FACING THE CHALLENGE OF PERMAFROST THAW IN NUNAVIK COMMUNITIES: HIGH RESOLUTION PERMAFROST AND GEOTECHNICAL CONDITIONS MAPPING TO SUPPORT LAND-USE PLANNING.

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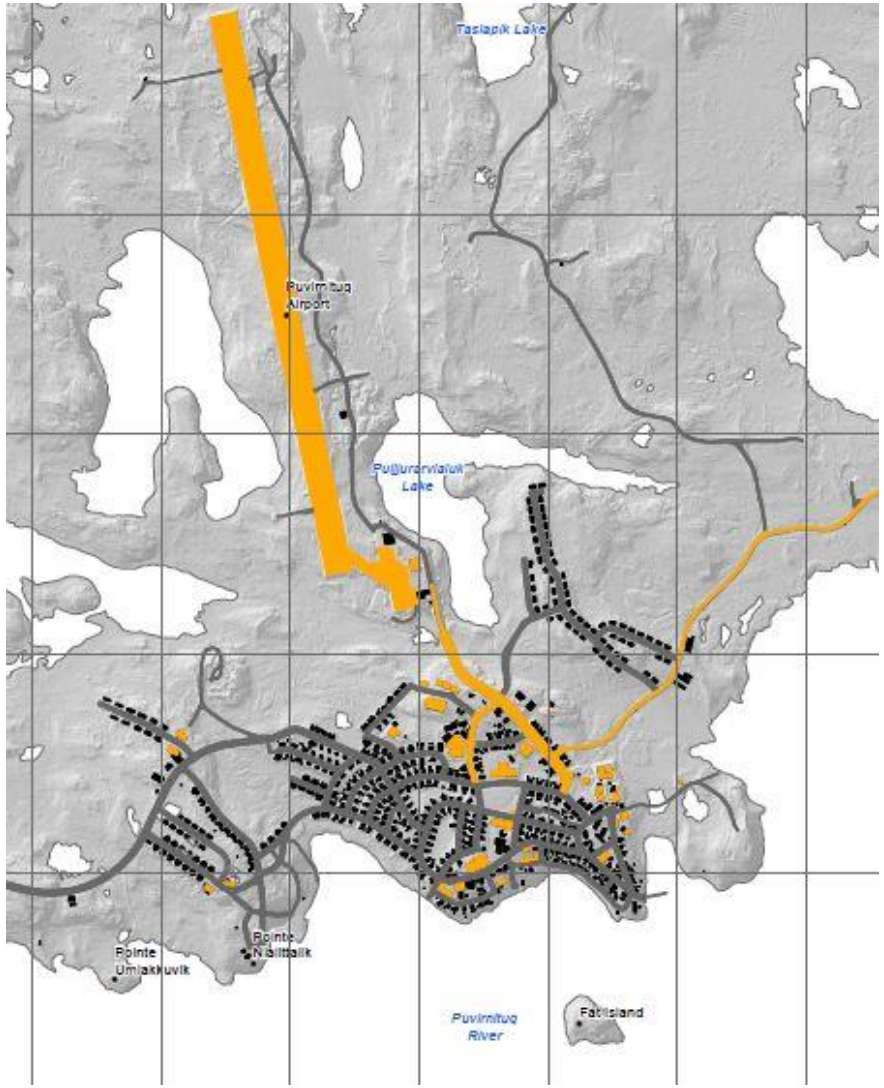
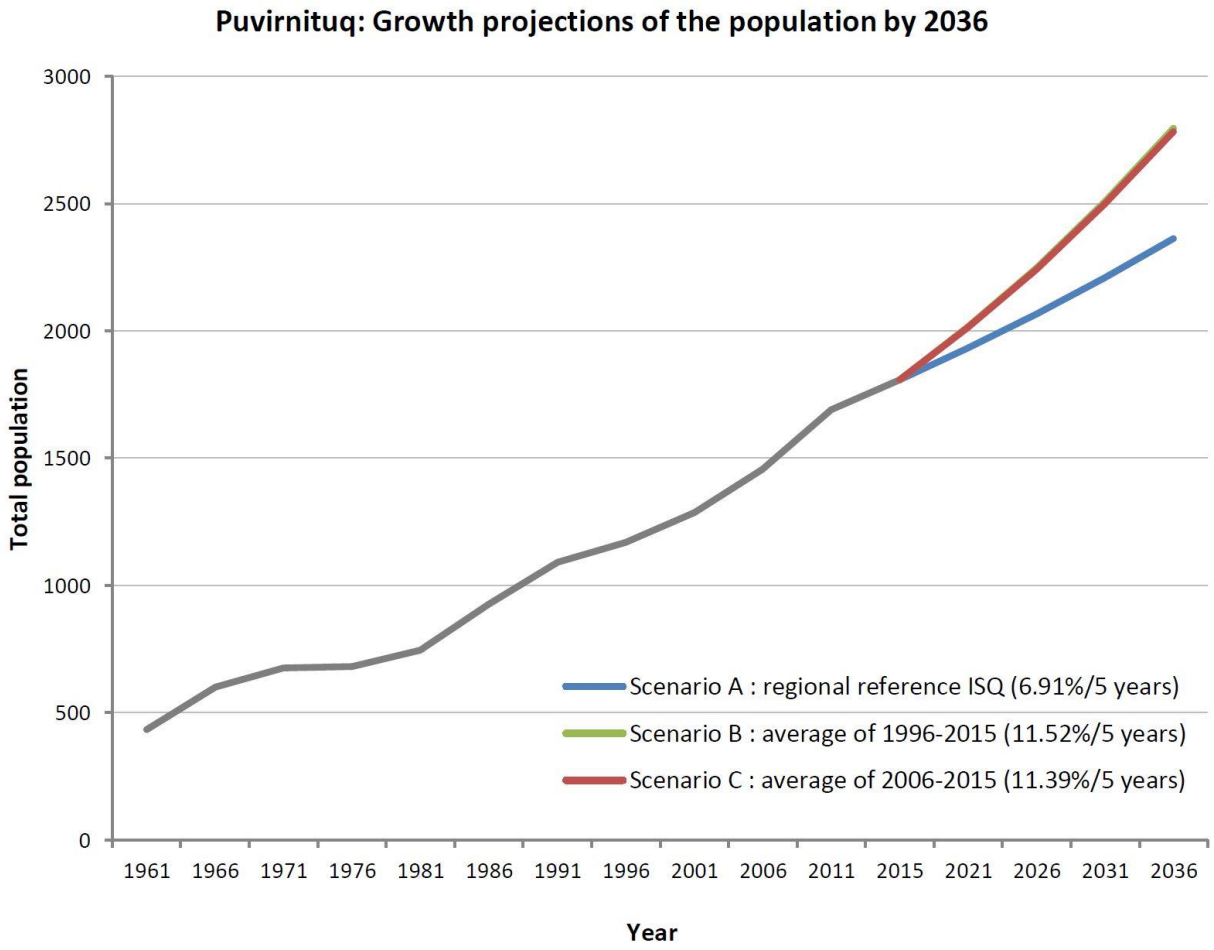
The general housing issue and community expansion in Inuit Nunangat



