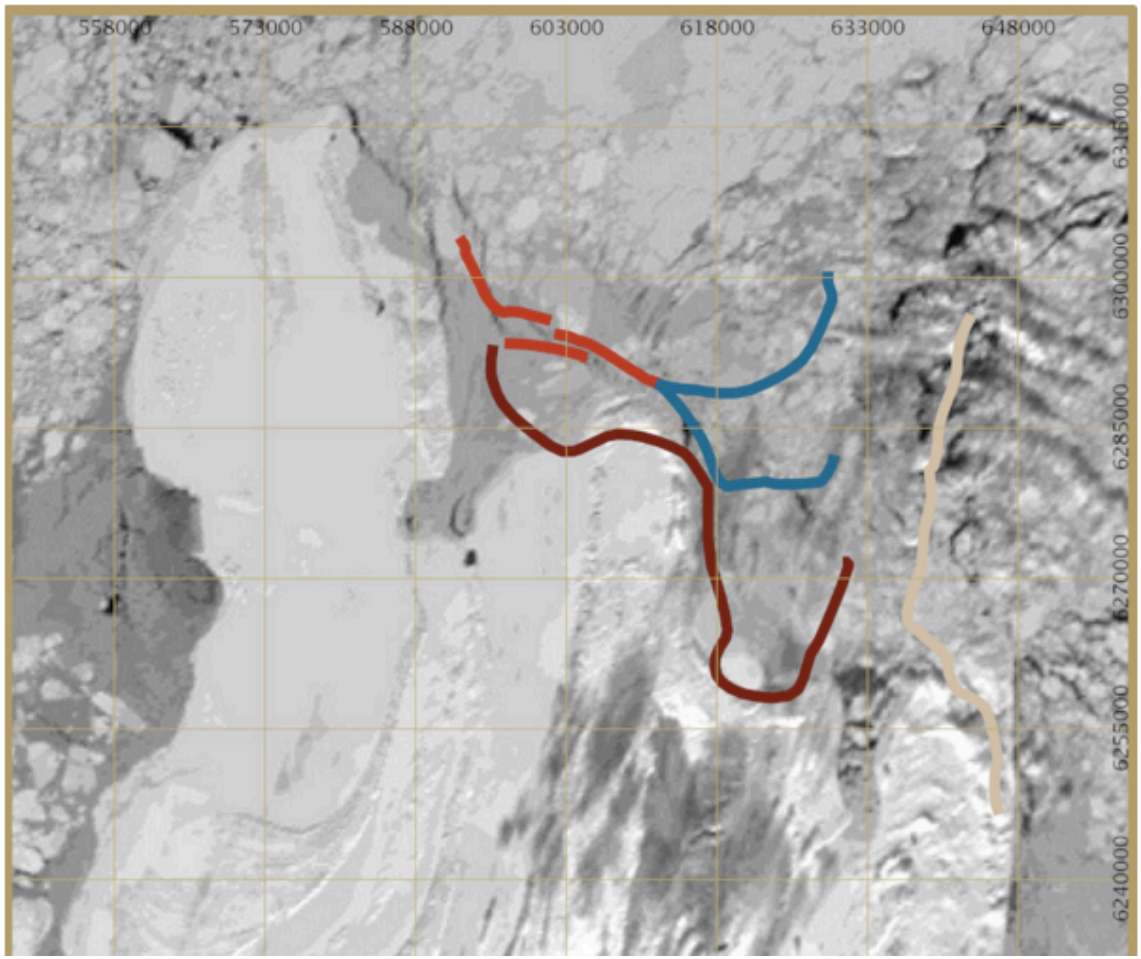
From 2005 to 2008, Nutendli had one brigade with three yaranga . The first brigade is led by Vitaly Kemlil, brother of Vyacheslav. By 2010, a second reindeer herding brigade had been established. In addition to herding, subsistence fishing and some hunting form the basis of Nutendli livelihoods. The Nutendli reindeer belong to the *khargin* breed, which is a stock of reindeer with a special national status.



Section of map of Nutendli community land use. View a full version of of the map. Credit: © Tero Mustonen, Snowchange Cooperative[/caption]

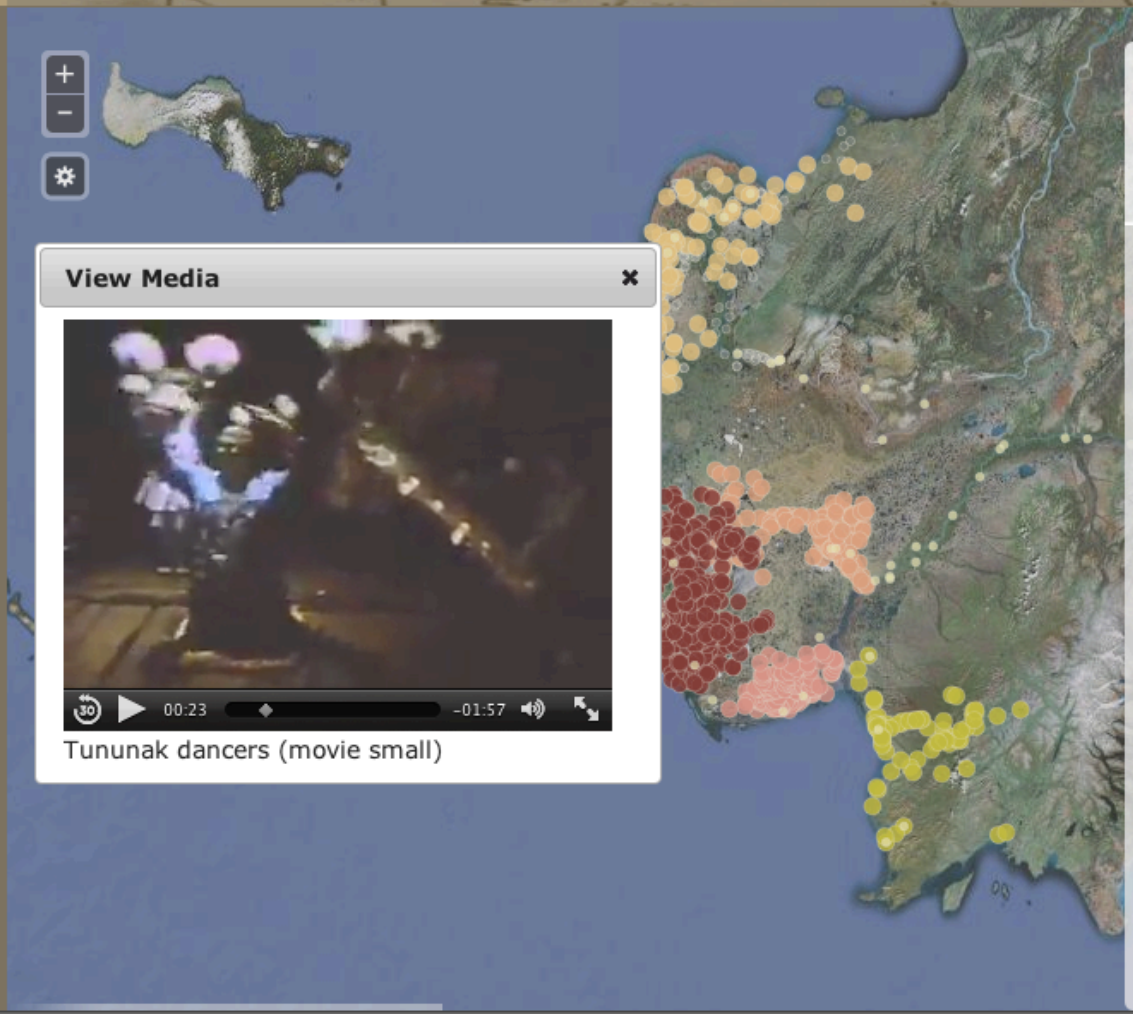
The work that Nutendli has undertaken with the Snowchange Cooperative follows the same lines as with Turvaurgin. One of the exceptions is the nomadic school that Nutendli established in 2002. Several donor organizations, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), Save the Children Iceland, the Snowchange Cooperative, and others have worked to support the school over the years because it is a unique