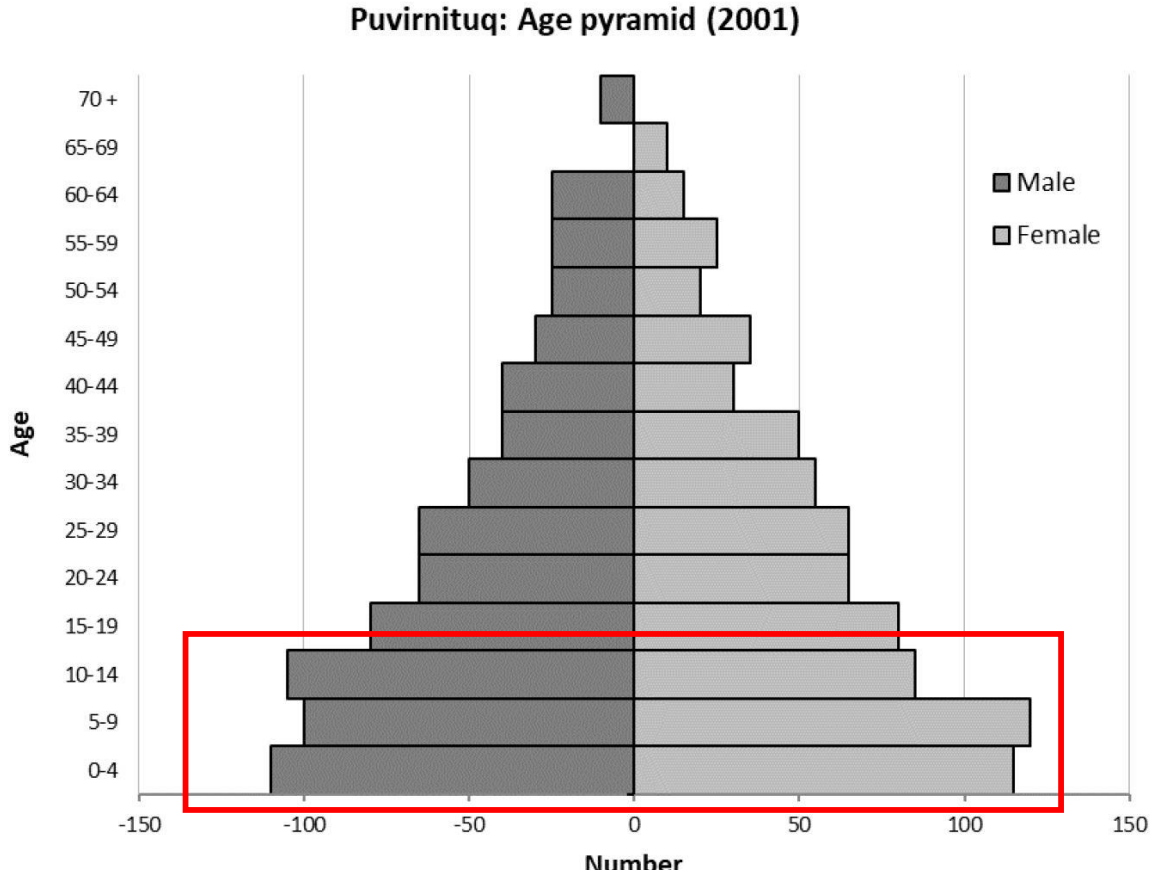


The case of Puvirnituq

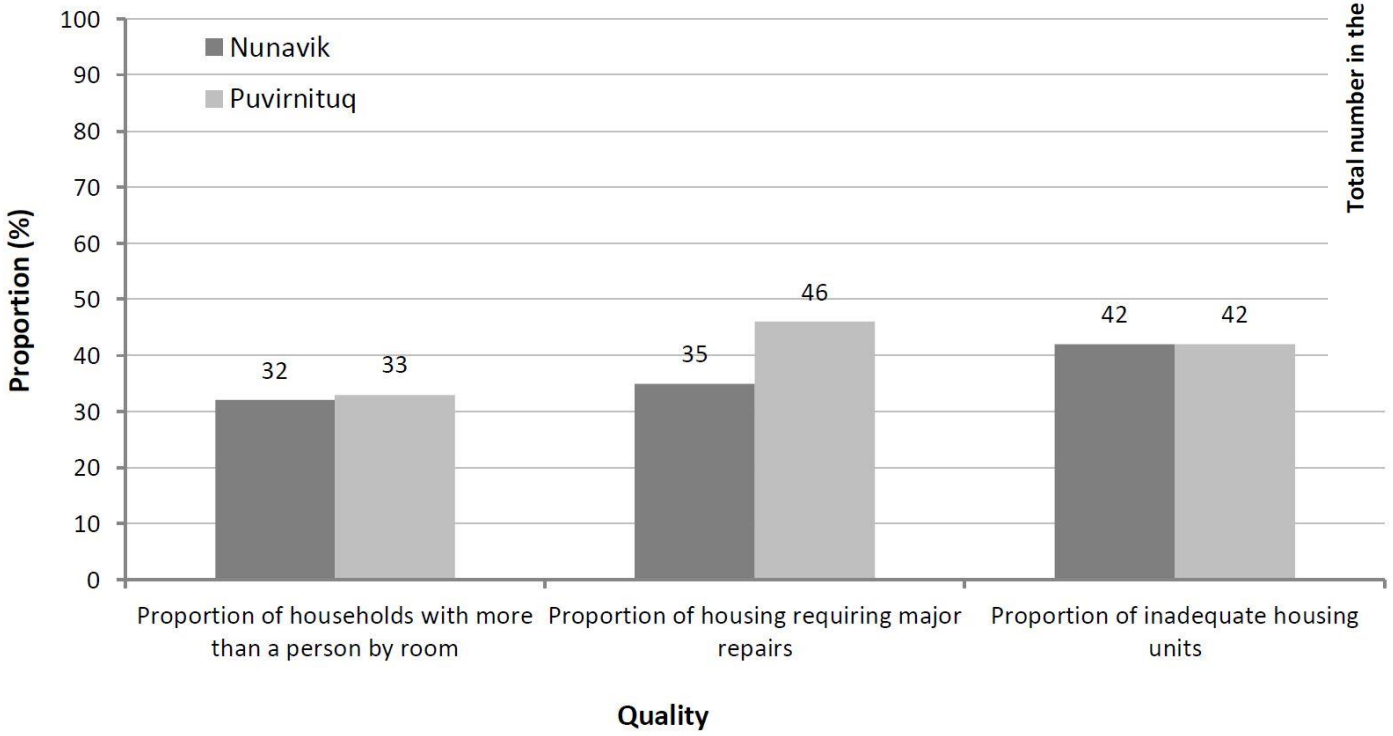
The general housing issue and community expansion in Inuit Nunangat

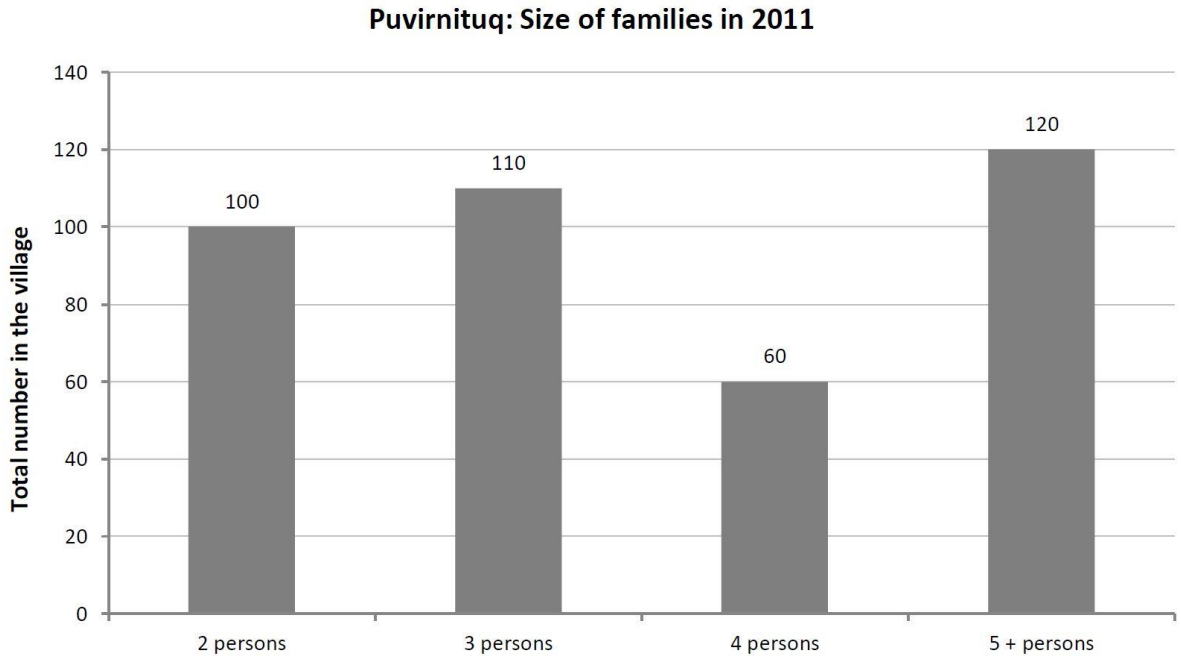
Table 5: Demographic profile of Puvirnituq in 2011 (Statistics Canada, 2015).