Sanikiluaq Community Maps & Imagery: Lucassie Takatak's Sea Ice Observations Overlain on a MODIS Image



Yup'ik Environmental Knowledge Project

Home | About Us



View Media

Tununak dancers (movie small)

Yup'ik Atlas

search the atlas

More Info

Tununak Dancers
Tununak, AK

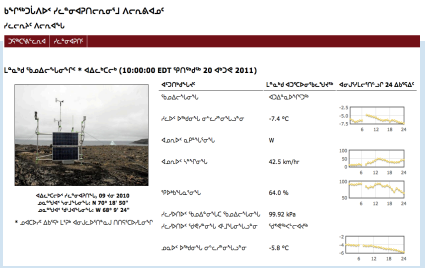
From the film "Once Our Way"
by Andrew Chikoyak
c. 1970s

(TununakDancers.mp4)

Title Tununak dancers (movie small)

http://www.arcticcbm.org

Observing Nodes



NODE

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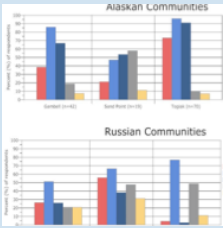

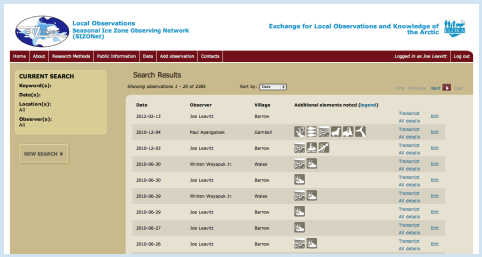

Clyderiverweather.org

Kangiqtugaapik (Clyde River) Weather Station Network

Silalirijiit Project

Home | Stations

Welcome! This site provides access to the current weather at Akuliaqattak, Silasiutitalik, and Ailaktalik. These new weather stations have been installed as part of the Silalirijiit Project in Kangiqtugaapik (Clyde River), Nunavut.

Inuktitut access to this site will be available soon, along with more information about the Silalirijiit Project. For more information, please contact:

Sheri Gearheard:
arheard@nsidc.org

q: eaqillaq@hotmail.com

ritage and Research Centre:
saqsivik.ca

Site supported by: ELOKA

ᑲᖏᕐᒪᑐᐃᓐᓇᐅᑉ ᓯᓚᖓᐊᑭᑎᓕᕆᓂᖅ ᐱᓕᕆᐊᒃᑯᓄᑦ

ᓯᓚᑕᓂᕐ ᐱᓕᕆᐊᖓ

ᑐᖏᑕᕐᕕᖏᓕᕆᐊ | ᓯᓚᖓᐊᑭᑎᓂ

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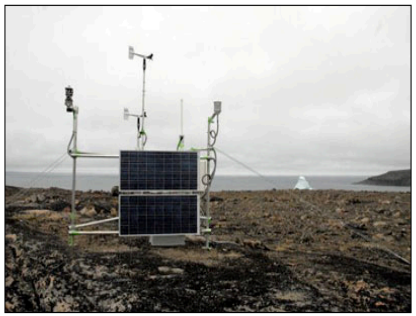

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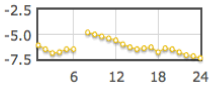
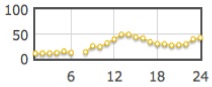
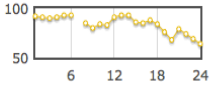
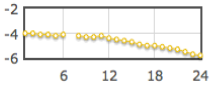
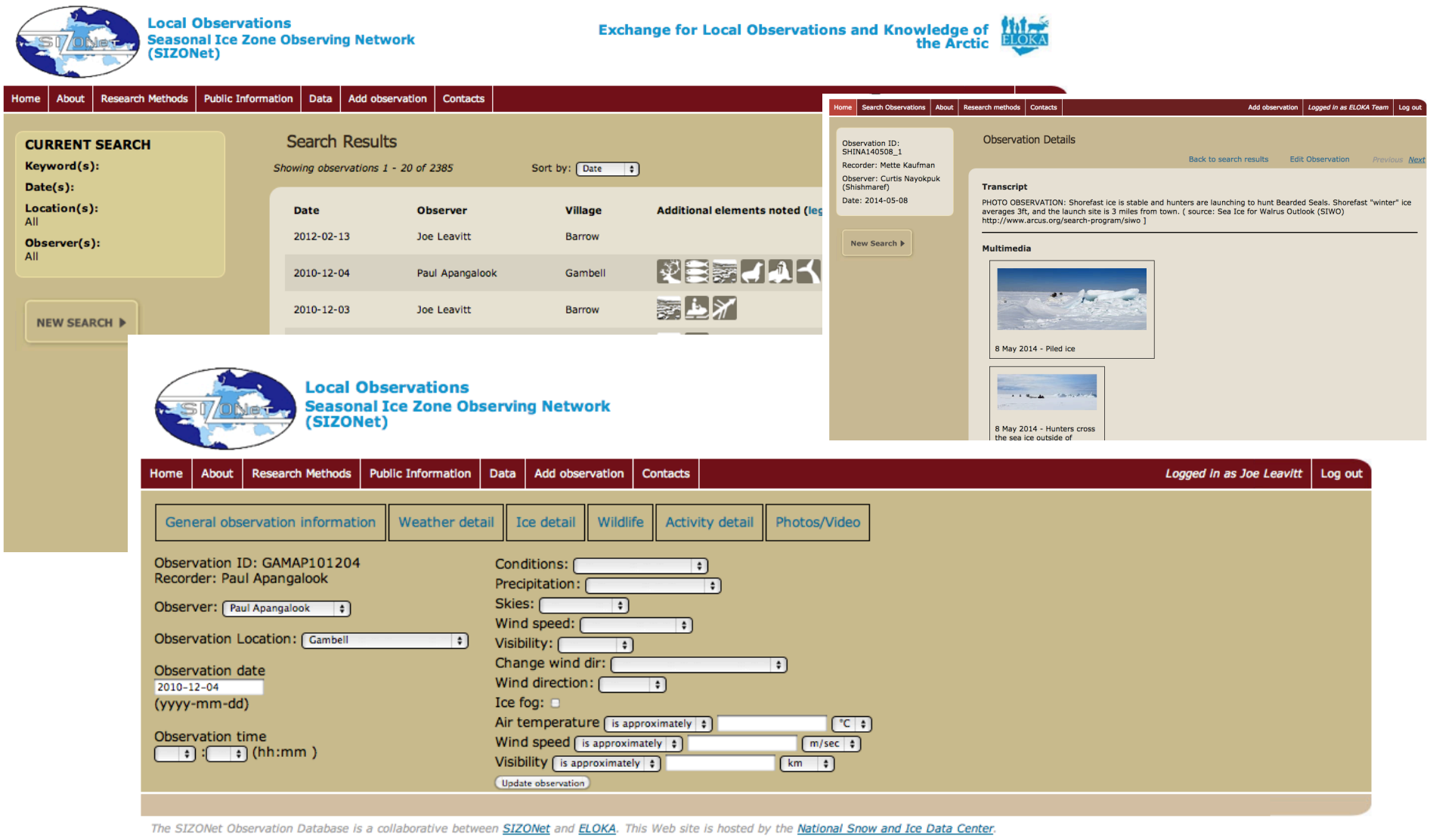
ᓄᓇᖏᓱᐊᑦ ᓴᓂᒍᖏᓂᖏᓐ: N 70° 18' 50"
ᓄᓇᖏᓱᐊᑦ ᖃᐅᒍᖏᓂᖏᓐ: W 68° 9' 24"