Demographic profile of Puvirnituq in 2011	
Total population (estimate for 2016)	1,692 (1,808)
Median age of the population	21.1
% of the population under 15 years old	48%
% of the population above 60 years old	65%
Total population in private households	390
Average number of people per family	3.8
Average number of children per family	2.2
Total number of children in families	870
Number of single parents	115 women; 50 men
Total number of non-census family persons	205



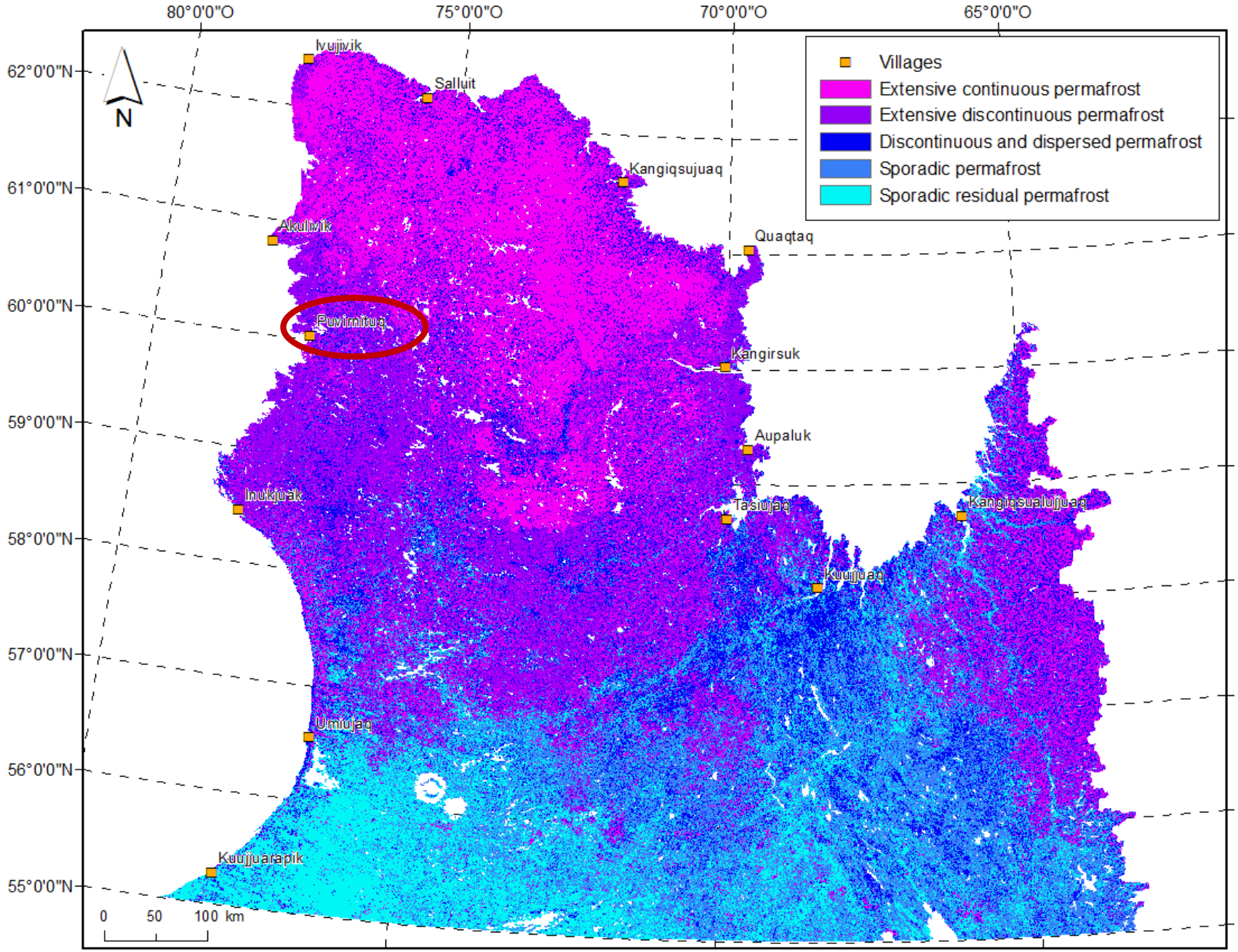
The general housing issue and community expansion in Inuit Nunangat





Permafrost distribution in Nunavik (Northern Quebec)

- 13 communities are built on permafrost



- This overarching research focuses on high resolution permafrost conditions mapping and characterization to support land-use for northern communities built on permafrost.

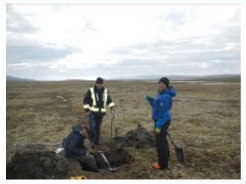
This project is the result of collaboration between researchers and the Inuit communities of Nunavik. The iteration mapping process has allowed us to refine our methods in order to provide up to date and high-quality maps about permafrost and geotechnical conditions at a community scale.

METHODS

1 FIELDWORK

- Meetings with the community's stakeholders to discuss about thawing permafrost issues;
- Fieldwork investigations involving drilling with recovery of undisturbed permafrost cores and ground penetrating radar surveys.

In situ observations



Permafrost coring

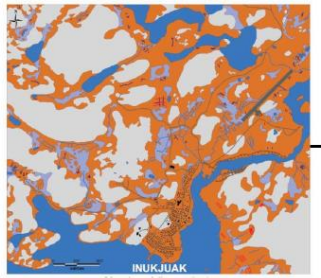
Ground penetrating radar (GPR) surveys

Meetings with leaders and community members

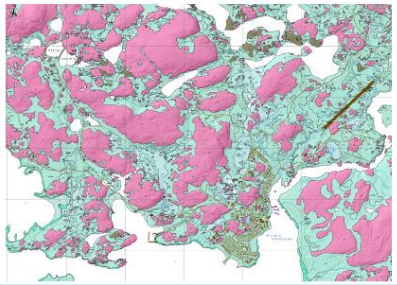
2 SURFICIAL GEOLOGY MAPPING

- Update of previous surficial geology map considering newly acquired field data;
- Geotechnical and stratigraphic information from the literature, including expert reports related to construction projects, was combined to our data.

1st edition



2nd edition



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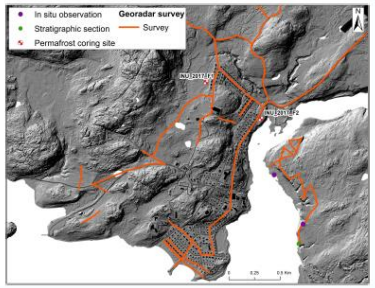
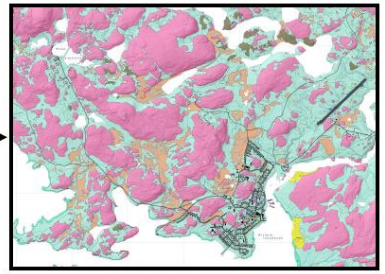
Fieldwork





Surficial geology map

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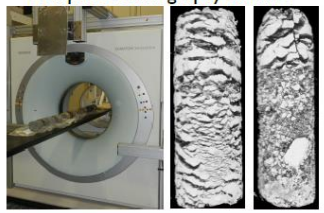
3 PERMAFROST AND GEOTECHNICAL CHARACTERIZATION OF THE SURFICIAL GEOLOGY UNITS

- Frozen cores collected during drilling were systematically scanned with X-rays (CT Scan);
- Provides high-resolution permafrost cryostructures and cryofacies;
- Samples deemed representative of permafrost conditions in the study area were tested for thaw settlement and consolidation.

Sample cutting

Computed tomography scanner



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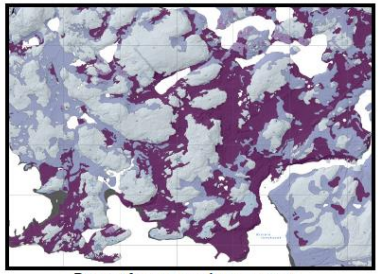
Thaw-consolidation tests



Permafrost conditions map

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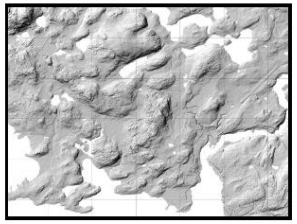
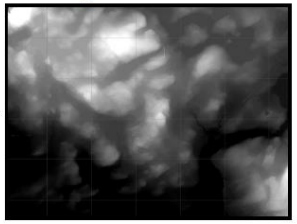
4 GIS BASED MULTI-CRITERIA ANALYSIS APPROACH: PRODUCTION OF MAPS (PERMAFROST CONDITIONS, CONSTRUCTION POTENTIAL AND NATURAL HAZARDS)

- Classification of land-use constraints (using LIDAR data and photo-interpretation);
- Definition of critical slope values for construction (>15°);
- Surficial deposits classification depending on their relative stability upon thawing.

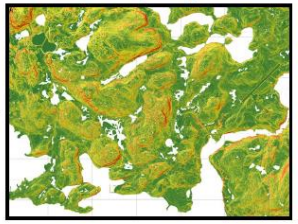
LIDAR data

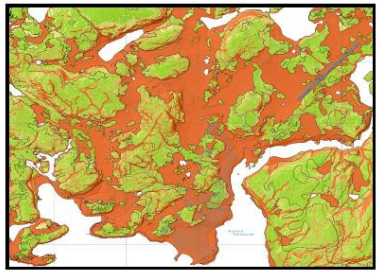


Digital elevation model



Slope map

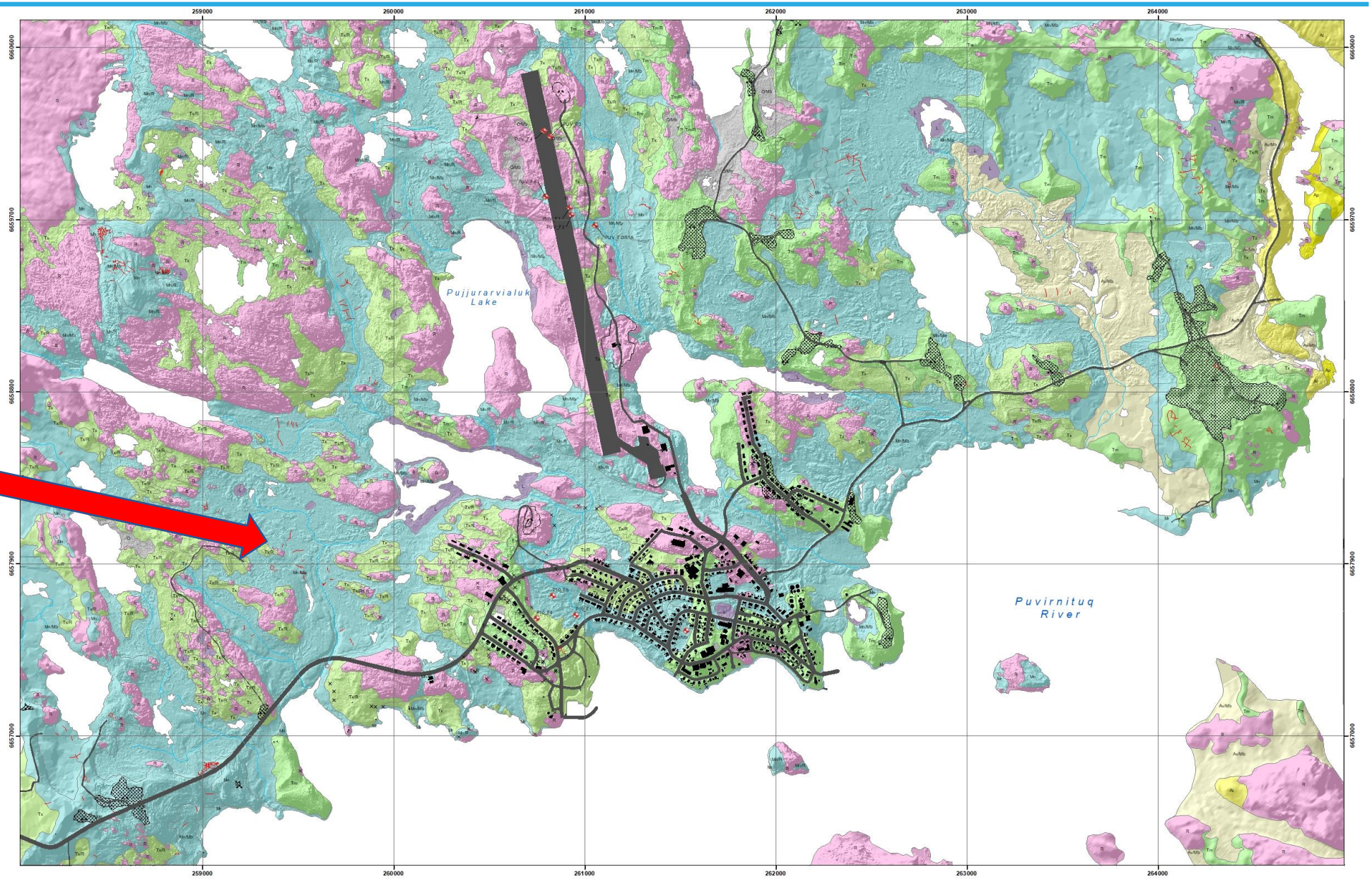




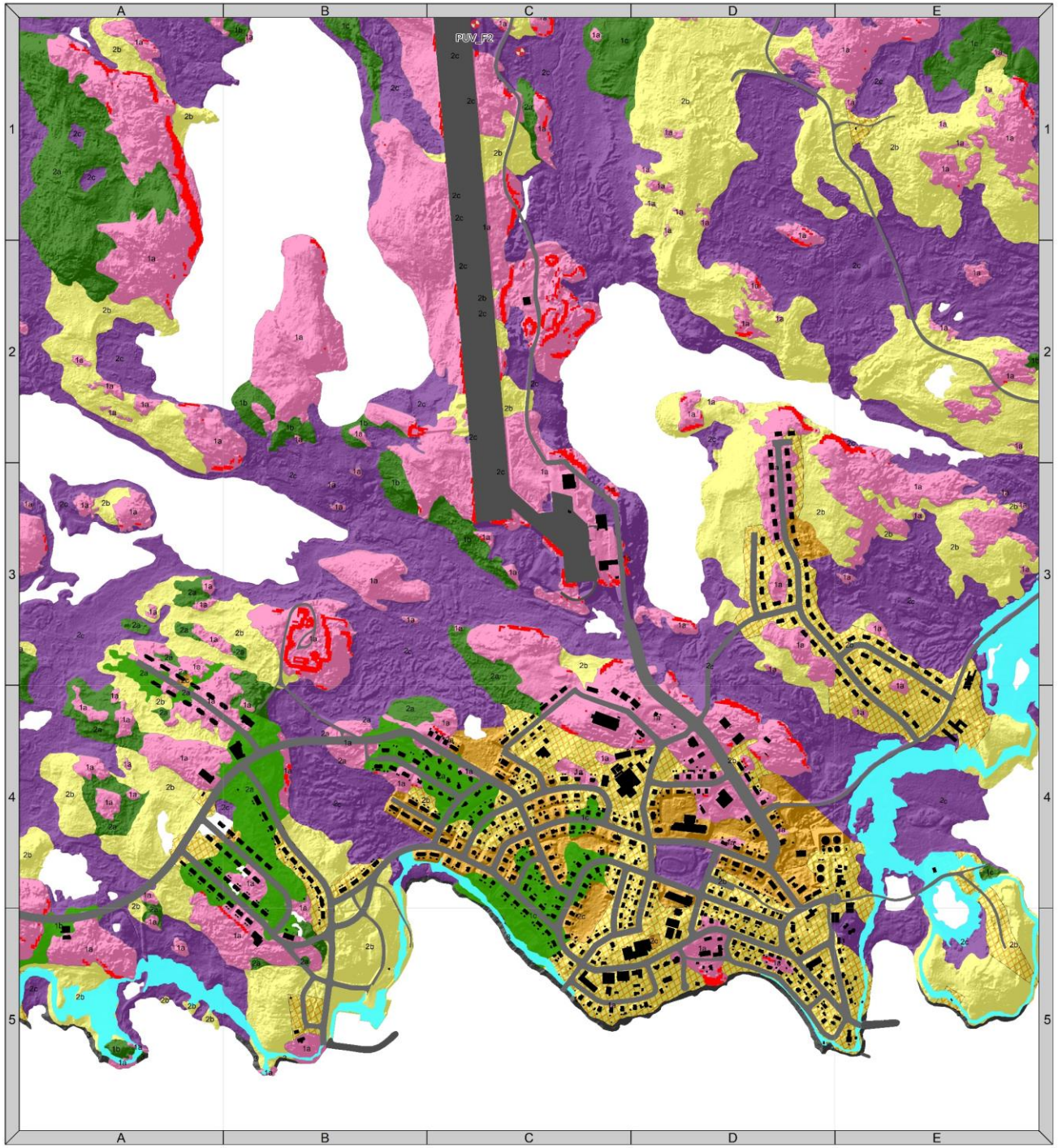
Construction potential map

Permafrost with presence of ice lenses.

Differential settlement



SURFICIAL GEOLOGY MAP OF PUVIRNITUQ


A
B
C
D
E
1
2
3
4
5
PUV F2


A
B
C
D
E

CONCLUSION

1. A set of 4 maps: surficial geology, permafrost, potential for construction map and a geohazards maps was produced for all communities (13) built on permafrost in Nunavik.

2. Synthesis tables were created and given to local stakeholders.

3. Communities were consulted during the process: leaders, municipal staffs and citizens were involved.

4. A web-based platform is being made to publish all the maps, reports and data online (*Sarah G. presentation*).

5. Still have large uncertainties in the future timing of permafrost thawing and degradation due to the discrepancy and complexities of greenhouse gas scenarios.