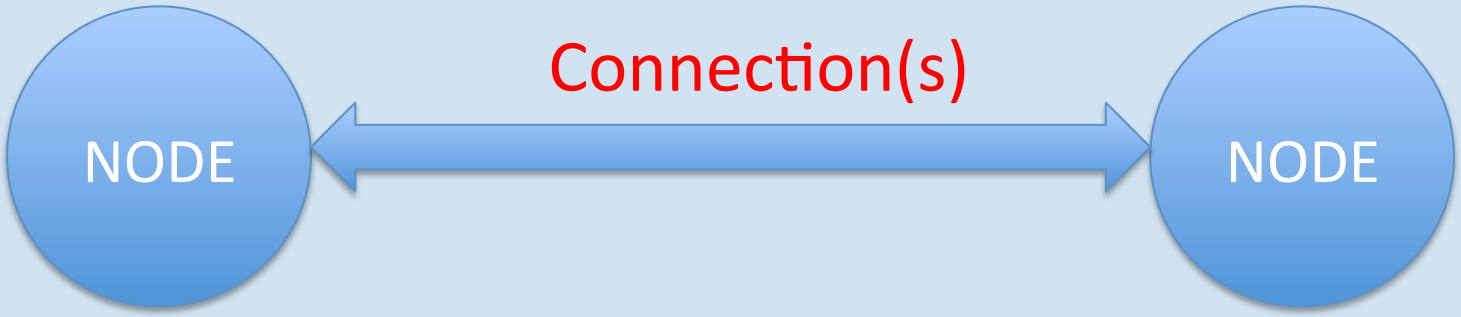
* ᓄᐊᑕᐅᓯᑉ ᐃᑲᖅᑎᖅ ᒪᕐᕉᖅ ᐊᓂᔪᓚᐅᕐᓂᖏᓇᒍ ᑎᑎᕋᑕᐅᓯᒪᓂᖏᑦ

ᐊᕐᑐᑎᓂᖏᓐᓴᑉ	ᒪᓇᒃᑯ ᐊᑐᕋᑕᐅᓂᖏᓕᖏᓐᓄᖅ	ᐊᓂᔪᓯᒪᓕᕋᑎᑉᓗᑉ 24 ᐃᑲᕋᐃᑦ
ᖁᑲᐃᓕᓕᖏᓐᓄᖏᓐ	ᐊᑐᐃᓇᐅᑦᑎᐊᓄᖅ	
ᓯᒪᐅᑦ ᐅᖃᓂᓂᖏᓐ ᓂᑦᓚᓯᓇᖏᓐᓄᓇᓂ	-7.4 °C	
ᐊᓄᑎᐅᑦ ᓇᑭᓇᕆᓂᖏᓐ	W	
ᐊᓄᑎᐅᑦ ᓴᓇᕐᓂᖏᓐ	42.5 km/hr	
ᖁᐅᐳᖏᓐᓇᕆᓂᖏᓐ	64.0 %	
ᓯᓚᑦᑎᖏᓐᓄᑦᑎᓐᓄᖏᓐ ᖁᓕᐃᓕᓕᖏᓐᓄᖏᓐ	99.92 kPa	
ᓯᓚᑦᑎᑎᐅᑦ ᖁᑦᖁᓂᓂᖏᓐ ᐊᒻᒪᓐᓄᖏᓐᓇᓇᓂ	ᖁᑦᖃᖅᓴᓕᐊᓴᖅ	
ᓄᓇᐅᑦ ᐅᖃᓂᓂᖏᓐ ᓂᑦᓚᓯᓇᖏᓐᓇᓇᓂ	-5.8 °C	

SIZONet


Local Observations
Seasonal Ice Zone Observing Network
(SIZONet)
Exchange for Local Observations and Knowledge of the Arctic
ELOKA
Home
About
Research Methods
Public Information
Data
Add observation
Contacts
CURRENT SEARCH
Keyword(s):
Date(s):
Location(s):
All
Observer(s):
All
NEW SEARCH
Search Results
Showing observations 1 - 20 of 2385
Sort by: Date
Date
Observer
Village
Additional elements noted
2012-02-13
Joe Leavitt
Barrow
2010-12-04
Paul Apangalook
Gambell
2010-12-03
Joe Leavitt
Barrow
Search Observations
Logged in as ELOKA Team
Log out
Observation ID: SHINA140508_1
Recorder: Mette Kaufman
Observer: Curtis Nayokpuk (Shishmaref)
Date: 2014-05-08
New Search
Observation Details
Back to search results
Edit Observation
Previous
Next
Transcript
PHOTO OBSERVATION: Shorefast ice is stable and hunters are launching to hunt Bearded Seals. Shorefast "winter" ice averages 3ft, and the launch site is 3 miles from town. (source: Sea Ice for Walrus Outlook (SIWO) http://www.arcus.org/search-program/siwo]
Multimedia
8 May 2014 - Piled ice
8 May 2014 - Hunters cross the sea ice outside of
Local Observations
Seasonal Ice Zone Observing Network
(SIZONet)
Home
About
Research Methods
Public Information
Data
Add observation
Contacts
Logged in as Joe Leavitt
Log out
General observation information
Weather detail
Ice detail
Wildlife
Activity detail
Photos/Video
Observation ID: GAMAP101204
Recorder: Paul Apangalook
Observer: Paul Apangalook
Observation Location: Gambell
Observation date
2010-12-04
(yyyy-mm-dd)
Observation time
(hh:mm)
Conditions:
Precipitation:
Skies:
Wind speed:
Visibility:
Change wind dir:
Wind direction:
Ice fog:
Air temperature
is approximately
°C
Wind speed
is approximately
m/sec
Visibility
is approximately
km
Update observation
The SIZONet Observation Database is a collaborative between SIZONet and ELOKA. This Web site is hosted by the National Snow and Ice Data Center.

Interoperability



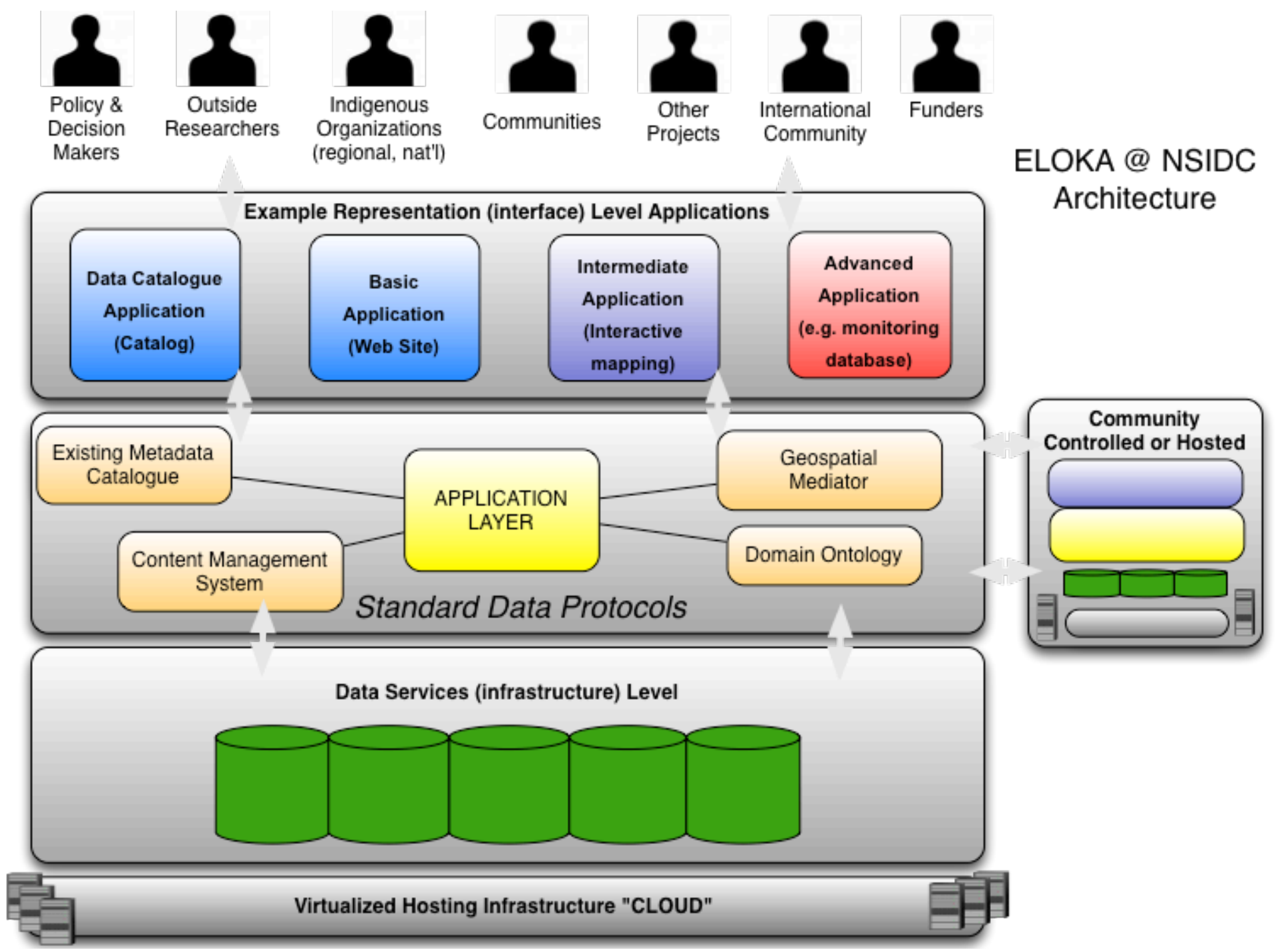
Knowledge,
observation,
Documents,
data…

Knowledge,
observation,
Documents,
data…

Interoperability

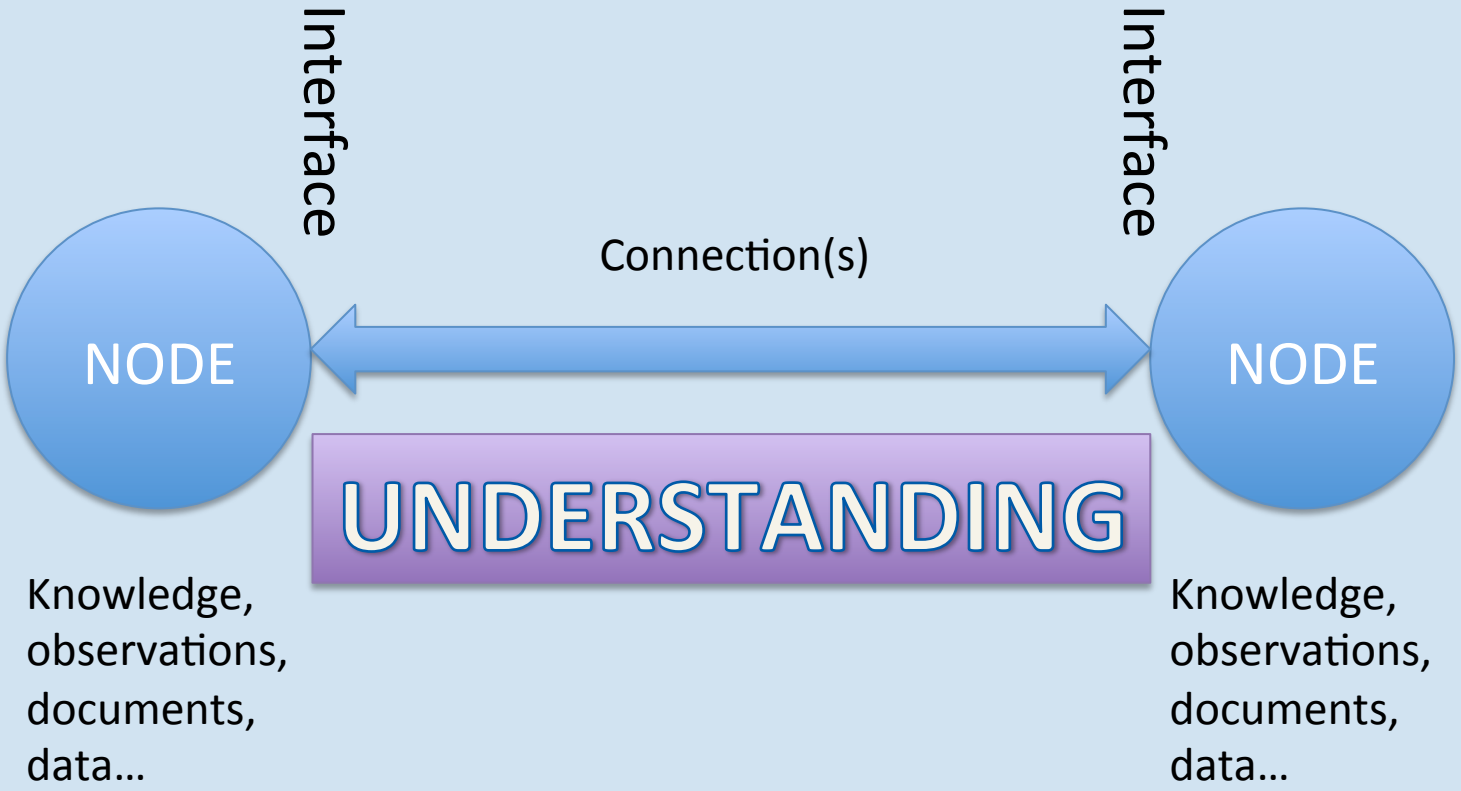
Technical Interfaces

- Many interfaces and related protocols
  - De-facto standards (e.g. Shapefile, CSV)
  - Community or industry driven (GeoJSON, KML etc.)
  - Open Geospatial Consortium (WMS, WFS)
  - ISO (19115)
  - OPeNDAP
  - Linked Open Data and Semantic Web
  - …