SECTION SARAH G.: WEB-BASED PERMAFROST KNOWLEDGE TRANSFER TOOL TO SUPPORT LAND USE PLANNING IN THE INUIT COMMUNITY.

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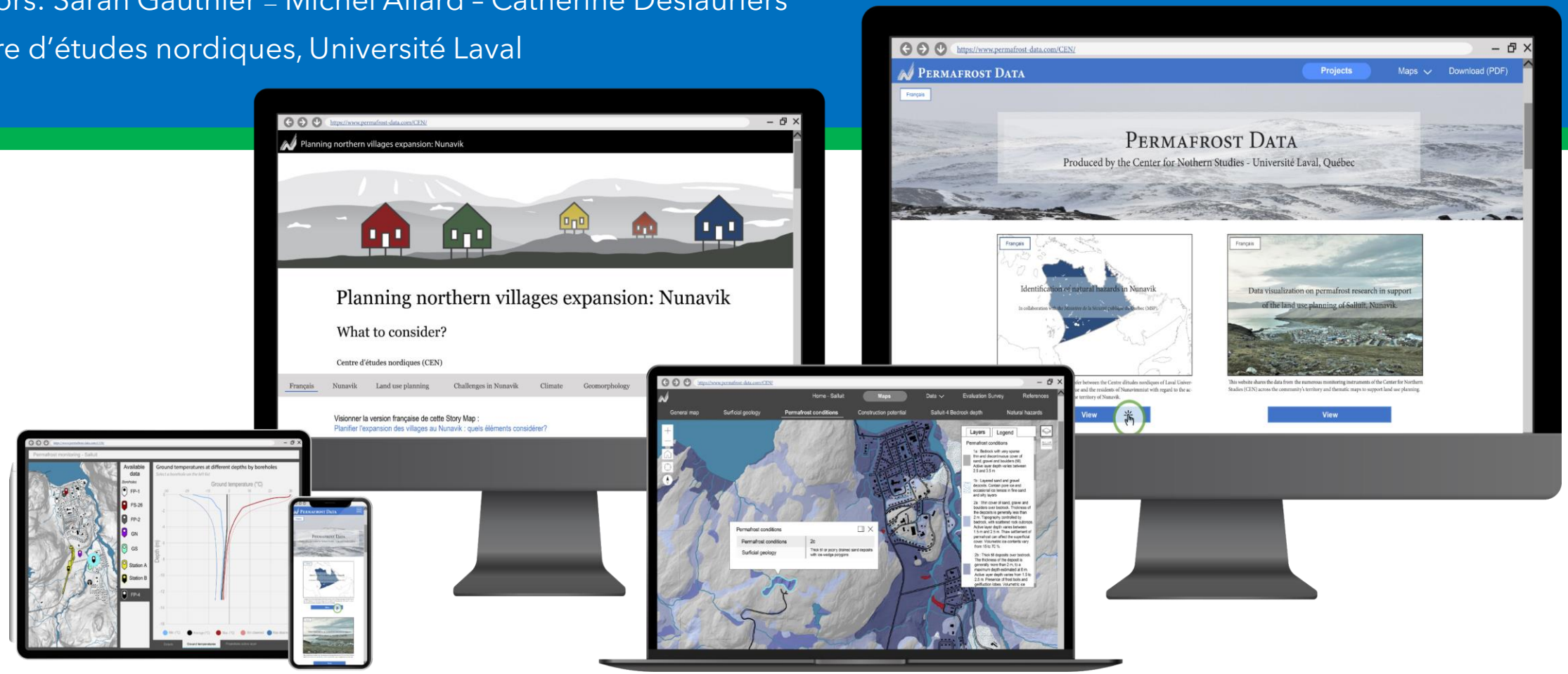
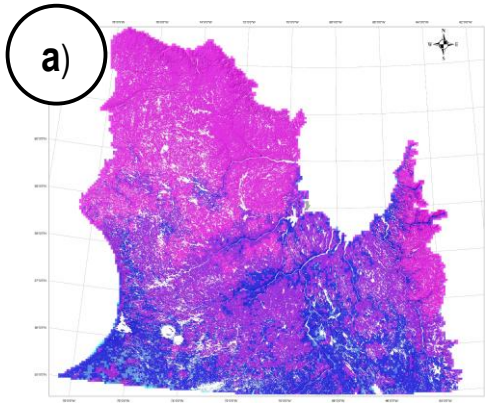
Permafrost Data: A New Web Platform for the Sharing of Permafrost Research in Nunavik in Support of the Development of Northern Villages

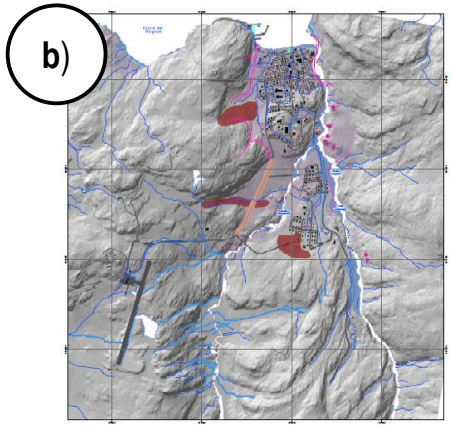
Authors: Sarah Gauthier – Michel Allard – Catherine Deslauriers

Centre d'études nordiques, Université Laval

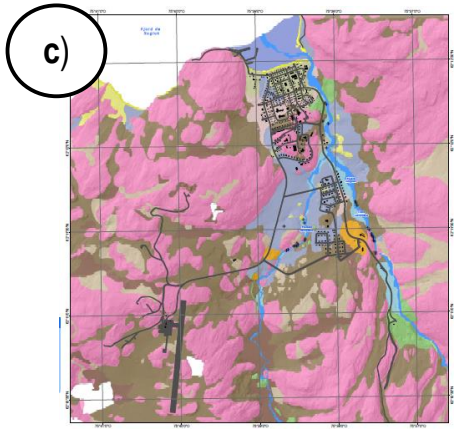




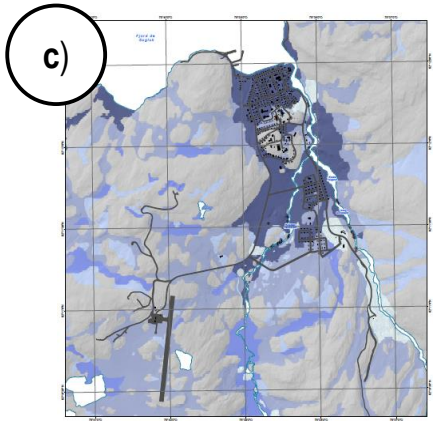
Permafrost distribution



Natural hazards

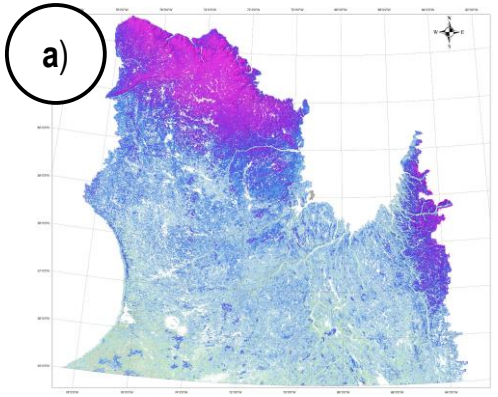


Surficial geology

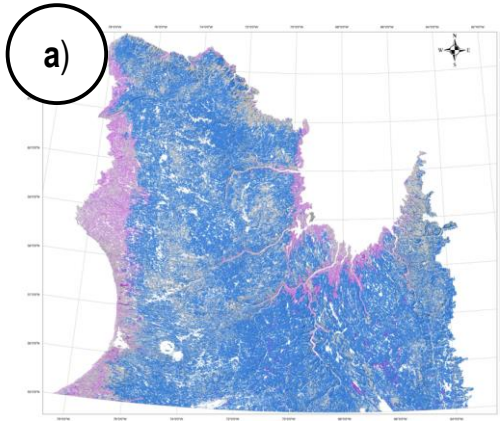


Permafrost conditions

Construction potential



Permafrost thickness



Ice-content in the ground

Example of projects

a) Identification of current and potential risks from climate change for the 14 Nunavik community territories (2019)

b) Production de la 2ième approximation de la carte de pergélisol du Québec en fonction des paramètres géomorphologiques, écologiques, et des processus physiques liés au climat

c) **Geotechnical characterization and permafrost mapping project in the Inuit communities of Nunavik (2020)**

Problem statement

Despite the abundance of permafrost research produced in the 14 Inuit communities of Nunavik, **there are no resources available to centralize and disseminate the results of these studies and make them easily accessible to the public**

Research results are most likely:

scattered on the Web and in organizations databases;

published in fee-based scientific journals;

communicated in a technical - *and complicated* - vocabulary to the general public, and;

poorly communicated and shared with new employees

Objectives

Integrate monitoring data on climate and permafrost temperatures, geomorphology and geotechnical expertise, and geospatial information produced by the CEN, **into an open-access, user-friendly and easily accessible online platform.**

The purpose of this web platform is therefore to **increase access to those results for everyone involved in construction and land use planning** – *such as community leaders, public decision-makers, consultants and contractors, to support decision-making towards sustainable development*.