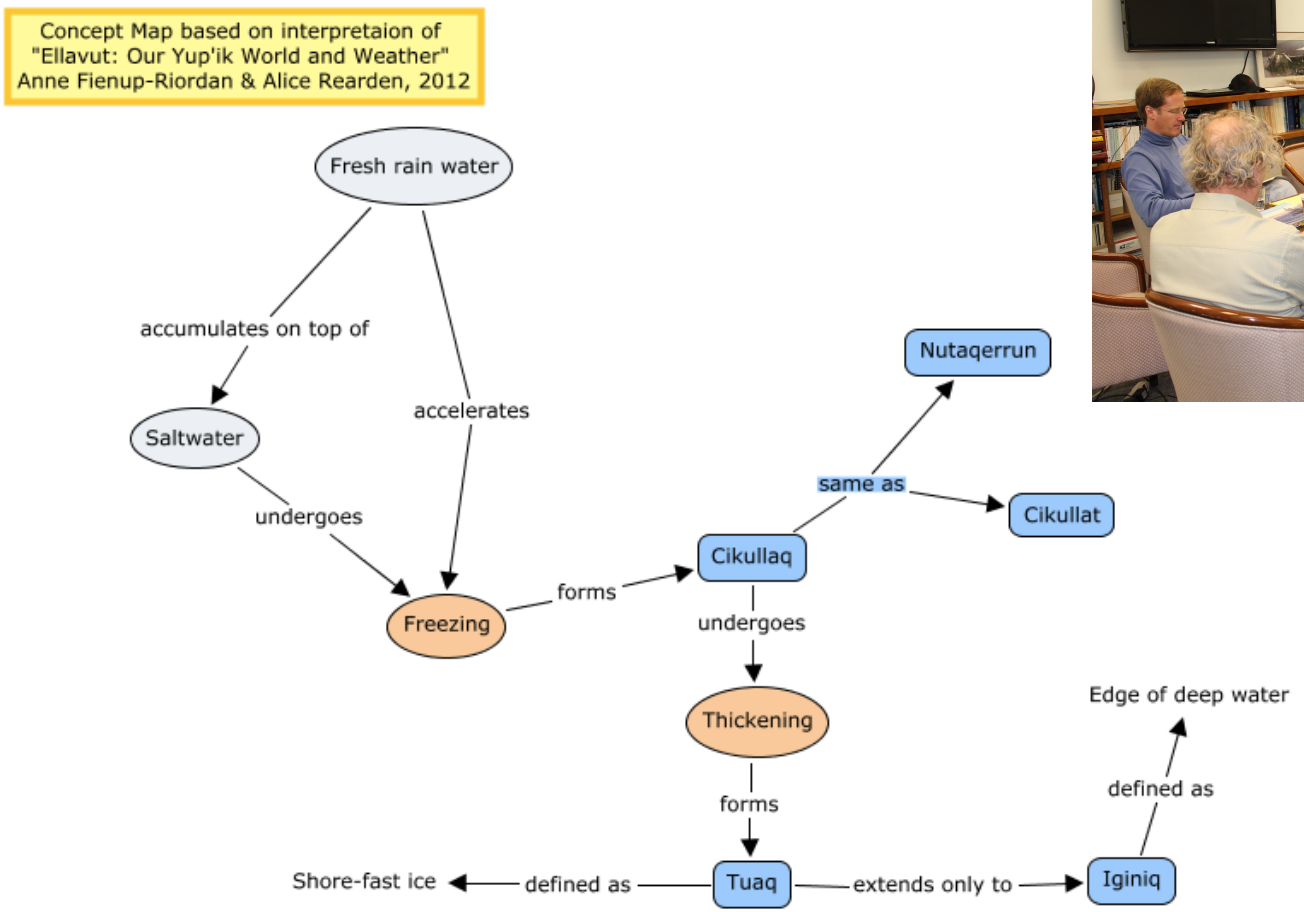

Policy & Decision Makers
Outside Researchers
Indigenous Organizations (regional, nat'l)
Communities
Other Projects
International Community
Funders
ELOKA @ NSIDC Architecture
Example Representation (interface) Level Applications
Data Catalogue Application (Catalog)
Basic Application (Web Site)
Intermediate Application (Interactive mapping)
Advanced Application (e.g. monitoring database)
Existing Metadata Catalogue
APPLICATION LAYER
Geospatial Mediator
Content Management System
Domain Ontology
Standard Data Protocols
Community Controlled or Hosted
Data Services (infrastructure) Level
Virtualized Hosting Infrastructure "CLOUD"

INTEROPERABILITY:
UNDERSTANDING

Interoperability

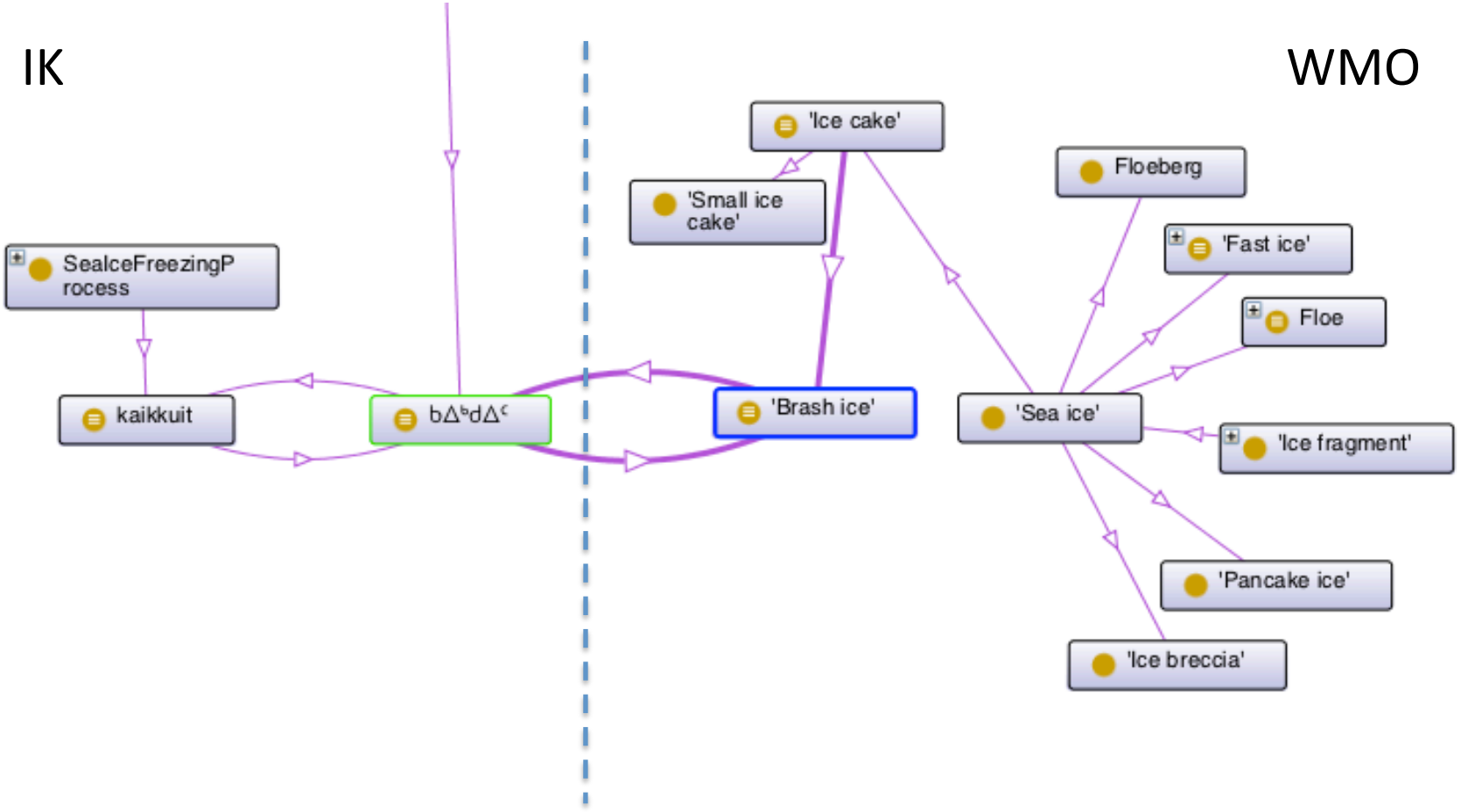


Building Knowledge Models

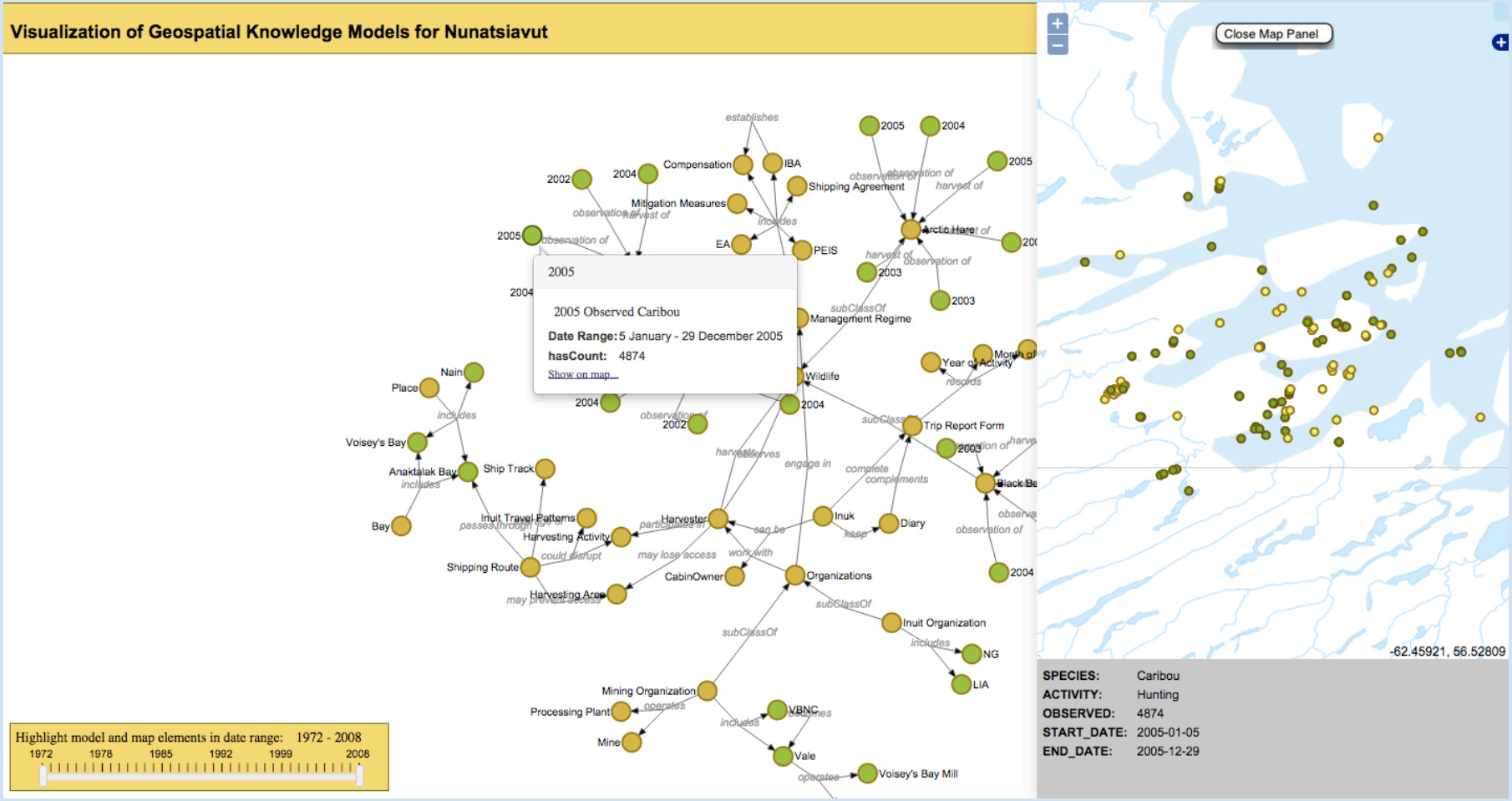


Activities under partnership with Semantic Sea Ice Interoperability Initiative (SSIII)