ArcGIS Apps by ArcGIS Online

Experience Builder

Web AppBuilder

Survey 123

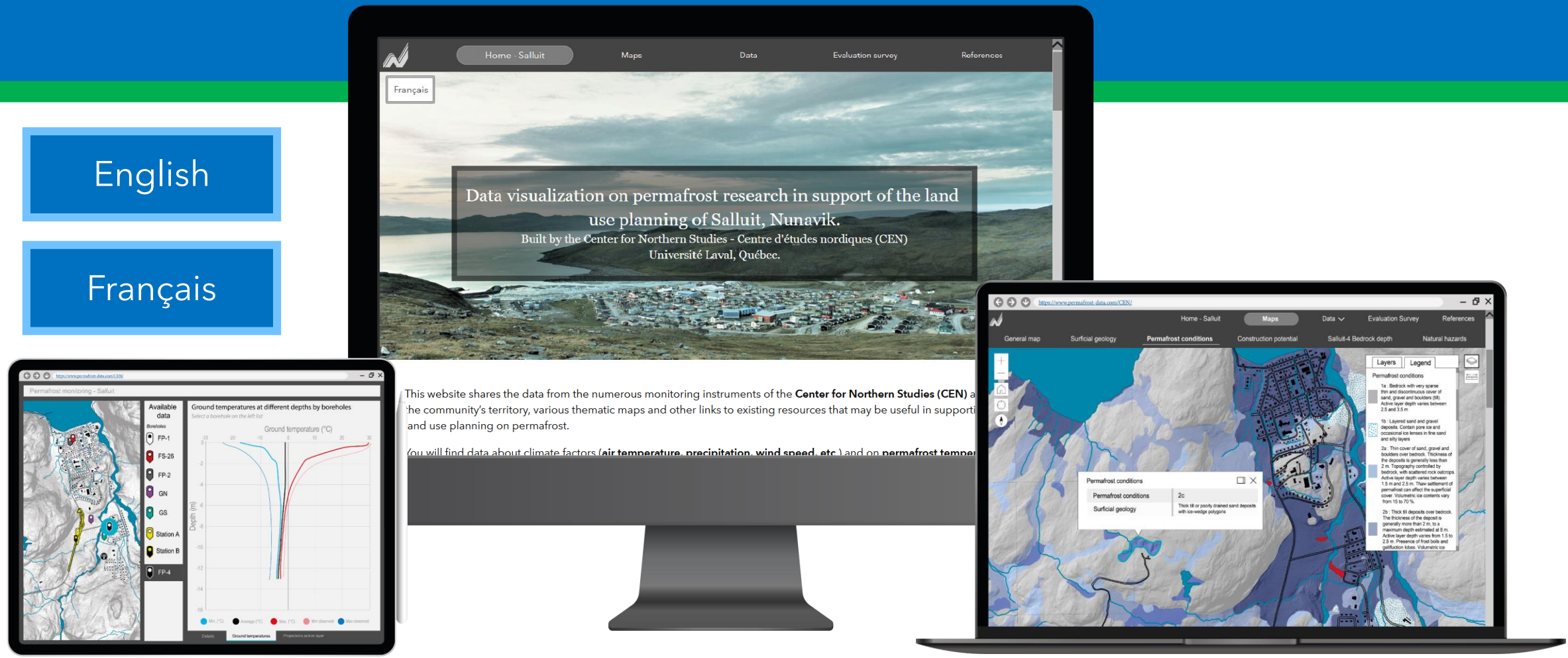
Story Maps

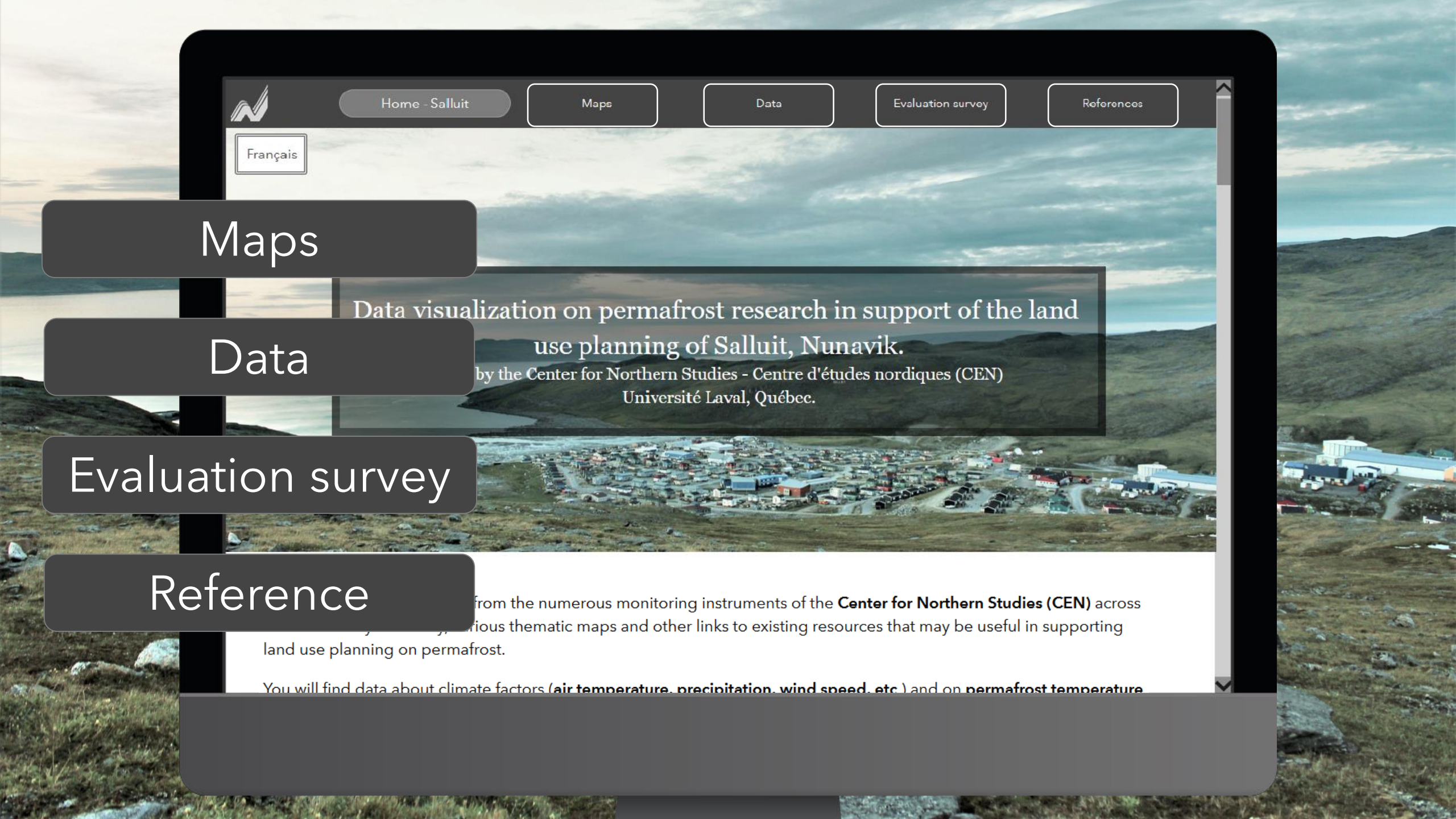
Dashboards

The methodological approach to build a web-based platform is first developed and tested with the community of Salluit, **where permafrost challenges are particularly acute**.