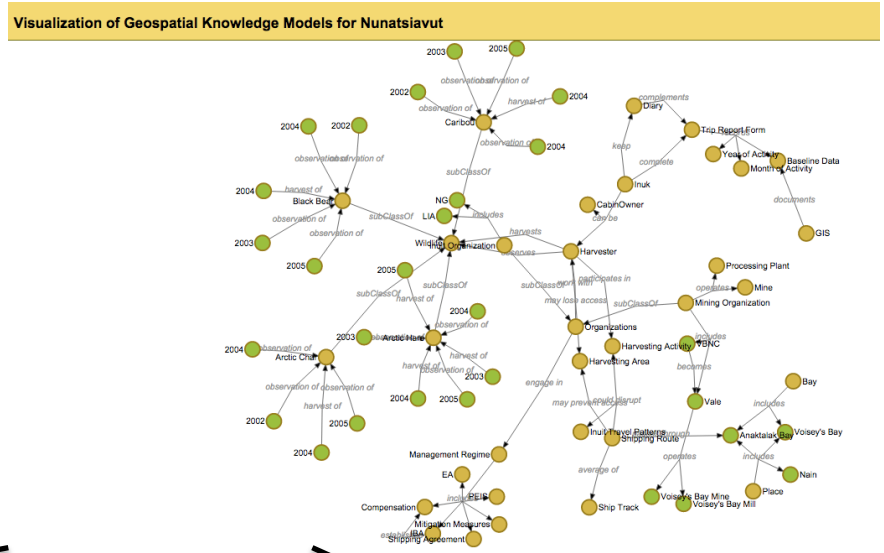
Linking Across Disciplines and Cultures

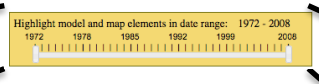


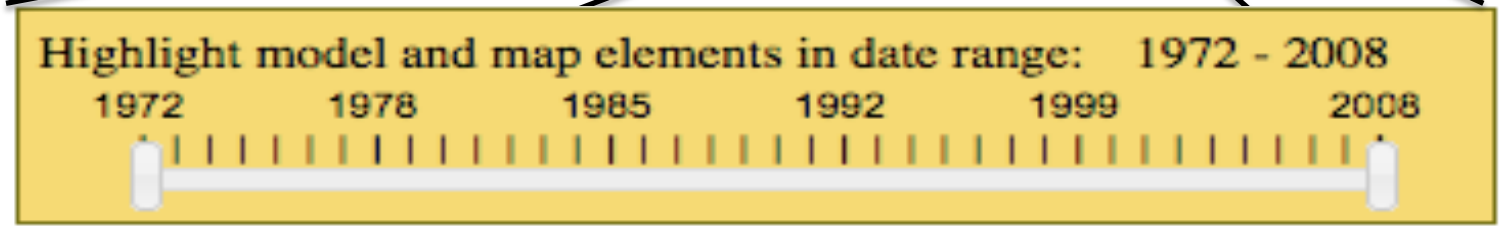
Communicating Geo Knowledge



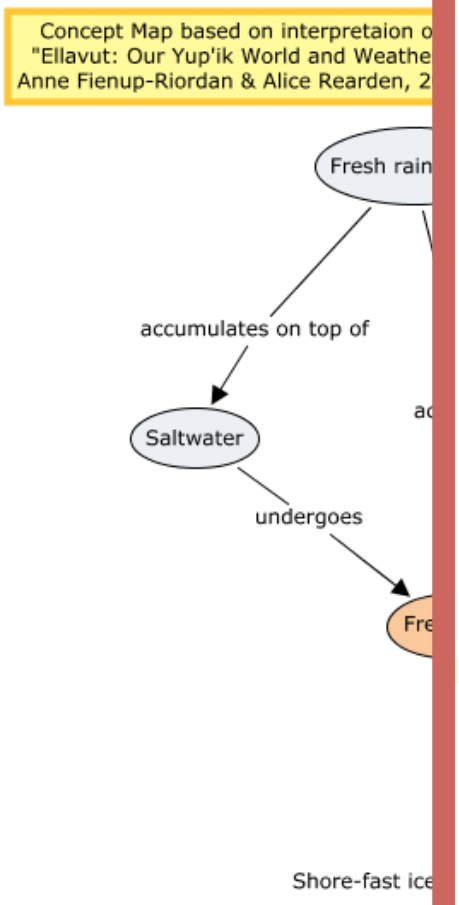
Space and Time







Can Knowledge be Code?

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<!DOCTYPE rdf:RDF [
    <!ENTITY map "http://qa.eloka-arctic.org/communities/inventory/index.html#" >
    <!ENTITY feature1 "eyJ0IjoieCIsImkiOiI4NjkwNDdjNjczZDcyNzNhODVkODE3OWJiOTFhNmVmMCJ9" >

]>

<rdf:RDF
    xmlns="http://purl.org/nsidc/ssiii/nunatsiavut_onto#"
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:owl="http://www.w3.org/2002/07/owl#"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
    xmlns:daml="http://www.daml.org/2001/03/daml+oil#"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
    xmlns:owltime="http://www.w3.org/2006/time#"
    xmlns:nunatsiavut="http://purl.org/nsidc/ssiii/nunatsiavut_onto#"
    xmlns:gn="http://www.geonames.org/ontology#"
    >

    <!--
    ///////////////////////////////////////////////////////////////////////////////////////
    //
    // Object Properties - kinds of relationships
    //
    ///////////////////////////////////////////////////////////////////////////////////////
     -->


  <owl:ObjectProperty rdf:about="http://purl.org/nsidc/ssiii/nunatsiavut_onto#include">
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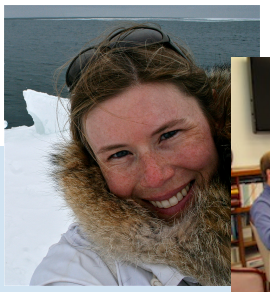
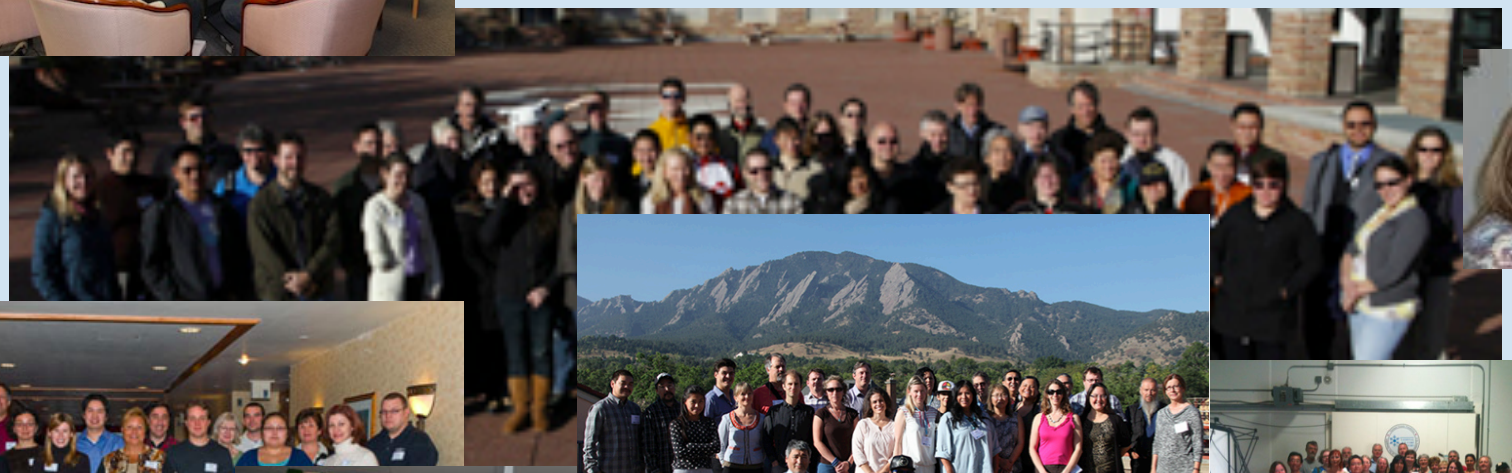
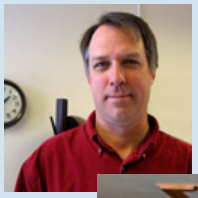
Activities part of Semantic

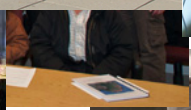
INTEROPERABILITY:
HUMAN INTERFACES AND CONNECTIONS

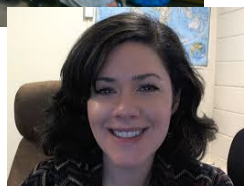
Individuals as Interface











Collective Statement

Indigenous Knowledge: Key Considerations for Polar Data Planning

Statement from the *Sharing Knowledge: Traditions, Technologies, and Taking Control of our Future Workshop* held 22-24 September 2015, Boulder, Colorado
Organized by the Exchange for Local Observations and Knowledge of the Arctic (ELOKA)

Indigenous peoples are increasingly leading and contributing to science and research activities across the Arctic. Indigenous knowledge is being documented in myriad ways in these activities and there is a need for this knowledge to be preserved, managed, and shared along side other data.

Indigenous knowledge is not western scientific knowledge and we should not try to make it so. We must recognize and embrace the differences and avoid the singular dominance of "hard data" or "hard science". We must be aware and careful of privileged perspectives in Arctic research and data management.

Working with Indigenous knowledge requires understanding the context of the knowledge and the context of Indigenous peoples in the Arctic. For example, Indigenous languages must be respected and supported. Language is more than a means of communicating, but a way of thinking. It is also deeply connected to (among others) observing, knowing, and skill. Also, Indigenous peoples should not be viewed as a group of "stakeholders" in the Arctic. The Arctic is a homeland to Indigenous peoples and there are critical issues related to the assertion of rights, sovereignty, security, and self-determination. These contexts must be considered when working with Indigenous data.