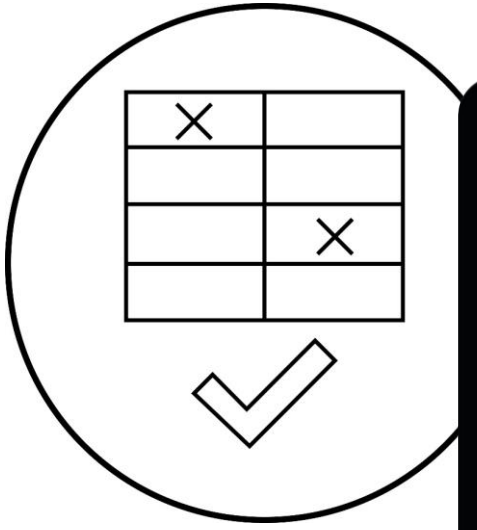
English

Français

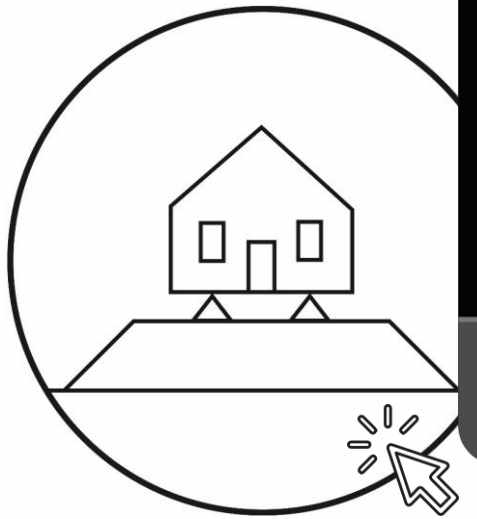



Maps
Data
Evaluation survey
Reference
Home - Salluit
Maps
Data
Evaluation survey
References
Français
Data visualization on permafrost research in support of the land use planning of Salluit, Nunavik.
by the Center for Northern Studies - Centre d'études nordiques (CEN)
Université Laval, Québec.
from the numerous monitoring instruments of the Center for Northern Studies (CEN) across
rious thematic maps and other links to existing resources that may be useful in supporting
land use planning on permafrost.
You will find data about climate factors (air temperature, precipitation, wind speed, etc.) and on permafrost temperature

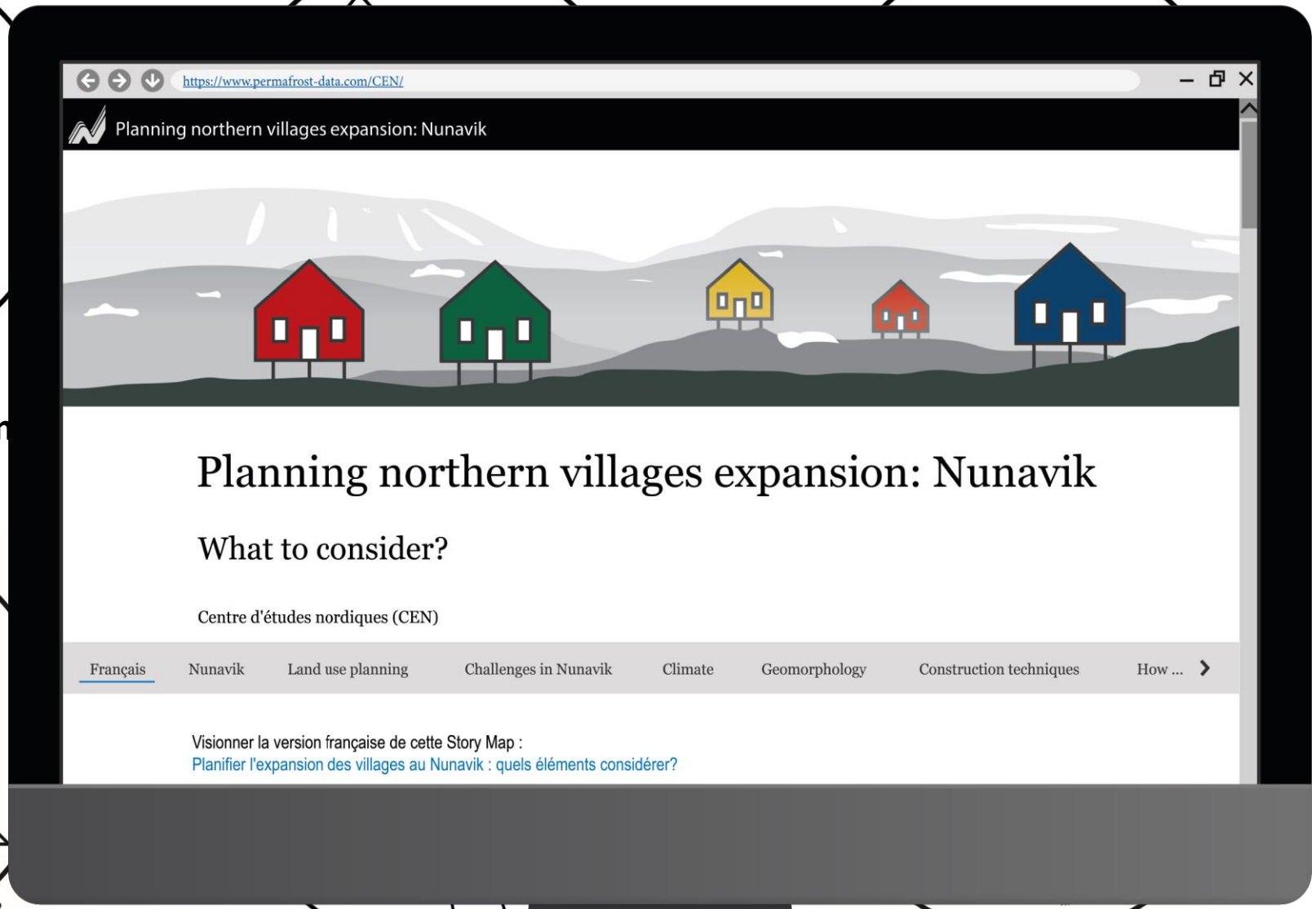
Story Maps available



How is risk analysis don

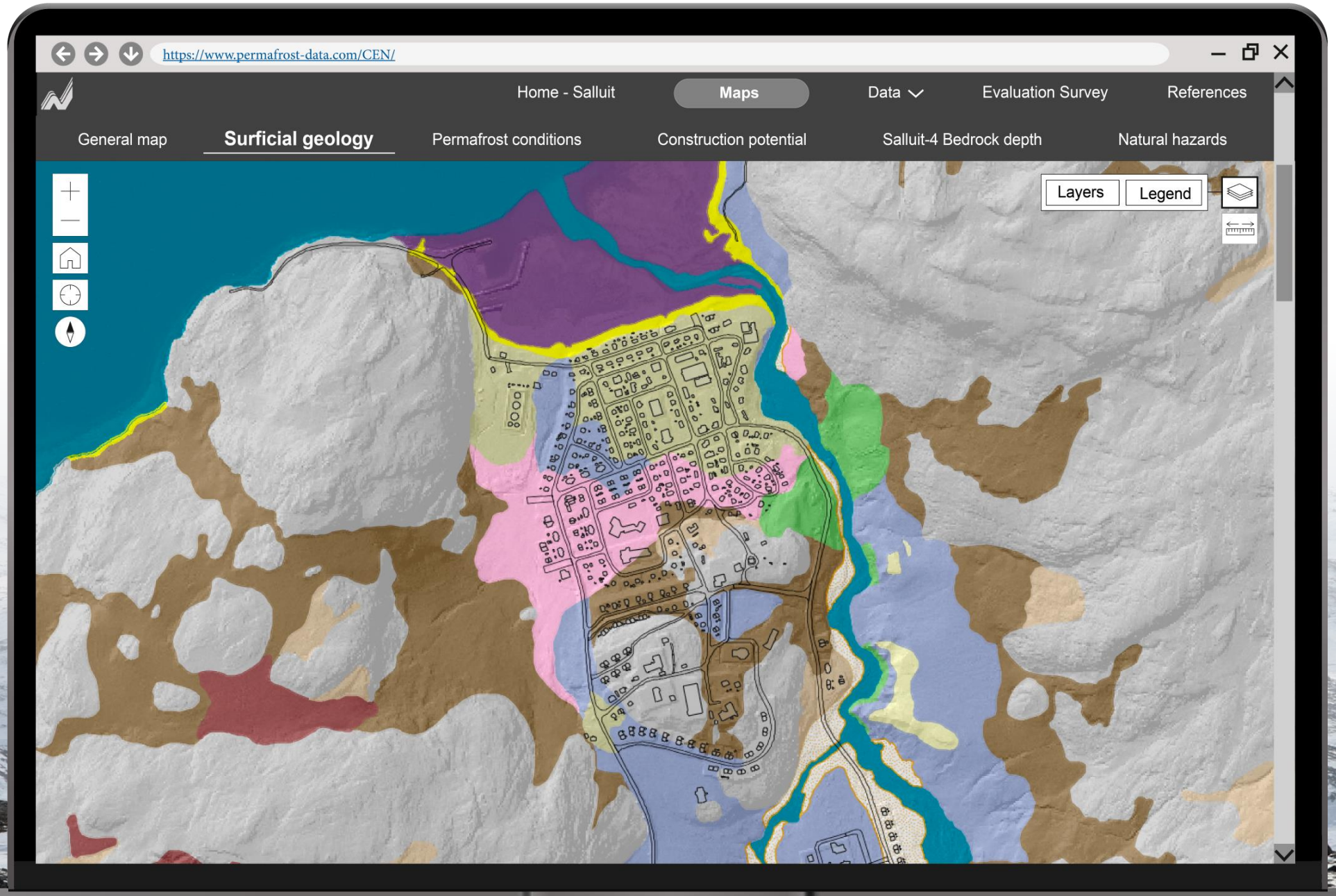


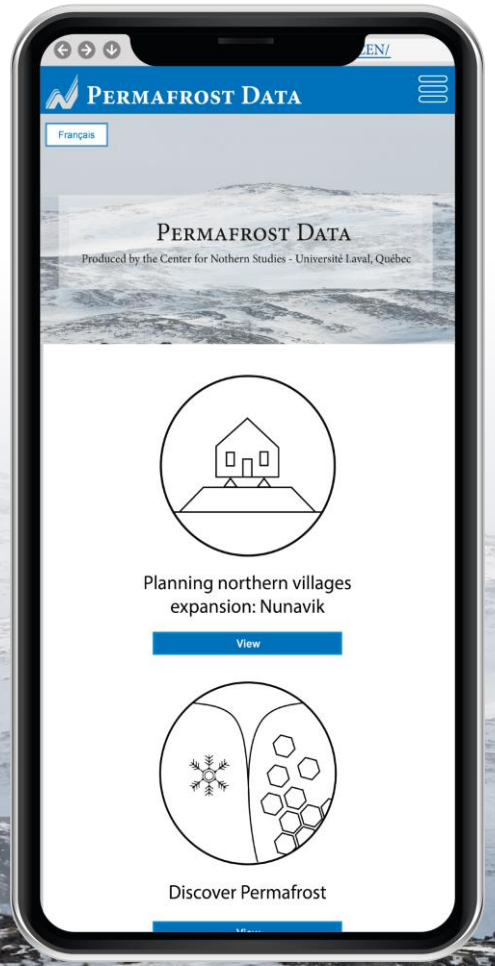
Planning northern villages expansion in Nunavik

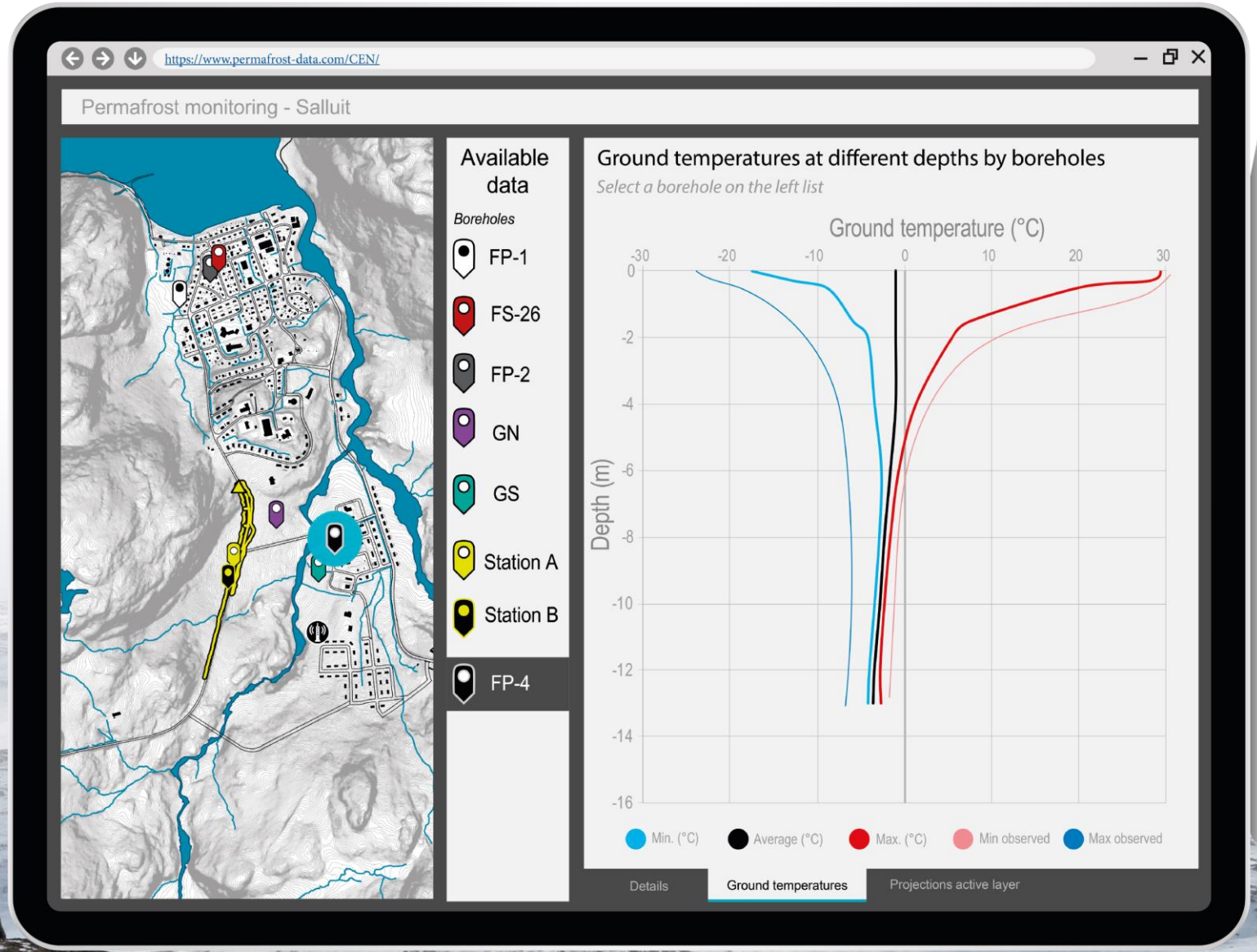


Discover perma

Climate and permafrost monitoring data in Salluit


https://www.permafrost-data.com/CEN/
Home - Salluit
Maps
Data
Evaluation Survey
References
General map
Surficial geology
Permafrost conditions
Construction potential
Salluit-4 Bedrock depth
Natural hazards
Layers
Legend


PERMAFROST DATA
Français
PERMAFROST DATA
Produced by the Center for Nothern Studies - Université Laval, Québec
Planning northern villages expansion: Nunavik
View
Discover Permafrost


https://www.permafrost-data.com/CEN/
Permafrost monitoring - Salluit
Available data
Boreholes
FP-1
FS-26
FP-2
GN
GS
Station A
Station B
FP-4
Ground temperatures at different depths by boreholes
Select a borehole on the left list
Ground temperature (°C)
Depth (m)
Min. (°C)
Average (°C)
Max. (°C)
Min observed
Max observed
Details
Ground temperatures
Projections active layer

Français

BETA VERSION - Please, give your feedback here

The app is now available for testing! In order to improve it and make it more efficient.

Salluit - Web App Evaluation

Participation in this survey is **voluntary and anonymous**, and the data will not be distributed or published. The data will be used exclusively for **the purpose of improving the general interface** and the relevance of the content of the website.

Example of questions

What layers of geographic information would you like to add?

In general, what would make the app better adapt for your use?

Do you think some sections need more details: If you answered "No, it's too complicated" to the previous question, do you have any suggestions for improving the understanding and expression of the content?

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Collaborators on CEN projects:

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Sarah Aubé-Michaud [4]
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Tina McCallum [6]
Jérémie Loeub [6]
Claude Desrochers[6]

Centre d'études nordiques [1]

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Ministère de l'Environnement et de la lutte aux changements climatiques [4]

Ministère des Affaires municipales et de l'Habitation du Québec [5]

Kativik Regional Government [6]

Thank you!

We would like to **thank the Northern Village of Salluit**, the **Qaqqalik Landholding Corporation of Salluit**, **all our collaborators in the community of Salluit** and **the Kativik Regional Government (KRG)** for their support and partnership throughout this research. The Center for Northern Studies, the Ministère des Transports du Québec (MTQ) and the Ministère des Affaires municipales et de l'Habitation (MAMH) were close collaborators in this project and shared their resources and knowledge in the making of this database.

This project was funded by the research programs Sentinel North and Living in Northern Quebec.