There is a need for distributed systems. Indigenous knowledge is geographically and culturally specific and information systems should reflect this. We need to avoid aiming to establish a centralized system but rather focus on meeting the needs of individual communities and on interoperability between systems.

Indigenous communities in the Arctic are the providers of information, users of information, monitors of information, and decision-makers. The uses of data technology are changing rapidly in these communities. We need to continue to work to put control of technology in local hands and invest in improving bandwidth, access to technologies, training and capacity building.

Establishing protocols for proper consent related to data collection and use, and for data management for Indigenous knowledge is critically important and urgent. There is a need for research and data management planning to be driven by Indigenous peoples, communities, families, and organizations. There is a need for infrastructure and resources so this can be realized.

Protocols are needed for documenting and using Indigenous knowledge in a digital form, however, these must be reflexive and consider cultural, historical, and geographical contexts rather than focusing on technical aspects of standards. Adaptability is key.

http://eloka-arctic.org/news/EAC_meeting.html

Organizations as Interface

Exchange for Local Observations and Knowledge of the Arctic

ACADIS

Carleton UNIVERSITY | Geomatics and Cartographic Research Centre

Inuit qaujisarvingat knowledge centre

Calista Elders Council

POLAR DATA CATALOGUE

IASSA INTERNATIONAL ARCTIC SOCIAL SCIENCES ASSOCIATION

IASC

Bering Sea Sub-Network

Holistic Knowlege - Better Understanding - Relevant Policies

ARCTIC PORTAL

BAID

SIONet

INUIT

UNESCO

United Nations Educational, Scientific and Cultural Organization

Arctic SDI

Arctic Spatial Data Infrastructure

PEOPLE Project

a.p.i.

Arctic Observing Viewer

Polar View

Earth Observation for Polar Monitoring

EYE ON EARTH

SAON

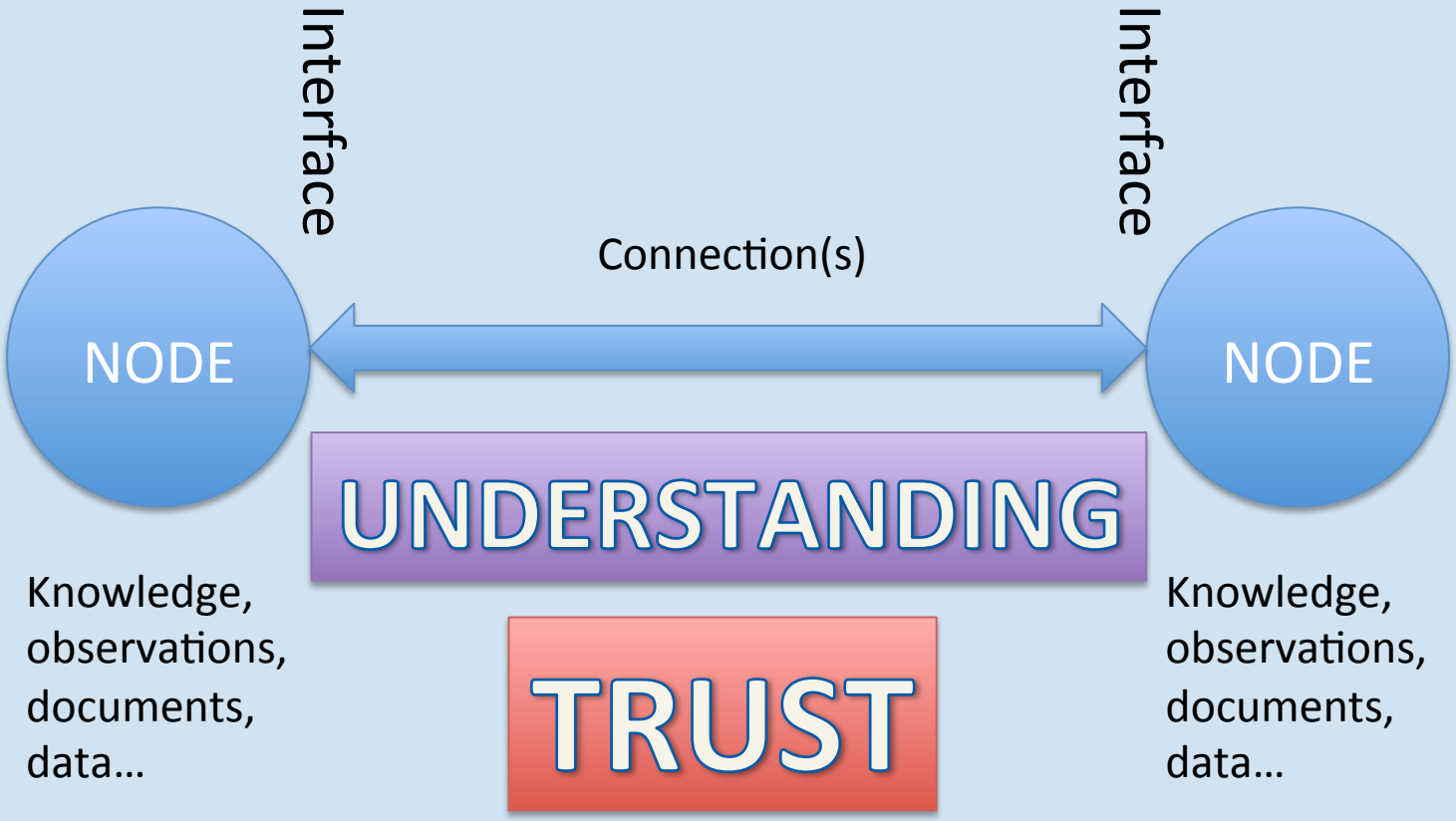
SUSTAINING ARCTIC OBSERVING NETWORKS

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM

AOOS

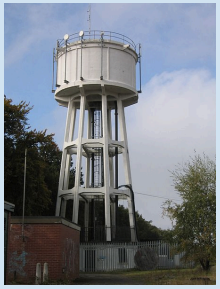
armap

Interoperability



INTEROPERABILITY:
NEXT STEPS?

Data, Information, Knowledge Flow



Interface

FLOW

Interface

Connection(s)

NODE

NODE

UNDERSTANDING

Knowledge, observations, documents, data…

TRUST

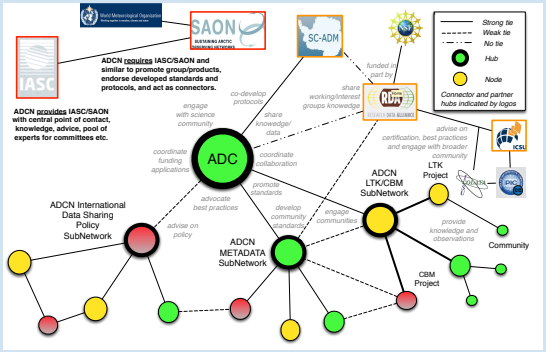
Knowledge, observations, documents, data…

https://commons.wikimedia.org/wiki/File%3AMoortown_Water_Tower.JPG

https://commons.wikimedia.org/wiki/File%3AMackenzie_River_near_Fort_Providence.jpg

Priorities

- Persistent nodes including organizational and human nodes (implies capacity)
- Trust
- Technical, human and organizational mediators (active hubs) to facilitate and maintain *flow*



http://eloka-arctic.org

eloka@nsidc.org

©photo Shari Gearheard

Thank You

Acknowledgements

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    - Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
- The Arctic Social Sciences Postdoctoral Fellowship is funded in part by the Council on Library and Information Resources